Solar Eclipse 2017

Mark the date: August 21

Prepared by Richard Berry
Eclipse day is coming...

- **August 21, 2017**

- At *Salem*, Oregon
  - First nibble from Sun: **9:05 a.m. PDT**
  - Totality begins: **10:17:21 a.m.**
  - Totality lasts only **two minutes**!
  - Last nibble from Sun: **11:38 a.m. PDT**

- Estimated 1,000,000 visitors to Oregon
- Possible congestion, confusion, crowding
- Significant positive economical impact

*At the State Capitol building.*
Key points...

- Why does a solar eclipse happen?
- Where can you see the eclipse?
- What are we seeing during an eclipse?
- What will the eclipse look like?
- Who are the eclipse watchers?
- What will eclipse watchers need?
- “Citizen science” during the eclipse.
- Plus...a visual tour of past solar eclipses.

Plus...a visual tour of past solar eclipses.
Here’s the picture people remember from grade school. It is correct, but it’s not to scale...
Here’s a “to-scale” picture. The tip of the Moon’s shadow grazes the Earth.
From space, this is what the tip of the Moon’s shadow looks like.

**Umbra:** the dark part of the Moon’s shadow.

**Penumbra:** part of the Sun is not covered.
This is the path the Moon’s shadow will trace across the Earth.
Total solar eclipses in North America for the next 50 years...
Center Line
Longest totality

Moon’s shadow

Northern Limit

Southern Limit
60 miles
Why Oregon?

- **Good Summer Weather**
  - Willamette Valley: 40% good skies
  - East, Madras: 50% good skies

- **Good Infrastructure**
  - Convenient I-5 Corridor
  - Clear shot for Seattle to San Fran
  - Hwy 22 runs along the center line

- **Good tourist opportunities**
  - Ocean, Coast, Cascades, etc.
The best prospects for clear skies on Eclipse Day
Prospects for a clear sky on the Eclipse Day

Total Solar Eclipse
2017 August 21
Average Cloud Amount along the Centre Line from Satellite Observations
Where in Oregon?

#1 Best Weather (50% Clear Skies!)
- Madras, Warm Springs
- Anywhere along Hwy 26
- I-84 Eastern Oregon

#2 Good Weather (40% Clear Skies)
- Monmouth, Dallas, Salem
- Stayton, Lyons, Mill City on Hwy 22
- Detroit Lake
Our Star: The Sun!
Our Star, the Sun...

- It’s an ordinary type G2 V star:
  - Distance: 93,000,000 miles from Earth.
  - Size: $109 \times$ Earth’s diameter.
  - Age: 4.7 billion years old.
  - Mass: $333,000 \times$ mass of Earth.
  - Temperature: $5772 \, K \approx 10,000 \, F$
  - Composition: 74% H, 25% He, 1% other.
We normally see only the photosphere.

It’s so bright we don’t see anything else...
As the Moon covers the photosphere...

...it’s *still* so bright we don’t see anything else...
Finally, when the Moon covers the last bit of the photosphere... 
...we see the “Diamond Ring” effect.
Then we see the outer parts of the Sun...

- Prominences
- Inner Corona
- Chromosphere
View as seen through a 100x telescope...

- Prominence
- Last sliver of photosphere
- Inner Corona
- Chromosphere
What you might see through a typical birding binocular.

The corona is one ten-millionth as bright as the photosphere. It is entirely safe to look at the corona with binoculars or a telescope.
What Will It Be Like?
• It will be as bright as late evening.
• It does NOT become pitch dark!
• Before totality use Eclipse Glasses.
• Totally SAFE to look during totality.
• After totality use Eclipse Glasses.
• You can see and walk around.
• The eclipsed Sun looks small.
Full Moon in the Night Sky

Eclipsed Sun in Daytime Sky
Solar Eclipse 2017

August 21, 2017

Stayton, OR

9:05 a.m.

10:17 a.m.

10:18 a.m.

10:19 a.m.

11:38 a.m.
Eclipse Times for Western Oregon

- Do not worry about the times.
- You will not miss the eclipse!
- Partial phases last 70 minutes.
- It gets quite dark as totality begins.
- Totality is only **two minutes long**!

<table>
<thead>
<tr>
<th>Location</th>
<th>Eclipse Begins</th>
<th>Totality Begins</th>
<th>Totality Ends</th>
<th>Eclipse Ends</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oregon Coast</td>
<td>9:05</td>
<td>10:15:59</td>
<td>10:17:57</td>
<td>11:36</td>
</tr>
<tr>
<td>Lyons/Mehama</td>
<td>9:06</td>
<td>10:17:44</td>
<td>10:19:45</td>
<td>11:39</td>
</tr>
</tbody>
</table>
What will you need?

• You want to be close to the Center Line...
  • Within ~20 miles is close enough.
• A place to observe...
  • No trees to block your view.
  • Where you can remain safely.
  • Where you stay as long as necessary.
• Important that you have access to:
  • Water, Food, Toilet
  • Sunscreen, sunhat, bug repellant, etc.
  • Gasoline (if you need to travel)
Visual Safety
Visual Safety

• Normally nobody looks at the Sun except for brief glimpses.
• During the partial phases of an eclipse, the Sun is still much too bright to look at, but people tend to stare at it anyway.
• For the partial phases, you need a dark filter like a "solar viewer," "eclipse glasses," or a #14 welder's glass.
Visual Safety

• Even when the Sun shrinks to a skinny crescent, the Sun is still too dazzlingly intense for direct viewing.
Visual Safety

• When the last bit of crescent vanishes, totality begins.
• During totality, is it entirely safe to view the eclipsed Sun.
• You will see a dark circle surrounded by the Solar Corona, the Sun’s atmosphere.
• The corona is no brighter than the Moon is at night.
• It's safe to look freely and you can use binoculars or a telescope for a closer view.
• But remember: totality is short. You have only two minutes of totality.
Visual Safety

• When the crescent reappears, you must again view the Sun through dark filter glasses or viewers.
Gadgets and Gizmos

• Direct Viewing
  • Eclipse glasses, eclipse viewers, #14 Welders glass.

• Pinhole Projection
  • A cardboard box with a pinhole at one end.

• Binocular Projection
  • Easy way to get sharp views of partial phases.

• Telescope Projection
  • Even better than binoculars!

• Telescope with Filters
  • You must use a safe solar filter!
Pinhole Projection

Pinhole projector using a box

Sunlight
Aluminium foil with pinhole

Paper taped to inside end

Image of the Sun

© timeanddate.com
Binocular Projection

Projector using binoculars

Binoculars

Sheet of paper with Sun's image

© timeanddate.com
Telescope Projection
Telescope with Filter
Remember: During the **two minutes** of totality, you **do not need a filter**.
“Citizen Science”

- Citizen CATE Project
  - Detailed study of the Sun’s inner corona
  - Sixty stations across the United States
- Modern Eddington Experiment
  - Reprises proof of Relativity in 1919
  - Gravitational deflection of starlight
- Eclipse “Megamovie”
  - Thousands of pictures combined
  - Two-hour movie tracing coronal changes
- High-Altitude Balloon Experimenters
  - At 55 high-schools across the USA
  - Images of umbra from 90,000 feet
Citizen CATE Experiment

- The Citizen CATE Experiment will use a fleet of telescopes to observe the eclipse.
- Citizen astronomers from more than 60 sites will take images of the brightness of the inner solar corona.
- The combined Citizen CATE Experiment data set will reveal how this part of the solar atmosphere changes during 90 minutes.
- New scientific results about the dynamics of the magnetic fields and plasmas will be derived from the data.
Citizen CATE cameras with pick up much more detail than the eye can see.
Modern Eddington Experiment

• In 1919, Sir Arthur Eddington measured the deflection of starlight by the Sun.
• The value he found verified a prediction by Einstein’s Theory of Relativity.
• Modern amateur astronomers will measure this deflection more accurately than Eddington did in 1919.
Eclipse Megamovie

- Goal: Produce a high definition, time-expanded video of the total solar eclipse.
- The Megamovie video will be pieced together from images collected by citizens.
- It will provide continuous datasets that far exceed what any one person could capture from a single location.
- The Eclipse Megamovie will be about two hours long.
Silverton High School High-Altitude Balloon Project

- Students conduct high-altitude balloon flights
  - Fifty locations on total eclipse path
  - From Oregon to South Carolina
  - Live videos and images from “near space.”
Five Eclipses...

Personal experiences in the shadow of the Moon...
Total Eclipse of the Sun

June 20, 1963

Mount Desert Island, Maine
In an open field on Cadillac Mountain
Total Eclipse of the Sun

March 7, 1970

Near Halifax, Nova Scotia
At a small tidal inlet
Total Eclipse of the Sun

June 11, 1983

Surabaya, Indonesia
Back court of the Chinese Temple
around the fish pond
Partial Eclipse of the Sun

May 10, 1994

Central Illinois
in a large field of corn
Total Eclipse of the Sun

July 11, 1991

Cabo San Lucas, Mexico
Aboard the
The “Flash Spectrum” of the chromosphere, seen through a prism.
And then it’s over...
Questions...
Solar Eclipse 2017

Thank you!

Prepared by Richard Berry