

Objective: To use flame tests and bright line spectra to identify elements.

Electrons for all atoms tend to remain in the ground state, the orbitals of lowest energy. They fill the different orbitals from lowest energy to highest in an orderly way. Sometimes atoms and their electrons can become excited because they gain energy from the environment, from heat or electricity for example. When this happens, the electrons can absorb some of this energy and be able to "jump" to a higher electron orbital than normal. This is possible but unstable for the atoms and electrons, and soon the electron will release this extra energy and when doing so, be able to "drop back down" to the ground state orbital arrangement it normally occupies.

When this release of energy occurs, this sometimes can be observed as color, or if you use special refractive lenses, as patterns of spectra lines, unique to each type of atom or molecule. In this lab we will excite different atoms and molecules, and we will see what light and/or spectra they emit. We can draw specific patterns that we see and then use our drawings to determine unknown atoms and molecules as well.

It is important that you do not touch the special tubes of gases that we will electrify (fingerprints will tend to cause hot spots and burn the lamps out) or touch the flames of heated compounds (fire is hot). Make your drawings as neat as possible, and make sure that they are nearly "MIRROR IMAGES" of each other on paper as they are in "real life".

Procedure: draw a Bright Line Spectra Line Pattern for six different elements or compounds.

Use about 6 lines on each side of the line (which represents the lamp) at most.

element or compound	draw the spectra for each center line for each spectra pattern	

Class Demonstration:

The teacher has six evaporating dishes, each containing a different salt. To each he will add some flammable liquid and set it on fire. The heat will produce energy that the salts will absorb, exciting their electrons. When the electrons return to their ground states, they will give off a particular spectra. We will observe these without refractive lenses, and each salt should present a different color flame. The individual colors are blends of the specific spectra emitted by the electrons of the salt as they return to their respective ground states. Let us agree on these particular color names and record them in the next table. Put the element symbol in each box with the salt metal name.

salt	Salt formulas	flame color
copper chloride		
lithium chloride		
potassium chloride		
sodium chloride		
strontium chloride		
magnesium chloride		
calcium chloride		

FLAME TESTS: In each of the sample solutions are dissolved salts in water. They are labeled with letters but are "unknowns" to us. Stick one end of a "Q-Tip" into a bottle and then light it on fire with a Bunsen Burner. Record the flame color. Using the chart above, determine what metal salt is dissolved into each solution. It is the heat from the fire that excites the electrons, and when they return to the ground state, they emit some energy that we can see as color flames. (same as the class demonstration above).

Unknown bottles	flame color	probable metal salt
A		
B		
C		
D		
E		
F		

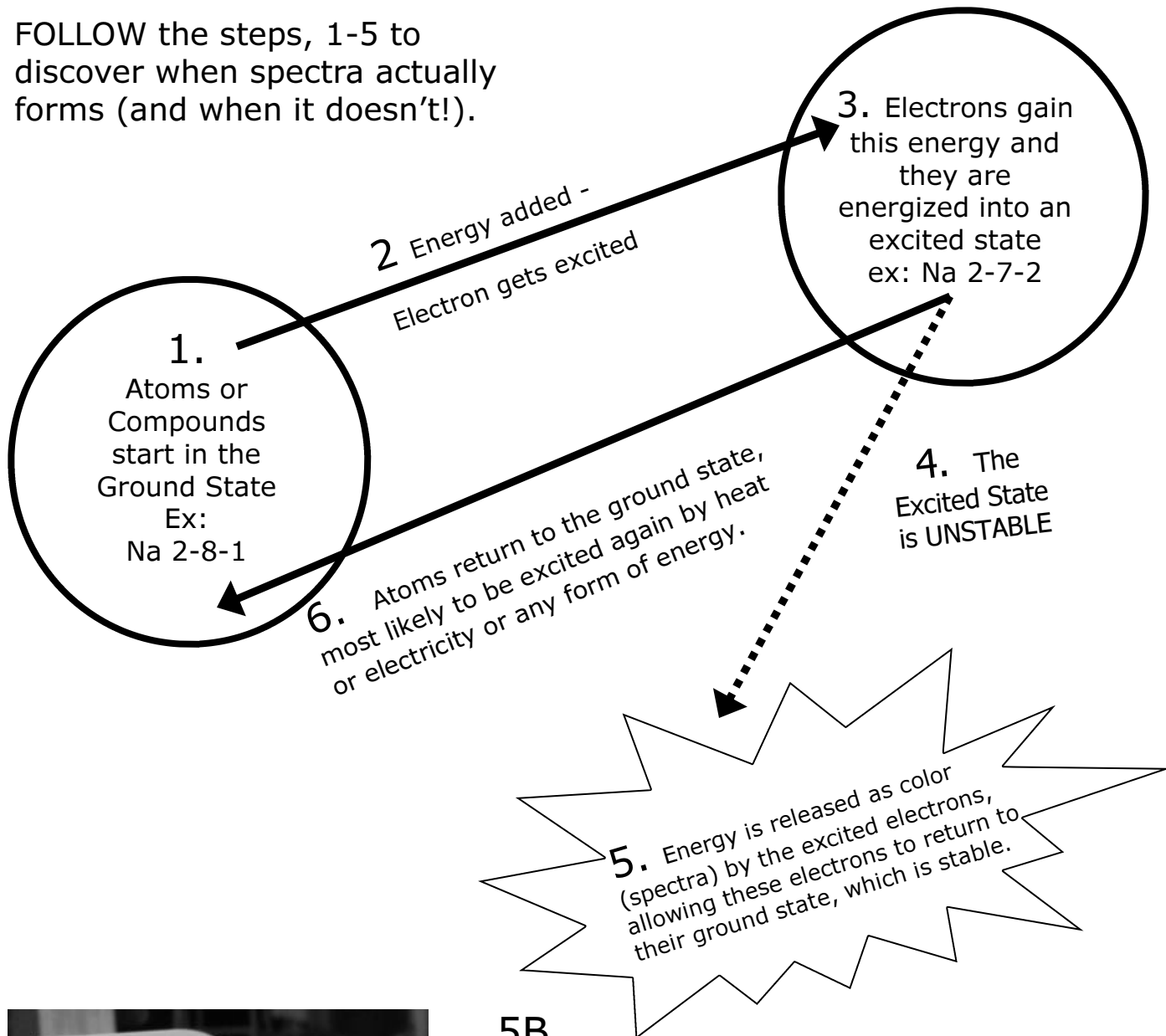
Lab Questions:

1. Explain why the lithium and the copper salts had different color flames (use the words electron orbitals, spectra, and mixture in your answer).
2. Does an atom in the ground state contain the same total number of electrons as when it's in the excited state? What's the difference?
3. By looking at a planet or a star using refractive lenses we can draw an accurate bright line spectra of all the mixed substances that are on that planet or star. Explain how a scientist could determine from this big mix of spectra lines photographed through a telescope what substances are found on that star without having to go there.
4. Clearly describe the connection between bright line spectra produced with the lamps in lab, and flame colors. Mention the absorption of energy (heat or electricity) and the release of energy by atoms or compounds. Be sure to indicate the exact cause of the spectra, for example, finish this sentence: "Bright Line Spectra are caused when..."

This lab report	includes	points
Cover page	Title, optional funny sub-title, 2 sentence introduction: Why are we doing this lab?	1
pages 2 - 3	this lab handout and the spectra drawings	2
Page 4	4 Lab questions above	8
Page 5	Fill in the big chart with all the electron configurations	6
Page 6	Conclusion: 1. Clearly state how spectra is produced. 2. Why are spectra unique to atoms and compounds? 3. How you could use spectrography to determine an unknown substance? 4. Why is it hard to use the flame tests to accurately determine all the dissolved salts in lab? Do all of the "orangey" color flames actually contain unique spectra? 5. How is spectra used in the "real world"?	8
this lab is due on: _____ (late = -5)		25 points

atomic number	atom name	atomic symbol	Total number of electrons	Ground state configuration	Possible excited state configuration	Total number of e ⁻ in an atom that's in an excited state
2						
3						
4						
5						
6						
7						
8	oxygen	O	8	2-6	2-5-1	8
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						

FOLLOW the steps, 1-5 to discover when spectra actually forms (and when it doesn't!).

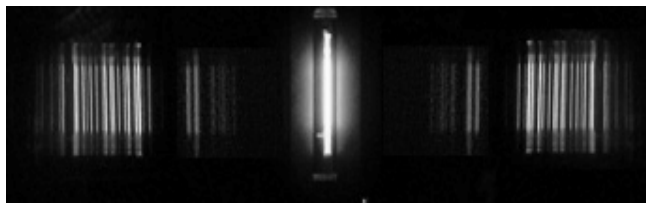


5C

The mixture of color light we see with our eyes will be broken down into the specific wave lengths, which are unique and measurable. We can see this with refractive lenses.

5B

No matter what type of energy excites these electrons, much of this energy is given off as visible light. We see this light as colored flames, or as one color of light in an electric lamp.



5D

Spectra are unique because each atom or compound has a unique number of protons & electrons in specific orbitals.