Welcome

Science Update:
Getting Ready for Two Spectacular Solar Eclipses in North America

October 20, 2022
7:00 PM ET

nsta
National Science Teaching Association

NSTA Virtual Program Norms

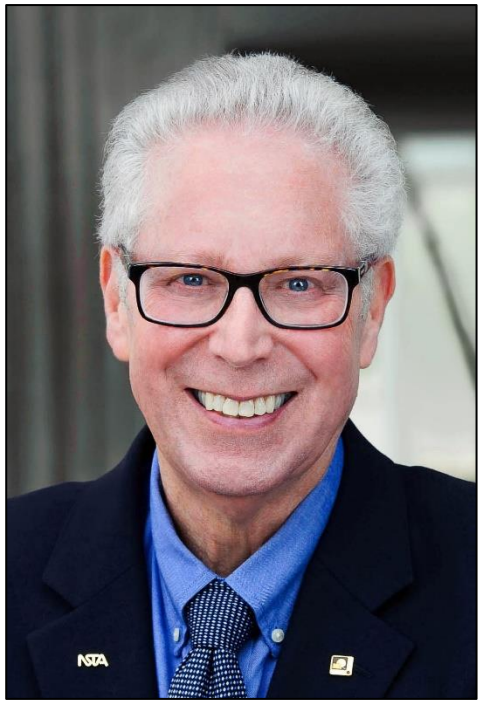
The National Science Teaching Association strongly supports diversity, equity and inclusion in the classroom, and in all of our programs. We are committed to providing a welcoming, safe, productive, harassment-free environment for all participants of our events and programs, regardless of their gender, gender identity, sexual orientation, ability, ethnicity, race, color, age, marital status, veteran status, socioeconomic status or religion.

We ask that all attendees be mindful of their surroundings and of their fellow participants. All participants are expected to exercise consideration and respect in their speech and actions, and to refrain from demeaning, discriminatory, or harassing behavior and speech.

NSTA does not allow promotion of other products in our chats during web seminars. We ask that attendees keep the conversation on topic, use positive language and remain courteous of others throughout the event, and allow everyone time to participate in the chat.

Meet Today's Presenters…

Andrew Fraknoi



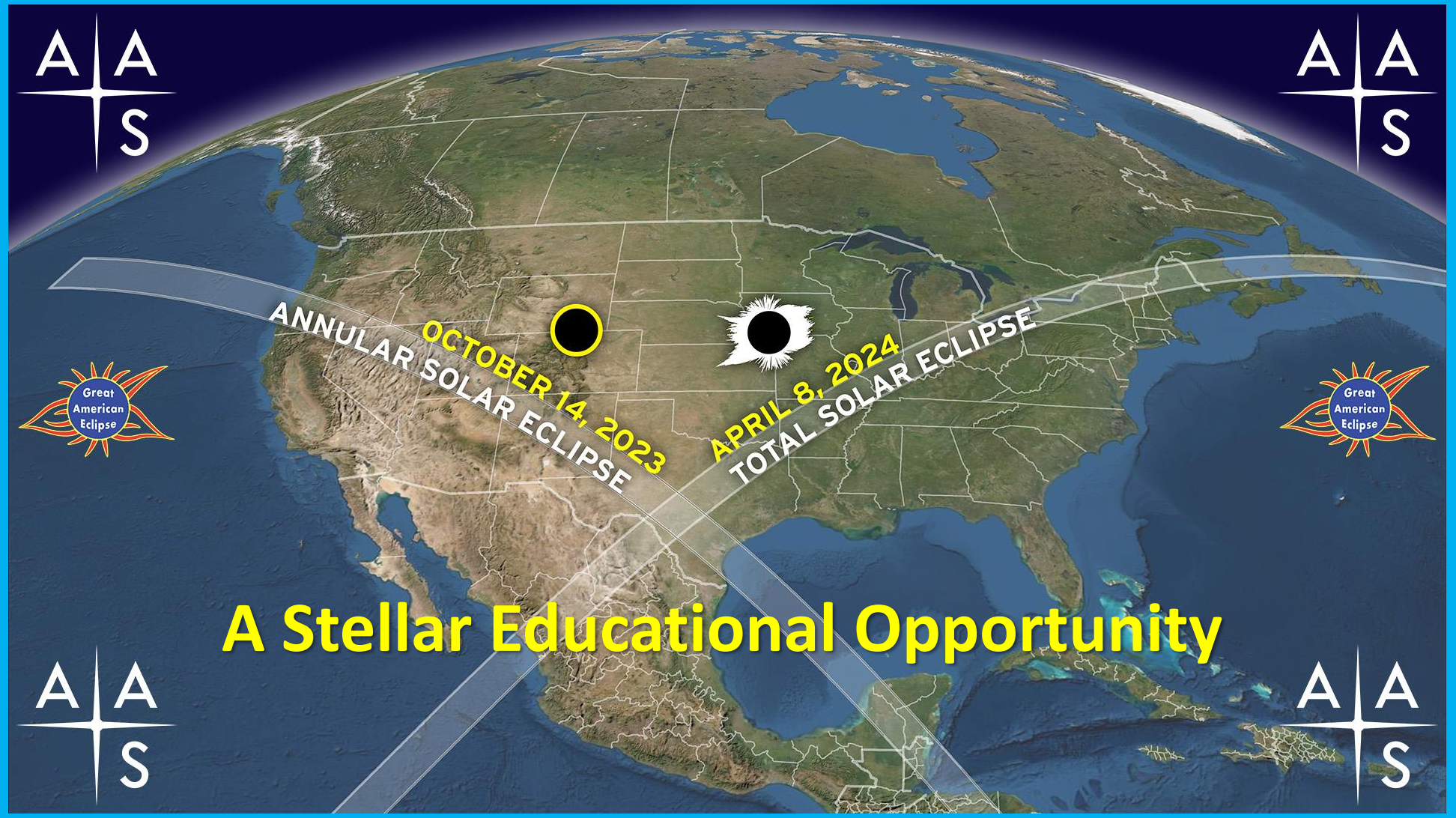
Dennis Schatz

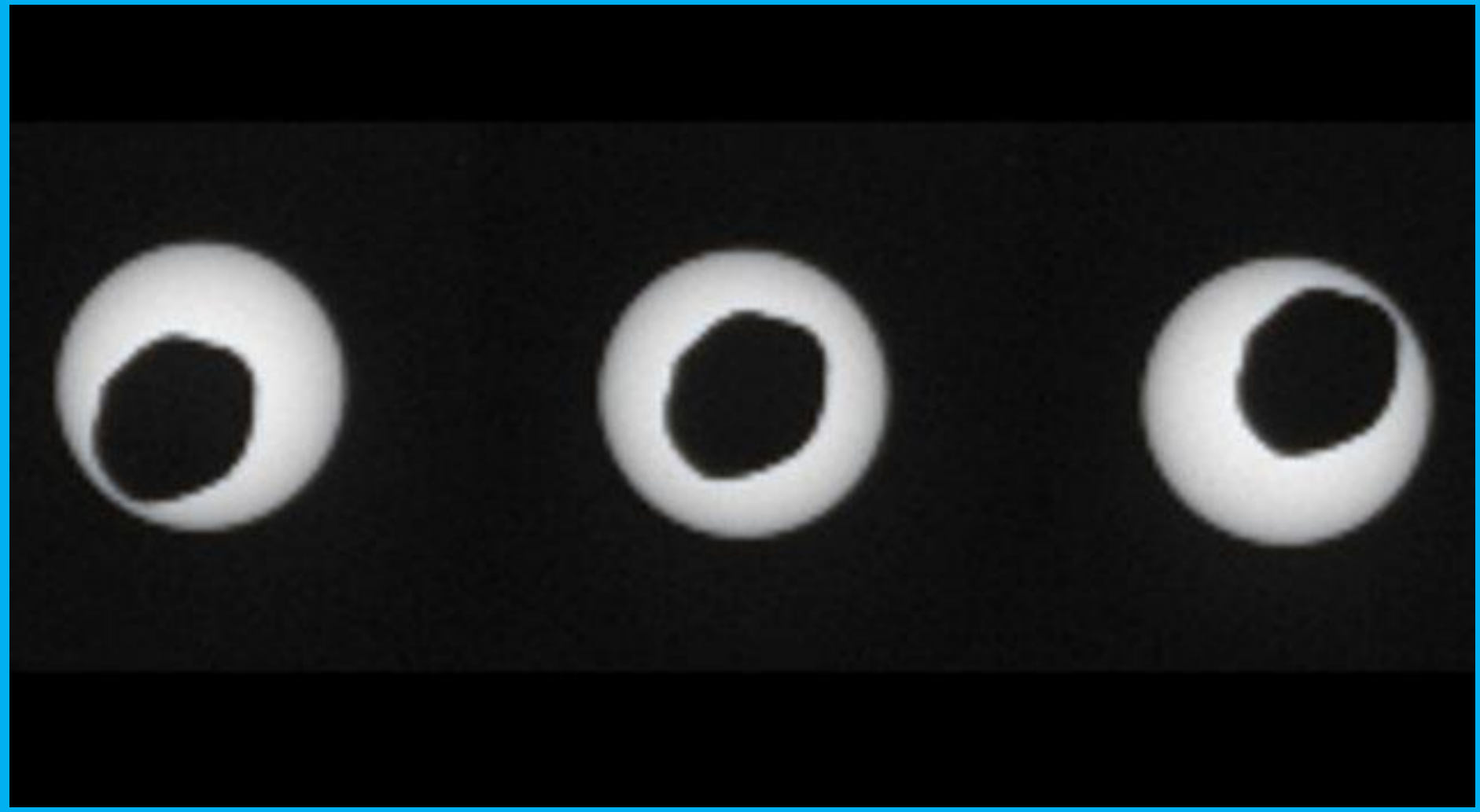
Poll question #1:

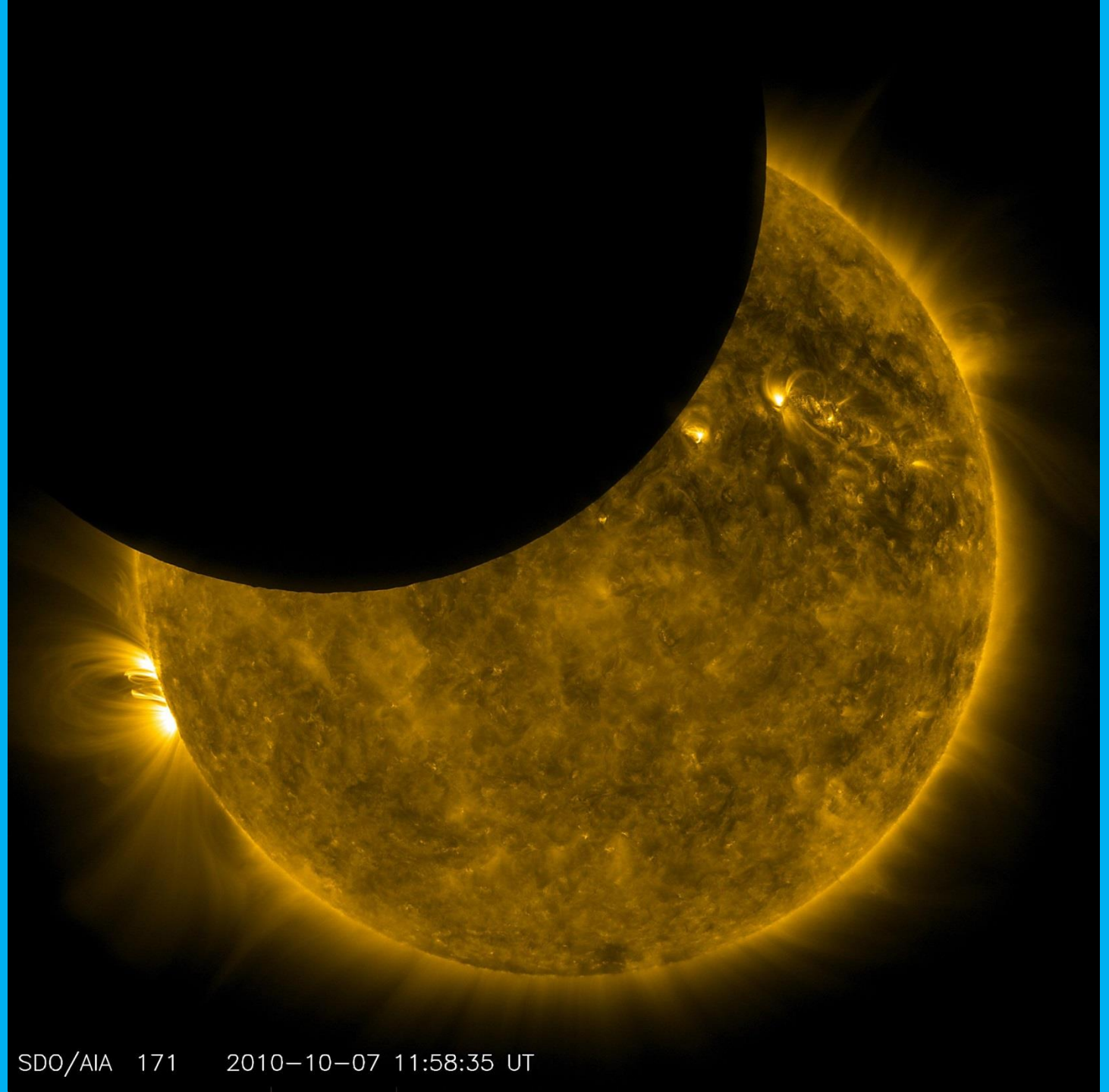
Where were you on August 21, 2017?

A. In the total eclipse zone
B. In school, meeting my classes
C. Still on vacation, but not in the total eclipse zone.

The 2023-2024 North American Eclipse Double-Header



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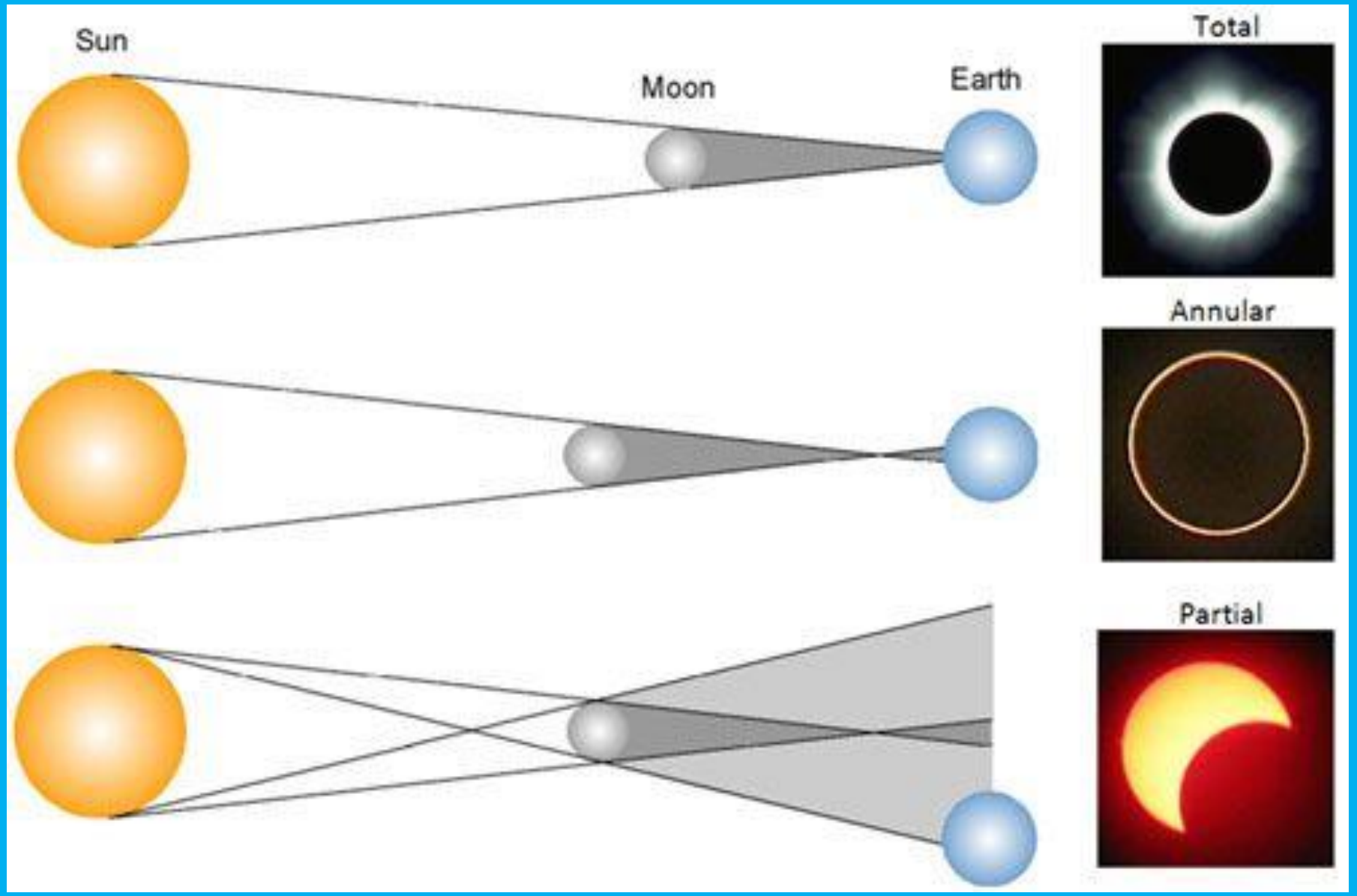
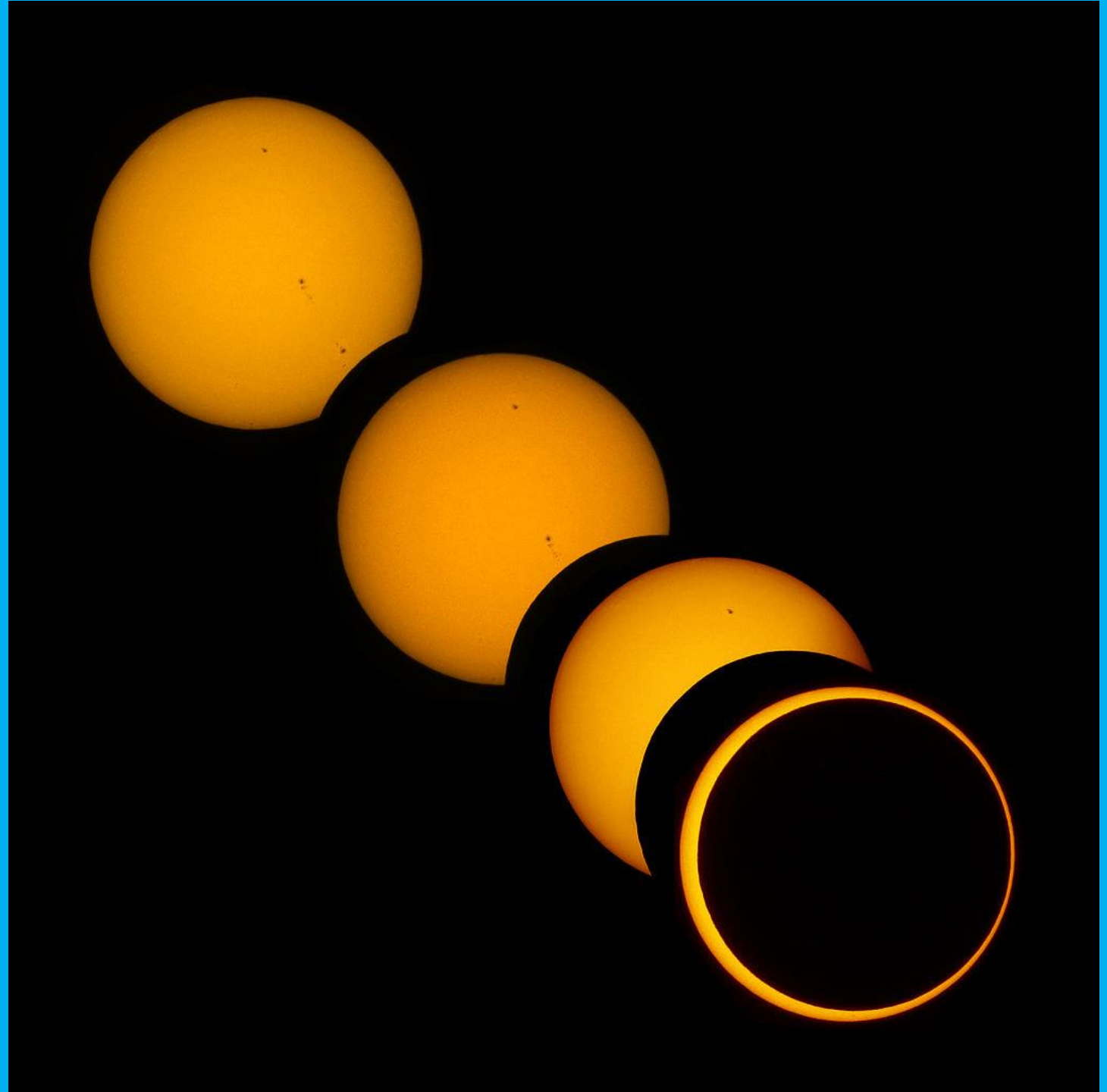
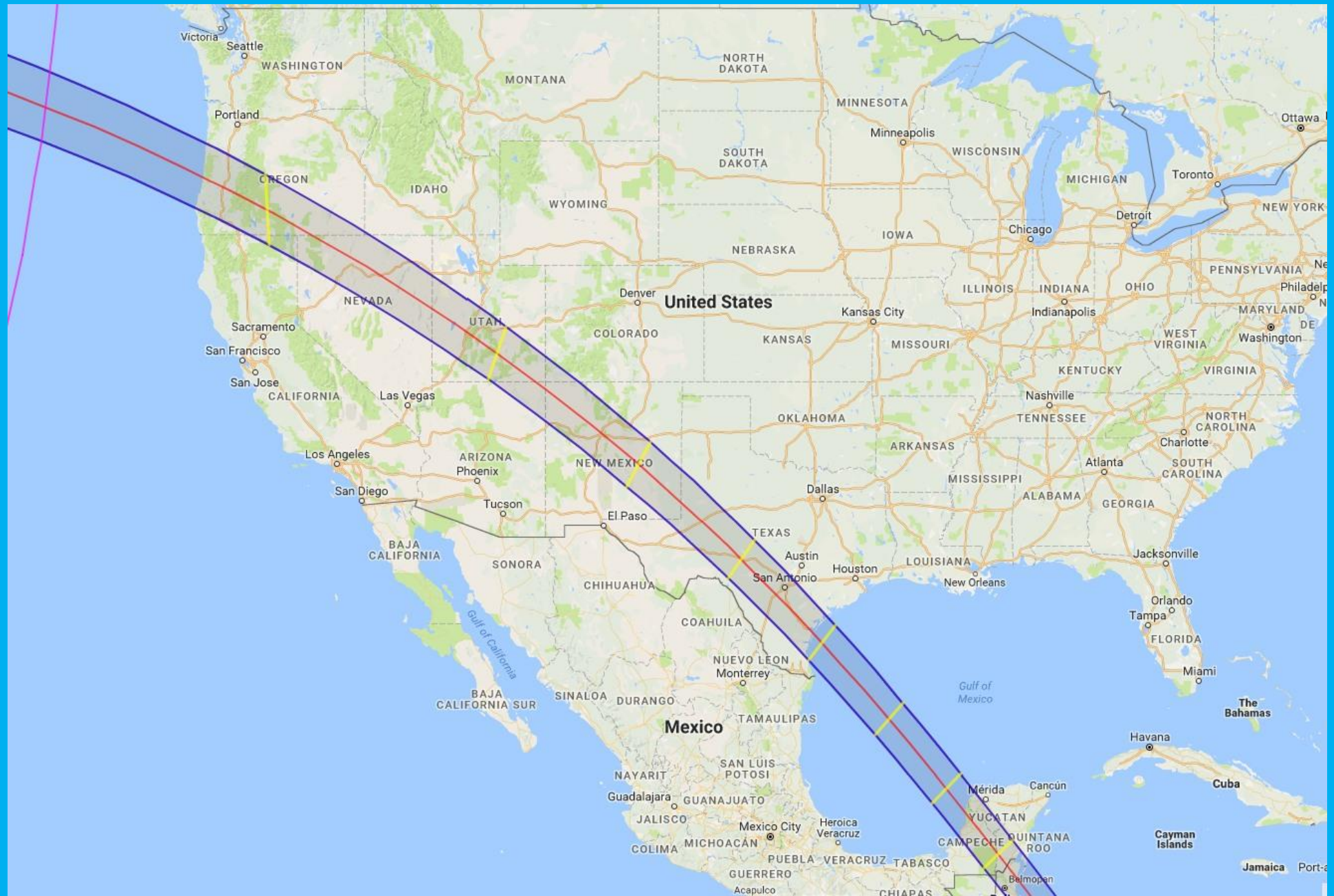
DIFFERENT TYPES OF SOLAR ECLIPSES




Oct. 14
2023
Nordgren
The
American West
Ring of Fire Solar Eclipse
Copyright Spaceartravelbureau.com 2022
★ OR ★ CA ★ NV ★ UT ★ CO ★ AZ ★ NM ★ TX ★
With a Partial Solar Eclipse for the entire United States!



Saturday, Oct. 14, 2023 Annular Eclipse



PLACES THE 2023 ECLIPSE WILL BE ANNULAR

Location	Partial Beg	Ann Beg	Ann End	Partial End	Alt	Duration
Eugene, OR	8:05 am	9:17	9:21	10:40 am	18°	3:55 min
Crater Lakes Nat Park OR	8:05 am	9:17	9:22	10:41 am	20°	4:33
Winnemucca NV	8:06 am	9:21	9:25	10:47 am	24°	4:27
Ticaboo UT	9:10 am	10:28	10:33	12 n	32°	4:45
Albuquerque NM	9:13 am	10:35	10:39	12:10 pm	36°	4:48
Roswell NM	9:16 am	10:39	10:43	12:15 pm	40°	4:41
Odessa TX	10:18 am	11:43	11:48	1:22 pm	43°	4:49
San Antonio TX*	10:24 am	11:52	11:56	1:33 pm	48°	4:21
Corpus Christy TX	10:26 am	11:56	12:01	1:38 pm	50°	4:53
Uxmal (near Merida), MEX	10:46 am	12:23	12:27	2:10 pm	62°	4:07
Belize City, BEL	9:53 am +	11:32	11:37	1:20 pm	65°	5:11
La Ceiba, HON	9:58 am	11:39	11:44	1:27 pm	67°	5:12
Santa Fe Nat'l Park, PAN	11:24 am	1:08	1:13	2:55 pm	68°	5:02

THE 2023 ECLIPSE IN MAJOR U.S. CITIES

Location	Begins	Max	Ends	Diam Cov	Alt at Max
New York City	12:08 pm	1:22	2:36 pm	35%	41°
Los Angeles	8:08 am	9:25	10:50 am	78%	28°
Chicago	10:37 am	11:58	1:22 pm	54%	40°
Houston	10:27 am	11:59	1:38 pm	90%	49°
Philadelphia	12:05 pm	1:21	2:37 pm	38%	42°
Phoenix	8:11 am	9:32	11:02 am	85%	34°
San Antonio *	10:24 am	11:54	1:33 pm	96%	48°
San Diego	8:09 am	9:26	10:53 am	76%	30°
Dallas	10:24 am	11:53	1:30 pm	86%	46°
San Francisco	8:05 am	9:20	10:42 am	83%	23°
Indianapolis	11:40 am	1:02	2:29 pm	55%	42°
Washington DC	12:00 pm	1:19	2:39 pm	42%	43°
Miami	11:57 am	1:34	3:12 pm	67%	56°


APR. 8
2024
Nordgren
Mazatlan Durango Torreón San Antonio
Austin Dallas Fort Worth Scottsdale
Indianapolis Toledo Cleveland
Buffalo Niagara Falls Hamilton Rochester
Montreal Syracuse Burlington Fredericton
THE GREAT
NORTH AMERICAN
TOTAL SOLAR ECLIPSE
MEXICO ★ UNITED STATES ★ CANADA
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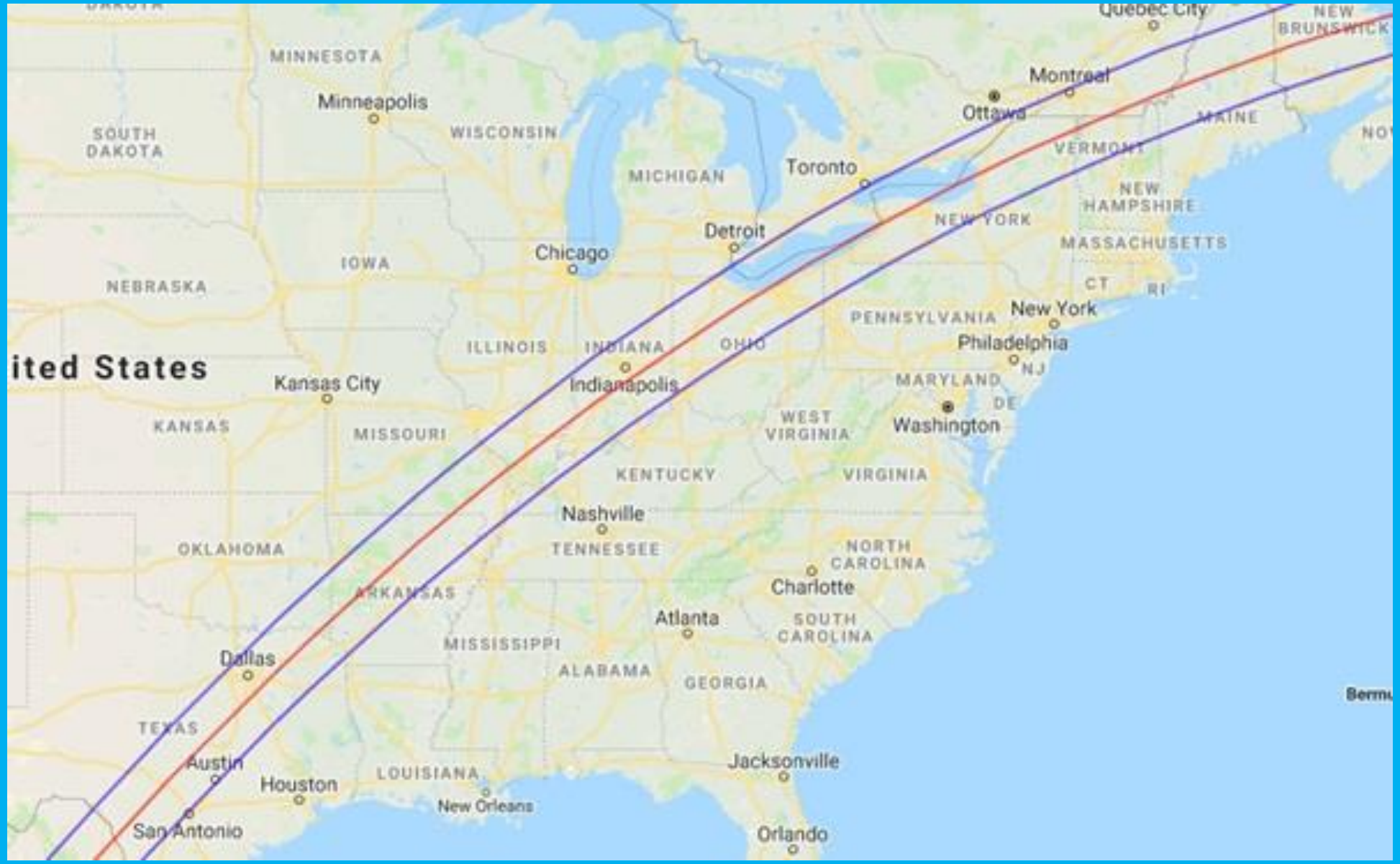
Photography

Monday, April 8, 2024 Total Eclipse



PLACES THE 2024 ECLIPSE WILL BE TOTAL

Location	Partial Beg	Tot Beg	Tot End	Part End	Alt	Duration
Torreon MEX	12 noon	1:17	1:21	2:43 pm	71°	4:09 min
Kerrville (near San Antonio) TX	12:15 pm	1:32	1:36	2:56 pm	68°	4:25
Arlington (near Dallas) TX	12:23 pm	1:40	1:44	3:02 pm	65°	3:22
Morrilton (near Little Rock) AK	12:34 pm	1:51	1:55	3:11 pm	62°	4:14
Cape Girardeau MO	12:42 pm	1:58	2:02	3:17 pm	58°	4:07
Carbondale, IL	12:43 pm	1:59	2:03	3:18 pm	57°	4:10
Indianapolis IN	1:51 pm	3:06	3:10	4:23 pm	54°	3:46
Cleveland OH	1:59 pm	3:14	3:18	4:29 pm	49°	3:49
Erie PA	2:02 pm	3:16	3:20	4:31 pm	48°	3:43
Niagara Falls NY	2:05 pm	3:18	3:22	4:32 pm	46°	3:31
Buffalo NY	2:05 pm	3:18	3:22	4:32 pm	46°	3:45
Sherbrooke (near Montreal) CAN	2:17 pm	3:28	3:31	4:38 pm	40°	3:26
Oakfield ME	2:22 pm	3:32	3:35	4:41 pm	36°	3:22


The further north you are,
the more likely it will be cloudy

THE 2024 ECLIPSE IN MAJOR U.S. CITIES

Location	Begins	Max	Ends	Diam Cov	Alt at Max
New York City	2:11 pm	3:26	4:36 pm	91%	43°
Los Angeles	10:06 am	11:12	12:22 pm	58%	55°
Chicago	12:51 pm	2:08	3:22 pm	94%	53°
Houston	12:20 pm	1:40	3:01 pm	94%	68°
Philadelphia	2:08 pm	3:24	4:35 pm	90%	46°
Phoenix	10:08 am	11:20	12:35 pm	71%	60°
San Antonio	12:15 pm	1:34	2:56 pm	99%	69°
San Diego	10:03 am	11:11	12:23 pm	62%	57°
Dallas *	12:23 pm	1:43	3:03 pm	100%	65°
San Francisco	10:14 am	11:13	12:16 pm	45%	50°
Indianapolis *	1:51 pm	3:08	4:23 pm	100%	54°
Washington DC	2:04 pm	3:21	4:33 pm	89%	47°
Miami	1:48 pm	3:02	4:13 pm	56%	61°

Who will see some kind of eclipse in 2023-24?

U.S. = 332 million

Canada = 37 million

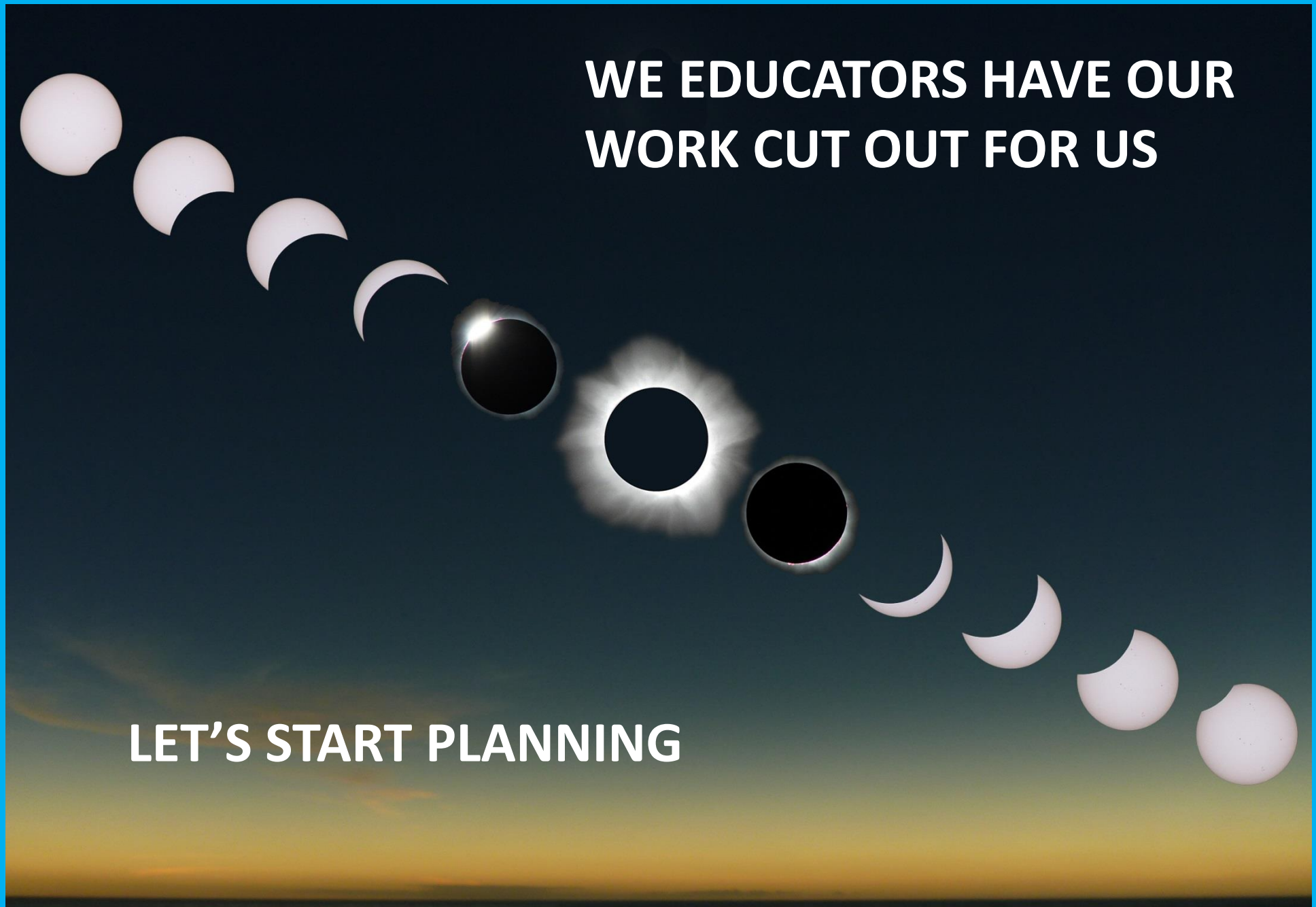
Mexico = 129 million

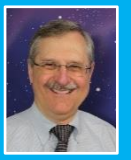
TOTAL = 498 million

Astronomy Teacher Contemplating Eclipse Education Challenges


Ancient Chinese Curse:
MAY YOU
LIVE IN
INTERESTING
TIMES

The Evolution of Eclipse Ideas


WE EDUCATORS HAVE OUR
WORK CUT OUT FOR US
LET’S START PLANNING



We'll need lots of solar viewing glasses


QUINCY PUBLIC LIBRARY
526

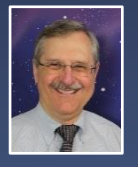
Gordon and Betty MOORE FOUNDATION

Google

5 million glasses
Distributed free
Through public libraries


POWERFUL FRESH BREATH
WRIGLEY'S
eclipse
PEPPERMINT
Artificial &
Natural Flavors
12 Pieces
Sugarfree Gum

Let's Pause…



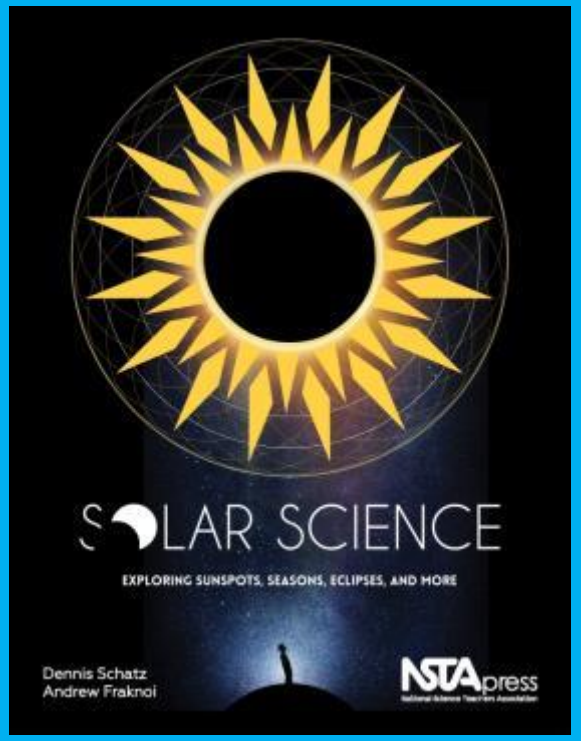
Let's pause for two questions from the audience.

Please share your questions in the chat window

Poll question #2:

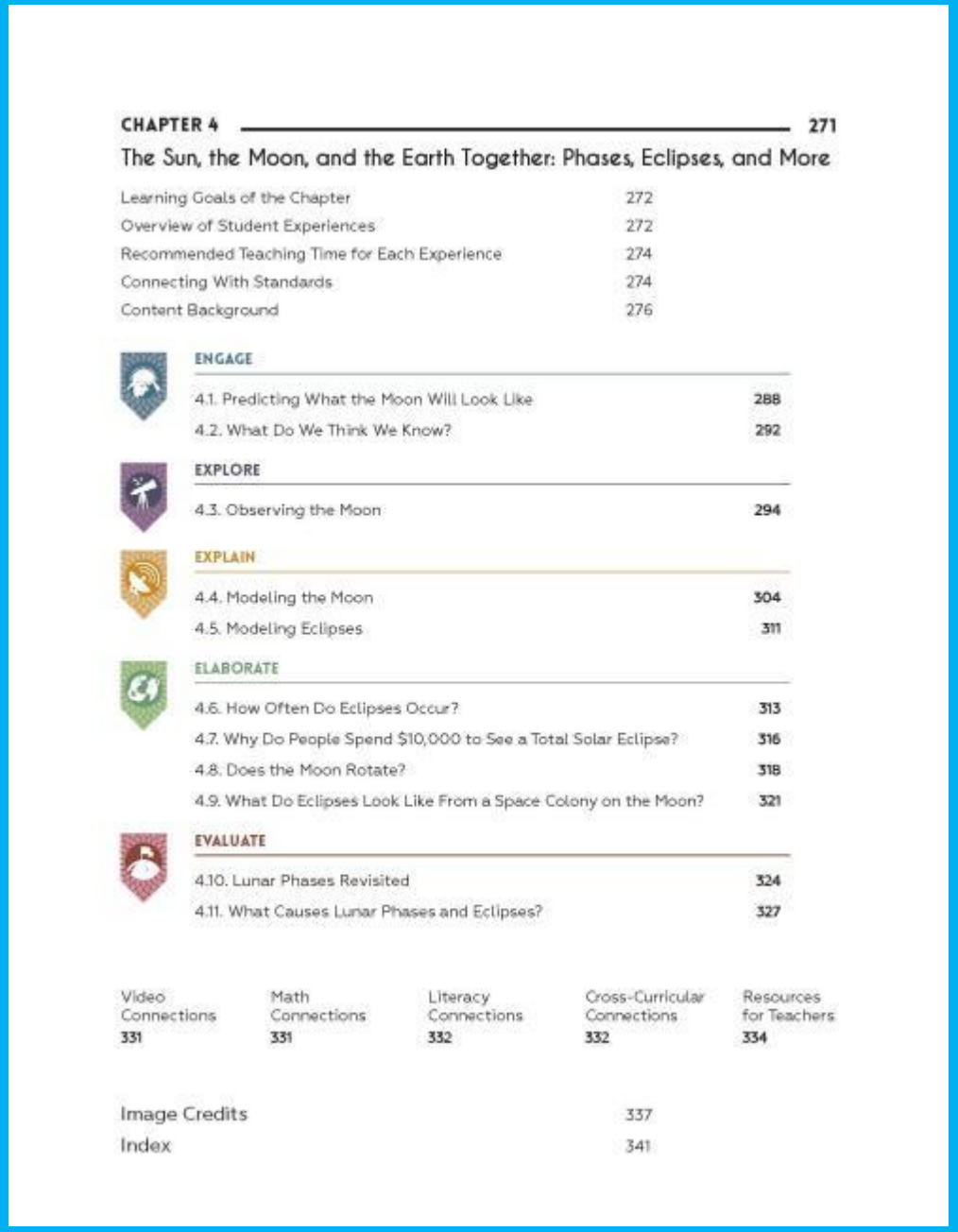
What Causes Solar Eclipses?

A. What phase the moon is in?
B. The inclination of the Moon's orbit around the Earth relative to the Earth's orbit around the Sun?
C. The varying distance of the Moon from the Earth as the Moon orbits the Earth?
D. All of the above.
E. Answers A and B.



Learning Experiences to be featured

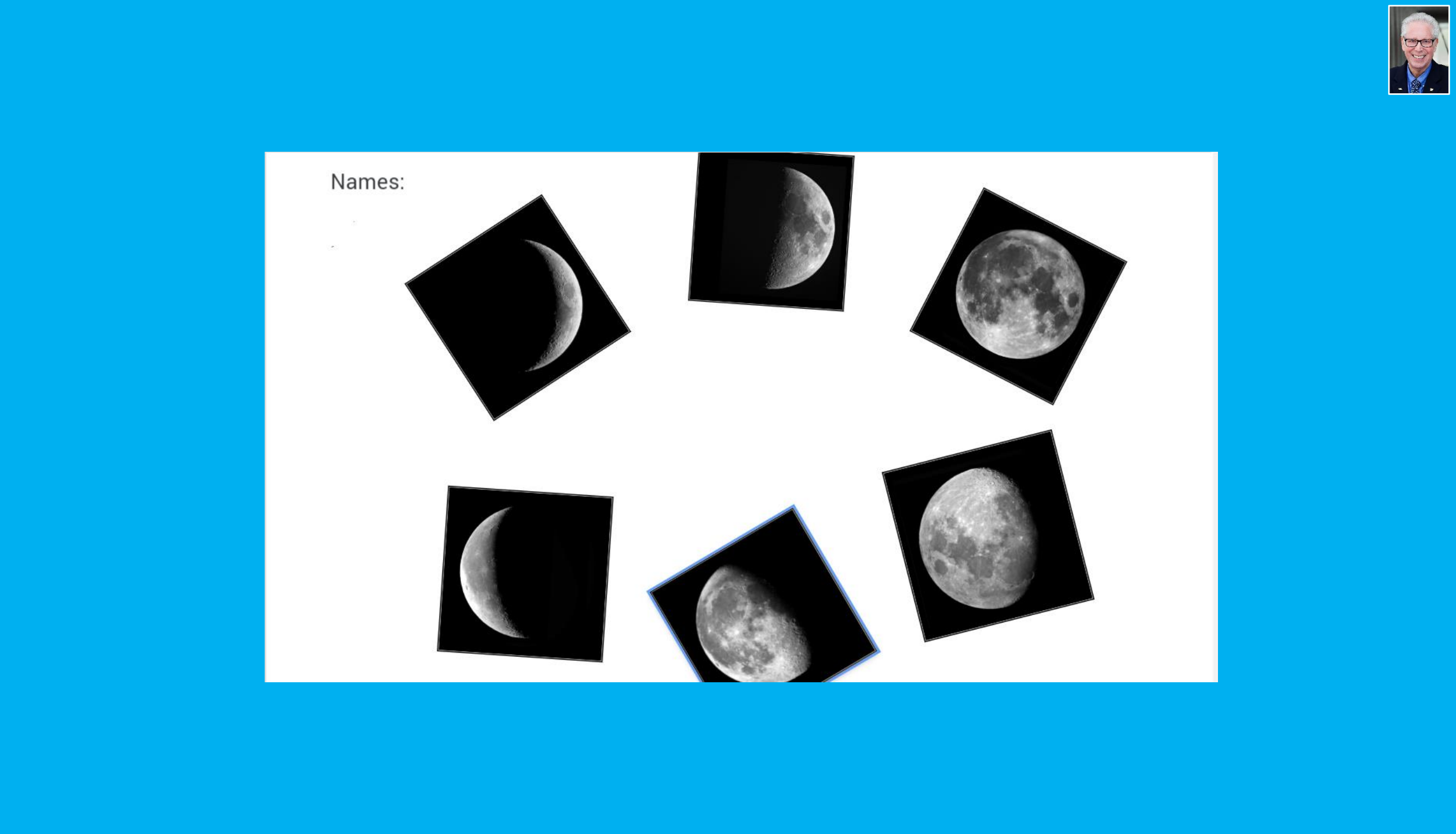
4.1 – Predicting What the Moon Will Look Like
4.3 – Observing the Moon
4.4 -- Modeling the Moon
4.5 – Modeling Eclipses



Six Lunar Photographs, Set 2

Source:
Fred Espenak

Names:

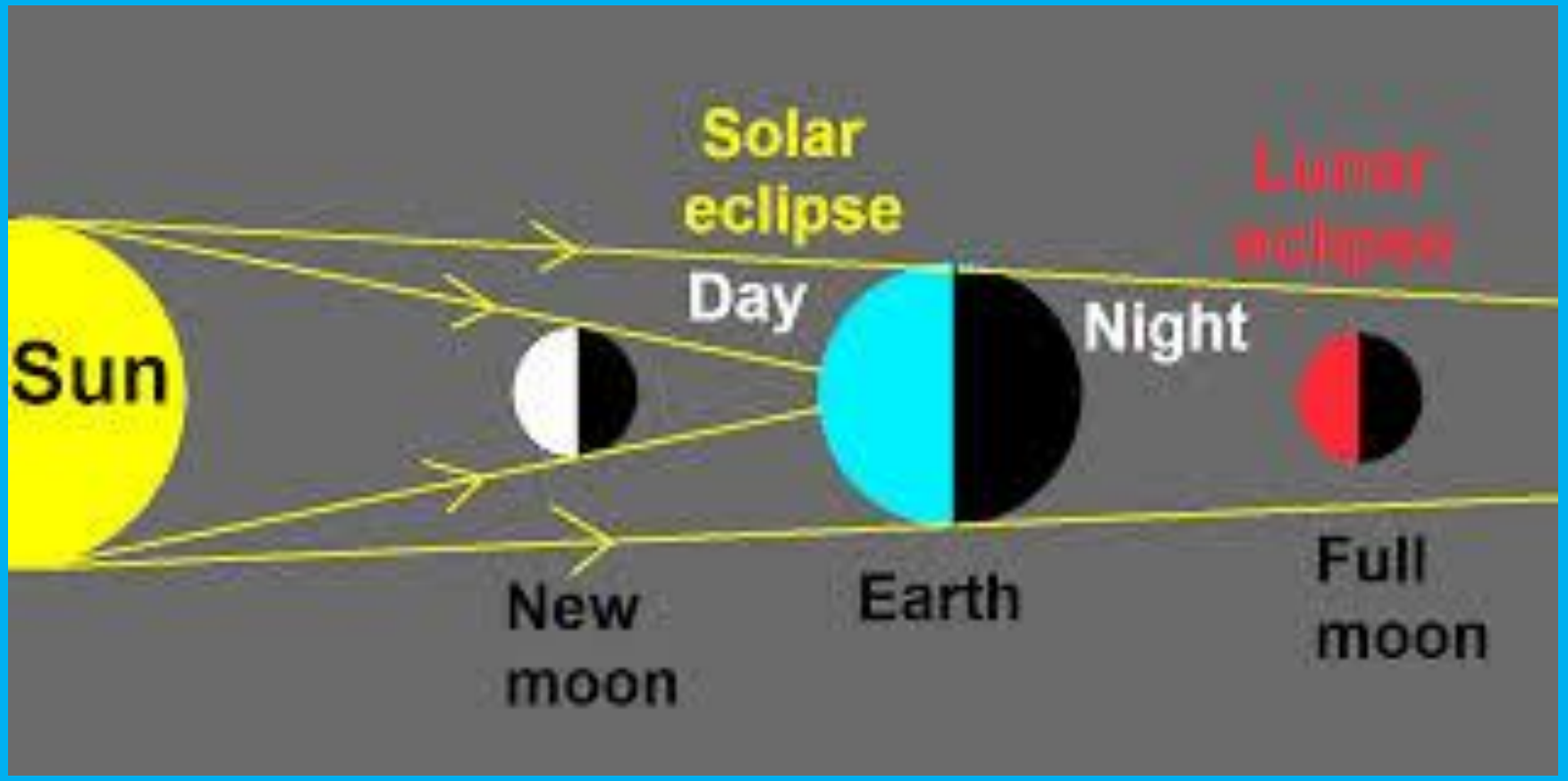

Names:

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

Modeling Lunar Phases and Eclipses



Questions That Immediately Come Up

- If a full Moon and new Moon happen every month, shouldn't we have eclipses every month?
- Why is 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

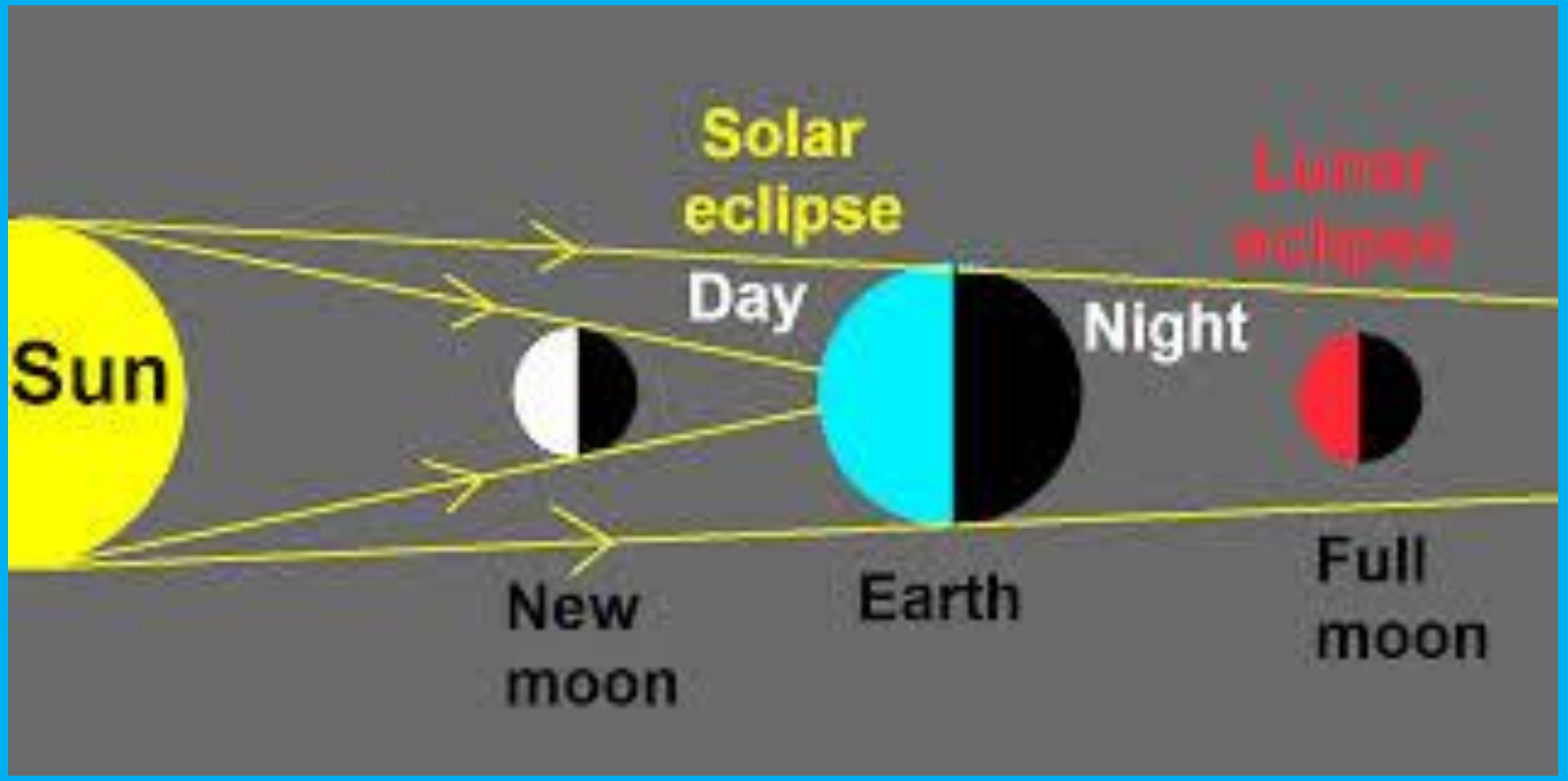
Experience 4.6

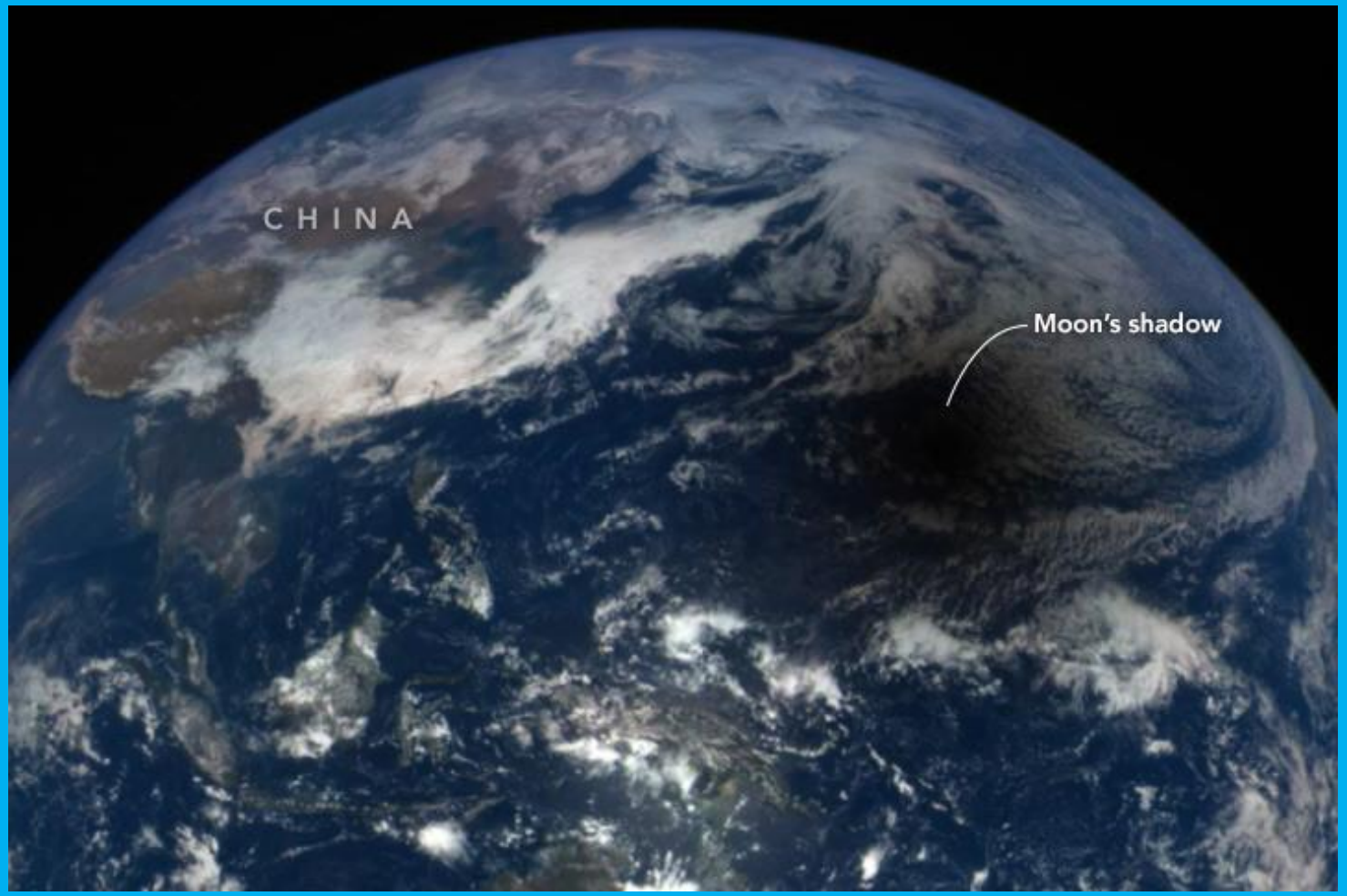
- One Hula Hoop is the orbit of the Moon around the Earth.
- The other Hula Hoop is the apparent path of the Sun around the Earth.
- Normally the Moon and Sun are not lined up to produce an eclipse.
- Eclipses only occur when Moon and Sun are at crossing points.
- Solar and lunar eclipses happen every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

Modeling Lunar Phases and Eclipses

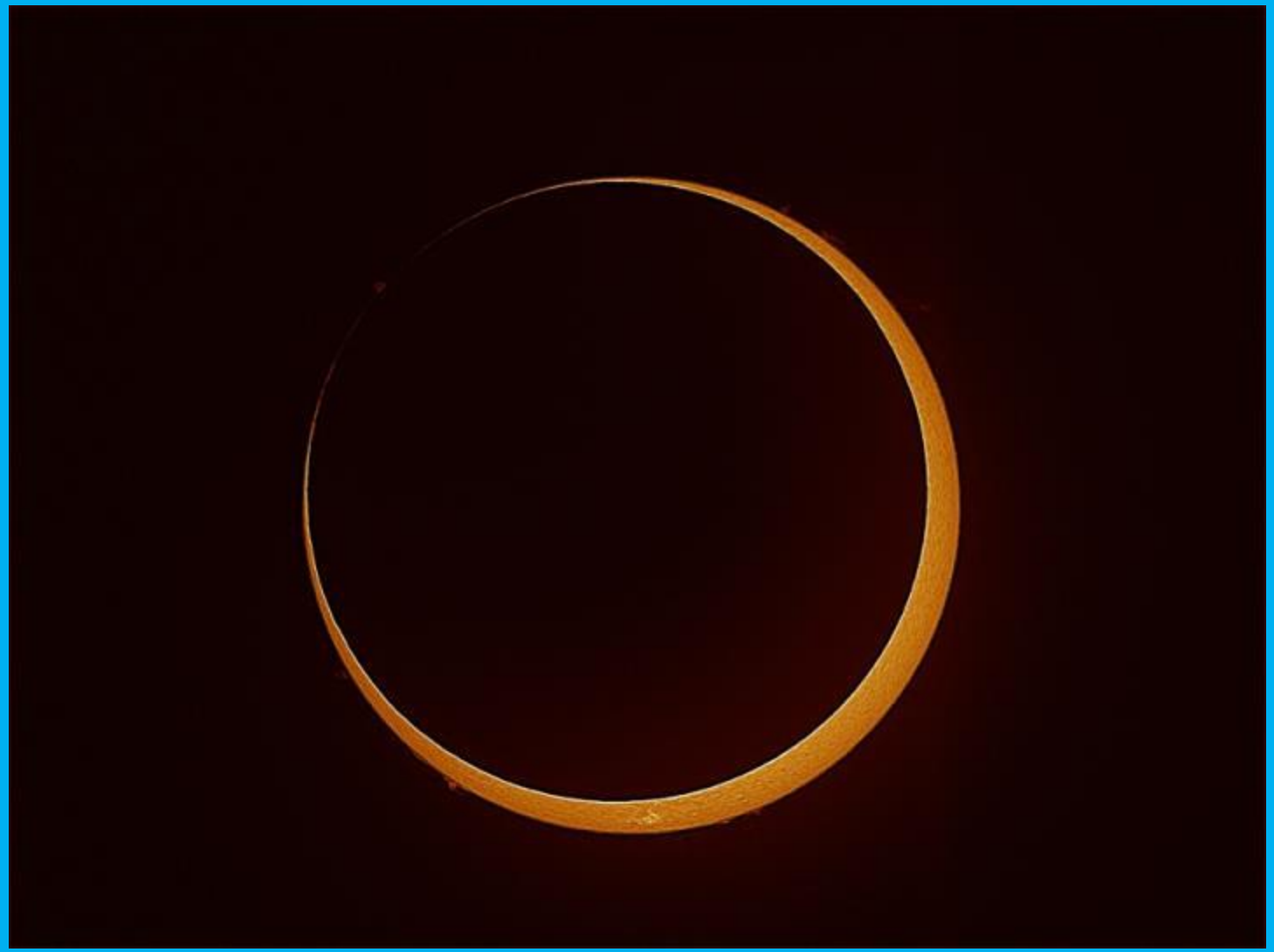




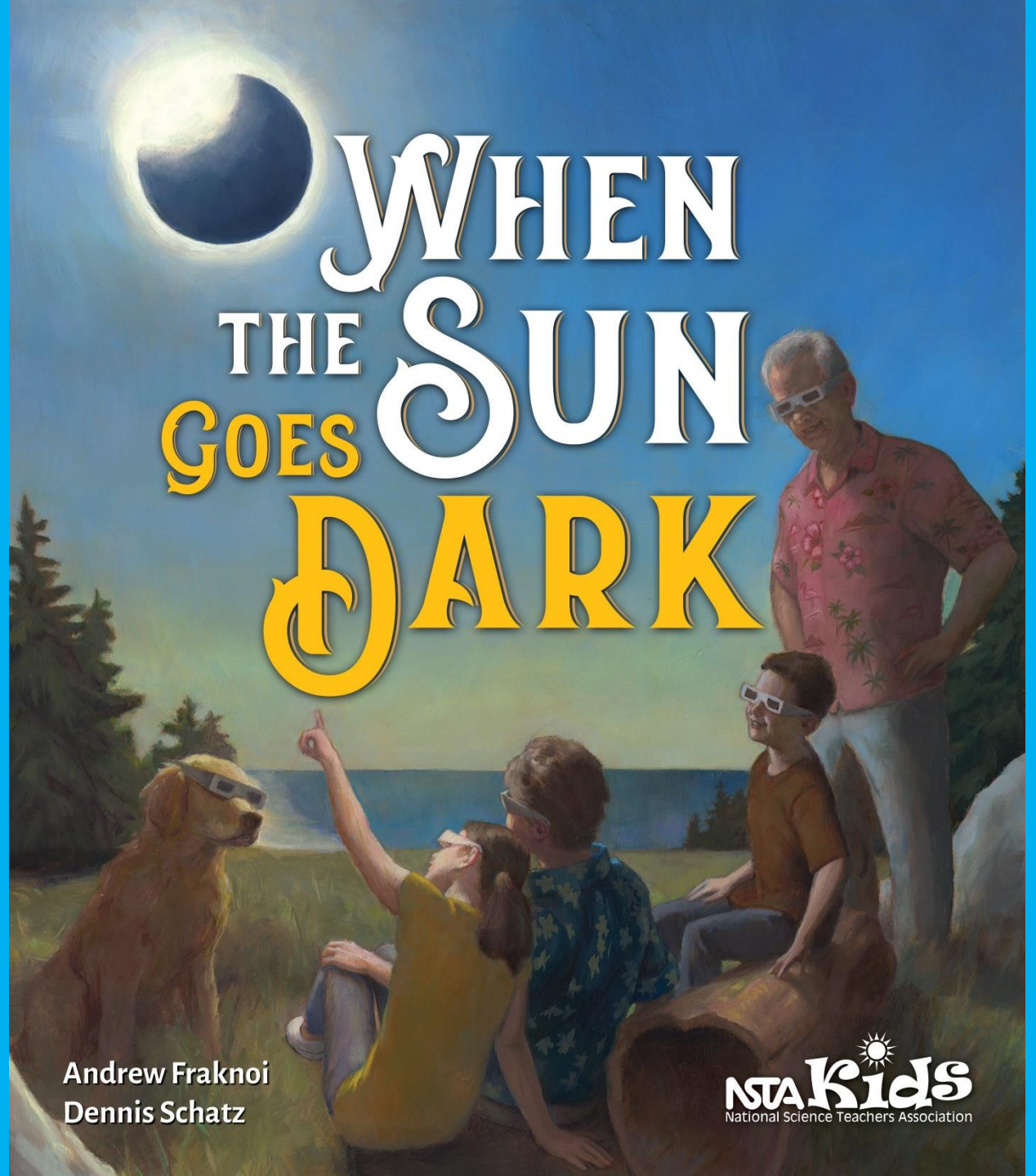
The eclipse shadow moves across the U.S. at 3900 kph (2400 mph).

Crosses the state of Oregon in about 10 minutes!

It will take 1 hour and 37 minutes to cross the U.S.




CHRIS COOK PHOTOGRAPHY


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.

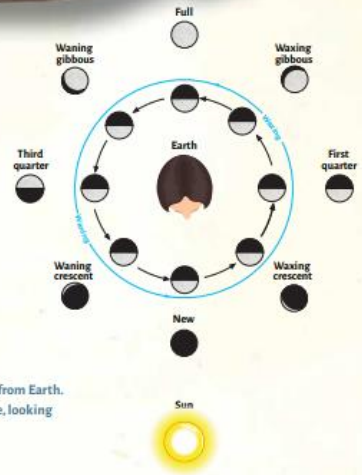
Grandma gave me a thumbs-up, but out of a corner of my eye, I could see Sammy sticking his tongue out at me. He didn't like it when I got an answer faster than he did. But it's not my fault I'm older.

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.

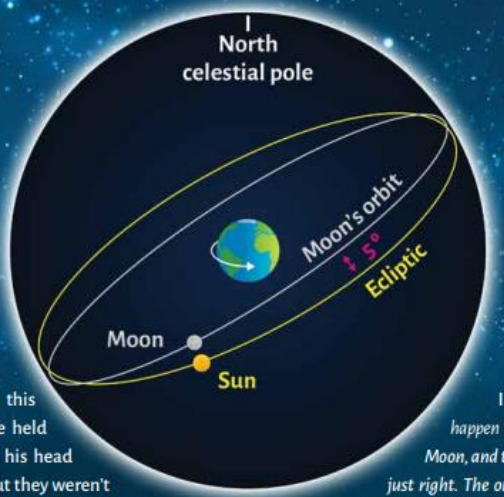
We moved the balls around our heads and saw different portions of the Moon lit up in different locations. In two places, the Moon was half lit up and half dark; in other places, we just saw a sliver of light, which Grandma called a *crescent Moon*.

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.

Let's Pause…

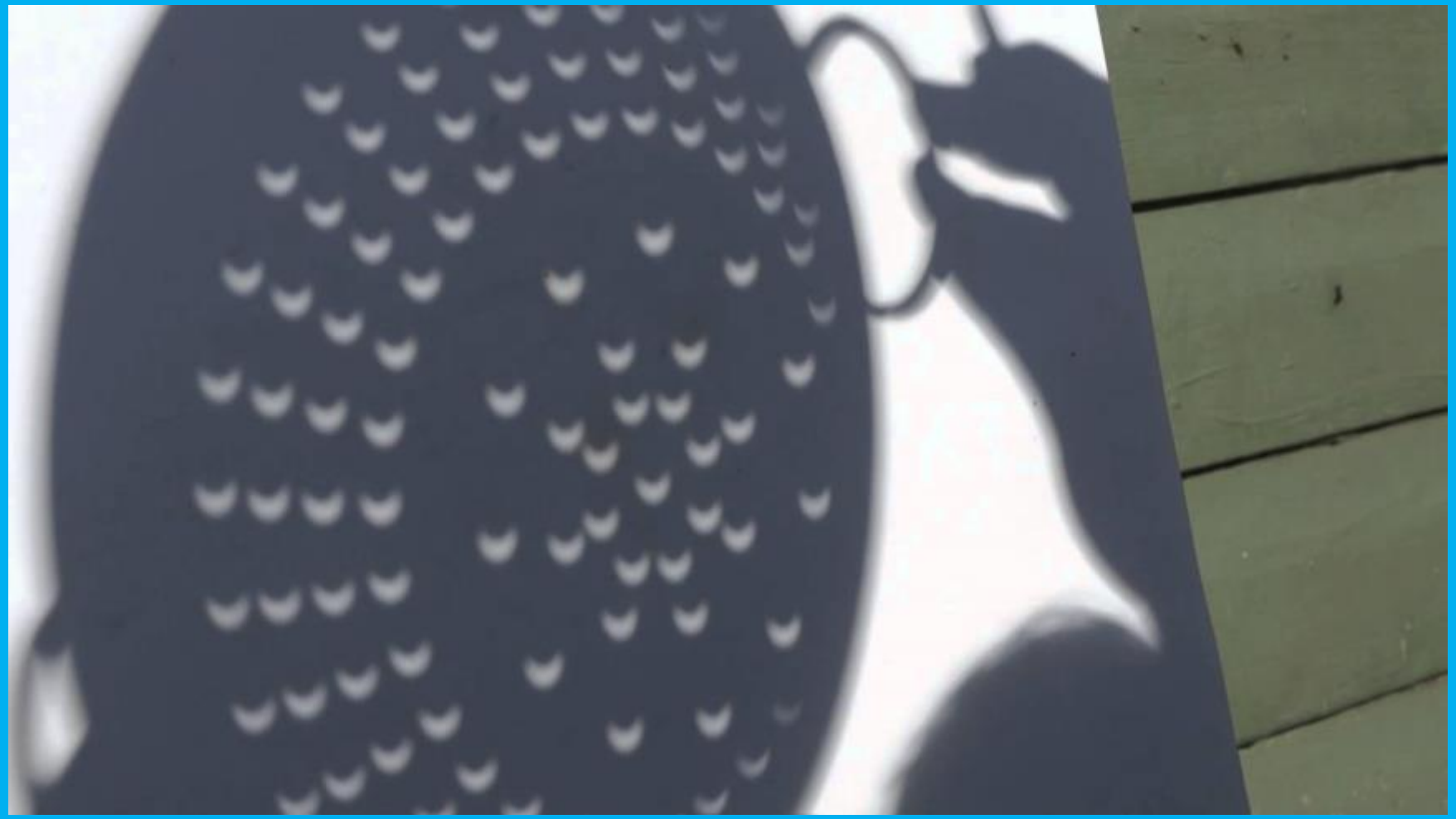
Let's pause for two questions from the audience.

Please share your questions in the chat window

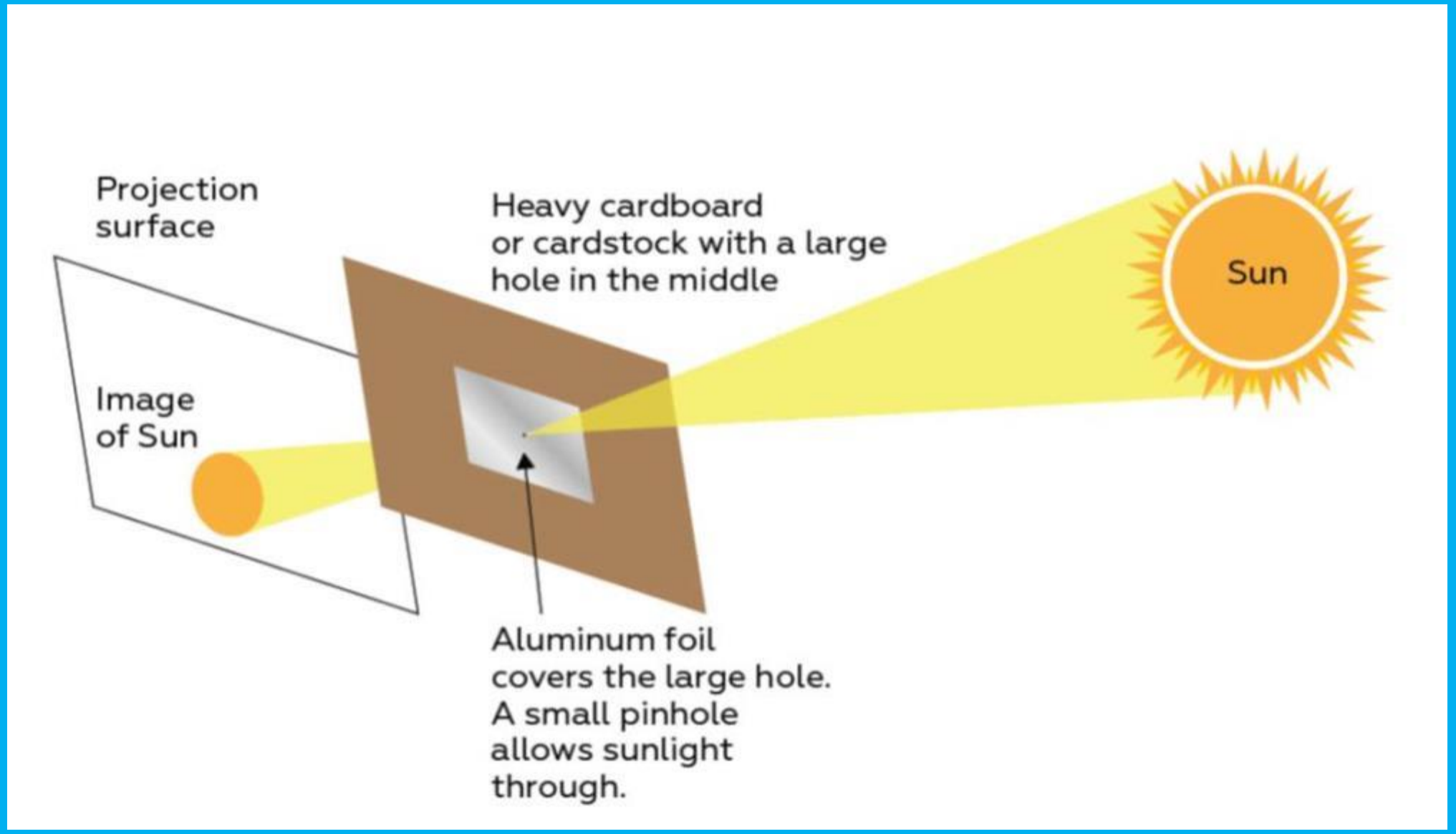
Poll question #3:

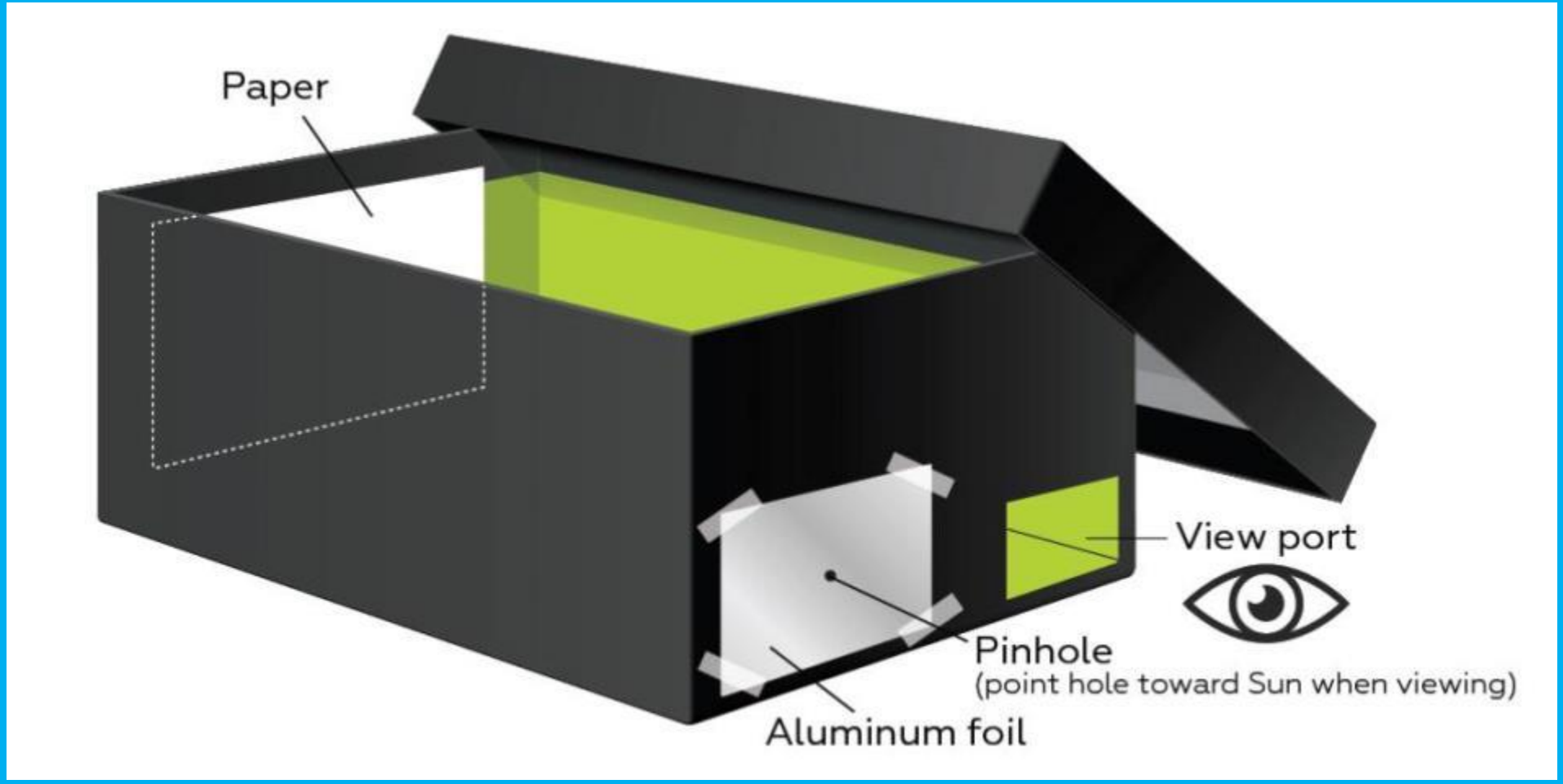
Which are safe ways to observe the eclipse?

A. Viewing the Sun through a sufficiently dense filter.
B. Projecting an image of the Sun on a light-colored surface.
C. Watching it on TV, computer or mobile device.
D. All of the Above.
E. Answers A and B.



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

Possible Partners:

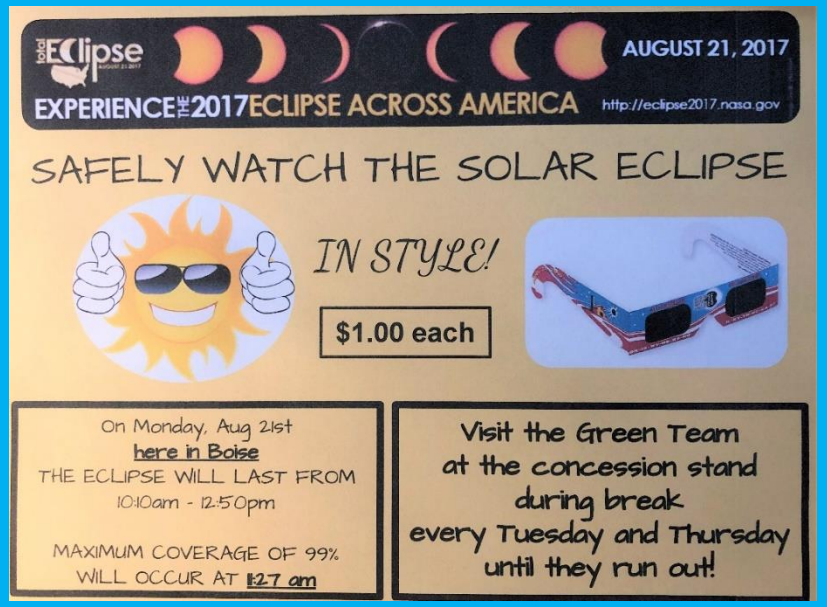
- NASA
- Libraries
- Amateur Astronomy Clubs
- Park Rangers
- Community Colleges
- University astronomy departments
- Planetariums
- American Astronomical Society Ambassadors
- Girl Scouts

Example from 2017

- We planned an entire day of STEM events for our students centered around the sun, moon, shadows, UV light, etc..
- We ordered NASA APPROVED glasses in May prior to the end of the previous school year for EVERY student and staff member.
- I invited a meteorologist to the school to speak to the kids ahead of time about what to expect, how to view safely, etc.
- We had an eye doctor come to the school and talk to all our students about eyesight and how and why we protect them from the sun the morning of the eclipse.

Example from 2017

A group of students and I were able to get money fronted to us to purchase (legit) eclipse viewing glasses. We sold them for $1 and made a small profit for future projects. We taped a small flyer to each pair to help communicate the details of our viewing times. It was really fun and we easily sold out (500 pairs).



AN OBSERVER'S GUIDE TO VIEWING THE ECLIPSE

SOLAR SCIENCE

ALL-AMERICAN TOTAL SOLAR ECLIPSE

AUGUST 21, 2017

By Andrew Fraknoi and Dennis Schatz

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 (*corona*) becomes visible—looking like a beautiful halo (Figure 1). This total eclipse will *only* be visible on a narrow track stretching across the United States from Oregon to South Carolina. No other country will get to see the total eclipse this time.

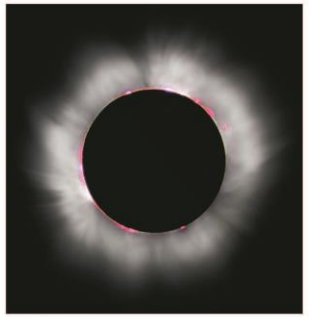
The rest of the United States and other parts of North and Central America will see a *partial* eclipse, in which the Moon covers only a portion of the Sun. A partial eclipse is interesting, but nowhere near as awe-inspiring and memorable as a total eclipse. A partial eclipse is also dangerous to look at without something to protect your eyes from the Sun's damaging rays.

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, as seen from Earth, 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. This allows us to see the Sun's corona,

FIGURE 1

During a total eclipse, the Sun is covered by the Moon, and the faint light of its corona becomes visible.



Source: Luc Viatour, Wikimedia Commons, CC BY-SA 3.0. *https://en.wikipedia.org/wiki/File:Solar_eclipse_1999_4_NR.jpg*

NSTA National Science Teachers Association

Future Eclipse Resources from NSTA

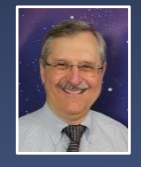
1. NSTA Eclipse Observing Guide
2. Summer/Fall 2023 issue of NSTA's K-12 Journals dedicated to the eclipses
3. Suggestions for how make the eclipses a school and/or community wide event
4. Future NSTA web seminars
5. Materials to share with your administrators

What to Tell Administrators

Look for future resource materials from NSTA that will allow you to inform your school administrators EARLY that:

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

Let's Pause…



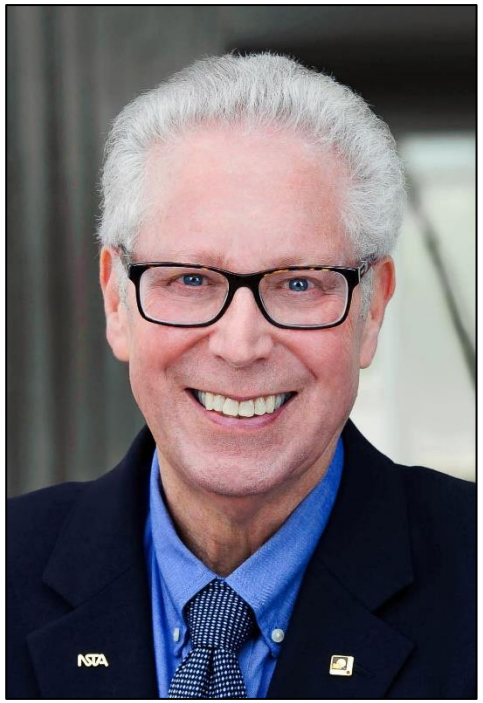
Let's pause for additional questions from the audience, as time allows.

Please share your questions in the chat window

We wish you clear skies for the eclipse in 2023 and 2024!

Thanks to Today's Presenters…

Andrew Fraknoi



Dennis Schatz

Thank You for Participating!

https://www.nsta.org

Post-program Survey – *coming up!*

We value your feedback!

The post-program survey link will be shared after the recording is stopped at the end of the program.

Your completed survey confirms your attendance which allows us to award you a certificate of participation and attendance.

Collection of Resources

This collection includes the slides (as PDF), handouts and other resources.

nsta
National Science Teaching Association

Link to the collection:
https://my.nsta.org/collection/zIQlcKEtn2k_E

Reminder: Upcoming Web Seminars

Web Seminar: NSTA Teacher Awards – Recognizing Excellence Rewarded
October 27, 7:00 PM ET

Science Update: NOAA – Observing and Understanding Earth Systems
November 3, 7:00 PM ET

Web Seminar: Developing a Competitive Application for Shell Teaching Awards
November 7, 7:00 PM ET

Transforming Science Learning: Leading the Implementation of High-Quality Instructional Materials to Enact Standards: Practical Guidance From the Field
November 7, 7:00 PM ET

Web Seminar: Exploration Generation: Sensemaking in Rocketry
November 9, 7:00 PM ET

Web Seminar: Case Studies from CSL: Developing Critical Consciousness in Middle-School Science Through Engineering for Sustainable Communities
November 14, 7:00 PM ET

https://www.nsta.org/webseminars

NSTA Virtual Learning Team

National Science Teaching Association
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Holly Hereau, Instructional Materials and PL Specialist
LaShawn Duckett, Director of Meetings
Emilee Clemens, Project Coordinator
Eddie Hausknecht, Senior Manager Web Development
Don Boonstra, Technical Coordinator

This concludes today's program.