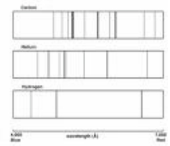
Student Activity: Spectral Analysis



Name ________________________
Date ________________________
Period ________ Table _________

Background:
The spectrum formed from white light contains all colors, or frequencies, and is known as a **continuous** spectrum. A gas in a vacuum tube is made incandescent by an electric discharge, the resulting spectra is a **bright-line** (emission) spectrum, consisting of a series of bright lines against a dark background. A **dark-line** (absorption) spectrum is produced when white light containing all frequencies passes through a gas not hot enough to be incandescent. It consists of a series of dark lines superimposed on a continuous spectrum. These dark lines are called Fraunhofer lines. Line spectrum of either type are useful in chemical analysis, since they reveal the presence of particular elements. Besides chemical composition, spectral lines can indicate star motion by using the Doppler shift. The instrument used for studying line spectra is the **spectroscope**.

Part I: Observation of Spectral Lines
In class, you will view the spectrum produced by incandescent light bulbs, and the spectrum produced by individual elements in gas tubes.

Materials Needed:

incandescent light bulb	socket and electric outlet	diffraction glasses
various gas tubes	power supply for gas tubes	(or spectroscopes)

Procedure: Students will use diffraction glasses to observe the various spectrum produced.

Observations:
1. What type of spectrum is produced by an incandescent light bulb? ____________________ line

2. What type of spectrum is produced by the gas tubes? _________________________ line

Part II: Spectral Analysis
Each element has its own "fingerprint." To analyze the spectra of stars, scientists collected spectra of all the known elements. If we compare the spectral lines of an unknown star with the spectral lines of elements, we can determine the chemical composition of the star. A star's temperature, rotational rate, and relative motion (Doppler shift) with regard to the Earth can also be determined.

Materials Needed:
Spectral Analyzer   Scissors

Procedure:
1. Cut out the pull tab card; the finger-prints card and Stars B, C, and D along the dashed lines.

2. Make five slits along the dashed lines A, B, C, D, and E on the fingerprints card

3. From left to right, insert "Pull tab Out" up through slit E, down through slit D, up through slit C, down through slit B, and up through slit A.

4. Compare the lines of each known element with the lines of Star A. If lines match, then that element is present in Star A. Record your findings in the Table.

5. Repeat, using Star B, Star C, and Star D. Each can be placed over Star A.

6. Using the spectral analyzer, draw line spectra when given element content for 3 unknowns

Observation Chart:

Star	Chemical Composition
A	
B	
C	
D	

Line spectra	**Element Content**
	Hydrogen and Mercury
	Calcium and Iron

Questions and Conclusions:

1. When you hear someone say that neon lights look beautiful, what color comes to mind? What (main) color is suggested by the "fingerprints" of neon?

2. Did any of the stars have the same chemical composition? Look at the table.

3. Sometimes scientists see spectral lines that do not fit the usual pattern. The lines might be shifted from their usual positions. This may suggest that the star is moving either **toward** the observer (shift toward the blue) or **away** from the observer (shift toward the red). Look at the spectral lines for Star B and Star D. Star B is the standard for comparison. How is Star D different? What is a possible explanation for the difference?

4. If the scientist sees the spectral lines wider than usual, he or she relates this spectral broadening to either rotational speed (the broader the faster), temperature (the broader the hotter) or pressure (the broader the greater pressure). Look at the spectral lines for Star B, and Star C. Star B is the standard. How is Star C different? What could be the possible explanation?