

**Eclipses – Pastor Mike Krech – Grace Presbyterian Church
August 6, 2017**

First four questions

1. What is the average distance from the sun to the earth? 93 million miles
2. What is the average distance from the moon to the earth? 238,000 miles
3. What is the diameter of the sun? 864,000 miles
4. What is the diameter of the moon? 2,160 miles

An eclipse of the sun happens when the moon casts its shadow upon some part of the surface of the earth. Or, to put it another way, when the moon blocks out all or some portion of the sun from our vantage point.

There are several terms to describe different types of eclipses of the sun:

Partial – Part of the moon covers part of the sun.

Central – All of the moon is over the disk of the sun.

Annular – A central eclipse where the moon is too small to cover all the sun.

Total – A central eclipse where the moon is large enough to cover all the sun.

Hybrid – An eclipse in which part of the path is a total eclipse.

The following terms are used by eclipse folk regarding solar eclipses:

First Contact – First “nibble” of the moon **Eclipse Path** – 70 miles wide

Second Contact – Totality begins **Center Line** – greatest totality

Third Contact – Totality ends **Graze Line** – edge of totality

Fourth Contact – Last “nibble” of the moon

Things to watch for as total eclipse of the sun approaches:

Baily’s Beads – sunlight streaming through lunar valleys

Diamond ring – the last of the bright sunshine before totality

Shadow bands – shimmery bands of black and white, best seen on large white surfaces (see youtube: shadow bands 2012 Australia)

Shadow sweep – the approaching shadow of the moon (moving at 2290 miles per hour) best seen from elevation (youtube: sweeping shadow 2012 Australia)

Things to watch for during totality:

Solar corona – the hot outer atmosphere of the sun

Solar flares, aka prominences

The 360 degree orange horizon

Bright stars and planets – Mars will be 8 degrees to the right of the sun;

Venus will be four times farther right from the sun than Mars,

Jupiter low in the southeast;

*Mercury, hard to see, but as far left of the sun as Mars is right.
The star Regulus in Leo will be two solar diameters left of the sun
Strange animal and human behavior – Try not to go crazy; remember to
look through your binoculars during totality to see solar flares. It's ok to look
naked eye once totality begins.*

The August 21, 2017 Total Eclipse

*The August 21, 2017, total eclipse begins in the North Pacific Ocean just south
of 40 degrees north latitude and 171 degrees west longitude, where the sun rises
fully eclipsed. It first touches land at Depoe Bay, Oregon, where the partial
phase begins at 9:05 a.m. PDT, and totality begins at 10:16 a.m. PDT. The
following cities are in the path (CL = on or very near the center line.)*

Salem OR

Corvallis OR

Ontario OR

Sun Valley ID

Idaho Falls ID

Teton Village WY (CL)

Casper WY (CL)

Alliance NE (CL)

North Platte NE

Kearney NE

Grand Island NE (CL)

Lincoln NE

St. Joseph MO (CL)

Kansas City MO – on the southern graze line

Columbia MO (2 minutes, 36 seconds)

St. Louis MO – on the northern graze line, if you're at the Arch you don't see it

Ellisville MO (1 minutes, 50 seconds)

Ste. Genevieve MO (CL; 2 minutes 40 seconds; close to max)

Cape Girardeau MO (1 minute, 31 seconds)

Carbondale IL (2 minutes, 37 seconds)

Paducah KY (2 minutes, 17 seconds)

Princeton KY (CL; 2 minutes, 40 seconds)

Hopkinsville KY (CL; 2 minutes, 40 seconds)

Clarksville TN (2 minutes, 22 seconds)

Downtown Nashville TN (1 minute, 57 seconds)

Gallatin TN (CL, 2 minutes, 39 seconds)

Cookeville TN (2 minutes, 34 seconds)

Sparta TN (CL, 2 minutes, 38 seconds)
Athens TN (CL, 2 minutes, 36 seconds)
Greenville SC (2 minutes, 18 seconds)
Columbia SC (CL, 2 minutes, 32 seconds)
Charleston SC (1 minute, 38 seconds)

Good website for more on this:

<https://eclipse.gsfc.nasa.gov/eclipse.html>

If You Stay in Bartlett/Memphis, on August 21, what will you see?

At 11:52am first contact. At 1:22pm the sun will be 94% covered. Venus should be visible in toward the southwest, possibly Jupiter in the southeast and maybe Mars, to the right of the sun. Coverage will then decrease and the sun will be completely uncovered by 2:50pm.

Some eclipses coincident with historic events

585 B.C. Stopped war between Lydians and Medes

A.D. 632 Coincided with the death of son of Muhammad

1806 Tecumseh, Shawnee warrior, used eclipse to persuade other tribes to follow him as an Indian leader

1831 Nat Turner viewed eclipse as a sign for rebellion

1912 Hybrid eclipse in Atlantic 2 days after sinking of Titanic, though

well south of the Titanic's route

1919 Eclipse used to test Einstein's hypothesis that space is curved and

that light from a star would bend near the sun

1925 Southern graze line of total eclipse was in Manhattan. New York

Times had reporters posted every two blocks to find out who could and could not see it total.

Associations with the Crucifixion

29 Nov A.D. 29 Total eclipse through Syria, though not Israel

19 Mar A.D. 33 Total eclipse in Indian Ocean

Connections of eclipses in the Bible

Joel 2:31 – “The sun shall be turned to darkness and the moon to blood, before the great and terrible day of the Lord comes. Also at Acts 2:20

Luke 23:44-45 – “It was now about noon, and darkness came over the whole land (or earth) until three in the afternoon, while the sun’s light failed (or the sun was eclipsed; or the sun was darkened); and the curtain of the temple was torn in two.

More generally, for me, a total eclipse of the sun is an eerie, unsettling, transcendent experience, which reminds me of Isaiah’s vision of the glory of God in the temple (Isaiah 6), the Transfiguration of Jesus (Matthew 17; Mark 9; Luke 9), and Paul’s being caught up into the third heaven (2 Cor. 12:2)

Appendix 1 – Distance, Diameter, & Angular Diameter of Sun and Moon

Average distance from earth to sun: 92,935,700 miles

Aphelion on July 3, 2017, the sun was 94,506,000 miles from earth.

Perihelion on January 4, 2017, the sun was 91,404,000 miles from earth.

Average distance from the center of the earth to moon: 238,900 miles

Moon’s apogee in August 2017: 251,628 (Aug 2); perigee: 227,499 (Aug 18)

Last November the perigee of 221,524 was the closest approach since 1948.

Ratio of average distance from earth to sun divided by average distance from earth to moon: 388

Diameter of sun – 864,576 miles

Diameter of moon – 2,159 miles

Ratio 400.452

Another way of thinking about their relative size is angular diameter:

Moon at 225,622 miles away has an angular diameter of 33’30”

Sun at 91,402,500 miles away has an angular diameter of 32’42”

Sun at 94,509,100 miles away has an angular diameter of 31’36”

Moon at 252,088 miles away has an angular diameter of 29'26"

Appendix 2 – Distances of Sun and Moon at Selected Eclipses

Type	Date	Sun dist.	Moon dist.	Ratio	Max
<i>Totality</i>					
<i>Annular</i>	05-30-1984	94,254,000	239,325	393.83	-----
<i>Total</i>	07-11-1991	94,501,000	222,269	425.16	6 min 53 sec
<i>Annular</i>	05-10-1994	93,877,000	251,954	372.59	-----
<i>Total</i>	02-26-1998	92,049,000	223,776	411.34	4 min 09 sec
<i>Total</i>	08-11-1999	94,214,000	232,703	404.87	2 min 23 sec
<i>Total</i>	03-29-2006	92,821,000	224,381	413.68	4 min 07 sec
<i>Annular</i>	05-20-2012	94,081,000	252,313	372.87	-----
<i>Total</i>	11-13-2012	91,962,000	222,355	413.58	4 min 02 sec
<i>Total</i>	08-21-2017	94,448,000	231,178	408.55	2 min 40 sec

Appendix 3 – Total Eclipses Visible in USA, A.D. 1900-2016

Date	Path of Totality
08 Jun 1918	Washington, Oregon, Idaho, Wyoming, Utah, Colorado, Kansas, Oklahoma, Arkansas, Mississippi, Louisiana, Alabama, Florida
10 Sep 1923	Southern California
24 Jan 1925	Minnesota, Wisconsin, Michigan, Pennsylvania, New Jersey, New York, Massachusetts, Connecticut, Rhode Island
28 Apr 1930	Hybrid eclipse with one second of totality in northern California, Nevada, Oregon and Idaho
31 Aug 1932	Vermont, New Hampshire, Maine, Cape Cod
04 Feb 1943	Alaska
09 Jul 1945	Idaho, Montana
30 Jun 1954	Nebraska, South Dakota, Iowa, Minnesota, Wisconsin, Michigan-Upper Peninsula only
02 Oct 1959	Massachusetts, New Hampshire
20 Jul 1963	Alaska, (Canada), Maine

07 Mar 1970 Florida, Georgia, South Carolina, North Carolina,
Virginia,
corner of Maryland, Nantucket
10 Jul 1972 Alaska, (Canada)
26 Feb 1979 Washington, Oregon, Idaho, Montana, North Dakota, (Canada)
11 Jul 1991 Hawaii (Mexico)

Appendix 4

Total or Annual eclipses you may have seen in partial phase in Memphis

09 Jul 1945	52% of sun eclipsed at 6:53 a.m. Central War Time
30 Jun 1954	71% of sun eclipsed as it rose at 4:56 a.m. CST
20 Jul 1963	50% of sun eclipsed at 3:48 p.m. CST
07 Mar 1970	75% of sun eclipsed at 12:14 p.m. CST
10 Jul 1972	35% of sun eclipsed at 3:37 p.m. CDT
26 Mar 1979	66% of sun eclipsed at 10:40 a.m. CST
30 May 1984	85% of sun eclipsed at 11:15 a.m. CDT
11 Jul 1991	33% of sun eclipsed at 2:20 p.m. CDT
10 May 1994	80% of sun eclipsed at 11:48 a.m. CDT
20 May 2012	35% of sun eclipsed as it set at 8:00 p.m. CDT

Appendix 5 – Total Eclipses Visible in Memphis/Shelby County A.D. 1000-3000

21 Jan 1395

A line going northeast from President's Island to Arlington marked the southern/eastern graze line of this total eclipse.

If one had stood on the lawn of Grace Presbyterian Church, one would have been at the southeastern graze line and seen 20 seconds of totality. Were one standing at the corner of Stage Road and Kirby Whitten Road, one would have been outside the path. On the center line near Marked Tree, AR, there was totality for 2 minutes, 34 seconds.

29 Jul 1478

All of Memphis was within the path of totality, for an eclipse that began near Carlisle, Arkansas, and hit Memphis with 2 minutes, 20 seconds of totality at 5:23 a.m.

30 Nov 1834

Southwest Memphis, President's Island, the current airport area, and Lamar Avenue/Highway 78 were just within the northern limits of totality.

Downtown Memphis was too far north (just as downtown St. Louis will be on August 21, 2017.)

08 April 2024

Memphis will again get 94% of total; go to Jonesboro AR to get in the path.

12 Aug 2045

Memphis will get 99% of total, the nearest northern graze line is at Tunica.

16 Aug 2566

The center line crosses Highway 51 at I-269 in Millington for 2 minutes, 25 seconds of totality

14 April 2591

The center line runs just north of Summer Avenue, for 2 minutes, 38 seconds of totality.

17 Sept. 2992

The center line runs through Earle AR and Horn Lake MS, and Memphis gets 4 minutes and 3 seconds of totality.

Appendix 6 – Coming Total Eclipses

2019 July 02	<i>South Pacific, Chile, Argentina</i>
2020 Dec 14	<i>South Pacific, Chile, Argentina, South Atlantic</i>
2021 Dec 04	<i>Antarctica</i>
2023 Apr 20	<i>A hybrid eclipse, whose total phase catches the northwest tip of Australia, East Timor, and Papua New Guinea</i>
2024 Apr 08	<i>Mexico, Texas, Arkansas, Missouri, Illinois, Indiana, Ohio, New York, Vermont, New Hampshire, Maine</i>

2026 Aug 12 *Greenland, Iceland, North Atlantic, Spain*
2027 Aug 20 *Atlantic Ocean, Gibraltar, Morocco, Algeria, Tunisia,
 Libya, Egypt Saudi Arabia, Yemen, Somalia, Indian Ocean*
2028 July 22 *Indian Ocean, Australia, New Zealand*
2030 Nov 25 *Namibia, Botswana, South Africa, Indian Ocean,
 Australia*
2031 Nov 14 *A hybrid eclipse, whose total phase is only in the Pacific*
2033 Mar 30 *Alaska, eastern tip of Russia*
2034 Mar 20 *Atlantic Ocean, Nigeria, Cameroon, Chad, Sudan, Egypt,
 Saudi Arabia, Kuwait, Iran, Afghanistan, Pakistan,
 Kashmir, China*
2035 Sep 02 *China, North Korea, Japan, Pacific Ocean*
2037 July 13 *Indian Ocean, Australia, New Zealand*
2038 Dec 26 *Indian Ocean, Australia, New Zealand*
2039 Dec 15 *Antarctica*
2041 Apr 30 *South Atlantic Ocean, Angola, Dem. Rep of Congo,
 Uganda, Kenya, Somalia*
2042 Apr 19 *Indian Ocean, Sumatra, Borneo, Brunei, Philippines*
2043 Apr 09 *Eastern Russia*
2044 Aug 23 *North Dakota, Montana, Saskatchewan, Alberta, British
 Columbia, Northwest Territories, Nunavut, Greenland
 California, Nevada, Utah, Colorado, Kansas, Oklahoma,
 Arkansas, Mississippi, Alabama, Georgia, Florida,
 Bahamas,
 and
 Turks and Caicos, Haiti, Dominican Republic, Trinidad
 Tobago, Venezuela, Guyana, Suriname, French Guiana,
 Brazil*