

Family Space Day Overview - Comets

Family Space Day is a three hour event. The activities are set up so that children and parents can select the order in which they undertake activities. Parents and children are encouraged to learn, play, and explore *together*.

Objectives of the Day

Children will:

- ☞ learn what comets are made of and the different parts of comets.
- ☞ understand that comet tails form as the comet approaches the Sun and that solar wind from the Sun causes the tail to always point away from the Sun.
- ☞ understand that comets formed early in the history of our solar system and contain important information about this time.

Activities

- ☞ Station 1: Comet Quest
Children and their parents view 8 posters. Each focuses on a specific aspect of comets. The children keep track of their answers to the multiple choice questions using the Comet Quest Answer Cards.
- ☞ Station 2: Build a Comet
Children use different craft items to create a model of a comet, based on what they learned from Comet Quest.
- ☞ Station 3: Walk Through Comets
Children walk through the different comet showers that occur during the year.
- ☞ Station 4: Dry Ice Comet Demonstration
(Adult Supervision Required At All Times)
Facilitators demonstrate the building blocks of a comet using dry ice and other ingredients. With a hair-dryer they show the effect of solar wind on a comet.
- ☞ Station 5: Coloring Sheets and Games
Children can relax and color and play simple games related to comets.
- ☞ Station 6: Reading Room
Children and their parents can browse and read a selection of books about comets (refer to book list for suggested reading).

Other Materials

- ☞ *Facilitator Information – Comets*
- ☞ *Explore Comet – Book and Website References*
- ☞ *All About Comets – A Comet Fact Sheet*
- ☞ *Additional Information about Meteor Showers*

Facilitator Information

(All you need to know about comets to survive the day)

What is a comet?

Comets are 'leftovers' from the formation of our solar system around 4.6 billion years ago. They have been called "dirty snowballs." They are small celestial objects, made of ice, gas, dust, and a small amount of organic material, that orbit our Sun. There are about 1000 known comets and more are discovered each year.

Where do comets come from?

Comets come from a region of icy bodies beyond the orbit of Neptune called the **Kuiper Belt**. These short-period comets are fairly predictable because they take less than 200 years to orbit the sun. Some less predictable comets arrive from a distant region called the **Oort cloud**. These comets can take as long as 30 million years to complete one trip around the sun.

What are the parts of a comet?

A comet is made up of the Nucleus, Coma, Hydrogen Cloud, Dust Tail, and a Gas Tail.



The **Nucleus** is the solid center of the comet that is made up of ice, gases (carbon dioxide, methane, and ammonia), rock, dust and organic material. The **Coma** surrounds the nucleus and contains gas and dust. It is the "atmosphere" of the comet.

Image: Nucleus of Comet Halley from the Giotto Project, European Space Agency. Note the jets of gas venting from the surface.

<http://antwrp.gsfc.nasa.gov/apod/ap000805.html>

As comets approach our Sun [within about 450 million kilometers (280 million miles)], they heat up and the ice begins to sublime (change from a solid directly to a gas). The gas (water vapor, carbon monoxide, carbon dioxide, and traces of other substances) and dust forms an "atmosphere" around the nucleus called a "**coma**." Material from the coma gets swept into the tail.

As comets move close to the Sun, they develop **tails** of dust and ionized gas. Comets have two main tails, a **dust tail** and a **plasma tail**. The dust tail appears whitish-yellow because it is made up of tiny particles — about the size of particles of smoke — that reflect sunlight. Dust tails are typically between 1 and 10 million kilometers (about 600,000 to 6 million miles) long. The plasma tail is often blue because it contains carbon monoxide ions. Solar ultraviolet light breaks down the gas molecules, causing them to glow. Plasma tails can stretch tens of millions of kilometers into space. Rarely, they are as long as 150 million kilometers (almost 100 million miles). A third tail of sodium has been observed on Comet Hale-Bopp.

How are comets named?

Comets are named after the person who first reports their discovery. For example, Comet Halley is named for Edmund Halley, who determined that comets observed in 1531, 1607, and 1682 had essentially the same orbits and thus were a single comet. Based on his calculations, he correctly predicted the comet's return in 1758, but unfortunately, he did not live to see Comet Halley. Sometimes more than one person reports a new comet at the same time. In that case, the names are combined — as in the cases of Comet Hale-Bopp or Comet Shoemaker-Levy.

What happens when Earth passes through the path of a comet?

Meteor showers occur when Earth passes through the trail of dust and gas left by a comet along its elliptical orbit. The particles enter Earth's atmosphere and most burn up in a lively light show — a meteor shower. Some meteor showers, such as the Perseids in August and the Leonids in November, occur annually when Earth's orbit takes it through the debris path left along the comet's orbit. Comet Halley's trails are responsible for the Orionids meteor shower.

For upcoming meteor showers in your area and viewing suggestions, explore *Sky and Telescope's* Observing Highlights page - <http://skytonight.com/observing/highlights>.

Why are scientists interested in comets?

Scientists think that comets formed with our planets 4.5 billion years ago, so they contain important clues to the materials and processes in our early solar system. Scientists hope to learn even more about comets with NASA missions such as Stardust and Deep Impact and the European Space Agency's Rosetta mission.

Read more about Comets at:
<http://www.lpi.usra.edu/education/explore/comets/>

Comet Quest

This activity will familiarize children and parents with the features of a comet, how they form, and where they come from in our solar system.

What You Need:

- ✎ 8 sheets of poster board in different colors
- ✎ Large print-outs of the questions and answers
- ✎ Color images related to the questions
- ✎ Cover sheets for the answers
- ✎ Glue or tape to adhere the questions to the poster board
- ✎ One Comet Quest Answer Card for each child
- ✎ Crayons or pencils or markers for each child

What to Do:

Each of the following questions should be made into a big, bold, colorful poster with related images. Make sure the answer is covered by a page labeled "lift me" that hides the answer.

Provide each child with a Comet Quest Answer Card and a crayon or pencil. Invite the parents and children to examine the posters and complete the Comet Quest!

The frozen center of a comet is called the _____?

- A. Coma
- B. Nucleus
- C. Tail
- D. All of the above

Answer:
B. Nucleus!

Comets are most commonly from which part of our solar system?

- A. Kuiper belt
- B. Black holes
- C. Saturn's rings
- D. All of the above

Answer:
A. Kuiper belt!

Comets are almost invisible except when they get near to _____?

- A. Earth
- B. The Sun
- C. A black hole
- D. All of the above

Answer:
B. Sun!

Can you name a comet that made newspaper headlines?

Possible Answers:
Hale Bopp, Comet Shoemaker-Levy, Comet Halley

Comets are made of which of the following?

- A. Dust
- B. Frozen carbon dioxide
- C. Ammonia
- D. All of the above

Answer:
D. All!

The cloud of dust and gas surrounding the solid center of a comet is called the _____?

- A. Tail
- B. Coma
- C. Nucleus
- D. All of the above

Answer:
B. Coma!

Why are comets important?

- A. They are the main source of ice cream in our solar system
- B. They are cool to watch in the night sky
- C. They contain stuff left over from the formation of our solar system 4.6 billion years ago and may provide water to planets and moons

Answer:
C. They are old and may provide water!

A comet's tail is shaped by the _____?

- A. Solar wind
- B. Moon
- C. Lots of people blowing on it
- D. All of the above

Answer:
A. Solar Wind!

Possible Images for Posters

The following links provide nice images for the posters.

Astronomy Picture of the Day Search Engine:

http://antwarp.gsfc.nasa.gov/cgi-bin/apod/apod_search

Planetary Photojournal's Small Body Images:

<http://photojournal.jpl.nasa.gov/target/Other>

Windows to the Universe Comet Images:

http://www.windows.ucar.edu/tour/link=/comets/comet_il.html

Amazing Space – Anatomy of a Comet

<http://amazing-space.stsci.edu/news/archive/2005/02/ill-01.php>

Astronomy Picture of the Day – Comet Halley's Nucleus

<http://apod.nasa.gov/apod/ap961210.html>

Astronomy Picture of the Day – Exploring Comet Tails

<http://antwarp.gsfc.nasa.gov/apod/ap000413.html>

Space Today Online – Comet Halley

<http://www.spacetoday.org/SolSys/Comets/CometsFamous.html>

Jet Propulsion Laboratory's Top 20 Images of Comet Shoemaker-Levy

<http://www2.jpl.nasa.gov/sl9/top20.html>

COMET QUEST

A comet's tail is shaped by the ____?

Answer

Comets are made of what?

Answer

Why are comets important?

Answer

The cloud of dust and gas surrounding the solid center of a comet is called the ____?

Answer

The frozen center of a comet is called the ____?

Answer

Comets are most commonly from which part of our solar system?

Answer

Comets are almost invisible except when they get near the ____?

Answer

Can you name a comet that made newspaper headlines?

Answer

Build a Comet

Comets are made of ice, gases, rock, dust and organic material. The nucleus is the solid center of the comet and contains ice, gases, dust & rocks, and organic material. The coma surrounds the nucleus and contains gas and dust. It is the 'atmosphere' of the comet.

The flow of energy and particles from the Sun – the solar wind – sweeps gas and dust into long tails. The tail actually has two parts – the dust tail and the ion tail. These can extend for millions of miles. The tail of the comet always points away from the Sun no matter what direction the comet travels because the solar wind always blows out from the Sun.

After completing 'Comet Quest' the children will be ready to use their knowledge and imagination to create a comet!

What You Need:

- ☛ Various craft items such as: Styrofoam balls, glitter, pipe cleaners, beads, confetti, foil, and ribbon
- ☛ Scissors
- ☛ Glue



What to Do:

Have the children review what they've learned about comets so far. Using various craft items help your child use their imagination in building a comet. BE CREATIVE and HAVE FUN! Every comet will be different.

Make sure that your child NAMES the comet when done! Comets are named after their discoverer. Some famous comets are Halley, Hyakutake, and Shoemaker-Levy 9. Around a dozen 'new' comets are discovered each year.

Once your child has completed his or her comet, ask that they share with you the different parts of their model. Do they have a nucleus? Tails?

Parent Prompts:

Ask your child to describe to you what he or she has learned about comets.

Have your child explain to you the parts of a comet and what they may look like.

Ask him or her what comets are made of? See what he or she has learned!

Walk Through Comets

Comets are 'leftovers' from the formation of our solar system around 4.6 billion years ago. They have been called "dirty snowballs." They are small celestial objects, made of ice, gas, dust, and a small amount of organic material, that orbit our Sun. There are about 1000 known comets and more are discovered each year.

Meteor showers occur when Earth passes through the dust and gas left by a comet along its elliptical orbit. The particles enter Earth's atmosphere and most burn up in a lively light show — a meteor shower. Some meteor showers, such as the Perseids in August and the Leonids in November, occur annually when Earth's orbit takes it through the debris path left along the comet's orbit. Comet Halley's trails are responsible for the Orionids meteor shower.

In this activity, you and your child will walk through the comet showers that occur throughout the year.

What You Need:

- ☞ Comet Shower Floor Labels
- ☞ Ribbon, yarn or string (lots!)
- ☞ Tape
- ☞ Scissors
- ☞ Image of sun
- ☞ Something to represent the Earth (or tell the child that he/she will be earth!)

What to Do:

- ☞ Tape Comet Shower floor labels in a large circle.
- ☞ Tape the image of the sun in the center of the circle.
- ☞ Hang several ribbons in groups above each of the floor labels, low enough that the children will be able to walk through them.
- ☞ Have the children orbit the Sun carrying the Earth, and invite them to read the labels on the floor to discover which comet shower can be seen during each month.

Parent Prompts:

What happens to the dust falling off a comet? (It stays in space, moving around the Sun, until something—like the Earth—runs into it.)

What do we see on Earth when we pass through dust that has fallen off a comet?
(Meteor Showers)

Why does the dust hit Earth? (Earth passes through the dust as it goes around the Sun)

January

Quadrantid Meteor Shower

April

Lyrid Meteor Shower

May

Eta Aquarid Meteor Shower

July

Delta Aquarid Meteor
Shower

August

Perseid Meteor Shower

October

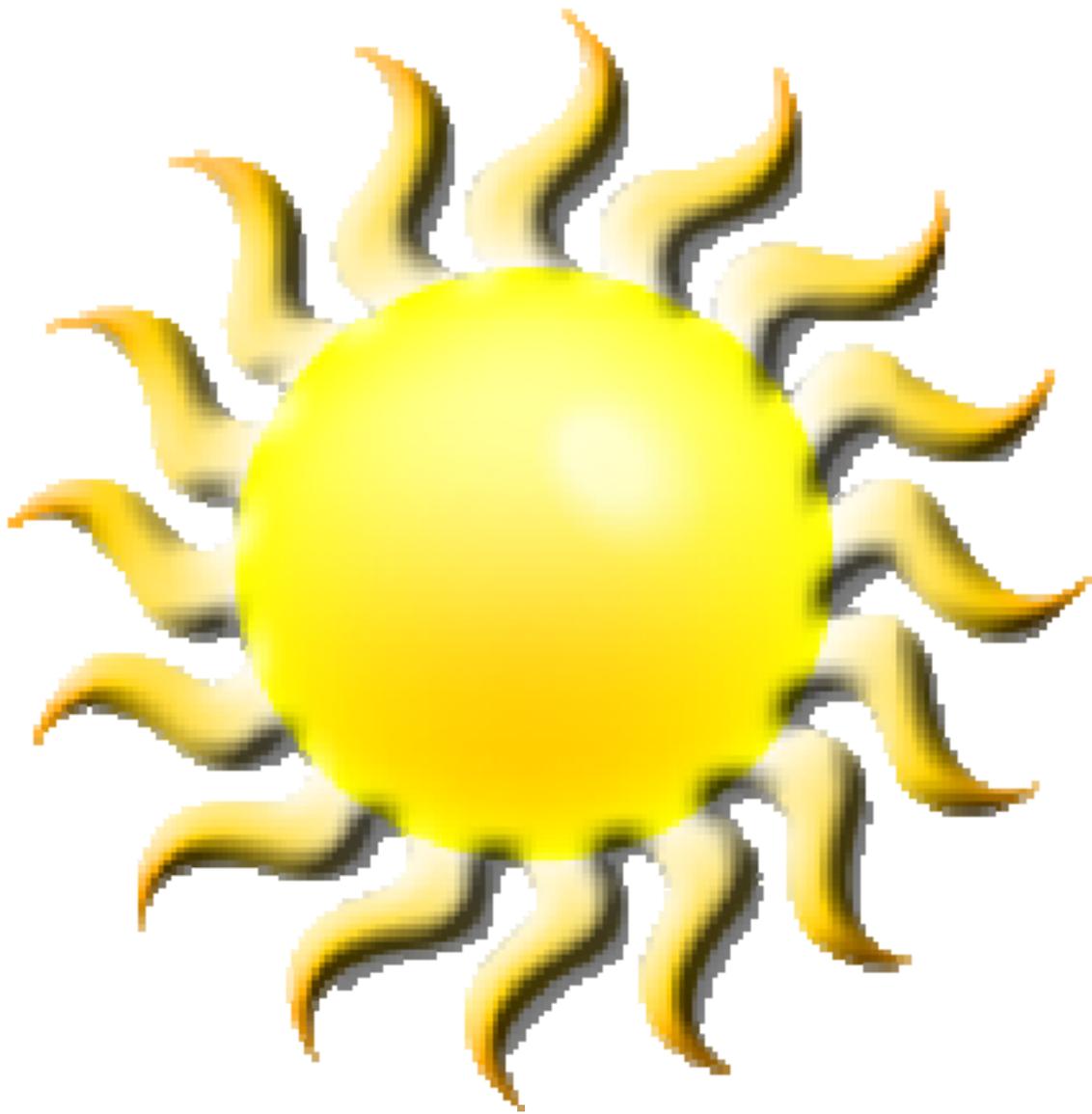
Orionid Meteor Shower

November

Leonid Meteor Shower

December

Geminid Meteor Shower



Dry Ice Comet Demonstration

Comets are composed of frozen water and gases, dust and rock, and a variety of organic materials. Heating from our Sun vaporizes frozen gases and water on the surface of comets. Solar wind sweeps the dust and gas of the coma into trailing tails. Because the solar wind always flow outward from our Sun's surface, the tails always point away from our Sun no matter what direction the comet is moving in its orbit. This means that the tails can be in front of the comet as the comet moves away from our Sun on its return to the outer part of its orbit.

Comet tails increase in length as the comet gets closer to the Sun.

This activity will introduce children to the structure of comets and the interactions between comets and our Sun. This demonstration provides a visual model of comets, particularly illustrating how the length and direction of a comet's tail varies in relationship to the comet's location relative to our Sun. It also helps the children gain a better understanding of the composition of comets.

This demonstration uses dry ice and should be conducted by an adult facilitator. Adult supervision is required at all times!

What You Need:

- ☞ 5 pounds of dry ice
- ☞ Mallet
- ☞ Eye protection
- ☞ Thick work gloves or insulated rubber gloves
- ☞ Plastic bowl - large
- ☞ Paper grocery bag
- ☞ 13 gallon garbage bag
- ☞ Pie pan or flat tray
- ☞ 1 liter (34 ounces) of water
- ☞ 1 cup of soil
- ☞ Dash of ammonia
- ☞ Dash of alcohol
- ☞ Dash of dark corn syrup
- ☞ Hairdryer with a low or cool setting
- ☞ Strong flashlight

What to Do to Create Dry Ice Comet:

Caution: Do Not Touch Dry Ice Without Protective Gloves

- ☞ Put on safety glasses and gloves. Ask the children to maintain a safe distance while still being able to see the demonstration.
- ☞ Put the dry ice into the paper grocery bag and crush it to a fine-grained consistency using the mallet. (The finer the texture, the better.)
- ☞ Line the large plastic bowl with the plastic garbage bag.
- ☞ Pour the following liquid ingredients into the garbage bag: half of the water, ammonia (warn the children about the strong smell!), alcohol, and the corn syrup. Next, add the soil.
- ☞ **Explain that each of the materials mixed into the model represents the actual components of comets – different types of ices, rock and dust, ammonia, organics - in somewhat realistic amounts.**

What to Do to Create Dry Ice Comet (cont'd):

- ☞ Carefully add in half of the crushed dry ice and mix well with other ingredients by kneading the outside of the garbage bag.
- ☞ **The dry ice will create a cool, cloudy vapor that is safe to touch. This vapor cloud represents the outgassing of the comet that forms the coma and gas tail as a comet approaches our Sun.**
- ☞ Add in the rest of the dry ice and mix well by kneading the outside of the garbage bag.
- ☞ Add in the rest of the water. It may be necessary to add a bit more water if the comet ball does not stick together.
- ☞ The water/dry ice slush will start to thicken as the dry ice freezes the water.
- ☞ Close the garbage bag around the comet and shape it into a ball.
- ☞ Carefully remove the comet ball and place it in the pie pan or tray.

What to do for the Demonstration:

- ☞ Holding the flashlight and hairdryer "Sun" (on low or cool setting) next to each other, point them toward the comet model from about 18 inches away. Turn out the lights to create a more dramatic visual effect. Move the hairdryer closer and farther from the dry ice ball.
- ☞ **The flashlight represents our Sun and the hairdryer represents the solar wind.**
- ☞ ***Potential Misconception Alert:* Make sure the children understand that our Sun does not "blow" a wind, but that the solar wind is instead a stream of particles, constantly coming from our Sun, that exert a very small pressure on matter.**
- ☞ Ask a few children to hold the flashlight/hairdryer "Sun." Holding the comet with gloves, walk in an ellipse around the "Sun." Comets trace long elliptical orbits around our Sun. The children will need to keep the hairdryer and flashlight aimed at the dry ice throughout your orbit, but they should stay in the same spot. Make sure to walk far enough away so there is no effect from the blow drier. Far from the Sun, comets do not have tails.
- ☞ Ask the children to focus on the changing orientation of the comet's tail relative to the Sun throughout the orbit. No matter where the comet is, the tail always points away from the Sun – so sometimes the tail "follows" the comet, and sometimes it is ahead of the comet! Prompt the children to notice how the tail is longer when the comet is close to the Sun and that it gets shorter and shorter as the comet moves away from the Sun.

Coloring Sheets

The following are links to different coloring sheets.

NASA Explores

http://www.nasaexplores.com/show_k4_student_st.php?id=021226124522

Enchanted Learning

<http://www.enchantedlearning.com/subjects/astronomy/activities/coloring/Comet.shtml>

Enchanted Learning

<http://www.enchantedlearning.com/subjects/astronomy/activities/label/comet/>

Explore Comets!

Websites

<http://starchild.gsfc.nasa.gov/docs/StarChild/teachers/asteroids.html>

Comets, asteroids and meteoroids – this activity website may be used to test students understanding and learning about space science topics after the activity sections have been completed. This is a good site for teachers and 'homeschoolers'. Comes with all of the printable materials needed.

<http://comet.hq.nasa.gov/comet/>

Near-live comet watching system – This system was designed to allow individuals on the Web to view recently uploaded images of comets. You can even register to upload your own images pending approval.

<http://www.windows.ucar.edu/>

Good site for interactive comet animation and comet coloring book material. Provides information on comet news and comet missions. Also, general information on the solar system, general astronomy, space missions, and space weather.

<http://www.adlerplanetarium.org/education/activities/read/sbsg/sky1.shtml>

Something fell from the sky! – A read only interactive site for small children (K-3). Utilizing simple characters the site reveals information about comets and meteors via a story line. The site also contains family activities to help introduce basic science concepts to children ages 2-4.

<http://deepimpact.jpl.nasa.gov/educ/index.html>

Great site for COMET activities at all grade levels. Eat a comet, comet on a stick, mission activities and more...

Check out some comet missions:

Giotto: Images of the nucleus of Comet Halley

<http://nssdc.gsfc.nasa.gov/planetary/giotto.html>

Stardust: Samples from Comet Wild 2

<http://stardust.jpl.nasa.gov/home/index.html>

Deep Impact: Looking inside Comet Tempel 1

http://www.nasa.gov/mission_pages/deepimpact/main/index.html

Rosetta: Investigating Comet 67P/Churyumov-Gerasimenko

<http://www.esa.int/SPECIALS/Rosetta/index.html>

Explore Comets!

Books

Halley Came to Jackson. Mary Chapin Carpenter, Harper-Collins Publishers, 1998, ISBN: 0-06-025400-9.

A father shows his baby daughter Halley's Comet as it soars across the Jackson sky in 1910 and the same girl (as an older woman) returns to Jackson to witness Halley's in 1986.

Comets. Samantha Bonar, Franklin Watts Publishing, 1998, ISBN: 0-531-20301-8. Easy-to-read book for children containing information about the history, anatomy, theory and future possible threat of comets.

The Return of the Comet. 1985, Pacific Science Center 200 – 2nd Ave N. Seattle, WA 98109.

A 40-page book that contains comet activities for children. Make model comets, flipbooks, calendars, observation charts, etc.

All About Comets

- ☞ Comets are sometimes called 'dirty snowballs' or 'icy dirt balls'.
- ☞ Each comet has a solid center part called a nucleus. The nucleus of a typical comet is about 12 miles across.
- ☞ The nucleus contains ices and gases (water, carbon dioxide, methane, and ammonia), rock, dust and organic material.
- ☞ The coma surrounds the nucleus and contains gas and dust. It is the "atmosphere" of the comet.
- ☞ Comets go around the sun in long elliptical orbits and usually are invisible – except when they get close to the sun.
- ☞ As a comet gets close to the sun, it begins to evaporate. The cloud of gas and dust around the nucleus – the coma – gets bigger and bigger.
- ☞ The flow of energy and particles from the sun – the solar wind – sweeps the gas and dust into long tails.
- ☞ The tail actually has two parts – the dust tail and the ion tail. These can extend for millions of miles.
- ☞ The tail of the comet always points away from the sun no matter what direction the comet travels because the solar wind always blows out from the sun.
- ☞ Meteor showers sometimes occur when the Earth passes through the dust and particles left behind by a comet.
- ☞ Comets come from a region of icy bodies beyond the orbit of Neptune called the Kuiper Belt. These short-period comets are fairly predictable because they take less than 200 years to orbit the sun.
- ☞ Some less predictable comets arrive from a distant region called the Oort cloud. These comets can take as long as 30 million years to complete one trip around the sun.
- ☞ Some famous comets are Halley, Hyakutake, and Shoemaker-Levy 9. Around a dozen 'new' comets are discovered each year.
- ☞ Comets are 'leftovers' from the formation of our solar system around 4.6 billion years ago.
- ☞ They are among the least-changed objects in our solar system and hold important clues about the composition of our early solar system.
- ☞ Scientists are studying comets to learn more about what they are made of and how they formed. New missions – like Giotto, Stardust, Rosetta, and Deep Impact - have revealed some surprising results!

What happens when Earth passes through the path of a comet?

Meteor showers occur when Earth passes through the trail of dust and gas left by a comet along its elliptical orbit. The particles enter Earth's atmosphere and most burn up in a lively light show — a meteor shower. Some meteor showers, such as the Perseids in August and the Leonids in November, occur annually when Earth's orbit takes it through the debris path left along the comet's orbit. Comet Halley's trails are responsible for the Orionids meteor shower.

Meteor Showers and Viewing Tips

Visit <http://stardate.org/nightsky/meteors/> to find out when the next meteor shower will take place.

What are meteor showers?

An increase in the number of meteors at a particular time of year is called a meteor shower.

Comets shed the debris that becomes most meteor showers. As comets orbit the Sun, they shed an icy, dusty debris stream along the comet's orbit. If Earth travels through this stream, we will see a meteor shower. Depending on where Earth and the stream meet, meteors appear to fall from a particular place in the sky, maybe within the neighborhood of a constellation.

Meteor showers are named by the constellation from which meteors appear to fall, a spot in the sky astronomers call the radiant. For instance, the radiant for the Leonid meteor shower is located in the constellation Leo. The Perseid meteor shower is so named because meteors appear to fall from a point in the constellation Perseus.

What are shooting stars?

"Shooting stars" and "falling stars" are both names that people have used for many hundreds of years to describe meteors -- intense streaks of light across the night sky caused by small bits of interplanetary rock and debris called meteoroids crashing and burning high in Earth's upper atmosphere. Traveling at thousands of miles an hour, meteoroids quickly ignite in searing friction of the atmosphere, 30 to 80 miles above the ground. Almost all are destroyed in this process; the rare few that survive and hit the ground are known as meteorites.

When a meteor appears, it seems to "shoot" quickly across the sky, and its small size and intense brightness might make you think it is a star. If you're lucky

enough to spot a meteorite (a meteor that makes it all the way to the ground), and see where it hits, it's easy to think you just saw a star "fall."

How can I best view a meteor shower?

If you live near a brightly lit city, drive away from the glow of city lights and toward the constellation from which the meteors will appear to radiate. For example, drive north to view the Leonids. Driving south may lead you to darker skies, but the glow will dominate the northern horizon, where Leo rises. Perseid meteors will appear to "rain" into the atmosphere from the constellation Perseus, which rises in the northeast around 11 p.m. in mid-August.

After you've escaped the city glow, find a dark, secluded spot where oncoming car headlights will not periodically ruin your sensitive night vision. Look for state or city parks or other safe, dark sites.

Once you have settled at your observing spot, lay back or position yourself so the horizon appears at the edge of your peripheral vision, with the stars and sky filling your field of view. Meteors will instantly grab your attention as they streak by.

How do I know the sky is dark enough to see meteors?

If you can see each star of the Little Dipper, your eyes have "dark adapted," and your chosen site is probably dark enough. Under these conditions, you will see plenty of meteors.

What should I pack for meteor watching?

Treat meteor watching like you would the 4th of July fireworks. Pack comfortable chairs, bug spray, food and drinks, blankets, plus a red-filtered flashlight for reading maps and charts without ruining your night vision. Binoculars are not necessary. Your eyes will do just fine.