**Flame Test & Spectroscopy Activity**

Activity taken from from <http://www.800mainstreet.com/spect/emission-flame-exp.html>

**Part 1 Flame tests and identification of an unknown metal.**

Observe and record the color of the flame for each metal ion. Remember the metal ions are paired with a nonmetal ion in an ionic formula unit. The electrical charges have to add to zero. The metal ions are converted to atoms in the flame and then excited by the heat from the Bunsen burner flame. The nonmetal ions, anions, do not get converted to atoms and do not emit visible light like the metals do. Repeat procedure for each known. Record the color observed for each unknown and use the color match to identify the metal atom that is the produced from the cation in each unknown.

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| **Metal ion** |  | **Observed Flame color** |
| Barium | [click for flame test](http://www.800mainstreet.com/spect/flame-barium-no-an.html) | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Calcium | [click for flame test](http://www.800mainstreet.com/spect/flame-ca-anim.html) | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Sodium | [click for flame test](http://www.800mainstreet.com/spect/flame-sodium.html) | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Rubidium | [click for flame test](http://www.800mainstreet.com/spect/rubidium-flame.html) | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Potassium | [click for flame test](http://www.800mainstreet.com/spect/potassium-anim.html) | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Lithium | [click for flame test](http://www.800mainstreet.com/spect/flame-li-anim.html) | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

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| **Unknowns** |  | **Flame color** | **Identity of metal ion based on flame test color** |
| Unknown 1 | [click for flame test](http://www.800mainstreet.com/spect/flame-unknown1.html) | \_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_ |
| Unknown 2 | [click for flame test](http://www.800mainstreet.com/spect/flame-unknown2.html) | \_\_\_\_\_\_\_\_\_\_\_\_ | \_\_\_\_\_\_\_\_\_\_ |

**Part 2 Observing line spectra with the spectroscope**

In the second part of the experiment you will observe the color of light emitted by excited gases of elements in sealed glass tubes called "spectrum" tubes. Direct current, DC, high voltage electrons are used to excite the atoms in the spectrum tube. High voltage means 1000 to 2000 volts. This is more than 10 times normal household voltage which is 120 volts AC.

The excited atoms release the energy they gained. Some of this energy is in the form of heat and some is in the form of light. The billions of excited atoms release energy. Each excited atom releases a single pulse of light energy as it returns to the "ground" state or low energy state. There are so many pulses emitted the light appears to be continuous.

The excited atoms do not all emit the same energy light because the amount of energy that excited them may differ, but there are limitations on the colors they do emit. The kind of light depends on the size of the gaps between the "shells" or energy levels in the atom. The electrons are changing "n" values in the atom. Remember "n" can have only positive whole number values like 1, 2, 3, ... up to infinity.

The kind of light energy that can be emitted by excited atoms is unique for an element. The pattern of "lines' or colors emitted can be used to identify an element. A powerful extension of this is the ability to measure amounts of an element by measuring the brightness of the emitted light.

A spectroscope can separate the light produced by an emission tube. The color seen by the naked eye is a combination of a number of colors of light. These are separated by a prism or a diffraction grating which acts like a prism. The emission lines can be seen when you look through the spectroscope at the light source. You will be able to observe the "line" spectrum for the elements and record the spectral lines.

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| **Element** | **Emission** | **Emission spectrum** |
| Sodium | [click here to view emission tube](http://www.800mainstreet.com/spect/sodium-spec-tube.html) | [click here to view emission spectrum](http://www.800mainstreet.com/spect/sodium_em_spectrum2.html) |
| Neon | [click here to view emission tube](http://www.800mainstreet.com/spect/neon-emission-tube.html) | [click here to view emission spectrum](http://www.800mainstreet.com/spect/neon_emission.html) |
| Mercury | [click here to view emission tube](http://www.800mainstreet.com/spect/mercury-emission_tube.html) | [click here to view emission spectrum](http://www.800mainstreet.com/spect/mercury_em_spectrum.html) |
| Helium | [click here to view emission tube](http://www.800mainstreet.com/spect/helium_gas_tube.html) | [click here to view emission spectrum](http://www.800mainstreet.com/spect/hrlium_em_spectrum.html) |

**Questions and observations**

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| Examine the spectra for the elements Na, Ne, Hg and He and answer the following questions.1. How do these emission spectra compare in terms of colors and numbers of emission line positions?
* Are the spectra identical?
* What if anything is similar?
* What is different?
1. Element with greatest number of visible emission lines \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Longest wavelength in the spectrum of this atom in nanometers \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Color of light for this longest wavelength \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
1. Element with fewest number of emission lines
* Longest wavelength in the spectrum of this atom in nanometers \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Color of light for this longest wavelength \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
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