

Ocean Layering: Density, Salinity, Temperature, and Circulation

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Activity: Density Lab

See '01c.handout.densitylab' (<http://earthref.org/cgi-bin/erda.cgi?n=998>)

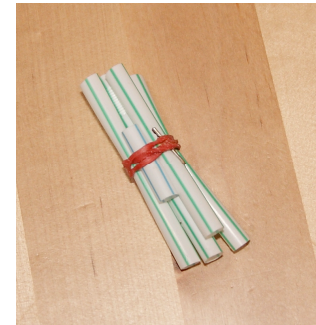
See '01t.handout.densitylab.answers' (<http://earthref.org/cgi-bin/erda.cgi?n=1003>)

Goal:

Students will determine the relationship between salinity and density.

Instructor Prep:

- 1) Gather materials for each group of students
 - 2 containers, 400mL or larger
 - Spoon
 - Salt, ~3Tbsp
 - 1.5 straws
 - 2 metal paperclips
 - String or a rubber band



- 2) Make the straw, paperclip and string into one object (see figure). This requires some experimenting and a little time. Cut one straw into four pieces and tie them together with the string. Make sure it floats in fresh water, if it sinks the string or rubber band is too heavy. Dissolve 2 Tbsp of salt in 2 cups of water. Make sure the paperclip sinks in SALT water. Cut the paperclip in half and add it to the tied straws (just slip it under the string or rubber band). Keep taking parts of the paperclip off until the object just floats in salt water. Or add a short segment of straw until the object just floats in salt water. The object should float in salt water and sink in fresh water. If it floats in fresh water, add more weight (paper clip). Note: try not to squish the straws or air bubbles will get caught inside the straws and make the object float. Remove any air bubbles that are stuck to the string underwater as well.

Left: ½ of a straw with one paperclip. This will sink in fresh and salty water.

Right: Whole straw with rubber band and segment of a paperclip. This will sink in fresh water and float in salty water.

- 3) Make the remaining half straw and paperclip into one object (see figure). Cut the straw in half so you have two quarters of a single straw. Paperclip the pieces of straw together. This object will sink in fresh and salt water.

- 4) Find two other objects for each group. I suggest using one that will float and one that will sink, or something that is hard to guess. Test the objects first if you want to be sure.

Objects that float: some plastic, wood (eg. toothpicks), styrofoam, turnips, apples, diet soda, garlic.

Objects that sink: some plastic (PVC pipe), rocks, paperclips, rubber bands, marbles, carrots, regular soda, metal washers, crayons.

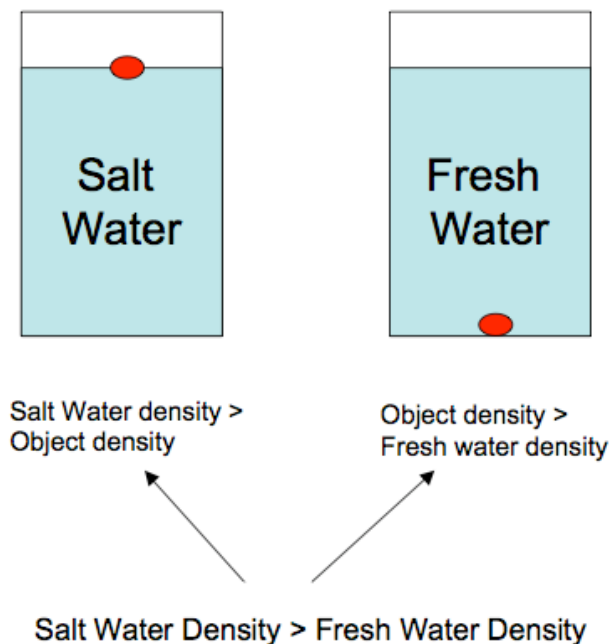
Almost any object can be used. Some, like peanuts and limes, will sometimes sink and sometimes float. That is ok too.

Implementation:

- Before the lab, soak the straw objects with the string. This will help prevent air bubbles from sticking to the string or straws.
- You can measure out the salt for each group, have each group use a specified number of spoonfuls, or have each group weigh out the salt to use. It is okay if they use too much salt, but not okay if they use too little. Their salt concentration should be saltier than the one used to make the straw/paperclip/string objects.
- Have students predict what will happen to the objects before you give out the salt.
- Students will follow the handout from there.

Conclude:

- Ask how many groups found an object that behaved differently in fresh water and in salt water. Go over how you can tell which is denser, fresh water or salt water. Diagram the following:



- If the diagram is confusing to the students, ask them what would happen if you had fresh water, salt water, and the object in the same container. You would have fresh water on top, then the object in the middle, and then salt water on the bottom.
- The main message: adding salinity to water changes its density. More salt makes water more dense. So if there is a fresh water river running out into the ocean, like the Amazon or the Mississippi, will the fresh water stay on the surface or sink to the bottom? It stays on the surface.

Extension:

- Give students some materials, straws, paper clips, toothpicks, etc. and see if they can build an object that sinks in fresh water and floats in salt water.
- Have the students start with the object in fresh water, and observe that it sinks. How much salt do they have to add (# spoonfuls) before the object floats?