18CYM101T-ECE-Sem: 3
Batch: 2

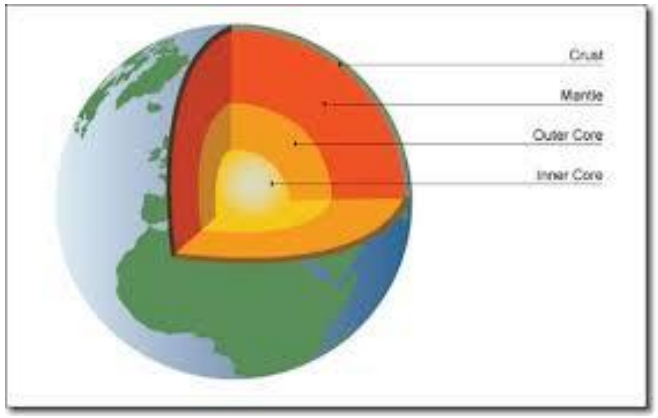
Dr. Anjan Bedi
Assistant Professor
Department of Chemistry

What is Environment?

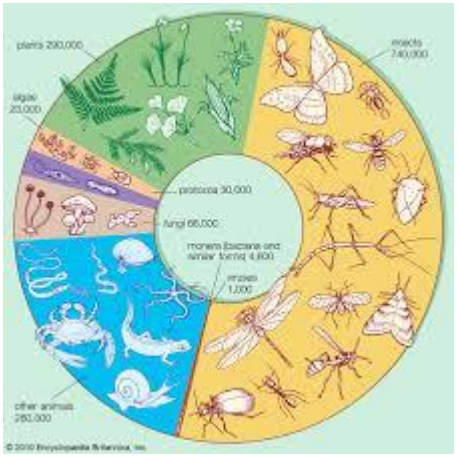
Our surroundings

What is Environment?

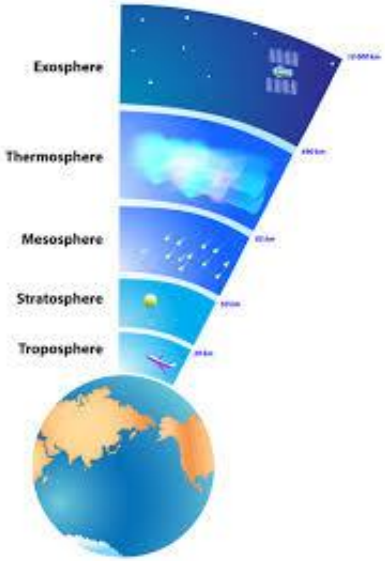
What is Environment?



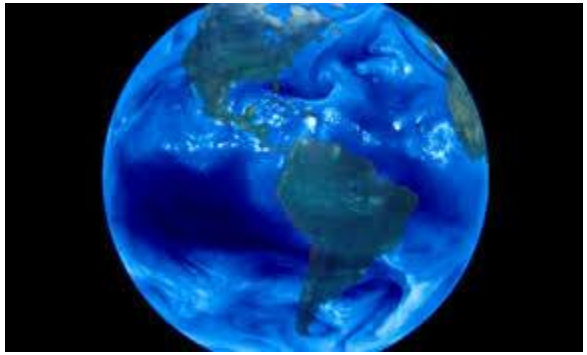
Lithosphere



Biosphere



Atmosphere



Hydrosphere

Why should we study EVS?

How we interact with the environment.

- How do we upset the natural balance?
- How do we use resources?
- How do we produce waste?
- What do we do with the waste?
- What will be the consequences?

Ecosystem

Animal Resources

Crude Oil

Forest Resources

Precious Metals, Minerals, Rocks

Water Resources

Land Resources

Wind Power and Solar Energy

Natural Gas

Why civil engineers shall study EVS?

Great Job

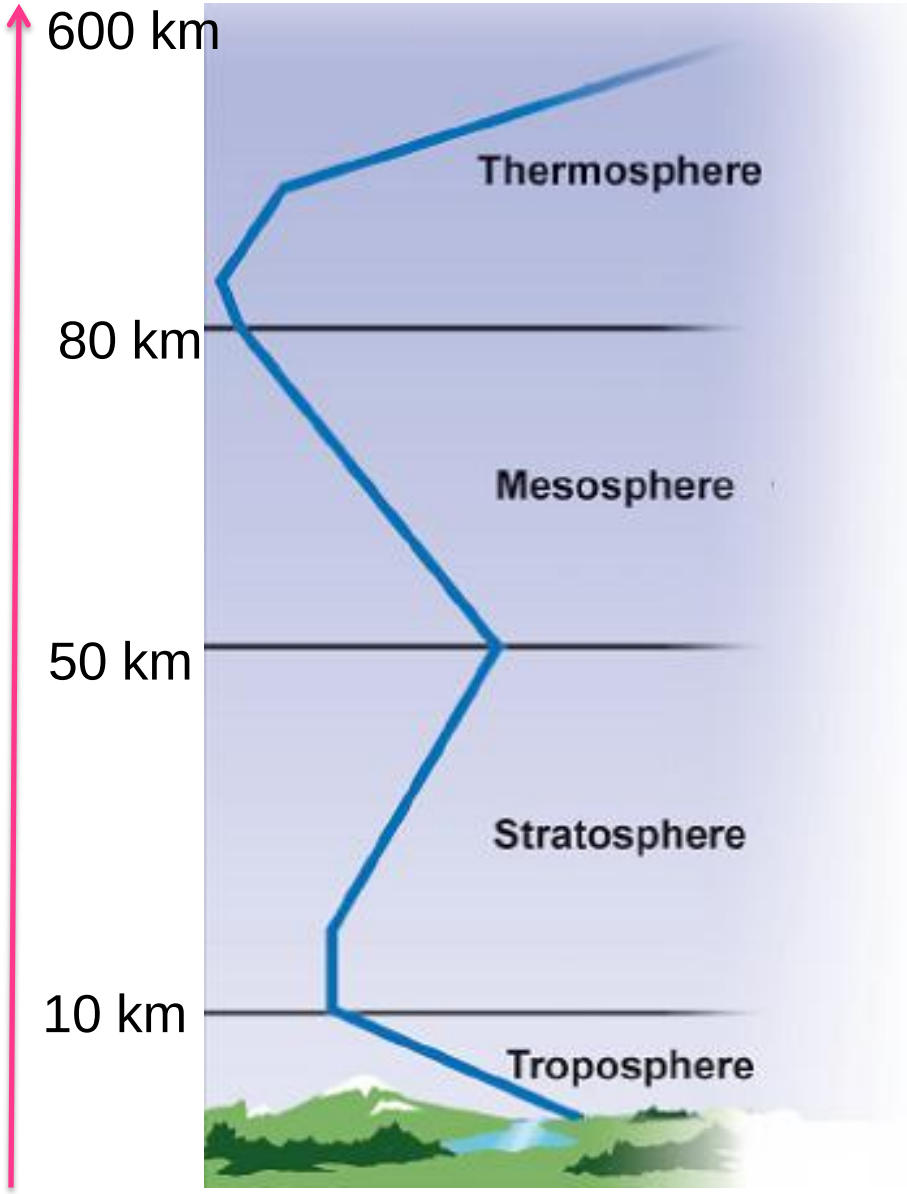
The Great Stink" of 1858

Introduction to the Structure and Composition of Earths Atmosphere

Layers of Atmosphere

The atmosphere has four layers

- **Thermosphere**
- **Mesosphere**
- **Stratosphere**
- **Troposphere**



Layers of Atmosphere

Troposphere

View of troposphere layer from an airplane's window.

- Lowest and thinnest layer
  - 16 km at equator, 8 km at poles
- 90% of the atmosphere's mass
- Temperature decreases with altitude
  - 6°C per kilometer
  - Top of troposphere averages –50°C
- Where weather occurs
- Boundary between the troposphere, and the stratosphere is called the **tropopause**

Layers of Atmosphere

Stratosphere

- Extends from 10 km to 50 km above the ground
- Less dense (less water vapor)
- Temperature **increases** with altitude
- Almost no weather occurrence
- Contains high level of ozone
  - **Ozone layer absorbs UV radiation**
- Upper boundary is called **stratopause.**

Layers of Atmosphere

Mesosphere

- Extends to almost 80 km high
- Gases are less dense.
- Upper boundary is called **mesopause, this is the** boundary between the mesosphere and the thermosphere atmospheric regions.
- Temperature decreases as altitude increases**.**
- Coldest layer of Atmosphere
- Gases in this layer absorb very little UV radiation.

Layers of Atmosphere

Thermosphere

- Above the mesosphere and extends to almost 600 km high
- Temperature **increases** with altitude
- Readily absorbs solar radiation which breaks the gaseous molecules and produces ions. Constitutes part of the **ionosphere**.
- Temperature can go as high as 1,500 °C
- Reflects radio waves

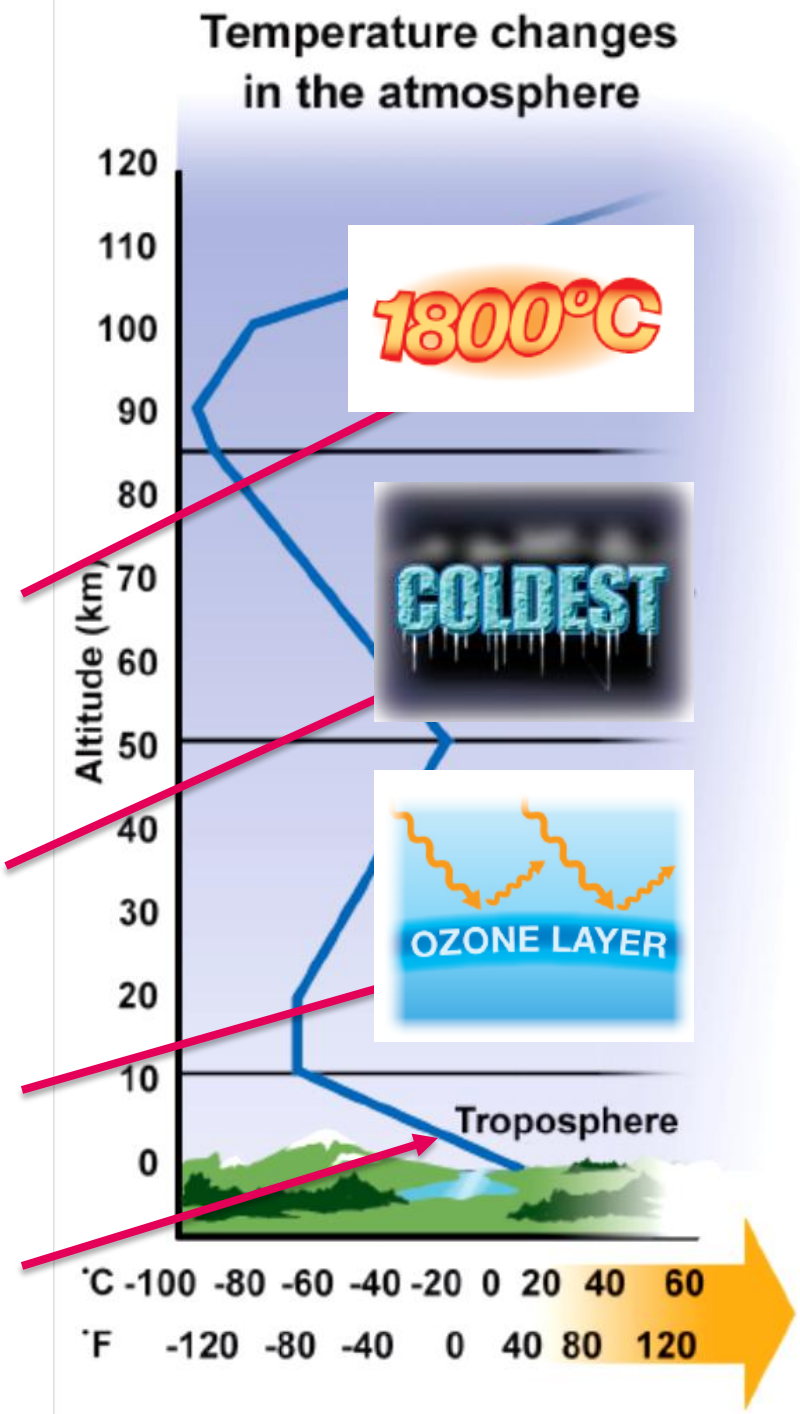
EXOSPHERE

- The exosphere begins at about 600 kilometers above Earth and does not have a specific outer limit.
- Communication on Earth depends on satellites.
- Satellites orbit Earth in the exosphere.

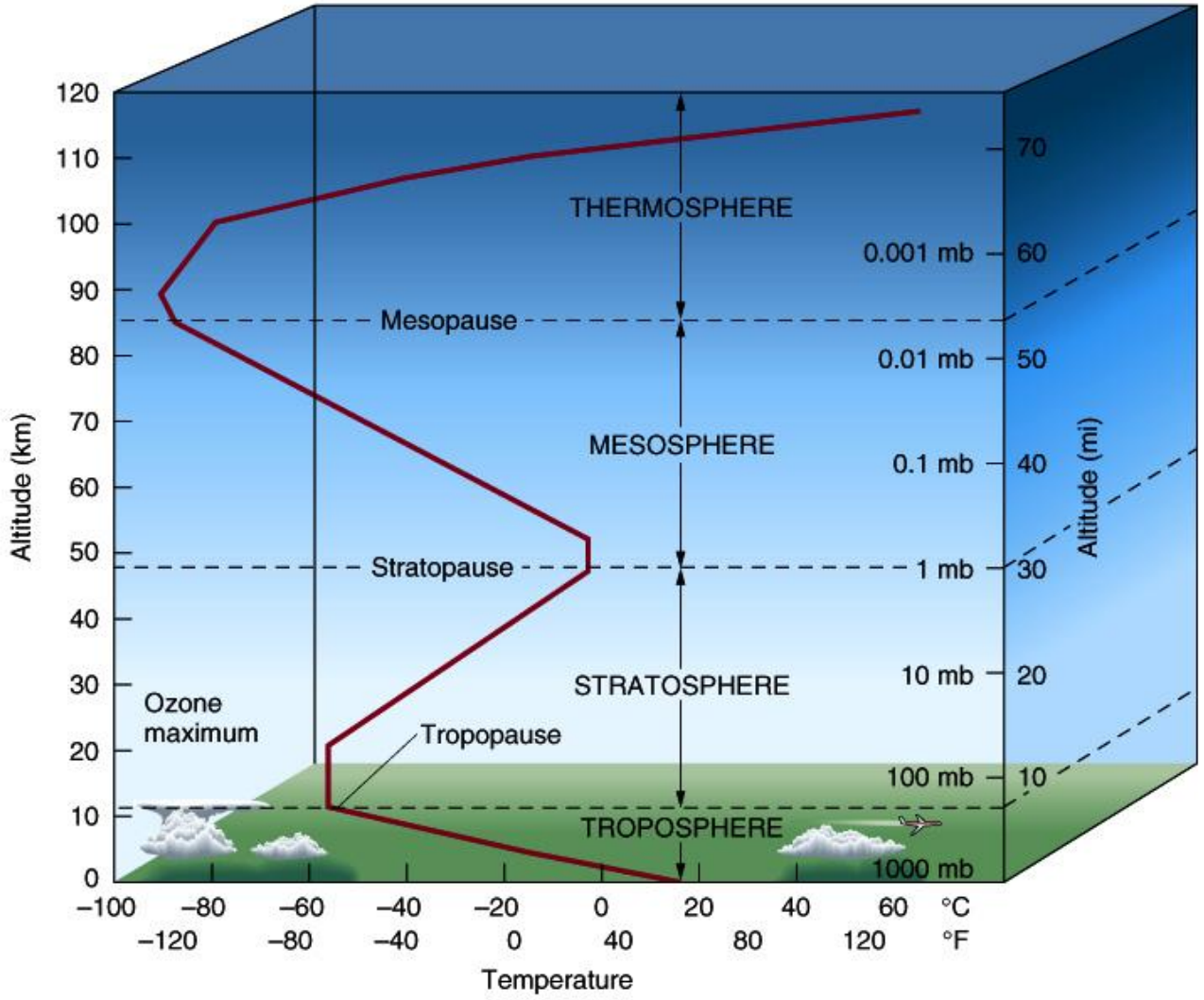
Layers of the Atmosphere

The four layers of the atmosphere include:

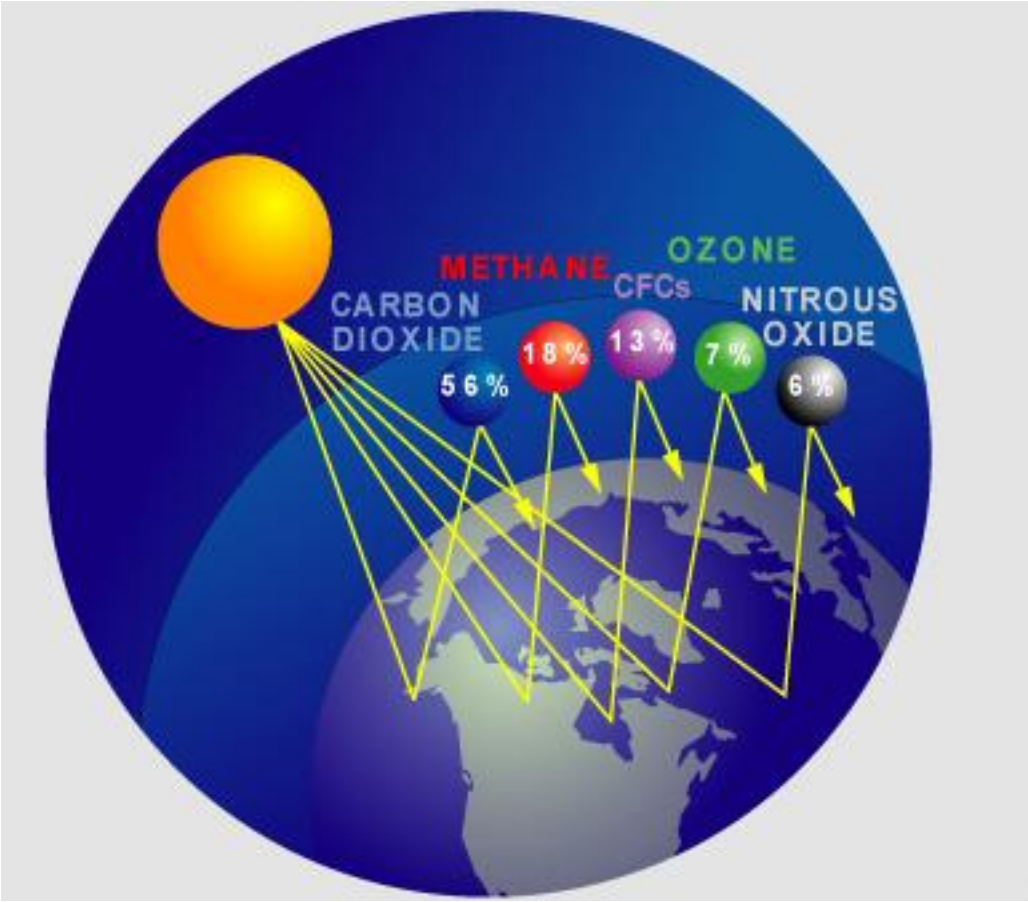
1. *the troposphere, where we live;*
2. *the stratosphere, which contains the ozone layer;*
3. *the mesosphere, where meteors burn; and coldest layer*
4. *The thermosphere, where space station orbit Earth. Temperature is very high*



Height, Pressure and Temperature



COMPOSITION OF ATMOSPHERE



Earth's Atmosphere

- *Earth's atmosphere is a layer of gases surrounding the planet.*
- *The Earth is surrounded by a blanket of air, which we call the atmosphere. It reaches over 560 kilometers from the surface of the Earth.*

Atmosphere:

- *Absorbs the energy from the Sun.*
- *Recycles water and other chemicals.*
- *Protects us from high-energy radiation and the frigid vacuum of space.*
- *The atmosphere protects and supports life.*

CRAZY FACT

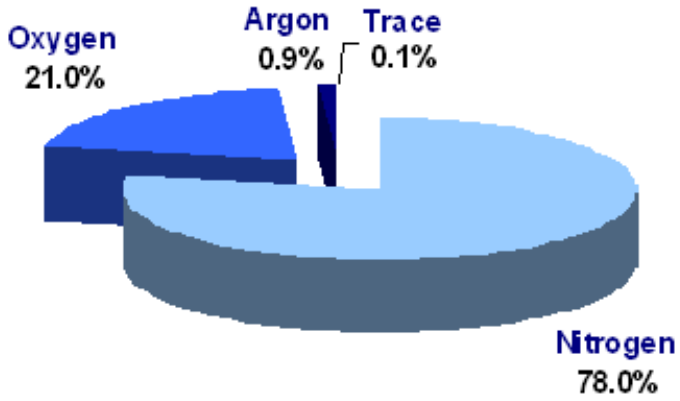
-**The total mass of the atmosphere is equivalent to 5.65 billion million tons.**

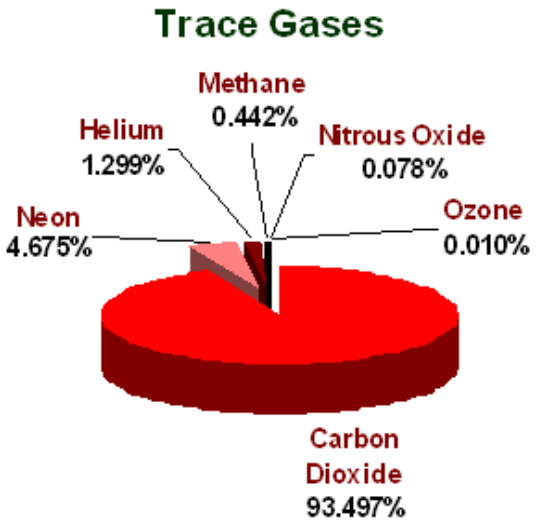
Composition of the Atmosphere

The atmosphere is comprised of a variety of gases:

- **Major Constituents (99%):**
  - Nitrogen (N_2): 78%
  - Oxygen (O_2): 21%
- **Trace Constituents:**
  - Argon (Ar), about 0.9%
  - Water vapor (H_2O), up to 10000 ppmv
  - Carbon dioxide (CO_2), 350 ppmv
  - Ozone (O_3), near zero at the surface, up to 10 ppmv in the stratosphere
  - Methane (CH_4), 1.7 ppmv
  - and others…..

ppmv = “parts per million by volume”



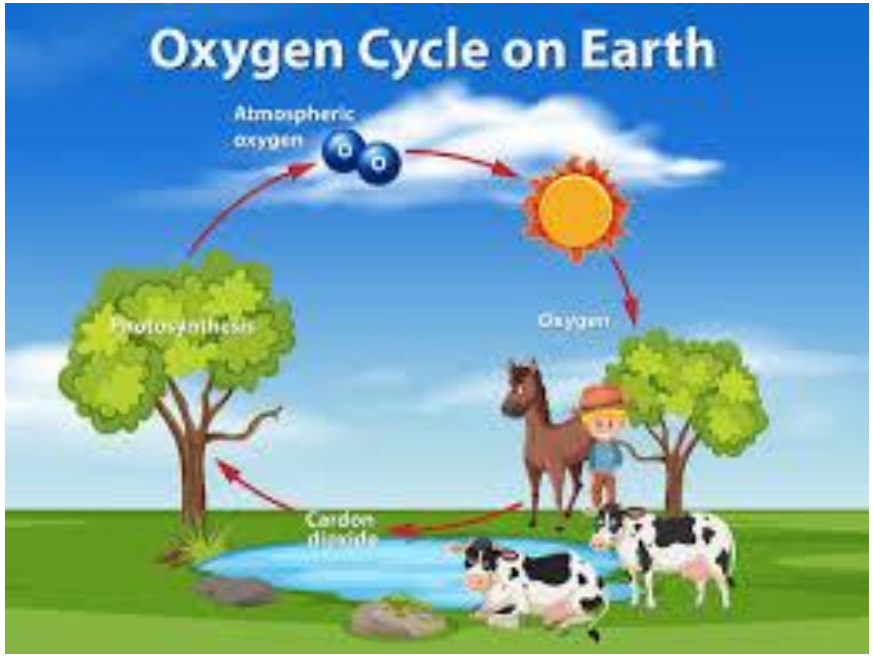


Composition of the Atmosphere

TABLE 3.2
Composition of the Atmosphere Near Earth's Surface

Permanent Gases			Variable Gases	
Gas	**Symbol**	**Percent (by Volume) Dry Air**	**Gas (and Particles)**	**Symbol**
Nitrogen	N_2	78.08	Water vapor	H_2O
Oxygen	O_2	20.95	Carbon dioxide	CO_2
Argon	Ar	0.93	Methane	CH_2
Neon	Ne	0.0018	Nitrous oxide	N_2O
Helium	He	0.0005	Ozone	O_3
Hydrogen	H_2	0.0006	Particles (dust, soot, etc.)	
Xenon	X_2	0.000009	Chlorofluorocarbons	

Composition of the Atmosphere

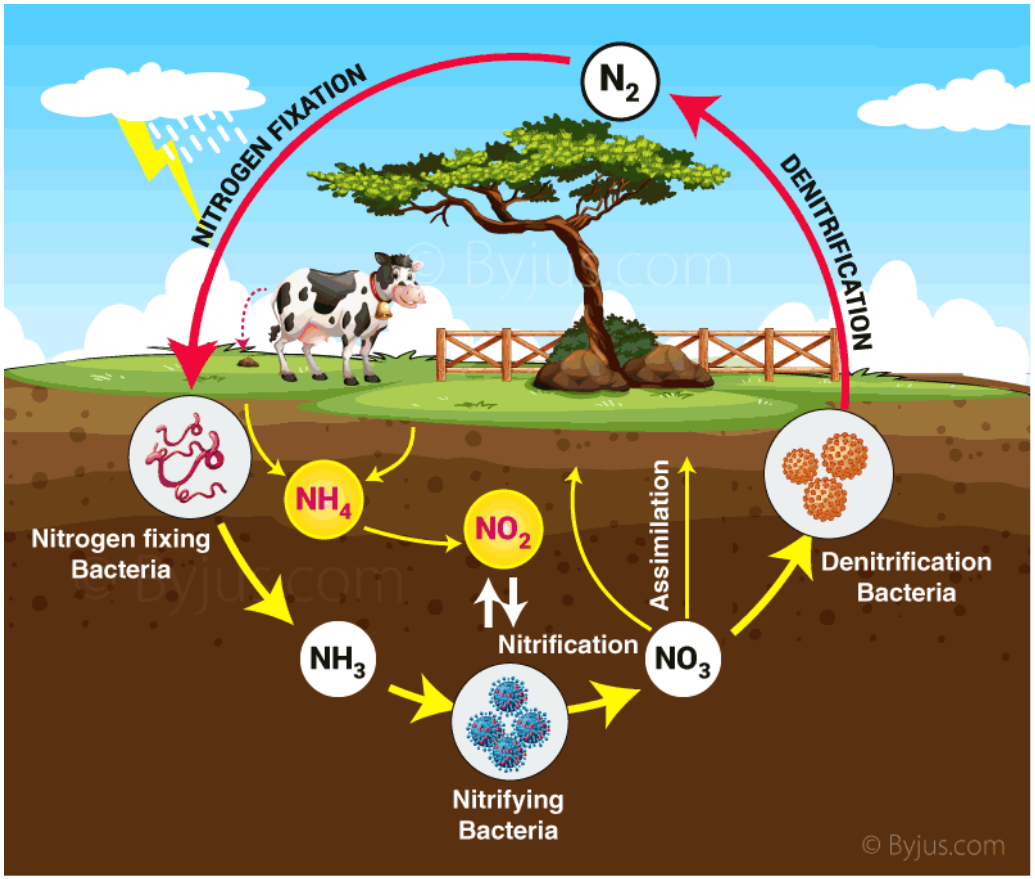


What about Nitrogen?

Proteins: important for survival

Human and plant can not use nitrogen directly. We need support from bacteria. This process called nitrogen fixation.

Composition of the Atmosphere



Not sufficient for modern cultivation requirement

Industrial Production

$$N_2 + 3H_2 \xrightarrow[\text{high T}]{\text{Catalyst,}} 2NH_3$$

Gases Making Up Atmosphere

- **Permanent Gases-**Those gases whose relative abundance is constant within the homosphere (homogeneous mixture). Ex. O_2, N_2, CO_2 etc..

- **Variable Gases-**Gases present in amounts that vary greatly in abundance, either vertically, horizontal, or seasonal. Water vapor is the most important variable gas.

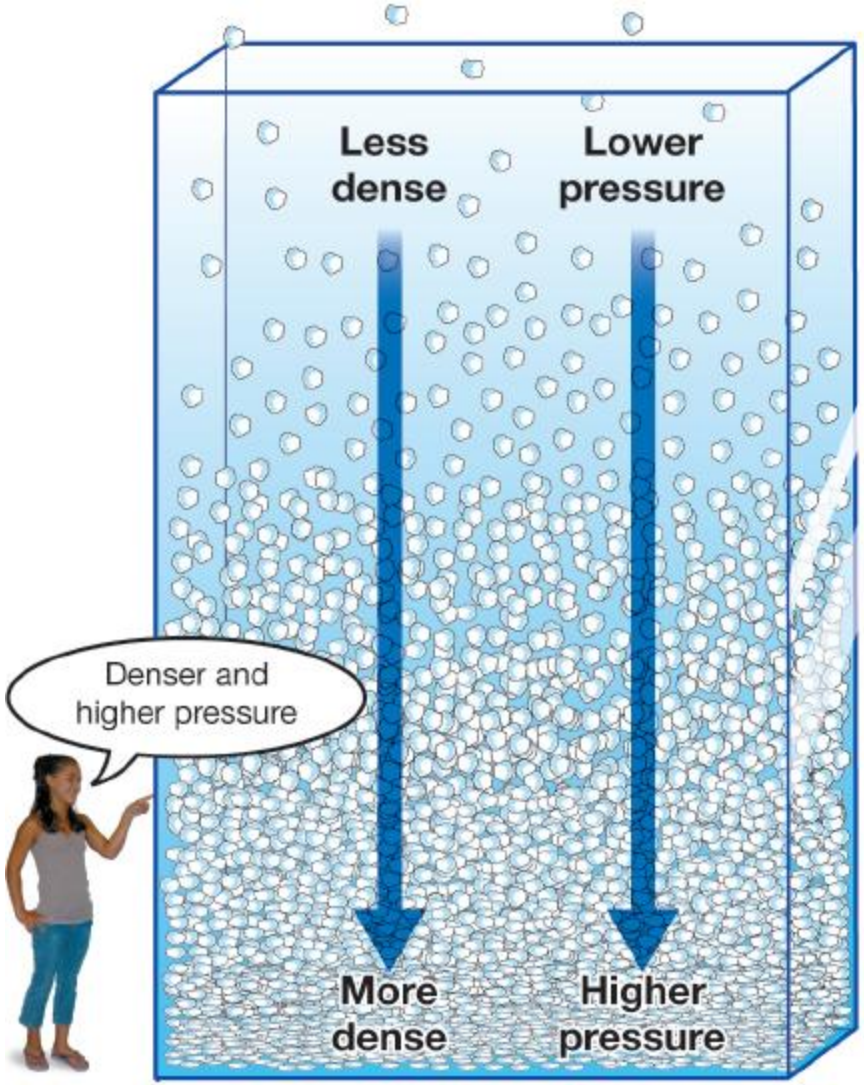
Relevant Terms

- **Homosphere-**The lowest 80km of the atmosphere, which the relative abundance of the permanent gases is constant.

- **Heterosphere-** At high altitude where gases are not well mixed but rather are stratified according to weight. Where lighter weighing gases are found.

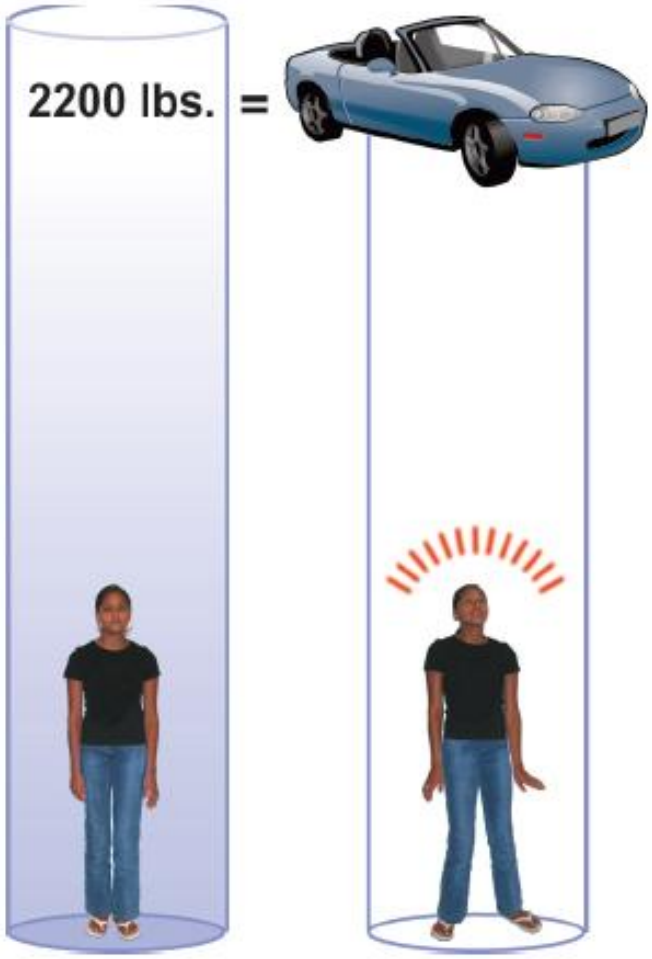
Pressure in the atmosphere

- **Atmospheric pressure** is the force per unit area exerted into a surface by the weight of air above that surface in the atmosphere of Earth.
- The gas molecules closest to Earth's surface are packed together very closely.
- This means pressure is lower the higher up you go into the atmosphere.



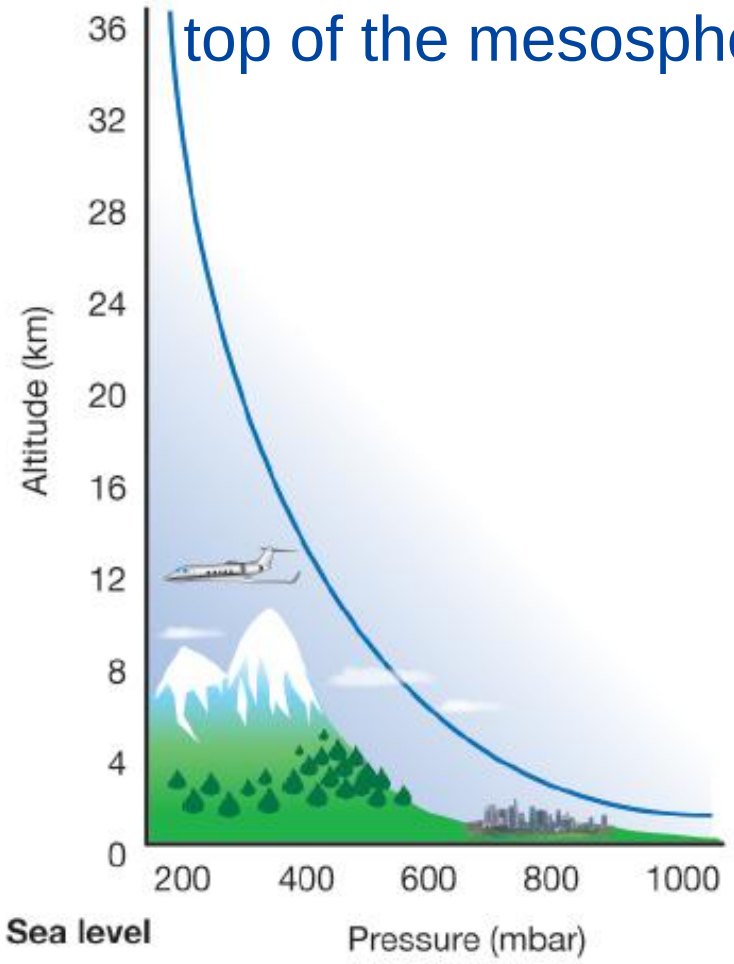
Pressure in the atmosphere

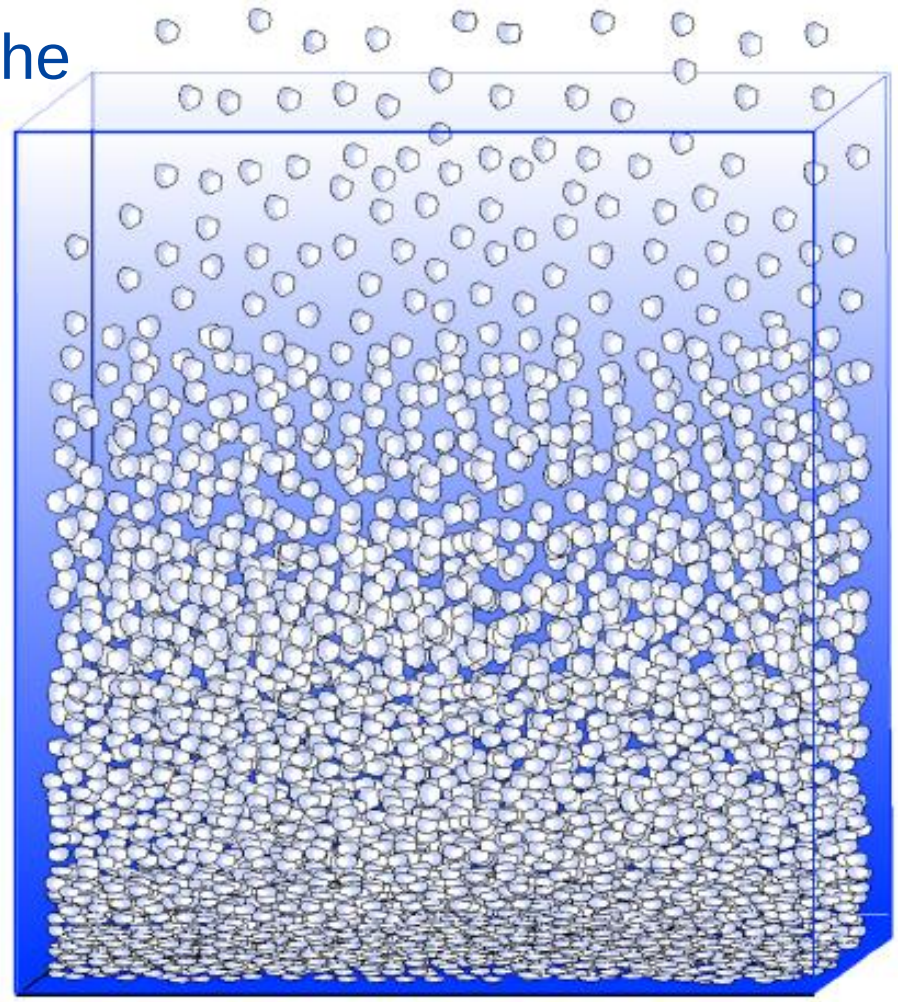
- At sea level, the weight of the column of air above a person is about 9,800 Newtons (2,200 pounds)!
- This is equal to the weight of a small car.



Pressure changes with altitude

Pressure varies smoothly from the Earth's surface to the top of the mesosphere.





ENVIRONMENTAL POLLUTION

World country/region ranking

1	Bangladesh
2	Pakistan
3	Mongolia
4	Afghanistan
5	India
6	Indonesia
7	Bahrain
8	Nepal
9	Uzbekistan
10	Iraq

10 Most Polluted Cities in the World

1. Ghaziabad, India
2. Lahore, Pakistan
3. Delhi, India
4. Lucknow, India
5. Muzaffarnagar, India
6. Dhaka, Bangladesh
7. Antakya, Turkey
8. Hapur, India
9. Peshawar, Pakistan
10. Kampala, Uganda

POLLUTION

Any act that

1. Contaminate the environment
2. Alters the surroundings unwantedly
3. Decreases the quality of air, water and soil
4. Affects the health of human, animals and plants

POLLUTANTS

The material which causes Pollution

CAUSES FOR POLLUTION

1. Tremendous uncontrolled growth of human populations.
2. Rapid industrialization
3. Rapid urbanization
4. Deforestation
5. Radio activities

Types of pollutants

Biodegradable pollutants

Non- Biodegradable pollutants

1.Biodegradable pollutants

They decompose rapidly by the natural process into simpler, harmless, substances in due course of time (by the action of micro-organisms like certain bacteria) Like, Domestic wastes (garbage), urine, sewage, agriculture residues, paper, wood

2. Non- Biodegradable pollutants

They do not decompose rapidly by the natural process into simpler, harmless substances in nature. Like plastics, polythene bags, insecticides, pesticides, mercury, lead, arsenic.

Classification of Pollution

- Air pollution
- Water pollution
- Soil pollution
- Marine pollution
- Noise pollution
- Thermal pollution
- Nuclear hazards

Air pollution

- ❖ Contamination of atmospheric air by gases, dust, smoke and wastes.
- ❖ Injurious to living organism.
- ❖ Most of the air pollutant present in the troposphere

- Every person breathes approximately 22000 times /day and inhaling 15-22 Kg of air daily.
- Polluted air causes Physical ill effects, besides undesirable aesthetic and physiological effect.

Sources of air pollution

1. Natural sources
2. Man made activities

1. Natural sources

Examples

a) Volcanic eruption

b) Forest fires

c) Biological decay

d) Radioactive materials

2. Man-made activities

a) Thermal power plants

b) Vehicular emission

c) Fossil fuel burning

d) Agricultural activities

e) Smoking

Classification of air pollutants

i) Primary pollutants
ii) Secondary pollutants

- Usually, primary pollutants are substances directly emitted from a process,

Examples: ash from a volcanic eruption, the carbon monoxide gas from a motor vehicle exhaust or sulfur dioxide released from factories.

- Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact.

Examples: Ground level ozone is a prominent example of a secondary pollutant.

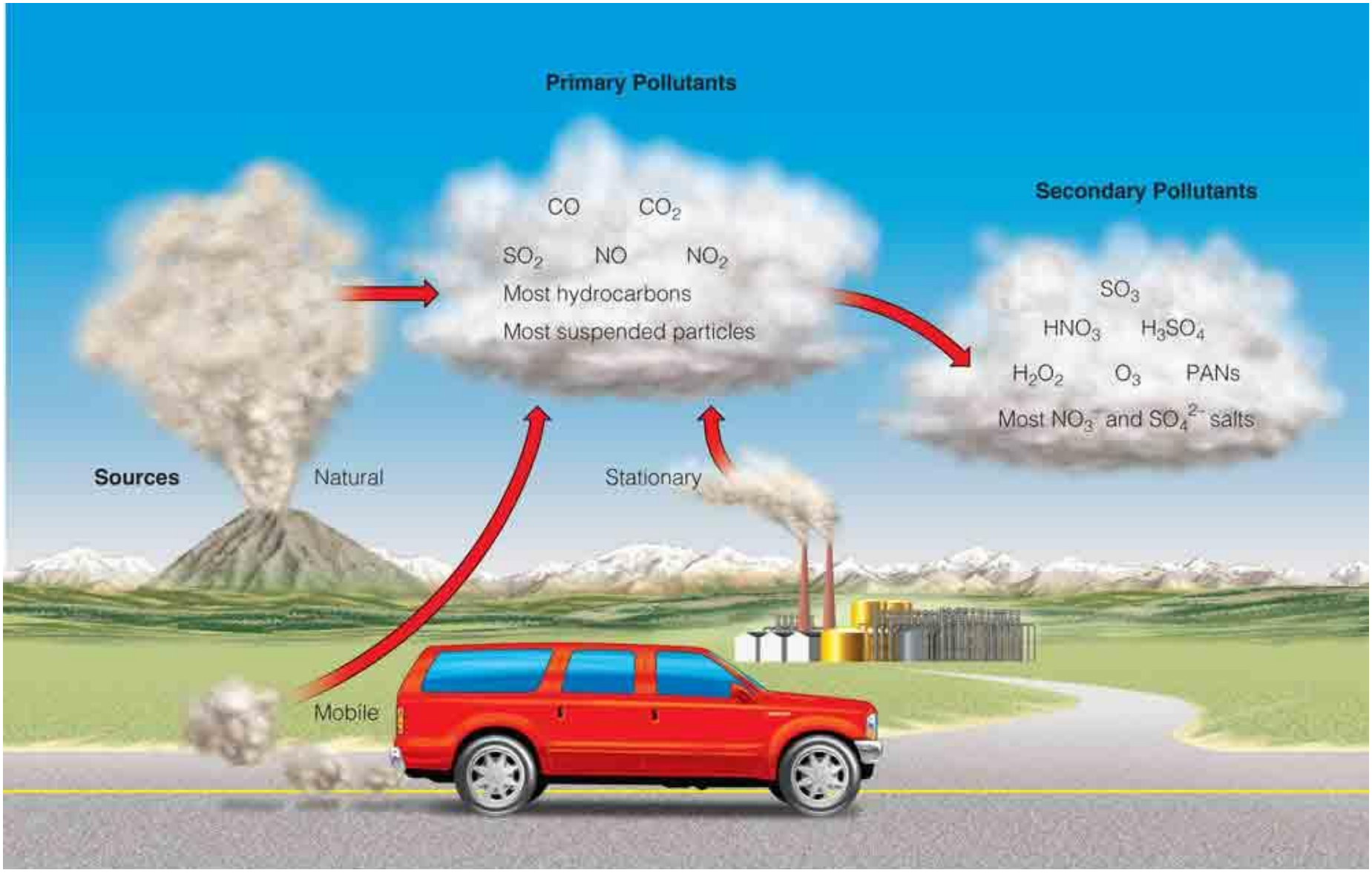
ii) Secondary pollutants

Examples

Ozone: forms when hydrocarbons (HC) and nitrogen oxides (NOx) combine in the presence of sunlight

NO_2: which is formed as NO combines with oxygen in the air

Acid rain: produces when sulfur dioxide or nitrogen oxides react with water.

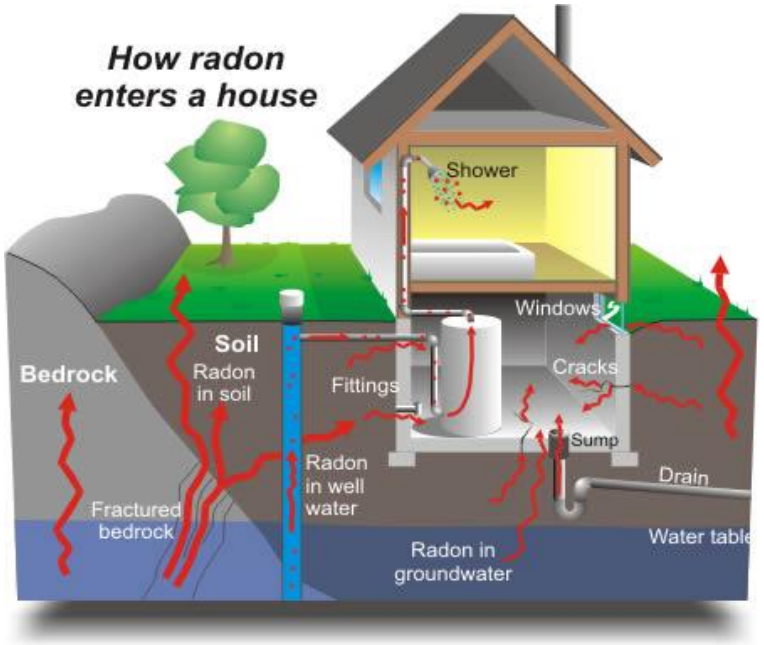

Primary Pollutants
CO
CO_2
SO_2
NO
NO_2
Most hydrocarbons
Most suspended particles
Secondary Pollutants
SO_3
HNO_3
H_3SO_4
H_2O_2
O_3
PANs
Most NO_3^- and SO_4^{2-} salts
Sources
Natural
Stationary
Mobile

INDOOR AIR POLLUTANTS:

Sources(causes):

Radon gas: emitted from the building material like bricks, concretes, tiles etc.,

Burning of fuels in the kitchen, cigarette smoke liberates the pollutants like CO , SO_2 .



Air Pollutants may exist in two major forms namely gases and particulates

1. Gases: SO_2, SO_3, CO, CO_2, NOx, H_2S, O_3 casus pollution

2. Particulates: Dust, Smoke, Smog, Asbestos, Lead dust, Polynuclear aromatic hydrocarbon

Common air pollutants

Sources and their effects

Carbon monoxide (CO)

Properties: Color less , Odorless and toxic gas

Affects: Injurious to human and animal health

Sources: About 77% comes from motor vehicles (mainly petrol engine vehicles)

Cigarette smoking

Industrial source, Automobile exhaust gases

Human sources

- Incomplete combustion of fossil fuel
- Power plants

Human health effects

CO binds with hemoglobin (RBC) to form carboxy hemoglobin, thereby hampering the transfer of oxygen to the tissues.

Headache, anemia

At high levels it leads to coma and death

Environmental effects

It increases global temperature

Sulphur dioxide(SO_2)

Colorless and irritating gas

Formed from burning of coal and oil.

It is converted in to sulphurous acid in acid rain process.

Human sources

Power plants 88%

Industrial process 10%

Health effects

Breathing problems even for healthy people

Eye irritation, Throat problem,

cardiac diseases to human,

Environmental effects

Damage to agriculture, Chlorophyll destruction

Sulphurous acid in acid rain damage trees, plants, soil and aquatic life.

Carbon dioxide (CO_2)

Colorless and odourless green house gas

Formed from Combustion of fossil fuel, woods, etc.

Cement production.

Human sources

Respiration process

Power plants

Health effects

Respiratory disorders and suffocations

Environmental effects

Increasing the temperature of climate

Each degree Celsius rise in temperature caused due to carbon dioxide levels could cause about 1,000 deaths. The gas boosts concentrations of surface ozone, particles and carcinogens, all of which are harmful to human health.

Ozone (O_3)

i) Highly reactive
ii) Irritating gas
iii) Unpleasant odour
iv) It forms in the troposphere
v) It is a major component in the smog.

Human sources

Nitrogen oxides
Volatile organic compounds (VOC)

Health & Environmental effect

skin cancer in animals and human
Casus lung infection
Destruction of life in earth
Moderates the climate

Sulphur trioxide(SO_3)

Oxidation of SO_2 in the atmosphere under the influence of sunlight.

Even 1 ppm of SO_3 in the air causes breathing trouble and irritation to the respiratory tract

Hydrogen sulphide (H_2S)

- H_2S enter the atmosphere as the pollutant through decomposition of sewage wastes or organic matter from various industries
- It is poisonous, it blackens the lead paints and causes corrosion of metals.

Nitrogen Oxides (N_2O, NO, NO_2)

Sources

- Combustion of fuel
- Acid manufacture
- Explosive industry
- Acid packing plants
- High temperature combination of N_2 and O_2

Health & environmental effects

- Human respiratory tract irritation
- Damage to plants
- Eye irritation
- Reaction of hydrocarbon under sunlight form smog (produces O_3)
- Formation of nitric acid causes acid rain problems

What is smog (Smoke + Fog)

It is also called as London smog. Smog which is normally happened in the morning hours during winter when the humidity is very high.

Smog is a kind of air pollution, commonly occurred in the industrial urban areas.

Analysis of the smog indicates mainly the presence of SO_2 along with the particulates. Sulphurdioxide oxidizes into sulphur trioxide in the atmosphere and forming acid aerosol.

Health effects

- Breathing problems
- Cough, Heart diseases
- Eye, Nose and Throat irritation

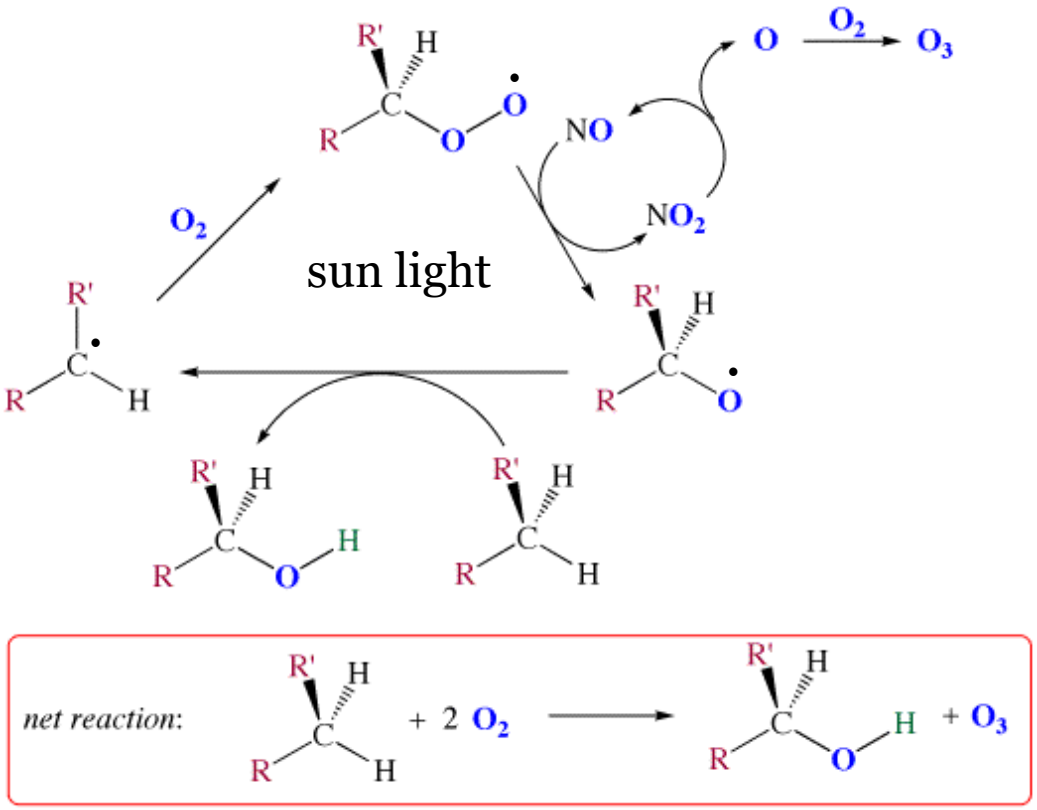
Environmental effects

- Ozone depletion
- It reduces the visibility
- It can damage plants and trees

PHOTOCHEMICAL SMOG

- Photochemical smog is produced when pollutants from the combustion of fossil fuels react with sunlight. The energy in the sunlight converts the pollutants into other toxic chemicals. In order for photochemical smog to form, there must be other pollutants in the air, specifically nitrogen oxides and other volatile organic compounds (VOCs).
- When nitrogen oxides and VOCs interact with sunlight, secondary pollutants are formed, such as ozone and peroxyacetyl nitrate (PAN). These secondary pollutants are what we have been calling photochemical smog. You might think, 'Hey, isn't ozone good for protecting our atmosphere?' Well, it is, but only at levels high above the surface. When ozone is near humans, it can cause serious problems with our lungs and vision. PAN is one of the chemicals that is responsible for damaging lung tissue.
- This is a toxic mixture of NO_2, troposphere Ozone, volatile organic compounds and peroxy-acetyl nitrate (PAN)
- All these chemicals are highly reactive and oxidizing substances. They are creating chemically reducing atmosphere

Photochemical Reactions



Hydrocarbons are attacked by ozone yielding partially oxidized hydrocarbons such as aldehydes, ketones, peroxides, peroxyacetyl nitrates (PAN) etc. These chemical compounds are capable of absorbing solar radiation and undergo photochemical reaction involving highly reactive free radicals such as $\dot{O}H$ free radicals resulting aerosol which is called photochemical smog.

Lead (Pb)

It is a solid, toxic metal

It can emit particulates

Human sources

Paint, smelters, storage batteries and leaded petrol.

Health effects

Damage brain and whole nervous system

Mental retardation

Digestive problems

Cancer in test animals

Environmental effects

Wild life destruction

ACID RAIN

- Normal rain water is always slightly acidic in nature because of the fact that CO_2 present in the atmosphere gets dissolved in it and produces carbonic acid, H_2CO_3.
- Because of the presence of SO_x and NO_x gases as pollutant in the atmosphere, the pH of the rain water is further lowered.
- This type of precipitation of water is called ACID RAIN (or) ACID DEPOSITION

Formation and causes of Acid rain

- Acid rain means the presence of excessive acids in rain water.

- The thermal power plants, industries and vehicles release nitrogen oxides and sulphur oxides into atmosphere due to burning of coal and oil.

- When these gases react with water vapour in the atmosphere, they form acids and descend on to the earths acid rain through rain water.

$$SO_3 + H_2O \longrightarrow H_2SO_4$$

$$NO_2 + H_2O \longrightarrow HNO_3$$

EFFECTS OF ACID RAIN

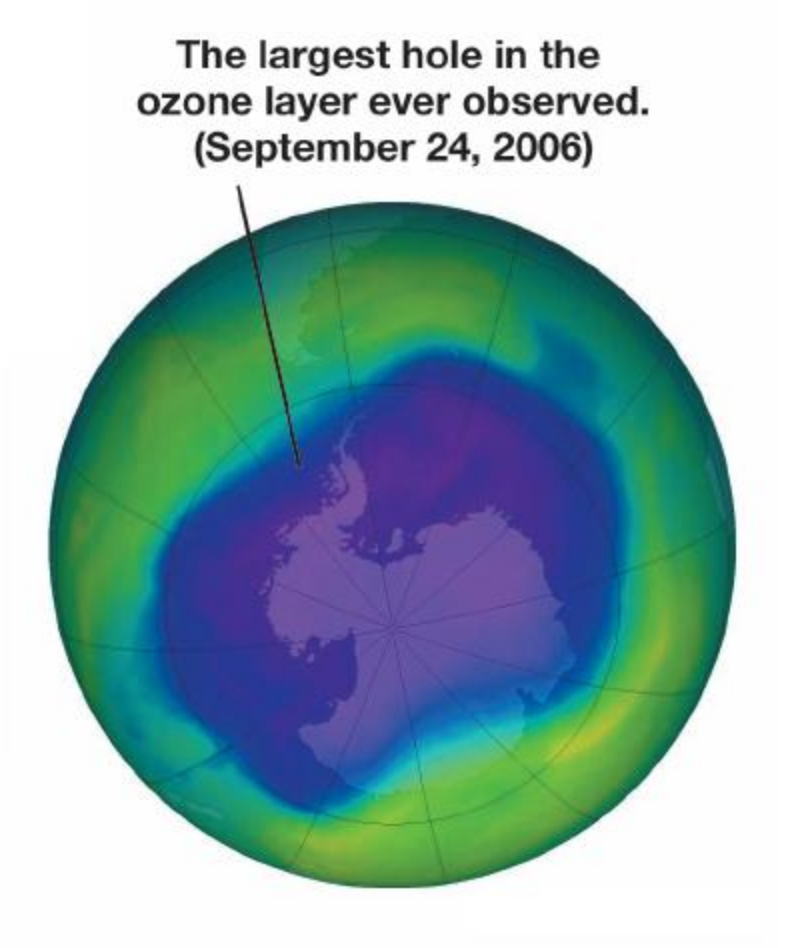
- Increases the acidity of rain-water
- Damages fresh water life.
- In the form of mist it causes direct damage to plants.
- Causes irritation to eyes and mucus membrane.
- Accelerates the rate of corrosion of metals.
- Causes damage of building block
- Dissolves salt in soil like $CaCO_3$, $MgCO_3$ and metal, which passes into ponds lakes river and cause toxic effect to aquatic life

Effects of Acid Rain

- Acidification of bodies of water
- Damage of vegetation
- Damage to building materials, statues, etc.

The ozone layer

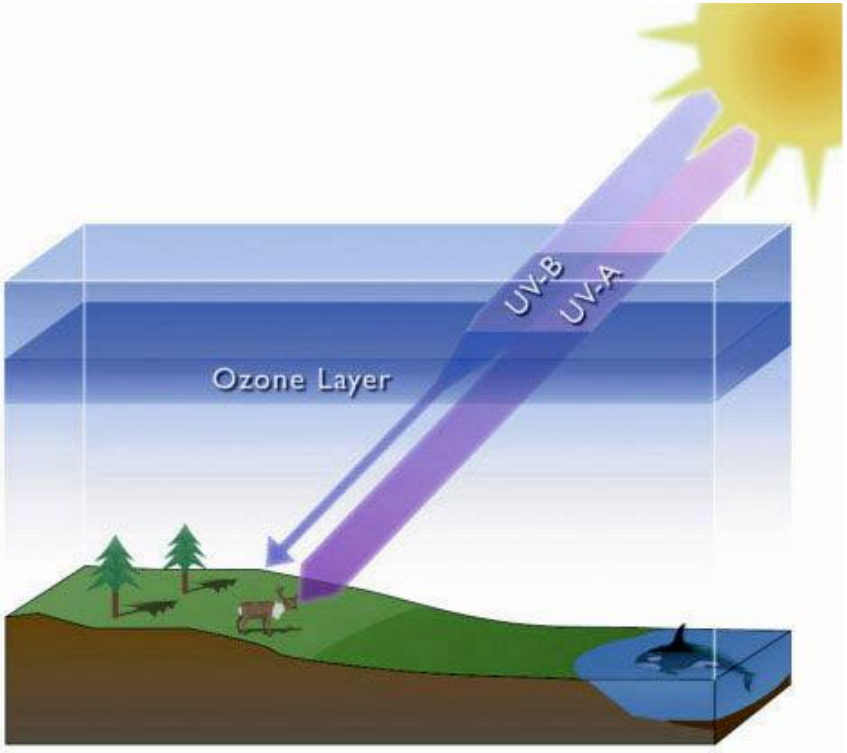
- *In the 1970s, scientists noticed that the ozone layer in the stratosphere above Antarctica was thinning.*



Chlorofluorocarbons & the ozone layer

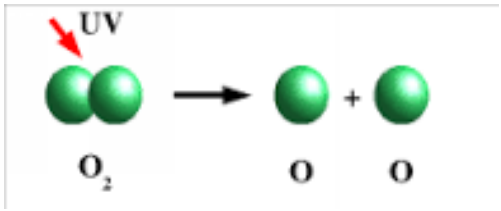
- *A group of chemicals called chlorofluorocarbons (or CFCs) were once commonly used in air conditioners, in aerosol spray cans, and for cleaning machine parts.*

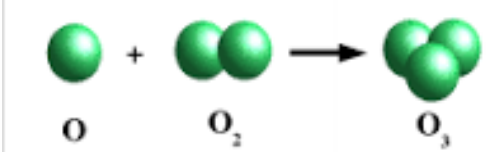
- *In the London Agreement of 1991, more than 90 countries banned the production and use of CFCs except for limited medical uses.*

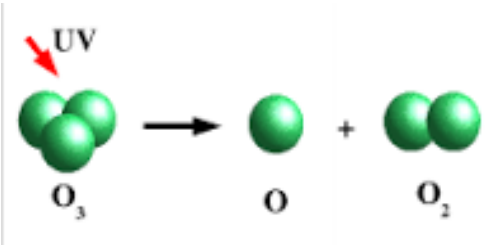


Chlorofluorocarbons & the ozone layer

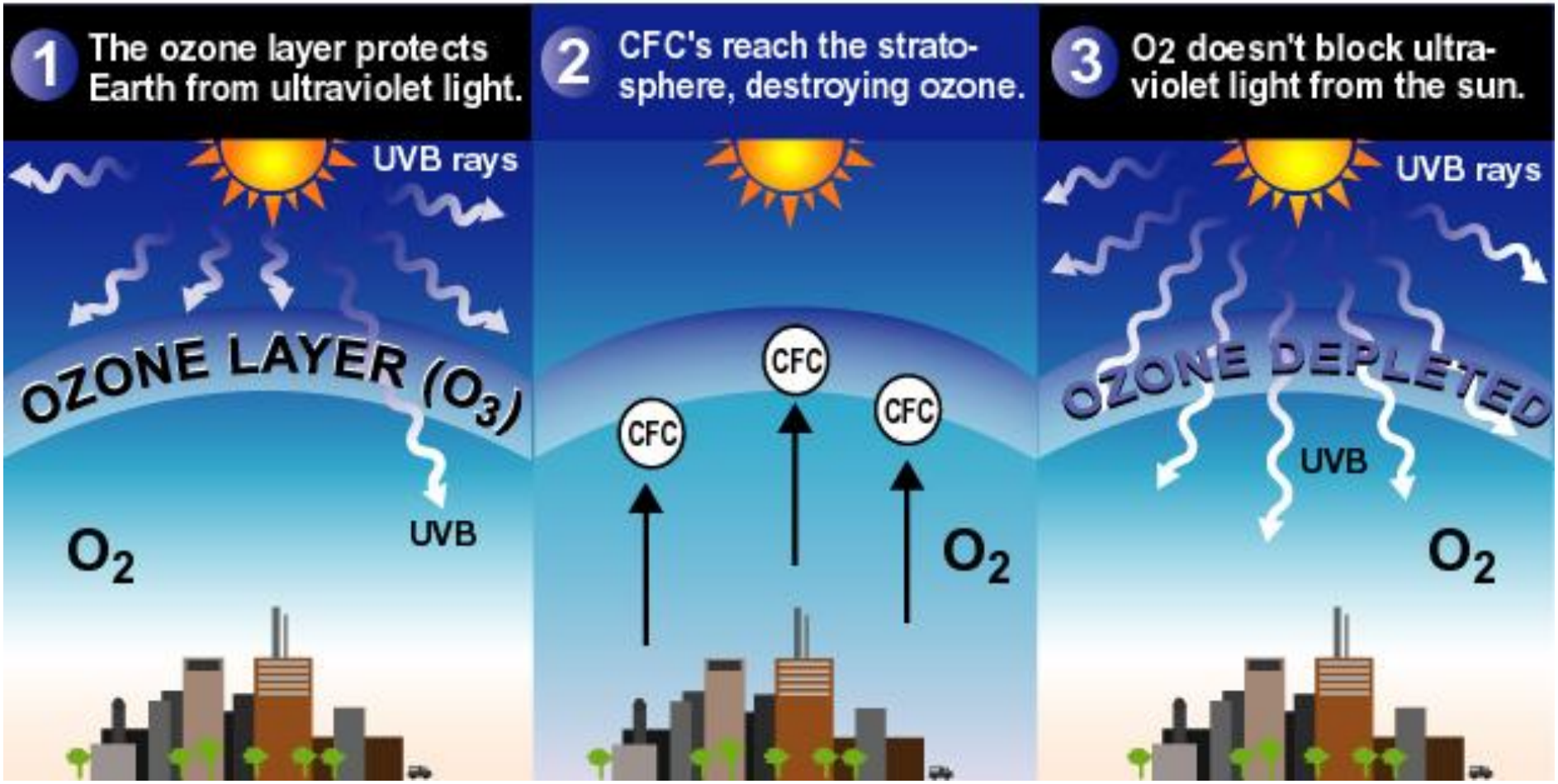
- The ozone layer absorbs the Sun's high-energy ultraviolet (UV) radiation and protects the Earth.







Chlorofluorocarbons (CFCs) and Ozone Depletion



Chlorofluorocarbons (CFCs) and Ozone Depletion

$$O_{2(g)} \xrightarrow{UV} O_{(g)} + O_{(g)}$$

$$O_{2(g)} + O_{(g)} \longleftrightarrow O_{3(g)}$$

$$CF_2Cl_{2(g)} \xrightarrow{UV} \dot{Cl}_{(g)} + \dot{C}F_2Cl_{(g)}$$

$$\dot{Cl}_{(g)} + O_{3(g)} \longrightarrow \dot{Cl}O_{(g)} + O_{2(g)}$$

$$\dot{Cl}O_{(g)} + O_{(g)} \longrightarrow \dot{Cl}_{(g)} + O_{2(g)}$$

GREENHOUSE EFFECT

The trapping of heat by gases in the atmosphere.

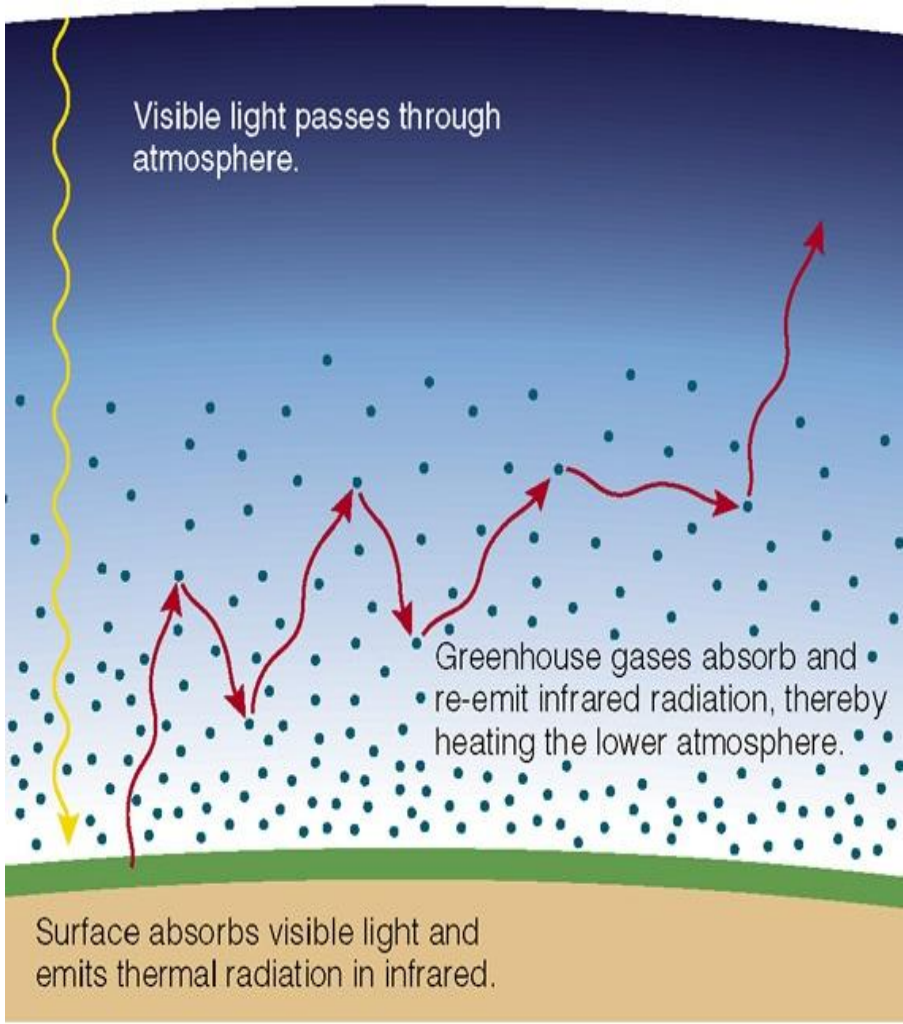
- **Naturally occurring greenhouse gases:**
  - *Water vapor*
  - *Carbon dioxide*
  - *Methane*
  - *Nitrous oxide*
  - *Ozone*
- **Greenhouse gases that are not naturally occurring**
  - *Hydro fluorocarbons* (HFCs)
  - *Per fluorocarbons* (PFCs)
  - *Sulfur hexafluoride* (SF_6)

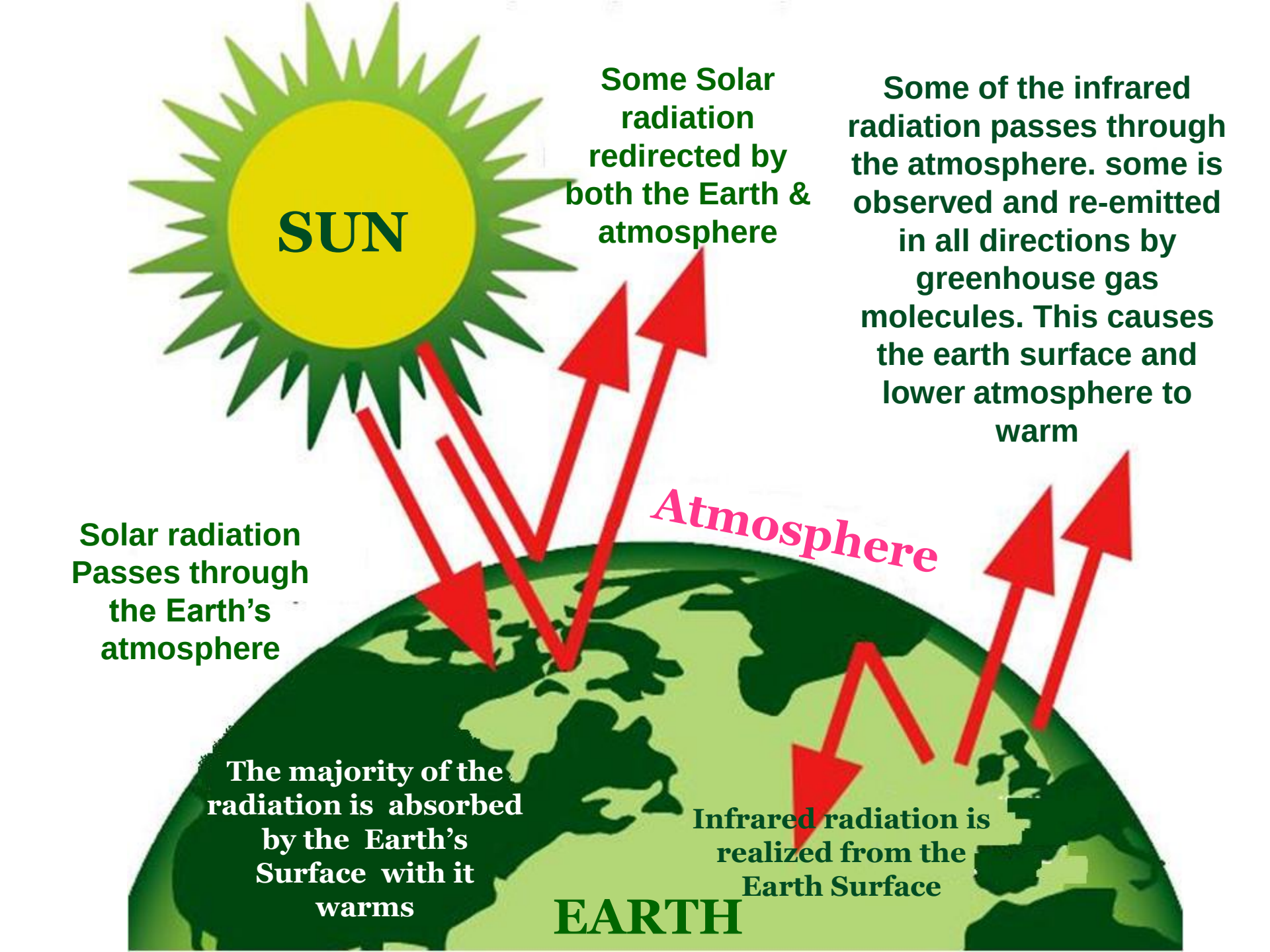
Generated in a variety of industrial processes.

The Greenhouse Effect on Earth

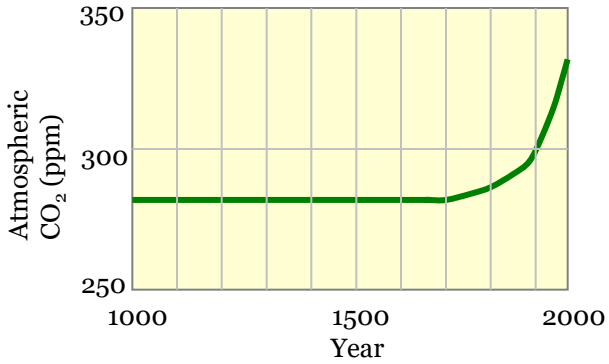
Earth's atmosphere is slightly warmer than what it should be due to direct solar heating because of a ***mild case of greenhouse effect…***

- The ground is heated by visible and (some) infrared light from the Sun.
- The heated surface emits infrared light.
- The majority of Earth's atmosphere (N_2 and O_2) are not good greenhouse gas.
- The small amount of greenhouse gases (H_2O, CO_2) traps (absorb and re-emit) the infrared radiation, increasing the temperature of the atmosphere…




SUN
Some Solar radiation redirected by both the Earth & atmosphere
Some of the infrared radiation passes through the atmosphere. some is observed and re-emitted in all directions by greenhouse gas molecules. This causes the earth surface and lower atmosphere to warm
Atmosphere
Solar radiation Passes through the Earth's atmosphere
The majority of the radiation is absorbed by the Earth's Surface with it warms
Infrared radiation is realized from the Earth Surface
EARTH

Greenhouse Effect



- FACT: 15% increase in [CO_2] in last 100 years
- **Cause**:
  - Change from agricultural to industrial lifestyle
  - Burning of fossil fuels (petroleum, coal)
  - Increase CO_2 emissions (cars, factories etc…)
  - Deforestation
- **Effects:**
  - Global warming

  - Melt polar ice caps → flooding at sea level
  - Warming oceans → more powerful storms

Consequences of Air Pollution

diseases due to air pollution:

heart disease, chronic obstructive pulmonary disease, lung cancer, acute lower respiratory infections in children

deaths in the world due to air pollution:

4.2 million/yr

deaths in India due to air pollution:

1.7 million/yr

Control measures of Air pollution

Source control

1. Use only unleaded petrol
2. Use the fuels with low ash content and sulphur content
3. People should be encouraged to walk and drive cycle
4. Plantation of trees and plants in busy street absorb the carbon dioxide.
5. Industries and waste disposal should be treated.
6. Emission of carbon di oxide and hydrocarbons should be catalytically controlled.
7. Secondary pollutants O_3 and PAN are controlled by their primary precursors.

9. Development of pollution-free power sources to internal combustion engine.
10. Acid and chemical fumes may be treated before release.

POLLUTION CONTROL EQUIPMENTS

They are generally two types

1. Control devices for particulate contaminant
2. Control devices of gaseous contaminant.

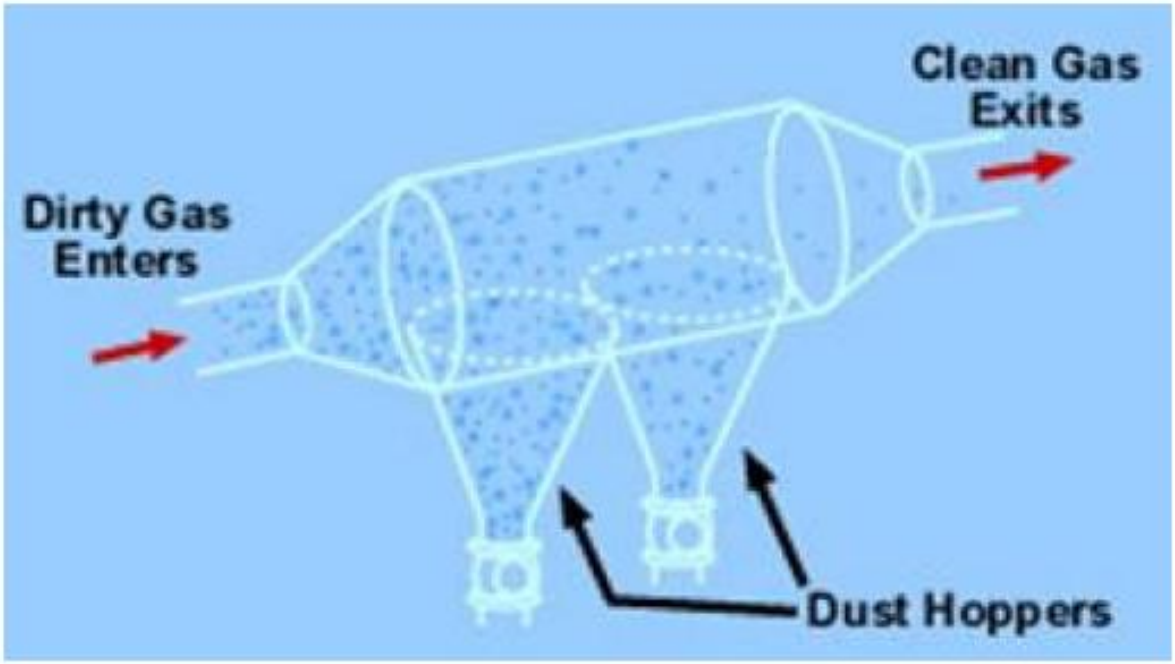
The choice of the equipment depends upon a number of factors such as

1. Physical and chemical properties of the particles
2. Particle size, concentration, volume of impurities
3. Temperature, Humidity of the medium
4. Efficiency required
5. Economic considerations.

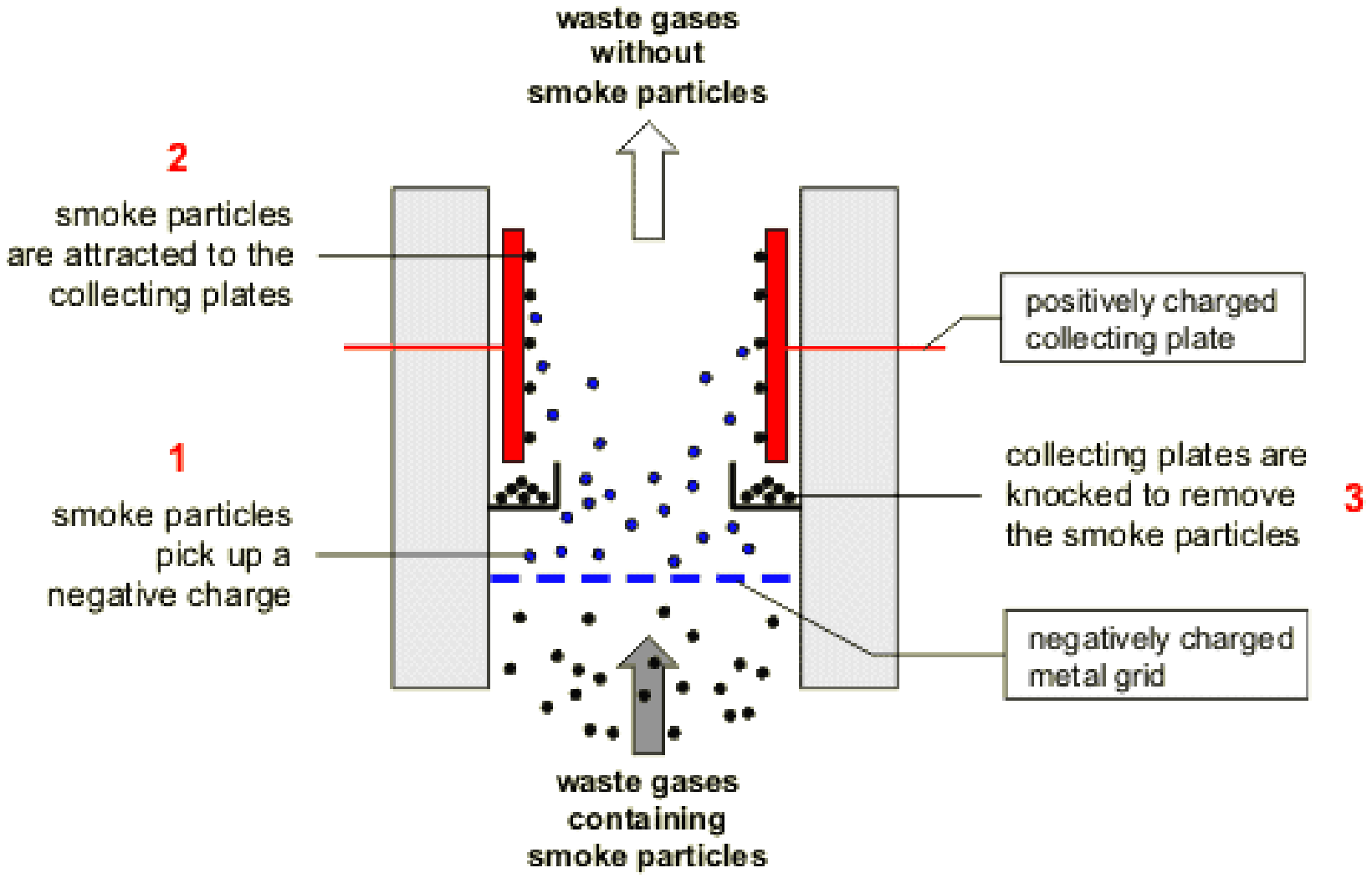
CONTROL DEVICERS FOR PARTICULATES

1. GRAVITATIONAL SETTLING CHAMBER
2. ELECTROSTATIC PRECIPITATORS
3. BAG HOUSES OR FABRIC FILTERS
4. CYCLONE SEPARATOR
5. WET SCRUBBERS

GRAVITATIONAL SETTLING CHAMBER

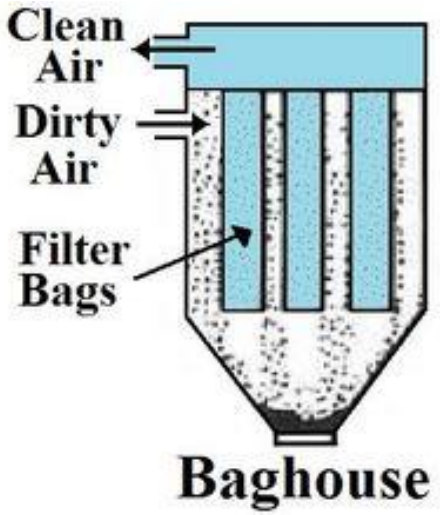


PICTURE OF ELECTROSTATIC PRECIPITATORS



BAG HOUSES

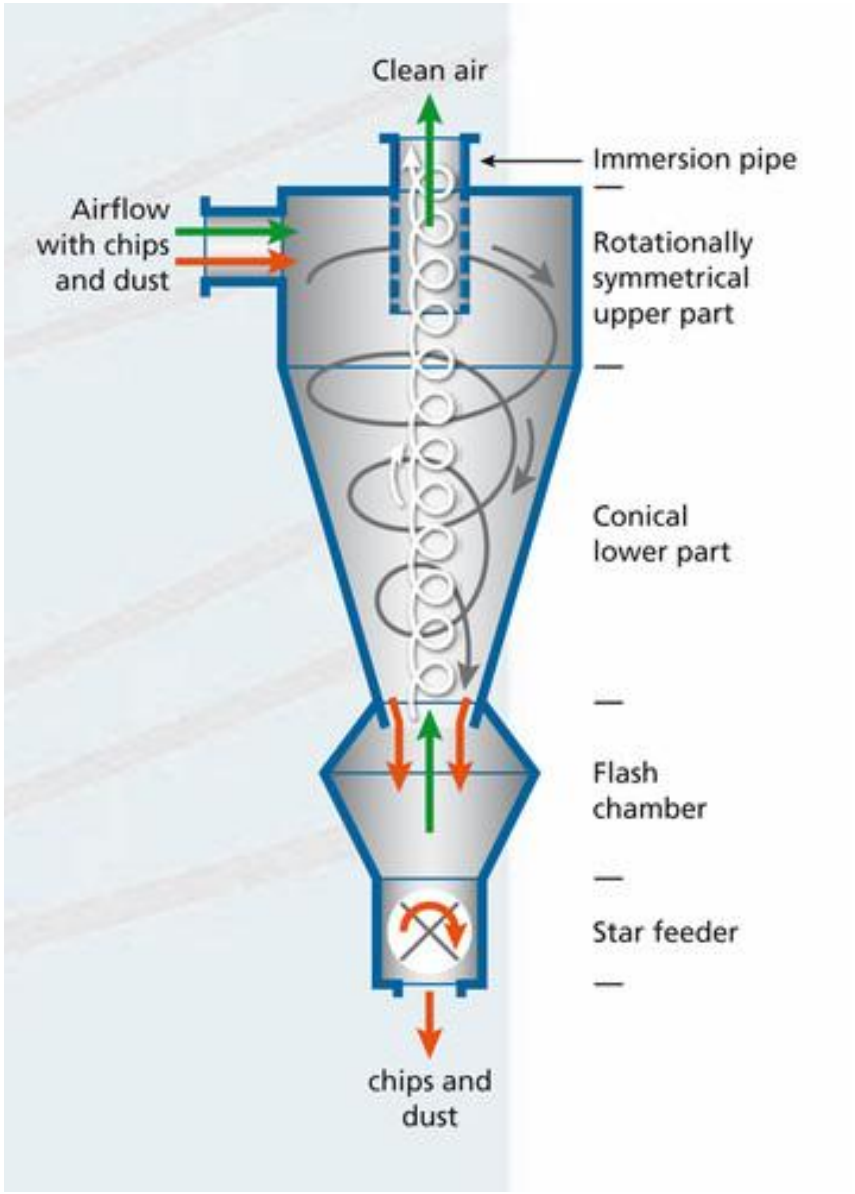
- Dry particulates are trapped by filters made up of cloth
- During shaken of the filter all the paper or similar materials blown from the filters down into the hopper.
- Asbestos and silicone coated glass cloth can withstand higher temperatures up to 350°C.
- They are used to control air pollutants from steel, foundries , furnances etc.



CYCLONES

- It produces a centrifugal force.
- Dust containing gas is whished very rapidly inside a collector shaped like cylinder.
- The spinning motion creates centrifugal forces causing particles to be thrown against the walls of the cylinder, drop into the hopper.
- They are used in cotton gins. Rock crushers and some industrial process

PICUTRES OF CYCLONES



WET SCRUBBERS

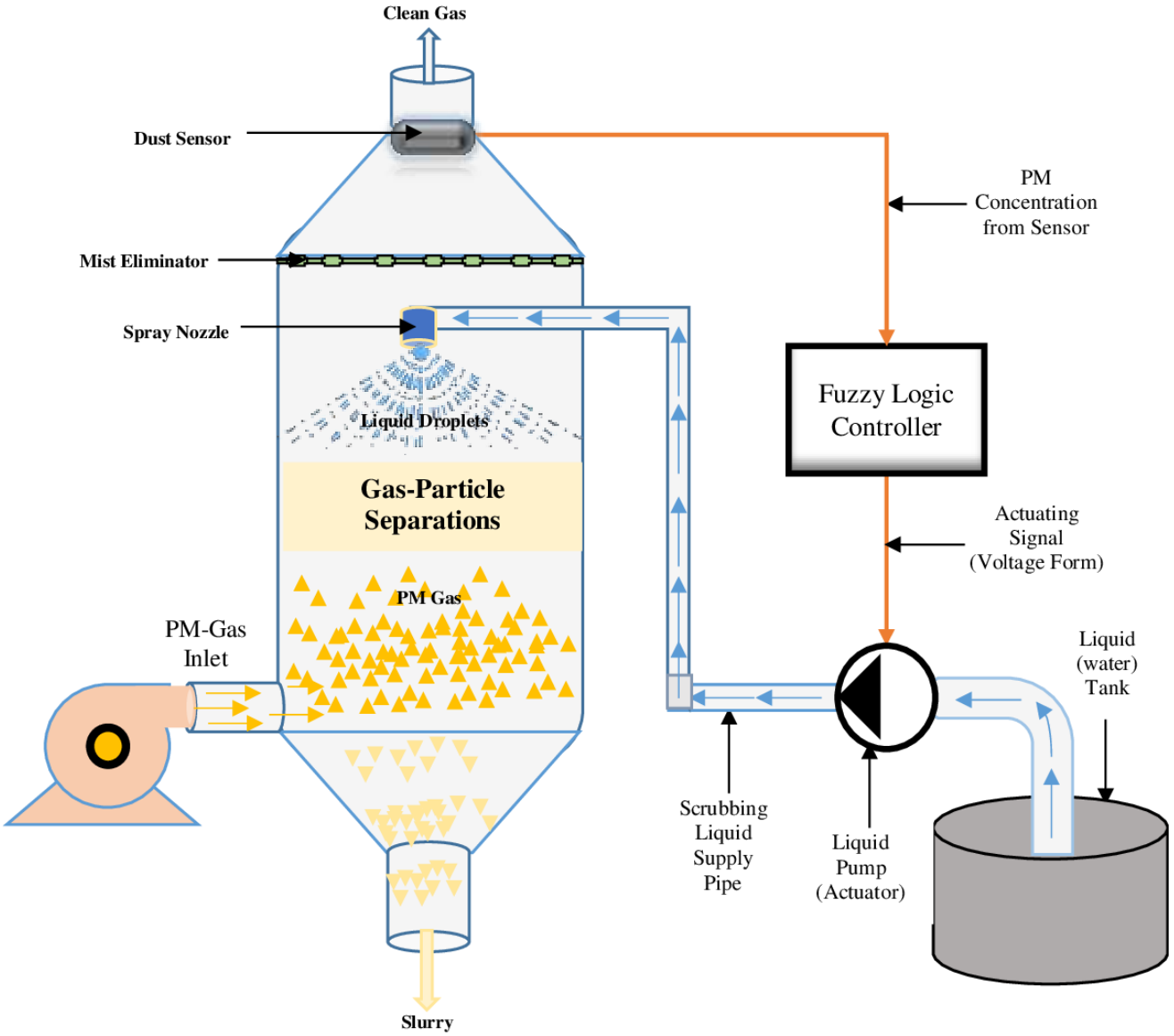
- Wet scrubbing is particularly useful for simultaneous removal of reactive gases and fine particulate matter from exhaust gases.

- In scrubber particulates, vapours, gases are controlled by passing the gas stream through a liquid solution.

- They are used on coal burning power plants. Concrete plants etc.

PICTURES OF WET SCRUBBERS

gas temperature changes.



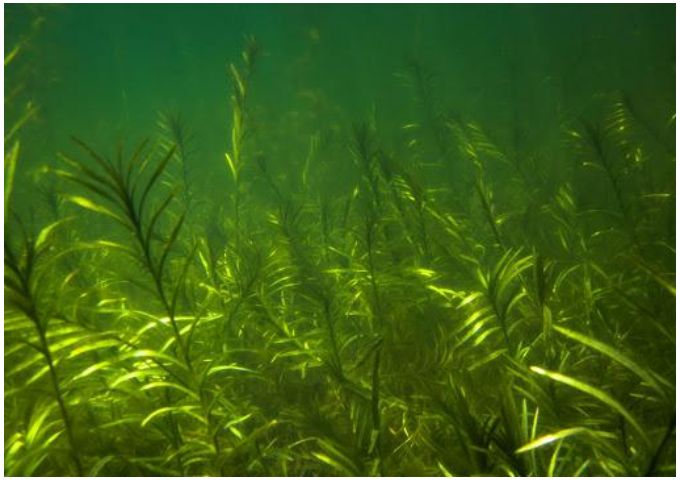
Water pollution

Water Pollution can be defined as the presence of some foreign substances or impurities (organic, inorganic, radiological, biological,) in such quantity so as to constitute a health hazard by lowering the quality and making it unfit for use

- Water waste release from domestic, commercial, municipal, institution etc. are grouped as Sewage.
- The discharge of waste from various industries is termed as Effluents

The sign of water pollution

1. The bad taste of drinking water
2. Offensive odors from lakes, rivers and Oceans
3. Unchecked growth of aquatic weeds in the water bodies
4. Decreases in the no of fishes in fresh water
5. Oil and grease floating on water surfaces



Causes of Water pollution

- Soil erosion due to rains, deposition of dead and decaying matters of plants and animals, food etc.
- Discharge of untreated waste or sewage disposal having biodegradable and degradable matter.
- Dumping of industrial effluent wide variety of inorganic, Organic pollutant such as Oil, metals, solvents
- Usage of synthetic organic substances, pesticides, insecticides used for agricultural purpose

Classification

Chemical pollution

Acidity, basicity (pH) , DO content etc., Organic compounds like carbohydrate, fats, polymers, biodegradable wastes causes depletion of DO.

Physical pollution

Color, odor, taste, turbidity, thermal properties due to impurities

Biological pollution

Mainly caused by discharge from feedlots, cowsheds, excretory products from mammals, wild and domestic animals, ….
Bacteria, protozoa, viruses, algae etc. makes water unfit for mankind.

Sources and effects of water pollution

1. **Infectious agent, bacteria, fungi, viruses, and parasites**
2. **Oxygen demanding wastes, organic waste**
3. **Inorganic chemicals, harmful metal salts**
4. **Organic pollutants, organic compounds**
5. **Plant nutrients, nitrogen, phosphorus**
6. **Radioactive pollutants, radioactive elements**

It has a harmful effect on living organisms or makes unsuitable for desirable uses.

1. Infectious agent

Infectious diseases are caused by diverse living agents that replicate in their hosts. The agents that cause disease fall into five groups: viruses, bacteria, fungi, protozoa, and helminthes (parasitic worms, are large multicellular organisms).

Example: bacteria, viruses, protozoa and parasitic worms

Sources: human and animal wastes, pathogenic disposal

Effects: variety of diseases including vomiting, fever, jaundice, chronic fatigue, Cholera, typhoid, tuberculosis

2. Oxygen demanding wastes

Example : Animal manure, Plant debris

- Organic wastes such as animal manure and plant debris that can be decomposed by aerobic (oxygen-requring) bacteria.
- This degradation consumes dissolved oxygen in water. Dissolved oxygen is the amount of oxygen dissolved in a given quantity of water at particular pressure and temperature.

Human sources

- Sewage
- Paper mills
- Food processing

Effects

- Degrade the water quality by depleting dissolved oxygen of water
- Oxygen consuming organisms, like fish and other aquatic life die

3. Inorganic chemicals

Water soluble/Insoluble chemicals

- Acids
- Toxic metals such as lead, arsenic, selenium
- Sodium chloride in ocean water and fluoride in soils

Human sources

Surface runoff, industrial effluents and household cleansers.

Effects

1. Fresh water contamination for drinking and irrigation
2. Skin cancer and neck damage
3. Harm fish and other aquatic life
4. Lower crop yields
5. Corrosion of metals

4. Organic chemicals

Example: oil, gasoline, plastics, pesticides and detergents

Human sources: Industrial effluents, household cleansers and surface runoff

Effects:

1. Damage the nervous system
2. Cause some cancer
3. Harm fish and wild life.

5. Plant nutrients

Example: compound containing nitrate, ammonium and phosphate

Human sources: sewage, manure, runoff fertilizers

Effects:

- Excessive growth of algae and aquatic plants
- Reduce dissolved oxygen in water and kill the fish
- Drinking water with excessive levels of nitrates lower the oxygen carrying capacity of the blood and can kill children and infants.

6. Radioactive pollutants

Sources: mining, nuclear power plats

Effects:

- ❖ cause cancer
- ❖ damage ecosystem
- ❖ cause harmful effects of living organisms

Sources of water pollution

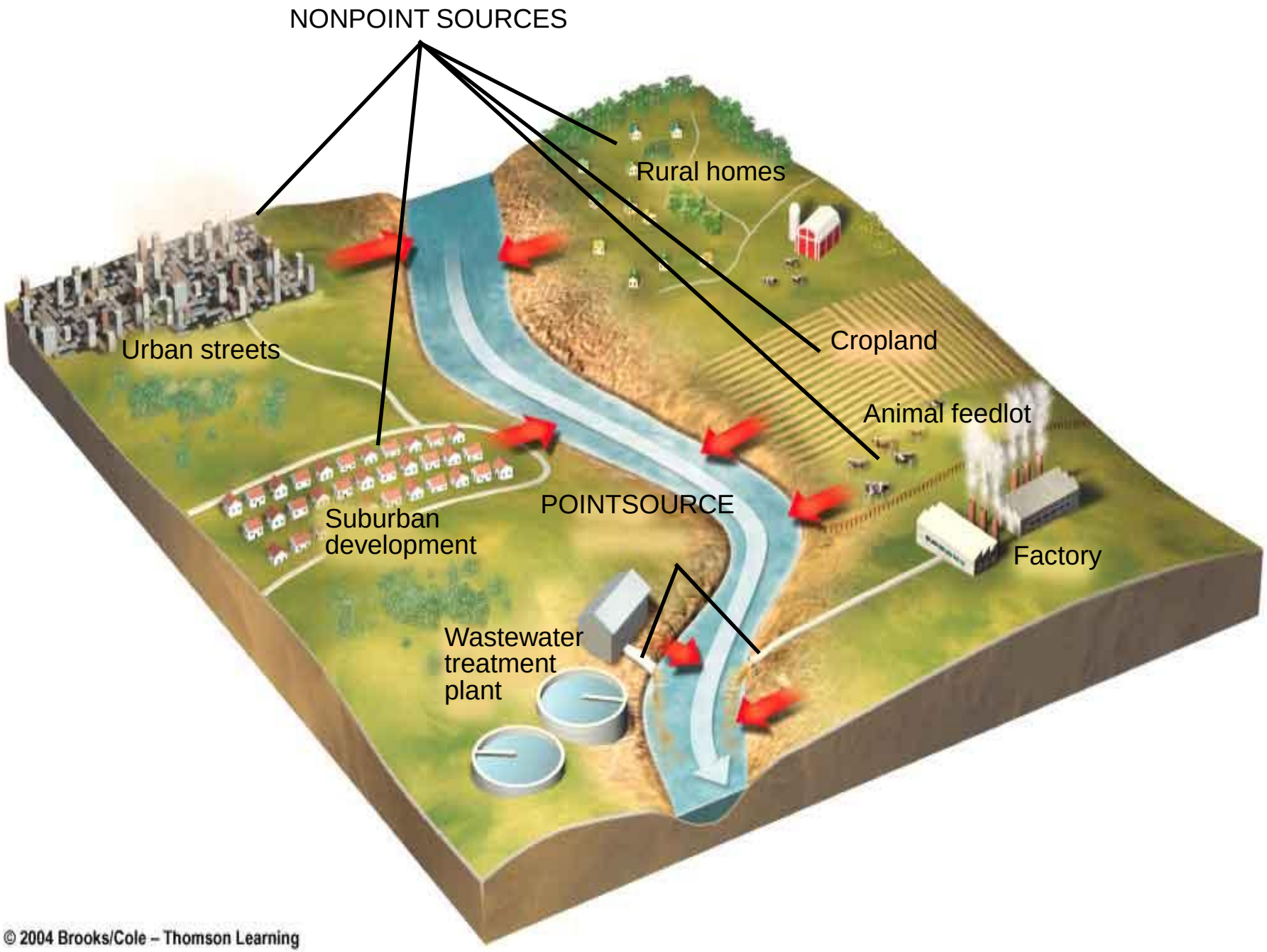
1. Point sources

They discharge pollutants in a place at a specific locations through pipes or drains in to water bodies. Example : Factories, sewage treatment plant

2. Non point sources

They are large land areas that pollute water by runoff, deposition from atmosphere. Location of which cannot be easily identified.

Example: Acid deposition and runoff chemicals in to surface water from croplands.



Control measures of water pollution

- Water pollution should be controlled by state or central government
- Scientific methods should be followed for pollution control.
- The industrial effluents should be recycled.
- Discharge of effluents into water bodies should be stopped.
- Follow a proper, efficient and effective water management strategies.
- Enforcement of laws, water pollution control acts and standard practising and monitoring to meet the requirements.
- Water quality monitoring at regular intervals at both domestic and industrial waste water treatment plants.

- Deforestation should be stopped.
- Plant more trees.
- Domestic waste water may be used for gardening.
- Create Public awareness .
- Laws and rules to protect the water should be framed.
- Advanced treatment for removal of nitrates and phosphates prevent eutrophication.