



SOLAR  
ECLIPSE

08.21.2017

# A Historic Day

For many Americans, Aug. 21 will be a once-in-a-lifetime opportunity to see one of the greatest displays in nature: a total solar eclipse.

Partial solar eclipses — those in which the moon blocks a portion of the sun during the daytime hours — aren't particularly uncommon. Total solar eclipses, in contrast, are far less common, especially for people who don't have the means or interest to travel to obscure corners of the globe to witness them.

## A UNIQUE PATH

What makes this year's eclipse special, then? It's the path it's taking across the United States, making it visible in or near populated areas where tens of millions of people can experience it.

National Geographic has called this year's event the "best total solar eclipse in a century" because it is the first to cross the United States from coast to coast since 1918.

Prime viewing spots are located along a narrow strip that crosses 12 states, from Oregon to South Carolina. People along this path will see a total eclipse, in which the moon fully



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blocks out the sunlight for a period of time, briefly turning day into night.

Millions more, though, will witness a near-total eclipse that is almost as spectacular. Because of its prime path across North America, most people in the United States will be able to see at least a 75-percent eclipse

If you want to know when the eclipse will appear in your area, NASA has created an interactive map at [eclipse2017.nasa.gov](http://eclipse2017.nasa.gov) that can give you

all the details.

## TRAVEL PLANS

Because of the unique nature of this year's eclipse, many people are expected to travel to get a better view of the unusual heavenly phenomenon.

Even months before the eclipse, hotels in some areas were reportedly sold out as sky gazers made reservations well in advance to ensure they had the best view of the event. It's a

good idea to plan early if you want to travel for the total eclipse.

Others are planning parties to mark the occasion, while many observatories and educators are holding special events in conjunction with the eclipse.

Being something that happens so rarely in the United States, the total eclipse is a great way to teach and raise excitement around science and the natural universe.

# Eye Safety Tips

While solar eclipses can be some of the most spectacular shows in nature, they also can be very dangerous if viewers don't follow proper precautions.

Here are some things to know.

## EYE DAMAGE CAN BE PERMANENT

Staring at the sun any time can cause permanent, irreversible eye damage, so it's important to take eye safety seriously.

The human retina is very sensitive to light and also quite delicate. Too much sunlight hitting the retina can cause damage, resulting in solar retinopathy. In extreme cases it can cause blindness, but more often it results in other serious vision problems such as yellow or dark spots or blurred eyesight.

Solar eclipses are a particular risk because viewers are tempted to stare at the sun for long periods of time. Even a small sliver of sunlight showing is enough to cause permanent eye damage.

To save your vision, make sure you use proper eye protection — not ordinary sunglasses.

## SPECIAL PROTECTION NEEDED

To watch the eclipse safely, you'll need to use appropriate eye glasses to filter out the sunlight.

According to NASA, only four manufacturers have been certified under the international ISO 12312-2 standard for these glasses: Rainbow Symphony, American Paper Optics, Thousand Oaks Optical and TSE 17.

It's a good idea to order eclipse glasses early because high demand may cause a backlog or shortage of



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these safety devices.

## STAY SAFE

NASA also offers these safety tips:

- Homemade filters or ordinary sunglasses, even very dark ones, are not safe for looking at the sun.

- Always inspect your solar filter before use; if scratched or damaged, discard it. Read and follow any instructions printed on or packaged with the filter. Always supervise children using solar filters.

- Stand still and cover your eyes

with your eclipse glasses or solar viewer before looking up at the bright sun. After glancing at the sun, turn away and remove your filter — do not remove it while looking at the sun.

- Do not look at the uneclipsed or partially eclipsed sun through an unfiltered camera, telescope, binoculars, or other optical device. Similarly, do not look at the sun through a camera, a telescope, binoculars, or any other optical device while using your eclipse glasses or hand-held solar viewer — the concentrated solar rays

will damage the filter and enter your eye(s), causing serious injury.

- Seek expert advice from an astronomer before using a solar filter with a camera, a telescope, binoculars, or any other optical device.

- If you are within the path of totality, remove your solar filter only when the moon completely covers the sun's bright face and it suddenly gets quite dark. Experience totality, then, as soon as the bright sun begins to reappear, replace your solar viewer to glance at the remaining partial phases.

# Solar Eclipse Basics

While solar eclipses have existed ever since the moon was formed — which scientists say happened several billion years ago — humans' understanding of the eclipse is more recent.

Below are answers to some common questions about eclipses.

## WHAT CAUSES AN ECLIPSE?

Eclipses are caused by the alignment of the sun, Earth and moon. A solar eclipse occurs when the moon's path falls between Earth and the sun, blocking out sunlight for a period of time.

## HOW OFTEN DOES A TOTAL ECLIPSE HAPPEN?

On average, a total solar eclipse occurs somewhere on Earth every 18 months. The timing for a total eclipse over any specific spot, though, can vary dramatically depending on how the cosmic bodies align. According to Science.com, a ballpark estimate of 400 years is a reasonable average for any given point, but some spots on Earth can take up to 3,600 years between totalities.

## WILL I SEE A TOTAL ECLIPSE?

If you live within the path of totality — a relatively narrow strip from Oregon to South Carolina — you will see a total eclipse on Aug. 21. Otherwise, observers in America will see a partial eclipse.

## CAN I WATCH IT ONLINE?

Yes. If the skies are cloudy or your job keeps you working at a desk, NASA is planning a two-hour-long live broadcast during the eclipse from the Newseum in Washington, D.C. It can be seen at [nasa.gov](http://nasa.gov) or on cable televi-



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sion's NASA Channel.

## HOW LONG WITH THE ECLIPSE LAST?

The Aug. 21 total eclipse will last no more than 2 minutes, 43 seconds, and perhaps considerably shorter depend-

ing on the viewing location. The longest eclipses have a duration over 7 minutes.

## WHAT IS THE DIFFERENCE IN A PARTIAL AND TOTAL ECLIPSE?

A total eclipse occurs when the sun

is completely blocked by the moon's path, revealing the corona that normally cannot be seen with the naked eye. In a partial eclipse, the moon passes the sun off center so that a portion of the sun's disk is still visible.

# Capturing the Images

Photography is all about capturing light, and one of the most dramatic and memorable ways to do that is during a solar eclipse.

Getting good images of an eclipse can be challenging, though, from both a technical and safety viewpoint. Here are some things for photographers to consider.

## SAFETY FIRST

Any time you plan on photographing the sun, you'll need to acquire an appropriate solar filter. Not only will a proper filter protect your eye sight — which should be your top concern in this type of photography — but it also can keep your equipment from being destroyed.

Both digital and film cameras can be damaged or ruined by unfiltered or improperly filtered sunlight.

Make sure you buy a filter that is properly certified and designed for direct sunlight, and follow all the manufacturer's directions for its safe use.

## PRACTICE

Like in any type of quality photography, practice makes perfect.

In the case of eclipses, which don't occur often, you have to replicate the right conditions to prepare for it. With the proper filter in place, you can practice shooting photos of the sun in daylight to get some idea of the lenses and camera setup that will give you the results you're hoping for.

You also can practice at night by photographing the moon, which will be the same size as the eclipse.

Because a total eclipse is the fastest and most dramatic change in lighting that Mother Nature can throw at a photographer, you should take the time to make sure you're familiar with



all the camera's settings. A total eclipse, which will last less than three minutes at peak locations, is no time to be learning about your new gear.

## THE CORONA

The most famous photographs of total solar eclipses always show the corona, that faint, pearly glow that surrounds the sun and is normally only visible during an eclipse.

The corona is made up of very dim light, though, so a proper filter that works during a partial eclipse may not result in good images during the darkness of a total eclipse.

Professional photographers may use

two or more cameras that are set up to capture the different phases of the eclipse safely — perhaps one with a filter for the partial eclipse, and another unfiltered for the brief total eclipse when the corona is visible.

The key is to have safety precautions in place to avoid eye damage by accidentally pointing the unfiltered camera into the sun before or after the total eclipse.

## SMARTPHONES

If you're careful to not look directly at the sun, it's possible to get great eclipse photos from a smartphone. If you try to use the digital zoom feature

to focus on the sun and moon, though, most phones will create a pixelated, unimpressive image.

It's better to use smartphones to capture wide-angle pictures of your friends and your surroundings while the eclipse is happening, not a close-up of the eclipse itself.

## BE 'IN THE MOMENT'

Finally, keep in mind that viewing a total solar eclipse may be a once-in-a-lifetime experience. No matter how much you want to take the perfect image, simply enjoying the wonder of this natural phenomenon can be far more rewarding.

# Viewing Tips

Millions of people will be stepping outside to watch the solar eclipse as it crosses the United States from coast to coast on Aug. 21.

With a bit of planning, you can find the perfect spot to see this wonder of nature.

## WHERE TO WATCH

If you're wanting to see a total solar eclipse, you need to make sure you find a spot within the path of totality. That's the roughly 70-mile-wide strip where the moon will completely block the sun's disk.

All Americans, though, will be able to see an impressive partial solar eclipse on Aug. 21.

A good location to watch the eclipse will be one with wide-open spaces, ideally with little light pollution from nearby cities. If you're going to a popular spot like parks or recreation areas, you'll want to arrive very early to make sure you can find parking and scout out a good location.

## KNOW THE TIME

Once you've picked a broad area for witnessing the eclipse, knowing the time the eclipse will occur can be helpful for narrowing down the exact spot.

Several apps are available on smartphones that can make the calculations easy. You can also search online to find the start and end times for your area.

When you know the correct time of the eclipse, it's a good idea to go outside a day or two before the eclipse so you'll know where the sun will be positioned at that moment. You may find a building, tree or other obstruction blocks the view, so you can scout out the best place to set up for eclipse



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viewing on Aug. 21.

## BRING SUPPLIES

In addition to your solar filter glasses and camera equipment, you should pack just like you would for any summertime outdoor event.

That means taking lots of extra water, sunblock and snacks. Even though the sun will be blocked for a portion of the time, you'll still probably be exposed to some strong solar rays before and after the eclipse.

## GOOD STEWARDSHIP

You should also follow good etiquette to help take care of the natural beauty in your area. Some things to know:

- **Clean up after yourself.** If you pack it in, you should pack it out, including any food scraps or pieces of trash. Any time you utilize the outdoors, your goal should be to tread lightly and leave no trace that you were there.

- **Follow any fire restrictions.** August is a hot, dry month that

marks the peak of fire season in many areas. Make sure you follow wildfire safety rules in your area by respecting burn bans, properly putting out campfires and carrying a fire extinguisher or extra water as required.

- **Use the correct routes.** You should try to stay on marked roads and trails that are designed to protect wildlife habitats. If an area is marked as restricted from walking, driving or camping, respect the rules to protect the natural environment.

# Solar Eclipses In History

Throughout human history, solar eclipses have fascinated, intrigued and sometimes puzzled us.

Both lunar and solar eclipses have provided the basis for superstitions as well as a challenge for scientists and astronomers throughout the ages as they tried to predict when and where each eclipse would occur.

## EARLY RECORDINGS

For ancient cultures, solar eclipses were important and noteworthy events, with the first recorded descriptions of them happening more than 2,000 years before the Christian era (B.C.E.) in China.

The Babylonian culture was one of the first to describe and predict eclipses. On May 3, 1375 B.C.E., a solar eclipse occurred that was described on ancient clay tablets. According to NASA, there is evidence that Babylonians used the Saros cycle of 18 years, 11 days to forecast approximately when solar eclipses would occur.

It wasn't until the time of Claudius Ptolemy, who lived from roughly 100-170 A.D. in Greece, that astronomers could achieve more accurate predictions of when eclipses might happen. Ptolemy's "handy tables" used data to calculate the positions of the sun, moon and planets, leading to better predictions of astronomical phenomena that were referenced through the Middle Ages.

The revolutionary work of Sir Isaac Newton resulted in even

more accurate predictions of eclipse paths after he published his gravitational theories in the book "Principia" in 1687.

Edmund Halley, famous for his comet predictions, made the first map of the moon's shadow as it would cross England during a total eclipse in 1715.

Today, eclipses and their paths across the Earth can be predicted with great accuracy by computers.

## SUPERSTITIONS

Before there was a scientific understanding of why eclipses happen, people developed their own superstitions and meaning behind the dimming of the sun.

A tradition of banging pots and drums to make lots of noise during an eclipse is believed to date back thousands of years in ancient China, when people would try to stop the sun from being "eaten by a dragon," according to NASA.gov.

People have long made ominous associations with eclipses, too. One of the most famous is the death of King Henry I of England in 1133 A.D., which coincided with a total solar eclipse on Aug. 2. After his death, England descended into civil war.

To many ancient cultures, a solar eclipse was a sign of angry gods or some kind of death, disaster or destruction to come.

Even today, some people around the world view eclipses as omens.



Sir Isaac Newton published his gravitational theories in 1687, which led to more accurate predictions for eclipse timing and paths.

# Planning An Eclipse Party

Whether you love astronomy or just want to get together with family and friends to watch this year's solar eclipse, Aug. 21 is a great time for a party.

## DECORATIONS

There's an obvious theme for any eclipse party — the solar system — so look to space for your inspiration.

Stars, crescents and circles can be a fun place to start if you want to keep the look simple, but there's no limit to how far your imagination can go.

Have a projector? Think about projecting an image of the moon on your wall for an unforgettable backdrop.

Globes or glass balls, often sold as garden sculptures, can make great space-themed centerpieces. Glowing balls from the toy aisle can make excellent moons.

For science-fiction lovers, using your favorite spaceships or characters in the decor can provide some inspiration.

And don't limit your creativity to decorating the room. Fun hats and star-themed hair pins can show your

fun-loving side.

## FOOD

**Moon Pies:** This one may be too easy, but it's perfect for the occasion. These delicious marshmallow and chocolate treats are ideal for any eclipse party, whether store-bought or homemade.

**Sun-dried fruits:** Raisins, dried apricots and dates can be fun and healthy ways to pay homage to solar energy.

**Freeze-dried ice cream:** Often thought of as treats that astronauts eat, freeze-dried ice cream pellets such as Dippin' Dots can be a great way to cool off on a summer day. While this chilled treat was never really used on the space shuttle, it still evokes the idea of space exploration.

**Themed treats:** Star-shaped cookies and crystal-like sprinkles can lend a celestial look to your baked goods.

## DRINKS

For the adults, mixed drinks can be a fun way to celebrate astronomy.

Some classic space-related cocktails include:

- **Black hole:** Black sambuca with ice and club soda.
- **Big bang:** One part vodka, one part sambuca, one part absinthe.
- **UFO:** One part gin, two parts lemon soda.



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- **Bailey's Comet:** One part butterscotch schnapps, one part Bailey's Irish cream, one part Goldschlager, one part sambuca.

In addition, Blue Moon beer is also a widely available drink, with the perfect name for an astro-themed party.

## MUSIC

No party would be complete without an eclipse-themed playlist. Some ideas:

- "Total Eclipse of the Heart" by Bonnie Tyler.
- "Fly Me to the Moon" by Frank Sinatra.
- "Eclipse" by Pink Floyd.
- "Man on the Moon" by R.E.M.
- "Moon Shadow" by Cat Stevens.
- "Space Jam" by Quad City DJs.
- "Black Hole Sun" by Soundgarden.
- "Black Star" by Radiohead.
- "Ain't No Sunshine" by Bill Withers.
- "Blue Moon" by The Marcels.



# Activities For Children

When children will be around for the solar eclipse, it's a great chance to have some fun and teach them about astronomy at the same time.

Using a globe, tennis ball and flashlight is a great way to demonstrate exactly how a solar eclipse works. Just turn off the lights and show how the flashlight can cast a shadow on the globe when the tennis ball passes in front of it like the moon passes in front of the sun.

## BIG SUN, SMALL MOON

Explaining the differences in size between the moon and the sun can be hard for young children to grasp. After all, when the moon covers the sun in the sky, it may look like the moon and sun are the same size.

In reality, it's all about perspective, and a simple game can demonstrate that. All you need is a quarter and a dinner plate.

Have one child hold the quarter while their friend holds the plate. Up close, it's obvious that the quarter is smaller. But as they step farther away from each other, or as the quarter is



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held closer to their eye, the quarter can soon look like it's bigger than the dinner plate.

You can also have your child predict how far their friend will have to walk before the quarter completely conceals the dinner plate. How far did they have to walk, and was the prediction accurate?

This is a great way to explain how the sun is 400 times bigger than the moon, even if they look similar in size when they cross in the sky.

## WATCH VIDEOS TOGETHER

Today's kids typically love watching videos online, and a solar eclipse is a great way to put their digital interests to good use.

There are plenty of child-friendly, age-appropriate videos online that explain what a total solar eclipse is and why this year's event is so unique. Search on YouTube or other video sites for fun videos that explain the basics of astronomy, then share your favorites with your children.

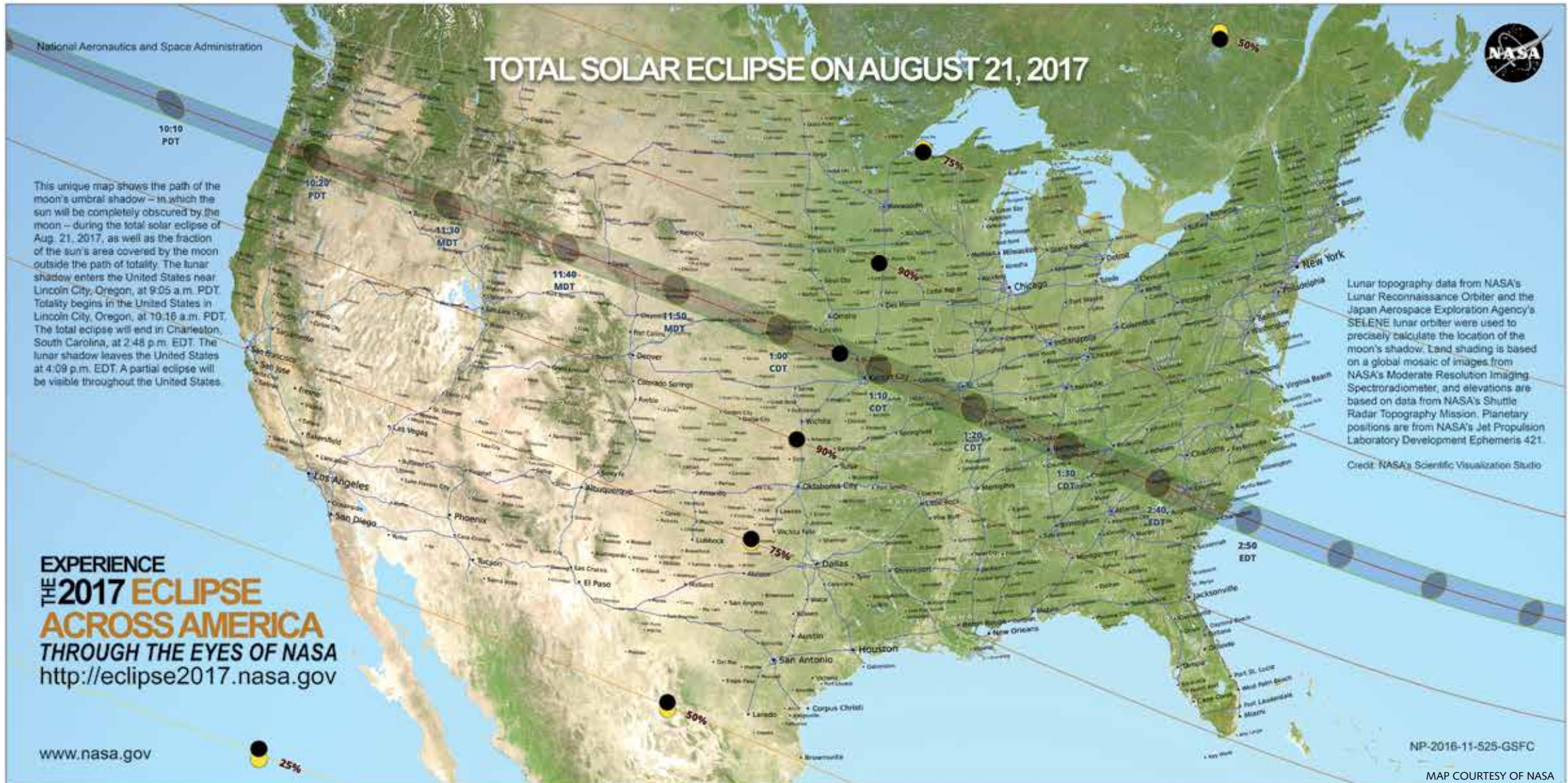
## HELP WITH BAKING

If you'll be making eclipse-themed treats, let the kids help.

While it can take a bit more time and perhaps create more clean-up work for Mom and Dad, letting children help in the kitchen is a great way to teach basic life skills and make memories at the same time.

With careful oversight, many kids can mix batters, cut out cookies and pour ingredients. It's a fun way to let them be a part of making the solar eclipse a special and memorable day.

# What Will Be Your View?



When the solar eclipse happens on Aug. 21, everyone in the continental United States will get a spectacular show.

Exactly what will the eclipse look like at your location, though? It depends on how close you are to the path of totality.

## TOTAL ECLIPSE

While this year's eclipse is a "total" one — meaning the entire sun's disk will be blocked by the moon — only a small slice of the United States will get to witness the eclipse in its totality.

Most Americans will witness a partial eclipse in which the moon leaves a portion of the sun exposed.

The closer you are to the path of totality, the more of the sun will be covered.

## NASA MAP

The National Aeronautics and Space Administration (NASA) has prepared the map shown above to illus-

trate where the total and partial eclipses will be visible.

A total solar eclipse will only be visible in the shaded gray area. People who want to see the total eclipse will either have to live in that area or make travel plans to get there.

Some cities in the path of totality are Salem, Ore.; Idaho Falls, Idaho; Casper, Wyo.; North Platte, Neb.; Kansas City, Mo.; Nashville, Tenn.; and

Columbia and Charleston, S.C.

Many other smaller cities will also fall inside the path of totality. If you want to see the total eclipse but don't want to fight the crowds, rural areas in the shaded map area will be great places to see the event.

NASA's map also shows the timeline for the eclipse, from around 10:20 a.m. Pacific time until 2:50 p.m. Eastern on Aug. 21.