UC Irvine FOCUS!
5 E Lesson Plan

Title: Flame Tests
Grade Level and Course: 7th Grade Life Science, 8th Grade Physical Science, 9-12th Grade Chemistry
Materials: Spatulas (straws cut at an angle) Sterno cans Matches or lighter Various salts (listed in lab)
Instructional Resources Used: (concept maps, websites, think-pair-share, video clips, random selection of students etc.) • Think-pair share-during engagement activity • Video clips: http://www.youtube.com/watch?v=jJvS4uc4TbU http://www.youtube.com/watch?v=7i8MtNP_JXY&feature=related http://vimeo.com/940357
California State Standards: 7th Grade Life Science 6: Physical principles underlie biological structures and functions. As a basis for understanding this concept: **a.** *Students know* visible light is a small band within a very broad electromagnetic spectrum. 8th Grade Physical Science Structure of Matter 3. Each of the more than 100 elements of matter has distinct properties and a distinct atomic structure. All forms of matter are composed of one or more of the elements. As a basis for understanding this concept: a. Students know the structure of the atom and know it is composed of protons, neutrons, and electrons. b. Students know that compounds are formed by combining two or more different elements and that compounds have properties that are different from their constituent elements. Grades 9-12 High School Chemistry Atomic and Molecular Structure 1. The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure. As a basis for understanding this concept: i. * Students know the experimental basis for the development of the quantum theory of atomic structure and the historical importance of the Bohr model of the atom. j. * Students know that spectral lines are the result of transitions of electrons between energy levels and that these lines correspond to photons with a frequency related to the energy spacing between levels by using Planck's

relationship (E = hv).
Investigation & Experimentation - Grades 9 To 12
1. Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other four strands, students should develop their own questions and perform investigations. Students will:
a. Select and use appropriate tools and technology (such as computer-linked probes, spreadsheets, and graphing calculators) to perform tests, collect data, analyze relationships, and display data.
d. Formulate explanations by using logic and evidence.

Lesson Objectives:

- Students will understand that light is made up of different wavelengths and frequencies of radiation in the electromagnetic spectrum.
- Students will understand the difference in color is a result of different energies of photons given off by electrons.
- Students will be able to use spectral lines to identify different metal ions in a compound.

Differentiation Strategies to meet the needs of diverse learners:

- English Learners: Place students into pre-arranged in lab groups that have been designed to maximize student time on task and understanding. Prior to lab, students will draw Bohr model of the three metal ions in the video http://www.youtube.com/watch?v=7i8MtNP_JXY&feature=related
The teacher will ask students to draw a conclusion between the color and the model.
- Special Education: As students watch http://www.youtube.com/watch?v=jJvS4uc4TbU , teacher asks "What do you see different?" Teacher explains that even though the different samples are giving off different colored light, the light is all produced the same way by electrons losing energy, different amounts of energy.
- GATE: Students will accomplish the appropriate experiment trials and then calculate the energy of the photons of each observed color using E=hv.

ENGAGE

- Describe how the teacher will capture the students' interest.
Hand out the spectrometer ($7) glasses and have students look at the sunlight. Students will record what they see. Next, have them pair with another student to collaborate on what they observed and hypothesize on why it is happening. Groups will then share out to the class with the teacher recording all statements on the board)
- What kind of questions should the students ask themselves after the engagement?
  1. Does anything they've seen in nature remind them of what they see through the glasses? (Rainbow)
  2. What causes the different colors seen in a spectrum?
  3. How is the wavelength of light related to the frequency of the light?

EXPLORE

- Describe the hands-on laboratory activity that the students will be doing.
In this lab, students will observe the characteristic colors produced by certain metallic ions when vaporized in a flame and then identify an

unknown metallic ion by means of its flame test. Students will sprinkle the different salts on the flame of a Sterno can and record their observations.

- List the "big idea" conceptual questions that the teacher will ask to focus the student exploration.
  1. Why is there a difference in color for different metal ions?
  2. Do all ions have a specific color, i.e., a physical property?
  3. Is the observed spectrum characteristic of the specific element?

EXPLAIN

- What is the "big idea" concept that students should have internalized from doing the exploration?

  Visible light is a small part of the electromagnetic spectrum and can be further broken down and defined by color. Atoms have electrons in specific energy levels that can move between energy levels based on the amount of energy gained. When the electrons give off that specific energy to return to their normal energy level, the energy is seen as colored light. The color emitted by the ion is characteristic of the element and based on the energy absorbed and emitted by the electrons of the ion.
  - List the higher order questions that the teacher will ask to solicit student explanations for their laboratory outcomes, and justify their explanations.
  1. Can the emission spectrum of an unknown element be analyzed to determine the ion?
  2. How can the spectrophotometer be used to assist in the determination of the metal ion?
  3. What color of light has the highest energy?

EXTEND

- Explain how students will develop a more sophisticated understanding of the concept.

  Students will watch http://vimeo.com/940357 and determine why there are different colors. Students will work in their same groups, employing the think-pair-share strategy and report out to class. Additionally, all students will answer the following question: Why is food kept under a light bulb to keep warm?
- How is this knowledge applied in our daily lives?

  Students, working in groups of two, will research the electromagnetic spectrum and prepare a power point presentation on one small area of the spectrum to include how that portion of the spectrum is used to enhance mankind.

EVALUATE

- How will the student demonstrate their new understanding and/or skill?
  - Students will correctly answer benchmark as well as unit exam questions. Correctly answering extend question. Gate students will be able to calculate the energy of the photons using $E=hv$.
- What is the learning product for the lesson?
  - Successful completion of the lab.
  - Correctly answering the lab questions.
  - Accurate completion of the data table.

○ Power point presentation.
Background Knowledge for the Teacher: The chemistry of an element strongly depends on the arrangement of the electrons. Electrons in an atom are normally found in the lowest energy level called the ground state. However, they can be "excited" to a higher energy level if given the right amount of energy, usually in the form of heat or electricity. Once the electron is excited to a higher energy level, it quickly loses the energy and "relaxes" back to a more stable, lower energy level. If the energy released is the same amount as the energy that makes up visible light, the element produces a color. While we see only one color of light, the spectrometer separates the light into a spectrum that corresponds to the color given off by the distinct element. -D. Ryan Costa Mesa High School , Costa Mesa, CA 7/2011

Student pages are attached.

Flame Tests

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Procedures:

1. Carefully light the Sterno can (the teacher may wish to do this for students).
2. Darken the lights.
3. Using a spatula, sprinkle a SMALL amount of salt over the flame.
4. Record the color that is produced in the data table.

Results:

Substance	**Color**
Sodium chloride	
Lithium chloride	
Strontium chloride	
Copper chloride	
Potassium chloride	
Unknown 1	
Unknown 2	

Analysis Questions:

1. Is the color of the flame a test for the metal or the chloride in each of the compounds? How do you know?

2. Why is it necessary to use a different spatula for each test material?

3. Each of the compounds you tested contains chlorine, which is a poisonous gas at room temperature. Why was it safe for you to perform these tests without a gas mask?

4. _______________ and ______________ are both ________________________.

5. While ____________ and ______________ have many similarities, they are

   different in that _______________________.

How to Interpret the Results:

The sample is identified by comparing the observed flame color against known values from a table or chart.

Red:
Carmine to Magenta: Lithium compounds. Masked by barium or sodium.
Scarlet or Crimson: Strontium compounds. Masked by barium.
Red: Rubidium (unfiltered flame)
Yellow-Red: Calcium compounds. Masked by barium.
Intense Yellow: Sodium compounds, even in trace amounts. A yellow flame is not indicative of sodium unless it persists and is not intensified by addition of 1% NaCl to the dry compound.

Green
Emerald: Copper compounds, other than halides. Thallium.
Bright Green: Boron
Blue-Green: Phosphates, when moistened with H_2SO_4 or B_2O_3.
Faint Green: Antimony and NH_4 compounds.
Yellow-Green: Barium, manganese(II), molybdenum.

Blue
Azure: Lead, selenium, bismuth, cesium, copper(I), $CuCl_2$ and other copper compounds moistened with hydrochloric acid, indium, lead.
Light Blue: Arsenic and come of its compounds.
Greenish Blue: $CuBr_2$, antimony

Purple
Violet: Potassium compounds other than borates, phosphates, and silicates. Masked by sodium or lithium.
Lilac to Purple-Red: Potassium, rubidium, and/or cesium in the presence of sodium when viewed through a blue glass.