The Day the Lights Go Out

Millions of Americans will get the chance to watch one of nature’s greatest spectacles as the Moon plays ‘peek-a-boo’ with the Sun

By Damond Benningfield

This map shows the path of the eclipse shadow, with local times given for key locations. The heavy lines outside the path of totality show the maximum extent of the partial eclipse; the numbers indicate the percentage of the Sun’s disk that will be covered by the Moon.
For those who have seen a total solar eclipse, nothing else compares. “There’s a primeval feeling of awe and wonder, not matched by any other phenomenon,” says Jay Pasachoff, an astronomer at Williams College in Massachusetts, who has viewed more than 30 of them. “It suddenly gets a million times darker while you’re just standing outside. TV, photographs — nothing else has any of the thrill of seeing it in person.”

Millions of Americans will get to experience that thrill on August 21, when the Moon will cast its shadow across a wide swath of the country, from Oregon to South Carolina. As the shadow races southeastward at almost 2,000 miles per hour, it will cross parts of 12 states and touch several major cities, including Kansas City, St. Louis, and Nashville.

The spectacle won’t last long, though; the maximum eclipse, near Makanda, Illinois, a village in the Shawnee Hills, will last just 2 minutes, 41.6 seconds. Yet during that brief darkness, the Sun’s silvery outer atmosphere, the corona, will encircle the intervening Moon. Stars and planets will shine through the daytime sky, the temperature will drop, birds and other animals will settle in for the brief “night,” and an odd, twilight-like glow will rim the horizon. “It’s a whole-body experience and then some,” says Angela Speck, an astronomer at the University of Missouri-Columbia and chair of the eclipse task force for the American Astronomical Society (AAS).

And this time around, it’s a uniquely American event: the Great American Eclipse. The total eclipse will be visible only from the United States, which hasn’t happened since 1918, and the entire country outside the path of totality (the zone where the Sun will be completely eclipsed) will see a partial eclipse, in which the Moon will cover a portion of the Sun’s disk.

Roughly 12.2 million people live directly along the path of totality, but 50 million live within 100 miles of that path, and 88 million within 200 miles — an easy drive for most Americans.

“It’s hard to predict how many people will turn out to see it because there’s no precedent,” says Speck (the last eclipse to touch the continental United States, in 1979, skimmed the northwestern corner of the country). “But if just four percent of the U.S. population chooses to travel to the eclipse, that will double the population in that zone.”

The initial crowds will gather along the Oregon coastline, where the Moon’s shadow will first touch American soil, at 10:16 a.m. PDT. As the shadow races eastward, the eclipse path will shoot the gap between Portland and Eugene, race across Idaho, then take dead aim at Casper, Wyoming. It will curve southeastward across the Great Plains, reach its maximum width of about 70 miles over southern Illinois and western Kentucky, then move into the southeast, crossing Tennessee and a corner of North Carolina before existing the country near Charleston, South Carolina, at 2:49 p.m. EDT, bringing the Great American Eclipse to an end.

A solar eclipse is the result of a combination of coincidence and clockwork.

The coincidence is that the Sun and Moon appear almost exactly the same size in Earth’s sky. The Sun is about 400 times wider than the Moon, but it also is about 400 times farther away. So when the new Moon passes directly between Earth and the Sun, it can cover the Sun’s disk, blocking it from view.

We don’t see an eclipse at every new Moon, however, because the Moon’s orbit around Earth is tilted a bit with respect to the Sun’s path across the sky, known as the ecliptic. Because of that angle, the Moon passes north or south of the Sun most months, so there’s no eclipse.

When the geometry is just right, though, the Moon casts its shadow on Earth’s surface, creating a solar eclipse,
and that’s where the clockwork comes in.

The Moon goes through several cycles. The best known is its 29.5-day cycle of phases, from new through full and back again. Other cycles include its distance from Earth (which varies by almost 30,000 miles over 27.5 days) and its relationship to the ecliptic (27.2 days), among others. These three cycles overlap every 6,585.3 days, which is a little more than 18 years. Eclipses occur at the point of overlap.

This 18-year cycle is known as a Saros. The circumstances for each succeeding eclipse (solar or lunar) in a Saros are similar — the Moon is about the same distance from Earth, for example, and the eclipses occur at the same time of year. (Because of the extra one-third day, however, each eclipse occurs one-third of the way around Earth from the previous eclipse; the next eclipse in this Saros, in 2035, will be visible across portions of Asia and the Pacific Ocean.)

A cycle begins with a partial eclipse. A portion of the Moon just nips the northern edge of the Sun, for example, blocking only a fraction of the Sun’s light. With each succeeding eclipse in the cycle, the Moon covers a larger fraction of the solar disk, peaking with a series of dozens of total eclipses. Then the Moon slides out of alignment again, this time in the opposite direction, creating more partial eclipses. The series ends with a grazing partial eclipse on the opposite edge of the solar disk.

The August 21 event is eclipse number 22 of Saros 145, which began on January 4, 1639, and will end on April 17, 3009. The cycle will produce 77 eclipses, including 41 total eclipses.

Several Saros cycles are taking place at any given time, however, so we don’t have to wait 18 years between eclipses. Solar eclipses occur at intervals of one, five, or six months, with no relationship between consecutive eclipses.

Because of the slow relative motions of the Sun and Earth, a solar eclipse is more than just a couple of minutes of totality. It begins roughly an hour and a half earlier, when the lunar disk first “touches” the Sun. As the Moon encroaches farther, the sky gets darker (although the eclipse is still too bright to watch without eye protection), and temperatures start to drop.

In the last moments before the Sun disappears, bits of sunlight filter through the rugged lunar terrain, forming bright points of light known as Baily’s beads (after Francis Baily, an astronomer who first described the effect in 1836). The last of the beads looks like a diamond ring.

**ECLIPSE TIPS**

**DON’T**

**LOOK AT THE SUN WHEN IT’S NOT FULLY ECLIPSED.**

Even the partially eclipsed Sun is so bright that it could damage your eyes, so be sure to use proper eye protection.

**PARK ON THE HIGHWAY SHOULDER.**

“It is not only unsafe, but it is illegal to stop in the roadway or along access controlled highways (interstates) for reasons other than an emergency situation,” says Lt. R. Kelley Hughes of the South Carolina Highway Patrol. “Also, we caution drivers to remember that the emergency lanes on the interstate are designated for first responders and disabled vehicles only.”

**SPEND ALL OF YOUR TIME LOOKING THROUGH A CAMERA.**

For many, this will be a once-in-a-lifetime event. Although it’s nice to remember it with your own photos and videos, the eclipse will be so brief that it would be easy to miss.

**DO**

**LOOK AT THE TOTAL ECLIPSE.**

The corona is roughly as bright as a full Moon, so it’s completely safe to watch with your eyes alone.

**PLAN AHEAD.**

Hotels along the eclipse path are full and traffic will be heavy, so plan your route in advance, and allow plenty of time to reach your viewing site.

**CHECK THE WEATHER.**

Nothing can spoil an eclipse-watching party faster than clouds (as many astronomers have discovered over the centuries). Check the forecast the night before, and have an alternate viewing site in mind if your site will be clouded out.

**START THINKING ABOUT THE NEXT ONE.**

Another total eclipse is coming up on April 8, 2024. The path of totality will stretch from Texas to Maine, with totality lasting up to about four and a half minutes.

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The solar eclipse of August 21, 2017, is not only a big astronomical deal, it is also a rarity in the U.S. The last time such an eclipse shadow traversed a comparable amount of the contiguous 48 states was nearly a century ago, on June 8, 1918. That eclipse had a similar path and duration, though it tracked a little farther south. It drew throngs of observers and made sensational front-page news coast to coast, as this year’s surely will.

One amateur astronomer drawn to the 1918 eclipse was Alfred Rordame, a Norwegian born near Oslo, who immigrated first to Eureka, Nevada, in 1880, and eventually Salt Lake City, in 1884. Rordame was an early aficionado of astrophotography, so when he learned of the proximity of totality, he vowed to photograph it from a favorable location. He chose Green River, Wyoming, based on U.S. Weather Bureau reports. He was not alone in choosing other public areas that will offer both good views and reasonable facilities: Sawtooth National Forest in Idaho, Washington State Park in Missouri (2 minutes, 35 seconds of totality), Lake Murphysboro State Park in Illinois (2:38), Congaree National Park in South Carolina (2:33), and many others. And schools, planetariums, museums, and many other venues have scheduled eclipse events, some of which will begin as early as August 18 or 19 (the Friday and Saturday before Monday’s eclipse).

No matter what part of the country you choose, most eclipse watchers recommend that you get fairly close to the center of that path, where totality lasts longest. “If you want to take it all in, get close to the centerline,” says Speck. “If you’re within, say, 10 miles, you still get a good duration. As you get closer to the edge, though, you lose more seconds.”

Pasachoff suggests another way to conserve the precious seconds of totality: “Don’t spend all your time looking at it with your camera — just enjoy yourself.”

If you do want to take pictures, though, a few tips will help you capture the eclipse with just about any type of camera, including the one in your phone.

Use a tripod or some other type of brace to keep the camera steady. For close-ups of the Sun, use a long-focal-length lens (500 mm, for example) or an equivalent setting on your digital camera. A shorter lens will allow you to capture the entire tableau of eclipsed Sun and twilight colors along the horizon, and to add drama with people or objects in the foreground.

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For the partial eclipse, use a mylar or glass solar filter over your camera lens to prevent eye damage.

It’s perfectly safe to look at the total phase of the eclipse through the camera or with the eye alone. In fact, experts say it’s the best way to enjoy the spectacle. The corona is only about as bright as a full Moon, so “you’d be crazy not to look at it,” says Rick Feinberg, a veteran eclipse watcher and press officer for the AAS.

From any given location, the entire eclipse actually lasts almost three hours, though, from the moment the Moon first appears to touch the solar disk to the moment of last contact, and, of course, most of the country won’t see totality. During the partial phases of the eclipse, your eyes need protection from the Sun’s blinding light; even a tiny sliver of direct sunlight can be dangerous.

To stay safe, experts recommend using commercially available eclipse viewers, which can look like eyeglasses or be embedded in a flat sheet that you hold in front of your face. Make sure your viewer meets the proper safety standards, and inspect it before you use it to make sure there are no scratches to let in unfiltered sunlight.

You can also view the eclipse through a piece of welder’s glass (No. 14 or darker), or stand under a leafy tree and look at the ground; the gaps between leaves act as lenses, projecting a view of the eclipse on the ground. With an especially leafy tree you can see hundreds of images of the eclipse at once.

One final mode of eclipse watching is through a pinhole camera. You can make one by poking a small hole in an index card, file folder, or piece of stiff cardboard. Let the Sun shine through the hole onto the ground or a piece of paper (but don’t look at the Sun through the hole!). The hole projects an image of the eclipsed Sun.

And if you can’t watch the eclipse in person, NASA and other groups will offer live video feeds of the entire event — bringing the Great American Eclipse to the world.

_Damond Benningfield is the executive editor of StarDate and writer/producer of StarDate radio._

**Stamping out a Souvenir**

The U.S. Postal Service has released a stamp to commemorate the eclipse. It is designed to change when you touch it. In one view, it shows the Sun’s corona around a dark Moon; in the alternate view, activated by body heat, the Moon becomes visible. Both images were shot by Fred Espenak, a former NASA astronomer and a leading expert on eclipses.

**ing this region:** Astronomers from major observatories and universities, such as Mount Wilson, Yerkes, and the University of Illinois, also planned expeditions to the Green River area.

Rordame wanted to increase his chances of clear skies. He obtained the use of a “high-powered motorcar” driven by friend Theodore Lovendale, who was a printer in Salt Lake City. Rordame's party, along with Lovendale’s family, set up near the Yerkes station below the big butte in Green River known as Castle Rock. From this location, the highway turned northwest and ran for a number of miles directly into the center of the eclipse’s coming shadow. The car was made ready, just in case.

At the hour and minute predicted, first contact occurred and the Moon began edging toward covering the Sun. In the meantime, clouds also began closing in, and Rordame soon realized they would obscure his view at the critical time. With minutes to spare, he bundled his camera and party into Lovendale’s 12-cylinder Cadillac and careened northwest three and a half miles into a clear sky in what must be one of the first instances of a ground-based eclipse chase. As he later reported in *Popular Astronomy*, “The distance was made in about 4 minutes, and no one, not even the ladies, complained of the speed at which we traveled as we hit the high spots in the road.”

Fortunately for Rordame, his relocation paid off and he was able to successfully photograph the Sun’s corona, which was his main objective.

“It is impossible to put in words the feeling that the sight of the corona produced—a celestial pearly radiance that I had dreamed of for years,” Rordame wrote. “One of the desires of my life was a sight of its heavenly beauty, and now that it actually appeared to me, the vision transcended all my anticipations.”

Rordame was not the only one to benefit from having access to wheels during the eclipse. A local resident and astronomy professor, Perry W. Jenkins, also fled the Yerkes observing station for clearer skies. Jenkins wrote in *Popular Astronomy* that, in future, observing parties should be provided with motorcars. The age of the automobile had truly begun.

Although no estimates exist, the June 8, 1918, total solar eclipse probably was seen by tens of thousands of people. By contrast, the August 21, 2017, event will be the Woodstock of solar eclipses, with millions of people amassing within the narrow centerline hoping to witness one of nature’s most unusual spectacles, and, to paraphrase Rordame, experience their own sense of a vision that transcends all expectations.

And, quite probably, traffic jams, as well.

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