What Are Asteroids?

Asteroids are chunks of rock that orbit the sun. Astronomers have discovered more than 300,000 asteroids, and they think that millions may exist. Like the orbits of planets, the orbits of asteroids are ellipses.

LOCATION OF ASTEROIDS

Most asteroids are located in a region between the orbits of Mars and Jupiter. This region is called the asteroid belt. Some asteroids, however, orbit the sun more closely. The closest asteroids to the sun are located inside the orbit of Mars. The Trojan asteroids are groups of asteroids found near Jupiter.
Minor Bodies of the Solar System

SECTION 4

Asteroids, Comets, and Meteoroids

continued

COMPOSITION OF ASTEROIDS

The composition of an asteroid is similar to the composition of the inner planets. Scientists group asteroids into three main categories based on their main component. The table below describes these categories.

<table>
<thead>
<tr>
<th>Category (main component)</th>
<th>Description</th>
</tr>
</thead>
</table>
| Carbon                    | • the most common type of asteroid  
                          | • generally dark colored          |
| Silicate minerals         | • look like Earth rocks            |
| Iron and nickel           | • the rarest type of asteroid      
                          | • look shiny and metallic         |

NEAR-EARTH ASTEROIDS

More than 1,000 asteroids have orbits that sometimes bring the asteroids very close to Earth’s orbit. Thus, scientists call them near-Earth asteroids.

Near-Earth asteroids make up only a very small percentage of the total number of asteroids. However, these asteroids could cause a great deal of damage if they struck Earth. Asteroid detection programs track asteroids whose orbits may bring them close to Earth. By monitoring these asteroids, scientists hope to predict and possibly avoid future collisions.

Barringer Meteorite Crater in Arizona formed when a small asteroid with a diameter of only 50 m struck Earth. This impact happened 49,000 years ago. Asteroid impacts have produced dozens of craters on Earth. However, most craters have eroded, or sediments have covered them. Therefore, they are hard to see.

Barringer Meteorite Crater, which is also called Meteor Crater, is the result of an asteroid impact.

Critical Thinking

4. Connect Ideas When an asteroid collides with Earth, it produces effects similar to those of a large volcanic eruption. What is one way an asteroid impact might harm life on Earth?

Looking Closer

3. Compare How is the appearance of a carbon asteroid different from the appearance of an iron and nickel asteroid?
What Are Comets?

A comet is a small body of ice, rock, and dust that follows a highly elliptical orbit around the sun. One of the most famous comets is Halley’s Comet, which passes by Earth every 76 years. It last passed Earth in 1986. Another comet, Hale-Bopp, is visible from Earth every 5 to 10 years.

COMPOSITION OF COMETS

A comet has several parts: a core (nucleus), a coma, and two tails. The core of a comet is made up of rock, metals, and ice. Comet cores are typically between 1 km and 100 km in diameter. The coma is a cloud of gas and dust that surrounds the core. A comet looks bright because the coma reflects sunlight. Together, the core and coma form the head of the comet.

Solar energy causes ice in a comet to change to a gas. Solar winds push the gas off behind the comet, forming the gas tail, or ion tail. Thus, the ion tail of a comet points away from the sun. A comet’s second tail, the dust tail, is made up of dust. The dust tail curves backward along the comet’s orbit.

THE KUIPER BELT

The Kuiper Belt is a region beyond Neptune’s orbit. It forms a ring of dwarf planets and small icy bodies. The dwarf planets Pluto and Eris are located in the Kuiper Belt.
Astronomers think most comets come from the Oort cloud. The **Oort cloud** is a cloud of dust and ice that lies far beyond Neptune’s orbit. It surrounds the solar system and contains the nuclei of billions of comets. Scientists think that the matter in the Oort cloud is left over from the formation of the solar system. Studying this matter helps scientist understand the history of the solar system.

Bodies within the Oort cloud may take a few million years to complete one circular orbit. Comets follow elliptical paths that take them closer to the sun. Those that take more than 200 years to complete one orbit are called **long-period comets**. Comets that complete one orbit in less than 200 years are called **short-period comets**. Recently, scientists discovered that most short-period comets actually come from the Kuiper Belt.

**What Are Meteoroids?**

Small bits of rock and metal called **meteoroids** also move through the solar system. Most meteoroids have a diameter less than 1 mm. Scientists think that most meteoroids are pieces of matter that broke off comets. Some comets may be pieces of asteroids.
SECTION 4 Asteroids, Comets, and Meteoroids continued

METEORS
Sometimes, meteoroids enter Earth’s atmosphere. In Earth’s atmosphere, friction between the meteoroid and the air heats the meteoroid. As a result, the meteoroid burns up. As the meteoroid burns, it produces a bright light called a meteor. Some people call meteors shooting stars. When many meteoroids enter Earth’s atmosphere in a short time, a meteor shower occurs.

METEORITES
Most meteoroids that enter Earth’s atmosphere burn up, but some larger meteoroids do not burn up completely. These meteoroids fall to Earth’s surface. A meteoroid that hits Earth’s surface is called a meteorite. Most meteorites are small. However, some meteorites strike Earth with the force of a large bomb. These impacts leave large craters.

Scientists group meteorites into three categories. The table below describes these categories.

The Main Categories of Meteorites

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stony</td>
<td>• similar in composition to rocks on Earth</td>
</tr>
<tr>
<td></td>
<td>• most common type of meteorite</td>
</tr>
<tr>
<td>Iron</td>
<td>• have a metallic appearance</td>
</tr>
<tr>
<td>Stony-iron</td>
<td>• contain both iron and stone</td>
</tr>
<tr>
<td></td>
<td>• rarest type of meteorite</td>
</tr>
</tbody>
</table>

Some stony meteorites contain carbon compounds.

Iron meteorites look very different from most Earth rocks.

Many stony-iron meteorites contain pieces of stone surrounded by iron.

8. Describe How does a meteor form?

9. Explain Iron meteorites are the easiest kind of meteorite to identify. What is the most likely reason for this?
Section 4 Review

SECTION VOCABULARY

| **asteroid** | a small, rocky object that orbits the sun; most asteroids are located in a band between the orbits of Mars and Jupiter |
| **comet** | a small body of rock, ice, and cosmic dust that follows an elliptical orbit around the sun and that gives off gas and dust in the form of a tail as it passes close to the sun |
| **Kuiper Belt** | a region of the solar system that starts just beyond the orbit of Neptune and that contains dwarf planets and other small bodies made mostly of ice |
| **meteor** | a bright streak of light that results when a meteoroid burns up in Earth’s atmosphere |
| **meteoroid** | a relatively small, rocky body that travels through space |
| **Oort cloud** | a spherical region that surrounds the solar system, that extends from the Kuiper Belt to almost halfway to the nearest star, and that contains billions of comets |

1. **Compare**  Describe two differences between asteroids and comets.

________________________________________________________________________

________________________________________________________________________

2. **Infer**  Could the ion tail of a comet ever point in the opposite direction from the dust tail? Explain your answer.

________________________________________________________________________

________________________________________________________________________

3. **Describe**  List the following parts of the solar system from closest to the sun to farthest from the sun: Kuiper Belt, asteroid belt, Neptune, Oort cloud.

________________________________________________________________________

________________________________________________________________________

4. **Apply Concepts**  Suppose astronomers discovered a comet that takes about 875 years to orbit the sun. Is the comet a short-period comet or a long-period comet? Where did it probably come from?

________________________________________________________________________

________________________________________________________________________

5. **Identify Errors**  Your friend tells you that he found a meteor in his backyard. What is wrong with your friend’s statement?

________________________________________________________________________