# The Incredible Denseness of Being



## Purpose

Students will use formulas to calculate the volumes of rectangular solids, will decide what degree of precision is adequate, and will round off the result of calculator operations to significant figures that reasonably reflect those of the inputs.

## Materials

*For each student:* pencil, copy of Black Line Master (BLM) *Voluminous Information*, graph paper
*For each group of students:* 10-gallon aquarium; ruler; 5 rectangular solids that are all approximately the same size but have different masses, such as a wooden block, a brick, a sealed empty plastic container, a sealed plastic container filled with sand, or a piece of polystyrene; grease pencil; water
*For the class:* a balance

## Activity

### A. Pre-Activity Preparation

1. Arrange for students to work outside.
2. Fill each aquarium approximately two-thirds full with water.

### B. Volume, Mass, and Density

1. Divide students into four groups.
2. Hand out copies of the BLM *Voluminous Information* to each student.
3. Tell students that they will be investigating the masses and volumes of various objects.
4. Instruct students to work together in their groups to find the information requested in Part 1 of the BLM *Voluminous Information*.
5. Ask students what the volumes of their aquaria and water are.
6. Ask students if it is appropriate to round the volume. Ask students to what decimal place the volume should be rounded.
7. Explain to students that the volume should not contain any more decimal places than the original measurements of length, width, and height – in other words, the volume can only be as precise as the original measurements. Explain that we did not measure any more precisely than millimeters, therefore our final measurement can only be precise to millimeters.

*(continued)*

### EXTENDING THE ACTIVITY

Have students produce a lab report including their graph of mass/volume explaining their results. Ensure that students round correctly, given the precision of their measurements.

### MEETING INDIVIDUAL NEEDS

Have students who need a challenge find the volumes of more complex shapes, such as cylinders, and calculate the densities of various soda and juice cans.

**Standards Link**
**7.2.7**

## Activity (continued)

8. Provide students with the various rectangular solids and instruct them to complete Part 2 of the BLM *Voluminous Information*.
9. Ask students if all the solids displaced a volume of water equal to their own volume and why they think a solid might not displace as much water as its own volume.
10. Instruct students to think about why a solid might not displace as much water as its own volume as the class completes Part 3 of the BLM *Voluminous Information* together.
11. Have students take the mass of each of the blocks using the balance and have students record the masses and volumes of the blocks in Part 3 of the BLM *Voluminous Information*.

### C. Discussion

1. Have students make a graph with mass on the *x*-axis and volume on the *y*-axis and ask students if they can identify the trend.
2. Explain that an object's density is determined by how tightly packed its molecules are and is found by dividing the object's mass by its volume.
3. Have students calculate each block's density and record the information in the density column in Part 3 of the BLM.
4. Ask students to compare the blocks' densities to the volumes of water they displaced and to the density of water.
5. Explain that objects with densities greater than water sink and displace an amount of water equivalent to their volume, but that objects with densities less than water are able to float (like ice) and displace less water than their volume.

## Classroom Assessment

### Basic Concepts and Processes

As the class completes their measurements, ask the following questions:


To what decimal place should you round your volume and density measurements? Why?


How do you calculate volume? Density?


How do mass, volume, and density relate to one another?

Name: _____

# Voluminous Information

## Part 1

1. Measure the length, width, and height of the aquarium in meters to the nearest millimeter (for example, the aquarium is 0.360 m tall). Record the information in the table below.
2. Calculate the volume, in cubic meters, of the aquarium by multiplying the length by the width by the height and record the information in the table below.
3. Using a grease pencil, mark where the water line is in the aquarium.
4. Determine the volume of water in the aquarium using the same procedure and record the information.
5. Find the percentage of the aquarium that is filled with water by dividing the volume of water by the total volume of the aquarium and then multiplying by 100.

| | Length | Width | Height | Volume |
|---|---|---|---|---|
| **Aquarium** | | | | |
| **Water** | | | | |

## Part 2

1. Determine the volume of each of the blocks provided and record the information below.
2. One at a time, place a block in the aquarium and use the grease pencil to mark the new water level.
3. Calculate the new volume of water.
4. Subtract the original volume of water from the new volume of water. This is the volume of water displaced (moved) by your object.

| Block | Length | Width | Height | Volume of Block | New Volume of Water | Amount of Water Displaced |
|---|---|---|---|---|---|---|
| | | | | | | |
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## Part 3

| Block | Mass of Block | Volume of Block | Density |
|---|---|---|---|
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