

Lesson Title: High School Spectroscopy Lab

Amount of time for this lesson = 60 minutes

1. Standards and Safety and Materials:

A. Standards –

Wyoming State Standards

SC8.2.3 Students clearly and accurately communicate the result of their own work, as well as information obtained from other sources.

NGSS Standards

SC.912.E.5.8: Connect the concepts of radiation and the electromagnetic spectrum to the use of historical and newly-developed observational tools

B. Safety Concerns: minimal safety concerns with regular class activity

C. Materials: Spectral tubes, Spectral Tube Power Supply, Various compounds, Q-tips, Matches, Computer, Lab Worksheet

2. Objectives:

A. Students will be able to **observe** the bright line spectra (emission spectra) for various elements

B. Students will **use** a flame test to observe the color produced when metal ions are heated.

C. Students will **identify** unknown metal ions based on the results of the flame test.

3. Connections, Misconceptions, and Crosscutting Concepts:

A. Real world connections: Frequency and wavelengths in everyday communication, How light works

B. Student connections: Students will understand that all energies have a specific wavelength and frequency shown in the electromagnetic spectrum, elements have their own emission spectra, elements give off different colors when heated

C. Misconceptions: visible light energy is safe – it is safe for many organisms but not all

D. Crosscutting Concepts: Energy and matter – electromagnetic spectrum contains different energies, Patterns – electromagnetic spectrum shows relationship between frequency, wavelength and energy

E. Academic Language: spectrum – to look at, view; electro – electron (having energy)

Instructor will use the words when discussing the lesson. Students will be asked to use the words when answering questions.

4. *Catch/Engagement*: Students will observe instructor exciting different elements using matches and various elements. Instructor will dip the q-tip in a granular compound (sodium chloride) and burn the compound using matches to see the color of the light being given off.

5. Pre-test: See Attached

6. Activity/*Exploration*:

Part 1: Demo: To engage students, instructor will show how elements have different spectral lines using spectral tubes. Students will use 3D glasses to view elements placed in a spectrum tube power supply

Part 2: Students will read the background information and discuss how that relates to what has been discussed prior in class. Students will complete the Spectroscopy Online Lab using a computer and worksheet

Part 3: Students will work in groups to complete questions and write a summary of what they learned, how it applies to the background information and include a real world example

7. Review/Essential Questions/*Explanation*:

A. Low Level – How many types of energy are in the electromagnetic spectrum? Which electromagnetic radiation is visible to the human eye?

B. Middle Level – When frequency increases what does wavelength do?

C. High Level – Explain how light is produced with electrons.

8. Assessments (Post-test)/*Evaluation*:

A. Formative: Discussion at end of activity and questions from lab worksheet

B. Post-test: Same as pre-test – see attached

C. Summative: (How will you check for final learning/understanding?) –

Students will turn in constructed spectral lines. They will identify unknown by comparing to elements viewed. They will summarize the lab and connect it to the background information as well as state a real world connection.

D. Explain how the data will inform tomorrow's teaching.

The class lab average must be a 80% or the next class will begin with a 10 minute review/discussion of today's material followed by another post-test of the same material.

9. Timeline:

A. Catch	7 min
B. Pre-test	3 min
C. Activity – 3 parts	40 min
D. Review and Post-test	10 min

10. Enrichment/*Elaboration*: Research how scientists are able to identify specific elements on planets. State two planets and the elements that have been identified.

11. IEP Accommodations/*Differentiation/Diversity*: Struggling students will be given preferential seating, staff support, clarification of directions and extended time to complete assignment.

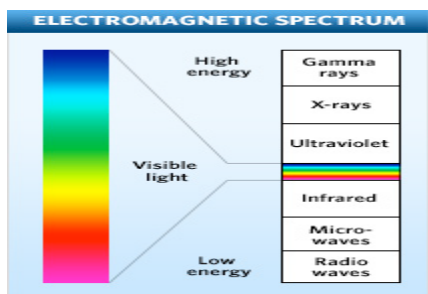
Spectroscopy Lab Pre-Test/Post Test

1. True or False – There are different types of light energy.
2. What type of light is the only one humans can see?
3. True or False - Wavelength and frequency are inversely related.
4. What subatomic particle is responsible for light energy?

Spectroscopy Lab

Background Info:

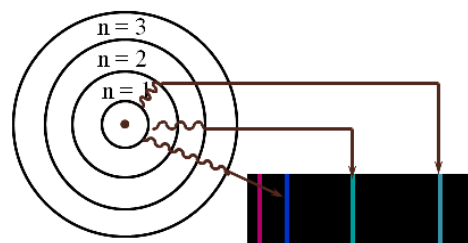
Bohr proposed that an electron is found only in specific circular paths, or orbits, around the nucleus. As a result, each orbit has a fixed energy called an energy level. These energy levels (orbits) are like the rungs of a ladder (See Figure A). The electrons cannot be found in between these energy levels, just like a person cannot stand in between the rungs. Electrons must gain energy (become excited) to move up energy levels. Electrons can become excited by heat, light, electricity etc. These high energy electrons are unstable and eventually fall back down to their lower energy levels (ground states) releasing the energy that they had gained when they were initially excited. This energy is released in the form of light and it is what Bohr observed.



(Figure B)



(Figure A)



(Figure C)

White light will produce a continuous spectrum when viewed using a prism or spectroscope (see Figure B). Different colors of light have different energies. When electrons of an atom are excited they will release different colors of light as they fall back to ground state (this is called **emission line spectra**). The colors of light correspond to the amount of energy released

(See Figure C). Using a spectroscope you can view the emission line spectra.

Different elements produce different spectra that are unique enough to be considered a "fingerprint" of the element.

Objective:

In this virtual lab you will observe the bright line spectra (emission spectra) for various elements.

Procedure:

Go to the Online Spectroscopy Lab. <http://www.mrpalermo.com/virtual-lab-spectroscopy.html>

1. Write the name of each element located in Part I. into data table 1 located below. Then click on each element and observe the line spectra that are produced. In data table 1 using crayons or colored pencils, draw lines representing the colors that you observed.

Data Table 1. Bright Line Spectra

Name of Gas	Line Spectra Observed

- Click on the metal ions to see the results of the flame test. Record your observations. Then click on each unknown and record the results of each flame test. Then identify the unknown by matching the flame color to one of the known metal ions.

Sample	Flame Color	Identify Unknown
Unknown 1		
Unknown 2		
Unknown 3		

Questions:

- There are three types of spectra. State all three and define them.
- How might emission spectra be used in studying stars?
- Colorful light emissions are applicable to everyday life. Where have you observed colorful light emissions?

Conclusion – Summarize what you learned from this activity. Connect it to the background information and state one real world connection.