EPA/450/2-81/017a

U.S. Environmental Protection Agency

Air Pollution Training Institute

COURSE SI:422

3rd Edition

AIR POLLUTION CONTROL

ORIENTATION COURSE

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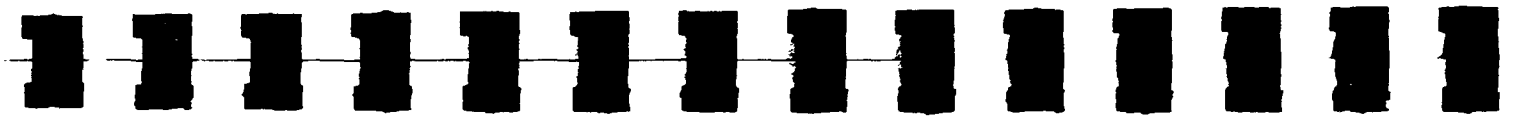
Unit 1

Air Pollution and Their Sources

EPA/450/2-81/017a

Tips for Effective Use of This Material

1. Listen to the recorded script while you go through this flipbook. The recorded portion is coordinated with the flipbook. Wait for the tape to finish the details of one point before studying the next point on the page.
2. When you hear a "beep" on the tape, direct your attention to the next page in the flipbook.
3. Pay attention to both words and pictures—they both convey important information. The flipbook will usually summarize main points or give examples.
4. Stop the tape at any point if you wish to spend more time reading a page in the flipbook. Rewind the tape if you wish to review a portion of the script.
5. Review the lesson objectives before answering the questions at the end of each lesson. Ask yourself whether you have mastered the information indicated in the objectives.
6. Answer the questions. They will help you assess your progress in mastering the course materials.
7. Check your answers. The correct responses can be found on the page(s) following the questions.
8. If you answer a question incorrectly, review the flipbook material covering the subject matter. **Now turn on the tape recorder and begin Lesson I of this unit.**



Lesson 1: Air Pollutants

Objectives

1. Identify the two basic physical forms of air pollution.
2. Explain how a secondary pollutant is formed.
3. Match the names of the criteria pollutants with their descriptions and their major sources.
4. State two differences between hazardous pollutants and criteria pollutants.

Two Basic Physical Forms of Air Pollution

Particles

- small, discrete masses of solid or liquid matter
- examples: dust, smoke, mists, and fly ash

Gases

- widely separated molecules in rapid motion
- lack definite shape and volume
- examples: carbon monoxide, sulfur dioxide, & hydrocarbon vapors

Primary Pollutants

- emitted into atmosphere directly from identifiable sources
- found in atmosphere in same chemical form as when emitted from source

Secondary Pollutants

- undergo chemical changes in the atmosphere as a result of reactions among two or more pollutants

National Ambient Air Quality Standards (NAAQS)

- Set for **criteria pollutants**—widespread, common pollutants shown to be harmful to human health and welfare
- Designed to meet two goals
  - protect human health & well-being
  - prevent undesirable effects on the environment

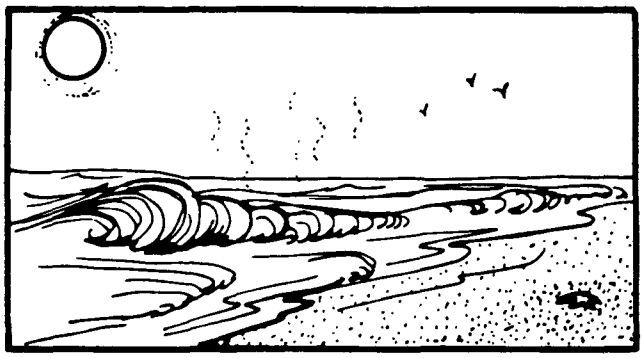
Criteria Pollutants

Pollutant	Symbol	form	type
Carbon monoxide	CO	gaseous	primary
Sulfur oxides	SO_X	gaseous	primary
Nitrogen dioxide	NO_2	gaseous	primary & secondary
Hydrocarbons	HC	gaseous	primary
Ozone	O_3	gaseous	secondary
Particulate matter	TSP	particulate	primary & secondary
Lead	Pb	particulate	primary

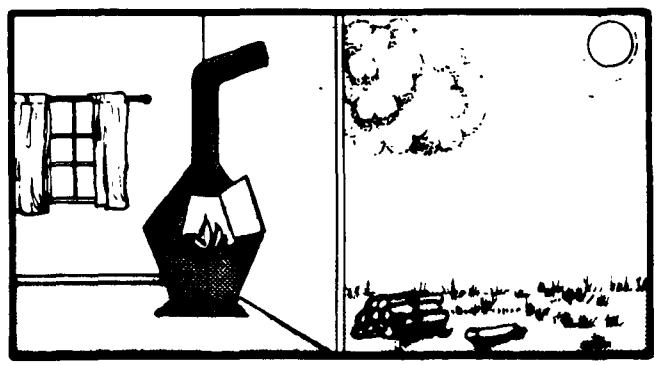
Carbon Monoxide (CO)

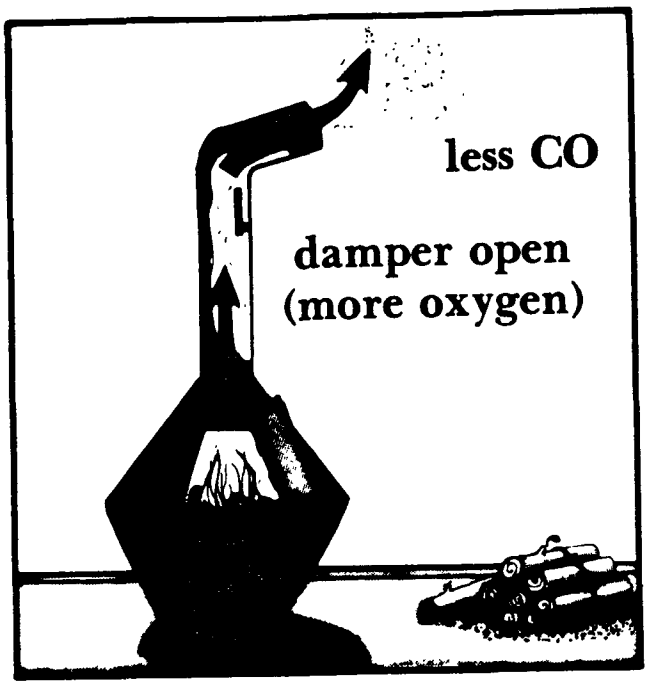
- colorless
- odorless
- tasteless

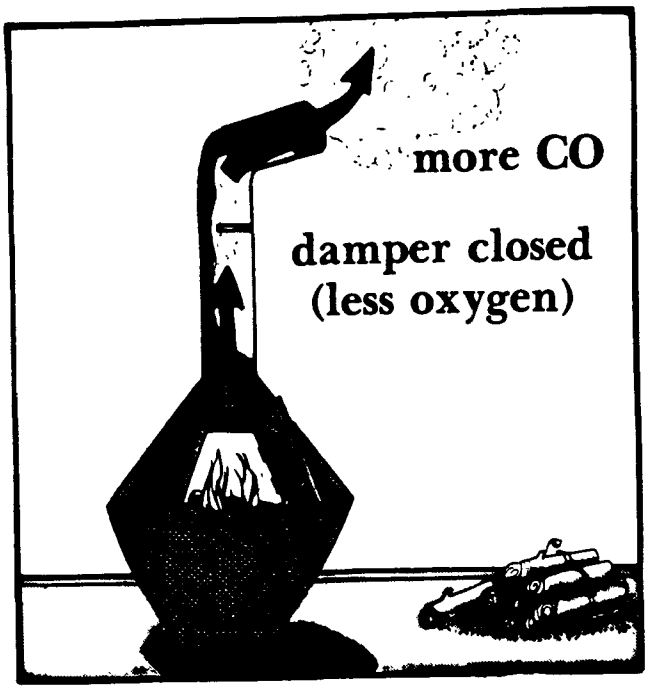
Natural Sources



Manmade Sources





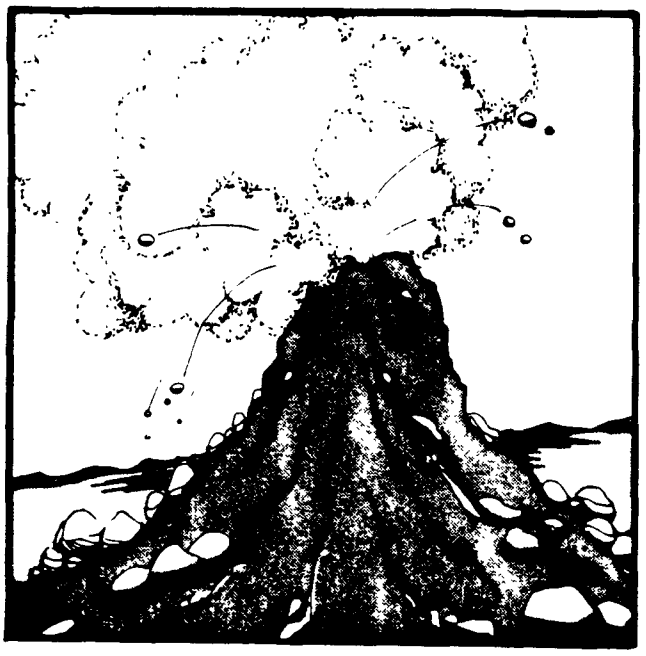


Sulfur Oxides (SOx)

Sulfur Dioxide

- colorless
- formed when sulfur burns

Natural Sources



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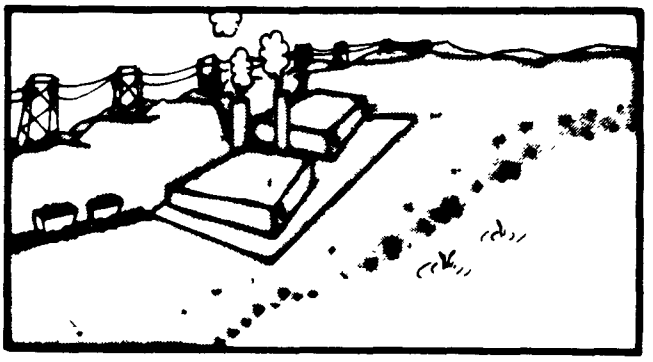
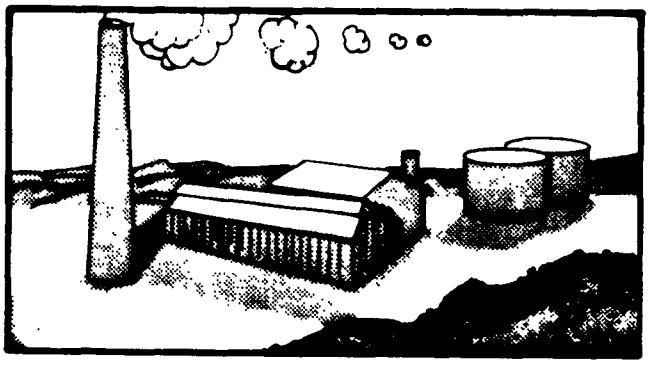
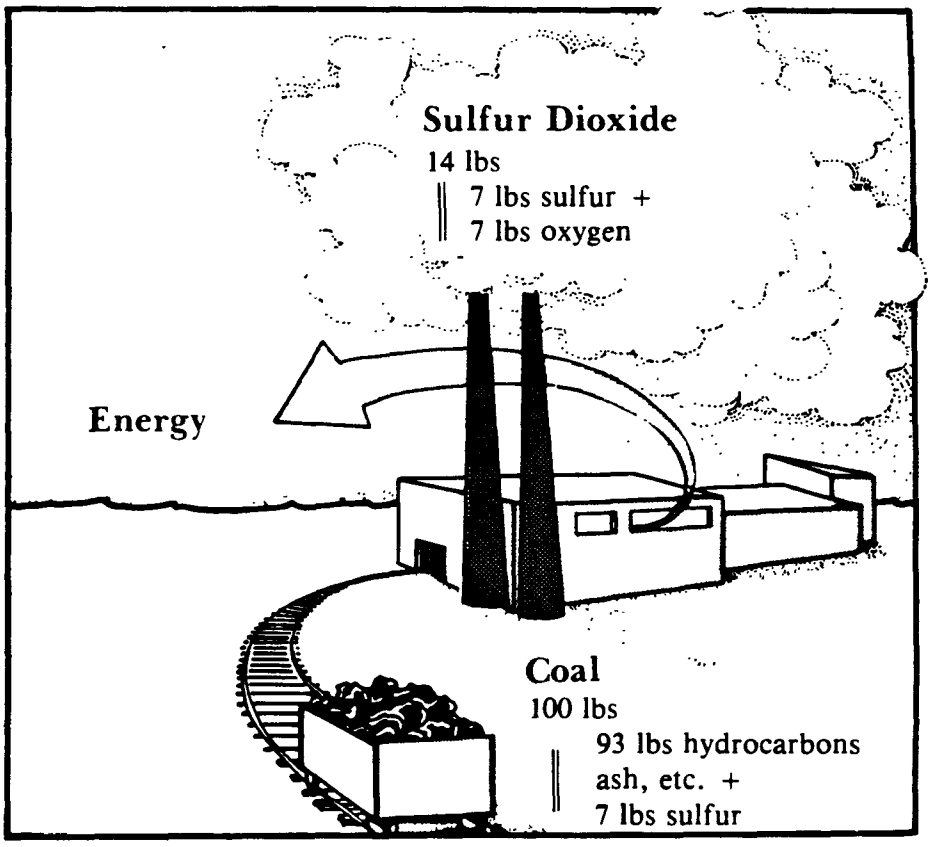


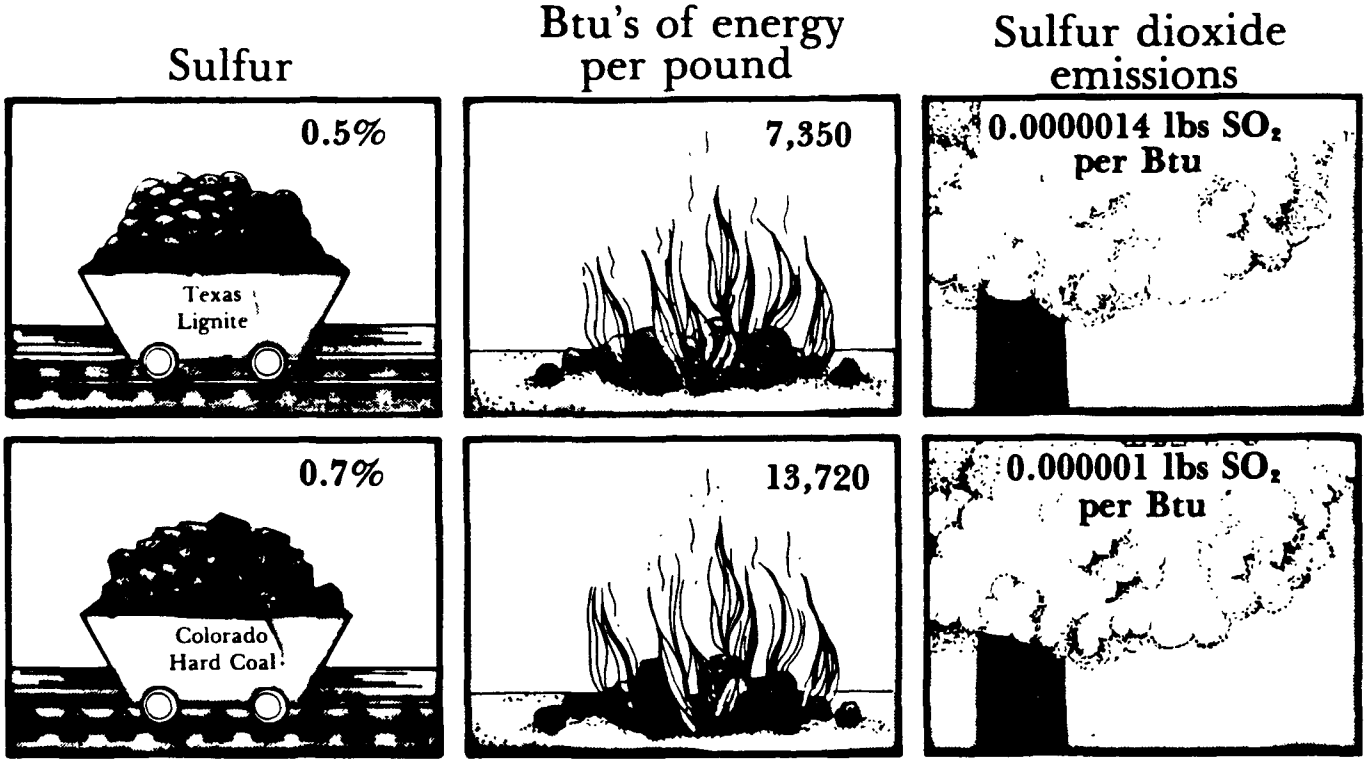


Sulfur Dioxide

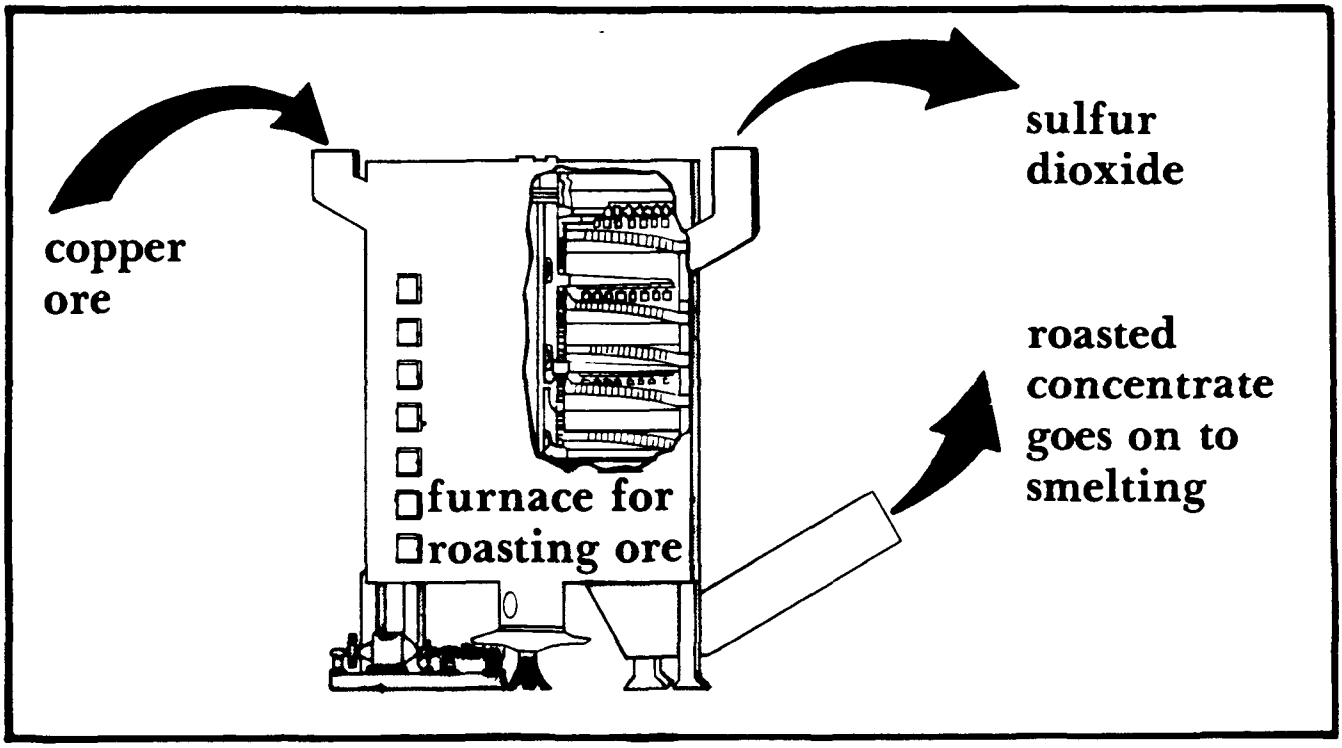
the "pass through" pollutant



Amount of Energy and Sulfur Dioxide Released per Pound of Fuel



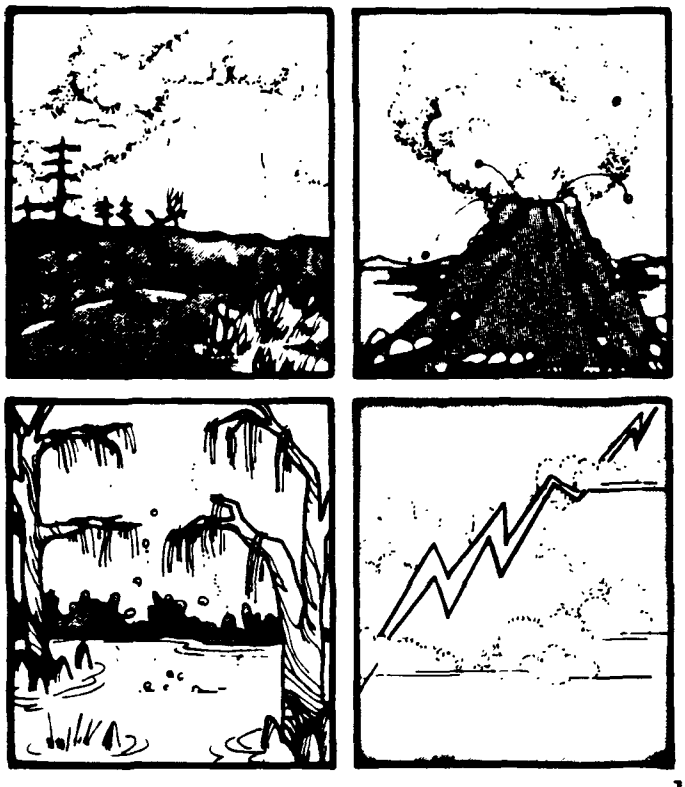
Smelting of Nonferrous Metals



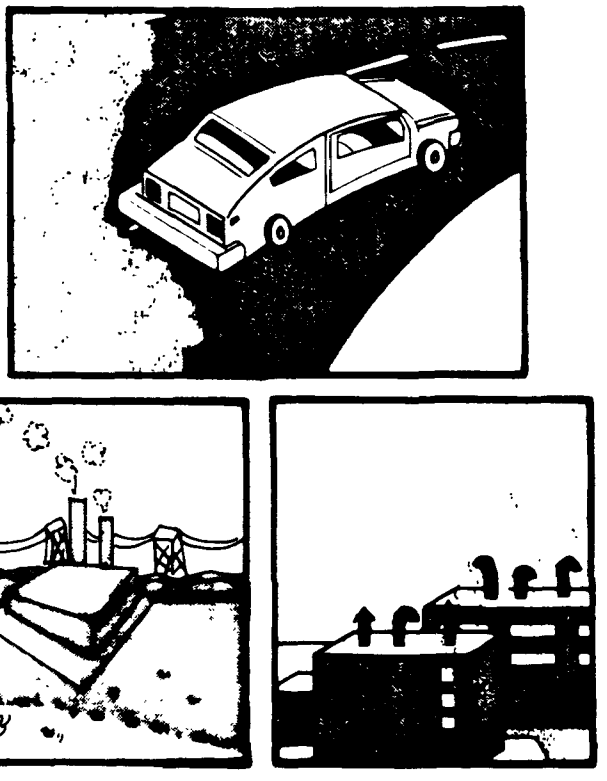
Nitrogen Oxides (NOx)

- several gases
- composed of nitrogen and oxygen
- nitrogen dioxide (NO_2) is of greatest concern—relatively more harmful than other criteria pollutants
- nitric oxide (NO) is relatively less harmful—most commonly emitted of all NOx

Natural Sources



Manmade Sources



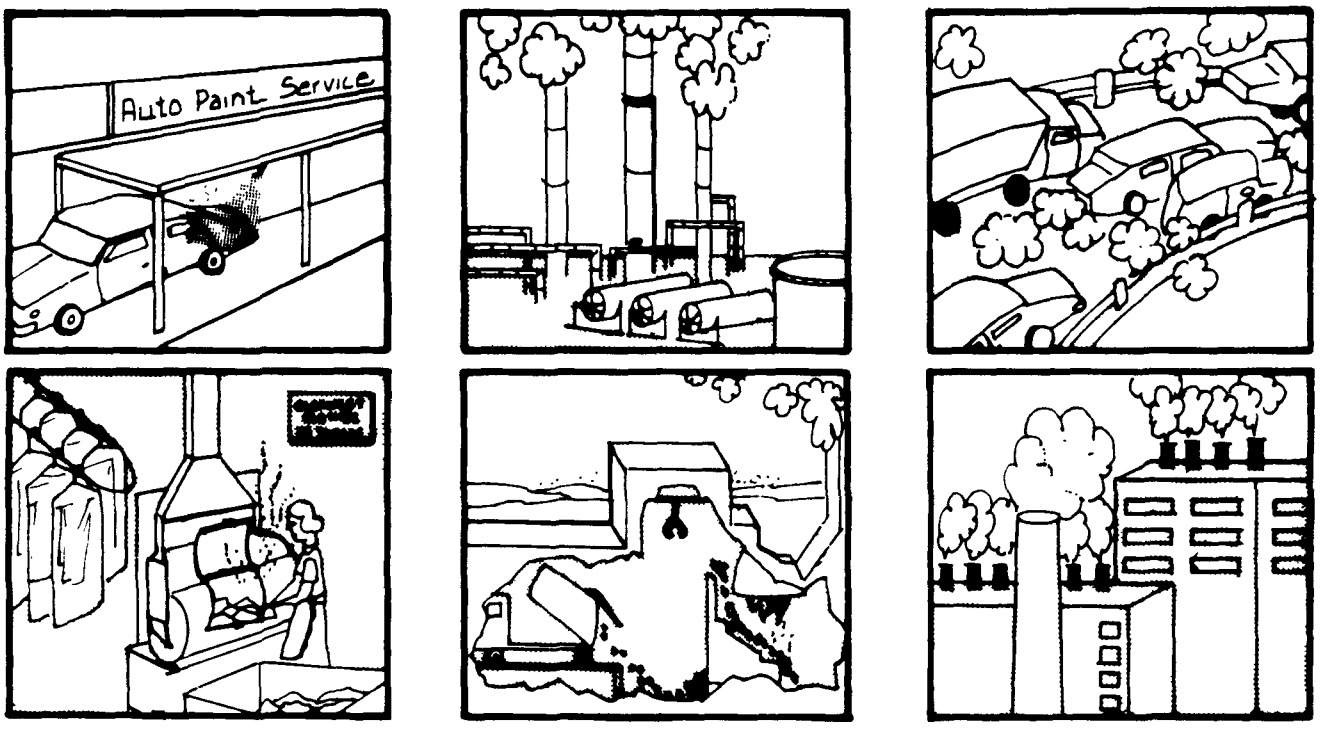
The main source of nitrogen oxides is the combustion of fossil fuels.

- Nitrogen in the fuel is oxidized to form nitric oxide and small amounts of nitrogen dioxide.
- Nitrogen in the air within the combustion chamber is also converted to nitrogen oxides, mostly nitric oxide.
- Oxidation of nitrogen from air in chamber is much slower than oxidation of nitrogen in fuel.
- Nitric oxides emitted to the air are converted to nitrogen dioxide by photochemical reactions promoted by sunlight.

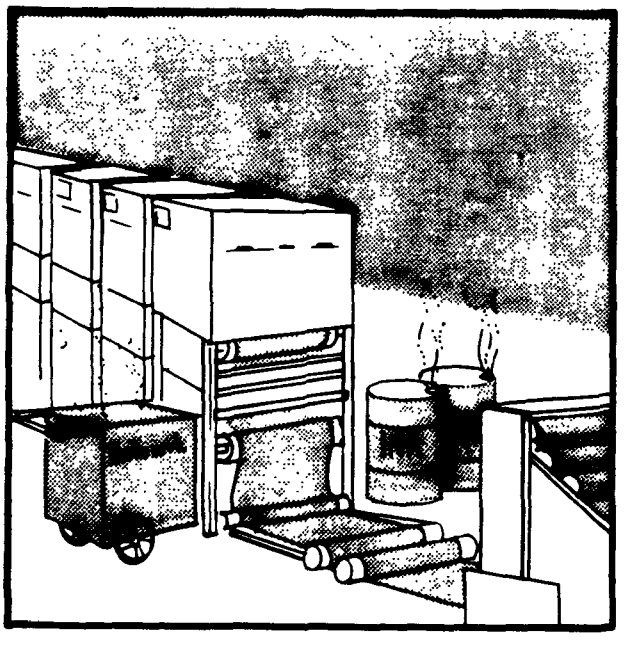
Hydrocarbons (HC)

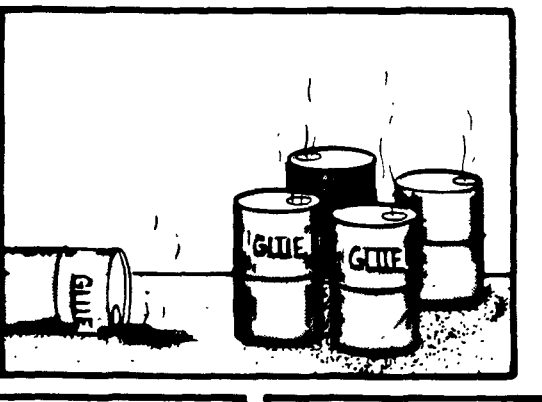
- HCs are composed of only hydrogen and carbon.
- VOC—Volatile Organic Compounds—include most volatile hydrocarbons.
- VOCs are composed of hydrogen and carbon; they may also contain elements such as oxygen, nitrogen, sulfur, chlorine, and fluorine.
- VOCs are defined to include only those compounds which take part in atmospheric photochemical processes.

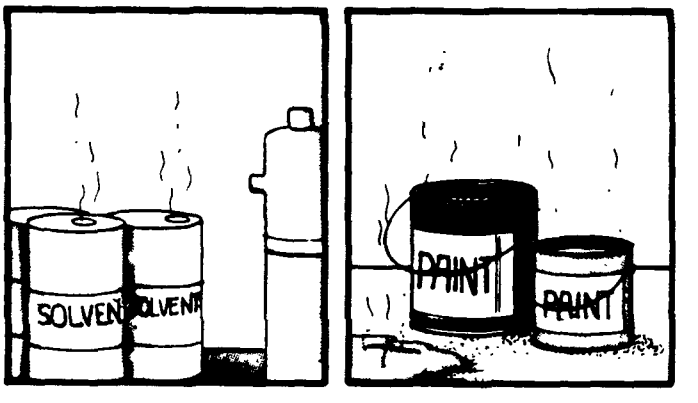
Manmade Sources



VOCs are used as solvents in many products.





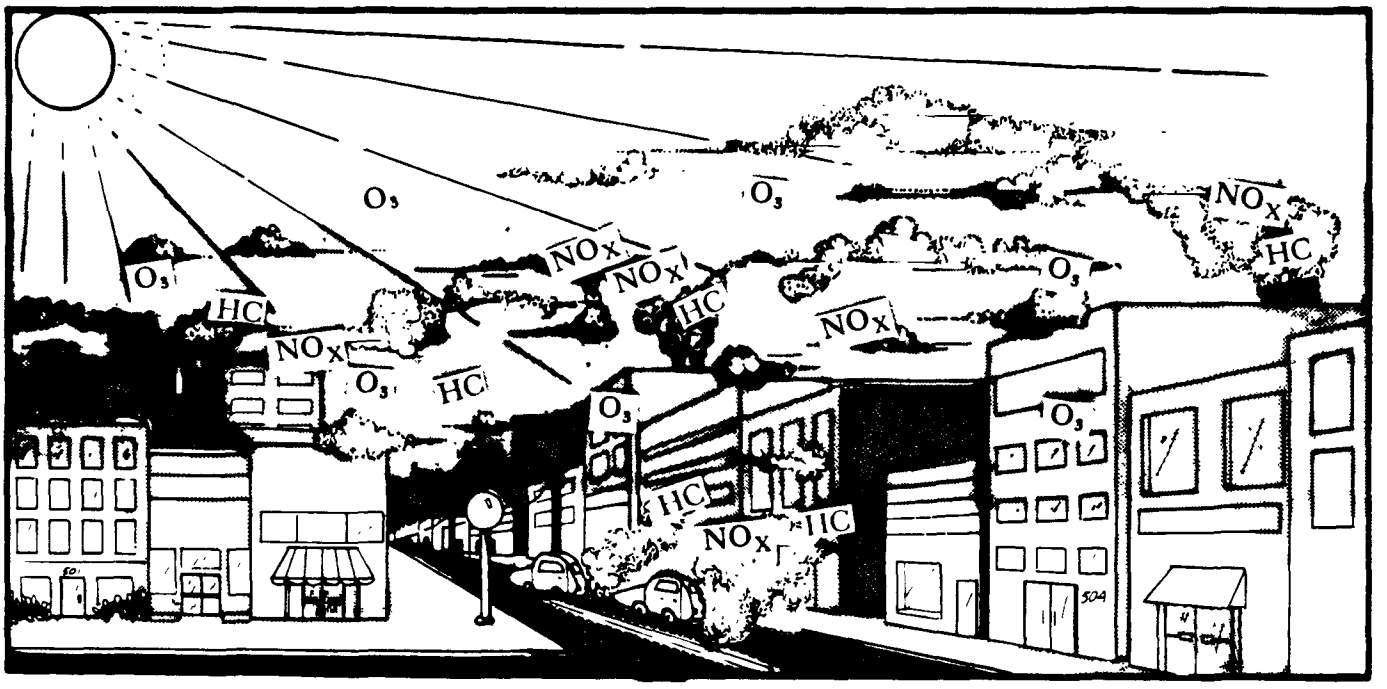


Combustion Factors Affecting VOC Emissions

- time in combustion chamber
- fuel and air mix
- turbulence in chamber
- temperature and pressure
- design of chamber

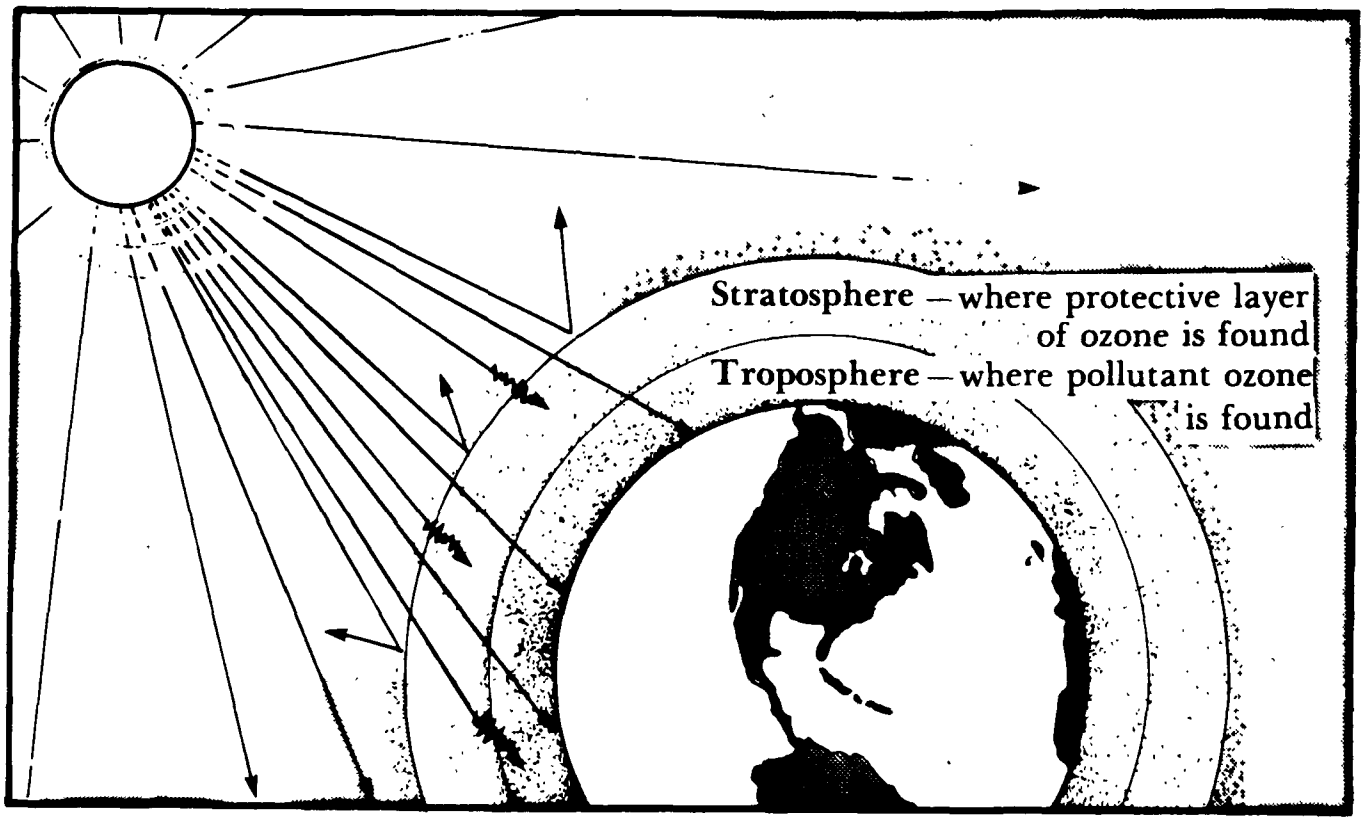
VOCs are controlled through the NAAQS because they take part in the photochemical production of ozone and other photochemical oxidants.

VOC Interaction with NO_X in Presence of Sunlight Forming Ozone and Other Smog

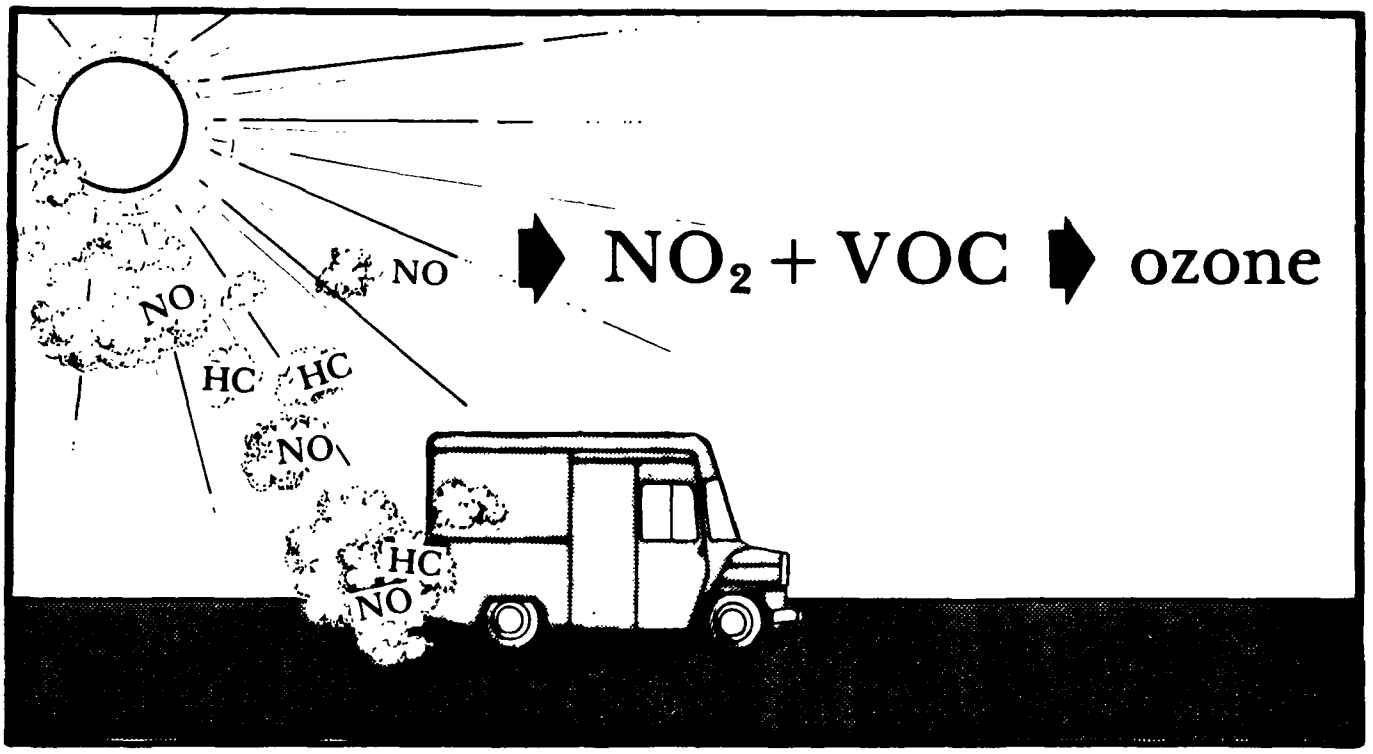


Ozone (O_3)

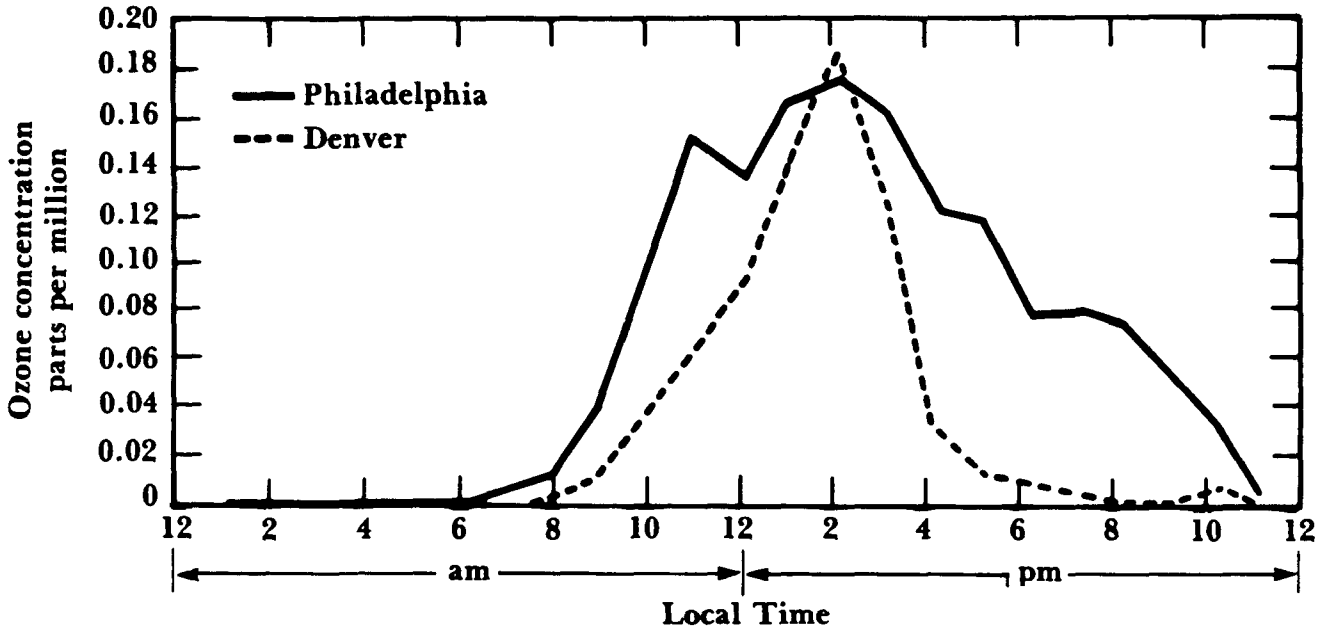
- gaseous
- secondary pollutant
- formed in our atmosphere
- the main constituent of photochemical smog



Formation of Ozone



Variations in Ozone Concentration over 24 hours

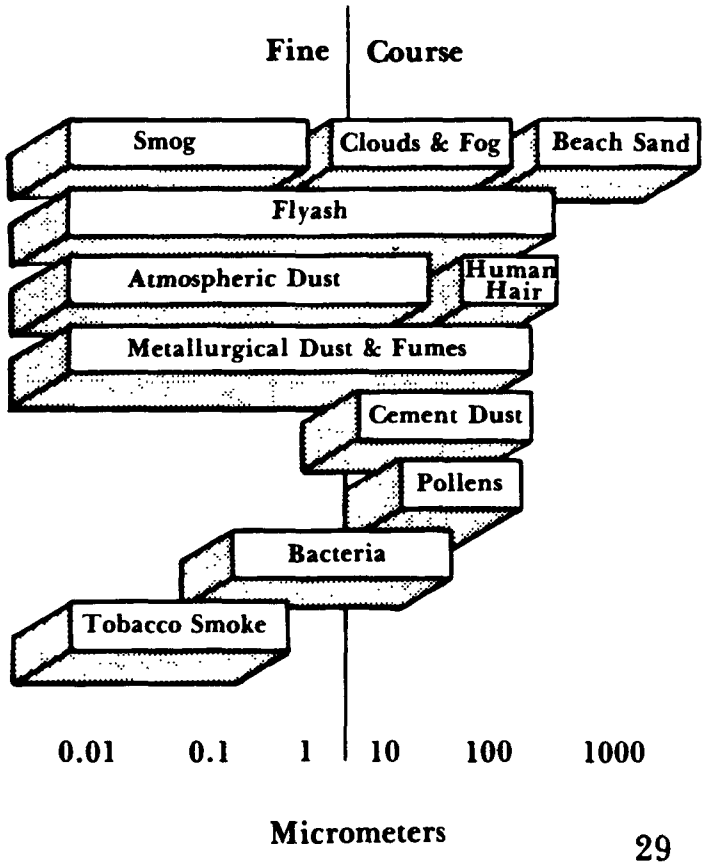


Factors Affecting Ozone Concentration

- primary pollutant concentration (HC, NO_x)
- reaction time
- reaction ratios
- intensity of sunlight
- temperature
- wind speed
- wind direction
- rainfall
- occasionally special weather conditions draw ozone-rich air from the upper atmosphere down to the earth along leading edges of cold fronts

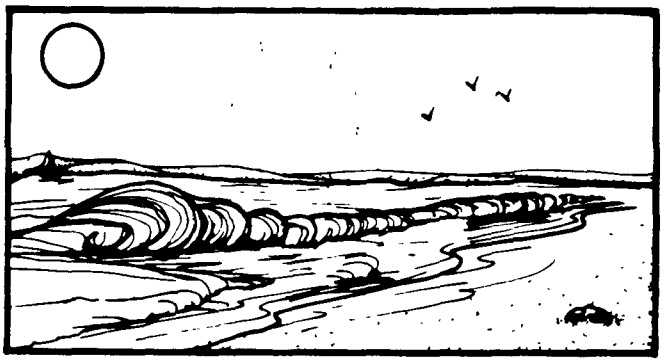
Suspended Particulate Matter

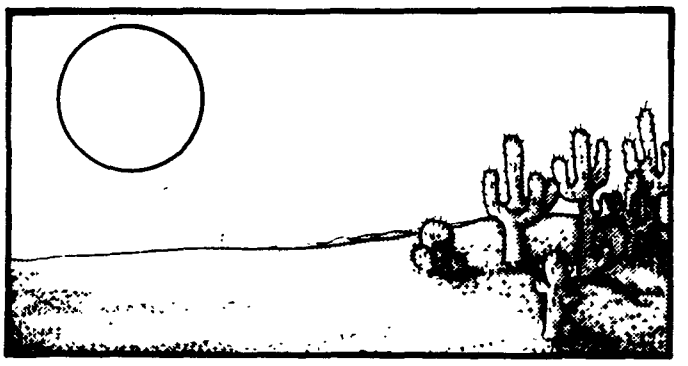
- measured as Total Suspended Particulates (TSP)
- mostly primary pollutants, but includes some secondary pollutants
- very small pieces of liquid or solid matter

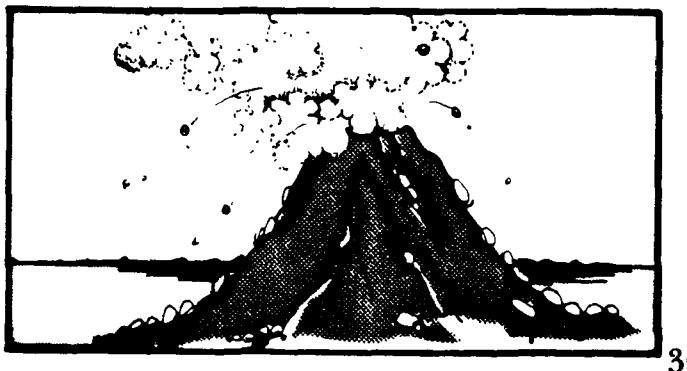


Sizes of Typical Airborne Particles Compared to Common Materials

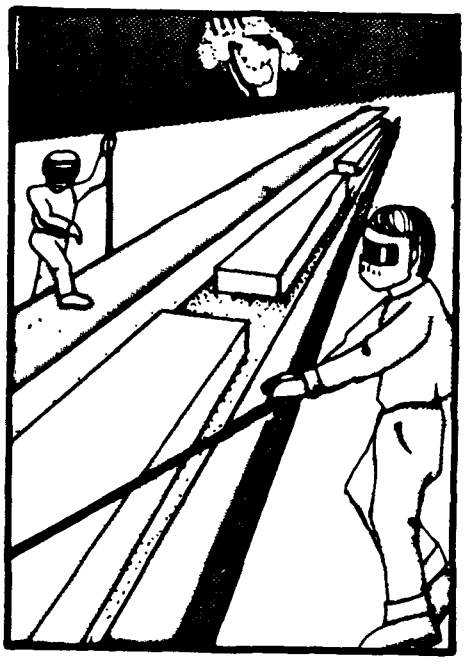
Natural Sources

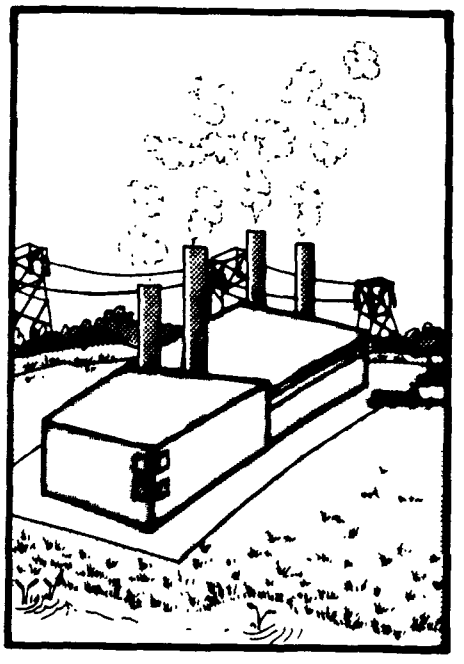


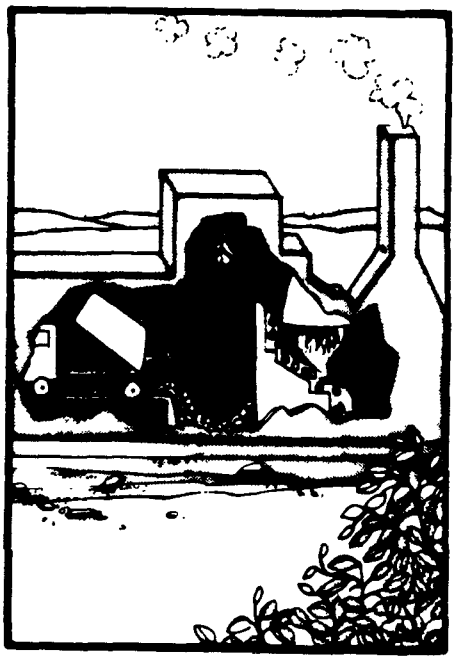




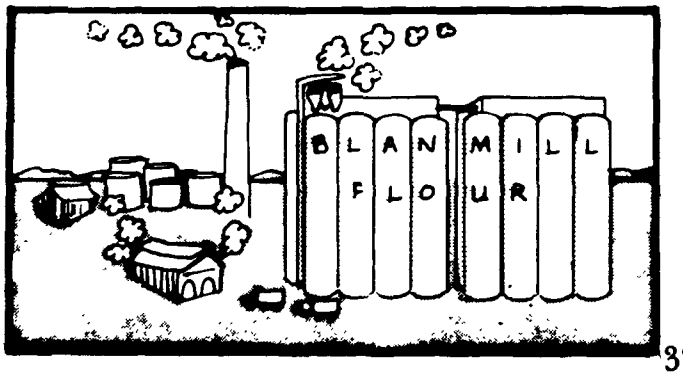
Manmade Sources

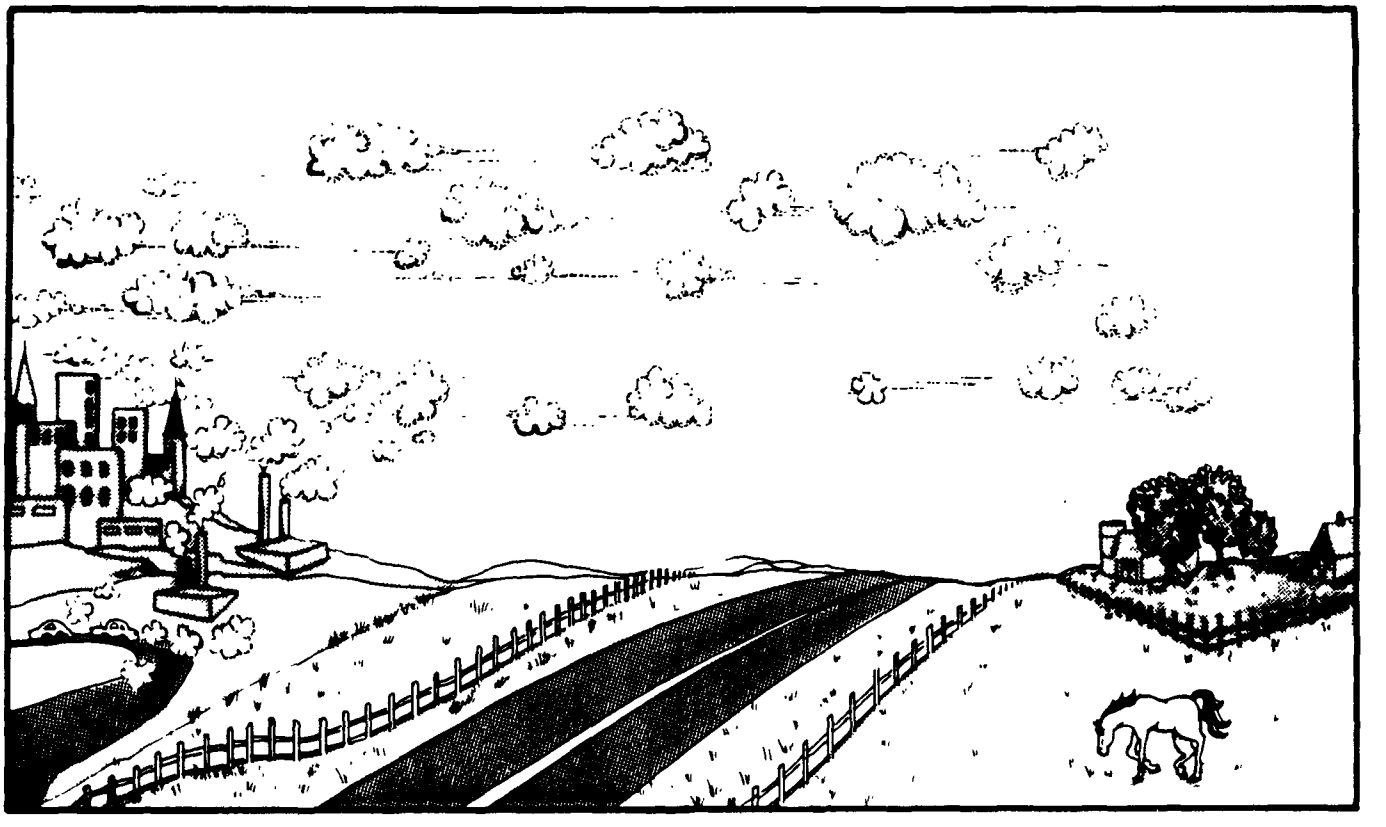






Agricultural Processes Contributing to TSP



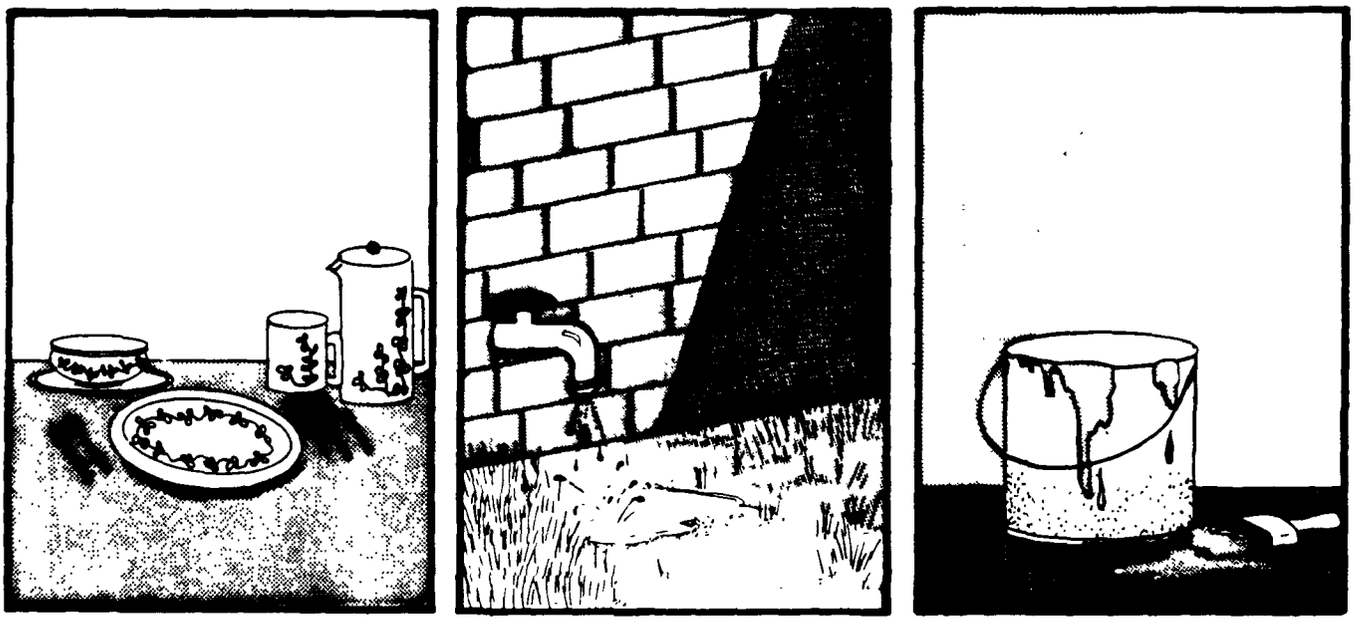


In addition to the pollution problems caused by the suspended particles themselves, these particles combine with other pollutants to form secondary—and sometimes more harmful—pollutants.

Lead (Pb)

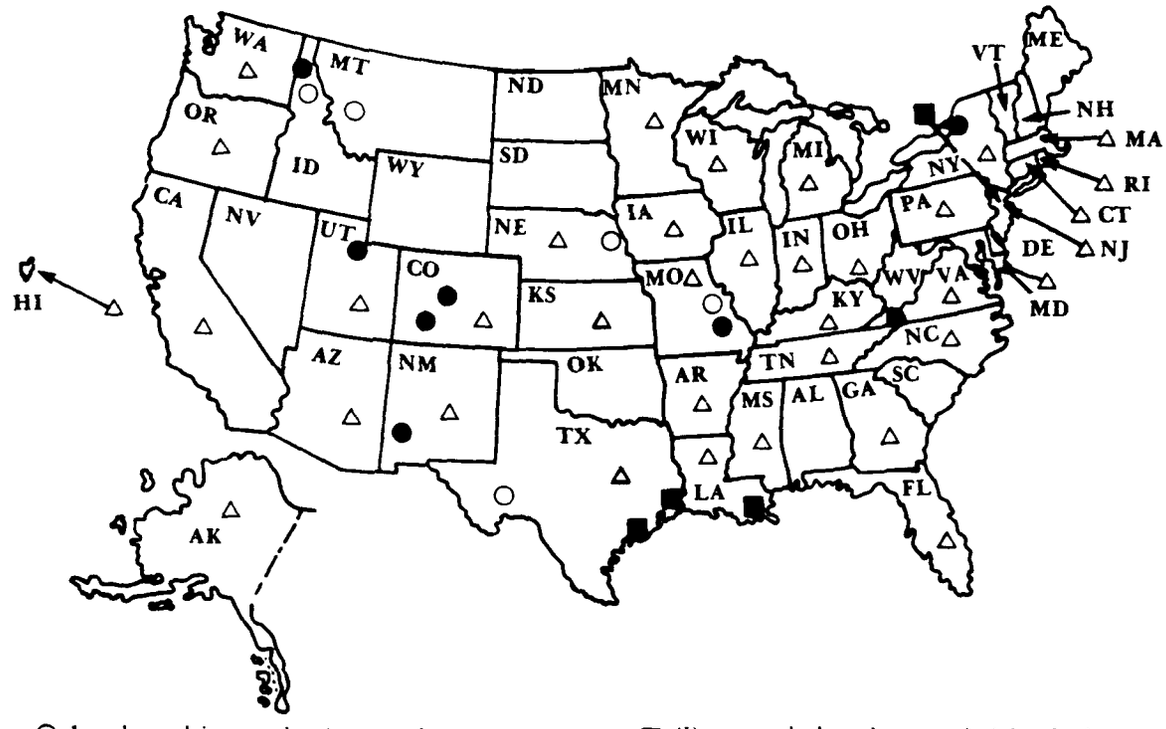
- grey metal
- fairly abundant
- derived from ore-bearing minerals
- can be easily formed, molded, and worked
- withstands weathering and chemical erosion

Because of its physical properties, lead has been used for...



- Most of the lead used in U.S. is mined in Missouri.
- Lead consumption in U.S. in 1976 was about 1,350,000 metric tons.
- Each year about 600,000 metric tons of lead are used in storage batteries.
- About 200,000 metric tons of lead are used in the manufacture of gasoline additives.

Location of major lead operations in the United States, 1976



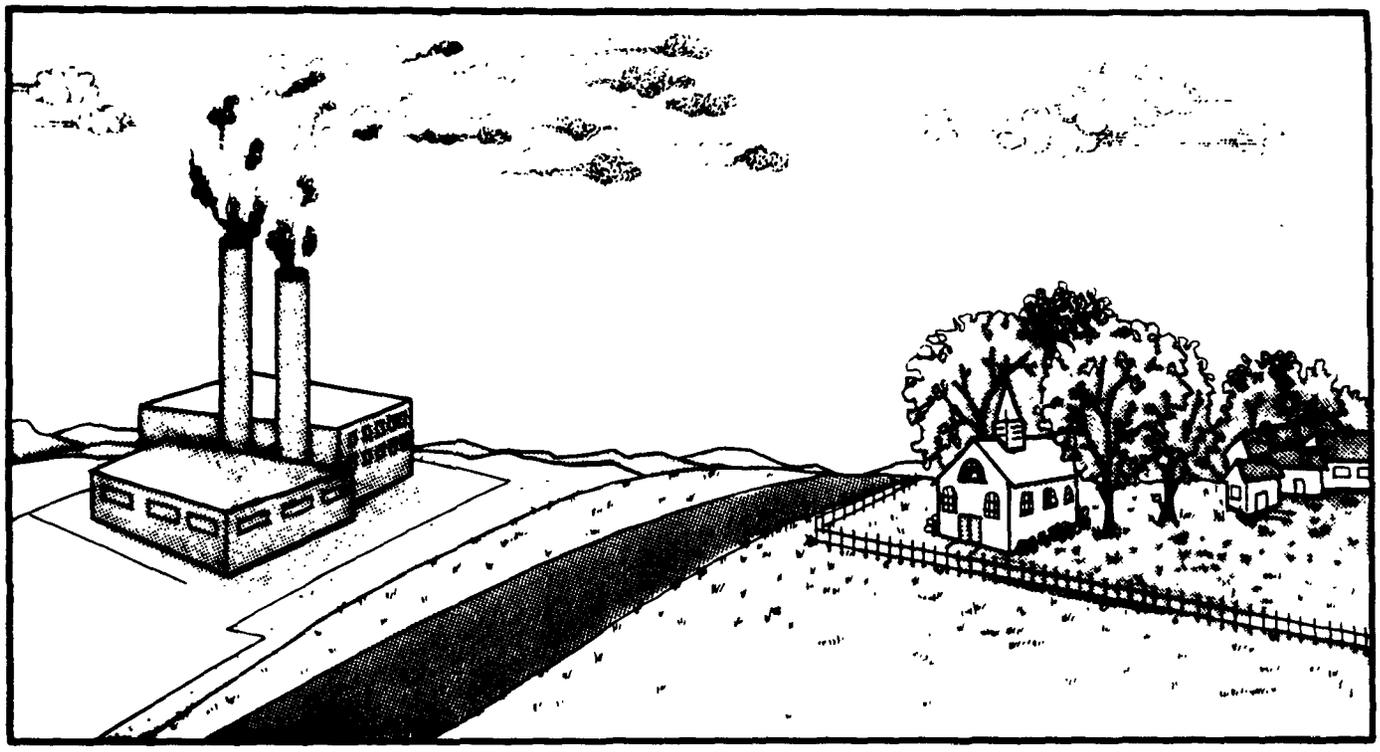
○ Lead smelting and refining plants

△ Storage battery manufacturers

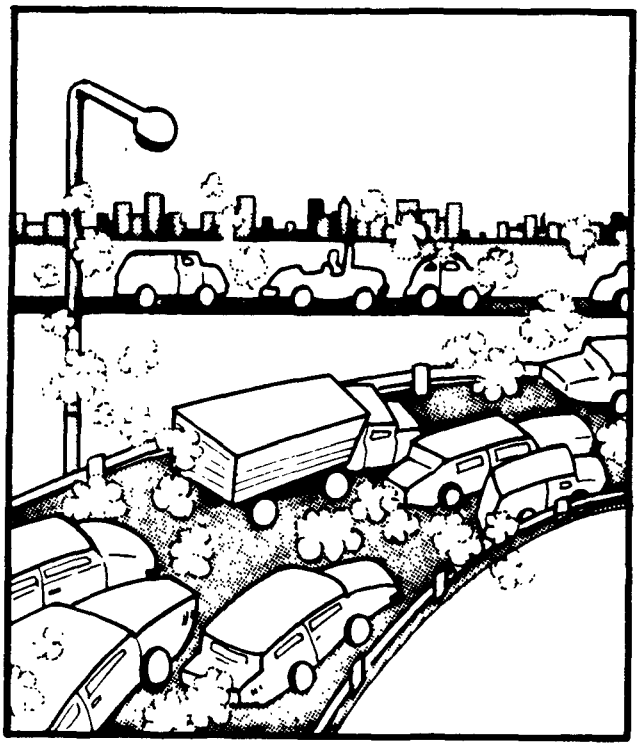
■ Tetramethyl and tetraethyl lead plants

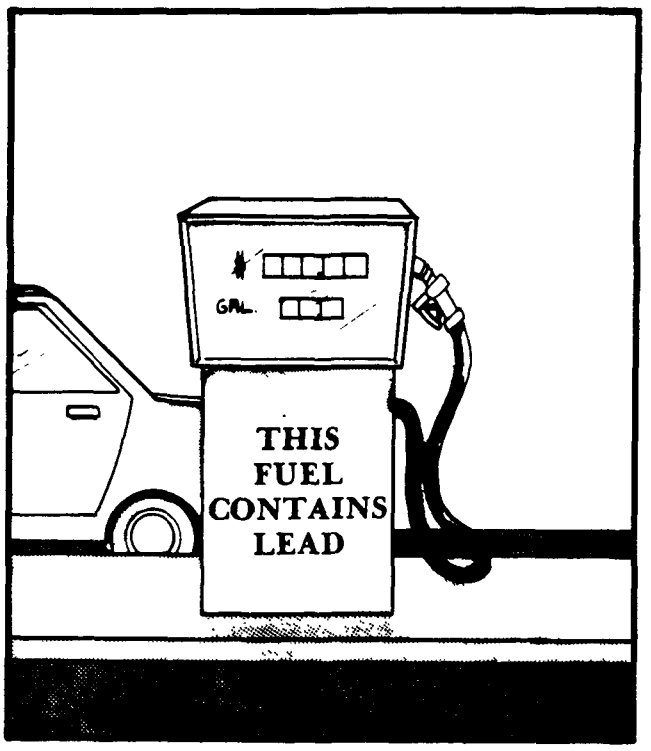
● Lead mines; production = >95% of domestic output

Distribution of Lead Emissions



Major Source of Atmospheric Lead





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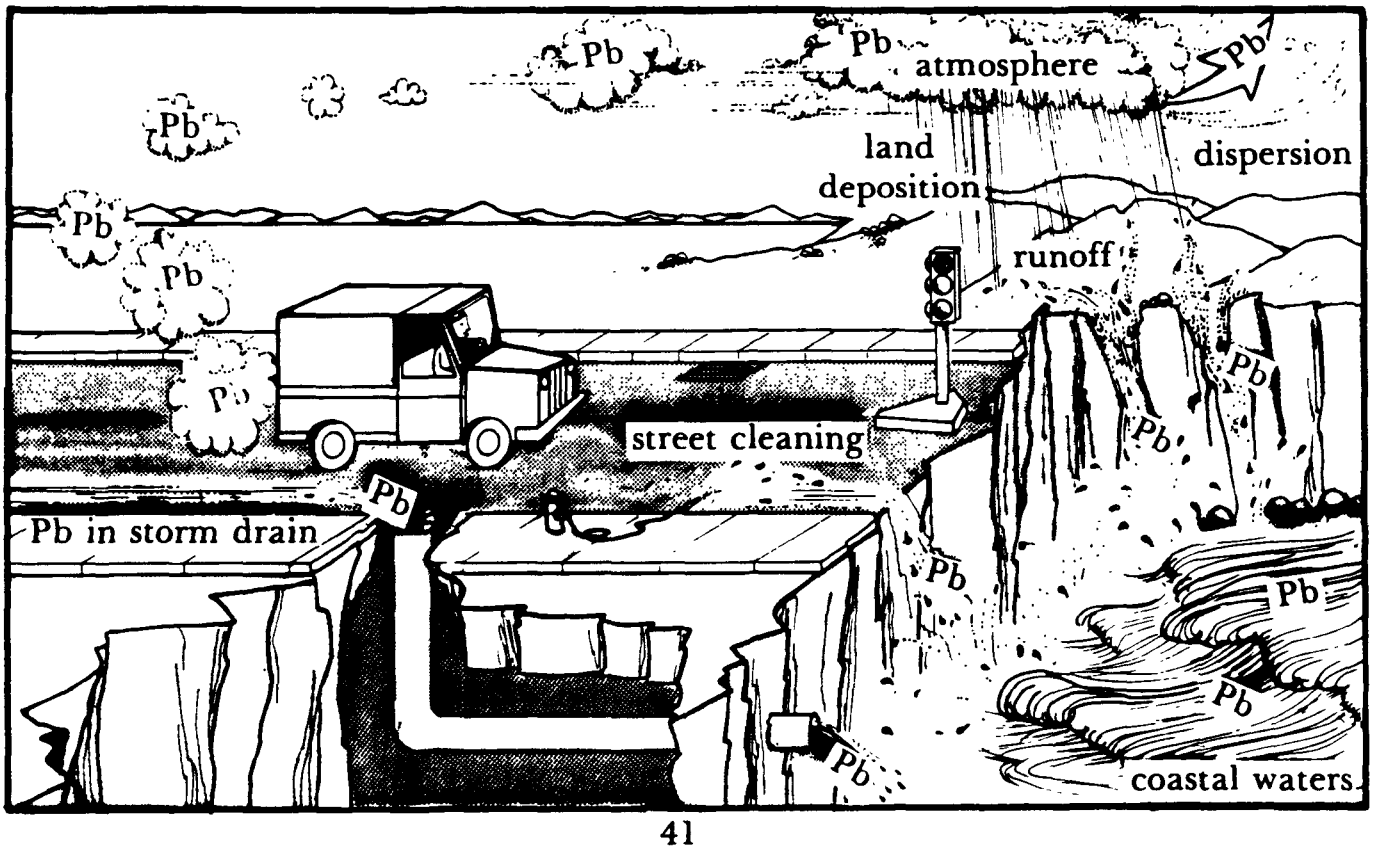
Deposition of Atmospheric Lead Pollution



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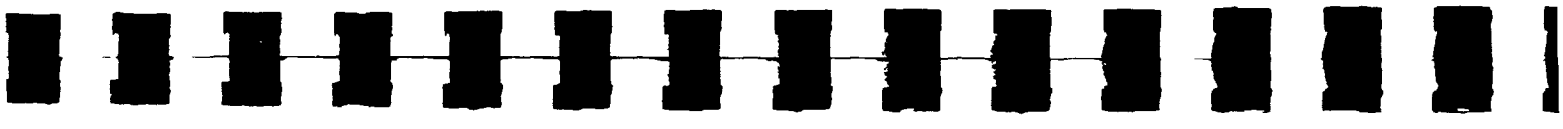
Hazardous Pollutants

- Pollutants that may cause or contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness
- Usually cause only localized problems
- Controlled with emissions standards rather than by limitations on the concentrations allowable in the ambient air



Hazardous Pollutants

Asbestos

Benzene

Vinyl Chloride

Beryllium

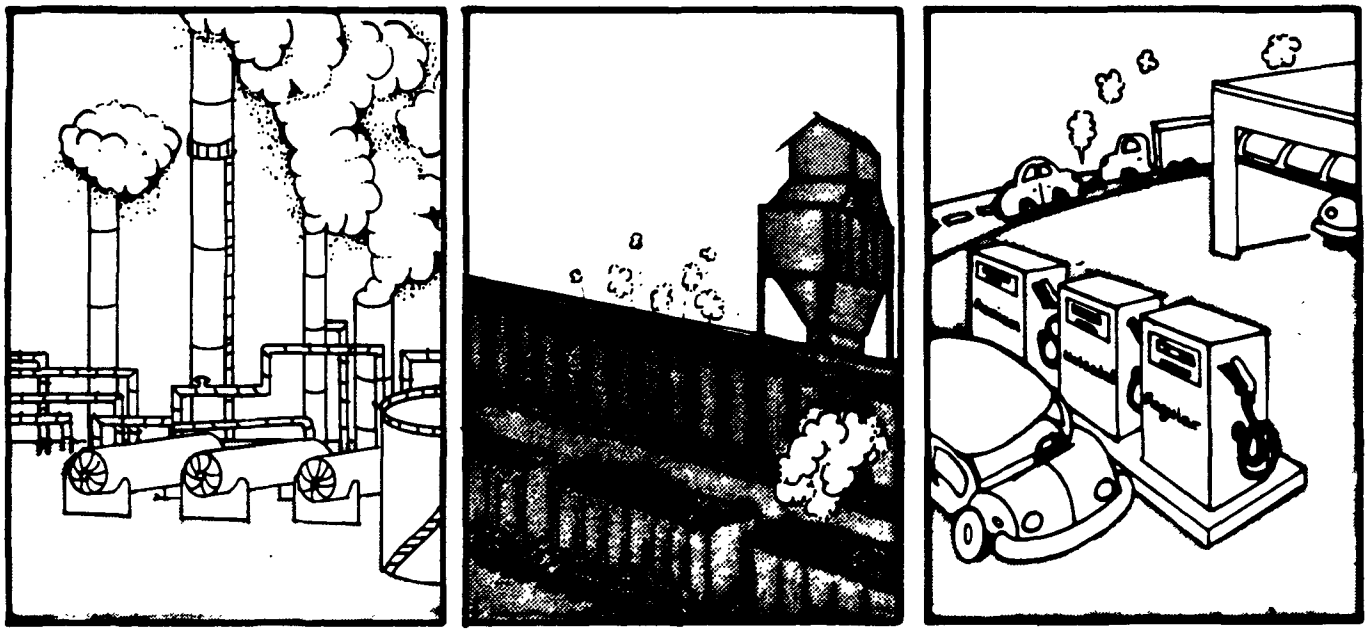
Mercury

Arsenic

Sources of Asbestos

- mining, milling, and spraying of asbestos
- manufacturing of asbestos-cement products, paper, plastics, gaskets, packings, roofing felts, and insulation

Sources of Benzene



Sources of Beryllium

- beryllium extraction plants
- machine shops working with beryllium-containing metals
- foundries handling beryllium or beryllium-containing alloys
- ceramic plants using beryllium
- rocket propellants containing beryllium
- incinerators burning waste that contains beryllium

Sources of Mercury

- mercury-ore processing plants
- mercury battery manufacturing plants
- plants which dispose of sewage treatment plant sludge by drying or burning

Sources of Vinyl Chloride

- Production of polyvinyl chloride
- General public exposure may result from use in
  - aerosol containers
  - food wrapping and containers
  - plumbing pipes
  - other plastic products

Other Pollutants Under Study for Possible Designation as Hazardous Air Pollutants

Manganese
Cadmium
Nickel
Polycyclic organic matter (coke oven emissions)
Ethylene dichloride
Formaldehyde
Vinylidene chloride
Epichlorohydrin
Ethylene oxide
Acrylonitrile

Lesson I
Questions

1. What are the two basic physical forms of air pollution?

Match the criteria pollutant listed below with its appropriate description on the following page.

2. carbon monoxide
3. sulfur dioxide
4. nitrogen dioxide
5. hydrocarbons
6. ozone
7. suspended particulate matter
8. lead

a. colorless gas—one major source is fossil-fuel combustion—"pass-through" pollutant
b. widely spaced organic molecules in rapid motion and without shape
c. grey metal—one major source is combustion of gasoline
d. very small pieces of liquid or solid matter
e. colorless, odorless, and tasteless gas—one major source is the automobile engine
f. secondary pollutant—forms when hydrocarbons and nitrogen oxides react in the presence of sunlight
g. results from the oxidation of nitric oxide in the air and is considered to be more hazardous than NO

Answers are on the next page.

Lesson I
Answers

1. gaseous and particulate
2. e
3. a
4. g
5. b
6. f
7. d
8. c

After checking your responses, please turn on the tape recorder.

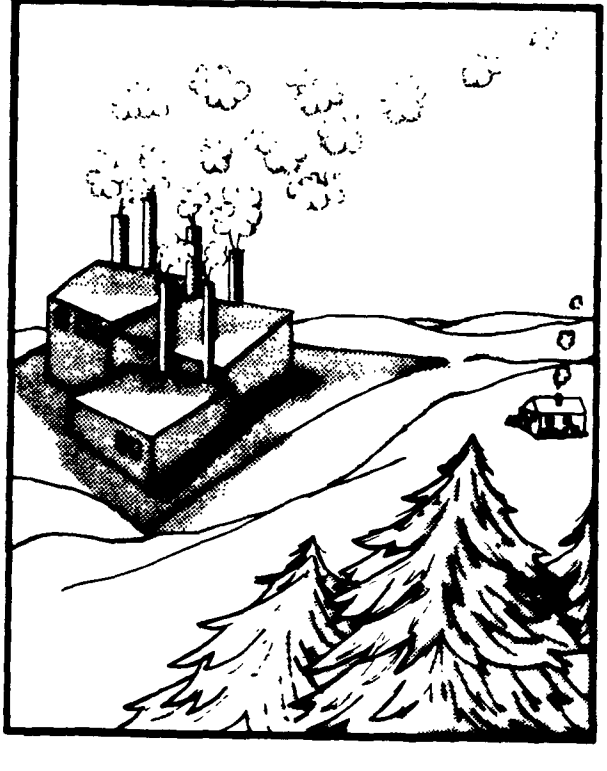
Lesson II: Pollutant Sources
Objectives

1. List and describe five mutually exclusive air pollutant source categories.
2. Identify an example of a source in each of the five major source categories.
3. Given examples of sources, distinguish between point sources and area sources.
4. State a major manmade source for each criteria pollutant.

Source classifications may be based upon

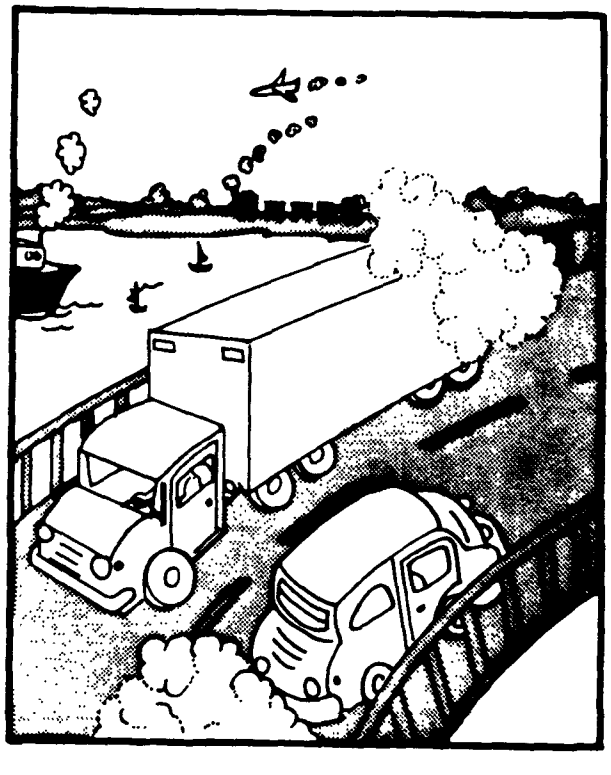
- whether the source is
  - stationary or mobile
  - combustion or noncombustion
  - area or point
- the way that the source generates emissions.

Stationary

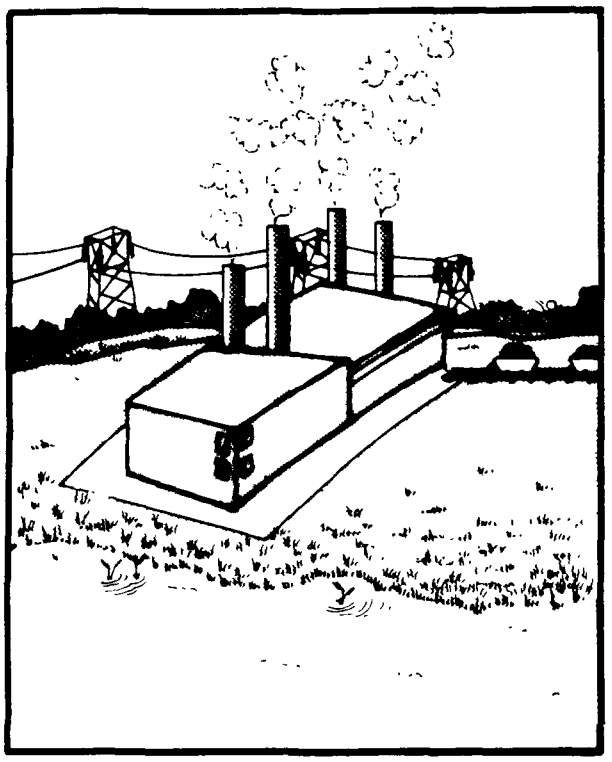


or

Mobile

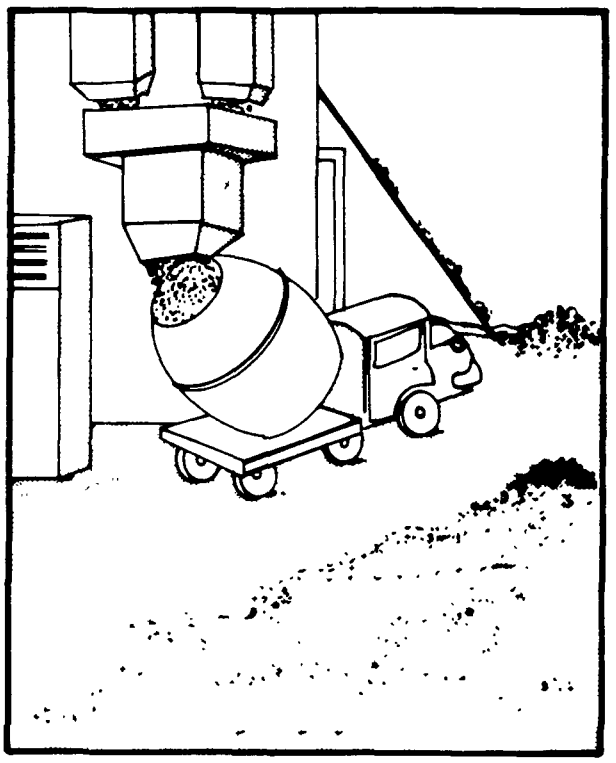


Combustion



or

Noncombustion



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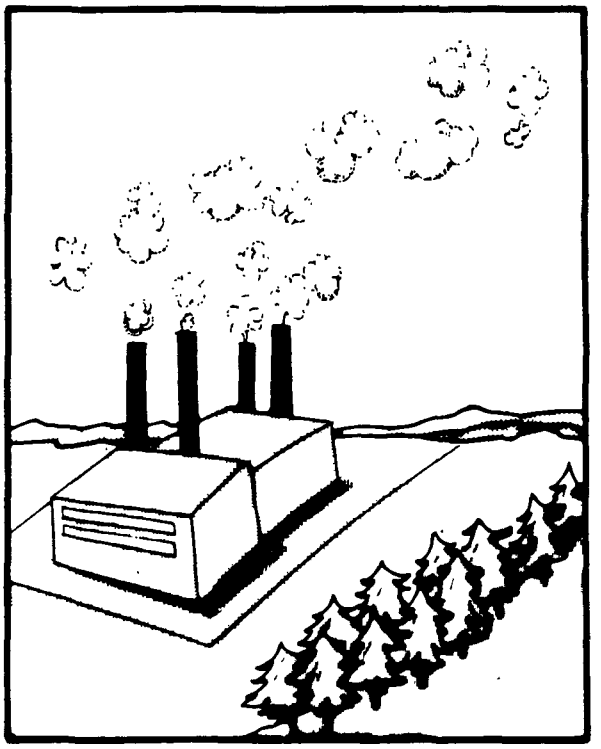
Area

or

Point



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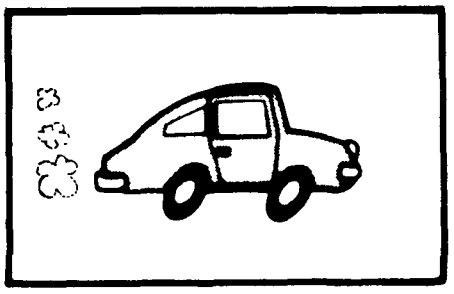
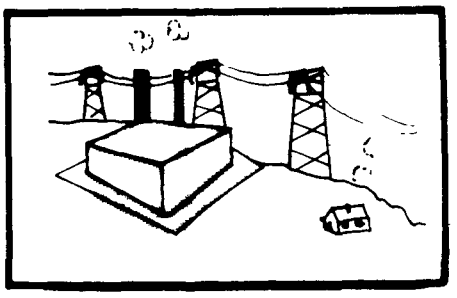
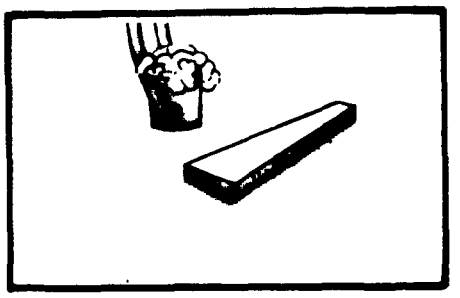
Emission Generation Categories



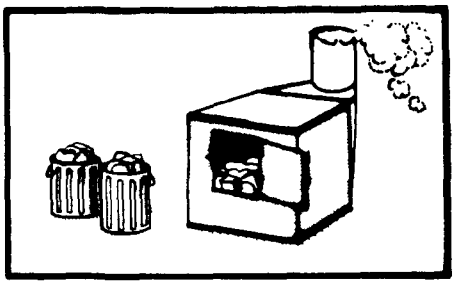
Transportation



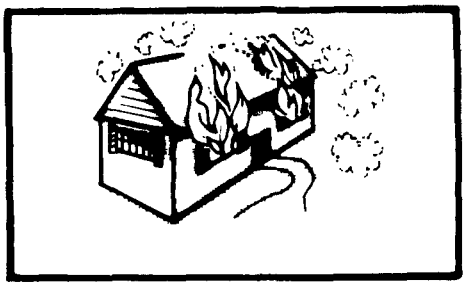
Stationary source fuel combustion



Industrial processes

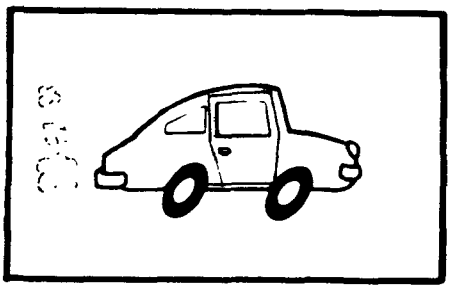


Solid waste disposal



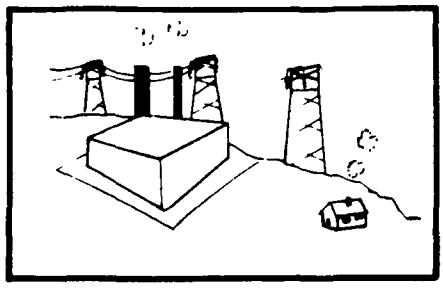
Miscellaneous

Transportation Sources



Most emissions produced in the combustion process that powers their motion. Evaporation of gasoline is also an important source of volatile organic emissions.

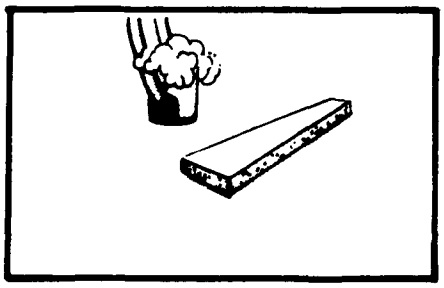
- biggest mobile emission producers are the gasoline- and diesel-fueled internal combustion engines used in motor vehicles
- other sources include planes, ships, trains, lawnmowers, farm tractors, and construction machinery



Stationary Combustion Sources

Produce energy but no other products. Emissions result from fuel combustion.

- fixed energy generating sources ranging in size from home heating furnaces to major power plants.
- sources include commercial, institutional, industrial, and steam-electric power plants.
- fuels used include coal, oil, natural gas, and wood. Other fuels such as liquified natural gas, propane, process gas, etc. may also be used.

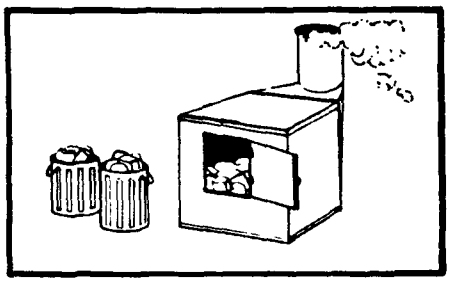


Industrial Processes

Emit pollutants in the course of manufacturing products

- major sources include chemical processing, food and agricultural industries, metallurgical and mineral product factories, petroleum refining, petrochemical plants, petroleum storage, and wood processing industries
- smaller (area) sources include painting, dry-cleaning, and degreasing operations

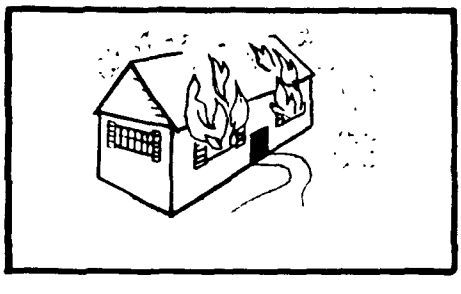
Solid Waste Disposal



Facilities that dispose of unwanted products and by-products. Emissions result from the disposal process, usually burning.

- Most important emission sources in this category are refuse incineration and open burning.

  Disposal operations range in size from small-scale burning of home trash to large central municipal incinerators.



Miscellaneous

Types of sources that do not fit into the other four categories

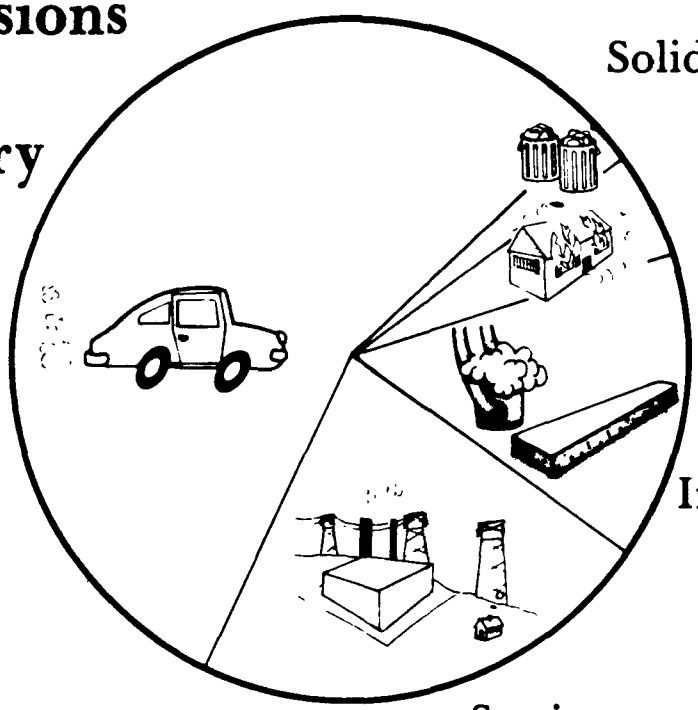
- the distribution of these sources is scattered and variable
- sources include house fires, forest fires, agricultural burning, asphalt road paving, and coal mining

Pollutants and Sources

	Transportation	Stationary source fuel combustion	Industrial processes	Solid waste disposal	Miscellaneous
CO	gasoline powered motor vehicles	improperly adjusted boilers	process losses when CO waste gas burning not practical	on-site incinerators	forest burn off house fires coal-refuse fires
TSP	gasoline vehicles tire wear aircraft diesel vehicles ship boiler emissions	power plants space heating commercial boilers	handling, processing and storing of rock, sand, and gravel metallurgical processes cement plants	incinerators	forest burn off house fires agricultural burning fugitive dust
HC	gasoline powered motor vehicles gasoline distribution and marketing	fossil fuel burning for power plants, space heating, and commercial boilers	petroleum refineries chemical mfg degreasing	organic chemical waste disposal	oil and gas production dry cleaning
NO_X	gasoline powered motor vehicles diesel powered vehicles	fossil fuel burning for power plants, space heating, and commercial boilers	explosives mfg rocket fuel mfg nitric acid mfg	incineration of plastics and other high temperature disposal of chemical wastes	grass fires forest burn off
SO_X	fuel additives gasoline and diesel powered vehicles	power plants space heating commercial boilers	petroleum refineries smelters sulfuric acid plants coke ovens pulp and paper mills	high temperature disposal of chemical wastes incinerators	burning of coal refuse piles
Lead	leaded fuels used in motor vehicles	burning of waste oils containing lead	smelters battery mfg gasoline additive mfg lead reclaiming operation lead glass mfg	incineration of old battery cases incineration of wood products with painted surfaces	weathering of painted surfaces

[redacted]

Source Emissions Listed by Category



Solid Waste Disposal
2%

Miscellaneous
5%

Transportation
56%

Industrial Processes
15%

Stationary Source
Fuel Combustion
22%

Lesson II
Questions

1. List five mutually exclusive air pollutant source categories.
2. Fill in the blank. _____ sources are small multiple sources that together can adversely affect air quality in an area.
3. For each source listed below, name the source category (from question 1) to which it belongs.

   a. power plant
   b. municipal incinerator
   c. automobile
   d. fugitive dust
   e. chemical processing plant

Answers are on the next page.

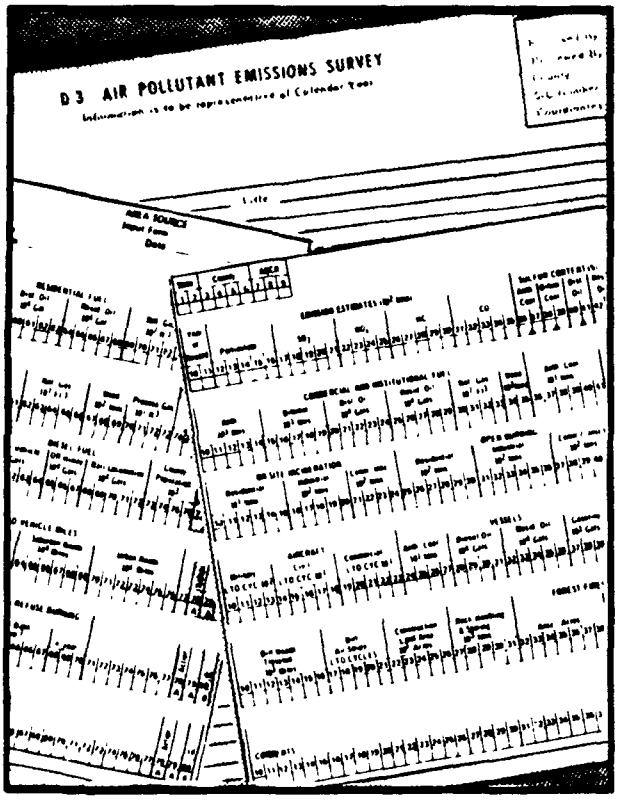
Lesson II
Answers

1. transportation
   stationary source fuel combustion
   industrial processes
   solid waste disposal
   miscellaneous
2. area
3. a. stationary source fuel combustion
   b. solid waste disposal
   c. transportation
   d. miscellaneous
   e. industrial process

After checking your responses, please turn on the tape recorder.

Lesson III: Source Emissions
Objectives

1. Identify uses of emission inventory data.
2. Describe the steps followed in conducting a source emission inventory.
3. Explain what an emission factor represents.
4. Briefly describe the way in which emission rates are estimated.
5. Explain the function of the National Emissions Data System.
6. Indicate whether, since 1970, there has generally been a rise or fall in emission levels of the seven criteria pollutants.



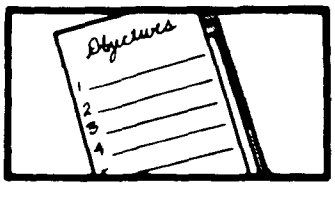
Emission Inventory

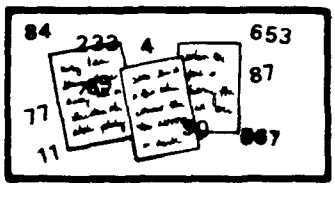
A study of the pollutant emissions in a given area

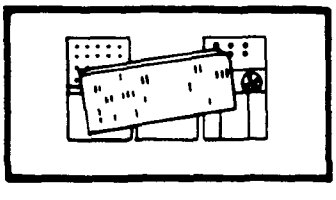
Emission inventories are designed to

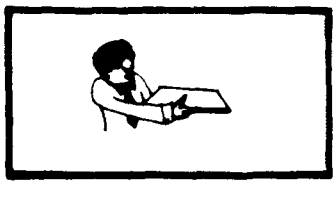
- locate air pollution sources
- define type and size of sources
- define type and amount of emissions from each source
- determine pollutant emission frequency and duration
- determine the relative contributions to air pollution problems of classes of sources and individual sources

Basic Elements of Source Emission Inventory

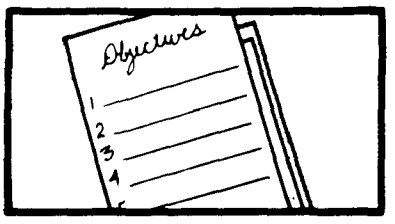








- planning
- data collection
- data analysis
- reporting data — including submission of data to the federal government



Planning

Defines purpose and scope of inventory

- determine how the data will be used
- determine geographical area to be inventoried
- specify data collection methods
- consider legal authority to acquire data
- assess resources available to carry out the inventory

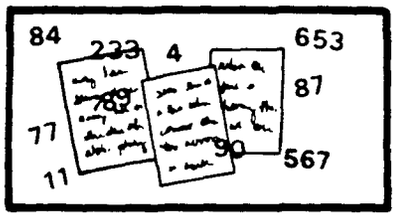
Uses of an Emission Inventory

To determine

- types of pollutants emitted from specific sources
- magnitude or amount of emissions from those sources
- emissions distribution in time and space
- emission rates under specific plant operating conditions
- relation of ambient air pollutant concentration to specific sources

Emission inventory data can be used in combination with other data to

- select locations for air monitoring sites
- set baselines for emissions trends analysis
- establish and re-evaluate emission standards and regulations
- assess the effect of emissions on air quality

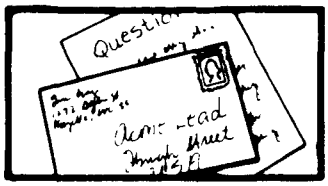


Data Collection

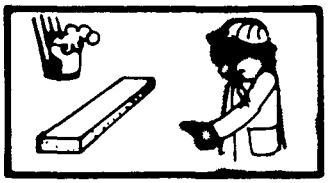
Follows plan of action set in planning stage

- classification of emissions
- classification and location of pollutant sources
- determination of quality and quantity of materials handled, processed, or burned in each source

Inventory Data Collection Methods

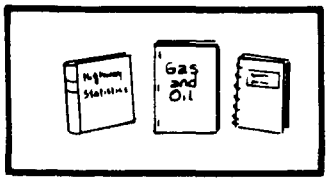


- mail survey

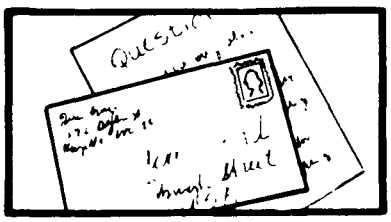


- plant inspection

- field survey

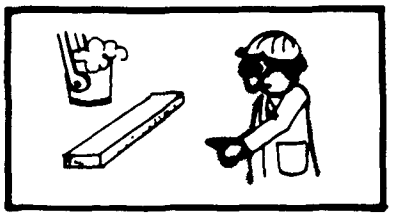


- data from publications



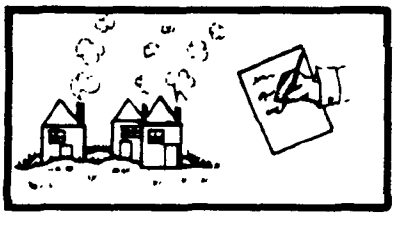
Mail Survey

- most common technique
- most economical technique



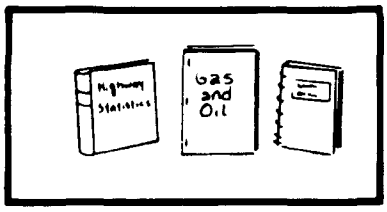
Plant Inspection

- examination of various processes
- interviews with plant personnel
- sometimes source testing
- more time consuming than mail surveys
- usually used only at important point sources
- most accurate method of data collection



Field Survey

- similar to plant inspection
- used mainly to gather data about small area sources



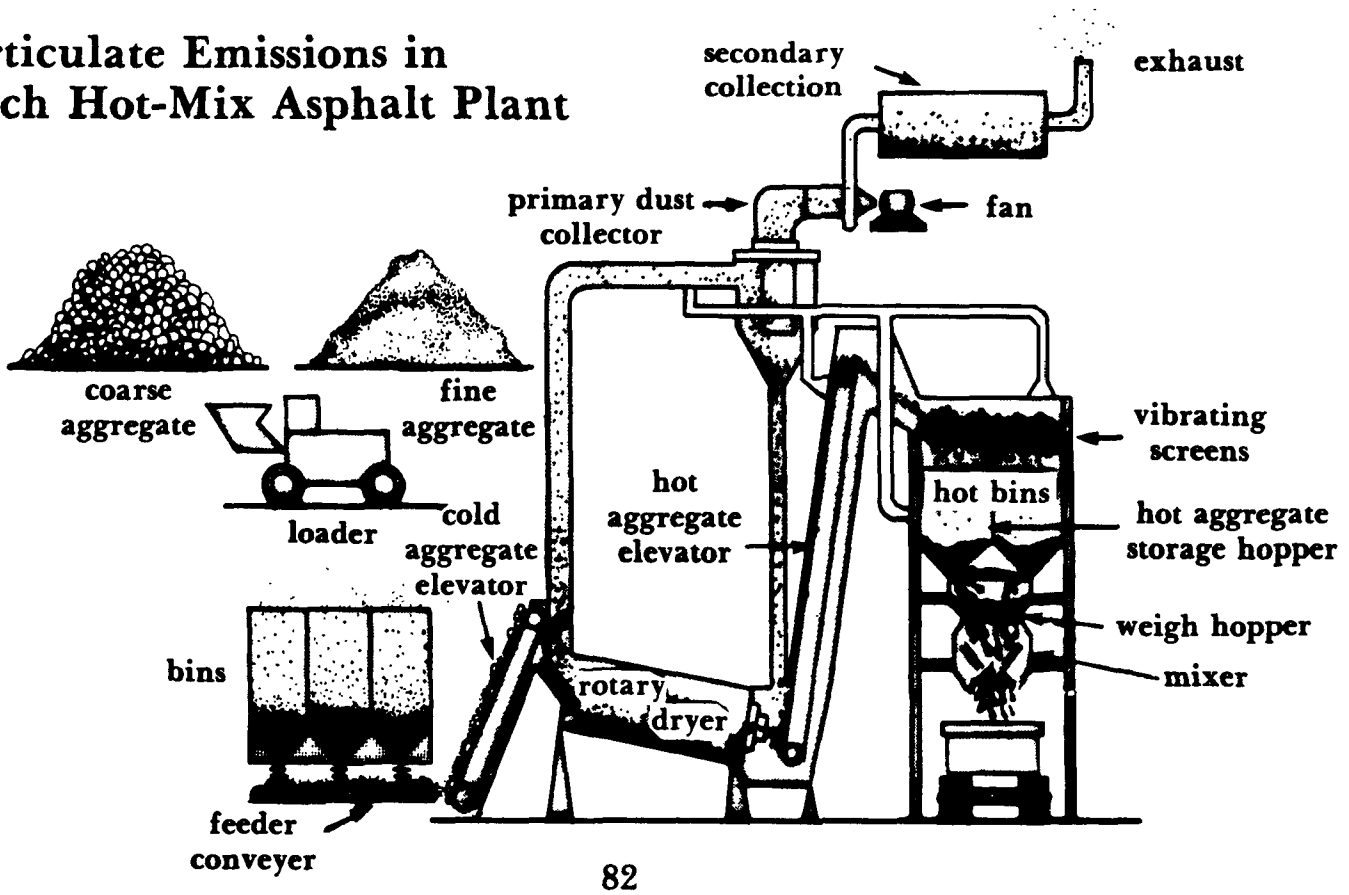
Data from Publications

- data often found in industrial and governmental files, periodicals, etc.
- these publications often contain process, activity level, and control device descriptions
- do not provide raw emissions data, but rely upon estimates of emissions from published data on related sources
- usually a last resort method

Kinds of Information Collected

- General source information—location, ownership, nature of business
- Process information—type of equipment, type of reactions
- Activity levels—amount of fuel and materials (input), amount of production (output)
- Control device information—types of devices
- Information needed to estimate emissions—temperature, tank conditions, hours of operation, seasonal variation, etc.

Particulate Emissions in Batch Hot-Mix Asphalt Plant



Printing

Material Being Coated: _____

County Permit Number	Printing Process	Type of Ink	Amount (Gal/Yr)	Type and % Major Solvents In Ink		Type and Amounts of Solvents Added (Gal/Yr)		Normal Operating Hr	Day	Week
Example Example P99999	Flexographic	Alcohol Solvent Based	2000	Isopropanol Methanol Ethanol	70 15 15	MEK	100	8	5	50

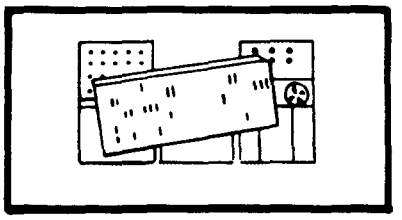
Dry Cleaning

Material Being Cleaned._____

County Permit Number	Amount of Clothes Cleaned (Tons/Yr)	Type of Cleaning	Type(s) of Cleaning Solvents	Amount (Gal/Yr)	Normal Operating Hr	Day	Week
Example P99999	2000	Hot	Perchloroethylene	2000	8	5	50

Control and Stack Information

				Stack Data				
County Permit Number	Type of Control Eqmt.	Control Eqmt. Effic. (%)	Instal-lation Date	Height (ft)	Inside Dia. (ft)	Temp. (°F)	Velocity (ft/sec)	Flow Rate (ft^3/min)
Example P99999	After-burner	95	1969	20	1 5	600	20	2100



Data Analysis

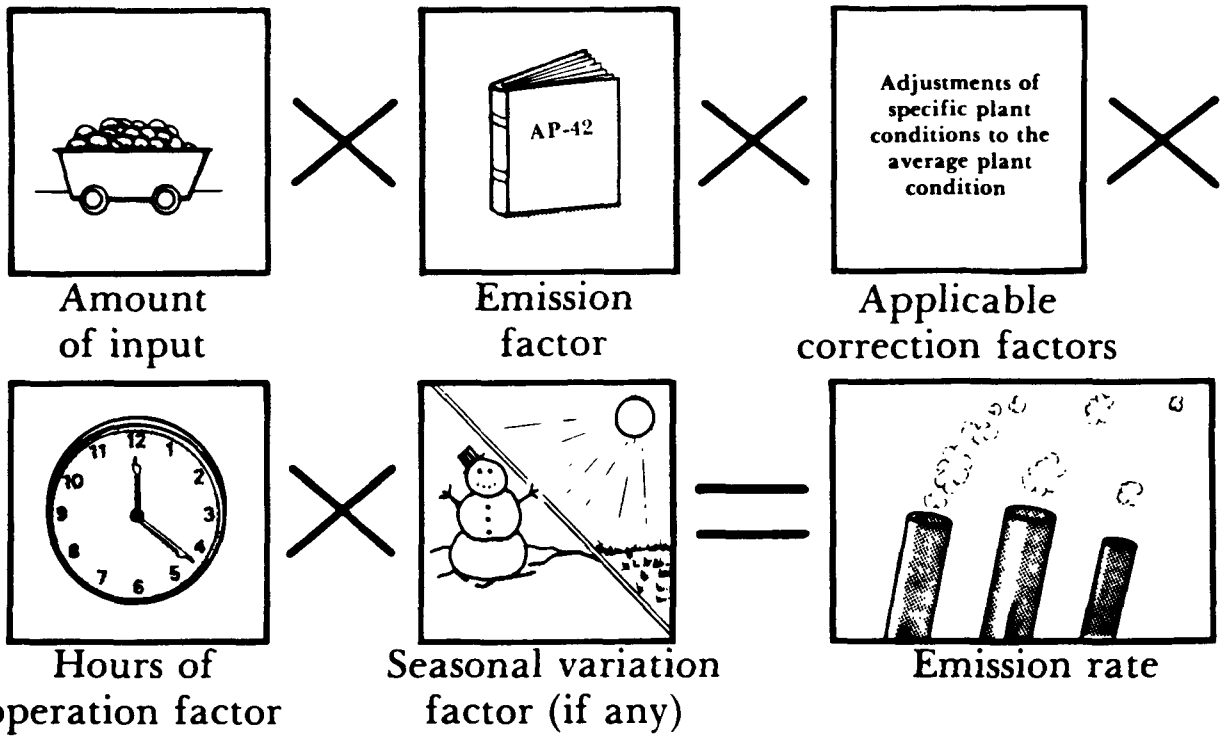
Calculate emission rate for each pollutant by

- using specific emission data for sources, when available
- locating emission factor in AP-42
- calculating emission rate, using data from inventory and emission factor

Emission Rate

the weight of a pollutant emitted per unit of time

Example Calculation of Emission Rate



Emission Factor

an estimate of the rate at which a pollutant is released into the atmosphere as a result of some activity

Determination of Emission Factors

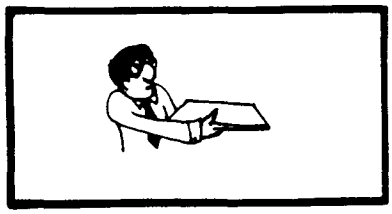
$$\frac{\text{Measured weight of pollutant emitted (e.g., kg of sulfur emitted)}}{\text{Unit level of activity (e.g., metric tons of coal burned)}}$$

Emission factors for major pollutants found in *AP-42, Compilation of Air Pollution Emission Factors*

Emission Factors for Bituminous Coal Combustion Without Control Equipment

	Particulates		Sulfur oxides		Carbon monoxide		Organics		Nitrogen oxides		Aldehydes	
Furnace size, 10^6 Btu/hr heat input	lb/ton coal burned	kg/mt coal burned	lb/ton coal burned	kg/mt coal burned	lb/ton coal burned	kg/mt coal burned	lb/ton coal burned	kg/mt coal burned	lb/ton coal burned	kg/mt coal burned	lb/ton coal burned	kg/mt coal burned
Greater than 100												
Pulverized												
General	16A	8A	38S	19S	1	0.5	0.3	0.15	18	9	0.005	0.0025
Wet bottom	13A	6.5A	38S	19S	1	0.5	0.3	0.15	30	15	0.005	0.0025
Dry bottom	17A	8.5A	38S	19S	1	0.5	0.3	0.15	18	9	0.005	0.0025
Cyclone	2A	1A	38S	19S	1	0.5	0.3	0.15	55	27.5	0.005	0.0025
10 to 100												
Spreader stoker	13A	6.5A	38S	19S	2	1	1	0.5	15	7.5	0.005	0.0025
Less than 10												
Underfeed stoker	2A	1A	38S	19S	10	5	3	1.5	6	3	0.005	0.0025
Hand-fired units	20	10	38S	19S	90	45	20	10	3	1.5	0.005	0.0025

S = weight percent of sulfur in coal
A = weight percent of ash in coal



Reporting Data

Data gathered by State control agencies is:

- used by the agencies for various purposes
- reported to EPA's National Emissions Data System (NEDS).

National Emissions Data System (NEDS)

- computerized data system developed for storage & retrieval of source and emissions data
- used to generate national emissions reports, fuel summary listings, and other data reports

Emission inventories are designed to

- locate air pollution sources
- define type and size of sources
- define type and amount of emissions from each source
- determine pollutant emission frequency and duration
- determine the relative contributions to air pollution problems of classes of sources and individual sources

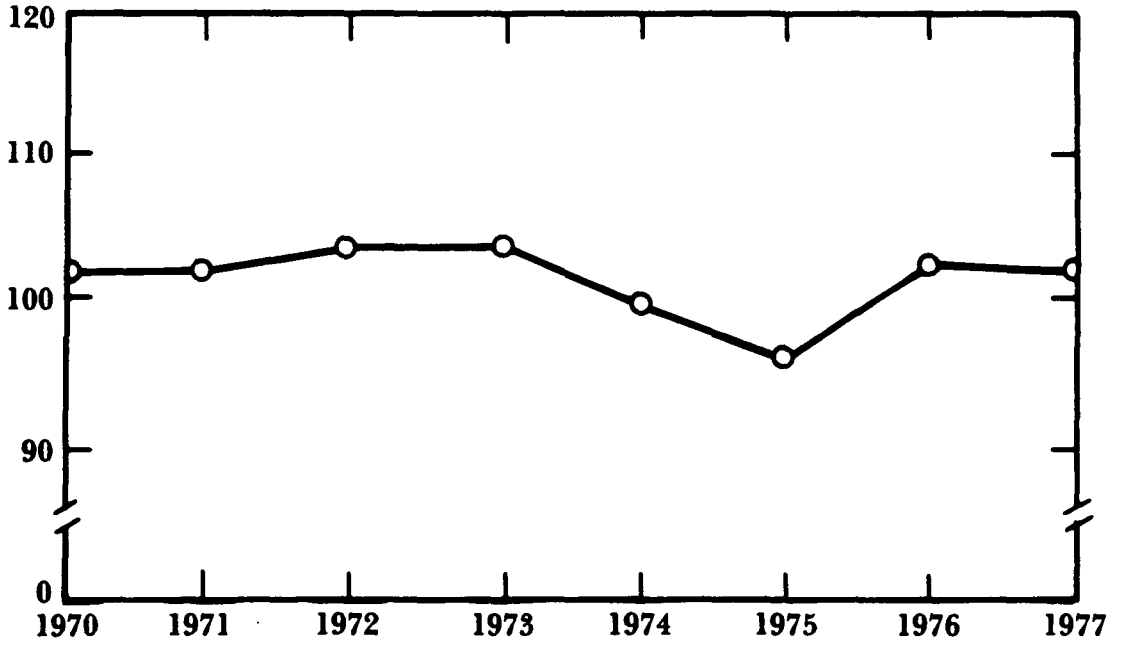
Hydrocarbon Emissions Baton Rouge Analysis Area

	1975 Emissions (tons/yr)	
Source	**Total Hydrocarbons**	**Nonmethane Hydrocarbons**
BASF Industries	590	572
Chemical Co.	1,389	1,362
CF Industries	1,873	1,848
Evan Hall Sugar Coop.	1	0
Chemicals, Inc.	2	0
Monochem	472	455

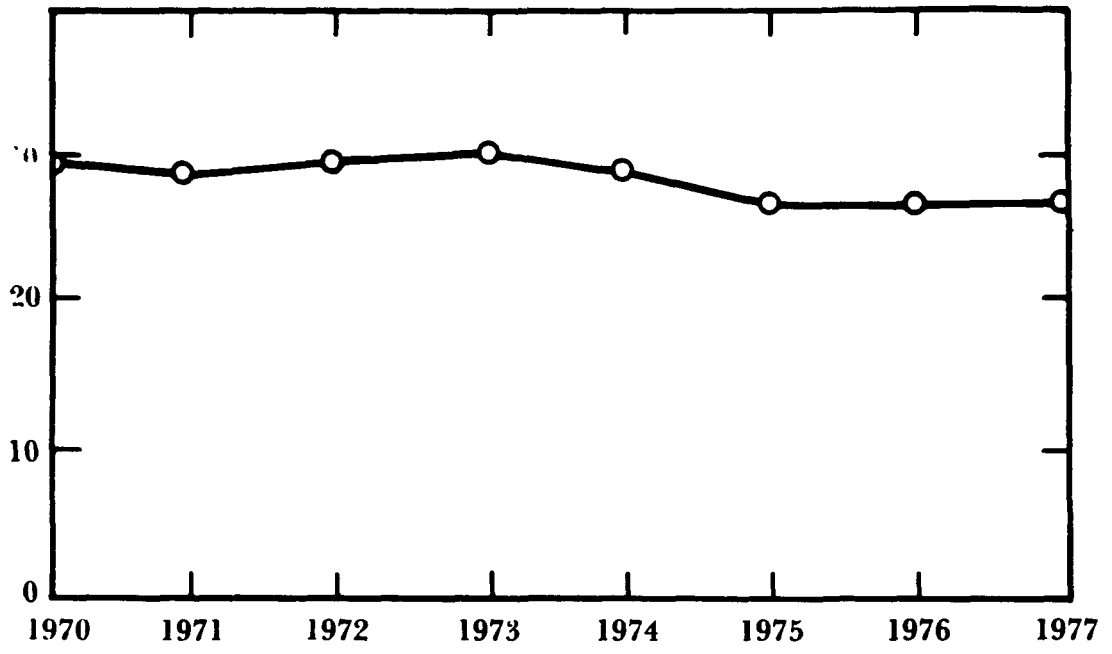
1977 Emissions (million metric tons)

	TSP	CO	SO_X	NO_X	HC
Transportation	1.1	85.7	.8	9.2	11.5
Stationary Sources	4.8	1.2	22.4	13.0	1.5
Industrial Processes	5.4	8.3	4.2	.7	10.1
Solid Waste	.4	2.6			
Miscellaneous	.7	4.9			
Total	12.2	102.7	27.4	23.1	28.3

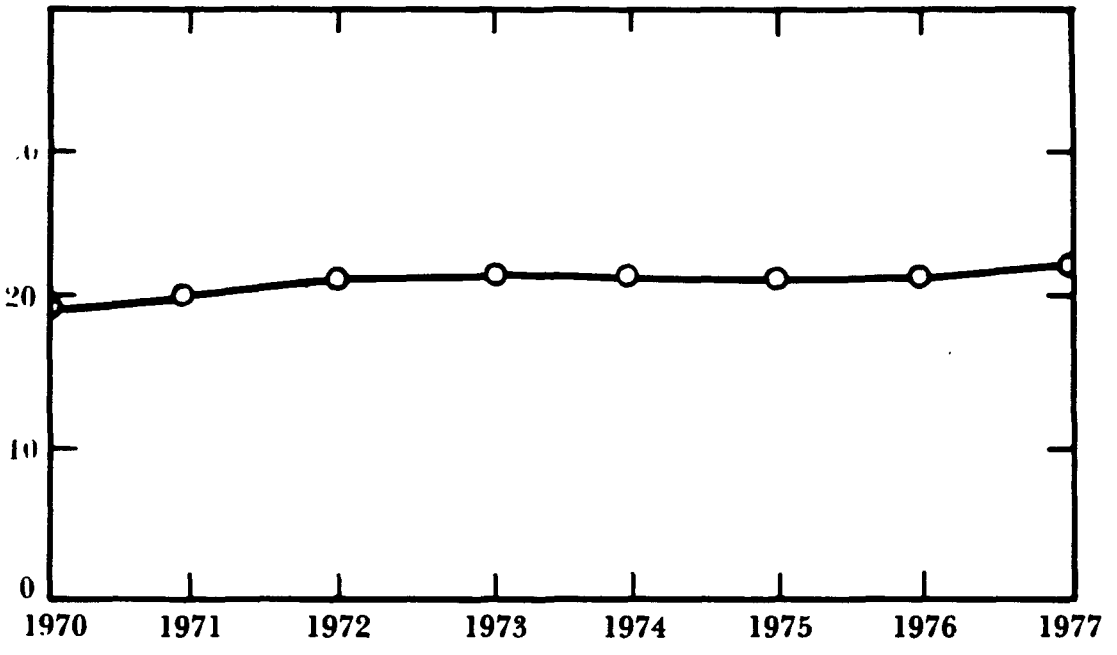
Carbon Monoxide Emissions, 1970-1977 (10^6 metric tons)



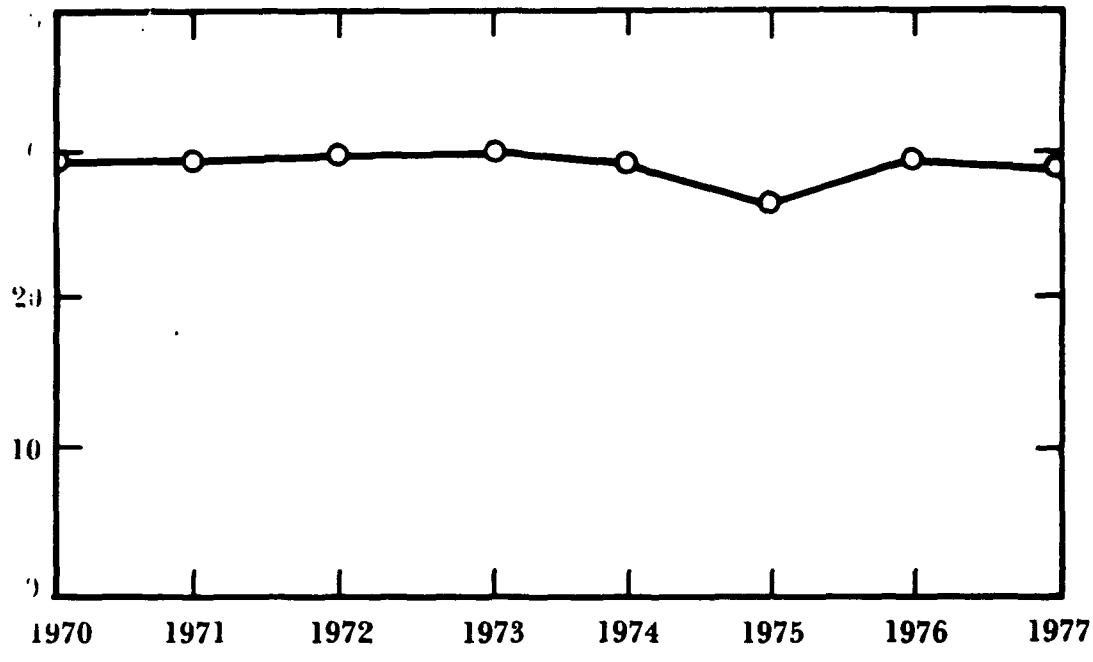
Sulfur Oxides Emissions, 1970-1977
(10^6 metric tons)



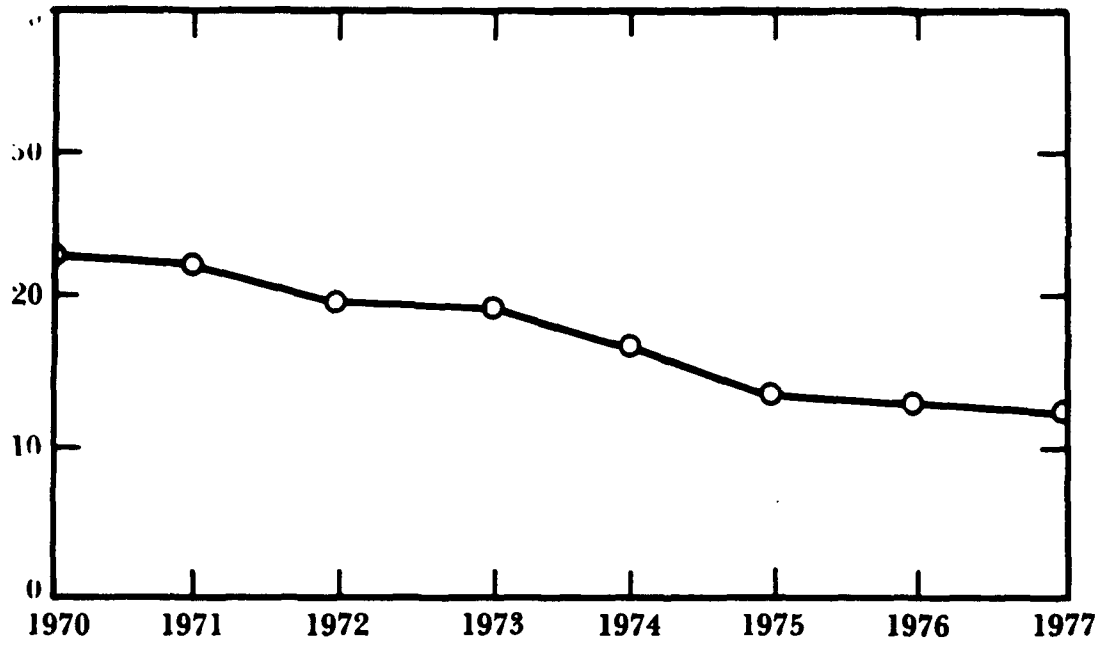
Nitrogen Oxides Emissions, 1970-1977
(10^6 metric tons)



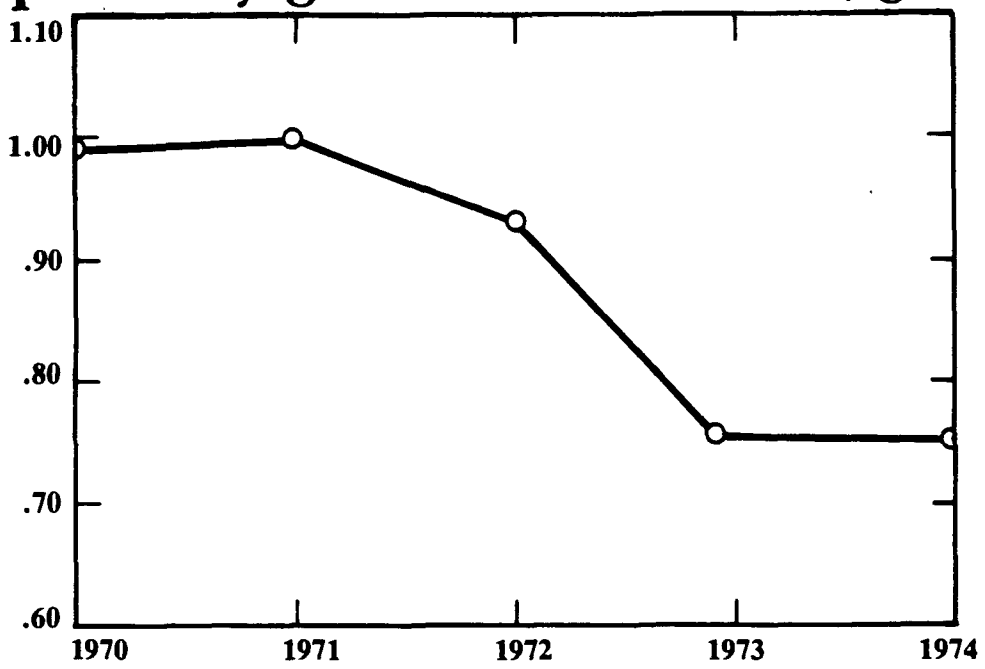
Hydrocarbon Emissions, 1970-1977
(10^6 metric tons)



Total Suspended Particulate Emissions 1970-1977
(10^6 metric tons)



Ambient Lead Concentrations, 1970-1974
(urban air monitoring stations)
quarterly geometric mean in $\mu g/m^3$



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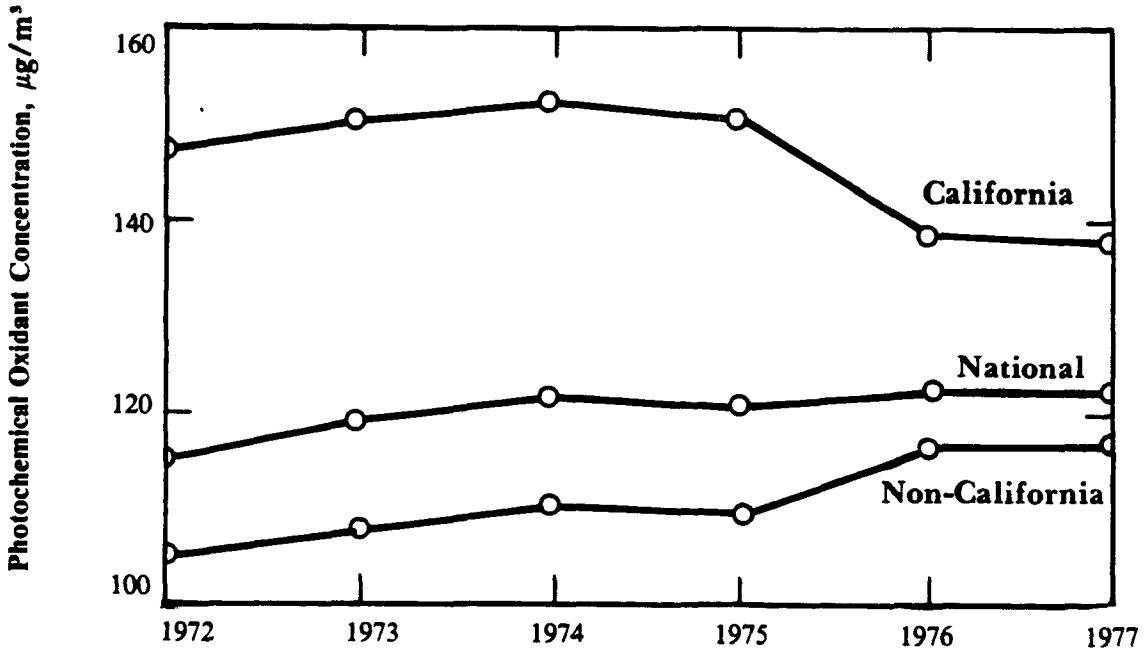
Photochemical Oxidant Trends, 1972-1977
(micrograms per cubic meter)



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Lesson III
Questions

1. Which of the following are potential uses for emission inventory data?
   a. determine types of pollutants emitted from specific sources
   b. determine the magnitude or amount of emissions from a source
   c. determine emission distribution in time and space
   d. determine pollutant concentration under specific plant operating conditions
   e. determine the relation of pollutant concentration to particular sources
   f. all of the above

2. List in order the four basic steps in a source emission inventory.
3. Explain what an emission factor represents.
4. Fill in the blank: Data gathered by air pollution control agencies is reported to the _____.
5. Choose the correct term: Since 1970 there has generally been a _____ (rise/fall) in emissions of suspended particulate matter.

Answers are on the next page.

Lesson III
Answers

1. f. all of the above
2. planning
   data collection
   data analysis
   reporting data
3. An emission factor is an estimate of the rate at which a pollutant is released into the atmosphere as a result of some activity. It is used when calculating emission rate.
4. National Emissions Data System
5. fall

After checking your responses, review any material that you are not sure of and then take the Unit Test which begins on the next page.

Unit Test

1. What are the two basic physical forms of air pollution?
2. Which of the following is not a criteria pollutant?
   a. sulfur dioxide
   b. asbestos
   c. lead
   d. ozone
   e. suspended particulate matter
   f. hydrocarbons
   g. nitrogen dioxide
   h. carbon monoxide
3. True or false? Hazardous pollutants, unlike criteria pollutants, are controlled with emissions standards rather than by ambient air quality standards which limit the concentration of a pollutant allowable in the ambient air.
4. The most widely used system of classifying pollution sources divides them into five mutually exclusive categories based on the way that the emissions are generated in the source. These include which of the following?
   a. solid waste disposal
   b. industrial processes
   c. transportation
   d. aerospace operations
   e. stationary source fuel combustion
   f. smelting processes
   g. liquid waste disposal
   h. miscellaneous sources

5. Is a large petroleum refinery with great quantities of pollutant emissions and many exhaust stacks an area source or a point source?
6. An emission inventory is designed to do which of the following?
   a. locate air pollution sources
   b. define the types of sources
   c. define the sizes of sources
   d. determine pollutant emission frequency and duration
   e. determine the relative contribution to air pollution problems of classes of sources and individual sources
   f. all of the above
   g. only a, b, and c above
   h. only a, d, and e above
7. Name the four basic elements of a source emission inventory.
8. What does an emission factor represent?
9. True or false? The *emission rate* for a pollutant is the weight of the pollutant emitted per unit of time. It is calculated by multiplying an activity unit by the emission factor, by applicable correction factors, by a factor for hours of operation, and perhaps by a correction factor for seasonal variation.
10. Give a brief description of NEDS.

Unit Test

Answers

1. particulate
   gaseous
2. b. asbestos
3. True
4. a, b, c, e, and h
5. point source
6. f. all of the above
7. planning
   data collection
   data analysis
   reporting the data
8. An emission factor is an estimate of the rate at which a pollutant is released into the atmosphere as a result of some activity.
9. True
10. NEDS stands for the National Emissions Data System, which is a computerized data system developed for storage and retrieval of source and emissions data. It is used to generate national emissions reports, fuel summary listings, and other data reports.