Name _____ Class _____ Date _____

Exploration Lab

OBSERVATION

Identifying Ocean Factors

Each year, the water at some locations in the ocean "turns over." That is, water from the ocean depths rises nearer the surface, and water from the top sinks to the bottom. This exchange brings fresh nutrients from the bottom of the ocean to the free-swimming organisms living near the ocean's surface. In other parts of the ocean, the water never "turns over." This activity will help you understand why.

Two important characteristics of ocean water are its temperature and its salinity, or "saltiness." You will investigate how these factors help determine the density of seawater, and how water density controls the vertical movement and circulation of ocean waters.

OBJECTIVES

Model the turning over of ocean water.

Predict factors that would influence the temperature and salinity of ocean water.

Compare the lab model to ocean phenomenon.

MATERIALS

- beaker, 200 mL (5)
- blue and red food color
- hot plate
- heat-resistant gloves
- ice
- masking tape
- plastic container
- plastic wrap, approximately 30 cm × 20 cm (4 sheets)
- salt
- stirring rod
- tablespoon
- tap water
- tweezers
- watch or clock

Procedure

PART I—PREPARE THE BEAKERS

1. Label the beakers from 1 through 5. Fill beakers 1 through 4 with tap water. Add a drop of blue food coloring to the water in beakers 1 and 2. Stir.
2. Add a drop of red food coloring to beakers 3 and 4. Stir.

3. Fill a plastic container with ice and water. Place beaker 1 in the ice bath for 10 minutes. Set beaker 3 on a hot plate turned to a low setting for 10 minutes.
4. Add one rounded spoonful of salt to beaker 4. Stir to dissolve the salt completely.

PART II—MIX THE WATERS

5. Pour half the blue water from beaker 1 into beaker 5. Return beaker 1 to the ice bath. Carefully place a sheet of plastic wrap into beaker 5. The plastic should rest on the surface of the water and line the upper half of the beaker.
6. Put on your gloves and protective eyewear. Slowly pour half the warm, red water from beaker 3 into the lined upper half of beaker 5 to form two layers. Return beaker 3 to the hot plate. Remove your gloves.
7. Very carefully use tweezers to gently pull one edge of the plastic wrap and remove the plastic by sliding it parallel between the two layers of water so that the heated water rests above the cold water. **CAUTION: The plastic wrap may be warm.**
8. Wait about 5 minutes, and then observe the two layers of water in beaker 5. Did one layer of water remain resting on top of the other? Was there any mixing or "turning over?" Record your observations in the Data Table. Empty beaker 5 and rinse it with clean water.

DATA TABLE: OCEAN MODEL OBSERVATIONS

Mixture of water	Observations
Warm water placed above cold water	
Cold water placed above warm water	
Salty water placed above fresh water	
Fresh water above salty water	

9. Repeat steps 5–8, this time with warm, red water from beaker 3 on the bottom and cold, blue water from beaker 1 on the top. Remember to wear gloves and eye protection when pouring the water. Record your observations.
10. Again repeat steps 5–8, this time with blue water from beaker 2 on the bottom and red, salty water from beaker 4 on top. Record what happens.
11. Repeat steps 7–10 a third time, this time with red, salty water from beaker 4 on the bottom and blue water from beaker 2 on the top. Record your observations.

Analysis

1. **Interpreting Information** What is the effect of temperature and salinity on the density of water?

2. **Explaining Events** Compare the results of the four trials. Explain why the water turned over in some of the trials but not in all of them.

Conclusions

3. **Making Predictions** What factors would make the temperature of ocean water decrease? What could make the salinity of ocean water change?

4. **Applying Conclusions** What explanations can you give for the fact that some parts of the ocean turn over in the spring, while others do not?

5. **Evaluating Models** How is the model you used in this lab similar to or different from what happens in nature?

Extension

1. **Designing Experiments** Suggest a method for modeling the combined effects of temperature and salinity on the density of water. Present your proposal to your teacher and then try it out.

2. **Research and Communications** The upward motion of colder, deeper masses of water from the ocean bottom due to density variations is also known as upwelling. Find out how this motion plays a role in the complex ocean food cycle. Report your findings to the class.