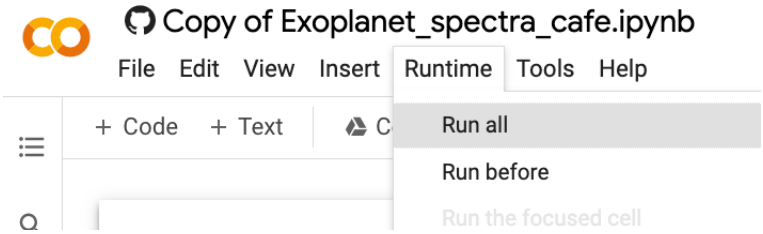
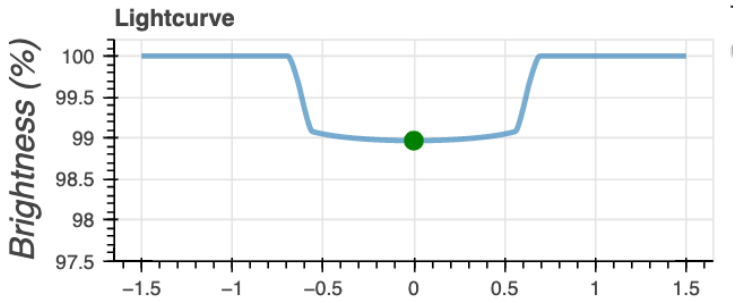
Student Worksheet for the Exoplanet Atmospheres Instant Pack

In this Teen Astronomy Café — To Go! Instant Pack, you will be recovering spectra from exoplanet systems to understand what their atmospheres are made of. This activity is conducted in a Python Notebook, a web-based interactive computational environment that contains code, text, and plots.

Pre-Activity Setup: Go to the "Runtime" menu and select the option to "Run all." Running all helps to ensure a cell was not skipped and all libraries are imported to help the activities work properly. As you work through the Python Notebook, you may also re-run each cell individually.



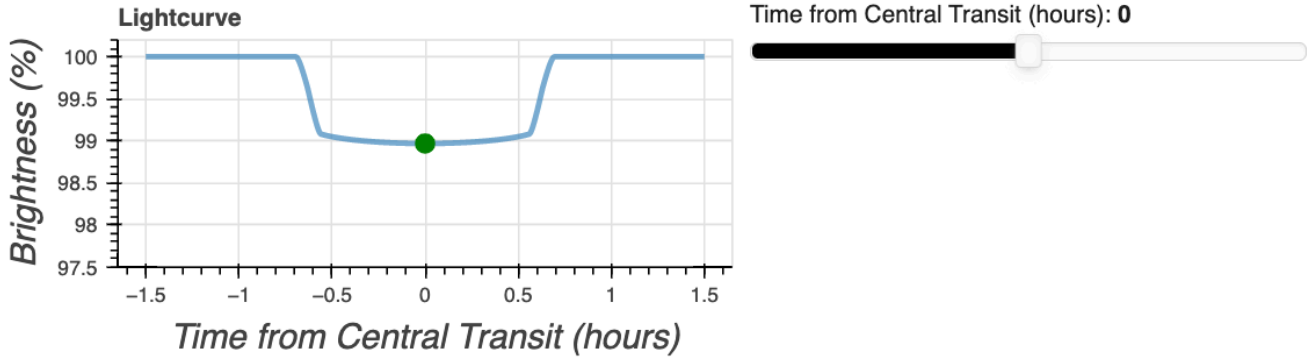
Activity 1: Introduction — Planet Lightcurves
In this activity, you will explore planet lightcurves to see how the brightness of a star and planet system changes over time as the planet goes in front of the star.



1. When does the brightness change? Why do you think the lightcurve has a value of 100% at the beginning and end of the graph?

Activity 2: Planet Radius

In this activity, you will look at another lightcurve to determine how the planet's radius affects the lightcurve and view of the star and planet. Adjust the slider to change the radius of the planet and observe the results in the lightcurve.



2. Does increasing the planet radius make the dip deeper or shallower?

3. How does the planet radius affect how long the brightness drops below 100%?

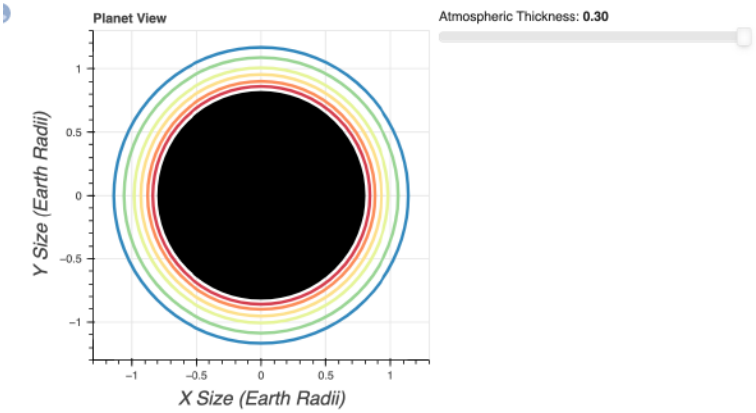
Activity 3: A Planet Spectrum

3.a. Planet Size in Different Colors

The slider in this activity adjusts the size of the planet's atmosphere as you explore how different colors of light pass through a planet's atmosphere.

4. In which color does the planet appear biggest?

5. How could you tell if a planet has an atmosphere?

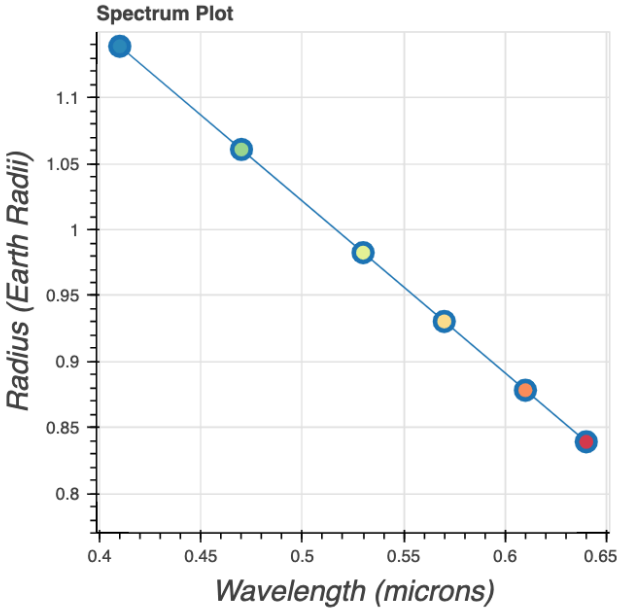


3.b. A Spectrum Plot

A transmission spectrum plot will be generated in this activity as you compare the atmosphere thickness to changes in the slope of the plot.

6. How would you describe the spectrum when the slope of this line is zero?

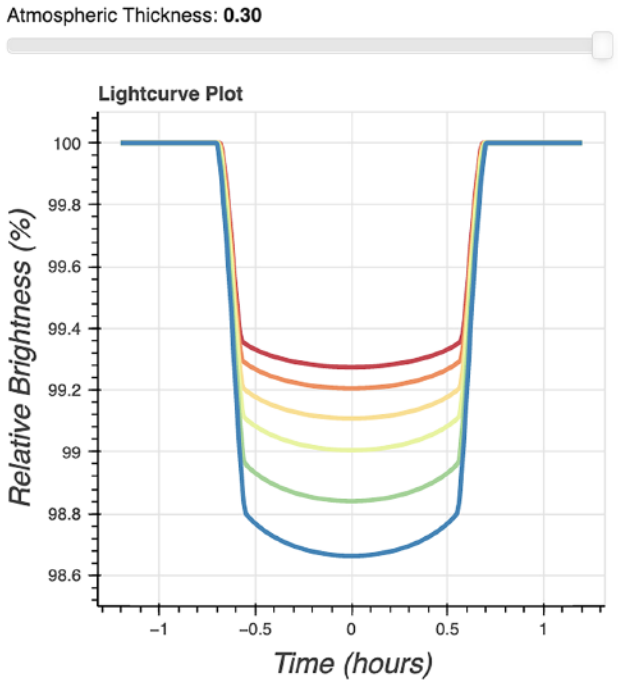
7. How would you describe the atmosphere when the slope of this line is zero?



3.c. A Multi-colored Lightcurve

The multi-colored light curve is very similar to the spectrum plot. This activity adds a lightcurve plot to explore the depth of the lightcurve at different wavelengths (colors).

8. What kind of measurement could you make to find out if a planet has an atmosphere?



Activity 4: Example Planet Atmospheres

In this activity, you will observe how different substances absorb and transmit different wavelengths of light. Note: The atmospheric sizes have been made larger than reality to make them easier to see.

9. There is a solid surface visible here. At which level (in Earth radii) is the surface? Where do you think it was in the above atmospheres?

Activity 5: Mystery Planet Atmospheres

In this activity, you will observe the lightcurve of a planet at different wavelengths to figure out what the radius of the planet (in Earth radii) is for that wavelength.

For the following mystery planets, compare your transmission spectrum to the models. What kind of atmosphere did you find?

10. Mystery Planet 1:

11. Mystery Planet 2:

12. Mystery Planet 3:

13. Mystery Planet 4: