



Measure Up

Purpose

- To practice making standard and non-standard measurements.
- To learn the purpose of making linear measurements and how to apply them to scientific investigations.

Overview

Students will use various objects in the classroom to experiment with non-standard measurement. They will make estimates and test these out. Then, working in pairs or small groups, students will use a ruler or a measuring tape to become familiar with how to use these tools for standard linear measurement.

Student Outcomes

Students will learn how to make measurements, both non-standard and standard (with a ruler). They will test their estimates and record their results.

Next Generation Science Standards

- Science Practice 3 Asking Questions
- Science Practice 8 Obtaining, Communicating, and Evaluating Information
- Crosscutting Concept 3 Scale, Proportion, and Quantity

CCSS.ELA Anchor Standards

- W.4 Produce clear and coherent writing...

CCSS.MATH Content Standards

- G.A.1 Reason with shapes and their attributes
- GB.4 Analyze, compare, create, and compose shapes

Time

- Part 1: One 30- to 45-minute class period
- Part 2: One 30- to 45-minute class period

Level

Elementary (most appropriate for grades K-4)

Materials

- *Elementary GLOBE* storybook: *Discoveries at Willow Creek*

Part 1:

- Various items from the classroom to measure
- Copies of the *Measure Up Student Activity Sheet 1*

Part 2:

- Metric rulers and/or measuring tapes
- Various items from the classroom to measure
- Plant seeds, soil, containers
- Copies of the *Measure Up Student Activity Sheets 2*

Prerequisites

- Students should have an understanding of the following terms: *as many as*, *more than*, *the same as*, and *as long as*. Younger students may need practice with these terms prior to doing this activity.



Preparation

Read the *Elementary GLOBE* storybook *Discoveries at Willow Creek* - either read it to the class or have students read it to themselves. The book can be downloaded from www.globe.gov/elementaryglobe.

You will need plants grown from different seeds for the second part of this activity in which students measure the plants as they grow. Before doing the activity with your students, plant 3-5 containers with seeds from different containers. You might want to have the students help you plant the seeds.

Teacher's Notes

There are two categories for units of measurement – standard and non-standard. Standard units of measurement are units that are used universally asuch as units from the metric system (millimeters, centimeters, meters, kilometers) and English units, which are commonly used in the United States (inches, feet, yards). Non-standard units are items you can use for measurements that don't have a standard that is universally accepted. For example, some non-standard units could be: paperclips, shoes, marbles, pencils, leaves, hands, tennis balls, etc. You can ask your students the question "How long is it?" and they can answer "As long as...." In this way, even without standard measurement units, there is still something with which to compare.

Both non-standard and standard units can be used for measurement. Introducing nonstandard units first is a good way to make students comfortable with the concept of measurement before introducing rulers and measuring tapes. Provide a frame of reference by having students measure with objects such as a pencil or a paper clip. The only requirement is that a measurement always has two parts: a number and a unit. For example, a desk might be 1 meter long, where "1" is the number and "meter" is the unit. Also, a measurement must be end-to-end for it to be accurate. Note: younger students will need time to practice measuring from end to end. Once students have this frame of reference, discuss with them why standard units

would be helpful; then have them practice. Point out that, for example, there are two common sizes of paper clips and you might not know which kind someone else was using when they measured an item. With standard units, the measurement is universal and consistent.

Rulers and measuring tapes use standard units, which are often in millimeters (mm), centimeters (cm), or inches (in) and are used to make linear measurements. The GLOBE Program uses the metric system (millimeters, centimeters, meters, kilometers) as the standard unit of measurement.

What To Do and How To Do It

Part 1:

1. Model for your students how to measure the length of a table using your hand. Ask them for ideas of how to use some other parts of their bodies to measure the table.
2. Allow them to explore this concept. Discuss the idea that a measurement unit can be anything you want it to be as long as you define the unit and only measure with that unit.
3. Have the students find another object to measure.
4. Have them pick something smaller than a shoe box to use for a measurement unit. Some ideas for units are: paperclips, marbles, leaves, pencils, hands/fingers. Once they have selected an object to measure and a measurement unit, have the students fill out the first part of the *Measure Up Student Activity Sheet 1*. Have the students make some observations about their object and compare the object to their measuring unit and write those observations on the student activity sheet.
5. Have the students estimate (guess) how many units long the object is that they have chosen. Have them write this estimate down on the *Measure Up Student Activity Sheet 1*.
6. Next, have the students count how many units long the object is (measure the object). They should record this number on the *Measure Up Student Activity Sheet 1*.



7. Have them compare the measurement with their estimate (guess). Have the students write a math statement explaining their measurement and share their results with the class. See the *Measure Up Student Activity Sheet 1* for a sample math statement.
8. Ask your students the following questions:
 - How accurate was your estimate?
 - How could you measure your object using a different unit?

Part 2:

1. Show your students a ruler. Ask them the following questions:
 - What are the marks on the ruler for?
 - Why is it important for people to take accurate measurements?
 - Why is it sometimes helpful to have a measuring system that everyone uses?
2. Point out the difference between inches and centimeters/millimeters on the ruler, and let the students know that they will be measuring using millimeters. (Note: this distinction is only necessary in classrooms where both English and metric measurements are used.) Pass rulers out to the students and talk to them about how this tool can be used to measure things. Ask for ideas about what people measure with a ruler and what other tools people use to measure different things.
3. Divide the students into groups of 2-3. Have the students practice measuring items in the classroom with a ruler. Have them record their measurements on the *Measure Up Student Activity Sheet 2*. Note: Younger students will have an easier time measuring smaller objects that are under 100 units long. Numbers bigger than 100 will be harder for them to understand.
4. Now have the students look at the plants that have been growing in the classroom for this activity. Have the students select a plant they want to measure. Before using their ruler to measure the plant, have the students estimate how tall they think the plant is in centimeters. They should record this estimate on the *Measure Up Student Activity Sheet 2*.

5. Next, have the students measure the plant with their rulers. After they record this number, have them write a math statement comparing their estimate with the measurement. Students may have questions about which part of the plant to measure and whether to stretch it out as tall as it goes. This is an opportunity to introduce why everyone using the same method is helpful in science investigations.
6. Continue to make these measurements weekly as the plants grow taller.

Adaptations for Younger and Older Students

Younger students can continue to experiment with nonstandard measurement until they are ready to try standard measurement. Read *Measuring Penny* by Loreen Leedy with your students to give them more ideas of how to use nonstandard measurement.

Older students can explore with other types of measurement and measure with more precision, such as measuring both centimeters and millimeters (if they are familiar with fractions). For more information go to the "Further Investigations section below.



Further Investigations

- Measurements in Nature:** After it has rained, take your students outside with sidewalk chalk. Have them draw a circle around the outside of a puddle. Wait several hours or a full day, depending on how quickly the water is evaporating, and draw another circle around what remains in the puddle (see Figure 1 below). Use a ruler or measuring tape to record the length of the narrowest and widest parts of the puddle. Have the students record this information in a journal. If it is a big puddle, do this several times until all of the water has evaporated.

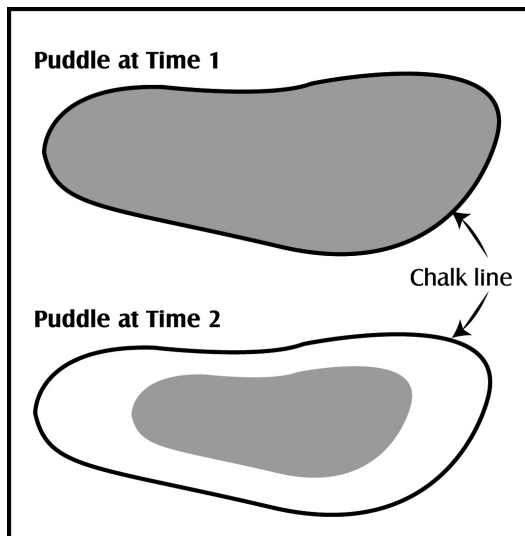


Figure 1. The chalk circle remains as the puddle dries.

- Explore Other Types of Measurement:** temperature, volume, and mass/weight. *How to Teach Measurements in Elementary School Science* by Neal J. Holmes and Joseph J. Snoble is a great resource for this area (www.nsta.org).
- Measuring Plants:** Have your students record the plant's growth every week on a calendar. Then, write math statements about the month's growth.

Week ____ had the most growth

Week ____ had the least growth

It grew more on week _____ than any other week of the month. (Week 3, for example)

_____ cm during week 1

+ _____ cm during week 2

+ _____ cm during week 3

+ _____ cm during week 4

= _____ Total month's growth

Measure Up Student Activity Sheet 1

Name _____

The object I will measure is _____.

Here's a drawing of what I measured.



I am using _____ to measure the length of my object. This is my measurement unit.

Here's a drawing of my measurement unit.



Estimate

I estimate (guess) that what I am going to measure is _____ units long.

Actual

My object is _____ units long.

Complete the math statement below to explain the difference between the estimated and actual length of what you measured.

My estimate was...

- more than

less than

the same as

...the actual amount I measured.



Measure Up Student Activity Sheet 2

Name _____

Practice measuring with a ruler

The object I will measure is a _____.

It was this long: _____

How tall is that plant?

Estimate

I estimate (guess)
that the plant is
_____ tall.



Actual

I measured and found
that it is actually
_____ tall.

In the space below, write a math statement that explains the difference between your estimate and the actual height.

My estimate was...

- more than
 less than
 the same as

...the actual height I measured.