Explore/Explain 3: Trials, Trials, Trials

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

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

Duration:
2 hours

Mathematics TEKS Objectives:
6.9B The student uses experimental and theoretical probability to make predictions. The student is expected to find the probabilities of a simple event and its complement and describe the relationship between the two.

6.10A The student uses statistical representations to analyze data. The student is expected to select and use an appropriate representation for presenting and displaying different graphical representations of the same data including line plot, line graph, bar graph, and stem and leaf plot.

6.10B The student uses statistical representations to analyze data. The student is expected to identify mean (using concrete objects and pictorial models), median, mode, and range of a set of data.

6.10C The student uses statistical representations to analyze data. The student is expected to sketch circle graphs to display data.

6.10D The student uses statistical representations to analyze data. The student is expected to solve problems by collecting, organizing, displaying, and interpreting data.

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

6.11B, 7.13B, 8.14B The student applies Grade 6/7/8 mathematics to solve problems connected to everyday experiences, investigations in other disciplines, and activities in and outside of school. The student is expected to use a problem-solving model that incorporates understanding the problem, making a plan, carrying out the plan, and evaluating the solution for reasonableness.

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

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

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

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

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

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

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

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

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

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

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

8.12C The student uses statistical procedures to describe data. The student is expected to select and use an appropriate representation for presenting and displaying

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

Technology Applications TEKS Objectives:

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

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

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

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

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

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

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

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

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

TAKS Objectives:

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

Technology:

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

Materials:

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

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

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

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

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

Activity 1 – Trials, Trials, Trials!

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

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

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

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

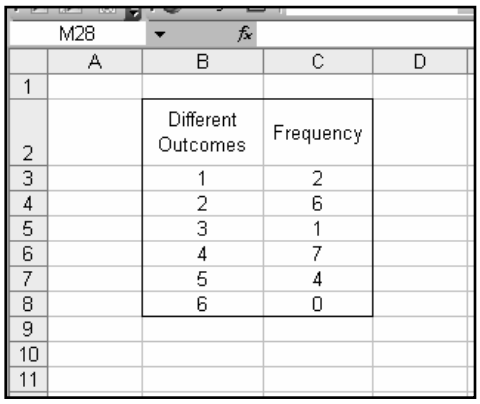
4. *Have groups work together and do the activity. Record the outcomes on the* ***Group Activity Sheet*** *using the frequency table for simulation #1.*

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

Example: Answers will vary.

Simulation #1

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



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

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

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

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

Facilitation Questions

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

Activity 2 - Trials, Trials, & More Trials

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

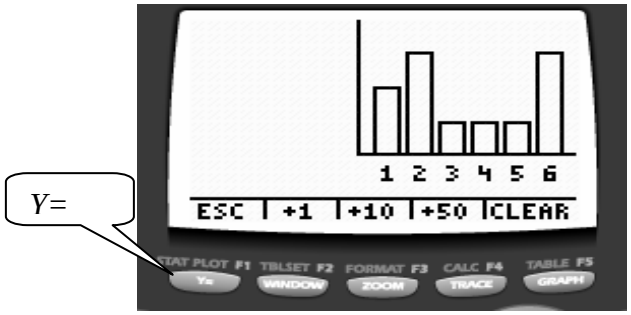
Notice that there are two different sets of ***Simulation Cards Set 2****. One set may require loading the probability simulator from the TI website. Also, the presenter may need to seed the number generator on any graphing calculator where the number generator has not been used before. (Refer to the*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

*the room facilitating the activity. Use the **Facilitation Questions** to guide and redirect participants, as needed.*

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

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

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



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

Example: Answers will vary.

Data Table: Simulation #2

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

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

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

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

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

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

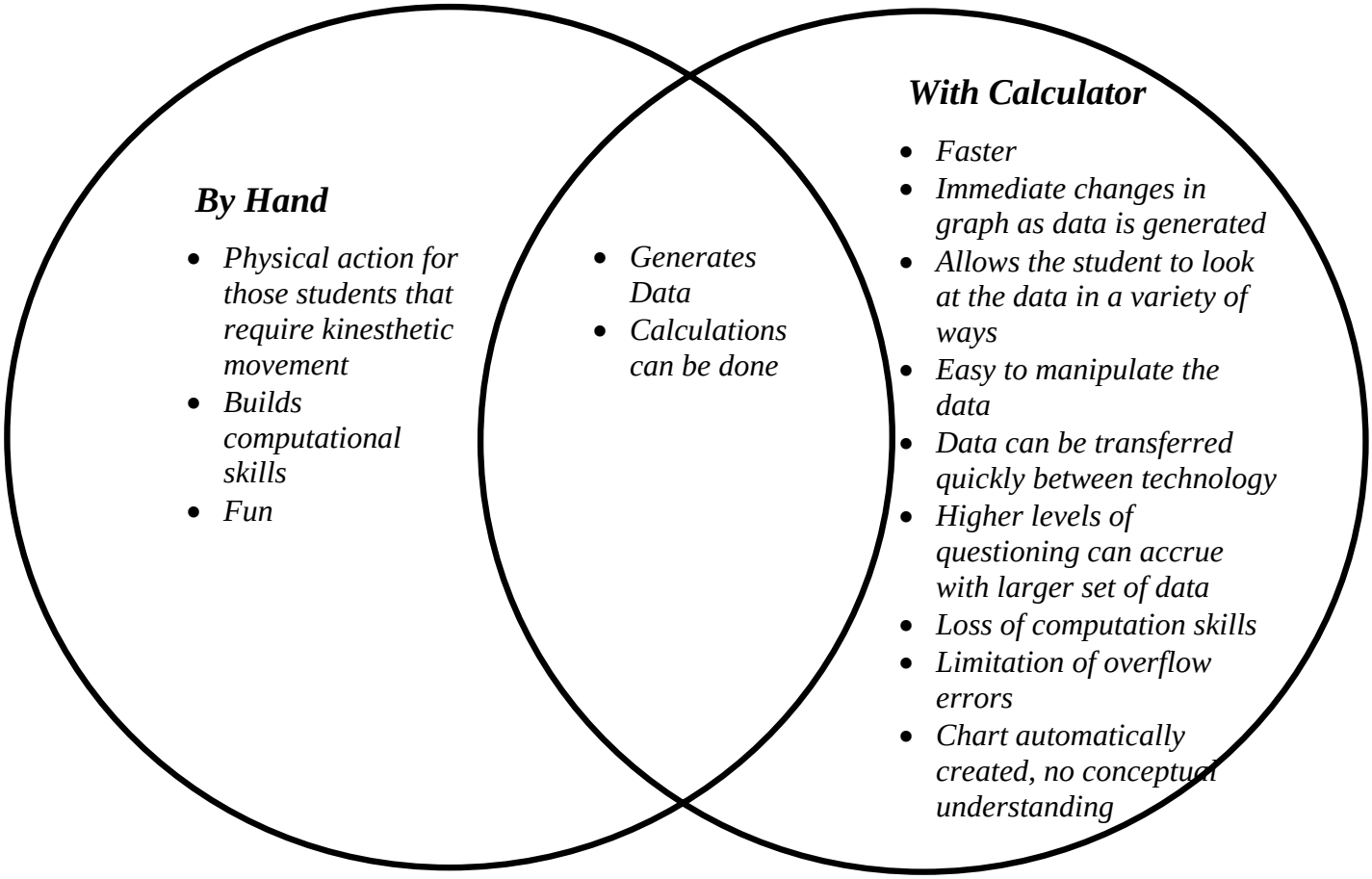
If the participants are using the Math PRB Menu, skip step #6.

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

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

Example: Answers may vary.

Participant Page: Venn Diagram



Facilitation Questions

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

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

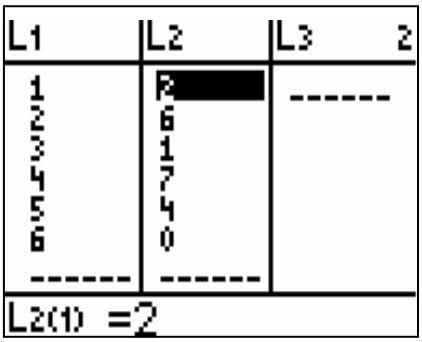
8. *Display the* ***To Do List*** *transparency and uncover the last four bullets, or display Power Point slide 8.*

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

Example: Answers will vary.

Simulation #2

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



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

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

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

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

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

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

Participant Page: My Best Graph Questionnaire

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

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

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

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

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

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

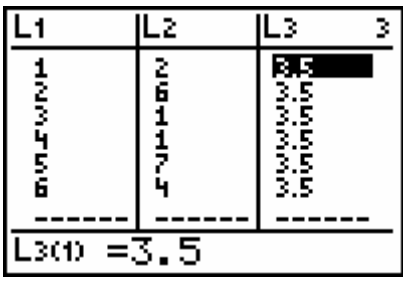
Activity 3 – The Big Question

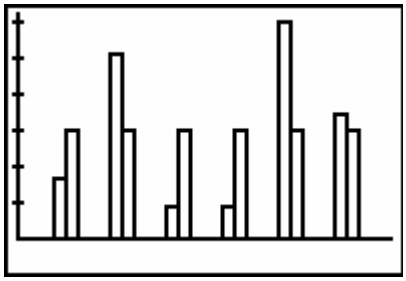
This part of the lesson focuses on a comparison of Theoretical Probability and Experimental Probability. Each group of participants creates a graphical representation, of their choice, of the data. Participants will have access to a computer with spreadsheet software, calculator, and/or Internet access.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

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

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

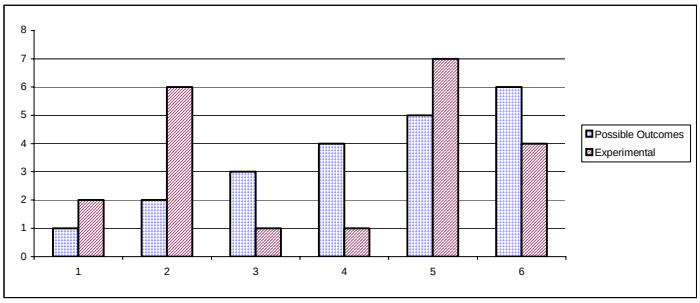
Example: Answers may vary.
Graphing Calculator



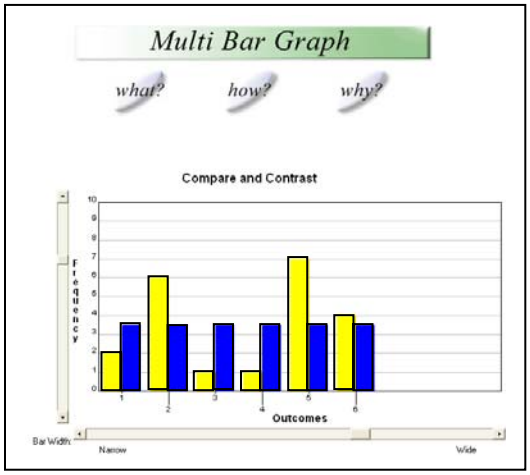


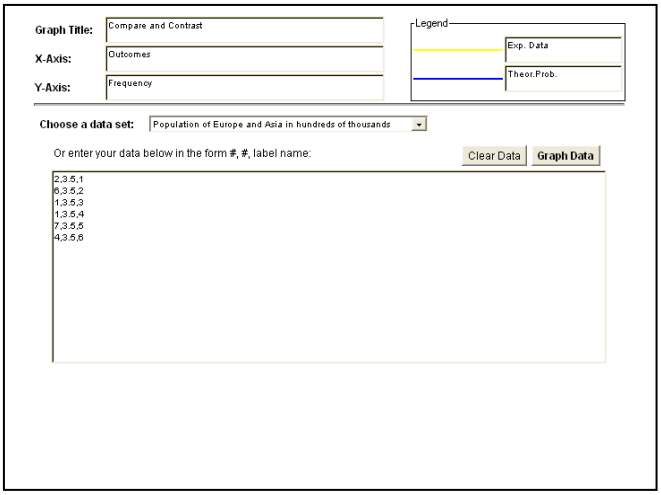
Example: Answers may vary.
Spreadsheet

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



Example: Answers may vary.
Interactive Website



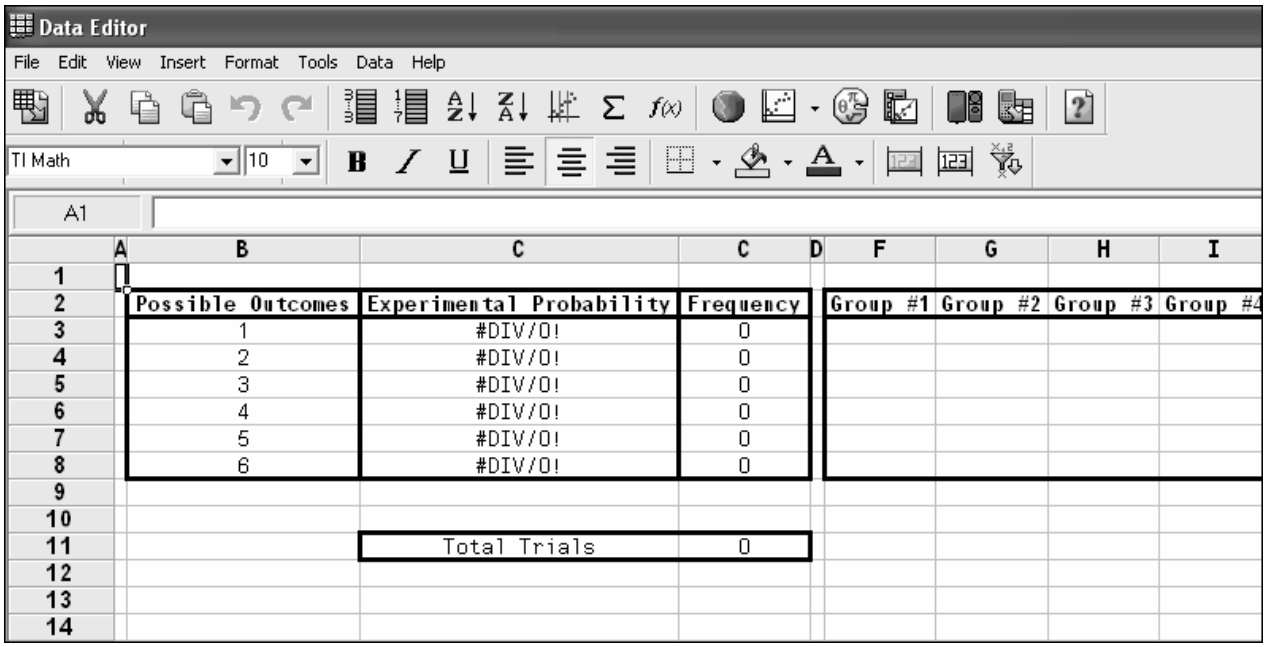


Facilitation Questions

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

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

Example of presenter(s) spreadsheet is below:



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

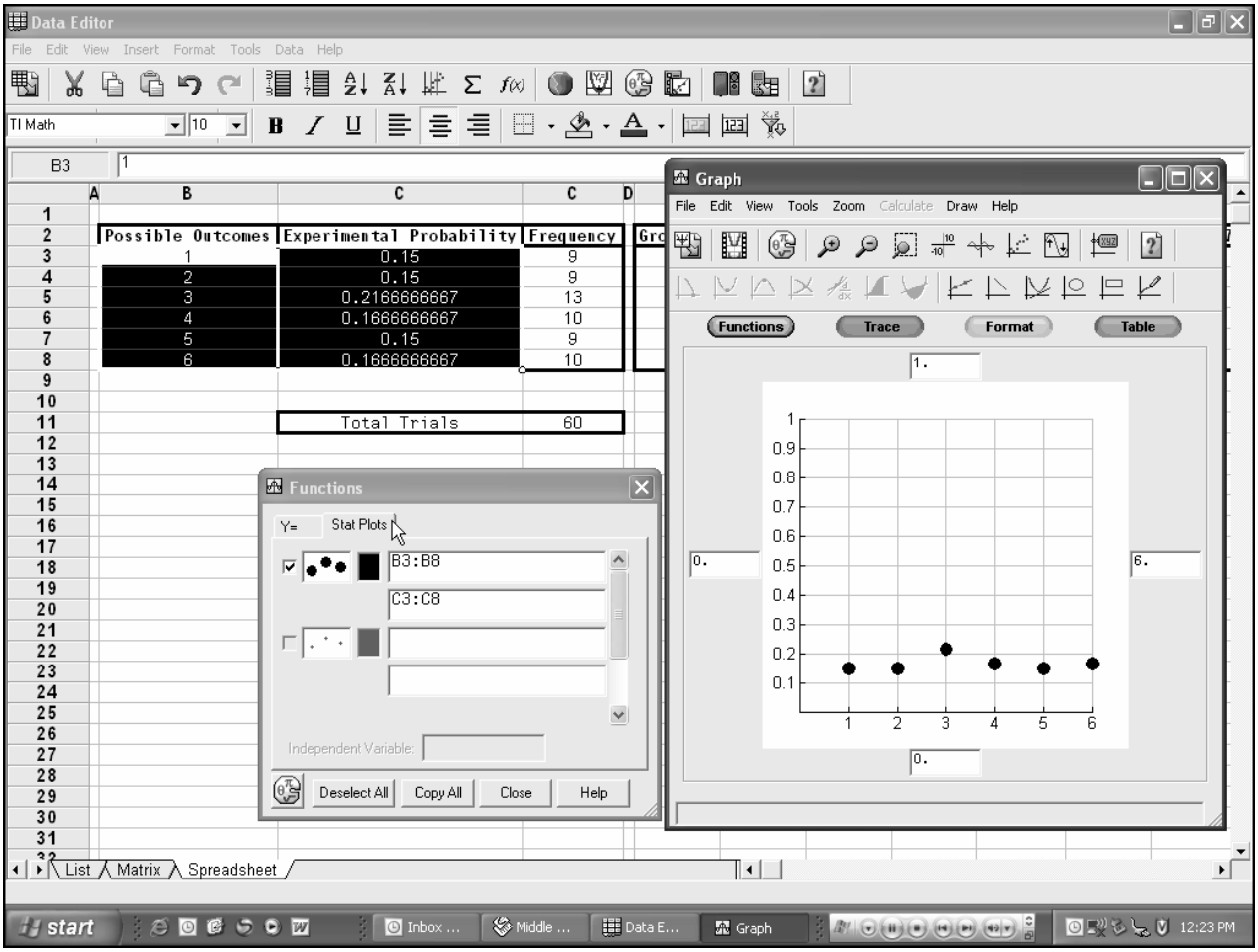
3. *Display Power Point slide 13 and/or state thought questions found on Power Point slide 13:* ***What are some of the visible changes you see in the experimental outcomes as more trials are entered?, What is the relationship between the points on the graph and the line on the graph?, and How does the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

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

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

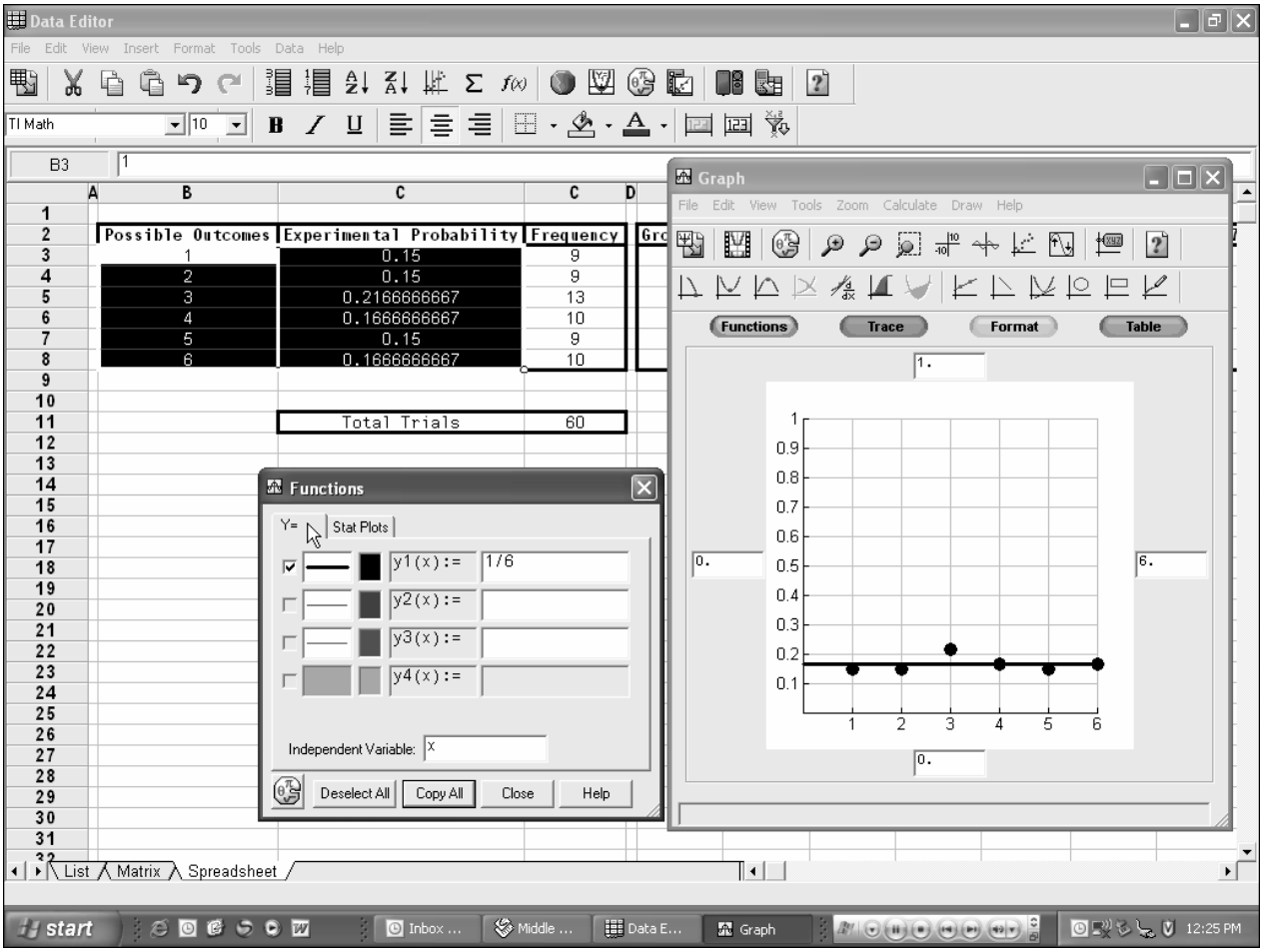
6. *Using the graphing function of the TI-interactive software create a graphical representation of the data using the Possible Outcomes and Experimental Probability columns.*

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



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

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



Facilitation Questions

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

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

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

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

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

Facilitation Questions

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

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

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

Facilitation Questions

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

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

Facilitation Questions

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

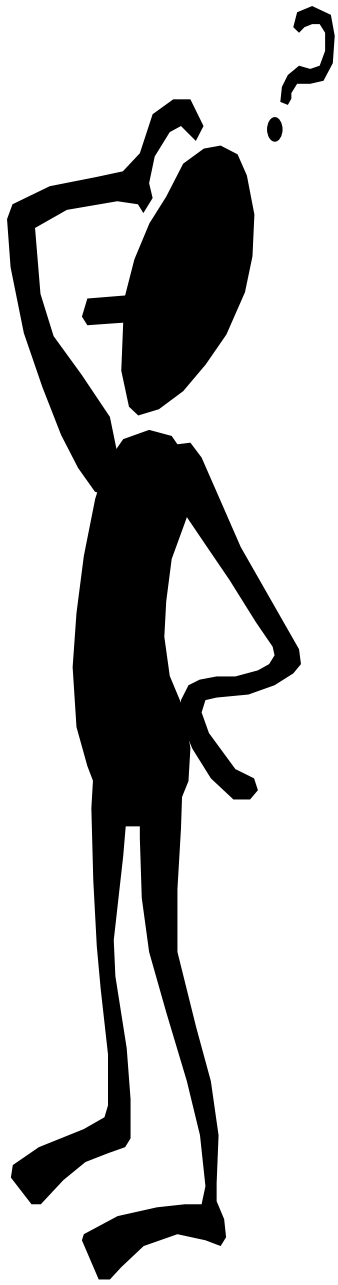
15. *Prompt the participants to set aside the completed Intentional Use of Data activity sheet for later discussion. These completed activity sheets will be used during the elaborate phase as prompts for generating attributes of judicious users of technology.*

Example: Answers may vary.

Explore/Explain 3: Intentional Use of Data

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

Transparency: The Big Question



What is the relationship between Experimental and Theoretical probability?

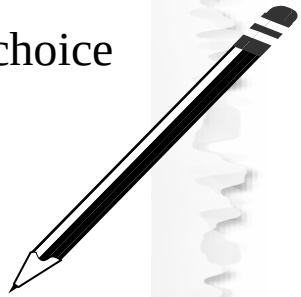
Transparency: Mini To Do List

☐ Do simulation.

☐ Using the Simulation #1 frequency table, record the results.

☐ Create a spreadsheet using Excel to represent the results of your simulation.
Remember to title and label!

☐ Create a graphical representation of your choice to represent the results of your simulation.
Remember to title and label!

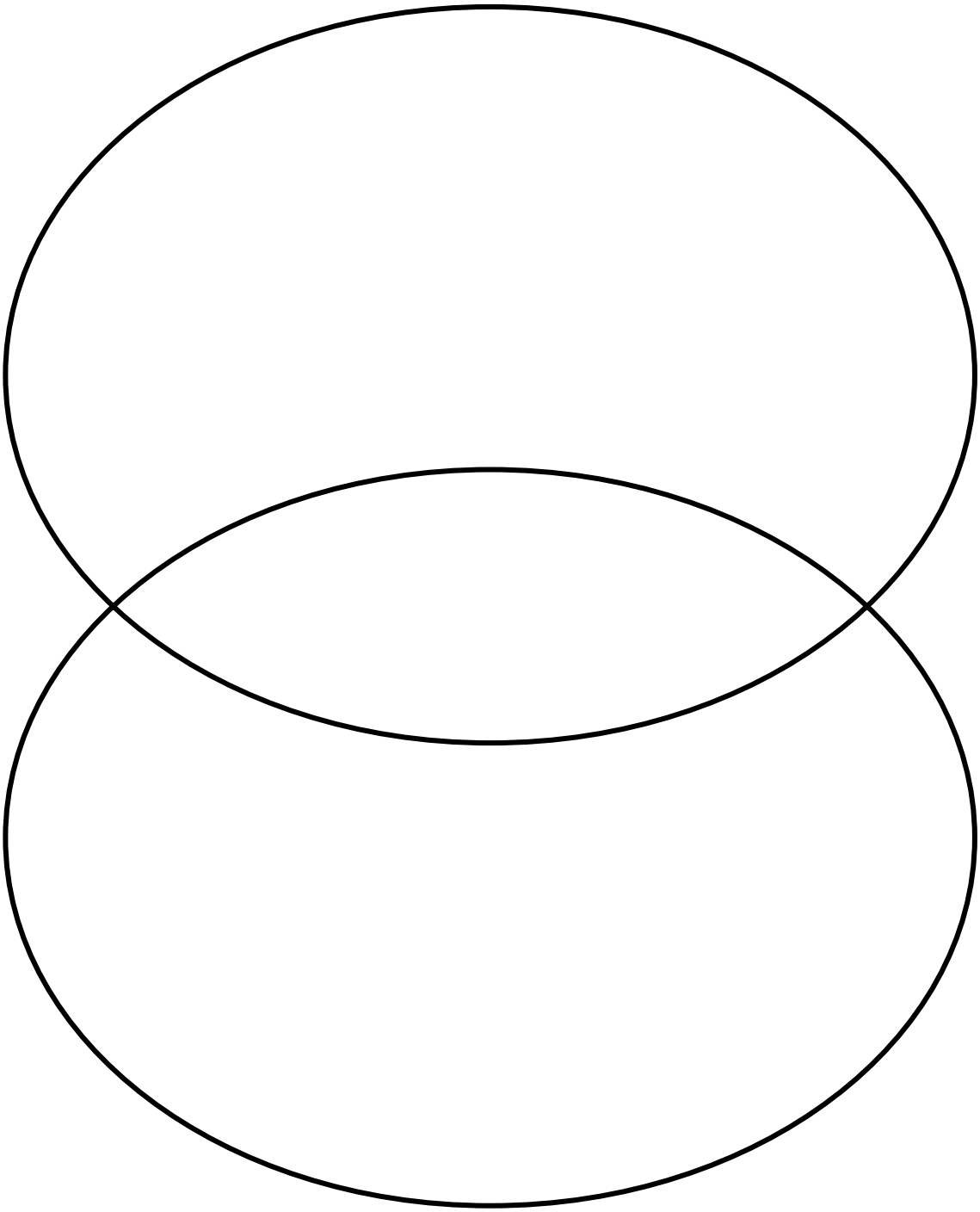


Transparency: To Do List

Refer to the Technology Tutorial flip chart as needed.

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

Transparency: Venn Diagram



Transparency: My Best Graph Questionnaire

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

   ⬭ Circle Graph ⬭ Histogram ⬭ Bar Graph ⬭ Line Plot

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

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

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

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

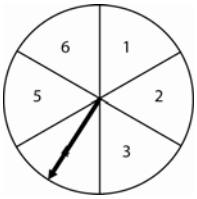
6. How does analyzing other graphical representations of the same data benefit your students?

Activity Master: Simulation Cards Set 1

Cards

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

Spinner



Using a six section spinner perform twenty spins.

Number Cube

Using a number cube perform twenty rolls.

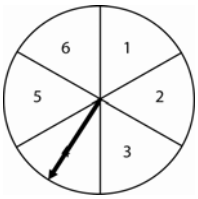
Activity Master: Simulation Cards Set 2
With APPS Program

Number Cube

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

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

Spinner



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

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

Activity Master: Simulation Cards Set 2
Without APPS Program

Number Cube

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

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

Number Generator

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

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

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

Supplies:

- Card Stock
- Paper bag
- Scissor

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

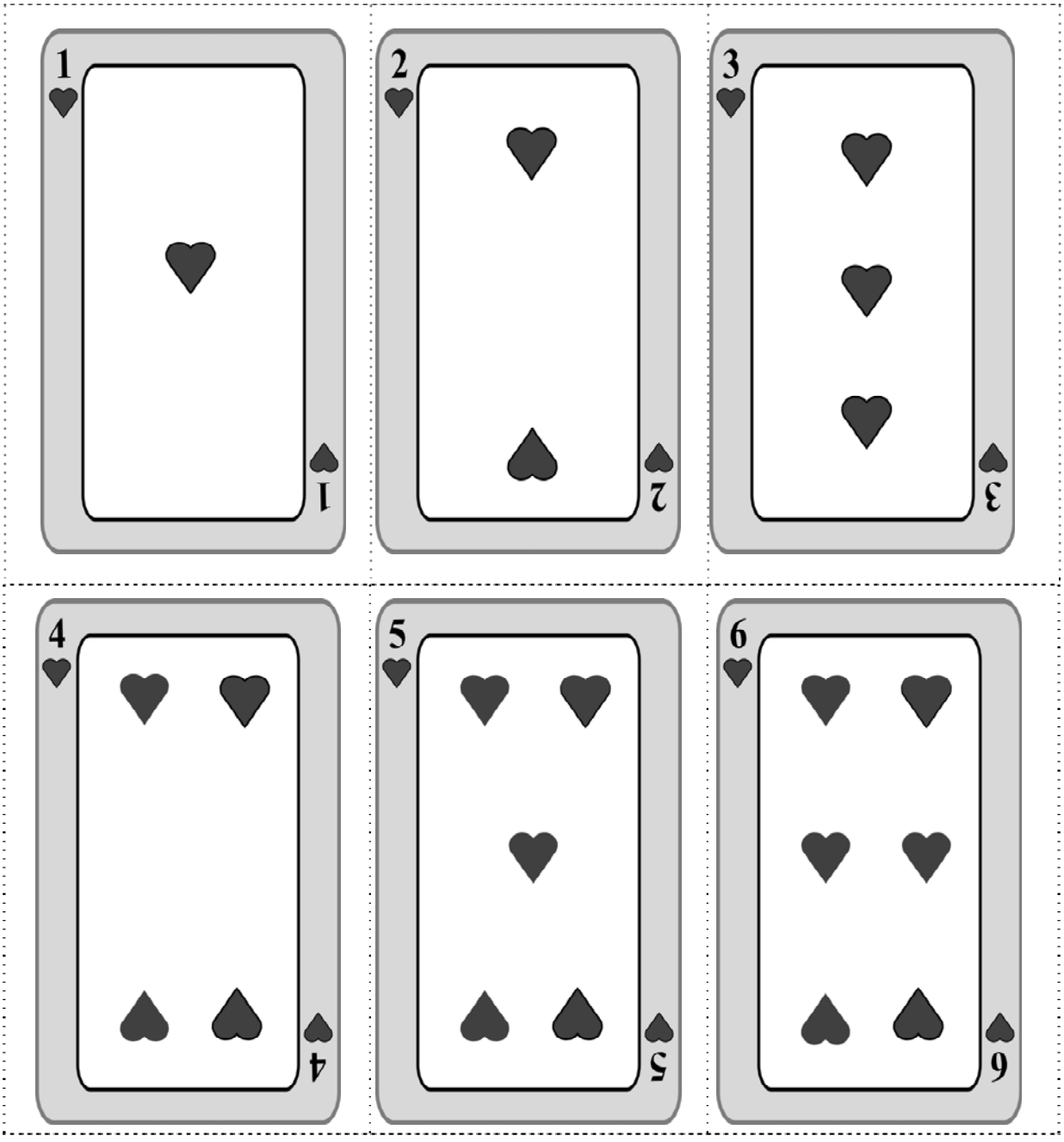
1	2	3
4	5	6

Activity Master: Playing Cards

Supplies:

- Card Stock
- Scissors

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

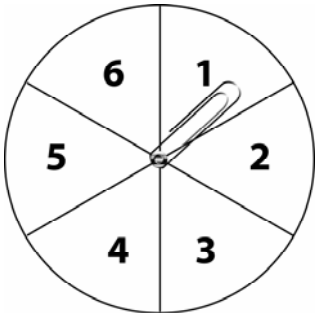


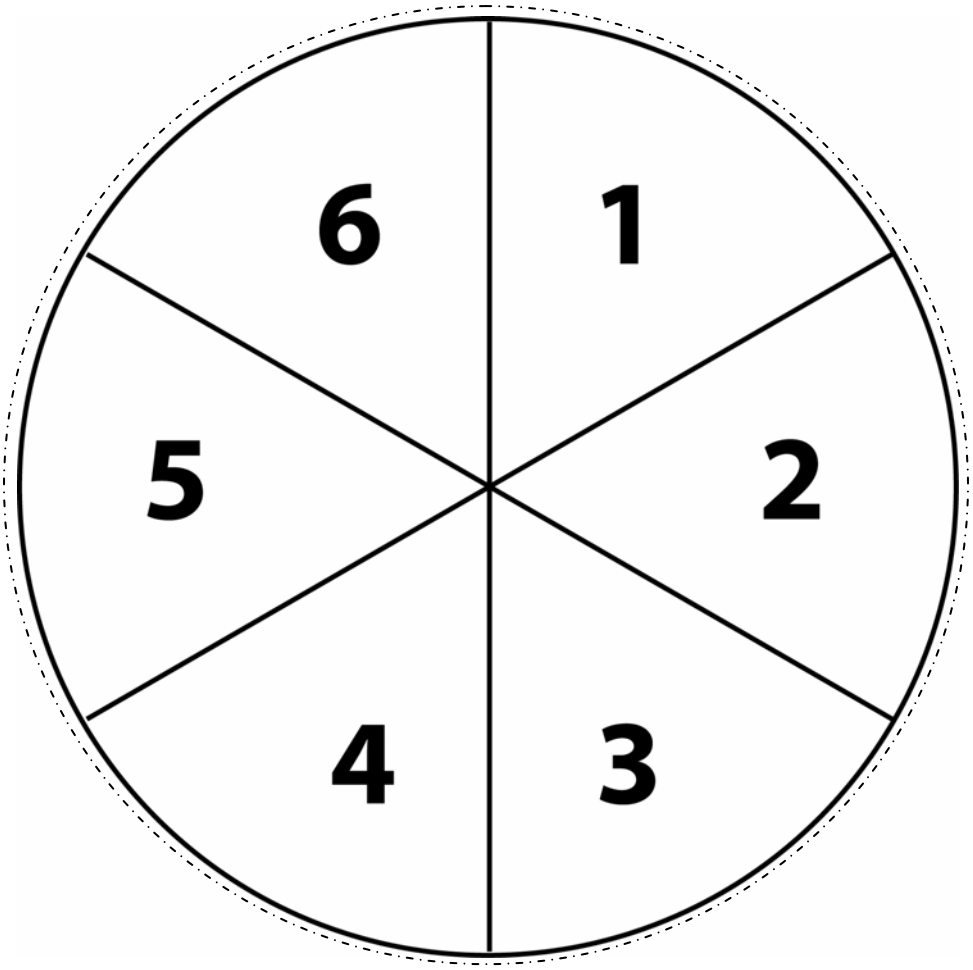
Activity Master: Spinner

Supplies:

- Card stock
- Brad
- Paper clip

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





Participant Page: Group Activity Sheet

Simulation #1

Outcomes	Tally	Frequency
1		
2		
3		
4		
5		
6		

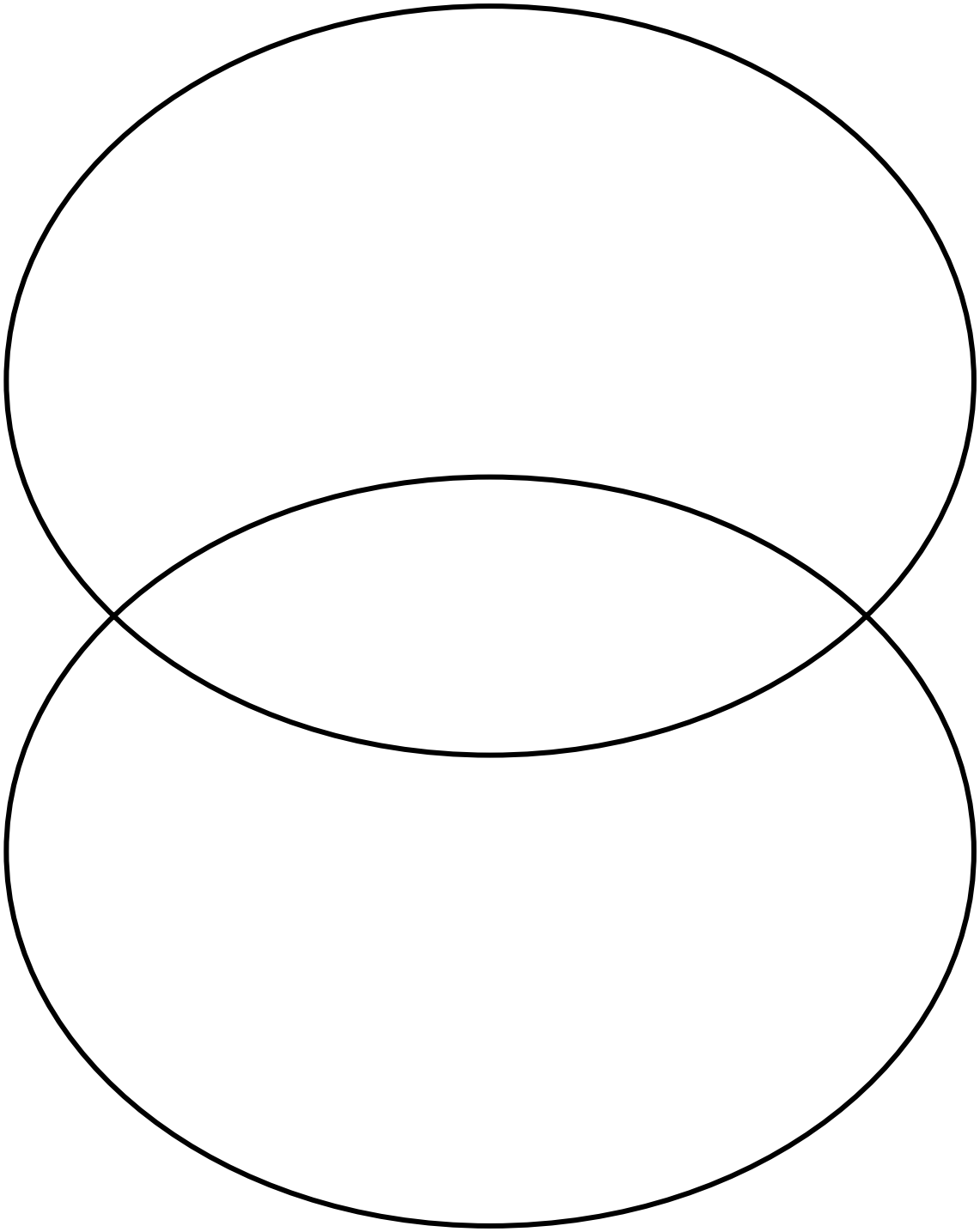
Data Table: Simulation #2

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

Simulation #2

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

Participant Page: Venn Diagram



Participant Page: My Best Graph Questionnaire

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

⬭ Circle Graph ⬭ Histogram ⬭ Bar Graph ⬭ Line Plot

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

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

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

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

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

Explore/Explain 3: Intentional Use of Data

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