# "Environmental Pollution"

## 1. Introduction

Developmental activities such as construction, transportation, and manufacturing not only deplete natural resources but also produce large amounts of waste that leads to pollution of air, water, and soil. Untreated or improperly treated waste is a major cause of pollution in the environment. In this lesson, you will study the major causes of pollution, their effects on our environment, and the various measures that can be taken to control such pollution.

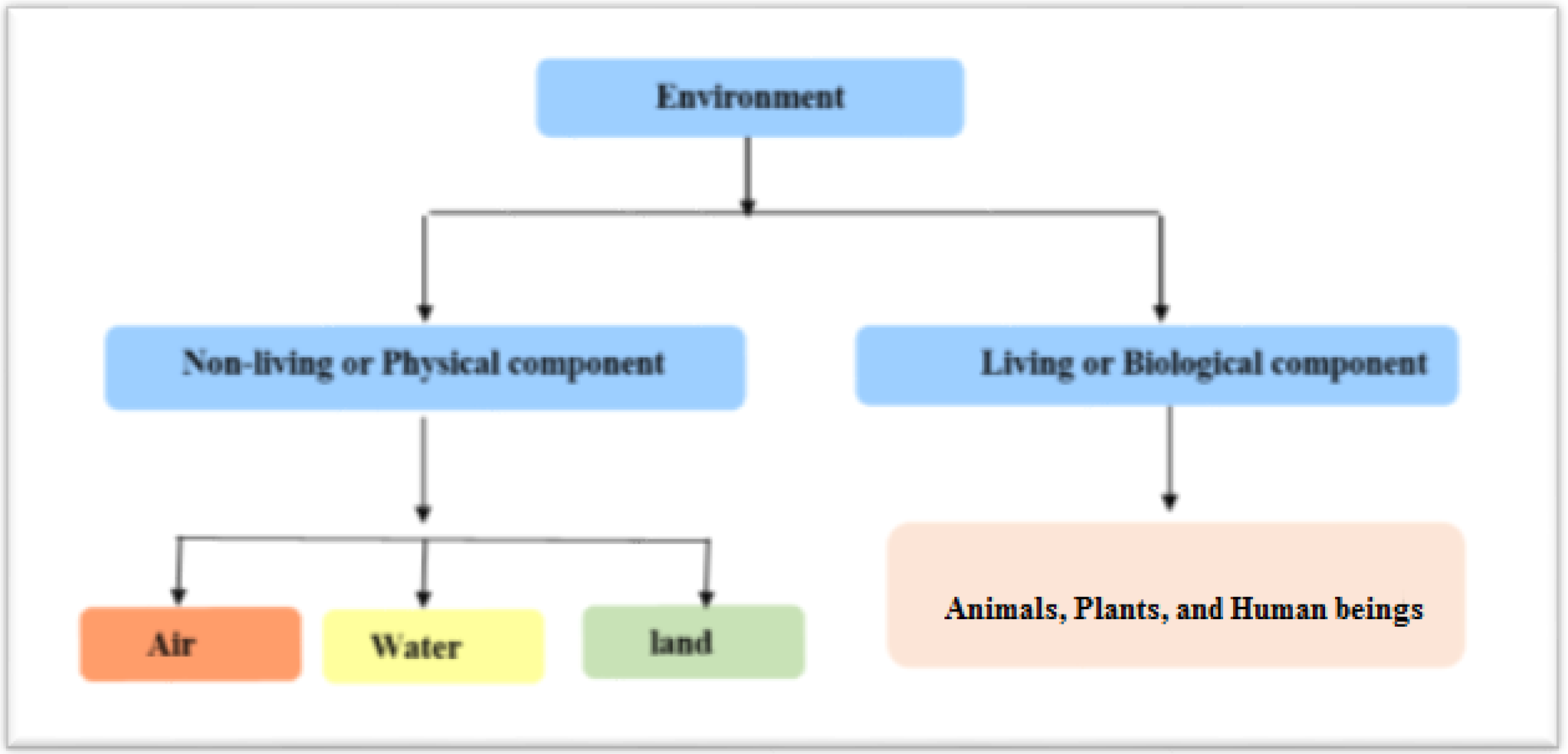
### 1.1 The Environment Definition:

**The Environment** the sum total of all surroundings of a living organism, including natural forces and other living things, which provide conditions for development and growth as well as danger and damage.

The term environment includes two components; the first is Non-living or Physical (air, water, land), and the second is Living or Biological (animals, plants, as well as human beings), and the inter-relationship between them.

### 1.2 Elements of Environment

The environment consists broadly of two components-Non-living or Physical and Living or Biological.




## 1.3 Pollution and Pollutants:

Human activities directly or indirectly affect the environment adversely. A stone crusher adds a lot of suspended particulate matter and noise into the atmosphere. Automobiles emit from their tail pipes oxides of nitrogen, sulphur dioxide, carbon dioxide, carbon monoxide and a complex mixture of unburnt hydrocarbons and black soot which pollute the atmosphere. Domestic sewage and run off from agricultural fields, laden with pesticides.

**Pollution** is defined as the addition of undesirable material into the environment as a result of human activities. The agents which cause environmental pollution are called pollutants. Pollutants may be defined as physical, chemical, or biological substance unintentionally released into the environment which is directly or indirectly harmful to humans and other living organisms.

## 1.4 Classification of Pollutants

### a. Classification based on environment:

1. Air pollution
2. Water pollution

3. Soil pollution

## b. Classification based on nature of pollutants

1. Chemical pollution
2. Noise pollution
3. Pollution by radio activity.

## 2. Air Pollution:

Air pollution consists of gaseous, liquid, or solid substances that, when present in sufficient concentration, for a sufficient time, and under certain conditions, tend to interfere with human comfort, health or welfare, and cause environmental damage.

**Air pollution causes: acid rain, ozone depletion, photochemical smog, and other such phenomena.**

Pollutants are classified as primary and secondary air pollutants:

**Primary pollutants** are those which are emitted directly to atmosphere, whereas.

**secondary pollutants** are formed through chemical reactions and various combinations of the primary pollutants.

These pollutants originate from the following four types of sources:

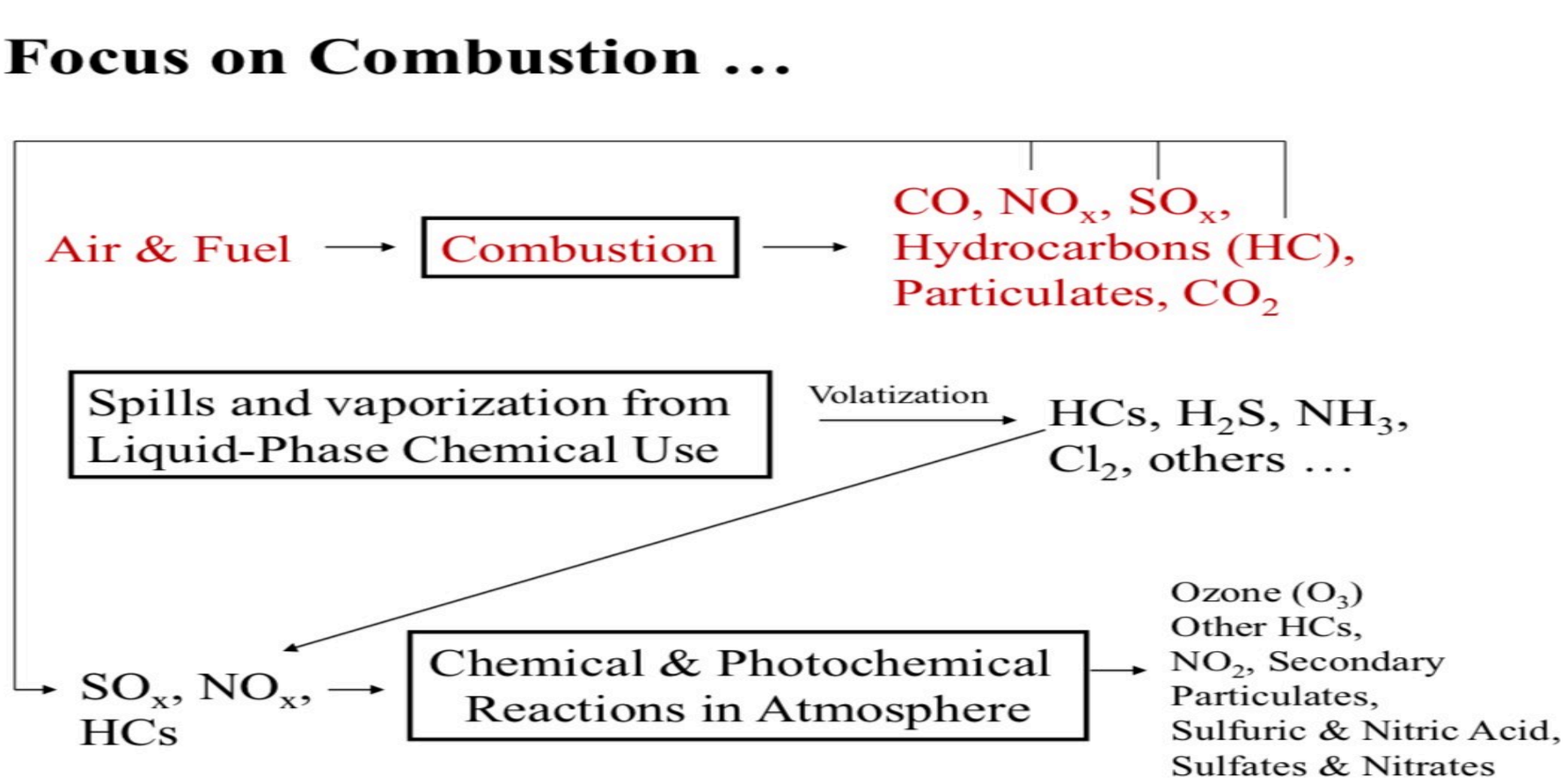
1. **Point sources,** which include facilities such as factories and electric power plants.
2. **Mobile sources,** which include cars and trucks but also lawn mowers, airplanes, and anything else that moves and releases pollutants into the air.
3. **Biogenic sources,** which include trees and vegetation, gas seeps, and microbial activity.
4. **Area sources,** which consist of smaller stationary sources such as dry cleaners and degreasing operations.

## 2.1 Combustion

Combustion = burning something

- **For example: -**
  - Burning gasoline in automobiles
  - Burning diesel fuel in trucks
  - Burning “residual oil” (bunker fuel) in ships
  - Burning coal in power plants
  - Burning natural gas (methane, $CH_4$) in power plants
  - Burning wood and other biomass in wildfires&controlled burns

### 2.1.1 Air Pollution from Fuel Combustion:




### 2.1.2 Internal combustion engines:

Internal combustion engines produce work by burning fuel inside the engine. This process releases pollutants such as carbon monoxide, nitrogen oxides, and hydrocarbons through the exhaust. These emissions contribute to air pollution, acid rain, and climate change by increasing greenhouse gases.There are three major types of internal combustion engines in use today:

1. The spark ignition engine.
2. The diesel engine.
3. The gas turbine.

### 2.1.3 Diesel Exhaust:

Diesel exhaust is formed when diesel fuel is burned in an engine. It contains many harmful gases and tiny particles called soot, including toxic and cancer-causing substances such as benzene and formaldehyde. It also releases nitrogen oxides, which contribute to air pollution and health problems.

## 2.2 Evaporative Emissions from Engines Occur in Several Ways:

**Diurnal:** Fuel evaporates when the vehicle is parked and the temperature increases during the day.
**Running losses:** Heat from the engine and exhaust causes fuel to evaporate while driving.
**Hot soak:** Fuel continues to evaporate after the engine is turned off while it is cooling down.
**Refueling:** Fuel vapors are released when the fuel tank is being filled.

## 2.3 Emissions Pollutants from Internal Consumption Engines:

***Hydrocarbons (HCs):***

Produced by incomplete fuel combustion. They react with NOx and sunlight to form ozone and smog, causing eye and lung irritation.

***Nitrogen Oxides (NOx):***

Formed at high temperature and pressure in engines. They contribute to ozone

formation and acid rain.

***Carbon Monoxide (CO):***

Results from incomplete combustion. It reduces oxygen delivery in the blood and is dangerous, especially for people with heart disease.

***Carbon Dioxide ($CO_2$):***

A greenhouse gas that contributes to global warming but does not directly harm human health.

***Sulfur Oxides (SOx):***

Formed from sulfur in fuel. They lead to acid rain, fine particles (PM-10), reduced visibility, and engine corrosion.

***Lead (Pb):***

Released mainly from leaded gasoline and industrial sources. It harms the blood, nervous system, kidneys, and other organs.

***Smoke and Particulate Matter (PM):***

White smoke: fuel or liquid particles during cold start or low load.

Blue smoke: burning oil.

Black smoke: soot from oxygen-poor combustion.

**Particles are classified by size:**

- 10 $\mu$m: dust (settles by gravity).
- 10–0.1 $\mu$m: ash and black smoke (Stokes law).
- <0.1 $\mu$m: very fine particles (Brownian motion).

## 2.4 Factors Affecting Emission Rates

Vehicle emissions depend on environment, fuel quality, and vehicle condition.

1. **Travel factors**: Number of trips, distance traveled, and driving style affect emissions.
2. **Highway factors**: Road design and slope influence emission levels.

3. **Vehicle factors**: Engine size, power, and vehicle weight play a role.
4. **Ambient temperature**: Higher temperatures increase evaporative emissions.
5. **Engine type**: Two-stroke petrol engines emit more pollutants than four-stroke diesel engines.
6. **Urbanization**: Traffic congestion in cities leads to higher emissions.

## 2.5 The health effects of diesel exhaust:

1. Diesel exhaust contains toxic gases and very small particles that enter deep into the lungs and cause health problems.
2. It can damage cells and increase the risk of cancer.
3. Diesel exhaust irritates the eyes, nose, throat, and lungs, causing cough, headaches, dizziness, and nausea.Diesel engines are a major source of fine particulate air pollution.
4. Diesel engines are a major source of fine particulate air pollution:

- Elderly people and those with asthma, emphysema, or heart and lung diseases are especially sensitive.
- Children are more vulnerable because their lungs are still developing, which can lead to more illnesses and reduced lung function.