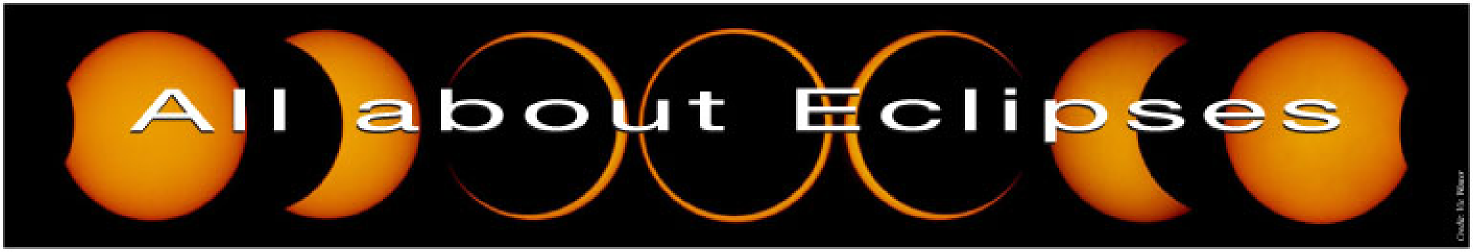
Sun-Earth Day

"The most spectacular and awe-inspiring sight in all of Nature."
— Fred Espenak, NASA astronomer

ECLIPSE in a different light

Find out where, when, how! Watch it live on our webcasts!
Learn when the next eclipse will occur where you live!

www.nasa.gov



Eclipse Basics

The Moon orbits Earth once every 29 days with respect to the Sun. During this period, the Moon undergoes all its familiar phases: new, first quarter, full, last quarter and back to new. During the new phase, the Moon passes between the Sun and Earth so the Moon's side illuminated by sunlight is turned away from Earth. This means that we cannot see the Moon in the new phase.

The Moon's orbit is tilted slightly compared to Earth's orbit around the Sun. As a consequence, the Moon usually passes a little above or below the Sun at most new moons. On rare occasions, the Sun, Moon and Earth line up at new moon phase so that some portion of the Moon's shadow falls onto Earth's surface. At that time, the Moon is seen to pass across the Sun and we experience an eclipse of the Sun.

Most people think that solar eclipses are quite rare but there are actually two to five eclipses every year. They only seem rare because each eclipse can only be seen from a small part of Earth.

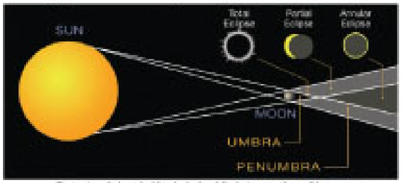


Illustration of where the Moon's shadow falls during an eclipse. Observers on Earth will see a different kind of eclipse depending on what part of the Moon's shadow falls on them.

The next total solar eclipse visible in North America will not occur until 2017. The next total solar eclipse anywhere will be March 29, 2006 with the path of totality crossing the west coast of Brazil, North Atlantic, Africa, and the Middle East.

The Geometry of Solar Eclipses

Solar eclipses can only occur during new moon phase and only when the Moon's shadow falls upon Earth. This shadow is actually composed of two parts. The penumbra is the pale, outer shadow where only part of the Sun is eclipsed. The umbra is the Moon's dark, inner shadow where the Sun's light is completely blocked. The diagram above (not drawn to scale) illustrates the geometry of eclipses caused by the Moon's two shadows.

There are three general classes of solar eclipses (as observed from any particular point on Earth):

- *Partial Solar Eclipses* occur when the penumbra of the Moon's shadow passes over a region on Earth's surface. A viewer sees only a portion of the Sun blocked by the Moon.
- *Total Solar Eclipses* occur when the umbra of the Moon's shadow touches a region on the surface of Earth. The Sun's bright disk is completely hidden from view.
- *Annular Solar Eclipses* occur when a region on Earth's surface is in line with the umbra, (like a total eclipse) but the Moon appears too small to completely cover the Sun. This happens because the Moon's orbit around Earth is an ellipse. As the Moon's distance from Earth changes, so does its apparent size.

At a partial eclipse, the Moon covers only a portion of the Sun's bright disk. In comparison, the Sun's disk is completely covered by the Moon at a total eclipse. Finally, the Moon covers the center of the Sun's disk during an annular eclipse, but the outer edge of the Sun remains visible as a bright ring (as shown in the photo series at the top of this poster).

Photo from space of the Moon's shadow striking Earth during an eclipse

A total eclipse can only be seen from within the narrow track of the Moon's umbra as it crosses Earth's surface. This path of totality is rarely more than 170 miles wide. Similarly, an annular eclipse can only be seen within the narrow track of the Moon's umbra. This path of annularity is rarely more than 230 miles wide. Outside the path of either a total or annular eclipse, the Moon's penumbra produces a broad band about 4000 miles wide where a partial eclipse can be seen.

How often do eclipses occur? There will be 36 solar eclipses from 2001-2025 of which 15 will be total eclipses on some part of Earth's surface – a little less than the average of about one a year. The common myth that eclipses don't occur very often has evolved because seeing a total eclipse from a specific point on the surface of Earth is not common.

Experiencing a Total Solar Eclipse

Every total eclipse begins with a partial eclipse in which the Moon gradually covers more and more of the Sun's disk. It usually takes about an hour for the Moon to completely cover the Sun before the start of the total phase or totality. During most of this time, the Sun and sky remain remarkably bright so that you would never know an eclipse was happening.

In the last minutes before totality, events occur at an accelerated pace. The sky in the direction of the Moon's shadow grows dark like an approaching thunderstorm. Sunlight shining through tree leaves reveals a series of crescent shapes on the ground below. Shadows take on an odd sharpness and daylight appears weak and grey.

In the final seconds, the Moon's dark shadow rises above the horizon like a curtain rushing towards you. The Sun's remaining crescent breaks up into a series of brilliant points along one rim of the Moon. These Baily's beads are caused by sunlight shining through deep valleys along the edge of the Moon. The last flash of light as the Sun disappears behind the Moon gives the appearance of a diamond. At the same instant, the Sun's ghostly white corona encircles the Moon forming the so-called diamond ring effect.

As totality begins, the solar corona (extended outer atmosphere of the Sun) blazes into view. The corona is a million times fainter than the surface of the Sun. It is only visible when a total eclipse blocks the Sun's brilliant disk from view. The sky is now an eerie twilight that is dark enough to see the planets and the brighter stars. Sometimes ruby red prominences can be seen along the edge of the Sun. These are huge clouds of hydrogen gas that are larger than Earth. Animals often behave as if night has fallen and the temperature can drop 15 degrees F.

The period of totality rarely lasts more than a few minutes (about seven minutes maximum). The Moon's disk begins to uncover the Sun as totality ends. Baily's beads and the diamond ring are seen once again as the corona fades from view and daylight returns.

A total eclipse is the most spectacular and awe-inspiring sight in all of Nature. Once seen it will never be forgotten. If you ever have an opportunity to observe a total solar eclipse, don't miss it!

About the eclipse photo on the front side: This 1991 photograph captures the brief moment of totality when the Sun's faint corona is most easily observed. It is made up of several photographs from cameras with different settings that were later combined into one image. Credit: Steve Albers, Dennis di Cicco, and Gary Emerson.

The Baily's Beads effect is seen here as sunlight begins to peek through valleys on the Moon just before or after a total solar eclipse

Partial solar eclipse at sunset – from this viewer's perspective the Moon will only cover a portion of the Sun

As the Sun begins to emerge from behind the Moon, a brightening on the Moon's edge creates the "diamond ring" effect

A photographer is captured as he watches a total solar eclipse at sunset at Antarctica in 2003. The eclipsed sun appears oval due to atmospheric effects.

Observing Eclipses

It is never safe to look at a partial or annular eclipse, or the partial phases of a total eclipse, without proper equipment and techniques. The lens in your eye can focus the Sun's rays just like a magnifying glass. This can cause permanent eye damage or blindness. Since the eye's retina has no pain sensors, you might not even know it's happening! Please be very careful and use safe techniques for viewing the Sun.

The projection technique is a simple and safe way to watch an eclipse. It requires two pieces of stiff white cardboard about 8" x 10" in size. Use a straight pin to make a small hole in the center of one piece of cardboard called the projector board. The second piece is the screen board. Hold up the projector board (with pinhole) so that its shadow falls onto the screen board. You will see a small image of the Sun safely projected onto the screen board. Try using a distance of 2-3 feet between the two boards. The larger this distance, the bigger the Sun's image will be.

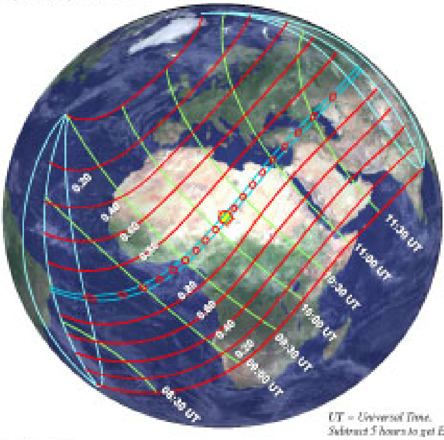
If you own a pair of solar viewing glasses (sold for less than $2.00), you can safely view an eclipse with these. Or you could use solar projecting products like sunspotters or solarscopes. Or even a telescope with an approved solar filter.

Light filtering through leaves on trees casts circular shadows during an annular eclipse in May 1994

If you have some shade trees in your location, try looking at the images of the sun coming through the holes that are formed by the leaves and projected onto the ground (see image above). A piece of white poster board is handy to have for great viewing.

The March 29, 2006 Total Eclipse

There will be a total eclipse on March 29, 2006. The path of totality begins in Brazil and extends across the South Atlantic Ocean, through Africa, and into Asia. It appears on the map below as the narrow pair of blue lines with small red circles in between. The red lines labeled 0.80, 0.60, 0.40 and 0.20 show the areas where a partial eclipse can be seen. The numbers indicate the fraction of the Sun's diameter eclipsed. The farther one travels from the path of totality, the smaller the partial eclipse. The longest period of totality will be just over four minutes. The next total solar eclipse after this will occur on August 1, 2008, and will be visible from northern Canada, Greenland, and central Asia.



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Did You Know?

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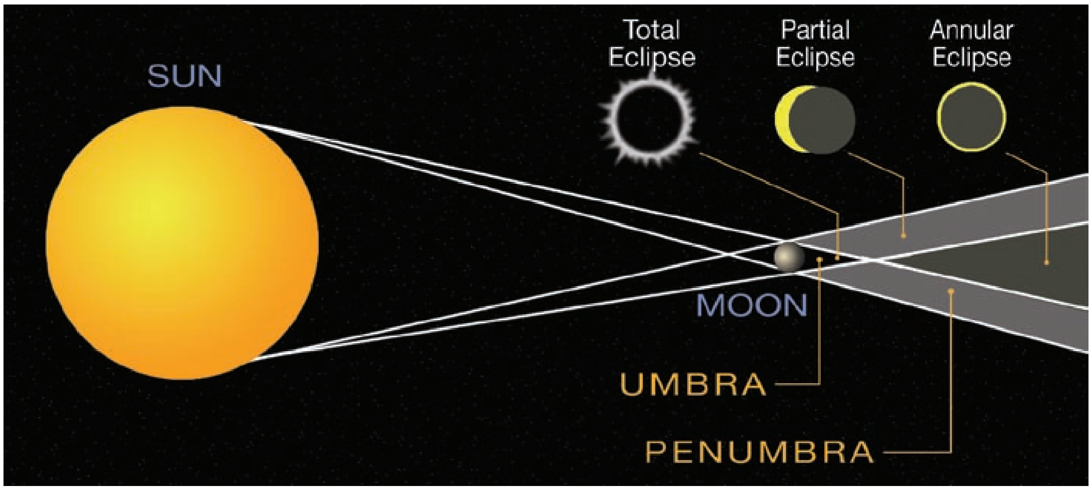

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Credit: Centre National d'Etudes Spatiales

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Credit: Ruth Benn

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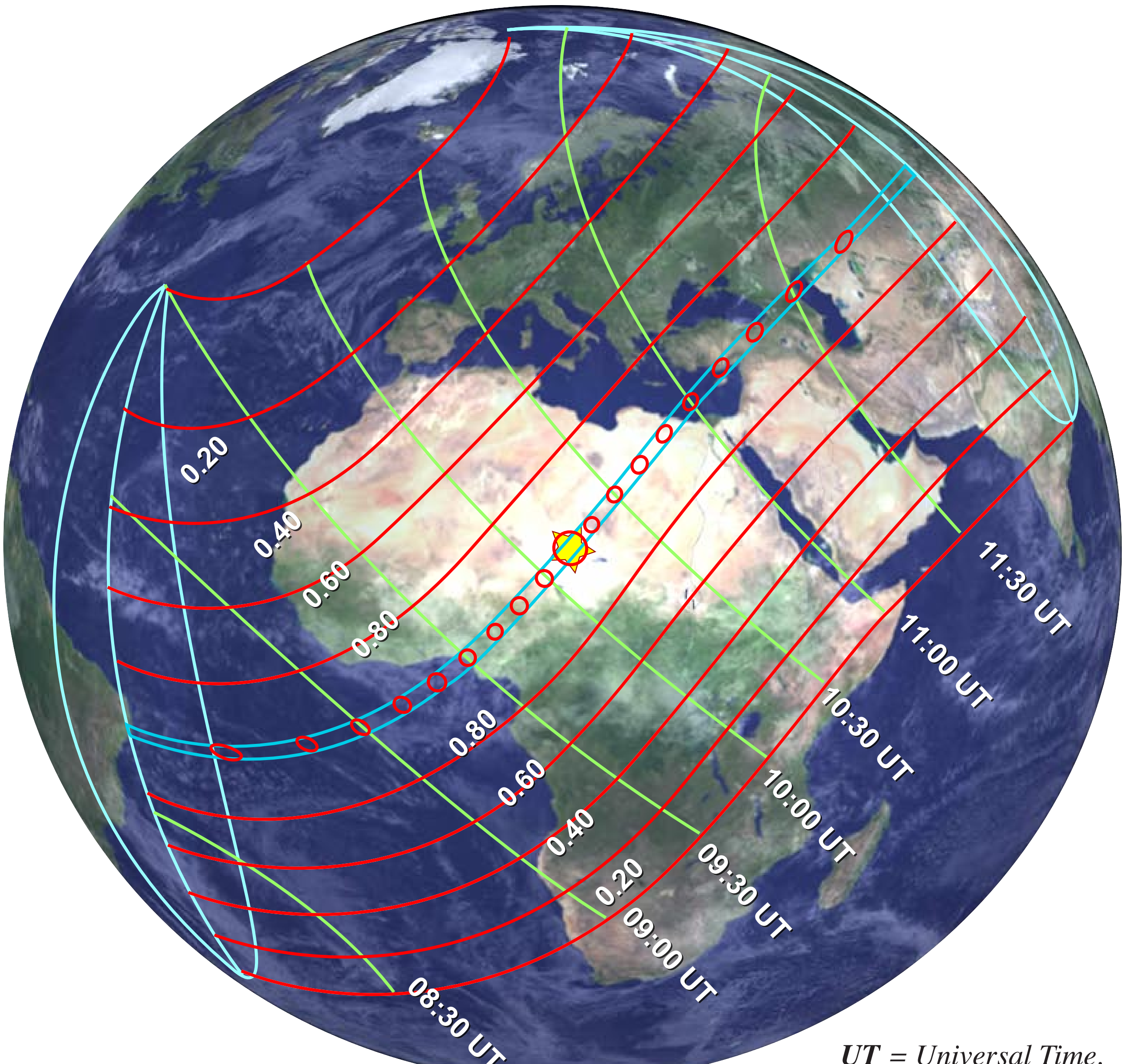

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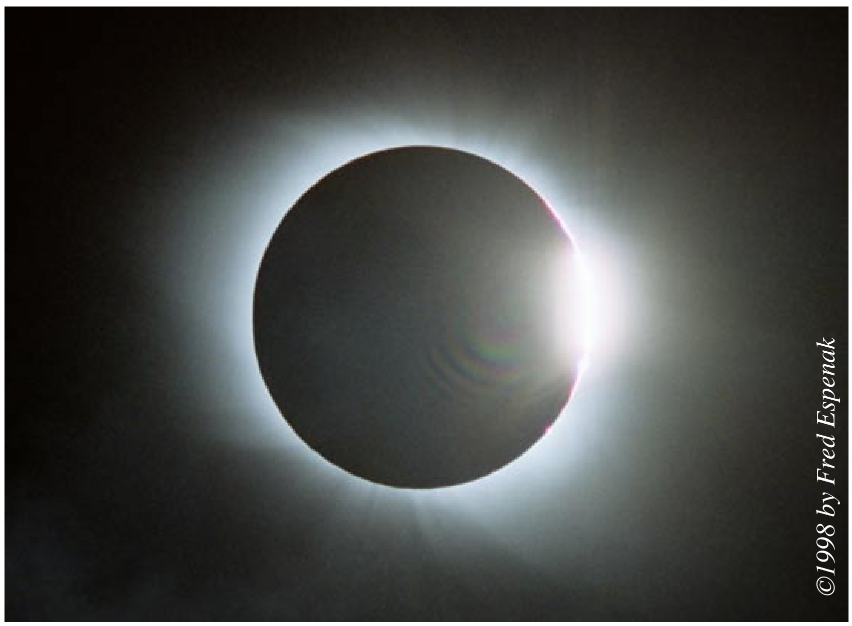

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