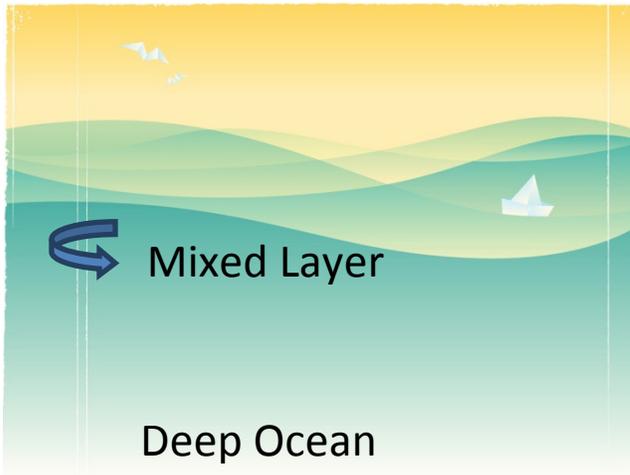


Name: \_\_\_\_\_

## Density and Stratification



### Background Information:

The temperature and salinity of water affects its density and the way it interacts with other water masses. Water with lower salinity or higher temperature is less dense and will float on top of water with high salinity or lower temperature. The layered water is “stratified” and the interface between layers may act as a barrier to prevent organisms from traveling between layers. Stratification also acts to prevent

mixing between layers, resulting in a surface layer that is typically well mixed while the bottom layer is more resistant to mixing. In this experiment, you will examine the interaction between cold salt water (high salinity, low temperature) and warm fresh water (low salinity, high temperature).

### Materials and Equipment:

- Glass or plastic tank(s) or tub
- Empty 2-liter bottle (e.g. soda / pop bottle) with small hole cut in bottom
- Cold, saturated salt water
- Very warm tap water
- Food coloring
- Duct tape
- Ruler (optional)
- Colored pencils

### Methods:

1. Add warm tap water to the tank to form a layer 8-10 cm (3-4 in) thick. Add some red food coloring to the water and mix thoroughly.
2. Add some food coloring (blue preferred) to the cold salt water. Cover the hole in the bottom of the soda bottle with duct tape and fill the bottle with the blue water. Place the bottle upright into the tank. Remove the duct tape from the hole at the bottom, allowing the salty water to slowly enter the bottom of the tank until a second layer 3-4 inches thick appears.

3. When you have added the salt water remove the bottle very slowly to minimize mixing. Let the tank sit without touching it for two minutes to stabilize. Avoid knocking the table to prevent mixing the layers.
4. Slowly lift one end of the tank until the water level almost reaches the top of the tank. Support the end of the tank with books.
5. Slowly and carefully set down the tank. Look closely at the waves between the fresh and salty water.
6. Let the tank settle until the water has formed layers again. With your hand, brush the surface layer of water in one direction (away from the edge of the tank) continuously for about 1 minute and skim water from the surface using a plastic cup.

**Analysis:**

The water forms layers because the densities between the water masses are different due to temperature and salinity. Density is a function of mass (or weight):

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

The same way that disturbed sediment will form layers based on weight (for example, larger sand particles will form the bottom layer), water masses will form layers based on weight. The temperature and amount of salt in water determines its density. Cold, salty water has more mass per volume, therefore greater density, and will sink to the bottom. These dynamics are important, for example:

1. In estuaries, fresh water from rivers and creeks meets salt water from the ocean. The fresh water tends to float above the salt water until it is mixed by wind or water currents. The stratification of fresh water and salt water affects the way organisms and sediments are distributed.
2. Changes in water density in the ocean contribute to the formation of ocean currents that can impact weather patterns. As water becomes warmer, it is less salty and will rise to the surface. Cold salty water will then move in to fill the void left by the warm water. This movement creates a current, or “thermohaline” circulation, that moves a river of water throughout the world’s oceans.

**Questions:**

1. Which layer is less dense?
2. Based on your observations, (a) how would you expect an influx of fresh water from a heavy rainstorm to affect life in a salt-water environment like the

Delaware Estuary? (b) would you expect life at the bottom to be more or less affected by an influx of fresh water compared to life at the surface? (c) would it matter if the bottom was in a shallow area or in deep water? Why?

a)

b)

c)

3. Repeat this experiment using less water and compare the results to your answer for part c in Question 2. How are the results similar to, or different from what you expected?

4. Would you expect to see organisms that can't tolerate both fresh and salt water (a) in shallow areas? (b) in deep areas? Why?

a)

b)

**Extra Reading:**

<http://centerforoceansolutions.org/climate/impacts/ocean-warming/water-column-stratafi/>

<http://geography.about.com/od/physicalgeography/a/oceancurrents.htm>

*Online videos:*

[http://www.youtube.com/watch?v=4\\_TQCiOQkio&feature=related](http://www.youtube.com/watch?v=4_TQCiOQkio&feature=related)

<http://www.youtube.com/watch?v=C5hTZSh1GtQ>

<http://www.youtube.com/watch?v=PCOL8kUtufg&feature=related>