Eclipses

A Reading A–Z Level V Leveled Book

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Eclipses

Written by David L. Dreier

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Back cover: Composite photo of an annular solar eclipse over Franklin Mountains State Park near El Paso, Texas

Title page: A total solar eclipse in the sky over the W. M. Keck Observatory in Hawaii

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Level V Leveled Book

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Correlation

LEVEL V	
Fountas & Pinnell	R
Reading Recovery	40
DRA	40

A girl prepares to watch a solar eclipse in Bangladesh.

Table of Contents

The Moon blocks part of the setting Sun during a solar eclipse.

Darkness at Noon or Midnight

Imagine being outside on a sunny day at noon and seeing the world become dark all around you, even though there's not a single cloud in the sky. Or imagine watching a full moon slowly change from milky white to a spooky blood-red color. Strange events such as these happen during eclipses.

Eclipses are amazing events that have caused wonder, fear, and excitement throughout history. During a solar eclipse, the Moon blocks out the Sun. During a lunar eclipse, the Moon changes color as it passes through Earth's shadow.

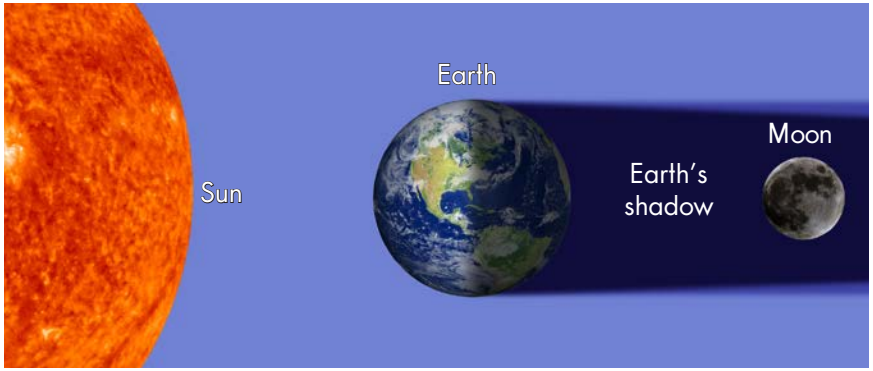
Eclipses in History

Eclipses can be frightening events if you don't know what causes them. Long ago, people were afraid of eclipses and considered them to be bad **omens**. People in ancient China thought the Sun was being eaten by a dragon during a solar eclipse. They banged on drums and pots to scare the dragon away. Some ancient people in Greece thought there might be a connection between earthquakes and eclipses. But there is no link between the two events.

A solar eclipse darkens the daytime sky over China.

Some eclipses may even have changed the course of history. One such event occurred in the Middle East in the sixth century BC. Two groups of people, the Lydians and the Medes, had been fighting a war for five years. On May 28, 585 BC, their armies were engaged in a fierce battle when suddenly a total eclipse turned day into night. The armies were so frightened by the eclipse that they laid down their weapons and agreed to make peace.

Ancient peoples such as the Chinese, Greeks, Babylonians, and Egyptians studied eclipses. They eventually learned that eclipses were natural events. There were no dragons or other monsters involved. However, knowledge about what really caused eclipses spread slowly.



Positions of the Sun, Earth, and Moon during a lunar eclipse

Eclipses Are All About Shadows

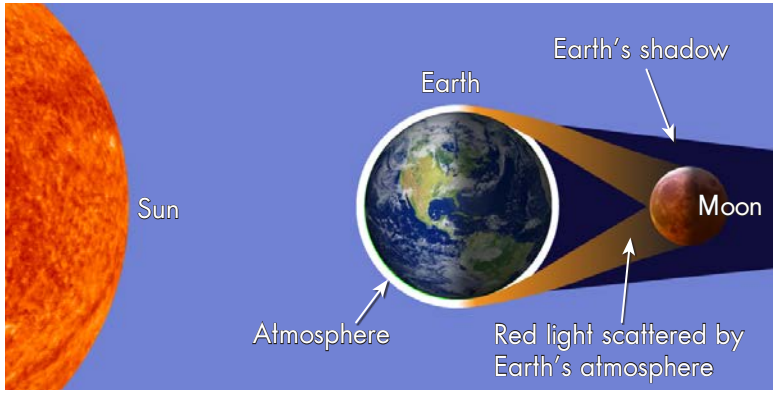
We now know that eclipses happen when Earth, its moon, and the Sun line up in space. An eclipse is nothing more than a really big shadow. Just as you cast a shadow on the ground when you stand outside on a sunny day, Earth and its moon cast shadows in space.

What an eclipse looks like depends on where you watch it from. If you were standing on the surface of the Moon during a lunar eclipse, you would see the Earth ringed by red light as it blocked out the Sun. But from Earth, a lunar eclipse looks much different. If you watch a lunar eclipse from Earth, you will see the full moon slowly go dark as it passes through Earth's shadow. That's because the Moon is only bright when it reflects the light of the Sun—something it can't do when Earth gets in the way.

Why the Moon Turns Red

If Earth had no atmosphere, the Moon would go completely dark during a total lunar eclipse. But Earth does have an atmosphere, and light from the Sun passes through it. Most of that light strikes Earth's surface and is blocked. But some light rays pass through the atmosphere without hitting the planet's surface.


Earth's atmosphere filters and scatters some of the sunlight that passes through it.



Some red light from the Sun bends as it passes through Earth's atmosphere and reaches the Moon, turning it red.

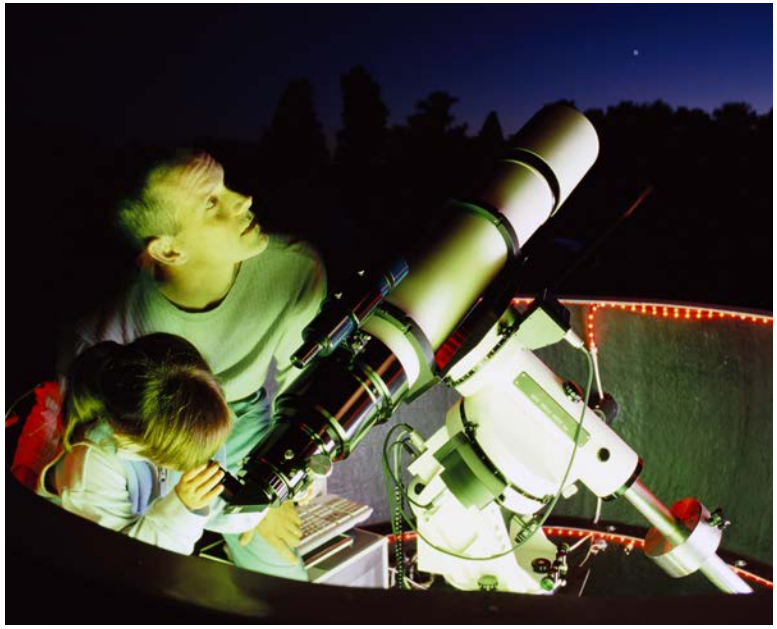
The Sun's light is made up of many colors that blend together to form white light. The atmosphere absorbs most of the blue light in the Sun's rays. But red light passes through the atmosphere and is scattered before passing back out into space. Some of that light strikes the Moon and gives it a spooky appearance. The Moon usually turns a reddish color, but it can also be orange, yellow, or brown. The color depends on the amount of dust and clouds in Earth's atmosphere.

A total lunar eclipse turns the Moon a dramatic red color.

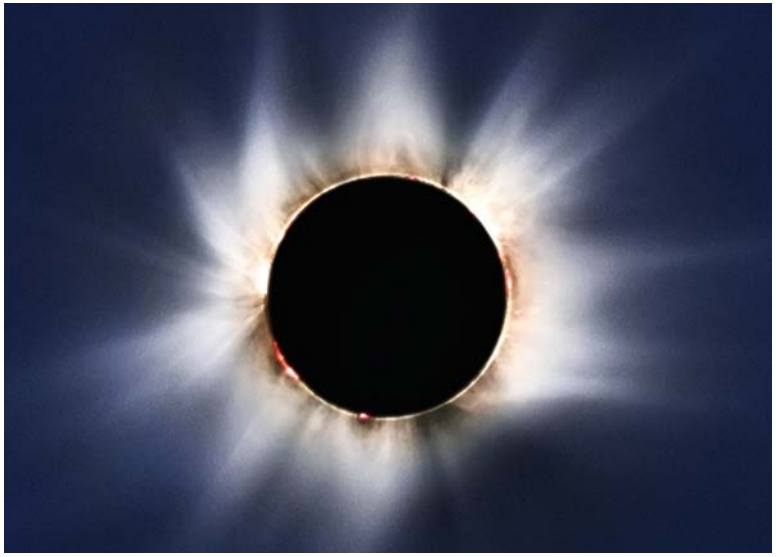
The Moon's changing appearance during the course of a lunar eclipse

Total lunar eclipses happen fairly frequently. There can be as many as three in a year. But in some years, there are none. It all depends on the changing positions of the Moon and Earth. And because lunar eclipses are visible from the entire side of Earth where it's nighttime, you will probably have many chances to see one near where you live.

Lunar eclipses are perfectly safe to watch and can be safely viewed through binoculars or telescopes. The length of time that the Moon is in full shadow during a total eclipse varies anywhere from about thirty minutes to more than an hour.



A telescope can give you a great view of a lunar eclipse.

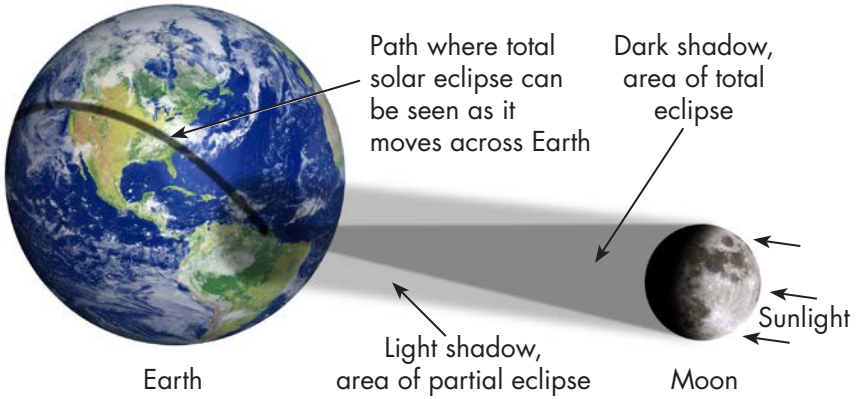


The hot gases of the Sun's corona are easy to see when the Moon blocks out the Sun.

The Sun Blotted Out

The other type of eclipse is a solar eclipse. During a solar eclipse, the positions of the Moon and Earth are just the opposite of their positions during a lunar eclipse. The Sun is about four hundred times larger than the Moon, but it is also about four hundred times as far away from Earth. This happy **coincidence** of nature means that, seen from Earth, the circular disk of the Moon is just the right size to block out the Sun. When the Moon blocks the light from the main part of the Sun, the Sun's outer part, called the *corona*, becomes visible. The hot gases of the corona glow brightly around the **obscured** disk of the Sun.

During a solar eclipse, the Moon casts a double shadow on Earth. People inside the dark center shadow see a total eclipse, in which the entire disk of the Sun is blocked for a short time. Inside the lighter outer shadow, part of the Sun's disk is still visible during a **partial** eclipse. Beyond the lighter shadow, people see no eclipse at all.



An annular eclipse creates a bright ring of light around the Moon.

Because the Moon's orbit around Earth is not a perfect circle, the Moon's distance from Earth changes. When the Moon is farther away, it appears slightly smaller and does not completely block out the Sun during an eclipse. The Sun's disk then forms a narrow ring around the Moon. This is called an *annular eclipse*. *Annular* comes from the Latin word meaning "ring."

The length of a total solar eclipse varies from one eclipse to another and also depends on where you view it from. The longest time that people can see the Sun totally darkened is about seven and a half minutes.

People have far fewer chances to see solar eclipses than lunar eclipses. Solar eclipses happen in one form or another somewhere on Earth about once every eighteen months. However, many solar eclipses occur over open oceans or in the polar regions, so very few people get to see them. Also, because the Moon's darker center shadow on Earth is never more than 269 kilometers (167 mi) wide, the chance of your area being in the path of a total eclipse is very small. Each particular spot on Earth experiences a total solar eclipse just once every 370 years, on average. For that reason, if you want to see a total solar eclipse, it is much better to travel to where you know one will happen than to wait for one to come to you. But how can you tell when and where the next solar eclipse will happen?

The Moon's shadow can be seen from space as it passes across Earth's surface during a solar eclipse.

Predicting Eclipses

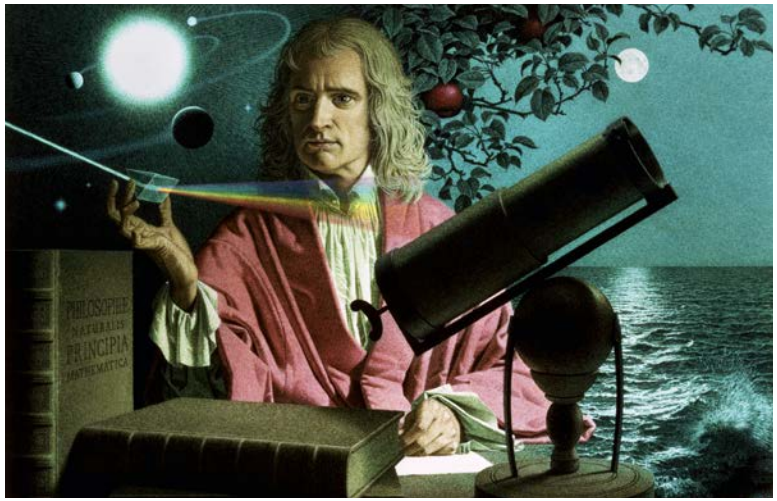
Astronomers have tried to **predict** eclipses since ancient times. Many astronomers in ages past kept careful records of eclipses. They learned that eclipses happen in a long cycle. They also studied how the Moon moves around Earth. Their findings helped them predict lunar eclipses with some **accuracy**. But figuring out when solar eclipses would happen was much more difficult.

By about 1,800 years ago, astronomers in China and Greece had learned to predict solar eclipses. One of the most famous of these astronomers was a Greek named Ptolemy (TAWL-uh-mee). But Ptolemy and other ancient astronomers could only predict a solar eclipse to within about a month.

Ptolemy was a famous mathematician and astronomer who lived around AD 90–168.

The first scientist to accurately predict solar eclipses was an English astronomer named Edmond Halley. During his lifetime in the early AD 1700s, people knew that Earth **orbited** the Sun. Knowing the correct positions of the Sun, Earth, and Moon made eclipse prediction simpler. But it was still difficult.

Another English scientist, Isaac Newton, made it easier to predict eclipses. Newton discovered how objects in the solar system move. He developed a very detailed **theory** of gravity. Halley used Newton's findings to calculate future eclipses. By using computers programmed with Newton's laws of gravity, scientists can now predict eclipses far into the future.



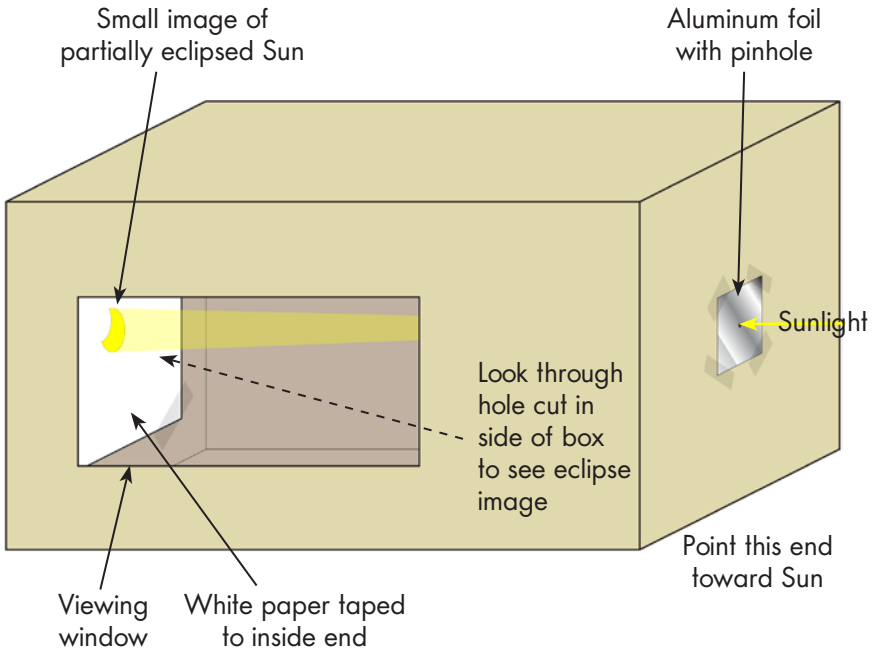
Isaac Newton's ideas about gravity and mathematics changed our understanding of the universe.


A shepherd boy and his goat watch a solar eclipse in Lebanon.

How to View a Solar Eclipse Safely

Once you've figured out where you need to be to see a solar eclipse, your work is not quite done. You need to take some steps to make sure you can watch the eclipse safely because looking directly at the Sun can damage your eyes. Normally, the Sun is too bright to look at for very long, and pain makes you look away. But during an eclipse, the brightness dims, and it's possible to look at the Sun without feeling any pain, even while severely damaging your eyes. For this reason, you should NEVER look directly at the Sun during an eclipse or at any other time.

Pinhole Projector



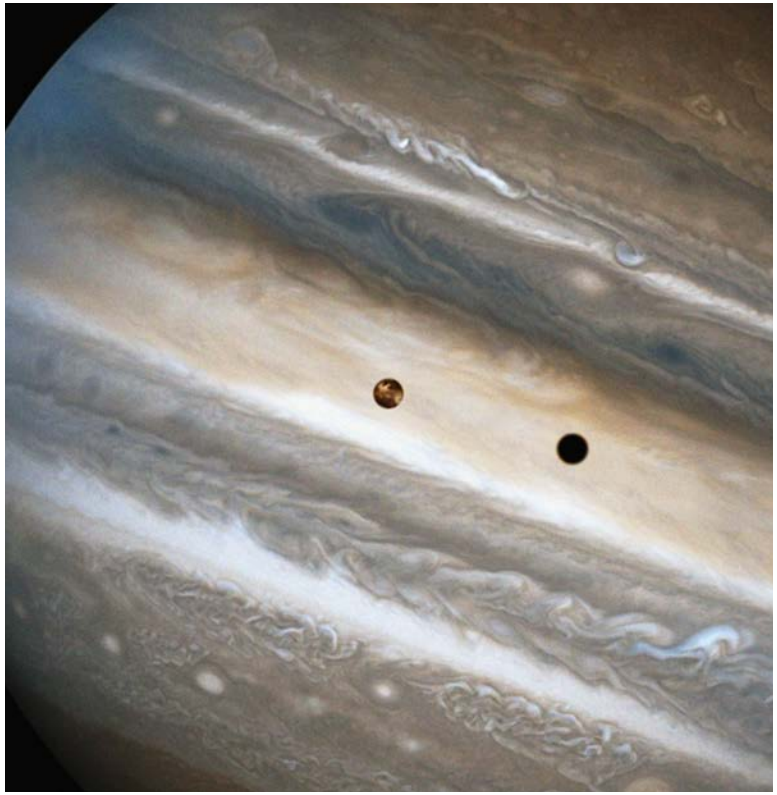
The safest way to view a solar eclipse is indirectly, using a pinhole projector. This simple device focuses the Sun's rays onto a flat surface, where they can be viewed safely.

Warning

Do not view a solar eclipse with unprotected eyes or regular sunglasses, and never look at a solar eclipse with a telescope or binoculars. Devices that magnify what you're looking at will also magnify the damage done to your eyes.

It also is possible to view a solar eclipse safely using special **light filters**, such as inexpensive eclipse-viewing safety glasses. Even when using these special glasses, you shouldn't look at the Sun for very long. Look for a few seconds and then turn away for a few seconds. Be sure to use these glasses only in the company of an adult. You can't be too careful when looking at the Sun.

A crowd practices using protective glasses before an eclipse in the United Kingdom in 1999.



A small moon casts a shadow on the surface of Jupiter as it orbits the giant planet.

Conclusion

Eclipses are impressive **cosmic** events that still inspire awe in people of all ages around the world. Thanks to science, we now understand the causes of eclipses and can predict them with amazing accuracy. But eclipses will probably always feel a little mysterious and magical to those who watch them, just as they did to people thousands of years ago.

This special photograph shows how the Moon looked every five minutes during a lunar eclipse over upstate New York.

Glossary

accuracy *(n.)* the state or quality of being precise, correct, or exact (p. 16)

astronomers *(n.)* scientists who study planets, stars, galaxies, and other objects in space (p. 16)

coincidence *(n.)* a situation in which similar or related things happen at the same time by accident (p. 12)

cosmic *(adj.)* of or relating to the space beyond Earth (p. 21)

light filters *(n.)* transparent materials that block light of certain wavelengths (p. 20)

obscured *(adj.)* concealed or covered (p. 12)

omens *(n.)* events believed to be signs about the future (p. 5)

orbited *(v.)* revolved around another object (p. 17)

partial *(adj.)* of or relating to a part rather than the whole (p. 13)

predict *(v.)* to say what is going to happen in the future, based on the past or present (p. 16)

theory *(n.)* a possible explanation that has not been proven true (p. 17)