



VOLUME

Teacher Notes



FOURTH GRADE BACKGROUND

- Basic understanding of measurement from previous lesson
- The students are not yet able to determine the volume of a cube
- Volume is a difficult concept because of the 3D perspective. Students are more comfortable dealing with 2D area than 3D volume and are more comfortable measuring the volume of solids than liquids.
- The students have no experience with graduated cylinders.

PREVIOUS LESSON REVIEW

- What have you learned about measurement (using a ruler, perimeter vs. area)?
- What have we measured so far? What tools did we use?

INTRODUCTION

Continuing from the measurement unit, this lesson focuses on measuring volume. Volume is a more challenging concept for the students because of the extra dimension involved. Review the concept of volume and how it relates to perimeter and area. As in the measurement unit, it should be stressed that volume has both a number and a unit. While mL is more commonly used, the students will be exposed to cubic centimeters (cc or cm^3). The conversion $1 \text{ mL} = 1 \text{ cm}^3$ of water can be used.

The difference between the length, width, and height of a cube should be discussed. Using the large block in the kit, point out the different sides and measure the volume of the large block. Students may get confused and measure three sides of a cube face rather than measure correctly the length, width, and height. The students might also have a difficult time with reading the scale on a graduated cylinder. Some time should be spent discussing how one knows what each mark on the cylinder means when only a few major lines are labeled. Finally, some students might think that it is possible to measure volume with a ruler. The volume of a cube can be measured with a ruler, however it needs to be pointed out that the volume of a liquid must be measured with the appropriate tool: a graduated cylinder, measuring cup, etc. You should also discuss and demonstrate how we measure the volume of an odd-shaped solid using the displaced volume.

DISCUSSION THOUGHTS

What tools do we use to measure liquids? What units do they use?

VOCABULARY

- **Volume:** The 3D space an object occupies (measured using mL, gal, etc.)
- **Graduated Cylinder:** A tool used to measure the volume of a liquid
- **Cubic centimeter (cm^3):** The space occupied by a cube 1 cm in length, width and height ($1 \text{ cc} = 1 \text{ mL}$)
- **Displaced Volume:** Change in volume when an object is added to a liquid (equals object's volume)

ACTIVITIES

- **Worksheets**
 - Students complete the volume worksheet. You can use the overhead to work together.
 - Materials:
- 25 Volume worksheets
- **Cubes Galore**
 - Break students into groups of four. Hand out four small cubes (1 cm^3) and two medium cubes (8 cm^3) to each group. Have them measure the sides of both cubes and record it on the Volume Experiment Worksheet (Questions 1-2). Have them put together the four small cubes to form a $2 \times 2 \times 1 \text{ cm}^3$ block. Hand out four 16 cm^3 blocks and a square container to each group and have them measure the side length and determine the volume (Questions 3-4). Fill out this

information for each of the four blocks on the worksheet and add up the volumes (Question 5). Stack the four blocks in the square container. The students should note that they fill the cylinder up to the 64 cc (or 64 mL) etch mark. They should mark this on the worksheet (Question 6). Now hand out the plastic graduated cylinders and cups filled with water. Have the students remove the wooden blocks and fill the square container with water up to the 64 cc etch mark. Pour the 64 cc of water into the plastic cylinder. On the board, show students how to read the markings on the graduated cylinder and then have them measure the amount of water poured into the graduated cylinder. Note the volume on the worksheet (Question 7) and comment on how the same volume of water looks different in different containers (Question 8).

- Objective: Teach students how to determine volumes of various blocks and become familiar with measuring volumes of water using a graduated cylinder.
- Materials:
 - 25 Volume Experiment Worksheets
 - 30 small cubes (1 cm^3), 15 medium cubes (8 cm^3), and 30 large flat blocks (16 cm^3)
 - 7 square containers with 64 cc etch mark
 - 7 plastic cylinders with graduated marks
 - 7 plastic cups filled with water

- **Displacement Experiment**

- This is a continuation of *Cubes Galore*. First, discuss with the class how they think the volume of an object could be measured using water and the graduated cylinders. After leading them to the displaced volume method solution, tell each group of four students to fill their graduated cylinders with two volumes of water from the square 64 cc containers. Have the students measure the volume after the addition of each volume of water and mark it on their worksheets (Question 9). Add the plaster cylinder and have each group read and record the volume of the plaster cylinder + water (Question 10). Review how to determine the object's volume via displaced volume, which is the water and object volume minus the water volume (Question 11).
- Objective: Students learn how to measure an object's volume using displaced volume
- Materials:
 - 7 square containers with 64 cc etch mark
 - 7 plastic cylinders with graduated marks
 - 7 plastic cups with water
 - 7 white plaster cylinders with strings

- **Double Dare Volume Competition**

- Break students into teams of four. Give each team a sponge and ask the team to pick a member to be the official sponge soaker, sponge squeezer, graduated cylinder holder, and volume reader. Have each team estimate the volume of water the sponge can hold and record these values on the board (Question 12). The sponge soaker soaks the sponge in water. The graduated cylinder holder holds this while the sponge squeezer squeezes as much of the water out of the sponge as possible. The volume reader reads the volume and has each team member check to make sure the measurement is correct (Question 13). Check the teams' measurement and help them to determine the deviation (Question 14). Record the volume measurement and the deviation results. Declare a winner. This is very similar to what they will find on their 4th grade science exam. Ask students how they might have found the mass of the squeezed sponge water. Emphasize the difference between weight and volume of the water.
- Objective: Practice measuring volume via a friendly tournament.
- Materials:
 - 10 sponges
 - 10 graduated cylinders
 - cups with water

CONCLUDING THOUGHT

How could you calculate the volume of water in a pool? How could you determine your own volume?