Modeling Water Masses

The water in the oceans is layered because water masses with higher densities sink below those with lower densities. The density of seawater depends on its temperature and salinity. In this activity, you’ll model different types of water masses to observe the effects of density firsthand.

Preparation

Problem
Determine how changes in salinity and temperature affect water density.

Materials
- scale
- graduated 500-mL cylinder
- 100-mL glass beakers (4)
- water
- red, yellow, and blue food coloring
- salt
- thermometer
- eyedropper
- graph paper
- pencil
- ruler
- calculator

Objectives

In this GeoLab you will:
- Predict the arrangement of layers in a body of water.
- Construct and interpret a temperature profile.

Safety Precautions
Always wear safety goggles and an apron in the lab. Wash your hands after completing the lab.
Procedure

1. Mix 200 mL of water and 7.5 g of salt in the graduated cylinder. Pour equal amounts of the salt solution into two beakers. Fill each of the two other beakers with 100 mL of freshwater.
2. Put a few drops of red food coloring in one of the salt solutions. Put a few drops of yellow food coloring in the other salt solution. Put a few drops of blue food coloring in one of the beakers of freshwater. Do not add food coloring to the other beaker of freshwater.
3. Place the beakers with the red salt solution and the blue freshwater in the refrigerator. Refrigerate them for 30 minutes.
4. Measure and record the temperature of the water in all four beakers.
5. Put several drops of the cold, red saltwater into the beaker with the warm, yellow saltwater and observe what happens. Record your observations.
6. Put several drops of the cold, blue freshwater into the beaker with the warm, clear freshwater and observe what happens. Record your observations.
7. Put several drops of the cold, blue freshwater into the beaker with the warm, yellow saltwater and observe what happens. Record your observations.

Analyze

1. In your science journal, describe the movement of the cold, red saltwater in step 5. Compare this to the movement of the cold, blue freshwater in step 7. What accounts for the differences you observed?
2. Based on your observations, list the water samples by color in order of increasing density.
3. If you poured the four water samples into the graduated cylinder, how would they arrange themselves into layers by color, from top to bottom?

Conclude & Apply

1. Assume that four water masses in a large body of water have the same characteristics as the water in the four beakers. The warm water layers are 100 m thick, and the cold layers are 1000 m thick. Graph the temperature profile of the large body of water.
2. What is the salinity in parts per thousand of the combined saline solutions? (Hint: ppt equals grams of salt per kilogram of solution. Assume that 200 mL of water has a mass of 200 g. Be sure to include the mass of the salt in the total mass of the solution.)
3. The temperature profile on the opposite page was constructed from measurements taken in the Atlantic Ocean off the coast of Spain. Study the profile, then infer why a high-temperature layer exists beneath the thermocline. Is this layer denser than the colder water above? Explain.