**Density Demonstration Coke vs Diet Coke:** 7th grade adapted from Liz LaRosa

Additional science lesson resources: [www.middleschoolscience.com](http://www.middleschoolscience.com)

**Objective and Summary:**

[](http://demoroom.physics.ncsu.edu/orders/demos/60.html)

* **Learning Target**: Understand the term density and how it relates to student life application, e.g. “will I float or sink in water?” or “why are some people heavier than others if they are the same size?”
* **Summary:** This lesson plan would fill about fifty minutes of class time. During class they will list similarities of given objects; to brainstorm and find a solution as to why Diet Coke floats and Coke sinks; to see how much sugar we consume drinking one can of soda and make the connection between how mass and volume relate to density.

Relationship to standards (NGSS) - [**PS1.A: Structure and Properties of Matter**](http://www.nap.edu/openbook.php?record_id=13165&page=106)

* [Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1)](http://www.nap.edu/openbook.php?record_id=13165&page=106)
* [Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2),(MS-PS1-3)](http://www.nap.edu/openbook.php?record_id=13165&page=106)

**Materials:**

* 12 ounce coke can
* 12 ounce diet coke can
* water
* fish tank
* sugar
* Equal (aspartame)
* weighing balances and balance paper
* notebook or graphing materials

**Procedure:**

1. Divide the students into groups of 2 to 4 per group. Pass the cans of coke around the room.  Have each student take a good look at each can and ask them to make careful observations about what they see. The students should record their observations.
2. Ask the students to record as many similarities and differences as they can about the 2 cans of coke.  Some answers they may come up with......

|  |  |
| --- | --- |
| Similarities | Differences |
| 1. the same company 2. have the same shape 3. made of aluminum 4. are sealed shut 5. have the same amount of liquid 6. contain water 7. contain carbon dioxide 8. both have caffeine | 1. one is red, the other is silver 2. one is diet, one is regular 3. one has aspartame, one has sugar |

1. Place the regular coke into a small tank of water.
2. Place the diet coke into the water
3. Ask the students to explain why one is floating.

* **The "Why":** Write out and explain the formula for density (density = mass/volume)

Ingredients of cans: <http://www.thecoca-colacompany.com/mail/goodanswer/soft_drink_nutrition.pdf>

Have the students weigh 39 g of sugar – this is the amount of sugar in a regular Coke can. Have the students weigh 0.188 g (188 mg) of Equal – this is the amount of aspartame in a Diet Coke can. Explain that ALL that sugar is in the regular Coke can, and that small amount of Aspartame in the Diet Coke can.  Explain that a small amount of Aspartame (200x sweeter > sugar) is needed to make the Diet Coke sweet because it is so concentrated.  Most students are surprised to actually SEE how much sugar there is!

Discuss how more "stuff" (matter) is crammed into the same amount of space, or **VOLUME**, and that increases the **MASS**.  The relationship of Mass to Volume is **Density**.  The more items (matter) you place into a defined space, the denser it becomes.  For example, New York City is DENSELY populated because there are a lot of people in a small area.  20 people in an elevator is DENSER than 2 people in an elevator.

Have the groups measure and determine the density of different materials and predict if that material will float or sink in water? They should record their findings and make a brief class presentation on their findings.

The density of water is **1g/cm3** (1 g/ml). An object will float if the density is less than 1 g/ml.  An object will sink if its density is greater than 1 g/ml.

**Assessment**:  The ensuing questions should be passed out to the students at least 5-10 minutes before the end of class.

Evaluation of Group Work Form

Answer the following questions. Please reach a consensus by discussing the “Group Response” questions below. Complete the individual response questions and exit ticket on your own.

**Group Response**

1. Name three ways your group functioned effectively together.

2. Identify one way your group could improve for future assignments.

**Individual Response**

Please rate your individual response in the following areas:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 4 | 3 | 2 | 1 |
|  | Yes - Yes | Yes | No | No - No |
| I understood the facts in the experiment and could write up a similar experiment on my own. |  |  |  |  |
| I actively participated in the group – recording, measuring, and setting up the experiment. |  |  |  |  |

**Exit Ticket**

1. What is the formula for density? Label all the symbols in the formula.

2. Name one substance that is denser than water and one that is less dense than water. Which will float or sink in water?

**Extension**:  Weigh the Coke and Diet Coke to determine mass of each can. Using water displacement, find the volume of each can.  Use the formula D=M/V and see if you can determine their densities.  Is Diet Coke's density less than 1?  Is regular Coke's density greater than 1?

Does this work for all Diet sodas?  Try different brands, for example Pepsi, Dr. Pepper, Sprite, etc.  Have the kids form predictions and test them out!

\*Note:  According to the Coca Cola company: An 8 oz can of Diet coke has 125 mg of aspartame, so a 12 oz. can has approximately 190 mg.  You can also say that there are ~**38,000 milligrams** of sugar in a 12 oz. can of regular Coke!!!

**Active Learning Instruction Rationale:**

The teaching of density and science in general, lend themselves well to an Active Learning Instruction type of lesson plan. The use of input and modeling relate to the hierarchical nature of science whereby a basic academic language needs to be established and then that language is transformed into a tangible concept through modeling. Independent practice and guided practice through active learning are useful in this lesson to reinforce the modeling and give the students sensible “hands-on” application of theory. Utilizing active learning practice can give depth to student understanding through the multiple intelligences of spatial, linguistic, mathematical, and kinesthetic.