NAME: _____

CLASS PERIOD: _____

CHAPTER 4: FLAME TEST & SPECTROSCOPY LAB

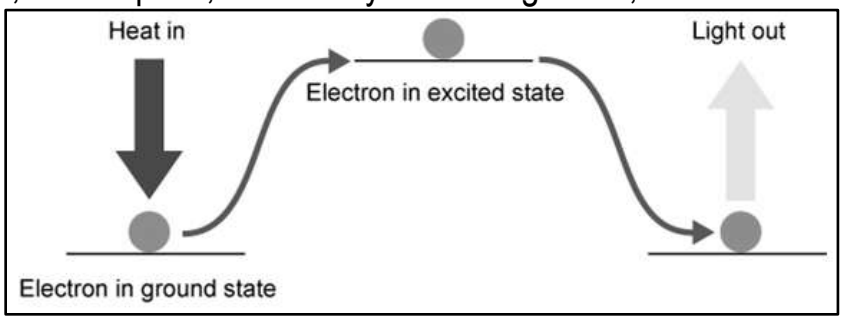
GROUP ROLES: *Students will perform multiple roles if group has less than five students.*

	ROLE	DESCRIPTION	STUDENT	PARTICIPATION SCORE (1-10)
1	Quality Control Specialist	• CLOSELY watches procedures to make sure contamination does not occur.		
2	Director	• Enforces all safety rules. • Keeps group on task and following directions.		
3	Materials Manager	• Makes sure group has ALL materials. • Makes sure all materials are CLEANED up.		
4	Experimenter #1	• Carefully, safely, and accurately performs procedures.		
5	Experimenter #2	• Carefully, safely, and accurately performs procedures.		

ESSENTIAL QUESTION: *How does light reveal the behavior of electrons in an atom?*

BACKGROUND INFORMATION:

From fireworks to stars, the color of light is useful in finding out what's in matter. The emission of light by hydrogen and other atoms has played a key role in understanding the electronic structure of atoms. Trace materials, such as evidence from a crime scene, lead in paint, or mercury in drinking water, can be identified by heating or burning the materials and examining the color(s) of light given off in the form of bright-line spectra. Excited states result from the absorption of energy by the outermost, or valence, electrons of an atom that cause a jump to higher energy shells, or orbitals. The excited state electron does not remain excited permanently but emits energy in the form of light, known as emission, with a specific energy and characteristic color in order to return to its original ground state. Excited states are important parts of some reactions as well as in the analysis of substances.



PURPOSE:

- Communicate and work collaboratively with peers.
- Use appropriate laboratory tools safely, strategically, accurately, and precisely.
- Make sense of questions and use perseverance and critical thinking skills to formulate answers.

OUTCOMES:

- Follow expectations and procedures in the laboratory. ***(F & PK)***
- Write electron configurations in regular order and noble gas methods. ***(F & PK)***
- Distinguish between ground state and excited state. ***(T & R)***
- Explain the fundamentals of emission spectroscopy. ***(T & R)***

PRE-LAB: *What do we know about fireworks?*

PART 1: *Before reading*, in the first column, write "A" or "D" indicating your agreement or disagreement with each statement. After making a decision about each statement compare answers with the students in your group and discuss the reasons you have for differences in your choices.

PART 2: *As you read the article*, compare your opinions with information from the article. Now compare notes again with your group. Does everyone agree?

Me	Text	Statement
		1. The colors of fireworks are produced by metals.
		2. Gunpowder is used to explode fireworks.
		3. During the explosion of fireworks, gases are moving faster than the speed of sound, so a sonic boom is produced.
		4. The color produced by incandescence can be controlled by the temperature.
		5. Colored light can be produced when electrons change energy levels inside atoms.
		6. Firework explosions can be designed to look like flowers or trees in the sky.
		7. Fireworks that can be legally purchased in most states contain less than 10 mg of gunpowder.
		8. The highest temperatures produced by firecrackers are only about 500 °C.
		9. The United States is the world's leading producer of fireworks.
		10. Chemists who design fireworks are experts on many kinds of explosions.
		11. Pyrotechnic chemists are working to make fireworks safer for both people and the environment.
		12. This article may change my views on fireworks.

HYPOTHESIS: *Write a hypothesis as a group.*

If _____

then _____

because _____.

MATERIALS:

- 6 test tubes with element samples
- Acid wash
- Aprons
- Burner connected to gas valve
- DI wash water
- Nichrome wire loop
- Safety glasses
- Spectroscope
- Striker
- Test tube holder

PROCEDURES:

1. Take off IDs and leave in classroom.
2. Bring "Fireworks!" article, this lab sheet, and something to write with to the lab.
3. Make sure the windows and blinds are fully raised.
4. Put on goggles and lab apron.
5. Use the spectroscope to observe the full light spectrum of both natural (outside) and artificial (ceiling) lights to get an idea of light splitting up into a rainbow. Be sure to look through the slit in the spectroscope both horizontally and vertically.
6. Turn the gas on and use the striker to light the burner.
7. Adjust the gas to create a small, blue triangle of flame.
8. ***Clean the nichrome wire loop by inserting it into the acid wash.***
9. ***Rinse in the beaker of DI wash water. It should remain slightly damp.***
10. Insert the nichrome wire loop into test tube #1 and touch it to the solid particles (enough to lightly coat the tip of the loop). ***Be EXTREMELY careful to avoid contaminating the test tubes!***
11. Introduce the metal ion into the flame of the burner noting the flame color in the data table below.
12. View the flame through the spectroscope.
13. Burn the nichrome wire loop until all solid particles are gone.
14. Compare the color to Table 1 on the "Fireworks!" pre-lab article to check your results and to determine the possible identity of the unknown elements.
15. Repeat steps 8-14 for the remaining 5 test tubes.
16. ***Turn the gas to the beaker off!***
17. ***COMPLETELY clean your entire lab station, especially the black lab top.***
18. Put away your goggles and apron ONLY once all lab groups have completed their tests AND the teacher gives permission.

DATA TABLE:

FLAME TEST FOR KNOWNS

	Element	Flame Color
#1	Lithium	
#2	Sodium	
#3	Potassium	

FLAME TEST FOR UNKNOWNS

	Element	Flame Color
#4		
#5		
#6		

DISCUSSION:

1. My hypothesis was (proven / disproven) by the results of the experiment because _____ _____.
2. What is the difference between an excited and ground state of an atom? _____ _____ _____ _____
3. What happens when electrons move from the excited state to the ground state? _____ _____ _____ _____

4. Why do different elements emit different colors of light? _____

_____

_____

POST-LAB: ASSESSMENT

1. Electrons can be found in specific locations known as _____.
- **A.** energy clouds
- **B.** energy shells
- **C.** orbital clouds
- **D.** orbital planes

2. Electrons in the energy level or orbital that is furthest from the nucleus of an atom are known as _____.
- **A.** frontier electrons
- **B.** outer electrons
- **C.** peripheral electrons
- **D.** valence electrons

3. When an electron releases energy to fall back to its original ground state, it _____ light.
- **A.** absorbs
- **B.** both absorbs and emits, depending on the situation
- **C.** emits
- **D.** None of the answers are correct.

4. A technique that uses the color of a flame to indicate if certain metals are dissolved in liquids is called a(n) _____.
- **A.** color test
- **B.** flame test
- **C.** liquid test
- **D.** metal test

5. The _____ is caused by the absorption of energy in the form of heat or light by an electron.
- **A.** energetic state
- **B.** excited state
- **C.** orbital state
- **D.** valence state

6. How many electrons are in the outermost, or *valence*, energy level of the following atoms? Al ____ C ____ F ____ Na ____

7. Write the electron configuration for:
- **A.** Lithium _____
- **B.** Potassium _____

8. Write the noble gas configuration for:
- **A.** Strontium _____
- **B.** Copper _____

9. Use Figure 3 from the "Fireworks!" pre-lab article to explain in your own words what you were observing during this lab.

_____

_____

_____

_____

REFLECTION:

1. What problems did you have during the experiment? _____

_____

2. Why do you think they occurred? _____

_____

3. What do you think you could do differently next time to decrease the problems? _____

_____

4. Go back to the beginning of this lab data sheet and rate (1 = worst, 10 = best) each group member based on their participation, collaboration, and communication throughout the ENTIRE lab today.

TURN THIS LAB DATA SHEET IN TO TEACHER WHEN FINISHED!