Headlight Chemistry Lab Grades K-5

Objectives: Students will learn about mixing substances to create a chemical reaction. Students will observe how chemical reactions produce light for headlights in comparison to electric headlights in modern vehicles. Through a lab activity, students will observe and explain a safe model of gas production using everyday materials.

*This lesson is differentiated for students in K-2 and 3-5.

Next Generation Science Standards:

K-PS1-1: Describe that different materials can be combined to make new substances.
1-PS1-1: Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.
2-PS1-4: Observe that some materials change when mixed together.
3-PS2-4: Define a simple design problem reflecting a need to light something.
4-ESS3-1: Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment.
5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances.

Materials:

- Plastic bottle
- Balloon
- Spoon/funnel
- Baking soda
- Vinegar
- Flashlights
- Chart paper or whiteboard (K-2)
- Lab notebook (3-5)
- Video of acetylene lamp, linked in directions

Directions for grades K-2:

1. Introduce the topic to students by explaining that old cars didn't have batteries or electricity to turn on headlights how we see today. Then, post some follow up critical thinking questions asking them how they think headlights might have lit up before these technologies. Write student ideas on chart paper or whiteboard.

2. Explain to students that before batteries or electricity, early automobile headlights used a special gas, which was made by mixing compounds like water and a chemical rock called calcium carbide. When the two mix, they create a gas called acetylene. To ignite the headlight, acetylene gas is sent through a small pipe to a burner at the front of the lamp, where it is lit with a flame. The burning acetylene makes a bright, white flame, which gives off enough light to be used as a headlight.

3. Show students this video to see an acetylene lamp in action: https://www.youtube.com/shorts/RkSNFIhJmuM

4. Before demonstrating the experiment, emphasize safety by explaining that whenever you are working with science equipment it is important to keep substances away from eyes and mouth, and keep your lab area clean.

5. Teachers should demonstrate the experiment for students to watch. Start by adding a few spoonfuls of baking soda to the inside of a balloon. Then, fill a plastic water bottle about halfway with vinegar. Carefully, without spilling the baking soda, stretch the mouth of the balloon over the open water bottle of vinegar.

6. Have students make observations in real time by asking them what they see happening, and if they observed any changes. Note for teachers: balloon should begin inflating, showing a gas is produced.

7. Explain that in old cars, this gas would be lit with a spark or flame to create a headlight.

8. Compare a flashlight to the video of the lit acetylene headlamp. Pose questions to students such as, “which light looks safer?”, “which light looks brighter?”, “which do you think works better over time?”.

9. Ask students for big ideas about what they learned during this lab and write their responses chart paper, or give students their own paper to draw about what they learned.

Directions for grades 3-5:

1. Introduce the topic to students by asking what they know about how headlights in modern cars work. Explain that old cars didn’t have batteries or electricity to turn on headlights how we see today. Then, post some follow up critical thinking questions asking them how they think headlights might have lit up before these technologies.

2. Explain to students that before batteries or electricity, compounds like water and chemical rock called calcium carbide were combined to create a gas. When that gas came into contact with a spark, flames for headlights were produced. Show students this video to see an acetylene lamp in action: https://www.youtube.com/shorts/RkSNFIhJmuM

3. Before beginning the experiment, emphasize safety protocol. All students should have proper safety equipment, such as gloves, goggles, lab coats, etc. Remind students that chemicals should always be kept away from eyes and mouth, and that lab areas should always be kept clean to avoid contamination.

4. In groups of 2-3, students should start by adding a few spoonfuls of baking soda to the inside of a balloon. Then, fill a plastic water bottle about halfway with vinegar.

5. In their lab notebooks, have students write predictions of what they think will happen when they mix these compounds.

6. Carefully, without spilling the baking soda, students should stretch the mouth of the balloon over the open water bottle of vinegar.

7. Students should write their observations of what is happening and any changes that are occurring in their lab notebooks in real time. Note for teachers: balloon should begin inflating, showing a gas is produced. Notice any fizzing, bubbling, or other changes as they occur.

8. When the experiment is complete, students should answer the following guiding questions in their lab notebooks:
    a. Did you observe a chemical or physical change? Why?
    b. What clues show us something new was created?
    c. What do you think caused the balloon to inflate?
    d. Why did early automobiles use acetylene headlights that produced gas?
    e. Do you think modern headlights or acetylene headlights are better? Why?

Bring this lesson to the museum!

Help students connect their learning to real-world contexts by exploring these related vehicles on display at Klairmont Kollections:

- 1909 Hupmobile Model 20
- 1912 Little Roadster
- 1914 Ford Model T Touring