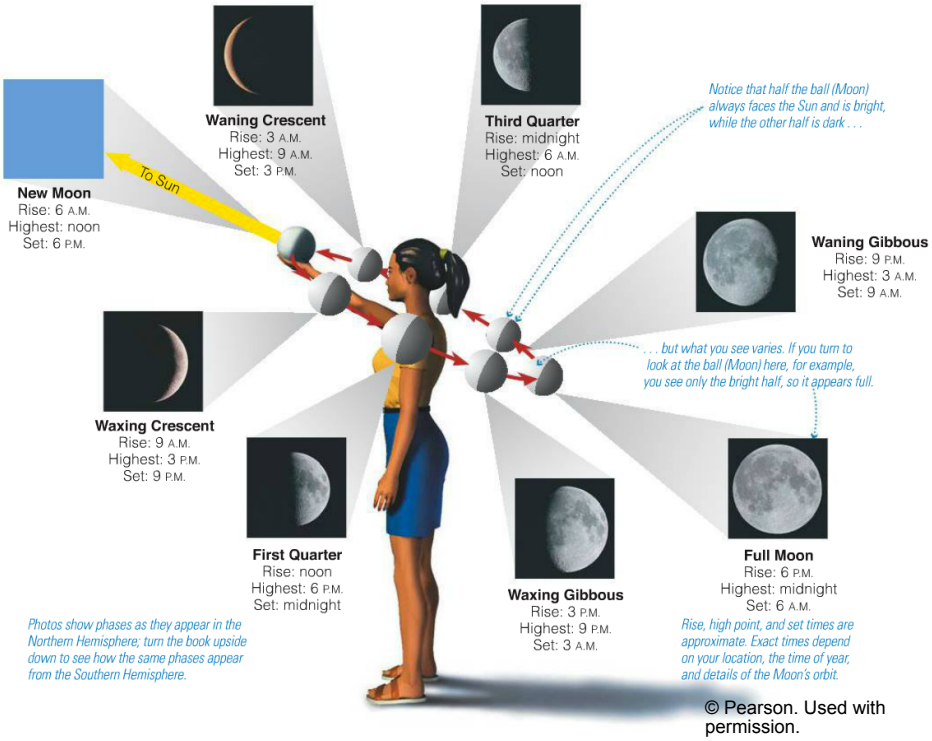
The Moon is the first milestone on the road to the stars.
Arthur C. Clarke

La Luna

Hi AST 111. In this module we'll explore a little bit about la luna, the moon, our constant companion, phases of the moon, telling time by the moon, and eclipses.



So why do we see phases of the moon? Well, as the moon moves through the sky, both its appearance and the times at which it rises and sets changes with the cycle of the lunar phases. The phase of the moon at any given day depends on its position relative to the sun as the sun orbits the Earth about once every 27.3 days.

Now, the complete cycle of phases takes a little bit longer. It takes roughly 29 and 1/2 days, hence the origin of the word month-- moon, month-- because the moon has to go around a little bit longer to reach the same position as the Earth goes around the sun.

In the image above, the Earth is at the center. The sun is to the right, and in the inner circle, you can see that one half of the moon is always lit. In fact, because the moon is in a locked orbit, it's always the same side of the moon that gets lit. And the outer circle then shows the phase that we see on Earth.

On the right, where the Earth, moon, and sun are aligned, the lit side is facing the sun and the

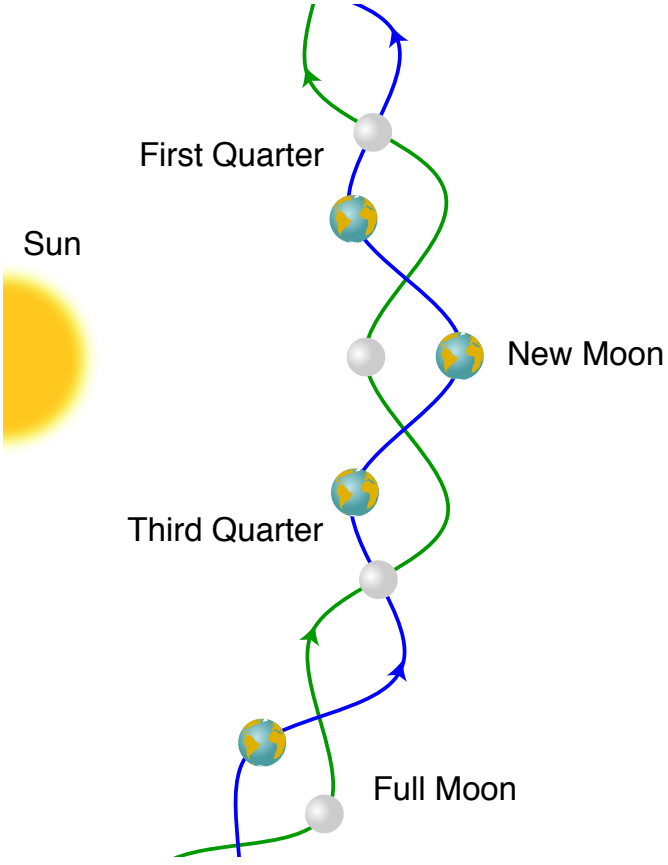
dark side of the moon is facing us. We see a new moon. On the opposite side, when it goes around halfway through its orbit, the front side is lit, the side that we see. This becomes a full moon and the far side of the moon is dark.

Now, one of things that you can do with the moon is you can actually tell time pretty well by the face of the moon. In fact, this is how the ancients did it. How they told time at night was by the moon. It takes a little bit of practice, but over the course of a month or so you can get pretty good. You can nail the time down within about a half hour just knowing the phase of the moon. Each of those phases rises and sets at particular times. So for example, when it's a new moon, the moon is between the sun and the Earth and rises at 6:00 AM. It reaches its zenith, its highest point, at noon, and it sets at 6:00 PM.

By looking at the daytime sky, when you can see the moon, or the nighttime sky, you can tell the time according to where the moon is. The full moon will then rise at 6:00 PM, reaches its zenith at midnight, and then sets at 6:00 AM. Depending on the phase of the moon and its height above the horizon, is on that angle, you can get pretty good at telling what the time is.

The image shows the names of the other phases. The other common phases would be a first quarter, when the moon is half-lit, or the third quarter, when it's also half-lit, and then the various other phases whether it's the gibbous phase or a waning or waxing phase as the moon goes through its different cycles. So study that figure a little bit, and convince yourself that you can tell the time with the moon. Maybe even try it.

Quick, does the Moon orbit the Sun?

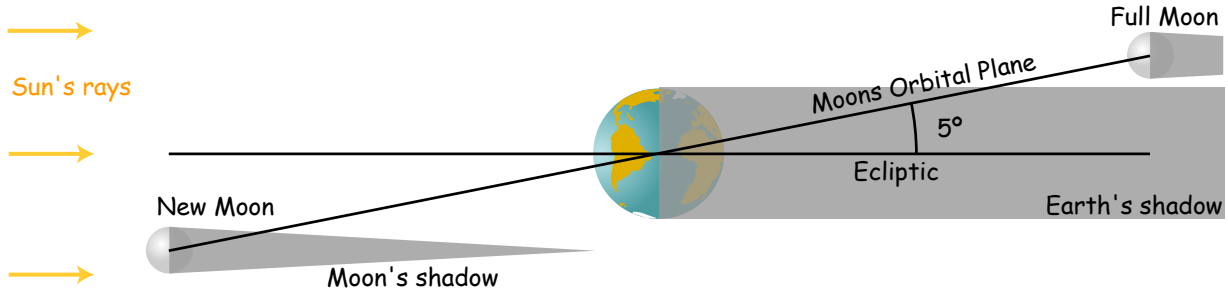


What causes eclipses? Well, occasionally, as we've seen, sometimes the moon is between the Earth and the sun, and at other times, the Earth is between the sun and the moon. And when those happen, you have the possibility of eclipses.

Why? Because each body casts a shadow. The Earth casts a shadow and the moon casts a shadow. If they happen to line up, then those shadows can blot out part of one of the bodies and you get an eclipse.

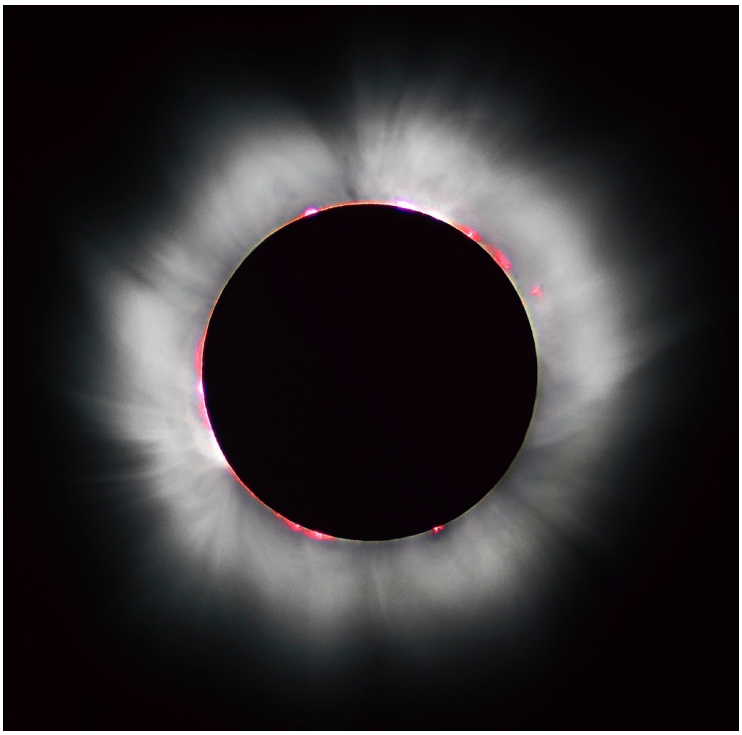
A lunar eclipse occurs when the Earth lies between the sun and the moon, so that the Earth's shadow falls on the moon. A solar eclipse occurs when the moon lies directly between the sun and the Earth, so that the moon's shadow falls on the Earth and people within that covered area of the moon's shadow are going to see the sun blocked out in a glorious solar eclipse.

As we just learned, this seems to happen every month. Once a month the moon is between the sun and the Earth in a new moon phase. In the full moon phase, the Earth is between the moon and the sun.



So why don't we see an eclipse every month, then? Well, the reason we don't see that is because the moon's orbital plane is actually inclined a little bit, about five degrees. So in general, as the figure shows, a full moon is generally above or below the Earth's shadow and not eclipsed. Similarly, with a new moon, the moon's shadow is either below or above the Earth-sun line, and so it can't eclipse the sun.

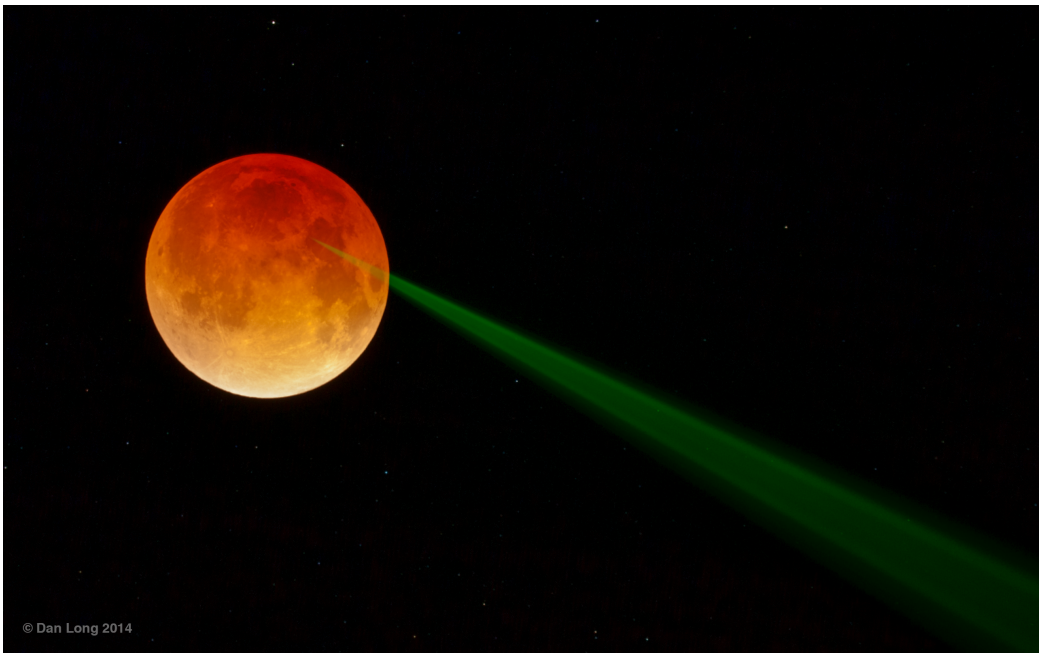
So only when the moon is in the ecliptic planes, that's a plane where all the planets are, and in the new or full phase, do you get the possibility of a lunar or solar eclipse. This generally happens a couple of times a year.



Credit: Wikipedia Public Commons

Solar eclipses happen because of complete coincidence. The sun is about 400 times bigger than the moon. That's a lot bigger. But on the other hand, the sun is also about 400 times farther away. Those two factors of 400 times bigger but 400 times farther away, by coincidence, are such that the moon can then completely overlap the sun.

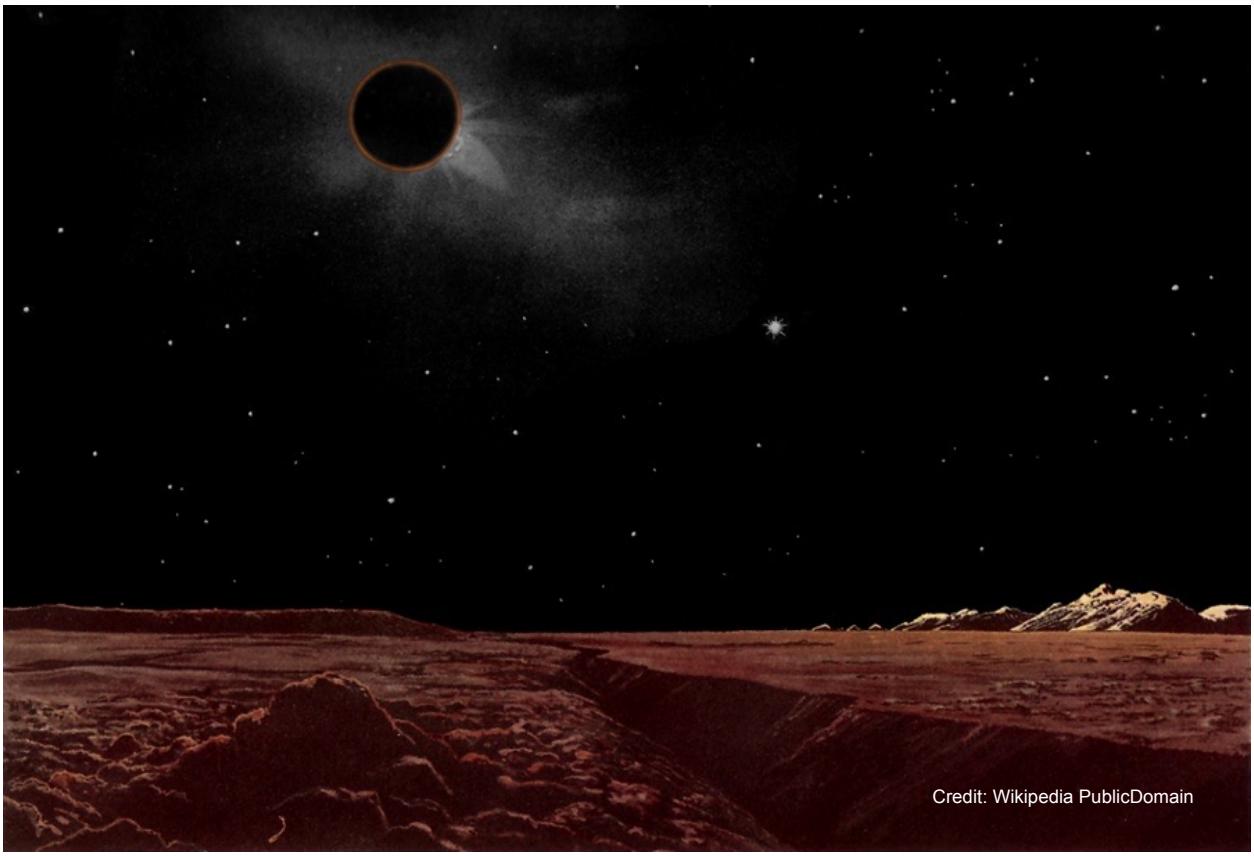
This wasn't always true. In the distant past when Earth was first forming, the moon was a lot closer. The moon is slowly drifting away from the Earth, at about one centimeter per year. And so in the distant future, the moon will be too far away to blot out the sun. So it's only sort of in the special epoch that we're in where the two are exactly balanced and you can get these glorious events known as the solar eclipses.



Total lunar eclipses are often coppery red because the Earth's atmosphere bends some of the sun's red light around the Earth toward the moon. It's the exact same phenomenon that causes a sunrise or a sunset. When the sun is overhead, the light all comes down and the sun looks yellow and the sky is blue and so on and so forth.

When the sun gets to the edge of the Earth, either at sunrise or at sunset, there's just a lot more atmosphere to go through, so the blue light all gets scattered out. It gets absorbed and the only thing that gets through is the longer red light.

The same thing happens with the moon. All the blue light, yellow light from the sun, all gets scattered out, absorbed out. The red light is able to pass through the atmosphere and then go on to the moon. So you will often see the moon in this coppery red color at peak.



If you put yourself in the opposite situation, if you happen to be on the moon during a lunar eclipse on Earth, you would see Earth in a ring of sunsets all the way around the Earth. As the image above suggests, that must be quite a spectacular sight to see!

Thanks! Bye bye.