



Activity 1 - Welcome to the Laboratory for the Study of ExoPlanets

PURPOSE. Use your first session as an opportunity to:

Introduce students to the ExoLab website and the tools and activities they will be pursuing.

Engage students in a preliminary discussion of this exciting frontier of science

Elicit student knowledge and prior ideas about stars, planets, and the possibility of extraterrestrial life.

NGSS EDUCATIONAL OBJECTIVES. To introduce students to the project, it is important to give them time to consider their existing personal knowledge and their own questions about the universe beyond Earth, and think about why it might be interesting to look for other worlds. Throughout the ExoLab, students will have opportunities to demonstrate their understanding of the NGSS Disciplinary Core Ideas associated with:

Earth's place in the Universe, including ideas about the Universe and Its Stars, and about Earth and the Solar System.

Core Concept Underpinning this Lesson:

Our Sun is a star, and the stars are suns. Even the nearest star lies enormously far beyond our own solar system. Stars are orbited by planets, which may be very different worlds from ours.

SUGGESTIONS FOR LEADING THE LESSON.

Welcome students to the community of planet hunters. Let them know they will be making their own observations of recently discovered extrasolar planets, using a robotic telescope owned by the Harvard-Smithsonian Center for Astrophysics, and located at the Center's Whipple Observatory in Arizona. The ExoLab website was designed by scientists and educators at the Center for Astrophysics, to provide students with access to the same kinds of instrumentation and analysis tools that the professionals use in this cutting-edge field of science. The students' goal is to see if they can first, *detect* the signal of a planet in their observed star system, and then *analyze* the signal to draw evidence-based conclusions about the planet's size, distance from its star, and orbital tilt.

Provide students with the usernames and passwords you set up for them, and once they log in, students can explore the website. (Students will know they are logged in when they see the upper right button change to "LOGOUT"). First, have them click on the "Overview" section from

the home page, and click through the Overview slideshow. Through a class discussion, have them express their ideas about the search for extraterrestrial life on other worlds. Here are some suggested thought questions for students; you may have some of your own.

Student Questions:

Most of the other solar systems discovered so far are not like our own. For a moment, travel in your imagination to an alien world. Describe what you think life might be like on:

a. A planet with one side that always faces its star.

Students should realize that this would make one side very hot all the time, and the other side very cold. They should also realize that it would be permanent day on one side of the planet and permanent night on the other. Have them think about whether there might be any parts of this planet that might have conditions conducive to life.

b. A rocky planet much bigger than Earth, where there's more space on the surface and where gravity is stronger.

Students might think about this question from a personal/human perspective, and imagine what it would be like to have more space for people to live, or for them to be heavier and for movements to be more difficult. They might also take a broader perspective and think about how life evolving on a planet with more gravity might look different from life on Earth.

c. A much smaller rocky planet, where you'd have less space on the surface and weigh very little.

Students' answers will vary depending on whether they are thinking about this from a human perspective or from the broader perspective of potential impacts on the evolution of life. They might think about the ease with which they could move about, or about increased competition for space on this smaller world.

d. A planet that is always cloudy, and there is never a clear day or night.

Students might wonder if there would be enough light on the surface to support life. From a human perspective, people on the surface would never have seen the stars.

e. A planet with a very eccentric orbit, so that for part of the year it is extremely close to the sun and part of the year it is very far away.

This question is a good opportunity to review students' understanding of the cause of Earth's seasons. Earth's seasons are caused by the planet's tilt (the orbit around the Sun is nearly round and the Earth is actually closer to the Sun during the Northern Hemisphere winter). In this

example, the very eccentric orbit would cause extreme temperature differences from one part of the year to another.

You may wish to go over the size and scale of planets in our own Solar System so that your students have this in their mind as they look at other planetary systems. Some teachers also like to start this project by having their students examine a physical model of a transiting planet system – e.g., a light bulb with a small ball on a stick orbiting around it. In the next “Modeling Lab” session; students will work with an online visual model of the kinds of systems they will be investigating.

Important Note for Teachers: Depending on your scheduling and the exoplanet transit calendar (on the Teachers page), you may wish to use your teacher account to request images for a few nights leading up to the date on which your students are ready to use the telescope. This will increase the chances that there will be a good set of images in your class account for at least one exoplanet target when your students are ready to reduce data. Remember, cloudy nights are the foil of all astronomers!