Build a Spectroscope

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Materials Needed:

35 mm film canister, black (Available from most photo or film processing shops.)
C-Spectra, holographic diffraction grating, 1 cm x 1 cm (Flinn Scientific, Catalog no. AP1714)
Drill, electric or hand with a ¼-inch bit
Tape, Scotch transparent, OR adhesive such as a gel Super Glue or hot glue (from a hot glue gun)
Wood applicator sticks (without cotton on ends)
Forceps (tweezers)
Utility knife
Heavy cardboard or a block of wood to protect table top
Spectrum tubes: Hydrogen, helium, neon, argon, and others.
Spectrum tube power supply. More than one, if available.
Colored pencils, crayons, or markers: red, orange, green, blue, and violet

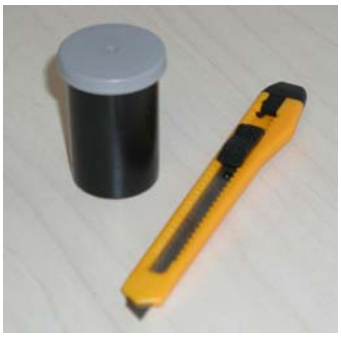

Figure 1. 35 mm film canister and utility knife.

Safety Precautions:

Do not drill into the 35 mm film canister holding it in your hand. Place it on a table or bench top with a piece of wood or heavy cardboard of wood under it to protect the table surface. Have another person assist you with the drilling.

If you use a super glue or hot glue to hold the diffraction grating in place, take extreme care in working with the glue. The super glue is strong enough to glue fingers together and skin to other surfaces. In the event that someone glues their fingers together or has another mishap, the super glue can be dissolved by acetone. The hot glue and the tip of the hot glue gun can cause burns.

The utility knife is very sharp. Take care that you cut the cap of the 35 mm film canister with it placed firmly on a table or bench top and with a piece of wood or heavy cardboard or a block of wood under it to protect the table surface.

Spectrum tubes will get hot during use. Do not touch spectrum tubes until they have cooled to room temperature.

Disposal:

There are no disposal hazards in this project. Pieces of plastic or unused film canisters should be recycled.

Procedure:

Obtain a 35 mm film canister. Remove the cap of the canister and put it aside for now.

Place the canister body on top of heavy cardboard or a piece of wood on the table top with the bottom facing up. On the bottom of the canister, there is usually a small indentation in the center. Drill a ¼-inch hole through the center of the film canister. Clean off any ragged pieces of plastic around the hole. (See Figure 2.)

Turn the canister over. The diffraction grating will be placed inside the film canister and can be held in place using clear Scotch tape or a small amount of glue.

Figure 2. 35 mm film canister with hole in bottom.

If you are using glue, use a wood applicator stick to place a small amount of glue inside the 35 mm film canister near the hole that you drilled. Place the diffraction grating into the canister so it is flat against the bottom and lightly press down to spread the glue and to make sure it is flat on the bottom. DO NOT COVER THE PIECE OF DIFFRACTION GRATING WITH GLUE, as it will prevent the diffraction grating from effectively dispersing the light.

If you are using Scotch tape to hold the diffraction grating in place, place a small piece of diffraction grating inside the canister so that it covers the hole in the bottom. Cut some small pieces of Scotch tape, and using the forceps, tape the piece of diffraction grating in place. DO NOT COVER THE PIECE OF DIFFRACTION GRATING WITH TAPE, as it will prevent the diffraction grating from effectively dispersing the light.

Figure 3. 35mm canister cap with slit.

Using a utility knife, carefully cut a small slit in the cap of the 35 mm film canister. (See Figure 3)

Place the cap against the body of the film canister and look at any light source through the hole in the bottom of the body. Rotate the canister body until a clear spectrum of the light is visible on both sides of the slit. Snap the cap into place. (See Figure 4.)

Use the spectroscope to observe some additional light sources, such as hydrogen (See Figure 5) or helium spectrum (See Figure 6) tubes, available in the laboratory or classroom Using colored pencils, crayons, or markers, draw representations of the line spectra you observe.

Take the spectroscope home.

Figure 4. Completed spectroscopes.

Figure 5. A hydrogen emission (or line) spectrum
Note: Sometimes a continuous spectrum is visible behind the line spectrum

Figure 6. A helium emission (or line) spectrum

Assignment:

The purpose of this assignment is to use your spectroscope to identify elements used in different types of lights found in your environment. This process is similar to the one astronomers use to identify elements in distant stars and other celestial objects.

Materials Needed:

the spectroscope you made in class
paper
crayons, colored pencils, or colored markers

Procedure:

In the evening, go out into your neighborhood and use your spectroscope to view at least 3 different light sources. These may be fluorescent lights, street lights, "neon-type" signs, or whatever you find that looks interesting. You should be looking for spectra that contain bright emission lines (similar to the hydrogen and helium spectra you observed in class – See Figure 5, above), or a continuous spectrum that may have black absorption lines in it. (See Figure 6)

Figure 6. A hydrogen absorption spectrum

Use your crayons or markers to draw the spectrum you observe from each of the light sources. Try to space any lines in the spectrum similar to those you observe, however, the colors are most important.

For each spectrum you observe, record the location of the light, source of light, and color of light to the unaided eye.

Examples: Street light at the corner of Market St. and 5th Ave.
Blue light on beer sign in window of Rick's Café, 100 Casablanca Drive

After recording the light spectra, using a computer with Internet access, search for any web site that contains **emission spectra of the elements**.

Log onto the web site. Using the spectra on the web site, identify the element(s) that are in the light sources you observed.

Turn in your drawings and data at the next class or on the date specified by your instructor.

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Results

Name:_____ Date _____

Observed spectra from spectrum tubes:

	Spectrum (Draw the spectrum of the element as you observe it in the lab)
Element: _____	
Element: _____	
Element: _____	
Element: _____	
Element: _____	
Element: _____	

Assignment: Observed spectra from your neighborhood:

Spectrum
(Draw the spectrum of the element as you observe it in your neighborhood)

Color of Light source: _____

Location of source: _____

_____

What element is present in the light source? _____

Color of Light source: _____

Location of source: _____

_____

What element is present in the light source? _____

Color of Light source: _____

Location of source: _____

_____

What element is present in the light source? _____

Color of Light source: _____

Location of source: _____

_____

What element is present in the light source? _____

What is the address of the web site where you found the spectra?

_____