

# From Small to Tall

## Focus

Reasoning about measurement relationships

## Summary

Students reason proportionally as they select different units of measure to construct life-sized representations of a baby, a ten-year-old, and a basketball player. They informally explore the relationship between the size of a unit of linear measure and the number of those units needed to determine the length of an object.

## Goals

- Identify relationships
- Develop and test conjectures

## Mathematical Connections

### *Measurement*

- Measuring lengths

### *Algebra*

- Reasoning proportionally

## Prior Knowledge

- Using a nonstandard unit to measure length

## Materials

- Sets of measuring strips copied onto heavy stock from the blackline master “Unit Lengths” and laminated if possible. You will need one set for each pair of students and one set for demonstration.
- A thirty-inch baseball bat (or other thirty-inch object)
- An object about eighteen inches long or high (e.g., a large tote bag)
- Scissors and pencils for each group of four students
- Tape or glue for each group of students
- A piece of chart paper or a large piece of newsprint for each student
- One copy of the blackline master “Body Building” for each group of four students
- Masking tape

## Investigation

### *Engage*

Organize the students into pairs, and distribute a set of measuring strips to each pair. Have the students familiarize themselves with the strips. Call on students to identify by letter the strips that are the longest and the shortest.



*Recognize reasoning ... as [a] fundamental [aspect] of mathematics*



*Make and investigate mathematical conjectures*



*Use various types of reasoning*



*pp. 42, 43*

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The applet *How Many?* is available on the CD-ROM that accompanies



this book. It offers students practice in estimating in nonstandard units and then measuring to check their estimates.



Demonstrate how to measure an object with strip E. For example, select an eighteen-inch-long object, and move strip E end to end along it to show that its length is equal to three repetitions of strip E.

In the same manner, measure the same object with strip B. Call on students to tell why it took more repetitions of strip B than of strip E to measure the object (the shorter the strip, the more repetitions of it that are needed to measure the same length). Call on students to predict the number of strips C that will be needed to measure the object. Then ask a student to measure the object with strip C to check the predictions.

Show the students the thirty-inch baseball bat or another thirty-inch object, and tell them that it is six strips long when it is measured with a particular strip. Call on students to guess which strip—B or D—you used and give reasons for their choices. (Six repetitions of strip D would be needed to measure a thirty-inch bat.) Ask the students to describe a bat whose length might measure six A strips. (The students might describe a toy bat for a baby.) Explain that the number of strips used, as well as the length of a strip, is important to know in order to estimate the size of an object.

Ask questions like the following about other measurements:

- "Suppose that a table is six strips wide. Which strip—C or E—do you think was used to measure the table? Can you be sure?" (A kitchen table might measure six E strips, but a coffee table might measure six C strips; we can't be sure, since we don't know the size of the table.)
- "A coffee mug is five strips tall. Which strip—A or C—do you think was used to measure the mug? How did you decide?" (Strip A is more likely to have been used, since a mug isn't very tall and quite a few strips were used.)
- "One T-shirt is eight strips long, and another T-shirt is ten strips long. Can you tell which shirt is the longer shirt?" (No, because you don't know if the same strip was used to measure both shirts. For example, a measure of ten A strips is much shorter than a measure of eight E strips.)
- "Suppose that the longer shirt measured eight D strips. About how many C strips would the same shirt measure?" (about ten)
- "How did you make this estimate?" (Strip C is a little shorter than strip D, so the shirt should measure more repetitions of strip C, but strip C is not a lot shorter, so it shouldn't take many more repetitions.)

### Explore

Engage the students in a discussion of the relative sizes of different people—in particular, a male professional basketball player, a ten-year-old girl, and a baby. Talk about how the lengths of their arms, legs, hands, and so on—not just their heights—might vary.

Divide the students into groups of four. Tell each group that it will be creating a life-sized copy of a baby, a ten-year-old girl, or a male basketball player. Distribute scissors, pencils, tape or glue, two sets of measuring strips, four pieces of chart paper or newsprint, and a copy of "Body Building" to each group. Assign different figures to the different

groups, and ask each group to circle its assigned figure. Have each group select a member to cut the activity page “Body Building” into five sections along the cut lines: the top part of the page, indicating the figure that they will create, and the bottom four sections, describing possible lengths for the arms (from shoulder to fingertips), legs, torso, and head (top of head to base of neck).

Distribute the bottom four sections of “Body Building” to different students in the group, being sure that the students know only the contents of their own sections. Keeping in mind the figure that the group has been assigned to create, each member then chooses what he or she believes is the appropriate length for the selected body part from the list of possibilities. The students in a group should not discuss their choices with the other members of the group.

Each student then uses the strip he or she has selected to measure the required body part (or parts, in the case of arms and legs), draws the body part to the correct measure on chart paper, and cuts it out. The students tape or glue the body together and then tape it to a wall with masking tape. At least one member of each group should be called on to explain why he or she chose the selected length for his or her body part



*“I think that if I used fifteen As for the arms, they would not be long enough. Three Bs would make the arms too short, and nine Cs would be too long, so I’ll use four Ds.”*



Students can continue their investigation of the relationship between the size of a unit and the numeric measure with the applet Which One? This interactive activity is available on the CD-ROM.



and whether, looking at the finished product, he or she is satisfied with the selection.

### *Extend*

You may choose to end the activity by allowing the students to “dress” their figures, or you may repeat the activity. If you repeat the activity, the goal could be to create a “crazy” character whose body parts do not go together well; for instance, a character might have a basketball player’s legs and a baby’s arms.

## Discussion

Observe how students make their decisions about the lengths of the various body parts. The students may look only at the numbers and assume that a smaller number of strips indicates a smaller size. Others will consider both the number of strips and the lengths of the units; for example, in choosing the measure for the baby’s legs, a student may reason, “The A strips are very small, so even nine of them are not that long. I’ll try nine A strips for the baby’s legs.” Other students may compare the given lengths with their own legs to try to reason about the length of a baby’s legs or a tall person’s legs.