CHEMICAL POLLUTION

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What is pollution?

- Pollution is the introduction of harmful substances or products into the environment
- Main types of pollution
  - Water Pollution
  - Air Pollution
  - Soil Pollution
  - Biological
  - Nuclear


Water Pollution

Causes of Water Pollution

- Factors that contribute to water pollution can be categorized into two different groups
  - Point sources
  - Non-point sources
- Point sources are the easiest to identify and control
- Non point sources are ambiguously defined and harder to control

Point Sources

- Some point sources of water pollution include
  - Factories
  - Sewage system
  - Power plants
  - Underground coalmines
  - Oil wells
- Are direct sources of water pollution and can be reduced and monitored

Example of a point source

Non-point Sources

- The term non-point source encompasses a large range of sources such as:
  - when rain or snow moves through the ground and picks up pollutants as it moves towards a major body of water
  - the runoff of fertilizers from farm animals and crop land
  - air pollutants getting washed or deposited to earth
  - storm water drainage from lawns, parking lots, and streets

Agricultural runoff

Kinds of water pollutants

- Inorganic Pollutants
- Organic Pollutants
- Biological Pollutants

Inorganic Pollutants

- Pb in gasoline
- Radionuclides
- Phosphorus, nitrogen (Great Lakes)

Inorganic Trace Contaminants-

-Mercury—methyl Hg and dimethyl Hg in fish—Minamata Bay, Japan, 1950's

-Lead—toxicity has been known for a long time

  – Tetraethyl lead—anti-knock additive for gas, 1930-1966

Phosphates and Nitrates

- Phosphates—mostly a result of sewage outflow and phosphate detergents
  - Additional phosphate grows excess algae…oxygen depletion

- Nitrates—sewage and fertilizers

Organic Pollutants

- Three classes of compounds
  - Pesticides and Herbicides
  - Materials for common household and industrial use
  - Materials for industrial use

Pesticides

- Chlorinated hydrocarbons
  - DDT, heptachlor, etc—2-15 years
- Organophosphates
  - Malathion, methyl parathion—1-2 weeks
- Carbamates
  - Carbaryl, maneb, aldicarb—days to weeks
- Pyrethroids
  - Pemethrin, decamethrin—days to weeks

Herbicides

- Triazines—e.g. atrazine, paraquat
  (interfere with photosynthesis)
- Systemic—phenoxy compounds, N compounds, Alar, glyphosate
  (create excess growth hormones)
- Soil sterilants
  trifluralin, dalapon
  (kill soil microorganisms)

Chemicals responsible for water pollution

- Each year 700-800 new chemicals are produced
- 55 million tons of hazardous chemical wastes are produced in the US each year
- The 20 most abundant compounds in groundwater at industrial waste disposal sites include TCE, benzene, vinyl chloride…all are carcinogens, and also affect liver, brain, and nervous system
- Polychlorinated biphenyls- Byproducts of plastic, lubricant, rubber & Paper Industry.

Air Pollution

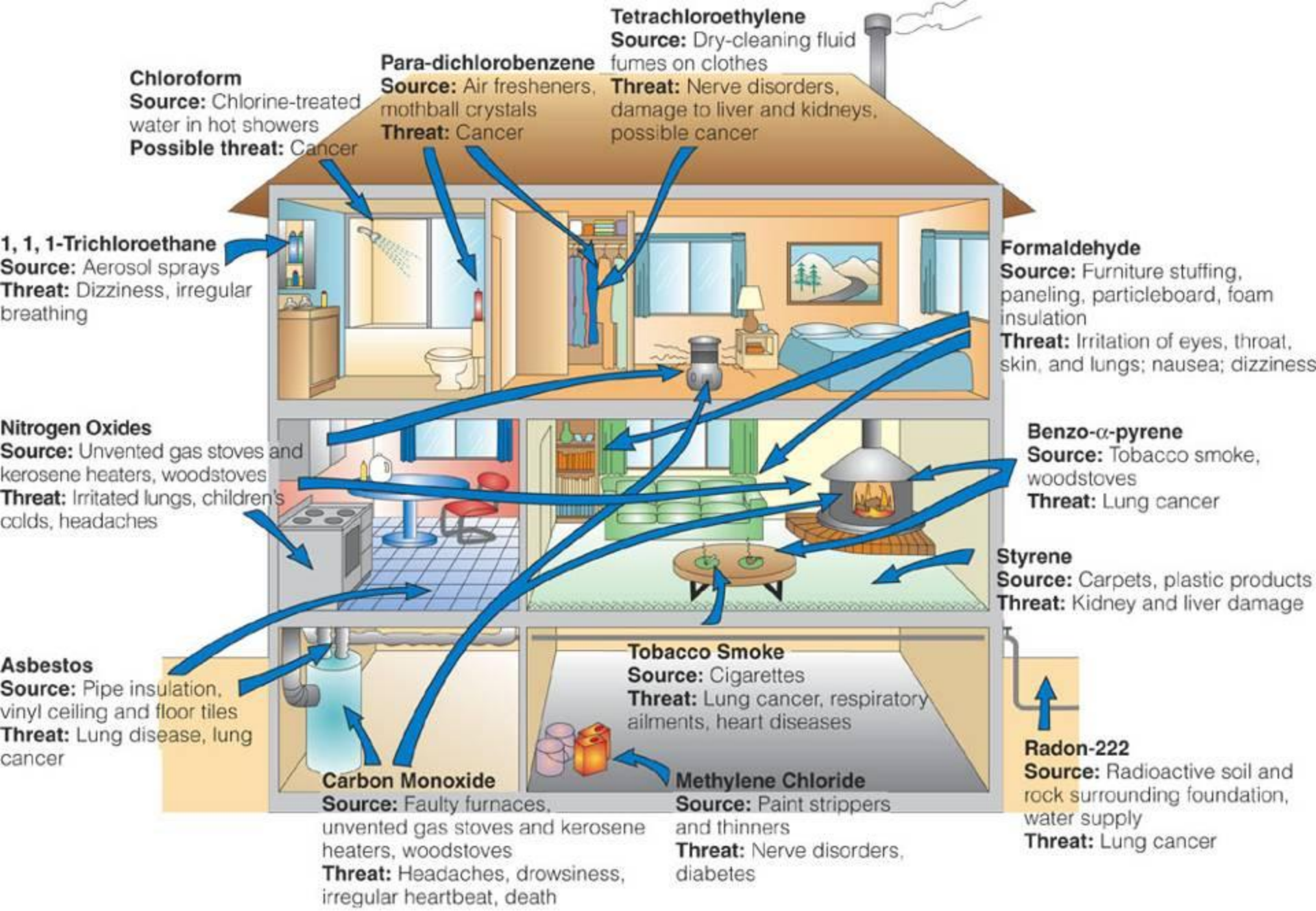
Causes of Air Pollution

- carbon dioxide -Deforestation and fossil fuel burning
- Sulfur dioxide -burning of sulfur containing compounds of fossil fuels.
- Chlorofluorocarbons (CFCs) reduces the amount of ozone. CFCs come from
  - the burning of plastic foam items
  - leaking refrigerator equipment
  - spray cans

- Hydrocarbons- from petrol engines
- NOx- from burning of fossil fuels
- Suspended particulate matter- by diesel engines, thermal power plants
- Lead compounds- from petrol engines

Natural Air Pollutants

- Natural air pollutants can include:
  - Smoke from wild fires
  - Methane released from live stock
  - Volcanic eruptions



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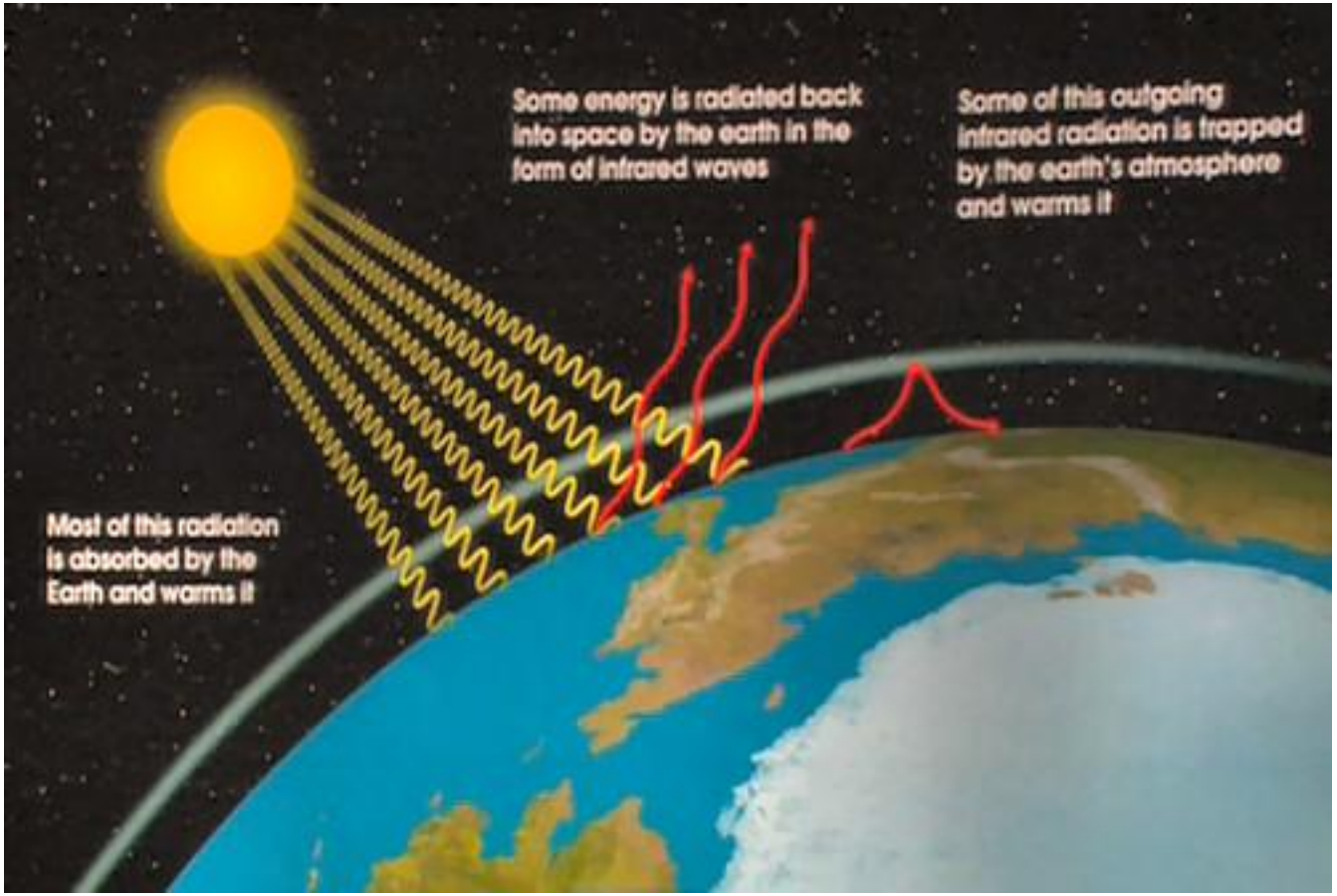
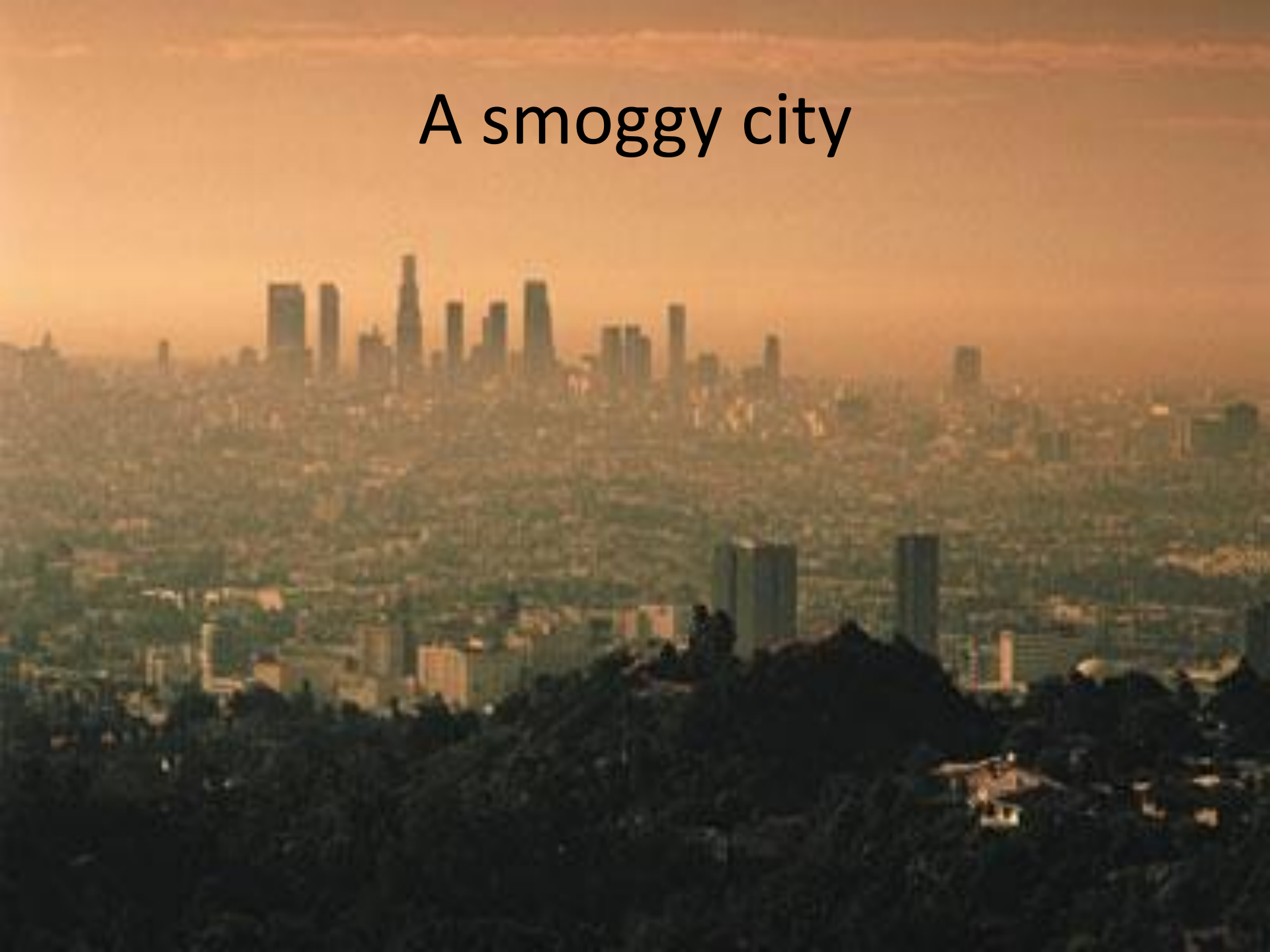
Consequences of Air Pollution

- CO_2 is a good transmitter of sunlight, but it also partially restricts infrared radiation going back from the earth into space, which produces the so-called greenhouse effect that prevents a drastic cooling of the Earth during the night
- Increasing the amount of CO_2 in the atmosphere reinforces this effect and is expected to result in a warming of the Earth's surface
- CO_2 in atmosphere→GLOBAL WARMING

The Greenhouse Effect



A smoggy city



Photochemical Smog

- Sulfur dioxide, nitrogen oxides, ozone and peroxyacl nitrates (PANs), give rise to photo chemical smog, irritates eyes and lungs.

- Chronic exposure of leaves and needles to air pollutants can also break down the waxy coating that helps prevent excessive water loss and damage from diseases, pests, drought and frost

Soil Pollution

Causes of Soil Pollution

- Contamination of soil system by considerable quantity of chemicals or other substances resulting in reduction of its fertility.
- Four Main causes of Soil pollution
  - Construction
  - Agriculture
  - Domestic waste
  - Industrial Waste

Chemicals causing soil pollution

- Metallic pollutants- textiles, dyes, soaps, detergents, drugs, cement, rubber, paper, metal industries release Fe, Pb, Cu, Zn, Hg, Cd, CN, acids, alkalies etc.
- Agro chemicals- Fertilizers, pesticides, insecticides, weedicides, rodenticides, fumigants release toxic chemicals like Pb, As, Cd, Hg, Co etc.
- Radioactive Chemicals

Biological Pollution

- Disturbance of the ecological balance by the accidental or deliberate introduction of a foreign organism, animal or plant species into an environment.

- an individual organism (internal biological pollution by parasites or pathogens)

- A population (by genetic change)

continued

- a community
- a habitat (by modification of physical-chemical conditions),
- An ecosystem (by alteration of energy and organic material flow).
- Biopollution may also cause decline in naturalness of nature conservation areas.

Biological Agents

- Soil gets human, animal & bird excreta
- Digested sewage sludge
- Heavy applications of manure to soil

Scale of Biologic Contaminant Problem:

-Major cause of infant deaths in third world

-Diarrhea kills 4-15 million children/year

-Bacteria, viruses, parasites

Radiological & Nuclear pollution

- Special form of physical pollution of air, water and soil with radioactive materials.

- Radioactivity- Property of certain elements like Ra, Th, U etc to spontaneously emit alpha, beta & gamma rays by disintegration of atomic nuclei.

Sources

- Nuclear explosions and detonations of nuclear weapons – U-235, Pu-239 for fission, H & Li for fusion. Fallouts contain Sr-90, Cs-137, I-131
- Defense weapon production- C-14, I-125, P-32
- Nuclear waste handling and disposal- high level & low level

Sources

- Mining – radioactive gases like radon
- Nuclear accidents
- Medical X-Rays- from diagnostic X-rays & radiation therapy for cancer.
- Nuclear reactors- U-235, U-238, Th-232

Effects of nuclear pollution

- The effects vary from organism to organism and from level of radioactivity of nuclear isotopes. The radiations destroy the cells in human body and causes cancer.

- A longer exposure to radioactive radiations can damage the **DNA** cells that results in cancer, genetic defects for the generations to come and even death.

continued

- Kills foetus in the womb

- Affects animals, some species preferentially accumulate specific radioactive materials- oysters deposit Zn-65, fish Fe-55, marine animals Sr-90.

Chemical Warfare agents

- A chemical used in warfare is called a *chemical warfare agent* (*CWA*).
- These agents may be in liquid, gas or solid form. Liquid agents are generally designed to evaporate quickly; such liquids are said to be *volatile* or have a *high vapour pressure*.
- In July 1917, the Germans employed mustard gas. Mustard gas easily penetrates leather and fabric to inflict painful burns on the skin.

- Chemical warfare agents are divided - into *lethal* and *incapacitating* categories. A substance is classified as incapacitating if less than 1/100 of the lethal dose causes incapacitation, e.g., through nausea or visual problems.
- Choking Agents (e.g., phosgene, chlorine)
- Blister Agents (e.g., nitrogen mustard, Lewisite)
- Nerve Agents (e.g., tabun, sarin, VX)
- The most commonly used chemicals are four lung-destroying poisons: chlorine, chloropicrin, phosgene, and trichloromethyl chloroformate, along with a skin-blistering agent known as mustard gas, or bis (2-chloroethyl) sulfide.


THANK YOU ALL