UNIT 4

Environmental Pollution

Definition: Environmental pollution can be defined as "An undesirable change in chemical, physical and biological characteristics of air, water and soil which causes the health problems to all the living beings".

Types of Pollution:

a) Natural Pollution: natural pollution is caused due to natures imbalances. This type of pollution involves natural activities or disasters like cyclone, tsunami, floods, draughts, earth quakes, forest fires etc
   - Volcanic eruption release gases and volcanic ash.
   - Forest fires produce smoke and trace gases
   - Dust storm increases the windblown dust into environment.
   - Bacteria, spores, cysts and pollens are all natural pollutants
   - Decay of organic matter in marshy places releases marsh gas (methane CH_4).

b) Artificial or manmade pollution: caused due to activities of industries or vehicles, pesticides, construction of buildings, dams, roads, sprays etc.

Classification of Pollutants:

1. Degradable or non-persistent pollutants: these pollutants can be broken down rapidly by the natural process. E.g. Domestic waste, garbage and sewage etc.
2. Slowly degradable or Persistent pollutants: these pollutants remain in the environment for a very long period of time, in the unchanged conditions, may for more than few decades. E.g. Pesticides, aerosols etc.
3. Non-degradable pollutants: these are the pollutants never get degraded by any natural process. They are difficult to eradicate and they go on accumulating and polluting the environments. E.g. the toxic elements like lead, mercury, nuclear waste etc.

Different Pollutants:

Sr. No.	Pollutants	Examples
1	Gases	NO_X, SO_2, CO_2
2	Industrial waste	Soot, smoke, tar, dust
3	Metal waste	Mercury, lead, zinc, nickel, cadmium, chromium etc.
4	Acids	H_2SO_4, MNO_3

5	Agro pesticides	Herbicides, fungicides, weedicides, bactericides.
6	Domestic waste	Garbage, rubbish
7	Radioactive waste	Nuclear ash from atomic reactors
8	E waste	From IT sectors

Land/Soil Pollution

Soil is a mixture of organic matter, minerals, gases, liquids, and organisms that together support life. **Soil pollution** is defined as the presence of toxic chemicals (pollutants or contaminants) in soil, in high enough concentrations to pose a risk to human health and/or the ecosystem. In the case of contaminants which occur naturally in soil, even when their levels are not high enough to pose a risk, soil pollution is still said to occur if the levels of the contaminants in soil exceed the levels that should naturally be present.

Causes of Soil Pollution:

- **Accidental spills and leaks** during storage, transport or use of chemicals (e.g. leaks and spills of gasoline and diesel at gas stations).
- **Industrial waste:** the metals like iron, copper, lead, mercury, zinc and the acids and alkalies enter in the soil directly through the industrial waste water i.e. the effluents directly or indirectly the air i.e. may due to acid rains. They make change in the composition of soil to make it toxic for plant growth.
- **Foundry activities** and manufacturing processes that involve furnaces or other processes resulting in the possible dispersion of contaminants in the environment;
- **Mining activities** involving the crushing and processing of raw materials, for instance, heavy metals, emitting toxic substances. Also release radioactive waste.
- **Construction activities**: Construction sites are the most important triggers of soil pollution in urban areas, due to their almost ubiquitous nature. Almost any chemical substance handled at construction sites may pollute the soil. However, the higher risk comes from those chemicals that can travel more easily through the air as fine particulate matter. The chemicals that travel as particulate matter are more resistant to degradation and bioaccumulation in living organisms, such as PAHs. Additionally, construction dust may easily spread around through the air and is especially dangerous because of its lower particle size (less than 10 microns). Such construction dust can trigger respiratory illnesses such as asthma and bronchitis, and even cancer. Moreover, the sites that involve the demolition of older buildings can release asbestos, a toxic mineral that can act as a poison in soil. Asbestos particles can be redistributed by the wind.
- **Agricultural activities** involving the diffusion of herbicides, pesticides and/or insecticides and fertilizers. The insecticides like D.D.T, Aldrin, benzene are used to control growth of soil borne pests. They degrade very slowly and hence get accumulated in soil and enter in the plants and affect food chain.
- **Chemical waste dumping**, whether accidental or deliberate – such as illegal dumping;
- **Cracked paint chips** falling from building walls, especially lead-based paint.

Effects of Soil Pollution:

1. Effect on Health of Humans: Considering how soil is the reason we are able to sustain ourselves, the contamination of it has major consequences on our health. Crops and plants grown on polluted soil absorb much of the pollution and then pass these on to us. This could explain the sudden surge in small and terminal illnesses. Long term exposure to such soil can affect the genetic make-up of the body, causing congenital illnesses and chronic health problems that cannot be cured easily. In fact, it can sicken the livestock to a considerable extent and cause food poisoning over a long period of time. The soil pollution can even lead to widespread famines if the plants are unable to grow in it.
2. Effect on Growth of Plants: The ecological balance of any system gets affected due to the widespread contamination of the soil. Most plants are unable to adapt when the chemistry of the soil changes so radically in a short period of time. Fungi and bacteria found in the soil that bind it together begin to decline, which creates an additional problem of soil erosion. The fertility slowly diminishes, making land unsuitable for agriculture and any local vegetation to survive. The soil pollution causes large tracts of land to become hazardous to health. Unlike deserts, which are suitable for its native vegetation, such land cannot support most forms of life.

3. Decreased Soil Fertility: The toxic chemicals present in the soil can decrease soil fertility and therefore decrease in the soil yield. The contaminated soil is then used to produce fruits and vegetables which lacks quality nutrients and may contain some poisonous substance to cause serious health problems in people consuming them.

4. Toxic Dust: The emission of toxic and foul gases from landfills pollutes the environment and causes serious effects on health of some people. The unpleasant smell causes inconvenience to other people.

5. Changes in Soil Structure: The death of many soil organisms (e.g. earthworms) in the soil can lead to alteration in soil structure. Apart from that, it could also force other predators to move to other places in search of food. A number of ways have been suggested to curb the current rate of pollution. Such attempts at cleaning up the environment require plenty of time and resources to be pitched in. Industries have been given regulations for the disposal of hazardous waste, which aims at minimizing the area that becomes polluted.

6. Organic methods of farming are being supported, which do not use chemical laden pesticides and fertilizers. Use of plants that can remove the pollutants from the soil is being encouraged. However, the road ahead is quite long and the prevention of soil pollution will take many more years.

Prevention/controlling the soil pollution:

- Excavate soil and take it to a disposal site away from ready pathways for human or sensitive ecosystem contact.
- Aeration of soil at contaminated site.
- Bioremediation, involving microbial digestion of certain organic chemicals.
- Phyto-remediation or using plants to extract heavy metals.
- Myco-remediation, using fungus to metabolize contaminants and accumulates heavy metals.
- By applying water infiltration measures for soil and moisture conservation.
- Soil can be saved from degradation by using proper methods of disposal of waste material e.g. composting of bio-degradable wastes, burning of the non-bio-degradable wastes.
- The heavy metals and toxic material must be treated before they are allowed to flow through the industrial effluents over the land surface.

Water Pollution

Definition: it can be defined as "the presence of impurities and foreign substance in water in such a quantity that lower its quality and makes it unfit for consumption and causes health hazard"

Or "any physical, biological or chemical change in water quality that adversely affects living organisms can be considered pollution"

Sources/Causes of water pollution:

1. Point sources: source is identifiable.
    1. The industrial effluent have a wide variety of organic and also inorganic pollutants e.g. pulp and paper, sugar, textile, tanneries, fertilizers and chemical industries are the main source of water pollution.
2. Non-point sources: source is not identifiable
    2. The modern agriculture is supported by the chemical fertilizers and chemical pesticides, herbicides and weedicides. The extra doses of these chemical based materials get dissolved in the irrigated water. This liquid waste reaches the river through small streams and settles in the water it chemically polluted.

Causes of water pollution:

1. Industrial waste: industries produces huge amount of waste which contains toxic chemicals and pollutants. They also contain heavy metals such as lead, mercury, asbestos, sulphur, nitrates and many other harmful chemicals. Many industries do not have proper waste management system and drain the waste in the fresh water which goes into rivers, canals and seas.
2. Sewage/waste water: the sewage that is produced by each household is chemically treated and released into sea with fresh water. If not treated, the sewage water carries harmful bacteria and chemicals that can cause serious health problems.
3. Mining activities: releases various chemicals and heavy metals.

4. Marine dumping: the garbage produced by household in the form of paper, aluminum, rubber, glass, plastic, food etc collected and released into the sea in some countries. these items take time from 2 weeks to 200 yrs to decompose it affects water as well as animals and plants in sea.
5. Accidental oil leakage: oil spill pose a huge concern as large amount of oil enters into the sea and forms a layer over water and thus cuts oxygen supply to microorganisms and aquatic life.
6. Burning of fossil fuels: fossil fuels like coal and oil burnt release ash and gases in the atmosphere when it will mix with water vapor result in acid rain.
7. Chemical fertilizers and pesticides: these chemical fertilizers and pesticides are mixed with up with water into river and it affects aquatic life.
8. Leakage from the landfills: it pollutes groundwater.
9. Animal waste: when it mixed with water streams it cause various waterborne diseases.

Effects of water pollution:

1. Death of aquatic animals: the main problem caused by water pollution is that depend on these water bodies. Dead fish, crabs, birds and sea gulls, dolphins and many other animals often wind up on beaches, killed by pollutants in their habitat.
2. Disruption of food chain: pollution disrupts the natural food chain as well as pollutants such as lead and cadmium are eaten by tiny animals and then big fishes and the food chain continue.
3. Diseases/human health: eventually humans are affected by this process as well. People can get diseases such as hepatitis by seafood that has been poisoned. Also in many countries the peoples are affected by various waterborne diseases like cholera, tuberculosis etc. due to poor drinking water treatment. Every year there are an estimated 3-5 million cholera cases and 100000-120000 death due to cholera. According to WHO (World health organization) only 5-10% cases are officially reported.
4. Destruction of ecosystem: ecosystem can be disturbed by water pollution.
5. Economic cost: if water is polluted it can cost a lot more to purify drinking water that take its source from nutrient polluted water bodies.

BIS (Bureau of Indian standards) water quality standards:

1. It should be colourless, odourless
2. It should be good in taste
3. It should not be hot
4. Turbidity is less than 10 ppm.
5. It should be free from objectionable dissolve gases like H_2S
6. It should be free from objectionable minerals such as lead, arsenic, chromium and manganese
7. The pH should be in range 7.0 – 8.5
8. Hardness less than 500ppm
9. Chloride – less than 250ppm, fluoride less than 1.5ppm, sulphate less than 250ppm.
10. It should be free from diseases producing microorganisms.

S. No.	Parameter	Acceptable limit	Permissible limit in the absence of alternate source
1.	Colour (Hazen units)	5	15
2.	Odour	Agreeable	Agreeable
3.	pH value	6.5–8.5	No relaxation
4.	Taste	Agreeable	Agreeable
5.	Turbidity (NTU units)	1	5
6.	Total dissolved solids (mg/l)	500	2000
7.	Aluminium (mg/l)	0.03	0.2
8.	Ammonia (mg/l)	0.5	No relaxation
9.	Anionic detergents (as MBAS) (mg/l)	0.2	1.0
10.	Barium (as Ba) (mg/l)	0.7	No relaxation
11.	Boron (as B) (mg/l)	0.5	1.0
12.	Cadmium (mg/l)	0.003	No relaxation
13.	Calcium (as Ca) (mg/l)	75	200
14.	Chloramines (as Cl_2) (mg/l)	4.0	No relaxation
15.	Chloride (as Cl) (mg/l)	250	1,000
16.	Copper (mg/l)	0.05	1.5
17.	Fluoride (mg/l)	1.0	1.5
18.	Iron (mg/l)	0.3	No relaxation
19.	Lead (mg/l)	0.01	No relaxation
20.	Magnesium (mg/l)	30	100
21.	Mercury (mg/l)	0.001	No relaxation
22.	Nickel (mg/l)	0.02	No relaxation

Treatment of water: the treatment method depends upon the nature and impurities present in water.

Techniques for treating impurities in water

Sr. no.	Types of impurities	Techniques
1	Floating matter (e.g. wood pieces, leaves, flowers, fruits etc.)	Screening or filtration
2	Suspended impurities (e.g. clay, sand, dust etc.)	Sedimentation
3	Fine suspended inorganic matter (e.g. silica, mica, fine dust etc.)	Sedimentation with coagulation
4	Colloidal impurities	Filtration or ultra filtration
5	Microorganisms	Disinfection or sterilization
6	Pathogenic bacteria	Disinfection or sterilization

Flow diagram of Water treatment plant:

Raw water ⟶ screening ⟶ aeration ⟶ softener/activated carbon ⟶ soda treatment ⟶ sand filter ⟶ chlorination/disinfection ⟶ treated water

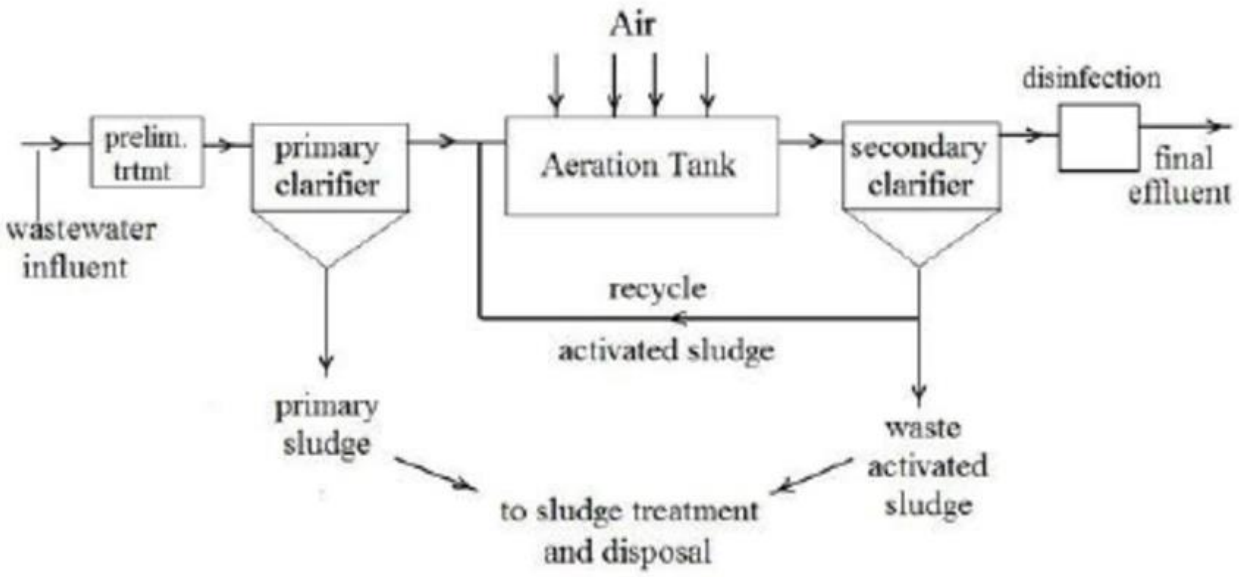
1. Screening: Screening removes objects such as rags, paper, plastics, and metals to prevent damage and clogging of downstream equipment, piping, and appurtenances. Some modern wastewater treatment plants use both coarse screens and fine screens.
2. Aeration: Aeration brings water and air in close contact in order to remove dissolved gases (such as carbon dioxide) and oxidizes dissolved metals such as iron, hydrogen sulfide, and volatile organic chemicals (VOCs). Aeration is often the first major process at the treatment plant.
3. Sedimentation: Sedimentation is the process of allowing particles in suspension in water to settle out of the suspension under the effect of gravity. The particles that settle out from the suspension become sediment, and in water treatment is known as sludge. When a thick layer of sediment continues to settle, this is known as consolidation. There are different types of tanks are used, circular tank, radial flow or circumferential flow, rectangular tank and hopper bottom tank.
4. Coagulation and flocculation: The destabilization of particles in water by adding chemicals (e.g., aluminium sulphate or ferric chloride) so that they can aggregate and form larger flocs. Coagulation is often used in combination with flocculation.

5. Softener: softening is a process of removing dissolve calcium and magnesium salt that cause harness in water. This harness is removed by boiling water or adding lime.
6. Soda treatment: this treatment is used if the pH of water is acidic add soda ash (sodium carbonate) or sodium hydroxide.
7. Filtration: in this process the water is allowed to pass through a bed of coarser and fine sand. It removes colour, taste, odor and also bacteria. These filters are of two tyapes i.e. pressure filters and gravity filters.
8. Disinfection: it is used for disinfection of water from pathogenic bacteria and microorganisms. It is removed by adding chlorine or bleaching powder.

Sewage Treatment

The sewage treatment can be either

1. Preventive treatment: it involves the steps to reduce volume of waste water or to reduce strength of pollutants. It can be done by recycle and reuse of water.
2. Curative measures: the water or polluted water has been treated by physical and biological methods.

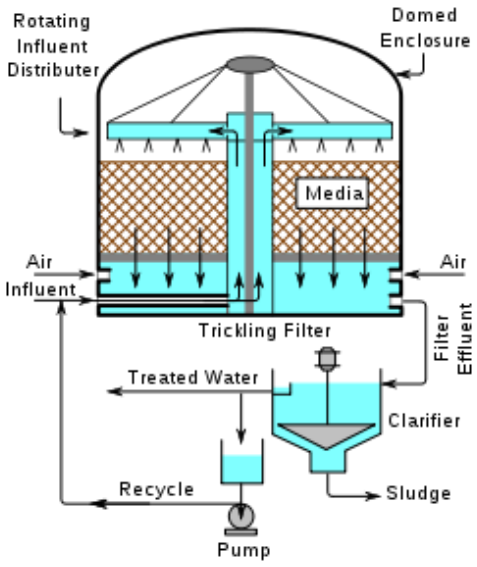


1. Preliminary treatment: waste water contains floating suspended solids such as rags, woods, metals, plastic etc. These have to be removed by screening or other mechanical equipments.

2. Primary treatment: Primary treatment of sewage mainly consists of the sedimentation process to remove suspended organic solids. Chemicals are sometimes added in primary clarifier to assist in removal of finely divided and colloidal solids.
3. Secondary treatment or biological treatment: The objective of secondary treatment is the further treatment of the effluent from primary treatment to remove the residual organics and suspended solids. In most cases, secondary treatment follows primary treatment and involves the removal of biodegradable dissolved and colloidal organic matter using aerobic biological treatment processes. Aerobic biological treatment (see Box) is performed in the presence of oxygen by aerobic microorganisms (principally bacteria) that metabolize the organic matter in the wastewater, thereby producing more microorganisms and inorganic end-products (principally CO_2, NH_3, and H_2O). Several aerobic biological processes are used for secondary treatment differing primarily in the manner in which oxygen is supplied to the microorganisms and in the rate at which organisms metabolize the organic matter.
    - Activated sludge process:
    - Activated sludge plant involves:
        1. wastewater aeration in the presence of a microbial suspension,
        2. solid-liquid separation following aeration,
        3. discharge of clarified effluent,
        4. wasting of excess biomass, and
        5. return of remaining biomass to the aeration tank.

        In activated sludge process wastewater containing organic matter is aerated in an aeration basin in which micro-organisms metabolize the suspended and soluble organic matter. Part of organic matter is synthesized into new cells and part is oxidized to CO_2 and water to derive energy. In activated sludge systems the new cells formed in the reaction are removed from the liquid stream in the form of a flocculent sludge in settling tanks. A part of this settled biomass, described as activated sludge is returned to the aeration tank and the remaining forms waste or excess sludge.

    - Tricking filters: A trickling filter , also called trickling biofilter, biofilter, biological filter and biological trickling filter , is a fixed-bed, biological reactor that operates under (mostly) aerobic conditions. Pre-settled wastewater is continuously ‘trickled’ or sprayed over the filter. As the water migrates through the pores of the filter or circular beds, 2-5 m high filled with porous lumpy material e.g. hard coke. organics are aerobically degraded by the biofilm covering the filter material.



Tertiary treatment: disinfect the water after biological treatment by adding chlorine or bleaching powder to kill pathogenic bacteria.

CPCB Norms of sewage discharge: CPCB is the regulatory authority and mandates the treated water quality for any STP in india. The discharge standards stipulate in 2015 and revised on 13-10-2017. The current values have been given by its notification for india dated April, 1994 from central office at new delhi.

Discharge standards

Parameters	Units	Old	Revised	Outside capital city
pH		6 to 8.5	6.5 to 9	6.5 to 9
BOD	Mg/l	10	< 20	<20
TSS	Mg/l	10	<50	<100
Fecal coliform	MPN	Nil	< 1000	<100

Waste water or Waste waters from industries

Waste water is generated from various sources:

- Domestic Sewage: This includes all wastewater generated by home dwellings, public restrooms, hotels, restaurants, motels, resorts, schools, places of worship, sports stadiums, hospitals and other health centers, apartments and the like. They all produce high volumes of wastewater.
- Non-sewage: These include water from floods (stormwater), runoff (rainwater running through cracks in the ground and into gutters), water from swimming pools, water from car garages and cleaning centers. They also include laundromats, beauty salons, commercial kitchens, energy generation plants and so

on. Wastewater is also generated from agricultural facilities. Water used for cleaning in animal farms, washing harvested produce and cleaning farm equipment.

Effects of wastewater:

1. Fertilizers and detergents add nutrient and helps to grow algae which consume the dissolve oxygen and biological oxygen demand increases. It reduce the dissolve oxygen kills aquatic life.
2. Domestic and commercial effluents provide nutrient to microorganisms which consume the dissolve oxygen and this also kill aquatic life.
3. The runoff from agricultural waste water contains pesticide which is non degradable they travel trough the food chain and enters into human body and affect the nervous system.
4. From mining and refining of uranium, thorium the radioactive pollutants enter in human body through water and food and get accumulated in blood, thyroid glands, liver, bones and muscles. This cause serious illness and death also.
5. Excess amount of fluorides consumption causes dental and intestinal problems. It causes diseases like typhoid, dysentery, cholera and amoebic dysentery etc.
6. Consumption of lead damages the liver, kidney and also reduces formation of hemoglobin. It also affect the central nervous system which leads to coma or death.

Minamata disease: minamata disease was first discovered in Minamata City in Kumamoto prefecture, Japan in 1956. It is caused to release Methyl Mercury from chemical factory. This is highly toxic chemical bioaccumulated in shellfish and fish in Minamata bay and Shiranui sea which eaten by local people resulted into mercury poisoning. It is a Neurological Syndrome. Symptoms include ataxia, numbness in hand and feet, hands. Extreme cases it cause paralysis, coma, death etc. When mercury added into water it converts into methyl mercury by anaerobic microbs.

Air Pollution

Definition: “presence/addition of any contamination to the air which cause harm to the health of living organisms”

3. Air pollution was traced way back to the period of Hippocrates, about 400 BC. He has mentioned about Air pollution. Use of coal as the domestic energy producer, made the air pollution more pronounced.
4. **In 1273, King Edward I made the first anti-pollution act** to restrict people from using coal for domestic purpose. Industrial revolution made the air pollution a serious problem in European countries.
5. **In 1952, London was attacked by smog,** which resulted in the death of the human and other living beings the toll death was more than 4000.
6. Use of petrol and diesel in the transport systems, has created the air pollution a serious problem in India and also in the **third** world countries.

7. Bhopal gas tragedy occurred in 1984 at Union carbide india limited pesticide plant in Bhopal, Madhya Pradesh, india. The gas leaked is MIC (Methyl isocyanate) gas. Leakage of MIC happened in Midnight.

Classification of air pollutants:

1. Primary Pollutants: released directly into the air.
   e.g. ash, salt particles, pollen and spores, smoke, windblown dust.

2. Secondary Pollutants: added after they are formed as a chemical reaction in the air between primary pollutants. E.g. smog: sunlight + NO_x, Acid rain: water + SO_x, Ozone: Volatile organic compound + NO_X compound.

Major air Pollutants:

1. Carbon compounds: CO_2 is released by complete combustion of fossil fuels and CO a very toxic gas and released by automobile exhausts.
2. Sulphur compounds: through thermal power plants, using coal and from the oil refineries, SO_2, H_2S, H_2SO_4 are released.
3. Nitrogen Oxides: these oxides like NO, NO_2, HNO_3 are released by automobiles, power plants and industries.
4. Fluorides: they are produced by the industrial and insecticide sprays.
5. Hydrocarbons: they are released by automobiles. E.g. Benzene, Benzpyrene etc.
6. Metals: the metals such as lead, nickel, tin, beryllium, titanium are present in to form of solid particles produced by metallurgical process.
7. Photochemical smog: the products such as PAN, PB_2N are the photochemical smog produced by automobiles.
8. Particulate matter: the suspended particulate matter is released into air by the stone crushing industries and dust and the ash from thermal power plants.
9. Biological particulate: they are mainly the bacterial cells, fungal spores and pollen.

Effects of air pollution:

Effects on Human health: the air pollution causes short term and long term effects on human health. These are as follows:

- Irritation of eyes, throat and nose
- Irritation of respiratory system
- Respiratory damage through tobacco smoke.
- Convulsions, delirium, coma due to lead poisoning
- Cigarette smoking causes cardiovascular diseases, due to cadmium particulates.
- Radioactive dust causes genetic effects on next generation
- The mercury from combustion of fossil fuel affects the nerves, brain and kidney.

Effects on vegetation:

- Over use of pesticides affect their growth and metabolic activities by destroying chlorophyll and also by disrupting photosynthesis.
- The rise in Ozone causes **Necrosis i.e. damaging the leaves.**
- The rise in NO_X causes **Abscission i.e. premature fall of leaves.** This results in reduction in the crop production.
- The rise in SO_2 causes **chlorosis i.e. yellowing of the leaves.**

Effects on Animals: when the animals during grazing consume the particulate coated plants mainly with fluorine, lead, arsenic they get affected resulting into illness or poisoning or even deaths. Also suffer from lung diseases.

Effects on material:

- The acid gases like O_3, SO_2, NO_2 affect the strength of the textile.
- The building material gets affected by SO_2 and acid rains.
- SO_2 and acid gases affect the quality of paper and leather.
- The paints get decoloured by SO_2 and H_2S.

Effect on climate:

- Burning of fossil fuels generate CO_2 which is heavy gas and has capacity to absorb the heat. Rise in CO_2 has caused the global warming.
- CFC depleted the ozone layer which has capacity to trap UV rays.

Prevention of air pollution: the nature has own mechanism to remove the air pollutants is called as **Scavenging.** When the speed pollutants entering in the air is greater than the self clearing mechanism, the air becomes polluted.

1. Natural mechanism:
    - Dispersion: some suspended pollutants are dispersed by the wind. It is called as dispersion of pollutants.
    - Settling: due to gravitational pull the heavy pollutants get settled on ground.
    - Absorption: some pollutants are absorbed by the moisture or raindrops and air is made clear. Some pollutants are absorbed by the dust particles and made air clear.
2. Artificial mechanism:
    - **Controlling pollution at the source only** i.e. use of **gravitational settling chambers, centrifugal separators, wet scrubbers bag filters and electrostatic precipitators** in the industry can reduce the air pollution.
    - **Construction of tall chimneys** to reduce the addition of pollutants at lower level of atmosphere. This help the dilution of gaseous pollutants in the atmosphere.
    - **Development of green belt** around the industry can reduce the suspended pollutants in the air. The tall trees act as a natural filter.
    - In automobile pollution **use of better quality of fuel and use of catalytic converters** will help to reduce the air pollution.

3. Controlling air pollution through regulation: “the clean air act of 1970” which mandates the setting of standards for four primary pollutants i.e.
    - Particulate matter
    - SO_2
    - CO
    - Nitrogen and one secondary pollutant i.e. ozone.

Ambient Air Quality Standards: the Central Pollution Control Board (CPCB) publishes the notification from time to time for country. The current values have been given by its notification for India dated **April, 1994** from central office at New Delhi. As per national ambient air quality standards the levels of air quality are necessary with an adequate margin of safety, to protect and public health, vegetation and property. The central pollution control board in exercise of its powers conferred under **section 16(2) (h) of the Air (Prevention and control of pollution) Act, 1981** hereby the national ambient air quality standards with immediate effect.

Noise Pollution

- The unpleasant, high intensity sound is called as noise.
- The noise pollution can be defined as “ a sound of unpleasant and annoying in nature”

Sources of noise pollution:

- Transport activities: automobiles, railways, airplanes
- Industrial activities: textile, steel rolling industries, wood cutting mills etc.
- Domestic activities: T.V., radio, tape recorders, mixer grinders.
- Cultural activities: festivals, marriage functions, public speeches, religious programmes.
- Agricultural activities: tractors, threshers
- Defense activities: tanks, gunfire, aeroplanes, bombs, army exercise.
- Mining activities: blasting
- Other activities: stone crushing, construction of dam, roads, landslides and earthquakes are the natural source of noise pollution.

Effects of noise pollution:

- Physical effects: temporary hearing loss, permanent deafness, damage to tympanic membrane.
- Physiological effects: headache, pains in heart, reduction in vision, rise in blood pressure, loss of memory.
- Psychological effects: depression, fatigue, emotional disturbance, frustration, irritation.

Noise levels at various zones of the city

The central pollution control board constitutes a committee on noise pollution control. The committee recommended noise standards for ambient air for different areas which later notified in Environment (protection) rules, 1986 as given below.

Code dB	Area/category of area	Limits in day time dB	Limits in night time dB
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence zone	50	40

Note:

- Day time is reckoned in between 6 a.m. and 9 p.m.
- Night time is reckoned in between 9 p.m. and 6 a.m.
- Silence zone is referred as areas upto 100 meters around such premises as hospitals, educational institutes and courts. The silence zones are to be declared by the competent authority. Use of vehicular horns, loudspeakers and bursting of crackers shall be banned in these zones.

Prevention or control of noise pollution:

- Laws regarding noise pollution must be followed
- Green belt should be developed to separate residential and industrial area.
- Regular servicing and tuning of automobiles can effectively reduce the noise pollution.
- Workers should be provided with equipments such as ear plugs and earmuffs for hearing protection.
- The industries having the source of noise pollution can reduce the noise at source.
- The maximum noise levels near the construction site should be limited to 75 dB in industrial areas and to 65 dB in other areas.

The permissible levels for noise exposure for work zone area of factories according to the **factories act, 1948.**

Peak sound pressure level in dB	Permitted number of impulses or impact/day
140	100
135	315
130	1000
125	3160
120	10000

No exposure in excess of 140 dB peak sound pressure level is permitted.

Municipal Solid waste

Sources of Solid Waste:

Residential: Residences and homes where people live are some of the major sources of solid waste. Garbage from these places include food wastes, plastics, paper, glass, leather, cardboard, metals, yard wastes, ashes and special wastes like bulky household items like electronics, tires, batteries, old mattresses and used oil. Most homes have garbage bins where they can throw away their solid wastes in and later the bin is emptied by a garbage collecting firm or person for treatment.

Industrial: Industries are known to be one of the biggest contributors of solid waste. They include light and heavy manufacturing industries, construction sites, fabrication plants, canning plants, power and chemical plants. These industries produce solid waste in form of housekeeping wastes, food wastes, packaging wastes, ashes, construction and demolition materials, special wastes, medical wastes as well as other hazardous wastes.

Commercial: Commercial facilities and buildings are yet another source of solid waste today. Commercial buildings and facilities in this case refer to hotels, markets, restaurants, go downs, stores and office buildings. Some of the solid wastes generated from these places include plastics, food wastes, metals, paper, glass, wood, cardboard materials, special wastes and other hazardous wastes.

Institutional: The institutional centers like schools, colleges, prisons, military barracks and other government centers also produce solid waste. Some of the common solid wastes obtained from these places include glass, rubber waste, plastics, food wastes, wood, paper, metals, cardboard materials, electronics as well as various hazardous wastes.

Construction and Demolition Areas: Construction sites and demolition sites also contribute to the solid waste problem. Construction sites include new construction sites for buildings and roads, road repair sites, building renovation sites and building demolition sites. Some of the solid wastes produced in these places include steel materials, concrete, wood, plastics, rubber, copper wires, dirt and glass.

Municipal services: The urban centers also contribute immensely to the solid waste crisis in most countries today. Some of the solid waste brought about by the municipal services include, street cleaning, wastes from parks and beaches, wastewater treatment plants, landscaping wastes and wastes from recreational areas including sludge.

Treatment Plants and Sites: Heavy and light manufacturing plants also produce solid waste. They include refineries, power plants, processing plants, mineral extraction plants and chemicals plants. Among the wastes produced by these plants include, industrial process wastes, unwanted specification products, plastics, metal parts just to mention but a few.

Agriculture: Crop farms, orchards, dairies, vineyards and feedlots are also sources of solid wastes. Among the wastes they produce include agricultural wastes, spoiled food, pesticide containers and other hazardous materials.

Biomedical: This refers to hospitals and biomedical equipment and chemical manufacturing firms. In hospitals there are different types of solid wastes produced. Some of these solid wastes include syringes, bandages, used gloves, drugs, paper, plastics, food wastes and chemicals. All these require proper disposal or else they will cause a huge problem to the environment and the people in these facilities.

Solid waste management:

- **Sanitary/secured Landfill**: This is the most popular solid waste disposal method used today. Garbage is basically spread out in thin layers, compressed and covered with soil or plastic foam. Modern landfills are designed in such a way that the bottom of the landfill is covered with an impervious liner which is usually made of several layers of thick plastic and sand. This liner protects the ground water from being contaminated because of leaching or percolation. When the landfill is full, it is covered with layers of sand, clay, top soil and gravel to prevent seepage of water.
- **Incineration**: The term incinerates means to burn something until nothing is left but ashes. An incinerator is a unit or facility used to burn trash and other types of waste until it is reduced to ash. An incinerator is constructed of heavy, well-insulated materials, so that it does not give off extreme amounts of external heat.The high levels of heat are kept inside the furnace or unit so that the waste is burned quickly and efficiently. If the heat were allowed to escape, the waste would not burn as completely or as rapidly. Incineration is a disposal method in which solid organic wastes are subjected to combustion so as to convert them into residue and gaseous products. This method is useful for disposal of residue of both solid waste management and solid residue from waste water management. This process reduces the volumes of solid waste to 20 to 30 per cent of the original volume. Incineration and other high temperature waste treatment systems are sometimes described as “thermal treatment”. Incinerators convert waste materials into heat, gas, steam and ash. Incineration is carried out both on a small scale by individuals and on a large scale by industry. It is used to dispose of solid, liquid and gaseous waste. It is recognized as a practical method of disposing of certain hazardous waste materials. Incineration is a controversial method of waste disposal, due to issues such as emission of gaseous pollutants.
- **Recovery and Recycling**: Recycling or recovery of resources is the process of taking useful but discarded items for next use. Traditionally, these items are processed and cleaned before they are recycled. The process aims at reducing energy loss, consumption of new material and reduction of landfills.

- **Composting**: Due to shortage of space for landfill in bigger cities, the biodegradable yard waste (kept separate from the municipal waste) is allowed to degrade or decompose in a medium. A good quality nutrient rich and environmental friendly manure is formed which improves the soil conditions and fertility. Organic matter constitutes 35%-40% of the municipal solid waste generated in India. This waste can be recycled by the method of composting, one of the oldest forms of disposal. It is the natural process of decomposition of organic waste that yields manure or compost, which is very rich in nutrients. Composting is a biological process in which micro-organisms, mainly fungi and bacteria, convert degradable organic waste into humus like substance. This finished product, which looks like soil, is high in carbon and nitrogen and is an excellent medium for growing plants. The process of composting ensures the waste that is produced in the kitchens is not carelessly thrown and left to rot. It recycles the nutrients and returns them to the soil as nutrients. Apart from being clean, cheap, and safe, composting can significantly reduce the amount of disposable garbage. The organic fertilizer can be used instead of chemical fertilizers and is better specially when used for vegetables. It increases the soil's ability to hold water and makes the soil easier to cultivate. It helped the soil retain more of the plant nutrients. Vermi-composting has become very popular in the last few years. In this method, worms are added to the compost. These help to break the waste and the added excreta of the worms makes the compost very rich in nutrients. In the activity section of this web site you can learn how to make a compost pit or a vermi-compost pit in your school or in the garden at home. To make a compost pit, you have to select a cool, shaded corner of the garden or the school compound and dig a pit, which ideally should be 3 feet deep. This depth is convenient for aerobic composting as the compost has to be turned at regular intervals in this process. Preferably the pit should be lined with granite or brick to prevent nitrite pollution of the subsoil water, which is known to be highly toxic. Each time organic matter is added to the pit it should be covered with a layer of dried leaves or a thin layer of soil which allows air to enter the pit thereby preventing bad odour. At the end of 45 days, the rich pure organic matter is ready to be used. Composting: some benefits

  1. Compost allows the soil to retain more plant nutrients over a longer period.
  2. It supplies part of the 16 essential elements needed by the plants.
  3. It helps reduce the adverse effects of excessive alkalinity, acidity, or the excessive use of chemical fertilizer.
  4. It makes soil easier to cultivate.
  5. It helps keep the soil cool in summer and warm in winter.
  6. It aids in preventing soil erosion by keeping the soil covered.
  7. It helps in controlling the growth of weeds in the garden.

- **Pyrolysis**: This is method of solid waste management whereby solid wastes are chemically decomposed by heat without presence of oxygen. This usually occurs under pressure and at temperatures of up to 430 degrees Celsius. The solid wastes are changed into gasses, solid residue and small quantities of liquid.

Biomedical waste

Biomedical waste is generated from biological and medical sources and activities, such as the diagnosis, prevention or treatment of diseases.

Types of medical waste:

- General medical waste
- Infectious medical waste
- Hazardous medical waste
- Sharps waste
- Pharmaceutical waste
- Radioactive medical waste

Waste treatment and disposal system

Category	Waste category	Treatment
Category 1	Human Anatomical Waste (human tissues, organs, body parts)	incineration/deep burial
Category 2	Animal Waste (animal tissues, organs, body parts carcasses, bleeding parts, fluid, blood and experimental animals used in research, waste generated by veterinary hospitals colleges, discharge from hospitals, animal houses)	incineration/deep burial
Category 3	Microbiology & Biotechnology Waste (wastes from laboratory cultures, stocks or specimens of micro-organisms live or attenuated vaccines, human and animal cell culture used in research and infectious agents from research and industrial laboratories, wastes from production of biologicals, toxins, dishes and devices used for transfer of cultures)	Incineration/alternate
Category 4	Waste sharps (needles, syringes, scalpels, blades,	Disinfection and autoclaving/microwaving/shredding

	glass, etc. that may cause puncture and cuts. This includes both used and unused sharps)	and mutilation
Category 5	Discarded Medicines and Cytotoxic drugs (wastes comprising of outdated, contaminated and discarded medicines)	incineration/destruction and drugs disposal in secured landfills
Category 6	Soiled Waste (Items contaminated with blood, and body fluids including cotton, dressings, soiled plaster casts, lines, beddings, other material contaminated with blood)	Incineration/ autoclaving/microwaving
Category 7	Solid Waste (wastes generated from disposable items other than the waste sharps such as tubing, catheters, intravenous sets etc.).	disinfection by chemical treatment/autoclaving/microwaving mutilation/ shredding
Category 8	Liquid Waste (waste generated from laboratory and washing, cleaning, house- keeping and disinfecting activities).	disinfection by chemical treatment and discharge into drains
Category 9	Incineration Ash (ash from incineration of any bio-medical waste)	Landfill
Category 10	Chemical Waste (chemicals used in production of biological, chemicals used in disinfection, as insecticides, etc.)	Chemical discharge into drains for liquids and secured landfill for solids

Colour Coded bags for disposal:

Color coding	Type of container	Waste categories
Yellow 	Plastic bags	Cat 1 human anatomical waste Cat 2 Animal Waste Cal 3 Microbiological Waste Cat 6 Solid Waste
Red 	Disinfected container plastic bags	Cat 3 Microbiological Cat. 6 Soiled Dressing
Blue/white 	Plastic bags, puncture proof containers	Cat. 4 Waste sharp Cat.7 Plastic disposable
Black 	Do	Cat. 5 Discarded medicine Cat. 9 Incineration ash Cat 10 Chemical Waste

Disposal of Biomedical waste: this methods are given by CPCB under Biomedical waste (Management and Handling) Rules 1998.

- **Deep burial**: Category 1 and 2 only. In cities having less than 5 lakh population & rural area.
- **Autoclave and microwave treatment**: Standards for the autoclaving and microwaving are also mentioned in the Biomedical waste (Management and Handling) Rules 1998. All equipment installed/shared should meet these specifications. Category 3, 4, 6 and 7 can be treated by these techniques.
- **Shredding**: The plastic (I.V. bottles, I.V. sets, syringes, catheters etc.), sharps (needles, blades, glass etc.) should be shredded but only after chemical treatment/microwaving/autoclaving. Needle destroyers can be used for disposal of needles directly without chemical treatment.
- **Land disposal:** Open dumps, Secured/Sanitary landfill: advantages. The incinerator ash, discarded medicines, cytotoxic substances and solid chemical waste should be treated by this option.
- **Incineration:** A high temperature dry oxidation process, which reduces organic and combustible waste to inorganic incombustible matter. Usually used for the waste that can not be reused, recycled or disposed of in landfill site. The incinerator should be installed and made operational as per specification under the BMW rules 1998.

E – Pollution

Electronic waste or e wastes are defined as, “waste material like discarded computers, office electronic equipment, entertainment electronic devices, mobile phones, television sets and refrigerators contribute as e-waste”

List of few important e waste and their sources:

1. **Lead:** lead found in solder, CRT monitor glass, lead-acid batteries, PVC.
2. **Tin:** tin is found in solder, coating on component leads.
3. **Copper:** found in copper wire, printed circuit boards, component leads.
4. **Alluminium:** found in electronic goods using more than a few watts of power, electrolytic capacitors.
5. **Iron:** found in steel chassis, cases and fixing.
6. **Germanium:** transistorized electronics.
7. **Silicon:** found in glass, transistors, printed circuit boards.
8. **Nickel:** found in nickel-cadmium batteries
9. **Lithium:** found in lithium-ion batteries
10. **Zinc:** found in plating for steel parts
11. **Gold:** found in connector plating, primarily in computer equipments

Effects of E pollution:

1. **Americium:** carcinogenic (causes cancer)
2. **Mercury:** Health effects include sensory impairment, dermatitis, memory loss and muscle weakness. Environmental effects in animals include death, reduced fertility, slower growth and development.
3. **Sulphur:** Health effects include liver damage, kidney damage, heart damage, eye and throat irritation. When released in environment it creates sulphuric acid.
4. **PCBs (Poly Chlorinated Biphenyls):** Health effects include impaired development of the nervous system, thyroid problems, liver problems. Similar effects in animals as humans.
5. **Cadmium:** when not properly recycled it can leach into soil, harming microorganisms and disrupting soil ecosystem. The inhalation of cadmium can cause severe damage to lung and kidney.

Control of E-Pollution:

1. A legal framework.
2. A collection system.
3. Logistics and other services.

Days related to environment

Date and month	Days celebrated
15th January	Animal welfare
2nd February	World wetland day
3rd February	Godess narmata jayanti
14th march	World anti dam day
21st march	World forest day
22nd March	World water day
22nd April	World earth day
31st may	World anti tobacco day
5th june	World environment day
17th june	World desertification day
6th july	Forest week
11th july	World population day
23rd july	Forest conservation day
26th august	Nature club day
16th September	Ozone layer protection day
21st September	World biosphere day
1st October	Wild life week starts
2nd October	World reaved animal day
8th October	Natural disaster protection day
14th October	World animal right day
16th October	World food day
24th October	World development and information day
1st November	World ecosystem day
14th November	National children day
25th November	No non veg day
29th November	International biodiversity day
1st December	Ocean protection day
Full December month	Biodiversity month