

**Al Mustaqbal University
College of Pharmacy
General Toxicology
4th stage
Lecture: 8**



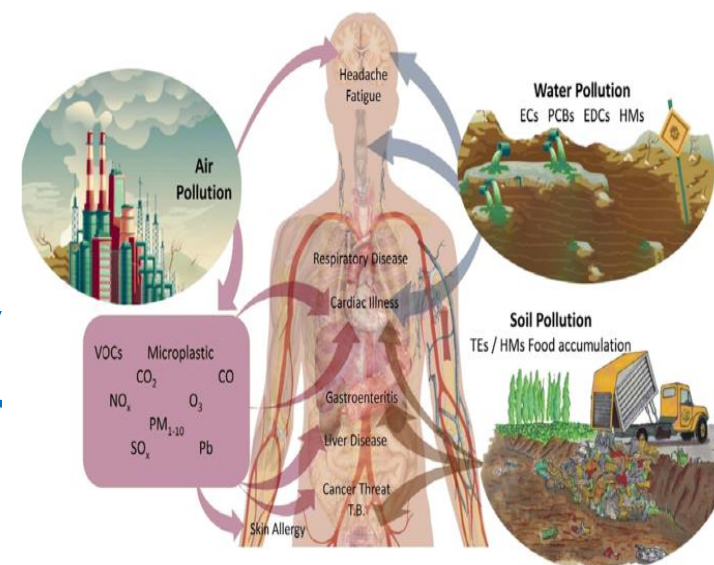
Environmental and Occupational Toxicology

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Environmental toxicology

Environmental toxicology is a field of study in the environmental sciences concerned with assessing toxic substances in the environment.

Although it is based on toxicology, environmental toxicology draws heavily on principles and techniques from other fields, including biochemistry, cell biology, developmental biology, and genetics.



Occupational toxicology

Occupational toxicologists assess the hazards and risks to health posed by chemicals encountered in the workplace.

Many of the chemicals that occupational toxicologists must deal with don't cause an appreciable risk to health when they are present at low levels in food, consumer products and the environment.

However, workers may be exposed to these chemicals at considerably higher levels than the general public, so the consequences of human exposure are potentially the most serious in the workplace.

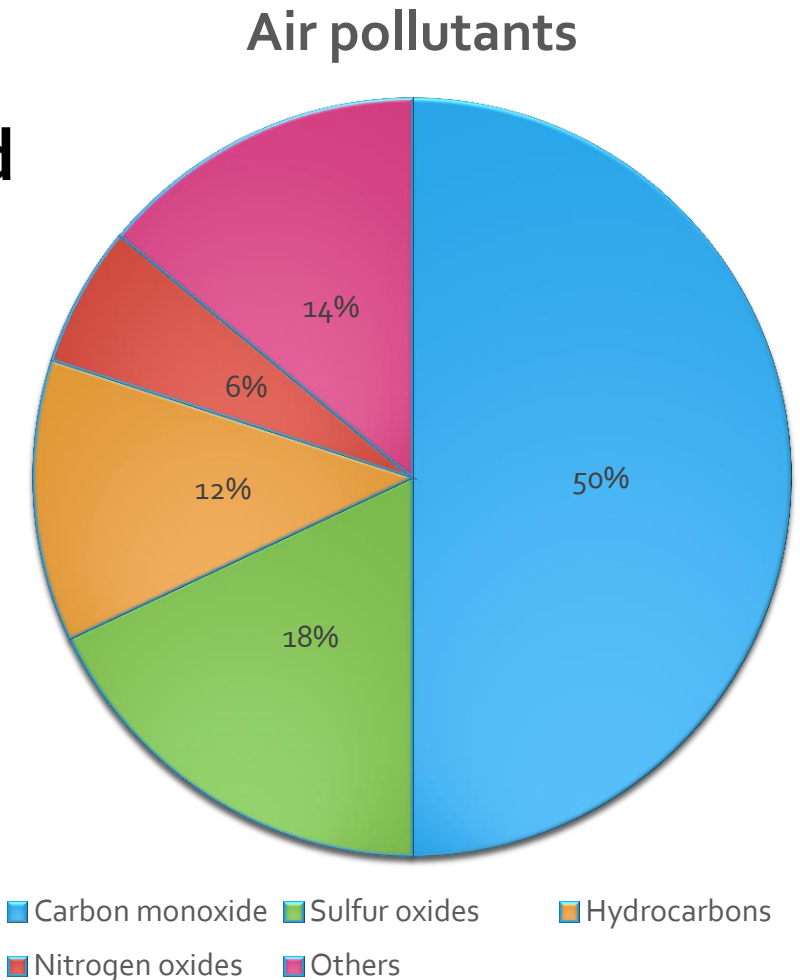


1. Air pollutants

A. Classification and Prototypes:

The major air pollutants in industrialized countries include:

1. **Carbon monoxide** (which accounts for about **50%** of the total amount of air pollutants),
2. **Sulfur oxides (18%),**
3. **Hydrocarbons (12%),** particulate matter (eg, smoke particles, 10%),
4. **Nitrogen oxides (6%).**



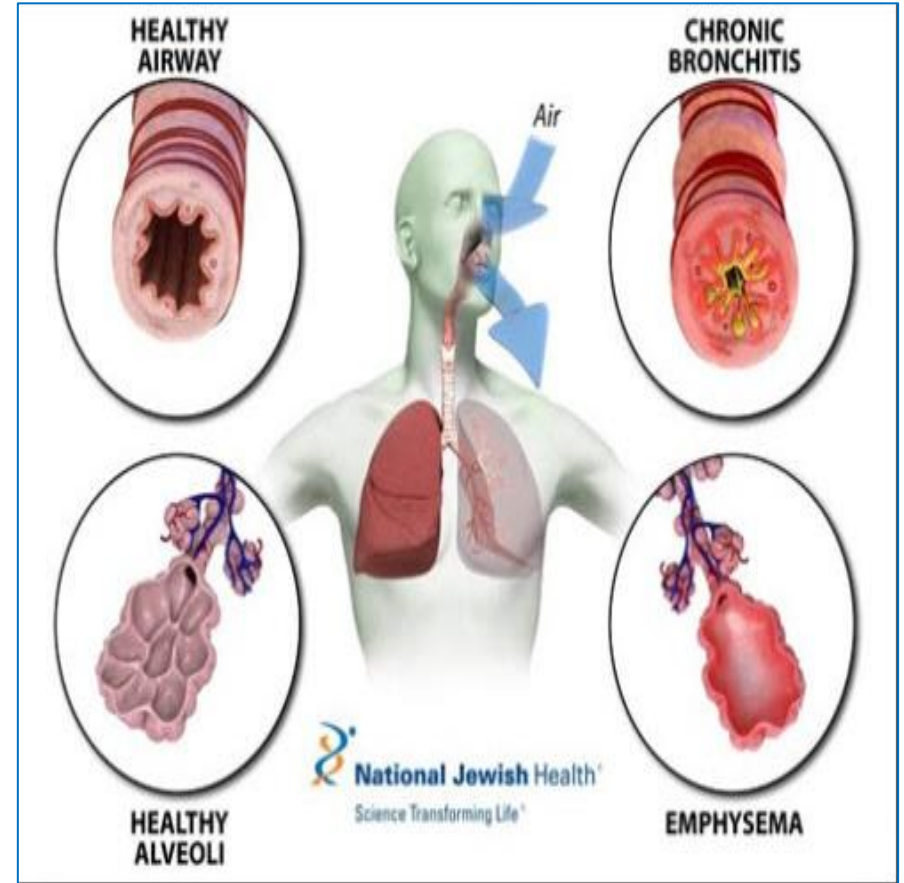
1. Air pollutants

Air pollution appears to be a contributing factor in:

1. Bronchitis

2. Obstructive pulmonary disease

3. Lung cancer



Carbon Monoxide

Carbon monoxide (CO) is an odorless, colorless gas that competes avidly with oxygen for hemoglobin.

The affinity of CO for hemoglobin is more than 200-fold greater than that of oxygen.

The threshold limit value of CO for an 8-h workday is 25 parts per million (ppm); in heavy traffic, the concentration of CO may exceed 100 ppm.



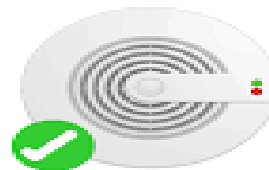
CAN'T
BE SEEN



CAN'T
BE HEARD



CAN'T
BE SMELLED



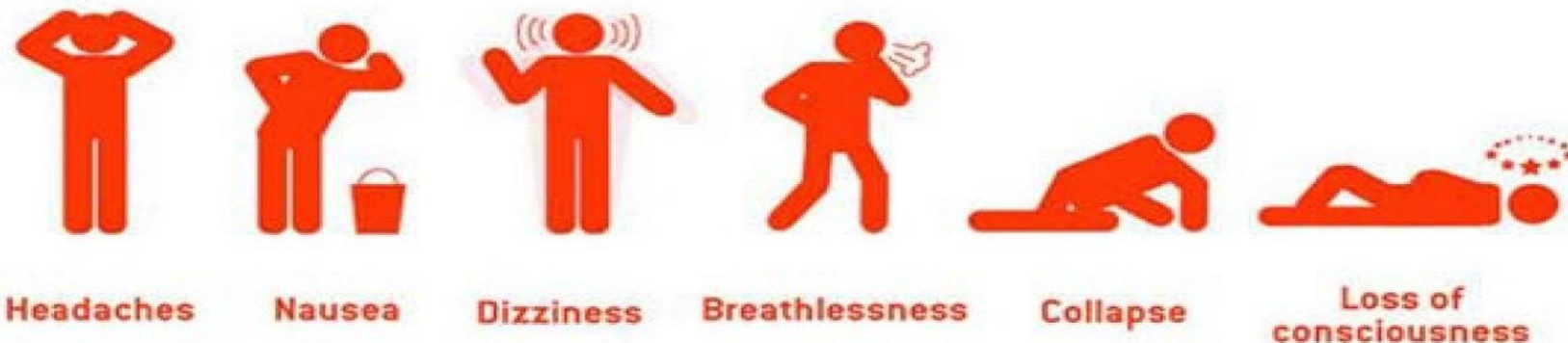
CAN
BE DETECTED

Carbon Monoxide effects

CO causes tissue hypoxia. Headache occurs first, followed by confusion, decreased visual acuity, tachycardia, syncope, coma, seizures, and death.

Collapse and syncope occur when approximately 40% of hemoglobin has been converted to carboxyhemoglobin.

Prolonged hypoxia can result in irreversible damage to the brain and the myocardium.



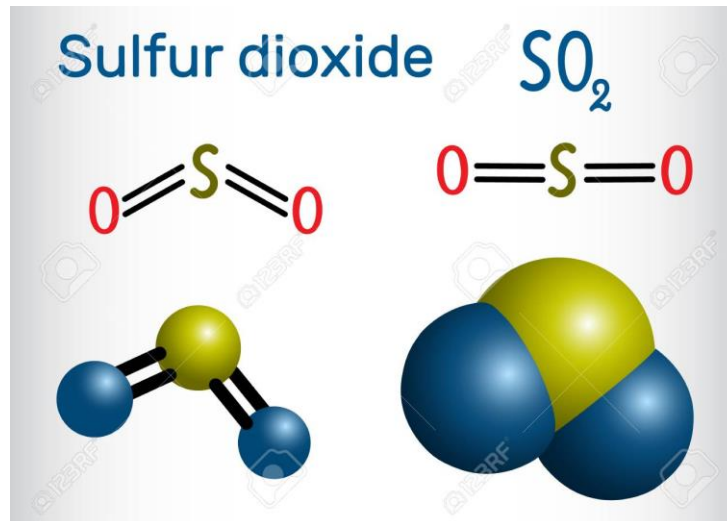
Carbon Monoxide Toxicity Rx

Removal of the source of CO and 100% oxygen are the main features of treatment.

Hyperbaric oxygen accelerates the clearance of carbon monoxide.

Sulfur Dioxide

- Sulfur dioxide (SO₂) is a colorless, irritating gas formed from the combustion of fossil fuels.



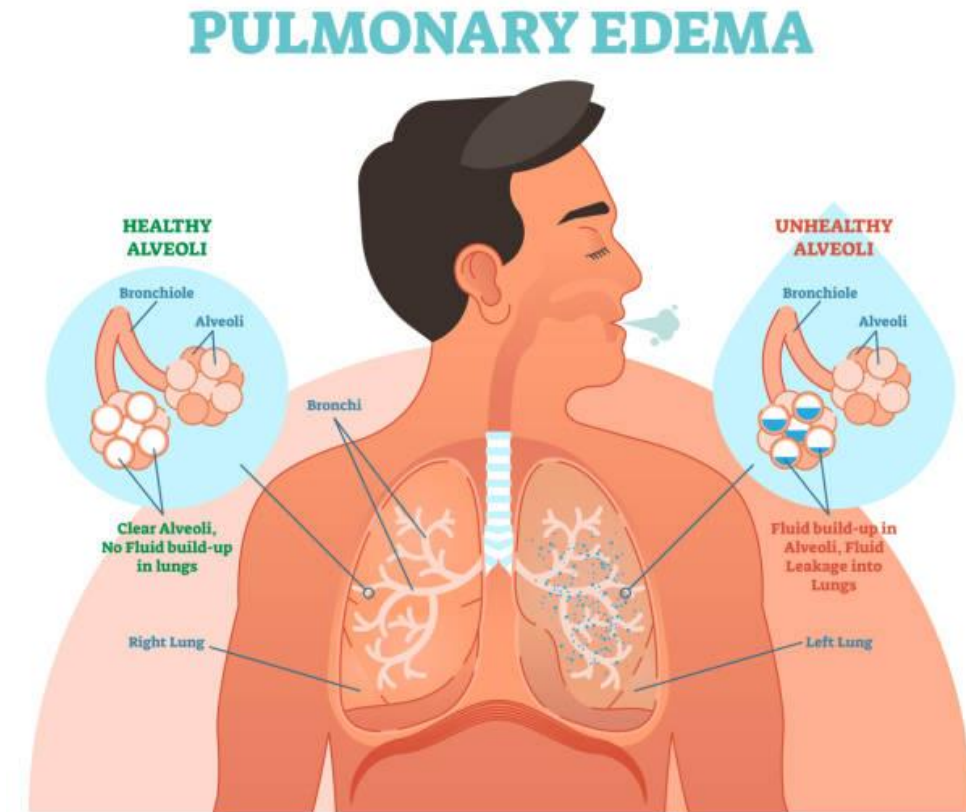
Sulfur Dioxide

- **SO₂ forms sulfurous acid on contact with moist mucous membranes; this acid is responsible for most of the pathologic effects.**
- **Conjunctival and bronchial irritation (especially in individuals with asthma) are the primary signs of exposure.**



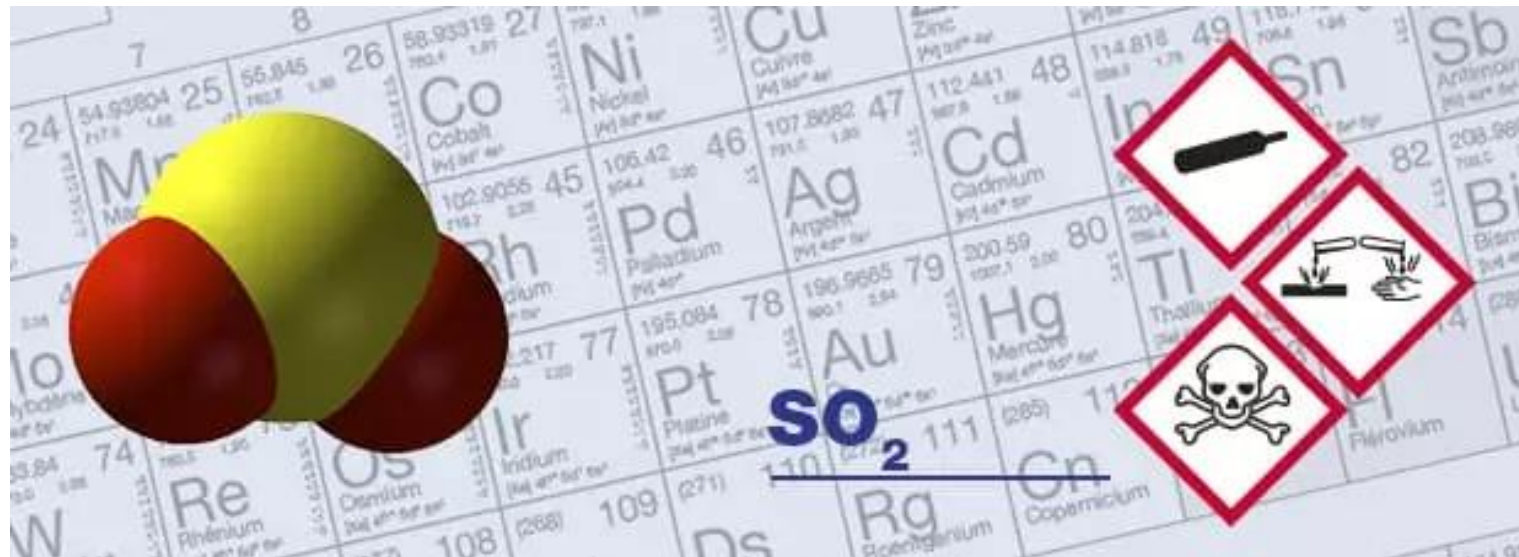
Sulfur Dioxide

- Presence of SO₂ in 5–10 ppm in the air is enough to cause severe bronchospasm.
- Heavy exposure may lead to delayed pulmonary edema.
- Chronic low-level exposure may aggravate cardiopulmonary disease.



Sulfur Dioxide Toxicity Rx

- Removal from exposure to SO₂ and relief of irritation and inflammation constitute the major treatment.



Nitrogen Oxides

Nitrogen dioxide (NO₂), a brownish irritant gas

It is the principal member of this group.

It is formed in fires and in silage on farms.

Nitrogen Oxides

- **NO₂ causes deep lung irritation and pulmonary edema.**
- Farm workers exposed to high concentrations of the gas within enclosed silos may die rapidly of acute pulmonary edema.
- Irritation of the eyes, nose, and throat is common.
- **No specific treatment is available.**
- Measures to reduce inflammation and pulmonary edema are important



NO



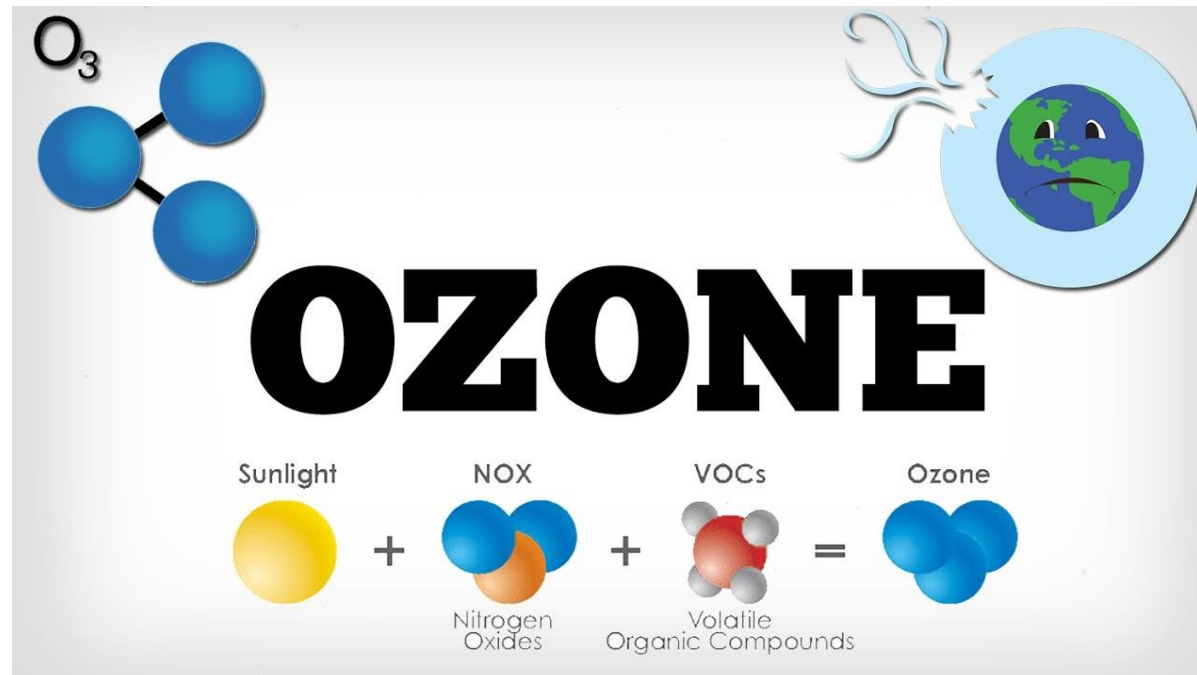
N₂O



NO₂

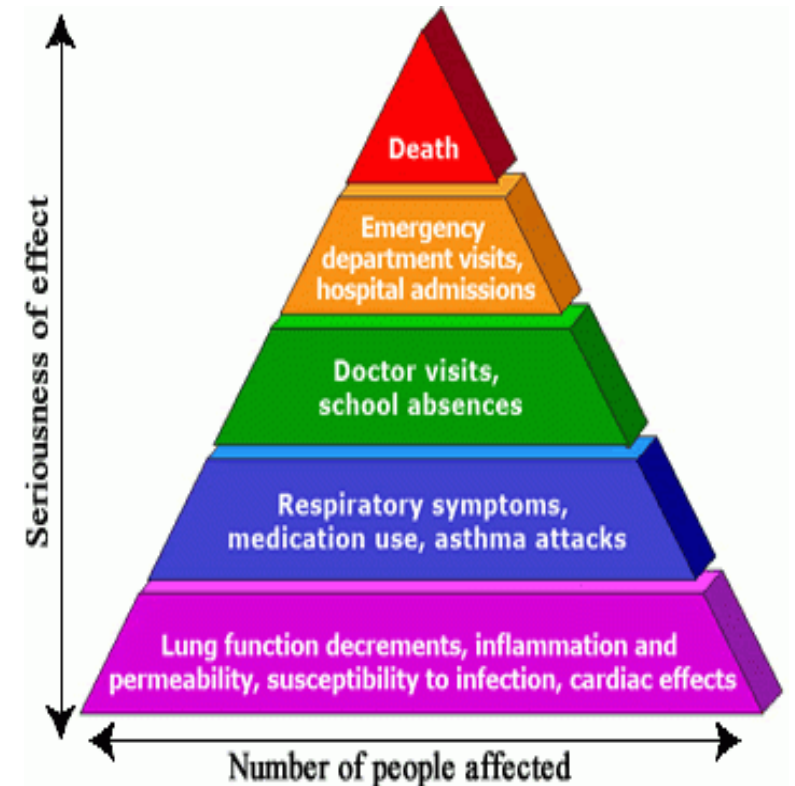
Ozone

- **Ozone (O₃) is a bluish irritant gas.**
- O₃ is produced in air and water purification devices and in electrical fields.



Ozone

- Exposure to 0.01–0.1 ppm may cause irritation and dryness of the mucous membranes.
- Pulmonary function may be impaired at higher concentrations.
- Chronic exposure leads to bronchitis, bronchiolitis, pulmonary fibrosis, and emphysema.



Ozone Toxicity Rx

- **No specific treatment is available.**
- Measures that reduce inflammation and pulmonary edema are emphasized.



2. SOLVENTS

- Solvents used in industry and solvents to clean clothing are a major source of direct exposure to hydrocarbons and also contribute to air pollution.



Aliphatic Hydrocarbons

- This group includes halogenated solvents such as carbon tetrachloride, chloroform, and trichloroethylene



Aliphatic Hydrocarbons

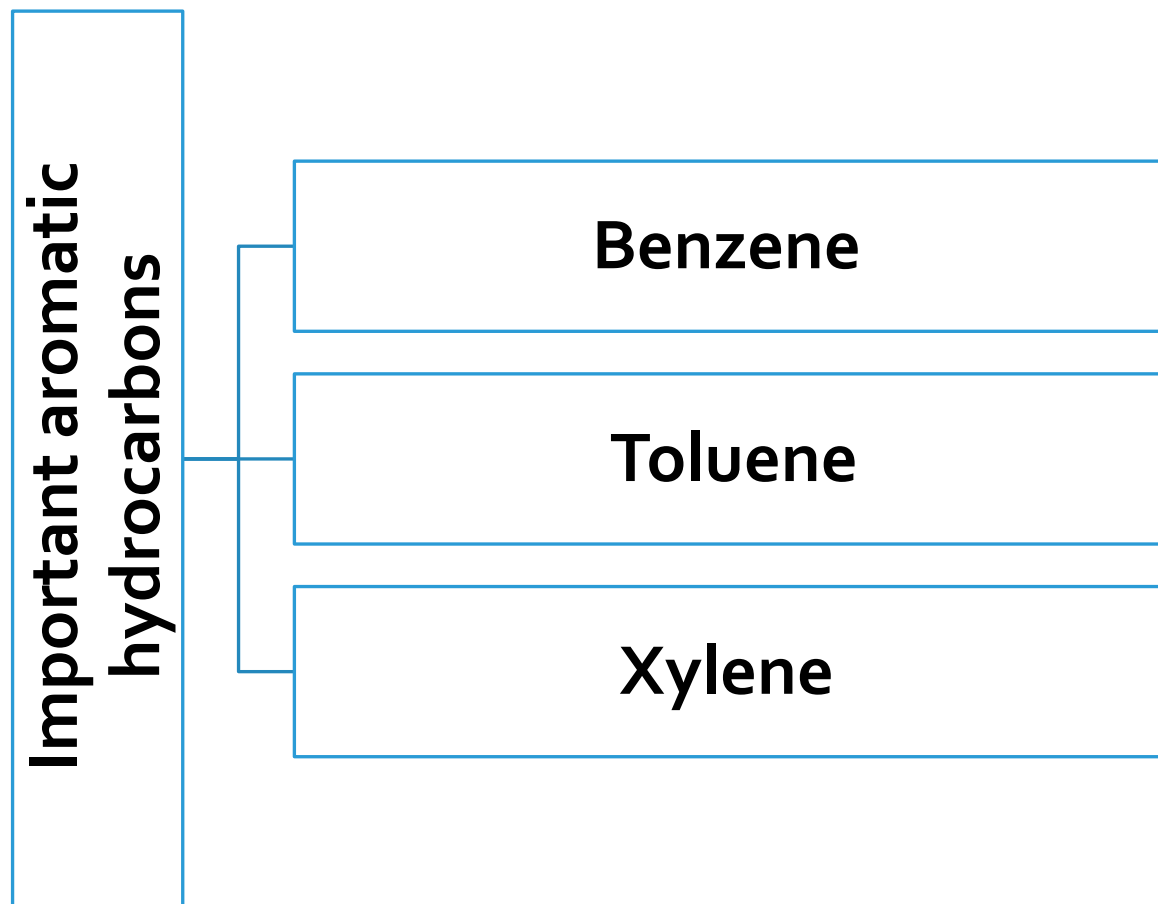
- Solvents are potent CNS depressants.
- The acute effects of excessive exposure are nausea, vertigo, locomotor disturbances, headache, and coma.
- Chronic exposure leads to hepatic dysfunction and nephrotoxicity.
- Long-term exposure to tetrachloroethylene or to trichloroethane has caused peripheral neuropathy.

Aliphatic Hydrocarbons Toxicity Rx

- **Removal from exposure is the only specific treatment available.**
- **Serious CNS depression must be treated with support of vital signs**



Aromatic Hydrocarbons



Aromatic Hydrocarbons

- Acute exposure to any of these hydrocarbons leads to CNS depression with ataxia and coma.
- Long-term exposure to benzene is associated with hematotoxicity (thrombocytopenia, aplastic anemia, pancytopenia) and various types of hematologic cancers, especially leukemia.



Aromatic Hydrocarbons Toxicity Rx

- Removal from exposure is the only specific way to reduce toxicity.
- CNS depression is managed by support of vital signs.



3. Environmental pollutants

- Chemical compounds that contribute to environmental pollution include:

1. Polychlorinated biphenyl

2. Dioxins

3. Asbestos

4. Heavy metals

Polychlorinated Biphenyls

- The polychlorinated biphenyls (PCBs) were used extensively in manufacturing electrical equipment until their potential for environmental damage was recognized.
- PCBs are among the most stable organic compounds known.
- They are poorly metabolized and lipophilic.
- They are therefore highly persistent in the environment, and they accumulate in the food chain.

Polychlorinated Biphenyls

- In workers exposed to PCBs, the most common effect is dermatotoxicity (acne, erythema, folliculitis, hyperkeratosis).
- Less frequently, mild increases in plasma triglycerides and elevated liver enzymes have been observed.

Asbestos

- Asbestos is a group of naturally occurring long, flexible mineral fibers, most commonly containing silicon.
- Asbestos has been used widely in manufacturing and building.
- Because it is poorly metabolized and lipophilic, it is highly persistent in the environment and accumulates in the food chain.
- Many countries have banned all use of asbestos because of its toxicity and strictly regulate handling of preexisting asbestos building products.

Asbestos

- Inhalation of asbestos fibers can cause a fibrotic lung disorder called asbestosis, which is characterized by shortness of breath.
- Asbestos is also associated with several cancers including lung cancer, mesothelioma, and cancers of the gastrointestinal tract.