



# Environmental Pollution

Dr. Nizam Uddin

Assistant Professor

Nutrition & Food Engineering

Daffodil International University

## How concern build up

- ❑ London Smog ( Dec 5-9, 1952), around 4000 deaths caused by SO<sub>2</sub>.
- ❑ Historic marble status in Greece & Italy getting damaged by rain water. ( Acid rain)
- ❑ Minamata Bay Incident in Japan (1960s), more than 100 people die and thousands were permanently paralyzed caused by organic Hg ( methyl mercury CH<sub>3</sub>Hg<sup>+</sup> )
- ❑ Bhopal Disaster, India (Dec 3, 1984), 10,000 people die, more than 1000 people became blind while more than 1lakh people continue to suffer, caused by methyl isocyanate CH<sub>3</sub>NCO.
- ❑ Chernobyl Disaster in former USSR now Ukraine (26<sup>th</sup>April, 1986), accident kills more than 2500 people, cancer among 10 millions of the survivors caused by nuclear reactor burst ( <sup>137</sup>Cs).

## Cause of environmental pollution

- Natural -volcanic eruptions, forest fire etc.
- Artificial (man made)



**Pollutant:** a substance present in nature, in greater than abundance due to human activity, which ultimately effect on the environment and therefore on living organisms and mankind. E.g. Pb, Hg, SO<sub>2</sub>, CO<sub>2</sub> etc.

**Contaminant:** a material which does not occur in nature, but is introduced by human activity into the environment, affecting its composition. A contaminant is classified as a pollutants when it exerts a detrimental effect.

**Dissolved oxygen :** Oxygen is a vitally important species in water. It is consumed by oxidation of organic matter/ reducing agents. It is an important water quality parameter. The optimum value for good water quality is 4-6 mg/L of DO, which ensures healthy aquatic life in water body. Lower DO values indicate water pollution. In natural & waste waters DO levels depend on the physical, chemical & biological activities of the water body.

**Chemical oxygen demand (COD):** This is an index of the organic content of water (oxygen demanding substances in water ) and is important water quality parameter. It is a rapidly measurable parameter for stream, industrial waste studies & control of water treatment plants.

**Bio-chemical oxygen demand (BOD):** Based on oxidation of organic matter in water. This is also a water quality parameter for organic matter in water, which is empirical in nature. It is measured by the quantity of oxygen utilized by suitable aquatic microorganisms during a five-day period.

**Threshold limit value(TLV):** This indicates the permissible level of a toxic pollutant in atmosphere to which a healthy industrial worker is exposed during an eight hour day without any adverse effect. TLV values for Be, Zn, are 0.002 and 1.000 mg/ m<sup>3</sup> respectively.



# What's Environmental Pollution?

Environmental pollution is any an undesirable change in physical, chemical, or biological characteristics of any component of the environment

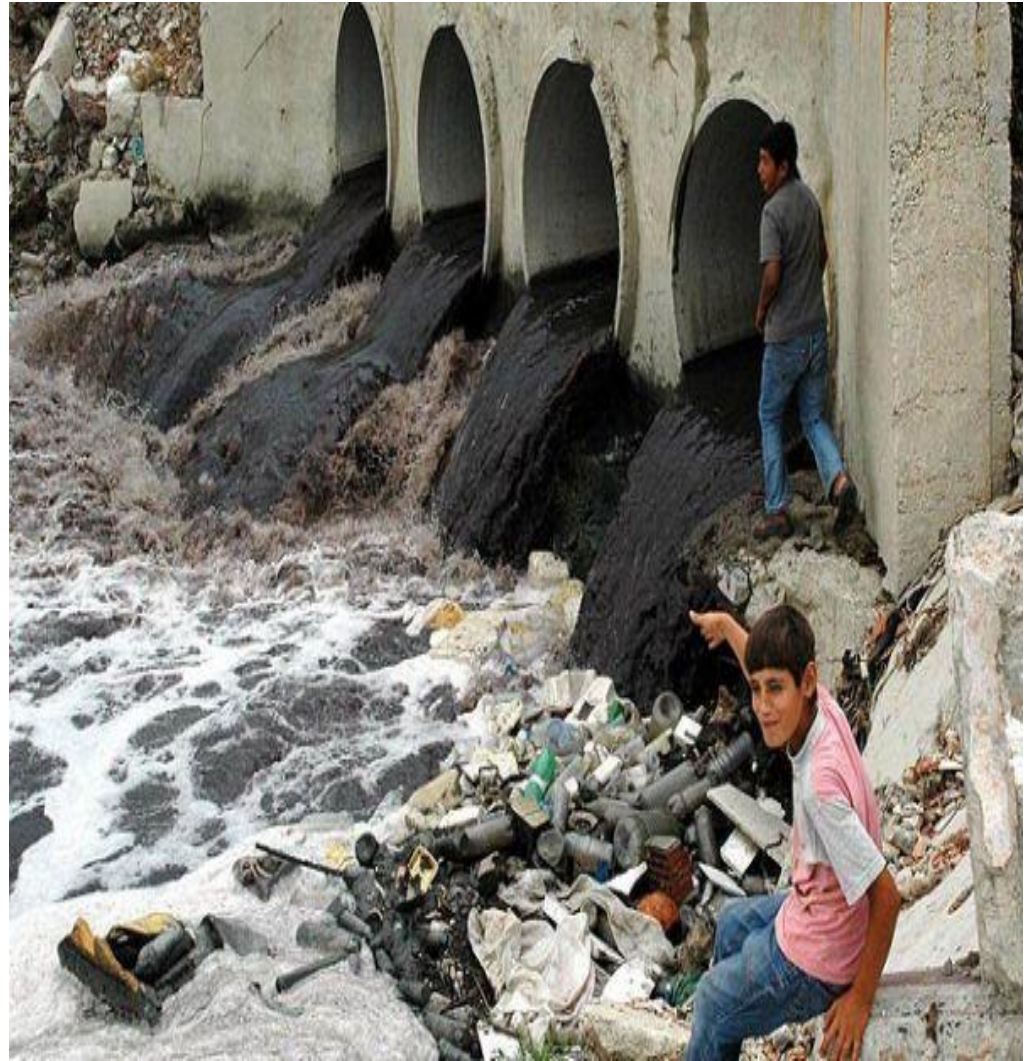


# Forms of Environmental Pollution

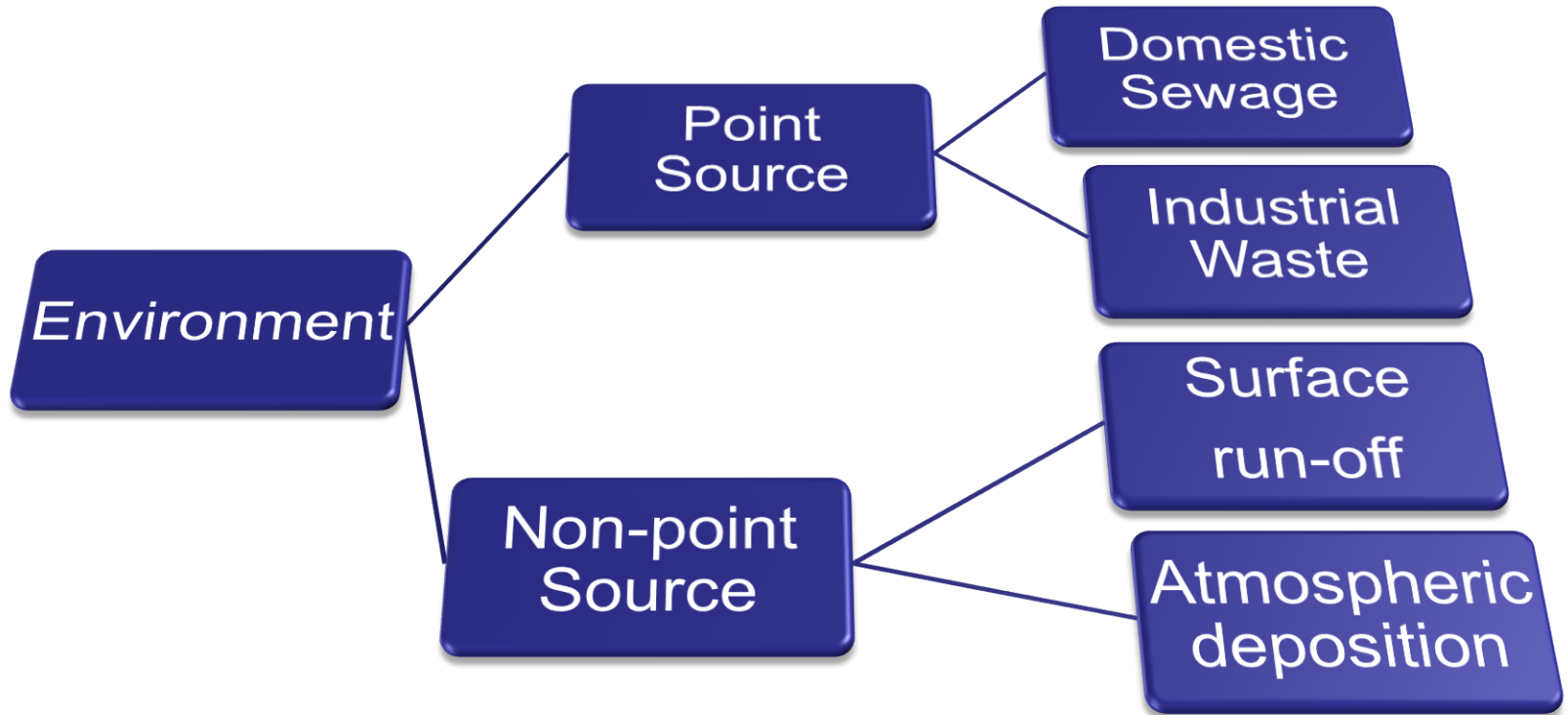
- \*Soil contamination
  - \*Air pollution
  - \*Water pollution
  - \*Noise pollution
- \*Radioactive contamination
  - \*Light pollution



- Littering
- Thermal pollution
- Visual pollution

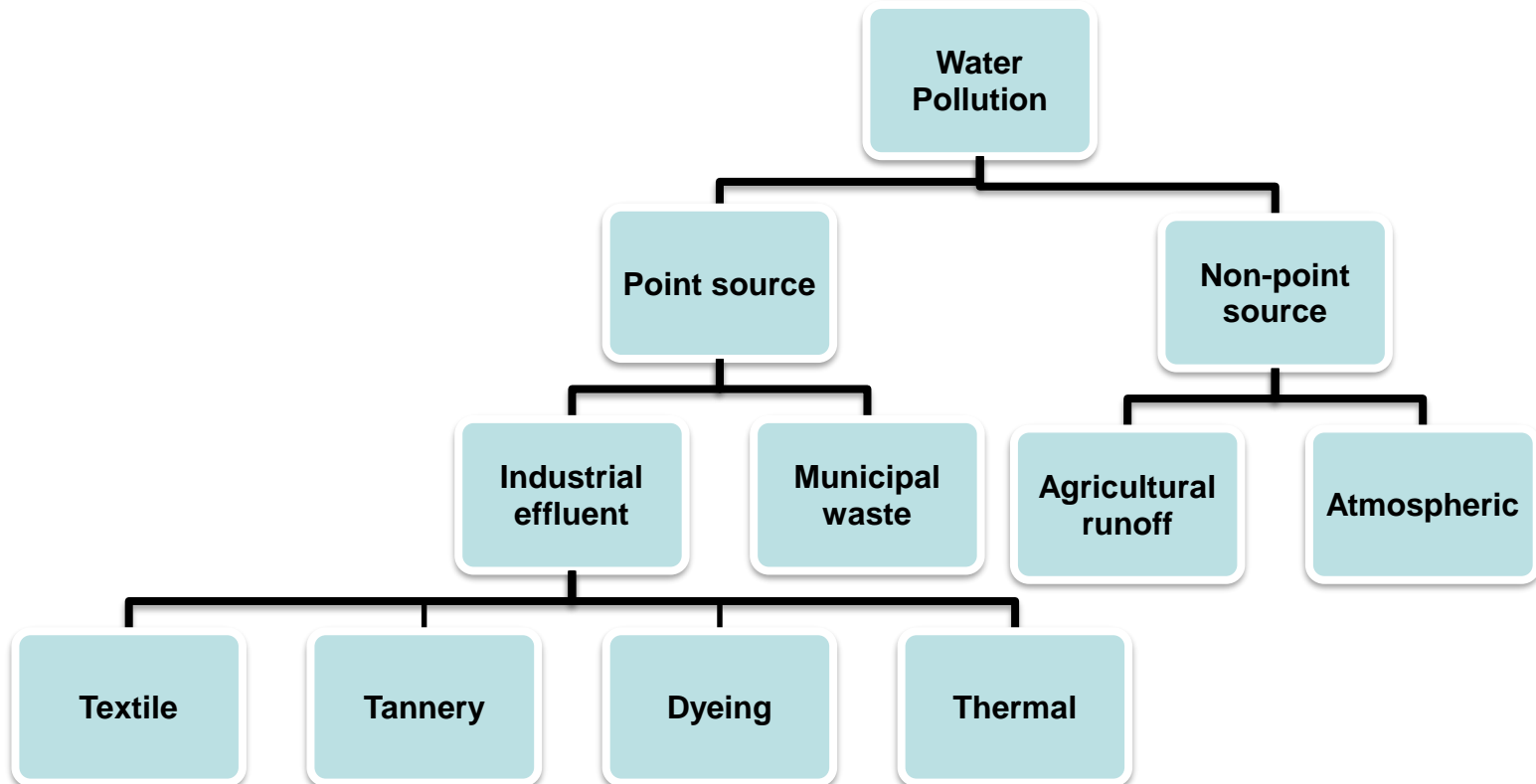


# Sources of Pollution

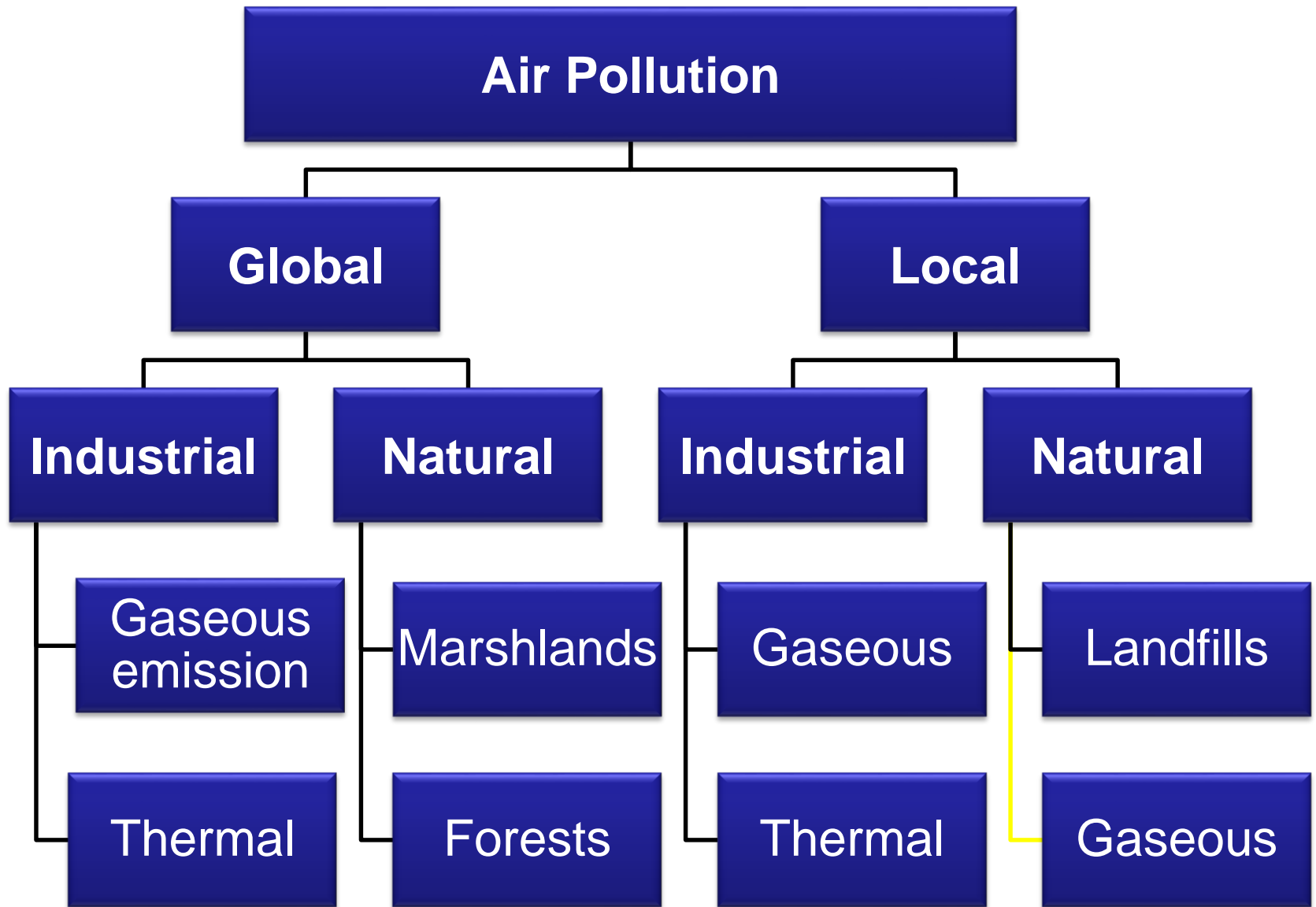


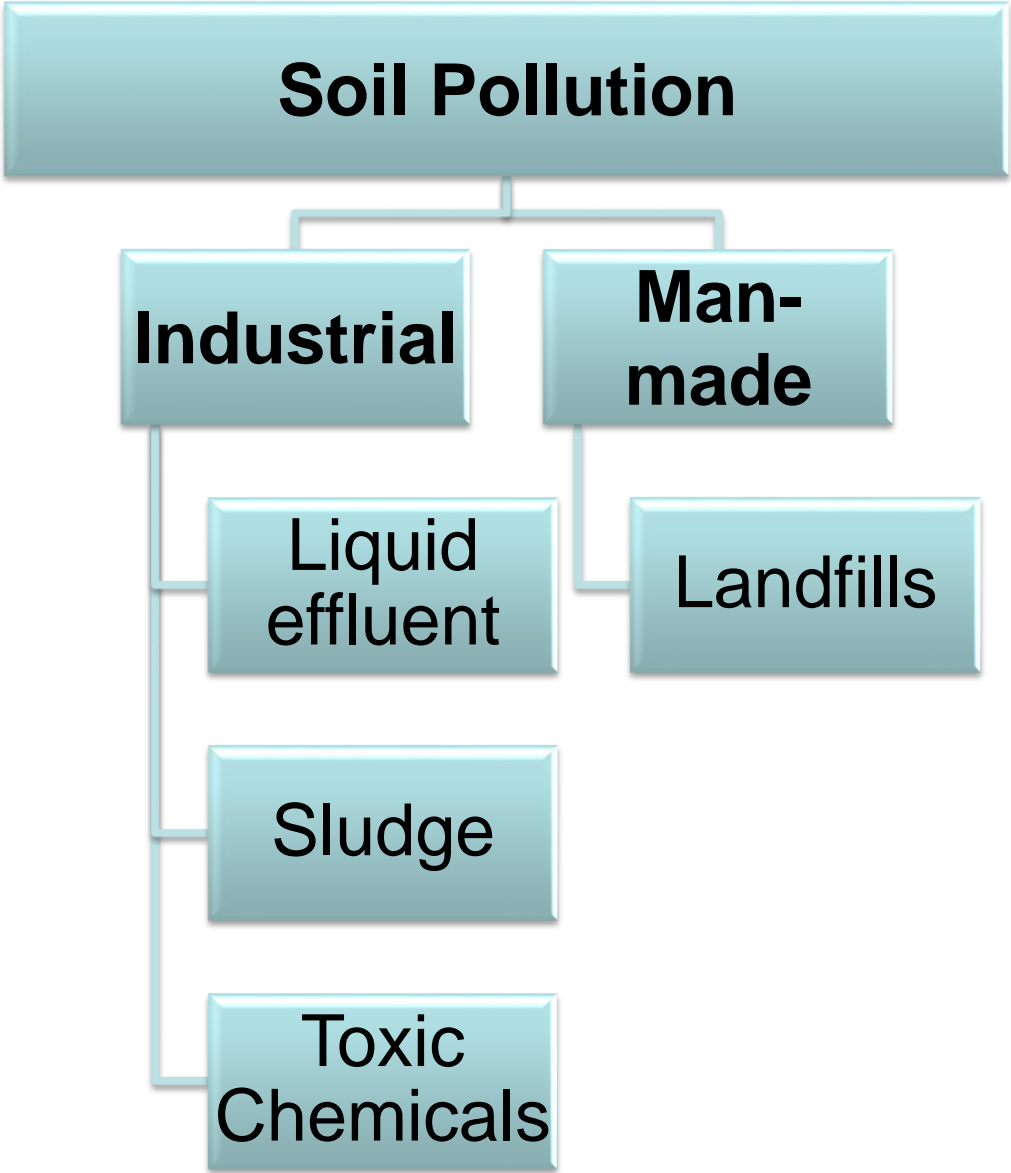
# Water Pollution

1. Organic pollutants
2. Inorganic pollutants
3. Suspended solids and sediments
4. Radioactive materials
5. Heat

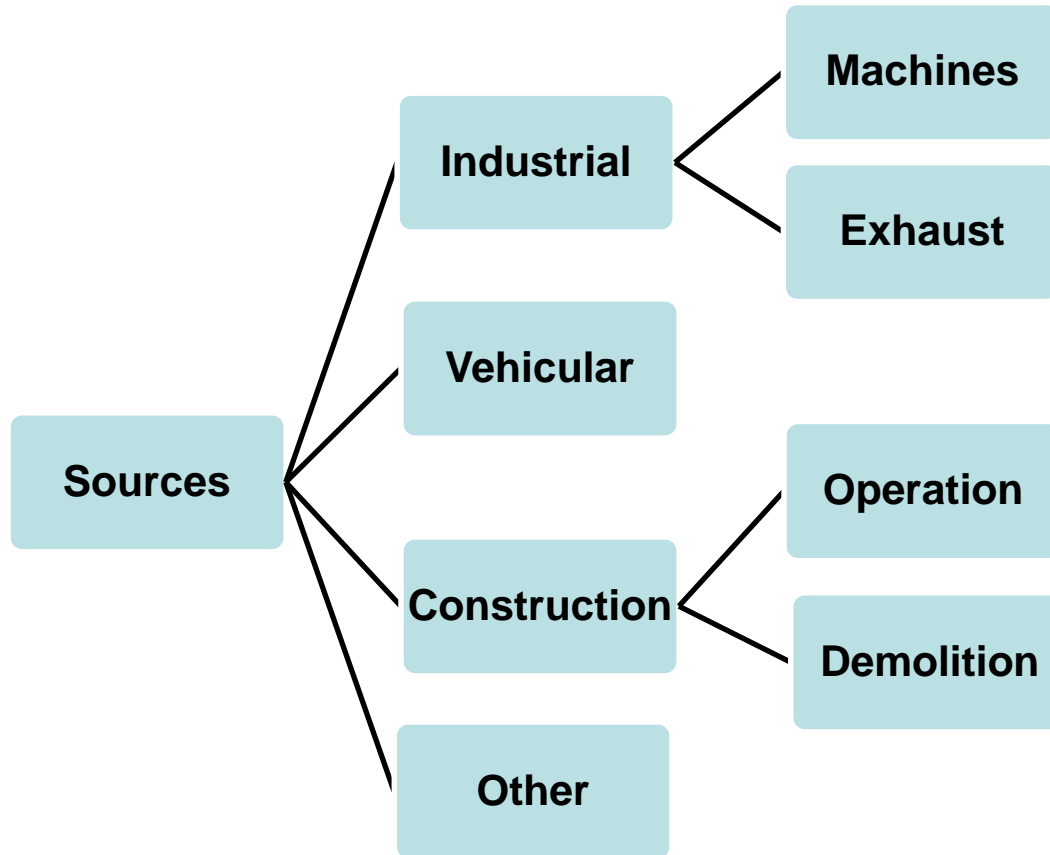








# Noise Pollution



# Some Examples



Industrial wastewater discharge in Turag river



Sewage discharge in Balu river



Waste materials dumping in Turag river



Sewage discharge in Bongshi river

## Dysfunctional ETP



Sludge Cake





Sewage outfall

Hatirjheel



# Thermal Plume Discharge in Sitalakhhya River



**Shiddhirgonj Power Plant Outfall**



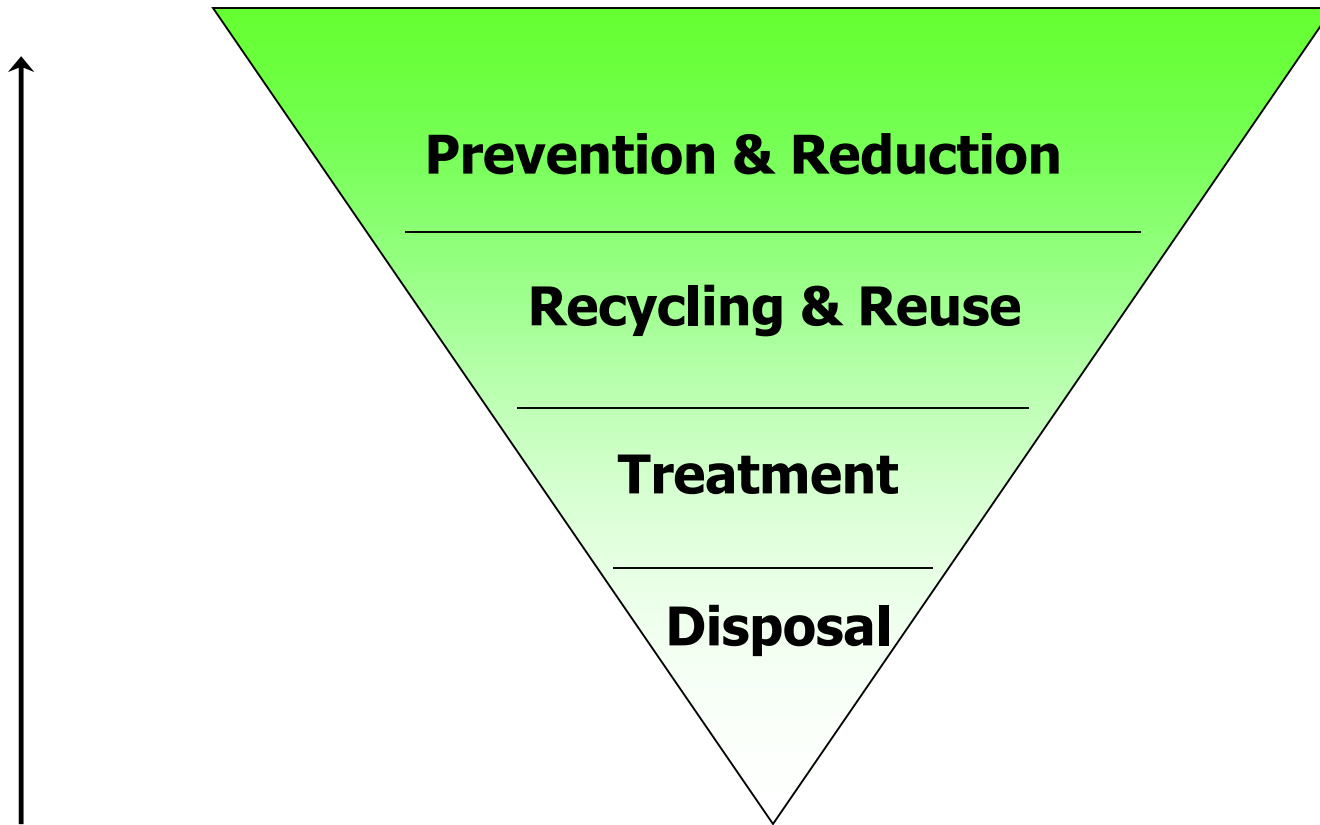
**Haripur Barge-Mounted Power Plant**



**CDC Globeleque Power Plant**



# Pollution Prevention Hierarchy



# **Air Pollution: The Dirty Truth**



# Air Pollution

Air pollution is the addition of gases, chemicals, and particle matter into the atmosphere. Air pollution **primarily comes from burning fossil fuels** such as natural gas, petroleum, and coal.

Poor air quality causes nearly **122,400 premature deaths** every year in Bangladesh, says a new study.

A study has listed air pollution as the **cause of four percent of the deaths** in the United States.



# **ORGANIC AIR POLLUTANTS**

**Acrylonitrile**

**Benzene**

**Butadiene**

**Carbon disulfide**

**Carbon monoxide**

**1,2-Dichloroethane**

**Dichloromethane**

**Formaldehyde**

**Polycycli aromatic hydrocarbons (PAHs)**

**Polychlorinated biphenyls (PCBs)**

**Polychlorinated dibenzodioxins and**

**Dibenzofurans(PCDDs/PCDFs)**

**Styrene**

**Tetrachloroethylene**

**Toluene**

**Trichlorethylene**

**vinylchloride**

# **INORGANIC AIR POLLUTANTS**

**Arsenic**

**Asbestos**

**Cadmium**

**Chromium**

**Fluoride**

**Hydrogen sulfide**

**Lead**

**Manganese**

**Mercury**

**Nickel**

**Platinum**

**Vanadium**

# **CLASSICAL AIR POLLUTANTS**

**Nitrogen dioxide**

**Ozone and other photochemical oxidants**

**Particulate matter**

**Sulfur dioxide**

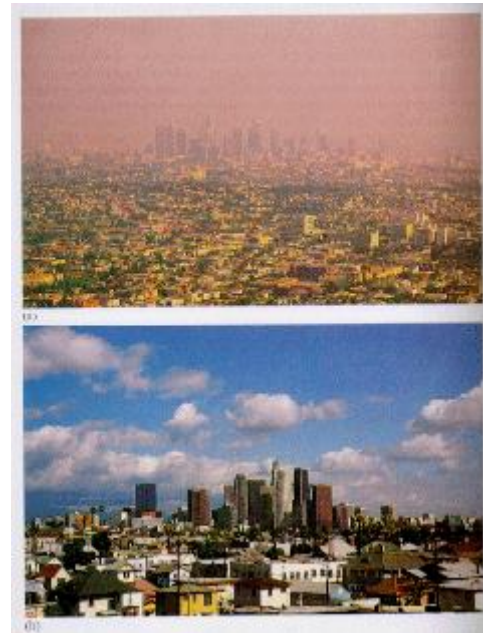
# Sources of Outside Air Pollution

- Combustion of gasoline and other hydrocarbon fuels in cars, trucks, and airplanes
- Burning of fossil fuels (oil, coal, and dinosaur bones)
- Insecticides
- Herbicides
- Everyday radioactive fallouts
- Dust from fertilizers
- Mining operations
- Livestock feedlots



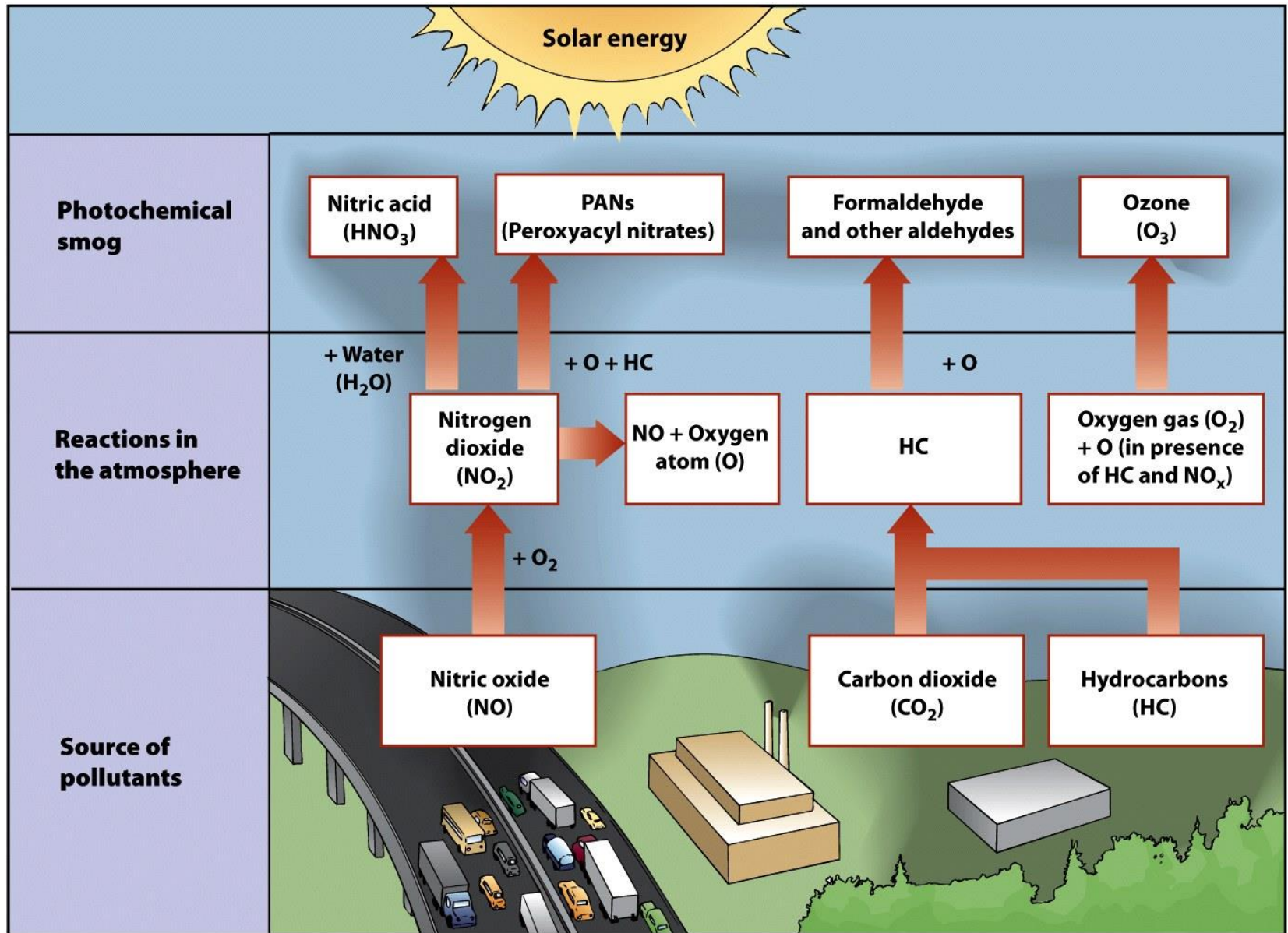
# What's in smog

- particulates  
(especially lead)
- nitrous oxides
- potassium
- Carbon monoxide
- Other toxic chemicals





# Formation of Photochemical Smog



# Sources of Indoor pollution

- Efficient insulation
- Bacteria
- Molds and mildews
- Viruses
- animal dander and cat saliva
- plants
- house dust
- Mites
- Cockroaches
- pollen

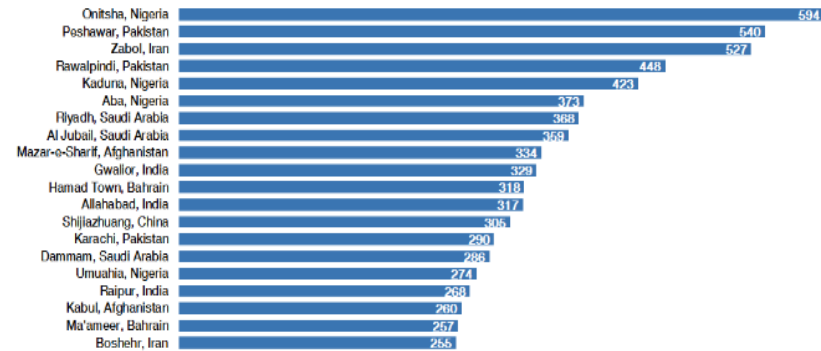


# Air Pollution Around the World

## The 20 most polluted cities in the world

WORLD  
ECONOMIC  
FORUM

PM10 particulate concentration, micrograms per cubic meter, annual mean



Source: World Health Organisation Urban Ambient Air Pollution database, 2016 update

Image: WHO

- Air quality is deteriorating rapidly in developing countries
- Shenyang, China
  - Residents only see sunlight a few weeks each year
- Developing countries have older cars
  - Still use leaded gasoline
- 5 worst cities in world
  - Beijing, China; Mexico City, Mexico; Shanghai, China; Tehran, Iran; and Calcutta, India

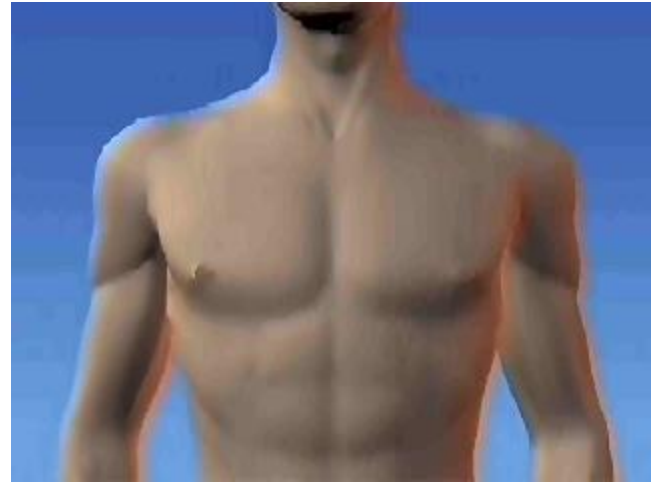


Air pollution has risen by 8% globally in the past five years, but China is addressing its air pollution problem.

Image: REUTERS/Kim Kyung-Hoon

# Effects on the environment

- Acid rain
- Ozone depletion
- Global warming
- In human population-  
respiratory problems,  
allergies, strengthens  
lungs, and a risk for  
cancer



# Acid rain

- contains high levels of sulfuric or nitric acids
- contaminate drinking water and vegetation
- damage aquatic life
- erode buildings
- Alters the chemical equilibrium of some soils



Figure 1: trees badly damaged by acid rain



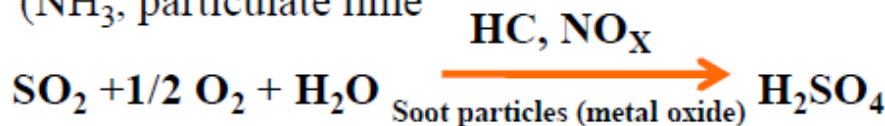
**How acid rain affects stonework.**  
The picture on the left was taken in 1908.  
The picture on the right was taken in 1968

# ACID RAIN

Much of the NO<sub>x</sub> and SO<sub>x</sub> entering into the atmosphere are converted into HNO<sub>3</sub> & H<sub>2</sub>SO<sub>4</sub> respectively. The detailed photochemical reactions in the atmosphere are summarized:

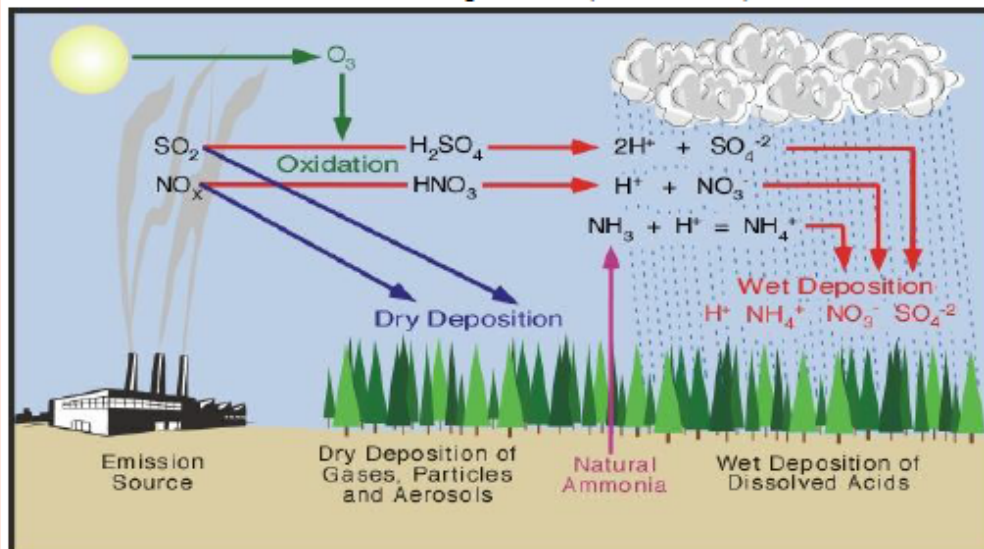


HNO<sub>3</sub> is removed as precipitated or as particular nitrates after reaction with bases (NH<sub>3</sub>, particulate lime



HNO<sub>3</sub> & H<sub>2</sub>SO<sub>4</sub> Combine with HCl emission (both by natural and anthropogenic sources) to generate acidic precipitation which is widely known as acid rain. Acid rain now a major pollution problem in some areas.

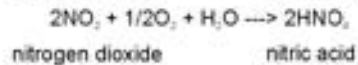
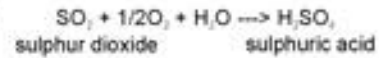
Acid rains causes extensive damage to buildings & sculptural materials of marble, limestone, slate, mortar etc. These materials become pitted and weakened mechanically as the soluble sulphates are leached out by rainwater



Sun's Energy

photochemical  
reactions are driven  
by the sun

### Oxidation



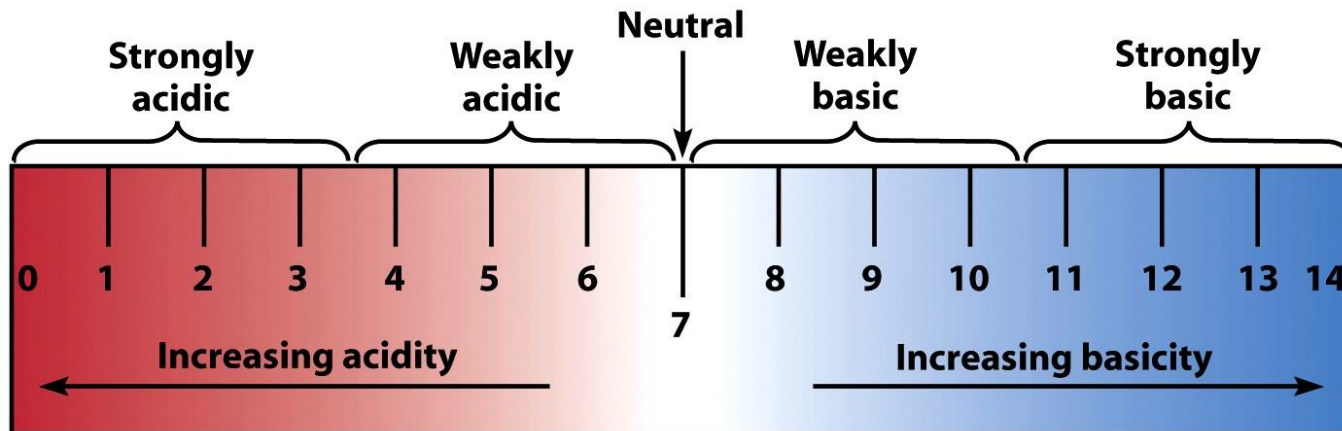
Acid-forming gases and particles have been linked to a variety of impacts, including forest decline, accelerated leaching of metals from rocks and soils, the decay of limestone, marble, and other building materials, and damage to the human respiratory system.

### Acid Rain



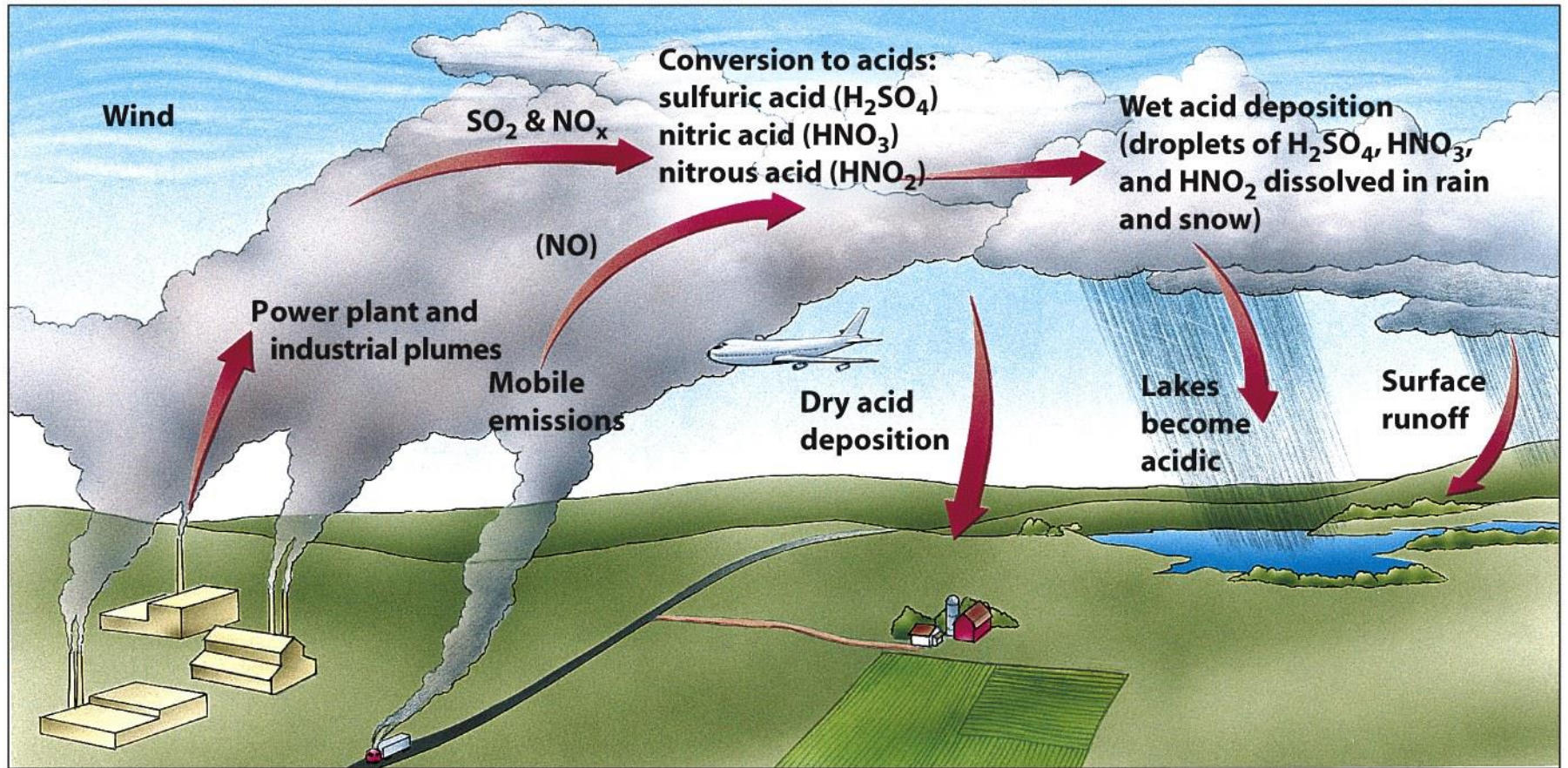
# Acid Deposition

- Sulfur dioxide and nitrogen dioxide emissions react with water vapor in the atmosphere and form acids that return to the surface as either dry or wet deposition
- pH scale





# How Acid Deposition Develops

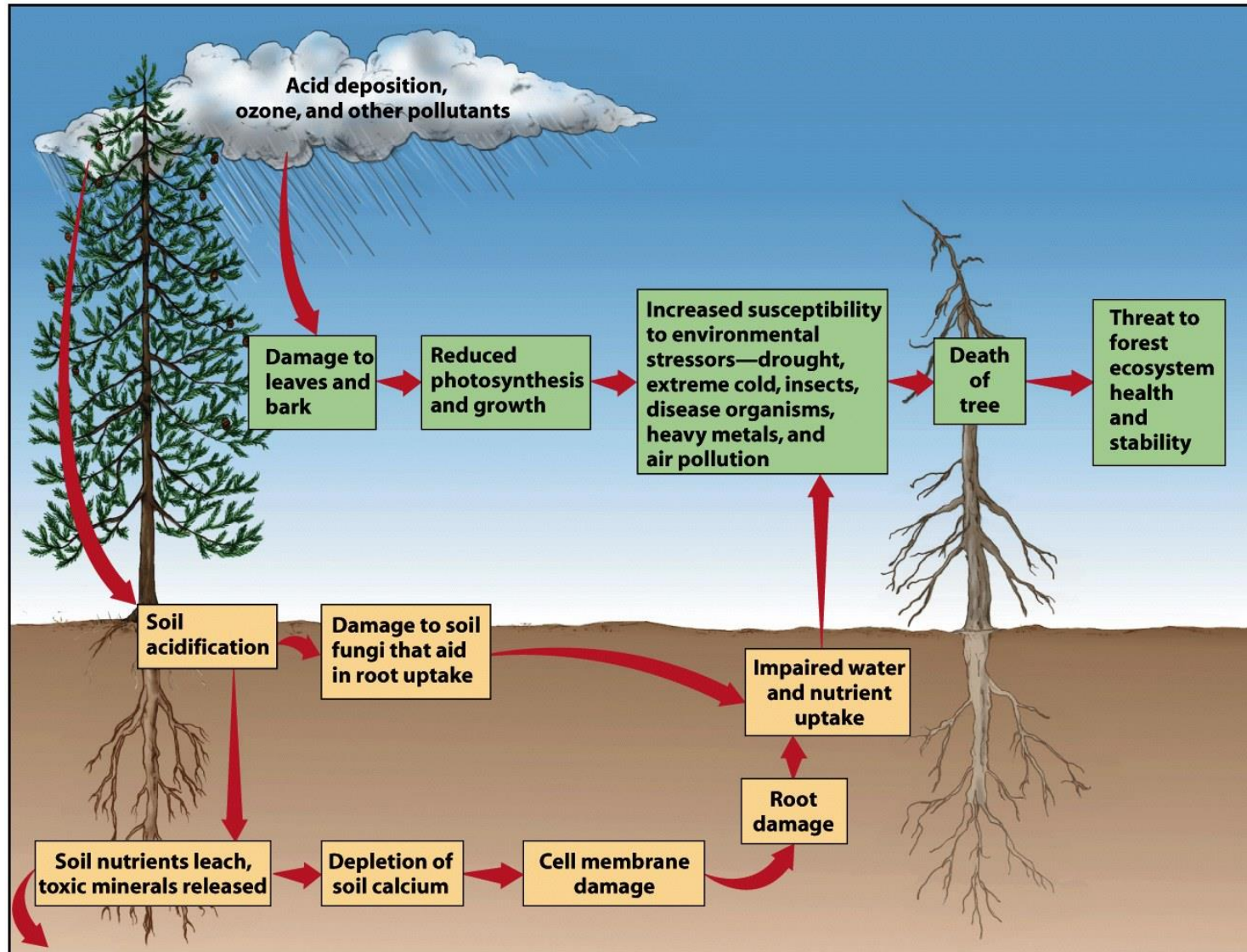


# Effects of Acid Deposition

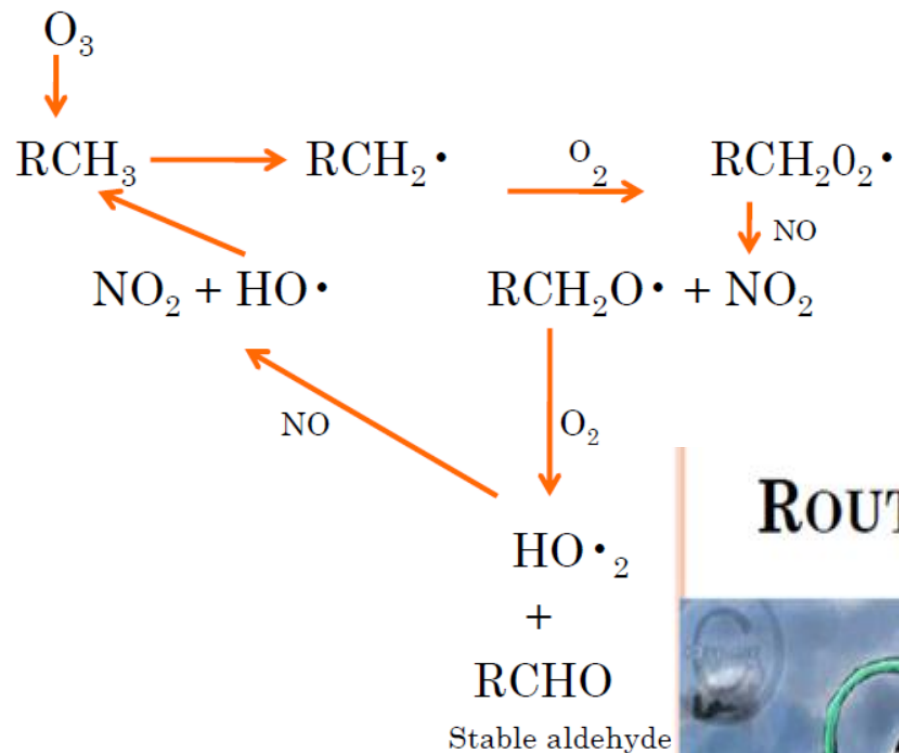
- Declining Aquatic Animal Populations
- Thin-shelled eggs prevent bird reproduction
  - Because calcium is unavailable in acidic soil
- Forest decline
  - Ex: Black forest in Germany (50% is destroyed)



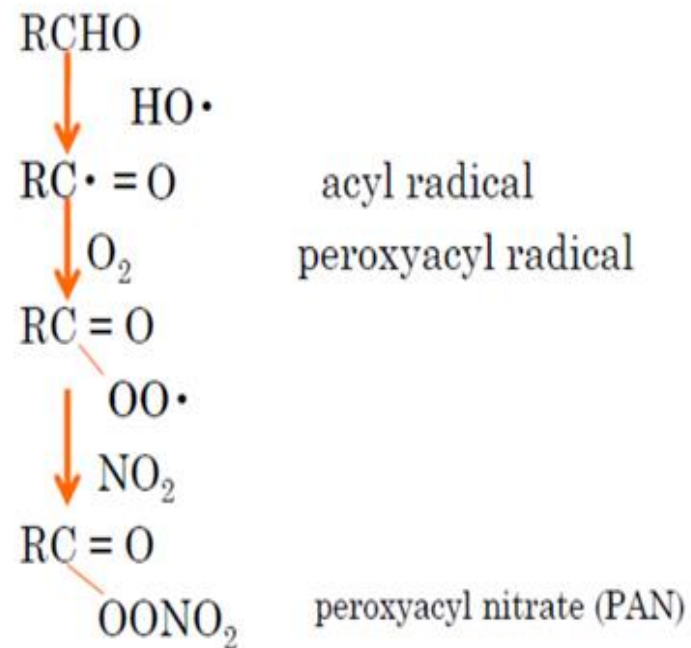
# Acid Deposition and Forest Decline



# Reactive hydrocarbon

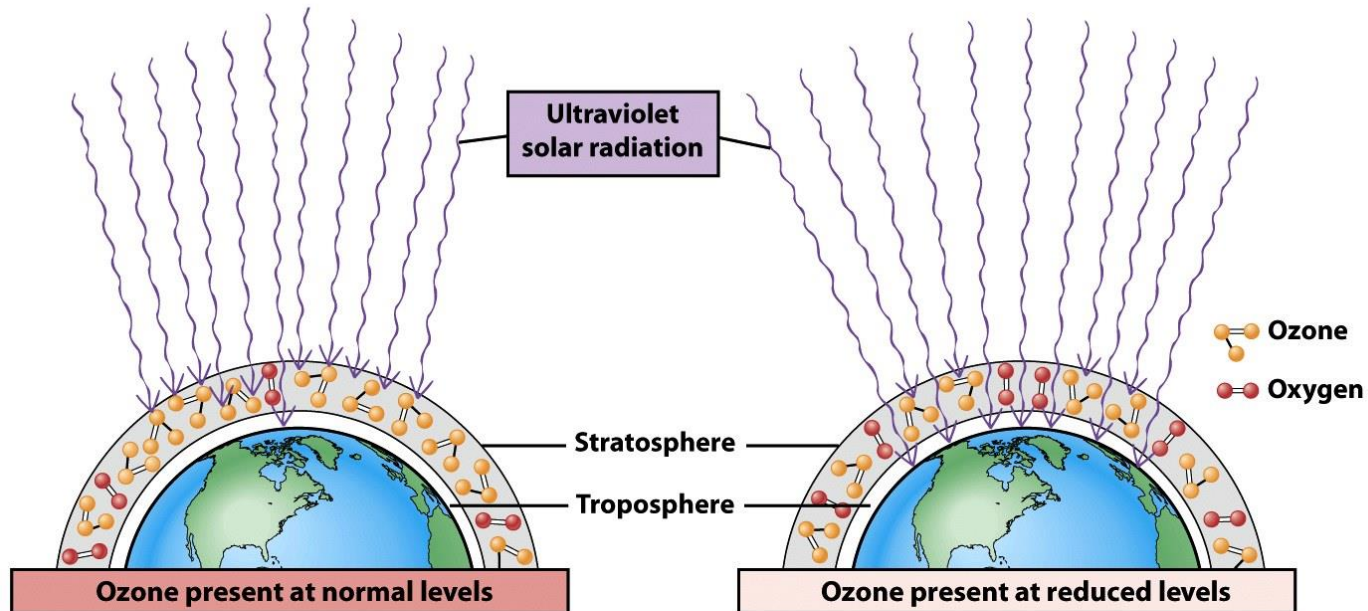


## ROUTE OF PAN FORMATION



# Ozone Depletion in Stratosphere

- Ozone Protects earth from UV radiation
  - Part of the electromagnetic spectrum with wavelengths just shorter than visible light

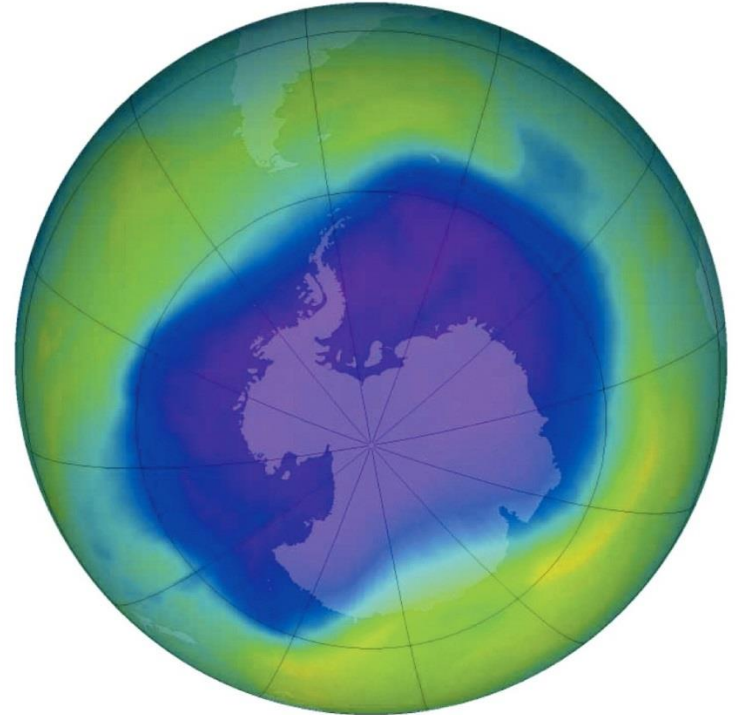


**(a) Stratospheric ozone absorbs about 99% of incoming solar ultraviolet (UV) radiation, effectively shielding the surface.**

**(b) When stratospheric ozone is present at reduced levels, more high-energy UV radiation penetrates the atmosphere to the surface, where its presence harms organisms.**

# Ozone Depletion in Stratosphere

- Ozone thinning/hole
  - First identified in 1985 over Antarctica
- Caused by
  - human-produced bromine and chlorine containing chemicals
  - Ex: CFCs



# Effects of Ozone Depletion

- Higher levels of UV-radiation hitting the earth
  - Eye cataracts
  - Skin cancer (right)
  - Weakened immunity
- May disrupt ecosystems
- May damage crops and forests



# Recovery of Ozone Layer

- Montreal Protocol (1987)
  - Reduction of CFCs
  - Started using HCFCs (greenhouse gas)
- Phase out of all ozone destroying chemicals is underway globally
- Satellite pictures in 2000 indicated that ozone layer was recovering
- Full recovery will not occur until 2050



## Eutrophication of the water

Larger or lesser amounts of nutrients enter surface waters all the time, and they provide the necessary conditions for the formation of organic substances in aquatic organisms using energy from sunlight.

These are photosynthesising plants and include different algae, higher aquatic plants – such as reeds, rush, pondweed, duckweed and others – as well some bacteria.

If the inflow of substances containing nutrients increases, their concentration in water increases too, in effect boosting the growth of plants, mostly algae, thus increasing the overall live mass of aquatic organisms.

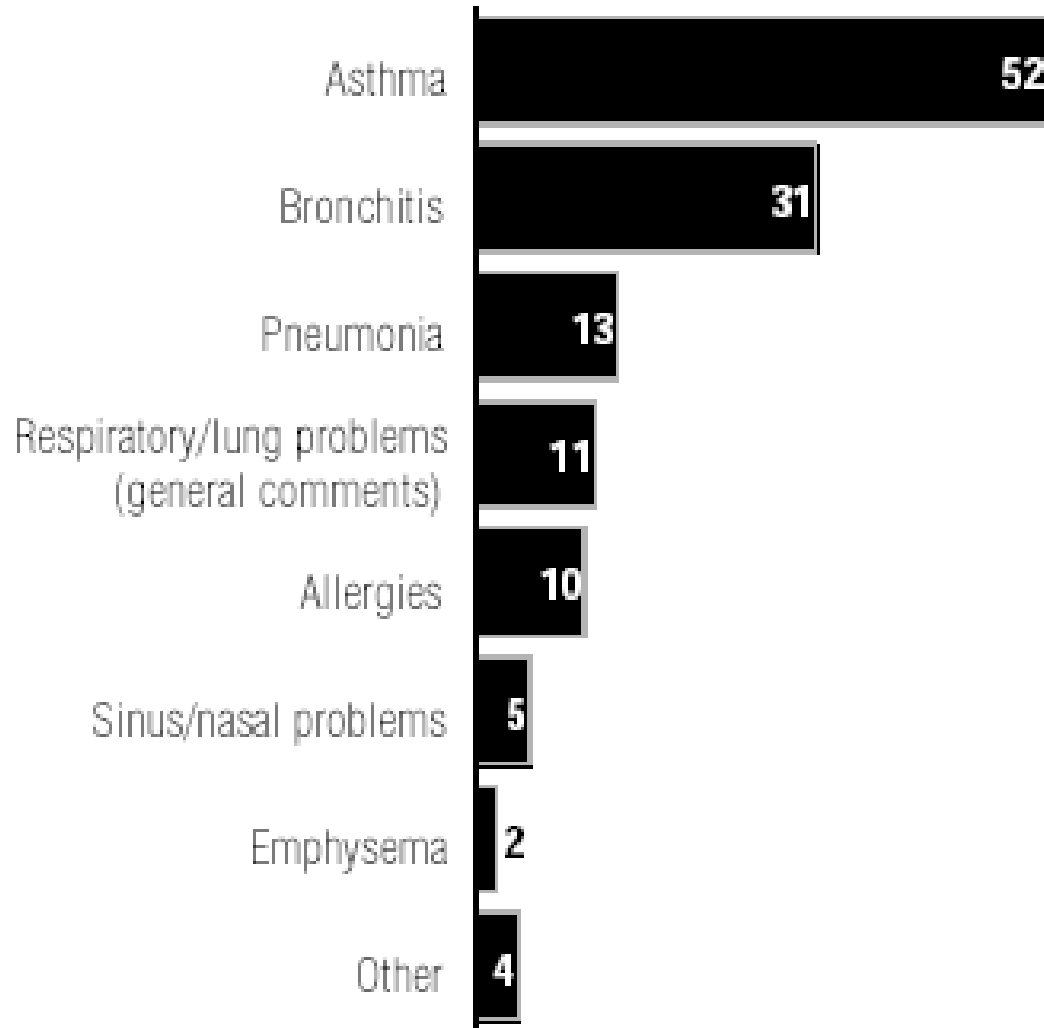
This process is called eutrophication (from the Greek – *eu-* 'well' + *trophe* – 'nourishment' = 'well nourished').



Overgrown part of the river Lielupe between Bauska and Mežotne

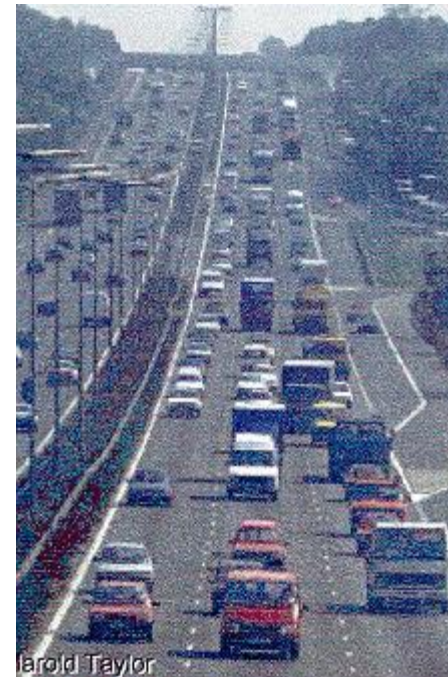
# Effects of Air Pollution

Type of respiratory illness diagnosed



# Strategies

- Air Quality Management Plan
  - Development of new technology- electric cars, cleaner fuels, low nitrogen oxide boilers and water heaters, zero polluting paints, less polluting BBQ lighter fluids
- Use of natural gas
- Carpooling
- Follow the laws enacted



## Other Ways to Improve Air Quality

- Reduce sulfur content in gasoline from its current average of 330 ppm to 30 ppm
  - Sulfur clogs catalytic converters
- Require federal emission standards for all passenger vehicles
  - Including SUVs, trucks and minivans
- Require emission testing for all vehicles
  - Including diesel

# Recommended strategies for air pollution reduction in Bangladesh

	Strategy	Area of application
A	Improve public transport	Large cities
B	Strengthen vehicle inspection and maintenance	All, especially large cities
C	Ban vehicles older than 20 years	Commercial vehicles, large cities
D	Encourage Diesel to CNG switch through incentives	All diesel vehicles, especially, truck & buses in large cities
E	Emissions (age) based annual registration fees	All vehicles
F	Stringent emissions standards	All new vehicles
G	Emissions based import tariff	All new vehicles
H	Comprehensive land use plan for industry locations	All industries, especially new ones
I	Cluster management	Cluster of highly polluting industries
J	Emissions (technology and fuel) based license fee	All kilns
K	Technology standards	All kilns
L	Alternate construction material	All country, especially large cities
M	Ensure adequate power supply	All country
N	Emissions standards	All new plants
O	Emissions standard for diesel generators	All new generators
P	Inspection & maintenance of diesel generators	All existing generators
Q	Technology specification	Existing steel mills, cement and glass factories
R	Inspection and maintenance	Existing steel mills, cement and glass factories
S	Emissions standards	All new and existing plants
T	Import control for quality of coal	Whole country, primarily brick and power industries
U	Better construction practices on site & during transport	All construction sites
V	Air pollution mitigation plan and its enforcement	Large construction projects
W	Timely road maintenance	All roads
X	Landscaping and gardening	All exposed soil in urban areas
Y	Encourage fuel switch	Urban slums and rural areas
Z	Improved cooking stoves	Rural areas

Air Pollution Reduction  
Strategy for Bangladesh  
Final Report , 2012

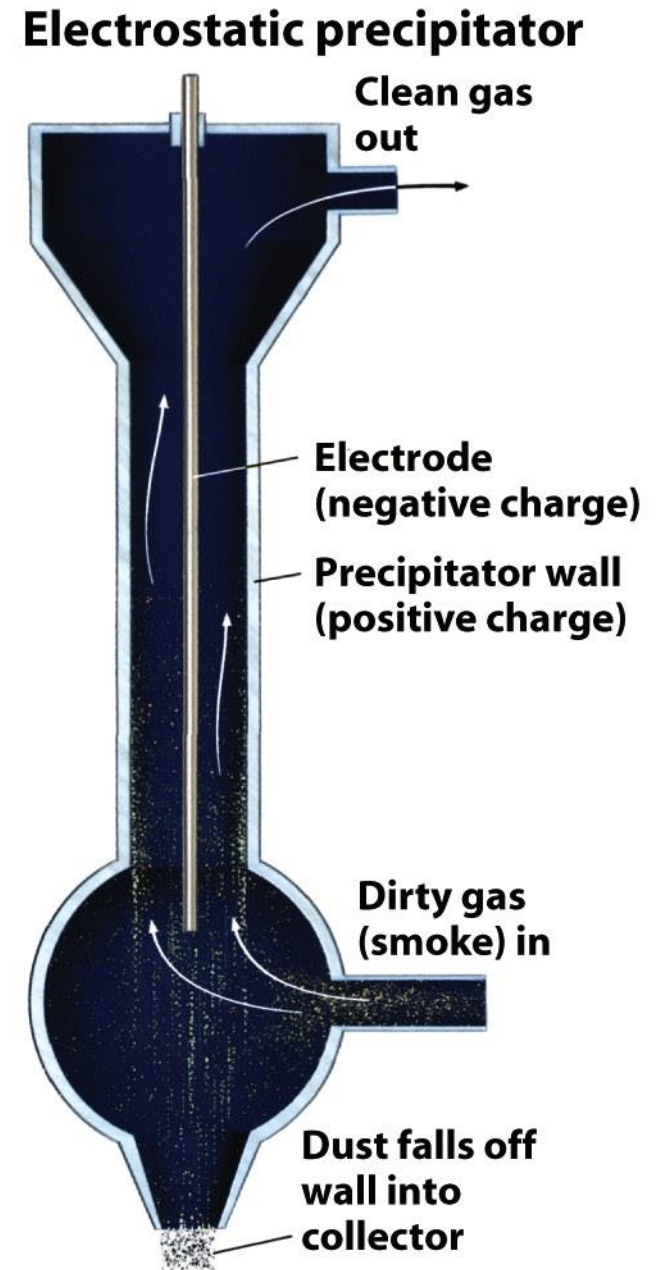
# Controlling Air Pollution in US

- Smokestacks with electrostatic precipitator (right)



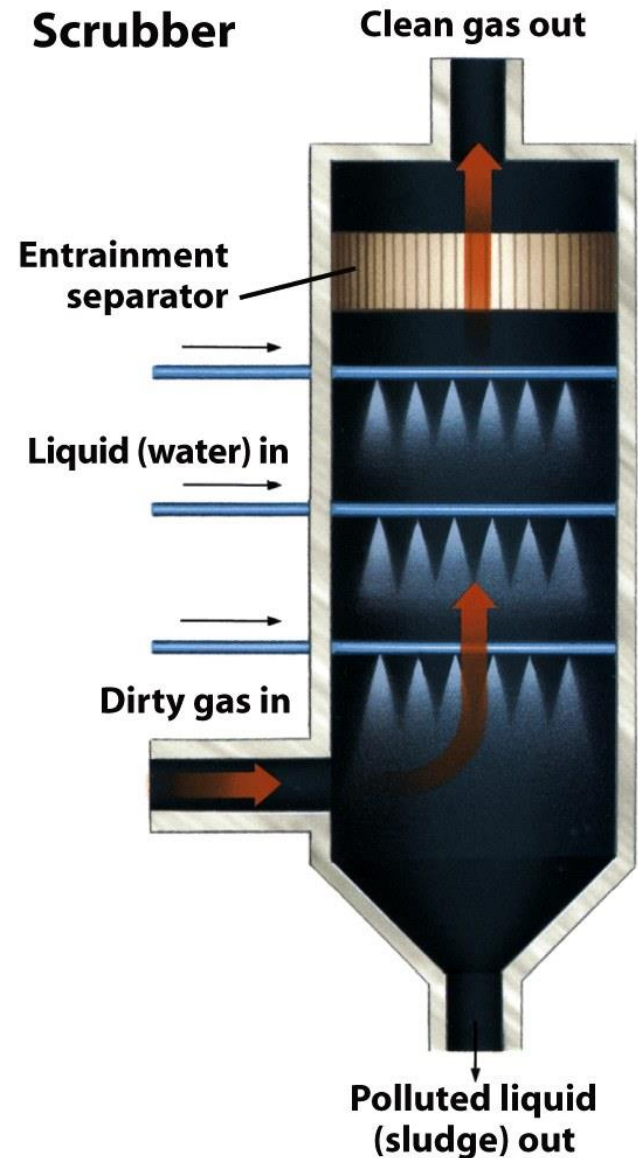
Without Electrostatic precipitator

With Electrostatic precipitator



# Controlling Air Pollution in the US

- Particulate material can also be controlled by proper excavating techniques



**A variety of Air Pollution Control (APC) methods is available to meet food industry requirements, they are:**

- **Fiber filter**
- **Wet scrubber**
- **High energy venture scrubber**
- **Packed bed scrubber**
- **Optimized scrubber/quencher**
- **Electrostatic precipitators**
- **Dry Electrostatic precipitators**
- **Wet Electrostatic precipitators**
- **Water cooled jacketed wet Electrostatic precipitators (Condensing WESP)**