

Marine Science: Introduction to Density Lab

Name: _____

Question: *Is all ocean water the same consistency? Does water have the same amount of salt and/or temperature throughout?*

Background Information: **Stratification** of ocean water is a naturally occurring phenomenon that is important to the *structure, circulation and productivity* of the oceans. The formation of **vertical stratification in the water column** is a consequence of water masses with different densities. Water density is strongly influenced by **temperature and salinity**; with **less dense, warmer surface waters floating on top of denser, colder waters**. The boundary between the warmer and cold waters is called the thermocline.

Water is unable to *passively (without help)* mix across the thermocline, but **wind, upwelling, down-welling and storms** help move water across the boundary. For example, winter storms create turbulent mixing between water layers. Mixing is critical for ecosystem productivity *because it brings nutrients to the surface and brings oxygen to deeper waters*. During springtime warming, the waters stratify, trapping phytoplankton near the surface, resulting in a spring bloom in the nutrient rich water. The spring bloom in turn provides food for many marine animals and plays an important role in the global carbon cycle.

While stratification of the water column is important, ***prolonged or strengthened stratification*** can have negative impacts. As

the temperature of coastal waters increase, the thermocline becomes a more powerful boundary, making it more difficult for the nutrient rich waters to reach the surface. This potential reduction in upwelling and mixing can result in local or widespread biomass loss and changes in species composition. Between 1951 and 1993 zooplankton biomass

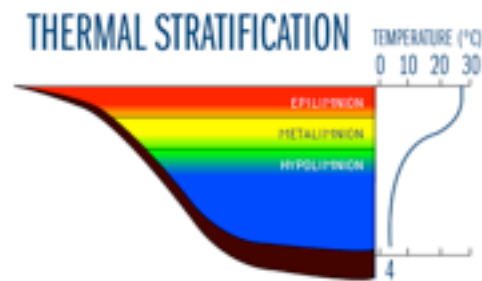


Figure 4

off Southern California decreased by 80% as a result of warming surface waters. In some areas the water temperature rose by 1.5oC and restricted coastal upwelling and nutrient availability.

Lesson Objective:

*After completing this laboratory activity, students will be able to explain how density differences affect **stratification**, some causes for stratification, and how mixing affects a water column with different density properties.*

Materials:

Two 250 ml beakers, one 500 ml beaker

Electronic Scale

Glass stirring rod, spon

Pickling Salt, Water Samples (warm and cold), and food coloring (yellow and blue)

ipad (to take photos for your report!)

Procedures:

Part 1: *What is the density?*

1: **Mass** each empty 250 ml beaker. Record the weight of the beaker below: **(in grams)**

Beaker # 1: _____ **Beaker # 2:** _____

2: Measure 250 ml of “cold” water and place into Beaker #1 and 250 ml the of “warm” water in Beaker #2.

3: To the “cold beaker” (Beaker #1), add 20g of salt and 5 drops of blue food coloring. *Use the stirring rod to stir the solution until the salt has fully dissolved.*

4: Add 5 drops of yellow food coloring to the warm, fresh water (Beaker # 2)

5: **Mass** each beaker PLUS water and record the **new mass** below:

Beaker # 1: _____ **Beaker # 2:** _____

6: Calculate the **mass, volume and density** of the water in each beaker.

Remember: Density = Mass / Volume

| | Cold, Salty Water | Warm, Fresh Water |
|-----------------------|--------------------------|--------------------------|
| Mass (g) | | |
| Volume (ml) | | |
| Density (g/ml) | | |

Part 2: Try It Out!

1: Pour the warm, fresh water (Beaker #1) into the 500 ml beaker and place the beaker on the table. Let the water settle until the surface has stopped moving.

2: **Carefully** add the cold, salt water. **Important: Use the spoon to break the fall of the liquid into the 500 ml beaker by placing the spoon at the top of the water in the 500 ml beaker and gently pouring the cold water from the 250 ml beaker onto the spoon.**

3: Allow the layers to settle for 2-3 minutes.

Part 3: Observations

1: Explain what you observe in the 500 ml beaker. Include a **diagram and vocabulary** in your explanation.

2: Carefully tilt the beaker (*do not spill any liquid!*) and hold it at a tilt for 15 seconds. Then gently (but quickly) place the beaker back on the table and observe what happens to the layers. **Write a few sentences about what you observed.**

Part 4: The Big Picture

The ocean has more than just two layers, and sometimes they are not so clearly defined. *Do you think you could create a third layer in your beaker? How?*

1: *What color* do you expect the third layer to be?

2: *Where* do you think the third layer will be formed?

3: Using the information from the density you calculated earlier, *what density do you expect this third layer might be?*

Try it out! (Hint: Use the glass rod very carefully)

1: If you managed to create the 3rd layer, explain how you completed this task.

Lesson Review:

1: What is thermal **stratification** of the oceans and WHY does it occur?

2: What is the name of this **temperature stratification**?

3: Describe a reason why thermal stratification of the ocean would be important or significant.