Earth in Space

Where is Earth in the universe, and how is Earth related to other objects in the universe?

Supplemental Worksheets

How Big?

When you see a photograph of Earth taken from space, Earth seems enormous. Although Earth is large compared to the Moon, it is tiny compared to the solar system and barely a speck compared to the universe.

- How do the motions of Earth and the Moon affect Earth?
- How does Earth compare with other objects in the solar system?
- What is Earth’s location in the universe?
**Quick Vocabulary**

**Lesson 1**

- **eclipse** movement of one solar system object into the shadow of another object
- **equinox** beginning of spring and fall; days on which hours of daylight equal hours of darkness
- **lava** molten volcanic material
- **revolution** orbit of one object around another object
- **rotation** spin of an object around its axis
- **solstice** beginning of summer or winter; days on which the hours of daylight are longest or shortest
- **tide** daily rising and falling level of the ocean and other large bodies of water
- **waning** visible portion of the Moon becomes smaller
- **waxing** visible portion of the Moon becomes larger

**Lesson 2**

- **asteroid** small, rocky object that orbits the Sun
- **comet** small, icy object that orbits the Sun and develops a tail as it nears the Sun
- **dwarf planet** object that orbits the Sun, is nearly spherical in shape, and shares its orbital path with other objects of similar size
- **meteor** streak of light produced by a meteoroid as it passes through Earth’s atmosphere
- **meteoroid** solid bit of debris that travels through the solar system
- **moon** natural satellite that orbits an object other than a star
- **planet** object that orbits the Sun, is massive enough to be nearly spherical in shape, and has no other large object in its orbital path
Quick Vocabulary

Lesson 3

**Big Bang theory** states that the universe began from one point and has been expanding and cooling ever since.

**estimate** to determine roughly the value, size, or extent of.

**galaxy** huge collection of stars, gas, and dust.

**light-year** distance light travels in one year.

**star** large sphere of hydrogen gas hot enough for nuclear reactions to occur in its core.
Lesson 1

Reading Guide

Key Concepts

ESSENTIAL QUESTIONS
- What causes seasons on Earth?
- How does the Moon affect Earth?
- How do solar and lunar eclipses differ?

Vocabulary

revolution p. 42
rotation p. 42
equinox p. 43
solstice p. 43
waxing p. 45
waning p. 45
tide p. 46
eclipse p. 47

Multilingual eGlossary

Video

What’s Science Got to do With It?

Crescent Sun?

This is an eclipse. The Moon is moving in front of the Sun, blocking a part of it. Do you know what kind of eclipse this is?
The Sun-Earth-Moon System

A. Earth and the Universe
   1. Earth is one of eight __________________________ orbiting the
      __________________________ in our solar system.
   2. The Sun is one of billions of __________________________ in the Milky Way, which
      is one of billions of __________________________ in the universe.
   3. Objects in our __________________________ orbit the Sun due to the Sun’s huge mass
      and __________________________ pull.

B. Motions of Earth
   1. Although we don’t sense its motion, Earth is __________________________ rapidly
      through space.
   2. A(n) __________________________ is the orbit of an object around another object.
      a. Earth orbits the Sun once every 365.25 __________________________.
      b. The average distance between __________________________ and the Sun is about
         150 million km, which is called a(n) __________________________ (AU).
   3. The spin of an object around its own axis is called __________________________; this
      motion causes __________________________ and __________________________.
   4. For Earth, a full rotation takes __________________________.

C. Earth’s Tilt and Seasons
   1. The cause of __________________________ on Earth is related to the tilt of Earth’s
      __________________________ toward or away from the Sun.
   2. On two days during the year, called the __________________________, one at the
      beginning of the spring and the other at the beginning of the fall, Earth’s axis
does not __________________________ toward or away from the Sun.
   3. On two days during the year, called the __________________________, one at the
      beginning of summer and one at the beginning of __________________________,
      Earth’s __________________________ tilts the most toward or away from the Sun.

D. Earth’s Moon
   1. The Moon __________________________ Earth for the same reason that Earth orbits
      __________________________; the reason is the force of __________________________.
Lesson Outline continued

2. A(n) ________________ between Earth and another planet-sized object might have thrown a large amount of ________________ into orbit around Earth, which gravity pulled together, forming ________________.

3. The Moon ________________ on its axis and ________________ around Earth in 27.3 ________________.

4. As the Moon orbits ________________, the visible part of the Moon reflecting the Sun's light seems to change ________________; these shapes are called the ________________ of the Moon.
   a. When the Moon is between Earth and the Sun, the half of the Moon facing Earth is in ________________ and the phase is a(n) ________________ moon; over the next two weeks, we say that the Moon is ________________.
   b. When Earth is between the Moon and the Sun, the half of the Moon facing Earth is completely lit up and the phase is a(n) ________________ moon; over the next two weeks, we say that the Moon is ________________.

E. Tides

1. The daily rising and falling levels of the oceans and other large bodies of water are called ________________, which are caused by the ________________ pull of the Moon and the Sun.

2. A bulge of water forms at the two places on Earth that are closest to and farthest from the Moon, and these places have ________________ tides.

3. The location of the ________________ relative to the ________________ can cause an increase or decrease in the level of the tides.

F. Eclipses

1. The movement of one solar system object into the ________________ of another solar system object is a(n) ________________.

2. During a(n) ________________ eclipse, people in the ________________ shadow on Earth see the Moon partially or completely cover the ________________.

3. During a lunar eclipse, people on Earth see ________________ shadow partially or completely cover the ________________.
Content Practice A

The Sun-Earth-Moon System

Directions: Complete the cause-and-effect chart with the correct term or phrase from the word bank in the space provided. Each term or phrase is used only once.

<table>
<thead>
<tr>
<th>a solar eclipse</th>
<th>move in a straight line</th>
<th>night and day</th>
<th>orbit the Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>spring tides</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cause</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Because the Sun contains more than 99 percent of the solar system's mass, objects in the solar system</td>
<td>1.orbit the Sun</td>
</tr>
<tr>
<td>If the Sun did not have gravitational pull, Earth would</td>
<td>2. move in a straight line</td>
</tr>
<tr>
<td>Earth rotates as it orbits the Sun, causing</td>
<td>3. night and day</td>
</tr>
<tr>
<td>The tilt of Earth's axis as it revolves around the Sun causes</td>
<td>4. a solar eclipse</td>
</tr>
<tr>
<td>The Moon reflects light, making</td>
<td>5. spring tides</td>
</tr>
<tr>
<td>The combined gravitational pull of the Moon and Sun causes</td>
<td>6. the Moon visible</td>
</tr>
<tr>
<td>Sometimes, a small part of Earth is in the Moon's shadow, causing</td>
<td>7. the seasons</td>
</tr>
</tbody>
</table>

**LESSON 1**
**The Sun-Earth-Moon System**

**Directions:** On the line before each definition, write the letter of the term that matches it correctly. Each term is used only once.

1. daily rising and falling of the oceans  
2. the spin of an object around its axis  
3. largest object in the solar system  
4. to circle around an object  
5. the orbit of an object around another object  
6. an object that revolves around Earth  
7. galaxy that includes our solar system  
8. shape of Earth’s orbit around the Sun  
9. occurs during a new moon  
10. occurs only during a full moon  
11. means equal night  
12. visible shapes of the Moon  
13. includes the Sun, planets, and the Moon  
14. beginning of summer or winter  
15. this object’s shadow covers the Moon during a lunar eclipse

A. lunar eclipse  
B. solar eclipse  
C. solar system  
D. the Sun  
E. the Moon  
F. orbit  
G. revolution  
H. rotation  
I. elliptical  
J. equinox  
K. solstice  
L. phases  
M. tides  
N. Earth  
O. Milky Way
Key Concept Builder

The Sun-Earth-Moon System

Key Concept  What causes seasons on Earth?

Directions: On the line before each statement, write T if the statement is true or F if the statement is false. If the statement is false, change the underlined word(s) to make it true. Write your changes on the lines provided. Use the diagram to choose your answer.

1. Earth’s distance during its orbit causes the seasons. __________________________
2. Earth’s orbit is elliptical, or nearly round. __________________________
3. It takes Earth one year to rotate around the Sun. __________________________
4. Seasons occur on Earth because the Moon’s tilt relative to the Sun does not change as Earth orbits the Sun. __________________________
5. As Earth orbits the Sun, its North and South Poles always point in the same direction. __________________________
6. Summer and fall begin when there are equal hours of daylight and darkness. __________________________
7. Winter begins in the northern hemisphere when Earth’s axis tilts away from the Sun. __________________________
8. When it is summer in the northern hemisphere, it is spring in the southern hemisphere. __________________________
The Sun-Earth-Moon System

Key Concept How does the Moon affect Earth?

Directions: On each line, write the term that correctly completes each sentence.

1. The Moon rotates on its axis and __________________________ around the Sun.

2. The time it takes for the Moon to rotate and revolve are __________________________.

3. The __________________________ side of the Moon never faces Earth.

4. The shape of the visible part of the Moon as it orbits Earth is called a(n) __________________________.

5. The __________________________ phase of the Moon occurs when the visible portion becomes larger.

6. The __________________________ gibbous is the phase following a full moon.

7. Tides result from the __________________________ pull of the Moon and the Sun.

8. __________________________ has more influence on Earth's tides than the Sun.

9. Water on Earth bulges slightly when the Moon is closest to or __________________________ from Earth.

10. Places on Earth where the water bulges slightly experience __________________________ tides.

11. Places on Earth that lie halfway between the two regions on Earth where water bulges experience __________________________ tides.

12. As Earth rotates, the areas of high and low tides __________________________.

13. Most coastlines experience __________________________ high tides and __________________________ low tides each day.

14. The Moon, water depth, coastline shape, and __________________________ affect tides.

15. Lower than usual high tides (neap tides) occur when the gravitational pull of __________________________ is perpendicular to the gravitational pull of the Sun.

16. Higher than usual high tides (spring tides) occur when Earth and the Moon are in line with the Sun, which means the Sun's __________________________ adds to the Moon's __________________________.
The Sun-Earth-Moon System

Key Concept: How does the Moon affect Earth?

Directions: Use the diagrams to answer each question on the lines provided.

1. What causes tides?

2. Why does the Moon have more influence on tides than the Sun?

3. What is the effect on water when the Moon, the Sun, and Earth are in line?

4. What causes neap tides?

5. Why do the water levels on Earth change daily?
**Key Concept Builder**

**LESSON 1**

**The Sun-Earth-Moon System**

**Key Concept** How do solar and lunar eclipses differ?

**Directions:** Use the diagrams to respond to each statement on the lines provided.

1. **Define** eclipse.

2. **Explain** how a solar eclipse occurs.

3. **Describe** how a lunar eclipse occurs.

4. **Explain** why the Moon is visible during a total lunar eclipse.

5. **Name** the phase in which a solar eclipse can occur.

6. **Name** the phase in which a lunar eclipse can occur.
Lesson Quiz A

The Sun-Earth-Moon System

Matching
Directions: On the line before each definition, write the letter of the term that matches it correctly. Each term is used only once.

1. motion around an axis
   A. equinox
   B. rotation
   C. revolution
   D. solstice

2. marks the beginning of fall or spring
3. marks the beginning of summer or winter
4. motion of one object around another

Multiple Choice
Directions: On the line before each question or statement, write the letter of the correct answer.

5. What two effects does the Moon have on Earth?
   A. seasons and tides
   B. solar eclipses and tides
   C. lunar eclipses and seasons

6. Seasons are the result of Earth's
   A. tilt on its axis.
   B. distance from the Sun.
   C. position during a solar eclipse.

7. The Moon is waning when it changes from
   A. full moon to last quarter.
   B. first quarter to full moon.
   C. new moon to first quarter.

8. High tides are lowest when the Moon is in its ______ phases.
   A. new and full
   B. new and last quarter
   C. first quarter and last quarter

9. What happens during a lunar eclipse?
   A. Earth casts a shadow on the Moon.
   B. The Moon casts a shadow on Earth.
   C. The Sun casts a shadow on Earth and the Moon.
Lesson Quiz B

The Sun-Earth-Moon System

Completion
Directions: On each line, write the term or phrase from the word bank that correctly completes each sentence. Not all terms and phrases are used.

eclipse  equinoxes  first quarter  full
last quarter  neap tide  new  revolution
rotation  solstices  spring tide  tilt

1. Seasons are caused by Earth’s ________________ on its axis.

2. The Moon is waxing as it changes from ________________ to ________________.

3. Earth’s ________________ on its axis causes day and night.

4. ________________ mark the start of summer or winter.

5. Fall and spring begin on days known as ________________.

6. One year is the time it takes Earth to complete one ________________ around the Sun.

Short Answer
Directions: Respond to each statement on the lines provided.

7. Draw a diagram and use labels to explain what causes tides. Indicate when they are higher than usual.

8. Contrast solar and lunar eclipses.
Lesson 2

Reading Guide

Key Concepts

ESSENTIAL QUESTIONS

• How does gravity influence the shape and the motion of objects in the solar system?

• What objects are in the solar system?

• How does Earth compare with other objects in the solar system?

Vocabulary

planet p. 51

dwarf planet p. 52

moon p. 53

asteroid p. 53

comet p. 53

meteoroid p. 53

meteor p. 53

Multilingual eGlossary

Video BrainPOP

inquiry Sponge?

Believe it or not, this is a moon! It is Saturn’s moon Hyperion. Most moons are spherical in shape. But some small moons, such as Hyperion, have irregular shapes. What other objects does the solar system contain?
The Solar System

The Solar System

1. The __________________________ is made up of the Sun and everything that
   __________________________ it.
   a. The solar system formed from a cloud of __________________________ and dust
      that pulled together due to the force of __________________________.
   b. The __________________________ is a star that formed at the
      __________________________ of the solar system.
   c. The other objects in the solar system formed from leftover gas and
      __________________________ pulled by gravity into
      a(n) __________________________.

2. An object that __________________________ the Sun, is massive enough to be
   nearly __________________________ in shape, and has no other large object in its
   orbital path is called a(n) __________________________.
   a. All eight planets revolve in the same __________________________ around the Sun.
   b. The closer a planet is to the Sun, the faster it __________________________.
   c. The most distant planet is __________________________, which is about 30 AU
      from the Sun; however the solar system includes billions of small, icy objects in
      orbit around the __________________________ as far as __________________________
      AU away.

3. __________________________ and objects that are too small to be classified as planets
   make up the solar system.
   a. Objects that __________________________ the Sun and are nearly spherical in
      shape, but they share their orbital paths with other objects of similar size are
      called __________________________.
   b. A natural satellite that orbits an object other than a star is called
      a(n) __________________________.
   c. Small, rocky objects that orbit the Sun are called __________________________;
      there are many of these objects in the __________________________ belt between
      the planets Mars and __________________________.
Lesson Outline continued

d. Small, icy objects that orbit the Sun and develop ________________ as they get close to the Sun are called ________________.

e. Solid bits of debris that travel through the solar system are called ________________.

f. A meteoroid that passes through Earth’s atmosphere produces a streak of ________________ and is called a(n) ________________.

g. If a meteoroid reaches Earth, it is called a(n) ________________.

4. The ________________ planets are the planets closest to the Sun; they are all ________________ because when the solar system was forming, the areas close to the ________________ were very ________________, and the gases were blown away.

a. There are ________________ inner planets—in order from the Sun, they are ________________, ________________, ________________, and ________________.

b. The inner planets all formed from ________________ elements, have few or no ________________, and ________________ more slowly than the outer planets.

5. There are ________________ outer planets—in order from the Sun, they are ________________, ________________, ________________, and ________________.

a. The outer planets are made up mainly of ________________ and other materials that have ________________ boiling points.

b. These planets are ________________ than the inner planets, have systems of ________________, have many ________________, and have thick atmospheres.

c. The largest planet in the solar system is ________________.

d. ________________ is the only planet that has rings that are easy to see.

e. ________________ and Neptune appear to be blue because of the amounts of the gas ________________ in their atmospheres.
The Solar System

Directions: Answer each question on the lines provided with the correct term from the word bank. Some terms may be used more than once or not at all.

asteroids  comets  dwarf planets  inner planets
meteoroids  moons  outer planets  solar system
the Sun

1. Which objects are nearly spherical in shape but share their orbital paths with other objects that are similar in size? ____________________________

2. Which objects are also called gas giants? ____________________________

3. Which group of planets is more massive than the group of rocky planets? ____________________________

4. Which space objects are dust or small pieces of debris? ____________________________

5. Which objects develop tails as they get near the Sun? ____________________________

6. Around which object do asteroids orbit? ____________________________

7. What formed 4.6 billion years ago? ____________________________

8. Which objects have several moons each? ____________________________

9. Which planets do not have solid surfaces? ____________________________

10. Which planets have no rings? ____________________________
The Solar System

Directions: On the line before each statement, write T if the statement is true or F if the statement is false. If the statement is false, change the underlined word(s) to make it true. Write your changes on the lines provided.

1. The solar system formed from a cloud of gas and dust.

2. Earth orbits the Sun at a distance of 1 AU.

3. The planet farthest from the Sun is Jupiter.

4. Asteroids are similar to planets in that they are spherical in shape but less massive in size.

5. Comets are small, icy objects that orbit the Sun.

6. When a meteoroid passes through Earth’s atmosphere it creates a streak of light called a meteorite.

7. The inner planets were formed from rocks and heavy elements.

8. All the outer planets have rings.

9. All outer and inner planets orbit in the same direction.

10. Venus is the hottest planet.

11. The smallest planet in the solar system is Mars.

12. Of the planets, Earth rotates fastest.

13. Dwarf planets have thick atmospheres of hydrogen and helium.

14. A moon is a small, rocky object that orbits the Sun.
**The Solar System**

**Key Concept**  How does gravity influence the shape and the motion of objects in the solar system?

**Directions:** On each line, write the term from the word bank that correctly completes each sentence. Some terms may be used more than once.

- direction
- dust
- gravity
- hotter
- Mercury
- Neptune
- orbits
- planets
- revolve
- rotated
- solar system
- star
- the Sun

The (1.) ________________ includes the Sun and everything that orbits it. A cloud of gas and (2.) ________________ formed the solar system 4.6 billion years ago. As (3.) ________________ acted on the cloud, it began to spin, becoming smaller and (4.) ________________. A(n) (5.) ________________ formed in the center of the cloud where the gas was hottest and densest. The star of our solar system is called (6.) ________________.

When the solar system first began, it was shaped like a ball, but gravity caused it to flatten as it (7.) ________________. Eventually it became a disk.

(8.) ________________ and other objects formed from leftover gas and dust that clumped together to form small, rocky or icy bodies. Each planet in the solar system (9.) ________________ the Sun.

There are eight planets in the solar system, and all of them move in the same (10.) ________________ around the Sun. Without (11.) ________________, the planets would move in a straight line. Planets that are closer to the Sun (12.) ________________ faster than planets that are farther from the Sun. For example, (13.) ________________ orbits the Sun once every 88 Earth days, and distant (14.) ________________ takes 165 Earth years to orbit the Sun.
**Key Concept Builder**

**The Solar System**

**Key Concept** What objects are in the solar system?

**Directions:** Complete the chart with the correct terms in the space provided.

<table>
<thead>
<tr>
<th>Definition</th>
<th>Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>massive enough to be nearly spherical in shape and has no other large object in its orbital path</td>
<td>1.</td>
</tr>
<tr>
<td>orbits the Sun, but shares its orbital path with other objects of similar size; nearly spherical in shape</td>
<td>2.</td>
</tr>
<tr>
<td>a natural satellite that orbits an object other than a star</td>
<td>3.</td>
</tr>
<tr>
<td>solid bits of debris that travel through the solar system</td>
<td>4.</td>
</tr>
<tr>
<td>small, icy objects that orbit the Sun and develop tails near the Sun</td>
<td>5.</td>
</tr>
<tr>
<td>streaks of light that result from a meteoroid passing through Earth’s atmosphere</td>
<td>6.</td>
</tr>
<tr>
<td>a meteoroid that reaches Earth</td>
<td>7.</td>
</tr>
<tr>
<td>small, rocky objects that orbit the Sun and are found mostly between the orbits of Mars and Jupiter</td>
<td>8.</td>
</tr>
<tr>
<td>the largest object in the solar system</td>
<td>9.</td>
</tr>
<tr>
<td>the most recent classification for Pluto</td>
<td>10.</td>
</tr>
</tbody>
</table>
The Solar System

Key Concept  How does Earth compare with other objects in the solar system?

Directions: Circle the correct answer to each question.

1. Which object is the largest?
   - Earth
   - Mercury
   - dwarf planet

2. Which object is nearly spherical in shape?
   - asteroid
   - Earth
   - Hyperion

3. Which object is small, icy, and orbits the Sun?
   - asteroid
   - comet
   - Earth

4. Which object is too cold for water to exist on its surface?
   - Earth
   - Mars
   - Venus

5. Which group of objects orbits between Mars and Jupiter?
   - asteroid
   - meteor
   - comet

6. Which object produces a streak of light when it travels through Earth’s atmosphere?
   - comets
   - meteoroids
   - asteroids

7. Which planet is the hottest planet in the solar system?
   - Earth
   - Venus
   - Neptune

8. Which planet has an atmosphere that contains methane?
   - Mars
   - Uranus
   - Earth

9. Which planet is the densest of the inner planets?
   - Earth
   - Mercury
   - Mars

10. Which planet has rings?
    - Jupiter
    - Venus
    - Earth

11. Which planet takes the longest to orbit the Sun?
    - Earth
    - Neptune
    - Mercury

12. Which object develops a tail when it nears the Sun?
    - meteoroid
    - Earth
    - comet
**Key Concept Builder**

**LESSON 2**

**The Solar System**

**Key Concept** How does Earth compare with other objects in the solar system?

**Directions:** Circle the term in parentheses that correctly completes each sentence.

1. (Earth, Saturn) is classified as an outer planet.

2. Another name used for the outer planets is (gas giants, rocky planets).

3. (Neptune, The Moon) cannot be seen without a telescope from Earth.

4. The atmosphere of (Earth, Jupiter) is mostly nitrogen.

5. (Uranus, Earth) is a bluish-green color because of the methane in its atmosphere.

6. One object that does not share orbital space with another object is (Earth, Pluto).

7. Mercury orbits the Sun once every 88 Earth days, and (Neptune, Mars) orbits the Sun once every 165 Earth years.

8. It takes (Jupiter, Venus) only 10 Earth hours to rotate.

9. (Mars, Saturn) is half the size of Earth.

10. Venus is 0.72 AU from the Sun, and (Earth, Jupiter) is 5 AU from the Sun.

11. (Earth, Neptune) has only one moon.

12. Clouds found on (Jupiter, Earth) swirl with various colors because they contain small amounts of sulfur and phosphorus.

13. When a(n) (asteroid, meteoroid) passes through Earth’s atmosphere, it produces a streak of light.

14. (Mars, Earth) is the only planet where life is known to exist.

15. (Earth, Jupiter) is classified as an inner planet.

16. (Mercury, Earth) has almost no atmosphere.

17. One thing Earth has in common with all other planets is a (rocky core, liquid surface).
Lesson Quiz A

The Solar System

True or False

Directions: On the line before each statement, write T if the statement is true or F if the statement is false. If the statement is false, change the underlined word(s) to make it true. Write your changes on the lines provided.

1. Gravity caused the early solar system to change its shape and caused the Sun and planets to form.

2. A dwarf planet does not share its orbital path with other objects in space.

3. Most asteroids orbit the Sun between Earth and Venus.

4. As a comet moves away from the Sun, it develops a long tail.

5. The outer planets have many moons, ring systems, and small rocky cores.

Multiple Choice

Directions: On the line before each statement, write the letter of the correct answer.

6. Earth is similar to Mercury because both
   A. rotate relatively slowly.
   B. have thick atmospheres.
   C. appear blue because of methane.

7. Earth and Mars have
   A. very thick atmospheres.
   B. ice on or below their surfaces.
   C. strong storm systems in their clouds.

8. Earth is NOT like Uranus and Neptune because Earth
   A. does not have hurricanes on its surface.
   B. has an atmosphere of nitrogen and oxygen.
   C. has more moons than either of these planets.
Lesson Quiz B

The Solar System

Matching
Directions: On the line before each definition, write the letter of the term that matches it correctly. Not all terms are used.

1. objects that melt as they revolve around the Sun

2. spherical objects that revolve around the Sun in their own orbits

3. small, rocky objects that generally orbit the Sun between Jupiter and Mars

4. nearly spherical objects that share their orbits around the Sun with similar-sized objects

   A. asteroids
   B. comets
   C. dwarf planets
   D. meteors
   E. meteoroids
   F. planets

Short Answer
Directions: Respond to each statement on the lines provided.

5. Explain how gravity helped form the solar system.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

6. Compare Earth to the other inner planets.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

7. Contrast Earth with the outer planets.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________
Stars, Galaxies, and the Universe

Key Concepts
ESSENTIAL QUESTIONS
- What are stars?
- How does the Sun compare to other stars?
- Where is Earth located in the universe?
- How is the universe structured?

Vocabulary
star p. 59
light-year p. 59
galaxy p. 61
Big Bang theory p. 62

Explosion in Space?
Yes, this is the remnant of a star explosion. When massive stars run out of fuel, they explode and release gas and other material into space. Do you think you have anything in common with an exploding star?
Stars, Galaxies, and the Universe

A. Stars

1. A(n) ________ is a large sphere of hydrogen gas that is hot enough for nuclear reactions to occur in its core.

2. The distance light travels in one year, 9.46 trillion km, is a unit of measurement called a(n) ________.

3. Stars vary in color, which is related to the ________ of a star.
   a. The coolest stars are ________ in color; the hottest stars are ________ in color.
   b. Stars of ________ temperature, including the Sun, are ________, ________, ________, or ________.
   c. The Sun is ________ than most stars; however it is tiny compared with the ________ stars.
   d. The Sun differs from many stars in that it is a(n) ________ star; many stars are part of a(n) ________ star system in which ________ stars orbit each other's center of ________.

B. Galaxies

1. A huge collection of stars, gas, and dust is called a(n) ________.

2. Scientists classify galaxies by their ________.

3. There are three main kinds of galaxies: ________ galaxies, ________ galaxies, and ________ galaxies.
   a. ________ galaxies have mainly older, redder stars and very few younger stars because these galaxies do not have very much ________ or gas; these galaxies are shaped like basketballs or ________.
   b. ________ galaxies contain large amounts of gas and dust, and many ________ stars form from this material; these galaxies are ________ shaped.
Lesson Outline continued

c. ______________________ galaxies have a central bulge containing older
   ______________________ stars and bluish, curved, dust-filled
   ______________________ containing younger stars.

4. Our galaxy—the ______________________—is a large ______________________
   galaxy with more than 100 ______________________ stars.

5. The Sun is not in the center of the Milky Way; it is in one of the
   ______________________ about halfway from the ______________________ of
   the galaxy.

C. The Universe

1. Just as ______________________ pulls stars near one another into galaxies, this
   force also pulls galaxies that are near each other into ______________________.

2. The Milky Way is part of a cluster of galaxies called the ______________________,
   which in turn is part of a supercluster of galaxies
   called the ______________________.

3. Clusters of galaxies are grouped together in a(n) ______________________ of
   galaxies, some of which contain ______________________ of galaxies.

4. Superclusters of galaxies form sheetlike ______________________ in space.

5. Stars explode and release ______________________ into space; the elements that
   form your body originated in a(n) ______________________.

6. The theory that the universe began from a single hot, dense point and has been
   ______________________ and ______________________ ever since is called the
   ______________________ theory.
   a. Scientists estimate that the universe is between 13 and 14
      ______________________ years old.
   b. Scientists debate whether the ______________________ will continue to
      expand forever or whether, at some point, ______________________ will cause
      it to stop expanding and begin to ______________________.
Stars, Galaxies, and the Universe

Directions: Circle the term in parentheses that correctly completes each sentence.

1. A (star, galaxy) is a large sphere that is hot enough for nuclear reactions to occur in its core.

2. Stars appear to twinkle as particles in the atmosphere move, causing the star’s light to change (energy levels, direction).

3. A light-year is the distance light travels in (one year, ten years).

4. Stars are randomly scattered throughout the (solar system, universe).

5. Earth is part of the (Milky Way, Andromeda) galaxy.

6. The three types of galaxies are elliptical, irregular, and (spherical, spiral).

7. Most scientists support the (Big Bang, Supercluster) theory that states that the universe began from one point.

8. One question asked by scientists is whether (energy, gravity) will cause the expanding universe to eventually contract.

9. A binary star system has two stars that orbit each other’s center of (gravity, mass).

10. The star nearest the Sun is (Aldebaran, Proxima Centauri).

11. Scientists believe the Sun has a life span of (five, ten) billion years.

12. The Sun is (larger, hotter) than 90 percent of all other stars.

13. Stars are composed of (silicon, hydrogen) gas.

14. The universe is structured by a series of larger (shapes, clusters) of stars.
Stars, Galaxies, and the Universe

Directions: Answer each question or respond to each statement on the lines provided.

1. What is a star?

2. How does the Sun compare in size and temperature to other stars?

3. Explain where Earth is found in the universe.

4. How do galaxies structure the universe?

5. Explain how matter in the universe recycles.

6. Compare the stars that are found in elliptical, irregular, and spiral galaxies.
Use Dimensional Analysis

Distances on Earth are often measured in kilometers, but distances in space are so large that scientists use other units. A light-year (ly) is 9,460,000,000,000 km. A parsec (pc) is even larger, equal to about 30,800,000,000,000 km. In other words,

\[
1 \text{ pc} \approx 3.26 \text{ ly} \\
1 \text{ ly} = 9.46 \text{ trillion km}
\]

The star Aldebaran is approximately 65 ly from Earth. What is that distance in parsecs?

Step 1  Select the appropriate conversion factor. The unit that answers the question should be in the numerator, and the unit given in the question should be in the denominator. You want to convert to parsecs from light-years.

\[
\frac{1 \text{ pc}}{3.26 \text{ ly}}
\]

Step 2  Multiply the given distance by the conversion factor. Remember to write units.

\[
65 \text{ ly} \times \frac{1 \text{ pc}}{3.26 \text{ ly}}
\]

Step 3  Cancel like units in the numerator and denominator and calculate.

\[
\frac{65 \text{ pc}}{3.26} = 20 \text{ pc}
\]

Practice

1. The star Vega is approximately 25 ly from Earth. What is that distance in parsecs?

2. The star Altair is approximately 5.0 pc from Earth. What is that distance in light-years?

3. The star Wolf 359 is approximately 73 trillion km from Earth. What is that distance in light-years?

4. If Proxima Centauri is 4.2 ly from Earth, how distant is it in trillions of kilometers?
**Key Concept Builder**

**LESSON 3**

**Stars, Galaxies, and the Universe**

**Key Concept**  What are stars?

**Directions:** On each line, write the term from the word bank that correctly completes each sentence. Each term is used only once.

- directions
- Earth’s atmosphere
- energy
- eye
- gravity
- hydrogen
- nuclear
- particles
- shines

A star is a large sphere of (1.) ________________ gas that is hot enough for (2.) ________________ reactions to occur in its core. As (3.) ________________ pulls gas inward, a star’s core heats. When the gas becomes hot enough for nuclear reactions, (4.) ________________ begins to travel outward.

When the energy reaches the star’s surface, the star (5.) ________________. A star appears to twinkle because its light passes through (6.) ________________ before reaching the human (7.) ________________. As (8.) ________________ in the atmosphere move, a star’s light changes (9.) ________________ just slightly.

**Directions:** On each line, write the term that correctly completes each sentence.

10. One ________________ is equal to 9.46 trillion km.

11. The ________________ of light is 300,000 km/s.

12. A star is in the shape of a(n) ________________.

13. Because ________________ must travel great distances before reaching Earth, stars are not seen as they are today, but as they were in the past.
**Stars, Galaxies, and the Universe**

**Key Concept** How does the Sun compare to other stars?

**Directions:** Answer each question on the lines provided.

1. What does the color of a star indicate? 
2. What color is the Sun? 
3. What color are the coolest stars? 
4. What color are the hottest stars? 
5. How many stars are in a binary star system? 
6. What is the remaining life of the Sun? 
7. What will the Sun become when it stops shining? 

**Directions:** Use the table to answer each question on the lines provided.

<table>
<thead>
<tr>
<th>Mass (in solar masses)</th>
<th>Temperature (K)</th>
<th>Expected Life Span of Star (in millions of years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>38,000</td>
<td>1</td>
</tr>
<tr>
<td>6.5</td>
<td>16,400</td>
<td>93</td>
</tr>
<tr>
<td>3.2</td>
<td>10,800</td>
<td>550</td>
</tr>
<tr>
<td>1.7</td>
<td>7,240</td>
<td>2,650</td>
</tr>
<tr>
<td>1.3</td>
<td>6,540</td>
<td>5,190</td>
</tr>
<tr>
<td>1</td>
<td>5,920</td>
<td>10,000</td>
</tr>
<tr>
<td>0.78</td>
<td>5,150</td>
<td>18,600</td>
</tr>
</tbody>
</table>

8. What is the relationship between a star’s mass and temperature?

9. What is the relationship between a star’s temperature and expected life?

10. What is the relationship between a star’s mass and expected life?
### Stars, Galaxies, and the Universe

**Key Concept** Where is Earth located in the universe?

**Directions:** Complete the chart with the correct information in the space provided.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. <strong>List</strong> three facts about galaxies.</td>
<td></td>
</tr>
<tr>
<td>2. <strong>List</strong> the three types of galaxies.</td>
<td></td>
</tr>
<tr>
<td>3. <strong>List</strong> three facts about the Milky Way galaxy.</td>
<td></td>
</tr>
<tr>
<td>4. <strong>Identify</strong> the galaxy that Earth is found in.</td>
<td></td>
</tr>
<tr>
<td>5. <strong>Describe</strong> where the Sun is in relation to the center of its galaxy.</td>
<td></td>
</tr>
</tbody>
</table>
Stars, Galaxies, and the Universe

Key Concept: How is the universe structured?

Directions: On the line before each statement, write T if the statement is true or F if the statement is false. If the statement is false, change the underlined words(s) to make it true. Write your changes on the lines provided.

1. Gravity pulls clusters of stars together in most galaxies.  
   
2. Earth is part of a cluster of 30 galaxies called the Local Group.  
   
3. The Milky Way is also part of a supercluster of galaxies called Proxima Centauri.  
   
   
5. The energy emitted from a galaxy is related to its distance from the Sun.  
   
6. Most of the mass in the universe is invisible, dark energy.  
   
7. Matter in the universe is lost when a star explodes.  
   
8. The Big Bang theory states that the universe began from several points.  
   
9. Many scientists believe that the universe is cooling and collapsing.  
   
10. According to most scientists, the universe formed 13 to 14 million years ago.  
   
11. All of the dark matter that forms the universe can be seen with a telescope.  
   
12. The universe is structured by gravity found in clusters of interacting galaxies.  
   
13. The universe is made up of superclusters that form enormous walls of galaxies in space.
Lesson Quiz A

Stars, Galaxies, and the Universe

Completion

Directions: On each line, write the term from the word bank that correctly completes each sentence. Each term is used only once.

Big Bang theory  cluster  galaxy  light-years  Milky Way  star  supercluster

1. A __________________ is a huge collection of stars, gases, and dust that is classified by shape.
2. The distance between stars is measured in units called __________________.
3. According to the __________________, the universe formed from a single point and is still expanding.
4. Earth and the rest of the solar system are located in the __________________ galaxy.
5. The Local Group is a __________________ made up of approximately 30 galaxies.
6. A __________________ is a sphere of very hot, burning gases.
7. The Local Group and other collections of stars, gases, and dust form a __________________.

Multiple Choice

Directions: On the line before each statement, write the letter of the correct answer.

_____ 8. Compared to most other stars, the Sun is
   A. very massive.
   B. relatively hot.
   C. a typical color.

_____ 9. Irregular galaxies
   A. are oddly shaped and contain many young stars.
   B. are shaped like footballs and contain little gas and dust.
   C. have arms that extend from the center and contain many old stars.

_____ 10. Earth is located _____ of the Milky Way galaxy.
    A. near the center
    B. in one of the arms
    C. at the outermost edge
Lesson Quiz B

LESSON 3

Stars, Galaxies, and the Universe

Matching

Directions: On the line before each definition, write the letter of the term that matches it correctly. Not all terms are used.

1. huge collections of stars, dust, and gases that are classified by shape
   ____  A. Big Bang
   ____  B. clusters
   ____  C. galaxies
   ____  D. light-years
   ____  E. Milky Way
   ____  F. recycled matter
   ____  G. stars
   ____  H. superclusters

2. spherical objects that emit light and thermal energy

3. units used to measure distances between stars

4. some of the largest structures in the universe

5. the Local Group and 30 other galaxies form one of these

6. theory stating that the universe began from a single point and is still expanding

Short Answer

Directions: Respond to each statement on the lines provided.

7. Describe Earth’s location in the universe.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

8. Compare the Sun to other stars.

   ____________________________________________________________
   ____________________________________________________________
   ____________________________________________________________

9. Describe the shape and make-up of irregular galaxies.

   ____________________________________________________________
   ____________________________________________________________
Lesson Outline for Teaching

Lesson 1: The Sun-Earth-Moon System

A. Earth and the Universe
   1. Earth is one of eight planets orbiting the Sun in our solar system.
   2. The Sun is one of billions of stars in the Milky Way, which is one of billions of galaxies in the universe.
   3. Objects in our solar system orbit the Sun due to the Sun's huge mass and gravitational pull.

B. Motions of Earth
   1. Although we don't sense its motion, Earth is moving rapidly through space.
   2. A(n) revolution is the orbit of an object around another object.
      a. Earth orbits the Sun once every 365.25 days.
      b. The average distance between Earth and the Sun is about 150 million km, which is called a(n) astronomical unit (AU).
   3. The spin of an object around its own axis is called rotation; this motion causes day and night.
      a. For Earth, a full rotation takes 24 hours.

C. Earth's Tilt and Seasons
   1. The cause of seasons on Earth is related to the tilt of Earth's axis toward or away from the Sun.
   2. On two days during the year, called the equinoxes, one at the beginning of spring and the other at the beginning of fall, Earth's axis does not tilt toward or away from the Sun.
   3. On two days during the year, called the solstices, one at the beginning of summer and one at the beginning of winter, Earth's axis tilts the most toward or away from the Sun.

D. Earth's Moon
   1. The Moon orbits Earth for the same reason that Earth orbits the Sun; the reason is the force of gravity.
   2. A(n) collision between Earth and another planet-sized object might have thrown a large amount of debris into orbit around Earth, which gravity pulled together, forming the Moon.
   3. The Moon rotates on its axis and revolves around Earth in 27.3 days.

E. Tides
   1. The daily rising and falling levels of the oceans and other large bodies of water are called tides, which are caused by the gravitational pull of the Moon and the Sun.
   2. A bulge of water forms at the two places on Earth that are closest to and farthest from the Moon, and these places have high tides.
   3. The location of the Sun relative to the Moon can cause an increase or decrease in the strength of the gravitational pull.

F. Eclipses
   1. The movement of one solar system object into the shadow of another solar system object is a(n) eclipse.
   2. During a(n) solar eclipse, people on Earth see the Moon partially or completely cover the Sun.
   3. During a lunar eclipse, people on Earth see Earth's shadow partially or completely cover the Moon.

Discussion Question

Compare and contrast spring, tides and neap tides. How often does each occur?
Lesson 2: The Solar System

The Solar System

1. The solar system is made up of the Sun and everything that orbits it.
   a. The solar system formed from a cloud of gas and dust that pulled together due to the force of gravity.
   b. The Sun is a star that formed at the center of the solar system.
   c. The other objects in the solar system formed from leftover gas and dust pulled by gravity into a(n) disk.

2. An object that orbits the Sun, is massive enough to be nearly spherical in shape, and has no other large object in its orbital path is called a(n) planet.
   a. All eight planets revolve in the same direction around the Sun.
   b. The closer a planet is to the Sun, the faster it revolves.
   c. The most distant planet is Neptune, which is about 30 AU from the Sun; however the solar system includes billions of small, icy objects in orbit around the Sun as far as 50,000 AU away.

3. Planets and objects that are too small to be classified as planets make up the solar system.
   a. Objects that orbit the Sun, are nearly spherical in shape, and share their orbital paths with other objects of similar size are called dwarf planets.
   b. A natural satellite that orbits an object other than a star is called a(n) moon.
   c. Small, rocky objects that orbit the Sun are called asteroids; there are many of these objects in the asteroid belt between the planets Mars and Jupiter.
   d. Small, icy objects that orbit the Sun and develop tails as they get close to the Sun are called comets.
   e. Solid bits of debris that travel through the solar system are called meteoroids.
   f. A meteoroid that passes through Earth’s atmosphere produces a streak of light and is called a(n) meteor.
   g. If a meteoroid reaches Earth, it is called a(n) meteorite.

4. The inner planets are the planets closest to the Sun; they are rocky because when the solar system was forming, the areas close to the Sun were very hot, and the gases were blown away.
   a. There are four inner planets—in order from the Sun, they are Mercury, Venus, Earth, and Mars.
   b. The inner planets formed from heavier elements, have few or no moons, and rotate more slowly than the outer planets.

5. There are four outer planets—in order from the Sun, they are Jupiter, Saturn, Uranus, and Neptune.
   a. The outer planets are made up mainly of gases and other materials that have high boiling points in contrast to the larger, more distant outer planets, which are made up mainly of gases.
   b. The outer planets are larger than the inner planets, have systems of rings, have many moons, and have thick atmospheres.
   c. The Earth’s atmosphere is primarily composed of nitrogen and oxygen.
   d. The outer planets have thick atmospheres due to the force of gravity, which is stronger than on Earth.
   e. The outer planets are the farthest from the Sun and are colder.
   f. The outer planets are the farthest from the Sun and are colder.
   g. The outer planets are the farthest from the Sun and are colder.
   h. The outer planets are the farthest from the Sun and are colder.
   i. The outer planets are the farthest from the Sun and are colder.
   j. The outer planets are the farthest from the Sun and are colder.

Discussion Question

What do all objects in the solar system, aside from the Sun, have in common? Contrast the following pairs of categories: objects in the solar system: planets and dwarf planets; asteroids and meteoroids; comets and moons; inner planets and outer planets.

All the objects in the solar system orbit the Sun. Planets differ from dwarf planets based on the relative size of other objects in their orbital paths; a planet has no object that is similar to its size in its orbital path. Meteors are called meteors when they reach Earth and become meteorites when they land on Earth.
Lesson Outline for Teaching

Lesson 3: Stars, Galaxies, and the Universe

A. Stars
   1. A(n) star is a large sphere of hydrogen gas that is hot enough for nuclear reactions to occur in its core.
   2. The distance light travels in one year, 9.46 trillion km, is a unit of measurement called a(n) light-year.
   3. Stars vary in color, which is related to the temperature of a star.
      a. The coolest stars are red in color; the hottest stars are blue-white in color.
      b. Stars of medium temperature, including the Sun, are orange, yellow, or white.
      c. The Sun is larger than most stars; however it is tiny compared with the giant stars.
      d. The Sun differs from many stars in that it is a(n) solitary star; many stars are part of a(n) binary star system in which two stars orbit each other’s center of mass.

B. Galaxies
   1. A huge collection of stars, gas, and dust is called a(n) galaxies.
   2. Scientists classify galaxies by their shape.
   3. There are three main kinds of galaxies: elliptical galaxies, irregular galaxies, and spiral galaxies.
      a. Elliptical galaxies have mainly older, redder stars and very few younger stars because these galaxies do not have very much dust or gas; these galaxies are shaped like basketballs or footballs.
      b. Irregular galaxies contain large amounts of gas and dust, and many younger stars form from this material; these galaxies are oddly shaped.
      c. Spiral galaxies have a central bulge containing older redder stars and bluish, curved, dust-filled arms containing younger stars.
   4. Our galaxy—the Milky Way—is a large spiral galaxy that has more than 100 billion stars.
   5. The Sun is not in the center of the Milky Way; it is in one of the arms that is about halfway from the center of the galaxy.

C. The Universe
   1. Just as gravity pulls stars near one another into galaxies, this force also pulls galaxies that are near each other into clusters.
   2. The Milky Way is part of a cluster of galaxies called the Local Group, which in turn is part of a supercluster of galaxies called the Local Supercluster.
   3. Clusters of galaxies are grouped together into a(n) supercluster of galaxies, some of which contain thousands of galaxies.
   4. Superclusters of galaxies form sheetlike walls in space.
   5. Stars explode and release elements into space; the elements that form your body originated in a(n) star.

Discussion Question
List the different groups of objects that you have learned about in space, starting with those that are found in the solar system and continuing to the level of the entire universe. What is the common reason that all these groups form?

Planets, including those that have moons, dwarf planets, asteroids, comets, and meteoroids; binary stars; multiple-star systems; galaxies; clusters of galaxies; and superclusters of galaxies.

Gravity is the force that causes each of the objects to form as well as what causes the groups to form.

Lesson Outline continued