

Cleaner Cars Student Manual

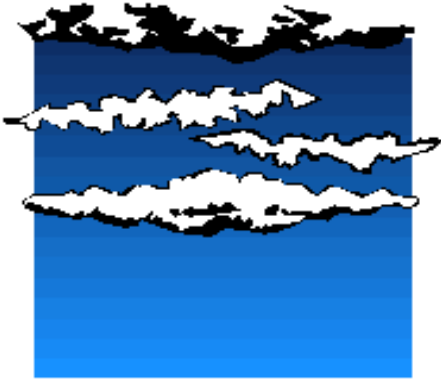


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Session 1:

Background on Air Pollution



Automobiles can have many potentially negative effects on human health and the environment. The air we breathe, the water we drink, wildlife habitats, natural resources, and Earth's protective atmosphere are all affected by decisions we make about the vehicles we buy, how we drive them, how we refuel them, and how we maintain and repair them.

You can not always see it, but the pollution from cars and trucks goes directly into the air we breathe.



Exercise #1

Questions:

- ♦ Have you ever driven down the road behind a car or truck that was emitting a lot of dirty smoke from its tailpipe? How did the pollution make you feel?
- ♦ Do some vehicles pollute more than others?
- ♦ Does your city/region have an air pollution problem?
- ♦ If your area has an air pollution problem, what do you think is the cause?
- ♦ How much do you think cars, trucks, and motorcycles contribute to air pollution?
- ♦ How can we reduce or prevent pollution from our cars?
- ♦ Compare the environmental impact of air pollution from automotive emissions to the environmental impact of pollution from litter.

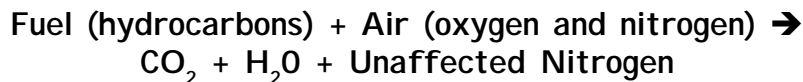


Session 1

Exercise #2

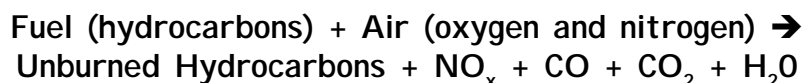
1 Write the following chemical reaction. Seeing the reaction on paper may clarify for you the different pollutants that are emitted in a perfect combustion compared to a typical engine. Are there any further comments regarding this chemistry equation?

Perfect Combustion:



2 In perfect combustion, the by-products are CO_2 , water, and unaffected nitrogen; in general, rather clean. However, do you see a problem in the by-products of perfect combustion? We now know that CO_2 may contribute to global warming and is not as harmless a by-product as was once believed. Did you make this connection?

Typical Engine Combustion (Reality):



3 What do you remember about these exhaust pollutants?

Carbon Dioxide
Hydrocarbons

Carbon Monoxide
Nitrogen Oxides

Cars emit pollutants during combustion and when fuel evaporates. Hydrocarbons are very volatile. (Volatility is a measure of how easily a liquid evaporates.) Hydrocarbons, a component of gasoline, emit small quantities of benzene.

4 How do you think evaporative emissions could occur? The following terms describe some possible evaporative emissions situations:

- Diurnal:** Evaporation increases as the temperature increases during the day.
Hot Soak: Engine remains hot for a period after the engine is turned off.
Refueling: Gasoline vapors are always present in fuel tanks. These vapors are forced out when the tank is filled with fuel.
Running Losses: The hot engine and exhaust system vaporizes gas when the car is running.

Since 1975, most new cars have been equipped with catalytic converters to meet emission standards set by the U.S. Environmental Protection Agency. Catalytic converters typically reduce CO emissions by 80 percent, hydrocarbons by 96 percent, and NO_x by 76 percent for a single engine. Catalytic converters are becoming more sophisticated, but much of the benefit is offset as more cars are being driven more miles. It is illegal to tamper with your car's catalytic converter.

Session 2:

Buying a Cleaner Car

Cars today are less polluting than ever before. Newer cars are generally cleaner cars, especially those with the most advanced pollution control equipment. These cars often get better gas mileage. If you are not in a position to buy a new car, you can still buy a cleaner-running car. No matter how old a car is, whether or not it pollutes largely depends on how well it has been maintained. Cars that pollute less are more efficient. Cars that are more efficient save you money.



Buying a cleaner-running car or truck can be one of the most important pollution preventing decisions you can make.

Car Buyer's Checklist

- **How old is the car?** New vehicles generally pollute less.
- **How large is the car?** Smaller cars are generally more fuel efficient.
- **How many cylinders does the car have?** Larger engines typically result in lower gas mileage.
- **What is the gear/axle ratio?** Gear/rear axle ratio is important for efficiency — sometimes there are choices, especially for small trucks.
- **Does the gas cap fit tightly?** There should be a hissing sound when you loosen it.
- **Has the vehicle been well maintained?**
- **Does the vehicle have a valid emissions inspection sticker?**
- **Is the catalytic converter disconnected?**
- **Does the gas tank have any leaks?**
- **How many miles are on the engine?** Less than 12,000 or 15,000 miles per year of vehicle age is ideal, but well-maintained high mileage vehicles with documented service and repair records may be fine.
- **Does the engine idle smoothly?**
- **Do you see exhaust from the tailpipe?** If so, what color is it and how long does it last? If white exhaust comes out first — it's okay, that's just condensation. If you see exhaust for longer than 10 seconds or it is dirty or blue, the engine probably needs repair.
- **Do any warning lights stay on when you start the vehicle?**
- **Does the vehicle have any missing components** (or nonremovable add-ons that have changed the vehicle's aerodynamics)?
- **MOST IMPORTANTLY — GET IT INSPECTED BY A PRO!**



New Cars are Cleaner Cars

Session 2

Exercise #3

This activity will demonstrate how much money you can save in a year by purchasing a car that gets good mileage.

Directions:

- 1 Fill the tank completely (but do not top it off!) and record the odometer reading.
- 2 When the tank is almost empty again, record the odometer reading and how many gallons of gas it takes to refill the tank.
- 3 Calculate the number of miles driven by subtracting the initial mileage from the ending mileage.
- 4 Calculate the MPG by dividing the total miles driven by the number of gallons purchased to refill the tank.

Mileage Log	
Initial Mileage (at time of fueling)	
Ending Mileage (at time of refueling)	
Miles Driven (ending mileage minus initial mileage)	
Gas Purchased (number of gallons)	
Miles per Gallon (MPG) (miles driven/gallons of gas used)	

Session 2

Fuel Efficiency

Features that *decrease* drag or increase fuel efficiency include the following:

- Fuel injection
- Flush windows
- Lower vehicle weight
- Optimized windshield angle slope
- Sealed openings or body design spaces
- Smooth wheel covers
- Streamlined front end
- Underbody panel
- Cleanly washed vehicles can decrease drag up to 12%



Features that *increase* drag or decrease fuel efficiency include the following:

- Brake-cooling devices
- Extra vehicle weight (removing 100 pounds can increase efficiency by 1 percent)
- Oversized side-view mirrors
- Oversized tires
- Pop-up headlamps
- Roof- and trunk-mounted luggage and ski racks

You can make the difference!

Session 3:

Fuel Choices in Buying a Car

Today's teenagers are among the first generation that will have real choices about the kinds of fuel used in new cars. Domestic and import automakers have been developing a range of alternative-fuel vehicles, and those are expected to be increasingly available in showrooms over the coming years.

Hybrid vehicles — those using a combination of electricity and gasoline, depending on the specific driving conditions at the moment — and all-electric vehicles (EVs) are becoming increasingly practical, and costs are expected to decrease over time as they become more widely available. Improvements in driving distance, acceleration, and recharging times are all key to increased acceptance of EVs. With some 40 percent of car trips in the United States less than five miles in distance — and with only 8 percent of the trips involving distances or more than 25 miles — EVs in coming years may prove an increasingly viable option for many drivers.

Exercise #4

Write a pros/cons list for using an EV or hybrid vehicles. Consider elements you have heard on the news or seen in the newspaper.

Pros

Cons

Session 4:

Cleaner Refueling and Energy Efficient Driving

Reducing fuel consumption helps the environment in many ways. Each step in the fuel production, distribution, and use chain — drilling, transporting, refining, and so on — can result in environmental pollution. Increased fuel consumption directly affects the amount of carbon dioxide (CO₂) emissions and tends to increase some other pollutants, such as nitrogen oxide (NO_x) and evaporative hydrocarbons. The amount of carbon monoxide (CO) and exhaust hydrocarbon emissions is closely related to how a vehicle is driven and how its emission controls are functioning.

Fueling Your Car

You can make a difference! You can adopt driving habits that increase fuel efficiency and save money. Here are some ideas:

- **Avoid high speeds.** Fuel efficiency decreases significantly at speeds more than 55 miles per hour. In addition, high-speed driving causes heat buildup that accelerates tire deterioration.
- **Avoid excessive idling.** Idling wastes gas. Don't start your car until you are ready to go and keep winter engine warm-ups brief.
- **Avoid rough roads and potholes.** Because driving on rough surfaces is hard on tires and wheel alignment, it can reduce fuel efficiency.
- **Don't rev the engine.** Revving the engine wastes gas. It may also dump gas on the cylinder walls, which can increase engine wear and cost you money. Revving can also overheat the vehicle's catalytic converter, which makes it less effective, damages it, and costs you money.
- **Drive smoothly.** Smooth driving saves gas and lowers vehicle emissions. Accelerate slowly, avoiding "jackrabbit" starts; shift to higher gears at the lowest practical speed if you have a standard transmission; and accelerate gently if you have an automatic transmission. If your car is equipped with overdrive, you should use it at the appropriate speeds. If your car is equipped with cruise control, you should use it where appropriate. Also, avoid sudden starts and stops, which increase wear on your tires.
- **Keep tires properly inflated.** Underinflated tires decrease gas mileage and shorten tire life. Newer cars have a label on the inside edge of the driver's door that lists recommended tire pressures for different speeds and loads. For older cars, check the owner's manual. Check the



pressure in all four tires every two weeks with an accurate, hand-held air pressure gauge. Also, because tire pressure changes with temperature, you should check and adjust pressure when the tire is cold and only after the vehicle has been sitting for at least three hours.

- **Consolidate trips.** Vehicle emissions and fuel consumption increase not only with the number of miles driven, but also with the number of trips taken. Vehicles burn more gas and emit far more pollutants in their first few minutes of operation because the emission control systems have not warmed up and reached peak efficiency. To make fewer trips, you should consolidate errands and trips. Try to drive during off-peak hours so that you can spend less time on the road and avoid excessive stop-start driving. When possible, carpool, ride mass transit, walk, or bike to your destination.
- **Minimize drag.** Drag reduces fuel efficiency. Driving with the windows open, using roof- or rear-mounted racks, and carrying heavy loads increase vehicle drag. If you sometimes need to transport large items, use a removable rack, or if possible, carry the items in the trunk or inside the vehicle. Heavy loads increase drag. Remove heavy items from the vehicle when you don't need to carry them. A clean car body can reduce drag up to 12 percent, thereby improving fuel economy.

Exercise #5

Write down the model and year of your car. Check the inside of the driver's door, the tire's sidewalls, or the owner's manual to find out the recommended tire pressure for all four tires. Write down what the tire pressure should be for all four tires. Check the tire pressure on your car.

Session 5:

Maintenance and Repair

Vehicles with properly maintained engines and emission control systems pollute less and are more fuel efficient. Well-maintained vehicles perform better, last longer, have higher resale values, and save you money. Although regular vehicle maintenance remains very important, high emissions from newer vehicles usually result from a system malfunction that must be diagnosed and corrected by a trained technician.



Maintenance and Repair Checklist

Here are some tips to keep your car running properly while reducing air pollution:

- **Follow the manufacturer's maintenance guidelines.** The owner's manual for the vehicle provides recommended maintenance intervals and product specifications. Following these recommendations helps identify any problems before they cause more serious ones.
- **Have your engine and emissions system checked** promptly if
 - you notice a change in the way your vehicle functions,
 - fuel efficiency drops,
 - a warning light goes on, or
 - the vehicle fails an emissions test.
- **Change the vehicle's oil regularly.** Follow the manufacturer's recommendations about which oil to use. Most motor oils have an energy conservation label, indicating that it improve fuel efficiency by reducing engine friction. When adding oil, don't overfill the crankcase; the extra oil is consumed more rapidly than necessary. If you change your own oil, don't mix the used oil with other substances and don't dump it into a sewer or on the ground where it can contaminate water supplies.
- **Have the fuel injection system checked** per manufacturer's recommendation. Fouled fuel injectors reduce fuel efficiency, make the vehicle more difficult to start and drive, and significantly increase pollutant emissions. Most gasoline sold today contains additives to control deposits that foul fuel injectors.
- **Change the air filter** as often as the manual recommends. In between changes, inspect it by taking it out and tapping it against a hard surface. If dirt falls out, replace the filter.



Let's Be Environmentally Friendly



- **Keep your tires properly inflated.** The Department of Energy states that if all tires were properly inflated in the United States, about 4 million gallons of gas could be conserved every day. Underinflated tires can reduce gas mileage by 1 mile per gallon. You may have noticed that more energy is required to ride a bicycle when the tires do not have enough air. With a car, more gas is required when the tires do not have enough air. Use a pressure gauge and check the pressure of your tires every two weeks. Maintaining the proper pressure saves money, reduces pollution, and is safer too. Check to see if there are any cuts or bruises on the sidewalls. Is there sufficient tread? (Use a penny, Lincoln's head down, to check tread depth. If Lincoln's entire head remains outside of the tread, depth is less than 2/32" and the tire should be replaced.) Tires are generally replaced in pairs or sets of four. Check to see if all the tires are worn evenly.
- **Check the antifreeze/coolant level** weekly by observing the overflow tank. (Never remove the radiator cap unless the engine is cold!)
- **Keep your vehicle tuned up.** The gas mileage of most cars could be improved by as much as 6 percent with a minor tune-up.
- **Check the headlights** on the car to be sure that all the lights work and are aimed properly. Properly aligned headlights allow you to see the road and help other drivers see your vehicle.
- **Keep the brakes maintained.** By stopping quickly you can avoid an accident. Make sure the vehicle stops straight and smoothly and does not pull to one side when the brakes are applied.
- **Check the steering fluid.** Make sure the vehicle does not pull to one side while driving.



Maintenance Checklist

Use this checklist to remind yourself of the maintenance activities that can reduce emissions and save fuel.

1. Read the owner's manual.
2. Follow the maintenance schedule.
3. Keep maintenance records.
4. Have your emission control system inspected regularly.
5. Use a high-quality gas cap.
6. Keep tires properly inflated.
7. Check belts and hoses.
8. Check the air conditioning system for leaks.
9. Change fuel filters and air filters regularly.
10. Change oil and oil filters as scheduled.
11. Check oil, transmission fluid, and radiator coolant regularly.
12. Replace the PCV valve and breather elements as needed/scheduled.

Session 6:

Maintenance Benefits

You can expect a number of benefits for your efforts:

1. Reduced air pollution and less environmental damage
2. Fewer health problems related to air pollution
3. Better vehicle performance
4. Longer vehicle life
5. Higher vehicle resale value
6. Money saved by preventing vehicle breakdowns
7. Money saved on fuel bills
8. Reduced dependency on foreign oil

Exercise #6

Questions:

1 Have you ever performed any of the following automotive maintenance procedures:

- Checked tire pressure?
- Inflated car tires?
- Checked the oil?
- Checked the transmission fluid?
- Checked the radiator coolant?
- Changed the oil and oil filter?
- Changed the fuel filter?
- Changed the air filter?

2 Do you or your parents take your car or truck in for regular maintenance?

Saves Money Too!

Session 6

Exercise #7

1 Look at the maintenance schedule from an owner's manual, including the page or pages listing important periodic checks.

2 This manual contains a maintenance schedule that tells you how often different parts of the car need to be checked or replaced. This maintenance schedule varies from car to car. If the owner's manual is lost, you can buy a replacement copy from the vehicle's manufacturer.

Maintenance Quiz

1. Describe some severe driving conditions that require some items to be serviced more frequently: _____
2. How often (in miles) do you need to change the oil?

3. How often (in miles) do you need to replace the air filter?

4. How often (in miles) do you need to replace the fuel filter?

5. How often (in miles) do you need to inspect the front and rear brakes?

6. How often (in weeks or months) do you need to check the tire pressure?

7. When is the first time you must change the PCV valve?

8. What should you check **every time** you stop for gas?

9. How often should you check all exterior lights: headlights, parking lights, and taillights?

Session 6

Exercise #8

WHEN CHECKING A CAR consider the following:

- Vehicle inspected by a professional (check fluids, air conditioning system, and all belts)
- Fuel efficiency
- Low mileage
- Maintenance history
- Newer or well-maintained vehicle
- No warning lights when vehicle starts
- No tailpipe smoke after 10 seconds
- No missing components (e.g., catalytic converter)
- Smooth-sounding engine
- Air conditioning system is not leaking

Session 7:

Reducing, Reusing, and Recycling



The popular slogan “Reduce, Reuse, and Recycle” can also apply to certain vehicle components. Several foreign auto manufacturers are building plants where cars will be taken apart and reusable materials will be salvaged.

Recycling

- **Motor Oil and Transmission Fluid** are toxic substances. Toxic substances may cause injury or death when ingested, inhaled, or touched, depending on dose and length of exposure. Two gallons of used oil can provide a utility boiler with enough fuel to run the average household’s electricity for about 24 hours. By recycling, you can prevent soil and water contamination, as well as damage to septic systems and wastewater treatment facilities. To recycle used motor oil and transmission fluid, take them to a service station, drop-off location, or household hazardous waste collection site. Keep all automotive fluids separate from each other.
- **Gasoline, Power Steering Fluid, and Windshield Wiper Fluid** should be completely used up. Gasoline and wiper fluid are toxic and flammable. Power steering fluid is toxic. If it is not completely used, be sure to store it safely and take it to a household hazardous waste collection location. Keep all automotive fluids separate from each other. Recycling gasoline, power steering fluid, and wiper fluid prevents soil and water contamination and reduces the risk of exposure to benzene and fire.
- Always take **Antifreeze and Brake Fluid** to a service station or household hazardous waste location for recycling. Never pour them down the sink, into septic tank, storm drain, or on the ground. Keep all automotive fluids separate from each other. Recycling antifreeze and brake fluid prevents children and animals from being poisoned (they are attracted to the sweet taste) and prevents soil and water contamination. Antifreeze is toxic but can still be regenerated and reused. Brake fluid is toxic and corrosive and can sometimes be regenerated.

You can make the difference!

Session 8:

Other Recyclable Vehicle Components

Auto Batteries



Auto batteries are toxic and corrosive. They contain recyclable metals. Discarded auto batteries should be taken to a service station, drop-off location, or household hazardous waste collection site for recycling. Properly disposing of batteries prevents lead and sulfuric acid contamination of soil and water.

Oil Filters



To properly dispose of used oil and oil filters, drain and collect used oil from the filter after turning off the engine for 24 hours. After the oil has been drained, take the filter and oil to a service station, drop-off location, or household hazardous waste collection site. Proper disposal prevents soil and water contamination, as well as damage to septic systems and wastewater treatment facilities. The used oil can be reused.

Tires



Properly maintaining tires makes them last longer. Keep tires properly inflated, repair punctures, and maintain alignment. Rotate tires every 6,000 to 8,000 miles, and check tread wear indicators periodically. When the tire tread is worn to same height as the tread wear indicator, replace the tire.

Session 8

Vehicle Maintenance Tips

1. Before you begin your vehicle maintenance program, call your local recycling center, service station, sanitation department, and local health department to learn about specific recycling opportunities in your community.
2. Make safety a priority and use protective equipment when necessary (e.g., goggles, gloves, mask). Work outdoors or in well-ventilated areas and beware of combustible materials.
3. Monitor and fix automotive fluid leaks.
4. Read labels on automotive fluid containers before using them.
5. Use a funnel when adding automotive fluids to avoid spills.
6. Fully use products so that little, if any, fluid remains in container.
7. Catch and contain drained fluid. Clean up spills using absorbent materials like kitty litter, saw dust, or rags.
8. Put used automotive fluids in well-sealed and labeled plastic jugs.
9. Do not mix automotive fluids.
10. Store automotive fluids according to directions.
11. Never discard used or leftover automotive fluids in sinks, storm drains, the trash, or on the ground. Remember, these materials can get into our drinking water supply. Use them up or store them safely until they can be taken to a household hazardous waste collection location.
12. Maintain your tires.



Exercise #9

Pick a component of your car. Determine whether this component can be recycled in your area. If so, where? Call local recycling centers, service stations, sanitation departments, and local health departments for specific recycling opportunities in your community.

Session 8

The Cleaner Dozen: A Short List to Cleaner Driving

- Minimize trips and mileage. (Walk, bike, carpool, or take public transportation.)
- Drive smoothly.
- Avoid high speeds.
- Avoid lengthy idling.
- Don't rev the engine.
- Avoid rough roads and potholes.
- Don't overfill or top off the gas tank.
- Keep your tires properly inflated.
- Check the spark plugs, belts, hoses, and oil.
- Change the fuel filter, PCV valve, and air filter when necessary.
- Keep track of what you do and when you do it — write it in the owner's manual.



You can make a difference!

Acronyms

CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CFCs	chlorofluorocarbons
CO	carbon monoxide
CO ₂	carbon dioxide
DOE	Department of Energy
EHC	Environmental Health Center
EPA	Environmental Protection Agency
EV	electric vehicle
HAPs	hazardous air pollutants
HFCs	hydrofluorocarbons
I / M	inspection and maintenance
LPG	liquefied petroleum gas
MPG	miles per gallon
NAAQS	National Ambient Air Quality Standards
NO _x	nitrogen oxides
NSC	National Safety Council
PM ₁₀	particulate matter smaller than 10 microns
SO ₂	sulfur dioxide
VOCs	volatile organic compounds

Resources

Car Care Council, (419) 734-5343, One Park Drive, Port Clinton, OH 43452, <http://www.carcarecouncil.org> or carcare@infinet.com

Department of Transportation (DOT) Auto Safety Hotline, National Highway Traffic Safety Administration, (202) 366-0123, <http://www.nhtsa.dot.gov>

ENDZONE Partners, Air Quality Division, (202) 962-3200

EPA's Acid Rain Hotline, (202) 564-9620

The EPA/DOE Fuel Economy Guide (free from DOE), (800) 363-3732 or the Consumer Information Center, Pueblo, CO 81009, <http://www.fueleconomy.gov/feguide>

EPA Office of Air Quality Planning and Standards, Research Triangle Park, NC 27711, (919) 541-5619, <http://www.epa.gov/oai/oaqps>
Transportation and Air Quality, National Vehicle and Fuel Emissions Laboratory, 2000 Traverwood Drive, Ann Arbor, MI 48105, (734) 214-4207, <http://www.epa.gov/otaq/01-nvfel.htm>

EPA's Stratospheric Ozone Information Hotline, (800) 296-1996

Greenlink, (888) GRN-LINK, <http://www.ccar-greenlink.org>

Kiplinger's Car Buyer's Guides (\$5.40), (888) 547-5464.

Northeast States for Coordinated Air Use Management (NESCAUM), (617) 367-8540, <http://www.nescaum.org>

National Highway Traffic Safety Administration, 400 Seventh Street, SW, Washington, DC 20590, (202) 366-0123, <http://www.nhtsa.dot.gov>

Ozone Transport Commission (OTC), 444 North Capitol Street, NW, Suite 638, Washington, DC 20001, (202) 508-3840, <http://www.sso.org/otc/otc.htm>, ozone@sso.org

State and Territorial Air Pollution Program Administrators/Association of Local Air Pollution Control Officials (STAPPA/ALAPCO), 444 North Capitol Street, NW, Washington, DC 20001, (202) 624-7864, <http://www.4cleanair.org>

The Surface Transportation Policy Project, 1100 17th Street, NW, 10th Floor, Washington, DC 20036, <http://www.istea.org>, <http://www.transact.org>, (202) 466-2636

Tire Retread Information Bureau (TRIB), 205 Cypress Road, Pacific Grove, CA 93950, (408) 372-1917

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