**Uncommon Properties Among Common Materials**

**Teacher Notes**

In this investigation, students will assemble the components of a could chamber and observe evidence of ionizing radiation, first that occurring from our natural sources in our environment; then from common items known to emit other forms of ionizing radiation. Trails visible from ionizing particles streaming across the base of the cloud chamber in **Part 1** may consist of muons (created when high energy protons from outer space interact with molecules in our atmosphere) and/or typically alpha and beta radiation from surrounding sources (building materials, radon gas, or traces from components of tables, chairs, etc.).

The items placed in the chamber in **Part 2** will show evidence of ionizing radiation (typically alpha and beta particles), the trails (clouds) from which are made visible by the condensation of the saturated vapor along the base of the chamber. The clouds will only form where the vapor reaches levels of saturation, in the 1 – 1 ½ cm above the base.

**Helpful Hints**

* The bed of dry ice must (1) as **flat** as possible; (2) **high enough** to be above the rim of the Styrofoam box; (3) **small enough pieces** to provide good contact with the metal base.
* The binder clips are helpful for the initial handling of the chamber assembly, but are not essential once the top is removed to insert the radioactive items. The box may just be placed in position for convenience.
* Please do not re-pack the components of the chamber assemblies wet and cold. Let them equilibrate to room temperature and dry them before wrapping and organizing them for return. Dry the boxes and plates with a paper towel.
* As time passes, you may notice a diminished efficiency of the working of the chamber. This generally due to loss of the density/temperature gradient of the alcohol vapor inside the chamber. This can be alleviated somewhat by warming the top of the chamber withy your hands, or even using a hair dryer briefly across the top of the plastic box.
* The cloud trails will be most visible by holding the Maglite at a low angle directly across and parallel to the bottom metal plate.

**Teacher Notes**

**Sources for Dry Ice**

These suggested sources for dry ice are not all-inclusive, but represent the kinds of sources you may be able to seek out. Typically welding supply and compressed gas dealers are good places to start. Some grocery/department stores may also be providers. Buying pellets will save from breaking up large blocks and give a more uniform layer.

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|  | Lake County area | Lafayette area | Indianapolis area |
| Praxair | 166 E State Rd 130, Hobart(219) 942-2195M-F 7:30-5:00 | 2655 Teal Rd.Lafayette(765) 447-8171M-F 8:00-5:00 |  |
| Indiana Oxygen |  | 3407 Rascal Dr.Lafayette, 47909(765) 494 7095M-F 7-5 (blocks, chunks) |  |
| Linde / BOC Gases |  | 400 E Pike St., Crawfordsville(765) 362-8502 |  |
| Continental Carbonic Products |  |  | 4140 Cashard Ave.Indianapolis, 46203(317) 784 3311M-F 7:00-4:00 (block, pellets) |
| Sutton Garten |  |  | 901 N. Senate Ave.Indianapolis, 46202(317) 264 3236M-F 7:30-5:00 (block, pellets) |
| Home City Ice |  |  | 3602 W. Washington St.Indianapolis 46241(317) 247 6757 (10 lb blocks)7 days 8:00-4:00 |
| Home City Ice |  |  | 2000 MLK Jr. St.Indianapolis, 46202(317) 921 6670 (10 lb blocks)7 days 8:00-4:00 |
| Meier Stores |  |  |  |

**Uncommon Properties Among Common Materials**

Properties of matter are those characteristics, features and behaviors that can often be used to, identify, describe and compare materials. Some properties, for example density, elasticity, conductivity, or hardness can be easily observed and even quantified with measurement. Other properties are less obvious – even surprising – and relate to phenomena more outside our daily experiences. In this investigation, you will try to identify and describe some phenomena related to some familiar objects and materials.

**Objectives**

* Explain how surroundings can be created to reveal phenomena that are otherwise invisible.
* Create models to describe and explain your observations.
* Classify the phenomena you observe to one or more of several categories.

**Materials and Supplies**

|  |  |  |
| --- | --- | --- |
| The kit | Accessories | Goodies |
| Plastic box with felt strips inside | Hammer | Brazil Nuts |
| Black metal plate | Gloves | Pieces of Fiesta pottery |
| Styrofoam tray | Terrycloth towel | Lantern mantle |
| Dry ice | Paper towels |  |
| Metal binder clips (4) | Hair dryer |  |
| Bright flashlight |  |  |
| Ethyl alcohol (in a squirt bottle) |  |  |

**Procedure**

**Part 1**

|  |  |
| --- | --- |
| 1. Gather the transparent box, metal base, binder clips, alcohol and a flashlight.
 | Clear plastic boxFelt strips |
| 1. There are two felt strips attached inside the box. Wet the felt with the rubbing alcohol; if the alcohol runs, wipe it off with paper towel.
 |
| 1. Then you turn the box upside down and clamp it securely to a metal base with a few binder clips creating a closed system.
2. Set it aside to rest for 5-10 minutes and answer the questions below.
 |  Felt stripMetal base |

1. What’s really inside the sealed box? Use the figures below to draw models (pictures) to show a “microscopic” particle view of what you think the contents inside the sealed container would look like (1) initially when you first seal the container, and (2) after the container sits undisturbed for a time, let’s say for 10 minutes.

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| --- | --- |
|  |  |
| Molecular view immediately upon sealing | Molecular view after the passage of time |

1. In the next part of the experiment, you will place the same sealed container on a bed of dry ice.
	1. Write a brief description for what you think will happen to the contents inside the container when you place it on the ice?
	2. Again, now draw a microscopic particle model of the contents after sitting in contact with the bed of ice for a several minutes.

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|  |
| Contents of the enclosed container several minutes after placing on the ice. |

1. Let’s discuss what we think.

**Part 2**

1. Now return to your experiment.
2. Wrap about a pound of dry ice in a towel and crush it into pieces with a hammer. Spread out the crushed solid evenly on an insulated tray.
3. Set the closed assembly you prepared previously directly on the dry ice, and darken the room.
4. Aim the beam of the flashlight parallel across the surface of the base of the enclosure.
	1. Look carefully in the region just above the metal base. Make as many observations as you can about what you see.
	2. Make a drawing of anything you see going on inside the enclosure.

**Part 2**

1. Remove the enclosure from the bed of ice and set aside. Gather a Brazil nut, a cloth lantern mantle and a piece of Fiesta pottery.
2. Do the following steps quickly!
3. Briefly open the assembly and dry any condensations on the base and sides with a paper towel.
4. Lay the three items equally spaced on the metal plate.
5. Re-assemble the enclosure replace it on the bed of dry ice.
6. Again, darken the room and glance the beam of the flashlight across the base.
7. Be patient; some of the effects you may see might take some time to become visible.
	1. Describe in general what you observe with each of the objects in the chamber.
	2. Draw each of the objects inside the enclosure and what you see.

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| Pottery fragment | Brazil nut | Cloth lantern mantle |

1. Describe the ways in which any of the observations you make among the objects are similar.
2. What differences do you notice?
3. How do you think you could explain what is causing the effects you are seeing?

**Part 3**

1. Using a radiation detector (Geiger-Mueller tube or Geiger counter) examine the items placed in the cloud chambers for possible radioactivity. How might you categorize or order the items based on your findings?
2. Recall you observations from when you initially placed the empty enclosure on the bed of ice. Based on your experiments, what do you think you were observing in the empty container?