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ACTIVITY : 50 MINS

Construct a Comet

Students build a model of a comet out of dry ice and common household materials. They use the scientific method to analyze the relationship between comets and solar wind.

GRADES

3 - 8

SUBJECTS

Earth Science, Astronomy

CONTENTS

1 Image, 1 Video, 1 Link, 2 PDFs

OVERVIEW

Students build a model of a comet out of dry ice and common household materials. They use the scientific method to analyze the relationship between comets and solar wind.

For the complete activity with media resources, visit:

<http://www.nationalgeographic.org/activity/construct-a-comet/>

Program



DIRECTIONS

1. Build background about solar wind.

Display the NASA illustration “Electromagnetic Radiation into the Atmosphere.” Ask students to describe what they see. Point out that the dashed yellow lines coming from the sun are

solar wind. Ask: *Why do you think it's called "solar wind"?* Elicit from students that solar wind originates at the sun, and moves from the sun outward into space. Show students the NASA video "What is the Solar Wind?" Then check students' comprehension. Ask:

- *What is solar wind?* (the outer layers of the sun, or plasma, moving outward)
- *Can you see solar wind? Why or why not?* (No. Solar wind is invisible.)
- *How fast does solar wind move?* (millions of miles an hour)

2. Have students make connections between comets and solar wind.

Ask: *What happens when a snowball is heated?* Elicit from students that it melts, or turns from a solid into a liquid. Ask: *What happens during evaporation?* (Water changes from a liquid to a gas.) Then explain that some materials sublimate, or turn directly from a solid to a gas.

Carbon dioxide does this at room temperature. Explain to students that comets are often described as "dirty snowballs," because they consist of a nucleus, or concentration of matter, made up of dust and other materials frozen in water and mixed with volatile compounds. Like other bodies in the solar system, comets orbit around the sun. Ask: *What happens to a comet when it nears the sun?* Explain that when a comet nears the sun, the heat causes it to sublimate. The released gases and dust particles form a coma, or cloud, around the nucleus.

Ask: *How do you think the solar wind affects the coma of a comet?* Elicit from students that solar wind blows the gases of the coma in the opposite direction, forming one or more tails. The tail always points away from the sun due to solar wind. Use NASA's Exploration of Comets interactive to reinforce these concepts. If time allows, have students investigate the tabs labeled Comet Anatomy and Life Cycle.

3. Introduce the experiment and have students write a hypothesis.

Tell students that the class is going to build its own "dirty snowball," or model of a comet. Distribute one copy of the worksheet Scientific Method Chart to each student. Tell students that the problem/question they will investigate as the class builds a model of a comet is: *What happens to a comet as it sublimates over time?* Have students complete row 1 of the worksheet. Then have them work independently to write a hypothesis in row 2.

4. Construct a comet, with students' help.

Distribute a copy of the handout Build a Comet to each student. Encourage them to follow along as you build a comet. Select one student to be your lab assistant. Ask that student to read the step-by-step directions as the comet is being built. Invite volunteers to help with any of the steps that do not involve dry ice, making sure they follow safety precautions. Have all students note the steps of the procedure in the "Procedure" row of their worksheets.

Students can also list data, if any, on their worksheets. After the comet model is built, place the comet on display for students to watch as it begins to melt and sublime.

5. Model the effects of solar wind on a comet.

Explain to students that you are going to simulate the effects of solar wind on a comet. Make sure you have enough space to plug in and turn the blow dryer toward the comet as you rotate around it. Ask students to orally describe what they see, using vocabulary terms *nucleus*, *coma*, and *sublimation*. Then ask: *What happens to the gasses as the blow dryer is directed toward the comet? How does the comet change after one minute of the blow dryer being directed toward it?*

6. Allow students to examine the comet and write their observations.

Provide a wooden spoon for students to use while examining the comet. As the comet begins to melt, the class should notice small jets of gas coming from it. Explain to students that these are locations where the gaseous carbon dioxide is escaping through small holes in the still-frozen water. Have students add their observations to the “Observations” row of the worksheet. Note that, after several hours, the comet will become a crater-filled ball of ice as the more volatile carbon dioxide sublimates before the ice melts.

7. Ask students to draw conclusions about comets based on the model.

Have students continue to observe and write their observations. Then ask them to draw conclusions about comets based on those observations, and write them in the “Conclusions” row of the worksheet. Prompt them with the following questions:

- *How might jets of gas escaping from the nucleus affect real comets?*
- *What do you think happens to a real comet as it continues to sublime?*

Encourage students to consider orbit and solar wind as they respond to both questions. After students have had a chance to draw conclusions, discuss the answers as a class. Explain that the jets can sometimes expel enough gas to make small changes in the orbit of a comet. Real comets are depleted by sublimation each time they come near the sun during orbit.

Eventually, 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. Make sure students understand major differences between actual solar wind and the simulation. The comet orbits the sun and sublimates during its closest pass to the sun. It takes millions of years for a comet to completely disintegrate.

TipSafety

Be careful as you handle ammonia. Ammonia can irritate skin, eyes, and lungs. Wear safety goggles and gloves to handle it.

TipSafety

Dry ice is frozen carbon dioxide. Do not touch dry ice with your skin. The temperature of dry ice is so cold that it can cause severe frostbite. As it melts, it changes directly into a gas. Avoid breathing in that carbon dioxide gas.

Modification

If possible, after mixing the materials, form multiple comets so small groups can each use a blow dryer and observe a comet. Recruit additional adult volunteers to participate in this activity and assign one adult volunteer per small group.

Informal Assessment

Check students' completed Scientific Method Charts for completeness and accuracy. Discuss their conclusions and how they arrived at those conclusions, including how they incorporated the factual information they learned in this activity.

Extending the Learning

Encourage students to participate in citizen science. NASA's Stardust spacecraft collected interstellar dust particles from a comet called Wild 2. The [Stardust@Home](#) citizen science project asks for help from volunteers to look for these microscopic particles in stacks of images, using a virtual microscope.

OBJECTIVES

Subjects & Disciplines

Earth Science

- Astronomy

Learning Objectives

Students will:

- use the scientific method to observe the anatomy of a comet and draw conclusions
- explain the interaction of comets with the sun and solar wind

Teaching Approach

- Learning-for-use

Teaching Methods

- Demonstrations
- Discussions
- Hands-on learning
- Multimedia instruction
- Simulations and games

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
 - Learning and Innovation Skills
 - Communication and Collaboration
- Critical Thinking Skills
 - Analyzing
 - Creating
 - Understanding

National Standards, Principles, and Practices

NATIONAL SCIENCE EDUCATION STANDARDS

- (5-8) Standard B-2:

Motions and forces

- (5-8) Standard E-2:

Understandings about science and technology

Preparation

What You'll Need

MATERIALS YOU PROVIDE

- 2 Cups of dry ice (frozen carbon dioxide)
- 2 Cups of water
- 2 spoonfuls of sand or dirt
- 4 medium-sized plastic garbage bags
- Dash of ammonia
- Dash of dark corn syrup or other organic material
- Hammer
- Large mixing spoon
- Large, plastic mixing bowl
- Paper towels
- Safety goggles
- Work gloves

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per classroom, Projector, Speakers
- Plug-Ins: Flash

PHYSICAL SPACE

- Classroom
- Laboratory space

SETUP

Arrange the classroom so that all students have a good line of sight as you build the comet model.

GROUPING

- Large-group instruction

OTHER NOTES

- Dry ice is available from ice companies in most cities. Day-old dry ice works best, so you may want to buy the dry ice the afternoon before the day you plan to do this activity. Keep the dry ice in an ice chest when transporting it and in your refrigerator's freezer compartment overnight. Most ice companies have a minimum on the amount of ice they will sell (usually 5 pounds). But having extra dry ice on hand will be useful because some will evaporate and also because it is advisable to practice this activity at least once before doing it with the class.
- For younger students, write a parent note informing them that students will work with dry ice. Send it home before doing this activity.

BACKGROUND & VOCABULARY

Background Information

Comets are often described as "dirty snowballs," because they consist of a nucleus, or concentration of matter, made up of dust and other materials frozen in water and mixed with volatile compounds. Comets undergo sublimation, turning from a solid into a gas, as they approach the sun. Other parts of a comet result from this sublimation, include the coma, a huge cloud of dust and gas surrounding the nucleus. While the nucleus of a comet may only be 3-30 kilometers (1-18 miles) in diameter, the coma can extend for 100,000-300,000 kilometers (62,137-186,411 miles) or more. Comets are also distinctive for their tails. While close to the sun in their orbits, comets usually have two tails due to the effect of solar wind on the coma. One is made primarily of gas and always points away from the sun. The other tail is made of dust that is left behind like a trail of crumbs. If a comet has an orbit that occasionally crosses the Earth's orbit, we might pass through that trail and experience a meteor shower.

Prior Knowledge

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Recommended Prior Activities

- None

Vocabulary

Term	Part of Speech	Definition
asteroid	<i>noun</i>	irregularly shaped planetary body, ranging from 6 meters (20 feet) to 933 kilometers (580 miles) in diameter, orbiting the sun between Mars and Jupiter.
coma	<i>noun</i>	gases surrounding the icy head (nucleus) of a comet when the comet heats up.
comet	<i>noun</i>	celestial object made up of ice, gas, and dust that orbits the sun and leaves a tail of debris.
evaporation	<i>noun</i>	process by which liquid water becomes water vapor.
nucleus	<i>noun</i>	head of a comet, mostly composed of frozen gases and solid particles of ice.
orbit	<i>verb</i>	to move in a circular pattern around a more massive object.
orbit	<i>noun</i>	path of one object around a more massive object.
solar wind	<i>noun</i>	flow of charged particles, mainly protons and electrons, from the sun to the edge of the solar system.
sublimate	<i>verb</i>	to change from a solid state to a gas state, without becoming liquid.

For Further Exploration

Websites

- [Nat Geo Movies: Wildest Weather in the Solar System](#)
- [National Geographic Science: Space](#)
- [NASA: Lunar and Planetary Science—Comets](#)
- [Space Telescope Science Institute: Amazing Space—Planet Impact!](#)
- [Window to the Universe: Interactive Comet Animation](#)
- [NASA: Space Place—Tails of Wonder](#)

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