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4. If a planet had one-fourth the surface gravity of earth, how many g would its gravity be? $0.25 g$
5. If earth didn't have an atmosphere, how would that change the temperature on its sides facing toward and away from the sun? *The side facing the sun would be blazing hot and the side facing away from the sun would be freezing cold.*

Teaching Tips

- Introduce this lesson with a few other fun facts about these three planets.
- Start a list of these planets and their characteristics that you can add to throughout this section to use for review purposes. Remember to take it down before quizzes!
- *Exploring Our Skies* by Shaphan Shank (available from CLP) is a book that gives viewing tips as well as some of the best objects to view throughout the year.
- Bring in books from the local library, or other resources with more pictures and information for the students to enjoy.
- Show pictures of each planet.
- Discuss what is unique about Venus's rotation.
- Make sure students understand the difference between the terms *revolve* and *rotate* and a day and a year.
- The exercise to record the moon phase on page 39 is a Teacher Check.

Lesson 5 Mars and the Asteroid Belt

pages 17-20

Objectives

- to understand what a dwarf planet is
- to understand the asteroid belt
- to understand where the asteroid belt is located

Vocabulary Word

dwarf planet: an object in orbit around the sun that is similar to a planet but is too small to be called a planet

Beyond the Lesson

On earth the highest mountain is Mount Everest. Geologists have calculated that, because of earth's relatively strong gravity, mountains on earth cannot be much taller than Mount Everest. Mount Olympus on Mars can be twice as high as Mount Everest because Mars' gravity is so much lower than earth's.

Mars' moon Phobos was named after the Greek god of fear. Today if anyone has a fear of something we call it a *phobia*. The word *phobia* is based on the same root word as *Phobos*.

The ancient Greeks and Romans named Mars after their gods of war because of its reddish color.

Comprehension Questions

1. What is the atmosphere on Mars like? *It is much thinner than Earth's atmosphere.*
2. What is the volcano on Mars called? *Olympus Mons.*
3. Why are asteroids misshapen? *Their gravity is so weak they cannot form a sphere like the planets.*

Teaching Tips

- Make sure students understand what a dwarf planet is. This will help them understand Pluto in Lesson 7.
- Be alert for any problems on Exercises 22-30.
- The exercise to record the moon phase on page 39 is a Teacher Check.
- The Curiosity rover took the self-portrait on page 18 by using a camera on the end of a long mechanical arm and pointing it towards itself.

Lesson 6 The Gas Giants: Jupiter and Saturn

pages 21-24

Objectives

- to understand where Jupiter and Saturn get their names
- to understand what Saturn's rings are made of

Beyond the Lesson

The Galilean moon Ganymede and Saturn's moon Titan are both larger than the planet Mercury.

Jupiter weighs more than all of the other planets combined.

Jupiter's moon Ganymede is the largest moon in the solar system.

Saturn's rings stretch more than 120,700 km (75,000 mi) from the planet, but are only about 1 km thick.

Titan is the only moon in the solar system with an atmosphere. Scientists believe that there are lakes and rivers of liquid methane (natural gas) on the surface of Titan.

The only space probe to land on a body in the outer solar system was the Huygens lander that landed on Titan in 1995. It was to take pictures and scientific measurements of Titan's surface. The lander was named after Christian Huygens, the Dutch astronomer who discovered Titan. Huygens, inspired by Galileo's discovery of Jupiter's moons, began to search for moons around Saturn. Using a telescope he built himself, Huygens discovered Titan in 1655.

The four Galilean moons make up over 99 percent of the total mass of all Jupiter's moons.

Jupiter's magnetic field is about ten times stronger than earth's.

Comprehension Questions

1. Why is it not possible to stand on the surface of Jupiter and Saturn? *Since both Jupiter and Saturn are made of gas, there is no surface to stand on.*

2. Which moon of Jupiter is larger than the planet Mercury? *Ganymede.*
3. What is the Great Red Spot? *A large storm in the atmosphere of Jupiter.*
4. When was the Great Red Spot discovered? *1660s.*
5. Why does Jupiter appear slightly flattened? *It rotates so fast that the middle of the planet bulges outward.*
6. Is Saturn the only planet with rings? *No.*

Teaching Tips

- Continue adding to the list of planet characteristics and review as you feel necessary.
- Discuss the why Jupiter and Saturn are called “gas giants.”
- It may be necessary to do the activity on page 24 as a class, or at least the first two. Students should grasp the concept after several are done.
- Do Exercise 12 as a class activity, or assign it as needed for extra work.
- Take down the list of characteristics and give students a pop quiz to see how much they remember about each planet.
- The exercise to record the moon phase on page 39 is a Teacher Check.

Extra Student Activities

- Assign the starred Exercise 12 if it wasn’t done already.
- Research some of the larger moons of Jupiter and Saturn and what makes each of them unique.

Lesson 7 Uranus, Neptune, and Pluto

pages 25-29

Objectives

- to know the characteristics of Uranus, Neptune, and Pluto
- to understand the terms *aphelion* and *perihelion*
- to understand why Pluto was downgraded to a dwarf planet

Vocabulary Words

aphelion (a fēl’ yən): the point farthest from the sun in the orbit of a planet

perihelion (per’ ə hēl’ yən): the point nearest the sun in the orbit of a planet

Beyond the Lesson

Beyond the orbit of Neptune is a region of space with small icy bodies called the Kuiper Belt.

Although Uranus was discovered using a telescope, it can be seen by the unaided eye under good viewing conditions by people with good eyesight.

Comprehension Questions

1. Why was Uranus named “George’s Star”? *It was named in honor of King George.*

2. How was Neptune discovered? *Its position was predicted using mathematics; then it was found near where the math had predicted it would be.*
3. What is the storm on Neptune called? *Great Dark Spot.*
4. What makes Pluto's orbit unique from the orbits of the eight planets? *It is tilted.*
5. What causes each pole of Uranus to have forty-two years of light and forty-two years of darkness? *It rotates on its side, so one pole faces away from the sun and one pole faces toward the sun.*
6. Are there any reasons Pluto should still be considered a planet? *Answers will vary.*

Teaching Tips

- The reason Uranus's poles receive forty-two years of light and forty-two years of darkness can be illustrated using a lamp or flashlight and a ball with each sides of the ball marked as "North Pole" or "South Pole." Have one student hold the light while the other student revolves around the light, keeping one of the poles of the ball pointed toward the same side of the room the entire time. If done correctly, you should see how that one pole is in light and the other pole is in darkness for half of the orbit, then the pole that was in darkness is now in light.
- Help students understand that Pluto was once considered a planet, and older people may still list it because of how they learned the planets.
- Compare the Great Red Spot on Jupiter with the Great Dark Spot on Neptune.
- The exercise to record the moon phase on page 39 is a Teacher Check.

Extra Student Activities

- Have students research why Pluto was demoted from a planet to a dwarf planet. Students can also research about other objects out in the Kuiper Belt that would have to be considered planets if Pluto was reinstated as a planet.

Lesson 8 Comets

pages 30-33

Objectives

- to understand what comets are
- to understand the three parts of a comet
- to understand why a comet's tails always point away from the sun
- to understand why the Greeks gave comets their name

Vocabulary Words

coma (kō' mə): an area of gas and dust around the nucleus of a comet

comet: a heavenly body with a core of ice and rock surrounded by gases, orbiting the sun in a very elliptical orbit. A comet may form a long tail that streams away from the sun.

nucleus (nü' klē əs): the solid center of a comet composed of frozen rock, dust, and ice

tail: gas and dust blown away from the comet by the solar wind

solar wind: a stream of charged particles that travel at very high speed away from the sun