ECLIPSE
NEWSLETTER

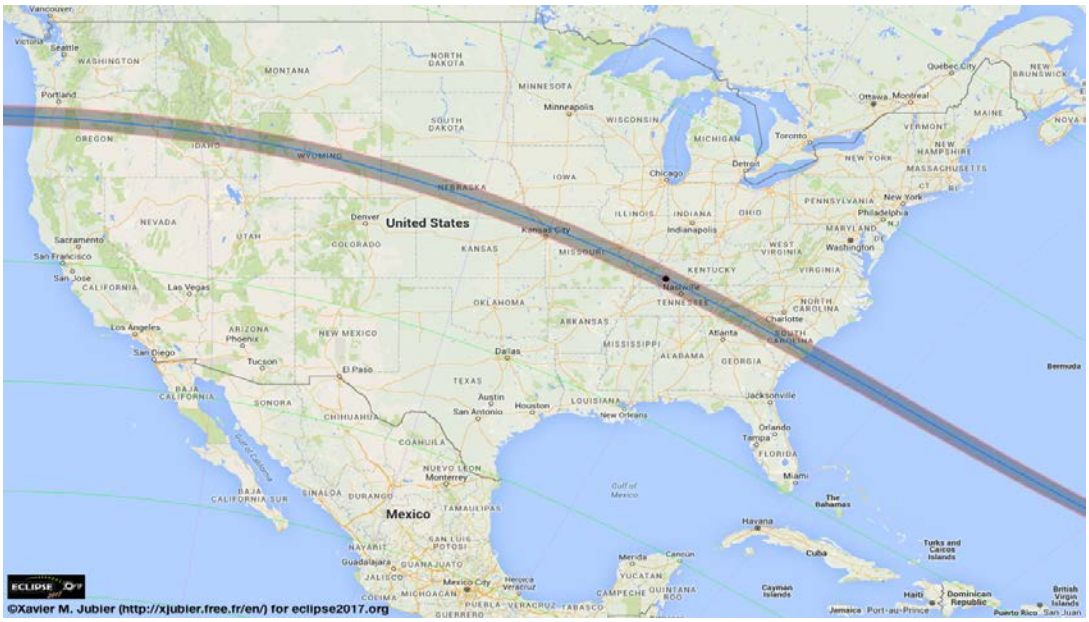
The Eclipse Newsletter is dedicated to increasing the knowledge of Astronomy, Astrophysics, Cosmology and related subjects.

SPECIAL ISSUE
SOLAR ECLIPSE AUGUST 2017

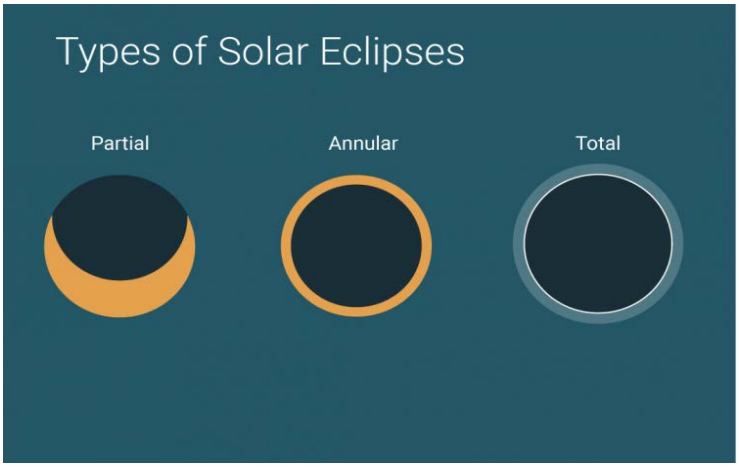
PLEASE SEND ALL PHOTOS, QUESTIONS AND REQUST FOR ARTICLES TO
pestrattonmcag@gmail.com

WARNING
Use only safe for direct Solar viewing products and labeled as such. Do not use Binoculars, Telescopes, Cameras or any other optical devise.

2017 SOLAR ECLIPSE

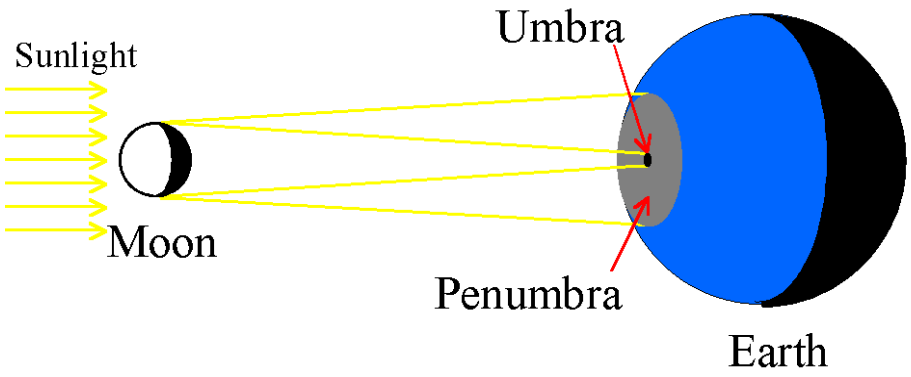


This shows the path of the 2017 Total Solar Eclipse. The dark path is the Umbra where the total Eclipse will be seen.



WHAT CAUSES A TOTAL SOLOR ECLIPSE?

A **total eclipse** occurs when the dark silhouette of the Moon completely obscures the intensely bright light of the Sun, allowing the much fainter **solar** corona to be visible. During any one **eclipse**, totality occurs at best only in a narrow track on the surface of Earth.



A **solar eclipse** occurs when the moon gets between Earth and the sun, and the moon casts a shadow over Earth. A **solar eclipse** can only take place at the phase of new moon, when the moon passes directly between the sun and Earth and its shadows fall upon Earth's surface.

The core of the Moon's shadow consists of a dark center that is referred to as the umbra. With growing distance from the Moon, the umbra's diameter decreases, creating a V-shaped shadow core (see illustration). If the umbra falls on Earth, we can see a total solar eclipse.

As we move further away from the Moon, the umbra is followed by another V-shaped shadow. That is the antumbra. In contrast to the umbra, the antumbra's diameter increases with growing distance from the Moon. Where they meet, the 2 shadow areas look a bit like an hourglass, if viewed from the side. If the antumbra falls on Earth, we can see an annular solar eclipse.

Interesting Aspects of a Total Eclipse.

The **diamond-ring effect** occurs at the beginning and end of totality during a total solar eclipse. As the last bits of sunlight pass through the valleys on the moon's limb, and the faint corona around the sun is just becoming visible, it looks like a **ring** with glittering **diamonds** on it.

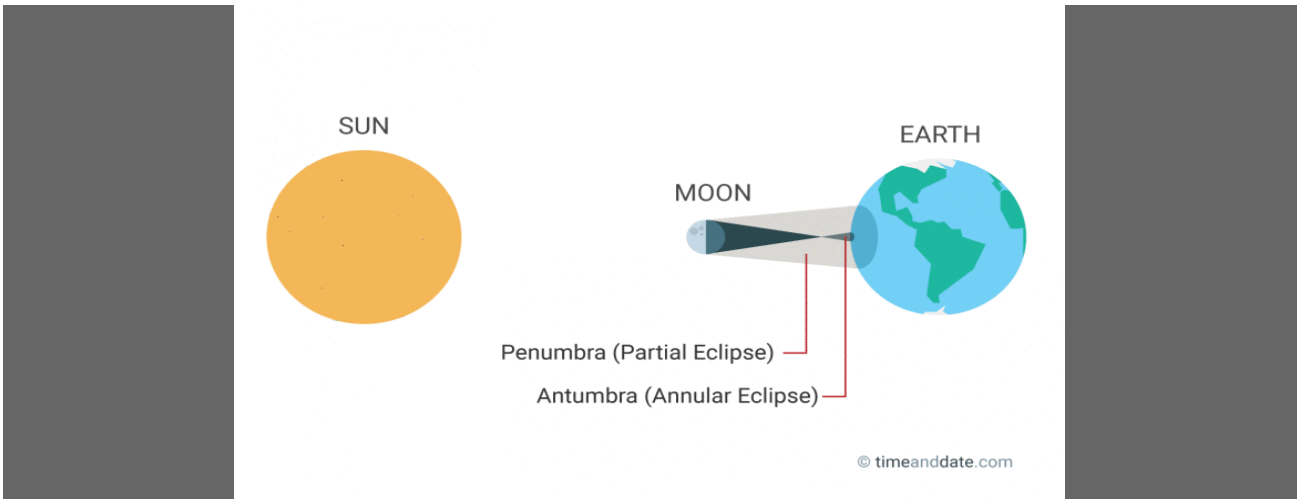
The Baily's beads **effect** is a feature of total solar eclipses. As the moon "grazes" by the Sun during a solar eclipse, the rugged lunar limb topography allows beads of sunlight to shine through in some places, and not in others.

These lights are called '**Baily's Beads**' after the British astronomer Francis Baily who discovered them. They occur because the edge of the Moon is not smooth but jagged with mountain peaks. When just one **bead** is visible, the effect is often likened to a diamond ring.

The word corona (Latin, 'crown') is an aura of plasma that surrounds the sun and other stars. The Sun's corona extends millions of kilometres into space and is most easily seen during a total solar eclipse, but it is also observable with a coronagraph. The word "corona" is a Latin word meaning "crown."

Eclipses: What Is the Antumbra?

The antumbra is the lighter part of a shadow that forms at a certain distance from the object casting the shadow. It is involved in annular solar eclipses and planet transits.



The Moon's antumbra.

When the Moon's antumbra falls on Earth, we experience an annular solar eclipse.

Like any other opaque objects illuminated by a light source, the Moon and the Earth cast shadows into space as they block the sunlight that hits them. Each shadow has 3 different areas: the umbra, the penumbra, and the antumbra.

Antumbra Definition

The antumbra is the lighter area of a shadow that appears beyond the umbra, at a certain distance from the object casting the shadow. It only exists if the light source has a larger diameter than the object.

In the antumbra, you will see the outer rim of the light source around the object casting the shadow. For example, if you are in the antumbra during an annular solar eclipse, you can see the edge of the Sun's disk as a “ring of fire” around the Moon.

The other 2 areas are:

Umbra – the shadow's dark center portion.

Penumbra – the lighter outer part of the shadow.

When the Earth enters the Moon's shadow, we see a solar eclipse; when the Moon travels through the Earth's shadow, a lunar eclipse occurs. The type of eclipse depends on the type of shadow that is involved.

Antumbra Rarely Falls on Earth.

On its journey through space, the Moon always casts a shadow. Most of the time, it includes an antumbra. However, since the antumbra starts at a certain distance from the Moon, beyond the umbra, it does not form if the shadow hits a solid object within the umbra's range. That is the case during a total solar eclipse when the Moon's umbra falls on Earth. This means that somewhere in space, on the dark side of the Moon, an annular solar eclipse is happening *right now* – unless there is a total solar eclipse in process as you read this.

The reason why annular solar eclipses are so rare is that the Moon's antumbra rarely hits the Earth's surface. Even during an annular solar eclipse, the antumbra only covers a small area on Earth.

As both the Moon and the Earth are in constant motion, the antumbra moves across the face of the Earth during the eclipse, so the annular phase can usually only be seen along a slim eclipse path. For example, the annular solar eclipse on February 26, 2017 is only visible along a narrow belt stretching from southern Latin America to central Africa, and across parts of the South Pacific Ocean and the South Atlantic Ocean.

Why Are Only Some Solar Eclipses Annular?

Annular solar eclipse with “ring of fire. “Within the Moon's antumbra, the Sun's edge is visible around the Moon.©iStockphoto.com/peisen zhao

The spot where the 2 V-shaped shadows meet and the umbra turns into the antumbra marks the location where the apparent size of the Sun matches that of the Moon. Imagine looking at the Sun from that spot. Sun and Moon appear equally large, so the Moon covers the entire Sun – but only just. If you move closer to the Moon and into its umbra, the Moon's apparent size increases, so the Sun is still completely obscured. If you move away from the Moon and into its antumbra, its size decreases, so the Sun's outer edge becomes visible – the characteristic “ring of fire”.

The Moon's orbit is elliptical, so its distance from Earth changes every day. The difference between its closest and farthest points from Earth (perigee and apogee) amounts to about 50,200 km (31,200 mi).

As it happens, the spot where the umbra meets the antumbra lies within that range. This means that the Moon's umbra falls on Earth when the Moon is close by, so we see a total solar eclipse. Conversely, an annular solar eclipse is visible from Earth if the Moon's distance is greater during the eclipse and the antumbra reaches us.

How Large Is the Moon's Antumbra?

The size of the area on the Earth's surface covered by the Moon's antumbra during an annular solar eclipse depends primarily on the Moon's current distance from Earth. The larger the distance, the larger the antumbra.

If the Moon is at its farthest from Earth (its apogee) during the eclipse, the Moon appears smaller in the sky and the “ring of fire” looks thicker. In that case, the antumbra's path typically reaches a width of just over 100 km (about 60 mi) at the Earth's equator. At higher latitudes, the Sun's rays hit the Earth's surface at a shallower angle, so the antumbra's size grows accordingly.

If the eclipse occurs when the Moon's distance is smaller, only the tip of the Moon's V-shaped antumbra may reach the Earth's surface during parts of the eclipse, meaning that its diameter is close to zero. The annular phase of the solar eclipse then lasts only a short moment. Because of the curvature of the Earth, the eclipse may even begin as an annular solar eclipse when it first hits the Earth's surface and turn into a total solar eclipse in later stages. This rare phenomenon is called a hybrid eclipse.

If the Moon is close to its perigee, its closest to Earth, during the eclipse, the Moon's shadow hits the Earth before the antumbra is formed, resulting in a total solar eclipse.

Why Are There No Antumbral Lunar Eclipses?

When the Earth's umbra falls on the Moon's surface, we can see either a total lunar eclipse or a partial lunar eclipse. When the Moon enters the Earth's penumbra, we experience a penumbral lunar eclipse.

So why are there no lunar eclipses involving the Earth's antumbra? And given the fact that the Moon's antumbra falls on Earth during an annular solar eclipse, why does the Earth's antumbra never reach the lunar surface? The reasons are the Earth's size on the one hand and its distance to the Moon on the other.

Earth has a larger diameter than the Moon, which means that its umbral shadow covers a larger distance before the antumbra begins. This means that the distance between the Earth and the Moon is simply too small for the antumbra to form before reaching the Moon – even when the Moon is at its farthest from Earth. In contrast, the Moon is small enough for the antumbra to form before it reaches Earth during annular solar eclipses.

Although the Earth's antumbra never falls on the Moon, it does sometimes reach other planets in our solar system, the distance being much greater. For example, when the Earth lines up with the Sun and Mars, its antumbra falls on the red planet. If you stood on Mars in that moment, you would see Earth as a small dot in front of the Sun.

Planet Transits.

During a planet transit of the Sun, Mercury or Venus pass in front of the Sun, as seen from Earth. Because of their large distance from the Earth, their umbras end a long way before they reach the Earth's surface.

This means we travel through a planet's antumbra during a transit. As the antumbra's diameter increases with growing distance, it is very wide when it reaches Earth, so most planet transits take several hours.

A rare event that stopped an ancient war comes to the US soon.

Over 2,600 years ago this Sunday, on May 28, 585 B.C., the sight of a total solar eclipse is said to have suddenly stopped a battle between the Medes and the Lydians in what is now Turkey. This year the anniversary comes as Americans prepare for a once-in-a-lifetime opportunity to watch as the same phenomenon roll across the skies of the contiguous United States on August 21. The ancient interpretation was sure fortunate for those soldiers fighting in what's come to be known as "The Battle of the Eclipse." When the eclipse passed over the battlefield, the warring kings took it as a sign from the gods that they should knock it off. Ancient Greek historians say the eclipse was actually the first such event to be predicted in advance, in this case by the philosopher Thales.

Lunar Eclipse Myths From Around the World

Many cultures view the disappearance of the moon as a time of danger and chaos.

By **Jane J. Lee**, National Geographic

The Inca feared that a lunar eclipse was caused by a jaguar attacking the moon. They'd try to drive it away by making noise, including beating their dogs to make them howl and bark.

Marauding demons, murderous pets, and ravenous jaguars are just some of the culprits that cultures around the world have blamed for the moon's disappearance during lunar eclipses.

During the night of April 14 through April 15, the first total lunar eclipse in more than two years will be visible across North and South America, and from Hawaii. (See "Viewing Guide: Watch Moon Turn Red During Total Lunar Eclipse.")

While such celestial events are celebrated today with viewing parties, road trips, and astronomy talks, eclipses haven't always been events that people looked forward to.

Many ancient cultures saw solar or lunar eclipses as a challenge to the normal order of things, says E. C. Krupp, director of the Griffith Observatory in Los Angeles, California. "Things that shouldn't be happening are happening." (See "Solar Eclipse Myths From Around the World.")

Howling at the Moon

"[The Inca] didn't see eclipses as being anything at all good," says David Dearborn, a researcher at the Lawrence Livermore National Laboratory in California, who has written extensively on how the Inca viewed astronomy. Accounts written by Spanish settlers in the New World record the Incan practices surrounding eclipses, he says.

Among the collected myths is a story about a jaguar that attacked and ate the moon. The big cat's assault explained the rusty or blood-red color that the moon often turned during a total lunar eclipse. (See "Lunar Eclipse Pictures: When the Moon Goes Red.")

The Inca feared that after it attacked the moon, the jaguar would crash to Earth to eat people, Dearborn says. To prevent that, they would try to drive the predator away by shaking spears at the moon and making a lot of noise, including beating their dogs to make them howl and bark. (Read about the Inca Empire in *National Geographic* magazine.)

A Substitute King

The ancient Mesopotamians also saw lunar eclipses as an assault on the moon, says Krupp. But in their stories, the assailants were seven demons.

Traditional cultures linked what happened in the sky to circumstances on Earth, he says. And because the king represented the land in Mesopotamian culture, the people viewed a lunar eclipse as an assault on their king. "We know from written records [that Mesopotamians] had a reasonable ability to predict lunar eclipses," says Krupp. So in anticipation of an eclipse, they would install a surrogate king intended to bear the brunt of any attack.

"Typically, the person declared to be king would be someone expendable," Krupp says. Though the substitute wasn't really in charge, he would be treated well during the eclipse period, while the actual king masqueraded as an ordinary citizen. Once the eclipse passed, "as you might expect, the substitute kings typically disappeared," Krupp says, and may have been dispatched by poisoning.

Healing the Moon

The eclipse myth told by the Hupa, a Native American tribe from northern California, has a happier ending.

The Hupa believed the moon had 20 wives and a lot of pets, says Krupp. Most of those pets were mountain lions and snakes, and when the moon didn't bring them enough food to eat, they attacked and made him bleed. The eclipse would end when the moon's wives would come in to protect him, collecting his blood and restoring him to health, Krupp says.

To the Luiseño tribe of southern California, an eclipse signaled that the moon was ill, says Krupp. It was tribe members' job to sing chants or prayers to bring it back to health.

Modern Myths

Not all cultures view an eclipse as a bad thing, says Jarita Holbrook, a cultural astronomer at the University of the Western Cape in Bellville, South Africa, in an interview last year.

"My favorite myth is from the Batammaliba people in Togo and Benin" in Africa, she says. In this myth, the sun and the moon are fighting during an eclipse, and the people encourage them to stop. "They see it as a time of coming together and resolving old feuds and anger," Holbrook says. "It's a myth that has held to this day."

Ancient rituals will mingle with contemporary science as the Griffith Observatory marks the April 14-15 eclipse. "Based on past experience, we expect a very large crowd to show up," Krupp says, as staff and astronomers gather on the Los Angeles observatory's front lawn with telescopes—and with noisemakers.

"If there's a celestial object threatened, Griffith Observatory is in the business of protecting and observing," Krupp says with mock gravity. He plans to don his "official eclipse-dispersing wizard's robe and hat" and lead marchers around the lawn with noisemakers, to scare off whatever is swallowing the moon.

MCAO PUBLIC NIGHTS AND FAMILY NIGHTS.

The general public and MCAO members are invited to visit the Observatory on select Monday evenings at 8PM for Public Night programs. These programs include discussions and illustrated talks on astronomy, planetarium programs and offer the opportunity to view the planets, moon and other objects through the telescope, weather permitting. Due to limited parking and seating at the observatory, admission is by reservation only.

Public Night attendance is limited to adults and students 5th grade and above. If you are interested in making reservations for a public night, you can contact us by calling 302-654-6407 between the hours of 9 am and 1 pm Monday through Friday. Or you can email us any time at KimGreenmcao@gmail.com or mtcuba@physics.udel.edu. The public nights will be presented even if the weather does not permit observation through the telescope. The admission fees are $3 for adults and $2 for children. There is no admission cost for MCAO members, but reservations are still required. If you are interested in becoming a MCAO member, please see the link for membership. We also offer family memberships.

Family Nights are scheduled from late spring to early fall on Friday nights at 8:30PM. These programs are opportunities for families with younger children to see and learn about astronomy by looking at and enjoying the sky and its wonders. It is meant to teach young children from ages 6-12 about astronomy in simple terms they can really understand. Reservations are required and admission fees are $3 for adults and $2 for children.

MCAO WEB SITE IS

mountcuba.org