



Astronomy: Phases of the Moon



MAIN IDEA

Launch into a lunar exploration of the special relationship between the Earth and the Moon by tracking how the phases of our Moon change in the night sky over time.

SCIENCE BACKGROUND

Originally defined by Sir Isaac Newton, gravity is the attraction force between two masses. Gravity is the force behind why things fall to the ground, why humans don't float through the air, and even why the Earth is spherical in shape. In space, gravity plays a big role as it is the main reason why objects orbit, or in other words travel around, each other. The Moon is Earth's natural satellite and closest celestial neighbor at only about 239,000 miles away. Due to this close proximity, the Earth's gravitational forces bend the path of the Moon as it travels with the Earth around the Sun. Thus the Moon orbits the Earth, and the Earth and Moon together orbit the Sun. For the Moon to complete a full circle around the Earth, it takes about 27 days. However, the phase cycle of the moon lasts approximately 29 days. This two-day difference between the orbit and visible phases is the Moon trying to catch up with the Earth in its orbit around the Sun.

As the Moon orbits our planet, it experiences a cycle of day and night (just like Earth!). However, the Moon's rotation on its own axis takes approximately 27 days, or about the amount of time it takes the Moon to orbit the Earth. This means we only ever see the same side of the Moon lit up at night by the Sun. When looking up at the Moon as it goes through its phases, we can see what parts of the Moon are experiencing daytime and nighttime. The part that is illuminated is experiencing daytime, whereas the shadowed part is experiencing nighttime. The shape of light that we can see on the Moon depends on the alignment of the Moon, the Sun and the Earth. For example, if the Moon is directly in between the Earth and the Sun, the part of the Moon facing the Earth will be completely shadowed. This occurrence is called the New Moon phase. Conversely, if the Moon is fully illuminated by the Sun as we see it from Earth, it is a Full Moon phase. If the Moon is at a 90-degree angle to the Sun, on Earth we see half of the Moon illuminated and half of it in shadow. These occurrences are known as the First and Last Quarter Moon phases.

The Moon goes through a complete phase cycle every 29 days. This cycle can be divided into eight phases:

WAXING CRESCENT

Waxing phases occur when the moon's illumination increases with time. This phase is known as a waxing crescent as light on the Moon begins to be reflected.

FIRST QUARTER

During this phase, the Moon is also called a half-moon because 50% of the Moon's surface facing the Earth is illuminated.

WAXING GIBBOUS

Waxing phases occur when the moon's illumination increases with time. This phase occurs when the Moon is nearing full brightness with over half the circle being illuminated.

NEW MOON

In this phase, the moon sits between the Earth and the Sun, so sunlight is hitting the side of the Moon opposite to Earth. You will not see the Moon that night.

FULL MOON

During this phase, the Moon's surface is fully illuminated as seen from Earth.

WANING CRESCENT

Waning phases occur when the moon's illumination decreases with time. During this phase less than half of the moon's surface as seen from Earth receives sunlight as it cycles back to the new moon phase.

THIRD QUARTER

During this phase, illumination is decreased to just half of the Moon's surface as seen from Earth. Note that this half-moon is shining on the opposite side of the first quarter moon!

WANING GIBBOUS

Waning phases occur when the moon's illumination decreases with time. This phase occurs when the Moon's illumination is between 100% and 50%.



MATERIALS

Journal, Paper, or printed Frost Science Moon Phases Log (see page 5)

Pencil or Marker

Optional: SkyPortal App (free) on a handheld device

Optional: Telescope

ACTIVITY PROCEDURE

STEP 1: Gather materials that are part of this activity toolkit and head outside to a place where you can see the night sky.

STEP 2: Locate the Moon's position in the night sky. If you are having difficulty finding the Moon, try using the SkyPortal App on a handheld device.

If you do not see the moon that night you can also check a moon phases calendar in case there is a New Moon that night (please see Additional Resources).

STEP 3: Record the date, time and location of when and where you observed the moon's phase. It is recommended that you observe the Moon at around the same time and around the same location each night.

STEP 4: In a blank circle, shade in the shadowed portion of the Moon that night.

- ✔ What does it look like?
- ✔ Does it look similar to one of the Moon's eight phases?

STEP 5: Repeat steps 1 through 4 over the course of a week.

- ✔ Does the Moon look the same every day?
- ✔ Did the Moon's phase look different on the first night compared to the last night?
- ✔ What do you think the Moon will look like next week?

PRO TIPS:

Sometimes the Moon is below the horizon, the boundary between the Earth and sky, for an entire night as it orbits the Earth, and thus may not be visible from your location.

You can extend your observations to watch an entire lunar cycle as the Moon goes from New Moon to Full Moon to New Moon again in 29 days! You can continue on your journal or print more copies of the Frost Science Moon Phases Log.

EDUCATIONAL STANDARDS

Kindergarten

Big Idea 5: Earth in Space and Time

SC.K.E.5.4 - Observe that sometimes the Moon can be seen at night and sometimes during the day.

Grade 4

Big Idea 5: Earth in Space and Time

SC.4.E.5.2 - Describe the changes in the observable shape of the moon over the course of about a month.

SC.4.E.5.4 - Relate that the rotation of Earth (day and night) and apparent movements of the Sun, Moon, and stars are connected.

Grade 5

Big Idea 5: Earth in Space and Time

SC.5.E.5.3 - Distinguish among the following objects of the Solar System – Sun, planets, moons, asteroids, comets – and identify Earth's position in it.

Grade 8

Big Idea 5: Earth in Space and Time

SC.8.E.5.9 - Explain the impact of objects in space on each other including:

- ✔ the Sun on the Earth including seasons and gravitational attraction.
- ✔ the Moon on the Earth, including phases, tides, and eclipses, and the relative position of each body.

ADDITIONAL RESOURCES

Moon Phases 2020 Lunar Calendar

<https://www.timeanddate.com/moon/phases/>

Earth's Moon, NASA

<https://moon.nasa.gov/>

Common Moon Misconceptions, NASA

<https://moon.nasa.gov/about/misconceptions/>

Moon Exploration

<http://lunarexploration.esa.int/explore>

The Moon's Phases in Oreos, NASA

<https://spaceplace.nasa.gov/oreo-moon/en/>

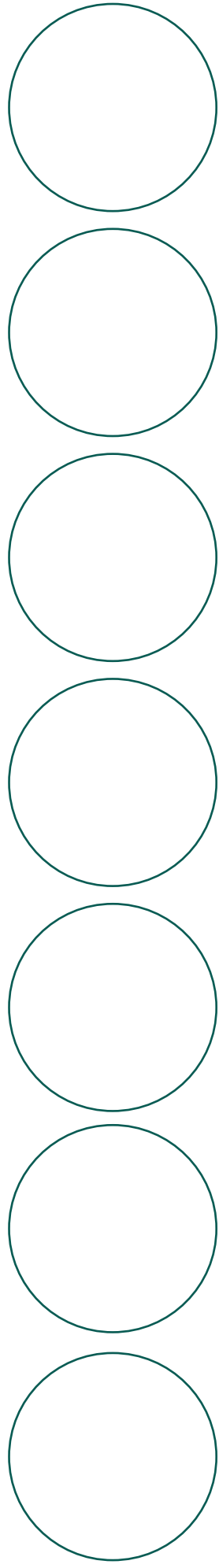


Frost Science Moon Phases Log

Shade the shadowed portion of the Moon for the night.



TIME:.....	TIME:.....	TIME:.....	TIME:.....	TIME:.....	TIME:.....
DATE:.....	DATE:.....	DATE:.....	DATE:.....	DATE:.....	DATE:.....
LOCATION:	LOCATION:	LOCATION:	LOCATION:	LOCATION:	LOCATION:



MOON PHASE:	MOON PHASE:	MOON PHASE:	MOON PHASE:	MOON PHASE:	MOON PHASE:
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Has the Moon changed over the last week?

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