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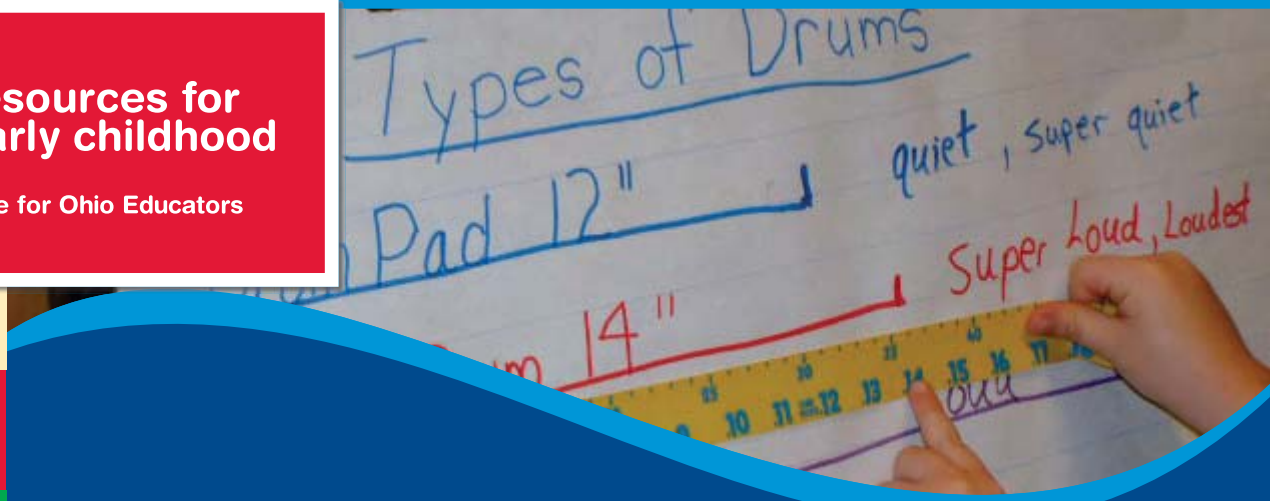
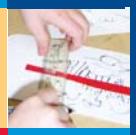
An Online Resource for Ohio Educators





Early Childhood Building Blocks

Children Using Data to Find Answers

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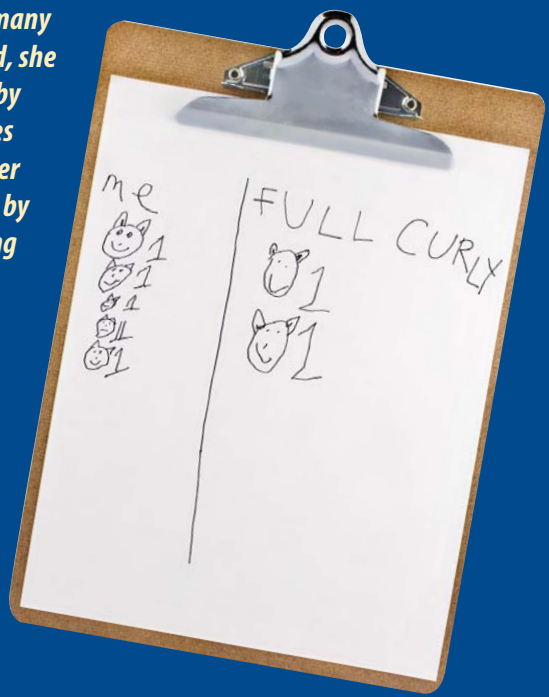
INTRODUCTION

Six-year-old Katie was playing a computer game. She was racing a cartoon bear—by the name of Full Curly—to see how many pies they each could eat at the county fair. As Katie played, she asked me who won more often, she or the bear? I replied by asking her, "How could you keep track of how many games you win?" She was excited at the idea of finding the answer herself. Katie decided to keep track of the wins and losses by making two columns on a sheet of paper, one for recording her wins and one for recording Full Curly's. For each win, Katie drew a smiley face in the appropriate column. After playing a number of games, she was ready to determine the grand winner. She put a "1" next to each of the faces; then she drew a circle on another piece of paper, counted her wins, and recorded them in the circle, using a happy face. She did the same for her losses, using a frowny face. She also made a circle showing Full Curly's wins and losses. When I asked Katie who won more, she told me that she did and explained her chart to me—and at that point, she decided she was tired of the game and would play again later.



What's Inside

In the scenario you just read, Katie was able to collect and analyze data to answer a question important to her. After she was encouraged to find her own method of collecting the information she wanted, Katie realized that she didn't have to rely on others for the answer. Helping children become more independent in their thinking and better able to problem-solve allows them to develop the skills needed to think critically. They also gain self-confidence and the mind-set needed to attack new problems. In this scenario, Katie was proud of herself for finding her own answer—and as she thought through and implemented her solution, she applied mathematics as part of the process.

RATIONALE

Children are curious about their world and learn by exploring. By observing children, asking them questions, and listening to their answers, we can take advantage of that natural curiosity and help them to further their understanding of concepts. Since young children are especially fond of sorting and counting, these early mathematics concepts are a natural way to extend their mathematics learning. Expanding these sorting and counting skills to include a few more formal skills, such as collecting specific data and looking for patterns, children can learn about the very powerful mathematical ideas involved in data analysis.

Data analysis is a process that is useful in many subjects in primary and secondary school and, of course, later in life too. Adults are asked to collect or interpret information on almost a daily basis in order to make sense of current and future events. Young children can begin to understand the process of data analysis while interacting with their everyday environment. For instance, in the scenario above, Katie showed the three phases of data analysis defined by the Ohio Academic Content Standards for Mathematics: She *collected and organized data* by drawing faces in columns and making tally marks; she *used* very basic *statistical methods* by counting up the number of wins for each and drawing a summary diagram. Most importantly, her work came from a question that *she* was interested in answering.

Katie's summary diagram showing wins and losses.

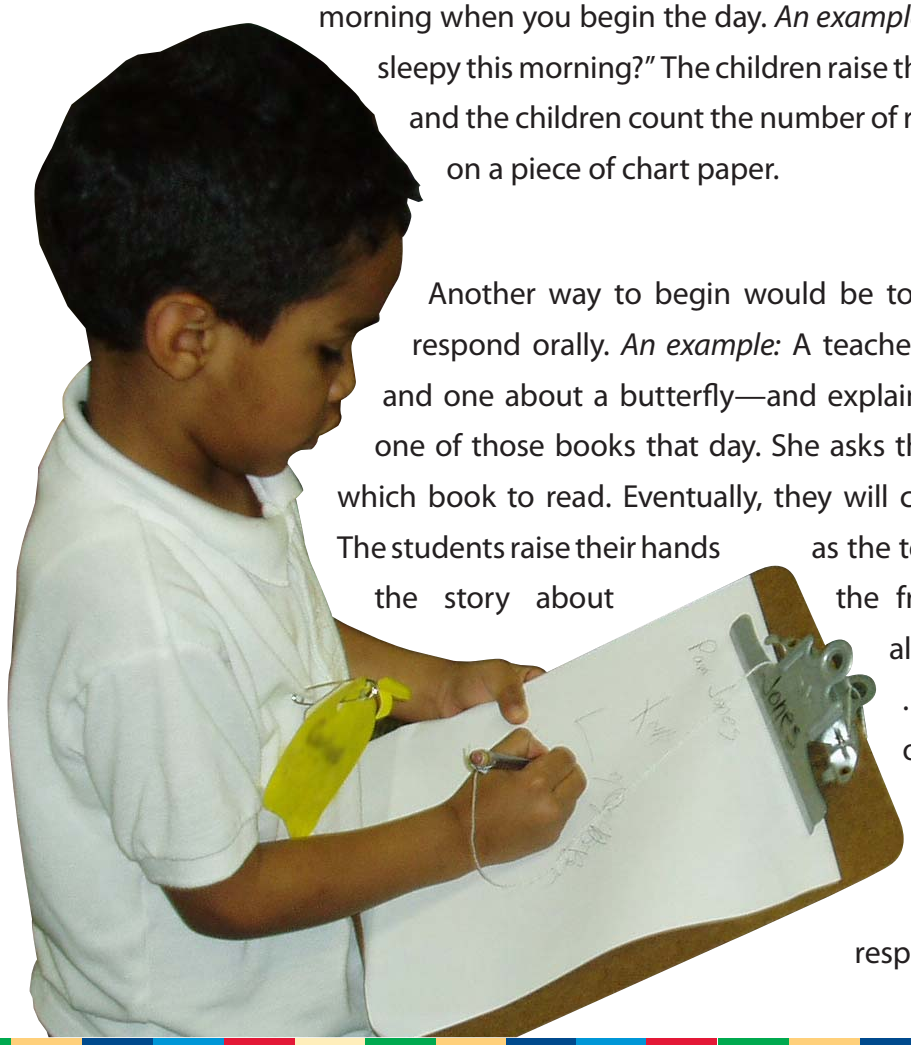
GETTING STARTED

Begin with Simple Questions

Questions should begin as a choice between two distinct options—for example, "How many children bring their lunch, and how many buy the school lunch?" Questions that require more than two choices can be added later after students have become comfortable working with just the two. For instance, "Do you have a pet?"—a "two-choice" question—could easily become "How many pets do you have?" or "What type of pet do you have?" Responses to these questions need to be discussed by the class to decide on the how to classify the answers and how to deal with students who have no pets. Letting the class choose the categories allows them to have ownership of the data and creates motivation for answering the question. Eventually, they can ask their own questions of each other and even take surveys of other groups of people, such as their parents or the students in other classrooms.

Practice Different Ways to Collect Data

One way to introduce the data collection process is to ask children a question at circle time, perhaps each morning when you begin the day. *An example:* A teacher asks, "How many of us still feel sleepy this morning?" The children raise their hands or stand up in response. Then she and the children count the number of respondents, and she tallies the information on a piece of chart paper.



Another way to begin would be to ask students a question and have them respond orally. *An example:* A teacher holds up two books—one about a frog and one about a butterfly—and explains that the class only has time to listen to one of those books that day. She asks the class to decide how they might choose which book to read. Eventually, they will come up with the idea of a vote by hand. The students raise their hands as the teacher asks, "How many would rather hear the story about the frog?" As she acknowledges the answers aloud ("Let's see, that's Maya, George, Iris, …"), she enters a tally mark for each response on a piece of chart paper. After asking, "How many would rather hear the story about the butterfly?" and marking the answers, the teacher and the children tally the responses together.

As the next step in learning to collect data, students could begin to answer in writing. In response to a question, students might write their names on Post-it notes and place the notes in the appropriate columns on a large paper located in a place that is accessible and visible to the class, perhaps at the front of the room. Or the children might write their names directly in these columns. For instance, if the class wanted to know how many pets each child had, Brian might write his name in the "2" column to show he has two pets.

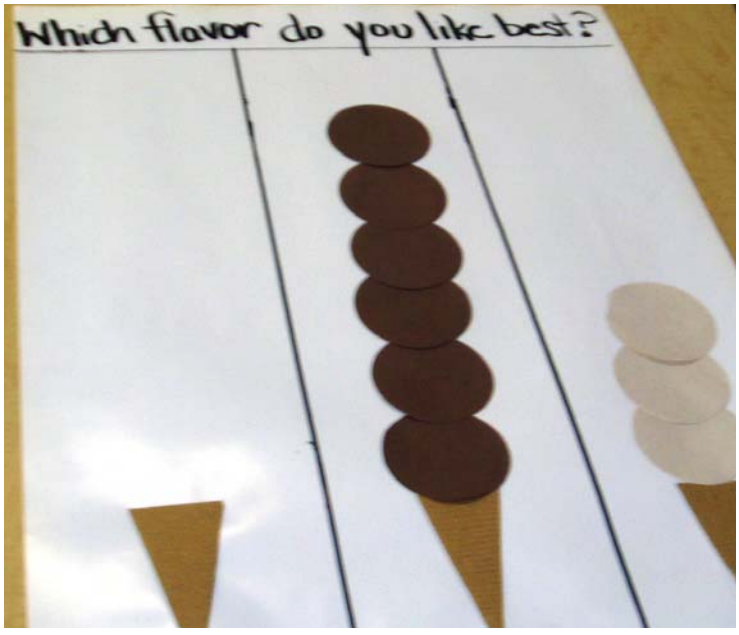
Many students seem to enjoy gathering data from family members, asking them, for example, what their favorite food is. Sometimes they may get responses that were not expected, and so they need to engage in discussion about what to do with the unexpected answer. For instance, in a poll of children about their mode of transportation to school, they may not have anticipated that someone would give "riding a bike" as a response. The discussion that would follow could include questions such as "Should this piece of data be included?" "Should a new category be created?" "Should the data 'riding a bike' be included in the category 'walking to school'?"

Experiment with Ways to Organize Data

Sometimes children find it difficult to organize the data in a way that will help them answer the question. It's helpful to allow them to experiment with various methods. They may choose to display their data as individual pieces of data written on scraps of paper or show the data written out on a page or entered into columns on a chart. As long as the data can be used to *answer their original question* or a question posed to them, their own methods of organizing and displaying the data are fine. If a child is unclear about how to organize or display the data, it's okay to offer suggestions about methods, such as listing the items larger than a pencil on one side of a paper and those items smaller on the other side. Questions about what they are doing, such as "How can you show a parent or friend what you are thinking?" can help focus their thinking on the organizing aspect of the work.

Ask More Questions

Once children have answered their original question (or the questions you posed to them), they or you can *ask more questions*. Katie, the child at the beginning who wanted to know if she won more than the bear, could be asked if her experiment would give her the same answer tomorrow as it did today.



HOW CAN TEACHERS AND PARENTS HELP CHILDREN COLLECT DATA?

Ask good questions throughout the process! A critical part of guiding children in their learning of mathematics or any other subject is asking students good questions—questions they can investigate. Asking good questions also means that we need to listen to their responses, observe their work, and ask more questions. What might a good question look like that will encourage your children to begin an exploration of data analysis and other mathematical topics? Here are a few examples:

- "How many youngsters bring their lunch, and how many buy the school lunch?" (*Counting*)

  Students might decide to collect data using tally marks and then display the counts.

- "What shapes are found in your room?" (*Geometry*)

  You might lead a discussion that helps children decide whether they want to categorize shapes that are physical features in their classroom, such as rectangular windows and round tables, or manipulative objects—say, brightly colored square and round blocks. After students classify and tally the different shapes, they might choose to display their results by using the shapes they found, by drawing a picture, or by creating a simple bar graph.

- "Can you sort the objects another way?" (*Patterns*)

  This question challenges children to think about ways to re-sort the objects using a different attribute, thus requiring more critical thinking on the part of the children. Again, they would discuss and choose a way to display their results.

- "What items in your room are longer than your pencil, and which are shorter?" (*Measurement*)

  A discussion might lead children to decide to measure items around the room using their pencils as a guide and then make a list of "shorter" versus "longer" to compare with the items on other students' lists. It also might lead to a discussion centered on the fact that "Rita's pencil is shorter than mine" and the practicality of having standard units of measure.

- "Who picks you up from school?" (*Data*)

  Children will need to find a commonly agreed-upon list of possible categories to use in gathering their data.

A REAL-WORLD EXAMPLE: DO YOU LIKE THE CHOCOLATE OR CINNAMON BREAD?

In a Let's Learn: Inquiry Project for Young Learners project on bread making, a preschool class was doing some bread tasting. The teachers noted:

They were really enjoying eating the bread they were making throughout this phase of the project and wanted to taste different breads. We decided to have a bread-tasting activity. The children selected different varieties of bread they wanted to taste and designed a sign-up list for families to bring in different breads. The children came up with so many varieties, and lots of bread came into our classroom for this activity.

"We want to taste different breads."

We tried to generate some ideas from the children on how they wanted to record their bread tasting, but they didn't seem to understand the concept, not having a lot of experience in interviewing or graphing. Our mentor suggested that we invite the children to pick only two varieties of bread and interview their peers, using their clipboards. Narrowing the focus this way worked out well; and in time, the children gained familiarity with surveys and the use of tally marks for grouping numbers.

As the investigation progressed, a small group of children became interested in sorting loaves of bread by shapes and sizes. The children in the group recorded the variety of breads they and their classmates tasted, using tally marks and numbers to represent the answers and brown shapes to represent the breads.

Other Let's Learn projects also included data collection. In one, the children investigated planting. In another, the children learned about ice cream.

CONCLUSION

The natural tendency of children to explore and to ask questions can help them further their understanding of mathematical concepts. Our task is to be watchful and listen well to children to know when and how to make the most of these moments. Collecting and organizing data is a wonderful way to help children make more sense of their world.

Throughout the process of data collection, you'll want to keep these essential points in mind:

- Help children to ask good questions about their environment.
- Ask how the children could find out the answer to their question.
- Encourage methods to collect and keep track of the data.
- Suggest ways to display the data to show someone else what they did.
- Let students answer their own question using the data they collected and displayed.
- Listen and ask follow-up questions.
- Encourage them to ask more questions!

Data Analysis & Probability Standards

Pre-K Indicators	Kindergarten Indicators	Grade 1 Indicators	Grade 2 Indicators
Pre-K–2 Benchmark **A. Pose questions and gather data about everyday situations and familiar objects.**			
• Gather, sort and compare objects by similarities and differences in the context of daily activities and play (e.g., leaves, nuts, socks).	• Gather and sort data in response to questions posed by teacher and students; e.g., how many sisters and brothers, what color shoes.	• Construct a question that can be answered by using information from a graph.	• Pose questions, use observations, interviews and surveys to collect data, and organize data in charts, picture graphs and bar graphs. • Recognize that data may vary from one population to another; e.g., favorite TV shows of students and of parents.
Pre-K–2 Benchmark **B. Sort and classify objects by attributes, and organize data into categories in a simple table or chart.**			
• Place information or objects in a floor or table graph according to one attribute (e.g., size, color, shape or quantity). • Select the category or categories that have the most or fewest objects in a floor or table graph (e.g., favorite ice cream).	• Arrange objects in a floor or table graph according to attributes, such as use, size, color, or shape. • Select the category or categories that have the most or fewest objects in a floor or table or table graph.	• Identify multiple categories for sorting data. • Collect and organize data into charts using tally marks. • Arrange five objects by an attribute, such as size or weight, and identify the ordinal position of each object. • Answer questions about the number of objects represented in a picture graph, bar graph or table graph; e.g., category with most, how many more in a category compared to another, how many altogether in two categories.	• Pose questions, use observations, interviews and surveys to collect data, and organize data in charts, picture graphs and bar graphs. • Write a few sentences to describe and compare categories of data represented in a chart or graph, and make statements about the data as a whole.
Pre-K–2 Benchmark **C. Represent data using objects, picture graphs and bar graphs.**			
• There are no indicators age appropriate for this level.	• There are no indicators age appropriate for this level.	• Display data in picture graphs with units of 1 and bar graphs with intervals of 1. • Read and interpret charts, picture graphs and bar graphs as sources of information to identify main ideas, draw conclusions, and make predictions.	• Read, interpret and make comparisons and predictions from data represented in charts, line plots, picture graphs and bar graphs. • Read and construct simple timelines to sequence events.) • Identify untrue or inappropriate statements about a given set of data.

RESOURCES FOR PARENTS AND TEACHERS

Burrill, G. F., & Elliott, P. C. (Eds.). (2006). *Thinking and reasoning with data and chance: Sixty-eighth yearbook*. Reston. VA: National Council of Teachers of Mathematics.

Hilton, S. C., Grimshaw, S. D., & Anderson, G. T. (2001). Statistics in preschool. *The American Statistician, 55*(4), 332–336.

Isaacs, A. C., & Kelso, C. R. (1996). Pictures, tables, graphs, and questions: Statistical processes. *Teaching Children Mathematics, 2*, 340–345.

Martin, W. G., Strutchens, M. E., & Elliott, P. C. (Eds.). (2007). *The learning of mathematics: Sixty-ninth yearbook*. Reston. VA: National Council of Teachers of Mathematics.

Putt, I. J., Jones, G. A., Thornton, C. A., Langrall, C. W., Mooney, E. S., & Perry, B. (1999). Young students; Informal statistical knowledge. *Teaching Statistics, 21*(3), 74–78.

Usnick, V. (2001). Mrs. Whatsits "socks" it to probability. *Teaching Children Mathematics, 8*(4), 246–249.

RESOURCES ON REC WEBSITE

Let's Learn: Inquiry Projects for Ohio's Young Learners, Bread-Making Project

Your Vote Counts, Teacher QuickSource, Record #9645

Look at Me: Freckle Face, National Council of Teachers of Mathematics, Record #3936

Early Math Activities: Let's Keep Track, PBS, Record #8168

ABOUT THE AUTHOR

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FOR MORE INFORMATION

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