



# Air Pollution

**Layla Al- Awadi**  
**Environmental and Live Science Research**  
**Center.**



## ☆ Environment

- Air
- Water
- Soil
- Sound

## ☆ Environmental Pollution

It is the unfavourable alteration of our surroundings through direct or indirect effects of changes in energy patterns, radiation levels, chemical and physical constitution and abundance of organisms.



# AIR

- ☆ **Natural Atmosphere of the Earth**
- ☆ **Nonflammable, Colourless and Odourless Gas**
- ☆ **Mixture of Gaseous Elements**
- ☆ **Dry Air is Non-Corrosive**
- ☆ **Liquefied Air is Transparent with Bluish Cast and has a Milky Colour when it Contains Carbon Dioxide**



# Composition of Air

Components	Percentage
------------	------------

Nitrogen	78.1
----------	------

Oxygen	20.1
--------	------

Carbondioxide	0.03
---------------	------

Rare gases	1.77
------------	------

(Argon, Neon, Helium, Krypton & Xenon)

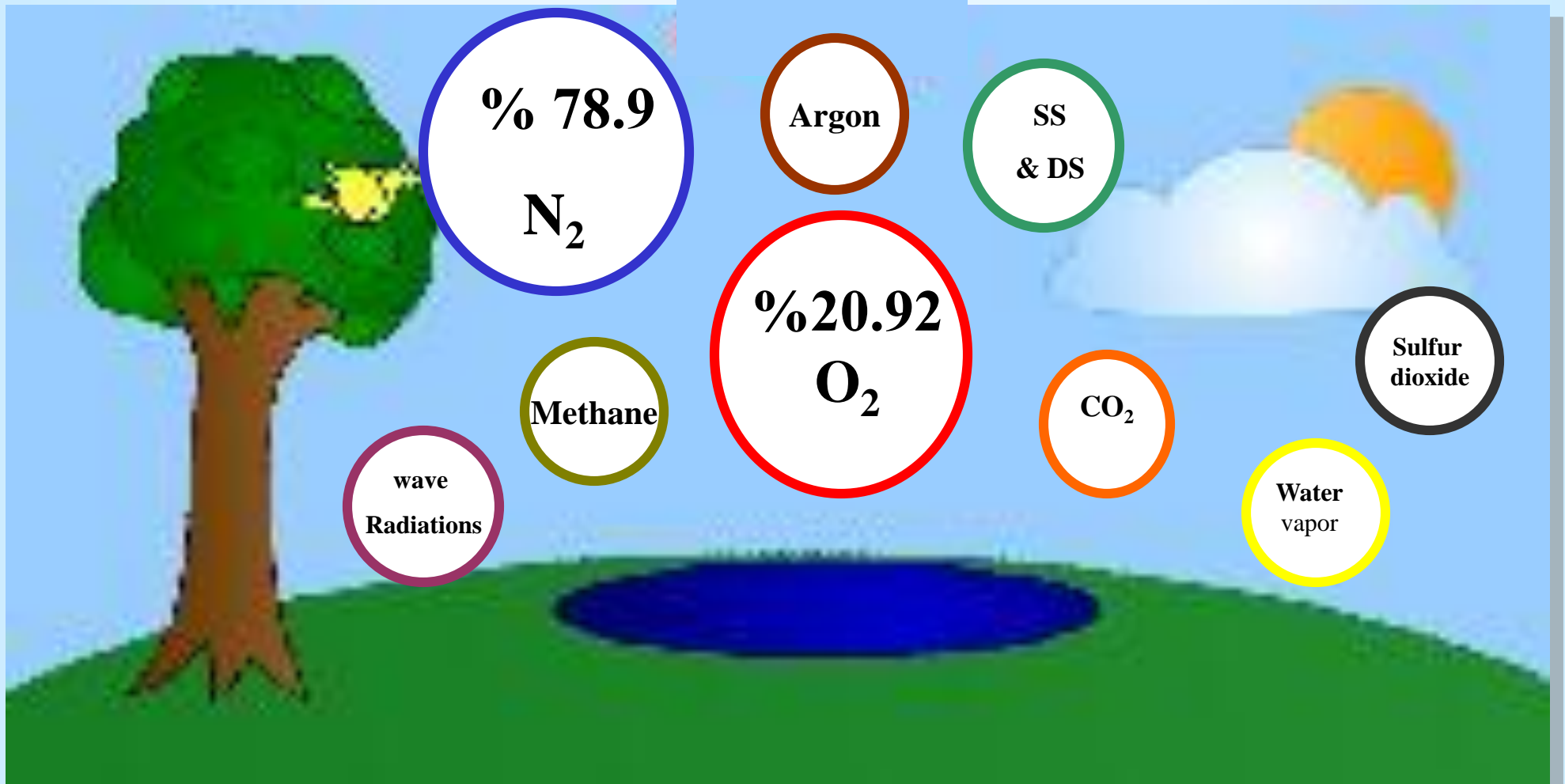
## ■ Human Requirements

- 16kg air./day
- cannot live without air for more than 3 min.



# Air Pollution

## Clean Air Component





# Common Definition of Air Pollution

***Air pollution is the introduction of chemicals, matter or other materials into the atmosphere that can bring harm or discomfort to humans or other living organisms and cause damage to the environment.***



# Definition of Air Pollution

## Legal definition in the state of Florida

***Air pollution is the presence in the outdoor atmosphere...of any one or more substances or pollutants in quantities which are or may be harmful or injurious to human health or welfare, animal or plant life, or property, or unreasonably interfere with the enjoyment of life or property, including outdoor recreation.***

***(Florida Administrative Code 1982)***



# when the contamination occurs ?

---

- **It occurs when the amount of the air compounds is increase or decrease which negatively effect the living organisms.**
- **The air is consider as polluted air when a Significant change release in the air component.**





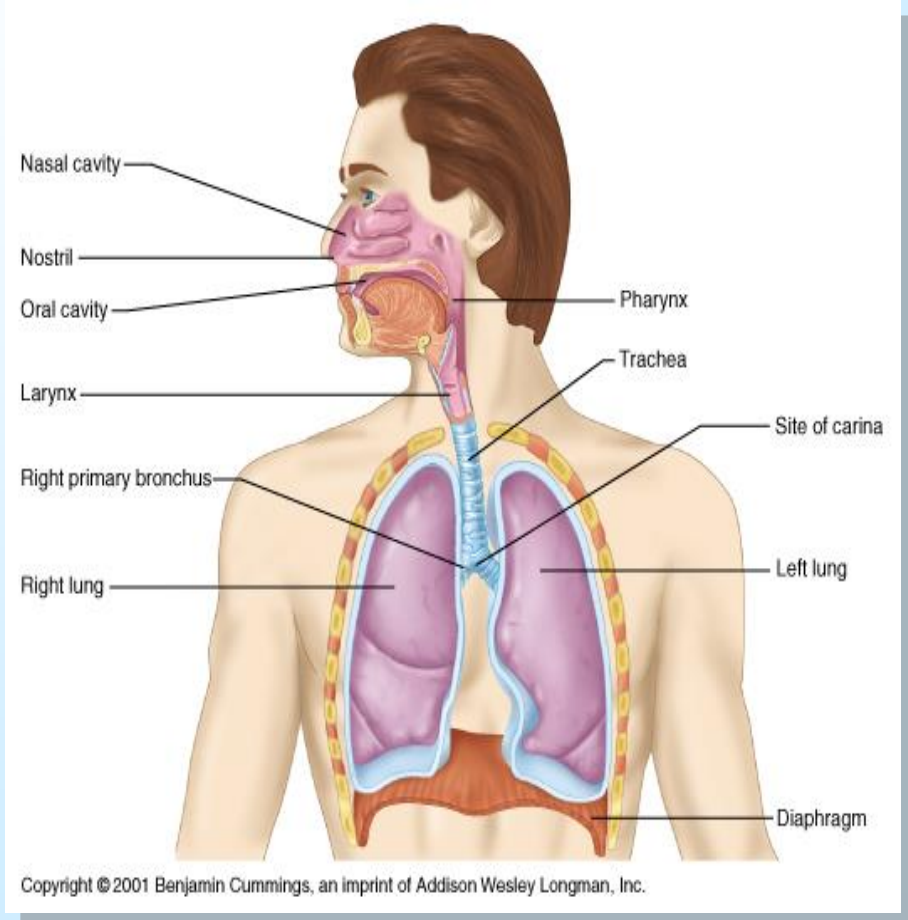
# Air Pollution

- **The exposure by pollution is release through:**

- 1) **Respiratory system**
- 2) **Skin**
- 3) **Digestive system**

**The degree of exposure risk is depend on:**

**Duration of exposure –  
Concentration – Toxicity**





# Clean Air Component

---



Through the inhalation process, Breathing rate is reach 17 to 18 times per minute. In each inhalation process, the person Consumes half liter of air. So, the consumed air is reached ten thousand liters per day



# Types of Pollutants

## Primary Pollutants:

A primary pollutant is an air pollutant emitted directly from a source

## Secondary Pollutant

Pollutants generated by chemical reactions occurring within the atmosphere.





# Sources of Air Pollution

- Natural
- Anthropogenic
- Classification of Air Pollutants
  - **Particulate Matters** : These are ensembles of solid and liquid particles suspended and dispersed in air. Properties of these particles vary in terms of :
    - Chemical composition
    - Morphology (size/shape)
    - Optical parameters
    - Electrical characteristics (charge, resistance)
  - **Gases:** Formless fluids which may be transformed into liquid or solid states by changing pressure and temperature



# Air Pollution Sources

---

- **Natural Sources**
- **Dust storms**
- **Volcanoes action and Volcanic ash**
- **Forest fires**

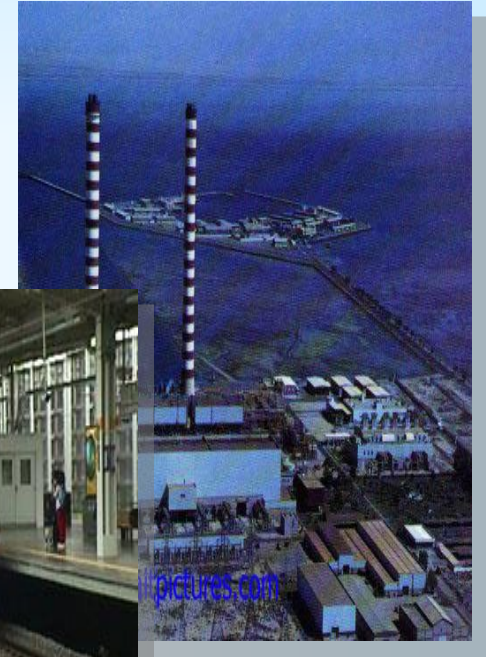




# Air Pollution Sources

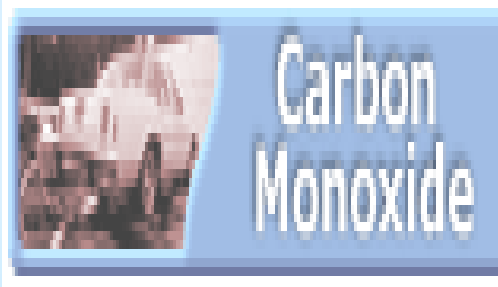
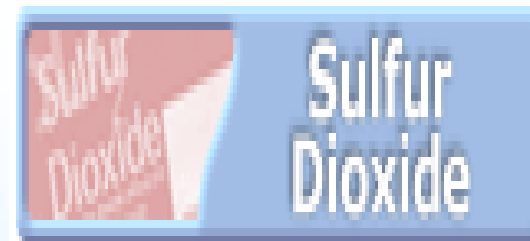
## • Man-Made Sources

- Oil Production & Petrochemical Products
- Solid waste
- Power Plants
- Transformation
- Technology development
- Constructions
- Mining Production
- Waste Water Treatment
- Oil Fires





# Six Common “Criteria” Air Pollutants

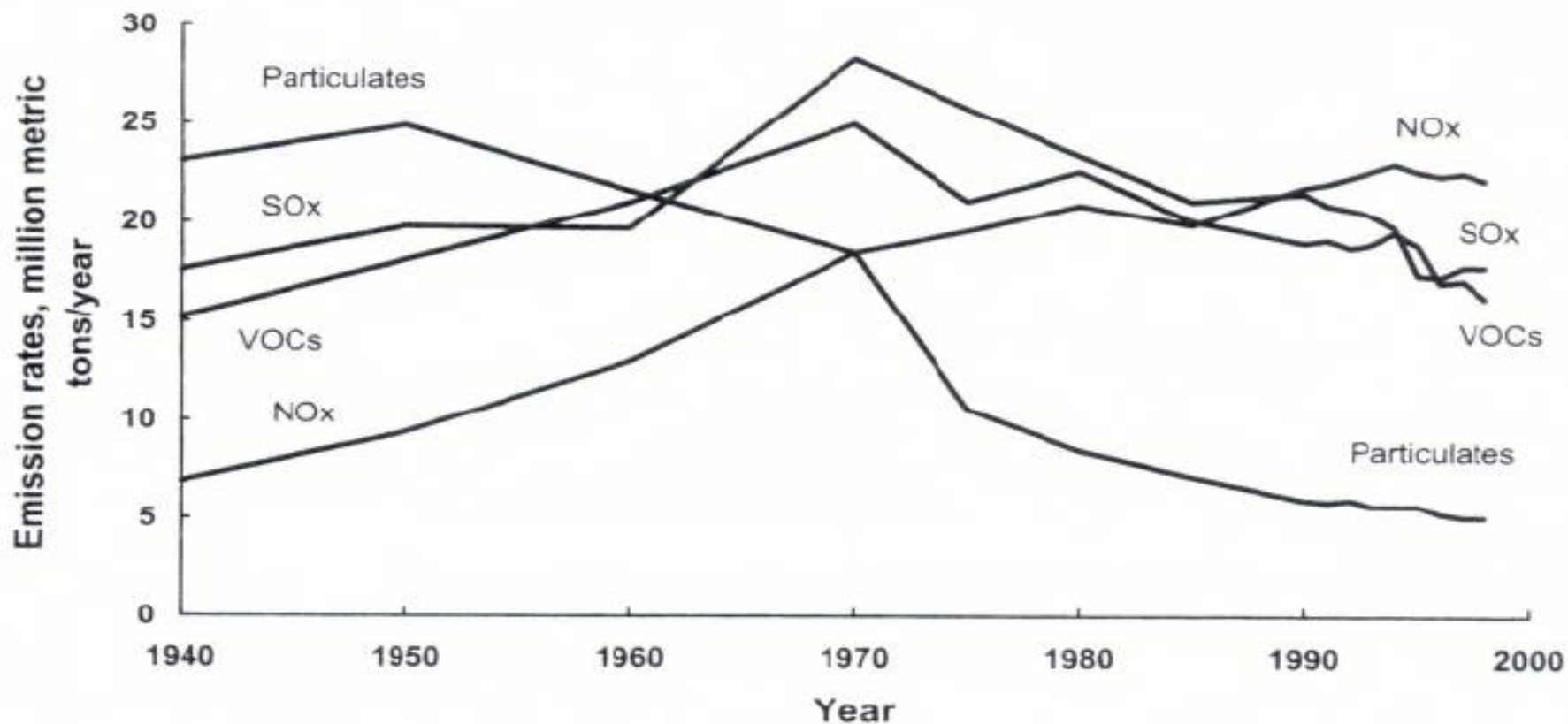




# Why Criteria Air Pollutants?

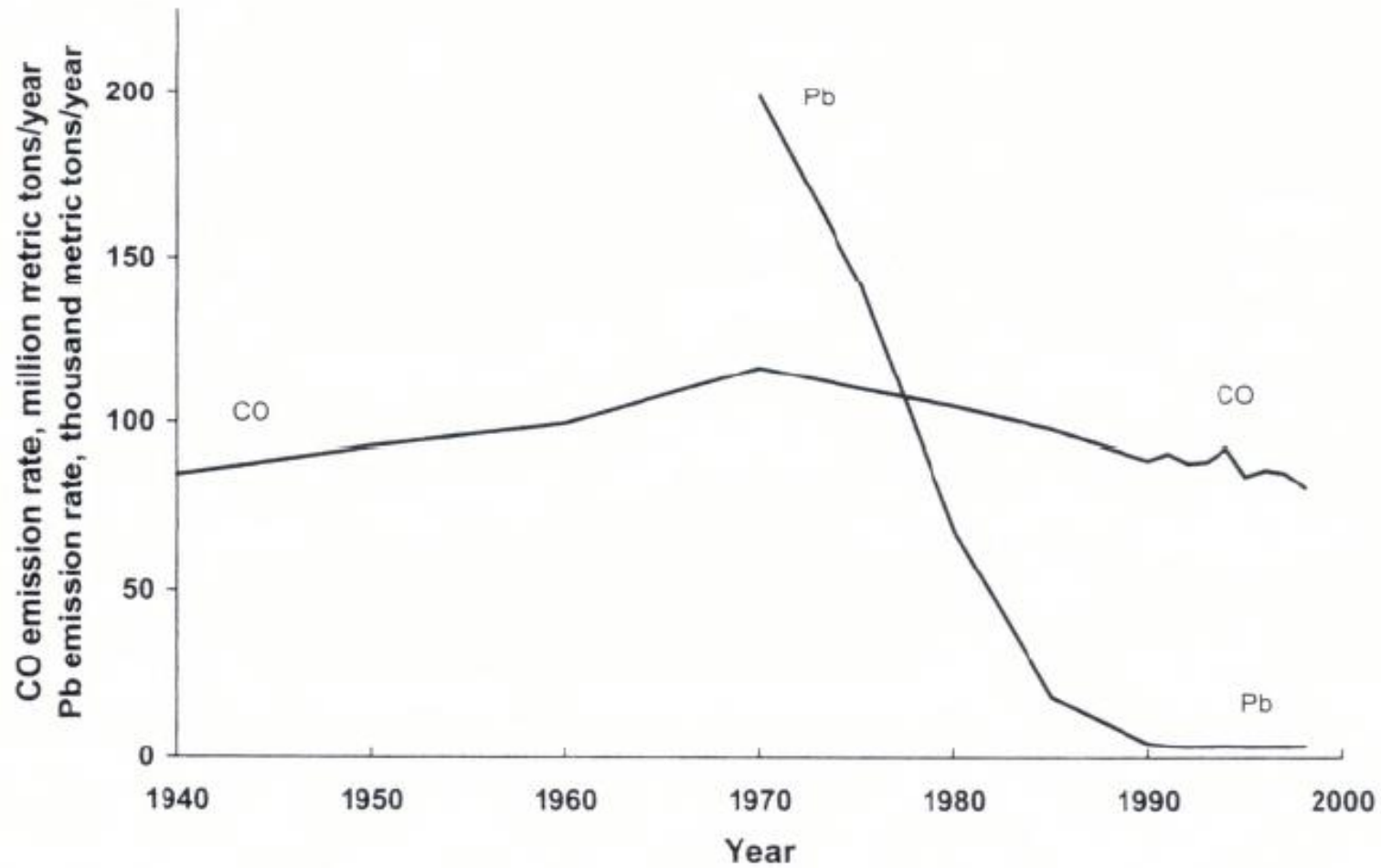
- US-EPA calls these pollutants "*criteria*" air pollutants because it *regulates them* by developing human health-based and/or environmentally-based criteria (science-based guidelines) for *setting permissible levels*.





**Figure 1.1**

Trends in U.S. annual emission rates for  $\text{SO}_x$ , particulates, VOCs, and  $\text{NO}_x$ .  
(Adapted from U.S. Environmental Protection Agency, EPA-454/R-00-003, 2000.)



**Figure 1.2**

Trends in U.S. annual emission rates for CO and lead.

Note: Lead data are unavailable prior to 1970.

(Adapted from U.S. Environmental Protection Agency, EPA-454/R-00-003, 2000.)



# The Most Important Pollutant in Kuwait

**NO<sub>x</sub> (NO, NO<sub>2</sub>)**

**NH<sub>3</sub>:Ammonia**

**O<sub>3</sub>: Ozone**

**HC: Hydrocarbon**

**Cl<sub>2</sub>:Chlorine**

**Pb: Lead**

**Dust**

**TSP: Total suspended particulates**

**SO<sub>2</sub>: Sulfur dioxide**

**H<sub>2</sub>S: Hydrogen sulphide**

**CO: Carbon Monoxide**

**CO<sub>2</sub> : Carbon Dioxide**



# Dust

---



- **Dust is a general name for solid particles (Organic & inorganic).**
- **Depending on the source of the particulate, it is differ in there chemical and physical composition.**
- **It is large and could be fall by the gravity.**



# Dust

**Dust Could be release  
because of:**

- **Drought**
- **Strong Wind**
- **Construction Process**
- **Open areas**





# Dust

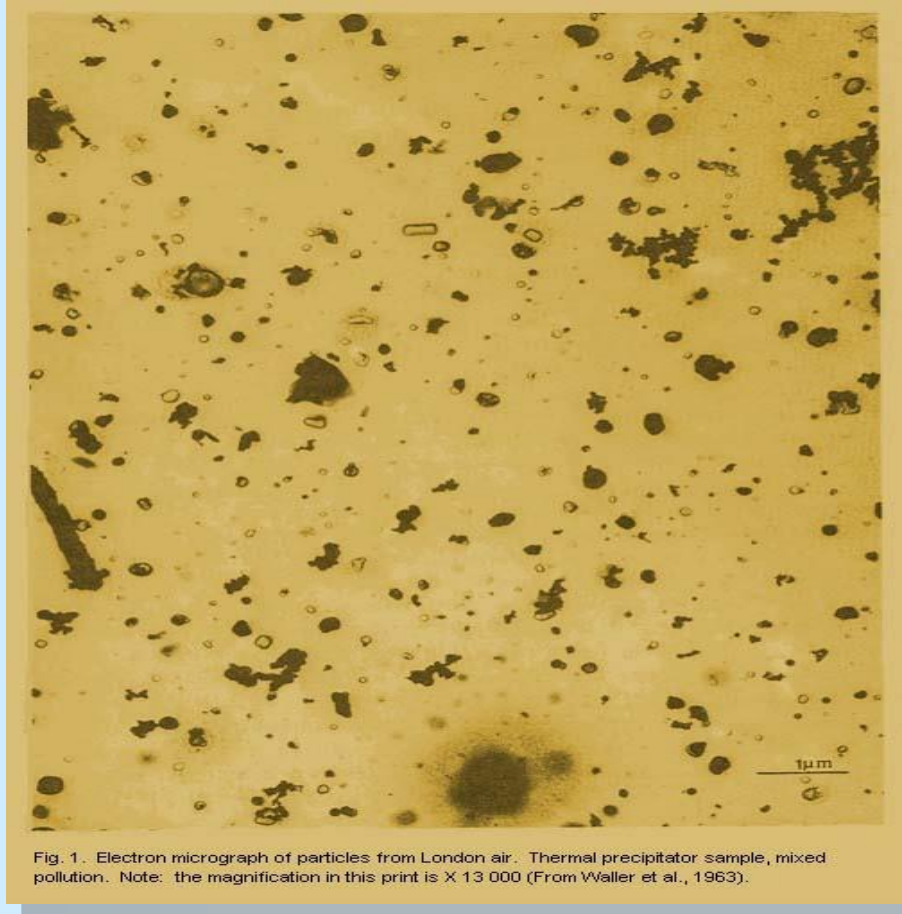
---



- **The Effect Dust :**
  - **Lousy vision**
  - **Changing in Sand Properties**



# TSP



- **Tiny Solids or Liquid particles**
- **Particles with diameters 0.1-100 micrometers**
- **It is travel to long distances because of the wind.**
- **The most danger particles are: Solids particles**



# Dust Origin and Types

## ■ Origin

Any process in which bigger particles are broken into smaller or any process in which powdered substances are transported from one place to other place

## ■ Type of Dust

- **Settleable dust**
  - **Settles under gravity**
  - **Size > 100 micron**
  
- **Suspended dust**
  - **Remains air borne**
  - **Size < 100 micron**





## Suspended Particulate Matter (SPM)

**Normally < 100 Micron in Size and Remains Suspended in Air for Considerable Time**

### **Types**

**Aerosols, Fumes, Smoke and Mists**

**Aerosols**

**Generally Particles < 1 Micron in size**

**Fumes**

**Solid particulates generated by condensation from gaseous state, often accompanied by chemical reaction such as oxidation, fumes flocculate**

**Smoke**

**Carbon or soot particles < 0.1 micron normally generated by incomplete combustion of carbonaceous fuel e.g. Coal, Tar, Oil**

**Mists**

**Suspended liquid droplets generated by condensation from gaseous to liquid state**



# Pollutant Characteristics and Effects

## Suspended Particulate Matter (SPM)

- **Characteristics**
- **Major sources of SPM include soot and condensed vapors from combustion in vehicles; stationary combustors; open burning of agricultural and domestic wastes; wind blown dust from devegetated areas; dust stirred up by vehicular traffic; and smelting and processing of non-metallic minerals. In asian cities, on an average over 60% of SPM is less than 10 microns in size (inhalable size range), frequently in the range of 0.6-1.0 microns, an 5-7 microns.**
- **Adverse Health Effects**
- **Exposure to high short-term levels of SPM has been linked to increase in illness and death from respiratory causes, especially when particulates include acid aerosols such as sulphate and nitrate particulates, and especially in the presence of high levels of SO<sub>2</sub>, Long-term exposure to high SPM levels results in increased susceptibility to respiratory illness, death from respiratory causes, and diminished lung function.**



# TSP



## Example of TSP:

- Lead – Cement Particles - Rubber Particles – Carbon release from incomplete combustion - SOOT
- Particles resulting from natural sources such as some types of bacteria, dust storms, salt particles resulting from the ocean, large number of volcanic eruptions ash.



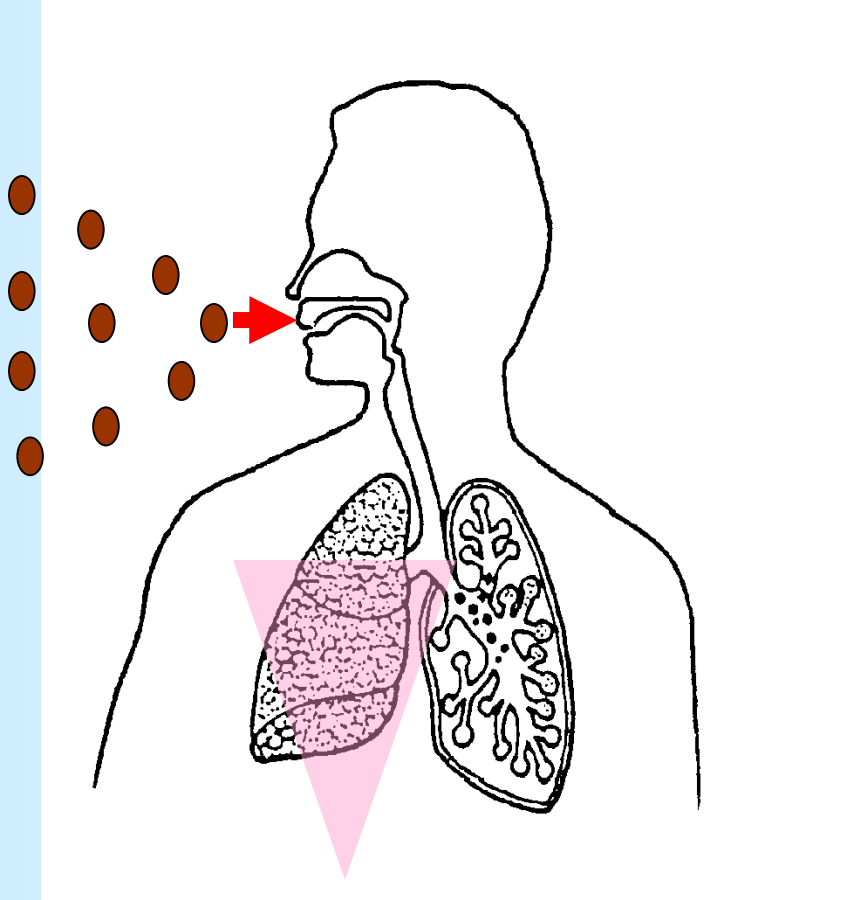
# TSP

- **TSP Sources:**
  - Car exhaust (It could release 80%)
  - Fuels used in the power plants application (it could release high concentrations of N<sub>2</sub> and SO<sub>2</sub>)
  - Volcanic ash
  - Fires
  - Cement Factories
  - Mining and quarries

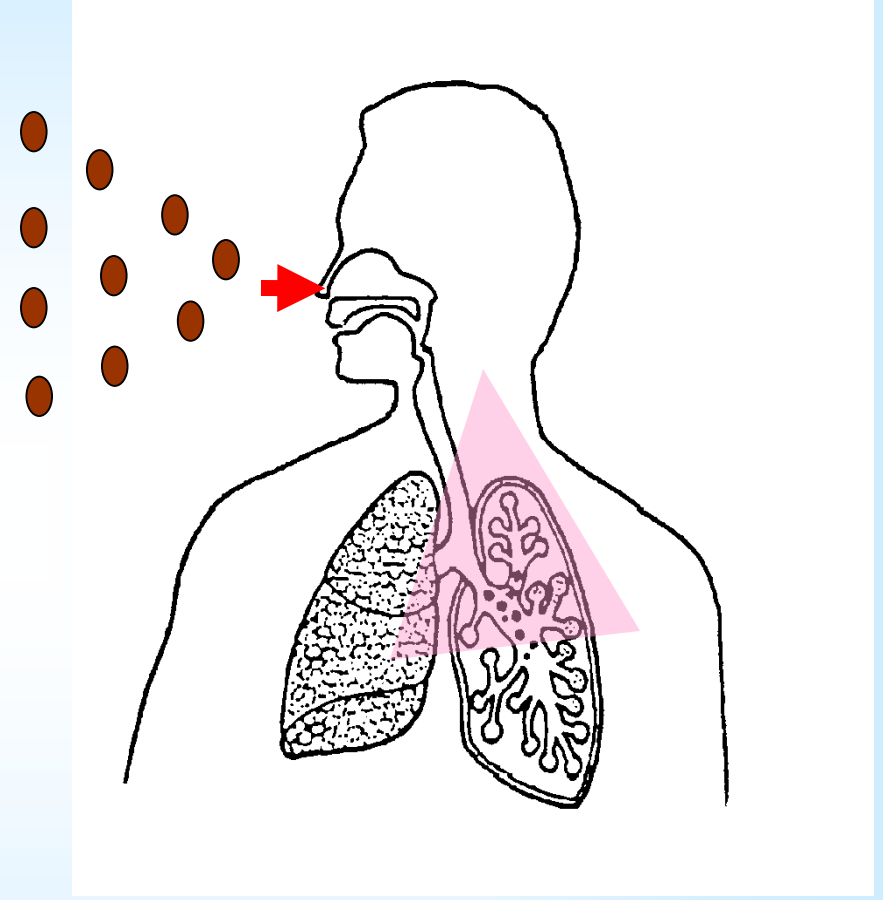




# الجسيمات العالقة TSP



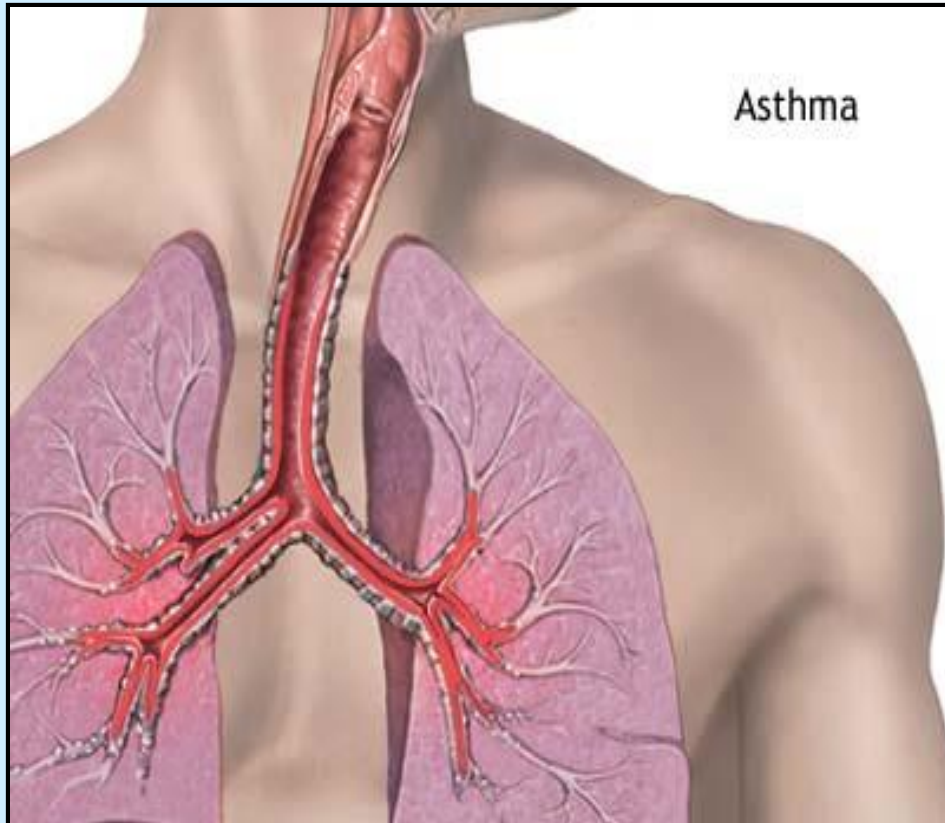
جسيمات تدخل الجهاز التنفسي السفلي  
قطرها من 5 ميكرون فأقل



جسيمات تدخل الجهاز التنفسي العلوي  
قطرها من 5-10 ميكرون



# TSP



## **TSP Health Effects:**

**-It could cause poisoning in some cases.**

**-It is negatively effect Patients with asthma and allergies**

# Fine Particulate Matter (PM<sub>2.5</sub>)

**Aerodynamic Diameter < 2.5  $\mu\text{m}$**

**Limits: 65  $\mu\text{g m}^{-3}$  for 24 hr**

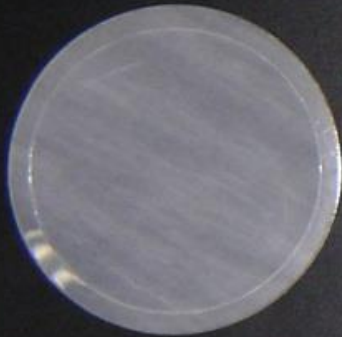
**15  $\mu\text{g m}^{-3}$  annual mean**

- **Primary and secondary pollutants.**
- **Major health effects**



# TSP

**Samples taken from Kuwait City (after Iraqi invasion) through the years (1992-1993) via using PM 10 device**



**Filter  
Without  
Sample**



**Coarse Particles  
(2.5-10  
Micrometer)**



**Micro Particles  
(2.5-0  
Micrometer)**





# The most important solid pollutants in the atmosphere

## Lead

- Lead could be result from the use of coal as an energy source in industrial installations
- The most important outcomes of the Gasoline combustion (The use of leaded benzene)





# The most important solid pollutants in the atmosphere

---

The following points are represent the health effect of Lead:

1. It has bad effect on human enzymes.
  2. Main cause of Anemia
  3. Effects the brain cells
  4. If the plant were exposed by lead, the lead could be bioaccummulate by human or animal
-



# The most important solid pollutants in the atmosphere

---

## Mercury

- Mercury metal is used in chemical industries such as: pesticides and mineral industries
- The major source of Mercury : pesticides + the waste of industries
- It could reach lakes and rivers by the Leakage Industrial wastewater
- Bioaccummulate through the food chain



# The most important solid pollutants in the atmosphere

---

The major bad effects of Mercury on human health:

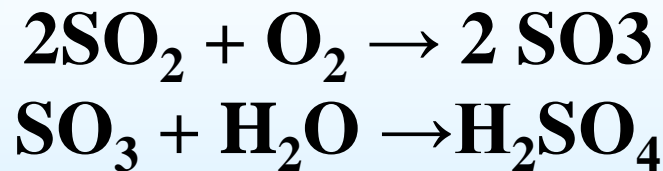
It could cause headache and dizziness, kidney failure, strong damage in the digestive system in the case of severe poisoning, then it will end up in a death



# SO<sub>2</sub>

---

- **Colorless gas**
- **Non-flammable gas with a penetrating odor that irritates the eyes and air passages**
- **Oxides in the air to form SO<sub>3</sub>**
- **Dissolved in water vapor to form H<sub>2</sub>SO<sub>4</sub>**





# SO<sub>2</sub>



**Power Plants Station**

## **The major Sources of SO<sub>2</sub>:**

- **Volcanoes**
- **The burning of fossil fuels**
- **Oil refinery**
- **Power Plants Station**
- **Car exhaust**



# SO<sub>2</sub>

---

- The major bad effects of SO<sub>2</sub> on human health:
  - Respiratory diseases
  - The erosion of buildings
  - The major cause of [Acid Rain]



# Volcano Etna in Italy



**Etna volcano release SO<sub>2</sub> gas each year, equivalent to about two million tons of sulfuric acid**



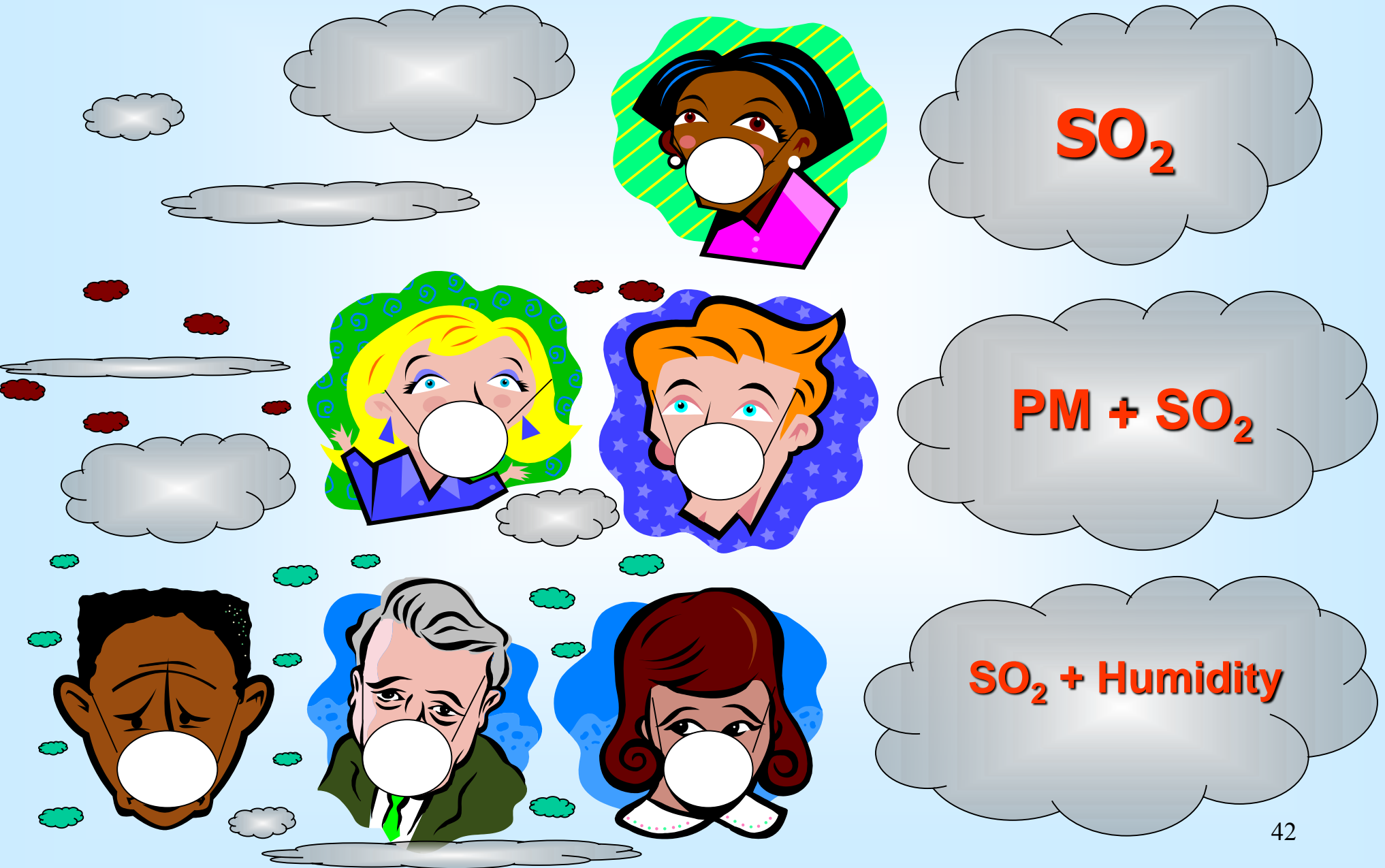


# How the spread of sulfur dioxide as a contaminant



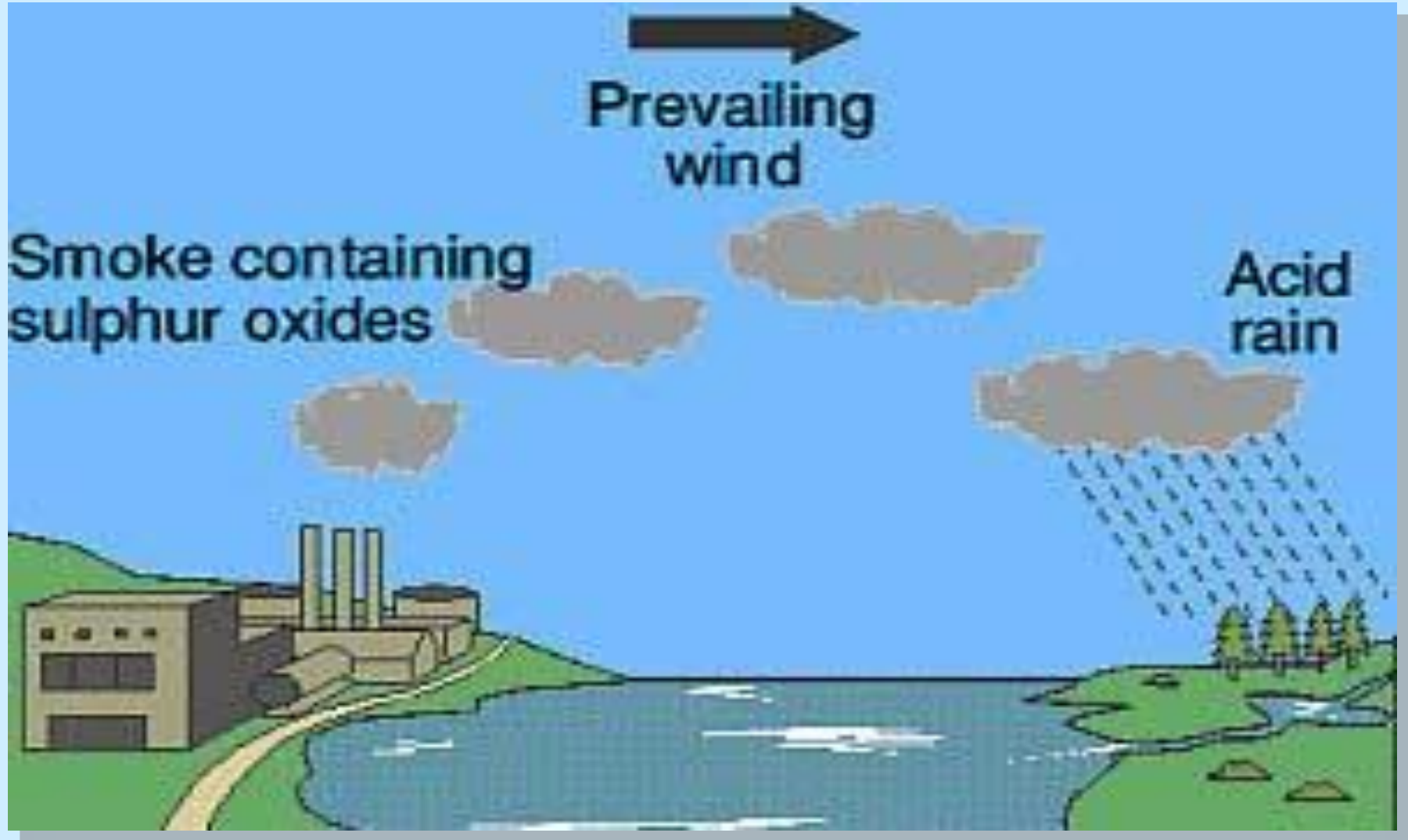


# The general effect of SO<sub>2</sub>





# Acid rain phenomena – $\text{SO}_2$



# LONDON-TYPE SMOG

## Sulfur Dioxide, $\text{SO}_2$

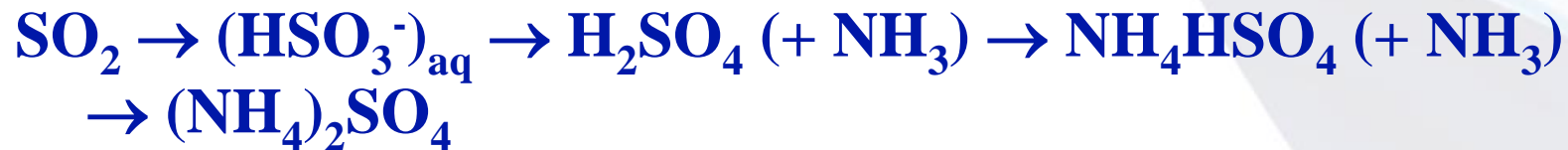
### Primary

### Effects

1. Produces  $\text{H}_2\text{SO}_4$  found on particles and in precipitation
  - Acid Deposition
2. Cloud Condensation Nuclei (climate)
3. Materials degradation
4. Respiratory tract (esp. bisulfites,  $\text{HSO}_3^-$ )
5. Phytotoxin

# Sulfur Dioxide, SO<sub>2</sub> (cont...)

**Limits: 140 ppb for 24 hr**  
**500 ppb for 3 hr**  
**30 ppb annual mean**



- **No catalytic photochemistry**



# H<sub>2</sub>S



**Sanitation Station**

H<sub>2</sub>S is A colorless, flammable, poisonous compound having characteristic rotten-egg odor.

- **Major Source of H<sub>2</sub>S:**
  - Decomposition of plant and animal protein
  - Oil refinery and production
  - Sanitation
  - Coal production



**The redness of eye**

## **H<sub>2</sub>S Health bad effect:**

- **Bad effect on eye and respiratory system**
- **Gives a strong feeling of Inaction**
- **Unwanted odor**



# Carbon Monoxide (CO)

---

- **colorless gas and smell**
- **Highly toxic**
- **The most widespread pollutants in the urban area**





# Carbon Monoxide (CO)

---

- **The most important factors to from CO:**

- ✓ **Waste incineration**
- ✓ **Incomplete Combustion**
- ✓ **Transportation**
- ✓ **The photosynthesis reactions for the**
- ✓ **hydrocarbons.**

**The problems of carbon monoxide are most concentrated in the cities, where the exhaust of cars lined the streets, tall buildings on either side**

**The degree of concentration of carbon monoxide in the air around us depends on the number of vehicles, as well as on the state of the atmosphere and the rate varies from day to day**



# أول أكسيد الكربون CO



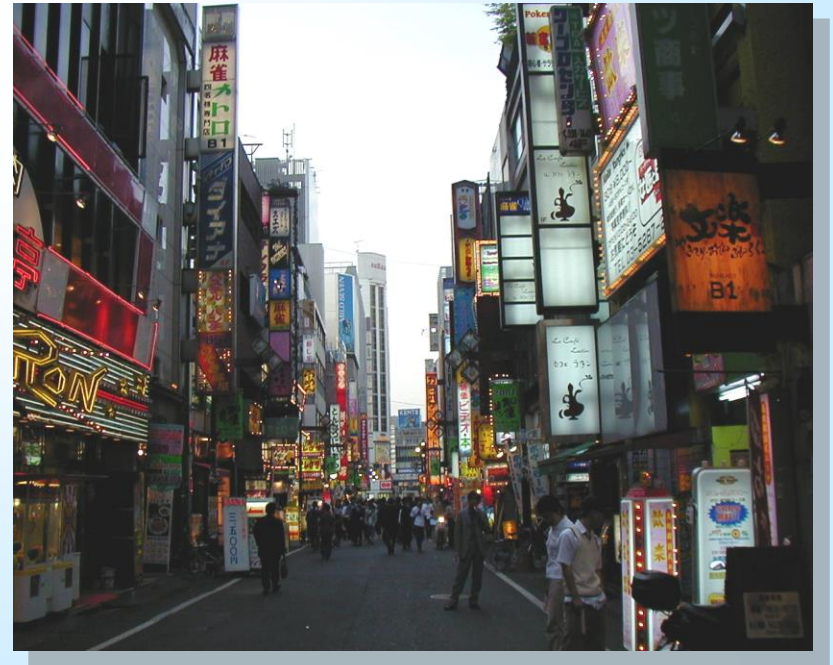
عوادم السيارات  
Car Exhausts



# أول أكسيد الكربون CO



Clear carbon monoxide problems are most concentrated in the cities where the exhausts of cars in streets lined with high buildings on either side





# أول أكسيد الكربون CO



**The degree of concentration of carbon monoxide in the air around us depends on the number of vehicles, as well as on the state of the atmosphere and the rate varies from day to day**



# The negative effects of carbon monoxide (CO)

---

- **Combine with hemoglobin in the blood forming carboxy hemoglobin compound, which prevent the access of oxygen to blood, because that the oxygen does not reach the body's cells**
- **Causing severe anemia and mental damage that compete in the oxygen absorption.**
- **Affect the fetuses and newborns, as well as older persons and vulnerable health**



# Carbon Monoxide (CO)

---

- Consisting of carbon monoxide gas as a result of photosynthesis interactions of hydrocarbons found in the polluted atmosphere, and from God's grace it is oxidized to carbon dioxide by natural factors such as certain types of bacteria that live in soil
- Oxidizes carbon monoxide by the sun's rays by 1% per hour

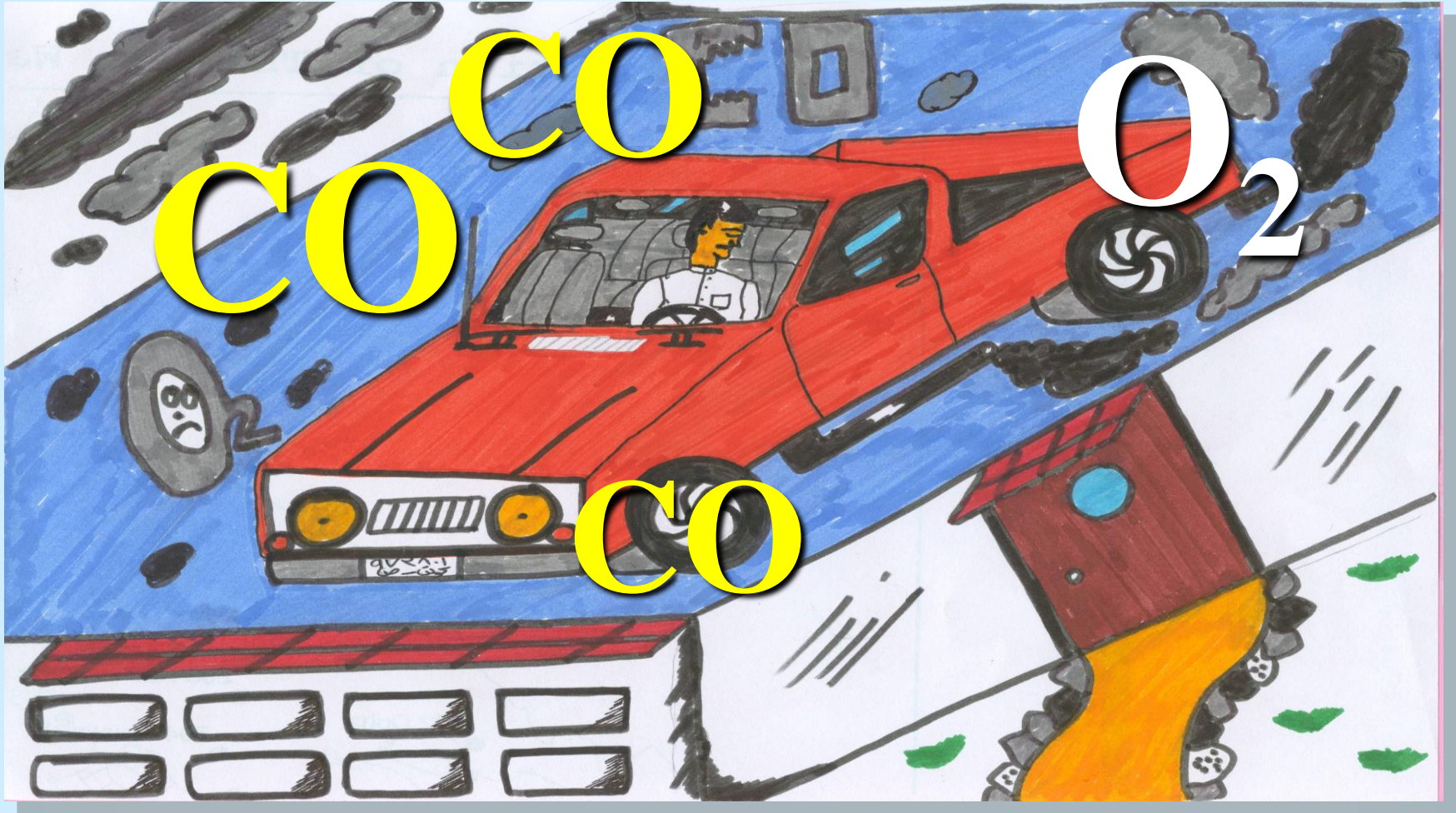


# CO become more danger in less aerated places





# CO become more danger in less aerated places







# CO become more danger in less aerated places





# CO become more danger in less aerated places



# Carbon Monoxide, CO

## Primary

### Effects:

- 1. Respiration (acute)**
- 2. Cardiovascular system (chronic)**

### Limits:

- 9.0 ppm for 8 hr**
- 35 ppm for 1 hr**
- 50 ppm for 8 hr is the "level of significant harm"**

# Carbon Monoxide, CO (cont...)

- **Affinity for hemoglobin 200 times that of O<sub>2</sub>.**
- **Concentrations above 750 ppm are fatal.**
- **Concentrations > 100 ppm cause dizziness, headache, loss of visual & mental acuity.**
- **Cigarette smoke contains ca. 400 ppm CO (also HCN, H<sub>2</sub>CO, Ni(CO)<sub>4</sub>, NO<sub>2</sub>).**

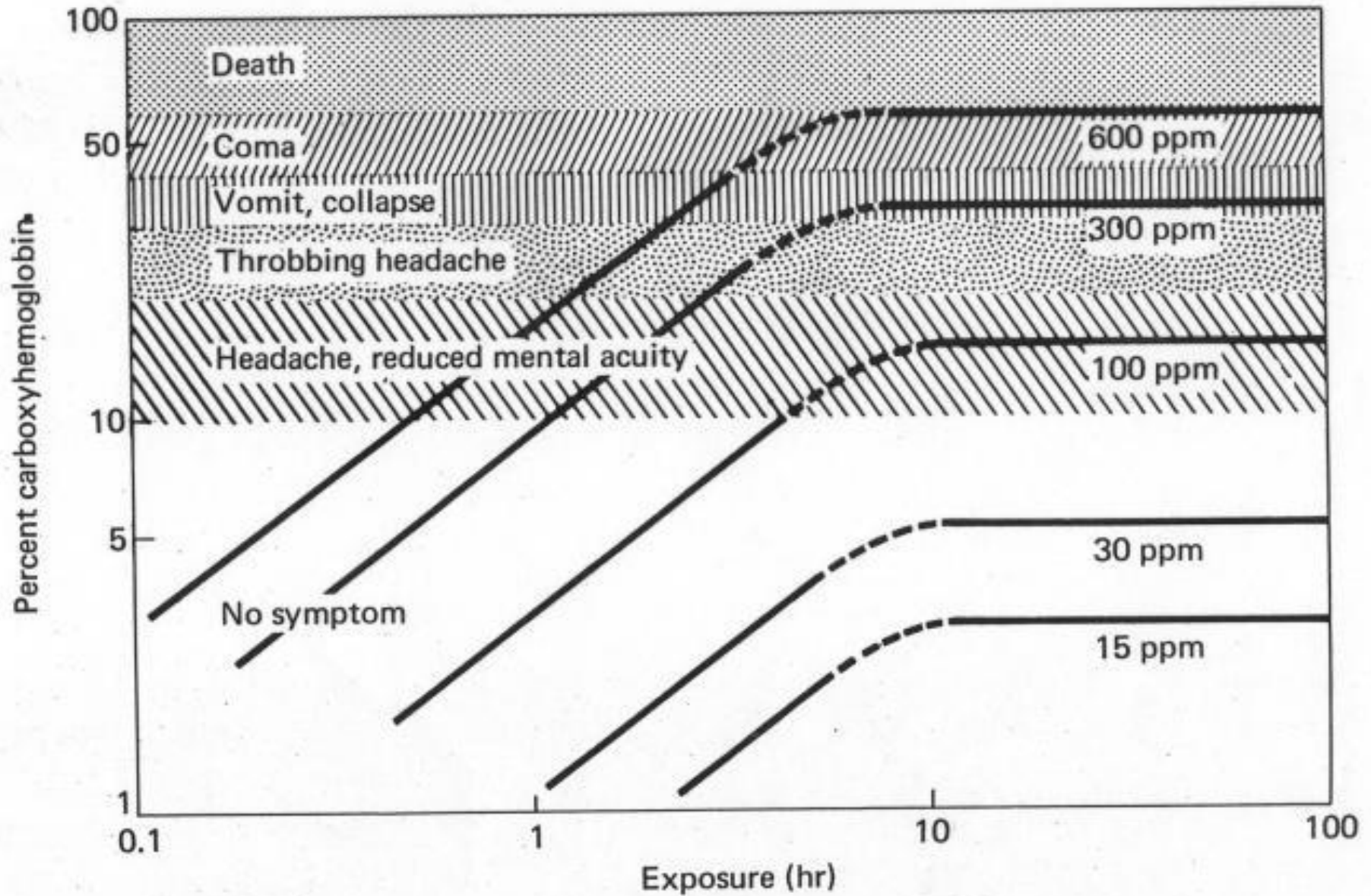


Figure 2.1. Effects of exposure to CO on man.



# Carbon Dioxide (CO<sub>2</sub>)

---

- Colorless gas and odorless. .
- Highlighted sour taste snobs .
- Is not considered air pollutants, it is about 0.03 to 0.06% of the atmosphere
- It is very important gas for life to be represented as organic material stored in plants and animals that depend on them as a food source
- It is considered as a greenhouse gas that protect the earth's temperature during night.
- It is responsible for global warming.



# **The most important factors for carbon dioxide**

---

- **The combustion of carbon materials (organic materials)**
- **The burning of coal and petroleum products**

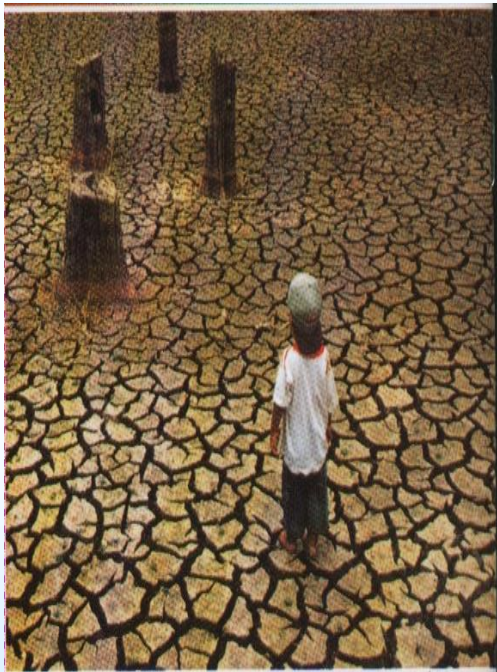


# Carbon Dioxide (CO<sub>2</sub>)

The increased concentration of carbon dioxide in the atmosphere every year is because of the expanding operations in the fuel combustion, and the spread of desertification, and deforestation



**Deforestation**



**Desertification**



**Fuel combustion**





# The negative effects of Carbon dioxide

---

- Shortness of breath when the gas concentration is about 5% and fainting when it reaches 10%
- Causes Greenhouse phenomenon



# **The risks for increasing Carbon Dioxide emissions in the atmosphere**

---

**Warming the earth's atmosphere than normal, leading to serious environmental problems which are:**

- Global warming**
- The theory of cooling (Ice Age)**



# Global Warming

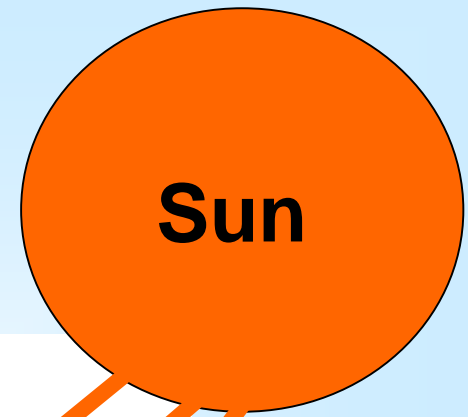
---



**This phenomenon leads to an increase in the temperature of the Earth's atmosphere**



# Greenhouse phenomenon



Sun Rays

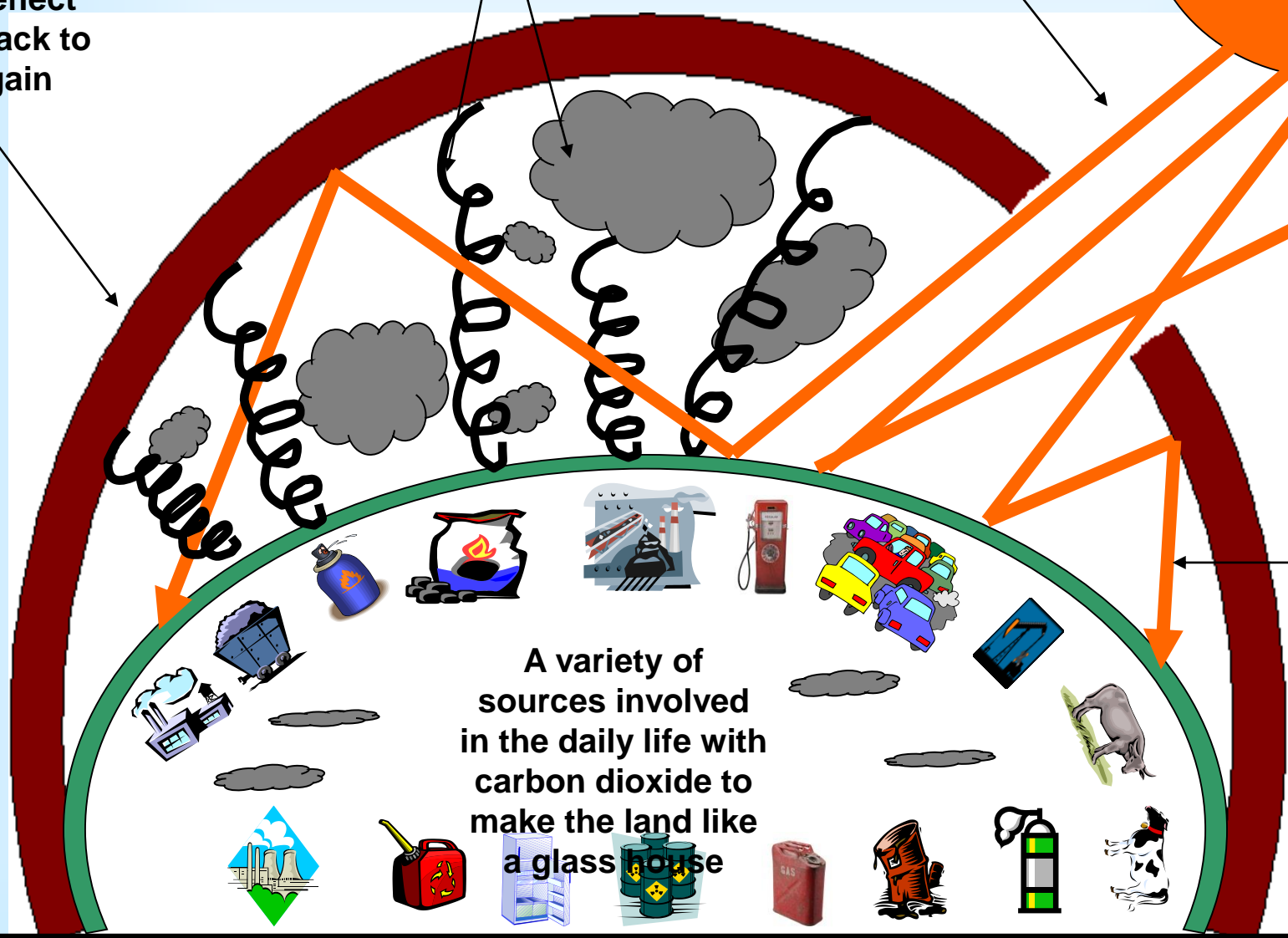
Carbon dioxide

Sun

A layer of carbon dioxide reflect sunlight back to earth again

Normal X-ray back up into outer space

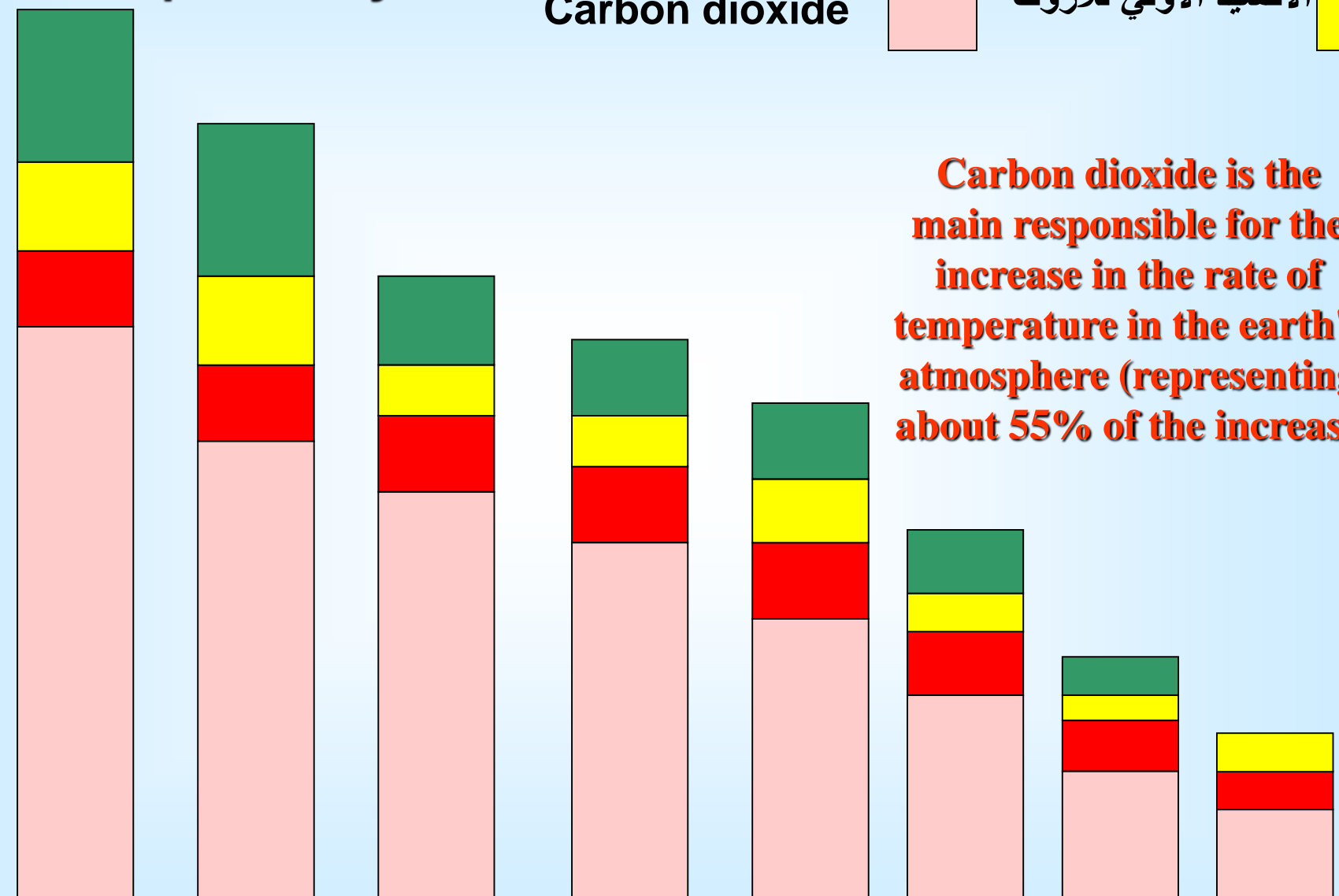
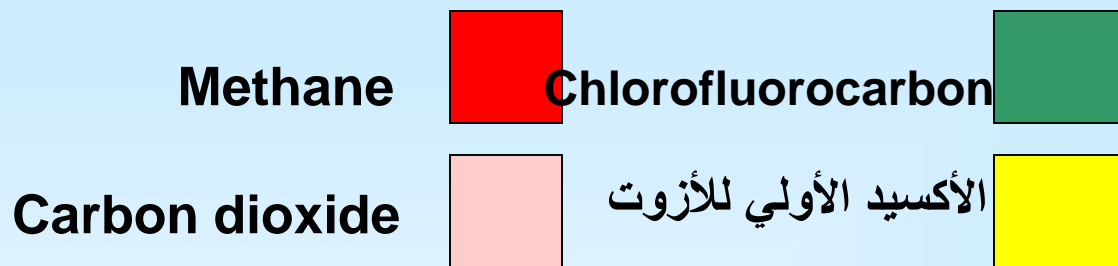
Rays reflected once again on the earth



A variety of sources involved in the daily life with carbon dioxide to make the land like a glass house



# The greenhouse gases percentage in the atmospheric layers



**Carbon dioxide is the main responsible for the increase in the rate of temperature in the earth's atmosphere (representing about 55% of the increase)**

2020 2010 2000 1990 1980 1970 1960 1950<sup>69</sup>



# Carbon dioxide CO<sub>2</sub> (The theory of cooling)

---

The theory of cooling (Ice Age), which eventually ends in the low temperature of the Earth





# Carbon dioxide CO<sub>2</sub>

---

**More likely, which is supported by the majority of scientists is the increase in temperature of the earth's atmosphere**



# Nitrogen Oxides $\text{NO}_x$ ( $\text{NO}_2$ , $\text{NO}$ )



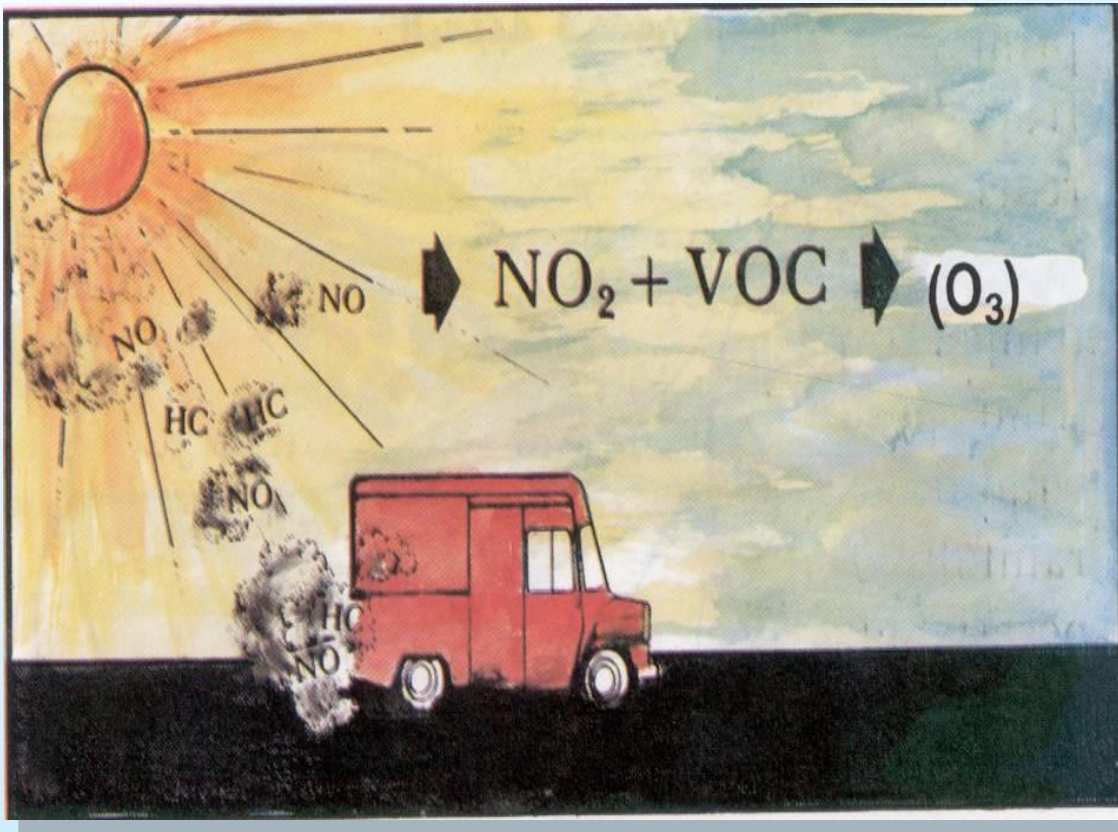
- **Reddish brown gas**
- **Has a pungent smell**
- **Most of the oxides is from the exhaust of motor vehicles, especially nitrogen dioxide, which is more toxic than carbon monoxide that gives the polluted air a dark color (reddish).**
- **Responsible for an acid rain or acid fog formation, especially nitrogen dioxide**





# Nitrogen Oxides (NO<sub>x</sub>)

## The ozone layer formation

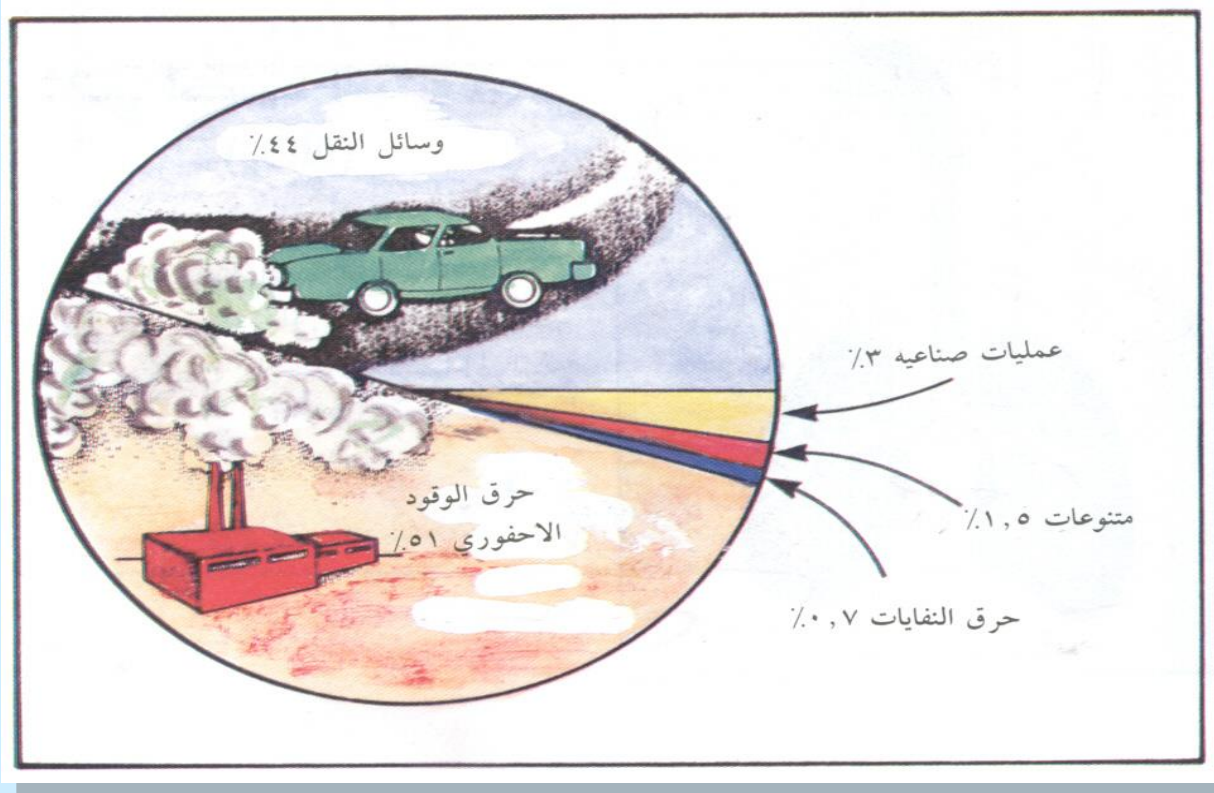


These oxides react with other air pollutants by some of the photosynthesis interactions which resulted in the formation of smog and form the ozone layer.



# Nitrogen Oxides (NO<sub>x</sub>)

## Sources of nitrogen oxides resulting from the human activities



- The most important factors to form the NO<sub>x</sub>:
  - Car exhausts
  - The burning of fossil fuels
  - Oxidation of nitrogen compounds
  - High-temperature combustion furnaces
  - At the time of the lightning
  - Volcanoes



# Nitrogen Oxides (NO<sub>x</sub>)

---

- **It's side effects:**
  - ✓ **Reduce the vision**
  - ✓ **Respiratory infection and affects the heart patients**



# Nitrogen Dioxide, NO<sub>2</sub>

## Primary

### Effects:

1. Lungs (acute chemical pneumonia)
2. Phytotoxin
3. Catalyst for ozone formation
4. Atmospheric acidity (about 1/3 of problem and growing)

**Limit: 100  $\mu\text{g m}^{-3}$  (50 ppb) annual mean**



# Ammonia gas $\text{NH}_3$

---

- Colorless gas has a strong smell
- Dissolves in water
- Found in the atmosphere in a small quantities
  
- ❖ The most important factors to form Ammonia gas:
  - Nitric acid manufacturing and oil refining
  - Manufacturing ammonia and urea
  - Fermentation of organic compounds of nitrogen
  
- ❖ It's side effects:
  - Highly toxic irritation of the mucous membrane of the respiratory system, eyes and throat
  - Affects the nervous system in the high concentrations



# Ozone gas ( $O_3$ )

---

- Gas with a pungent odor
- Blue color
- Composed by human activities in the troposphere layer by photosynthesis interactions

❖ The most important factors to form Ozone gas:

- Nitrogen oxides with hydrocarbon vapors and carbon monoxide reaction in the presence of sunlight
- Welding operations and the use of high-voltage electrical currents

❖ It's side effects:

- Damage to lung tissue
- Has toxic effects on plants
- Impacts on the atmosphere

# Ozone, (Photochemical Oxidant)

## Secondary

### Effects:

1. **Respiration - premature aging of lungs (Bascom et al., 1996).**
2. **Phytotoxin, i.e. Vegetation damage (Heck et al., *JAPCA.*, 1982; Schmalwieser et al. 2003; MacKinzie and El-Ashry, 1988)**
3. **Materials damage - rubber**
4. **Greenhouse effect (9.6  $\mu\text{m}$ )**

**Limit: 120 ppb for 1 hr. (Ambient Air Quality Standard)**

**80 ppb for 8 hr**

- **Ozone is an *indicator* of smog.**
- **Ozone regulates many other oxidants**

# O<sub>3</sub> damage to animals and plants

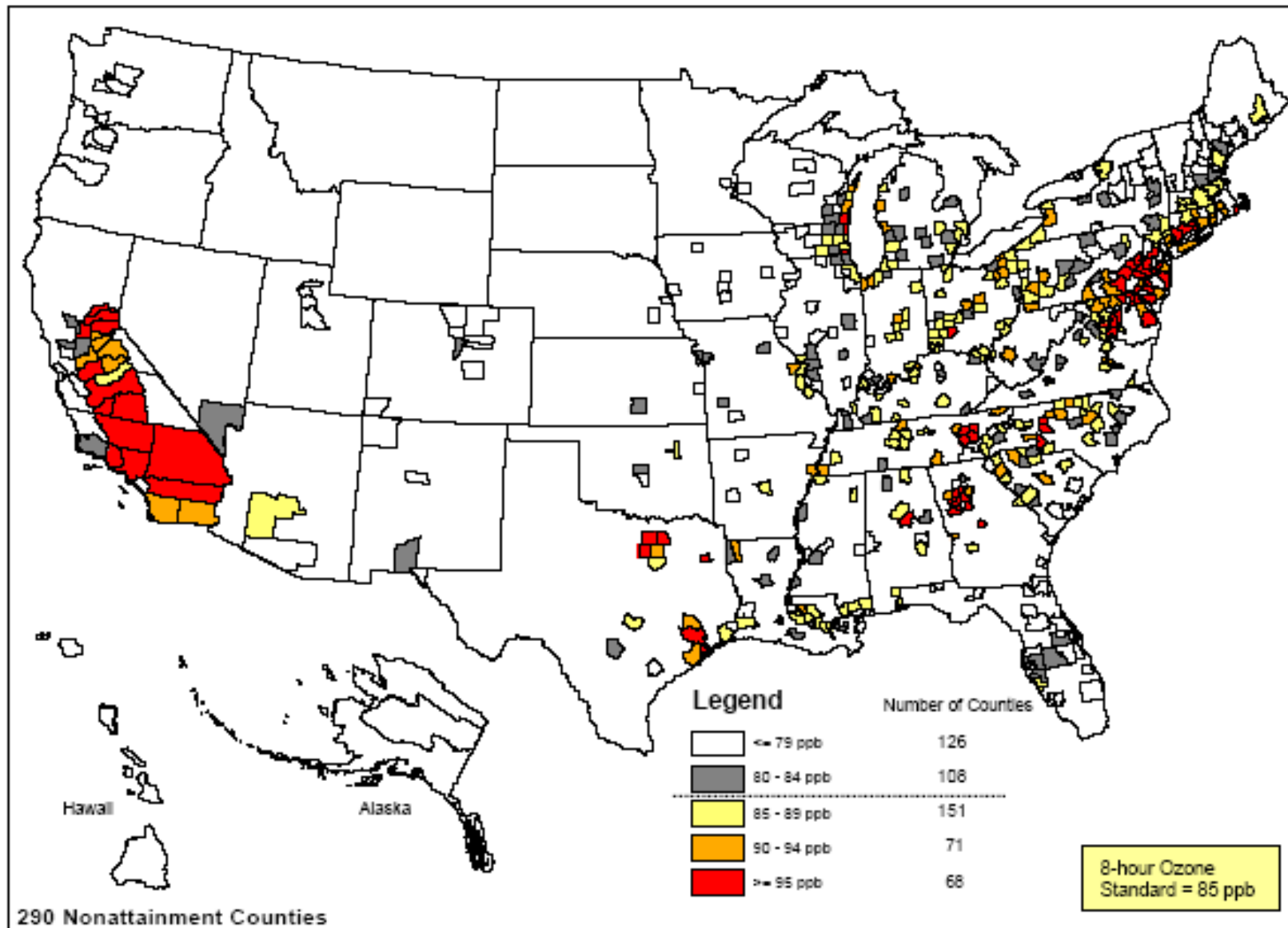
- a) **Kills microorganisms**
- b) **Oxidizes organic compounds**
- c) **Effects sensitive tissues**
- d) **Etching of eyes and skin**







# Ozone is a national problem

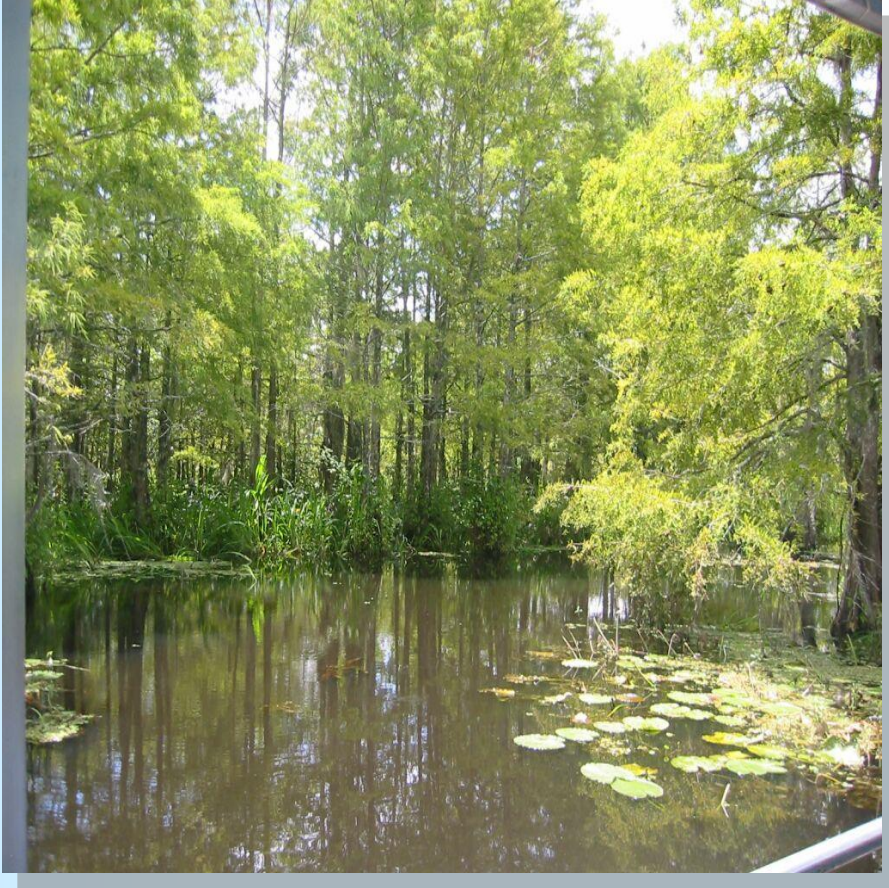


Note: Based on 1999-2001 monitoring data of counties with monitors that have three years of complete data.

**Ozone : Good Up High, Bad Nearby**



# Hydrocarbons



**Swamps**

- ❖ Organic compounds consisting of hydrogen and carbon combination only .
- ❖ It is form as a gaseous state, liquid or solid in the normal weather conditions, depending on (the degree of boiling - volatility - the pressure of the steam
- ❖ Simplest of these compounds of methane gas ( $\text{CH}_4$ ) and is characterized as:
  - Colorless gas, and the tasteless and smell less.
  - Heavier than air and replace the oxygen of the atmosphere, causing the drowsiness and sleepiness
  - Known as marsh gas or ponds because it is generated from fermentation plant material at the bottom



# Hydrocarbons



**Safe lung**



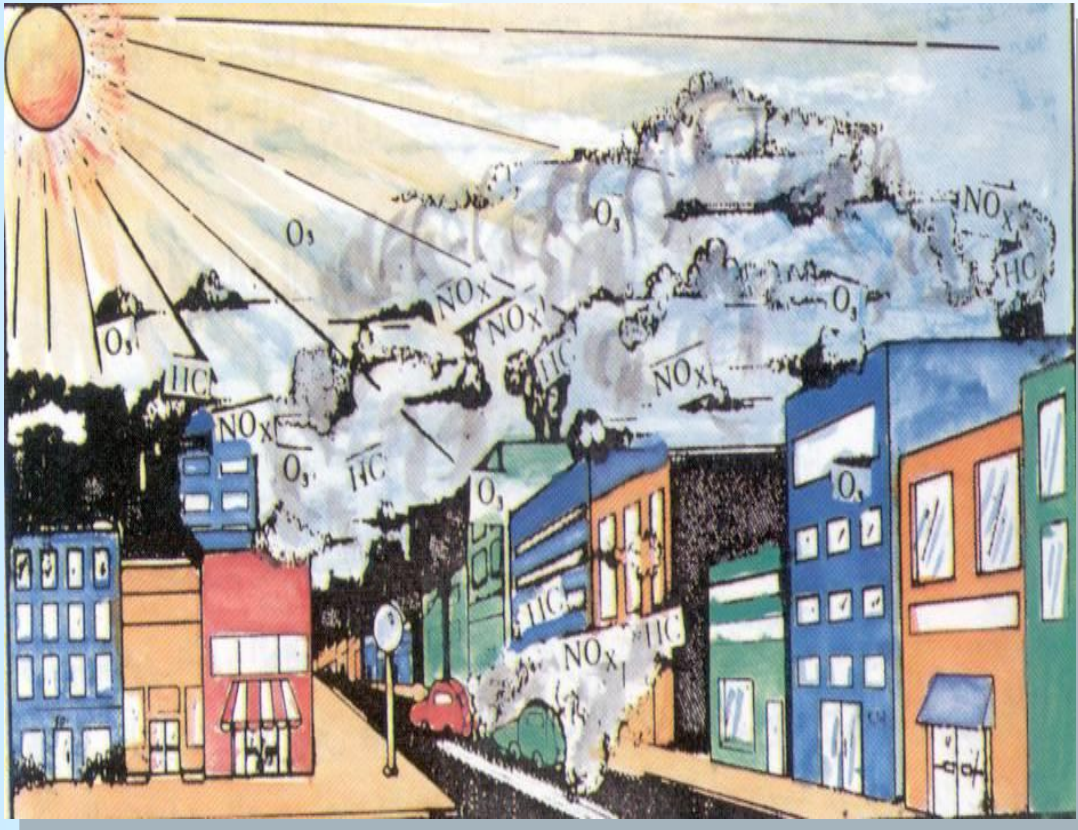
**With lung cancer**

- ❖ The most dangerous of these compounds are aromatic hydrocarbons such as multiple episodes of gasoline .
- ❖ The seriousness of such materials is due to cause cancer
- ❖ Benzopyrene compound is one of the most harmful hydrocarbons that cause cancer .Its the result of
  - Fuel combustion
  - Smoke from the cigarettes smoked
  - Combustion of coal in the barbecue meat
  - During the use of tar in the pavement of the streets



# Hydrocarbons

**The ozone layer due to the photosynthesis interactions (the interaction of nitrogen oxides with organic compounds)**

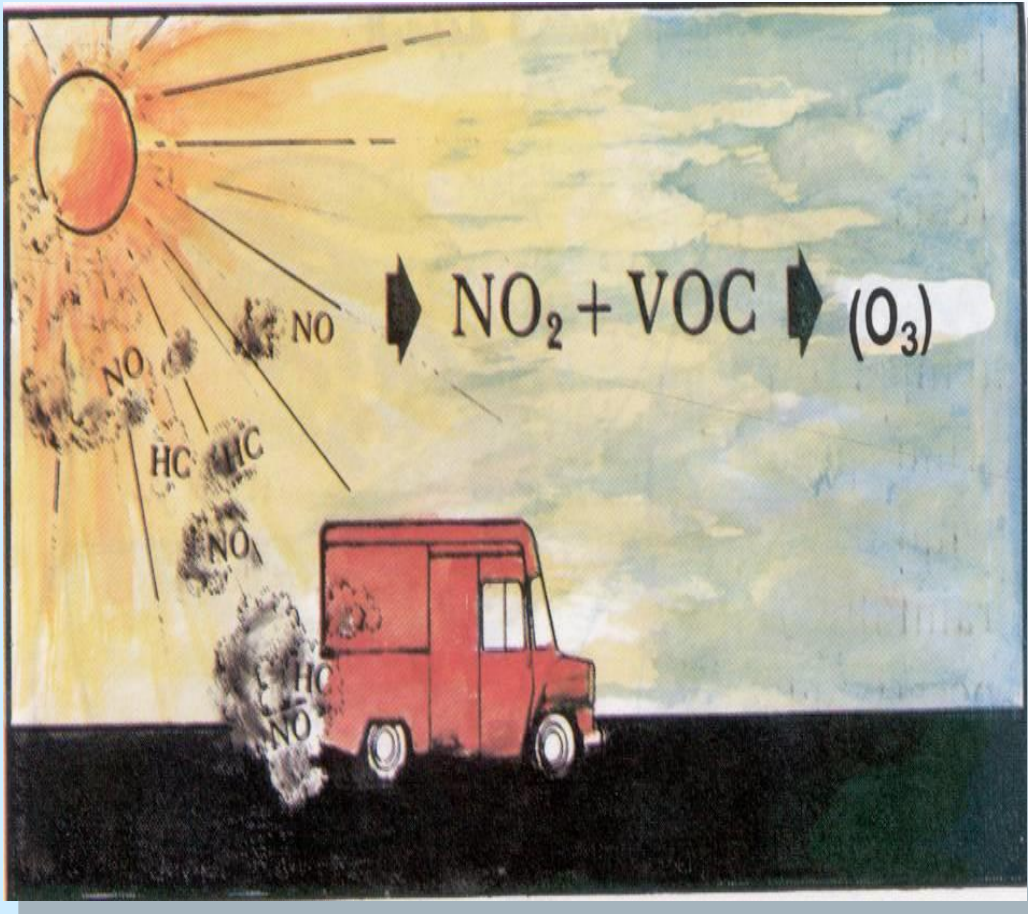


- Volatile organic compounds derived from hydrocarbons and is characterized as containing carbon and hydrogen and some other elements
- Many of them toxic .
- Low boiling point and high evaporation so that it called the volatile organic compounds.
- The proportion of hydrocarbons in the air of the crowded cities of the cars because it is resulted from the combustion processes and especially the combustion of fuel for automobiles
- Hydrocarbons (VOC) is responsible for the ozone gas layer in the troposphere and also in the formation of smog



# Hydrocarbons

## Smog Phenomenon



- What is the phenomenon of smog?
- Fog + smoke = smog
- The main reason for this phenomenon is due to the combustion products and hydrocarbons from vehicle exhausts, which when exposed to ultraviolet radiation (sunlight) within the photosynthesis reaction consists of ozone and smog, which remains hanging in the air



# Hydrocarbons

---

## Sources of hydrocarbons:

- Paint - paints - household detergents
- Furniture and carpets in particular
- Volatile organic solvents used in dry cleaning (laundry)
- Organic solvents, pesticides
- Petrol stations (during filling)
- Oil depots during shipping, packaging and in the event of a leak
- Spray perfumes and the air perfumed.





# Hydrocarbons

---

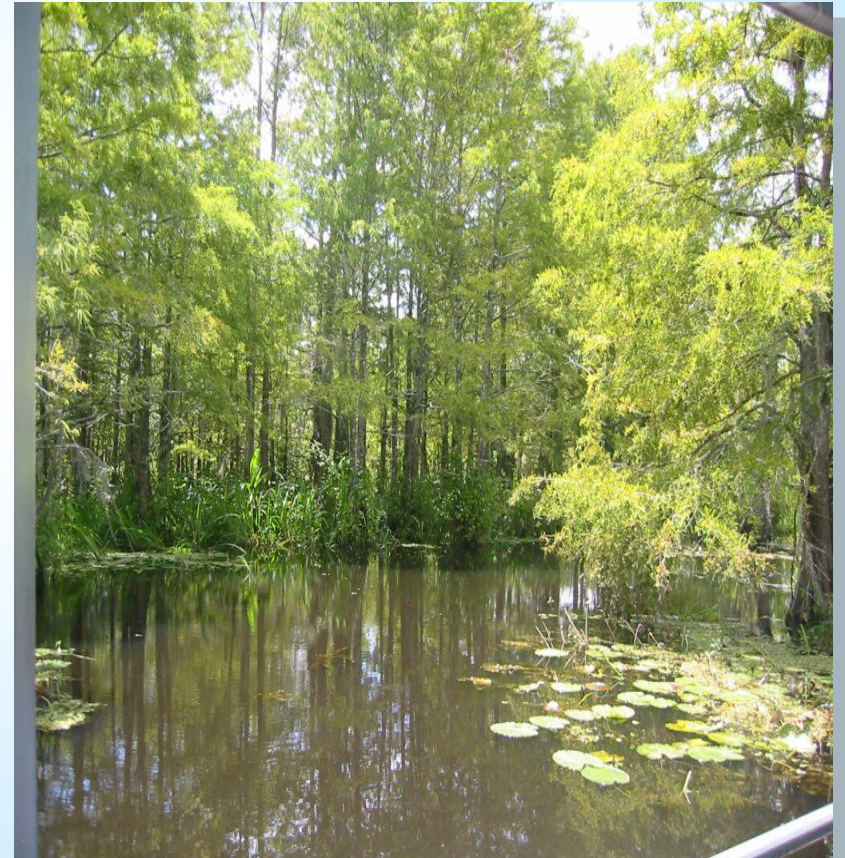
- Combustion processes
- Car exhaust.
- Factories and power plants and refineries
- Biological decomposition of organic material (one of decay and rot products of organic matter
- Marsh



# Hydrocarbons Sources



**Swamps** المستنقعات





# Hydrocarbons Sources

## Paints الأصباغ





# Hydrocarbons Sources



## المنظفات المنزلية Detergents





# Hydrocarbons Sources

## Carpets & Furniture السجاد و الأثاث





# Hydrocarbons Sources



**Pesticides** المبيدات الحشرية





# Hydrocarbons Sources

محطات البنزين (أثناء التعبئة)

Petrol stations during filling





# Hydrocarbons Sources



محطات غسيل الملابس  
Laundromat







# Hydrocarbons Sources

تأثير التدخين على الأمهات و الأجنة





# Hydrocarbons Sources



**Burning** الاحتراق





# Hydrocarbons Sources



## Factories المصانع





# Hydrocarbons Sources

تساقط أوراق الشجر

Falling Tree  
Leaves





# Examples of smog phenomenon

---

## Examples of smog phenomenon:

**-Smog in London phenomenon 1952**

**-Incident Valley industrial Meuse in 1930**

**-Donora incident, Pennsylvania, USA, 1948**

**-Kuwait Oil fires - 1990**



# Smog

London 1952



# Smog

Prairie 2002



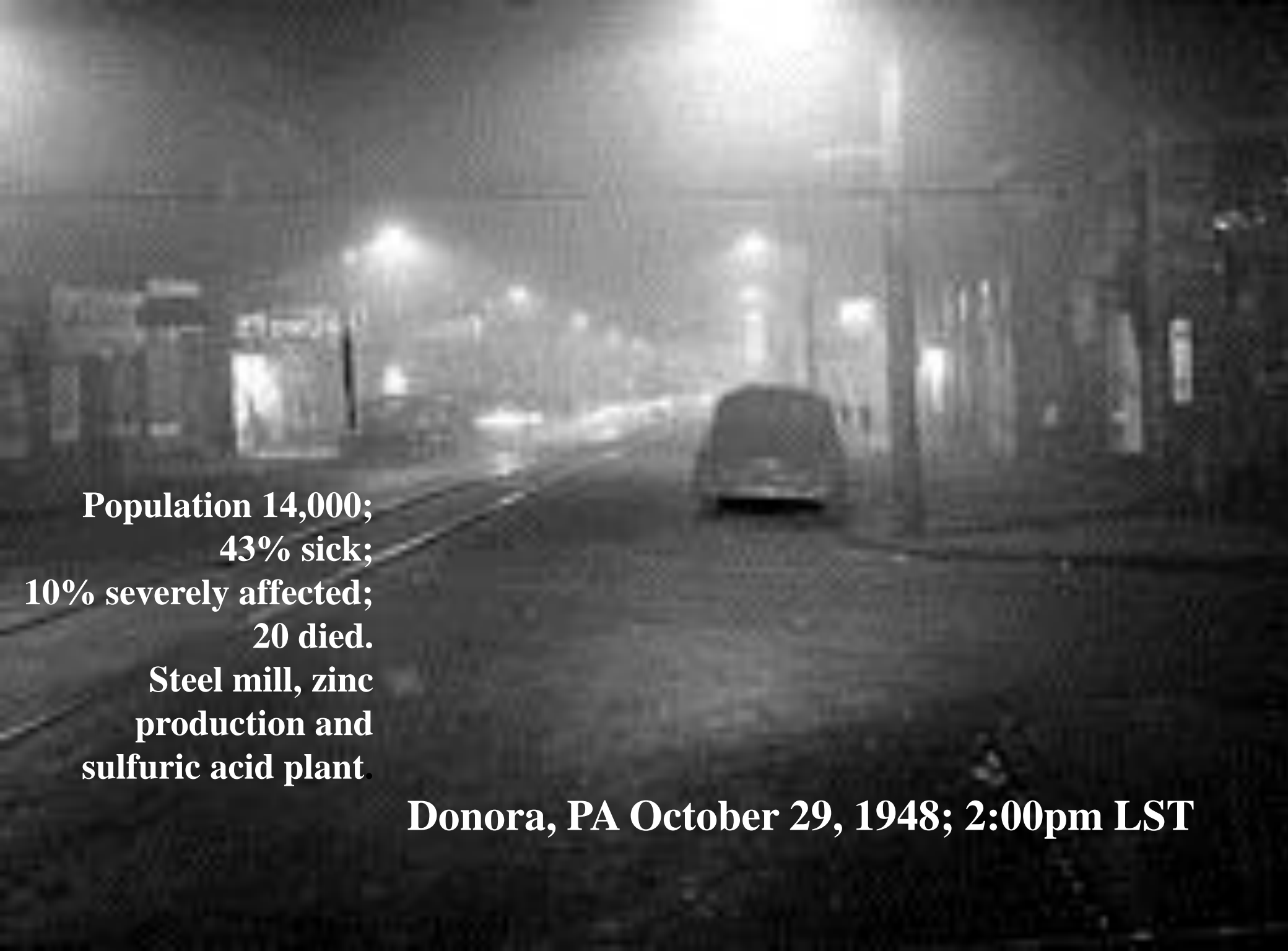


**O<sub>3</sub> Damaged plants**



Fig. 8.4 Reduced visibility during the London sulfurous smog on December 8, 1952. Copyright © by the Radio Times Hulton Picture Library; reprinted by permission.

**Poor visibility London  
8<sup>th</sup> December 1952,  
sulphurous smog**



**Population 14,000;  
43% sick;  
10% severely affected;  
20 died.  
Steel mill, zinc  
production and  
sulfuric acid plant.**

**Donora, PA October 29, 1948; 2:00pm LST**



- **Los Angeles Smog** (photochemical smog) is the mixture of ozone, hydrocarbons, partially oxidized hydrocarbons, oxides of nitrogen and other trace gases that results from the action of sunlight on automobile exhaust and other pollutants. It is characterized by high temperatures stagnant winds (high barometric pressure), and sunny conditions.
- **London Smog** (particulate, or sulfurous smog) is a mixture of sulfur dioxide and sulfate and sulfite aerosol resulting primarily from the combustion of high sulfur coal followed by conversion of  $\text{SO}_2$  to  $\text{H}_2\text{SO}_4$ . It is characterized by low temperatures, high humidity and stagnant winds.



# Smog

## United States of America





# Smog

## China 2000



# Smog

## Japan



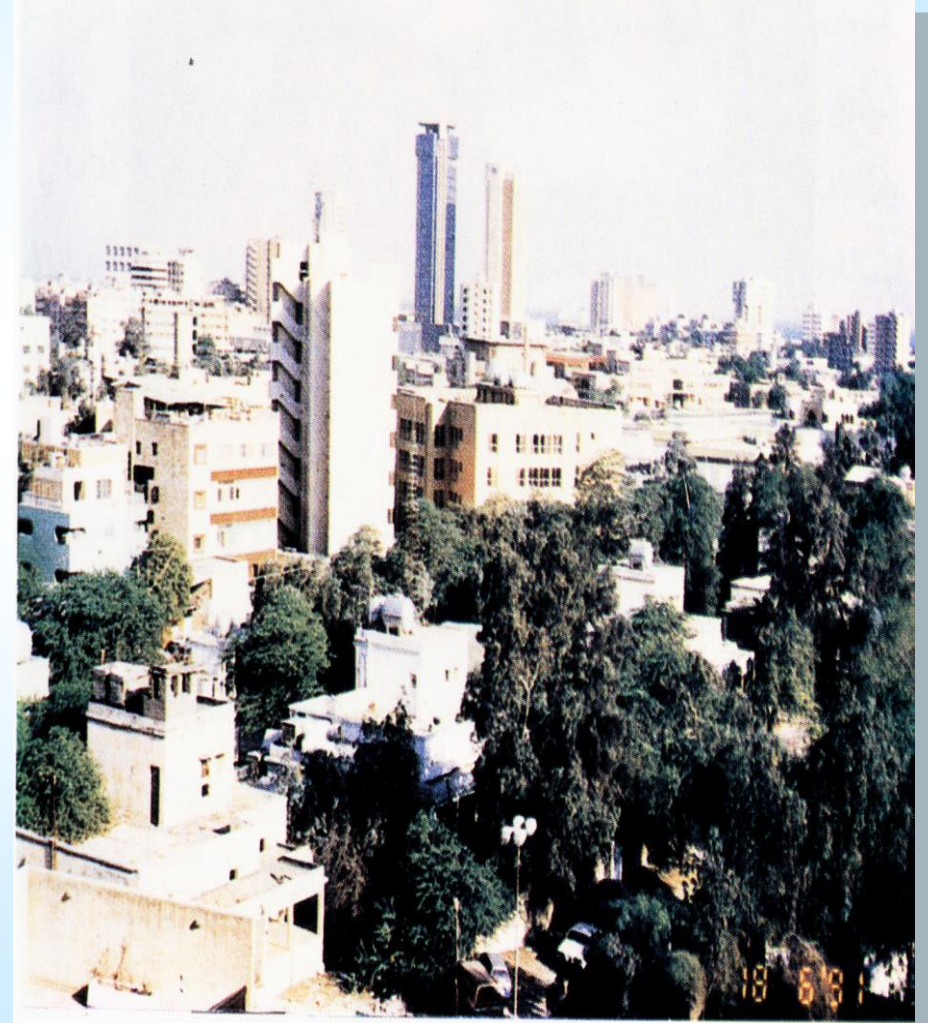


# Smog

## Kuwait



صورتان تنطقان بهول الكارثة، كارثة إضرام النيران في آبار  
البترويل. إنهما لمدينة الكويت في أيام التلوث وأيام النقاء في تمام السادسة والنصف  
صباحاً، وقد أحالت سحب الدخان الكثيف نهار المدينة إلى ليل



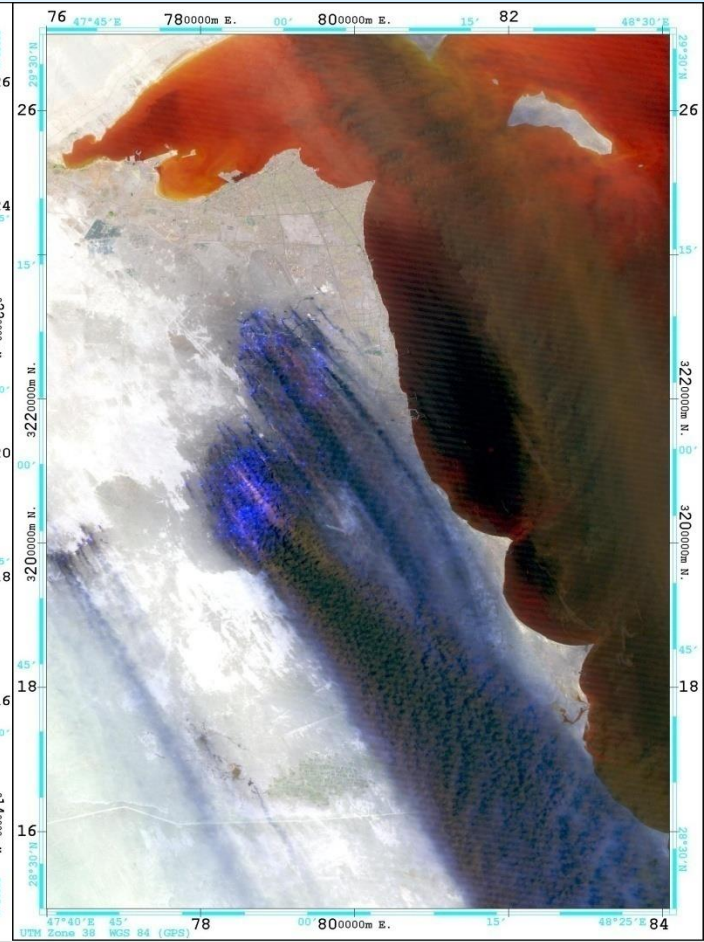
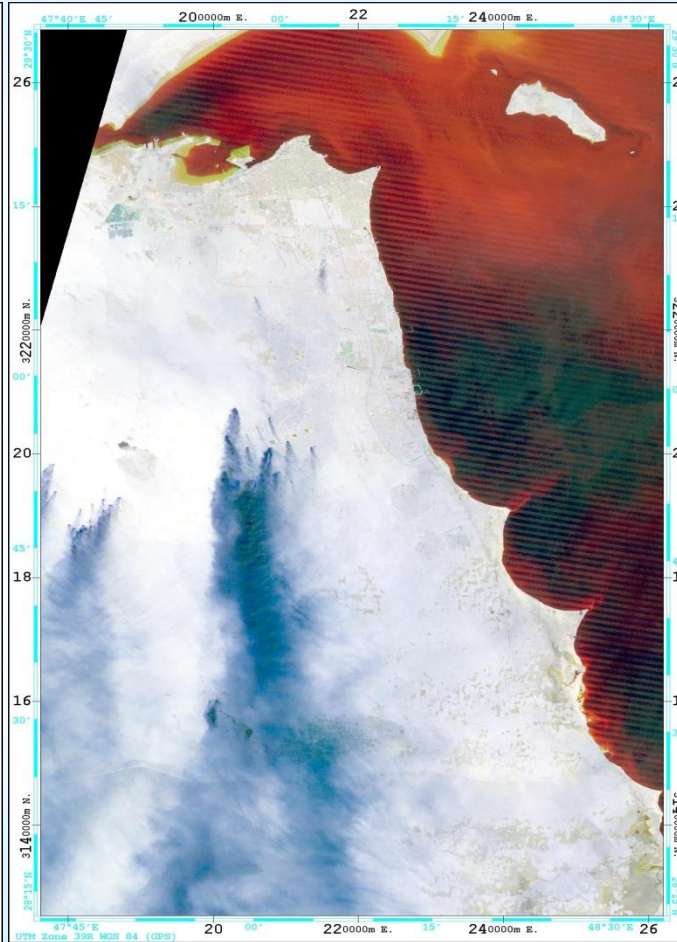
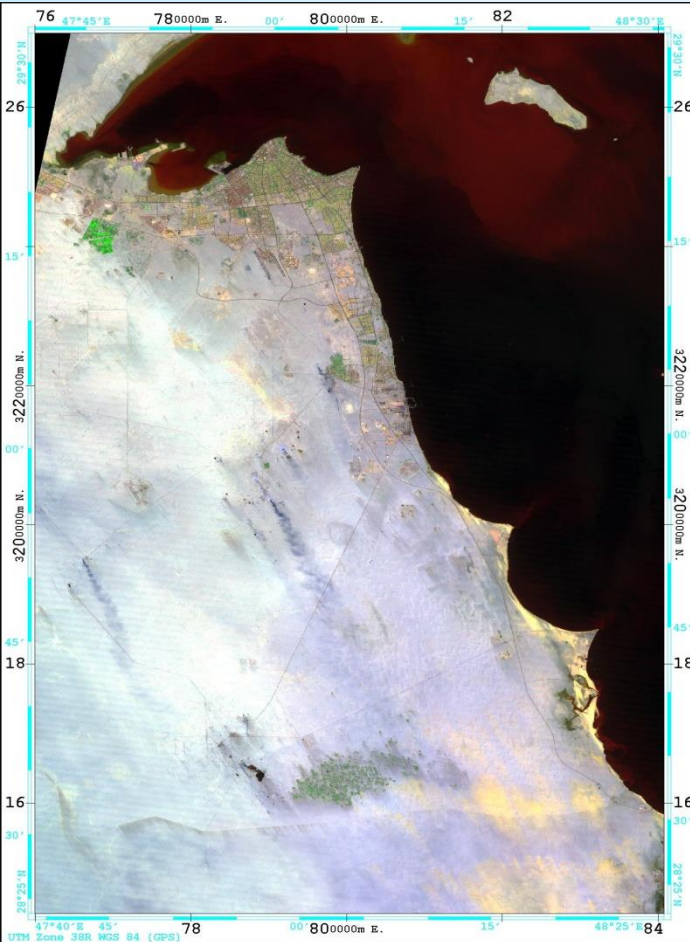


# Kuwait Oil fires - 1990

25/6/1989

15/2/1991

28/4/1991



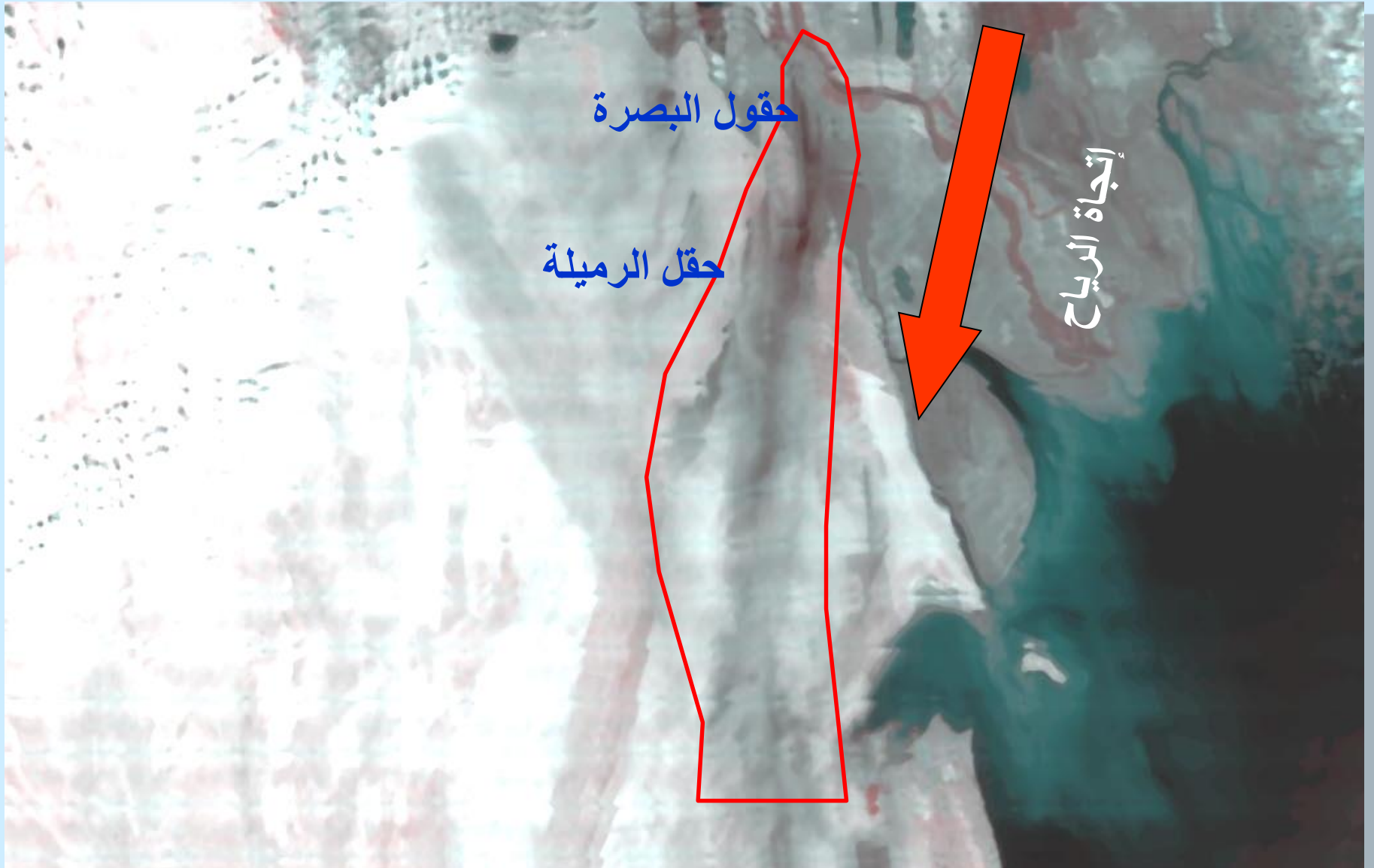


# Kuwait Oil fires – 25 Feb, 1991



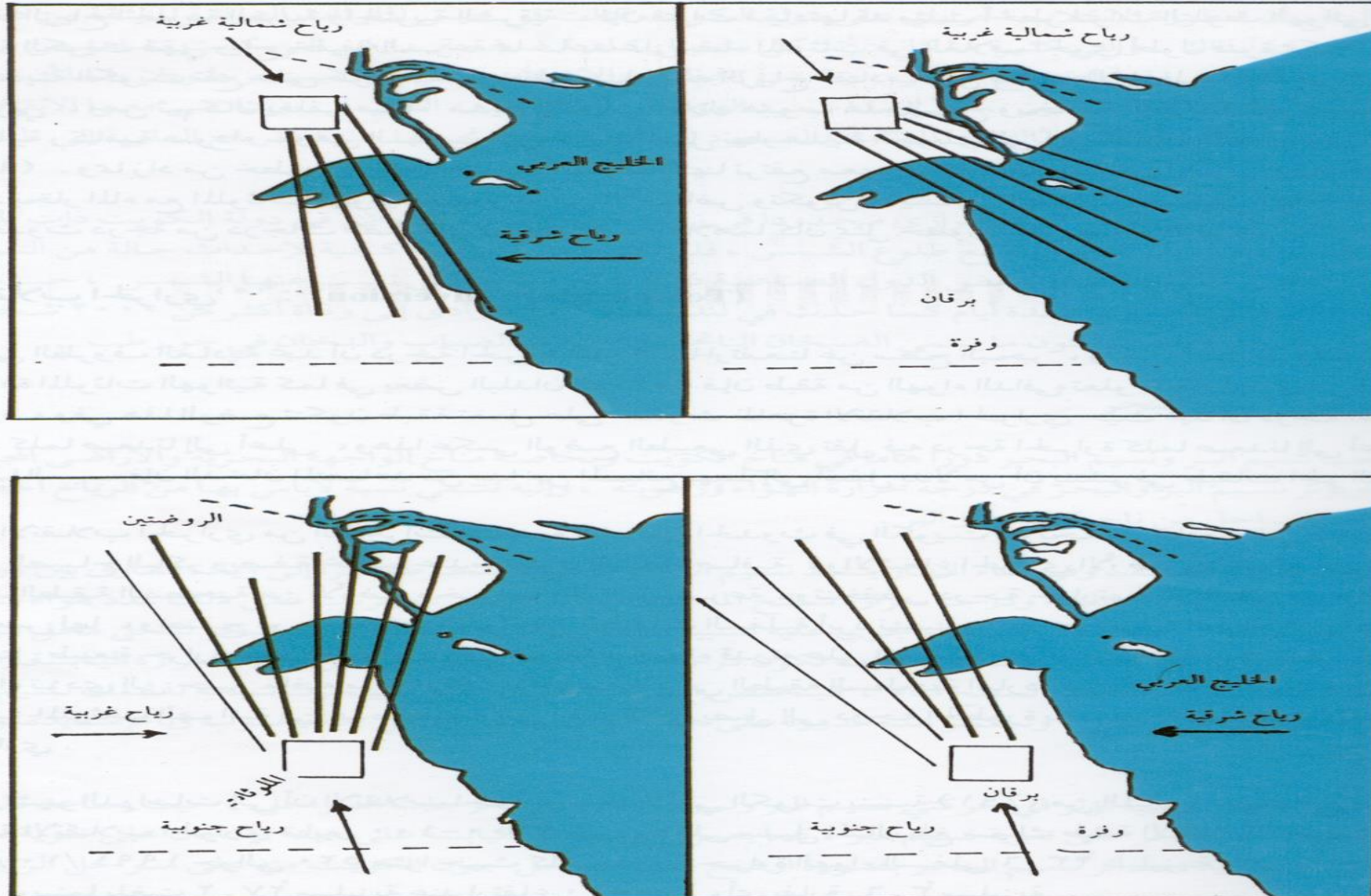


# Oil fires – South Iraq – 23 March, 2003





# Wind and the main Oil Fires Problems



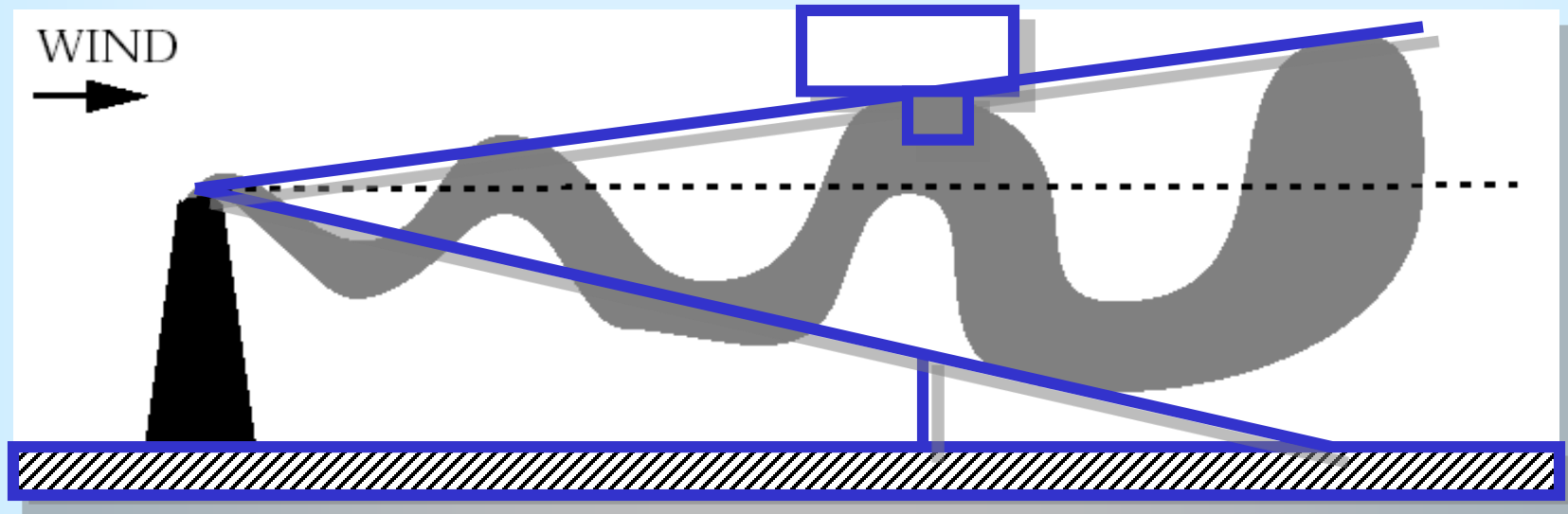
شكل رقم (٢٠) مسار الملوثة الهوائية في أثناء هبوب الرياح في اتجاهات مختلفة

المصدر : الغنيم وآخرون ، ١٩٩٥





# Flue Air Pollution Distribution

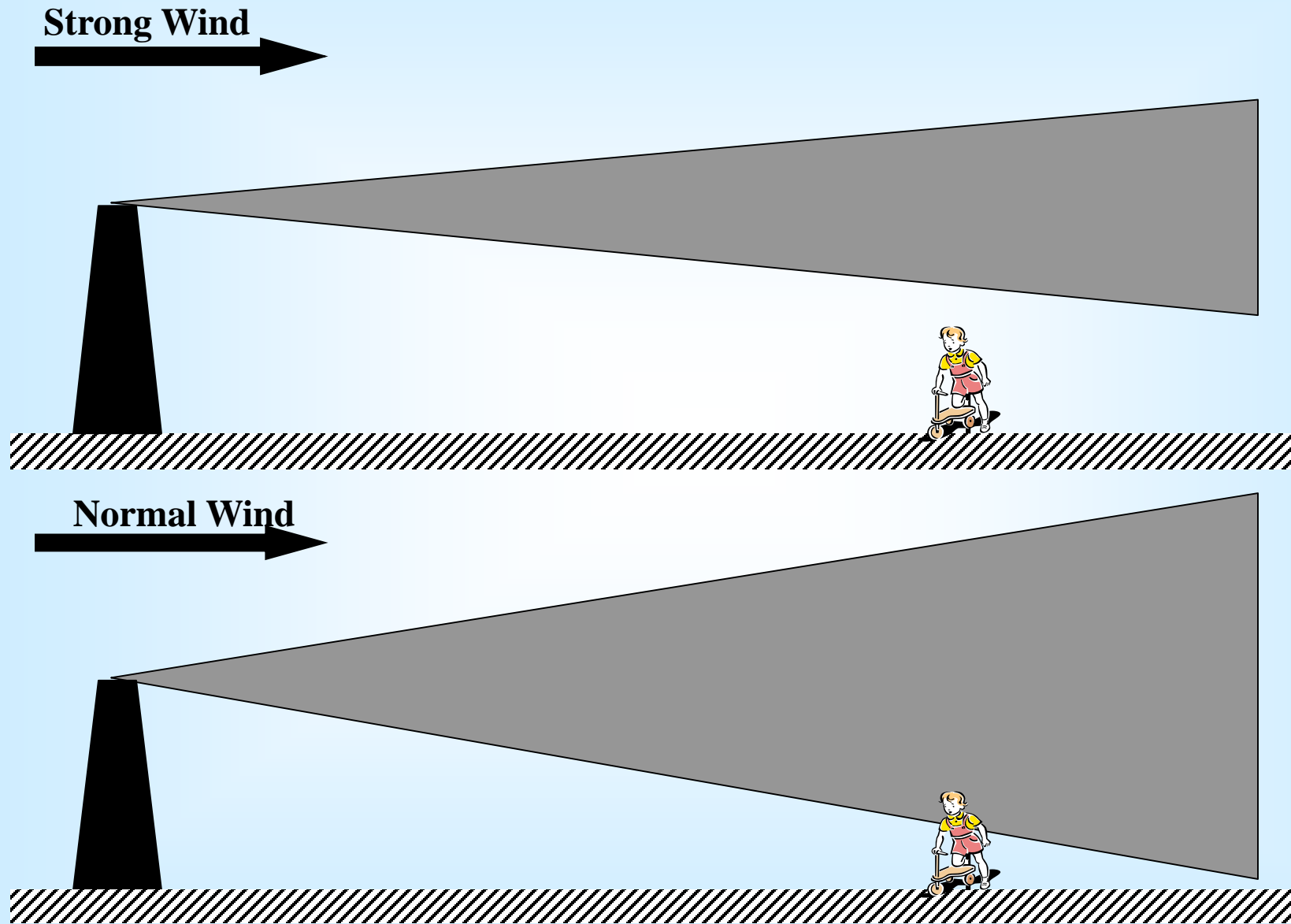


- **Wind speed**
- **Wind Direction**
- **Temperature**
- **Flue Properties**





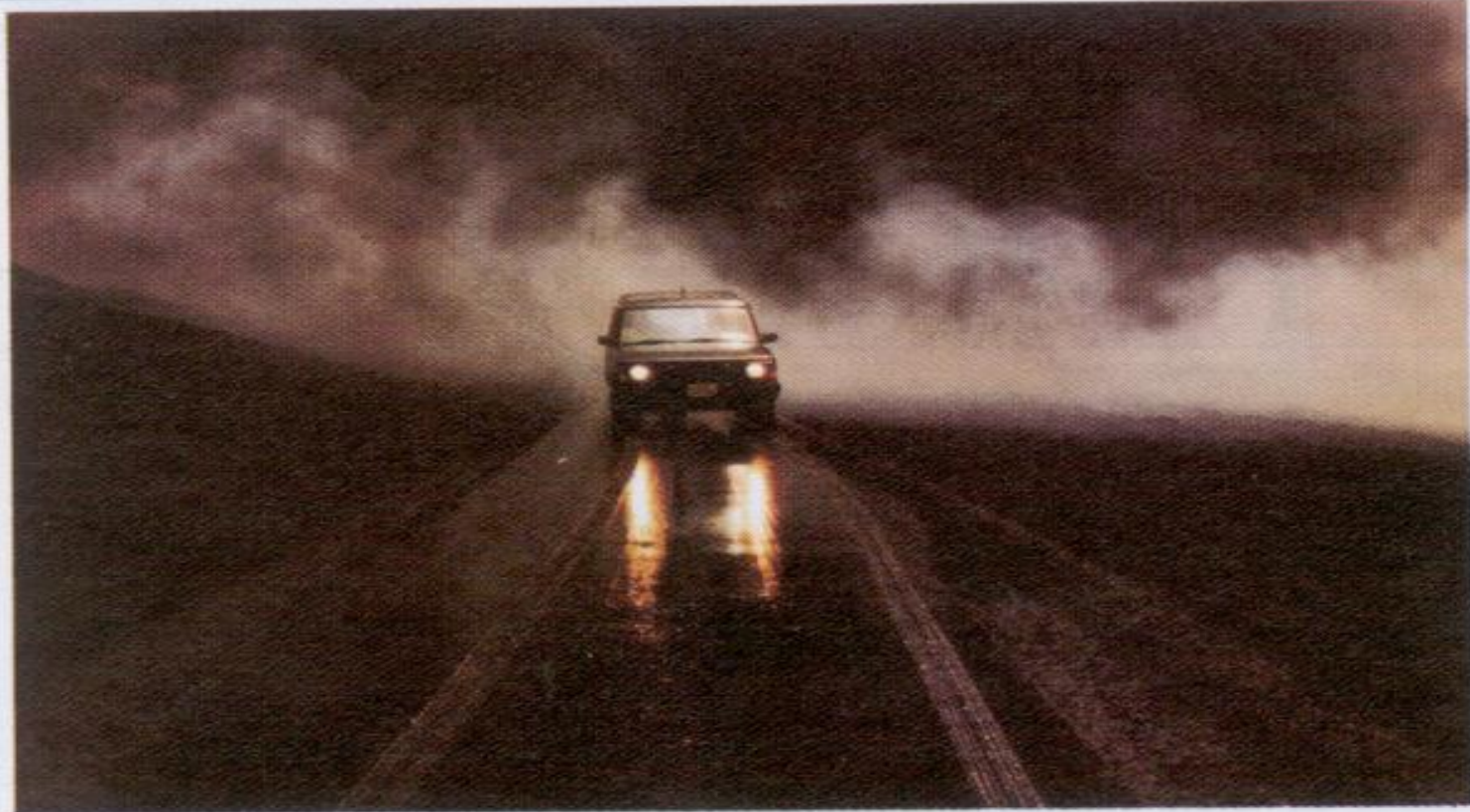
# Flue Air Pollution Distribution





# Smog

# Kuwait



لوحة رقم (٩) صورة تبين كيف تحول نهار الكويت إلى ليل بسبب حرائق آبار النفط (المصدر: الغنيم وآخرون ١٩٩٥)



---

## **Examples of some of the causes of air pollution**

**Global warming**

**Air conditioning systems**

**Home detergents**

## **Examples of problems resulting from air pollution**

**Acid rains**

**The erosion of metals**

**Ozone depletion**

# **Some ways to reduce the pollution**

---

- Follow the appropriate ways to dispose of waste.**
- Reduce dependence on petrol and transport of fuel.**
- Obliging companies to industrial-based global environmental requirements to reduce the emission of hazardous substances**
- Continuous monitoring of the quality of air in the polluted area.**



# Studies & Experiments

## The H<sub>2</sub>S Problem in Ahmas Aljaber st, and Alawadi House Project



## Alawadi House Project



# The H<sub>2</sub>S Problem in Ahmas Aljaber st, and Alawadi House Project



**H<sub>2</sub>S Measurement Device**



# The H<sub>2</sub>S Problem in Ahmas Aljaber st, and Alawadi House Project



**Canisters**



**Air Sample Collectors Devices**

**Distribute the devices in several places around the source of the problem**





# The H<sub>2</sub>S Problem in Ahmas Aljaber st, and Alawadi House Project



## H<sub>2</sub>S Data Recorder (Recording Process)



# The H<sub>2</sub>S Problem in Ahmas Aljaber st, and Alawadi House Project

---



**The effect of H<sub>2</sub>S on a Wire**



# The H<sub>2</sub>S Problem in Ahmas Aljaber st, and Alawadi House Project



**Analyzer Devices for the collected air sample**



**Several Chemical Process to determine the pollutants**



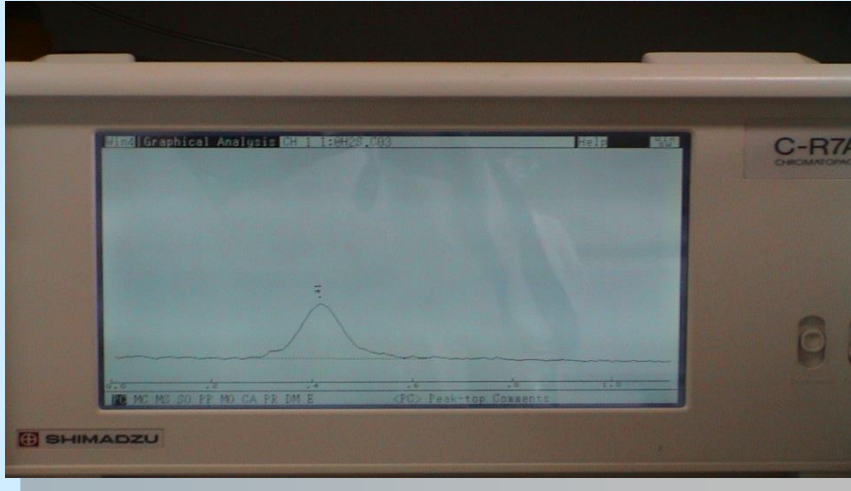
# Air Pollution Laboratory



## Chromatography (GC)



# Air Pollution Laboratory



## Gases Concentration Measurement Device





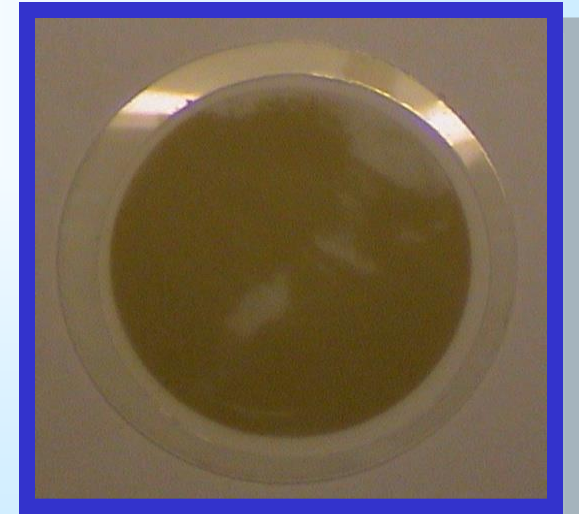
# Air Pollution Laboratory



**PM10 Measurement Device**



# Filters Used To Measure $PM_{10}$





# Mobile Lab Station

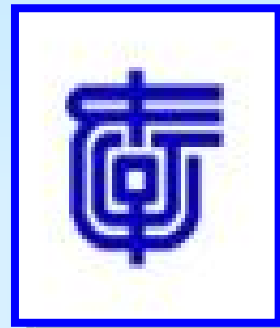


**KISR Mobile lab Station**





# Mobile Lab Station



**KISR Mobile lab Station**



# Air Pollution Measurement Devices





# Air Pollution Measurement Devices





# Nitrogen Oxides Measurement Devices





# SO<sub>x</sub> Measurement Devices





# Hydrocarbons Measurement Devices





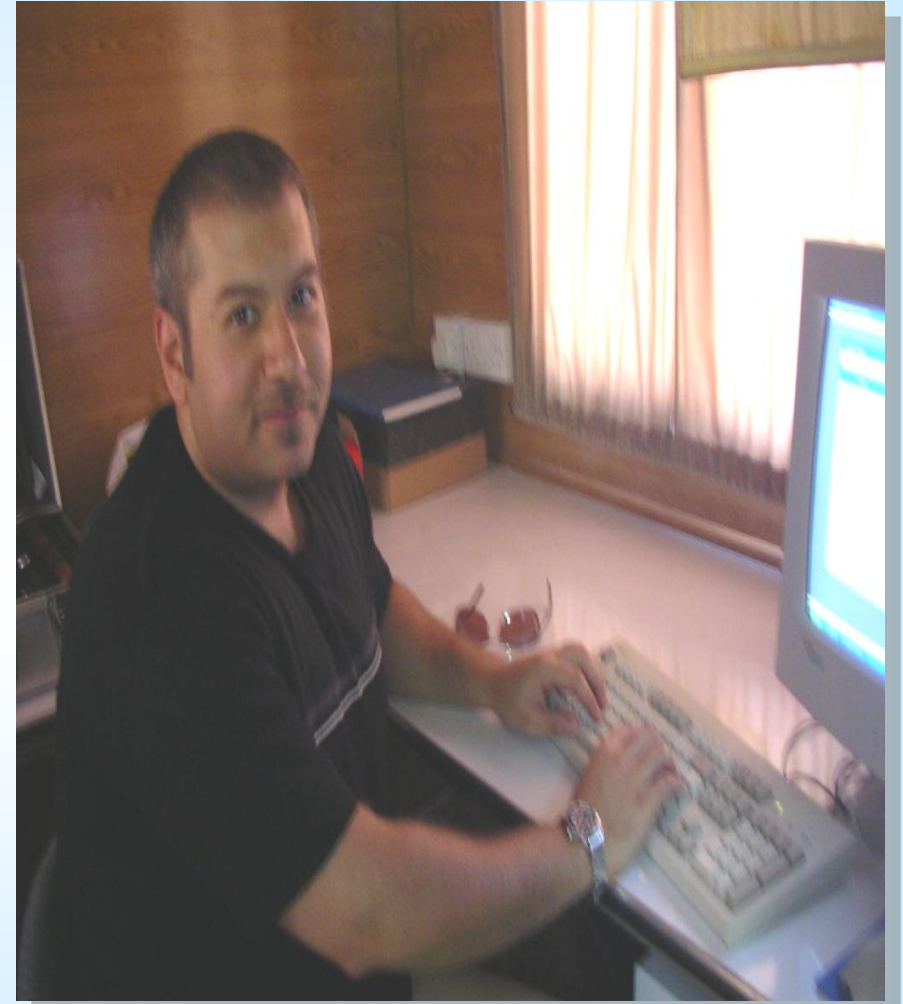
# Computer Software Recorder (24 Hours)



Channel	Input Signal	Instantaneous	Last 5Min AVG.	Last 60Min AVG.
01 - DUST [ug/m3]	7649.000	76.5	76.5	65.7
02 - BENZEN [ppb]	0.000	0.0	0.0	0.0
03 - TOLUEN [ppb]	0.000	0.0	0.0	0.0
04 - ETHYLB [ppb]	0.000	0.0	0.0	0.0
05 - MPXY [ppb]	0.000	0.0	0.0	0.0
06 - OXYLE [ppb]	0.000	0.0	0.0	0.0
07 - HCT [ppm]	0.000	0.0	0.0	0.0
08 - CH4 [ppm]	166.000	1.66	1.77	1.92
09 - HCnH [ppm]	179.000	1.79	1.84	1.99
10 - O3 [ppb]	0.000	0.00	0.00	0.01
11 - SO2 [ppb]	50.405	50.5	48.3	45.4
12 - H2S [ppb]	0.000	0.0	0.0	0.0
13 - TRS [ppb]	0.000	0.0	0.0	0.0
14 - SOLAR RADIATION [W/M2]	2.375	2.4	3.3	16.7
15 - NO [ppb]	2.735	820.5	813.9	779.6
16 - NO2 [ppb]	1.157	1.2	1.2	1.5
17 - NOx [ppb]	0.928	0.9	0.8	0.5
18 - NOx [ppb]	NoData	NoData	NoData	NoData
19 - NOy [ppb]	6.117	6.1	7.3	8.6
20 - NOy [ppb]	45.462	45.5	49.3	53.1
21 - NH3 [ppb]	39.345	39.3	42.0	44.7
22 - CO [PPM]	0.328	0.85	0.88	0.92
23 - CO2 [PPM]	2.564	389.3	386.5	390.2
24 - TEMPERATURE [C°]	3.437	38.9	38.6	38.4
25 - HUMIDITY [%]	2.267	34	35	37
26 - WIND SPEED [M/S]	1.323	4.8	3.8	2.4
27 - WIND DIRECTION [DEG]	4.946	547.1	6.6	9.2



# Computer Software Recorder (24 Hours)







# Weather Station

---



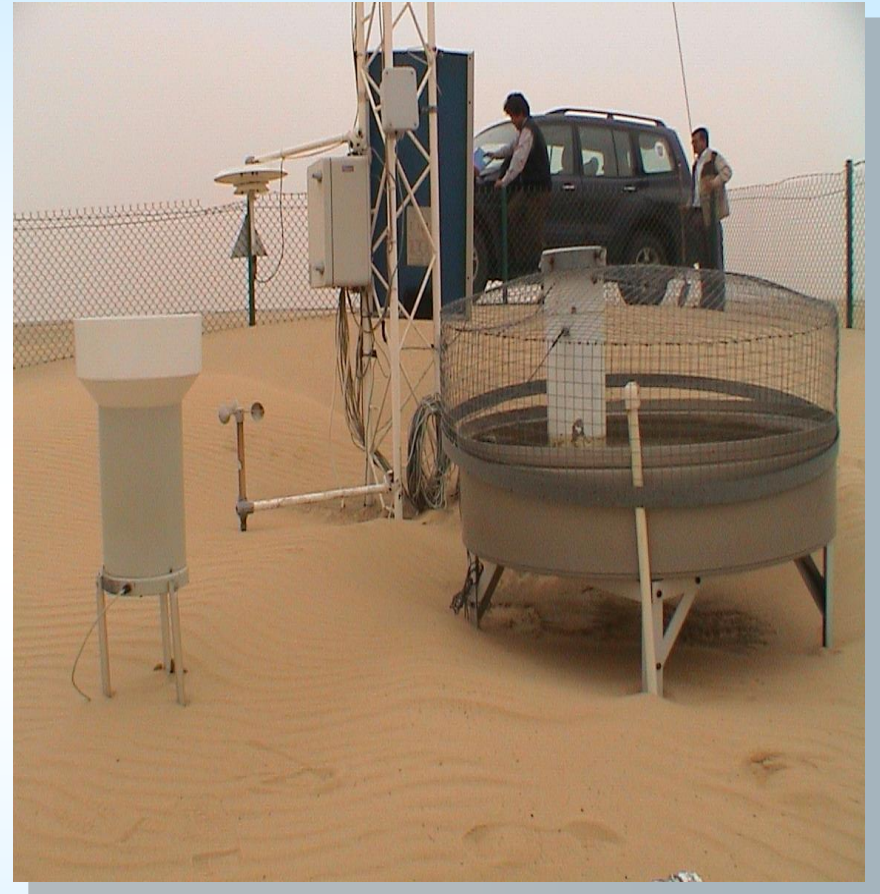
**KISR Weather Station**



# Weather Station



**Evaporation  
Measurement Device**



**Rain & Evaporation  
Measurement Devices**



# Weather Station



**Anemometer (Wind Speed Measurement Device)**



# Weather Station



**Solar Panel: used to receive the sun radiation at the morning and use it as energy at night**



# Weather Station



**Rain Measurement  
Device**



**Barometer, Air Pressure  
Measurement Device**



# Weather Station

---



**Temperature & Humidity  
Measurement Device**

---



# Ozone layer O<sub>3</sub>

---

- **The ozone layer consists of the ozone gas which is a toxic pale blue gas, with a distinctive smell**
- **Cause bronchitis, sore eyes and the incidence of asthma .**
- **This gas (ozone) consists in the stratosphere within a 20 km thick layer at an altitude of 15-50 km from the Earth's surface**
- **Comprises a natural result of electrical discharge caused by lightning or the impact of ultraviolet radiation on the normal oxygen in the stratosphere .**
- **Composed by human activities in the troposphere by photosynthesis reactions**
- **Comprises as a natural result of the electric discharge**
- **The ozone layer working in the stratosphere as a protective shield against ultraviolet radiation**
-



# Ozone layer O<sub>3</sub>

---

- **What are the reasons for the ozone depletion?**

CFCs established industrial materials have the greatest -  
impact on the depletion of the ozone layer

- The most famous of CFCs compounds are Freon gas -11 (CFCL 3) and Freon gas - 12 (CF<sub>2</sub>C<sub>12</sub>)





# Ozone layer $O_3$

---

## Freon gas uses

**Use of Freon as an organic solvent**

**Industry spray cans (aerosols)**

**The use of freon, "11" in the manufacture of soft sponge**

**The use of freon in refrigerators**

**The use of Freon 12 in air conditioners cars**

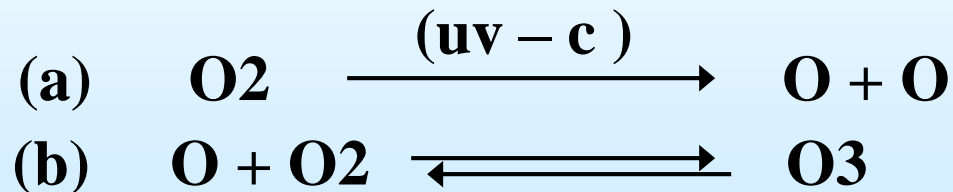


# How does Chlorofluorocarbon gas affect the Ozone Layer?

## Source of ozone:

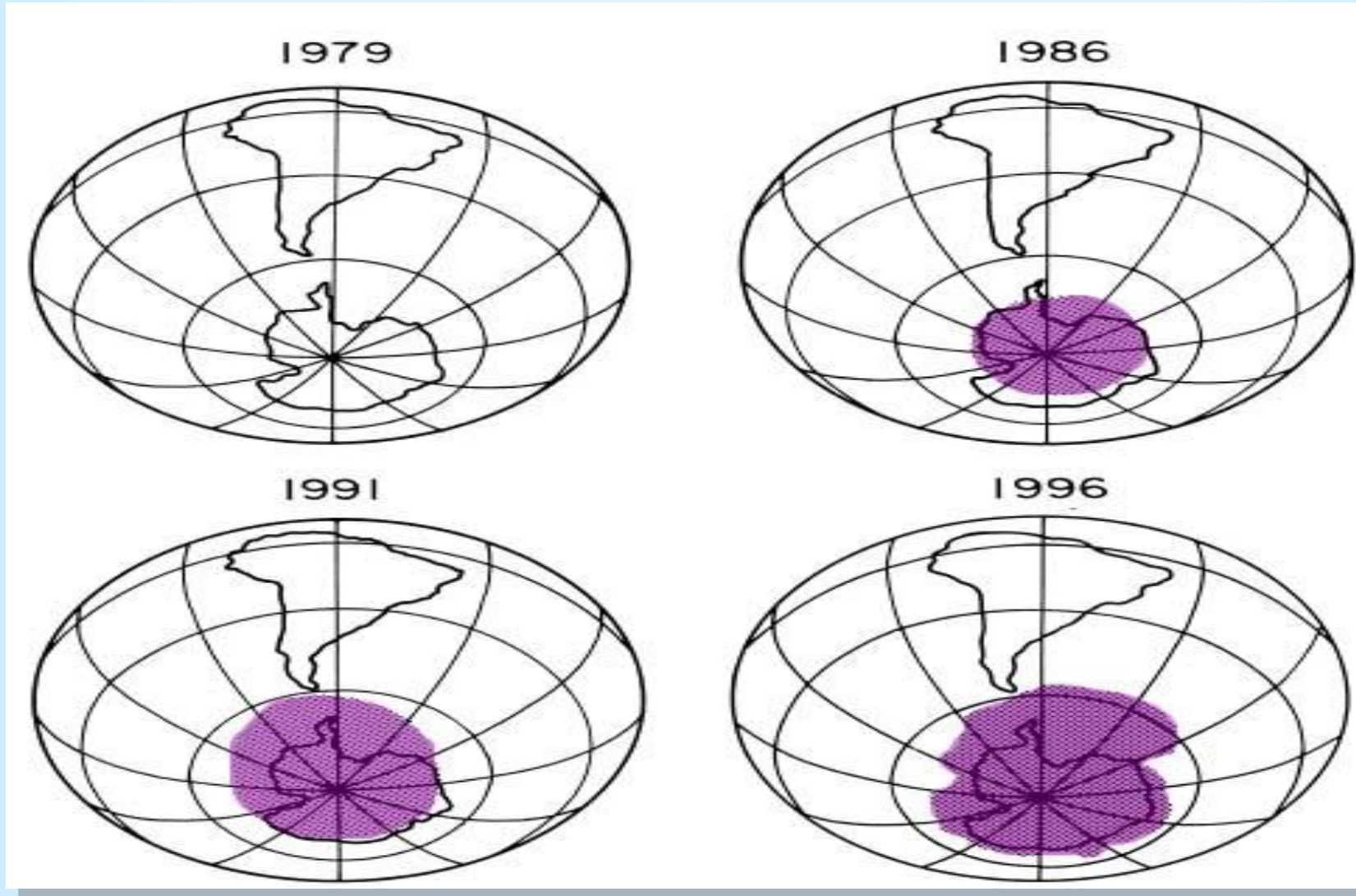
Ozone is composed of natural result of the factors of physical, - chemical and optical interactions that occur daily in the upper atmosphere

- The most important factors are the short ultraviolet (uv-c), which does not reach to the ground in any way and under any circumstances, such as the analysis of oxygen molecules to oxygen atoms, and the oxygen atom composed of oxygen gas, ozone, according to the food consignment the following:





# Increasing the size of the ozone depletion over time





# Risks arising from the ozone depletion

---

**The leakage of harmful cosmic rays to the earth in large quantities (UV + alpha particles) is working to break the nucleic acids DNA and genetic factors influence the living organisms**

**Increased exposure to such radiation causes skin cancer (as far as scientists in the United States Environmental Protection Agency that the lack of 1% of the concentration of ozone cause of skin cancer by 5%)**

**Increased ultraviolet radiation affects the immune system in humans are also active antiretroviral AIDS and herpes and hepatitis**

**UV affecting cattle, leading to inflammation of her eyes and skin cancer, as well as the manifestations of life in the seas and oceans have caused the loss of fungi and algae that are food for fish, and cause the loss of microscopic fungi in the soil, which are a source of food for plants**

**The economic damage in the paint flakes and the changing colors**



**The industrialized countries  
produce about 90% of the  
materials that cause the  
depletion of the ozone layer**