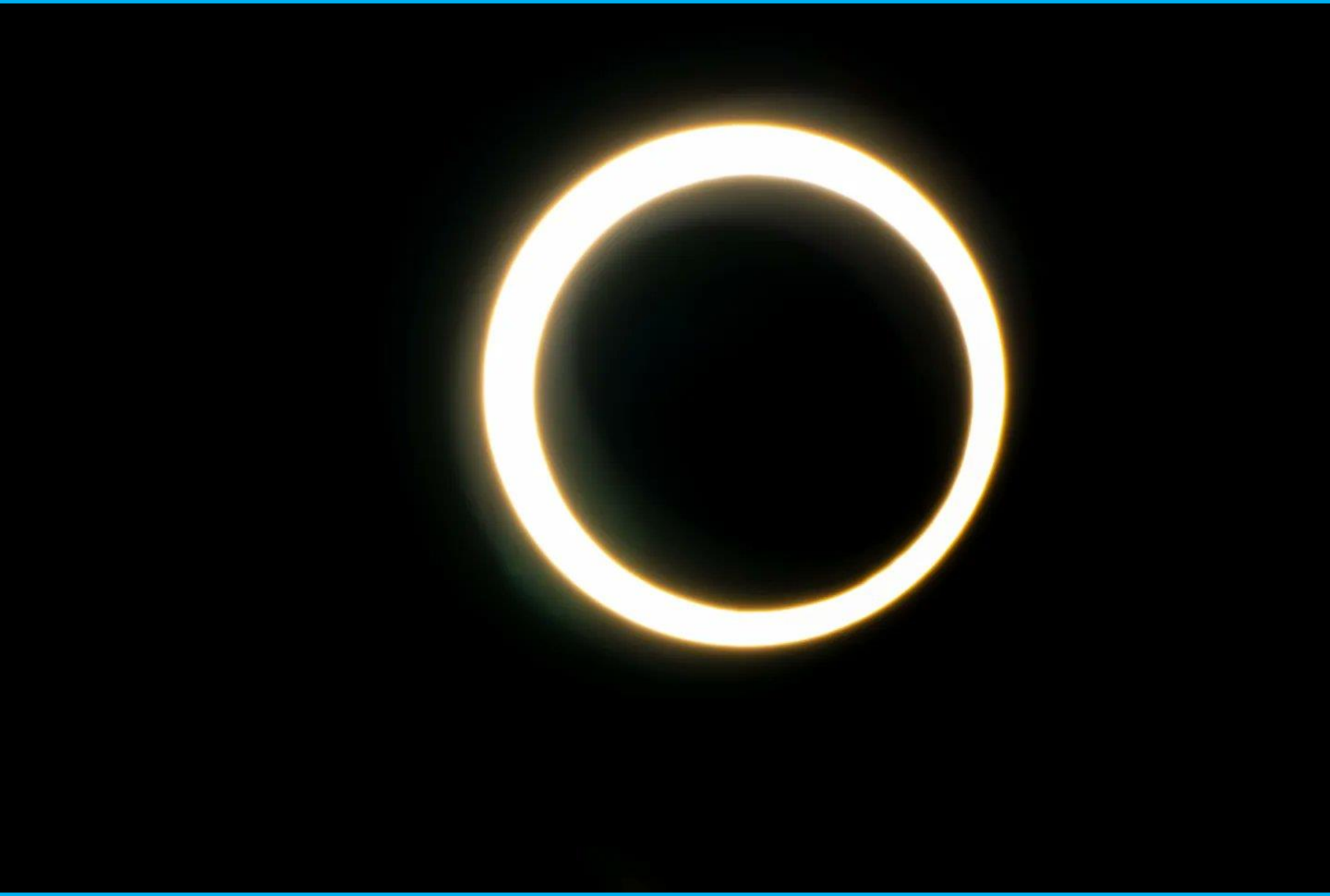
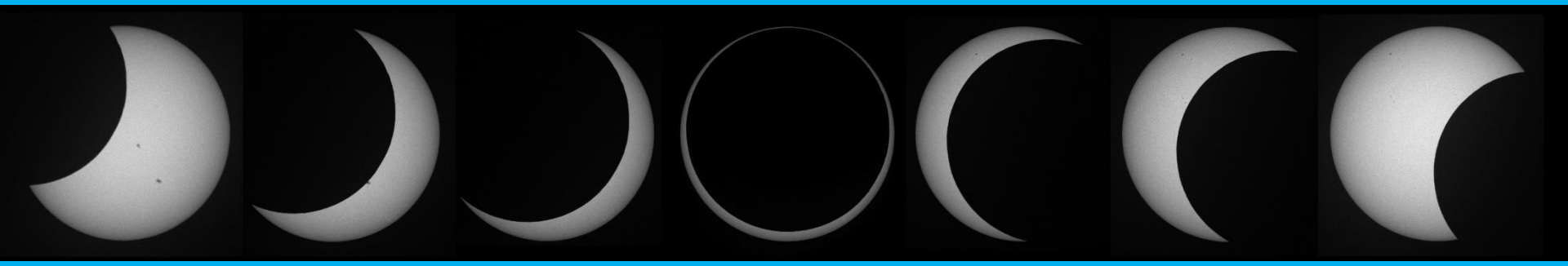
Get Ready for the April 8, 2024 Total Solar Eclipse

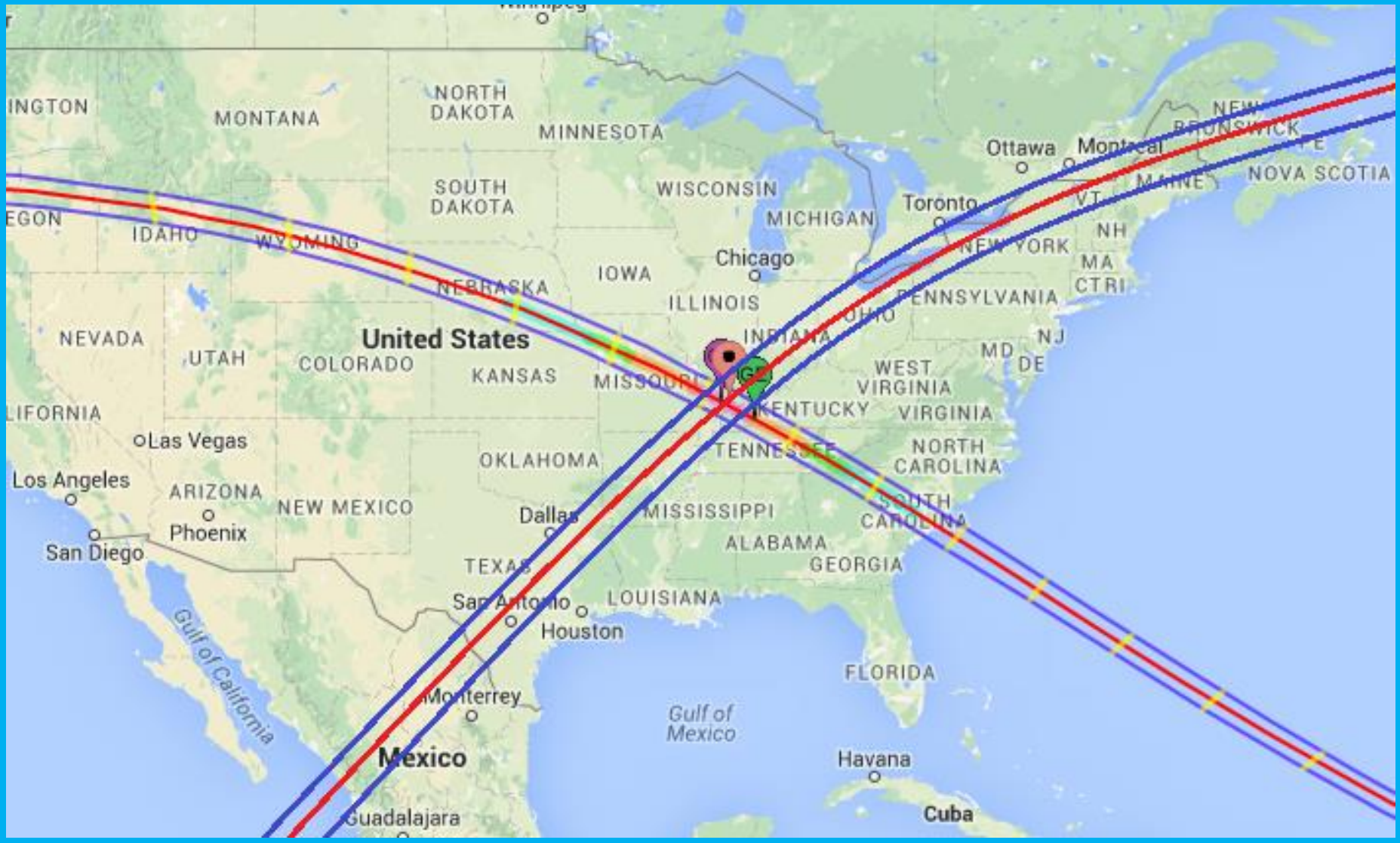
Dennis Schatz
Past President - NSTA
Senior Fellow – Institute for Learning Innovation


Tuscany

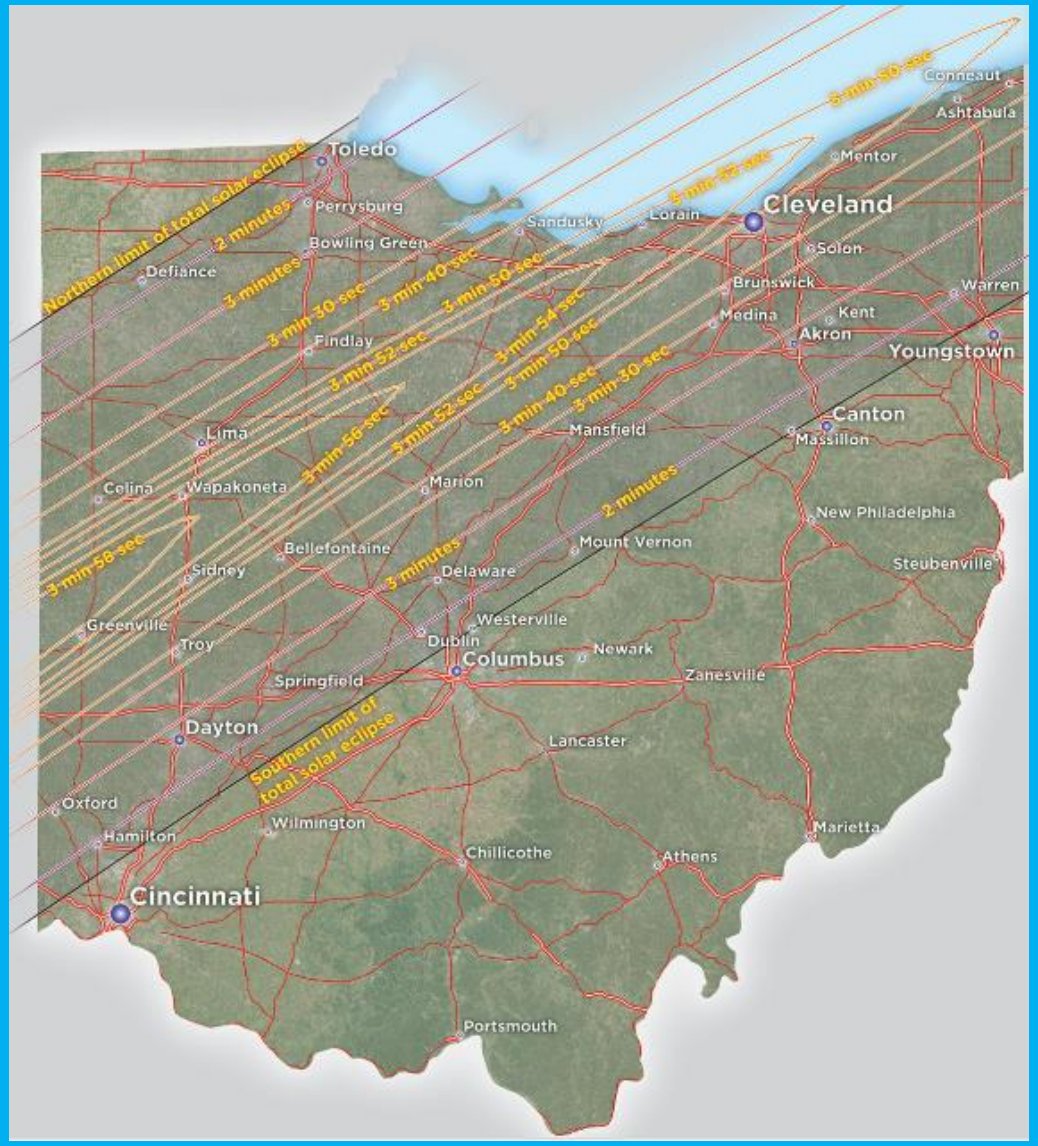


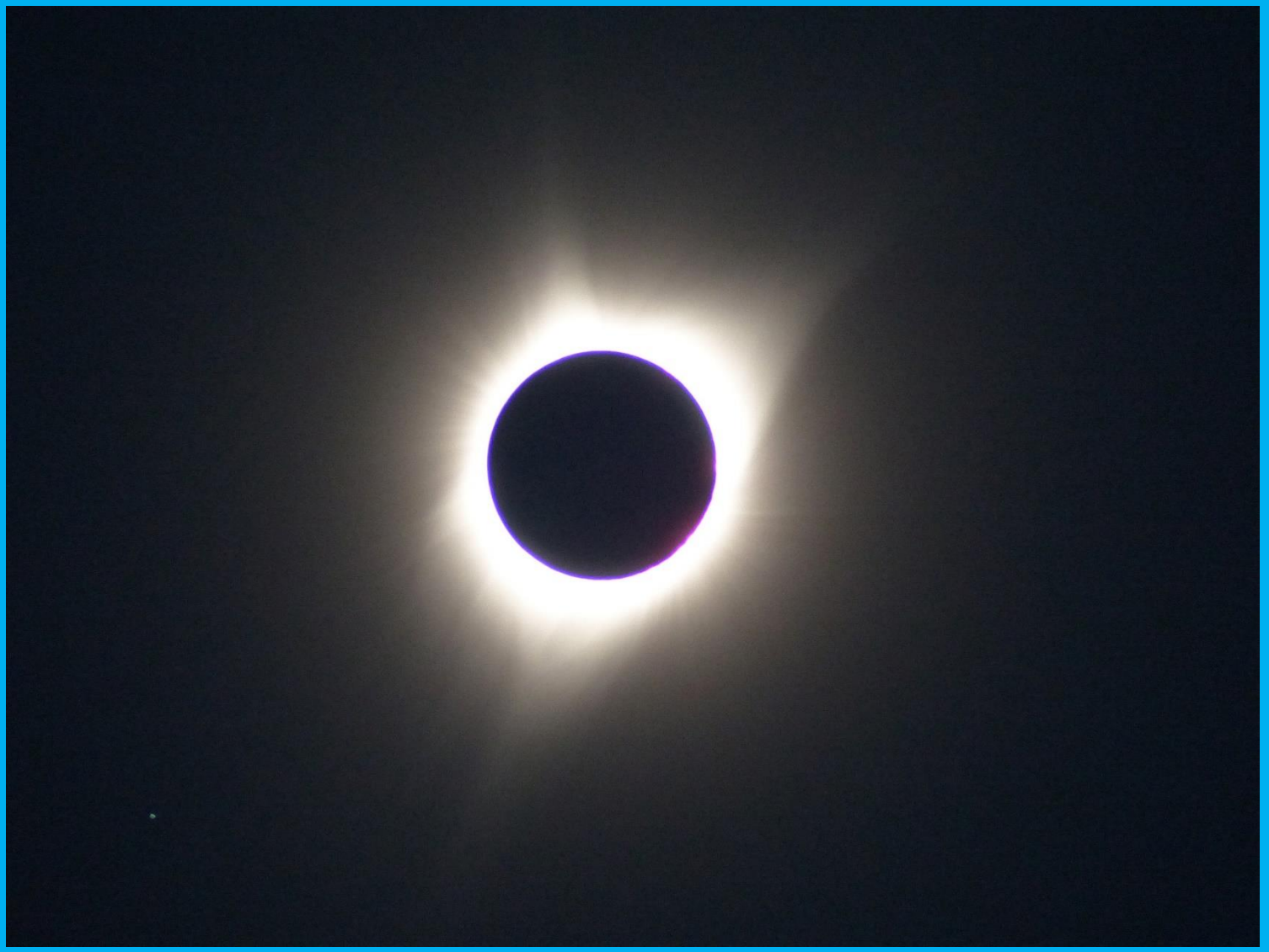


April 8, 2024 Total Solar Eclipse

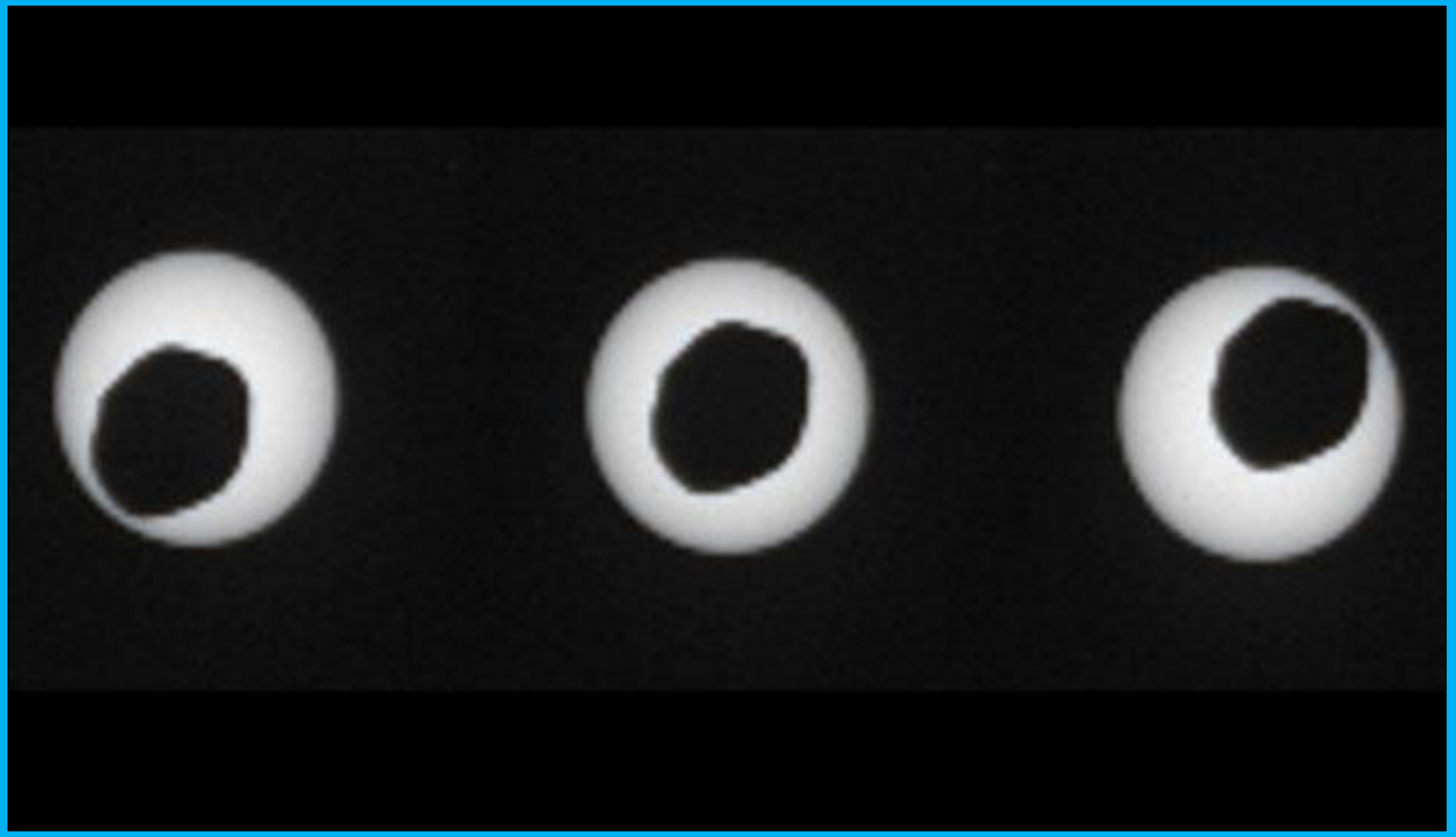


April 8, 2024 Total Solar Eclipse in Ohio





No Other Planet in the System Experiences A Similar Total Eclipse



D. *Ritual for the Observances of Eclipses*

As the eclipse begins, the . . . priest shall light the torch, and attach it to the altar . . .

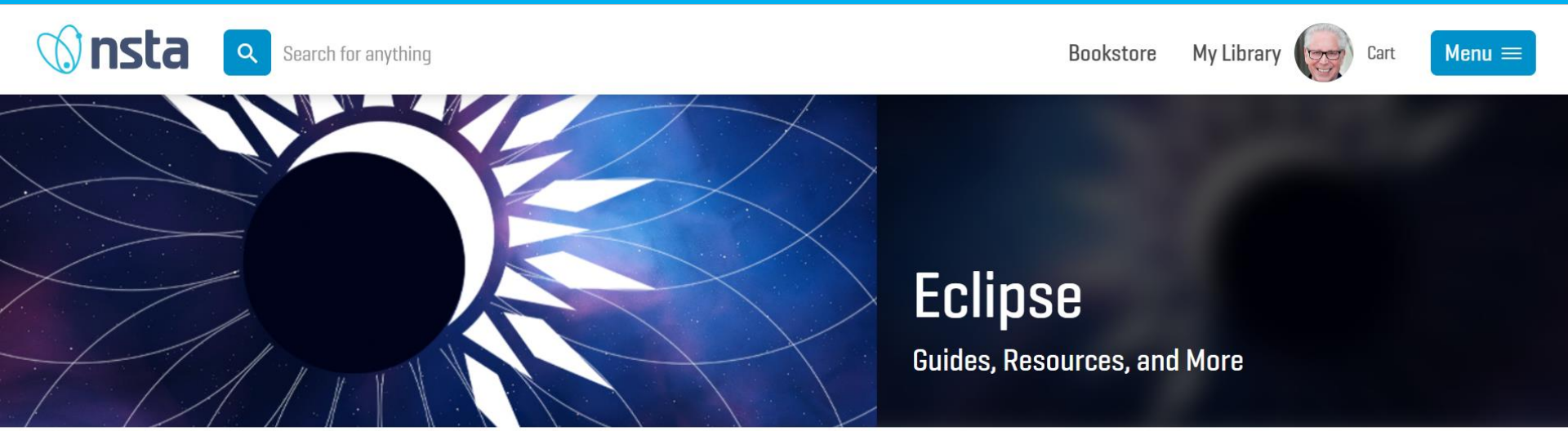
As long as the eclipse lasts, the fire upon the altar thou shalt not remove.

A dirge for the fields thou shalt intone; a dirge for the streams that the water shall not devastate, thou shalt intone . . .

As long as the eclipse lasts, the people of the land shall remove their headgear; they shall cover their heads with their garments.

That catastrophe, murder, rebellion, and the eclipse approach not . . . they shall cry aloud; for a lamentation they shall send up their cry. . . .

NSTA Solar Eclipse Resource Website



Two Beautiful Eclipses Coming to North America!

An Annular Eclipse in 2023 and a Total Eclipse in 2024

Kick-start your planning for the upcoming eclipse events. Solar Eclipses are exciting astronomical events that can provide a great opportunity for teachers and students to learn about the science of astronomy and explore the beauty of the natural world. Check out the following collection of resources and teaching materials to use in the classroom.

https://www.nsta.org/eclipse

Educator and Administrator Guides
Family/Friends Handout

The Great American Annular Eclipse of the Sun

Saturday, October 14, 2023

An Information Sheet by astronomers/educators Dennis Schatz & Andrew Fraknoi

Distributed courtesy of the National Science Teaching Association

On Oct. 14, 2023, there will be a dramatic annular eclipse visible to people on a narrow path from Oregon gazing southeast to Texas (see map below). A partial eclipse of the Sun will be visible to everyone in North and Central America, with a bigger "bite" taken out of the Sun the closer you are to the path of the annular eclipse.

In this kind of eclipse, the Moon gets in front of the Sun, but it is too far away and, therefore, too small to cover it completely, leaving an annulus (or "ring of fire") around the dark disk of the Moon.

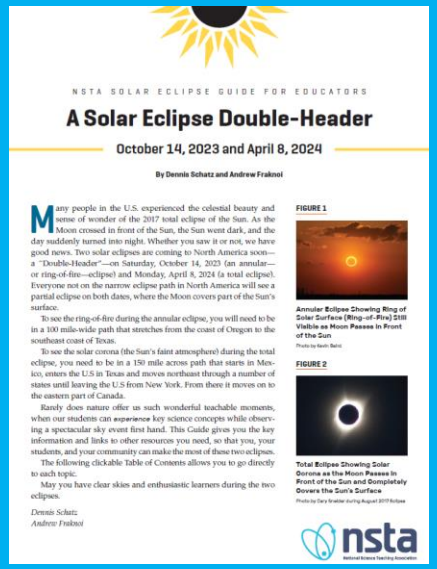
We talked about the annular eclipse in class, so your child should be able to tell you more about what to expect. On the next page is the information for what will happen in our location.

Most people in North America will see a partial eclipse.

Only those people in the narrow path of annularity will see the annular eclipse.

The path of the annular eclipse. (Credit: Xavier Jubier)

25



NSTA SOLAR ECLIPSE GUIDE FOR EDUCATORS

A Solar Eclipse Double-Header

October 14, 2023 and April 8, 2024

By Dennis Schatz and Andrew Fraknoi

Many people in the U.S. experienced the celestial beauty and sense of wonder of the 2017 total eclipse of the Sun. As the Moon crossed in front of the Sun, the Sun went dark, and the day suddenly turned into night. Whether you saw it or not, we have good news. Two solar eclipses are coming to North America soon—a "Double-Header"—on Saturday, October 14, 2023 (an annular—or ring-of-fire—eclipse) and Monday, April 8, 2024 (a total eclipse). Everyone not on the narrow eclipse path in North America will see a partial eclipse on both dates, where the Moon covers part of the Sun's surface.

To see the ring-of-fire during the annular eclipse, you will need to be in a 100 mile-wide path that stretches from the coast of Oregon to the southeast coast of Texas.

To see the solar corona (the Sun's faint atmosphere) during the total eclipse, you need to be in a 150 mile across path that starts in Mexico, enters the U.S in Texas and moves northeast through a number of states until leaving the U.S from New York. From there it moves on to the eastern part of Canada.

Randy does nature offer us such wonderful teachable moments, when our students can *experience* key science concepts while observing a spectacular sky event first hand. This Guide gives you the key information and links to other resources you need, so that you, your students, and your community can make the most of these two eclipses.

The following clickable Table of Contents allows you to go directly to each topic.

May you have clear skies and enthusiastic learners during the two eclipses.

Dennis Schatz
Andrew Fraknoi

FIGURE 1

Annular Eclipse Showing Ring of Solar Surface (Ring-of-Fire) Still Visible as Moon Passes in Front of the Sun

Photo by Keith Baird

FIGURE 2

Total Eclipse Showing Solar Corona as the Moon Passes in Front of the Sun and Completely Covers the Sun's Surface

Photo by Gary Kraisler during August 2017 Eclipse

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AAS AMERICAN ASTRONOMICAL SOCIETY

Annular solar eclipse October 14, 2023

Total solar eclipse April 8, 2024

Solar Eclipse Double-Header in October 2023 and April 2024

What School Administrators and Other Education Leaders Need to Know

Many people in the U.S. experienced the beauty and sense of wonder of the 2017 total solar eclipse—when the Moon crossed in front of the Sun, The Sun went dark, and the day turned into night. Now is the time to prepare for the next solar eclipses in North America—a "Double-Header" on Saturday, October 14, 2023 (an annular—or ring of fire—eclipse) and Monday, April 8, 2024 (a total eclipse). Randy does nature offer us such clear teachable moments, when our students can experience key science concepts while observing a spectacular celestial event first hand.

In 2017, many administrators were unprepared when their science teachers asked to take students outside to view the eclipse. So for the upcoming eclipses, we've prepared this document to give you the background you need to help your teachers make the two eclipses an unforgettable learning experience.

Annular eclipse showing ring of solar surface (ring-of-fire) still visible as Moon passes in front of the Sun.

Photo by Keith Baird

Total eclipse showing solar corona as the Moon passes in front of the Sun and completely covers the Sun's surface

Photo by Gary Kraisler during August 2017 Eclipse

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SOLAR SCIENCE

EXPLORING SUNSPOTS, SEASONS, ECLIPSES, AND MORE

Dennis Schatz
Andrew Fraknoi

NSTApress
National Science Teachers Association

Key Features Throughout the Book

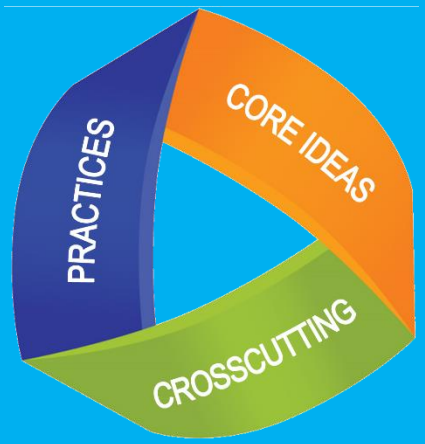
1. Aligned with the Framework for K-12 Science Education and the Next Generation Science Standards (NGSS)
2. Uses the BSCS 5E approach to organizing student experience around each topic –Engage, Explore, Explain, Elaborate, Evaluate
3. Indicates connections to the language arts and mathematics standards in the Common Core State Standards
4. Includes resources to provide interdisciplinary experiences.

Incorporates the three key dimensions of effective science learning from the Framework for K-12 Science Education.

1. **Disciplinary Core Ideas** (DCIs) – The most important science and engineering ideas that students should know.

2. **Science and Engineering Practices** (SEPs) – behaviors that students need to investigate and build models and theories about the natural world.

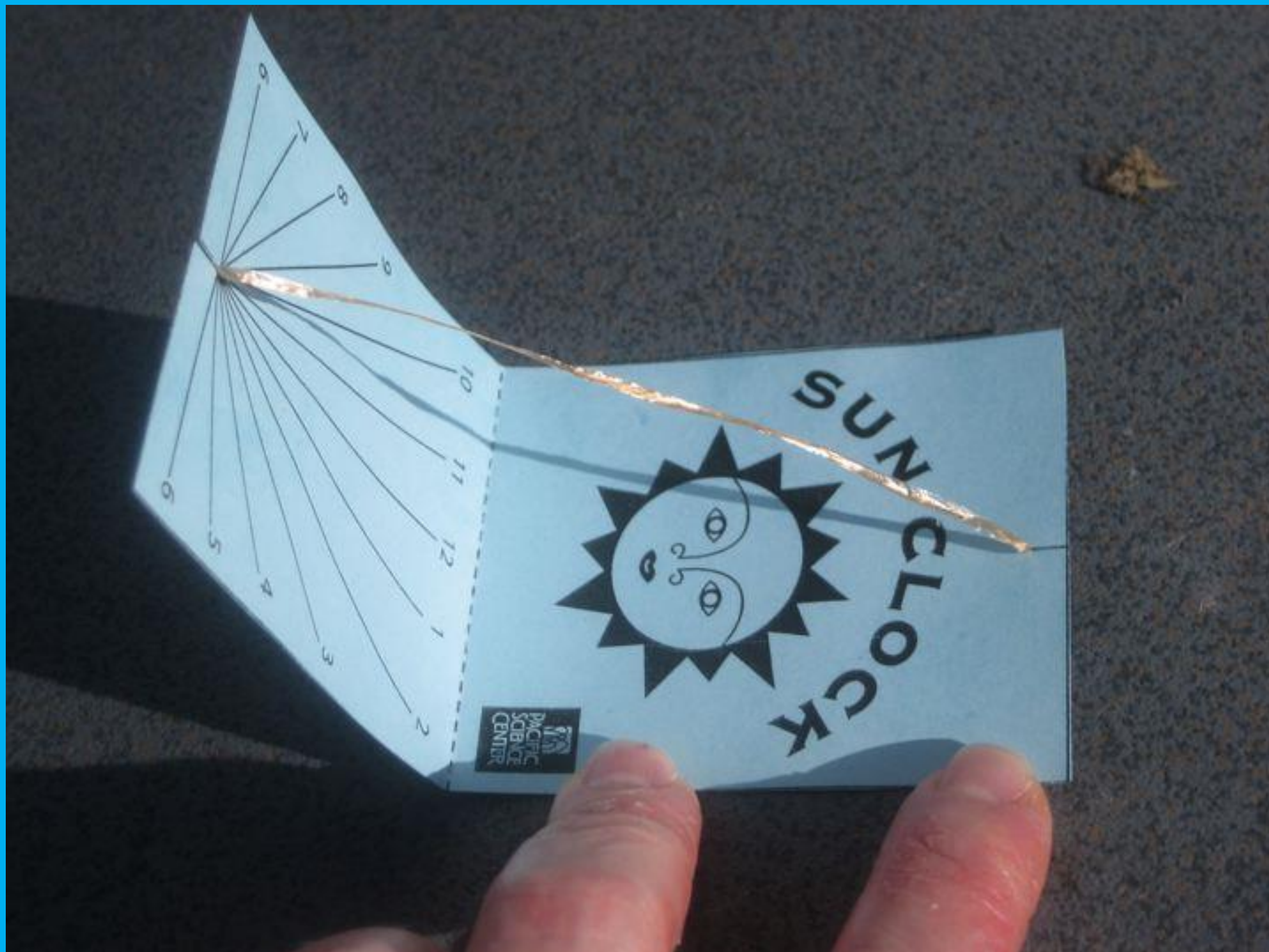
3. **Crosscutting Concepts** (CCCs) – Science concepts that have application across all domains of science.



Provides Examples of Three-Dimensional Learning

- Interweaves the dimensions, so students see them as a connected whole.
- Not every individual activity lends itself to incorporating all three dimensions.
- It is only when you look at a sequence of learning experiences that one can identify effective ways to incorporate 3D Learning.

CONTENTS


SUN CLOCK
PACIFIC SCIENCE CENTER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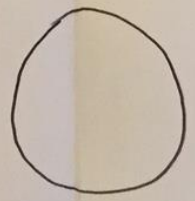
March 22

gnomon = 22cm tall
(standard time)



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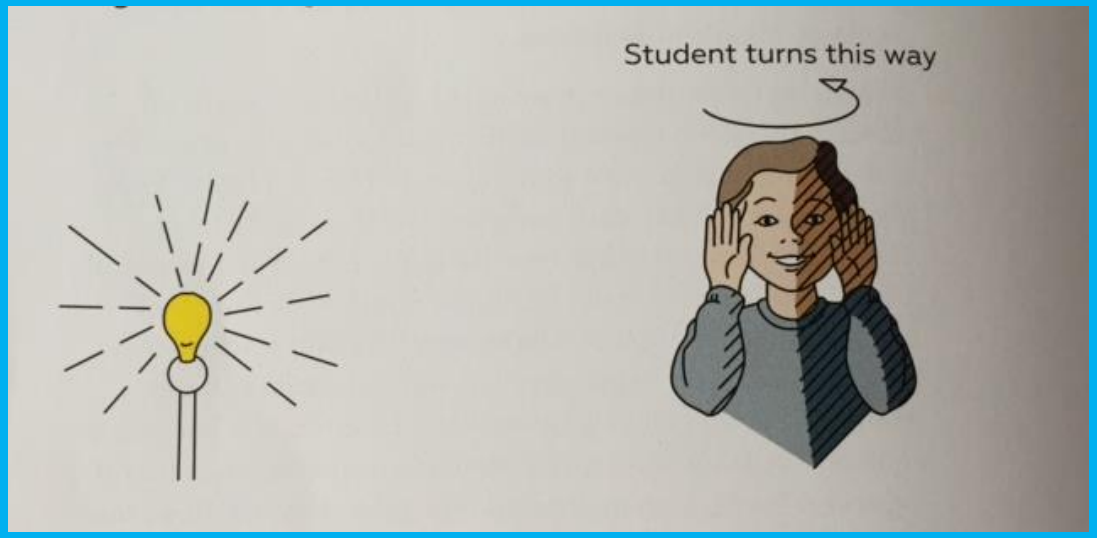
Modeling Relationship Between Earth and Sun

Students now develop their modeling skills using a simple model of the Earth and Sun



CHAPTER 2 — 67

Understanding and Tracking the Annual Motion of the Sun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March 22

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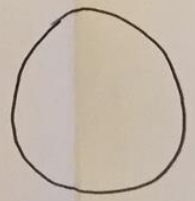

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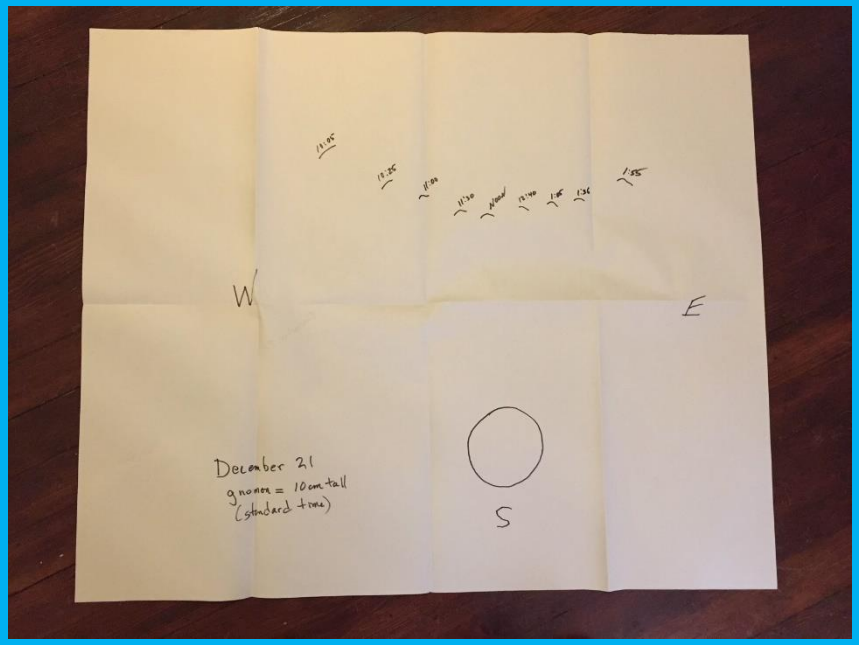
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December 21
gnomon = 10cm tall
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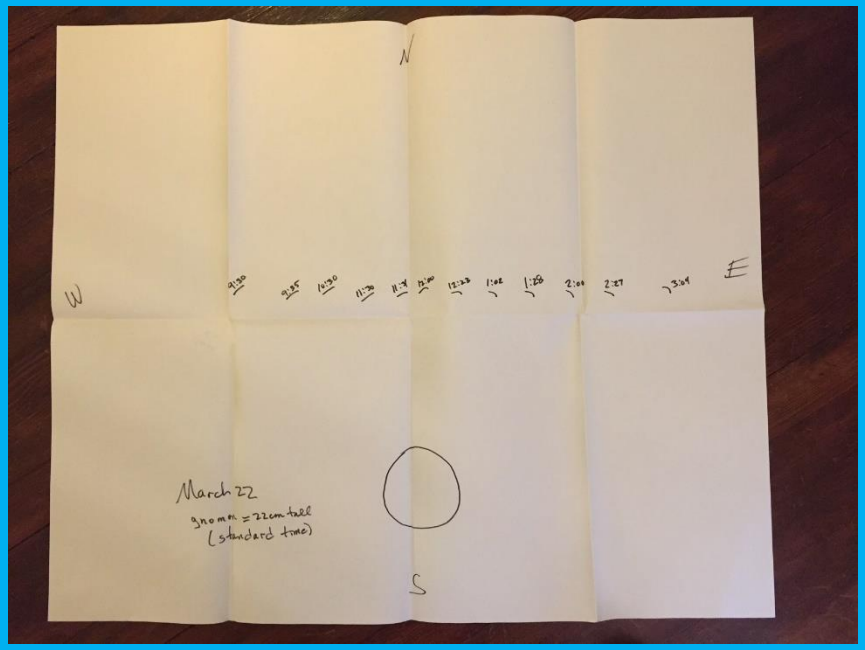
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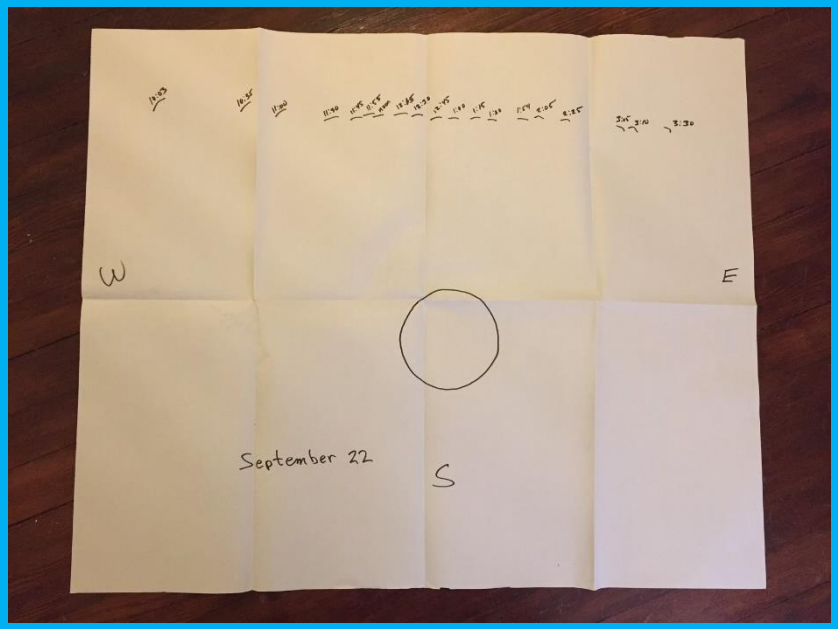
March 22
gnomon = 22cm tall
(standard time)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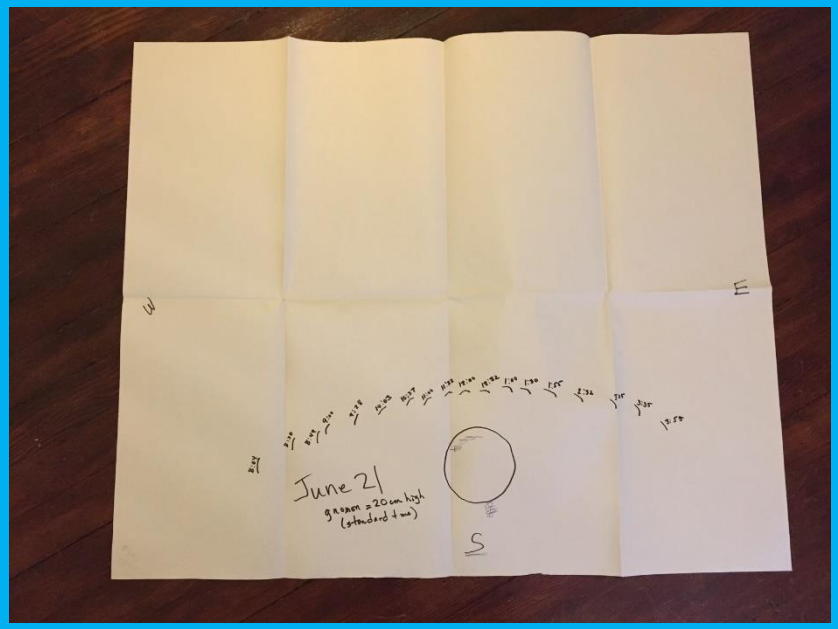
September 22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June 21
gnomon = 20cm high
(standard time)


globemaster
12 INCH DIAMETER GLOBE
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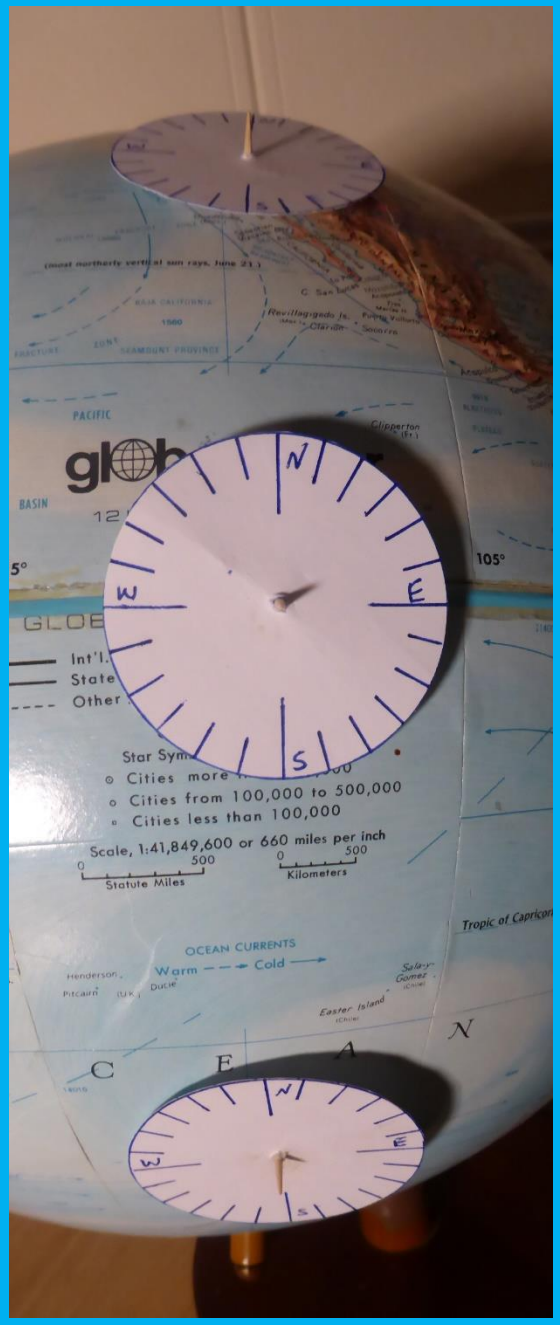
POLYNESIA
Tropic of Capricorn
OCEAN


PACIFIC
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Cities less than 100,000
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Warm
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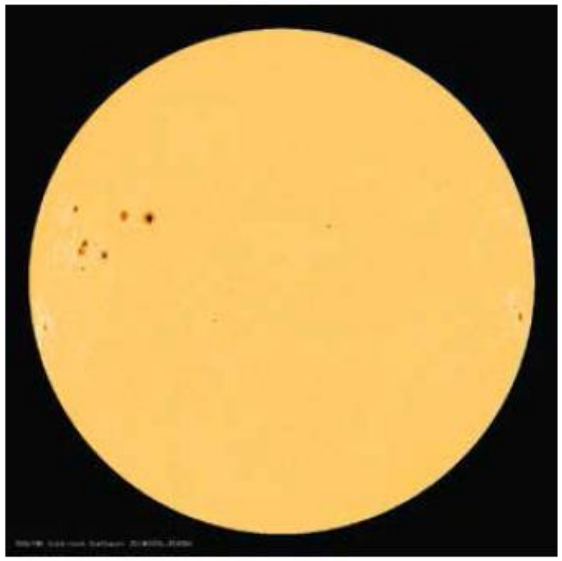
Easter Island
Tropic of Capricorn

Solar Activity and Space Weather

SHEET 1: IMAGES OF THE SUN FROM THE SOLAR DYNAMICS OBSERVATORY IN MAY 2014



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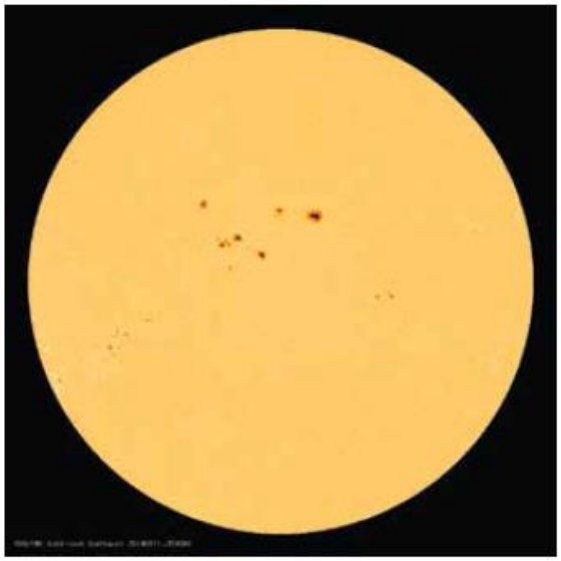

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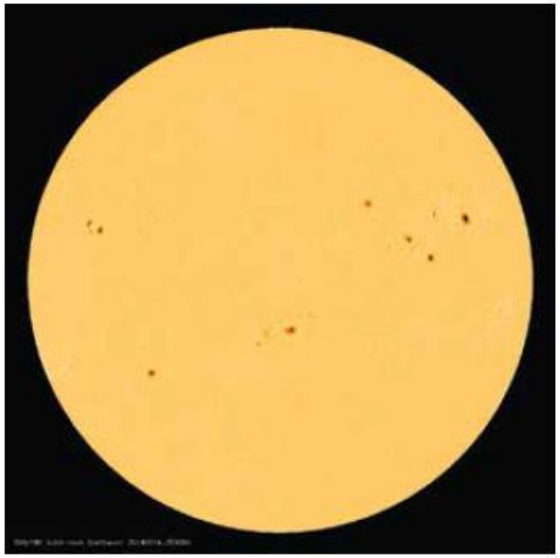


DCI Related to Solar and Lunar Eclipses

Performance Expectation associated with MS-ESS1.A

Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

Students also engage with the following key Scientific Practices

- **Analyze and interpret data** during their efforts to predict the order of the lunar phases and then as they make regular observations of the Moon in the sky.
- **Use a model of the Earth-Moon-Sun system** to describe the relationship between them and to help them develop an understanding of what causes the Moon's phases and eclipses.
- **Engage in argumentation** based on evidence as they compare their predictions for the order of lunar photographs and their daily observations of the Moon.

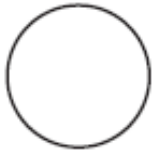
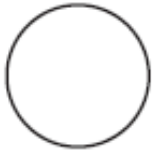
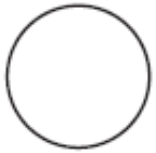
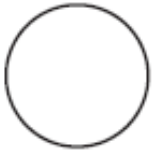
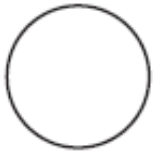
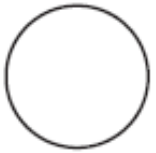
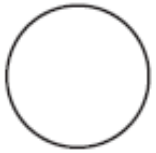
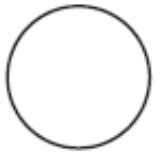
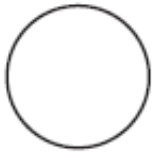
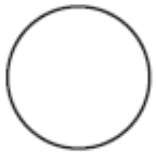
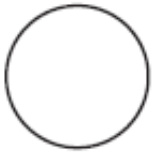
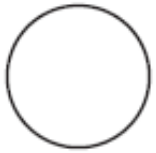
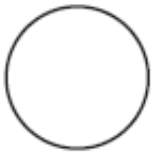
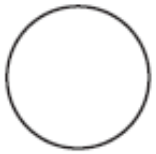
Students also engage with the following Crosscutting Concepts

- **Patterns** observed in the experiences can identify cause-and-effect relationships, as seen in how the relative position of the Earth, Moon and Sun produce the Moon's phases.
- **Science assumes that objects and events in natural systems occur in consistent patterns** that are understandable through measurement and observation, as demonstrated by observations of the Moon and Sun leading to an understanding of when solar and lunar eclipses occur.
- **System models** provide an opportunity for understanding and testing ideas, as seen in the student's head, Styrofoam ball and light bulb model of the Earth- Moon-Sun system.

Six Lunar Photographs, Set 2

Source:
Fred Espenak

Lunar Observing Record Chart

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Date Time Location 	Date Time Location 	Date Time Location 	Date Time Location 	Date Time Location 	Date Time Location 	Date Time Location 
Date Time Location 	Date Time Location 	Date Time Location 	Date Time Location 	Date Time Location 	Date Time Location 	Date Time Location 

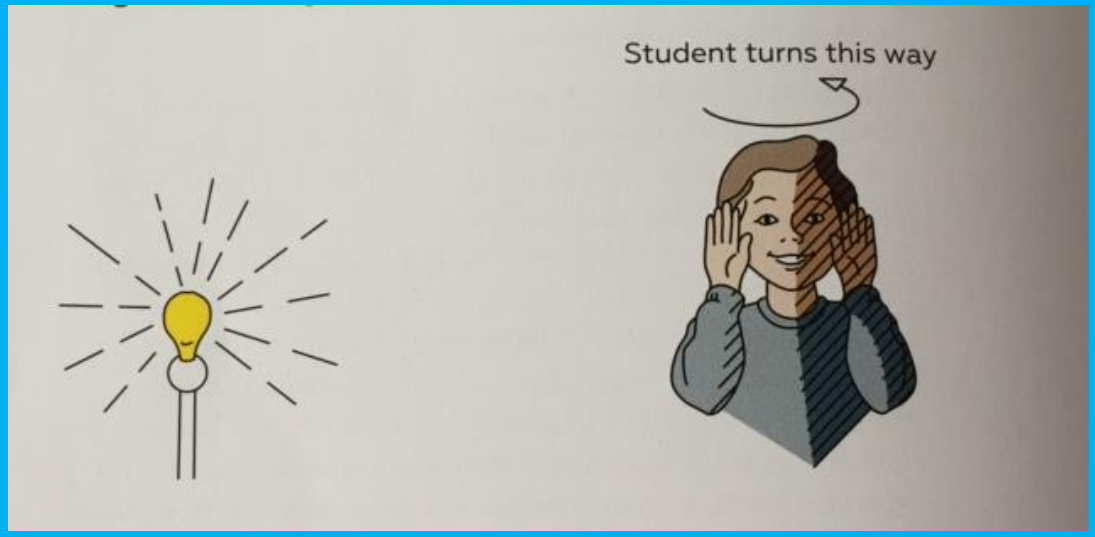

www.AstroPixels.com
©2012 F. Espenak

Lunar Map

Source:
Fred Espenak

Modeling Lunar Phases and Eclipses

Students now develop their modeling skills using a simple model of the Earth and Sun

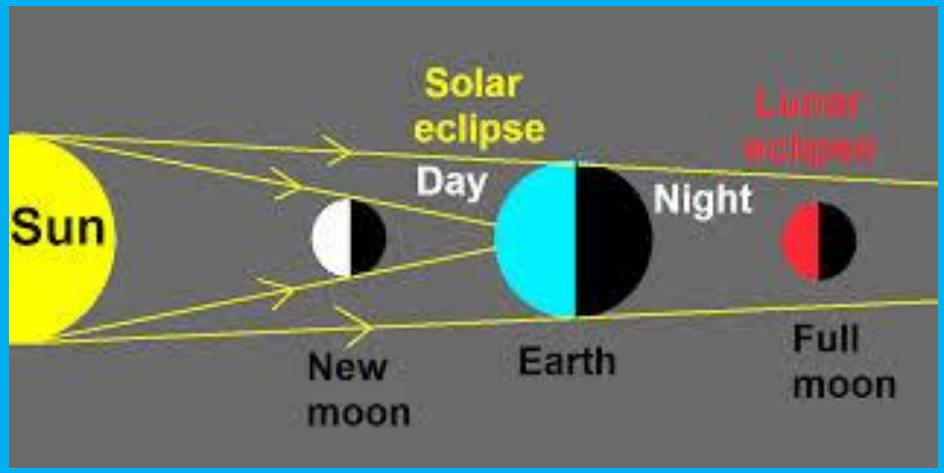


Modeling Lunar Phases and Eclipses

We now add a model Moon to expand and deepen their understanding of the relevant DCI and continue their practice using models

Modeling Lunar Phases and Eclipses

Students then explore moving their model Moon in its orbit to determine what phase the Moon has to be in to block the Sun's light from reaching the Earth (a solar eclipse) and when the Earth can block the Sun's light from getting to the Moon (a lunar eclipse)



More Questions Than Answers

- If a full Moon and new Moon happen every month, shouldn't we have eclipses every month?
- Why was the 2017 total solar eclipse the first one in the US in almost 40 years?
- Why do people spend thousands of dollars and travel thousands of miles to see a solar eclipse, but don't travel to see a lunar eclipse?

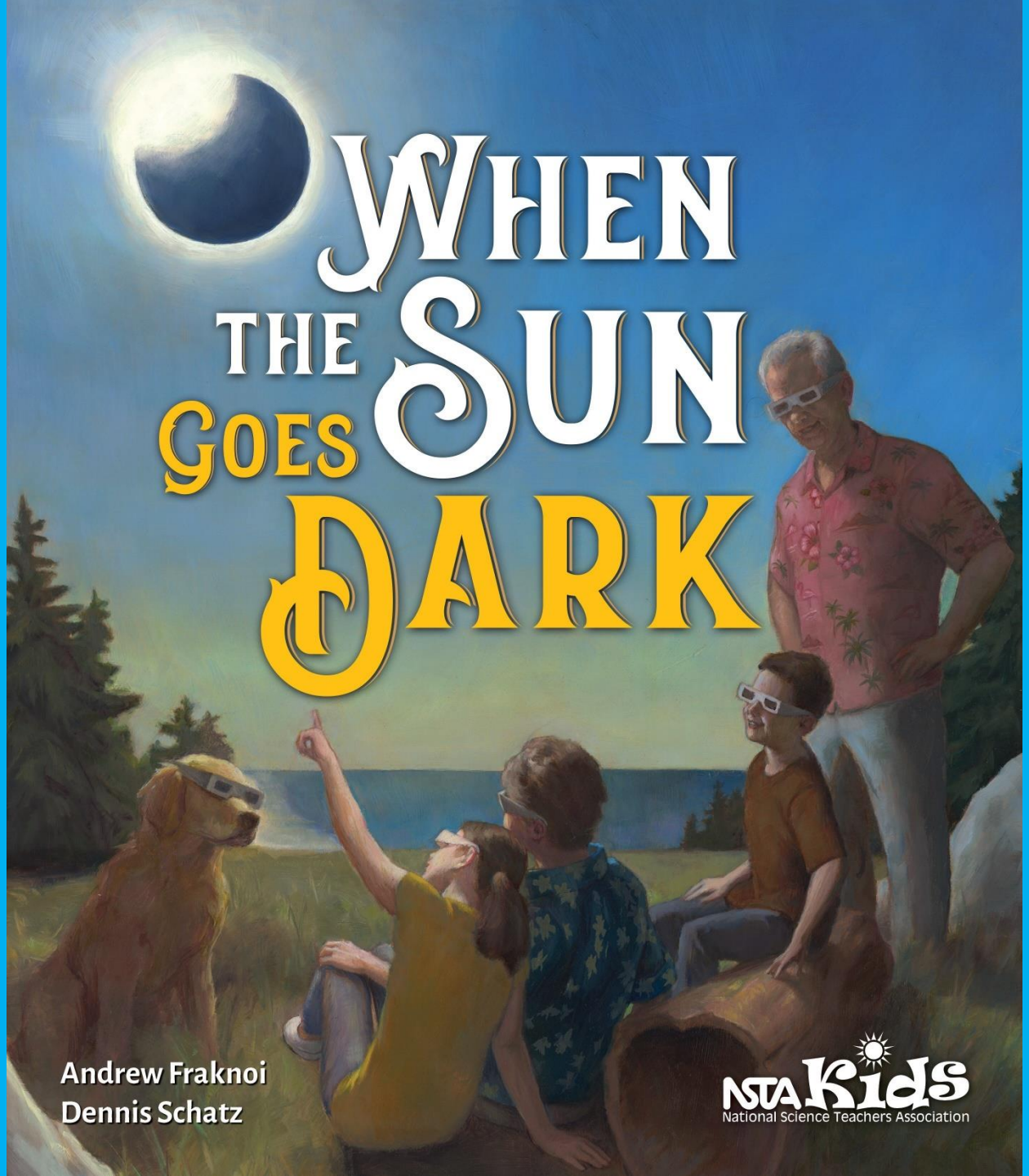
Hula Hoops Provide the Answer

Experience 4.6

- One Hula Hoop is the orbit of the Moon around the Earth.
- The other Hula Hoop is the apparent path of the Sun around the Earth.
- Normally the Moon and Sun are not lined up to produce an eclipse.
- Eclipses only occur when Moon and Sun are at crossing points.
- Solar and lunar eclipses happen every six months (separated by two weeks).

Experience 4.7

- Uses the Earth-Sun-Moon model to show only a small area on the Earth sees a solar eclipse.
- While half the Earth gets to see a lunar eclipse.
- Thus, people travel thousands of miles to see a total solar eclipse.


When the Sun Goes Dark
Andrew Fraknoi
Dennis Schatz
NSTA Kids
National Science Teachers Association

Now Grandma told us to move the balls around our heads a little bit at a time, going from right to left. As I slowly took the ball around, the side facing me started getting lit up a bit by the lamp's light.

Grandma told us to stop moving the tennis balls for a minute, then said, "That's what happens to the Moon. As it goes around the Earth, we see different amounts of sunlight reflecting off its surface."

As I moved the tennis ball Moon farther around my head, the ball showed more and more light. When the ball was on the opposite side of my head from the lamp, I held it high and could see it all lit up.

"What do we call it when the lit-up side of the Moon is facing the Earth?" Grandma asked.

Sammy didn't know, but after I thought about it for a minute, I thought I knew. "Is that a full Moon?" I asked.

Grandma gave me a thumbs-up, but out of a corner of my eye, I could see Sammy sticking his tongue out at me. He didn't like it when I got an answer faster than he did. But it's not my fault I'm older.

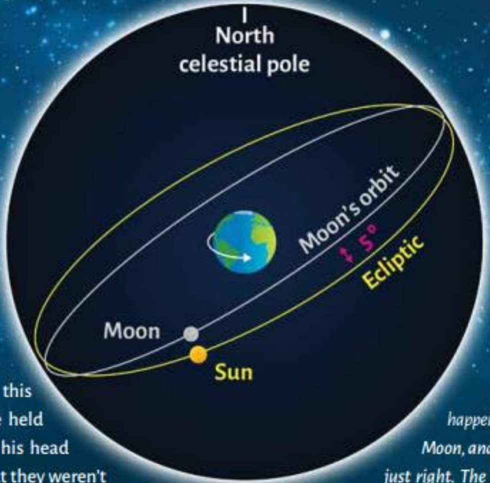
Grandma told us that the time it took for the Moon to go from new Moon to full Moon and back to new Moon is close to what we call a month. I was used to connecting months to events on Earth, like vacations, but I thought it was OK for months to be connected to something in space, too.

We moved the balls around our heads and saw different portions of the Moon lit up in different locations. In two places, the Moon was half lit up and half dark; in other places, we just saw a sliver of light, which Grandma called a *crescent Moon.*

After Sammy and I had explored for a while, Grandma said, "The different portions of the Moon lit up by reflected sunlight are called the *phases* of the Moon."

That was a good new word to know, but even after Sammy and I had taken the tennis ball Moon around the Earth about five times, I still wasn't sure how this was connected to eclipses.

RIGHT: The outer circle of Moon diagrams shows what is visible in the sky from Earth. The inner circle of Moon diagrams shows what would be visible from space, looking down from above the Earth–Moon system.



Next, Grandpa did this odd thing where he held both hoops around his head at the same time, but they weren't lined up. The purple one was above the yellow one on one side and below it on the other side, and they only touched in two places.

Grandpa told us that's what happens with the paths of the real Moon and Sun in the sky. The Moon is usually above or below the Sun by a small amount. If they are not lined up exactly, the Moon can't pass directly in front of the Sun, and there won't be an eclipse.

"How often do the Hula-Hoops cross?" Grandpa asked me and my brother.

We both said, "Twice" at the same time, which made all four of us laugh.

"What do you think happens when the Moon and Sun arrive together at one of the two places where the Hula-Hoops cross?" Grandpa asked us.

I thought, *Eclipses happen when the Sun, the Moon, and the Earth are lined up just right. The only place that lineup can happen is where the hoops cross.* So I said, "Eclipses," and Grandpa gave me a big smile.

Grandpa then told us, "It turns out that the Sun and the Moon arrive at the crossing points *together* only twice a year. So we have a kind of 'eclipse season' roughly every six months when eclipses of the Sun and the Moon happen somewhere on Earth."

I had to think about that. First of all, this was the first time Grandma or Grandpa had mentioned that the Moon could have eclipses, too. I wanted to ask more about that later. Also, two times a year still seemed like a lot of eclipses. So I asked Grandpa why they went on a long trip to see an eclipse of the Sun if they happen twice a year.

Free Web Seminars

Recordings of the web seminars will be available post-event.

Science Update: Get Ready for the April 8 Total Solar Eclipse
February 8, 2024

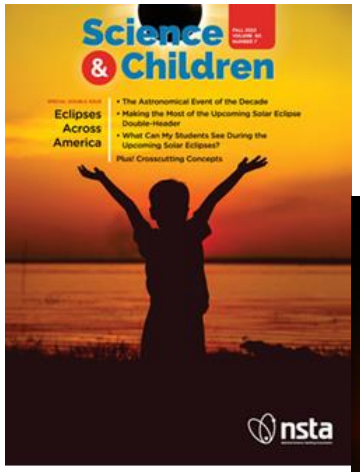
Safe Solar Eclipse Viewing Techniques and What School Administrators Need to Know
Thursday, September 14, 2023 • 7:30 PM ET

A Solar Eclipse 'Double-Header: The Perfect Way to Engage Your Preservice Teachers in Capitalizing on These Teachable Moments
Thursday April 27, 2023 • 7:00 PM ET

An Eclipse 'Double-Header' is Coming this School Year!
Thursday August 31, 2023 • 7:00 PM ET

Getting Ready for Two Spectacular Solar Eclipses in North America
October 20, 2022

Journal Articles



Science & Children · Elementary

Preparing for the Eclipse: How to safely observe the Sun with young children

Science Scope · Middle School

July/August 2023 • Volume 46 • Issue 6

- Hurrah for Teachable Moments
- Preparing for the Great American Eclipse of 2024
- The 2023 and 2024 Solar Eclipse Double-Header
- Transitioning from Partial to Total Understanding
- Making the Most of the Upcoming Solar Eclipse Double-Header October 14, 2023, and April 8, 2024
- Megamovie 2024: A Project to Eclipse All Others

The Science Teacher · High School

Total_Eclipse: The solar eclipse this August is an ideal opportunity to practice three-dimensional science learning

NSTA Collection

A Collection of external links curated by NSTA with additional resources related to solar eclipses.

View Collection

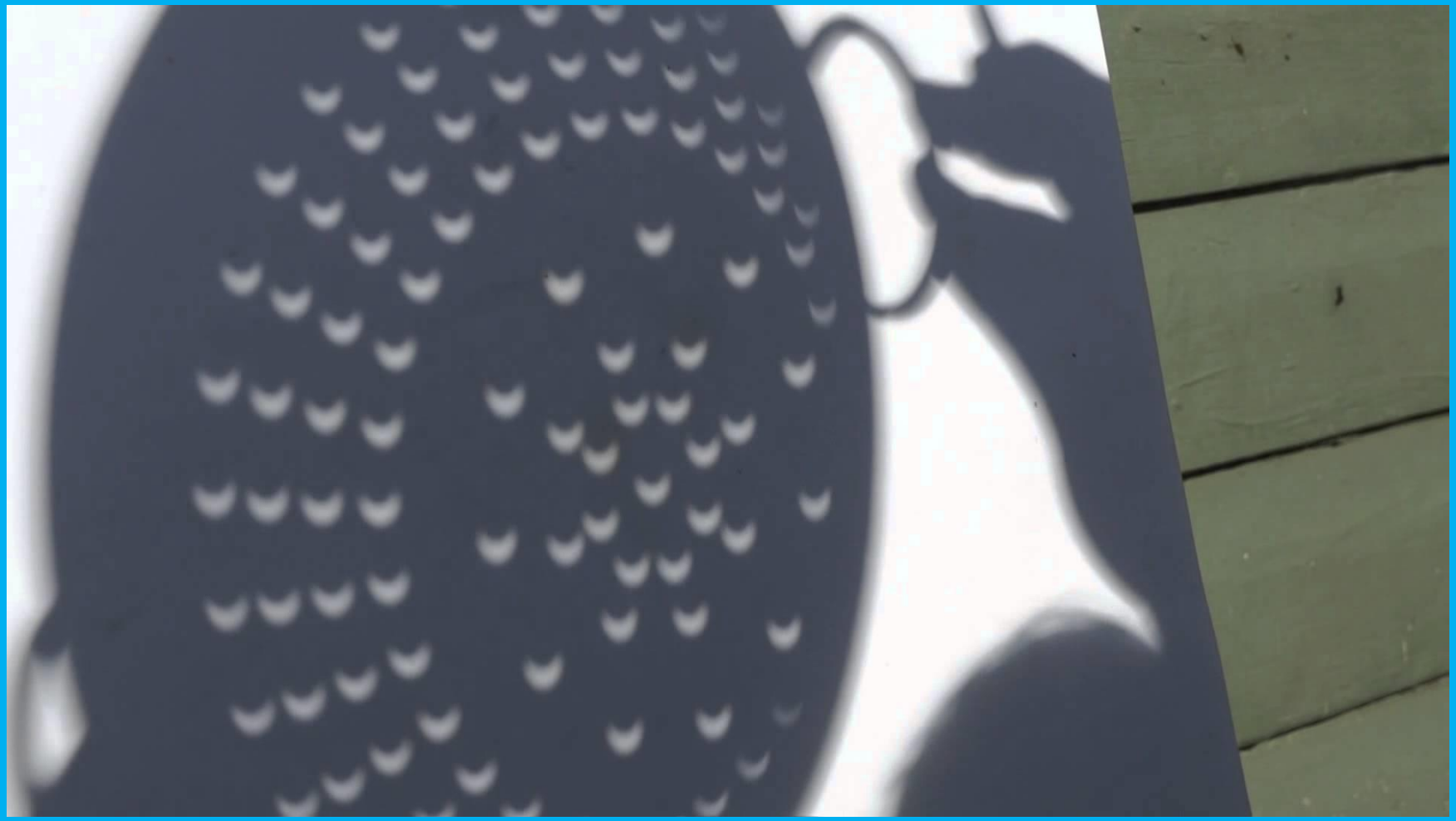
See what our fellow science friends have to offer.

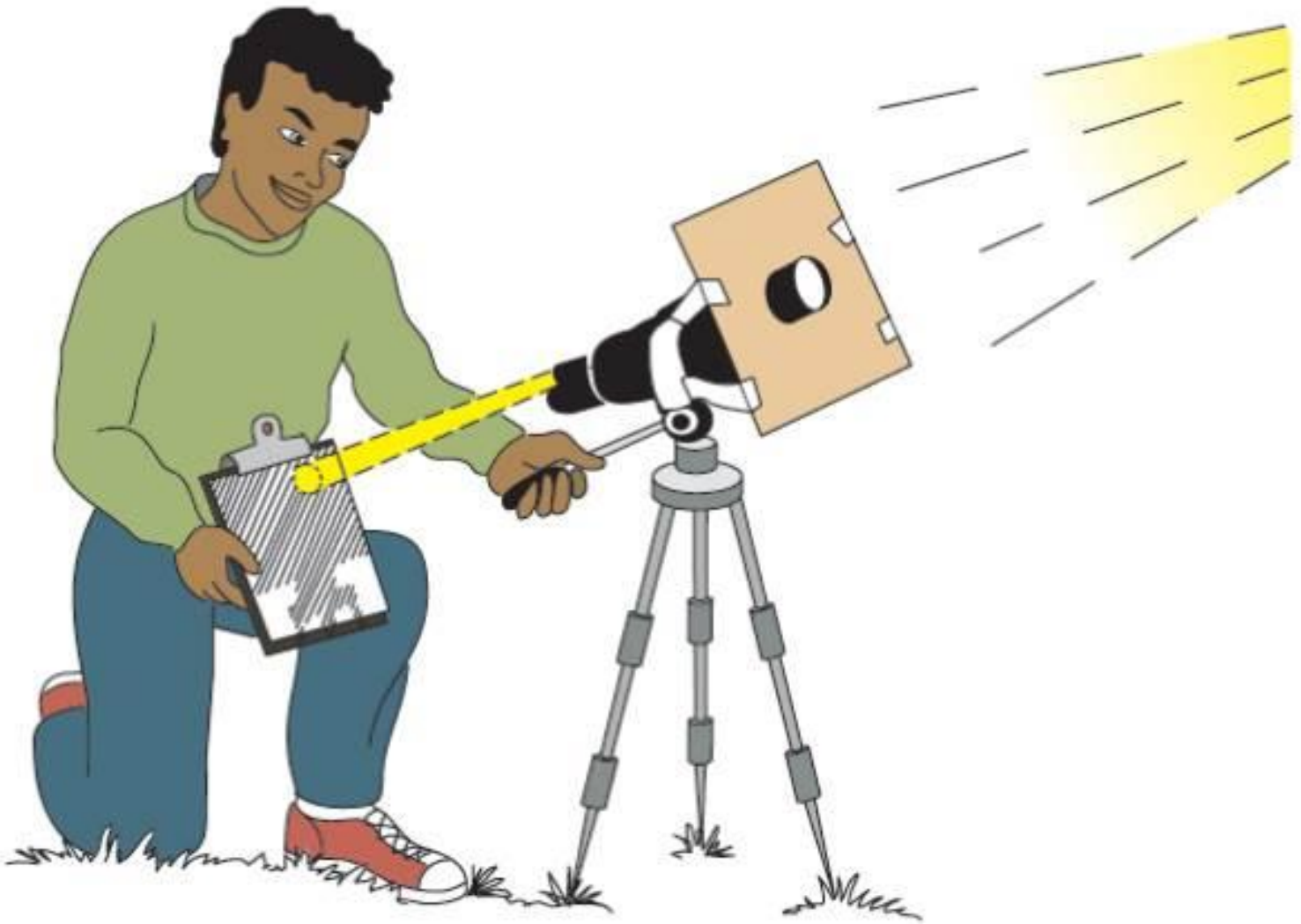
What to Tell Administrators

Connect with your school administrators EARLY and OFTEN, emphasizing that:

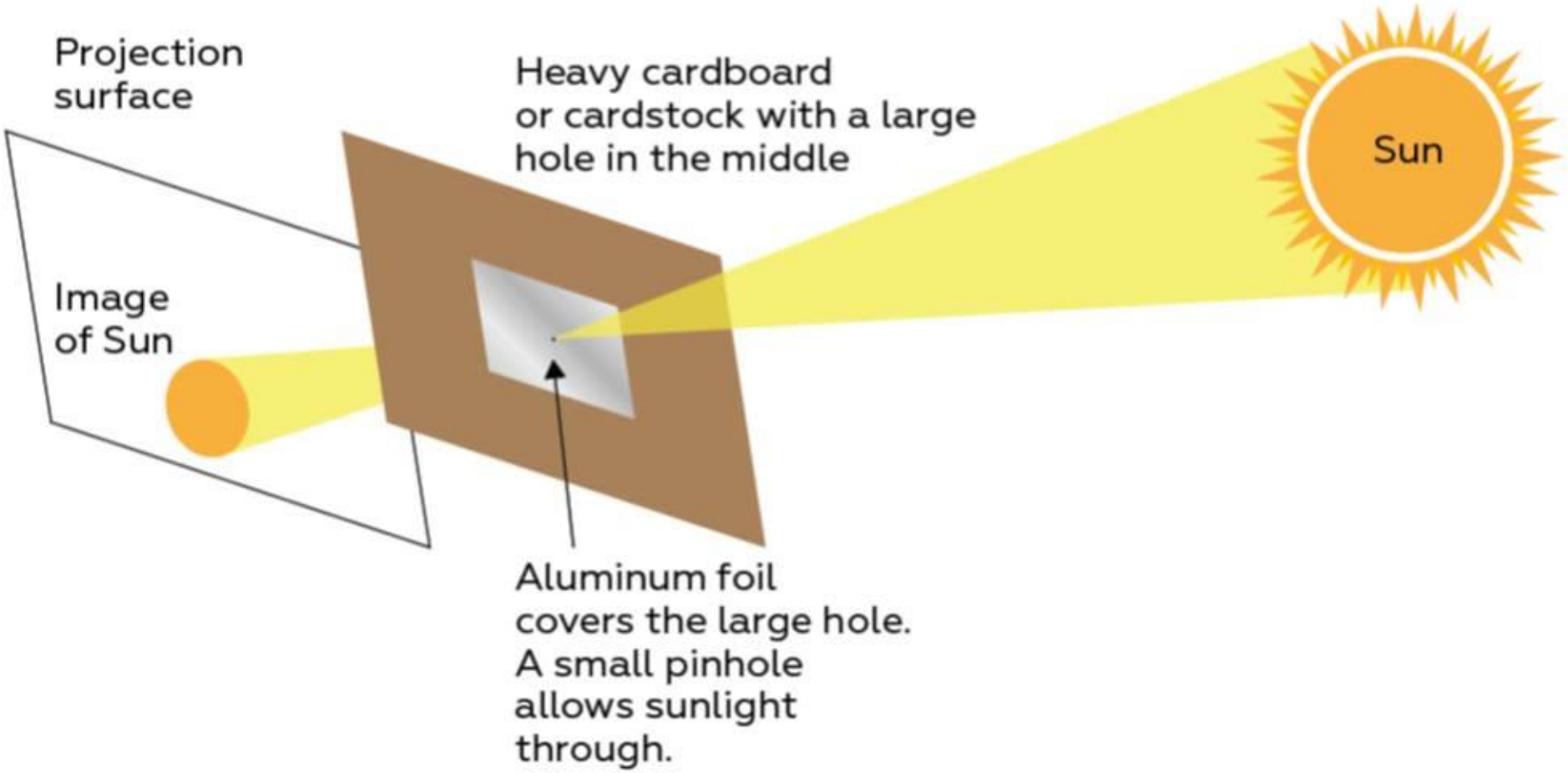
- Eclipses are a wonderful, important learning experiences
- Eclipses are safe to view
- Safe eclipse-viewing techniques are easy to find and use

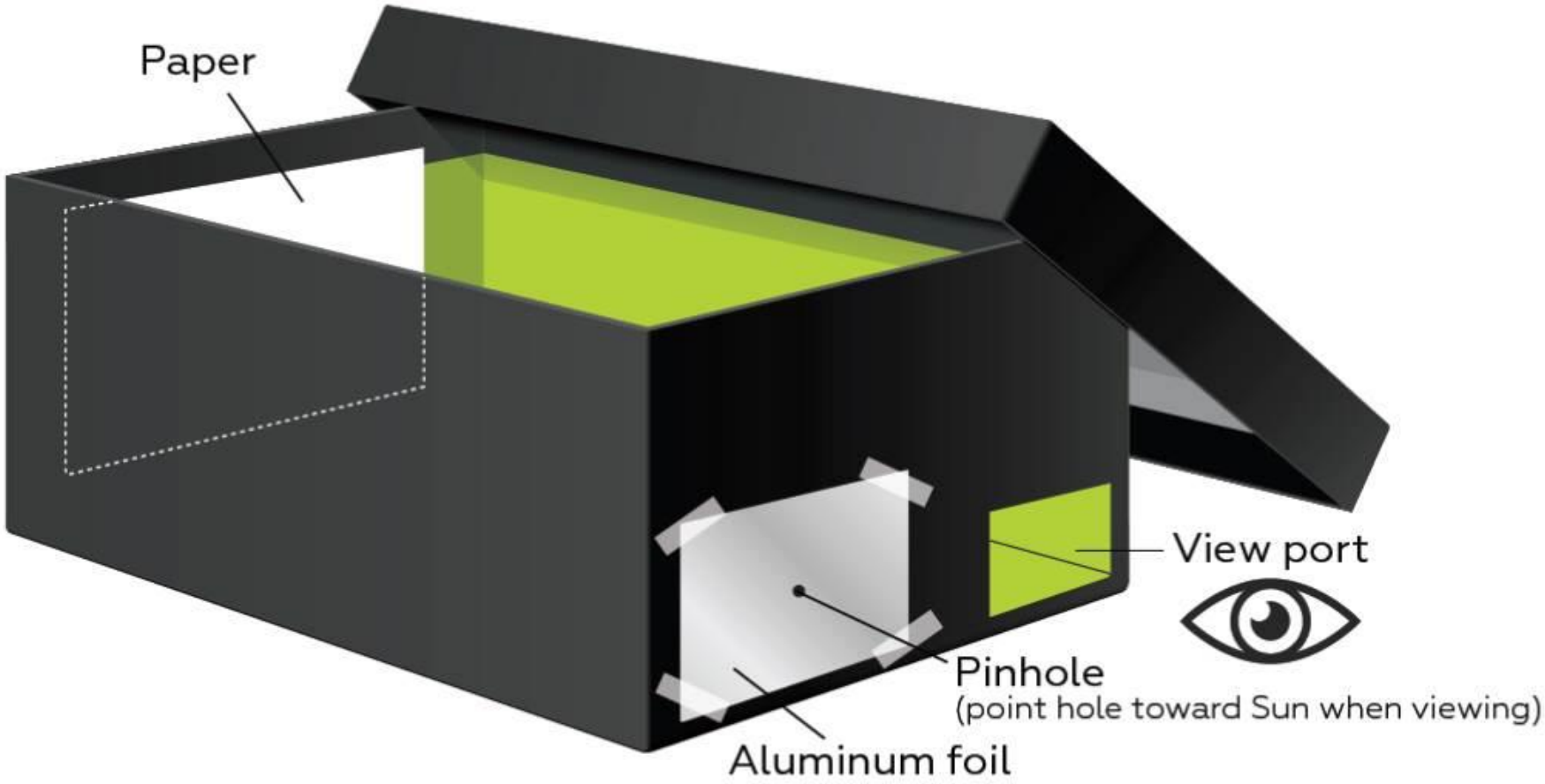
Safe Viewing Techniques



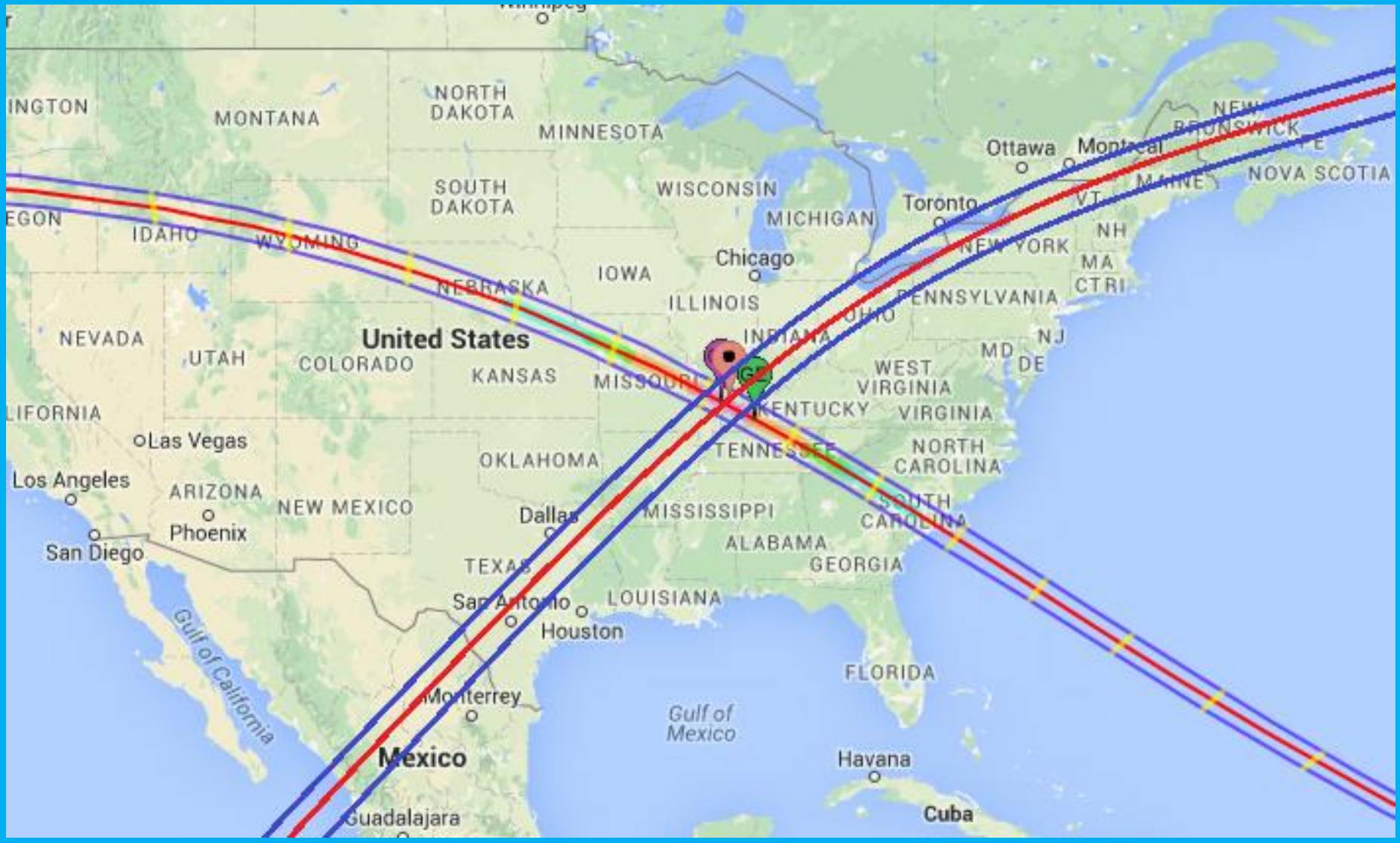


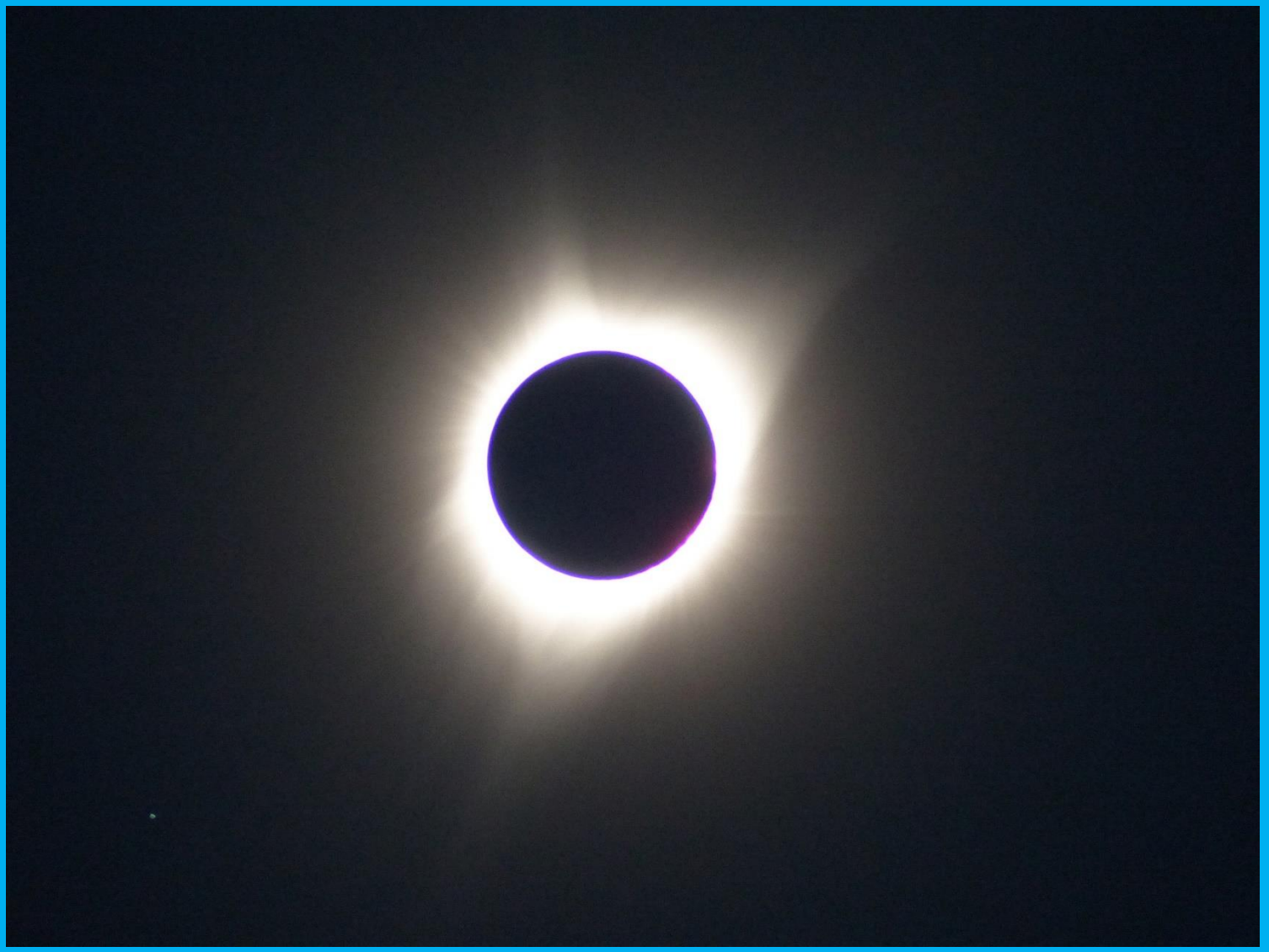
Source: Schatz, D., and P. Allen. 2003. *Astro adventures II: An activity-based astronomy curriculum*. Seattle, WA: Pacific Science Center, p. 52.


Projection surface
Heavy cardboard or cardstock with a large hole in the middle
Sun
Image of Sun
Aluminum foil covers the large hole. A small pinhole allows sunlight through.


Paper
View port
Pinhole
(point hole toward Sun when viewing)
Aluminum foil

April 8, 2024 Total Solar Eclipse






I wish you clear skies
and great solar viewing