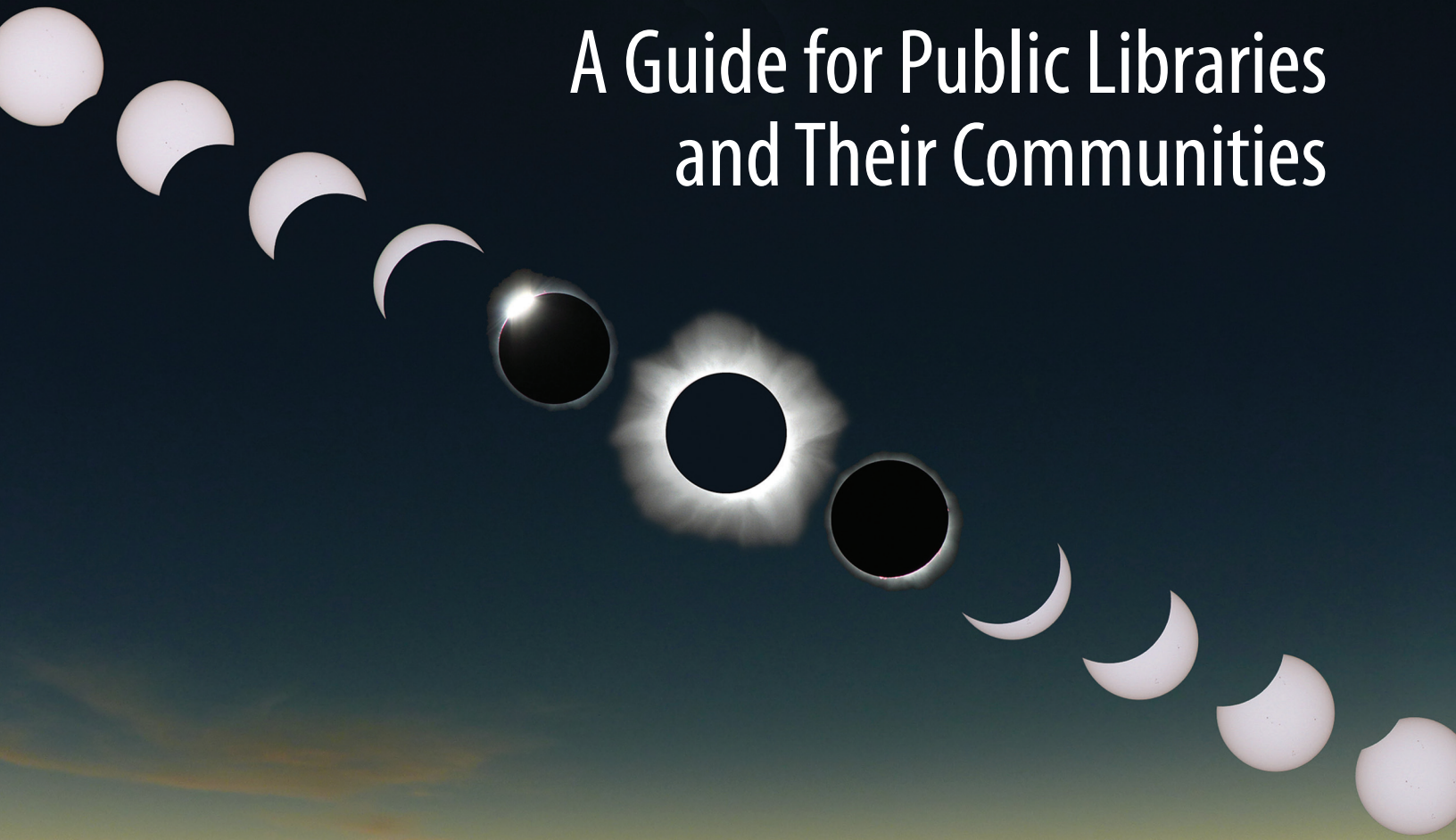


The “All-American” Eclipse

A Guide for Public Libraries
and Their Communities



by Andrew Fraknoi (Foothill College) and
Dennis Schatz (Pacific Science Center)

Table of Contents

- 1** Introduction to Eclipses and the 2017 Eclipse

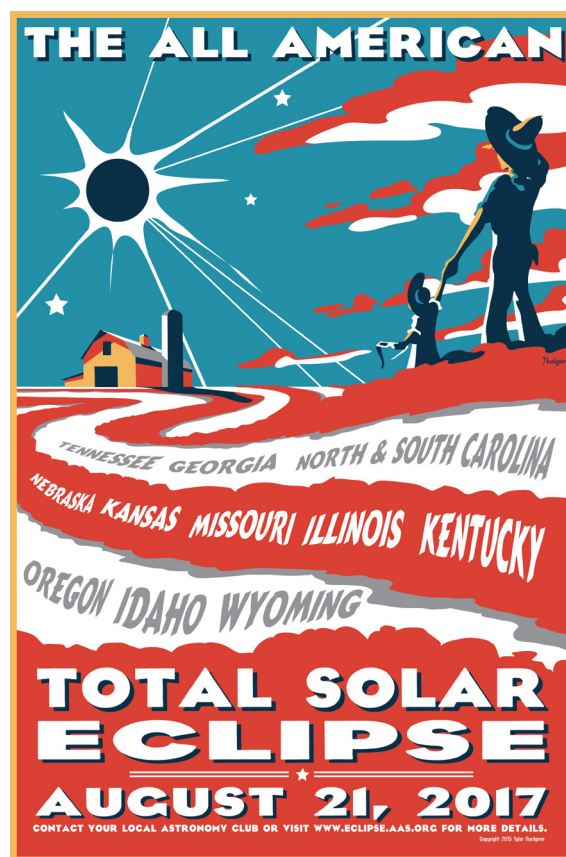
- 2** How to View an Eclipse Safely

- 3** Eclipse Glasses: Getting Them, Using Them

- 4** Ideas for Eclipse Events for Libraries

- 5** Finding Partners

- 6** Eclipse Guide Authors and Contributors



All-American Eclipse Poster
(Credit: Tyler Nordgren, U. of the Redlands)

The 2017 Solar Eclipse project is funded by the Gordon and Betty Moore Foundation through Grant GBMF5373 to the Space Science Institute. Google has also provided additional funding.

Cover Photo: 2012 Eclipse Sequence by Rick Fienberg (AAS)

© 2017 Andrew Fraknoi and Dennis Schatz





Introduction to Eclipses and the 2017 Eclipse

On Monday, August 21, 2017, a total eclipse of the Sun will be visible in the continental United States for the first time in almost 40 years. A total eclipse is when the Sun is completely hidden by the Moon, the sky becomes dark, and the Sun's faint atmosphere (its corona) becomes visible – like a beautiful halo. This total eclipse will ONLY be visible on a narrow track stretching from Oregon to South Carolina across the U.S. Because no other country will get to see this total eclipse, it's being nick named "The All-American Eclipse."

The rest of the U.S. and other parts of North and Central America will see a partial eclipse, where the Moon covers only a portion of the Sun. A partial eclipse may not be as awe-inspiring and memorable as a total eclipse, but it is still a beautiful experience that will not quickly be forgotten. It will be important to use safe viewing strategies during the partial eclipse, since it is dangerous to look at without something to protect your eyes from the Sun's damaging rays.

As we get closer to August, there will be much media excitement about this eclipse and therefore a lot of public interest in seeing it. The August date means that some students will still be on vacation, while others will just be starting school. Many families will be traveling away from their homes. In the following pages, we explain what the excitement is all about, show you how, where, and when to see the eclipse safely, and give a few hints on how libraries and families can use the occasion of the eclipse as a learning experience.

We'll set out the basic facts in the form of questions and answers.



Total eclipse, revealing the Sun's atmosphere (corona)
(Credit: Luc Viatour)



Partial eclipse (Credit: Giorgio Galeotti)

What exactly is a total eclipse of the Sun?

A total eclipse of the Sun occurs when the Moon gets between the Sun and the Earth and covers up the Sun. It just so happens that the Moon and the Sun, as seen from Earth, are the same size in the sky. So if the two are exactly lined up, the Moon can hide the Sun from our sight.

When this happens, the sky darkens and the fainter outer layers of the Sun become visible. This allows us to see the Sun's atmosphere (corona) — a beautiful ring of light around the edge of the dark Moon. The sky becomes so dark, stars become visible, birds stop chirping because they think it is time to roost, and people have an eerie sense of it being night in the middle of the day. Many people feel that a total eclipse is one of the most beautiful natural sights, and worth seeing at least once in a lifetime.

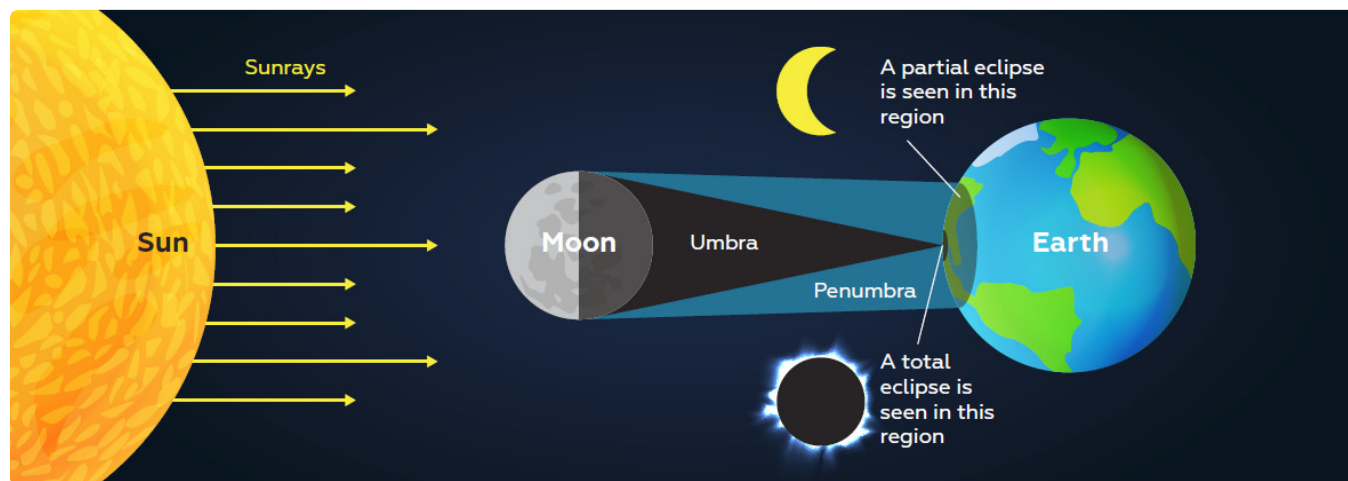
Total eclipses of the Sun are only visible on a small part of the Earth's surface where the line-up of the Moon and Sun is exact and the

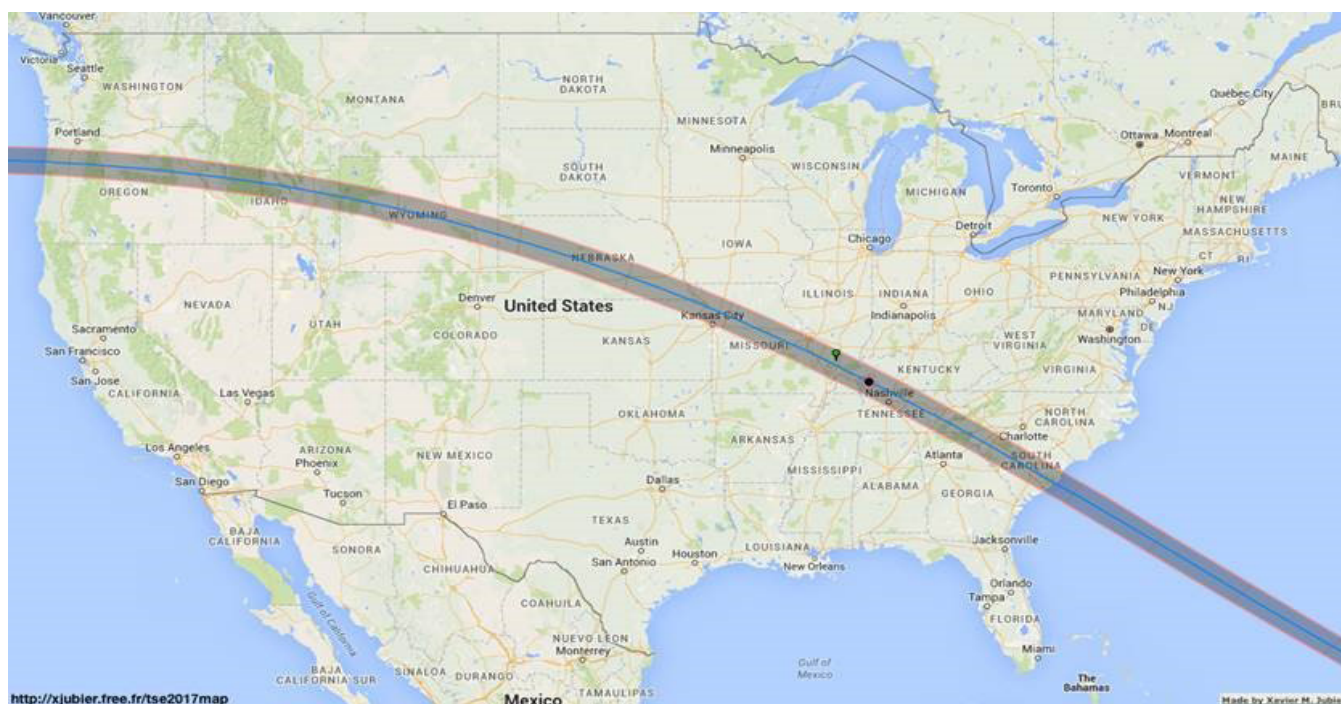
Moon's shadow is darkest. If you are outside the zone of totality (which in 2017 will only be about 60 to 70 miles wide), you will see just a partial eclipse. During a partial eclipse, part of the Sun is still visible, and that means the Sun is dangerous to look at. You will need protection for your eyes before you can look directly at the Sun — or you will need to project an image of the Sun (see instructions further on in this booklet).

Where and when can people see this total eclipse?

For those in the U.S., the August 21 eclipse begins on a beach on the west coast of Oregon, and ends on a beach on the east coast of South Carolina, making a narrow diagonal track across the United States. It goes through PORTIONS of Oregon, Idaho, Wyoming, Nebraska, a tip of Kansas, Missouri, Illinois, Kentucky, Tennessee, Georgia, North Carolina, and South Carolina. The map to the right shows you the areas it crosses.

Diagram of eclipse shadows (Credit: From the book *Solar Science*, published by the National Science Teachers Association)





Map of the 2017 total eclipse path in the U.S. by Xavier Jubier; used with permission

Note that the path of the beautiful total eclipse really doesn't go through any of America's largest cities. It will be visible from Nashville, TN and parts of the St. Louis and Kansas City metropolitan areas. But all our largest cities will see only a partial eclipse. In Los Angeles, the eclipse will only cover 62% of the Sun, in Chicago 87%, in New York City 72%, in Miami 78%, and so on.

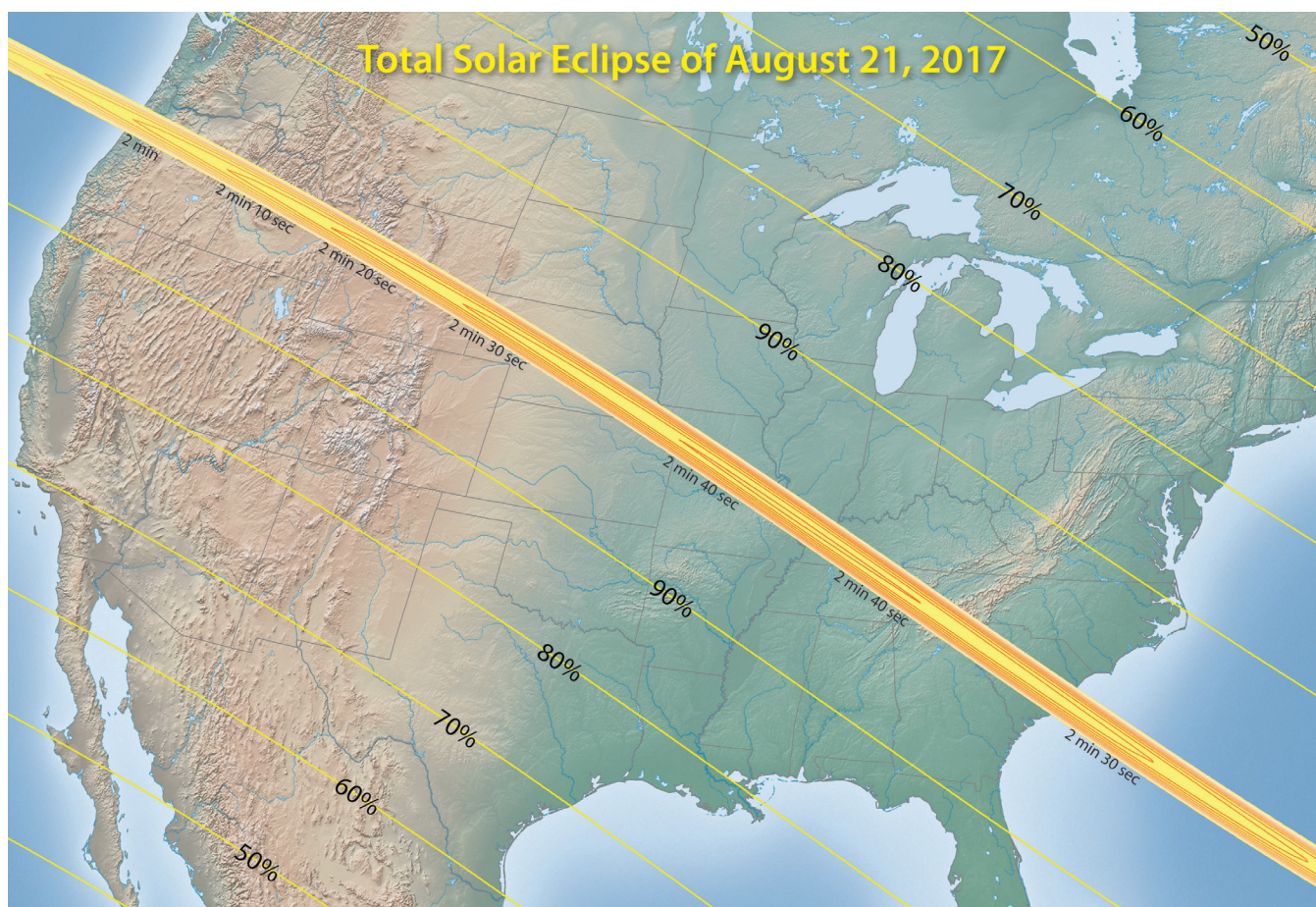
Smaller towns that are well placed for total eclipse viewing include Salem OR, Saint Joseph MO, Carbondale IL, Hopkinsville KY, and Columbia SC, among others. Visit our Eclipse Resource Center (see the link below) for interactive maps and get lists of towns or parks where the total phase will be visible.

<http://www.starnetlibraries.org/2017eclipse/eclipse-resource-center>

How long will the total eclipse in August last?

The exact cosmic line-up that forms a total eclipse lasts only a short time in any given location. The total phase in 2017 will last a maximum of 2 minutes 40 seconds in the center of the Moon's shadow. (This is short for a typical total solar eclipse; some can last 7 minutes.) The exact time it lasts depends on your location in the shadow band, and will likely be less than the maximum. The closer you are to the central line of the eclipse shadow the longer you will have to enjoy the spectacle.

Also, the sky must be clear to see the eclipse. If clouds hide the Sun the entire time, you're out of luck, although it will still get dark. Section 4 (Ideas for Eclipse Events) offers suggestions to help plan for inclement weather; see the Eclipse Resource Center for websites that keep track of eclipse weather.



Map showing where the eclipse will be partial. Each diagonal line indicates how much of the Sun's area will be covered (Credit: Michael Zeiler and GreatAmericanEclipse.com)

Where will the partial eclipse be visible?

The partial eclipse will be visible all over North America, weather permitting. Many millions of people will be able to see a big bite taken out of the Sun as the Moon moves in front of it. The map above shows a rough estimate of what percent of the Sun will be covered in different locations. See the chart on page 9. To enjoy it, however, people must plan ahead for how to protect their eyes. Remember, if they are viewing the partial eclipse, some part of the Sun is still showing and can cause eye damage. (See section 2 on safe viewing techniques.)

What's the best location for seeing the total eclipse?

There is no simple answer to this question. The ideal place to be is on the center line near a town or park where the weather is usually clear. The "wild card" is undoubtedly going to be the weather. Meteorologist Jay Anderson is the "guru" of eclipse weather and many eclipse websites carry his predictions. But, as you know from life experience, no one can predict the weather for sure. And if it turns out to be cloudy in a popular location, lots of people will try to move to get away from the clouds, perhaps creating traffic jams on small roads not designed for such crowds.

How will the 2017 eclipse move across the U.S.?

The total eclipse begins at about 10:15 am Pacific daylight time on the westernmost Oregon beach within the dark shadow of the Moon, and ends at about 2:48 pm Eastern daylight time on the easternmost cape in South Carolina. It will take about 90 minutes to cross the U.S. and the shadow will move at an average speed of 1450 mph, faster than commercial jets travel. (If you're wondering how 10:15 am to 2:48 pm could be a total time of only about 90 minutes, keep in mind that the eclipse will move across the four time zones of the U.S.)

What should people expect to happen during a total eclipse?

To begin with, only a small part of the Sun is covered by the Moon. During this partial phase, the Sun is dangerous to look at without proper protection. Either wear one

of the certified eclipse glasses or use one of the safe viewing methods discussed in section 2 of this booklet. It takes some time (on the order of 75 to 90 minutes) for the eclipse to reach totality, so be sure you are prepared for a long period of waiting under the summer sun (see suggestions later in booklet).

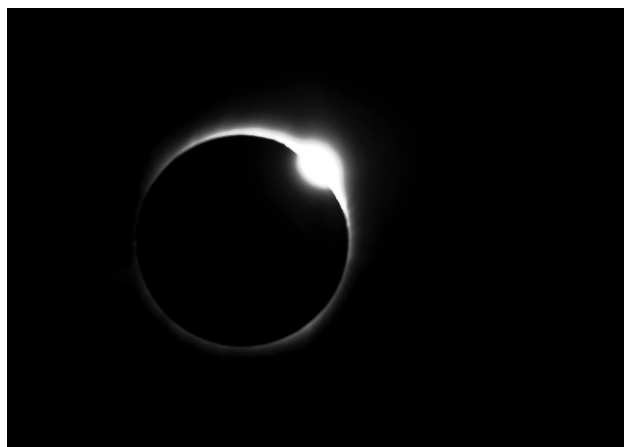
As more and more of the Sun is covered by the Moon, eventually you will see shadows getting sharper, temperatures (slowly) getting lower, and the sky getting darker. If you are viewing from high ground, you may be able to see the Moon's shadow on the land racing toward you (but that's not always easy to see).

Just before the Moon completely covers the Sun, it will get significantly darker, and you may see "the diamond ring effect." For a second you see the faint ring of the Sun's last crescent of light and then the bright (diamond) flash of the last glimpse of the Sun. That flash is the light of the Sun glimpsed through a valley on the edge of the Moon.

Then, when the Sun is completely covered, the outer atmosphere (the Sun's corona) becomes



Eclipse from space (Credit: NASA)



Diamond ring during the total solar eclipse of 22 July 2009 in the Kurigram district of Bangladesh. (Credit: Lutfar Rahman Nirjhar)

visible as a faint flickering glow around the dark disk of the Moon. This is when you need to look directly at the Sun without safe viewing devices, so you can see the beauty of the corona. Sometimes, you can see red or pink prominences, small tongues of hot material jutting outwards. Also, take a moment to tear your eyes away from the Sun and glance around. The world is dark, but it's a darkness that is not quite like night, and nothing like a cloudy day. (The sky in the direction of the Sun may look darker than the sky near the horizon.) You can frequently notice the absence of sound as wind dies down and living things seem to hold their breath.

During this eclipse, you will be able to see what looks like a bright star not far from the Sun. This will not be a star at all, but rather the planet Venus, our neighbor planet whose cloudy atmosphere reflects sunlight very effectively.

You may see another diamond ring as the Sun emerges from behind the Moon and then it's time again to place protection in front of your eyes, or to view the Sun indirectly, as the glowing sliver of the Sun becomes blindingly bright. After totality is over, there is an equally long period of time that the Moon slowly moves off the disk of the Sun and the eclipse is only partial.



What should I expect to happen if I am viewing from a location where the eclipse is partial (not total)?

Most of North America will observe a partial eclipse on August 21. People in these areas must wear eclipse glasses or view the Sun in some other safe way for the entire time! Safe viewing is important to emphasize throughout the time people are outdoors, because the temptation to look directly at the Sun can be hard to resist, especially for children.

The entire partial eclipse – from beginning to end – lasts from a little over two and a half hours to almost three hours. For half that period, the Moon is covering up the Sun, and for the other half, it is moving off the Sun. The closer a location is to the path of totality, the more of the Sun will be covered up.

During the partial eclipse, if you are near any trees that let light filter through their leaves, you will see hundreds of little “crescent suns” on the ground under them. Each one is an image of the Moon covering the Sun. A colander will do the same (see photo on page 12).

It's important that everyone who wants to stay for a significant part of the eclipse be prepared for the long period that the experience can take. As discussed in the next question/answer, if the temperatures are likely to be warm, people should be reminded in advance to bring Sun protection to help them spend time in the Sun.

A partial eclipse on May 20, 2012, captured from the San Juan Mesa Wind Farm off Highway 70 in Elinda, New Mexico. (Credit: Evan Zucker)



People viewing a 2012 Eclipse (Credit: National Park Service)

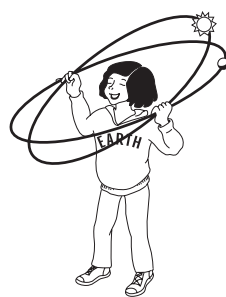
What do eclipse chasers recommend for those who are seeing their first eclipse?

Some of their helpful hints include: Expect a big crowd and prepare for it. Everyone in your group should go to the bathroom just before leaving for viewing the eclipse, and know where the nearest bathroom is if one is needed. Bring drinks and snacks with you. Don't neglect the sunscreen, hats, and sunglasses. For young kids, bring something to keep them occupied while waiting. For older people, bring a folding chair and a sun umbrella. (And remember: sunglasses are for reducing glare; they don't have the protection to let you look directly at the Sun!)

Like two hula hoops held slightly apart, the path the Moon takes in the sky is tilted relative to the path that the Sun takes. (Credit: Dennis Schatz, *Astro Adventures*)

Why is there not an eclipse every month, each time the Moon in its orbit reaches the direction of the Sun?

The orbit of the Moon is tilted by about five degrees from the orbit of the 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 or so, the two orbits cross, and then eclipses of the Sun and of the Moon are possible. Total eclipses of the

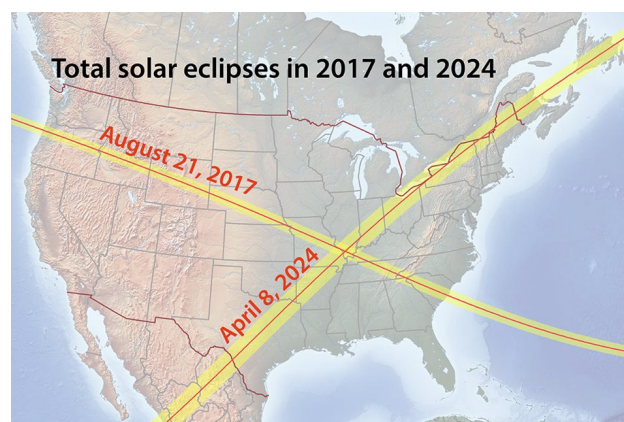


Sun are visible in only a narrow path along the Earth where the Moon's shadow is really dark. The average time that passes before any given spot on Earth sees a total eclipse again is 375 years.

If I miss this eclipse, when is the next one visible from the U.S.?

The next eclipse to go through the continental U.S. will be on April 8, 2024. It will mostly go through a different set of states than the one in 2017.

Eclipses of 2017 and 2024 (Credit: Michael Zeiler)



Duration of the Aug. 21, 2017 Partial Eclipse for the Largest Cities in the U.S. (None of the largest U.S. cities will get to see the total eclipse)

City	Eclipse Starts	Max Eclipse	Eclipse Ends	Fraction of Sun's Diameter Covered	Percent of Sun's Area Covered
New York City	1:23 pm	2:45 pm	4:01 pm	0.77	71%
Los Angeles	9:06 am	10:21 am	11:45 am	0.69	62%
Chicago	11:54 am	1:20 pm	2:43 pm	0.89	87%
Houston	11:47 am	1:17 pm	2:46 pm	0.73	67%
Philadelphia	1:21 pm	2:44 pm	4:01 pm	0.8	75%
Phoenix	9:14 am	10:34 am	12:00 n	0.7	63%
San Antonio	11:41 am	1:09 pm	2:38 pm	0.69	61%
San Diego	9:07 am	10:23 am	11:47 am	0.66	58%
Dallas/Ft Worth	11:40 am	1:10 pm	2:39 pm	0.8	75%
San Francisco	9:01 am	10:15 am	11:37 am	0.8	76%
Indianapolis	12:58 pm	2:25 pm	3:49 pm	0.93	91%
Washington DC	1:18 pm	2:43 pm	4:02 pm	0.84	81%
Miami	1:27 pm	2:59 pm	4:21 pm	0.82	78%

Eclipse Information for Selected Cities Where the Eclipse Will be Total

City	Partial Eclipse Starts	Total Eclipse Starts	Total Eclipse Ends	Partial Eclipse Ends	Sun's Altitude At Totality
Salem, OR	9:05 am	10:17 am	10:19 am	11:38 am	40 degrees
Casper, WY	10:22 am	11:43 am	11:45 am	1:09 pm	54 degrees
St. Joseph, MO	11:41 am	1:06 pm	1:09 pm	2:34 pm	62 degrees
Carbondale, IL	11:52 am	1:20 pm	1:23 pm	2:48 pm	64 degrees
Nashville, TN	11:58 am	1:27 pm	1:29 pm	2:54 pm	64 degrees
Columbia, SC	1:13 pm	2:42 pm	2:44 pm	4:06 pm	62 degrees



How to View an Eclipse Safely

It's not the eclipse that is dangerous to observe, it's the Sun! The Sun's visible (and invisible) rays can cause serious damage to the sensitive tissues of the eyes, often without 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 something with them to protect their eyes before the eclipse becomes total – or if they are only seeing the partial eclipse.

Are eclipses of the Sun dangerous to watch?

The few minutes of total eclipse (when the Sun is completely covered) ARE safe, but anytime that even a small piece of the bright Sun shows, your eyes are in danger. Paper glasses with special filters made of protective material will be sold in lots of places. (Make sure that on the back, in small print, they say that they are ISO 12312-2 certified.) Sunglasses are NOT sufficient to protect your eyes!

To summarize: If you are lucky enough to be in the path of the total eclipse, you can and should remove your glasses during the few minutes that the eclipse is total, so you can take in the beauty of the scene. But if you are viewing the partial eclipse only, you must keep your glasses on anytime you are looking in the direction of the Sun.



Girls and Woman With Eclipse Glasses

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

A. Sun Filters to Look Directly at the Sun

To look at the Sun directly, except during the total phase of the eclipse, you need a good filter that can cut out not just its intense light, but also its ultraviolet and infrared waves. 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 an excellent filter (but it has to be #14 and not lower numbers). Or you can use special black or aluminized polymer filters that are sold as eclipse glasses; but make sure you get them from a reliable source and that they are certified. Companies making and selling them in bulk include:

American Paper Optics:

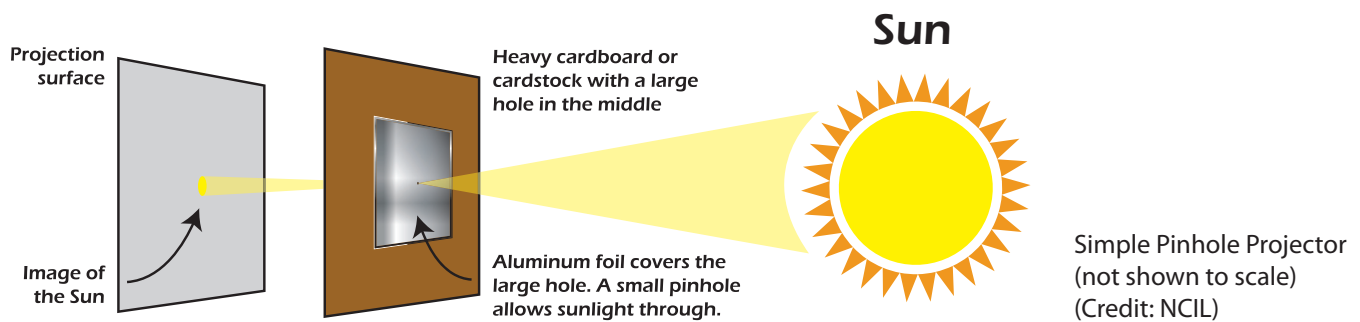
<http://www.eclipseglasses.com/>

Rainbow Symphony:

<http://www.rainbowsymphony.com/>

Thousand Oaks Optical:

<http://www.thousandoaksoptical.com/>



B. Pinhole Projectors to Indirectly View Sun

If you don't have safe glasses, a good way to see the eclipse is to project an image of the partially eclipsed Sun. One easy method is to make a 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 cardboard, tape a sheet of aluminum foil over the hole and put the pinhole in the foil instead of paper.) The further apart the two pieces of paper, the larger the image of the Sun will be (but it will be a small image in any case).

You can also make a pinhole projector inside a box, such as a shoebox, cereal box or a tube (e.g. poster shipping box). You can find links to the following instructions on the *STAR_Net STEM Activity Clearinghouse*, or at:

Shoebox:

<http://static.nsta.org/extras/solarscience/chapter3/3.10PinholeProjectionInABox.pdf>

Cereal box:

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

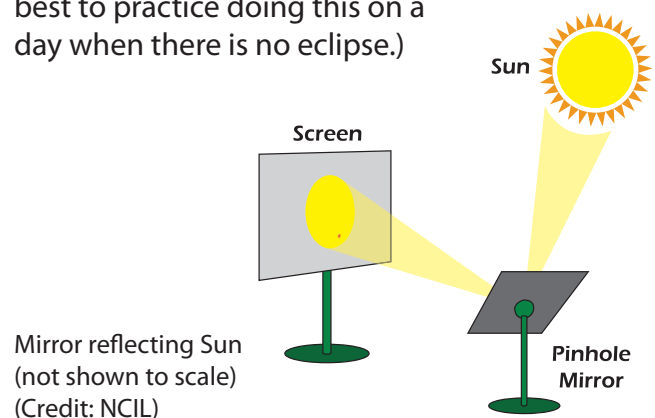
UPS Triangular Shipping Box:

<https://www.exploratorium.edu/eclipse/how-to-view-eclipse>

Again, the image of the eclipsed Sun on the box will be quite small, but distinct.

C. 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. For example, you can use an envelope to make a jacket for it. Cut out a hole the size of a dime (or smaller) in the covering to reveal a small part of the mirror. Now use that small 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 and it reflects the image where you want it to go. It's best to practice doing this on a day when there is no eclipse.)





Binocular Projection
(Credit: Dennis Schatz, *Astro Adventures*, and *Solar Science*)

D. Projecting an Image of the Sun through Binoculars

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 to) one lens on the larger end of the binoculars to block the light. Then take a piece of cardboard and cut out a hole the size of the lens on the larger side of the binoculars. Tape the cardboard to the binoculars, making a kind of sunshade through which one lens shows.

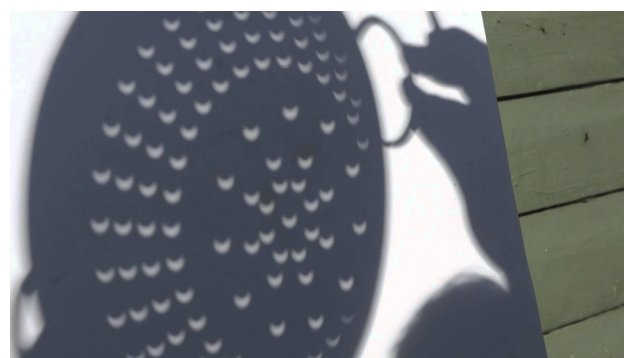
Attach the binoculars to a tripod or other device to hold the binoculars steady. Point the large end of the binoculars toward the Sun and have someone else hold a white sheet or cardboard some distance away from the smaller end. Move things around until you see an image of the Sun on the paper or cardboard. Use the focus knob of the binoculars to make the Sun's image sharper.

Important Note: *You should definitely NOT look at the Sun through binoculars or a telescope, because they 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!*

A Note about Telescopes: If you have a tight-fitting, certified solar filter and know how to use it, a telescope can also be used to view the Sun or project an image of it.

E. Using a Colander

If none of these materials are available, you can hold up a colander toward the partially eclipsed Sun, and look in the opposite direction from the Sun for the light and shadow pattern on the ground or a wall. You will see many tiny images of the eclipsed Sun.



Using a colander to make an image of a partial eclipse on a white wall. (Credit: Ally Bing)

The information in the preceding pages has been adapted from two sources:

1) *Solar Science* by Dennis Schatz and Andrew Fraknoi, published in 2016 and © by the National Science Teachers Association. All rights reserved. The book features a wide array of hands-on activities and information about the Sun, its movement in the sky, its effects on Earth (such as the seasons), and its eclipses. For information, see: <http://www.nsta.org/solarscience>



2) "Run a 2017 Eclipse Event for Friends, Neighbors, and Profit" by Douglas Duncan, first published in Summer 2015 issue of *Mercury*, the magazine of the Astronomical Society of the Pacific. You can read the entire article here:

https://cdn.shopify.com/s/files/1/0744/4007/files/2017_event.pdf



Eclipse Glasses: Getting Them, Using Them

If you are a librarian and are reading this booklet because it was enclosed in a box of free eclipse glasses courtesy of the Moore Foundation (with additional help from Google and the Research Corporation) you already have your supply of eclipse glasses.

If you are a librarian and are reading this on the web, or if your free glasses have run out, you can order additional glasses at a significant bulk discount for educational institutions (such as libraries) at: <http://eclipsediscount.com>.

If you are an individual reading this on the web, and would like to order glasses for yourself, your family, or a group, the three main companies that make certified eclipse glasses are:

American Paper Optics:

<http://www.eclipsesglasses.com/>

Rainbow Symphony:

<https://www.rainbowsymphony.com/eclipse-glasses>

Thousand Oaks Optical:

<http://www.thousandoaksoptical.com/>



Kids using certified eclipse glasses. (Credit: Rainbow Symphony)

How to use your eclipse glasses safely:

1. Before you put the glasses on, make sure that the black plastic within the paper frames is not scratched or broken. Carefully check any glasses that children will be wearing as well.
2. Make sure that the glasses fit behind your ears; try moving your head around to make sure they don't fall off. Also make sure any children under your supervision also have their glasses on so that the handles fit behind the ears. Keep children within your view while they are looking at the Sun.
3. Continue to remind everyone that when any part of the Sun's bright disk is visible, it's never safe to look at the Sun without the eclipse glasses or other indirect viewing technique.
4. 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.

When do you need to wear the glasses?

1. You need to wear the glasses whenever any part of the bright Sun is visible.
2. The only time it is safe to view the Sun without the glasses is the period of a few minutes when the eclipse is total (when the Moon completely covers the Sun.)

Can I use the glasses when there is no eclipse?

1. 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)

2. When looking at the Sun through the glasses, you may occasionally be able to see tiny dark spots on it (these are groups of sunspots – cooler areas on the Sun’s surface that look darker to us.)



Ideas for Eclipse Events for Libraries

Some people mistakenly believe that the most important eclipse-related programming occurs on the day of the eclipse. Nothing could be further from the truth. On Monday, Aug. 21, 2017, people will be at work, at school, or at home and it may be difficult for them to attend a library program. The important time for library programming is during the months and weeks leading up to the eclipse! The public needs to know when and where the eclipse will occur and to have time prepare for observing it safely, no matter where they are during the eclipse.

Engaging Your Community in the Months Leading up to the Eclipse

Online and Physical Eclipse Displays

Set up an eclipse display area, with books, posters, handouts, and an exhibit showing safe viewing methods. Download resources from the *STAR_Net Eclipse Resource Center*, to create informative displays about the Sun, Moon, and eclipses, such as:

- Video displays with eclipse videos, animations, and images on a loop.
- Posters, handouts, and even exhibit panels set up for patrons to read.

Lists of books and videos are also available in the *STAR_Net* resource area to help you create displays of library resources available for checkout.

Daytime Children’s and Youth/Family Programs

Schedule a daytime family program that includes time to go outside and practice looking at the Sun using safe viewing techniques. Encourage families to attend together, promising one pair of eclipse glasses free for each family (given out at the end of the program). Make an effort to

include people who are underrepresented in science (e.g. African Americans, Latinos, the economically disadvantaged, people with disabilities, and women and girls).

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 event (if you are having one), including when the eclipse will be visible in the community and where people will be gathering that day.

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:

STAR_Net STEM Activity Clearinghouse:
<http://clearinghouse.starnetlibraries.org/>

Evening or Weekend Eclipse Talk and Training

Invite a local astronomer, amateur astronomer, science teacher, or museum educator to give a short talk on the upcoming eclipse and how to view it safely (see section 5 on finding partners.) Include a demonstration of various safe viewing techniques and promise one pair of eclipse glasses for each family (given out at the end.)

Include a question and answer period. Practice using the glasses and other safe viewing methods outside, if the event is during the daytime.

Make and Take Activity

Provide supplies for each patron (or family) to make a "pinhole viewer." Pinhole viewers can be used at home for projecting an image of the Sun on eclipse day. (See safe viewing strategies in section 2 for how to make simple pinhole projectors).



Sun Party in Tucson (Credit: David Eicher)

Sun Party Events

Amateur astronomers enjoy bringing their telescopes to public outreach events, called "star parties" when done at night. Many amateur astronomers have a filter for their telescope that makes it safe to view the Sun during the daytime. Ask the local amateur club to put on a "sun party" in front of the library. Museum educators may also be able to help provide a sun party. During or afterwards 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.



Girls with solar viewing glasses (Credit: Rainbow Symphony)

Library and School Collaboration Event

Consider doing an eclipse training session for teachers, daycare, and other educators in cooperation with a local astronomer, veteran science teacher, or science museum/nature center educator helping to lead it. Coordinate advertising the event with the local school

district and encourage teachers and others who do not have a science background to attend. In addition to the topics listed above, have a discussion on how best to work with a group of students, so everyone is viewing the eclipse safely. Include information on how teachers and schools can purchase eclipse glasses. See page 19 for suggestions of partners for helping with your eclipse events.

An Important Note About Selling Glasses

By the rules established by the Moore Foundation, libraries may not sell the glasses they receive free from this project. But many libraries are likely to find that the local demand for glasses far outstrips their free supply (especially if they get the word out via the local media.) In that case, libraries can order more glasses at bulk rates (see below) and then sell them for a reasonable fee (such as \$2 each.) Income could go to your Friends of the Library or similar group.

We have arranged with one of the manufacturers of certified eclipse glasses to make glasses in quantity available to educational institutions (like libraries) at highly discounted rates. To order your own supply of glasses through this program, go to: <http://www.eclipsediscount.com>. Close to the eclipse date, this offer may no longer be available; so it will be important to order glasses as soon as possible.



NOTE: It is never safe to look at the Sun's disk when any part of it is showing without proper precautions. Make sure everyone is practicing safe viewing by having eclipse glasses and ways of projecting an image available. See the safe viewing pages for more information. Ordinary sunglasses are NOT safe!

Events on the Day of the Eclipse

Eclipse Viewing Training Before the Eclipse Begins

The partial eclipse on Monday, Aug. 21, starts just after 9 am on the West Coast, but after 1:15 pm on the East Coast. For libraries in the eastern half of the U.S., it may be possible to squeeze in a pre-eclipse session where people get glasses (if any are left) or train on other ways to view the eclipse, and then go and see the eclipse with family, friends or colleagues.

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 August 21 eclipse. A local astronomer or science educator can help you determine where the Sun will be in the sky and whether it will be visible from the library. (Informative maps with the eclipse circumstances can be found at: <https://www.greatamericaneclipse.com/nation/>)

If there is a good viewing site at the library, invite the public (and the local media) to watch the eclipse from there. Have glasses available and other methods for safe viewing (See safe viewing strategies in section 2 earlier.) If your library does not have a good viewing site, you might partner with others in city government, schools, community centers, nature centers, science centers or 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 (roughly 2.5 hours, with maximum coverage about halfway through this time). Perhaps someone else can distribute and collect viewing materials, since 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 bathroom overflow – if you pardon the expression.)



Eclipse with Clouds (Credit: Rick Fienberg - AAS)

What to Do if it's Cloudy on Eclipse Day

Include 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. Download a variety of eclipse activities from the *STAR_Net STEM Activity Clearinghouse*.

Arrange to have a live feed from NASA eclipse viewing locations on the NASA TV Channel and through the Exploratorium (a science museum in San Francisco). Google, through its Megamovie project (<https://eclipsemega.movie/>), will stitch together images of the eclipse as it moves across the country.

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 ways to see live views of the eclipse. Console your eclipse audience by letting them know that while the previous eclipse that crossed the entire country was back in 1918, the next eclipse going across the U.S. will be on April 8, 2024. It will cross a different set of states, but should again be visible as a partial eclipse everywhere in North America.



Finding Partners

Your library should be able to find partners in the community who can team up with you to help provide eclipse events before August 21. While astronomy experts and eclipse enthusiasts are likely to be busy viewing the total eclipse on Aug. 21, many of them will be happy to help with public events in the months preceding the eclipse, which is the best time to prepare the public to understand the eclipse and to observe it safely. This section provides information on where and how you can find partners to train your library staff and assist with public eclipse events.

The STAR Library Education Network (*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 registered library map (at <http://www.starnetlibraries.org/2017eclipse/registered-libraries-map/>) and find a library near their own work or home where they can volunteer. But libraries can also contact such experts (or their work places) directly, to see if they can find eclipse experts who can work with them.

Professional Astronomers and Their Students

A list of astronomy and physics departments at universities and colleges that offer astronomy degrees can be found at: <https://aas.org/learn/college-departments-offering-astronomy-related-degrees>. Reach out to professors to see if they or their graduate students are interested in partnering.

In addition, many smaller colleges (including community colleges) have someone on staff who teaches an introductory astronomy course. A list of all community colleges in the U.S. (by state) is at: <http://www.aacc.nche.edu/pages/ccfinder.aspx>. Wikipedia also has entries that list all the colleges and universities in the U.S. state by state.



People with Moon Balls
(Credit: Astronomical Society of the Pacific)

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 more research or asking people at a local college or amateur astronomy club. NASA facilities are shown at: <https://www.nasa.gov/about/sites/index.html>.

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 can be found at: <https://aas.org/outreach/roster-aas-astronomy-ambassadors>.

Amateur Astronomers and NASA Volunteers

Astronomy hobbyists have organized astronomy clubs in communities throughout the country and there may be one near you.



To find a club, use the following tools:

NASA's Night Sky Network consists of 400+ clubs that specifically dedicate some of their energy to public outreach: <https://nightsky.jpl.nasa.gov/club-map.cfm>

Solar System Ambassadors are a special group of amateur astronomers and educators who are trained to work help with public events. You can find a national directory of these Ambassadors at: <http://solarsystem.nasa.gov/ssa/directory.cfm>

The Astronomical League is an umbrella organization of many clubs around the country. Here is the list of their clubs organized by state: <https://www.astroleague.org/al/general/society.html?order=state&sort=asc>

Sky & Telescope magazine has a club finder on their website: <http://www.skyandtelescope.com/astronomy-clubs-organizations/>

Astronomy magazine also has a finder and their list includes more types of organizations: <http://www.astronomy.com/groups.aspx>

Once you find a club in your area, look for their contact information or 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 eclipse to their attention. A teacher of physics or earth science may be willing to help you with your eclipse programming. In addition, many science teachers belong to their state science teacher organization and to the National Science Teachers Association (NSTA), which are actively informing and training their members in anticipation of the eclipse.

If you have not been able to find a science teacher to assist you through the local schools, your next step should be to approach your state science teacher organization. To find the officers and contacts for your state science teachers group, you can go to: <http://www.nsta.org/about/collaboration/chapters.aspx#chapterlist>



Interactive exhibits at the Exploratorium, a science museum in San Francisco (Credit: Fred Hsu)

Science Museum or Nature Center Educator



A good list of science and technology museums can be found at the website of Association

of Science/Technology Centers (ASTC). They have a finder tool to help you locate a science museum near you at:

<http://www.astc.org/about-astc/about-science-centers/find-a-science-center/>.

A planetarium is a facility where the stars are projected on a dome and special shows about astronomical topics are featured. Some planetariums are part of a larger science museum or school district, but some are

independent facilities. Below are some web-based tools for finding a planetarium near you:

The World Wide Planetarium Database:

<http://www.aplf-planetariums.org/en/index.php>

The Loch Ness Planetarium Compendium:

<http://www.lochnessproductions.com/ldco/ldco.html>

State by state lists of nature and environmental centers in the U.S. are compiled in a series of Wikipedia articles, centralized at:

https://en.wikipedia.org/wiki/List_of_nature_centers_in_the_United_States

Locate a national park in your area at

<http://findyourpark.com/>.

We hope your library can find a partner in your community who can help you share the excitement, wonder, and science of the eclipse 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. Send your eclipse event reports to: Anne Holland at aholland@SpaceScience.org. (Please have signed image release forms on file for any people who appear in your images.)



Eclipse Guide Authors and Contributors

This booklet was written by Andrew Fraknoi and Dennis Schatz, with assistance and advice from Douglas Duncan (U. of Colorado), Paul Dusenbery (Space Science Institute), Anne Holland (SSI) and Kelliann LaConte (SSI).

Main Authors



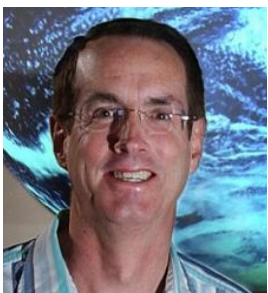
Credit: Tucker Hiatt

Andrew Fraknoi is Chair of the Astronomy Department at Foothill College, near San Francisco, and was the California Professor of the Year in 2007. He is the lead author of a free, electronic, college textbook, *Astronomy*, published by OpenStax and appears regularly on local and national radio, explaining astronomical developments in everyday language. He serves on the Eclipse Task Force of the American Astronomical Society, working to make the 2017 eclipse a safe and educational experience for everyone.



Credit: BSCS

Dennis Schatz is Senior Advisor at the Pacific Science Center in Seattle, Washington. For four years, he served as a Program Director for in the Education and Human Resources Directorate at the National Science Foundation. He is also the author of 23 science books for children that have sold 2 million copies worldwide and have been translated into 23 languages. He is on the board of the National Science Teachers Association (NSTA) and received NSTA's Distinguished Service to Science Education Award.



Douglas Duncan, an astronomer at the University of Colorado and the Director of the Fiske Planetarium, contributed a number of ideas on effective astronomy outreach to this booklet.

We would like to thank Janet Coffey and Robert Kirshner at the Moore Foundation for their guidance with this national education outreach project.

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. *STAR_Net* is managed by the Space Science Institute’s National Center for Interactive Learning.

Public library staff can immediately join this FREE network to access:

- *STEM Activity Clearinghouse* (for hands-on STEM activities for all age levels and related resources)
<http://clearinghouse.starnetlibraries.org/>
- *Eclipse Resource Center* (to assist libraries in creating promotion and program materials for eclipse events)
<http://www.starnetlibraries.org/2017eclipse/eclipse-resource-center/>
- Blogs (share success stories!)
<http://www.starnetlibraries.org/blog/>
- Forums (discuss promising practices)
<http://www.starnetlibraries.org/resources/online-forums/>
- Webinars (online professional training, including webinars on preparing for the 2017 eclipse)
<http://www.starnetlibraries.org/resources/webinars/>
- Workshops and meet-ups at library conferences (in-person professional training)
<http://www.starnetlibraries.org/resources/conferences/>
- *STAR_Net News* (online newsletter)
<http://www.starnetlibraries.org/resources/newsletters/>

NASA@ My Library, an initiative of *STAR_Net*, endeavors to engage public audiences nationwide in informal and lifelong learning with the excitement of NASA exploration and discovery. The vision for the *NASA@ My Library* project is for NASA, public libraries, and state library agencies to work together to increase and enhance STEM learning opportunities for millions of library patrons throughout the nation, including geographic areas and populations that are currently underserved in STEM education. *NASA@ My Library* is made possible through the support of the National Aeronautics and Space Administration (NASA) (NNX16AE30A) Science Mission Directorate as part of its STEM Activation program.

with support from the

GORDON AND BETTY
MOORE
FOUNDATION

