

ENGAGE

WHERE DO SPACE ROCKS COME FROM?

MAKE A COMET WITH DRY ICE AND WATER ICE

TWO 30 MINUTES AND OVERNIGHT

SUMMARY

Meteorites, asteroids, comets – they're all kinds of space rocks aren't they? The terminology can be confusing and often is confused – by journalists and scientists as well! Use this lesson to chat about what the different terms mean and ways to remember them, and to pique the curiosity of your students.

The fact sheets on pages 70 - 85 are very useful for understanding the differences. A meteorite is called a meteor (shooting star, fireball) when it's entering the atmosphere.

Before it enters, it's called a meteoroid. Most meteorites are rocks that have come off asteroids or comets and landed on Earth. Asteroids are rocks with a stable orbit around the sun, such as those in the asteroid belt between Mars' and Jupiter's paths. Comets are more complex than asteroids because they have unusual orbits and aren't all rock. Comets are mostly

water ice and other kinds of ice including frozen CO₂ (dry ice) and other frozen liquids and gases such as methane and ammonia. They are sometimes called "dirty snowballs"



Comet 67P
<http://www.esa.int/rosetta>

Dry ice, or solid Carbon Dioxide, can be picked up from a supplier in most towns quite cheaply but it is dangerous if not handled correctly. Read all of the safety information and be prepared well in advance for this demonstration. Make the dry ice comet as a class demonstration – have a look at NASA's video demonstration (see suggestions).

While that's slowly melting, students will make their own comet mixes with water, and stick them in the freezer to inspect the following day.

OUTCOMES

1. Students understand that Earth is part of a system of planets (and other things!) orbiting our sun, and their motions are controlled by a force called gravity
2. Students experiment with changing variables, handle equipment safely, compare data with predictions and suggest improvements for making comets.

EQUIPMENT

- 500g Dry ice (see info sheet) - in styrofoam esky
- Temperature resistant safety gloves
- Safety glasses
- Water
- Dirt (solar system dust particles)
- Honey (organic molecules)
- Methylated spirits (methanol)
- Vinegar (amino acids)
- Cloth bag
- Hammer
- Large bowl
- Plastic bag
- Large plastic tray
- What is a comet fact sheet, page 78-79
- Worksheet, page 60
- Freezer bags

SAFETY

Dry ice is frozen carbon dioxide

Dry ice can be dangerous if not handled correctly. Make sure you:

- Wear temperature resistant gloves
- Wear safety glasses
- Maintain student distance from ice at all times

Dry ice can be obtained from BOC gases shops. You will need less than 1 kg of ice for this experiment. In a polystyrene esky, 5 kg of ice can sublime or 'disappear' in 8 hours on a warm day.

Sublimation is the process of a solid going directly into a gas phase, without melting. Dry ice sublimates at temperatures above -78 degrees celcius. This means that at room temperature it will be turning from solid to a gas.

Gases take up more space than their solid form. Do not trap dry ice in a container with a screw-on lid. When transporting in a car, ensure windows are open to allow for excess Carbon Dioxide to escape.

SET UP

This activity is best done in an outdoor courtyard.

Have equipment ready, including your safety gear, and establish where you are going to use dry ice and where the students will stay sitting down.

We suggest you run your demonstration like this:

What's out in our solar system?

Planets, sun, moon, moons, asteroids, comets, space, satellites, dust, rocks, ice, aliens?

What do we call rocks in space?

Asteroids, meteoroids, comets, rings on Saturn

What's the difference?

Orbit, size, etc.

Asteroids= regular orbit, whole rocks, between mars and Jupiter, and further out

Comets = more icy balls of rock and dust, eccentric orbits – come in close to sun, but also out with Pluto

Today we're making a comet. What will we need? What's in them?

In comets	Notes	To make comet:
<ul style="list-style-type: none"> Water ice 	water is very common in the solar system, but it's almost always solid, except on Earth	2 - 3 cups water
<ul style="list-style-type: none"> Dry ice 	solid carbon dioxide is also common on comets	500 g dry ice
<ul style="list-style-type: none"> Dirt/rock 	dust and rock left over from the beginnings of the Solar System	1 cup dirt
<ul style="list-style-type: none"> Organic molecules 	there is evidence of carbon-hydrogen containing molecules on comets. These provide a hint that perhaps life on Earth and other planets has been initiated by comet impacts	see below
<ul style="list-style-type: none"> amino acids 	these are the building blocks of proteins	1 tbs vinegar
<ul style="list-style-type: none"> nucleic acids 	these are the building blocks of DNA	1 tbs honey
<ul style="list-style-type: none"> methyl alcohol 	this is a very simple organic molecule	1 tbs methylated spirits

Mix these ingredients (except dry ice) well, then add: (Put on safety gloves!) about 500 g dry ice (doesn't need to be exact), crushed into small pieces. Use the plastic bag to mould the dry ice and ingredients into a rough lump (hands outside the bag, have a look at the video).

What happens when a comet comes near the sun? what would happen to an icecube?

Melt - vapourise CO₂, water, dust all stream off in direction away from sun because of direction of travel and solar winds

What happens when Earth passes through this stream? - *meteor shower!*

You will be able to feel when all the ingredients are frozen into a solid "comet" lump, which can now be handled with gloved hands. If you like, you can sprinkle some more dirt over the top, most real comets are very dark.

Analyse:

Study the comet as it melts. What is happening? You might like to use a hair dryer and a fan to simulate the heat and solar winds from the sun.

The comet model will shoot out "jets" of gas as it solidifies, just like a real comet. The "gas" we see here is actually water vapour from the air around us, which is turned into tiny ice crystals when it comes into contact with the cold dry ice.

Real comets are much bigger than our model - the nucleus of a comet (the "dirty snowball") can be from 1-10km across. As comets approach the sun, they develop a dust tail and a plasma tail (containing gas particles) which are visible from Earth as comets go past.

Scientists can tell what comets are made of by studying the light reflected from a comet. Different substances reflect light in different ways. Some space missions have also taken samples from comets.

THE EXPERIMENT - WATER ICE COMETS

Students will make their own water ice comets in a bag and freeze it. The aim of the experiment is to find out how each of the components affects the whole while using representations to understand what comets are made from.

Plan:

Students discuss what a comet looks like and why a comet might create a meteor shower on Earth.

Students plan variables – what will make an awesome tail/ meteor shower, but stick together enough to still be a comet? Make predictions and divvy up the variables. See the worksheet for recipe details

There are five variables so five different groups can test each ingredient to see how it affects the comet as a whole.

Predict:

Make the equipment available to students. Students predict what the comet will look like when its first made and how it will hold together (see worksheet).

Test:

Pour all the ingredients into the plastic bag and mix by massaging mixture from the outside. Twist the loose bag up tightly, squeeze out air and put in a freezer.

Are students' predictions the same as when they started?

- Leave overnight -

Analyse:

Take the bags out of the freezer and examine – what held together best? Worst?

Allow comets to warm up for about 10 minutes before examining. Students will enjoy 'testing' their integrity by throwing them across a clear grassed area. Do they crumble? How would you make it differently?



A dry ice comet

Communicate:

Students answer questions on worksheet and discuss:

Why do comets have tails?

What would happen to comet tail remnants falling towards the moon?

SUGGESTIONS FOR THE CLASSROOM

- Have a look at different images of comets and discuss how we have the photographs.
- The recent ESA space mission Rosetta landed a probe on comet 67P. Check out videos and images on the website:

<http://rosetta.esa.int/>

- See NASA JPL video on comet making:

<http://www.jpl.nasa.gov/video/details.php?id=945>

The students might have some good ideas how to find out the answers of these questions if you have some left over dry ice. You will need to be their experimenter, but let them lead the experiment by following their instructions, where safe to do so

- What would happen if we had dry ice icebergs on Earth? (e.g. stick some in a clear bowl or cup of water)
- How much gas does one pellet give off? (e.g. insert a pellet into a balloon)
- What sound would dry ice glaciers make against rock? Other glaciers?



Rosetta mission on Comet 67P - <http://www.esa.int/rosetta>