Science 10: Flame Test Lab Activity

Name:_____ **Block:** _____
Group Members:_____ **Date:** _____/_____/_____
Due Date:_____ **Drop Date:**_____

The report is submitted in full, **on the due date**. If you are absent on the day, the report is expected to be submitted electronically. Late reports are penalized, and will *not accepted past the drop date*.

Criteria	Student Self Evaluation	Teacher Assessment
Variables & Hypothesis: Correctly identifies independent and dependent variables, controls and develops a reasonable hypothesis based on scientific knowledge.	**/6**	**/6**
Flow Chart: a flow chart diagram of the procedure completed individually by each group member ***before the lab!*** **Pre-Lab Questions:** displays a critical understanding of the background theory.	**/13**	**/13**
Data, Results: Provides results & detailed observations (and diagrams where appropriate) that are presented in **correctly labelled** tables with **descriptive, numbered titles**.	**/4**	**/4**
Follow up Questions: Correctly identifies and explains the theory relating to the experiment and supports this with accurate observations & data.	**/5**	**/5**
Conclusion: Identifies and defines important concepts and principles relevant to the experiment by relating back and answering to the objective and hypothesis.	**/3**	**/3**
Presentation: Practical report is presented in third person past tense & in the **correct format**. Is written fluently and provides **appropriate section headings** and accurate referencing. ***Tables & graphs*** have numbered headings & descriptive titles. Data & calculations may be hand written, however the remainder of the report is to be **word-processed.**	**/2**	**/2**
Practical: Demonstrates an organized and safe approach to experimental work during the lab. Shows maturity, cooperation and leadership during laboratory work. Works collaboratively within lab group and cleans up safely and appropriately.	**/3**	**/3**
Results Summary	**/36**	**/36**

We will be doing the lab on _____.

In order to be ready to go, you need to complete the following sections of your lab report:

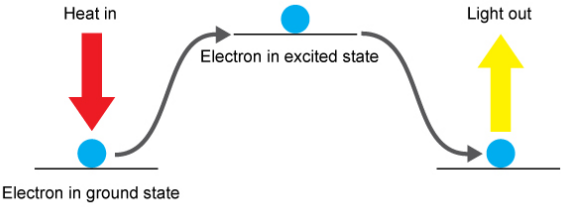
- ☐ *Flow Chart*
- ☐ *Pre-Lab Questions*
- ☐ *Data & Observations: Draw & set-up Table 1 into your lab notebook.*

Flame Test Background Information & Pre-Reading ***(this will help with pre-lab questions)***

The flame test is used to visually determine the identity of an unknown metal ion based on the color the metallic salt turns the flame of a Bunsen burner. When metals are exposed to high temperatures, electrons transition to a higher energy level (the excited state), and after, the return to the ground state while simultaneously emitting a photon. The color of this photon, in the visible spectrum, allows us to say if a ***metal cation*** is copper or potassium, for example.

Chemists began studying colored flames in the 18th century and soon used the term "flame tests" to distinguish between some elements. Different elements burn with different colored flames. Although some of the flames you will be seeing will appear similar in color, their light can be resolved (separated) with a prism into distinctly different bands of colors on the ***electromagnetic spectrum*** (ROYGBIV) These bands are called atomic line spectra, and they are **UNIQUE** in colour and wavelength to each element .

Niels Bohr studied the line spectrum for hydrogen, and wondered what the specific line spectrum had to do with the structure of the atom. He postulated that an electron can have only *specific energy values in an atom,* which are called energy levels, Bohr believed that the energy levels for electrons were quantized, meaning only certain, specific energy levels were possible.



How does an electron move between energy levels ? By gaining the right amount of energy, an electron can move, or undergo a transition, from one energy level to the next. By placing atoms of metals into a flame, electrons can be induced to absorb energy and jump to an excited state, a quantum jump. They then return to their ground state by emitting a photon of light (the law of conservation of energy indicates that the photon emitted will contain the same amount of energy as that absorbed in the quantum jump). The amount of energy in the photon determines its color : red for the lowest visible light, increasing energy through the spectrum (ROYGBIV) with violet being the highest energy of visible light. Photons outside the visible spectrum may also be emitted, but we can not see them.

The arrangement of electrons in an atom determines the sizes of the quantum jumps, and thus the energy and colors of the collection of photons emitted, known as the emission spectrum. In this way the emission spectrum serves as a "fingerprint" of the element to which the atoms belong. We can view the emission spectrum of colors all at once with the naked eye. It will appear to be one color, which we will carefully describe. It is also possible to view the separate colors of the emission spectrum by using a spectroscope, which bends light of different energies differently. Low energy red light, is bent the most, and high energy violet the least. This allows us to see distinct colors of the emission spectrum of a sample.

We will use the data we collect to identify a metal in an *unknown salt solution*. This process is the same as that used by chemical laboratories to identify the make-up of chemical combination in chemical spills, land fills, industrial sites, etc. This must be done to determine the possible threat to human health and the ecosystem due to contamination.

Objective
To observe the characteristic flame color of known solutions containing metals and ***to identify the unknown solution(s)***

Variables: **__/ 3 marks**

Independent Variable: *(what is being manipulated/changed? In the experiment?)*

Dependent Variable*: (what is being observed/recorded/measured?)*

Control(s): *(what needs to be kept the same for it to be a 'fair test'?)*

Hypothesis: *(If….what are you altering in the experiment? Then…what are you measuring? What is the expected change? Because….explain WHY you expect to see this happen? What is this 'prediction' based on?)*

___/ 3 marks

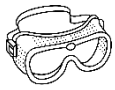
If,

Then,

Because,

Safety Precautions

Copper(II) chloride is moderately toxic; avoid contact with eyes, skin, and mucous membranes.



Lithium chloride is a body tissue irritant.

Safety glasses & lab apron are to be worn at all times, for all experiments involving chemicals!

Procedure: Use this to **prepare a flow chart** for next class ***(MUST be completed to participate in the lab!)***

1. Collect and put on all personal protective equipment. Collect lab equipment and set up your bench
2. Fill a beaker half full of water. This will be your ***rinsing solution*** to clean the wire loop between each flame test
3. Set up a Bunsen burner, carefully following teachers directions. Be sure to **always leave the Bunsen burner on the safety (orange) flame unless heating a test compound!** One lab partner should be supervising the flame at all times. **DO NOT** leave the flame unattended!
4. Your teacher has prepared **8 test compounds** (**A**-Calcium chloride, **B**-Copper (II) chloride, **C**- Lithium chloride, **D**-potassium chloride, **E**- sodium chloride and **F**- strontium chloride **G-** Iron (III) chloride, **H**- Nickel (II) chloride) and **1 unknown compound** for you to identify.
5. Dip a CLEAN wire loop into the water beside the sample you are testing.
6. Use the wet wire loop to pick up one of the solid, metal containing compounds. Keep track of which one you are working with! (A→G)
7. Carefully carry the wire loop OVER A PETRI DISH *(in case of spills)* back to your bench.
8. Switch your Bunsen burner to the heating *(blue)* flame. Being careful NOT to drop any metal or metal compounds into the Bunsen burner, hold the wire loop in the flame and burn to show color. Exercise caution and be sure to carefully hold the end of the wire loop furthest away from the flame.
9. Record the metal compound sampled *(and any other observations*, and the ***immediate color shown*** in your data table.
10. Making sure to turn your Bunsen burner to the safety *(orange)* flame between tests, repeat steps #5-9 for all

remaining metal compounds and the unknown(s). Make sure you are cleaning your wire loop and using the proper water beaker BEFORE testing each sample to avoid cross contamination of samples.

11. Turn off the Bunsen burner. Make sure all equipment is cleaned and returned to the equipment station.
12. Pour all chemical waste *(including water in beakers)* into the WASTE DISPOSAL FLASK provided by your teacher.
13. Wash, clean up and return the equipment you have used. Spray and wipe your lab bench. Wash your hands with soap & water.

Reagent Disposal: all waste is to be collected in the **WASTE DISPOSAL**.

Clean Up: clean up all materials as instructed by your teacher. Glassware needs to be washed and dried for use by other students. Wipe lab bench with disinfectant and wash hands *well* with soap and water before you leave the lab each day.

Flow-Chart *(must be completed to participate in the lab):*

Checked by teacher

Pre lab Questions : (*show your teacher your answers before you begin the lab with your flow chart)*

Checked by teacher

1. What precautions should be taken to ensure safety during this lab? *Explain.* *(2 marks)*

2. Explain the steps for lighting a Bunsen burner: *(2 marks)*

3. What is the **independent variable** in this lab? *(1 mark)*

4. What is the **dependent variable** in this lab? *(1 mark)*

5. What variables are important to control to ensure a fair test? *(1 mark)*

6. Why is it important to clean the wire loop before performing each new test? *(1 mark)*

7. Analyze the compounds used in this experiment. What is **similar** about the compounds? What is **different** about the compounds? (2 marks)

8. What happens to an electron when **heat is added** ? *(1 mark)*

9. What happens to an electron when **heat is removed** ? *(1 mark)*

___/12 marks

Data, Results & Calculations

Table 1: _____ ***___/4 marks***

	Name of Compound	Chemical Formula	Observation(s)
A			
B			
C			
D			
E			
F			
G			
H			
UNKNOWN 1			
UNKNOWN 2			

Follow-Up Questions:

1. Flame tests provide evidence that electrons do occupy different energy levels. Explain how elements produce different colors? (3 marks)

2. Is it the metal part of the compound or the chloride part that produces the color? Consider your results table and explain how you know. (2 marks)

Conclusion: *In full sentences & paragraph format:* (3 marks)

- ☐ Answer objective/ hypothesis.
- ☐ Briefly summarize experimental results.
- ☐ Discuss any sources of experimental error.