

## Probability and Statistics

**Activity:** Problems Kids Care About

**TEKS:** (K.12) **Probability and statistics.** The student constructs and uses graphs of real objects or pictures to answer questions.  
The student is expected to:

- (A) construct graphs using real objects or pictures in order to answer questions; and
- (B) use information from a graph of real objects or pictures in order to answer questions.

**Overview:** According to the National Center for Educational Statistics (2000), three factors influence successful mathematics instruction: a) mathematics instruction within a real-world context, b) problem-solving, student-centered classrooms, and c) mathematics communication. To address the first factor, Hatfield et al. (2005, p. 19) state: “No student should leave elementary school without a sense of the importance of mathematics in human history.” Looking at human history, it would not take long before one identified the mathematical ideals developed to understand the problems within the context of everyday life. For example, much of what we understand about statistics and probability was developed because people wanted to understand the movement of the stars or the probabilities of winning when gambling. Now we use these mathematical concepts to help make decisions in marketing, drug development, investing, and other real-world situations.

Focus within the mathematics classroom should be on problem solving with children communicating about mathematics (NCTM, 2000). Not only do students need experience with problem-solving lessons, but they also need practice discussing and presenting mathematical information. Shand (1999) argues that children must be able to question and challenge data and information to make reasonable decisions. They must be able to communicate what they are learning by analyzing and supporting their findings. She states, “Students need to develop skills that enable them to live in a society that increasingly makes use of ideas found in statistics and probability” (p. 1).

According to the NCTM Principles and Standards (NCTM, 2000), students, even as early as Pre-K, should “pose questions and gather data about themselves and their surroundings” (p. 108). This includes formulating questions, collecting data, organizing, displaying, and presenting relevant data. Once students collect the data, they should analyze the data using appropriate statistical methods. Questions that are important to the students should lead the students to form inferences, predictions, and further questions.

This lesson is very open-ended and can be modified to meet the needs of your students. The purpose of the lesson is to give students a chance to solve meaningful problems. As the teacher, you must be willing to allow the students the freedom to explore the world around them. The more problems the children solve, the more powerful their questions become. They will begin to solve problems that really affect their lives.

- Materials:**
- Pre-Lesson Materials
    - Digital Camera
    - Pictures of children
    - List of students’ names on chart paper
    - Hair length labels with words (Short Hair, Shoulder Length Hair, Long Hair) and pictures of children
    - Number labels
    - Table with hair length listed on chart paper
    - Pre-made blank graph on chart paper
  
  - Lesson Materials
    - Chart paper
    - Marker
    - Floor graph
    - Blank sentence strip
    - Tape
    - Book such as *All the Colors of the Earth* by Sheila Hamanaka or *The Colors of Us* by Karen Katz

**Grouping:** Large Group

**Time:** 1 ½ hours

**Lesson:**

Procedures	Notes
<p>1. <b>Prior to Lesson:</b> Using digital camera, take individual pictures of each of the students in your class.</p> <p>Create on separate sheets of chart paper a list of student names, a table that lists all the students’ hair length, and a graph with a blank at the top for a title and on the left side and bottom to place headings.</p> <p>Create hair length labels and number labels to be attached to the floor graph.</p>	<p>This lesson should be taught as an introduction to data collection. It may take more than one day to teach the whole lesson depending on how much time you have to devote to math instruction or if this lesson is integrated with another subject.</p> <p>Once the TEKS have been introduced, the focus needs to be changed or eliminated, and children should be able to determine their own questions.</p>

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	<p>You may also want to give students a question based on the thematic unit you are teaching.</p> <p>This lesson is open-ended and is easily integrated into language arts, social studies, or science.</p>
<p>2. <b>Focus:</b> Gather students around on the floor in a horse-shoe. Post student pictures randomly on the wall at the front of the room. Read a book similar to <i>All the Colors of the Earth</i> by Sheila Hamanaka or <i>The Colors of Us</i> by Karen Katz. Talk with the students about what makes us similar. List these attributes on chart paper. Make a second list of attributes that make the students different. If students do not say hair length, lead them to this attribute. Ask the students, “How we can find out what length of hair all the children in our classroom have?”</p> <p>Have the students self-sort by hair length and keep them in groups. This will make it difficult to determine which group has more than, less than, or the same number of students. Ask the students to tell you what they can determine by separating in this manner. Ask students: “What might be a better way to tell which group has more than, less than, or same number of students in each group without counting?”</p> <p>Brainstorm with children about how they can determine which group has more than, less than, or same number of children. Record these ideas on chart paper. Lead the children to understand that they can list their names based on their groups. Have children record their name on the chart paper with the pre-made table.</p> <p>After organizing the data in the table, introduce the floor graph by hanging it on the wall. Place hair length labels at the bottom</p>	<p>As the teacher, you want to facilitate this process. You want to guide the students in determining what should be done without telling them exactly what to do.</p> <p>Hair length was randomly chosen for this particular lesson. You may choose any of the attributes the children list to develop this lesson. The list also gives you many ideas for collecting and representing data in future lessons.</p> <p>Sample surveys and tables are provided in this lesson.</p> <p>This will possibly lead to a</p>

Procedures	Notes
<p>of the graph. Have students find their picture on the wall and place their picture in the correct column. Allow students to place their picture in any space in the correct column.</p> <p>Show students how to label the parts of the graph correctly by placing numbers along the left side and hair length along the bottom and also giving the graph a title that describes the graph.</p> <p>Ask students to tell you what they can determine by organizing the student pictures in this manner.</p>	<p>teachable moment. If children do not line-up pictures from the bottom up without leaving a square blank, the students will not be able to visually determine which group has more than, less than, or same number of students as the other groups. Lead students to understand that the pictures need to be organized so that they have to use one-to-one correspondence to visually check their answer.</p> <p>The first question asked should not be: “How many _____ are there?” If this is the only question you are asking, all that is needed is for the children to count. The purpose of graphs is to visually be able to determine number in each column or section, which column has more than, less than, or the same as other columns.</p>
<p><b>3. Development of the Question:</b> Ask the students to identify questions about which they are curious. List these questions on the board or chart paper.</p> <p>Have the class vote on which question they would like to investigate. You can do this by having students raise their hand as you call out a topic. If students have trouble voting on one topic, use containers with the question on the outside and have students place their piece of paper in the container with the question they would like to investigate.</p> <p>Once the question is determined, the students may decide to limit the number of choices to four or five items. For instance, if the question is “What is your favorite fast</p>	<p>If students have trouble developing questions, give them a choice of four or five questions that they can vote on as a class to determine what they would like to answer.</p>

Procedures	Notes
<p>food restaurant?”, the children would decide on what four or five restaurants from which everyone may choose. This is not a requirement and may not be necessary.</p>	
<p>4. <b>Development of the Survey:</b> Once the question is determined, have the students decide how they would like to collect the information. This includes the method they will use to gather the data and the tool(s) that they will use.</p>	<p>Examples of how students could gather data for a favorite pets survey follow. Students could: (1) draw a picture of their favorite pet, (2) use containers with a picture of a pet in which they drop a piece of paper, or (3) call student’s name from a list and write their favorite pet next to their name.</p> <p>The possible choices are varied depending on the type of question that is asked. Also, if this lesson is taught more than once during the year, the methods for gathering the data should vary.</p>
<p>5. <b>Gathering of the Data:</b> Students should be actively engaged in collecting the data. How they collect the data will be determine by the type of instrument used to collect data.</p>	<p>Another term for gathering data is polling. If this lesson is to be as realistic as possible, students need to be out of their seats communicating with their classmates and asking questions.</p>
<p>6. <b>Graphical Representation:</b> Have students construct graphs using real objects or pictures in order to answer questions.</p> <p>Be sure students label the x and y axis and give the graph a title. Be sure the title describes the data represented in the graph.</p> <p>If using a bar graph, assess whether or not students know to start at the bottom of the graph and line the objects or pictures up using equal distances between each one.</p>	<p>Usually the graphs used in kindergarten are bar graphs or pictographs. According to the Kindergarten Student Expectations (TEKS), students should use real objects or pictures to construct graphs.</p> <p>The correct use of a pie graph is provided in the following example of Kindergarten students answering the question “What is your favorite pizza?”</p>

Procedures	Notes
	<p>The teacher cut out two equivalent circles. She cut one circle into 16 even pieces (the number of students in the classroom). The students colored their “favorite pizza” and placed their piece of pizza on the full circle, sorting by type. This gave a good visual. Then the teacher asked the students to discuss what they could determine. She was also able to talk about fractions as the students discussed that over half the students liked pepperoni pizza (Collier, unpublished).</p>
<p><b>7. Analysis of the Data:</b>                      The first question asked should be open-ended. Ask the students what they can determine from the graph.</p> <p>If a bar graph was created, students should be able to tell which column has more than, less than, or the same number as other columns. If they are unable to do this through the open-ended question, then ask specific questions that allow students to analyze the graphs.</p>	<p>The first question asked should not be “How many _____ are there?” All that students need to do to answer this question is counting. The purpose of graphs is to visually be able to determine numbers in each column or section and which column has more than, less than, or the same as other columns.</p> <p>If students use real objects to construct the graphs, addition and subtraction problems can also be created using the information from the graph.</p>

**Assessment:** Because this lesson is an introduction, assessment is conducted through observation and informal questioning. A sample of an observation checklist or an anecdotal notes page is given. Formal assessment will be conducted after the students can construct and analyze graphs independently. Examples of how to mark the observation rubric could be: D-Developing, C-Competent, P-Proficient, or letter grades (U, NI, S, E).

**Extensions:** As students become familiar with the data collection process, split the children into groups of 4 and allow them to develop their own

questions and survey and to actually survey each other. They should continue to finish the process by creating their graphs based on information gathered and present their analysis of data to the rest of the class.

Students may also survey other classrooms as well. Possible ways of doing this depends on the type of question that is asked. Students may go to other classrooms and conduct a class survey by having children raise their hands or vote using paper ballots. Envelopes could be placed in a common area (i.e., outside the cafeteria), and after ballots are distributed, students would place their ballots in the appropriate envelopes. For example, students may want to determine what month students celebrate their birthdays. Twelve envelopes with the months recorded on the outside could be hung on the wall, and students would place a blank ballot in the envelope matching their birthday month.

- Resources:** Collier, A. (unpublished). What is your favorite pizza?: Kindergarten problem kids care about. Tarleton State University.
- Hamanka, S. (1994). *All the colors of the earth*. New York: William Morrow and Company, Inc.
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- National Center for Educational Statistics. (2000). *Pursuing excellence: Comparison of 8<sup>th</sup> grade mathematics and science achievement from a U.S. Perspective, 1985 and 1999*. Washington, DC: U.S. Department of Education.
- National Council of Teachers of Mathematics. (2000). *NCTM principles and standards for school mathematics*. Reston, VA: NCTM.
- Shand, K. B. (1999). The numbers game: Teaching kids how to play ... and win! *The Social Studies*, 90(3), p 121-124.





