Racing grapes, grapefuits and eggs

Duration:
2 hours

Objectives:
Students will:
- Manipulate salinity and determine how it affects density
- Graph the data collected

Vocabulary:
Density
The mass in a given unit of volume; a more dense substance has more molecules in a given area than a less dense one
Salinity
A measure of the amount of salts dissolved in water

British Columbia PLO's:
Science 6, 7, 8
Math 6, 7, 8

Background:
This activity is good for students who are familiar with density and some chemistry, and should be done in the middle of a climate change unit. In this activity students will study density through a series of activities using eggs, grapes, and grapefruits in freshwater and saltwater.

One of the major concerns about climate change is the melting polar ice caps and the subsequent addition of freshwater to the oceans. Many agree that ocean currents will change but there is little consensus as to how. With temperatures rising due to abrupt climate change we are seeing major glaciers are melting worldwide, from Europe to South America.

We have also seen major melting of the Larsen B shelf in Antarctica. In 2002 a major area of the Larsen B shelf lost an area of ice about half the size of Prince Edward Island, 2717 km2, collapsed into the ocean. Between 1997 and 2002 the shelf lost about 60% of its total mass, reaching an all time new low for stable extent of the shelf previously seen.

Scientists also are predicting major melting of the pack ice in Greenland. This could have major impacts on the ecosystems of the area, but what is more highly debated is the affects it will have on the ocean currents of the North Atlantic. There is evidence that a large input of freshwater into the waters around Greenland has lead to major changes in global ocean currents. These changes could alter the climate throughout the Atlantic Ocean that will exacerbate other impacts abrupt climate change may have on the area.

The density of ocean water is dependent on salinity and temperature. This lab allows the students to manipulate the salinity of water and see how its physical properties are affected. This activity mimics how salinity and temperature can affect ocean waters and currents.

Materials:
- Class set of *Ocean News* articles
- Photocopies of the activity worksheet for each student
- Instruction sheet for each station

Grape Races
Grapes
Freshwater
Tank, any size
Salt (lots)
Balance or scale
250 ml graduated cylinder
Stop watch
Spoon
Aluminum foil

Egg Suspension
Hardboiled eggs
3 x 500 ml beakers
Freshwater
Salt (instant ocean!)
Scale

Grapefruit Floating
Tanks (2) – 10 L tanks work well
Freshwater
Seawater or salt
Grapefruit

Procedure:

In Advance: Sort out the equipment needed for each station in separate totes that can be distributed to the students and prepare the hardboiled eggs.

During class:

1. As a class or individually read the *Ocean News* article *Changing Currents.* Discuss any questions or vocabulary.
2. Ask the students to write in their own words how salinity affects density, and how this affects the world's oceans.
3. Set-up the class in three stations (grapes, eggs and grapefruits) for the students to visit. Bring out the totes with the equipment required for each activity.
4. At each station have the students write the following headers in their workbooks: title, hypothesis, results, and discussion questions. This will get them thinking about what might happen before hey begin the experiment.

Grape Races

1. Start with a 250 mL graduated cylinder filled with freshwater.
2. Drop a grape and time how long it takes to sink to the bottom.
3. Remove the grape (to get the grape out, pour the entire contents into a tank, pick out the grape, then carefully put the water back into the cylinder.)
4. Add 2.5 g (2.5 g/250 ml = 10g/ 1000 ml = 10 ppt) of salt, stirring until the salt is dissolved.
5. Race the grape again and record the time (the same grape should be used every time or else variable race times will result).
6. Continue adding 2.5 g of salt (increasing by 10 ppt) to your water sample and record the time it takes the grape to hit the bottom.

Egg Suspension

1. Set-up two large beakers, one with freshwater, one with seawater. If you are doing one station at a time, use the saltiest water from the grape race (the seawater with salt added) because a high salinity level is needed to suspend an egg. Be prepared to add around 200 g of salt.
2. Place the hardboiled egg in the freshwater beaker. The egg should sink.
3. Gently place the egg in seawater. The egg should float.
4. Have the students attempt to float their eggs in the middle of the third beaker. The trick is to gently pour the freshwater on top of the seawater (perhaps use food colouring) so that the egg will sink to the bottom of the freshwater but float on the seawater.

Grapefruit Floating

1. Fill a tank with freshwater.
2. Fill another tank with seawater. You can use seawater or you can use the water from the egg races.
3. Try to float the grapefruit in each of the tanks. What tank does the grapefruit float in? What can you say about the density of grapefruits compared to grapes or eggs?

Wrap-up

1. Collect the data from the whole class. Find the average race time for grapes. Create a chart on the board where the students can write their values. Have the students calculate the average speed of the grapes in different salinities. Graph the rate of the

falling grapes versus the salinity and look for an overall pattern.
2. Ask the students how changing the salinity in the oceans may affect the living organisms there. Have the students re-visit their entries from the beginning of the class and add any ideas they have learned from the activity.
3. Have them brainstorm ideas about how salinity affects organisms reminding them that there are few diadromous fish (fish that can tolerate both freshwater and saltwater i.e. Smelt, Coho salmon and Atlantic salmon).
4. Discuss what challenges these organisms face in changing salinities.

Discussion:

- Why does the grape sink at different rates depending on different amounts of salt?
- Why are all the numbers not identical for each student group? Are there large disparities in time between the groups?
- How high is the salinity in the seawater that eventually floated the egg?
- How does this experiment mimic what may happen in the oceans with global warming melting large glaciers?

Extension and Resources:

- If the students are unfamiliar with density and salinity you can do a quick lesson, a good starting reference is, http://en.wikipedia.org/wiki/Density
- For a challenge, have the students read the paper Rahmstorf, S., 2003, The concept of the thermohaline circulation. *Nature*, **421**, 699. Write a summary paragraph and add new terms to their vocabulary lists.
- The *Changing Densities* worksheet can be given to students at their workstations to help keep them focused.
- Read the Wikipedia entry on the meridional overturning current in the North Atlantic http://en.wikipedia.org/wiki/Thermohaline_circulation