

LET'S SOCK CAR EXHAUST!

OBJECTIVES:

The student will do the following:

1. Describe different sources of air pollution and some of the effects of air pollution.
2. Describe air pollution from motor vehicles.
3. 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.

SUBJECTS:

Science, Social Studies

TIME:

1 class period

MATERIALS:

new white tube socks
a variety of motor vehicles
(cars, trucks, buses, 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 one 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 air pollutants: lead, carbon monoxide, nitrogen oxides, ozone, and airborne particulate matter. Of these pollutants, only lead has decreased dramatically between 1977 and 1986. Strict limitations 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 usually 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, government agencies—the Environmental Protection Agency (EPA) and Environment 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 to reduce motor vehicle pollution are actively 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 future air pollution control.

PROCEDURE

I. Setting the Stage

- A. Ask the students to identify sources of air pollution in the community. Included in this 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 blackboard.)
- B. Explain to the students what happens when a car burns gasoline or diesel fuel. Some of the fuel is changed into energy to move the vehicle. By-products of the process include heat and air pollutants which exit through the exhaust system.
- C. Use the background information to discuss with the students the pollutants that are emitted from exhaust.

II. 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 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 tailpipes. 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. Discuss 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 particulate matter pollutants and that cars 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 fuels. 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 emission 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 or state 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.)
- 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.

