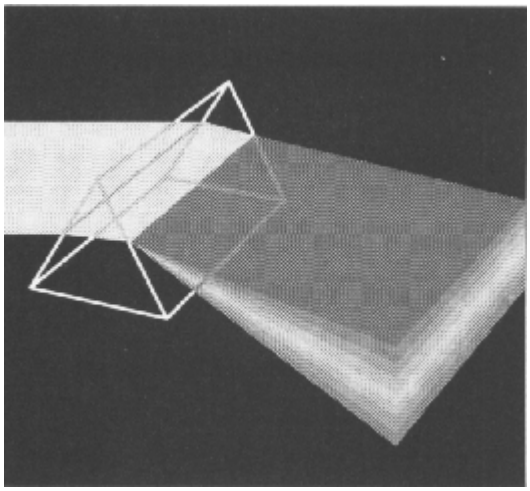


Simple Spectroscope

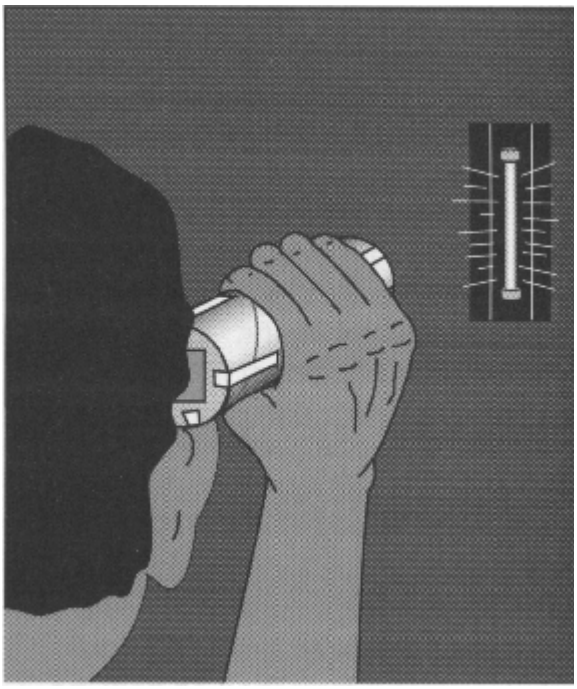
Description: A basic hand-held spectroscope is made from a diffraction grating and a paper tube.

Objective: To construct a simple spectroscope with a diffraction grating.

Materials:

- Diffraction grating 2 cm square (See note.)*
- Paper tube (tube from toilet paper roll)*
- Poster board square (5x10cm)*
- Masking tape
- Scissors
- Razor blade knife
- 2 single edge razor blades
- Spectrum tubes and power supply (See note.)
- Pencil

* per spectrosc



Procedure:

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 addult cuts the squares and the
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 flourescent 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.

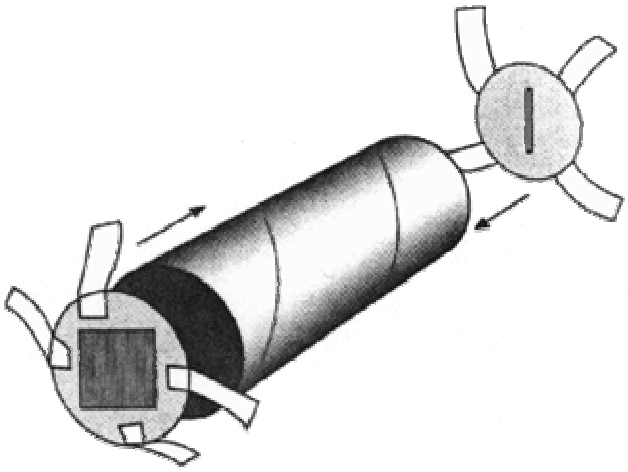
slot in step 4 below.

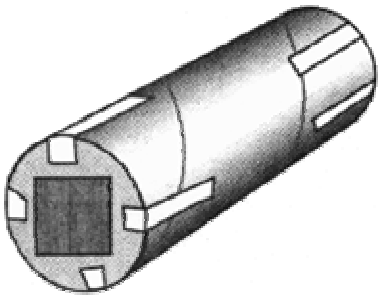
3. Tape the circle with the grating inward to one end of the tube.
4. Make a slot cutter tool by taping two single edge razor blades together with a piece of poster board between. Use the tool to make parallel cuts about 2 centimeters long across the middle of the second circle. Use the razor blade knife to cut across the ends of the cuts to form a narrow slot across the middle of the circle.
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.**

Discussion:

Refer to the discussion on Analytical Spectroscopes for information on how diffraction gratings produce spectra.

Glass prisms are heavy. The more separation one wants for the wavelengths, the thicker the glass needs to be. Grading spectroscopes can do the same job but are much lighter. A diffraction grating can spread out the spectrum more than a prism can. This ability is called dispersion. Because gratings are smaller and lighter, they are well suited for spacecraft where size and weight are important considerations. Most research telescopes have some kind of grating spectrograph attached. Spectrographs are spectroscopes that provide a record, photographic or digital, of the spectrum observed.





Notes:

- Most science supply houses sell diffraction grating material in sheets or rolls. One sheet is usually enough for every student in a class to have a piece of grating to build his or her own spectroscope. Holographic diffraction gratings work best for this activity.
- Many light sources can be used for this activity, including flourescent and incandescent lights and spectra tubes with power supplies. Spectra tubes and the power supplies to run them are expensive. It may be possible to borrow tubes and supplies from another school if your school does not have them. The advantage of spectrum tubes is that they provide spectra from different gases such as hydrogen and helium.

For Further Research:

- Using colored pencils or crayons, make sketches of the spectrum emitted by different light sources. Try incandescent and flourescent lamps, bug lights, street lights (mercury, low-pressure sodium, and high-pressure sodium), neon signs, and candle flames. How do these spectra differ?
- How do astronomers measure the spectra of objects in space? What do those spectra tell us about these objects?

Reference: "Space Based Astronomy - Teacher's Guide with Activities", NASA EG-102, August 1994, pp 32-33.