



Use *Measuring Penny* to Introduce the Unit

“**W**ould you come to my class and read *Measuring Penny* for the introduction to our measurement unit?” asked Jill Metzger, a fifth-grade teacher at Westwood Elementary School in Stillwater, Oklahoma.

I was delighted to accept this invitation. The elementary education faculty at Oklahoma State University had been working closely with Westwood for the past several years. English is a second language for almost one-third of the students in that school; their parents are international students at OSU. We knew from standardized test results that measurement was an area of concern at the school and had offered assistance in curriculum development. The faculty followed guidelines from *Principles and Standards for School Mathematics* (NCTM 2000) and Oklahoma’s *Priority Academic Student Skills* (2000) in developing lessons for improving the understanding of measurement. The Measurement Standard for grades 3–5 states that students should—

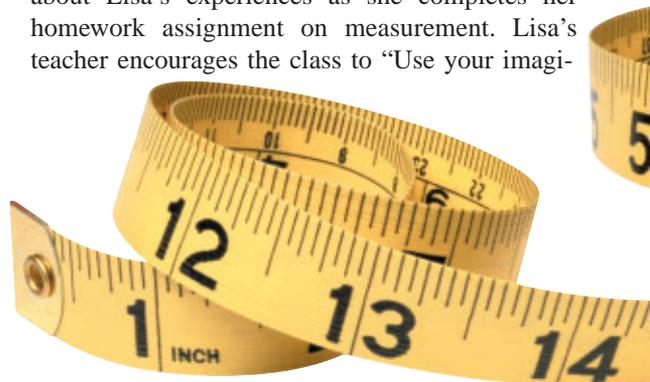
- understand such attributes as length, area, weight, volume, and size of angle and

select the appropriate type of unit for measuring each attribute;

- understand the need for measuring with standard units and become familiar with standard units in the customary and metric systems; and
- understand that measurements are approximations and understand how differences in units affect precision. (NCTM 2000, p. 170)

The students needed more experiences in planning and doing measurements; they needed practice in estimating a reasonable answer and checking the result against that estimate; and they needed to build confidence in comparing nonstandard to standard measurements. To introduce the unit, *Measuring Penny* stimulated the children’s thinking about measurement, provided a beginning assessment for the teacher of what the students knew and understood about measurement, and pinpointed areas in which the students needed additional practice and knowledge.

Measuring Penny, written and illustrated by Loreen Leedy, links literature and mathematics in an appealing and meaningful way. The book tells about Lisa’s experiences as she completes her homework assignment on measurement. Lisa’s teacher encourages the class to “Use your imagi-



Margaret M. Scott



Margaret Scott, mascott@okstate.edu, teaches mathematics education courses at Oklahoma State University, Stillwater, OK 74078. Her research interests include children’s meaningful learning of mathematics and preservice teachers’ beliefs and attitudes about teaching mathematics.

Edited by Pat Lamphere-Jordan, lampher@okstate.edu, Oklahoma State University, Willard Hall, Stillwater, OK 74078. Readers are encouraged to share experiences using children’s books with

Teaching Children Mathematics. Please send such descriptions to “Links to Literature,” NCTM, 1906 Association Drive, Reston, VA 20191-1502.

nation!” Lisa decides to measure her dog, Penny. After school, Lisa and Penny go to the park to meet her friends and their dogs. At the park, they make many interesting measurements and comparisons, using standard and nonstandard units. Lisa completes the assignment at home, adding monetary measurements to her report.

After getting approval to bring a live Boston terrier to the classroom for the introductory lesson, I contacted my colleague, Dr. Paula Dohoney, who agreed to bring Buster. He is a friendly, well-mannered dog who loves children. Buster investigated the classroom and the children before lying down in the center of the room to hear the story.

A medium-sized stuffed dog can be used in a classroom where live animals are not permitted. Jill had a stuffed version of Clifford the Big Red Dog that she and the students used for subsequent lessons.

Before presenting the lesson, I checked Jill’s classroom measuring devices to make sure that rulers, yardsticks, tape measures, and cups marked with customary and metric units were available. I brought a tub that contained items that could be used for nonstandard units of measure: toothpicks, cotton swabs, pencils, straws, and paper clips. We also needed to measure time and weight, so I brought a stopwatch and a bathroom scale marked with metric units.

Jill and I had located several copies of *Measuring Penny* that we shared with students who needed to read along. At the conclusion of the story, I asked the students to identify the different kinds of measurement that Lisa did during her homework assignment. We made a list on the chalkboard: length, width, height, weight, volume, temperature, and time. It was evident from the discussion that these students were familiar with the various attributes of measurement and the appropriate associated units.

Where’s the Math?

The terms *volume* and *capacity* are confusing to many students. They are sometimes used interchangeably, but there is a distinct difference between the two. *Volume* is a term that describes the three-dimensional size of an object or space. When calculating the volume of an item such as a box, you multiply the length by the width by the height. Volume is expressed in cubic units, such as cubic centimeters or cubic feet. *Capacity* refers to the amount of something that a measuring vessel or a container of known volume will hold. For example, a graduated cylinder is described as having a capacity of 100 cubic centimeters or 100 milliliters. To measure the capacity of an irregular shape such as a dog’s bowl, you might fill it with water and then pour the water into a graduated cylinder. You would have indirectly determined the volume of the bowl and therefore its capacity.

Planning What to Measure

Next, we discussed how we could measure Buster using standard and nonstandard units or make comparisons by following the homework assignment instructions from the book. Our inquiry included these questions:

- What can we measure by using what is available in the classroom?
- Which device should we use for the measurement?
- What unit will we use to describe the measurement?

Types of linear measurement and units of linear measure were not problematic for this class. Using past experience and prior knowledge, the students quickly determined standard and nonstandard units for length, width, and height. Their estimations using these attributes were close to the actual measurements. They were familiar with customary and metric linear units and shared understandings of comparisons between the two systems and the nonstandard units that they had selected.

Other measurement attributes generated lively discussions. The students wanted to know how much Buster weighed. The only device available was a bathroom scale using metric units. Michelle said, “I can hold Buster, step on the scale, and see how much we both weigh; then I’ll put Buster down and see how much I weigh. The difference is what Buster weighs.” The class agreed with Michelle’s solution. Finding a comparison or nonstandard unit for measuring weight proved more difficult. Several students said we needed a big balance scale so “we could see how many math books Buster weighed.” We decided to leave that space on our chart temporarily blank.

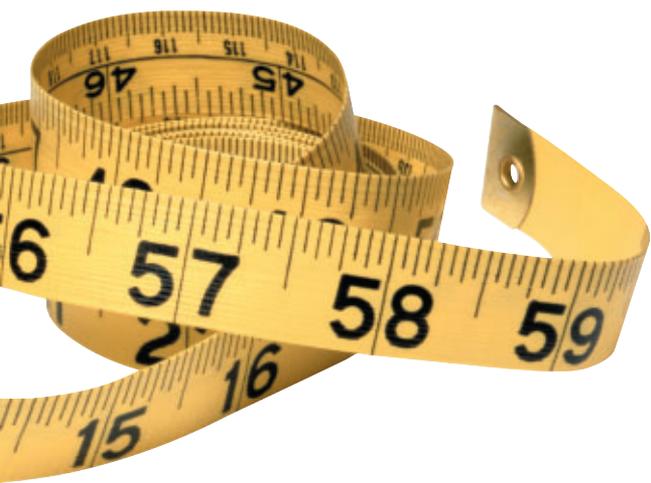


FIGURE 1

Brittney measures Buster's length from his hind foot to the top of his head.



Photograph by Jill Metzger; all rights reserved

Lack of an appropriate device to measure temperature also stimulated discussion. A mercury thermometer was not available, “and Buster wouldn’t like that anyway,” Clayton said. “If I did this at home with my dog, I would use the ear thermometer my mother has.” We settled on touching Buster’s nose and making an estimate within a temperature range: hot, warm, cool, or cold. Through this discussion, the students were able to determine reasonable and unreasonable measuring devices for each situation and ways to collect data about measurement attributes.

Hands-on Measurement of Buster

Collecting the data on the measurements that we had listed was completed as a class, with different students volunteering to make the measurements.

The measurer explained which device was selected, estimated what the measurement would be, described how the measurement was made, and reported the number and unit found. Estimation is an important mathematics skill associated with measurement, but it is overlooked when students are given measurement activities that are confined to paper-and-pencil calculations rather than activities involving hands-on opportunities.

After the comparison or nonstandard measurement was made, the standard measurement was again estimated and an adjustment was made if necessary. For example, Brittney observed that when Buster stood on his hind legs, he was about as long as the height of Clayton’s desk. She estimated the length to be about three feet. Brittney chose to use a tape measure to find the length from Buster’s hind foot to the top of his head (see **fig. 1**). “Thirty-four inches,” she read. “That is about three feet.” Brittney demonstrated good spatial sense and an understanding of equivalent units.

To help students stay on task during the activities, each student recorded his or her estimations and the actual measurement information in a personal mathematics notebook. The results from the chart that the class made on the chalkboard are shown in **figure 2**.

During the actual measuring activity, several noteworthy educational experiences occurred. Initially, Eftim said that he would measure the height to Buster’s shoulder by using straws and a ruler. He said that Buster’s height was more than one straw and probably about eleven inches from his foot to his shoulder. After he found that the height was about one and a half straws, he tried to use the ruler (see **fig. 3**). But then he said, “A ruler isn’t the best device; I need a yardstick because his height is going to be more than twelve inches.” Eftim’s thinking showed flexibility—he was willing to change after obtaining better information. He also wanted a more accurate

FIGURE 2

Results of the students' measurements

How We Measured Buster

Type	What	Comparison or Nonstandard Unit	Standard Unit
Length	Standing on hind legs	Longer than height of desk	34 inches (tape measure)
Width	Paw	6 paper clip widths	5 centimeters (ruler)
Height	Shoulder	One and a half straws	14 1/2 inches (yardstick)
Weight	Buster	—	13 kilograms
Temperature	Nose	Cool	—
Time	Run across room	—	3.8 seconds

- Share with your family the measuring activities that we did in class with Buster.
- Choose something to measure.
- Measure it in as many ways as you can: by height, width, length, weight, volume, temperature, and time.
- Record your results.
- Include at least one comparison, such as “It is taller than ...” or “It is heavier than ...”
- Remember that a measurement always has two parts: a number and a unit; for example, “five feet tall.”
- Use standard units, such as inches, feet, centimeters, kilograms, teaspoons, and minutes.
- Also use nonstandard units, such as paper clips, toothpicks, and hands.
- Bring your assignment to class tomorrow.

Just like Lisa’s class in *Measuring Penny*, the students were encouraged to “Use your imagination!”

Three students asked to check out *Measuring Penny* overnight so they could share the story with their families. Jill showed me the returned homework assignments. The students used their imaginations in selecting what to measure. They involved their families by sharing the activities with Buster that they had recorded in their mathe-

matics notebooks. The homework gave the students an additional opportunity to gain experience in a hands-on situation and to talk about measurement and comparisons. Examples of the completed homework are shown in **figure 6**.

Conclusion

After reflecting on this introductory lesson, Jill and I agreed that literature had engaged the fifth-graders. We noted how they used prior experiences and knowledge, which measurement activities stimulated their curiosity, and which measurement topics needed additional instruction. Jill used the assessment information that she obtained during the lesson to modify and improve several of her lesson plans. For the next two weeks, Jill and her students continued to explore measurement using this hands-on approach.

References

- Leedy, Loreen. *Measuring Penny*. New York: Henry Holt and Company, 1997.
- National Council of Teachers of Mathematics (NCTM). *Principles and Standards for School Mathematics*. Reston, Va.: NCTM, 2000.
- Oklahoma State Department of Education. *Priority Academic Student Skills*. Oklahoma City, 2000. ▲