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COMMUNITY RESOURCES FOR SCIENCE

BASIS Lesson Plan

Lesson Name:

Making Sense of What's Dense

Grade Level Connection(s):

NGSS Standards: Grade 2, Physical Science
FOSS CA Edition: Grade 2 Physical Science: Solids and Liquids Module

**Note to teachers: Detailed standards connections can be found at the end of this lesson plan.*

Teaser/Overview

Students will explore the concepts of density, mass, and weight through interactive demonstrations and hands-on activities. They will learn why objects sink or float, construct rainbow sucrose density gradients, and watch as "elephant toothpaste" foams up in front of them.

Lesson Objectives

- *Students will learn to identify the relative density of objects based on whether they float or sink in water*
- *Students will understand how multiple layers can remain separated based on density*
- *Students will be able to discern between mass and weight*
- *Students will be able to distinguish between reversible and irreversible processes*

Vocabulary Words

- Matter: A physical substance that makes up the world around us
- Density: How tightly or loosely packed an object is
- Mass: A measure of the amount of matter an object contains
- Weight: A measure of gravity's pull on an object
- Gradient: An increase or decrease in a property between two points

Materials

Scientist Volunteers will bring:

Item	Use	Quantity	Price
Water bottles Test tubes Plastic transfer pipetters (3 mL) Sugar	Sucrose gradients / reuse Consumable	20 5 50 -	Free Free $20 $4 / 4 lb
Clear storage bin (31 quarts) Golf ball Ping-pong ball Rock Pumice Coke Diet coke	Float vs. sink activity / reuse	1 1 1 1 1 1 1	$28.00 Free except purchase pumice $6.00
100 mL plastic graduated cylinder Tray (storage bin cover) PPE (Nitrile glasses, gloves, goggles) Scale	Elephant's toothpaste / reuse	1 1 ~ 2 sets 1	$6.33 Included w/ bin Free $14.00
Food coloring Liquid detergent 30% hydrogen peroxide Saturated solution of potassium iodide	Elephant's toothpaste / consumables	~ 3 drops 3 mL 10 mL 5 mL	$3.50 / 4 vials $3.00 / 1 L $8.34 / 500 mL $32 / 100 g

Classroom Set-Up

A demonstration table is needed in the front and center of the classroom, preferably adjacent to a chalk/white board with chalk or markers. We will start the discussion with the whole class, but please have the students divided into four smaller groups to facilitate small group activities after the introduction. Nametags are helpful for calling on students.

Classroom Visit

1. Introduction (10 minutes)

Role Model Introductions: Introduce ourselves, talk a little about what is a graduate student, what is a scientist, what kind of research do we do, what grade are we in?

Topic Introduction: Density is a measure of how tightly packed the molecules are in an object, and objects separate based on density, with higher density objects at the bottom.

- What is mass? Versus weight?
    - You are the same mass on the moon but different weight
- What is heavier, a pound of feathers or a pound of bricks? (Raise hands to answer)
    - Describe difference between weight and density
- In terms of molecules, what is density?
    - Draw a pictures on whiteboards with dots

2. Learning Experience (35 minutes)

Lesson agenda

1. Group demonstration on density—will it float?
2. Breakout group activity: Sucrose Density Gradients
3. "Quiz": Which is more dense?
4. Group demonstration: Elephant's Toothpaste

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1. Group Density Demonstration

Compare the floating and sinking of different objects in a clear plastic bin filled with water:

- ping pong ball vs. golf ball
- rock vs. pumice
- coke vs. diet coke, etc.

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2. Breakout Group Activity Sucrose Density Gradients

Prep before lesson:

- 4 concentrations of sugar divided into 5 groups
    - Bottle 1: no sugar- red food dye
    - Bottle 2: ⅓ saturated solution- yellow food dye
    - Bottle 3: ⅔ saturated solution- green food dye
    - Bottle 4: saturated sugar solution (could even supersaturate as well to make it easier)- blue food dye
    - Tape pictures of sugar to water ratio in each bottle

Outline of activity:

- Experiment: Create density gradients, starting with the most dense - what happens? What would happen if we put the more dense sugar after the less dense sugar? Result is that the more dense solution falls to the bottom, mixing the dye and turning the whole thing brown.
    a. Split up into groups of 4-6 students with one teacher
    b. Give each student a color and decide who has the most dense liquid to go first
    c. Take turns adding each color into the test tube
    d. One rainbow per group

- Discussion: What happens if we shake the bottle? Everything will mix together and turn brown - why? What will happen if we let this sit for a long time? It will eventually turn brown. Why? Because the sugar will slowly diffuse down and mix together. If we used oil instead of sugar, would it eventually mix as well? Why?

- Discussion: Reiterate observations about density. Ask students "how might we make a rainbow using sugar water with different densities?" Explain how the four bottles of clear sugar have different amounts of sugar. "Which one do you think is more dense? Which one would sink? What color do we want at the bottom of the rainbow? Should we put the more dense solution in first or second? What will happen if we put it in the other way?"

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3. Quiz: Which is more dense?

In small groups, go through the printed PowerPoint quiz: First have the students think about the question on their own, then choose answer 1, 2, or 3, then go over the answers together and reiterate key points on density, mass, and matter.

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4. Final Activity: Elephant's toothpaste

a) Dress up in PPE and explain the importance of safety in science
b) Set up elephant toothpaste experiment on top of weight scale
c) Let the students observe what happens when we add the active ingredient
d) Discussion: What happens when something goes from being more dense to less dense? Notice how the mass/ weight on the scale doesn't change
e) Discussion: Do you think this reaction is reversible? Why or why not?

3. Wrap Up: Review and Discuss the Learning Experience (10 minutes)

We will reconvene at the end of the Elephant Toothpaste experiment to discuss what we've learned

- Can anyone explain to me what density is?
- What did we decide earlier - is there more mass in a pound of bricks or a pound of feathers?
- What is more dense - a ping pong ball or a golf ball?
- When we made a rainbow, what color was on the bottom? Was this the most dense or least dense?

4. Connections & Close (5 minutes)

Connections to the real world around students:
Connections to the real world around students: Why do things sink or float? Try using our vocabulary words to justify. If possible, tie lesson back into your research or role model story.

- Ask students if they have any questions about science or being a scientist
- Close with a goodbye and a thank you, and encourage the kids to keep thinking about density observations they see around them every day!
- Don't forget to help clean up!

Close:

Wrap up as a role model by leaving a few minutes for students to ask questions about science, about being a scientist, and about becoming a scientist. Then, thanks and goodbye!

Follow Up: After the Presentation

Teachers who wish to extend the impact of this lesson may find the following CRS web pages useful:

- http://www.crscience.org/educators/helpfulreports
- http://www.crscience.org/educators/treasuretrove

Standards Connections

NGSS:

- Connections by topic
  - Physical Science: 2. Structure and Properties of Matter
- Connections by disciplinary core ideas
  - Physical Science: 2-PS1. Matter and Its Interactions
- Connections by scientific & engineering practices
  - 1. Asking questions and defining problems
  - 3. Planning and carrying out investigations
  - 4. Analyzing and interpreting data
  - 6. Constructing explanations and designing solutions
- Connections by crosscutting concepts
  - 1. Patterns
  - 2. Cause and effect: Mechanism and explanation
  - 3. Scale, proportion, and quantity
- Connections by performance expectation
  - 2-PS1-1. Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
  - 2-PS1-2. Analyze data obtained from testing different materials to determine which materials have the properties that are best suited for an intended purpose.
  - 2-PS1-4. Construct an argument with evidence that some changes caused by heating or cooling can be reversed and some cannot.