

The Sun and Solar Wind: A Search for the Beginning

Here Comes the Light!

STUDENT ACTIVITY

PART 1

A diabolical spectroscopist tells you that the wavelength of light is often expressed either in nanometers or Angstrom units and that you must become familiar with both, as well as with the frequency of light, for him to consider letting the light shine into the dark cave that you occupy. The diabolical spectroscopist's assistant will provide hints and materials as needed and will evaluate your work.

- a) Complete Table 1 on the [Reporting/Data Sheet](#) to demonstrate to that you have acquired sufficient knowledge of wavelengths to satisfy the assistant.
- b) Draw an arrow off to the side of the table that indicates whether the energy of the light increases or decreases in going from the top to the bottom of the table.



PART 2

After the assistant has approved your work in Part 1, you will be allowed to use the diabolical spectroscopist's spectroscope as you continue your quest to let the light shine in. Obtain a spectroscope from the assistant and follow instructions for using it.

- a) Observe the spectrum of an incandescent light bulb.
 - i. On the Reporting/Data Sheet draw, in color and between the two parallel lines, what you have observed.
 - ii. Place small marks along the bottom line to indicate the position of the following wavelengths: 400, 450, 500, 550, 600, 650, and 700 nanometers, labeling the marks as you place them along the line.
 - iii. Classify this spectrum as being either a continuum spectrum or a line spectrum.
- b) If the assistant directs you to do so, observe the spectrum of other hot glowing objects and in the space below the parallel lines briefly describe any similarities or differences that you have observed. Also answer the question in the space below the figure.

When the assistant approves of your work, you may proceed to PART 3.

PART 3

Observe the spectrum of a fluorescent light.

- a) On the Reporting/Data Sheet draw, in color and between the parallel lines, note what you observe.
- b) Note and reproduce as accurately as possible any especially bright lines of color, record their wavelengths, and again label the positions of the following wavelengths: 400, 450, 500, 550, 600, 650, and 700 nanometers.
- c) In the space below the parallel lines write a brief description of the observed spectrum and of how it differs from the spectrum of a hot, glowing object. (Hint: A fluorescent lamp does not contain a hot glowing incandescent material, but instead contains gaseous mercury atoms that have been promoted to an excited state by electrical means. Bright lines are emission lines of mercury. See the Student Text, "[Electromagnetic Radiation](#).")
- d) If the assistant asks you to calibrate the spectroscope, the bright green line should have been observed at 546 Angstroms. In the space below the figure enter the calibration factor for the spectroscope.



When the assistant approves of your work, you may proceed to PART 4.

PART 4

You have done so well that sunlight is now visible through the door to the cave and the assistant has given very positive reports to the diabolical spectroscopist about your work. The assistant will now give you directions for observing the spectrum of the sun.

- a) Observe the sun's spectrum as directed.
- b) On the Reporting/Data Sheet write your conclusion about whether we should regard the sun as a hot glowing object that provides a continuum spectrum or a line spectrum of the type provided by excited gas molecules.

**PART 5**

You have now learned enough about electromagnetic radiation that you are beginning to think that the spectroscopist is not so diabolical after all and that the work he does with his sidekick, the assistant, is pretty neat. So you tell the assistant that you want to learn more about spectroscopy. In response the assistant gives you the opportunity to investigate the emission spectra of other ions and molecular materials. Check with the assistant to determine what materials are to be used and the directions for using them.

Report your findings on the Reporting/Data Sheet, including wavelengths of spectral lines as determined with your calibrated spectroscope.

PART 6

As a good spectroscopist you should also learn about absorption spectra, which are the exact parallel of emission spectra, with the role of the photon being reversed. In other words, photons of a specific energy (or range of energies) from the visible spectrum of a continuum source are used to excite electrons in a material such as an atom, ion, or molecule to a higher energy state. Thus, one or more photons may be absorbed by the material, with the consequence that the corresponding wavelengths of light are removed from the continuum spectrum. This gives rise to blank spots called absorption lines. To make observations of absorption spectra it is necessary to place the material of interest between a continuum source and the spectroscope and then observe the spectrum in the spectroscope.

Obtain the materials to be investigated as well as the directions for the investigation from the assistant.

On the Reporting/Data Sheet draw (in color) any spectra that you obtained that exhibit lines. Write brief descriptions of any other spectra that you obtained from other materials provided by the assistant.

PART 7

As is discussed in the Student Text, many years ago Fraunhofer observed absorption lines in the light coming from the sun. The spectroscopist and the assistant now believe that you are ready to put your hard-won spectroscopic knowledge to good use. You will be asked to prove from spectroscopic measurements that at least one element other than H or He exists on the sun.

Again, follow the assistant's directions and report your conclusions on the Reporting/Data Sheet.