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Lunar Eclipse FAQ

Courtesy Prof. Patricia Reiff, the Rice Space Institute. Paid for by NASA MMS education program. Also thank various websites (listed) for imagery. This may be freely copied for classroom use; contact Prof. Reiff for commercial use.

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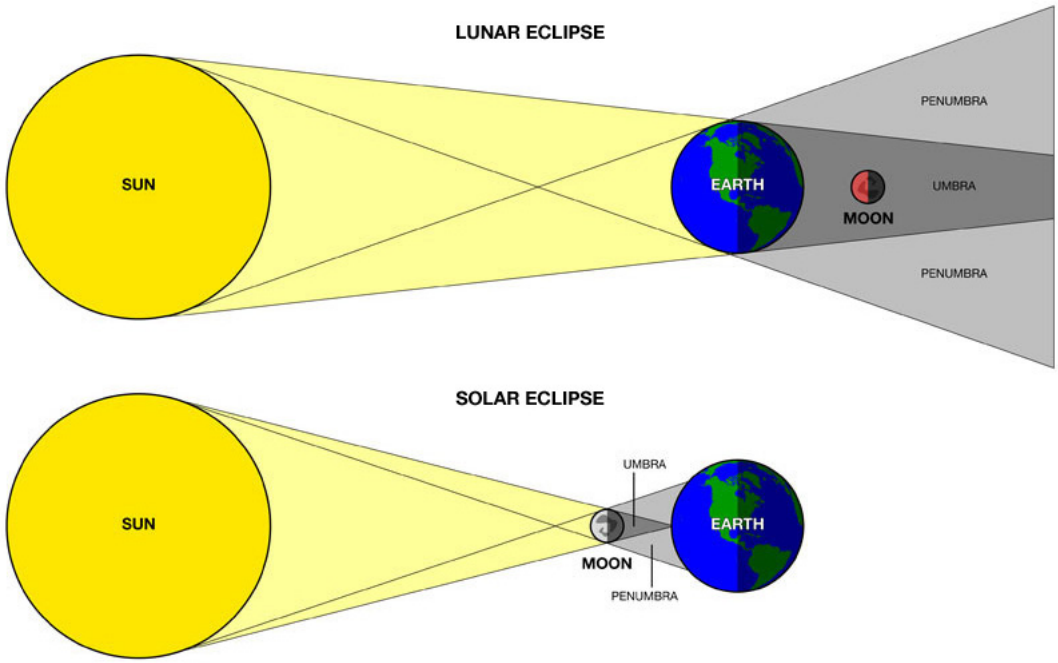
1. Why does a lunar eclipse only happen during full moon?

Only during full moon and new moon is the Moon in a line with the Earth and Sun. If the Earth is in the middle, the Moon is ‘full’ and fully lit by the sun. Only then, if the alignment is perfect, we get *lunar* eclipses [the Earth's shadow falling on the Moon]; if the Moon is in the middle, the Moon is ‘new’ (we see only the dark side) and, if the alignment is perfect, we get *solar* eclipses [the Moon's shadow falling on the Earth].



2. Why don't we have a lunar eclipse every month?

The plane of the Moon's orbit around the Earth is not exactly the same as the plane of the Earth's orbit around the Sun, so the Earth (as seen from the Moon) generally passes over or under the Sun during times of Full Moon. Only twice a year, when the orbits cross, at the "nodes", are eclipses possible, called "eclipse seasons"; even then, the Moon also has to be in the right place in its orbit to experience an eclipse. There will generally be at least two partial lunar eclipses each year, but there can be more. If

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there is a total solar eclipse that season, then there must be at least a partial lunar eclipse two weeks earlier or two weeks later. The converse is not necessarily true: if there is a total lunar eclipse, there may or may not be a partial or total solar eclipse two weeks before or after.

3. When is the next lunar eclipse?

The best site to find out the next lunar or solar eclipse is at Goddard Space Flight Center http://eclipse.gsfc.nasa.gov/lunar.html.

In 2018-2019, there are three total lunar eclipses in a row: http://eclipse.gsfc.nasa.gov/LEdecade/LEdecade2011.html: January 31, 2018; July 27, 2018; and January 21, 2019. The best for the continental US will be January 21, 2019. The lunar eclipse on January 31, 2018 will occur during moonset early in the morning for the central and western U.S.

4. Does the time of the eclipse depend on where on Earth I am?

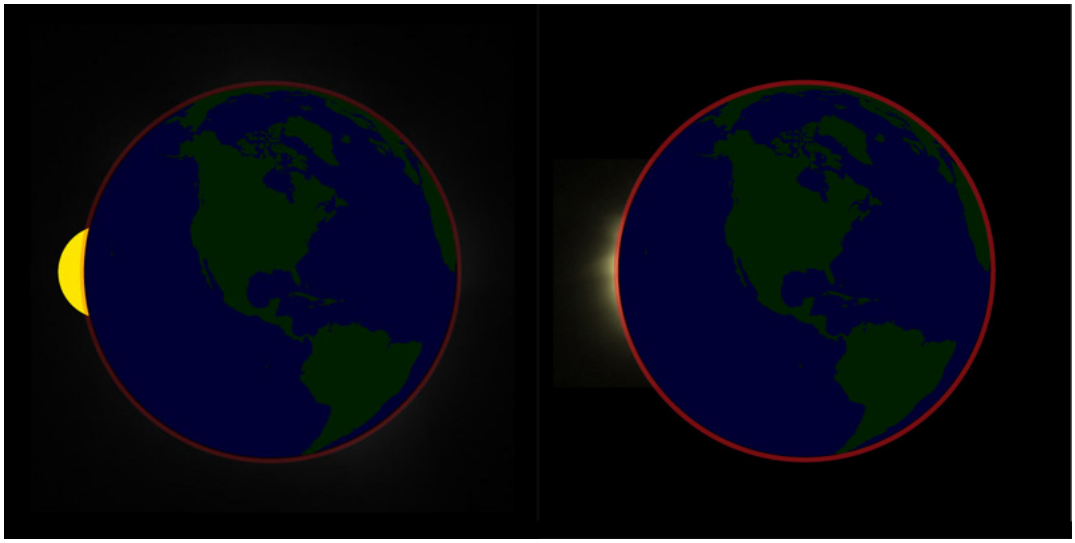
Times for lunar eclipses are given in UT (Universal Time), which is the official time (based on Greenwich Meridian Time, GMT). Since it is the Moon that is moving through the Earth's shadow, it occurs at the same Universal Time for all. But your local time of the event depends on your longitude (your time zone), and whether you are in Daylight Savings Time or not. The general principle for lunar eclipses is: if you can see the Moon, you can see the eclipse. So, more than half of the Earth can see a given lunar eclipse, since the eclipse will generally last one to two hours (approximately an hour of totality, plus partial phases). Some, however, will miss the beginning of the eclipse because it starts before their sunset, or miss the end of the eclipse because it ends after their sunrise.

5. A lunar eclipse is when the Moon moves into the Earth' shadow. What would you see if you were standing on the Moon?

A partial or total *solar* eclipse - the Earth will cross in front of the Sun. We have a video of what it might look like posted here.

6. Will it look like a solar eclipse as seen from Earth?

Not exactly, because the Earth's atmosphere can scatter and refract (bend) sunlight. The "penumbra" is the area of the earth's shadow that is only partially dark (the Earth covers only part of the Sun), whereas the "umbra" is the area of the shadow where the Earth covers all of the Sun, and so is the darkest. When the Moon is in the umbra (totally eclipsed), the Earth would appear to have a red ring around it from sunlight refracting through the atmosphere. Only at the beginning and ending of totality might you be able to see the Sun's corona from the Moon, and only on the side where the Earth just barely covers the Sun. Note that most images you see on the web are not very accurate… here is my prediction when we finally get to see one. At left is the partial phase (the Earth's angular size is much larger than the Moon), and on the right is just a bit of the corona visible just after totality begins (a little of the corona should be visible on the right just before totality ends.



7. If it is in the "partial" phase at Earth will it be in the partial phase at the Moon?

It depends on where you are on the Moon. If your location is in the umbra, you will see a total solar eclipse. If you are in the brighter part, the penumbra, you will see a partial solar eclipse. When we see a "total" lunar eclipse, then the entire Moon is inside the umbra and **everywhere** on the Moon would see a total solar eclipse.

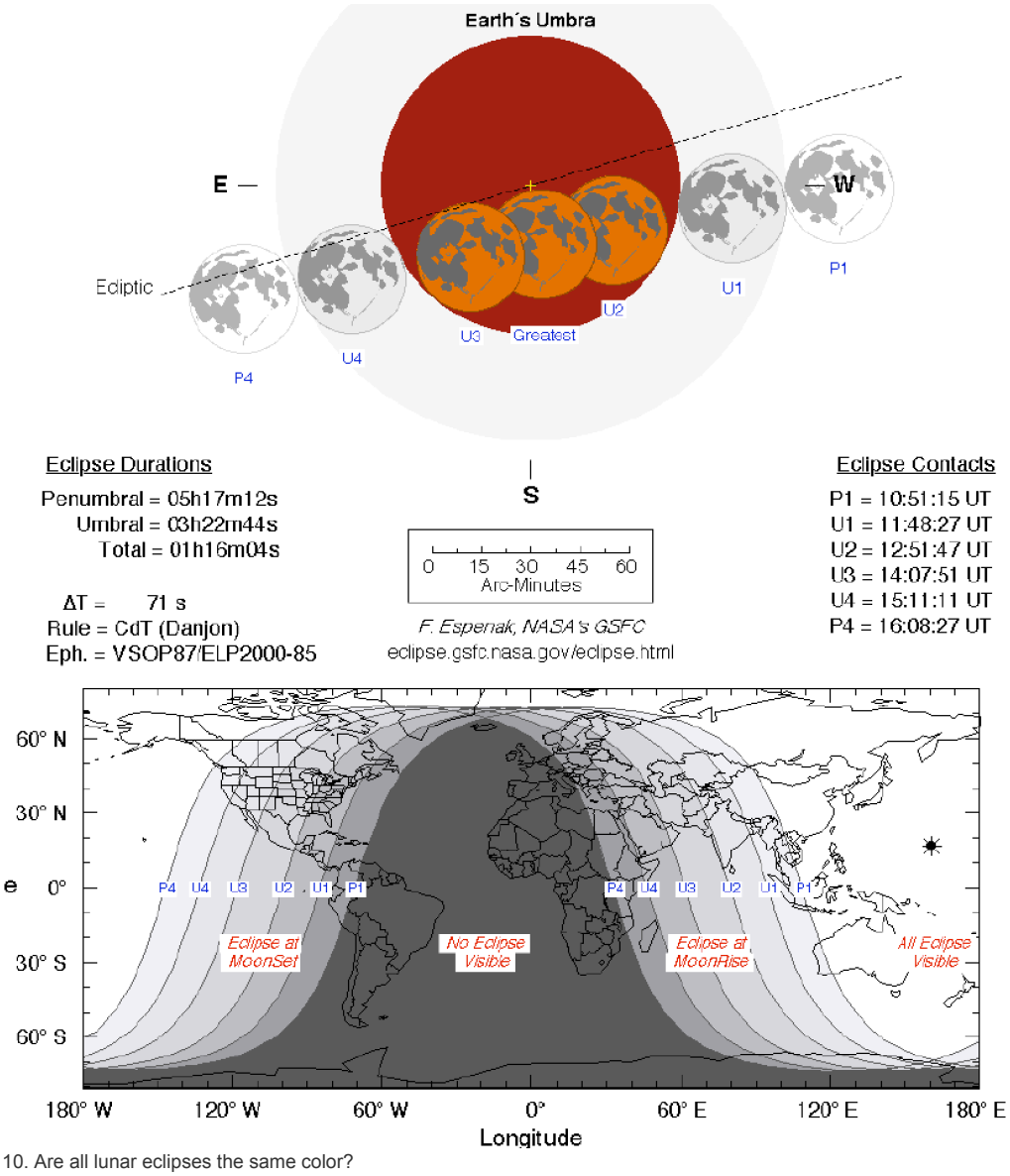
8. Why does the Moon turn red during a lunar eclipse?

The light from the Sun is refracted (bent) by the earth's atmosphere, but the part of the solar spectrum in the blue is scattered.

That's why the Sun looks red to us at sunset (seeing direct sunlight) and the sky looks blue (seeing scattered sunlight)! If you are on the Moon during a total lunar eclipse, you will see a dark Earth with a red halo of the atmosphere around it - see http://apod.nasa.gov/apod/ap070302.html for an artist's conception.

9. Will all parts of the Moon be the same color?

The edge of the Moon that is closest to the penumbra will need less bending of the light to be lit by scattered light, so will appear brighter. It will also be partially be lit by the Sun's corona. For the eclipse of January 31, 2018 I predict that the SOUTH side of the moon will be brighter. This diagram is from eclipse.gsfc.nasa.gov - the best place to learn about upcoming eclipses. Note the times here are in UT: subtract 5 hours for EST, 6 hours for CST, 7 hours for MST, 8 hours for PST, etc. For the full version of this figure see https://eclipse.gsfc.nasa.gov/LEplot/LEplot2001/LE2018Jan31T.pdf.



10. Are all lunar eclipses the same color?

Sometimes because of volcanoes or dust storms on Earth, the Earth's atmosphere is dustier and so less light can get through. In that case the Moon will appear a darker red because less light will be able to reach it.

11. If you were on the Moon, could you see the solar corona during a lunar eclipse?

It would not be as easy as during a total solar eclipse from Earth. The scattered sunlight through the Earth's atmosphere would be brighter than the corona, but you might see it peeking up behind it. The angular size of the Earth is four times the diameter of the Sun as seen from the Moon [why?], so the Earth will cover up the brightest part of the corona, except just after totality begins and just before totality ends (or if you are in a location near the edge of the umbra). No human has ever viewed a solar eclipse from the Moon!) My guess is in answer 6. Here are two cool sites, though:

1. This is an actual image of a "diamond ring" from a Japanese satellite in lunar orbit
2. Here is a NASA simulation, but I don't think the corona would be visible until the sun is completely covered.

12. What is a selenelion?

If a total lunar eclipse occurs near sunrise or sunset, you get a *"selenelion"*. A selenelion occurs when you can see the total lunar eclipse and the rising (or setting) sun at *almost* the same time. If the lunar eclipse occurs at sunset, you see the setting sun and then immediately the eclipsed moon rises. For the lunar eclipse of Jan 31, 2018, the central US will have the moon setting either partially or completely eclipsed and then immediately the sun rises. This makes a very good "teachable moment". The eclipsed moon looks red because the only light reaching it is sunlight refracted through the Earth's atmosphere - in fact, the same reason that the rising (or setting) sun looks red. The blue light is scattered out of the sun's rays (causing the sky to appear blue). Only the red light is left to illuminate the moon, and part of that light reaching the moon is actually passing over your head! In a selenelion, you can see the red moon and the red sun only a few minutes apart. If you are in a high building or high parking lot, you might just see both of them at the same time. But you do need a good unobstructed view of the moon, just north of west, and the sun, just south of east.

13. Are lunar eclipses safe to view with the naked eye?

Absolutely, *lunar eclipses are always safe* - use eyes, binoculars, telescopes, any kind of camera or videocamera - enjoy it! Be sure you use a "fast" setting so that time exposures don't cause the image to blur. **Solar eclipses, on the other hand, are DANGEROUS except for the lucky ones in the path of totality, and only while the eclipse is TOTAL**. For solar eclipses you have to use special eye protection and special camera filters. If you haven't ventured to to a total solar eclipse, go if you can – it is one of nature's most wonderful marvels! There was a recent total solar eclipse crossing the United States on August 21, 2017. The next total eclipse which will cross the US will be April 8, 2024.

Total Solar Eclipse of 2024 Apr 08

Geocentric Conjunction = 18:36:02.5 UT J.D. = 2460409.275029
Greatest Eclipse = 18:17:13.1 UT J.D. = 2460409.261957

Eclipse Magnitude = 1.0565 Gamma = 0.3432

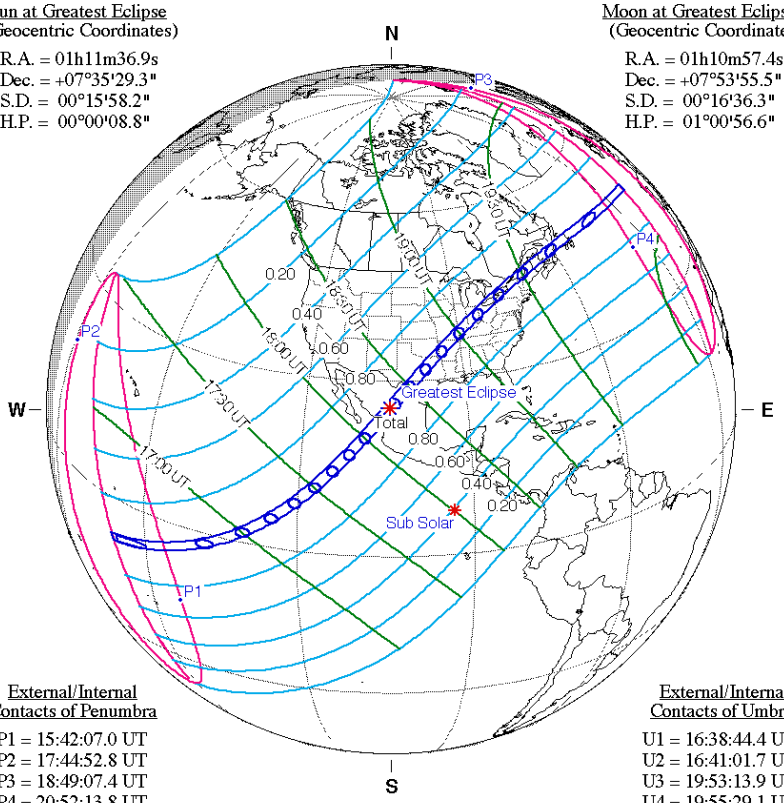
Saros Series = 139 Member = 30 of 71

Sun at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 01h11m36.9s
Dec. = +07°35'29.3"
S.D. = 00°15'58.2"
H.P. = 00°00'08.8"

Moon at Greatest Eclipse
(Geocentric Coordinates)

R.A. = 01h10m57.4s
Dec. = +07°53'55.5"
S.D. = 00°16'36.3"
H.P. = 01°00'56.6"



External/Internal Contacts of Penumbra

P1 = 15:42:07.0 UT
P2 = 17:44:52.8 UT
P3 = 18:49:07.4 UT
P4 = 20:52:13.8 UT

External/Internal Contacts of Umbra

U1 = 16:38:44.4 UT
U2 = 16:41:01.7 UT
U3 = 19:53:13.9 UT
U4 = 19:55:29.1 UT

Local Circumstances at Greatest Eclipse

Lat. = 25°17.5'N Sun Alt. = 69.8°
Long. = 104°07.2'W Sun Azm. = 149.4°
Path Width = 197.5 km Duration = 04m28.1s

Ephemeris & Constants

Eph. = Newcomb/ILE
ΔT = 81.2 s
k1 = 0.2724880
k2 = 0.2722810
Δb = 0.0" Δl = 0.0"

Geocentric Libration
(Optical + Physical)

l = 2.00°
b = -0.46°
c = -20.75°
Brown Lun. No. = 1253

0 1000 2000 3000 4000 5000
Kilometers

F. Espenak, NASA's GSFC - Fri, Jul 2,
sunearth.gsfc.nasa.gov/eclipse/eclipse.html