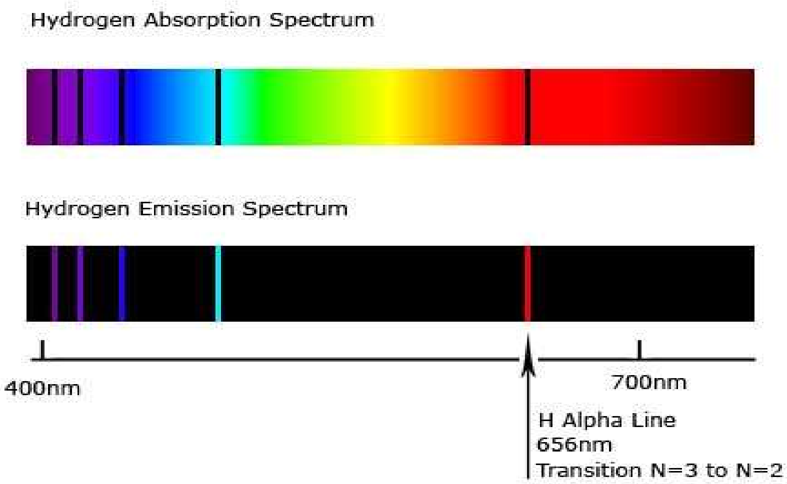
# Lab on Emission Spectrum & Flame Tests

## Background




In this lab students will investigate line emission spectrums by using a spectroscope, (see below). Students will first look at a fluorescent light source and then using a simple plastic filter that causes the fluorescent light to bend. You will draw the colors you see. Next students will look different types of gasses suspended in a glass tube connected to an energy source the spectrum tube power supply seen at the left. The differences between line emission spectrum and absorption spectrum cam be seen above.


When elements are heated to high temperatures, or electricity is added to atoms their electrons are excited to higher energy levels, or the electrons absorb energy. These **"excited,"** electrons eventually fall back to a lower energy state, called their **"ground state,"** releasing energy in the form of light **"packages,"** or **"quanta".** The farther the electron, **"falls"** in returning to its ground state, the more energy that is released-hence a higher frequency/ energy of light.

Elements do not randomly emit different colors of light, but emit a characteristic pattern of light energies, (colors) which can be used for *identification of an element;* a fingerprint of sorts. The colors produced when a substance such as hydrogen, helium, or other gases are excited by a voltage source are called **"emission spectra".** When the colors are produced by heated by a flame of a Bunsen burner, these are appropriately called, **"flame tests".**

The colors produced in these flame tests are a mixture of light of various wavelengths. A device called a spectroscope is used to directly view the light by breaking up the light into different light components line spectra. These spectrum lines can be used to identify an element and to deduce some information about atomic structure, (used by Niels Bohr).

The flashing neon lights of Times Square and Las Vegas shine because of electrons being excited in their electron orbitals. When electric current passes through the gas, the atoms absorb some of the electrical energy, causing some of their electrons to move to higher energy levels, or orbitals. While dropping back to lower orbitals the electrons give off the energy in the form of light. The color is characteristic of the gas in the tube. Neon shines orange-red. By combining Neon with other gases, other colors can be obtained.

## I. Objectives

1. **To observe and compare continuous and bright-line spectra.**
2. **To identify an unknown metal ion by means of a flame test**

## II. PRE-Lab Questions: **(Answer in your notebook in complete sentences)**

1. According to the modern theory of the atom, where might the electrons of an atom be located?
2. What is meant by, "ground state" and "excited state" of an atom?
3. Explain how electrons become excited?
4. Write an energy equation that could be used to determine the energy content of a packet of light that has a specific frequency, (it has a constant that includes Plank's constant).

## III. Materials

- Fluorescent light source
- Spectrum gas tubes of different elements
- Power source for gas tubes
- Spectroscope
- Q-tips
- Different salt solutions and salt for flame tests
- Bunsen Burner
- Safety Goggles

### Safety Precautions

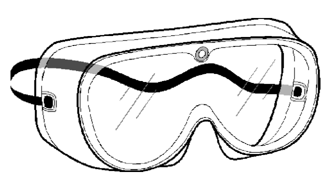
*Always use care when handling hot objects*

*Always use eye protection*

*Always know where emergency equipment and exits are located*

*Know how to dispose of all materials before starting the lab.*

*Absolutely no horse play will be tolerated!*

## IV. Procedure

The procedure will be broken down into three parts**: Part I, Part II. And Part III.**

**Part I:**

1. Using spectroscope, observe the spectrum emitted by the fluorescent light source. Record your observations in the appropriate data table on a separate piece of paper. *( You will draw this on your paper).*

**Part II**

**The high –voltage power source required for the spectral gas tubes will be set up for the class. This will be done by the teacher only; do *NOT* touch either the gas tubes or the power source.**

1. Once the gas tube has been inserted into the power source and the power source has been turned on, aim the diffraction grating or spectroscope at the glowing tube. Record the order of positions (from left to right as you view the emission spectrum) of the bright emission lines from that gas in the table provided (also record the wavelength of the lines)
2. Repeat for the other gas tubes Mrs. DeLine will write on the board which gases we will be using

**Part II: Light Emission Spectroscopy**

Results of observing spectra from excited gases. Place the lines of color that you see in in the box for each color of visible light that you observe in each spectrum**.**

| Gas Tube symbol | Reds | Oranges | Yellows | Greens | blues | Violets |
|---|---|---|---|---|---|---|
| | | | | | | |
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**Part III:**

**Results of flame tests on known substances.** ***Note: The flame colors are from the positive ion, not from the chloride ion or nitrate ion.***

**Observations of Flame Colors**

| Substance | Observations |
|---|---|
| $LiCl$ | Lithium chloride: |
| $CaSO_4$ | Calcium sulfate: |
| $Na_2SO_4$ | Sodium sulfate: |
| $KCl$ | Potassium chloride: |
| $Sr(NO_3)_2$ | Strontium nitrate: |
| $BaCl_2$ | Barium chloride: |
| $CuCl_2$ | Copper II chloride: |
| unknown | |

**Part III continued**

**View the flame of each solution with the diffraction glasses. Emission Spectra of the 7 Metal Ions (Place a lines of color in the box for each color of visible light that you observe.)**

| Metal Ion | REDs | ORANGEs | YELLOWs | GREENs | BLUEs | VIOLETs |
|---|---|---|---|---|---|---|
| $Li+$ | | | | | | |
| $Na^+$ | | | | | | |
| $K+$ | | | | | | |
| $Ca^{+2}$ | | | | | | |
| $Sr^+$ | | | | | | |
| $Ba+$ | | | | | | |
| $Cu^{+2}$ | | | | | | |
| unknown | | | | | | |

**Part IV: ANALYSIS and CONCLUSIONS: Answer in your notebook in complete sentences**

1. Do you think that flame tests would be valuable in detecting which metal ions were present in a mixture of metal ions? Explain.
2. Arrange the elements used in the flame tests according to the color produced from the lowest energy emitted to the highest energy.

Explain why some spectral lines are brighter than others