Building a Spectroscope to Learn About Spectra

The electromagnetic spectrum consists of waves of many wavelengths ranging from very long wavelength radio waves to very short wavelength gamma rays. Visible light, consisting of short wavelength waves, is placed near the middle of this spectrum. Visible light can pass through window glass, but a solid wall will absorb a portion of the light and reflect the remaining portions. Scientists would say that glass is transparent to visible light, but a wall is opaque. Since the atmosphere is transparent to visible light (while absorbing some of the light), astronomers who use telescopes can see things from far away using visible light to form images. Earth's atmosphere, however, acts as an opaque barrier for much of the electromagnetic spectrum. The atmosphere absorbs most of the wavelengths shorter than perfect conditions signals as high as 300 GHz have been detected.

This activity will give your students an opportunity to see spectra and discover the "finger print" of light sources.

Materials:

- Shoe Box/ cereal box
- Utility knife or scissors
- Tape
- Pen or Pencil
- Diffraction Grating
- Index Cards
- Rubber Bands

Procedure:

Using a pen or pencil, draw a rectangle measuring about 3/4" wide by 1-1/2" high at one end of the shoe box. The rectangle should be roughly the size of one diffraction grating. This hole will be for the diffraction grating.

Using the utility knife or scissors, cut around the rectangle. You may wish to start the hole with the utility knife and then finish the hole with the scissors. Ask an adult for help with the utility knife.

The next step is to draw another rectangle on the opposite end of the shoe box. This hole should be roughly the same size as the last one. Using the utility knife or scissors, cut around the rectangle.

Next, using your scissors cut one of the index cards in half. You will use each half of the index card to make a slit in the end of the shoe box.

Place the two halves of the index card over one of the holes, creating a vertical slit (about 3/16" wide). Tape these pieces in place using masking or scotch tape.

Next, cut out a piece of diffraction grating and place it over the opening on the shoe box. Lightly tape the diffraction grating in place.

Put the top on the shoe box. Put rubber bands around the shoe box to hold the top in place. Hold the shoe box so that the slit is facing a light source. Make sure that the slit is oriented vertically.

Now look through the diffraction grating into the box. You should see colors.

If you don't see the spectrum extending to both sides, the scratches on the grating are not parallel to the slit. Remove the diffraction grating and rotate it 90 degrees and try again. When the spectrum extends in both directions from the slit, securely tape the grating in place.

Exploring Spectra using light sources:

When you have finished building your spectroscope, you may look at the continuous spectra of light bulbs and fluorescent lights. Is there any difference in their spectra?

You may also use your spectroscope to look at neon signs, sodium vapor lights, and mercury vapor lights. Is there any difference between these spectra and those from light bulbs?

If your school has gas vapor lamps containing hydrogen, helium, neon, or argon, you may use your spectroscope to observe the emission line spectra of these gases. Why are the spectra of these gases not continuous like the spectra of a light bulb or the sun?

You may be able to use your spectroscope to observe the dark lines in the solar spectrum. BE CAREFUL! Do not look directly at the sun! The dark lines in the solar spectrum result from the absorption of some of the sun's visible light by the gases of the earth's atmosphere.