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Which Takes up more Space?



Concepts: Changes in states of matter through sublimation

National Science Standards:

A	B	C	D	E	F	G

Background: There is a variety ways that matter can be used to demonstrate comparative volumes of the three most common types of matter: solid, liquid, and gas. Dry ice is an easily obtainable type of matter that goes from the solid state directly to the gaseous state. This process is called sublimation. This may be a new concept or vocabulary word for many who do this experiment. Dry ice should be wrapped in newspaper, then stored in a Styrofoam™ cooler. Purchase about a pound to allow for sublimation.

Objective: Students will be able to observe changes in states of matter in relation to the amount of space they occupy.

Suggested grade levels: 3-6

Estimated time:

- Teacher prep: 10-15 minutes
- Activity: 20-30 minutes

Materials needed:

- dry ice (approximately 1 pound)
- gloves, mittens, or insulated tongs
- large balloons
- GOGGLES
- funnels
- hammer
- newspaper
- cooler

Safety/Disposal: Because the temperature of dry ice is -78°C (about -110°F), caution is necessary as students will be burned if skin comes into contact with dry ice. Use gloves or insulated tongs at all times and dispose of in the sink when through.

Procedure:

1. Generate discussion about states of matter and the amount of space each takes up. Possibly show a beaker filled with sand or BBs, a beaker filled with water and an empty beaker filled with air. Does each of these occupy the same amount of space?
2. Introduce dry ice, including all safety recommendations. Using gloves and a hammer, break the dry ice into small pieces. Students should observe the immediate sublimation of dry ice
3. Attach the balloon to a wide-mouthed funnel, and using tongs or gloved hand place several pieces of dry ice into a funnel and stuff them down into the balloon with a Popsicle stick. Students may tie the balloon. Remember never to touch the dry ice.
4. Students' verbal, written, or pictorial observations should be recorded
5. At this time students may experiment with variables such as shaking, amount of dry ice inserted into balloon, tying balloon, etc.
6. Students should record results and complete lab sheet.
7. It is a good idea to make a hole in each balloon during cleanup to prevent any unexpected popping of the balloons.

Wrap-up:

- Students should be able to conclude that matter in the gaseous state takes up a larger amount of space than a solid or liquid.

Extension:

- See page 3.

Resources:

This activity is based upon a presentation given at the MATR Institute by Dr. Steve Wright, University of Wisconsin- Stevens Point chemistry professor and MATR safety coordinator.

Which Takes up more Space? Extension

Extensions:

- Use freeze pops to show solid going to liquid.
- Make ice cream to demonstrate liquid going to a solid.

“Bag Lady” Ice Cream

1-1/3 cups sugar	2 egg yolks
1 tablespoon cornstarch	1(5.33 oz.) can evaporated milk
1/4 teaspoon salt	1 cup whipping cream
3 cups whole milk	1 tablespoon vanilla extract

In a medium saucepan, combine sugar, cornstarch and salt. Stir in whole milk. Stir over medium heat until mixture begins to simmer. Simmer 1 minute over low heat; set aside. In small bowl, lightly beat

egg yolks. Stir about 1 cup milk mixture into egg yolk mixture; stir egg yolk mixture into remaining milk mixture. Cook and stir over low heat 2 minutes or until slightly thickened. Stir in evaporated milk, whipping cream and vanilla. Cool to room temperature. Pour into ice cream canister and freeze in ice cream maker as instructed.

Science Room Fun:

Place 1/2 cup of the cooled ice cream mixture into a snack-sized Ziploc™ baggie.

In a quart sized baggie , mix 6:1 ratio of ice to rock salt.

Place the ice cream mixture in snack-sized baggie into the quart baggie of rock salt and ice.

Shake, rattle and roll the bag. Playing catch is a fun way to do this, but be sure that the bag is sealed to avoid spills.

You may have to go through a second round of ice to set the ice cream. Ice cream will have a texture like “soft serve.”

Sprinkle with M&Ms, chocolate, or whatever, and enjoy.

Caution: Because these bags get very cold, you may want to have some gloves, mittens, paper towels, or pot holders available for the students.

Resources:

Thematic unit on Ice Cream by Teacher Created Materials

Aldo Ice Cream by Joanna Hurwitz

Ice Cream by Stella Keller

Sources for dry ice:

Animal and people hospitals, grocery stores, soda distributors, liquor stores, or any source for picnic-type supplies.

Sources of rock salt:

Any hardware supply store.