

Definition of an Eclipse

In general, an eclipse is defined as when one object blocks another object's view of the Sun. Here on Earth, we can have two types of eclipses, a lunar eclipse, when the Earth covers up the Moon (Figure 1), and a solar eclipse, when the Moon covers up the Sun (Figure 2).



Figure 1: Lunar Eclipse

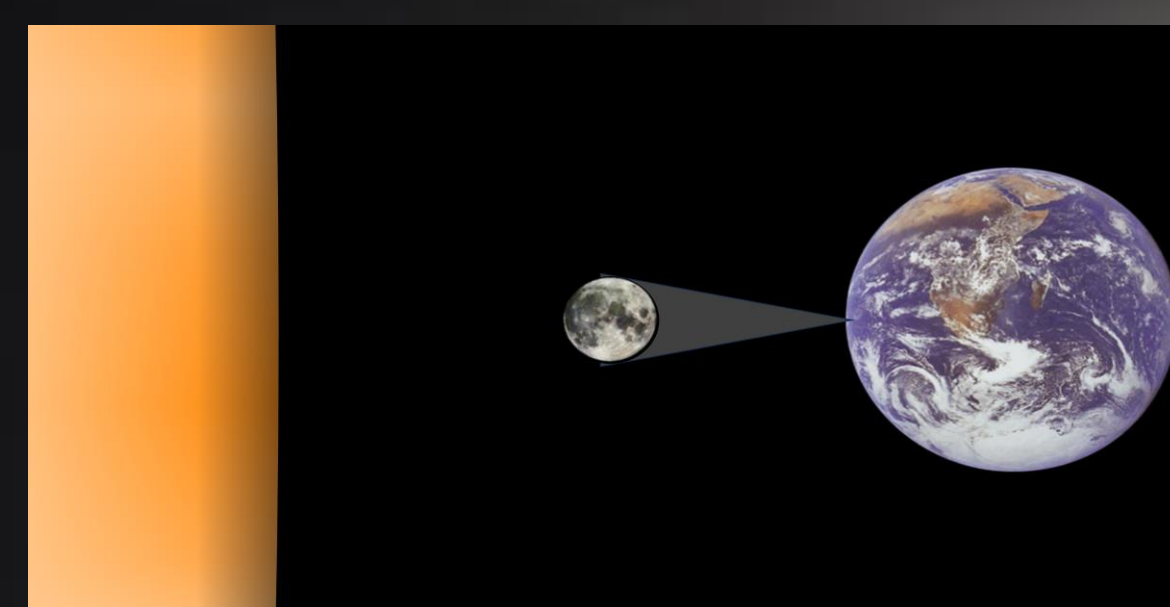


Figure 2: Solar Eclipse

Conditions for a Solar Eclipse

As seen in Figure 2, the Moon must be between the Earth and the Sun for a solar eclipse to occur. The only time that condition is met is when the phase of the Moon is new. The other condition of a solar eclipse is due to the orientation of the Moon's orbit. The Moon's orbit is inclined by approximately five degrees from the plane of the solar system (Figure 3). For a solar eclipse to occur, the new moon phase must happen when the Moon is at one of the two points in its orbit that intersect with the Earth-Sun plane. This is why there is not an eclipse every month

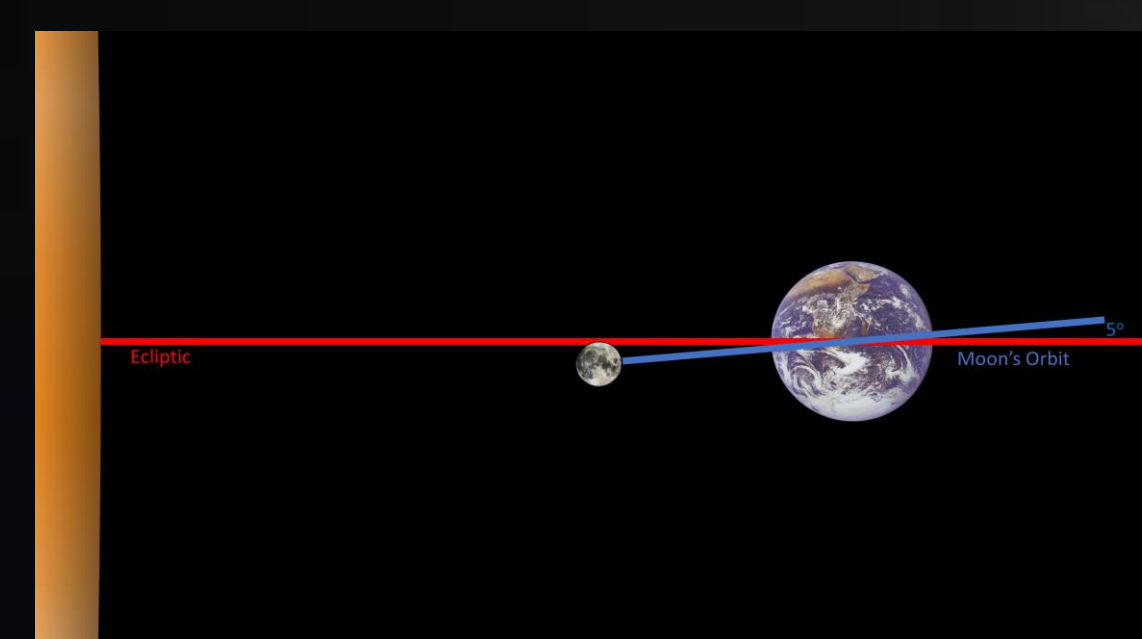


Figure 3: Inclination of Moon's Orbit

Types of Solar Eclipse

Because the Moon orbits the Earth in an ellipse, two different types of solar eclipses can occur. If the Moon is near perigee (closest approach to Earth), it has the same size in the sky as the Sun and a total solar eclipse occurs (Figure 4). If the Moon is near apogee (furthest point from Earth), the Moon is too small in the sky to cover the Sun and an annular eclipse occurs (Figure 5)



Figure 4: Total Solar Eclipse (Courtesy NASA)



Figure 5: Annular Solar Eclipse (Courtesy NASA)

Viewing Solar Eclipses

Even when all the conditions for a total solar eclipse are satisfied, the entire Earth will not see the eclipse. The main reason is the size of the Moon's shadow, which is very small compared to the surface of the Earth (Figure 6). If a geographical location is in the umbra (darkest part of the Moon's shadow), that location will see a total solar eclipse. If the location is in the penumbra, they will see a partial solar eclipse. If the location is in neither, no eclipse will be seen (Figure 7).



Figure 6: Moon's Shadow on Earth (Courtesy NASA)

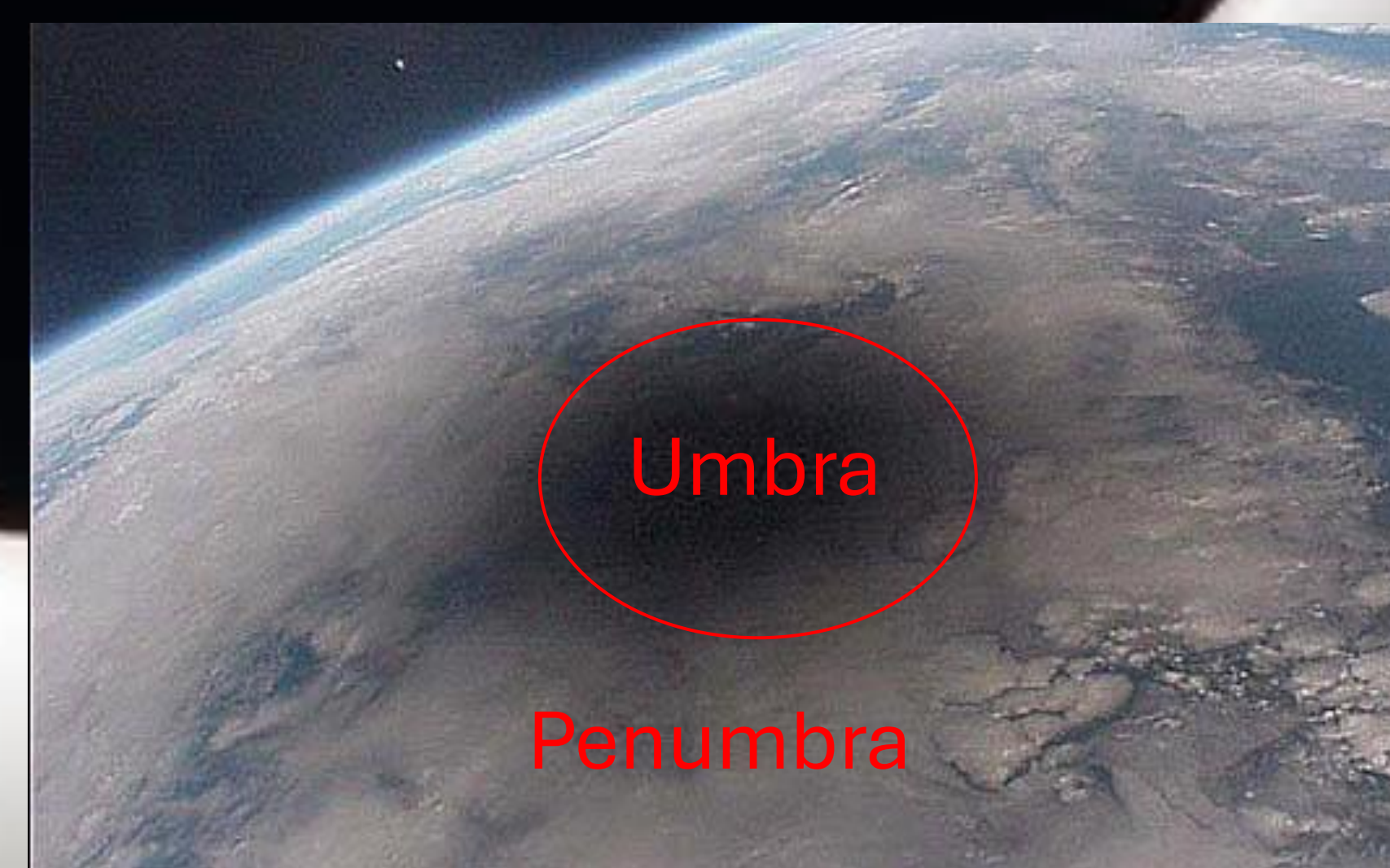


Figure 7: Moon's Shadow on Earth (Courtesy NASA)

Anatomy of a Total Solar Eclipse

The start of the eclipse, called first contact, is when the Moon first covers any of the Sun's disk (12:45 p.m. CDT). The Moon will continue to cover more of the Sun until totality begins, called second contact (2:02 p.m. CDT). Just before the beginning of totality, the Sun will shine through the valleys on the edge of the lunar disk, causing the Bailey's Beads and Diamond Ring effects. Totality will last until 2:05 p.m. CDT when the Sun reemerges from behind the Moon, called third contact. The eclipse will then continue in reverse until the Moon no longer covers the Sun, called fourth contact (3:20 p.m. CDT) (Figure 8)



Figure 8: Timelapse of a Total Solar Eclipse (Courtesy NASA)

Solar Eclipse Safety

In general, it is never safe to look at the Sun with your naked eye. This is especially true during an eclipse. A solar eclipse will decrease the Sun's brightness, but not the danger to our eyes. In fact, because the Sun is not as bright during the partial phase of the eclipse, it is possible to burn your retina since your autonomic response will not cause you to look away. Therefore, you must wear approved solar glasses during the majority of the eclipse. The only time it is safe to remove your solar glasses while viewing the eclipse is during totality.

Rarity of Eclipses

There are four to seven eclipses (both lunar and solar) per year. Of those, two to five of them are solar eclipses (total, annular or partial). So, in general, solar eclipses are not rare events. However, these numbers are for the entire planet. Since most of the Earth's surface is covered by water, most eclipses occur over an ocean. For a specific geographic location, a solar eclipse is rare, and a total eclipse is even rarer. Here in Evansville, we had a partial solar eclipse in 2017 and 2023, and a total eclipse in 2024. The next partial eclipse will not be until 2028 and the next total solar eclipse will not be until 2645.