

Summary of Lecture 4

Key points include:

1. The Moon does not shine with its own light. Instead, it reflects the light of the Sun. Only the side of the Moon facing the Sun has significant light.
2. This is the key to understanding the phases of the Moon. If, for example, Sun–Moon–Earth forms a line in that order, then the lit side of the Moon is away from the Earth and thus we don't see light from the Moon: we have a *new Moon*. If Sun–Earth–Moon forms a line in that order then the lit side of the moon is fully visible from the Earth: we have a *full Moon*. Similarly for crescent, quarter, and gibbous Moons.
3. The Moon orbits the Earth in the same direction that the Earth orbits the Sun. As a result, when the Moon has gone completely around the Earth, it has to go a little bit farther to get to the same location relative to the Sun (for example, to go from one new Moon to the next takes longer than to go from one location to the next relative to the distant stars). This is why, although the orbital period of the Moon around the Earth is 27.3 days, the phases of the Moon are in a 29.5 day cycle.
4. The gravity of the Earth has locked the Moon's spin to its orbit around the Earth. Thus only one side of the Moon is visible to us. But there is *not* a “dark side of the Moon”; as the Moon orbits and rotates, different portions are illuminated by the Sun. There is a near side of the Moon relative to the Earth, and a far side of the Moon relative to the Earth.
5. Eclipses are produced by shadows. When the Earth's shadow falls on the Moon, we have a lunar eclipse. When the Moon's shadow falls on the Earth, we have a solar eclipse. The Earth has $4\times$ the diameter of the Moon, so its shadow is much bigger than the Moon's shadow on the Earth. In fact, by chance, the Moon's apparent (or “angular”) size is very close to the Sun's, so total solar eclipses (when the Sun is completely blocked out by the Moon) are very rare at any given place on the Earth.
6. We don't have a total solar eclipse at every new Moon because (a) the Moon's orbit is tilted (by 5°) relative to the Earth's orbit around the Sun, and (b) the Moon's orbit around the Earth isn't perfectly circular, so there are times when it is too far away to completely block out the Sun.