Frank Ashley, Ph.D.
Texas A&M University-Commerce
P.O. Box 3011
Commerce, TX 75429-3011
Phone: 903-886-5180
Fax: 903-886-5905
E-mail: Frank_Ashley@tamu-commerce.edu

The Teaching Mathematics TEKS Through Technology Institutes were developed under the direction and assistance of the following:

Tyson Bennett, Ph.D., Project Manager .... Texas A&M University-Commerce
Jo Ann Wheeler, Project Manager .... Region 4

David Eschberger, Project Co-Director .... Region 4
Eileen Faulkenberry, Ph.D., Project Co-Director .... Texas A&M University-Commerce

Development Team
Sharon Benson .... Region 4
Kareen Brown .... Region 4
Cheryl Black .... Cypress-Fairbanks ISD
Gary Cosenza .... Independent Consultant
Ramona Davis .... Cypress-Fairbanks ISD
Diane Edgar .... Region 4
Eileen Faulkenberry, Ph.D. .... Texas A&M University-Commerce
David Eschberger .... Region 4
Linda Gillis .... Region 4
Paul Gray .... Region 4
Dina Griffin .... Region 4
Marcy Kay Harris .... Region 4
Julie Horn .... Region 4
David Jacobson .... Region 4
Anne Konz .... Cypress-Fairbanks ISD
Denise Kubecka .... Cypress-Fairbanks ISD
Donna Landrith .... Region 4
Christy Linsley .... Region 4
David McReynolds .... Region 4
Sherry Olivares .... Region 4
Judy Rice .... Region 4
Linda Sams .... Cypress-Fairbanks ISD
Lymeda Singleton .... Texas A&M University-Commerce
Callie Shelton .... Region 4
Pamela Webster, Ed.D. .... Texas A&M University-Commerce
Jo Ann Wheeler .... Region 4

Editors
Deborah Fitzgerald .... Independent Consultant
Martha Parham .... Independent Consultant

Project Evaluation
Maribeth McAnally .... Texas A&M University-Commerce

Advisory Committee Members

Dr. Lesa Beverly	Stephen F. Austin State University
Susan Boone	Houston ISD
Beth Bos	University of Houston
Cindy Boyd	Abilene ISD
Sandra Browning	Seguin ISD
Gary Cosenza	Independent Consultant
Marc Curliss	Region 12
Karen Duncan	Northside ISD
Carrie English	Anahuac ISD
James Epperson, Ph.D.	University of Texas-Arlington
David Eschberger	Region 4
Eileen Faulkenberry, Ph.D.	Texas A&M University Commerce
Gaye Glenn	Region 2
Ken Grantham	Dallas ISD
Kathy Hale	Region 14
Donna Harris	Region 11
Shary Horn	Alvin ISD
Karen Kahan	Texas Education Agency
Michelle King	Coppell ISD
Denise Kubecka	Cypress-Fairbanks ISD
Gail London	Rockwall ISD
Jack Madding	Region 9
Dollie Mayeux	Galena Park ISD
Maribeth McAnally	Texas A&M University Commerce
Daniel O'Killen	Alief ISD
Sherry Olivares	Region 4
Richard Powell	Texas Education Agency
Judy Rice	Region 4
Sheryl Roehl	South Texas Rural Systemic Initiative
Rozanne Rubin	Alief ISD
Linda Sams	Cypress-Fairbanks ISD
Jane Silvey	Region 7
Sally Staner	Fort Bend ISD
Norma Torres-Martinez	Texas Education Agency
Jacqueline Weilmuenster	Grapevine-Colleyville ISD
Jo Ann Wheeler	Region 4
Elaine Young, Ph.D.	Texas A&M University-Corpus Christi

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.

TABLE OF CONTENTS

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.

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.

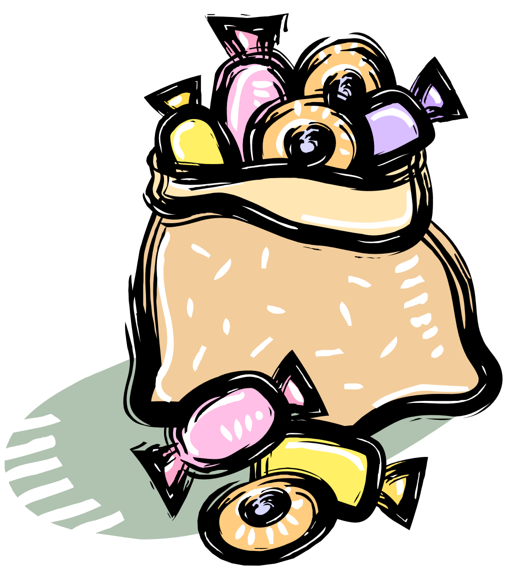
Transparency: Chocolate Candy

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.



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.

Simple Probability, Bar and Circle Graphs Spreadsheet

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.

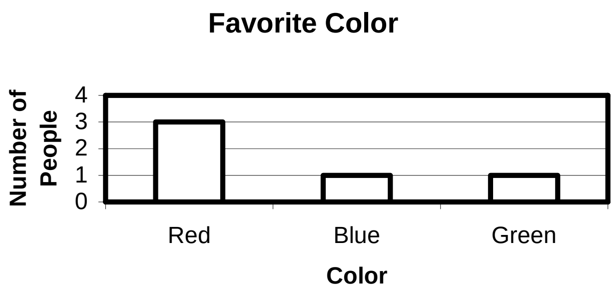
1. Distribute the **You Design It** activity sheet to each student.
2. Upon completion of the activity sheet, use a rubric to assess student understanding of the concepts addressed in the lesson.

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.

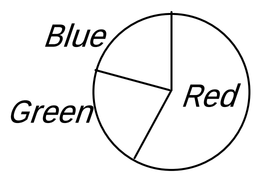
1. How many color tiles of each color should she put in the bag? Justify your answer.
   3 red, 1 blue, and 1 green

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.

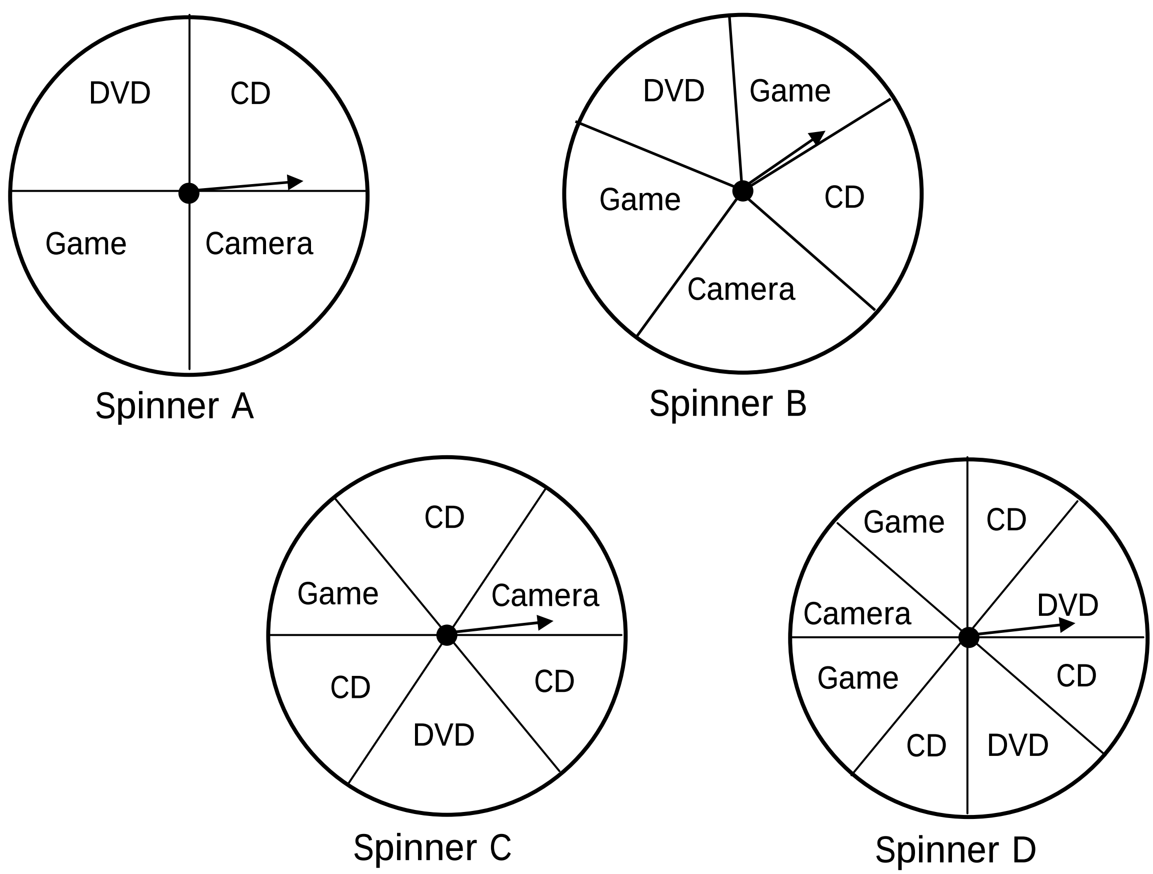
P(Red) $= \frac{1}{3}$
P(Blue) $= \frac{1}{4}$
P(Green) $= \frac{1}{4}$
P(Yellow) $= \frac{1}{6}$

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.



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.

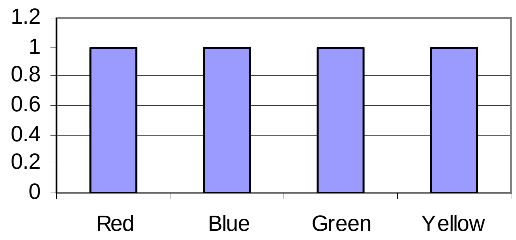
5. Create a spinner so the customer's chance of winning a DVD is better than the chance of winning a video game. Justify your spinner.

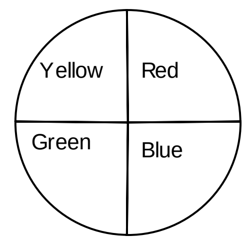
6. Create a spinner so that the customer's chance of winning a CD is the same as not winning a CD. Justify your spinner.

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 $\frac{1}{4}$.

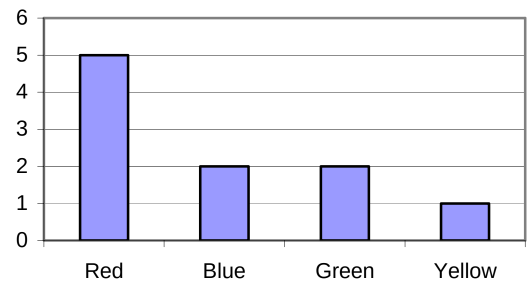
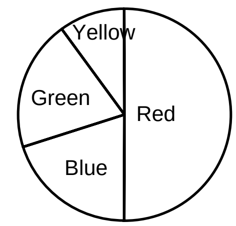
The theoretical probability of NOT drawing green is $\frac{3}{4}$.

The theoretical probability of drawing yellow is $\frac{1}{4}$.

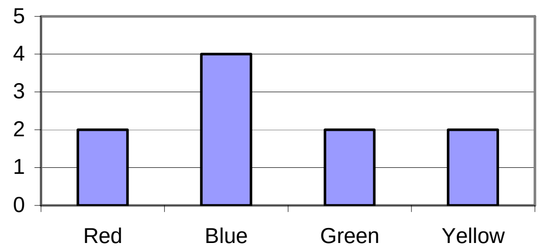
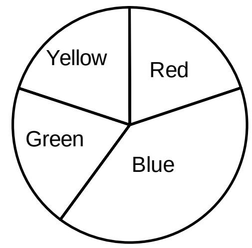
The theoretical probability of NOT drawing blue is $\frac{3}{4}$.

A bag contains four marbles: 1 red, 1 blue, 1 yellow, and 1 green marble.

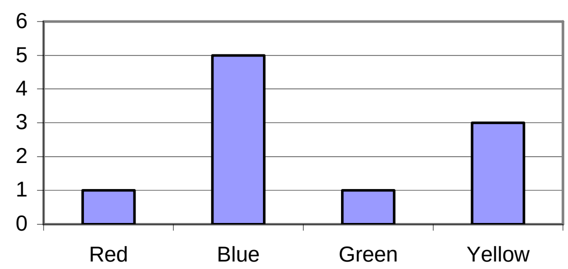
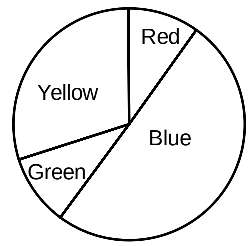
Let's Match It - Activity Master

	
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

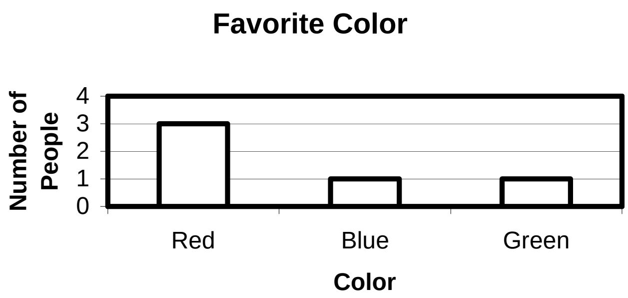
	
The theoretical probability of drawing red is $\frac{1}{5}$.	The theoretical probability of NOT drawing blue is $\frac{3}{5}$.
The theoretical probability of NOT drawing yellow is $\frac{4}{5}$.	The theoretical probability of drawing green is $\frac{1}{5}$.
A bag contains 10 marbles: 2 red, 4 blue, 2 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.	

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 $\frac{1}{4}$

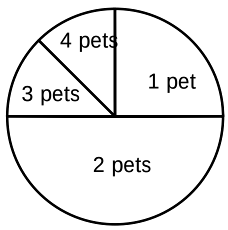
3 Alicia conducted a survey about the number of pets people owned. The results of the survey are shown in the table below.

Number of Pets

Number of Pets	People
1	50
2	100
3	25
4	25

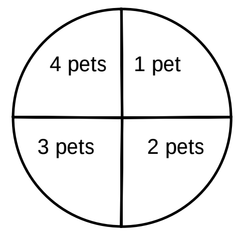
A

Number of Pets



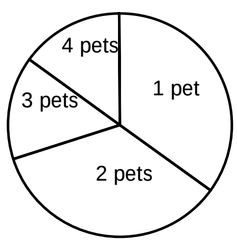
C

Number of Pets

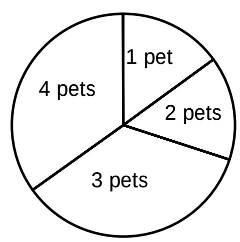


B

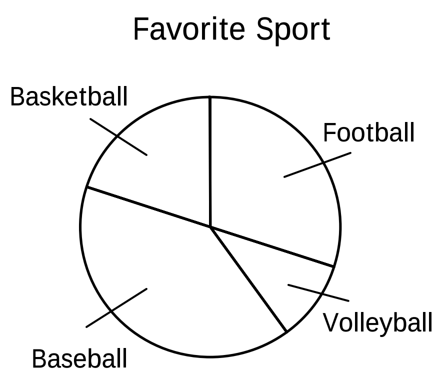
Number of Pets



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.

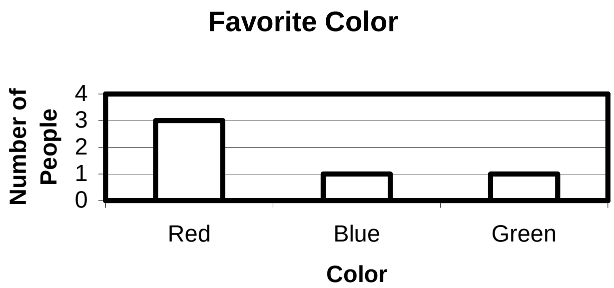
Answers and Error Analysis for selected response questions:

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.

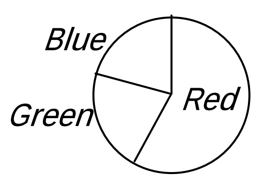
1. How many color tiles of each color should she put in the bag? Justify your answer.
   3 red, 1 blue, and 1 green

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.

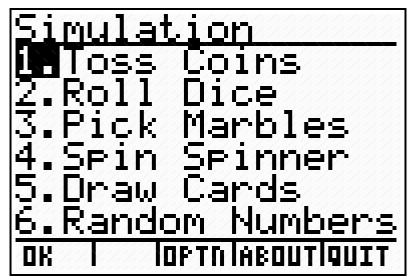
Part III.

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

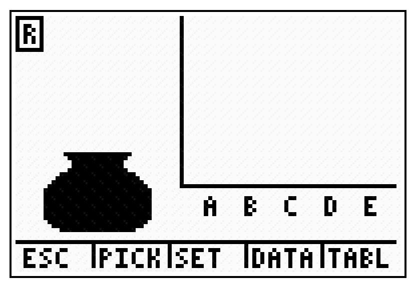
By using the TI-73 calculator to simulate the experiment a large data set can be collected in a very short amount of time.

A. [ON]→[APPS] → (Prob Sim)→[ENTER]

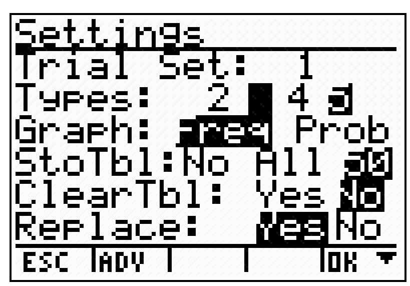
B. [3] *(Pick Marbles)*



C. [ZOOM] *(Set for settings)*



D. Under Settings, set up as illustrated.
Trial Set: 1
Types: 3
Replace: Yes



(Continue: What Color? – Part III.)

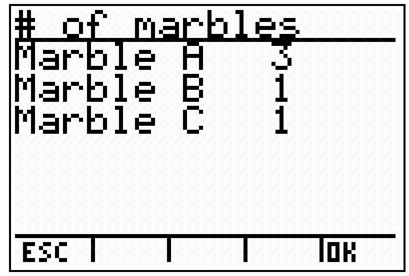
E. [WINDOW]

Under # of marbles, set up colors as illustrated.

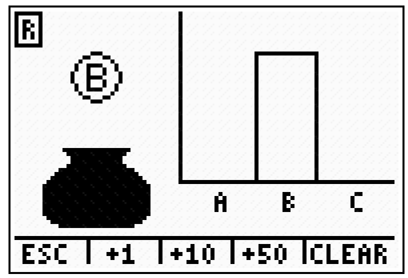
Red → Marble A: 3

Blue → Marble B: 1

Green →Marble C: 1

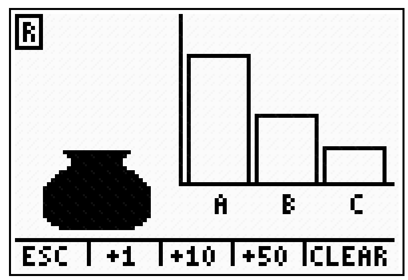


F. [ENTER]



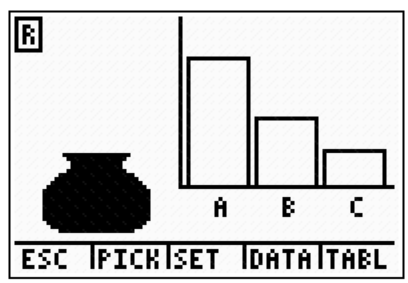
G. [TRACE]

(this will simulate 50 trials)



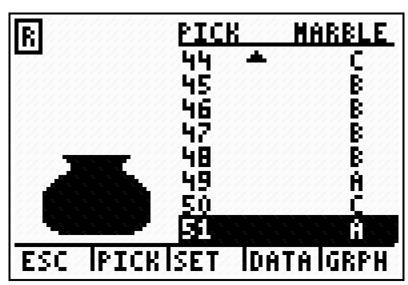
H. [GRAPH]

(this will show a table of the data generated)



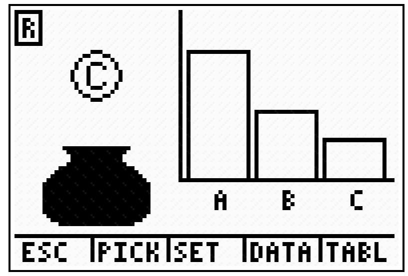
I. [TRACE]

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.

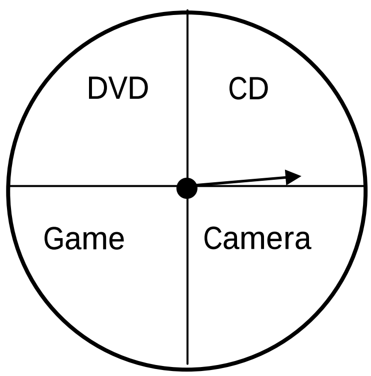
P(Red) $= \frac{1}{3}$
P(Blue) $= \frac{1}{4}$
P(Green) $= \frac{1}{4}$
P(Yellow) $= \frac{1}{6}$

Explain how you designed your spinner.

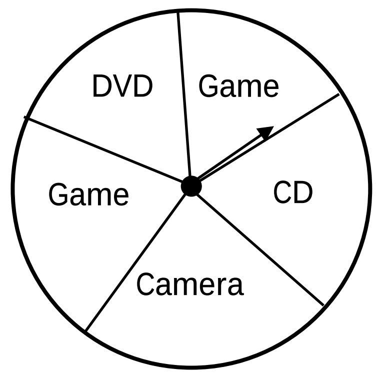
Answers may vary. However, the spinner should have 12 sections with 4 labeled red, 3 labeled blue, 3 labeled green, and 2 labeled yellow.

Prize Dilemma - Transparency

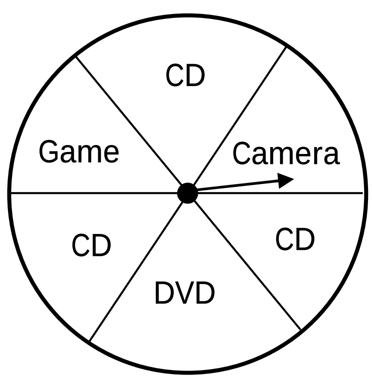
An electronics store is giving away prizes to its customers. Each customer will spin a spinner and receive the prize that the spinner lands on. The four spinners shown below are the spinners the company is considering using.



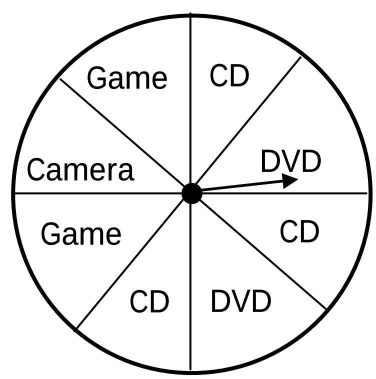
Spinner A



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

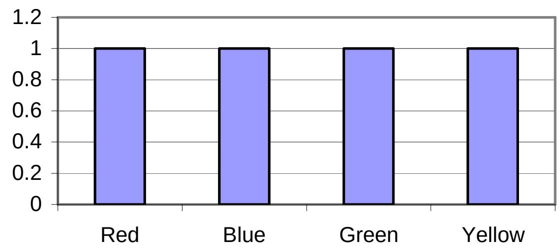
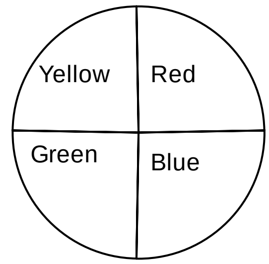
Let's Match It

Let's Match It

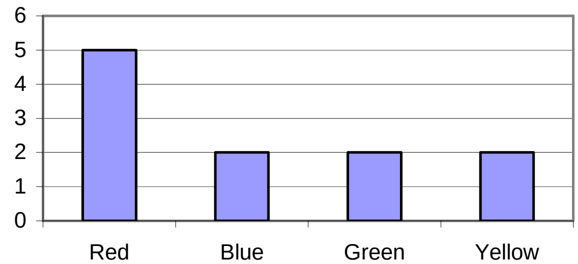
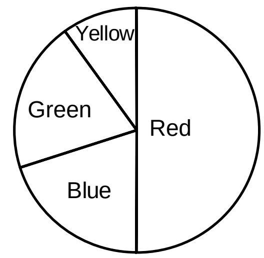
Let's Match It

Let's Match It

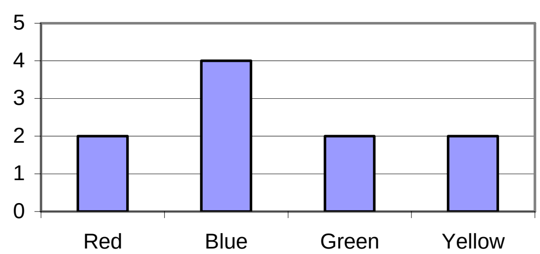
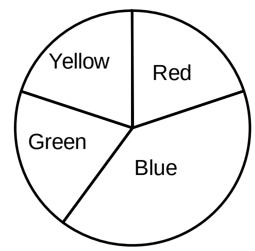
Activity Master – Let's Match It

	
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.	

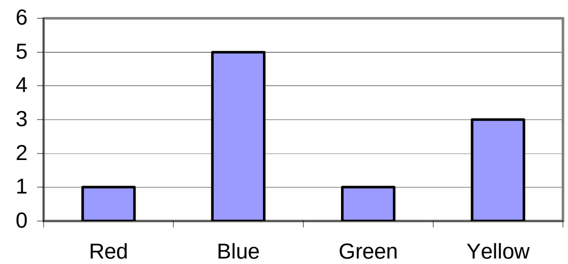
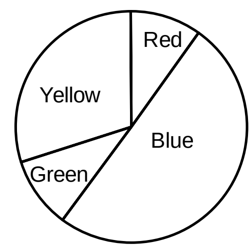
Activity Master – Let’s Match It

<table>
<tr>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>The theoretical probability of NOT drawing red is $\frac{1}{2}$.</td>
<td>The theoretical probability of drawing blue is $\frac{1}{5}$.</td>
</tr>
<tr>
<td>The theoretical probability of drawing green is $\frac{1}{5}$.</td>
<td>The theoretical probability of NOT drawing yellow is $\frac{9}{10}$.</td>
</tr>
<tr>
<td>A bag contains 10 marbles: 5 red, 2 blue, 1 yellow, and 2 green marbles.</td>
<td></td>
</tr>
</table>

Activity Master – Let's Match It

<table>
<tr>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>The theoretical probability of drawing red is $\frac{1}{5}$.</td>
<td>The theoretical probability of NOT drawing blue is $\frac{3}{5}$.</td>
</tr>
<tr>
<td>The theoretical probability of NOT drawing yellow is $\frac{4}{5}$.</td>
<td>The theoretical probability of drawing green is $\frac{1}{5}$.</td>
</tr>
<tr>
<td>A bag contains 10 marbles: 2 red, 4 blue, 2 yellow, and 2 green marbles.</td>
<td></td>
</tr>
</table>

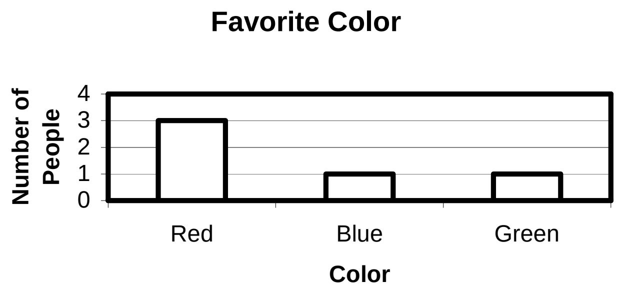
Activity Master – Let's Match It

	
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.

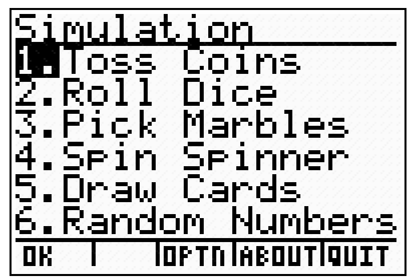
Part III.

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

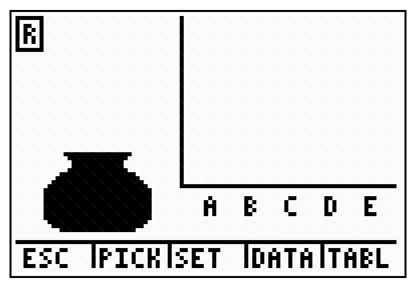
By using the TI-73 calculator to simulate the experiment a large data set can be collected in a very short amount of time.

A. [ON]→[APPS] → (Prob Sim)→[ENTER]

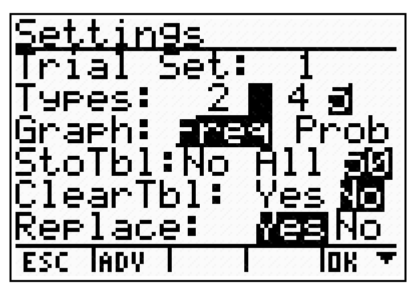
B. [3] *(Pick Marbles)*



C. [ZOOM] *(Set for settings)*



D. Under Settings, set up as illustrated.
Trial Set: 1
Types: 3
Replace: Yes



(Continue: What Color? – Part III.)

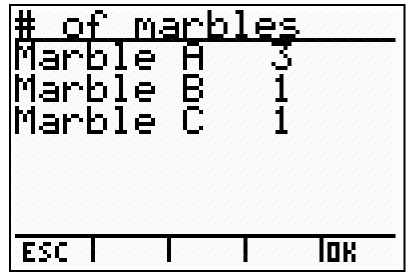
E. WINDOW

Under # of marbles, set up colors as illustrated.

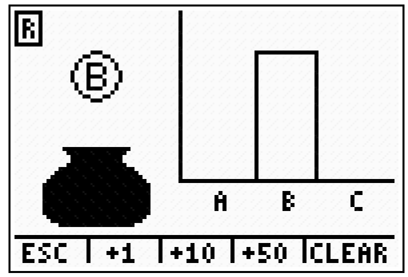
Red → Marble A: 3

Blue → Marble B: 1

Green →Marble C: 1

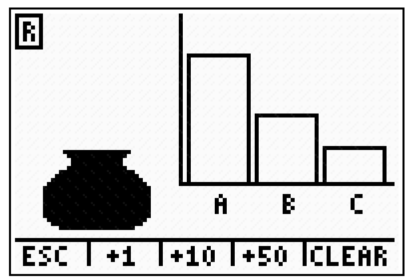


F. ENTER



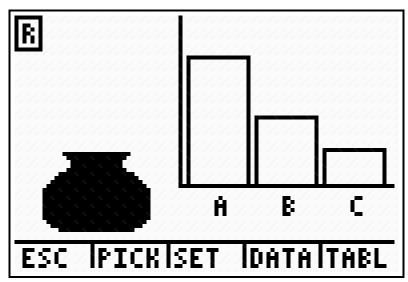
G. TRACE

(this will simulate 50 trials)

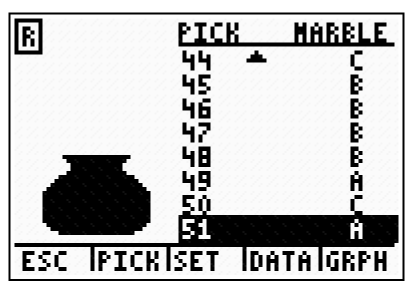


H. GRAPH

(this will show a table of the data generated)



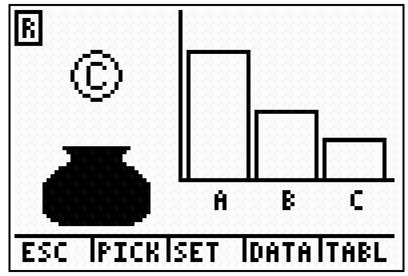
I. TRACE



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 $\frac{1}{4}$

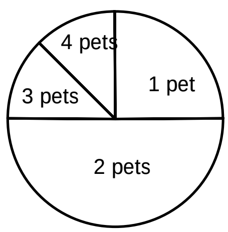
3 Alicia conducted a survey about the number of pets people owned. The results of the survey are shown in the table below.

Number of Pets

Number of Pets	People
1	50
2	100
3	25
4	25

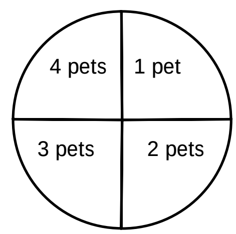
A

Number of Pets



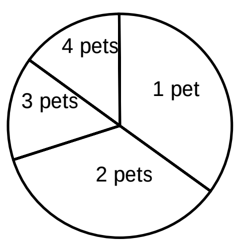
C

Number of Pets

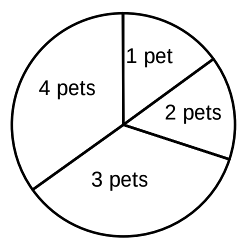


B

Number of Pets

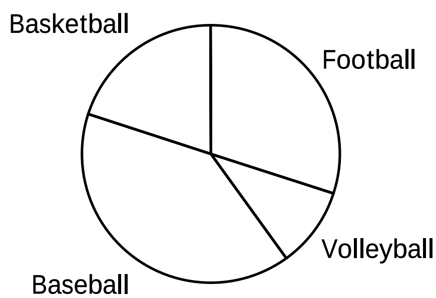


Number of Pets



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.

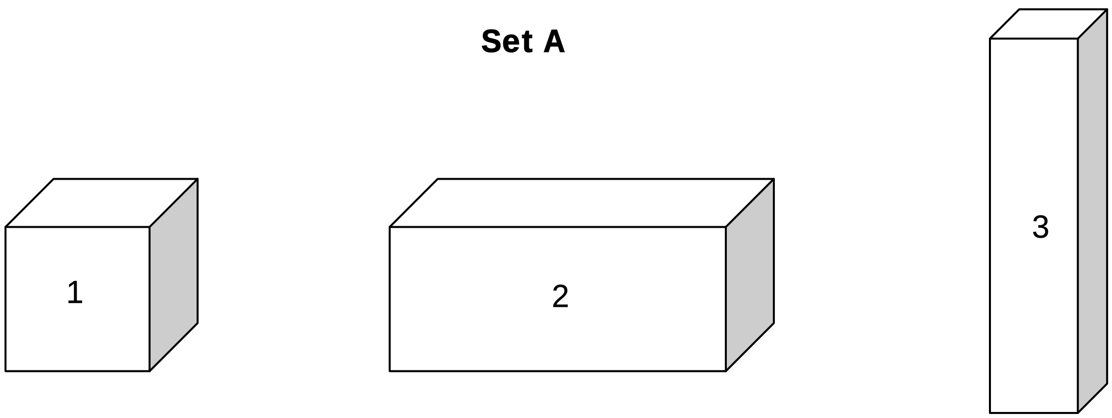
5. Print the file when finished. Be sure to ask your teacher for any special directions before printing.

How Do These Shapes Measure Up? ***(Possible Answers)***

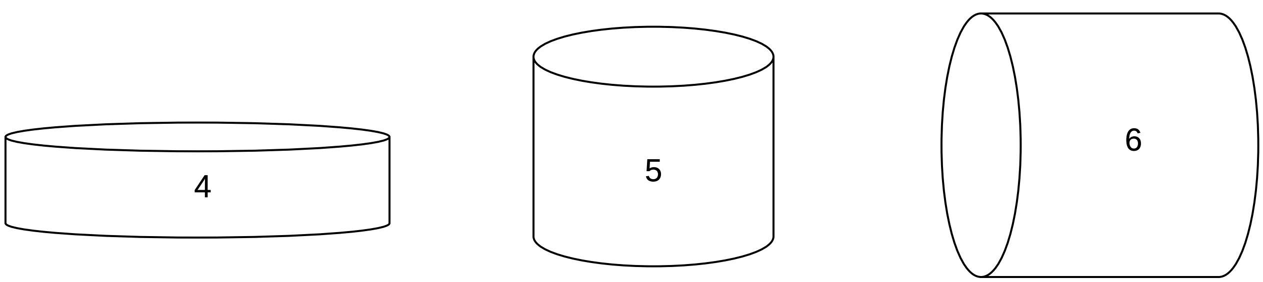
1. Look at each set of figures below. Make a prediction about the mean, median, and mode for the heights of each set. For which set of data do you predict the mean, median, and mode to be the same? Which set do you predict to have the greatest mean? Which set do you predict to have the smallest mean?

   Answers may vary. Students should use the size of the figures to make predictions.

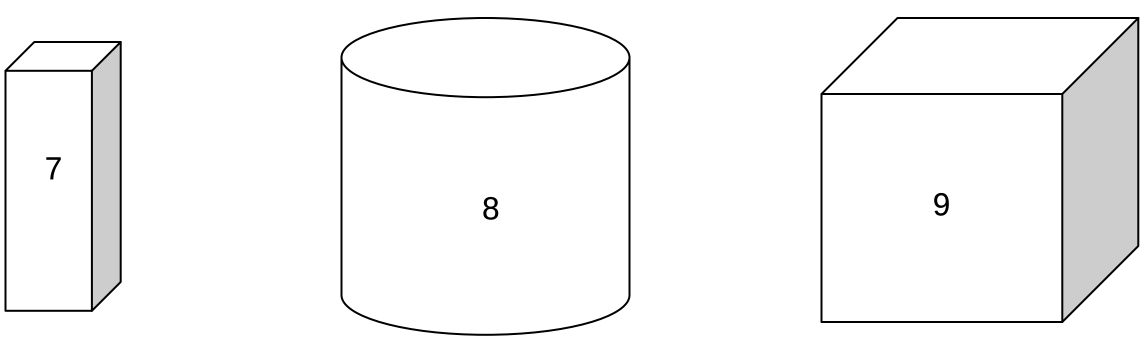
Set A



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.

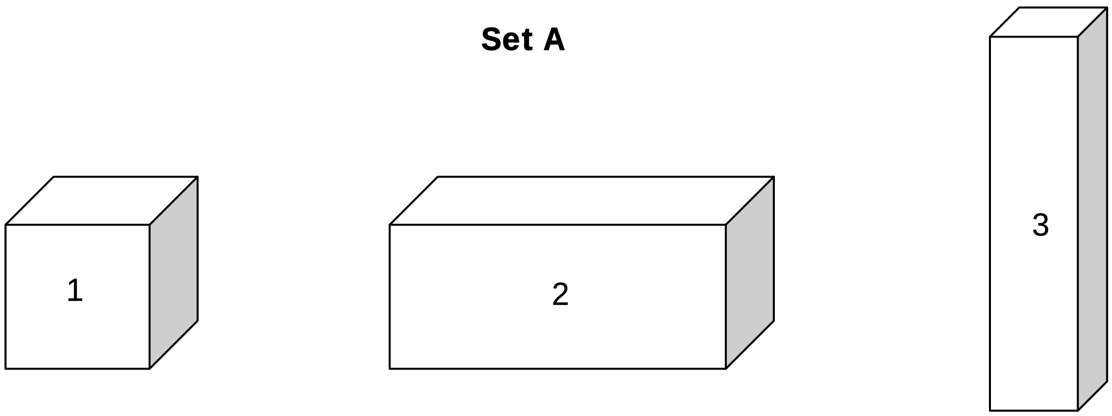
4. How close were your predictions to the actual mean, median and mode? Explain similarities and differences.

5. Print the file when finished. Be sure to ask your teacher for any special directions before printing.

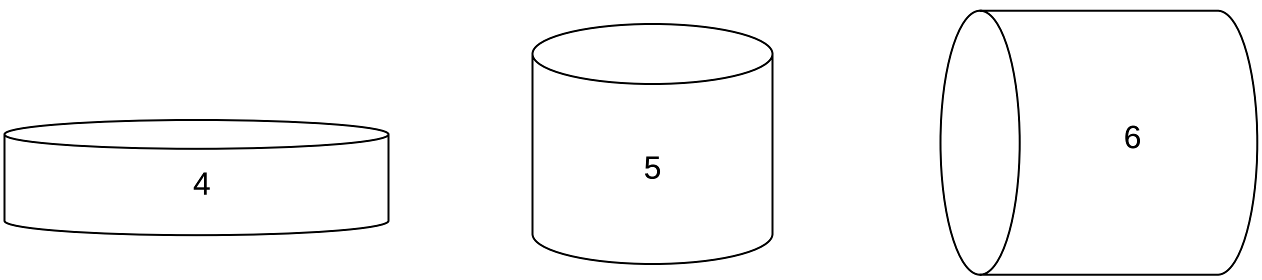
How Do These Shapes Measure Up?

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?

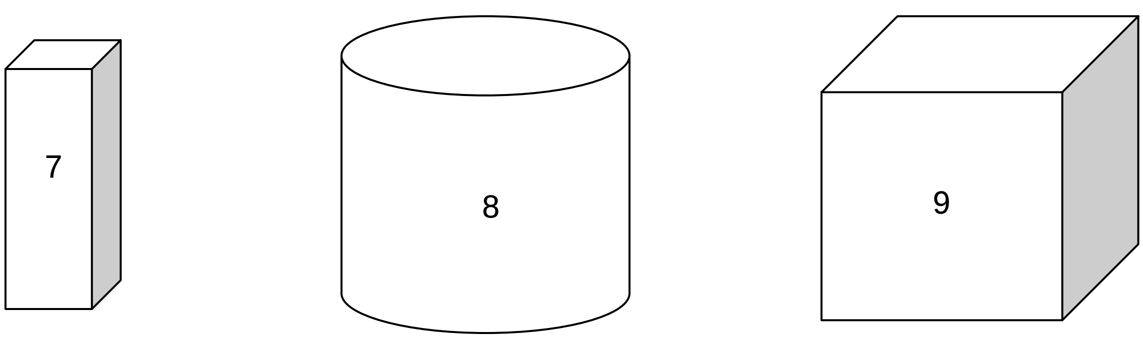
Set A



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
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.

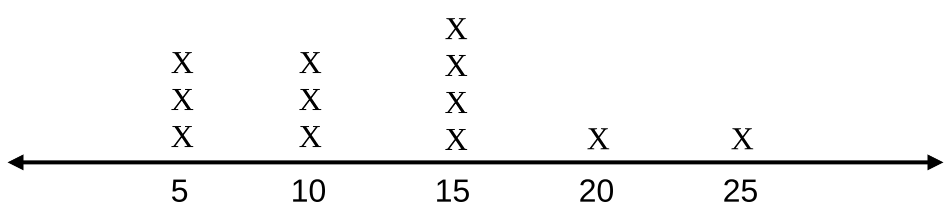
1. The table shows the number of points Menu scored during the first 5 basketball games.

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)	***(Definition)***
Mean	*The sum of the numbers in a set of data divided by the number of pieces of data.*
(Examples)	***(Non-Examples)***
Average of 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?
  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 $\boxed{\text{LIST}}$.
      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 $\boxed{\text{2nd}}\boxed{\text{LIST}}$ to access the STAT menu.
Press $\boxed{\blacktriangleright}$ to arrow over to MATH.
Press $\boxed{\blacktriangledown}$ to arrow down to median(
Press $\boxed{\text{ENTER}}$.
Press $\boxed{\text{2nd}}\boxed{\text{LIST}}$ L_1 $\boxed{\text{ENTER}}$.
Press $\boxed{\text{ENTER}}$.

To check the mode:

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 mode(
Press $\boxed{\text{ENTER}}$.
Press $\boxed{\text{2nd}}\boxed{\text{LIST}}$ L_1 $\boxed{\text{ENTER}}$.
Press $\boxed{\text{ENTER}}$.

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.

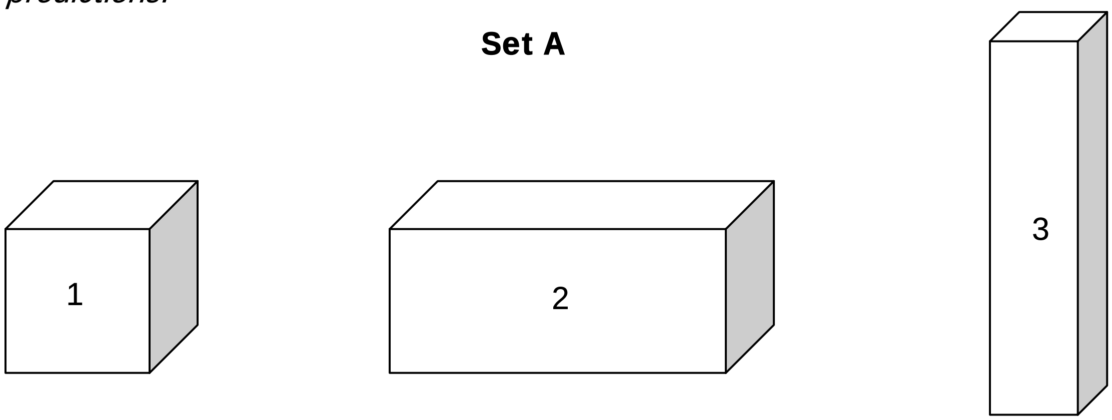
   Mean __*31.7*_ Median __*29.5*__ Mode __*52*__

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.

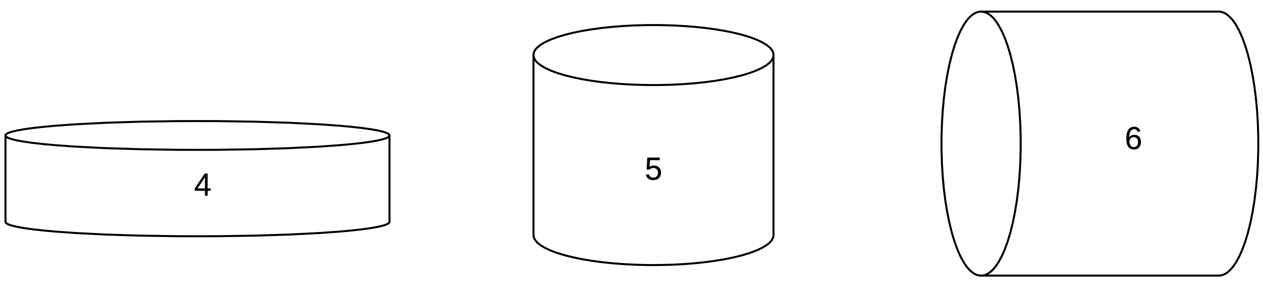
How do these shapes measure up? ***(Possible Answers)***

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.

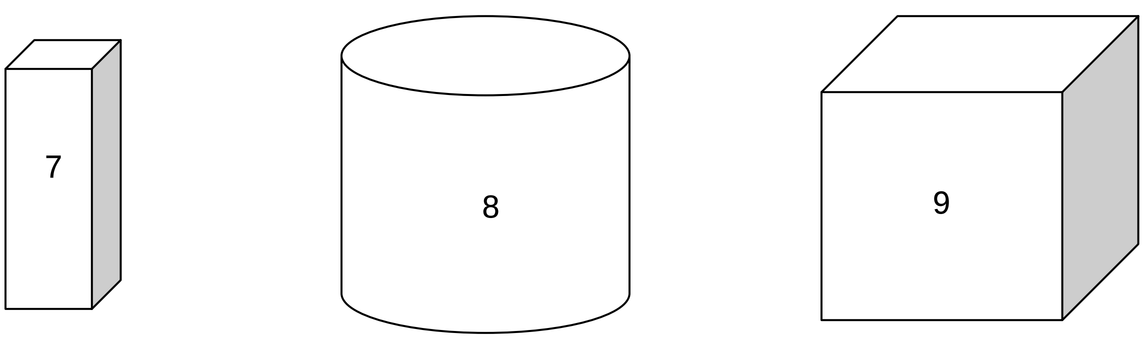
Set A



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.

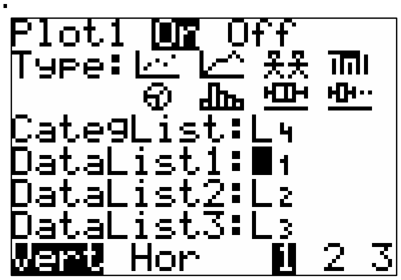
Set A	**Height**
1	*0.75*
2	*0.75*
3	*2*
Mean	*1.17*
Median	*0.75*
Mode	*0.75*

Set B	**Height**
4	*0.5*
5	*1*
6	*1.25*
Mean	*0.92*
Median	*1*
Mode	*None*

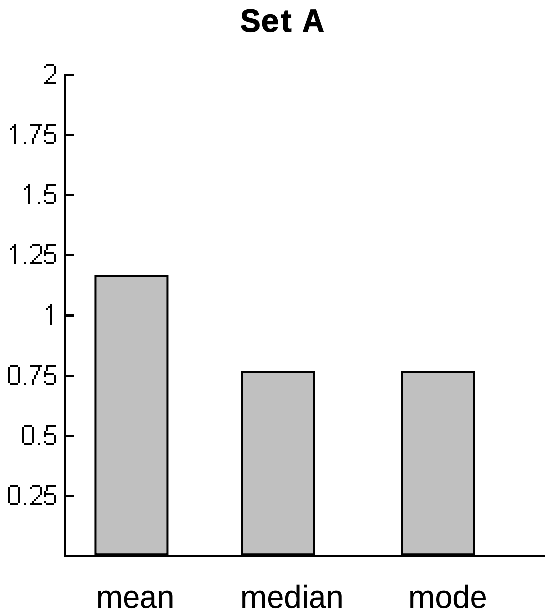
Set C	**Height**
7	*1.25*
8	*1.25*
9	*1.25*
Mean	*1.25*
Median	*1.25*
Mode	*1.25*

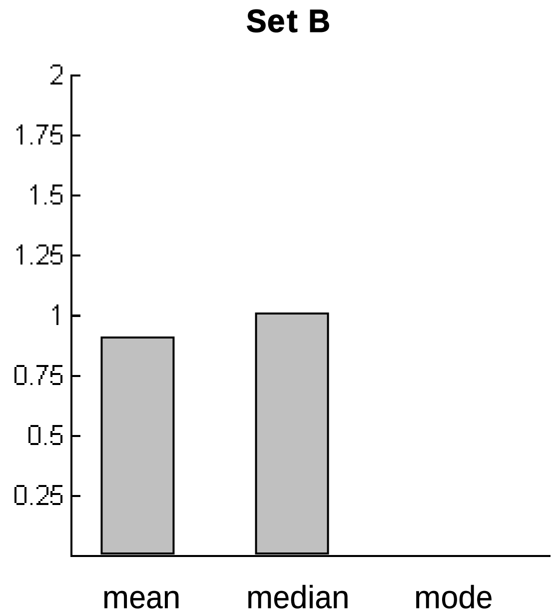
5. Input the mean, median and mode for each set of data using the **LIST** feature.
   Set A – L_4 Set B – L_5 Set C – L_6

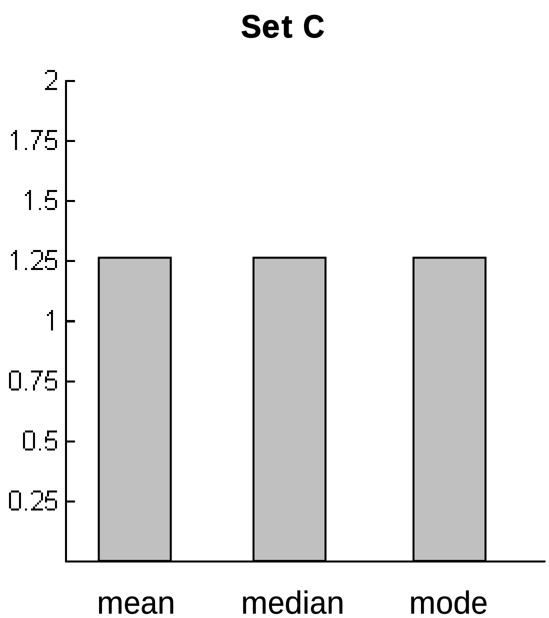
6. Create a bar graph for the mean, median and mode of each set of heights. Sketch what you see.
   For each set:
   Press [2nd][Y=][ENTER].
   With the cursor blinking on ON, press [ENTER].
   Press [▼] to arrow down to the next row. Press [►] to arrow over to (the bar graph). Press [ENTER].
   Since 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.







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.

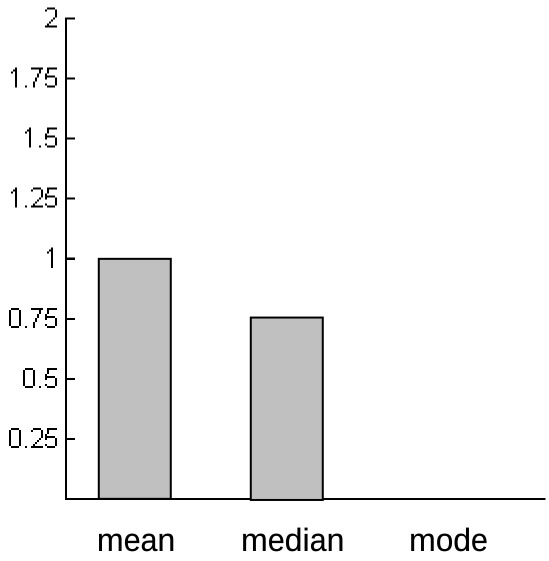
Set A	Length/ Diameter
1	*0.75*
2	*1.75*
3	*0.5*
Mean	*1*
Median	*0.75*
Mode	*None*

Set B	Length/ Diameter
4	*2*
5	*1.25*
6	*1.5*
Mean	*1.58*
Median	*1.5*
Mode	*None*

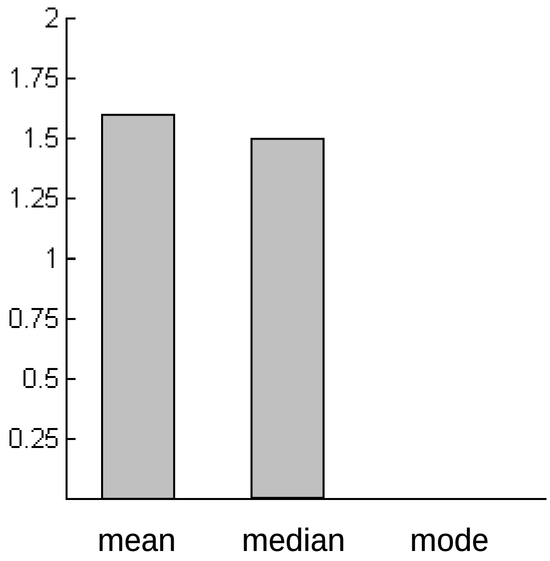
Set C	Length/ Diameter
7	*0.5*
8	*1.5*
9	*1.25*
Mean	*1.08*
Median	*1.25*
Mode	*None*

11. Create a bar graph for each set of lengths/diameters. Sketch what you see.

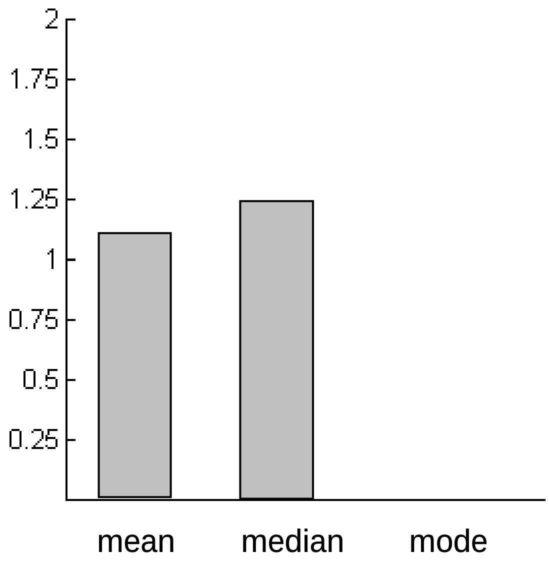
Set A



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.

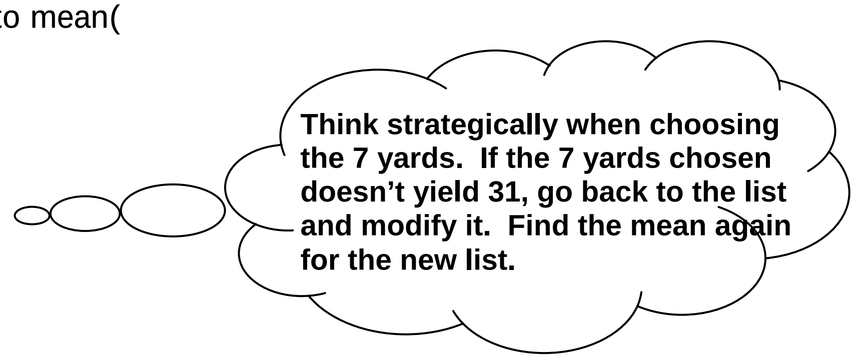
24 9 52 32 5 52 27 13 65 38

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 [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].



	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.

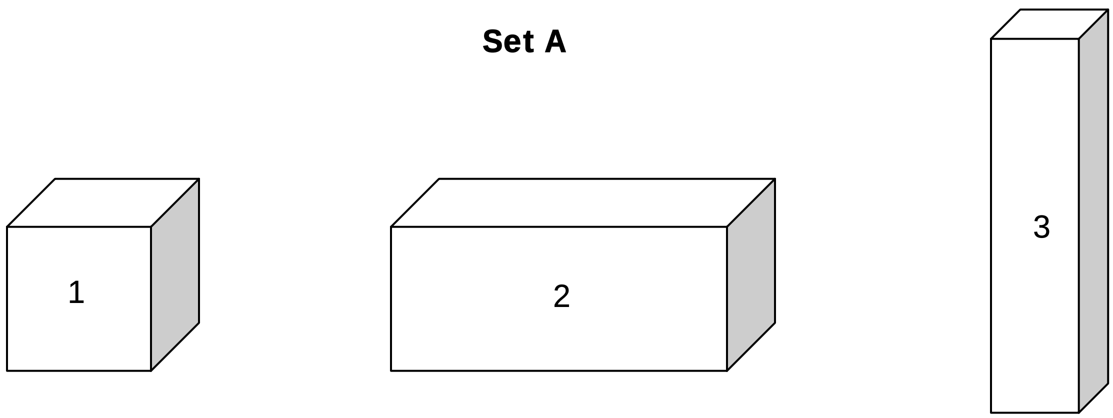
   Mean ________ Median ________ Mode ________

5. How close were your predictions to the actual mean, median and mode? Explain similarities and differences.

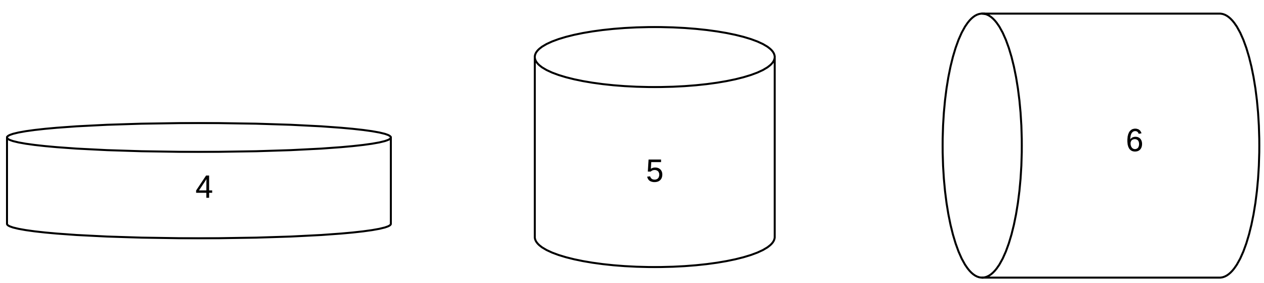
How do these shapes measure up?

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?

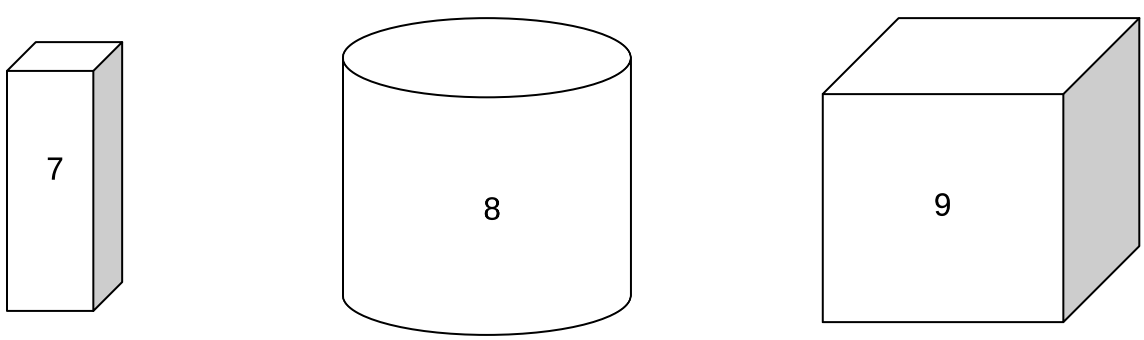
Set A



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.

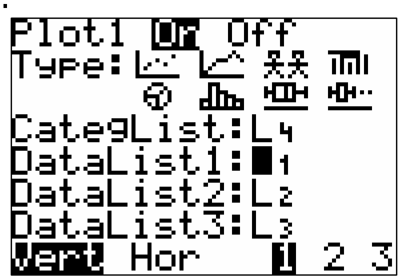
Set A	Height
1	
2	
3	
Mean	
Median	
Mode	

Set B	Height
4	
5	
6	
Mean	
Median	
Mode	

Set C	Height
7	
8	
9	
Mean	
Median	
Mode	

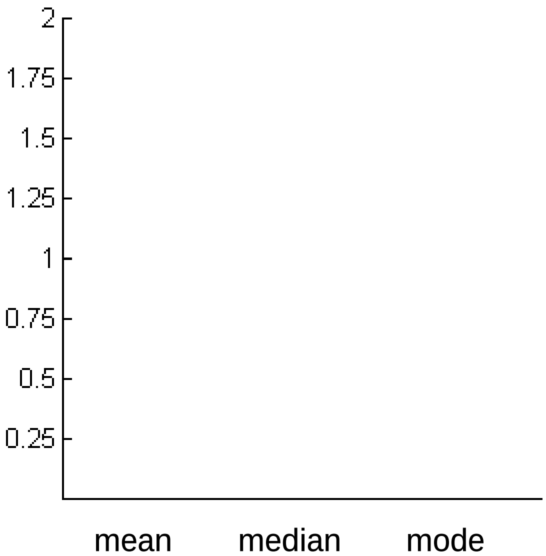
5. Input the mean, median and mode for each set of data using the **LIST** feature.
   Set A – L_4 Set B – L_5 Set C – L_6

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:

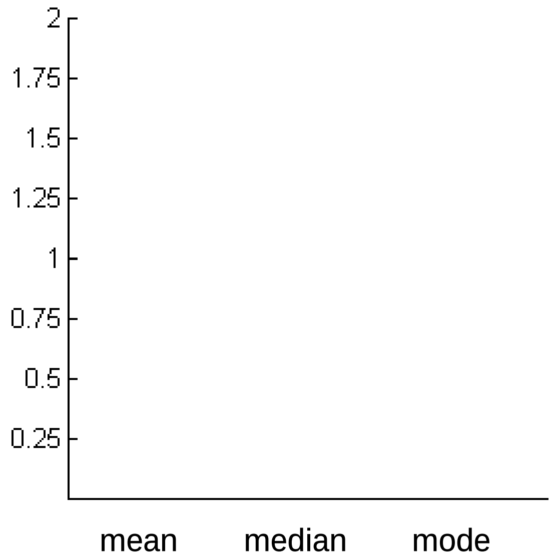


   Press [ZOOM] and arrow down to ZoomStat to see the graph.
   Sketch your graph on the next page. Repeat the process for Sets B and C.

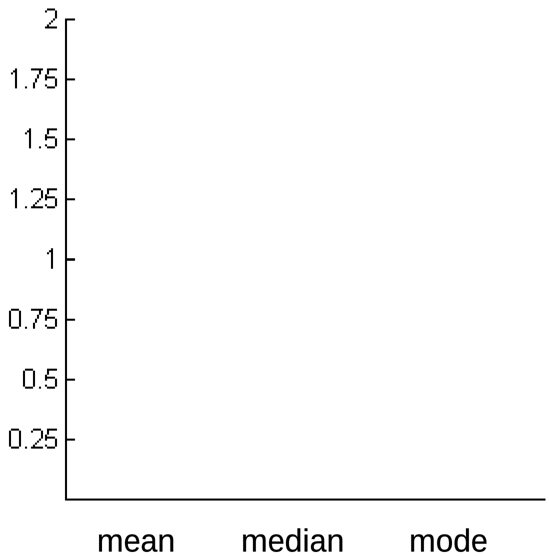
Set A



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?

   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.

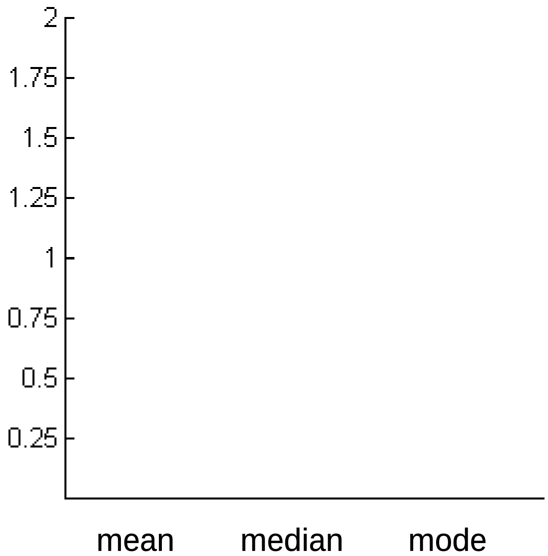
Set A	Length/ Diameter
1	
2	
3	
Mean	
Median	
Mode	

Set B	Length/ Diameter
4	
5	
6	
Mean	
Median	
Mode	

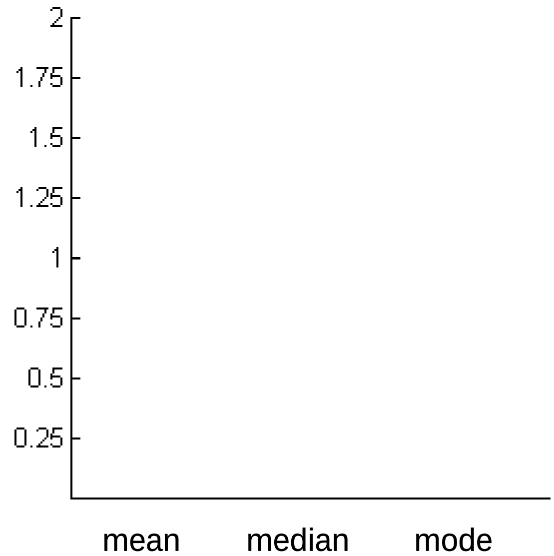
Set C	Length/ Diameter
7	
8	
9	
Mean	
Median	
Mode	

11. Create a bar graph for each set of lengths/diameters. Sketch what you see.

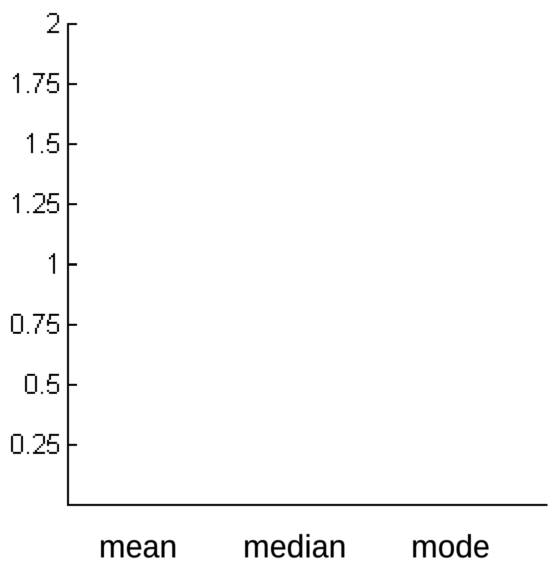
Set A



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.

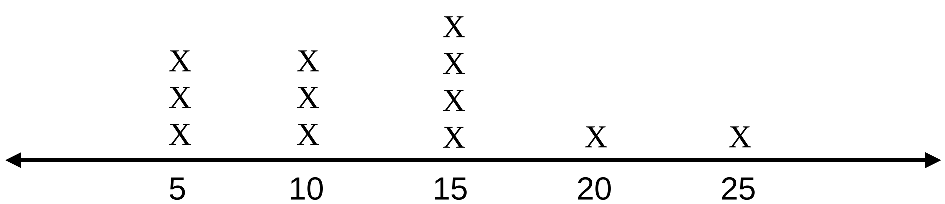
1. The table shows the number of points Menu scored during the first 5 basketball games.

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.

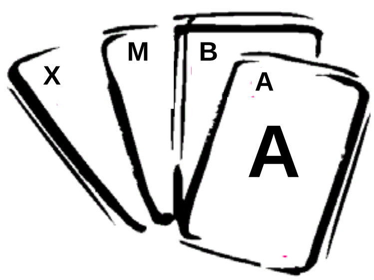
The Choir Helper – (Possible Answers)

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.

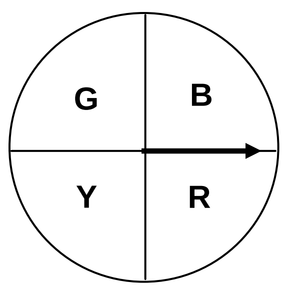
A Coin

A Six-Sided Number Cube

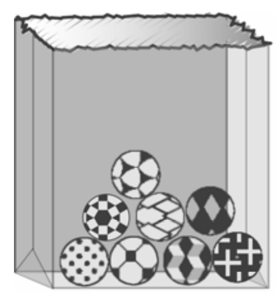
A 10-sided Number Decahedron with the numbers 1-10



A Set of Alphabet Cards A-Z

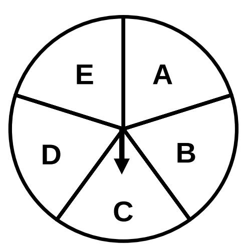


A Spinner



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.

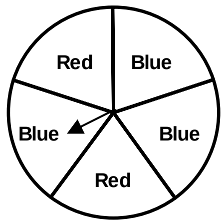
   Answers may vary, but formulas should include that the results in #3 are multiplied by a scale factor of 2 for 100 trials and a scale factor of 5 for 250 trials.

5. Print the document.

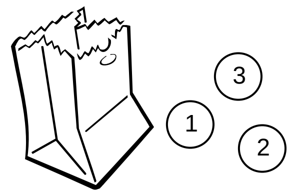
Simulation – (Possible Answers)

Use the following items to simulate an experiment.

A Coin



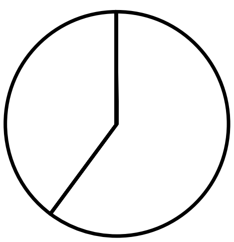
A Spinner



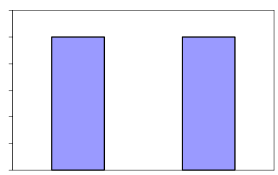
A Bag of 3 Marbles Numbered 1-3

Which of the following graphs best represents the results of the experiment? Justify your reasoning.

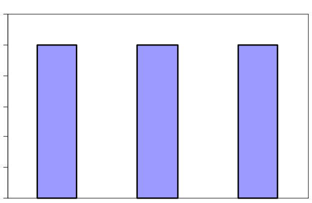
A.



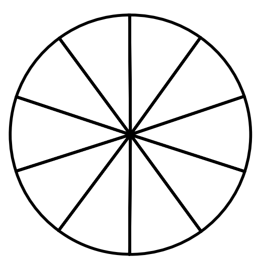
C.



B.



D.

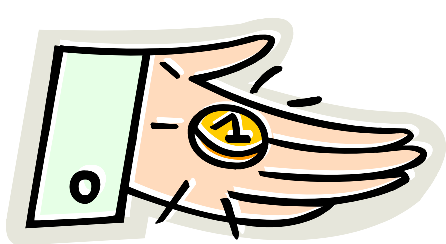


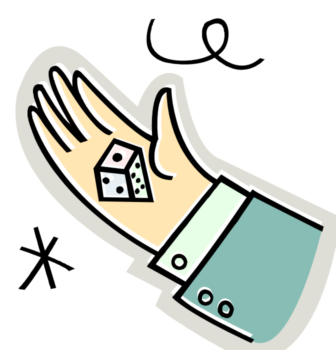
Answer: The graph in A best represents the experiment. In the experiment, the spinner has more blue than red. A circle graph representing the results of blue to red would show a larger section for blue.

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.

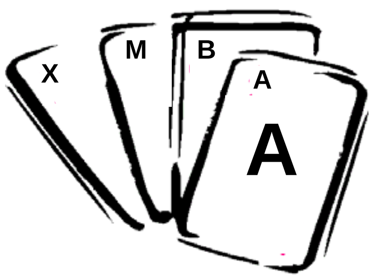
The Choir Helper

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.

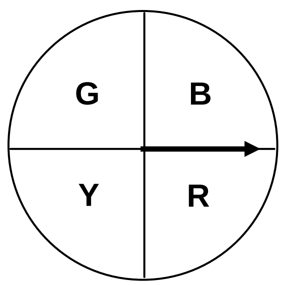
A Coin

A Six-Sided Number Cube

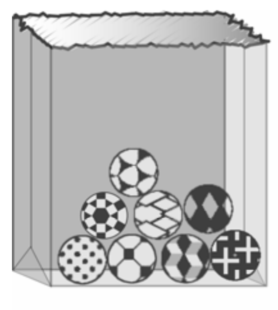
A 10-sided Number Decahedron with the numbers 1-10



A Set of Alphabet Cards A-Z

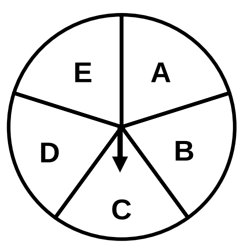


A Spinner



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.

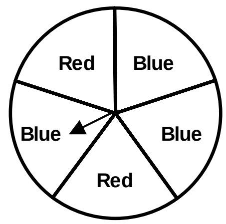
4. Use the spreadsheet to predict the results if the event had been simulated for 100 trials? 250 trials? Make a separate column for each and use formulas to make predictions.

5. Print the document.

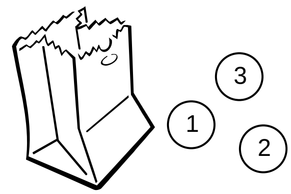
Simulation

Use the following items to simulate an experiment.

A Coin



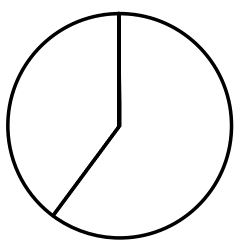
A Spinner



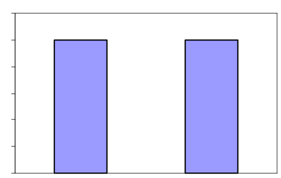
A Bag of 3 Marbles
Numbered 1-3

Which of the following graphs best represents the results of the experiment? Justify your reasoning.

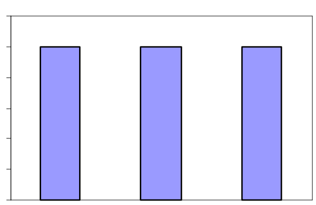
A.



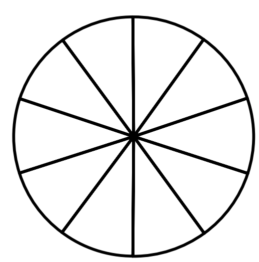
C.



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.

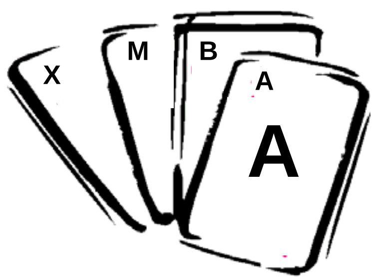
The Choir Helper – (Possible Answers)

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.

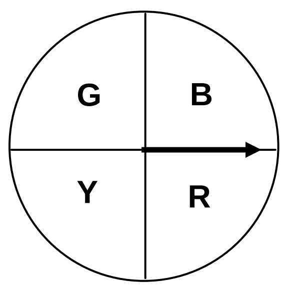
A Coin

A Six-Sided Number Cube

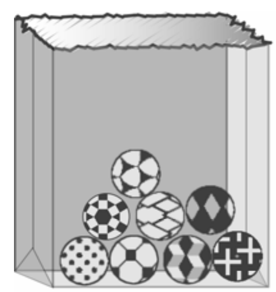
A 10-sided Number Decahedron with the numbers 1-10



A Set of Alphabet Cards A-Z

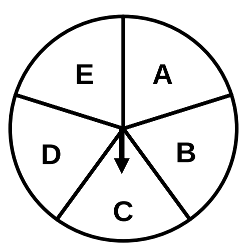


A Spinner



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.

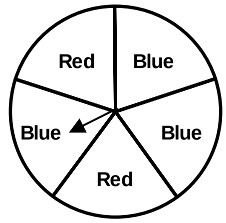
4. From the above results, predict the results if the event had been simulated for 100 trials.

   Answers may vary, but should include that the results in #3 should be multiplied by a scale factor of 2.

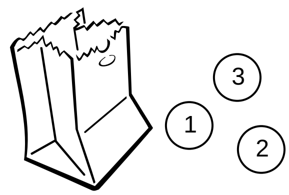
Simulation – (Possible Answers)

Use the following items to simulate an experiment.

A Coin



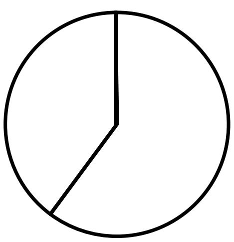
A Spinner



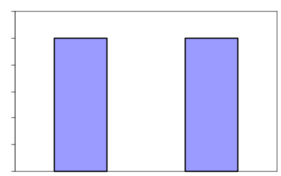
A Bag of 3 Marbles
Numbered 1-3

Which of the following graphs best represents the results of the experiment? Justify your reasoning.

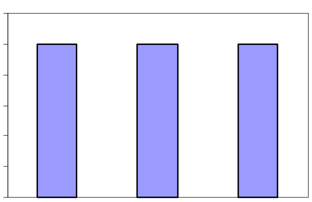
A.



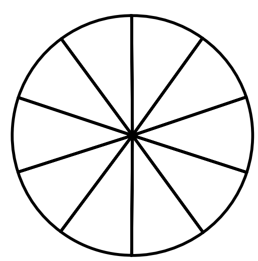
C.



B.



D.

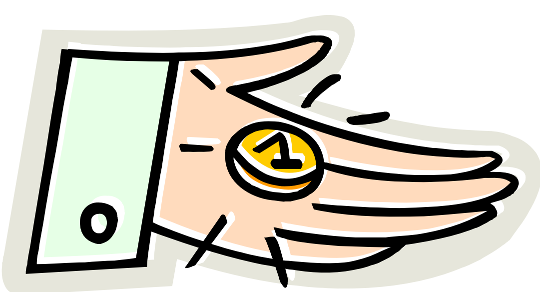


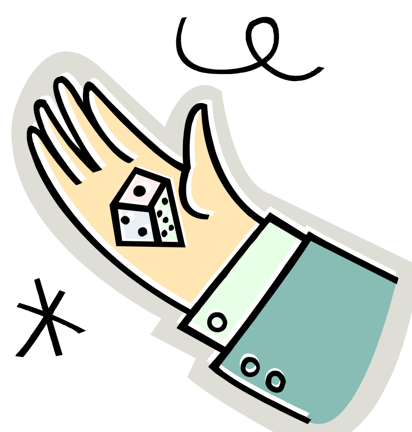
Answer: The graph in A best represents the experiment. In the experiment, the spinner has more blue than red. A circle graph representing the results of blue to red would show a larger section for blue.

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.

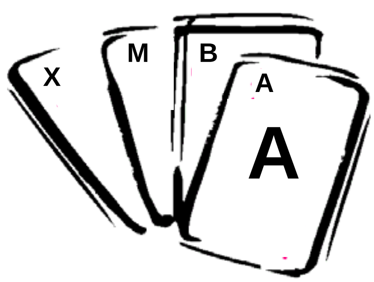
The Choir Helper

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.

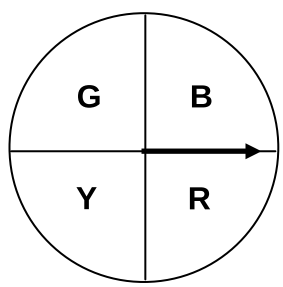
A Coin

A Six-Sided Number Cube

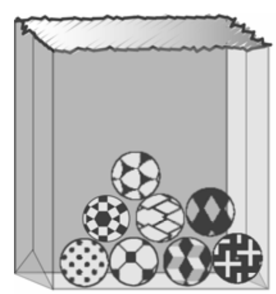
A 10-sided Number Decahedron with the numbers 1-10



A Set of Alphabet Cards A-Z

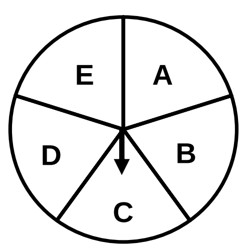


A Spinner



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.

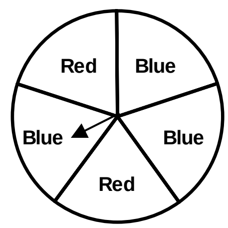
3. Use the plan outlined in #2 to simulate the event for 50 trials. Create a table to record the results.

4. From the above results, predict the results if the event had been simulated for 100 trials.

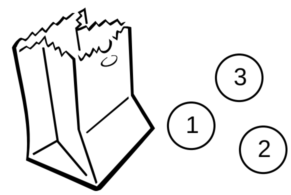
Simulation

The following items are being used to simulate an experiment.

A Coin



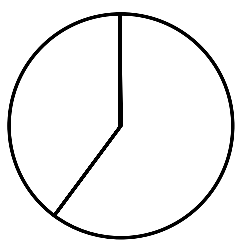
A Spinner



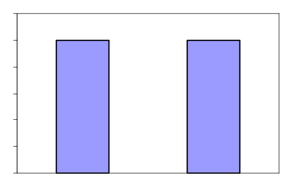
A Bag of 3 Marbles
Numbered 1-3

Which of the following graphs best represent the results of the experiment? Justify your reasoning

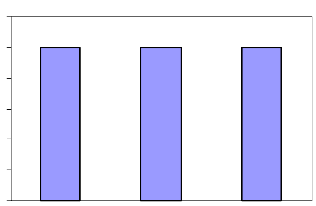
A.



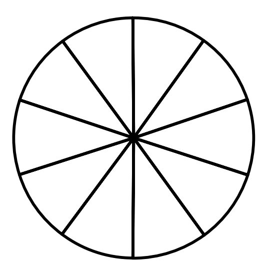
C.



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

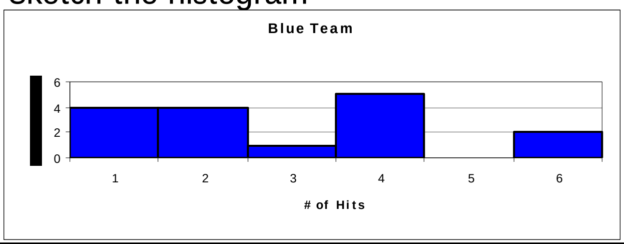
(Give this page to students if printing their spreadsheet is not an option)

See GoTeam-Key spreadsheet.

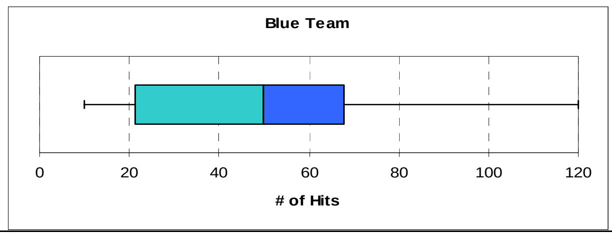
BLUE TEAM

Minimum:	*10*	Mean:	*50.7*	25th %-tile:	*19.5*
Maximum:	*120*	Mode:	*10*	Median:	*50*
Range:	*110*			75th %-tile:	*69.5*

Sketch the histogram



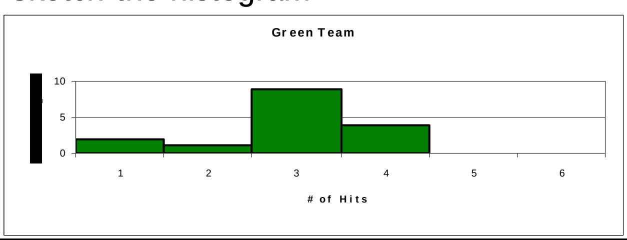
Sketch the box and whisker plot



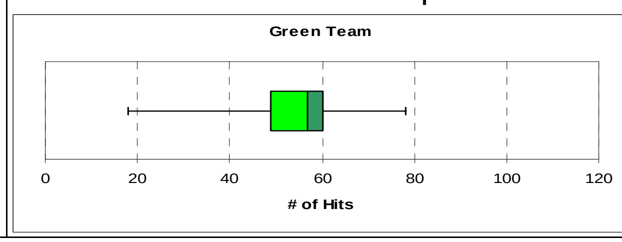
GREEN TEAM

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



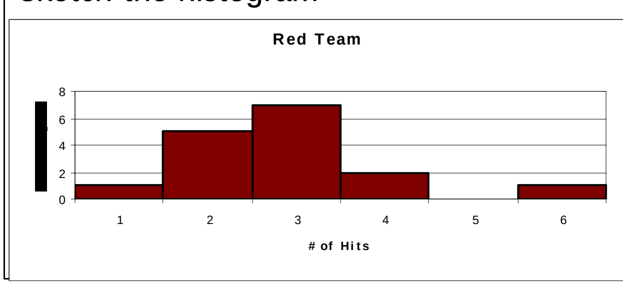
Sketch the box and whisker plot



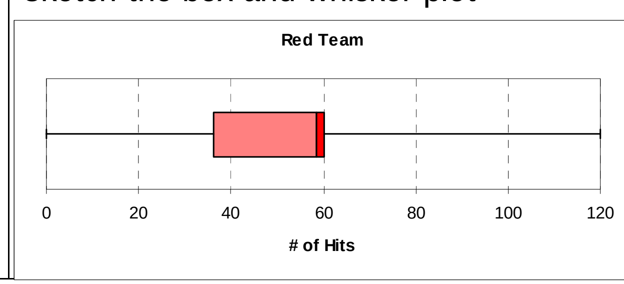
RED TEAM

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



Box and Whisker Plot and Histogram Spreadsheet

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

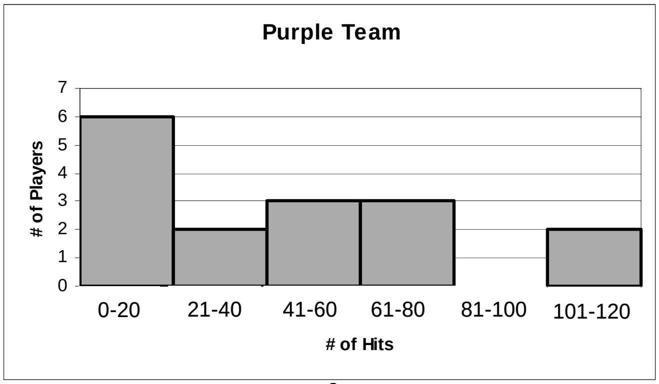
1. The box and whisker plot of the ***Red*** Team has the longest whisker. This is usually an indication that the set of data contains at least one ***outlier*** .
2. The ***mode*** of the data is the central tendency for which the graphic representations give us the least information.
3. The graphic 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.

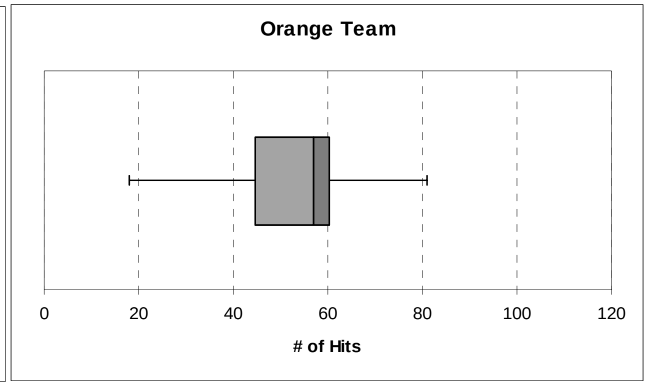
---

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

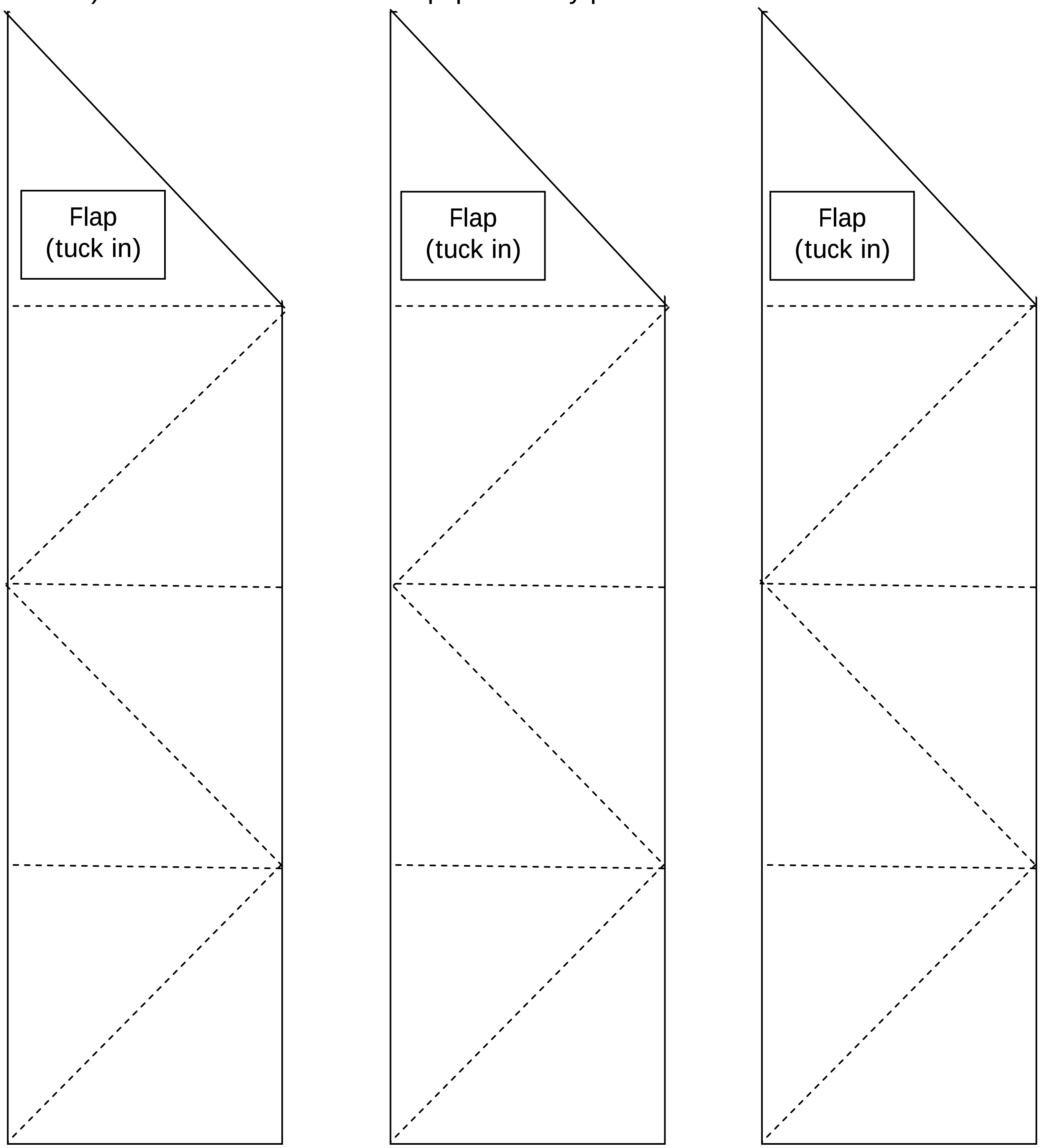
4. Should H^3 join the team, what would be the impact on the range, median, and mean number of hits for the Purple team? for the Orange team? *Answers may vary. Purple…will not change the range…will likely increase the median and mean (although hard to say by how much because of the ranges within the 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 **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**

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.

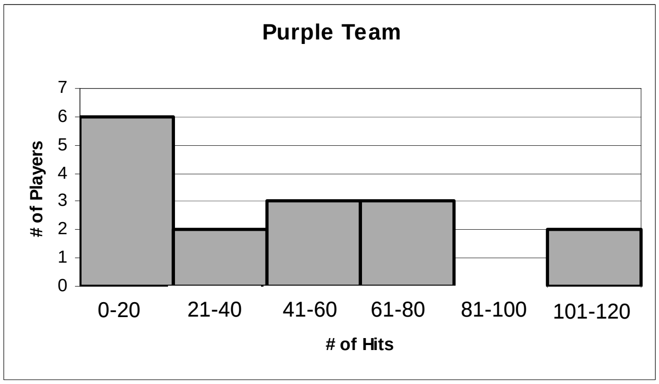
6. The __________ of the number of hits was the smallest for the Green Team.

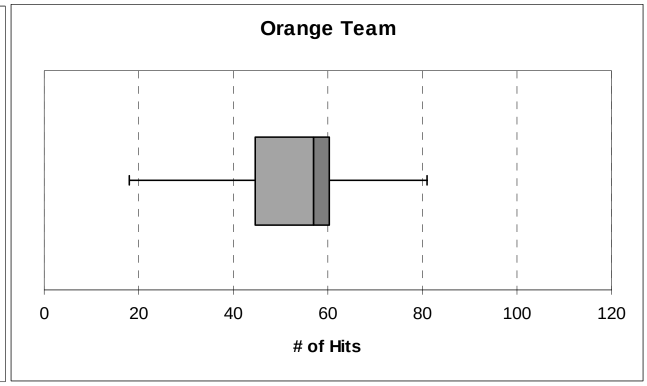
---

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.

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 both the Purple team and 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.)

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?

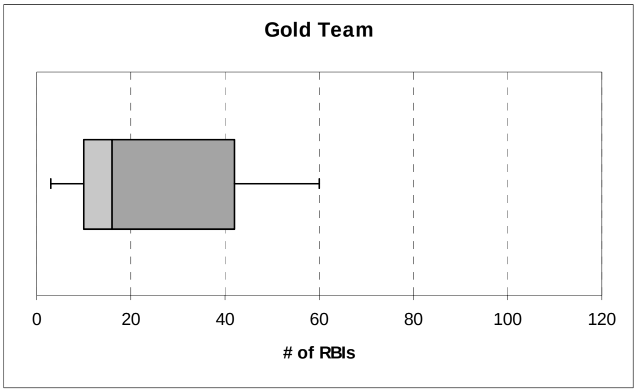
4. Should H^3 join the team, what would be the impact on the range, median, and mean number of hits for the Purple team? for the Orange team?

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.

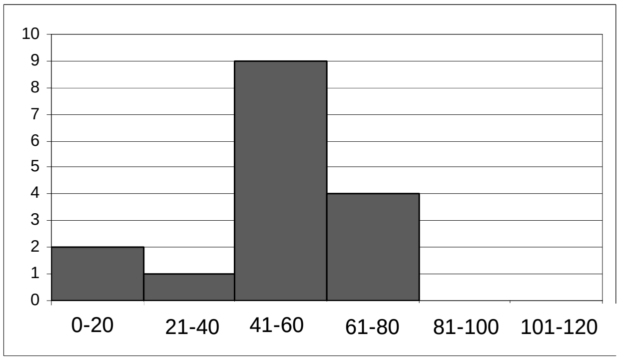
c. Prepare a statement for the press that lists the RBIs of the players you added and describes the impact of these additions on each of the following statistical measures for your team.

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

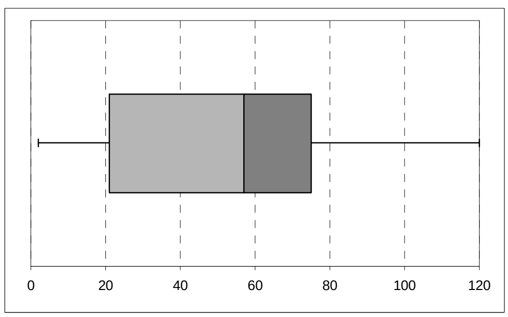
Box and Whisker Plot and Histogram Spreadsheet

1.

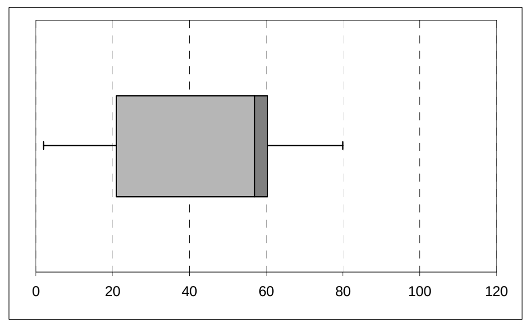


Which of the following box and whisker plots would contain data similar to the histogram above?

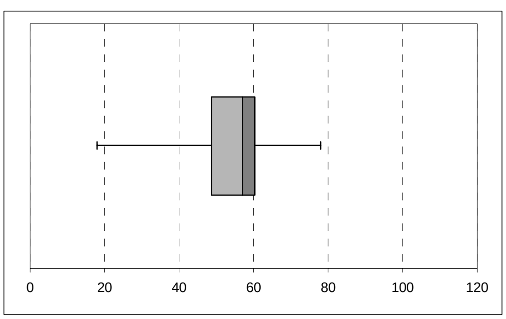
A.



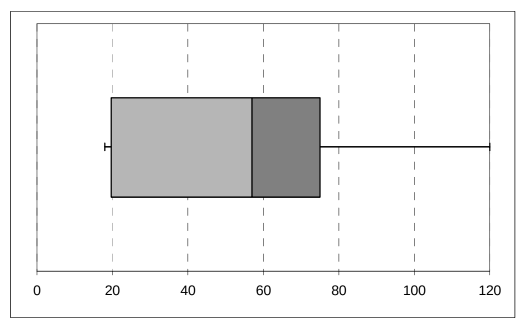
C.



B.



D.

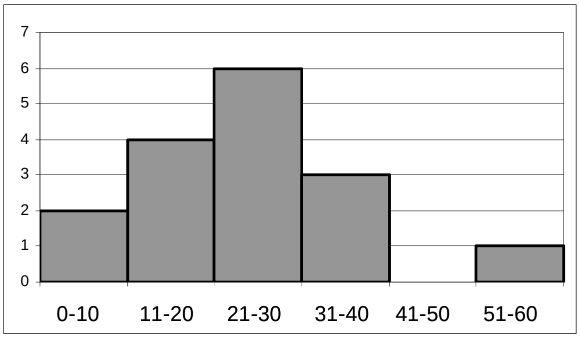


2. Which statistical measure is NOT evident on a box and whisker plot?

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.)

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.
- 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.)

$$\overbrace{x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x\ x}^{\text{sitting}}\ \overbrace{X\ X\ X\ X\ X\ X\ X\ X\ X\ X\ X\ X\ X\ X}^{\text{standing}}$$

   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.

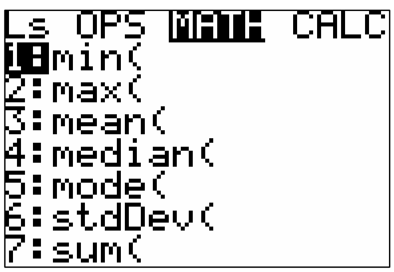
Facilitation Questions

- 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.

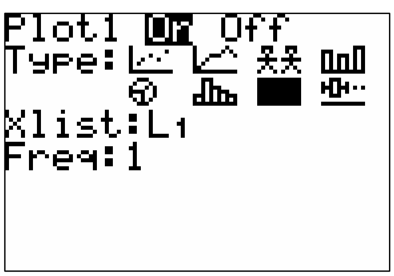


    - Select the formula and press [2nd][LIST] to access the appropriate list number. Press [ENTER], then press [ENTER] again to see the calculation.

- 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

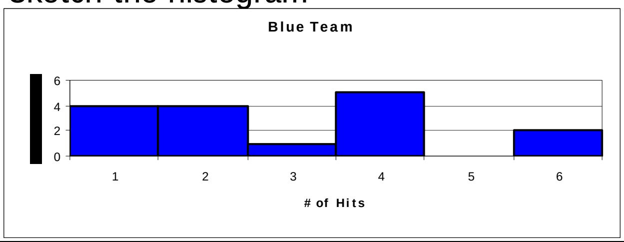
Question Number	TEKS	Correct Answer	Conceptual Error	Conceptual Error	Procedural Error	Procedural Error	Guess
1	8.12(C)	B	A	D	C		
2	8.12(C)	C	A	B			D
3	8.12(A)	D	A	B	C		
4	8.12(C)	A	C	D	B		

Team Stats

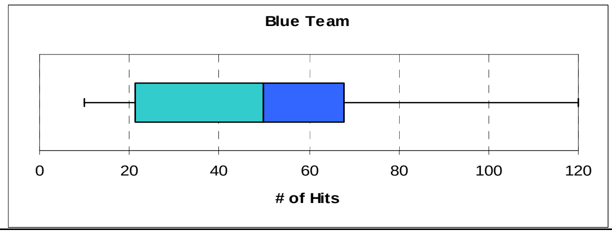
BLUE TEAM

Minimum:	10	Mean:	50.7	25th %-tile:	19.5
Maximum:	120	Mode:	10	Median:	50
Range:	110			75th %-tile:	69.5

Sketch the histogram



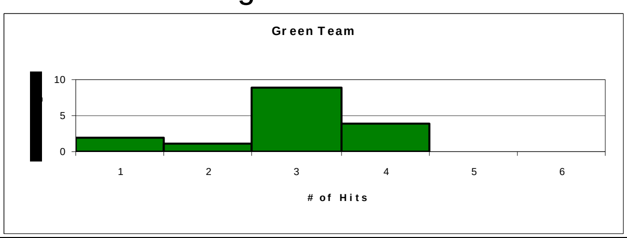
Sketch the box and whisker plot



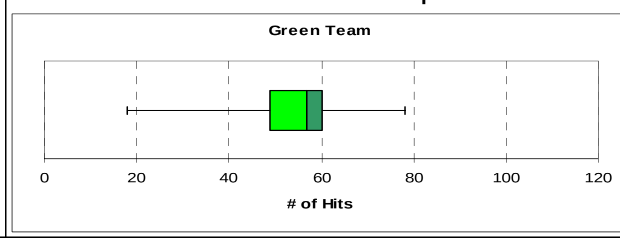
GREEN TEAM

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



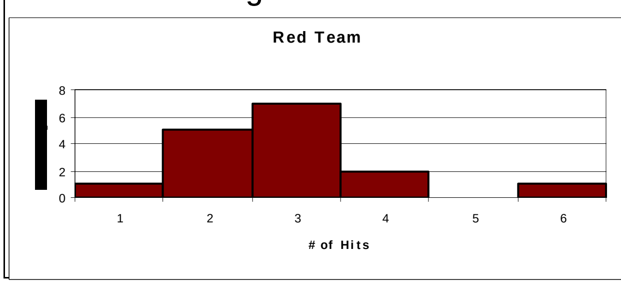
Sketch the box and whisker plot



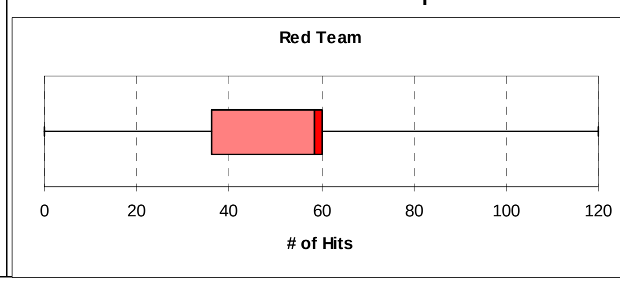
RED TEAM

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.

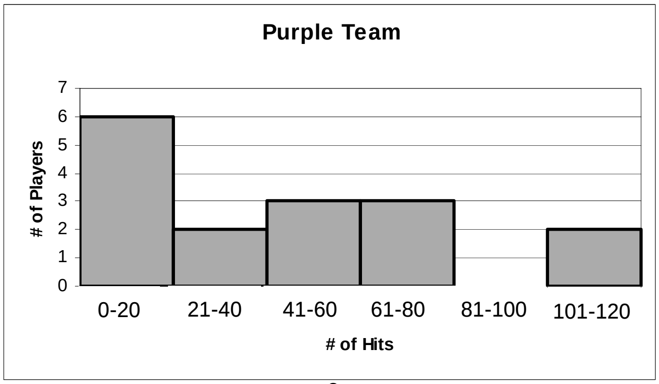
6. The ***range*** of the number of hits was the smallest for the Green Team.

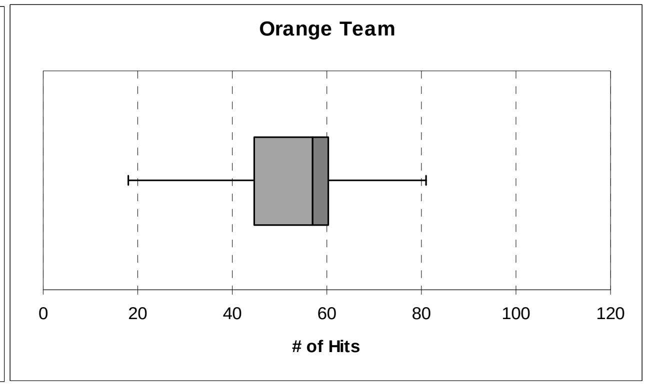
---

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

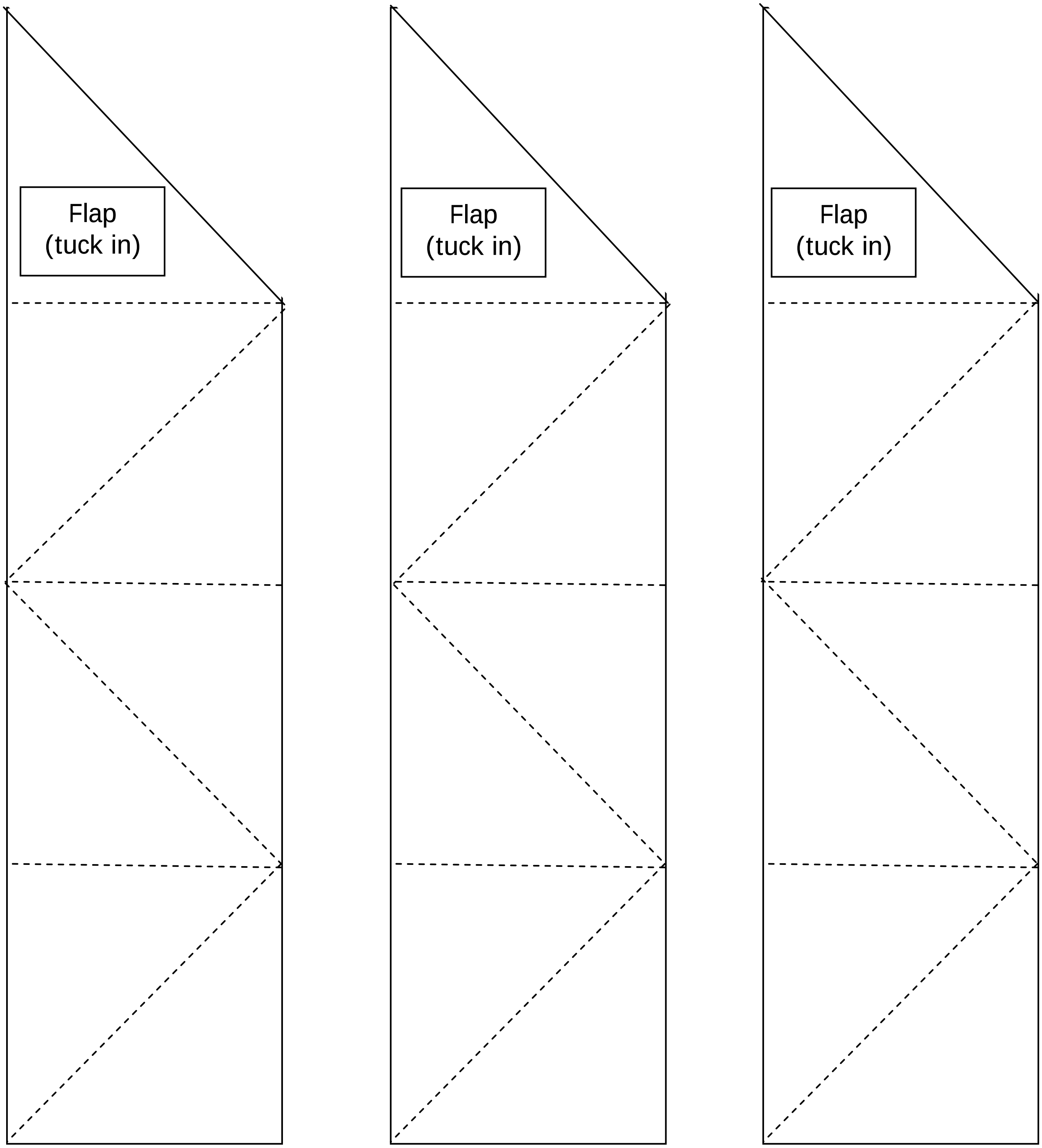
4. Should H^3 join the team, what would be the impact on the range, median, and mean number of hits for the Purple team? for the Orange team? *Answers may vary. Purple…will not change the range…will likely increase the median and mean (although hard to say by how much because of the ranges within the 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:	______	25^{th} %-tile:	______
Maximum:	______	Mode:	______	Median:	______
Range:	______			75^{th} %-tile:	______

Sketch the histogram	Sketch the box and whisker plot

GREEN TEAM

Minimum:	______	Mean:	______	25^{th} %-tile:	______
Maximum:	______	Mode:	______	Median:	______
Range:	______			75^{th} %-tile:	______

Sketch the histogram	Sketch the box and whisker plot

RED TEAM

Minimum:	______	Mean:	______	25^{th} %-tile:	______
Maximum:	______	Mode:	______	Median:	______
Range:	______			75^{th} %-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.

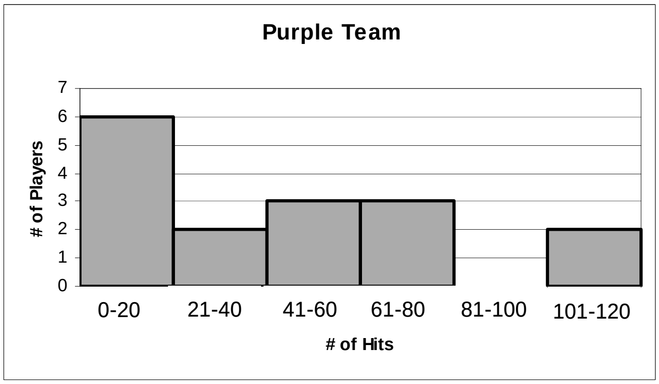
6. The __________ of the number of hits was the smallest for the Green Team.

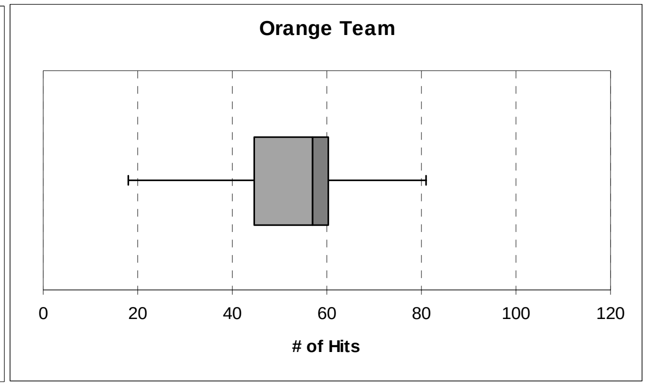
---

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.





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.)

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?

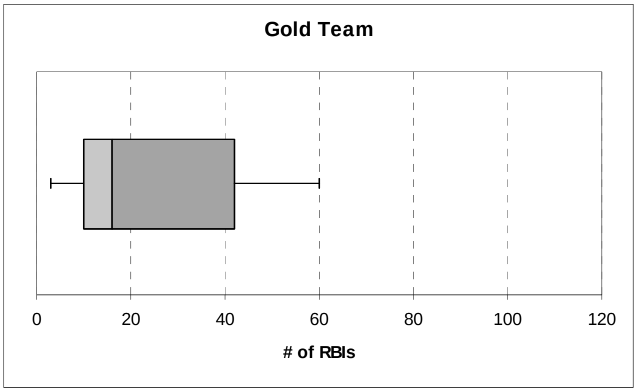
4. Should H^3 join the team, what would be the impact on the range, median, and mean number of hits for the Purple team? for the Orange team?

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.

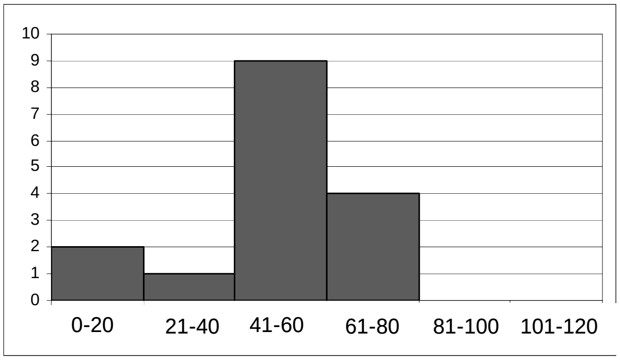
- Do not increase the current range of RBIs.
- Keep the various numbers of RBIs as clustered around the median as possible.

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.

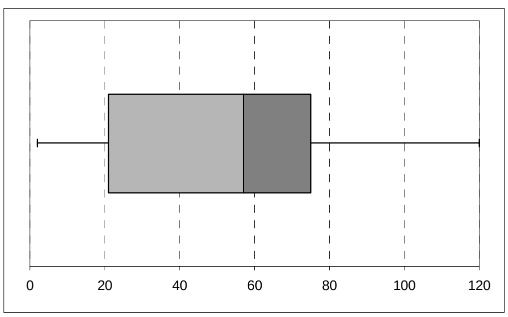
c. Prepare a statement for the press that lists the RBIs of the players you added <u>and</u> describes the impact of these additions on each of the following statistical measures for your team. Justify your statement by including the amount of change (if any) from the original statistics and original box and whisker plot, along with how these additions might benefit the team.
   - Range
   - Median
   - Mean

1.

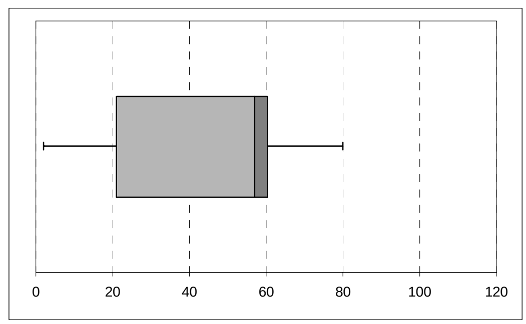


Which of the following box and whisker plots would contain data similar to the histogram above?

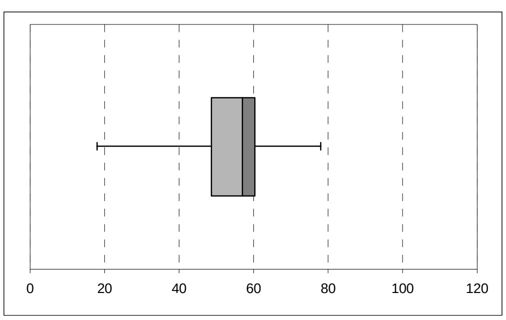
A.



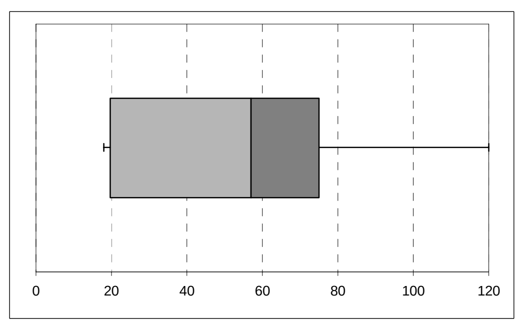
C.



B.



D.

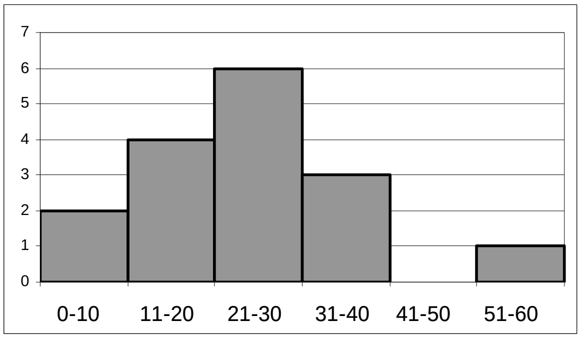


2. Which statistical measure is **not** evident on a box and whisker plot?

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 <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 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

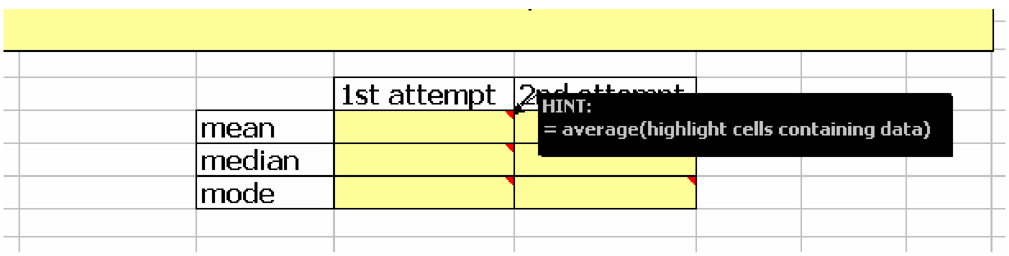
- How would you describe any trends that you might see in the scatterplot drawn from the data from your class?
  Answers may vary depending on the data collected. Look for statements such as "As the number of revolutions during the 1st attempt increases, the number of revolutions during the 2nd attempt (increases/decreases)." Or "Students <u>tend</u> 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.

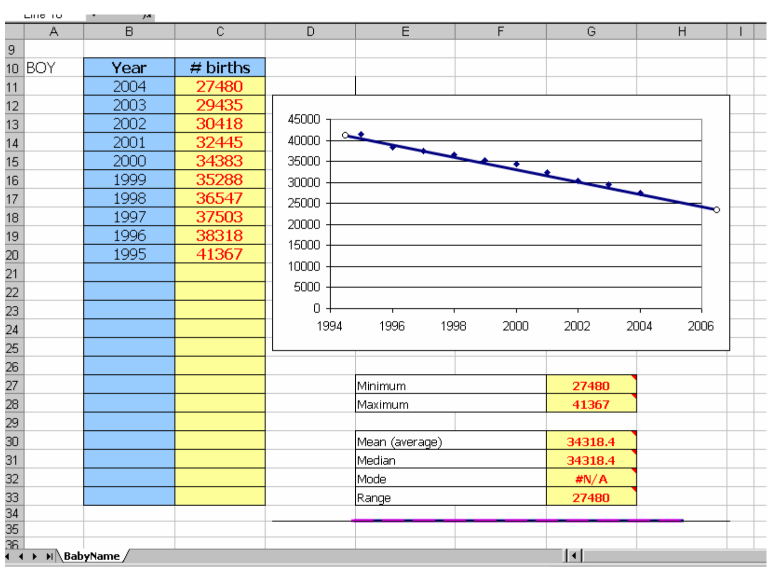
Facilitation Questions

- 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 1^{st} attempt, most students were able to increase the number of revolutions on their 2^{nd} attempt.

____*none*____ 2. After the 1^{st} attempt, most students made fewer revolutions on their 2^{nd} attempt.

____*A*_____ 3. The number of revolutions on the 1^{st} attempt is about the same as the number of revolutions on the 2^{nd} 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 2^{nd} attempt than on their 1^{st} 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?

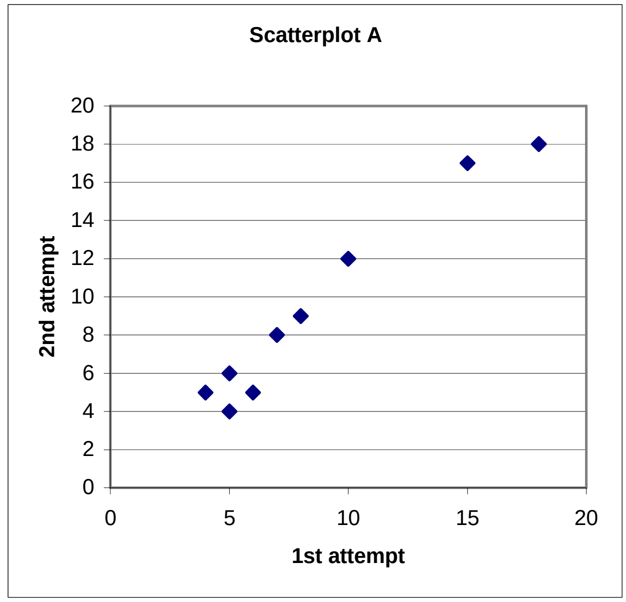
Transparency 2

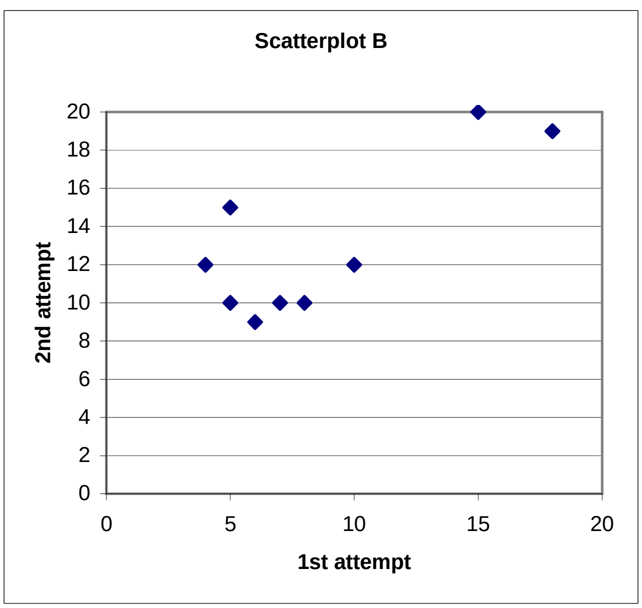
Student	# Revolutions on 1st Attempt	# Revolutions on 2nd Attempt

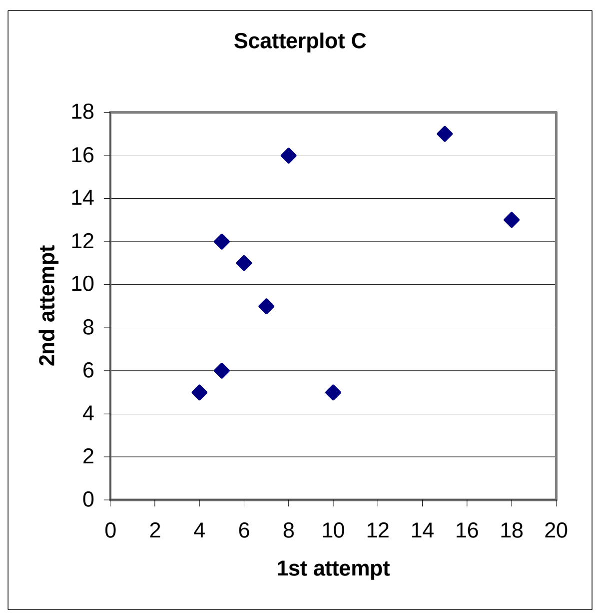
Transparency 3

1. If possible, sketch a trendline.

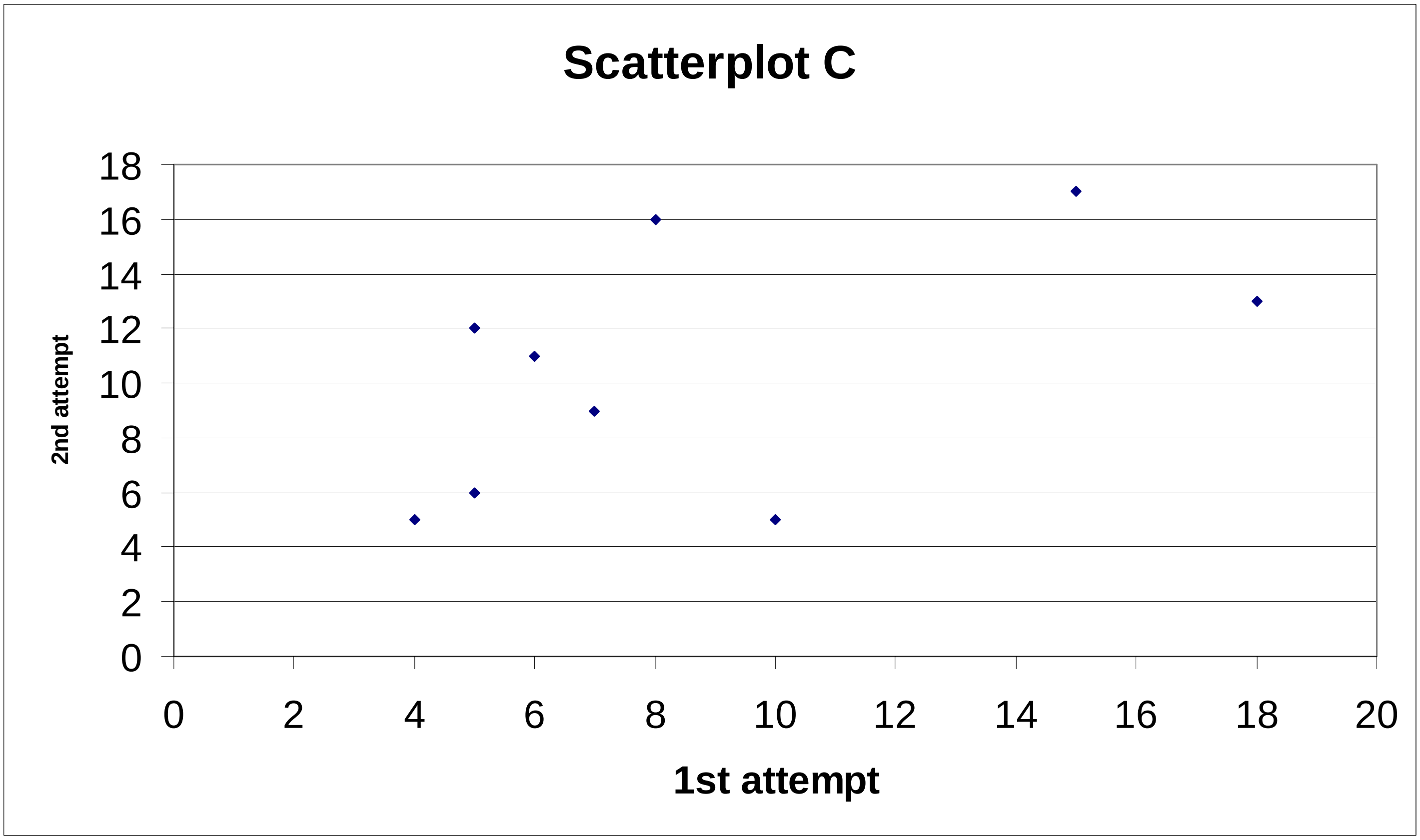
2. Predict the number of revolutions on the 2nd attempt if the number on the 1st attempt was 13...30...100.





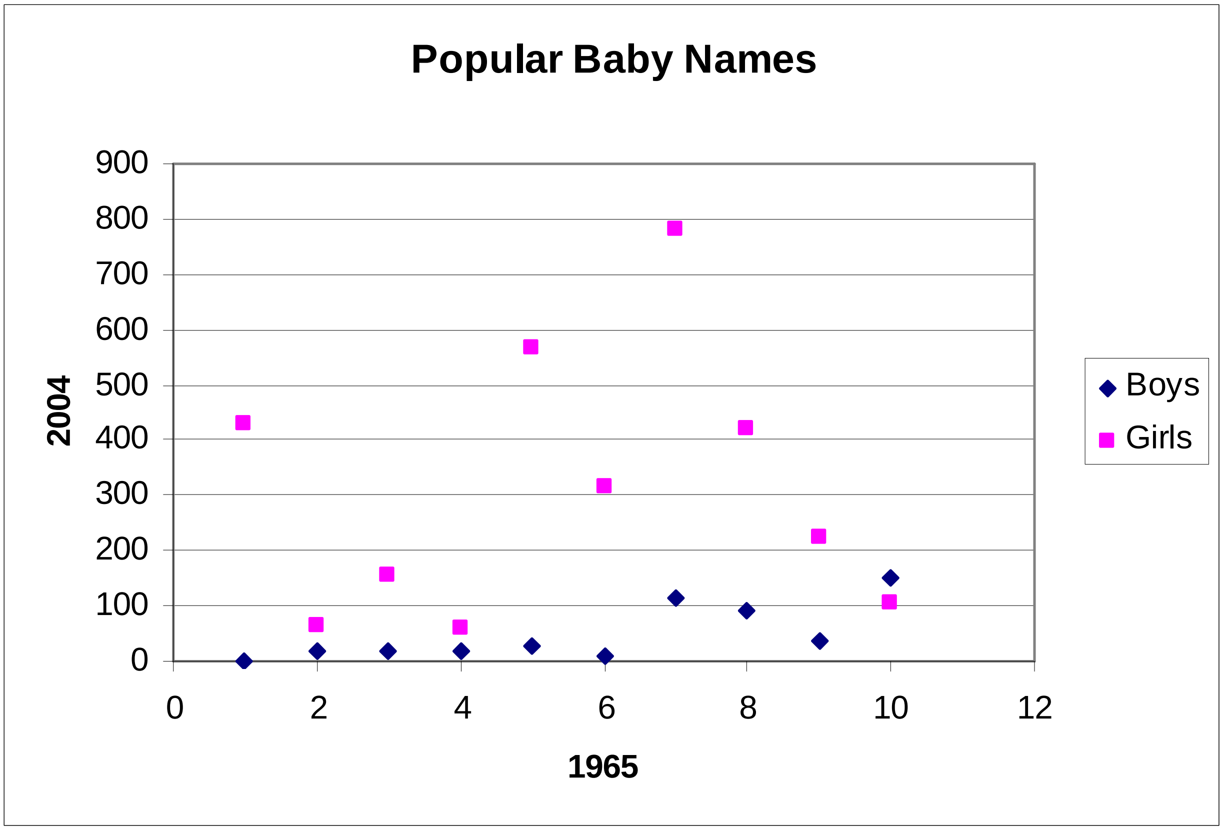


Transparency 4



	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 1^{st} attempt, most students were able to increase the number of revolutions on their 2^{nd} attempt.

__________2. After the 1^{st} attempt, most students made fewer revolutions on their 2^{nd} attempt.

__________3. The number of revolutions on the 1^{st} attempt is about the same as the number of revolutions on the 2^{nd} 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 2^{nd} attempt than on their 1^{st} 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.

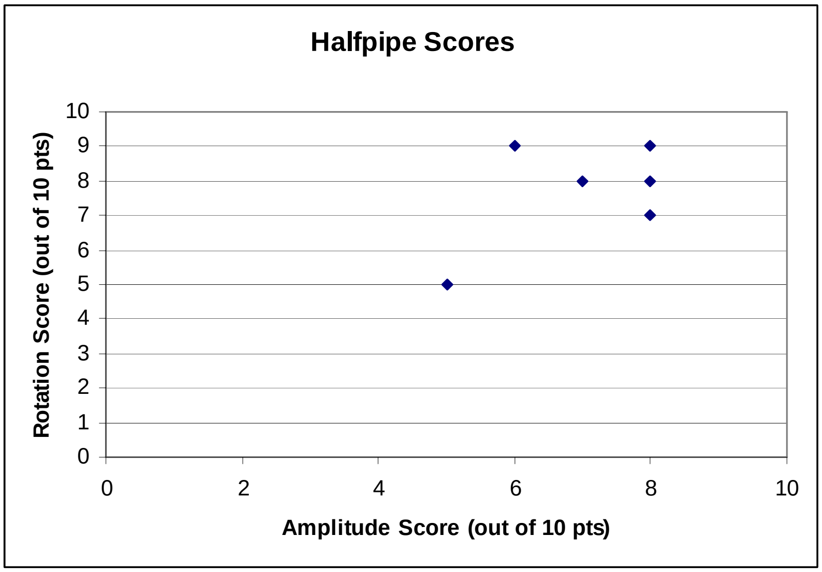
c. Draw a trendline if appropriate.

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.



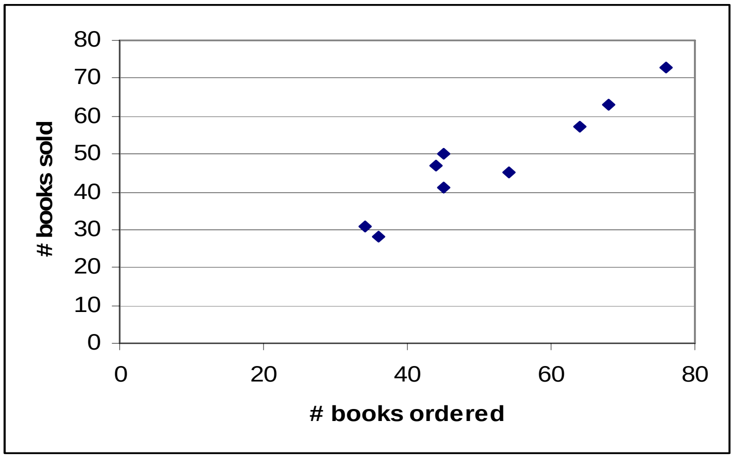
Which of the following statements would be supported by the scatterplot?

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.

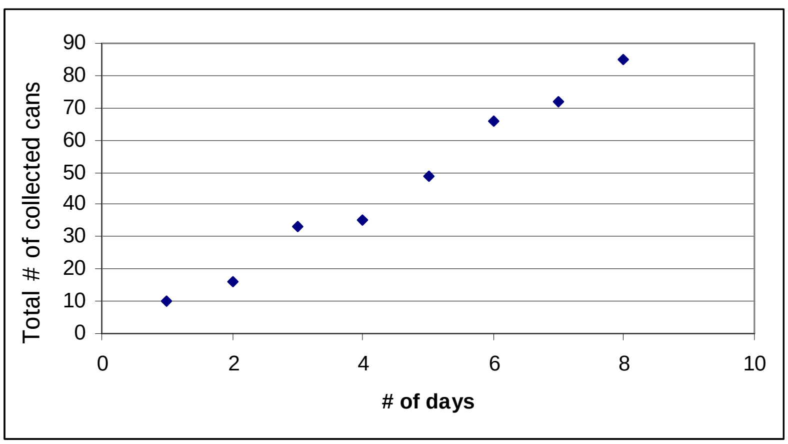
3. The following scatterplot compares the number of books ordered through the school fund raiser to the number of books that were sold.



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 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. 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

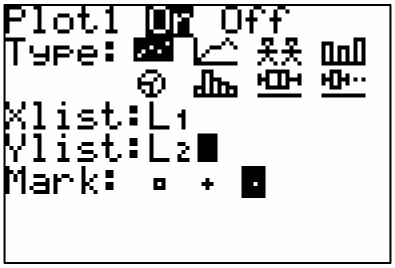
The Explore portion of the lesson provides the student with an opportunity to be actively involved in the exploration of the mathematical concepts addressed. This part of the lesson is designed for groups of 2 students or individual investigation.

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

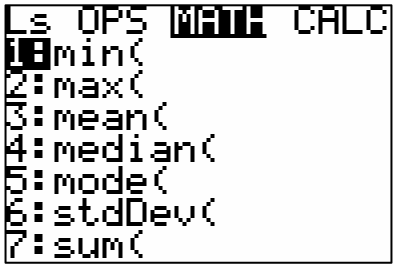
- Based on our data, what will you need to consider when setting the Xmin and Xmax in the window?
  The Xmin will need to be as small or smaller than the least value in list 1 and the Xmax will need to be as large or larger than the greatest value in list 1.
- Based on our data, what will you need to 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?

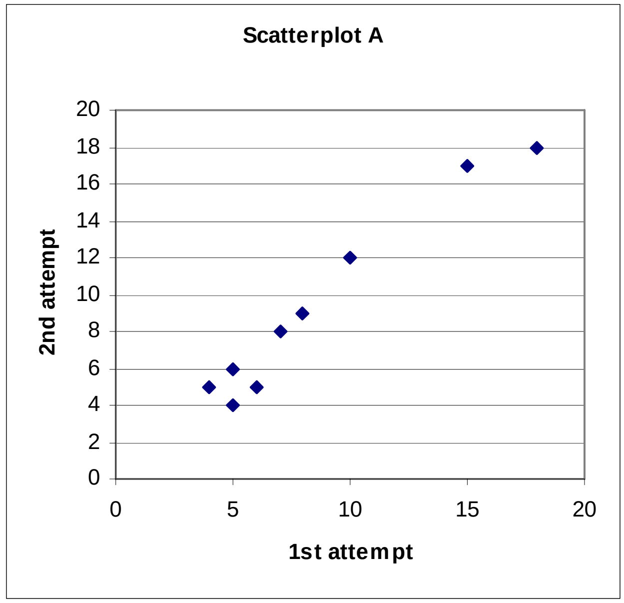
Transparency 2

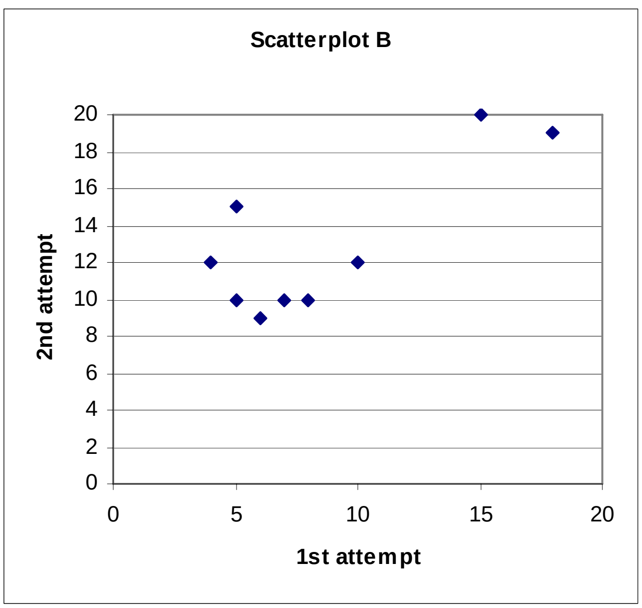
Student	# Revolutions on 1st Attempt	# Revolutions on 2nd Attempt

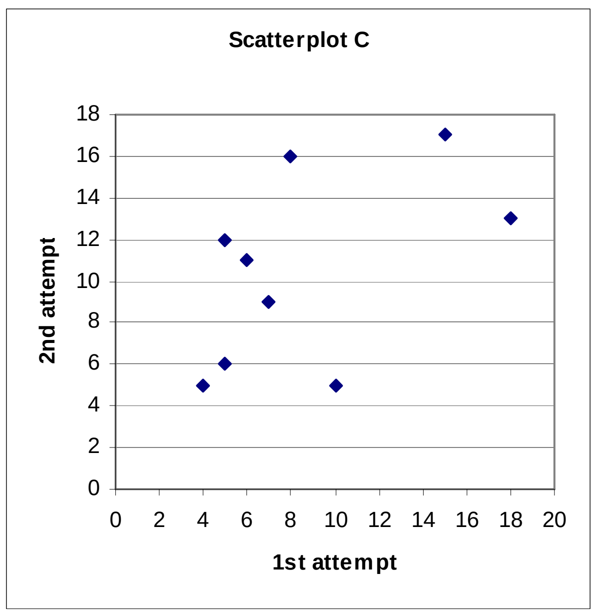
Transparency 3

1. If possible, sketch a trendline.

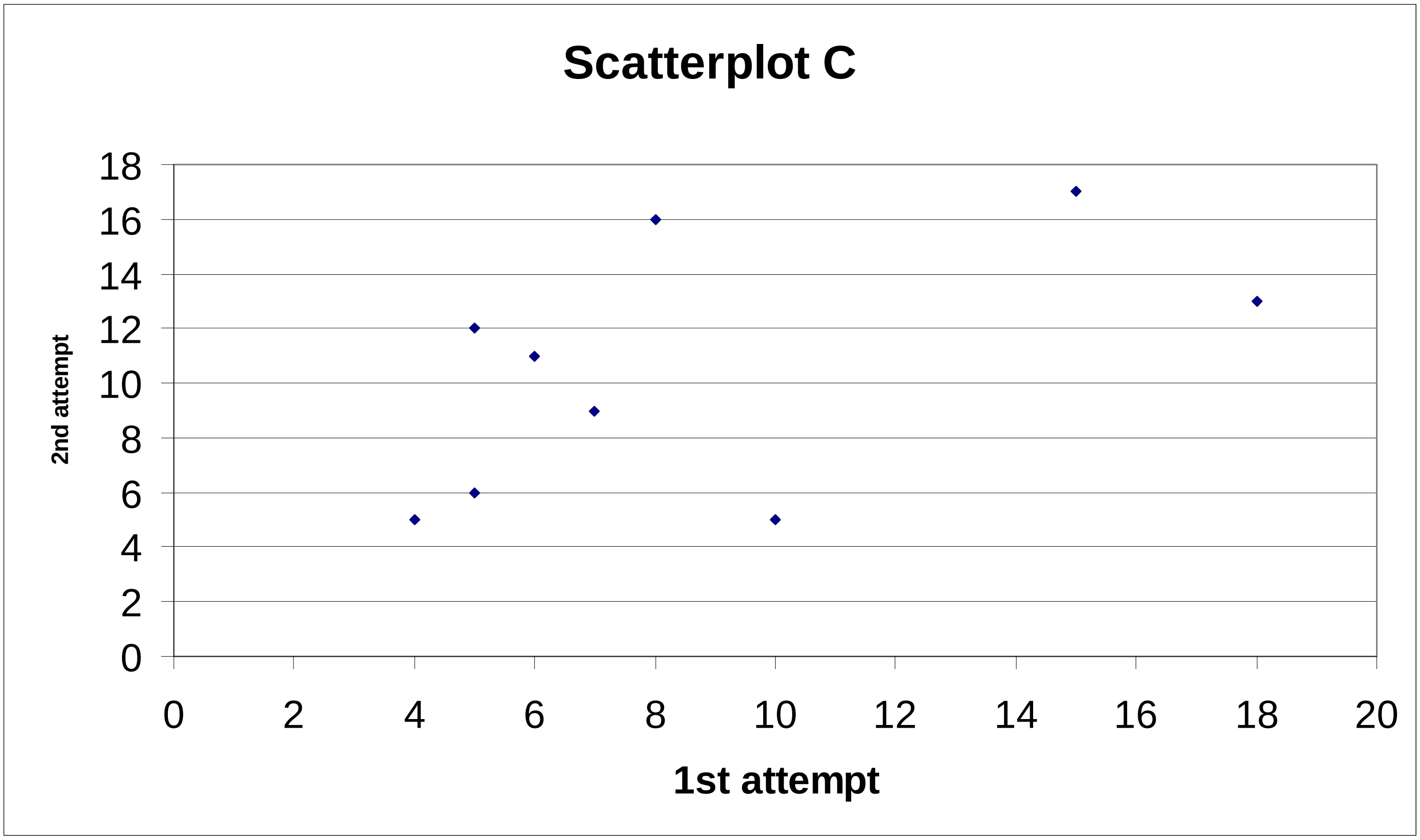
2. Predict the number of revolutions on the 2nd attempt if the number on the 1st attempt was 13...30...100.





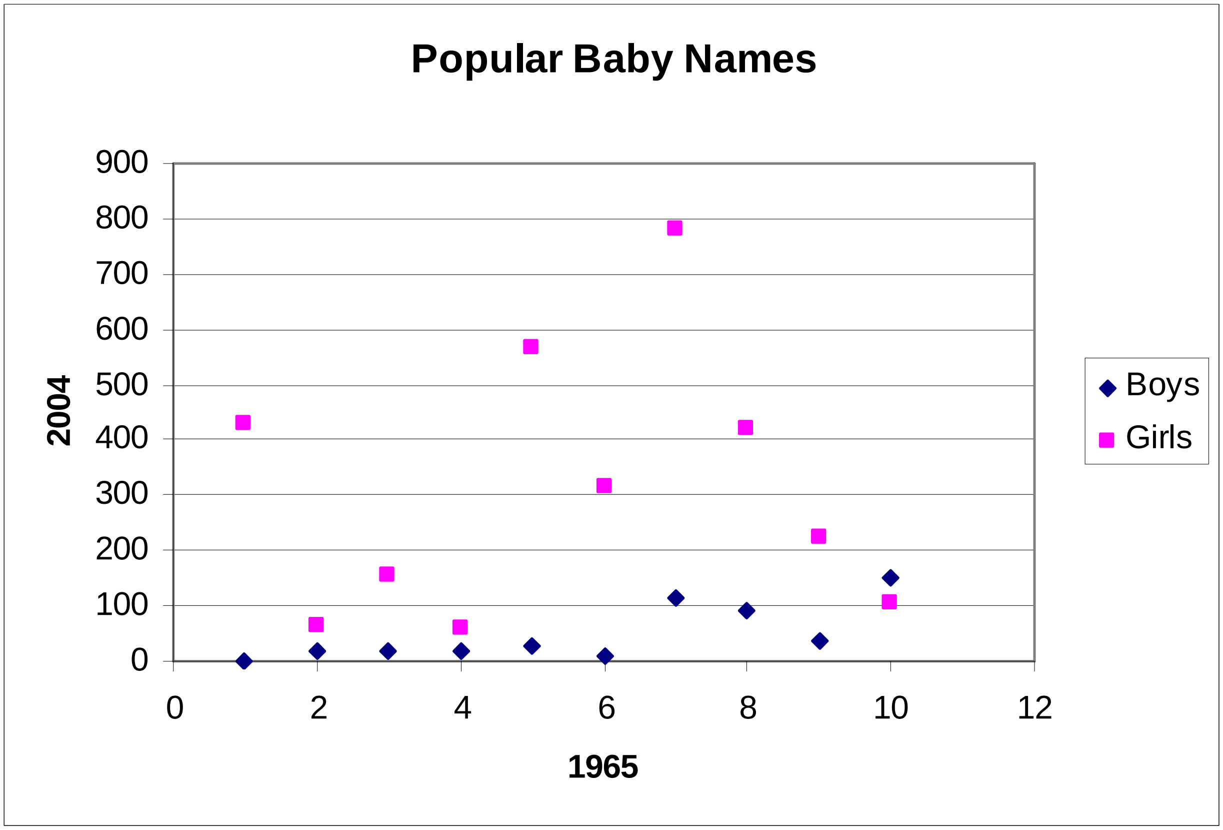


Transparency 4



	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

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 1^{st} attempt, most students were able to increase the number of revolutions on their 2^{nd} attempt.

__________2. After the 1^{st} attempt, most students made fewer revolutions on their 2^{nd} attempt.

__________3. The number of revolutions on the 1^{st} attempt is about the same as the number of revolutions on the 2^{nd} 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 2^{nd} attempt than on their 1^{st} 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.

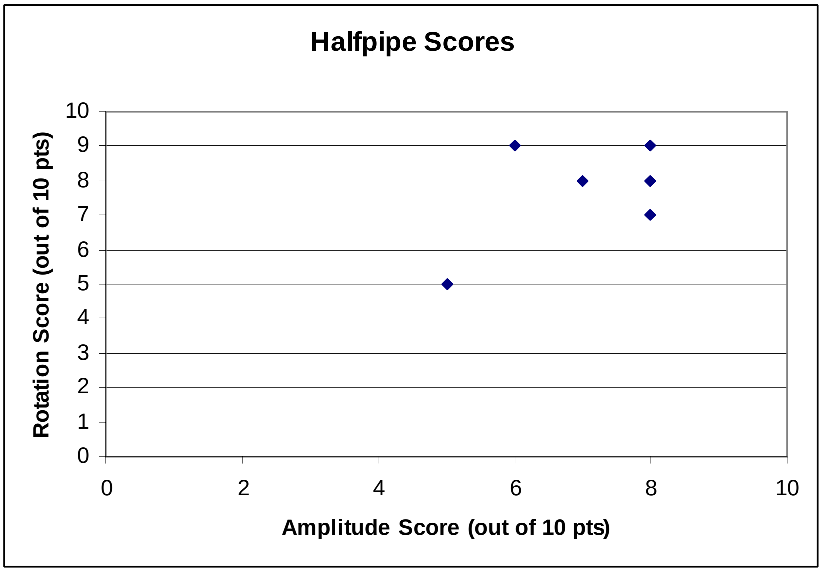
?	**?**

   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.



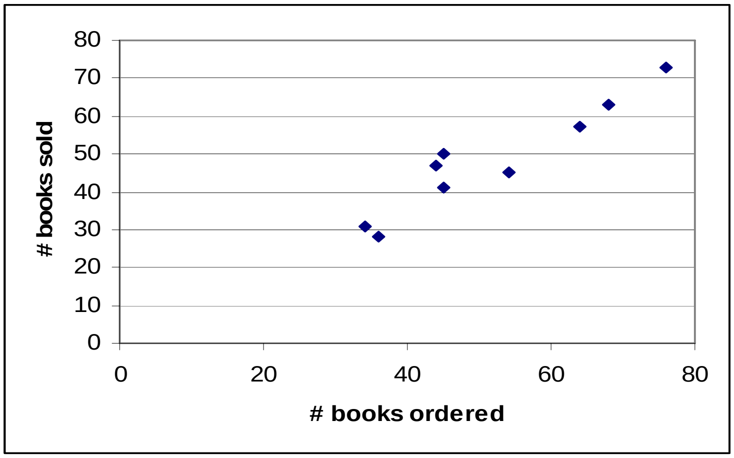
Which of the following statements would be supported by the scatterplot?

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.

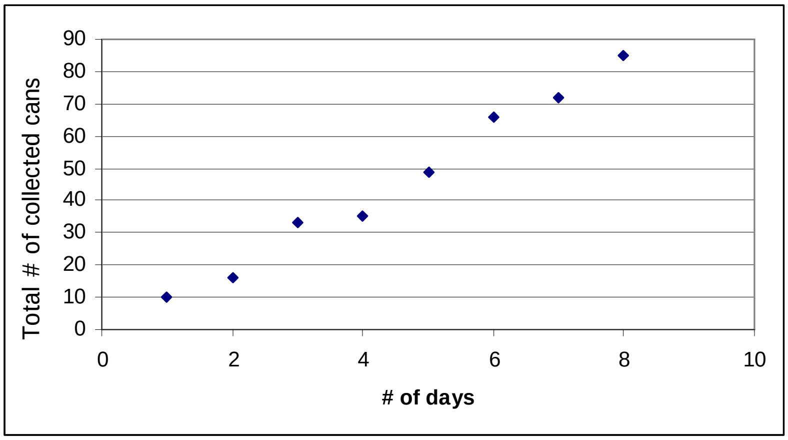
3. The following scatterplot compares the number of books ordered through the school fund raiser to the number of books that were actually paid for and sold.



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