611-2125 (45-060)

What is Density Kit

Including magic-dough lab & density identification set

Warranty and Parts:

We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

P/N 24-45060

What is Density?
Teacher Pages

Benchmarks and Standards

These activities were formulated to fulfill the following recommendations of the Benchmarks for Science Literacy and the National Science Education Standards shown below.

Benchmarks for Science Literacy	*National Science Education Standards*
The Physical Setting (4D.2) Heating and cooling cause changes in the properties of materials,	**Unifying Concepts and Processes Constancy, Change and Measurement -** Changes might occur in properties of materials. Changes vary in rate, scale, and pattern, including trends and cycles.
The Physical Setting (4D.3) Equal volumes of different substances have different weights (densities).	**Content Standards:** **Science as Inquiry (A) -** Thinking critically and logically to make the relationships between evidence and explanations. **Physical Science (B) -** Properties and Changes of Matter: A substance has characteristic properties such as density, a boiling point, and solubility, all of which are independent of the amount of the sample.
The Physical Setting (4D.3) Increased temperature means greater average energy of motion, so most substances expand when heated.	
The Nature of Science (1B.3) Scientific investigations usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected evidence.	

Background on Density

Density is a term often misused and misunderstood by people of all ages. It is such an abstract concept that some scientists try to avoid talking about it altogether. Density is actually defined as follows by Webster's dictionary online (http://www.webster-dictionary.org/definition/density Accessed 28 August 2005):

n. 1. The quality of being dense, close, or thick; compactness; - opposed to rarity.

2. *(Physics)* The ratio of mass or quantity of matter, to bulk or volume. especialy as compared with the mass and volume of a portion of some substance used as a standard.

3. *(Photog.)* Depth of shade.

The first definition is an easy way to describe density in everyday terms; the quality of "compactness". Definition #2 above is the one we will be discussing here. Most students, when asked what density is, regurgitate the formula for determining density (density = mass/volume); they do not know what it means. They are not aware that density describes how tightly packed the matter (or "stuff") is in a substance. This kit was designed to allow students to discover what density really is, how they can apply it to real-life situations and how to change the density of a substance. Also, this kit includes a 12 piece Density Identification set to introduce the formula for calculating density. This kit is aimed at getting students to understand what density is, and then how to calculate its numeric value.

Before They Begin

The magic dough lab is meant to demonstrate density across different phases of matter. The foam pieces between the balls of dough represent space between molecules, and thus a less densely packed particle. This activity is best used as an inquiry-based activity where students have NOT been formally introduced to the concept (and especially the formula) of density. Be certain to stress the importance of DENSITY on floating or sinking, NOT WEIGHT. Often these two terms are used interchangeably, when in fact, they are quite different. Here our two "substances" will have the same mass (weight on earth), and they will only be comparing substances with differing volumes. Students should read the procedure before they begin. It is especially important that they only put the "substances" into the water for a moment, so as not to ruin the magic-dough for future use.

Extensions of this Activity

Teachers can vary any of the "crystal shapes" by changing the angles of the toothpicks or having the dough balls link up differently. Use this activity as a starting point for student understanding of sinking vs. floating — test LOTS of objects and have students re-iterate that it is the object's DENSITY which causes it to sink or float (not just its weight). After this activity, you can introduce the formula for density by. There are two ways to determine volume for use in the density calculation — mathematically finding the volume of a regularly-shaped object (for a cube or rectangular object, volume = length x width x height of the object) and displacement, which is adding the object to a known volume of water and finding the difference. (Example — you put 5OmL water in a graduated cylinder and add a rock. The rock sinks and the volume of the cylinder rises to 53.6mL. The volume of the rock is 3.6mL or 53.6-5OmL). For irregularly shaped objects, you must use displacement but be careful not to use objects like Styrofoam, which float completely, otherwise you will have to submerge them with a pencil or other small object. As a wrap-up kinesthetic activity, you can arrange students in rows of various spacing (shoulders touching, arms linked, hands out to side touching) and ask them to describe the differences between the rows. You may also wish to use this activity as a springboard for the different states of matter or crystalline structure.

Assessment

There should be a class discussion at the end of this activity to address the Challenge questions. It is important to teach (especially to middle and high school students) that the size of the sample of material doesn't matter. If a small piece floats, so will a big piece of the same material. Collect and score Student Journal Pages as you like.

Answers to Think It Over questions

1. a) the second and third substances (cubes)
   b) a gas, liquid, or solid
   c) Density increases as the space between the balls decreases. (Inverse relationship)
2. a) The cubes were representations of phases of matter
   b) The objects which were less dense tended to float. (If the density of the object is less than the density of water it will float.)
3. Students should communicate that density is a measure of the closeness of particles and the NOT the weight of an object.
4. Answers will vary and give you a direction for the wrap-up discussion.
5. Gases are less dense than their solids and liquids.
6. Fish live in the water and could get frozen solid, crushed or die if an entire pond froze where they live.
8. Design a cube using 1/2 of the materials, and show that the proportion that floats is the same as that of the larger cube

What is Density?
Student Instructions

Name _____ Date_____

Class _____

Objectives

- To create models of a substance in different phases.
- To test these models for "sinkability" and "floatability".
- To relate sinking and floating to density.

Materials

Tray filled with 6 inches of water
One can of Magic-dough
12 toothpicks
24 pieces of foam squares
Paper towels
Student Journal Page

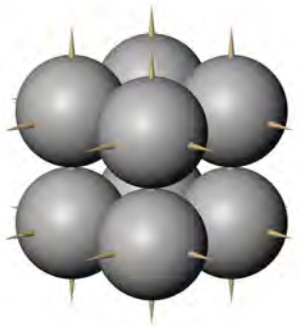
Background

Density is a term that describes how closely-packed the particles are. Usually, density is used to compare two substances — one substance is less dense than the other. In this investigation, we will compare the overall density of our substance to the density of water. The less dense substance will rise to the top. This is because the less dense substance has more space between the particles for the other substance to fit through.

Procedure

Part I - Making A Model of a Solid

1. Form the magic-dough into 8 3/4 inch balls.
2. Connect all the balls to each other using the toothpicks to make a cube like so:

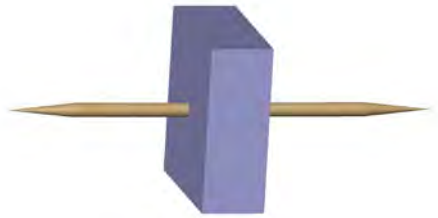


This substance represents a solid.

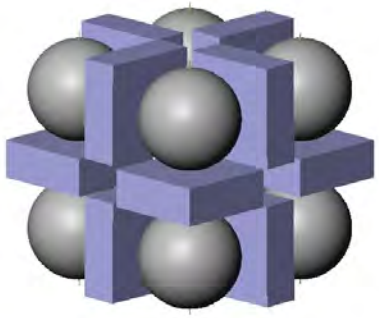
3. Place the cube into the tub of water and observe its position in the water. (Does it float, sink, sink ¼ of the way, sit half-way in the water, etc.)
Remove the cube from the water and pat dry with paper towels. Describe and draw a picture of the substance's position on your Journal Page.

Part 2 — Changing the spacing of the particles in the substance

1. Take your model apart, remove the toothpicks but keep the balls intact. One group member can re-shape the balls of dough, making sure they are the proper size.
2. Push the tooth picks through the center of 12 of the foam squares.



3. Add the balls to the ends of the toothpicks, and assemble into a cube as in the diagram.

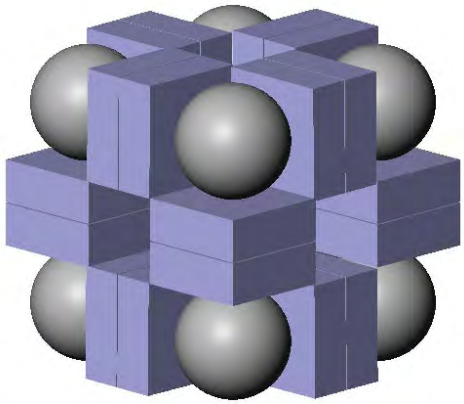


Notice that the particles (balls) have now become spread farther apart. The substance is now LESS DENSE or less tightly packed.
4. Make a hypothesis (guess) about where the cube will sit in the water. Record your hypothesis under the chart on your Journal Page.
5. Place the cube in the tub of water and note its position in the water. Be sure to only put the substance into the water for a moment, then pat dry with paper towels. Record this observation on your Journal Page by drawing a picture of the water and the cube.

Part 3 — Increasing the spacing of the particles in the substance

1. Take your model apart, this time remove the balls but keep the toothpick and foam intact. One group member can re-shape the balls of dough, making sure they are the proper size.
2. Add a second foam square to each of the tooth picks.

3. Add the balls to the ends of the toothpicks, and assemble into a cube as in the diagram.



Notice that the particles (balls) have now become spread even farther apart. The substance is now LESS DENSE or less tightly packed than before (in part 2).

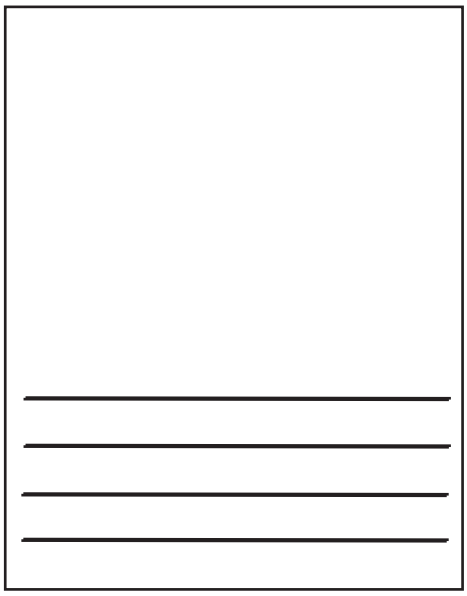
4. Make a hypothesis (guess) about where the cube will sit in the water. Record your hypothesis under the chart on your Journal Page.
5. Place the cube in the tub of water and note its position in the water. Be sure to only put the substance into the water for a moment, then pat dry with paper towels. Record this observation on your Journal Page by drawing a picture of the water and the cube.
6. Clean up your work area and answer the "Think It Over" Questions on your Journal Page.

What is Density?
Student Journal Pages

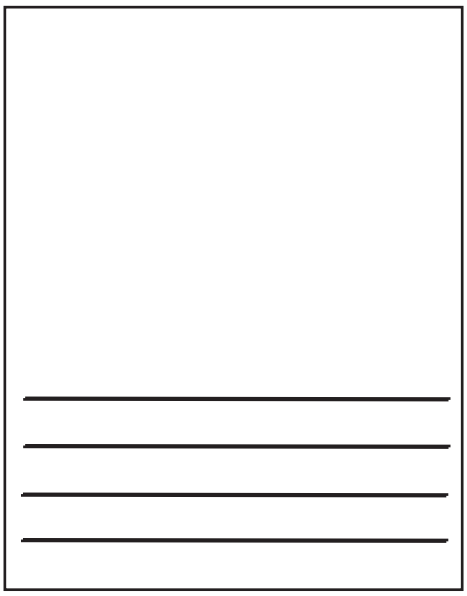
Name _____ Date_____

Class _____

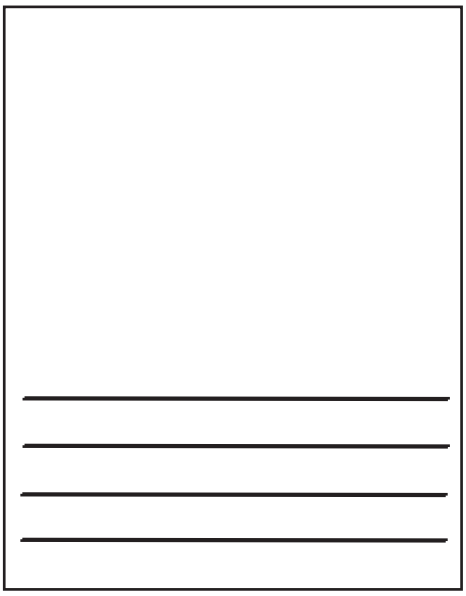
Directions: Record your observations of the cubes in water. Draw AND describe the substance's position in the water (sinks to bottom, floats completely, partially underwater— how much? 1/2? 1/5? etc.)



Solid model from part 1



Liquid model from part 2



Gas model from part 3

Hypothesis - Will the smaller more compact cube sink or float? _____

Think It Over

3. In your own words, what is density? _____

_____

_____

4. What are some questions that you still have about density? _____

_____

_____

CHALLENGE

NOTES: