

## Annular eclipses of the Sun

The Moon's elliptical orbit carries it as close as 355,000 kilometres to Earth (perigee) and as far away as 405,000 kilometres (apogee), in a cycle of about 27½ days. This range of about 13 percent also causes a variation of 13 percent in the apparent size of the Moon. However, that variation is not readily observable except with accurate measuring devices.

In a cycle lasting 29½ days, the Moon goes through phases, from new, to first quarter, to full, to last quarter, and back to new again. There is no connection between the cycle of phases and the cycle of distance, and at any particular phase of the Moon, such as new Moon, it may be at its nearest to Earth, its furthest, or anywhere in between.

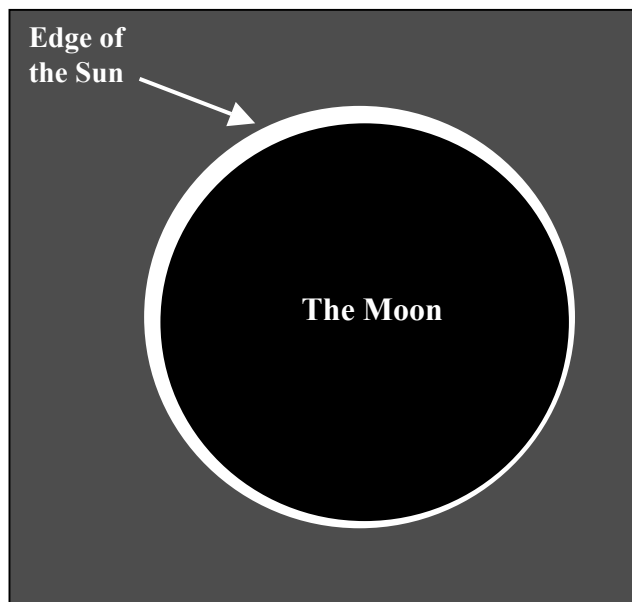
Solar eclipses occur about twice a year, when the new Moon is directly in line with the Sun as seen from some point on Earth. If the new Moon occurs when the Moon is at least as close as average to Earth, the Moon appears to be at least as big as the Sun, and the eclipse will be total. For a few seconds at least, the entire Sun will be covered by the Moon when viewed from a point on the Earth. That point sweeps over Earth's surface, from the sunrise horizon (west side of Earth) to the sunset horizon (east side), at about 1 kilometre per second.

But what happens when the Moon is further away than average when an eclipse occurs? At such times, the disk of the Moon is a bit smaller (up to 10 percent smaller) than the disk of the Sun. The Moon's umbral shadow falls short of Earth. An observer underneath that point will see a thin ring, or annulus, of uneclipsed Sun around the black disk of the Moon. Please note, it is an annular, or ring-shaped eclipse, not an "annual" eclipse! Again, there will be a track of annularity that sweeps across the Earth from west to east. Observers within about 3,000 kilometres of the path will see a partial eclipse.

Annular eclipses are as common as total solar eclipses, and there is one visible somewhere from Earth every couple of years. They are interesting, although not nearly as much as a total eclipse. Even a thin ring of sunlight prevents us from seeing the much

fainter solar corona, and the stars do not come out as they briefly do during total eclipses.

There is a rare type of eclipse known as an annular-total eclipse, occurring roughly once a decade. The Moon's shadow may be just barely long enough to reach the surface of the Earth where it is nearest to the Moon (at which point it will be close to local noon), but not long enough to reach the surface near the "edges", i.e. the areas where it is near sunrise or sunset. Such an eclipse begins as an annular eclipse, and as the path of annularity sweeps eastward and approaches the Earth's surface, the Moon's size increases. At some point, the Moon's size is exactly the same as the Sun's, and there will be a total eclipse for a moment. The Moon's size continues to grow until its shadow passes the midday point on Earth. It then shrinks again, to another point of exact size match. Between these two points is an extremely narrow strip of Earth from which an observer would see a very brief total eclipse. From that second point onwards, observers will again see an annular eclipse.



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