Incomplete Combustion: Chemistry of Air Pollution

Summary

Students will design and carry out a class experiment comparing the emissions of a diesel and gasoline car then use chemical equations and molar proportions to see why larger molecules are more difficult to burn completely.

Time Frame

1 class periods of 90 minutes each

Group Size

Pairs

Life Skills

Thinking & Reasoning, Social & Civic Responsibility, Systems Thinking

Materials

- New white socks
- Rubber Bands
- 1 Gasoline car and 1 Diesel car
- Scale and/or light meter
- Colored Pencils
- Incomplete Combustion worksheet

Student Prior Knowledge

Students should be able to:

- Use chemical formulas to represent molecules.
- Write and balance chemical equations.
- Have been introduced to the concept of a mole.

Intended Learning Outcomes

- Manifest science interests and attitudes.
- Understand important science concepts and principles.
- Demonstrate awareness of the social and historical aspects of science.
- Use science process and thinking skills.

Instructional Procedures

Start by asking students some questions about their experiences with air pollution such as: Did you ever have to stay in from recess in elementary school because the air was too bad? Have you ever noticed health problems on bad air days? Have you ever studied or worked to lessen the air pollution in the Salt Lake Valley?

Explain to students that the class is going to do an experiment comparing the pollution caused by two vehicles that run on different fuels: diesel and gasoline. Show them two clean white socks and explain that you will be putting the socks on the tailpipes to capture/filter emissions from the cars. Together brainstorm ways to measure results. Some possibilities are: qualitatively comparing the colors of the socks afterward, measuring the change in mass of the socks, or using a light meter to measure how much light comes through both before and after the experiment.

Have students list as many constants/controlled variables for the experiment as they can (i.e. the length of time the car is on, the starting temperature of the car, lightly cleaning the outside of the tailpipes of both cars ahead of time). And identify sources of error for the variables that you can't control. Ask students to write a hypothesis that gives specific information about the data they will collect (i.e. I think the sock on the diesel car will increase in mass more than the sock on the gasoline car).
Collect control data such as initial mass and initial light readings then go outside with the whole class to run the tests. Have a student attach the sock to the tailpipe of the gasoline car using a rubber band. Then start the car after all students are at a safe distance. Repeat with the diesel car and compare results and collect final data. Usually the diesel is much dirtier.
Back in class have students write conclusions and reflect on sources of error for the experiment.
Then explain to students that chemistry can help explain why the diesel fuel produces more air pollution and that they will work in pairs on the Incomplete Combustion worksheet. Give students one packet per every pair and have each student use a colored pencil that is different from their partners and try to share the responsibility of writing in the packet. Write their names in their color so that the teacher can track their responses.
Students complete the worksheet while you circulate helps.
When students are done they can log on to the game to apply their chemistry knowledge to air quality policy decision-making.

Assessment Plan

Students can play the new air quality game " Bad Air Day" as an assessment and then reflect / discuss how chemistry concepts influenced their decisions on the game.

Authors

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