Discover the Universe with NASA: What Lies Beyond the Solar System?

Core Workshop Activities

Realms of the Universe

This activity is part of the "How Big Is the Universe?" inquiry station, which is a part of the larger "Modeling the Universe" suite of activities. In this activity, participants consider their cosmic address and develop an appreciation for the scale of each realm of the Universe relative to the other realms. The "Modeling the Universe Workshop: An Exploration of Space and Time" professional development short course was developed by a team of education and public outreach professionals from NASA's astrophysics missions.
http://www.cfa.harvard.edu/seuforum/mtu/

Kepler's Other Worlds

Activities developed by the Kepler education and public outreach team can be found at http://kepler.nasa.gov/ed/activities.html and include:

- **Transit Tracks** (http://kepler.nasa.gov/ed/lc) - Using a model of a planet transiting a star, students learn what a transit is, under what conditions a transit may be seen, and what effects a planet's size and distance from its star have on transit behavior. They interpret graphs of brightness vs time to deduce characteristics of a star-planet system. This activity was developed for an educational poster and as an investigation for a newly revised edition of the "Planetary Science" course in the middle school series of Full Option Science System (FOSS).

- **Detecting Planet Transits** (http://kepler.nasa.gov/ed/activities.html) is part of the Lawrence Hall of Science Great Explorations in Math and Science (GEMS) Space Science Sequence for grades 6-8 (Sessions 4.5 and 4.6) published in 2008. Students model NASA's Kepler mission observations of planetary transits (a planet moving in front of a star) by standing in a circle with model star (light bulb) in the center, and observing, through rolled up paper viewing tubes, a marble planet orbiting the star.

- **Human Orrery** (http://kepler.nasa.gov/ed/activities.html) is part of the GEMS Space Science Sequence for grades 6-8 (Session 3.10) published in 2008. Students lay out and act out a kinesthetic model of the solar system in 3 dimensions: 2 of space and one of time. Kepler Models and Simulations (http://kepler.nasa.gov/ed/sim/) - has instructions for a number of physical models,

including of a paper model of the spacecraft, as well as LEGO model orreries, which are star-planet system models that can be used to demonstrate how planets can be found by the transit method.

- **The Kepler Exoplanet Simulation** ((http://kepler.nasa.gov/ed/xo) is an online Flash interactive simulation of the entire process of finding planets by the transit method, including generating "light curves" (graphs of brightness vs time), making "observations" of candidate stars, making measurements of depth of transit and period of orbit, and calculating planet orbit radius, temperature, and size. Ultimately, the simulation determines if a given planet is in the habitable zone of its star.

- **Kepler Star Wheel** (http://kepler.nasa.gov/ed/starwheel) - One of the Uncle Al's Starwheels" series of planispheres, inexpensive star maps, adjustable for any time of night in any month of the year. There are interchangeable star wheel disks designed to help people find constellations with a "Basic Constellations" wheel, locate objects with a "Coordinates Wheel" and, with the "Kepler Wheel," to find the location of the Kepler target field of view as well as naked eye stars known to have exoplanets visible from the northern hemisphere. These Star Wheels are based on the Lawrence Hall of Science (LHS) Sky Challenger star wheels that have even more star wheels: a set of 6, available at http://www.lawrencehallofscience.org/pass/AST110&111&121.html

Tour of the Invisible Universe
This activity explores the essential question: What do we know about our Universe? By examining images and descriptions of celestial objects obtained in different regions of the electromagnetic spectrum and placing these objects in space, participants develop a better understanding of how and why scientists view objects, and where these objects are located in space relative to the Earth. Tour of the Invisible Universe is part of the GEMS “Invisible Universe: From Radio Waves to Gamma-rays” guide, developed through a partnership between the Lawrence Hall of Science and NASA’s Swift mission. This GEMS guide is available at: http://lhsgems.org/gemsInvUniv.html

Share-A-Thon Resources

Making Your Own Observations

Student Hera
This resource provides students access to analysis software and data for studying objects such as black holes, pulsars, and supernova remnants. Student Hera is available at:
http://imagine.gsfc.nasa.gov/docs/teachers/hera

Hands-On Universe
The NASA Wide-field Infrared Survey Explorer (WISE) and Kepler missions are collaborating with University of California's Hands-On Universe (HOU) project to involve high school classrooms in discovery of asteroids and exoplanets using real astronomical images and image processing software, similar to what professional astronomers do. The latest version of the HOU high school material is called A Changing Cosmos, for which a draft version can be found at http://www.handsonuniverse.org/hs/. HOU also has a set of activities geared for middle school called Hands-On Solar System that can be found at http://www.handsonuniverse.org/ms/. It also uses real telescope images of solar system objects and students analyze them with image processing software.

MicroObservatory Online Telescopes
Anyone with an email address can control these robotic telescopes over the Internet to take CCD images of the moon, planets, stars, and galaxies tonight (and every night!) They are operated by the
Harvard-Smithsonian Center for Astrophysics, and are currently located in Cambridge, MA, and Amado, AZ. In 2009 we will debut a special "Observing With NASA" portal to the telescopes to help users compare their OWN images and data to those of NASA missions.

- Take an image tonight at our Guest Observer Portal: http://microobservatory.org/
- Find out more about MicroObservatory here: http://mo-www.harvard.edu/
- Download free, easy-to-use image processing software to analyze and enhance your images and pursue real investigations (downloads available for both PC and Macs): http://mo-www.harvard.edu/MicroObservatoryImage/
- Download teacher and student guides for investigations to pursue with MicroObservatory: http://www.cfa.harvard.edu/webscope

Telescopes and Data in the Classroom

Amazing Space
Amazing Space uses the Hubble Space Telescope's discoveries to inspire and educate about the wonders of the universe. Developed at the Space Telescope Science Institute, these materials for educators and learners of all ages are accurate, classroom-friendly, visually appealing, and carefully crafted to adhere to accepted educational standards.

- Follow our sweeping history of the telescope from Galileo's first look at the stars to the work of modern observatories in Telescopes from the Ground Up
- Simulate the process astronomers have gone through to count, classify, and identify objects in the Hubble Deep Field
- Bring current science to your classroom through specially designed StarWitness news content readings
- Learn how to use images as engagement tools in inquiry-based lessons.

Find these resources and more at http://amazing-space.stsci.edu.

Models and Evidence

Beyond the Solar System Professional Development DVD
This project draws on up-to-date resources from both the scientific and educational research communities in order to help teachers deepen their own and their students' understanding of the structure and evolution of the universe and of the nature of science. The DVD features field-tested inquiry activities, assessment tools, and video resources from both the Harvard-Smithsonian Center for Astrophysics and NASA space science missions. Astronomy educators and professional development providers from many settings will find this resource valuable during IYA. Educators can register to obtain their own free copy at http://www.universeforum.org/btss/.

The Multiwavelength Universe

GEMS Invisible Universe, Activity #2, Invisible Light Sources and Detectors
In this activity, participants explore several stations featuring a portion of the electromagnetic spectrum. At each station there is a source of invisible light (e.g. a black light), a detector for that same light (e.g. fluorescent paint swatches), and several possible shields. Participants investigate what materials are and are not shields for that part of the electromagnetic spectrum.
http://www.lhsgems.org/gemsInvUniv.html

Cool Cosmos
We are used to seeing the world around us in visible light. However, there are many other types of light, including x-rays, gamma rays, ultraviolet, infrared, microwaves and radio waves, which we cannot see with our eyes. Each of these types of light gives us a unique view of our world - and the universe! Visit Cool Cosmos for activities, tutorials, images, videos, and more! http://coolcosmos.ipac.caltech.edu

The Electromagnetic Spectrum
This poster features a Hubble Space Telescope image of the Whirlpool Galaxy and three classroom activities designed to introduce students to different regions of the electromagnetic spectrum, including infrared, visible, and ultraviolet light. Images of the Whirlpool Galaxy in different regions of the electromagnetic spectrum illustrate the use of the electromagnetic spectrum in astronomy. Suggested science standards, vocabulary, and science background information are also provided. Contact us at http://amazing-space.stsci.edu to request a copy for educational use.

Touch the Invisible Sky
Touch the Invisible Sky uses Braille, large type print, and tactile diagrams of celestial images observed by space telescopes Hubble, Chandra, and Spitzer to reveal the cosmos to the blind and seeing-impaired. Available through Library of Congress repositories and Ozone Publishing (http://www.ozonepublishiing.net).