

Spectral Lines

In the late 1800's, it was discovered that when pure substances are burned or made to glow, they burn or glow with a characteristic color: neon glows red, copper glows green, sodium glows yellow, etc. This phenomenon also accounts for the familiar orange glow of a wood fire and the blue glow of a methane flame in a gas stove.

A *gas discharge tube* is a glass tube filled with a certain pure gas through which an electric current can flow. This electric current causes the gas inside to glow its characteristic color.

It has been known several centuries that when white light is passed through a prism or diffraction grating, an array of color is formed as the different wavelengths of light are broken up into individual color bands. This spreading out of colors is called *dispersion* and results in the familiar color pattern of the continuous electromagnetic *spectrum* or "rainbow".

However, when light from a pure substance is passed through a prism or diffraction grating, the color pattern is not continuous (like in a rainbow), but results in a series of discontinuous, discrete, narrow bands called *spectral lines*. Furthermore, each different pure substance produces its own unique and characteristic pattern of spectral lines. *No two elements or compounds produce exactly the same pattern of spectral lines.* A particular spectral line pattern is as unique to an given element or compound as fingerprints are to a given human -- no two humans on the planet have exactly the same fingerprint pattern. Today, we want to use this information to identify certain elements based solely on their spectral line patterns.

DIRECTIONS: After a demonstration and viewing in class, you and your partner will view the spectra of several different elements or compounds and record that information in the chart below. Use crayons or colored pencils to copy the spectrum of each element or compound into the chart as well as you can. After you are done, the teacher will then light up several different gas discharge tubes. Based on your observations of their spectral patterns, and by comparison to the data you previously collected, identify the unknown elements. Finally, you will write a short essay on the back of this paper explaining how one can identify an element or compound based upon its spectral pattern.

FOLLOW ALL SAFETY INSTRUCTIONS GIVEN IN CLASS!!!

Element or Compound	Spectral Pattern
Hydrogen	
Helium	
CO ₂	
Mercury	
Nitrogen	
Krypton	
Argon	
Neon	

Part 2: Identification of Unknown Substances

Your instructor will show you several different glowing elements or compounds. Using a spectroscope and your knowledge of spectral lines acquired from Part 1 of this lab, identify the compounds shown.

- | | |
|-----|-----|
| (1) | (4) |
| (2) | (5) |
| (3) | (6) |

Part 3: Conclusion Questions

Use the Earth Science Book to help answer these questions

1. What does spectrum analyses tell astronomers about stars? (Spectra of Stars pg 817)
2. Why is this information useful to Astronomers? (In complete sentences give me your reason)
3. What is the most common element found in stars and its percentage? (Solar composition pg 812)
4. What is the 2nd most common element in stars and its percentage? (Solar composition pg 812)
5. What other information does spectrum analysis provide astronomers besides composition and temperature? (Wavelength shifts pg 818)
6. 6. What is the nature of the EFFECT and how does it work? (Wavelength shifts pg 818)