

Name: _____

Scuba Divers

Two identical twins named Jill and Rachel were planning separate trips to go scuba diving. Jill planned to scuba dive in the ocean off the coast of Maine and Rachel planned to scuba dive in Lake Champlain.





Scuba divers who dive in cold water locations such as the ones the girls had chosen, must wear wet suits. Wet suits make you more buoyant (cause you to float). In order to sink, divers add lead bars to their belts. Jill and Rachel are the same size and the same weight, however, they were told that they would need to add different amounts of lead to their belts because one planned to dive in the ocean and the other planned to dive in a lake. The girls were curious about this and wondered if the different “sink weights” had something to do with their density compared to the density of the ocean and the lake. They decided to investigate density in order to help them understand this confusing situation. Their investigation question was “How does the density of an object compare to the density of the liquid in which it is submerged?”


- 1) Using the experience of Jill and Rachel and your understanding of density, predict (formulate a hypothesis) about how the density of an object must compare to the density of a liquid in order for the object to sink in the liquid. Explain your thinking.


Part 1:

Follow this experimental procedure in order to test your hypothesis:


Materials For the Experiment

- 200 ml clear beaker or similar size clear container 
- 50 ml corn syrup, 50 ml mineral oil, 50 ml colored water 


syrup
oil
water
- metric balance 
- density cube set (metal, PVC, acrylic)





A
metal



B
acrylic



C
PVC

Optional: small metal object, rubber stopper, PVC plastic
- metric ruler 
- tray and paper towels 

- Calculate the **volume** of each cube in cm^3 (calculators can be used). You can find the volume of the cylinders by submerging them in water and finding their displacement ($1\text{ml}=1\text{cm}^3$) or by measuring the area of the base of the cylinder and multiplying it by its height.

Use this space below for calculations and to record your results:

- Use the metric balance to find the **mass** of each solid cylinder in grams.

Use this space below for calculations and to record your results:

- Calculate the **density** of each solid cylinder using the following formula:
{density = mass \div volume}. Your calculation should be rounded to **tenths** place.

Use this space below for calculations and to record your results:

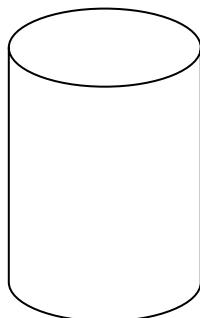
2. Organize the data you just collected into a table. The title of the table will be “Mass, Volume, and Density”. Create, organize and clearly label the table. Your table should include all objects tested and data collected.

Mass, Volume, and Density

Part 2:

- Carefully pour 50 ml of each of the three liquids into the beaker in the following order:
Liquid 1: corn syrup
Liquid 2: colored water
Liquid 3: mineral oil
- Carefully drop cylinder A into the liquid column.
- Carefully drop cylinder B into the liquid column.
- Carefully drop cylinder C into the liquid column.

3) Make a diagram with labels that represents the positions of the liquids and solids in the beaker.



- Jill and Rachel did an internet search to find the densities of the three liquids. The results of their research are included in the following table.

Liquid	Density
corn syrup	1.4 g/cm ³
water	1.0 g/cm ³
mineral oil	0.84 g/cm ³

4) Do the results of your experiment and the data that the girls found on the internet support your prediction about how the density of an object compares to the density of a liquid in which they are submerged? Explain your thinking. (Provide specific examples from the data on how the experimental results support or refute your predictions.)

5) If cylinder B (acrylic) was twice the size, what would its position in the beaker be? Explain.

6) If salt water has a density of 1.2 g/cm^3 and fresh water has a density of 1 g/cm^3 , then which of the twins will need to add more “lead” to her weight belt in order to sink:

Rachel in Lake Champlain or Jill in the Ocean?

Explain your thinking. (Use data from your experiment to support your choice.)

7) When water changes state from a liquid to a solid it becomes ice and floats on the liquid water. Use the understanding that you gained from doing this experiment to explain what happens to the density of water when it changes from a liquid to a solid?
