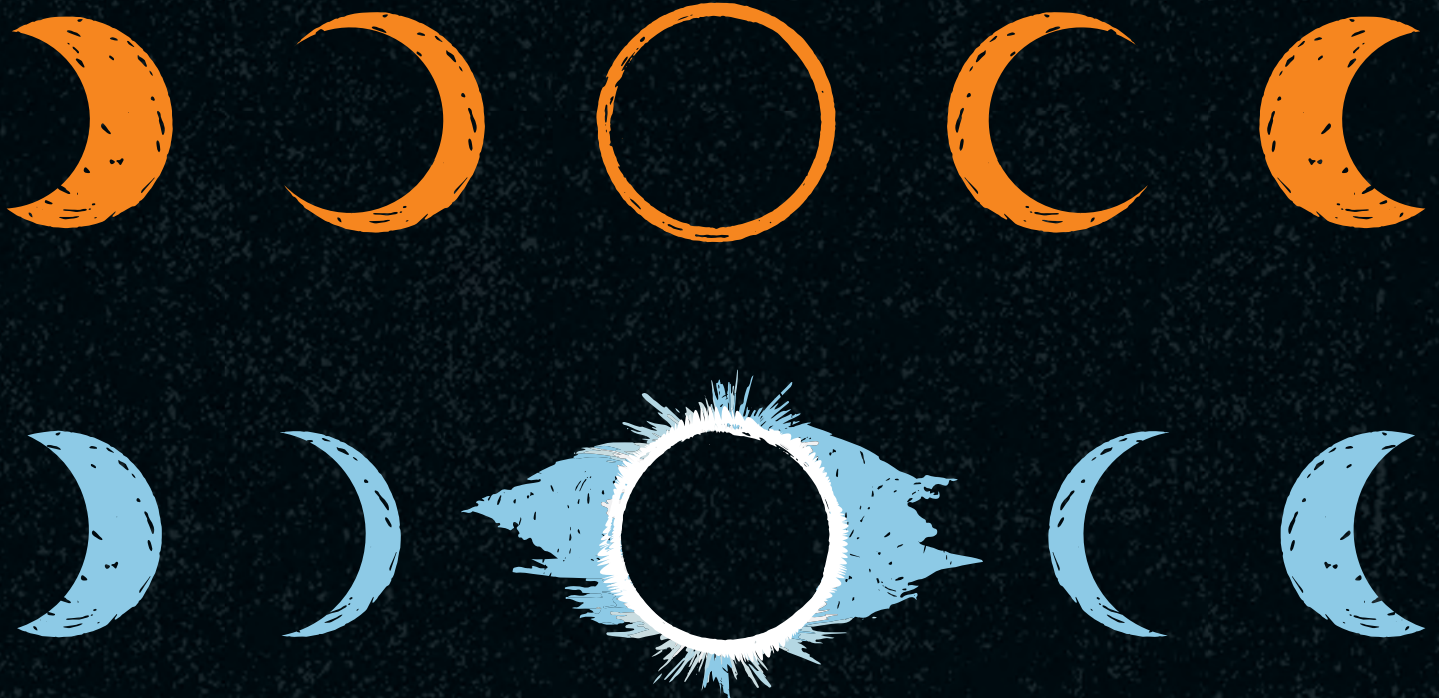


*The STAR Library Network presents*

# SOLAR ECLIPSES of 2023 and 2024

A North American “Double-Header”

A Guide for Public Libraries and  
Their Communities



by Andrew Fraknoi (*Fromm Institute, University of San Francisco*)  
and Dennis Schatz (*Institute for Learning Innovation*)



With Support from the

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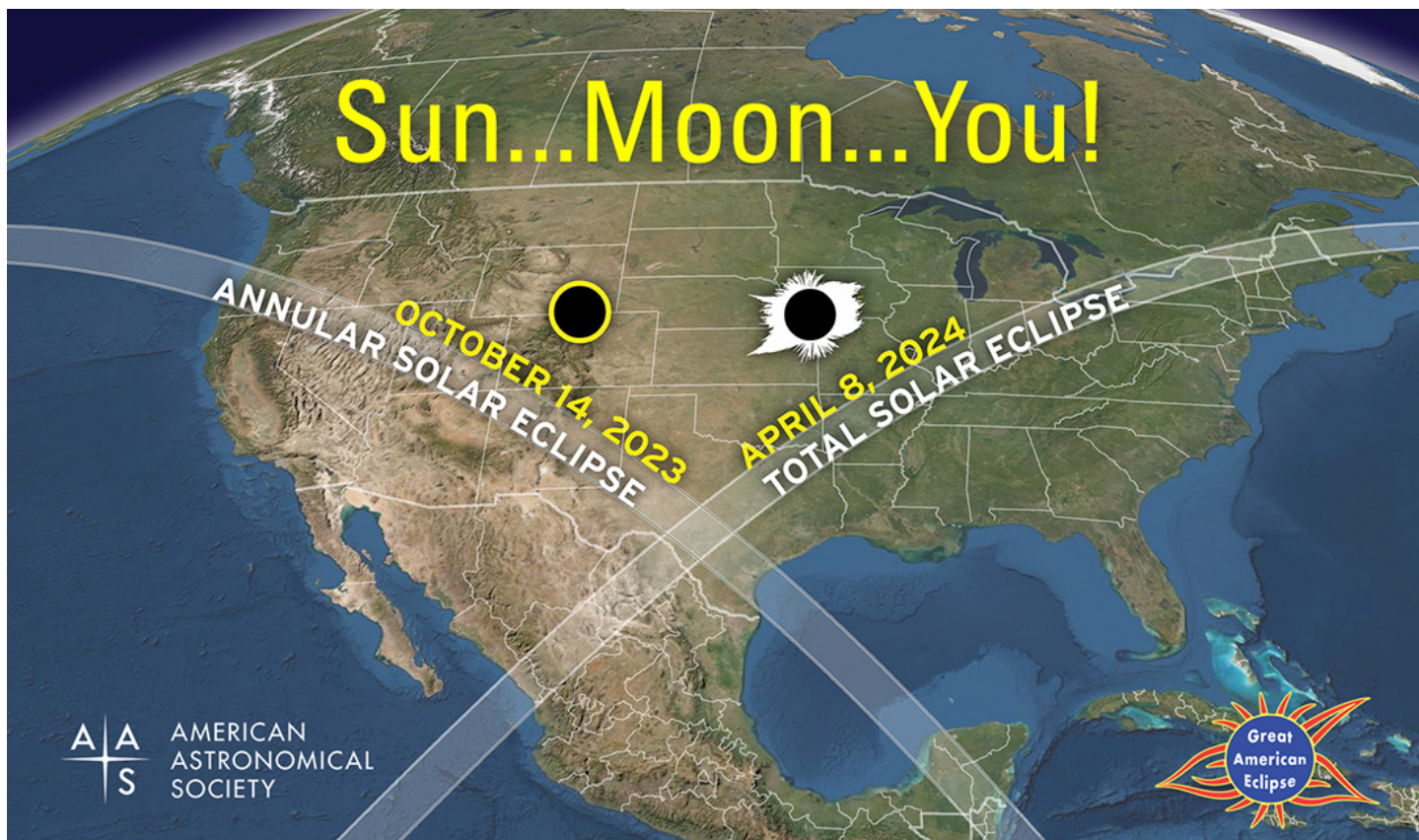


1

# Introduction to this Booklet



In this booklet the **SEAL (Solar Eclipse Activities for Libraries)** team will introduce you and your patrons to eclipse science and viewing. We also provide a range of ideas for library eclipse events and community partners you can enlist to help. Pages 28 through 34 contain two handouts for your patrons, in both English and Spanish: one for the 2023 annular eclipse, and the other for the 2024 total eclipse. Each is two pages and formatted for printing on a single double-sided sheet of paper so they are easily shared with the public. You can also provide them electronically by going to [scigames.org/eclipse](https://scigames.org/eclipse). We encourage you to distribute the handouts to as many of your patrons as possible!



“Sun...Moon...You!” by [Michael Zeiler](#)

In August 2017, a spectacular total eclipse of the Sun was visible on a narrow path stretching across the United States. In such an eclipse, the Moon exactly covers the Sun, fully blocking the Sun’s light. Those outside of the path saw a partial eclipse, where the Moon covers only part of the Sun.

To help the public view the eclipse safely the **Gordon and Betty Moore Foundation** funded the **Space Science Institute’s (SSI) STAR Library Network** to distribute 2 million pairs of safe solar-viewing glasses, as well as eclipse information, through public libraries across the country. We estimate that some 6 million people used these glasses in 2017; the largest national effort to distribute solar-viewing glasses.

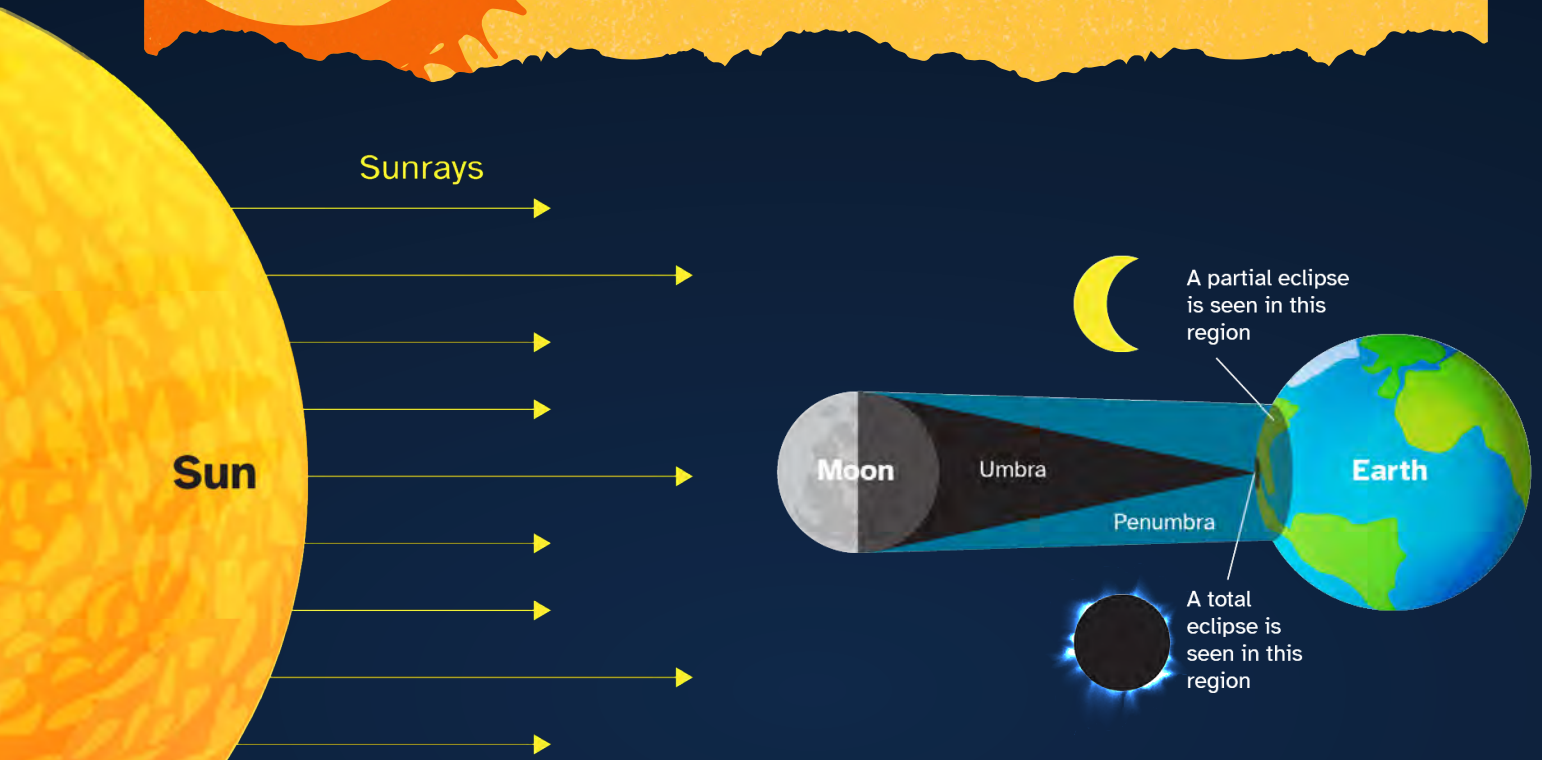
Many libraries reported that their eclipse events in 2017 were the best attended programs in their history, and that people enthusiastically thanked them for the glasses

and the information made available. In view of this success, the **Moore Foundation** has generously agreed to fund the distribution of **5 million** pairs of solar-viewing glasses for the two eclipses that will cross the United States in October 2023 and April 2024. These eclipses will again be visible, at least as partial eclipses, for the entire country. Our intent is that your libraries will get their glasses before October 2023 so that they can be used for both eclipses.

The October 14, 2023 eclipse is on a Saturday, while the April 8, 2024 eclipse is on a Monday, potentially affecting what programs are viable. In addition, you will want to determine if the 2024 eclipse is during spring break for schools in your area. In 2017, many libraries did extensive programing before the eclipse occurred to get their patrons prepared for eclipse day with sufficient observing information and tools.

# 2

# Solar Eclipses 101



## *Why and how often do eclipses of the Sun occur?*

An eclipse of the Sun occurs when the Moon moves between the Sun and Earth, blocking some or all of the Sun. While the Sun is *much* bigger than the Moon, it is also *much* farther away. It just happens that these two things combine to make the Sun and Moon appear roughly the same size in the sky when seen from Earth. When the two are exactly lined up, the Moon can hide the Sun from our sight – hence a “*total*” eclipse. If the line-up is not exact you experience a “*partial*” eclipse.

As you can see in the diagram above, total eclipses of the Sun – such as the one that will occur in April 2024 – are only visible on a small part of Earth’s surface where the Moon’s shadow is darkest. This zone of dark shadow is called the *umbra*. If you are outside the zone of totality – but not too far outside – you will see a partial eclipse. During a partial eclipse part of the Sun’s surface is still visible. As always, *any part* of the Sun’s surface is dangerous to look at without proper protection. You will need a pair of safe solar-viewing glasses or you must project an image of the Sun if any of the Sun’s surface is showing.



If you are along the path where you see a total eclipse in April 2024, it is safe to look directly at the Sun during the brief period that the Moon totally covers the Sun's surface. In fact, you will need to look directly at the Sun during those few minutes to see the solar atmosphere (*the corona*). **See observing strategies further on in this booklet.**

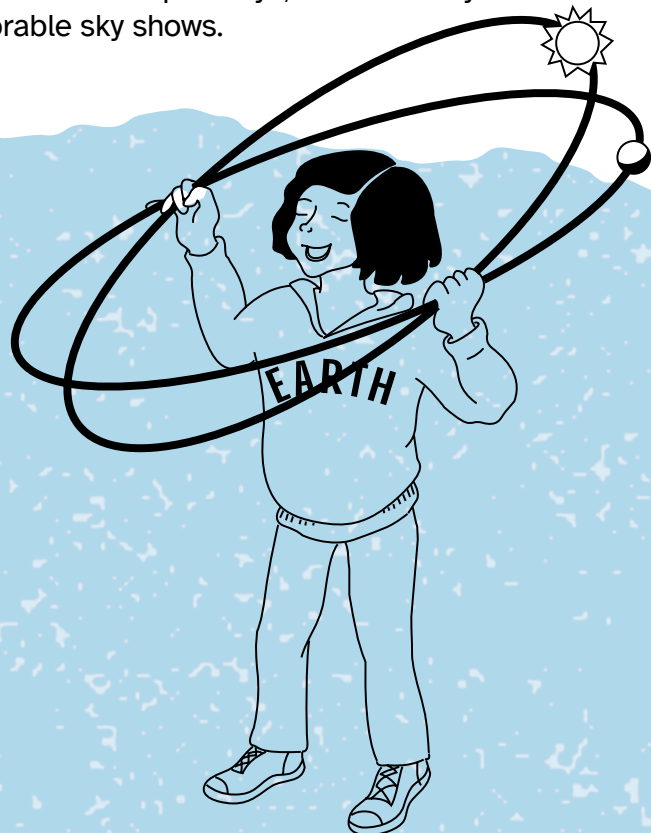
However, the Moon doesn't orbit Earth in a perfect circle: it moves in an ellipse that brings it sometimes a bit closer, sometimes a bit farther, from Earth. If the Moon and Sun are lined up, but the Moon is farther away from us in its orbit, the Moon will not be able to cover the Sun completely. In that case, we will see the Moon covering most of the Sun but leaving a bright ring around the Moon's dark disk. This line-up is called an "annular" eclipse and it's what we will see in October 2023.

Historical records and mathematical calculations tell us that there is a total eclipse of the Sun visible from somewhere on Earth every year and a half on average. But, the path of totality is just a narrow strip, so any given spot on the surface of our planet only witnesses a total eclipse roughly once every 350 years – and most of the time this is over an ocean, which covers 2/3 of Earth. There are groups of eclipse enthusiasts who find total eclipses so enchanting that they travel regularly to places where such eclipses are visible, even if they have to rent a boat or a plane!

Partial eclipses are visible in a much larger region than the narrow zone where totality or annularity can be seen. In 2023 and 2024, many, many more people will see a partial eclipse than will witness the total or annular eclipses. It will be important to make everyone, no matter where they will be on the eclipse days, feel that they are lucky to see one of nature's most memorable sky shows.

## *Why isn't there a solar eclipse each month?*

The orbit of the Moon is tilted by about five degrees from the orbit of Earth around the Sun. This means that, most months, the Moon's position is either above or below the Sun's position when they are in the same part of the sky. But every six months the two orbits cross, and eclipses of the Sun and the Moon occur. These periods when eclipses happen are called "eclipse seasons."



"Like two hula hoops held slightly apart, the path the Moon takes in the sky is tilted relative to the path the Sun takes." by [Dennis Schatz, ASTROAdventures](#)

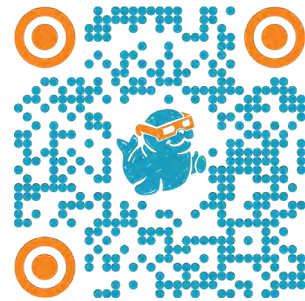
## *What's the best location to see the total or annular solar eclipses?*

The ideal place to be for each eclipse is on the center line of the eclipse path, near a town or park where the weather is usually clear. The closer an observer is to the center line the longer the total or annular eclipse experience will last.

Our web page provides maps, information about communities where each eclipse is best seen, and tables of what the eclipse will be like in the most populous cities.

*You can find this information at:*

[scigames.org/eclipse](http://scigames.org/eclipse)



The “wild card” is the weather. Many places on the path of the two eclipses tend to be cloudy in the months the eclipses occur (October and April). Also note that weather patterns vary between morning and afternoon. Cloud patterns change and storm systems may develop or go away. Jay Anderson, the best-known eclipse weather expert, keeps a website [eclipsophile.com](http://eclipsophile.com) all about weather conditions in each region. Keep it in mind if someone is asking about where to go. Additionally, the Time and Date Website, referred to on the next page, has historical weather information for the eclipse days for each community.

*“Diamond Ring and Shadow Bands”* by Stephen Mudge







## *What do experts recommend for those seeing their first solar eclipse?*

*Some helpful hints include:*

- Bring solar-viewing glasses, and/or supplies for other safe viewing techniques (see next section).
- Expect a big crowd and prepare for it.
- Everyone should go to the bathroom just before leaving home.
- Know where the nearest bathroom at your viewing site is.
- Bring drinks and snacks.
- Don't neglect sunscreen, hats, and regular sunglasses.
- For young kids, bring something to keep them occupied while waiting.
- Bring a folding chair and a sun umbrella.



*Remember regular sunglasses are for reducing glare; they don't have the protection to let you look directly at the Sun!*

To see what the eclipses will be like in some prime locations, as well as in some of the largest cities in the US, go to [scigames.org/eclipse](https://scigames.org/eclipse)

## *What will people see during 2023 and 2024 solar eclipses?*

For basic information about what can be seen during the eclipses of 2023 and 2024, please read the sheets in Pages 28 through 34.

*To figure out what the eclipse will be like in your community, you can go to these webpages:*



### **2023 Annular and Partial Eclipse:**

[2023 Time and Date Website](#)

[2023 Eclipse Website](#)



### **2024 Total and Partial Eclipse:**

[2024 Time and Date Website](#)

[2024 Eclipse Website](#)

# 3

## Viewing Solar Eclipses Safely

### *Are eclipses of the Sun dangerous to watch?*

It's not the eclipse that is dangerous to observe, it's the Sun! The Sun is so bright that its rays can cause serious damage to the sensitive tissues of the eyes, often without our being immediately aware of it. Normally, our common sense protects us from looking directly at the Sun for more than a second. But during an eclipse, astronomical enthusiasm can overwhelm common sense and people can wind up staring at the Sun for too long. Make sure all attendees have special, safe solar-viewing glasses to protect their eyes or are prepared to use an indirect method to view the eclipse (see *suggestions on the following pages*).

The few minutes of a **total** eclipse when *the Sun is completely covered* is the only time you should view the Sun directly. This is when you can see the faint but beautiful outer

atmosphere around the Sun, called the "solar corona." But any time even a small piece of the Sun is visible your eyes are in danger. This includes the entire duration of the annular eclipse: unlike the total eclipse, there is no point during the annular eclipse when it is safe to view the Sun without protection. Safe solar-viewing glasses with special filters made of protective material will be sold in lots of places. Just make sure that on the back, in small print, they say that they are ISO 12312-2 certified. Don't forget, there are also many ways to *indirectly* view the Sun.

A solar eclipse – especially a total eclipse – is an amazing and rare opportunity that you won't want to miss. Don't let these warnings scare you away from watching it: you can watch the eclipse safely, but you do have to protect your eyes using one of the techniques described in this booklet.

["2012 May 20 Albuquerque Open Access Eclipse Viewing"](#) by Skoch3 is in the [Public Domain, CC0](#)



# What are some ways I can watch the eclipse safely when part of the Sun is still visible?

## Sun Filters to Look Directly at the Sun (like Solar-Viewing Glasses!)

To look at the Sun directly, except during *totality* when the Sun is fully covered, you need a good filter that can cut out intense light. That's what the special glasses that the Space Science Institute is providing for libraries do. If you run out of them, suggest that patrons call local science museums, college bookstores, or stores that carry cameras, telescopes, or science-related equipment. We recommend that you only distribute glasses during eclipse preparation programs or other programs with solar science themes to slow distribution of your glasses inventory.

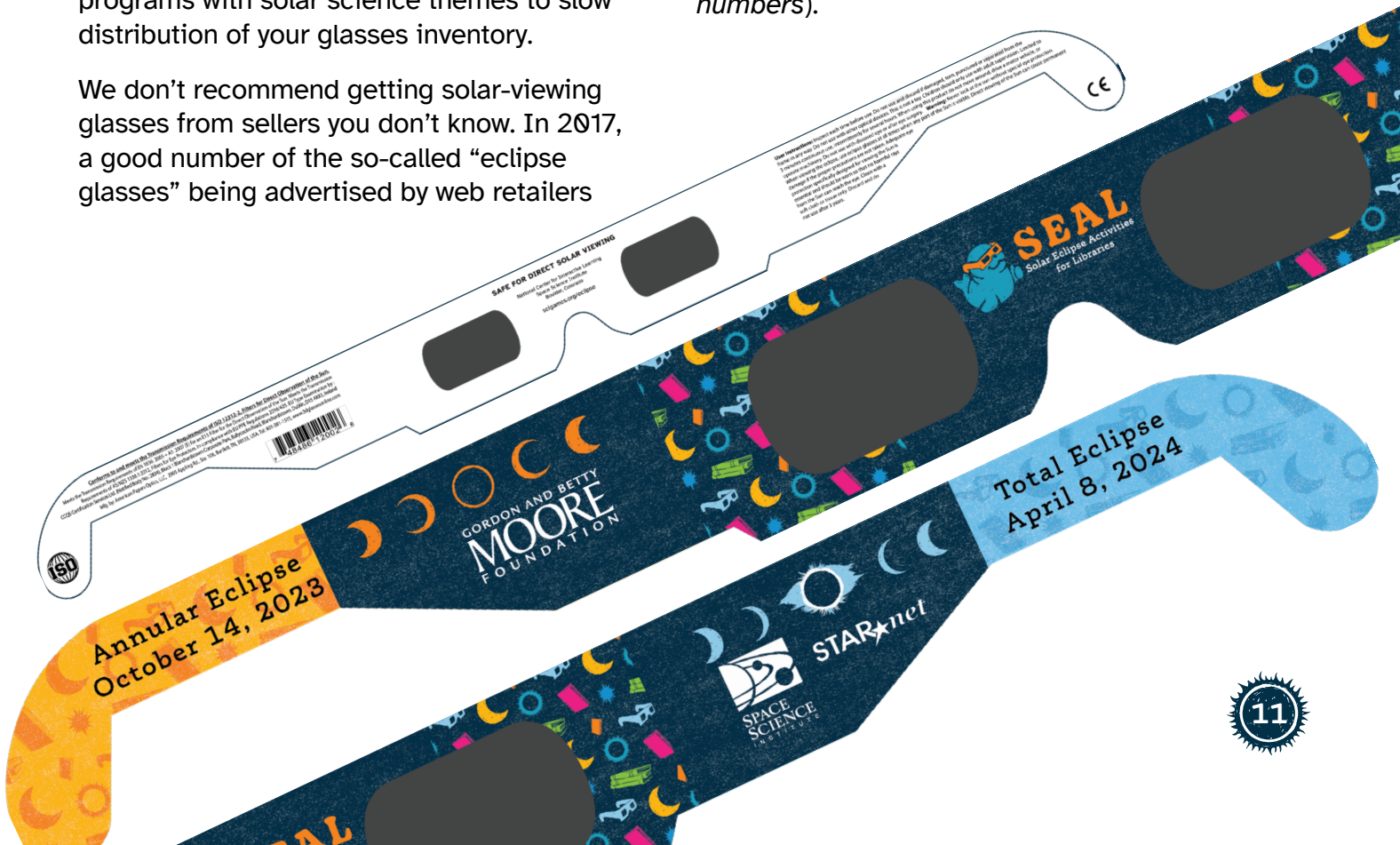
We don't recommend getting solar-viewing glasses from sellers you don't know. In 2017, a good number of the so-called "eclipse glasses" being advertised by web retailers

were manufactured by firms who had never submitted their product for testing by US laboratories. Up to date information on safe glasses and where to find them can be consulted at:

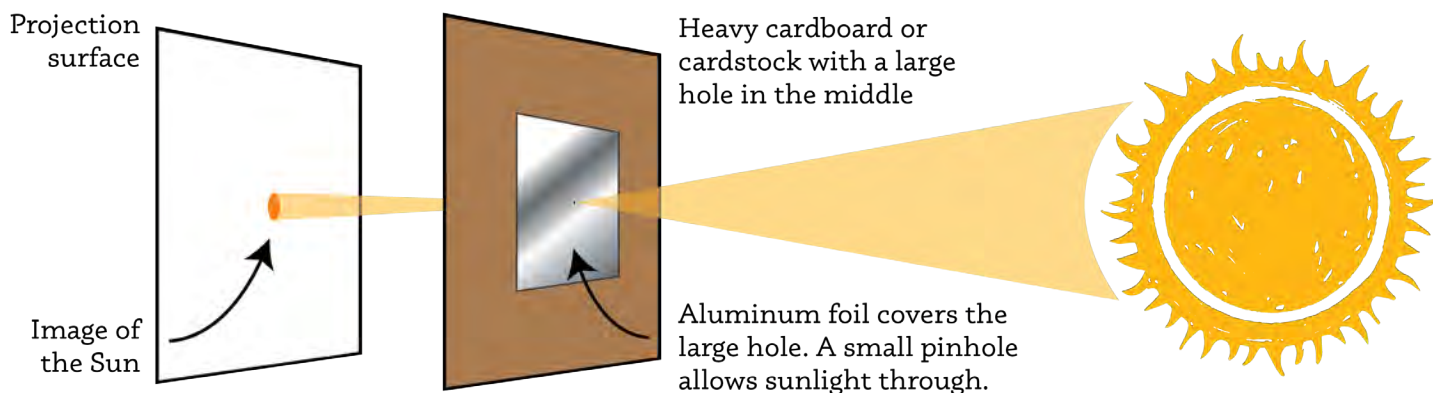
- [Eclipse Eye Safety](#)

### **Sunglasses or smoked glass are NOT OK!**

If you have access to welder's supplies (and not many people do), #14 arc-welder's glass is a safe filter (but it has to be #14 and not lower numbers).



## Using Pinhole Projectors to Indirectly View the Sun



"Simple pinhole projector" by [NCIL](#)

If you don't have solar-viewing glasses, a good way to see the eclipse is to project an image of the partially eclipsed Sun. You can use simple items you have around the house to create your own!

Here's one of the simplest things you can do: stand with your back to the Sun and hold up a colander so that the partially eclipsed Sun's light shines through it. Watch the colander's shadow pattern on the ground or a wall and you will see many tiny images of the eclipsed Sun. (See *the image on the next page.*)

You can also make your own pinhole projector! Take two pieces of cardboard or thick paper. Put a pinhole in one, taking care to make a small, neat hole. Then stand with your back to the Sun and let the Sun's light fall through the hole and onto the other sheet. You'll get a small, but distinct, image of the Sun. To get a sharper pinhole, cut a square out of the middle of one piece of cardboard, tape a sheet of aluminum foil over the hole, and put the pinhole in the foil instead of paper. The farther

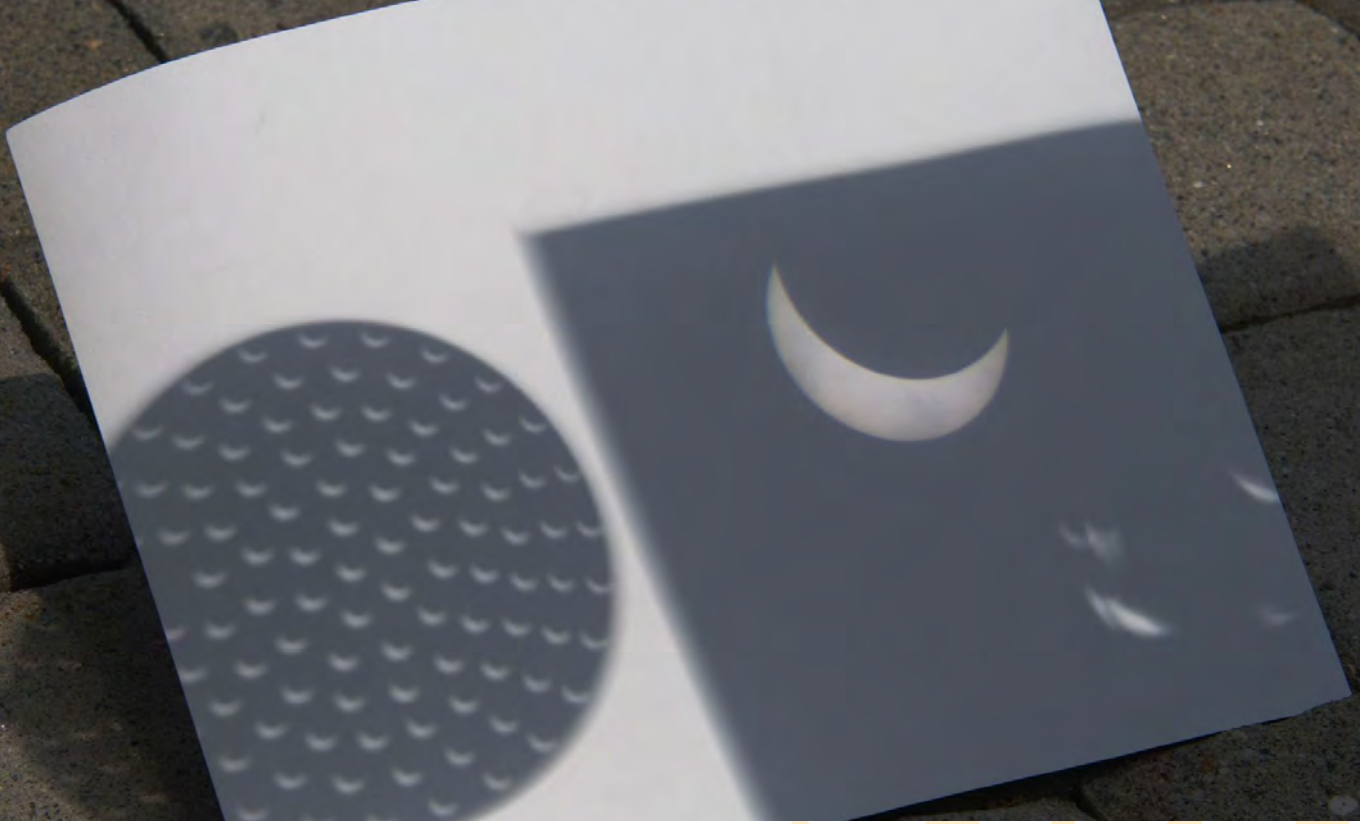
apart the two pieces of paper, the larger the image of the Sun will be, though it will be a small image in any case.

You can also make such a pinhole projector inside a box, such as a shoe box, cereal box, or a tube or poster shipping box.

You can find instructions on the **STAR Net STEM Activity Clearinghouse** at:

- [STEM Activity Clearinghouse Pinhole Projector Instructions](#)
- [NASA Pinhole Projector Instructions](#)
- [Exploratorium How to View an Eclipse](#)

Again, the image of the eclipsed Sun in the box will be quite small, but will be distinct and safe to look at.

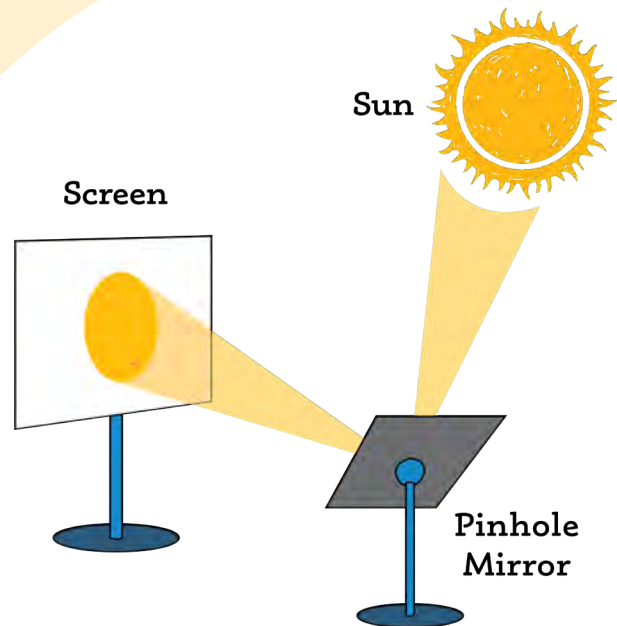


On the left - partial eclipse as projected through a colander.  
On the right- solar image as projected through a telescope  
or one side of a binoculars (see [page 14 for instructions](#))

["Colander and Monocular"](#) by [Charles Tilford](#) is licensed under [CC BY-SA 2.0](#)

## Reflecting the Sun with a Covered Mirror

To project a larger image than a pinhole projector provides, take a hand-mirror, or other small mirror, and cover it up with cardboard or a piece of paper. Cut out a hole the size of a dime, or smaller, in the covering to reveal a small part of the mirror. Angle the mirror to reflect the light of the Sun onto a light wall or poster paper some distance away. The further away the projected image is from the mirror, the larger it will look. It's a little tricky to orient the mirror so that the Sun is shining on it in such a way that it reflects the image where you want it to go. Plus, it is not easy to hold the mirror steady enough with just your hand. You will want to attach the mirror to a tripod or other stable object (e.g., *taped to the back of a chair*). It's best to practice on a day when there is no eclipse.

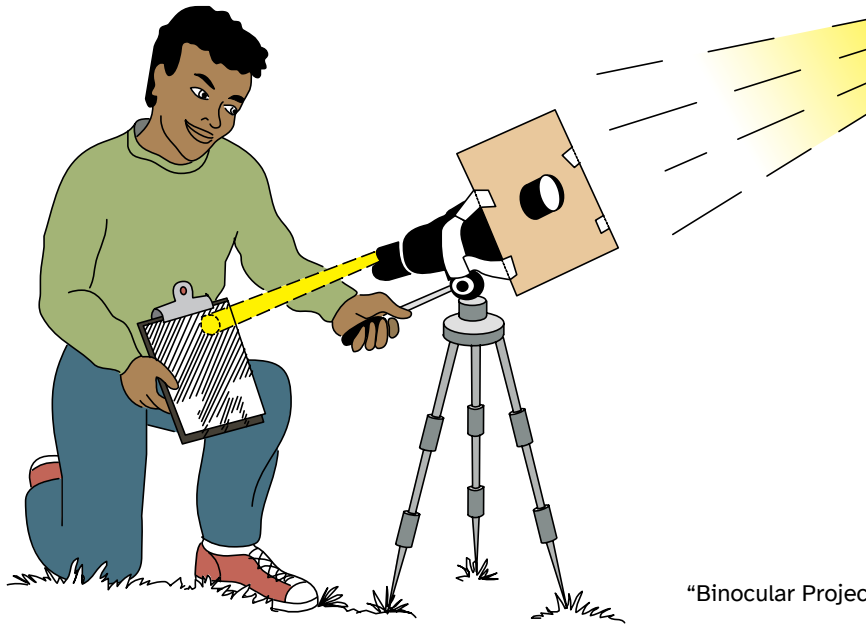


"Mirror reflecting the Sun" by [NCIL](#)

## Projecting an Image of the Sun through Binoculars on a Tripod

You can use one side of a pair of binoculars to project a larger image of the eclipsed Sun. First, put a secure lens cap on (or tape cardboard over) one lens on the larger end of the binoculars. Then take a piece of cardboard and cut out a hole the size of the other lens on the larger side of the binoculars. Tape the cardboard to the binoculars, making a sunshade through which one lens shows.

Attach the binoculars to a tripod or other device to hold them steady. Point the large end of the binoculars toward the Sun and have someone else hold a white sheet of paper or cardboard some distance away from the smaller end. Move things around until you see an image of the Sun on the paper or cardboard. Use the focus knob of the binoculars to make the image of the Sun sharper. This technique will also allow you to see sunspots on the Sun if they are there.



“Binocular Projection” by [Dennis Schatz, Astro Adventures](#)



**Important Note: DO NOT** look at the Sun through binoculars or a telescope. They will concentrate the rays and make looking at the Sun **MORE** dangerous, not less. However, such instruments may be used to look directly at the Sun if, and only if, you have a **certified** solar filter designed to fit them and know how to use it! Please see the next section for reputable glasses dealers to also find reputable filter dealers.

# 4

## Solar-Viewing Glasses: Getting Them, Using Them

If you work or volunteer at a library and are reading this booklet because it was enclosed in a box of free safe solar-viewing glasses courtesy of the Moore Foundation, congratulations! You already have your supply of safe solar-viewing glasses!

Bear in mind that everyone in the family doesn't need their own glasses. The glasses can be passed around during the eclipse and three or four people can easily use the same pair of glasses.

If you need additional glasses, or want to direct patrons who ask for glasses after your supply runs out, please read:

- **[Reputable Vendors of Solar Filters and Viewers](#)**

It includes an up-to-date listing of reliable companies that make or distribute certified glasses in a variety of frames and prices.

"Half-plate solar-viewing glasses method" by [NCIL](#)

### *How to use your solar-viewing glasses safely:*

1. Before you put your solar-viewing glasses on, make sure the black plastic within the paper frames is not scratched or broken. Carefully check any glasses that children will be wearing as well.
2. You shouldn't be able to see anything through the glasses except the Sun: if any other light gets through, you shouldn't use them.
3. Make sure that the glasses fit behind your ears; try moving your head around to make sure they don't fall off. Make sure any children under your supervision also have their glasses on so that the handles fit behind their ears. Keep children within your view while they are looking at the Sun. Consider using the "half plate" method to help children secure their glasses. (See photo to the left.)
4. Continue to remind everyone that while any part of the Sun's bright disk is visible it's never safe to look at the Sun without the special glasses or some safe indirect viewing technique.
5. Note that these glasses will NOT be able to protect you if you look at the Sun through a telescope that doesn't have a certified solar filter attached to it.

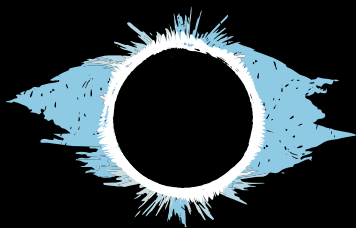
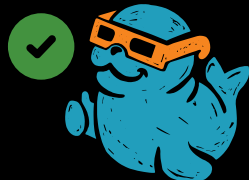




*To summarize: When do you need to wear the safe solar-viewing glasses?*



You need to wear the glasses whenever any part of the Sun's surface is visible.



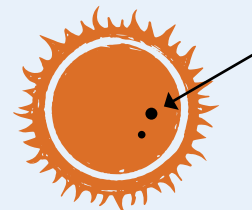
The only time it is safe to view the Sun without the glasses is the few minutes when an eclipse is **TOTAL** (when the Moon completely covers the Sun.)

Above photo: "Kids using certified solar-viewing glasses" by Mark Margolis, [Rainbow Symphony](#) is licensed under [CC BY-NC-ND 4.0](#)

*Can I use the safe solar-viewing glasses when there is no eclipse?*



Yes, you can view the Sun any time with the glasses, but check them carefully each time before you use them to be sure there are no cracks or other damage.



When looking at the Sun through the glasses you may occasionally be able to see tiny dark spots on its surface. These are groups of sunspots – cooler areas on the Sun's surface that give off less intense light and look darker to us. Such sunspots hold important clues about the seething activity in the Sun's surface layers



# 5

## Ideas for Eclipse Events

Some people mistakenly believe that the only important eclipse-related programming occurs on the days when the eclipses happen. Nothing could be further from the truth! Equally important times for library programming will be during the months and weeks leading up to the annular eclipse, and then again in the time before the total eclipse! The public needs to know when and where the two eclipses will occur and have time to prepare themselves and their families for observing it safely, no matter where they will be during each eclipse. Be aware, if you are counting on scientists, teachers, or astronomy enthusiasts to help you during your day-of events, it is likely only a few of them will be available on the actual days of the eclipses.

Also remember that during the 2017 eclipse, there were members of the public (*including*

*school leaders*) who thought the eclipsed Sun was MORE dangerous than the everyday Sun. There is no increase in the amount of light or heat during the eclipse, but any exposed part of the Sun is dangerous to look at without protection. You may want to share this booklet with leaders at your local schools to help them have good information on eclipse safety. Remember also when reaching out to certain cultural groups in your community that some cultures view the eclipse as dangerous for other reasons. Please respect these responses and consider other ways to engage such patrons! For example, solar-viewing glasses can be used to view the Sun anytime and not just during an eclipse!

The following page provides some ways of engaging your community in the months leading up to the eclipses.

“Solar Viewing Activity at Cerritos Library” provided by [Cerritos Library](#)



## Online or Physical Eclipse Displays

Set up an eclipse display area with books, posters, handouts, and an exhibit showing safe viewing methods. Download materials from our [SEAL project webpage](#).

Create informative displays about the Sun, Moon, and eclipses, such as:

- A computer or monitor with eclipse videos, animations, and images on a loop
- Exhibit panels with photos, posters, scans of book covers, even eclipse related products (Eclipse gum is popular)

Lists of books and videos are also available in the **STAR Net** resource area to help you create displays of library materials available for checkout. For additional free images and videos, see the listings at:

- [AAS Royalty free images and videos](#)

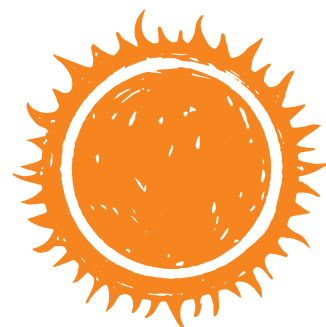
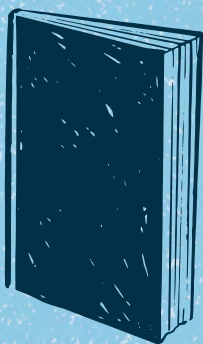
## Daytime Youth/Family Programs

Schedule a daytime family program on a weekend or late afternoon that includes time to go outside and practice looking at the Sun using safe viewing techniques. If possible, have some of your community partners ([see section 6](#)) help you. Encourage families to attend together, promising one pair of eclipse glasses free for each family (given out at the end of the program so they stay and really learn the safety rules). Make an effort to include people who are underrepresented in science (e.g., *women and girls, Black and Latinx families, the economically disadvantaged, people with disabilities*).

Discuss the basics of eclipses, read from a children's book on eclipses, and then explain and demonstrate ways to observe the eclipse safely with or without glasses. Include videos, animations, and images from the Eclipse Resource Center. Describe the details of your eclipse day events (*if you are having them*), including when the eclipses will be visible in your community and where people will gather to see them. At the end, leave enough time to practice using the glasses and other safe viewing methods outside, if the Sun is visible. Fun and educational eclipse-related activities can be found at:

- [STEM Clearinghouse Solar Eclipse Activities](#)

**Be sure to distribute copies of the two-page public handouts, which are available electronically or in hard copy starting on page 28.**



## *Evening or Weekend Eclipse Talk and Training*

Invite a local professional or amateur astronomer, science teacher, or museum educator to give a short talk on the upcoming eclipses and viewing them safely. ([See section 6 for how to find such speakers.](#))

Include a demonstration of various safe viewing techniques, practice using the glasses if the event is during the day, and promise one pair of eclipse glasses for each family or small group (*given out at the end.*) Don't forget to save time for questions at the end.



## *Sun Party Events*

Amateur astronomers enjoy bringing their telescopes to public outreach events, called “star parties” when done at night. But many amateur astronomers will have a filter for their telescope that makes it safe to view the Sun during the daytime. Invite the local amateur club to put on a “Sun party” in front of the library. Museum educators and science teachers may also be able to help provide a Sun party. ([Section 6 has guidelines for how to find such partner groups locally.](#)) During or after, there could be a place where families can pick up eclipse glasses and learn how to use them, or get to practice other techniques for safe Sun viewing.

## *Maker Program*

Provide supplies for each patron (*or group*) to make a “pinhole projector.” Pinhole projectors can be used at home for projecting an image of the Sun on eclipse day. ([See safe viewing strategies on page 12 for how to make simple pinhole projectors.](#))

## *Library, School and/or Afterschool Collaboration Event*

Consider doing an eclipse training session for teachers, after school practitioners, and other educators in cooperation with a local astronomer, veteran science teacher, or science museum/nature center educator. Coordinate advertising the event with the local school district and/or after school program and encourage educators and other school/program staff who do not have a science background to attend. In addition, you might have a discussion on how to work with a class or youth group so that participants are helping each other to view the eclipses safely.

If educators, schools, and after school programs want to purchase safe solar-viewing glasses in bulk, emphasize that the earlier they order the better. Information on safe glasses and where to find them can be found at:

- [Eclipse Eye Safety](#)

The manufacturers and distributors of certified glasses expect to be completely sold out by the time the eclipses are near.

# Events on the Days of the Eclipses



"Kids with eclipse viewers" [Mark Margolis, Rainbow Symphony](#) is licensed under [CC BY-NC-ND 4.0](#)



**NOTE:** It is never safe to look at the Sun without proper precautions, even if only a small part of the Sun's surface is visible. Make sure everyone is practicing safe viewing by having safe solar-viewing glasses and ways of projecting an image available. See the safe viewing pages for more information.

## Planning Your Eclipse-day Party

First, determine in advance if there is a safe, comfortable place on or near the library grounds where the Sun will not be behind a hill, a building, a grove of trees, etc. during the time of the October 14, 2023 and April 8, 2024 eclipses. Check the position of the Sun a few weeks earlier during the expected eclipse times to get an approximate sense of where the Sun will be in the sky during the eclipse. A local astronomer or educator can also help determine where the Sun will be in the sky and whether it will be visible from the library.

If there is a good viewing site at the library, invite the public and local media to watch the eclipse from there. Have glasses available and other methods for safe viewing ([see safe viewing strategies in section 3.](#)) If your library does not have a good viewing site, you might plan in advance to partner with others in city government, schools, or a local business to arrange for a place where the community can gather to watch the eclipse and have access

to vetted information and options for safe viewing.

Have someone ready to explain what is happening, and provide some running narration, since the partial phases of the eclipse take a long time from start to finish (*up to 2 ½ hours*). Perhaps someone else can distribute and collect viewing materials, as people may come and go during this long period. Make sure bathrooms are ready for a larger than usual crowd if the library or other site has limited facilities. Maybe another institution nearby can take the bathroom overflow – if you pardon the expression. It's good to have water available, especially if it turns out to be a sunny day.



### NOTE ABOUT SELLING FREE GLASSES:

By the rules established by the **Moore Foundation**, libraries may not sell the glasses they receive through this project. However, many libraries are likely to find that the local demand for glasses far outstrips their free supply, especially if they get word out via the local media. In that case, libraries can try to order more glasses at bulk rates and then sell them for a reasonable fee (such as \$2 or 3 each.) Profits could go to your Friends of the Library or similar group. For your free glasses, we recommend only providing them during eclipse programs, like those described above, to make sure the supply lasts.



## What to Do if it's Cloudy on Eclipse Day

Include relevant hands-on activities as part of your plans – these can engage your patrons in case of poor weather conditions and they can keep young and old alike busy for the duration of your event. Discover a variety of **[eclipse activities from the STEM Activity Clearinghouse](#)**:

Arrange to have a live feed from NASA eclipse viewing locations on the NASA TV Channel or through the **[San Francisco Exploratorium](#)**

If it's partly cloudy, remember that the partial eclipse lasts over two hours, so glimpses of the Sun may be possible as the cloud cover changes.

If the Sun seems to have no chance of peeking through, don't despair! Access to cable TV or the internet will provide many ways to see live views of the eclipse as it's happening. Patrons can also see images and video later in the news.

Whether it is cloudy or not, access to images on cable TV or the internet will allow patrons to see what others are seeing across the country, especially along the path of annularity or totality.

# STEM ACTIVITY Clearinghouse

Here are some favorite, library-friendly activities you could use for your programs.

**[Big Sun, Small Moon?](#)** is a fun way to demonstrate why the Sun and Moon appear to be the same size during an eclipse. This easy, low-cost activity not only will result in audible gasps from your patrons but can easily be adapted to showcase the difference between an annular and total eclipse.

**[Eclipse Chalk Art](#)** incorporates art into your program. If clouds are obscuring the actual eclipse, this allows kids to create their own as a souvenir to take home using chalk and paper.

**[UV Kid](#)** utilizes common craft materials and ultraviolet (UV) sensitive beads to construct a person, animal, or imaginary creature. Kids can then use sunscreen, foil, paper, and other test materials that might protect it from being exposed to too much UV radiation.

**[Shadow Tracing](#)** engages participants in creating and tracing their shadows indoors and on the playground, exploring how shadows change throughout the day as the Sun appears to change position across the sky.

Left image: "Partial eclipse covered by clouds" by James B. Harold, [Space Science Institute](#)

# 6

## Finding Partners for Your Library

Many libraries should be able to find partners in the community they can team up with to help provide events before the two eclipses. The **SEAL** project staff members will actively identify, train, and encourage knowledgeable volunteers to work with their libraries. While astronomy experts and eclipse enthusiasts are likely to be busy viewing the eclipses on the days that they happen, many of them will be happy to help with public events in the months preceding or between the eclipses. This section provides information on where and how you can find partners to assist with public eclipse events and to train library staff.

**STAR Net** is reaching out to science experts through notices in the newsletters, websites, and social media they read. They are encouraged to look at the map of registered libraries on the **STAR Net** website to find a library near their own work or home where they can volunteer. Science experts willing to share their interest in assisting libraries are listed on the **STAR Net** website at [starnetlibraries.org](http://starnetlibraries.org). But there may be experts in your area that you can contact directly. Some organizations are suggested in the following pages.

### *Amateur Astronomers and NASA Volunteers*

Astronomy hobbyists have organized astronomy clubs in communities throughout the country. There may be one near you. To find a club, use the following tools:

The nonprofit **Astronomical Society of the Pacific** is training about 500 pairs of amateur-astronomers and undergraduate students to be “eclipse ambassadors” in their communities. They will be encouraged to contact nearby libraries and offer their help. For more on the project, see:

- [\*\*Astro Society Eclipse Ambassadors\*\*](#)



“Solar Event” by [Astronomical Society of the Pacific](#)

**NASA** also has a special group of over 1000 amateur astronomers and educators, called the Solar System Ambassadors, who are trained to help with public events. You can find a national directory of these Ambassadors at:

- [\*\*Solar System Ambassadors\*\*](#)



**NASA's Night Sky Network**, run by the nonprofit Astronomical Society of the Pacific, consists of 400+ clubs that specifically dedicate some of their energy to public outreach. A finder is at:

- [Night Sky Network Club Map](#)

**The Astronomical League** is an umbrella organization of many clubs around the country. Here is the listing of their clubs organized by state:

- [Astronomy Clubs in the USA](#)

**Sky & Telescope** magazine has a club finder on their website (they also list other astronomy organizations by location):

- [Sky and Telescope club finder](#)

**Astronomy magazine** also has a finder and their list includes more types of organizations:

- [Astronomy magazine club finder](#)

Once you get a state listing, click on the name of each organization (*even though it doesn't look like a link*) to get more info.

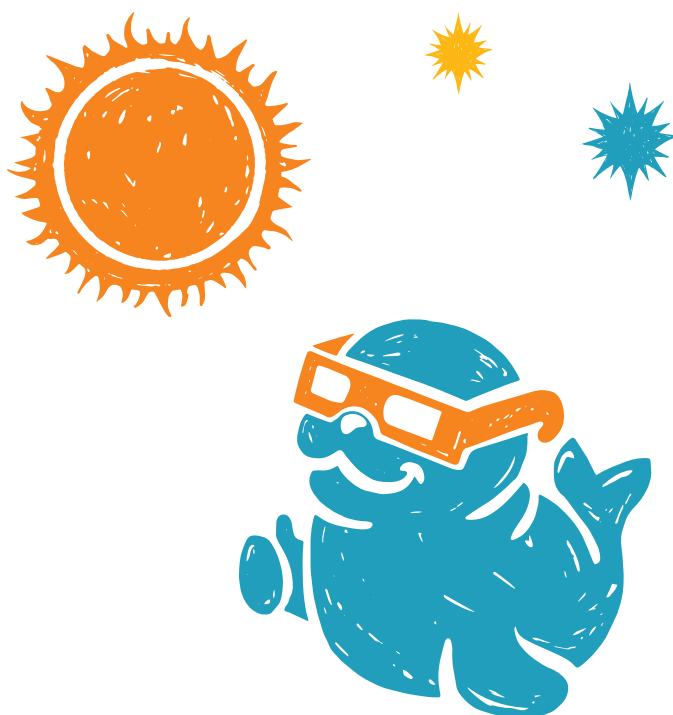
Once you find a club in your area, look at their website or social media to get contact information for the list of officers. Call or email them to see if anyone in the club is an eclipse enthusiast who wants to work with libraries and the public.

## High-School Science Teachers

If you have already established a relationship with your local school district, they may appreciate you bringing information and resources about the eclipses to their attention early. A teacher of physics or Earth science might be willing to help you with your eclipse programming. In addition, many science teachers belong to the **National Science Teaching Association (NSTA)**, which is actively informing and training its members in anticipation of the eclipses.

If you have not been able to find a science teacher to assist you through the local schools, your next step might be to approach your state science teacher organization. To find the officers and contacts for your state science teachers' group, you can go to:

- [NSTA State/Province Chapters & Associated Groups](#)



## Science Museum or Nature Center Educators



Many science centers and museums have educators on staff who may be able to assist a local library, given enough notice. A good list of science and technology museums can be found at the website of the **Association of Science and Technology Centers (ASTC)**. They have a finder tool to help you locate a science museum near you at:

- [ASTC Science Center Finder](#)

A planetarium is a facility where the stars are projected on a dome; they feature regular shows about astronomical topics. Some planetariums are part of a larger science museum or school district, but some are independent facilities. Here are some web-based tools for finding a planetarium near you:

- [The World Wide Planetarium Database](#)
- [International Planetarium Society finder page](#)
- [The Loch Ness Planetarium Compendium](#)

Wikipedia has state-by-state lists of nature and environmental centers in the U.S., which are centralized at:

- [List of Nature Centers in the United States](#)

## Professional Astronomers and Their Students

A list of astronomy and physics departments at universities and colleges that offer astronomy degrees can be found at:

- [College Departments offering astronomy degrees](#)

Reach out to these departments to see if any professors and their students are interested in partnering.

In addition, many smaller colleges (including community colleges) have someone on staff who teaches an introductory astronomy course, often as part of a physics or physical science department. A search page to find a community college near you is at:

- [Community College finder](#)

Wikipedia also has entries that list all the colleges and universities in the U.S. state by state. Just search for “colleges in Nebraska” for example.

Astronomers also work at dedicated research centers such as observatories, science institutes, NASA centers, etc. Finding any of these near you may require a bit of research or asking people at a local college or amateur astronomy club. NASA facilities are shown at:

- [NASA Centers and Facilities](#)

The American Astronomical Society runs an “Astronomy Ambassadors” program consisting of younger astronomers who are interested in reaching out to the public. A list of them, and the institutions where they are located, can be found at:

- [Roster of AAS Astronomy Ambassadors](#)





How can the community help our library build on its strengths and bring STEM learning to underserved audiences?

## Partnering in Your Community Through Community Dialogues

“Lisa Jackson facilitating a Community Dialogue” by [African-American Research Library and Cultural Center](#)



There are several ways you can reach out to potential partners in your community. One method we recommend are “Community Dialogues”. Community Dialogues are informal, flexible conversations between library staff, leaders in the local community, and key stakeholders. These conversations can focus on a variety of topics and are a great tool for engaging with new and potential community partners. Unlike other roundtables and focus groups, Community Dialogues are meant for actionable items to be discussed and implemented. They are an open space to brainstorm ideas, ask questions, present topics, and formulate plans. To use this method, and learn how to implement it in your library, please check out the full Community Dialogue guide at:

- [STAR Net Community Dialogues](#)

We hope your library can use the resources above to find partners in your community who can help you share the excitement, wonder, and science of eclipses with the public.

We encourage you to document your public eclipse events in words and images, and to share the best of them with us. Please use this URL to submit your post-eclipse report:

- [Post-Eclipse Survey Report](#)

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# Useful Eclipse Web Resources

## [Maps and City Tables for the 2023 and 2024 Eclipses](#)

## [Solar Eclipse Activities for Libraries \(SEAL\) Project page](#)

- The central website for the project of providing glasses and information to libraries

## [The American Astronomical Society Eclipse Task Force pages](#)

- The authoritative website for safety tips, equipment, and many other resources

## [Time and Date Eclipse pages](#)

- Tells you the circumstances of each eclipse for your location in non-technical language

## [NASA Eclipses page](#)

- Information on eclipses and what NASA and its missions will be doing in 2023 and 24

## [Great American Eclipse](#)

- Very detailed maps and tourist information for upcoming solar eclipses

## [Eclipse2024](#)

- Good information on both eclipses, and animations of what they will look like at many locations

## [Eclipsophile](#)

- Reliable weather predictions for celestial events, especially eclipses

## [National Eclipse](#)

- Very clear maps and observing suggestions

## [Eclipse Outreach Activities & Resources from the Night Sky Network](#)

## Two Books by the Authors of this Booklet:



## [Solar Science: Exploring Sunspots, Seasons, Eclipses and More \(for 5th through 9th grade teachers\)](#)



## [When the Sun Goes Dark \(for kids ages 8-13\)](#)

## [Other Eclipse Books and Articles](#)

# 8

## About the Authors and STAR Library Network (STAR Net)

### Authors

This booklet was written by Andrew Fraknoi and Dennis Schatz, with assistance and advice from the **STAR Net** team.



**Andrew Fraknoi** retired in 2017 as Chair of the Astronomy Department at Foothill College, near San Francisco. He now teaches programs for retired people at the University of San Francisco and San Francisco State University. He is the lead author of a free, electronic, introductory college textbook, *Astronomy*, published by the nonprofit OpenStax project, which has become the leading astronomy textbook in the U.S. Over the years, he has appeared on local and national radio explaining astronomical developments in everyday language. These days, he also writes science fiction stories based on astronomy; five of them have been published so far. You can see them at [Fraknoi.com](http://Fraknoi.com)



**Dennis Schatz** retired as the Senior Vice President for Strategic Programs at the Pacific Science Center in Seattle and now works on educational projects at the Institute for Learning Innovation. For four years he served as a Program Director for the Education and Human Resources Directorate at the National Science Foundation. He was the first astronomer to be elected President of the National Science Teaching Association. Schatz is the author of 26 science books for children that have sold almost 2 million copies worldwide and have been translated into 23 languages. He received the National Science Teachers Association's Distinguished Service to Science Education Award.

Both authors serve on the Eclipse Task Force of the American Astronomical Society, working to make the 2023-24 eclipse a safe and educational experience for everyone. They both have asteroids named after them by their colleagues in recognition of their work in improving the public understanding of science. They are co-authors of a children's book about eclipses, [\*When the Sun Goes Dark\*](#), published by NSTA Press.

### STAR Net team

This eclipse project leverages and expands upon the [\*STAR Library Education Network \(STAR Net\)\*](#), a hands-on learning network for libraries and their communities across the country. **STAR Net** focuses on helping library professionals build their science, technology, engineering, and math (STEM) skills by providing science-technology activities and resources (STAR) and training to use those resources.

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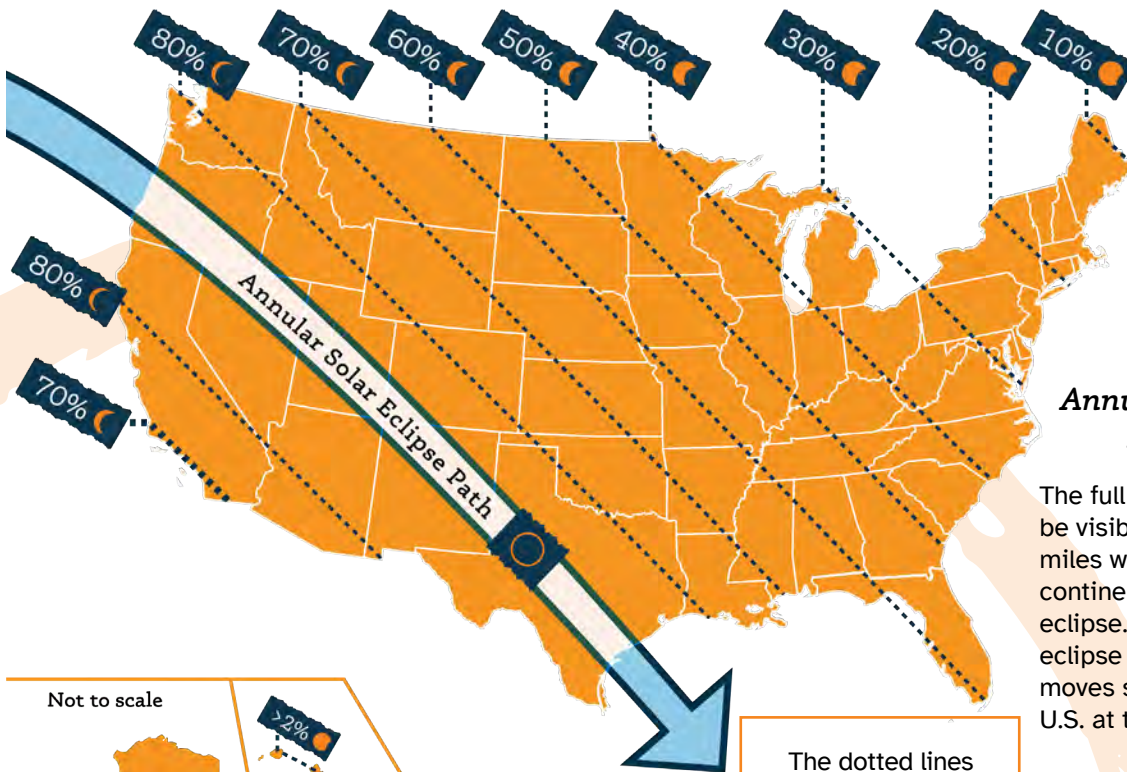
Stephanie Vierow-Fields  
*Education Associate*

# Annular Solar Eclipse

Courtesy of your Library, the *Space Science Institute*, and the *Gordon and Betty Moore Foundation*



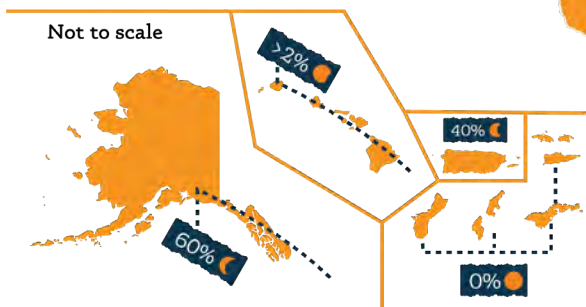
## Saturday, October 14, 2023



In an eclipse of the Sun, the Moon gets in front of the Sun and covers some or all of it. This is possible because, as seen from Earth, the Sun and the Moon are roughly the same size in the sky.

### Annular and Partial Solar Eclipse Visibility

The full annular eclipse will be visible over a path ~125 miles wide, and all parts of the continental U.S. will see a partial eclipse. The path of the annular eclipse starts in Oregon and moves southeastward, leaving the U.S. at the Texas Gulf Coast.

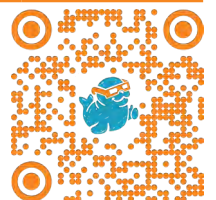


The dotted lines show percentage of Sun's diameter covered (partial eclipse)

### Local Eclipse Times

Your town	Partial Begins	Annular Begins (when applicable)	Eclipse Maximum	Annular Ends (when applicable)	Partial Ends

Scan the QR code or go to [scigames.org/eclipse](https://scigames.org/eclipse) to find out what the eclipse will be like in your area. There is also info on safe eclipse glasses and other safe viewing techniques.



# The 2023 Annular Eclipse

A partial eclipse of the Sun will be visible in all parts of North America on October 14, 2023, with those along a narrow path seeing a full annular eclipse. During an annular eclipse the Moon passes in front of the Sun but is too far away from Earth in orbit to cover the Sun completely. Thus, a “ring of fire” (an annulus) can be seen around the dark sphere of the Moon. The full annular eclipse can be viewed in parts of Oregon, Nevada, Utah, New Mexico, and Texas.

## How Can I Observe the Sun Safely?



*Because some part of the Sun will be showing throughout this eclipse it will be important to use safe-viewing strategies to protect your eyes.*

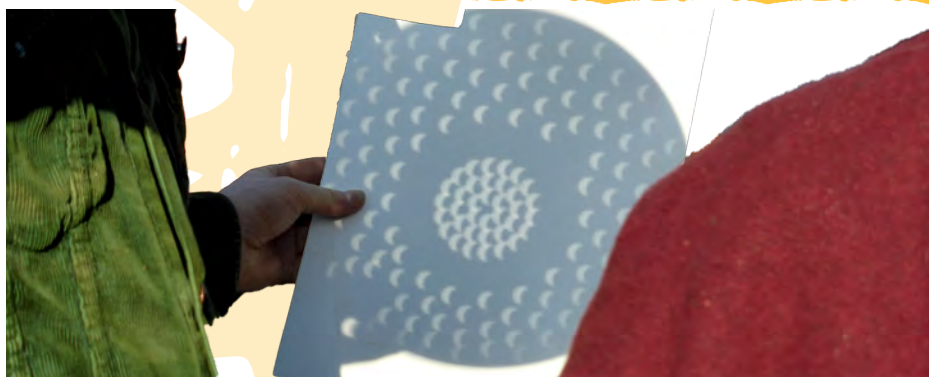
### Solar-Viewing Glasses



“Solar eclipse viewing” by [NCIL](#)

It is never safe to look directly at the Sun, and this eclipse is no different. Regular sunglasses, swimming goggles, and most camera filters are NOT safe for looking directly at the Sun. You can safely protect your eyes with certified solar-viewing glasses from your library or another reliable institution (such as a local science museum or college/high-school science department). Make sure that on the back, in small print, they say that they are ISO 12312-2 certified.

### Project an image



Stand with your back to the Sun and use a colander or a piece of cardboard with a small hole in it to project images of the eclipsed Sun on any light-colored surface.

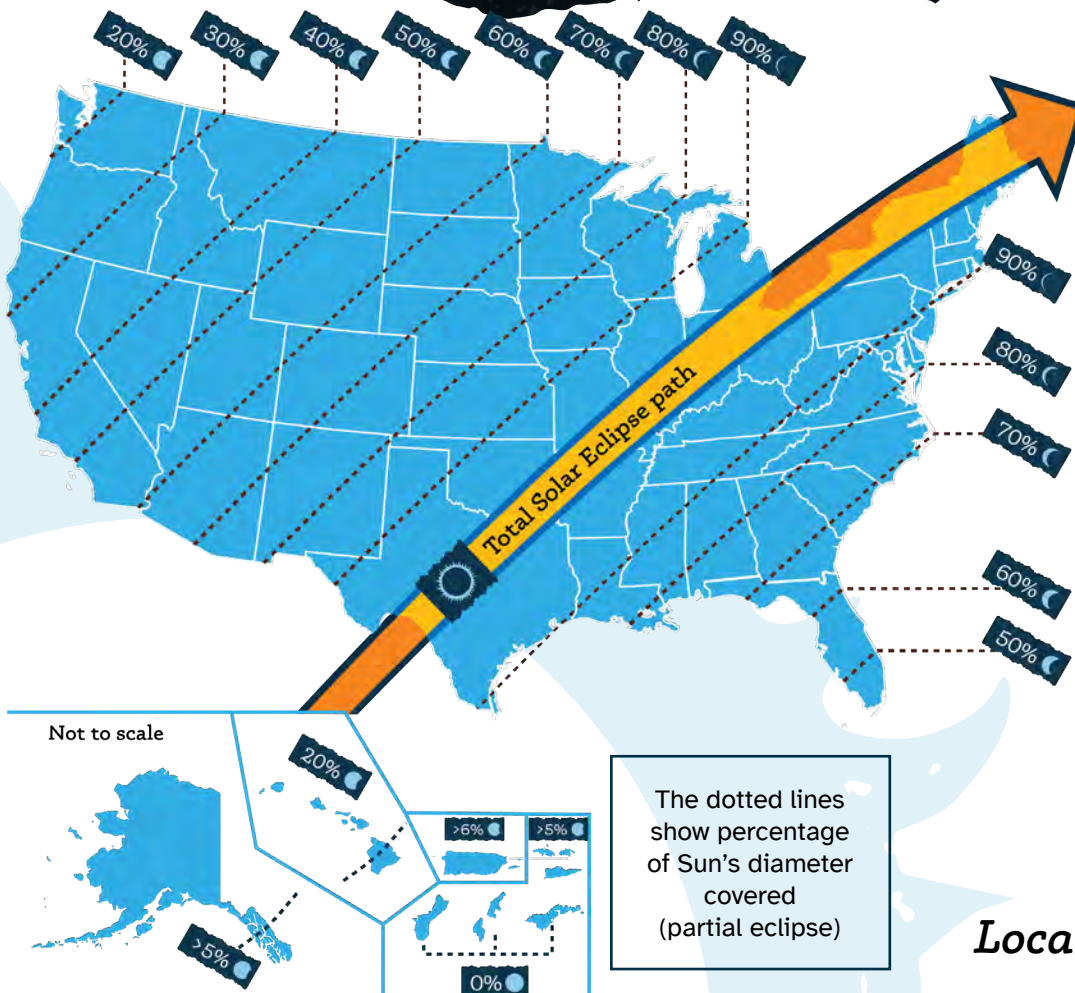
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This project is funded by the support from the **Gordon and Betty Moore Foundation** through Grant Agreement 10756 to the **Space Science Institute**. Additional funding has been provided by **NASA Science Mission Directorate** through a supplement to the **NASA@ My Library** program. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the **Gordon and Betty Moore Foundation** or **NASA**.

# Total Solar Eclipse

Courtesy of your Library, the **Space Science Institute**, and the **Gordon and Betty Moore Foundation**

## Monday, April 8, 2024



In an eclipse of the Sun, the Moon gets in front of the Sun and covers some or all of it. This is possible because, as seen from Earth, the Sun and the Moon are roughly the same size in the sky.

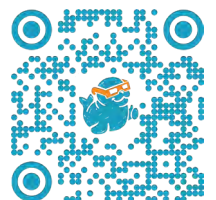
### Total and Partial Solar Eclipse Visibility

The total eclipse will only be visible over a path ~115 miles wide, but all of the continental U.S. will see a partial eclipse. The total eclipse path enters the U.S. in southwest Texas and moves northeastward, leaving the U.S. at the Gulf of Maine.

### Local Eclipse Times

Your town	Partial Begins	Total Begins (when applicable)	Eclipse Maximum	Total Ends (when applicable)	Partial Ends

Scan the QR code or go to [scigames.org/eclipse](https://scigames.org/eclipse) to find out what the eclipse will be like in your area. There is also info on safe eclipse glasses and other safe viewing techniques.



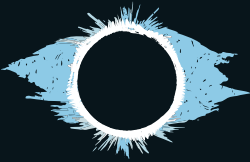
# The 2024 Total Eclipse

A partial eclipse of the Sun will be visible in all parts of North America on April 8, 2024, but only those on a narrow path will see a total eclipse. During a total eclipse the Sun is completely hidden by the Moon and the sky becomes dark, making for an eerie “night in the middle of the day.” The Sun’s faint outer atmosphere (its corona) becomes visible like a beautiful halo. As the map on the other side shows, the total eclipse can **ONLY** be viewed on a track stretching from Texas northeastward to Maine.

## How Can I Observe the Sun Safely?



Whenever any part of the Sun is showing it is important to use solar-viewing glasses or to project an image of the Sun to protect your eyes. The only safe time to look at the Sun is during the 3-5 minutes of totality experienced along the narrow path when the Sun is completely covered.



*When totality begins the Sun’s outer atmosphere (the corona) becomes visible as a faint glow around the dark disk of the Moon. During totality, look directly at the Sun to see the beautiful corona. This the **ONLY** time you can safely look directly at the Sun without any viewing devices.*

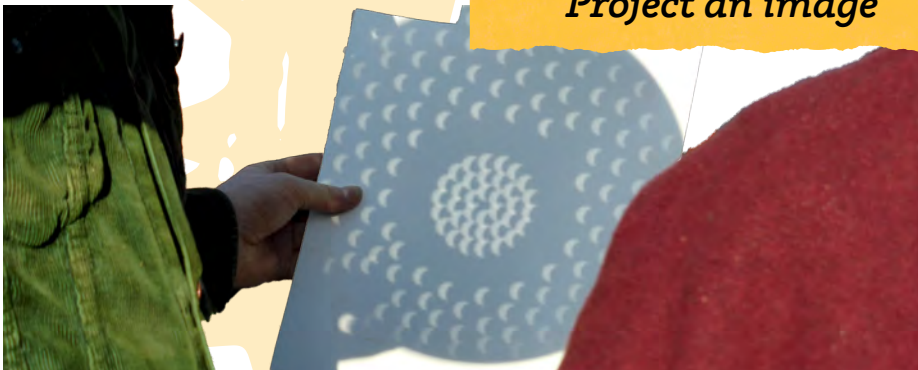
### Solar-Viewing Glasses



“Solar eclipse viewing” by [NCIL](#)

Regular sunglasses, swimming goggles, and most camera filters are **NOT** safe for looking directly at the Sun. You can safely protect your eyes with certified solar-viewing glasses from your library or another reliable institution (such as a local science museum or college/high-school science department). Make sure that on the back, in small print, they say that they are ISO 12312-2 certified.

### Project an image



Stand with your back to the Sun and use a colander or a piece of cardboard with a small hole in it to project images of the eclipsed Sun on any light-colored surface

“Colander community” by [John Lord](#) is licensed under [CC BY 2.0](#)

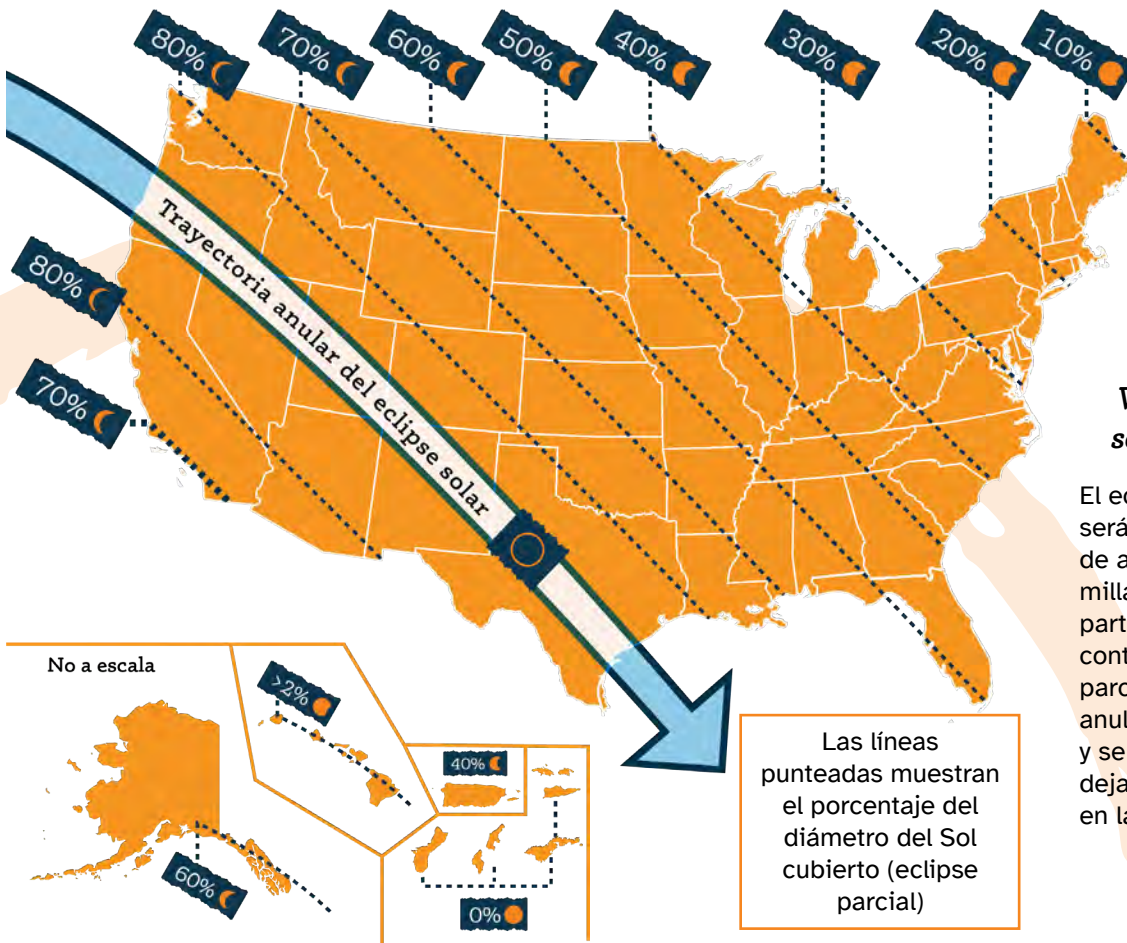
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# Eclipse solar anular

Cortesía de su Biblioteca, el *Space Science Institute* y la *Gordon and Betty Moore Foundation*



## sábado, 14 de octubre de 2023



En un eclipse de Sol, la Luna se coloca frente al Sol y lo cubre en parte o en su totalidad. Esto es posible porque, visto desde la Tierra, el Sol y la Luna tienen aproximadamente el mismo tamaño en el cielo.

### Visibilidad de eclipse solar anular y parcial

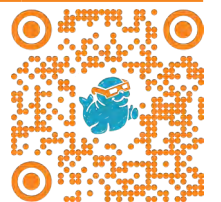
El eclipse anular completo será visible en un camino de aproximadamente 125 millas de ancho, y todas las partes de los Estados Unidos continentales verán un eclipse parcial. El camino del eclipse anular comienza en Oregon y se mueve hacia el sureste, dejando a los Estados Unidos en la costa del golfo de Texas.

### Horarios de eclipses locales

Las líneas punteadas muestran el porcentaje del diámetro del Sol cubierto (eclipse parcial)

Su ciudad	Comienza el eclipse parcial	Comienza el eclipse anular (cuando corresponda)	Eclipse Máxima	Termina el eclipse anular (cuando corresponda)	Termina el eclipse parcial

Escanee el código QR o visite [scigames.org/eclipse](https://scigames.org/eclipse) para averiguar cómo será el eclipse en su área. También hay información sobre anteojos de eclipse seguros y otras técnicas de visualización seguras.





# El eclipse anular de 2023

Un eclipse parcial de Sol será visible en todas partes de América del Norte, y aquellos a lo largo de un camino estrecho verán un eclipse anular completo. Durante un eclipse anular, la Luna pasa frente al Sol pero está demasiado lejos de la Tierra en órbita para cubrir al Sol por completo. Por lo tanto, se puede ver un “anillo de fuego” (un anillo) alrededor de la esfera oscura de la Luna. El eclipse anular completo se puede ver en partes de Oregón, Nevada, Utah, Nuevo México y Texas.

## ¿Cómo puedo observar el sol de forma segura?



Debido a que una parte del Sol se mostrará a lo largo de este eclipse, será importante utilizar estrategias de visualización segura para proteger sus ojos.

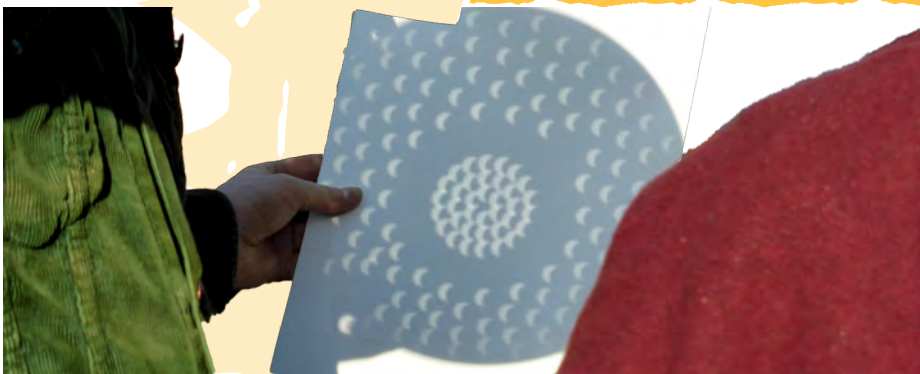
### Gafas de visión solar



“Solar eclipse viewing” by [NCIL](#)

Nunca es seguro mirar directamente al Sol, y este eclipse no es diferente. Las gafas de sol normales, las gafas de natación y la mayoría de los filtros de las cámaras **NO** son seguros para mirar directamente al sol. Puede proteger sus ojos de manera segura con anteojos certificados para ver eclipses de su biblioteca u otra institución confiable (como un museo de ciencias local o el departamento de ciencias de la universidad/escuela secundaria). Asegúrate de que en el reverso, en letra pequeña, digan que tienen la certificación ISO 12312-2.

### Proyectar una imagen



Párate de espaldas al Sol y usa un colador o un trozo de cartón con un pequeño agujero para proyectar imágenes del Sol eclipsado en cualquier superficie de color claro.

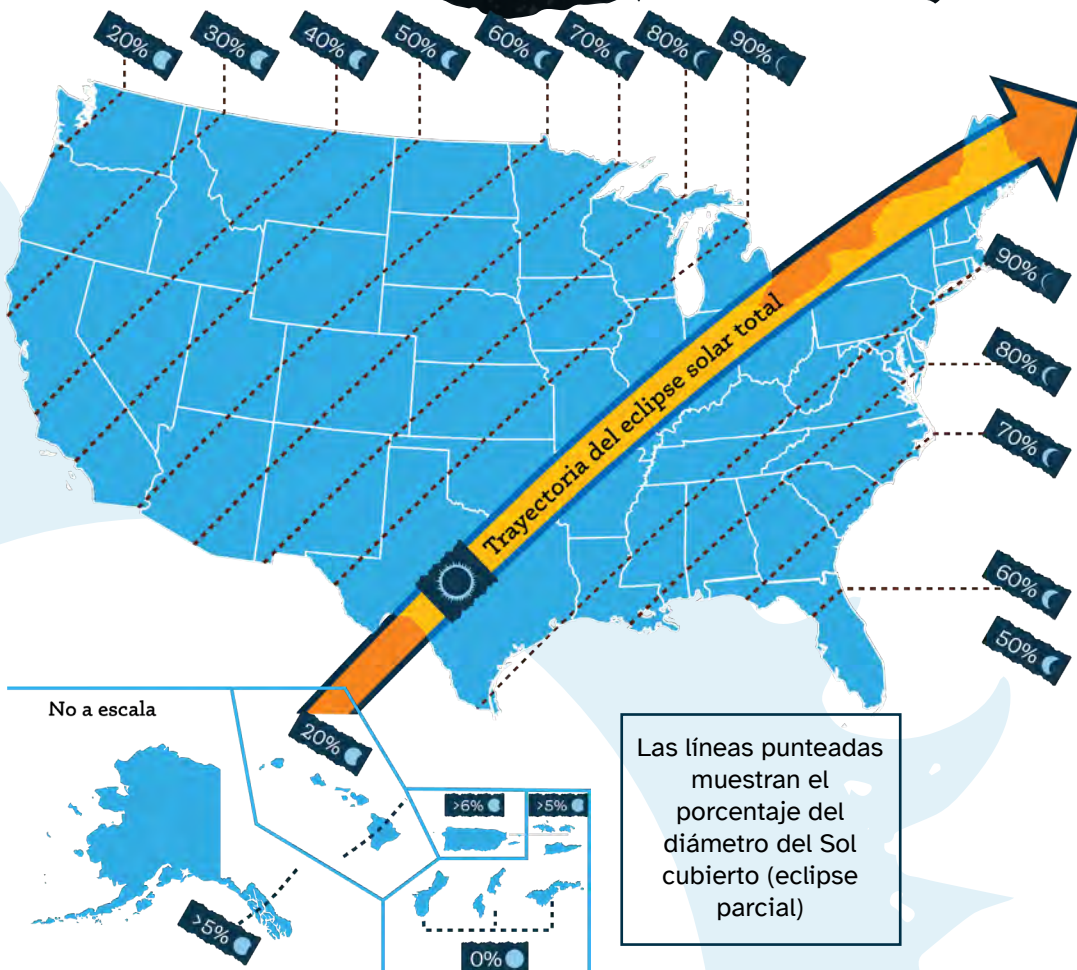
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Este proyecto está financiado por el apoyo de la **Gordon and Betty Moore Foundation** a través del Acuerdo de Subvención 10756 al **Space Science Institute. NASA Science Mission Directorate** ha proporcionado fondos adicionales a través de un complemento del programa **NASA@My Library**. Todas las opiniones, hallazgos y conclusiones o recomendaciones expresadas en este material pertenecen al autor o autores y no reflejan necesariamente los puntos de vista de la **Fundación Gordon y Betty Moore** o de la **NASA**.

# Eclipse solar total

Cortesía de su Biblioteca, el **Space Science Institute** y la **Gordon and Betty Moore Foundation**

## lunes, 8 de abril de 2024



En un eclipse de Sol, la Luna se coloca frente al Sol y lo cubre en parte o en su totalidad. Esto es posible porque, visto desde la Tierra, el Sol y la Luna tienen aproximadamente el mismo tamaño en el cielo.

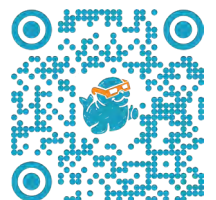
### Visibilidad total y parcial del eclipse solar

El eclipse total solo será visible en un camino de aproximadamente 115 millas de ancho, pero todos los Estados Unidos continentales verán un eclipse parcial. La trayectoria del eclipse total ingresa a los Estados Unidos en el suroeste de Texas y se mueve hacia el noreste, dejando los Estados Unidos en el Golfo de Maine.

### Horarios de eclipses locales

Su ciudad	Comienza el eclipse parcial	Comienza el eclipse total (cuando corresponda)	Eclipse Máxima	Extremos totales (cuando corresponda)	Termina el eclipse parcial

Escanee el código QR o visite [scigames.org/eclipse](https://scigames.org/eclipse) para averiguar cómo será el eclipse en su área. También hay información sobre anteojos de eclipse seguros y otras técnicas de visualización seguras.



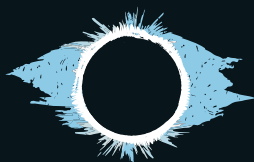
# El eclipse total de 2024

Un eclipse parcial de Sol será visible en todas partes de América del Norte, pero solo aquellos en un camino angosto verán un eclipse total. Durante un eclipse total, el Sol queda completamente oculto por la Luna y el cielo se oscurece, creando una misteriosa “noche en medio del día”. La tenue atmósfera exterior del Sol (su corona) se vuelve visible como un hermoso halo. Como muestra el mapa del otro lado, el eclipse total SÓLO se puede ver en una pista que se extiende desde el noreste de Texas hasta Maine.

## ¿Cómo puedo observar el sol de forma segura?



Cada vez que se muestre cualquier parte del Sol, es importante usar anteojos de seguridad o proyectar una imagen del Sol para proteger sus ojos. El único momento seguro para mirar al Sol es durante los 3-5 minutos de totalidad experimentados a lo largo del camino angosto cuando el Sol está completamente cubierto.



**Cuando comienza la totalidad, la atmósfera exterior del Sol (la corona) se vuelve visible como un tenue brillo alrededor del disco oscuro de la Luna. Durante la totalidad, mire directamente al Sol para ver la hermosa corona. Esta es la ÚNICA vez que puede mirar directamente al Sol de manera segura sin ningún dispositivo de visualización.**

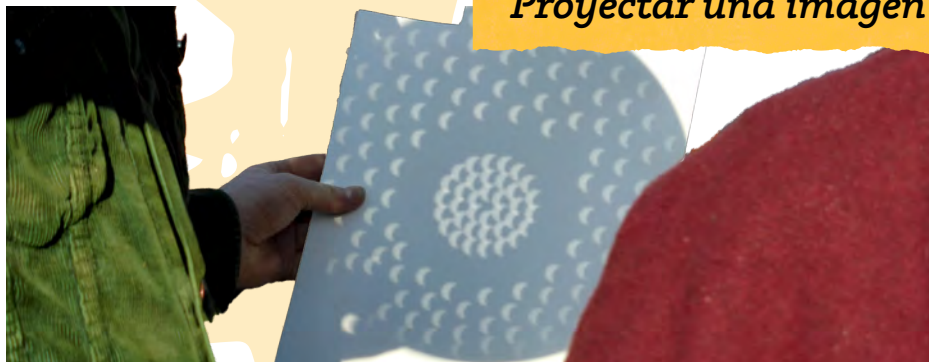
### Gafas de visión solar



“Solar eclipse viewing” by [NCIL](#)

Las gafas de sol normales, las gafas de natación y la mayoría de los filtros de las cámaras **NO** son seguros para mirar directamente al sol. Puede proteger sus ojos de manera segura con anteojos certificados para ver eclipses de su biblioteca u otra institución confiable (como un museo de ciencias local o el departamento de ciencias de la universidad/escuela secundaria). Asegúrate de que en el reverso, en letra pequeña, digan que tienen la certificación ISO 12312-2.

### Proyectar una imagen



Párate de espaldas al Sol y usa un colador o un trozo de cartón con un pequeño agujero para proyectar imágenes del Sol eclipsado en cualquier superficie de color claro.

“Colander community” by [John Lord](#) is licensed under [CC BY 2.0](#)

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This eclipse project leverages and expands upon the [STAR Library Education Network \(STAR Net\)](#), a hands-on learning network for libraries and their communities across the country. **STAR Net** focuses on helping library professionals build their science, technology, engineering, and math (STEM) skills by providing science-technology activities and resources (STAR) and training to use those resources. Public library staff can immediately [join this FREE network](#) to access:

## Community

*Discuss promising practices*

## **STEM** ACTIVITY Clearinghouse

*For hands-on STEM activities for all age levels and related resources*

## Blogs

*Share success stories*

## Webinars

*Online professional training*

## Workshops and meet-ups

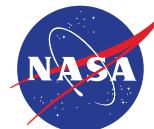
*In-person professional training*

## STAR Net News

*Online Newsletters*

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