



## Exoplanet Facebook Project

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#### Purpose

Students will learn about exoplanets and how they are discovered and characterized by researching an assigned *Kepler* planet, designing and presenting a mock Facebook page for the planet, and using computational models to demonstrate the physical size and scale of the planet-star system and model observations of the planet transiting its host star.

#### Overview

Students will work in groups to research an assigned exoplanet. This research will include reading parts of the original scientific paper describing the discovery of the planet as well as gathering facts about the physical characteristics of the planet and its host star. Information about the planets' size and orbit are used as input to computer models that demonstrate the physical size of the star-planet system and illustrate the transit method by which they were discovered. The students will use the results of their research to construct a mock Facebook page for their assigned planet. Students present their mock Facebook page to the class.

#### Student Outcomes

- SWBAT understand the difference between a planet in our solar system and an exoplanet.
- SWBAT understand concepts and terms related to exoplanets and their discovery such as 'orbital period', 'semi-major axis', 'radius', 'light-curve', and 'transits'.
- SWBAT use the Exoplanet App (or similar resource) to find information about an exoplanet.
- SWBAT construct and interpret a model of their planetary system generated with a computer program.
- SWBAT understand the factors that influence an exoplanet's habitability.
- SWBAT present their information to the class.

#### Standards Addressed

- **HS-ESS1-4:** Use mathematical or computational representations to predict the motion of orbiting objects in the solar system.

Students utilize computational models in this lesson to model the motion of planets orbiting other stars and predict the signature of their transits on the observed flux from their host star.

#### Time

4-5 class days with minimal work outside of class; less if some is assigned for homework.

#### Level

Physics or Astronomy class, any level



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## Materials and Tools

Computers with ability to run Wolfram and [NetLogo](https://ccl.northwestern.edu/netlogo/) (<https://ccl.northwestern.edu/netlogo/>)  
Exoplanet App for the iPad  
Additional resources found [here](#), including a mock Facebook page, NetLogo simulation, and grading rubric.  
(<https://northwestern.box.com/s/r9qzomgqjvntzncgyebzk2xesfy9rcsd>)

## Preparation

Load and be familiar with the Exoplanet App and computer simulations to help students navigate through the information.

## Prerequisites

None.

## Background

We are all familiar with the 8 planets of our Solar System. However, we now know our solar system is just one example among thousands of planetary systems discovered over the past ~20 years in our own galaxy. These planetary systems, in turn, likely represent only a miniscule sample of all planetary systems throughout our galaxy and others. These planets, which orbit other stars in our galaxy, are referred to as 'exoplanets'. Many of these newly discovered were the found by NASA's *Kepler* mission, a space-based telescope designed specifically for finding and studying these alien worlds. Most of these planets are quite different than our own Solar System both in planet sizes and arrangement of their orbits, and it is natural to ask how these planets compare to Earth or whether they might be habitable.

For this project, you will be researching a particular exoplanet. Based on your research, you will create a Facebook page for your assigned planet and present this Facebook page to the class. The page should give a sense of what your planet is like and how it compares to the Earth. You will also be using some computer-based models to simulate the size and scale of your exoplanet system and to simulate the discovery. You will include the results of these simulations as part of the Facebook page that you will present to the class.

## Teaching Notes

- Students are presented with the list of exoplanets (included [here](#)), each with a brief description, and choose the planet they will research.
- After choosing a planet, the students will read (part of) the original discovery paper. The students should at least read the paper abstract and introduction section. Students should keep note of any of the terms or concepts presented that they don't understand and record any questions they have based on reading the paper.
- The students should attempt to research the answers to any questions they have. The teacher can provide guidance. The teacher may consider having students post their questions to a class online discussion thread.
- In classes with access to iPads, students should download the "Exoplanet" App. This app contains information on each discovered exoplanet along with various visualization tools. The students should familiarize themselves with their assigned exoplanet. Alternative sources for information on exoplanets are listed below under "Additional Information"



- Students should begin designing the planet Facebook page. Each group should decide on an original name for their exoplanet.
- Next, students will use the Mathematica CDF and/or NetLogo programs to model their planet-star system. This should be introduced with a discussion of the “transit” method that the *Kepler* telescope uses to find planets. This includes how the transit method works as well as the factors effecting the detectability of a planet (e.g., the orientation of its orbit, the planets size and period). The teacher may also want to discuss any related physics concepts, e.g. central force motion and Keplerian orbits, equilibrium temperature, black-body radiation and a star’s color, etc.
- Students should screen-capture video of the Mathematica and NetLogo simulations with their planet’s relevant parameters used as input. These screen-capture videos should be included on their planet’s Facebook page and used as part of the presentation.
- Students should finalize their Facebook pages and decide how they will present it.
- Each group should present their planet Facebook page to the class.

### **Assessment**

Assessment is based on the final Facebook page and presentation. An example grading rubric is included.

### **Additional Information**

Classes that are unable to use the Exoplanet App can use other resources that list information about different exoplanet systems, e.g.:

<http://www.openexoplanetcatalogue.com>

<http://www.exoplanets.org>

<http://exoplanetarchive.ipac.caltech.edu>

In the original implementation of this lesson, students were given the option to create actual Facebook pages for their planets, rather than using the PowerPoint template. Teachers can consider allowing students this option.