Sink or Swim

Cartoon of Experiment Setup

Time Required:

- ☒ 0-30 minutes
- ☐ 30-60 minutes
- ☐ 60-120 minutes (1-2 hours)
- ☐ 120-180 minutes (2-3 hours)
- ☐ 180-240 minutes (3-4 hours)
- ☐ > 4 hours

Materials Needed:

- A sink, aquarium, bowl, or large container filled ¾ full with water
- Rock
- Ping pong ball
- Golf ball
- Can of soda
- Can of diet soda
- Aluminum foil in the shape of a boat
- Towel

Optional Materials:

- Any other material/object that will not be destroyed by water
- Several coins

Concepts:

- ☒ Density

Parental Supervision:

- ☒ Recommended for children under 5
- ☐ Recommended for children under 12
- ☐ Highly recommended for children under 12
- ☐ Recommended for children under 18
- ☐ Adults Only

Age Recommendation:

- ☒ 0-3
- ☒ 3-8
- ☒ 8-12
- ☒ 12-18
- ☒ Above 18

Safety:

A towel is needed to dry off the wet objects and to clean up any spilled water

Procedure:

1. Fill the sink/aquarium/container ¾ full with water.

2. Pick one of the materials/items and drop it in the water or place it on the bottom of the sink/aquarium/container and see if it sinks or floats.
3. Observe the behavior of the item for about 30 seconds.
4. Remove the item from the sink/aquarium/container and repeat with the next item.
5. Do not place all of the items into the sink/aquarium/container at once, as it can cause for the water level to overflow the sink/aquarium/container, if it is filled too high with water.

Optional:

1. The aluminum foil boat can be crumpled up into a ball and it can be seen to sink
2. Coins can be gradually added to the aluminum foil boat to be seen how many coins are needed for the boat to sink

Clean Up:

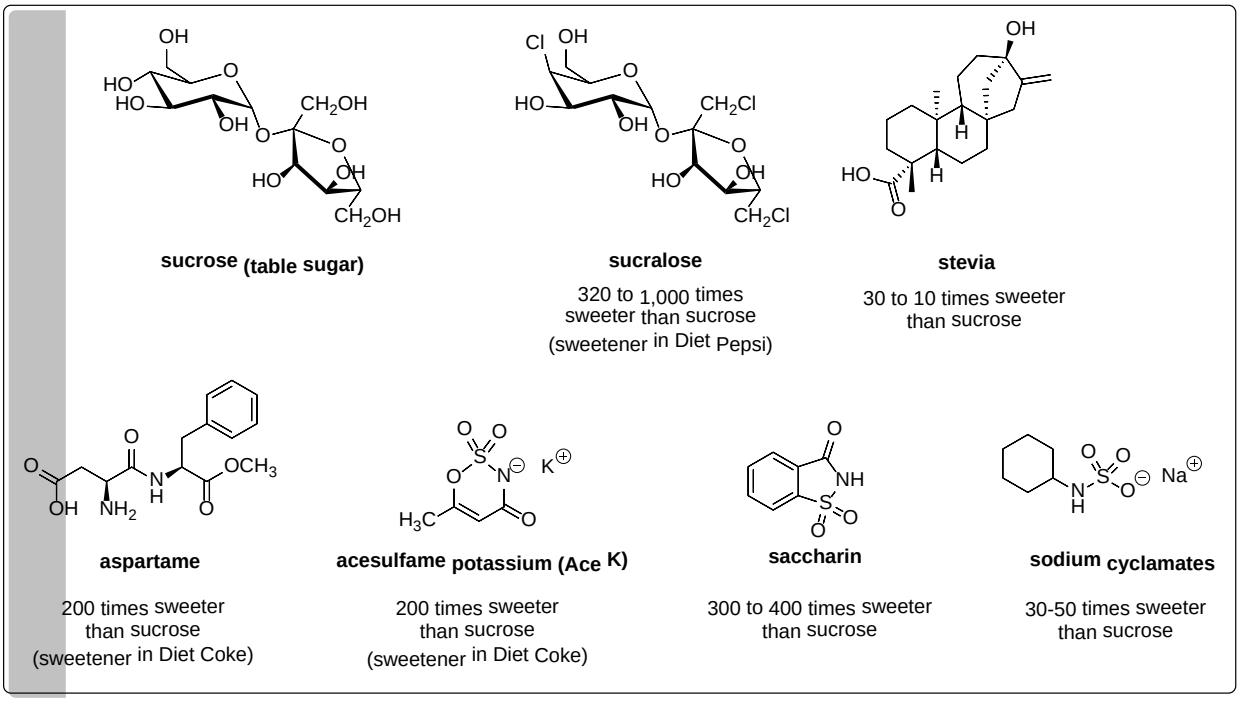
The materials placed in water can be dried off with a towel and the water can be poured down the drain after the experiment has been completed.

What is going on?

Density is a physical property of matter that quantifies the weight of the material in a given amount of space. The amount of space that the material takes up is described by a quantity called volume. Volume is measure the amount of space a substance takes up in three dimensions. The volume of solids is often measured in units of m^3 (meters cubed), in^3 (inches cubed), or ft^3 (cubic feet). The volume of liquids and gases are often measured in units of liters, quarts, or gallons. The most common units for density are grams (abbreviated with a g) per milliliter (abbreviate with mL).

Water has a density of the 1 g/mL, which means that 1 mL (~1/5 tsp) weighs one gram. mL is a measure of volume, where volume is to. In order for a material to float (swim) the density has to be less than the density of water, which means that it displaces its volume of water, but more mass of water than its mass. For a material to sink it displaces its volume in water, but less mass.

In the case of the soda cans, diet soda has a sugar substitute which can consist of aspartame, saccharin, sucralose, cyclamates (outside the US), acesulfame potassium ("Ace K"), and stevia. A mixture of aspartame and Ace K is used in Diet Coke and sucralose is used in Diet Pepsi. Since these compounds are 200-1,000 times sweeter than sugar, often only 200 milligrams (or 0.007 oz.) of sweetener is needed. This small amount of sweetener results in a soda that has similar density to water and results in a can that floats. In the case of a non-diet soda, the soda will often contain > 30 grams (1 oz.) of sugar. This amount of sugar is enough to add extra weight to the soda and make it denser than water, causing it to sink.



Questions and Discussion

1. Oil has a density of around 0.8 g/mL, would you expect oil to be more or less dense than water?

   Answer: The density of oil is less than that of liquid water, so it should float on top of water.

2. Ice has a density of about 0.92 g/mL, would you expect ice to sink or float in water?

   Answer: The density of ice is less than that of liquid water, so it should float on top of water.

3. If a material has a density greater than 1.0 g/mL, how can the material be altered to allow for it to float on water?

   Answer: An example of this is aluminum foil. Aluminum has a density of 2.7 g/mL and when the foil is crumpled up into a ball it will sink in water, but if the foil is made into a boat, it will displace more water than its weight and the boat will float on water.