Activity Guidelines for Creating a Comet

Grade: 6 – 12

Subject: Space Science

Purpose:

To observe the materials that go into making a comet, and to translate this information into knowledge of the types of materials found in the solar system. In the hands-on exercise, the purpose is to learn about sublimation.

Objective:

Students will understand the following:

What a comet is.
Where comets come from.
What a comet is made of.
Why a comet has a tail.

Materials:

- Dry ice
- Water ice
- Water
- Sand
- Pebbles
- Household ammonia (this represents the ammonia found in comets)
- Corn syrup (this represents the organic carbon found in comets)
- Small plastic bowls
- Plastic spoons
- Pennies
- Slide projector and several slides concerning comets
- Large plastic bowl
- Mixing spoon
- Winter gloves for handling the dry ice
- Hammer for breaking up the dry ice, if ice is in a block

Procedures:

During this activity, students will learn what comets are, what they are made of, and where they come from. The activity begins with a slide presentation of several famous comets and their compositional characteristics. Many students often have difficulty distinguishing between comets and shooting stars so it may be necessary to include a discussion about this topic during the slide show. After the slide show it might be necessary to discuss where comets originate (primarily in the area near Neptune and can then be "kicked out" into the Oort cloud surrounding

the solar system). This will lead into a discussion about what happens as a comet gets close to the sun. It might be helpful to draw the sun on the board and then draw the elliptical orbit of a comet traveling around the sun. Start far away from the sun and progressively move the comet closer. Ask the students what will happen to comet, as it gets closer to the sun. Most likely someone will say that the comet will begin to melt, which will obviously produce a tail. In turn, the tail will get longer and longer as it gets closer to the sun. At this point it may be useful to note that the tail of the comet will always point directly away from the sun due to the solar wind that is emitted from the sun.

I. Creating a comet

Begin by asking the students what a comet is made of. Hopefully there will be some response but if not, this activity will serve as a reminder. You can note that many times comets have been referred to as dirty snowballs. Scientists think that comets are made from stuff left over from when the Sun and planets were formed. They are made from dirty ice, dust, and gas.

In a large plastic bowl lined with a plastic shopping bag, mix in the following ingredients, explaining why you are adding them:

i. Dry ice: Frozen CO2
ii. Water ice: H2O
iii. Sand
iv. Pebbles
v. Ammonia: NH4
vi. Corn syrup: Organic carbon
vii. Water (for effect)

Then close the plastic bag and try to squeeze all of the ingredients into a ball and hold for 30-40 seconds. You now have a comet! The students can come up individually to look at this creation. Next, hold the comet up and have one student hold a hairdryer and pretend to be the sun. Bring the comet around to the hairdryer, and explain that the comet gets its tail when it travels close to the sun. Explain that this is why we have meteor showers. The Earth is traveling through the debris a comet has left behind.

Now it is time for the students to examine the difference between the two types of ice that make up a comet. At this point the students should be warned about the potential hazards associated with working with dry ice. Most of the students will keep their fingers on the dry ice a little too long and some will even try to eat the dry ice, so a little advanced warning will be beneficial.

Beforehand you should have at least one piece of each type of ice in several of the small plastic bowls. Next to each bowl place a plastic spoon and a penny. Have the students break into groups of two or more, and work preferably on a counter top near a sink. Ask the students what will happen when they apply the penny to the regular ice and then to the dry ice. Hopefully someone will say that the water ice will melt, due to the heat that is conducted through the penny. Explain that the dry ice will also melt but instead of going from a solid to a liquid, the dry ice goes from a solid to a gas (sublimation). Given this information instruct the students

place the edge of a penny on both types of ice and observe what happens. In a few moments, the room will be filled with screeching sounds.

Let the students experiment for several minutes while you go around to each group asking them why the screeching sound is being produced. After ~ 10 minutes have the students return to their seats (otherwise they will continue to play with the dry ice). Once again solicit an answer about how the screeching noise is created. Most groups probably won't be able to come up with an answer so it will be necessary to explain that as the dry ice is being converted to a gas, the gas is trying to rapidly escape but the penny is blocking the way. So as the gas tries to move around the penny it produces a vibration, which in turn leads to the screeching noise.

Ask any of the students if the penny they placed on the dry ice quickly became cold. Most of the students will have experienced this. Ask why they thought this was. This is an opportunity to explain thermal energy and conduction to students. If you are working with younger students, you may want to explain this before they experiment with the dry ice, since the penny can become very cold.

Additional Questions:

Ask the students if they would do anything unusual if they saw a comet in the sky. Then explain that in the late 1800's and early 1900's people feared the "poisonous" tails of comets that they could see in the sky, so they would do absurd things such as commit suicide, buy comet umbrellas, and would even buy anti-comet pills.

Ask the students if they have heard of NASA's Stardust mission. Ask why scientists want to study the dust left over from comets.

Links:
http://www.nasa.gov/home/
http://encke.jpl.nasa.gov/whats_visible.html
http://spaceplace.nasa.gov/en/kids/stardust/index.shtml
http://antwrp.gsfc.nasa.gov/apod/astropix.html
http://kids.msfc.nasa.gov/
Vocabulary:
Solar system
Comet
Meteor

National Science Education Standards addressed:
Grades 5-8, Earth and Space Science Content Standard D, Earth in the solar system: The Earth is the third planet from the sun in a system that includes the moon, the sun, eight other planets and their moons, and smaller objects, such as asteroids and comets.

Grades 9-12, Earth and Space Science Content Standard D, The origin and evolution of the Earth system: The sun, the Earth, and the rest of the solar system formed from a nebular cloud of dust and gas 4.6 billion years ago.

New Mexico Science Education Standards addressed:

Grades 5-8, Earth and Space Science, Strand II, Standard III, Benchmark I: Describe how the concepts of energy, matter, and force can be used to explain the observed behavior of the solar system, the universe, and their structures. Grade 6, #3: Identify the components of the solar system, and describe their defining characteristics and motions in space.

Grades 5-8, Physical Science, Strand II, Standard I, Benchmark I: Know the forms and properties of matter and how matter interacts. Grade 5, #2: Describe how matter changes from one phase to another (e.g., condensation, evaporation).

Grades 9-12, Earth and Space Science, Strand II, Standard III, Benchmark I: Examine the scientific theories of the origin, structure, contents, and evolution of the solar system and the universe, and their interconnections. Grade 9-12, #1: Understand the scale and contents of the universe, including the range of structures from atoms through astronomical objects to the universe.

Grades 9-12, Physical Science, Strand II, Standard I, Benchmark II: Understand the transformation and transmission of energy and how energy and matter interact. Grade 9-12, #1: Identify different forms of energy, including kinetic, gravitational (potential), chemical, thermal, nuclear, and electromagnetic.