

Reflect

Have you ever heard someone refer to “the Man in the Moon”? The Moon’s surface is covered in deep pits, called *craters*. Seen from Earth, these craters can appear like a the face of a man.



You may have noticed that every night you can see the same, recognizable features that make up “the Man in the Moon.” In other words, no matter what time of year it is, you always see the same side of the Moon. Why do you think this is? Do you think the Moon is fixed in space? Does it **revolve** around Earth, but not **rotate**? Might there be another explanation for this phenomenon?

revolve: to move around, or orbit, something in a circular motion

rotate: to spin

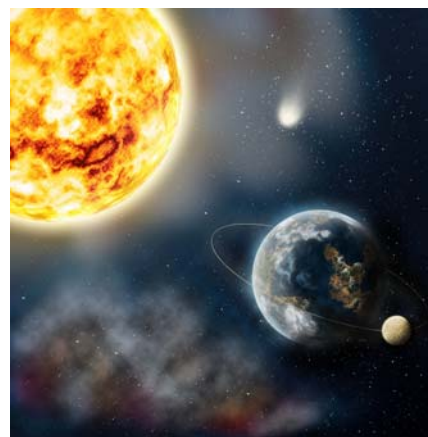
The Moon’s Rotation

Our solar system contains many moons. Like the planets, each of these moons rotates, or spins, about an axis. (An *axis* is an imaginary line through an object’s center.) Earth’s moon, known simply as “the Moon,” is no exception. Like Earth, the Moon has an axis that tilts relative to its orbit. However, the Moon’s axis does not tilt as much as Earth’s. Earth’s axis tilts at an angle of about 23.5°; the Moon’s axis tilts 6.68°.

The Moon rotates on its axis at a continuous rate. On any planet or moon, a *day* is defined as the amount of time that celestial object takes to complete one full rotation about its axis. One Earth day is 24 hours. The Moon rotates much more slowly than Earth. It takes more than 650 hours for the Moon to complete one full rotation about its axis. Therefore, one Moon day is equal to about 27.3 Earth days.

The Moon’s Revolution

As the planets rotate about their axes, they also revolve around the Sun. However, unlike the planets, each of the moons in our solar system revolves around a planet. Some planets have multiple moons, and some planets have no moons; Earth has only one moon.



The Moon revolves around Earth as Earth revolves around the Sun. (This diagram is not drawn to scale. In reality, the Sun is much larger than Earth.)

It takes Earth 365.25 days—one year—to complete one full revolution around the Sun. The Moon revolves around Earth at a much slower rate than Earth revolves around the Sun. Earth is much smaller than the Sun, however, so the Moon makes one full revolution around Earth in much less time than Earth needs to revolve around the Sun. The Moon revolves all the way around Earth in about 27.3 Earth days.

You may have noticed the Moon takes the same amount of time to make one full rotation about its axis as to make one full revolution around Earth. One Moon day is the same as one Moon year. This is the reason you always see the same side of the Moon every night.

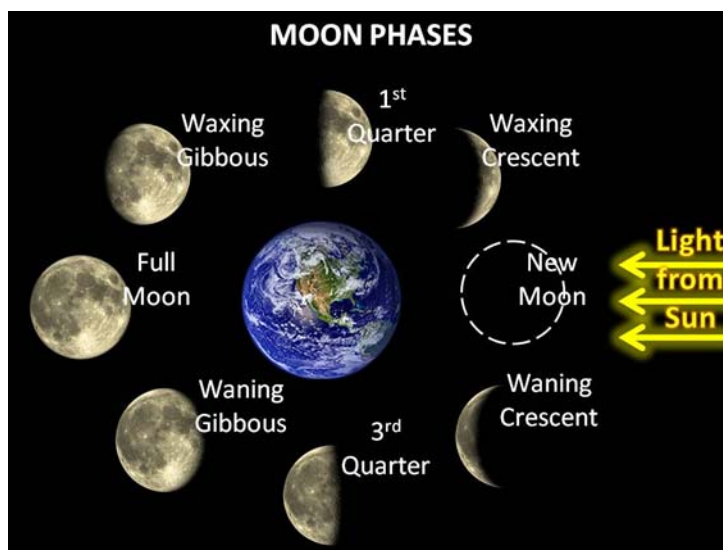
Look Out!

You see the same side of the Moon glowing in the sky each night, no matter where the Moon is in its orbit. However, you don't always see the whole side. Sometimes you see a full circle, but other times you see only a tiny sliver. Even though it appears to be glowing, the Moon does not produce its own light. Instead, the face of the Moon is illuminated by the Sun. The Moon's surface reflects sunlight, so the Moon appears to be glowing when observed from Earth. As it revolves around Earth, the Moon reflects different amounts of sunlight. As a result, we see different amounts of the Moon at different times of the month.

The Lunar Cycle

At any time, the Sun illuminates only half of the Moon's surface. Sometimes, the Sun illuminates the half of the Moon facing Earth. Other times, the Sun illuminates the half of the Moon facing away from Earth. The rest of the time, the Sun illuminates part of the side facing Earth, and part of the side facing away from Earth. This happens in a predictable pattern called the *lunar cycle*.

As the Moon goes through its lunar cycle, we observe different *phases* of the Moon from Earth. During each phase, Earth, the Moon, and the Sun are located in different positions relative to each other. This diagram shows the eight phases of the lunar cycle. Each phase is described in greater detail on the next page.



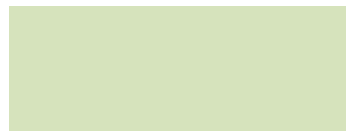
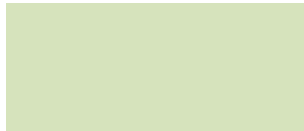
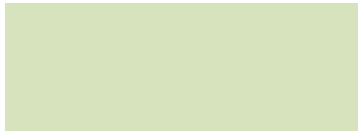
As the Moon revolves around Earth, it moves through these eight phases in its cycle. The lunar cycle happens because the Sun illuminates varying amounts of the side of the Moon that faces Earth.

1. **New Moon:** Occurs when the Moon is located directly between Earth and the Sun. As a result of this alignment, the Sun illuminates the side of the Moon that faces away from Earth. The Moon is not visible from Earth during the new moon phase.
2. **Waxing Crescent:** Occurs as the new moon changes to a first-quarter moon. (*Waxing* describes the period when we see more and more of the Moon from Earth.) During the waxing crescent phase, the Sun illuminates less than half of the side of the Moon facing Earth and more than half of the side facing away from Earth. As a result of this alignment, the Moon appears as a crescent shape in the sky.
3. **First Quarter:** Occurs when the waxing Moon is at a 90° angle relative to Earth and the Sun. During the first-quarter phase, the Sun illuminates exactly half of the side of the Moon facing Earth and half of the side facing away from Earth. The first-quarter phase is also called a half moon.
4. **Waxing Gibbous:** Occurs as the first-quarter moon changes to a full moon. During the waxing gibbous phase, the Sun illuminates more than half of the side of the Moon facing Earth and less than half of the side facing away from Earth. As a result of this alignment, the Moon appears nearly full in the sky.
5. **Full Moon:** Occurs when Earth is located between the Moon and the Sun. During the full moon phase, the Sun illuminates the whole side of the Moon facing Earth. During the full moon phase, the Moon appears as a full circle in the sky.
6. **Waning Gibbous:** Occurs as the full moon changes to a last-quarter moon. (*Waning* describes the period when we see less and less of the Moon from Earth.) The waning gibbous phase is the mirror image of the waxing gibbous phase.
7. **Last (Third) Quarter:** Occurs when the waning Moon is at a 90° angle relative to Earth and the Sun. The last-quarter phase (also called a half moon) is the mirror image of the first-quarter phase.
8. **Waning Crescent:** Occurs as the last-quarter moon changes to a new moon. The waning crescent phase is the mirror image of the waxing crescent phase.

A new moon follows the waning crescent phase, as the cycle starts over again. The Moon takes approximately 28 days to complete one lunar cycle.

What Do You Think?

Use the diagram on the previous page to identify each of these phases in the lunar cycle. Write your answer in the box below each image.

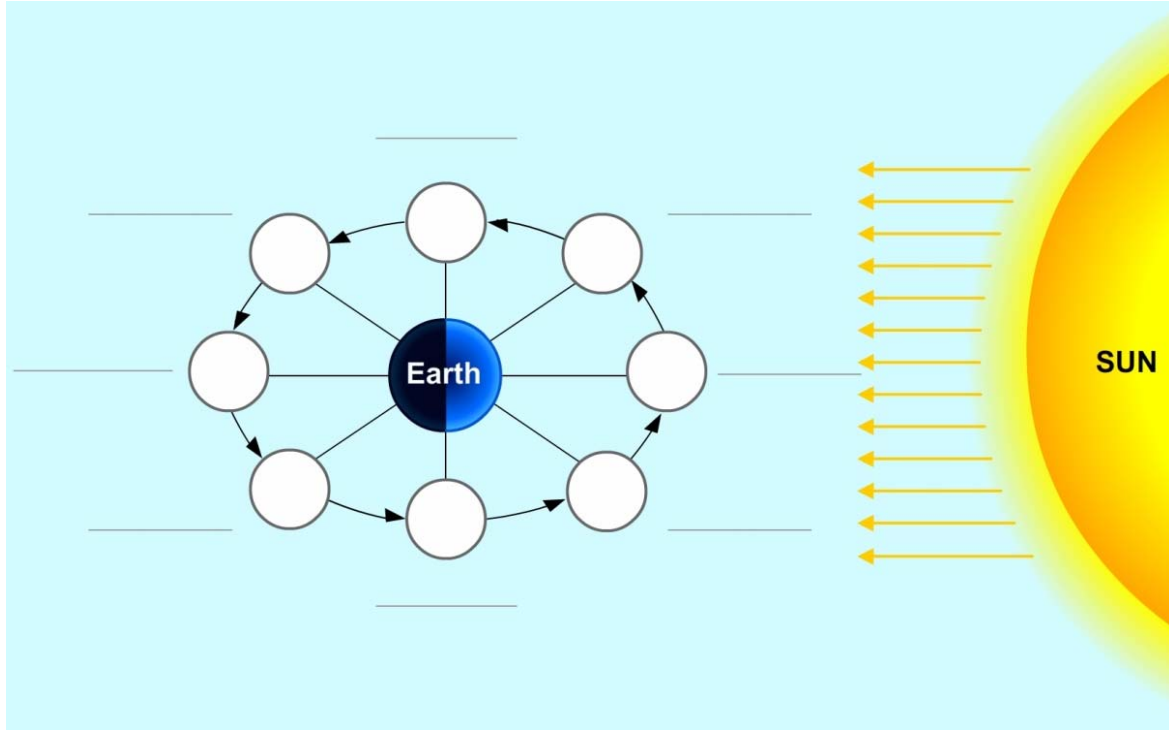
**Scientists in the Spotlight:****Harrison Schmitt**

Only 12 human beings have walked on the surface of the Moon. The last person to do so was Harrison Schmitt, who landed on the Moon on December 11, 1972, as part of the *Apollo 17* mission. Schmitt is the only professional scientist ever to walk on the Moon. All previous astronauts had been pilots, but Harrison Schmitt was a professional geologist. While he went through his flight and astronaut training, Schmitt trained the other astronauts on the mission to perform scientific procedures.

The lunar missions were spectacular achievements in the development of technology. Harrison Schmitt turned them into achievements of science as well. He incorporated geology into the lunar space program by analyzing samples of rocks found on the Moon. This led to major advancements in scientific knowledge about the Moon's features and origins.

What Do You Know?

The lunar cycle includes eight phases. Study the diagram below. Then decide which phase the Moon is experiencing based on its current position relative to Earth and the Sun. Write the name of each phase in the appropriate place on each diagram. Then color in the Moon to show the parts that are illuminated or dark as viewed from Earth during each phase.



Connecting With Your Child: Recording the Lunar Cycle

To help your child learn more about the lunar cycle, try observing and documenting Moon phases together. Choose a time each night to go outside with your child and observe the Moon. Discuss how much of the Moon is illuminated and identify the current phase of the Moon each night; in addition, ask your child to describe the Moon's current position relative to Earth and the Sun. Continue this observation and discussion for 28 nights in order to complete a full lunar cycle. This process will be easiest if you begin on the night of a full or new moon.

To record your observations of the lunar cycle, create a diagram using a large sheet of paper and a compass or round object to trace circles representing the Moon. (Your child can shade the part of the Moon that is dark in each circle.)

Your child should record this information each night for 28 nights:

- The date and time when you made your observations
- The name of the Moon's current phase
- The amount of the Moon that is visible during this phase

Here are some questions to discuss with your child:

- How much of the Moon can you see tonight?
- What phase do you think the Moon is in tonight?
- Where do you think the Moon is located in relation to the Earth and the Sun?
- How much of the Moon do you predict we will see tomorrow? Why?