Collisions Lesson Plan

Ionization Energy

Time: 1 -2 class periods

Lesson Description

In this lesson, students will use Collisions to explore and compare first, second, and third ionization energies.

Key Essential Questions

1. What is the trend in ionization energy?
2. What is the trend in first, second, and third ionization energies?

Learning Outcomes

Students will be able to describe the trend of ionization energy.

Prior Student Knowledge Expected

Ions are formed by the gaining or losing of electrons from an atom.

Lesson Materials

- Individual student access to Collisions on tablet, Chromebook, or computer.
- Projector / display of teacher screen
- Accompanying student resources (attached)

Standards Alignment

NGSS Alignment		
Science & Enginnering Practices	**Disciplinary Core Ideas**	**Crosscutting Concepts**
• Developing and Using models • Construcing explanations and designing solutions	• **HS-PS-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.	• Cause and Effect: Mechanism and Prediction • Recognizing Patterns

PART 1: Explore (15 minutes)

This is an inquiry-driven activity where students play a few game levels and begin making observations. Students will complete levels in the Ions game to begin to observe the concept of ionization energy.

1. Direct students to log into Collisions with their individual username and password.
2. Students should enter the Ions game and play Levels 1 - 8.
3. Ask students to answer the following questions during gameplay:

- *Does removing an outer electron use or release energy?*
- *In Level 5, which atom were you able to remove an outer electron from - lithium (Li) or potassium (K)? Why and what is different about these atoms?*
- *In Level 6, does it take the same amount of energy to remove each outer electron in beryllium? in boron?*

After completing this activity, students will begin to understand that energy is required to remove an electron from an atom and this energy differs depending on the atom.

PART 2: Explain (15 minutes)

Explain to students that the formation of ions can either use or release energy. The amount of energy that it takes to remove an electron from an atom is called **ionization energy.**

Introduce the trend of **ionization energy.**

1. In the Collisions Ions Sandbox, as a class remove 1 outer electron from Li, Na, and K and record the energy USED. As students to describe the overall trend observed.

Ionization Energy Down a Group (completed)			
	Li	Na	K
Energy USED	*6*	*5*	*4*

2. In the Collisions Ions Sandbox, as a class remove 1 outer electron from Li, Be, B, N, O, and F and record the energy USED. Ask students to describe the overall trend observed. ***Note: Drag the ion back into the bank once the energy has been recorded.***

Ionization Energy Across a Period (completed)						
	Li	Be	B	N	O	F
Energy USED	*6*	*9*	*8*	*15*	*14*	*17*

3. As a class, discuss WHY this trend occurs. What is different about these atoms? Why would certain atoms more strongly hold onto their electrons?

PART 2: Explain cont. (15 minutes)

Introduce **first, second, and third ionization energies**.

1. In the Collisions Ions Sandbox, as a class remove each outer electron from Al and record the energy USED for each electron. Ask students to describe the overall trend.

First, Second, and Third Ionization Energy of Al			
	1st electron	2nd electron	3rd electron
Total energy USED	*6*	*25*	*53*
Energy USED for each electron	*6*	*19 (25 - 6 = 19)*	*28 (53 - 25 = 28)*

2. As a class, discuss WHY this trend occurs. Why does it take more energy to remove the 2nd electron? And the 3rd electron?

PART 3: Exend (30 minutes)

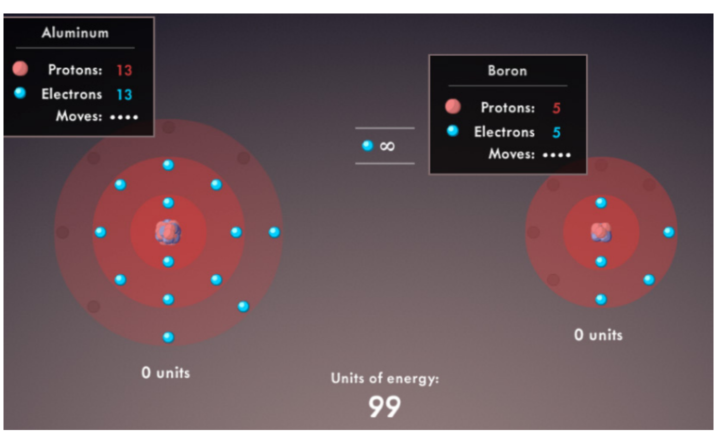
Students will use the Ions Sandbox to continue to practice the concept of ionization energy. In this activity, students will create ions in the Sandbox and track the energy used for each ion created. They will then graph atomic number vs. ionization energy to continue to observe the trend of ionization energy.

1. Direct students to log into Collisions with their individual username and password.
2. Students should enter the Ions Sandbox.
3. Provide your students with the **Ionize It!** worksheet (below).

PART 4: Evaluate (5 minutes)

Students will complete an independent exit ticket to show their knowledge of electron configuration.

Share the below image with your students and have then answer the 3 questions below.



1. Which atom in this image will require more energy to ionize? EXPLAIN.
2. How many electrons must be removed from each atom to form an ion?
3. What will happen to the amount of energy used when removing each of these electrons?

Ionization Energy Student Activity

IONIZE IT!

Name: ____________________________

DIRECTIONS: Complete the following activity to extend your knowledge and practice of ionization energy.

Part 1: In the Ions Sandbox, ionize each atom listed below and record the information listed.

Atom Name	Atomic Number	Ion Formed	Energy Used
lithium			
beryllium			
boron			
sodium			
lithium			
magnesium			
aluminum			
potassium			
calcium			

Part 2: Using the information from Part 1, graph the atomic number vs. energy used on the next page.

Part 3: Write a summary of your graph below to describe the trend of ionization energy both across and down a periodic table, using the data to support your statement.

Atomic Number vs. Ionization Energy