Center for the Environment at Catawba College

Campaign for Clean Air

Clean Air in the Classroom

Stage 1 Activity 6 | "Let's Sock Car Exhaust!"

Overview

In this activity, the students get to practice their experimentation skills outside with socks and exhaust pipes on vehicles in your schools parking lot.

North Carolina Standard Course of Study

This lesson meets seventh grade science competency goals 1.03, 1.04, 1.08, 3.02, 3.03, and 3.04.

Learning Objectives

Students Will Be Able To describe sources of air pollution and some of the effects of air pollution.

SWBAT describe air pollution from motor vehicles.

SWBAT understand the role of the Environmental Protection Agency or of Environment Canada in the federal vehicle control programs and what has been accomplished under these programs.

Materials

- new white tube socks
- access to a variety of vehicles (car, truck, bus, etc.)
- oven mitts or heavy gloves
- marker/pen
- masking tape or small tags with safety pins for labels
- rubber bands

Background Information

In 1986 there were almost 500 million vehicles operating world-wide. If the present growth rate continues, by the year 2030 there will be on billion vehicles world-wide. As the number of vehicles on the road continues to grow, so does the atmospheric pollution. Presently more than half of the air pollution in North America is the direct result of mobile sources, such as airplanes, trains, buses, trucks, boats, and automobiles. Emissions from motor vehicles contribute to five of the six criteria pollutants: lead, carbon monoxide, nitrogen oxides, ozone, and airborne particulate matter. Of these pollutants, only lead has decreased dramatically between 1977 and 1986. A strict limitation of the level of lead in gasoline has reduced lead emissions by 94 percent and lead in the air by 87 percent. Levels of lead in the air are expected to continue decreasing as less

leaded gasoline is produced. Motor vehicles are the main source of carbon monoxide, an invisible, odorless gas resulting from incomplete fuel combustion. Inefficient burning of gasoline occurs when vehicles are started in the morning, idled, or moved slowly in heavy or congested traffic. Nitrogen dioxide, a reddish-brown toxic gas, is also produced by combustion sources, such as motor vehicles. Ozone, a major component of smog, is produced when sunlight triggers a chemical reaction between naturally occurring atmospheric gases and pollutants such as nitrogen oxide and hydrocarbons. Diesel engines are considered a major source of particulate matter pollution. There are a number of ways the air pollution produced by motor vehicles is already being reduced. In the United States and Canada, governmental agencies - the Environmental Protection Agency (EPA) and Environmental Canada - set manufacturers' emission standards for motor vehicles through federal vehicle emission control programs. State and local governments have implemented other important programs: vehicle maintenance inspections, inspections to check for the presence of pollution control devices, and incentives to encourage use of public transportation and ride-sharing. New technologies that reduce motor vehicle pollution are also being developed. Increased fuel economy (more miles per gallon), more efficient burning of gasoline (particularly in city driving), vehicle design change to reduce wind drag, and vehicle fuel sources other than petroleum-based sources will all be part of the future in controlling air pollution.

Procedures

Part 1: Setting the Stage

A. Ask the students to identify sources of air pollution in the community. Included in the list should be automobiles, factories, power plants, farming (which increases particulate matter, dust, and soil), wood- or coal burning stoves, and natural sources. Make a list on the board.

B. Explain to the students what happens when a vehicle burns gasoline or diesel fuel. Some of the fuel is changed into energy to move the vehicle. By-products of the process include heat an air pollutants which exit through the exhaust system.

C. Use the background information to discuss pollutants that are emitted from exhaust.

Part 2: Activity

A. Have the students assemble in the parking lot around pre-selected vehicles (choose vehicles that use a variety of fuels) for a demonstration to test exhaust fumes. Cars using unleaded gasoline and diesel fuels are the most common. You might be able to find vehicles using leaded gasoline or alternative fuels such as alcohol or methane. Old and new vehicles can provide variation. You may also be able to make arrangements to have a school bus available for the experiment.

CAUTIONS: *The experiment should never be conducted in a closed building. Emergency brake should be set on each vehicle. Use oven mitts or gloves when putting socks on and taking them off. Students should stand away from the automobiles during the test. Exhaust tailpipes emit carbon monoxide gas and can cause burns. Do not touch the tailpipe until car has cooled for five minutes.*

1. Make a label for each sock that includes the following information about the vehicle: model, make, engine type, and model year.

2. Place a white tube sock over the tailpipe of each vehicle and then start the engines.

CAUTION: *Make sure the students are standing away from the vehicles before starting the engines.*

NOTE: The elastic sock tops should fit snugly over the tailpipe. If not, secure with rubber bands.

3. After approximately five minutes, turn the engines off. Using extreme caution because of the possibility of burns from the metal tailpipes, remove the socks (using mitts). Turn the socks inside out and attach vehicle labels to the appropriate socks.

4. Arrange the socks in order from dirtiest to least dirty.

B. Discus the results with the students. Ask the students to identify the vehicles which produced the most visible pollution. Ask if the socks were dry or damp.

NOTE: Remind the students that they are seeing evidence of particulate matter pollutants and that vehicles also produce a great deal of invisible air pollutants.

C. Make a display of the "exhaust pipe socks" from different types of vehicles, old and new, using different types of fuel.

NOTE: Explain to the students that tune-ups can make a big difference in emissions.

III. Follow Up

A. Have the students use the collected information to make posters of the most heavily polluting vehicles by year or model. These posters can include the socks from the experiment. (See note above).

B. Divide the students into groups, and assign each group one of the following tasks.

1. Determine how many service stations within the city or county sell leaded, unleaded, and diesel fuel, and find out how much of each kind is sold per month. (If necessary, conduct a random survey.)

2. Determine how many motor vehicles are registered in your county. Are emissions inspections required? How often?

3. Contact local automobile and truck dealerships to collect information on what anti-pollution devices are available as standard equipment and as optional equipment on vehicles they sell.

4. Determine the number of employed persons in your city or county. Collect information from the local mass transit company about how many people use that system per month.

5. Contact the local state or government to obtain information on levels of air pollution in your area.

6. Discuss alternative transportation and how alternatives to individual cars can be made to work. (Mass transit, biking, and walking all could be discussed.)

Assessment

C. Using the information collected by the groups, have the students prepare a class report on "air pollution from motor vehicles." Submit the report to the school paper or local newspaper for publication.

Resources

Brown, Lester, et. al. *State of the World*, 1990. Worldwatch Institute. New York: Norton,1990.

Hammond, Allen L., ed. *World Resources: A Guide to the Global Environment*. The World Resources Institute. New York: Oxford University Press, 1990.

National Wildlife Federation. *We Care About Clean Air: National Wildlife Week Educator's Guide*. Washington: n.p., 1987.