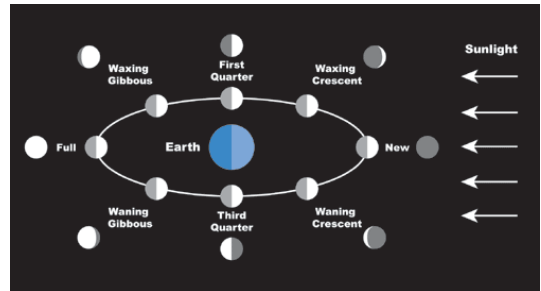




Lunar CRater Observation and Sensing Satellite

Considering The Moon's Phases

When does the Moon rise and set each day? Is the Moon ever visible during the day? When the Moon is in the New Moon phase, the direction to the Sun and the Moon as seen from Earth is very nearly the same. Because that is the case, the New Moon rises with the Sun and sets with the Sun, or rises at sunrise and sets at sunset. When the Moon is in its Full Moon phase, the direction to the Moon and to the Sun as seen from Earth is very nearly opposite.



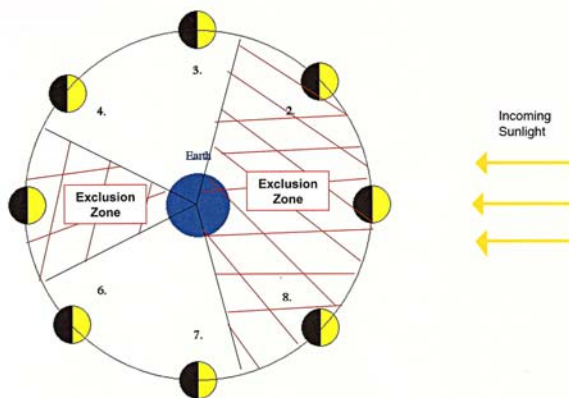
Therefore, the Full Moon rises and sets each day opposite the Sun, rising at sunset and setting at sunrise. Half way in between the New Moon and Full Moon phase is the First Quarter Moon. A First Quarter Moon rises at noon and sets at midnight. Yes, it is in the sky and visible during the daytime! Directly opposite it in terms of geometry, a Third Quarter Moon therefore rises at midnight and sets at noon.

The phases of the Moon we see from Earth can be derived from the change in direction to the Moon and to the Sun as seen from Earth, as the Moon goes through its orbit. Considering the geometry or the relative positions of the Sun, Moon, and Earth for each Moon phase, gives perspective to many considerations about the Moon. Photo courtesy NASA

What phase must the Moon be in, in order to have the correct geometry to make a lunar or solar eclipse possible? Eclipses occur when the Sun, Earth, and Moon are all in a straight line. A lunar eclipse¹ occurs when the shadow of the Earth blocks sunlight from reaching the Moon's surface. Check the above diagram to see that this can only occur during a Full Moon. A solar eclipse² occurs when the Moon blocks our view of the Sun. Check the diagram again to see this can only occur during a New Moon. But, do we have a lunar and solar eclipse with each Full Moon and New Moon?

The answer is no! The Moon's orbit around the Earth is slightly tilted with respect to the Sun's path in the sky due to the Earth's orbit around the Sun, by 5 degrees. This slight tilt means that during most months the Moon is enough above or below the Sun to avoid an eclipse.

Phases of the Moon



Only certain phases of the Moon will work for LCROSS plume viewing:

- 3. First Quarter;
- 4. Waxing Gibbous;
- 6. Waning Gibbous; or
- 7. Third Quarter, as shown.

Photo courtesy NASA/Ames

What must the LCROSS scientists consider about the Moon's phases in timing the impact of the upper stage of the Centaur rocket with the Moon, so that the Moon's excavated material from the impact, or the plume, may be viewed from Earth-based telescopes? Telescopes on Earth cannot view the plume during the daytime. Therefore, the LCROSS impact must be planned to take place during phases of the Moon that are not close to a New Moon. When the Moon is in the New Moon phase it is very close to the direction to the Sun or daylight. In

addition to planning for darkness, the Moon must be sufficiently above the horizon to assure that telescopes are not looking through too much of Earth's light distorting atmosphere. Telescopes also need to avoid the brightness of a Full Moon when observing the plume. All these considerations exclude certain phases of the Moon for observation of the plume, as per the diagram.

1: Lunar eclipse - when the Moon passes through some portion of the Earth's shadow. 2: Solar eclipse - when the Moon passes between the Sun and the Earth, partially or totally obscuring the Sun.

