

PSI:

PHYSICAL SCIENCE INVESTIGATION



Teacher's Lesson Description

Title	Red, Wet, and Blue
Brief Description of Videos	In these videos, students will watch as Danté releases individual containers of cold water and hot water into an aquarium of room temperature water. The layers form and demonstrate to the students that colder water sinks and warmer water float.
Time Needed	2 class periods
Ohio Science Benchmarks Addressed	Earth and Space Sciences, 6-8 Benchmark C, and E Physical Science, 6-8 Benchmarks A and D Science Inquiry, 6-8 Benchmark A Science Ways of Knowing, 6-8 Benchmarks A and C
Ohio Grade Level Indicators Addressed	Earth and Space Sciences Benchmark C <ul style="list-style-type: none">• 7th Grade Weather Indicators 1, 3, 5, 7, 8, and 9 Earth and Space Science Benchmark E <ul style="list-style-type: none">• 8th Grade E Earth Systems Indicators 9, 10, 12 and 13 Physical Science Benchmark A <ul style="list-style-type: none">• 7th Grade Nature of Matter Indicator 1 Physical Science Benchmark D <ul style="list-style-type: none">• 7th Grade Nature of Energy Indicators 2, 3, and 4 Science Inquiry Benchmark A <ul style="list-style-type: none">• 7th Grade Doing Scientific Inquiry Indicators 1, 2, and 3 Science Inquiry Benchmark B <ul style="list-style-type: none">• 6th Grade Doing Scientific Inquiry Indicators 3 and 4 Science Ways of Knowing Benchmark A <ul style="list-style-type: none">• 8th Grade Nature of Science Indicator 1 Science Ways of Knowing Benchmark C

	<ul style="list-style-type: none"> • 6th Grade Science and Society Indicators 3, 4 and 5 • 7th Grade Science and Society Indicator 3
Concepts Developed	<p>Students will be able to explain that:</p> <ul style="list-style-type: none"> • Air has mass and volume. • Temperature affects the volume of air. • Increased temperature increases the space that a gas takes up or its volume. • Density of a substance is mass (g) divided by volume (mL or cm³). • When the volume of a given mass changes, its density changes. • Increased volume = decreased density • Decreased volume = increased density • Warm and cold air sink and float in the same way as warm and cold water •
Lesson Rationale	<p>Most students are familiar with hot air balloons and helium balloons. They know that both “float” in air. To dispel the myth that these objects are lighter than air, students have the opportunity to hold the mass constant on a water balloon, change its temperature and change the ability of an object to sink or float. Understanding this concept is critical as students begin to do in depth studies of weather, plate tectonics, etc.</p>
Background Knowledge for Teachers	<p>Review the “teacher video” segment and student video segments.</p> <ul style="list-style-type: none"> • Air has mass. • Air has volume. • The volume of air is affected by temperature. Increasing temperature increases volume. Decreasing temperature decreases volume. • Density is the relationship between mass and volume. It is calculated by dividing the mass by the volume and is recorded as g/cm³. • When the density of the object is greater than the density of the substance into which it is placed, the object sinks.

	<ul style="list-style-type: none"> • When the density of the object is less than the density of the substance into which it is placed, the object floats. • When the density of the object is equal to the density of the substance into which it is placed, the object subsurface floats. • An object immersed in a fluid (Gases and liquids are both considered fluids.) experiences an upward force called buoyant force. • Buoyant force opposes the gravitational force. • Buoyant forces of air cause it to move in a circular motion known as a convection current • Convection currents are involved in small-scale weather like thunderstorms and large-scale weather like desert areas and tropical region formations.
Classroom Procedures	<p>Students will watch the videos and record all observations and predictions as requested in the stopped segments. To reinforce these concepts, complete the “Balloons in Water” laboratory either as a teacher demonstration or as independent laboratory.</p> <p style="text-align: center;">Balloons in Water</p> <p>Problem: Does the temperature of the water inside the balloon affect the sinking of the balloon in cold water, tap water, and hot water? How does temperature affect density?</p> <p>Background knowledge:</p> <ul style="list-style-type: none"> • Density is the relationship between mass and volume. Density is calculated by dividing the mass by the volume and is recorded as g/cm^3. For example a 500 gram mass that occupies 200 cm^3 of volume has a density of 2.5 g/cm^3. A 100 gram mass that occupies 1000 cm^3 of volume has a density of 0.10 g/cm^3. • When the density of the object is greater than the density of the substance into which it is placed, the object sinks. • When the density of the object is less than the density of the substance into which it is placed, the object floats.

- When the density of the object is equal to the density of the substance into which it is placed, the object subsurface floats.

Hypothesis:

Using the table below students should predict what might happen when the cold water balloon is placed in the cold water bath, etc.

<u><i>PREDICT</i></u>	COLD WATER BATH	TAP WATER BATH	WARM WATER BATH
COLD WATER BALLOON			
TAP WATER BALLOON			
WARM WATER BATH			

Procedure:

1. Tie a 6” string to the neck of each balloon so that you can lift and place balloons without handling them. Place water balloons with string attached into each of 3 containers. One with ice water, one with tap water, and one with hot water.
2. Fill a 1 liter beaker with ice water. One at a time, place a balloon into the beaker. Record your observations. (DO NOT KEEP A BALLOON IN THE WATER BATH FOR MORE THAN 20 TO 30 SECONDS. IF YOU DO, THE HEAT BEGINS TO TRANSFER BETWEEN THE BATH AND BALLOON.)
3. Repeat step 2 using a tap water beaker and then a hot water beaker.

Data Collection:

Students will record their observations on the data table below.

<u>OBSERVE</u>	COLD WATER BATH	TAP WATER BATH	WARM WATER BATH
COLD WATER BALLOON	subsurface	sink	float
TAP WATER BALLOON	float	subsurface	sink
WARM WATER BATH	sink	float	subsurface

Conclusions:

Students should be able to discuss the relationship of temperature to sinking and floating.

- If the temperature of the balloon is the same as the temperature of the bath, the balloon subsurface floats.
- If the temperature of the balloon is lower than the temperature of the bath, the balloon sinks.
- If the temperature of the balloon is higher than the temperature of the bath, the balloon floats.

Materials Needed

Balloons in Water

	<ul style="list-style-type: none"> • Water balloons (be sure no air bubbles are in the balloon) • String • Ice • Heat source • 1 liter (or larger) beakers for observing sinking or floating. A fish aquarium or 2-liter pop bottles (with tops cut off to make a tall cylinder) will serve as a good substitute for the beakers.
Science Connections	<p>Concepts of density and buoyancy in water are connected to swimming, fishes' use of air bladders, operation of submarines, rafts and boats, sinking and floating in general, convection currents that move matter because of differences in temperature.</p>
Additional Web Resources	<p>Ohio State University WOW Project: Making Density Bottles http://wow.osu.edu/experiments/statesofmatter/psm2/densbot.html</p> <p>Teacher's Domain: Mixing Hot and Cold Water http://www.teachersdomain.org/resources/phy03/sci/phys/descwrlld/zhot/index.html</p> <p>Intel Education: Gas Density http://www97.intel.com/en/ProjectDesign/UnitPlanIndex/GotGas/</p> <p>Search for more Web pages related to this topic at the Ohio Resource Center http://www.ohiorc.org/for/science/Default.aspx</p> <p>Classroom Safety: http://membership.acs.org/c/ccs/pubs/chemical_safety_manual.pdf</p> <p>Search the National Science Digital Library: http://nsdl.org/</p> <p>Find more science teaching lessons at Teacher's Domain: http://www.teachersdomain.org/</p>

Ohio Science Standards Abbreviations:

ES – Earth/Space Science

SI – Scientific Inquiry

LS – Life Sciences

ST – Science and Technology

PS – Physical Sciences

SW – Scientific Ways of Knowing