

Propensity for Density

Subject: Physical Science

Grade Level: 4-8

Rationale or Purpose: This activity explores water chemistry and density

Materials for one small lab group:

- Table salt (1/4 cup)
- Liquid measuring cup
- 2 cups water
- 2 clear 500mL beakers
- 1 eye dropper
- food coloring
- 2 eggs

Lesson Duration: 20-30 minutes; additional discussion of ocean water properties is encouraged

Objectives:

4th Grade Science 112.6

- (1A) demonstrate safe practices during field and laboratory investigations
- (2A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology
- (2B) collect data by observing and measuring
- (2C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence
- (2D) communicate valid conclusions
- (3A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information
- (3B) draw inferences based on data related to promotional materials for products and services
- (4A) collect, analyze, and record information using tools
- (7B) conduct tests, compare data, and draw conclusions about physical properties of matter including states of matter, conduction, density, and buoyancy

5th Grade Science 112.7

- (1A) demonstrate safe practices during field and laboratory investigations
- (2A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology
- (2B) collect data by observing and measuring
- (2C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence
- (2D) communicate valid conclusions
- (3A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information
- (3B) draw inferences based on data related to promotional materials for products and services
- (4A) collect, analyze, and record information using tools

6th Grade Science 112.22

- (1A) demonstrate safe practices during field and laboratory investigations
- (2A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology
- (2B) collect data by observing and measuring
- (2C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence
- (2D) communicate valid conclusions
- (3A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information
- (3B) draw inferences based on data related to promotional materials for products and services
- (4A) collect, analyze, and record information using tools

7th Grade Science 112.23

- (1A) demonstrate safe practices during field and laboratory investigations
- (2A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology
- (2B) collect data by observing and measuring
- (2C) organize, analyze, make inferences, and predict trends from direct and indirect evidence
- (2D) communicate valid conclusions
- (3A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information
- (3B) draw inferences based on data related to promotional materials for products and services
- (3C) represent the natural world using models and identify their limitations
- (4A) collect, analyze, and record information to explain a phenomenon using tools
- (4B) collect and analyze information to recognize patterns such as rates of change

8th Grade Science 112.24

- (1A) demonstrate safe practices during field and laboratory investigations
- (2A) plan and implement investigative procedures including asking questions, formulating testable hypotheses, and selecting and using equipment and technology
- (2B) collect data by observing and measuring
- (2C) organize, analyze, make inferences, and predict trends from direct and indirect evidence
- (2D) communicate valid conclusions
- (3A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information
- (3B) draw inferences based on data related to promotional materials for products and services
- (3C) represent the natural world using models and identify their limitations
- (4A) collect, analyze, and record information to explain a phenomenon using tools
- (4B) extrapolate from collected information to make predictions

112.42. Integrated Physics and Chemistry

- (7A) investigate and identify properties of fluids including density, viscosity, and buoyancy

112.49. Geology, Meteorology, and Oceanography

- (11A) identify physical characteristics of ocean water including salinity, solubility, heat capacity, colligative properties, and density

Background Information:

How is water density determined? Water density can be defined as the “weight of water [mass] divided by the amount of space it occupies.”¹ Three properties work together to determine water density: pressure, salinity, and temperature. For example: cold, saltwater is much denser than warm fresh water. This means that cold saltwater would sink below the less dense layers.

Ocean waters are typically made up of three density layers: the surface (mixed) zone, the transition zone (pycnocline), and the deep (aphotic) zone, which represents the densest zone. Coral reefs typically grow in clear, warm, shallow tropical zones of ocean waters.

Average ocean water salinity is about 35 parts per thousand (ppt). Freshwater is typically less dense at less than 0.5 ppt. Waters that range between 0.5 ppt and 17 ppt are called “brackish.” An estuary is an example of brackish water.¹

Activity:

Which is Denser: Saltwater or Freshwater?

1. Fill one 500mL beaker with 1 cup of water
2. Place one egg into the water beaker. What happens? Set aside after writing down observations.
3. Fill the second 500mL beaker with 1 cup water. Add ¼ cup salt and stir until dissolved.
4. Add a few drops of food coloring to the saltwater beaker. Let sit for 5 minutes. Now, very carefully, using the eyedropper, add a layer of freshwater to the ‘top’ of the colored salt water (You are creating a sort of pycnocline, and the colored saltwater helps you see the less dense, clear freshwater “floating” on top).
5. Carefully place the egg into the beaker. What happens? Observe and diagram the results.
6. Compare how the 2 eggs floated or sank differently in the 2 beakers. What does this tell you about differing densities of fresh vs. saltwater? Why does the egg react differently in these 2 types of water?

****Do you want to find out more about our ocean waters? Check out the National Oceanic and Atmospheric Administration, <http://www.noaa.gov/>**

¹ Office of Naval research, Science and Technology focus,
<http://www.onr.navy.mil/focus/ocean/water/density1.htm>