



April 8, 2024 North American Total Solar Eclipse: Viewer's Guide

Page T1

Choosing a Product for Safely Observing the Sun & Solar Eclipses

Page PG1



VIEWER'S GUIDE



NORTH AMERICAN
TOTAL SOLAR
ECLIPSE

APRIL 8, 2024

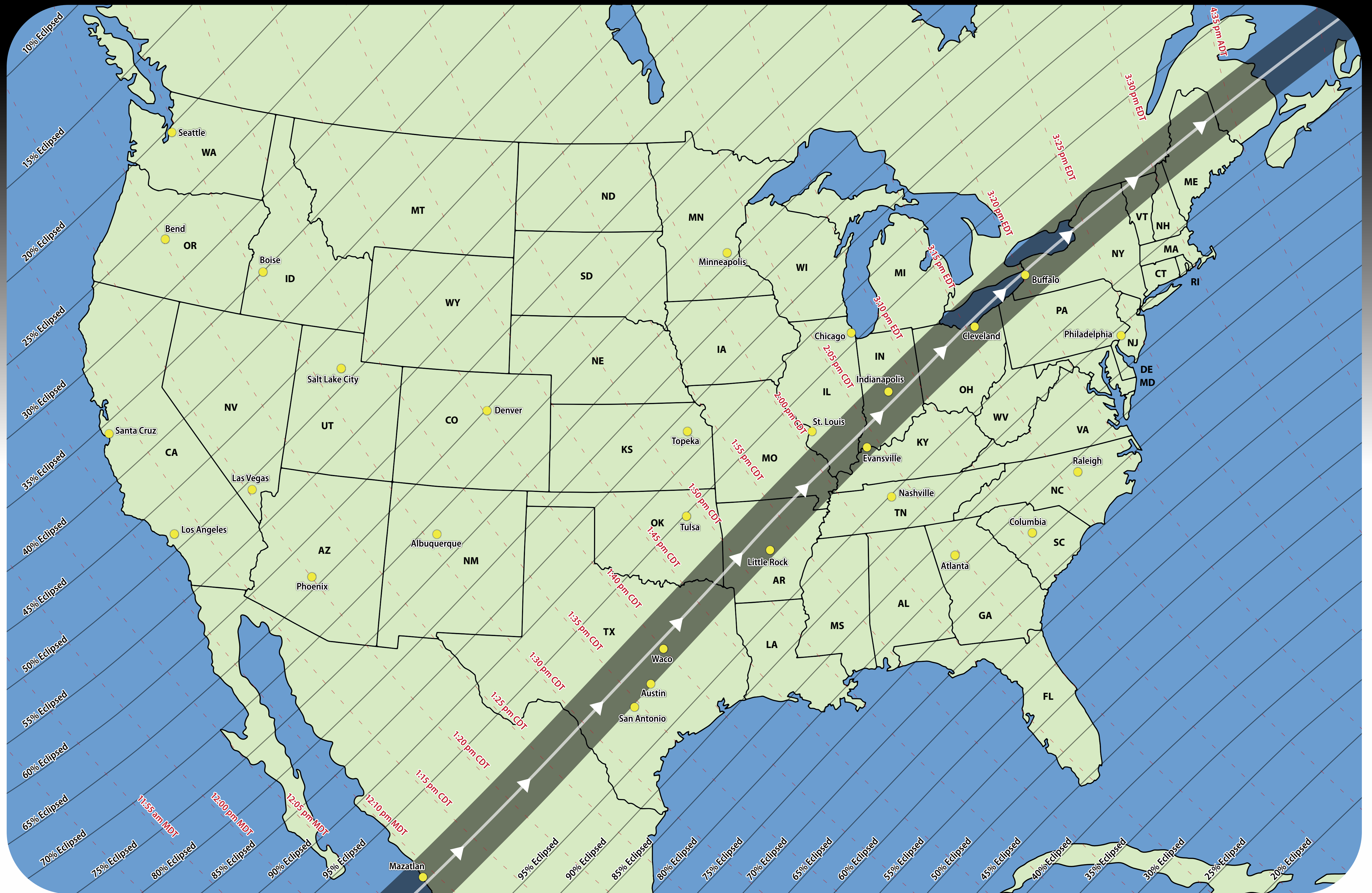
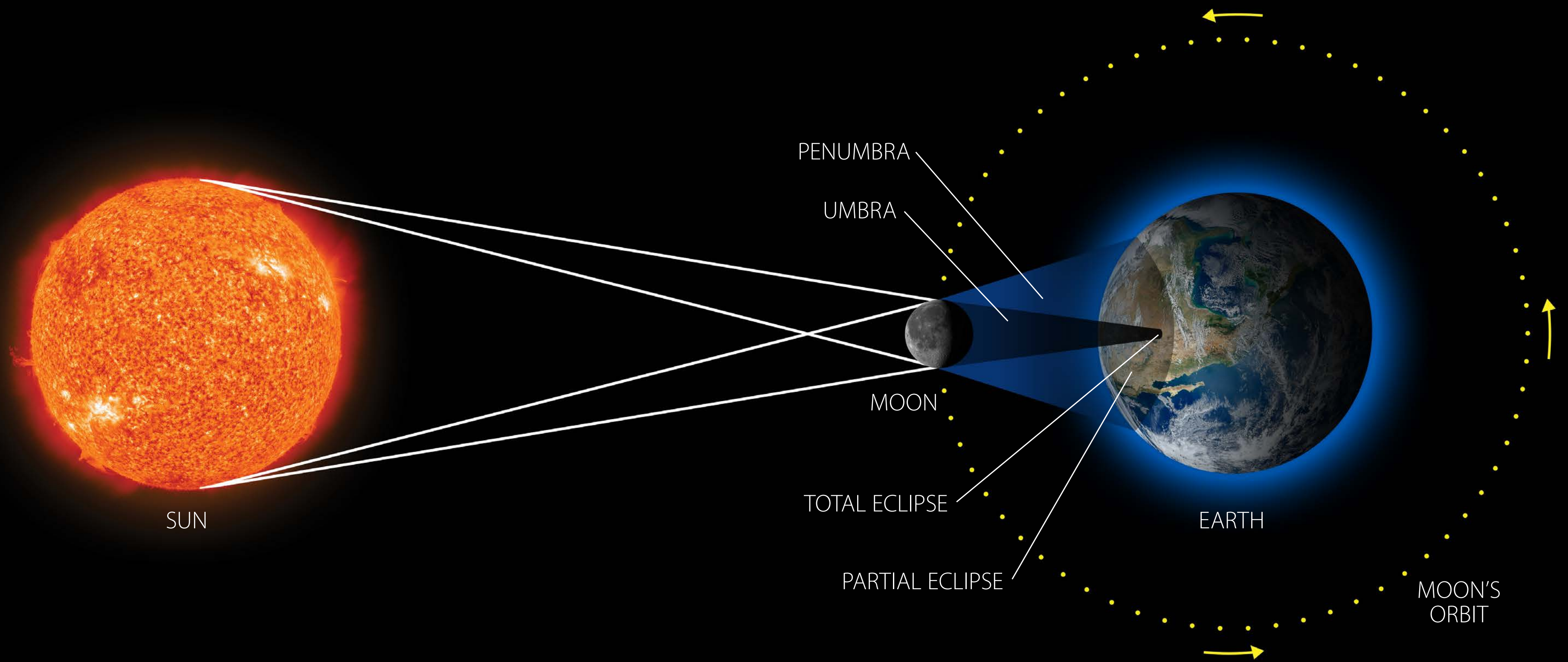
[Telescope.com/SolarEclipse](https://www.telescope.com/SolarEclipse)

 **ORION**[®]
TELESOPES & BINOCULARS
AN EMPLOYEE-OWNED COMPANY

On April 8, 2024, a total eclipse of the Sun will occur over North America and cross a vast swath of the continental United States, giving millions of people a rare opportunity to see one of the most visually exotic events in nature. Coming so soon after the spectacular total solar eclipse of 2017, which wowed American viewers from coast to coast, the 2024 eclipse will feature a wider path and last twice as long!

What is a Total Solar Eclipse?

A total solar eclipse occurs when the Moon passes directly in front of the Sun, completely covering its luminous disk. The dark shadow (the umbra) cast onto the Earth by this blockage sweeps eastward in a narrow path—the “path of totality.” Anyone inside the boundaries of this path under clear skies will see daylight turn to near darkness, and the Moon’s silhouette ringed by a pearly white corona—the Sun’s ethereal outer atmosphere.



The Path of Darkness

The April 8, 2024 path of totality cuts northeast across the United States from Texas to Maine, crossing parts of 11 other states (*see the map above*). If you are outside the path, you’ll be enveloped in the Moon’s pale outer shadow (the penumbra) and experience only a partial eclipse. The closer you are to the path, the more the Sun’s disk will be eclipsed. But even a 99% partial eclipse will fall short of the wondrous spectacle of totality. The unblocked 1% of sunlight will overpower the corona, hiding it from view. So if at all possible, get yourself inside the path of totality—or you’ll miss the jaw-dropping main event.

Time and Duration of Totality

The time of occurrence and duration of totality depend on your location in the path. As the shadow sweeps northeastward, the eclipse occurs slightly later in the day—with totality starting at 1:27 p.m. CDT in Texas and ending at 3:35 p.m. EDT in Maine. The maximum duration of totality also decreases a bit—from 4 minutes 25 seconds at the Texas-Mexico border, to around 3 minutes 22 seconds at the Maine-New Brunswick border. And the closer you are to the path's centerline—the imaginary line that runs midway between its outer boundaries—the longer totality will last. For example, while viewers near the centerline in Sulphur Springs, Texas will see 4 minutes 21 seconds of totality, those along the path's edge to the east or west of Sulphur Springs will see only ~45 seconds.

Prepping for the Big Event

The first order of business: make plans to get to the path of totality! Anywhere outside of it and you're going to see only a partial eclipse. And be forewarned, hotels, rentals, and campgrounds inside or near the path can book up many months in advance—so make your travel plans early!

1. Gather your gear—Give yourself plenty of time before the big day to get all the gear you'll need together. Lawn chairs, food and drink, sun hat, and sunscreen since you'll be outdoors on a (hopefully!) sunny day, for starters. Order some ISO-approved eclipse glasses. If you will be using a telescope, binoculars, and/or a camera, bring all the needed components, including a solar filter properly sized for your instrument. Purchase the eclipse glasses and solar filters well in advance while retailers' supplies are plentiful.
2. Create an eclipse "workflow"—You may want to review or even rehearse the actions you plan to take during the eclipse, especially if you will be viewing and photographing it. The particular actions, their timing, and the order in which you do them constitute your eclipse workflow. Memorize it.
3. Arrive early—Get to your eclipse viewing site a few hours before first contact. This gives you time to find a good spot, unload your gear, set up your telescope (if you have one) and/or camera equipment, and bask in the excited vibe.
4. Have your phone ready—Use your smartphone's video camera or an audio recording app to make periodic notes as the eclipse progresses about things like the changing temperature, quality of ambient light, changes in the behavior of animals, and the reactions of other eclipse-watchers. It will be fun to compile and relive your observations later.



Experiencing a Total Solar Eclipse

First Contact: The Bite

The eclipse kicks off at *First Contact*, the moment when the Moon's leading edge contacts the Sun's disk. This is the beginning of the partial phase. Look closely and you will see a small black "bite" out of the Sun's disk, on its western side. The "bite" slowly grows bigger as time progresses.

It's interesting to note that before first contact, you can't see the Moon approaching the Sun at all. That's because it is in the "New Moon" phase, when none of its Earth-facing side is illuminated. Only when it begins passing in front of the Sun can we see the Moon—in silhouette against the Sun's bright disk.

About 30 minutes into the eclipse, if you are near a tree, you may notice numerous "crescent Suns" on the ground below it. They're caused by sunlight passing through tiny gaps among the tree leaves. These gaps project and magnify the bright crescents onto the ground. Bring a piece of pegboard or a colander—anything with small holes in it—to produce the same effect yourself!

It's Getting Cooler, Darker

When about half of the Sun's disk is covered, see if you can feel the temperature cooling a bit. (Consider bringing a thermometer to make periodic temperature readings.) Has a breeze kicked up as well? The surroundings are looking a little darker, as with an approaching sunset.

When about 75% of the Sun's disk is eclipsed, sky color deepens and clouds become more pronounced. The eastern horizon exhibits richer yellow and orange hues, while the western horizon is growing darker, gloomier. Shadows take on a sharper and more contrasty appearance.

When the Sun shrinks to a thin crescent in the minute or two before totality, you will definitely notice the chill in the air. Pets might start acting nervously, sensing that something is up. Look down (remove your solar glasses for a moment) and see if you can detect shadow bands—alternating dark and light bands that wash across the ground like ripples in a pool. They occur when light from the Sun's narrowing crescent interacts with turbulent air in Earth's atmosphere. They're easiest to see on flat, white surfaces; some observers will spread out a white sheet to try to see them better. The sky around the Sun turns twilight purple. The western horizon grows darker and more ominous as the Moon's umbral shadow races toward you.



Projected "Crescent Suns"



Baily's Beads

Baily's Beads and the Diamond Ring

In the few seconds before totality, the remaining sliver of Sun transforms into a "string of pearls" called Baily's Beads, caused by the last shafts of sunlight shooting through deep valleys on the Moon's eastern edge. These beads are fleeting, though, quickly winking out until just one remains—creating a stunningly beautiful *Diamond Ring*! At this point everyone within earshot will be gasping with awe, whooping with excitement, yelling "Oh my god!", even applauding!

Second Contact: Totality Begins

When that last bead disappears, that's *Second Contact*, the start of totality.



Diamond Ring

IT IS NOW SAFE TO REMOVE YOUR ECLIPSE GLASSES AND ANY SOLAR FILTERS FROM YOUR BINOCULARS OR TELESCOPE.



Solar Prominences

The Sun's mesmerizing, ghostly white corona now streams outward in all directions from the Moon's dark disk. You may also make out a bright red fringe on the Moon's limb. This is the Sun's thin middle atmosphere, the *chromosphere*. With the aid of a telescope or binoculars you may spot magenta-red knots and streamers called "prominences" reaching up from the chromosphere. They are colossal eruptions of hydrogen gas being ejected in jets and curls from the Sun's surface. Their number, size, and shape vary from one eclipse to another.

Stars and a 360-Degree Sunset

With the Sun now gone, but for its ethereal corona, daylight has turned into twilight, with the corona providing enough light to prevent total darkness. Some bright stars and possibly a planet or two pop into view in the blue-black sky. The horizon in all directions, being outside of the Moon's shadow, glows with sunset colors of orange and yellow.

Peel your eyes away from the eclipsed Sun for a few seconds (if you can), and take in the sights and sounds of your surroundings. Others have reported phenomena like flowers closing up their petals as they normally would at dusk, then reopening them once totality has ended. Cattle saunter back to the barn like they do at nightfall. Birds may roost, singing their evening choruses as the light dims before totality, then go silent when the Sun blots out. Nocturnal animals like bats and owls may wake up and take to the sky. Evening insects start to chirp. Do you notice anything strange or interesting about the behavior of flora and fauna where you are?

Third Contact: Totality Ends

Before you know it, the end of totality is just seconds away. A second diamond ring bursts into view, this time on the Moon's trailing side, as the corona fades out. The chromosphere and more Baily's Beads make a final, fleeting appearance. When they blink off, you've reached *Third Contact*.



Mid-totality

NOW PUT YOUR ECLIPSE GLASSES AND YOUR INSTRUMENT'S SOLAR FILTER BACK ON (if you will continue to view the Sun)!

Thus ends the main act of Nature's Greatest Show on Earth. Now the super-bright edge of the solar disk peeks out and the sky immediately brightens. Cheers and applause will ring out from the thrilled, gobsmacked masses.

Quickly look to the east (with eclipse glasses off). Can you see the Moon's shadow racing away? Look down once more to try to catch shadow bands fluttering on the ground. Check out your shadow if you didn't do so right before totality. Do you see how unusually sharp it is? Also check your thermometer; how much did the temperature drop during totality?

Fourth Contact: It's Over

It will be about another hour before *Fourth Contact*, when the Moon moves completely past the Sun's disk, marking the official end of the solar eclipse.



Use Eye Protection!

In a total solar eclipse, it is safe to directly view the Sun only during the brief period of totality, when the Sun's disk is **completely** covered. Before and after totality, when the Sun's disk is only partially eclipsed, you must use specialized, certified-safe "eclipse glasses" or a safe solar filter if viewing through a telescope or binoculars—to prevent serious eye damage. Be sure also to cover your telescope's finder scope with its cap. *(Note: Orion does not sell eclipse glasses.)*

Using Binoculars or a Telescope

Binoculars will offer good views of the corona at totality, their wide field of view and modest magnifying power revealing tapered streamers, polar brushes (feathery rays that stick out from the Moon's disk), and pinkish prominences. For all phases of the eclipse **except** for totality, the binoculars must be fitted with a pair of certified solar filters, to prevent damage to your eyes.

A telescope will provide a detailed, magnified view of totality. (Make sure your solar filter is **OFF** the telescope during totality, or you won't see anything!) It can bring out fine "structure" in the Sun's corona: luminous threadlike rays, streamers, and arcing plumes that extend from the Moon's limb. It will also provide higher-resolution images of solar prominences, better showing their color, shape, and extent.

For direct viewing of the partial phases of the eclipse, you must use a certified solar filter fitted securely on the front of your telescope. A "white-light" solar filter, which is made from glass or a special film polymer such as Mylar® polyester film, blocks 99.999% of incoming sunlight so you can safely observe the Sun without damaging your eyes or the telescope. With a white-light filter you can see sunspots, which appear as dark splotches on the Sun's photosphere, and faculae, which are bright regions. On close inspection you may even resolve some surface "granulation." Each tiny granule as seen from Earth is actually a cell of Texas-sized hot, ionized gas that rises up from deep inside the Sun, then cools and falls back down.



Hydrogen-Alpha Solar Telescopes

Some telescopes are specially designed for safe, ultra high-resolution viewing of the Sun. Hydrogen-alpha telescopes and filters reject all light except that in a narrow portion of the electromagnetic spectrum around the red H-alpha line, at 656 nanometers. With an H-alpha telescope, the Sun's disk springs to life with mesmerizing phenomena and detail. You're seeing the Sun's chromosphere, the atmospheric layer just above the bright and (in normal light) overpowering photosphere. Spicules, shape-shifting prominences, snake-like filaments, fibrils, bright plages, and dramatic flares burst into view across the Sun's disk through an H-alpha telescope or filter.

An H-alpha solar telescope or filter will, however, block the view of the corona during totality. So that's when you will want to look up from the telescope or look into a standard telescope with any solar filter removed.

We hope you enjoy this rare celestial spectacle and that it sears indelibly into your memory (it will)! Because the next total solar eclipses visible from the continental United States will not occur until August 23rd, 2044 (in parts of Montana and N. Dakota only) and August 12th, 2045 (in parts of 13 states).

Good luck, view safely, and clear skies!

Browse our selection of Coronado H-alpha Solar Telescopes and Filters at [Telescope.com/Coronado](https://www.telescope.com/coronado).

See our selection of White-Light Solar Filters at [Telescope.com/SolarFilters](https://www.telescope.com/solarfilters).



These Items Are **NOT** Safe for Eclipse Viewing!

- Sunglasses or stacked pairs of sunglasses
- Photographic neutral-density filters
- Photographic UV filters
- Polarizing filters
- Smoked glass
- Compact discs
- Metallic food/candy wrappers

These items may reduce the Sun's brightness, but they do not completely block infrared and ultraviolet wavelengths, which are harmful to your eyes.



CHOOSING A PRODUCT FOR SAFELY
OBSERVING THE SUN &
SOLAR ECLIPSES

Choosing a Product for Safely Observing the Sun and Solar Eclipses

To witness any solar eclipse, you will need to consider what type of product to use to both protect your eyes and provide the type of observing experience you want for the special events. Orion provides a myriad of eclipse viewing solutions to fit any budget, and for any level of Sun-watching sophistication, from first-timers to experienced eclipse chasers.

Solar Eclipse Glasses

The least expensive type of eye protection commonly used for solar eclipse viewing is solar eclipse glasses. Although Orion does not carry them, they are widely available from many other retailers. Eclipse glasses are eyeglasses with cardboard (usually) or plastic frames and polymer-type solar filters for “lenses”. Fashion forward eyewear they are not, given their clunky one-size-fits-all design, but they are easy to pop on and off and are relatively comfortable to wear because they are so lightweight. They provide a non-magnified view of the Sun, which means you will be able to see sunspots if they are very large (and your eyesight is very good). Keep in mind that with eclipse glasses you will not be able to see anything except the Sun.

Solar eclipse glasses are handy for safely viewing both total and annular solar eclipses, including the partial phases of solar eclipses.

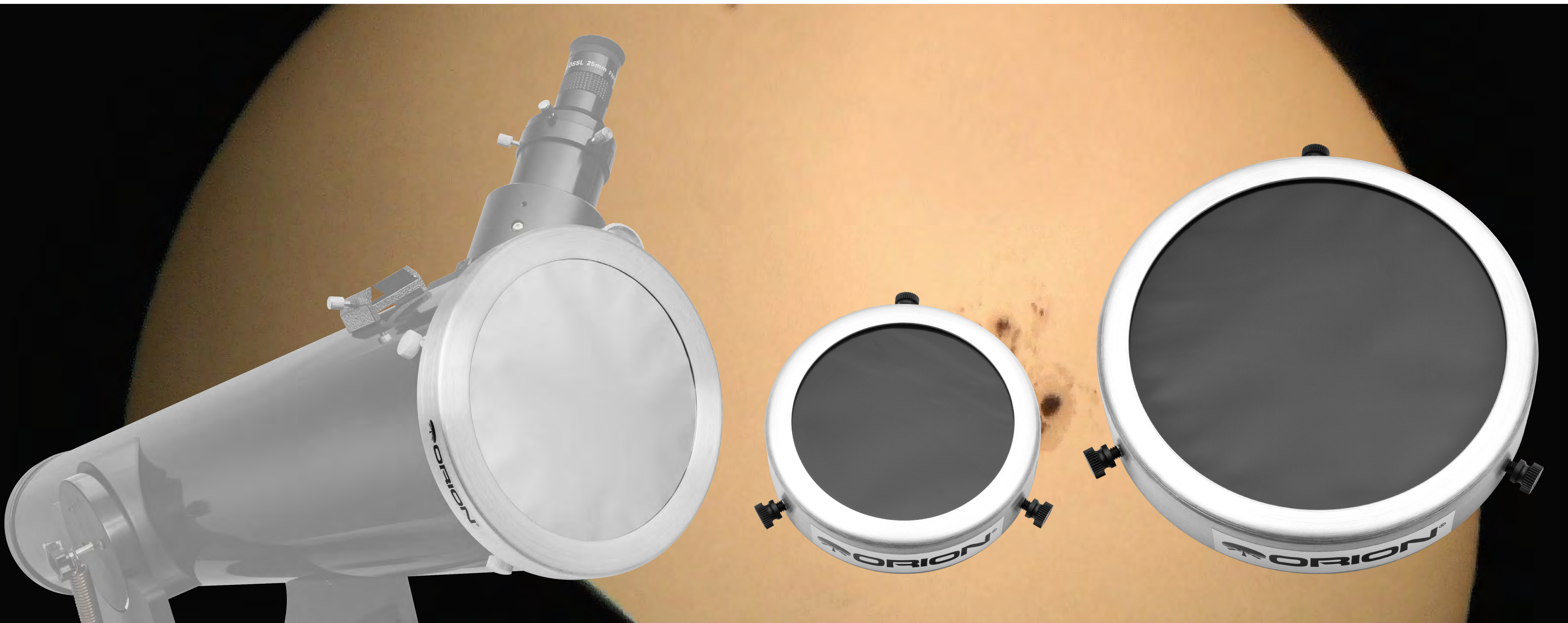
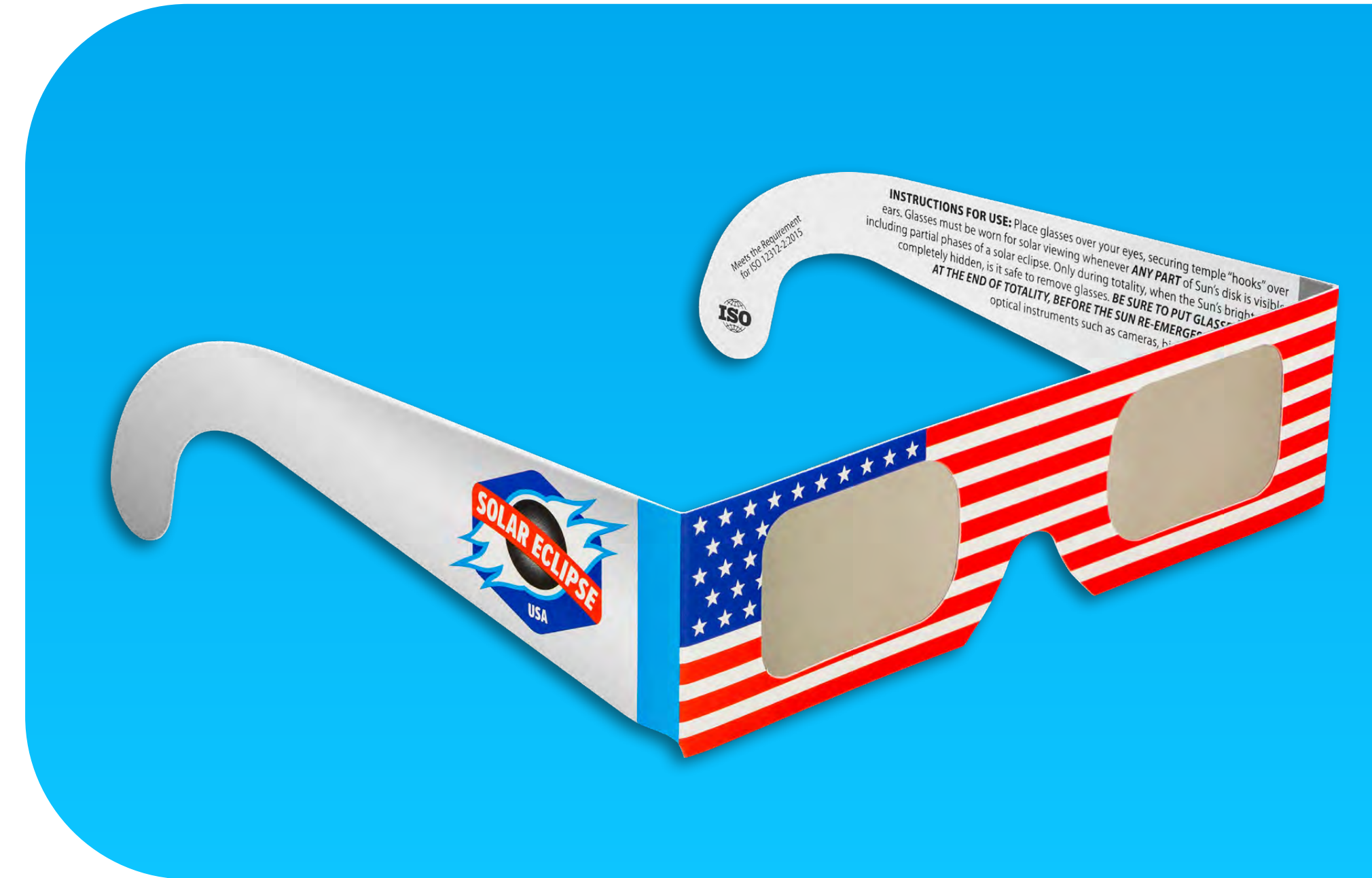
Make sure to select only eclipse glasses that are ISO 12312-2 certified.

+ Advantages:

Inexpensive; easy to use; shows larger sunspots; allows safe viewing of Sun anytime, including during solar eclipses

- Disadvantages:

Non-magnifying so minimal solar detail visible; some on market may not meet ISO safety standard



Orion Safety Film Solar Filters

Orion offers ISO-certified Safety Film Solar Filters designed to fit a wide variety of popular Orion telescopes and binoculars of various sizes. These are “white light”, visible-spectrum solar filters made from a durable “film” polymer, which shows the Sun in its natural color. With a white-light filter you can see sunspots, which appear as dark splotches on the Sun’s photosphere, and faculae, which are bright regions. On close inspection you may even resolve some surface “granulation.”

Orion assures that all our solar filters are tested at specialized labs that are accredited to verify compliance with the ISO 12312-2 safety specifications for solar viewing. Designed and manufactured in the USA, most of our solar filters have a brushed aluminum mounting cell with three nylon thumbscrews to insure secure attachment of the filter over the front aperture of the instrument.

Be forewarned that due to high demand, supplies of Orion Safety Film Solar Filters could run out in the weeks leading up to the two North American Solar Eclipses, so don’t wait to order yours!

+ Advantages:

Shows Sun in natural color; sizes to fit many different telescopes and binoculars; made in USA; ISO 12312-2 certified for safe solar viewing

- Disadvantages:

Does not show as much solar detail as more-specialized H-alpha filters



Product Selection Wizard ▶

Solar Binocular Kits

Binoculars offer excellent, modestly magnified views of solar eclipses. Of course they must be fitted with a pair of certified-safe solar filters, one filter to cover each of the two front lenses, to prevent damage to your eyes! Even the relatively low magnifying power of binoculars—typically 7- to 12-times magnification relative to your natural eyesight—can nicely reveal Baily’s Beads, tapered coronal streamers and polar brushes as well as pinkish prominences shooting out from the exposed chromosphere during the total phase of a total solar eclipse. For all phases of a total solar eclipse except for totality, the filters must remain on the binoculars. For annular eclipses, binoculars will present a bigger, better-resolved view of the ring of fire and Baily’s Beads than would be visible with just eclipse glasses. During the partial phases you’ll see sunspots on the Sun’s disk, if any are present, as well as granulation around the sunspots.

To make it easy to choose binoculars for viewing solar eclipses, we have created several Solar Binocular Kits featuring popular Orion binoculars and a pair of Orion Safety Film Solar Filters of just the right size. Our Solar Binocular Kits offer binoculars from hand-holdable 7x50 and 10x50 models, to 70mm and 80mm “giant” models, right up to the most powerful jaw-dropper, our 25x100 binoculars. All Orion Solar Binocular Kits are priced at a nice savings over the combined individual prices of the included items.

And when you’re not viewing the Sun or watching a solar eclipse, the Orion binoculars in these kits can be used sans filters for regular, high-resolution daytime terrestrial viewing and nighttime stargazing. The whole family will enjoy exploring the world and beyond—on trips or right from the back yard—with these high-quality binoculars.

No matter what size binoculars you use for eclipse watching, consider mounting them on a tripod (sold separately). A sturdy tripod will provide a rock-steady view through the binoculars, as opposed to the shakier view you get when hand holding them. And it will prevent the inevitable arm fatigue that sets in when holding the binoculars for a prolonged period of time. Depending on the particular binocular, you may also need a “binocular tripod adapter” to couple the binoculars to the tripod.

Not sure which Solar Binocular Kit to purchase? Let our Product Selection Wizard help you. It will ask you a few questions about what you’re looking for in a binocular as well as the views you’d like to experience. Then it will provide you with the perfect product solution to meet your needs and exceed your expectations. [Click here for the Product Selection Wizard!](#)

+ Advantages:

Compact and highly portable; relatively inexpensive; the filters show the Sun in natural color; magnified view shows more eclipse detail; most are hand-holdable; use the binoculars without solar filters for general daytime viewing and nighttime stargazing

- Disadvantages:

Lower-power views than a telescope provides; tripod (sold separately) may be useful for steadier images and less arm fatigue



Product Selection Wizard ▶

Telescope Sun & Moon Kits

With a telescope you will enjoy a detailed, highly magnified view of the total or annular solar eclipses. The magnifying power will depend on the focal length of the particular telescope—longer focal lengths provide greater magnification—but any telescope will let you get in tight to see fine “structure” in the Sun’s corona during a total solar eclipse, and will let you glimpse Baily’s beads, the Diamond Ring effect, and flame-like solar prominences on the Sun’s chromosphere in stunning resolution. For annular eclipses a telescope fitted with a white-light solar filter will resolve sunspots large and small and the bright faculae that surround them during the partial phases, and will reveal surface granulation better than binoculars can.

We offer an exciting variety of Telescope Sun & Moon Kits geared toward beginners. Each kit includes everything you’ll need to experience the North American Total and Annular Solar Eclipses up close and in eye-widening detail. We have paired some of our most popular beginner telescopes with a made-in-USA Orion Safety Film Solar Filter to protect your eyes during the big events. Most of the telescopes come with more than one eyepiece, providing different magnification options. And since you will want to use your telescope to view other astronomical objects throughout the year, including the Moon, these kits also include an Orion Moon Filter. By dimming the Moon’s overpowering brightness, this neutral density filter, which simply threads into the telescope’s eyepiece barrel, enhances the visibility of craters, mountains, and other fascinating lunar features. What’s more, two of the telescopes—notably the refractor-type telescopes on altazimuth mounts—also excel for daytime terrestrial viewing, which give them even greater versatility.

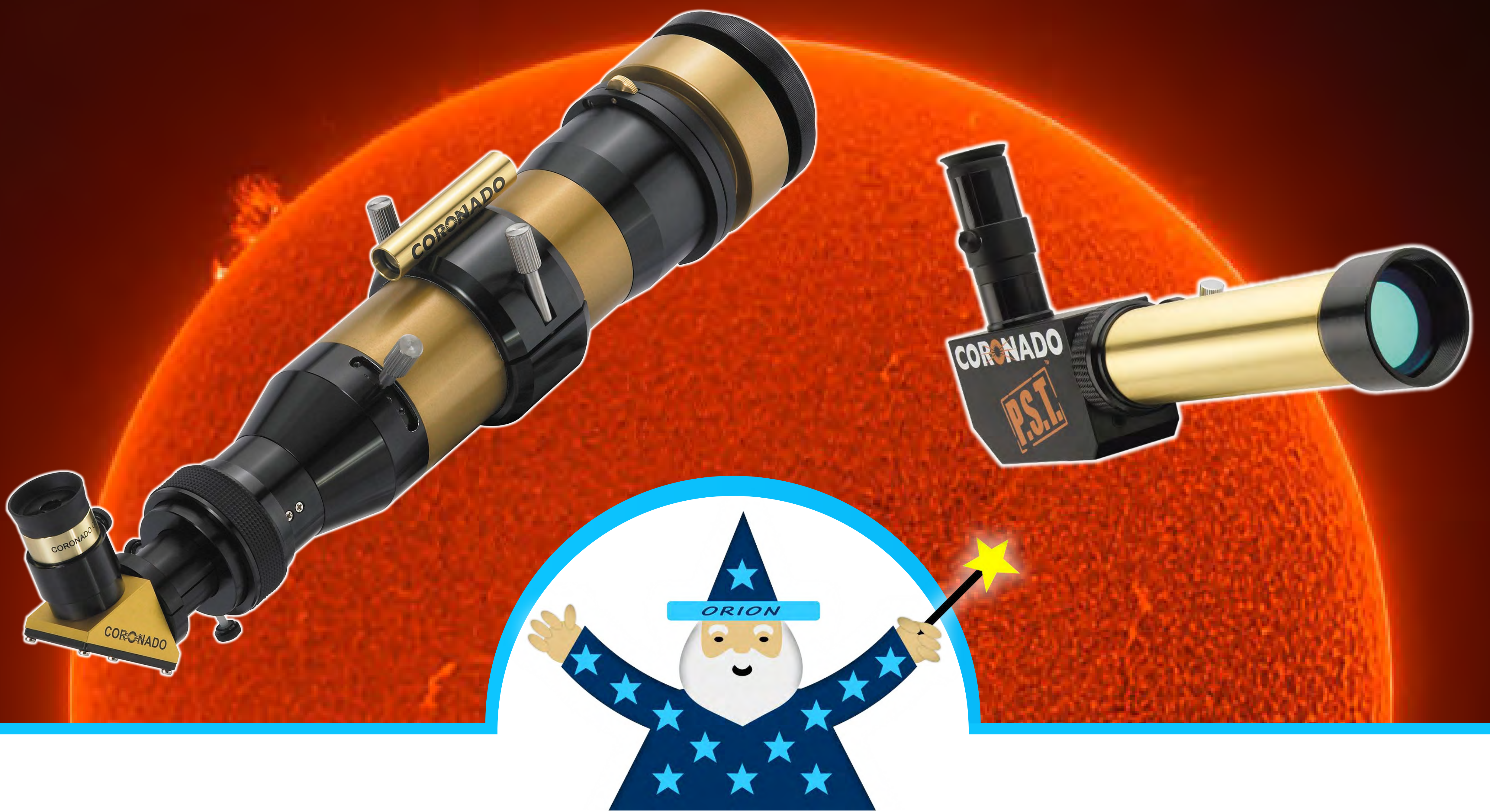
To help you decide which Telescope Sun & Moon Kit is best for you and your budget, use our Product Selection Wizard. It will ask you a few questions about what you’re looking for in a telescope as well as the views you’d like to experience. Then, Presto!, based on your answers the Wizard will serve up the perfect product solution to meet your needs and exceed your expectations. [Click here for the Product Selection Wizard!](#)

+ Advantages:

Complete telescope packages geared toward beginners; high-magnification views of eclipse phenomena; multiple magnification options; includes white-light Sun filter and Moon filter; during total eclipse totality phase, solar filter can be removed to see the corona, chromosphere, and prominences; use for general astronomical viewing throughout the year (some for daytime terrestrial viewing as well); quality family time under the stars!

- Disadvantages:

Bulkier than binoculars; initial setup/assembly required; included white-light solar filter shows limited solar features and detail compared to H-alpha telescopes



Product Selection Wizard ▶

H-Alpha Solar Telescopes

Designed exclusively for safe, ultra high-resolution viewing of the Sun, hydrogen-alpha telescopes take solar viewing to the next level. “H-alpha” telescopes are refractor-type telescopes that use specialized filters that reject all light except that in a narrow portion of the electromagnetic spectrum around the red hydrogen-alpha wavelength, at 656 nanometers. With an H-alpha telescope, the Sun’s disk springs to life with mesmerizing phenomena and detail. You’re seeing the Sun’s chromosphere, the atmospheric layer just above the bright and (in normal light) overpowering photosphere. Spicules, shape-shifting prominences, snake-like filaments, fibrils, bright plages, and dramatic flares burst into view across the Sun’s disk through an H-alpha telescope. Surface “granulation” is also much better resolved in an H-alpha telescope than with white-light filters.

An H-alpha telescope will reveal incredible, ever-changing solar detail and phenomena year-round. During a total solar eclipse it will cut through the bright photosphere to show features on the chromosphere during the partial phases. During totality, however, H-alpha telescopes with built-in filters will block the view of the Sun’s white corona. But some H-alpha telescopes do have removable filters to allow use of the telescope as a normal refractor for night time astronomy.

H-alpha solar telescopes are typically sold as optical tube only, so you will need a telescope mount, which is sold separately, to support it. H-alpha solar telescopes come in a range of apertures and prices. If you need help in deciding which H-alpha telescope is right for you, use our Product Selection Wizard! It will ask you some questions and then provide the best choice to meet your needs and exceed your expectations.

[Click here for the Product Selection Wizard!](#) (and choose “Highly Specialized Solar Viewing to view H-alpha telescopes” when you reach the “Will you use a telescope to view more than the Sun?” question).

+ Advantages:

Shows phenomena on Sun’s chromosphere that can’t be seen with a regular telescope equipped with white-light filter; some models have removable H-alpha filters so the telescope can be used as a regular refractor for nighttime astronomy

- Disadvantages:

Expensive; usually sold as telescope tube only, which requires telescope mount/tripod (sold separately); prior telescope experience recommended; some models limited to solar viewing only; during totality phase of total solar eclipse, cannot see corona

Copyright © 2023 Optronic Technologies, Inc. All rights reserved.

No part of this guide may be reproduced, copied, modified or adapted, without the prior written consent of Orion Telescopes & Binoculars.

Image Credits

Page T0 (cover): NASA/Aubrey Gemignani

Page T1: Earth, NASA/NOAA/GSFC/Suomi NPP/VIIRS/Norman Kuring; Sun, NASA/SDO and the AIA, EVE, and HMI science teams

Page T2: Totality (widefield), NASA/Dominic Hart; Crescent Suns, Charley280, CC BY 3.0 via Wikimedia Commons

Page T3: Bailey’s Beads, NASA/Aubrey Gemignani; Diamond Ring, Rick Fienberg/TravelQuest Int’l/Wilderness Travel; Prominence, Andrew Santangelo; Mid-totality, Rick Fienberg/TravelQuest International

Page T4: H-alpha Sun, Richard Keele

Page PG0 (cover): NASA/Aubrey Gemignani

All other images: Orion/Meade