Finding Earth-Like Planets

NASA SUMMER OF INNOVATION

UNIT
Earth and Space Science - Planetology

GRADE LEVELS
7 – 9

CONNECTION TO CURRICULUM
Earth Science and Astronomy

TEACHER PREPARATION TIME
2 hours Complexity: Moderate

LESSON DESCRIPTION
This lesson combines activities used to provide students with an understanding on how extra-solar and Earth-like planets are detected.

OBJECTIVES
Students will

- Detect a slight flicker when a small ball passes in front of a light bulb illustrating how astronomers detect extra-solar planets as they pass in front of stars
- Simulate how light collected from a space object converts into binary data and reconverts into an image of the object

NATIONAL STANDARDS

National Science Education Standards (NSTA)
Earth and Space Science Standards
- Origin and evolution of the Earth system
- Earth in the solar system

History and Nature of Science
- Science as a human endeavor

Common Core State Standards for Mathematics (NCTM)
Expressions and Equations
- Understand the connections between proportional relationships, lines, and linear equations

Statistics and Probability
- Investigate patterns of association in bivariate data
- Use random sampling to draw inferences about population

ISTE NETS and Performance Indicators for Students (ISTE)
Creativity and Innovation
- Apply existing knowledge to generate new ideas, products, or processes

Critical Thinking, Problem Solving, and Decision Making
- Use multiple processes and diverse perspectives to explore alternative solutions

MANAGEMENT

Detecting Planet Transits: Conduct this activity as a total class project.

Count Your Lucky Stars: Instruct students to work in pairs for this activity.

Paint By Numbers
Students can be paired together or work as a class to complete this activity. If working in pairs, ask one student to call out the "shading value" from 0 to 3 as the other student shades in the appropriate value. (Refer to Procedure in the Paint by Numbers activity). If working as a whole class, the instructor can call out the shading value from 0 to 3 as the class shades in the appropriate value. Print copies of page 85 from the Paint by the Numbers activity for the students. It is recommended that a digital projector or large monitor be used to project the Paint by Numbers grid to see the pattern being created.

MATERIALS

DETECTING PLANET TRANSITS:

- Overhead LCD projector or large LCD display
- Prepared key concept sheet from CD–ROM file
- 1 lamp socket (tabletop)
- 1 extension cord
- A 25-watt incandescent light bulb
- 1 round opaque plastic bead (about 16 mm in diameter)

Count Your Lucky Stars

- Page 58 from NASA's SciFiles Activity, The Case of the Galactic Vacation (note: although this activity is Grades 3 to 5, the background in students understanding the vastness of the amount of stars in the universe can easily be realized.

Paint by Numbers

- NASA's Space Based Astronomy teacher guide, pages 84–87.

CONTENT RESEARCH
To learn more about the size of bodies in the solar system and the distances between them, visit the following Web sites. Additionally, background information about missions exploring our solar system can be found at these sites.

Exploring Planet Sizes: Students investigate planetary sizes
http://solarsystem.nasa.gov/educ/docs/3-stardst-ch03.pdf
Walking the Planet Distances: Walk scaled distances among planets
http://solarsystem.nasa.gov/educ/docs/3-stardst-ch03.pdf
Solar System Missions: Investigate recent discoveries about the solar system
http://discovery.nasa.gov/index.cfml

VOCABULARY:
Solar System Missions: The Space Agency's (NASA) terminology used to define projects and programs that are responsible for developing hardware and technologies used in the exploration of solar system bodies.
Planets: Larger spherical bodies in the solar system in orbit around the Sun characterized by having a gravitational field to maintain their spherical shape.
Asteroid: A class of small solar system bodies in orbit around the Sun and believed to be remnants of the solar system formation.
Extra Solar Planet: Planets that are in orbit around stars beyond our solar system, but are within our galaxy.
Meteoroid: Remnants of rock and small debris in orbit around the Sun or planets left over from the formation of the solar system. Meteoroids may also be formed as a result of collisions between other meteoroids.
Comets: Solar system bodies consisting of ice and rock and believed to be remnants of the solar system formation.
Sun: The nearest star to earth, generates its energy by nuclear fusion, changing hydrogen atoms into helium by the its intense gravity.

LESSON ACTIVITIES
Detecting Planet Transits: This lesson incorporates activities that have students understanding how astronomers can detect extra solar planets by noting dimness in the total light output of a star by using a light bulb from a table lamp and a small bead attached to a string. A student moves a ball on a string in front of the light, which is known by astronomers as a "transit." Other students should be able to detect a "flicker" or slight dimness of the total light output from the light bulb.
http://kepler.nasa.gov/education/activities/gr68/detectingPlanetTransits/

Count Your Lucky Stars: Students will readily understand that the number of stars in the galaxy are truly astronomical, not to mention the total number of stars in the universe.
http://scifiles.larc.nasa.gov/docs/guides/guide2_03.pdf

Paint by Numbers:
The Kepler mission's goal is to detect Earth-like planets within our galaxy and acquire images of planetary transits by possible Earth-like planets around stars. Students will use printed grids to demonstrate how digital imagery is deciphered. http://aesp.psu.edu/files/soi/paint%20by%20the%20numbers.pdf

ADDITIONAL RESOURCES

Solar System Lithograph Set
This lithograph set features images of the planets, the sun, asteroids, comets, meteors and meteorites, the Kuiper Belt and Oort Cloud, and moons of the solar system. General information, significant dates, interesting facts, and brief descriptions of the images are included.
Lithograph Set
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NASA's Great Observatories (NASA CORE)
http://corecatalog.nasa.gov/item.cfm?num=300.0-85

Hubble Space Telescope Deep Field
http://hubblesite.org/hubble_discoveries/hubble_deep_field/

DISCUSSION QUESTIONS

- Once students grasp the meaning of planetary transits, whereby a planet's disk will be silhouetted against a star, ask the students what planet could astronomers derive by studying the time it takes for the planet to travel across the disk of the star? *Astronomers could determine by using mathematics, the mass, density, orbital revolution, and size of the planet.*

- Allow students the opportunity to research the various disciplines required to be an astronomer. *Astronomers would require a thorough understanding of mathematics, physics, science, and chemistry. There are many classes of astronomers; some astronomers would devote a career to cosmology, the study of the origin of the universe. Other astronomers would specialize in the study of astrobiology, the study of the possible life forms in the universe.*

ASSESSMENT ACTIVITIES
Have students develop a 5-minute PowerPoint presentation, with narration, on five topics learned about extra-solar planetary transits. For example, what could an extra-solar planetary transit tell an astronomer about the planet itself? What are the number of extra-solar planets discovered to date and what method was used to discover them? What other means can be used to determine extra-solar planets besides using the "transit-method?"

ENRICHMENT
Invite a guest astronomer from a local college or university or speakers from a local astronomy group to speak to students about why they chose astronomy as a career or hobby.

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