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| --- | --- | --- | --- | --- | --- |
| Name: | **[insert name]** | Period: | **[insert Period]** | Date: | **[insert date]** |

How Eclipse Locations Change

# Background

We’ve seen that we tend to get 2 solar eclipses in a year with about 6 months in between each event. And more often than not, if one eclipse occurs in the northern hemisphere, the second will occur in the southern hemisphere. So why do we see that pattern?

To better understand how this happens, we’ll need to look closely at how the sun’s path changes throughout the year.

# Using a Computer Model for Sun Motion

To help us understand why these eclipses occur in different locations, we first need to look at the sun. You may have noticed that during some months of the year, the sun is high in the sky and in other months the sun sits lower even at noon. This model will help us to see that pattern before we learn more.

## 

## A Look at Chile

1. Follow the link to the [Sun Path Model](http://andrewmarsh.com/apps/staging/sunpath3d.html).
2. The box in the top left corner shows the location we are viewing from. Click the magnifying glass to set this to “Chile”.
   1. The red line shows the path of the sun that day over that location.
   2. You can change your view by clicking and dragging the model.
3. Click on the box “Date and Time”. Drag the slider under “Date” to 01 Jan 2021 and the slider under “Time” to 0:00.
4. Select the triangle play button at the top of the window (next to the settings gear button) and watch how the sun moves over the course of a day. Stop the animation when the model becomes dark again and answer question 1 in the table below.
   1. Feel free to rotate and move the model as it plays to see the sun’s motion and the motion of the shadows over the surface. You can also scroll to zoom in and out.
5. Now drag the slider under “Date” as close to 01 Jul 2021 as possible and the slider under “Time” to 0:00.
6. Select the triangle play button at the top of the window (next to the settings gear button) and watch how the sun moves over the course of a day. Stop the animation when the model becomes dark again and answer questions 2 and 3 in the table below.
7. Open the box “Geographic Location”, record Chile’s latitude in the table below and answer questions 4 and 5.

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| --- | --- |
| **Question/ Prompt** | **Your Response** |
| 1. In January, is the sun high or low in the sky in Chile? How can you tell? |  |
| 1. In July, is the sun high or low in the sky in Chile? How can you tell? |  |
| 1. When the sun’s path is lowest in Chile, is it seen in the northern or southern part of the sky? |  |
| 1. What is Chile’s latitude?   (Round to the nearest whole number.) |  |
| 1. Latitude tells us the distance from the equator. Positive numbers are north and negative numbers are south.   Is Chile in Earth’s northern or southern hemisphere? |  |

## 

## A Look at Idaho

1. Follow the link to the [Sun Path Model](http://andrewmarsh.com/apps/staging/sunpath3d.html).
2. The box in the top left corner shows the location we are viewing from. Click the magnifying glass to set this to “Idaho USA”.
   1. The red line shows the path of the sun that day over that location.
   2. You can change your view by clicking and dragging the model.
3. Click on the box “Date and Time”. Drag the slider under “Date” to 01 Jan 2021 and the slider under “Time” to 0:00.
4. Select the triangle play button at the top of the window (next to the settings gear button) and watch how the sun moves over the course of a day. Stop the animation when the model becomes dark again and answer question 6 in the table below.
   1. Feel free to rotate and move the model as it plays to see the sun’s motion and the motion of the shadows over the surface. You can also scroll to zoom in and out.
5. Now drag the slider under “Date” as close to 01 Jul 2021 as possible and the slider under “Time” to 0:00.
6. Select the triangle play button at the top of the window (next to the settings gear button) and watch how the sun moves over the course of a day. Stop the animation when the model becomes dark again and answer questions 7 and 8 in the table below.
7. Open the box “Geographic Location”, record Idaho’s latitude in the table below and answer questions 9 and 10.

|  |  |
| --- | --- |
| **Question/ Prompt** | **Your Response** |
| 1. In January, is the sun high or low in the sky in Idaho? How can you tell? |  |
| 1. In July, is the sun high or low in the sky in Idaho? How can you tell? |  |
| 1. When the sun’s path is lowest in Idaho, is it seen in the northern or southern part of the sky? |  |
| 1. What is Idaho’s latitude?   (Round to the nearest whole number.) |  |
| 1. Latitude tells us the distance from the equator. Positive numbers are north and negative numbers are south.     Is Idaho in Earth’s northern or southern hemisphere? |  |

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# Gathering Information

1. Watch TED-Ed’s [“Reason for the seasons”](https://youtu.be/DD_8Jm5pTLk?t=113) to learn why these differences exist. Watch from 1:53 to 2:33.
2. Answer the following question.

|  |  |
| --- | --- |
| **Question/ Prompt** | **Your Response** |
| 1. What allows for some areas to experience long days of daylight while others experience shorter days? |  |

### Using a Computer Model for Earth’s Tilt

1. Follow the link to Interactive Earth’s [Sun, Earth and Moon Visualization](https://www.interactive-earth.com/earth/solar-system.html).
2. You can close the dialog box on the left, but keep the right on open.
3. You can click and drag the model to change your view of the model. You can also pause the model by setting the Earth Orbital Velocity to 0. Some things to note:
   1. The large white sphere in the center is the sun and the small white sphere closer to earth is the moon.
4. Without changing any of the settings in the panel on the right, watch as the earth moves around the sun and watch for solar eclipses. Remember you can pause the model by lowering the “Earth Orbital Velocity” in the panel on the right to 0.
   1. Answer question 12 in the table below.
5. Now set the “Earth’s Axis Tilt” to 0. Watch as the Earth moves around the sun, and watch for solar eclipses.
   1. Answer question 13 in the table below.
6. Set the “Earth’s Orbital Velocity to 0 when you have the sun, Earth, and moon in view. Adjust the “Moon Axis Tilt” and “Earth Axis Tilt” to help answer question 14.

|  |  |
| --- | --- |
| **Question/ Prompt** | **Your Response** |
| 1. When eclipses occur, do they occur closer to the poles or closer to the equator? |  |
| 1. When eclipses occur, do they occur closer to the poles or closer to the equator? Do they happen more or less often? Why? |  |
| 1. Do the eclipses happen more or less often? Why? |  |

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# Thinking About the Phenomena

We tend to get about 2 solar eclipses each year- one in each hemisphere. Using your new knowledge of the Earth’s tilt adjust the model below to help show why eclipses alternate hemispheres.

Rotate the Earth to show the tilt of the axis that would allow an eclipse in the southern hemisphere in February like we saw in Chile in 2017 and an eclipse in the northern hemisphere in August like we saw in Idaho in 2017.

Remember this model is not to scale. You do not need to move the sun or the moons.

