Name_____ Period _____Date_____

How Dense Is My GloFish®?
Determining the Density of Irregular Shaped Objects

Objective
The learner will determine the densities of regular and irregular shaped objects and use these skills to determine the density of a GloFish® fluorescent fish.

Introduction
Observe your GloFish as it swims. When it stops moving its fins, does it sink to the bottom, stay in the same place, or float to the top? The answer to this question depends upon the density of its body. **Density is a measure of the volume of space occupied by a particular mass.** The formula for calculating density is: Density = Mass/Volume. The density of pure water is 1 g/cm^3. Objects with a density lower than 1 g/cm^3 will float in water. Objects with densities greater than that of water will sink below the surface of the water. In this activity, you will determine the densities of a regular shaped object and an irregular shaped object. Once you have mastered the ability to determine densities, you will use your density calculating skills to determine the density of a GloFish. Will the fish be more or less dense than the water in which it swims?

National Standards Addressed
Physical Science B—Properties of Matter

Materials Per Group
100 ml graduated cylinder
Balance
Small block of wood
Ruler
Small stone or similar irregular shaped object
100 mL beaker or cup
One GloFish

Safety Precautions
Care should be taken to avoid contact of water and electricity if an electronic balance is used in this activity.
Students should use proper procedure for handling live fish during the experiment.
Instruct learners to wash their hands thoroughly after handling living organisms.

Procedures
Part A: Measuring the Density of a Regular Shaped Object

1. Determine the volume of the block of wood by measuring its length, width and height. Record the values in *Data Table 13.1*.

2. Using the balance, determine the mass of the block of wood. Record the value in *Data Table 13.1*.

3. Calculate the density of the block of wood using the density formula: Density = mass /volume. (d = m/v)

Part B: Determining the Density of an Irregular Shaped Object

1. Use the balance to determine the mass of the irregularly shaped object. Record the mass in Table 13.2

2. The volume of an irregular shaped object can be determined by measuring how much water the object displaces. Place 50 mL of water in a 100 mL graduated cylinder. The 50 mL mark will be considered the original volume. Record the original volume in Table 13.2.

3. Place the irregular shaped object in the 100 mL graduated cylinder. Record the volume of the water and the irregular object in Table 13.2.

4. Determine the amount of water displaced by the irregular shaped object by subtracting the original volume from the volume of the water plus the irregular shaped object. The difference in the two volumes is the volume of the irregular shaped object.

5. Calculate the density of the irregular shaped object using the density formula.

Part C: Determining the Density of a GloFish®

1. Place 50 mL of aquarium water in a beaker. Determine the mass of the beaker and the water.

2. Add a GloFish to the beaker of aquarium water. Determine the mass of the GloFish and water. Subtract this value from the mass of the beaker and the water measured in step one. This small difference is the mass of the GloFish.

3. A GloFish is considered an irregularly shaped object. Use the skills you gained during Part B of this activity to determine the volume and then density of the GloFish.

4. In the space provided, prepare a bar graph comparing the densities of the regular shaped object, irregular shaped object and GloFish.

5. Answer the discussion questions.

Data

Table 13.1 - Density of Wooden Block

Length (cm)	Width (cm)	Height (cm)	Volume (cm^3) (LxWxH)	Mass of Block (g)	Density(g/cm3) D=M/V

Table 13.2 - Density of Irregular Shaped Object

Mass (g)	Original Volume (mL)	Volume of water and object (mL)	Volume of object (mL)	Density g/mL D=M/V

Table 13.3 - Density of a GloFish®

Mass of water and beaker (g)	Mass of GloFish (g)	Volume of GloFish (mL)	*Density g/mL D=M/V*

Graph 13.1

Discussion Questions:

1. What is the formula used to calculate density?

2. Which has a higher density, water, or wood? Explain your answer.

3. If an object has a density of 0.93 g/mL, would it sink or float in pure water? Explain your answer.

4. What is the density of an object with a mass of 5.2 grams and a volume of 1.6 mL? Show your work.

5. What is the mass of an object with a density of 2.84 g/mL and a volume of 2 mL? Show your work.

6. How can you determine the volume of an irregularly shaped object?

7. Describe how you would determine the density of an egg that does not fit into a graduated cylinder.

8. How does the density of your GloFish® compare to that of water?

9. Identify at least two possible errors that could have occurred in Part C as you determined the density of your GloFish.

10. Most fish have a density that is higher than that of water. One adaptation that allows fish to remain at a particular level under water is a swim bladder. A swim bladder is a pouch to which gas can be added or removed to adjust the fish's level in the water. If a GloFish® removes gas from its bladder would you expect the fish to rise higher or sink lower in the water? Explain your answer in terms of density.

Elaborations or Extensions

Instruct students to research the structure of a typical air bladder in fish and describe how the volume of gas in the bladder can be regulated.

Have students conduct research to determine an explanation of the fact that an object as massive as a billiard ball can float in a container of mercury.

How Dense Is My GloFish®?
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Answer Sheet

Intended Grade Level
9th, 10th, 11th

Teacher Information
An electronic balance with readability of .01 grams will reduce errors in calculating the density of the small GloFish®. If fish are too small, students should use two similarly sized fish and divide the volume of water displaced by 2.

When selecting an irregular shaped object for Part B select a nonporous object that will fit easily into the mouth of the graduated cylinder.

Discussion Questions and Possible Answers

1. What is the formula used to calculate density?
   Density = mass/ volume

2. Which is has a higher density, water or wood? Explain your answer.
   Most wood will have a density less than 1 g/cm^3 and as a result will float on water, which has a density of 1 g/cm^3.

3. If an object has a density of 0.93 g/ml, would it sink or float in pure water? Explain your answer.
   An object with a density of 0.93 g/mL will float when placed in pure water because its density is less than that of water.

4. What is the density of an object with a mass of 5.2 grams and a volume of 1.6 ml? Show your work.
   Density = mass / volume 5.2 g / 1.6 mL =8.32 g/mL

5. What is the mass of an object with a density of 2.84 g/mL and a volume of 2 mL? Show your work.
   Mass = density x volume 2.84 g/mL x 2 mL = 5.68 g

6. How can you determine the volume of an irregularly shaped object?
   Begin with a known volume of water in a graduated cylinder. Place the object in the graduated cylinder and note the change in volume. The change in volume is equal to the volume of the irregularly shaped object.

7. Describe how you would determine the density of an egg that does not fit in a graduated cylinder.
   Take the mass of the egg using a balance. Using water displacement, determine the volume of the egg. One way would be to mark the level of water in a beaker, then add the egg and make a second mark noting the rise in water level. Remove the egg and the water level will return to the original mark. Then decant water from a graduated flask to cause the water to rise to the second mark. The amount of water poured from the

graduated cylinder will be the same as the volume of the egg.

8. How does the density of your GloFish® compare to that of water?
   The GloFish's density should be very close to or slightly higher than that of the water (1 g/ml).

9. Identify at least two possible errors that could have occurred in Part C as you determined the density of your GloFish.
   1. Some additional water may be accidentally introduced as the GloFish is transferred into the graduated cylinder.
   2. The mass of the GloFish is so small that it causes little change in the mass of the beaker and water.

10. Most fish have a density that is higher than that of water. One adaptation that allows fish to remain at a particular level under water is a swim bladder. A swim bladder is a pouch to which gas can be added or removed to adjust the fish's level in the water. If a GloFish removes some of the gas from its bladder would you expect that to cause the fish to rise higher or fall lower in the water? Explain your answer in terms of density.
    Removing gas from the air bladder should cause an increase in the density of the fish which would result in the fish sinking in the water.