Teachers Guide to Resolution and Doppler Activities

Objective:

The main goal of these activities is to expose students to the basics of electromagnetic spectrum, and to apply this knowledge in the field of astronomy. These activities touch on many points of the curriculum framework for grade 9 and 10 physics, and on skills of inquiry also outlined in the curriculum. Students will use math skills to analyze and support findings and model conclusions, which is one of the skills of inquiry. On points of curriculum for physics, these activities will cover the electromagnetic spectrum, the nature of waves, and their properties (more specifically, Doppler effect, and constructive and destructive interference.). The activities will also explain the usefulness of the various wavelengths in the field of astronomy. These activities would be ideal in any discussion on the electromagnetic spectrum.

Preparation:

In beginning the activities, I started with the resolution and radio wave primer, and followed it up with the worksheet, to get them comfortable working with the equations, and so they would be able to concentrate on the activity without any math anxiety.

The activities will require a small bit of legwork. Images for the matching game were obtained from the web sites listed below. Any images using different wavelengths can be used. I used Cas A, Cen A, The Crab Nebulae, Jupiter and the Sun. For the telescope in the resolution activity, the ARIES telescope (manufactured by Learning Things, Inc. 68 A Broadway, Arlington, MA 02474 Tel. (781) 646-0093) was used. For the shapes in the resolution experiment, I used the paint program on windows to make the following shapes in red and blue: circle, top of a screw, paint spot, circle with a line on top, and the letter R (size was 20 X 20 pixels). When putting the shapes up, I placed the R upside down and backwards, so the students wouldn't suspect the working of the telescope, until they got close enough to observe with their own eyes.

Before doing the observation of the crab nebulae, have students do a little research on it. How far away is it, how and when did it form, what is it? You can also find the VLA picture of the crab nebulae from either of the observation sites given below. The MIT Haystack telescope can be run from computers at your school, or by a visit up to Westford. Both methods would require you to contact Dr. Preethi Pratap (preethi@haystack.mit.edu or 781-981-5402) to schedule a viewing or setting up your computers to run the 37-meter telescope.

Information and Resources

In addition to the activities, I have also written a small primer on some basics of the electromagnetic spectrum, resolution, and radio astronomy, which you will find on the MIT Haystack web site. Also, please find below a list of some of the sites that I have found invaluable in researching this topic, and where I found images for the matching game activity.

Web sites:
http://www.jpl.nasa.gov/radioastronomy/index.htm - JPL radio astronomy tutorial
http://www.haystack.mit.edu - Haystack's radio astronomy tutorial
http://chandra.harvard.edu/photo/category.html - Chandra pictures. A great site for getting pictures in all spectra
http://www.gb.nrao.edu/~sheather/imagegallery.shtml - NRAO site. Another very good site for images

More to come…

Books:
The Invisible Universe Revealed, Gerrit L. Vershuur. Springer-Verlag 1987

Articles
Zorpette. Radio Astronomy: New Windows on the Universe. IEEE Spectrum, February 1997
Dahlem, M. and Brinks, E. The World of Radio Astronomy Parts I-IV. Mercury, March-April 1996