All About Eclipses

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Why is the word “eclipse”?

Summary
A borrowing from French.
Etymon: French eclipse.

< Old French eclipse, esclipse, < Latin eclipsis, Greek ἐκλείπεις, noun of action < ἐκλείπειν to be eclipsed, literally to forsake its accustomed place, fail to appear.

From: Oxford English Dictionary
The Sun is ~400 times larger than the Moon, but it’s also ~400 times farther away.

Both the Sun and the Moon have an angular size of 1/2° so they appear as the same size in the sky.

Angular size of an object depends on both the object’s linear diameter (its actual size) and its distance.
Why don’t we experience two eclipses each month?

The Moon's orbit is tipped ~5° with respect to the **ecliptic** (plane of Earth’s orbit.)

The Moon’s path is alternately slightly north (above) and slightly south (below) the Earth’s orbital plane (no eclipse occurs)

A node is where the Moon’s orbit intersects the Earth’s orbital plane (the line connecting the two nodes - “line of nodes“)
When does an eclipse occur?

An eclipse will occur only if:

- the three bodies (Moon, Earth, Sun) are in alignment and
- The New/Full Moon must be at/near a node (the line of nodes points at the Sun)

No eclipse here
Eclipse Geometry

Intersection of the Moon (in its orbital path) and the ecliptic (Earth’s orbital plane)

Possible Solar eclipse

Possible Lunar eclipse

Note – the above examples of eclipses will be Partial Eclipses since the Moon is near the Node (and not ‘at’ the Node)
The Moon becomes a reddish color during a Total Lunar Eclipse because the only sunlight getting to the Moon has been refracted (bent) around the Earth’s atmosphere.

Lunar eclipses can only occur at the Full Moon phase.

The Moon passes through the Earth’s shadow, so the Earth blocks the Sun’s direct light from reaching the Moon...
These images show the Earth’s shadow (blue curve) sweeping across the Moon during a lunar eclipse.

Aristotle (~350 BC) observed lunar eclipses and reasoned that the Earth caused the shadow and that the Earth must be round!
A penumbral lunar eclipse takes place when the Moon moves through the faint, outer part of Earth's shadow, the penumbra. This type of eclipse is not as dramatic as other types of lunar eclipses and is often mistaken for a regular Full Moon.
The umbra is the region of total shadow.

The penumbra is the region of partial shadow.

Solar eclipses can only occur at the New Moon phase.

The Earth passes through the Moon’s shadow, so the Moon covers (or partially covers) the bright disc of the Sun.
The umbra of the Moon’s shadow ‘touches down’ on Earth causing a total solar eclipse.

Eight photos made by a weather satellite have been combined to show the Moon’s shadow moving across Mexico, Central America, and Brazil.

Note - a Partial solar eclipse will result if the alignment is not perfect OR your location is outside of the Path of Totality (only a portion of the Sun’s disc is covered).
The Great American Eclipse
Total Solar Eclipse: Aug 21, 2017

Locally: Partial Solar Eclipse in RI
(RI was outside of the Path of Totality)

Photos taken by a camera attached to a telescope
(by Rebecca Reddy at the Greenville Public Library)

Photo taken by me with my cell phone through the eyepiece of the telescope
Observed only during a total solar eclipse when the bright surface of the Sun (photosphere) is covered by the Moon:

- the Chromosphere: thin, red atmospheric layer
- the Corona: larger, whitish halo
- Baily's Beads/Diamond Ring Effect: seen just before & at the end of totality
Annular Solar Eclipse

Annular eclipses occur when the Moon would be at or near the farthest point in its orbit.

Named for the annular ring of sunlight that is seen.
During an Annular eclipse, the corona and chromosphere are not visible as even the small amount of the Sun's disc that is visible completely overwhelms the faint glow of the corona.

Annular Solar Eclipses

May 2012 near Albuquerque, New Mexico,

October 2005 as seen from Spain
Total Solar Eclipse
April 8, 2024

Obscuration for this eclipse: 91.50%
The eclipse obscuration is the fraction of the Sun’s area that is covered by the disk of the Moon

Magnitude of this eclipse: 0.923
The magnitude of an eclipse is the fraction of the diameter of the disk of the eclipsed body that is covered by the eclipsing body

Note - in Rhode Island, the event will be viewed as a Partial Solar Eclipse (we are outside of the Path of Totality)

Partial begins: 2:15:08 pm
Maximum: 3:29:06 pm
Partial ends: 4:38:43 pm

View at this eclipse’s maximum extent in RI
Magnitude of the April 8\textsuperscript{th} solar eclipse in RI: 0.923

This graph shows the reduction in daylight as the Moon covers the Sun from 1st contact (the beginning of the partial eclipse) to 2nd contact (the beginning of the total eclipse) 1/4 hour later for a typical solar eclipse. Eclipse magnitude refers to the fraction of the Sun's diameter covered by the Moon; eclipse obscuration (mentioned in the text) is the fraction of the Sun's area covered by the Moon and is more closely related to the change in brightness. Most of the reduction in ambient illumination occurs in the final minute or so before totality, and daylight returns just as quickly at totality's end.

\textit{Courtesy the author}
How to safely view the April Solar Eclipse

Do NOT use your naked eyes, sunglasses, or UNFILTERED cameras/binoculars/telescopes!

Photos taken by an unfiltered Smartphone camera may damage the camera... use a solar filter

Safe to use:

- Eclipse glasses
- Telescope with solar filter
- Pinhole projector
- Kitchen 'gadgets': colander, grater, grill sheet with holes
Thank you for attending!

Here’s hoping for clear skies on April 8th!

Please join us for our Solar Eclipse Watch Party beginning at 2pm!

For information on reputable sellers of solar filters:
https://eclipse.aas.org/eye-safety/viewers-filters