

Measure for Measure: Lengths & Heights

Grade Level: 6-8

Subject: Mathematics

Duration: Three class periods

Objectives

Students will

- discuss the importance of accurate measurements;
- recall how units of measurements have been calculated throughout history; and
- use their own feet as a standard measurement and then measure and compare distances.

Materials

- Rulers or tape measures, one for every two students
- Quarters, one for every two students
- Paper and pencil for each student

Procedures

1. Before you begin this lesson, determine the distances between the places listed below. You can use MapQuest (<http://www.mapquest.com/directions>) for those in the U.S. and the Distance Calculator (<http://www.indo.com/cgi-bin/dist>) for international distances.
 - Distance between your school and the closest shopping mall
 - Distance between your school and a school in another town in your state
 - Distance between your town and a large city elsewhere the United States.
 - Distance between your town and Paris, France, or any other foreign city
2. Watch *Measure for Measure: Lengths and Heights*, and point out that the narrator says, "Measurement rules our lives. It has sliced up our world and helped us impose order and logic on our restless universe." Ask students what they think this means. Ask what a world with no measurements would be like. Then have students discuss how people featured in the program (below) used measurements.
 - Sailors calculate positions of stars and the accurate time to determine longitude and latitude at sea.
 - Scientists measure the wavelengths, speeds, and heights of tsunamis, as well as a deep-sea gauge measuring underwater pressure to detect incoming tsunamis.
 - The rower measured his heart rate.
3. Ask students why accurate measurements were so important to these people. (*Sailors needed to know the time to determine longitude or they could be off course by hundreds of miles. Accurate measurements allow scientists to predict tsunamis and give warnings. The rower must know how well his heart is pumping blood.*)
4. The video segment "Going the Distance" reviewed the history of measurements and noted that different countries once used their own measurement systems. How have units of length been determined? (*People used the length of their own foot, hand, fingertip, pace, or the distance from the elbow and fingertip. In England, the distance from the ruling monarch's nose to fingertip was one yard and three barleycorns made up one inch.*) What was the problem with using the human body or natural products as a standard of measurement? (*They always differ.*) Who first called for standard measurements, and why? (*Traders needed to know how much they were buying or selling.*)

- The foot has long been a unit of measurement, but it has ranged between 10 and 27 inches. Explain to students that in this activity, they will use their own feet as a standard measurement and then measure and compare distances.
- Have students work with a partner to measure the length of their feet without shoes. Have them record this measurement in standard inches.

Length of my foot in standard inches: _____

- Using their personal unit measurement, have students determine the length of a personal non-standard inch. They should divide the length of their foot by 12. (Example: If a student's foot measures 8 inches, a non-standard inch would be $8 \div 12 = .6$.) Students may round their answer to the nearest eighth.

Length of my personal inch in standard inches: _____

- Have students draw two squares with four-inch sides, one using standard inches, the other using personal inches. (Using the example above, the second square would have 2.5-inch sides.)
- Have students attach their personal squares to the board. Discuss the consequences of countries using non-standard measurements. For example, what if one country supplied parts for a machine to be produced in another country?
- Now students will consider their personal units of measurement on a larger scale. How many personal feet would go into a mile? (5,280 standard feet = one mile) When comparing feet to miles, the numbers are very large, so it will be easier to compare standard miles and new miles using a ratio. First, determine the ratio of the standard foot to a personal foot. For example, 12 inches to 8 inches is 12:8, or 1.5. In other words, a standard foot is 1.5 times larger than the new foot. Since ratios are constant, you can also say that a standard mile is 1.5 times longer than a personal mile. That means a distance of 100 standard miles would measure 150 personal miles. (They will multiply the distance times 1.5: $100 \times 1.5 = 150$)
- Give students a chart to show distances between your school or town and different locations. Then have them use the ratio to determine the distances with their personal measurement system. For example, your chart might look like this:

Distance	Standard Miles	Personal Miles
from school to mall	5 miles	7.5 miles
from Charlotte, North Carolina, to Asheville, North Carolina	130 miles	195 miles
from Charlotte to New York, New York	630 miles	945 miles
from Charlotte to Paris, France	4,165 miles	6,247.5 miles

- Have students share some of the distances they determined. Then discuss the consequences of using non-standard units of measurement. Pose these questions to the class: What would happen if you gave directions to the mall using personal miles? What if a pilot used personal miles to calculate the distance on an international flight to Paris? Why are standard measurements so important? Ask students to share other examples of why accurate measurements are critical.

Evaluation

Use the following three-point rubric to evaluate students' work during this lesson.

- **Three points:** Students actively participated in class discussions about measurements; accurately measured their own feet; correctly calculated all of the questions comparing lengths and distances; demonstrated a clear understanding of the importance of standard measurements.
- **Two points:** Students participated in class discussions about measurements; closely measured their own feet; correctly calculated most of the lengths and distances; demonstrated a satisfactory understanding of the importance of standard measurements.
- **One point:** Students did not participate in class discussion about measurements; made sloppy, inaccurate measurements of their own feet; could not calculate the lengths and distances; demonstrated a poor understanding of the importance of standard measurements.

Vocabulary

distance

Definition: the length of the space between two points

Context: The distance between Los Angeles, California, and Tokyo, Japan, is 5,478 miles, or 8,815 kilometers.

metric system

Definition: a decimal system of units based on the meter as a unit length

Context: Most countries use the metric system.

foot

Definition: a unit of length equal to 12 inches

Context: Although the standard length of a foot is 12 inches, it has ranged throughout history between 10 and 27 inches.

ratio

Definition: the relation of one part to another or to a whole

Context: In the group are four boys and three girls, so the ratio of boys to girls is 4 to 3, or 4:3.

Academic Standards

The National Council of Teachers of Mathematics (NCTM) has developed national standards to provide guidelines for teaching mathematics. To view the standards online, go to <http://standards.nctm.org>.

This lesson plan addresses the following national standards:

Measurement:

- understand both metric and customary systems of measurement;
- understand relationships among units and convert from one unit to another within the same system;
- select and apply techniques and tools to accurately find length, area, volume, and angle measures to appropriate levels of precision;
- solve problems involving scale factors, using ratio and proportion.

Credit

Joy Brewster, curriculum writer, editor, and consultant