What Causes Eclipses?

▲ **Figure 22** The color of the Moon during a lunar eclipse can vary from dark gray or brown to red or a coppery orange color.

An **eclipse** occurs when one object in space moves into the shadow cast by another object. Consider how your hand can make a shadow when you hold it between a light source and a wall. In the same manner, solid objects like Earth and the Moon cast shadows in space because they block light from the Sun.

Lunar Eclipses

A **lunar eclipse** occurs when the Moon moves into Earth's shadow. During a lunar eclipse, people on the night side of Earth can see the Moon slowly turn dark as it moves into Earth's shadow (Figure 22). As the Moon moves back out of Earth's shadow, it shines once again from reflected sunlight.

Lunar eclipses happen when the Moon, Earth, and Sun line up in space, with Earth between the Moon and the Sun (Figure 23). Since this is the position during the full Moon, lunar eclipses occur only when the Moon is full. However, eclipses do not happen at every full Moon. This is because the plane of the Moon's orbit around Earth is tilted slightly from the plane of Earth's orbit around the Sun. During most full Moons, the Moon is slightly above or below the plane of Earth's orbit, so the Moon does not pass through Earth's shadow.

Earth's shadow has two zones. The **umbra** is the darkest zone of the shadow, where sunlight is completely blocked. Around the umbra is a lighter zone called the **penumbra**, where some, but not all, of the sunlight is blocked.

The type of lunar eclipse depends on the Moon's position in relation to Earth's shadow. When the entire Moon moves into the

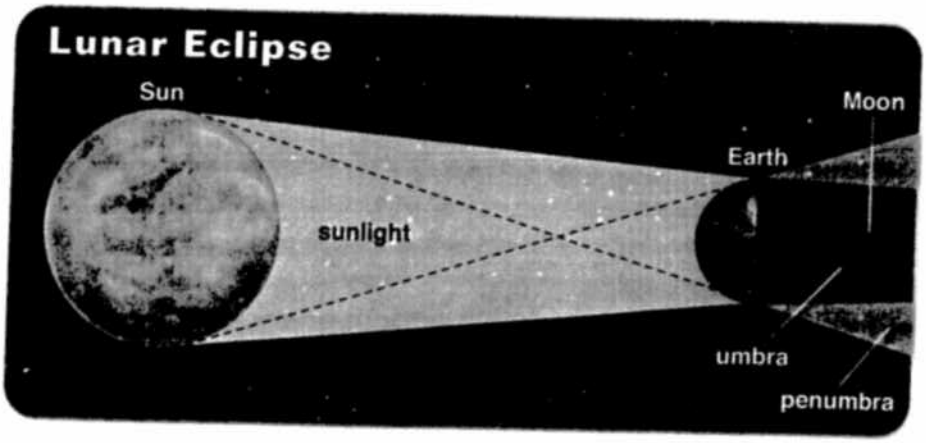
READ TO UNDERSTAND

- When can a lunar eclipse be seen on Earth?
- When can a solar eclipse be seen on Earth?
- How can the Moon block our view of the Sun, which is much larger?

VOCABULARY

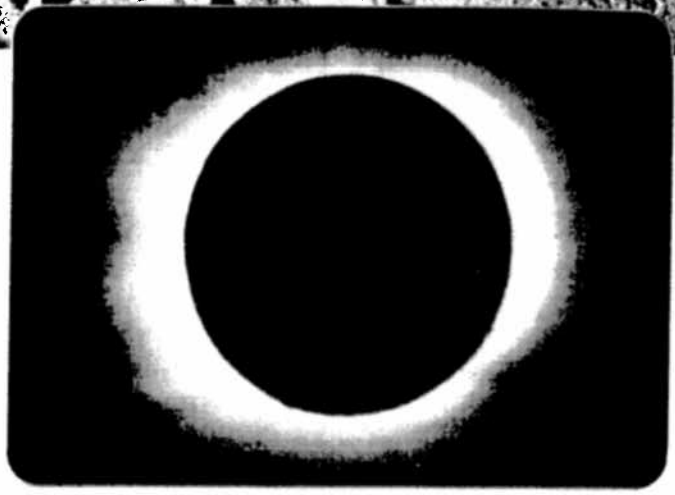
eclipse, lunar eclipse, umbra, penumbra, solar eclipse

▼ **Figure 23** A lunar eclipse happens only during a full Moon, when Earth is between the Moon and the Sun. A lunar eclipse can be seen by everyone on the night side of Earth.



umbra, a *total eclipse* can be seen from Earth. At the moment of a total eclipse, the whole Moon appears dark. A *partial eclipse* can be seen when only part of the Moon moves into the umbra.

People can watch a lunar eclipse safely without any special equipment. The Moon takes about 3.5 hours to pass through Earth's shadow. The total eclipse phase is shorter but can last up to 2 hours. Up to three lunar eclipses can occur in a year. Total lunar eclipses are slightly less common than partial lunar eclipses.



▲ **Figure 24** During a total solar eclipse, only the outer part of the Sun's atmosphere can be seen.

Solar Eclipses

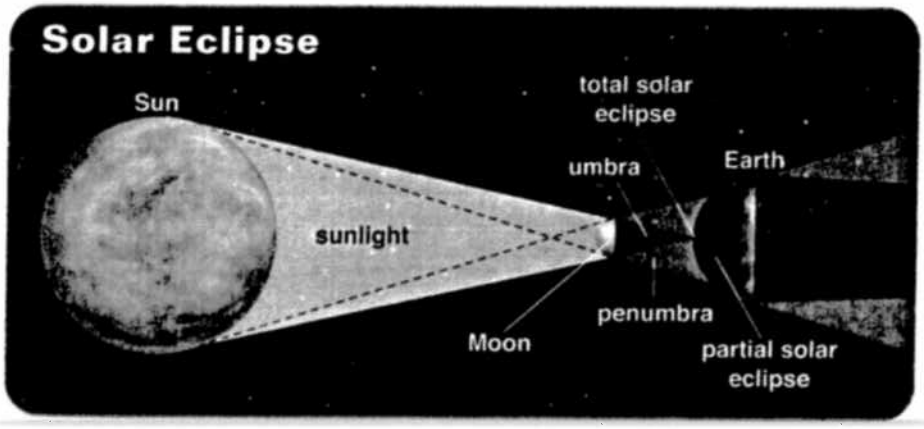
A **solar eclipse** occurs when Earth moves into the Moon's shadow. During a solar eclipse, the Moon can be seen moving in front of the Sun, blocking out most of its light (Figure 24).

Solar eclipses happen when the Moon, Earth, and Sun line up in space, with the Moon between Earth and the Sun (Figure 25). This position occurs only during a new Moon. As with lunar eclipses, the plane of the Moon's orbit prevents solar eclipses from happening at every new Moon.

A total solar eclipse can be seen only from the part of Earth that is in the Moon's umbra. As the Moon moves, its umbra travels across Earth's surface in a path called the "path of totality." During a total eclipse, only the Sun's corona can be seen around the edge of the Moon's disk. The sky is darkened and stars can be clearly seen. A partial solar eclipse can be seen from the areas of Earth that are in the Moon's penumbra. The disk of the Moon appears to move over part of the Sun.

The Moon is 400 times smaller than the Sun, so how can the Moon block the Sun? The Moon also happens to be about 400 times closer to Earth than the Sun is. You can model this by using a quarter to block the light from a full Moon. Although the quarter is much smaller than the Moon, the quarter can cover the Moon because the quarter is so much closer to your eye.

Caution: Never view a solar eclipse directly. Looking at the Sun, even during an eclipse, can cause permanent eye damage. Instead, you can project an image of the eclipse onto a piece of paper using a sheet of cardboard with a pinhole poked into it. Solar eclipses can last anywhere from a few minutes to a few hours. A solar eclipse occurs somewhere on Earth in most years. Total solar eclipses are more rare than partial solar eclipses.



◀ **Figure 25**
A solar eclipse happens only during a new Moon, when the Moon is between Earth and the Sun. Total solar eclipses occur fewer than 70 times a century. The path of a total solar eclipse is usually less than 320 kilometers (about 200 miles) wide.