

## How the Moon Phases Work

Fact or fiction? The phases of the moon are caused by the shadow of the Earth falling on the moon.



Fiction! This is probably the most commonly held misconception in all astronomy. Here's how the moon's phases really come about:

The moon is a sphere that travels once around the Earth every 29.5 days. As it does so, it is illuminated from varying **angles** by the sun. At "new moon," the moon is between the Earth and Sun, so that the side of the moon facing towards us receives no direct sunlight, and is lit only by dim sunlight reflected from the Earth. As the moon moves around the Earth, the side we can see gradually becomes more illuminated by direct sunlight.

When the illuminated side of the moon appears to be getting larger in size the moon is said to be in a waxing phase. When the moon is illuminated from 1 % to 49 % the moon is in a "waxing crescent moon" phase. Many people say this looks like a banana or the letter C.

After a week, the moon is 90 degrees away from the Sun in the sky and is half illuminated, what we call "first quarter" because it is about a quarter of the way around the Earth.

The next week the moon continues to be in a waxing state. When the moon is illuminated from 51 % to 99 % the moon is in a "waxing gibbous moon" phase. So more than half of the moon is illuminated.

After this the moon is 180 degrees away from the Sun, so that Sun, Earth and the Moon form a straight line. The moon is fully illuminated by the Sun, so this is called "full moon." This is the only time in the whole month when the Earth's shadow is anywhere close to the moon. The Earth's shadow points towards the moon at this time, but usually the moon passes above or below the shadow and no eclipse occurs.

When the illuminated side of the moon appears to be getting smaller in size the moon is said to be in a waning phase. The moon for the next week will be in a "waning gibbous" phase.

A week later the moon has moved another quarter of the way around the Earth, to the "third quarter" position. The sun's light is now shining on the other half of the visible face of the moon.

For the next week the moon will continue in its waning phase. This moon is called a "waning crescent." You will only see 49 – 1% of the moon.

Finally, a week later, the moon is back to its new moon starting position. Usually it passes above or below the sun, but occasionally it passes right in front of the Sun, and we get an eclipse of the Sun.

So, the moon's phases are not caused by the shadow of the Earth falling on the moon. In fact the shadow of the Earth falls on the moon only twice a year, when there are lunar eclipse. Phases are caused by changes in the relative positions of the moon, Earth, and the sun. Because the sun lights the moon, half the moon is almost always in sunlight. However, **since the moon revolves around Earth, you see the moon from different angles.** The half of the moon that faces Earth is not always the half that is sunlit. **The phase of the moon you see depends on how much of the sunlit side of the moon faces Earth.**

Because of the Earth's rotation, the moon is above the horizon roughly 12 hours out of every 24. Since those 12 hours almost never line up with the 12 hours of daylight in every 24 hours, the possible window for observing the moon in daylight averages about 6 hours a day.

The moon is visible in daylight nearly every day, the exceptions being close to new moon, when the moon is too close to the sun to be visible and a full moon. The best times in the month to see the moon in daylight are close to first and third quarter, when the moon is 90 degrees away from the sun in the sky. So Earth can see the moon in the daytime because the Earth rotates faster than the moon revolves. Earth takes only 24 hours to rotate on its axis and the moon takes 29.5 days to revolve. So if the moon is in any moon phase for over a 24-hour period of time, and Earth takes 12 hours to rotate half way around, all people on Earth will always see the same moon phase on the same day.

