**Science Assignment 3: You are my density**
Density is a measurable quantity of matter that is crucial in describing motion in a gravitational field. Density is calculable by dividing the mass of a piece of matter (for instance, a copper cylinder or a given amount of air) by the volume (space) that it occupies. Roughly put, density is a measure of how much stuff is crammed into a given space. Air is less dense than rocks because rocks manage to cram more matter than air into a given space.

**Procedure:**
Break up into groups of four to five. There will be several “stations” scattered around the room; feel free to perform the experiments at the stations in any order, except do Station 5 last.

**Station 1 — Salt water versus fresh water**
Fill one of the test tubes about half full of 10% sodium chloride (NaCl, which is table salt) solution, and add a drop of food color. Swirl the tube to evenly distribute the color.

Meanwhile, obtain about half a beakerful of distilled water; do not add food color to this beaker, yet.

Either using a plastic pipet or by careful pouring, drip the contents of the salt water test tube down the side of the beaker, then answer the questions:

1-1. Where did the salt water go, and what did it do once there?

1-2. What does this suggest to you about the density of salt water versus the density of fresh water?

Clean the area for the next group.

**Station 2 — Hot water versus cold water**
Fill one of the test tubes about half full of cold tap water, and add a drop of food color. Swirl the tube to evenly distribute the color.
Meanwhile, obtain about half a beakerful of the **hottest** tap water you can from the sink in the back of the room; do not add food color to this beaker, yet.

Either using a plastic pipet or by careful pouring, drip the contents of the cold water test tube down the side of the beaker, then answer the questions:

2-1. Where did the cold water go, and what did it do once there?

2-2. What does this suggest to you about the density of cold water versus the density of hot water?

Clean the area for the next group.

**Station 3 — Coke and diet Coke**

Fill the **four-liter beaker** about two-thirds full of water. Carefully place a can of Coke and a can of diet Coke in the water and let go. Answer the questions:

3-1. What did the can of Coke do?

3-2. What did the can of diet Coke do?

3-3. Order the following from **highest** density to **lowest** density: water, Coke, diet Coke.

3-4. Assuming the density of the aluminum can to be negligible and assuming the amount of aspartame in the diet Coke to also be negligible, what does this suggest to you about the **amount of sugar** in Coke?

Clean the area for the next group.

**Station 4 — Calculating density**

Obtain a **copper** cylinder (it’s copper-colored) and an **aluminum** cylinder (it’s silver-colored). Obtain also a **portable scale** and a **graduated cylinder**. Fill in the table below. You will need the formula density = mass/volume. Let the units of each quantity guide how you will measure that quantity. “g” means grams; “mL” means milliliters.
Table 4-1.

<table>
<thead>
<tr>
<th>Cylinder material</th>
<th>Mass of cylinder (g)</th>
<th>Volume of cylinder (mL)</th>
<th>Density of cylinder (g/mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Copper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminum</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4-2. If molten copper and molten aluminum have the same densities are their respective solids, would the aluminum float on the copper or would the aluminum sink under the copper?

4-3. If you had a much bigger aluminum cylinder, would it ever become the same density as the copper cylinder? Give a reason why or why not. (If you don’t believe your answer, there are a couple of different sized aluminum cylinders, so try it and see!)

Clean the area for the next group.

Station 5 — At long last, rocks

Obtain a speckly rock and a black rock; the speckly rock is granite and the black rock is basalt. Granite is what most of a continental plate is made of; basalt is what oceanic plates are made of. The granite rock in front of you has a density of 2.3 g/mL; the basalt rock in front of you has a density of 2.7 g/mL.

5-1. Of course, a tectonic plate is not as small as a rock, so you’ll just have to imagine these rocks growing to thousands of kilometers wide and tens of kilometers thick. What will the density of a continental plate be? What will the density of an oceanic plate be? Hint: this is a trick question and no calculation is needed.

5-2. If a continental plate and an oceanic plate collide with each other, they will not pulverize each other. Instead, what happens? In other words, which plate will end up on top of which other plate? This is called subduction, and a subduction zone is where it happens.
5-3. If an oceanic plate collides with another oceanic plate, subduction will also occur. Hey, wait a minute, aren’t they both the same density, and therefore neither plate should “win” the collision? Well, yes, but... There is an exception to this rule. Give a reason, related to your answer to station 2 (where you had tap water versus tap water), that two colliding oceanic plates can result in subduction.

5-4. When a continental plate collides with another continental plate, instead of subduction, both plates crumple and form tall mountains (like the Himalayas or the Rocky Mountains). This implies that both continental plates were the same density. Wait, how come oceanic plates can be different densities but all continental plates are the same density? What is different about continental plates compared to oceanic plates? Hint: can a continental plate ever “lose” during subduction? What does this imply about the age of the continental plate versus the age of an oceanic plate?