

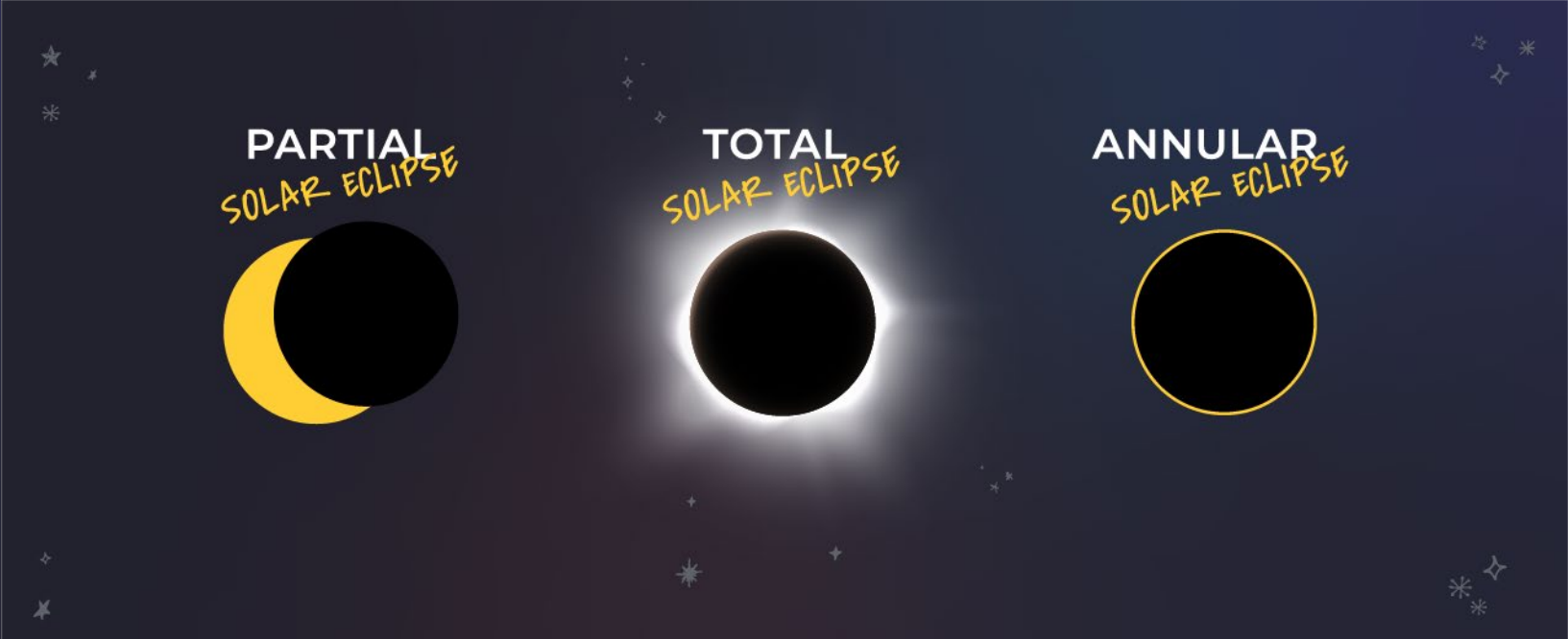
CHASING ECLIPSES

October 14, 2023 & April 8, 2024





NOT TO SCALE



What is a solar eclipse?

A **solar eclipse** is a special temporary lineup of the Sun, the Moon, and Earth. The Moon has to be directly between the Sun and Earth for a solar eclipse to be seen on Earth.

How does a solar eclipse happen?

Sunlight falls on the Moon. The Moon casts a shadow into space. If the Moon's shadow happens to fall on the Earth, anyone within the region on the Earth where the shadow falls will see the Moon partly or fully cover the Sun. We call this phenomenon where the Moon *eclipses* or *blocks* the Sun a **solar eclipse**. The only Moon phase where the Sun-Moon-Earth special lineup can happen to create a solar eclipse is **New Moon**. New Moon occurs when the Moon is between the Earth and the Sun.

Do we get a solar eclipse at every New Moon? Nope!

Why not?

The Moon's orbit around the Earth is angled a little with respect to Earth's orbit around the Sun. Because of this angled orbit, the Moon's shadow at New Moon usually misses the Earth. When the Sun, Moon, and Earth line up just right and the Moon's shadow falls on the Earth, then we see a solar eclipse.



Does everyone everywhere see a solar eclipse?

No. The specific Sun-Moon-Earth lineup is temporary, so your part of Earth needs to be facing the Sun when the lineup occurs AND you need to be somewhere within that shadow area to see a solar eclipse.

Are all solar eclipses the same? No.

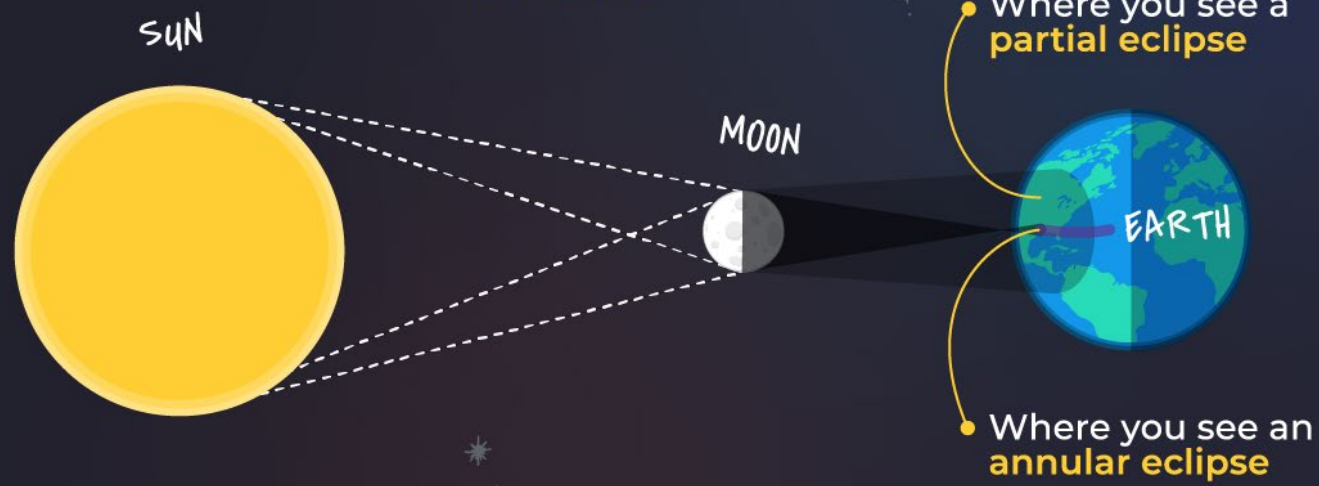
There are different types of solar eclipses:

- If the Moon partly covers the Sun and the Sun looks like a bite has been taken out of it, then that is a **partial solar eclipse**.
- If the Moon totally covers the bright disc of the Sun, then that is a **total solar eclipse**.
- If the disc of the Moon isn't quite big enough to totally cover the Sun and we see the Moon's disc surrounded by a ring of bright Sun, then that is an **annular solar eclipse** (explained below). The word annular is Latin and means "ring."



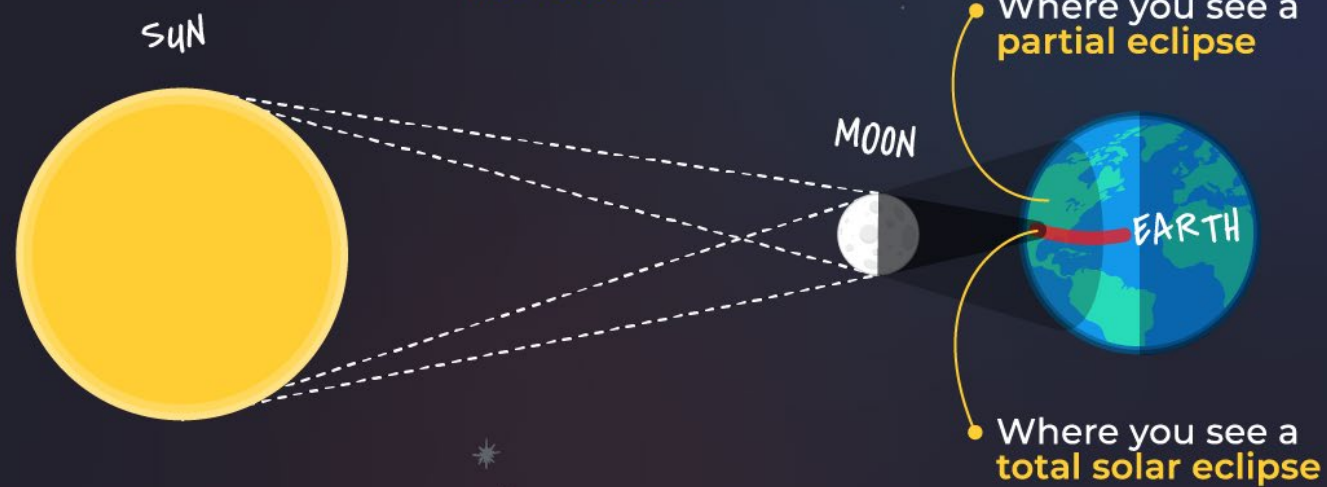
ANNULAR SOLAR ECLIPSE

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TOTAL SOLAR ECLIPSE

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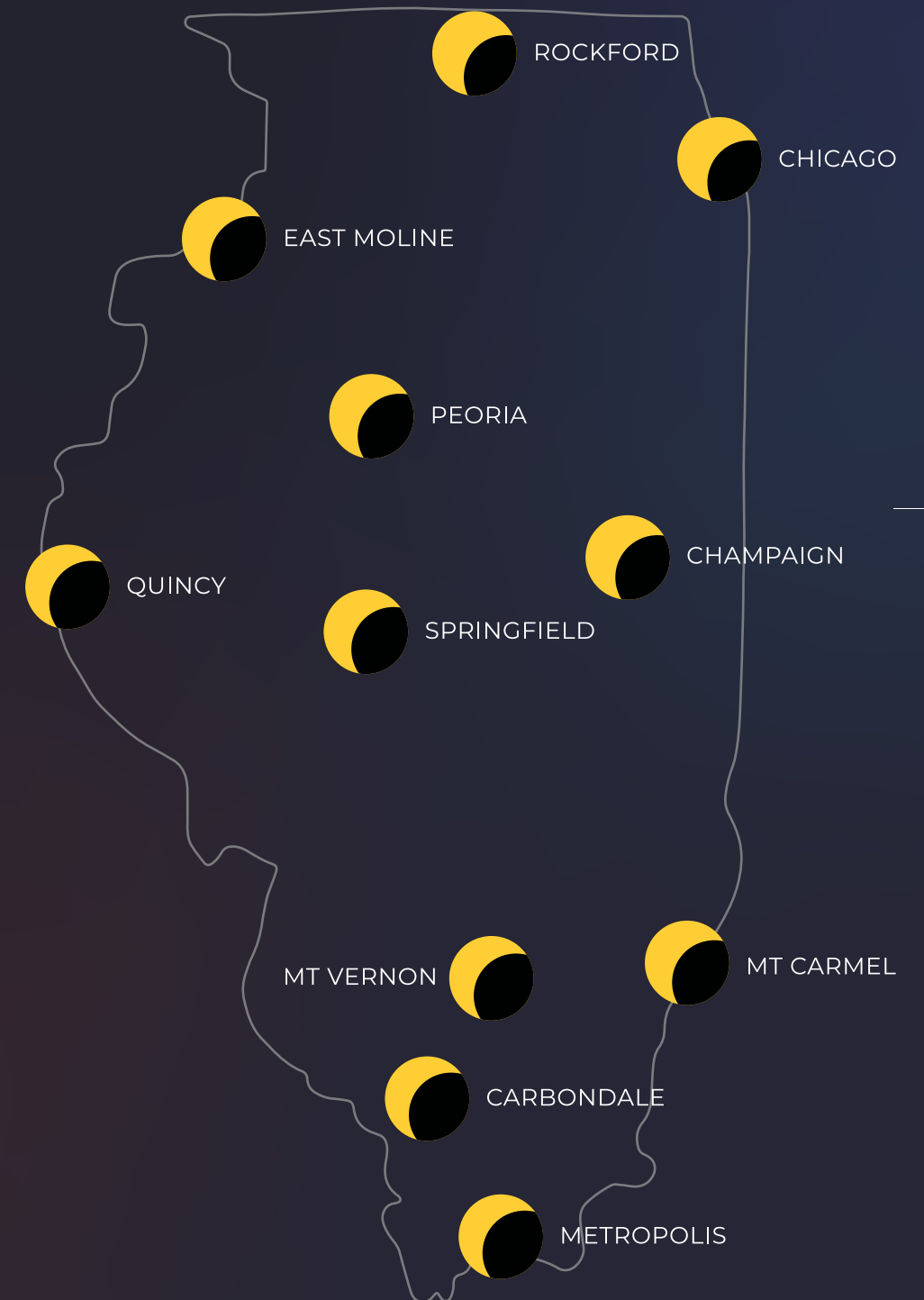


Whether we get an **annular solar eclipse** or a **total solar eclipse** depends on two distances. The Earth-Moon distance varies by about 12%, and the Earth-Sun distance varies by about 3%. The result of those changing distances means that the apparent sizes of the Moon and Sun in our sky both change a little bit. Sometimes, the Moon appears large enough to fully cover the Sun and we get a total eclipse. Sometimes, the Moon isn't large enough to fully cover the Sun, and we get an annular eclipse.

October 14, 2023:

WHAT WILL ILLINOIS SEE?

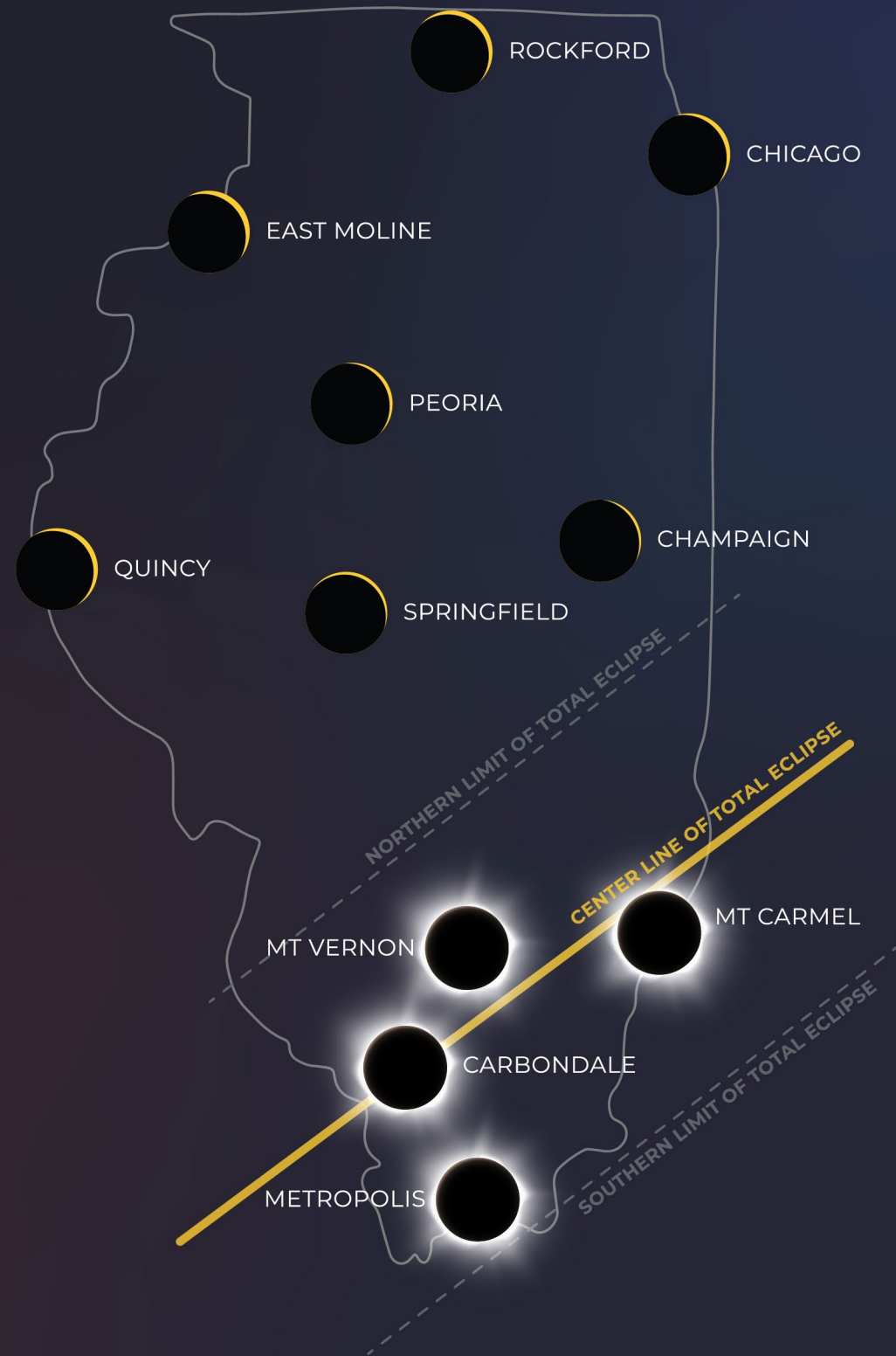
Solar Eclipse Maximum Visibility in Illinois



April 8, 2024:

WHAT WILL ILLINOIS SEE?

Solar Eclipse Maximum Visibility in Illinois



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How do you safely view a solar eclipse?

At no time is the uneclipsed Sun safe to view with just your eyes. **At no time** is the annularly-eclipsed Sun safe to view with just your eyes, even if you are within the path of annularity. **At no time** is the partially-eclipsed Sun safe to view with just your eyes. Do not look at the bright surface of the Sun. Eye damage can occur in seconds, and the damage is irreversible. You won't feel eye damage until it has happened. You do not have nerve endings inside your eyes that will register pain as the damage is occurring.

Whenever any of the uneclipsed, partially-eclipsed, or annularly-eclipsed Sun is visible, you will need safe solar viewing glasses or viewers to look directly at the Sun, as long as the glasses or viewers comply with the transmission requirements of the ISO 12312-2 international standard. Homemade filters or ordinary sunglasses, even very dark ones, are not safe for looking at the Sun; they transmit thousands of times too much sunlight.

The only exception to the rule of never looking at the Sun is this: If you are within the path of totality and the Moon has covered 100% of the bright surface of the Sun, that's the only time when you can safely view the eclipse without solar viewers or glasses. In fact, you need to remove your viewers or glasses to view totality directly. Why? The solar viewers are too dark! You won't see totality! As soon as the bright surface of the Sun reappears after totality, then you will need to look away from the Sun and/or put your solar glasses or viewers back on.





ACTIVITY: PINHOLE PROJECTION

If you do not have solar viewers or solar glasses, you will need to look at an image of the eclipse projected onto the ground or onto a wall. This is called pinhole projection. Pinhole projection means that sunlight projects through a small hole in an object onto a surface beyond, and you look at the solar image on the surface. Never look through a pinhole at the Sun.

Here are some pinhole projection ideas.

Your hands as pinhole projectors:

Put your back to the Sun. Put the outstretched, slightly open fingers of one hand over the outstretched, slightly open fingers of your other hand in a criss-cross or tic-tac-toe pattern. Look at your hands' shadow on the ground. The little spaces between your fingers will be the pinholes that will project a grid of small eclipse images. You may need to adjust the spacing of your fingers a bit to see the shadows better.

Trees as pinhole projectors:

Look down at the ground underneath trees. The tiny spaces between the leaves will be the pinholes that will create dozens of images of the partial eclipse.

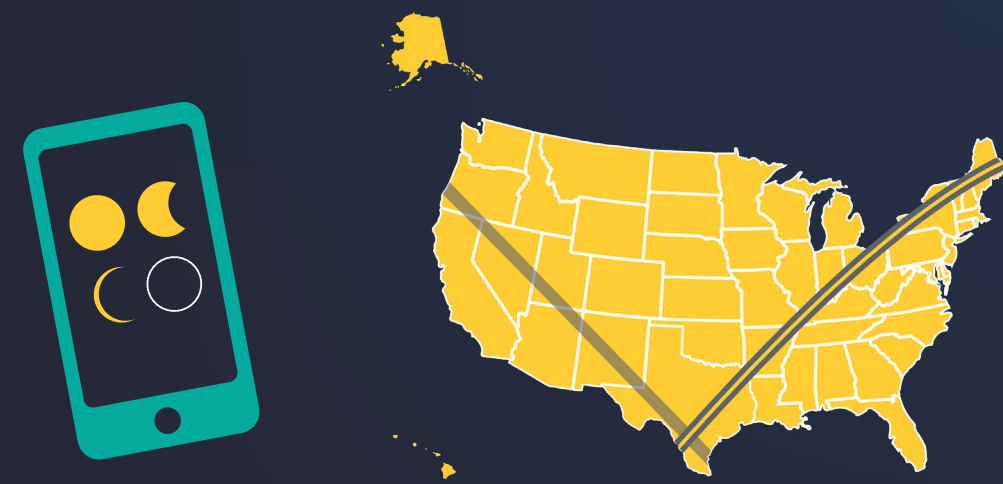
Household materials as pinhole projectors:

Punch a small hole in an index card or paper plate or piece of aluminum foil, and use that to project an image of the eclipse onto the ground. Or, find objects that have small holes in them, such as pasta strainers or pieces of pegboard. You can even try using small holes in different foods as the pinholes—try crackers!

Make a cereal box pinhole projector:

http://hilaroad.com/camp/projects/eclipse_viewer/eclipse_viewer.html

Can you come up with others?



ACTIVITY: SMARTPHONE ECLIPSE IMAGING

Want to get an image of a partial solar eclipse* using your smartphone? With a little effort, you can do it. Just remember: **Never point your unprotected smartphone camera at the Sun if any part of the bright Sun is visible!** Just like for your eyes, camera damage from the bright Sun will be quick and likely permanent.

Instructions:

- Turn off your phone's screen auto-lock feature.
- Securely attach one of the lenses of safe solar viewing glasses completely over all your phone's camera lenses. Face the shiny reflective side of the material outward.
- Open your camera app, and change the imaging mode from photo to video.
- Turn HDR (High Dynamic Range) on, if your camera app has it.
- Attach your smartphone to a camera tripod or prop it against something sturdy.
- Point your camera at the Sun. Zoom the camera's view in on the Sun since this may help limit overexposure or auto-focusing.
- When you are happy with how the view looks on the screen, record video for a few seconds. Hopefully, at least a few frames of your video will have decent images.
- Reposition your phone periodically and repeat these instructions.

*If you are in the path of totality, especially if it is your first total solar eclipse, totality itself is so short that you do not want to waste a single second of it fumbling around with your camera, the solar material, your tripod, finding the Sun, zooming in, etc. Leave those totality images to the professionals and just experience totality with all your senses.





MORE ECLIPSE FUN FACTS:

ADDITIONAL RESOURCES:

[American Astronomical Society eclipse website:](https://eclipse.aas.org/)
<https://eclipse.aas.org/>

[Reputable vendors of solar glasses & viewers:](https://eclipse.aas.org/resources/solar-filters)
<https://eclipse.aas.org/resources/solar-filters>

[How to view a solar eclipse safely:](https://eclipse.aas.org/eye-safety)
<https://eclipse.aas.org/eye-safety>

[Details & timing for the October 14, 2023 eclipse:](https://www.timeanddate.com/eclipse/solar/2023-october-14)
<https://www.timeanddate.com/eclipse/solar/2023-october-14>

[Details & timing for the April 8, 2024 eclipse:](https://www.timeanddate.com/eclipse/solar/2024-april-8)
<https://www.timeanddate.com/eclipse/solar/2024-april-8>

[Generate a visualization of both eclipses for your specific city or town:](https://eclipse2024.org/eclipse-simulator/)
<https://eclipse2024.org/eclipse-simulator/>

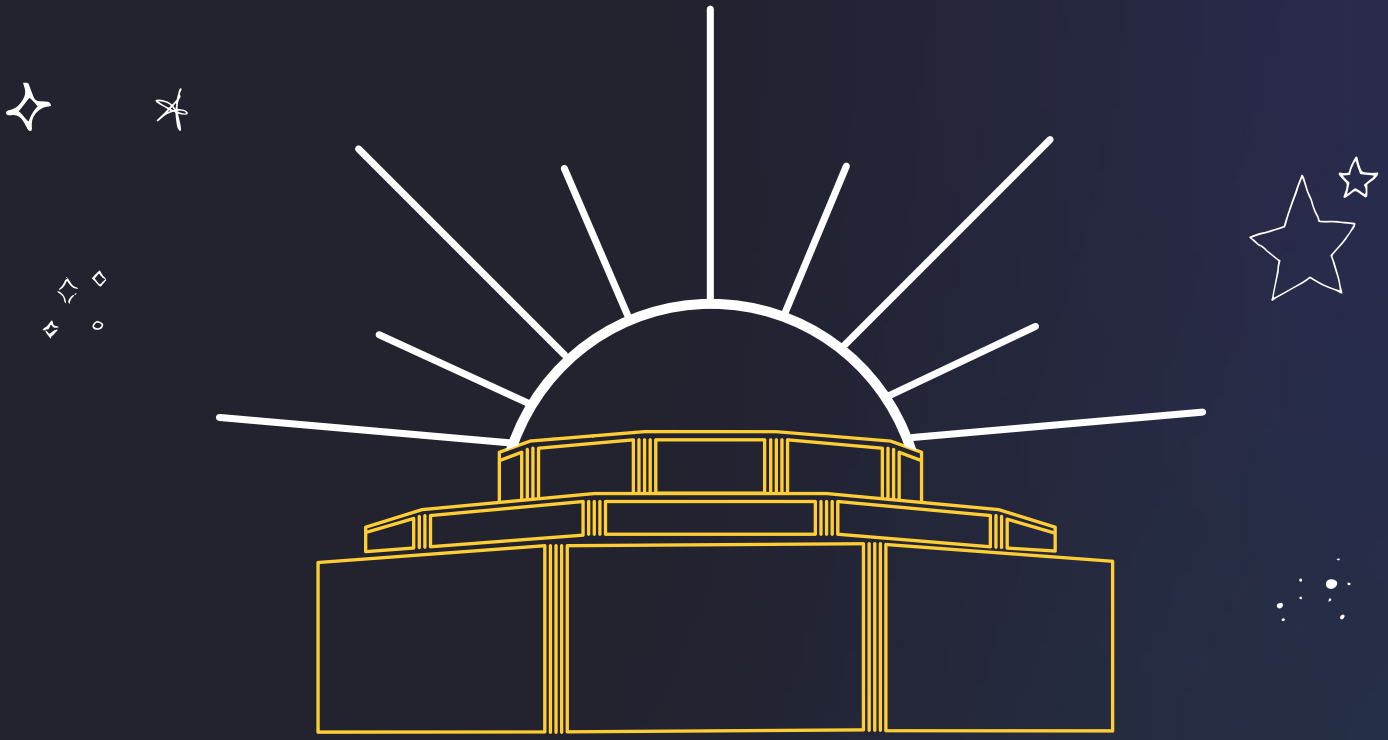
[Eclipse Activities for Libraries \(or anyone!\):](https://www.starnetlibraries.org/about/our-projects/solar-eclipse-activities-libraries-seal/)
<https://www.starnetlibraries.org/about/our-projects/solar-eclipse-activities-libraries-seal/>

[Eclipse Activities for Educators \(or anyone!\):](http://bit.ly/teacheclipse)
<http://bit.ly/teacheclipse>



- Solar eclipses on Earth are a coincidence of size and distance. Our Sun's diameter is about 400 times larger than that of the Moon. The Sun is about 400 times farther away than the Moon is. They end up appearing approximately the same size in our sky.
- On average, solar eclipses are visible from somewhere on Earth about every 18 months. Many calendar years have two solar eclipses. There can be up to five solar eclipses in one year. The last time this happened was 1935. The next time it will happen is 2206.
- The same spot on Earth will see a total solar eclipse about every 375 years. This isn't a firm number though, just an average.
- When the Sun, Moon, and Earth line up to produce a solar eclipse at New Moon, that means that the lineup will also produce a lunar eclipse at Full Moon, either the Full Moon just before or the Full Moon just after the solar eclipse. A lunar eclipse is a lineup of Sun-Earth-Moon, when the Moon passes into the shadow cast by the Earth into space. The lunar eclipse may or may not be visible in the same region that sees the associated solar eclipse.

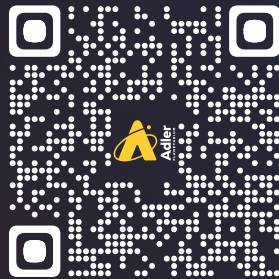




Questions? askadler@adlerplanetarium.org

Need more info? <https://www.adlerplanetarium.org/equippedtoeclipse>

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