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Module Overview

The Teaching Mathematics TEKS through Technology Professional development is designed to provide teachers an opportunity to increase their depth of understanding about the judicious use of technology in the mathematics classroom. Expected learning outcomes for participants include an understanding of how technology can:

- Provide access to a deeper understanding of mathematical content;
- Provide access to “real world” mathematical topics;
- Improve the economy and efficiency of teaching mathematics TEKS relative to time;
- Facilitate the use of various instructional tools in a mathematical setting.

The structure of the professional development will be designed around the inquiry based 5E instructional model. This model has a strong foundation in research and has been shown to be highly effective in instructional settings.

The components of the “5E” Instructional Model are:

ENGAGE:
The presenter initiates this phase by asking well-chosen questions, posing a problem to be solved, or showing something intriguing. The activity should be designed to interest participants in the problem and to make connections between past and present learning.

The goal of the Engage phase is to begin conversations about data. As the participants see the value of data and the mathematics that can be explored and reinforced through the use of data, they will begin to seek data. Technology offers the tools to make sense of data efficiently. Technology also offers effective means for representing data so that analysis may take place. Participants work with data from the Internet, data collection devices, and basic measuring tools. They compare the different methods and determine similarities and differences as well as the benefits of each method.

The presenter’s role is to ask well-chosen questions to guide the activity but to allow participants to proceed in a nonjudgmental fashion. These questions are provided in the leader notes of the training.

EXPLORE/EXPLAIN:

Explore

The exploration phase provides the opportunity for participants to become directly involved with the key concepts of the lesson through guided exploration that requires them to probe, inquire, and question. As we learn, the puzzle pieces (ideas and concepts necessary to solve the problem) begin to fit together or have to be broken down and reconstructed several times. In this phase, presenters observe and listen to participants as they interact with each other and the activity. Presenters ask probing questions to help participants clarify their understanding of major concepts and redirect the participants when necessary.

Explain

In the explanation phase, collaborative learning teams begin to logically sequence events and facts from the investigation and communicate these findings to each other and the presenter. The presenter, acting in a facilitation role, uses this phase to offer further explanation and provide additional meaning or information, such as formalizing correct terminology. Giving labels or correct terminology is far more meaningful and helpful in retention if it is done after the participant has had a direct experience. The explanation phase is used to record the participant's development and grasp of the key ideas and concepts of the lesson.

There are 3 Explore/Explain cycles in this module.

In the first Explore/Explain cycle, participants will measure attributes to gather data. They will create stem and leaf plots using web-based tools to represent the center and the spread of this data. Participants will use a web-based tool to create a box and whisker plot to explore in greater detail the shape and the spread of the data. Participants will also use hand-held graphing technology to create box and whisker plots. They will gather additional data to explore how such changes impact measures of central tendency.

In the second Explore/Explain cycle, participants will be given descriptive statements about a set of data. Different groups of participants will receive different statements. Each group of participants will create a set of possible data and a graphical representation of the data based on these statements. Participants will also be given a graphical representation of a set of data. They will create a set of possible data and write descriptive statements about the data.

In the third Explore/Explain cycle, participants will conduct sets of experiments that have the same number of outcomes. They will create graphical representations that compare the experimental results and the theoretical results using spreadsheet technology and hand-held graphing technology. Participants will compare and contrast the use of these two technologies and their effectiveness in representing the data.

The presenter's role in the Explore/Explain phases is to ask well-chosen questions to guide participants and clarify their understandings. These questions are provided in the leader notes of the training.

ELABORATE:

The elaboration phase allows for participants to extend and expand what they have learned in the first three phases and connect this knowledge with their prior learning to create understanding. It is critical that presenters verify participants' understanding during this phase.

In the Elaborate phase, a problem is posed to the participants. Based on this problem, participants will collect reaction time data. They will analyze their data using both hand-held technology and spreadsheet technology to determine generalizations about their data sets. Participants will identify the strengths and weaknesses of each technology. These tasks will take place within the structure of the problem-solving model: understand the problem; make a plan; carry out the plan; evaluate the plan and the solution; and extend the problem.

Participants may use any of the technologies presented during the professional development. Participants will then apply or extend their understandings acquired in the professional development by generating a list of attributes to guide judicious use of technology.

The presenter's role in the Elaborate phase is to ask well-chosen questions to guide participants and extend their understandings. These questions are provided in the leader notes of the training.

EVALUATE:
Throughout the learning experience, the ongoing process of evaluation allows the presenter to determine whether or not the participant has reached the desired level of understanding of the key ideas and concepts. More formal evaluation can be conducted at this phase.

Participants will review the instructional phases of this professional development and the student lessons according to the list of attributes generated in the Elaborate phase of the professional development. Revisions to the list of attributes may occur. Participants will engage in discussion about how each lesson exhibits a judicious use of technology; i.e., participants will address the question, "How does the use of technology in this student lesson help me teach the concepts and skills more effectively and efficiently?"

The presenter's role in the Evaluate phase is to ask well-chosen questions to assess participants' understandings as they evaluate student lessons for judicious use of technology. These questions are provided in the leader notes of the training.

STUDENT LESSONS
This training is specifically designed for adult learners. Student lessons with detailed teacher notes and resources are provided to facilitate the implementation of the knowledge acquired by participants in the professional development.

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Elaborate

This provisions of this subchapter were adopted by the State Board of Education in February 2005 to be implemented beginning with the 2006-2007 school year.

Text of Adopted Amendments to 19 TAC

Chapter 111. Texas Essential Knowledge and Skills for Mathematics

Subchapter B. Middle School

§111.22. Mathematics, Grade 6.

(a) Introduction.

(1) Within a well-balanced mathematics curriculum, the primary focal points at Grade 6 are using ratios to describe direct proportional relationships involving number, geometry, measurement, probability, and adding and subtracting decimals and fractions.

(2) Throughout mathematics in Grades 6-8, students build a foundation of basic understandings in number, operation, and quantitative reasoning; patterns, relationships, and algebraic thinking; geometry and spatial reasoning; measurement; and probability and statistics. Students use concepts, algorithms, and properties of rational numbers to explore mathematical relationships and to describe increasingly complex situations. Students use algebraic thinking to describe how a change in one quantity in a relationship results in a change in the other; and they connect verbal, numeric, graphic, and symbolic representations of relationships. Students use geometric properties and relationships, as well as spatial reasoning, to model and analyze situations and solve problems. Students communicate information about geometric figures or situations by quantifying attributes, generalize procedures from measurement experiences, and use the procedures to solve problems. Students use appropriate statistics, representations of data, reasoning, and concepts of probability to draw conclusions, evaluate arguments, and make recommendations.

(3) Problem solving in meaningful contexts, language and communication, connections within and outside mathematics, and formal and informal reasoning underlie all content areas in mathematics. Throughout mathematics in Grades 6-8, students use these processes together with graphing technology and other mathematical tools such as manipulative materials to develop conceptual understanding and solve problems as they do mathematics.

(b) Knowledge and skills.

(6.1) **Number, operation, and quantitative reasoning.** The student represents and uses rational numbers in a variety of equivalent forms.

The student is expected to:

(A) compare and order non-negative rational numbers;

(B) generate equivalent forms of rational numbers including whole numbers, fractions, and decimals;

(C) use integers to represent real-life situations;

(D) write prime factorizations using exponents;

(E) identify factors of a positive integer, common factors, and the greatest common factor of a set of positive integers; and

(F) identify multiples of a positive integer and common multiples and the least common multiple of a set of positive integers.

(6.2) **Number, operation, and quantitative reasoning.** The student adds, subtracts, multiplies, and divides to solve problems and justify solutions.

The student is expected to:

(A) model addition and subtraction situations involving fractions with objects, pictures, words, and numbers;

(B) use addition and subtraction to solve problems involving fractions and decimals;

(C) use multiplication and division of whole numbers to solve problems including situations involving equivalent ratios and rates;

(D) estimate and round to approximate reasonable results and to solve problems where exact answers are not required; and

(E) use order of operations to simplify whole number expressions (without exponents) in problem solving situations.

(6.3) **Patterns, relationships, and algebraic thinking.** The student solves problems involving direct proportional relationships.

The student is expected to:

(A) use ratios to describe proportional situations;

(B) represent ratios and percents with concrete models, fractions, and decimals; and

(C) use ratios to make predictions in proportional situations.

(6.4) **Patterns, relationships, and algebraic thinking.** The student uses letters as variables in mathematical expressions to describe how one quantity changes when a related quantity changes.

The student is expected to:

(A) use tables and symbols to represent and describe proportional and other relationships such as those involving conversions, arithmetic sequences (with a constant rate of change), perimeter and area; and

(B) use tables of data to generate formulas representing relationships involving perimeter, area, volume of a rectangular prism, etc.

(6.5) **Patterns, relationships, and algebraic thinking.** The student uses letters to represent an unknown in an equation.

The student is expected to formulate equations from problem situations described by linear relationships.

(6.6) **Geometry and spatial reasoning.** The student uses geometric vocabulary to describe angles, polygons, and circles.

The student is expected to:

(A) use angle measurements to classify angles as acute, obtuse, or right;

(B) identify relationships involving angles in triangles and quadrilaterals; and

(C) describe the relationship between radius, diameter, and circumference of a circle.

(6.7) **Geometry and spatial reasoning.** The student uses coordinate geometry to identify location in two dimensions.

The student is expected to locate and name points on a coordinate plane using ordered pairs of non-negative rational numbers.

(6.8) **Measurement.** The student solves application problems involving estimation and measurement of length, area, time, temperature, volume, weight, and angles.

The student is expected to:

(A) estimate measurements (including circumference) and evaluate reasonableness of results;

(B) select and use appropriate units, tools, or formulas to measure and to solve problems involving length (including perimeter), area, time, temperature, volume, and weight;

(C) measure angles; and

(D) convert measures within the same measurement system (customary and metric) based on relationships between units.

(6.9) **Probability and statistics.** The student uses experimental and theoretical probability to make predictions.

The student is expected to:

(A) construct sample spaces using lists and tree diagrams; and

(B) find the probabilities of a simple event and its complement and describe the relationship between the two.

(6.10) **Probability and statistics.** The student uses statistical representations to analyze data.

The student is expected to:

(A) select and use an appropriate representation for presenting and displaying different graphical representations of the same data including line plot, line graph, bar graph, and stem and leaf plot;

(B) identify mean (using concrete objects and pictorial models), median, mode, and range of a set of data;

(C) sketch circle graphs to display data; and

(D) solve problems by collecting, organizing, displaying, and interpreting data.

(6.11) **Underlying processes and mathematical tools.** The student applies Grade 6 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school.

The student is expected to:

(A) identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics;

(B) use a problem-solving model that incorporates understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness;

(C) select or develop an appropriate problem-solving strategy from a variety of different types, including drawing a picture, looking for a pattern, systematic guessing and checking, acting it out, making a table, working a simpler problem, or working backwards to solve a problem; and

(D) select tools such as real objects, manipulatives, paper/pencil, and technology or techniques such as mental math, estimation, and number sense to solve problems.

(6.12) **Underlying processes and mathematical tools.** The student communicates about Grade 6 mathematics through informal and mathematical language, representations, and models.

The student is expected to:

(A) communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models; and

(B) evaluate the effectiveness of different representations to communicate ideas.

(6.13) **Underlying processes and mathematical tools.** The student uses logical reasoning to make conjectures and verify conclusions.

The student is expected to:

(A) make conjectures from patterns or sets of examples and nonexamples; and

(B) validate his/her conclusions using mathematical properties and relationships.

§111.23. Mathematics, Grade 7.

(a) Introduction.

(1) Within a well-balanced mathematics curriculum, the primary focal points at Grade 7 are using direct proportional relationships in number, geometry, measurement, and probability; applying addition, subtraction, multiplication, and division of decimals, fractions, and integers; and using statistical measures to describe data.

(2) Throughout mathematics in Grades 6-8, students build a foundation of basic understandings in number, operation, and quantitative reasoning; patterns, relationships, and algebraic thinking; geometry and spatial reasoning; measurement; and probability and statistics. Students use concepts, algorithms, and properties of rational numbers to explore mathematical relationships and to describe increasingly complex situations. Students use algebraic thinking to describe how a change in one quantity in a relationship results in a change in the other; and they connect verbal, numeric, graphic, and symbolic representations of relationships. Students use geometric properties and relationships, as well as spatial reasoning, to model and analyze situations and solve problems. Students communicate information about geometric figures or situations by quantifying attributes, generalize procedures from measurement experiences, and use the procedures to solve problems. Students use appropriate statistics, representations of data, reasoning, and concepts of probability to draw conclusions, evaluate arguments, and make recommendations.

(3) Problem solving in meaningful contexts, language and communication, connections within and outside mathematics, and formal and informal reasoning underlie all content areas in mathematics. Throughout mathematics in Grades 6-8, students use these processes together with graphing technology and other mathematical tools such as manipulative materials to develop conceptual understanding and solve problems as they do mathematics.

(b) Knowledge and skills.

(7.1) **Number, operation, and quantitative reasoning.** The student represents and uses numbers in a variety of equivalent forms.

The student is expected to:

(A) compare and order integers and positive rational numbers;

(B) convert between fractions, decimals, whole numbers, and percents mentally, on paper, or with a calculator; and

(C) represent squares and square roots using geometric models.

(7.2) **Number, operation, and quantitative reasoning.** The student adds, subtracts, multiplies, or divides to solve problems and justify solutions.

The student is expected to:

(A) represent multiplication and division situations involving fractions and decimals with models, including concrete objects, pictures, words, and numbers;

(B) use addition, subtraction, multiplication, and division to solve problems involving fractions and decimals;

(C) use models, such as concrete objects, pictorial models, and number lines, to add, subtract, multiply, and divide integers and connect the actions to algorithms;

(D) use division to find unit rates and ratios in proportional relationships such as speed, density, price, recipes, and student-teacher ratio;

(E) simplify numerical expressions involving order of operations and exponents;

(F) select and use appropriate operations to solve problems and justify the selections; and

(G) determine the reasonableness of a solution to a problem.

(7.3) **Patterns, relationships, and algebraic thinking.** The student solves problems involving direct proportional relationships.

The student is expected to:

(A) estimate and find solutions to application problems involving percent; and

(B) estimate and find solutions to application problems involving proportional relationships such as similarity, scaling, unit costs, and related measurement units.

(7.4) **Patterns, relationships, and algebraic thinking.** The student represents a relationship in numerical, geometric, verbal, and symbolic form.

The student is expected to:

(A) generate formulas involving unit conversions, perimeter, area, circumference, volume, and scaling;

(B) graph data to demonstrate relationships in familiar concepts such as conversions, perimeter, area, circumference, volume, and scaling; and

(C) use words and symbols to describe the relationship between the terms in an arithmetic sequence (with a constant rate of change) and their positions in the sequence.

(7.5) **Patterns, relationships, and algebraic thinking.** The student uses equations to solve problems.

The student is expected to:

(A) use concrete and pictorial models to solve equations and use symbols to record the actions; and

(B) formulate problem situations when given a simple equation and formulate an equation when given a problem situation.

(7.6) **Geometry and spatial reasoning.** The student compares and classifies two- and three-dimensional figures using geometric vocabulary and properties.

The student is expected to:

(A) use angle measurements to classify pairs of angles as complementary or supplementary;

(B) use properties to classify triangles and quadrilaterals;

(C) use properties to classify three-dimensional figures, including pyramids, cones, prisms, and cylinders; and

(D) use critical attributes to define similarity.

(7.7) **Geometry and spatial reasoning.** The student uses coordinate geometry to describe location on a plane.

The student is expected to:

(A) locate and name points on a coordinate plane using ordered pairs of integers; and

(B) graph reflections across the horizontal or vertical axis and graph translations on a coordinate plane.

(7.8) **Geometry and spatial reasoning.** The student uses geometry to model and describe the physical world.

The student is expected to:

(A) sketch three-dimensional figures when given the top, side, and front views;

(B) make a net (two-dimensional model) of the surface area of a three-dimensional figure; and

(C) use geometric concepts and properties to solve problems in fields such as art and architecture.

(7.9) **Measurement.** The student solves application problems involving estimation and measurement.

The student is expected to:

(A) estimate measurements and solve application problems involving length (including perimeter and circumference) and area of polygons and other shapes;

(B) connect models for volume of prisms (triangular and rectangular) and cylinders to formulas of prisms (triangular and rectangular) and cylinders; and

(C) estimate measurements and solve application problems involving volume of prisms (rectangular and triangular) and cylinders.

(7.10) **Probability and statistics.** The student recognizes that a physical or mathematical model can be used to describe the experimental and theoretical probability of real-life events.

The student is expected to:

(A) construct sample spaces for simple or composite experiments; and

(B) find the probability of independent events.

(7.11) **Probability and statistics.** The student understands that the way a set of data is displayed influences its interpretation.

The student is expected to:

(A) select and use an appropriate representation for presenting and displaying relationships among collected data, including line plot, line graph, bar graph, stem and leaf plot, circle graph, and Venn diagrams, and justify the selection; and

(B) make inferences and convincing arguments based on an analysis of given or collected data.

(7.12) **Probability and statistics.** The student uses measures of central tendency and range to describe a set of data.

The student is expected to:

(A) describe a set of data using mean, median, mode, and range; and

(B) choose among mean, median, mode, or range to describe a set of data and justify the choice for a particular situation.

(7.13) **Underlying processes and mathematical tools.** The student applies Grade 7 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school.

The student is expected to:

(A) identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics;

(B) use a problem-solving model that incorporates understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness;

(C) select or develop an appropriate problem-solving strategy from a variety of different types, including drawing a picture, looking for a pattern, systematic guessing and checking, acting it out, making a table, working a simpler problem, or working backwards to solve a problem; and

(D) select tools such as real objects, manipulatives, paper/pencil, and technology or techniques such as mental math, estimation, and number sense to solve problems.

(7.14) **Underlying processes and mathematical tools.** The student communicates about Grade 7 mathematics through informal and mathematical language, representations, and models.

The student is expected to:

(A) communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models; and

(B) evaluate the effectiveness of different representations to communicate ideas.

(7.15) **Underlying processes and mathematical tools.** The student uses logical reasoning to make conjectures and verify conclusions.

The student is expected to:

(A) make conjectures from patterns or sets of examples and nonexamples; and

(B) validate his/her conclusions using mathematical properties and relationships.

§111.24. Mathematics, Grade 8.

(a) Introduction.

(1) Within a well-balanced mathematics curriculum, the primary focal points at Grade 8 are using basic principles of algebra to analyze and represent both proportional and non-proportional linear relationships and using probability to describe data and make predictions.

(2) Throughout mathematics in Grades 6-8, students build a foundation of basic understandings in number, operation, and quantitative reasoning; patterns, relationships, and algebraic thinking; geometry and spatial reasoning; measurement; and probability and statistics. Students use concepts, algorithms, and properties of rational numbers to explore mathematical relationships and to describe increasingly complex situations. Students use algebraic thinking to describe how a change in one quantity in a relationship results in a change in the other; and they connect verbal, numeric, graphic, and symbolic representations of relationships. Students use geometric properties and relationships, as well as spatial reasoning, to model and analyze situations and solve problems. Students communicate information about geometric figures or situations by quantifying attributes, generalize procedures from measurement experiences, and use the procedures to solve problems. Students use appropriate statistics, representations of data, reasoning, and concepts of probability to draw conclusions, evaluate arguments, and make recommendations.

(3) Problem solving in meaningful contexts, language and communication, connections within and outside mathematics, and formal and informal reasoning underlie all content areas in mathematics. Throughout mathematics in Grades 6-8, students use these processes together with graphing technology and other mathematical tools such as manipulative materials to develop conceptual understanding and solve problems as they do mathematics.

(b) Knowledge and skills.

(8.1) **Number, operation, and quantitative reasoning.** The student understands that different forms of numbers are appropriate for different situations.

The student is expected to:

(A) compare and order rational numbers in various forms including integers, percents, and positive and negative fractions and decimals;

(B) select and use appropriate forms of rational numbers to solve real-life problems including those involving proportional relationships;

(C) approximate (mentally and with calculators) the value of irrational numbers as they arise from problem situations (such as π, $\sqrt{2}$); and

(D) express numbers in scientific notation, including negative exponents, in appropriate problem situations.

(8.2) **Number, operation, and quantitative reasoning.** The student selects and uses appropriate operations to solve problems and justify solutions.

The student is expected to:

(A) select appropriate operations to solve problems involving rational numbers and justify the selections;

(B) use appropriate operations to solve problems involving rational numbers in problem situations;

(C) evaluate a solution for reasonableness; and

(D) use multiplication by a constant factor (unit rate) to represent proportional relationships.

(8.3) **Patterns, relationships, and algebraic thinking.** The student identifies proportional or non-proportional linear relationships in problem situations and solves problems.

The student is expected to:

(A) compare and contrast proportional and non-proportional linear relationships; and

(B) estimate and find solutions to application problems involving percents and other proportional relationships such as similarity and rates.

(8.4) **Patterns, relationships, and algebraic thinking.** The student makes connections among various representations of a numerical relationship.

The student is expected to generate a different representation of data given another representation of data (such as a table, graph, equation, or verbal description).

(8.5) **Patterns, relationships, and algebraic thinking.** The student uses graphs, tables, and algebraic representations to make predictions and solve problems.

The student is expected to:

(A) predict, find, and justify solutions to application problems using appropriate tables, graphs, and algebraic equations; and

(B) find and evaluate an algebraic expression to determine any term in an arithmetic sequence (with a constant rate of change).

(8.6) **Geometry and spatial reasoning.** The student uses transformational geometry to develop spatial sense.

The student is expected to:

(A) generate similar figures using dilations including enlargements and reductions; and

(B) graph dilations, reflections, and translations on a coordinate plane.

(8.7) **Geometry and spatial reasoning.** The student uses geometry to model and describe the physical world.

The student is expected to:

(A) draw three-dimensional figures from different perspectives;

(B) use geometric concepts and properties to solve problems in fields such as art and architecture;

(C) use pictures or models to demonstrate the Pythagorean Theorem; and

(D) locate and name points on a coordinate plane using ordered pairs of rational numbers.

(8.8) **Measurement.** The student uses procedures to determine measures of three-dimensional figures.

The student is expected to:

(A) find lateral and total surface area of prisms, pyramids, and cylinders using concrete models and nets (two-dimensional models);

(B) connect models of prisms, cylinders, pyramids, spheres, and cones to formulas for volume of these objects; and

(C) estimate measurements and use formulas to solve application problems involving lateral and total surface area and volume.

(8.9) **Measurement.** The student uses indirect measurement to solve problems.

The student is expected to:

(A) use the Pythagorean Theorem to solve real-life problems; and

(B) use proportional relationships in similar two-dimensional figures or similar three-dimensional figures to find missing measurements.

(8.10) **Measurement.** The student describes how changes in dimensions affect linear, area, and volume measures.

The student is expected to:

(A) describe the resulting effects on perimeter and area when dimensions of a shape are changed proportionally; and

(B) describe the resulting effect on volume when dimensions of a solid are changed proportionally.

(8.11) **Probability and statistics.** The student applies concepts of theoretical and experimental probability to make predictions.

The student is expected to:

(A) find the probabilities of dependent and independent events;

(B) use theoretical probabilities and experimental results to make predictions and decisions; and

(C) select and use different models to simulate an event.

(8.12) **Probability and statistics.** The student uses statistical procedures to describe data.

The student is expected to:

(A) select the appropriate measure of central tendency or range to describe a set of data and justify the choice for a particular situation;

(B) draw conclusions and make predictions by analyzing trends in scatterplots; and

(C) select and use an appropriate representation for presenting and displaying relationships among collected data, including line plots, line graphs, stem and leaf plots, circle graphs, bar graphs, box and whisker plots, histograms, and Venn diagrams, with and without the use of technology.

(8.13) **Probability and statistics.** The student evaluates predictions and conclusions based on statistical data.

The student is expected to:

(A) evaluate methods of sampling to determine validity of an inference made from a set of data; and

(B) recognize misuses of graphical or numerical information and evaluate predictions and conclusions based on data analysis.

(8.14) **Underlying processes and mathematical tools.** The student applies Grade 8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school.

The student is expected to:

(A) identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics;

(B) use a problem-solving model that incorporates understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness;

(C) select or develop an appropriate problem-solving strategy from a variety of different types, including drawing a picture, looking for a pattern, systematic guessing and checking, acting it out, making a table, working a simpler problem, or working backwards to solve a problem; and

(D) select tools such as real objects, manipulatives, paper/pencil, and technology or techniques such as mental math, estimation, and number sense to solve problems.

(8.15) **Underlying processes and mathematical tools.** The student communicates about Grade 8 mathematics through informal and mathematical language, representations, and models.

The student is expected to:

(A) communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models; and

(B) evaluate the effectiveness of different representations to communicate ideas.

(8.16) **Underlying processes and mathematical tools.** The student uses logical reasoning to make conjectures and verify conclusions.

The student is expected to:

(A) make conjectures from patterns or sets of examples and nonexamples; and

(B) validate his/her conclusions using mathematical properties and relationships.

Chapter 126. Texas Essential Knowledge and Skills for Technology Applications

Subchapter B. Middle School

Statutory Authority: The provisions of this Subchapter B issued under the Texas Education Code, §28.002, unless otherwise noted.

§126.11. Implementation of Texas Essential Knowledge and Skills for Technology Applications, Middle School.

The provisions of this subchapter shall supersede §75.51 of this title (relating to Computer Literacy) beginning September 1, 1998.

Source: The provisions of this §126.11 adopted to be effective September 1, 1998, 22 TexReg 5203.

§126.12. Technology Applications (Computer Literacy), Grades 6-8.

(a) General requirements. Districts have the flexibility of offering technology applications (computer literacy) in a variety of settings, including a specific class or integrated into other subject areas.

(b) Introduction.

(1) The technology applications curriculum has four strands: foundations, information acquisition, work in solving problems, and communication.

(2) Through the study of technology applications foundations, including technology-related terms, concepts, and data input strategies, students learn to make informed decisions about technologies and their applications. The efficient acquisition of information includes the identification of task requirements; the plan for using search strategies; and the use of technology to access, analyze, and evaluate the acquired information. By using technology as a tool that supports the work of individuals and groups in solving problems, students will select the technology appropriate for the task, synthesize knowledge, create a solution, and evaluate the results. Students communicate information in different formats and to diverse audiences. A variety of technologies will be used. Students will analyze and evaluate the results.

(c) Knowledge and skills.

(1) **Foundations.** The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections.

The student is expected to:

(A) demonstrate knowledge and appropriate use of operating systems, software applications, and communication and networking components;

(B) compare, contrast, and appropriately use the various input, processing, output, and primary/secondary storage devices;

(C) demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency;

(D) delineate and make necessary adjustments regarding compatibility issues including, but not limited to, digital file formats and cross platform connectivity;

(E) use technology terminology appropriate to the task;

(F) perform basic software application functions including, but not limited to, opening an application program and creating, modifying, printing, and saving documents;

(G) explain the differences between analog and digital technology systems and give examples of each;

(H) use terminology related to the Internet appropriately including, but not limited to, electronic mail (e-mail), Uniform Resource Locators (URLs), electronic bookmarks, local area networks (LANs), wide area networks (WANs), World Wide Web (WWW) page, and HyperText Markup Language (HTML); and

(I) compare and contrast LANs, WANs, Internet, and intranet.

(2) **Foundations.** The student uses data input skills appropriate to the task.

The student is expected to:

(A) demonstrate proficiency in the use of a variety of input devices such as mouse/track pad, keyboard, microphone, digital camera, printer, scanner, disk/disc, modem, CD-ROM, or joystick;

(B) demonstrate keyboarding proficiency in technique and posture while building speed;

(C) use digital keyboarding standards for data input such as one space after punctuation, the use of em/en dashes, and smart quotation marks; and

(D) develop strategies for capturing digital files while conserving memory and retaining image quality.

(3) **Foundations.** The student complies with the laws and examines the issues regarding the use of technology in society.

The student is expected to:

(A) discuss copyright laws/issues and model ethical acquisition and use of digital information, citing sources using established methods;

(B) demonstrate proper etiquette and knowledge of acceptable use while in an individual classroom, lab, or on the Internet and intranet;

(C) describe the consequences regarding copyright violations including, but not limited to, computer hacking, computer piracy, intentional virus setting, and invasion of privacy;

(D) identify the impact of technology applications on society through research, interviews, and personal observation; and

(E) demonstrate knowledge of the relevancy of technology to future careers, life-long learning, and daily living for individuals of all ages.

(4) **Information acquisition.** The student uses a variety of strategies to acquire information from electronic resources, with appropriate supervision.

The student is expected to:

(A) use strategies to locate and acquire desired information on LANs and WANs, including the Internet, intranet, and collaborative software; and

(B) apply appropriate electronic search strategies in the acquisition of information including keyword and Boolean search strategies.

(5) **Information acquisition.** The student acquires electronic information in a variety of formats, with appropriate supervision.

The student is expected to:

(A) identify, create, and use files in various formats such as text, bitmapped/vector graphics, image, video, and audio files;

(B) demonstrate the ability to access, operate, and manipulate information from secondary storage and remote devices including CD-ROM/laser discs and on-line catalogs; and

(C) use on-line help and other documentation.

(6) **Information acquisition.** The student evaluates the acquired electronic information.

The student is expected to:

(A) determine and employ methods to evaluate the electronic information for accuracy and validity;

(B) resolve information conflicts and validate information through accessing, researching, and comparing data; and

(C) demonstrate the ability to identify the source, location, media type, relevancy, and content validity of available information.

(7) **Solving problems.** The student uses appropriate computer-based productivity tools to create and modify solutions to problems.

The student is expected to:

(A) plan, create, and edit documents created with a word processor using readable fonts, alignment, page setup, tabs, and ruler settings;

(B) create and edit spreadsheet documents using all data types, formulas and functions, and chart information;

(C) plan, create, and edit databases by defining fields, entering data, and designing layouts appropriate for reporting;

(D) demonstrate proficiency in the use of multimedia authoring programs by creating linear or non-linear projects incorporating text, audio, video, and graphics;

(E) create a document using desktop publishing techniques including, but not limited to, the creation of multi-column or multi-section documents with a variety of text-wrapped frame formats;

(F) differentiate between and demonstrate the appropriate use of a variety of graphic tools found in draw and paint applications;

(G) integrate two or more productivity tools into a document including, but not limited to, tables, charts and graphs, graphics from paint or draw programs, and mail merge;

(H) use interactive virtual environments, appropriate to level, such as virtual reality or simulations;

(I) use technical writing strategies to create products such as a technical instruction guide; and

(J) use foundation and enrichment curricula in the creation of products.

(8) **Solving problems.** The student uses research skills and electronic communication, with appropriate supervision, to create new knowledge.

The student is expected to:

(A) participate with electronic communities as a learner, initiator, contributor, and teacher/mentor;

(B) complete tasks using technological collaboration such as sharing information through on-line communications;

(C) use groupware, collaborative software, and productivity tools to create products;

(D) use technology in self-directed activities by sharing products for defined audiences; and

(E) integrate acquired technology applications skills, strategies, and use of the word processor, database, spreadsheet, telecommunications, draw, paint, and utility programs into the foundation and enrichment curricula.

(9) **Solving problems.** The student uses technology applications to facilitate evaluation of work, both process and product.

The student is expected to:

(A) design and implement procedures to track trends, set timelines, and review/evaluate progress for continual improvement in process and product; and

(B) resolve information conflicts and validate information through research and comparison of data.

(10) **Communication.** The student formats digital information for appropriate and effective communication.

The student is expected to:

(A) use productivity tools to create effective document files for defined audiences such as slide shows, posters, multimedia presentations, newsletters, brochures, or reports;

(B) demonstrate the use of a variety of layouts in a database to communicate information appropriately including horizontal and vertical layouts;

(C) create a variety of spreadsheet layouts containing descriptive labels and page settings;

(D) demonstrate appropriate use of fonts, styles, and sizes, as well as effective use of graphics and page design to effectively communicate; and

(E) match the chart style to the data when creating and labeling charts.

(11) **Communication.** The student delivers the product electronically in a variety of media, with appropriate supervision.

The student is expected to:

(A) publish information in a variety of ways including, but not limited to, printed copy, monitor display, Internet documents, and video;

(B) design and create interdisciplinary multimedia presentations for defined audiences including audio, video, text, and graphics; and

(C) use telecommunication tools for publishing such as Internet browsers, video conferencing, or distance learning.

(12) **Communication.** The student uses technology applications to facilitate evaluation of communication, both process and product.

The student is expected to:

(A) design and implement procedures to track trends, set timelines, and review and evaluate the product using technology tools such as database managers, daily/monthly planners, and project management tools;

(B) determine and employ technology specifications to evaluate projects for design, content delivery, purpose, and audience, demonstrating that process and product can be evaluated using established criteria or rubrics;

(C) select representative products to be collected and stored in an electronic evaluation tool; and

(D) evaluate the product for relevance to the assignment or task.

Source: The provisions of this §126.12 adopted to be effective September 1, 1998, 22 TexReg 5203.

Presenter Preparation Checklist

Table set (per group of 4):

- ☐ Post-it notes
- ☐ Rulers
- ☐ Tape measures (metric)
- ☐ Highlighters
- ☐ Post-it flags
- ☐ Tape
- ☐ Masking tape
- ☐ Flip chart markers
- ☐ Transparency markers
- ☐ Sticky dots
- ☐ Pencils
- ☐ Technology Tutorials binder (one per computer)
- ☐ Chart paper

Manipulatives/Materials:

Engage:

- ☐ One-inch color cubes – 1 bag of 50 per every 8 participants
- ☐ Color tiles - 1 bag of 50 per every 8 participants
- ☐ One-inch construction paper squares - 1 bag of 36 per every 8 participants
- ☐ Yard stick – 1 per every 8 participants

Explore/Explain 1:

- ☐ Centimeter cubes – 1 bag of 50 per group of 4 participants

Explore/Explain 2:

- ☐ Lunch bags (4 per group)

Explore/Explain 3:

- ☐ Dice – 1 die per 12 participants
- ☐ 6-sectioned spinners – 1 spinner per 12 participants
- ☐ Playing cards (cards A – 6 of each suit) – 1 set per 12 participants

Evaluate:

- ☐ Sentence strips – three colors, one of each per participant

Prepare:

Engage:

- ☐ Data Station Tents - A, B, C, D
- ☐ Data Station Cards – print using a color printer. Attach each shape to an index card.
- ☐ Chart Paper
  - Survey Statements
  - Reflections on Data Venn Diagram – Data Sources (1 per 12 participants)
  - Reflections on Data Venn Diagram – Tools (1 per 12 participants)

Explore/Explain 1:

- ◻ Cardstock labeled: "minimum", "lower quartile/Q1", "median", "upper quartile/Q3", "maximum" (available on Resource CD)
- ◻ Number Line (available on Resource CD)

Explore/Explain 2:

- ◻ Graph Cards – 1 card per group
- ◻ Data Cards – 1 set per group
- ◻ Data Statement Cards – 1 set of 4 per group
- ◻ Chart Paper
  - Guided Questions 1 and 2

Explore/Explain 3:

- ◻ Probability Simulation Cards Set 1 – one card with corresponding tool (dice, spinner, cards)
- ◻ Probability Simulation Cards Set 2 – one card per group of 2 participants
- ◻ Chart Paper
  - The Big Question

Technology:

- ◻ Presentation computer loaded with most recent version of:
  - PowerPoint
  - TI-Interactive (load with The Big Question Presenter Spreadsheet – for Explore/Explain 3)
  - TI-Connect
  - Excel (load with Grams of Fat spreadsheet - for Explore/Explain 2)
  - Word
  - Internet access
  - Hyperlink document
- ◻ Data projector
- ◻ TI-73 presentation calculator and viewscreen
- ◻ Overhead projector
- ◻ One computer per two participants loaded with most recent version of:
  - TI-Interactive
  - TI-Connect
  - Excel (load with Grams of Fat spreadsheet - for Explore/Explain 2)
  - Word
  - Internet access
  - Hyperlink document
- ◻ TI-73 calculator – one per participant (loaded with Probability Simulator Application – for Explore/Explain 3)
- ◻ CBRs – one per Data Station C (Engage)
- ◻ Jumpdrives (optional)

Transparencies (or use Power Point slides):

Engage:

- □ Reflections on Data – Data Sources
- □ Reflections on Data – Tools
- □ Debriefing the Exploration of Data

Explore/Explain 1:

- □ The Foot Question 1, 2, and 3
- □ Sticky Dot
- □ Box and Whisker Plot
- □ Venn Diagram
- □ Box and Whisker Participant Page (must use transparency here)

Explore/Explain 2:

- □ Survey Question
- □ Spreadsheet
- □ Comparison
- □ Guided Questions 1 and 2
- □ Gallery Walk 1 and 2

Explore/Explain 3:

- □ The Big Question
- □ Mini To-Do List
- □ To-Do List
- □ My Best Graph Questionnaire
- □ Venn Diagram

Elaborate:

- □ How's Your Timing?
- □ Data Collection
- □ Teaching Strategies
- □ Transparency 1: Looks Like, Sounds Like
- □ Transparency 2: Looks Like, Sounds Like
- □ Research

Evaluate:

- □ Encouraging Judicious Use of Technology

Handouts: Prepare one folder per participant with the following handouts.

Engage: (Copy all on light pink paper. Staple.)

- □ Data Station Recording Sheet A
- □ Data Station Recording Sheet B
- □ Data Station Recording Sheet C
- □ Data Station Recording Sheet D
- □ Reflections on Data – Data Sources
- □ Reflections on Data - Tools
- □ Debriefing the Exploration of Data
- □ Planning for Intentional Use of Data in the Classroom (copy on green paper)

Handouts (continued):

Explore/Explain 1: (Copy all on light blue paper. Staple.)

- □ Stem and Leaf
- □ Box and Whisker Participant Page
- □ Box and Whisker Plot – Page 1 and 2
- □ Venn Diagram
- □ Planning for Intentional Use of Data in the Classroom (copy on green paper)

Explore/Explain 2: (Copy all on lavender paper. Staple.)

- □ Generating Data
- □ Collecting Data
- □ Time to Play
- □ Comparison
- □ Planning for Intentional Use of Data in the Classroom (copy on green paper)

Explore/Explain 3: (Copy all on light yellow paper. Staple.)

- □ Group Activity Sheet
- □ Venn Diagram
- □ My Best Graph Questionnaire
- □ Planning for Intentional Use of Data in the Classroom (copy on green paper)

Elaborate: (Copy all on salmon paper. Staple.)

- □ Rubric for Answering the Question
- □ Understanding the Question
- □ Making a Plan
- □ Carrying Out the Plan and Answering the Question
- □ Evaluating the Answer and the Plan
- □ Extending the Question

Evaluate: (Copy all on taupe paper. Staple.)

- □ Gallery Walk Observations
- □ Sample Student Lessons

Engage: Name Your Source!

Purpose:

Participants will investigate a variety of data sources. Assess participants' experience and comfort with various avenues and tools for collecting data. Compare and contrast technology-based data sources with technology-free data sources.

Descriptor:

Participants will rotate through four stations to gather data:

- Internet data sources for archival data
- Internet-based tools for collecting data
- Calculator-based data collection tools
- Technology free data collection tools

Upon completion of the activities at each station, participants will compare and contrast their experiences with Internet data sources and printed data sources. They will also compare and contrast their experiences with calculator-based data collection tools and technology-free data collection tools. Introduce participants to the formulation of questions that will spark data collection and investigation.

Duration:

1.5 hours

Mathematics TEKS Objectives:

6.10A	The student uses statistical representations to analyze data. The student is expected to select and use an appropriate representation for presenting and displaying different graphical representations of the same data including line plot, line graph, bar graph, and stem and leaf plot.
6.10B	The student uses statistical representations to analyze data. The student is expected to identify mean (using concrete objects and pictorial models), median, mode, and range of a set of data.
6.10D	The student uses statistical representations to analyze data. The student is expected to solve problems by collecting, organizing, displaying, and interpreting data.
7.11A	The student understands that the way a set of data is displayed influences its interpretation. The student is expected to select and use an appropriate representation for presenting and displaying relationships among collected data, including line plot, line graph, bar graph, stem and leaf plot, circle graph, and Venn diagrams, and justify the selection.
7.11B	The student understands that the way a set of data is displayed influences its interpretation. The student is expected to make inferences and convincing arguments based on analysis of given or collected data.
7.12A	The student uses measures of central tendency and range to describe a set of data. The student is expected to describe a set of data using mean, median, mode, and range.

7.12B The student uses measures of central tendency and range to describe a set of data. The student is expected to choose among mean, median, mode, or range to describe a set of data and justify the choice for a particular situation.

8.12A The student uses statistical procedures to describe data. The student is expected to select the appropriate measure of central tendency or range to describe a set of data and justify the choice for a particular situation.

8.12A The student uses statistical procedures to describe data. The student is expected to draw conclusions and make predictions by analyzing trends in scatterplots.

8.12C The student uses statistical procedures to describe data. The student is expected to select and use an appropriate representation for presenting and displaying relationships among collected data, including line plots, line graphs, stem and leaf plots, circle graphs, bar graphs, box and whisker plots, histograms, and Venn diagrams, with and without the use of technology.

8.13A The student evaluates predictions and conclusions based on statistical data. The student is expected to evaluate methods of sampling to determine validity of an inference made from a set of data.

8.13B The student evaluates predictions and conclusions based on statistical data. The student is expected to recognize misuses of graphical or numerical information and evaluate predictions and conclusions based on data analysis.

6.11A, 7.13A, 8.14A The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics.

6.11D, 7.13D, 8.14D The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to select tools such as real objects, manipulatives, paper/pencil, and technology or techniques such as mental math, estimation, and number sense to solve problems.

6.12A, 7.14A, 8.15A The student communicates about Grade 6/7/8 mathematics through informal and mathematical language, representations, and models. The student is expected to communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models.

6.12B, 7.14B, 8.15B The student communicates about Grade 6/7/8 mathematics through informal and mathematical language, representations, and models. The student is expected to evaluate the effectiveness of different representations to communicate ideas.

6.13A, 7.15A, 8.16A The student uses logical reasoning to make conjectures and verify conclusions. The student is expected to make conjectures from patterns or sets of examples and nonexamples.

6.13B, 7.15B, 8.16B The student uses logical reasoning to make conjectures and verify conclusions. The student is expected to validate his/her conclusions using mathematical properties and relationships.

Technology Applications TEKS Objectives:

(1)(H) Use terminology related to the Internet appropriately, including but not limited to, electronic mail (e-mail), Uniform Resource Locators (URLs), electronic bookmarks, local are networks (LANs), wide area networks (WANs), World Wide Web (WWW) page, and HyperText Markup Language (HTML).

(2)(A) Demonstrate proficiency in the use of a variety of input devices such as mouse/track pad, keyboard, microphone, digital camera, printer, scanner, disk/disc, modem, CD-ROM, or joystick.

(3)(D) Identify the impact of technology applications on society through research, interviews, and personal observation.

(3)(E) Demonstrate knowledge of the relevancy of technology to future careers, life-long learning, and daily living for individuals of all ages.

(4)(A) Use strategies to locate and acquire desired information on LANs and WANs, including the Internet, intranet, and collaborative software.

(6)(C) Demonstrate the ability to identify the source, location, media type, relevancy, and content validity of available information.

(7)(H) Use interactive virtual environments, appropriate to level, such as virtual reality or simulations.

TAKS:

- Objective 5: Probability and Statistics
- Objective 6: Underlying Processes and Mathematical Tools

Technology:

- Internet Websites:
  M&Ms *http://www1.mms.com/us*
  Hit the Dot *http://faculty.washington.edu/chudler/java/dottime.html*
- Calculator-based ranger and graphing calculator

Materials:

Advance Preparation: Create survey statements on chart paper for the recording of individual responses. Print **Data Station Cards** using a color printer. Recreate Venn diagrams from the **Reflections on Data** activity sheet on large chart paper. Create one set of Venn diagrams for every 12 participants. Cut out 36 one-inch squares for each Data Station D that will be made available to participants.

Presenter(s): Internet access and projection device, overhead graphing calculator, PowerPoint slides or transparencies of transparencies and activity sheets

Per group: *Data Station A:* Computer with Internet access
Data Station B: Computer with Internet access
Data Station C: CBR and graphing calculator
Data Station D: One-inch color tiles, one-inch cubes, one-inch paper squares, yard sticks

Per Participant: Sticky dots, **Data Station** recording sheets for **Stations A-D**, **Reflections on Data** activity sheets, **Debriefing the Exploration of Data** activity sheet, **Planning for Intentional Use of Data in the Classroom** activity sheet

Leader Notes:
The goal of the Engage phase is to begin conversations about data. As teachers see the value of data and the mathematics that can be explored and reinforced through the use of data, they will begin to seek data. Technology offers the tools to make sense of data efficiently. Technology also offers effective means for representing data so that analysis may take place. Encourage participants to interact with each other. The presenter(s) should move around the room to facilitate the activity. Use the ***Facilitation Questions*** *to guide and redirect participants, as needed.*

Engage

1. *Record the following statements on chart paper. Post these statements around the room.*

Technology offers the opportunity to strengthen mathematical learning in my classroom.

Strongly Disagree	Strongly Agree

Students should learn first with paper-and-pencil methods and then with technology.

Strongly Disagree	Strongly Agree

My students know how to discern which of these methods best serves the purposes of a given problem: mental strategies, paper-and-pencil techniques, and technology applications.

Strongly Disagree	Strongly Agree

The best technology tool for the mathematics classroom is the graphing calculator.

Strongly Disagree	Strongly Agree

2. *As participants enter the session, direct them to respond to the posted statements by placing a marker, such as a sticky dot, in the location that best corresponds to their response. Use only one color of sticky dot for this activity.*

3. *As you provide a welcome and introduction to this professional development session, direct the participants' attention to the posted statements, noting that they will explore their reflections about these statements in greater detail during the course of this professional development.*

4. *Distribute a* ***Data Station Card*** *to each participant. Direct the participants to move to the station described on his or her card.*

> ***Archival data*** *are data that are not, under normal circumstances, subject to change. Examples of archival data include results from concluded research, medical records, and historical data.*
> ***Dynamic data*** *are data that are, under normal circumstances, subject to change. The data may be updated routinely or on request. An example of dynamic data is survey results that update based on each new response.*
> ***Categorical data*** *reflect data organized by category rather than by number. The frequencies of the categorical data are counted. Examples of categorical data include favorite color, voting, males/females, etc.*
> ***Numerical data*** *are data that reflect measurable, quantifiable attributes. The measures, rather than the attributes, form the data. Examples of numerical data include measures of length, measures of radio frequency, measures of time, etc.*

5. *After participants have moved to the appropriate station, model the activity at Station A for the whole group using a projection system so that participants understand the intent of the activity. Avoid walking the participants through the entire activity sheet so that the groups at Station A still have a meaningful learning experience. Direct participants to the M&Ms® website at http://www1.mms.com/us. Demonstrate linking to the "About M&M's®" webpage by using the pop-down menu located under "About M&M's®" and clicking on Products. Click on one of the products to see data about this product.*

Facilitation Questions

- What data does this webpage provide? How would we record this information on the **Data Station A Recording Sheet**?
  Answers may vary. Color distribution within a product, nutritional data, packaging size.
- Are the data numerical, categorical, or both? How would we record this on the **Data Station A Recording Sheet**?
  The data are numerical and categorical.
- What relationships are present in this data? Why? How would we record this on the **Data Station A Recording Sheet**?
  Answers may vary. The percentages represent the part-to-whole part relationship.

6. *Explain that the time allotted for each data station is 12 minutes. In these 12 minute segments, the participants should explore the given data source while recording observations and notes on the station's recording sheet. A count-down timer is a beneficial tool for keeping participants on task.*

7. *Walk to each data station, clarifying directions as necessary and prompting discussion as necessary.*

Facilitation Questions

Data Station A

- What numerical data have you found?
  Answers may vary. Percentages describing color ratios, nutritional quantities, etc.
- What categorical data have you found?
  Answers may vary. Colors represented in each type of candy, etc.
- What relationships occur within the numerical data? Why?
  Answers may vary.
- What relationships occur within the categorical data? Why?
  Answers may vary.
- How might you describe the nutritional aspects of this product using a circle graph?
  Answers may vary. Represent the portion of the recommended daily allowance of fat contained in one package of candy.
- How might you represent other aspects of this product?
  Answers may vary.
- What question(s) can we pose to students that would require them to gather data on two or more products?
  Answers may vary. If we were to mix one bag of two types of candies together, what would be the color distribution of the mixture?

Data Station B

- What numerical data did you generate?
  Answers may vary. A score, an updated representation of activity results, etc.1
- What categorical data did you generate?
  Answers may vary. Ranges of scores.
- What relationships occur within the numerical data? Why?
  Answers may vary. Percentages falling within certain ranges of scores, etc.
- How might you summarize the data generated by your group?
  Answers may vary. For example, the group might have a second individual counting the number of mouse clicks for the purpose of comparing this data to the score obtained to determine accuracy rates.
- How might you represent the data generated by your group?
  Answers may vary.
- To what real-life experiences might our students relate this data collection activity?
  Answers may vary.

Facilitation Questions

Data Station C

- What numerical data did you generate?
  Answers may vary.
- What categorical data did you generate?
  Answers may vary.
- What relationships occur within the numerical data? Why?
  Answers may vary.
- What relationships occur within the categorical data? Why?
  Answers may vary.
- How might you summarize the data generated by your group?
  Answers may vary.
- To what real-life experiences might our students relate this data collection activity?
  Answers may vary.

Data Station D

- What numerical data did you generate?
  Answers may vary.
- What categorical data did you generate?
  Answers may vary.
- What relationships occur within the numerical data? Why?
  Answers may vary.
- What relationships occur within the categorical data? Why?
  Answers may vary.
- How might you summarize the data generated by your group?
  Answers may vary.
- How might you represent the data generated by your group?
  Answers may vary.
- How might you use these tools to generate two sets of data for comparison purposes?
  Answers may vary.
- To what real-life experiences might our students relate this data collection activity?
  Answers may vary.

8. *After 12 minutes have passed, direct the participants to rotate to the next data station. Data Station D participants should move to Data Station A, Data Station A participants should move to Data Station B, etc. Allow approximately 3 minutes to transition between groups.*

9. *Repeat the rotation until each group has been at each data station. Continue to use the facilitation questions as needed.*

10. *Upon completing rotation through each station, reorganize participants into groups of 4. If using the* ***Data Station Cards,*** *regroup by color. Prompt the participants to complete the*

__Reflections on Data__ activity sheet individually. They are in groups of 4 to simplify the transition to groups of 12. Allow approximately 5 minutes for each individual's completion of these activity sheets.

11. *While the participants are completing their individual Reflections on Data activity sheets, post 1 set of Venn Diagrams for every 12 participants.*

12. *Prompt participants to move to the chart paper Venn diagrams in groups of 12 by combining 3 existing groups of 4 participants. Prompt participants tol work silently in these groups of 12 to create summary Venn diagrams of the three groups' discussions.*

13. *Prompt the group to identify the person with the longest hair. This person will be the first recorder. Prompt this person to record one statement on the large chart paper Venn diagrams. The statement may be a personal observation or an observation from the group's Venn diagrams.*

14. *Prompt the participant to pass the marker to a new recorder, preferably a person who was not a member of his or her discussion group. This person will record a new statement on the Venn diagram. Prompt participants to continue this process until each participant has had an opportunity to record a statement. Participants may record new observations or statements that occur as a result of seeing the reflections of others. __Note__: Depending on time, you may choose to have multiple participants recording on the Venn diagrams at the same time.*

Facilitation Questions

- Which similarities did each group note?
  Answers may vary.
- Which similarities were new to you?
  Answers may vary.
- Which differences did each group note?
  Answers may vary.
- Which differences were new to you?
  Answers may vary.
- What are the benefits of an archival data source?
  Answers may vary. The teacher is able to prepare models of representations to which students can compare their efforts.
- What are the benefits of a dynamic data source, such as the applet used to generate data at Station B?
  Answers may vary. Dynamic data sources engage students' interest.
- What are the benefits of a CBR data source over a technology-free data source?
  Answers may vary. The CBR provides dynamic data in a graphical representation.
- What are the benefits over a technology-free data source over a CBR data source?
  Answers may vary. Technology-free data allows for timely exploration when technology resources may not be available or accessible.

*15. Distribute the **Debriefing the Exploration of Data** activity sheet. Prompt participants to reflect upon the discussions summarized by the Venn diagrams and record their responses to each of the questions posed on the activity sheet. After a few minutes of recording time, prompt the participants to share their responses with another participant. Debrief the responses in whole-group setting, keeping in mind that the goal of this phase of the professional development is to consider data.*

Facilitation Questions

- When might an archival data source support the learning of the math TEKS?
  Answers may vary.
- When might a dynamic data source support the learning of the math TEKS?
  Answers may vary.
- Are trends more apparent in data resulting from an archival or a dynamic data source? Why?
  Answers may vary.
- What are the limitations of an archival data source?
  Answers may vary.
- What are the limitations of a dynamic data source?
  Answers may vary.
- How might these limitations impact the learning of the math TEKS?
  Answers may vary.
- What topics in middle school mathematics lend themselves to archival data?
  Answers may vary.
- How do internet-based data sources serve to engage students in the learning process?
  Answers may vary.
- How might you use internet-based data sources to assess student learning?
  Answers may vary.
- Looking at the two Venn diagrams, how are the data sources related?
  Answers may vary.
- Looking at the two Venn diagrams, how are the data sources different?
  Answers may vary.

16. *Pose the questions listed below to the whole group. Explain to the participants that these questions serve as "filtering questions" when seeking to incorporate the use of data into classroom instruction.*
    a. *What TEKS in a particular unit of study are enhanced through the use of data?*
    b. *What data are required to enhance the study of these TEKS?*
    c. *What question(s) may be answered using this data?*
    d. *How does using data allow one to increase the rigor of the learning experience? How might using data move the learner from remembering, understanding, and applying to analyzing and evaluating?*
    e. *What type of data would be most useful for the stated TEKS?*
    f. *What setting will be available during instruction related to these mathematical goals?*
    g. *What actual data source(s) may prove helpful in enhancing mathematical learning related to these TEKS?*

17. *Distribute the* ***Planning for Intentional Use of Data in the Classroom*** *activity sheet to each participant. Share with the participants that these reflective questions form the basis for the* ***Planning for Intentional Use of Data in the Classroom*** *activity. Share with the participants that these filtering questions helped to develop each of the activities contained within this professional development. This template will serve as a reflection tool to summarize each activity that follows in order to identify elements that support the judicious use of technology.*

Data Station Card

**Print in color.

Station A	Station B	Station C	Station D
Station A	Station B	Station C	Station D
Station A	Station B	Station C	Station D
Station A	Station B	Station C	Station D
Station A	Station B	Station C	Station D
Station A	Station B	Station C	Station D
Station A	Station B	Station C	Station D
Station A	Station B	Station C	Station D

Data Station A Recording Sheet

Data Source	http://www1.mms.com/us Link to the "About M&M's®" webpage by using the pop-down menu located under "About M&M's®" and clicking on Products.
How would you describe this set of data? Why?	
What relationships occur within this set of data? Why?	
How would you represent this data? Why?	
What question(s) can we pose to students that this set of data helps to answer?	
How might this data be used to extend what students already understand about our course content?	

Data Station B Recording Sheet

Data Source	http://faculty.washington.edu/chudler/java/dottime.html
How would you describe this set of data? Why?	
What relationships occur within this set of data? Why?	
How would you represent this data? Why?	
What question(s) can we pose to students that this set of data helps to answer?	
How might this data be used to extend what students already understand about our course content?	

You will need to delete the cookie for this website to record data for each participant.

Data Station C Recording Sheet

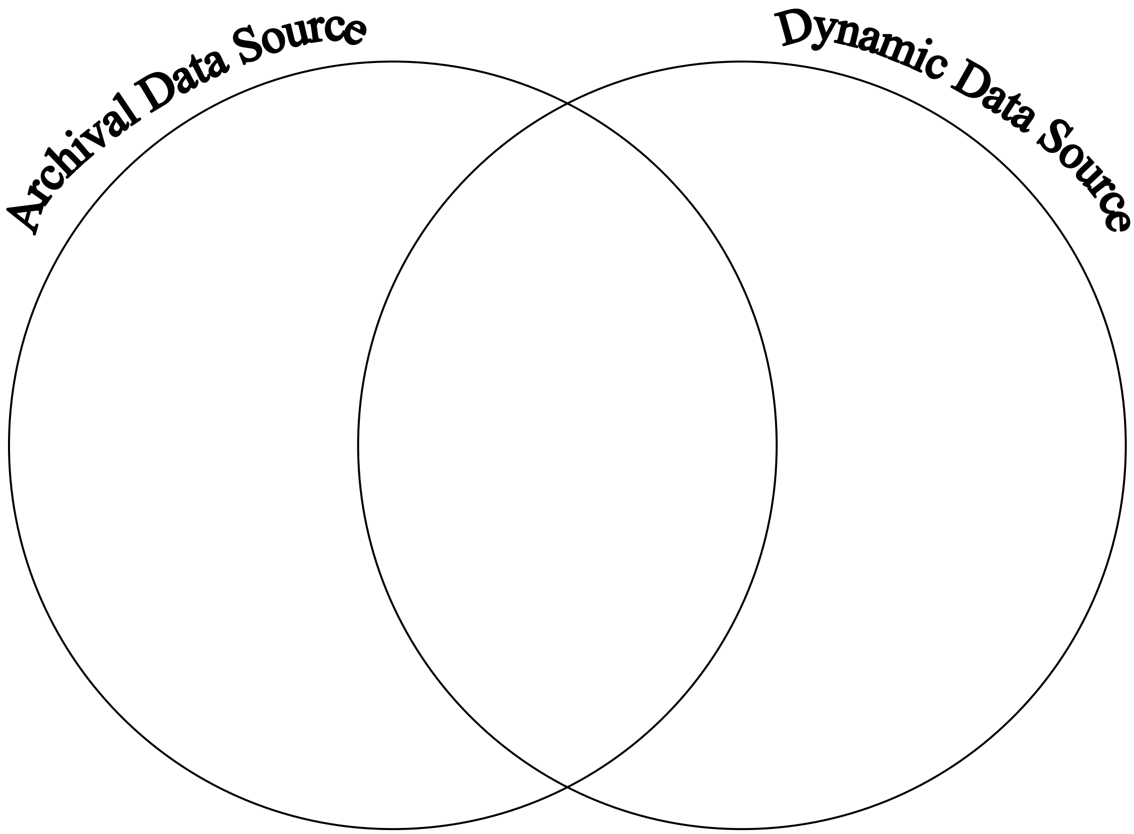
Data Source	CBR and graphing calculator
How would you describe the data generated by these tools? Why?	
What relationships occur within this set of data? Why?	
How would you represent this data? Why?	
What question(s) can we pose to students that this set of data helps to answer?	
How might this data be used to extend what students already understand about our course content?	

Data Station D Recording Sheet

Data Source	Color tiles, one-inch cubes, one-inch paper squares, yard sticks
How would you describe the data generated by these tools? Why?	
What relationships occur within this set of data? Why?	
How would you represent this data? Why?	
What question(s) can we pose to students that this set of data helps to answer?	
How might this data be used to extend what students already understand about our course content?	

Reflections on Data

Complete the following Venn Diagram to compare and contrast the uses of archival and dynamic data found on the Internet.



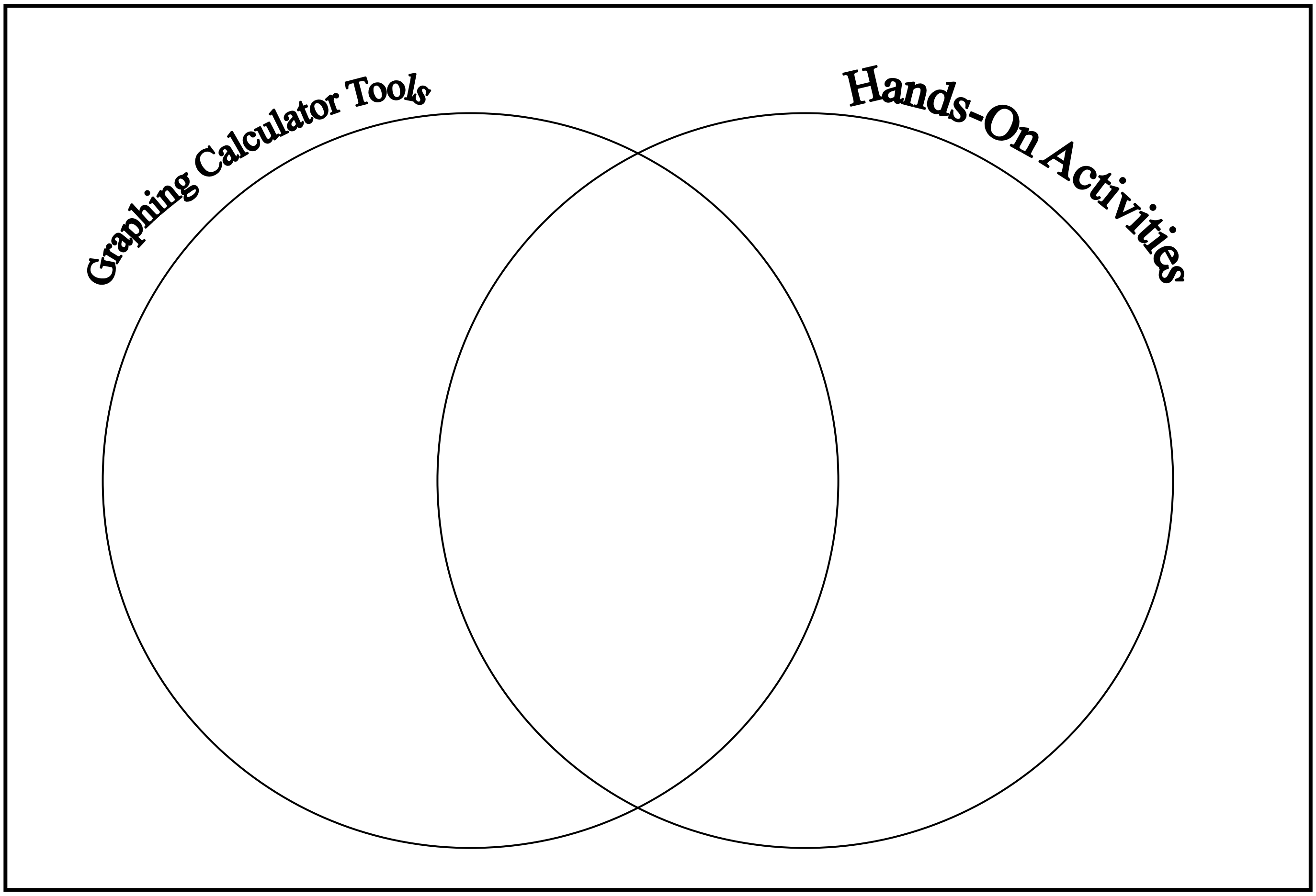
What are the benefits of using archival data found on the Internet?

What are the benefits of using a dynamic data source, such as an applet on the Internet?

How might teachers use these data sources in a middle school mathematics classroom?

Reflections on Data

Complete the following Venn Diagram to compare and contrast the uses of the graphing calculator tools and hands-on activities as data sources.



What are the benefits of using data resulting from graphing calculator tools?

What are the benefits of using data derived from hands-on activities?

How might teachers use these data sources in a middle school mathematics classroom?

Debriefing the Exploration of Data

1. What questions can we ask as reflective practitioners to determine the appropriateness of a data source for promoting mathematical learning?

2. How does the technology-based data offer an opportunity to strengthen mathematical learning?

3. How might hands-on activities complement the judicious use of technology?

4. What paper-and-pencil methods do students need to know to make sense of the data we explored?

Planning for Intentional Use of Data in the Classroom

TEKS	Math	
	Tech Apps	
Question(s) to Pose to Students	Math	
	Tech Apps	
Cognitive Rigor	Knowledge	
	Understanding	
	Application	
	Analysis	
	Evaluation	
	Creation	
Data Source(s)	Real-Time	
	Archival	
	Categorical	
	Numerical	
Setting	Computer Lab	
	Mini-Lab	
	One Computer	
	Graphing Calculator	
	Measurement Based Data	
Bridge to the Classroom		

Explore/Explain 1: Man In The Box

Purpose: Explore measures of central tendency and range using numerical and graphical representations. Technology tools will be used to generate numerical and graphical representations.

Descriptor: Participants will measure attributes to gather data. They will create stem and leaf plots using web-based tools to represent the center and the spread of this data. Participants will use a web-based tool to create a box and whisker plot to explore in greater detail the shape and the spread of the data. Participants will also use hand-held graphing technology to create box and whisker plots. They will gather additional data to explore how such changes impact measures of central tendency.

Duration: 2.25 hours

Mathematics TEKS Objectives:

6.10A	The student uses statistical representations to analyze data. The student is expected to select and use an appropriate representation for presenting and displaying different graphical representations of the same data including line plot, line graph, bar graph, and stem and leaf plot.
6.10B	The student uses statistical representations to analyze data. The student is expected to identify mean (using concrete objects and pictorial models), median, mode, and range of a set of data.
6.10D	The student uses statistical representations to analyze data. The student is expected to solve problems by collecting, organizing, displaying, and interpreting data.
7.11A	The student understands that the way a set of data is displayed influences its interpretation. The student is expected to select and use an appropriate representation for presenting and displaying relationships among collected data, including line plot, line graph, bar graph, stem and leaf plot, circle graph, and Venn diagrams, and justify the selection.
7.11B	The student understands that the way a set of data is displayed influences its interpretation. The student is expected to make inferences and convincing arguments based on analysis of given or collected data.
7.12A	The student uses measures of central tendency and range to describe a set of data. The student is expected to describe a set of data using mean, median, mode, and range.
7.12B	The student uses measures of central tendency and range to describe a set of data. The student is expected to choose among mean, median, mode, or range to describe a set of data and justify the choice for a particular situation.
8.12A	The student uses statistical procedures to describe data. The student is expected to select the appropriate measure of central tendency or range to describe a set of data and justify the choice for a particular situation.
8.12C	The student uses statistical procedures to describe data. The student is expected to select and use an appropriate representation for presenting and displaying

relationships among collected data, including line plots, line graphs, stem and leaf plots, circle graphs, bar graphs, box and whisker plots, histograms, and Venn diagrams, with and without the use of technology.

6.11A, 7.13A, 8.14A The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics.

6.11D, 7.13D, 8.14D The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to select tools such as real objects, manipulatives, paper/pencil, and technology or techniques such as mental math, estimation, and number sense to solve problems.

6.12A, 7.14A, 8.15A The student communicates about Grade 6/7/8 mathematics through informal and mathematical language, representations, and models. The student is expected to communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models.

6.12B, 7.14B, 8.15B The student communicates about Grade 6/7/8 mathematics through informal and mathematical language, representations, and models. The student is expected to evaluate the effectiveness of different representations to communicate ideas.

6.13A, 7.15A, 8.16A The student uses logical reasoning to make conjectures and verify conclusions. The student is expected to make conjectures from patterns or sets of examples and nonexamples.

6.13B, 7.15B, 8.16B The student uses logical reasoning to make conjectures and verify conclusions. The student is expected to validate his/her conclusions using mathematical properties and relationships.

Technology Applications TEKS Objectives:

(1)(B) The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to compare, contrast, and appropriately use the various input, processing, output, and primary/secondary storage devices.

(1)(C) The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency.

(6)(A) The student evaluates the acquired electronic information. The student is expected to determine and employ methods to evaluate the electronic information for accuracy and validity.

(7)(H) The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to use interactive virtual environments, appropriate to level, such as virtual reality or simulations.

TAKS Objectives:

- Objective 5: Probability and Statistics
- Objective 6: Mathematical Processes and Tools

Technology:

- Internet websites:
  http://www.shodor.org/interactivate/activities/stemleaf/index.html
  http://nlvm.usu.edu/en/nav/frames_asid_200_g_3_t_5.html?open=instructions
- Hand-held graphing technology

Materials:

Advanced Preparation: Prepared signs - “minimum”, “maximum”, “upper quartile/Q3”, “lower quartile/Q1”, and “median” (available on CD); Height Number Line (available on CD); Transparencies or PowerPoint**– The Foot Question 1, 2, and 3; Sticky Dot; Box and Whisker Plot**; **Box and Whisker Participant Page, Venn Diagram.** Transparencies of **Group Recording Sheet –** each group will need a transparency of ½ page. The presenter may wish to bookmark the two websites for easy access.

Presenter Materials: Computer with internet access and data projection device or access to a computer lab, graphing calculator with presentation capabilities.

Per group: Centimeter cubes, **Group Recording transparency** (1/2 sheet), transparency marker**, s**ticky dots in two colors

Per participant: Measuring tape, TI-73 graphing calculator, ruler, **Stem and Leaf – Computer Participant Page**, **Box and Whisker Participant Page**, **Box and Whisker Plot – Computer Participant Pages**, **Intentional Use of Data Activity Sheet**, **Technology Tutorials binder**

Per pair of participants: Venn Diagram Participant Page

Leader Notes:

Due to the number of topics present in this lesson, several Explore/Explain cycles occur. As each new topic is introduced, participants explore the topic. The Explain cycle then occurs. This is repeated several times throughout the lesson.

Introductory Activity – Stem and Leaf Plot

This part of the lesson is designed for the entire group of participants. Encourage participants to interact with each other. Ideally, each participant or pair of participants will have access to a computer for this activity. The presenter(s) should move around the room facilitating the activity. Use the ***Facilitation Questions*** *to guide and redirect participants, as needed.*

1. **What is the average number of centimeters that are added to a person’s height when standing on his tiptoes? Who do you predict would gain the most centimeters**

and why do you think this is so? Display **The Foot Question Transparency 1** or PowerPoint slide 1. In groups of 4-5, have participants discuss this question and their reasoning. Allow several participants to share their reasoning. One answer may be "females will gain more height because they tend to be more flexible than males, therefore their feet can flex further." Another answer may be "taller people may gain more height because they tend to have larger feet which will give them added height when standing on their tiptoes."

2. **What data would need to be collected to answer this question?** Flat-footed and tiptoe heights will need to be measured. As a group, determine how the each of these will be measured. Will you measure with or without shoes? When standing on tiptoes, will participants lean against the wall? How accurately should we measure? (Measure to the nearest centimeter.)

3. **Allow participants several minutes to measure their flat-footed and tiptoe heights.** Each group should record their results on the **Group Recording Sheet** transparency. Groups should keep this transparency at their tables at this time.

4. **Each participant should** c**ount out the number of centimeter cubes that represents the number of centimeters of height that were added when he/she stood on their tiptoes**. For example, if a participant's flat-footed height was 162 centimeters and tiptoe height was 167 centimeters, the participant will need 5 cubes (167-162=5).

5. **How could the cubes be used to find the mean number of centimeters that were added to participants' heights?** In groups of 4-5, have participants trade centimeter cubes until everyone has the same number of cubes. If this is not possible because the cubes are discrete, ask the students to describe the mean as between "___ and ___, nearer to ____ because we have more students with this number than the other." Use the Facilitation Questions below to debrief this further.

Facilitation Questions

- On average, how many centimeters of height were added to a participant when he/she stood on tiptoes?
  Answers may vary.
- Was the amount of height increase the same for everyone?
  Probably not.
- Which participants gained the most height when standing on his/her tiptoes? Why do you think this is so?
  Participants with larger feet may have gained the most height.
- Which participants gained the least height when standing on his/her tiptoes? Why do you think this is so?
  Participants with smaller feet may have gained the least height. Also, heels on shoes may have impacted the flat-footed height so there is not as great a gain on the tiptoe height.

6. **What impact will the tiptoe heights have on the mean, median, mode, and range of the flat-footed heights?** Display **The Foot Question Transparency 2** or PowerPoint slide 2. Allow groups several minutes to discuss this question. As groups are discussing this question, collect the **Group Recording transparencies**. Then have several groups share their predictions and reasoning on the impact of the tiptoe heights on the mean, median, mode, and range of the flat-footed heights.

7. **In order to find the measures of central tendency and the range for the flat-footed heights, participants will create a stem and leaf plot on the computer.** Distribute the **Stem and Leaf – Computer Participant Page** to each participant. The participants should open the web page to access the Stem and Leaf Plotter.

8. Randomly call out one of the flat-footed heights from the transparencies. Participants should enter this height into the applet and press Update Plot. **What did the applet do to the number to begin creating the stem and leaf plot?**

9. Using the transparencies, continue to call out the flat-footed heights of the remaining participants in a random order.

10. Participants should complete the activity page - **Stem and Leaf – Computer Participant Page**. As participants are completing the page, monitor and ask the following Facilitation Questions if necessary. Make sure participants have copied down their stem and leaf plot onto their activity page before moving to the next step.

Facilitation Questions

- Describe some stems and leaves that would be unreasonable for this situation. Why are they unreasonable?
  Stems that would be unreasonable include values above 20 (unless there are very tall participants.) Stems less than 14 would also be unreasonable unless there is a very short participant.
- Identify the minimum value of the data. Where is this found on the stem-and-leaf plot?
  The minimum value is the first data value listed on the stem-and-leaf plot.
- Identify the maximum value of the data. Where is this found on the stem-and-leaf plot?
  The maximum value is the last data value listed on the stem-and-leaf plot.
- Is the data symmetrical?
  Answers will depend on data collected. If it is not symmetrical, lead a discussion on why it is not.
- Is there any clustering in the stem and leaf plot? (Data that is grouped closely together). If so, what does this clustering imply?
  If clustering occurs, it means that several participants had similar heights.

11. **The applet created what is called a stem and leaf plot. What is the purpose of a stem and leaf plot?** *It provides the data in a least-to-greatest format. You can identify the mode, minimum, maximum, range, and median fairly easily on a stem-and-leaf plot. You can also identify extreme values.*

12. **The stem and leaf plotter found the mean, median, and mode of the data. What does the mode height signify?** The mode height is the most common height. **How could we show the mode height by using the actual participants?** One possible answer is that the participants could line up to identify the most common height.

13. **The applet also found the median of the flat-footed heights. What is the meaning of the median?** The median is the height of the person in the center of the group when the group is lined up from shortest to tallest.

14. **How could we demonstrate finding the median with a sample of participants?** Ask one person from each group to come to the front of the room. Have participants devise a strategy to find the median height. Use a strategy suggested by the participants. One suggestion is for the participants to line up from shortest to tallest. Then take one participant off both ends until only one remains.

15. **Could there be more than one participant in the middle? Explain how this could happen.** When there is an even number of participants, there will be two participants left in the middle. **How will you determine the median height if there are an even number of participants?** Find the average of the two heights in the center.

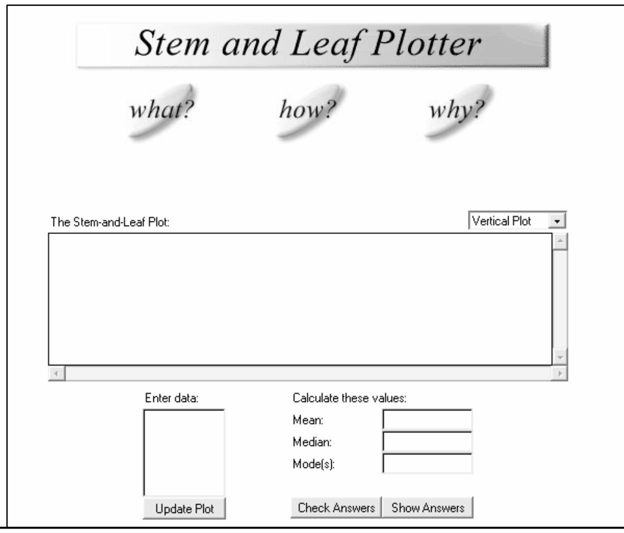
16. **The applet did not calculate the range of heights. How could we find the range of the heights?** The range of the heights is the difference between the height of the tallest person and the shortest person.

17. **How could we physically show the range?** Have the tallest and shortest participants stand next to each other. The difference in their heights is the range. **If another group performed this same experiment and found a larger range, what could you conclude about that group?** The difference in heights between the tallest and shortest person was greater.

18. **Why was technology used to introduce the concept of a stem and leaf plot?** It provided a way for students to learn about the concept by making hypotheses and verifying their predictions. The technology shows students how to create a stem and leaf plot. By middle school, students know how to order whole numbers from least to greatest. The technology can do this quickly so that more time can be spent analyzing the data.

Stem and Leaf - Computer Activity Page

1. Open the Stem and Leaf Plotter on the computer.
   http://www.shodor.org/interactivate/activities/stemleaf/index.html
2. Enter the data as the presenter calls it out in the box titled: “Enter data.” Then select “Update Plot.”
3. Sketch your stem and leaf plot below.



Stem and Leaf Plotter retrieved 10/29/05 from
http://www.shodor.org/interactivate/activities/stemleaf/index.html

4. Estimate the values of the mean, median, and mode(s). Enter your estimates in the boxes. Then select “Check answers.”

5. The stems are the values found to the left of the vertical line on the stem and leaf plot. Where do these values come from?
   These values represent the hundreds and tens place of the heights.

6. The leaves are the values found to the right of the vertical line on the stem and leaf plot. Where do these values come from?
   These values represent the ones place of the heights.

7. If you turned the stem and leaf plot horizontally, what type of graph would it resemble? Use the drop down menu to select Horizontal Plot. Does this verify your prediction?
   The graph would resemble a histogram since the stems represent ranges of numbers.

Box and Whisker Plots – By Hand

This part of the lesson is designed to show the participants how to transform the collected data into a box and whisker plot. The presenter should mount the Height Number Line on the wall where it will be easily visible. Use the ***Facilitation Questions*** *to guide and redirect participants, as needed.*

Box and whisker plots can be created several ways. One way is to find the lower and upper quartiles with the median removed from the data set. Another method includes the median as a member of both the upper and lower 50% of the data in order to find the upper and lower quartiles. This difference will only be apparent if there are an odd number of values in the data set. The method used below does not include the median when finding the upper and lower quartiles. This method of not including the median to calculate upper and lower quartiles is the one the state of Texas will use when assessing students.

1. In order to answer the question that was posed earlier, "What impact will the tiptoe heights have on the mean, median, mode, and range of the flat-footed heights?" a box and whisker plot will be created. This will be done by hand first with the flat-footed heights in order to understand how box and whisker plots are created. The plot will then be created on the computer.

2. A box and whisker plot organizes the data in a very unique way. One thing a box and whisker plot will show is where the middle 50% of the heights falls. **What strategy can be used to find the heights that represent the middle 50% of the class?** Display the PowerPoint slide 3 or **Box and Whisker Plot Transparency**. In groups of 4-5, allow participants time to discuss strategies for accomplishing this task.

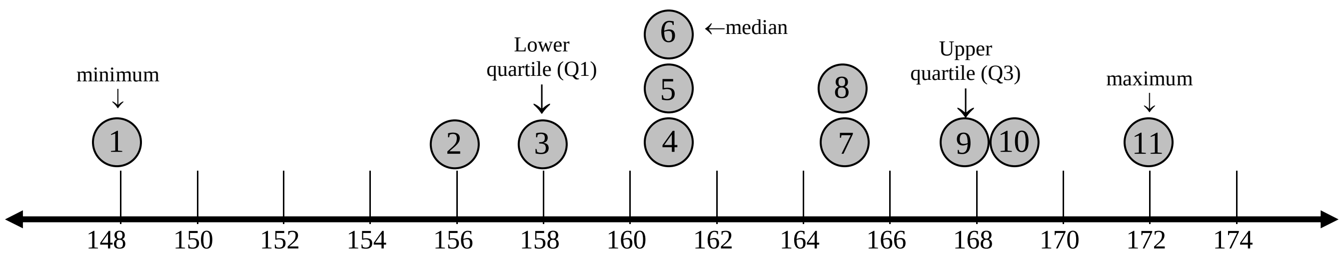
3. **Display PowerPoint slide 4 or Sticky Dot Transparency**. As participants are discussing the questions from the Box and Whisker Plot transparency, each participant will place two sticky dots on the number line to designate his flat-footed height and tiptoe height. One color will be used for each. Sticky dots placed above the number line will be for the tiptoe height. Sticky dots placed below the number line will be for the flat-footed heights.

4. **How do the sticky dots compare for the two data sets**? *The sticky dots for the tiptoe heights are shifted to the right of the sticky dots for the flat-footed heights. The clustering and spread should be fairly similar for the two data sets.*

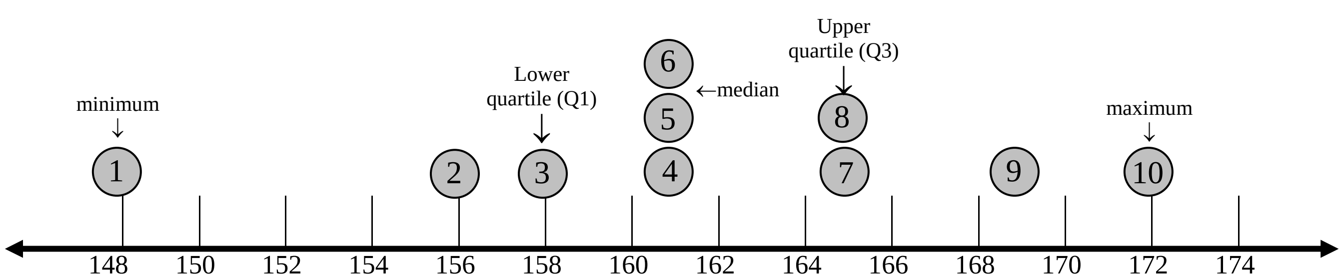
5. **Now that we see where all the heights fall, how could we find the flat-footed heights of the participants that represent the middle 50% of the participants?**
The median height divides the group into two equal sections. Divide each of those sections into two equal groups and take the "half" closest to the center.

6. **Using a strategy suggested by the participants, ask two participants to help find the sticky dots that represent the middle 50% of the class.** As the participants identify the lower quartile, median, and upper quartile, mark these values with the prepared signs. See the samples below. Use the Facilitation Questions to debrief participants.

Example with an odd number of sticky dots: (Note: the dots have been numbered for illustrative purposes only.) Since there are 11 sticky dots, the 6th dot would be the median. Therefore, 5 dots are to the left of the median and 5 dots are to the right of the median. The 3rd dot is the median of the left half of the data (Q1) and the 9th dot is the median of the right half of the data (Q3).



Example with an even number of sticky dots: (Note: the dots have been numbered for illustrative purposes only.) Since there are 10 sticky dots, the median would fall between the 5th and 6th dots. Therefore, 5 dots are to the left of the median and 5 dots are to the right of the median. The 3rd dot is the median of the left half of the data (Q1) and the 8th dot is the median of the right half of the data (Q3).



Facilitation Questions

- Is there the same number of sticky dots in each group? Which groups have the same number of sticky dots?
  There should be the same number of sticky dots in each group. About one-fourth of all the dots should be in each group.
- Can you tell the height of the tallest person and shortest person from the sticky dots? If so, what are they and how do you know?
  The sticky dot that is farthest to the right represents the tallest person and the sticky dot that is farthest to the left represents the shortest person.
- Explain how to find the range from the sticky dots.
  Find the difference between the tallest height and shortest height.
- Can you tell the mean height from the sticky dots?
  Just by looking at the sticky dots, you cannot tell the mean. You would have to perform some calculations.
- Can you tell the mode height from the sticky dots?
  You will probably be able to see this based on the placement of the sticky dots.
- Can you tell the median height from the sticky dots? If so, what is it and how do you know?
  Yes, the median height is the height that falls in the center of the spread of data.

7. **Lead the participants through the creation of the box and whisker plot on a number line.** (Refer to the Box and Whisker How-To Presenter Page for directions on how to create a Box and Whisker Plot.) Participants will create the box and whisker plot on the **Box and Whisker Plot Participant Page**, part I, at the same time as the presenter creates the plot on a transparency of the same page. After completion of this task, each participant will mark where his/her height falls on his/her box and whisker plot.

8. **What information does the length of the box and whiskers provide?**
   They show the spread of data. The longer they are, the more spread out the data is.

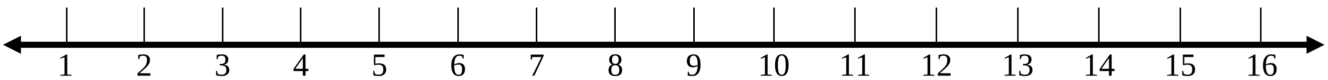
9. **If the range were smaller, predict the impact that would have on the box and whisker plot.**
   It would be more compact on the number line.

10. **Why are the box sections not equal in length? (If they are equal in length, have participants discuss if they will always be equal in length.)**
    The box sections are usually not equal in length because they represent the spread of the data. Even though they have the same amount of data in each section, the spread may differ.

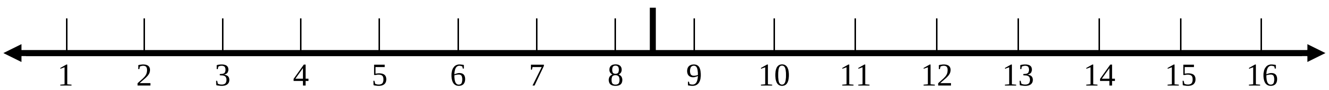
Presenter Page: How To Create a Box and Whisker Plot

The steps and examples listed below are for the following data set:
1, 3, 5, 5, 5, 8, 9, 10, 12, 15, 15, 16

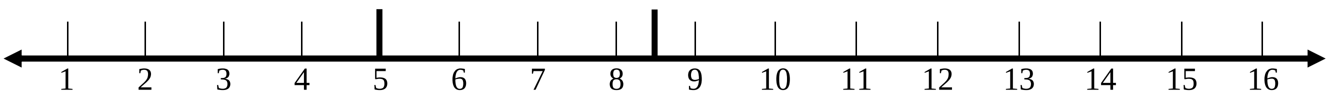
1. Draw a horizontal number line that represents the range of your data.



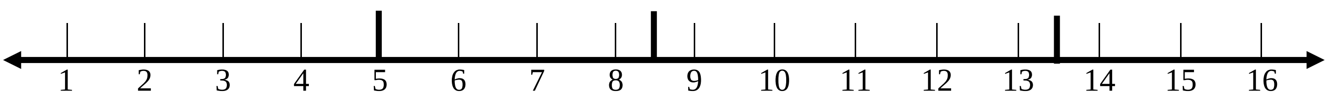
2. Draw a vertical line at the median of your data.



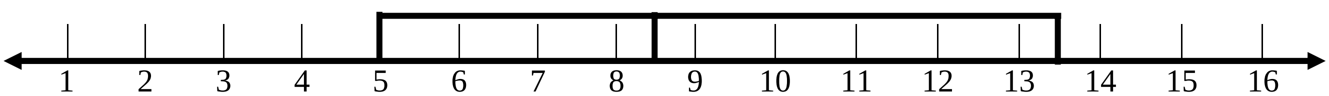
3. Draw a vertical line at the lower quartile of your data (the lower ¼ of the data).



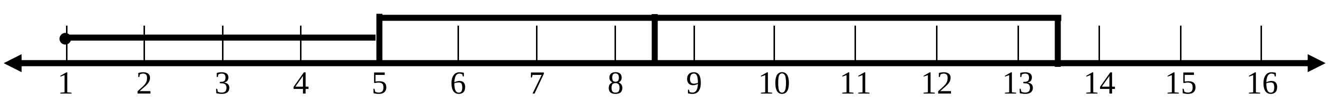
4. Draw a vertical line at the upper quartile of your data (the upper ¼ of the data).



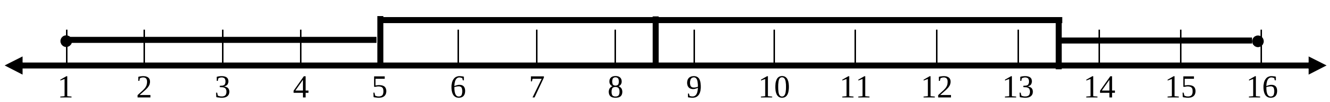
5. Connect the three vertical lines to create a "box".



6. Mark a point at the minimum value of your data. Connect this point with a horizontal line to the lower quartile. This creates your left whisker.



7. Mark a point at the maximum value of your data. Connect this point with a horizontal line to the upper quartile. This creates your right whisker.



Box and Whisker Plot - Computer

This part of the lesson is designed to show the participants how to create a box and whisker plot on the computer. Ideally, each participant or pair of participants will have access to a computer for this activity. ***This applet includes the median as a member of both the upper and lower 50% of the data, so results may differ from the box and whisker plot created by hand if there are an odd number of data values.*** *Use the* ***Facilitation Questions*** *to guide and redirect participants, as needed.*

1. Distribute the **Box and Whisker Plot – Computer Participant Pages**. Participants will complete this activity individually or with a partner. The presenter should be moving around the room guiding participants where needed.

Facilitation Questions

- What value(s) could be added to "stretch out" the box? Explain why.
  Increasing or decreasing values within the box will stretch it out.
- Predict how the plot would change if each height was increased by 10 centimeters.
  The plot would shift 10 units to the right on the number line.

2. **Why did you use the data from your stem and leaf plot to create the box and whisker plot?** *To practice reading a stem and leaf plot.*

3. **Why did we create a box and whisker plot by hand before using the technology?**
   Answers may include: box and whisker plots are more complicated to figure out what is happening with the data – the creation of a box and whisker plot is not as apparent as a stem and leaf plot.

4. **What are some benefits to using this website to create a box and whisker plot?**
   Answers may include: automatic creation of number line, calculation of first and third quartiles, calculation of mean and median, automatically sorts data, etc. The applet was large and easy to read.

5. **How does the technology allow you to manipulate the data?**
   We can continue entering new values and the plot will automatically adjust. By hand, it would take much longer to adjust the plot.

6. **How does the technology support us as we ask questions?**
   We can verify our predictions using the technology.

7. **Are there any limitations of using this website to create a box and whisker plot?**
   You can only have one box and whisker plot displayed at a time.

8. **What types of information does a box and whisker plot show that a stem and leaf plot does not show?**
   A box and whisker plot identifies median and lower/upper quartiles. It also shows the spread of the data.

9. **What types of information does a stem and leaf plot show that a box and whisker plot does not show?**
   A stem and leaf plot shows individual data values.

Box and Whisker Plot – Computer
Participant Page 1

1. Open the Virtual Manipulatives website. **http://nlvm.usu.edu/en/nav/vlibrary.html**
   - Click on Data Analysis and Probability Grades 6-8.
   - Click on Box Plot.
   - Click on Clear in the lower left corner to clear the list of data.
2. Using your Stem and Leaf Activity Page, enter the shortest height first.
3. Using your Stem and Leaf Activity Page, enter the tallest height second.
4. Continue by entering heights from the lower 50% of the data. Why does the "box" shift as more values are entered? ***The box shifts to the right as larger values are entered. The box contains the approximate middle 50% of the data.***
5. Predict what will happen to the graph as the remainders of the class heights are entered. ***The box will continue to shift to the right.***
6. Verify your prediction by entering the upper 50% of the data. More cells will automatically be created as you need them. Was your prediction correct? _____
7. What is the minimum value of data? ______ Where do you see this on the graph? ***The minimum value is the point at the far left of the box and whisker plot.***
8. What is the maximum value of data? ______Where do you see this on the graph? ***The maximum value is the point at the far right of the box and whisker plot.***
9. About 75% of the class is taller than what height? ***Q1***
10. About 50% of the class is shorter than what height? ***The median height***
11. What is the median height? ________Where do you see this on the graph? ***The line in the middle of the box***

Box and Whisker Plot – Computer Activity Page 2

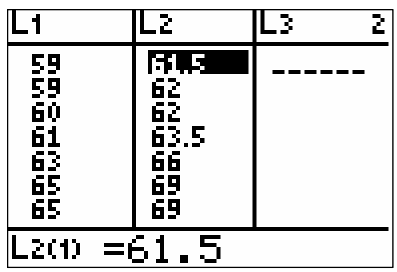
12. Add some data that will change the minimum value. What data did you add? Why did this data change the minimum value? ***Any value less than the minimum will change the minimum value. There is a new number that is less than all the other numbers.***
13. Add some data that will change the maximum value. What data did you add? Why did this data change the maximum value? ***Any value greater than the maximum will change the maximum value. There is a new number that is greater than all the other numbers.***
14. Add some data that will shift the median to the left. What data did you add? Why did this data shift the median to the left? ***Any value less than the median will shift the median to the left. It shifted to the left because there is now more data on the left than on the right. The median has to shift to adjust and become the center of the data set.***
15. Add some data that will shift the median to the right. What data did you add? Why did this data shift the median to the right? ***Any value greater than the median will shift the median to the right. It shifted to the right because there is now more data on the right than on the left. The median has to shift to adjust and become the center of the data set.***
16. Add some data that will cause the whiskers to be equal in length. What data did you add? Why did this data create whiskers of equal length? ***Data should be added so the ranges of the whiskers are equal in length.***
17. Add some data that will cause the box sections to be equal in length. What data did you add? Why did this data create box sections of equal length? ***Data should be added so the range from the lower quartile to the median is equal to the range from the median to the upper quartile.***
18. Add some data that will cause the right whisker to be about twice the length of the left whisker. What data did you add? Why did this happen? ***The range of the right whisker should be twice the range of the left whisker.***
19. Generate a list of new data that will allow the average to fall in the whiskers. Why did the average fall in the whiskers? ***Example: 1, 2, 3, 4, and 20***. ***The average can be found in the whiskers when extreme values of the data exist.***

Box and Whisker Plot – Graphing Calculator

This part of the lesson is designed to show the participants how to create a box and whisker plot on the graphing calculator. Participants should be seated in groups of 4-5 and each participant will need a graphing calculator.

1. Display **The Foot Question Transparency 3** or PowerPoint slide 5**. How do you think the box and whisker plot will change if we graph the tiptoe heights rather than the flat-footed heights?** Allow participants several minutes to discuss this step. Ask 2-3 groups to share their predictions.

2. **Since the applet only allowed one box and whisker plot at a time, the data will be entered into the graphing calculator.** This will allow participants to see the impact on the statistical measures and on the box and whisker plot. Lead participants through entering the flat-footed and tiptoe heights of the participants in L_1 and L_2. Participants will enter the flat-footed heights into L_1 and the tiptoe heights into L_2. Display the Group Recording transparencies one at a time for participants to enter the data. Participants may wish to refer to the **Creating a Box and Whisker Plot Tech Tutorial**.



3. **Participants will verify the mean, median, mode, and range** they previously found for the flat-footed heights on their Box and Whisker Plot Participant Page. Participants may wish to use the One-Variable Statistics Tech Tutorial. **They will also find these values for the tiptoe heights**.

4. **How do the measures of central tendency and range compare for List 1 and List 2**?
   The mean and median should be larger. The range may or may not be the same.

5. **How can we verify the mean we found using the centimeter cubes?**
   Subtract the mean of the flat-footed heights from the mean of the tiptoe heights.

6. **Create two box and whisker plots on the graphing calculator**, referring to the Creating a Box and Whisker Plot Tech Tutorial as necessary. Participants will sketch the tiptoe plot on the Box and Whisker Plot Participant Page above the flat-footed graph.

7. **Use the Trace feature of the calculators to verify the key values** (the minimum, first quartile, median, third quartile, maximum) on their Box and Whisker Plot Participant Page.

8. Debrief this part of the lesson with the following Facilitation Questions.

Facilitation Questions

- What were your predictions on the comparison of the tiptoe height box and whisker plot to the flat-footed box and whisker plot? Were your predictions accurate?
  Answers may vary.
- What were your predictions on the comparison of the statistical measures for the tiptoe heights and the flat-footed heights? Were your predictions accurate?
  Answers may vary.
- How are the two plots similar?
  The spread and shape of the plots should be similar.
- How are the two plots different?
  The answer will depend on the data collected.
- Is the spread of the data the same for the two plots? How do you know?
  The answer will depend on the data collected.
- What types of information does the box and whisker plot show?
  Spread of data, median, minimum, maximum values.
- What types of information does a box and whisker plot NOT show?
  Mean, individual data values, mode.
- What type of information can be used to create a box and whisker plot?
  Numerical since it is a plot of data on a number line.
- Name some benefits to using a box and whisker plot.
  Seeing the spread of the data is the primary benefit to using a box and whisker plot.
- What are the relative advantages and disadvantages of using a graphing calculator to solve this problem?
  Responses may vary. Answers may include: automatic sorting of data, calculation of median and quartiles very quickly with only a few keystrokes, ability to look at more than one box and whisker plot at a time, etc. However, the small screen is difficult to see and the axes cannot be labeled.
- What are the relative advantages and disadvantages of using web-based tools to solve this problem?
  Like the graphing calculator, data analysis can be done with a few keystrokes and clicks. The graphs can be copied and pasted into other computer documents. A disadvantage would be lack of Internet access at times. Computers are not as portable as graphing calculators.

Summary

Pairs of participants will create a Venn diagram to summarize what they have learned about stem and leaf plots and box and whisker plots.

1. Display the **Venn Diagram Transparency** or PowerPoint slide 6. Distribute the **Venn Diagram Participant Page** to each pair of participants. Without talking, one person will write something they have learned about stem and leaf plots and box and whisker plots into the Venn Diagram. This can address a mathematical or a technological aspect. The second person will add to the Venn diagram. The participants will continue to complete their two Venn diagrams in this manner.

2. **In small groups of 3-4, participants should share their Venn diagrams**. They may continue to add to their Venn diagrams during this final discussion.

3. Distribute the **Intentional Use of Data Activity Sheet** to each participant.

4. Prompt the participants to work in pairs to identify those TEKS that received greatest emphasis during this activity. Participants should refer to the Mathematics TEKS and the Technology Applications TEKS. *The Leader Notes contain a comprehensive list of the TEKS addressed in this phase of the professional development.*

5. **How does the technology that you used enhance the teaching of those TEKS?** Responses may vary. However, participants should note that using technology enables them to explore a mathematical concept to a much deeper level. Technology makes rich mathematics accessible to a variety of learning styles.

6. Prompt the participants to also identify two key questions that were emphasized during this activity. Participants should identify one key question for mathematics and one key question for technology. Allow four minutes for discussion. Debrief with the Facilitation Questions below.

Facilitation Questions

- Which mathematical TEKS formed the primary focus of this activity? *6.10A, 7.12A, 8.12C*
- What additional math TEKS supported the primary TEKS? *6.10B, 6.10D, 7.11B*
- What Technology Applications TEKS are addressed during this activity? *(1)(B), (1)(C), (6)(A), (7)(H)*
- How do these TEKS translate into guiding questions to facilitate student exploration of the content? *Answers may vary.*
- How do your questions reflect the depth and complexity of the TEKS? *Answers may vary.*
- How do your questions support the use of technology? *Answers may vary.*

7. As a whole group, identify the level(s) of rigor (based on Bloom's taxonomy) addressed, the data sources, and the setting used during this Explore/Explain cycle. Allow three minutes for discussion.

Facilitation Questions

- What attributes of the activity support the level of rigor that you identified? *Answers may include synthesis – when participants generated data to cause changes in the box and whisker plot.*

8. As a whole group, discuss how this activity could be bridged to the classroom. Are there pieces of the activity that could be used with students? What extensions could be made to the activity? *Scatterplots could easily be created to compare the flat-footed heights with the tiptoe heights.*

9. **Discuss how this activity might be implemented in other settings**. Participants should complete the Setting section on their Intentional Use of Data sheet. How could the activity be implemented in these settings? Allow five minutes for discussion. Use the Facilitation Questions below.

Facilitation Questions

- How would this activity change if we had access to one computer or one graphing calculator per participant? *If each participant had their own computer, less discussion would have occurred between participants. The discussion is an important component of the learning.*
- How would this activity change if we had access to one computer or one graphing calculator for the entire group of participants? *The teacher could model the activity using a presentation calculator and computer. However, this does not allow for participants to manipulate the data individually and explore the concepts.*
- How would this activity change if we had used only graphing calculators instead of computer-based applications? *The stem and leaf plot can not be created on the graphing calculator.*
- How would this activity change if we had used only computer-based applications instead of graphing calculators? *The comparison of the box and whisker plots cannot happen using the applet.*
- How might we have made additional use of available technologies during this activity? *Other statistical programs could be used to create the graphs. Participants could have entered their heights into the presenter's calculator. The calculators could then be linked to share the data.*
- Why was technology withheld during the beginning box and whisker part of this activity? *Box and whisker plots are not as easy to understand as stem and leaf plots. Participants need to develop an understanding of how box and whisker plots are created before moving to the technology.*

10. Prompt the participants to set aside the completed **Intentional Use of Data Activity Sheet** for later discussion. These completed activity sheets will be used during the Elaborate phase as prompts for generating attributes of judicious users of technology.

Explore/Explain 1 - Intentional Use of Data

TEKS	Math	6.10A, 6.10B, 6.10D, 7.11A, 7.11B, 7.12A, 7.12B, 8.12A, 8.12C, 6.11A, 7.13A, 8.14A, 6.11D, 7.13D, 8.14D, 6.12A, 7.14A, 8.15A, 6.12B, 7.14B, 8.15B, 6.13A, 7.15B, 8.16B	
	Tech Apps	(1)(B), (1)(C), (6)(A), (7)(H)	
Question(s) to Pose to Students	Math	*How do you distinguish between when to create a stem and leaf plot and when to create a box and whisker plot?*	
	Tech Apps	*Why is it important to know how to create statistical representations with technology?*	
Cognitive Rigor		Knowledge	✓
		Understanding	✓
		Application	✓
		Analysis	✓
		Evaluation	✓
		Creation	✓
Data Source(s)		Real-Time	*Actual measurements of flat-footed and tiptoe heights were collected.*
		Archival	*The teacher could give the students data that has already been collected.*
		Categorical	*Categorical data can't be used to create stem and leaf plots and box and whisker plots.*
		Numerical	*The data collected was numerical.*
Setting		Computer Lab	*Would work, but not as much communication would occur between participants if each person had his own computer.*
		Mini-Lab	*This is the ideal setting.*
		One Computer	*Students can't discover and explore on their own.*
		Graphing Calculator	*Stem and leaf plots can't be created on graphing calculator.*
		Measurement Based Data	*The activity could be done only with measurement based data, but the technology allows it to be done quicker.*
Bridge to the Classroom		*The stem and leaf activity and box and whisker plot activity can easily be taken to the classroom. The activity could be extended to include scatterplots. In addition, a different question could be asked such as, "Do all people gain the same percentage to their height when standing on their tiptoes?"*	

The Foot Question – Transparency 1

What is the average number of centimeters that are added to a person's height when standing on his tiptoes? Who do you predict would gain the most centimeters and why do you think this is so?

The Foot Question – Transparency 2

How do the measures of the mean, median, mode and range of the tiptoe heights compare to the flat-footed heights?

The Foot Question – Transparency 3

How do the measures of the mean, median, mode and range of the tiptoe heights compare to the flat-footed heights?

How will the box and whisker plots compare for the flat-footed heights and tiptoe heights?

Sticky Dots – Transparency

Place an orange dot above the number line to represent your tiptoe height.

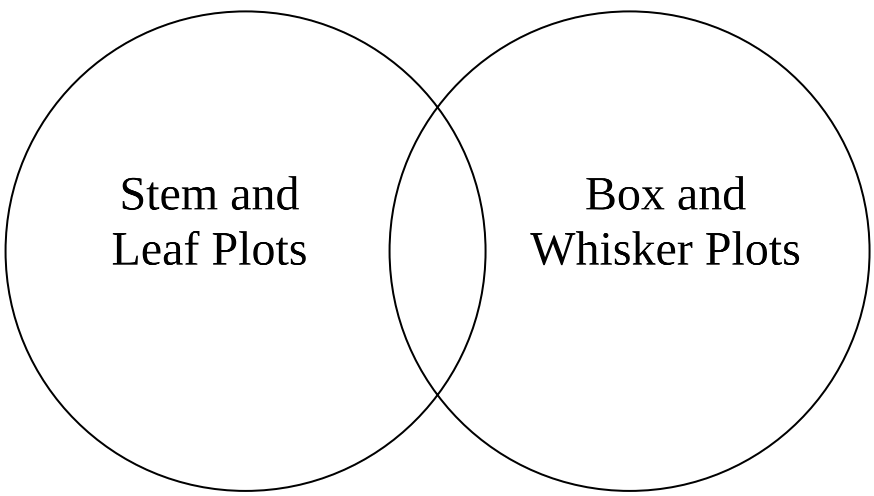
Place a blue dot below the number line to represent your flat-footed height.

Box and Whisker Plot – Transparency

What strategy can you use to find the heights that represent the middle 50% of the participants?

Venn Diagram – Transparency

Without talking, take turns filling in the Venn Diagram. Write what you have learned about stem and leaf plots and box and whisker plots. Address both mathematical and technological aspects.



Group Recording Sheet - Transparency

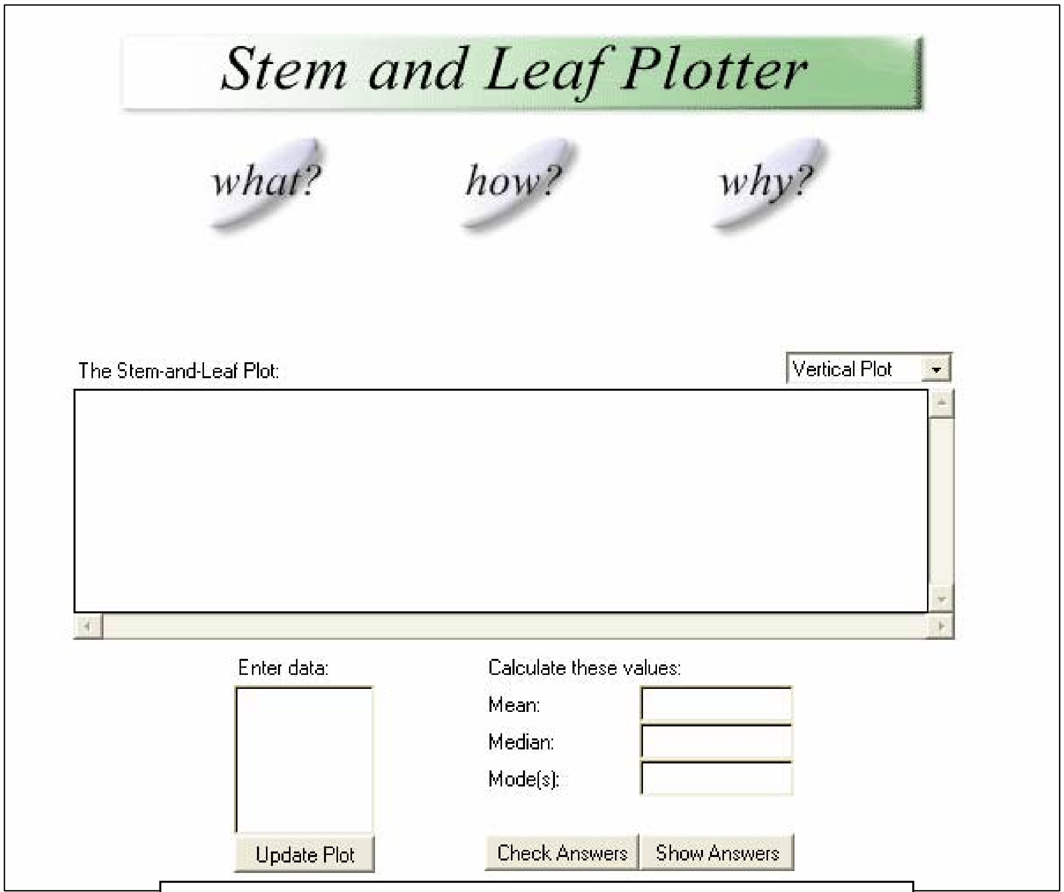
Name	Flat-footed height	Tiptoe height

Group Recording Sheet - Transparency

Name	Flat-footed height	Tiptoe height

Stem and Leaf – Computer Participant Page

1. Open the Stem and Leaf Plotter on the computer.
   http://www.shodor.org/interactivate/activities/stemleaf/index.html
2. Enter the data as the presenter calls it out in the box titled: “Enter data:” Then select “Update Plot.”
3. Sketch your stem and leaf plot below.



Stem and Leaf Plotter retrieved 10/29/05 from http://www.shodor.org/interactivate/activities/stemleaf/index.html

4. Estimate the values of the mean, median, and mode(s). Enter your estimates in the boxes. Then select “Check answers.”

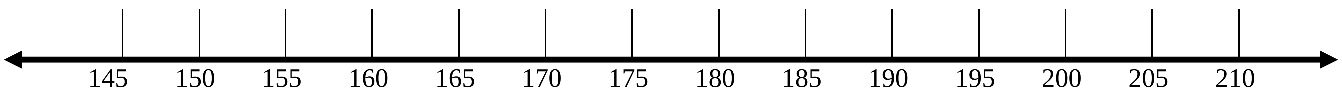
5. The stems are the values found to the left of the vertical line on the stem and leaf plot. Where do these values come from?

6. The leaves are the values found to the right of the vertical line on the stem and leaf plot. Where do these values come from?

7. If you turned the stem and leaf plot horizontally, what type of graph would it resemble? Use the drop down menu to select Horizontal Plot. Does this verify your prediction?

Box and Whisker Plot – Participant Page

I. Create a box and whisker plot that represents the flat-footed heights of the participants. Fill in the appropriate values in the table for the flat-footed heights.



		Flat-footed height	Tiptoe height
minX	**Minimum**		
Q_1	**Lower Quartile**		
Med	**Median**		
Q_3	**Upper Quartile**		
maxX	**Maximum**		
$\bar{x}$	**Mean**		
maxX-minX	**Range**		

II. Using the number line above, create a box and whisker plot that represents the tiptoe heights of the participants. Create the plot above the flat-footed plot. Then fill in the appropriate values in the table for the tiptoe heights.

Box and Whisker Plot – Computer Participant Page

1. Open the Virtual Manipulatives website. **http://nlvm.usu.edu/en/nav/vlibrary.html**
    - Click on Data Analysis and Probability Grades 6-8.
    - Click on Box Plot.
    - Click on Clear in the lower left corner to clear the list of data.
2. Using your Stem and Leaf Activity Page, enter the shortest height first.
3. Using your Stem and Leaf Activity Page, enter the tallest height second.
4. Continue by entering heights from the lower 50% of the data. Why does the "box" shift as more values are entered? ____
5. Predict what will happen to the graph as the remainders of the class heights are entered.

    ____
6. Verify your prediction by entering the upper 50% of the data. More cells will automatically be created as you need them. Was your prediction correct? _____
7. What is the minimum value of data? ______ Where do you see this on the graph?

    ____
8. What is the maximum value of data? ______Where do you see this on the graph?

    ____
9. About 75% of the class is taller than what height? __________
10. About 50% of the class is shorter than what height? _________
11. What is the median height? ________Where do you see this on the graph? __________

    ____

Box and Whisker Plot – Computer Participant Page

Experiment with the data on the computer to answer the following questions. Record your solutions below.

12. Add some data that will change the minimum value. What data did you add? Why did this data change the minimum value?

13. Add some data that will change the maximum value. What data did you add? Why did this data change the maximum value?

14. Add some data that will shift the median to the left. What data did you add? Why did this data shift the median to the left?

15. Add some data that will shift the median to the right. What data did you add? Why did this data shift the median to the right?

16. Add some data that will cause the whiskers to be equal in length. What data did you add? Why did this data create whiskers of equal length?

17. Add some data that will cause the box sections to be equal in length. What data did you add? Why did this data create box sections of equal length?

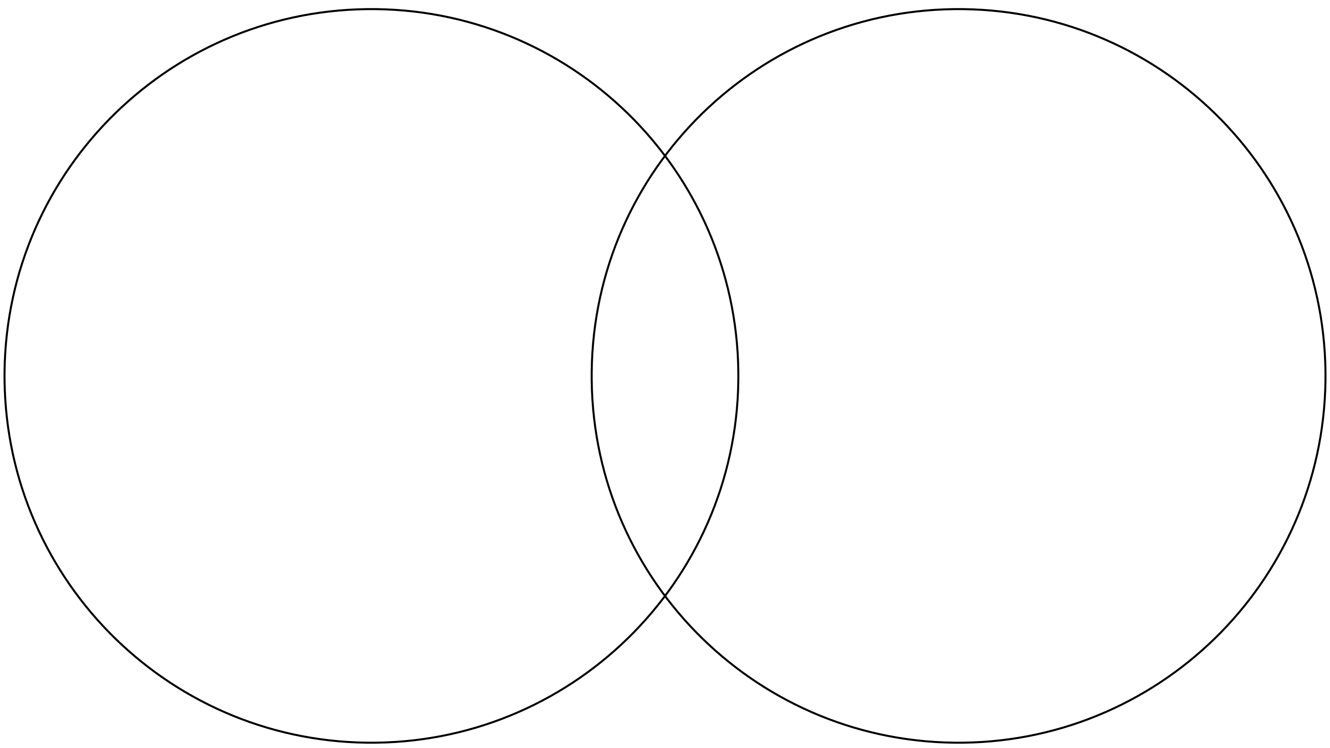
18. Add some data that will cause the right whisker to be about twice the length of the left whisker. What data did you add? Why did this happen?

19. Generate a list of new data that will allow the average to fall in the whiskers. Why did the average fall in the whiskers?

Venn Diagram – Participant Page

Stem and Leaf Plots

Box and Whisker Plots



Explore/Explain 1 - Intentional Use of Data

TEKS	Math		
	Tech Apps		
Question(s) to Pose to Students	Math		
	Tech Apps		
Cognitive Rigor		Knowledge	
		Understanding	
		Application	
		Analysis	
		Evaluation	
		Creation	
Data Source(s)		Real-Time	
		Archival	
		Categorical	
		Numerical	
Setting		Computer Lab	
		Mini-Lab	
		One Computer	
		Graphing Calculator	
		Measurement Based Data	
Bridge to the Classroom			

Explore/Explain 2: Grams of Fat

Purpose:

Generate equivalent representations of sets of data based on verbal descriptors of the data. Technology tools will be used to create the multiple representations of the data sets.

Descriptor:

Participants will be given descriptive statements about a set of data. Different groups of participants will receive different statements. Each group of participants will create a set of possible data and a graphical representation of the data based on these statements. Participants will also be given a graphical representation of a set of data. They will create a set of possible data and write descriptive statements about the data.

Duration:

2.25 hours

Mathematics TEKS Objectives:

6.10A	The student uses statistical representations to analyze data. The student is expected to select and use an appropriate representation for presenting and displaying different graphical representations of the same data including line plot, line graph, bar graph, and stem and leaf plot.
6.10B	The student uses statistical representations to analyze data. The student is expected to identify mean (using concrete objects and pictorial models), median, mode, and range of a set of data.
6.10D	The student uses statistical representations to analyze data. The student is expected to solve problems by collecting, organizing, displaying, and interpreting data.
6.11A, 7.13A, 8.14A	The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics.
6.11D, 7.13D, 8.14D	The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to select tools such as real objects, manipulatives, paper/pencil, and technology or techniques such as mental math, estimation, and number sense to solve problems.
6.12A, 7.14A, 8.15A	The student communicates about Grade 6/7/8 mathematics through informal and mathematical language, representations, and models. The student is expected to communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models.
6.12B, 7.14B, 8.15B	The student communicates about Grade 6/7/8 mathematics through informal and mathematical language, representations, and models. The

student is expected to evaluate the effectiveness of different representations to communicate ideas.

6.13A, 7.15A, 8.16A The student uses logical reasoning to make conjectures and verify conclusions. The student is expected to make conjectures from patterns or sets of examples and nonexamples.

6.13B, 7.15B, 8.16B The student uses logical reasoning to make conjectures and verify conclusions. The student is expected to validate his/her conclusions using mathematical properties and relationships.

7.11A The student understands that the way a set of data is displayed influences its interpretation. The student is expected to select and use an appropriate representation for presenting and displaying relationships among collected data, including line plot, line graph, bar graph, stem and leaf plot, circle graph, and Venn diagrams, and justify the selection.

7.11B The student understands that the way a set of data is displayed influences its interpretation. The student is expected to make inferences and convincing arguments based on an analysis of given or collected data.

7.12A The student uses measures of central tendency and range to describe a set of data. The student is expected to describe a set of data using mean, median, mode, and range.

7.12B The student uses measures of central tendency and range to describe a set of data. The student is expected to choose among mean, median, mode, or range to describe a set of data and justify the choice for a particular situation.

8.12A The student uses statistical procedures to describe data. The student is expected to select the appropriate measure of central tendency or range to describe a set of data and justify the choice for a particular situation.

8.12C The student uses statistical procedures to describe data. The student is expected to select and use an appropriate representation for presenting and displaying relationships among collected data, including line plots, line graphs, stem and leaf plots, circle graphs, bar graphs, box and whisker plots, histograms, and Venn diagrams, with and without the use of technology.

Technology Applications TEKS Objectives:

(1)(B) The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to compare, contrast, and appropriately use the various input , processing, output, and primary/secondary storage devices.

(1)(C) The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency.

(1)(E) The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to use technology terminology appropriate to the task.

(1)(F)	The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to perform basic software application functions including, but limited to, opening an application program and creating, modifying, printing, and saving documents.
(2)(A)	The student uses data input skills appropriate to the task. The student is expected to demonstrate proficiency in the use of a variety of input devices such as mouse/track pad, keyboard, microphone, digital camera, printer, scanner, disk/disc, modem, CD-ROM, or joystick.
(3)(B)	The student complies with the laws and examines the issues regarding the use of technology in society. The student is expected to demonstrate proper etiquette and knowledge of acceptable use while in an individual classroom, lab, or on the Internet and intranet.
(3)(E)	The student complies with the laws and examines the issues regarding the use of technology in society. The student is expected to demonstrate knowledge of the relevancy of technology to future careers, life-long learning, and daily living for individuals of all ages.
(5)(A)	The student complies with the laws and examines the issues regarding the use of technology in society. The student is expected to identify, create, and use files in various formats such as text, bitmapped/vector graphics, image, video, and audio files.
(6)(A)	The student evaluates the acquired electronic information. The student is expected to determine and employ methods to evaluate the electronic information for accuracy and validity.
(7)(B)	The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to create and edit spreadsheet documents using all data types, formulas and functions, and chart information.
(8)(E)	The student uses research skills and electronic communication, with appropriate supervision, to create new knowledge. The student is expected to integrate acquired technology applications skills, strategies, and use of the word processor, database, spreadsheet, telecommunications, draw, paint, and utility programs into the foundation and enrichment curricula.
(10)(E)	The student formats digital information for appropriate and effective communication. The student is expected to match the chart style to the data when creating and labeling charts.

TAKS Objectives:

- Objective 5: Probability and Statistics
- Objective 6: Mathematical Processes and Tools

Technology:

- Spreadsheet software
- Handheld graphing technology
- Word-processing technology

Materials:

Advance Preparation: Copy Activity Masters: **Generating Data**, **Time To Play**, and **Comparison,** - one copy per group of 4-5 students, copy **Intentional Use of Data**, - one per participant, prepare Transparencies- **Survey Question**, **Guided Questions #1**, **Spreadsheet, Gallery Walk, Comparison**, **Guided Questions #2,** and **Gallery Walk 2**. Copy and cut out sets of **Data Statement Cards** (four cards per set, one set per group) and **Graph Cards** (one card per group) – you may need duplicates of these based on number of participants. Create a chart-paper sized version of **Guided Questions #1** and **Guided Questions #2**. Copy and cut out sets of **Collecting Data Cards** - one set per group. Purchase brown lunch bags. Check and load the Data Analysis Toolpak into Excel (see **Technology Tutorial**: Fat Grams Graph Activity 2.) Load and/or create **Middle School-Explore Explain 2 Spreadsheet** and **Middle School-Explore Explain 2 Spreadsheet #2** onto computers.

Presenter: Transparencies, Computer with data projection device or access to a computer lab, and Graphing calculator with presentation capabilities.

Per Group: **Data Statement Cards**, **Collecting Data Cards**, four brown bags, **Graph Card**, computer with spreadsheet capabilities, **Middle School-Explore Explain 2 Spreadsheet** and **Middle School-Explore Explain 2 Spreadsheet #2** spreadsheets, Post-it ™ notes, and **Technology Tutorial** flip chart.

Per Participant: Graphing calculator

Leader Notes:
Due to the number of topics present in this lesson, several Explore/Explain cycles occur. As each new topic is introduced, participants explore the topic. The Explain cycle then occurs. This is repeated several times throughout the lesson.

Activity 1 – Grams of Fat

*This part of the lesson requires computer stations for small groups of two participants. It is designed to actively involve participants in generating a data set given specific guidelines. Encourage participants to interact with each other. The presenter(s) should move around the room facilitating the activity. Use the **Facilitation Questions** to guide and redirect participants, as needed.*

1. *Place **Survey Question** transparency on the overhead or display Power Point slide 1 to set up scenario with participants. Have participants read the scenario*

and discuss how to use a scenario such as this in the classroom.

2. *Distribute a set of* ***Data Statement Cards*** *to each group. Place the* ***Guided Questions #1*** *transparency on the overhead or display Power Point slide 2, and display* ***Guided Questions #1*** *chart. Tell the participants to be ready to discuss each of the questions found on the transparency/slide with the whole group. Have groups discuss the information given in each card set. Participants are to use Post-it^{TM} notes (labeled 1, 2, 3, and 4), one per question, to record their thoughts.*

3. *Debrief questions as a whole group, post participants' answers on the* ***Guided Questions #1*** *chart as they share answers. (If there is more than one presenter, one of other the other presenters can help facilitate the process by collecting Post-it^{TM} notes and placing them on the chart as the group discussion continues.) Give each group of participants an opportunity to respond.*

   **** Guided Questions*** *with possible responses are on the next page.*

Transparency: Guided Questions

1. **What information have you been given?**
   Verbal descriptors that include percents, fractions, and decimals.
   Defined intervals of data.

2. **Which statement card(s) would make a good starting point(s) for creating a data set that would satisfy these statement cards? And why?**
   Answers may vary.
   Statements that contain a larger amount of data: 50%, 25%, etc.

3. **What type of data would be reasonable for the situation?**
   Numeral between 0 and 40.
   Make sure the conversation includes the difference between categorical and numerical data, and how this plays into the situation.

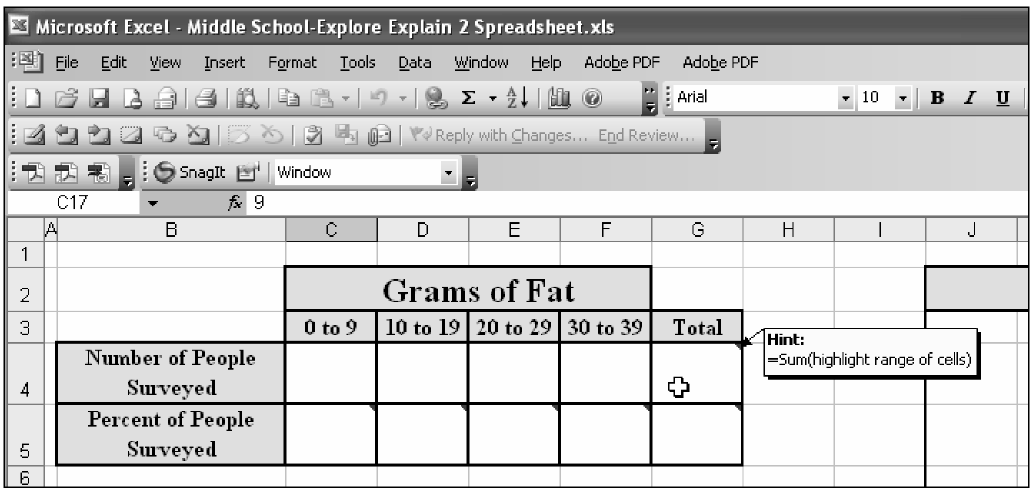
4. **What are the benefits of having your students generate data in this manner?**
   Answers may vary.
   The use of different numerical representation, such as fractions, decimals, and percents.
   Differentiating between categorical and numerical data.
   Requires thinking at the analysis and synthesis levels.

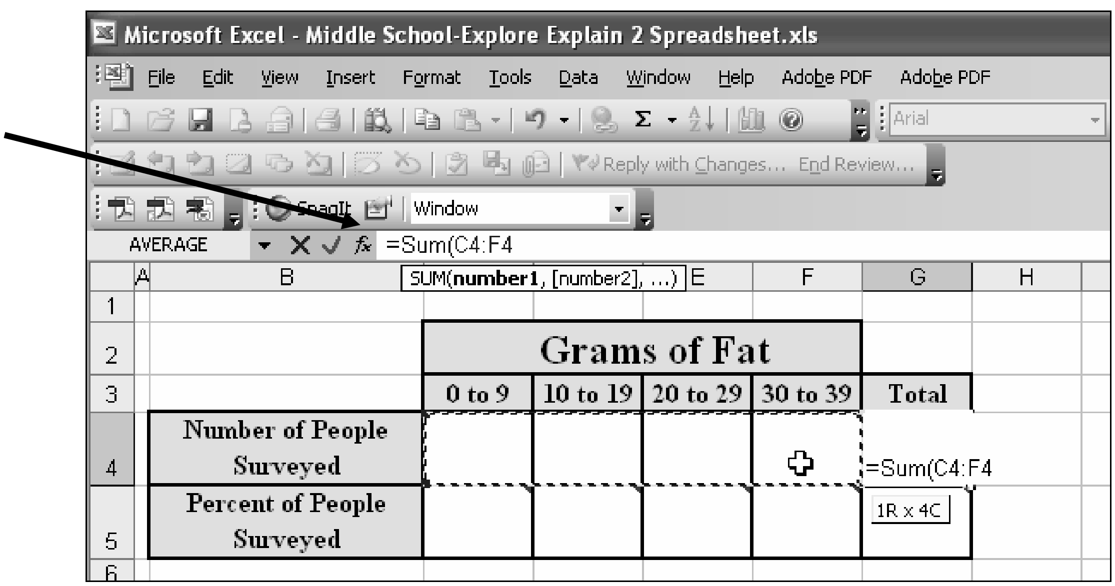
   Lead discussion into the non-use of a calculator to generate data.

4. *Place **Spreadsheet** transparency on the overhead or display Power Point slide 3. Have participants navigate and open **Middle School-Explore Explain 2 Spreadsheet.xls**.*

5. *Illustrate how the flags are used in the spreadsheet. Scroll over the hint flag in cell G4. Explain the Hint: the hint implies that the formula needed for that cell is "=Sum(highlight range of cells)," which means to enter **=Sum(** then highlight the cells necessary by clicking and dragging the mouse from cell C4 to cell F4.*

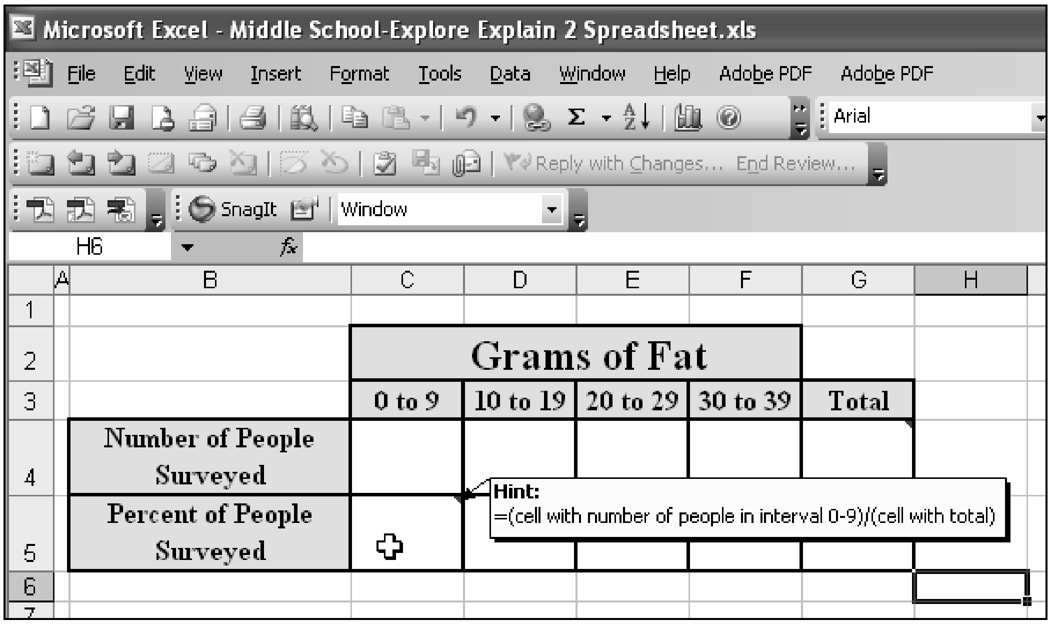
Example:

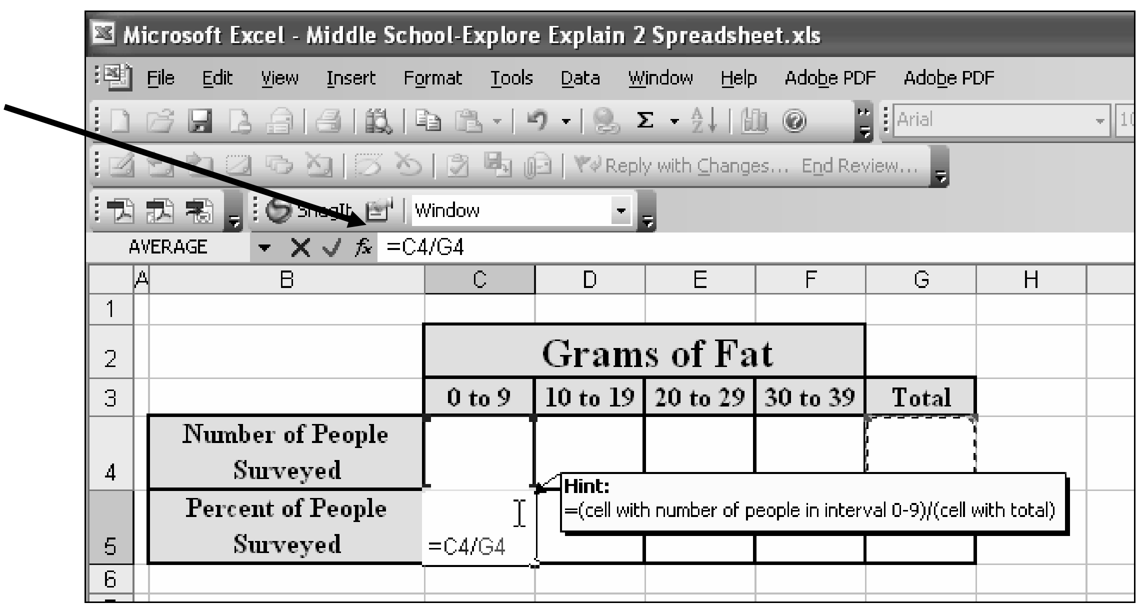




6. *Repeat step 5 for cell C5. Explain the Hint: the hint implies that the formula needed for that cell is "=(cell with number of people in interval 0 to 9)/(cell with total)," which means to enter =, then click on cell C4, followed by the backslash, and followed by cell G4.*

Example:





7. *If using the Power Point display Power Point slide 4. Have participants complete the activity **Generating Data**.*

   ** **Generating Data** activity with possible responses is on the next page followed by an example.*

8. *Presenter(s) should walk around the room and observe groups. Make sure the participants format the total and percent cells correctly using the red hint flags. They are <u>not</u> to use the sum or percent functions listed in the software at this time. Participants are to format the cells using a formula they create through discussion. Since the participants are setting up formulas without data being present in the cells, they may get an error message due to division by zero. Once they enter the data, the error message will go away. Use the **Facilitation Questions** to guide and redirect participants, as needed.*

Facilitation Questions

- Why would you set up a cell that calculates the total? What type of formula would you use? What data will you total?
  In order to calculate the percentage, you need a cell that calculates the total. To find the total, one could use: =Sum(Start Cell:Ending Cell) or =C4+D4+E4+F4 (or whichever cells contain the column totals.)
- Why would you set up cells that calculate percentages?
  Answers may vary. It makes it easy to see when you have generated the right amount of data for each interval.
- How would you want the percentages displayed (percent cells have been formatted to read as a percent in the spreadsheet)?
  As a percentage or as a decimal
- What type of formula would you use to calculate the percentage of each?
  Example one: (number of data pieces/ total pieces)
  Example two: (C4/G4) would be an appropriate formula for cell C5 if the number of data pieces is in C4 and the total pieces is in G4.
- How would you have your students think through creating the formulas?
  Answers will vary. Ask students how to find the percent without using a spreadsheet. Then transfer that knowledge to the spreadsheet.

Participant Page: Generating Data

Part 1:

- Input formulas for all cells containing a red hint flag:
  Total Number of People Surveyed,
  Total Percent of People Surveyed,
  Percent of People Surveyed for each interval,

Part 2:

- Complete Grams of Fat table by entering data into the Number of People Surveyed using the Data Statement Cards. Manipulate data until all cards have been satisfied.
- Save as: JDoe_Grams_of_Fat_Spreadsheet

1. What approach did your group take to complete the table?
   Answer will vary dependent on their Data Statement Cards. Started with the largest interval first, converted all numbers to the same format, thought of a number of elements that would work well with the card set.

2. What type of manipulation did it take to make your data set fit the Data Statement Cards you were given?
   Answer will vary, changing the group size (number of elements in the data set.)

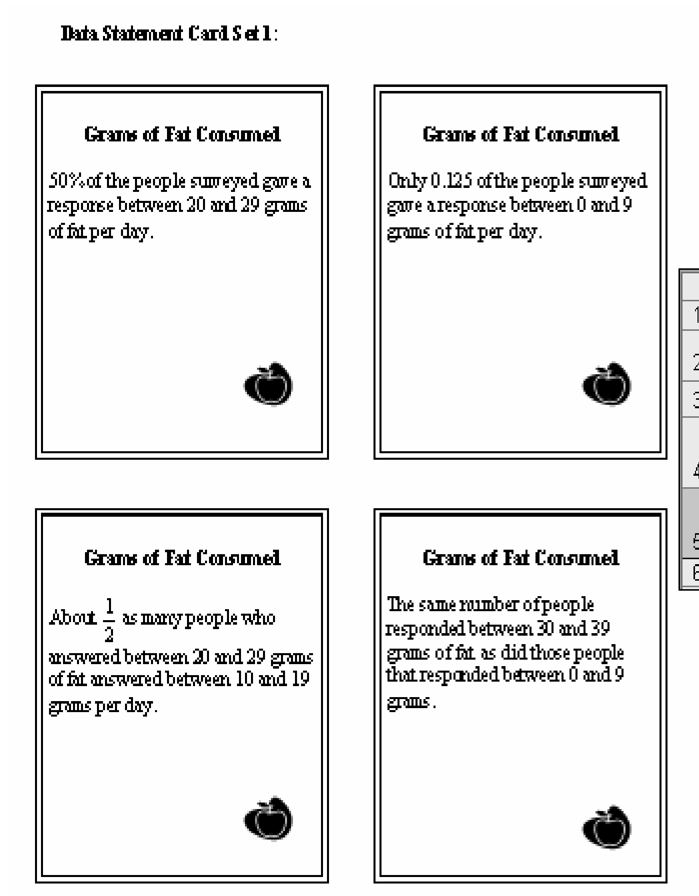
3. How would you manipulate the data when you have half or a third of a person represented in your data set? Is it okay to have half a person? Why, or why not?
   Double or triple the data depending on what fraction of a person you have.

4. What is the smallest meaningful value you can have for the total number of people surveyed for your data?
   For Data Set 1, the smallest number of data elements is 8. For Data Set 2, the smallest possible total is 12. For Data Set 3, the smallest possible total is 6. For Data Set 4, the smallest possible total is 12. Any smaller values would result in a fractional person.

5. How does using a dynamic spreadsheet encourage student learning and thinking?
   Answer may vary. It allows the student to watch the changes in data happen at a very fast rate, so the student is not tied down with computations.

6. How could you combine what you just did on the spreadsheet with what you do in the classroom?
   Answer may vary. Use it to create an understanding of number of elements in a data set and how it relates to the intervals of the data, etc.

Example Card Set 1: Answers may vary.



	Grams of Fat				
	0-9	10-19	20-29	30-39	Total
Number of People Surveyed	25	50	100	25	200
Percent of People Surveyed	12.50%	25.00%	50.00%	12.50%	100.00%

9. *Have groups "**Save As**" their work to the desktop and name it, **JDoe_Grams_of_Fat-Spreadsheet**.*

*This part of the lesson actively involves the participants in generating and manipulating the elements in a data set using the spreadsheet software. Encourage participants to interact with each other. The presenter(s) should be moving around the room facilitating the activity. Use the **Facilitation Questions** to guide and redirect participants, as needed.*

10. *If using the Power Point display Power Point slide 5. Have groups complete activity **Time To Play** part 1.*

11. *Have groups complete activity **Time To Play** part 2. Use the **Facilitation Questions** on the next page to guide and redirect participants, as needed.*

Facilitation Questions

- What type of changes did you make to your data set to create the same mean and mode? Were you able to make the changes to satisfy these parameters?
  Answers may vary (depends on the group's generated data set.) By using higher values in the lower intervals and lower values in the upper intervals moving data closer to the middle of the data set, and repeating the middle data more than any other.
- What type of changes did you make to your data set to create a situation where the median would be the best descriptor of the data set? Were you able to make changes to satisfy this condition?
  Answers may vary (depends on the group's generated data set.)The median is often the best descriptor when there are extreme values in the data set.
- What type of changes did you make to your data set to create a situation where the mode would be the best descriptor of the data set? Were you able to make changes to satisfy this condition?
  Answers may vary (depends on the group's generated data set.) Use the same value more than five or six times.
- Would making these changes in your data set change the measures of central tendencies?
  Answers may vary. Maybe, it would depend on the changes you make.
- How could you manipulate the data in order to change a specific measure? Mode? Mean? Median?
  Answer may vary. By changing specific pieces of data while keeping the same number of elements in each interval.
- Which of the measures of central tendencies best described your data set before all the changes occurred, and why?
  Answers will vary depending on the group's generated data set, and what studies/comparisons are being done with the data set.
- How does manipulating the data in this type of dynamic setting encourage student learning?
  It allows the student to watch the changes in data happen at a very fast rate, so the student is not tied down with computations.

12. *Place the* ***Comparison*** *transparency on the overhead or display Power Point slide 6. Have groups begin activity* ***Comparison****. At this point, the comparison should address both the mathematical aspect and the technological aspect of generating and manipulating data and the TEKS. Have participants reflect on their answers on the* ***Guided Question #1 Chart*** *.Use the* ***Facilitation Questions*** *to guide a whole group discussion.*

Facilitation Questions

- What TEKS does this activity address?
  Participants should brainstorm a list of TEKS that they believe they have covered in this activity. The Leader Notes contain a comprehensive list of the TEKS addressed in this phase of the professional development. If participants do not mention some of these TEKS, ask them if the activity also covers these TEKS.
- How does the technology that you used enhance the teaching of those TEKS?
  Answers may vary. However, participants should note that using technology enables them to explore a mathematical concept to a much deeper level. Technology makes rich mathematics accessible to a variety of learning styles.

Activity 2 – Fat Grams Graph

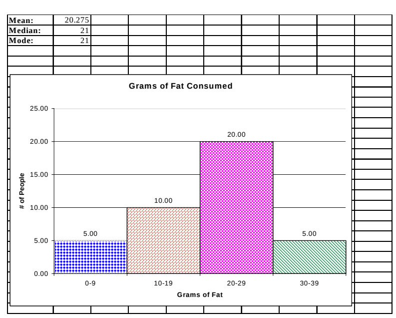
*This part of the lesson actively involves the participants in generating a graphical representation by manipulating their data set using the spreadsheet software. Encourage participants to interact with each other. The presenter(s) should be moving around the room facilitating the activity. Use the **Facilitation Questions** to guide and redirect participants, as needed.*

Participants may need to understand the distinction between a Bar Graph and a Histogram. A Bar graph shows the frequency of specific data, the data may be categorical or numerical. A Histogram is used when the data can be arranged into continuous intervals.

1. *Have each pair of participants open their saved document (JDoe_Grams_of_Fat_Spreadsheet.)*

2. *If using the Power Point display Power Point slide 7. Ask groups to create a graphical representation of their choice using the **Chart Wizard** found on the spreadsheet toolbar, and the "Number of People Surveyed" data and "Grams of Fat Intervals." If participants have never used the **Chart Wizard** in Excel, participants may use the **Technology Tutorial** flip chart **Fat Grams Graph Activity 2**: **Creating the Grams of Fat Graph** to create their graph.*

Sample Graph: Histogram.



3. *Display Power Point slide 8, and/or state thought questions:* ***Would you expect the graphs to be similar or different? What similarities would you expect to see? What differences would you expect to see?***

4. *Place transparency* ***Gallery Walk*** *on the overhead or display Power Point slide 9 and have participants read over questions. Tell participants to be ready to discuss each of the questions found on the transparency with the whole group at end of gallery walk. Set a timer (limiting time will help facilitate activity.)*

5. *Have groups do a computer gallery walk and observe the other groups work.*

6. *Lead whole group in a discussion with the focus on which graphical representation was the best to use and why. Use the* ***Gallery Walk/****Power Point slide 9 questions on next page to guide discussion, as needed.*

Transparency: Gallery Walk

- **Which type of graphical representation did you choose to display your data? Why did you choose to display the data in this way?**
  Answer may vary based on the type of graph the group chose.

- **Would it be better to consider one of the other types of graphical representation? Why or why not?**
  Best choices are a histogram or circle graph. Histograms show how data falls into different ranges and circle graphs show a part-whole relationship.

- **Compared to the other graphical representations, did you see a better choice for displaying the data? If so, which one and why?**
  Answer may vary based on the type of graph the group chose.

- **Can you determine the different measures of central tendencies with the type of graph you selected?**
  Answer may vary based on the type of graph the group chose. Also, it depends on which measure of central tendency you are looking for.

- **What are some of the strengths of using a dynamic spreadsheet to generate graphs?**
  Gives time to analyze the data in different graphical situations, is easy to switch from one graph to another, time saver, and allows for large data sets.

7. *Ask the groups to print (if printers are available) and save their work.*

8. *Place the* ***Comparison*** *transparency on the overhead or display Power point slide 10. Have groups add to* ***Comparison Activity****. The comparison should address both the mathematical aspect and the technology aspect of graphing data and the TEKS. Have participants reflect back on their answers using* ***Guided Question #1 Chart****. Use the* ***Facilitation Questions*** *to guide a whole group discussion.*

Facilitation Questions

- What TEKS does this activity address?
  Participants should brainstorm a list of TEKS that they believe they have covered in this activity. The Leader Notes contain a comprehensive list of the TEKS addressed in this phase of the professional development. If participants do not mention some of these TEKS, then ask if the activity also covers these TEKS.
- How does the technology that you used enhance the teaching of those TEKS?
  Answers may vary. However, participants should note that using technology enables them to explore a mathematical concept to a much deeper level. Technology makes rich mathematics accessible to a variety of learning styles.

Activity 3: Graphs Oh No!

This part of the lesson is designed for small groups of two to four participants. Encourage participants to interact with each other and refer to the Technology Tutorial flip chart. The presenter(s) should be moving around the room facilitating the activity. Use the ***Facilitation Questions*** *to guide and redirect participants, as needed.*

1. *Display* ***Guided Questions #2*** *chart. Distribute a set of* ***Graph Cards*** *to each group, and place the* ***Guided Questions #2*** *transparency on the overhead or display Power Point slide 11. Tell the participants to be ready to discuss each of the questions found on the transparency with the whole group. Have groups discuss the information given in each card set. Participants are to use Post-it™ notes, one per question (labeled 1, 2, 3, and 4), to record their thoughts.*

2. *Debrief questions as a whole group posting participants' answers on the* ***Guided Questions #2*** *chart as they share answers. (If there is more than one presenter, one of the other presenters can help facilitate the process by collecting Post-it™ notes and placing them on the chart as the group discussion continues.) Give each group of participants an opportunity to respond.*

*** Guided Questions*** *with possible responses are on the next page.*

Transparency: Guided Questions #2

1. **What information have you been given?**
   Graphical: Histograms, Circle graphs, Box-and-Whisker plot
   Percents
   Decimals
   Fractions

2. **What can you infer from the graph you were given?**
   Numerical data is missing,
   There are missing values, labels and intervals,
   Meaning of graph has not been defined,
   Identification and labeling will need to be done before a data set can be created, etc.

3. **Do you need to define missing information or labels before you can create your data set? Why is this important?**
   Yes, because some of the graphs are missing critical information such as interval, tick marks, labeling, etc.

4. **What are the benefits of having your students generate data in this manner?**
   Students will see the need for labels. Student must use critical thinking skills, demonstrate a deep understanding of the concept, etc.

3. *Place* ***Spreadsheet*** *on the overhead or display Power Point slide 12. Have each pair of participants open their saved document.*

4. *Ask groups to create a numerical set of data that satisfies the conditions of their graphs, using the* ***Middle School-Explore Explain 2 Spreadsheet #2****. They may refer to the* ***Technology Tutorial*** *flip chart* ***Fat Grams Graph Activity 2: Creating the Grams of Fat Graph*** *as needed. Use the* ***Facilitation Questions*** *to guide and redirect participants, as needed.*

5. *Display Power Point slide 13 and/or state thought questions:* ***Would you expect the graphs to be similar or different? What similarities would you expect to see? What differences would you expect to see?***

6. *Place* ***Gallery Walk #2*** *transparency on the overhead or display Power Point slides 14 and 15, and have participants read the questions. Tell participants to be ready to discuss each of the questions found with the whole group at end of gallery walk. Set a timer (limiting time will help facilitate activity.)*

7. *Have groups do a computer gallery walk and observe the other groups work.*

8. *Lead whole group in a discussion with the focus on which graphical representation was the best to use and why. Use the* ***Gallery Walk #2/****Power Point slides 14 and 15 questions on the next page to guide discussion, as needed.*

Transparency: Gallery Walk 2

- **What are some of the benefits of generating data from generic graphs for the student?**
  Creates a situation where the students are analyzing, synthesizing, and evaluating the information they have previously learned.
- **What are some of the benefits of generating the verbal descriptors of different types of graphical representations?**
  Students verbalize learning. This will allow the teacher to assess students' understanding of the concepts.
- **Which type of graphical representation did you choose to display your data? Why did you choose to display the data in this way?**
  Answer may vary based on the type of graph the group chose.
- **Would it be better to consider a different type of graphical representation? Why or why not?**
  Best choices are a histogram or circle graph. Histograms show how data falls into different ranges and circle graphs show a part-whole relationship.
- **Compared to the other graphical representations, did you see a better choice for displaying the data? If so, which one and why?**
  Answer may vary based on the type of graph the group chose.

- **Can you determine the different measures of central tendencies with the type of graph you selected?**
  Answer may vary based on the type of graph the group chose. Also, it depends on which measure of central tendency you are looking for.
- **What are some of the strengths of using a dynamic spreadsheet to generate graphs?**
  Gives time to analyze the data in different graphical situations, is easy to switch form one graph to another, saves time, and allows for large data sets.

9. *Distribute the **Intentional Use of Data** activity sheet to each participant.*

10. *Prompt the participants to work in pairs to identify those TEKS that received greatest emphasis during this activity. Prompt the participants to identify two key questions emphasized during this activity. Allow four minutes for discussion.*

Facilitation Questions

- Which mathematical TEKS formed the primary focus of this activity?
  6.10D, 7.11B, 8.12A
- What additional math TEKS supported the primary TEKS?
  6.11, 6.12, 6.13; 7.13, 7.14, 7.15; 8.14, 8.15, 8.16
- What Technology Applications TEKS are addressed during this activity?
  1B, C;E ,and F; 2A; 3B, and E; 5A; 6A; 7B; 8E; 10E
- How do these TEKS translate into guiding questions to facilitate student exploration of the content?
  Answers may vary. These TEKS allow for application and problem solving type questions at the analysis, synthesis and evaluate levels.
- How do your questions reflect the depth and complexity of the TEKS?
  Answers may vary.
- How do your questions support the use of technology?
  Answers may vary.

11. *As a whole group, share responses for two to three minutes.*

12. *As a whole group, identify the level(s) of rigor (based on Bloom's taxonomy) addressed, the types of data, the setting, and the data sources used during this Explore/Explain cycle. Allow three minutes for discussion.*

Facilitation Questions

- What attributes of the activity support the level of rigor that you identified?
  Answers may vary. The exploring and questioning.

13. *As a whole group, discuss how the participants could implement this activity in other settings. Allow five minutes for discussion.*

Facilitation Questions

- How would this activity change if we had access to one computer per participant?
  The student could independently generate the data set.
- How would this activity change if we had access to one computer for the entire group of participants?
  The students could generate data sets using a calculator and then manipulate the data using the one computer and/or interactive software.
- How would this activity change if we had used graphing calculators instead of computer-based applications?
  Answers may vary. The students could use the list function of the graphing calculators to record data, and manipulate it.
- How might we have made additional use of available technologies during this activity?
  Answers may vary. Use of a graphing calculator
- Why was technology withheld during the first part of the *Time to Play* activity part of this activity?
  To provide the students with hands-on experience, and provide the students with conceptual understanding of generating data.
- How does technology enhance learning?
  Technology enhances the learning by allowing for large set of data, a variety of was to look at data, easy manipulation of the data, and higher levels of questioning can accrue.

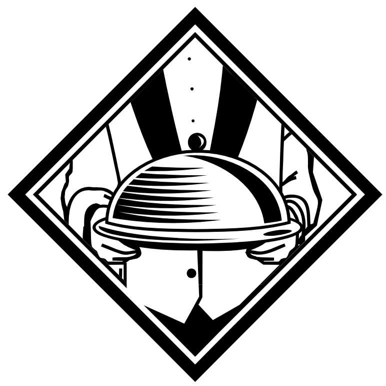
14. Prompt the participants to set aside the completed Intentional Use of Data activity sheet for later discussion. These completed activity sheets will be used during the elaborate phase as prompts for generating attributes of judicious users of technology.

Answers may vary.

Explore/Explain 2: Intentional Use of Data

TEKS	*6.10A,B,D; 6.11A,D; 6.12A,B; 6.13A,B* *7.11A,B; 7.12A,B; 7.13A,D; 7.14A,B; 7.15A,B* *8.12A,C; 8.14A,D; 8.15A,B; 8.16A,B*	
Question(s) to Pose to Students	*What is the relationship between the measures of central tendency*?	
	How did the use of a computer help determine the relationship between the measures of central tendency?	
Cognitive Rigor	Knowledge	
	Understanding	√
	Application	√
	Analysis	√
	Evaluation	√
	Creation	√
Data	Real-Time	√
	Archival	
	Categorical	
	Numerical	√
Setting	Computer Lab	√
	Mini-Lab	√
	One Computer	√
	Graphing Calculator	√
	Measurement Based Data	
Data Source(s)	*Answers may vary.*	

Transparency: Survey Question



Ms. Grant’s Health Education class took a field trip to the local mall to conduct various health surveys. One of the surveys was to generate information about the amount of fat a person thinks he or she eats each day. The question was stated in the following manner:

How many grams of fat do you think you eat in each day?

Transparency: Guided Questions #1

1. **What information have you been given to generate your data?**

2. **Which statement card(s) would make a good starting point(s) for creating a data set that would satisfy these statements? Why?**

3. **What type of data would be reasonable for the situation?**

4. **What are the benefits of having your students generate data in this manner?**

Transparency: Spreadsheet

Middle School-Explore Explain 2 Spreadsheet.xls

Middle School-Explore Explain 2 Spreadsheet #2.xls

Transparency: Gallery Walk

- **Which type of graphical representation did you choose to display your data? Why did you choose to display the data in this way?**

- **Would it be better to consider one of the other types of graphical representation? Why or why not?**

- **Compared to the other graphical representations, did you see a better choice for displaying the data? If so, which one and why?**

- **Can you determine the different measures of central tendencies with the type of graph you selected?**

- **What are some of the strengths of using a dynamic spreadsheet to generate graphs?**

Transparency: Comparison

How does using the spreadsheet software compare to manipulating data and graphing data by hand?

Software Justification:

By Hand Method Justification:

Student Value:

Student Value:

Transparency: Guided Questions #2

1. **What information have you been given?**

2. **What can you infer from the graph you were given?**

3. **Do you need to define missing information or labels before you can create your data set? Why is this important?**

4. **What are the benefits of having your students generate data in this manner?**

Transparency: Gallery Walk 2

- **What are some of the benefits of generating data from generic graphs for the student?**
- **What are some of the benefits of generating the verbal descriptors of different types of graphical representations?**
- **Which type of graphical representation did you choose to display your data? Why did you choose to display the data in this way?**
- **Would it be better to consider a different type of graphical representation? Why or why not?**
- **Compared to the other graphical representations, did you see a better choice for displaying the data? If so, which one and why?**
- **Can you determine the different measures of central tendencies with the type of graph you selected?**
- **What are some of the strengths of using a dynamic spreadsheet to generate graphs?**

Activity Master: Data Statement Cards

Data Statement Card Set 1:

Grams of Fat Consumed

50% of the people surveyed gave a response between 20 and 29 grams of fat per day.

Grams of Fat Consumed

Only 0.125 of the total responses were between 0 and 9 grams of fat per day.

Grams of Fat Consumed

About half as many people who answered between 20 and 29 grams of fat answered between 10 and 19 grams per day.

Grams of Fat Consumed

The same number of people responded between 30 and 39 grams of fat as did those people that responded between 0 and 9 grams.

Data Statement Card Set 2:

Grams of Fat Consumed

25% of the people surveyed gave a response between 10 and 19 grams of fat per day.

Grams of Fat Consumed

One third of the people responded with an answer of between 20 and 29 grams of fat each day.

Grams of Fat Consumed

The same number of people who responded between 10 and 19 grams of fat gave a response of 0 to 9 grams.

Grams of Fat Consumed

About $\frac{1}{2}$ as many people had a response of 30 to 39 grams as did those that gave a response of 20 to 29 grams each day.

Data Statement Card Set 3:

Grams of Fat Consumed

Thirty-three and a third percent of the people surveyed gave a response between 30 and 39 grams of fat.

Grams of Fat Consumed

About $\frac{1}{3}$ of the people responded with an answer between 10 and 19 grams of fat.

Grams of Fat Consumed

About half as many people who were surveyed responded with 0 to 9 grams of fat as responded with 10-19 grams of fat.

Grams of Fat Consumed

The rest of the people gave a response between 20 and 29 grams.

Data Statement Card Set 4:

Grams of Fat Consumed

One fourth of the people surveyed responded with an answer between 30 and 39 grams of fat per day.

Grams of Fat Consumed

$\frac{1}{3}$ of the people responded with an answer between 0 and 9 grams of fat.

Grams of Fat Consumed

The same number of people who responded with answers between 30 and 39 grams of fat per day responded with an answer between 20 to 29 grams of fat per day.

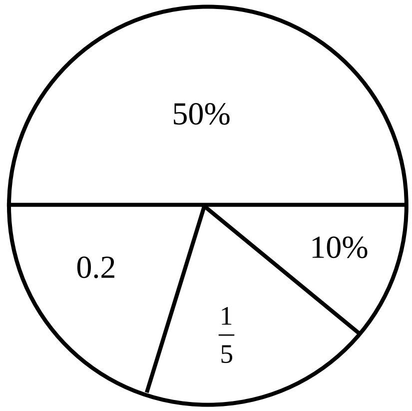
Grams of Fat Consumed

About 0.5 as many people who responded with answers between 0 and 9 grams of fat gave a response between 10 and 19 grams each day.

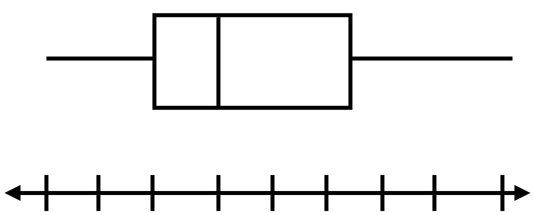
Activity Master: Data Cards

24	30	36	
25	31	37	
26	32	38	
27	33	39	
28	34		
29	35		

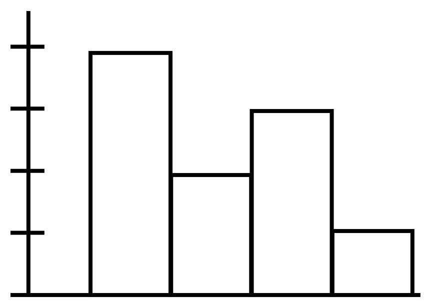
Activity Master: Graph Cards



Circle Graph



Box and Whisker Plot



Histogram

Participant Page: Generating Data

Part 1:

- Input formulas for all cells containing a red hint flag:
  Total Number of People Surveyed,
  Total Percent of People Surveyed,
  and Percent of People Surveyed for each interval.

Part 2:

- Complete Grams of Fat table by entering data into the Number of People Surveyed using the Data Statement Cards. Manipulate data until all cards have been satisfied.
- Save as: JDoe_Grams_of_Fat_Spreadsheet

1. What approach did your group take to complete the table?

2. What type of manipulation did it take to make your data set fit the Data Statement Cards you were given?

3. How would you manipulate the data when you have half or a third of a person represented in your data set? Is it okay to have half a person? Why, or why not?

4. What is the smallest <u>meaningful</u> value you can have for the total number of people surveyed for your data?

5. How does using a <u>dynamic</u> spreadsheet encourage student learning and thinking?

6. How could you combine what you just did on the spreadsheet with what you do in the classroom?

Participant Page: Time to Play

Part I. Collecting Data!

1. Sort and place data cards into the brown-paper bags by the defined intervals. Label each bag.

2. Based on the information in your table, draw data cards out one at a time with replacement.
   Example: You have 5 people that stated they ate between 0 and 9 grams of fat each day. Then you would make 5 pulls from the bag labeled 0-9 grams of fat.

3. Record results as you draw data from the bags into the Data Pieces table found on sheet 2 of the Middle School-Explore Explain 2 Spreadsheet spreadsheet.

4. Continue until all data has been generated.

5. Format the Measures of central tendency using the red flag hints.

6. Record the mean, median and mode. Which of the measures of central tendencies best describes your original data set, and why?

   Mean: _____

   Median: _____

   Mode: _____

7. Save your work as **JDoe_Grams_of_Fat_Spreadsheet** on your desktop.

Part II. What If?

In the following What If's: Manipulate the data elements in a way that keeps the Data Statements Cards **TRUE**. Open your spreadsheet and begin.

1. **What if**, you create a data set in which the mean is the same as the mode:

   What type of changes did you make to your data set? Were you able to make the changes to satisfy these parameters?

   ____

   ____

(Part 2 continued)

2. **What if**, you create a data set in which the mode would be the best measure of central tendency to use to describe the data set:

   What type of changes did you make to your data set? Were you able to make the changes to satisfy these parameters?

   ____

   ____

3. **What if**, you create a data set in which the median would be the best measure of central tendency to use to describe the data set:

   What type of changes did you make to your data set? Were you able to make the changes to satisfy these parameters?

   ____

   ____

Participant Page: Comparison

How does using the spreadsheet software compare to manipulating data and graphing data by hand?

Software Justification:

By Hand Method Justification:

Student Value:

Student Value:

Explore/Explain 2: Intentional Use of Data

TEKS		
Question(s) to Pose to Students		
Cognitive Rigor	Knowledge	
	Understanding	
	Application	
	Analysis	
	Evaluation	
	Creation	
Data	Real-Time	
	Archival	
	Categorical	
	Numerical	
Setting	Computer Lab	
	Mini-Lab	
	One Computer	
	Graphing Calculator	
	Measurement Based Data	
Data Source(s)		

Explore/Explain 3: Trials, Trials, Trials

Purpose:
Compare and contrast experimental results and theoretical results of probabilistic events. Technology tools will be used to create graphical representations that compare these experimental and theoretical results.

Descriptor:
Participants will conduct sets of experiments that have the same number of outcomes (such as a 6-spinner and a die). They will create graphical representations that compare the experimental results and the theoretical results using spreadsheet technology and hand-held graphing technology. Participants will compare and contrast the use of these two technologies and their effectiveness in representing the data.

Duration:
2 hours

Mathematics TEKS Objectives:

6.9B	The student uses experimental and theoretical probability to make predictions. The student is expected to find the probabilities of a simple event and its complement and describe the relationship between the two.
6.10A	The student uses statistical representations to analyze data. The student is expected to select and use an appropriate representation for presenting and displaying different graphical representations of the same data including line plot, line graph, bar graph, and stem and leaf plot.
6.10B	The student uses statistical representations to analyze data. The student is expected to identify mean (using concrete objects and pictorial models), median, mode, and range of a set of data.
6.10C	The student uses statistical representations to analyze data. The student is expected to sketch circle graphs to display data.
6.10D	The student uses statistical representations to analyze data. The student is expected to solve problems by collecting, organizing, displaying, and interpreting data.
6.11A, 7.13A, 8.14A	The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics.
6.11B, 7.13B, 8.14B	The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to use a problem-solving model that incorporates understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness.

6.11C, 7.13C, 8.14C The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to select or develop an appropriate problem-solving strategy from a variety of different types, including drawing a picture, looking for a pattern, systematic guessing and checking, acting it out, making a table, working a simpler problem, or working backwards to solve a problem.

6.11D, 7.13D, 8.14D The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to select tools such as real objects, manipulatives, paper/pencil, and technology or techniques such as mental math, estimation, and number sense to solve problems.

6.12A, 7.14A, 8.15A The student communicates about Grade 6/7/8 mathematics through informal and mathematical language, representations, and models. The student is expected to communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models.

6.12B, 7.14B, 8.15B The student communicates about Grade 6/7/8 mathematics through informal and mathematical language, representations, and models. The student is expected to evaluate the effectiveness of different representations to communicate ideas.

6.13A, 7.15A, 8.16A The student uses logical reasoning to make conjectures and verify conclusions. The student is expected to make conjectures from patterns or sets of examples and nonexamples.

6.13B, 7.15B, 8.16B The student uses logical reasoning to make conjectures and verify conclusions. The student is expected to validate his/her conclusions using mathematical properties and relationships.

7.11A The student understands that the way a set of data is displayed influences its interpretation. The student is expected to select and use an appropriate representation for presenting and displaying relationships among collected data, including line plot, line graph, bar graph, stem and leaf plot, circle graph, and Venn diagrams, and justify the selection.

7.11B The student understands that the way a set of data is displayed influences its interpretation. The student is expected to make inferences and convincing arguments based on an analysis of given or collected data.

7.12A The student uses measures of central tendency and range to describe a set of data. The student is expected to describe a set of data using mean, median, mode, and range.

7.12B The student uses measures of central tendency and range to describe a set of data. The student is expected to choose among mean, median, mode, or range to describe a set of data and justify the choice for a particular situation.

8.12A The student uses statistical procedures to describe data. The student is expected to select the appropriate measure of central tendency or range to describe a set of data and justify the choice for a particular situation.

8.12C The student uses statistical procedures to describe data. The student is expected to select and use an appropriate representation for presenting and displaying relationships among collected data, including line plots, line graphs, stem and leaf plots, circle graphs, bar graphs, box and whisker plots, histograms, and Venn diagrams, with and without the use of technology.

Technology Applications TEKS Objectives:

(1)(B) The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to compare, contrast, and appropriately use the various input, processing, output, and primary/secondary storage devices.

(1)(C) The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency;

(1)(E) The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to use technology terminology appropriate to the task.

(2)(A) The student uses data input skills appropriate to the task. The student is expected to demonstrate proficiency in the use of a variety of input devices such as mouse/track pad, keyboard, microphone, digital camera, printer, scanner, disk/disc, modem, CD-ROM, or joystick.

(3)(E) The student complies with the laws and examines the issues regarding the use of technology in society. The student is expected to demonstrate knowledge of the relevancy of technology to future careers, life-long learning, and daily living for individuals of all ages.

(4)(A) The student uses a variety of strategies to acquire information from electronic resources, with appropriate supervision. The student is expected to use strategies to locate and acquire desired information on LANs and WANs, including the Internet, intranet, and collaborative software; and

(6)(A) The student evaluates the acquired electronic information. The student is expected to determine and employ methods to evaluate the electronic information for accuracy and validity.

(6)(B) The student evaluates the acquired electronic information. The student is expected to resolve information conflicts and validate information through accessing, researching, and comparing data.

(10)(E) The student formats digital information for appropriate and effective communication. The student is expected to match the chart style to the data when creating and labeling charts.

TAKS Objectives:

- Objective 5: Probability and Statistics
- Objective 6: Mathematical Processes and Tools

Technology:

- Internet Websites:
  http://education.ti.com/us/product/tech/73/apps/appslist.html
  http://nlvm.usu.edu/en/nav/vlibrary.html
  http://www.shodor.org/interactivate/activities/multibargraph/index.html
- TI-Interactive
- TI-Connect
- Handheld graphing technology

Materials:

Advance Preparation: Download APPS program Probability Simulator onto each calculator if using TI-73 calculators (calculator linking can be used here.) Bookmark websites on computers. Set up/or load the pre-designed spreadsheet **Middle School-Explore Explain 3 Spreadsheet** (refer to **Technology Tutorial** flip chart **TI-Interactive: The Big Question Presenter(s) Spreadsheet** if file is not available.) Copy **Group Activity Sheet** and **Venn Diagram** one per group, and copy **My Best Graph Questionnaire,** and **Intentional Use of Data** one per participant. Copy and cut out sets of **Simulation Cards Set 1** and **Simulation Cards Set 2** *that fits the correct calculator situation of the group* (one card per group from each set.) If more than one set is needed, repeat cards. Make transparency of **The Big Question**, **My Best Graph Questionnaire**, **Mini To Do List** and **To Do List**. Create a **The Big Question** chart on chart paper. Put together manipulatives: deck of cards (only the cards numbered between 1 and 6 will be used), six section spinner (may need more than one depending on group size), number cube (may need more than one depending on group size) *If manipulatives are not available a card stock master is provided for cards, spinners and number pulls.*

Presenter(s): TI-Interactive software and projection device or access to a computer lab.

Per group: **Simulation Card Set 1**, **Simulation Card Set 2**, a **Group Activity Sheet**, a **Venn Diagram**, Post-it™ notes, Computer with spreadsheet and graphing capabilities, **Technology Tutorial** flip chart, and access to the **Middle School-Explore Explain 3 Spreadsheet**.

Per Participant: Graphing calculator and handout **My Best Graph Questionnaire**

Leaders Notes:
Due to the number of topics present in this lesson, several Explore/Explain cycles occur. As each new topic is introduced, participants explore the topic. The Explain cycle then occurs. This is repeated several times throughout the lesson.

Activity 1 – Trials, Trials, Trials!

This part of the lesson is designed for small groups of three or four participants where each participant uses a graphing calculator and each group has access to a computer with spreadsheet software. Participants will perform experimental trials using number cubes, cards, and spinners, and generate graphical representation of their results. Encourage participants to interact with each other. The presenter(s) should be moving around the room facilitating the activity. Use the ***Facilitation Questions*** *to guide and redirect participants, as needed.*

1. *Display* ***The Big Question*** *chart on the wall for use throughout activity.*

2. *Place* ***The Big Question*** *transparency on the overhead, or display Power Point slide 1 to set up scenario with participants. Have participants read over the question. Ask the participants to think about how their students would respond to a question such as this. Have participants record their thoughts on Post-it™ notes. Then, have participants share their thoughts with the participant to their right (Think-Pair-Share). Have each group share their thoughts with the whole group, one group at a time. As each group shares, have them place the Post-it™ notes on the* ***The Big Question*** *chart.*

3. *Display the* ***Mini To Do List*** *transparency or Power Point slide 2. Distribute a* ***Simulation Card*** *from* ***Set 1*** *and* ***Group Activity Sheet*** *to each group.*
   If presenter(s) does not have access to manipulatives needed in this activity, card stock masters with instructions can be found in the activity master section of the lesson.

4. *Have groups work together and do the activity. Record the outcomes on the* ***Group Activity Sheet*** *using the frequency table for simulation #1.*

5. *Have participants generate a table using a computer with spreadsheet software. Participants should be able to create a table with little assistance; however, participants who need help may refer to the* ***Technology Tutorial*** *flip chart* ***Trials, Trials, Trials, Activity: Creating the Table*** *for assistance.*

Example: Answers will vary.

Simulation #1

Outcomes	Tally	Frequency
1	*ll*	*2*
2	*~~llll~~ l*	*6*
3	*l*	*1*
4	*~~llll~~ ll*	*7*
5	*llll*	*4*
6		*0*

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	A	B	C	D
1				
2		Different Outcomes	Frequency	
3		1	2	
4		2	6	
5		3	1	
6		4	7	
7		5	4	
8		6	0	
9				
10				
11				

6. *Have groups create a graphical representation of their data. Groups should independently choose what type of graphical representation to use for their data.*

Participants should be able to create graphs with little assistance; however, participants who need help may refer to the ***Technology Tutorial*** *flip chart* ***Trials, Trials, Trials, Activity: Creating the Graph*** *for assistance.*

7. *Once each group has generated a graphical representation of their data, display Power Point slide 3 and/or state thought questions found on Power Point slide 3:* ***Would you expect the graphs to be similar or different?, What similarities would you expect to see?, and What differences would you expect to see?***

8. *Have groups do a gallery walk. (A gallery walk is when each group walks around the room from one computer to the next to examine the works of other groups.) Display Power Point slide 4 and/or use the* ***Facilitation Questions*** *below to generate classroom discussion on using a spreadsheet to create graphical representations of student generated data.*

Facilitation Questions

- What did you observe when the graphs were shared?
  Answers may vary. Different types of graphs, data sets are different….
- Are the graphs similar? Are the graphs different? Why?
  Answers may vary. Some are similar and some are different because some groups used a scatter plot, bar graph, or circle graph to represent their data.
- How would you defend your choice of graph?
  Answers may vary. The choice of graph would depend on how you were going to use the data, for example a circle graph could be used because the data is categorical.
- How would you decide which type of graph is best for this situation?
  Answers may vary. The type of graph would depend on the generated data or the method of analysis. Some graphs would not show "0" outcomes, for example the circle graph.

Activity 2 - Trials, Trials, & More Trials

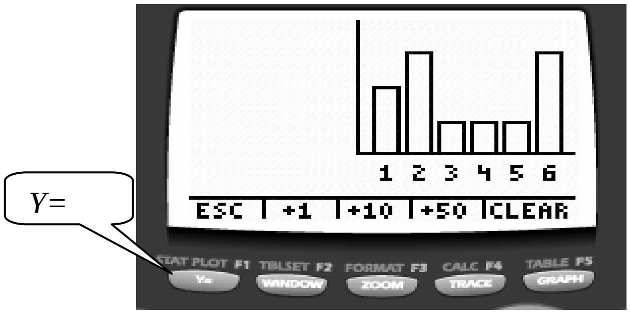
This part of the lesson is designed where each participant uses a graphing calculator and each group has access to a computer with spreadsheet software. Participants will perform experimental trials using a graphing calculator and generate a graphical representation of their results.

Notice that there are two different sets of ***Simulation Cards Set 2****. One set may require loading the probability simulator from the TI website. Also, the presenter may need to seed the number generator on any graphing calculator where the number generator has not been used before. (Refer to the* ***Technology Tutorial*** *flip chart* ***Loading TI Probability Simulator APPS****.) Use the set of simulation cards that fit the capabilities of the participants' graphing calculator. Encourage participants to interact with each other. The presenter(s) should be moving around* *the room facilitating the activity. Use the **Facilitation Questions** to guide and redirect participants, as needed.*

1. *Place **To Do List** transparency on the overhead (at this time only display the first three bullets,) or display Power Point slide 5. Use the transparency or slide to keep groups focused as they move through the activities. Distribute a **Simulation Card** from **Set 2** to each group. Have each participant in the group do the simulation using a graphing calculator. Participants may refer to the **Technology Tutorial** flip chart **Trials, Trials, & More Trials with APPS (or) with NO APPS** as needed.*

If the participants are <u>not</u> using the Probability Simulator, skip step #2.

2. *Once the participants have completed the simulation, use the ESC function to view a table of their generated data. (The Y= function key is the ESC function key for the probability simulator.)*



3. *Have participants take turns recording their data on the **Group Activity Sheet** Data Table for Simulation #2.*

Example: Answers will vary.

Data Table: Simulation #2

Participant Name	Data List
#1: *Terri*	*2, 5, 6, 1, 2, 4, 3, 3, 3, 1*
#2: *Darla*	*1, 1, 4, 5, 4, 6, 5, 6, 1, 1*
#3: *Sherry*	*2, 4, 3, 1, 5, 6, 4, 5, 5, 3*
#4: *Dina*	*6, 5, 6, 4, 1, 2, 3, 3, 3, 2*

This part of the lesson requires participants to reflect on the differences between generating huge amounts of data by hand with manipulatives vs. by calculator with a probability simulator. Each participant will use a graphing calculator to generate a huge amount of data in a short amount of time.

4. *Uncover the next bullet on the **To Do List** transparency, if not using the Power Point.*

5. *Display Power Point slide 6. Inform participants that the following activity is a quick look at the difference between generating huge amounts of data by hand with manipulatives vs. by calculator with a probability simulator.*

   If participants <u>do</u> have the APPS – Probability Simulator, have them explore multiple trials using the +50 function.

   *If participants <u>do not</u> have the APPS – Probability Simulator, use the dice simulator found in the Math PRB Menu. Participants may use the **Technology Tutorial** flip chart as needed.*

If the participants are using the Math PRB Menu, skip step #6.

6. *Have participants examine the changes in the graph as the simulation generates the data, if using the APPS – Probability Simulator.*

7. *Display transparency **Venn Diagram** or Power Point slide 7, and distribute a **Venn Diagram** to each group of participants. Have groups create their own Venn diagram as they discuss within their group the difference between generating huge amounts of data by hand using manipulatives vs. by calculator with a probability simulator. Use the **Facilitation Questions** to generate classroom discussion on using a graphing calculator to generate data.*

Example: Answers may vary.

Participant Page: Venn Diagram

By Hand

- *Physical action for those students that require kinesthetic movement*
- *Builds computational skills*
- *Fun*

Both

- *Generates Data*
- *Calculations can be done*

With Calculator

- *Faster*
- *Immediate changes in graph as data is generated*
- *Allows the student to look at the data in a variety of ways*
- *Easy to manipulate the data*
- *Data can be transferred quickly between technology*
- *Higher levels of questioning can accrue with larger set of data*
- *Loss of computation skills*
- *Limitation of overflow errors*
- *Chart automatically created, no conceptual understanding*

Facilitation Questions

- What is the importance of having students generate one trial at a time? Multiple trials at the same time?
  Answers may vary. One trial at a time allows the student to watch the progression of the graph changes (visible change), while multiple trial at the same time does not allow for the progression (invisible change).
- How could this use of technology benefit your students?
  Answers may vary. Using the multiple trial generators allows the student to observe how the experimental probability moves towards the theoretical probability as more trials are conducted.
- How would you determine the appropriateness of one technology over another to generate data when working with students?
  Answers may vary. Student ability would be a huge factor…
- How would you determine the judicious use of the technology when using the technology in this way?
  Answers may vary. If the use of technology benefits the students' learning and allows for critical thinking to accrue, then it is appropriate to use the technology. What is it you want your students to learn?

*At this time the activity goes back to using the data the participants collected and recorded in the data table on their **Group Activity Sheet**.*

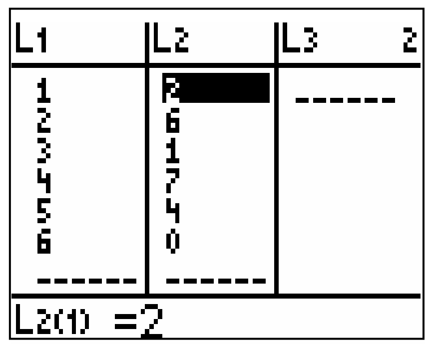
8. *Display the **To Do List** transparency and uncover the last four bullets, or display Power Point slide 8.*

9. *Have each group complete the frequency table, Simulation #2, using the data from the Data Table: Simulation #2 on their **Group Activity Sheet,** and then input their data into a graphing calculator using the list function. (Participants are not to complete the Theoretical Outcome at this time.) Participants may need direction on how to use the list functions. Refer to the **Technology Tutorial** flip chart **Trials, Trials, & More Trials Activity: Creating a Line Plot**.*

Example: Answers will vary.

Simulation #2

Outcomes	Tally	Exp. Outcomes	Theor. Outcomes
1	*~~ll~~*	*2*	
2	*~~llll~~ l*	*6*	
3	*l*	*1*	
4	*~~llll~~ ll*	*7*	
5	*llll*	*4*	
6		*0*	



10. *Have each group create a line plot that represents the data. Participants are to create a line plot using the list and stat plot functions of the graphing calculator. Participants may need help to create their graphs. Have them refer to the **Technology Tutorial** flip chart **Trials, Trials, & More Trials Activity: Creating a Line Plot**.*

11. *Display Power Point slide 9, if not using the **To Do List** transparency. Have groups create a second (different from the first) graphical representation of their data.*

12. *Once each group has generated two graphical representations of their data, display Power Point slide 10 and/or state thought questions found on Power Point slide 10: **Would you expect the graphs to be similar or different? Why? How would they be similar or different/ why?, and What does having larger data sets infer?***

13. *Have groups do a calculator pass around. (A calculator pass around is when each participants passes around their calculator to the next participant to examine.)*

14. *Display Power Point slide 1, if using Power Point. Have participants complete the* ***Best Graph Questionnaire.***

15. *Debrief* ***My Best Graph Questionnaire*** *as a whole group. (Copy of questionnaire with possible responses on next page.)*

Participant Page: My Best Graph Questionnaire

1. **What type of graphical representation(s) do you think would represent your data in the best way?**

☑ Circle Graph ☐ Histogram ☑ Bar Graph ☑ Line Plot

2. **Why did you choose the type(s) of graph that you did?**
   The data were in categories.

3. **Is there more than one graphical representation that will represent the data in a satisfactory way? Why?**
   Answers may vary.
   Yes, because the data can be categorized.

4. **When would you use one graphical representation over another?**
   Answers may vary.
   Which graph to use depends on the problem's situation, what measure of central tendency you want to analyze…

5. **What conjectures can you make from the graph that you decided to generate?**
   Answers may vary.
   One category has more/less data elements or all categories are about the same.

6. **How does analyzing other graphical representations of the same data benefit your students?**
   It allows the student to observe how the experimental probability moves towards the theoretical probability as more trials are conducted, it allows for large amounts of data to be generated and calculated quickly…

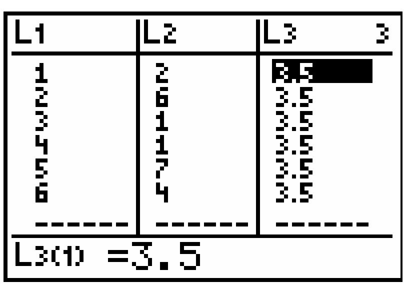
Activity 3 – The Big Question

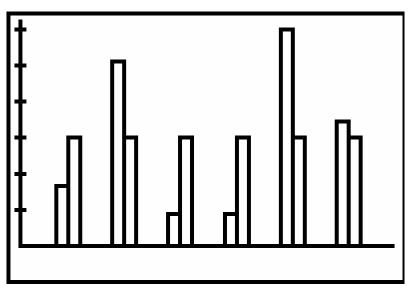
This part of the lesson focuses on a comparison of Theoretical Probability and Experimental Probability. Each group of participants creates a graphical representation, of their choice, of the data. Participants will have access to a computer with spreadsheet software, calculator, and/or Internet access. Participants should interact with each other. The presenter(s) should be moving around the room facilitating the activity. Use the ***Facilitation Questions*** *to guide and redirect participants, as needed.*

1. *Display Power Point slide 12, and/or ask groups to calculate the theoretical outcomes for each outcome in their given situation. Have groups record their results on the* ***Group Activity Sheet*** *Simulation Table #2. Discuss as a whole group what the theoretical probability would be for each outcome: 1, 2, 3, 4, 5, and 6. (The theoretical outcome is the same for each outcome:* $\frac{1}{6}$ *of the trials. Example: if there were 21 trials, you would expect each possible outcome to occur 3.5 times.)*

2. *Have each group generate a graphical representation that will compare and contrast their experimental outcomes vs. the theoretical outcomes using either a graphing calculator, interactive website or a spreadsheet. This will require the use of two lists, one for the experimental outcomes and one for the theoretical outcomes. (A double bar graph, or scatter plot works well here.) Have participants refer to the* ***Technology Tutorial*** *flip chart as needed for assistance; however a specific tutorial has not been written for this part of the* ***The Big Question*** *activity. At this time participants should be proficient with the available technology platforms. Use the* ***Facilitation Questions*** *on the next page to generate classroom discussion.*

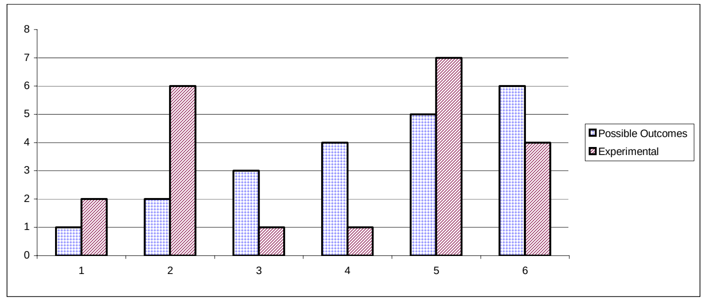
Example: Answers may vary.
Graphing Calculator



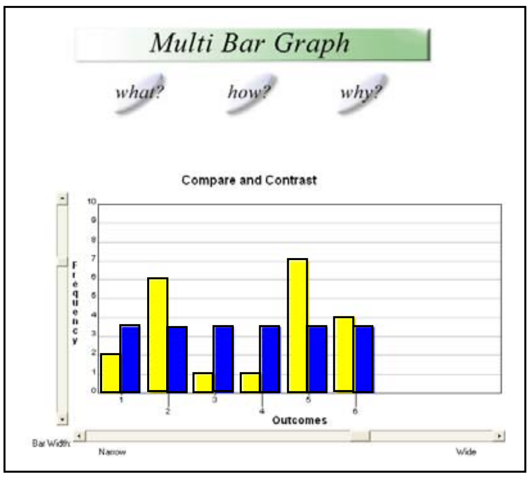


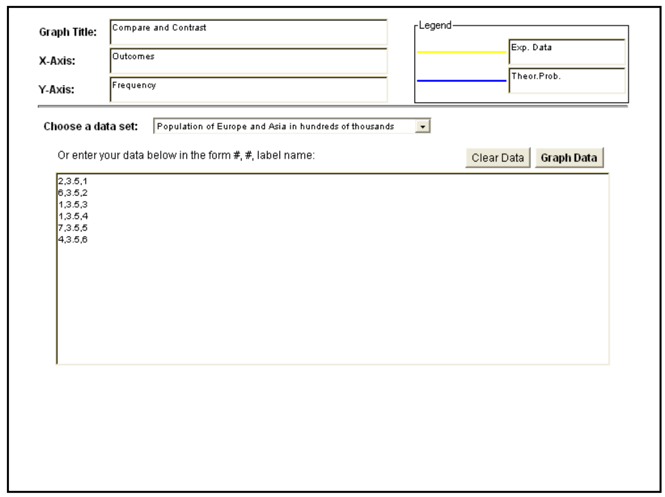
Example: Answers may vary.
Spreadsheet

Possible Outcomes	Experimental	Theoretical
1	2	3.5
2	6	3.5
3	1	3.5
4	1	3.5
5	7	3.5
6	4	3.5



Example: Answers may vary.
Interactive Website



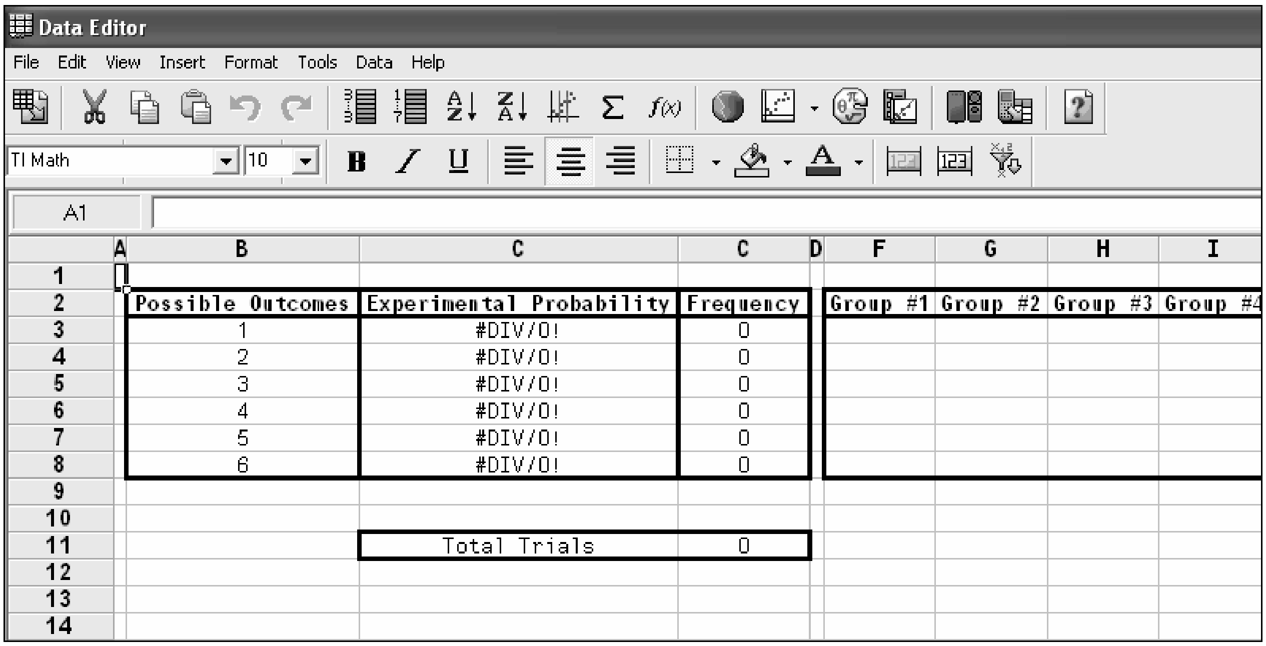


Facilitation Questions

- Would you use the same type of graph to do the comparison as you used for your experimental data?
  Answers will vary. Maybe, if it displays two sets of data at the same time.
- How does your experimental outcomes of your data compare to the theoretical outcomes?
  Answers may vary depending on the data set they have generated. Due to the small amount of data collected it may or may not be close to the theoretical.

*This part of the lesson focuses on a comparison of Theoretical Probability and Experimental Probability as a data set increases in elements. In the following activity the presenter(s) will use a pre-designed TI-Interactive spreadsheet to graph collected data sets and a projection device. The presenter will need to set up a spreadsheet in TI-Interactive, if file is not available. A **Presenter(s) Spreadsheet Set-Up** instructions can be found in the **Technology Tutorial** flip chart **TI-Interactive: The Big Question Presenters(s) Spreadsheet**.*

Example of presenter(s) spreadsheet is below:



	A	B	C	C	D	F	G	H	I
1									
2		Possible Outcomes	Experimental Probability	Frequency		Group #1	Group #2	Group #3	Group #4
3		1	#DIV/0!	0					
4		2	#DIV/0!	0					
5		3	#DIV/0!	0					
6		4	#DIV/0!	0					
7		5	#DIV/0!	0					
8		6	#DIV/0!	0					
9									
10									
11			Total Trials	0					
12									
13									
14									

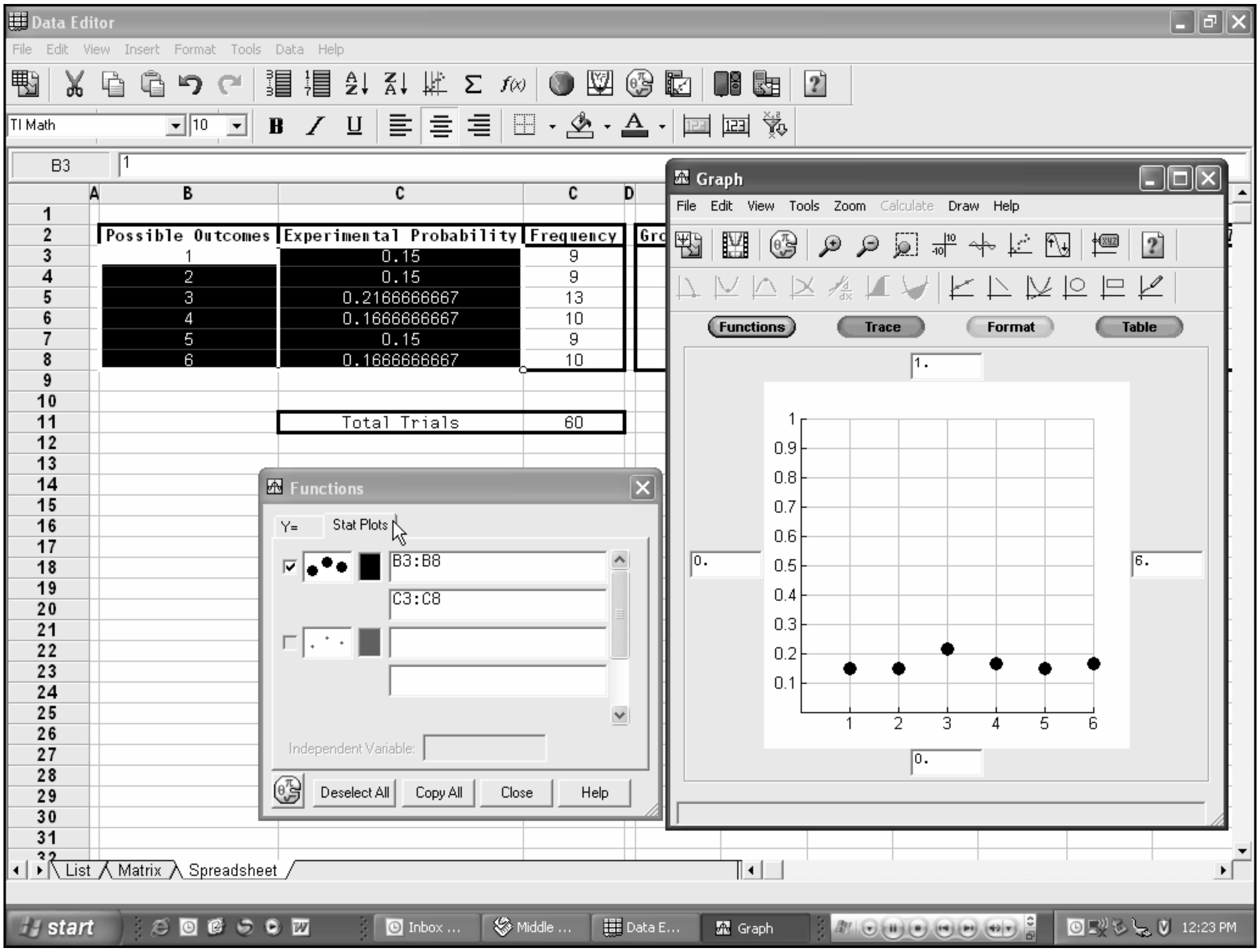
3. *Display Power Point slide 13 and/or state thought questions found on Power Point slide 13: **What are some of the visible changes you see in the experimental outcomes as more trials are entered?, What is the relationship between the points on the graph and the line on the graph?, and How does the technology allow the students to reflect on the Big Question?.** (Use these questions as data collection takes place.)*

4. *The presenter(s) will use TI Interactive to collect and display each group's data set as it is collected. Participants should be encouraged to interact with each other, and practice the steps used to input and manipulate data using TI-Interactive. Use the **Facilitation Questions** to guide and redirect participants, as needed.*

5. *Have one person from three different groups input the group's data into the spreadsheet by hand. As the data is recorded in the presenter's spreadsheet, participants should input the data into their spreadsheet. (There are four ways to upload the data: by copying from a spreadsheet, linking to a TI-83 graphing calculator and uploading a list, copying data from a website or entering data by hand.)*

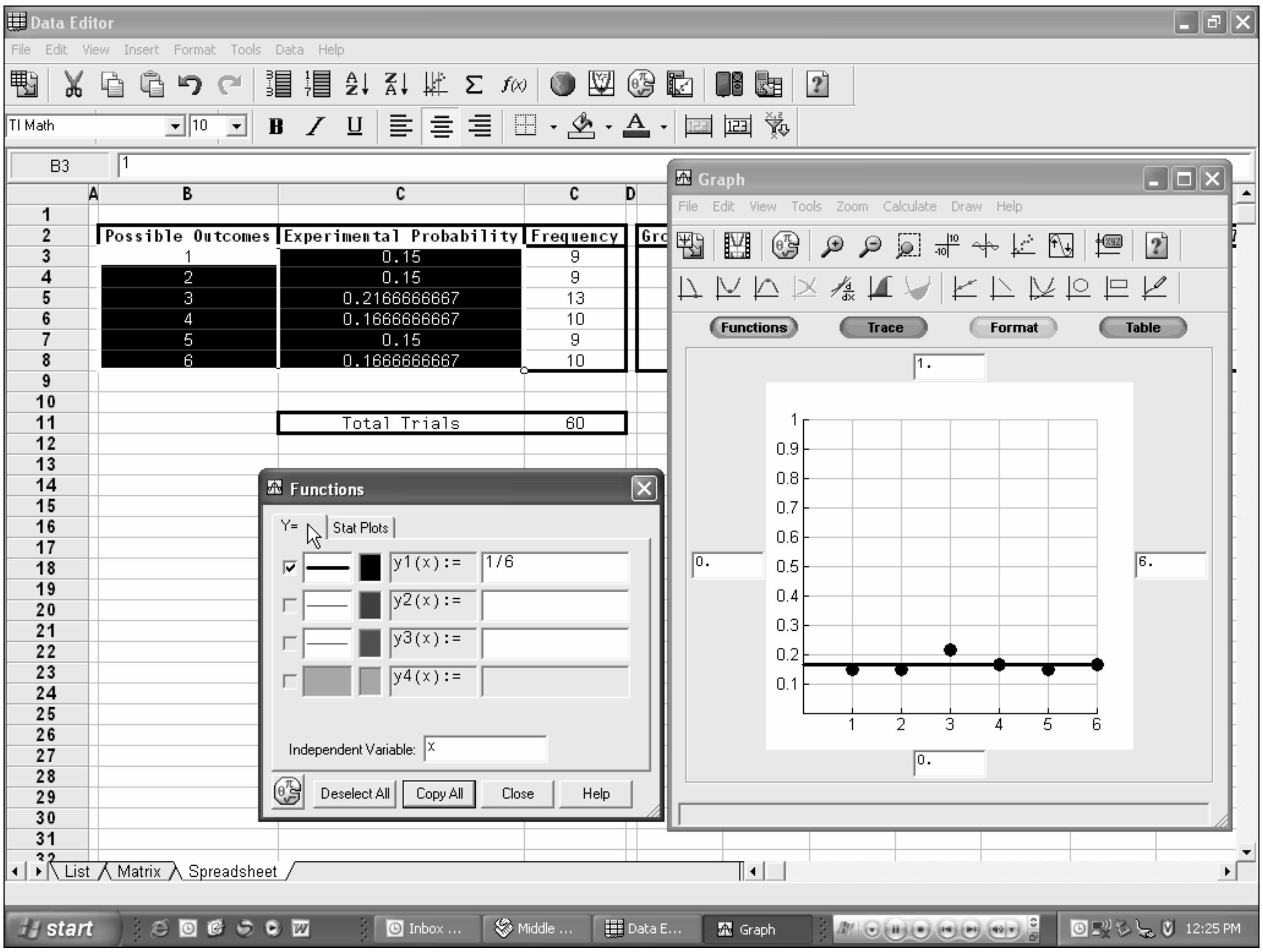
6. *Using the graphing function of the TI-interactive software create a graphical representation of the data using the Possible Outcomes and Experimental Probability columns.*

Example: Graphs may vary.
(Highlight and click Copy All)



7. *Use the Y= function to input the theoretical probability: (1/6). As you create and manipulate the graph of the accumulated data, remind participants that the steps to creating graphs using TI-interactive can be found in the **Technology Tutorial** flip chart **TI-Interactive: The Big Question Graph**.*

Example: Graphs may vary.
(Input function for theoretical probability and click copy all)



Facilitation Questions

- How does the experimental data compare to the theoretical probability as we input more trials?
  Experimental probability moves closer to the theoretical probability.
- What are some of the visible changes you see in the graph?
  More data, change in heights of bars, change in mean, …
- What are some of the benefits of using the interactive software in this manner?
  It allows the student to observe how the experimental probability moves towards the theoretical probability as more trials are conducted, it allows for large amount of data to be generated and calculated quickly…
- What are some of the weaknesses of using the interactive software in this manner?
  Loss of computation.

8. *Place **The Big Question** transparency on the overhead or display Power Point slide 14 to review the question that was set up at the beginning of the activities with participants. Have participants re-read over the question. Ask the participants to think about how their students would respond to a question such as this, after activities such as these were incorporated into the classroom.*

9. *Have participants record their thoughts on Post-it™ notes. Then have them share their thoughts with each other. Have each group share their thoughts with the whole group, one group at a time. As each group shares, have them place the Post-it™ notes on the **The Big Question** chart.*

10. *Distribute the **Intentional Use of Data** activity sheet to each participant. (Key with possible answers follows the activity.)*

11. *Prompt the participants to work in pairs to identify those TEKS that received greatest emphasis during this activity. Prompt the participants to also identify two key questions that were emphasized during this activity. Allow four minutes for discussion.*

Facilitation Questions

- Which mathematical TEKS formed the primary focus of this activity?
  6.9B, 7.11A, 8.12C
- What additional math TEKS supported the primary TEKS?
  6.11, 6.12, 6.13; 7.13, 7.14, 7.15; 8.14,8.15, 8.16
- What Technology Applications TEKS are addressed during this activity?
  1B,C, and E; 2A, 3E, 4A, 6A and B, 10E
- How do these TEKS translate into guiding questions to facilitate student exploration of the content?
  Answers may vary. These TEKS allow for application and problem solving type questions at the analysis, synthesis and evaluate levels.
- How do your questions reflect the depth and complexity of the TEKS?
  Answers may vary.
- How do your questions support the use of technology?
  Answers may vary.

12. *As a whole group, share responses for two to three minutes.*

13. *As a whole group, identify the level(s) of rigor (based on Bloom's taxonomy) addressed, the types of data, the setting, and the data sources used during this Explore/Explain cycle. Allow three minutes for discussion.*

Facilitation Questions

- What attributes of the activity support the level of rigor that you identified?
  Answers may vary. The exploring and questioning.

14. *As a whole group, discuss how this activity might be implemented in other settings. Allow five minutes for discussion.*

Facilitation Questions

- How would this activity change if we had access to one computer per participant?
  The students could independently generate a large set of data.
- How would this activity change if we had access to one computer for the entire group of participants?
  The students could generate data sets using a calculator and then manipulate the data using the one computer and/or interactive software.
- How would this activity change if we had used graphing calculators instead of computer-based applications?
  Since the activity used both, it would be easy to adjust either way.
- How might we have made additional use of available technologies during this activity?
  Answers may vary. Generating data form different Internet sites.
- Why was technology withheld during the first part of the Explore activity?
  To provide the students with hands-on experience, and provide the students with conceptual understanding of probability.
- How does technology enhance learning?
  Technology enhances the learning by allowing for large sets of data, a variety of ways to look at data, easy manipulation of the data, and higher levels of questioning can accrue.

15. *Prompt the participants to set aside the completed Intentional Use of Data activity sheet for later discussion. These completed activity sheets will be used during the elaborate phase as prompts for generating attributes of judicious users of technology.*

Example: Answers may vary.

Explore/Explain 3: Intentional Use of Data

TEKS	Math	*6.9B; 6.10A,B,C,D; 6.11A,BC,D; 6.12A,B; 6.13A,B; 7.11A,B; 7.12A,B;7.13A,B,C,D; 7.14A,B; 7.15A,B; 8.12A,C; 8.14A,B,C,D; 8.15A,B; 8.16A,B*	
	Tech Apps	*1B,C,E; 2A; 3E; 4A; 6A,B; 10E*	
Question(s) to Pose to Students	Math	*What is the relationship between Experimental and Theoretical probability?*	
	Tech Apps	*How did the use of a calculator and computer help determine the relationship between Experimental and Theoretical probability?*	
Cognitive Rigor		Knowledge	
		Understanding	
		Application	
		Analysis	√
		Evaluation	√
		Creation	√
Data Source(s)		Real-Time	√
		Archival	
		Categorical	√
		Numerical	√
Setting		Computer Lab	√
		Mini-Lab	√
		One Computer	√
		Graphing Calculator	√
		Measurement Based Data	
Bridge to the Classroom		*Answers may vary.*	

Transparency: The Big Question

What is the relationship between Experimental and Theoretical probability?

Transparency: Mini To Do List

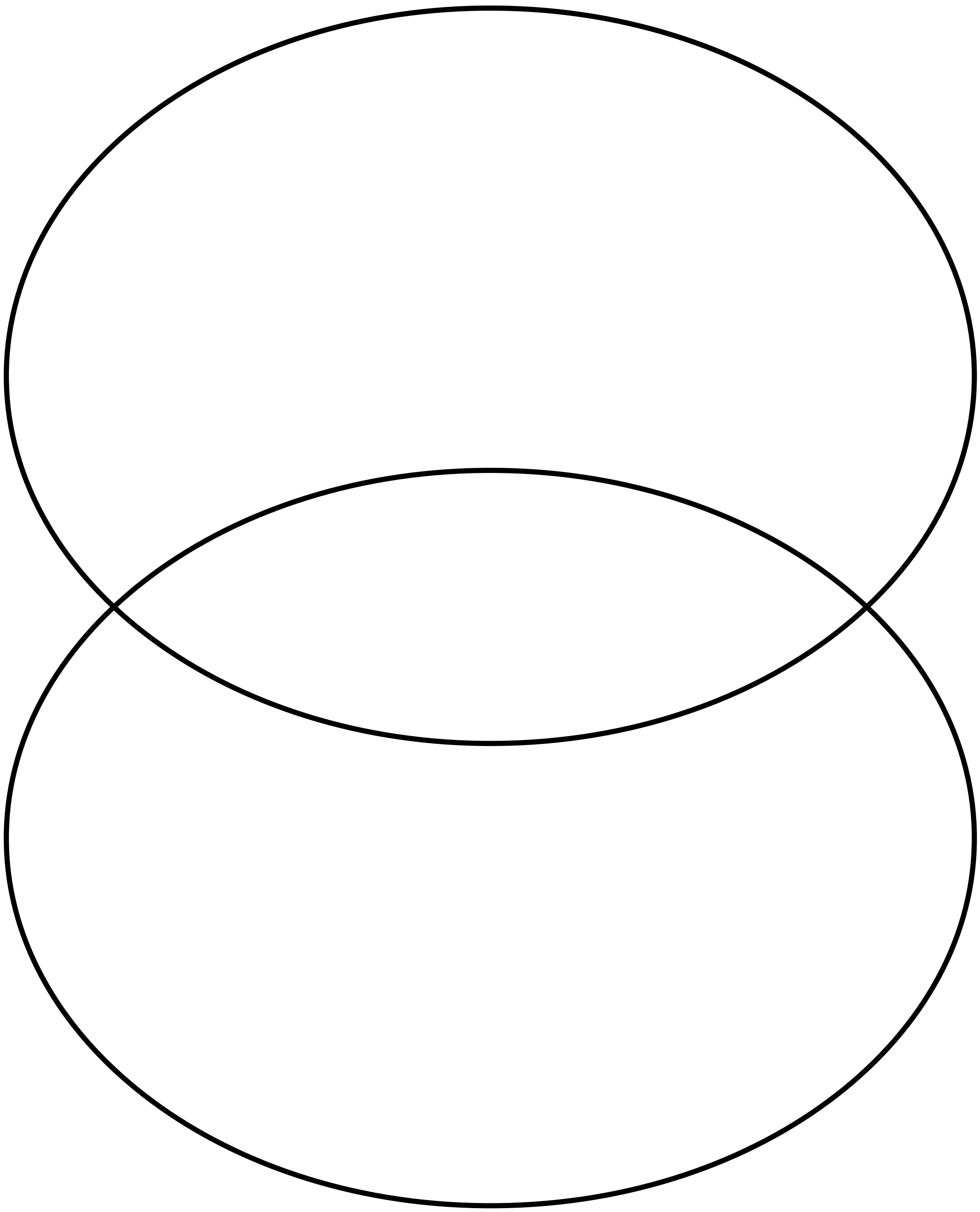
- ☐ Do simulation.
- ☐ Using the Simulation #1 frequency table, record the results.
- ☐ Create a spreadsheet using Excel to represent the results of your simulation.
  Remember to title and label!
- ☐ Create a graphical representation of your choice to represent the results of your simulation.
  Remember to title and label!

Transparency: To Do List

Refer to the Technology Tutorial flip chart as needed.

- ☐ Do simulation.
- ☐ View table of generated data.
- ☐ Record your data in the table on the Group Activity Sheet using the Data Table: Simulation #2.
- ☐ Perform 50 to 100 trials using the multiple trial functions of the calculator.
- ☐ Complete the frequency table Simulation #2 on the Group Activity Sheet.
- ☐ Input data using the list function.
- ☐ Create a line plot of your data using the list and stat plot functions.
- ☐ Create a different graphical representation of your choice.

Transparency: Venn Diagram



Transparency: My Best Graph Questionnaire

1. What type of graphical representation(s) do you think would represent your data in the best way?

   ⬭ Circle Graph ⬭ Histogram ⬭ Bar Graph ⬭ Line Plot

2. Why did you choose the type(s) of graph that you did?

3. Is there more than one graphical representation that will represent the data in a satisfactory way? Why?

4. When would you use one graphical representation over another?

5. What conjectures can you make from the graph that you decided to generate?

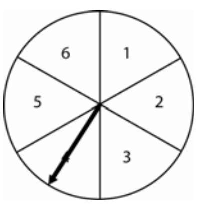
6. How does analyzing other graphical representations of the same data benefit your students?

Activity Master: Simulation Cards Set 1

Cards

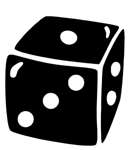
Using a set of cards numbered between 1 and 6 perform twenty draws. Replace the drawn card and reshuffle each time.

Spinner



Using a six section spinner perform twenty spins.

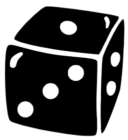
Number Cube



Using a number cube perform twenty rolls.

Activity Master: Simulation Cards Set 2
With APPS Program

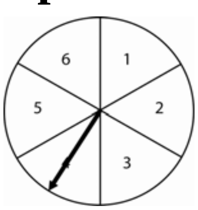
Number Cube



Using a graphing calculator simulate ten rolls of a number cube.

Using the APPS → Prob Sim(probability simulator) menu select the dice simulator.

Spinner

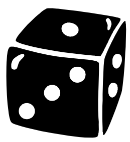


Using a graphing calculator simulate ten spins of a spinner that has six equal sections.

Using the APPS → Prob Sim(probability simulator) menu select the Spin Spinner simulator and set sections to 6.

Activity Master: Simulation Cards Set 2
Without APPS Program

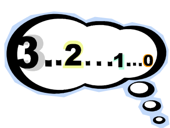
Number Cube



Using a graphing calculator simulate ten rolls of a number cube.

Using the MATH → PRB(probability) menu select the dice simulation generator and perform 10 simulations, by inputting 1 roll and then ENTER ten times.

Number Generator



Using a graphing calculator generate ten random numbers between 1 and 6.

Using the MATH → PRB(probability) menu select the randInt number generator and perform 10 simulations, by inputting (1,6) and then ENTER ten times

Activity Master: Number Generator
(Numbers between 1 and 6)

Supplies:

- Card Stock
- Paper bag
- Scissor

Copy on to card stock, and cut along the dashed lines. Place cards into a paper bag and draw one at a time with replacement.

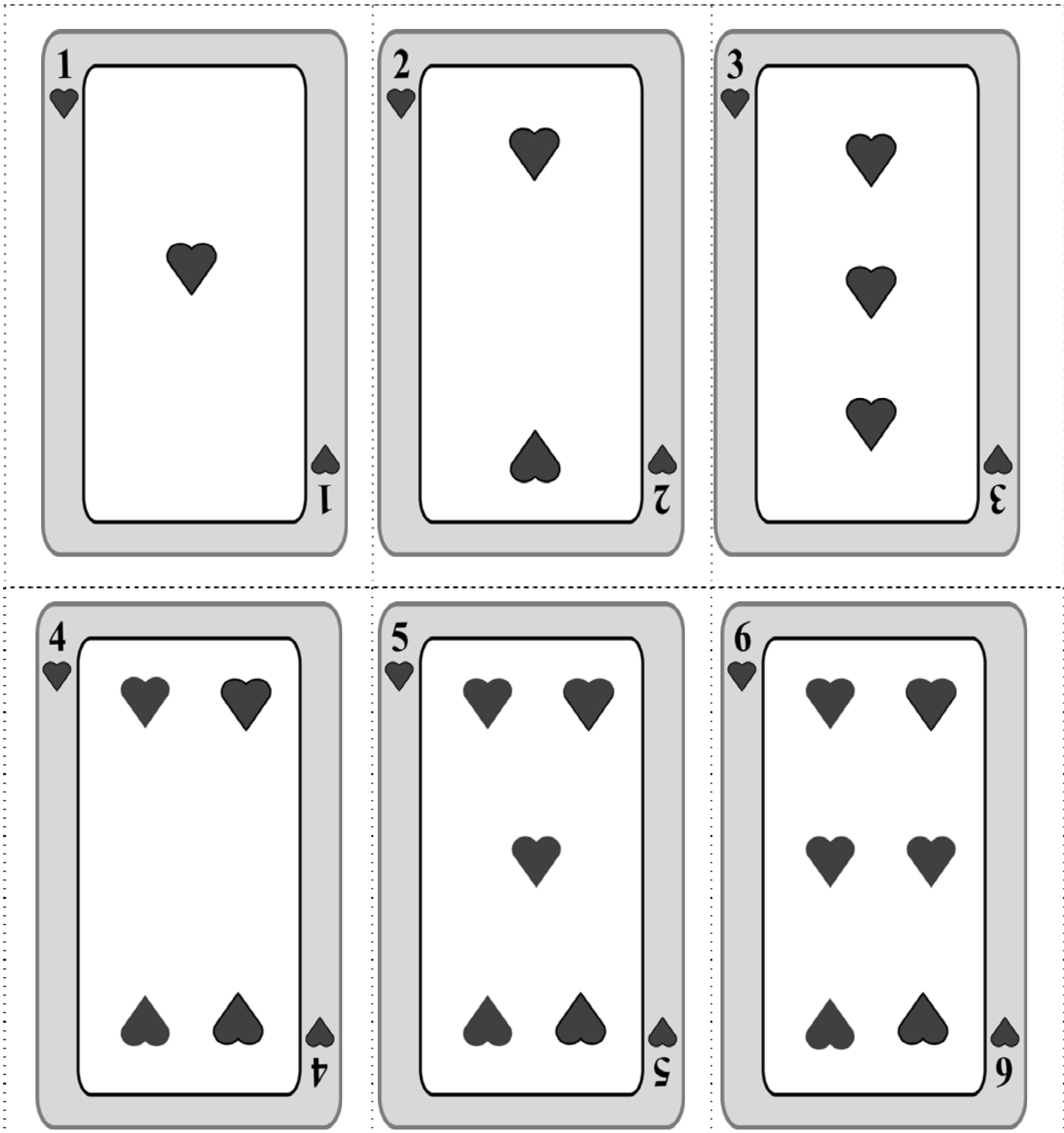
1	2	3
4	5	6

Activity Master: Playing Cards

Supplies:

- Card Stock
- Scissors

Copy on to card stock, and cut along the dashed lines.

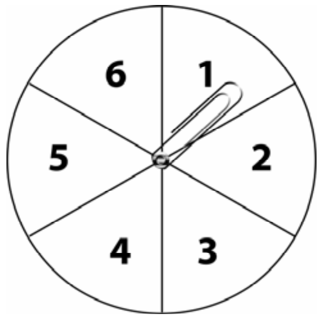


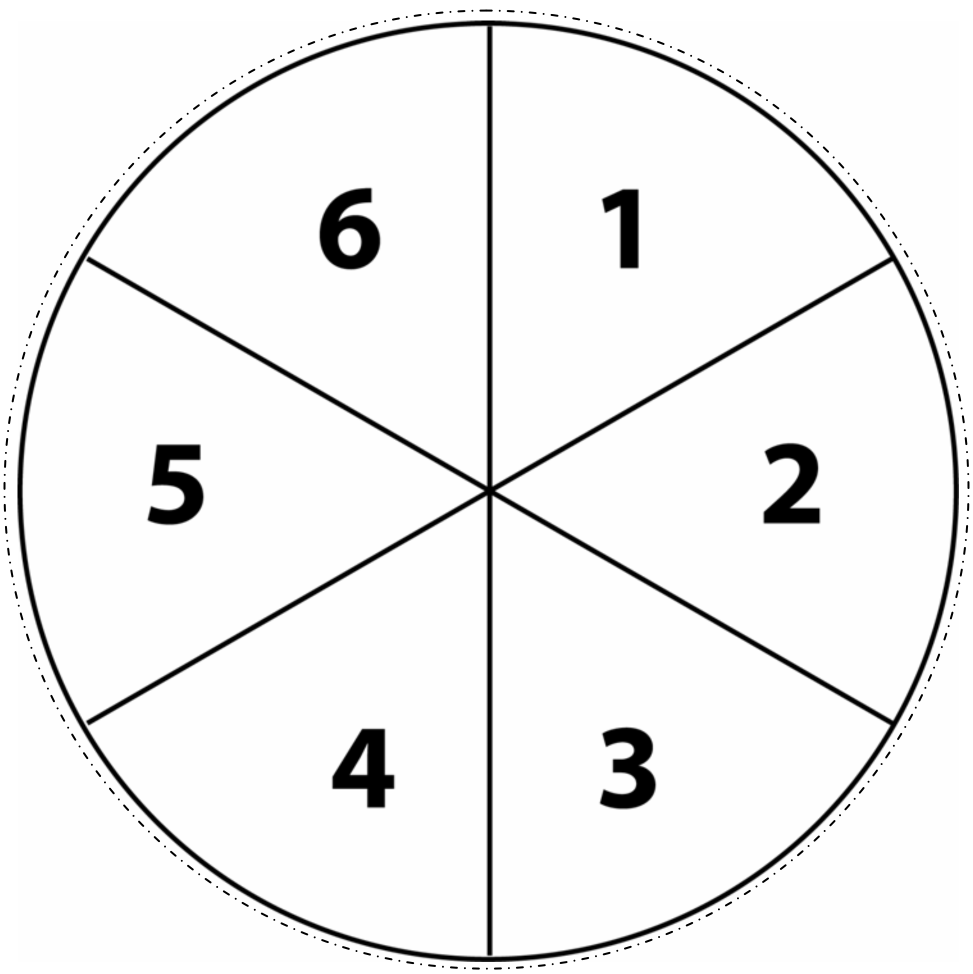
Activity Master: Spinner

Supplies:

- Card stock
- Brad
- Paper clip

Copy spinner on to card stock, and cut along the dashed line. Hole punch the center of the spinner and place a brad with an attached paper clip as illustrated below:





Participant Page: Group Activity Sheet

Simulation #1

Outcomes	Tally	Frequency
1		
2		
3		
4		
5		
6		

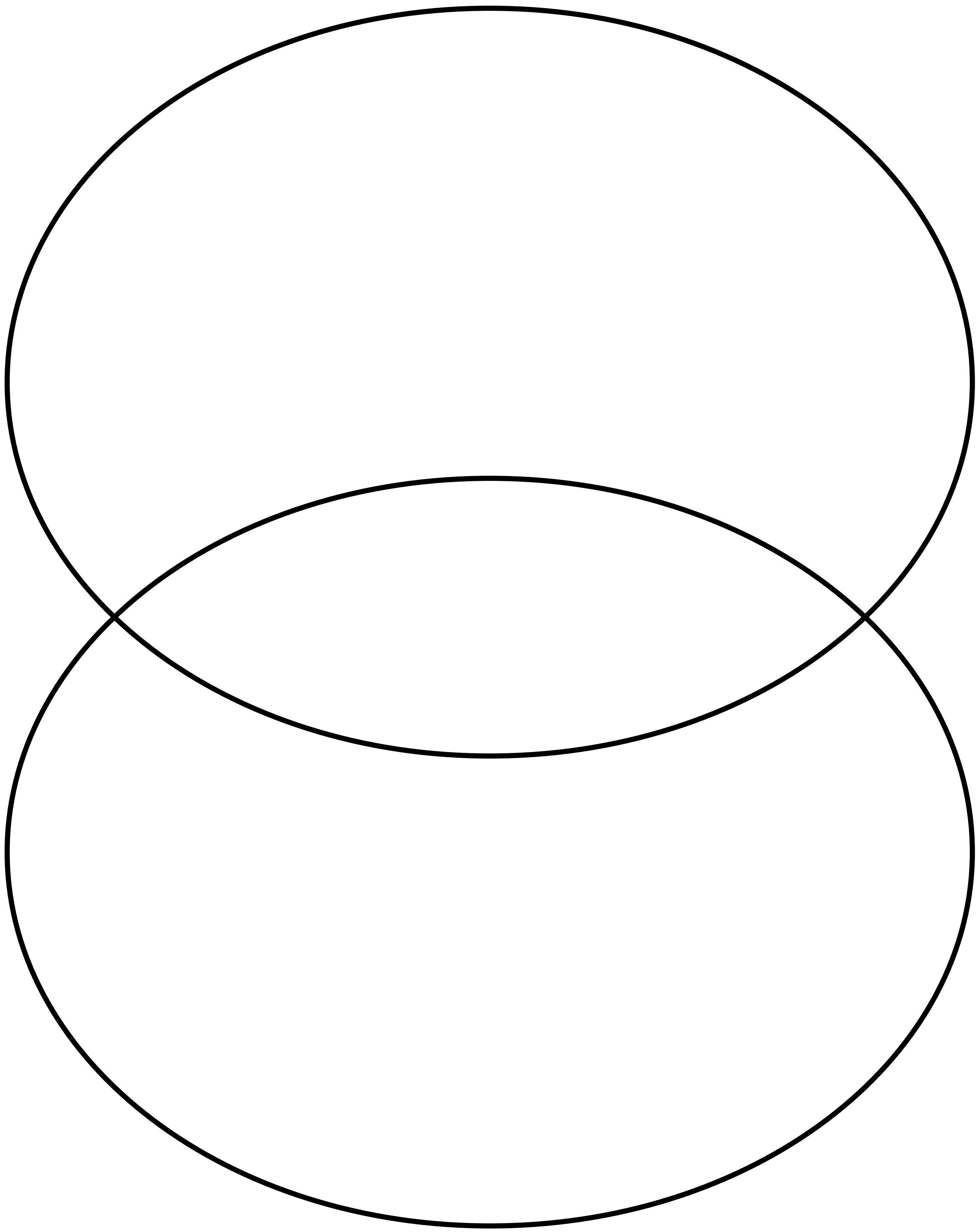
Data Table: Simulation #2

Participant's Name	Data List
#1:	
#2:	
#3:	
#4:	

Simulation #2

Outcomes	Tally	Experimental Outcomes	Theoretical Outcomes
1			
2			
3			
4			
5			
6			

Participant Page: Venn Diagram



Participant Page: My Best Graph Questionnaire

1. What type of graphical representation(s) do you think would represent your data in the best way?

○ Circle Graph ○ Histogram ○ Bar Graph ○ Line Plot

2. Why did you choose the type(s) of graph that you did? (Give details for each choice.)

3. Is there more than one graphical representation that will represent the data in a satisfactory way? Why?

4. When would you use one graphical representation over another?

5. What conjectures can you make from the graph that you decided to generate?

6. How does analyzing other graphical representations of the same data benefit your students?

Explore/Explain 3: Intentional Use of Data

TEKS	Math		
	Tech Apps		
Question(s) to Pose to Students	Math		
	Tech Apps		
Cognitive Rigor		Knowledge	
		Understanding	
		Application	
		Analysis	
		Evaluation	
		Creation	
Data Source(s)		Real-Time	
		Archival	
		Categorical	
		Numerical	
Setting		Computer Lab	
		Mini-Lab	
		One Computer	
		Graphing Calculator	
		Measurement Based Data	
Bridge to the Classroom			

Elaborate: How Much Longer?

Purpose:
Use various technologies to generate and communicate an answer to a question. Compare strengths and weaknesses of different technologies when gathering, representing, and analyzing data. Generate a list of attributes to guide judicious use of technology.

Descriptor:
Participants will collect reaction time data. They will analyze their data using both hand-held technology and spreadsheet technology to determine generalizations about their data sets. Participants will identify the strengths and weaknesses of each technology. These tasks will take place within the structure of the problem-solving model: understand the problem; make a plan; carry out the plan; evaluate the plan and the solution; and extend the problem.

Duration:
2 hours

Mathematics TEKS Objectives:

6.10A	The student uses statistical representations to analyze data. The student is expected to select and use an appropriate representation for presenting and displaying different graphical representations of the same data including line plot, line graph, bar graph, and stem and leaf plot.
6.10B	The student uses statistical representations to analyze data. The student is expected to identify mean (using concrete objects and pictorial models), median, mode, and range of a set of data.
6.10D	The student uses statistical representations to analyze data. The student is expected to solve problems by collecting, organizing, displaying, and interpreting data.
7.11A	The student understands that the way a set of data is displayed influences its interpretation. The student is expected to select and use an appropriate representation for presenting and displaying relationships among collected data, including line plot, line graph, bar graph, stem and leaf plot, circle graph, and Venn diagrams, and justify the selection.
7.11B	The student understands that the way a set of data is displayed influences its interpretation. The student is expected to make inferences and convincing arguments based on analysis of given or collected data.
7.12A	The student uses measures of central tendency and range to describe a set of data. The student is expected to describe a set of data using mean, median, mode, and range.
7.12B	The student uses measures of central tendency and range to describe a set of data. The student is expected to choose among mean, median, mode, or range to describe a set of data and justify the choice for a particular situation.
8.12A	The student uses statistical procedures to describe data. The student is expected to select the appropriate measure of central tendency or range to describe a set of data and justify the choice for a particular situation.

8.12B Draw conclusion and make predictions by analyzing trends in scatterplots.

8.12C The student uses statistical procedures to describe data. The student is expected to select and use an appropriate representation for presenting and displaying relationships among collected data, including line plots, line graphs, stem and leaf plots, circle graphs, bar graphs, box and whisker plots, histograms, and Venn diagrams, with and without the use of technology.

6.11A, 7.13A, 8.14A The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to identify and apply mathematics to everyday experiences, to activities in and outside of school, with other disciplines, and with other mathematical topics.

6.11B, 7.13B, 8.14B The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to use a problem-solving model that incorporates understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness.

6.11C, 7.13C, 8.14C The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to select or develop an appropriate problem-solving strategy from a variety of different types, including drawing a picture, looking for a pattern, systematic guessing and checking, acting it out, making a table, working a simpler problem, or working backwards to solve a problem.

6.11D, 7.13D, 8.14D The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to select tools such as real objects, manipulatives, paper/pencil, and technology or techniques such as mental math, estimation, and number sense to solve problems.

6.12A, 7.14A, 8.15A The student communicates about Grade 6/7/8 mathematics through informal and mathematical language, representations, and models. The student is expected to communicate mathematical ideas using language, efficient tools, appropriate units, and graphical, numerical, physical, or algebraic mathematical models.

6.12B, 7.14B, 8.15B The student communicates about Grade 6/7/8 mathematics through informal and mathematical language, representations, and models. The student is expected to evaluate the effectiveness of different representations to communicate ideas.

6.13A, 7.15A, 8.16A The student uses logical reasoning to make conjectures and verify conclusions. The student is expected to make conjectures from patterns or sets of examples and nonexamples.

6.13B, 7.15B, 8.16B The student uses logical reasoning to make conjectures and verify conclusions. The student is expected to validate his/her conclusions using mathematical properties and relationships.

Technology Applications TEKS Objectives:

(1)(B)	The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to compare, contrast, and appropriately use the various input, processing, output, and primary/secondary storage devices.
(1)(C)	The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency.
(1)(E)	The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to use technology terminology appropriate to the task.
(1)(F)	The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to perform basic software application functions including, but not limited to, opening an application program and creating, modifying, printing, and saving documents.
(3)(D)	The student complies with the laws and examines the issues regarding the use of technology in society. The student is expected to identify the impact of technology applications on society through research, interviews, and personal association.
(3)(E)	The student complies with the laws and examines the issues regarding the use of technology in society. The student is expected to demonstrate knowledge of the relevancy of technology to future careers, life-long learning, and daily living for individuals of all ages.
(5)(A)	The student acquires electronic information in a variety of formats, with appropriate supervision. The student is expected to identify, create, and use files in various formats such as text, bitmapped/vector graphics, image, video, and audio files.
(7)(A)	The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to plan, create, and edit documents created with a word processor using readable fonts, alignment, page setup, tabs, and ruler settings.
(7)(B)	The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to create and edit spreadsheet documents using all data types, formulas and functions, and chart information.
(7)(G)	The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to integrate two or more productivity tools into a document including, but not limited to, tables, charts and graphs, graphics from paint or draw programs, and mail merge.
(7)(H)	The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to use interactive virtual environments, appropriate to level, such as virtual reality or simulations.
(8)(E)	The student uses research skills and electronic communication, with appropriate supervision, to create new knowledge. The student is expected to integrate

acquired technology applications skills, strategies, and use of the word processor, database, spreadsheet, telecommunications, draw, paint, and utility programs into the foundation and enrichment curricula.

(10)(E) The student formats digital information for appropriate and effective communication. The student is expected to match the chart style to data when creating and labeling charts.

TAKS Objectives:

- Objective 5: Probability and Statistics
- Objective 6: Underlying Processes and Mathematical Tools

Technology:

- Internet
- Spreadsheet technology
- Hand-held graphing technology
- Word-processing technology

Materials:

Advanced Preparation: **Transparency: How's Your Timing?**, **Transparency: Data Collection**, **Transparency: Teaching Strategies**, **Transparency 1: Looks Like – Sounds Like**, **Transparency 2: Looks Like – Sounds Like**, **Transparency: Research**

Presenter Materials: Computer with internet access and data projection device or access to a computer lab, graphing calculator with presentation capabilities.

Per group: Computer, masking tape

Per participant: graphing calculator, sentence strips in three different colors, **Rubric for Answering the Question**, **Understanding the Question** activity page, **Making a Plan** activity page, **Carrying Out the Plan and Answering the Question** activity page, **Evaluating the Answer and the Plan** activity plan, **Extending the Question** activity page

Leader Notes:

This activity prompts the participants to use a problem-solving model to generate a plan for collecting data, to collect data, and to determine what statistical measures and what statistical representations may be generated from this data. The participants will represent the data using spreadsheet and hand-held graphing technology. The participants will evaluate each technology tool in light of the solution process used to answer the questions posed at the beginning of the activity.

The leader should attend to the understanding that participants' exhibit with respect to the mathematical and technological goals of the previous phases. The facilitation questions are offered as a means for helping participants articulate their learning and as a means for enhancing participants' learning. Some facilitation questions may be beneficial in a whole group setting. Use those questions that "fill in the blanks" that may be remaining after the Engage, Explore, and Explain phases.

Posing the Problem:

1. **What is elapsed time?**
   Answers may vary. The amount of time that passes between a beginning time and an ending time.

2. **What are real-life applications of elapsed time?**
   Answers may vary. Estimating one minute to get to class when the "run bell" rings, race times, surgical times for scheduling surgeries, instructional time, etc.

3. **What is feedback?**
   Answers may vary. Information returned from the output of effort or a process. This information guides the evaluation and revision of the effectiveness or efficiency of the effort or process.

4. **What are ways that people provide feedback?**
   Answers may vary. The ways by which people provide feedback vary according to the role of the feedback provider. The feedback may be in the form of qualitative statements such as "You seemed at ease when presenting." The feedback may be in the form of quantitative statements such as "You spent 37 minutes on an activity designed to take 15 minutes."

5. **What are ways that coaches provide feedback?**
   Answers may vary. Coaches make use of qualitative and quantitative data.

6. *Use the **Transparency: How's Your Timing?** to pose the problem for the elaborate phase of this professional development session.*

Part 1: Understanding the Problem (5-10 min)

This part of the Elaborate phase is designed for paired and whole-group discussion. Listen to the participants' responses to assess the learning that is taking place as a result of the Explore/Explain phases.

1. *Distribute the **Understanding the Question** activity page to each participant.*

2. *Prompt participants to brainstorm responses to the questions and then share responses with another participant.*

3. *Debrief questions 4 and 5 on the **Understanding the Question** activity page as a whole group. If the presenter assesses the participants' understandings as lacking, the presenter may choose to review each of the questions posed on the **Understanding the Question** activity page.*

Understanding the Question Activity Page

1. Have you answered a question or conducted an investigation similar to this one before? If yes, what was the problem or investigation? How did you answer the question?
   Answers may vary. A sample response: We have done estimating activities in class that require us to estimate the length of a piece of string. We were asked to determine which pieces of string were longer than 0.5 meter. We answered the question by predicting a length and then measuring the piece of string to determine the actual length. Knowing the actual measurement was similar to feedback. I became a better estimator after predicting and measuring.

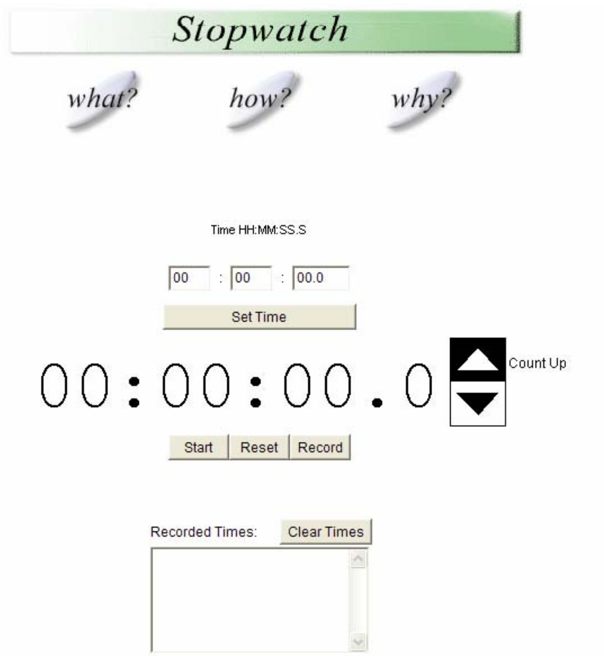
2. How might you restate the question?
   Answers may vary. A sample response: Does feedback improve my ability to estimate lengths of time?

3. What is the unknown you are investigating?
   Answers may vary. A sample response: We are investigating the unknown effect of feedback.

4. What data might you gather to answer the question: When estimating elapsed time, does feedback help you become a better estimator? Why might this data be appropriate?
   Answers may vary. A sample response: The participant's estimated times with and without feedback.

5. What data collection tools are available to help answer this question?
   Answers may vary. Sample responses include stopwatches and on-line stopwatch tools.

4. *Use a projection system to demonstrate the on-line stopwatches for the participants. Use the Word document containing links for the elaborate phase. Click on the link for Stopwatch 1. This stopwatch is a java applet.*
http://www.shodor.org/interactivate/activities/stopwatch/index.html.



Stopwatch retrieved November 27, 2005 from
http://www.shodor.org/interactivate/activities/stopwatch/index.html
Click on the start and stop buttons to illustrate how the timer counts up. Click on the record button to show the times recorded in a list.

Click on the link for Stopwatch 2. This stopwatch uses Macromedia Flash technology.
http://www.shodor.org/interactivate/activities/stopwatch/indexflash.html

Stopwatch retrieved November 27, 2005 from
http://www.shodor.org/interactivate/activities/stopwatch/indexflash.html
Click on the Play and Pause buttons to illustrate how the timer counts up. Click on the record button to show the times recorded in a list.

Part 2: Making a Plan (15-20 min)

This part of the Elaborate phase is designed for paired and whole-group discussion. Listen to the participants' responses to assess the learning that is taking place as a result of the Explore/Explain phases.

1. *Distribute the* ***Rubric for Answering the Question*** *activity page and the* ***Making a Plan*** *activity page to each participant.*

2. *Display the* ***Transparency: Data Collection*** *so that it is visible to all participants.*

3. *Prompt the participants to brainstorm responses to the questions posed on the* ***Making a Plan*** *activity page while considering the information found on the* ***Rubric for Answering the Question*** *and the* ***Transparency: Data Collection****. Remind the participants that they will use the spreadsheet and a graphing calculator to organize, represent, and analyze data.*

4. *Prompt participants to share responses with another participant.*

Facilitation Questions

- Have you made a prediction or formulated a testable hypothesis? What is your prediction or hypothesis?
  Answers may vary. A sample response: Feedback will impact one's ability to estimate times greater than 5 seconds.
- What process will lead to reliable data?
  Answers may vary. A sample response: One group member will be the one to push the start and stop buttons on the stopwatch for each data collection process. One group member will ensure that we are consistent in our steps as we gather data. A larger data sample will provide better results.
- What materials might help you answer this question?
  Answers may vary. A sample response: An accurate stopwatch, a spreadsheet to organize and represent data, a word-processing document to summarize findings and to justify the answer.
- How might you organize your data?
  Answers may vary. A sample response: A table with two columns: The data without feedback next to the column containing data with feedback.
- How might measures of central tendency answer this question?
  Answers may vary. The effect of feedback may be evaluated based on averages of each data sample.
- How might a bar graph answer this question?
  Answers may vary. For each attempt, one may compare the time with feedback and without feedback with side-by-side bars. One may look for trends in the bars according to order of attempts.

Facilitation Questions

- How might a scatterplot answer this question?
  Answers may vary. One may plot attempts (first, second, third, etc. attempts) without feedback against attempts (first, second, third, etc. attempts) with feedback. One may graph the lines showing $x = 1$ and $y = 1$ to represent exact estimates of one second.
- How might a circle graph be answer this question?
  Answers may vary. One may graph comparisons between the number of estimates that are less than the given time, equal to the given time, and greater than the given time. One may create two graphs: one to represent the data without feedback and one to represent the data with feedback.

5. *Prompt participants to open the **Making a Plan** document to record answers that describe the plan resulting from their collaborative conversations.*

Making a Plan Activity Page

1. How might you gather data?
   Answers may vary. A sample response: A participant will say "start" and then "stop" when estimating one second. Repeat this process 15 times. The participant will then repeat this process again; however, this time the data recorder will say "over one second," "exactly one second," or "less than one second." The participant will repeat this process again with the data recorder stating the measured elapsed time. Repeat these three steps for estimating five seconds and then ten seconds.

2. What statistical concepts might you address after collecting data related to estimating elapsed time?
   Answers may vary. If we gather more than one data point, we can determine measures of central tendency as well as the range of the data. We can examine our data in tabular and graphical form to determine trends in the data.

3. How might you use spreadsheet software to organize, represent, and analyze this data?
   Answers may vary. A sample response: Create a table to record the data as the estimates are measured by the stopwatch. Use these data to create bar graphs, circle graphs, and scatterplots. Use the range, median, and mean functions to calculate these values for the data set.

4. How might you use a graphing calculator to organize, represent, and analyze this data?
   Answers may vary: A sample response: Record the estimates measured by the stopwatch in lists. Use these data to create bar graphs, circle graphs, and scatterplots. Use the range, median, and mean functions to calculate these values for the data set.

5. How might you create a summary document that explains and justifies our answer to the question?
   Answers may vary. Sample responses: Enter text boxes onto the spreadsheet document where the data are stored to describe how the tables of data and graphical representations help to answer the question. Cut and paste the data and graphs into a word-processing document. Make screen shots of the graphing calculator screens and import these into a word-processing document.

6. After discussing your plan with another participant, use a word processor to open the **Making a Plan** document. Record your plan on this document. As you work, save this file.

Part 3: Carrying Out the Plan (40 min)

This part of the Elaborate phase is designed for paired and whole-group discussion. Listen to the participants' responses to assess the learning that is taking place as a result of the Explore/Explain phases.

1. *Distribute the **Carrying Out the Plan** activity page to each participant.*

2. *Prompt the participants to gather the data described on the **Transparency: Data Collection** according to the plan that they developed.*

Facilitation Questions

- What activity might we see as we collect this data?
  Answers may vary. One person is estimating the time. One person is operating the stopwatch. One person is entering the data into the graphing calculator.
- What might we hear as we collect this data?
  Answers may vary. We will hear people saying "Start." And "Stop." We will hear people announcing elapsed time.

3. *Prompt the participants to create summary document* ***Answering the Question*** *as described on the* ***Carrying Out the Plan*** *activity page. Techniques for importing information from the spreadsheet and the graphing calculator are included in the technology tutorial.*

Facilitation Questions

- How might knowing the mode of the data assist you in answering the question? Why?
  Answers may vary. If a mode is present, the participant may have prior experience that leads to a consistent estimate of elapsed time.
- How might knowing the median of the data assist you in answering the question? Why?
  Answers may vary. If the median of the data is greater for the data with feedback than for the data without feedback, one might make a statement about the upper half of the collected data being improved by feedback.
- How might knowing the mean of the data assist you in answering the question? Why?
  Answers may vary. If the mean of the data is greater for the data with feedback than for the data without feedback, one might make a statement that feedback improves one's ability to estimate time.
- How might knowing the range of the data assist you in answering the question? Why?
  Answers may vary.
- How might a line plot assist you in answering the question? Why?
  Answers may vary. The line plot provides a sketch of the shape and the spread of the data. Comparing the line plots of data with and without feedback would let one evaluate the impact of feedback on the shape and the spread of data, provided that the participants used the same scales for both plots.
- How might a line graph assist you in answering the question? Why?
  Answers may vary. The line graph does not reveal much as the data are not continuous.
- How might a bar graph assist you in answering the question? Why?
  Answers may vary. One might graph each estimate separately by placing the first estimate without feedback next to the first estimate with feedback. This would allow one to explore if the "position" of the estimate impacts the estimate.
- How might a stem and leaf plot assist you in answering the question? Why?
  Answers may vary. The stem and leaf plot may be used to quickly organize the data.

Facilitation Questions

- How might a box and whisker plot assist you in answering the question? Why?
  Answers may vary. A box and whisker plot provides a pictorial representation of the spread of the data and the ranges of the data above and below the median.
- How might a circle graph assist you in answering the question? Why?
  Answers may vary. A circle graph might allow one to explore the relationships within the set of estimates. For example, graph three sections: times less than one second, times equal to one seconds, and times greater than one second.
- How might a scatterplot assist you in answering the question?
  Answers may vary.
- How does your graphical representation show the shape and the spread of the data?
  Answers may vary.
- What is the meaning of point (x, y) on your scatterplot?
  Answers may vary.
- How might drawing $x = 1$ and $y = 1$ on your scatterplot assist you in answering the question?
  Answers may vary. If one creates a scatterplot where the estimated times without feedback are represented by the x-axis and the estimated times with feedback are represented by the y-axis, one might gauge whether one is overestimating or underestimating following feedback based on how the data cluster about the lines.
- How might drawing $x = 5$ and $y = 5$ on your scatterplot assist you in answering the question?
  Answers may vary. If one creates a scatterplot where the estimated times without feedback are represented by the x-axis and the estimated times with feedback are represented by the y-axis, one might gauge whether one is overestimating or underestimating five seconds of elapsed time following feedback based on how the data cluster about the lines.
- How might drawing $x = 10$ and $y = 10$ on your scatterplot assist you in answering the question?
  Answers may vary. If one creates a scatterplot where the estimated times without feedback are represented by the x-axis and the estimated times with feedback are represented by the y-axis, one might gauge whether one is overestimating or underestimating five seconds of elapsed time following feedback based on how the data cluster about the lines.
- How might graphing all of your data in one chart assist you in answering the question?
  Answers may vary. It allows one to see all the data at one time to see if the effect of feedback is consistent for all the estimated times.

Sample ***Answering the Question*** *document:*

We are to address two questions:
Does feedback on estimating elapsed time help you become a better estimator of elapsed time?
How does technology assist you in answering this question?

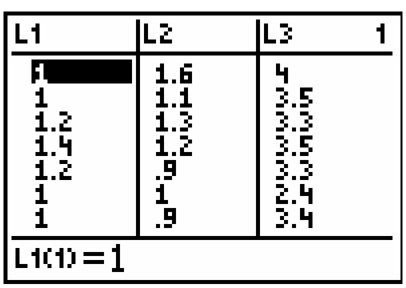
As times were recorded by the stopwatch, a group member entered the time into the spreadsheet. Another group member entered the data into lists on the graphing calculator. We chose to use both tools so as to compare their use in answering the questions.

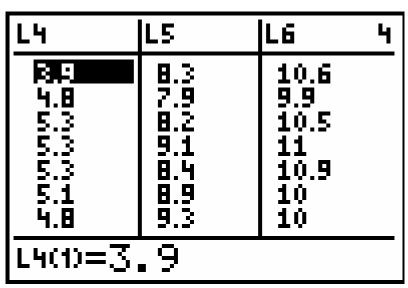
We organized our data in the spreadsheet as shown below.

1 second without	*1 second with*	*5 seconds without*	*5 seconds with*	*10 seconds without*	*10 seconds with*
1.0	*1.6*	*4.0*	*3.9*	*8.3*	*10.6*
1.0	*1.1*	*3.5*	*4.8*	*7.9*	*9.9*
1.2	*1.3*	*3.3*	*5.3*	*8.2*	*10.5*
1.4	*1.2*	*3.5*	*5.3*	*9.1*	*11.0*
1.2	*0.9*	*3.3*	*5.3*	*8.4*	*10.9*
1.0	*1.0*	*2.4*	*5.1*	*8.9*	*10.0*
1.0	*0.9*	*3.4*	*4.8*	*9.3*	*10.0*
0.9	*0.9*	*3.7*	*5.2*	*9.4*	*10.0*

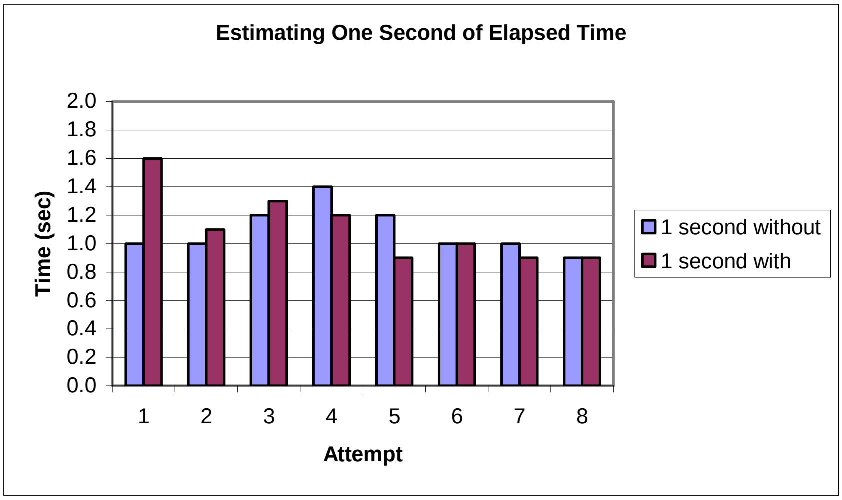
We organized our data in the graphing calculator as shown below.

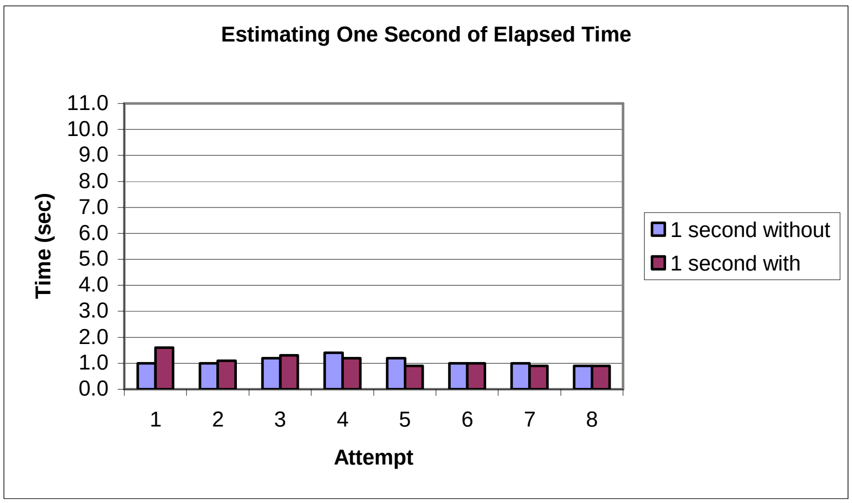
L_1 contains the estimations for 1 second without feedback.
L_2 contains the estimations for 1 second with feedback.
L_3 contains the estimations for 5 seconds without feedback.
L_4 contains the estimations for 5 seconds with feedback.
L_5 contains the estimations for 10 seconds without feedback.
L_6 contains the estimations for 10 seconds with feedback.

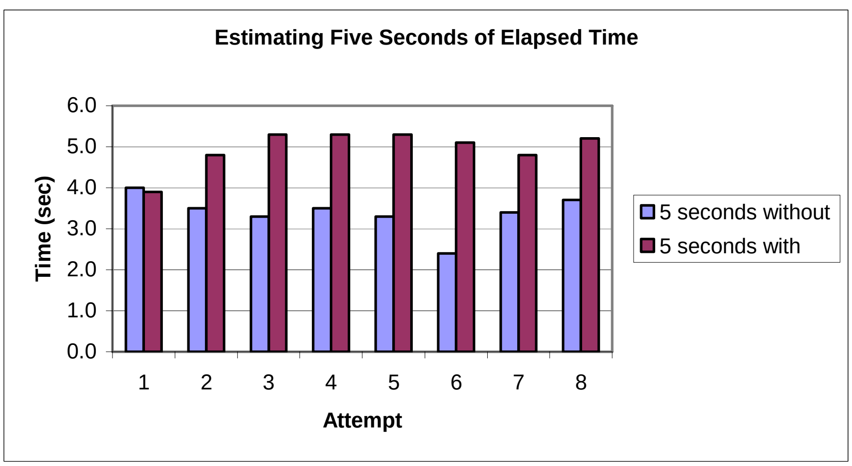


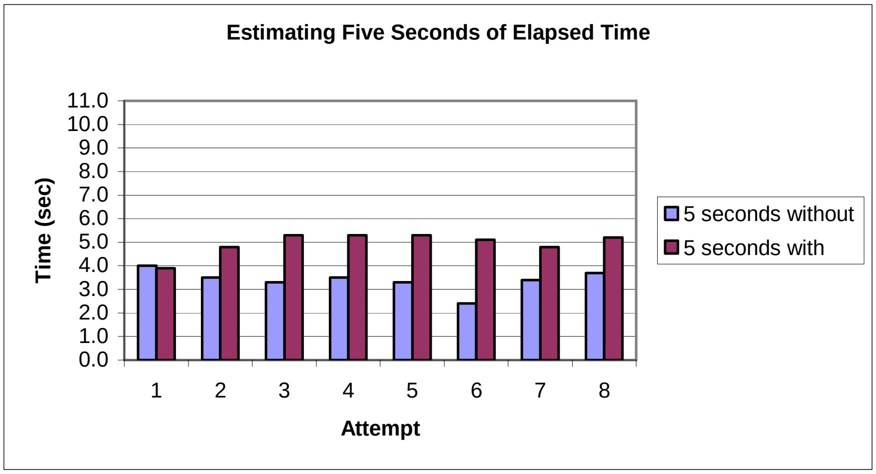


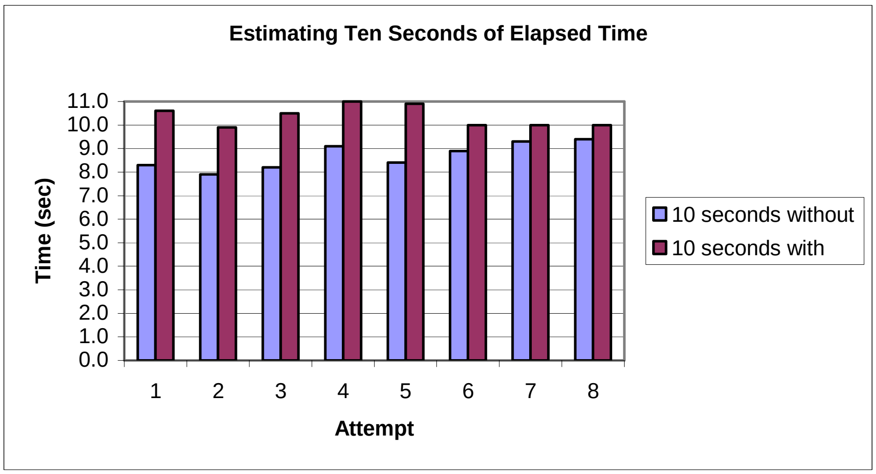
We created several representations using the spreadsheet.
We created bar graphs to compare estimates in the order in which we made the estimates. For example, the first estimate of time without feedback is next to the first estimate of time with feedback. We graphed the data twice: using a scale that is "friendly" to the data being recorded and using 10 seconds so that we can visually compare the data with the other two trials.


Estimating One Second of Elapsed Time
Time (sec)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1
2
3
4
5
6
7
8
Attempt
1 second without
1 second with

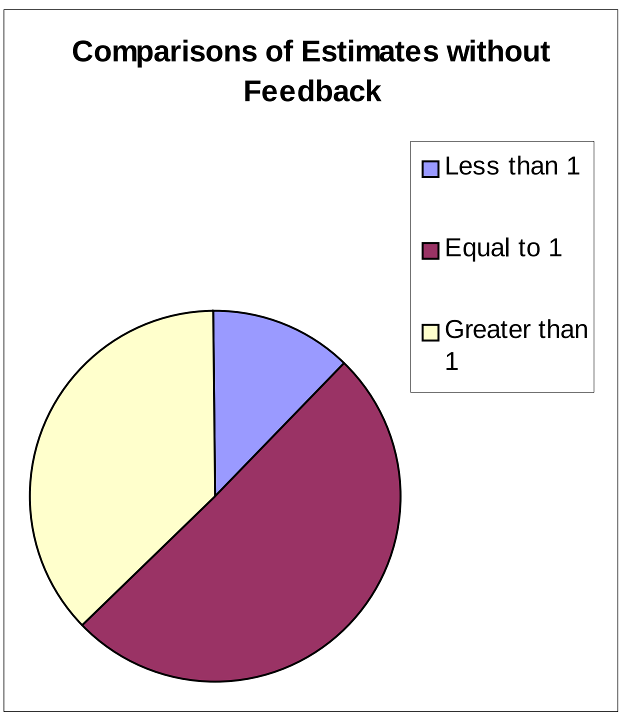

Estimating One Second of Elapsed Time
Time (sec)
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1
2
3
4
5
6
7
8
Attempt
1 second without
1 second with

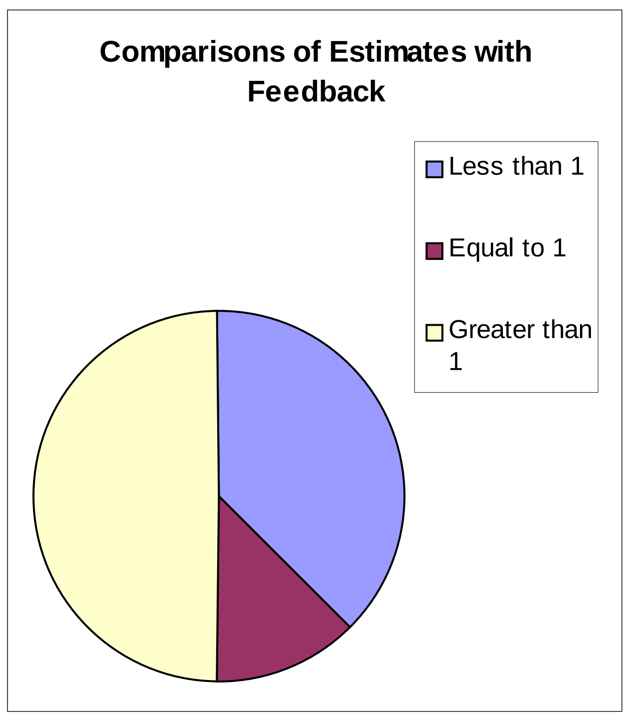

Estimating Five Seconds of Elapsed Time
Time (sec)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1
2
3
4
5
6
7
8
Attempt
5 seconds without
5 seconds with

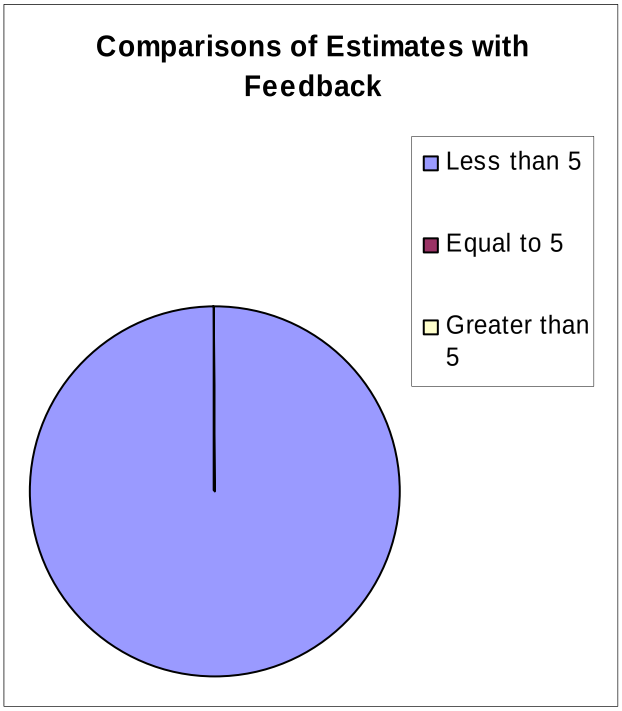


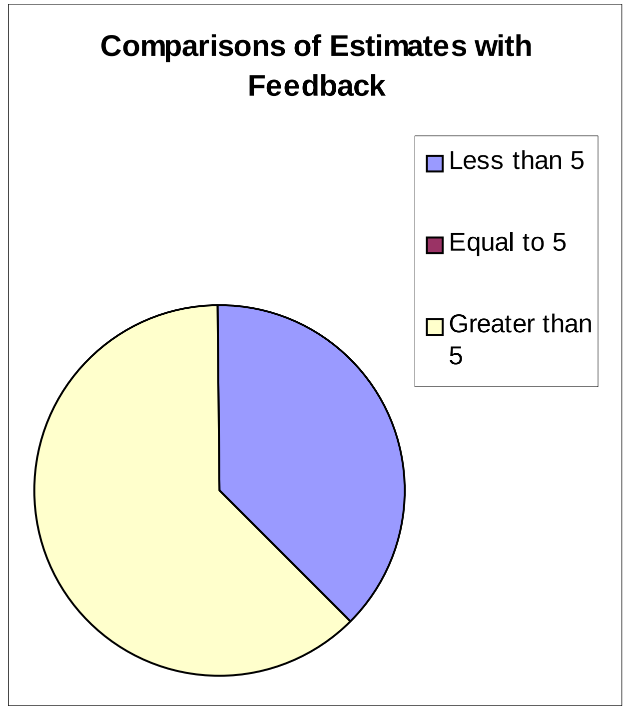


We created circle graphs to make comparisons between those estimated times that were less than, equal to, or greater than one second.



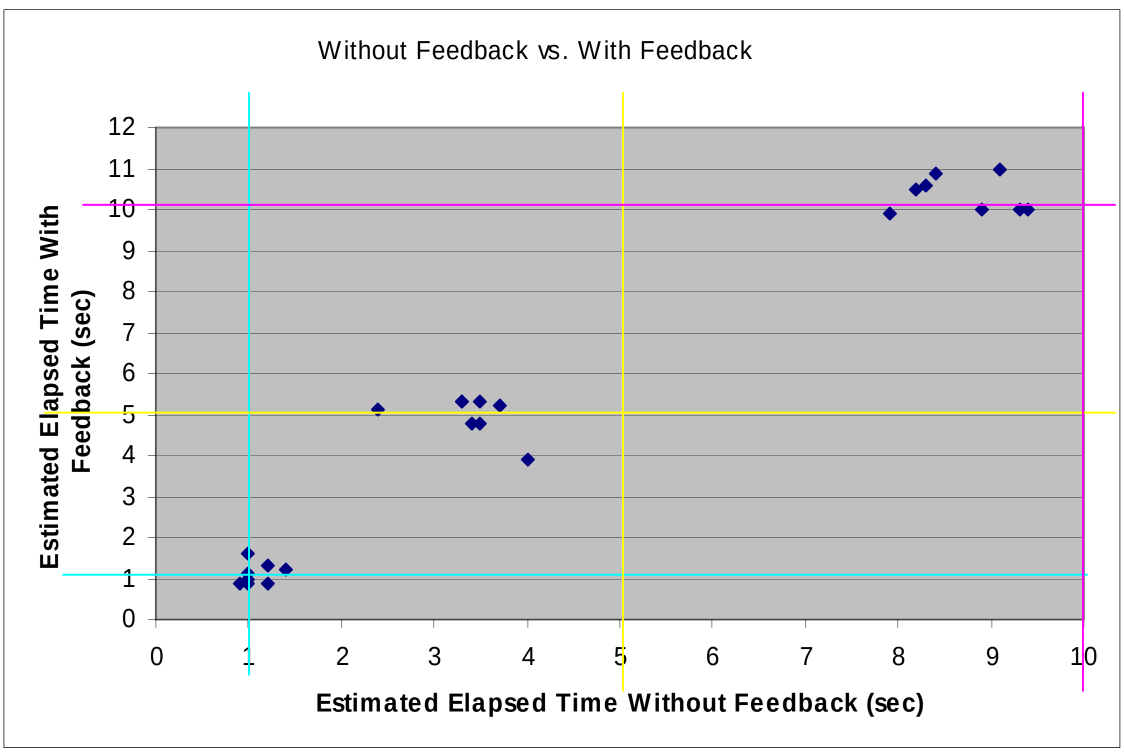






At this point, we decided not to continue with the circle graphs. It was interesting to see how the frequencies within ranges changed, but we did not feel we were gaining representations relevant to answering the questions.

We created a scatterplot including all three sets of data. We used the draw function to draw lines to represent estimates equal to the goal time.

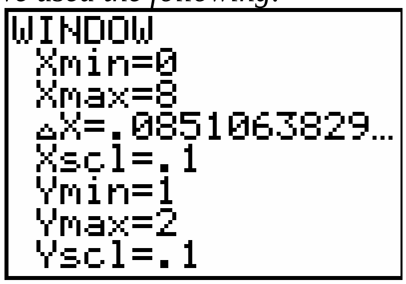


We did all of our representations on the spreadsheet first because they were easily visible to the entire group. Based on this experience, we decided to create bar graphs and scatterplots using the graphing calculator to compare the use of the technologies.
To do this, we had to insert a category list before L1 as shown below as the bar graph plotter requires a list that contains the categories of the data. We also learned that we can only enter up to seven data points in this plotter, so we had to delete our eighth data point to represent the data graphically.

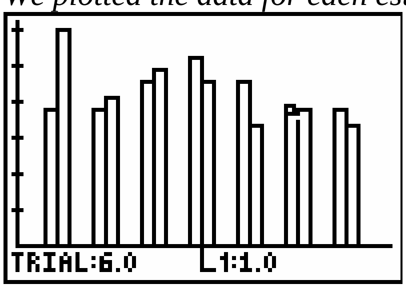
TRIAL	L1	L2
1.0	1.0	1.6
2.0	1.0	1.1
3.0	1.2	1.3
4.0	1.4	1.2
5.0	1.2	.9
6.0	1.0	1.0
7.0	1.0	.9

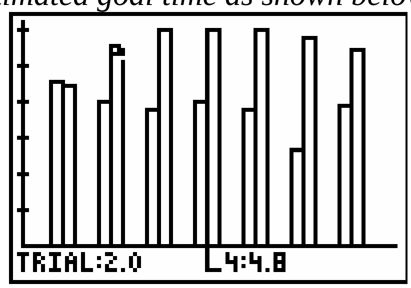
TRIAL(1)=1

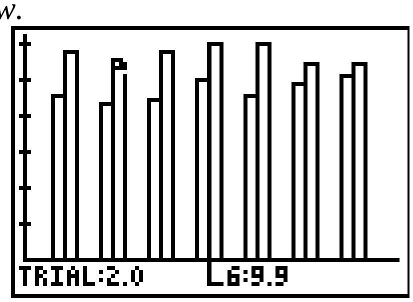
To set up the bar graph plotter, we used the following:



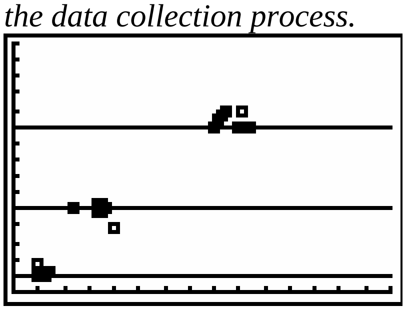
We plotted the data for each estimated goal time as shown below.







We plotted the data of attempts without feedback against with feedback in order of occurrence in the data collection process.



To analyze the data, we determined the mean, the median, and the range of each set of data using the spreadsheet and the graphing calculator. Effective feedback resulted in a smaller range of data. Effective feedback resulted in a mean value and a median value closer to the goal time.

One second:

	Without Feedback (sec)	With Feedback (sec)
Range	0.5	0.7
Median	1.0	1.1
Mean	1.1	1.1

Five seconds:

	Without Feedback (sec)	With Feedback (sec)
Range	1.6	1.4
Median	3.5	5.2
Mean	3.4	5.0

Ten seconds:

	Without Feedback (sec)	With Feedback (sec)
Range	1.5	1.1
Median	8.7	10.3
Mean	8.7	10.4

We cut and pasted the view with formulas to show we used the spreadsheet:

	Without Feedback (sec)	With Feedback (sec)
Range	=MAX(D25:D32)-MINA(D25:D32)	=MAX(E25:E32)-MINA(E25:E32)
Median	=MEDIAN(D25:D32)	=MEDIAN(E25:E32)
Mean	=AVERAGE(D25:D32)	=AVERAGE(E25:E32)

With the graphing calculator:

One second without feedback

```
max(L1)-min(L1)
               .5
median(L1)
              1.0
mean(L1)
              1.1
```

One second with feedback

```
              1.1
max(L2)-min(L2)
               .7
median(L2)
              1.1
mean(L2)
              1.1
```

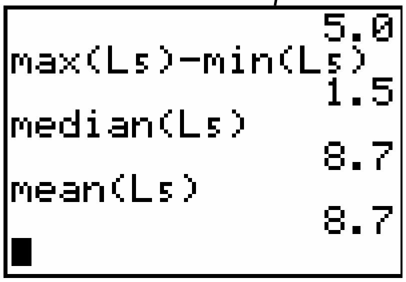
Five seconds without feedback

```
              1.1
max(L3)-min(L3)
              1.6
median(L3)
              3.5
mean(L3)
              3.4
```

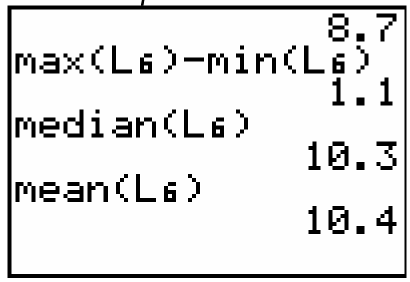
Five seconds with feedback

```
              3.4
max(L4)-min(L4)
              1.4
median(L4)
              5.2
mean(L4)
              5.0
```

Ten seconds without feedback



Ten seconds with feedback



We believe that feedback on estimating elapsed time helps you become a better estimator of elapsed time when estimating times greater than 1 second. The data for 1 second appear similar because they are, with one exception, no more than 0.4 second from 1 second. The data with feedback for 5 seconds and 10 seconds appear to represent more accurate estimates than the data without feedback.

How does technology assist you in answering this question?
One may import the data directly into the spreadsheet. One can write formulas that may be "cut and pasted" to increase efficiency. One may generate scatterplots quickly and efficiently. One can edit an imported chart from a spreadsheet without leaving the word-processing document. The graphing calculator allowed us to do the same activities with the greater efficiency than using paper-and-pencil methods. We had to "fiddle" with the graphing calculator to make it graph the data as we wanted. We like the spreadsheet for graphing because it does not limit the number of data points that we could graph in a bar graph, and it offers the option to provide titles and axes labels. If we didn't have access to a lab, we would like the graphing calculator. Students could sketch or record their screenshots by hand. The recording would be more tedious, but the calculator would support efficiency in graphing and calculation.

Part 4: Evaluating the Answer and the Plan (30 min)

This part of the Elaborate phase is designed for paired and whole-group discussion. Listen to the participants' responses to assess the learning that is taking place as a result of the Explore/Explain phases.

1. *Distribute the* ***Evaluating the Answer and the Plan*** *activity page to each participant.*

2. *Prompt the participants to reflect upon and respond to the questions posed on the* ***Evaluating the Answer and the Plan*** *activity page.*

Facilitation Questions

- What might you have done differently? Why?
  Answers may vary. A sample response: We might have gathered more data in order to draw a more reliable conclusion.
- What other means might you have used to answer the question?
  Answers may vary. A sample response: We might have used handheld stopwatches and recorded our data on paper, looking for numerical patterns. We could have used the graphing tools to represent the data to see how it compared to our numerical observations.
- What other ways might you have analyzed the data?
  Answers may vary. A sample response: We might have determined "how far" from the goal time each estimate was and analyzed that data.

Evaluating the Answer and the Plan Activity Page

1. Is your answer reasonable? Why?
   Answers may vary. A sample response: Our answer would have been more reliable had we gathered more data or collected the data of other groups.

2. Did you alter your plan while carrying it out? Why?
   Answers may vary. A sample response: Yes, we decided not to continue our exploration of the data using circle graphs because the distribution of the data did not tell us what we hoped to learn.

3. What other representations might you have used to communicate your solution to the question?
   Answers may vary. A sample response: We might have used a table that summarized all of our data instead of using separate tables for each data collection.

4. If you did this again, which technology tool(s) would you select to carry out your plan? Why?
   Answers may vary. A sample response: We would use the on-line stopwatch and the spreadsheet. The spreadsheet allowed us to label our graphs.

5. Summarize your responses to these questions in your **Answering the Question** document.
   Answers may vary. A sample response: Our answer would have been more reliable had we gathered more data or collected the data of other groups. We decided not to continue our exploration of the data using circle graphs because the distribution of the data did not tell us what we hoped to learn. We might have used a table that summarized all of our data instead of using separate tables for each data collection. We would use the on-line stopwatch and the spreadsheet. The spreadsheet allowed us to label our graphs.

3. If jump drives are available, prompt participants to save their word processing document to the jump drive. Prompt participants to disconnect the jump drive using the “Safely Remove Hardware” tool on the bottom menu bar and move the jump drive to the presenter computer. Display the documents for comparison purposes.

Facilitation Questions

- How do the summary documents compare?
  Answers may vary. Each participant copied and pasted a chart from the spreadsheet document to the word processing document. Each participant used the average function on the spreadsheet.
- What mathematical understandings does the document communicate?
  Answers may vary. Each participant explained the meaning of the mean of the data.
- What skills with the spreadsheet and the word processor do you need to create the document?
  Answers may vary. Each participant demonstrated how to change the format of data in a cell and how to use these data to generate summary data such as the mean.
- What skills with the graphing calculator do you need to create the document?
  Answers may vary. One needed to be familiar with the mathematical functions available to describe the data found in the lists.

Part 5: Extending the Question (10 min)

This part of the Elaborate phase is designed for paired and whole-group discussion. Listen to the participants' responses to assess the learning that is taking place as a result of the Explore/Explain phases.

1. *If time allows, complete the part of the Elaborate activity. If you are running short on time, continue on to **Part 6: Technology Reflection**.*

2. *Distribute the **Extending the Question** activity page to each participant.*

3. *Prompt the participants to reflect upon and respond to the questions posed on the **Extending the Question** activity page.*

4. *Prompt participants to share their responses in a whole group setting.*

Facilitation Questions
• Who responded similarly? *Answers may vary.* • What about the question prompts similar responses? *Answers may vary.* • Who responded differently? *Answers may vary.* • What about the question prompts different responses? *Answers may vary.*

Extending the Question

1. Based on the data that you have collected, organized, represented, and analyzed, answer the questions:
   a. What do you predict the average time for estimating one minute of elapsed time without feedback will be?
   b. What do you predict the average time for estimating one minute of elapsed time with feedback will be?
   c. How might you test your predictions?
   Answers may vary.

2. How might you connect this question to everyday experiences, investigations in other disciplines, and activities in and outside of school?
   Answers may vary.

3. How might answering this question provide opportunities for communication through informal and formal mathematical language, representations, and models?
   Answers may vary. As we work together, we will use informal language. As we begin to use the spreadsheet, we will need to use the formal terminology to enter formulas where needed.

4. How might answering this question provide opportunities for you to use logical reasoning to make conjectures and verify conclusions?
   Answers may vary. As we gather initial data, we may notice trends that result from their data collection and that their approach impacts those trends. We may adjust our approach by reasoning through the impact of the possible changes.

5. Summarize your responses to these questions in your **Answering the Question** document.
   Answers may vary. As we work together, we will use informal language. As we begin to use the spreadsheet, we will need to use the formal terminology to enter formulas where needed. As we gather initial data, we may notice trends that result from our approach to data collection impacts the trends that result from the data collection. We may adjust our approach by reasoning through the impact of the possible changes.

Part 6: Technology Reflection (30 min)

1. *Upon completing the use of these two technology tools, prompt participants to work in pairs to brainstorm the role(s) technology played in the process of gathering, representing, and analyzing data. How does this compare to using paper-and-pencil only for this activity?*

2. *Repost the Venn diagram summaries from the Engage phase.*

3. *Prompt participants to collect the "green sheets" from each Explore/Explain phase, the summaries about the intentional use of data that followed each Explore/Explain phase.*

4. *Display the **Transparency: Teaching Strategies** and prompt participants to reflect on the following question, "How do the summaries on the Venn diagrams, our summaries about the use of data, and the activities reflect the following four teaching strategies for developing judicious users of technology?"*

Facilitation Questions

- How have the experiences in this professional development promoted careful decision-making about the appropriate use of technology?
  Answers may vary.
  E/E 1: When the participants generated data that would cause specified changes in the box-and-whisker plot.
  E/E 2: When selecting a graphical representation.
  E/E 3: When the participants compared and contrasted the use of technology-free and technology-based probability simulations.
  Elaborate: The graphing calculator was limited in its ability to graph data using a bar graph, so the participants chose to rely more on the spreadsheets graphing functions.
- How was technology integrated into the teaching and the learning of the TEKS?
  Answers may vary.
  E/E 1: The web tools for stem and leaf plots were used to help students generate the processes for creating stem and leaf plots.
  E/E 2: The technology allowed participants to organize, represent, and describe data.
  E/E 3: The participants explored theoretical and experimental probability using a probability application on the graphing calculator.
  Elaborate: Using technology, the participants determined two measures of central tendencies so that conjectures about the effect of feedback could be verified.

Facilitation Questions

- When was technology use promoted? Why?
  Answers may vary.
  E/E 1: When representing the data so that representations would be accurate
  E/E 2: When testing conjectures about data sets that would produce certain distributions.
  E/E 3: When the participants were asked to compare and contrast the use of technology-free and technology-based probability simulations to promote critical thinking about tools.
  Elaborate: The rubric encouraged the use of word-processors, spreadsheets and graphing calculators during the entire process of answering the question so that technology would be perceived as an integral tool for the activity.
- When was technology use restricted? Why?
  Answers may vary.
  E/E 1: When generating physical models of the distribution of the data so that participants would focus on the conceptual modeling
  E/E 2: When working "by hand" to provide a comparison to "with technology"
  E/E 3: When the participants were asked to compare and contrast the use of technology-free and technology-based probability simulations to promote critical thinking about tools.
  Elaborate: When the participants were seeking to understand the question so that they would focus on the question rather than on how to answer the question.
- How did the technology support anticipatory, or "what if…", thinking about "statistical insight"?
  Answers may vary.
  E/E 1: When the participants made conjectures about data that would cause specified changes in the box-and-whisker plot and tested their conjectures.
  E/E 2: When the participants made conjectures about potential data sets and tested their conjectures.
  E/E 3: The participants were able to generate more trials using technology to address conjectures about experimental probability.
  Elaborate: Participants made conjectures about which statistical measures to use. The technology allowed them to quickly determine these measures for evaluative purposes.

5. *Prompt the participants to respond to the following statement and question: "A successful teacher is one who uses technology judiciously. What does this ideal teacher look like and sound like?" as described on* ***Transparency 1: Looks Like – Sounds Like****. Have the participants record their responses on sentence strips. Post the sentence strips randomly so that they are visible to the entire group. Use participants as scribes as needed to facilitate the recording process.*

6. *Prompt the participants to respond to the following statement and question: "A successful student is one who uses technology judiciously. What does this ideal student look like and sound like?" as described on* ***Transparency 2: Looks Like – Sounds Like****. Have the participants record their responses on sentence strips. Post the sentence strips randomly so that they are visible to the entire group. Use participants as scribes as needed to facilitate the recording process.*

7. *Direct the participants to work in small groups to brainstorm categories for classifying the "looks like" and "sounds like" responses.*

Facilitation Questions

- Do any of these responses require the teacher or the student to make decisions about technology use? Is this important? Should we add some responses?
  Answers may vary.
- Do any of these responses reflect decision making about how best to integrate technology? Is this important? Should we add some responses?
  Answers may vary.
- Do any of these responses reflect decision making about when to use or when not to use technology? Is this important? Should we add some responses?
  Answers may vary.
- Do any of these responses reflect the need for thinking about how the technology provides "statistical insight"? Is this important? Should we add some responses?
  Answers may vary.

8. *As a whole group, debrief the categories created within the small group discussions. Reorganize the sentence strips into broad categories. As a whole group, create titles for each of these categories. Record each title on a separate sheet of chart paper. Post the chart paper and reorganize the related sentence strips as shown below. Enlist participants to help with this process.*

Sample Category:
Student Choice

The teacher allows students to select the computer or the graphing calculator and refrains from commenting while students decide.

The student chooses to use a scatterplot instead of a table to represent her data.

9. *Prompt the participants to consider adding additional statements to any of the categories listed above that are not already posted. Reorganize "looks like, sounds like" sentence strips as needed.*

10. *Distribute sentence strips to each group that are a different color than the previously used sentence strips. Prompt each group to generate two classroom suggestions for each category. Examples may include "The teacher should ask, 'Should we use the spreadsheet to make our prediction or verify our prediction? Why?'", "Students monitor their own use and misuse of technology.", "Include examples that require technology use.", "Do not allow students to use technology until after predictions are made and justified", etc.*

11. *Prompt participants to post their sentence strips as shown below.*

Sample Category: Student Choice

The teacher allows students to select the computer or the graphing calculator and refrains from commenting while students decide.

The teacher posts a transparency that says, "Which tool will you use? Go there!"

The teacher provides students with a "pros and cons" chart to develop for the computer and the graphing calculator and then directs students to select a tool.

12. *Ask the participants to summarize any trends or patterns observed in the classroom suggestions.*

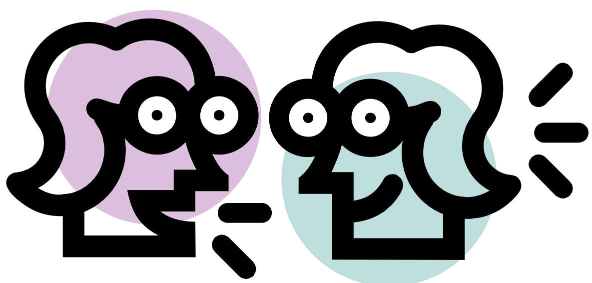
13. *Read the statement by Ball and Stacey found on* ***Transparency: Student Research*** *as a closing thought to this phase of the professional development. Pose the facilitation question to the whole group.*

Facilitation Question

- What is the value of this statement?
  Answers may vary. It is encouraging to read that technology use is teachable. It makes me consider how I might better meet the needs of the student who doesn't struggle with the math yet struggles with the technology.

Transparency: How's Your Timing?

When estimating elapsed time, does feedback help you become a better estimator?



How does technology assist you in answering this question?

Transparency: Data Collection

Collect data about your estimation skills for **one second** of elapsed time without feedback.

Collect data about your estimation skills for **one second** of elapsed time with feedback.

Collect data about your estimation skills for **five seconds** of elapsed time without feedback.

Collect data about your estimation skills for **five seconds** of elapsed time with feedback.

Collect data about your estimation skills for **ten seconds** of elapsed time without feedback.

Collect data about your estimation skills for **ten seconds** of elapsed time with feedback.

Transparency: Teaching Strategies

How do the summaries on the Venn diagrams, our summaries about the use of data, and the activities reflect the following four teaching strategies for developing judicious users of technology?

Judicious users of technology:

a. Promote careful decision-making about the appropriate use of technology.

b. Integrate technology whenever relevant to the mathematical learning goals.

c. Promote and restrict the use of technology when appropriate for promoting mathematical learning

d. Promote anticipatory thinking about "statistical insight."

Transparency 1: Looks Like – Sounds Like

A successful teacher is one who uses technology judiciously.

What does this ideal teacher look like and sound like?

Looks like…	Sounds like…

Transparency 2: Looks Like – Sounds Like

A successful student is one who uses technology judiciously.

What does this ideal student look like and sound like?

Looks like…	Sounds like…

Transparency: Research

Research by Pierce (2002) indicates that some students are always judicious users and others persist with passive or random, unthinking use. However, she found that a large, middle group can be helped to learn to work judiciously.

Ball & Stacey, 2005, p. 5

Ball, L., & Stacey, K. (2005). Teaching strategies for developing judicious technology use. In Masalski, W. J., & Elliott, P. C. (Eds.), *Technology-supported mathematics learning environments, sixty-seventh yearbook*, pp. 3-16. Reston, VA: National Council of Teachers of Mathematics.

Understanding the Question

1. Have you answered a question or conducted an investigation similar to this one before? If yes, what was the problem or investigation? How did you answer the question?

2. How might you restate the question?

3. What is the unknown you are investigating?

4. What data might you gather to answer the question: When estimating elapsed time, does feedback help you become a better estimator? Why might this data be appropriate?

5. What data collection tools are available to help answer this question?

Making a Plan

1. How might you gather data?

2. What statistical concepts might you address after collecting data related to estimating elapsed time?

3. How might you use spreadsheet software to organize, represent, and analyze this data?

4. How might you use a graphing calculator to organize, represent, and analyze this data?

5. How might you create a summary document that explains and justifies our answer to the question?

6. After discussing your plan with another participant, use a word processor to open the **Making a Plan** document. Record your plan on this document. As you work, save this file.

Carrying Out the Plan and Answering the Question

1. Open a new spreadsheet document. Use this document to organize, represent, and analyze the data resulting from your plan. Save this document as **Gathering the Data**.

2. Open a new word-processing document. Use this document to hold imported screen shots from the graphing calculator. Save this file as **Gathering the Data with a Graphing Calculator**.

3. Open another new word-processing document. Use this document to summarize and explain your answer to the questions: *Does feedback on estimating elapsed time help you become a better estimator of elapsed time?* and *How does technology assist you in answering this question?* Save this file as **Answering the Question**.

4. How did you organize your data? Record your organized data in the **Answering the Question** document. Include text explanations of why you organized your data as you did. Use this word-processing document to record how you carried out your plan to answer the question: When estimating elapsed time, does feedback help you become a better estimator?

5. What representations of your data did you create? Record your representations in the **Answering the Question** document. Include text explanations of why you represented your data as you did.

6. What tools did you use to represent the data? Include text explanations of why you selected that tools that you used to represent the data.

7. What analyses of your data did you perform? Record your analyses in the **Answering the Question** document. Include text explanations of how you decided to analyze your data, including justification for the appropriateness of your analysis.

8. Record your answer to the following questions, using imported graphics from spreadsheet software and graphing calculators as needed, to justify your solution.
   Does feedback on estimating elapsed time help you become a better estimator of elapsed time? and *How does technology assist you in answering this question?*

Evaluating the Answer and the Plan

1. Is your answer reasonable? Why?

2. Did you alter your plan while carrying it out? Why?

3. What other representations might you have used to communicate your solution to the question?

4. If you did this again, which technology tool(s) would you select to carry out your plan? Why?

5. Summarize your responses to these questions in your **Answering the Question** document.

Extending the Question

1. Based on the data that you have collected, organized, represented, and analyzed, answer the questions:
    a. What do you predict the average time for estimating one minute of elapsed time without feedback will be?
    b. What do you predict the average time for estimating one minute of elapsed time with feedback will be?
    c. How might you test your predictions?

2. How might you connect this question to everyday experiences, investigations in other disciplines, and activities in and outside of school?

3. How might answering this question provide opportunities for communication through informal and formal mathematical language, representations, and models?

4. How might answering this question provide opportunities for you to use logical reasoning to make conjectures and verify conclusions?

5. Summarize your responses to these questions in your **Answering the Question** document.

Rubric for Answering the Question		Proficient	Developing	Emerging
Making a Plan	Content	Fully addresses the statistical concepts and representations to be found in the data.	Partially addresses the statistical concepts and representations to be found in the data.	Barely addresses the statistical concepts and representations found in the data.
	Technology	Includes strategies to address the spreadsheet and the graphing calculator.	Includes strategies to address the spreadsheet or the graphing calculator.	Includes one strategy to address the spreadsheet or the graphing calculator.
Carrying out the Plan - Spreadsheet	Organize Data	The data are organized and labeled.	The data are organized.	The data are not organized.
	Represent Data	The data are represented in multiple ways and labeled appropriately.	The data are represented in one way and labeled appropriately.	The data are not represented appropriately.
	Analyze Data	The data are analyzed.	The data are partially analyzed.	The data are analyzed inappropriately.
Carrying out the Plan – Graphing Calculator	Organize Data	The data are organized and labeled.	The data are organized.	The data are not organized.
	Represent Data	The data are represented in multiple ways and labeled appropriately.	The data are represented in one way and labeled appropriately.	The data are not represented appropriately.
	Analyze Data	The data are analyzed.	The data are partially analyzed.	The data are analyzed inappropriately.
Answering the Question		The answer to the question includes full justification of the answer.	The answer to the question includes partial justification of the answer.	The answer to the question does not address the question.
Evaluating the Answer and the Plan	Reasonableness	The answer to the question includes full justification of the reasonableness of the answer.	The answer to the question includes partial justification of the reasonableness of the answer.	The answer to the question does not address reasonableness.

Rubric for Answering the Question		Proficient	Developing	Emerging
	Reflection	The summary addresses reflections about the mathematics and the technology used to answer the question.	The summary partially addresses reflections about the mathematics and the technology used to answer the question.	The summary lacks reflections about the mathematics and the technology used to answer the question.
Extending the Question	Mathematics	The prediction is reasonable and fully justified based on the data gathered to answer the original question.	The prediction is reasonable and partially justified based on the data gathered to answer the original question.	The prediction is unreasonable.
	Connections	Connections are made to everyday experiences, investigations in other disciplines, and activities in and outside of school.	Connections are made to everyday experiences, investigations in other disciplines, or activities in and outside of school.	Connections are made to everyday experiences.
	Communication	Informal and formal mathematical language is used to describe how the data has been organized, represented, and analyzed.	Informal mathematical language is used to describe how the data has been organized, represented, and analyzed.	Lacks descriptions of how the data has been organized, represented, and analyzed.
	Reasoning	The conjectures and conclusions are logical.	The conjectures and conclusions are partially logical.	Lacks conjectures and conclusions.

Evaluate: The Who, What, When, Why, Where, and How

Purpose:
Evaluate judicious uses of technology in the mathematics classroom.

Descriptor:
Participants will review the instructional phases of this professional development and the classroom-ready lessons according to the list of attributes generated in the elaborate phase of the professional development. Revisions to the list of attributes may occur. Participants will engage in discussion about how each lesson exhibits a judicious use of technology; i.e., participants will address the question, "How does the use of technology in this student lesson help me teach the concepts and skills more effectively and efficiently?"

Duration:
2 hours

Materials:
Small (1" x 1.5") restickable notes
Chart paper
Markers
Tape to adhere chart paper to the wall

Leader Notes:
The Evaluate phase allows participants to reflect upon their experiences and apply their knowledge to a new situation. The facilitator can deduce from the participants' actions how well they have been able to develop a sense of the judicious use of technology.

1. *Distribute small restickable notes to each participant.*

2. *Assign different phases of this professional development to pairs of participants.*

3. *Prompt each pair of participants to use the restickable notes to highlight locations in each phase of the professional development that make judicious use of technology, according to the criteria on the Transparency: Encouraging Judicious Use of Technology. Participants should use the restickable notes to highlight those attributes of the teaching strategies outlined during the Elaborate Phase of this professional development.*
   Sample responses may include:
   - *Allowing students to enter data into a web-based tool that automatically creates a stem-and-leaf plot allows the students to analyze the organization of data. As students analyze the organization of the data, they develop a list of attributes for a stem-and-leaf plot.*
   - *Asking students to graph on chart paper first encourages students to think about how to set up the graphing calculator to illustrate the graph in its entirety.*

- *Technology use is thoroughly integrated into this phase of the lesson.*
- *Was the graph of the data what we expected? Why?*

4. *After each pair has had time to evaluate the given phase of the professional development, prompt each pair of participants to create a summary of its findings on chart paper.*

5. *Identify a location in the room for each phase of the professional development. Direct participants to post their summaries in the appropriate location.*

6. *Perform a gallery walk through each phase, asking participants to determine which teaching strategies for judicious use of technology seemed to have the greatest impact on the given phase.*

7. *Prompt participants to share any new thoughts to add to the classroom suggestions for each teaching strategy.*

8. *Distribute the classroom-ready lessons to each participant. Prompt each participant to continue the evaluation process for judicious use of technology, using the classroom-ready lessons as the context for evaluation. The participants should use the restickable notes to highlight those parts of each lesson that reflect the four teaching strategies for developing judicious use of technology.*

9. *As time allows, offer small-group and whole-group opportunities for participants to share what participants highlighted.*

10. *Redirect participants' attention to the four statements made at the beginning of the professional development session. Ask the participants if they would "shift" the placement of their sticky dots. If they respond with a "Yes," ask the participants why they would shift the placement of their sticky dots.*

11. *Draw an end to the professional development session with a parting thought rather than a closing thought so that participants leaving thinking "How will I use what I learned?" rather than "That was a good session." Examples of such parting thoughts include:*
    a. *As you leave, please consider ways that you might include the use of data and technology in your classroom next week.*
    b. *As you leave, please consider how you might best make use of the computer or computers available for your classroom use.*
    c. *As you leave, please consider how students might be equipped to ask better questions about what they are learning when they have graphing calculators in their hands.*

Transparency: Encouraging Judicious Use of Technology

- How did the activity promote careful decision making about the use of technology?
- How did the activity integrate technology into the learning of mathematics?
- Was technology use ever restricted for the purpose of enhancing learning? Why?
- How did the technology facilitate discussion about “statistical sense”?

Gallery Walk Observations

Man in the Box Explore/Explain I	How did the activity promote careful decision making about the use of technology? How did the activity integrate technology into the learning of mathematics? Was technology use ever restricted for the purpose of enhancing learning? Why? How did the technology facilitate discussion about “statistical sense”?

Grams of Fat Explore/Explain II	How did the activity promote careful decision making about the use of technology? How did the activity integrate technology into the learning of mathematics? Was technology use ever restricted for the purpose of enhancing learning? Why? How did the technology facilitate discussion about “statistical sense”?

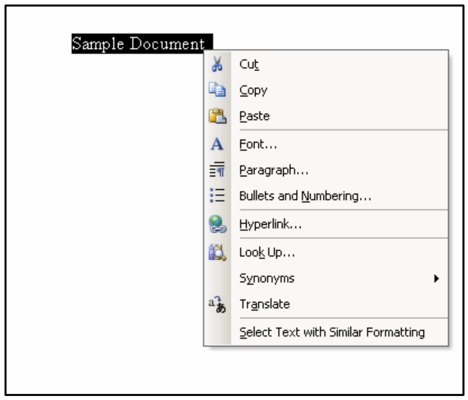
Trials! Trials! Trials! Explore/Explain III	How did the activity promote careful decision making about the use of technology? How did the activity integrate technology into the learning of mathematics? Was technology use ever restricted for the purpose of enhancing learning? Why? How did the technology facilitate discussion about "statistical sense"?

How Much Longer? Elaborate	How did the activity promote careful decision making about the use of technology? How did the activity integrate technology into the learning of mathematics? Was technology use ever restricted for the purpose of enhancing learning? Why? How did the technology facilitate discussion about “statistical sense”?

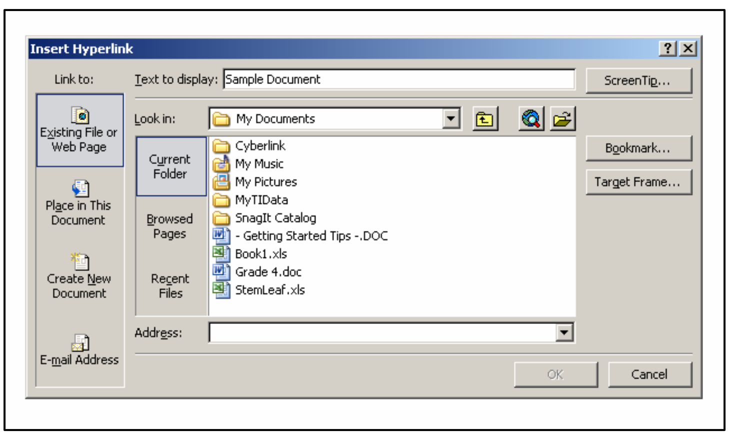
Creating a Hyperlink Document

1. Create a document in Word, referencing Internet sites or folders you wish to hyperlink.

2. Using your mouse, highlight the text you want to hyperlink. Right-click with your mouse.



3. Select Hyperlink from the drop-down list.



4. Select the file you wish to hyperlink to and click OK. If you want to hyperlink to a website, type the website address in the field titled Address. Then click OK.

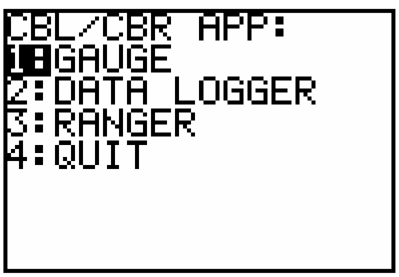
Using the CBR
TI-73

1. Connect the CBR to the TI-73 using the calculator-to-CBR cable. Make sure both ends are pressed firmly to make the connection.

2. Press [APPS].

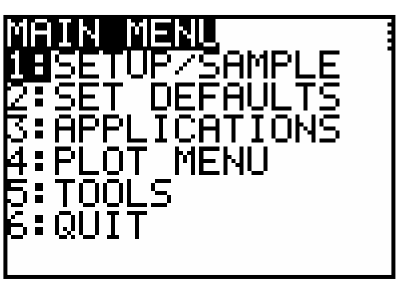
3. Select CBL/CBR.

4. Press any key. Then select Ranger.



5. Follow the on-screen instructions. Press [ENTER].

6. Select 1: Setup/Sample.



Using the CBR
TI-73

7. If necessary, change REALTIME to "no" by pressing ▼ to move to the REALTIME row and pressing ENTER.

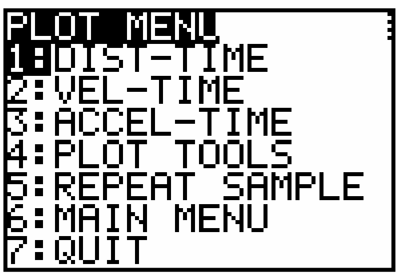
8. Use ▼ to arrow to the TIME row. Change the time to 5 seconds.

9. Use ▲ to arrow to START NOW. Press ENTER.

10. Point the CBR at the target and press ENTER.

11. The CBR will collect data for 5 seconds. A graph of the data will appear.

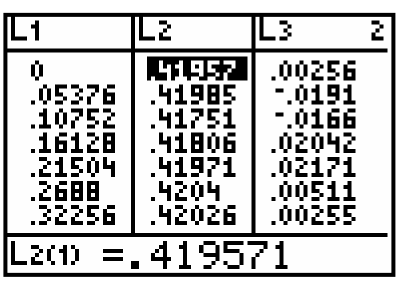
12. Press ENTER to return to the plot menu.



13. Select 7: QUIT or choose other options as desired.

14. The calculator will tell you the lists where it has stored the data.

15. Press ENTER. Then press LIST to see the data.



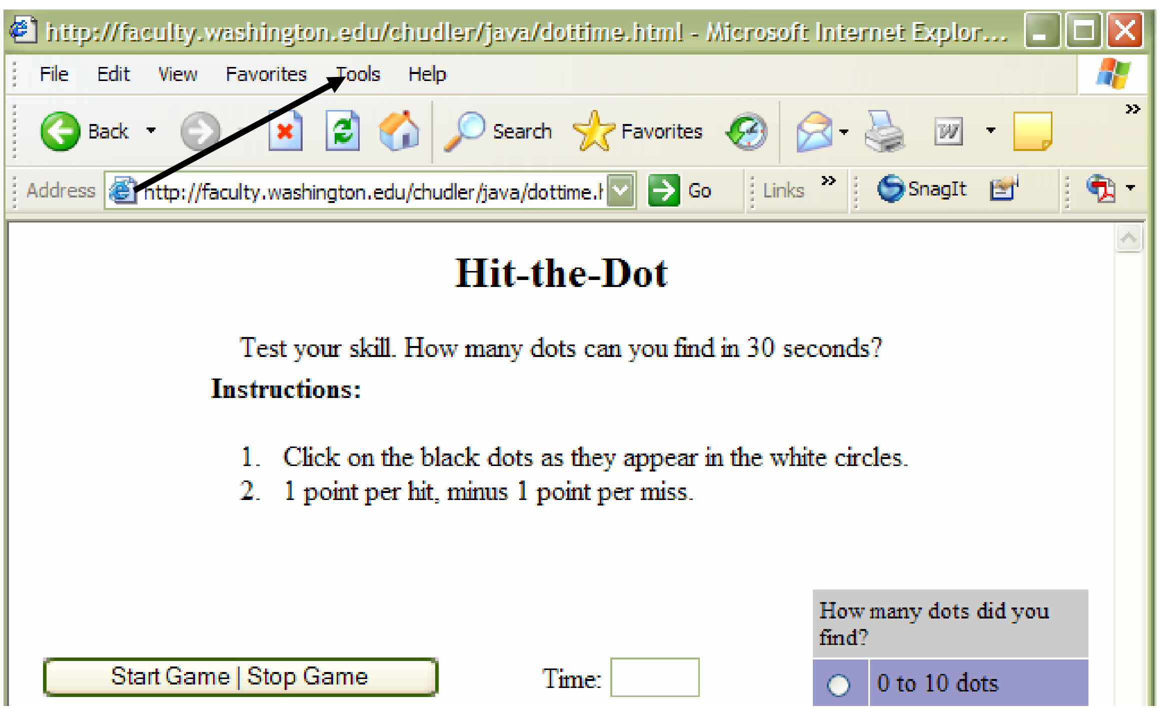
16. Repeat as necessary.

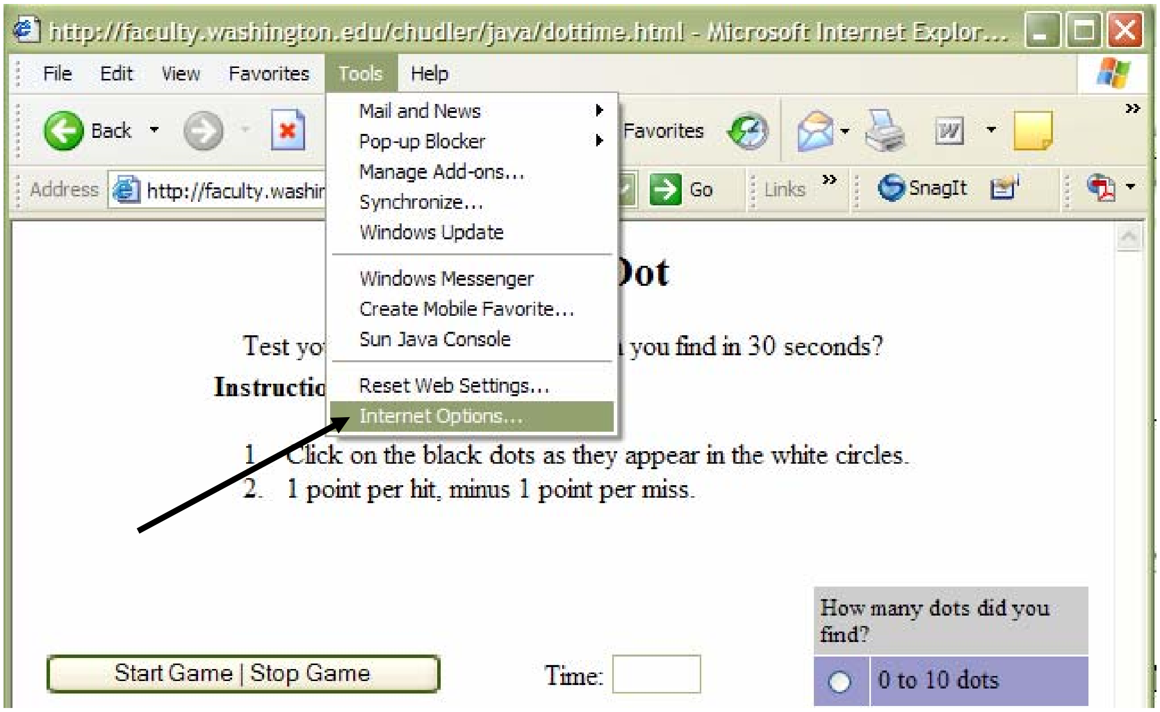
Technology Tutorial: Internet Explorer: Data Station B

Hit the Dot, *http://faculty.washington.edu/chudler/java/dottime.html*, collects cumulative data as individuals play the game. The cumulative data represents the scores earned on first attempts at **Hit the Dot**. To prevent an individual from recording more than one score, the website places a "Cookie" on the computer that indicates that you have already posted a score to the website. You may play the game as many times as you like; however, the website's cumulative data only adds your first score.

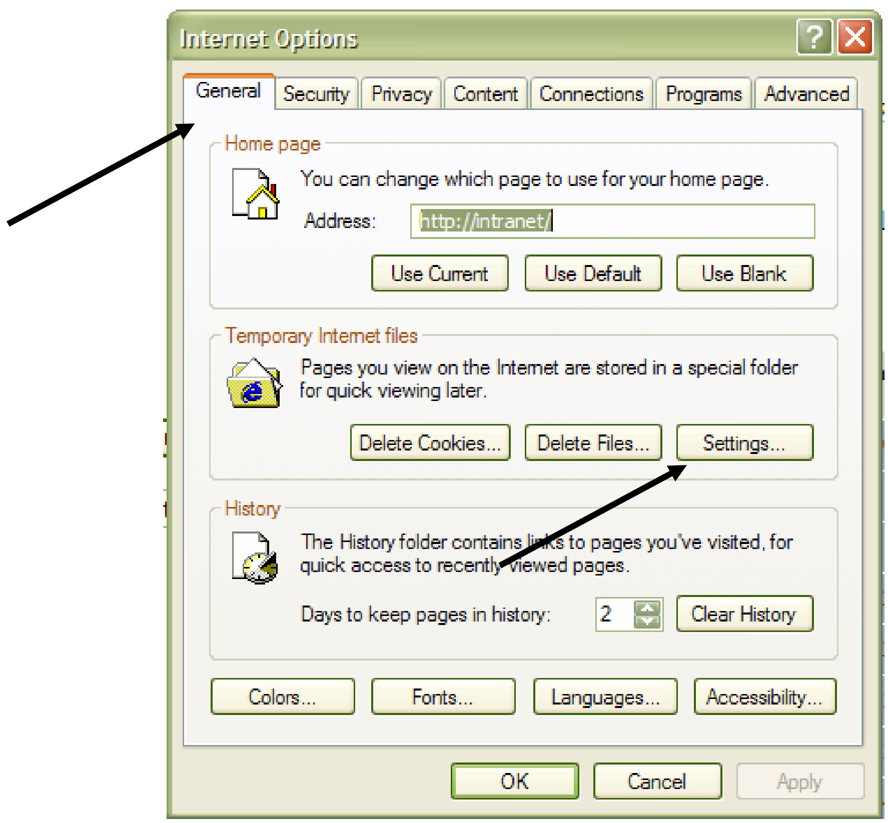
Because more than one individual is playing the game at this computer, it becomes necessary to delete the Cookie after each individual plays the game. This will allow the score for each individual to become part of the cumulative data.

1. In Internet Explorer, click on the **Tools** menu to view the drop-down menu. Click **Internet Options.**



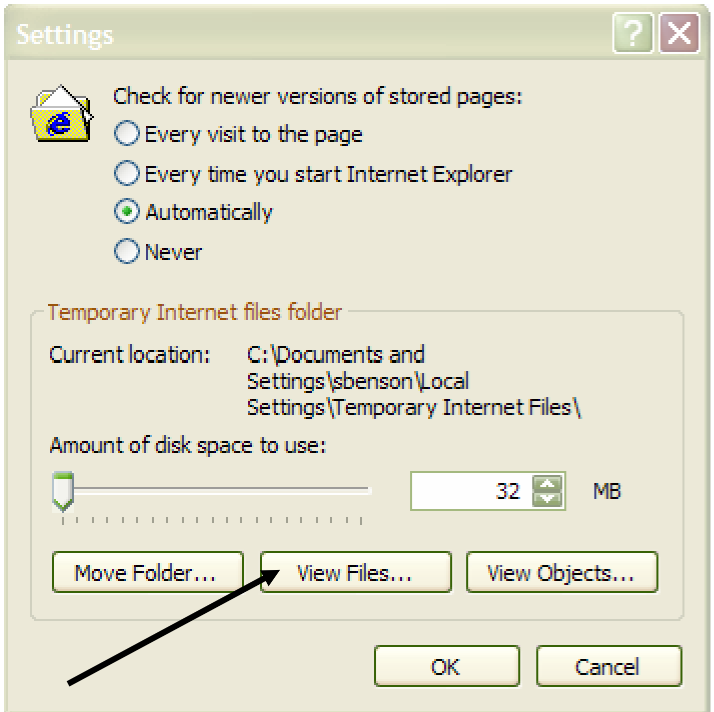


2. On the **General** tab, click **Settings**.

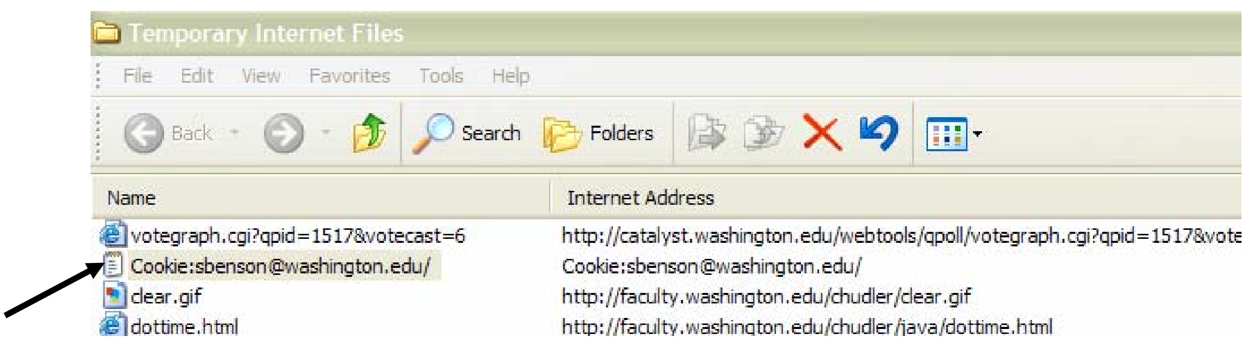


3. Click **View**

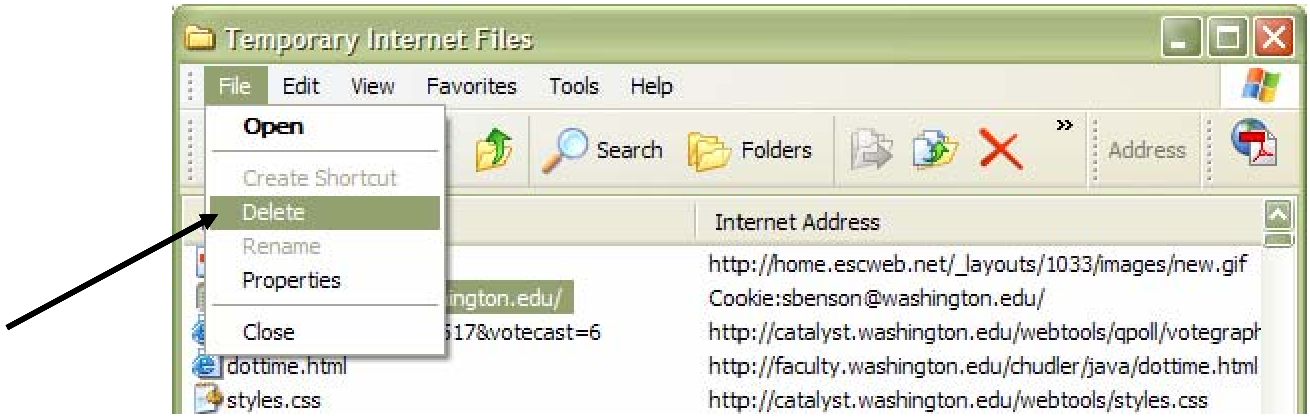
Files.



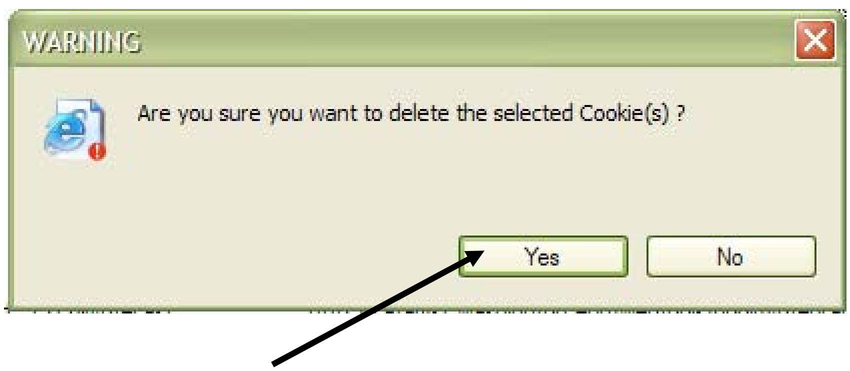
4. Select the Cookie that contains " @washington.edu" in the nam



5. Click on the **File** menu, click **Delete**.



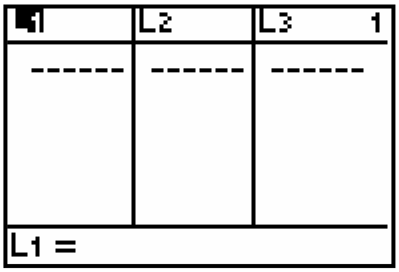
6. Click on the **Yes** button to delete the selected Cookie.



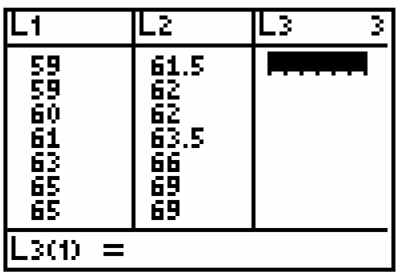
Creating a Box and Whisker Plot
TI-73

1. Press [ON].

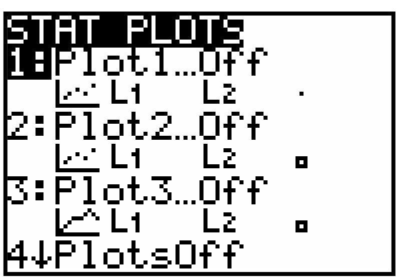
2. Press [LIST]. If data is in the columns, you will need to clear the data by moving the cursor to the top with the arrow keys until L_1 is highlighted, press [CLEAR] then [ENTER]. Repeat to clear all data from the other lists if needed.



3. Enter data in L_1 and L_2. After each value is typed, press [ENTER].



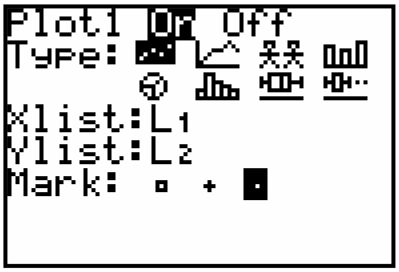
4. To access the Plot menu, press [2nd][Y=].



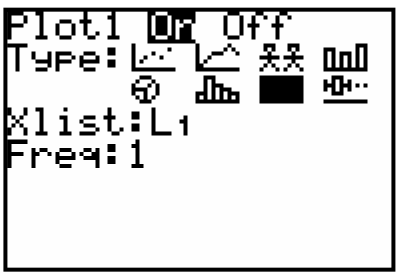
5. Press [ENTER].

Creating a Box and Whisker Plot
TI-73

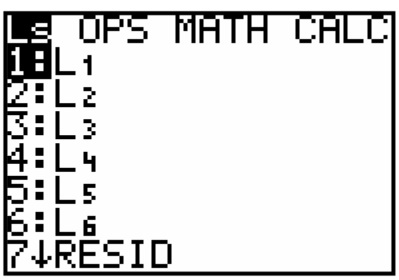
6. Turn the plot on by using the arrow keys to move the cursor over On and pressing ENTER.



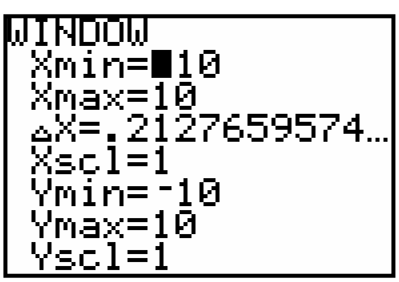
7. Arrow down to TYPE, then use your ▶ key to move to the first box and whisker plot. Press ENTER.



8. Arrow down to XLIST. The calculator defaults to L_1. If your data is in another list, you will need to press 2nd LIST, select the appropriate list, then press ENTER.

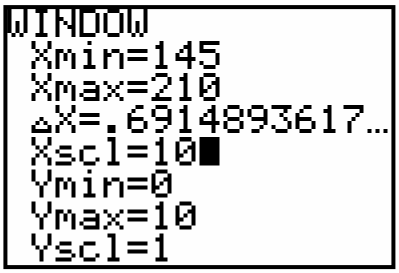


9. To set your window, press WINDOW. Xmin is the minimum x-value that you want displayed in your viewing window. Xmax is the maximum x-value that you want displayed in your viewing window.



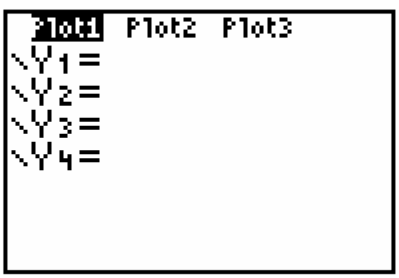
Creating a Box and Whisker Plot
TI-73

The range of the heights was from about 145 centimeters to 210 centimeters. Xscl defines the distance between tick marks : 10 is an appropriate Xscl for this window. Use ▲ or ▼ to move the cursor to the variable you want to change. Type the new value on each line, then press ENTER after each change.

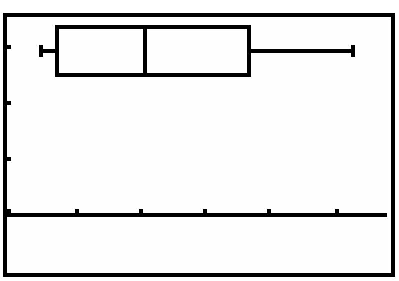


For box and whisker plots, Ymin and Ymax are ignored, so you will not need to make any changes.

10. You may need to remove graphs located in Y=. If so, press Y= then clear out all equations by pressing CLEAR for each line.



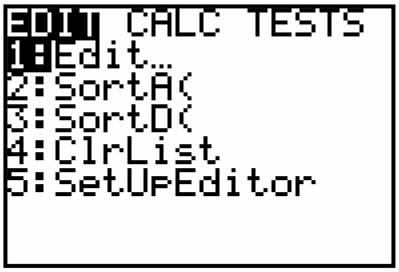
11. Press GRAPH to view the graph.



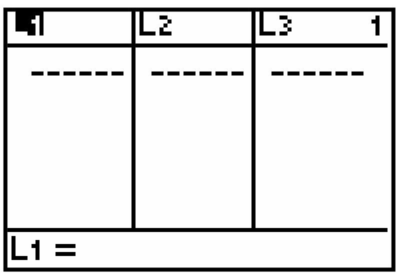
Creating a Box and Whisker Plot
TI-83

1. Press [ON].

2. Press [STAT].

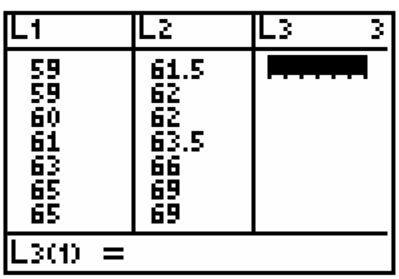


3. Press 1 to select Edit.

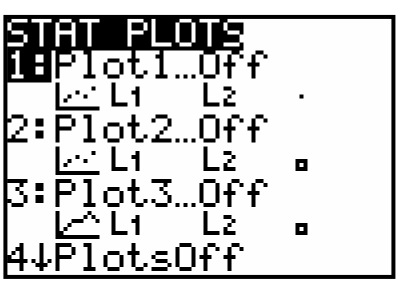


If data is in the columns, you will need to clear the data by moving the cursor to the top with the arrow keys until L_1 is highlighted, press [CLEAR] then [ENTER]. Repeat to clear all data from the other lists if needed.

4. Enter data in L_1 and L_2. After each value is typed, press [ENTER].



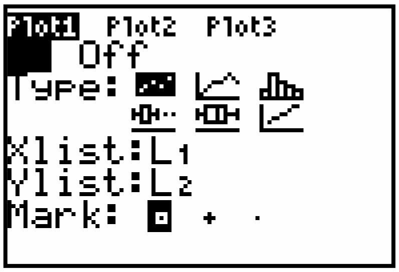
5. To access the Stat Plot menu, press [2nd][Y=].



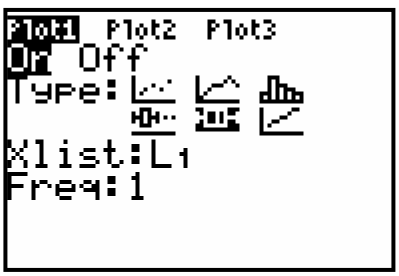
Creating a Box and Whisker Plot
TI-83

6. Press [ENTER].

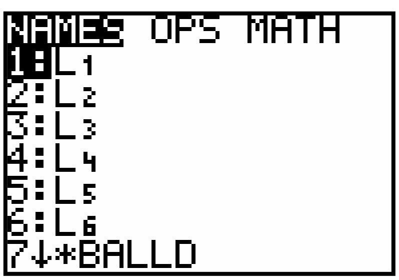
7. Turn the plot on by using the arrow keys to move the cursor over On and pressing [ENTER].



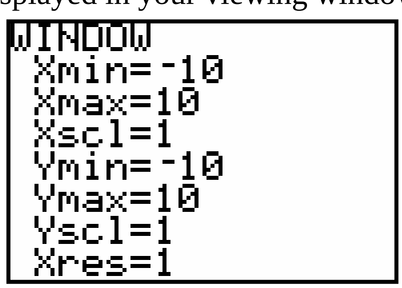
8. Arrow down to TYPE, then use your [▶] key to move to the second box and whisker plot. Press [ENTER].



9. Arrow down to XLIST. The calculator defaults to L_1. If your data is in another list, you will need to press [2nd][STAT], select the appropriate list, then press [ENTER].

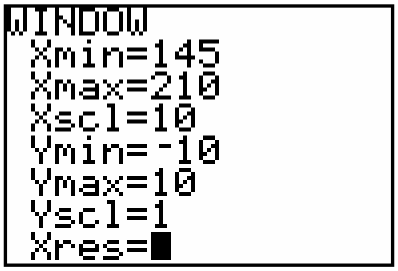


10. To set your window, press [WINDOW]. Xmin is the minimum x-value that you want displayed in your viewing window. Xmax is the maximum x-value that you want displayed in your viewing window.



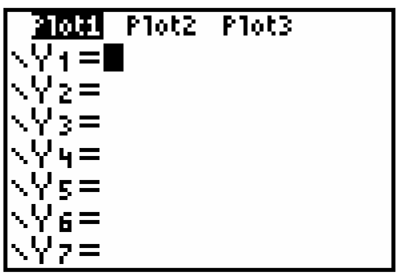
Creating a Box and Whisker Plot
TI-83

The range of the heights was from about 145 centimeters to 210 centimeters. Xscl defines the distance between tick marks : 10 is an appropriate Xscl for this window. Use ▲ or ▼ to move the cursor to the variable you want to change. Type the new value on each line, then press ENTER after each change.

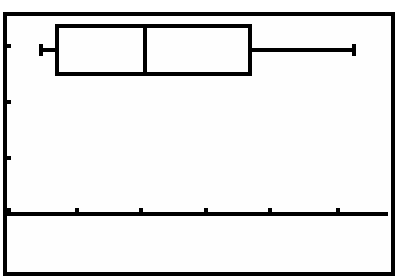


For box and whisker plots, Ymin and Ymax are ignored, so you will not need to make any changes.

11. You may need to remove graphs located in Y=. If so, press Y= then clear out all equations by pressing CLEAR for each line.



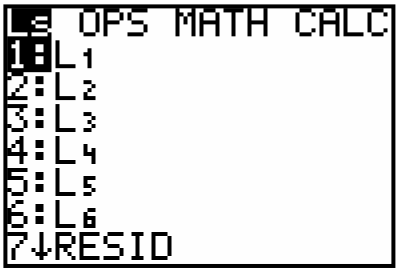
12. Press GRAPH to view the graph.



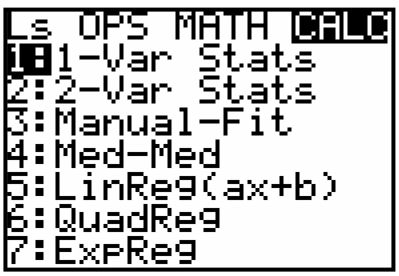
One-Variable Statistics
TI-73

1. Press [ON].

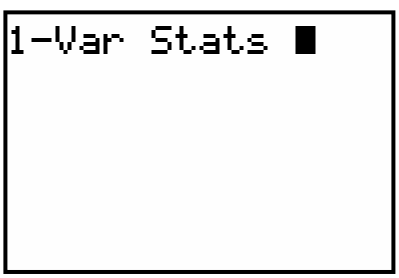
2. To calculate one-variable statistics for data that has already been entered in your lists, press [2nd][LIST].



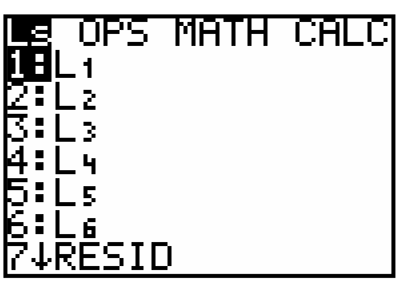
3. Use your right arrow button [▸] to arrow over to CALC.



4. Press 1.

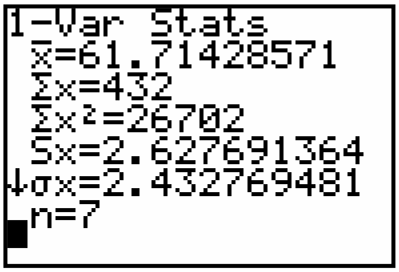


5. Press [2nd][LIST] then select the list you wish to use. Press [ENTER].



One-Variable Statistics
TI-73

6. Press [ENTER] again.



7. You can now use the [▲] and [▼] keys to scroll through the statistics.

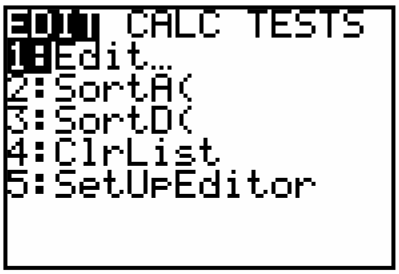
8. The various calculations listed in this window are:

Symbol	**Definition**
$\bar{x}$	Mean
$\sum x$	Sum of x values
$\sum x^2$	Sum of x^2 values
Sx	Sample standard deviation of x
σx	Population standard deviation of x
n	Number of data points
minX	Minimum of x values
Q_1	Lower (1st) Quartile
Med	Median
Q_3	Upper (3rd) Quartile
maxX	Maximum of x values

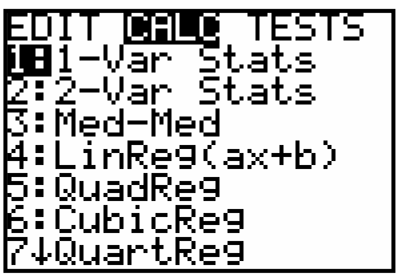
One-Variable Statistics
TI-83

1. Press ON.

2. To calculate one-variable statistics for data that has already been entered in your lists, press STAT.

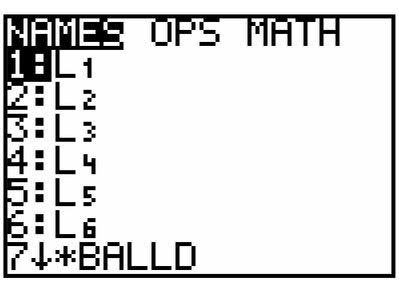


3. Use your right arrow button ► to arrow over to CALC.



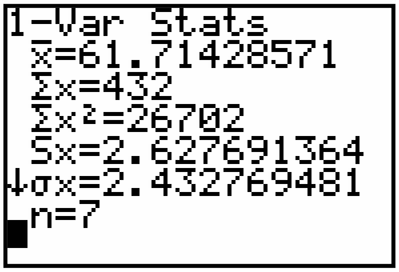
4. Press 1.

5. Press 2nd STAT. then select the list you wish to use. Press ENTER.



One-Variable Statistics
TI-83

6. Press [ENTER] again.



7. You can now use the [▲] and [▼] keys to scroll through the statistics.

8. The various calculations listed in this window are:

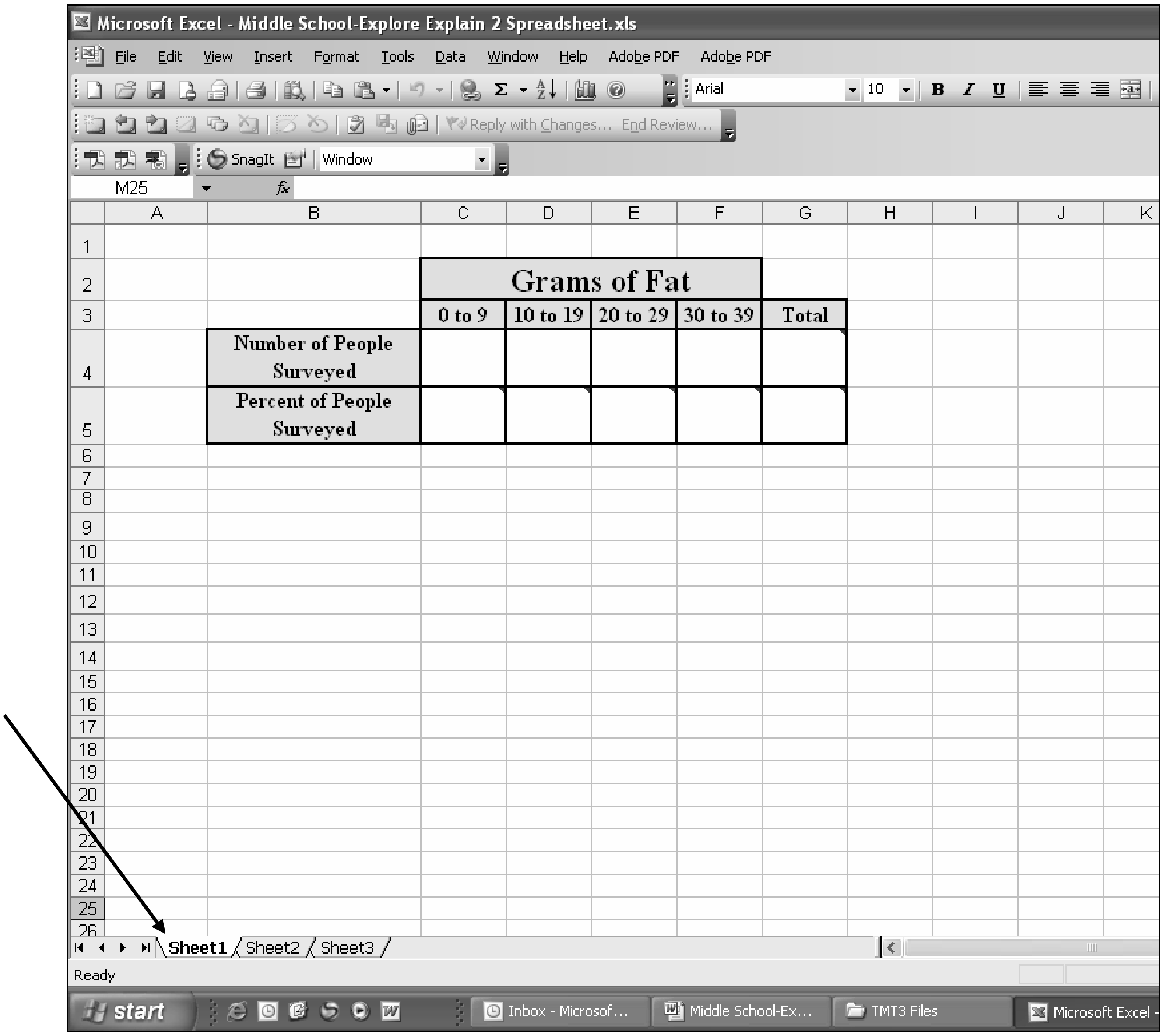
Symbol	**Definition**
$\bar{x}$	Mean
$\sum x$	Sum of *x* values
$\sum x^2$	Sum of x^2 values
S*x*	Sample standard deviation of *x*
σx	Population standard deviation of *x*
n	Number of data points
minX	Minimum of *x* values
Q_1	Lower (1st) Quartile
Med	Median
Q_3	Upper (3rd) Quartile
maxX	Maximum of *x* values

Technology Tutorial: Grams of Fat Activity 1

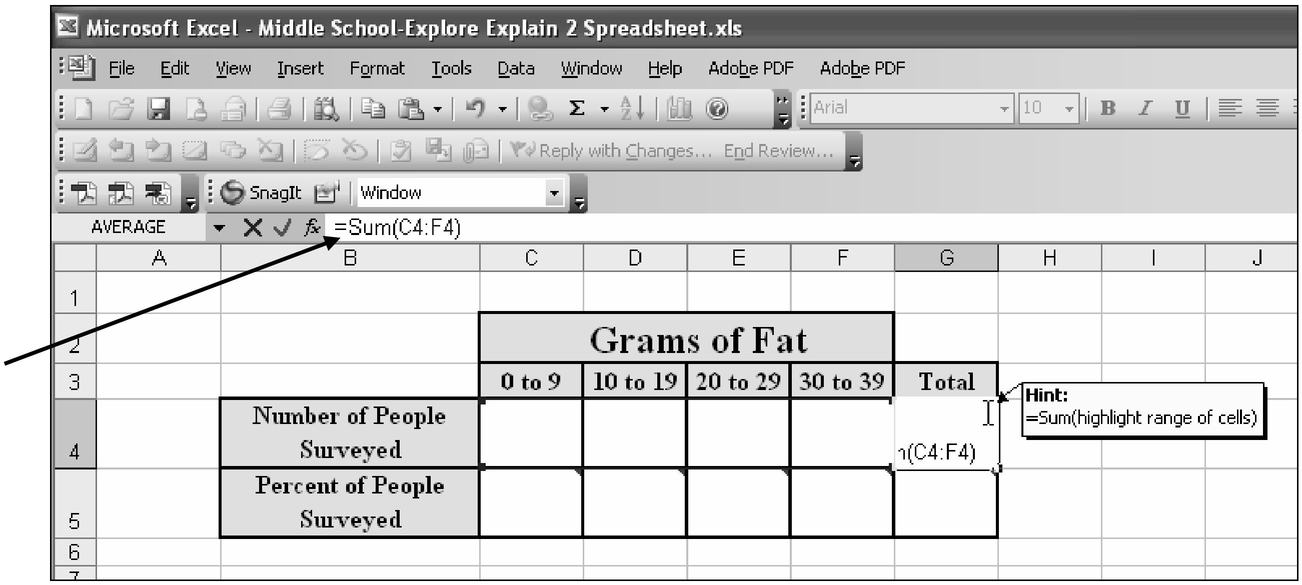
Formatting Chart Cells

1. Open the **Excel** document **Middle School-Explore Explain 2 Spreadsheet.xls**.

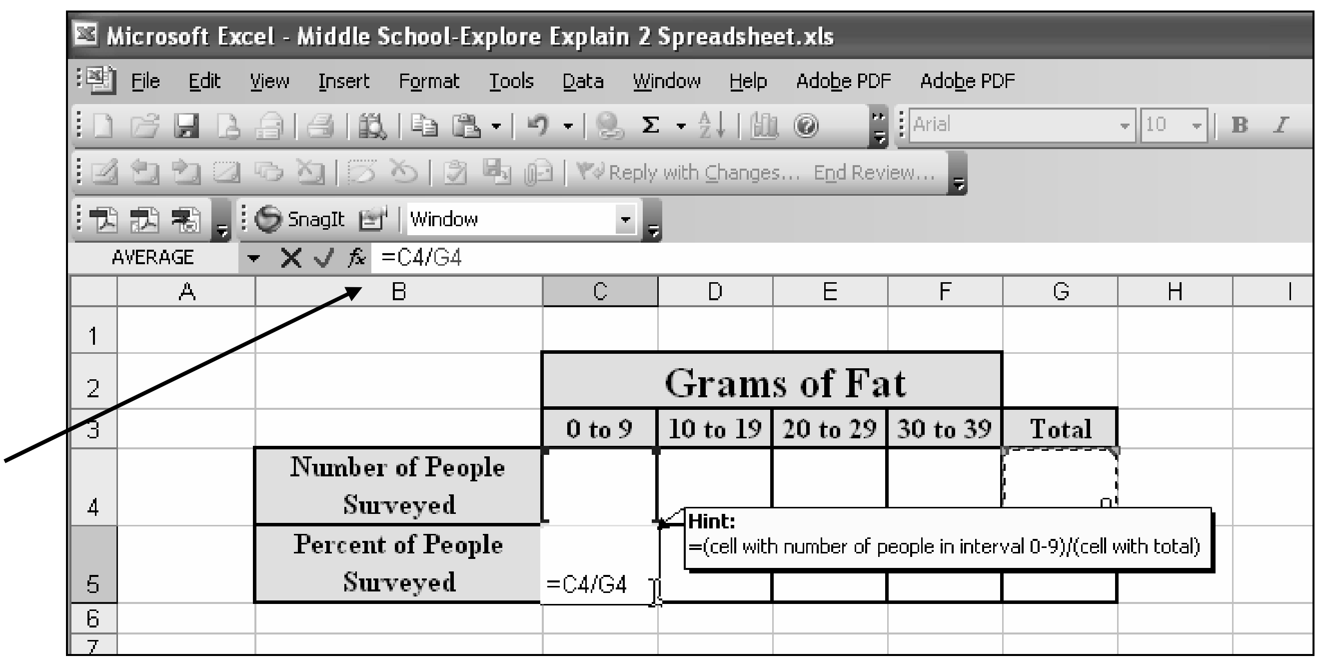
2. Select **Sheet 1** containing the template: **Grams of Fat**.



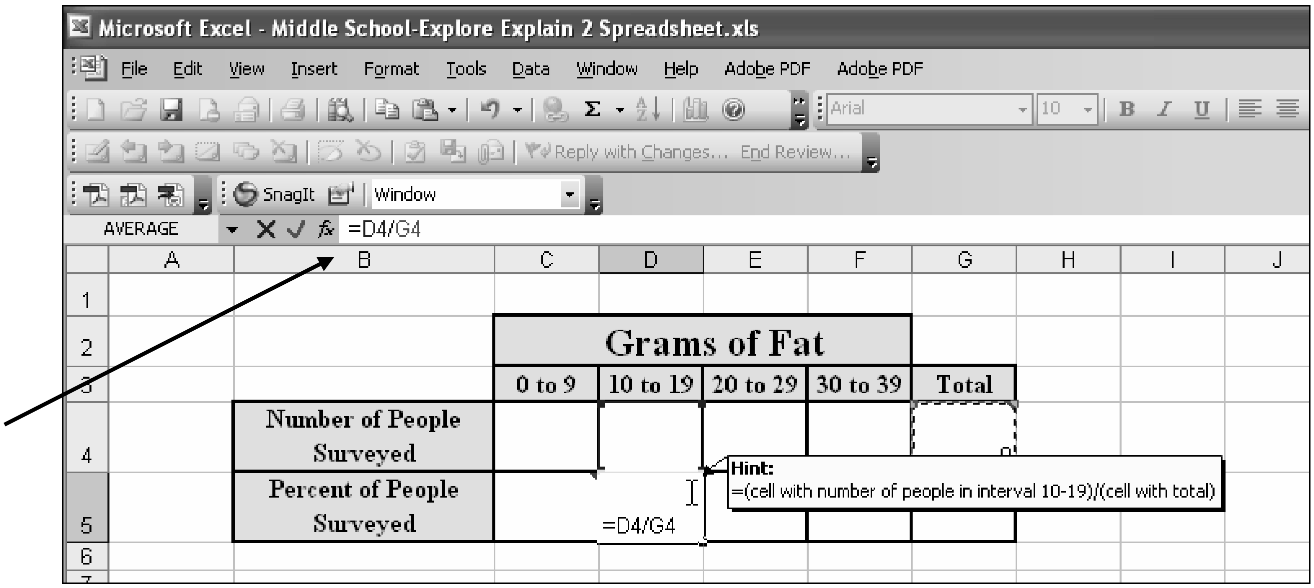
3. Scroll over the flag in cell **G4**. The HINT implies that the formula needed for this cell is **=Sum(highlight range of cells)**, which means to enter **=SUM(** and then highlight the cells necessary by clicking and dragging the mouse from cell **C4** to cell **F4**. Followed by a close parenthesis and **Enter**.



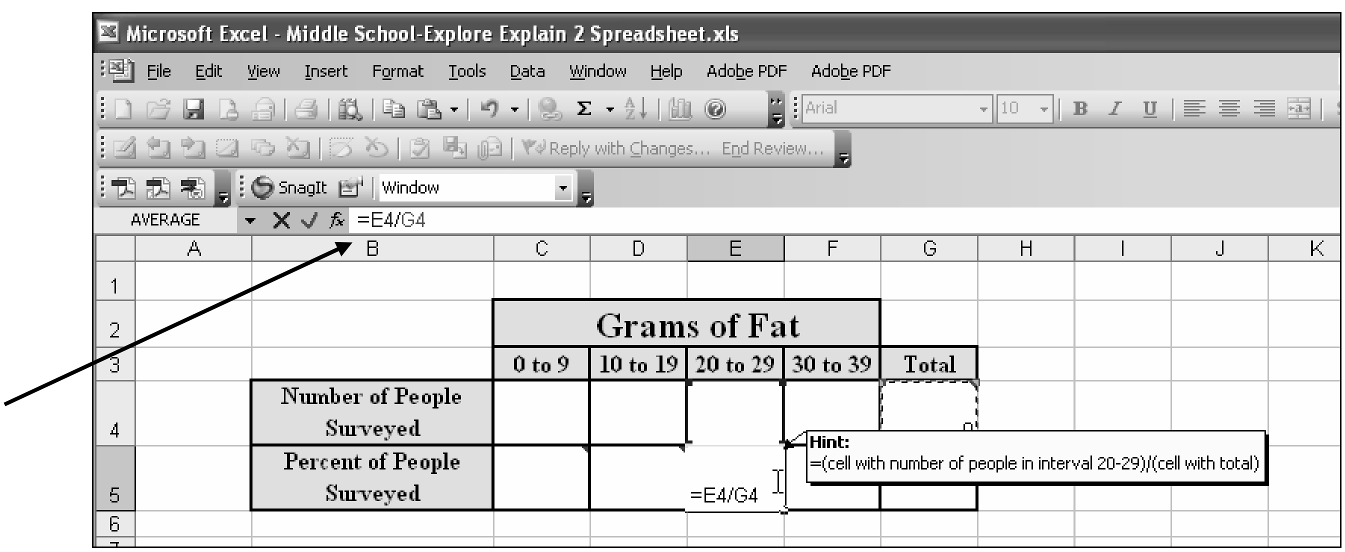
4. Scroll over the flag in cell **C5**. The HINT implies that the formula needed for this cell is **=(cell with number of people in interval 0 to 9)/(cell with total)**, which means to input =. Then click on cell **C4**, followed by the backslash, followed by cell **G4**, and **Enter**.



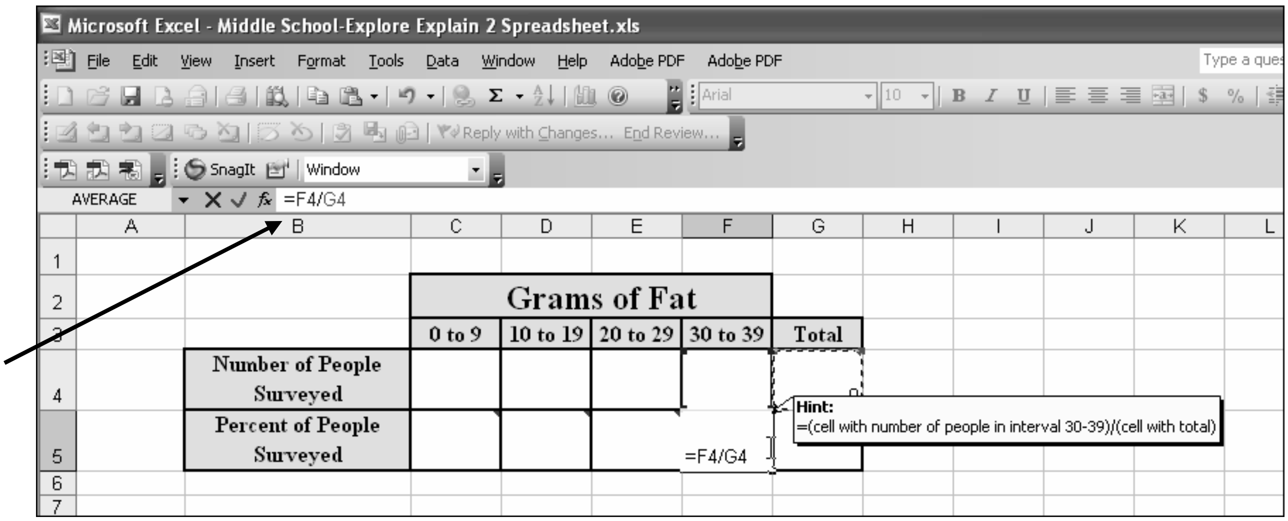
5. Scroll over the flag in cell **D5**. The HINT implies that the formula needed for this cell is **=(cell with number of people in interval 10 to 19)/(cell with total)**, which means to enter **=**. Then click on cell **D4**, followed by the backslash, followed by cell **G4**, and **Enter**.



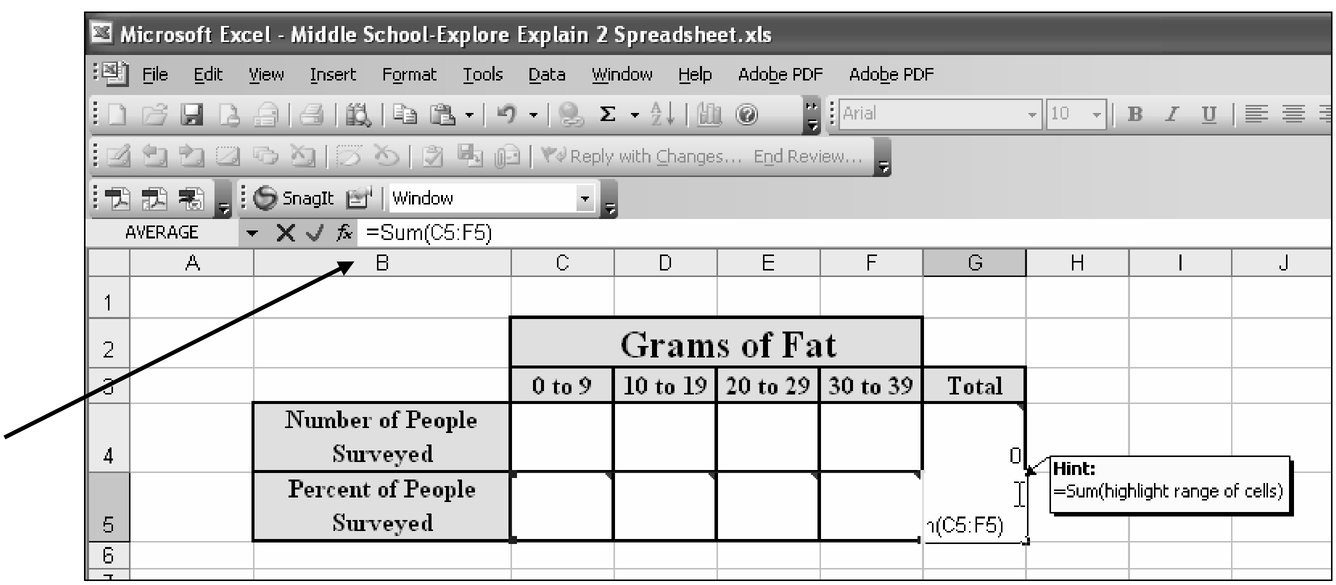
6. Scroll over the flag in cell **E5**. The HINT implies that the formula needed for this cell is **=(cell with number of people in interval 20 to 29)/(cell with total)**, which means to input **=**. Then click on cell **E4**, followed by the backslash, followed by cell **G4**, and **Enter**.



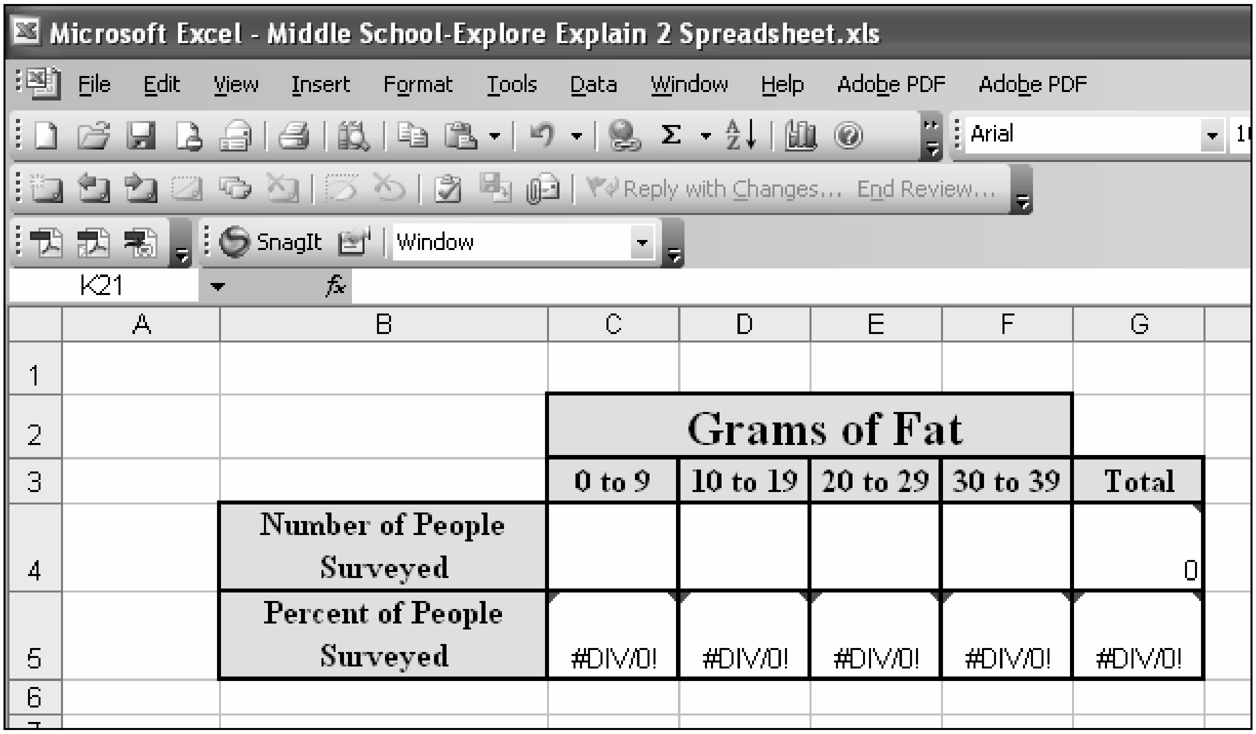
7. Scroll over the flag in cell **F5**. The HINT implies that the formula needed for this cell is **=(cell with number of people in interval 30 to 39)/(cell with total)**, which means to enter **=**. Then click on cell **F4**, followed by the backslash, followed by cell **G4**, and **Enter.**



8. Scroll over the flag in cell **G5.** The HINT implies that the formula needed for this cell is **=Sum(highlight range of cells)**, which means to enter **=SUM(** and then highlight the cells necessary by clicking and dragging the mouse from cell **C5** to cell **F5**. Followed by a close parenthesis and **Enter**.



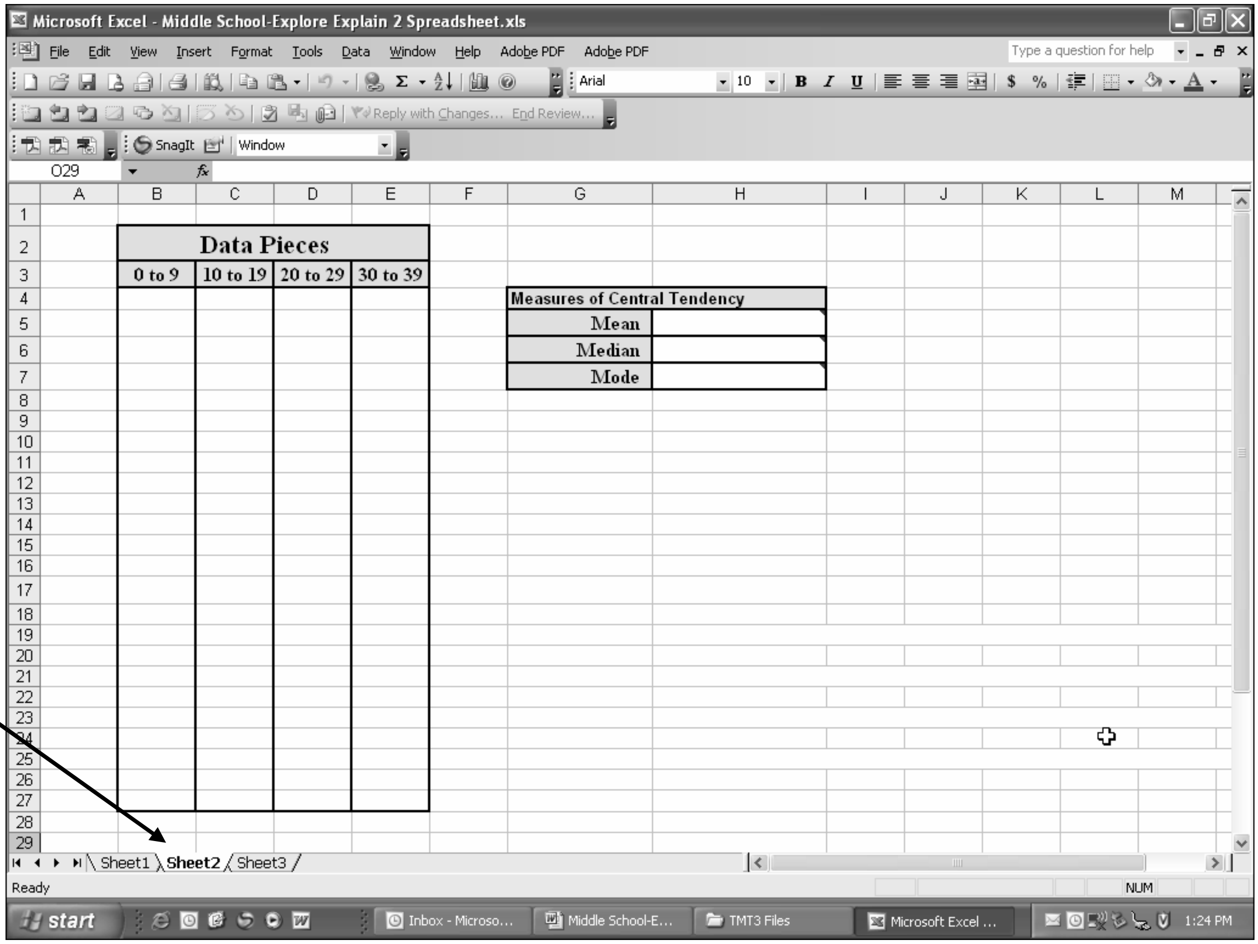
9. Note: Until data is entered, cells will show an error message due to division by zero.



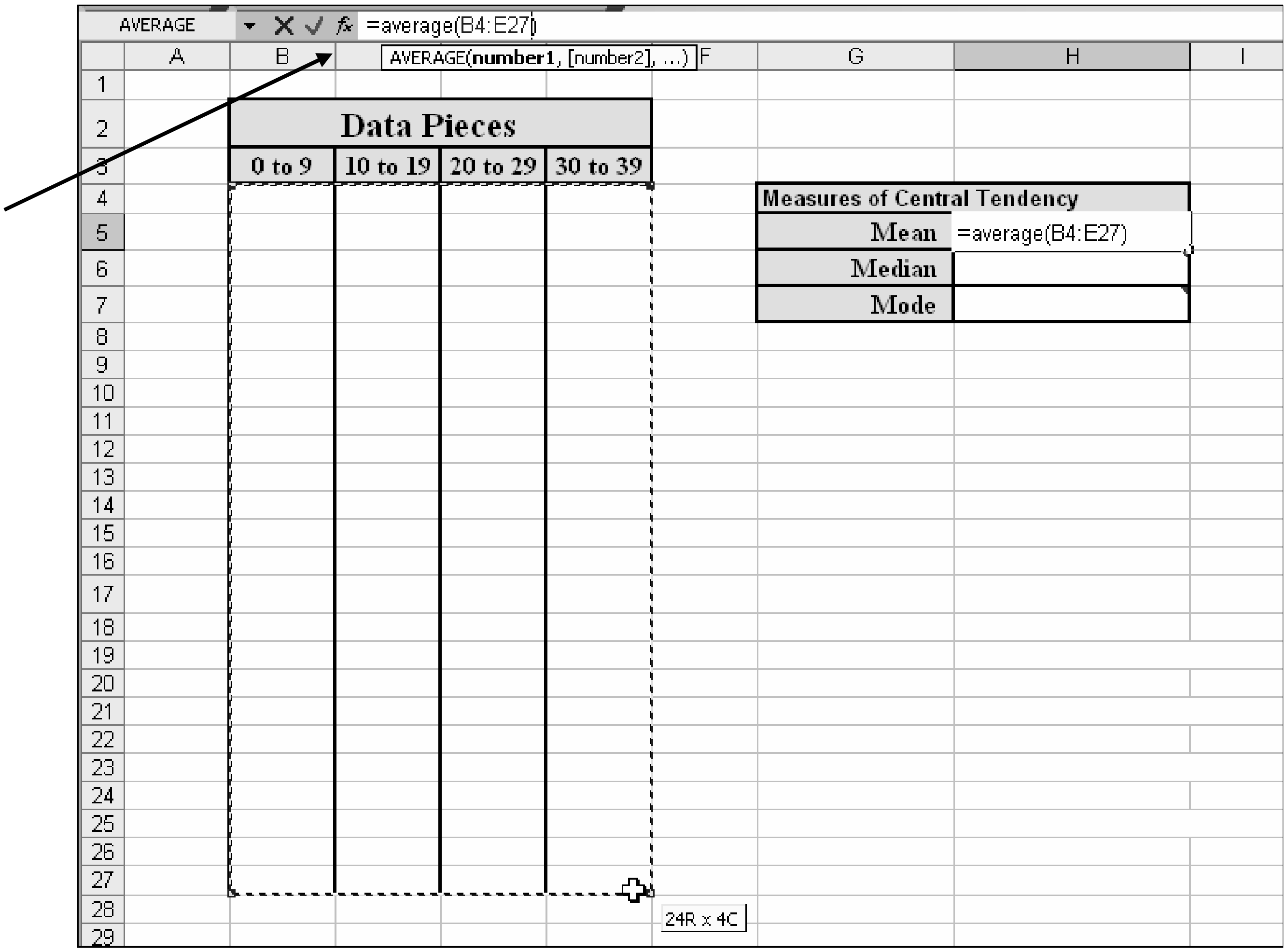
Formatting Mean, Median and Mode

1. Open the **Excel** document **Middle School-Explore Explain 2 Spreadsheet.xls**.

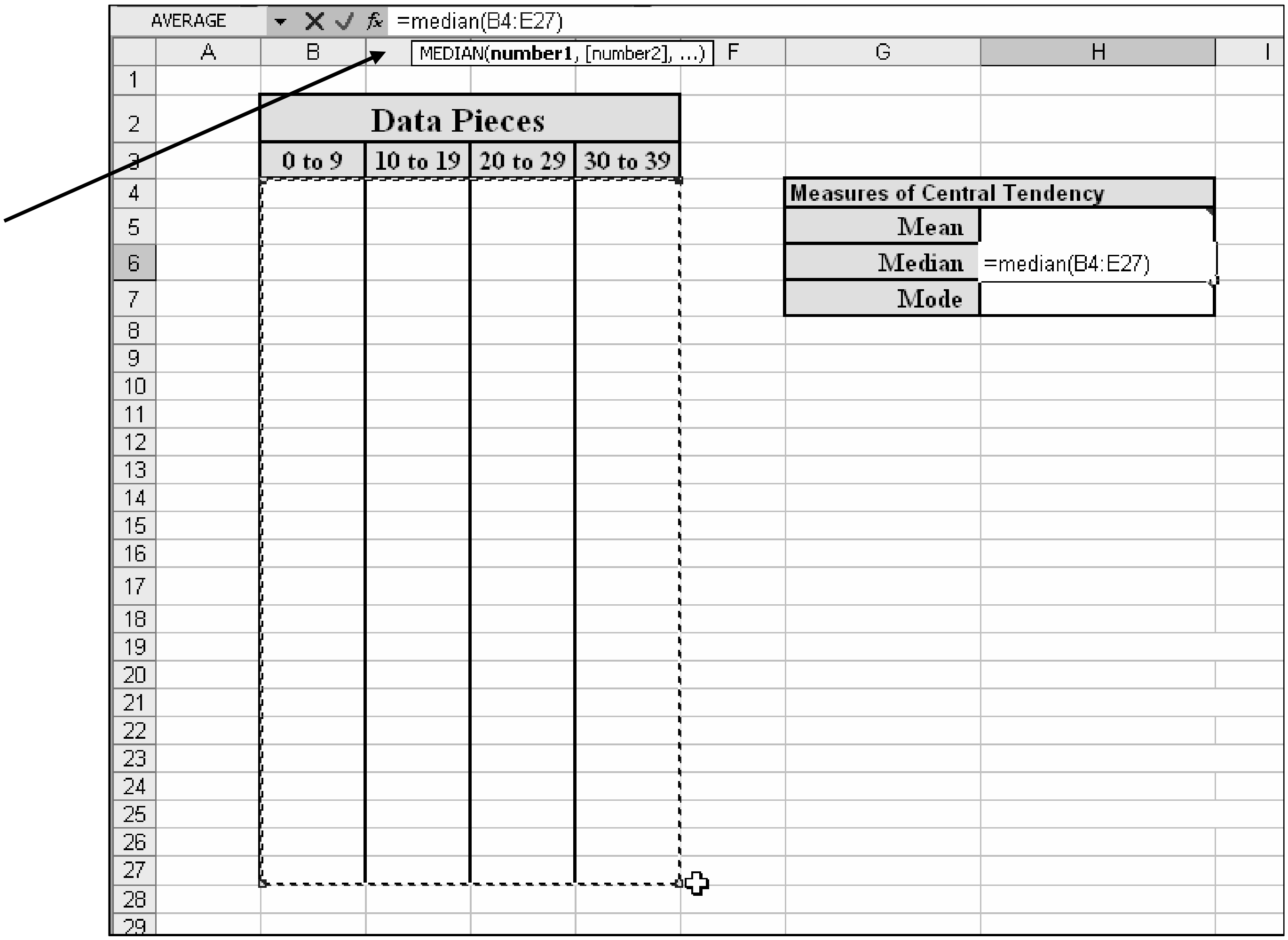
2. Select **Sheet 2** containing the templates: **Data Pieces** and **Measures of Central Tendency**.



3. Scroll over the flag in cell **H5.** The HINT implies that the formula needed for this cell is **=Average(highlight range of cells)**, which means to enter **=Average(** and then highlight the cells necessary by clicking and dragging the mouse from cell **B4** to cell **E27**. Followed by a close parenthesis and **Enter**.

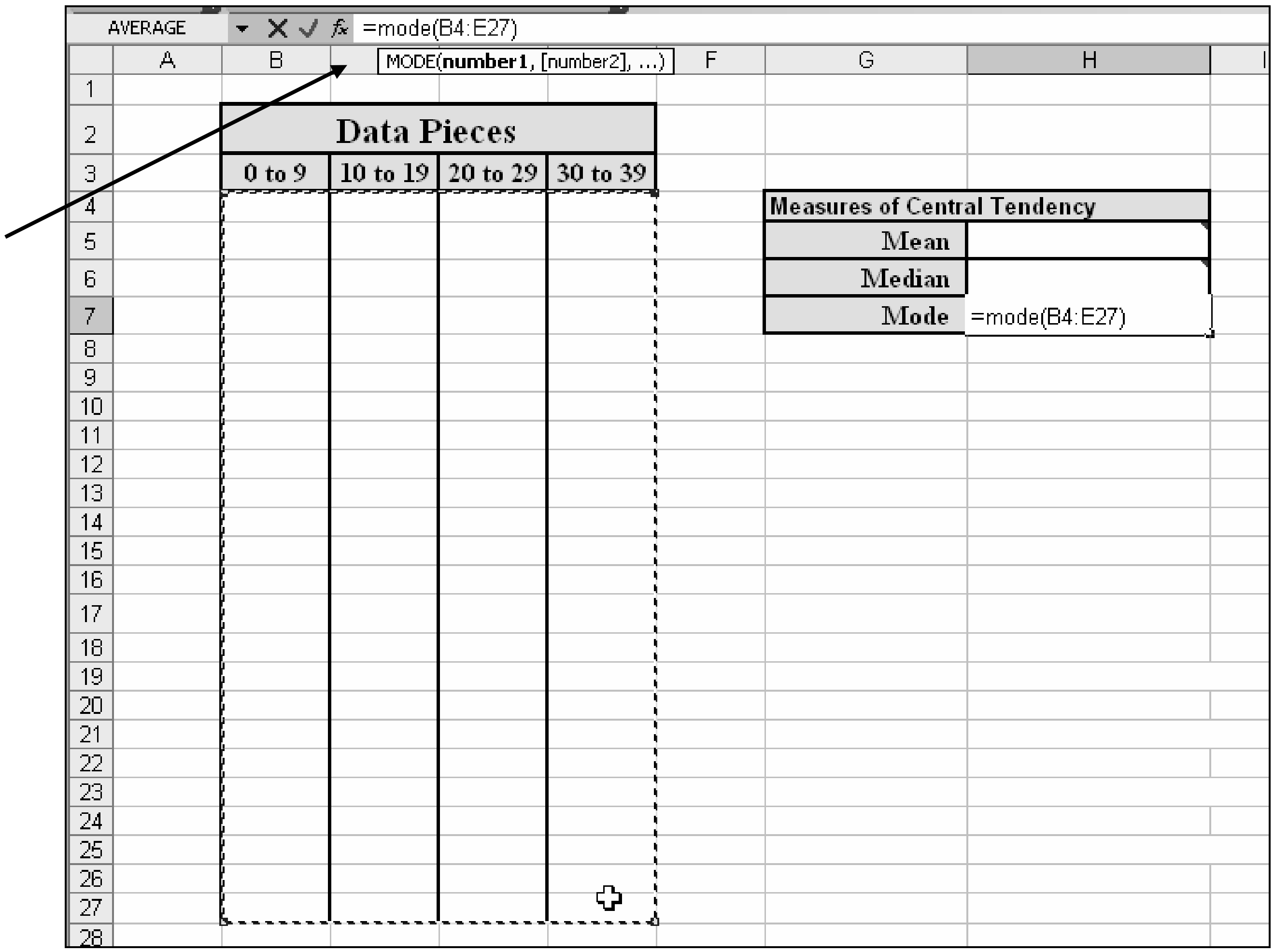


4. Scroll over the flag in cell **H6.** The HINT implies that the formula needed for this cell is **=Median(highlight range of cells)**, which means to enter **=Median(** and then highlight the cells necessary by clicking and dragging the mouse from cell **B4** to cell **E27**. Followed by a close parenthesis and **Enter**.



5. Scroll over the flag in cell **G5.** The HINT implies that the formula needed for this cell is **=Mode(highlight range of cells)**, which means to enter **=Mode(** and then highlight the cells necessary by clicking and dragging the mouse from cell **B4** to cell **E27**. Followed by a close parenthesis and **Enter**.

* Note: If the data set contains more than one mode, only the one with the lowest value will be recorded.



6. Note: Until data is entered, cells will show an error messages.

Data Pieces			
0 to 9	10 to 19	20 to 29	30 to 39

Measures of Central Tendency	
Mean	#DIV/0!
Median	#NUM!
Mode	#N/A

Technology Tutorial: Fat Grams Graph Activity 2

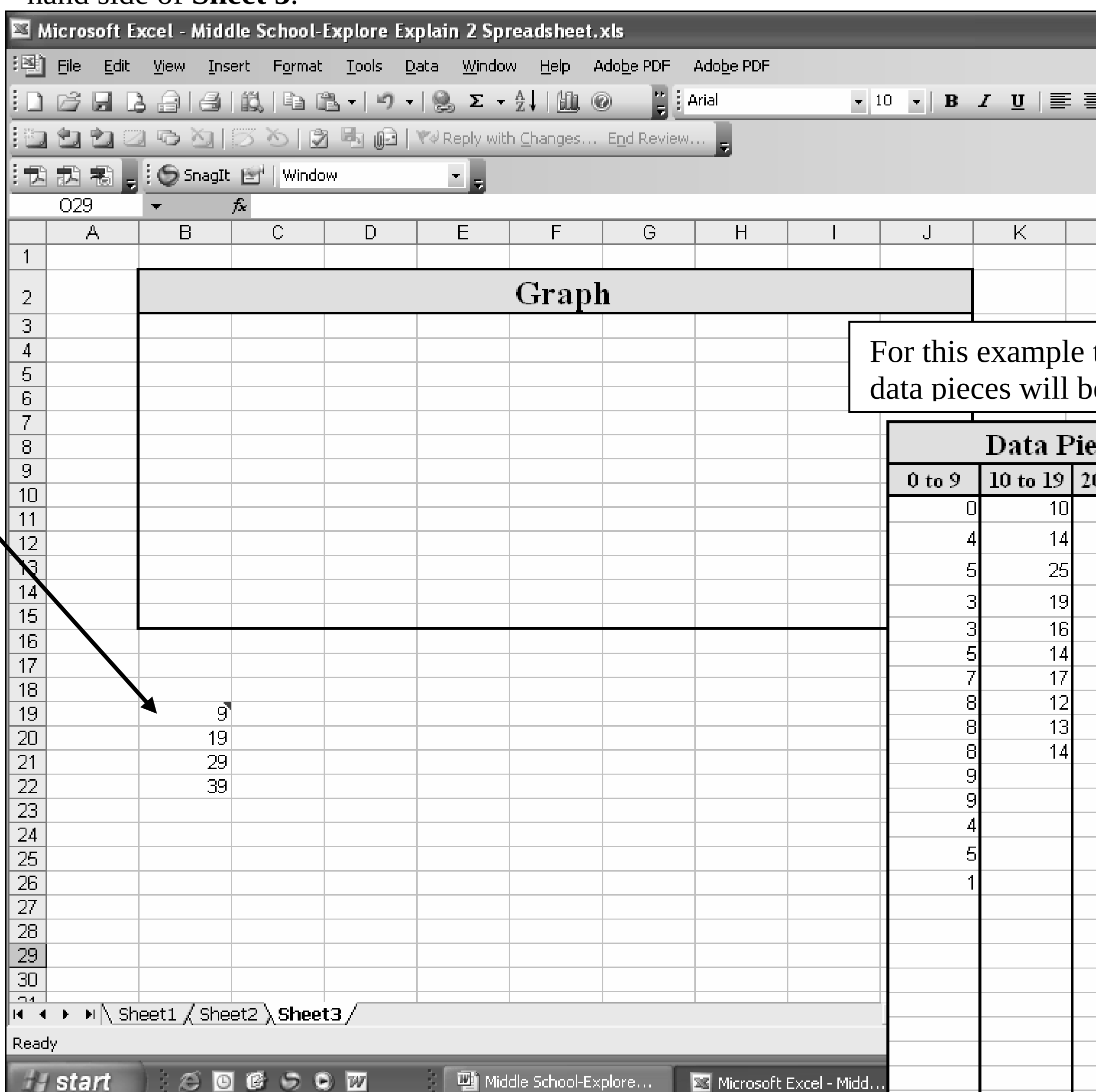
Creating the *Grams of Fat* Graph:

Participants are allowed to select the type of graphical representation of their choice; therefore two possible types of graphs are shown: **Histogram** and **Pie Graph**.

I. Histogram

1. Open the **Excel** document **Middle School-Explore Explain 2 Spreadsheet.xls**.

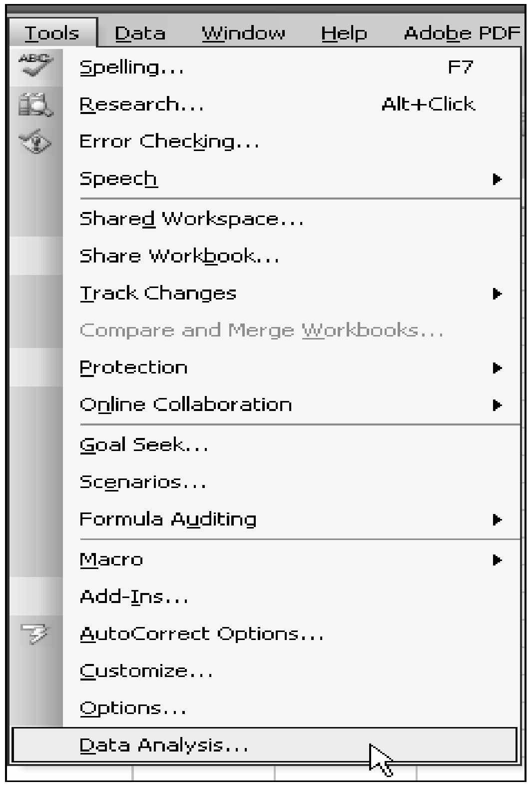
2. In order to use the Data Analysis Toolpak to create a histogram, you will need to create Bin Values. The Bin Value represents the highest value of each interval in the data set.
   For example, if the intervals sort the data from 0 to 9, 10 to 19, 20 to 29, and 30 to 39, there would be four Bin Values: 9, 19, 29, and 39 as seen on the lower left hand side of **Sheet 3**.



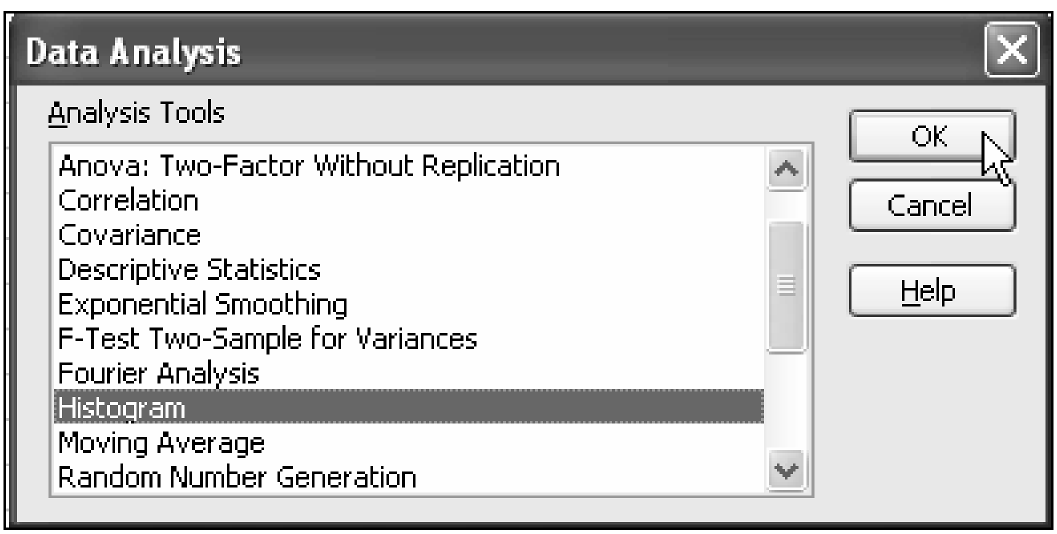
For this example the following data pieces will be use.

Data Pieces			
0 to 9	10 to 19	20 to 29	30 to 39
0	10	28	30
4	14	24	30
5	25	24	37
3	19	26	36
3	16	21	34
5	14	28	32
7	17	29	32
8	12	29	32
8	13	26	32
8	14	25	36
9			34
9			35
4			34
5			37
1			38

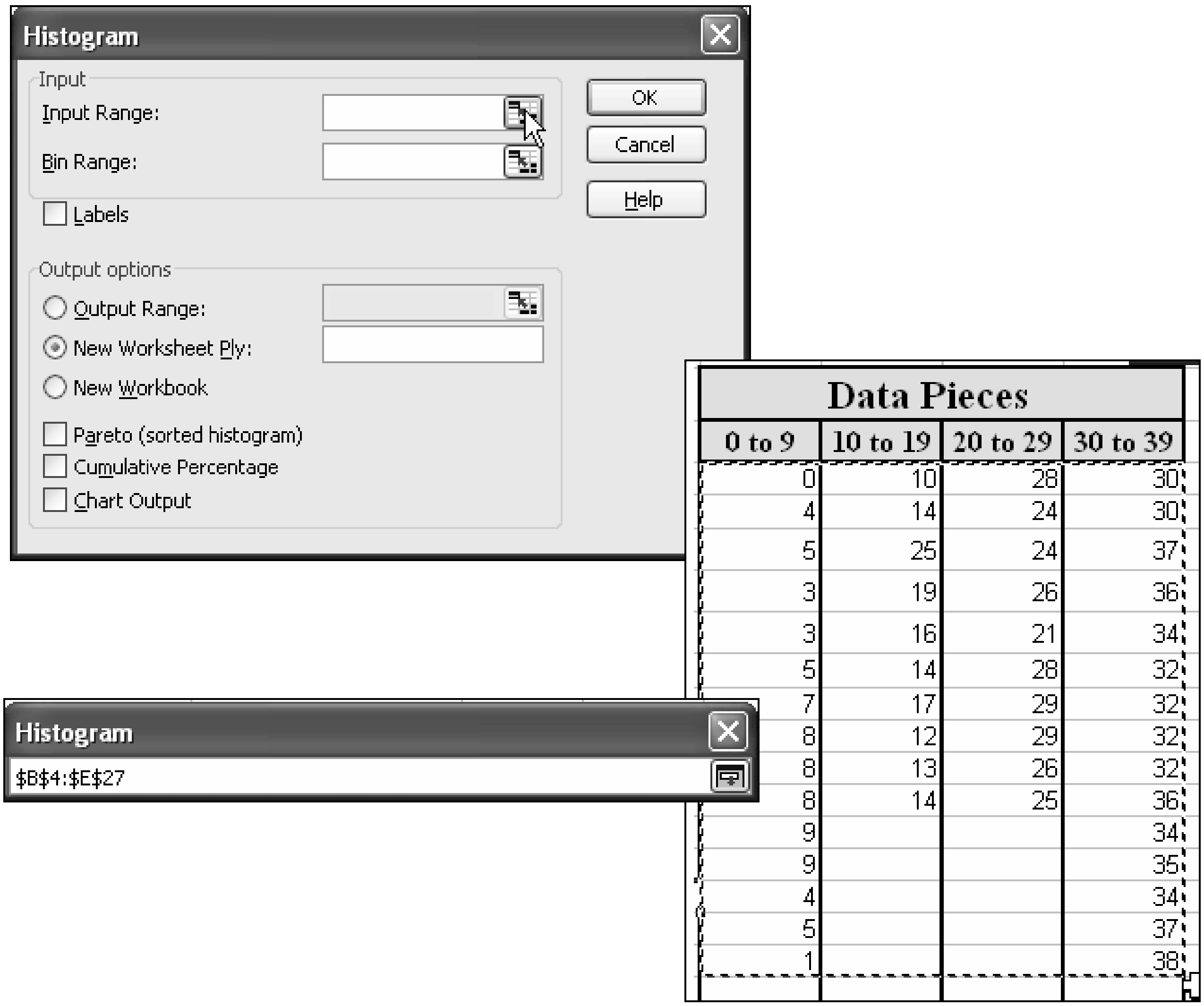
3. In the toolbar under the **Tools** menu select **Data Analysis**.



4. Select **Histogram** and click **OK**.

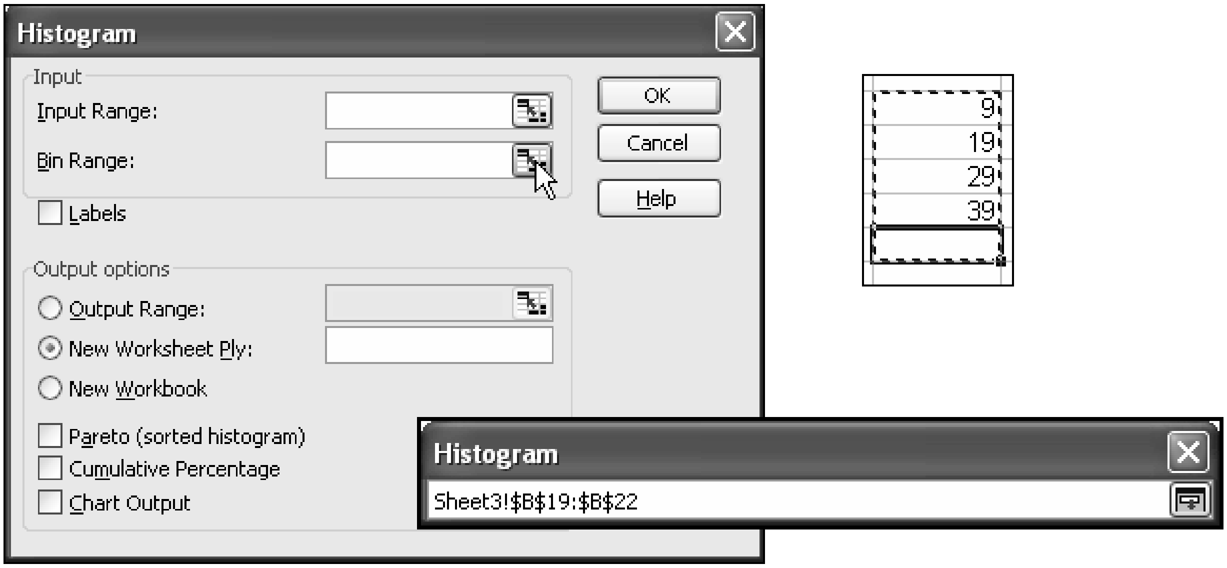


5. Click the **Input Range** icon. Highlight the cells that contain your data, by clicking on cells **B4** and dragging down to **E18**. The numbers will be highlighted by "marching ant" tracks. Then click on the **Import** icon.

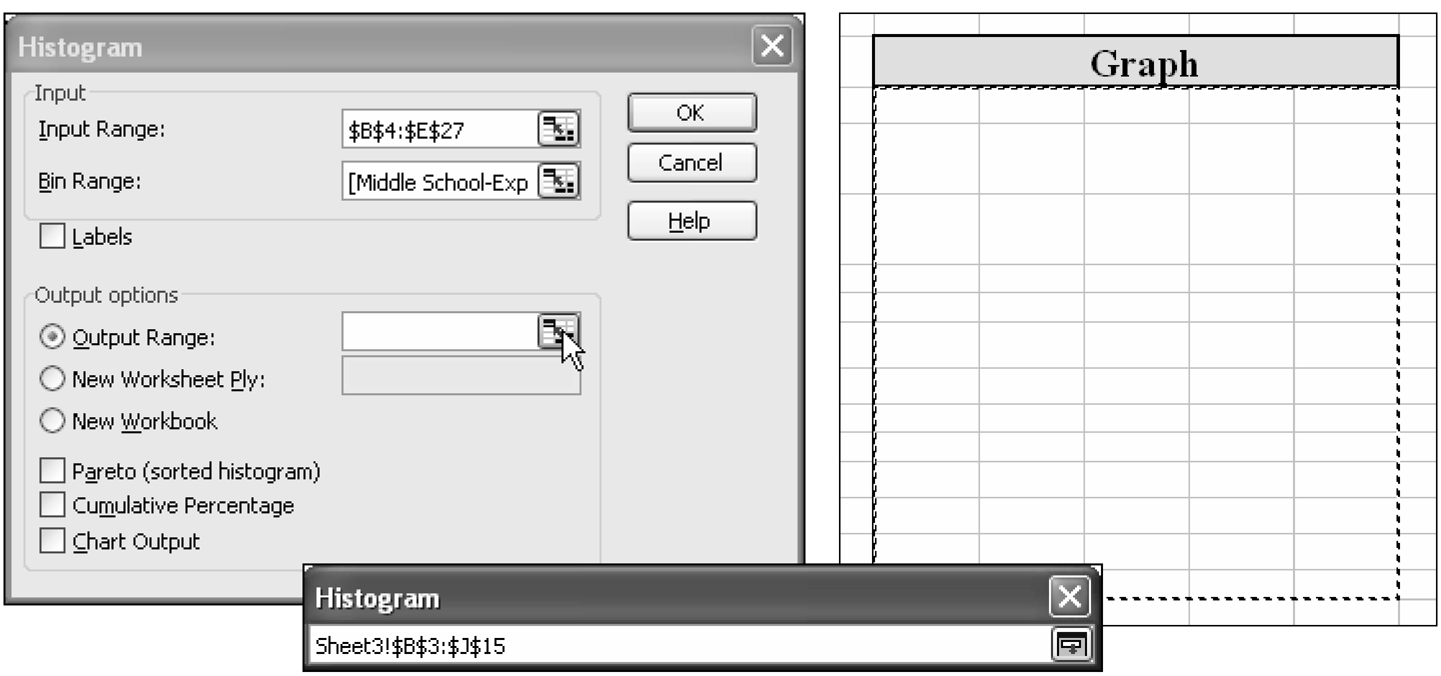


Data Pieces			
0 to 9	10 to 19	20 to 29	30 to 39
0	10	28	30
4	14	24	30
5	25	24	37
3	19	26	36
3	16	21	34
5	14	28	32
7	17	29	32
8	12	29	32
8	13	26	32
8	14	25	36
9			34
9			35
4			34
5			37
1			38

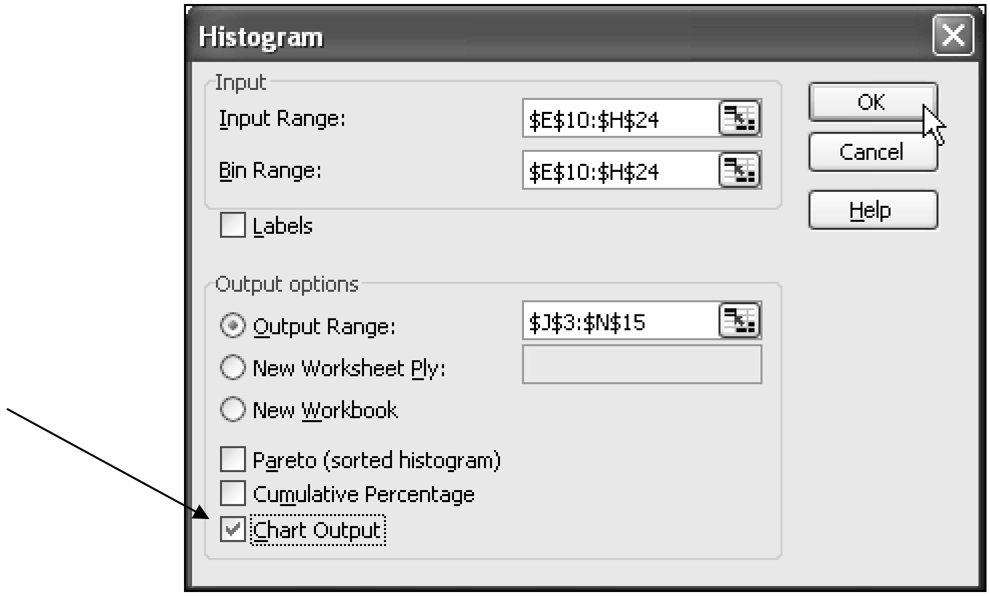
6. Click the **Bin Range** icon. You may need to select **Sheet 3** before, highlighting the cells that contain your Bin values and then click on the **Import** icon.

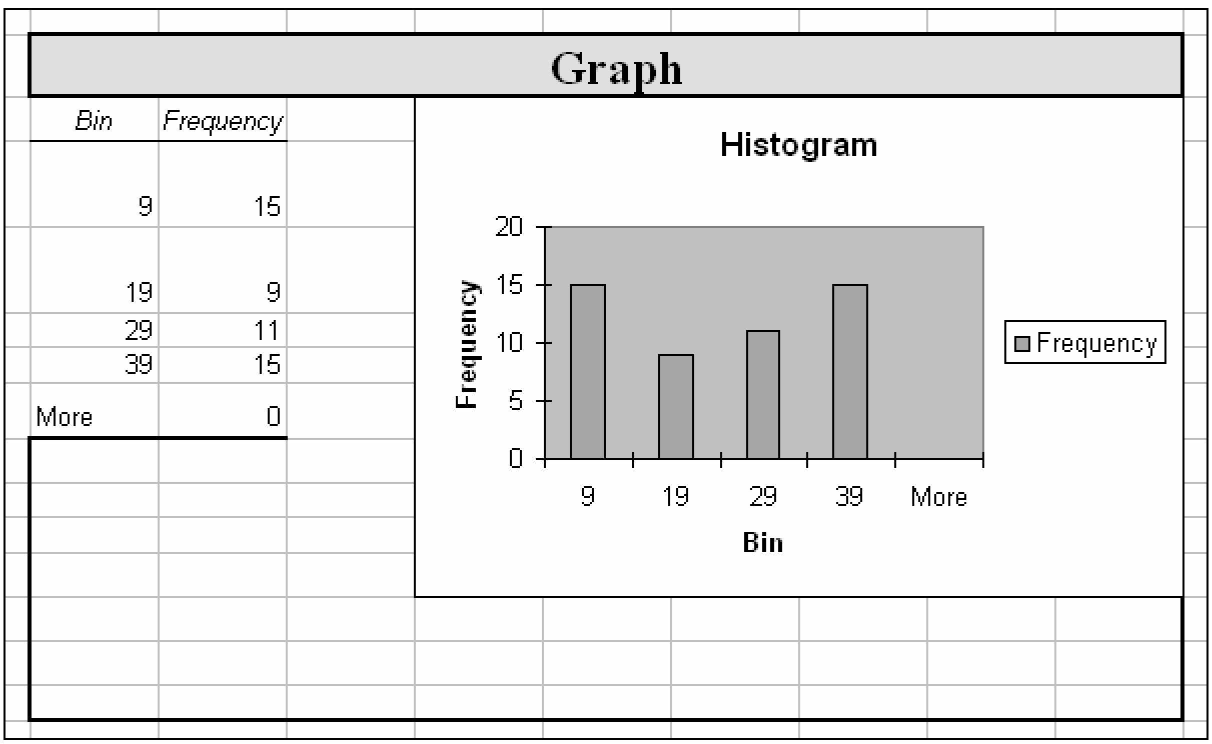


7. Under **Output Options** select **Output Range,** and click the **Output Range** icon. The Output Range allows you to choose where the histogram will appear on the spreadsheet. You may need to select **Sheet 3** before selecting the empty cells below the Graph section of the spreadsheet, and then click on the **Import** icon.

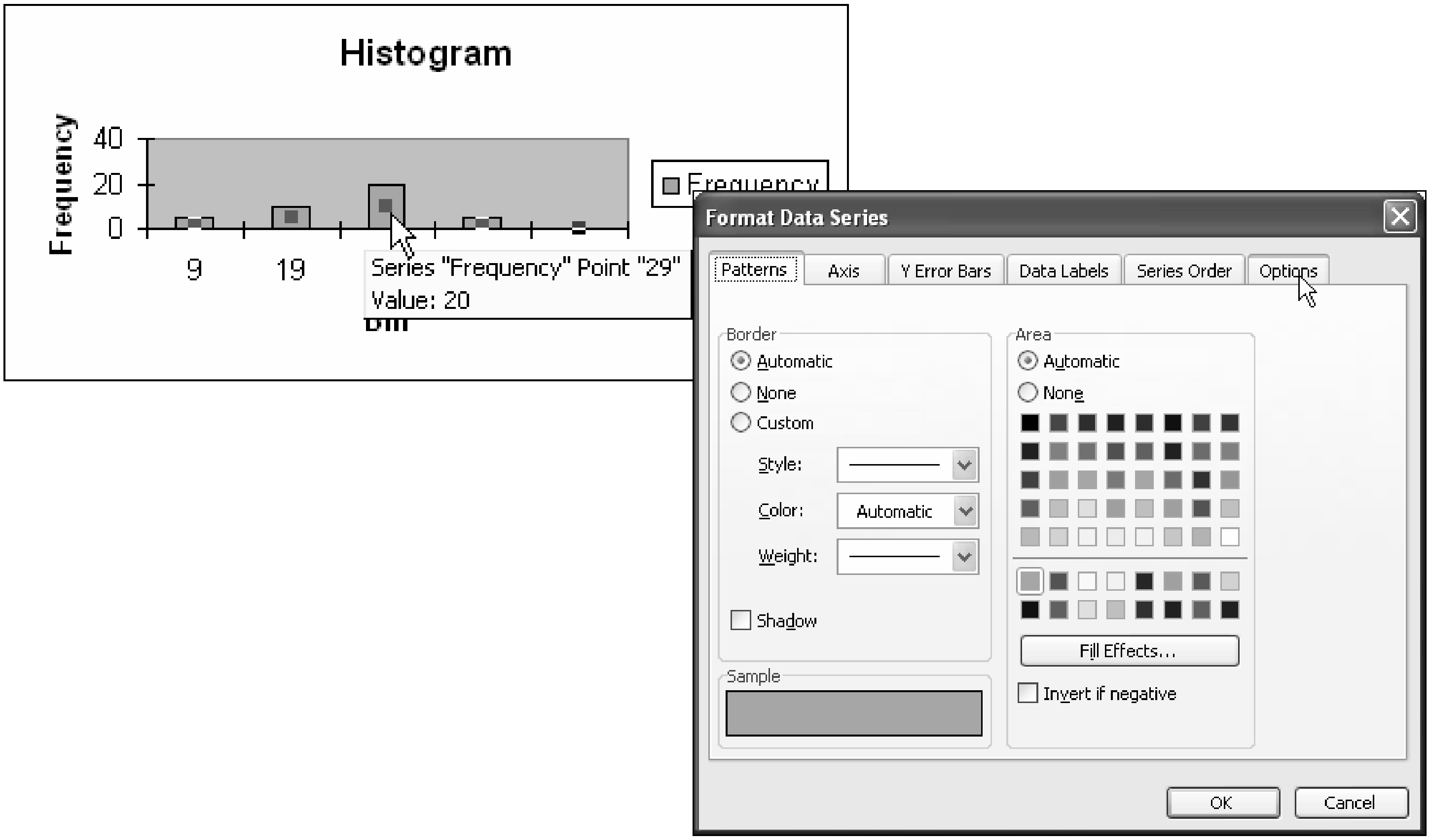


8. Then select **Chart Output** and click **OK.**

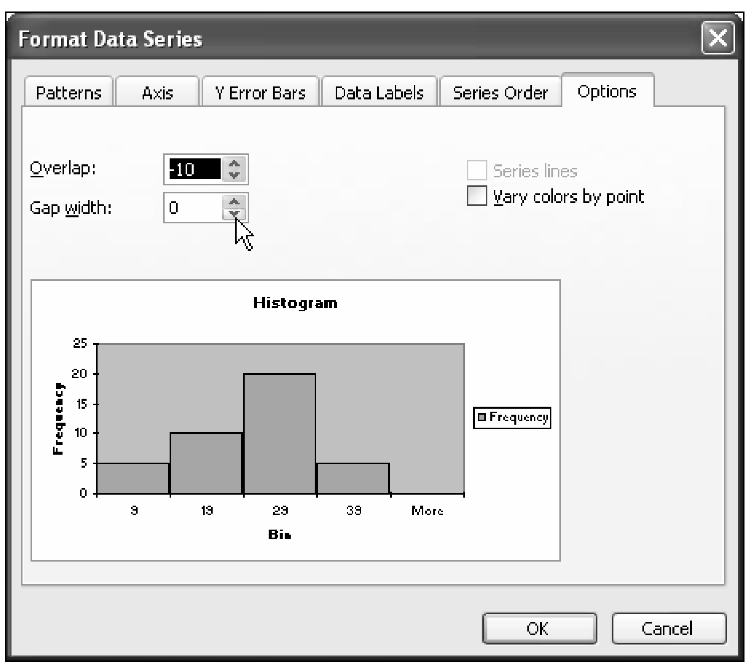




9. **Double Click** on the middle of a bar in the graph. Select **Options**



10. Choose **Option** and change **Gap Width** to 0. Click **OK**.



11. To adjust the size of the graph, click in the area between the graph and the border. Click and drag a corner handle until the graph is the correct size.

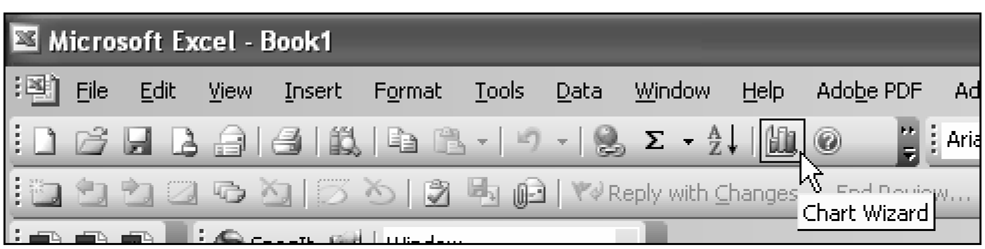
II. Pie Graph

1. Open the **Excel** document **Middle School-Explore Explain 2 Spreadsheet.xls**.

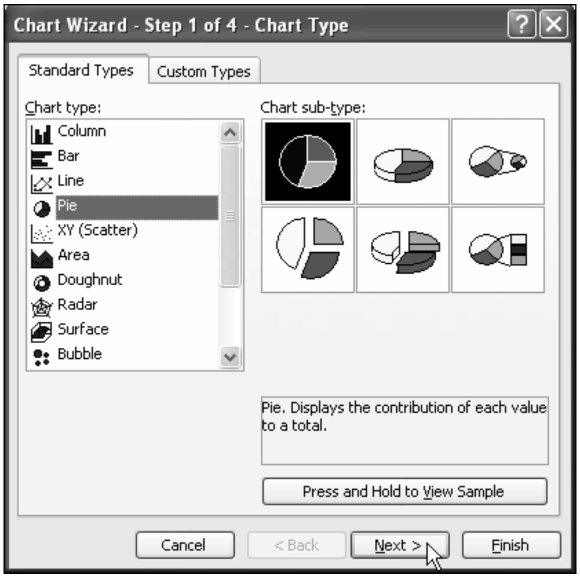
2. Select **Sheet 2**, and highlight data pieces by clicking on cell **B4** and dragging down to cell **E18**. The numbers will be highlighted by "marching ant" tracks.

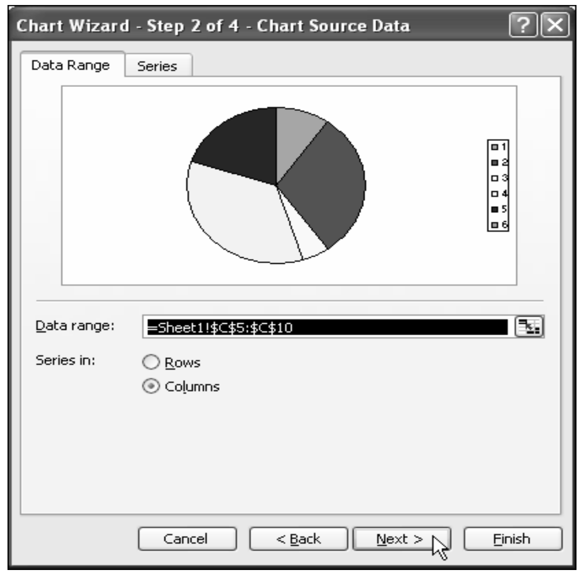
Data Pieces			
0 to 9	10 to 19	20 to 29	30 to 39
0	10	28	30
4	14	24	30
5	25	24	37
3	19	26	36
3	16	21	34
5	14	28	32
7	17	29	32
8	12	29	32
8	13	26	32
8	14	25	36
9			34
9			35
4			34
5			37
1			38

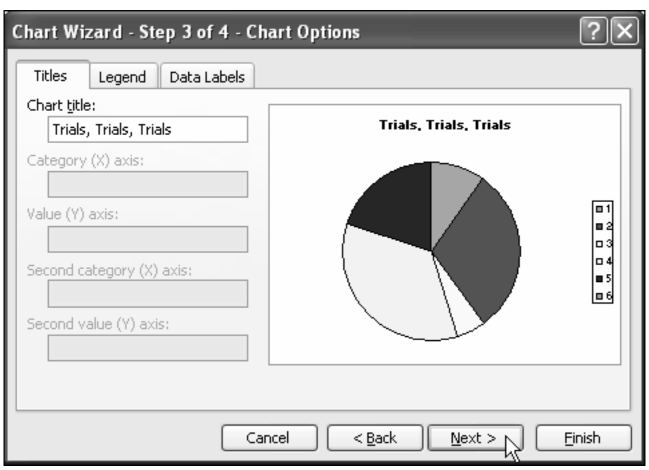
3. Select the Chart Wizard in the toolbar

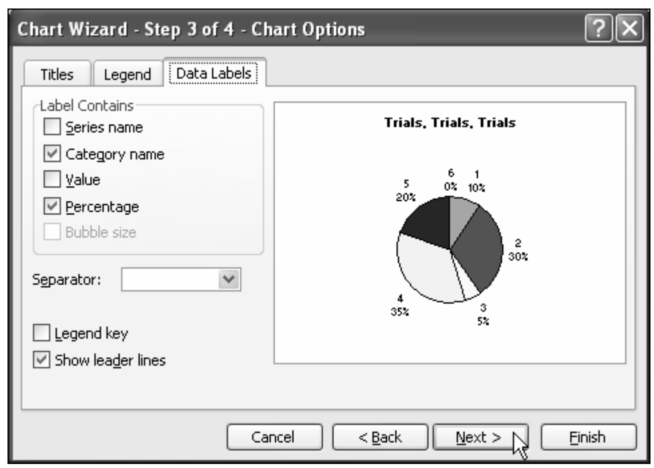


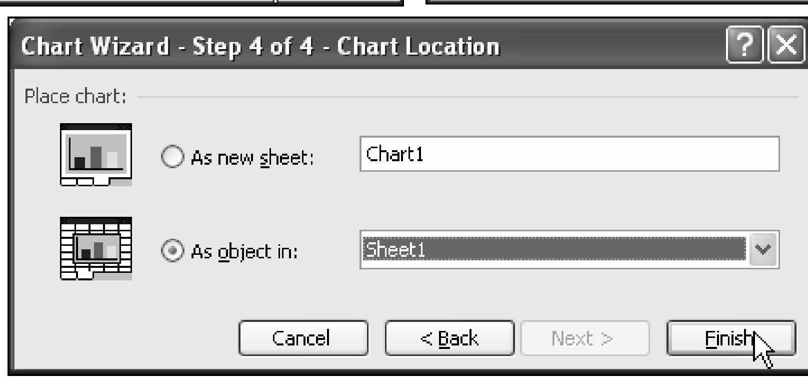
4. **Step 1**: Select the **Pie** chart type, and then click **Next**.
   Step 2: Since the data was highlighted first click **Next**.
   Step 3: Enter a **Chart tile** (Trials, Trials, Trials), then select the **Data Labels** tab and check **Category name**, **Percentage** and click **Next**.
   Step 4: Select **As object in**, and then **Finish.**











5. A graph will appear on the spreadsheet.

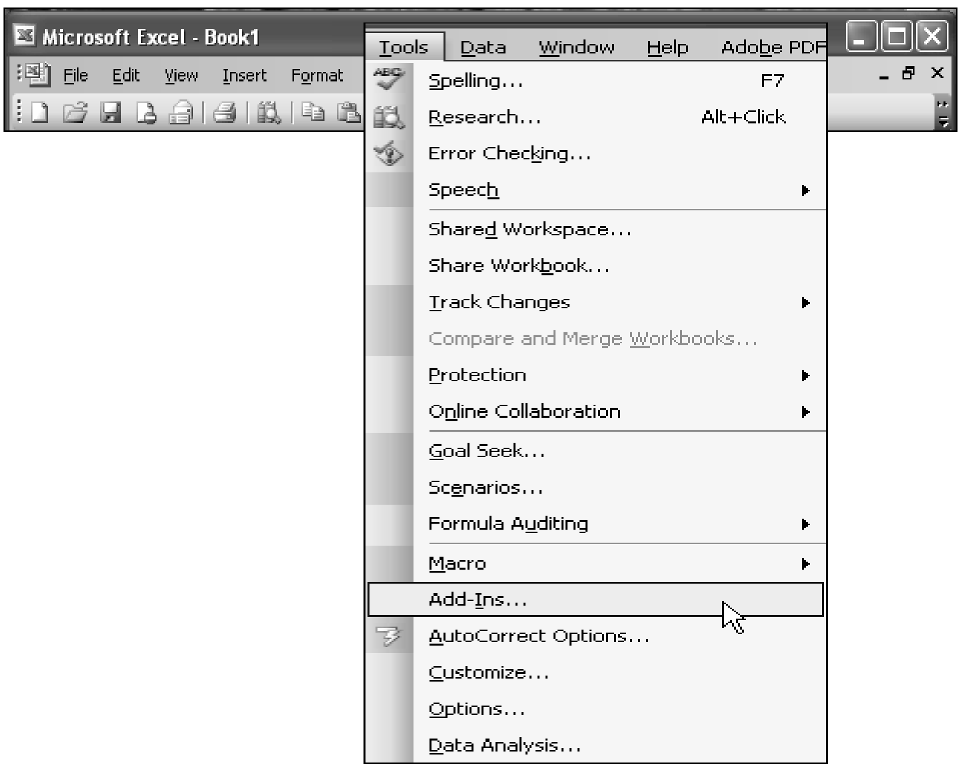
6. To adjust the size of the graph, click in the area between the graph and the border. Click and drag a corner handle until the graph is the correct size.

Technology Tutorial: Loading Data Analysis Toolpak

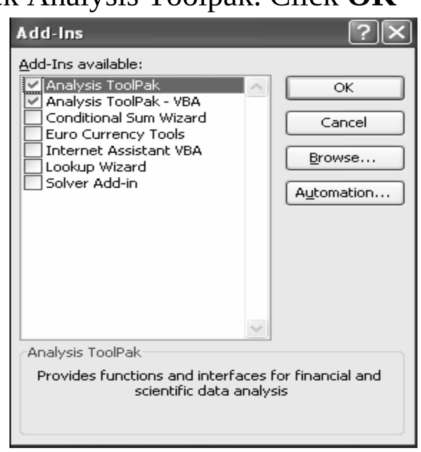
Advance Preparation: Loading the Toolpak

You must load the Data Analysis Toolpak before you can generate a histogram using Excel. If the Data Analysis Toolpak is not under the Tools menu, complete the following steps to load the Toolpak.

1. Click **Start**, **Programs**, **Microsoft Office**, **Microsoft Office Excel**.
2. Open an **Excel**  document.
3. In the toolbar under the **Tools** menu, click **Add-Ins**.



4. In the Add-Ins box, check Analysis Toolpak. Click **OK**



5. The **Data Analysis** Toolpak can now be found in the **Tools** menu.

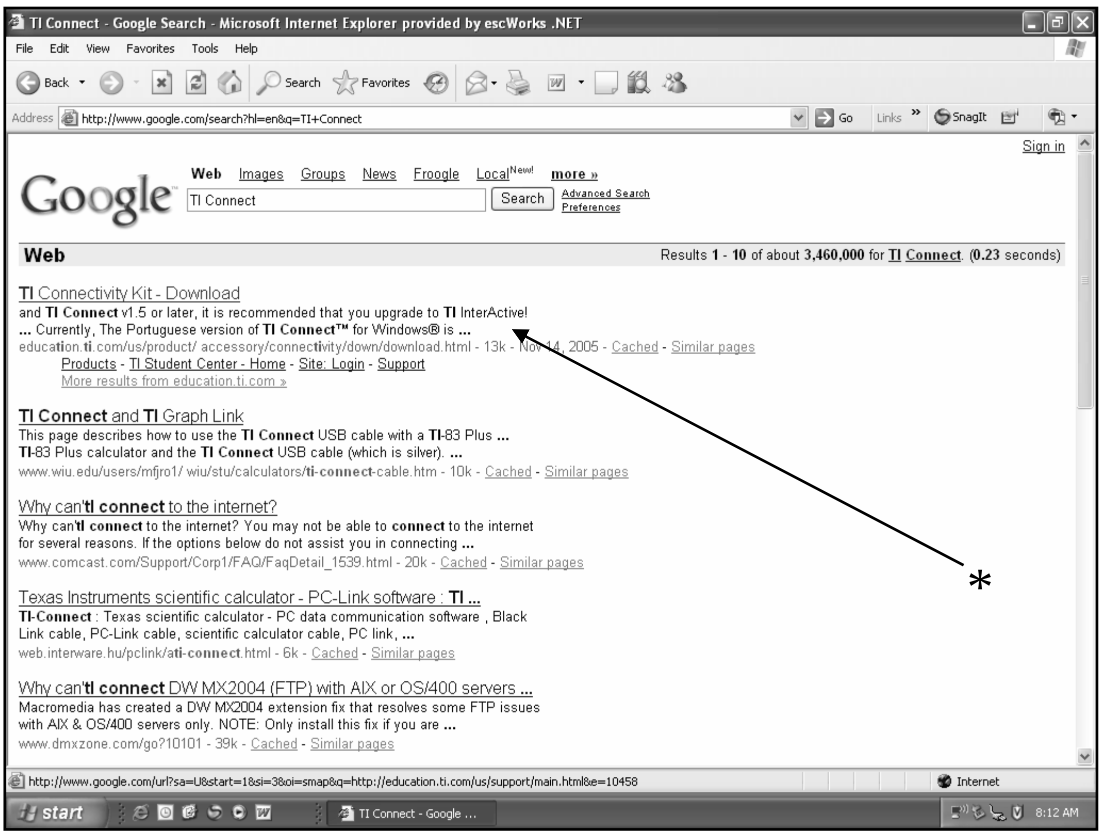
Technology Tutorial: Loading TI Connect

TI Connect is a linking software used to download and transfer data, and connect calculator, computer and internet platforms.

Note: In order for TI Interactive 1.3 software to interface with the TI Connect software a 1.5 or higher version of TI Connect must be downloaded.

Advance Preparation

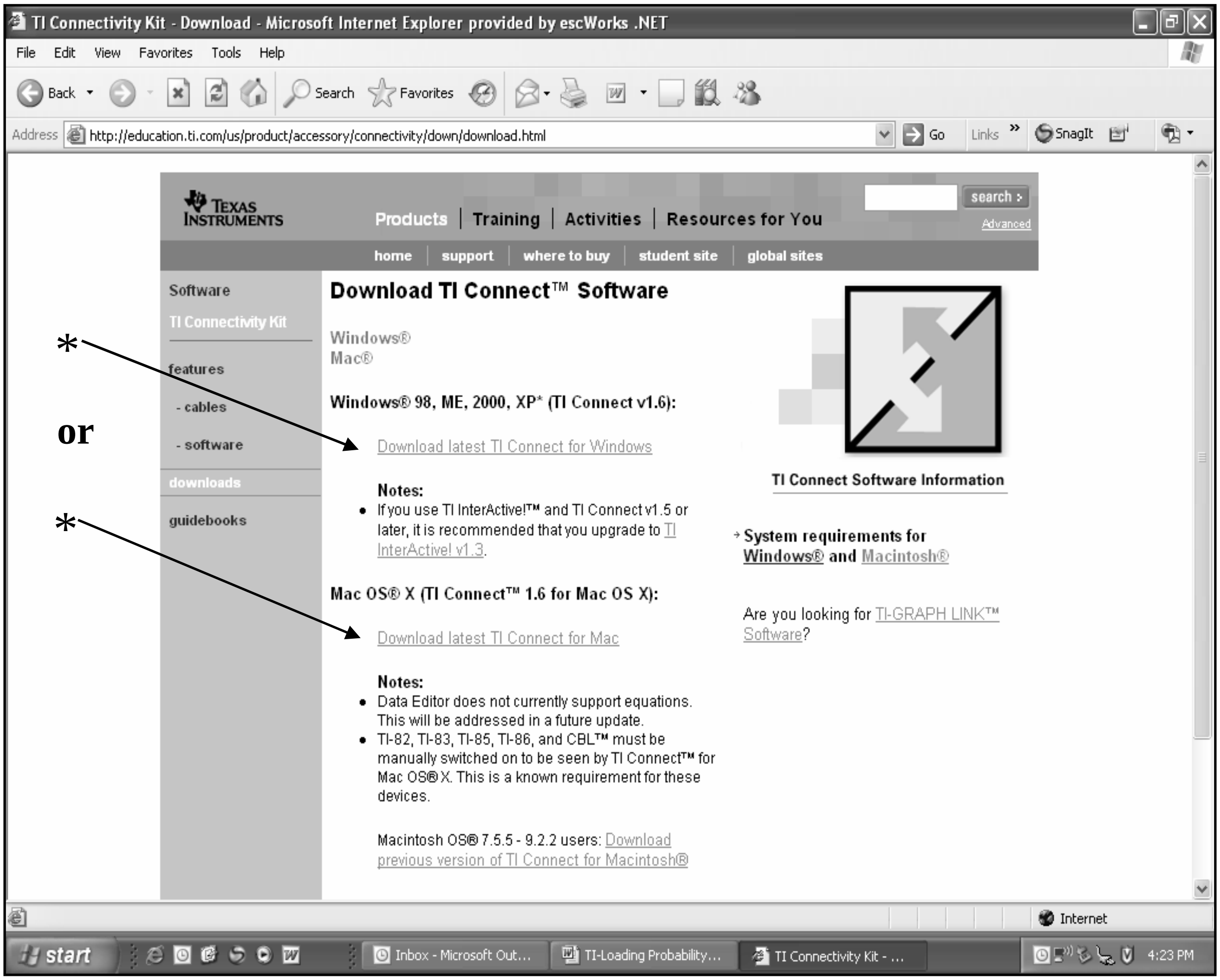
Google search: TI Connect, select TI Connectivity Kit (*) and Bookmark.
Website: Appearance of the Texas Instruments website may differ.
http://education.ti.com/us/product/accessory/connectivity/down/download.html



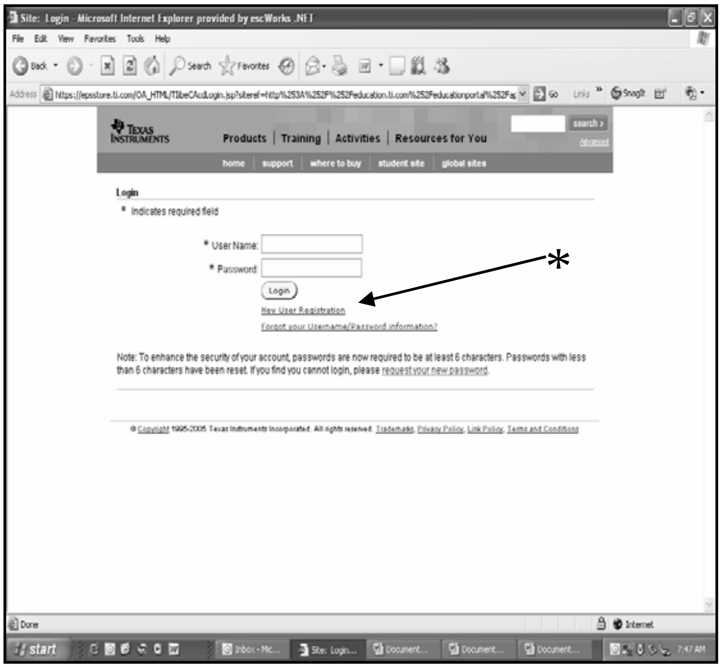
1. TI requires a registration/login process to the website. Registration/Login process follows:

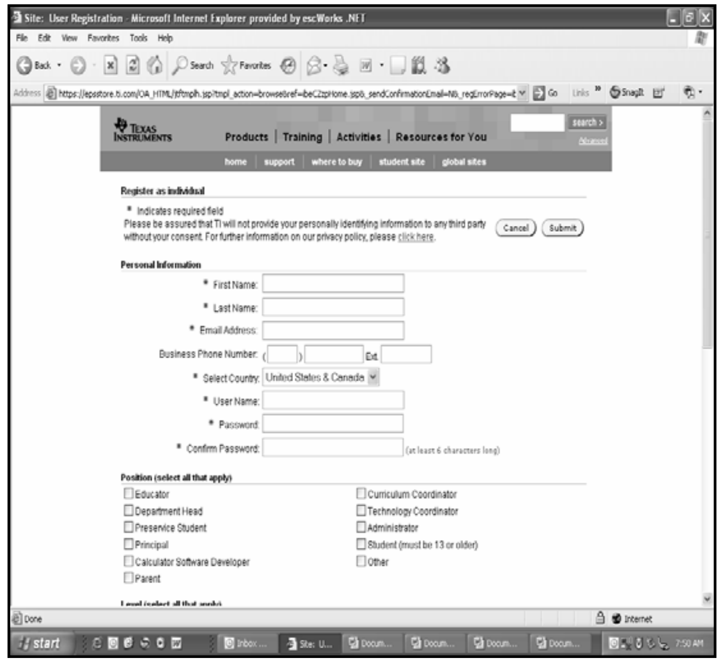
   A. Google/Browse to website, if bookmarked use bookmark:
   http://education.ti.com/us/product/accessory/connectivity/down/download.html

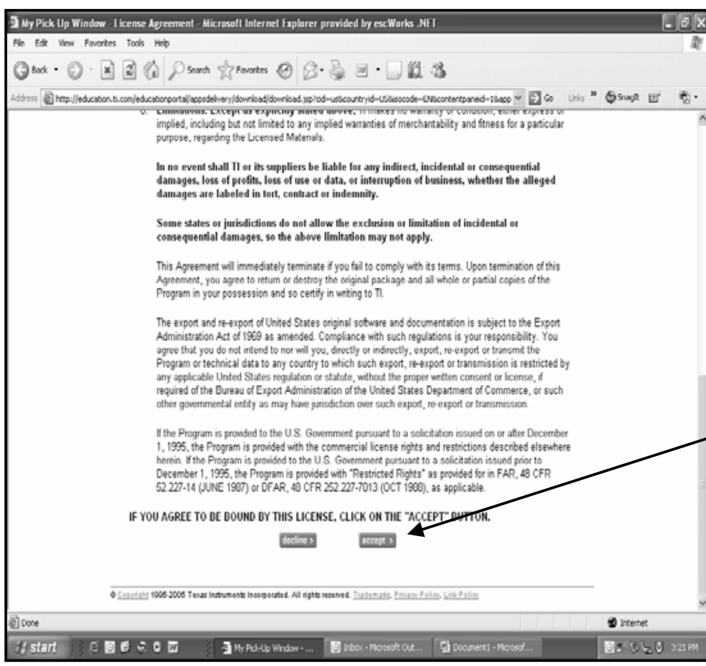
B. Select the appropriate computer platform (*). If a **Security Alert** window pops up click **OK**.



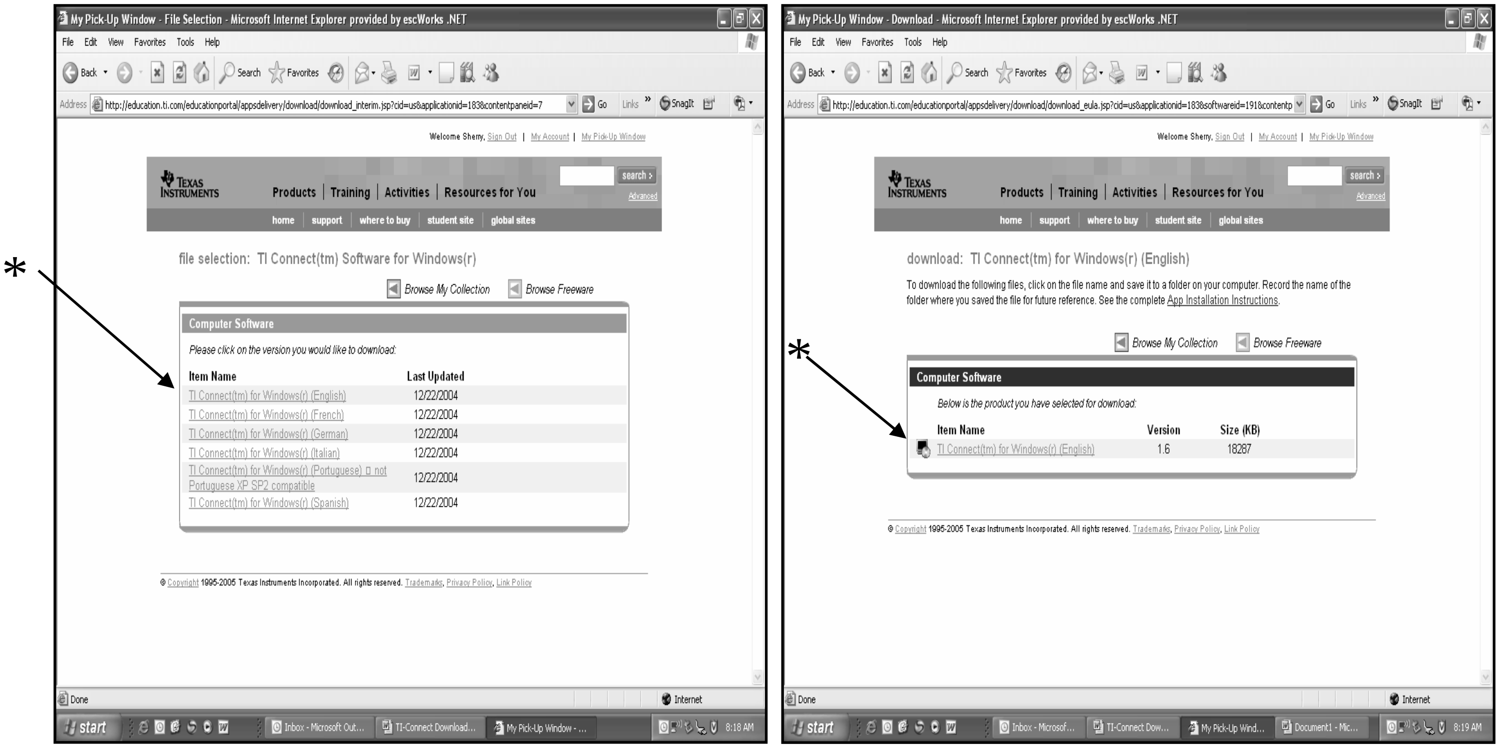
C. The registration/login process will begin at this point. Select **New User Registration** or input **User Name** and **Password**. Personal information and an agreement with terms will follow for new users. As illustrated below (*). If a **Security Alert** window pops up click **YES**.



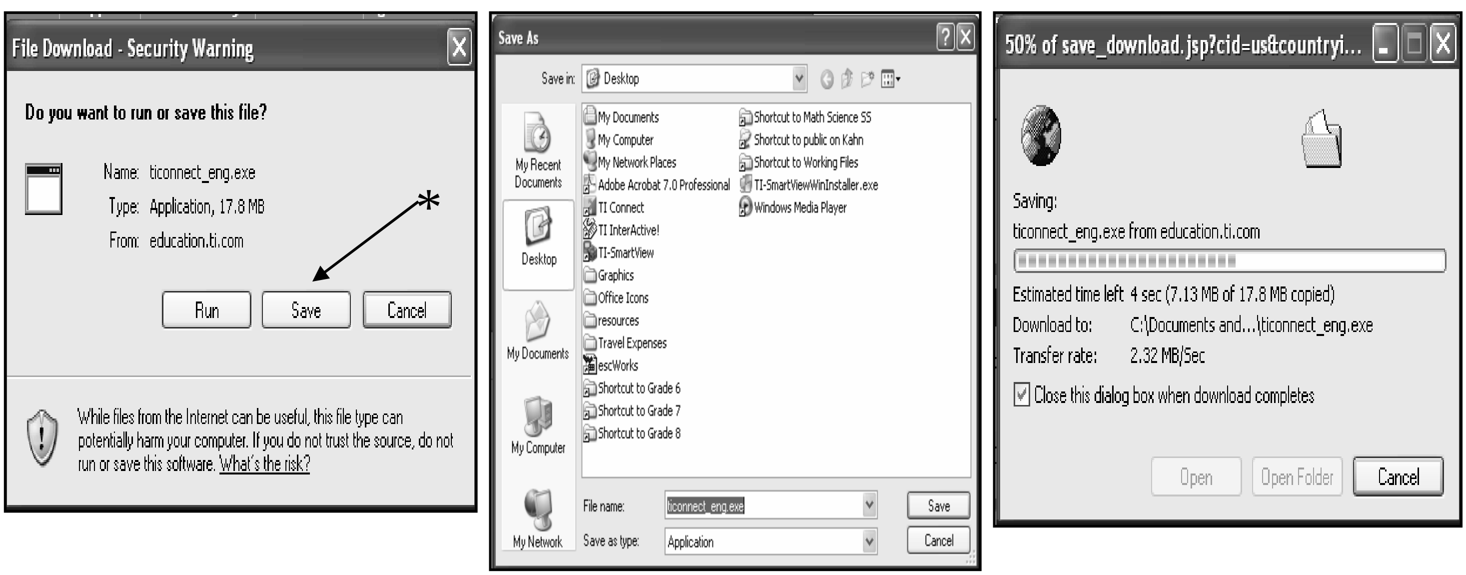


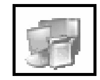


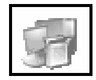
2. Select the **TI Connect(tm)** language platform that is appropriate. Then click on the file name (*). Example: Windows (English) version was selected.

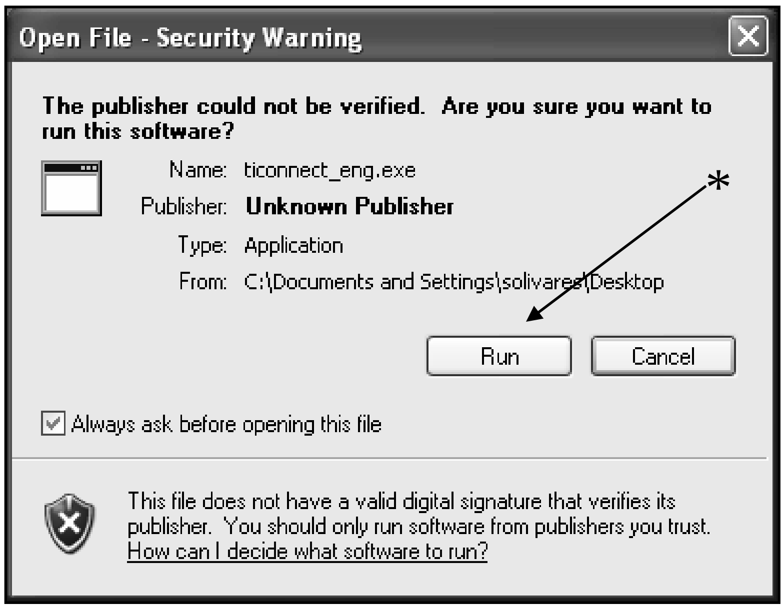


3. Select **Save** (*), and save to the **Desktop**. Download will begin.

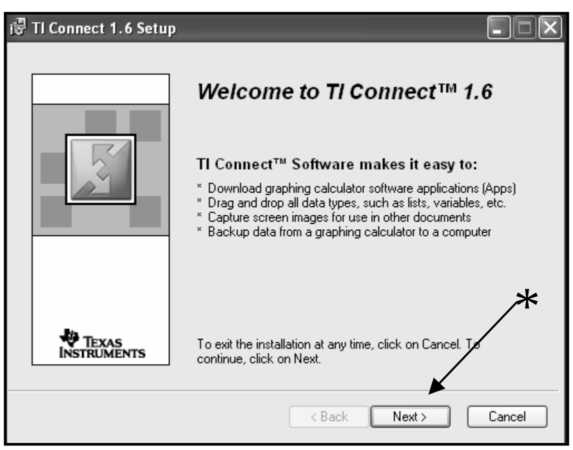


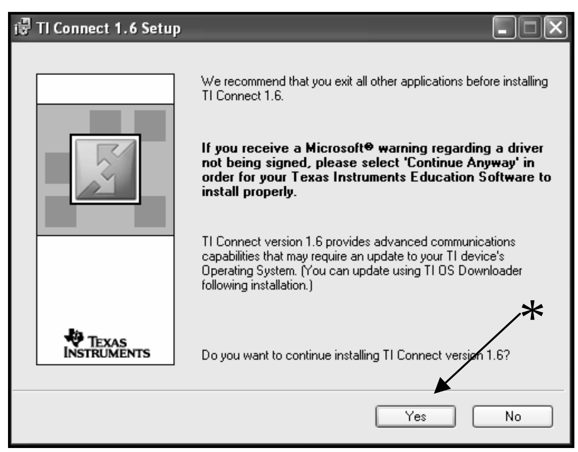
4. Once download is complete, close all windows. A **TI Connect_eng.exe** icon  will appear on the desktop.

5. Double click on the **TI Connect_eng.exe** icon  , and run set up.

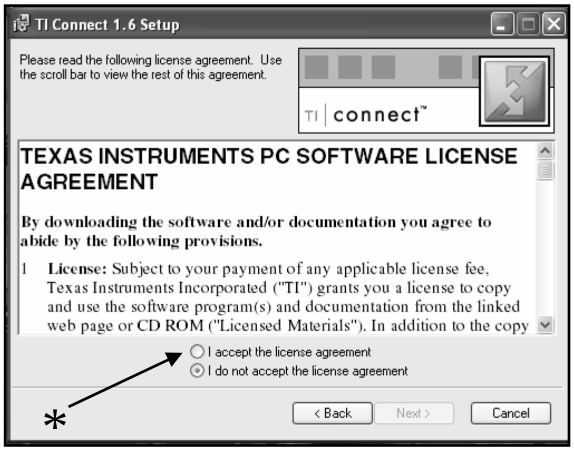


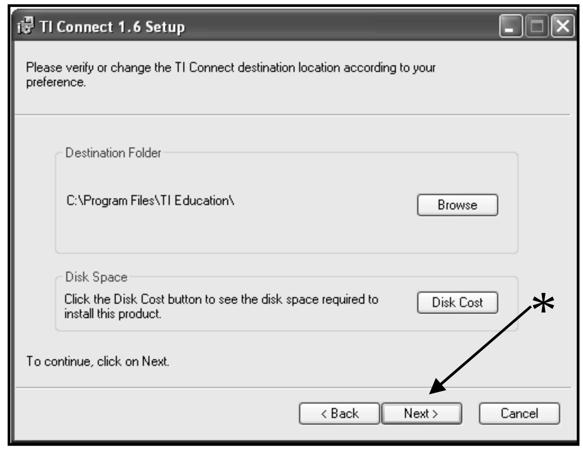
6. The **TI Connect Set**-up will go through several windows including a software license agreement.

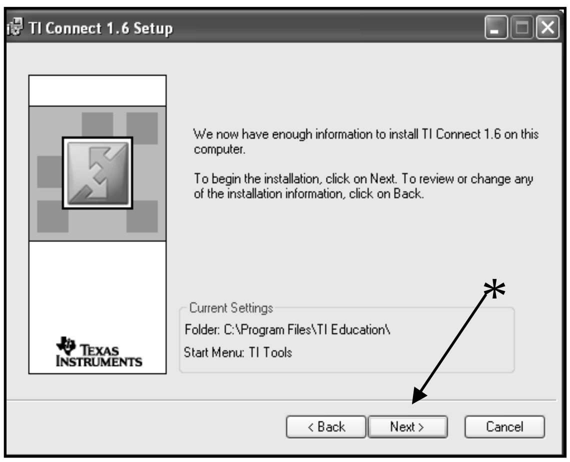


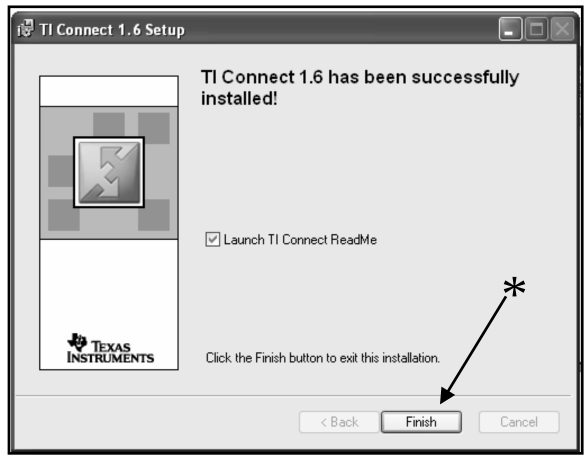


(continue)

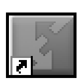








7. Close all windows when setup is complete.

8. A **TI Connect** icon  will appear on the desktop.

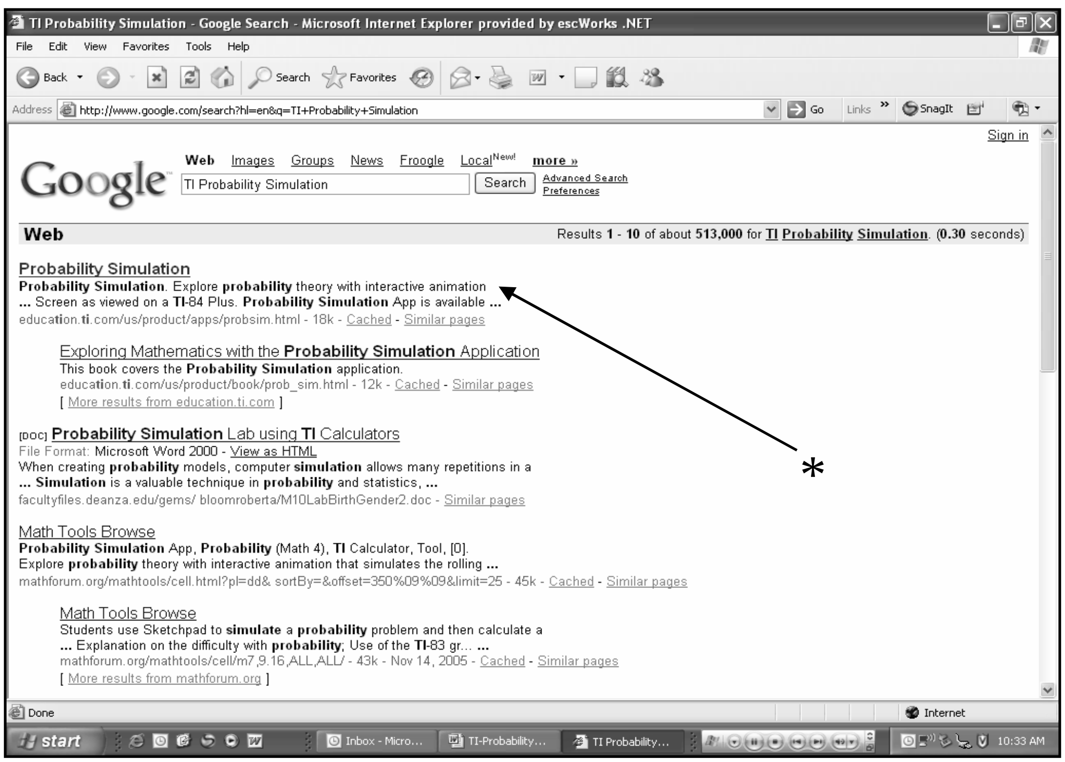
9. Drag the **TI Connect _eng.exe** icon to the trash can, and delete.

Technology Tutorial: Loading TI Probability Simulator APPS

The TI Probability Simulation APPS is an application software with interactive animation of the following probability situations: tossing coins, rolling dice, drawing marbles, spinning spinners, drawing cards, and generating random numbers. The TI Probability Simulator APPS requires the TI-73 Operating System 1.6.

Advance Preparation

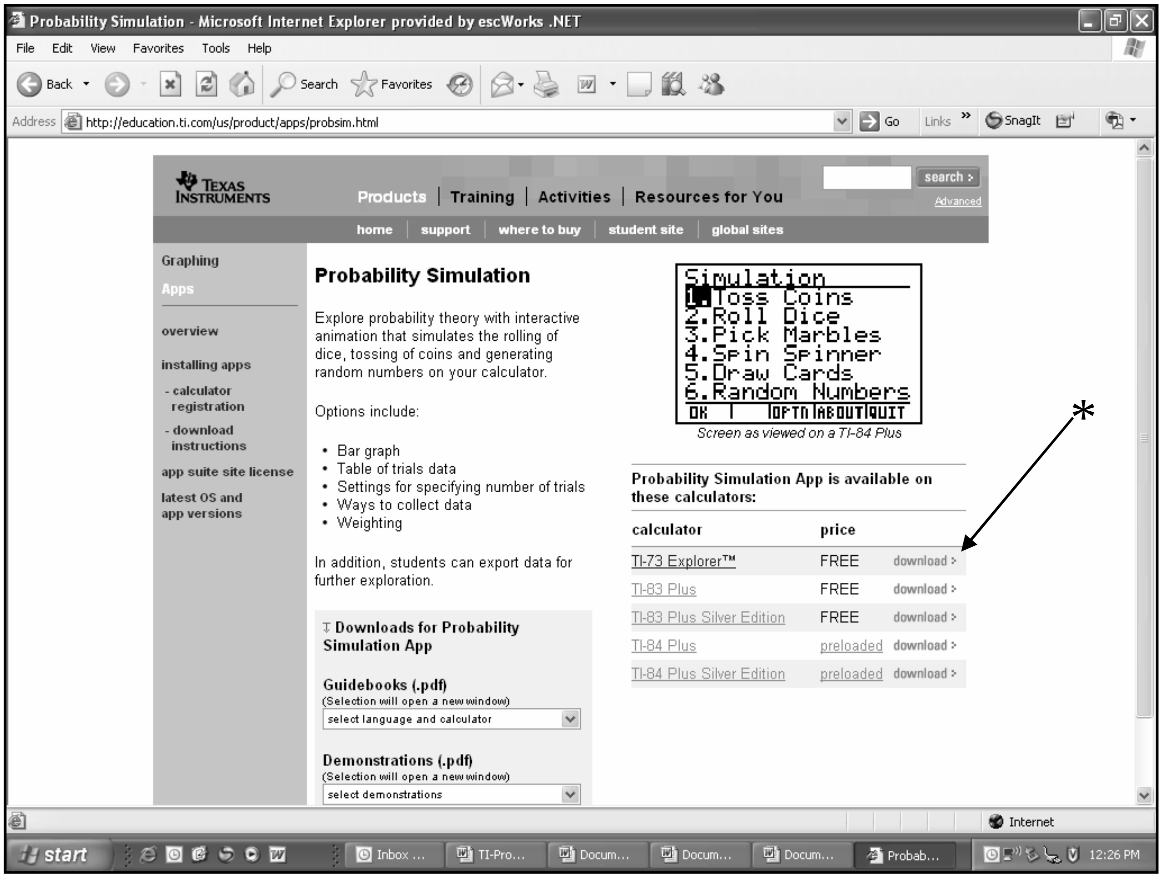
- Check for TI Connect software on computer; if not loaded, load using Technology Tutorial **Loading TI Connect**.
- If the computer has TI Interactive, make sure it is version 1.3 or higher.
- Connect a TI-73 calculator to a computer with internet access using a **TI Silver Graph Link**. Be sure to turn on the calculator.
- Google and Bookmark the website (appearance of the Texas Instruments website may differ): http://education.ti.com/us/product/apps/probsim.html



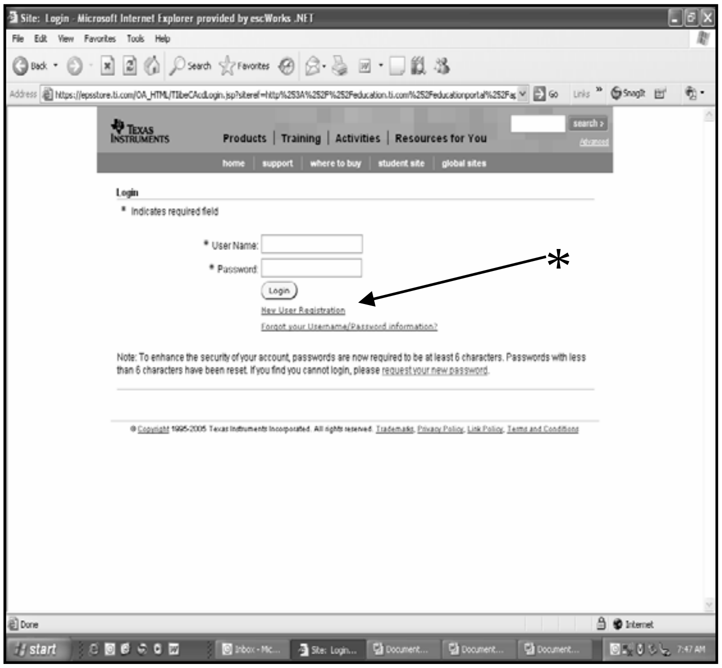
1. TI requires a registration/login process to the website. Registration/Login process follows:

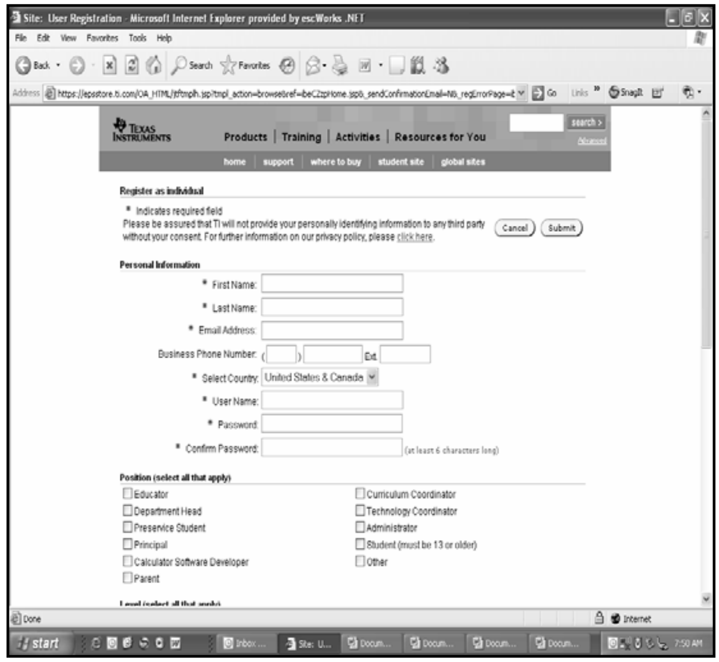
   A. Google/Browse to website, if bookmarked use bookmark: http://education.ti.com/us/product/apps/probsim.html

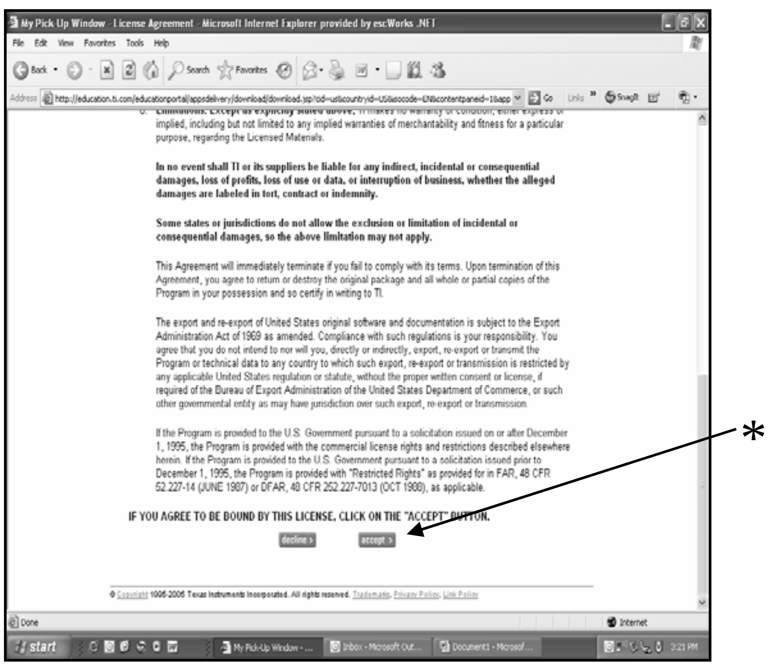
B. Select **download** for the appropriate calculator. For Example: TI-73 Explorer (*) was selected. If a **Security Alert** window pops up click **OK**.



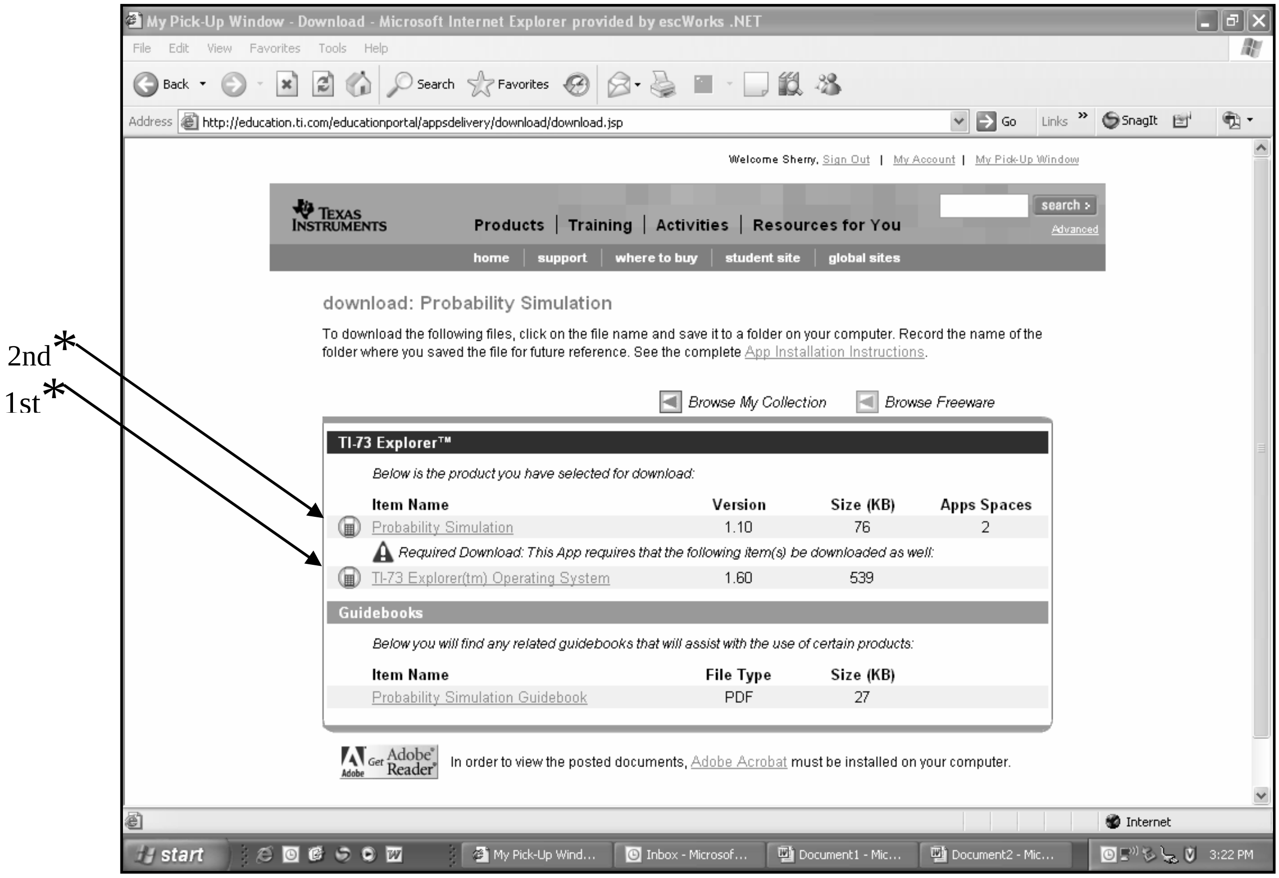
C. The registration/login process will begin at this point. Select **New User Registration** (*) or input **User Name** and **Password**. Personal information and an agreement with terms will follow for new users, as illustrated below (*). If a **Security Alert** window pops up click **YES**.



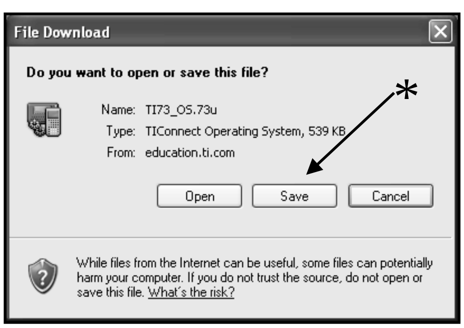


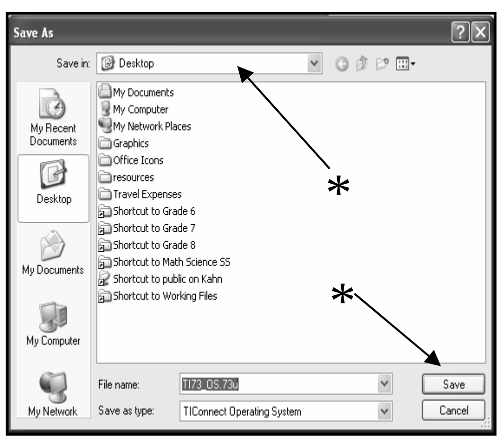


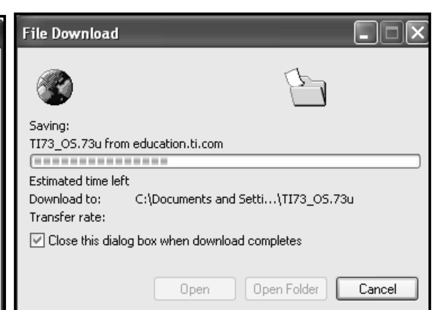
2. You will need to download the **TI-73 Explorer(tm) Operating System** first, followed by the **Probability Simulation** (*). For Example: **TI-73 Explorer(tm) Operating System** was selected first.

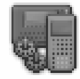


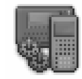
3. Select the **TI-73 Explorer(tm) Operating System,** select **Save** (*), and save to the **Desktop**. Download will begin.



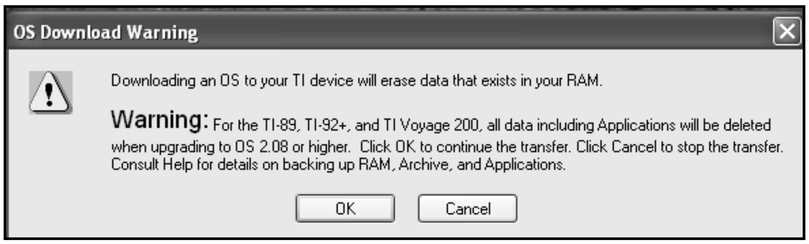




4. Once download is complete, minimize the window, **My Pick-Up…**. A **TI Operating System** icon  will appear on the desktop.

5. Click and drag the **TI Operating System** icon  <u>onto</u> the **TI Connect** icon .

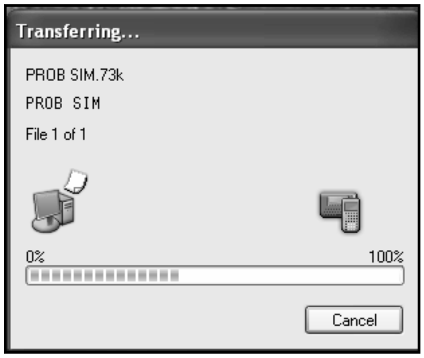
6. A **OS Download Warning** will appear, click **OK**. (*Note: all applications on the calculator will be deleted when upgrading to the new operating system.)*



7. Transferring of the operating system to the TI-73 calculator will begin. While the operating system is transferring, the graphing calculator will read: Receiving Calculator Software. This process will take about 5 to 10 minutes. Once you have downloaded the operating system, the calculator will read: Validating Calculator Software followed by Graph Explorer Software 1.60 title screen.

8. Maximize the window, **My Pick-Up**. Repeat steps 2-5 for downloading the **Probability Simulation**. If a **Document and Setting** window pops up click and **OK**, then restart download by selecting the **Probability Simulation** again.

9. Transferring of the **Probability Simulation APPS** will begin and the TI-73 calculator will read: Receiving Pro Sim APP. This process will take about 1 minute.



10. Check to see if you have downloaded the **Probability Simulation APPS** correctly onto the calculator, by selecting the [APPS] key on the calculator. If the download was successful a new application titled **Prob Sim** will be in the list.

11. Drag to trash the **TI Operating System** and the **Probability Simulator** icon to the trash can and delete.

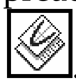
Technology Tutorial: TI-Interactive: The Big Question Presenter(s) Spreadsheet

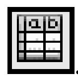
Create a Presenter(s) Spreadsheet before starting the activity. This will enable the presenter(s) to flow between each group's data efficiently.

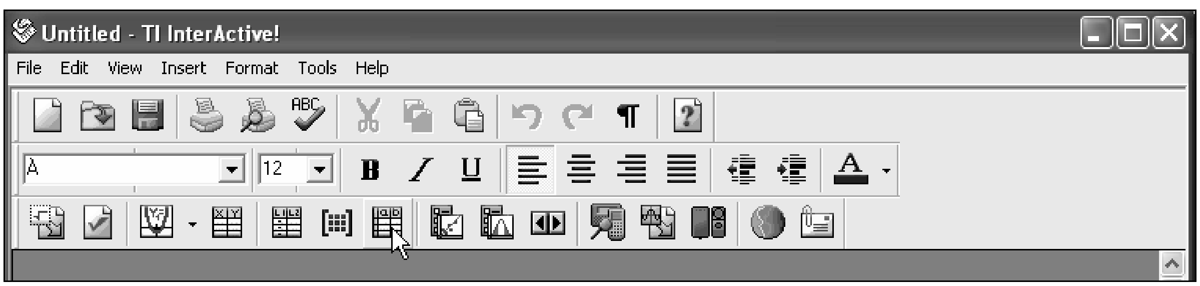
Advance Preparation

- Load TI-Interactive 1.3 software (will need to be purchased) onto computer: See TI-Interactive instructions manual.
- Load TI-Connect 1.5 software onto computer: See Loading TI Connect Technology Tutorial.

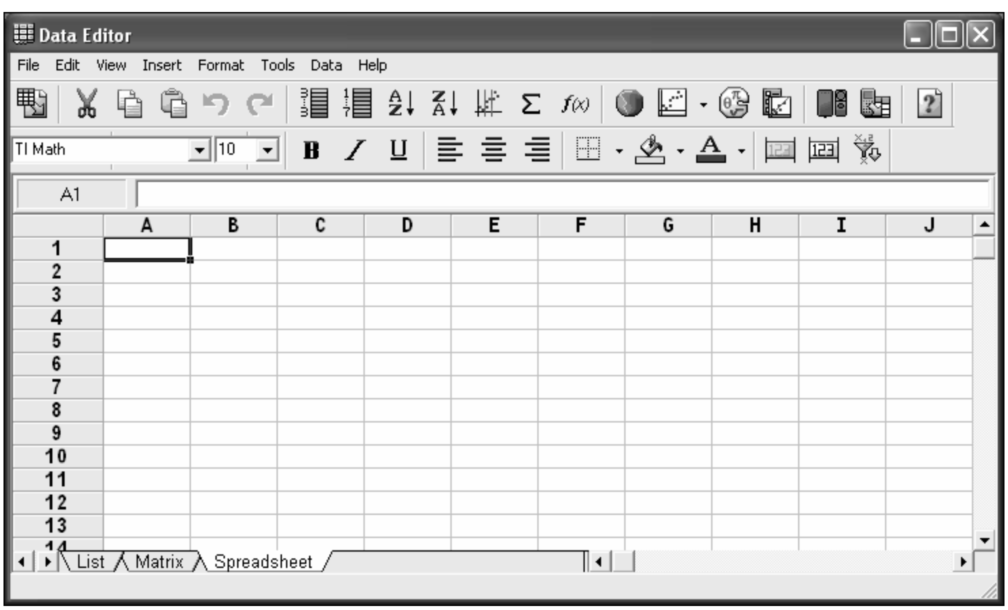
Create Presenter(s) Spreadsheet

1. Open TI-Interactive .

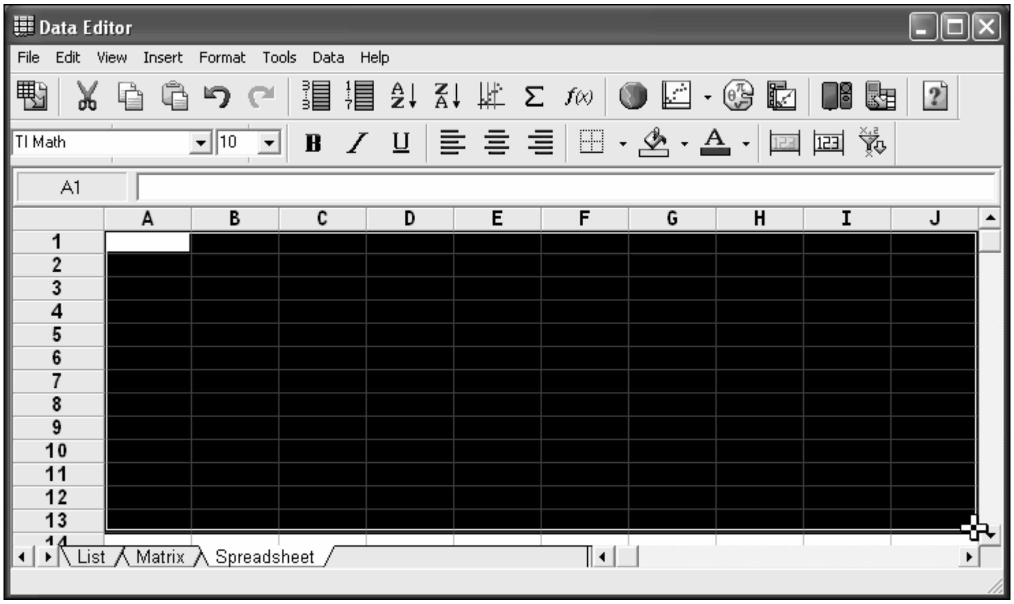
2. In the toolbar select the **Spreadsheet** icon .



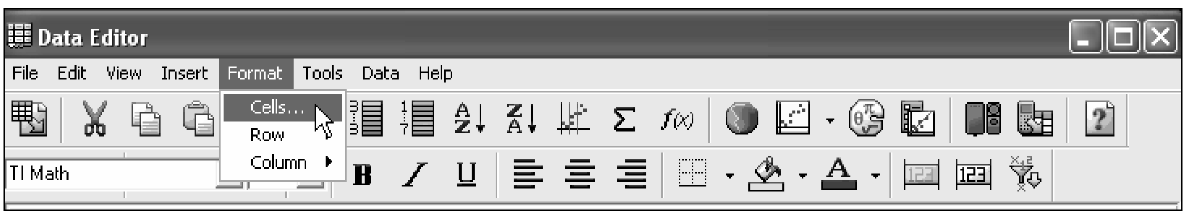
3. A spreadsheet will be activated in the form of a **Data Editor**.



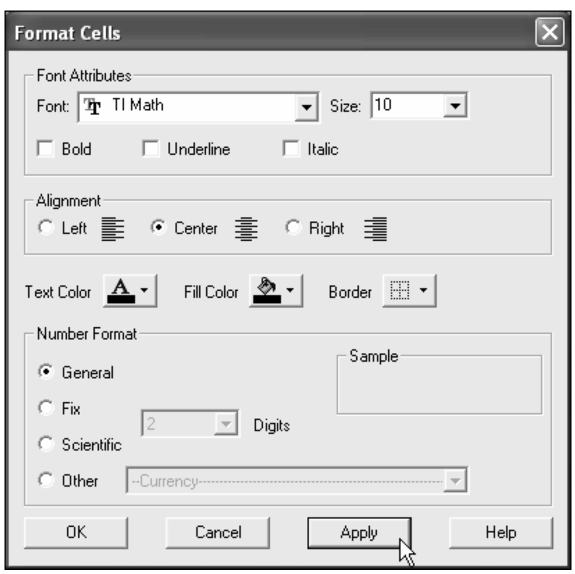
4. Starting with cell **A1** click and drag to the lower right-hand side of the spreadsheet until all cells are highlighted.



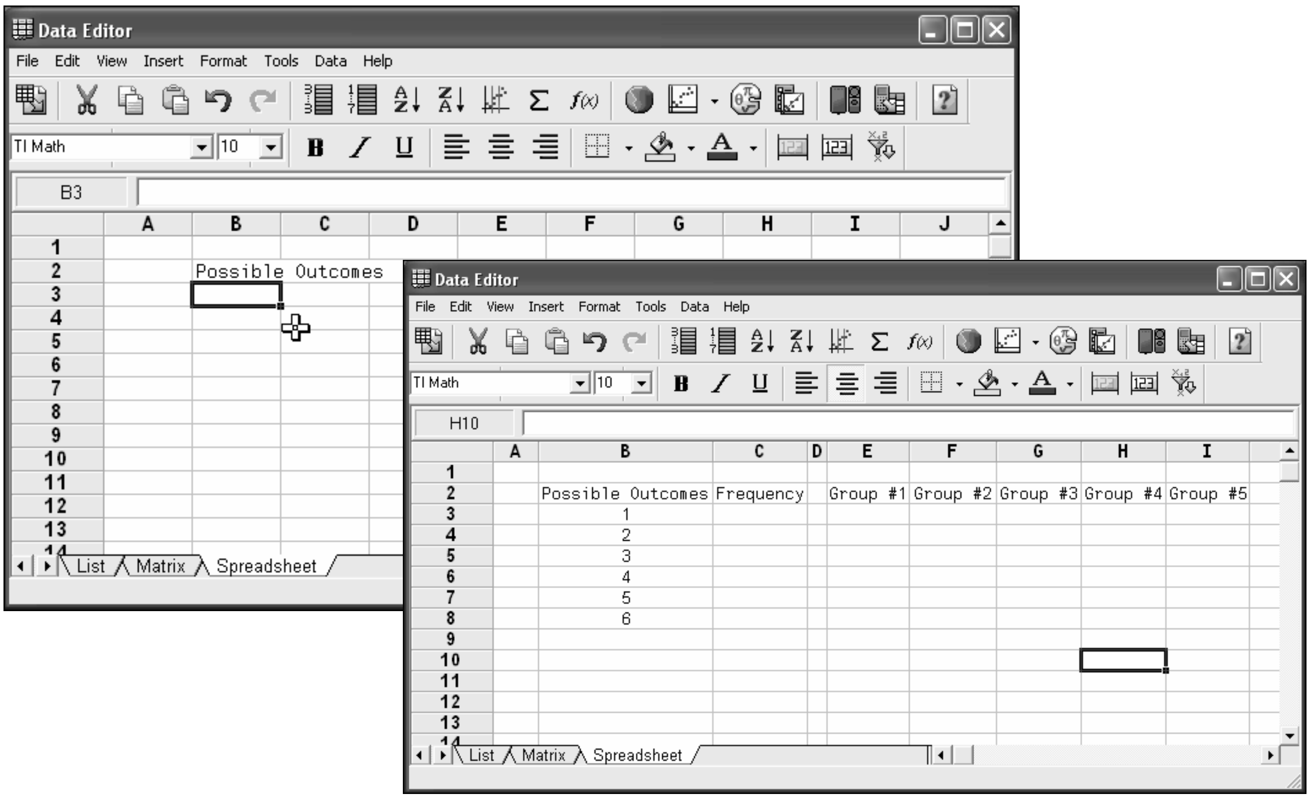
5. In the tool under the **Format** menu select **Cells**.



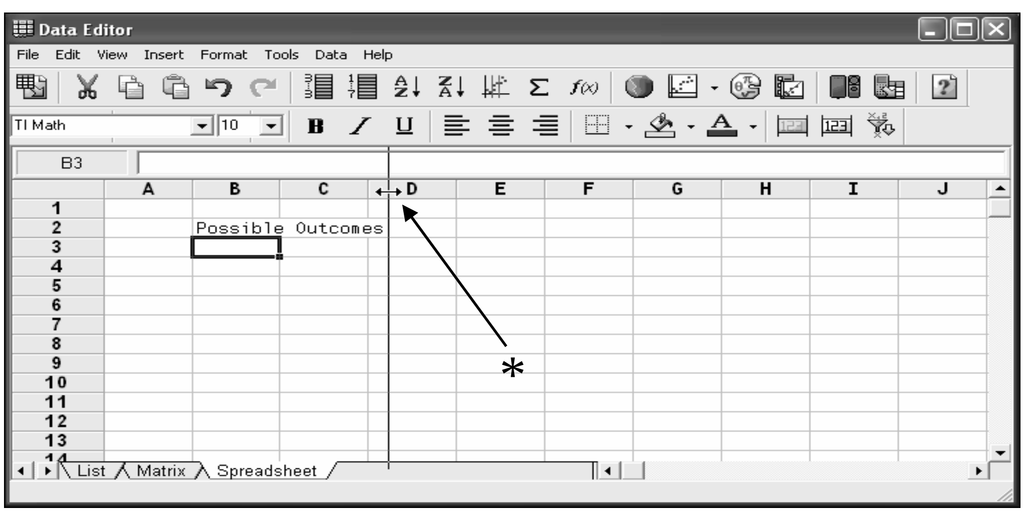
6. Set Alignment to **Center** and Number Format to **General**, select **Apply** and then **OK**.



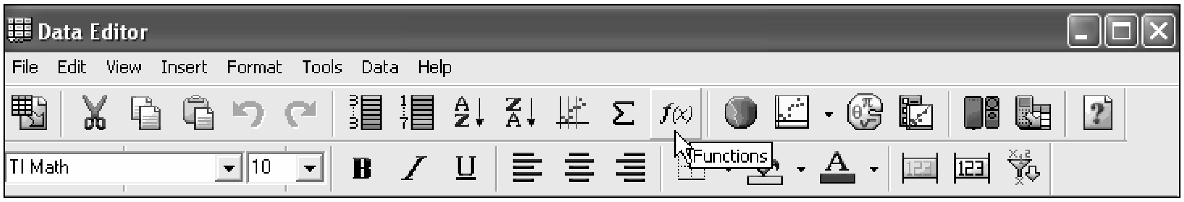
7. Click on cell **B2** and type in **Possible Outcomes**, then **Enter**. Continue until you have set up all labels and groups. Some columns may need to be resized; instructions for resizing are below illustration. *Note: if more than five groups are needed just include another column labeled accordingly. Also, if fewer than five groups participate in the activity, having extra columns set up will not affect the outcome of the calculations. It is better to have too many groups set up, than too few.*



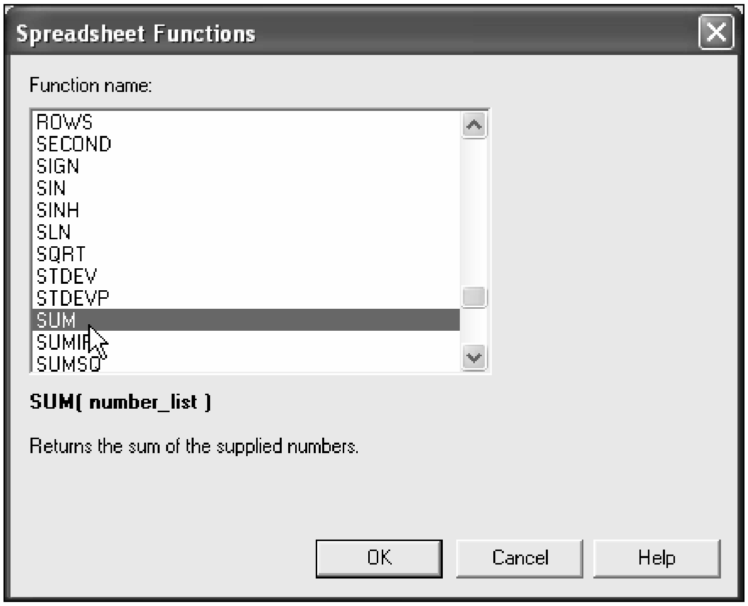
To resize column width or roll height: move curser into the column labels (or roll labels) when the curser changes from a pointer to a **two sided arrow** (*) and a **resizing line** appears, click and drag to the desired size.



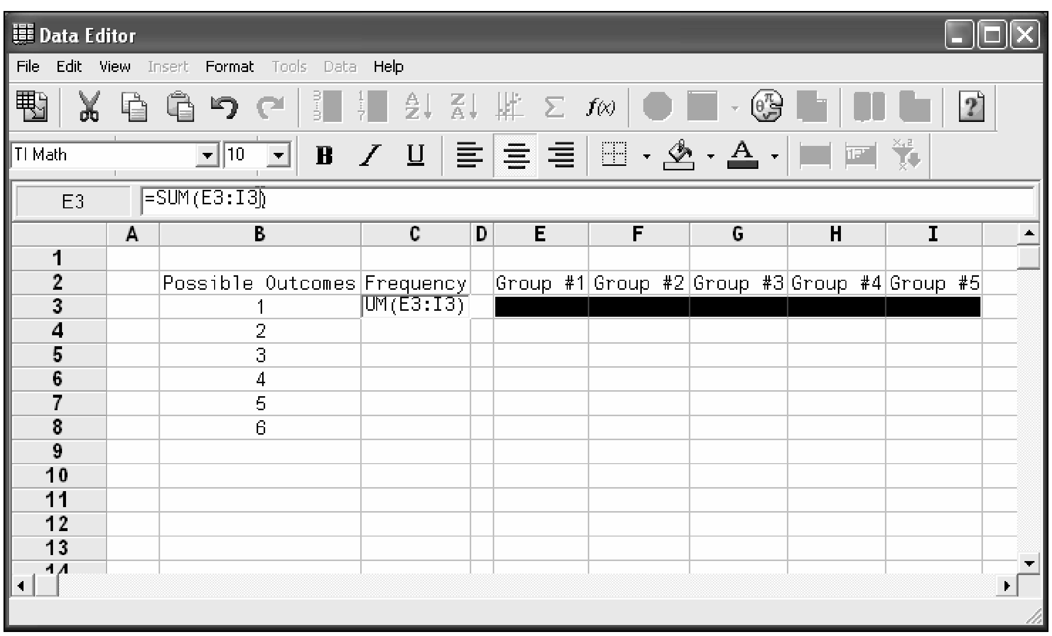
8. Click on cell **C3**, in the toolbar select **Functions (** $f(x)$ **).**



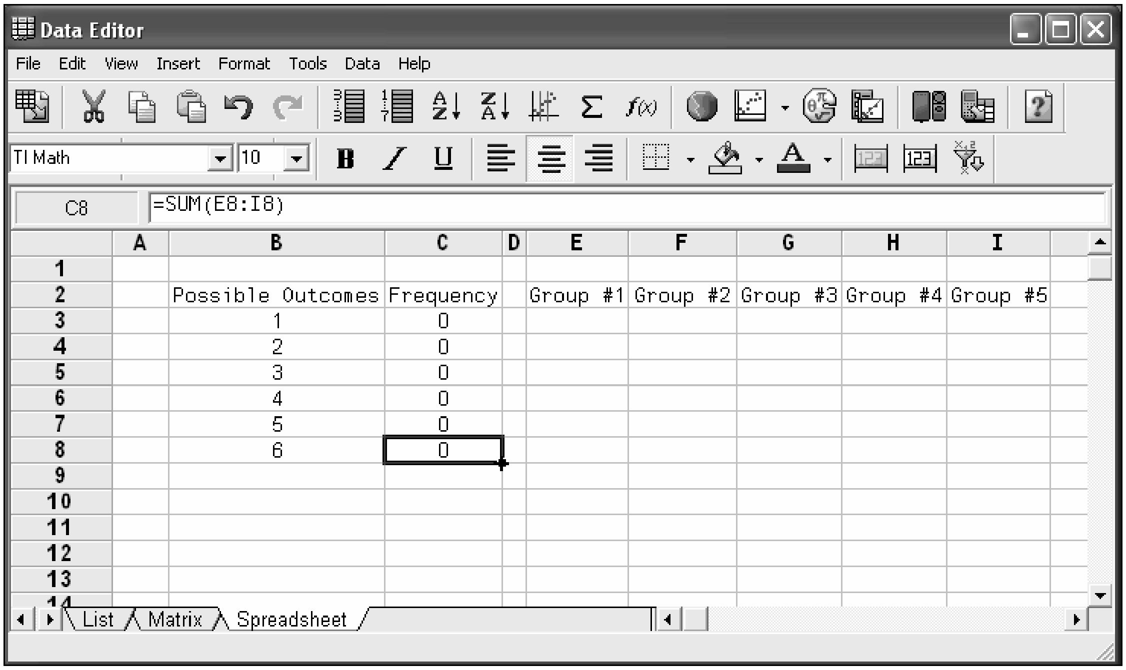
9. Scroll down to **SUM**, and then click **OK**.



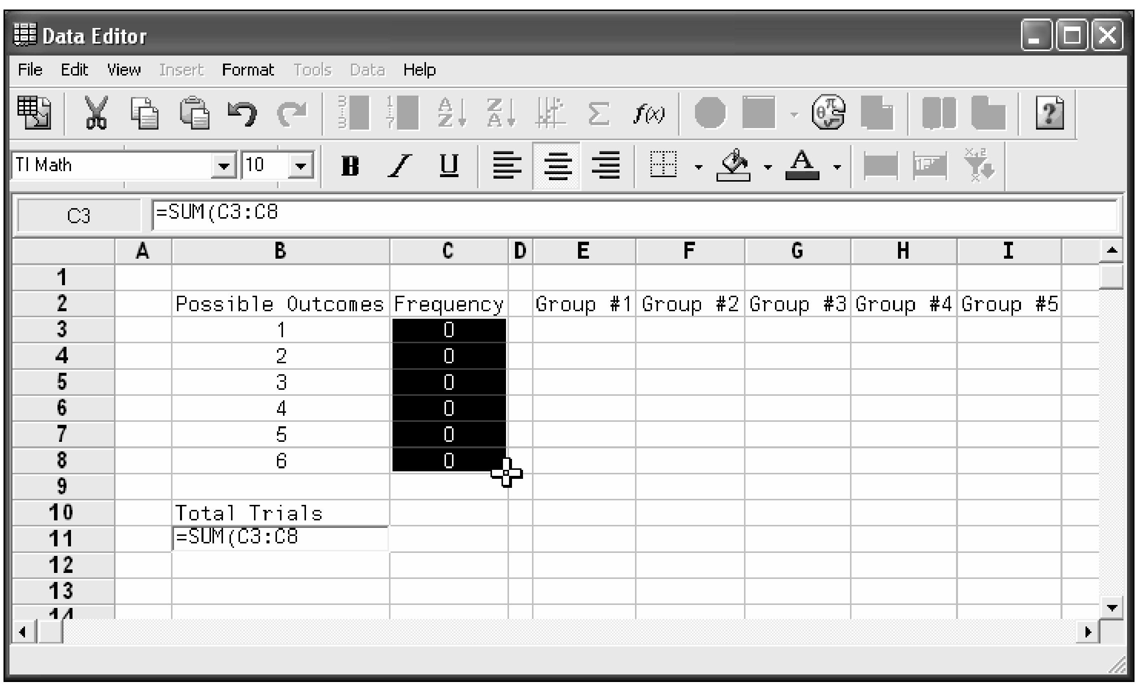
10. Highlight cells **E3** to **I3**. *Note: There will be changes in the Sum formula as you highlight the cells.* Enter a close (**)**) parentheses and then **Enter**. *Also, the sum will be zero at this time.*



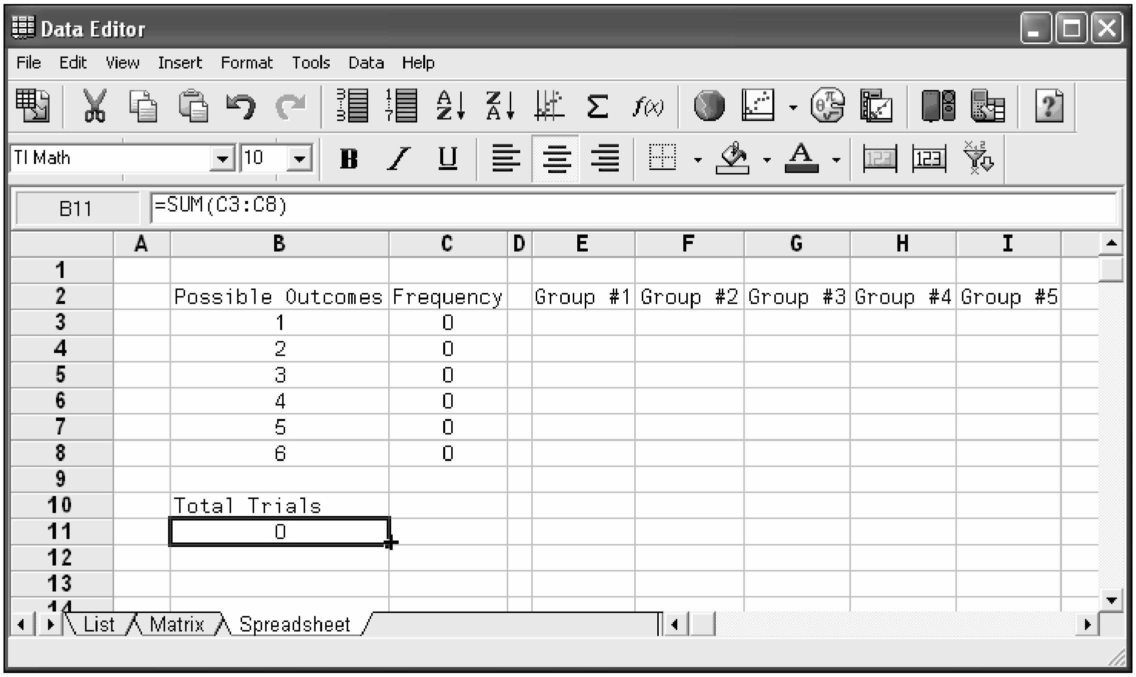
11. Repeat steps 9-11 for cells **C4**, **C5**, **C6**, **C7**, and **C8** using the corresponding Group cells.



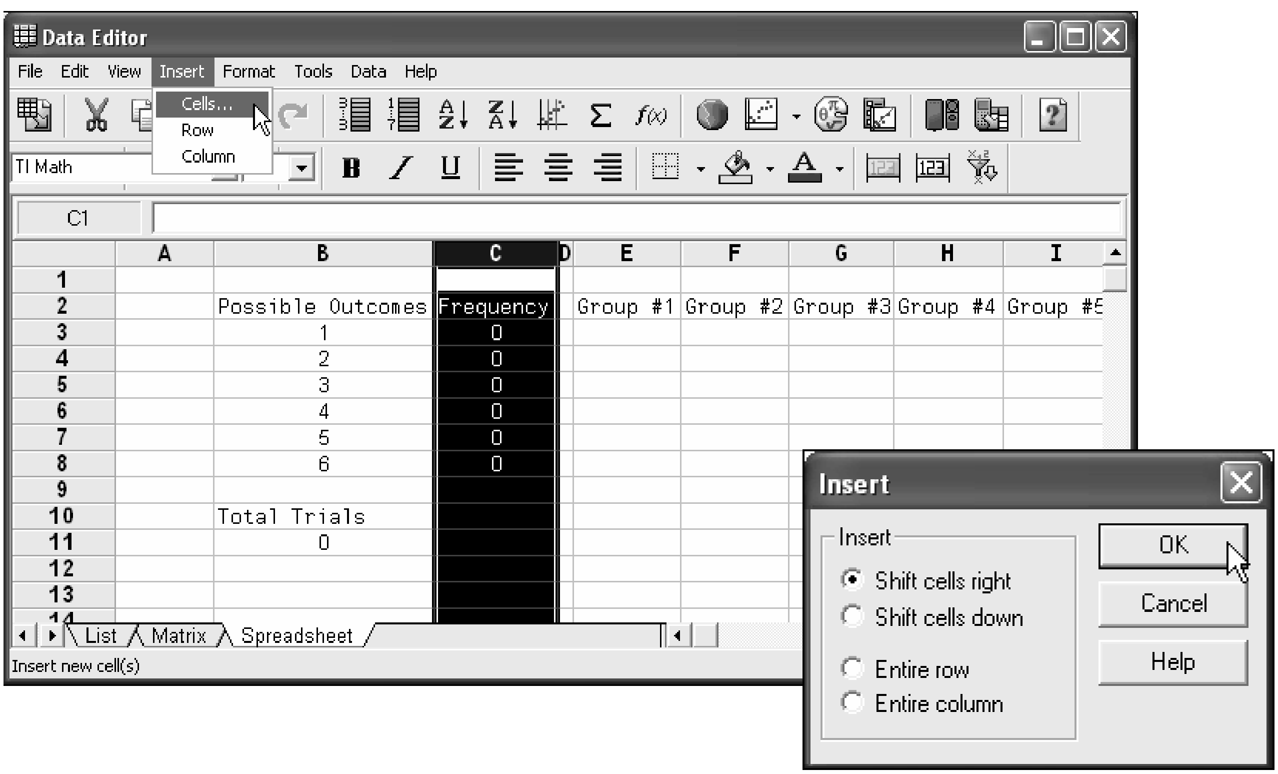
12. Click on cell **B10**, and input label, **Total Trials**. Click in cell **B11** and use the sum formula to total the frequency column, this will require highlighting cells **C3-C8**. Enter a close ()) parentheses and then **Enter**



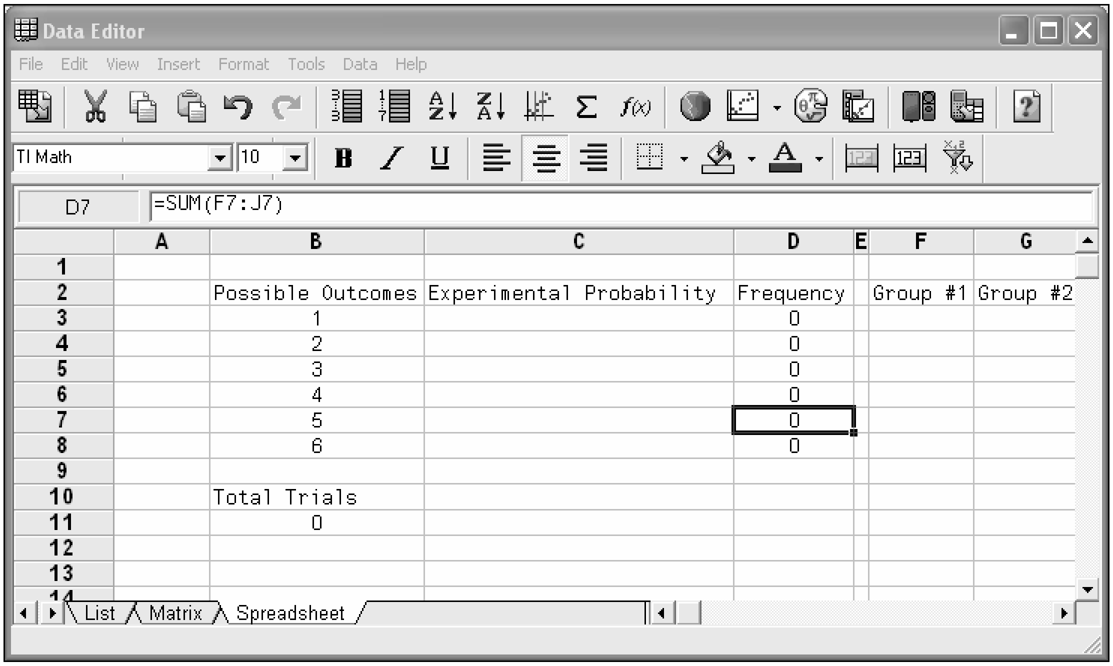
13. Table with formatted cells.



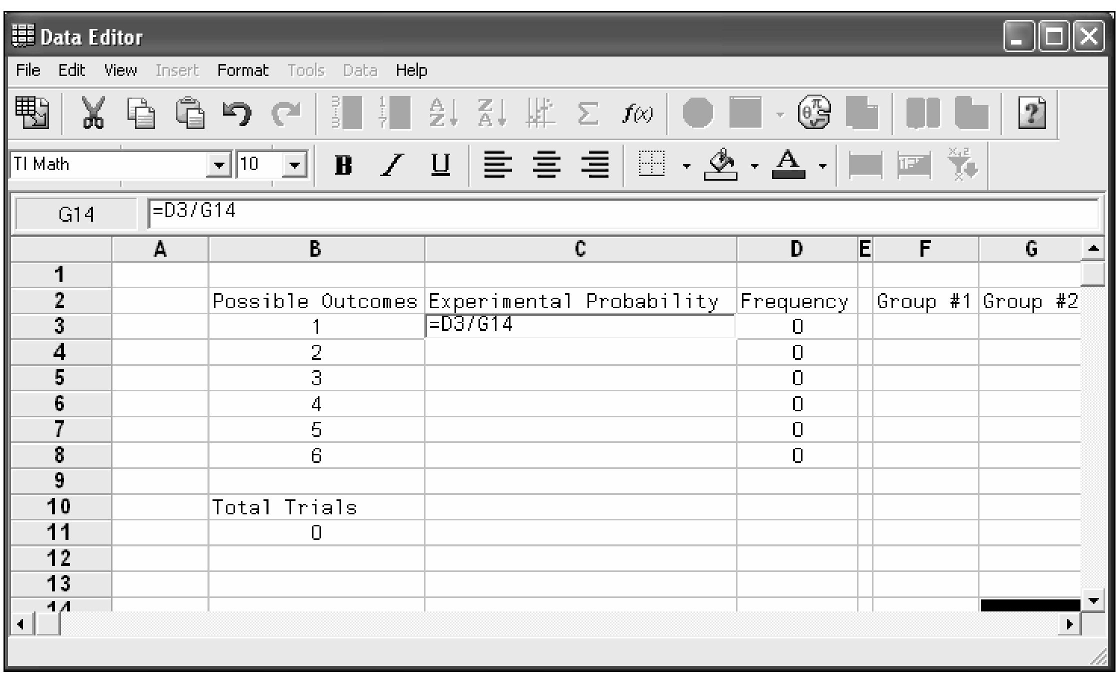
14. Click on the C column. In the toolbar under the **Insert** menu select **Cells**. In the pop-up menu select **Shift cells right** and click **OK**.



15. Resize new column as explained in step 7, and input label **Experimental Probability**.

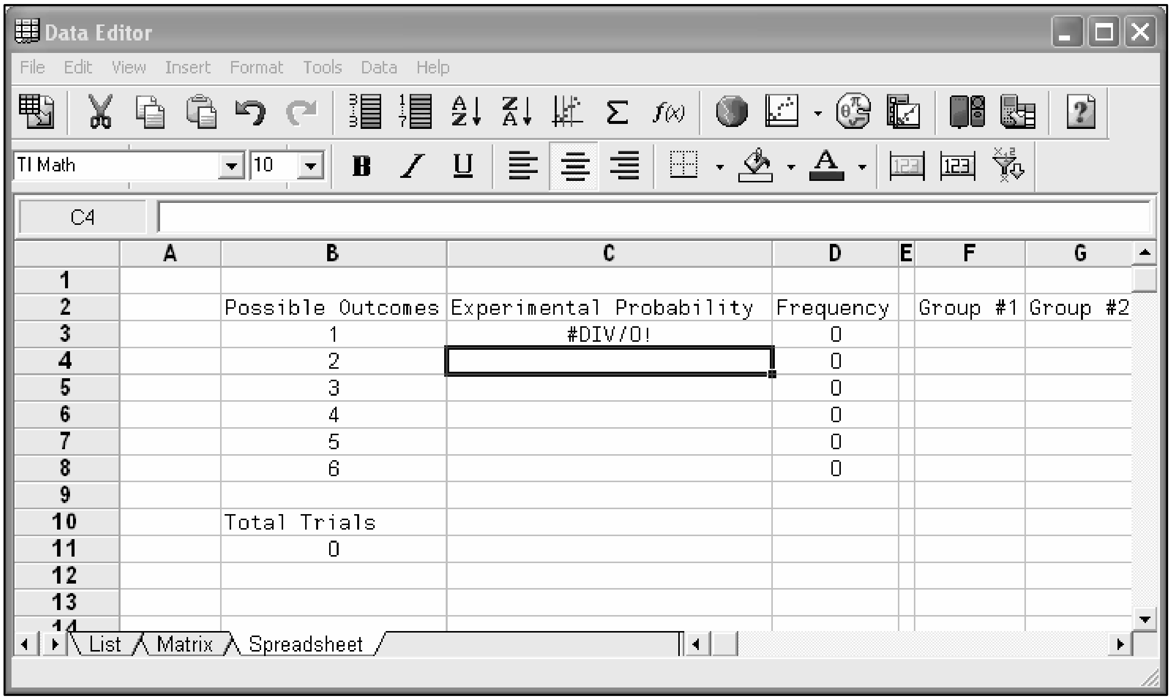


16. Click in cell **C3.** Enter = followed by clicking on cell **D3, backslash** and **cell G14,** and then **Enter**

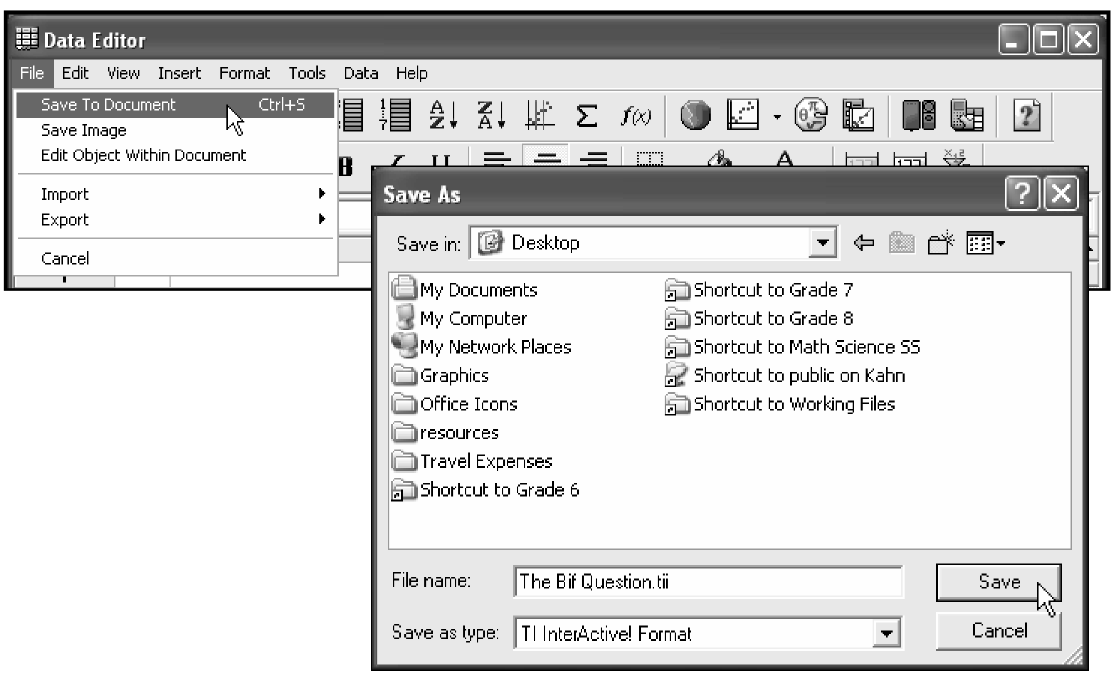


17. Repeat step 16 for cells **C4, C5, C6, C7**, and **C8** using the appropriate corresponding cells.

Note: Due to division by zero an error message will appear until data has been entered.



18. In the toolbar under the **File** menu select **Save To Document**. Save to the **Desktop** as **The Big Question**.



Technology Tutorial: TI-Interactive - The Big Question Graph

Create a Presenter(s) Spreadsheet before starting the activity. This will enable the presenter(s) to flow between each group's data efficiently.

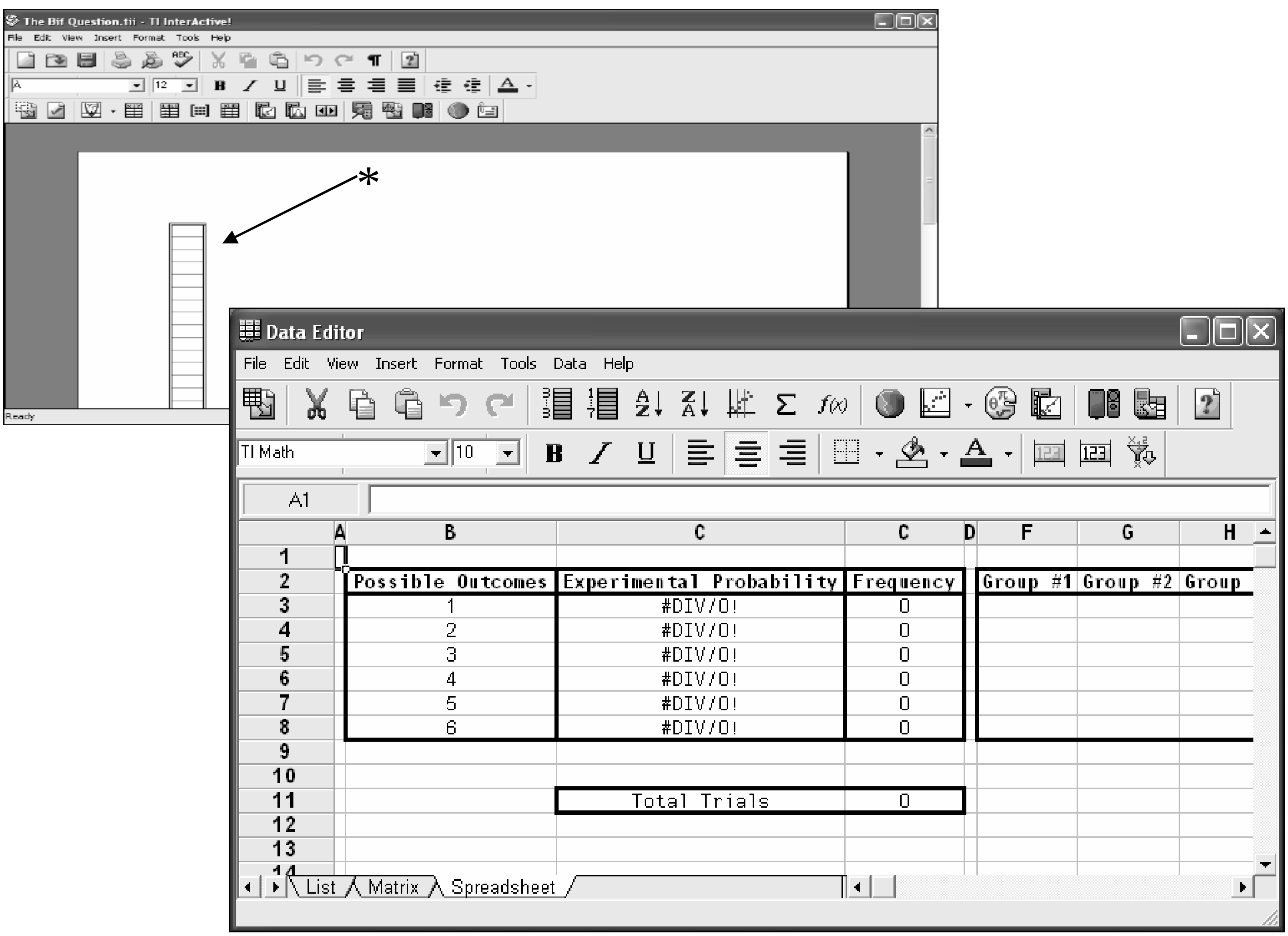
Advance Preparation

- Create The Big Question Presenter(s) Spreadsheet using the Technology Tutorial: The Big Question Present(s) Spreadsheet.

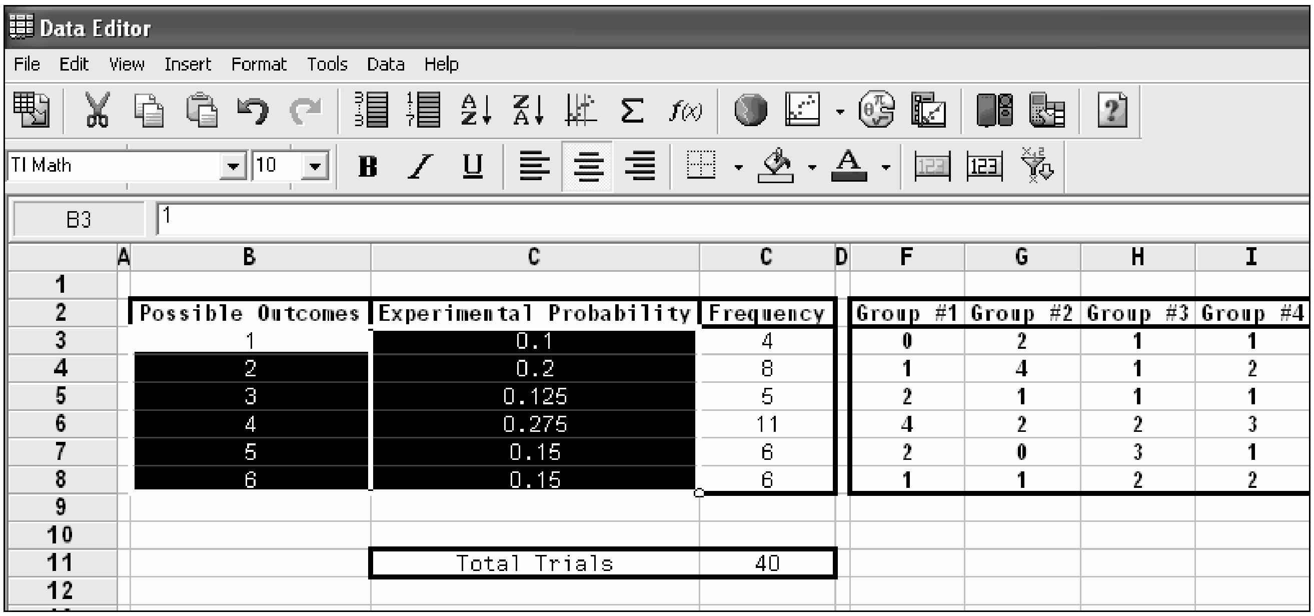
Create Presenter(s) Graph

1. Open TI-Interactive: **Middle School-Explore Explain 3 Spreadsheet.tii or The Big Question** spreadsheet (if formatted by presenter.)

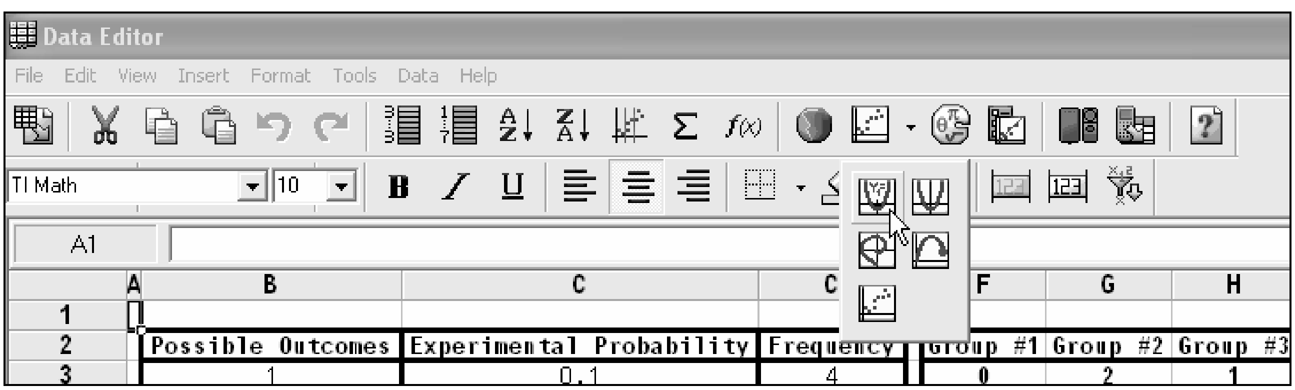
2. Double click on the graphic (*).



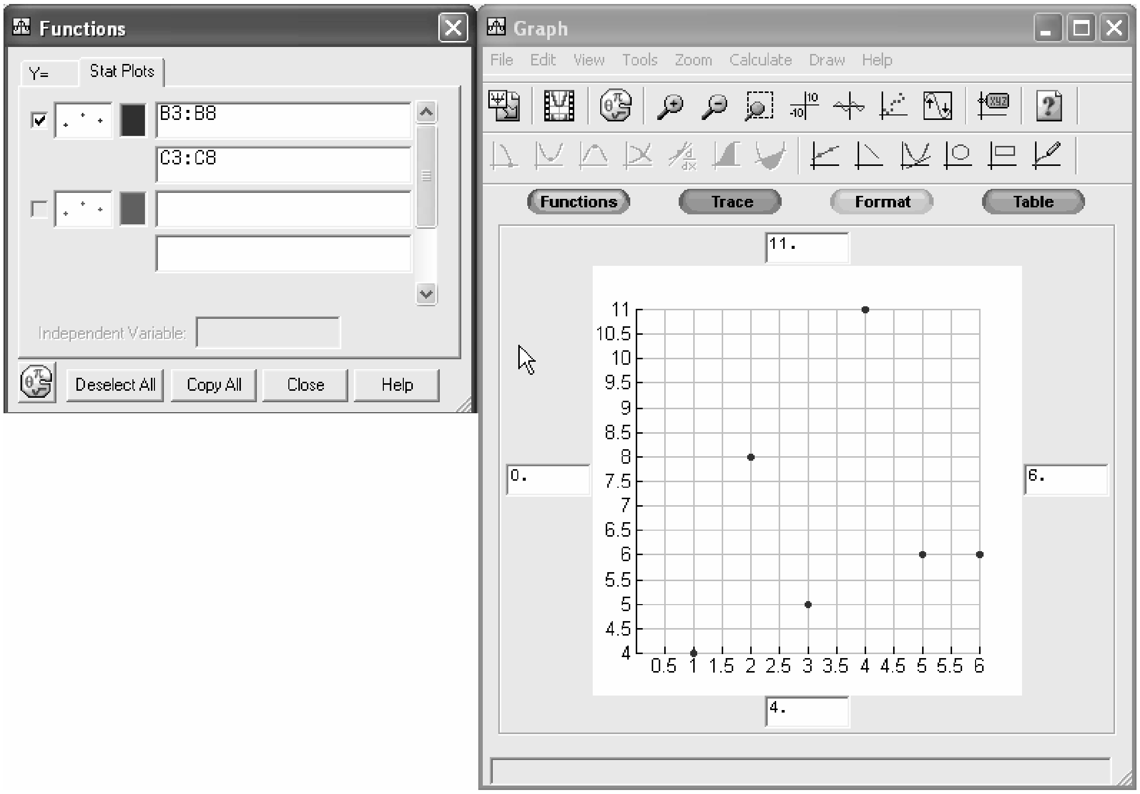
3. Have one group at a time input their results for each outcome. Once two or three groups have inputted data, highlight the **Possible Outcomes** and **Experimental Probability** columns, by clicking on cell **B3** and dragging to cell **C8**.
   (If using TI-83 calculators, data may be collected using a linking device between the computer and a calculator. Steps for linking and importing data can be found at the end of this tutorial.)



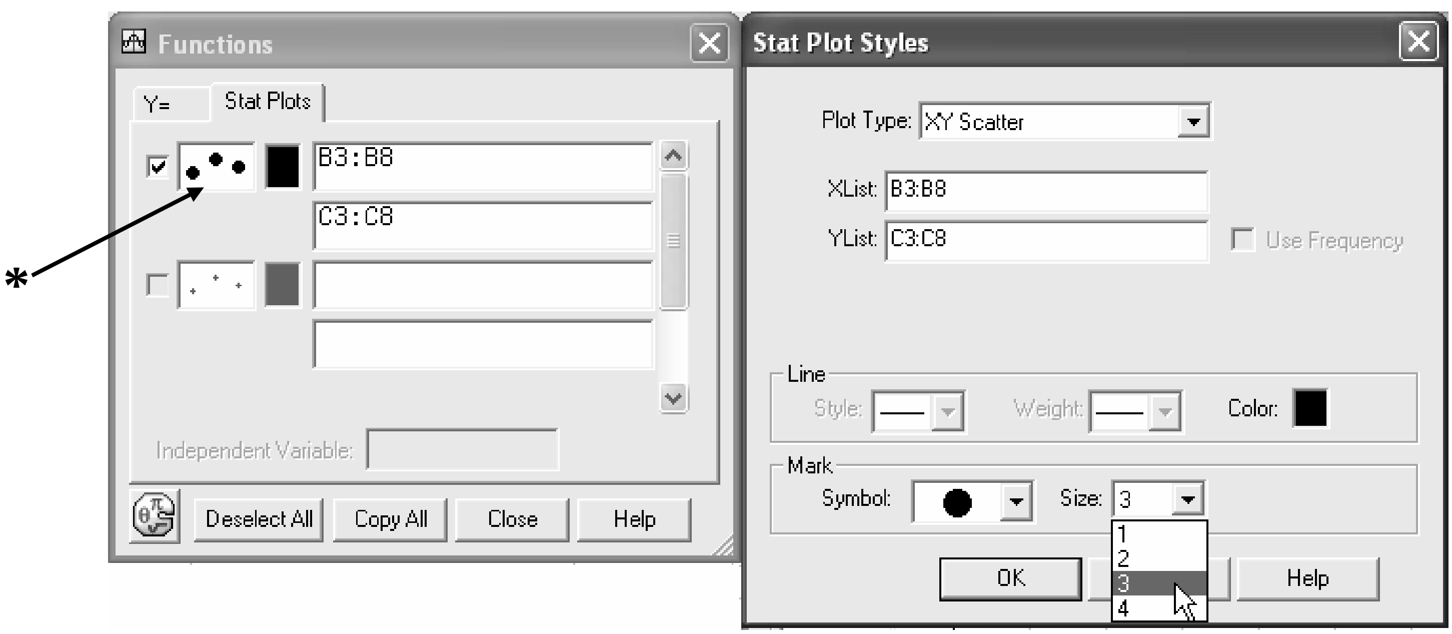
4. In the toolbar select the **Graph** icon . *Note: The graph icon may look different based on the last type of graph created*. In the **Graph** menu select the **Y=** graph icon .



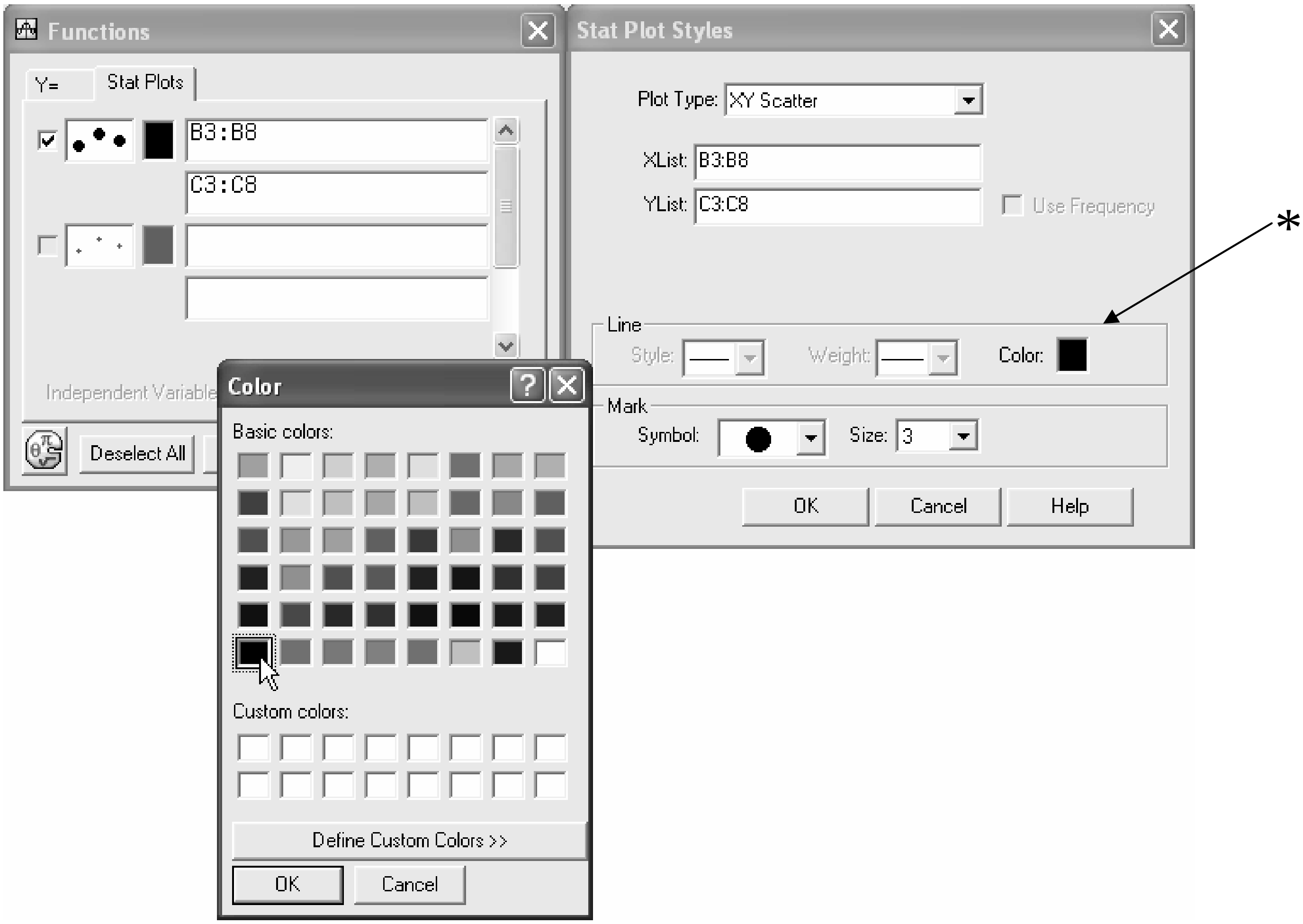
5. Notice the sample shows data plotted, and corresponding cell ranges set under **Stat Plots** in the **Functions** window.



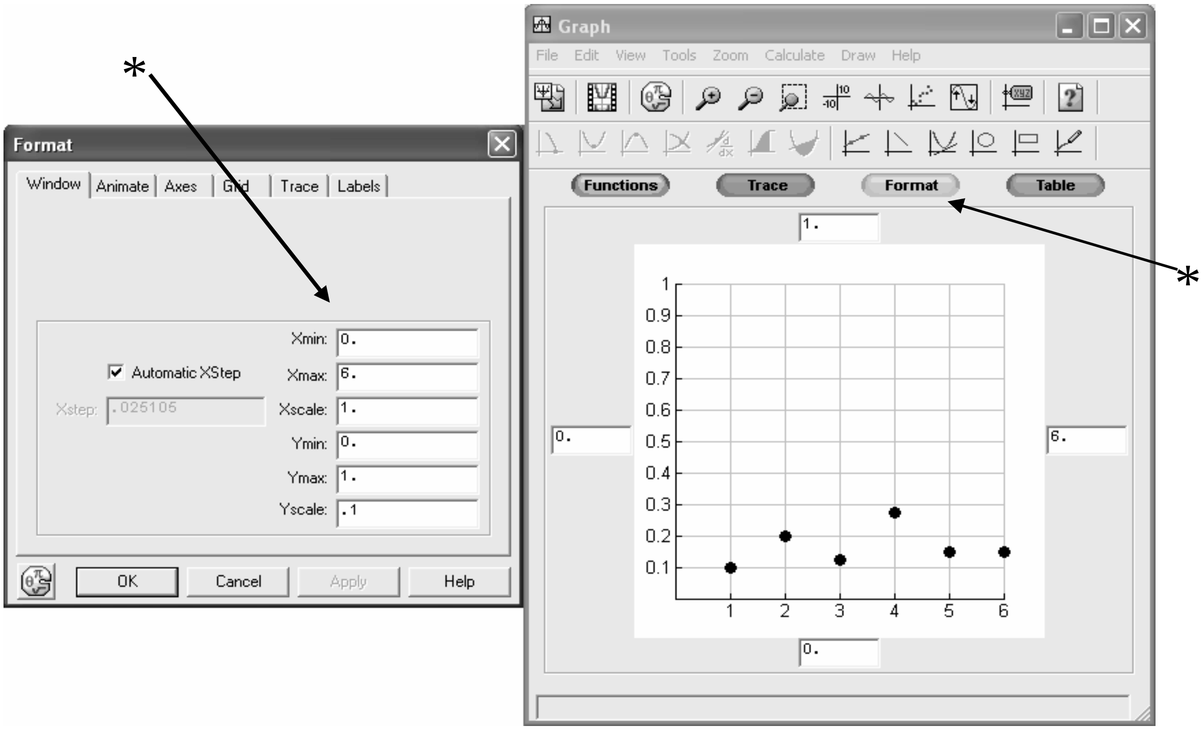
6. Reset point size by clicking on the **Point Selection Box**, and selecting **3** in the **Size** drop-down menu.



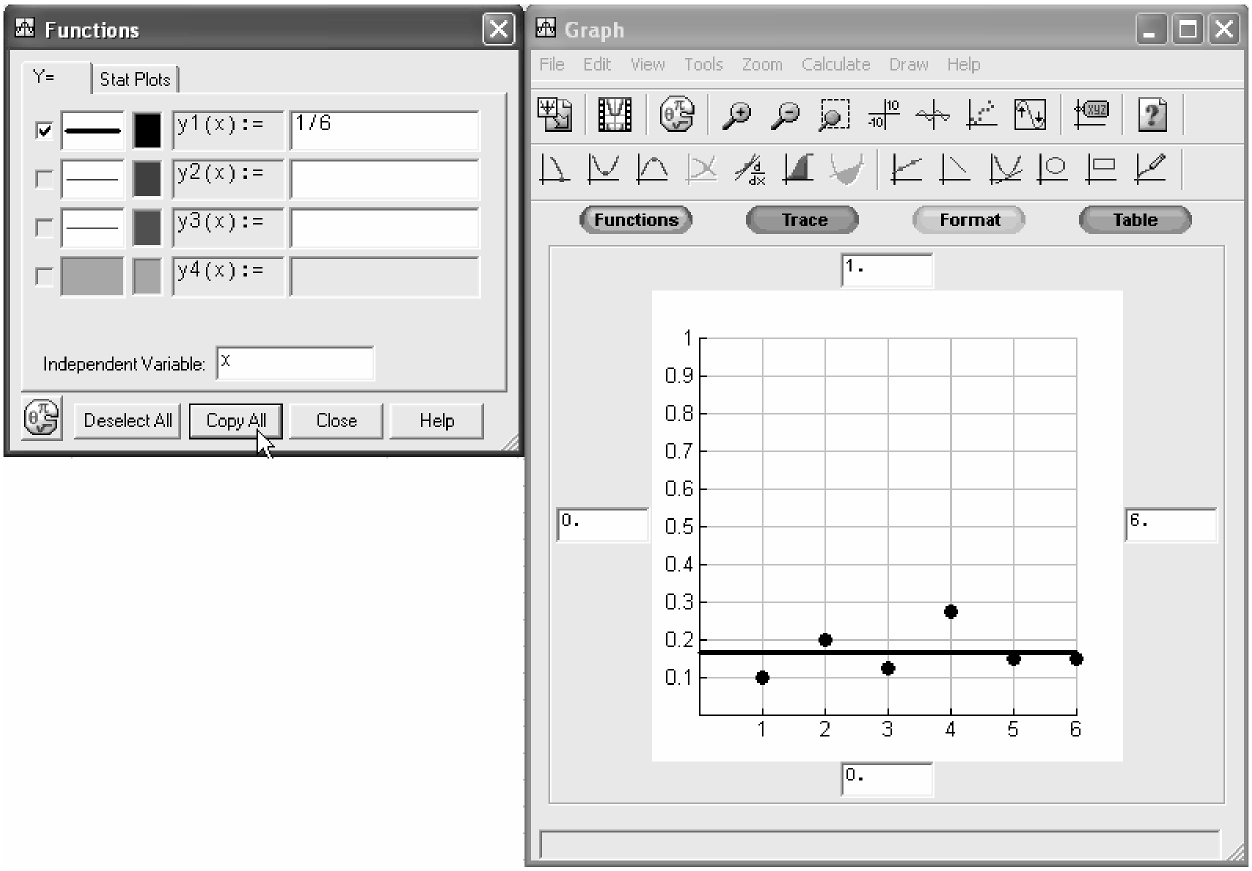
7. Reset point color by selecting **Black** in the **Color** drop-down menu.



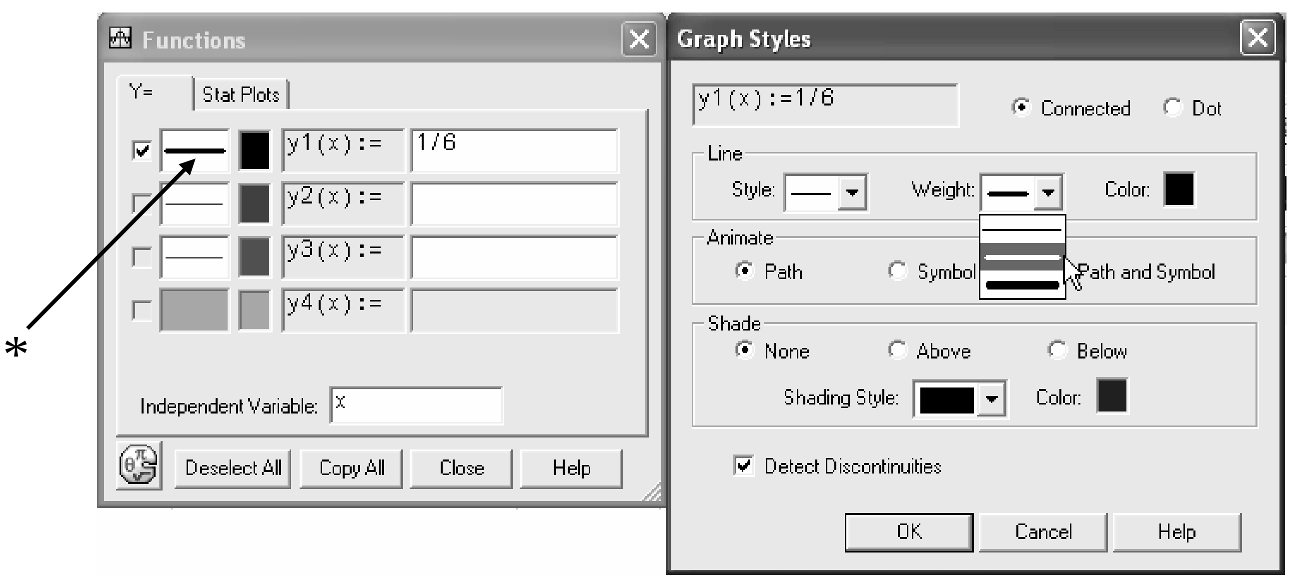
8. Click **Format** (*), under **Window** set the x- and y-axis minimums and maximums as shown, click **Apply**, and then **OK**.



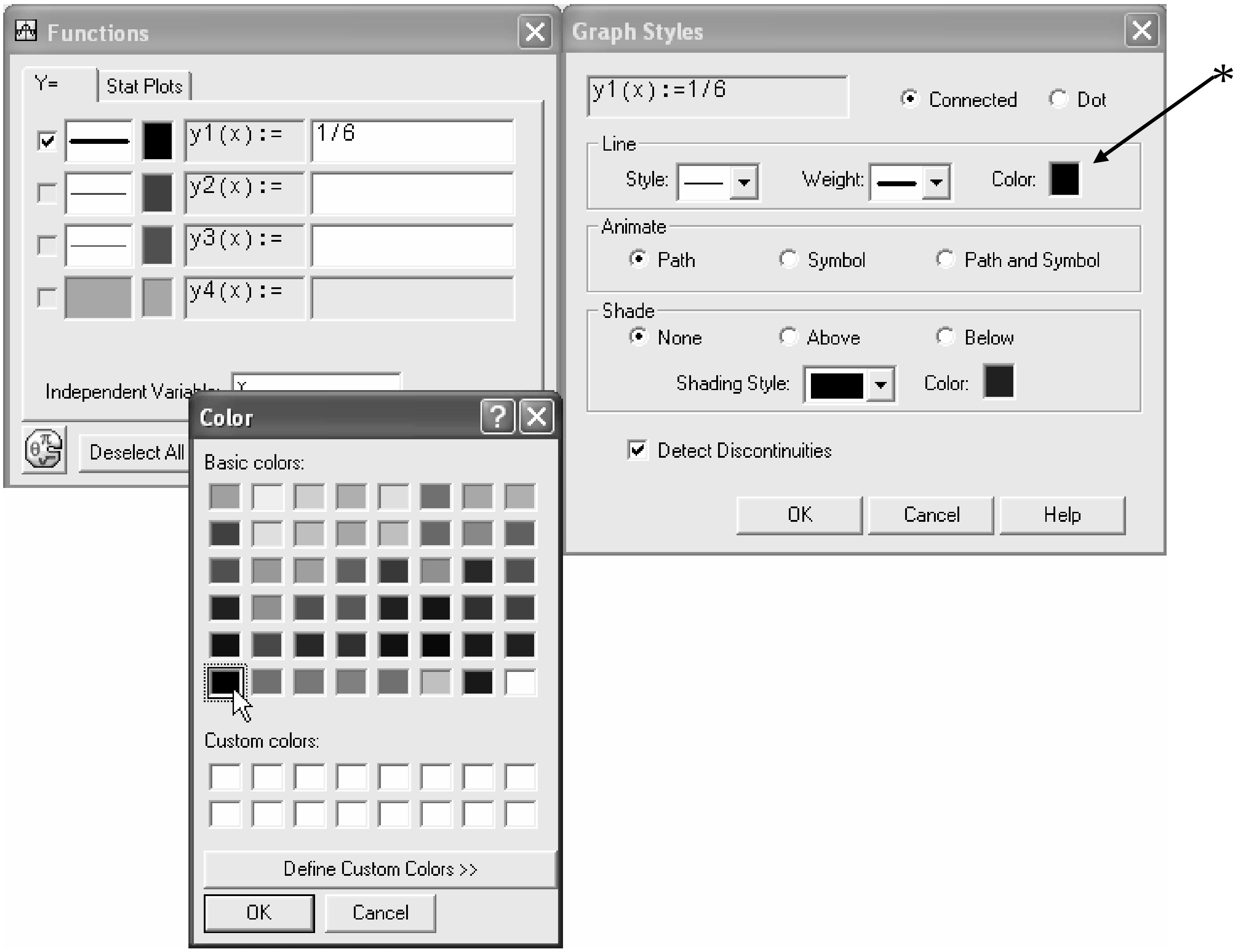
9. Under **Y=** in the **Function** window input the appropriate function. The leader notes for this activity discuss function.



10. Reset the line width by clicking on the **Line Selection Box**, and selecting **the second width choice** in the **Weight** drop-down menu.



11. Reset line color by selecting **Black** in the **Color** drop-down menu.



12. Have another group input their data, continue process as classroom discussion continues

13. Close **Middle School-Explore Explain 3 Spreadsheet.tii** or **The Big Question** using the close box .

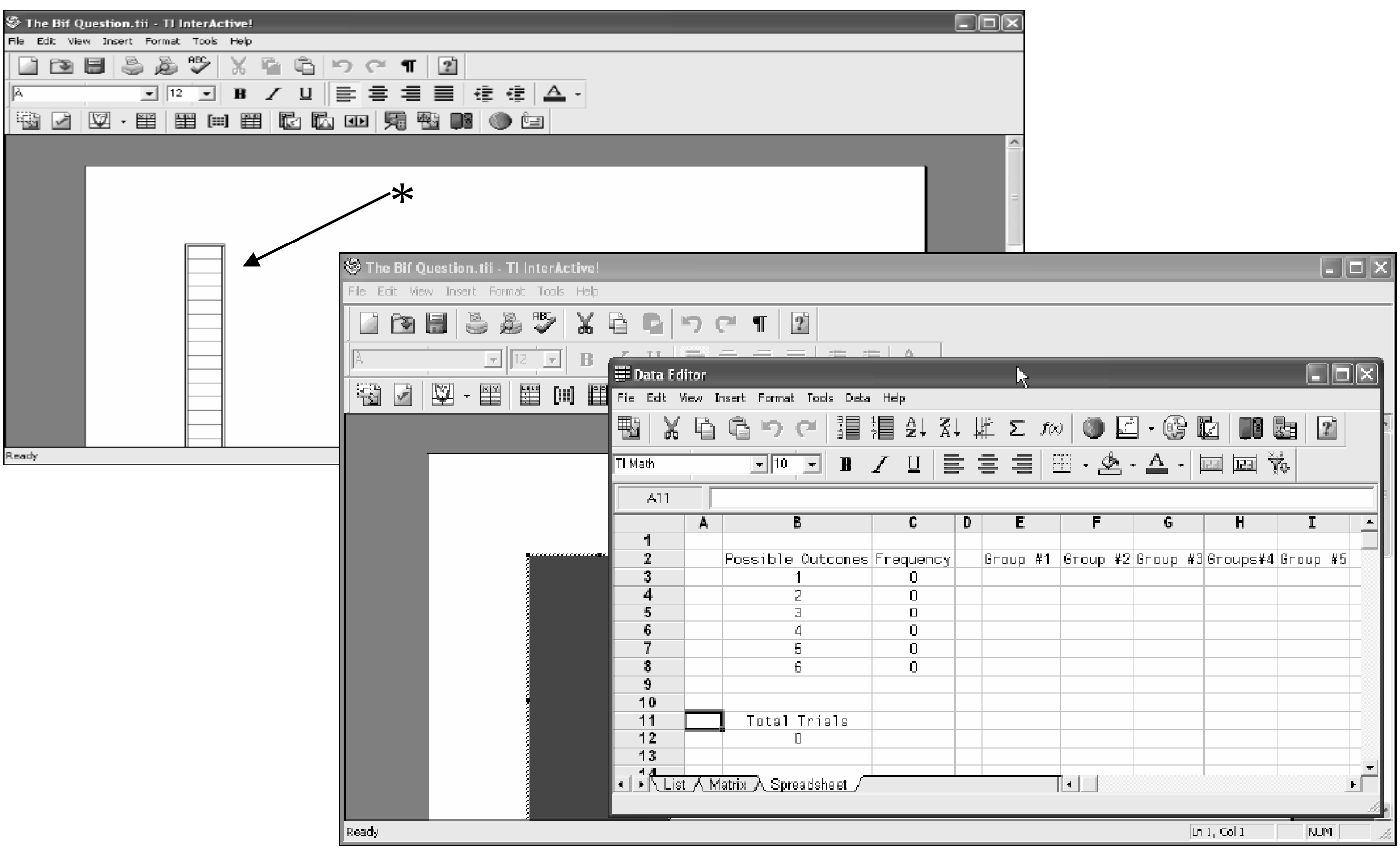
Importing Data using a Linking Device

One at a time each group of participants will connect their calculator to the computer using a TI-Graph Link USB. Make sure the calculator in turned on, and at home screen.

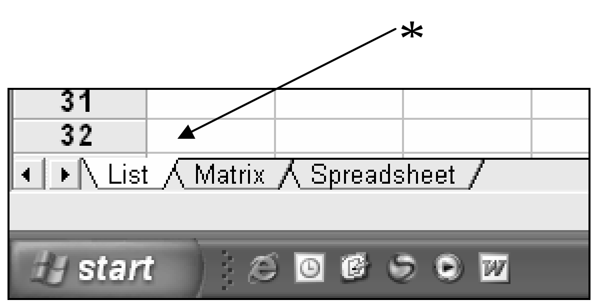
*Note: Graphic of tables may differ, but procedure is the same.

1. Open TI-Interactive: **Middle School-Explore Explain 3 Spreadsheet.tii** or **The Big Question** spreadsheet (if formatted by presenter.).

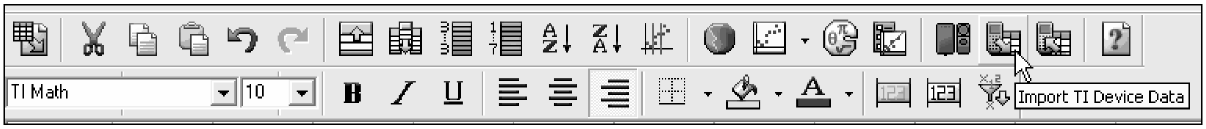
2. Double click on the graphic (*).



3. Select the **List** tab at bottom of spreadsheet.

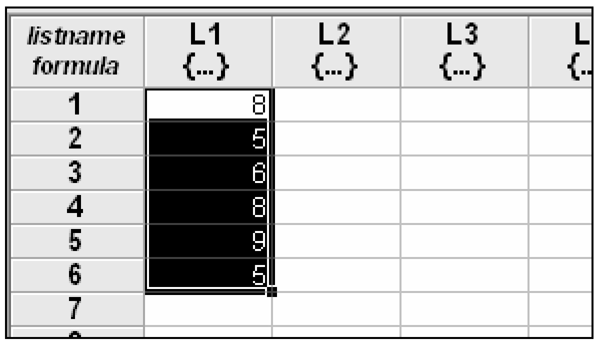


4. Select the **Import TI Device Data** icon on the **Toolbar**.

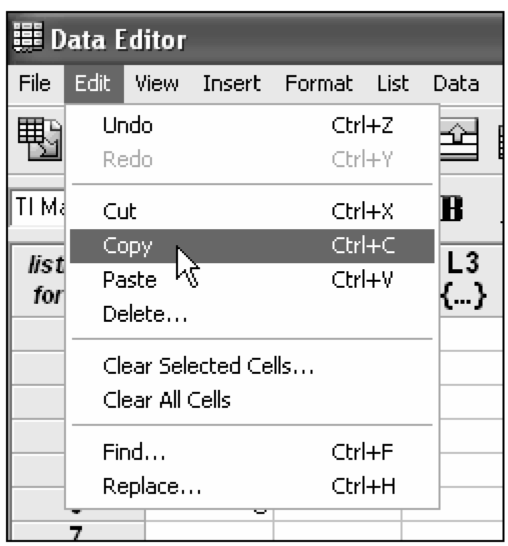


Follow instruction and select the list that contains the data you intend to import. (Instructions will vary here depending on what type of calculator the participants use.)

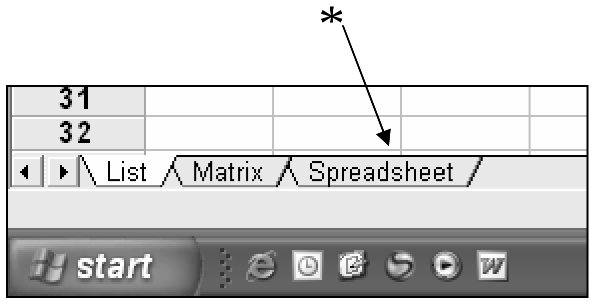
5. Data will import into the appropriate list: In the example, data were in **L1** of the calculator; therefore they were imported into **L1** in the list editor.



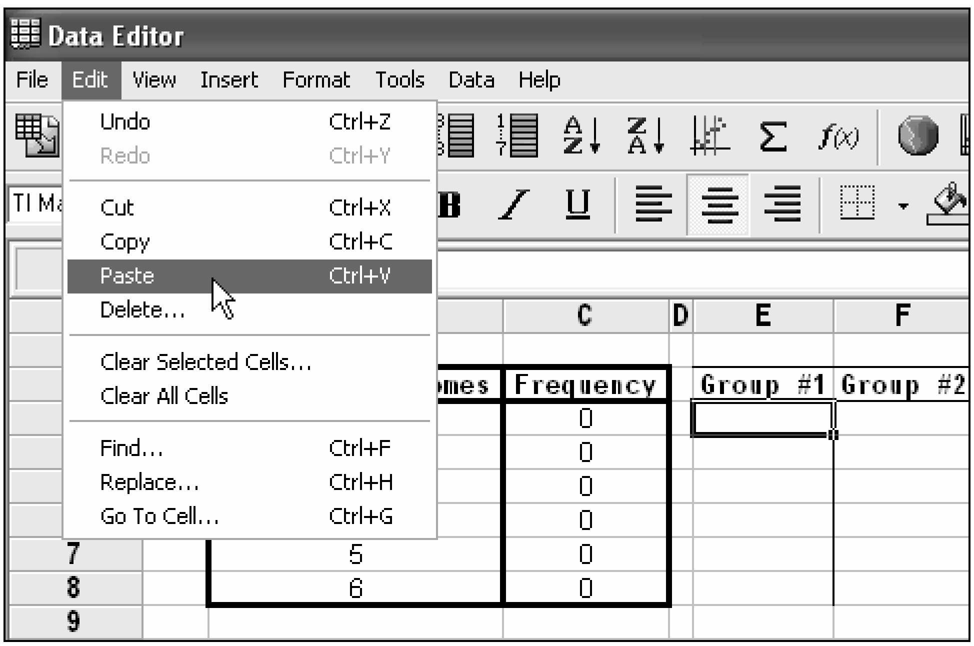
6. Highlight data as shown above and select **Copy** in the **Edit** menu.



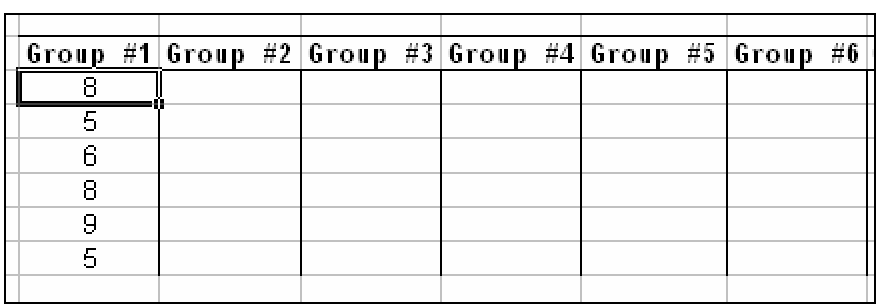
7. Select the **Spreadsheet** tab.



8. Highlight the first cell under the appropriate Group, and select **Paste** under the **Edit** menu.



9. Data will be imported into the appropriate cells.



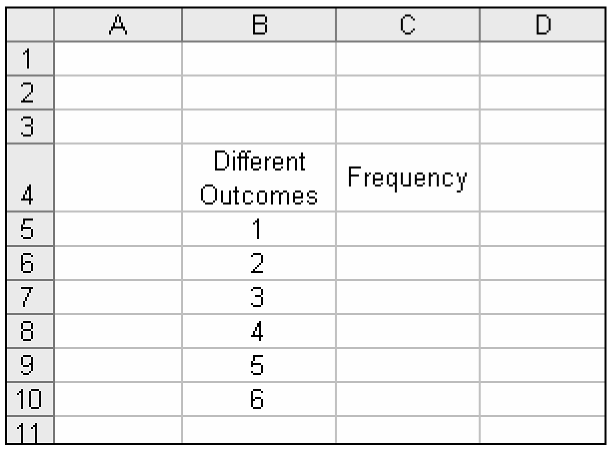
Technology Tutorial: Trials, Trials, Trials Activity

The following is an example: participants may create a table and labels independent of this example. Therefore participants table and graph will vary.

Creating the Table

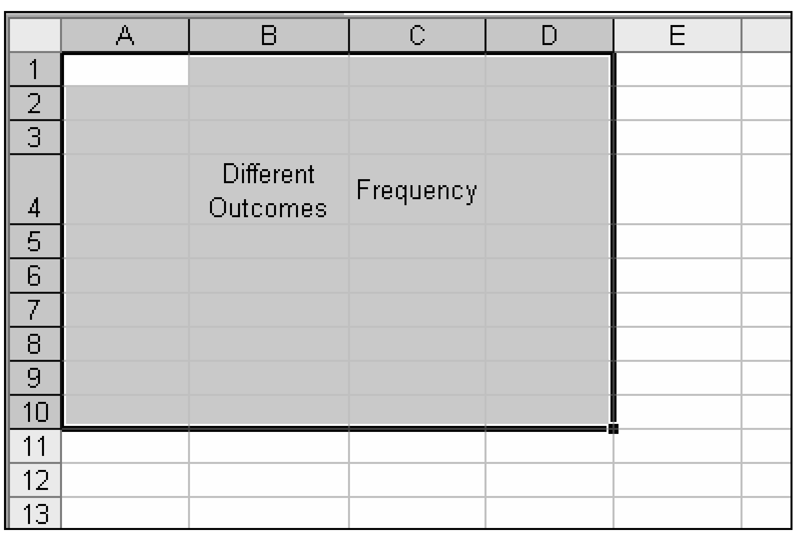
1. Open an Excel document.

2. The following illustration is the product created in steps 3-7.



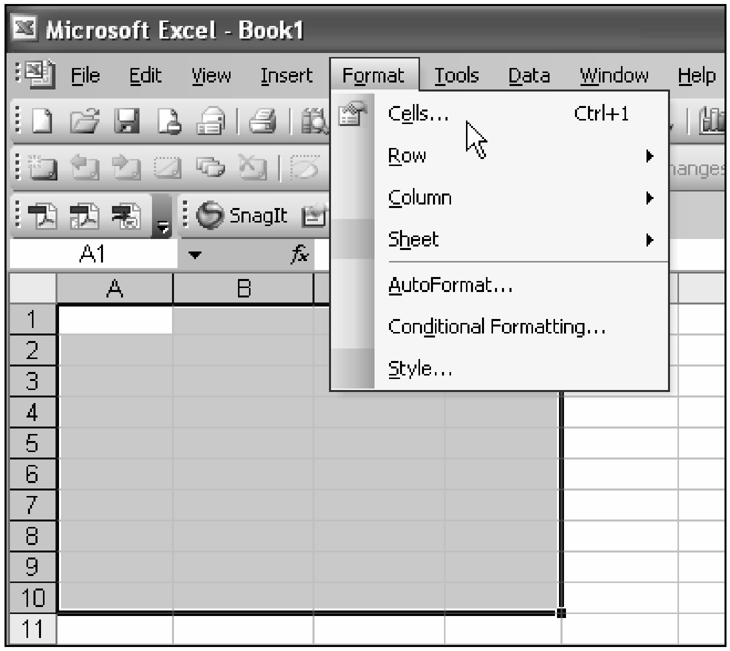
	A	B	C	D
1				
2				
3				
4		Different Outcomes	Frequency	
5		1		
6		2		
7		3		
8		4		
9		5		
10		6		
11				

3. Click on cell **A1** and drag to cell **D10**.

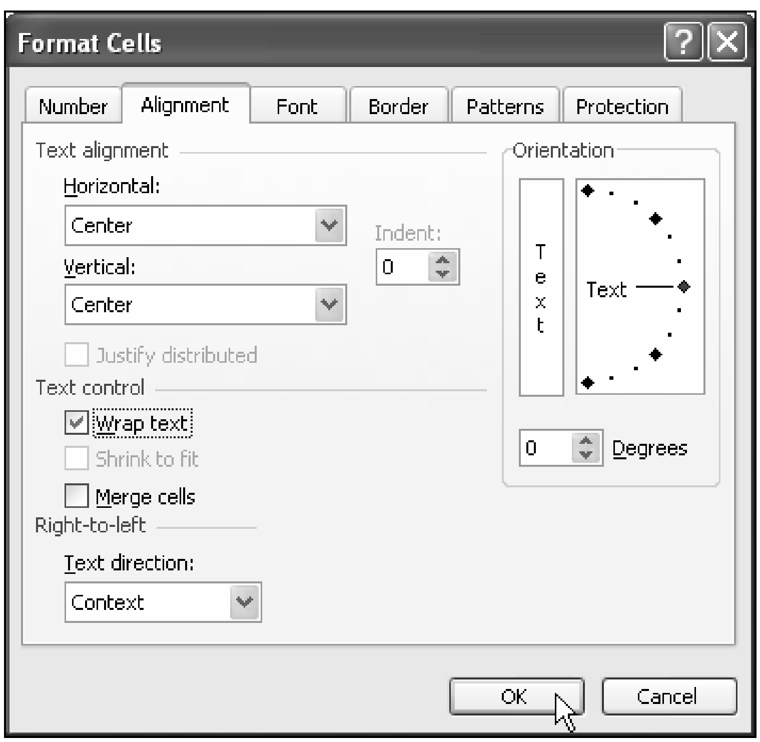


	A	B	C	D	E	
1						
2						
3						
4		Different Outcomes	Frequency			
5						
6						
7						
8						
9						
10						
11						
12						
13						

4. In the toolbar under the **Format** menu, select **Cells**.



5. Under the **Alignment** tab, use the pop-down menu under the Horizontal and Vertical text alignment to select Center. Select **Wrap Text** by clicking in the box under text control. Click **OK**.



6. Click cell **B4** and enter **Different Outcomes,** and click on **cell C4** and enter **Frequency**. If needed, adjust the size of the cells by clicking on the line to the left of the column and dragging the line left or right as needed. (Short cut: Use the down arrows on your keyboard to move down the column.)

C4 fx Frequency

	A	B	C	D
1				
2				
3				
4		Differenct Outcomes	Frequency	
5				
6				

7. Click on cell **B5** and enter **1**, continue entering **2-6** in the cells below as illustrated.

	A	B	C	D
1				
2				
3				
4		Differenct Outcomes	Frequency	
5		1		
6		2		
7		3		
8		4		
9		5		
10		6		
11				

8. Table is complete and ready to input data from the **Group Activity Sheet: Simulation #1** frequency table. Input data using cells **C5-C10**. (*Example uses the data found in the leader notes.*)

C10 fx 0

	A	B	C	D
1				
2				
3				
4		Differenct Outcomes	Frequency	
5		1	2	
6		2	6	
7		3	1	
8		4	7	
9		5	4	
10		6	0	
11				

Creating the Graph

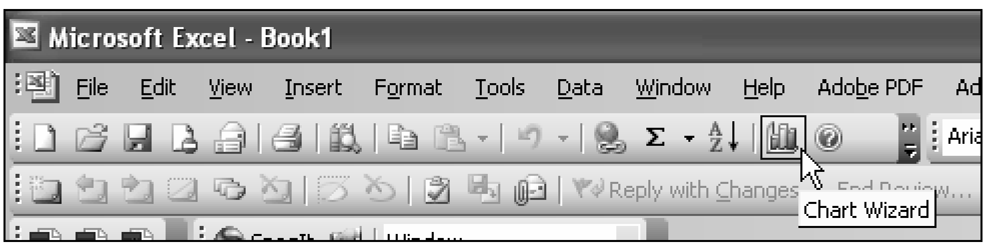
Participants may select the type of graphical representation of their choice; therefore, two possible types of graphs appear: **Bar Graph**, and **Pie Graph**. You may want to experiment with others.
More than one graph may be created and displayed side by side.

Bar Graph

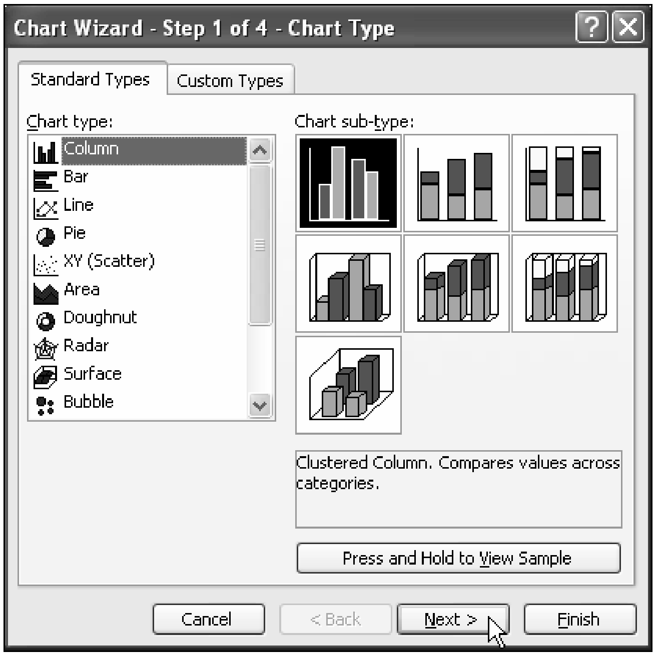
1. Click and drag curser over the data to highlight. The example has cells **C5-C10** highlighted.

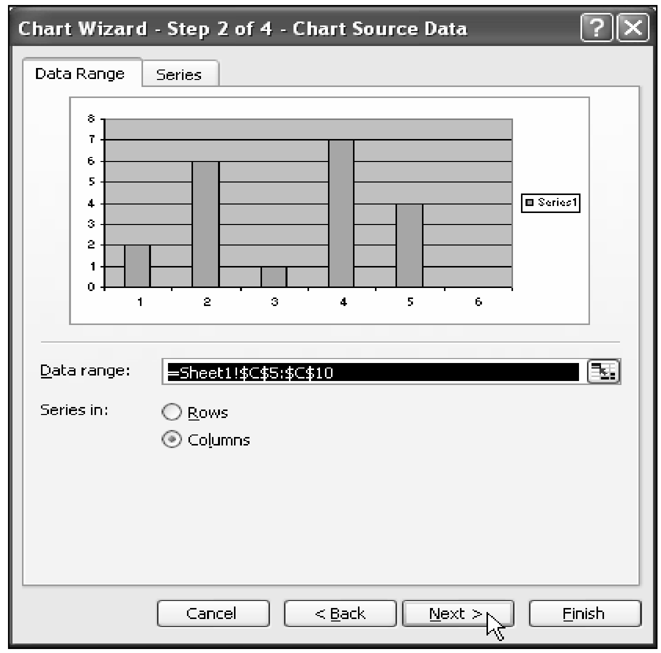
Differenct Outcomes	Frequency
1	2
2	6
3	1
4	7
5	4
6	0

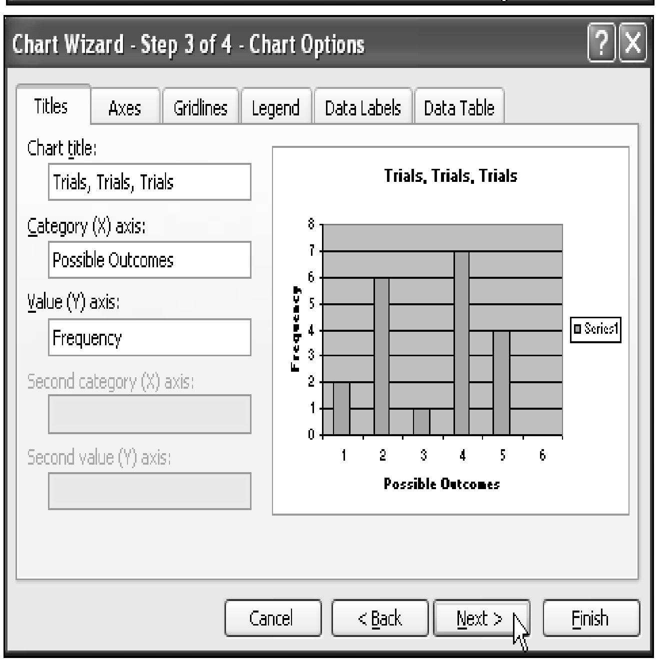
2. Select the Chart Wizard  in the toolbar.

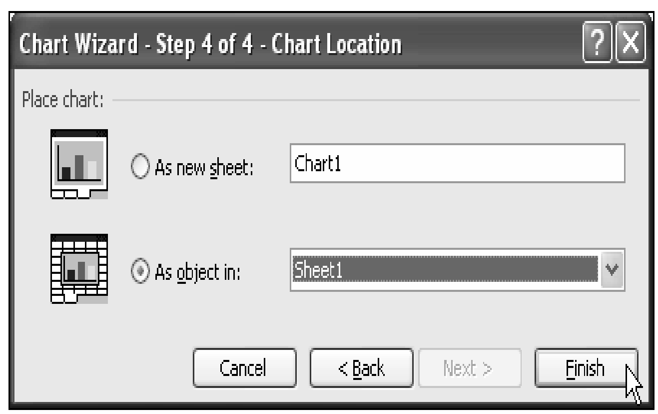


3. **Step 1**: Select the **Column** chart type, then click **Next**.
   Step 2: Since the data was highlighted first click **Next**.
   Step 3: Input a **Chart tile** (Trials, Trials, Trials), **Categories (X) axis** (Possible Outcomes), and **Categories (Y) axis** (Frequency), then click **Next**.
   Step 4: Select **As object in**, and then **Finish.**

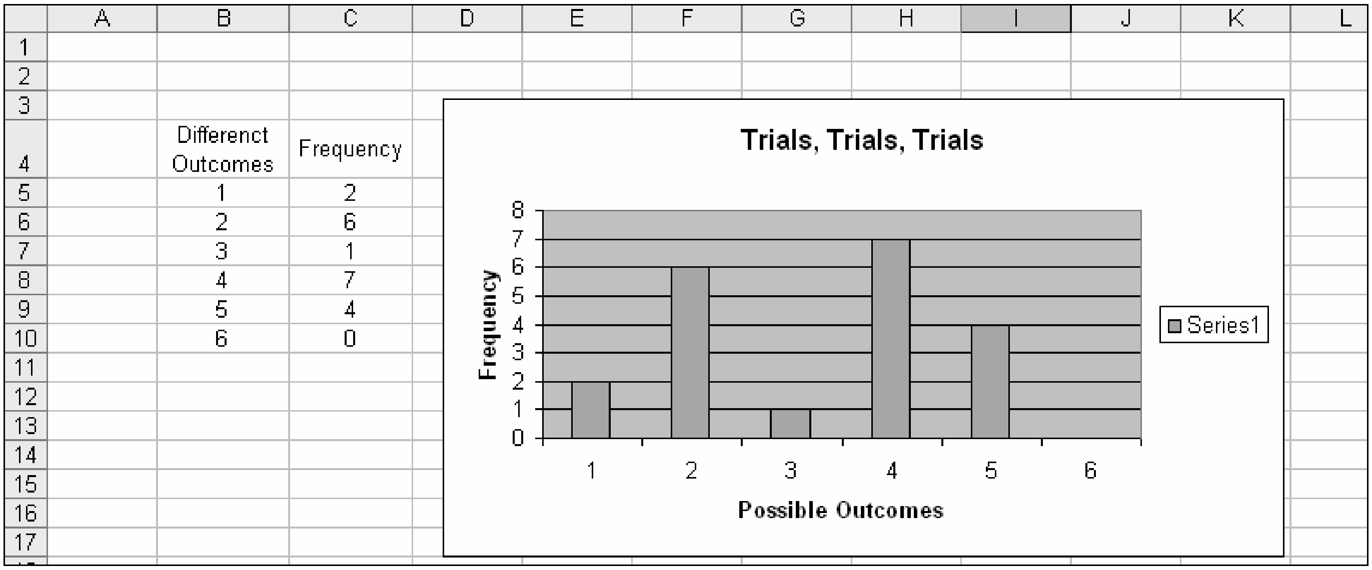








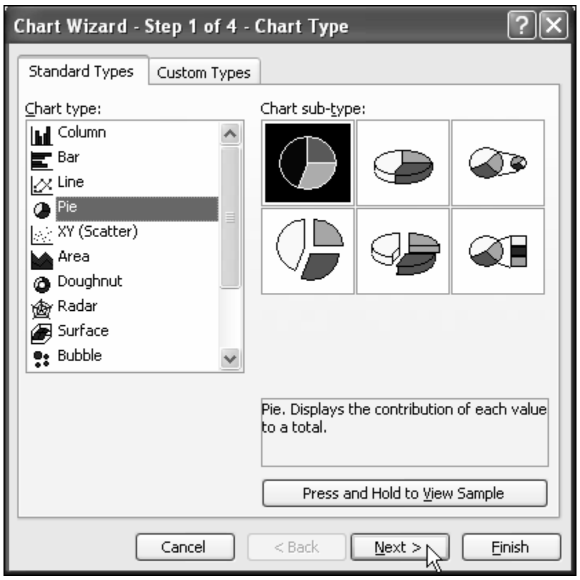
4. A graph will appear on the spreadsheet.

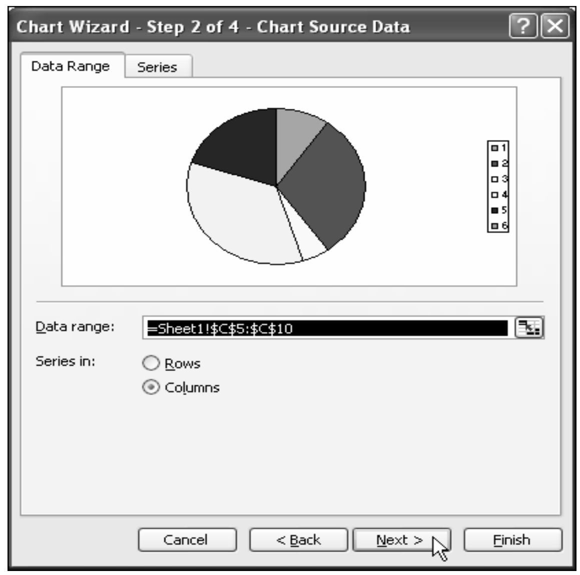


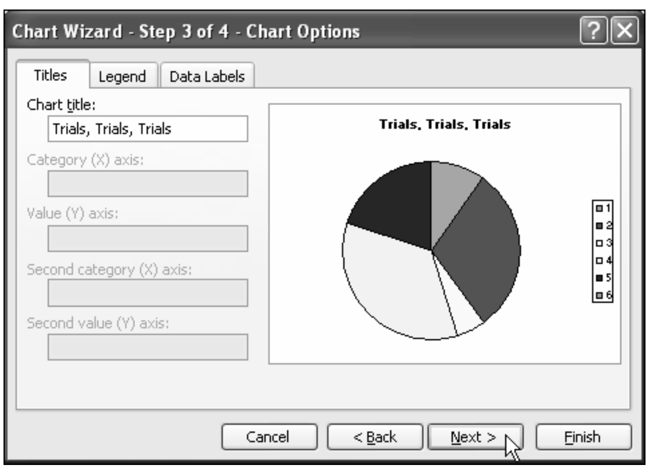
Pie Graph

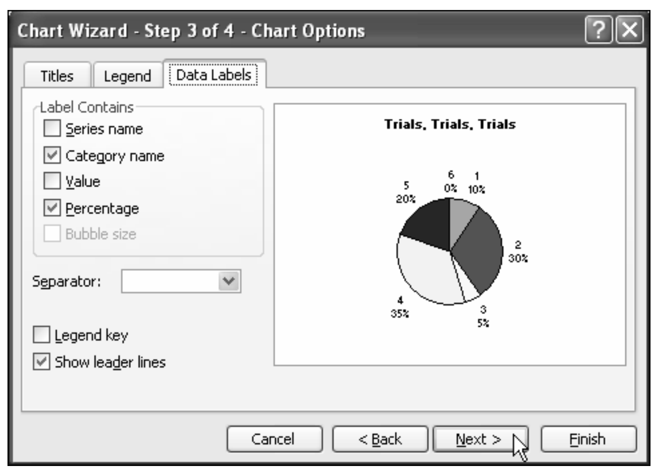
1. Complete steps 1 and 2 of the Bar Graph on page 4.

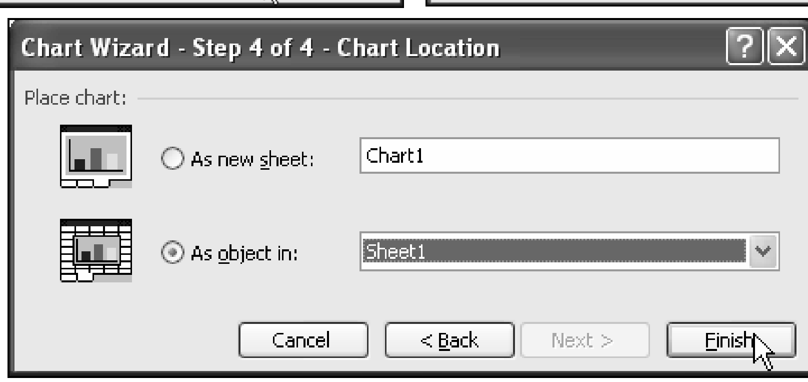
2. **Step 1**: Select the **Pie** chart type, and then click **Next**.
   Step 2: Since the data was highlighted first click **Next**.
   Step 3: Input a **Chart tile** (Trials, Trials, Trials), then select the **Data Labels** tab and check **Category name**, **Percentage** and click **Next**.
   Step 4: Select **As object in**, and then **Finish.**





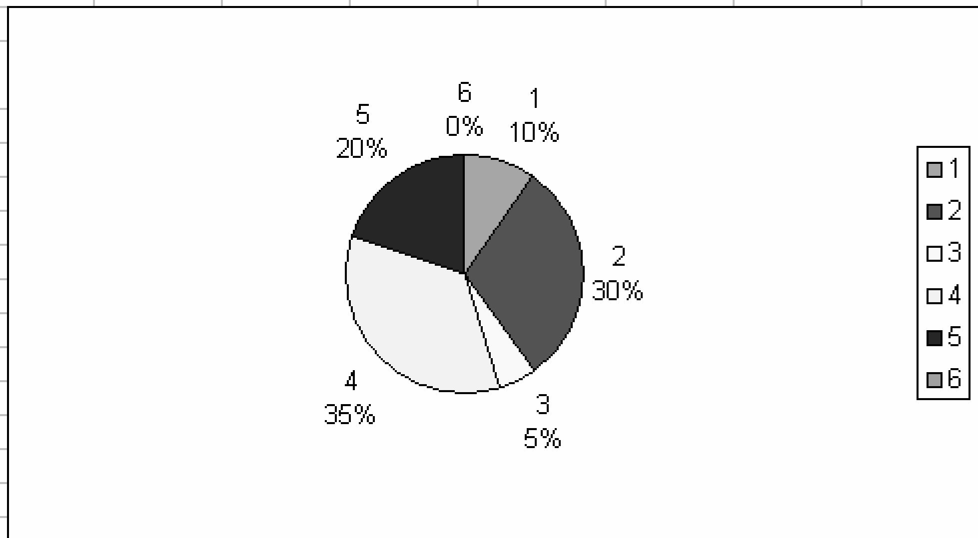






3. A graph will appear on the spreadsheet.

Differenct Outcomes	Frequency
1	2
2	6
3	1
4	7
5	4
6	0



Technology Tutorial: TI-73: Trials, Trials, & More Trials Activity with APPS

Notice there are two different sets of **Simulation Cards**. **The best scenario is to use Simulation Card Set 2 With APPS Program**. Card set 2 with APPS Program requires the **Probability Simulator APPS**, you can perform the activity without the simulator using Card Set 2 without APPS Program.
The following is an example: participants will generate different data independent of this example. Therefore participant's data and list will vary.

Advanced Preparation

Check all calculators for the **Probability Simulator APPS** by checking the APPS list for **Pro Sim**.

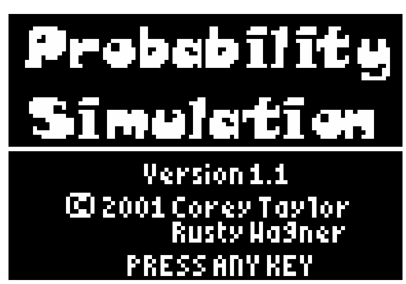
If the applications list does not contain the Probability Simulator APPS, then refer to the Technology Tutorial **Loading TI Probability Simulator APPS** and load the application software.

Trials, Trials, & More Trials with Probability Simulator

1. Press ON.

2. Press APPS.

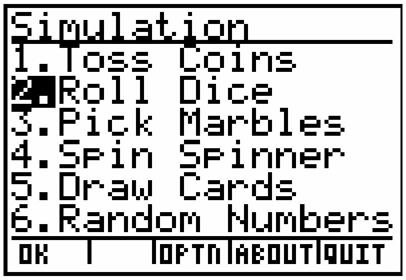
3. Select the Probability Simulator, **Prob Sim.** Press ENTER twice.

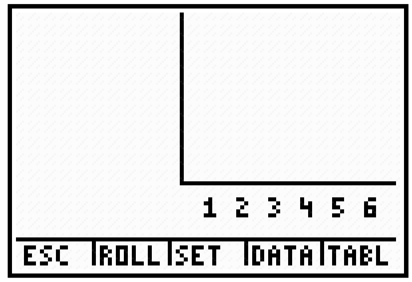


4. Follow the instructions below for each specific simulation.

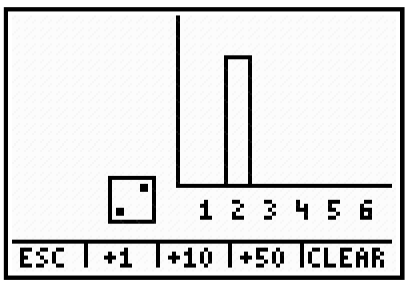
Number Cube

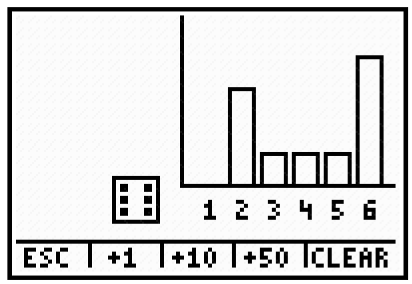
A. Select **Roll Dice**. Press [ENTER].





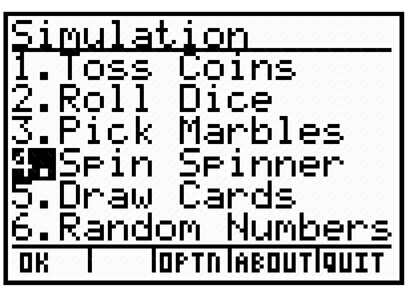
B. Press [WINDOW] which will activate the first roll of the die. Continue pressing [WINDOW] until you have recorded 10 rolls.

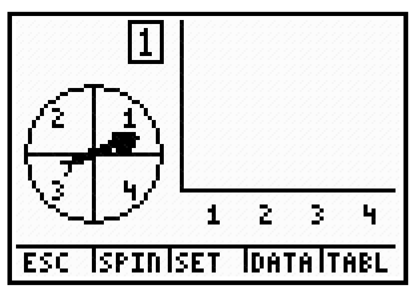




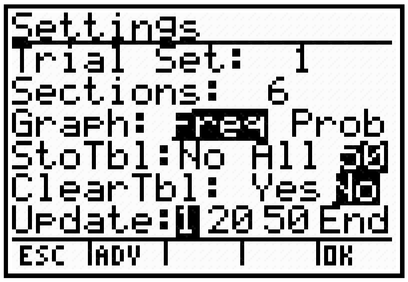
Spinner

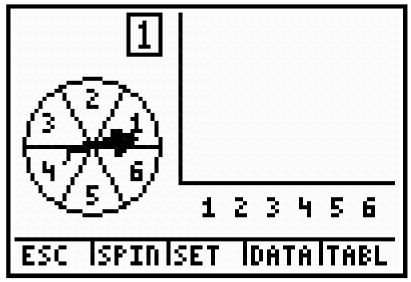
A. Select **Roll Dice**. Press [ENTER].



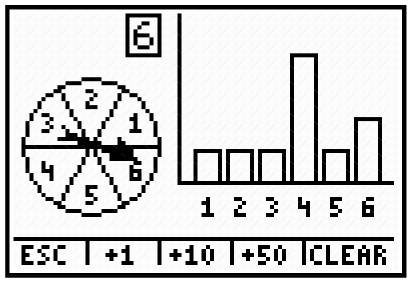


B. Press [ZOOM] to activate settings. Using the arrow keys: set **Sections** to 6 and **Graph** to Freq. Press [GRAPH].

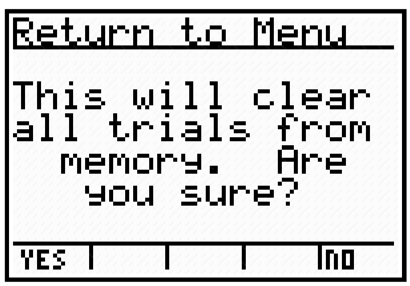




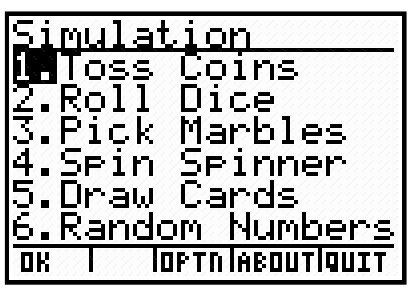
C. Press [WINDOW] which will activate the first spin. Continue pressing [WINDOW] until you have recorded 10 spins.



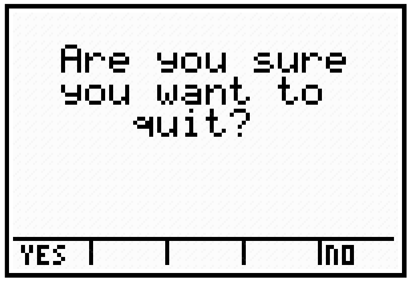
5. To quit Probability Simulation: Press [Y=].



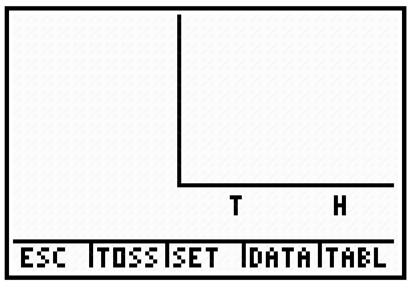
6. Press [Y=].



7. Press [GRAPH].



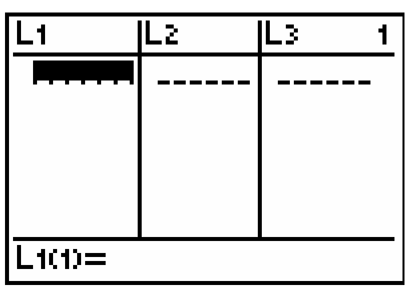
8. Press [Y=].



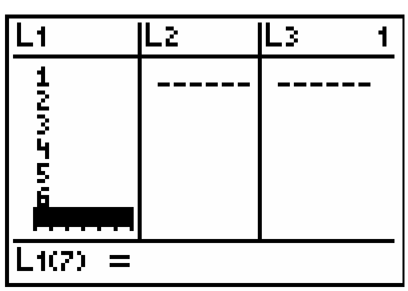
Creating a Line Plot

1. Press [ON].

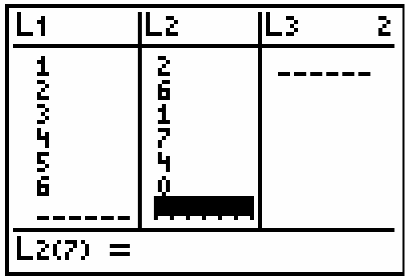
2. Press [LIST].



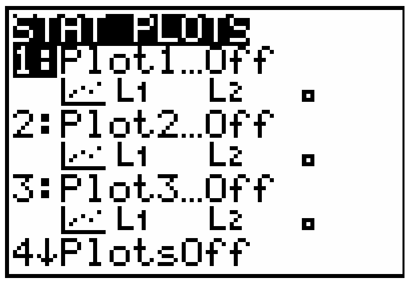
3. Input the possible outcomes into **L1** (list 1**)**, one at a time. Press [ENTER] each time.



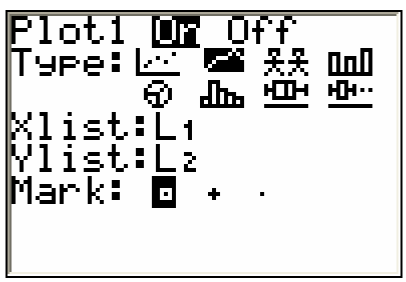
4. Curser over to **L2** (list 2) using the arrow key [▶]. Input the frequency of each possible outcome one at a time. Press [ENTER] each time.
Record frequencies in the **Groups Activity Sheet: Simulation #2** table.
In this example: 2, 6, 1, 7, 4, 0 will be the frequencies of the six possible outcomes



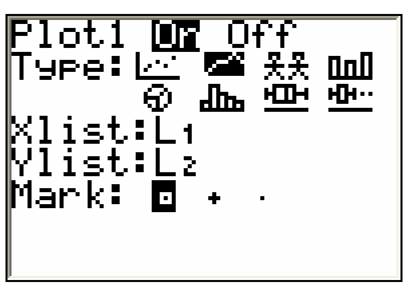
5. Press [2nd][Y=].



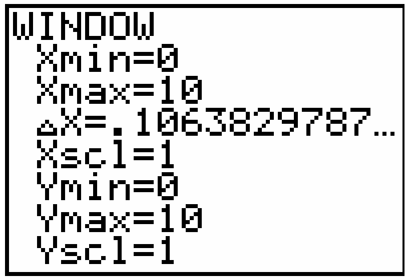
6. Select **Stat Line**. Press [ENTER].



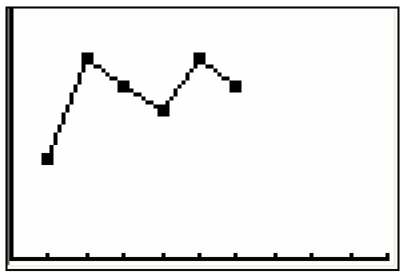
7. Using the curser keys and [ENTER], select Plot 1 **On**, Type **Line Plot**, Xlist **L1**, and Ylist **L2**.



8. Press [WINDOW]. Set window using illustration.



9. Press [GRAPH].



10. To quit: Press [2nd][MODE].

11. Press [2nd][ON].

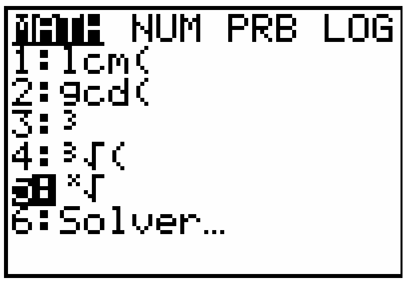
Technology Tutorial: TI-73: Trials, Trials, & More Trials Activity with No APPS

Notice there are two different sets of **Simulation Cards**. **The best scenario is to use Simulation Card Set 2 With APPS Program**. Card set 2 with APPS Program requires the **Probability Simulator APPS**, the activity can be done without the simulator using Card Set 2 without APPS Program.
The following is an example: participants will generate different data independent of this example. Therefore participant's data and list will vary.

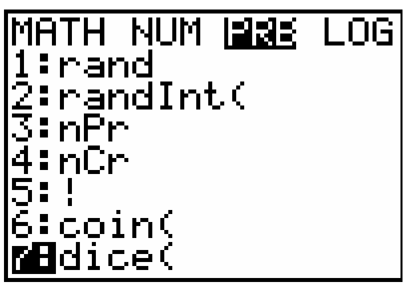
Trials, Trials, & More Trials with No Probability Simulator

1. Press [ON].

2. Press [MATH].



3. Curser over to the [MATH] **PRB** menu using the [►] key.

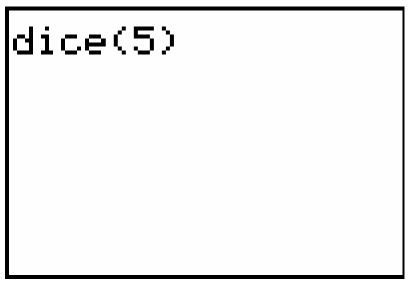


4. Follow the instruction below for each type of simulation.

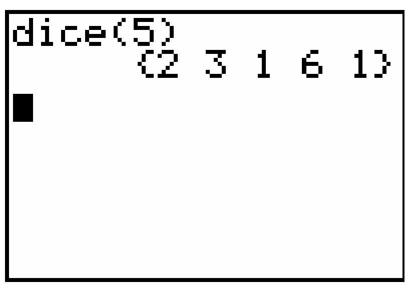
Number Cube

A. Select **dice(**. Press [ENTER].

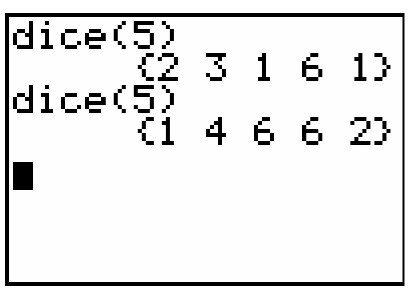
B. To simulate 5 rolls of a die: Enter [5][)].



C. Press [ENTER], which will generate the first 5 rolls.

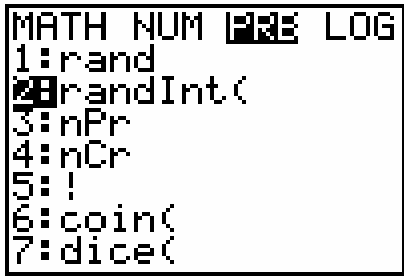


D. Press [ENTER], to generate the next 5 rolls.

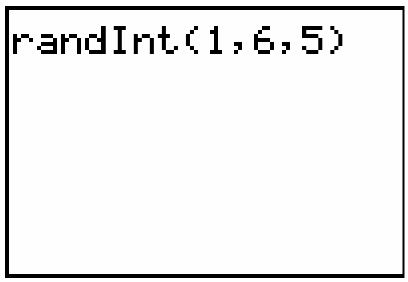


Number Generator

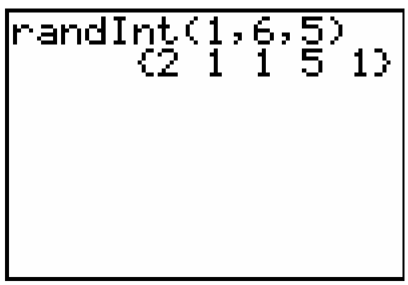
A. Select **randInt(.** Press [ENTER].



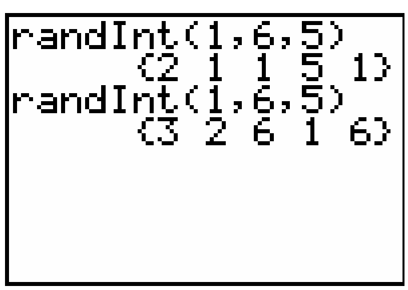
B. To generate 5 random integers between 1 and 6: Enter [1][,][6][,][5][)].



C. Press [ENTER] which will generate the first five numbers.



D. Press [ENTER] which will generate the next five numbers.

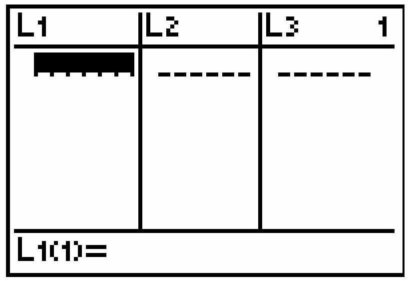


5. To quit: Press [2nd][ON].

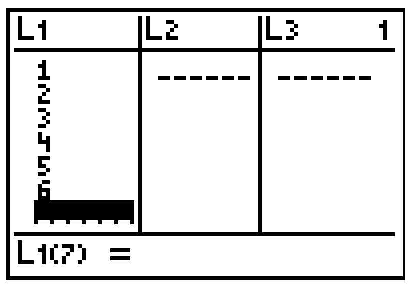
Creating a Line Plot

1. Press [ON].

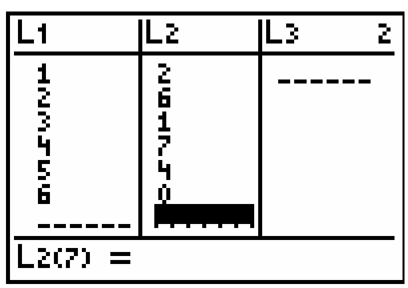
2. Press [LIST].



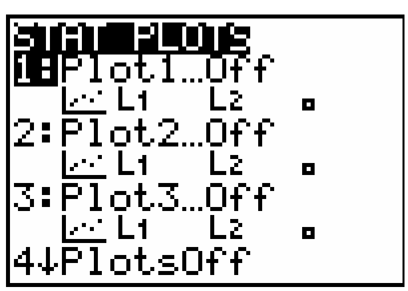
3. Input the possible outcomes into **L1** (list 1**)**, one at a time. Press [ENTER] each time.



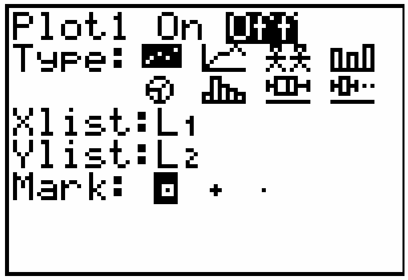
4. Curser over to **L2** (list 2) using the arrow key [▸]. Input the frequency of each possible outcome one at a time. Press [ENTER] each time.
   Record frequencies in the **Groups Activity Sheet: Simulation #2** table.
   In this example: 2, 6, 1, 7, 4, 0 will be the frequencies of the six possible outcomes



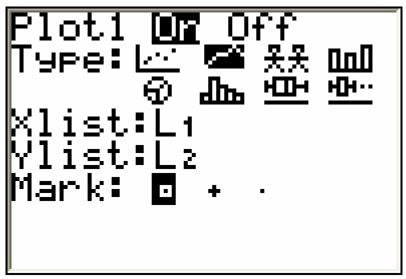
5. Press [2nd][Y=].



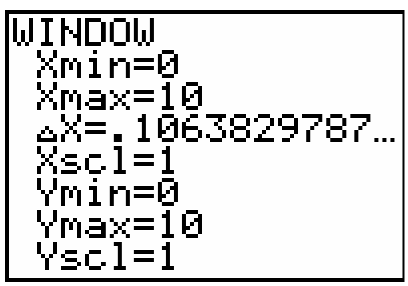
6. Select **Stat Plot** 1. Press [ENTER].



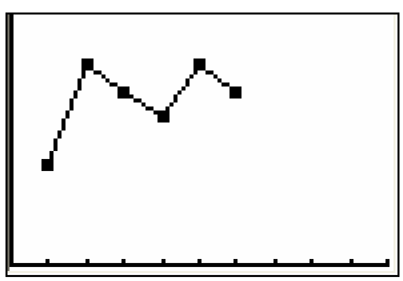
7. Using the curser keys and [ENTER], select Plot 1 **On**, Type **Line Plot**, Xlist **L1**, and Ylist **L2**.



8. Press [WINDOW]. Set window using illustration.



9. Press [GRAPH].



10. To quit: Press [2nd][MODE].

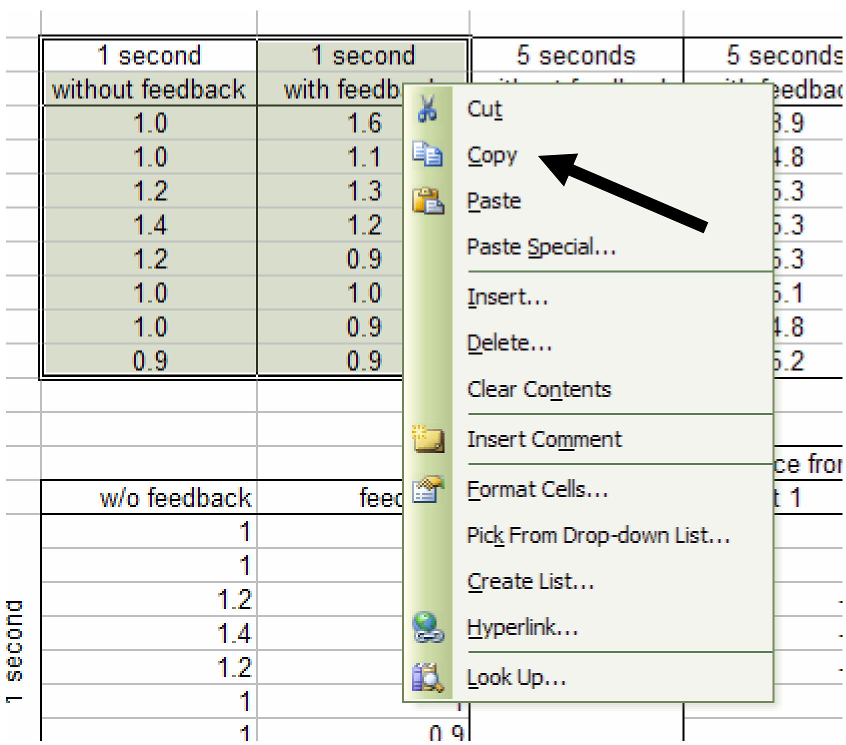
11. Press [2nd][ON].

Technology Tutorial: Importing Data and Charts

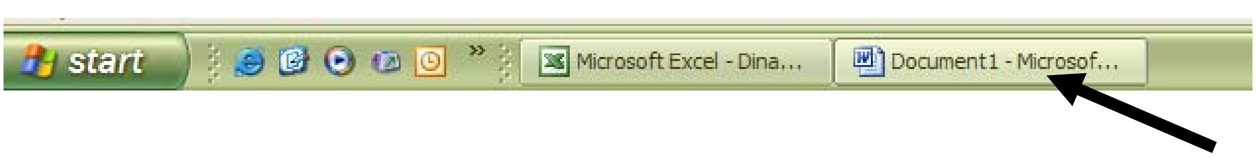
1. To import data, “click and drag” to highlight the cells containing the data and data labels.

1 second without feedback	1 second with feedback	5 seconds without feedback
1.0	1.6	4.0
1.0	1.1	3.5
1.2	1.3	3.3
1.4	1.2	3.5
1.2	0.9	3.3
1.0	1.0	2.4
1.0	0.9	3.4
0.9	0.9	3.7

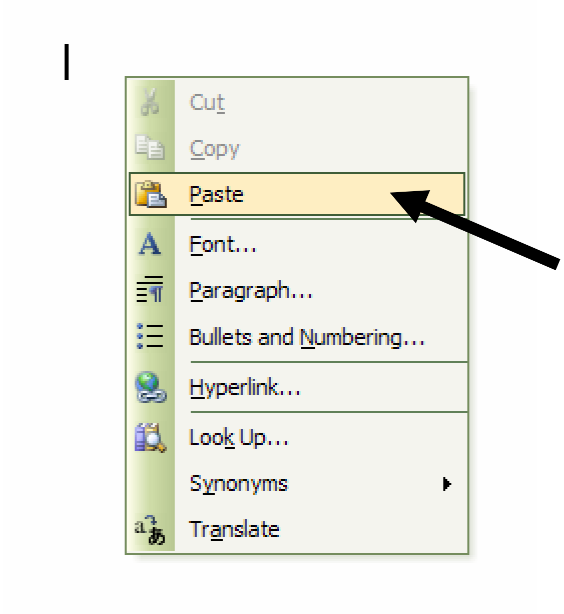
2. Right click on the highlighted cells. Click on **Copy**.



3. Click on the appropriate file on the menubar to open the document that will contain your imported data.



4. Right click on this document. Click on **Paste**.



5. The highlighted cells will be imported into your document.

1 second without feedback	1 second with feedback
1.0	1.6
1.0	1.1
1.2	1.3
1.4	1.2
1.2	0.9
1.0	1.0
1.0	0.9
0.9	0.9

6. Use the same process to import a chart.

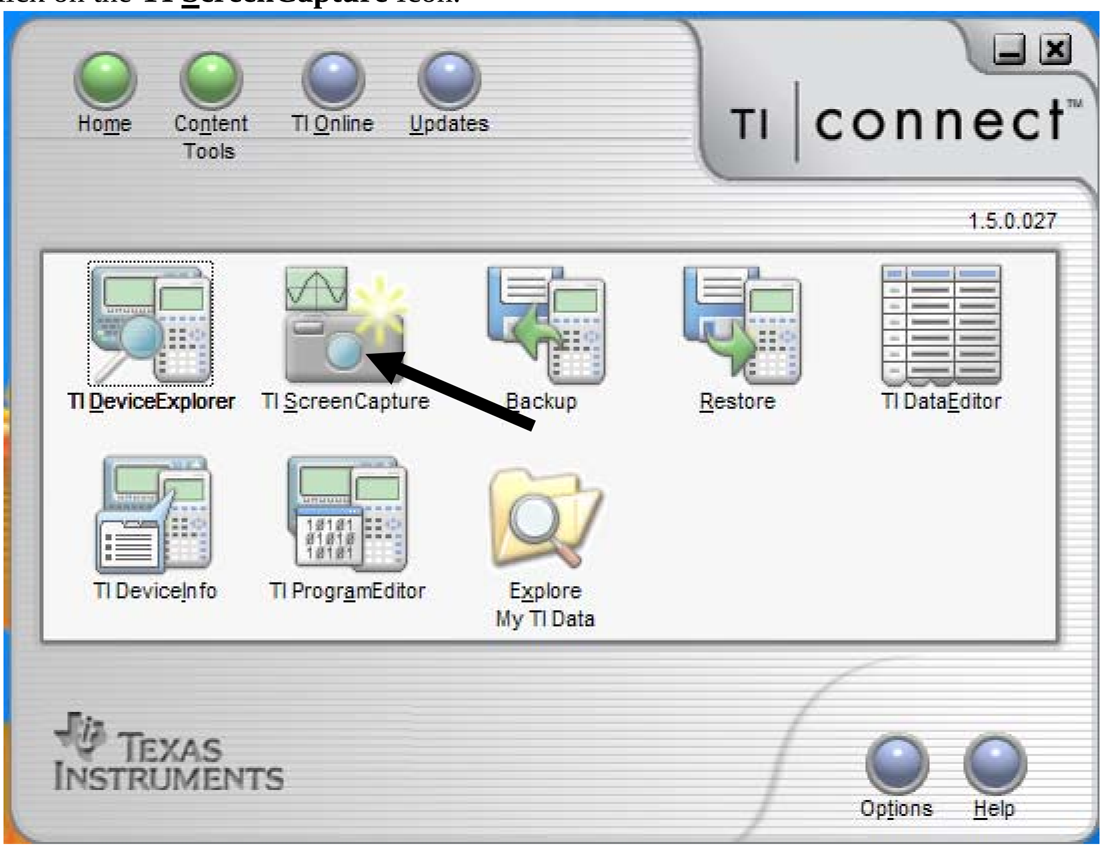
Technology Tutorial: Importing Screen Shots

1. To import screen shots from a graphing calculator, TI Connect must be loaded onto the computer.

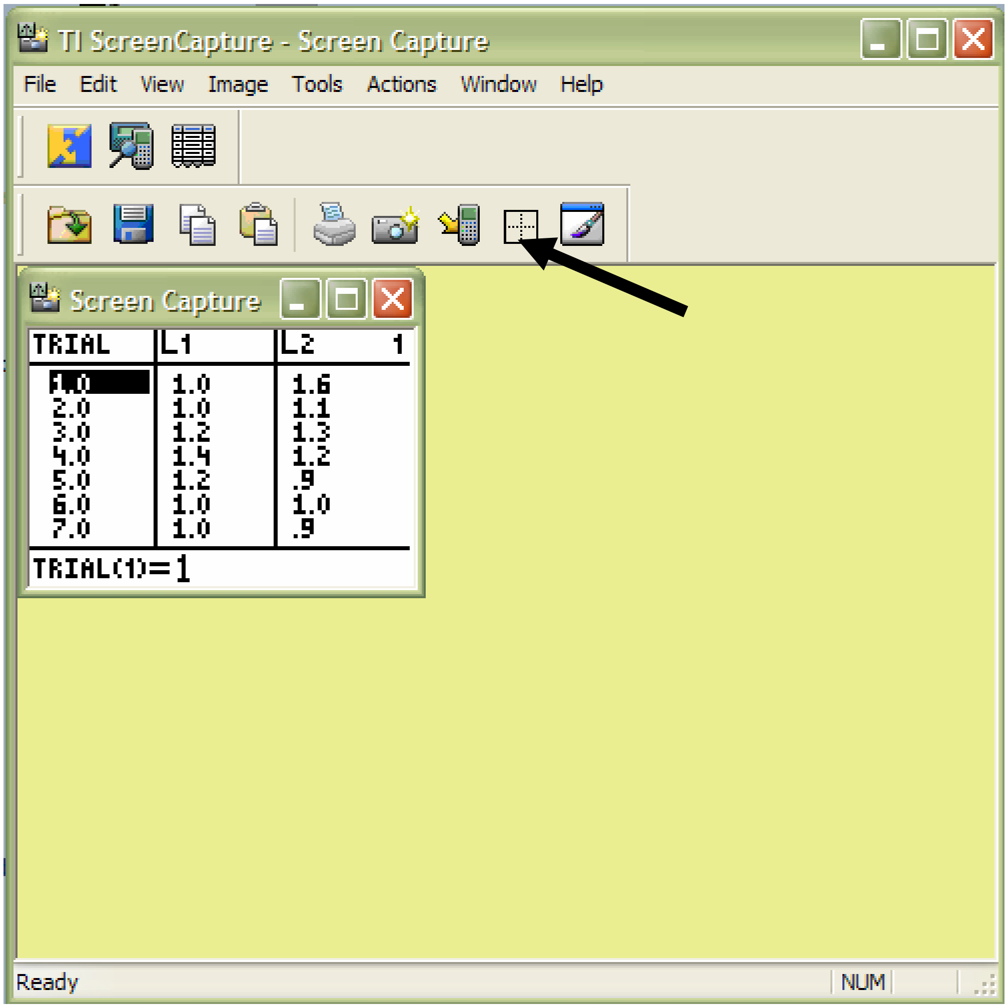
2. Link the TI-73 graphing calculator to the computer using a TI Connectivity Cable Serial for Windows® (black).

3. Double click on the **TI Connect** icon on the desktop.

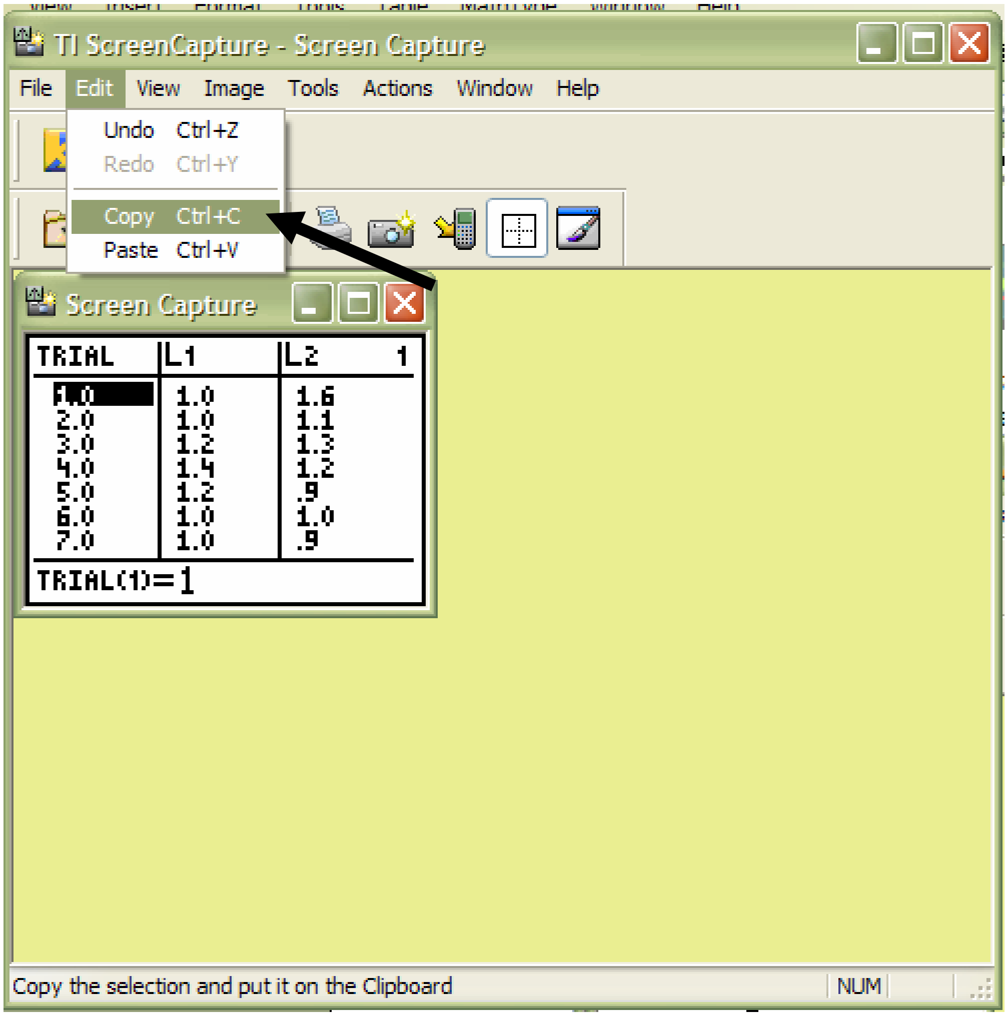
4. Click on the **TI ScreenCapture** Icon.



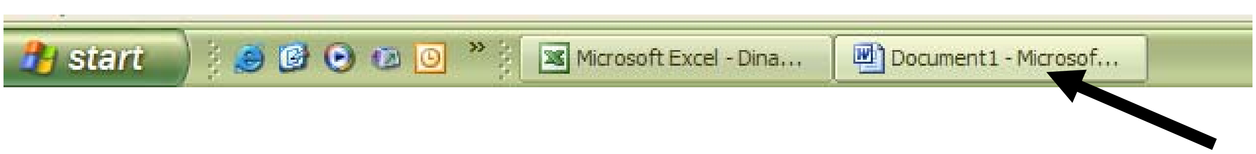
5. The Screen Capture window will open up. The screen shot containing whatever is presently displayed on your graphing calculator will be displayed within this window. Click on the **Add/Remove Border** icon to add a border to your screen shot.



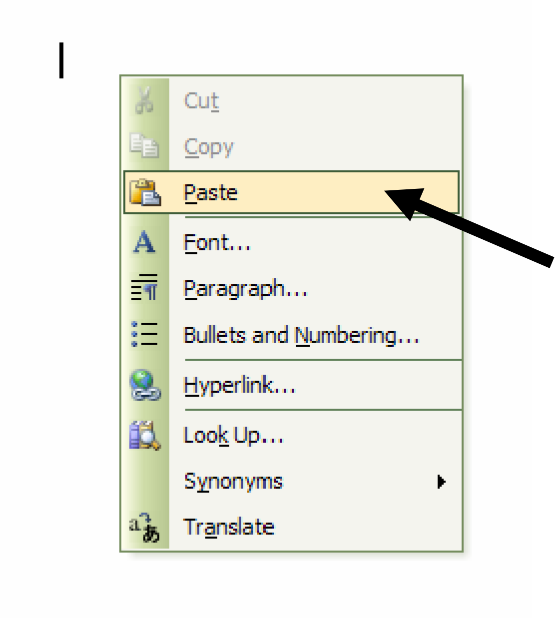
6. Click on **Edit** on the menubar. Click on **Copy** to copy the image to the clipboard.



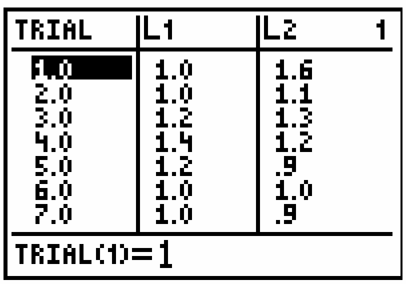
7. Click on the appropriate file on the menubar to open the document that will contain your imported data.



8. Right click on this document. Click on **Paste**.



9. The screen shot will be imported into your document as shown below.



Mean, Line Plots, Stem and Leaf Plot Spreadsheet

Mathematics

6.10 The student uses statistical representations to analyze data. The student is expected to:

- (A) select and use an appropriate representation for presenting and displaying different graphical representations of the same data including line plot, line graph, bar graph, and stem and leaf plot.
- (B) identify mean (using concrete objects and pictorial models), median, mode, and range of a set of data
- (D) solve problems by collecting, organizing, displaying, and interpreting data.

Technology Applications

The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to:

- (1)(a) demonstrate knowledge and appropriate use of operating systems, software applications, and communicate and networking components.
- (1)(c) demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency.
- (1)(f) perform basic software application function including, but not limited to, opening an application program and creating, modifying, printing, and saving documents.

The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to:

- (7)(b) plan, create, and edit spreadsheet documents using all data types, formulas and functions, and chart information.

Materials

Advanced Preparation:

- Students should have access to computers with a spreadsheet program and/or a projection device to use a spreadsheet as a class demonstration. Load the **Seven Friends spreadsheet** on each computer.
- Transparencies: **Chocolate Candy**, **Class Data**
- Piece of paper labeled **"Median"** in large print.
- In large print, label one piece of paper with the number **32**.
- In large print, label seven pieces of paper with the following numbers (one number per paper):**18, 24, 24, 24, 32, 36, 38**
- Prepare 4 zipper bags for each student group – fill each as indicated. Bag A: 25 centimeter cubes; Bag B: 28 centimeter cubes, Bag C: 42 centimeter cubes, and Bag D: 9 centimeter cubes.

For each student:

- **Seven Friends** activity sheet
- **How Far Can We Stretch?** activity sheet
- **What is Missing?** activity sheet
- **Class Data** recording sheet

For each student group of 3 - 4 students:

- Chart paper
- Markers
- Prepared zipper bags with cubes
- Measuring tapes with customary measurements

ENGAGE

The Engage portion of the lesson is designed to create student interest in the development and understanding of mean. This part of the lesson is designed for groups of three to four students.

1. Distribute a set of 4 bags to each group and place **Chocolate Candy Transparency** on the overhead. If a group has only 3 participants, have them pretend they have a fourth participant for this activity.
2. Give student groups time to work the problem and then write their answers and solution strategy on a piece of chart paper. Have groups hang their chart paper on the wall.
3. When all groups are finished, one person from each group should stay with their chart paper to answer questions others may have during a Gallery Tour. Allow about 5 minutes for a Gallery Tour. Students should be looking for similarities and differences in the group's strategies.

Note: The teacher is looking for at least two different solution strategies. One of the strategies should be to combine all of the colored chocolate candies and divide them up evenly into four groups. The other important strategy is to take some of the colored chocolate candies from the person with the most and give them to the person with the least in an attempt to balance or even out the pairs.

Facilitation Questions

- How many colored chocolate candies should each person have once the candy is distributed evenly? *26*
- Did each group find the number of colored chocolate candies each friend should have using the same strategy? *Answers may vary.*
- What are the similarities in the strategies? What are the differences in the strategies? *Answers may vary.*
- Did any group give an example of when their strategies may not work? If so, what were they? *If the data would not divide evenly into the given number of groups, they may encounter some difficulty. However, students could decide the approximate number of candies that would be in each bag.*
- Suppose the four bags had the following numbers of candies: 142, 158, 212, and 356. What strategy could be used to find how many candies each bag would have if the candies were redistributed evenly? Why would you choose this strategy? *Since you are working with much larger numbers, it would not be as efficient to model redistributing that many candies. The most efficient method would be to add to find the total number of candies (868), and then divide into 4 groups (217).*

EXPLORE

The Explore portion of the lesson provides the student with an opportunity to be actively involved in the exploration of the mathematical concepts addressed. This part of the lesson is designed for groups of three to four students. Ideally, there should be one computer for each pair of students.

1. Distribute the **Seven Friends** activity sheet to each student. Students should work with their group members to complete steps 1 to 7 of this activity. For step 7, students will need access to the **Seven Friends Spreadsheet Sheet 1**. The teacher should be actively monitoring the groups, redirecting and providing assistance where necessary.

2. After students have successfully completed steps 1 to 7, direct them to open **Seven Friends Spreadsheet Sheet 2** on their computers. In groups, students will analyze their data and graphs to discover how stem and leaf plots and line plots are created.

EXPLAIN

The Explain portion of the lesson is directed by the teacher to allow the students to formalize their understanding of the TEKS addressed in the lesson. Debrief the activity as directed below.

1. Debrief the concept of mode by asking the following questions.

Facilitation Questions

- What was the most common number of candies in a bag? *24*
- How would the answer change if two more bags were added, each containing 32 candies? *There would be 2 modes : 24 and 32*
- What if each bag of candy contained a different number of candies? *There would be no mode, since no number occurs any more often than any other number.*

2. Debrief the concept of median by asking 7 volunteers to come to the front of the room. Hand each volunteer one of the numbered cards (18, 24, 24, 24, 32, 36, 38).

Facilitation Questions

- Ask the class to explain a strategy that could be used in order to find the median. *The students should line up from least to greatest. Remove one student from each end. The student left in the middle represents the median.*

3. Using a strategy suggested by the class, find the student who represents the median value. Have that student hold the "Median" sign so that all students can see it. Ask the 7 volunteers to line up again from least to greatest.

Facilitation Questions

- What do you notice about the values of the numbers on the papers to the median's left? *The values are equal to or smaller than the median's value.*
- What do you notice about the values of the numbers on the papers to the median's right? *The values are larger than or equal to the median's value.*
- How many people are standing to the left of the median? *3*
- How many people are standing to the right of the median? *3*

4. Ask for one more volunteer to join the other students at the front of the room. Hand that student the additional card labeled “32”. Ask the students to line up again from least to greatest.

Facilitation Questions

- What happens this time when they try to find the median? *There are 2 students left in the middle.*
- What value would represent the number of candies that would be halfway between the two students? *The value that falls exactly halfway between 24 and 32. (28)*
- How many values fall to the left of 28? *4*
- How many values fall to the right of 28? *4*
- What do you notice about the number of values that are to the left and the right of the median? *They are equal.*

5. Have the students return to their seats.

6. Debrief the concept of range using the following questions.

Facilitation Questions

- Using the original set of data, what was the difference between the number of candies in the largest bag and the smallest bag? *20*
- What if the smallest number of candies remained at 18, but the set of data had a range of 25 instead of 20? What does that imply about the data set? *The largest number of candies would have been 43 (25+18).*

7. Debrief the concept of mean using the questions below.

Facilitation Questions

- If the candies were redistributed so each person had the same amount, how many would each person have? *28*
- What strategy did you use to find this value? *Answers may vary.*
- What if the mean for the 7 friends was 25? Would the total number of candies be more or less than the previous total? Why? *The total number of candies would be less than the previous total. If 7 friends each had 25 candies, the total number of candies would be 175 instead of 196.*

8. To debrief the concept of stem and leaf plots, ask participants to share their thoughts on how the computer created the stem and leaf plot.

Facilitation Questions

- How are stem and leaf plots created? *Answers may vary.*
- The values to the left of the vertical line are called the stems. What values were used to make the stems? *1, 2, and 3*
- Where did these values come from? *They represented the tens places of the number of candies in a bag.*
- The values to the right of the vertical line are called leaves. Where did these values come from? *They represented the ones places of the number of candies in each bag.*
- What type of information does a stem and leaf plot provide? *It shows each number in least to greatest order.*
- Can you identify the mode from the stem and leaf plot? *Yes, it is easy to see that 24 occurs more often than any of the other values.*
- Can you identify the minimum value from the stem and leaf plot? If so, what is it and where is it located? *Yes, the minimum value is 18. It is the first "leaf" and its corresponding stem.*
- Can you identify the maximum value from the stem and leaf plot? If so, what is it and where is it located? *Yes, the maximum value is 38. It is the last "leaf" and its corresponding stem.*
- Can you identify the median from the stem and leaf plot? If so, how? *You could mark off a leaf from the top and bottom until there is exactly one value left in the middle. This value represents the median.*
- Can you identify the mean from the stem and leaf plot? *No, but you could do calculations to find the value of the mean.*

9. To debrief the concept of line plots, ask participants to share their thoughts on how the computer created the line plot.

Facilitation Questions

- How are line plots created? *Answers may vary.*
- Where did the values along the horizontal axis come from? *It was a number line that included all values from the data set.*
- What was the significance of the squares above the horizontal axis? *Each square represented an occurrence of that value in the data set.*
- What type of information does a line plot provide? *It shows each number in on a number line. It also shows the frequency of each number.*
- Can you identify the mode from the line plot? *Yes, it is easy to see that 24 occurs more often than any of the other values.*
- Can you identify the minimum value from the line plot? If so, what is it and where is it located? *Yes, the minimum value is 18. It is the first square on the number line.*
- Can you identify the maximum value from the line plot? If so, what is it and where is it located? *Yes, the maximum value is 38. It is the last square on the number line.*
- Can you identify the median from the line plot? If so, how? *You could mark off a square from the left and the right until there is exactly one value left in the middle. This value represents the median.*
- Can you identify the mean from the line plot? *No, but you could do calculations to find the value of the mean.*

ELABORATE

The Elaborate portion of the lesson provides an opportunity for the student to apply the concepts of the TEKS within a new situation. This part of the lesson is designed for groups of three to four students.

1. Distribute the **How Far Can We Stretch?** activity sheet to each student. Read through step 1 as a class.

Facilitation Questions

- What things do you need to keep in mind before your group starts the activity so that the group and class data are comparable?
  Students should make comments about determining the procedures to use when measuring each length of stretch (i.e. measure from middle fingertip to middle fingertip, round each measurement to the nearest inch, etc.).

2. Have students follow the directions on the activity sheet to collect data on the length that each student can stretch.
3. Put the **Class Recording Sheet Transparency** on the overhead and allow students to record the stretch lengths for each student on the chart.
4. After the data from all students has been entered on the transparency, direct students to complete through problem 10 on their activity sheet.
5. Direct students to use Excel and the websites to verify their work on the activity page. Use the following facilitation questions as needed.

Facilitation Questions

- What things do you need to keep in mind when you create stem and leaf plots and line plots?
  What are the values for the stem? What are the values for the leaves? What does the horizontal axis represent? What does the vertical axis represent?
- Does one of the plots tell you more about the data than the other?
  Answers may vary. Students should realize that both plots display the data so that it is easy to determine what the data was from the problem.
- Is it easier to determine the mean, median, mode, and/or range from one of the plots than the other?
  Answers may vary. Students should realize that the mode, median, and the range are easy to determine from either plot. The mean is not easy to determine from either plot.

EVALUATE

The Evaluate portion of the lesson provides the student with an opportunity to demonstrate his or her understanding of the TEKS addressed in the lesson.

1. Provide each student with the **What is Missing?** activity sheet.
2. Upon completion of the activity sheet, use a rubric to assess student understanding of the concepts addressed in the lesson.

Answers and Error Analysis for selected response questions:

Question Number	*TEKS*	*Correct Answer*	*Conceptual Error*	*Conceptual Error*	*Procedural Error*	*Procedural Error*	*Guess*
1	6.10A	D	A	B	C		
2	6.10B	B	C	D	A		
3	6.10B	A	B	D			C
4	6.10D	B	C	D	A		

Activity Page: Seven Friends *(Possible Answers)*

Seven friends each have a package of colored chocolate candies. Some of the packages are the fun size and some of the packages are the regular size. The chart below shows how many individual colored chocolate candies each person has in his or her package.

Friend's Name	Number of Colored Chocolate Candies
Miriam	24
Martha	18
Mark	38
Maria	24
Melissa	32
Michael	36
Melinda	24

1. What was the most common number of candies in a bag?

24

2. If the bags of candy were arranged in order from the least number of candies in a bag to the greatest number of candies in a bag, which bag would be located in the exact center? How many candies would be in this bag?

One of the bags with 24 candies would be in the center

3. Who has the greatest number of candies? How many does he/she have?

Mark, 38

4. Who has the least number of candies? How many does he/she have?

Martha, 18

5. How many more candies does the person with the most have than the person with the least?

20

6. If the candies were redistributed so each person has the same amount, how many would each person have?

28

7. Open the **Seven Friends spreadsheet** and complete the activities on **sheet 1**.

Activity Page: How Far Can We Stretch? *(Possible Answers)*

1. Record the names of all of the students in your group in the chart below. Then measure across each person's back the length of how far each person can stretch. Measure from fingertip to fingertip the length in inches of each member of your group (round to the nearest inch) and record each length in the table.

Student Name	**Height in Inches**
Answers may vary	*Answers may vary*
Answers may vary	*Answers may vary*
Answers may vary	*Answers may vary*
Answers may vary	*Answers may vary*

2. When your group has measured and recorded the length of each person's stretch in the group, transfer the information to the chart on the overhead.

3. Record the class data on the last page of this activity.

4. Create a stem and leaf plot to display the lengths of how far the students in your class can stretch.

   Answers may vary based on class data.

5. Create a line plot to display the lengths of how far the students in your class can stretch.

   Answers may vary based on class data.

6. What are the similarities and differences in the two plots? Can you tell more about the data in one of the plots than the other? If so, which plot displays the data better? If you had to pick only one plot to display the data which one would you choose and why?
   Answers may vary based on class data.

7. What is the mean of the data? Justify your answer.
   Answers may vary based on class data.

8. What is the mode of the data? Justify your answer.
   Answers may vary based on class data.

9. What is the median of the data? Justify your answer.
   Answers may vary based on class data.

10. What is the range of the data? Justify your answer.
    Answers may vary based on class data.

11. Use the Stem and Leaf Plotter to verify your stem and leaf plot.
    http://www.shodor.org/interactivate/activities/stemleaf/index.html

12. Use the Line Plotter to verify your line plot.
    http://www.shodor.org/interactivate/activities/plop/index.html

13. Use formulas in a spreadsheet to verify your answers for mean, median, mode, and range.

14. Which method (paper and pencil or website) was easier to use to construct the Stem and Leaf Plot and Line Plot?
    Answers may vary, but the students should comment that the technology made the creation of the plots much faster.

15. How is calculating the mean, median, mode, and range from the spreadsheet different from calculating the statistics by hand? How is it the same?
    Answers may vary, but the students should not notice significant differences in the way they calculated the statistics.

16. Which method (paper and pencil or spreadsheet) was easier to use to calculate the mean, median, mode, and range? Why?
    Answers may vary, but the students should comment that the technology made the calculation of the statistics much faster.

Activity Page: What is Missing? *(Answer Key)*

There are nine sixth grade classes at Texas Middle School. Mary knows the number of students in six of the classes. The data she knows appears in the table below.

Class A	22 students	Class F	24 students
Class B	25 students	Class G	?
Class C	23 students	Class H	?
Class D	22 students	Class I	?
Class E	24 students		

She knows that the largest class has twenty-five students. She also knows the information listed below.

The mean is 23 students.
The mode is 24 students.
The median is 23 students.
The range is 5 students.

How many students are in each of the three missing classes?

Use the websites and a spreadsheet to help find the number of students in the three missing classes.

Answer: The three classes have 20 students, 24 students, and 23 students.

Transparency: Chocolate Candy

You have each been given a bag of “chocolate candy”.

Devise a strategy so that each person in your group will have the same number of candies.

Try your strategy to see if it works. Record your strategy and solution on your chart paper.

Will your strategy always work? If not, write an example of when it will not work.

Mean, Line Plots, Stem and Leaf Plot Spreadsheet

Class Data

Student Name	Length of Stretch in Inches

Activity Page: Seven Friends

Seven friends each have a package of colored chocolate candies. Some of the packages are the fun size and some of the packages are the regular size. The chart below shows how many individual colored chocolate candies each person has in his or her package.

Friend's Name	Number of Colored Chocolate Candies
Miriam	24
Martha	18
Mark	38
Maria	24
Melissa	32
Michael	36
Melinda	24

1. What was the most common number of candies in a bag?

2. If the bags of candy were arranged in order from the least number of candies in a bag to the greatest number of candies in a bag, which bag would be located in the exact center? How many candies would be in this bag?

3. Who has the greatest number of candies? How many does he/she have?

4. Who has the least number of candies? How many does he/she have?

5. How many more candies does the person with the most have than the person with the least?

6. If the candies were redistributed so each person has the same amount, how many would each person have?

7. Open the **Seven Friends spreadsheet** and complete the activities on **sheet 1**.

Activity Page: How Far Can We Stretch?

1. Record the names of all of the students in your group in the chart below. Then measure across each person's back the length of how far each person can stretch. Measure from fingertip to fingertip the length in inches of each member of your group (round to the nearest inch) and record each length in the table.

Student Name	Height in Inches

2. When your group has measured and recorded the length of each person's stretch in the group, transfer the information to the chart on the overhead.

3. Record the class data on the last page of this activity.

4. Create a stem and leaf plot to display the lengths of how far the students in your class can stretch.

5. Create a line plot to display the lengths of how far the students in your class can stretch.

6. What are the similarities and differences in the two plots? Can you tell more about the data in one of the plots than the other? If so, which plot displays the data better? If you had to pick only one plot to display the data which one would you choose and why?

7. What is the mean of the data? Justify your answer.

8. What is the mode of the data? Justify your answer.

9. What is the median of the data? Justify your answer.

10. What is the range of the data? Justify your answer.

11. Use the Stem and Leaf Plotter to verify your stem and leaf plot.
    http://www.shodor.org/interactivate/activities/stemleaf/index.html

12. Use the Line Plotter to verify your line plot.
    http://www.shodor.org/interactivate/activities/plop/index.html

13. Use formulas in a spreadsheet to verify your answers for mean, median, mode, and range.

14. Which method (paper and pencil or website) was easier to use to construct the Stem and Leaf Plot and Line Plot?

15. How is calculating the mean, median, mode, and range from the spreadsheet different from calculating the statistics by hand? How is it the same?

16. Which method (paper and pencil or spreadsheet) was easier to use to calculate the mean, median, mode, and range? Why?

Activity Page: What is Missing?

There are nine sixth grade classes at Texas Middle School. Mary knows the number of students in six of the classes. The data she knows appears in the table below.

Class A	22 students	Class F	24 students
Class B	25 students	Class G	?
Class C	23 students	Class H	?
Class D	22 students	Class I	?
Class E	24 students		

She knows that the largest class has twenty-five students. She also knows the information listed below.

The mean is 23 students.
The mode is 24 students.
The median is 23 students.
The range is 5 students.

How many students are in each of the three missing classes?

Use the websites and a spreadsheet to help find the number of students in the three missing classes.

http://www.shodor.org/interactivate/activities/stemleaf/index.html

http://www.shodor.org/interactivate/activities/plop/index.html

1 Which of the following is the data set represented in the stem and leaf plot shown below?

5	6 8 9
6	1 3 4 5
7	0

A 0, 1, 3, 4, 5, 6, 7, 8, 9

B 50, 60, 70

C 5689, 61345, 70

D 56, 58, 59, 61, 63, 64, 65, 70

2 The range in weight of several boxes in a warehouse is 25 pounds. If the greatest weight of a box is 78 pounds, how much does the lightest box weigh?

A 25 pounds

B 53 pounds

C 103 pounds

D 128 pounds

3 Andrew kept a record of his bowling scores. The scores are shown in the table below.

Game	Score
1	150
2	140
3	170
4	200
5	140

What is the mean of his scores?

A 160

B 140

C 200

D 170

4 The line plot shows the ages of the grandchildren in a large family.

	X		
	X	X	
X	X	X	X
10	11	12	13

Which statement does the information in the line plot support?

A There are just as many grandchildren that are 11 years old as grandchildren that are 12 years old.

B There are six grandchildren that are 11 years old or older.

C There are more grandchildren that are 11 years old than grandchildren that are 12 years old or 13 years old.

D There are two grandchildren that are 12 years old or older.

Mathematics

6.9 The student uses experimental and theoretical probability to make predictions. The student is expected to

- (B) find the probabilities of a simple event and its complement and describe the relationship between the two.

6.10 The student uses statistical representations to analyze data.

- (A) select and use an appropriate representation for presenting and displaying different graphical representations of the same data including line plot, line graph, bar graph, and stem and leaf plot.
- (C) sketch circle graphs to display data.
- (D) solve problems by collecting, organizing, displaying, and interpreting data.

Technology Applications

The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to:

- (1)(a) demonstrate knowledge and appropriate use of operating systems, software applications, and communicate and networking components.
- (1)(c) demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency.
- (1)(f) perform basic software application function including, but not limited to, opening an application program and creating, modifying, printing, and saving documents.

The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to:

- (7)(b) plan, create, and edit spreadsheet documents using all data types, formulas and functions, and chart information.

Materials

Advanced Preparation:

- Students should have access to computers with a spreadsheet program and/or a projection device to use a spreadsheet as a class demonstration.
- Copy the **Prize Dilemma** and **Spinner Creation** transparencies for the overhead.
- Copy the **Activity Master: Let's Match It** onto colored card stock and cut into sets one for each student group.

For each student:

- **What Color?** activity sheet
- **You Design It** activity sheet

For each student group of 3 - 4 students:

- Chart paper
- Markers
- Rulers
- Compass or large circular objects
- Protractors
- Color Tiles
- Paper bag (lunch size)
- **Let's Match It** card set

For whole group instruction:

- Transparencies: **Prize Dilemma** and **Spinner Creation**

ENGAGE

The Engage portion of the lesson is designed to create student interest in the development and understanding of simple probability as well as the creation of bar graphs and circle graphs. This part of the lesson is designed for groups of 3 to 4 students.

1. Place **Prize Dilemma** transparency on the overhead.
2. Distribute a piece of chart paper and markers to each student group.
3. Give student groups time to work the problem and record their solution on chart paper.

Facilitation Questions – Engage Phase

- Which spinner should the store choose? Why? *Spinner D, the spinner contains the smallest amount of area for cameras.*
- Which spinner should the customer choose? Why? *Spinner A, the spinner contains the largest amount of area for cameras.*
- How many different prizes are available? *4 (DVD, CD, Games and Camera)*
- Which spinner would allow an equal chance of winning each prize? *Spinner A, because all section are the same size.*
- In spinner A, how could you describe the chances of landing on a space labeled CD? DVD? Video Game? Camera? *1 out of 4 for each prize*
- Which spinner provides the greatest chance of winning the CD? How did you determine the answer? *Spinner C, more sections are assigned CD, and CD's cover half the circle.*
- In spinner C, how could you describe the chances of landing on a space labeled CD? *1 out 2*
- In spinner C, how could you describe the chances of landing on a space labeled DVD? Video Game? Camera? *1 out of 6 for each prize.*
- Which spinner would give a customer a 3 out of 8 chance of winning a CD? How did you determine the answer? *Spinner D, because it has eight section and three of them are CD's.*

All questions should be extended with a follow-up question like "How did you determine the answer?" or "Did anyone get the answer using a different strategy?"

4. Place **Spinner Creation** transparency on the overhead.
5. Distribute a second piece of chart paper, rulers, protractors and compasses (or large round objects to make circles on the chart paper.)
6. Give student groups time to create the spinners on the piece of chart paper.
7. Use a Gallery Tour to allow students to examine other groups' solutions to all the questions: Prize Dilemma and Spinner Creation.
8. Use the Facilitation Question on the next page to debrief Gallery Tour.

Facilitation Questions – Engage Phase

- What do you notice about the spinners that were created for the electronics store to use so that it would never have to give away a digital camera? *Answers may vary. Digital cameras are not found on the spinner.*
- What is the probability of landing on a digital camera for these spinners? Why? *Zero*, *because the digital camera is not a possible outcome.*
- What do you notice about the spinners that were created for the electronics store to use so that the customer would always win a digital camera? *Answers may vary. The whole spinner is digital camera.*
- What is the probability of landing on a digital camera for these spinners? Why? *100%, because the digital camera is the only possible outcome.*
- In the spinner you created so that the customer's chance of winning a DVD was better than a video game, how many sections did you label DVD and how many sections did you label video game? *Answers may vary*
- In the spinner you created so that the customer's chance of winning a CD was the same as not winning a CD, how many of the sections did you label CD and how many did you not label CD? *Answers may vary.*

* All questions should be extended with a follow-up question like "How did you determine the answer?" or "Did anyone get the answer using a different strategy?"

EXPLORE

The Explore portion of the lesson provides the student with an opportunity to be actively involved in the exploration of the mathematical concepts addressed. This part of the lesson is designed for groups of three to four students.

1. Distribute the **What Color?** activity sheet.
2. Distribute a sheet of chart paper, a paper bag, some red color tiles, some blue color tiles, and some green color tiles to each student group.
3. Students will need access to the spreadsheet **What Color?**
4. Allow student groups time to work through the activity sheet.
   Note: If students are not familiar with the operation of a spreadsheet, they will need the necessary instruction at this time. Use a Gallery Tour to allow students to examine other groups' solutions.

Facilitation Questions – Explore Phase

- What fraction of the color tiles is red? How did you determine the answer? $\frac{3}{5}$
- What percent of the color tiles is red? How did you determine the answer? *60%*
- What fraction of the color tiles is blue? How did you determine the answer? $\frac{1}{5}$
- What percent of the color tiles is blue? How did you determine the answer? *20%*
- What fraction of the color tiles is green? How did you determine the answer? $\frac{1}{5}$
- What percent of the color tiles is green? How did you determine the answer? *20%*
- What is another way without using a fraction to describe the chance of getting each color? *3 out of 5 chances to get red, 1 out of 5 chances to get blue, and 1 out of 5 chances to get green.*
- What information do you need to sketch a circle graph? *The number of sections needed to divide the circle into, and the labels of each section.*
- How can you determine the number of times you will draw a particular color if you increase the number of draws from the bag? *Multiply the fraction of getting the color you want from the original problem by the scale factor used to enlarge the set.*

EXPLAIN

The Explain portion of the lesson is directed by the teacher to allow the students to formalize their understanding of the TEKS addressed in the lesson.

1. Debrief the **What Color?** activity.

Facilitation Questions – Explain Phase

- How did you and your group determine how many tiles of each color to put in the bag? *Counted the number of reds, blues, and greens from the bar graph.*
- How did you and your group determine the likelihood Mary would draw a red tile? *Determined the number of red tiles in the bag compared to the total number of tiles in the bag.*
- What does this part-whole ratio represent? *The numerator represents the number of tiles there are of one color, and the denominator represents the total number of tiles.*
- How did you and your group determine the likelihood Mary would draw a blue tile? *Determined the number of blue tiles in the bag compared to the total number of tiles in the bag.*
- What part-whole ratio represents the likelihood that Mary would draw a blue tile? $\frac{1}{5}$
- What does this part-whole ratio represent? *The numerator represents the number of blue tiles, and the denominator represents the total number of tiles.*
- How did you and your group determine the likelihood Mary would draw a green tile? *Determined the number of green tiles in the bag compared to the total number of tiles in the bag.*
- What part-whole ratio represents the likelihood that Mary would draw a green tile? $\frac{1}{5}$
- What does this part-whole ratio represent? *The numerator represents the number of green tiles, and the denominator represents the total number of tiles.*
- A part-whole relationship describes the theoretical probability of getting a particular outcome. What is the theoretical probability of drawing a red tile? $\frac{3}{5}$

  A blue tile? $\frac{1}{5}$ A green tile? $\frac{1}{5}$

* All questions should be extended with a follow-up question like “How did you determine the answer?” or “Did anyone get the answer using a different strategy?”

Facilitation Questions – Explain Phase

- What is the theoretical probability of not drawing a red tile? $\frac{2}{5}$
- What do you notice about the theoretical probability of drawing a red tile and not drawing a red tile? *The sum of the probabilities is 1.*
- What is the theoretical probability of not drawing a blue tile? $\frac{3}{5}$
- What do you notice about the theoretical probability of drawing a blue tile and not drawing a blue tile? *The sum of the probability is 1.*
- What is the theoretical probability of not drawing a green tile? $\frac{3}{5}$
- What do you notice about the theoretical probability of drawing a green tile and not drawing a green tile? *The sum of the probabilities is 1.*
- How did you and your group determine how many of the tiles in the 100 draws should be red, blue, and green? *Answers may vary. Students should say something about converting the fractions to percentages using benchmark mark fractions.*
- How could you find the theoretical probability of drawing a particular color if the number of draws was a number other than the original 5 or 100? *Determine the scale factor used to generate the number of draws compared to the original 5 tiles. Then multiply the theoretical probability of getting the particular color by the scale factor.*
- If Mary drew 25 tiles from the bag, how many of the tiles should be red? *15* How did you determine the answer?
- If Mary drew 25 tiles from the bag, how many of the tiles should be blue? *5* How did you determine the answer?
- If Mary drew 25 tiles from the bag, how many of the tiles should be green? *5* How did you determine the answer?
- How does the spreadsheet create the circle graph? *Find the total number of sections to know how many sections to make and then label each section according to the number of each color.*
- How did you and your group create a circle graph? *Divided the circle into the same number of sections as total tiles in the bag. Labeled each section to correspond to each of the color tiles.*
- Which one of the graphs (bar or circle), if either, tells you more about the data than the other? *Answers may vary.*

* All questions should be extended with a follow-up question like “How did you determine the answer?” or “Did anyone get the answer using a different strategy?”

ELABORATE

The Elaborate portion of the lesson provides an opportunity for the student to apply the concepts of the TEKS within a new situation. This part of the lesson is designed for groups of three to four students.

1. Distribute to each student group a set of **Let's Match It** cards, a sheet of chart paper, and markers.
2. Inform students that they will be matching a graph card to a spinner card and 5 statement cards that would match the graph and spinner.
3. Allow student groups time to work through the activity.
4. Assign each student group one match to put on chart paper.

Facilitation Questions – Elaborate Phase

- How did your group decide how to sort the cards?
  Put the bar graphs together, the circle graphs together, and the description cards together.
- How did your group determine which bar graph and which circle graph to match together?
  Look to see what the total number of items is for both, and then look at the number of each color.
- How did your group decide which cards to match with the circle graphs and the bar graph?
  Answers may vary. Students should describe how they looked at the card and then tried to determine which circle graph had the probability listed on the card.
- How did your group check to make sure your match was accurate?
  Answers may vary.

EVALUATE

The Evaluate portion of the lesson provides the student with an opportunity to demonstrate his or her understanding of the TEKS addressed in the lesson.

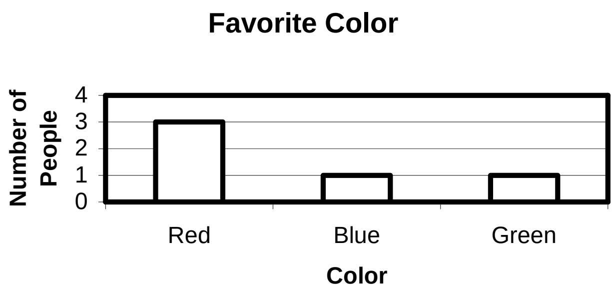
1. Distribute the **You Design It** activity sheet to each student.
2. Upon completion of the activity sheet, use a rubric to assess student understanding of the concepts addressed in the lesson.

Answers and Error Analysis for selected response questions:

Question Number	*TEKS*	*Correct Answer*	*Conceptual Error*	*Conceptual Error*	*Procedural Error*	*Procedural Error*	*Guess*
1	6.9B	D	B	C	A		
2	6.9B	A	B	C	D		
3	6.10C	A	C		B	D	
4	6.10D	B	C	D	A		

What Color? - (Possible Answers)

Mary conducted a survey to determine the favorite color of 5 students in her advisory class. The results are shown in the bar graph below.



She then took a color tile and let it represent the color of each student's vote and put it in a bag.

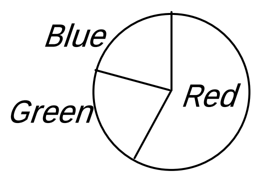
1. How many color tiles of each color should she put in the bag? Justify your answer.
   3 red, 1 blue, and 1 green

2. If Mary draws a color tile at random out of the bag, how likely is she to draw a red tile? Why?
   3 chances out of 5

3. If Mary draws a color tile at random out of the bag, how likely is she to draw a blue tile? Why?
   1 chance out of 5

4. If Mary draws a color tile at random out of the bag, how likely is she to draw a green tile? Why?
   1 chance out of 5

5. Sketch a circle graph to represent what part of the whole each color tile represents in the Favorite Color data.



6. Transfer your sketch onto a piece of chart paper.

7. Record on the chart paper: What are the similarities and differences in the circle graph you drew and the bar graph you were given?

(Continue: What Color?)

Mary wanted to conduct an experiment using the bag of tiles she created based on the information in the Favorite Color graph. She decided she would draw a tile out of the bag, record the color of the tile, return the tile to the bag, and draw again. She decided to repeat this process for 25 draws.

8. How many of the 25 draws should Mary expect to be red? Why?
   15

9. How many of the 25 draws should Mary expect to be blue? Why?
   5

10. How many of the 25 draws should Mary expect to be green? Why?
   5

You will need to model the same experiment that Mary did.

- **Create a frequency table like the one below on the chart paper**
- **Put a color tile for each student vote in the bag**
- **Draw a color tile at random from the bag**
- **Record the color of the tile on the chart paper and worksheet**
- **Return the tile to the bag**
- **Repeat this process 25 times**

Color	Tally	Frequency
Red		
Blue		
Green		

The number of tiles you actually draw from the bag in an experiment is called the *Experimental Probability*.

11. What was your experimental probability of drawing a red?
   Answers may vary.

12. What was your experimental probability of drawing a blue?
   Answers may vary.

13. What was your experimental probability of drawing a green?
   Answers may vary.

(Continue: What Color?)

14. How did the number of red tiles you drew compare to the number you said Mary should have drawn?
    Answers may vary.

15. How did the number of blue tiles you drew compare to the number you said Mary should have drawn?
    Answers may vary.

16. How did the number of green tiles you drew compare to the number you said Mary should have drawn?
    Answers may vary.

17. How close was your prediction to the actual results?
    Answers may vary.

Open the *What Color?* spreadsheet file.

- **Select *Sheet 1* and follow the directions to simulate the experiment.**
- **Select *Sheet 2* and follow the directions to create a circle graph.**

Color	Tally	Frequency
Red		
Blue		
Green		

The number of tiles of one color in the bag compared to total number of tiles in the bag is called the *Theoretical Probability* of selecting a tile of that color.

18. How close was your prediction to the actual results? (Record your response on the chart paper.)

19. What could you do to get your experimental probability to be closer to the theoretical probability? (Record your response on the chart paper.)
    Perform more trials.

You Design It - (Possible Answers)

Open a spreadsheet document. Use the spreadsheet to design a spinner that has each of the theoretical probabilities listed in the table.

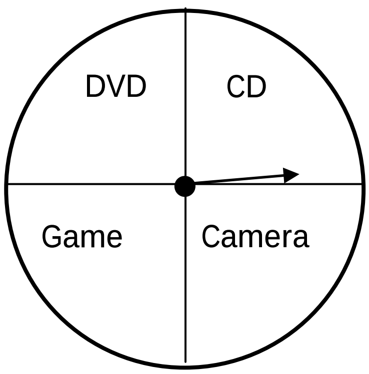
P(Red) $= \frac{1}{3}$
P(Blue) $= \frac{1}{4}$
P(Green) $= \frac{1}{4}$
P(Yellow) $= \frac{1}{6}$

Explain how you designed your spinner.

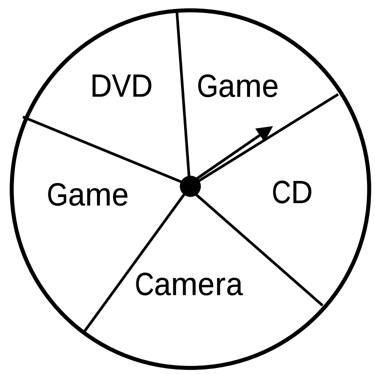
Answers may vary. However, the spinner should have 12 sections with 4 labeled red, 3 labeled blue, 3 labeled green, and 2 labeled yellow.

Prize Dilemma - Transparency

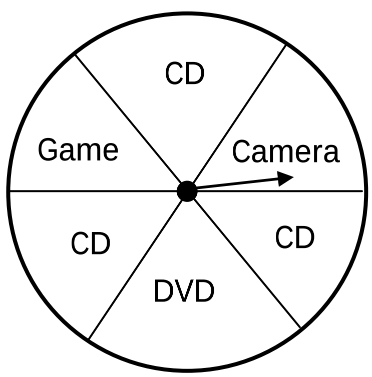
An electronics store is giving away prizes to its customers. Each customer will spin a spinner and receive the prize that the spinner lands on. The four spinners shown below are the spinners the company is considering using.



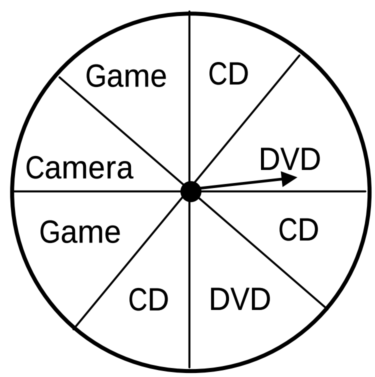
Spinner A



Spinner B



Spinner C



Spinner D

1. If the store wants to give away as few digital cameras as possible, which spinner should it offer each customer to use? Justify your answer.

2. If a customer can select any spinner and he or she wants the best chance to win the digital camera, which spinner should he or she use? Justify your answer.

Spinner Creation - Transparency

3. Create a spinner for the electronics store to use so that it would never have to give away a digital camera. Justify your spinner.

4. Create a spinner that the customer could use so that he or she would win a digital camera every time. Justify your spinner.

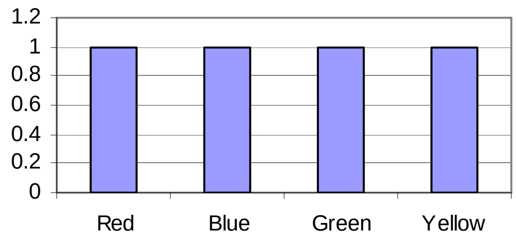
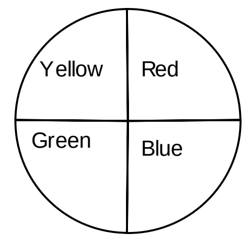
5. Create a spinner so the customer's chance of winning a DVD is better than the chance of winning a video game. Justify your spinner.

6. Create a spinner so that the customer's chance of winning a CD is the same as not winning a CD. Justify your spinner.

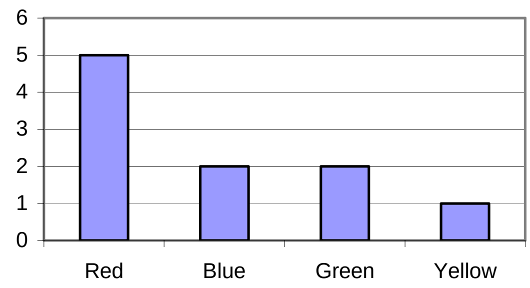
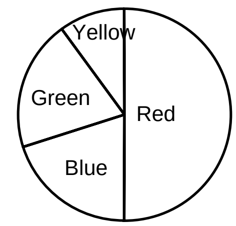
Let's Match It - Activity Master

Let's Match It 	**Let's Match It** 
Let's Match It 	**Let's Match It** 
Let's Match It 	**Let's Match It** 
Let's Match It 	**Let's Match It** 

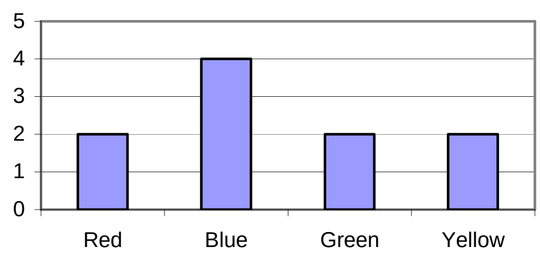
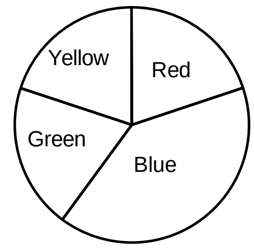
Let's Match It - Activity Master

	
The theoretical probability of drawing red is $\frac{1}{4}$.	The theoretical probability of NOT drawing green is $\frac{3}{4}$.
The theoretical probability of drawing yellow is $\frac{1}{4}$.	The theoretical probability of NOT drawing blue is $\frac{3}{4}$.
A bag contains four marbles: 1 red, 1 blue, 1 yellow, and 1 green marble.	

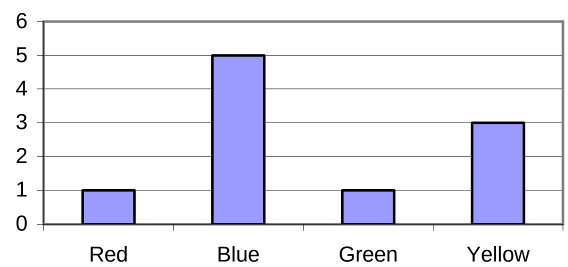
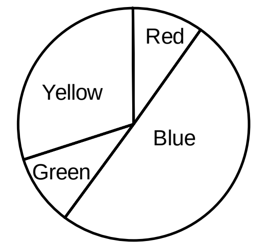
Let's Match It - Activity Master

	
The theoretical probability of NOT drawing red is $\frac{1}{2}$.	The theoretical probability of drawing blue is $\frac{1}{5}$.
The theoretical probability of drawing green is $\frac{1}{5}$.	The theoretical probability of NOT drawing yellow is $\frac{9}{10}$.
A bag contains 10 marbles: 5 red, 2 blue, 1 yellow, and 2 green marbles.	

Let's Match It - Activity Master

	
The theoretical probability of drawing red is $\frac{1}{5}$.	The theoretical probability of NOT drawing blue is $\frac{3}{5}$.
The theoretical probability of NOT drawing yellow is $\frac{4}{5}$.	The theoretical probability of drawing green is $\frac{1}{5}$.
A bag contains 10 marbles: 2 red, 4 blue, 2 yellow, and 2 green marbles.	

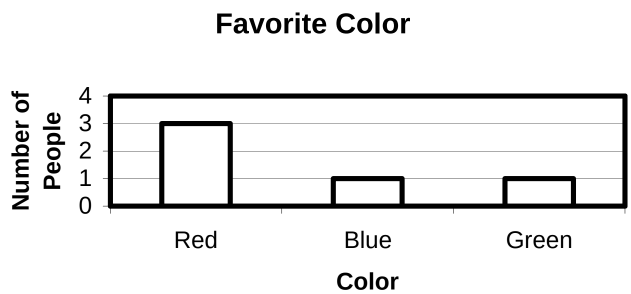
Let's Match It - Activity Master

	
The theoretical probability of NOT drawing yellow is $\frac{7}{10}$.	The theoretical probability of drawing green is $\frac{1}{10}$.
The theoretical probability of NOT drawing blue is $\frac{1}{2}$.	The theoretical probability of drawing red is $\frac{1}{10}$.
A bag contains 10 marbles: 1 red, 5 blue, 3 yellow, and 1 green marble.	

Simple Probability, Bar and Circle Graphs Spreadsheet

What Color?

Mary conducted a survey to determine the favorite color of 5 students in her advisory class. The results are shown in the bar graph below.



She then took a color tile and let it represent the color of each student's vote and put it in a bag.

1. How many color tiles of each color should she put in the bag? Justify your answer.

2. If Mary draws a color tile at random out of the bag, how likely is she to draw a red tile? Why?

3. If Mary draws a color tile at random out of the bag, how likely is she to draw a blue tile? Why?

4. If Mary draws a color tile at random out of the bag, how likely is she to draw a green tile? Why?

5. Sketch a circle graph to represent what part of the whole each color tile represents in the Favorite Color data.

6. Transfer your sketch onto a piece of chart paper.

7. Record on the chart paper: What are the similarities and differences in the circle graph you drew and the bar graph you were given?

(Continue: What Color?)

Mary wanted to conduct an experiment using the bag of tiles she created based on the information in the Favorite Color graph. She decided she would draw a tile out of the bag, record the color of the tile, return the tile to the bag, and draw again. She decided to repeat this process for 25 draws.

8. How many of the 25 draws should Mary expect to be red? Why?

9. How many of the 25 draws should Mary expect to be blue? Why?

10. How many of the 25 draws should Mary expect to be green? Why?

You will need to model the same experiment that Mary did.

- **Create a frequency table like the one below on the chart paper.**
- **Put a color tile for each student vote in the bag.**
- **Draw a color tile at random from the bag.**
- **Record the color of the tile on the chart paper and worksheet.**
- **Return the tile to the bag.**
- **Repeat this process 100 times.**

Color	Tally	Frequency
Red		
Blue		
Green		

The number of tiles you actually draw from the bag in an experiment is called the *Experimental Probability*.

11. What was your experimental probability of drawing a red?

12. What was your experimental probability of drawing a blue?

13. What was your experimental probability of drawing a green?

(Continue: What Color?)

14. How did the number of red tiles you drew compare to the number you said Mary should have drawn?

15. How did the number of blue tiles you drew compare to the number you said Mary should have drawn?

16. How did the number of green tiles you drew compare to the number you said Mary should have drawn?

17. How close was your prediction to the actual results?

Open the *What Color?* spreadsheet file.

- **Select *Sheet 1* and follow the directions to simulate the experiment.**
- **Select *Sheet 2* and follow the directions to create a circle graph.**

Color	Tally	Frequency
Red		
Blue		
Green		

The number of tiles of one color in the bag compared to total number of tiles in the bag is called the *Theoretical Probability* of selecting a tile of that color.

18. How close was your prediction to the actual results? (Record your response on the chart paper.)

19. What could you do to get your experimental probability to be closer to the theoretical probability? (Record your response on the chart paper.)

You Design It

Open a spreadsheet document. Use the spreadsheet to design a spinner that has each of the theoretical probabilities listed in the table.

P(Red) $= \frac{1}{3}$
P(Blue) $= \frac{1}{4}$
P(Green) $= \frac{1}{4}$
P(Yellow) $= \frac{1}{6}$

Explain how you designed your spinner.

1 Alan has 3 peppermint candies, 8 cinnamon candies, 4 root beer candies, and 6 butterscotch candies in a bag. If he draws a piece of candy at random from the bag, what is the probability he will draw a piece of butterscotch candy?

A $\frac{5}{7}$

B $\frac{3}{5}$

C $\frac{2}{5}$

D $\frac{2}{7}$

2 Mary has a quarter to buy a gumball from a machine. In the machine there are 3 red gumballs, 4 blue gumballs, 3 yellow gumballs, and 2 green gumballs. What is the probability that Mary will NOT get a yellow gumball when she puts her quarter in the machine to buy a gumball?

A $\frac{3}{4}$

B $\frac{2}{3}$

C $\frac{1}{3}$

D $\frac{1}{4}$

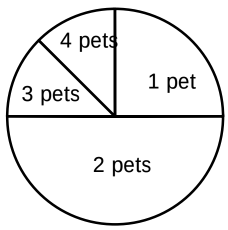
3 Alicia conducted a survey about the number of pets people owned. The results of the survey are shown in the table below.

Number of Pets

Number of Pets	People
1	50
2	100
3	25
4	25

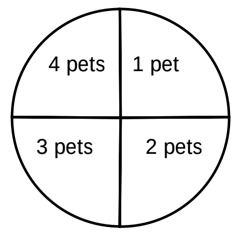
A

Number of Pets



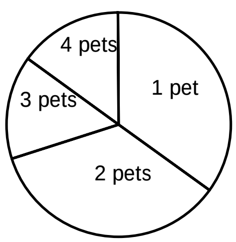
C

Number of Pets

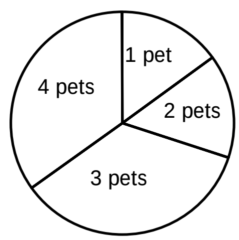


B

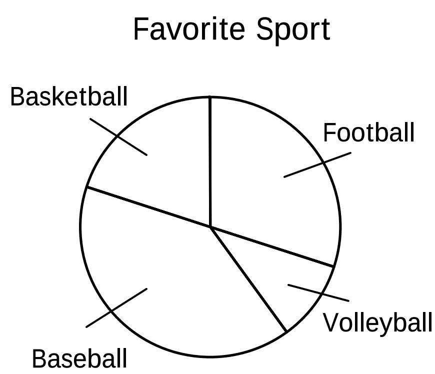
Number of Pets



Number of Pets



4 The circle graph shows the results of a survey about students' favorite sports.



Which statement is supported by the information in the circle graph?

A Football is the most popular sport.

B More people said baseball was their favorite sport than basketball.

C Basketball is the least favorite sport.

D More people said basketball was their favorite sport than football.

Simple Probability, Bar Graphs, and Circle Graphs TI-73

Mathematics
6.9 The student uses experimental and theoretical probability to make predictions. The student is expected to
- (B) find the probabilities of a simple event and its complement and describe the relationship between the two.

6.10 The student uses statistical representations to analyze data. The student is expected to
- (A) select and use an appropriate representation for presenting and displaying different graphical representations of the same data including line plot, line graph, bar graph, and stem and leaf plot.
- (C) sketch circle graphs to display data.
- (D) solve problems by collecting, organizing, displaying, and interpreting data.

Materials

Advanced Preparation:
- Students should have access to TI 73 calculators and the teacher should have a projection device to display the TI 73 on the overhead or TV.
- Copy the **Prize Dilemma** and **Spinner Creation** transparencies for the overhead.
- Copy the activity master, **Let's Match It**, onto colored card stock and cut into sets one for each student group.

For each student:
- TI 73 Graphing Calculator
- **What Color?** activity sheet
- **You Design It** activity sheet

For each student group of 3 - 4 students:
- Chart paper
- Markers
- Rulers
- Compass or large circular objects
- Protractors
- Color Tiles
- Paper bag (lunch size)
- **Let's Match It** card set

For whole group instruction:
- Transparencies: **Prize Dilemma** and **Spinner Creation**

ENGAGE

The Engage portion of the lesson is designed to create student interest in the development and understanding of simple probability as well as creating bar graphs and circle graphs. This part of the lesson is designed for groups of three to four students.

1. Place **Prize Dilemma** transparency on the overhead.
2. Distribute a piece of chart paper and markers to each student group. Have groups fold the chart paper in half.
3. Give student groups time to work the problem and record their solution on one half of the chart paper.

Facilitation Questions – Engage Phase

- Which spinner should the store choose? Why? *Spinner D, the spinner contains the smallest amount of area for cameras.*
- Which spinner should the customer choose? Why? *Spinner A, the spinner contains the largest amount of area for cameras.*
- How many different prizes are available? *4 (DVD, CD, Games and Camera)*
- Which spinner is designed so that each prize would have an equal chance of being won? How did you determine the answer? *Spinner A, because all section are the same size.*
- In spinner A, how could you describe the chances of landing on a space labeled CD? DVD? Video Game? Camera? *1 out of 4 for each prize*
- Which spinner is designed so that the CD has the greatest change of being won? How did you determine the answer? *Spinner C, more sections are assigned CD, and CD's cover half the circle.*
- In spinner C, how could you describe the chances of landing on a space labeled CD? *1 out 2*
- In spinner C, how could you describe the chances of landing on a space labeled DVD? Video Game? Camera? *1 out of 6 for each prize.*
- Which spinner would give a customer a 3 out of 8 chance of winning a CD? How did you determine the answer? *Spinner D, because it has eight sections and three of them are CD's.*

* All questions should be extended with a follow up question like "How did you determine the answer?" or "Did anyone get the answer using a different strategy?"

4. Place **Spinner Creation** transparency on the overhead.
5. Distribute rulers, protractors and compasses (or large round objects to make circles on the chart paper.)
6. Give student groups time to create the spinners on other half of the piece of chart paper.

7. Use a Gallery Tour to allow students to examine other groups' solutions to all the questions: Prize Dilemma and Spinner Creation.
8. Use the Facilitation Question on the next page to debrief Gallery Tour.

Facilitation Questions – Engage Phase

- What do you notice about the spinners that were created for the electronics store to use so that they would never have to give away a digital camera? *Answers may vary. Digital cameras' are not found on the spinner.*
- What is the probability of landing on a digital camera for these spinners? Why? *Zero, because the digital camera is not a possible outcome.*
- What do you notice about the spinners that were created for the electronics store to use so that the customer would always win a digital camera? *Answers may vary. The whole spinner is digital camera.*
- What is the probability of landing on a digital camera for these spinners? Why? *100%, because the digital camera is the only possible outcome.*
- In the spinner you created so that the customer's chance of winning a DVD was better than a video game, how many sections were labeled DVD and how many sections were labeled video game? *Answers may vary*
- In the spinner you created so that the customer's chance of winning a CD was the same as not winning a CD, how many of the sections were labeled CD and how many were not labeled CD? *Answers may vary.*

* All questions should be extended with a follow up question like "How did you determine the answer?" or "Did anyone get the answer using a different strategy?"

EXPLORE

The Explore portion of the lesson provides the student with an opportunity to be actively involved in the exploration of the mathematical concepts addressed. This part of the lesson is designed for groups of three to four students.

1. Distribute the **What Color?** activity sheet.
2. Distribute a sheet of chart paper, a paper bag, some red color tiles, some blue color tiles, and some green color tiles to each student group.
3. Students will need a TI-73 graphing calculator.
4. Allow student groups time to work through the activity sheet.
   Note: If students are not familiar with the operation of a TI-73 graphing calculator they will need the necessary instruction at this time. Use a Gallery tour to allow students to examine other groups' solutions.

Facilitation Questions – Explore Phase

- What fraction of the color tiles is red? *$\frac{3}{5}$* How did you determine the answer?
- What percent of the color tiles is red? *60%* How did you determine the answer?
- What fraction of the color tiles is blue? *$\frac{1}{5}$* How did you determine the answer?
- What percent of the color tiles is blue? *20%* How did you determine the answer?
- What fraction of the color tiles is green? *$\frac{1}{5}$* How did you determine the answer?
- What percent of the color tiles is green? *20%* How did you determine the answer?
- What is another way without using a fraction to describe the chance of getting each color? *3 out of 5 chances to get red, 1 out of 5 chances to get blue, and 1 out of 5 chances to get green.*
- What information do you need to sketch a circle graph? *The number of sections needed to divide the circle into, and the labels of each section.*
- How can you determine the number of times you will draw a particular color if you increase the number of draws from the bag? *Multiply the fraction of getting the color you want from the original problem by the scale factor used to enlarge the set.*

EXPLAIN

The Explain portion of the lesson is directed by the teacher to allow the students to formalize their understanding of the TEKS addressed in the lesson.

1. Debrief the **What Color?** activity sheet.

Facilitation Questions – Explain Phase

- How did you and your group determine how many tiles of each color to put in the bag? *Counted the number of reds, blues, and greens from the bar graph.*
- How did you and your group determine the likelihood Mary would draw a red tile? *Determined the number of red tiles in the bag compared to the total number of tiles in the bag.*
- What does this part-whole ratio represent? *The numerator represents the number of tiles there are of one color and the denominator represents the total number of tiles.*
- How did you and your group determine the likelihood Mary would draw a blue tile? *Determined the number of blue tiles in the bag compared to the total number of tiles in the bag.*
- What part-whole ratio represents the likelihood that Mary would draw a blue tile? $\frac{1}{5}$
- What does this part-whole ratio represent? *The numerator represents the number of blue tiles and the denominator represents the total number of tiles.*
- How did you and your group determine the likelihood Mary would draw a green tile? *Determined the number of green tiles in the bag compared to the total number of tiles in the bag.*
- What part-whole ratio represents the likelihood that Mary would draw a green tile? $\frac{1}{5}$
- What does this part-whole ratio represent? *The numerator represents the number of green tiles and the denominator represents the total number of tiles.*
- A part-whole relationship describes the theoretical probability of getting a particular outcome. What is the theoretical probability of drawing a red tile? $\frac{3}{5}$

  A blue tile? $\frac{1}{5}$ A green tile? $\frac{1}{5}$

* All questions should be extended with a follow up question like “How did you determine the answer?” or “Did anyone get the answer using a different strategy?”

Facilitation Questions – Explain Phase

- What is the theoretical probability of not drawing a red tile? $\frac{2}{5}$
- What do you notice about the theoretical probability of drawing a red tile and not drawing a red tile? *The sum of the probabilities is 1.*
- What is the theoretical probability of not drawing a blue tile? $\frac{3}{5}$
- What do you notice about the theoretical probability of drawing a blue tile and not drawing a blue tile? *The sum of the probability is 1.*
- What is the theoretical probability of not drawing a green tile? $\frac{3}{5}$
- What do you notice about the theoretical probability of drawing a green tile and not drawing a green tile? *The sum of the probabilities is 1.*
- How did you and your group create a circle graph? *Divided the circle into the same number of sections as total tiles in the bag. Labeled each section to correspond to each of the color tiles.*
- Which one of the graphs (bar or circle), if either, tell you more about the data than the other? *Answers may vary.*
- How did you and your group determine how many of the tiles in the 100 draws should be red, blue, and green? *Answers may vary. Students should say something about converting the fractions to percentages using benchmark mark fractions.*
- How could you find the theoretical probability of drawing a particular color if the number of draws was a number other than the original 5 or 100? *Determine the scale factor used to generate the number of draws compared to the original 5 tiles. Then multiply the theoretical probability of getting the particular color by the scale factor.*
- If Mary drew 25 tiles from the bag, how many of the tiles should be red? *15* How did you determine the answer?
- If Mary drew 25 tiles from the bag, how many of the tiles should be blue? *5* How did you determine the answer?
- If Mary drew 25 tiles from the bag, how many of the tiles should be green? *5* How did you determine the answer?
- How does the spreadsheet create the circle graph? *Find the total number of sections to know how many sections to make and then label each section according to how many is each color.*

* All questions should be extended with a follow up question like “How did you determine the answer?” or “Did anyone get the answer using a different strategy?”

Facilitation Questions – Explain Phase

- How did you and your group create a circle graph? *Divided the circle into the same number of sections as total tiles in the bag. Labeled each section to correspond to each of the color tiles.*
- Which one of the graphs (bar or circle), if either, tell you more about the data than the other? *Answers may vary.*
- How does the calculator create the circle graph? *Find the total number of sections to know how many sections to make and then label each section according to how many is each color.*

* All questions should be extended with a follow up question like “How did you determine the answer?” or “Did anyone get the answer using a different strategy?”

ELABORATE

The Elaborate portion of the lesson provides an opportunity for the student to apply the concepts of the TEKS within a new situation. This part of the lesson is designed for groups of three to four students.

1. Distribute to each group a set of **Let’s Match It** cards, a sheet of chart paper, and markers.
2. Inform students that they will be matching a graph card to a spinner card and 5 statement cards that would match the graph and spinner.
3. Allow student groups time to work through the activity.
4. Assign each student group one match to record on chart paper.

Facilitation Questions – Elaborate Phase

- How did your group decide how to sort the cards?
  Put the bar graphs together, the circle graphs together, and the description cards together.

- How did your group determine which bar graph and which circle graph should be matched together?
  Look to see what the total number of items is for both and then look at the number of each color.

- How did your group decide which cards to match with the circle graphs and the bar graph?
  Answers may vary. Students should describe how they looked at the card and then tried to determine which circle graph had the probability listed on the card.

- How did your group check to make sure your match was accurate?
  Answers may vary.

EVALUATE

The Evaluate portion of the lesson provides the student with an opportunity to demonstrate his or her understanding of the TEKS addressed in the lesson.

1. Distribute the **You Design It** activity sheet to each student.
2. Upon completion of the activity sheet, a rubric should be used to assess student understanding of the concepts addressed in the lesson.

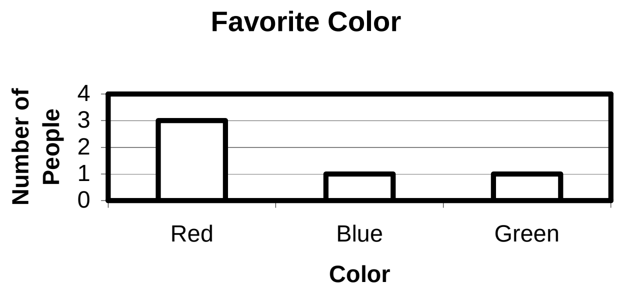
Answers and Error Analysis for selected response questions:

Question Number	*TEKS*	*Correct Answer*	*Conceptual Error*	*Conceptual Error*	*Procedural Error*	*Procedural Error*	*Guess*
1	6.9B	D	B	C	A		
2	6.9B	A	B	C	D		
3	6.10C	A	C		B	D	
4	6.10D	B	C	D	A		

What Color? - (Possible Answers)

Part I.

Mary conducted a survey to determine the favorite color of 5 students in her advisory class. The results are shown in the bar graph below.



She then took a color tile and let it represent the color of each student's vote and put it in a bag.

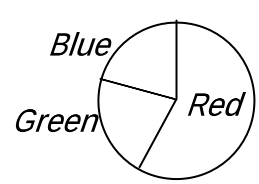
1. How many color tiles of each color should she put in the bag? Justify your answer.
   3 red, 1 blue, and 1 green

2. If Mary draws a color tile at random out of the bag, how likely is she to draw a red tile? Why?
   3 chances out of 5

3. If Mary draws a color tile at random out of the bag, how likely is she to draw a blue tile? Why?
   1 chance out of 5

4. If Mary draws a color tile at random out of the bag, how likely is she to draw a green tile? Why?
   1 chance out of 5

5. Sketch a circle graph to represent what part of the whole each color tile represents in the Favorite Color data.



6. Transfer your sketch onto a piece of chart paper.

7. Record on the chart paper: What are the similarities and differences in the circle graph you drew and the bar graph you were given?

Part II.

Mary wanted to conduct an experiment using the bag of tiles she created based on the information in the Favorite Color graph. She decided she would draw a tile out of the bag, record the color of the tile, return the tile to the bag, and draw again. She decided to repeat this process for 25 draws.

1. How many of the 25 draws should Mary expect to be red? Why?
   15

2. How many of the 25 draws should Mary expect to be blue? Why?
   5

3. How many of the 25 draws should Mary expect to be green? Why?
   5

The number of possible outcomes (how many tiles of a color) out of all possible outcomes (total number of tiles) is called the *Theoretical Probability*

Model the same experiment that Mary did using color tiles and a bag.

- **Create a frequency table like the one below on the chart paper**
- **Put a color tile for each student vote in the bag**
- **Draw a color tile at random from the bag**
- **Record the color of the tile on the chart paper and worksheet**
- **Return the tile to the bag**
- **Repeat this process 25 times**

Color	Tally	Frequency
Red		
Blue		
Green		

The number of tiles you actually draw from the bag in an experiment is called the *Experimental Probability*.

4. What was your experimental probability of drawing a red?, a blue?, a green?
   Answers may vary.

5. How did the number of red tiles you drew compare to the number you said Mary should have drawn?
   Answers may vary.

(Continue: What Color? – Part II.)

6. How did the number of blue tiles you drew compare to the number you said Mary should have drawn?
   Answers may vary.

7. How did the number of green tiles you drew compare to the number you said Mary should have drawn?
   Answers may vary.

8. How close was your prediction to the actual results?
   Answers may vary.

9. What could you do to get your experimental probability to be closer to the theoretical probability?
   Perform more trials.

10. Predict what would happen if you continued the experiment for 100 more draws.
    The experimental probability should move closer to the theoretical probability.

11. Sketch a circle graph of the experimental data on the chart paper.

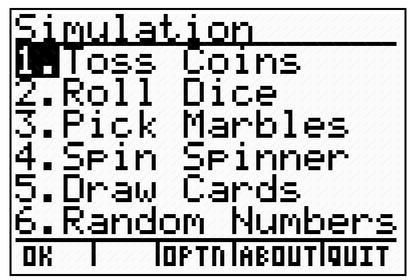
Part III.

Model Mary's experiment using the TI-73 calculator, and create a circle graph of the collected. Create a second frequency table like the one in Part I on the chart paper. Record the results on the chart paper and worksheet

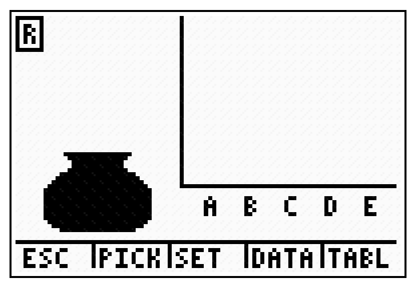
By using the TI-73 calculator to simulate the experiment a large data set can be collected in a very short amount of time.

A. [ON]→[APPS] → (Prob Sim)→[ENTER]

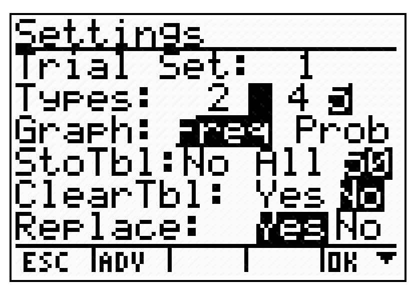
B. [3] *(Pick Marbles)*



C. [ZOOM] *(Set for settings)*



D. Under Settings, set up as illustrated.
Trial Set: 1
Types: 3
Replace: Yes



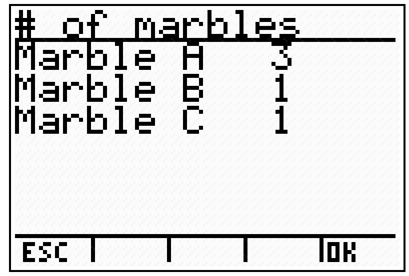
(Continue: What Color? – Part III.)

E. [WINDOW]
Under # of marbles, set up colors as illustrated.

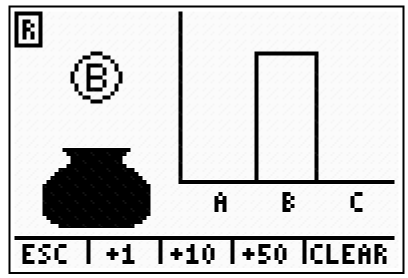
Red → Marble A: 3

Blue → Marble B: 1

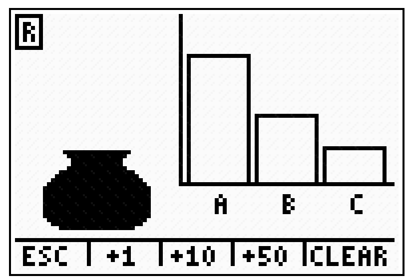
Green → Marble C: 1



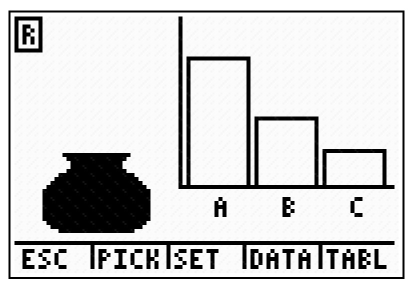
F. [ENTER]



G. [TRACE]
(this will simulate 50 trials)

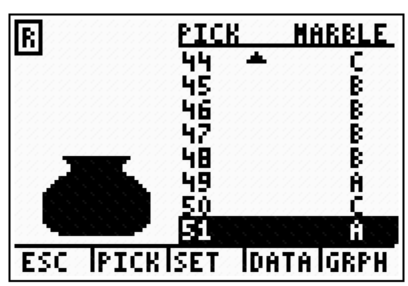


H. [GRAPH]
(this will show a table of the data generated)



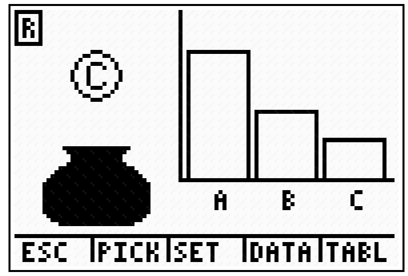
I. [TRACE]

Copy the data into the frequency table.



(Continue: What Color? – Part III.)

J. Sketch the graph on chart paper.



1. What was the experimental probability of drawing a red?, a blue?, a green?
   Answers may vary.

2. Has the experimental probability moved closer to the theoretical probability? Justify your answer.
   Answers may vary.

You Design It – (Possible Answers)

Use a graphing calculator to design a spinner that has each of the theoretical probabilities listed in the table.

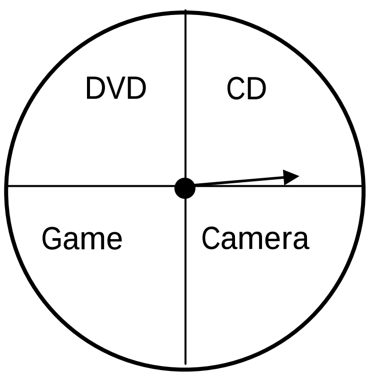
P(Red) $= \frac{1}{3}$
P(Blue) $= \frac{1}{4}$
P(Green) $= \frac{1}{4}$
P(Yellow) $= \frac{1}{6}$

Explain how you designed your spinner.

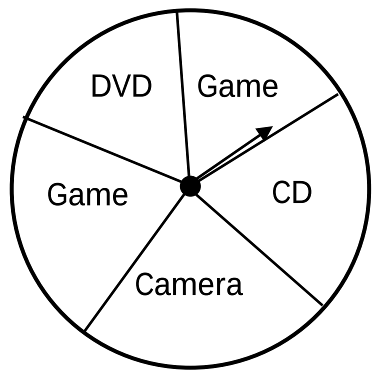
Answers may vary. However, the spinner should have 12 sections with 4 labeled red, 3 labeled blue, 3 labeled green, and 2 labeled yellow.

Prize Dilemma - Transparency

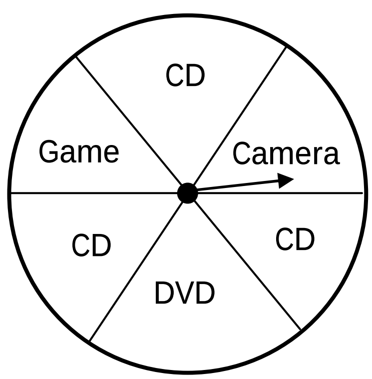
An electronics store is giving away prizes to its customers. Each customer will spin a spinner and receive the prize that the spinner lands on. The four spinners shown below are the spinners the company is considering using.



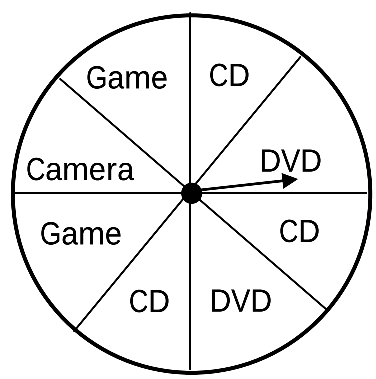
Spinner A



Spinner B



Spinner C



Spinner D

1. If the store wants to give away as few digital cameras as possible which spinner should they offer each customer to use? Justify your answer.

2. If a customer can select any spinner and he wants the best chance to win the digital camera, which spinner should he use? Justify your answer.

Spinner Creation - Transparency

3. Create a spinner for the electronics store to use so that they would never have to give away a digital camera. Justify your spinner.

4. Create a spinner that the customer could use so that he would win a digital camera every time. Justify your spinner.

5. Create a spinner so the customer's chance of winning a DVD is better than the chance of winning a video game. Justify your spinner.

6. Create a spinner so that the customer's chance of winning a CD is the same as not winning a CD. Justify your spinner.

Activity Master – Let's Match It

Let's Match It

Let's Match It

Let's Match It

Let's Match It

Let's Match It

Let's Match It

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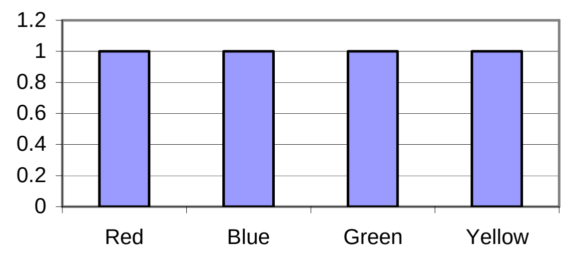
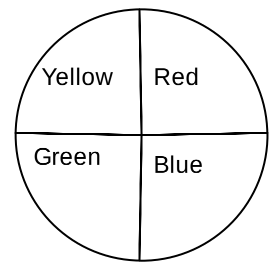
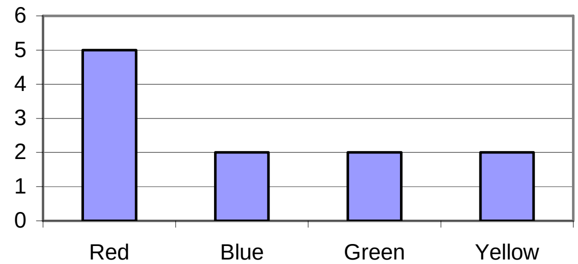
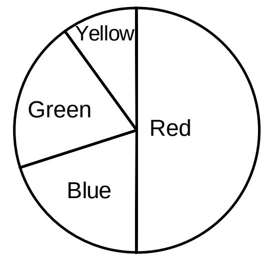
Let's Match It

Activity Master – Let's Match It

	
The theoretical probability of drawing red is $\frac{1}{4}$.	The theoretical probability of NOT drawing green is $\frac{3}{4}$.
The theoretical probability of drawing yellow is $\frac{1}{4}$.	The theoretical probability of NOT drawing blue is $\frac{3}{4}$.
A bag contains four marbles: 1 red, 1 blue, 1 yellow, and 1 green marble.	

Activity Master – Let's Match It





The theoretical probability of NOT drawing red is $\frac{1}{2}$.

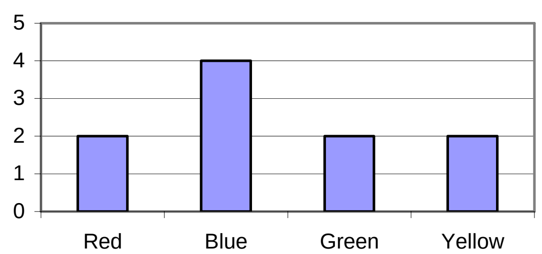
The theoretical probability of drawing blue is $\frac{1}{5}$.

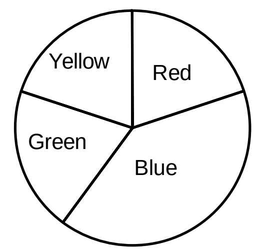
The theoretical probability of drawing green is $\frac{1}{5}$.

The theoretical probability of NOT drawing yellow is $\frac{9}{10}$.

A bag contains 10 marbles: 5 red, 2 blue, 1 yellow, and 2 green marbles.

Activity Master – Let's Match It





The theoretical probability of drawing red is $\frac{1}{5}$.

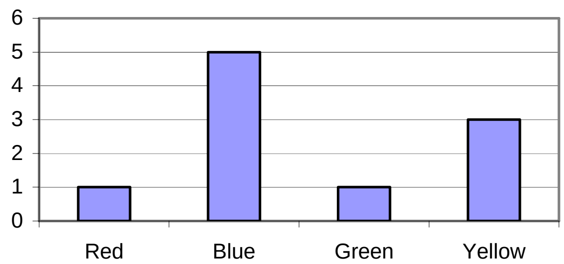
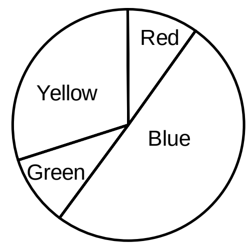
The theoretical probability of NOT drawing blue is $\frac{3}{5}$.

The theoretical probability of NOT drawing yellow is $\frac{4}{5}$.

The theoretical probability of drawing green is $\frac{1}{5}$.

A bag contains 10 marbles: 2 red, 4 blue, 2 yellow, and 2 green marbles.

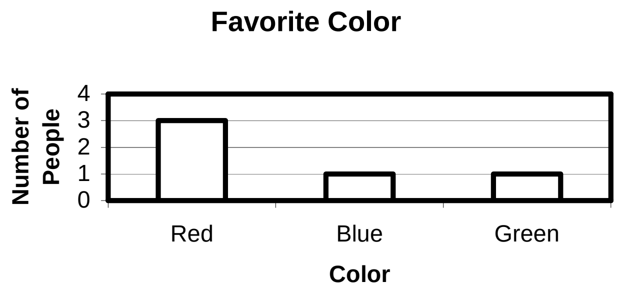
Activity Master – Let's Match It

	
The theoretical probability of NOT drawing yellow is $\frac{7}{10}$.	The theoretical probability of drawing green is $\frac{1}{10}$.
The theoretical probability of NOT drawing blue is $\frac{1}{2}$.	The theoretical probability of drawing red is $\frac{1}{10}$.
A bag contains 10 marbles: 1 red, 5 blue, 3 yellow, and 1 green marble.	

What Color?

Part I.

Mary conducted a survey to determine the favorite color of 5 students in her advisory class. The results are shown in the bar graph below.



She then took a color tile and let it represent the color of each student's vote and put it in a bag.

1. How many color tiles of each color should she put in the bag? Justify your answer.

2. If Mary draws a color tile at random out of the bag, how likely is she to draw a red tile? Why?

3. If Mary draws a color tile at random out of the bag, how likely is she to draw a blue tile? Why?

4. If Mary draws a color tile at random out of the bag, how likely is she to draw a green tile? Why?

5. Sketch a circle graph to represent what part of the whole each color tile represents in the Favorite Color data.

6. Transfer your sketch onto a piece of chart paper.

7. Record on the chart paper: What are the similarities and differences in the circle graph you drew and the bar graph you were given?

Part II.

Mary wanted to conduct an experiment using the bag of tiles she created based on the information in the Favorite Color graph. She decided she would draw a tile out of the bag, record the color of the tile, return the tile to the bag, and draw again. She decided to repeat this process for 25 draws.

1. How many of the 25 draws should Mary expect to be red? Why?

2. How many of the 25 draws should Mary expect to be blue? Why?

3. How many of the 25 draws should Mary expect to be green? Why?

The number of possible outcomes (how many tiles of a color) out of all possible outcomes (total number of tiles) is called the *Theoretical Probability*

Model the same experiment that Mary did using color tiles and a bag.

- **Create a frequency table like the one below on the chart paper**
- **Put a color tile for each student vote in the bag**
- **Draw a color tile at random from the bag**
- **Record the color of the tile on the chart paper and worksheet**
- **Return the tile to the bag**
- **Repeat this process 25 times**

Color	Tally	Frequency
Red		
Blue		
Green		

The number of tiles you actually draw from the bag in an experiment is called the *Experimental Probability*.

4. What was your experimental probability of drawing a red?, a blue?, a green?

5. How did the number of red tiles you drew compare to the number you said Mary should have drawn?

(Continue: What Color? – Part II.)

6. How did the number of blue tiles you drew compare to the number you said Mary should have drawn?

7. How did the number of green tiles you drew compare to the number you said Mary should have drawn?

8. How close was your prediction to the actual results?

9. What could you do to get your experimental probability to be closer to the theoretical probability?

10. Predict what would happen if you continued the experiment for 100 more draws.

11. Sketch a circle graph of the experimental data on the chart paper.

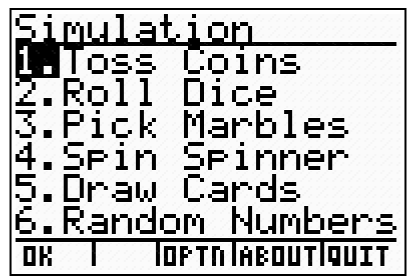
Part III.

Model Mary's experiment using the TI-73 calculator, and create a circle graph of the collected. Create a second frequency table like the one in Part I on the chart paper. Record the results on the chart paper and worksheet

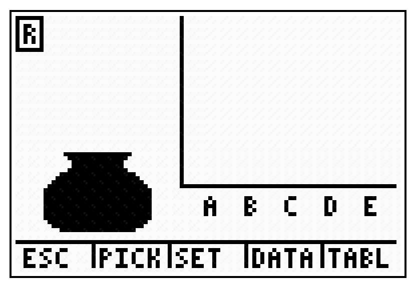
By using the TI-73 calculator to simulate the experiment a large data set can be collected in a very short amount of time.

A. [ON]→[APPS] → (Prob Sim)→[ENTER]

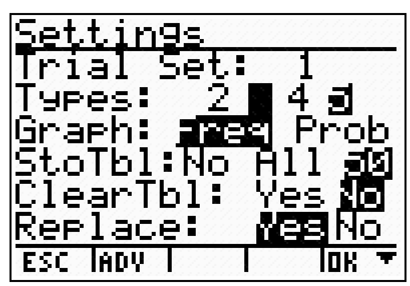
B. [3] *(Pick Marbles)*



C. [ZOOM] *(Set for settings)*



D. Under Settings, set up as illustrated.
Trial Set: 1
Types: 3
Replace: Yes



(Continue: What Color? – Part III.)

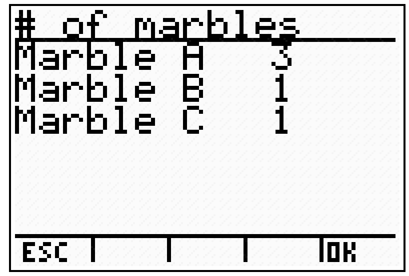
E. [WINDOW]

Under # of marbles, set up colors as illustrated.

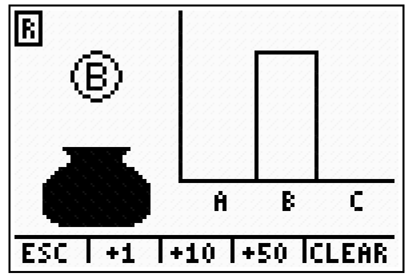
Red → Marble A: 3

Blue → Marble B: 1

Green →Marble C: 1

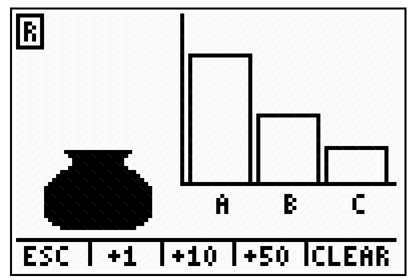


F. [ENTER]



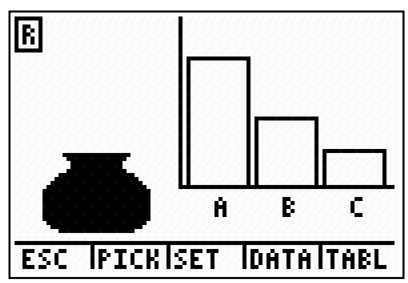
G. [TRACE]

(this will simulate 50 trials)



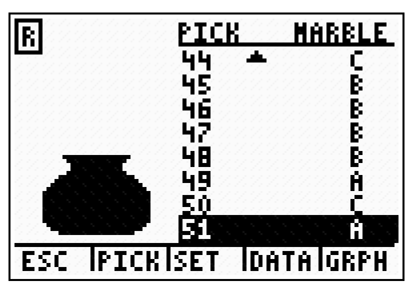
H. [GRAPH]

(this will show a table of the data generated)



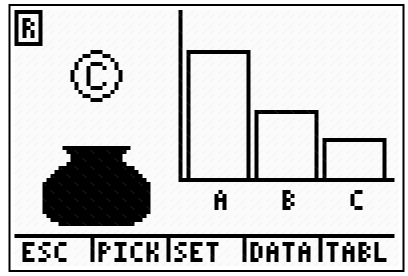
I. [TRACE]

Copy the data into the frequency table.



(Continue: What Color? – Part III.)

J. Sketch the graph on chart paper.



1. What was the experimental probability of drawing a red?, a blue?, a green?

2. Has the experimental probability moved closer to the theoretical probability? Justify your answer.

You Design It

Use a graphing calculator to design a spinner that has each of the theoretical probabilities listed in the table.

P(Red) $= \frac{1}{3}$
P(Blue) $= \frac{1}{4}$
P(Green) $= \frac{1}{4}$
P(Yellow) $= \frac{1}{6}$

Explain how you designed your spinner.

1 Alan has 3 peppermint candies, 8 cinnamon candies, 4 root beer candies, and 6 butterscotch candies in a bag. If he draws a piece of candy at random from the bag, what is the probability he will draw a piece of butterscotch candy?

A $\frac{5}{7}$

B $\frac{3}{5}$

C $\frac{2}{5}$

D $\frac{2}{7}$

2 Mary has a quarter to buy a gumball from a machine. In the machine there are 3 red gumballs, 4 blue gumballs, 3 yellow gumballs, and 2 green gumballs. What is the probability that Mary will NOT get a yellow gumball when she puts her quarter in the machine to buy a gumball?

A $\frac{3}{4}$

B $\frac{2}{3}$

C $\frac{1}{3}$

D $\frac{1}{4}$

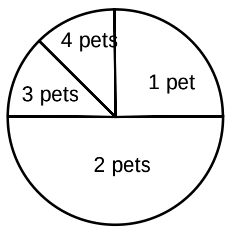
3 Alicia conducted a survey about the number of pets people owned. The results of the survey are shown in the table below.

Number of Pets

Number of Pets	People
1	50
2	100
3	25
4	25

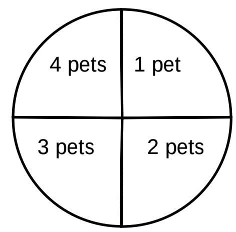
A

Number of Pets



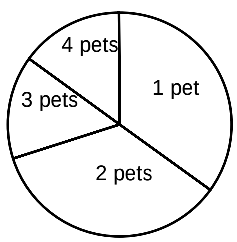
C

Number of Pets

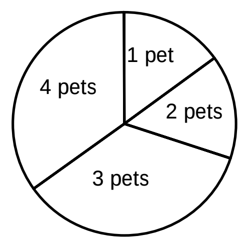


B

Number of Pets

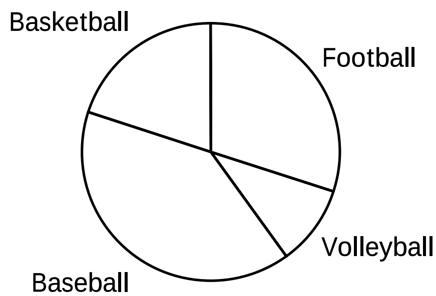


Number of Pets



4 The circle graph shows the results of a survey about students' favorite sports. Which statement is supported by the information in the circle graph?

Favorite Sport



A Football is the most popular sport.

B More people said baseball was their favorite sport than basketball.

C Basketball is the least favorite sport.

D More people said basketball was their favorite sport than football.

Mathematics

7.11 The student understands that the way a set of data is displayed influences its interpretation. The student is expected to:

(A) select and use an appropriate representation for presenting and displaying relationships among collected data including line plot, line graph, bar graph, stem and leaf plot, circle graph, and Venn diagrams, and justify the selection.

(B) make inferences and convincing arguments based on analysis of given or collected data.

7.12 The student uses measures of central tendency and range to describe a set of data. The student is expected to:

(A) describe a set of data using mean, median, mode and range.

(B) choose among mean, median, mode or range to describe a set of data and justify the choice for a particular situation.

Technology Applications

The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to:

(1)(B) compare, contrast, and appropriately use the various input, processing, output, and primary/secondary storage devices.

(1)(C) demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency.

(1)(E) use technology terminology appropriate to the task.

(1)(F) perform basic software application functions including, but not limited to, opening an application program and creating, modifying, printing, and saving documents.

The student uses data input skills appropriate to the task. The student is expected to:

(2)(A) demonstrate proficiency in the use of a variety of input devices such as mouse/track pad, keyboard, microphone, digital camera, printer, scanner, disk/disc, modem, CD-ROM, or joystick.

The student acquires electronic information in a variety of formats, with appropriate supervision. The student is expected to:

(5)(A) identify, create, and use files in various formats such as text, bitmapped/vector graphics, image, video, and audio files.

The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to:

(7)(G) integrate two or more productivity tools into a document including, but not limited to, tables, charts and graphs, graphics from paint or draw programs, and mail merge.

Materials

Advanced Preparation:

- Sign up for 2 to 3 days in the computer lab
- Have the **Central Tendencies and Technology** file ready for students to access in the computer lab.

For whole class demonstration:

- **Transparency: Fumble Bumbles**

For each student:

- **Football Statistics** activity sheet
- **How Do These Shapes Measure Up?** activity sheet
- **Data Mix-Up** performance assessment

ENGAGE

The Engage portion of the lesson is designed to create student interest in the concepts addressed. Technology is not being used in this phase since the focus of this activity is to remind students of the measures of central tendency. This part of the lesson is designed for groups of 2 students or individual investigation.

1. Display **Transparency 1: Fumble Bumbles** so that it is visible to all students.
2. Students should read the problem and solve for the mean, median, and mode. Provide math vocabulary glossaries or dictionaries for students who may need to refresh their memories on these terms.
3. Debrief the activity using the Facilitation Questions.

Facilitation Questions

- How did you determine the mean for this set of data?
  Answers may vary. Lead students in the development/review of the vocabulary word by using a graphic organizer, such as a vocabulary model, or creating a word wall for Probability and Statistics. Some students may know the algorithm for finding the mean. Other students may make a picture to find the mean, as addressed in the grade 6 mathematics TEKS. The mean is 1.375 or 1.4 fumbles.

  Vocabulary Model Example

(Word)	***(Definition)***
Mean	*The sum of the numbers in a set of data divided by the number of pieces of data.*
(Examples)	***(Non-Examples)***
Average *3, 5, 4, 8* $3+5+4+8=20$ $20 \div 4 = 5$	*Median* *Mode*

- How did you find the median for this set of data?
  Answers may vary. Lead students in the development/review of the vocabulary word by using a graphic organizer or creating a word wall for Probability and Statistics. The median is 1.5 fumbles.
- How did you find the mode for this set of data?
  Answers may vary. Lead students in the development/review of the vocabulary word by using a graphic organizer or creating a word wall for Probability and Statistics. The mode is 2 fumbles.
- Which measure of data would the Texans prefer the media to report? Why?
  Answers may vary. The Texans would probably prefer the mean to be reported since it is the lowest of the three.

EXPLORE

The Explore portion of the lesson provides the student with an opportunity to be actively involved in the exploration of the mathematical concepts addressed. This part of the lesson is designed for groups of 2 students or individual investigation.

1. Distribute **Football Statistics** to each student.
2. Students should work to complete the worksheet using the accompanying spreadsheet document **Central Tendencies and Technology** under the tab labeled **Football Statistics**.
3. When monitoring students in the lab, use the facilitation questions.
4. Before students print, lead them to set the print area so only one page prints.

Facilitation Questions

- How do you name a cell?
  Name a cell using the letter of the column and the number of the row (A1, D32, etc.).
- How do you highlight a range of cells?
  Click the mouse and hold inside the first cell and drag to the last cell needed.
- How do you format cells?
  Use the mouse and right click or choose "Format" in the menu bar and cells from the pull down menu.
- How do you put a range of cell locations when entering a formula?
  Type the cell locations using the keyboard. Start with the first cell needed followed by a colon and the last cell needed (A1:A5).
- How did you make your prediction? Did any information help you make your prediction?
  Answers may vary. Students may discuss that the mode gave them a clue to include both of the 52 yard amounts in the first 7 games.
- What strategies did you use for choosing the numbers to put in for the 7 games?
  Answers may vary.
- Which measure of central tendency is the easiest to determine first?
  The mode is the easiest one to recognize in a set of data because one only looks at frequencies.
- If your mean is too high, how might you change your data choices?
  Answers may vary. Students may recognize that lower numbers need to be included or that higher numbers need to be replaced.

EXPLAIN

The Explain portion of the lesson is directed by the teacher to allow the students to formalize their understanding of the TEKS addressed in the lesson.

1. Debrief the **Football Statistics** activity using the facilitation questions.

Facilitation Questions

- How did the spreadsheet allow you to manipulate data?
  By using a formula to find each central tendency, any yardage can be changed in the list and each central tendency is automatically recalculated.
- How did the spreadsheet assist you in interpreting data?
  Answers may vary. Some students may say that the spreadsheet helped them to focus on the concept of mean, median, and mode since they did not have to think about the math operations involved.
- With a mean of 31, what can you conclude about the data set?
  The numbers will cluster in the middle or the numbers will vary. If the numbers vary, they must include high and low numbers to average out.
- How did the median of 24 help narrow your choices?
  Answers may vary, but lead students to put the numbers in numerical order. Discuss observations.
- If the yards from the other 3 games were included in the data set, how would you predict the mean would change? The median? The mode?
  Answers may vary. After students make predictions, point out that the 3 remaining numbers cluster within the same range, so the mean may not change much. The median should be higher since the 3 numbers would come in the middle of the existing data. The mode isn't affected.
- Were you surprised by the results? Why?
  Answers may vary. Students should explain their reasoning for being surprised.
- Were there times when the technology made the task easier? Why?
  Answers may vary. Some students may say that not having to calculate the math with paper/pencil made the task easier.
- Are there times when the technology made the task more difficult? Why?
  Answers may vary. Students may say that formatting the cells and inputting formulas made the task more difficult.

ELABORATE

The Elaborate portion of the lesson provides an opportunity for the student to apply the concepts of the TEKS within a new situation. This part of the lesson is designed for groups of 2 students or individual investigation.

1. Distribute **How Do These Shapes Measure Up?** activity sheet to each student.
2. Tell students that in the first phases of this lesson we looked at numerical data generated from football statistics, but in this phase we will be looking at numerical data generated by measuring the dimensions of figures.

3. Students should work to complete the worksheet using the accompanying spreadsheet document **Central Tendencies and Technology** under the tab labeled **How do these shapes measure up**?
4. Before students print, lead them to set the print area so only one page prints.
5. Debrief using the facilitation questions.

Facilitation Questions

- Which set of data did you predict to have the same mean, median and mode?
  Answers may vary. Some students may notice that Set C appears to be the same height, so the mean, median and mode might be the same.
- Which set of data did you predict to have the greatest mean?
  Answers may vary. Some students may realize that the taller objects will most likely create a greater mean.
- Which set of data did you predict to have the smallest mean?
  Answers may vary. Some students may realize that the shorter objects will most likely create a smaller mean.
- How does the spreadsheet assist you in analyzing data?
  Answers may vary. Some students may say that the ability to make a graph quickly helps you visually analyze similarities and differences.
- How does the spreadsheet assist you in communicating your results?
  Answers may vary. Some students may say that the spreadsheet helps them organize the data into a table and display the information graphically.
- What formula did you use to find the mean?
  =AVERAGE(first cell:last cell)
- What formula did you use to find the median?
  =MEDIAN(first cell:last cell)
- What formula did you use to find the mode?
  =MODE(first cell:last cell)
- Which set of figures has the same mean, median and mode?
  Set C
- Which set has no mode?
  Set B
- Which set has the same median and mode?
  Set A and C
- Which data set has the greatest mean?
  Set C
- Which data set has the smallest mean?
  Set B
- How can looking at the figures in Set A help you determine the central tendencies?
  Answers may vary. Visually examine the figures and use reasonableness to draw conclusions. For example, two of the figures in Set A appear to have the same height so the mode will be equal to the height of Figure 1 and 2 and so will the median since one of these heights will be the middle number. The mean will be slightly more because figure 3 will raise the average.

Facilitation Questions

- How can looking at the figures in Set B help you determine the central tendencies?
  Answers may vary. Visually look at the figures and use reasonableness to draw conclusions. For example, all of the heights in Set B are different, so that set won't have a mode. The median will be the height of Figure 5. The mean may be close to the median since the figures on either side of Figure 5 will balance out the average.
- How can looking at the figures in Set C help you determine the central tendencies?
  Answers may vary. Visually look at the figures and use reasonableness to draw conclusions. For example, all of the figures in Set C appear to be the same height, so they will have the same mean, median and mode.
- How might combining the data sets affect the mean? The median? The mode? Why?
  mean – Answers may vary. One possible answer is that the mean will be 1.25 or maybe slightly lower since the heights in the other groups are slightly higher and lower than 1.25
  median – Answers may vary. One possible answer is the median will be similar to Set C since figures 6-9 seem to have the same height and would fall in the middle of the data.
  mode – Answers may vary. The students will most likely say 1.25 since no other height occurs more than the height of the figures in Set C.
- How did the mean, median and mode of the lengths/diameters compare to that of the heights?
  Answers may vary. None of the sets has a mode. Set B has the highest mean. The median for Set C was the same for its length and its height.
- How do the bar graphs help you to interpret the data?
  Answers may vary. Students should recognize that the graph provides a visual representation, but caution them about misleading statistics.
- Why do you think we are using a bar graph instead of a circle graph?
  Answers may vary. Circle graphs are typically used with data represented as percentages.

EVALUATE

The Evaluate portion of the lesson provides the student with an opportunity to demonstrate his or her understanding of the TEKS addressed in the lesson.

1. Distribute **Data Mix-Up** activity sheet to each student.
2. Upon completion of **Data Mix-Up** activity sheet, the teacher should use a rubric to assess student understanding of the concepts addressed in this lesson.

Answers and Error Analysis for selected response questions:

Question Number	TEKS	Correct Answer	Conceptual Error	Conceptual Error	Procedural Error	Procedural Error	Guess
1	7.12B	B	A	C			D
2	7.12A	B	C	D	A		
3	7.12B	C	A	B			D
4	7.11B	C	A	B			D

Football Statistics *(Possible Answers)*

In 2004 Cory Bradford was a receiver for the Texans. He received the ball in 12 out of the 16 games played by the team. The total yards received during each of the first 10 games are shown below.

24 9 52 32 5 52 27 13 65 38

If Cory Bradford's mean, median and mode for receptions during the first 7 games were 31, 24, and 52 (when rounded to the nearest whole number), which of the above yardages represents his stats?

1. Use the spreadsheet document to help you find the yards received by Cory Bradford during the first 7 games. Follow the instructions on the spreadsheet given in each of the colored boxes.

2. If the yards from the other 3 games were included in the data set, how would you predict
    a. the mean would change?
        Answers may vary. Since the numbers remaining cluster together, students may suggest the mean will stay the same.

    b. the median would change?
        Answers may vary. Help the students realize they will average the 2 numbers in the middle.

    c. the mode would change?
        The mode won't change since 52 is the only repeating number.

3. Use the spreadsheet to calculate the mean, median, and mode for all 10 games. Set up a table beside or below the existing information.

4. How close were your predictions to the actual mean, median and mode? Explain similarities and differences.
    Answers may vary. Students should be detailed in explanations.

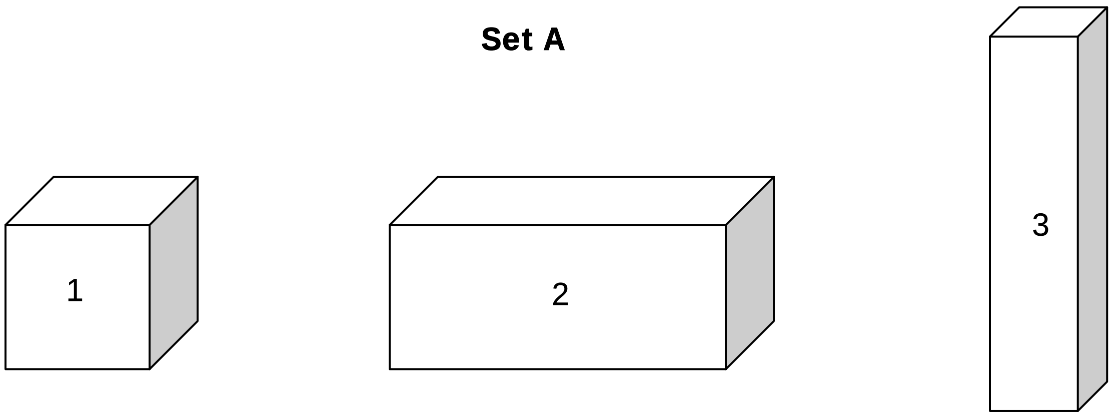
5. Print the file when finished. Be sure to ask your teacher for any special directions before printing.

How Do These Shapes Measure Up? ***(Possible Answers)***

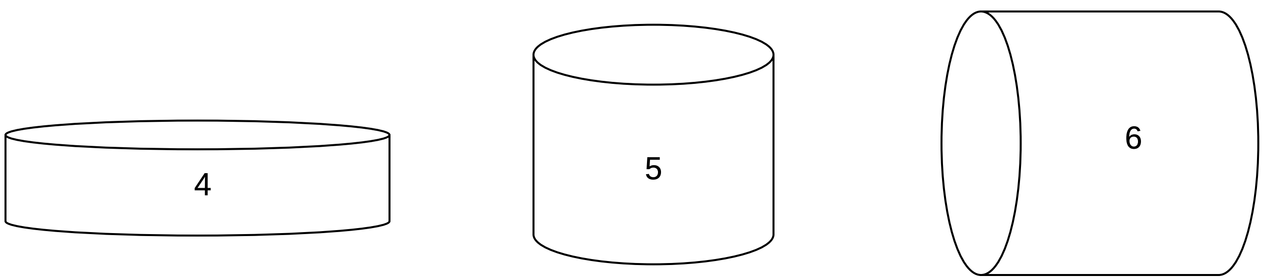
1. Look at each set of figures below. Make a prediction about the mean, median, and mode for the heights of each set. For which set of data do you predict the mean, median, and mode to be the same? Which set do you predict to have the greatest mean? Which set do you predict to have the smallest mean?

   Answers may vary. Students should use the size of the figures to make predictions.

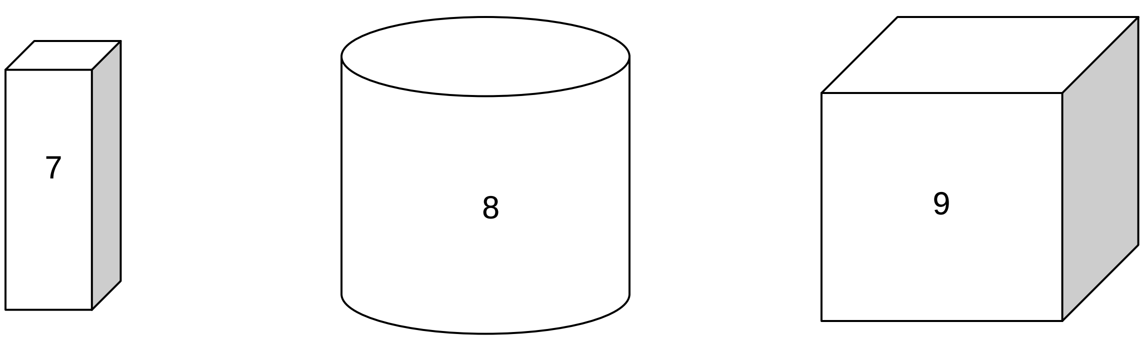
Set A



Set B



Set C



2. Measure the height of each figure. Round measurements to the nearest $\frac{1}{4}$ inch.

   (For example, for any measurement between 1 and 1.25, round to 1.25.)

3. Use the spreadsheet document to
   a. organize data
   b. determine the mean, median and mode using formulas for the heights of each set
   c. chart the mean, median and mode for the heights of each set

4. Use this information to answer the following questions.
   a. Which set of figures has the same mean, median and mode?
      Set C
   b. Which set has no mode?
      Set B
   c. Which set has the same median and mode?
      Set A and C
   d. Which data set has the greatest mean?
      Set C
   e. Which data set has the smallest mean?
      Set B
   f. How can looking at the figures help you determine the central tendencies?
      Answers may vary. Lead students to realize they could visually look at the figures and use reasonableness to draw conclusions. For example, all of the figures in Set C appear to be the same height, so they will have the same mean, median and mode. All of the heights in Set B are different, so that set won't have a mode.
   g. How would combining the data sets affect the mean? The median? The mode?
      mean – *Answers may vary. One possible answer is that the mean will be 1.25 or maybe slightly lower since the heights in the other groups are slightly higher and lower than 1.25*
      median – *Answers may vary.*
      mode – *Answers may vary. The students will most likely say 1.25 since no other height occurs more than the height of the figures in Set C.*

5. How different do you think the data sets would be if you measured the lengths or diameters of the figures? What would be similar? What would be different? Explain your reasoning.
   Answers may vary. Students should reason about the differences in the data sets by looking at the sides.

6. Create a new table to the side of the current spreadsheet in order to find the mean, median, and mode of the lengths or diameters for each set of figures. Be sure to round measurements to the nearest $\frac{1}{4}$ inch.

7. Print the file when finished. Be sure to ask your teacher for any special directions before printing.

Data Mix-Up *(Possible Answers)*

Mr. Tucker gave his students the following data from the 2004 football season.

The Houston Texans played 16 games in 2004. The numbers in the table represent the total passing yards by David Carr, the quarterback, for each game.

229	215
313	164
233	201
228	157
372	167
266	220
276	139
245	114

Each student had to create a data set of passing yards for the losing games and a data set of passing yards for the winning games using the clues provided.

Clue 1: The Texans had 2 fewer wins in 2004 than losses.
Clue 2: The mean passing yards for the losing data set is less than the mean passing yards for the winning data set.
Clue 3: All of the passing yard totals for the winning games are in the same hundreds group except for 1.
Clue 4: The range for the passing yards of the losing games is 258 and of the winning games is in the one hundred range.
Clue 5: The smallest value in both data sets is in the one hundred range.

The data sets for 2 students are shown below.

Marissa	
Losses	Wins
313	372
276	266
245	233
229	228
215	220
167	201
164	114
157	
139	

Sheldon	
Losses	Wins
372	276
313	266
245	233
229	228
215	220
167	201
164	139
157	
114	

Use the clues and a spreadsheet to make your own data set. Find the mean, median and mode using formulas for each of your data sets. Compare your results to the given student results to decide which student is correct. Justify your reasoning.

Sheldon is correct. See spreadsheet answer key for work.

Fumble Bumbles

A fumble in a football game is the failure to hold or handle the ball properly. If the opposing team recovers the fumble, they gain possession of the ball at the precise location of the recovery. Fumbles are many times key turning points in a game and could cause the team a loss.

In the 2004 football season, the Houston Texans played 16 games. The chart below shows the number of fumbles made by the Texans.

Game Date	# of Fumbles
Sept. 12	2
Sept. 19	4
Sept. 26	2
Oct. 3	1
Oct. 10	0
Oct. 17	2
Oct. 31	2
Nov. 7	0
Nov. 14	3
Nov. 21	0
Nov. 28	0
Dec. 5	2
Dec. 12	1
Dec. 19	0
Dec. 26	2
Jan. 2	1

Which measure of data (mean, median, or mode) would the Texans prefer the media report? Explain your reasoning.

Football Statistics

In 2004 Cory Bradford was a receiver for the Texans. He received the ball in 12 out of the 16 games played by the team. The total yards received during each of the first 10 games are shown below.

24 9 52 32 5 52 27 13 65 38

If Cory Bradford's mean, median and mode for receptions during the first 7 games were 31, 24, and 52 (when rounded to the nearest whole number), which of the above yardages represents his stats?

1. Use the spreadsheet document to help you find the yards received by Cory Bradford during the first 7 games. Follow the instructions on the spreadsheet given in each of the colored boxes.

2. If the yards from the other 3 games were included in the data set, how would you predict
   a. the mean would change?

   b. the median would change?

   c. the mode would change?

3. Use the spreadsheet to calculate the mean, median, and mode for all 10 games. Set up a table beside or below the existing information.

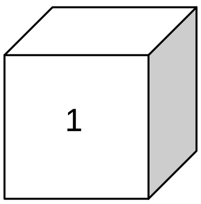
4. How close were your predictions to the actual mean, median and mode? Explain similarities and differences.

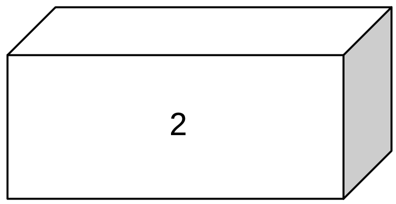
5. Print the file when finished. Be sure to ask your teacher for any special directions before printing.

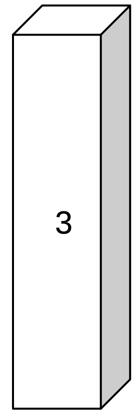
How Do These Shapes Measure Up?

1. Look at each set of figures below. Make a prediction about the mean, median, and mode for the heights of each set. For which set of data do you predict the mean, median and mode to be the same? Which set do you predict to have the greatest mean? Which set do you predict to have the smallest mean?

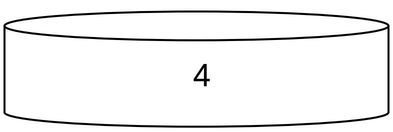
Set A

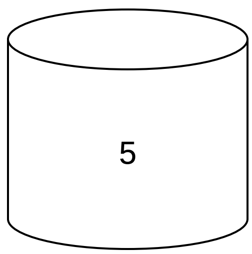


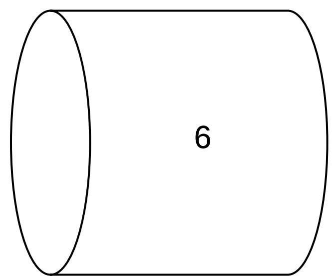




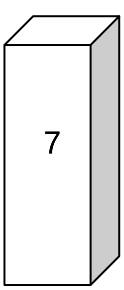
Set B

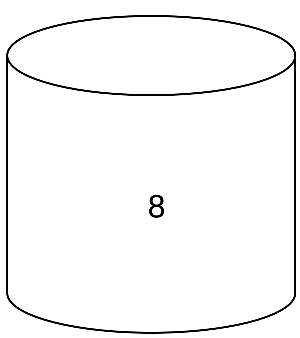


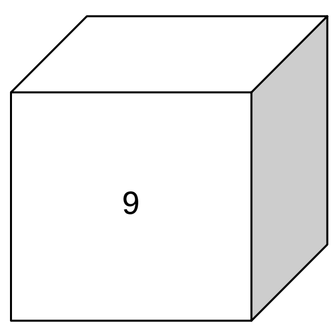




Set C







2. Measure the height of each figure. Round measurements to the nearest $\frac{1}{4}$ inch.

3. Use the spreadsheet document to
   a. organize data.
   b. find the mean, median and mode using formulas for the heights of each set.
   c. chart the mean, median and mode for the heights of each set.

4. Use the information to answer the following questions.

   d. Which set of figures has the same mean, median and mode?

   e. Which set has no mode?

   f. Which set has the same median and mode?

   g. Which data set has the greatest mean?

   h. Which data set has the smallest mean?

   i. How can looking at the figures help you determine the central tendencies?

   j. How would combining the data sets affect the mean? The median? The mode?

      mean –

      median –

      mode –

5. How different do you think the data sets would be if you measured the lengths or diameters of the figures? What would be similar? What would be different? Explain your reasoning.

6. Create a new table to the side of the current spreadsheet in order to find the mean, median, and mode of the lengths or diameters for each set of figures. Be sure to round measurements to the nearest $\frac{1}{4}$ inch. Chart the data.

7. Print the file when finished. Be sure to ask your teacher for any special directions before printing.

Data Mix-Up

Mr. Tucker gave his students the following data from the 2004 football season.

The Houston Texans played 16 games in 2004. The numbers in the table represent the total passing yards by David Carr, the quarterback, for each game.

229	215
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Each student had to create a data set of passing yards for the losing games and a data set of passing yards for the winning games using the clues provided.

Clue 1: The Texans had 2 fewer wins in 2004 than losses.
Clue 2: The mean passing yards for the losing data set is less than the mean passing yards for the winning data set.
Clue 3: All of the passing yard totals for the winning games are in the same hundreds group except for 1.
Clue 4: The range for the passing yards of the losing games is 258 and of the winning games is in the one hundred range.
Clue 5: The smallest value in both data sets is in the one hundred range.

The data sets for 2 students are shown below.

Marissa	
Losses	Wins
313	372
276	266
245	233
229	228
215	220
167	201
164	114
157	
139	

Sheldon	
Losses	Wins
372	276
313	266
245	233
229	228
215	220
167	201
164	139
157	
114	

Use the clues and a spreadsheet to make your own data set. Find the mean, median and mode using formulas for each of your data sets. Compare your results to the given student results to decide which student is correct. Justify your reasoning.

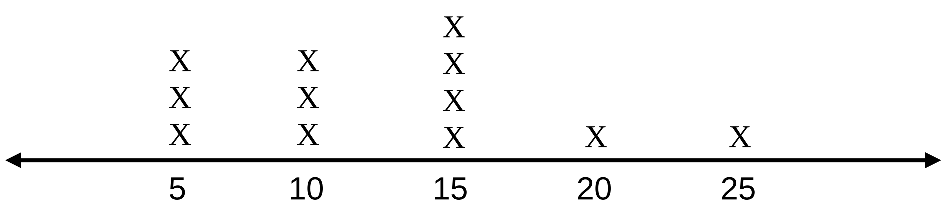
1. The table shows the number of points Menu scored during the first 5 basketball games.

Game	Points Scored
1	15
2	11
3	18
4	12
5	29

If Menu wants to predict how many points he will score during the next game, which measure of the data should he use?

A Mean
B Median
C Mode
D Range

2. Mai charges $5 per hour for babysitting. She decided to chart the amount she earned on different evenings spent babysitting during the past month.



What was the median amount she earned during the month?

A $10
B $12.50
C $14
D $15

3. In his first three hours of waiting tables, Kimiko received the following tip amounts.

$2 $1.50 $2 $3.25 $5 $2.25 $12

If Kimiko wants to ask for a raise by showing his tips are not very good, which measure of central tendency should he show his boss?

A Mean
B Median
C Mode
D Range

4. To participate in an activity at the Fall Festival or purchase food items, tickets must be purchased. Below is a table that describes some booths and food items at the Fall Festival and the number of tickets needed for that booth.

Activity or Food Item	Number of Tickets
Cake Walk	3
Fishing	2
Moon Walk	4
Pony Ride	6
Ring Toss	2
Rock Climbing	7
Chips	3
Drinks	3
Hot Dogs	5
Nachos	5

If a petting zoo is added to the list above, how many tickets should the Festival organizers assigned to the petting zoo for the mean to stay the same?

A 3
B 3.5
C 4
D 5

Mathematics

7.11 The student understands that the way a set of data is displayed influences its interpretation. The student is expected to:

(A) select and use an appropriate representation for presenting and displaying relationships among collected data including line plot, line graph, bar graph, stem and leaf plot, circle graph, and Venn diagrams, and justify the selection.

(B) make inferences and convincing arguments based on analysis of given or collected data.

7.12 The student uses measures of central tendency and range to describe a set of data. The student is expected to:

(A) describe a set of data using mean, median, mode and range.

(B) choose among mean, median, mode or range to describe a set of data and justify the choice for a particular situation.

Materials

For whole class demonstration:

- **Transparency: Fumble Bumbles**

For each student:

- TI-73 calculator
- **Football Statistics** activity sheet
- **How Do These Shapes Measure Up?** activity sheet
- **Data Mix-Up** performance assessment

ENGAGE

The Engage portion of the lesson is designed to create student interest in the concepts addressed. Technology is not used in this phase since the focus of this activity is to remind students of the measures of central tendency. This part of the lesson is designed for groups of 2 students or individual investigation.

1. Display **Transparency 1: Fumble Bumbles** so that it is visible to all students.
2. Students should read the problem and solve for the mean, median, and mode. Provide math vocabulary glossaries or dictionaries for students who may need to refresh their memories on these terms.
3. Debrief the activity using the Facilitation Questions.

Facilitation Questions

- How did you determine the mean for this set of data?
  Answers may vary. Lead students in the development/review of the vocabulary word by using a graphic organizer, such as a vocabulary model, or creating a word wall for Probability and Statistics. Some students may know the algorithm for finding the mean. Other students may make a picture to find the mean, as addressed in the 6th grade TEKS. The mean is 1.375 or 1.4 fumbles.

  Vocabulary Model Example

(Word) *Mean*	***(Definition)*** *The sum of the numbers in a set of data divided by the number of pieces of data.*
(Examples) *Average of 3, 5, 4, 8* $\underbrace{3+5+4+8}=20$ $\downarrow$ $20\div4=5$	***(Non-Examples)*** *Median* *Mode*

- How did you find the median for this set of data?
  Answers may vary. Lead students in the development/review of the vocabulary word by using a graphic organizer or creating a word wall for Probability and Statistics. The median is 1.5 fumbles.
- How did you find the mode for this set of data?
  Answers may vary. Lead students in the development/review of the vocabulary word by using a graphic organizer or creating a word wall for Probability and Statistics. The mode is 2 fumbles.
- Which measure of data would the Texans prefer the media to report?
  Answers may vary. The Texans would probably prefer the mean to be reported since it is the lowest of the three.

EXPLORE

The Explore portion of the lesson provides the student with an opportunity to be actively involved in the exploration of the mathematical concepts addressed. This part of the lesson is designed for groups of 2 students or individual investigation.

1. Distribute **Football Statistics** activity sheet to each student and a TI-73 calculator.
2. When monitoring students thinking, use the facilitation questions.

Facilitation Questions

- What do you know about the problem?
  Possible answer: For the first 10 games, the mean is 31, the median is 24 and the mode is 52.
- What do you need to know to find a solution for the problem?
  Possible answer: I need to find the data set for the 7 games.
- Where is the information located in the calculator that you need?
  The information is in List 1 under the LIST feature of the calculator.
- What should you do if the mean is higher than the targeted mean?
  The values in the data set need to be decreased if the mean is too high.
- What should you do if the mean is lower than the targeted mean?
  The values in the data set need to be increased if the mean is too low.
- How did you make your prediction? Did any information help you make your prediction?
  Answers may vary. The mode gave them a clue to include both of the 52 yard amounts in the first 7 games.
- What strategies did you use for choosing the numbers to put in for the 7 games?
  Answers may vary.
- Which measure of central tendency is the easiest to determine first?
  The mode is the easiest one to recognize in a set of data because one only looks at frequencies.

EXPLAIN

The Explain portion of the lesson is directed by the teacher to allow the students to formalize their understanding of the TEKS addressed in the lesson.

1. Debrief the **Football Statistics** activity using the facilitation questions.

Facilitation Questions

- How did the calculator allow you to manipulate data?
  By using the LIST feature and allowing the calculator to find each measure of central tendency, any yardage can be changed in the list and each measure of central tendency recalculated easily.
- How did the calculator assist you in interpreting data?
  Answers may vary. Some students may say that the calculator helped them to focus on the concept of mean, median, and mode since they did not have to think about the math operations involved.
- With a mean of 31, what can you conclude about the data set?
  The numbers will cluster in the middle or the numbers will vary. If the numbers vary, they must include high and low numbers to average out.
- How did the median of 24 help narrow your choices?
  Answers may vary, but lead students to put the numbers in numerical order. Discuss observations.
- If the yards from the other 3 games were included in the data set, how would you predict the mean would change? The median? The mode?
  Answers may vary. After students make predictions, point out that the 3 remaining numbers cluster within the same range, so the mean may not change much. The median should be higher since the 3 numbers would come in the middle of the existing data. The mode isn't affected.
- Were you surprised by the results? Why?
  Answers may vary. Students should explain their reasoning for being surprised.
- Were there times when the technology made the task easier? Why?
  Answers may vary. Some students may say that not having to calculate the math with paper/pencil made the task easier.
- Are there times when the technology made the task more difficult? Why?
  Answers may vary. Students may say that manipulating back and forth between the lists and calculations made the task more difficult.

ELABORATE

The Elaborate portion of the lesson provides an opportunity for the student to apply the concepts of the TEKS within a new situation. This part of the lesson is designed for groups of 2 students or individual investigation.

1. Distribute **How Do These Shapes Measure Up?** activity sheet and TI-73 calculator to each student.
2. Tell students that in the first phases of this lesson we looked at numerical data generated from football statistics, but in this phase we will be looking at numerical data generated by measuring the dimensions of figures.

3. Students should work to complete the worksheet.
4. Debrief using the facilitation questions.

Facilitation Questions

- Which set of data did you predict to have the same mean, median and mode?
  Answers may vary. Some students may notice that Set C appears to be the same height, so the mean, median and mode might be the same.
- Which set of data did you predict to have the greatest mean?
  Answers may vary. Some students may realize that the taller objects will most likely create a greater mean.
- Which set of data did you predict to have the smallest mean?
  Answers may vary. Some students may realize that the shorter objects will most likely create a smaller mean.
- How does the calculator assist you in analyzing data?
  Answers may vary. Some students may say that the ability to make a graph quickly helps you visually analyze similarities and differences.
- How does the calculator assist you in communicating your results?
  Answers may vary. Some students may say that the calculator helps them organize the data into a table and display the information graphically.
- What formula did you use to find the mean?
  MEAN(L_1)
- What formula did you use to find the median?
  MEDIAN(L_1)
- What formula did you use to find the mode?
  MODE(L_1)
- Which set of figures has the same mean, median and mode?
  Set C
- Which set has no mode?
  Set B
- Which set has the same median and mode?
  Set A and C
- Which data set has the greatest mean?
  Set C
- Which data set has the smallest mean?
  Set B
- How can looking at the figures in Set A help you determine the central tendencies?
  Answers may vary. Visually examine the figures and use reasonableness to draw conclusions. For example, two of the figures in Set A appear to have the same height so the mode will be equal to the height of Figure 1 and 2 and so will the median since one of these heights will be the middle number. The mean will be slightly more because figure 3 will raise the average.

Facilitation Questions

- How can looking at the figures in Set B help you determine the central tendencies?
  Answers may vary. Visually examine the figures and use reasonableness to draw conclusions. For example, all of the heights in Set B are different, so that set won't have a mode. The median will be the height of Figure 5. The mean may be close to the median since the figures on either side of Figure 5 will balance out the average.
- How can looking at the figures in Set C help you determine the central tendencies?
  Answers may vary. Visually examine the figures and use reasonableness to draw conclusions. For example, all of the figures in Set C appear to be the same height, so they will have the same mean, median and mode.
- How would combining the data sets affect the mean? The median? The mode?
  mean – Answers may vary. One possible answer is that the mean will be 1.25 or maybe slightly lower since the heights in the other groups are slightly higher and lower than 1.25
  median – Answers may vary. One possible answer is the median will be similar to Set C since figures 6-9 seem to have the same height and would fall in the middle of the data.
  mode – Answers may vary. The students will most likely say 1.25 since no other height occurs more than the height of the figures in Set C.
- How different did you think the data sets would be for the lengths/diameters?
  Answers may vary. Students should reason about the differences in the data sets by looking at the sides.
- How did the mean, median and mode of the lengths/diameters compare to that of the heights?
  Answers may vary. None of the sets has a mode. Set B has the highest mean. The median for Set A and Set C are the same for both.
- How do the bar graphs help you to interpret the data?
  Answers may vary. Students should recognize that the graph provides a visual representation, but caution them about misleading statistics.
- Why do you think we are using a bar graph instead of a circle graph?
  Answers may vary. Circle graphs are typically used with data represented as percentages.

EVALUATE

The Evaluate portion of the lesson provides the student with an opportunity to demonstrate his or her understanding of the TEKS addressed in the lesson.

1. Distribute **Data Mix-Up** activity sheet to each student.
2. Upon completion of **Data Mix-Up** activity sheet, the teacher should use a rubric to assess student understanding of the concepts addressed in this lesson.

Answers and Error Analysis for selected response questions:

Question Number	TEKS	Correct Answer	Conceptual Error	Conceptual Error	Procedural Error	Procedural Error	Guess
1	7.12B	B	A	C			D
2	7.12A	B	C	D	A		
3	7.12B	C	A	B			D
4	7.11B	C	A	B			D

Football Statistics *(Possible Answers)*

In 2004 Cory Bradford was a receiver for the Texans. He received the ball in 12 out of the 16 games played by the team. The total yards received during each of the first 10 games is shown below, but the yards are not listed in a particular order.

24 9 52 32 5 52 27 13 65 38

If Cory Bradford's mean, median and mode for receptions during the first 7 games were 31, 24, and 52 (when rounded to the nearest whole number), which of the above yardages represent his stats?

1. Make a prediction for the yards received in the first 7 games. Justify your reasoning.
   Answers will vary. Encourage students to use reasoning when making predictions.

2. Use the TI-73 calculator and the given information to help you find the yards received by Cory Bradford during the first 7 games. Follow the instructions below.
   a. Input the data using the **LIST** feature.
      Press [LIST].
      Input the 7 yards one by one into L_1.
      Press [2nd][MODE] to return to the home screen.

   b. Find the mean of the data using the **STAT** feature. Record your trials in the table on the next page.
      Press [2nd][LIST] to access the STAT menu.
      Press [►] to arrow over to MATH.
      Press [▼] to arrow down to mean(
      Press [ENTER].
      Press [2nd][LIST] L_1 [ENTER].
      Press [ENTER].

Think strategically when choosing the 7 yards. If the 7 yards chosen doesn't yield 31, go back to the list and modify it. Find the mean again for the new list.

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9
1									
2									
3									
4									
5									
6									
7									
mean									

c. Once you get 31 for the mean of a data set, check the median and mode.

You could find these in any order. Another option would be to find the median of the data. Once you find a median that matches 24, check the mean and mode. Use reasonableness when choosing your numbers.

To check the median:

Press [2nd][LIST] to access the STAT menu.

Press [▸] to arrow over to MATH.

Press [▾] to arrow down to median(

Press [ENTER].

Press [2nd][LIST] L_1 [ENTER].

Press [ENTER].

To check the mode:

Press [2nd][LIST] to access the STAT menu.

Press [▸] to arrow over to MATH.

Press [▾] to arrow down to mode(

Press [ENTER].

Press [2nd][LIST] L_1 [ENTER].

Press [ENTER].

d. Record the yards for the first 7 games below.

5, 9, 13, 24, 52, 52, 65

e. How many trials did it take before finding the yards for the 7 games?
Answers will vary. If more columns are needed for recording trials, have students draw more tables on a sheet of paper.

f. What strategies did you use to help you choose the numbers for each trial?
Answers will vary. Hopefully, answers will include reasonableness.

3. If the yards from the other 3 games were included in the data set, how would you predict
   a. the mean would change?
   Answers will vary. Since the numbers left cluster together, students may suggest the mean will stay the same.

   b. the median would change?
   Answers will vary. Help the students realize they will average the 2 numbers in the middle.

   c. the mode would change?
   The mode won't change since 52 is the only repeating number.

4. Use the TI-73 to calculate the mean, median, and mode for all 10 games. Record below.

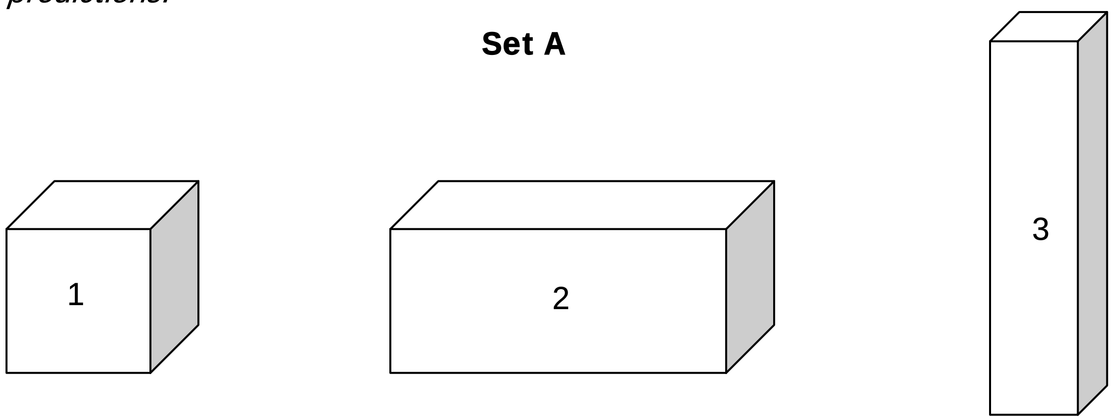
   Mean __*31.7*_ Median __*29.5*__ Mode __*52*__

5. How close were your predictions to the actual mean, median and mode? Explain similarities and differences.
   Answers will vary. Students should be detailed in explanations.

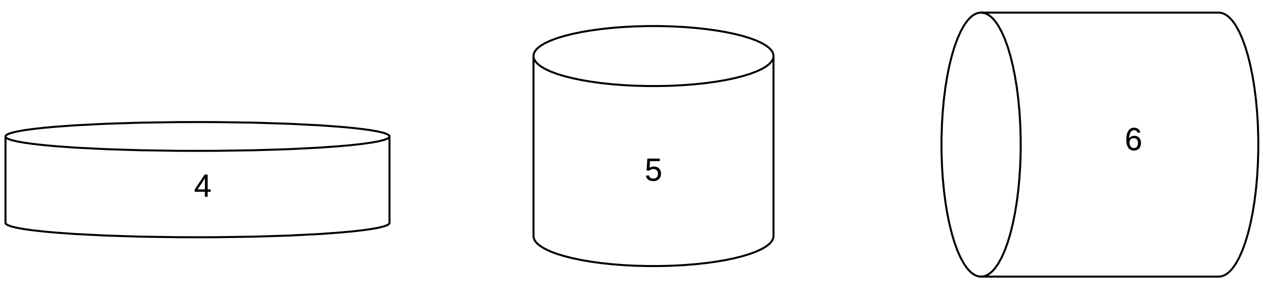
How do these shapes measure up? ***(Possible Answers)***

1. Look at each set of figures below. Make a prediction about the mean, median, and mode for the heights of each set. For which set of data do you predict the mean, median and mode to be the same? Which set do you predict to have the greatest mean? Which set do you predict to have the smallest mean?
   Answers will vary. Students should use the size of the figures to make predictions.

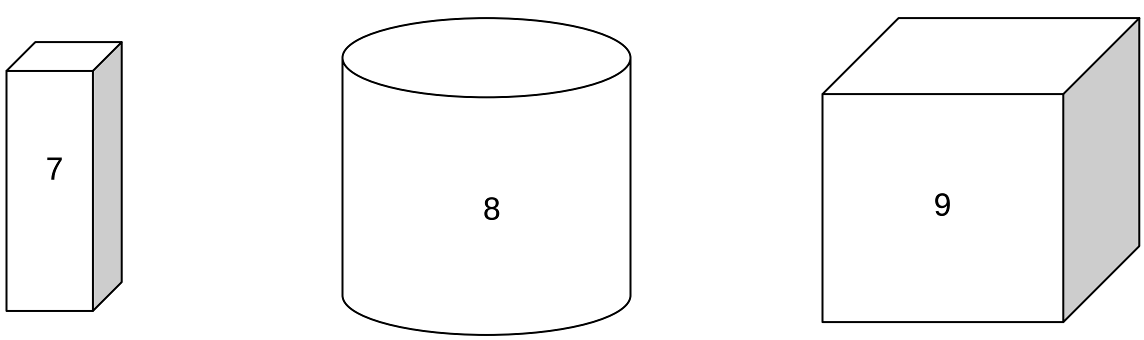
Set A



Set B



Set C



2. Measure the height of each figure. Round measurements to the nearest $\frac{1}{4}$ inch. Record in the chart under #4.

3. Input the height data for each set of figures using the **LIST** feature.
   Set A – L_1 Set B – L_2 Set C – L_3

4. Find the mean, median, and mode for each set of heights. Record data in the chart.

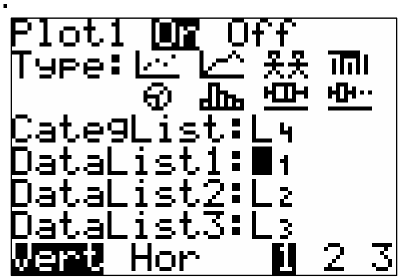
Set A	Height
1	*0.75*
2	*0.75*
3	*2*
Mean	*1.17*
Median	*0.75*
Mode	*0.75*

Set B	Height
4	*0.5*
5	*1*
6	*1.25*
Mean	*0.92*
Median	*1*
Mode	*None*

Set C	Height
7	*1.25*
8	*1.25*
9	*1.25*
Mean	*1.25*
Median	*1.25*
Mode	*1.25*

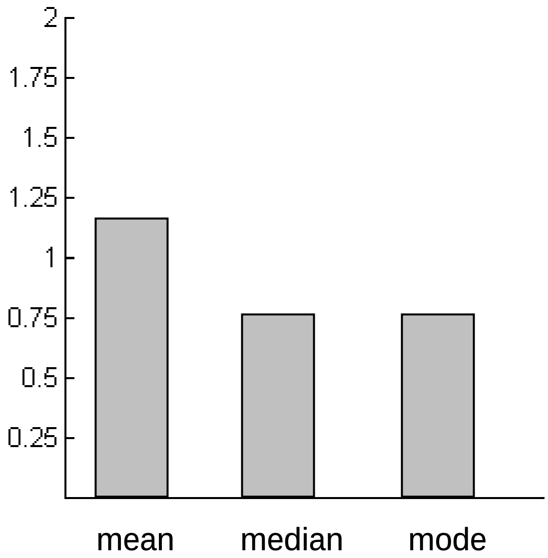
5. Input the mean, median and mode for each set of data using the **LIST** feature.
   Set A – L_4 Set B – L_5 Set C – L_6

6. Create a bar graph for the mean, median and mode of each set of heights. Sketch what you see.
   For each set:
   Press [2nd][Y=][ENTER].
   With the cursor blinking on ON, press [ENTER].
   Press [▼] to arrow down to the next row. Press [▶] to arrow over to (the bar graph). Press [ENTER].
   Since the measures of central tendency for Set A were in L_4, choose L_4 for the CategList. To do this, press [▼] to arrow down to the CategList row. Press [2nd][LIST] and select L_4. Press [ENTER].
   Your screen should look like this:

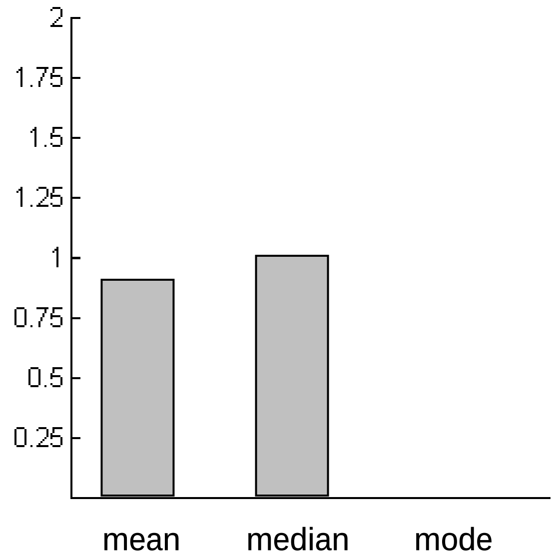


   Press [ZOOM] and arrow down to ZoomStat to see the graph.
   Sketch your graph on the next page. Repeat the process for Sets B and C.

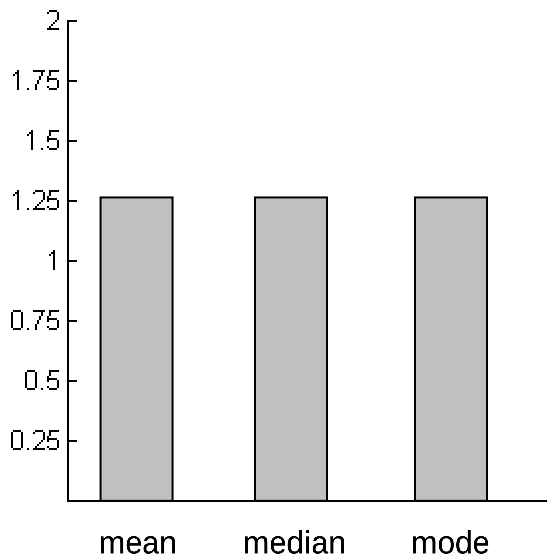
Set A



Set B



Set C



7. Use the information to answer the following questions.
   a. Which set of figures has the same mean, median and mode?
      Set C
   b. Which set has no mode?
      Set B
   c. Which set has the same median and mode?
      Sets A and C
   d. Which data set has the greatest mean?
      Set C

e. Which data set has the smallest mean?
Set B

f. How can looking at the figures help you determine the central tendencies?
Answers will vary. Lead students to realize they could visually look at the figures and use reasonableness to draw conclusions. For example, all of the figures in Set C appear to be the same height, so they will have the same mean, median and mode. All of the heights in Set B are different, so that set won't have a mode.

g. How would combining the data sets affect the mean? The median? The mode?
mean – *Answers will vary. One possible answer is that the mean will be 1.25 or maybe slightly lower since the heights in the other groups are slightly higher and lower than 1.25*

median – *Answers will vary.*

mode – *Answers will vary. The students will most likely say 1.25 since no other height occurs more than the height of the figures in Set C.*

8. How different do you think the data sets would be if you measured the lengths or diameters of the figures? What would be similar? What would be different? Explain your reasoning.
Answers will vary. Students should reason about the differences in the data sets by looking at the sides.

9. Measure the lengths or diameters for each set of figures. Be sure to round measurements to the nearest $\frac{1}{4}$ inch. Record in the chart under #10.

10. Input the length/diameter data for each set of figures using the **LIST** feature.
Set A – L_1 Set B – L_2 Set C – L_3
Find the mean, median, and mode. Record data in the chart.

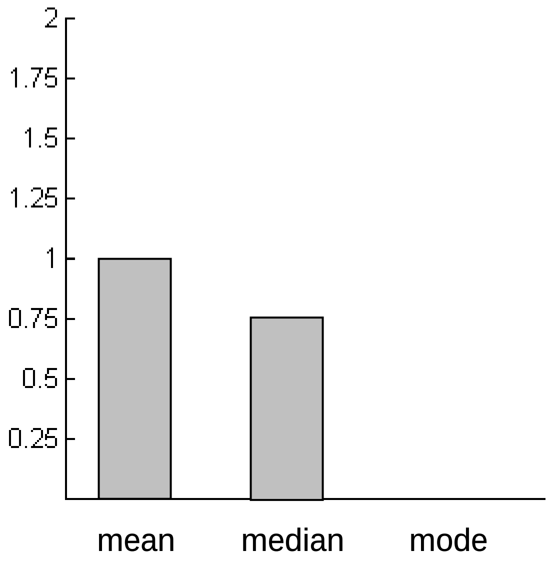
Set A	Length/ Diameter
1	*0.75*
2	*1.75*
3	*0.5*
Mean	*1*
Median	*0.75*
Mode	*None*

Set B	Length/ Diameter
4	*2*
5	*1.25*
6	*1.5*
Mean	*1.58*
Median	*1.5*
Mode	*None*

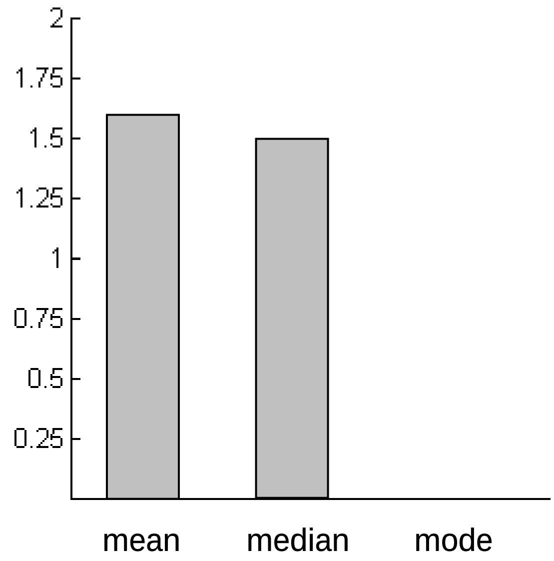
Set C	Length/ Diameter
7	*0.5*
8	*1.5*
9	*1.25*
Mean	*1.08*
Median	*1.25*
Mode	*None*

11. Create a bar graph for each set of lengths/diameters. Sketch what you see.

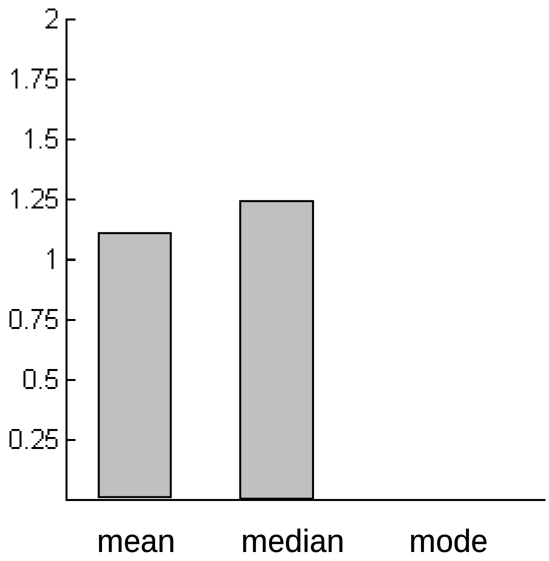
Set A



Set B



Set C



Data Mix-Up *(Possible Answers)*

Mr. Tucker gave his students the following data from the 2004 football season.

The Houston Texans played 16 games in 2004. The numbers in the table represent the total passing yards by David Carr, the quarterback, for each game.

229	215
313	164
233	201
228	157
372	167
266	220
276	139
245	114

Each student had to create a data set of passing yards for the losing games and a data set of passing yards for the winning games using the clues provided.

Clue 1: The Texans had 2 fewer wins in 2004 than losses.
Clue 2: The mean passing yards for the losing data set is less than the mean passing yards for the winning data set.
Clue 3: All of the passing yard totals for the winning games are in the same hundreds group except for 1.
Clue 4: The range for the passing yards of the losing games is 258 and of the winning games is in the one hundred range.
Clue 5: The smallest value in both data sets is in the one hundred range.

The data sets for 2 students are shown below.

Marissa	
Losses	Wins
313	372
276	266
245	233
229	228
215	220
167	201
164	114
157	
139	

Sheldon	
Losses	Wins
372	276
313	266
245	233
229	228
215	220
167	201
164	139
157	
114	

Use the clues and a TI-73 calculator to make your own data set. Find the mean, median and mode for each of your data sets. Compare your results to the given student results to decide which student is correct. Justify your reasoning.

Sheldon is correct.

Fumble Bumbles

A fumble in a football game is the failure to hold or handle the ball properly. If the opposing team recovers the fumble, they gain possession of the ball at the precise location of the recovery. Fumbles are many times key turning points in a game and could cause the team a loss.

In the 2004 football season, the Houston Texans played 16 games. The chart below shows the number of fumbles made by the Texans.

Game Date	# of Fumbles
Sept. 12	2
Sept. 19	4
Sept. 26	2
Oct. 3	1
Oct. 10	0
Oct. 17	2
Oct. 31	2
Nov. 7	0
Nov. 14	3
Nov. 21	0
Nov. 28	0
Dec. 5	2
Dec. 12	1
Dec. 19	0
Dec. 26	2
Jan. 2	1

Which measure of data (mean, median, or mode) would the Texans prefer the media report? Explain your reasoning.

Football Statistics

In 2004 Cory Bradford was a receiver for the Texans. He received the ball in 12 out of the 16 games played by the team. The total yards received during each of the first 10 games is shown below, but the yards are not listed in a particular order.

24 9 52 32 5 52 27 13 65 38

If Cory Bradford's mean, median and mode for receptions during the first 7 games were 31, 24, and 52 (when rounded to the nearest whole number), which of the above yardages represents his stats?

1. Make a prediction for the yards received in the first 7 games. Justify your reasoning.

2. Use the TI-73 calculator and the given information to help you find the yards received by Cory Bradford during the first 7 games. Follow the instructions below.
   a. Input the data using the **LIST** feature.
      Press $\boxed{\text{LIST}}$.
      Input the 7 yards one by one into L_1.
      Press $\boxed{\text{2nd}}\boxed{\text{MODE}}$ to return to the home screen.

   b. Find the mean of the data using the **STAT** feature. Record your trials in the table on the next page.
      Press $\boxed{\text{2nd}}\boxed{\text{LIST}}$ to access the STAT menu.
      Press $\boxed{\blacktriangleright}$ to arrow over to MATH.
      Press $\boxed{\blacktriangledown}$ to arrow down to mean(
      Press $\boxed{\text{ENTER}}$.
      Press $\boxed{\text{2nd}}\boxed{\text{LIST}}$ L_1 $\boxed{\text{ENTER}}$.
      Press $\boxed{\text{ENTER}}$.

Think strategically when choosing the 7 yards. If the 7 yards chosen doesn't yield 31, go back to the list and modify it. Find the mean again for the new list.

	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	Trial 6	Trial 7	Trial 8	Trial 9
1									
2									
3									
4									
5									
6									
7									
mean									

c. Once you get 31 for the mean of a data set, check the median and mode.

You could find these in any order. Another option would be to find the median of the data. Once you find a median that matches 24, check the mean and mode. Use reasonableness when choosing your numbers.

To check the median:

Press [2nd][LIST] to access the STAT menu.
Press [▶] to arrow over to MATH.
Press [▼] to arrow down to median(
Press [ENTER].
Press [2nd][LIST] L_1 [ENTER].
Press [ENTER].

To check the mode:

Press [2nd][LIST] to access the STAT menu.
Press [▶] to arrow over to MATH.
Press [▼] to arrow down to mode(
Press [ENTER].
Press [2nd][LIST] L_1 [ENTER].
Press [ENTER].

d. Record the yards for the first 7 games below.

e. How many trials did it take before finding the yards for the 7 games?

f. What strategies did you use to help you choose the numbers for each trial?

3. If the yards from the other 3 games were included in the data set, how would you predict
   a. the mean would change?

   b. the median would change?

   c. the mode would change?

4. Use the TI-73 to calculate the mean, median, and mode for all 10 games. Record below.

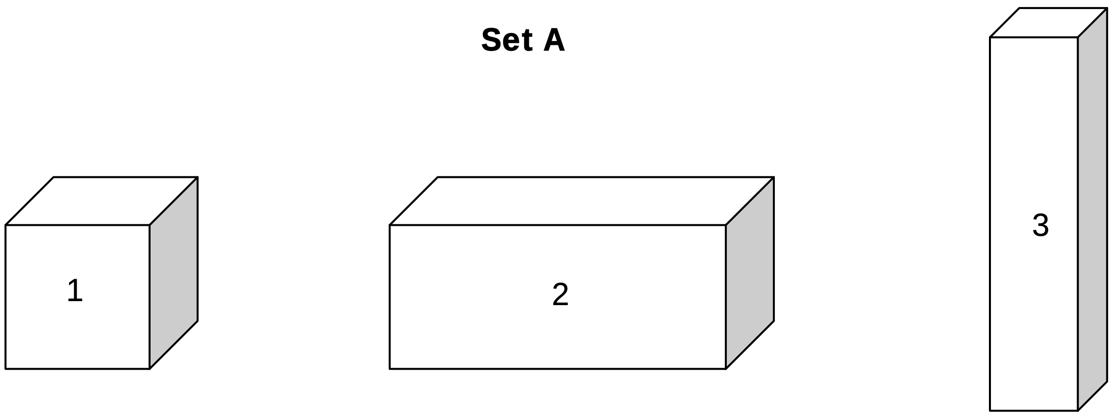
   Mean _______ Median _______ Mode _______

5. How close were your predictions to the actual mean, median and mode? Explain similarities and differences.

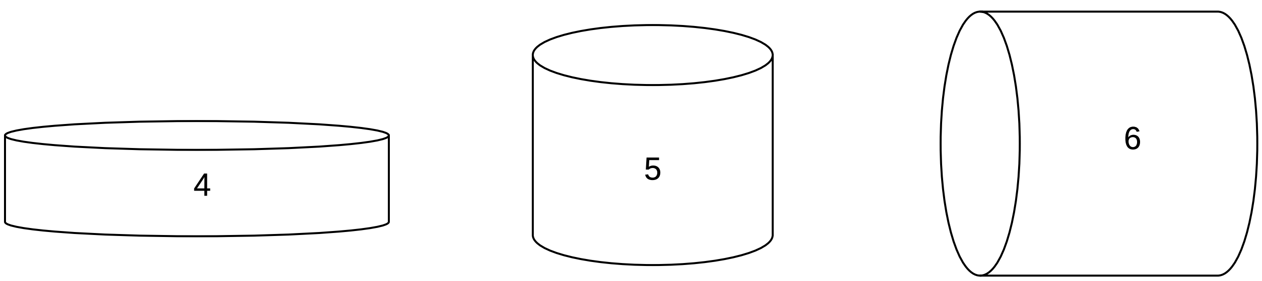
How do these shapes measure up?

1. Look at each set of figures below. Make a prediction about the mean, median, and mode for the heights of each set. For which set of data do you predict the mean, median and mode to be the same? Which set do you predict to have the greatest mean? Which set do you predict to have the smallest mean?

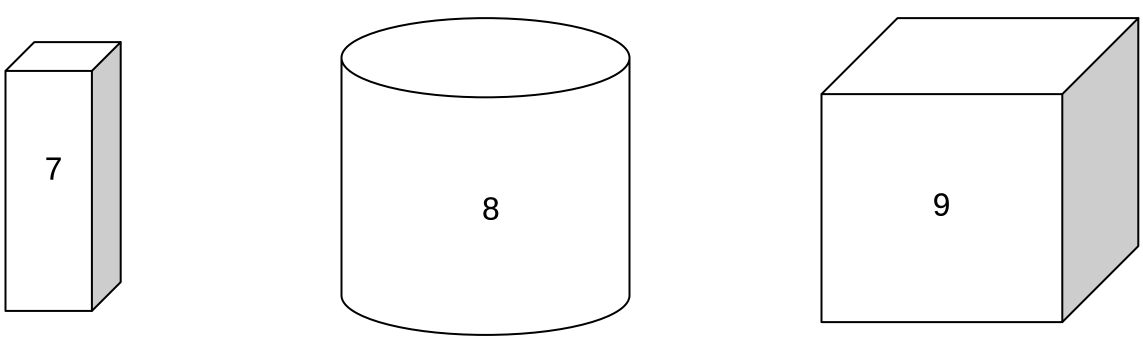
Set A



Set B



Set C



2. Measure the height of each figure. Round measurements to the nearest $\frac{1}{4}$ inch.

   Record in the chart under #4.

3. Input the height data for each set of figures using the **LIST** feature.
   Set A – L_1 Set B – L_2 Set C – L_3

4. Find the mean, median, and mode for each set of heights. Record data in the chart.

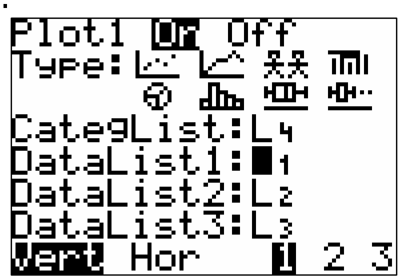
Set A	Height
1	
2	
3	
Mean	
Median	
Mode	

Set B	Height
4	
5	
6	
Mean	
Median	
Mode	

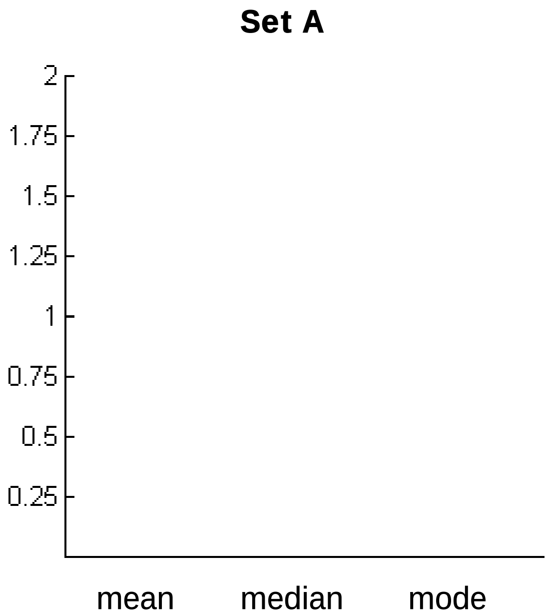
Set C	Height
7	
8	
9	
Mean	
Median	
Mode	

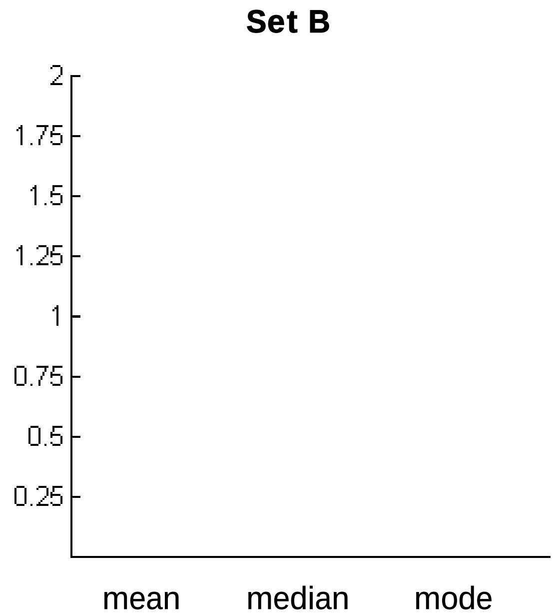
5. Input the mean, median and mode for each set of data using the **LIST** feature.
   Set A – L_4 Set B – L_5 Set C – L_6

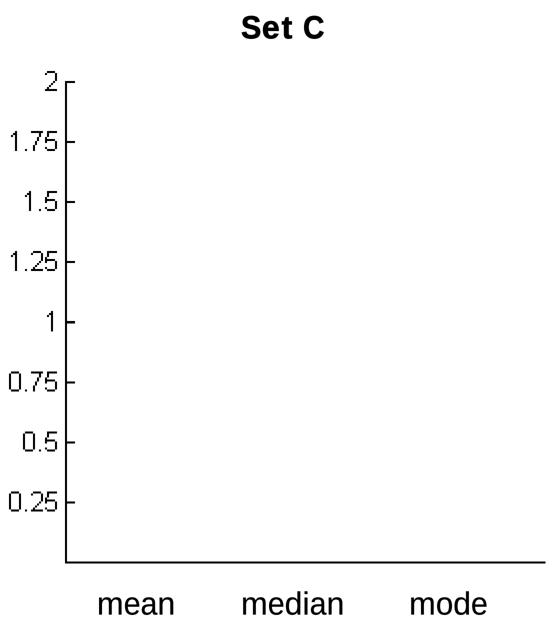
6. Create a bar graph for the mean, median and mode of each set of heights. Sketch what you see.
   For each set:
   Press [2nd][Y=][ENTER].
   With the cursor blinking on ON, press [ENTER].
   Press [▼] to arrow down to the next row. Press [►] to arrow over to (the bar graph). Press [ENTER].
   Since the measures of central tendency for Set A were in L_4, choose L_4 for the CategList. To do this, press [▼] to arrow down to the CategList row. Press [2nd][LIST] and select L_4. Press [ENTER].
   Your screen should look like this:



   Press [ZOOM] and arrow down to ZoomStat to see the graph.
   Sketch your graph on the next page. Repeat the process for Sets B and C.







7. Use the information to answer the following questions.

   a. Which set of figures has the same mean, median and mode?

   b. Which set has no mode?

   c. Which set has the same median and mode?

d. Which data set has the greatest mean?

e. Which data set has the smallest mean?

f. How can looking at the figures help you determine the central tendencies?

g. How would combining the data sets affect the mean? The median? The mode?

mean –

median –

mode –

8. How different do you think the data sets would be if you measured the lengths or diameters of the figures? What would be similar? What would be different? Explain your reasoning.

9. Measure the lengths or diameters for each set of figures. Be sure to round measurements to the nearest $\frac{1}{4}$ inch. Record in the chart under #10.

10. Input the length/diameter data for each set of figures using the **LIST** feature.
Set A – L_1 Set B – L_2 Set C – L_3
Find the mean, median, and mode. Record data in the chart.

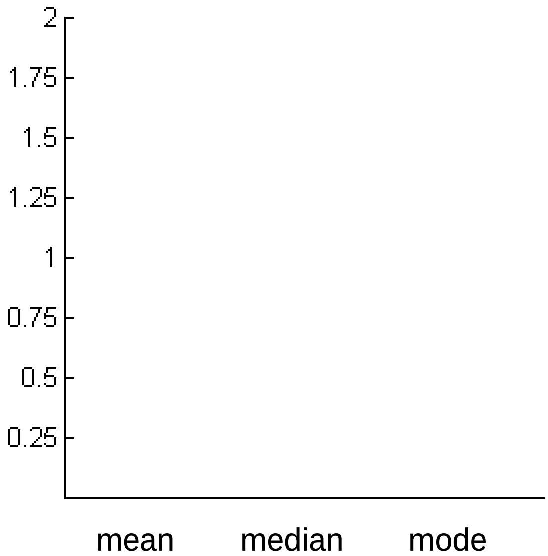
Set A	Length/ Diameter
1	
2	
3	
Mean	
Median	
Mode	

Set B	Length/ Diameter
4	
5	
6	
Mean	
Median	
Mode	

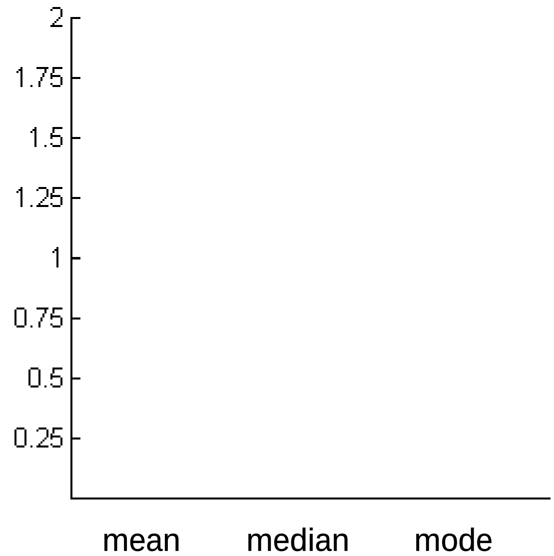
Set C	Length/ Diameter
7	
8	
9	
Mean	
Median	
Mode	

11. Create a bar graph for each set of lengths/diameters. Sketch what you see.

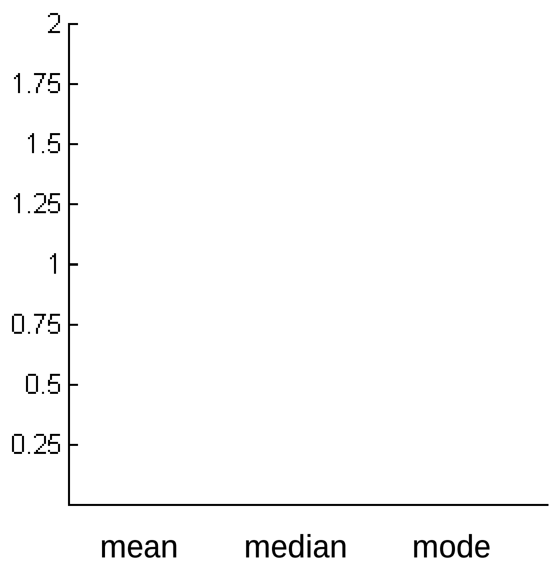
Set A



Set B



Set C



Data Mix-Up

Mr. Tucker gave his students the following data from the 2004 football season.

The Houston Texans played 16 games in 2004. The numbers in the table represent the total passing yards by David Carr, the quarterback, for each game.

229	215
313	164
233	201
228	157
372	167
266	220
276	139
245	114

Each student had to create a data set of passing yards for the losing games and a data set of passing yards for the winning games using the clues provided.

Clue 1: The Texans had 2 fewer wins in 2004 than losses.
Clue 2: The mean passing yards for the losing data set is less than the mean passing yards for the winning data set.
Clue 3: All of the passing yard totals for the winning games are in the same hundreds group except for 1.
Clue 4: The range for the passing yards of the losing games is 258 and of the winning games is in the one hundred range.
Clue 5: The smallest value in both data sets is in the one hundred range.

The data sets for 2 students are shown below.

Marissa	
Losses	Wins
313	372
276	266
245	233
229	228
215	220
167	201
164	114
157	
139	

Sheldon	
Losses	Wins
372	276
313	266
245	233
229	228
215	220
167	201
164	139
157	
114	

Use the clues and a TI-73 calculator to make your own data set. Find the mean, median and mode for each of your data sets. Compare your results to the given student results to decide which student is correct. Justify your reasoning.

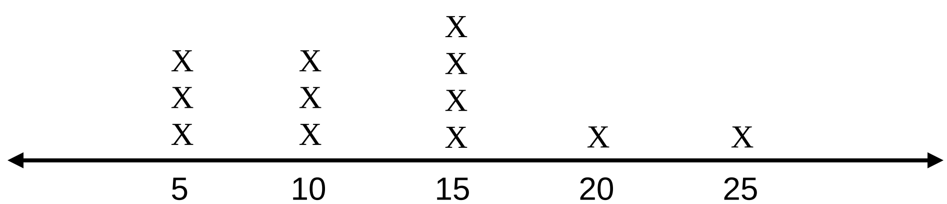
1. The table shows the number of points Menu scored during the first 5 basketball games.

Game	Points Scored
1	15
2	11
3	18
4	12
5	29

If Menu wants to predict how many points he will score during the next game, which measure of the data should he use?

A Mean
B Median
C Mode
D Range

2. Mai charges $5 per hour for babysitting. She decided to chart the amount she earned on different evenings spent babysitting during the past month.



What was the median amount she earned during the month?

A $10
B $12.50
C $14
D $15

3. In his first three hours of waiting tables, Kimiko received the following tip amounts.

$2 $1.50 $2 $3.25 $5 $2.25 $12

If Kimiko wants to ask for a raise by showing his tips are not very good, which measure of central tendency should he show his boss?

A Mean
B Median
C Mode
D Range

4. To participate in an activity at the Fall Festival or purchase food items, tickets must be purchased. Below is a table that describes some booths and food items at the Fall Festival and the number of tickets needed for that booth.

Activity or Food Item	Number of Tickets
Cake Walk	3
Fishing	2
Moon Walk	4
Pony Ride	6
Ring Toss	2
Rock Climbing	7
Chips	3
Drinks	3
Hot Dogs	5
Nachos	5

If the Fall Festival adds a petting zoo to the list above, how many tickets should the petting zoo cost for the mean to stay the same?

A 3
B 3.5
C 4
D 5

Mathematics

7.10 The student recognizes that a physical or mathematical model can be used to describe the experimental and theoretical probability of real –life. The student is expected to

(B) find the probability of independent events.

7.11 The student understands that the way a set of data is displayed influences its interpretation.

(A) select and use an appropriate representation for presenting and displaying relationships among collected data, including line plot, line graph, bar graph, stem and leaf plot, circle graph, Venn diagrams, and justify the selection.

(B) make inferences and convincing arguments based on analysis of given or collected data.

Technology Applications

The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to

(1)(B) compare, contrast, and appropriately use the various input, processing, output, and primary/secondary storage devices.

(1)(C) demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency.

(1)(E) use technology terminology appropriate to the task.

(1)(F) perform basic software application functions including, but not limited to, opening an application program and creating, modifying, printing, and saving documents.

The student uses data input skills appropriate to the task. The student is expected to

(2)(A) demonstrate proficiency in the use of a variety of input devices such as mouse/track pad, keyboard, microphone, digital camera, printer, scanner, disk/disc, modem, CD-ROM, or joystick.

The student acquires electronic information in a variety of formats, with appropriate supervision. The student is expected to

(5)(A) identify, create, and use files in various formats such as text, bitmapped/vector graphics, image, video, and audio files.

The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to

(7)(G) integrate two or more productivity tools into a document including, but not limited to, tables, charts and graphs, graphics from paint or draw programs, and mail merge.

Materials

Advanced Preparation:
- Sign up for the computer lab.
- Have the **The Teacher Helper** file ready for students to access in the computer lab.
- Make the **Teacher Helper** transparency.

For each student:
- **The Helper Dilemma** activity sheet
- **The Choir Helper** activity sheet
- **Simulation** activity sheet
- Sticky notes

For whole class demonstration:
Transparency of **Teacher Helper**

For each student group of students:
- Coin
- 10-sided number decahedron
- Assortment of spinners, polyhedral-dice, marbles, or cards for **The Choir Helper** activity or materials for students to create their own

ENGAGE

The Engage portion of the lesson is designed to create student interest in the concepts addressed. Technology is not used in this phase since the focus of this activity is to remind students of sample spaces and probability. This part of the lesson is designed for whole group instruction and groups of 2 students.

1. Display the **Teacher Helper** transparency on the overhead.
2. Read the problem as a class and ask students to take a moment to think about the problem on their own. Have students record their solutions on a sticky note.
3. Prompt the students to work with a partner to share and/or compile their thoughts and answer the questions.
4. Debrief using the facilitation questions.
5. Extend the discussion to find other probabilities such as the probability of getting an even number, the number 11, etc.

Facilitation Questions – Engage Phase

- How many students are in Mrs. Alexander's class?
  20
- How do you know?
  Answers may vary. This will hopefully lead into a discussion on sample spaces.
- What is a sample space?
  A sample space is the set of all possible outcomes for a given scenario.
- What is the sample space for this scenario?

Heads, 1	*Heads, 6*	*Tails, 1*	*Tails, 6*
Heads, 2	*Heads, 7*	*Tails, 2*	*Tails, 7*
Heads, 3	*Heads, 8*	*Tails, 3*	*Tails, 8*
Heads, 4	*Heads, 9*	*Tails, 4*	*Tails, 9*
Heads, 5	*Heads, 10*	*Tails, 5*	*Tails, 10*

- Are all of the possibilities equally likely? Why?
  Yes, there is only one head and one tail. Also, each number occurs only one time.
- What is the probability of the student assigned to Head, 6 being the helper?
  Have students refer back to the sample space. There is a $\frac{1}{20}$ *chance for the student with a Head, 6 to be the helper. Connect the sample space to finding the independent probability.*

EXPLORE

The Explore portion of the lesson provides the student with an opportunity to be actively involved in the exploration of the mathematical concepts addressed. This part of the lesson is designed for groups of 2 students.

1. Distribute a 10-sided number decahedron and a coin to each pair of students.
2. Distribute **The Helper Dilemma** activity sheet to each student.
3. The students should perform the experiment and record results.
4. Take students into the computer lab to complete the activity.
5. Use the facilitation questions when students need help.

Facilitation Questions – Explore Phase

- How do you highlight a range of cells?
  Click the mouse and hold inside the first cell and drag to the last cell needed. Let go of the mouse.
- How do you format cells?
  Use the mouse and right click or choose "Format" in the menu bar and cells from the pull down menu.
- How do you start any formula in a spreadsheet document?
  All formulas start with an equal sign.
- When inputting formulas is it better to use numerical values or cell locations? Why?
  Cell locations are better since the value will automatically change in the formula cell if any numerical values are changed in the linked cells. However, numerical values are also appropriate at times as seen in the spreadsheet.
- What do you know about the problem?
  Answers may vary. Have students verbalize the parts of the problem they know.
- What do you need to know?
  Answers may vary. Have students verbalize the parts of the problem they need to know through questioning.
- Have you worked problems like this before? Explain.
  Answers may vary. Relate the problem to prior learning and prior experiences.

EXPLAIN

The Explain portion of the lesson is directed by the teacher to allow the students to formalize their understanding of the TEKS addressed in the lesson.

1. Debrief **The Helper Dilemma**.
2. Discuss notation for probability of compound events (i.e. P(head, one)).

Facilitation Questions – Explain Phase

- What is the difference between theoretical and experimental probability?
  Answers may vary. Take this opportunity to review these topics.
- How were the experimental and theoretical probabilities the same numerically?
  Answers may vary. Depending on the experiment, some may say that the experimental probabilities were close to being equally distributed.

Facilitation Questions – Explain Phase

- How were the experimental and theoretical probabilities the same numerically?
  Answers may vary. Depending on the experiment, some may say that the experimental probabilities were equally distributed like the theoretical probabilities.
- How were the experimental and theoretical probabilities different?
  Answers may vary. Depending on the experiment, some of the combinations may have occurred more than others. Possibly discuss at this time how Mrs. Alexander should keep track of who is helper so that when repeats occur she knows to flip the coin and roll the number decahedron again.
- If the fractions were changed to percents, what would you expect the percents to total and why?
  Answers may vary. Lead students to the understanding that the experiment is a whole event, so that the percents would add to 100% and the fractions to 1 whole.
- How could we use the spreadsheet to change the fractions to percents?
  To change fractions to percents, highlight the desired cells and choose format cells.
- How could we use the spreadsheet to total the percent values?
  To find a total, insert a formula by typing "=SUM" and highlighting or typing in the desired cells.
- If Mrs. Alexander has more students enrolled in her class, how can she change or modify her procedure for finding a helper?
  Answers may vary. Students may suggest that she use a numbered cube with 12 sides. Some students may suggest that she flip a coin, roll the numbered cube and use a spinner with 3 or 4 sections. Some students may suggest that she use a deck of cards and assign each student a card from the deck.
- What can you conclude about the class where Mrs. Alexander assigned tails to girls and heads and prime numbers to boys?
  Answers may vary. Not all of the combinations in the sample space will be used for this class. This class has more girls than boys since more combinations are assigned to girls than boys.
- How could Mrs. Alexander change or modify her procedure for finding a helper in this class to eliminate the extra combinations?
  Answers may vary. Mrs. Alexander could use the coin and a bag of marbles with 4 different colors for the boys or a spinner with 4 equal sections.

Facilitation Questions – Explain Phase

- In a previous question you were asked, "If Mrs. Alexander has more students enrolled in her class, how can she change or modify her procedure for finding a helper?" If 3 items were used to find the helper, for example, a coin, a number cube and a spinner, how would the results be affected?
  Answers may vary. Discuss that a third item would increase outcomes.
- How could we use the spreadsheet to help us record and calculate the results?
  Answers may vary. To calculate theoretical probability, three columns will be needed on the spreadsheet. In the 4th column a formula will be inserted to multiply the probability of 3 events.
- Do the items always have to yield equally likely results?
  Answers may vary. Discuss with students that they do not. Have students give examples where the outcomes are not equally likely.
- How does technology assist us in communicating our results?
  Answers may vary. Some students may suggest that the graph is easier to interpret and helps by eliminating the fractions. Others may suggest that the ease in changing from fractions to percents helps in communicating results.

ELABORATE

The Elaborate portion of the lesson provides an opportunity for the student to apply the concepts of the TEKS within a new situation. This part of the lesson is designed for individual investigation.

1. Distribute **The Choir Helper** to each student.
2. Prompt students to complete #1-2 before going to the lab.
3. Prompt students to open the file **The Teacher Helper** spreadsheet and click on the tab titled **The Choir Helper**.
4. Students should complete the remainder of the worksheet using the spreadsheet.
5. Students should print the document when finished.
6. Ask Facilitation Questions as needed.

Facilitation Questions – Elaborate Phase

- How do you write a formula in a spreadsheet document?
  Formulas start with the = sign.
- How do spreadsheets help you?
  Answers may vary. Spreadsheets will do calculations needed with a formula.
- How is this activity similar and different to **The Helper Dilemma**?
  Answers may vary. Still has two simulation items, but larger sample space.

Facilitation Questions – Elaborate Phase

- How do you make predictions from results?
  Include a discussion here of scale factors. The simulation was for 50 trials, so to predict results for 100 trials use a scale factor of 2 (multiply by 2).
- How could you use a graph to show that the results for 50 trials, 100 trials, 250 trials, etc. are proportional?
  Answers may vary. Discuss with students that a graph could be made charting each individual outcome. For example, chart the results for P(tail, letter A) for 50 trials by letting the x-axis represent trials and the y-axis represent outcomes. Other outcomes for the same probability could be graphed, and a discussion of the data points should follow. The points should appear to be in a straight line that would travel through the origin. Thus, the data is proportional.

EVALUATE

The Evaluate portion of the lesson provides the student with an opportunity to demonstrate his or her understanding of the TEKS addressed in the lesson.

1. Distribute **Simulation** activity sheet to each student.
2. Upon completion of **Simulation** activity sheet, the teacher should use a rubric to assess student understanding of the concepts addresses in this lesson.

Answers and Error Analysis for selected response questions:

Question Number	TEKS	Correct Answer	Conceptual Error	Conceptual Error	**Procedural** Error	Procedural Error	**Guess**
1	7.10B	D	A		C		B
2	7.11B	B	A	D			C
3	7.11A	A	B	C			D
4	7.10B	A	D		B	C	

The Helper Dilemma – (Possible Answers)

1. Use a coin and a 10-sided number decahedron to simulate the experiment 40 times. Record your results in the frequency table.

Combination	Tally	Frequency
Head, 1		
Head, 2		
Head, 3		
Head, 4		
Head, 5		
Head, 6		
Head, 7		
Head, 8		
Head, 9		
Head, 10		

Combination	Tally	Frequency
Tail, 1		
Tail, 2		
Tail, 3		
Tail, 4		
Tail, 5		
Tail, 6		
Tail, 7		
Tail, 8		
Tail, 9		
Tail, 10		

2. Transfer your information into **The Teacher Helper** document. Follow the instructions in the orange boxes numbered 1-6.

3. Create a graph to represent the Theoretical Probability in Column B.
   - Highlight the Combinations (i.e. Head, 1) in Column A along with the data in the green cells in Column B.
   - Go to Insert Chart.
     - Choose "doughnut" for the chart type on the left-hand side.
     - Click on next twice and type in the title "Theoretical Probability."
     - Click on the tab that reads "Legend." Click in the box next to "Show Legend" so that the check mark disappears.
     - Click on the tab that reads "Data Labels." Click inside the boxes next to "Category Name and Value" so that a check mark appears in both boxes.
     - Click on finish.
     - Click and hold inside the chart. Drag the chart below the first set of data.
     - Enlarge the chart by clicking on a corner and dragging to the desired size.

(continue: The Helper Dilemma)

4. Create a graph to represent the Experimental Probability in Column I (include the Combinations such as Head, 1). Follow the same instructions as #3 except highlight the information in Columns H and I and use the title "Experimental Probability." Drag the chart next to the Theoretical Probability Chart, the first chart.

5. Print the document. Be sure to preview the pages to be printed. You may need to adjust margins so that you only print 1 or 2 pages.

6. How were the experimental and theoretical probabilities the same? Explain.
   Answers may vary. Depending on the experiment, some may say that the experimental probabilities were close to being equally distributed.

7. How were the experimental and theoretical probabilities different? Explain.
   Answers may vary. Depending on the experiment, some of the combinations may have occurred more than others. Possibly discuss at this time how Mrs. Alexander should keep track of who is the helper so that when repeats occur, she knows to flip the coin and roll the number decahedron again.

8. If the fractions were changed to percents, what would you expect the percents to total and why?
   Answers may vary. Lead students to the understanding that the experiment is a whole event, so that the percents would add to 100% and the fractions to 1 whole.

9. If Mrs. Alexander has more students enrolled in her class, how can she change or modify her procedure for finding a helper?
   Answers may vary. Students may suggest that she use a number dodecahedron with 12 sides. Some students may suggest that she flip a coin, roll the number decahedron and use a spinner with 3 or 4 sections. Some students may suggest that she use a deck of cards and assign each student a card from the deck.

Use the following information to answer questions 8-13.

In one particular class, Mrs. Alexander assigned combinations with Heads and a prime number to only boys and combinations with Tails to only girls.

10. What is the sample space for this class?

Head, 1	*Head, 6*	*Tail, 1*	*Tail, 6*
Head, 2	*Head, 7*	*Tail, 2*	*Tail, 7*
Head, 3	*Head, 8*	*Tail, 3*	*Tail, 8*
Head, 4	*Head, 9*	*Tail, 4*	*Tail, 9*
Head, 5	*Head, 10*	*Tail, 5*	*Tail, 10*

(continue: The Helper Dilemma)

11. What can you conclude about this particular class? Explain.

    Not all of the combinations in the sample space will be used for this class. This class has more girls than boys since more combinations are assigned to girls than boys.

12. Which gender is most likely to be the helper? Explain.

    A girl is most likely to be the helper since more combinations are assigned to girls than boys.

13. What is the probability of a girl being the helper? Explain.

    There is a $\frac{1}{2}$ *chance of getting a tail and a* $\frac{10}{10}$ *chance of getting a number on the decahedron. Combine the probabilities using multiplication,* $\frac{1}{2}\cdot\frac{10}{10}$*, to get a* $\frac{10}{20}=\frac{1}{2}$ *chance of getting a girl helper.*

14. What is the probability of a boy being the helper? Explain.

    There is a $\frac{1}{2}$ *chance of getting a head and a* $\frac{4}{10}$ *chance of getting a prime number on the number decahedron. Combine the probabilities using multiplication,* $\frac{1}{2}\cdot\frac{4}{10}$*, to get a* $\frac{4}{20}=\frac{1}{5}$ *chance of getting a boy helper.*

15. How could Mrs. Alexander change or modify her procedure for finding a helper in this class to eliminate the extra combinations? Explain.

    Answers may vary. Mrs. Alexander could use the coin and a bag of marbles with 4 different colors for the boys or a spinner with 4 equal sections.

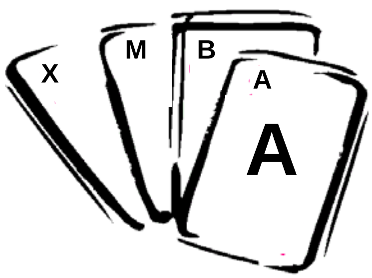
The Choir Helper – (Possible Answers)

The choir teacher, Mr. Roberts, heard Mrs. Alexander in the teacher's lounge describe her method for assigning a helper. He thought the idea would be a big help in his classes. Since his choir classes sometimes have between 45 and 50 students and no students can be assigned the same "code", Mr. Roberts can not use the coin and 10-sided number decahedron. Mrs. Alexander gave Mr. Roberts 8 different items that he could use to assign helpers in his class.

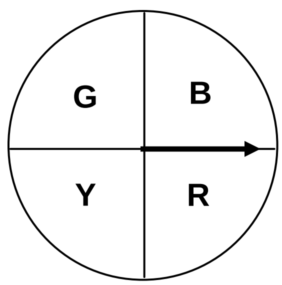
A Coin

A Six-Sided Number Cube

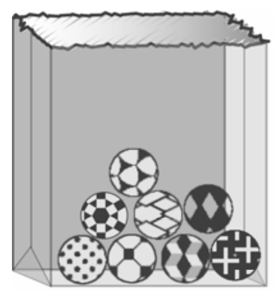
A 10-sided Number Decahedron with the numbers 1-10



A Set of Alphabet Cards A-Z

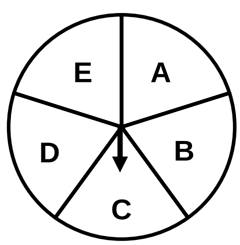


A Spinner



A Bag of 8 Different Marbles

A 12-sided Number Dodecahedron with the numbers 1-12



A Spinner

(continue: The Choir Helper)

1. Help Mr. Roberts pair the items together that he can use them to assign helpers. There will be 4 pairs. Justify your reasoning for each pair made and tell how many assignments for helpers could be made from each pair.

   Pair 1: A bag of 8 marbles and the 6-sided number cube (48 assignments)

   Pair 2: The coin and Set of Alphabet Cards (52 assignments)

   Pair 3: The spinner of colors and the 12-sided number dodecahedron (48 assignments)

   Pair 4: The spinner with letters and the 10-sided number decahedron (50 assignments)

2. Choose one of the pairs of items above and simulate the event for 50 trials. Create a frequency table to record your results.

   Answers may vary experiment to experiment.

3. Create a table in **The Teacher Helper** document under the tab titled **The Choir Helper** to organize the results.

4. Use the spreadsheet to predict the results if the event had been simulated for 100 trials? 250 trials? Make a separate column for each and use formulas to make predictions.

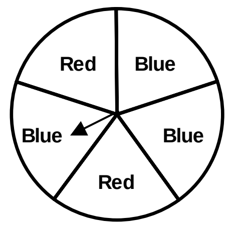
   Answers may vary, but formulas should include that the results in #3 are multiplied by a scale factor of 2 for 100 trials and a scale factor of 5 for 250 trials.

5. Print the document.

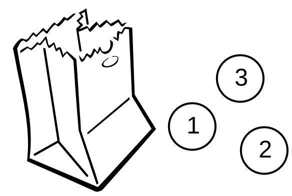
Simulation – (Possible Answers)

Use the following items to simulate an experiment.

A Coin



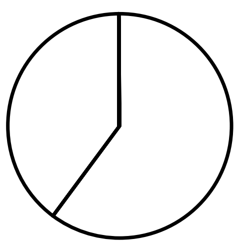
A Spinner



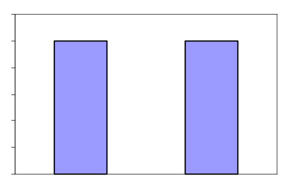
A Bag of 3 Marbles Numbered 1-3

Which of the following graphs best represents the results of the experiment? Justify your reasoning.

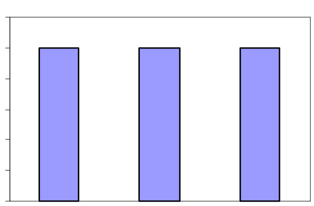
A.



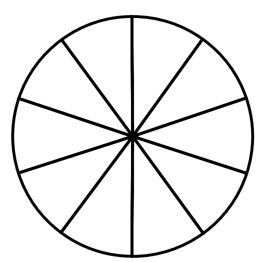
C.



B.



D.

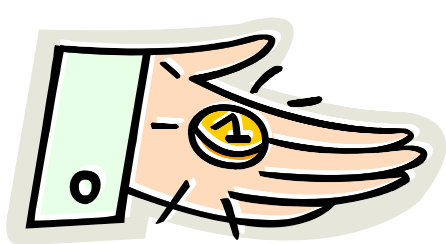


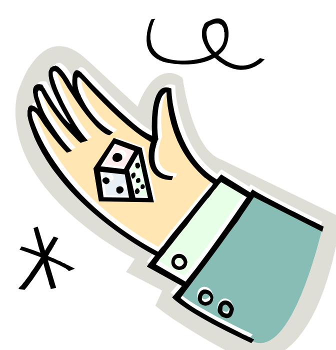
Answer: The graph in A best represents the experiment. In the experiment, the spinner has more blue than red. A circle graph representing the results of blue to red would show a larger section for blue.

Teacher Helper

Mrs. Alexander assigns the job of Teacher Helper in her class by flipping a coin and rolling a 10-sided number decahedron. Each student in her class is assigned a combination of a head or tail and a number from the decahedron. Students in the same class do not share the same combination.

- If all the possible combinations are assigned, how many students are in Mrs. Alexander's class?
- What are the possible combinations?





The Helper Dilemma

1. Use a coin and a 10-sided number decahedron to simulate the experiment 40 times. Record your results in the frequency table.

Combination	Tally	Frequency
Head, 1		
Head, 2		
Head, 3		
Head, 4		
Head, 5		
Head, 6		
Head, 7		
Head, 8		
Head, 9		
Head, 10		

Combination	Tally	Frequency
Tail, 1		
Tail, 2		
Tail, 3		
Tail, 4		
Tail, 5		
Tail, 6		
Tail, 7		
Tail, 8		
Tail, 9		
Tail, 10		

2. Transfer your information into the **The Teacher Helper** document. Follow the instructions in the orange boxes numbered 1-6.

3. Create a graph to represent the Theoretical Probability in Column B.
   - ➢ Highlight the Combinations (i.e. Head, 1) in Column A along with the data in the green cells in Column B.
   - ➢ Go to Insert Chart.
     - Choose "doughnut" for the chart type on the left-hand side.
     - Click on next twice and type in the title "Theoretical Probability."
     - Click on the tab that reads "Legend." Click in the box next to "Show Legend" so that the check mark disappears.
     - Click on the tab that reads "Data Labels." Click inside the boxes next to "Category Name and Value" so that a check mark appears in both boxes.
     - Click on finish.
     - Click and hold inside the chart. Drag the chart below the first set of data.
     - Enlarge the chart by clicking on a corner and dragging to the desired size.

(continue: The Helper Dilemma)

4. Create a graph to represent the Experimental Probability in Column I (include the Combinations such as Head, 1). Follow the same instructions as #3 except highlight the information in Columns H and I and use the title "Experimental Probability." Drag the chart next to the Theoretical Probability Chart, the first chart.

5. Print the document. Be sure to preview the pages to be printed. You may need to adjust margins so that you only print 1 or 2 pages.

6. How were the experimental and theoretical probabilities the same? Explain.

7. How were the experimental and theoretical probabilities different? Explain.

8. If the fractions were changed to percents, what would you expect the percents to total and why?

9. If Mrs. Alexander has more students enrolled in her class, how can she change or modify her procedure for finding a helper?

Use the following information to answer questions 8-13.

In one particular class, Mrs. Alexander assigned combinations with Heads and a prime number to only boys and combinations with Tails to only girls.

10. What is the sample space for this class?

11. What can you conclude about this particular class? Explain.

(continue: The Helper Dilemma)

12. Which gender is most likely to be the helper? Explain.

13. What is the probability of a girl being the helper? Explain.

14. What is the probability of a boy being the helper? Explain.

15. How could Mrs. Alexander change or modify her procedure for finding a helper in this class to eliminate the extra combinations? Explain.

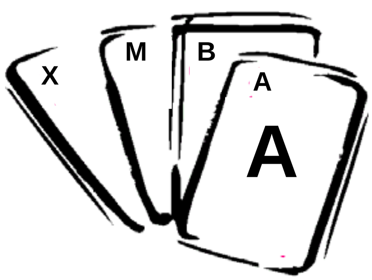
The Choir Helper

The choir teacher, Mr. Roberts, heard Mrs. Alexander in the teacher's lounge describe her method for assigning a helper. He thought the idea would be a big help in his classes. Since his choir classes sometimes have between 45 and 50 students and no students can be assigned the same "code," Mr. Roberts cannot use the coin and 10-sided number decahedron. Mrs. Alexander gave Mr. Roberts 8 different items that he could use to assign helpers in his class.

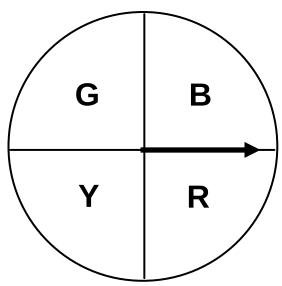
A Coin

A Six-Sided Number Cube

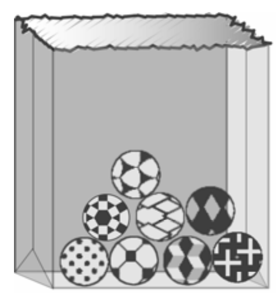
A 10-sided Number Decahedron with the numbers 1-10



A Set of Alphabet Cards A-Z

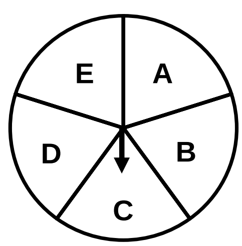


A Spinner



A Bag of 8 Different Marbles

A 12-sided Number Dodecahedron with the numbers 1-12



A Spinner

(continue: The Choir Helper)

1. Help Mr. Roberts pair the items together that he can use to assign helpers. There will be 4 pairs. Justify your reasoning for each pair made and tell how many assignments for helpers could be made from each pair.

2. Choose one of the pairs of items above and simulate the event for 50 trials. Create a frequency table to record your results.

3. Create a table in **The Teacher Helper** document under the tab titled **The Choir Helper** to organize the results.

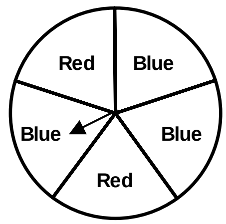
4. Use the spreadsheet to predict the results if the event had been simulated for 100 trials? 250 trials? Make a separate column for each and use formulas to make predictions.

5. Print the document.

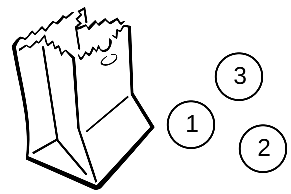
Simulation

Use the following items to simulate an experiment.

A Coin



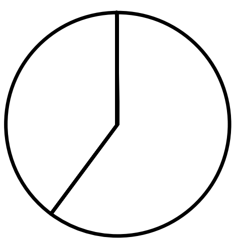
A Spinner



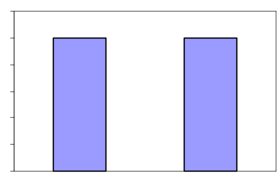
A Bag of 3 Marbles
Numbered 1-3

Which of the following graphs best represents the results of the experiment? Justify your reasoning.

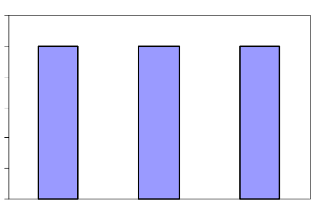
A.



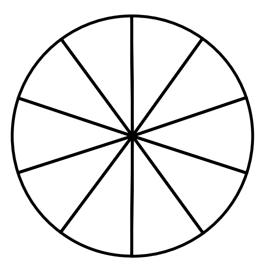
C.



B.



D.



1. Corbyn has a standard code of dress at his school. He can wear a white or green shirt with navy or khaki pants. He had 3 white shirts and 2 green shirts in his shirt drawer and 1 pair of navy pants and 3 pairs khaki pants in his pants drawer. What is the probability that Corbyn will reach in both drawers, without looking, and get a white shirt and navy pants?

   A $\frac{17}{20}$

   B $\frac{4}{9}$

   C $\frac{3}{25}$

   D $\frac{3}{20}$

2. A 6-sided number cube, a spinner divided into 3 equal parts labeled A, A, B, and a coin are being used for an experiment. Ozzie calculated the theoretical probability of an event where the number cube was rolled, coin tossed, and spinner spun. His calculation was $\frac{1}{3} \cdot \frac{1}{2} \cdot \frac{2}{3} = \frac{2}{18} = \frac{1}{9}$. For which of the following events did Ozzie calculate the probability?

   A P(even number, head, B)

   B P(1 or 2, head, A)

   C P(prime number, tail, A)

   D P(odd number, tail, A)

3. The letters of the word WINNER are cut apart and placed in a bag. A letter was drawn from the bag and a coin tossed at the same time. Results were recorded and the letter was placed back into the bag. Which of the following could NOT be used to represent the experimental data?

   A Venn diagram

   B Bar graph

   C Circle graph

   D Line Plot

4. A container of markers containing 3 red, 1 yellow, 2 green and 4 blue are placed at the map center in social studies. The rule is you can only use one marker at a time so that everyone will have a marker to use. What is the probability of reaching into the container without looking for each use and getting a red marker, a blue marker and then a yellow marker?

   A $\frac{3}{250}$

   B $\frac{12}{30}$

   C $\frac{12}{100}$

   D $\frac{8}{10}$

Mathematics

7.10 The student recognizes that a physical or mathematical model can be used to describe the experimental and theoretical probability of real –life. The student is expected to

(B) Find the probability of independent events.

7.11 The Students understands that the way a set of data is displayed influences its interpretation. The student is expected to

(A) to select and use an appropriate representation for presenting and displaying relationships among collected data, including line plot, line graph, bar graph, stem and leaf plot, circle graph, and Venn diagrams, and justify the selection.

(B) make inferences and convincing arguments based on an analysis of given or collected data.

Technology Applications

The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to

(1)(B) compare, contrast, and appropriately use the various input, processing, output, and primary/secondary storage devices.

(1)(C) demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency.

The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to

(7)(H) use interactive virtual environments, appropriate to level, such as virtual reality or simulations.

Materials

Advances Preparation:

- Make the **Teacher Helper** transparency.

For each student:

- **The Helper Dilemma** activity sheet
- **The Choir Helper** activity sheet
- **Simulation** activity sheet
- TI-73 calculator

For each student group of students:

- Coin
- 10-sided number decahedron

For whole class demonstration:

- Transparency of **Teacher Helper**

ENGAGE

The Engage portion of the lesson is designed to create student interest in the concepts addressed. Technology is not used in this phase since the focus of this activity is to remind students of sample spaces and probability. This part of the lesson is designed for whole group instruction and groups of 2 students.

1. Display the **Teacher Helper** transparency on the overhead.
2. Read the problem as a class and ask students to take a moment to think about the problem on their own.
3. Prompt students to work with a partner to compile their thoughts and answer the questions.
4. Debrief using the facilitation questions.
5. Extend the discussion to find other probabilities such as the probability of getting an even number, the number 11, etc.

Facilitation Questions – Engage Phase

- How many students are in Mrs. Alexander's class?
  20
- How do you know?
  Answers may vary. This will hopefully lead into a discussion on sample spaces.
- What is a sample space?
  A sample space is the set of all possible outcomes for a given scenario.
- What is the sample space for this scenario?

Heads, 1	*Heads, 6*	*Tails, 1*	*Tails, 6*
Heads, 2	*Heads, 7*	*Tails, 2*	*Tails, 7*
Heads, 3	*Heads, 8*	*Tails, 3*	*Tails, 8*
Heads, 4	*Heads, 9*	*Tails, 4*	*Tails, 9*
Heads, 5	*Heads, 10*	*Tails, 5*	*Tails, 10*

- Are all of the possibilities equally likely? Why?
  Yes, there is only one head and one tail. Also, each number occurs only one time.
- What is the probability of the student assigned to Head, 6 being the helper?
  Have students refer back to the sample space. There is a $\frac{1}{20}$ *chance for the student with a Head, 6 to be the helper. Connect the sample space to finding the independent probability.*

EXPLORE

The Explore portion of the lesson provides the student with an opportunity to be actively involved in the exploration of the mathematical concepts addressed. This part of the lesson is designed for groups of 2 students.

1. Distribute a TI-73 to each student.
2. Distribute **The Helper Dilemma** activity sheet to each student.
3. The students should perform the experiment and record results.
4. Use the facilitation questions when students need help.

Facilitation Questions – Explore Phase

- How does the calculator help you generate the data?
  Answers may vary. The probability simulator performs the trials for you.
- How is using the calculator more beneficial than actually flipping the coin and rolling the number decahedron?
  Answers may vary. The calculator may be more reliable since it takes out the human error factor.
- How is using the calculator less beneficial than using the objects to simulate the experiment?
  Answers may vary. Lead students in a discussion that batches of calculators are programmed to start at the same random generating point. The data collected may be less random than data simulated with the actual objects.
- What do you know about the problem?
  Answers may vary. Have students verbalize the parts of the problem they know.
- What do you need to know?
  Answers may vary. Have students verbalize the parts of the problem they need to know through questioning.
- Have you worked problems like this before?
  Answers may vary. Relate the problem to prior learning and prior experiences.

EXPLAIN

The teacher directs the Explain portion of the lesson to allow the students to formalize their understanding of the TEKS addressed in the lesson.

1. Debrief **The Helper Dilemma**.
2. Discuss notation for probability of compound events (i.e. P(head, one)).

Facilitation Questions – Explain Phase

- What is the difference between theoretical and experimental probability?
Answers may vary. Take this opportunity to review these topics.
- How were the experimental and theoretical probabilities the same?
Answers may vary. Depending on the experiment, some may say that the experimental probabilities were close to being equally distributed.
- How were the experimental and theoretical probabilities different?
Answers may vary. Depending on the experiment, some of the combinations may have occurred more than others. Possibly discuss at this time how Mrs. Alexander should keep track of who is helper so that when repeats occur, she knows to flip the coin and roll the number decahedron again.
- If the fractions were changed to percents, what would you expect the percents to total and why?
Answers may vary. Lead students to the understanding that the experiment is a whole event, so that the percents would add to 100% and the fractions to 1 whole.
- If Mrs. Alexander has more students enrolled in her class, how can she change or modify her procedure for finding a helper?
Answers may vary. Students may suggest that she use a number polyhedron with 12 sides. Some students may suggest that she flip a coin, roll the polyhedron and use a spinner with 3 or 4 sections. Some students may suggest that she use a deck of cards and assign each student a card from the deck.
- What can you conclude about the class where Mrs. Alexander assigned tails to girls and heads and prime numbers to boys?
Answers may vary. Not all of the combinations in the sample space will be used for this class. This class has more girls than boys since more combinations are assigned to girls than boys.
- How could Mrs. Alexander change or modify her procedure for finding a helper in this class to eliminate the extra combinations?
Answers may vary. Mrs. Alexander could use the coin and a bag of marbles with 4 different colors for the boys or a spinner with 4 equal sections.
- In a previous question you were asked, "If Mrs. Alexander has more students enrolled in her class, how can she change or modify her procedure for finding a helper?" If 3 items were used to find the helper, for example, a coin, a number polyhedron and a spinner, how would the results be affected?
Answers may vary. Discuss that a third item would increase outcomes.
- Do the items always have to yield equally likely results?
Answers may vary. Discuss with students that they do not. Have students give examples where the outcomes are not equally likely.
- Are there times when the technology made the task easier? Why?
Answers may vary. Some students may say that simulating the events using the calculator made the task easier.

Facilitation Questions – Explain Phase

- Are there times when the technology made the task more difficult? Why?
  Answers may vary. Some students may say recording the data into the lists and creating the graph would have been easier using only paper and pencil.

ELABORATE

The Elaborate portion of the lesson provides an opportunity for the student to apply the concepts of the TEKS to a new situation. This part of the lesson is designed for individual investigation.

1. Distribute a TI-73 calculator and **The Choir Helper** activity sheet to each student.
2. Have students should work individually to solve the problems using the calculator to help them.
3. Ask Facilitation Questions as needed.
4. Debrief by going over the worksheet.

Facilitation Questions – Elaborate Phase

- How do you use the calculator to help you?
  Possible answer: The calculator can be used to simulate the trials.
- How is this activity similar to **The Helper Dilemma**?
  Possible answer: Both activities used two items for simulation.
- How is this activity different?
  Possible answer: The sample spaces were different.
- How do you make predictions from results?
  Include a discussion here of scale factors. The simulation was for 50 trials, so to predict results for 100 trials use a scale factor of 2 (multiply by 2).
- How could you use a graph to show that the results for 50 trials, 100 trials, 250 trials, etc. are proportional?
  Answers may vary. Discuss with students that a graph could be made charting each individual outcome. For example, chart the results for P(tail, letter A) for 50 trials by letting the List 1 represent trials and the List 2 represent outcomes. Other outcomes for the same probability could be entered into the lists and then graphed. A discussion of the data points should follow. The points should appear to be in a straight line that would travel through the origin. Thus, the data is proportional.

EVALUATE

The Evaluate portion of the lesson provides the student with an opportunity to demonstrate his or her understanding of the TEKS addressed in the lesson.

1. Distribute **Simulation** activity sheet to each student.
2. Upon completion of **Simulation** activity sheet, the teacher should use a rubric to assess student understanding of the concepts addresses in this lesson.

Answers and Error Analysis for selected response questions:

Question Number	TEKS	Correct Answer	Conceptual Error	Conceptual Error	**Procedural** Error	Procedural Error	**Guess**
1	7.10B	D	A		C		B
2	7.11B	B	A	D			C
3	7.11A	A	B	C			D
4	7.10B	A	D		B	C	

The Helper Dilemma – (Possible Answers)

1. Use two TI-73 calculators to simulate the probability. Each student should hold a calculator. One calculator should be used to simulate the coin toss and the other used to simulate rolling a 10-sided number decahedron. Follow the instructions below to simulate the events with the calculators. Combine the results and place a tally mark in the frequency table below. Perform the experiment 40 times.

Coin Toss	Roll Dice
APPS 7: Prob Sim Press any key 2. Toss Coin Toss (Window)	APPS 7: Prob Sim Press any key 1. Roll Dice Set (Zoom) Sides: 10 OK (Graph) Roll (Window)

Combination	Tally	Frequency
Head, 1		
Head, 2		
Head, 3		
Head, 4		
Head, 5		
Head, 6		
Head, 7		
Head, 8		
Head, 9		
Head, 10		

Combination	Tally	Frequency
Tail, 1		
Tail, 2		
Tail, 3		
Tail, 4		
Tail, 5		
Tail, 6		
Tail, 7		
Tail, 8		
Tail, 9		
Tail, 10		

(continue: The Helper Dilemma)

2. Graph the data using the instructions below. Sketch the resulting graph.

Graph Data	Sketch graph here.
Enter the frequency data in L2 of the LIST feature. 2nd Plot (Y=) 1: Plot 1 On Type: Pie Chart Graph	*Graph will vary, but should match results in table.*

3. Find the experimental probability for each.
   Answers may vary experiment by experiment.

Combination	Experimental Probability
Head, 1	
Head, 2	
Head, 3	
Head, 4	
Head, 5	
Head, 6	
Head, 7	
Head, 8	
Head, 9	
Head, 10	

Combination	Experimental Probability
Tail, 1	
Tail, 2	
Tail, 3	
Tail, 4	
Tail, 5	
Tail, 6	
Tail, 7	
Tail, 8	
Tail, 9	
Tail, 10	

(continue: The Helper Dilemma)

4. How were the experimental and theoretical probabilities the same? Explain.
   Answers may vary. Depending on the experiment, some may say that the experimental probabilities were close to being equally distributed.

5. How were the experimental and theoretical probabilities different? Explain.
   Answers may vary. Depending on the experiment, some of the combinations may have occurred more than others. Possibly discuss at this time how Mrs. Alexander should keep track of who is helper so that when repeats occur, she knows to flip the coin and roll the decahedron again.

6. If the fractions were changed to percents, what would you expect the percents to total and why?
   Answers may vary. Lead students to the understanding that the experiment is a whole event, so that the percents would add to 100% and the fractions to 1 whole.

7. If Mrs. Alexander has more students enrolled in her class, how can she change or modify her procedure for finding a helper?
   Answers may vary. Students may suggest that she use a number polyhedron with 12 sides. Some students may suggest that she flip a coin, roll the polyhedron and use a spinner with 3 or 4 sections. Some students may suggest that she use a deck of cards and assign each student a card from the deck.

Use the following information to answer questions 8-13.

In one particular class, Mrs. Alexander assigned combinations with Heads and a prime number to only boys and combinations with Tails to only girls.

8. What is the sample space for this class?

Head, 1	*Head, 6*	*Tail, 1*	*Tail, 6*
Head, 2	*Head, 7*	*Tail, 2*	*Tail, 7*
Head, 3	*Head, 8*	*Tail, 3*	*Tail, 8*
Head, 4	*Head, 9*	*Tail, 4*	*Tail, 9*
Head, 5	*Head, 10*	*Tail, 5*	*Tail, 10*

9. What can you conclude about this particular class? Explain.
   Not all of the combinations in the sample space will be used for this class. This class has more girls than boys since more combinations are assigned to girls than boys.

10. Which gender is most likely to be the helper? Explain.
    A girl is most likely to be the helper since more combinations are assigned to girls than boys.

(continue: The Helper Dilemma)

11. What is the probability of a girl being the helper? Explain.

    There is a $\frac{1}{2}$ *chance of getting a tail and a* $\frac{10}{10}$ *chance of getting a number on the decahedron. Combine the probabilities using multiplication,* $\frac{1}{2}\cdot\frac{10}{10}$*, to get a* $\frac{10}{20}=\frac{1}{2}$ *chance of getting a girl helper.*

12. What is the probability of a boy being the helper? Explain.

    There is a $\frac{1}{2}$ *chance of getting a head and a* $\frac{4}{10}$ *chance of getting a prime number on the decahedron. Combine the probabilities using multiplication,* $\frac{1}{2}\cdot\frac{4}{10}$*, to get a* $\frac{4}{20}=\frac{1}{5}$ *chance of getting a boy helper.*

13. How could Mrs. Alexander change or modify her procedure for finding a helper in this class to eliminate the extra combinations? Explain.

    Answers may vary. Mrs. Alexander could use the coin and a bag of marbles with 4 different colors for the boys or a spinner with 4 equal sections.

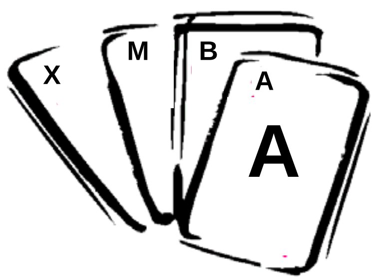
The Choir Helper – (Possible Answers)

The choir teacher, Mr. Roberts, heard Mrs. Alexander in the teacher's lounge describe her method for assigning a helper. He thought the idea would be a big help in his classes. Since his choir classes sometimes have between 45 and 50 students and no students can be assigned the same "code," Mr. Roberts cannot use the coin and 10-sided number decahedron. Mrs. Alexander gave Mr. Roberts 8 different items that he could use to assign helpers in his class.

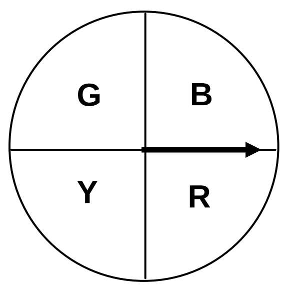
A Coin

A Six-Sided Number Cube

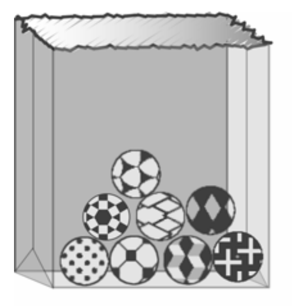
A 10-sided Number Decahedron with the numbers 1-10



A Set of Alphabet Cards A-Z

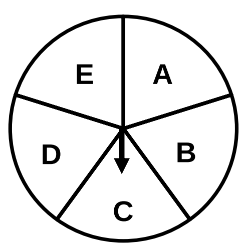


A Spinner



A Bag of 8 Different Marbles

A 12-sided Number Dodecahedron with the numbers 1-12



A Spinner

(continue: The Choir Helper)

1. Help Mr. Roberts pair the items together that he can use to assign helpers. There will be 4 pairs. Justify your reasoning for each pair made and tell how many assignments for helpers could be made from each pair.

   Pair 1: A bag of 8 marbles and the 6-sided number cube (48 assignments)

   Pair 2: The coin and set of Alphabet Cards (52 assignments)

   Pair 3: The spinner of colors and the 12-sided number dodecahedron (48 assignments)

   Pair 4: The spinner with letters and the 10-sided number decahedron (50 assignments)

2. Choose one of the pairs of items above and describe how to simulate the event using the calculator.

   Answers may vary experiment to experiment.

3. Use the plan outlined in #2 to simulate the event for 50 trials. Create a table to record the results.

   Answers may vary experiment to experiment.

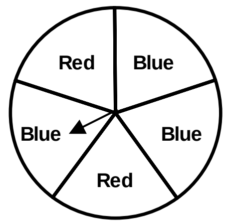
4. From the above results, predict the results if the event had been simulated for 100 trials.

   Answers may vary, but should include that the results in #3 should be multiplied by a scale factor of 2.

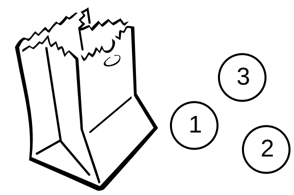
Simulation – (Possible Answers)

Use the following items to simulate an experiment.

A Coin



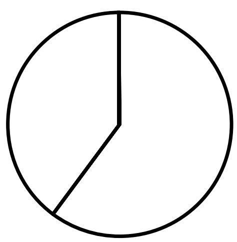
A Spinner



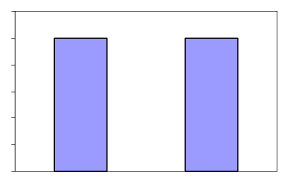
A Bag of 3 Marbles
Numbered 1-3

Which of the following graphs best represents the results of the experiment? Justify your reasoning.

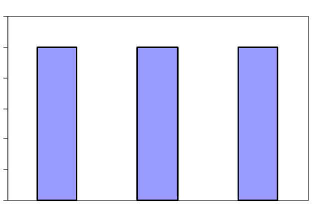
A.



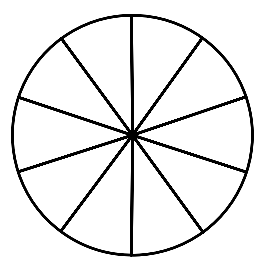
C.



B.



D.

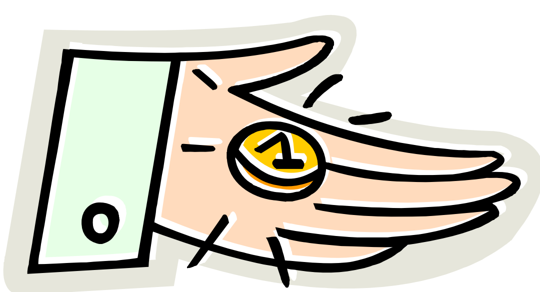


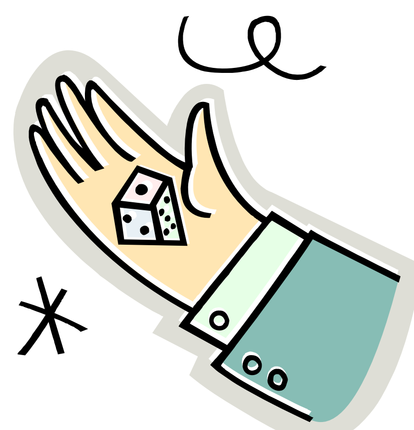
Answer: The graph in A best represents the experiment. In the experiment, the spinner has more blue than red. A circle graph representing the results of blue to red would show a larger section for blue.

Teacher Helper

Mrs. Alexander assigns the helping job in her class by flipping a coin and rolling a 10-sided number decahedron. Each student in her class is assigned a combination of a head or tail and a number from the decahedron. Students in the same class do not share the same combination.

- ❖ If all the possible combinations are assigned, how many students are in Mrs. Alexander's class?
- ❖ What are the possible combinations?





The Helper Dilemma

1. Use two TI-73 calculators to simulate the probability. Each student should hold a calculator. One calculator should be used to simulate the coin toss and the other used to simulate rolling a 10-sided number decahedron. Follow the instructions below to simulate the events with the calculators. Combine the results and place a tally mark in the frequency table below. Perform the experiment 40 times.

Coin Toss	Roll Dice
APPS 7: Prob Sim Press any key 4. Toss Coin Toss (Window)	APPS 7: Prob Sim Press any key 3. Roll Dice Set (Zoom) Sides: 10 OK (Graph) Roll (Window)

Combination	Tally	Frequency
Head, 1		
Head, 2		
Head, 3		
Head, 4		
Head, 5		
Head, 6		
Head, 7		
Head, 8		
Head, 9		
Head, 10		

Combination	Tally	Frequency
Tail, 1		
Tail, 2		
Tail, 3		
Tail, 4		
Tail, 5		
Tail, 6		
Tail, 7		
Tail, 8		
Tail, 9		
Tail, 10		

2. Graph the data using the instructions below. Sketch the resulting graph.

Graph Data	Sketch graph here.
Enter the frequency data in L2 of the LIST feature. 2nd Plot (Y=) 1: Plot 1 On Type: Pie Chart Graph	

3. Find the experimental probability for each.

Combination	Experimental Probability
Head, 1	
Head, 2	
Head, 3	
Head, 4	
Head, 5	
Head, 6	
Head, 7	
Head, 8	
Head, 9	
Head, 10	

Combination	Experimental Probability
Tail, 1	
Tail, 2	
Tail, 3	
Tail, 4	
Tail, 5	
Tail, 6	
Tail, 7	
Tail, 8	
Tail, 9	
Tail, 10	

(continue: The Helper Dilemma)

4. How were the experimental and theoretical probabilities the same? Explain.

5. How were the experimental and theoretical probabilities different? Explain.

6. If the fractions were changed to percents, what would you expect the percents to total and why?

7. If Mrs. Alexander has more students enrolled in her class, how can she change or modify her procedure for finding a helper?

Use the following information to answer questions 8-13.

In one particular class, Mrs. Alexander assigned combinations with Heads and a prime number to only boys and combinations with Tails to only girls.

8. What is the sample space for this class?

9. What can you conclude about this particular class? Explain.

10. Which gender is most likely to be the helper? Explain.

11. What is the probability of a girl being the helper? Explain.

(continue: The Helper Dilemma)

12. What is the probability of a boy being the helper? Explain.

13. How could Mrs. Alexander change or modify her procedure for finding a helper in this class to eliminate the extra combinations? Explain.

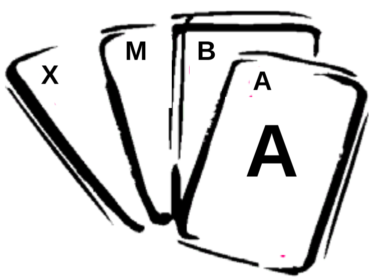
The Choir Helper

The choir teacher, Mr. Roberts, heard Mrs. Alexander in the teacher's lounge describe her method for assigning a helper. He thought the idea would be a big help in his classes. Since his choir classes sometimes have between 45 and 50 students and no students can be assigned the same "code," Mr. Roberts cannot use the coin and 10-sided number decahedron. Mrs. Alexander gave Mr. Roberts 8 different items that he could use to assign helpers in his class.

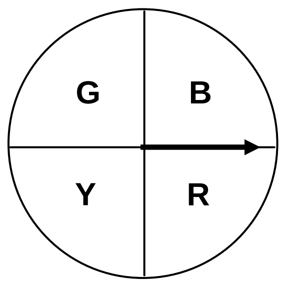
A Coin

A Six-Sided Number Cube

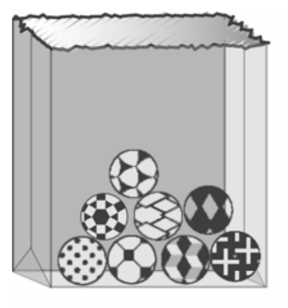
A 10-sided Number Decahedron with the numbers 1-10



A Set of Alphabet Cards A-Z

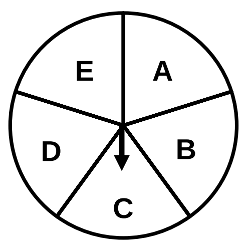


A Spinner



A Bag of 8 Different Marbles

A 12-sided Number Dodecahedron with the numbers 1-12



A Spinner

(continue: The Choir Helper)

1. Help Mr. Roberts pair the items together that he can use to assign helpers. There will be 4 pairs. Justify your reasoning for each pair made and tell how many assignments for helpers could be made from each pair.

2. Choose one of the pairs of items above and describe how to simulate the event using the calculator.

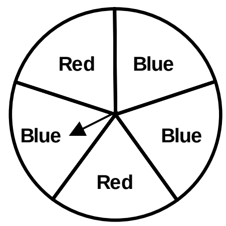
3. Use the plan outlined in #2 to simulate the event for 50 trials. Create a table to record the results.

4. From the above results, predict the results if the event had been simulated for 100 trials.

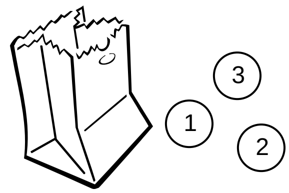
Simulation

The following items are being used to simulate an experiment.

A Coin



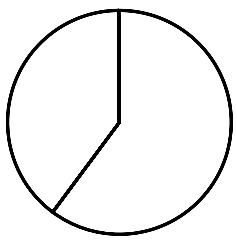
A Spinner



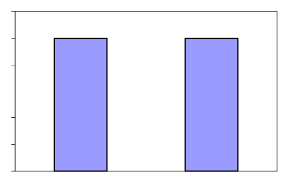
A Bag of 3 Marbles
Numbered 1-3

Which of the following graphs best represent the results of the experiment? Justify your reasoning

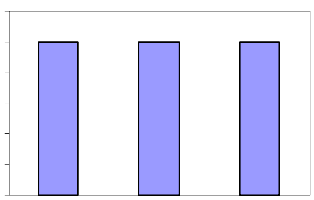
A.



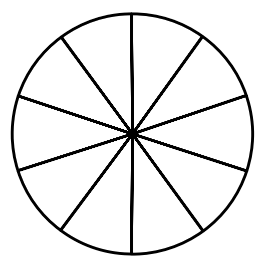
C.



B.



D.



1. Corbyn has a standard code of dress at his school. He can wear a white or green shirt with navy or khaki pants. He had 3 white shirts and 2 green shirts in his shirt drawer and 1 pair of navy pants and 3 pairs of khaki pants in his pants drawer. What is the probability that Corbyn will reach in both drawers, without looking, and get a white shirt and navy pants?

   A $\frac{17}{20}$

   B $\frac{4}{9}$

   C $\frac{3}{25}$

   D $\frac{3}{20}$

2. A 6-sided number cube, a spinner divided into 3 equal parts labeled A, A, B, and a coin are used for an experiment. Ozzie calculated the theoretical probability of an event where the number cube was rolled, coin tossed, and spinner spun. His calculation was $\frac{1}{3} \cdot \frac{1}{2} \cdot \frac{2}{3} = \frac{2}{18} = \frac{1}{9}$. For which of the following events did Ozzie calculate the probability?

   A P(even number, head, B)

   B P(1 or 2, head, A)

   C P(prime number, tail, A)

   D P(odd number, tail, A)

3. The letters of the word WINNER are cut apart and placed in a bag. A letter was drawn from the bag and a coin tossed at the same time. Results were recorded and the letter was placed back into the bag. Which of the following could NOT be used to represent the experimental data?

   A Venn diagram

   B Bar graph

   C Circle graph

   D Line Plot

4. A container of markers containing 3 red, 1 yellow, 2 green and 4 blue are placed at the map center in social studies. The rule is you can only use one marker at a time so that everyone will have a marker to use. What is the probability of reaching into the container without looking for each use and getting a red marker, a blue marker and then a yellow marker?

   A $\frac{3}{250}$

   B $\frac{12}{30}$

   C $\frac{12}{100}$

   D $\frac{8}{10}$

Mathematics

8.12 The student uses statistical procedures to describe data. The student is expected to:

(A) select the appropriate measure of central tendency or range to describe a set of data and justify the choice for a particular situation.

(C) select and use an appropriate representation for presenting and displaying relationships among collected data, including line plots, line graphs, stem and leaf plots, circle graphs, bar graphs, box and whisker plots, histograms, and Venn diagrams, with and without the use of technology.

Technology Applications

The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to:

(1)(a) demonstrate knowledge and appropriate use of operating systems, software applications, and communicate and networking components.

(1)(c) demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency.

(1)(f) perform basic software application function including, but not limited to, opening an application program and creating, modifying, printing, and saving documents.

The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to:

(7)(a) plan, create, and edit documents created with a word processor using readable fonts, alignment, page setup, tabs, and ruler settings.

(7)(b) plan, create, and edit spreadsheet documents using all data types, formulas and functions, and chart information.

(7)(e) create a document using desktop publishing techniques including, but not limited to, the creation of multi-column or multi-section documents with a variety of text-wrapped frame formats.

(7)(g) integrate two or more productivity tools into a document including, but not limited to, tables, charts, and graphs, graphics from paint or draw programs, and mail merge.

The student formats digital information for appropriate and effective communication. The student is expected to:

10)(a) use productivity tools to create effectiveness document files for defined audiences such as slide shows, poster, multimedia presentations, newsletters, brochures, or reports.

(11)(a) publish information in a variety of ways including, but not limited to, printed copy, monitor display, Internet documents, and video.

Materials

Advanced Preparation:

- Pre-cut **TEAM CARDS**, enough for one card per group of 2-3 students
- Copies of **Paper Hockey Puck** Directions, **Go Team!**, (optional) **Purple or Orange**, and **Pure Gold** worksheets
- Access to spreadsheet and large monitor or projector/screen for demonstrations
- Access to **GoTeam** and **PureGold** spreadsheet file for each student or pair of students if there is not enough technology available
- Access to a word processor and/or presentation software for each pair of students and **Purple or Orange** file

For each student:

- **Go Team!** and (optional) **Purple or Orange** worksheets
- **PureGold** worksheet

For each student group of 2 -3 students:

- Blank paper or large index cards, one per student
- One **Paper Hockey Puck Directions**, scissors, and one tape measure
- One **TEAM CARD** and one sheet of chart paper, markers

ENGAGE

The Engage portion of the lesson is designed to create student interest in the concepts addressed. This part of the lesson is designed for groups of 2-3 students and then whole group instruction.

1. In small groups, direct the students to take turns flicking a paper hockey puck so that it glides along the surface of the table, measuring the distance traveled (to the nearest inch), and writing that amount with a marker on a blank sheet of paper (or large index card) until each student in the group has a measurement. (Students may design their own paper hockey pucks or use the **Paper Hockey Puck Directions** handout.)

Facilitation Questions

- (Before conducting the activity of flicking the hockey puck) What factors involved in the actual flicking of the hockey puck and measurement of the distance should we standardize for consistency?
  Answers may vary. Factors may include how you made the hockey puck, how you hold the hockey puck, starting points, surface on which you are flicking the hockey puck, method of flicking the hockey puck, measuring tools, etc.

Facilitation Questions

- Why should we be concerned with consistency in the way we collect our data? In other words, how might inconsistency affect the validity of our results?
  We need to limit the number of variables (factors that may differ) for each event in order to compare distances made when all other factors were the same/controlled. For example, results might be skewed if one group flicked their hockey puck across carpet, and others flick theirs across a slick table.

2. Once each student in the group has recorded his/her measurement, have students line up in numeric order around the room based on the distance traveled by their hockey puck.

Facilitation Questions

- How did you (or how might you) represent the fact that two or more students may have had the same measurement?
  Stand behind each other in one spot
- How did you (or how might you) represent the proportional distance between the values of your distances?
  Consider themselves as a human number line…proportionally spacing the values.

3. Prompt students to determine the median, mode, and range of their data without technology. Record these statistics on a sheet of chart paper or overhead projector for all to see. Have all students return to their seats.

Facilitation Questions

- How did you (or how might you) determine the median of your data without technology? What impact does the spread of the data have on the value of the median? What is the significance of this value?
  Answers may vary. Students could count off from each end of the line to find the middle of their line (median), averaging the values should there be two students in the middle. You might have students raise their hands if their value is above the median, and then do the same for those below the median…to demonstrate that this is a "middle" value. This middle value is not affected by extreme values (outliers) on either end of the data. In this example, it would not be affected by distances that were significantly lower or higher than the rest of the group.

Facilitation Questions

- How did you (or how might you) determine the mode of your data without technology? What is the significance of this value?
  Answers may vary. Students could look for where they have students with the same values lined up behind each other (if any). If a set of data has a mode, it indicates that there is a value that occurred multiple times. In this example, this measure of central tendency may not be the best representative of the data unless there is a measurement that occurs many more times than the others.
- How did you (or how might you) determine the range of your data without technology? What is the significance of this value?
  Answers may vary. Students could have the students on each end of the line (highest and lowest) find the difference in their measurements. The range helps to describe the spread of the data. In this example, it would tell us if the distances achieved were about the same, or if some students were able to flick for distances that were much longer than others.

4. Input the data into a blank spreadsheet file (using a large monitor or projector for viewing) and demonstrate using formulas to calculate the median, mode, and range.
   - To find median: =median (highlight range of cells with data)
   - To find mode (*If there is more than one mode, Excel returns the smallest mode*): =mode (highlight range of cells with data)
   - To find range: =max (highlight range of cells with data) – min (highlight range of cells with data)
5. Prompt the students to estimate the mean. Verify the estimate using the spreadsheet. To find mean: =average (highlight range of cells with data)
6. Add this statistic to the sheet of chart paper or overhead for all to see.
7. Have students return to their original number line position.
8. Direct the students to form a human histogram.

Facilitation Questions

- How might you organize yourselves to create a histogram?
  Students in each group should stand behind each other, forming a line ("bar") for each group/range of data.
- What ranges would be appropriate for the bars in our histogram?
  Answers may vary based on the data.
- What conjectures can we make based on the spread of the data within this human histogram? In other words, what do we notice about the "shape" of the data?
  Answers may vary. Based on the actual spread of the data, students should notice clusters and/or gaps in the spread of the data.

Facilitation Questions

- What kind of information was “lost” when we grouped students together to form the human histogram?
  While we know the number of pieces of data in each group, we do not know where in the range for each group the data lies. For example, if there are 5 values within a range of 20 to 30 inches, they could all be closer to 20 inches, 30 inches, or spread throughout the range.

9. Direct the students to form a human box and whisker plot by asking the following questions.
   a. What was the value of our median? (Identify that person or point between two persons if there is an even number of data points.)
   b. Raise your hand if your value is above the median or, in other words, if you are in the upper half of the data? (Once you agree that you have the upper half with their hands raised, ask the lower half to sit on the floor and the upper half can put their hand down.)

   sitting standing

   x x x x x x x x x x x x x x X X X X X X X X X X X X X X

   c. Raise your hand if you are above the median of those standing, in other words, if you are in the upper half of the upper half of the data? (Once you agree that you have the upper half with their hands raised, ask the upper-upper half to sit on the floor and the lower-upper half to kneel.)

   sitting kneeling sitting

   x x x x x x x x x x x x x x X X X X X X X X X X X X X X

   d. Repeat the procedure to find the upper half of the lower half. Ask the lower - lower half to sit and the upper - lower half to remain standing. Ask the lower - upper half to now stand.

   sitting standing standing sitting

   x x x x x x x X X X X X X X X X X X X X X x x x x x x x

10. Inform the students that they will create histograms and box and whisker plots using technology in the next activity. They will use this “human” version to help understand what is happening “behind the scenes” as the technology creates the graphs.

Facilitation Questions

- How would you describe the data for the group of students still standing? What is the significance of this group?
  Answers may vary. Students should note that those standing represent the middle half of the data. Essentially this is the middle group that ignores (does not include) the highs and the lows (outliers).

11. Prompt students to return to their seats.

EXPLORE

The Explore portion of the lesson provides the student with an opportunity to be actively involved in the exploration of the mathematical concepts addressed. This part of the lesson is designed for groups of 2-3 students initially and moving to pairs or individual investigation.

1. Divide the class into groups (teams) of 2-3 students each.
2. Give each group a **TEAM CARD** with a list of numbers that represents the number of hits last season by each person on a particular baseball team. (Duplicate sets of data will be distributed to promote comparing/contrasting comments later in the activity.)
3. Ask each group to calculate the mean (average) of the number of hits their team had last season.
4. Prompt each group to write their team name, list of hits, and the mean on a piece of chart paper.

Facilitation Questions

- What do you notice about each team?
  The mean is the same for each team.
- If all three teams had the same mean (average) number of hits last season, what other statistical measures might you examine in order to distinguish between the teams?
  Answers may vary. Lead students to classify teams by measurements such as median, mode, range or the spread of the data.

5. Prompt students (or pairs of students if there is not enough technology available) to open the spreadsheet **GoTeam**. Point out that there are four “worksheets” within the file (Blue Team, Green Team, Red Team, Graphs). Have students click on the various tabs toward the bottom of the screen to become familiar with moving between the pages.
6. Distribute the **Go Team** worksheet. (Include the optional page where students may record a summary of their spreadsheet work to each student, if printing capabilities are not available.) If printing student spreadsheets is an option, wait to distribute this worksheet until step 11.
7. In the **Blue Team** worksheet (spreadsheet), ask the students to fill in the number of hits (using the chart paper/Team Card) for each of the 16 players (in any order) in the light yellow cells (B7 – B22).

Facilitation Questions

- How will the order in which you input the data affect the calculations of central tendencies by the technology?
  Answers may vary. One benefit of using technology to calculate central tendencies is that order of input does not matter. This would be especially helpful if there were a large number of data points.

8. Once the data has been entered in cells B7-B22, students must sort the data in order for the box and whisker plot to graph correctly. (*Excel uses a different formula to find the lower and upper quartiles than the state will use to assess students. To make the box and whisker plot match the state expectations, certain formulas were entered into the spreadsheet. These formulas will only work if the data is sorted in ascending order.*)
9. Guide the students through inserting the statistical formulas in the light yellow cells in column F. (NOTE: Formula hints will be visible when the cursor is over that cell.)
10. Prompt the students to input the data and formulas for the Green Team and the Red Team, in order for the technology to generate the remaining histograms and box and whisker plots.
11. Distribute the **GoTeam** worksheet with questions 1 – 7 to each student.
12. Prompt the students to use the Graphs worksheet to help them answer the 7 questions on the **Go Team** worksheet.
13. Question #7 will be addressed further in the “Explain” phase.

EXPLAIN

The Explain portion of the lesson is directed by the teacher to allow the students to formalize their understanding of the TEKS addressed in the lesson.

1. Debrief the concept of median using the following questions.

Facilitation Questions

- The median is also referred to as the 50th percentile. Why is this?
  50th percentile refers to the value such that, if the data points are sorted from least to greatest, 50% of the data points are less than this value and 50% of the data points are greater than this value.
- Where is the median in your data list? How many values are less than the median and how many are greater than the median?
  The median is 50 hits. There are 8 players with fewer than 50 hits, and 8 players with more than 50 hits.

Facilitation Questions

- If the median of the entire group is the 50th percentile, what is the significance of the 25th percentile? How many values are less than the 25th percentile? How many values are greater than the 25th percentile?
  This is the median of the lower half of the data. 25% of the data points are less than this value, leaving 75% of the data points to be greater than this value. In this case there are 4 values below the 25th percentile and 12 values above the 25th percentile.
- If the median of the entire group is the 50th percentile, what is the significance of the 75th percentile? How many values are less than the 75th percentile? How many values are greater than the 75th percentile?
  This is the median of the upper half of the data. 75% of the data points are less than this value, leaving 25% of the data points to be greater than this value. In this case there are 12 values below the 75th percentile and 4 values above the 75th percentile.
- What is the statistical significance of the median of any group of data? In other words, why does knowing the median of a group of data give us more information than just knowing the average (mean)?
  The median represents the "middle" of the data, once the data has been ordered. Since the value of the median is a result of position alone, it is not affected by outliers, whereas even one or two outliers (data points that are significantly higher or lower than the rest of the data) might skew the mean.
- How is this discussion of median versus mean related to the data we have on the number of hits for each player on a team?
  The median number of hits is the value that represents the number of hits that is in the "middle" once the values have been ordered. Since this value is based on position alone, it is not as likely to be affected should certain players suddenly have more or less hits.

2. Using a large monitor or projector/screen for viewing, demonstrate how the median is not affected by outliers.

Facilitation Questions

- Since the median and mean numbers of hits for the Blue team are close to the same values (50 and 50.7 respectively), which would change the most if your best hitter was traded for someone with 500 hits? Justify your prediction.
  Answers may vary. The median would not change because the data points would not change in position if the largest value is exchanged for an even larger value. The mean would change more because there would be a larger total number of hits, therefore a larger average when those hits were divided out among the players. Type "500" in place of the "120" in the computer and note the lack of change in the median and the significant change in the mean.

Facilitation Questions

- With this exchange of players, does the median (50) or the mean (74.4) better describe the data for the team? Justify your selection.
  The median is a better descriptor of the data. Justifications may vary, but students should note that there are very few players on the team that are hitting at or above the mean, while there are still one-half of the players hitting at or above the median (and the other one-half hitting at or below the median).
- How is having the data in the computer helping us justify our thoughts about referring to medians versus means?
  Answers may vary. As we are changing values, the computer instantaneously recalculates the central tendencies so that we can focus our discussion on the meaning and significance of each value, without having to get "bogged down" in the recalculations.
  NOTE: Ensure that students return the "500" value to "120" before proceeding.

3. Prompt the students to explain how the median is reflected in each graphical representation on the **Graphs** worksheet.

Facilitation Questions

- How is the median represented in each of the histograms on the **Graphs** worksheet?
  The median value is contained within the bar representing the group of data on the "41 – 60" bar on each histogram.
- If you did not know the value of the median from the list of data, how could you determine it from the histogram?
  By counting frequencies for each bar, you would be able to narrow it down to the appropriate bar, but you would not be able to identify the exact median from the histograms alone.
- How is the median represented in each of the box and whisker plots on the **Graphs** worksheet?
  The median value is represented by the line within the box on each box and whisker plots.
- If you did not know the value of the median from the list of data, how could you determine it from the box and whisker plot?
  By looking at the position of the line within the box and the number line associated with the plot, you could find the value of the median.

4. Prompt the students to make conjectures about the mean, given the median and the shape of the data in the graphical representations.

Facilitation Questions

- If you had to make an estimate of the mean (average) number of hits, would you rather base your estimate on the histogram or the box and whisker plot? Justify your answer.

  Answers may vary. In box and whisker plots, it is easy to estimate the median and then make conjectures about the value of the mean based on the shape of the data around the median. Because of grouping data in ranges on the histogram, it may make the median harder to pinpoint, therefore making it more difficult to determine the relationship between the mean and median.
- Knowing that the mean number of hits for each team is about 50.7, explain why this value "makes sense" based on what you know about the median and the shape of the data in the box and whisker plot.

  Possible answers:
  Blue team – One might estimate that the value of the mean would be fairly close to the value of the median since the shape of the data in the box and whisker plot indicates that the data on either side of the median is somewhat evenly spread…possibly skewing just a little above the median since there is a little bit larger spread in the data above the median than in the data below the median. You can see this by noting that the right whisker on the box and whisker plot is longer.
  Green team- Similar to the discussion about the Blue team, but this time the data below the median is more spread out, leading you to estimate that the mean is a little less than the median.
  Red team – While the right whisker is longer than the left, the size of the box to the right of the median indicates that those values are very close to the median. Looking at the spread of the data to the left of the median, one could determine that since these values tend to be farther from the median, the mean would be less than the median.

5. Debrief the concept of range by asking the following Facilitation Questions.

Facilitation Questions

- What is the statistical significance of the range of any group of data? In other words, why does knowing the range of a group of data give us more information than just knowing the average (mean)?
  The range is the difference between the maximum and minimum values in a set of data. The range gives you an idea of the spread of the data. The smaller the range, the closer the values of the data points are to each other. As the range increases, so does the spread between the values of the data points.
- How is this discussion of range related to the data we have on the number of hits for each player on a team?
  The range in numbers of hits for a team will help us distinguish between teams where the number of hits for the players are more consistent (closer together) and teams where they are not as consistent (some players have significantly more hits than other players on the same team).

6. Prompt the students to make conjectures about the range, given the shape of the data in the graphical representations.

Facilitation Questions

- Would you feel more confident estimating the range of a set of data from a histogram or a box and whisker plot? Justify your answer.
  Because some values might get "lost" in the bars at the extremes of the histogram, it is sometimes difficult to closely estimate the range given only this graphical representation…but you can determine a "ballpark" range.
- How is the range reflected in each of the histograms on the **Graphs** worksheet ?
  Blue team - While looking at the histogram alone you could only estimate the range to be between 81 and 120, an exact range can be seen on the box and whisker plot by comparing the ends of the whiskers.
  Green team - While looking at the histogram alone you could only estimate the range to be between 41 and 80, an exact range can be seen on the box and whisker plot by comparing the ends of the whiskers.
  Red team - While looking at the histogram alone you could only estimate the range to be between 81 and 120, an exact range can be seen on the box and whisker plot by comparing the ends of the whiskers.

7. Debrief the concept of mode using the following questions.

Facilitation Questions

- Why does knowing the mode of a group of data give us more information than just knowing the average (mean)?
  The mode is the data point with the greatest frequency. If a set of data has a mode, it tells you which value was most common. Depending on the frequency, the value of the mode may or may not impact the mean.
- How is this discussion of mode related to the data we have on the number of hits for each player on a team?
  The mode in numbers of hits for a team only tells us if a particular number of hits occurs more often than others. In this case, it would not be uncommon for a set of data to have no mode because there are so many possibilities for numbers of hits.
- If you did not know the value of the mode from the list of data, how could it be determined from the histogram or box and whisker plot alone?
  The specific mode is not evident on either representation.

8. Prompt the students to make conjectures about any outliers or clusters, given the shape of the data in the graphical representations.

Facilitation Questions

- For each team, are there any outliers or clusters of data? If so, how are they represented in the histogram and box and whisker plot?
  Possible answers:
  Blue Team – Two players have a significantly higher number of hits (110 and 120) as seen by the gap in the histogram and the long right whisker on the box and whisker plot. According to the histogram, only one player falls within the range including both the mean and median, leading you to believe the data is spread out.
  Green Team – Both the histogram and box and whisker plot show that the vast majority of the players have numbers of hits close to both the mean and median. According to the box and whisker plot, the "middle half" of the data is compressed between the upper 40s and 60, leading you to believe that the numbers of hits for those players are very close together.
  Red Team – While the numbers of hits for players are not as tight around the mean and median as the green team, there are still many players clustered within the upper 30s and 60.

9. To answer question #7 on their **Go Team** sheets, prompt the students to use what they know about the central tendencies and range, as well as the graphical representations to explain which team you would like to join.

Facilitation Questions

- Now that we have explored these graphical representations further, think about your response to #7 on your **Go Team** worksheet. If you had the opportunity to join any of these teams for next season, which would it be? Explain.
  Answers may vary. Look for explanations that use the data as their justification such as--
  The Blue and Red Teams both have players having more than 100 hits.
  The Red Team has the highest median.
  The Green Team has more consistency between players when it comes to number of hits.
  The Blue Team has a number of players hitting well above the median.

ELABORATE

The Elaborate portion of the lesson provides an opportunity for the student to apply the concepts of the TEKS within a new situation. This part of the lesson is designed for pairs of students.

1. Pair up the students, to foster student conversation and extend their thoughts as they interpret graphical representations.
2. Direct each pair of students to open **Purple or Orange** with their word processor. NOTE: They need the file copy (not just a hard copy) in order to have the ability to cut and paste the graphical representations in their newsletter or slide show. *(Optional) Distribute a hard copy of the* ***Purple or Orange*** *file to each student for reference.*
3. Prompt students to summarize the directions for the task, giving them additional directions on how to name and save their newsletter or slide show.
4. When half of the work time remains, have the student pairs go on a quick (5 - 10 minutes) “spy mission.” (For each pair, one student will stay with the work/computer to share their work/thoughts with others, and the other will visit with other students to “compare notes” and possibly hear a different point of view or get a technology tip. The pairs will reunite and continue their work on their newsletter or slide show.)
5. After the students have completed the “spy mission,” prompt students to defend their answer to #5 to the whole group.

Facilitation Questions

- What evidence is there in the graphical representation(s) to defend your position?
  Answers may vary.
- If the data point of 100 hits was added, what change (if any) would you notice in the graphical representation(s)?
  Answers may vary.
- If you could call the front office of either team, what question(s) might you ask to help you get a better understanding of the data? In other words, what do you wish you knew that you either don't know or are not sure of based on the graphical representation(s) alone?
  Answers may vary.

6. Allow each pair of students a short amount of time to make adjustments to their newsletter or slide show based on information they gained from the whole group discussion.
7. Upon completion of the **Purple or Orange** activity, the teacher should use a rubric to assess student understanding of the concepts addressed in this lesson.

EVALUATE

The Evaluate portion of the lesson provides the student with an opportunity to demonstrate his or her understanding of the TEKS addressed in the lesson.

1. Distribute the **Pure Gold** activity sheet to each student.
2. Clarify the location of and saving procedure for the **PureGold** spreadsheet.
3. Upon completion of the **Pure Gold** activity sheet, the teacher should use a rubric to assess student understanding of the concepts addressed in this lesson.

Answers and Error Analysis for selected response questions

Question Number	TEKS	Correct Answer	Conceptual Error	Conceptual Error	Procedural Error	Procedural Error	Guess
1	8.12(C)	B	A	D	C		
2	8.12(C)	C	A	B			D
3	8.12(A)	D	A	B	C		
4	8.12(C)	A	C	D	B		

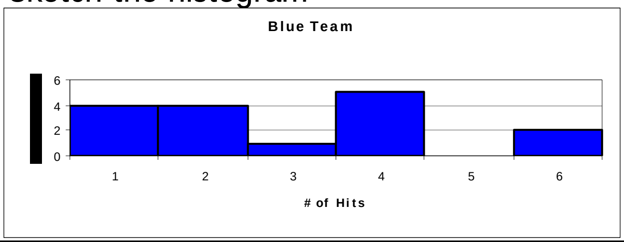
Box and Whisker Plot and Histogram Spreadsheet

Team Stats
(Give this page to students if printing their spreadsheet is not an option)
See GoTeam-Key spreadsheet.

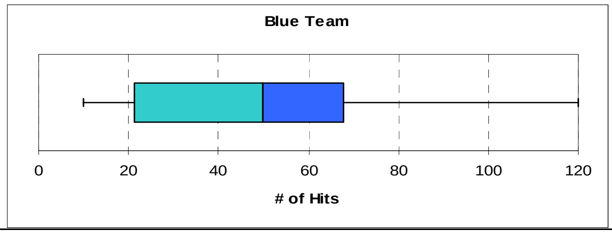
BLUE TEAM

Minimum:	*10*	Mean:	*50.7*	25th %-tile:	*19.5*
Maximum:	*120*	Mode:	*10*	Median:	*50*
Range:	*110*			75th %-tile:	*69.5*

Sketch the histogram



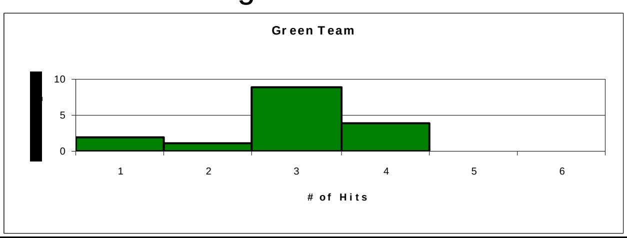
Sketch the box and whisker plot



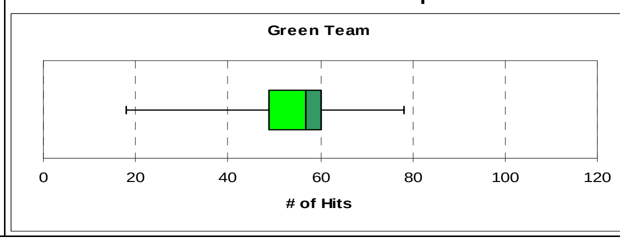
GREEN TEAM

Minimum:	*18*	Mean:	*50.7*	25th %-tile:	*48.5*
Maximum:	*78*	Mode:	*57, 61*	Median:	*57*
Range:	*60*			75th %-tile:	*60.5*

Sketch the histogram



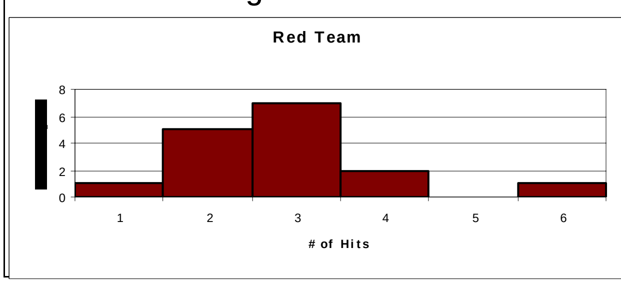
Sketch the box and whisker plot



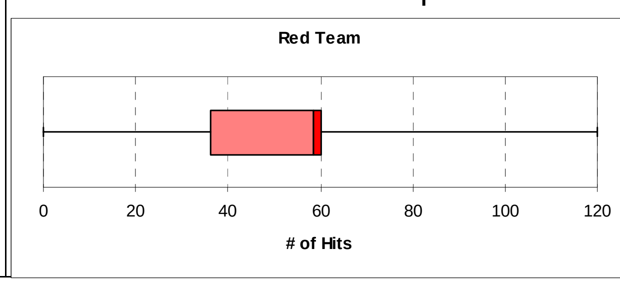
RED TEAM

Minimum:	*0*	Mean:	*50.7*	25th %-tile:	*34.5*
Maximum:	*120*	Mode:	*60*	Median:	*58.5*
Range:	*120*			75th %-tile:	*60*

Sketch the histogram



Sketch the box and whisker plot



Go Team!

Use the terms in the word bank below to complete the statements about the statistics and graphic representations in your spreadsheet. Each term can be used only once.

median	Red	mode	Blue
Green	range	outlier	mean

1. The box and whisker plot of the ***Red*** Team has the longest whisker. This is usually an indication that the set of data contains at least one ***outlier*** .

2. The ***mode*** of the data is the central tendency for which the graphic representations give us the least information.

3. The graphic representation with the smallest box (on the box and whisker plot) or with the middle bars significantly taller than the outer bars (on the histogram) for the ***Green*** Team reflects the fact that the number of hits for many of the players on that team is close to the ***median***.

4. While the data for each of the three teams is very different, the ***mean*** number of hits is the same for all.

5. The ***Blue*** and Red Teams both have players with more than 100 hits.

6. The ***range*** of the number of hits was the smallest for the Green Team.

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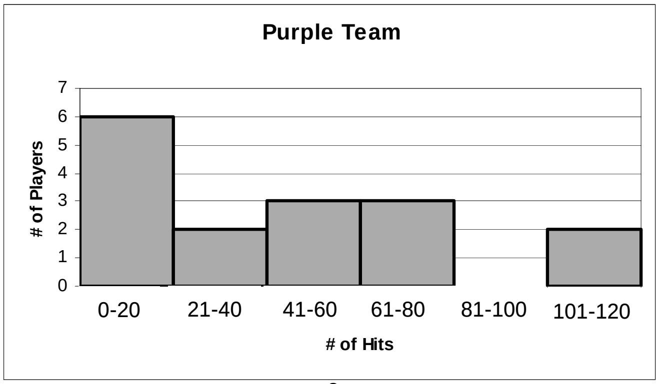
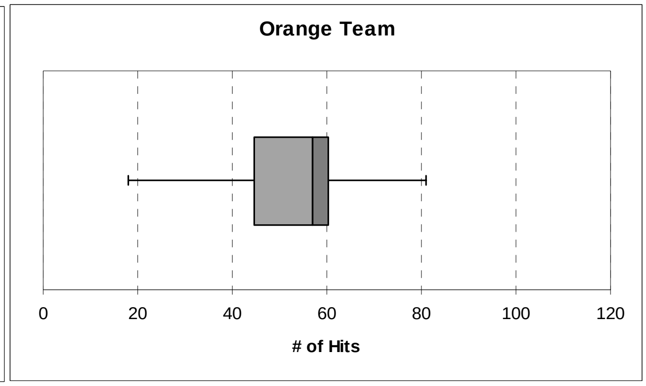
7. If you had the opportunity to join any of these teams for next season, which would it be? Explain using statistics and/or the graphical representation(s) to justify your selection.
   Answers may vary.

Purple or Orange? (hard copy of Microsoft Word file)

Below are graphical representations of the number of hits last season by members of the Purple and Orange teams.





Hard Hitting Harold (H^3 for short) has offers to join either the Purple team or the Orange team. H^3 had 100 hits last season.

As a local sports reporter, you have received the task of analyzing the impact for each team, should H^3 join either the Purple or the Orange team. You must base your analysis on what you can gather from the graphical representations you have received.

Use either a word processor to create a newsletter or presentation software to create a slide show that will communicate your interpretations. Copy and paste the graphical representations into your newsletter or slide show and use the drawing tools to help make your points.
Your newsletter or slide show should answer the following questions.

1. From the given graphical representations, what do you know about the spread of the data (numbers of hits per player) for the Purple team? for the Orange team? (Include a “discussion” of any clusters, gaps, and/or outliers.)
   Answers may vary. Purple…spread between 0 and 120 with half below 41 and a couple of outliers between 101 and 120. Orange…middle half clustered between about 45 and 60…overall spread between about 18 and 81.

2. Should H^3 join the team, how would his number of hits (100) impact the current spread of the data for the Purple team? for the Orange team?
   Answers may vary. Purple…would appear to fill the 81-100 gap in the histogram, but is just one hit away from being included in the 101-120 group. Orange…would increase the overall spread of the data since the current maximum is around 81…would likely be an outlier, almost 20 greater than the current maximum.

3. From the given graphical representations, what do you know about the current range, median, and mean number of hits for the Purple team? for the Orange team?
Answers may vary. Purple…range is somewhere between 80 (20 to 101) and 120 (0 to 120)…median falls between the highest value in the 21-40 bar and the lowest value in the 41-60 bar…mean is likely higher than the median as a result of the outliers over 100. Orange…range is just over 60…median is around 57…mean will likely be less than the median due to the larger spread (not number of data points) of the data below the median

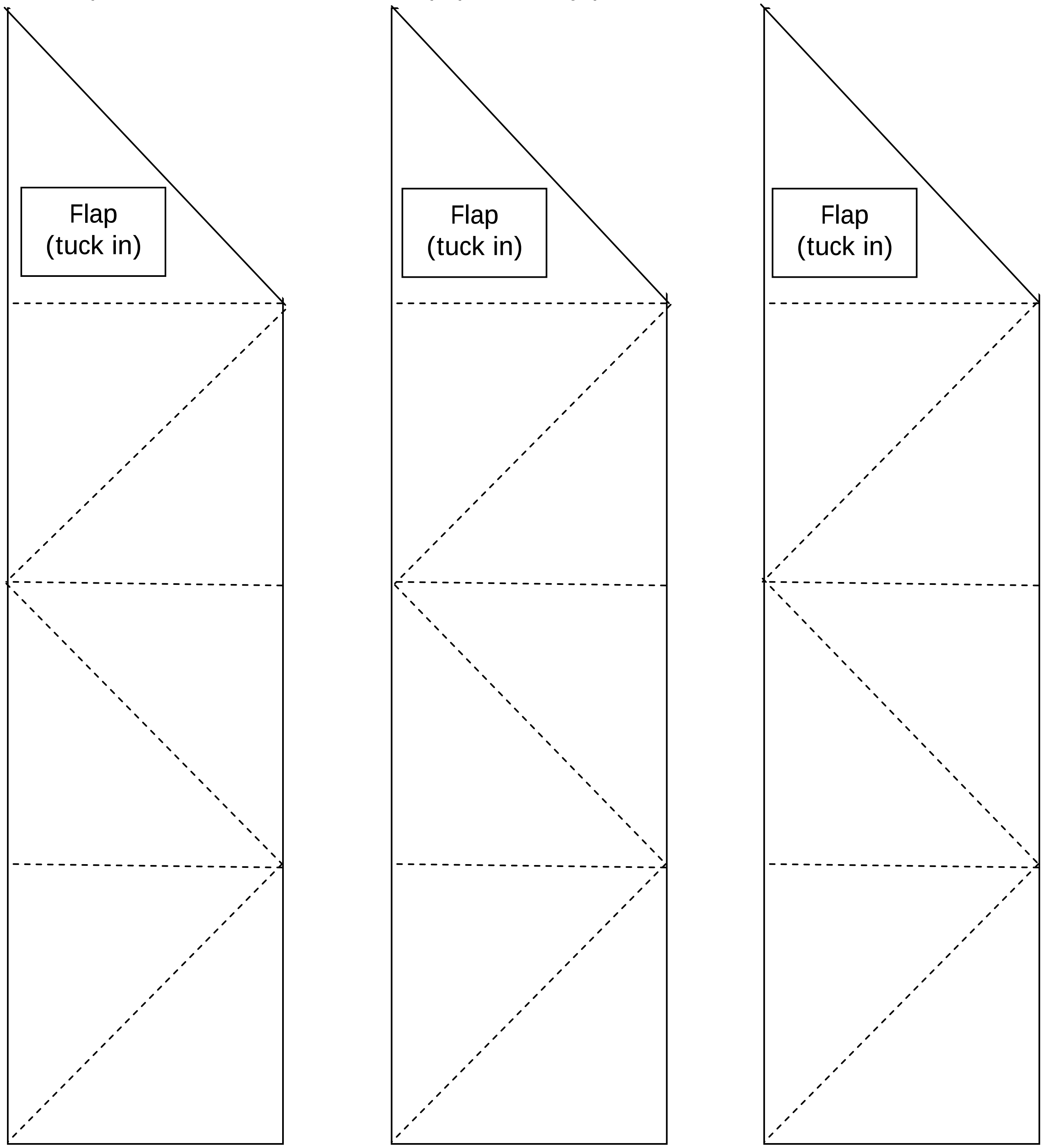
4. Should H^3 join the team, what would be the impact on the range, median, and mean number of hits for the Purple team? for the Orange team? *Answers may vary. Purple…will not change the range…will likely increase the median and mean (although hard to say by how much because of the ranges within the bars) because it is greater than both. Orange…will increase the range by around 20,,,will likely increase the median and mean because it is greater than both (probably the mean more than the median since the 100 is significantly greater than the current maximum)*

5. In your opinion, which team would benefit the most from having H^3 join their team?
Answers may vary. One could make a case for the Purple team since the 100 would begin to fill in the current gap and/or help to balance against those with very few hits, while the Orange team would gain a player with significantly more hits than the rest of their players, therefore increasing their average number of hits. Accept students' opinions if they can support that opinion with interpretations of the statistics.

6. As an added note or disclaimer, compare and contrast the amount and type of information you were able to get from the histogram versus the box and whisker plot when you addressed questions #1 and 3. What information might you get from a histogram that you would not get from a box and whisker plot? What information might you get from a box and whisker plot that you would not get from a histogram?
Answers may vary. Both help us to see the spread in the data. Since histograms often have more than 4 groupings (6 in this case), gaps and outliers may be more evident. Box and whisker plots, on the other hand, often allow you to estimate the median and range better.

PAPER HOCKEY PUCK DIRECTIONS

Cut out, fold on the dotted lines, and tuck in the flap. (It will form a right triangle when folded.) Each student will need one paper hockey puck.



Use your thumb and pointer of one hand to hold the triangle vertically by the vertices on either side of the hypotenuse. Use your other hand to flick the triangle (hockey puck).

TEAM CARDS

Blue Team	Blue Team
10, 120, 15, 16, 23, 27, 66, 39, 40, 60, 10, 61, 64, 73, 77, 110	10, 120, 15, 16, 23, 27, 66, 39, 40, 60, 10, 61, 64, 73, 77, 110
Green Team	**Green Team**
20, 51, 21, 78, 48, 49, 50, 57, 18, 57, 58, 59, 60, 61, 63, 61	20, 51, 21, 78, 48, 49, 50, 57, 18, 57, 58, 59, 60, 61, 63, 61
Red Team	**Red Team**
29, 60, 30, 38, 60, 40, 42, 120, 57, 60, 0, 60, 61, 63, 31, 60	29, 60, 30, 38, 60, 40, 42, 120, 57, 60, 0, 60, 61, 63, 31, 60

Box and Whisker Plot and Histogram Spreadsheet

Team Stats

BLUE TEAM

Minimum:	______	Mean:	______	25th %-tile:	______
Maximum:	______	Mode:	______	Median:	______
Range:	______			75th %-tile:	______

Sketch the histogram	Sketch the box and whisker plot

GREEN TEAM

Minimum:	______	Mean:	______	25th %-tile:	______
Maximum:	______	Mode:	______	Median:	______
Range:	______			75th %-tile:	______

Sketch the histogram	Sketch the box and whisker plot

RED TEAM

Minimum:	______	Mean:	______	25th %-tile:	______
Maximum:	______	Mode:	______	Median:	______
Range:	______			75th %-tile:	______

Sketch the histogram	Sketch the box and whisker plot

Go Team!

Use the terms in the word bank below to complete the statements about the statistics and graphic representations in your spreadsheet. Each term can be used only once.

median	Red	mode	Blue
Green	range	outlier	mean

1. The box and whisker plot of the __________ Team has the longest whisker. This is usually an indication that the set of data contains at least one __________ .
2. The __________ of the data is the central tendency for which the graphic representations give us the least information.
3. The graphic representation with the smallest box (on the box and whisker plot) or with the middle bars significantly taller than the outer bars (on the histogram) for the __________ Team reflects the fact that the number of hits for many of the players on that team is close to the __________.
4. While the data for each of the three teams is very different, the __________ number of hits is the same for all.
5. The __________ and Red Teams both have players with more than 100 hits.
6. The __________ of the number of hits was the smallest for the Green Team.

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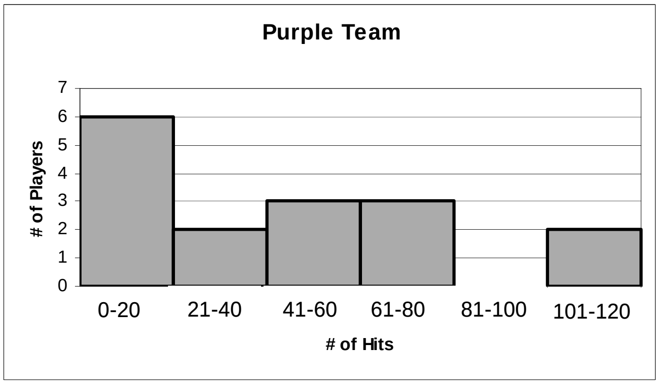
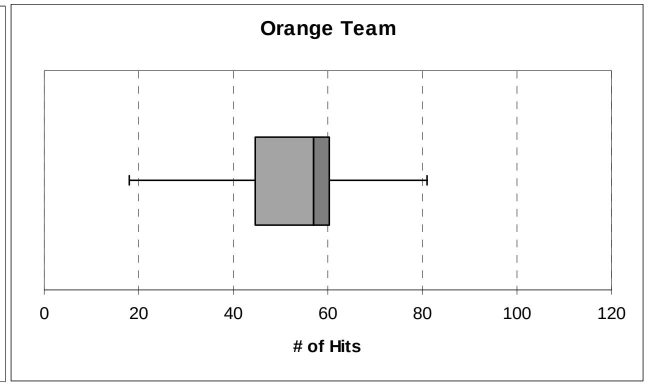
7. If you had the opportunity to join any of these teams for next season, which would it be? Explain using statistics and/or the graphical representation(s) to justify your selection.

Box and Whisker Plot and Histogram Spreadsheet

Purple or Orange? (hard copy of Microsoft Word file)

Below are graphical representations of the number of hits last season by members of the Purple and Orange teams.





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Use either a word processor to create a newsletter or presentation software to create a slide show that will communicate your interpretations. Copy and paste the graphical representations into your newsletter or slide show and use the drawing tools to help make your points.
Your newsletter or slide show should answer the following questions.

1. From the given graphical representations, what do you know about the spread of the data (numbers of hits per player) for the Purple team? for the Orange team? (Include a "discussion" of any clusters, gaps, and/or outliers.)

2. Should H^3 join the team, how would his number of hits (100) impact the current spread of the data for the Purple team? for the Orange team?

3. From the given graphical representations, what do you know about the current range, median, and mean number of hits for the Purple team? for the Orange team?

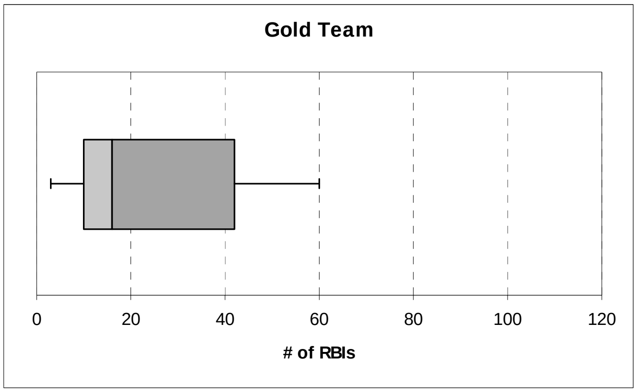
4. Should H^3 join the team, what would be the impact on the range, median, and mean number of hits for the Purple team? for the Orange team?

5. In your opinion, which team would benefit the most from having H^3 join their team?

6. As an added note or disclaimer, compare and contrast the amount and type of information you were able to get from the histogram versus the box and whisker plot when you addressed questions #1 and 3. What information might you get from a histogram that you would not get from a box and whisker plot? What information might you get from a box and whisker plot that you would not get from a histogram?

Pure Gold

You have just been hired as the manager of the Gold Team. A plot of the number of RBIs (runs batted in) of your team is shown below.



Your first job as team manager is to add 3 players (to replace 3 that retired) to the team. You must meet these goals.

- Do not increase the current range of RBIs.
- Keep the various numbers of RBIs as clustered around the median as possible.

a. Open the **PureGold** spreadsheet to see the RBI statistics on your current players and the players that are available to join your team.

b. Add 3 players to get the desired results.

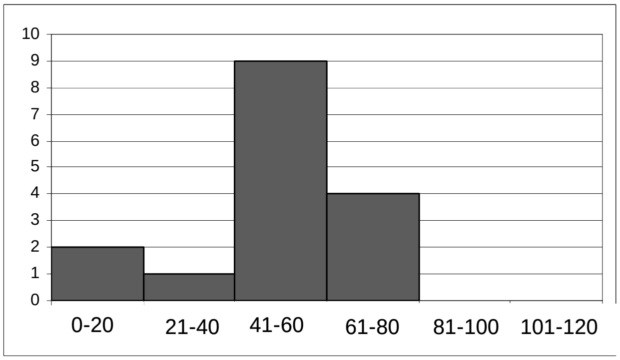
c. Prepare a statement for the press that lists the RBIs of the players you added and describes the impact of these additions on each of the following statistical measures for your team.

d. Justify your statement by including the amount of change (if any) from the original statistics and original box and whisker plot, along with how these additions might benefit the team.

- Range
- Median
- Mean

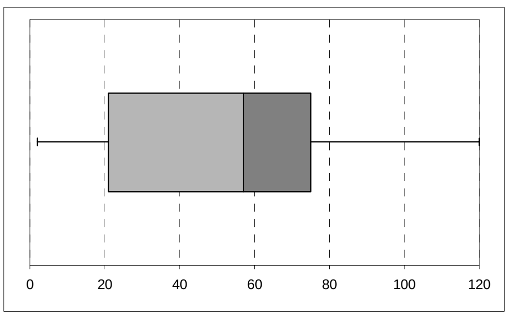
Box and Whisker Plot and Histogram Spreadsheet

1.

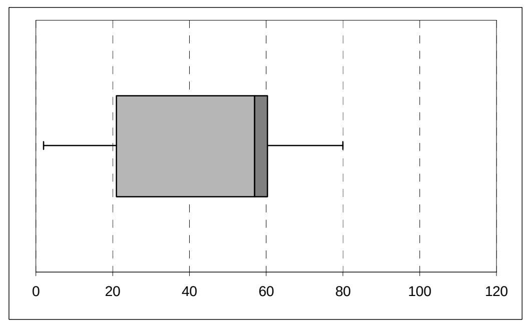


Which of the following box and whisker plots would contain data similar to the histogram above?

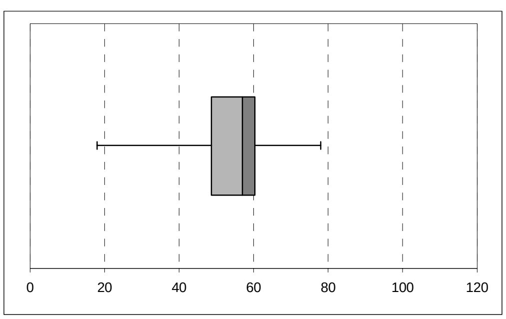
A.



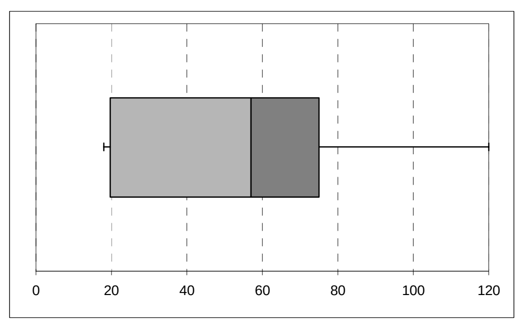
C.



B.



D.

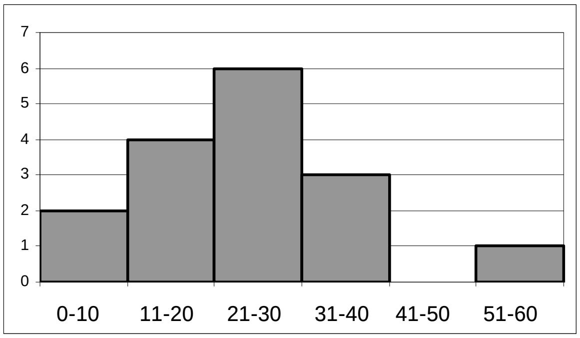


2. Which statistical measure is NOT evident on a box and whisker plot?

A. range
B. median
C. mode
D. all are evident

Use the information below to answer questions 3 and 4.

A police officer sat on the side of the road and monitored the speed of the traffic with a radar gun. The histogram below represents the speeds of the first sixteen cars to go by.



3. What was the range in speed of the cars?

A. 60 mph
B. 6 mph
C. 50 mph
D. cannot be determined from the graph

4. If the road the officer was monitoring was a school zone (speed limit of 20 mph), how many of those cars were speeding?

A. 10
B. 40
C. 6
D. not enough information

Mathematics

8.12 The student uses statistical procedures to describe data. The student is expected to:

(A) select the appropriate measure of central tendency or range to describe a set of data and justify the choice for a particular situation.

(C) select and use an appropriate representation for presenting and displaying relationships among collected data, including line plots, line graphs, stem and leaf plots, circle graphs, bar graphs, box and whisker plots, histograms, and Venn diagrams, with and without the use of technology.

Technology Applications

The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to:

(1)(a) demonstrate knowledge and appropriate use of operating systems, software applications, and communicate and networking components.

(1)(c) demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency.

(1)(f) perform basic software application function including, but not limited to, opening an application program and creating, modifying, printing, and saving documents.

The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to:

(7)(a) plan, create, and edit documents created with a word processor using readable fonts, alignment, page setup, tabs, and ruler settings.

(7)(b) plan, create, and edit spreadsheet documents using all data types, formulas and functions, and chart information.

(7)(e) create a document using desktop publishing techniques including, but not limited to, the creation of multi-column or multi-section documents with a variety of text-wrapped frame formats.

(7)(g) integrate two or more productivity tools into a document including, but not limited to, tables, charts, and graphs, graphics from paint or draw programs, and mail merge.

The student formats digital information for appropriate and effective communication. The student is expected to:

10)(a) use productivity tools to create effectiveness document files for defined audiences such as slide shows, poster, multimedia presentations, newsletters, brochures, or reports.

(11)(a) publish information in a variety of ways including, but not limited to, printed copy, monitor display, Internet documents, and video.

Materials

Advanced Preparation:

- Access to **TI-73** and large monitor or projector/screen for demonstrations
- Pre-cut **TEAM CARDS**, enough for one card per group of 4-5 students
- Copies of **Paper Hockey Puck** Directions, **Team Stats**, **Go Team!**, **Purple or Orange**, and **Pure Gold** worksheets
- Access to a word processor and/or presentation software for each pair of students – load with **Purple or Orange** file
- Access to a **TI-73** for each student or pair of students
- Transparency of each **TEAM CARD**

For each student:

- **Team Stats, Go Team!** and **Purple or Orange** worksheets
- **PureGold** worksheet

For each student group of 4 - 5 students:

- Blank paper or large index cards, one per student
- One **Paper Hockey Puck Directions**, scissors, and one tape measure
- One **TEAM CARD** and one sheet of chart paper, markers

ENGAGE

The Engage portion of the lesson is designed to create student interest in the concepts addressed. This part of the lesson is designed for groups of 4 - 5 students and then whole group instruction.

1. In small groups, direct the students to take turns flicking a paper hockey puck so that it glides along the surface of the table, measuring the distance traveled (to the nearest inch), and writing that amount with a marker on a blank sheet of paper (or large index card) until each in the group has a measurement. (Students may design their own paper hockey pucks or use the **Paper Hockey Puck Directions** handout.)

Facillitation Questions

- (Before conducting the activity of flicking the hockey puck) What factors involved in the actual flicking of the hockey puck and measurement of the distance should we standardize for consistency?
  Answers may vary. Factors may include how you made the hockey puck, how you hold the hockey puck, starting points, surface on which you are flicking the hockey puck, method of flicking the hockey puck, measuring tools, etc.
- Why should we be concerned with consistency in the way we collect our data? In other words, how might inconsistency affect the validity of our results?
  We need to limit the number of variables (factors that may differ) for each event in order to compare distances made when all other factors were the same/controlled. For example, results might be skewed if one group flicked their hockey puck across carpet, and others flick theirs across a slick table.

2. Have the students take their paper with their measurement and line up in numeric order around the room.

Facilitation Questions

- How did you (or how might you) represent the fact that two or more students may have had the same measurement?
  Stand behind each other in one spot
- How did you (or how might you) represent the proportional distance between the values of your distances?
  Consider themselves as a human number line…proportionally spacing the values.

3. Prompt the students to determine the median, mode, and range of their data without technology. Record these statistics on a sheet of chart paper or overhead for all to see.

4. Prompt students to return to their seats.

5. Input the data into the **TI-73** List 1 (using a large monitor or projector for viewing) and demonstrate using formulas to calculate median, mean, and mode. You will need to subtract the minimum value from the maximum value to determine the range.

Facilitation Questions

- How did you (or how might you) determine the median of your data without technology? What impact does the spread of the data have on the value of the median? What is the significance of this value?
  Answers may vary. Students could count off from each end of the line to find the middle of their line (median), averaging the values should there be two students in the middle. You might have students raise their hand if their value is above the median, and then do the same for those below the median…to further demonstrate that this is a "middle" value. This middle value is not affected by extreme values (outliers) on either end of the data. In this example, it would not be affected by distances that were significantly lower or higher than the rest of the group. (Verify the value with the calculator.)
- How did you (or how might you) determine the mode of your data without technology? What is the significance of this value?
  Answers may vary. Students could look for where they have students with the same values lined up behind each other (if any). If a set of data has a mode, it indicates that there is a value that occurred multiple times. In this example, this measure of central tendency may not be the best representative of the data unless there is a measurement that occurs many more times than the others.
- How did you (or how might you) determine the range of your data without technology? What is the significance of this value?
  Answers may vary. Students could have the students on each end of the line (highest and lowest) find the difference in their measurements. The range helps to describe the spread of the data. In this example, it would tell us if the distances achieved were about the same, or if some students were able to flick for distances that were much longer than others. (Verify the value with the calculator)

6. Have the students return to the front of the room and line up again in order from least to greatest.

7. Ask students the following questions on creating a histogram.

Facilitation Questions

- How might you organize yourselves to create a histogram (a bar graph based on the ranges agreed to before)?
  Students in each group should stand behind each other, forming a line ("bar") for each group/range of data.

8. After students have determined a strategy and appropriate ranges for the histogram, direct them to form a human histogram.

Facilitation Questions

- What conjectures can we make based on the spread of the data within this human histogram? In other words, what do we notice about the "shape" of the data?
  Answers may vary. Based on the actual spread of the data, students should notice clusters and/or gaps in the spread of the data.
- What kind of information was "lost" when we grouped students together to form the human histogram?
  While we know the number of pieces of data in each group, we do not know where in the range for each group the data lies. For example, if there are 5 values within a range of 20 to 30 inches, they could all be closer to 20 inches, 30 inches, or spread throughout the range.

9. Have students return to their number line formation. Lead them in forming a human box and whisker plot.
   What was the value of our median? (Identify that person or point between two persons if there is an even number of data points.) Raise your hand if your value is above the median or, in other words, if you are in the upper half of the data? (Once you agree that you have the upper half with their hands raised, ask the lower half to sit on the floor and the upper half can put their hand down.)

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   Raise your hand if you are above the median of those standing, in other words, if you are in the upper half of the upper half of the data? (Once you agree that you have the upper half of the upper half with their hands raised, ask the upper group to sit on the floor and the lower half to sit on their knees.)

$$\overbrace{x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x}^{\text{sitting}}\ \overbrace{X\ X\ X\ X\ X\ X\ X}^{\text{kneeling}}\ \overbrace{X\ X\ X\ X\ X\ X\ X}^{\text{sitting}}$$

   (Repeat the procedure to find the upper half of the lower half. Ask the lower half of the lower half to sit and the upper half of the lower half to remain standing. Ask the lower half of the upper half to now stand.)

$$\overbrace{x\ x\ x\ x\ x\ x\ x}^{\text{sitting}}\ \overbrace{X\ X\ X\ X\ X\ X\ X}^{\text{standing}}\ \overbrace{X\ X\ X\ X\ X\ X\ X}^{\text{standing}}\ \overbrace{x\ x\ x\ x\ x\ x\ x}^{\text{sitting}}$$

Facilitation Questions

- How would you describe the data for the group of students still standing? What is the significance of this group?
  Answers may vary. Students should note that those standing represent the middle half of the data. Essentially this is the middle group that ignores (does not include) the highs and the lows (outliers).

10. Students should return to their seats.
11. Sketch the graphical representations on chart paper. Note to the students that they will create histograms and box and whisker plots using technology in the next activity. They will use this "human" version to help understand what is happening "behind the scenes" as the technology creates the graphs.

EXPLORE

The Explore portion of the lesson provides the student with an opportunity to be actively involved in the exploration of the mathematical concepts addressed. This part of the lesson is designed for groups of 4 – 5 students initially, moving to 2 students or individual investigation.

1. Divide the class into 6 groups (teams) of 4 – 5 students each.
2. Give each group a **TEAM CARD** with a list of numbers that represent the number of hits last season by each person on a particular baseball team. Duplicate sets of data will be distributed to promote comparing/contrasting comments later in the activity.
3. Ask each group to calculate the mean (average) of the number of hits their team had last season.
4. Prompt each group to write their team name and list of hits on a piece of chart paper, along with the mean, so that all can see.
5. After noting that all of the teams had the same mean (average) number of hits last season, prompt each group to use something other than the mean to describe the hitting strengths and/or weaknesses that are specific to their team.

Facilitation Questions

- If all three teams had the same mean (average) number of hits last season, what other statistical characteristics might you examine in order to distinguish between the teams?
  Answers may vary. Lead students to classify teams by measurements such as median, mode, range or the spread of the data..

6. Distribute a **TI-73** to each student or pair of students.
7. Distribute the **Team Stats** worksheet to each student.

8. Display a transparency of the Blue Team card. Direct the students to fill in the number of hits for each of the 16 players (in any order) in L_1 of their graphing calculators for the Blue Team.

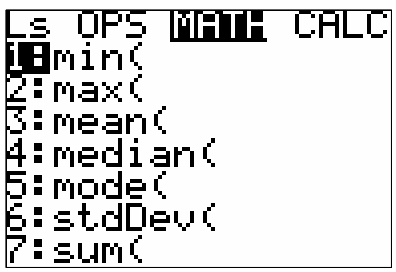
Facilitation Questions

- How will the order in which you input the data affect the calculations of central tendencies?

  Answers may vary. One benefit of using a spreadsheet to calculate a central tendency is that the order of input does not matter. This would be especially helpful if there were a large number of data points.

9. Display a transparency of the Green Team and Red Team cards. Direct the students to fill in the number of hits for each of the 16 players (in any order) in L2 for the Green Team and L3 for the Red Team.

10. Guide the students through using the statistical formulas built in the TI-73 to complete the table of stats for the Blue Team.
    - Go to the home screen.
    - Press [2nd][LIST][▸] to MATH to get the formulas.

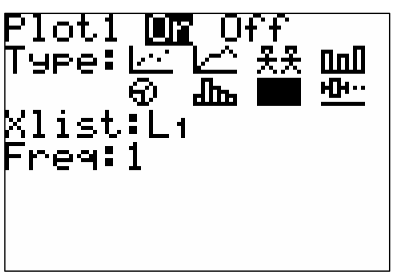


    - Select the formula and press [2nd][LIST] to access the appropriate list number. Press [ENTER], then press [ENTER] again to see the calculation.

- The median is also referred to as the 50th percentile. Why do you think this is so?
  50th percentile refers to the value such that, if the data points are sorted from least to greatest, 50% of the data points are less than this value and 50% of the data points are greater than this value. (Students can sort their lists to verify this. Press [2nd][LIST], arrow over to OPS, select SortA, then press [2nd][LIST] to choose the appropriate list. Press [ENTER]. When you return to the list, it should be sorted in ascending order.)
- Where is the median in your data list? How many values are less than the median and how many are greater than the median?
  The median is 50 hits. There are 8 players with fewer than 50 hits, and 8 players with more than 50 hits.
- If the median of the entire group is the 50th percentile, what is the significance of the 25th percentile? How many values are less than the 25th percentile? How many values are greater than the 25th percentile?
  This is the median of the lower half of the data. 25% of the data points are less than this value, leaving 75% of the data points to be greater than this value. In this case there are 4 values below the 25th percentile and 12 values above the 25th percentile.
- If the median of the entire group is the 50th percentile, what is the significance of the 75th percentile? How many values are less than the 75th percentile? How many values are greater than the 75th percentile?
  This is the median of the upper half of the data. 75% of the data points are less than this value, leaving 25% of the data points to be greater than this value. In this case there are 12 values below the 75th percentile and 4 values above the 75th percentile.

11. Direct the students to use their **TI-73** to complete the statistical tables for the Green and Red teams as well.
12. Guide the students through creating a box and whisker plot on the **TI-73**.

- Press [2nd][Y=][ENTER] to turn on Plot1 as a box and whisker plot.



- Press [WINDOW] and adjust the Xmin and Xmax to fit your data (or press ZoomStat).

13. Direct the students to create a box and whisker plot for the Green team on Plot 2 and for the Red team on Plot 3, using their **TI-73**. Students should sketch their box and whisker plots on the **Team Stats** sheet. They will sketch the histograms later in the activity.
14. Prompt the students to use their plots to help them answer the 7 questions on the **Go Team** worksheet.
15. Question #7 will be addressed further in the "Explain" phase.

EXPLAIN

The Explain portion of the lesson is directed by the teacher to allow the students to formalize their understanding of the TEKS addressed in the lesson.

1. Direct the students to sketch a histogram of the data for each team along side the box and whisker plot they sketched on their **Team Stats** worksheet. These graphs will be used to further understand the box and whisker plots. (Suggested interval ranges: 0-20, 21-40, 41-60, 61-80, 81-100, 101-120)
2. Debrief the concept of median using the following questions.

Facilitation Questions

- What is the statistical significance of the median of any group of data? In other words, why does knowing the median of a group of data give us more information than just knowing the average (mean)?
  The median represents the "middle" of the data, once the data has been ordered. Since the value of the median is a result of position alone, it is not affected by outliers, whereas even one or two outliers (data points that are significantly higher or lower than the rest of the data) might skew the mean.
- How is this discussion of median versus mean related to the data we have on the number of hits for each player on a team?
  The median number of hits is the value that represents the number of hits that is in the "middle" once the values have been ordered. Since this value is based on position alone, it is not as likely to be affected should certain players suddenly have more or less hits.

3. Using a large monitor or projector/screen for viewing, prompt the students to go to the **Blue Team** data in L1 and Plot 1 and demonstrate how the median is not affected by outliers.

Facilitation Questions

- Noting that currently the median and mean numbers of hits for the Blue team are close to the same values (50 and 50.7 respectively), which would change the most if your best hitter was traded for someone with 500 hits? Justify your prediction.
  Answers may vary. The median would not change because the data points would not change in position if the largest value is exchanged for an even larger value. The mean would change more because there would be a larger total number of hits, therefore a larger average when those hits were divided out among the players. Students can type "500" in place of the "120" in their spreadsheet and note the lack of change in the median and the significant change in the mean.
- With this exchange of players, does the median (50) or the mean (74.4) better describe the data for the team? Justify your selection.
  The median is a better descriptor of the data. Justifications may vary, but students should note that there are very few players on the team that are hitting at or above the mean, while there are still one-half of the players hitting at or above the median (and the other one-half hitting at or below the median).
- How is having the data in a graphing calculator helping us justify our thoughts about referring to medians versus means?
  Answers may vary. As we are changing values, we can quickly recalculate the central tendencies so that we can focus our discussion on the meaning and significance of each value, without having to get "bogged down" in the recalculations.
  NOTE: Ensure that students return the "500" value to "120" before proceeding.

4. Prompt the students to explain how the median is reflected in each graphical representation on the **GRAPH** screen.

Facilitation Questions

- How is the median reflected in each of the box and whisker plots on the **GRAPH** screen on your calculator?
  The median value is represented by the line within the box on each box and whisker plots.
- If you did not already know the value of the median from the list of data, what would you know about it from the box and whisker plot alone?
  By looking at the position of the line within the box and the number line associated with the plot, you could find the value of the median.

5. Prompt the students to make conjectures about the mean, given the median and the shape of the data in the graphical representations.

Facilitation Questions

- If you had to make an estimate of the mean (average) number of hits, would you rather base your estimate on the histogram or the box and whisker plot? Justify your answer.
  Answers may vary. In box and whisker plots, it is easy to estimate the median and then make conjectures about the value of the mean based on the shape of the data around the median. Because of grouping data in ranges on the histogram, it may make the median harder to pinpoint, therefore making it more difficult to determine the relationship between the mean and median.
- Knowing that the mean number of hits for each team is about 50.7, explain why this value "makes sense" based on what you know about the median and the shape of the data in the box and whisker plot.
  Answers may vary.
  Blue team – One might estimate that the value of the mean would be fairly close to the value of the median since the shape of the data in box and whisker plot indicates that the data on either side of the median is somewhat evenly spread…possibly skewing just a little above the median since there is a little bit larger spread in the data above the median than in the data below the median. You can see this by noting that the right whisker on the box and whisker plot is longer.
  Green team- Similar to the discussion about the Blue team, but this time it is the data below the median that is more spread out, leading you to estimate that the mean is somewhat lower than the median.
  Red team – While the right whisker is longer than the left, the size of the box to the right of the median indicates that those values are very close to the median. Looking at the spread of the data to the left of the median, one could determine that since these values tend to be farther from the median, the mean would be less than the median.

6. Debrief the concept of range by asking the following Facilitation Questions.

Facilitation Questions

- What is the statistical significance of the range of any group of data? In other words, why does knowing the range of a group of data give us more information than just knowing the average (mean)?
  The range is the difference between the maximum and minimum values in a set of data. The range gives you an idea of the spread of the data. The smaller the range, the closer the values of the data points are to each other. As the range increases, so does the spread between the values of the data points.
- How is this discussion of range related to the data we have on the number of hits for each player on a team?
  The range in numbers of hits for a team will help us distinguish between teams where the number of hits for the players are more consistent (closer together) and teams where they are not as consistent (some players have significantly more hits than other players on the same team.

7. Prompt the students to make conjectures about the range, given the shape of the data in the graphical representations, using the following questions.

Facilitation Questions

- Would you feel more confident estimating the range of a set of data from a histogram or a box and whisker plot? Justify your answer.
  Because some values might get "lost" in the bars at the extremes of the histogram, it is sometimes difficult to closely estimate the range given only this graphical representation…but you can determine a "ballpark" range.
- How is the range reflected in each of the histograms on the **Graphs** page of your spreadsheet?
  Blue team - While looking at the histogram alone you could only estimate the range to be between 81 and 120, an exact range can be seen on the box and whisker plot by comparing the ends of the whiskers.
  Green team - While looking at the histogram alone you could only estimate the range to be between 41 and 80, an exact range can be seen on the box and whisker plot by comparing the ends of the whiskers.
  Red team - While looking at the histogram alone you could only estimate the range to be between 81 and 120, an exact range can be seen on the box and whisker plot by comparing the ends of the whiskers.

8. Debrief the concept of mode using the following questions.

Facilitation Questions

- What is the statistical significance of the mode of any group of data? In other words, why does knowing the mode of a group of data give us more information than just knowing the average (mean)?
  The mode is the data point with the greatest frequency. If a set of data has a mode, it tells you which value was most common. Depending on the frequency, the value of the mode may or may not impact the mean.
- How is this discussion of mode related to the data we have on the number of hits for each player on a team?
  The mode in numbers of hits for a team only tells us if a particular number of hits occur more often than others. In this case, it would not be uncommon for a set of data to have no mode because there are so many possibilities for numbers of hits.

9. Prompt the students to make conjectures about the range, given the shape of the data in the graphical representations.

Facilitation Questions

- If you did not already know the value of the range from the list of data, what would you know about it from the histogram or box and whisker plot alone?
  The specific mode is not evident on either representation.

10. Prompt the students to make conjectures about any outliers or clusters, given the shape of the data in the graphical representations.

Facilitation Questions

- For each team, are there any outliers or clusters of data? If so, how are they reflected in the histogram and box and whisker plot?
  Answers may vary.
  Blue Team – Two players have a significantly higher number of hits (110 and 120) as see by the gap in the histogram and the long right whisker on the box and whisker plot. According to the histogram, only one player falls within the range including both the mean and median, leading you to believe the data is spread out.
  Green Team – Both the histogram and box and whisker plot show that the vast majority of the players have numbers of hits close to both the mean and median. According to the box and whisker plot, the "middle half" of the data is compressed between the upper 40's and 60, leading you to believe that the numbers of hits for those players are very close together.
  Red Team – While the numbers of hits for players is not as tight around the mean and median as the green team, there are still many players clustered within the upper 30s and 60.

11. To answer question #7 on their **Go Team** sheets, prompt the students to use what they know about the central tendencies and range, as well as the graphical representations to explain which team you would like to join.

Facilitation Questions

- Now that we have explored these graphical representations further, think again about your response to #7 on your **Go Team** worksheet. If you got the choice to join any of these teams for next season, which would it be? Explain. (Go to the **Graphs** worksheet to make it easier to see all at the same time.)
  Answers may vary. Look for explanations that use the data as their justification such as--
  The Blue and Red Teams both have players having more than 100 hits.
  The Red Team has the highest median.
  The Green Team has more consistency between players when it comes to number of hits.
  The Blue Team has a number of players hitting well above the median.

ELABORATE

The Elaborate portion of the lesson provides an opportunity for the student to apply the concepts of the TEKS within a new situation. This part of the lesson is designed for pairs of students.

1. Pair up the students, to foster student conversation and extend their thoughts as they interpret graphical representations.
2. Direct each pair of students to open **Purple or Orange** with their word processor. NOTE: They need the file copy (not just a hard copy) in order to have the ability to cut and paste the graphical representations in their newsletter or slide show.
3. Distribute a hard copy of the **Purple or Orange** file to each student for reference.
4. Prompt students to summarize the directions for the task, giving them additional directions on how to name and save their newsletter or slide show.
5. With about one-half of the work time remaining, have the pairs go on a quick (5 - 10 minutes) "spy mission." For each pair, one student will stay with their work/computer to share their work/thoughts with others, and the other will visit with other students to "compare notes" and possibly hear a different point of view or get a technology tip. The pairs will reunite and continue their work on their newsletter or slide show.
6. After the students are near completion of their newsletter or slide show, prompt students to defend their answer to #5 to the whole group.

Facilitation Questions

- What evidence is there in the graphical representation(s) to defend your position?
  Answers may vary.
- If the data point of 100 hits was added, what change (if any) would you notice in the graphical representation(s)?
  Answers may vary.
- If you could call the front office of either team, what question(s) might you ask them to help you get a better understanding of the data? In other words, what do you wish you knew that you either don't know or are not sure of based on the graphical representation(s) alone?
  Answers may vary.

7. Allow the pairs of students a short amount of time to make adjustments to their newsletter or slide show based on what they gained from the whole group discussion.
8. Upon completion of the **Purple or Orange** activity, the teacher should use a rubric to assess student understanding of the concepts addressed in this lesson.

EVALUATE

The Evaluate portion of the lesson provides the student with an opportunity to demonstrate his or her understanding of the TEKS addressed in the lesson.

1. Distribute **Pure Gold** activity sheet to each student.
2. Upon completion of the **Pure Gold** activity sheet, the teacher should use a rubric to assess student understanding of the concepts addressed in this lesson.

Answers and Error Analysis for selected response questions

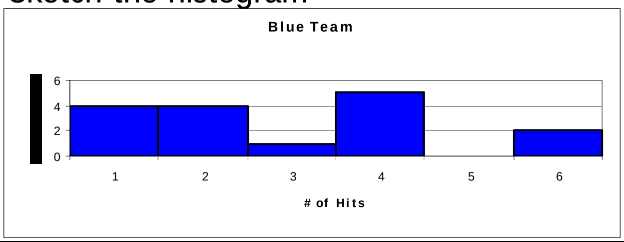
Question Number	TEKS	Correct Answer	Conceptual Error	Conceptual Error	Procedural Error	Procedural Error	Guess
1	8.12(C)	B	A	D	C		
2	8.12(C)	C	A	B			D
3	8.12(A)	D	A	B	C		
4	8.12(C)	A	C	D	B		

Team Stats

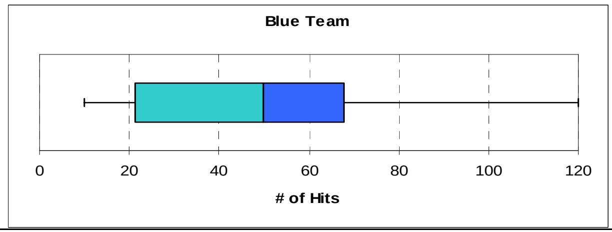
BLUE TEAM

Minimum:	10	Mean:	50.7	25th %-tile:	19.5
Maximum:	120	Mode:	10	Median:	50
Range:	110			75th %-tile:	69.5

Sketch the histogram



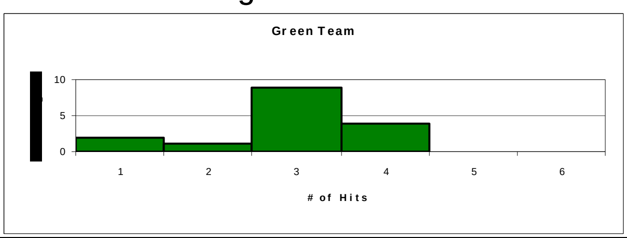
Sketch the box and whisker plot



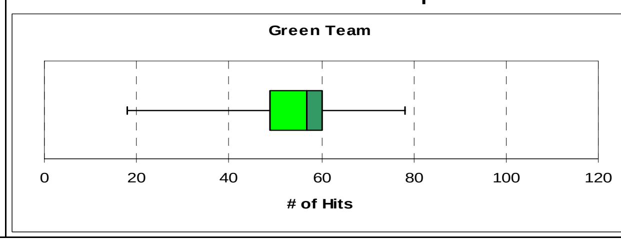
GREEN TEAM

Minimum:	18	Mean:	50.7	25th %-tile:	48.5
Maximum:	78	Mode:	57, 61	Median:	57
Range:	60			75th %-tile:	60.5

Sketch the histogram



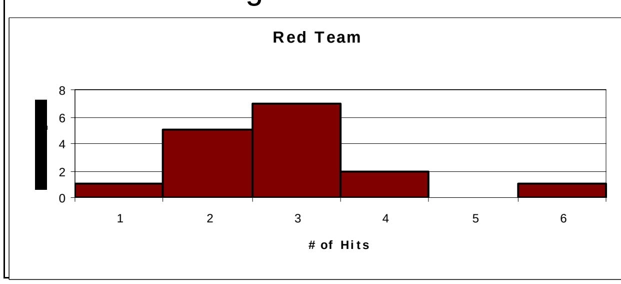
Sketch the box and whisker plot



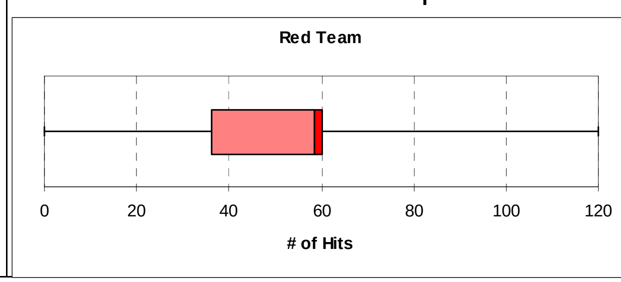
RED TEAM

Minimum:	0	Mean:	50.7	25th %-tile:	34.5
Maximum:	120	Mode:	60	Median:	58.5
Range:	120			75th %-tile:	60

Sketch the histogram



Sketch the box and whisker plot



EXPLORE

Go Team!

Use the terms in the word bank below to complete the statements about the statistics and graphic representations in your calculator. Each term can be used only once.

median	Red	mode	Blue
Green	range	outlier	mean

1. The box and whisker plot of the ***Red*** Team has the longest whisker. This is usually an indication that the set of data contains at least one ***outlier*** .

2. The ***mode*** of the data is the central tendency for which the graphic representations give us the least information.

3. The graphic representation with the smallest box (on the box and whisker plot) for the ***Green*** Team reflect the fact that the number of hits for many of the players on that team is close to the ***median***.

4. While the data for each of the three teams is very different, the ***mean*** number of hits was the same for all.

5. The ***Blue*** and Red Teams both have players with more than 100 hits.

6. The ***range*** of the number of hits was the smallest for the Green Team.

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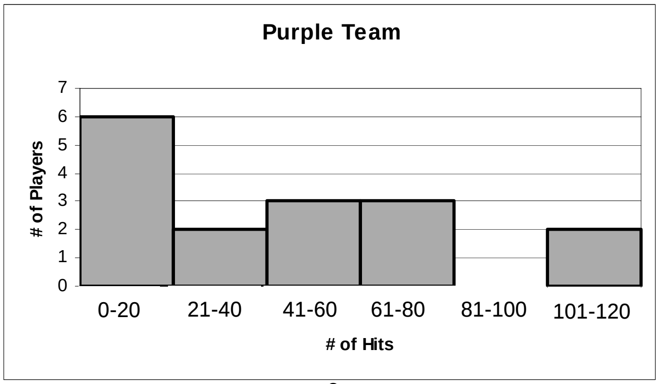
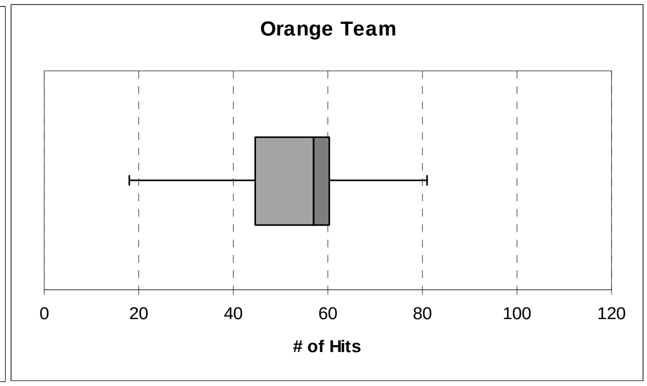
7. If you got the choice to join any of these teams for next season, which would it be? Explain using statistics and/or the graphical representation(s) to justify your selection. (Go to the **Team Stats** worksheet to make it easier to see all at the same time.)
Answers may vary.

Purple or Orange? (hard copy of Microsoft Word file)

Below are graphical representations of the number of hits last season by members of the Purple and Orange teams.





Hard Hitting Harold (H^3 for short) has offers to join either the Purple team or the Orange team. H^3 had 100 hits last season.

As a local sports reporter, you have been given the task of analyzing the impact for each team, should H^3 join either the Purple or the Orange team. You must base your analysis on what you can gather from the graphical representations you have been given.

Use either a word processor to create a newsletter or presentation software to create a slide show that will communicate your interpretations. Copy and paste the graphical representations into your newsletter or slide show and use the drawing tools to help make your points.
Your newsletter or slide show should answer the following questions.

1. From the given graphical representations, what do you know about the spread of the data (numbers of hits per player) for the Purple team? for the Orange team? (Include a “discussion” of any clusters, gaps, and/or outliers.)
   Answers may vary. Purple…spread between 0 and 120 with half below 41 and a couple of outliers between 101 and 120. Orange…middle half clustered between about 45 and 60…overall spread between about 18 and 81.

2. Should H^3 join the team, how would his number of hits (100) impact the current spread of the data for the Purple team? for the Orange team?
   Answers may vary. Purple…would appear to fill the 81-100 gap in the histogram, but is just one hit away from being included in the 101-120 group.
   Orange…would increase the overall spread of the data since the current maximum is around 81…would likely be an outlier, almost 20 greater than the current maximum.

Purple or Orange? (hard copy of Microsoft Word file) - continued

3. From the given graphical representations, what do you know about the current range, median, and mean number of hits for the Purple team? for the Orange team?
Answers may vary. Purple…range is somewhere between 80 (20 to 101) and 120 (0 to 120)…median falls between the highest value in the 21-40 bar and the lowest value in the 41-60 bar…mean is likely higher than the median as a result of the outliers over 100. Orange…range is just over 60…median is around 57…mean will likely be less than the median due to the larger spread (not number of data points) of the data below the median

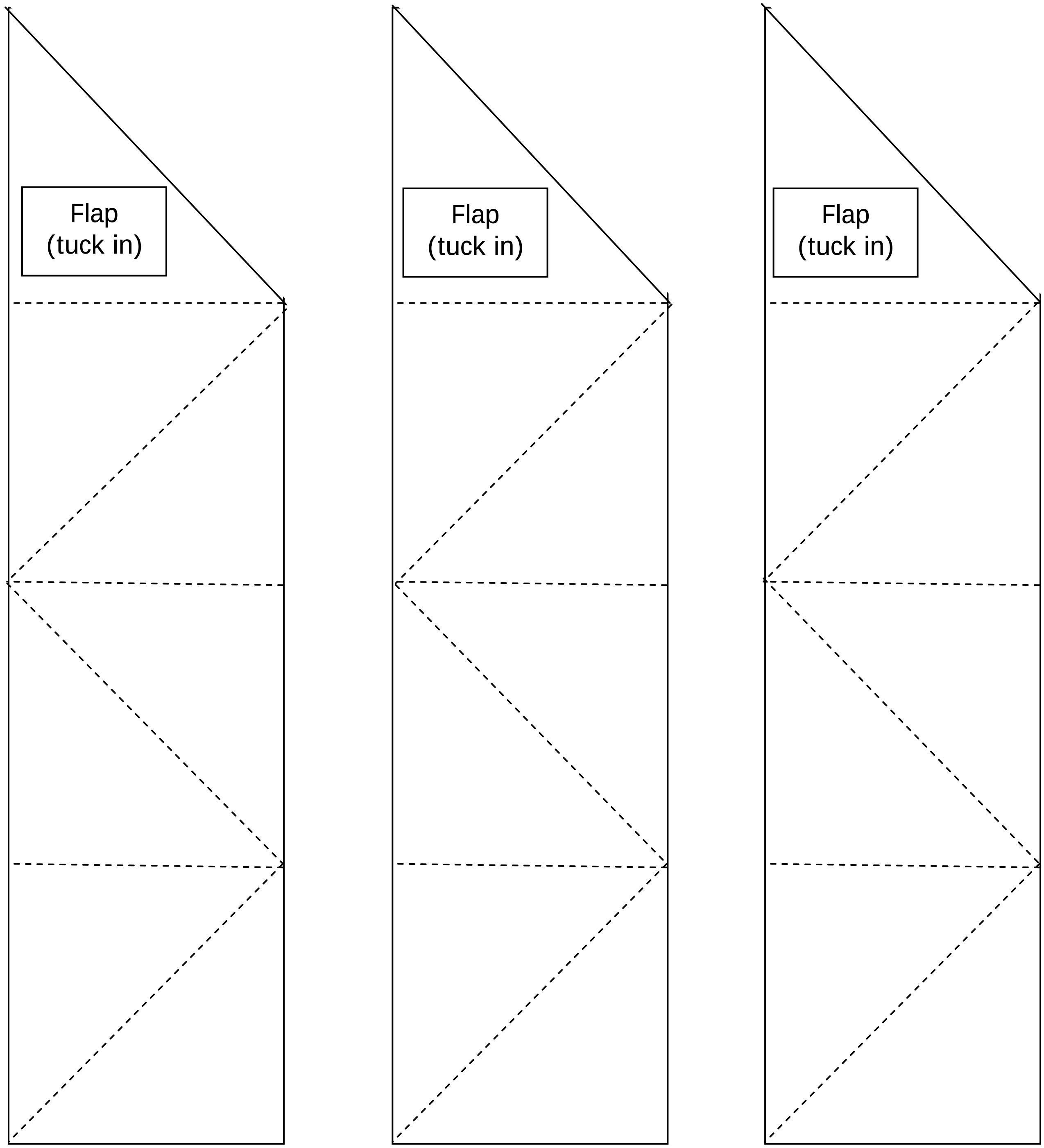
4. Should H^3 join the team, what would be the impact on the range, median, and mean number of hits for the Purple team? for the Orange team? *Answers may vary. Purple…will not change the range…will likely increase the median and mean (although hard to say by how much because of the ranges within the bars) because it is greater than both. Orange…will increase the range by around 20…will likely increase the median and mean because it is greater than both (probably the mean more than the median since the 100 is significantly greater than the current maximum)*

5. In your opinion, which team would benefit the most from having H^3 join their team?
Answers may vary. One could make a case for the Purple team since the 100 would begin to fill in the current gap and/or help to balance against those with very few hits, while the Orange team would gain a player with significantly more hits than the rest of their players, therefore increasing their average number of hits. Opinions should be accepted if the student is able to verbalize how they can back up that opinion with interpretations of the statistics.

6. As an added note or disclaimer, compare and contrast the amount and type of information you were able to get from the histogram versus the box and whisker plot when you addressed questions #1 and 3. What information might you get from a histogram that you would not get from a box and whisker plot? What information might you get from a box and whisker plot that you would not get from a histogram?
Answers may vary. Both help us to see the spread in the data. Since histograms often have more than 4 groupings (6 in this case), gaps and outliers may be more evident. Box and whisker plots, on the other hand, often allow you to better estimate the median and range.

PAPER HOCKEY PUCK DIRECTIONS

Cut out, fold on the dotted lines, and tuck in the flap. (It will form a right triangle when folded.) Each student will need one paper hockey puck.



Use your thumb and pointer of one hand to hold the triangle vertically by the vertices on either side of the hypotenuse. Use your other hand to flick the triangle (hockey puck).

TEAM CARDS

Blue Team **10, 120, 15, 16, 23, 27, 66, 39, 40, 60, 10, 61, 64, 73, 77, 110**	**Blue Team** **10, 120, 15, 16, 23, 27, 66, 39, 40, 60, 10, 61, 64, 73, 77, 110**
Green Team **20, 51, 21, 78, 48, 49, 50, 57, 18, 57, 58, 59, 60, 61, 63, 61**	**Green Team** **20, 51, 21, 78, 48, 49, 50, 57, 18, 57, 58, 59, 60, 61, 63, 61**
Red Team **29, 60, 30, 38, 60, 40, 42, 120, 57, 60, 0, 60, 61, 63, 31, 60**	**Red Team** **29, 60, 30, 38, 60, 40, 42, 120, 57, 60, 0, 60, 61, 63, 31, 60**

Team Stats

BLUE TEAM

Minimum:	______	Mean:	______	25th %-tile:	______
Maximum:	______	Mode:	______	Median:	______
Range:	______			75th %-tile:	______

Sketch the histogram	Sketch the box and whisker plot

GREEN TEAM

Minimum:	______	Mean:	______	25th %-tile:	______
Maximum:	______	Mode:	______	Median:	______
Range:	______			75th %-tile:	______

Sketch the histogram	Sketch the box and whisker plot

RED TEAM

Minimum:	______	Mean:	______	25th %-tile:	______
Maximum:	______	Mode:	______	Median:	______
Range:	______			75th %-tile:	______

Sketch the histogram	Sketch the box and whisker plot

Go Team!

Use the terms in the word bank below to complete the statements about the statistics and graphic representations in your calculator. Each term can be used only once.

median	Red	mode	Blue
Green	range	outlier	mean

1. The box and whisker plot of the __________ Team has the longest whisker. This is usually an indication that the set of data contains at least one __________ .

2. The __________ of the data is the central tendency for which the graphic representations give us the least information.

3. The graphic representation with the smallest box (on the box and whisker plot) for the __________ Team reflect the fact that the number of hits for many of the players on that team is close to the __________.

4. While the data for each of the three teams is very different, the __________ number of hits was the same for all.

5. The __________ and Red Teams both have players with more than 100 hits.

6. The __________ of the number of hits was the smallest for the Green Team.

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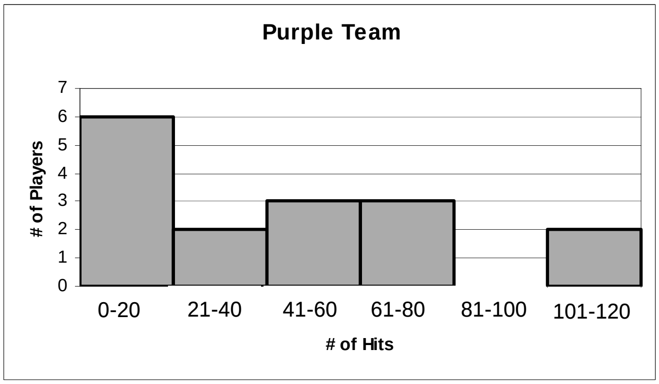
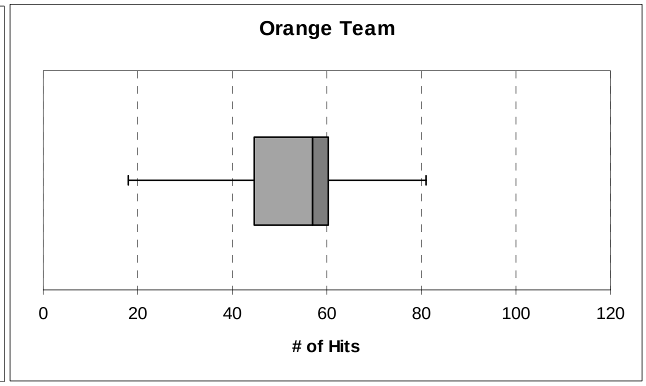
7. If you got the choice to join any of these teams for next season, which would it be? Explain using statistics and/or the graphical representation(s) to justify your selection. (Go to the **Graphs** worksheet to make it easier to see all at the same time.)

Purple or Orange? (hard copy of Microsoft Word file)

Below are graphical representations of the number of hits last season by members of the Purple and Orange teams.





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As a local sports reporter, you have been given the task of analyzing the impact for each team, should H^3 join either the Purple or the Orange team. You must base your analysis on what you can gather from the graphical representations you have been given.

Use either a word processor to create a newsletter or presentation software to create a slide show that will communicate your interpretations. Copy and paste the graphical representations into your newsletter or slide show and use the drawing tools to help make your points.
Your newsletter or slide show should answer the following questions.

1. From the given graphical representations, what do you know about the spread of the data (numbers of hits per player) for the Purple team? for the Orange team? (Include a “discussion” of any clusters, gaps, and/or outliers.)

2. Should H^3 join the team, how would his number of hits (100) impact the current spread of the data for the Purple team? for the Orange team?

3. From the given graphical representations, what do you know about the current range, median, and mean number of hits for the Purple team? for the Orange team?

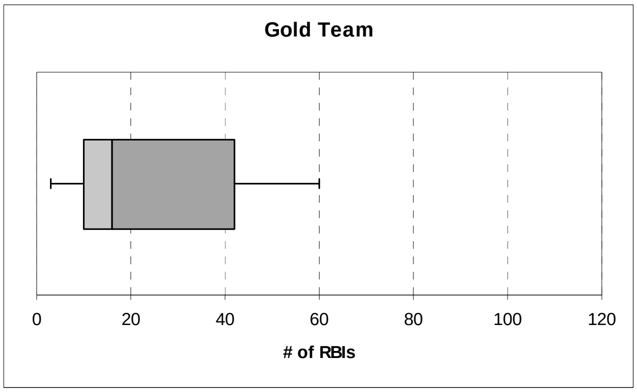
4. Should H^3 join the team, what would be the impact on the range, median, and mean number of hits for the Purple team? for the Orange team?

5. In your opinion, which team would benefit the most from having H^3 join their team?

6. As an added note or disclaimer, compare and contrast the amount and type of information you were able to get from the histogram versus the box and whisker plot when you addressed questions #1 and 3. What information might you get from a histogram that you would not get from a box and whisker plot? What information might you get from a box and whisker plot that you would not get from a histogram?

Pure Gold

You have just been hired to take over as manager of the Gold Team. Currently, a plot of the number of RBIs (runs batted in) by the members of your team is shown below.

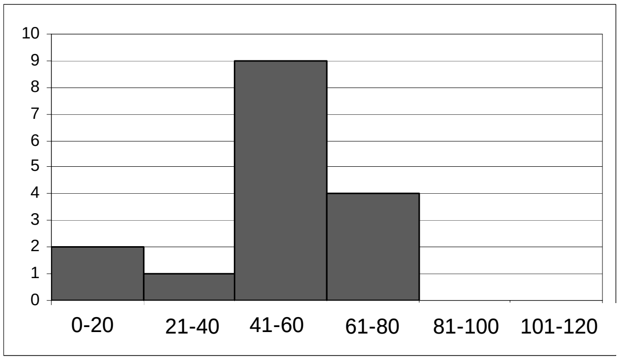


Your first task will be to add 3 players (to replace 3 that retired) to the team to meet these goals.

- Do not increase the current range of RBIs.
- Keep the various numbers of RBIs as clustered around the median as possible.

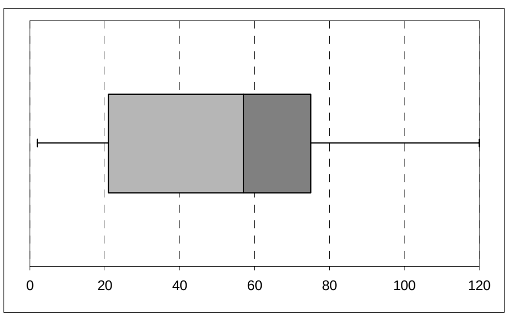
a. Input the RBIs for the players currently on the team in L1.
   3, 15, 8, 20, 45, 16, 39, 10, 10, 42, 60, 55, 5
b. Add 3 players to get the desired results. The RBIs for the players available to join your team are 65, 18, 22, 6, and 30.
c. Prepare a statement for the press that lists the RBIs of the players you added <u>and</u> describes the impact of these additions on each of the following statistical measures for your team. Justify your statement by including the amount of change (if any) from the original statistics and original box and whisker plot, along with how these additions might benefit the team.
   - Range
   - Median
   - Mean

1.

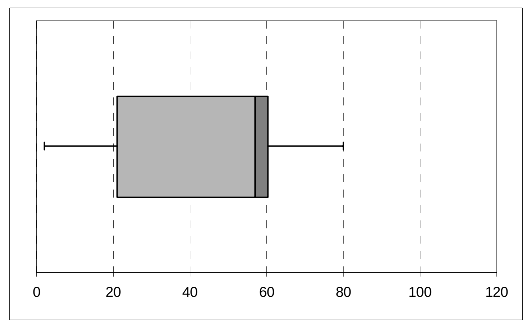


Which of the following box and whisker plots would contain data similar to the histogram above?

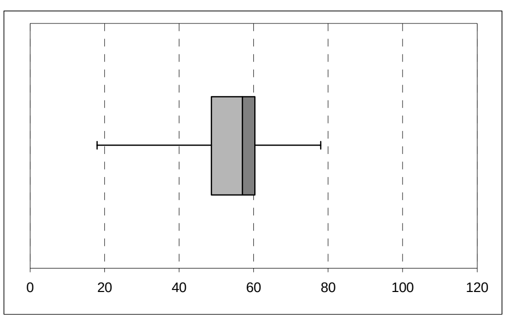
A.



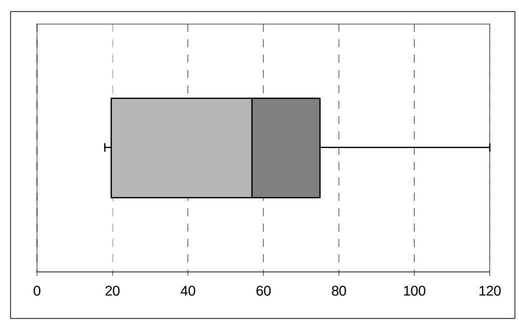
C.



B.



D.

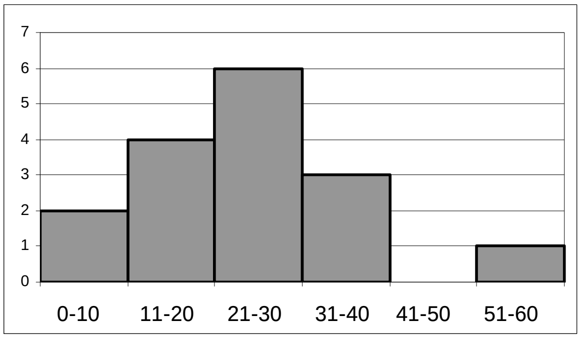


2. Which statistical measure is **not** evident on a box and whisker plot?

A. range
B. median
C. mode
D. all are evident

Use the following graph to answer questions 3 and 4.

A police officer sat on the side of the road and monitored the speed of the traffic with a radar gun. The histogram below represents the speeds of the first sixteen cars to go by.



3. What was the range in speed of the cars?

A. 60 mph
B. 6 mph
C. 50 mph
D. not enough information

4. If the road the officer was monitoring was a school zone (speed limit of 20 mph), how many of those cars were speeding?

A. 10
B. 40
C. 6
D. not enough information

Mathematics
8.12 The student uses statistical procedures to describe data. The student is expected to:

(A) select the appropriate measure of central tendency or range to describe a set of data and justify the choice for a particular situation.
(B) draw conclusions and make predictions by analyzing trends in scatterplots.
(C) Select and use an appropriate representation for presenting and displaying relationships among collected data, including line plots, line graphs, stem and leaf plots, circle graphs, bar graphs, box and whisker plots, histograms, and Venn diagrams, with and without the use of technology.

Technology Applications
The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to:

(1)(a) demonstrate knowledge and appropriate use of operating systems, software applications, and communicate and networking components.
(1)(c) demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency.
(1)(f) perform basic software application function including, but not limited to, opening an application program and creating, modifying, printing, and saving documents.

The students uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to:

(7)(a) plan, create, and edit documents created with a word processor using readable fonts, alignment, page setup, tabs, and ruler settings.

Materials

Advanced Preparation:

- Student copies of **RoundandRound, BabyName,** and **WhatName** spreadsheets or copies available on a network
- Internet access to **http://www.ssa.gov/OACT/babynames/**
- Printer access
- Copies of **Round and Round** and **What's In A Name** worksheets for each student

For whole class demonstration:

- Transparencies 1 - 5 (2 copies of Transparency 4)
- Several hula hoops (ideally, one for every 2-3 students)

For each student:

- **Round and Round** worksheet
- Access to **RoundandRound** spreadsheet
- Access to **BabyName** spreadsheet
- **What's In A Name** worksheet
- Access to **WhatName** spreadsheet

ENGAGE

The Engage portion of the lesson is designed to create student interest in the concepts addressed. This part of the lesson is designed for whole class discussion/ demonstration.

1. Prompt a student to read **Transparency 1** and ask students to individually consider their prediction.
2. Prompt students to share their predictions with a neighbor before getting responses from the large group.

Facilitation Questions

- What data are you collecting and comparing for each student?
  We are looking for, and comparing, the number of revolutions on the first attempt and the number of revolutions on the second attempt.
- Once several students have recorded their predictions on the numbers of revolutions on the first attempt, what will you need to consider when making predictions about the second attempt?
  *Answers may vary, but you are looking for the fact that students recognize that, chances are, the change in the number of revolutions between attempts will not be exactly the same for all students—some will increase, some will not. Instead, they should look for trends that describe the change, such as "The number of revolutions for the second attempt **tends** to be ______."*
- Will your prediction be true for every student? Why or why not?
  No. Point out that this exemplifies how "real" data often does not fit into "clean" or exact patterns such as linear patterns. Instead, we have to look for any trends in the data.
- How many pieces of data would you need to make a prediction about the number of revolutions on a second attempt?
  Answers may vary, but you are looking for students to recognize that the more data you have, the better defined any correlation will be.

3. Show the table on **Transparency 2** that will be used to collect the data. Ask for 2-3 volunteers to demonstrate what will be recorded in the table. You may want to agree ahead of time as to whether or not each student will be allowed a practice attempt. (If hula-hoops are not available, you can substitute another event such as

paddle-ball, trash can basketball, etc. The goal is to choose an event where the trend in the data is not obvious or that you could make a case for multiple trends. For example, one might make the case that students would have more revolutions with the hula-hoop on their 2nd attempt because of the practice they got during the 1st attempt or that they would have fewer on their 2nd attempt because they were tired from the 1st attempt or that there would be no clear correlation.)

4. Pair the students in the class to collect the data for Transparency 2. Each student will take turns being the hula-hooper and the recorder. Record the results on Transparency 2.

Facilitation Questions

- If a student is able to complete 6 revolutions on the first attempt, what could happen on the second attempt? Why?
  The number of revolutions could be more than 6, less than 6, or the same as 6 on the second attempt.
- If that same student were able to make 10 revolutions on the second attempt (an increase of 4 over the first attempt), would this mean that the same will be true for the next student? Why?
  Possibly, but possibly not—we do not have enough data to make that prediction yet.

EXPLORE

The Explore portion of the lesson provides the student with an opportunity to be actively involved in the exploration of the mathematical concepts addressed. This part of the lesson is designed for groups of 2 students or individual investigation.

1. Prompt students (or pairs of students if there is not enough technology available) to open the spreadsheet **RoundandRound**.
2. Distribute the **Round and Round** worksheet. Have students follow the directions on the spreadsheet.

Facilitation Questions

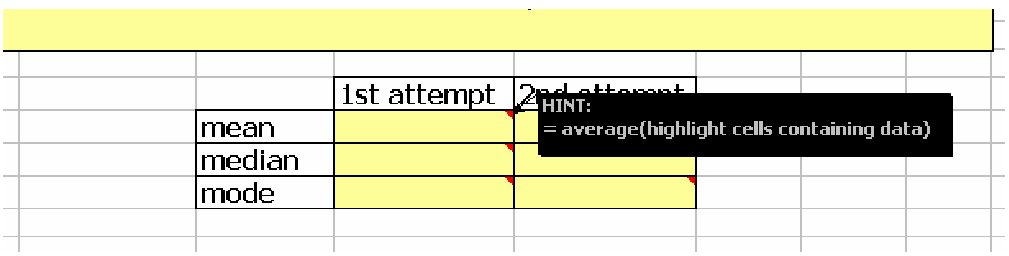
- How would you describe any trends that you might see in the scatterplot drawn from the data from your class?
  Answers may vary depending on the data collected. Look for statements such as "As the number of revolutions during the 1st attempt increases, the number of revolutions during the 2nd attempt (increases/decreases)." Or "Students tend to ___________ ."

3. For part B, inform students these graphs were drawn based on fictitious data, and not their own, as they answer questions #1 – 7 on the worksheet.

Facilitation Questions

- Describe a possible scenario that would produce each of the three scatterplots.
  Answers may vary…
  Scatterplot A – Most students performed about the same on their first attempt as on their second attempt.
  Scatterplot B – Most students did considerably better on their second attempt than on their first attempt.
  Scatterplot C – Some students followed the explanation of the scenario for scatterplot A and some for scatterplot B…no clear pattern for the group as a whole.

NOTE: There are comments with "HINTS" in the cells requiring the formulas to calculate central tendency.



Facilitation Questions

- What do mean, median, and mode describe about any set of data?
  Answers may vary…
  Mean – the value of each data point should all data points be "evened out"
  Median – the value of the data point in the "middle" when considering the data points in numerical order (one-half are equal or greater than the median and one-half are equal or less than the median)
  Mode – the value of the data point that occurs more often than other data points
- Looking at your data, how do the mean, median, and mode for the 1st attempt compare to that in the 2nd attempt? What might this imply about the comparison of the number of revolutions in the 2nd attempt as related to those in the 1st attempt? *Answers may vary.*
- Have the students share their answer to #9. What are you looking for in the data when you try to determine the measure of central tendency that will best describe the data?
  Answers may vary.
  Mean – data is clustered with no outliers
  Median – most of the data is clustered except for one or more outliers
  Mode – if one piece of data appeared significantly more times than others

EXPLAIN

The Explain portion of the lesson is directed by the teacher to allow the students to formalize their understanding of the TEKS addressed in the lesson.

1. Once the students have completed their work on the spreadsheet **RoundandRound**, display **Transparency 3** to debrief. (Transparency 3 contains the same graphs that are on the RoundandRound spreadsheet.)
2. Guide the students in drawing trendlines (if possible) on the three original scatterplots using the spreadsheet's drawing toolbar.

Facilitation Questions

For each scatterplot (A, B, C)

- Use the drawing toolbar in the spreadsheet to draw a line that would include the data points if the number of revolutions on the second attempt for each student were the same as the first attempt. ($y=x$) Does this line "fit" the data? Why or why not?
  Answers may vary. A line y = kx (proportional) will best "fit" to scatterplot A because it follows a similar trend…as x increases, y increases. Line y = kx does not "fit" with scatterplots B or C because the data on those scatterplots does not fit a similar trend.
- For each scatterplot on the spreadsheet, is it possible to click on the red line below the scatterplot and place it on the scatterplot in such a way that it better exemplifies the relationships/trends in the data? (Click on the red line to move it and select "draw," "rotate," and "free rotate" to rotate the line.)
  Answers may vary. Minor adjustments (as compared to line y = x) may be made for scatterplot A, whereas the red trend lines for scatterplots B and C should be significantly different than line y = kx.

3. Select students to draw possible trendlines on the transparency. Discuss any differences in opinion. Use the trendlines to make predictions.

Facilitation Questions

- After drawing a trendline for scatterplot A, consider the points that would fall on or near the trendline we drew. As the number of revolutions made on the 1st attempt increases, what happens to the corresponding number of revolutions made on the 2nd attempt?
  They increase as well.
- What type of correlation (trend) is this?
  A positive correlation (trend)
- Based on this trendline, about how many revolutions would you expect students to make on the second attempt if they made 13 revolutions on their 1st attempt? What about if they had made 30 revolutions? 50 revolutions?
  Answers may vary slightly depending on how the trendline was drawn.
- After drawing a trendline for scatterplot B, consider the points that would fall on or near the trendline we drew. As the number of revolutions made on the 1st attempt increases, what happens to the corresponding number of revolutions made on the 2nd attempt?
  They increase.
- What type of correlation (trend) is this?
  A positive correlation (trend)
- Based on this trendline, about how many revolutions would you expect students to make on their second attempt if they made 13 revolutions on their 1st attempt? What about if they had made 30 revolutions? 50 revolutions?
  Answers may vary slightly depending on how the trendline was drawn.
- After attempting to draw a trendline for scatterplot C, why is it more difficult to draw a trendline on this scatterplot?
  Answers may vary. Students should note that there is no clear pattern in the number of revolutions on the 2nd attempt (increasing or decreasing) as the number of revolutions increases on the 1st attempt. Visually, the points do not cluster around any line, rather they are spread more randomly throughout the scatterplot.
- What type of correlation (trend) is this?
  There is no correlation (trend)
- Knowing we did not draw a trendline, about how many revolutions would you expect students to make on the second attempt if they made 13 revolutions on their 1st attempt? What about if they had made 30 revolutions? 50 revolutions?
  With no clear trend, it is impossible to make a prediction based on this data alone.

4. Use **Transparency 4** to debrief the data in relationship to the mean or median.

5. Draw in the mean lines and discuss the characteristics (in relationship to the mean) of the pieces of data in each of the four resulting quadrants. (Students can use the drawing toolbar to draw the lines on their spreadsheet as you draw them on the transparency.)

Facilitation Questions

- Another way of looking at the data, other than a trendline, is to look at it in relationship to a central tendency such as mean or median. Look at scatterplot C where it was difficult to draw a trendline. What is the mean(average) number of revolutions made on the 1st attempt?
  8.6667 (Draw in a vertical line at 8.6667 on the x-axis.)
- About how many data points fell below the mean? above the mean? What does this say about the data from those students?
  6 below…3 above… Rationale may vary…should include a discussion about outliers and/or the spread of the data.
- What is the mean(average) number of revolutions made on the 2nd attempt?
  10.44 (Draw in a horizontal line at 10.44 on the y-axis.)
- About how many data points fell below that mean? Above the mean? What does this say about the data from those students?
  4 below…5 above… Rationale may vary…should include a discussion about outliers and/or the spread of the data.
- When you look at both mean lines, the data points divide into 4 groups. Describe the characteristic of each group.
  Below the average on both attempts, below the average on the 1st attempt and above the average on the 2nd, above the average on the 1st attempt and below the average on the 2nd, above average on both attempts
- Why do you think the number of data points varies from group to group?
  The lines were drawn using the mean values. Outliers may "pull" the line away from the center.

6. Use the second copy of Transparency 4 to draw in the median lines and discuss the characteristics (in relationship to the mean) of the pieces of data in each of the four resulting quadrants. (Students can use the drawing toolbar to draw the lines on their spreadsheet as you draw them on the transparency.)

Facilitation Questions

- If you were to do the same for the median lines, how do you think the data will be spread among the 4 groups?
  Because the medians are the midpoints, the data should be evenly spread between the groups.
- Why might you want to look at the data in this manner?
  Answers may vary. This is another way (other than trend lines) to communicate the relationship between the number of revolutions on the corresponding 1st and 2nd attempts.

ELABORATE

The Elaborate portion of the lesson provides an opportunity for the student to apply the concepts of the TEKS within a new situation. This part of the lesson is designed for groups of 2 students or individual investigation.

1. Direct students (or pairs of students if there is not enough technology available) to open the spreadsheet **BabyName**. Have students record their answers on notebook paper if the option of printing their work is not available.
2. Read the “Given” and the “Question” and have students turn to a neighbor and share their thoughts before sharing with the large group.

Facilitation Questions

- Read the “Given” statements and tell me what that means in your own words.
  Answers may vary. Look for paraphrasing that connects “popularity” of names with frequency and the concept of ranking.
- Why might the popularity of certain names vary over time?
  Answers may vary. Students might consider factors such as culture, famous figures, etc.
- Read the “Question” and turn to your neighbor and share your thoughts. (Pause) Do you think there will be a difference in the change in popularity of boy names versus girl names? Why or why not?
  Answers may vary. Accept all answers for now.

3. Read through the directions. Make sure students can access the data website (**http://www.ssa.gov/OACT/babynames/**) or print and have hard copies of the data available if using the Internet is not an option. NOTE: Using technology to search on the Internet is much more efficient than searching on paper.
4. Have students complete spreadsheet.

Facilitation Questions

- (After locating the top ten boy names for 1965…) Look at the data source and explain again how certain names make this list and others do not.
  Answers may vary. Students should determine that the data comes from counting the number of times a particular first name was put on applications for Social Security cards for newborns. Ex. Since "Michael" is ranked first, this means that there were more newborns with the first name of "Michael," according to the information parents gave on their baby's Social Security card application, than any other first name.

5. Use **Transparency 5** to debrief the activity.

Facilitation Questions

- What was the only central tendency not calculated in the activity?
  Mode
- Why do you think mode was not included?
  Since the names each have a unique rank (understanding that it would be highly unlikely that two names would occur exactly the same number of times), there will be no mode.
- When answering #9, what characteristics in the data made you choose to draw the lines for the mean or for the median?
  Answers may vary. Looking for some discussion of clustering of data and/or outliers.
- (Transparency 5 – Draw in the lines based on the discussion from the previous question, then draw in a line representing the ranking from 1965.) Describe the relationship among the three lines.
  Answers may vary. Students should note that the central tendency line for the rankings of boy names is much closer to the line representing the rankings in 1965…a visual demonstrating how the popularity of those boy names has remained somewhat steady in comparison to the girl names of similar rankings.
- Look at the lines you drew on the scatterplot. Would you say, based on the data you have, that you could better predict the change in popularity of a boy name or a girl name?
  Answers may vary. Since the points representing boy names are more clustered around that line, chances are the popularity of a boy name will change less than that of girl names with similar original rankings.

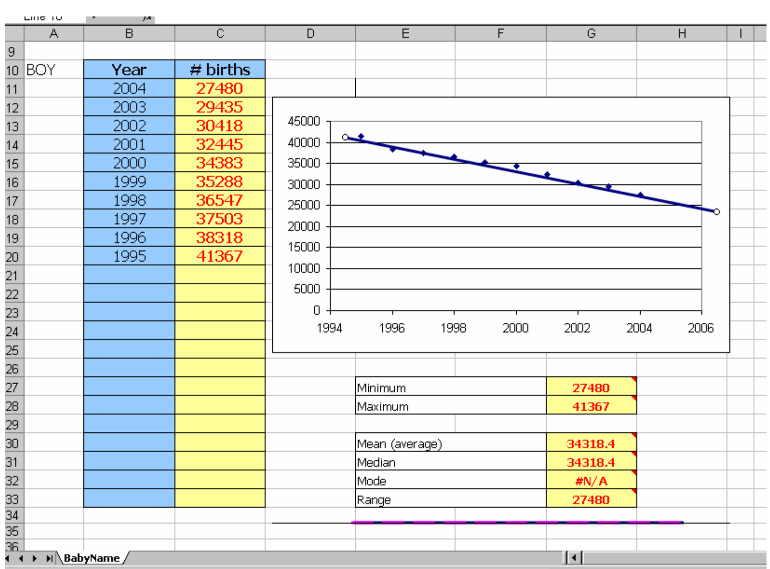
Facilitation Questions

- Think back to your response to the "Question" at the beginning of the activity. Given the additional information you now have, do you need to revise or elaborate on your initial thoughts?
  Answers may vary. In general, the selection of names for girls tends to be more susceptible to varying trends than names for boys. In other words, based on the data for the names we researched, the popularity of a particular name for a girl is much more likely to change over time; whereas the popularity for a particular name for a boy is more likely to remain somewhat steady. Just a thought…This could be related to the custom many have of designating males as the ones who will carry on the family name.
- How are the trends in this data similar to or different from the trend you saw in your data from the hula hoop experiment?
  Answers may vary. For example, if there were no clear trend between the numbers of revolutions made on the 1st and 2nd attempts, students might see similarities between that data and the data for the girl names.

EVALUATE

The Evaluate portion of the lesson provides the student with an opportunity to demonstrate his or her understanding of the TEKS addressed in the lesson.

1. Distribute **What's In A Name?** activity sheet to each student.
2. Upon completion of the **What's In A Name?** activity sheet, the teacher should use a rubric to assess student understanding of the concepts addressed in this lesson.



Answer may vary somewhat…around 20,000 people with the top ranking boy name in 2010

Justifications may vary…Based on the data in this scatterplot, there is a negative correlation between the year and the number of people with the top ranking boy name. As the years increase, the number of people with the selected name decreases. If this trend were to continue, you would expect around 20,000 people with the top ranking boy name in 2010. Students could also justify their prediction with one of the statistical measures such as finding a range and extending it to future years.

Answers and Error Analysis for selected response questions:

Question Number	TEKS	Correct Answer	Conceptual Error	Conceptual Error	Procedural Error	Procedural Error	Guess
1	8.12(B)	A	B	C			D
2	8.12(B)	C	A	B			D
3	8.12(A)	C	A		B		D
4	8.12(B)	C	A	B			D

EXPLORE

Round and Round

Open the **RoundandRound** spreadsheet.

A. Input your class data from Transparency 2. (Use the table that starts in row 6.)

Sketch the resulting scatterplot.

Will vary depending on data

B. For each statement, choose the scatterplot(s) that best represents the situation.

___*A, B, C*____1. After the 1st attempt, most students were able to increase the number of revolutions on their 2nd attempt.

____*none*____ 2. After the 1st attempt, most students made fewer revolutions on their 2nd attempt.

____*A*_____ 3. The number of revolutions on the 1st attempt is about the same as the number of revolutions on the 2nd attempt.

____*C*_____ 4. There is not a strong relationship between the number of revolutions made in the two attempts.

____*B*_____ 5. Most students did considerably better on their 2nd attempt than on their 1st attempt.

___*vary*____ 6. Based on the data you have from your class, which scatterplot would look most like yours? Explain.

7. Now that you have analyzed possible scenarios for scatterplots A, B, and C, write a statement that describes the relationship between the 1st attempt and 2nd attempt for your class.
Answers may vary.

8. Use formulas to calculate the mean, median, and mode of the data for the 1st attempt and for the 2nd attempt. (Use the table in rows 50-53.) Record the results below.
Answers may vary.

	1st attempt	**2nd attempt**
mean		
median		
mode		

9. Which measure of central tendency best describes the number of revolutions made on the 1st attempt and 2nd attempt? Explain your choice.
Answers may vary.

Transparency 1

How many revolutions of a hula hoop can you achieve in one attempt?

Will this prediction change for a second attempt? Why or why not?

How might we gather data to test our predictions?

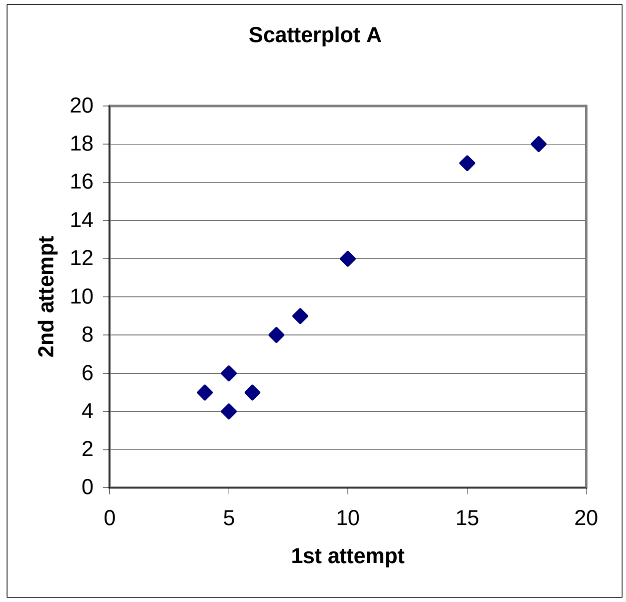
Transparency 2

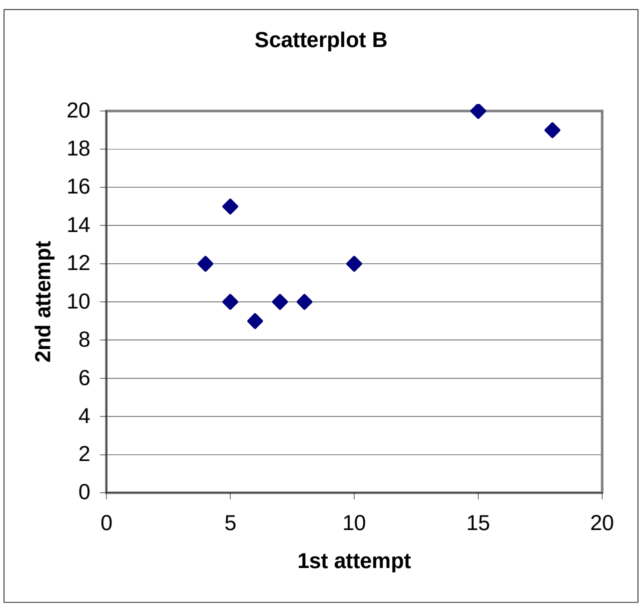
Student	# Revolutions on 1st Attempt	# Revolutions on 2nd Attempt

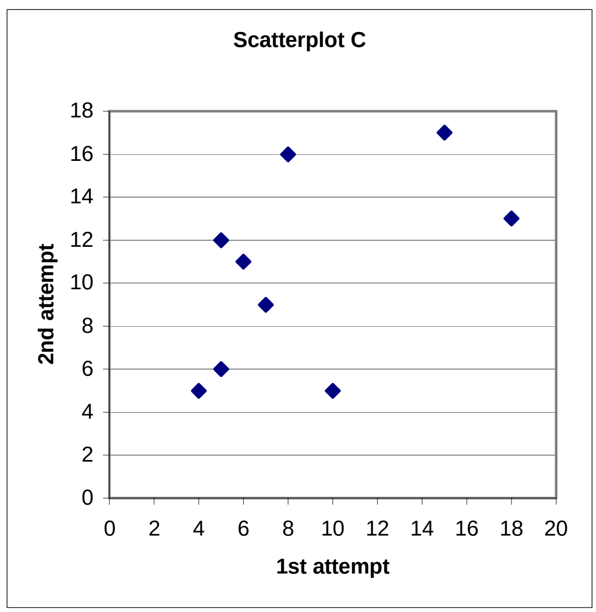
Transparency 3

1. If possible, sketch a trendline.

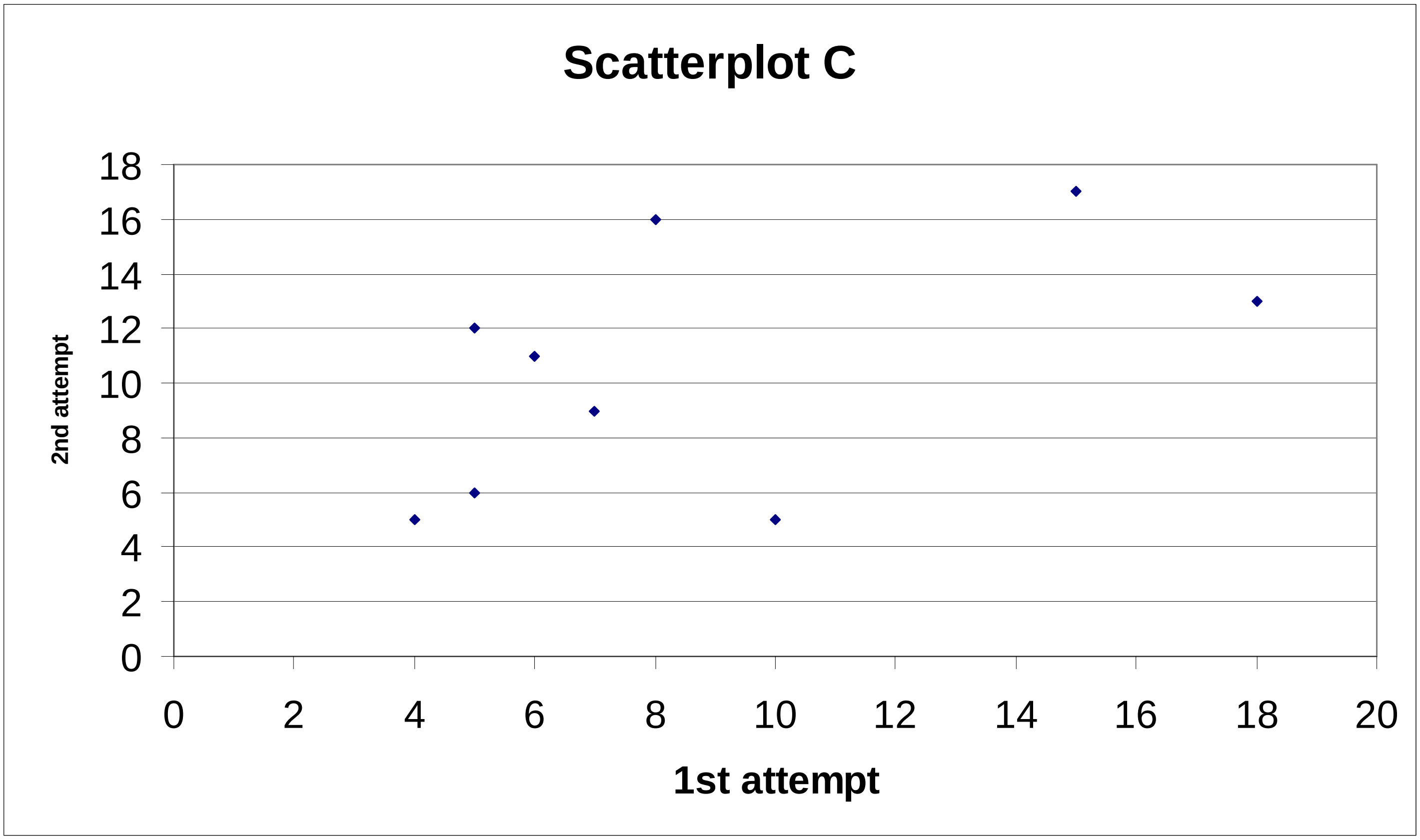
2. Predict the number of revolutions on the 2nd attempt if the number on the 1st attempt was 13...30...100.





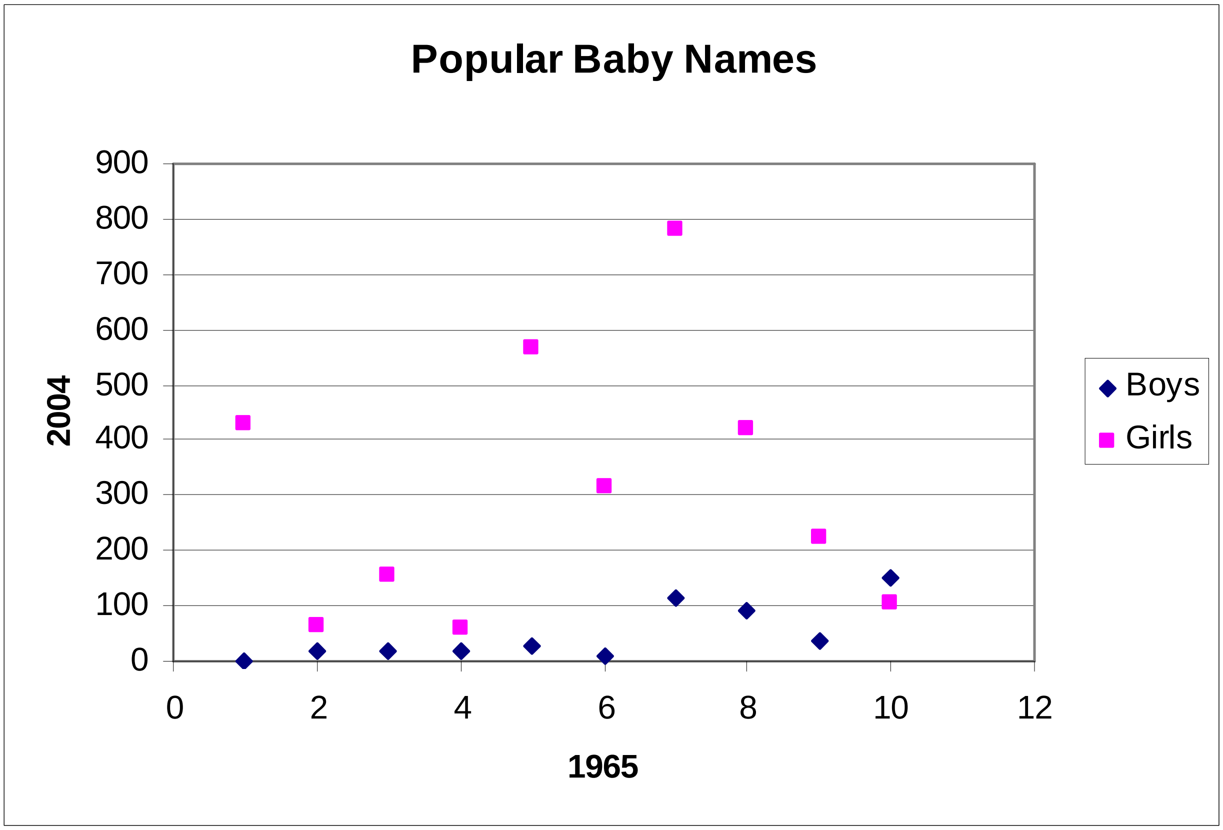


Transparency 4



	1st attempt	2nd attempt
mean	8.6667	10.44
median	9.0741	10.94

Transparency 5



	1965	2004 – Boys	2004 – Girls
Mean	5.5	48.1	312.1
Median	5.5	23.5	269.5
Range	9	147	504

Student Name(s)_____________________________________ Date_______________

Round and Round

Open the **RoundandRound** spreadsheet.

A. Input your class data from Transparency 2. (Use the table that starts in row 6.)

Sketch the scatterplot that resulted from entering class data.

B. For each statement, choose the scatterplot(s) that best represents the situation.

__________1. After the 1st attempt, most students were able to increase the number of revolutions on their 2nd attempt.

__________2. After the 1st attempt, most students made fewer revolutions on their 2nd attempt.

__________3. The number of revolutions on the 1st attempt is about the same as the number of revolutions on the 2nd attempt.

__________4. There is not a strong relationship between the number of revolutions made in the two attempts.

__________5. Most students did considerably better on their 2nd attempt than on their 1st attempt.

__________6. Based on the data you have from your class, which scatterplot would look most like yours? Explain.

7. Now that you have analyzed possible scenarios for scatterplots A, B, and C, write a statement that describes the relationship between the 1st attempt and 2nd attempt for your class.

8. Use formulas to calculate the mean, median, and mode of the data for the 1st attempt and for the 2nd attempt. (Use the table in rows 50-53.) Record the results below.

	1st attempt	**2nd attempt**
mean		
median		
mode		

9. Which measure of central tendency best describes the number of revolutions made on the 1st attempt and 2nd attempt? Explain your choice.

Student Name(s)___________________________________ Date______________

What's In A Name?

Access the website **http://www.ssa.gov/OACT/babynames/**. In an earlier activity we compared the ranking of the top ten names of your parents' generation (1965) to the ranking of those names today to answer the question about how the popularity of names stands the test of time.

a. Consider the following set of questions.
   How has the number of people having the most popular boy name changed over the last 10 years? How many people do you predict might have the most popular name in 2010?

b. Open the **WhatName** spreadsheet and input the data to create a scatterplot.

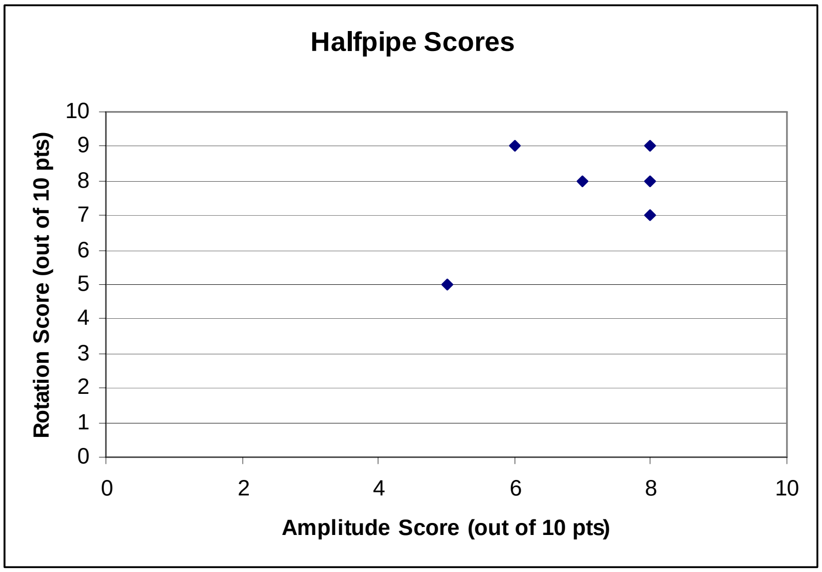
c. Draw a trendline if appropriate.

d. Calculate the mean, median, and range of your data.

e. Respond to the questions in part a. Justify your answers using the scatterplot, trendline, and/or statistical measurements to support your conclusions.

Student Name(s)________________________________ Date_____________

1. The scatterplot below compares the score for amplitude (height) to the score for rotations (spins and flips) for six skateboarders at the weekend meet.



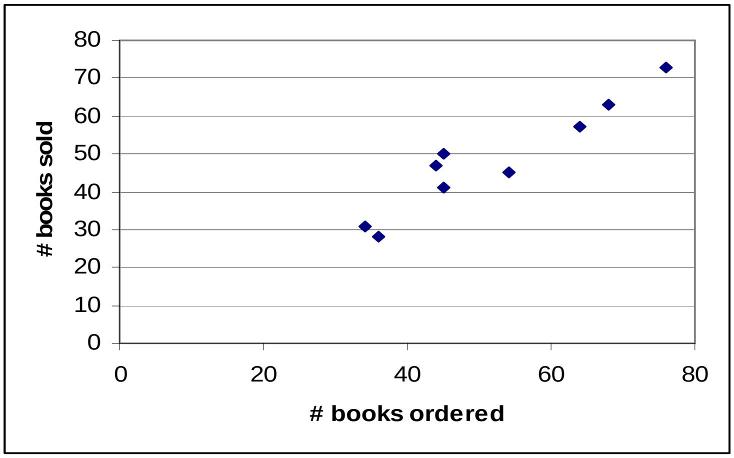
Which of the following statements would be supported by the scatterplot?

A. As the score for amplitude increases, the score for rotations tends to increase.
B. As the score for amplitude increases, the score for rotations tends to decrease.
C. As the score for rotations increases, the score for amplitude tends to decrease.
D. The score for rotations tends to be the same as the score for amplitude.

2. Which relationship, when graphed on a scatterplot, would NOT be described as having a positive trend?

A. The number of fans in a football stadium compared to the noise level of the stadium.
B. The amount of money earned babysitting compared to the number of hours spent babysitting.
C. The number of miles driven compared to the amount of gasoline in the tank.
D. All of the above relationships have a positive trend.

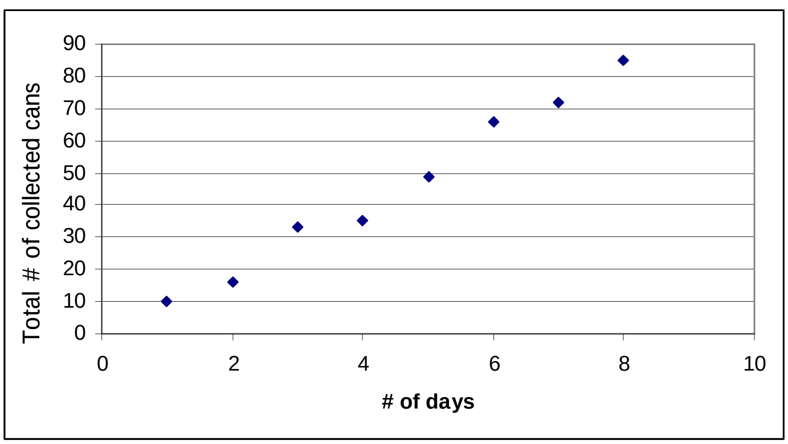
3. The following scatterplot compares the number of books ordered through the school fund raiser to the number of books that were sold.



If the mean number of books ordered is about 52, estimate the mean number of books sold based on the trends in data in the scatterplot.

A. greater than 55
B. between 50 and 55
C. between 45 and 50
D. less than 40

4. Ms. Smith's class is recording data about an aluminum can recycling project as shown in the scatterplot below.



At this rate, about how many days will it take to collect 150 cans?

A. 150 days
B. 20 days
C. 15 days
D. 10 days

Mathematics
8.12 The student uses statistical procedures to describe data. The student is expected to:

(A) select the appropriate measure of central tendency or range to describe a set of data and justify the choice for a particular situation.
(B) draw conclusions and make predictions by analyzing trends in scatterplots.
(C) Select and use an appropriate representation for presenting and displaying relationships among collected data, including line plots, line graphs, stem and leaf plots, circle graphs, bar graphs, box and whisker plots, histograms, and Venn diagrams, with and without the use of technology.

Technology Applications
The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to:

(1)(a) demonstrate knowledge and appropriate use of operating systems, software applications, and communicate and networking components.
(1)(c) demonstrate the ability to select and use software for a defined task according to quality, appropriateness, effectiveness, and efficiency.
(1)(f) perform basic software application function including, but not limited to, opening an application program and creating, modifying, printing, and saving documents.
(1)(h) use terminology related to the Internet appropriately including, but not limited to, electronic mail (e-mail), Uniform Resource Locators (URLs), electronic bookmarks, local area networks (LANs), wide area networks (WANs), World Wide Web (WWW) page, and HyperText Markup Language (HTML).

The student uses a variety of strategies to acquire information from electronic resources, with appropriate supervision. The student is expected to:

(4)(a) Use strategies to locate and acquire desired information on LANs and WANs, including the Internet, intranet, and collaborative software.

Materials

Advanced Preparation:

- Internet access to **http://www.ssa.gov/OACT/babynames/**
- Copies of **Round and Round**, **Baby Names**, and **What's In A Name** worksheets for each student
- Access to a **TI-73** for each student or pair of students

For whole class demonstration:

- Transparencies 1 - 5
- Several hula hoops (up to 1 per 2 students to save time)

- Chart paper, markers

For each student:

- **Round and Round** worksheet
- **BabyNames** worksheet
- **What's In A Name** worksheet
- TI-73

ENGAGE

The Engage portion of the lesson is designed to create student interest in the concepts addressed. This part of the lesson is designed for whole class discussion/ demonstration.

1. Prompt a student to read the "Problem" aloud from **Transparency 1** and ask students to individually consider their prediction.
2. Prompt students to share their predictions with a neighbor before getting responses from the large group.

Facilitation Questions

- What data are you collecting and comparing for each student?
  We are looking for, and comparing, the number of revolutions on the first attempt and the number of revolutions on the second attempt.
- Once several students have recorded their predictions on the numbers of revolutions on the first attempt, what will you need to consider when making predictions about the second attempt?
  Answers may vary, but you are looking for the fact that students recognize that, chances are, the change in the number of revolutions between attempts will not be exactly the same for all students—some will increase, some will not. Instead, they should look for trends that describe the change, such as "The number of revolutions for the second attempt ***tends*** *to be ______."*
- Will your prediction be true for every student? Why or why not?
  No. Point out that this exemplifies how "real" data often does not fit into "clean" or exact patterns such as linear patterns. Instead, we have to look for any trends in the data.
- How many pieces of data would you need to make a prediction about the number of revolutions on a second attempt?
  Answers may vary, but you are looking for students to recognize that the more data you have, the better defined any correlation will be.

3. Show the table on **Transparency 2** that will be used to collect the data and agree on a sample size of 10 to 15 students. You may want to agree ahead of time as to whether or not each student will be allowed a practice attempt. (If hula-hoops are not available, you can substitute another event such as paddle-ball, trash can

basketball, etc. The goal is to choose an event where the trend in the data is not obvious or that you could make a case for multiple trends. For example, one might make the case that students would have more revolutions with the hula-hoop on their 2nd attempt because of the practice they got during the 1st attempt <u>or</u> that they would have fewer on their 2nd attempt because they were tired from the 1st attempt <u>or</u> that there would be no clear correlation.)

4. Pair the students. One will hula-hoop twice and the other will record the number of revolutions on the 1st and 2nd attempt on **Transparency 2**.

Facilitation Questions

- If a student is able to complete 6 revolutions on the first attempt, what could happen on the second attempt? Why?
  The number of revolutions could be more than 6, less than 6, or the same as 6 on the second attempt.
- If that same student were able to make 10 revolutions on the second attempt (an increase of 4 over the first attempt), would this mean that the same will be true for the next student? Why?
  Possibly, but possibly not—we do not have enough data to make that prediction yet.

EXPLORE

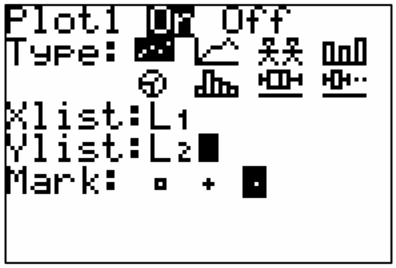
The Explore portion of the lesson provides the student with an opportunity to be actively involved in the exploration of the mathematical concepts addressed. This part of the lesson is designed for groups of 2 students or individual investigation.

1. Distribute a TI-73 to each student (or pairs of students if there is not enough technology available).
2. Distribute and go over the directions on the **Round and Round** worksheet.
3. Direct the students to input their student data from **Transparency 2** in List 1 and List 2.

Facilitation Questions

- What will you put in list 1 [L1] and what will you put in list 2 [L2]?
  List 1 will contain values from the data on the 1st attempt, and list 2 will contain values from the data on the 2nd attempt.
- Is the order in which you input the values important? Why or why not?
  The order in which the pairs of data are input is not important, but keeping the pairs of values within the same row on the list is important. In other words, it is acceptable to input the data from student #2 before the data from student #1, but it is not acceptable to pair the value of the 1st attempt from student #1 with the value of the 2nd attempt from student #2.

4. Create a scatterplot. Press [2nd][Y=] to access the Plot menu. Press [ENTER] to set the plot as shown below.



5. Press [WINDOW] to set an appropriate window that would contain the data.

Facilitation Questions

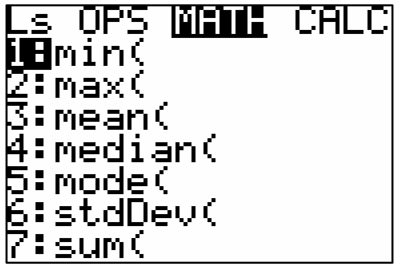
- Based on our data, what will you need to consider when setting the Xmin and Xmax in the window?
  The Xmin will need to be as small or smaller than the least value in list 1 and the Xmax will need to be as large or larger than the greatest value in list 1.
- Based on our data, what will you need to consider when setting the Ymin and Ymax in the window?
  The Ymin will need to be as small or smaller than the least value in list 2 and the Ymax will need to be as large or larger than the greatest value in list 2.
- How would you describe any trends that you might see in the scatterplot drawn from the data from your class?
  Answers may vary depending on the data collected. Look for statements such as "As the number of revolutions during the 1st attempt increases, the number of revolutions during the 2nd attempt (increases/decreases)." Or "Students tend to __________ ."

6. Point out the three scatterplots on the **Transparency 3**. Make sure the students understand that these were drawn based on fictitious data, and not their own, as they answer questions #1 – 7 on the worksheet.

Facilitation Questions

- Describe a possible scenario that would produce each of the three scatterplots.
  Answers may vary…
  Scatterplot A – Due to their practice in attempt 1, students were able to make more revolutions in attempt 2.
  Scatterplot B – Due to their efforts in attempt 1, students did not have as much energy to make as many revolutions in attempt 2.
  Scatterplot C – Some students followed the explanation of the scenario for scatterplot A and some for scatterplot B…no clear pattern for the group as a whole.

7. Prompt the students to calculate and compare the measures of central tendencies, including mean, median, and mode (worksheet #8 and 9).
   a. Go to the home screen.
   b. Press [2nd][LIST] then arrow over to the Math menu. Choose the appropriate measure.



   c. Press [ENTER]. Then press [2nd][LIST] to choose the appropriate list. Press [ENTER].
   d. Record on chart paper.

	List 1	**List 2**
Mean		
Median		
Mode		

Facilitation Questions

- What do mean, median, and mode describe about any set of data?
  Answers may vary…
  Mean – the value of each data point should all data points be "evened out"
  Median – the value of the data point in the "middle" when considering the data points in numerical order (one-half are equal or greater than the median and one-half are equal or less than the median)
  Mode – the value of the data point that occurs more often than other data points
- Looking at your data, how do the mean, median, and mode for the 1st attempt compare to that in the 2nd attempt? What might this imply about the comparison of the number of revolutions in the 2nd attempt as related to those in the 1st attempt?
  Answers may vary.
- Have the students share their answer to #9. What are you looking for in the data when you try to determine the measure of central tendency that will best describe the data?
  Answers may vary.
  Mean – data is clustered with no outliers
  Median – most of the data is clustered except for one or more outliers
  Mode – if one piece of data appeared significantly more times than others

EXPLAIN

The Explain portion of the lesson is directed by the teacher to allow the students to formalize their understanding of the TEKS addressed in the lesson.

1. Once the students have completed their work, put up **Transparency 3** to debrief.
2. Guide the students in drawing trendlines (if possible) on the three original scatterplots. Select students to draw possible trendlines on the transparency. Discuss any differences in opinion. Use the trendlines to make predictions.

Facilitation Questions

For each scatterplot (A, B, C)

- Draw a line that would include the data points if the number of revolutions on the second attempt for each student was the same as their first attempt. ($y=x$) Does this line "fit" the data? Why or why not?
  Answers may vary. Line $y = x$ will best "fit" to scatterplot A because it follows a similar trend…as x increases, y increases. Line $y = x$ does not "fit" with scatterplots B or C because the data on those scatterplots does not fit a similar trend…as x increases, y increases.
- For each scatterplot, is it possible to draw a line on the scatterplot in such a way that it better exemplifies the relationships/trends in the data?
  Answers may vary. Minor adjustments (as compared to line $y = x$) may be made for scatterplot A, whereas the trend lines for scatterplots B and C should be significantly different than line $y = x$.
- (After drawing a trendline for scatterplot A) Consider the points that would fall on or near the trendline we drew. As the number of revolutions made on the 1st attempt increases, what happens to the corresponding number of revolutions made on the 2nd attempt? *They increase as well.*
- What type of correlation (trend) is this?
  A positive correlation (trend)
- Based on this trendline, about how many revolutions would you expect students to make on their second attempt if they made 13 revolutions on their 1st attempt? What about if they had made 30 revolutions? 50 revolutions?
  Answers may vary slightly depending on how the trendline was drawn.
- (After drawing a trendline for scatterplot B) Consider the points that would fall on or near the trendline we drew. As the number of revolutions made on the 1st attempt increases, what happens to the corresponding number of revolutions made on the 2nd attempt? *They increase.*
- What type of correlation(trend) is this?
  A positive correlation(trend).
- Based on this trendline, about how many revolutions would you expect students to make on their second attempt if they made 13 revolutions on their 1st attempt? What about if they had made 30 revolutions? 50 revolutions?
  Answers may vary slightly depending on how the trendline was drawn.

Facilitation Questions

- (After attempting to draw a trendline for scatterplot C) Why is it more difficult to draw a trendline on this scatterplot?
  Answers may vary. Students should note that there is no clear pattern in the number of revolutions on the 2nd attempt (increasing or decreasing) as the number of revolutions increases on the 1st attempt. Visually, the points do not cluster around any line, rather they are spread more randomly throughout the scatterplot.
- What type of correlation (trend) is this?
  There is no correlation (trend).
- Knowing we did not draw a trendline, about how many revolutions would you expect students to make on their second attempt if they made 13 revolutions on their 1st attempt? What about if they had made 30 revolutions? 50 revolutions?
  With no clear trend, it is impossible to make a prediction based on this data alone.

3. Use **Transparency 4** to discuss looking at the data in relationship to the means or medians.
4. Draw in the mean lines and discuss the characteristics (in relationship to the mean) of the pieces of data in each of the four resulting quadrants.

Facilitation Questions

- Another way of looking at the data, other than a trendline, is to look at it in relationship to a central tendency such as mean or median. Look at scatterplot C where it was difficult to draw a trendline. What is the mean(average) number of revolutions made on the 1st attempt?
  8.6667 (Draw in a vertical line at 8.6667 on the x-axis.)
- About how many data points fell below the mean? above the mean? What does this say about the data from those students?
  6 below…3 above… Rationale may vary…should include a discussion about outliers and/or the spread of the data.
- What is the mean(average) number of revolutions made on the 2nd attempt?
  10.44 (Draw in a horizontal line at 10.44 on the y-axis.)
- About how many data points fell below that mean? Above the mean? What does this say about the data from those students?
  4 below…5 above… Rationale may vary…should include a discussion about outliers and/or the spread of the data.

Facilitation Questions

- When you look at both mean lines, the data points divide into 4 groups. Describe the characteristics of each group.
  Below the average on both attempts, below the average on the 1st attempt and above the average on the 2nd, above the average on the 1st attempt and below the average on the 2nd, above average on both attempts
- Why do you think the number of data points varies from group to group?
  The lines were drawn using the mean values. Outliers may "pull" the line away from the center.

5. Draw in the median lines and discuss the characteristics (in relationship to the mean) of the pieces of data in each of the four resulting quadrants.

Facilitation Questions

- If you were to do the same for the median lines, how do you think the data will be spread between the 4 groups?
  Because the medians are the midpoints, the data should be evenly spread between the groups.
- Why might you want to look at the data in this manner?
  Answers may vary. This is another way (other than trend lines) to communicate the relationship between the number of revolutions on the corresponding 1st and 2nd attempts.

ELABORATE

*The Elaborate portion of the lesson provides an opportunity for the student to apply the concepts of the TEKS within a new situation. This part of the lesson is designed for **groups of 2 students or individual investigation.***

1. Distribute a **Baby Name** worksheet to each student.
2. Read the "Given" and the "Question" and have students turn to a neighbor and share their thoughts before sharing with the large group.

Facilitation Questions

- Read the "Given" statements and tell me what that means in your own words.
  Answers may vary. Look for paraphrasing that connects "popularity" of names with frequency and the concept of ranking.
- Why might the popularity of certain names vary over time?
  Answers may vary. Students might consider factors such as culture, famous figures, etc.
- Read the "Question" and turn to your neighbor and share your thoughts. (Pause) Do you think there will be a difference in the change in popularity of boy names versus girl names? Why or why not?
  Answers may vary. Accept all answers for now.

3. Read through the directions and make sure students can access the data website **(http://www.ssa.gov/OACT/babynames/)** or print and have hard copies of the data available if using the Internet is not an option. NOTE: Using technology to search on the Internet is much more efficient than searching on paper.
4. Begin completing the table for the boy names as a large group to ensure students are comfortable with accessing the appropriate data.

Facilitation Questions

- (After locating the top ten boy names for 1965...) Look at the data source and explain again how certain names make this list and others do not.
  Answers may vary. Students should determine that the data comes from counting the number of times a particular first name was put on applications for Social Security cards for newborns. Ex. Since "Michael" is ranked first, this means that there were more newborns with the first name of "Michael," according to the information parents gave on their baby's Social Security card application, than any other first name.

5. Direct the students to create a scatterplot as before. Once the scatterplot is complete, direct the students' attention to the questions for the scatterplot which will have them calculate and interpret the mean, median, and range of the data. Use **Transparency 5** to debrief the activity.

Facilitation Questions

- (Upon completion of the scatterplot…) Have students share their answers to the questions below the scatterplot.
  Answers may vary..
- What was the only central tendency not calculated in the activity?
  Mode
- Why do you think mode was not included?
  Since the names each have a unique rank (understanding that it would be highly unlikely that two names would occur exactly the same number of times), there will be no mode.
- When answering #9, what characteristics in the data made you choose to draw the lines for the mean or for the median?
  Answers may vary. Look for some discussion of clustering of data and/or outliers.
- (Transparency 5 – Draw in the lines based on the discussion from the previous question, then draw in a line representing the ranking from 1965.) Describe the relationship among the three lines.
  Answers may vary. Students should note that the central tendency line for the rankings of boy names is much closer to the line representing the rankings in 1965…a visual demonstrating how the popularity of those boy names has remained somewhat steady in comparison to the girl names of similar rankings.
- Look at the lines you drew on the scatterplot. Would you say, based on the data you have, that you could better predict the change in popularity of a boy name or a girl name?
  Answers may vary. Since the points representing boy names are more clustered around that line, chances are the popularity of a boy name will change less than that of girl names with similar original rankings.
- Think back to your response to the "Question" at the beginning of the activity. Given the additional information you now have, do you need to revise or elaborate on your initial thoughts?
  Answers may vary. In general, the selection of names for girls tends to be more susceptible to varying trends than names for boys. In other words, <u>based on the data for the names we researched</u>, the popularity of a particular name for a girl is much more likely to change over time; whereas the popularity for a particular name for a boy is more likely to remain somewhat steady. Just a thought…This could be related to the custom many have of designating males as the ones who will carry on the family name.
- How are the trends in this data similar to or different than the any trend you saw in your data from the hula hoop experiment?
  Answers may vary. For example, if there was no clear trend between the numbers of revolutions made on the 1st and 2nd attempts, students might see similarities between that data and the data for the girl names.

EVALUATE

The Evaluate portion of the lesson provides the student with an opportunity to demonstrate his or her understanding of the TEKS addressed in the lesson.

1. Distribute **What's In A Name?** activity sheet to each student.
2. Upon completion of the **What's In A Name?** activity sheet, the teacher should use a rubric to assess student understanding of the concepts addressed in this lesson.
   Answers may vary somewhat…around 20,000 people with the top ranking boy name in 2010
   Justifications may vary…Based on the data in this scatterplot, there is a negative correlation between the year and the number of people with the top ranking boy name. As the years increase, the number of people with the selected name decreases. If this trend was to continue, you would expect around 20,000 people with the top ranking boy name in 2010. Students could also justify their prediction with one of the statistical measures such as finding a range and extending it to future years.

Answers and Error Analysis for selected response questions:

Question Number	TEKS	Correct Answer	Conceptual Error	Conceptual Error	Procedural Error	Procedural Error	Guess
1	8.12(B)	A	B	C			D
2	8.12(B)	C	A	B			D
3	8.12(A)	B	A	D	C		D
4	8.12(B)	A	D		B		C

Round and Round

A. Input your class data from Transparency 2.
Sketch the resulting scatterplot.

Will vary depending on data

B. For each statement, choose the scatterplot(s) that best represents the situation.

___*A, B, C*____1. After the 1st attempt, most students were able to increase the number of revolutions on their 2nd attempt.

____*none*____ 2. After the 1st attempt, most students made fewer revolutions on their 2nd attempt.

____*A*_____ 3. The number of revolutions on the 1st attempt is about the same as the number of revolutions on the 2nd attempt.

____*C*_____ 4. There is not a strong relationship between the number of revolutions made in the two attempts.

____*B*_____ 5. Most students did considerably better on their 2nd attempt than on their 1st attempt.

___*vary*____ 6. Based on the data you have from your class, which scatterplot would look most like yours? Explain.

Round and Round (continued)

7. Now that you have analyzed possible scenarios for scatterplots A, B, and C, write a statement that describes the relationship between the 1st attempt and 2nd attempt for your class.
Answers may vary.

8. Use formulas to calculate the mean, median, and mode of the data for the 1st attempt and for the 2nd attempt. Record the results below.
Answers may vary.

	1st attempt	**2nd attempt**
mean		
median		
mode		

9. Which measure of central tendency best describes the number of revolutions made on the 1st attempt and 2nd attempt? Explain your choice.
Answers may vary.

Baby Names

(based on data from Social Security card applications)

Given: Some baby names are more popular (occur more often) than others. The list of the most popular baby names changes from year to year. While some names are used less over time, others remain popular.

Question: Over the last 40 years, do you think boy names or girl names have been less "trendy"? In other words, do you think children in your generation are more likely to have the same names as adults in your parents' generation if they are boys or girls? Today you will research to compare the ranking of the most popular names in the year 1965 to the ranking of those names in the year 2004 (a span of 40 years).

Directions:
1. Go to the website below to determine the top 10 names for boys and girls in the year 1965.
2. Record the names missing in the tables below.
3. Look up ranks missing for each name for the year 2004 and add that data to the chart. (The database lists the top 1000 names. Use a rank of 1001 if a name is not included.)

http://www.ssa.gov/OACT/babynames/

BOYS		
Name	**1965 Rank**	**2004 Rank**
Michael	1	**2**
John	2	18
David	3	**16**
James	4	17
Robert	5	**29**
William	6	**8**
Mark	7	113
Richard	8	**92**
Thomas	9	37
Jeffrey	10	**149**

GIRLS		
Name	**1965 Rank**	**2004 Rank**
Lisa	1	**431**
Mary	2	**63**
Karen	3	154
Kimberly	4	**61**
Susan	5	565
Patricia	6	**317**
Donna	7	781
Linda	8	**422**
Cynthia	9	**222**
Angela	10	105

4. Looking at the data in the table, what do you notice about the change in rank of the top 10 names for boys versus the change in rank of the top 10 names for girls over the last 40 years?

Answers may vary. Students should note that the change in the rankings of the girls names is much larger than that of the boys.

5. Looking at the data in the scatterplot, explain how any observations you made from the table in #4 are reflected in the scatterplot.
Answers may vary. Students should note that the points representing the rankings of the girls names are much more spread apart (compared to their rank in 1965) than the boys.
6. Calculate the mean rank of the given boy names for 2004 and girl names for 2004. How many boy names and how many girl names were more popular than the mean rank?
7 boy names and 5 girl names are less than their respective means, therefore more popular.
7. Calculate the median rank of the given boy names for 2004 and girl names for 2004. How many boy names and how many girl names were more popular than the median rank?
5 boy names and 5 girl names are less than their respective medians, therefore more popular.
8. Calculate the range in the rankings of the given boy names for 2004 (cell B43) and girl names for 2004. How does the range value for the boys compare to that of the girls? What does this mean?
Answers may vary. Students should note that the range in 2004 rankings for the boys is much smaller than that of the girls, meaning their rankings are closer together in value.
9. Determine whether the mean or median best describes the data. Position the lines below the scatterplot (solid for boys and dashed for girls) on the scatterplot to represent these measurements. What does the position of the lines on the scatterplot emphasize about the relationship between how the popularity of the top ten names for boys and girls has changed from your parents' generation to now?
Answers may vary…a case could be made for the median being the better descriptor due to the wide spread in the data. In either case, students should note that any change in popularity over time was more dramatic for girl names than it was for boy names since that line is farther from the original rankings.
10. Describe the relationship between the points on the scatterplot and the lines you drew in #9 for the boy names and the girl names. What does this mean?
Answers may vary. The points representing rankings of the boy names are much closer to that line than the points representing rankings of the girl names are to their line.

Transparency 1

How many revolutions of a hula hoop can you achieve in one attempt?

Will this prediction change for a second attempt? Why or why not?

How might we gather data to test our predictions?

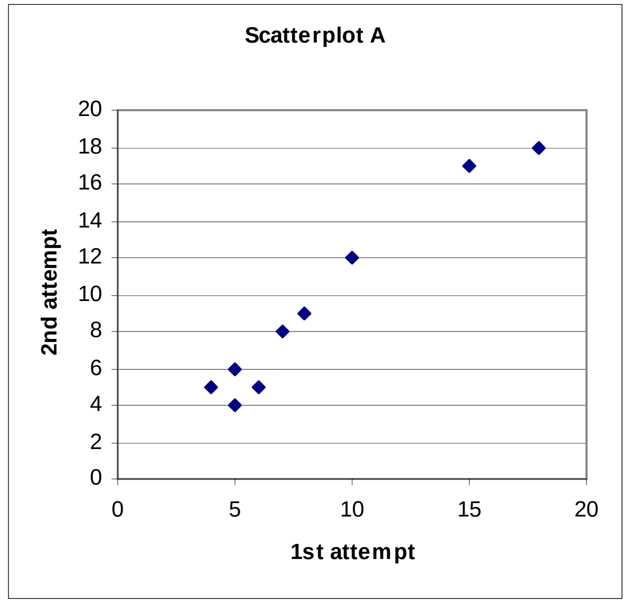
Transparency 2

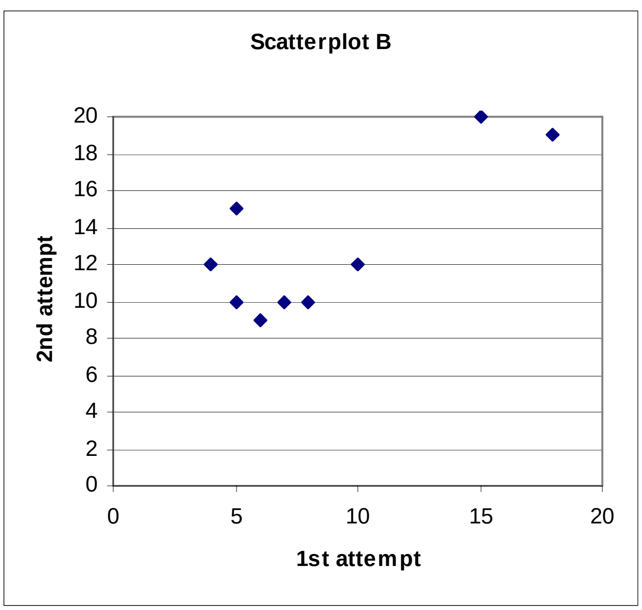
Student	# Revolutions on 1^{st} Attempt	# Revolutions on 2^{nd} Attempt

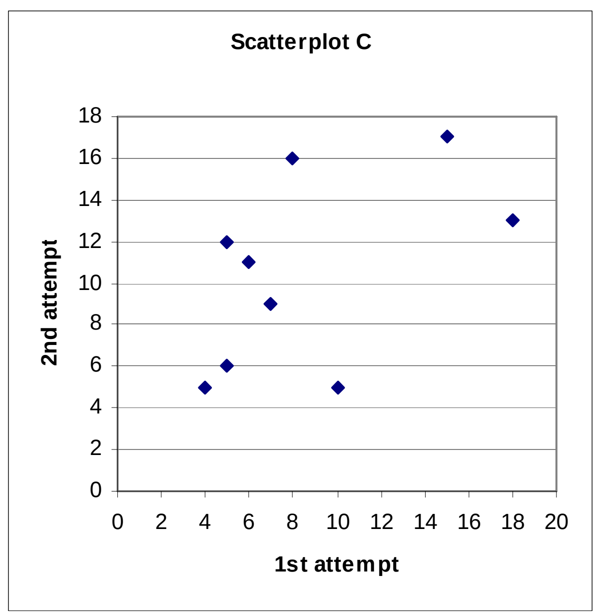
Transparency 3

1. If possible, sketch a trendline.

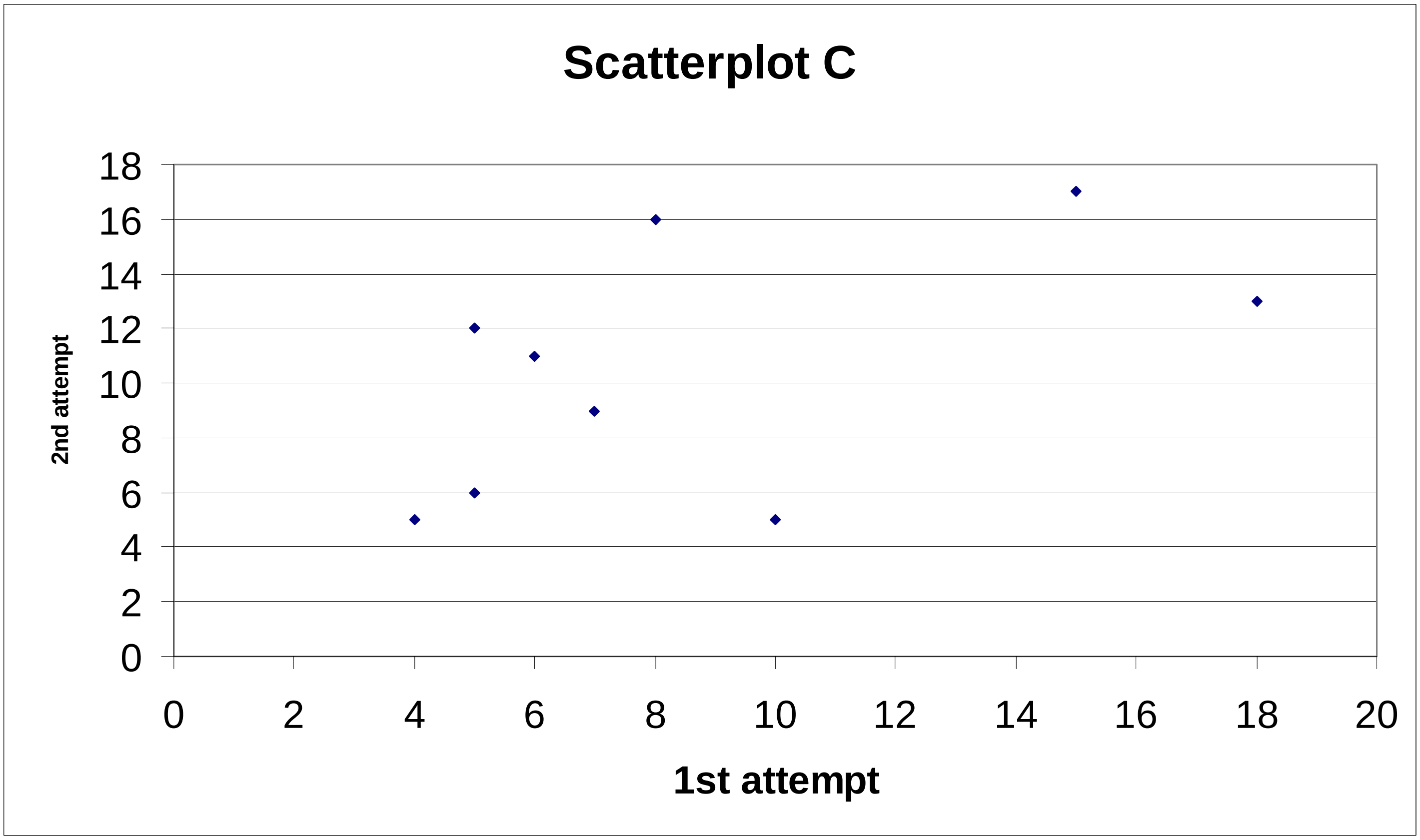
2. Predict the number of revolutions on the 2nd attempt if the number on the 1st attempt was 13...30...100.





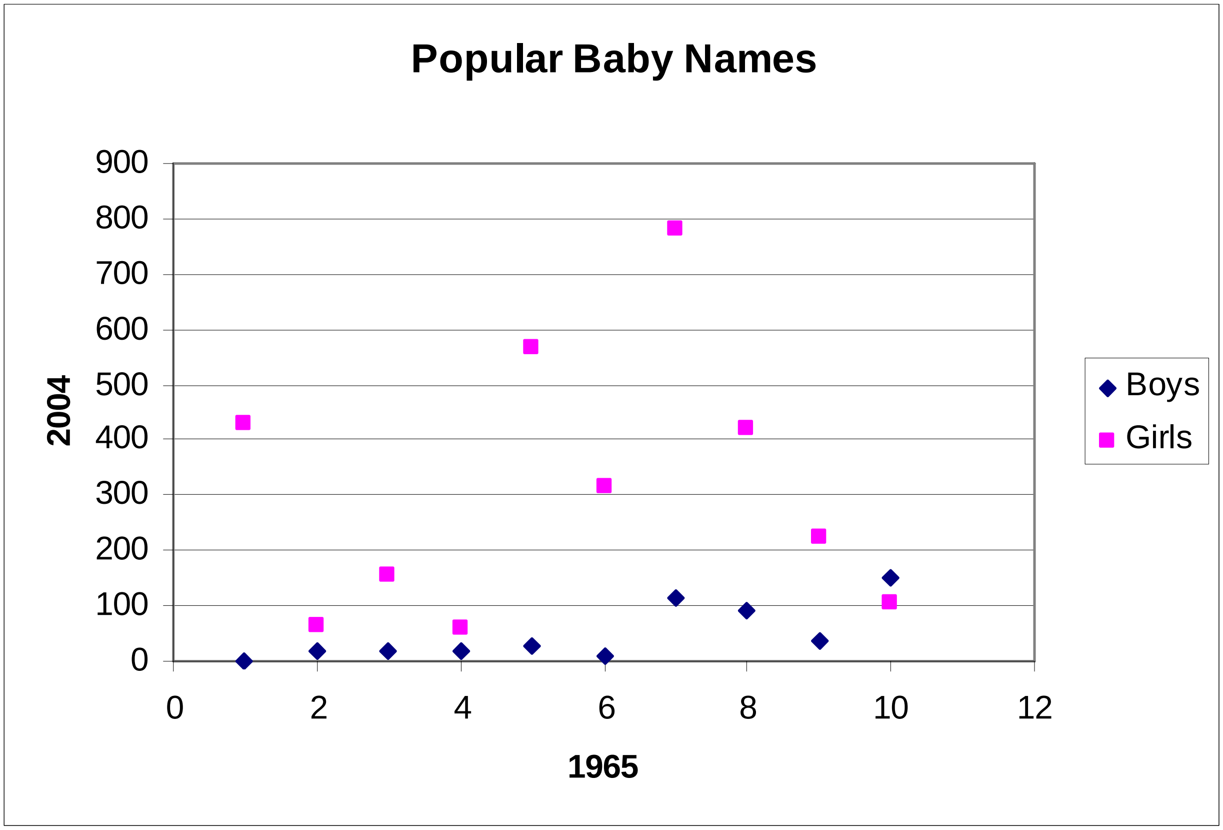


Transparency 4



	1^{st} attempt	2^{nd} attempt
mean	8.6667	10.44
median	9.0741	10.94

Transparency 5



	1965	2004 – Boys	2004 – Girls
Mean	5.5	48.1	312.1
Median	5.5	23.5	269.5
Range	9	147	504

Student Name(s)________________________________ Date______________

Round and Round

A. Input your class data from Transparency 2. (Use the table that starts in row 6.)

Sketch the resulting scatterplot.

B. For each statement, choose the scatterplot(s) that best represents the situation.

__________1. After the 1st attempt, most students were able to increase the number of revolutions on their 2nd attempt.

__________2. After the 1st attempt, most students made fewer revolutions on their 2nd attempt.

__________3. The number of revolutions on the 1st attempt is about the same as the number of revolutions on the 2nd attempt.

__________4. There is not a strong relationship between the number of revolutions made in the two attempts.

__________5. Most students did considerably better on their 2nd attempt than on their 1st attempt.

__________6. Based on the data you have from your class, which scatterplot would look most like yours? Explain.

Student Name(s)____ Date________________

Round and Round (continued)

7. Now that you have analyzed possible scenarios for scatterplots A, B, and C, write a statement that describes the relationship between the 1st attempt and 2nd attempt for your class.

8. Use formulas to calculate the mean, median, and mode of the data for the 1st attempt and for the 2nd attempt. Record the results below.

	1st attempt	**2nd attempt**
mean		
median		
mode		

9. Which measure of central tendency best describes the number of revolutions made on the 1st attempt and 2nd attempt? Explain your choice.

Baby Names

(based on data from Social Security card applications)

Given: Some baby names are more popular (occur more often) than others. The list of the most popular baby names changes from year to year. While some names are used less over time, others remain popular.

Question: Over the last 40 years, do you think boy names or girl names have been less "trendy"? In other words, do you think children in your generation are more likely to have the same names as adults in your parents' generation if they are boys or girls? Today you will research to compare the ranking of the most popular names in the year 1965 to the ranking of those names in the year 2004 (a span of 40 years).

Directions:
1. Go to the website below to determine the top 10 names for boys and girls in the year 1965.
2. Record the names missing in the tables below.
3. Look up ranks missing for each name for the year 2004 and add that data to the chart. (The database lists the top 1000 names. Use a rank of 1001 if a name is not included.)

http://www.ssa.gov/OACT/babynames/

BOYS		
Name	**1965 Rank**	**2004 Rank**
	1	
John	2	18
David	3	
James	4	17
	5	
William	6	
	7	113
Richard	8	
Thomas	9	37
Jeffrey	10	

GIRLS		
Name	**1965 Rank**	**2004 Rank**
	1	
Mary	2	
	3	154
Kimberly	4	
Susan	5	565
Patricia	6	
Donna	7	781
	8	
Cynthia	9	
Angela	10	105

Baby Names

4. Looking at the data in the table, what do you notice about the change in rank of the top 10 names for boys versus the change in rank of the top 10 names for girls over the last 40 years?

5. Looking at the data in the scatterplot, explain how any observations you made from the table in #4 are reflected in the scatterplot.

6. Calculate the mean rank of the given boy names for 2004 and girl names for 2004. How many boy names and how many girl names were more popular than the mean rank?

7. Calculate the median rank of the given boy names for 2004 and girl names for 2004. How many boy names and how many girl names were more popular than the median rank?

8. Calculate the range in the rankings of the given boy names for 2004 and girl names for 2004. How does the range value for the boys compare to that of the girls? What does this mean?

9. Determine whether the mean or median best describes the data. Position the lines below the scatterplot (solid for boys and dashed for girls) on the scatterplot to represent these measurements. What does the position of the lines on the scatterplot emphasize about the relationship between how the popularity of the top ten names for boys and girls has changed from your parents' generation to now?

10. Describe the relationship between the points on the scatterplot and the lines you drew in #9 for the boy names and the girl names. What does this mean?

What's In A Name?

1. Access the website **http://www.ssa.gov/OACT/babynames/** . In an earlier activity we compared the ranking of the top ten names of your parents' generation (1965) to the ranking of those names today to answer the question about how the popularity of names stands the test of time.
   a. Consider the following set of questions.
      How has the number of people having the most popular boy name changed over the last 10 years? How many people do you predict might have the most popular name in 2010?
   b. Fill in the table using the website.

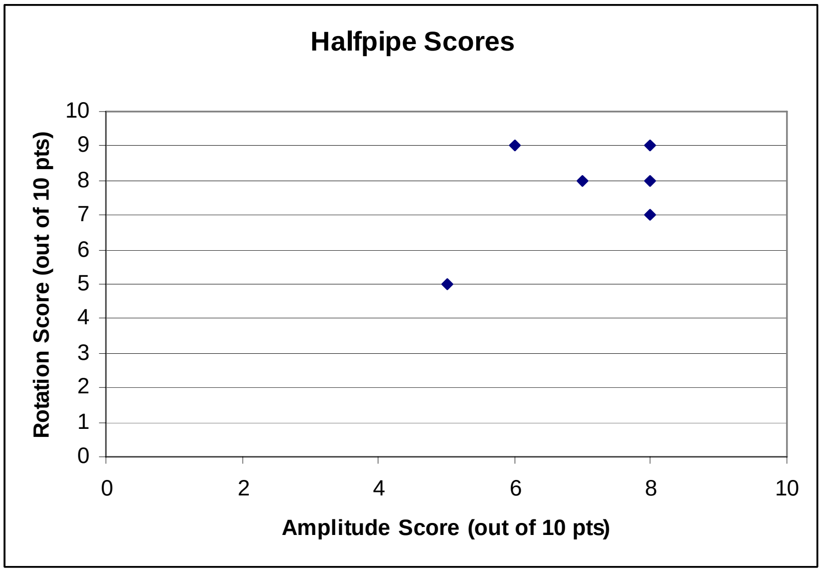
?	**?**

   c. Use the TI-73 to create a scatterplot.
   d. Draw a trendline if appropriate.
   e. Calculate the mean, median, and range of your data.

Minimum	
Maximum	
Mean (average)	
Median	
Mode	
Range	

   f. Respond to the questions in part a. Justify your answers using the scatterplot, trendline, and/or statistical measurements to support your conclusions.

1. The scatterplot below compares the score for amplitude (height) to the score for rotations (spins and flips) for six skateboarders at the weekend meet.



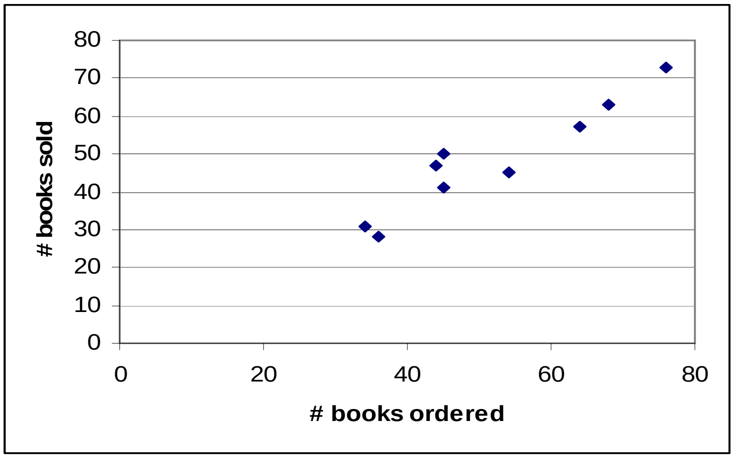
Which of the following statements would be supported by the scatterplot?

A. As the score for amplitude increases, the score for rotations tends to increase.
B. As the score for amplitude increases, the score for rotations tends to decrease.
C. As the score for rotations increases, the score for amplitude tends to decrease.
D. The score for rotations tends to be the same as the score for amplitude.

2. Which relationship, when graphed on a scatterplot, would **not** be described as having a positive trend?

A. Height of a student compared to his/her weight
B. The amount of money earned babysitting compared to the number of hours spent babysitting
C. The number of miles driven compared to the amount of gas in the tank of the car
D. All of the above relationships have a positive trend.

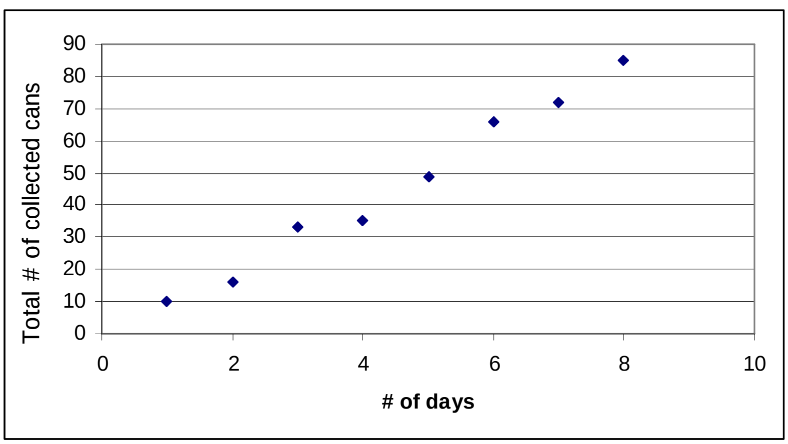
3. The following scatterplot compares the number of books ordered through the school fund raiser to the number of books that were actually paid for and sold.



If the mean(average) number of books ordered is about 52, estimate the mean(average) number of books sold based on the trends in data in the scatterplot.

A. greater than 49
B. between 47 and 49
C. between 45 and 47
D. less than 45

4. Ms. Smith's class is collecting aluminum cans for a recycling project as shown in the scatterplot below.



At this rate, about how many days will it take to collect 150 cans?

A. 15 days
B. 10 days
C. 20 days
D. 150 days