



This shows how the Sun's rays reflect a different portion of the Moon back to a viewer on Earth. When the Moon is between the Earth and the Sun, it is a new Moon. About 7 days later, or about  $\frac{1}{4}$  the way through its full period, only half the Moon appears lighted (this is sometimes called a first quarter Moon...NOT because of how much appears lighted but because of what fraction of its cycle has passed since the new Moon. Half way through the Lunar (about 14 days after new) cycle, the Moon is full (also called a second quarter Moon...NOT because you see any "quarters of the Moon but because the Moon is through 2 quarters of its cycle).

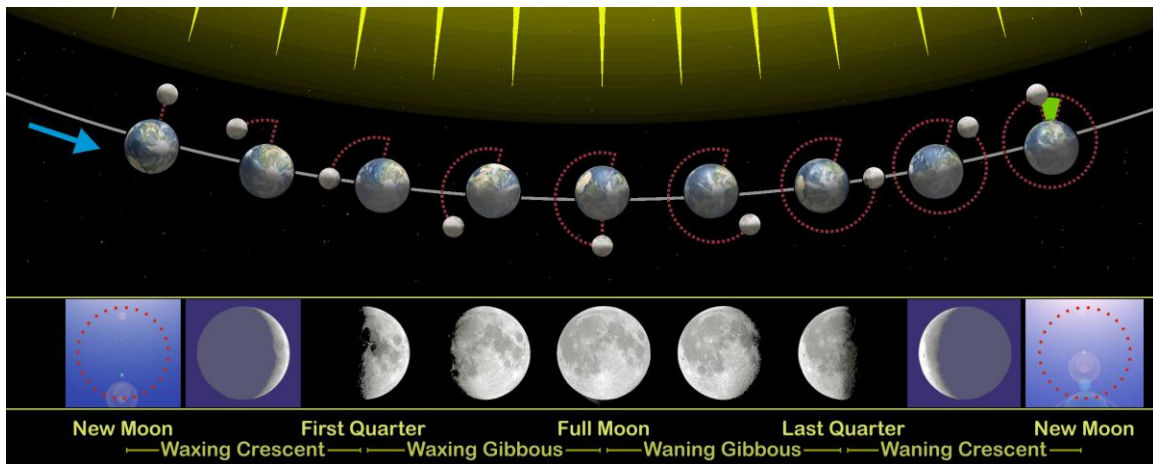
The Lunar cycle, or time it takes for the Moon to return to the phase in which it began (new Moon to new Moon or full to full) is 29.5 days. Since the number of days in a month does not match this 29.5 day cycle, the day a full Moon falls on is constantly shifting.

Some students might find a shortcoming of this illustration. It is the position of the Sun. This illustration works for the first 2 quarters of the cycle...~14.75 days, but if one looks at the illustration, how can the Sun light up the waning gibbous Moon if it is shining from the right and the left side of the Moon appears lighted? This is

because the Sun is shifting in its position in relation to the Moon and the illustration fails.

The following illustration is more complicated but more accurate. The waxing crescent just a day past the new Moon occurs in the evening when the Sun is setting in the West -- just past dusk. (When this occurs on a clear winter night and Venus is the evening star it can be stunningly beautiful.) The next day the Moon rises an hour later and the Sun is still "west" of the Moon with its right side lighted. As the cycle approaches the full Moon, the Moon rises later and later until it rises at the same time the Sun is setting on the evening of a full Moon. As the Moon wanes the Sun seems to be East of the Moon and the left side is lighted. If this seems overwhelmingly complex, do not be discouraged...it took hundreds of years for humans to grasp it all and thousands more to come to our present understanding of it. This west-east description assumes you are looking at the moon in the southern sky, which is the common view point from mid-northern latitudes.

These changes are shown more accurately in the more complex illustration below.



*Phases of the Moon, as seen looking southward from the Northern Hemisphere. The Southern Hemisphere will see each phase rotated through 180° (upside down). The upper part of the diagram is not to scale, as the Moon is much farther from the Earth than shown here. The relation of the phases of the Moon with its revolution around Earth. The sizes of Earth and Moon, and their distance you see here are far from real.*

*On this image the following are also depicted: the synchronous rotation of the Moon, the motion of the Earth around the common center of mass, the difference between the sidereal and synodical month (green mark), the Earth's axial tilt.*

*(NOTE: the precise moment of a New Moon take place in daylight when you can see only the bright Sun.)*

*Now for a table of what is going on!*

Phase	Northern Hemisphere	Southern Hemisphere	Visibility	Standard time of culmination (mid-phase)
<b>New moon</b>	Not visible, traditionally Moon's first visible <b>crescent</b>		after sunset	12 noon
<b>Waxing crescent moon</b>	Right 1–49% visible	Left 1–49% visible	afternoon and post-dusk	3 pm
<b>First quarter moon</b>	Right 50% visible	Left 50% visible	afternoon and early night	6 pm
<b>Waxing gibbous moon</b>	Right 51–99% visible	Left 51–99% visible	late afternoon and most of night	9 pm
<b>Full moon</b>	Fully visible	Fully visible	sunset to sunrise (all night)	12 midnight
<b>Waning gibbous moon</b>	Left 51–99% visible	Right 51–99% visible	most of night and early morning	3 am
<b>Third (last) quarter moon</b>	Left 50% visible	Right 50% visible	late night and morning	6 am
<b>Waning crescent moon</b>	Left 1–49% visible	Right 1–49% visible	pre-dawn and morning	9 am
<b>Dark moon</b>	Not visible, traditionally Moon's last visible <b>crescent</b>		before sunrise	12 noon

The following illustration tries to combine all the previous information from the table and the first image that didn't quite work. Hmmmm... In the end, the only way you will come to fully appreciate the motions of the Moon is to become more connected to Mother Nature and watch the Moon in the sky whenever it is a clear night. Go outside on a clear night, take a snack...maybe a Milky Way candy bar and relax; watch the sky and get connected. A second way is to use an iPad and watch the entire sky changing over hours to days using a app like "skysafari"— which we will be doing in class since we do not have evening classes. You will learn quite a bit by this approach, but there is NO substitute for the REAL THING!

