

Exploration Guide: Moon Phases

The continuous cycle of the phases of the Moon—from New Moon to Full Moon and back again—has fascinated every culture from the dawn of civilization.

The native Inuit people of Greenland believed that Anningan, the Moon god, chased Malina, the Sun goddess, across the sky so stubbornly that he would forget to eat. As a result he would become thinner and thinner until he was eventually forced to leave the sky and come to Earth to eat for three days each month. This period would correspond to the New Moon—the few days when the Moon is almost invisible.

The real explanation of the phases of the Moon is no less fascinating and was proposed as early as 270 B.C. by Aristarchus in Greece.

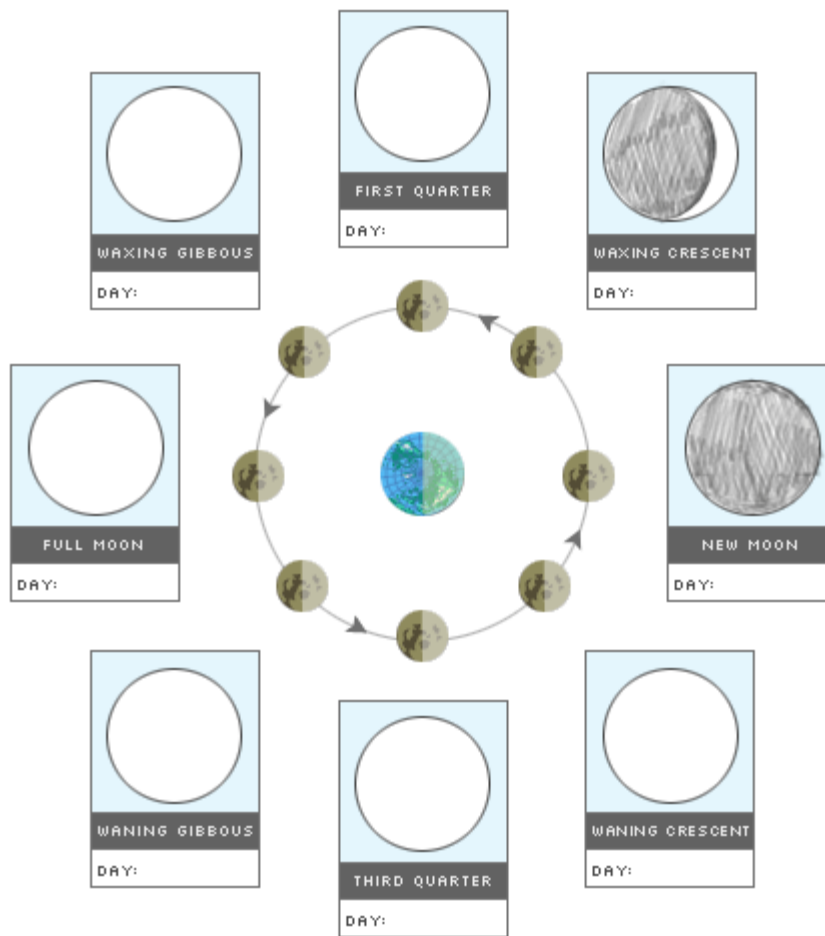
Phases of the Moon

In this activity, you will answer the fundamental question, what causes the phases of the Moon?

1. In the Gizmo[™], set the **Speed** slider to **Fast** and click **Play** (▶). Observe the orbit of the Moon in the **SIMULATION** pane, and the changing phases on the **VIEW OF MOON FROM EARTH** pane. Click **Pause** (⏸) when the Moon has returned to its starting position.
 - a. In which direction does the Moon orbit the Earth, clockwise or counterclockwise?
 - b. Look at the Moon and Earth on the **SIMULATION** pane. At any given time, how much of the Moon and Earth are lit up by the Sun?
 - c. Can an observer on Earth always see the lighted portion of the Moon? Explain your answer.
 - d. When the Moon is between the Earth and the Sun, how much of the

lighted part of the Moon is visible from Earth? Based on the **VIEW OF MOON FROM EARTH** pane, would you be able to see the Moon from Earth at this time? This phase of the Moon is called the **New Moon**.

2. With the simulation paused, click on the Moon in the **SIMULATION** pane and drag it slowly in a counterclockwise direction about one quarter of the way around the Earth. Observe the **VIEW OF MOON FROM EARTH** pane as you do this.
 - a. When the Moon is in this position, how much of the lighted part of the Moon is visible from Earth? This phase of the Moon is called **First Quarter**.
 - b. Continue to drag the Moon slowly around Earth until it is about halfway around the Earth. When the Moon is in this position, how much of the lighted part of the Moon is visible from Earth? This phase is called **Full Moon**.
 - c. As the Moon appears to grow from a New Moon to a Full Moon, it is said to be **waxing**. When viewed from Earth, which side of the Moon is lit during the waxing phases?
 - d. Drag the Moon slowly in a counterclockwise direction back to the New Moon position. As the Moon appears to shrink from Full Moon to New Moon, it is said to be **waning**. When viewed from Earth, which side of the Moon is lit during the waning phases?
 - e. Based on what you have observed, why do we see phases of the Moon?
3. In your notes, sketch the diagram below. Be sure to include the Sun, shown on the right of the image. Click and drag the Moon to each of the positions shown on the diagram. For each position, sketch the **VIEW OF THE MOON FROM EARTH**. Then write the number of days that have passed. The first two phases have been done for you.



Rotation of Earth and the Orbit of the Moon

In this activity, you will explore the nature of the orbit of the Moon as well as the rotation of Earth.

1. Click **Reset** (↺). Set the **Speed** slider midway between **Slow** and **Fast** and click **Play**. Observe the revolution of Earth and the orbit of the Moon in the **SIMULATION** pane.
 - a. From this point of view, what is the direction of the Moon's orbit, clockwise or counterclockwise?
 - b. In what direction does the Earth rotate?
 - c. Click **Reset**, set the speed to **Slow**, and click **Play**. Observe the Earth carefully. Approximately how long does it take for the Earth to complete one rotation? What unit of time is about this long?

2. Click **Reset**, and set the speed to **Fast**. Click **Play**. Observe the flag on the Moon as the Moon orbits the Earth. **Pause** the simulation when the Moon has returned to its starting point.
 - a. What did you notice about the direction of the flag as the Moon orbits Earth? Can an observer on Earth ever see the other side of the Moon? (In other words, the side without the flag?)
 - b. About how many days did it take for the Moon to orbit Earth? This is the **period of revolution** of the Moon. What commonly used unit of time is about this long?
 - c. The flag helps you to see the slow rotation of the Moon. Click **Reset**, and notice that the flag is pointing left. Click **Play**, and then click **Pause** when the flag is again pointing left. How long did it take for the flag to complete one full circle? This is the **period of rotation** of the Moon.
 - d. What do you notice about the period of revolution and the period of rotation of the Moon? How does this help explain why we always see the same face of the Moon from Earth?