

## Flame Tests of Elements

Laboratory Experiment # \_\_\_\_\_

### **RESEARCH QUESTION: Could flame tests be useful in identifying the identity of elements?**

**Background:** When metals are heated, their valence electrons become excited and jump up to higher energy levels. These energized electrons are not stable at higher energy levels so they fall back down to lower energy levels, giving off their extra energy as specific wavelengths of light. As a result, metals impart characteristic colors to a flame. The flame test is used to visually determine the identity of an unknown metal or metalloid ion based on the characteristic color the salt turns the flame of a Bunsen burner. The heat of the flame excites the metals ions, causing them to emit visible light. The characteristic emission spectra can be used to differentiate between some elements.

#### **Pre-Lab:**

##### **1. Fill in the blanks (rewrite in lab notebook under "Pre-Lab")**

When the atoms of metals in solution are excited by heating, their \_\_\_\_\_ are able to move from their \_\_\_\_\_ state to an \_\_\_\_\_ state. This high energy state is \_\_\_\_\_ so the electrons return to ground state releasing \_\_\_\_\_. This energy corresponds to particular wavelengths of \_\_\_\_\_, and so produces particular \_\_\_\_\_ of light. Each element has its "fingerprint" in terms of its \_\_\_\_\_ line emission spectrum.

##### **2. CLAIM: Answer the research question above, here...**

##### **3. Complete the second column of Data Table 2 by filling in the cations, positive ions, for each of the given salts (one has been done for you)**

##### **4. Read through ALL safety procedures.**

**Objective:** To perform flame tests with a variety of metal compounds and identify unknowns based on these flame test results. You will be identifying the metals that exist as cations in solution.

**Materials (per group):**

Bunsen burner, Bathroom cups, Q-tips, solid samples of NaCl, KCl, LiCl, CaCl<sub>2</sub>, SrCl<sub>2</sub>, BaCl<sub>2</sub>, CuCl<sub>2</sub>, 3 Unknowns

**Safety:** In this lab, the solutions you will be using contain harmful materials. Avoid skin contact with these chemicals. Observe all precautions, especially the ones listed below.

**Caution:**

- Wear your safety goggles at all times.
- Do not leave a flame unattended
- Do not taste any of the substances or touch them with your hands.
- Do not leave Q-tip in the flame for too long. Make sure it is placed in the EDGE of the flame.
- Make sure to place the Q-tip in the water they were received from after use. Do NOT cross-contaminate Q-tips.
- Return or dispose of all materials according to your teacher's instructions.

**Procedure:**

1. Report to one of ten stations as set up by your teacher
2. At your station there should be two bathroom cups. One should contain some solid salt from the list above. The other should be filled half way with tap water.
3. Carefully light your Bunsen burner. Adjust your air ports to obtain a controlled flame.
4. Dunk a Q-tip into the cup of water.
5. Now put the Q-tip into the cup on solid salt so that some of it sticks to the Q-tip. Put this Q-tip into the EDGE of the flame. Record the color in your table below. **Be as SPECIFIC as possible when recording the flame color, it will help when trying to identify your unknowns.**
6. Rotate to the next station as assigned by your teacher. Repeat this procedure until you have completed your data table.

\*For the unknown stations... Each of the unknowns is one of the solids you examined above. Based on the color imparted to the flame, identify the metals present in each of the unknown solutions. Make a prediction first and then after record the identity of the unknowns after comparing flame colors\*

**Table 1:** Known Solutions

Solid Salt	Metallic Cation	Flame Color
NaCl	Na <sup>+</sup>	
LiCl		
KCl		
CaCl <sub>2</sub>		
SrCl <sub>2</sub>		
BaCl <sub>2</sub>		
CuCl <sub>2</sub>		

**Table 2:** Unknown Solutions

<b>Substance</b>	<b>Flame Color</b>	<b>Solid Salt Prediction</b>
Unknown #1		
Unknown #2		
Unknown #3		

**QUESTIONS AND CONCLUSION MUST BE HANDWRITTEN!!!**

**Questions:** Answer on separate looseleaf paper in COMPLETE SENTENCES!!

1. Explain, thoroughly, how the colors of the flame test are produced (in terms of atoms). Use appropriate vocabulary from this unit.
2. You have just returned from the moon with a handful of crystals. Describe how you could use flame tests to identify some elements that might be in these crystals.
3. If a pan of milk boils over on a gas stove, the flame turns orange/red. Explain why.
4. What is a spectroscope? What is observed if each flame test is viewed through a spectroscope?
5. In your own words, explain the following terms: (a) quantum (b) ground state (c) excited state
6. What are some drawbacks for using flame tests for identification purposes?

**CONCLUSION (reasoning):** Connect your claim and your evidence using the following format

- The evidence from the Flame test shows...
- I know (from our notes...Bohr Model, Excited vs. Ground State Electrons)...
- I can apply (the big ideas...Bright Line Spectra/Emission spectra)...
- Therefore, I can conclude that...

**Due Date:** \_\_\_\_\_