**DENSITY: WHY DO THINGS FLOAT?**

## LEVEL B: BUOYANCY AND DENSITY

**MATERIALS:**

Computer with internet access (http://phet.colorado.edu/en/simulation/buoyancy)

**OBJECTIVES:**

* To investigate factors that affect whether thing float or sink
* To explain the concept of density in terms of forces acting on an object

**BACKGROUND:**

A force is a push or pull that results from one object’s interaction with another object that causes it to move. The amount of force is dependent on the mass of the object (how much matter it contains) and the change in its speed. Therefore it has units of kg-m/s2 in the SI system of measurement. 1 kg⋅m/s2 is also called a Newton (N). In this activity, we will explore the forces involved in causing objects to float or sink. Forces are measured using a scale.

**PROCEDURE:**

Getting Familiar

1. Open the website.

2. On the Intro screen, explore the simulation, changing the blocks, observing what can be changed.

3. Click on the “same” mass button. What happened to the blocks? Place the two blocks into the tank. What happens to the blocks? Do the same for “same volume” and “same density”.

* Does the mass, by itself, determine whether an object floats or sinks? What is your evidence for your answer?
* Does the volume, by itself, determine whether an object floats or sinks? What is your evidence for your answer?
* Does the density determine whether an object floats or sinks? What is your evidence for your answer?
* Can you find a relationship that determines if on object floats or sinks?

4. Check and uncheck the boxes under “Show Forces” to see where they act.

1. What does each force do? When are they present? What do you notice about their measurement?
   1. Gravity
   2. Buoyancy
   3. Contact

* From these observations, what is the relationship between the forces that an object to float (or sink) in a fluid?
* Using these ideas, draw a particle diagram to illustrate what happens to the particles of a fluid as an object sinks. How is this different when an object floats? Why?

**Lab Setup**

* + 1. Click over to the Buoyancy Playground and begin the lab.
    2. There are 5 different fluids to choose from in the lab and five different types of materials. (Styrofoam, wood, ice, brick and aluminum)
    3. Use the table supplied to organize your work.

**Part 1:**

1. In each of the scenarios below, determine first, ***by predicting***, whether the object will sink or float. Use a mass of 1.0 kg.
2. Test each object once you have predicted and record the results.
   1. Select the mass by typing in the value in the mass select area on the upper left of the screen.
   2. Select the fluid by using the slider bar on the bottom center of the screen.
   3. Write an “S” for sink or an “F” for float. Predictions first!!

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Air** | | **Olive Oil** | | **Water** | | **Gasoline** | | **Honey** | |
| . | **Pred.** | **Act.** | **Pred.** | **Act.** | **Pred.** | **Act.** | **Pred.** | **Act.** | **Pred.** | **Act.** |
| Styrofoam |  |  |  |  |  |  |  |  |  |  |
| Wood |  |  |  |  |  |  |  |  |  |  |
| Ice |  |  |  |  |  |  |  |  |  |  |
| Brick |  |  |  |  |  |  |  |  |  |  |
| Aluminum |  |  |  |  |  |  |  |  |  |  |

**Part 2:**

For each of the objects, determine the density at which it sinks in kg/L by slowly sliding the fluid density until the object just sinks or stays suspended in the middle of the tank. This condition is called “**zero buoyancy**”.

1. Use a mass of 1.0 kg.
2. You may need to use the slide to get close to zero buoyancy and then physically enter numbers until zero buoyancy is achieved. List this value in the table.

|  |  |  |
| --- | --- | --- |
|  | **Density of object** | **Density to sink** |
| **Styrofoam** |  |  |
| **Wood** |  |  |
| **Ice** |  |  |
| **Brick** |  |  |
| **Aluminum** |  |  |

* How does the density of the liquid at zero buoyancy compare to the density of the object?

**Part 3:** In this part of the lab, determine the amount of fluid displaced by objects of mass 1.0 kg floating/ sinking.

* How you will find the amount of fluid displaced by each object. Look at the volume indicator on the right side of the tank. Write your procedure.

Draw a table to show your results.

Summarize your information:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **weight of object** | **Volume of object** | **Volume before object** | **Volume after object** | **Volume of fluid displaced** |
| **Styrofoam** |  |  |  |  |  |
| **Wood** |  |  |  |  |  |
| **Ice** |  |  |  |  |  |
| **Brick** |  |  |  |  |  |
| **Aluminum** |  |  |  |  |  |

**Conclusions:**

1. In the part 1 of the lab, what happened when the ice was placed in olive oil? Draw a particle diagram of this behavior.
2. In part 2 of the lab, which of the objects had the greatest density? What were the characteristics of this object from a mass/ volume relationship? (relative size and weight)
3. From part 3, what is the relationship between the buoyant force and the weight of an object when the object:
4. Sinks
5. Floats
6. How is it possible to have two objects of the same mass where one object sinks and the other object floats? Use your observations from the Intro part of the lab to answer this question.
7. How is the volume of fluid displaced related to the density for

a. Objects that float?

b. Objects that sink?