Lesson 21: Missions Outside Our Solar System: Kepler

Summary
This learning module is meant for adaptation into any course wishing to introduce students to planets outside Earth's solar system. Students will learn about the 'habitable zone' and apply techniques used to find planets outside our solar system.

Learning Goals

Students will be able to:
- Identify and explain the "habitable zone"
- Explain and apply the planet transit technique of detecting planets outside our solar system in the Kepler Mission.
- Utilize software programs such as Planet Hunters and the Kepler Exoplanet Transit Hunt sponsored/created by NASA missions.

Context for Use
This learning module can be used in any course of instruction where instructors would like to introduce students to planets outside our solar system and the concept of the habitability zone.

Description and Teaching Materials
In-Class Activity
　　　In-Class Activity 1: Seeing like Kepler
Homework/Lab
　　　Homework 1: Light Grapher
　　　Homework 2: Planet Hunters!

Teaching Notes and Tips
1. Purchase or order an orrery device in order to use *In-Class Activity 1* Seeing Like Kepler in your course
2. All Homework sets can be adapted for the classroom if desired.

3. Before students are assigned *Homework 1* "Light Grapher" provide a demonstration of how the software works and explain to students that they will need a webcam in order to do the homework
4. Create a planethunters.org account so you can demonstrate how the website interacts with the user in the *Homework 2* "Planet Hunters".

Assessment
Methods of assessment are within each individual *In-Class Activity* and *Homework*.

Mars for Earthlings

References and Resources
1. Kepler Exoplanet Transit Hunt computer interaction:
   http://kepler.nasa.gov/multimedia/Interactives/keplerFlashAdvDiscovery/#
2. Orrery suggestions for building:
   http://kepler.nasa.gov/education/ModelsandSimulations/LegoOrrery/
3. Planet Hunters: http://www.planethunters.org

Mars for Earthlings

Homework 1
Detecting Planets_MFE
Light Grapher

Directions

1. Go to: http://kepler.nasa.gov/education/ModelsandSimulations/lightgrapher/

2. Read over the webpage for context.

3. Briefly describe the principle(s) being used in order to locate planets.

4. Read through the directions and hints.

5. Run the program at least 3 different times. For each iteration, change the parameters by trying different methods of interaction with the camera, objects, sizes of objects, spacing of objects from camera, light source, etc. Report each iteration as follows as in the example below.

   Ex:
   Iteration #1
   Parameters Used:
   Outcomes (describe the graph and cut/paste the captured images)**:**

6. From their different iterations, what did the students learn about the objects? Did the size, color, transparency, or opacity matter?

7. Consider the planet Mars (typically red-tones) and a planet like Neptune (lighter blue colors). If students were to pass it in front of the webcam which planet would yield a greater change in light? Have students explain your reasoning.