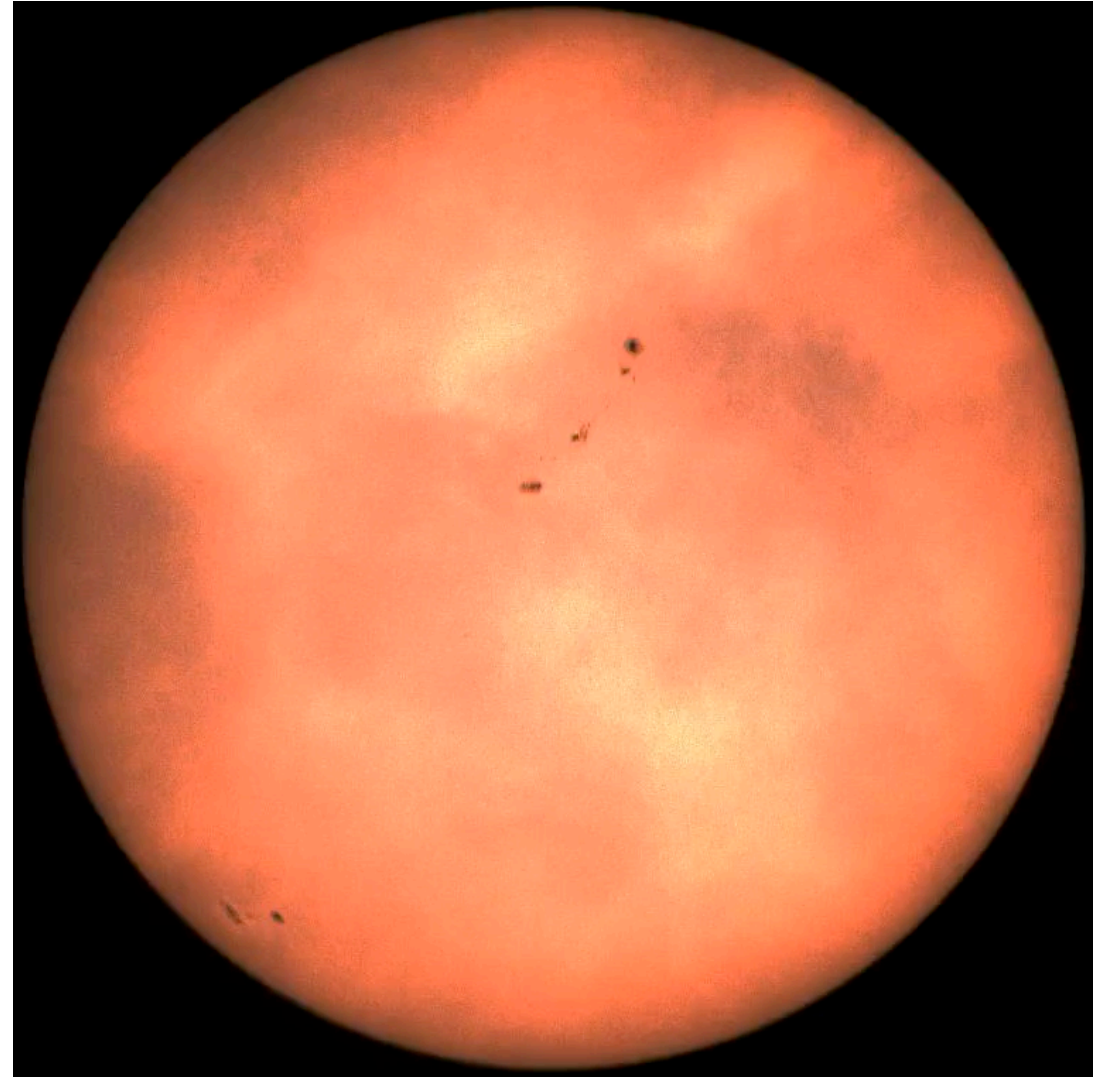


How to SAFELY view and photograph the upcoming solar eclipse.



Outline

- How to safely observe the eclipse: people and pets
- How to safely photograph the sun: smartphones and cameras
- Esoterica: IYKYK

Essential Safety Lesson:

Ultraviolet light (UV): bad for eyes

Infrared light (IR): bad for cameras

Injury to the retina, generally termed “retinal burns,” resulting in a loss of vision following observation of the sun, has been described throughout history. Even Socrates, in Plato’s *Phaedo* (Plato, 1892), discussed eclipse blindness (solar retinitis or eclipse scotoma) and suggested that a suitable precaution was to observe the eclipse by viewing the sun’s reflected image in water. As was discussed in Chapter 2, water reflects only 2% at normal incidence, so this recommendation could have the effect of looking at the sun through goggles having a 50-fold attenuation factor. Man-made optical radiation sources, comparable to the sun in luminance and capable of causing chorioretinal injury, have been developed chiefly in this century. The incidence of injury from man-made sources is no doubt far less than the incidence of eclipse blindness. Until recently it was felt that chorioretinal injury would not result from exposure to visible light in industrial operations. Indeed, this is still largely true, since the normal aversion response to high brightness light sources (the blink reflex and movement of the head and eyes away from the source) provides adequate protection from most bright visual sources. However,

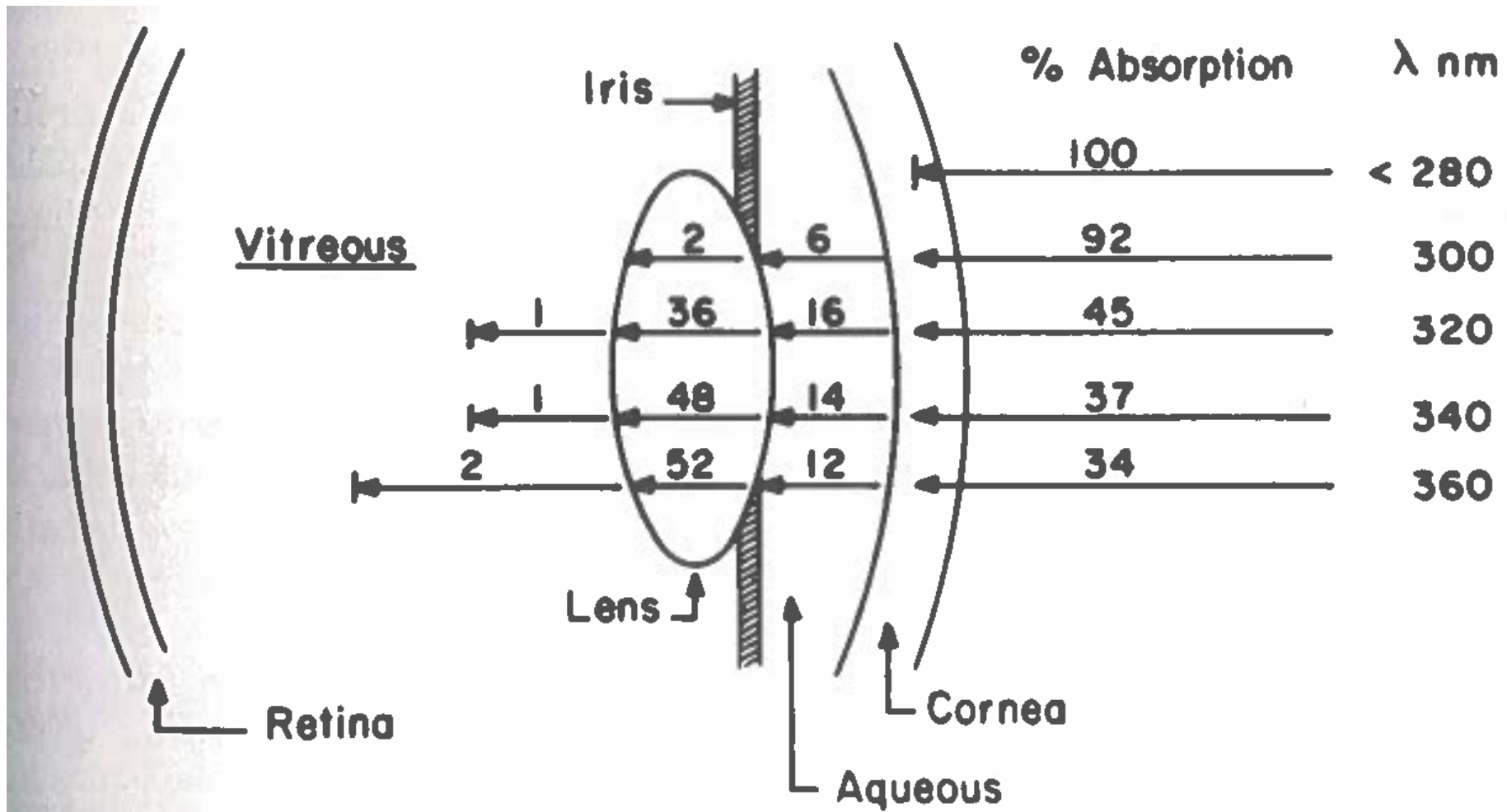


Figure 4-5. Schematic of absorption of ultraviolet radiation in the ocular media. Values represent the percent of ultraviolet radiation incident upon the corneal surface that are absorbed by various layers, redrawn from a figure by Matelsky, 1969. Based on data by Boettner and Wolter, 1962.

Comparison of light sources

Eye Protection: ISO 12312-2 Transmittance Requirements

Requirement	Value	Wavelength Range
Maximum transmittance (visible)	0.0032% (OD 4.5)	380-780 nm
Minimum transmittance (visible)	0.000061% (OD 6.2)	380-780 nm
Maximum transmittance (infrared)	3% (OD 1.5)	780-2000 nm

Note: fully darkened photographic film is no longer considered safe to use as an eclipse viewing aid.

Comparison of Transmittance Limits (%) of Solar & Welding Filters

Filter Type	Ultraviolet spectral range		Visible spectral range	Infrared spectral range
	280–315 nm	315–380 nm	400–700 nm	780–1400 nm
Solar ¹	0.0032	0.0032	0.0032	3
Welder's SN ² 12	0.0003	0.0012	0.0032	0.5
Welder's SN ² 13	0.0003	0.00044	0.0012	0.4
Welder's SN ² 14	0.00016	0.00016	0.00044	0.3

¹ Adapted from the ISO 12312-2:2015 standard. ² SN = Shade No. and is for arc-welding, not gas-welding, filters.

Welders' filters with shade numbers 12 to 14, as specified in the occupational eye and face protector standard ANSI Z87.1, are protective filters that are suitable for electric arc welding.

Arc-welders' filters should not be used in conjunction with telescopes (in front of the objective) for observation of the Sun, as their relatively poor optical quality will result in blurred images.

About the ISO 12312-2 Standard for Solar Viewers

The [International Organization for Standardization, or ISO](#) is a nongovernmental organization composed of members from the national standards bodies of 167 countries. (Here in the U.S., our national standards body is the American National Standards Institute, or ANSI.) As ISO puts it, a standard "describes the best way of doing something."

When it comes to observing the Sun, the relevant international standard for this activity is [ISO 12312-2:2015](#), "Eye and face protection — Sunglasses and related eyewear — Part 2: Filters for direct observation of the Sun." ISO 12312-2 specifies the properties that a solar viewer should have in order to protect your eyes from injury and provide a comfortable view.

ISO standards are not laws, though governments sometimes base laws on ISO standards. This means it is not necessarily *illegal* for a product to fail to meet the requirements of an ISO standard. But it may be *inadvisable* to buy or use such a product, as failure to meet the requirements of an applicable standard likely means the product is not genuinely safe, not well suited to its purpose, or both.

Solar filters meant for use with camera lenses, binoculars, or telescopes are not covered by ISO 12312-2.

<https://eclipse.aas.org/eye-safety/iso12312-2>



SOLAR TELESCOPE FILTER: The dual-lens, non-removable glass solar filter conforms to ISO 12312-2:2015(E), Filters for Direct Observation of the Sun.

Pet vision safety



<https://www.nwfdailynews.com/story/news/2017/08/18/blinded-by-light-are-pets-safe-during-eclipse/19418896007/>

<https://www.ibtimes.com/solar-eclipse-2017-should-cats-dogs-wear-eclipse-glasses-eye-protection-2558861>





<https://time.com/4882733/total-solar-eclipse-animals-react/>

Smartphone Cameras:

Placing a ISO 12312-2 compliant filter over the lens will protect your camera

Some apps let you have more control over the camera settings, for example:

- ProCam X
- Manual Camera DSLR
- Camera FV-5

(Note: I don't know how well these work)

Smartphone suggestions from CSU Prof. Mark Slankard, Art & Design

Smart phones don't have true apertures - they do have AN aperture, but it's fixed. Any adjustments in "aperture" on a smart phone do not affect the amount of light. It only affects to (digitally) blur the background (or maybe foreground too?) based on scene, object, and face recognition.

Speaking of video, that might be the best option for smart phone users. The exposure will compensate in real time. Although auto exposure is going to WANT to overexpose during totality, it won't be able to because the shutter speed will have a floor to record the video.

Also, thinking of the way you hold/view smart phones for images, it might be awkward to hold the phone up and get sharp still images. It would be challenging to have the phone over your head, looking up, and not look directly at the sun. I haven't tried this except as a thought experiment. Using a tripod would also be awkward.

After thinking about it, I might recommend someone using a smart phone simply lay their phone down while recording video, camera face up, tilted toward the sun, if necessary. Let it record and experience the eclipse first hand. There will be lots of better photos and video of it after the fact.

Some basics

Fully automated may be easier, but manual control is more effective.

- You should be able to control the shutter speed and lens aperture (f/#).
- Autofocus sometimes fails; set-n-forget is preferable.
- Turn off your flash

- PRACTICE
- PRACTICE
- PRACTICE (sunsets, moonlit landscapes)

More basics

- Bring extra batteries
- Bring extra memory cards
- PRACTICE
- PRACTICE
- PRACTICE (sunsets, moonlit landscapes)

Wide angle



<https://whenisthenexteclipse.com/how-to-video-the-2019-total-solar-eclipse/>

Timelapse video



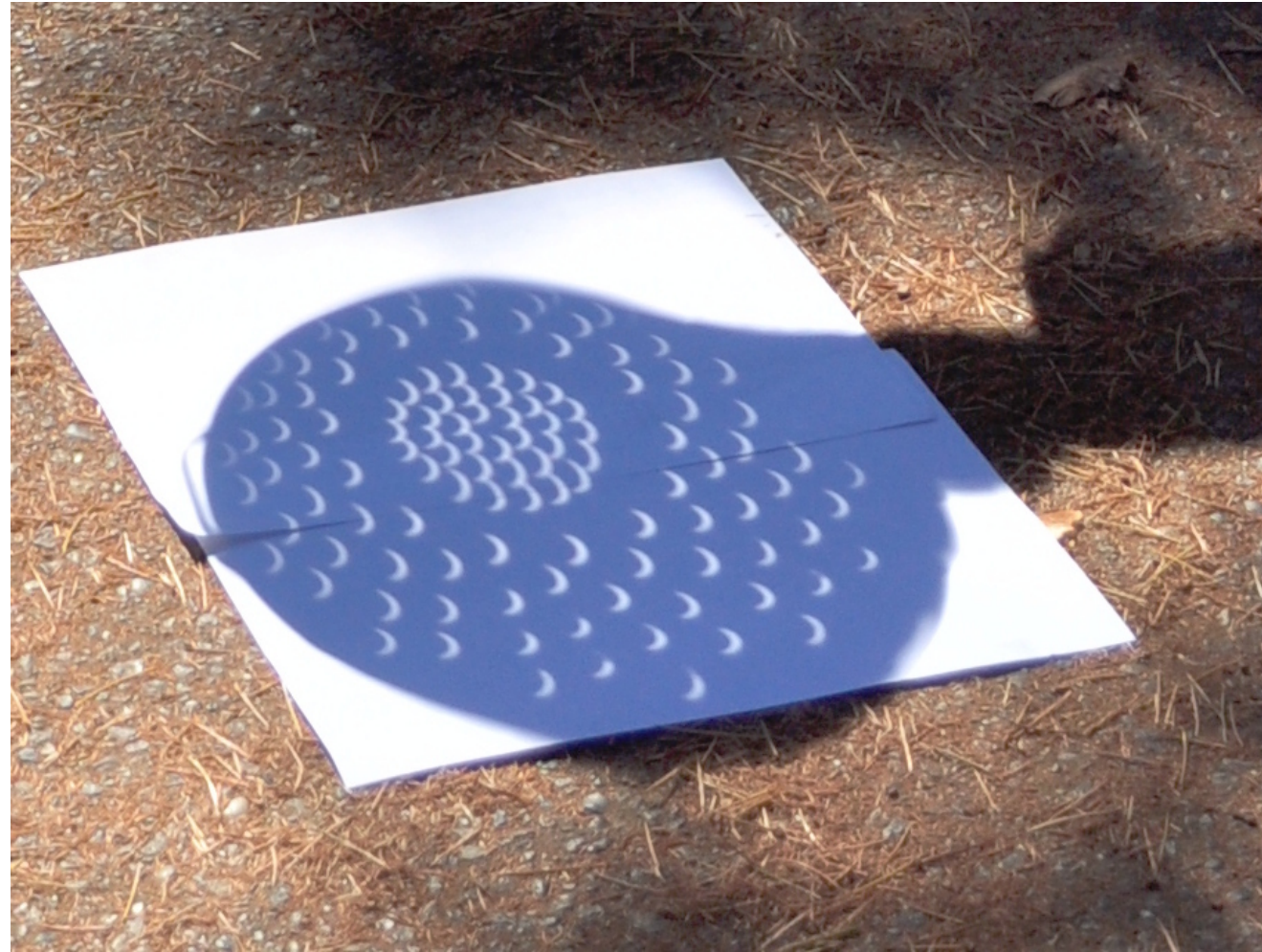
Felipe Trueba, Imagen de Chile
via Reuters
Timelapse



Play with shadows



<https://www.flickr.com/photos/claraj/35910734834>



[https://commons.wikimedia.org/wiki/File:Colander_eclipse_viewing_05_\(cropped\).jpg](https://commons.wikimedia.org/wiki/File:Colander_eclipse_viewing_05_(cropped).jpg)



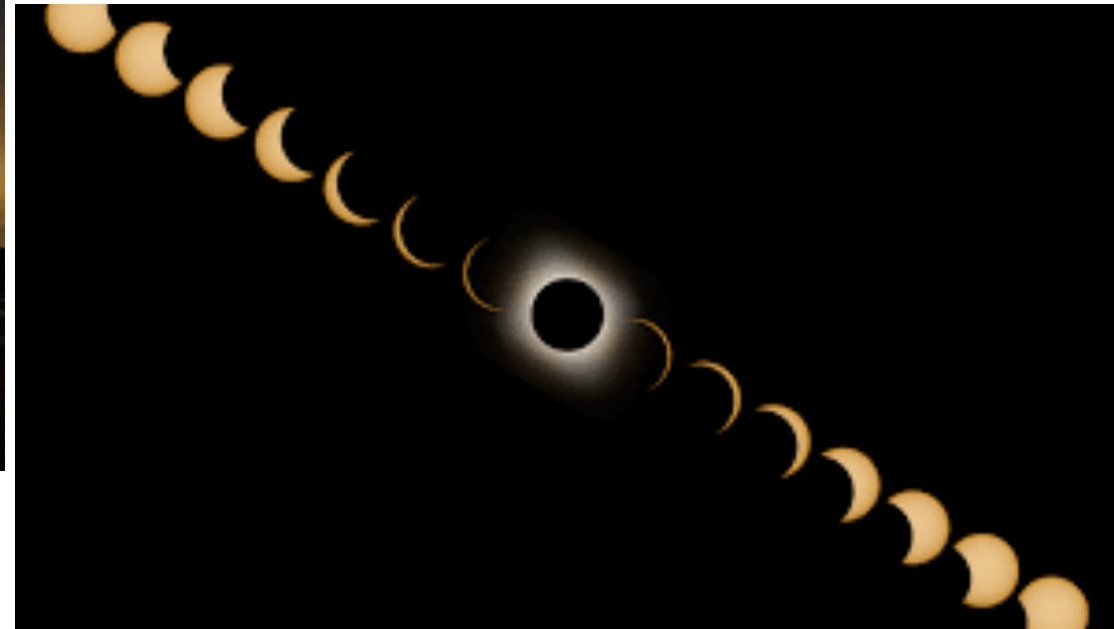
<https://www.latimes.com/science/sciencenow/la-sci-sn-eclipse-watching-tips-20170815-htm1story.html>



<https://www.livescience.com/60207-how-animals-responded-to-the-eclipse.html>

Composited images

<https://www.nikonusa.com/en/learn-and-explore/a/tips-and-techniques/capturing-and-compositing-lunar-solar-eclipses.html#>



<https://www.mcnhealthcare.com/solar-eclipse-safety/>



www.mikemezphotography.com

<https://www.nikonusa.com/en/learn-and-explore/a/tips-and-techniques/capturing-and-compositing-lunar-solar-eclipses.html>

Crowd reaction shots



<https://www.space.com/most-crowded-places-for-total-solar-eclipse-april-2024>

<https://www.photographingspace.com/photograph-total-solar-eclipse/>

<http://www.mreclipse.com/Totality2/TotalityCh12-1.html>

Solar Eclipse Exposure Guide

ISO	f/Number									
25	1.4	2	2.8	4	5.6	8	11	16	22	32
50	2	2.8	4	5.6	8	11	16	22	32	44
100	2.8	4	5.6	8	11	16	22	32	44	64
200	4	5.6	8	11	16	22	32	44	64	88
400	5.6	8	11	16	22	32	44	64	88	128
800	8	11	16	22	32	44	64	88	128	176
1600	11	16	22	32	44	64	88	128	176	

Eclipse Feature	Q	Shutter Speed								
Partial ¹ - 4.0 ND	11	—	—	—	1/4000	1/2000	1/1000	1/500	1/250	1/125
Partial ¹ - 5.0 ND	8	1/4000	1/2000	1/1000	1/500	1/250	1/125	1/60	1/30	1/15
Baily's Beads ²	11	—	—	—	1/4000	1/2000	1/1000	1/500	1/250	1/125
Chromosphere	10	—	—	1/4000	1/2000	1/1000	1/500	1/250	1/125	1/60
Prominences	9	—	1/4000	1/2000	1/1000	1/500	1/250	1/125	1/60	1/30
Corona - 0.1 Rs	7	1/2000	1/1000	1/500	1/250	1/125	1/60	1/30	1/15	1/8
Corona - 0.2 Rs ³	5	1/500	1/250	1/125	1/60	1/30	1/15	1/8	1/4	1/2
Corona - 0.5 Rs	3	1/125	1/60	1/30	1/15	1/8	1/4	1/2	1 sec	2 sec
Corona - 1.0 Rs	1	1/30	1/15	1/8	1/4	1/2	1 sec	2 sec	4 sec	8 sec
Corona - 2.0 Rs	0	1/15	1/8	1/4	1/2	1 sec	2 sec	4 sec	8 sec	15 sec
Corona - 4.0 Rs	-1	1/8	1/4	1/2	1 sec	2 sec	4 sec	8 sec	15 sec	30 sec
Corona - 8.0 Rs	-3	1/2	1 sec	2 sec	4 sec	8 sec	15 sec	30 sec	1 min	2 min

Instructions

Choose the ISO speed in the upper left column. Next, select the f/number of the lens or telescope (on same line as ISO). Finally, drop straight down to the bottom table to get the correct exposure for each feature of the solar eclipse.

Esoterica

- HDR/image stacking
- Tracking (automated camera motion)
- 10-stop filters
- White balance

HDR/Image Stacking

Computational techniques that compress the dynamic range acquired via multiple images and tone-map the result



<https://www.photographingspace.com/author/alexc/>

10-stop filters

Confusion between stops and OD

1 stop = half intensity

OD 1 = one-tenth intensity

10 stops = OD 3



- Autoexposure can fail depending on exposure metering and solar filter.
- Auto Color balance can fail due to solar filter
- Bracketing may not work (objects move during and between exposures)
- PRACTICE
- PRACTICE
- PRACTICE (sunsets, moonlit landscapes)



Light Gathering Power: 51x the naked eye
18x magnification

Combination is 1.5 stops faster than naked eye



Light Gathering Power: 36x the naked eye
10x magnification

Combination is 1.8 stops faster than naked eye

EclipSmart solar products feature Solar Safe filter technology—the ultimate protection from harmful solar radiation, including IR and UV light, plus 99.999% of visible light. Celestron Solar Safe filter technology is safe for direct observation of the Sun.

OD 5, 1.6 stops slower than recommended



SAFE TO USE

EclipSmart optical products feature Solar Safe filter technology—the ultimate protection from harmful solar radiation, including IR and UV light, plus 99.999% of visible light. Celestron Solar Safe filter technology is safe for direct observation of the Sun.

A Warning About Warning Messages

In the days and weeks before a solar eclipse, there are often news stories and announcements in the media warning about the dangers of looking at the eclipse. Unfortunately, despite the good intentions behind these messages, they frequently contain misinformation and may be designed to scare people from viewing the eclipse at all. This tactic may backfire, however, particularly when the messages are intended for students. A student who heeds warnings from teachers and other authorities not to view the eclipse because of the danger to vision, and who later learns that other students did see it safely, may feel cheated out of the experience. Having now learned that the authority figure was wrong on one occasion, how is this student going to react when other health-related advice, such as about drugs, acquired immunodeficiency syndrome (AIDS), or smoking is given (Pasachoff 2001)? Misinformation may be just as bad, if not worse, than no information.

Thanks for listening!

Remember:

- Watch the eclipse and enjoy!
- Watch the eclipse and enjoy!



- Don't forget: Watch the eclipse and enjoy!