

Comets (Demonstration) Teacher Notes

Purpose: To demonstrate the physical characteristics of a comet.

Background Information:

Comets are sometimes called dirty snowballs or "icy mudballs". They are a mixture of ices (both water and frozen gases) and dust that for some reason didn't get incorporated into planets when the solar system was formed. This makes them very interesting as samples of the early history of the solar system.

When they are near the Sun and active, comets have several distinct parts:

- **Nucleus:** Relatively solid and stable, mostly ice and gas with a small amount of dust and other solids.
- **Coma:** Dense cloud of water, carbon dioxide and other neutral gases sublimed from the nucleus.
- **Hydrogen cloud:** Huge (millions of km in diameter) but very sparse envelope of neutral hydrogen.
- **Dust tail:** Up to 10 million km long composed of smoke-sized dust particles driven off the nucleus by escaping gases; this is the most prominent part of a comet to the unaided eye.
- **Ion tail:** As much as several hundred million km long composed of plasma and laced with rays and streamers caused by interactions with the solar wind.

Comets are invisible except when they are near the Sun. Most comets have highly elliptical orbits that take them far beyond the orbit of Pluto; these are seen once and then disappear for millennia. Only the short- and intermediate-period comets (like Comet Halley), stay within the orbit of Pluto for a significant fraction of their orbits.

Preparation Time:

Pre Lab, 10 minutes

Demo, 35-45 minutes

Ingredients:

- 2 cups of water
- 2 heaping spoonfuls of dirt
- Dash of ammonia
- Dash of alcohol
- Dash of corn syrup
- 2 cups of finely crushed dry ice (frozen carbon dioxide)

Other Materials:

Large plastic or glass bowl

Plastic spoons
4 garbage bags
Styrofoam cups to use for measuring
Tray or pie pan
Work gloves
Wooden Spoon
Hammer
Paper towels for cleanup
Hairdryer

Procedure:

WARNING: Do not touch dry ice with your bare hands; it will burn your skin. Always wear work gloves when handling the plastic bag containing the dry ice or the comet itself.

1. Place the dry ice into two garbage bags that have been placed inside one another and crush it with a hammer. The ice should be crushed to a fine consistency.
2. Line the bowl with two other garbage bags that have been placed inside one another.
3. Pour the water into the bowl.
4. Pour in the dirt, ammonia, corn syrup and alcohol.
5. Pour the crushed dry ice into the bowl.
6. Mix well.
7. Using the garbage bag and gloves as protection, form the mixture into a “snowball.”
8. Place the comet onto a tray or pie pan to display to the class.
9. Look and listen. What is happening to your comet?

The ingredients used in this recipe represent what a comet is composed of: frozen water; frozen gases (methane-alcohol, ammonia); dust (dirt); organic substances (corn syrup). The comet is reasonably safe to touch without getting burned by the dry ice, but it is still best to have a spoon or a stick for the students to use while examining it. As the comet begins to melt, the class may notice small jets of gas coming from it. These are locations where the gaseous carbon dioxide is escaping through small holes in the still frozen water. This type of activity is also detected on real comets, where the jets can sometimes expel sufficient quantities of gas to make small changes in the orbit of the comet.

10. Blow on the comet with a hair dryer and a coma and tail will form.

The hair dryer represents the solar winds. After several hours, the comet will become a crater-filled ice ball as the more volatile carbon dioxide sublimates (turn directly from a solid to a gas - which is what carbon dioxide does at room temperature and comets do under the conditions of interplanetary space when they are heated by the Sun) before the water ice melts. Real comets are also depleted by sublimation each time they come near the Sun. In the end, old comets may break into several pieces or even completely disintegrate. In some cases, the comet may have a solid, rocky core that is then left to travel around the comet's orbit as a dark barren asteroid.

This activity is based on a lesson from the Challenger Center.