PSI: PHYSICAL SCIENCE INVESTIGATION

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GREAT LAKES Science Center

Teacher's Lesson Description

Title	**What Does It Matter?**
Brief Description of Videos	Dante breaks a candle into pieces and uses a large piece and a small piece to place into two beakers of clear liquid. He asks whether the candle pieces will float or sink. Will it sink because it is too heavy or float because it is light? The larger one floats and the smaller one sinks. Then the pieces are dropped again in the opposite beakers and the smaller one floats and the larger one sinks. The beakers contain water (high relative density) and isopropyl alcohol (low relative density) which vary in density. The sinking or floating is due to the densities of the liquids compared to the density of the candle; not because of the weight, or heaviness, of the candle pieces.
Time Needed	1-2 periods of laboratory time is used to repeat the demonstrations or have the students carry out the experiments.
Ohio Science Benchmarks Addressed	Earth and Space Sciences Grade 6-8 Benchmark E Physical Sciences Grade 6-8 Benchmark A
Ohio Grade Level Indicators Addressed	Grade 8 Earth/Space Indicator 9 Grade 6 Physical Science Indicator 1
Concepts Developed	Density is a property of all states of matter; solids, liquids, and gases Units are used when describing density: g/cm3 or g/ml mass expressed in grams ; volume expressed in cubic centimeters or milliliters (usually for liquids or gases)

	Relative density of matter
Lesson Rationale	Physical science involves understanding the basic properties of matter. Density is such a property. Weight or mass only take one aspect of **density** into account and many natural processes can be better understood by realizing that the density of any object is a ratio, or comparison, of its **mass** in grams to its **volume** in cubic centimeters, or for liquids, in milliliters. Densities of objects can be compared to determine how density contributes to predicting and understanding phenomena.
Background Knowledge for Teachers	Density is a measure of the compactness of a material – How much "stuff" is packed within a given space. When we feel the weight of an object we might have some sense of its density, too. Students often make connections between weight and density, but may have misconceptions, or have not made a distinction between the differences between weight and density. (Think about the old brain teaser – "which is heavier, a pound of lead or a pound of feathers?" This problem takes advantage of a very common partial understanding of density.) We should see the role of density (less dense than the medium, it floats and more dense than the medium, it sinks) in such things as helium balloons, floating birds and boats, sinking metal tools, floating sticks, the ability of fish to swim at different water depths, and even things like whether it is easier or harder to hit a baseball or golf ball. The arrangement of some of Earth's rock layers - especially igneous rocks (many of which seem quite "light" - is better grasped (lower layers, greater density and upper layers, lesser density) with a better understanding of density. Oil slicks and floating seeds on water, as well as other flotsam we might find on the surface of lakes or streams, screams DENSITY! Air and its convection currents can be better understood if we understand how heated air has a lower density than (and rises above) cooler air. Daily upward air currents occur over land, where the air gets hotter than it does over water. When air or any object heats up, the particles move/vibrate more rapidly and take up more space or volume. Mathematically, the density of air and water decreases. This is actually true for nearly all phases of matter, with only a few special exceptions, like the density of ice (solid water). Identification of rocks, minerals and metals can be facilitated by understanding density and knowing or researching some accepted values for the density of elements or compounds in grams per cubic centimeter. Panning for gold is a real activity, and one that can be more understandable, with this property in mind. In fact many manufacturing processes make use of materials' properties of density to separate and manipulate one product from others.

Classroom Procedures	Prior to classroom viewing, teachers should look at all of the "What Does It Matter" segments- both teacher and student videos, and should plan for how they will fit into classroom instruction. Introduce and view the student segments in the classroom, pausing whenever Dante poses questions for discussion. Try to get students involved in a dialogue about what they know or think about density, and have them suggest other situations where the density of objects is relevant (see Background For Teachers above). Secure some of the materials, similar to those used in the video or those listed below, to allow students to calculate density by manipulating the objects and using measurements of their own. Show how to measure volume of an irregularly shaped object by displacement of water in a graduated cylinder or by capturing overflow from a full beaker into a graduate. *Resource- Measuring the Volume by Displacement of Water:* *http://ch185.semo.edu/comp2obj/comp2obj.html* One milliliter is equal to one cubic centimeter (and for water the mass is one gram). You may want to have students practice by predicting what they might observe, or the results they might obtain, before doing the activity. You can duplicate the demonstration of the candles in water and isopropyl alcohol to firm up the concept of relative densities. Density Columns: If the liquids are available, predict the resulting order of colors first, and then pour them into a narrow beaker or graduate and see how they stack up according to relative densities. A good density column can be produced with water, many dishwashing liquids (usually more dense than water), alcohol colored with food coloring, and baby oil or mineral oil (which doesn't mix well with food coloring, so it is best to leave them "clear").
Materials Needed	Candles for breaking into pieces, water, isopropyl alcohol. Graduated cylinders or narrow beakers, Dawn dishwashing liquid-blue, water dyed yellow with food coloring, isopropyl alcohol dyed red, baby oil-clear.
Science Connections	Discussions should include devices and situations where density plays a role: life jackets or other flotation devices, barrels under rafts in swimming areas, the Goodyear blimp or other blimps seen at sporting events, placement of hot air vents near the floor for heat to rise naturally and cold air

	vents near the floor for natural convection down to the furnace for reheating, the use of ballast or air in boats and submarines, or the manipulation of temperature and air density in hot air balloons.
Additional Web Resources	Suite101.com- Density of Objects: Critical Thinking in Action http://teachertipstraining.suite101.com/article.cfm/density_of_objects_critical_thinking_in_action Teacher's Domain Video- Density and Buoyancy: Testing Liquids http://www.teachersdomain.org/resource/phy03.sci.phys.matter.zoil/ Visionlearning - Density http://www.visionlearning.com/library/module_viewer.php?mid=37 Science Education Resource Center at Carleton College- How do I calculate density? http://serc.carleton.edu/mathyouneed/densityexpl.html

Ohio Science Standards Abbreviations:

ES – Earth/Space Science	LS – Life Sciences	PS – Physical Sciences
SI – Scientific Inquiry	ST – Science and Technology	SW – Scientific Ways of Knowing