

Diffraction Unit, Lesson 2: Funky Flames

Using Flame Tests to Explore Electrons' Energy Levels

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Grade Level	9th – 12th Grade	**Time Frame**	90-135 minutes
Subject	Science	**Duration**	2-3 periods
Course	Chemistry, Physics		

Essential Question

How is the electron's position in the atom related to its energy? What is the relationship between the energy of light released/absorbed and the change in the electron's energy?

Summary

In this lesson, students will watch a video of fireworks and write down what they notice and wonder. Students will participate in a flame test lab. They then will draw Bohr models for the element hydrogen, labeled with arrows to show the release and absorption of energy. Finally, students will research the science behind fireworks and how it relates to an electron's energy.

Snapshot

Engage

Students watch a firework video and fill out an I Notice, I Wonder chart.

Explore

Students participate in a flame test lab.

Explain

Students draw a Bohr models for hydrogen and answer questions.

Extend

Students research the science behind fireworks.

Evaluate

Students create a Caption This image and add 1-2 sentences answering the essential questions.

Standards

ACT College and Career Readiness Standards - Science (6-12)

IOD403: Translate information into a table, graph, or diagram
IOD404: Perform a simple interpolation or simple extrapolation using data in a table or graph
SIN301: Understand the methods used in a simple experiment
SIN303: Find basic information in text that describes a complex experiment
SIN401: Understand a simple experimental design
SIN403: Identify a control in an experiment
SIN502: Predict the results of an additional trial or measurement in an experiment
SIN503: Determine the experimental conditions that would produce specified results
EMI201: Find basic information in a model (conceptual)
EMI301: Identify implications in a model
EMI302: Determine which models present certain basic information
EMI403: Determine which models imply certain information

Next Generation Science Standards (Grades 9, 10, 11, 12)

HS-PS1: Matter and Its Interactions
HS-PS1-1: Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.

Oklahoma Academic Standards (Chemistry)

CH.PS1.1 : Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
CH.PS1.1.1: Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons.
CH.PS1.1.2: The periodic table orders elements horizontally by the number of protons in the atom's nucleus and places those with similar chemical properties in columns. The repeating patterns of this table reflect patterns of outer electron states.

Attachments

- Electrons in Atoms—Funky Flames - Spanish.docx
- Electrons in Atoms—Funky Flames - Spanish.pdf
- Electrons in Atoms—Funky Flames.docx
- Electrons in Atoms—Funky Flames.pdf
- Flame Test Facilitator's Guide—Funky Flames.docx
- Flame Test Facilitator's Guide—Funky Flames.pdf
- Flame Test Lab Instructions—Funky Flames - Spanish.docx
- Flame Test Lab Instructions—Funky Flames - Spanish.pdf
- Flame Test Lab Instructions—Funky Flames.docx
- Flame Test Lab Instructions—Funky Flames.pdf
- Flame Test Lab Sheet—Funky Flames - Spanish.docx
- Flame Test Lab Sheet—Funky Flames - Spanish.pdf
- Flame Test Lab Sheet—Funky Flames.docx
- Flame Test Lab Sheet—Funky Flames.pdf
- I Noticed, I Wonder—Funky Flames - Spanish.docx
- I Noticed, I Wonder—Funky Flames - Spanish.pdf
- I Noticed, I Wonder—Funky Flames.docx
- I Noticed, I Wonder—Funky Flames.pdf
- Lesson Slides—Funky Flames.pptx

Materials

- Lesson Slides (attached)

- I Notice, I Wonder handout (attached; one per student)
- Electrons in Atoms Handout (attached, one per student)
- Flame Test Lab Facilitator's Guide (attached)
- Flame Test Lab Instructions (attached; 1 per group)
- Flame Test Lab (attached; 1 per student)
- Device (1 per student)
- Goggles (1 per student)
- Apron or lab coat (1 per student)
- Science notebook or blank notebook paper (1 per student)
- Bunsen burner and related equipment (1 per group)
- Spot plate (1 per group)
- Cotton swabs (number depends on how many tests will be performed)
- Beaker of distilled water (1 per group)
- Cobalt glass (1 per group)
- Metallic salts (1 sample per group)
    - Calcium chloride, $CaCl_2$
    - Copper (II) chloride, $CuCl_2$
    - Potassium chloride, KCl
    - Lithium chloride, $LiCl$
    - Manganese chloride, $MnCl_2$
    - Sodium chloride, $NaCl$
    - Strontium chloride, $SrCl_2$
    - Unknown metallic salt

Engage

Introduce the lesson using the attached **Lesson Slides** and display **slide 2**.

Move to **slide 3** to share the essential questions and **slide 4** to go over the lesson's learning objectives to the extent you feel necessary.

Display **slide 5**, share the I Notice, I Wonder strategy with students, and pass out the I Notice, I Wonder handout.

Move to **slide 6** to show the "The Greatest Showman - A Pyromusical Fireworks Display by Pyromania Fireworks" video. As students watch the video they will record their thoughts on the I Notice, I Wonder chart.

Embedded video

https://youtube.com/watch?v=oe-8QopJn9k

As a class, discuss the things students noticed and are wondering about.

Explore

Teacher's Note: Lesson Preparation

Before the lesson, fill in **slides 8-10** to customize your flame test safety directions, materials, and instructions. For tips on how to handle a flame test lab in the classroom, see the attached **Flame Test Facilitator's Guide** document.

Move to **slide 7** and show the "Flame Test Colorful Elements - Sick Science!" video. Discuss with students what they believe the mystery powder is and why. Inform them that they will be completing a flame test and put students into groups for the experiment.

Embedded video

https://youtube.com/watch?v=Y1LMYP-lJJY

Teacher's Note: Mystery Powder Explanation

For written details of this experiment, read the lab. The mystery powder is cream of tartar.

Show **slide 8** and display the safety directions for the flame test. Explain them in detail to ensure safe procedures are followed.

Move to **slide 9** and go over the materials students will use to complete the flame test. Ask students the following questions prior to starting the lab.

- Besides the fact that they all contain a metal, what do all four substances have in common that you can consider a constant or control (and therefore ignore) while doing the flame test?
- When the electrons are in an excited state, they (absorb, release) energy and move to a (higher, lower) energy level. How will we be exciting the electrons in the lab?
- When the electrons return to ground state, they (absorb, release) energy and move to a (higher, lower) energy level. How will we know when that has happened?

Move to **slide 10** and guide your students through the directions for the flame test. Pass out the attached **Flame Test Lab Instructions** and **Flame Test Lab** handout for students to record their findings from their lab. Students will test four to five known samples and one unknown sample. Encourage your students to use color words and other adjectives to describe what they observe during the lab.

Explain

Teacher's Note: Lesson Preparation

According to your classroom norms, customize the instructions for what students should do with the Electrons in Atoms handout when finished. Insert these instructions into **slide 11**.

Examples include:

- Turn handout in to be graded.
- Discuss answers as a class.
- Discuss answers with partners/groups.

Move to **slide 11,** use this slide to introduce the Bohr model drawing activity. Pass out the attached **Electrons in Atoms** handout to each student. Students will draw Bohr models for the element hydrogen. They will draw arrows showing the absorption and release of energy for different energy transitions.

Extend

Display **slide 12** and inform students that they will be researching the science behind fireworks. Have students access the website titled *The Science Behind Fireworks*. Inform students that they will be using what they learn about fireworks to answer the essential questions. Optionally, have students take notes in line with class note-taking norms. Provide students sufficient time to research the science behind fireworks. This research will be used in the Evaluate section of the lesson. Encourage students to share and discuss what they discover with peers as they research.

Evaluate

Move to **slide 13** and explain the Caption This strategy to students. Instruct them to use this strategy to show what they learned during their research on fireworks and how it relates to the essential questions. This can be done using Google Drawings.

Students should either find an image online or draw their own in order to demonstrate what they have learned about the science behind fireworks. Images could be of fireworks, elements, or anything else that is relevant.

Resources

- *Flame Test - Colorful Elements*. Steve Spangler Amazing Science Experiments. https://stevespangler.com/experiments/flame-test/
- K20 Center. (n.d.). Caption This. Strategies. https://learn.k20center.ou.edu/strategy/82
- K20 Center. (n.d.). I Notice, I Wonder. Strategies. https://learn.k20center.ou.edu/strategy/180
- K20 Center. (n.d.). Google Drawings. Tech Tools. https://learn.k20center.ou.edu/tech-tool/629
- PyromaniaFireworks. (2018, November 11). *The Greatest Showman - a Pyromusical Fireworks Display by Pyromania Fireworks* [Video]. YouTube. https://www.youtube.com/watch?v=oe-8QopJn9k
- SteveSpanglerScience. (2013, July 2). *Flame Test Colorful Elements - Sick Science! #146* [Video] . YouTube. https://www.youtube.com/watch?v=Y1LMYP-lJJY