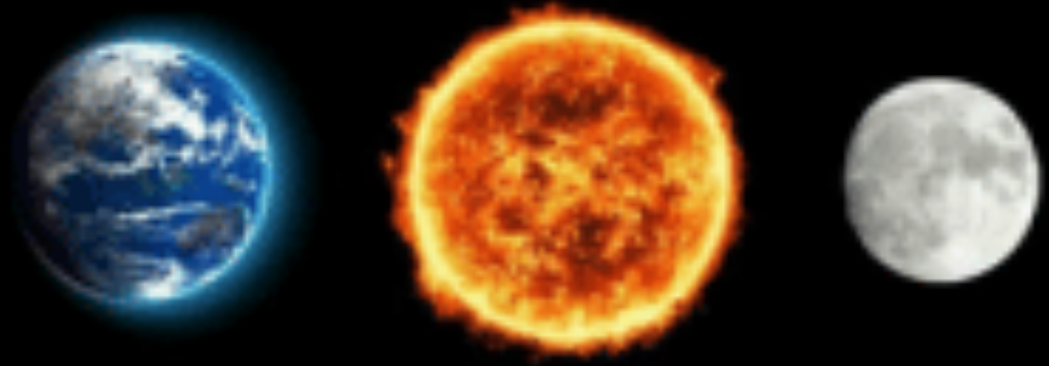
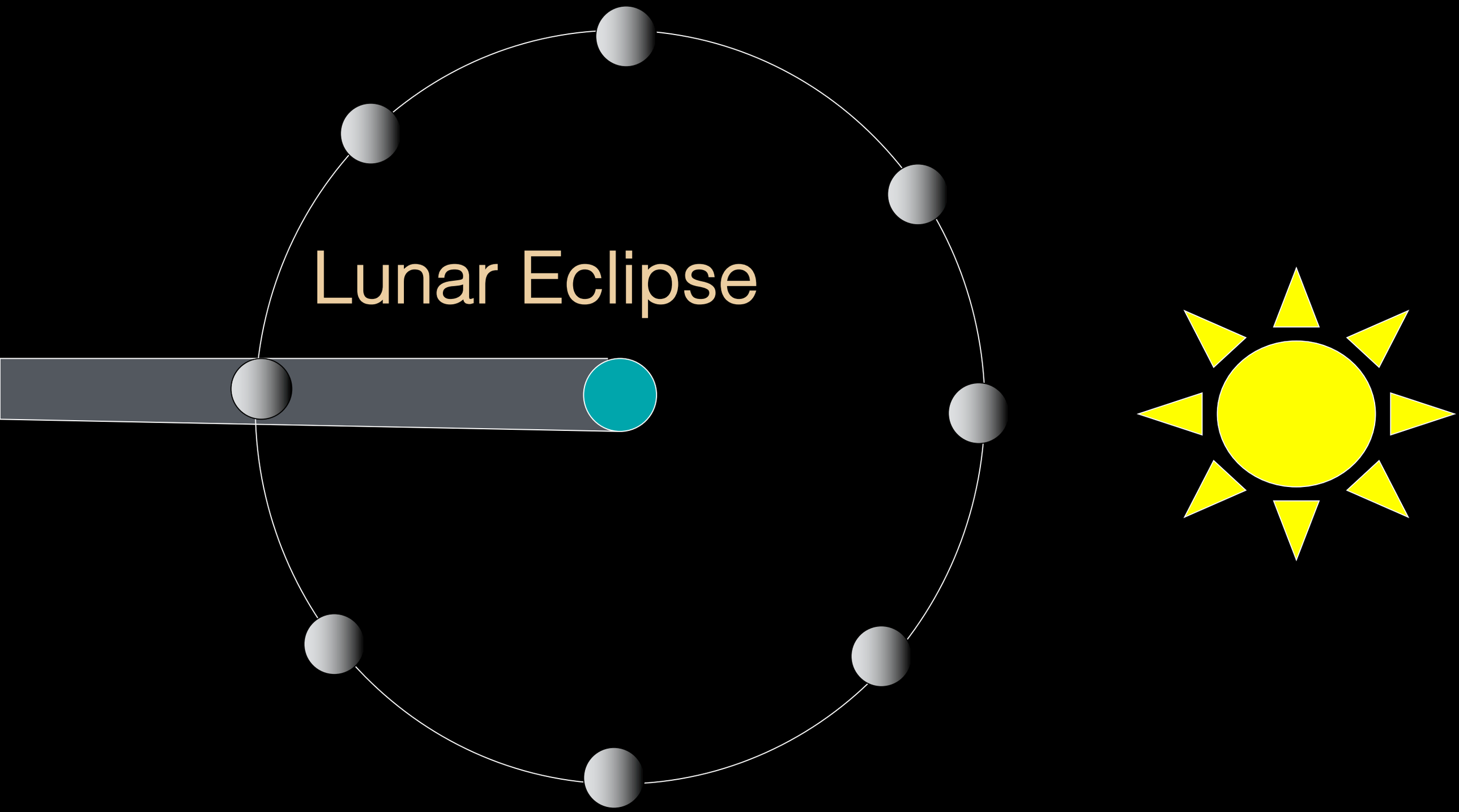
Lunar Eclipse

Solar Eclipse

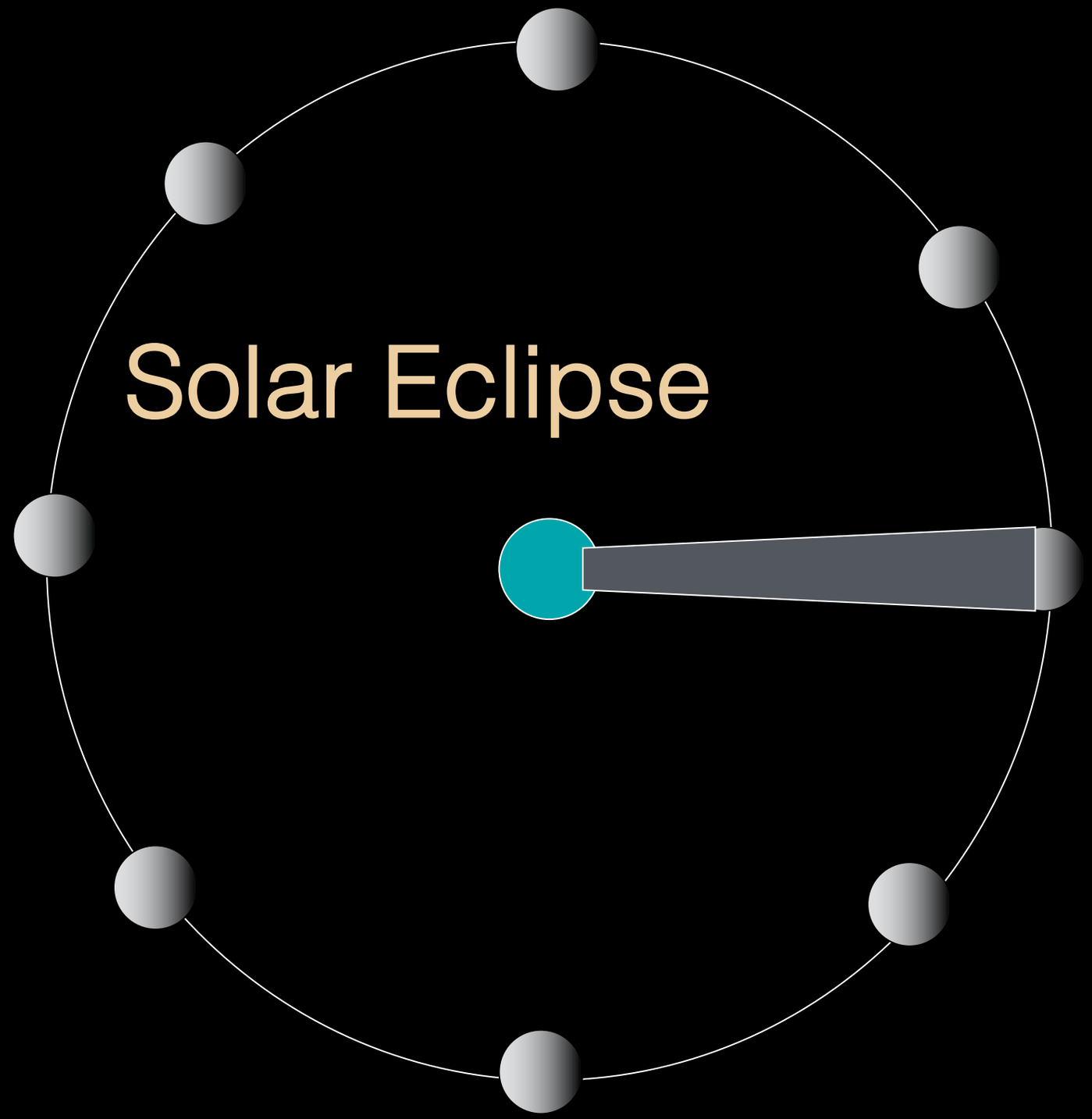
Apocalypse

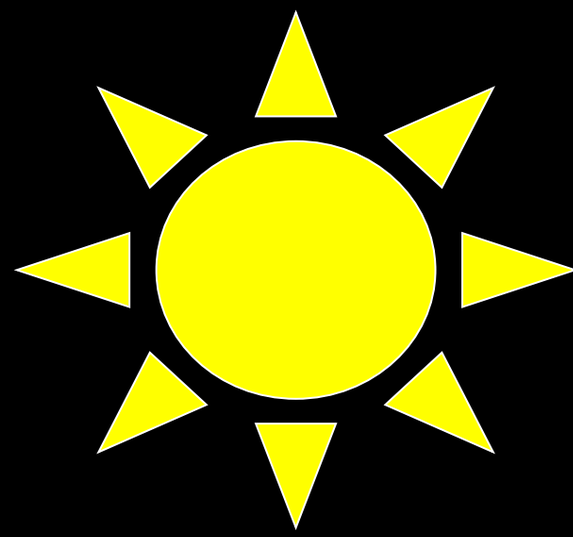


When the Earth's shadow hits the Moon we have a...

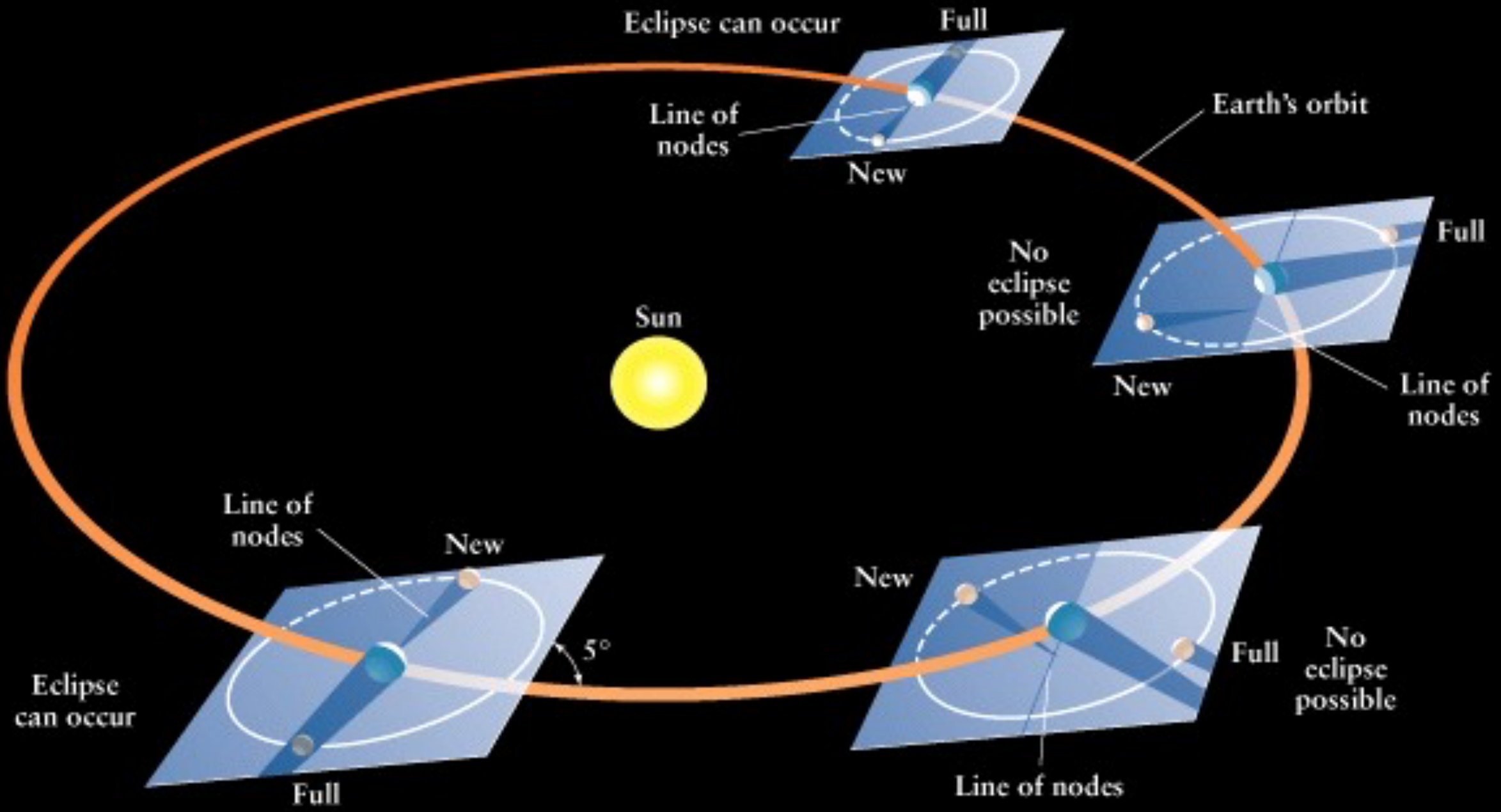


When the Moon’s shadow hits the Earth, we have a ….

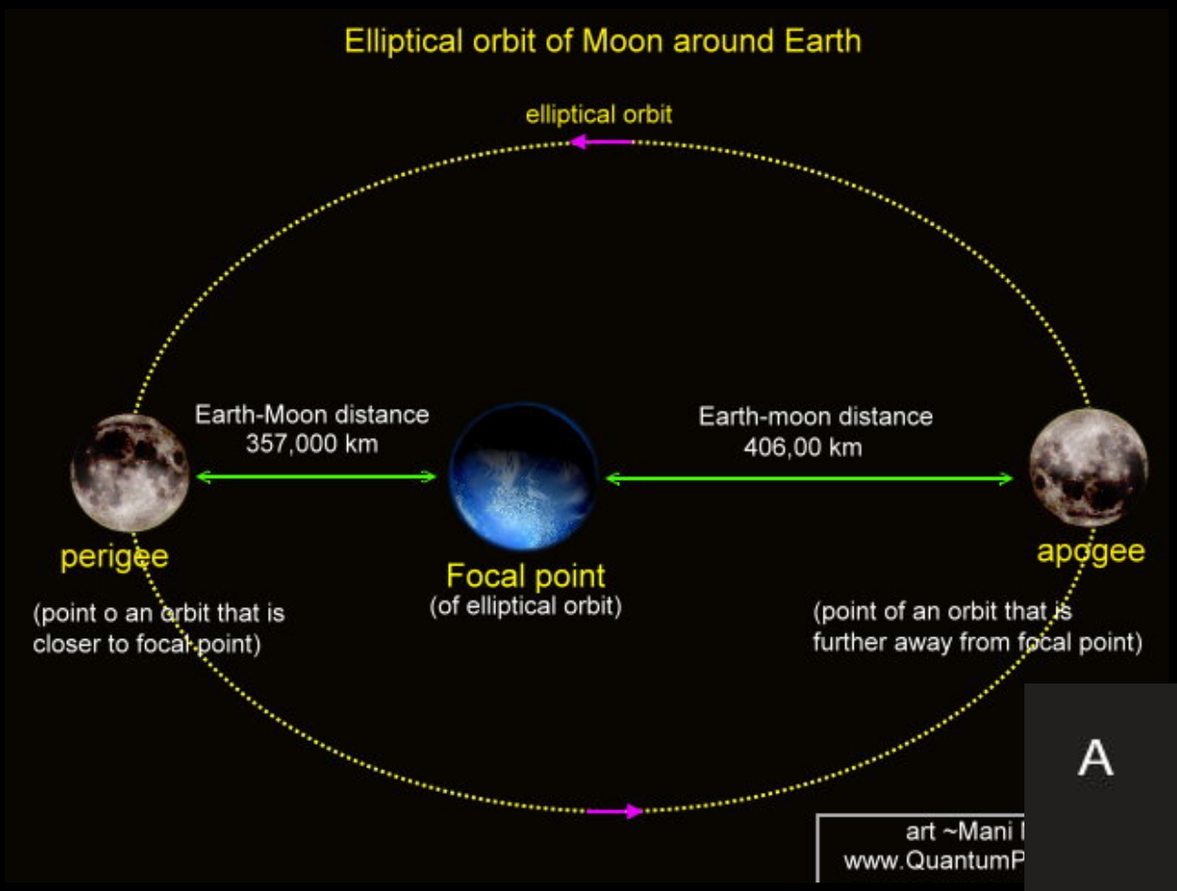




Eclipses occur ONLY when the Moon crosses the plane of Earth's orbit around the Sun AND ONLY during the NEW or FULL phases

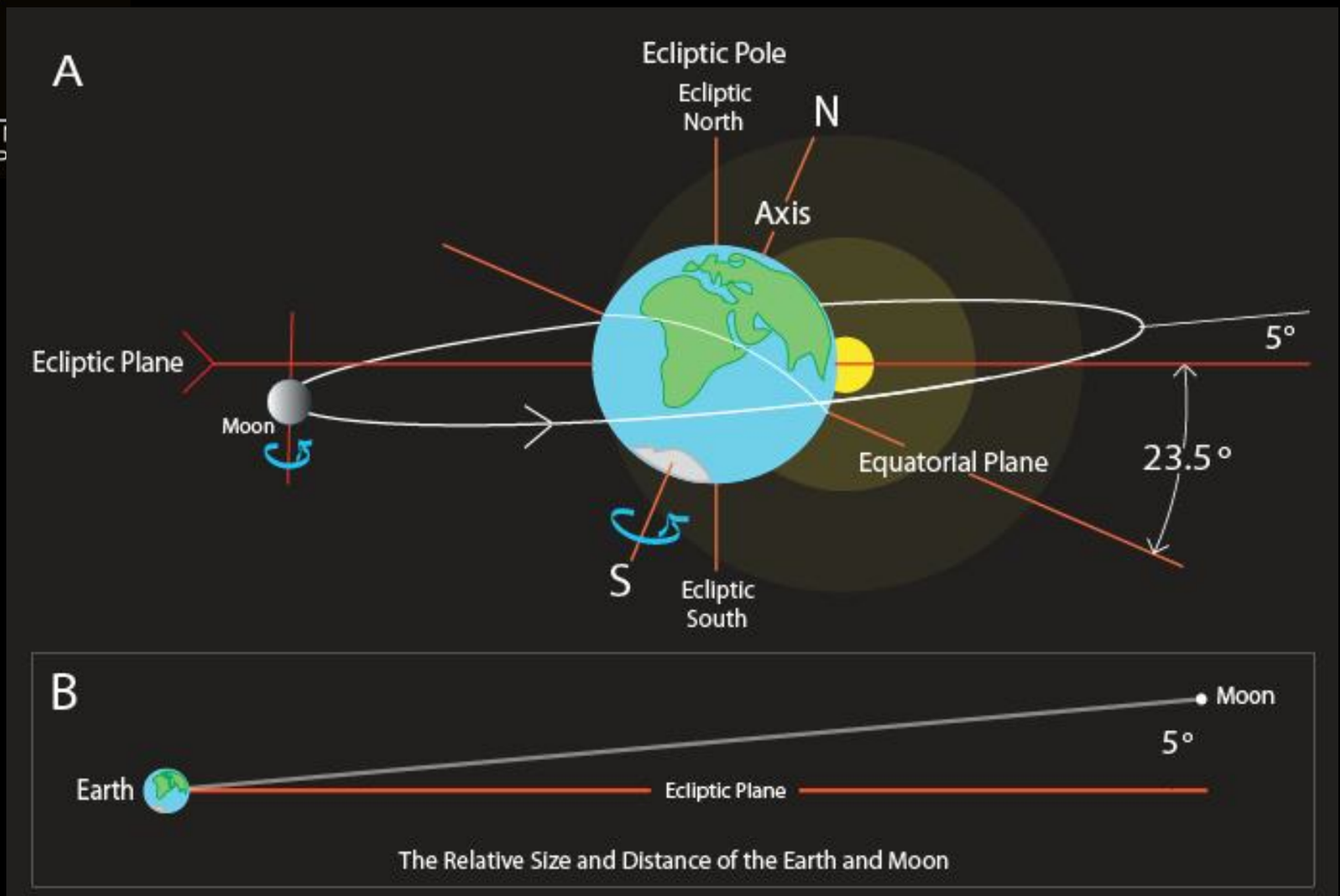


Two Important Properties of the Moon's Orbit

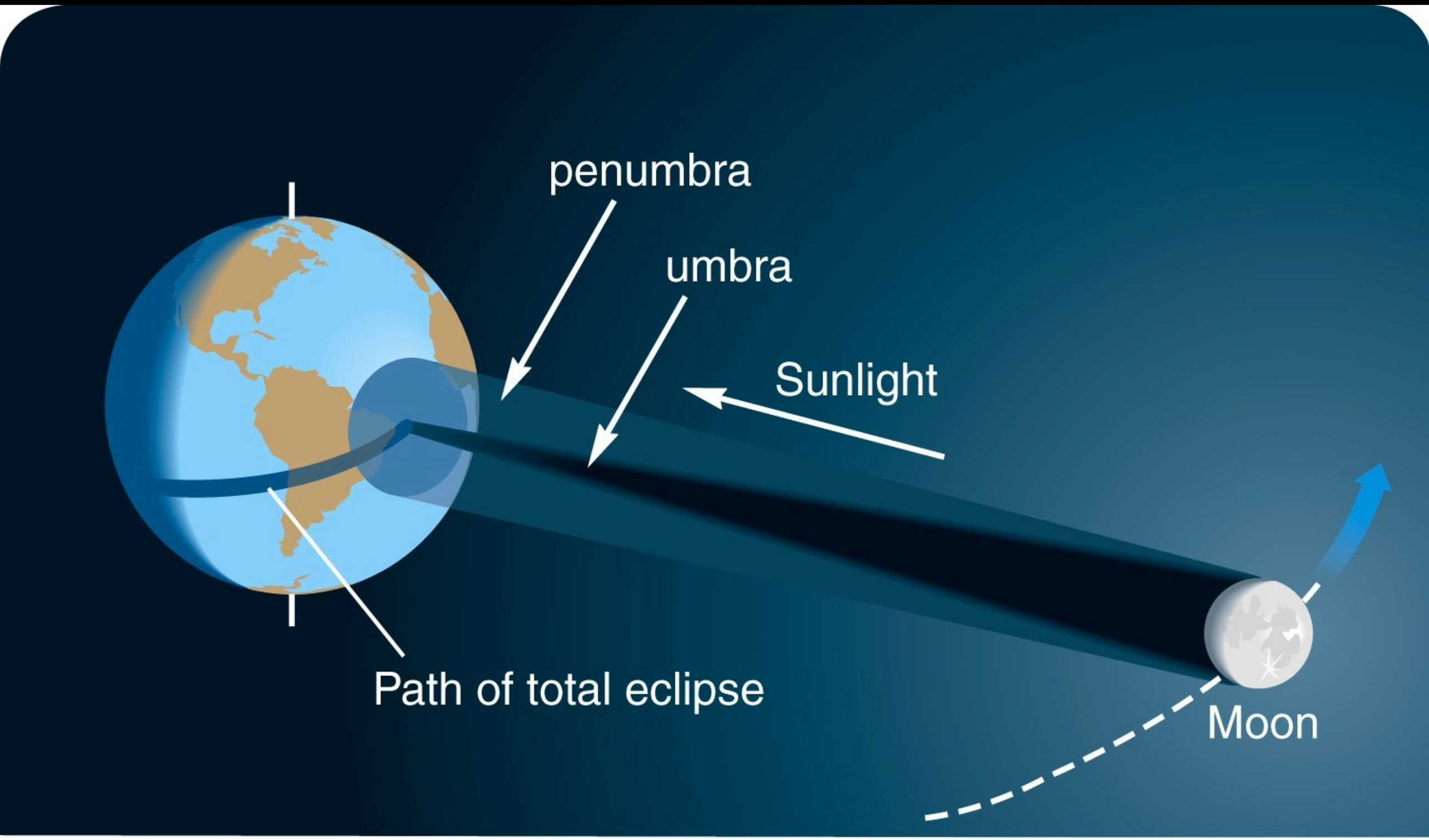


<- Its an ellipse

It's tilted 5 degrees with respect to the ecliptic plane ->



Solar eclipse – when the moon passes in front of the Sun as seen from the Earth



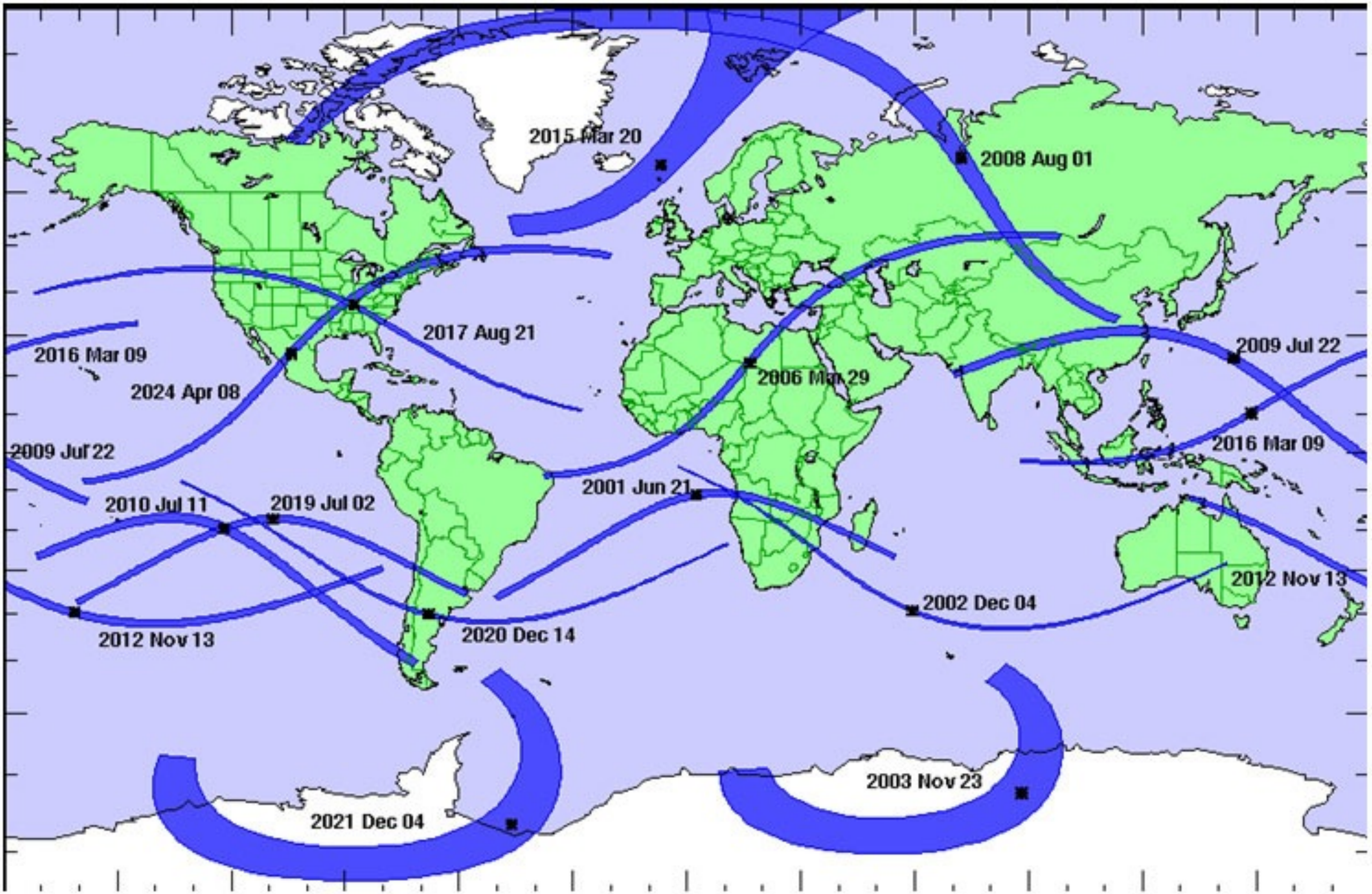
They are spectacular but not common.

Next total eclipse visible from USA: April 8, 2024

Partial Solar Eclipse

Annular Solar Eclipse

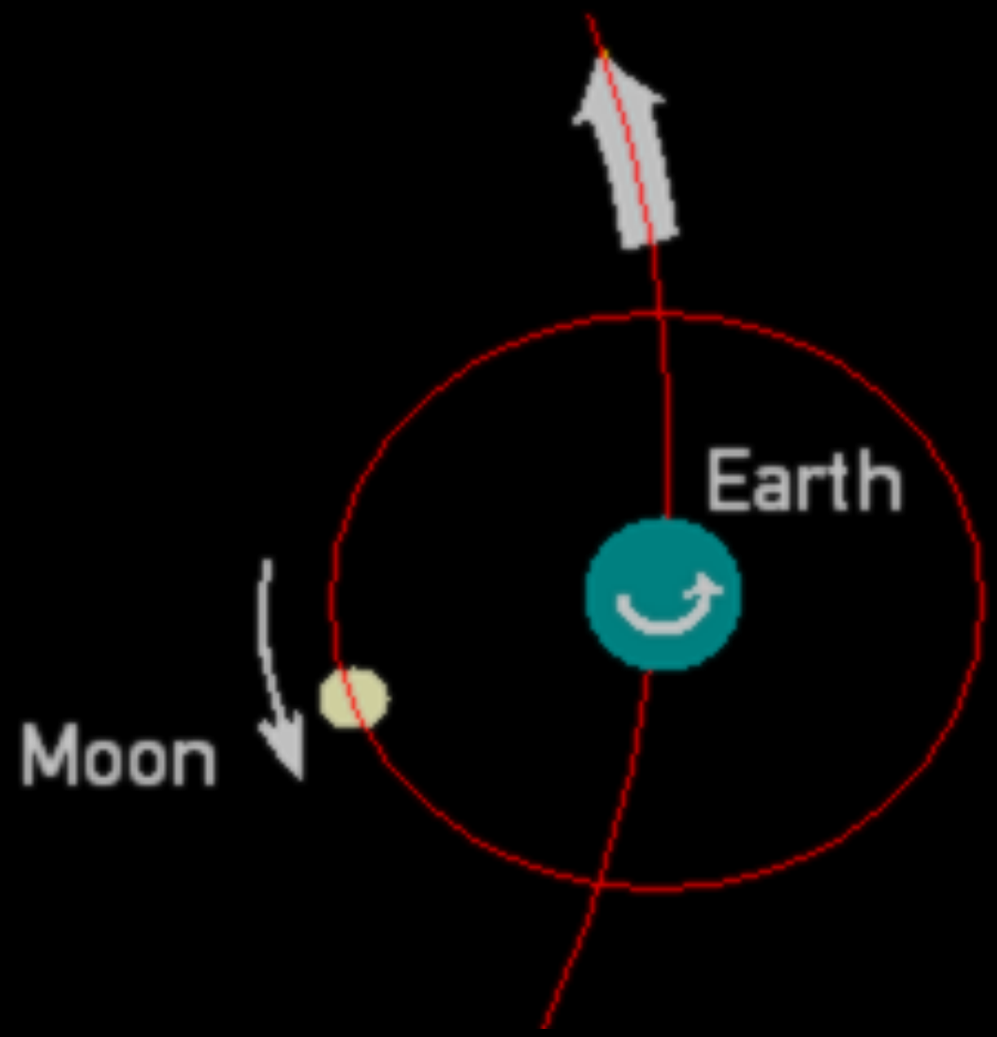
Map of solar eclipses



Lunar eclipses are more common than solar eclipses – its geometry

Photographed by Keith Burns, winner of NASA/JPL's I'm There: Lunar Eclipse Wallpaper Contest 2010

The eclipse frequency is related to distances and sizes of Sun, Earth and Moon.



Now let’s do a demo…

Which positions cause which eclipses

- When the _____ is in the _____ phase and is directly in line with the _____ and the ____ , you get a _____ eclipse.

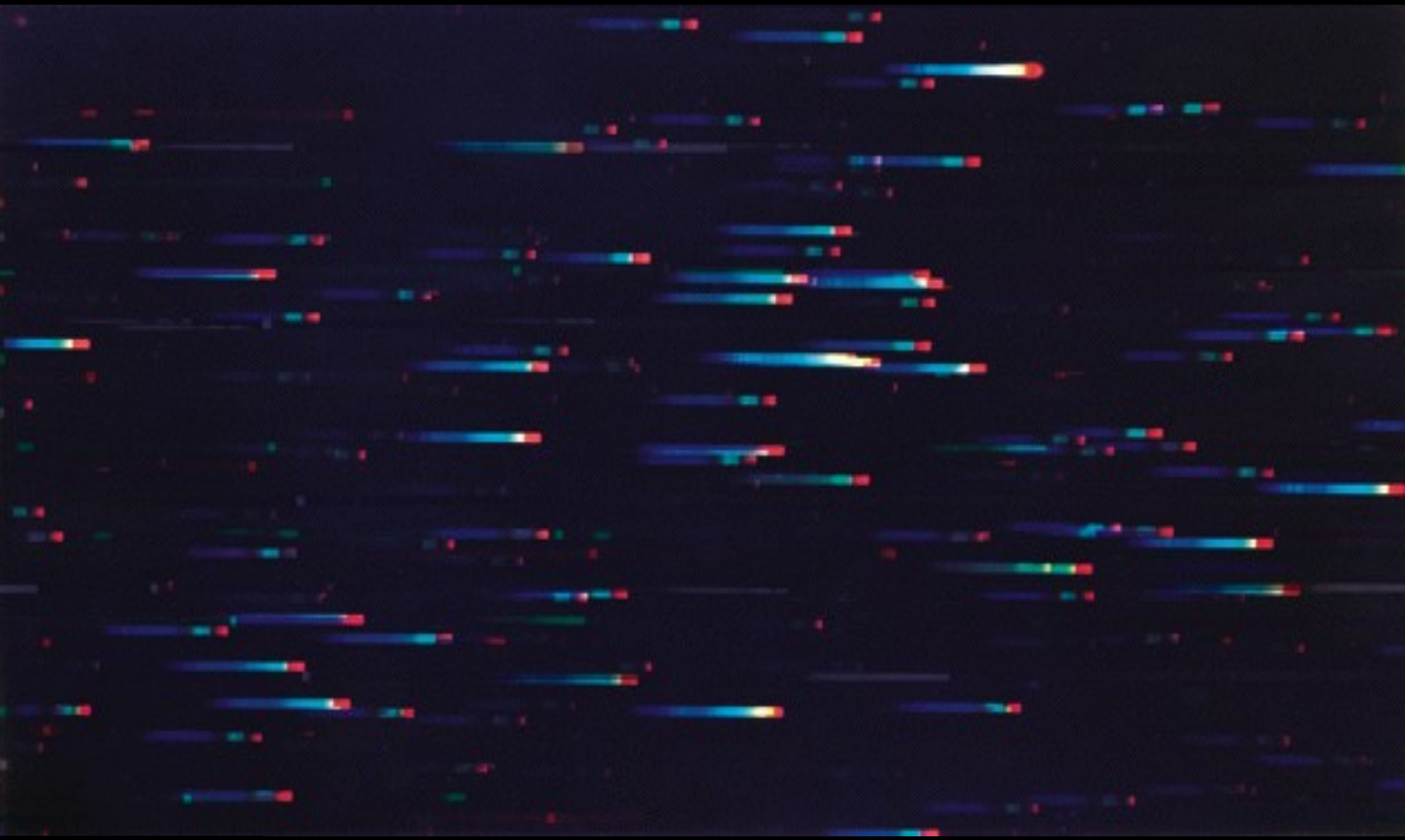
- When the _____ is in the _____ phase and is directly in line with the _____ and the ____ , you get a _____ eclipse.

Which positions cause which eclipses

- When the Moon is in the full phase and is directly in line with the Earth and the Sun , you get a lunar eclipse.

- When the Moon is in the new phase and is directly in line with the Earth and the Sun , you get a solar eclipse.

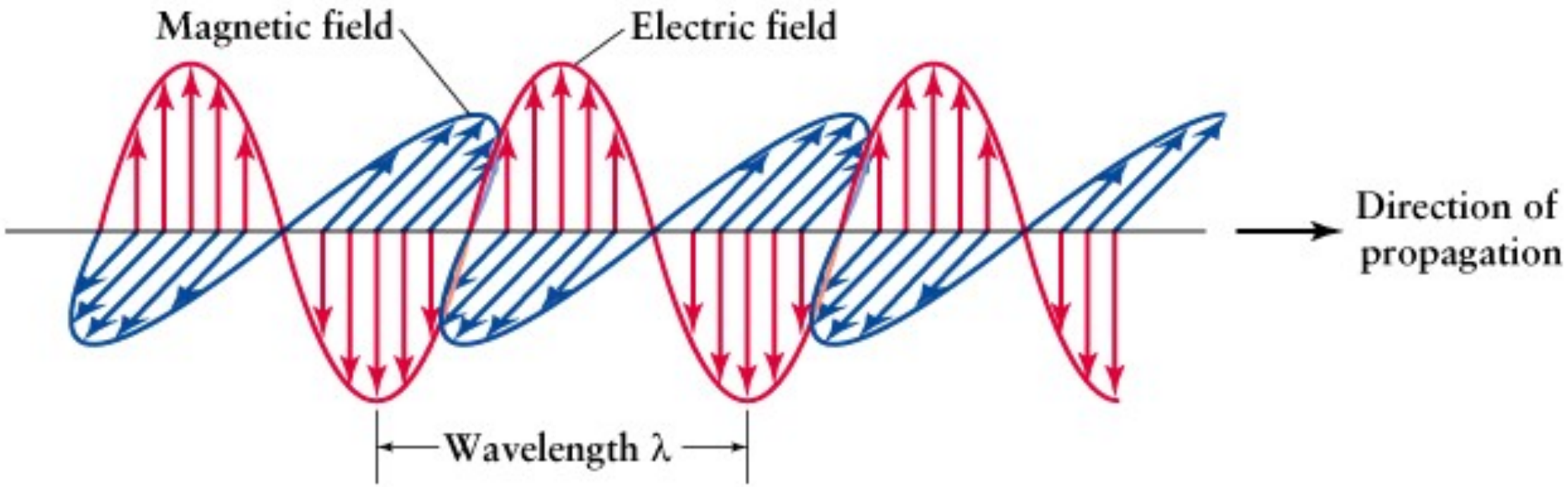
The Origin and Nature of Light



But, what is light?

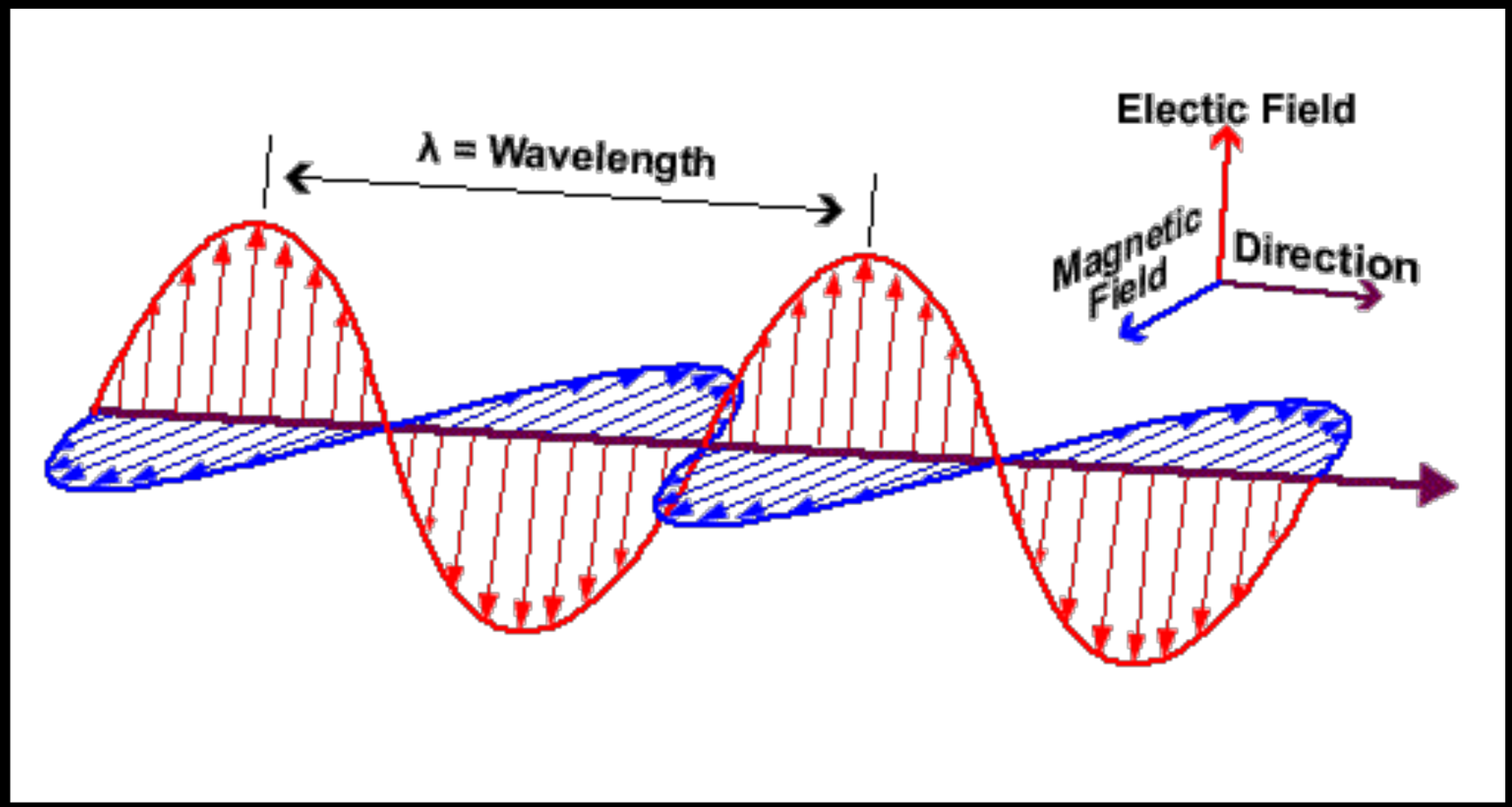
- In the 17th Century, Isaac Newton argued that light was composed of little particles while Christian Huygens suggested that light travels in the form of waves.
- In the 19th and 20th Century Maxwell, Young, Einstein and others were able to show that light behaves both like a particle and a wave depending on how you observe it.

Scottish physicist James Clerk Maxwell showed mathematically in the 1860s that light must be a combination of electric and magnetic fields.



Light is produced by accelerating charges, and can travel through empty space – electromagnetic radiation

- Unlike sound, light waves do not require a medium and thus can travel through a vacuum.

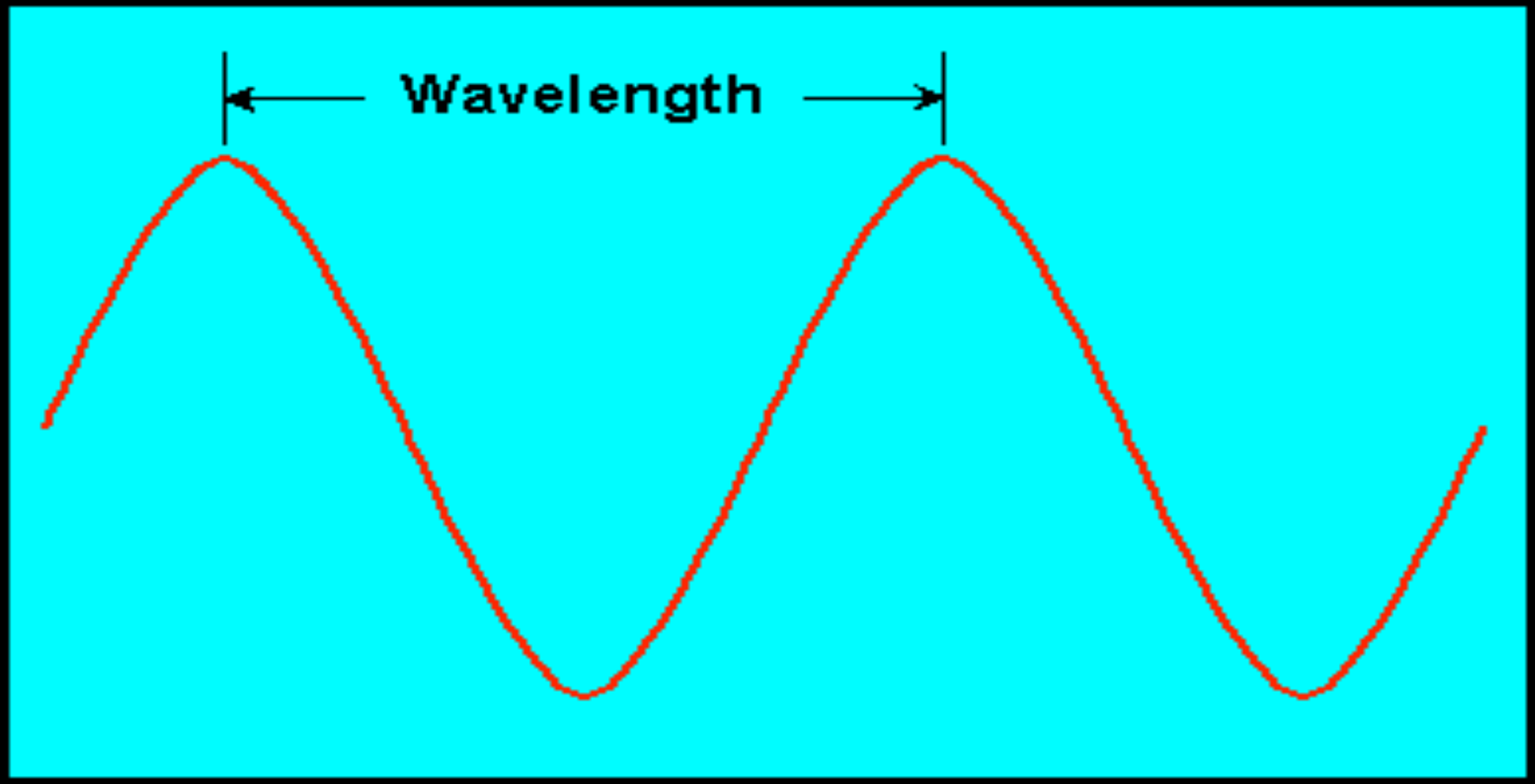


- Electromagnetic radiation is a wave phenomenon.
  - That is, it is associated with a periodically repeating disturbance (a wave) that carries energy.
- Imagine waves in water.
  - If you disturb a pool of water, waves spread across the surface.

DO NOT confuse radioactivity with the term EM radiation!

The distance between peaks of a light wave is the wavelength

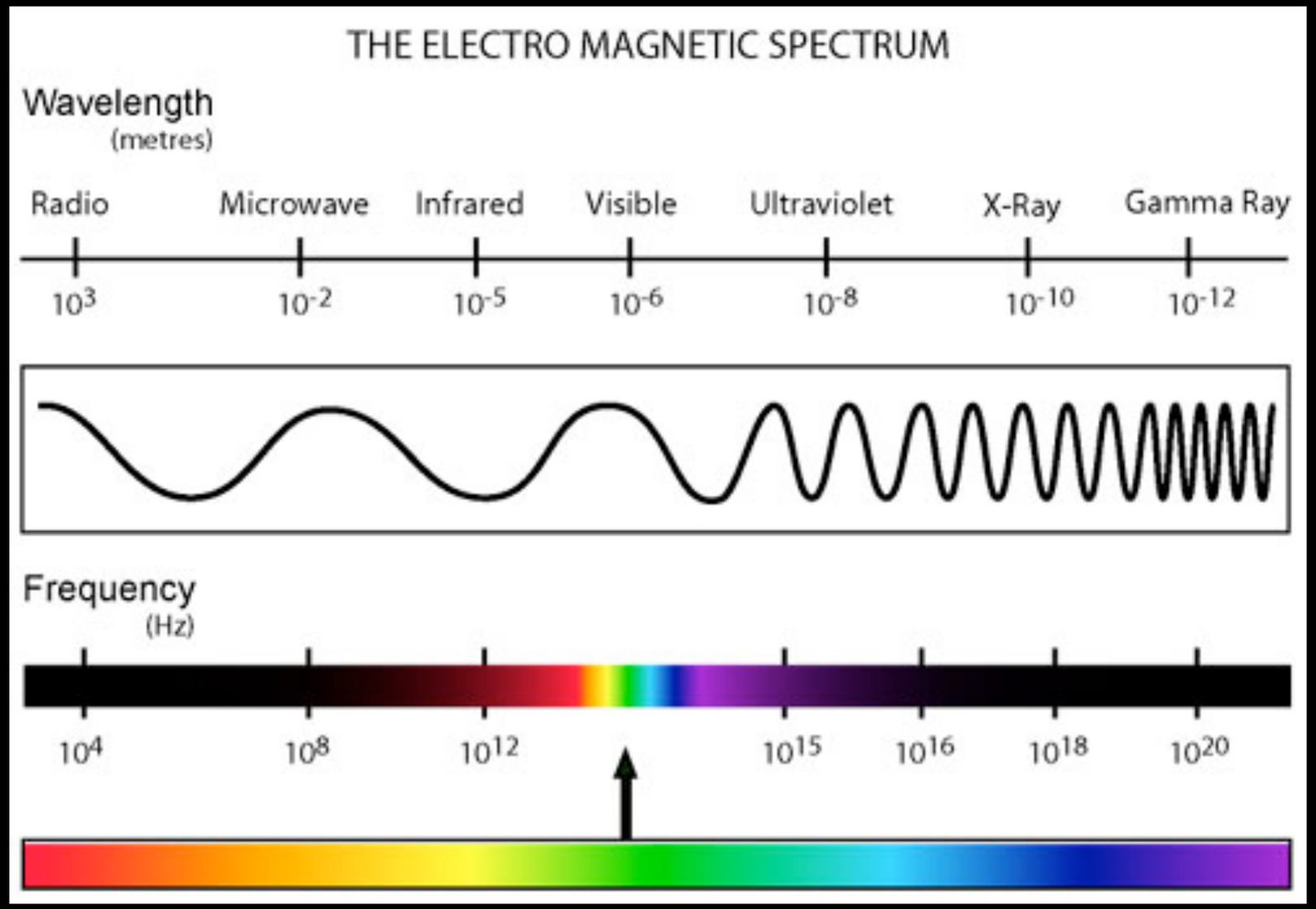
- Astronomers use nano-meters (10^{-9} m), Angstroms (10^{-10} m) or microns (10^{-6} m) as the unit of a wavelength of light



- Light waves travel through space at about 300,000 kilometers per second (186,000 miles per second).
  - It is the speed of ALL electromagnetic radiation.

The number of repeating events per unit time = frequency

Unit = Hertz (Hz)



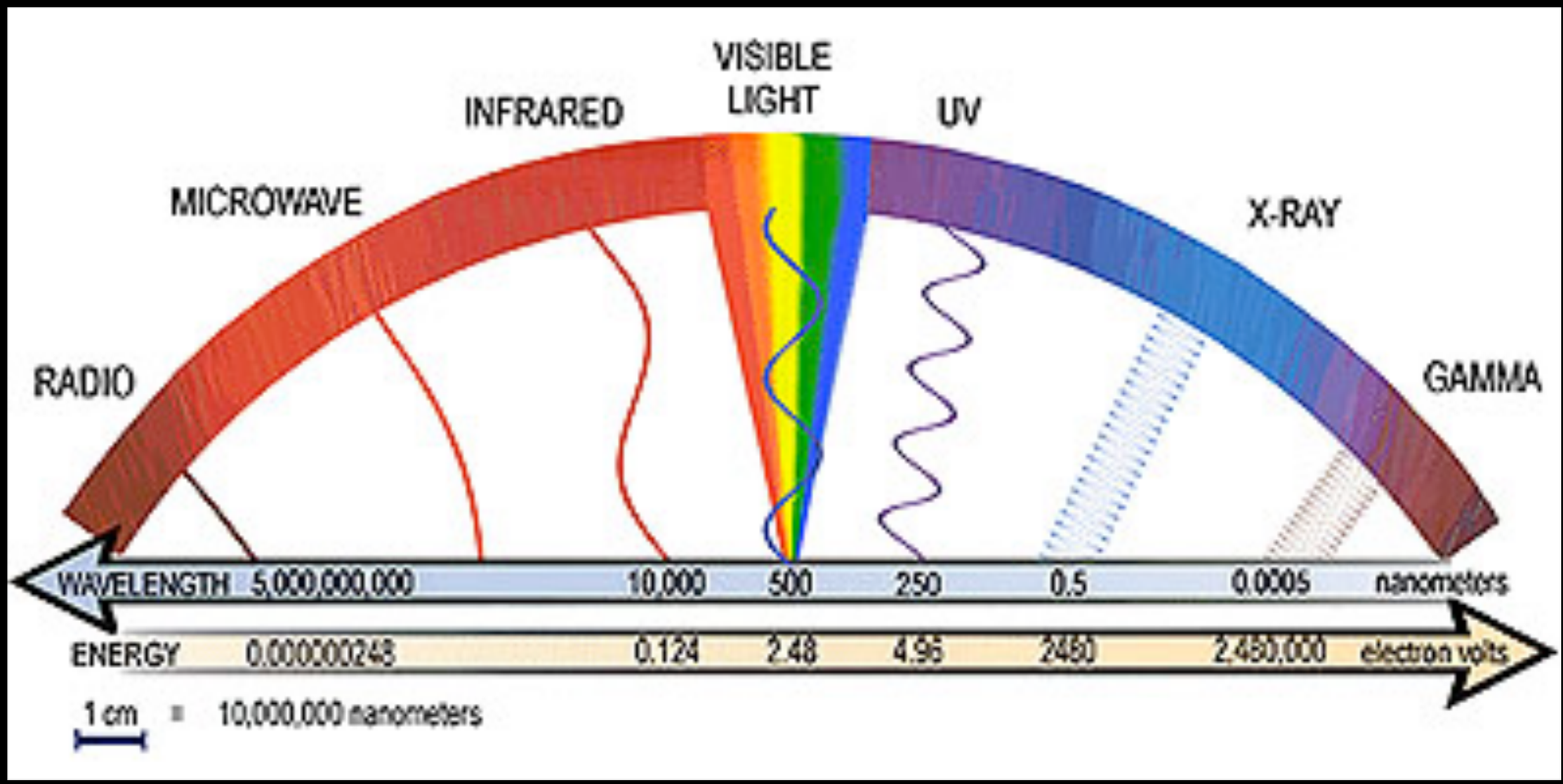
Longer the wavelength, smaller the frequency

Although light behaves as a wave, under certain conditions, it also behaves as a particle.

- A particle of light is called a photon.
- You can think of a photon as a minimum-sized bundle of electromagnetic waves.

The amount of energy a photon carries depends on its wavelength.

- Shorter-wavelength photons carry more energy.
- Longer-wavelength photons carry less energy.



Light waves travel at the same speed as sound waves?

A) True

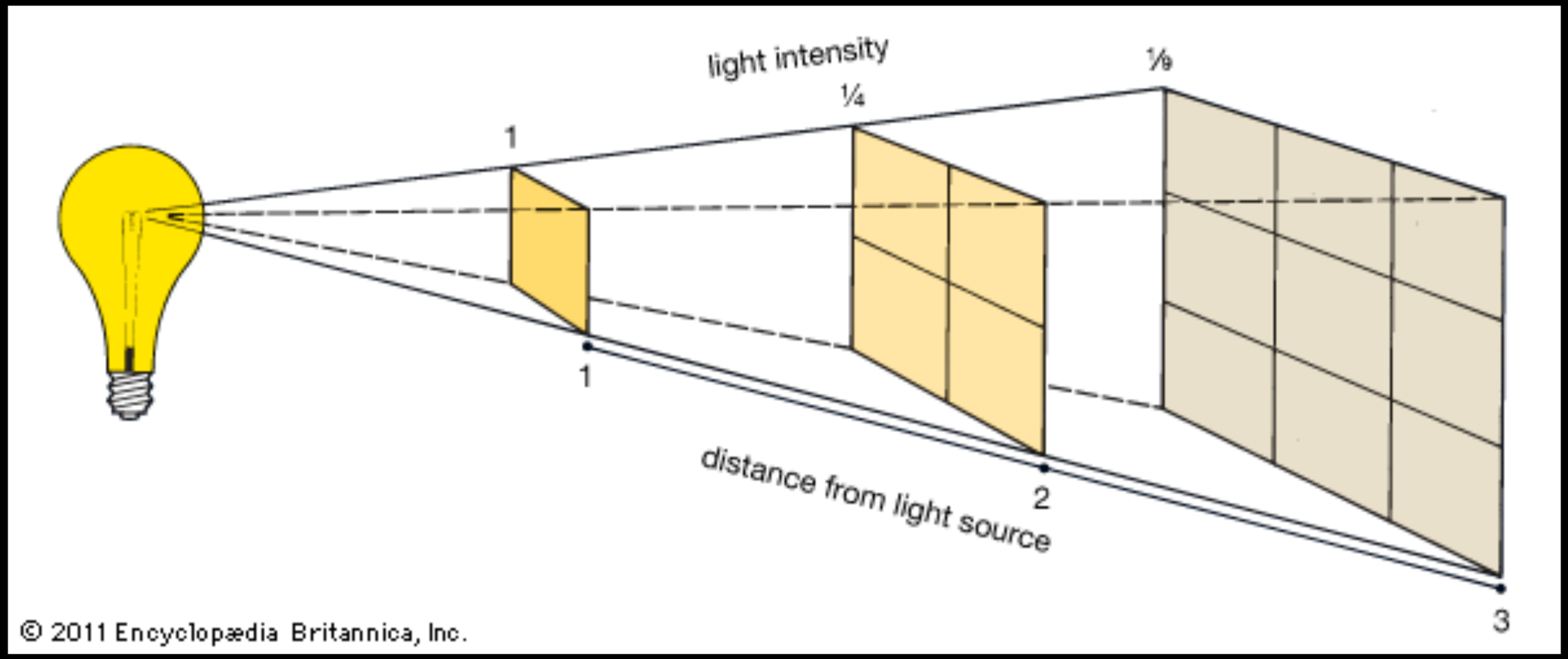
B) False

Light waves travel at the same speed as sound waves?

False: This is why you see the lightening and then hear the thunder.

Speed of light >> speed of sound

Light follows an inverse square law



Amount of light hitting each square foot/meter goes down as $1/d^2$.

(d = distance from central source)