Section 5 Comets, Asteroids, and Meteors

Objectives
After this lesson, students will be able to

J.3.5.1 Describe the characteristics of comets.
J.3.5.2 Identify where most asteroids are found.
J.3.5.3 Explain what meteoroids are and how they form.

Target Reading Skill
Comparing and Contrasting
Explain that comparing and contrasting information shows how ideas, facts, and events are similar and different. The results of the comparison can have importance.

Answers
Possible answers include the following:

Comets:
- Origin: Kuiper belt and Oort cloud; Size: excluding the tail, about the size of a mountain; Composition: ice, dust, small rocky particles

Asteroids:
- Origin: between the orbits of Mars and Jupiter; Size: typically less than 1 km; some are more than 300 km in diameter; Composition: rock

Meteoroids:
- Origin: comets or asteroids; Size: smaller than comets or asteroids; Composition: rock or dust

Preteach
Build Background Knowledge
Shooting Stars
Ask students whether they have ever seen a “shooting star.” Ask them to describe what it looked like. What did they think it was? After the discussion, tell students that in this section, they will investigate the nature of comets, asteroids, and shooting stars, which are actually meteorites.

Reading Preview
Key Concepts
- What are the characteristics of comets?
- Where are most asteroids found?
- What are meteoroids and how do they form?

Key Terms
- comet • Kuiper belt • Oort cloud
- asteroid • asteroid belt
- meteoroid • meteorite

Feature Comets Asteroids
Origin
Kuiper belt and Oort cloud
Between the orbits of Mars and Jupiter
Size
Kuiper belt: excluding the tail, about the size of a mountain
Asteroid belt: typically less than 1 km
Composition
Comet: ice, dust, small rocky particles
Asteroid: rock

Discover Activity
Which Way Do Comet Tails Point?
1. Form a small ball out of modeling clay to represent a comet.
2. Using a pencil point, push three 10-cm lengths of string into the ball. The strings represent the comet’s tail. Stick the ball onto the pencil point, as shown.
3. Hold the ball about 1 m in front of a fan. The air from the fan represents the solar wind. Move the ball toward the fan, away from the fan, and from side to side.

Think It Over
Inferring
How does moving the ball affect the direction in which the strings point? What determines which way the tail of a comet points?

Expected Outcome
The strings point away from the fan, behind the ball of clay.
Comets
One of the most glorious things you can see in the night sky is a comet. But what exactly is a comet? You can think of a comet as a “dirty snowball” about the size of a mountain. Comets are loose collections of ice, dust, and small rocky particles whose orbits are usually very long, narrow ellipses.

A Comet’s Head
When a comet gets close enough to the sun, the energy in the sunlight turns the ice into gas, releasing gas and dust. Clouds of gas and dust form a fuzzy outer layer called a coma. Figure 24 shows the coma and the nucleus, the solid inner core of a comet. The brightest part of a comet, the comet’s head, is made up of the nucleus and coma.

A Comet’s Tail
As a comet approaches the sun and heats up, some of its gas and dust stream outward, forming a tail. The name comet means “long-haired star” in Greek. Most comets have two tails—a gas tail and a dust tail. Both tails usually point away from the sun, as shown in Figure 25.

A comet’s tail can be more than 100 million kilometers long and stretch across most of the sky. The material is stretched out very thinly, however, so there is little mass in a comet’s tail.

Origin of Comets
Most comets are found in one of two distant regions of the solar system: the Kuiper belt and the Oort cloud. The Kuiper belt is a doughnut-shaped region that extends from beyond Neptune’s orbit to about 100 times Earth’s distance from the sun. The Oort cloud is a spherical region of comets that surrounds the solar system out to more than 1,000 times the distance between Pluto and the sun.

What is the Oort cloud?

Figure 25
Comet Orbits
Most comets revolve around the sun in very long, narrow orbits. Gas and dust tails form as the comet approaches the sun. Observing: What shape is a comet’s orbit?

FIGURE 25
Comet Orbits
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Comets
Teach Key Concepts

Viewing Comets
Focus: Remind students that astronomers can calculate the orbits of many comets.
Teach: Point out the coma and the nucleus of the comet shown in Figure 24. Have students examine the orbits of Earth and the comet. Ask: How does the orbit of the comet differ from the orbit of a planet? (The orbits of most comets are much longer and narrower than the orbits of planets.)
Apply: Are you likely to see Halley’s comet? Explain your answer. (Yes, Halley’s comet, which appears approximately every 76 years, last appeared in 1986.) When will Halley’s comet next appear? (2062) How old will you be? (Answers will vary.)

Independent Practice

Guided Reading and Study Worksheet: Comets, Asteroids, and Meteors

Less Proficient Readers
Creating Flashcards: Provide each student with three note cards. Have each student write comet, asteroid, and meteor on the cards, one term per card. Ask students to read the section, have them list the characteristics of each object on the opposite side of the appropriate card. Then have partners take turns using their flashcards for testing each other’s knowledge of comets, asteroids, and meteors. Learning Modality: Visual

Gifted and Talented
Researching the First Asteroid
Ask interested students to research and write about Ceres, the first asteroid to be discovered. (It was discovered twice and is the largest known asteroid.) Learning Modality: Verbal

Monitor Progress

Writing: Have students tell how the coma and the tail of a comet are formed.

Answers
Figure 25: Typically a long, narrow ellipse

A spherical region of comets that surrounds the solar system out to more than 1,000 times the distance between Pluto and the sun.
Asteroids

Teach Key Concepts

Asteroid Strike

Focus Show the Yucatan Peninsula of Mexico on a world map. Explain that an asteroid struck near there 65 million years ago.

Teach Tell students that asteroids and other objects from space that land on Earth usually explode into dust or vapor. Ask: Which technique was probably used to clean up the debris? (Between the orbits of Mars and Jupiter.)

Apply Ask: What may have happened to the dust from the asteroid that hit the Yucatan? (Possible answer: It fell into the ocean, settled on the ocean floor, was buried by layers of sediment, and eventually turned back into rock.)

learning modality: logical/mathematical

KWL Teaching Resources
- Transparency 132

Meteors

Teach Key Concepts

Meteors

Focus Remind students of the difference between a meteoroid, a meteor, and a meteorite.

Teach Ask: What do you see when a meteor burns up in Earth's atmosphere? (A bright streak of light)

Apply Ask: What causes the streak of light to appear? (Friction with the air creates heat; the air becomes white-hot.)

learning modality: verbal

Student Edition on Audio CD

Help Students Read

KWL. Refer to the Content Refresher for guidelines on KWL. Have students fill out the W column. Then have them scan the section and ask them to think of questions they may have about comets, asteroids, and meteors. Those questions will form the basis for what they write in the W column. As students read, have them write answers to their questions in the L column.

Try This Activity

Micrometeorites

An estimated 300 tons of material from space fall on Earth each day. Much of this is micrometeorites, tiny, dust-sized meteorites.

1. To gather magnetic micrometeorites, tie a string to a small, round magnet and place the magnet in a plastic freezer bag. Lower the magnet close to the ground as you walk along sidewalk cracks, drain spouts, or a parking lot.

2. To gather nonmagnetic and magnetic micrometeorites, cover one side of a few microscope slides with petroleum jelly. Leave the slides outside for several days in a place where they won’t be disturbed.

3. Use a microscope to examine the materials you have gathered. Any small round spheres you see are micrometeorites.

Estimating Which technique allows you to gather a more complete sample of micrometeorites? Were all the particles that were gathered in Step 2 micrometeorites? How could you use the method described in Step 2 to estimate the total number of micrometeorites that land on Earth each day?

Skill Focus estimating

Materials string; small, round magnet; plastic freezer bag; microscope slides; petroleum jelly; microscope

Time 45 minutes

Tips Stay in open areas away from trees and other overhead obstructions. Use the magnet in low spots where runoff from rain will have washed micrometeorites into one place.

Expected Outcome Most of the debris will be dust, pollen, and other microscopic objects. But some will be micrometeorites.

Extend Collect samples from several distinct areas and compare results. Have students hypothesize about their findings.

learning modality: kinesthetic

Figure 26 Asteroids The asteroid belt (right) lies between Mars and Jupiter. Asteroids come in many sizes and shapes. The photo below shows the oddly shaped asteroid Eros.
**Section 5: Assessment**

**Target Reading Skill** Comparing and Contrasting Use the information in your table about comets, asteroids, and meteoroids to help you answer the questions below.

**Reviewing Key Concepts**

1. **a. Defining:** What is a comet? b. **Listing:** What are the different parts of a comet? c. **Relating Cause and Effect:** How does a comet’s appearance change as it approaches the sun? Why do these changes occur?

2. **a. Describing:** What is an asteroid? b. **Explaining:** Where are most asteroids found? c. **Summarizing:** How did the asteroids form?

3. **a. Describing:** What is a meteoroid? b. **Explaining:** What are the main sources of meteoroids? c. **Comparing and Contrasting:** What are the differences between meteoroids, meteors, and meteorites?

**Monitor Progress**

**Answers**

- **Teaching Checkpoint:** Ceres, Pallas, and Vesta
- **Teaching Checkpoint:** A meteoroid that has passed through the atmosphere and hits Earth’s surface

**Assess**

**Reviewing Key Concepts**

1. **a.** A loose collection of ice, dust, and small rocky particles. **b.** Coma, nucleus, and tail. **c.** The ice turns into gas, releasing gas and dust forming a coma and two tails; because of the energy in sunlight

2. **a.** A small, rocky space object. **b.** In the asteroid belt that lies between Mars and Jupiter. **c.** They are leftover pieces of the early solar system that never came together to form a planet.

3. **a.** A chunk of rock or dust in space. **b.** Comets or asteroids. **c.** A meteoroid is a chunk of rock or dust in space. A meteor is a meteoroid that enters Earth’s atmosphere and burns up. A meteorite is a meteoroid that passes through the atmosphere and hits Earth’s surface.

**Reteach**

Have students reexamine Figure 24 and discuss the structure of a comet.

**Performance Assessment**

**Oral Presentation** Have students write, then present the life story of a meteoroid whose orbit occasionally approaches Earth and eventually strikes Earth’s surface.

**Teaching Resources**

- **Section Summary:** Comets, Asteroids, and Meteors
- **Review and Reinforce:** Comets, Asteroids, and Meteors
- **Enrich:** Comets, Asteroids, and Meteors

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**Meteors**

It’s a perfect night for stargazing—dark and clear. Suddenly, a streak of light flashes across the sky. For an hour or so, you see a streak at least once a minute. You are watching a meteor shower. Meteor showers happen regularly, several times a year.

Even when there is no meteor shower, you often see meteors if you are far from city lights and the sky is not cloudy. On average, a meteor streaks overhead every 10 minutes.

**Meteoroid** is a chunk of rock or dust in space. Meteoroids come from comets or asteroids. Some meteoroids form when asteroids collide in space. Others form when a comet breaks up and creates a cloud of dust that comes to move through the solar system.

When a meteoroid enters Earth’s atmosphere, friction with the air creates heat and produces a streak of light in the sky—a meteor. If the meteoroid is large enough, it may not burn up completely. Meteoroids that pass through the atmosphere and hit Earth’s surface are called **meteorites**. The craters on the moon where bright lights do not block the glow of meteors. The glow is caused by the earth’s atmosphere heats the rock as it falls.

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**At-Home Activity**

**Observing Meteors** Because students will be outdoors after dark, caution them to view a meteor shower only with an adult. Meteor showers are more easily seen outside cities, in areas where bright lights do not block the glow from the meteors. The glow is caused by friction that occurs when Earth’s atmosphere heats the rock as it falls.