

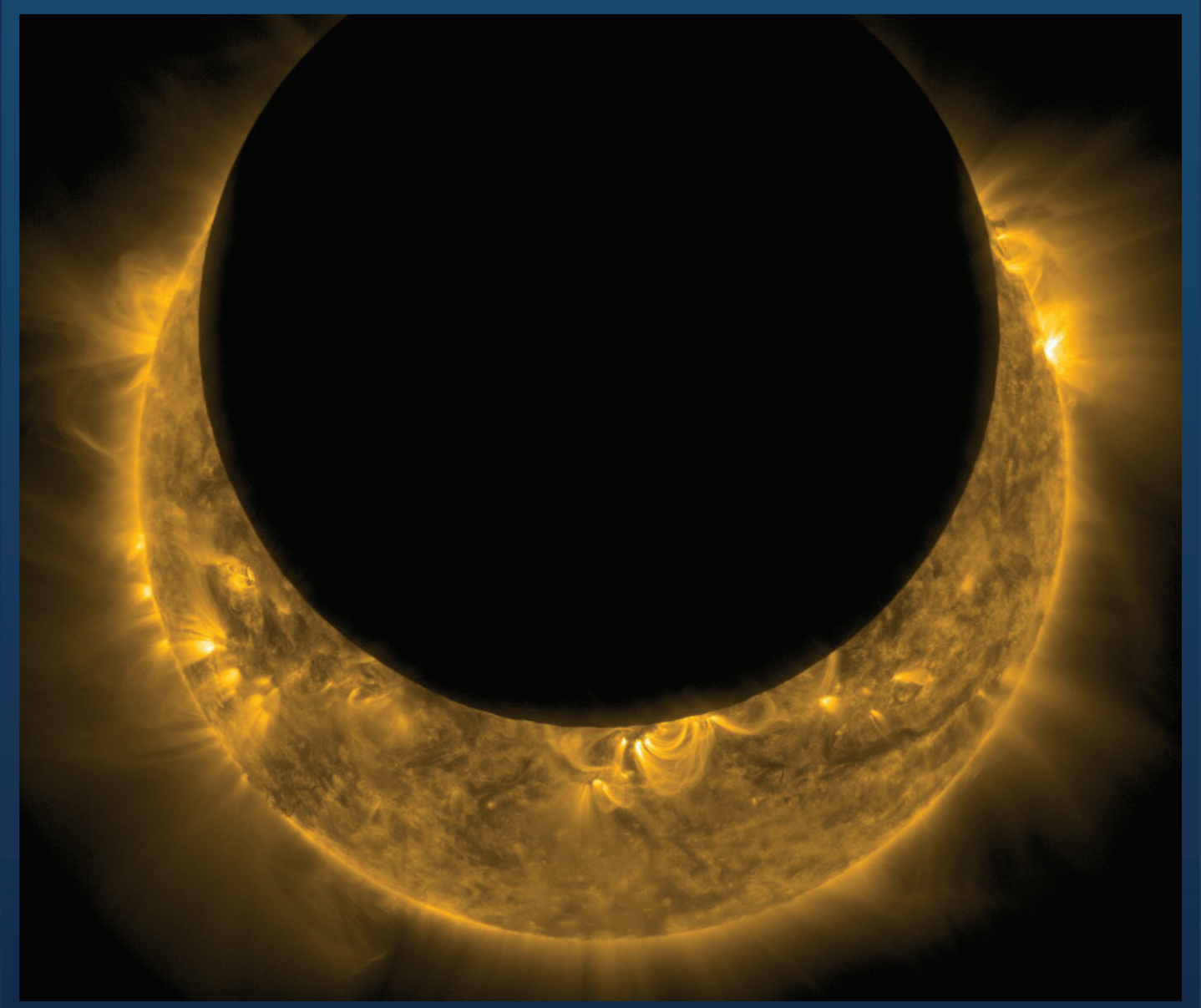
# ECLIPSES 101

## WHEN OUR STAR AND MOON ALIGN

A solar eclipse occurs when the Moon moves between the Sun and Earth. When this happens, some areas of the Earth are cast into the Moon's shadow.

In places where the Moon completely blocks the Sun, we experience a total solar eclipse, and a dusk-like darkness falls over the Earth.

Where only part of the Sun is covered, we experience a partial eclipse, and the Sun appears as if a bite has been taken out of it.



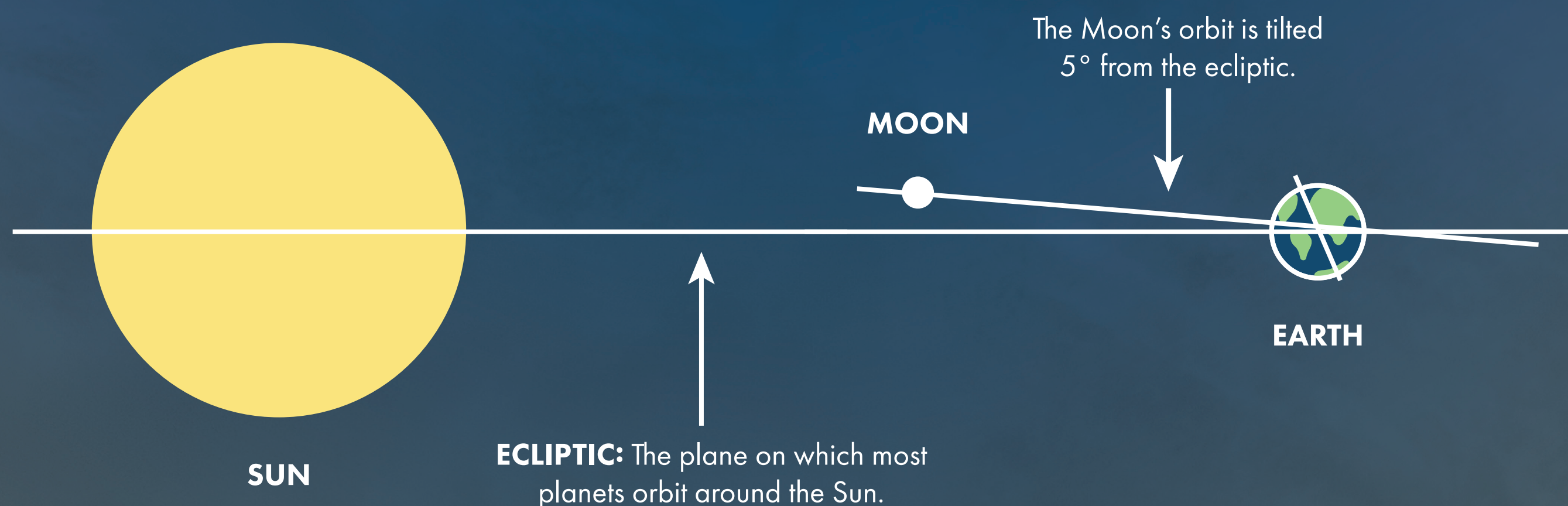
NASA/SDO/AIA/MSAL

The area from where you can see a total eclipse at the same moment is never more than 167 miles.

## WHY DON'T WE HAVE A SOLAR ECLIPSE EVERY MONTH?

The Moon orbits around the Earth every month. But the Moon does not pass exactly between the Earth and Sun every month. This is because the orbit of the Moon is at a  $5^\circ$  tilt relative to the plane of our orbit around

the Sun. There are just two times a year when orbits align allowing the possibility of a total solar eclipse. Most of the time the Moon passes well above or below our view of the Sun.



Most of the time the Moon passes well above or below our view of the Sun. Otherwise, we would experience a solar eclipse with every New Moon.

Adapted from Wright Seneres, Science Learning Research Group, Temple University. CC-BY-NC-SA 4.0



# OUR VIEW FROM EARTH

## A COSMIC COINCIDENCE OF SCALE

Earth is the only planet in our solar system from which you can witness a total solar eclipse. This is because the Sun is 400x the Moon's diameter but is also 400x farther away from Earth. As a result, both bodies appear to be the same size in our sky.

But the Moon is slowly inching away from Earth. Hundreds of millions of years from now, the Moon will appear too small to entirely cover the Sun.

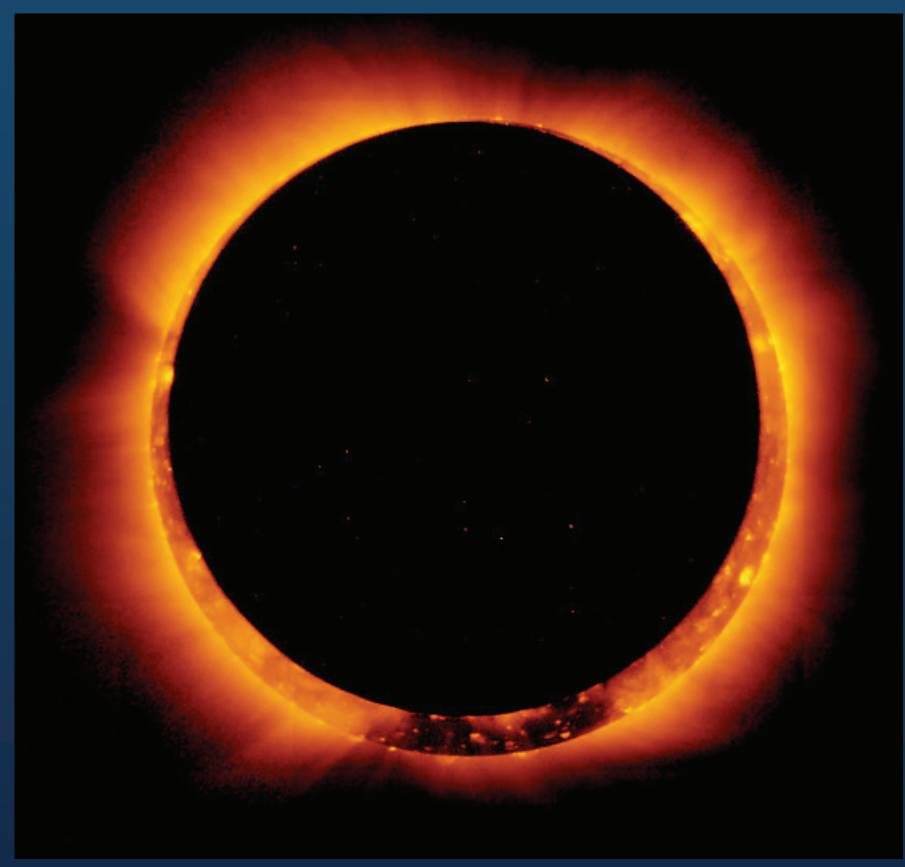
SUN

EARTH

MOON

*This drawing shows the true relative sizes of the Sun, Moon, and Earth.*

JAXA/NASA/SAO/NAOJ



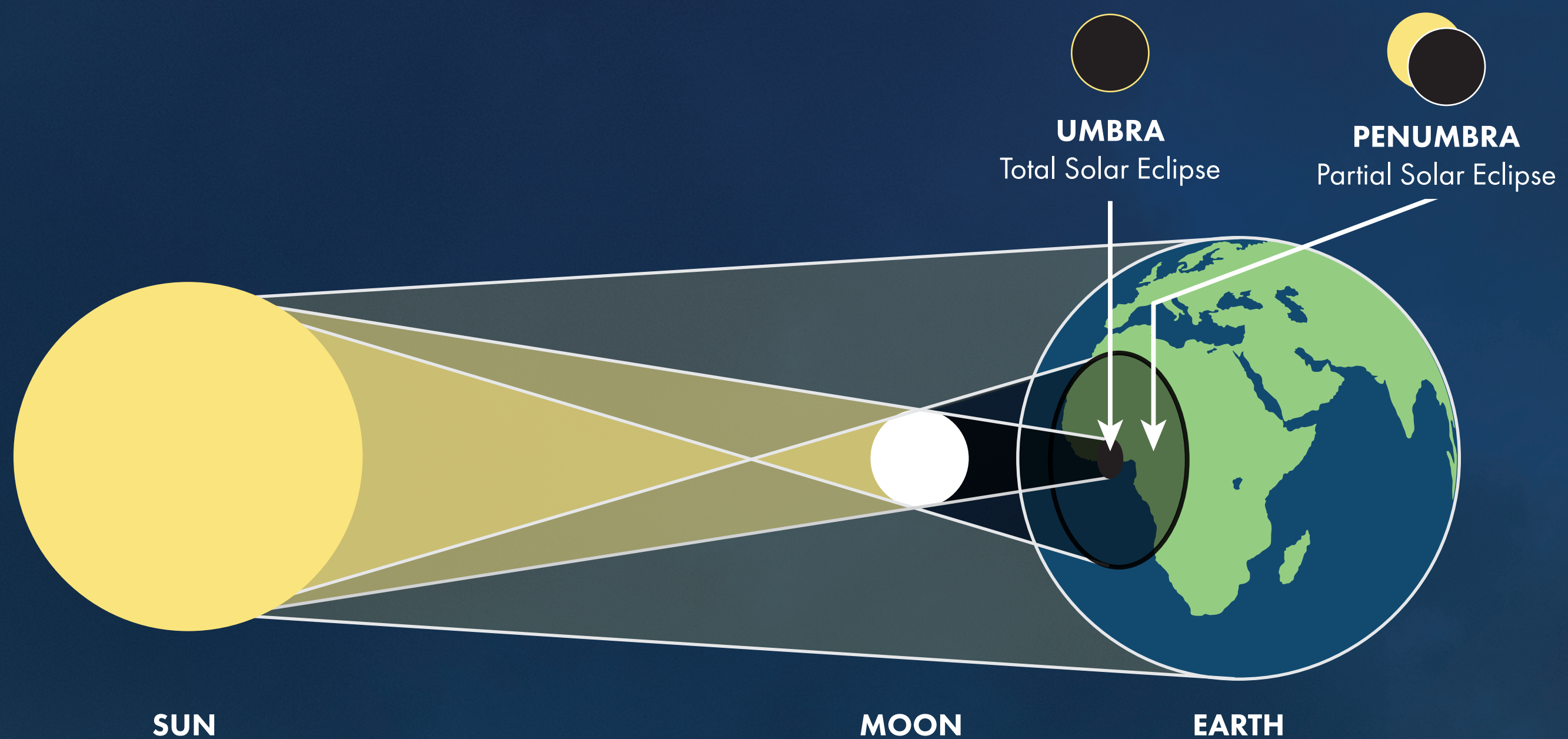
People in the American Southwest enjoyed a "Ring of Fire" eclipse this past October.

## THE MOON KEEPS ITS DISTANCE DURING A 'RING OF FIRE' ECLIPSE

The Moon is farther from the Earth during an annular or "Ring of Fire" eclipse than during a total eclipse. At its closest point, the Moon is about 226,000 miles away. At its farthest point, the Moon is about 251,000 miles away. Objects that are farther away are smaller from our perspective. Thus when the Moon is farther from us, it appears too small to obscure our entire view of the Sun, leaving a circle of light or "Ring of Fire."



# ECLIPSE PATHS



Only the areas on Earth that fall in the path of the Moon's shadow experience a solar eclipse.

Illustration adapted from Nandalal Sarkar/Shutterstock.

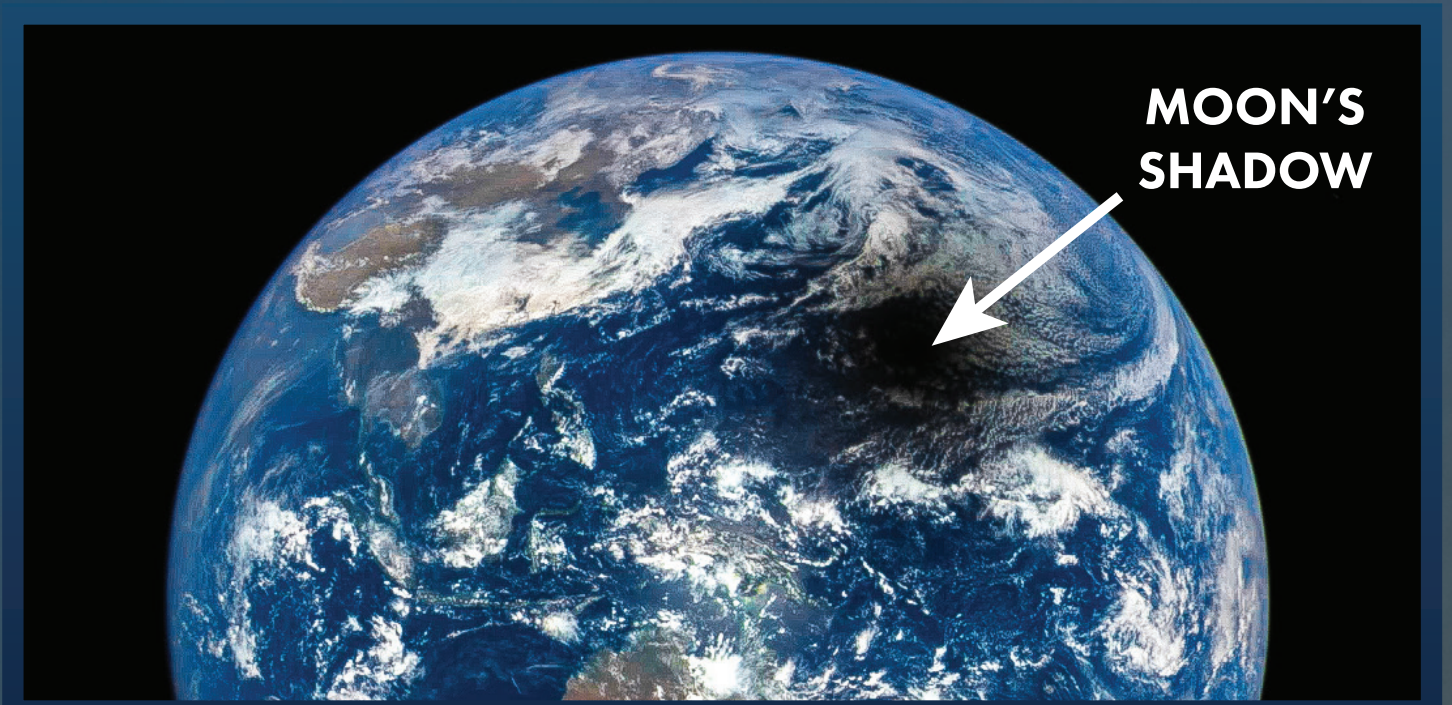
## IN AND OUT OF THE PATH OF TOTALITY

The center of the Moon's shadow, or umbra, is its darkest part. There, the Sun is completely obscured by the Moon, and viewers experience a total eclipse.

The penumbra is an extended part of the shadow that is slightly lighter than the umbra. There, the Sun is only partially obscured, and viewers experience only a partial eclipse.

## HOW OLD WILL YOU BE DURING THE NEXT TOTAL SOLAR ECLIPSE?

Total solar eclipses occur somewhere on Earth about every 18 months. Partial solar eclipses are more common and occur two to five times per year. The next total solar eclipse that can be viewed from the contiguous United States won't be until 2044. And the next one to cross Vermont won't be until 2079!



NASA, courtesy of DISCOVER EPIC Team. Label added.

The Moon's shadow will race across Vermont at approximately 2,700 miles per hour during the April eclipse.



# THE MOON

## EVER NOTICE THE MOON'S MANY SEAS?

You've likely heard of the Sea of Tranquility. It's the site of the first Moon landing and one of the Moon's 23 maria.

Lunar maria are large plains made of hardened lava. Early astronomers mistook these dark, basalt plains for seas and dubbed them maria.

Maria are located in the Moon's low spots and are less reflective than its highlands and hence appear dark.



NASA/JPL

*The Moon's valleys, plains, and mountains were formed by meteor impacts and volcanic activity.*

## BAILY'S BEADS AND A DIAMOND RING

Watch for these two effects as the April eclipse approaches totality. As the Moon moves across the Sun, several points of light will appear as if strung on a necklace around the Moon. Known as Baily's Beads,

this effect results from the Sun's rays streaming through valleys along the Moon's horizon. As Baily's Beads disappear, a single bright spot will remain. This bright spot resembles a diamond in a celestial ring.



NASA/Aubrey Gemignani

*The Baily's Beads effect can be seen close to totality.*

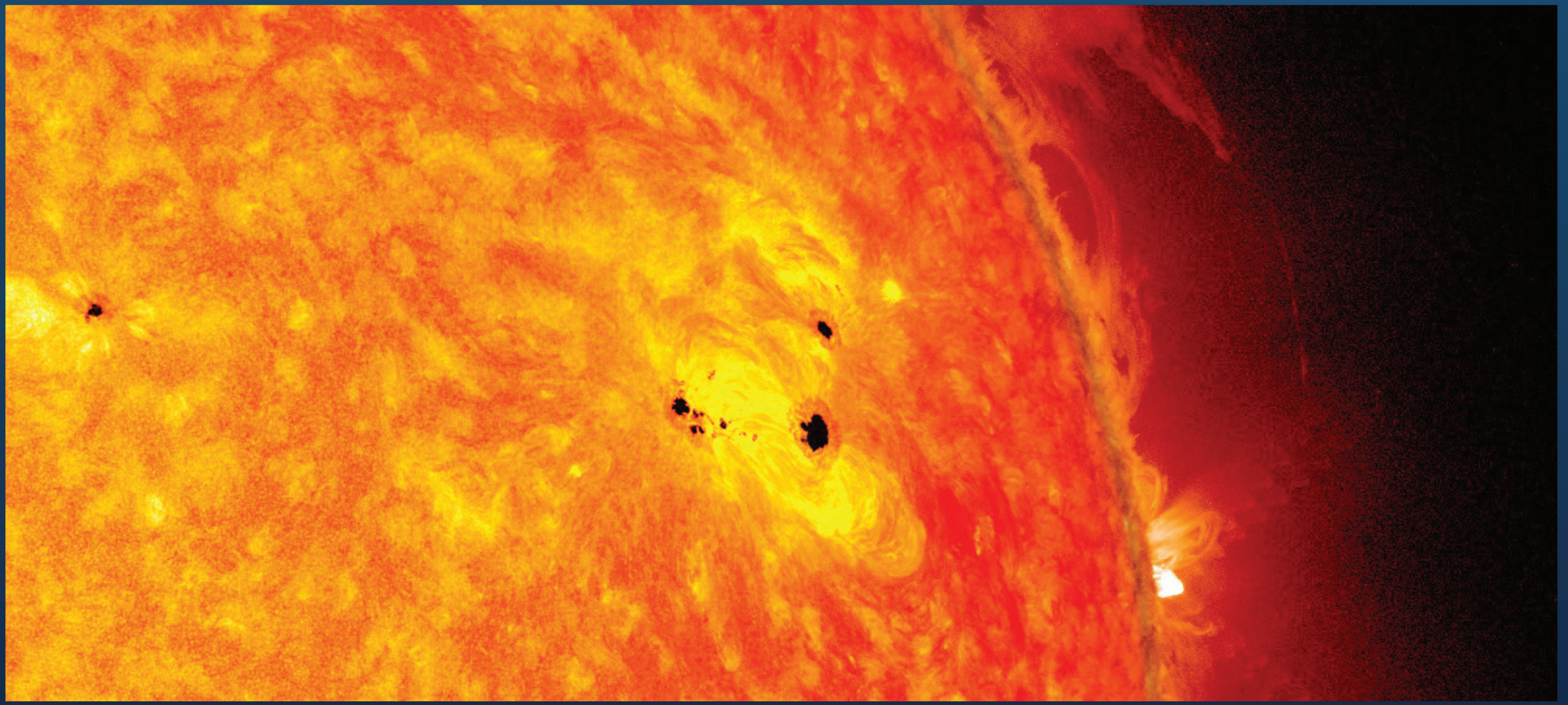


NASA/Aubrey Gemignani

*The Diamond Ring effect follows Baily's Beads.*



# THE SUN



NASA/SDO/AIA/HMI/Goddard Space Flight Center

*The Sun is made of gas and plasma and does not have a solid surface like the Earth and Moon.*

## SUNSPOTTING

Sunspots are dark, planet-size regions with strong magnetic fields on the surface of the Sun. These regions of the Sun appear darker because they are cooler than their surroundings.

The center of a sunspot is about  $6,000^{\circ}\text{F}$  whereas the surrounding area can be almost  $4,000^{\circ}\text{F}$  hotter. The frequency and intensity of sunspots indicate the current level of solar activity driven by the Sun's magnetic field.

## THE SUN'S CROWN

Total solar eclipses allow scientists to see a part of the Sun that is usually hidden—its atmosphere or corona.

Why? The Sun's surface is much brighter than the corona and continuously outshines it.

Watch closely, once the Moon completely blocks out the Sun during totality, you will be able to spy the elusive corona with your naked eye for a few short minutes.



NASA/Aubrey Gemignani

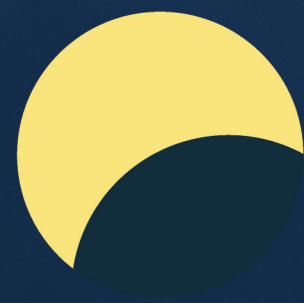
*The Sun's corona as seen during a total solar eclipse.*





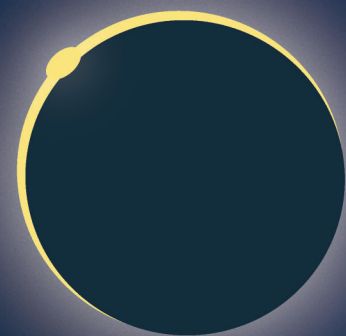
**2:14 PM  
FIRST CONTACT**

Partial eclipse begins.  
Edge of Moon starts to overlap the Sun.



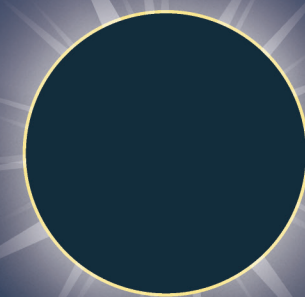
**2:50 PM**

The Moon partially covers the Sun.



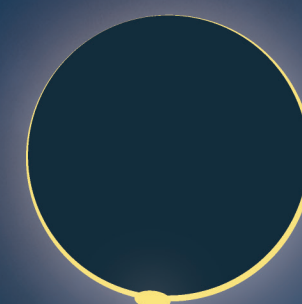
**3:26 PM  
SECOND CONTACT**

Total eclipse begins.  
The Moon covers the entire disk of the Sun.



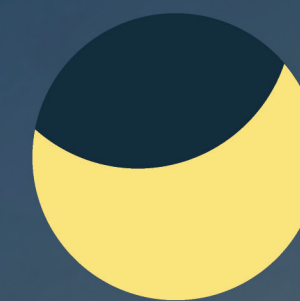
**3:27 PM  
TOTALITY**

The Sun is completely covered.  
The Sun's corona (outermost atmosphere) is visible.



**3:29 PM  
THIRD CONTACT**

Full eclipse ends.  
The Moon continues its path past the Sun.



**4:03 PM**

A greater portion of the Sun becomes visible.



**4:37 PM  
FOURTH CONTACT**

Partial eclipse ends.  
The full Sun is visible.



**WATCH**

Planets and bright stars appearing  
Plant buds opening or closing  
A 360° sunset

**Note:** Wear eclipse glasses when looking directly at the Sun.



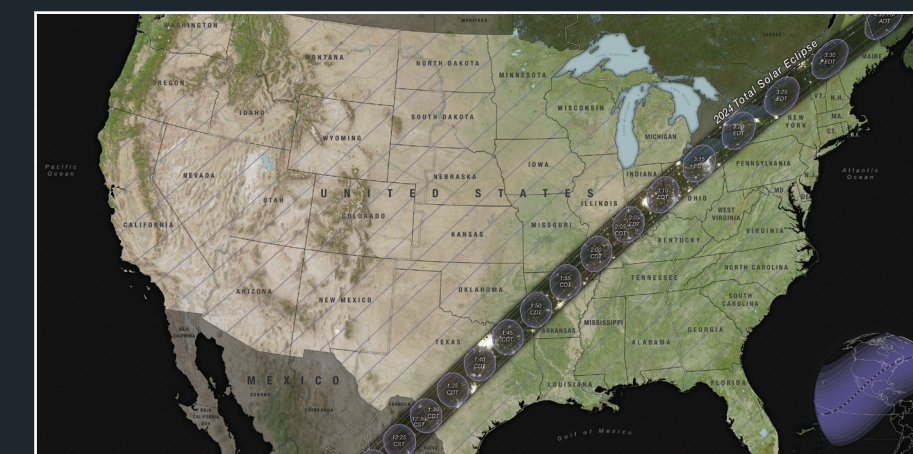
**HEAR**

Daytime birds singing an evening song, quieting, then calling to the dawn  
Nocturnal animals waking: crickets chirping, owls hooting, frogs croaking



**FEEL**

The air cooling  
Wind direction changing  
Wind speed decreasing  
A sudden stillness



NASA's Scientific Visualization Studio.

The path of the Total Solar Eclipse on April 8, 2024.

# TOTAL SOLAR ECLIPSE

APRIL 8, 2024  
Timing shown for Burlington, Vermont.

