Chemistry Lab
Lesson Plan

Duration:
1 hour

Description:
In the Chemistry Lab students are challenged to make their own fire extinguisher. Following the example of Baltimore firefighter and inventor Charles T. Holloway, students use a chemical reaction, created by mixing baking soda and vinegar, to spray water. Students will be able to observe how chemicals react to create carbon dioxide and understand the real life application used by the fire service. This STEM program is complemented by the Fire Museum's actual chemical fire engines and extinguishers.

Inquiry Question:
How can we use a chemical reaction?

Desired Results:
By the end of this lab students will understand:

- The chemical reaction taking place when an acid and a base are combined.
- That water, carbon dioxide, and sodium acetate are byproducts of this reaction.
- How the pressure of these byproducts in an enclosed space can be quickly harnessed.
- That excessive pressure in a confined space can be dangerous.

Activities:
Students will engage in the following activities during this lab:

- Observe the reaction of baking soda and vinegar in an open space.
- Combine baking soda and vinegar in a confined space with a predetermined release point.
- Control the stream of pressurized water to target a simulated fire.

Assessment:
Students will be able to demonstrate an understanding of the following:

- What happens when baking soda and vinegar are combined?
- How did a chemical fire extinguisher/engine harness the pressure created by this reaction?
- How did quickly pressurizing water give an advantage to firefighters arriving at a fire?

Next Generation Science Standard Connections

5-PS1-3. Make observations and measurements to identify materials based on their properties.
5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.
MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.
MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.
MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.

Maryland State Curriculum - Science Connections:

Subject: Chemistry
Grade: 5
Topic: D. Physical and Chemical Changes
Indicator: 1. Provide evidence to illustrate that when a new material is made by combining two or more materials, its properties are different from the original materials.
Objectives:
a. Investigate and describe what happens to the properties of materials when several materials are combined to make a mixture, such as table salt and pepper;
various kinds of nuts, chocolate pieces, and coconut; sugar dissolved in milk.
b. Based on observations from investigations and video technology, describe what happens to the observable properties of materials when several materials are combined to make a new material, such as baking soda combined with vinegar.
c. Share data gathered and construct a reasonable explanation of the results.

Subject: Chemistry
Grade: 7
Topic: A. Structure of Matter
Indicator: 1. Cite evidence to support the fact that all matter is made up of atoms, which are far too small to see directly through a microscope.
Objectives:
a. Recognize and describe that the atoms of each element are alike but different from atoms of other elements.
b. Recognize and describe that different arrangements of atoms into groups compose all substances.
c. Provide evidence from the periodic table, investigations and research to demonstrate that elements in the following groups have similar properties.
- Highly reactive metals, such as magnesium and sodium
- Less-reactive metals, such as gold and silver
- Highly reactive non-metals, such as chlorine, fluorine, and oxygen
- Almost non-reactive gases, such as helium and neon

d. Provide examples to illustrate that elements are substances that do not breakdown into smaller parts during normal investigations involving heating, exposure to electric current or reactions with acids.
e. Cite evidence to explain all living and non-living things can be broken down into elements.

Subject: Chemistry
Grade: 8
Topic: B. Conservation of Matter
Indicator: 1. Provide evidence to support the fact that the idea of atoms explains conservation of matter.
Objectives: a. Use appropriate tools to gather data and provide evidence that equal volumes of different substances usually have different masses.
b. Cite evidence from investigations that the total mass of a system remains the same throughout a chemical reaction because the number of atoms of each element remains the same.
c. Give reasons to justify the statement, "If the number of atoms stays the same no matter how the same atoms are rearranged, then their total mass stays the same."

Subject: Chemistry
Grade: 8
Topic: D. Physical and Chemical Changes
Indicator: 3. Provide evidence to support the fact that common substances have the ability to change into new substances.
Objectives: a. Investigate and describe the occurrence of chemical reactions using the following evidence:
- Color change
- Formation of a precipitate or gas
- Release of heat or light

b. Use evidence from observations to identify and describe factors that influence reaction rates.
- Change in temperature
- Acidity

c. Identify the reactants and products involved in a chemical reaction given a symbolic equation, a word equation, or a description of the reaction.
d. Provide data from investigations to support the fact that energy is transformed during chemical reactions.
e. Provide examples to explain the difference between a physical change and a chemical change.