

The Varying Density of Sea Water

Based on <http://www.maine.gov/doc/nrmmc/mgs/education/lessons/act37.htm>

Focus on Inquiry

The student will collect and analyze data to determine the effects of temperature and dissolved on sea water.

Lesson Overview

This activity demonstrates to students how water temperature and the concentration of dissolved and suspended solids affect the density of sea water. Surface waves from the winds and the influence of tides notwithstanding, the great majority of ocean currents are controlled by the varying densities of sea water.

Duration 50 minutes	Setting Lab or classroom	Grouping 3-4 students per group	PTI Inquiry Subskills 1.3, 2.6, 3.1, 3.2, 3.5, 3.7, 4.3, 4.4, 5.2, 5.4, 7.2, 7.3
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Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	5 min	1.3, 5.2, 5.4	none	2,3	Students observe and explain the difference between a diet Coke can and a regular Coke can floating in water.
Explore	20 min	1.3, 2.6, 3.1, 3.2, 3.5, 3.7, 4.3, 4.4	none	3	Students complete four guided inquiry activities on varying solutions of salt water and varying temperatures of water and record their data on a lab report.
Explain	15 min	5.2, 5.4, 7.3	none	3	Students answer analysis questions on their lab report and come up with a group definition of density and the variables that affect density. A class definition follows relating how each of the four activities provided insight for the definition.
Expand	5 min	7.2	none	2	Students revisit the Engage activity and relate their observations to what they now know about density.
Evaluate	5 min	n/a	none	n/a	Teacher developed rubric for prompt question, data collection, and discussion.

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

National Science Education Standards – Inquiry

Develop description, explanations, predictions and models using evidence.



National Science Education Standards – Earth Science

The sun is the major source of energy for phenomena on the earth's surface, such as growth of plants, winds, ocean currents, and the water cycle. Seasons result from variations in the amount of the sun's energy hitting the surface, due to the tilt of the earth's rotation on its axis and the length of day.

Louisiana Grade Level Expectations – Inquiry

- Gr. 8, Inquiry GLE #5 – Identify independent variables, dependent variables, and variables that should be controlled in designing an experiment (SI-M-A2)
- Gr. 8, Inquiry GLE #6 – Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3)
- Gr. 8, Inquiry GLE#12 – Use data and information gathered to develop an explanation of experimental results (SI-M-A4)
- Gr. 8, Inquiry GLE#22 – Use evidence and observations to explain and communicate the results of investigations (SI-M-A7)



Louisiana Grade Level Expectations Earth Science

- Gr. 8, GLE#10 – Illustrate the movement of convection currents (ESS-M-A2)

Materials List (per group)

- Three 8-ounce capacity paper or plastic cups
- Stop watch or a clock or watch with a second hand
- a 25-ml graduated cylinder
- two 100-ml graduated cylinders
- ice-cold water
- red, blue, and yellow food color
- 125 ml of mineral oil
- 60 ml of tap water
- ½ teaspoon (2.5 ml) measuring spoon (1 spoon)
- 1 medicine dropper
- clay
- 10 grams of salt.

Advance Preparation

1. Obtain materials listed in the materials list and prepare set up.
2. Make copies of Blackline Master 1 (attached).

Other Information

Learning Objective

The learner will...

- identify how density of sea water is controlled by temperature and the amount of dissolved salts present in the water.

Prior Knowledge Needed by the Students

none

Procedure

Engage

1. Set up an aquarium with tap water. Have on hand a can of coke and a can of diet coke. Have the students predict what will happen when the can drinks are dropped into the aquarium. Accept all answers.
2. Drop the can drinks in the water.
3. Have the students explain why the diet coke stays suspended in the water and why the coke sank to the bottom of the tank. Accept and record all answers on the blackboard. Revisit after completing activity.

Explore/Explain:

1. Allow students time to complete activity as outlined on **Blackline Master 1**. Have students record their data and answers to the questions on the worksheet as they complete the activity.

Explain:

1. Students should come up with a group definition for density and the three things that affect density based on the results of through four guided inquiry activities. Each group of students should write their group definition on a sheet of newsprint or 11x17" paper, and on a second sheet of paper, list how the three things affect density. These should be posted.
2. Read all the definitions and come up with a class definition of density, recalling how each of the four activities provided insight into the definition.

Expand/Elaborate:

1. Revisit **Engage** section of the lesson and have students revise their first predications and conclusions.
2. Have students relate the floating/sinking Coke cans to the density activity and provide an explanation for this discrepant event.

Evaluate:

1. Have the students write a paragraph to answer the following prompt.
Assume that the rainfall decreases significantly for several years, but that evaporation continues to take place at its normal rate. What would be the effect of this situation on the salinity of the ocean?
2. Student worksheets can be graded for accuracy and completeness.



Blackline Master

1. The Varying Density of Sea Water.

Supplementary Resources

The Varying Density of Sea Water

<http://www.maine.gov/doc/nrimc/mgs/education/lessons/act37.htm>

This site contains background information on causes of ocean currents and reasons for different density.

The Temperature of Ocean Water

<http://www.windows.ucar.edu/tour/link=/earth/Water/temp.html&edu=high>

Contains background information on ocean temperatures and salinity.

Name: _____ Date: _____ Class Hour: _____

The Varying Density of Sea Water

Problem/Purpose: How is the density of seawater controlled by temperature and the amount of dissolved salts present in the water?

Hypothesis: _____

Materials: _____



Procedure:

Part I

1. Label the three plastic cups A, B, C.
2. Using the 25-ml graduated cylinder, measure and pour 20 ml of tap water at room temperature (21 degrees C) into each of the cups.
3. To cup A, add 5 ml (1 level teaspoon) salt and two drops blue food color.
4. To the cup labeled B, add 2.5 ml (1/2 level teaspoon) salt and two drops of yellow food color.
5. Add two drops of red food color to cup C (no salt added).
6. Stir all three cups until all salt is dissolved and the food color is evenly mixed in the water.
7. Put 100 ml of mineral oil into one of the 100-ml graduated cylinder.
8. Using the medicine dropper, squeeze out one drop of water from cup A just beneath the surface of the mineral oil. Make certain that the tip of the medicine dropper is just below the surface before squeezing out the drops. Using the stopwatch, measure the amount of time (in seconds) it takes one blue drop to sink from the 100 ml mark to the 5 ml mark.
9. Record this value in the data table below.
10. Repeat steps 8 and 9 again with a second drop from cup A. (Note: You will record the time for two drops from each cup and get an average time.)
11. Repeat steps 8-10, but this time using two drops of water from cup B. Don't pour the oil out. You can use the same oil for this step.
12. Repeat steps 8-10, but this time using two drops of water from cup C. Don't pour the oil out. You can use the same oil for this step.
13. Finally, record the average time for each cup in the data table below.

Data table:

	Cup A 1 teaspoon NaCl (salt)	Cup B ½ teaspoon NaCl (salt)	Cup C No NaCl (salt)
Time for drop #1			
Time for drop #2			
Average time			

Analyze your Data from Part I:

1. Which drops sank fastest? _____
2. Which drops sank slowest? _____
3. Explain why the drops sank at different rates: _____

Blackline Master 1 – page 2

Part II

1. Pour 20 ml of mineral oil from the 100 ml graduated cylinder into the second (empty) 100 ml graduated cylinder.
2. To this second cylinder, with 20 ml of mineral oil in it, add the following. Holding the cylinder at a slant, slowly pour the water from cup A into the mineral oil. After the blue water has settled to the bottom, slowly pour the water from cup B into the mineral oil. After it settles, slowly pour the water from cup C into the cylinder. Return the cylinder to an upright position; sketch and label what you observe in the cylinder in the space below.

Part III

1. Wash the cup labeled C. Fill the cup 2/3 full of hot tap water. Put 25 ml of ice-cold water into the 25 ml graduated cylinder, and add three drops of blue food coloring. Using the medicine dropper, squeeze two drops of cold blue water beneath the surface of the hot water in the cup. Make certain that the tip of the medicine dropper is below the surface of the water before squeezing out the drops. Describe what happens:

Part IV

1. Wash out one of the 100 ml graduated cylinders.
2. Put about 70 ml of water into the 100 ml graduated cylinder.
3. Make a thick suspension of clay and water by mixing 5 ml of dry clay into 20 ml of water in a cup. Mix the clay and water well. Without delay, slowly pour the muddy water suspension into the clear water. Describe what happens:

ANALYZE YOUR OBSERVATION DATA and DRAW CONCLUSIONS

1. Based on your observation, define density.

2. List three factors that can affect the density of water.
 - a.

 - b.

 - c.

3. Explain how each factor listed in Question #2 above affects the density of seawater.
 - a.

 - b.

 - c.
