

Measure for Measure: Lengths and Heights: Teacher's Guide

Grade Level: 6-8

Curriculum Focus: Mathematics

Lesson Duration: Three class periods

Program Description

Accurate measurement is essential to scientific practice and many other human endeavors. Segments cover the significance and systems of assessing time, distance, waves, altitude, and body metabolism. This presentation emphasizes why we need precise measurement in many different aspects of our lives. This program includes one feature segment and four short segments.

Onscreen Questions

- What timekeeping devices do sailors use to navigate?
 - Why are standardized measurements so important?
 - How does the circulatory system move fuel and waste products through the body?
 - How does high altitude make breathing difficult?
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Lesson Plan

Student Objectives

- Discuss the importance of accurate measurements.
- Recall how units of measurement have been calculated throughout history.
- Use their own feet as a standard measurement, and then measure and compare distances.

Materials

- *Forensic Detectives: Lengths and Heights* video and VCR, or DVD and DVD player
- Rulers or tape measures (one for every two students)
- Quarters (one for every two students)
- Paper and pencil

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 do you think the narrator means? What would a world with no measurements 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 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.)
5. 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.
6. 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: _____



7. 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 divided by 12 = .6.) Students may round their answer to the nearest eighth.

Length of my personal inch in standard inches: _____

8. Have students draw two squares with four-inch sides, one using standard inches, the other using personal inches. (Using the personal non-standard inch example above, the second square would have 2.5-inch sides.)
9. 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 produced in another country?
10. 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 personal 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: $100 \times 1.5 = 150$)
11. 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, a completed chart might look like this:

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

12. 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.

Assessment

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

- **3 points:** Students actively participated in class discussions about measurements; accurately measured their own feet; correctly calculated all of the lengths and distances; demonstrated a clear understanding of the importance of standard measurements.
- **2 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.
- **1 point:** Students did not participate in class discussions 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.

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.

metric system

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

Context: Most countries use the metric system.

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

National Council of Teachers of Mathematics

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 math standards:

- 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:

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit <http://www.mcrel.org/>.

This lesson plan addresses the following national standards:

- Mathematics – Understands and applies basic and advanced properties of the concepts of measurement, Understands the general nature and uses of mathematics
 - Language Arts – Viewing: Uses viewing skills and strategies to understand and interpret visual media
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Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>
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DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How To Use the DVD

The DVD starting screen has the following options:

Play Video – This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index – Here the video is divided into five parts (see below), indicated by video thumbnail icons. Watching all parts in sequence is similar to watching the video from start to finish. Brief



descriptions and total running times are noted for each part. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

Curriculum Units – These are specially edited video segments pulled from different sections of the video (see below). These nonlinear segments align with key ideas in the unit of instruction. They include onscreen pre- and post-viewing questions, reproduced below in this Teacher's Guide. Total running times for these segments are noted. To play a particular segment, press Enter on the TV remote or click once on the Curriculum Unit title on a computer.

Standards Link – Selecting this option displays a single screen that lists the national academic standards the video addresses.

Teacher Resources – This screen gives the technical support number and Web site address.

Video Index

I. Perfect Measurements (6 min.)

For centuries, sailors looked to the skies to navigate the world's oceans. Learn why this method is still used, and explore modern navigational tools.

II. Waves of Destruction (7 min.)

Travel to Japan to see how coastal regions are working to protect themselves from the huge surges of water known as tsunamis.

III. Going the Distance (20 min.)

Trace the history of measurement from the relative paces and cubits of the ancient world to the precision of today's standardized systems.

IV. The Heart of Health (9 min.)

The circulatory system transports oxygen to every organ in your body. Yet, its efficiency depends greatly on the shape you're in.

IV. The Height of Illness (5 min.)

The human body needs oxygen to function properly. Witness how it combats oxygen-deprived environments like Mount Everest.

Curriculum Units

1. Using the Stars

Pre-viewing question

Q: If you were lost, how would you find your way?

A: Answers will vary.

Post-viewing question

Q: What do scientists mean by the "accuracy of a measurement"?

A: They are referring to how close a measurement comes to the real value.



2. Tracking in the Open Ocean

Pre-viewing question

Q: What would life be like without an accurate way to tell time?

A: Answers will vary.

Post-viewing question

Q: Which is more dependable, GPS satellites or stars?

A: Answers will vary, but students should recognize that satellites, which give more accurate readings, can fail.

3. Tsunami!

Pre-viewing question

Q: What do you know about tsunamis?

A: Answers will vary.

Post-viewing question

Q: What causes tsunamis?

A: Three different types of high-energy events – underwater earthquakes, the most common cause; underwater landslides, which create localized tsunamis; and underwater or coastal volcanic activity, which are less common but can be just as deadly.

4. Vulnerable Locations

Pre-viewing question

Q: If you lived in a tsunami-prone area, how would you prepare?

A: Answers will vary.

Post-viewing question

Q: Why is Japan particularly vulnerable to tsunamis?

A: Japan's coastline, which has many indentations, is the perfect shape to channel a tsunami. Instead of being spread out over a wide area, the wave energy is concentrated in the indentations, increasing a tsunami's height and power as it nears the shore.

5. Ancient Measurements

Pre-viewing question

Q: What would life be like without standardized measurements?

A: Answers will vary.

Post-viewing question

Q: How did ancient Romans measure out a foot?

A: They used a one-pound copper bar that was divided into 12 equal parts, called unciae. Units of both weight and length, unciae were the source of the modern terms ounce and inch.

6. Setting the Standards

Pre-viewing question

Q: How could the lack of standardized measurements cause problems for traders?

A: Answers will vary.



Post-viewing question

Q: Was it problematic that monarchies remodeled the yard to match their own measurements?

A: Answers will vary.

7. The Standard Yard

Pre-viewing question

Q: What units of measurement do you use daily?

A: Answers will vary.

Post-viewing question

Q: Why didn't the pendulum theory work?

A: The theory didn't account for the fluctuating effects of gravity.

8. Metric Conversion

Pre-viewing question

Q: What do you know about the metric system?

A: Answers will vary.

Post-viewing question

Q: What is triangulation?

A: In this technique of measuring a distance, an area is divided into triangles. The baseline is measured as accurately as possible. Then, from either end of the baseline, scientists measured the angles to a third distant point, such as a mountain peak. They then use trigonometry to calculate the distance to that third point.

9. The Circulatory System

Pre-viewing question

Q: What foods do you eat even though you know they're not good for you?

A: Answers will vary.

Post-viewing question

Q: What is the circulatory system?

A: Also known as the cardiovascular system, this complex network transports blood through our bodies. It includes the heart, blood, and a system of channels called blood vessels.

10. Athletes and Exercise

Pre-viewing question

Q: How does exercise make your body feel?

A: Answers will vary.

Post-viewing question

Q: What is the purpose of blood?

A: It delivers oxygen and the nutrients our cells need to function.



11. Acclimatizing to Everest

Pre-viewing question

Q: What dangers do mountain climbers face?

A: Answers will vary.

Post-viewing question

Q: Why is serious preparation needed to climb Mount Everest?

A: The extreme altitude of Mount Everest makes it impossible to climb without serious preparation. Before a summit attempt can be made, individuals undertake a month-long acclimatization program, climbing up and down the mountain to camps at intervals of roughly .7 kilometers. At the start, they feel short of breath because their bodies are trying to get more oxygen. Over time, breathing gets easier as the body brings in other processes to help out, for example increasing the number of red blood cells that carry oxygen.

12. Fighting Altitude Sickness

Pre-viewing question

Q: Have you ever experienced altitude sickness?

A: Answers will vary.

Post-viewing question

Q: How can you recover from altitude sickness?

A: The only sure way to recover is by descending in altitude back down to a point where there is enough oxygen for your body's oxygen-depleted cells.

