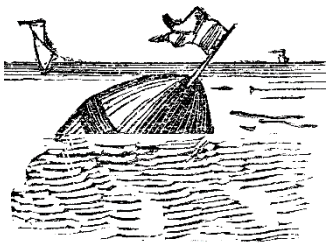

Old School Demonstrations:

Soda Pop (sink or float?)

➢ Lesson Plan: Density Experiment

Background:

Density is the mass per unit volume (Mass/Volume) of an object.

$$\textbf{Density} = {}^{\text{mass}}/_{\text{volume}} \ (d = {}^{m}/_{v})$$

Density can be a very confusing concept for students to understand, especially when referencing the following question, "Which weighs more, a ton of steel or a ton of feathers?" Many students will automatically answer a ton of steel before they even think about the question. To me this is good because the answer is based on their prior knowledge of density. They have an understanding that the steel is "heavy" and that feathers are "light."

The students need to realize that many times the terms "heavy" and "light" are used inadvertently to describe density. Steel has a very high density resulting in a small amount of material needed to make a ton. The students have all lifted a small metal object and they experienced that the object was heavy. They have also lifted a feather and they know that it was very light. It would take many feathers to make a ton because feathers have a low density. The students need to make the distinction between heavy and high density and light and low density. Terms like heavy and light could be used to describe the weight of something, but not the density of the item. This small distinction makes a difference in the understanding of density.

I like to use the following simple demonstration to explain density. This is a demonstration that I keep handy when I am working with density and weight, because is very easy to understand and can be used as a reference to explain density problems/questions. The demonstration is shown in the accompanying video Lesson. All you need for this demonstration is two baby food jars (one filled with nails) and a tub of water. Show the students the baby food jars; one is empty (filled with air) and the other is filled with nails. Ask the students if the two jars will float or sink. Most students will say that the one with air will float and that the one with nails will sink. The students can physically see that the jar with nails has more stuff (matter) in it resulting in a greater density. The density of the baby food jar with nails is greater than the density of water because it sinks. The density of water is 1 ${}^{\text{gram}}/_{\text{ml}}$ or 1 ${}^{\text{gram}}/_{\text{cm}^3}$. The density of the jar with air is less than the density of the water because the jar floats. Now take the empty jar and add water. Eventually the density of the jar including the air and the water will be greater than the density of the water in the tub, and then the jar will sink.

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Density = mass/volume (d = m/v)

- **Water** = 1 $^{g}/_{ml}$ (standard value)
- **Diet Pop**
  - Volume = 355 ml
  - Mass = 368.3 g
  - Density = 1.03 $^{g}/_{ml}$
- **Regular**
  - Volume = 355 ml
  - Mass = 383.6 g
  - Density = 1.08 $^{g}/_{ml}$

Density Using Balance

- Water
  - Volume = 4.93 ml
  - Mass = 5.1 g
  - Density = 1.03 $^{g}/_{ml}$

Materials:

- Soda pop (1 diet, 1 regular)
- Sugar, balance, weighing paper and spoon
- Clear tub (water)
- Baby food jars (2 – one with nails)
- Towel

Procedure:

The Soda Pop (sink or float?) resource can be presented as a standalone class demonstration or it can be expanded into a class activity. I ask the students, by a show of hands, if they think the 2 pop cans will float or sink. I pass the cans around, so everyone can hold the cans. The demonstration is shown in the accompanying video Lesson.

Setup/Process

1. Fill clear tank with water.
2. Ask the students whether the pop cans will sink or float; pass cans around the room.
3. Place both pop cans in the water – remove air from bottom of cans.
4. Ask the students why the diet pop floats and the regular pop sinks.
5. Pass the cans around the room. The students should look at the "Nutritional Facts".
6. Compare the pop cans to the baby food jars.
7. Add sugar to the baby food jar so it sinks at the same rate as the regular pop.
8. Compare the volumes of the cans – same. Place each can on a balance – different. $D=^{m}/_{v}$; the mass is greater in the regular pop.

What to expect:

The diet pop will float, and the regular pop will sink. The density of the diet pop is less than the density of water and the density of the regular pop is more than water. The density of both should be calculated by obtaining the volume from each can (same) and using a balance to establish the mass of each. An example from the cans used in the video lesson is shown above.

This demonstration can easily be adapted into a class experiment by changing the following:

- Different types or brands of pop
- Different sized cans or pop bottles
- The density of the water could be changed:
  - Add sediment (like river water) – density increase
  - Add salt (like the ocean or sea) – density increase
  - The temperature of the water could be changed by adding ice or hot water. (The density of freshwater is the densest at 4 degrees Celsius.)
- Related Resource

Related Web Resource:

PBS LearningMedia (More lessons and video from SDPB)