Data Analysis and Probability

STANDARD for Grades

Pre-K–2

Instructional programs from prekindergarten through grade 12 should enable all students to—

Expectations

In prekindergarten through grade 2 all students should–

Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them	• pose questions and gather data about themselves and their surroundings; • sort and classify objects according to their attributes and organize data about the objects; • represent data using concrete objects, pictures, and graphs.
Select and use appropriate statistical methods to analyze data	• describe parts of the data and the set of data as a whole to determine what the data show.
Develop and evaluate inferences and predictions that are based on data	• discuss events related to students' experiences as likely or unlikely.
Understand and apply basic concepts of probability	

Data Analysis and Probability

Informal comparing, classifying, and counting activities can provide the mathematical beginnings for developing young learners' understanding of data, analysis of data, and statistics. The types of activities needed and appropriate for kindergartners vary greatly from those for second graders; however, throughout the pre-K–2 years, students should pose questions to investigate, organize the responses, and create representations of their data. Through data investigations, teachers should encourage students to think clearly and to check new ideas against what they already know in order to develop concepts for making informed decisions.

As students' questions become more sophisticated and their data sets larger, their use of traditional representations should increase. By the end of the second grade, students should be able to organize and display their data through both graphical displays and numerical summaries. They should be using counts, tallies, tables, bar graphs, and line plots. The titles and labels for their displays should clearly identify what the data represent. As students work with numerical data, they should begin to sort out the meaning of the different numbers—those that represent values ("I have four people in my family") and those that represent how often a value occurs in a data set (frequency) ("Nine children have four people in their families"). They should discuss when conclusions about data from one population might or might not apply to data from another population. Considerations like these are the precursors to understanding the notion of inferences from samples.

Ideas about probability at this level should be informal and focus on judgments that children make because of their experiences. Activities that underlie experimental probability, such as tossing number cubes or dice, should occur at this level, but the primary purpose for these activities is focused on other strands, such as number.

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Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them

The main purpose of collecting data is to answer questions when the answers are not immediately obvious. Students' natural inclination to ask questions must be nurtured. At the same time, teachers should help them develop ways to gather information to answer these questions so that they learn when and how to make decisions on the basis of data. As children enter school and their interests extend from their immediate surroundings to include other environments, they must learn how to keep track of multiple responses to their questions and those posed by others. Students also should begin to refine their questions to get the information they need.

Organizing data into categories should begin with informal sorting experiences, such as helping to put away groceries. These experiences and the conversations that accompany them focus children's attention on the attributes of objects and help develop an understanding of "things that go together," while building a vocabulary for describing attributes and for classifying according to criteria. Young students should continue activities that focus on attributes of objects and data so that by

the second grade, they can sort and classify simultaneously, using more than one attribute.

Students should learn through multiple experiences that how data are gathered and organized depends on the questions they are trying to answer. For example, when students are asked to put a counter into a bowl to indicate whether they vote for a class trip to the zoo or to the museum, the responses are organized as the data are gathered (see fig. 4.20). To address a particular question such as "What is your favorite beverage served in the school cafeteria?" real objects such as containers for chocolate milk, plain milk, or juice can be collected, organized, and displayed. At other times, pictures of objects, counters, name cards, or tallies can be contributed by students, organized, and then displayed to indicate preferences.

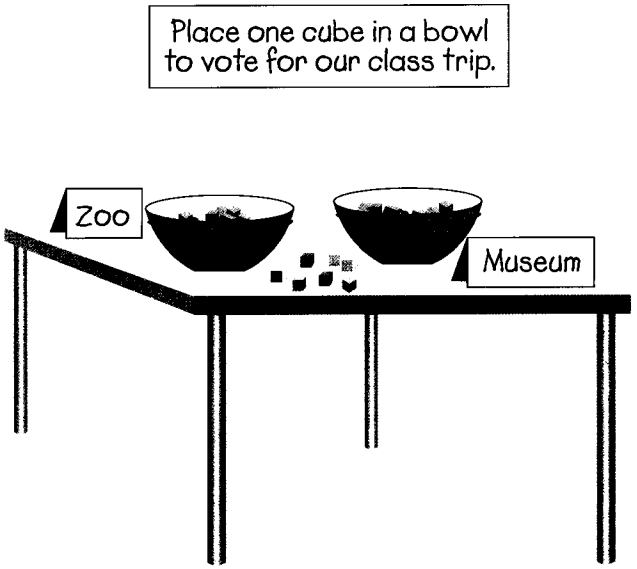

Fig. **4.20.**
Students can contribute counters to bowls to vote.

Methods used by students in different grades to investigate the number of pockets in their clothing provide an example of students' growth in data investigations during the period through grade 2. Younger students might count pockets (Burns 1996). They could survey their classmates and gather data by listing names, asking how many pockets, and noting that number beside each name. Together the class could create one large graph to show the data about all the students by coloring a bar on the graph to represent the number of pockets for each student (see fig. 4.21). In the second grade, however, students might decide to count the number of classmates who have various numbers of pockets (see fig. 4.22). Their methods of gathering the information, organizing it, and displaying the data are likely to be different because they are grouping the data—three students have two pockets, five students have four pockets, and so on. They will have to think carefully about the meaning of all the numbers—some represent the value of a piece of data and some represent how many times that value occurs.

Students do not automatically refine their questions, consider alternative ways of collecting information, or choose the most appropriate way to organize and display data; these skills are acquired through experience, class discussions, and teachers' guidance. Take, for example, the following episode drawn from a classroom experience:

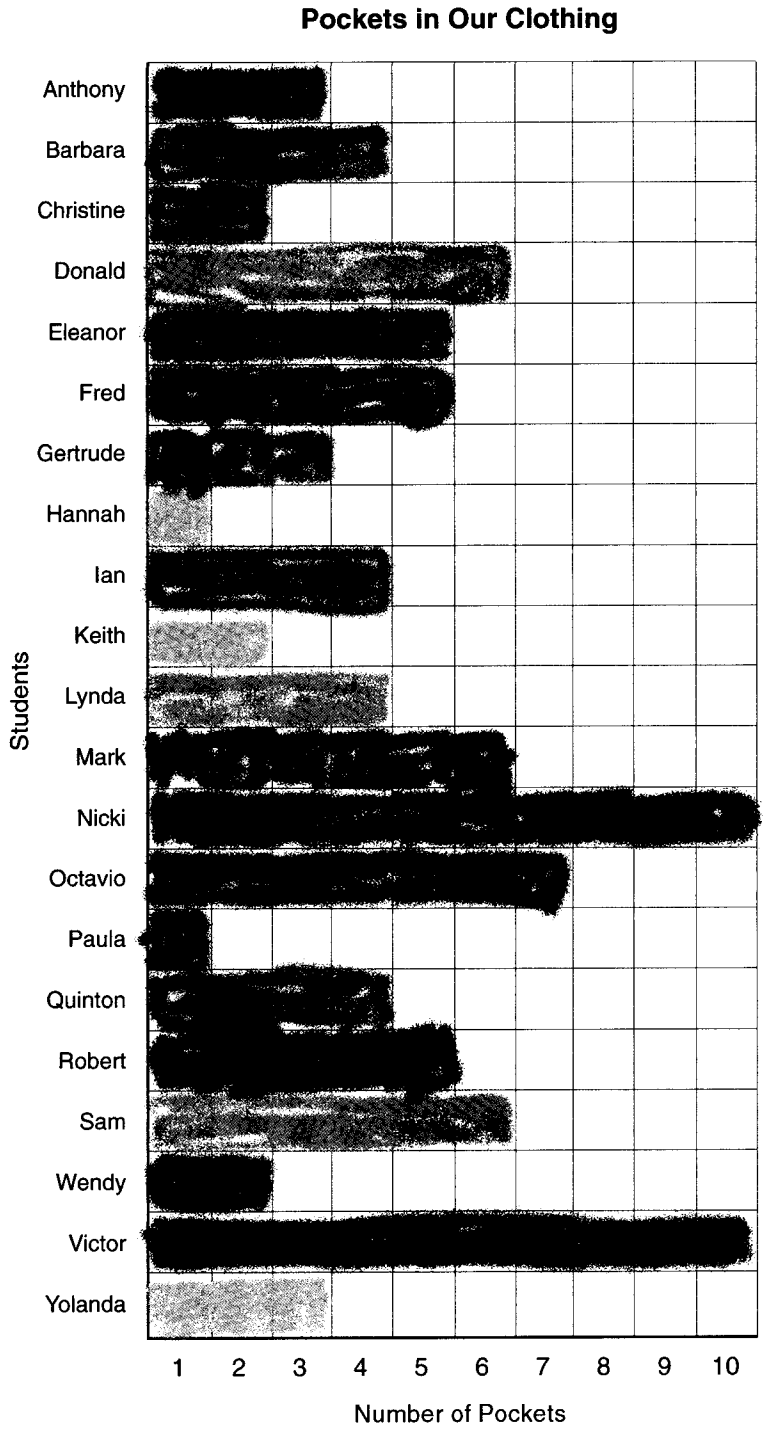

Fig. **4.21.**

A bar graph illustrating the number of pockets in kindergarten students' clothes

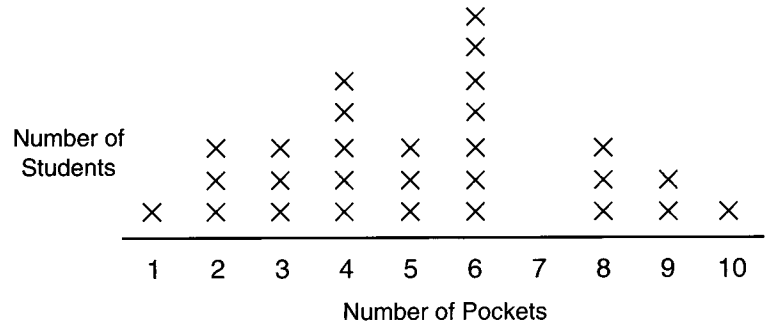

Fig. **4.22.**

A line-plot graph of the number of students in a second-grade class who have from one to ten pockets