2. Notice that the plastic disk with the attached diffraction grating can be rotated. Looking in the spectrometer, you should notice that the colors move as you rotate the disk. Rotate the disk until you see colors in a horizontal line to your left. The colors should appear between the two lines of numbers on the scales.

3. Look at an illuminated incandescent bulb through the spectrometer. Be careful to aim the slit (on the right side of the spectrometer) at the light bulb and look straight ahead at the spectrum on the scale. You should see a continuous spectrum of colors from red through violet. On the scale below (Figure 2), draw the colors you see. Use colored pencils to shade in the observed colors. The various colors are described by wavelength in nanometers (nm) or by the energy of the particle of light, a photon, expressed in electron-Volts (eV). (1 eV = 1.6022 X 10^{-19} joule)

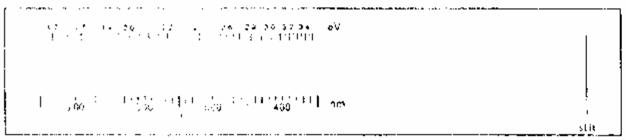


Figure 2

4. Read the number on the scale corresponding to the light farthest to the right that you can see and the number corresponding to the light farthest to the left that you can see.

a) The observed spectrum extends
from ________________nm to ______________ nm.

b) The colors at these places on the scale are:
________________ and ________________ .

5. Now look at a fluorescent light through the spectrometer. Describe the spectrum you see. Is it different from the spectrum you observed in Step 1?

6. Again record the ends of the spectrum.
The colored spectrum extends
from ______________nm to ______________nm .

The spectrum from the fluorescent light should include several bright vertical "lines". These are images of the slit. Indicate the positions of these lines on the scale below.

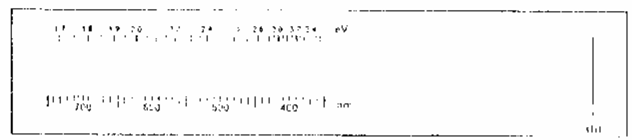


Figure 3

7. Read the positions of the bright lines on the scale and record them in Table 1.

Color	Position (nm)

Table 1

8. The most common type of fluorescent light will have the mercury emission lines superimposed on a continuous spectrum. The scale should be adjusted so that the bright green line in the spectrum of the fluorescent light is at 546 nm (notice the small mark on the scale). Adjust the scale by inserting the tip of a pen or pencil into one of the sprocket holes on the film. (see Figure 1)

NOTE: If the green line is to the LEFT of the 546 nm mark, push to film to the right (AS SEEN THROUGH THE SPECTROMETER). If the green line is to the right of the 546 nm mark, move the film to the LEFT.

9. Point the slit of your spectrometer at a white surface that has fluorescent light shining on it, such as a wall or a movie screen, and measure the ends of the spectrum and the positions of any bright lines that you see. Record your data in Table 2.

Color	Position (nm)

Table 2

a) Compare the results of Steps 5 and 6. Was the spectrum that you saw from the fluorescent light similar to or different from the spectrum you saw when you looked at the white surface?

b) Why do you think the spectra were similar or different?

10. Use your spectrometer to observe as many other light sources as you can find. These could include the red or green LEDs (Light Emitting Diodes) on a VCR (Video Cassette Recorder) or stereo system; chemical light sticks; and "neon" signs in the windows of stores and restaurants.
List the object and describe the spectrum you observed.
(Are there any bright or dark lines in the spectrum? If there are any bright or dark lines, give the positions and the colors of the lines.)

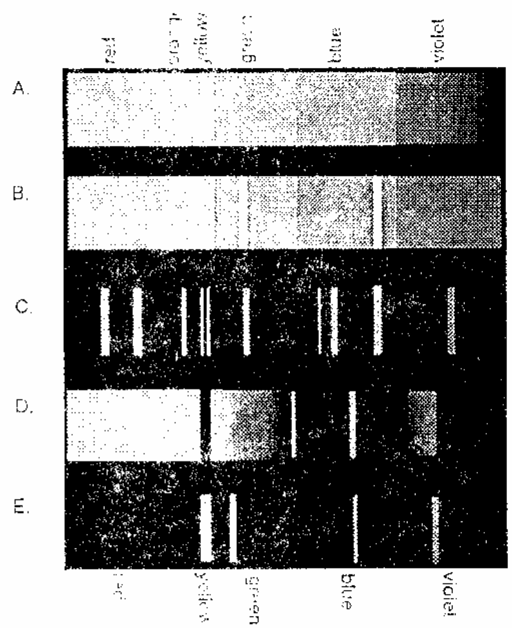
Object 1:
Color as seen without spectrometer:
Description of spectrum:

Object 2:
Color as seen without spectrometer:
Description of spectrum:

Object 3:
Color as seen without spectrometer:
Description of spectrum:

12. Observe the spectra of some indoor lights and a few street lights or security lights. Write the letter of the observed spectrum (on the left) on the blank that corresponds with the type of light (and its apparent color) below.

SPECTRA OF SELECTED LIGHTS



______ incandescent light bulb ______ high pressure sodium

______ fluorescent light ______ low pressure sodium

______ mercury vapor

13. Take your spectrometer outside (better yet, look through a window from a darkened room) and point the slit toward the bright sky near the Sun.

DO NOT LOOK DIRECTLY AT SUN!!

IT CAN DAMAGE YOUR EYES!!

You should see a spectrum of all the colors with narrow, dark lines superimposed.

a) The spectrum extends from ______________nm to ______________nm .

Now measure the positions of the dark lines that you see. Record the results in Table 3.

Missing Color	Position (nm)

Table 3

14. Compare these absorption lines in the Sun's spectrum with those listed in **Table 4.**

a) What elements do you conclude are present in the Sun?

b) Do you think that you have found all the elements that are in the Sun? Why or why not?

c) Where do you expect that elements would have to be located in order to cause dark absorption lines in the spectrum of the Sun? (Would they have to be located inside the Sun, on the Sun's surface, above the Sun's surface, in space between the Sun and the Earth, or in the Earth's atmosphere?)

15. Point the spectrometer slit at a bright, white cloud.

a) Describe the spectrum that you see. How does the "cloud" spectrum compare to the spectrum of the Sun? Does the cloud spectrum have dark lines as the solar spectrum does?

b) Why do you think the cloud spectrum appears the way it does?

16. Look at the Moon through the spectroscope. (This activity is best done at night when the Moon is bright compared to the background sky, such as when there is a full Moon visible two or three hours after sunset. Also, the small apparent size of the Moon and the unsteadiness of holding the spectrometer will present a problem.)

Describe the spectrum. (How does the Moon's spectrum compare to the spectrum of the Sun? Does the lunar spectrum have dark lines as the solar spectrum does? Are they the same lines? Why or why not?)

ABSORPTION LINES IN THE SUN

(from the *CRC Handbook of Chemistry and Physics*)

Lines due to	Wavelength (nm)	Lines due to	Wavelength (nm)
Iron	372.8	Iron	516.8
Iron	382.0	Magnesium	516.7
Calcium	393.4	Magnesium	517.3
Calcium	396.8	Magnesium	518.4
Hydrogen	410.2	Iron	527.0
Calcium	422.7	Sodium	589.0
Iron	430.8	Sodium	590.0
Hydrogen	434.0	Hydrogen	656.3
Hydrogen	486.1	Oxygen	759.4
		Oxygen	762.1

Table 4

OPTIONAL ACTIVITY

The purpose of this activity is to study how certain transparent materials will allow some colors of light through and absorb the others. Locate various pieces of colored transparent glass or cellophane or make a colored liquid. The liquid can be made by mixing food dyes and water in a clear glass or plastic container. (Don't forget good experimental practice: Check to see if the "clear" glass absorbs any colors before observing light through a colored liquid in the bottle AND observe the light source to make sure that it is producing all colors)

Place a transparent colored object (glass, cellophane, liquid) between a bright white light source and the spectrometer. For each object, record in Table 5 (on page 10) the following data: the type of object and its color, the missing color(s), and the position(s) of the dark bands on the spectrometer scale. (The dark bands, called absorption bands, are due to photons of certain wavelengths being absorbed by the object. When the photons are absorbed, the colors corresponding to the photon energies are removed from the spectrum and gaps, or bands, show up in the spectrum where the missing colors would have appeared if there was no absorption.)

Object and Color	Missing Color	Position (nm)

Table 5

NOTES

