

Cookin' Up a Comet



Notes

Overview

Students will learn the basic components of a comet and demonstrate how the comet's head and tail form by building a comet model.

Objective

- ◆ Compare the parts of the model to the parts of a comet.

Preparation

1. Purchase dry ice from ice companies or ice cream parlors the afternoon or evening prior to the demonstration. If possible, get the pellet form of dry ice. Be sure to purchase at least five pounds of dry ice. You will want to get enough extra for a test run at home the night before.
2. Store the dry ice in an ice chest. Place an inch or so of newspaper between the dry ice and the container to prevent the container from cracking.
3. Conduct this activity before using it in the classroom to get a feel for the correct amount of water to use.

CAUTION! Dry ice is -79°C (-110°F). Any more than brief exposure to the skin will cause "burns." Everyone handling dry ice should wear heavy, rubber gloves! Be sure to discuss safety precautions with students when working with dry ice.

Timeline

1 class

Key Question

Of what are comets made?

Materials

- 5 lbs (~ 2 kg) dry ice pellets or block, chopped finely
- 3 cups of water
- A few drops of ammonia
- A handful of sand or ground charcoal
- A can of soda (cola)
- A large wide mixing bowl
- A large wooden or plastic spoon for stirring
- A hammer
- A large plastic tub
- Heavy, rubber gloves
- Protective eye goggles (1 pair per student)
- Cloth or paper towels
- Optional: Overhead projector, hair dryer, and plastic wrap



Management

This comet recipe is fun to do. It is also messy and one of the more scientifically accurate demonstrations in astronomy.

Procedure

1. Put on heavy gloves before using a hammer to crush the dry ice pellets or block in the large plastic tub to the consistency of snow. Everyone should wear protective eye goggles.
2. Pour 18 oz (2.5 cups) of water into the mixing bowl. Add a handful of sand, a little ammonia, and the cola, mixing as you pour.
3. Add 2.5 cups of dry ice to the mixture. Stir carefully. Vapor will form as you stir, and the mixture will get slushy. Keep stirring for a few seconds while it thickens.
4. Use the mixing spoon to clean the slush away from the sides of the bowl into the bottom. Reach in and pack the slush into a ball. Keep packing and forming until you have a ball that forms a big lump. Add water to help the ice stick together.
REMINDER: DO NOT HANDLE DRY ICE MIXTURE WITH BARE HANDS!
5. Sprinkle more sand over the comet. Pour some of the remaining water over the comet turning it as you do, so that a layer of water ice forms over the entire surface.
6. Observe the behavior of your miniature comet nucleus. Cool Comet Viewing Tip: So the whole class can watch the gas sublimating out of the comet, use an overhead projector. Be sure to protect the overhead projector by covering the glass with plastic wrap. CAUTION! Do not leave the comet on the projector long; the dry ice could damage it.
7. Blowing hard on the comet gives a sense of simulating a comet tail. One suggestion is to use a hair dryer set on a low setting.
8. Discuss the parts of a comet using the Comet Fact Sheet.

The ingredients used to “build” a comet represent our current understanding of the components found in actual comets: frozen water, frozen carbon dioxide and other frozen gases, dust and rock, and organic (carbon-based) substances.

Scientists have studied the spectrum of light coming from real comets’ comas and tails to determine the presence of these substances. The research carried out in the Comet Halley flyby missions and the ICE mission to Comet Giacobini-Zinner provided further evidence of comet composition.

As the comet in this experiment melts, you can see little jets of gas coming off the comet just like the observed “outgassing” of real comets, which can actually affect the movement of the comet. After further melting of the experimental comet, craters will begin to form, another characteristic of real comets.

9. Discuss the Reflection Questions as a class.





Reflection Questions

1. When you place the comet on the tray to observe it, what part of the comet does it represent?
2. Describe changes, if any, in the comet after 5 minutes have elapsed.
3. Use the hair dryer to represent the Sun and the solar wind. Set the dryer on the low setting and blow air on the comet. What part of the comet begins to form? What happens when you move the hair dryer closer to the comet?
4. What components of real comets are represented by each of the ingredients in your comet?

Answer Key

1. The nucleus or the head.
2. You could see melting, small gas jets escaping.
3. The tail; jets begin to point away from the blow dryer (Sun).
4. The ingredients are either actual components or handy analogous ones. Dry ice is frozen carbon dioxide. Water is water. Ammonia is ammonia. Cola provides the organic (carbon-based) molecules, and sand is rocky material.

