Optional Lab: Eclipses, Upcoming Lunar Eclipse

Finish by Nov 27, 2022

1 Lab Layout

This take-home lab is meant to act as extra credit or as a make up for any absences from the in-person labs. It therefore will rely on some independent research, and will include a writing/essay-style questions. Feel free to follow the included links, or to look elsewhere online- but, make sure that all writing is your own original work. Don't copy in any text without proper attribution.

In theory, the links I've provided have all of the information necessary to answer each of these questions, and you're allowed to look elsewhere on the internet as well. So, if you're stuck, the first step is to do some independent research or work together to track down an explanation.

2 Eclipse geometry

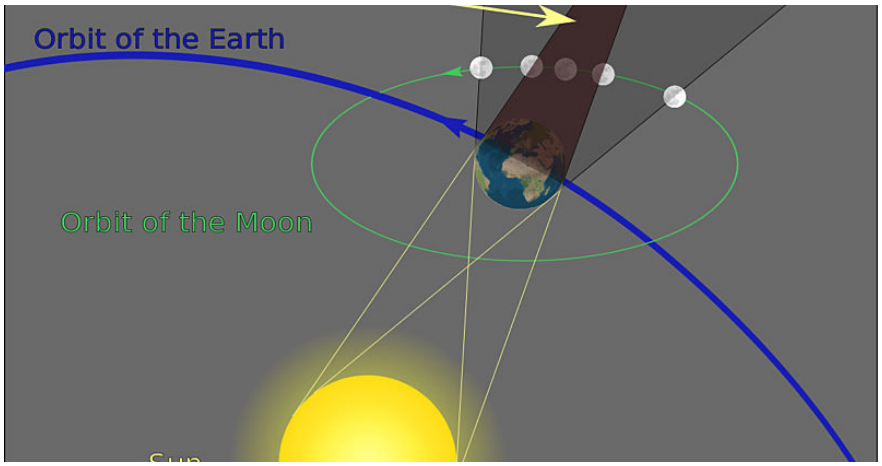

Figure 1: An illustration of the layout of the sun, Earth, and moon during a lunar eclipse. Credit: The Planetary Society.

Eclipses refer to times when three bodies in space all fall on the same line - the exoplanet transits we considered a few weeks ago can be classified as eclipses, since during transit the planet-star-Earth all fall on the same line. Within our solar system, eclipses fall into two flavors: lunar eclipses, when the Earth falls between the moon and the sun, and much more dramatic solar eclipses, when the moon falls between the Earth and the sun. For lunar eclipses, check out the the wikipedia page or this NASA page about the upcoming eclipse. For solar eclipses, check out this wikipedia page and this NASA page which was put together ahead of the last solar eclipse visible in the US, in 2017.

With information from those pages, the links within (the Solar Eclipse 101 page is very useful) or other websites, answer the following:

1. During what moon phase are lunar eclipses possible, new or full moons?
2. During what moon phase are solar eclipses possible, new or full moons?
3. Why don't we see a lunar and solar eclipse every month?

With the basics of eclipse geometry covered, let's visually combine those answers. Create diagrams of the following situations:

4. A top-down view of the sun, moon, and earth during a lunar eclipse happening on the autumnal equinox. Include the locations of each body, circles marking the paths of their orbits, and labels for the autumnal equinox, vernal equinox, summer solstice, and winter solstice. The convention of top-down views of the Earth's orbit is to place the vernal equinox along the positive X axis and assume the Earth moves counterclockwise.
5. A top-down view of the sun, moon, and earth during a solar eclipse happening on the summer solstice. Include all the same labels as before.

3 Lunar Eclipse Colors

Solar eclipses are dramatic, beautiful events where the sun seems to disappear in the middle of the day. Lunar eclipses are more subtle, but still very strange: the moon doesn't disappear, it just gets darker, then turns a dark red. Using information from online/the same links above:

6. Explain why the moon turns red, not some other color.
7. If the Earth didn't have an atmosphere, what would the moon look like during a lunar eclipse?

4 Make a hypothetical plan to view the next solar eclipse

On Monday, April 8th, 2024, a total solar eclipse will be visible along a narrow corridor running across the United States. Using information from NASA, Great American Eclipse, or elsewhere, write a ∼500 word hypothetical plan to view the eclipse. Be sure to include:

- Where you would go. When deciding, consider the visibility of the eclipse from your location, the feasibility of getting there, how cloudy it is in April historically (it'd be awful to make a trip far away and hit clouds), and if there's any other draws to the area besides the eclipse.
- A timeline of what you would see in the sky- when would you notice something weird was happening with the naked eye? When would you notice something was weird if using eclipse glasses?
- What you would see during the eclipse: what is the outermost edge of the sun called? What does it look like? What about the stars?

- Any equipment you would need to observe the sun.
- This isn't strictly part of a plan, is fun to imagine: if you were standing on the moon looking up at the Earth during this event, what would you see? Why?

5 Conclusions

Please complete this section on your own.

1. What was your favorite and least favorite parts of this lab?
2. What is a question you still have at the end of this lab?