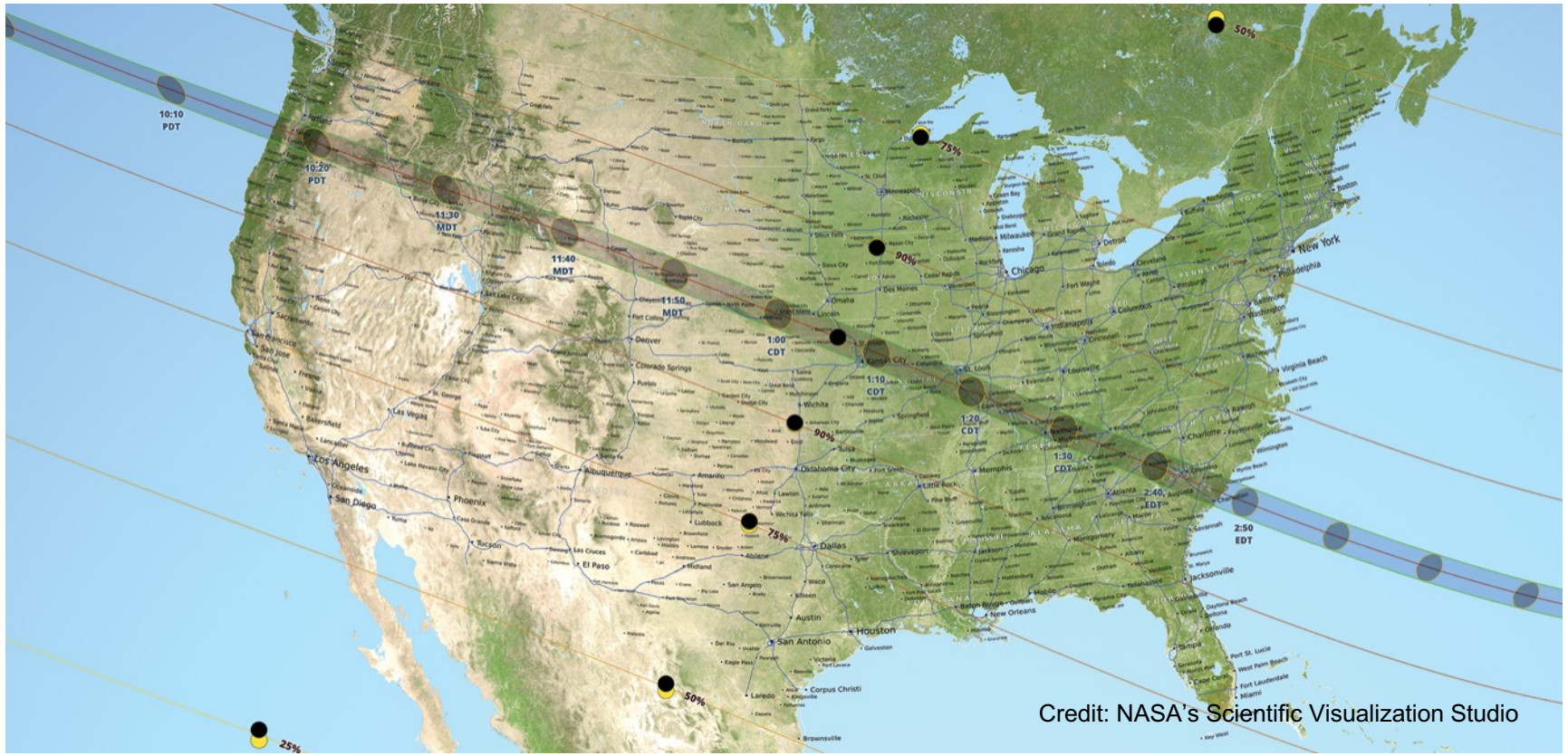
National Aeronautics and Space Administration

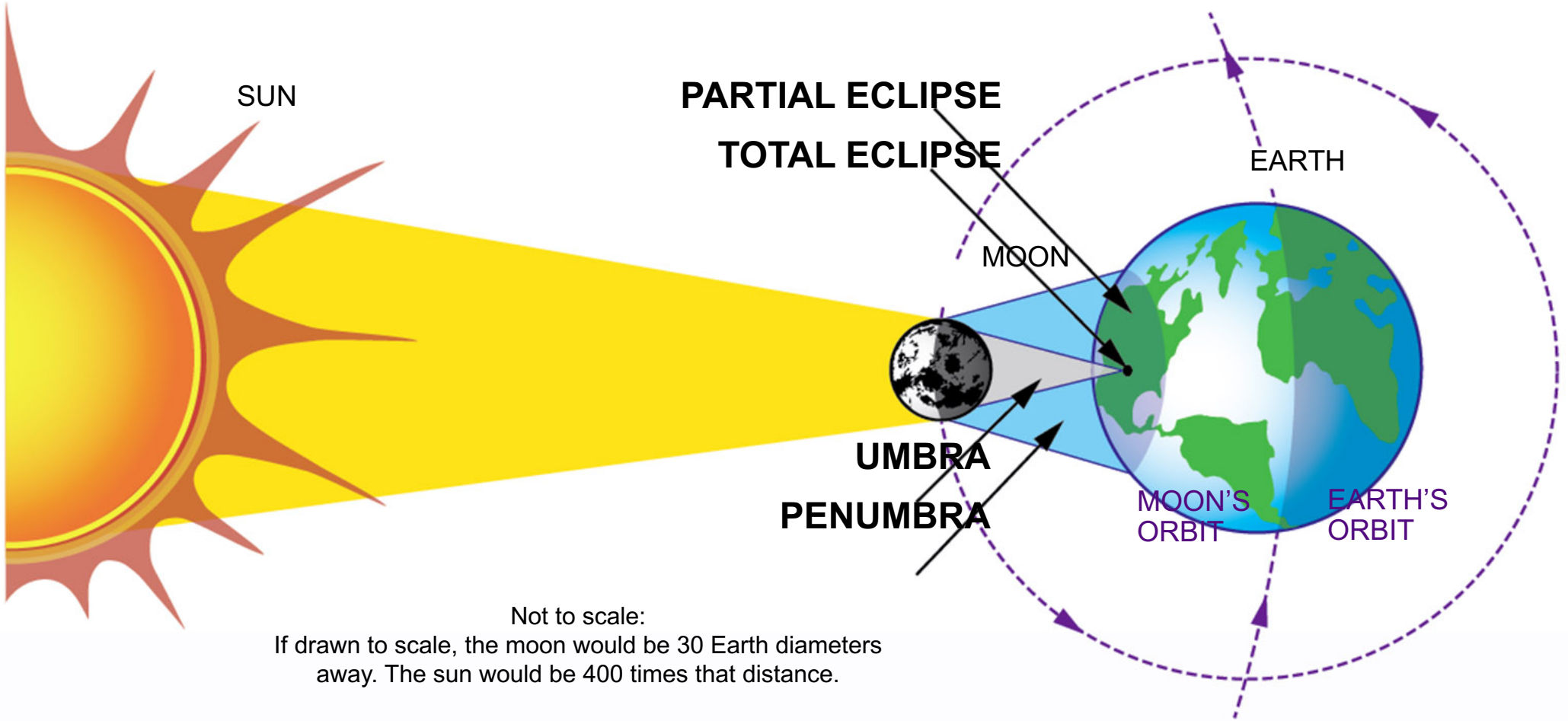
ECLIPSE BASICS

Credit: S. Habbal, M. Druckmüller and P. Aniol

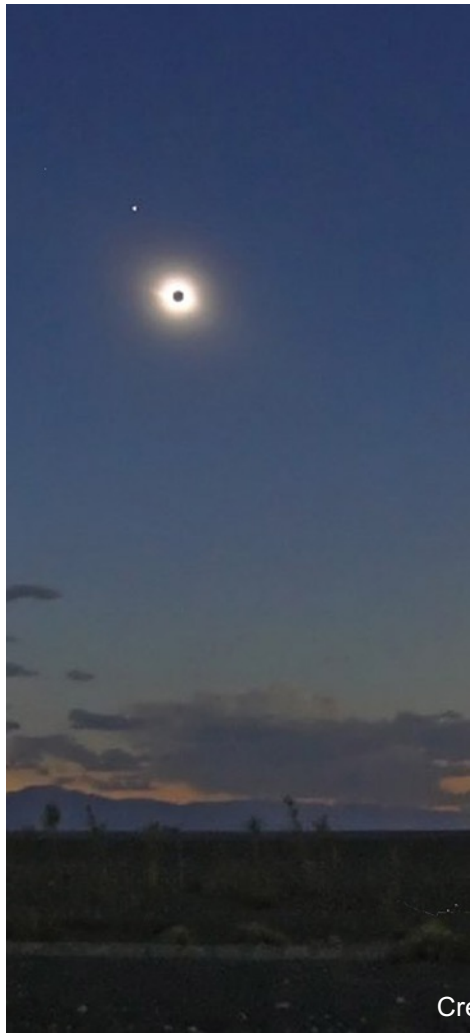


This map shows the path of the moon's umbral shadow—in which the sun will be completely obscured by the moon—during the total solar eclipse of Aug. 21, 2017. The lunar shadow enters the United States near Lincoln City, Oregon, at 9:05 a.m. PDT. Totality begins in Lincoln City, Oregon, at 10:16 a.m. PDT. The total eclipse will end in Charleston, South Carolina, at 2:48 p.m. EDT. The lunar shadow leaves the United States at 4:09 p.m. EDT. Outside this path, a partial solar eclipse will be visible throughout all of North America.

TOTAL SOLAR ECLIPSE: Monday • August 21, 2017



Not to scale:
If drawn to scale, the moon would be 30 Earth diameters away. The sun would be 400 times that distance.



Eclipses happen approximately once every 18 months, but only rarely cross over the same area.

THE LAST ECLIPSE

The last total eclipse in the United States occurred on **February 26, 1979.** The last total eclipse that crossed the entire continent occurred on **June 8, 1918.**

THE NEXT ECLIPSE

After the 2017 solar eclipse, the next total solar eclipse visible over the continental United States will be on **April 8, 2024**.

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www.nasa.gov

Credit: S. Habbal, M. Druckmüller and P. Aniol

SAFE ECLIPSE VIEWING

Eye safety

Travel safety

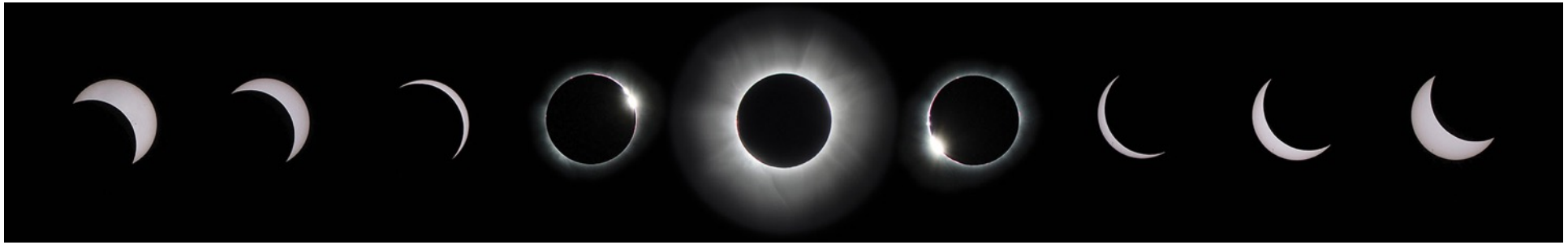
SAFELY observing THE SUN

Never look directly at the sun without proper eye protection. You can ***seriously*** injure your eyes.

View the eclipse with special eclipse glasses.

Regular sunglasses are not safe to view the eclipse.

Check with local science museums, schools and astronomy clubs for eclipse glasses—or purchase an ISO 12312-2 compliant and CE certified pair of these special shades!



In this series of stills from 2013, the eclipse sequence runs from right to left. The center image shows totality; on either side are the 2nd contact (right) and 3rd contact (left) diamond rings that mark the beginning and end of totality respectively.

1

PARTIAL ECLIPSE • GLASSES ON

The eclipse begins when the sun's disk is partially blocked by the moon. This partial eclipse phase can last over an hour.

2

BAILY'S BEADS • GLASSES ON

As totality approaches, only the low-lying valleys on the moon's edge allow sunlight through, forming bright spots of light called Baily's Beads.

3

DIAMOND RING • GLASSES ON

The last of the sunlight streaming through the moon's valleys creates a single bright flash of light on the side of the moon. This is known as the diamond ring effect, and it marks the last few seconds before totality begins.

4

TOTALITY • GLASSES OFF

Once the diamond ring disappears and the moon completely covers the entire disk of the sun, you may safely look at the eclipse without a solar filter. Be careful to protect your eyes again before the end of totality—the total eclipse may last less than a minute in some locations.

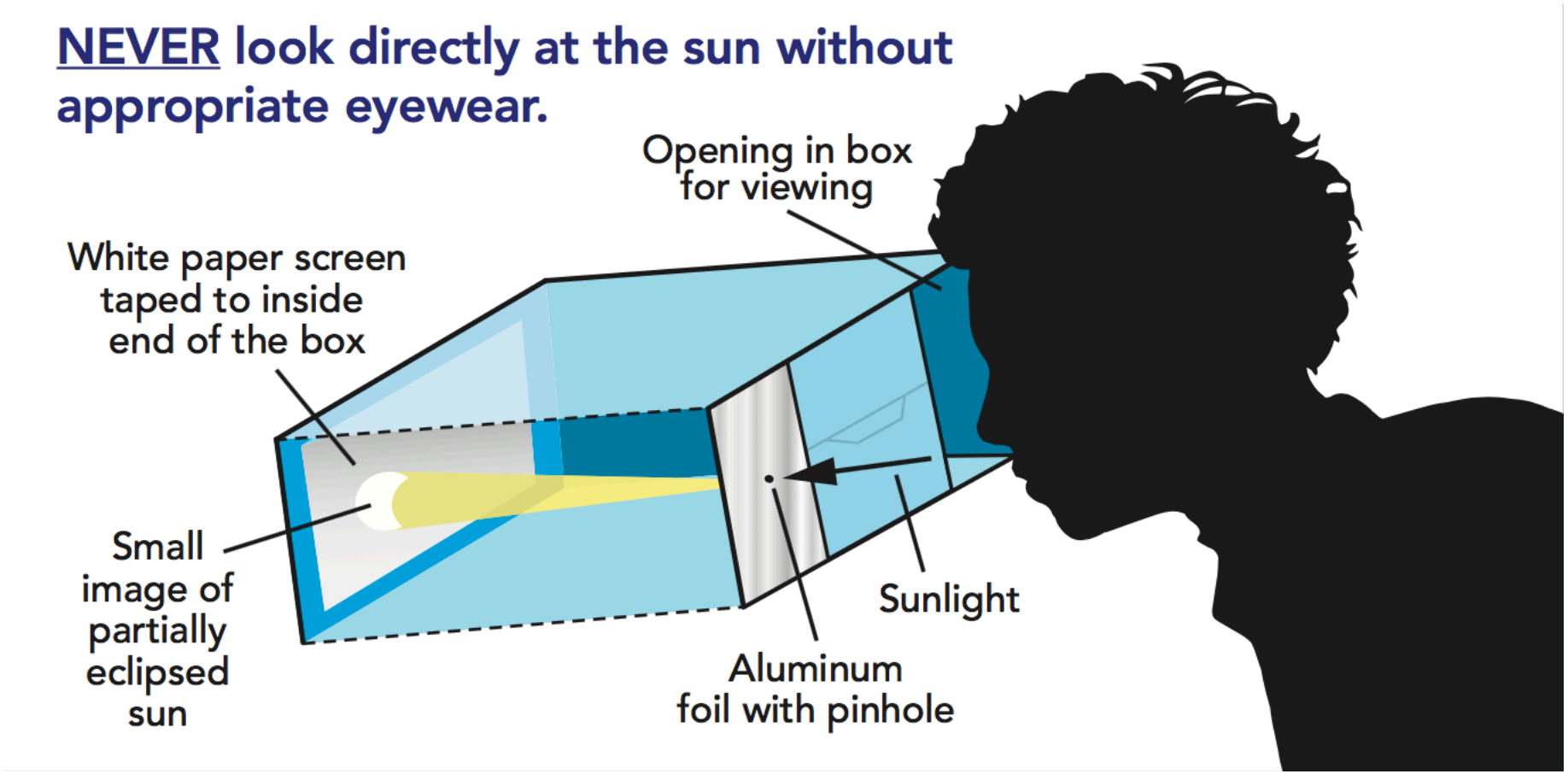
5

FINAL STAGES • GLASSES ON

A crescent will begin to grow on the opposite side of the sun from where the Baily's Beads shone at the beginning. This crescent is the lower atmosphere of the sun, beginning to peek out from behind the moon and it is your signal to stop looking directly at the eclipse. Make sure you have safety glasses back on—or are otherwise watching the eclipse through a safe, indirect method—before the first flash of sunlight appears around the edges of the moon.

MAKE YOUR OWN CARDBOARD PROJECTOR

You can make this simple eclipse projector with some cardboard, paper, tape and foil. The longer the distance from the pinhole to screen, the larger the image of the sun will be.



TRAVELING DURING THE ECLIPSE

The U.S. Department of Transportation anticipates intense traffic both before and after the eclipse along the path of totality.

Please warn people to attempt to get to their viewing spot well ahead of time – a day in advance if possible.

Suggest that travelers bring food and water, and that they know how to access a bathroom to wait out the traffic when they leave.

MORE SAFETY INFORMATION

http://eclipse 2017.nasa.gov/safety

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THROUGH THE EYES OF NASA

www.nasa.gov

Credit: S. Habbal, M. Druckmüller and P. Aniol

AUGUST 21: THREE-HOUR LIVE TV BROADCAST

AUGUST 21: NASA LIVE STREAMS

- Montana State University – 57 high-altitude balloons
  - https://stream.live/eclipse
- Up to 11 different sites around the nation streaming their NASA-related eclipse events.
  - Nasa.gov/eclipselive
- SDO imagery -- real time images of the sun. Including a lunar transit from 3:27 to 3:55 pm EDT.
  - https://sdo.gsfc.nasa.gov
- NASA EDGE will be holding a 4.5 hour live telecast of the eclipse from Carbondale, Illinois, including scientist interviews, high resolution sun imagery in various wavelengths, and a balloon launch from the stadium.
  - https://www.nasa.gov/multimedia/podcasting/nasaedge/index.html

KEY NASA PARTICIPATION

- Eclipse observations will occur from 11 space missions, 57 research balloons, and two WB57 planes.

- Astronauts aboard the International Space Station will gather imagery of partial eclipse and moon's shadow on Earth.

- NASA's Lunar Reconnaissance Orbiter, will turn its instruments to face Earth and track the shadow of the moon on our planet.

- Two NASA sun watchers -- NASA's Solar Dynamics Observatory and the JAXA/NASA Hinode -- will observe a partial eclipse from space.

- Several of NASA's Earth-observing spacecraft can both observe the shadow of the moon and measure how the eclipse affects Earth's atmosphere.

KEY NASA PARTICIPATION

- NASA funds 11 ground-based eclipse projects to study the sun's atmosphere – visible in high relief during a total eclipse in ways hard to replicate with instruments – and the effects of the eclipse on Earth.

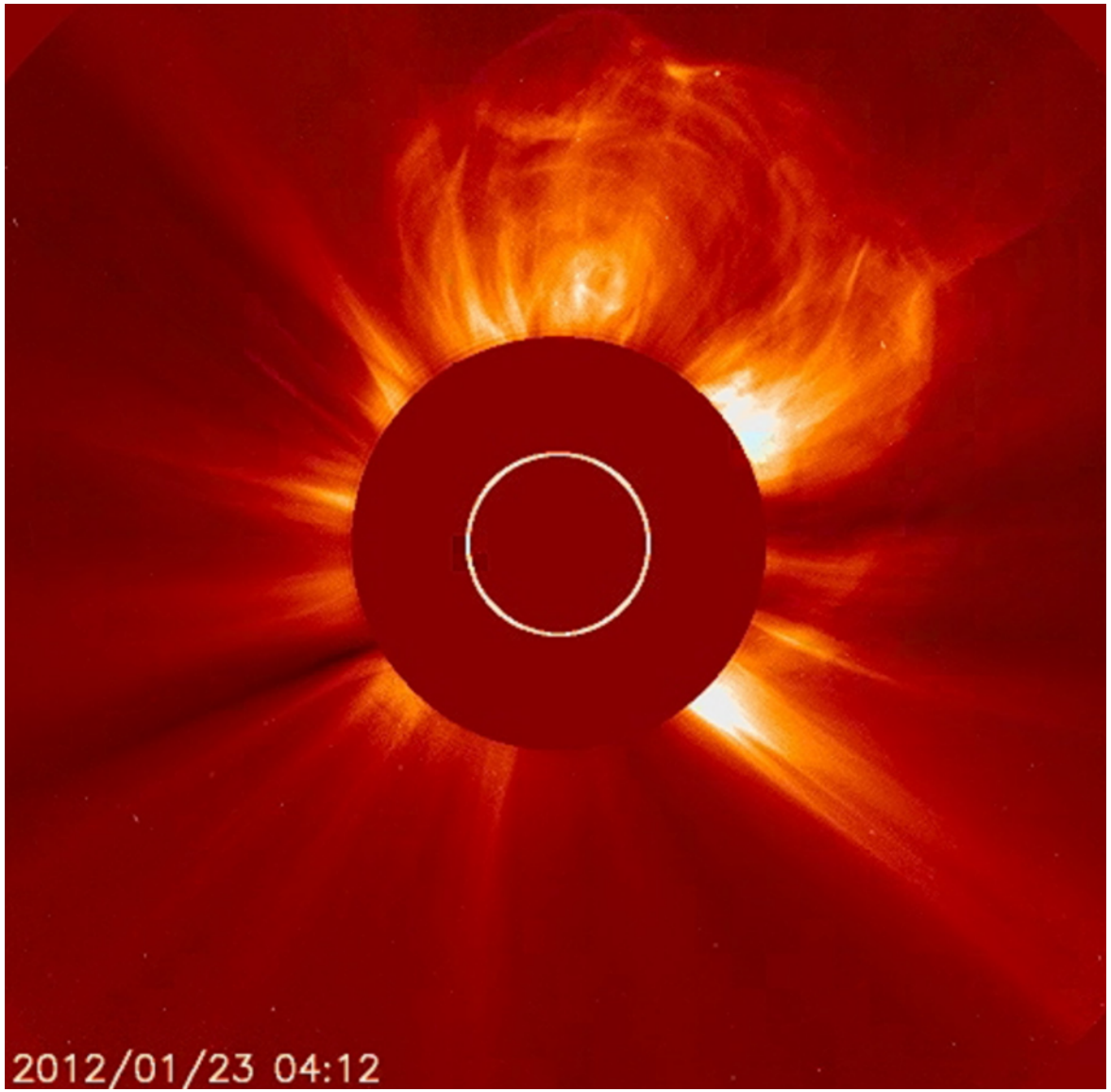
- NASA supports several citizen science projects, including Citizen CATE and GLOBE, to encourage citizen scientists to gather observations during the eclipse.

- NASA supports the Montana State University balloon project (http://eclipse.montana.edu/), for which students will conduct high-altitude balloon experiments from 25 locations across the total eclipse path.

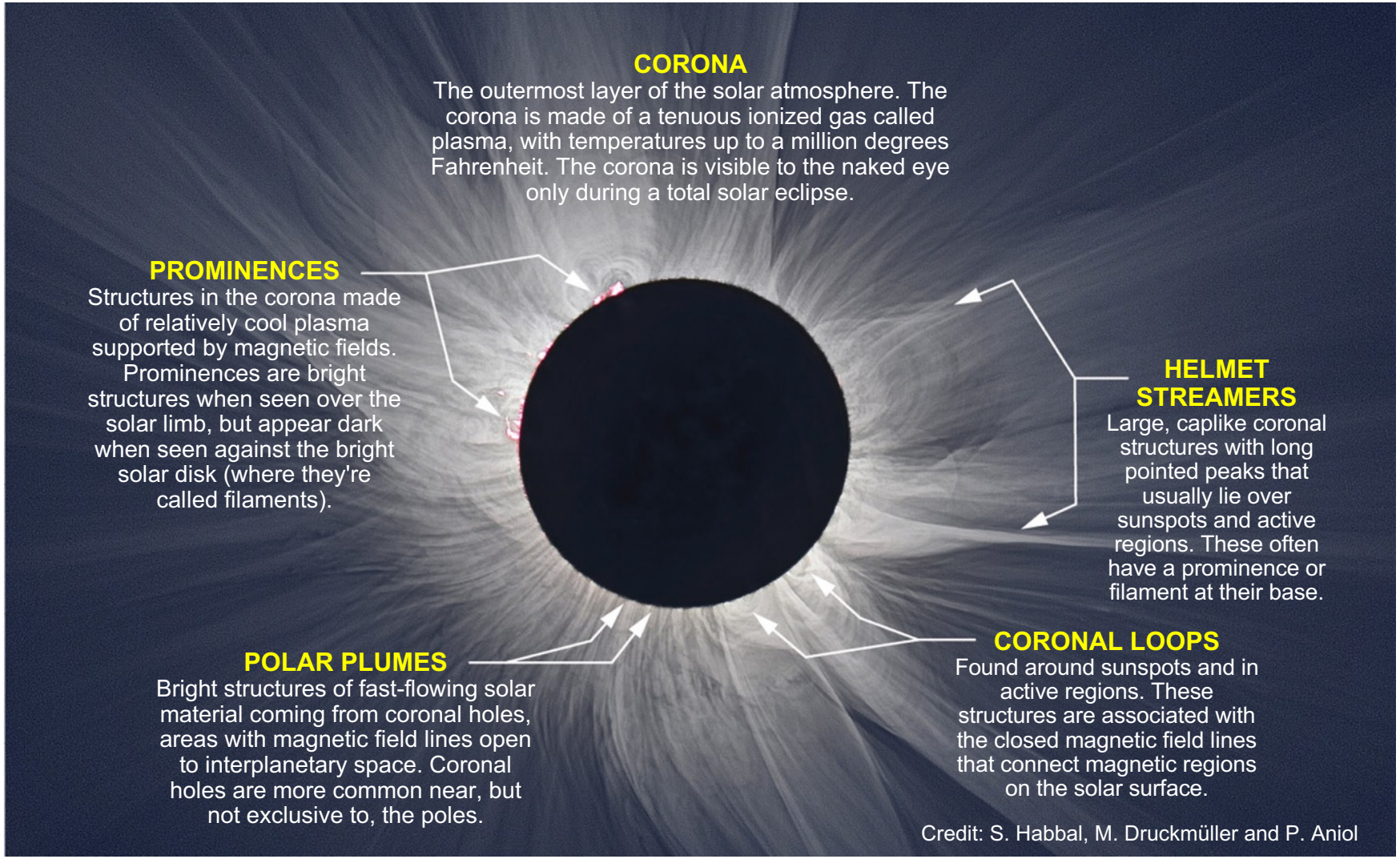
NASA SCIENCE: THE SUN

During a total eclipse, the lower parts of the sun's atmosphere, or corona, can be seen in a way that cannot completely be replicated by current human-made instruments.

The lower part of the corona is key to understanding why the sun’s atmosphere is so much hotter than its surface as well as the process by which the sun sends out a constant stream of solar material and radiation, which can cause changes in the nature of space and impact spacecraft, communications systems, and orbiting astronauts.



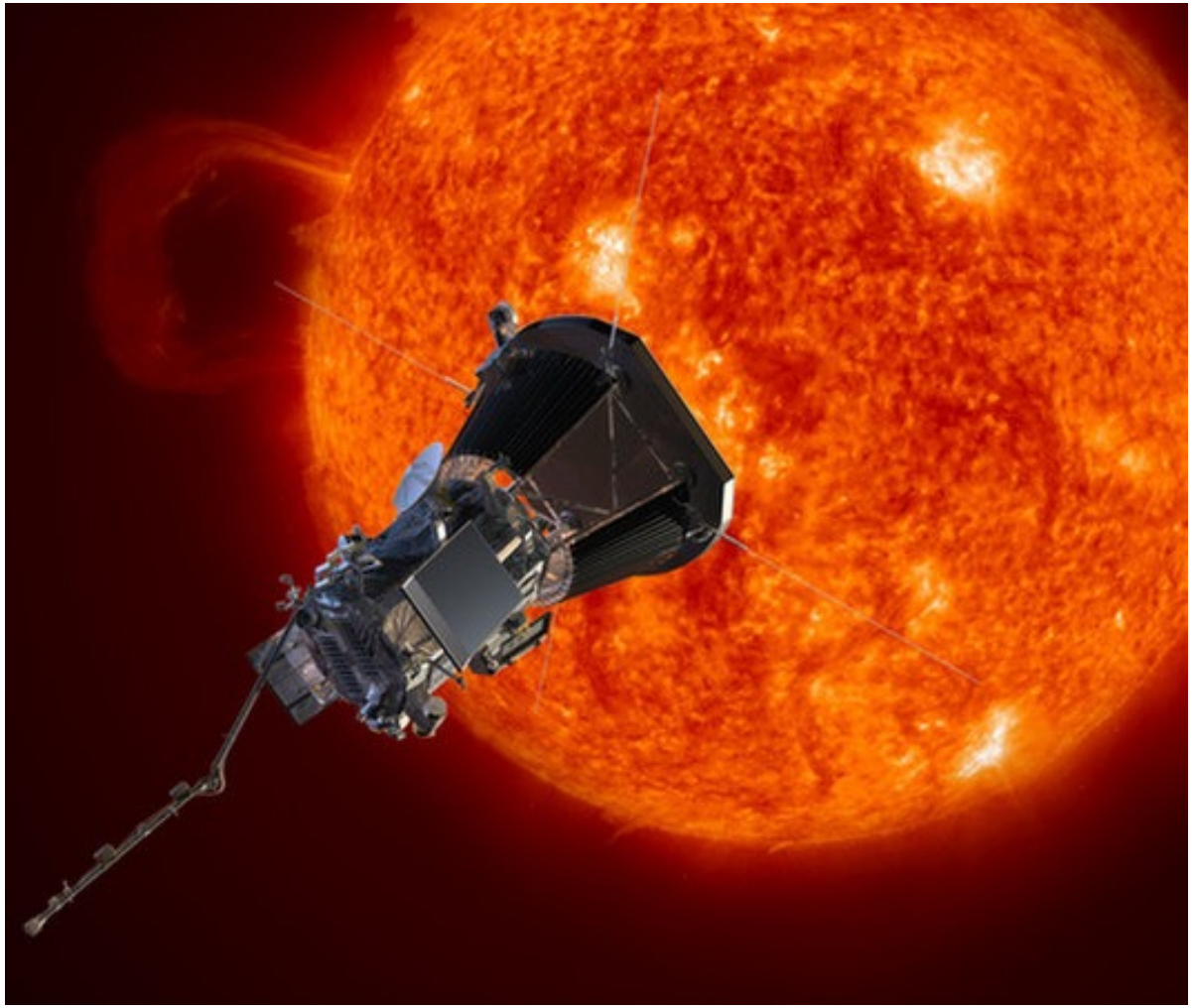
WHAT YOU CAN SEE DURING A TOTAL SOLAR ECLIPSE



NASA SCIENCE:
PARKER SOLAR PROBE

- Parker Solar Probe will launch in 2018 and will fly directly into the solar atmosphere that we can see with the naked eye during a total solar eclipse.

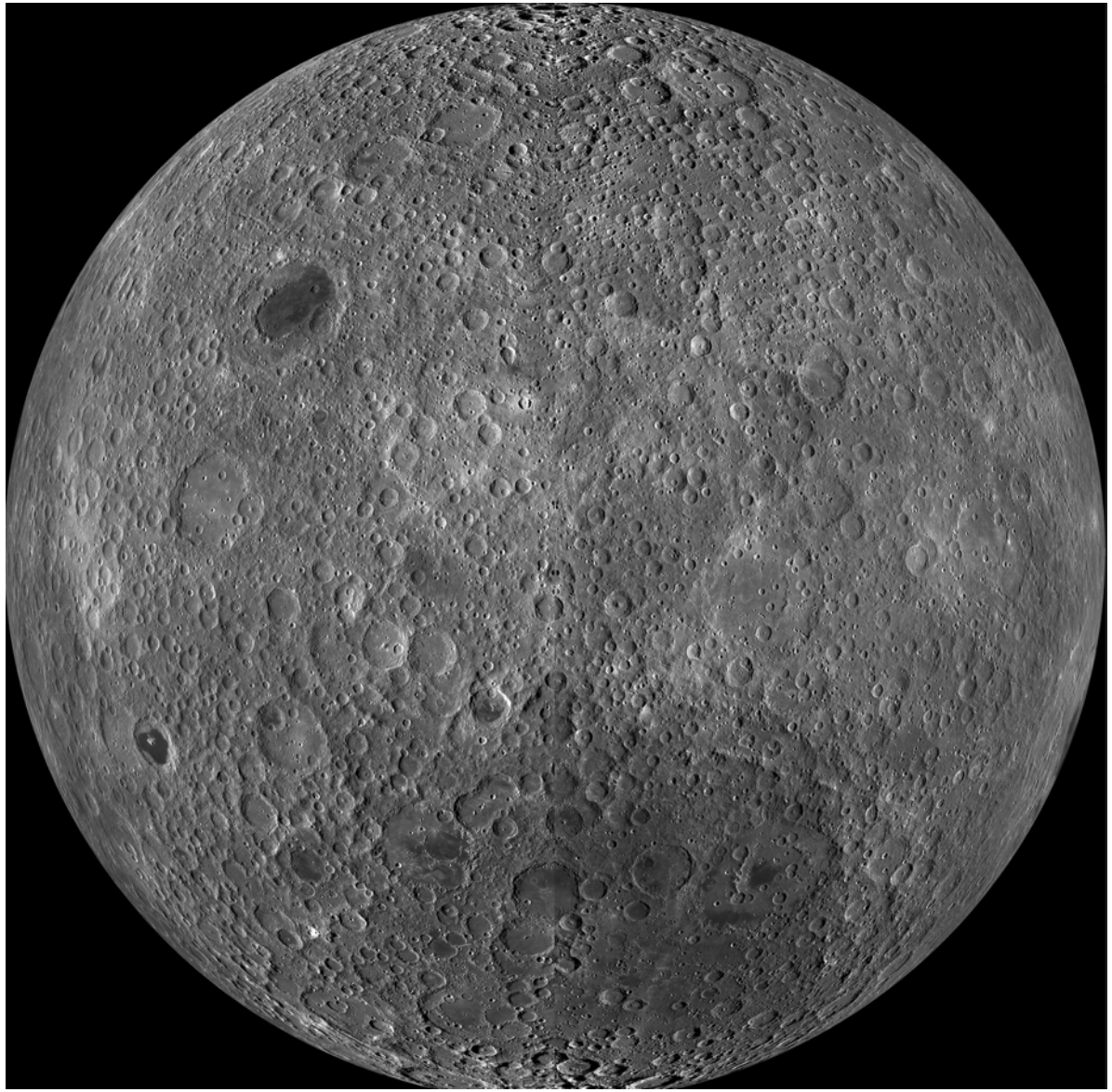
- Parker Solar Probe is being built by the Johns Hopkins University Applied Physics Lab.



NASA SCIENCE: THE MOON

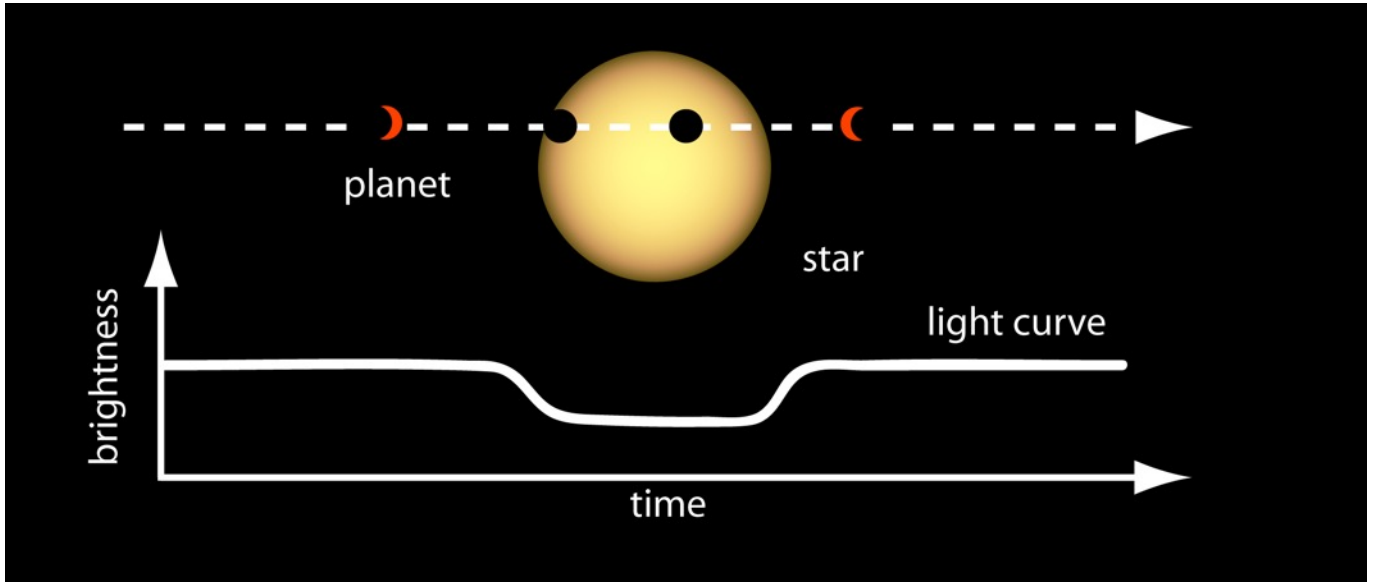
NASA's Lunar Reconnaissance Orbiter has provided the highest resolution images of the moon's horizon – providing information on just how light rays stream through lunar valleys. During totality, sunlight peeks through valleys and around mountains, adding edges to the umbra. These edges warp even more as they pass over Earth's own mountain ranges. Visualizers used data from NASA's Lunar Reconnaissance Orbiter, or LRO, coupled with NASA topographical data of Earth, to precisely map the upcoming eclipse in unprecedented detail. This work shows the umbral shape varies with time, and is not simply an ellipse, but an irregular polygon with slightly curved edges.

LRO instruments will turn around and take pictures of Earth during the eclipse.



NASA SCIENCE: EXOPLANETS

An eclipse is a specialized transit – any time one celestial object passes in front of another. Transits are key for discovering exoplanets, as we have tools for determining when a distant planet passes in front of a star. (Kepler, TESS, etc.)



NASA SCIENCE: THE EARTH

The eclipse can be used to discuss the Earth and sun relationship.

- Earth is a solar powered planet
- NASA Earth Science seeks to monitor and understand Earth's energy balance
- For almost 40 years, NASA jas measured the solar energy hitting the top of Earth's atmosphere.

NASA SCIENCE: THE EARTH

Total solar eclipses are an opportunity to study Earth under uncommon conditions. The sudden blocking of the sun during an eclipse reduces the light and temperature on the ground. These quick-changing conditions can affect local atmospheric conditions and animal behavior: Birds and animals will settle in for sleep in the middle of the day.

NASA SCIENCE: THE EARTH

Terra and DSCOVR will capture imagery of the sun's shadow across Earth.

NASA has funded eclipse research to monitor changes in atmosphere around the country.

NASA Earth research activities will enable citizen scientists from around the country to observe the clouds and take air and surface temperature readings during the hours immediately before and after the eclipse.

NASA SCIENCE: THE SOLAR SYSTEM

Depending on conditions, several planets will be observable during the total eclipse.

There are also similar transits and eclipses throughout the solar system – eg. Pluto and Charon have eclipse seasons and transits of Venus and Mercury travel across the sun. Occultations of solar system bodies are also used to understand the shapes and orbits of asteroids and the composition of planetary and satellite atmospheres.

It was observations of stellar occultations, when solar system planets passed in front of distant stars, which led to the discoveries of the rings of Uranus and Neptune.

NASA-FUNDED SCIENCE

NASA funds 11 ground- or airplane-based science missions across the United States for scientists around the nation to study the total solar eclipse. They will be able to see the faintest regions of the sun, as well as study the sun's effects on Earth's upper atmosphere.

Why NASA-funded?

- In some cases, the ground based observations will be compared to space based observations.
- Some of the observations will take place from NASA airplanes
- Some of the observations will test new instruments.

FOLLOW ALONG WITH NASA

eclipse2017.nasa.gov
@NASASun
Facebook.com/NASASunScience
snapchat.com/add/NASA
Instagram.com/NASAGoddard

TV show: nasa.gov/nasatv

WEBSITES OF NOTE

- NASA Communications info: http://communications.nasa.gov/content/solar-system-and-beyond

- IMAGERY:
  - Eclipse visualizations and maps : https://svs.gsfc.nasa.gov/cgi-bin/search.cgi?series=383
  - Path of totality and partial eclipses: https://svs.gsfc.nasa.gov/4518
  - State maps for the total eclipse: https://svs.gsfc.nasa.gov/4552
  - Eclipse events around the country: https://eclipse2017.nasa.gov/sites/default/files/2017_solar_eclipse_general_events.html

- Find subject matter experts here: https://eclipse2017.nasa.gov/sites/default/files/2017_solar_eclipse_SME_s_map.html

- Information about NASA funded ground-based research: https://www.nasa.gov/feature/goddard/2017/eclipse-2017-nasa-supports-a-unique-opportunity-for-science-in-the-shadow

- Link to eclipse art projects: https://eclipse2017.nasa.gov/eclipse-art-projects

- Link to 3D Pinhole Projectors: https://eclipse2017.nasa.gov/3d-printable-pinhole-projectors

National Aeronautics and Space Administration

EXTRA SLIDES

Credit: S. Habbal, M. Druckmüller and P. Aniol

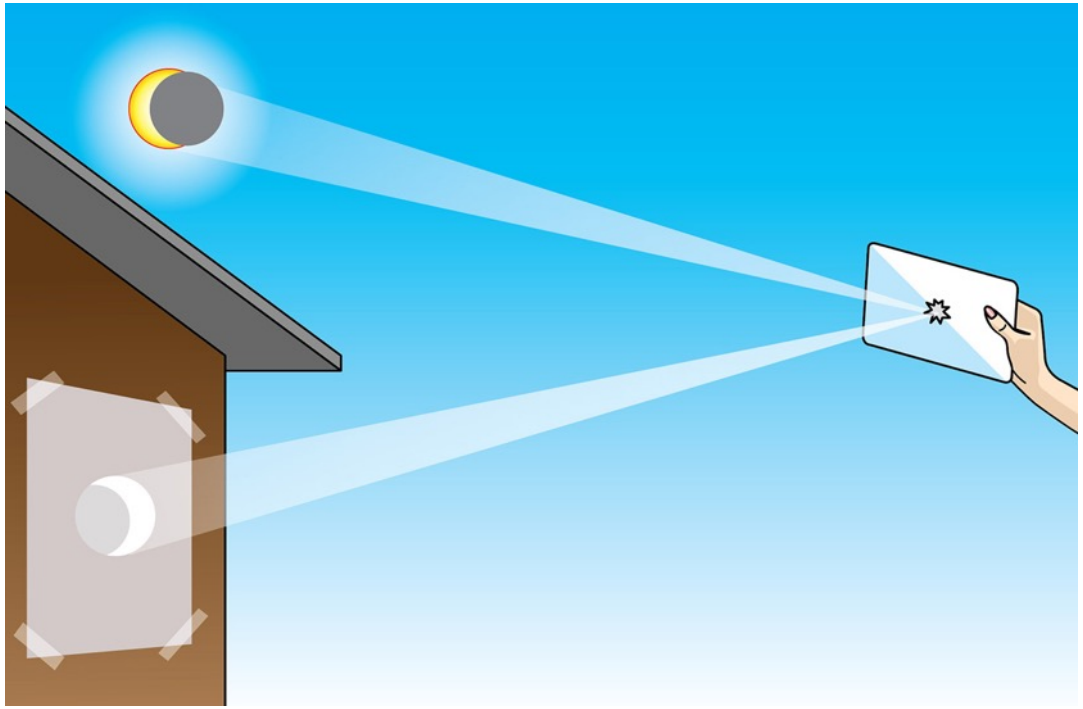
STRANGE SHADOWS!

Sunlight from a partial eclipse funnels through tree leaves to project images of crescents on the ground.

MIRROR IN AN ENVELOPE

Slide a mirror into an envelope with a ragged hole about 5/8 inch (1.5 cm) cut into the front. Point the mirror toward the sun so that an image is reflected onto a screen about 15 feet (5 meters) away. The longer the distance, the larger the image.

DO NOT LOOK AT THE MIRROR, ONLY AT THE SCREEN.



EYE SAFETY DURING AN ECLIPSE

It's NEVER safe to look directly at the sun, except when the sun is completely blocked during the period of a total eclipse known as *TOTALITY*.

This photo taken from the International Space Station shows the moon's umbral, or inner, shadow during the total solar eclipse of March 29, 2006.