Student Name _____ Date _____

ELECTROMAGNETIC SPECTRUM: SIMPLE SPECTROSCOPE

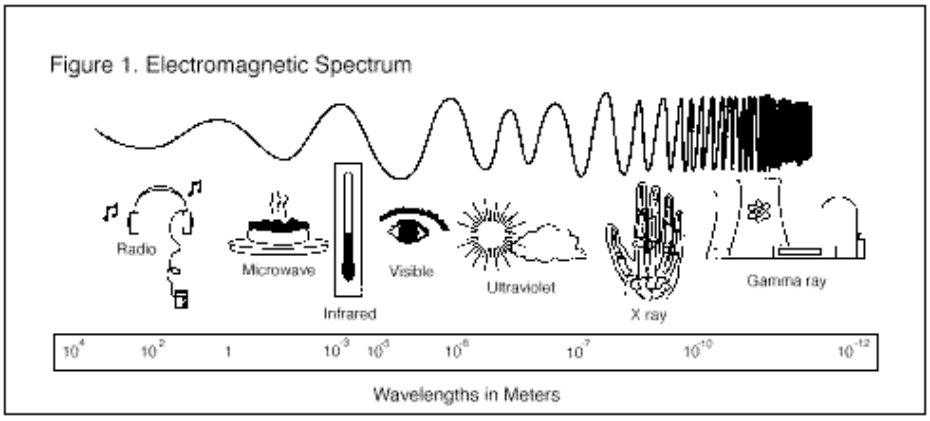
THIS ACTIVITY IS ADAPTED FROM NASA'S SPACE-BASED ASTRONOMY ACTIVITY GUIDE

Contrary to popular belief, outer space is not empty. It is filled with electromagnetic radiation that crisscrosses the universe. This radiation comprises the spectrum of energy ranging from radio waves on one end to gamma rays on the other. It is called the electromagnetic spectrum because this radiation is associated with electric and magnetic fields that transfer energy as they travel through space. Because humans can see it, the most familiar part of the electromagnetic spectrum is visible light--red, orange, yellow, green, blue, and violet. Like expanding ripples in a pond after a pebble has been tossed in, electromagnetic radiation travels across space in the form of waves. Their wavelengths, the distance from wave crest to wave crest, vary from thousands of kilometers across, in the case of the longest radio waves, to smaller than the diameter of an atom, in the cases of the smallest x-rays and gamma rays.

Electromagnetic radiation has properties of both waves and particles. What we detect depends on the method we use to study it. The beautiful colors that appear in a soap film or in the dispersion of light from a diamond are best described as waves. The light that strikes a solar cell to produce an electric current is best described as a particle. When described as particles, individual packets of electromagnetic energy are called photons. The amount of energy a photon of light contains depends upon its wavelength. Electromagnetic radiation with long wavelengths contains little energy. Electromagnetic radiation with short wavelengths contains a great amount of energy.

Materials

Diffraction grating 2 cm/ (~1inch) square
Toilet paper tube
Poster board 5x10cm/ (~2x4 inch) square
Masking tape
Scissors
Exacto Knofe
Spectrum tubes
Power supply
Pencil



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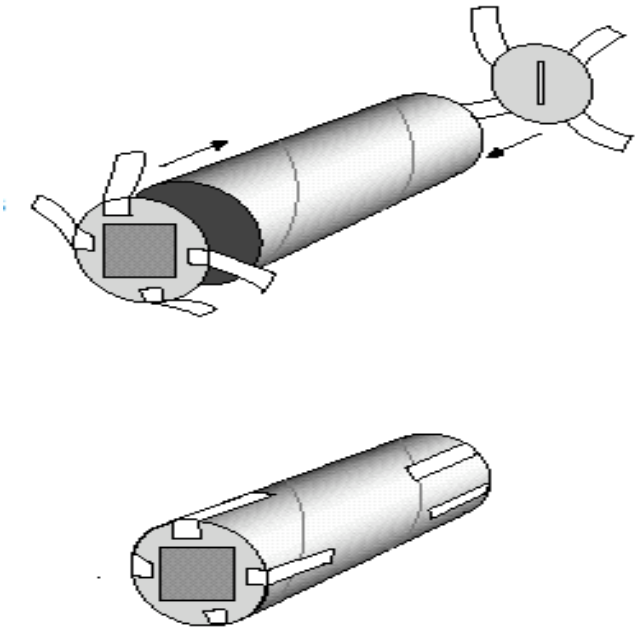

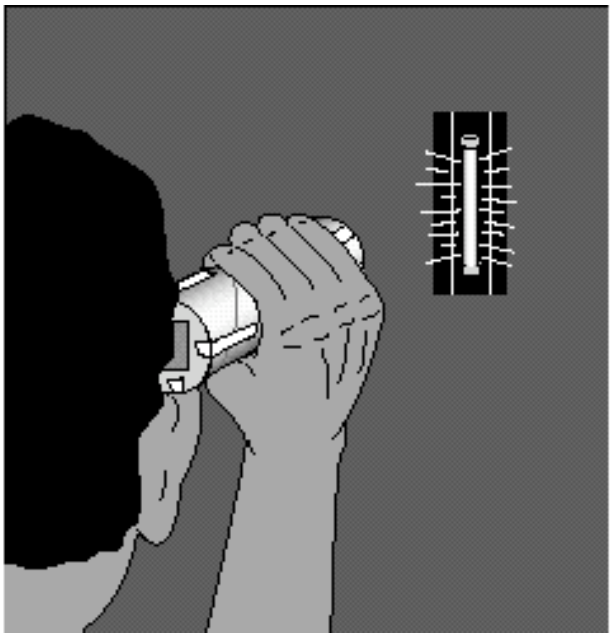

Procedures

1. Using the pencil, trace around the end of the paper tube on the poster board. Make two circles and cut them out. The circles should be just larger than the tube's opening.
2. Cut a 2 centimeter square hole in the center of one circle. Tape the diffraction grating square over the hole. If students are making their own spectroscopes, it may be better if an adult cuts the squares and the slot in step 4 below.
3. Tape the circle with the grating inward to one end of the tube.
4. Make a slot cutter tool by taping two single edge razor blades together with a piece of poster board between. Use the tool to make parallel cuts about 2 centimeters long across the middle of the second circle. Use the razor blade knife to cut across the ends of the cuts to form a narrow slot across the middle of the circle.
5. Place the circle with the slot against the other end of the tube. While holding it in place, observe a light source such as a fluorescent tube. Be sure to look through the grating end of the spectroscope. The spectrum will appear off to the side from the slot. Rotate the circle with the slot until the spectrum is as wide as possible. Tape the circle to the end of the tube in this position. The spectroscope is complete.
6. Examine various light sources with the spectroscope. If possible, examine nighttime street lighting. Use particular caution when examining sunlight; **do not look directly into the Sun.**

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Directions: Use your spectroscope to analyze the colors of light given off by different sources. Reproduce the spectra you observe with crayons or colored markers in the spaces below. Identify the light sources. (**When using the Sun as a light source, do not look at it directly with your spectroscope. You can harm your eye. Instead, look at sunlight reflected from a white cloud or a sheet of white paper.)**

Light Source: _____

Light Source: _____

Light Source: _____

On a separate sheet of paper, answer the following questions:

1. Describe how the spectra of the three light sources you studied differed from each other. How were they similar?
2. Would you be able to identify the light sources if you only saw their visible spectra?