

Unit 13: The Earth, the Moon, and the Sun

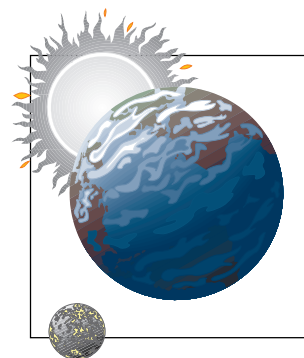
This unit describes the relative positions of the sun, Earth, and moon and changes associated with them. Students will learn about eclipses, tides, and seasons.

Student Goals

- Understand why Earth can support life.
- Describe features of the moon.
- Identify solar and lunar eclipses.
- Identify the phases of the moon and the relative positions of the moon, Earth, and sun.
- Recognize the relationship of tides to the relative positions of the Earth, moon, and sun.
- Understand what causes the seasons.

Unit Focus

- Understand the relationships between events on Earth and the movements of the Earth, its Moon, the other planets and the Sun. (SC.E.1.4.1)
- Know how the characteristics of other planets and satellites are similar to and different from those on the Earth. (SC.E.1.4.2)
- Know the various reasons that Earth is the only planet in our Solar System that appears to be capable of supporting life as we know it. (SC.E.1.4.3)



- Know how climatic patterns on Earth result from an interplay of many factors (Earth's topography, its rotation on its axis, solar radiation, the transfer of heat energy where the atmosphere interfaces with lands and oceans, and wind and ocean currents). (SC.D.1.4.1)



Vocabulary

Use the vocabulary words and definitions below as a reference for this unit.

- corona** the low-density cloud of gases surrounding the sun
- craters** holes or bowl-shaped depressions on a moon or planet
- ebb tide** the movement of a tidal current away from the shore
- elliptical** oval-shaped
- equinox** either of the two times of the year when the number of hours of daylight and darkness are the same in both hemispheres; marks the first day of spring and fall; means *equal night*
- flood tide** the tidal current associated with the increase in the height of the tide
- highland areas** areas on the moon which are high mountain ranges and large craters; appear light in color
- lunar eclipse** an event which occurs when Earth blocks the light as it moves between the sun and the moon
- lunar month** the measure of time it takes for the moon to pass from one new moon to the next (29½ days)



- maria** (MAR-ee-uh) lunar seas or plains on the moon which appear dark
- meteors** fragments of rocky material from space that burn as they fall through Earth's atmosphere; also known as meteoroids
- moon phase** the changing appearance of the moon which depends on the moon's position relative to the sun
- neap tide** tide occurring at the first and third quarters of the moon when the sun, Earth, and moon form a right angle; produces tides in a medium range
- orbit** (noun) the path of an object revolving around another object; (verb) to revolve in an orbit around another object
- partial eclipse** an event which occurs when part of the sun is blocked out by the moon
- penumbra** part of a shadow cast by an object in which light from the source is only partly blocked
- revolve** to move around another heavenly body
Examples: the moon revolves around Earth; planets revolve around the sun
- rotate** to spin on an axis
Example: Earth rotates, causing day and night



- seasons** the four divisions of the year characterized by differences in weather and the number of hours of daylight
- solar eclipse** an event which occurs when the moon passes between Earth and the sun
- solstice** either of the two times a year when the sun is at its greatest apparent distance north or south of the equator; marks the first day of *summer* and *winter*
- spring tide** tide that occurs when the sun, moon, and Earth are in a straight line
- tide** the rise and fall of the oceans caused by the gravitational attraction between the sun, Earth, and moon
- total eclipse** an event which occurs when the sun is completely blocked out by the moon
- umbra** the part of a shadow cast by an object in which light from the source is completely blocked



Introduction

Through scientific study and space exploration, we have learned that Earth exists as a part of a larger system called the *solar system*. Within our solar system, the moon and Earth have a very important relationship. The relationship between sun, Earth, and moon affects many of the everyday occurrences that we take for granted—the **tides**, the amount of solar energy, the length of our days and nights, and the **seasons**.

Learning about this relationship helps us to understand these daily occurrences and to understand our need for future exploration of the world beyond our Earth.



Earth seen from the moon.

The Relationship of the Earth and the Moon

Earth has one moon. The moon **revolves** around Earth about once a month. The moon also turns, or **rotates**, on its axis one time per month. Because of this, we only see one side of the moon. The moon does not give off light of its own. It reflects the light of the sun.

Earth has a blanket of air surrounding it called an *atmosphere*. The moon does not have an atmosphere because it does not have a strong enough gravitational force to hold a blanket of air around it. Since there is no atmosphere on the moon, there is no water. Without an atmosphere and water, the moon is unable to support life.



Without an atmosphere and water, the moon is unable to support life.

Earth is the third planet from the sun. Earth's atmosphere is different from the other planets. It contains oxygen and water vapor and thus can support life. The atmosphere also protects Earth from extremes in



When viewed from Earth, the surface of the moon has light and dark areas.

temperatures. Without an atmosphere, the moon is subjected to very high and low temperatures. The dark side of the moon may get as cold as -175° Celsius, and the lighted side may reach temperatures of 130° Celsius.

When viewed from Earth, the surface of the moon has light and dark areas, which sometimes combine to look like a person's face.

The light-colored areas are **highland areas**. The *highland areas* have mountains that are much higher than any found on Earth. The parts of the moon that appear dark are called **maria**. *Mare* (singular for maria) is the Latin word for *seas*. The maria are flat areas that look like seas, except that they do not have any water in them.

The surface of the moon also has many bowl-like depressions called **craters**. Craters vary in diameter from a few inches to over 500 miles. Most of the craters were produced long ago by the impact of **meteors**. In contrast, Earth has only about a dozen well-known craters. Although many *meteors* travel towards Earth, most of those meteors burn up in Earth's atmosphere. The moon, on the other hand, has no atmosphere to affect the meteors' impacts. Additional craters may have been on Earth in early geologic history, but these have been destroyed by erosion.



The surface of the moon also has many bowl-like depressions called craters.



Practice

Match each definition with the correct term. Write the letter on the line provided.

- | | | |
|----------|--|-------------------|
| _____ 1. | lunar seas or plains on the moon which appear dark | A. craters |
| _____ 2. | to move around another heavenly body | B. highland areas |
| _____ 3. | holes or bowl-shaped depressions on a moon or planet | C. maria |
| _____ 4. | the rise and fall of the oceans caused by the gravitational attraction between the sun, Earth, and moon | D. meteors |
| _____ 5. | the four divisions of the year characterized by differences in weather and the number of hours of daylight | E. revolve |
| _____ 6. | areas on the moon which are high mountain ranges and large craters; appear light in color | F. rotate |
| _____ 7. | to spin on an axis | G. seasons |
| _____ 8. | fragments of rocky material from space that burn as they fall through Earth's atmosphere | H. tide |



Practice

Answer the following using complete sentences.

1. What are two conditions of Earth that allow it to support life?

2. Is there life on the moon? _____

Why or why not? _____

3. Why doesn't the moon have an atmosphere? _____

4. Why does the moon have much hotter and much colder temperatures than Earth? _____



5. Why do we sometimes see a person's face in the moon? _____

6. The word *mare* means sea in Latin, but how do the maria on the moon differ from the seas on Earth? _____

7. Describe the highland areas on the moon. _____

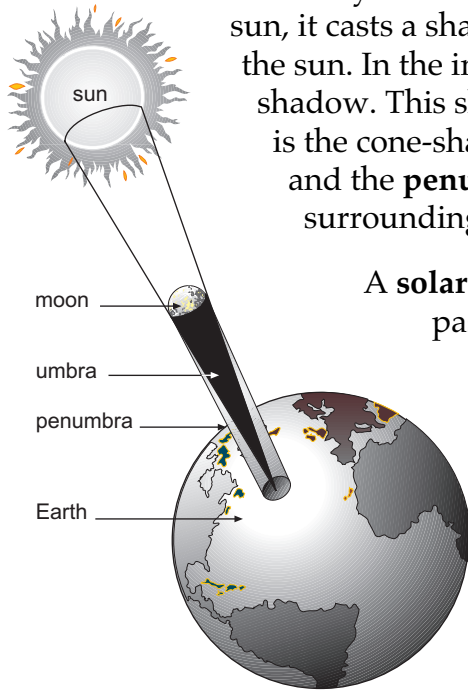
8. What are the bowl-like depressions on the moon? What caused them? _____

9. How large are the craters on the moon? _____

10. Why are the moon's craters so well preserved? _____



Solar Eclipse



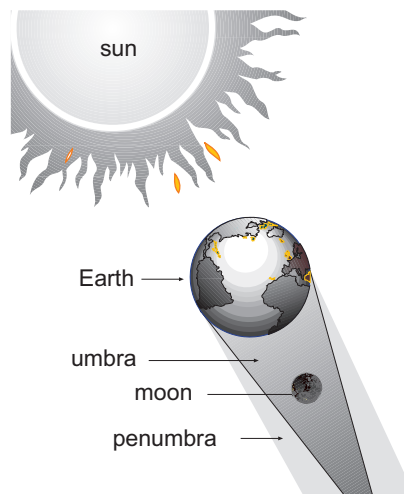
A solar eclipse takes place when the moon passes into a straight line between the sun and Earth.

As a body follows its **elliptical orbit**, or path, around the sun, it casts a shadow thousands of miles long away from the sun. In the image to the left, the moon is casting a shadow. This shadow has two parts—the **umbra**, which is the cone-shaped inner part that is completely dark, and the **penumbra**, which is the partly shaded region surrounding the *umbra*.

A **solar eclipse** takes place when the moon passes into a straight line between the sun and Earth. When the moon is in this position, its shadow moves onto a small area of Earth. During a **total eclipse** of the sun, the moon totally blocks out the sun and, for a short time, becomes dark. Only a halo of light from the sun's rim, called a **corona**, can be seen. Other parts of Earth that fall in the *penumbra* experience a **partial eclipse**, where only part of the sun is blocked by the moon. A *partial eclipse* is seen by many more people than a *total eclipse*.

Lunar Eclipse

When the moon moves into Earth's shadow, we have a **lunar eclipse**. During a *lunar eclipse*, hardly any sunlight reaches the moon and, consequently, it looks very dim. A lunar eclipse will last about three or four hours. It is longer than a *solar eclipse* because Earth's shadow is very wide, and it takes a long time to pass through it. A lunar eclipse can be seen from more areas of Earth than a solar eclipse. Also, there are many more lunar eclipses than solar eclipses.



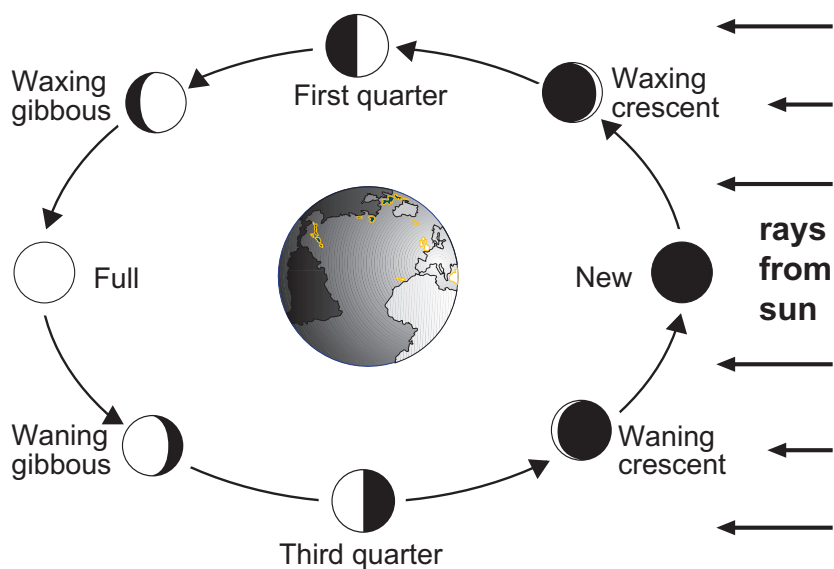
When the moon moves into Earth's shadow, we have a lunar eclipse.








Moon Phases

The moon moves around Earth in exactly the same way that the planets *revolve* around the sun. It takes the moon $27\frac{1}{3}$ days to make one trip around Earth. The moon also *rotates* or spins on its axis one time as it revolves around Earth. While the moon is moving around Earth, Earth is also moving around the sun. Therefore, it takes about two more days for the moon to return to its original position in relation to the sun and Earth. It takes a total of $29\frac{1}{2}$ days for the moon to pass from one new moon to the next new moon. This period of time is called a **lunar month**.

As the moon *orbits* Earth, sometimes the side that is lighted by the sun is facing Earth, and at other times part or all of the lighted side is facing away from Earth. The different portions of the lighted side of the moon that are visible as the moon revolves around Earth are known as **moon phases**.



The circle shows the phases of the moon as seen from Earth.

-  New Moon—when the moon is in between Earth and the sun, the unlighted side of the moon is facing Earth and cannot be seen
-  Crescent Moon—just before and after the new moon; only a slice of the lighted side is seen
-  Quarter Moon—halfway between the new moon and full moon; half the moon is dark and half is lighted
-  Gibbous Moon—just before and just after a full moon; over half of the moon is lighted; it appears lopsided
-  Full Moon—when the moon is on the opposite side of Earth from the sun; the entire lighted side is facing Earth



Practice

Use the list below to write the correct term for each definition on the line provided.

corona	lunar month	partial eclipse	total eclipse
elliptical	moon phase	penumbra	umbra
lunar eclipse	orbit	solar eclipse	

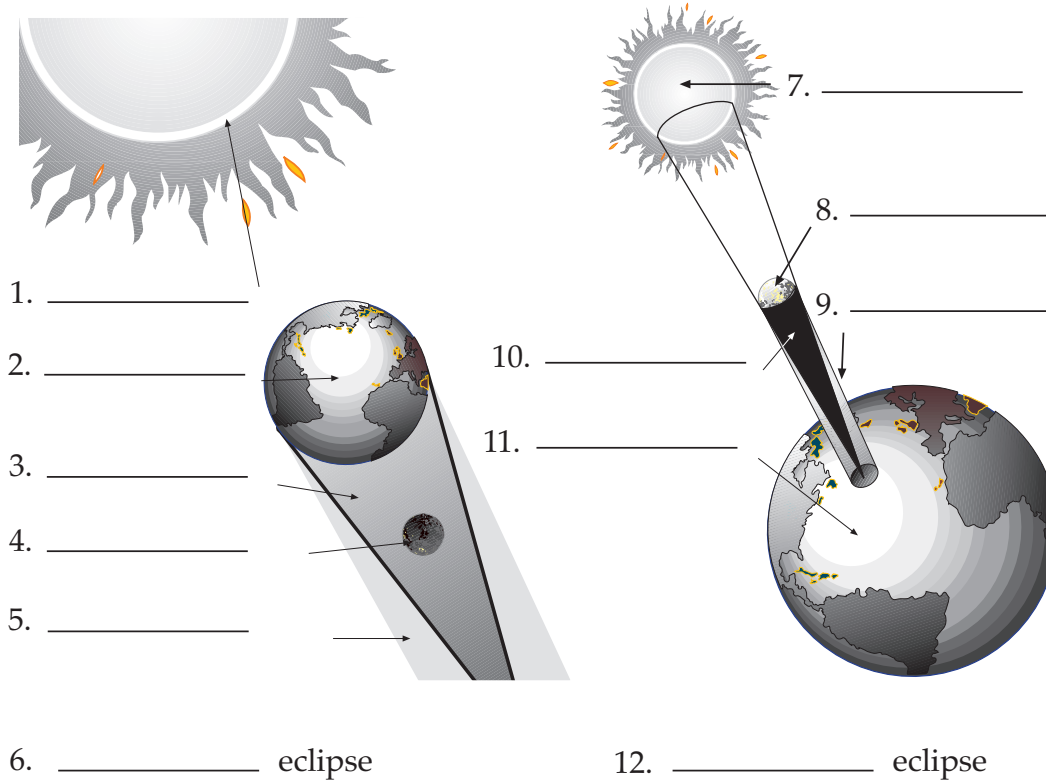
- _____ 1. the measure of time it takes for the moon to pass from one new moon to the next
- _____ 2. oval-shaped
- _____ 3. the changing appearance of the moon which depends on the moon's position relative to the sun
- _____ 4. part of a shadow cast by an object in which light from the source is only partly blocked
- _____ 5. the part of a shadow cast by an object in which light from the source is completely blocked
- _____ 6. the low-density cloud of gases surrounding the sun
- _____ 7. an event which occurs when Earth blocks the light as it moves between the sun and the moon
- _____ 8. the path of an object revolving around another object
- _____ 9. an event which occurs when the moon passes between Earth and the sun
- _____ 10. an event which occurs when part of the sun is blocked out by the moon
- _____ 11. an event which occurs when the sun is completely blocked out by the moon



Practice

Identify the two **eclipses** shown in the diagrams below. Use the list below to label the parts of each. Write the correct term on the line provided. **One or more terms will be used more than once.**

Earth	solar
lunar	sun
moon	umbra
penumbra	





Practice

Match each definition with the correct term. Write the letter on the line provided.

- | | | |
|----------|---|-------------------------|
| _____ 1. | the time that it takes the moon to make one trip around Earth | A. one |
| _____ 2. | the amount of time that it takes the moon to go through its phases from one new moon to the next new moon | B. lunar month |
| _____ 3. | the measure of time it takes the moon to go through its phases | C. $29\frac{1}{2}$ days |
| _____ 4. | the different portions of the lighted side of the moon that we see as it revolves around Earth | D. $27\frac{1}{3}$ days |
| _____ 5. | the number of times the moon rotates during one revolution around Earth | E. phases |
| _____ 6. | where the light of the moon comes from | F. the sun |



Practice

Use the list below to complete the following statements. **One or more terms will be used more than once.**

corona	partial	shadows	three or four hours
lunar	partial eclipse	solar	total
lunar eclipse	penumbra	solar eclipse	umbra

1. Eclipses are caused by the _____ cast by either moon or Earth as they pass by one another.
2. The part of a shadow that is cone-shaped and completely dark is the _____ .
3. The outer, partly shaded part of a shadow is called the _____ .
4. A _____ takes place when the moon passes in a straight line between the sun and Earth.
5. During a _____ eclipse of the sun, the moon totally blocks out the sun, and for a short time it becomes dark.
6. A halo of light from the sun's rim, called the _____ , can be seen around the edges of the moon during a total eclipse.
7. A _____ eclipse can be seen by more people than a _____ eclipse.



8. A _____ occurs when only part of the moon passes in front of the sun.
9. When the moon moves into Earth's shadow, we have a _____ .
10. During a lunar eclipse, hardly any sunlight reaches the moon, and it looks very dim for about _____ .
11. There are more _____ eclipses than _____ eclipses.
12. A _____ eclipse can be seen from more areas of Earth than a solar eclipse.



Practice

Answer the following questions using the **weather section** of your **local newspaper** or the **Internet**; then do the activity that follows.

1. What time will the moon rise today? _____
2. What time will the moon set today? _____
3. On what date this month is there a full moon? _____
4. On what date this month is there a new moon? _____
5. Go outside and observe the moon tonight after it rises. (Check the time in the newspaper.)
6. Fill out the information on the chart below, noting the date and time of your observation. Draw the shape of the moon that you saw. Use a compass or stationary landmark to determine the location of the moon.
7. Record the same information on the same night of the week for the next three weeks and record your findings.
8. Did your results correspond with the information the newspaper gave?

Explain. _____

Date	Time	Shape	Location



Practice


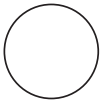
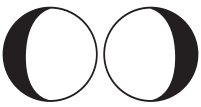


Match each definition with the correct term. Write the letter on the line provided.

- | | | |
|----------|--|------------------|
| _____ 1. | phase when the moon is between Earth and the sun; it cannot be seen because the dark side is facing Earth | A. crescent moon |
| _____ 2. | phase when the moon is on the opposite side of Earth from the sun; we see the entire lighted side | B. full moon |
| _____ 3. | phase just before and after the new moon; only a slice of the lighted side is seen | C. gibbous moon |
| _____ 4. | phase when the moon is halfway between the new moon and full moon; we see one-half of the light side and one-half of the dark side | D. new moon |
| _____ 5. | phase just before and after the full moon; looks lopsided | E. orbit |
| _____ 6. | the path that the moon takes around Earth | F. quarter moon |



Practice

Name each **phase** of the moon that is shown below. In the column on the right, tell where the moon is in **relation** to Earth and sun at each phase.

		Phase	Position
1.		_____	_____ _____ _____ _____
2.		_____	_____ _____ _____ _____
3.		_____	_____ _____ _____ _____
4.		_____	_____ _____ _____ _____
5.		_____	_____ _____ _____ _____