How Do Salinity Differences Influence Density-driven Currents?

In the last investigation, you learned about density and how to calculate the density of different liquids. One of the liquids was tap water, which you found had a density of about 1 g/ml. However, the density of all water is not the same. If you alter its properties—for example, by adding salt, raising, or lowering the temperature—the density of water will change. When waters with different densities encounter each other, they behave in some interesting ways.

In this part of Activity Two, half of the class will investigate how density differences between fresh water and salt water help create density-driven currents. The other half of the class will investigate how density differences between hot water and cold water can help drive density-driven currents. Your teacher will tell you what group you are in.

Materials

Salinity Groups

1 large shatterproof glass container
Water at room temperature
Non-iodized salt
Food coloring
Beam balance
1 beaker (500 ml)
Salinity Record Sheet
Temperature Record Sheet

Predictions

Although you will only do one part of the lab, salinity or temperature, make predictions for both parts. Make sure that the predictions for the salinity lab go on the salinity record sheet and that the predictions for the temperature lab go on the temperature record sheet.

Salinity Group Procedures

All ocean water is salty, but some is saltier than others. How do differences in salinity help drive ocean currents? Today you will try to answer this question.
First you will observe what happens when fresh water is added to fresh water. This is your "control experiment"; it serves as a point of comparison for your saltwater experiment, which comes next. These investigations will help you see what happens when water with different salinities are mixed together, as in the ocean.

The fresh water control

1. Fill your container with room temperature water.
2. Fill a beaker with 250 ml of room temperature water and then add at least 10 drops of food coloring.
3. Pour some of the colored water very slowly along the inside wall of the container. Only a small stream of water should enter the container at any given time.
4. As you pour, observe what happens as the colored water enters the water in the container. Pay attention to both the vertical and horizontal movement of the added water.

5. After two minutes, write your observations in the data table on your record sheet.

The salt water experiment

1. Empty your container and refill it with room-temperature water.
2. Fill a beaker with 250 ml of room temperature water. Measure out at least 10 grams of salt and add it to the water, then stir until all the salt has dissolved. You will probably have to stir vigorously. Add enough food coloring to make the water very dark (at least 10 drops).
3. Pour some of the salty water very slowly along the inside wall of the container. Once again, only a small stream of water should enter the container at any given time.
4. As you pour, observe what happens as the colored water enters the water in the container. Pay attention to both the vertical and horizontal movement of the salt water.
5. After two minutes, write your observations in the data table.
6. Choose one member in your group to share data with the temperature group. When this member returns, copy the temperature data onto your student record sheet.

Temperature Group Procedures

Some ocean water is cold and some is warm. How do differences in water temperature help drive ocean currents? Today you will try to answer this question.

In this investigation, you will add food coloring to water. First you will add cold food coloring, then you will repeat the experiment using hot food coloring. The food coloring will help you see how liquids of different temperatures move in relation to each other, as in the ocean. As you do this lab, keep in mind that room-temperature food coloring has approximately the same density as room-temperature water.

Temperature Groups

1 large shatterproof glass container
2 beakers, (500 ml)
Food coloring
Water at room temperature
Hot water
Cold water
Salinity Record Sheet
Temperature Record Sheet

Adding cold water

1. Fill your container with room-temperature water.
2. Fill a beaker with 250 ml of cold water and then add at least 10 drops of food coloring.
3. Pour some of the colored water very slowly along the inside wall of the container. Only a small stream of water should enter the container at any given time.
4. As you pour, observe what happens as the cold water enters the water in the container. Pay attention to both the vertical and horizontal movement of the added water.
5. After two minutes, write your observations in the data table.

Adding hot water

1. Empty your container and refill it with room-temperature water .
2. Ask your teacher to fill the second beaker with 250 ml of hot water. Add at least 10 drops of food coloring.
3. Pour some of the colored water very slowly along the inside wall of the container. Only a small stream of water should enter the container at any given time.
4. As you pour, observe what happens as the hot water enters the water in the container. Pay attention to both the vertical and horizontal movement of the added water.
5. After two minutes, write your observations in the data table.
6. Choose one member in your group to share data with the salinity group. When this member returns, copy the salinity data onto your student record sheet.

How Do Salinity Differences Influence Density-driven Currents? Record Sheet

Exploration questions

What happens when you add fresh water to fresh water?
What happens when you add salt water to fresh water?

Prediction and explanation

1. When you add fresh water to fresh water, what do you think will happen? Do you think it will move vertically? Horizontally? Explain your reasoning.

2. When you add salt water to fresh water, what do you think will happen? Do you think it will move vertically? Horizontally? Explain your reasoning.

Data

	Draw the water's path	Direction of vertical movement, if any	Speed of vertical movement, if any	Direction of horizontal movement, if any	Speed of horizontal movement, if any
Fresh water to fresh water					
Salt water to fresh water					

Questions

1. Were your predictions correct? If they were not, explain why you might have been wrong.
2. What are your results? What do they have to do with density?

3. The Amazon River contains fresh water, traveling to the east coast of Brazil before emptying into the Atlantic Ocean. What do you think happens to this fresh water as it enters the Atlantic Ocean? Why?

How Do Temperature Differences Influence Density-driven Currents? Record Sheet

Exploration questions

What will happen when cold food coloring is added to room temperature water?
What will happen when hot food coloring is added to room temperature water?

Prediction and explanation

1. When you add cold food coloring to room temperature water, what do you think will happen? Do you think it will move vertically? Horizontally? Explain your reasoning.

2. When you add hot food coloring to room temperature water, what do you think will happen? Do you think it will move vertically? Horizontally? Explain your reasoning.

Data

	Draw the water's path	Direction of vertical movement, if any	Speed of vertical movement, if any	Direction of horizontal movement, if any	Speed of horizontal movement, if any
Cold water to room-temperature water					
Hot water to room-temperature water					

Questions

1. Were your predictions correct? If they were not, explain why you might have been wrong.
2. What are your results? What do they have to do with density?
3. Water in the Gulf Stream moves from the warm tropics to the cold region of northern England. What do you think happens to the Gulf Stream waters, now called the North Atlantic Current waters, as they move into the Greenland Sea and are cooled? Why?