

ENVIRONMENTAL POLLUTION

1. Environmental Pollution: An undesirable change in the physical, chemical, or biological characteristics of any component of the environment that can cause harmful effects on various forms of life or property.
2. Pollution: influence of any substance causing nuisance harmful effects and uneasiness to organisms.
3. Pollutants : any substance causing nuisance or ham; effects then that particular substance may called pollutants.
4. Atmosphere= air around us
5. Lower atmosphere- touches the surface of earth ; Upper atmosphere- gradual transition to space, From space atmosphere is a thin spherical shell around the earth
6. **Atmosphere is mostly nitrogen and oxygen and co₂ is a small component of environment and plays an important**

role in greenhouse effect

7. Density of air decreases rapidly with increasing altitude

thermosphere	blocks the harmful radiation from sun. Radio Communication possible
Mesosphere	meteors and asteroids burn up as they approach earth.
Stratosphere	has a layer of ozone that partially blocks suns UV light
Troposphere	contains all of our weather and living organisms

8. Environment Lapse Rate during normal situation is positive while during inversion situation it is negative

9. In thermal inversions, the normal

temperature pattern reverses.

10. Vertical mixing happens when $EVL < ALR$ while Pollutant mixing is high when $ELR > ALR$ (adiabatic lapse rate)

Vertical Mixing and Lapse Rates:

- **Environmental Lapse Rate (ELR):** Actual rate of temperature decrease with height.
- **Adiabatic Lapse Rate (ALR):** Idealized rate of temperature change with height for rising or sinking air.
- **When $ELR < ALR$ (Stable conditions):** Vertical mixing is limited, leading to pollution buildup.
- **When $ELR > ALR$ (Unstable conditions):** High vertical mixing allows pollutants to disperse more effectively.

Key Meteorological Factors:

1. **Rainfall:** Can wash out pollutants from the air, reducing pollution levels.
2. **Wind Speed:** Influences the horizontal dispersion of pollutants; higher wind speeds spread pollutants over a larger area.
3. **Temperature:** Affects vertical mixing of pollutants in the atmosphere.
4. **Humidity:** Can influence the formation of secondary pollutants like smog.
5. **Solar Radiation:** Drives photochemical reactions, leading to the formation of pollutants like ozone.

Thermal inversion (or **temperature inversion**) is a meteorological phenomenon where the normal temperature gradient in the atmosphere is reversed. Under typical conditions, air temperature decreases with height. However, during a thermal inversion, a layer of warmer air lies above cooler air, trapping the cooler air (and any pollutants) near the surface.

Effects of Thermal Inversion:

1. **Air Pollution Trapping:** Pollutants like smoke, dust, and industrial emissions become trapped near the surface, leading to smog formation and poor air quality.
2. **Reduced Visibility:** Trapped pollutants can create haze or fog, impairing visibility.
3. **Health Impacts:** Prolonged exposure to trapped pollutants can exacerbate respiratory and cardiovascular issues.
4. **Weather Stability:** Thermal inversions inhibit vertical mixing, creating calm and stagnant conditions.

AIR POLLUTION

1. Air must be kept free of oxides of sulphur, nitrogen and carbon. Air pollution is responsible for acute chromic respiratory problems such as lung infection, asthma and even cancer. It is also responsible for acid rain in megacities.

Pure Fuels	Dirty fuels
Only contains fuel	It contains additional non combustable elements mixed in with the fuel.
Release carbon dioxide and water vapor as products	Release many forms of air pollutants

Ex: methane
gasoline and
ethanol

Coal wood and oil

NATURAL POLLUTANTS(results of natural phenomenon)

1. Volcanic eruptions generate so much polluting gases and ash in the air that even sun rays are blocked and land temperature in the affected area is lowered as happened with **mount Pinatubo**.
2. Forests fire emit co₂, so₂ , no₂ and ozone and particulate matter

Primary pollutants	Secondary pollutants
They are released into the atmosphere from the source	They are formed when primary pollutants react with gases in the atmosphere.

EX: ozone, NO₂
(NO+O₂) and acid rain which is formed when SO₂ or NO₂ +H₂O and form sulphuric acid

3. CO₂ plays a major role in greenhouse effect and also produces weak carbonic acid adding to acid rain
4. CO affects human health by binding to haemoglobin which may result in asphyxia because hemoglobin has more affinity for CO₂ than O₂. Also, affects the central nervous system, perception and reflexes. Vision and Brain damage
5. Oxides of Sulphur is produced by combustion of sulphur containing fuel such as coal petroleum extraction dn refining and paper manufacturing ore smelting for metal extraction. It is responsible for acid rain and also causes severe damage to human and other animals lungs. It causes swelling of tissues (EDEMA), chronic bronchitis

and pulmonary fibrosis.

6. Source of Oxides of nitrogen are mainly burning of fuels, by product of manufacturing of fertilizers and by product during the nitration process such as manufacturing of Trinitrotoulene(TNT). It reduces lung function and oxygen carrying capacity of blood, edema of respiratory tract. NO₂ is harmful for humans and plants

Hydrocarbons, VOCs (Methane, Ethane, Propane, Butane, Ethylene, Benzene, Benzopyrene)

- **Source:** Evaporation from gasoline tanks, carburetors, burning of fuels, biomass, microbial activity of sewage, industrial process involving solvents
- **Effect:** May be *carcinogenic to humans*; higher concentration are toxic to plants and animals; some are more reactive and produce photochemical smog on reaction with sunlight

7.

8. Polycyclic aromatic hydrocarbons including benzene and benzopyrene are carcinogenic and can be fatal.

9. Suspended particulate matter(SPM) are solid particle such as dust,

soil ,soot and they are also called as aerosols. They cause chronic effects on respiratory system and deposition on the surface of green leaves and thus interfering with the absorption of CO₂ and release of O₂ and also blocking sunlight

Photochemical oxidants O₃, Peroxyacetyl Nitrates (PANs), formaldehyde (CH₂O), Acetaldehyde (CH₃CHO), Hydrogen peroxide (H₂O₂), Hydroxyl radical (HO)

- **Source:** Photochemical reactions in the atmosphere that involve sunlight, oxides of nitrogen and hydrocarbons
- **Effect:** Haze and smog production; irritation to eyes, nose and throat; respiratory problems; blocking on sunlight

10. Air pollution 5th largest killer in India.India has also the highest death rate from chronic respiratory diseases such as asthma according to WHO

11. Worst air quality : Delhi>Gwalior and Raipur

12. The badarpur Thermal Power Plant Station a coal fired power plant built in 1973 is another major source of air

pollution in Delhi(8% less electricity produced contributes to 80-90% of the pollution)

13. Bhopal Gas Tragedy: Worlds worst industrial Disaster. Pesticide Sevin(UCC's brand name for Cabaryl) using methyl isocyanate(MIC) as an intermediate resulted in this disaster.

FOG, HAZE AND SMOG

1. Mist and Fog are caused by water droplets in the atmosphere and the only difference is how far can you see. They are a type of "hydrometers"

Fog

Smog

<p>It is a visible mass consisting of low lying cloud water droplets or ice crystals suspended in the air at or near the earth's surface</p>	<p>It is mixture of smoke and fog in the air. Classic smog results from combustion of large amount of coal and is caused by a mixture of smoke and sulphur dioxide. In 1950 a new type of smog called Photochemical Smog came into existence.</p>
Fog	Less than 1 km
Mist	Btw 1 - 2km
Haze	More than 2 to 5 km

2. Haze is the reflection of sunlight off air pollution. Haze and Smog results from pollutants. Haze, smoke and dust are like "**lithometers**"
3. In winters inversion occurs so ground

temp are lowers than those of upper atmosphere thus inhibiting the dispersion of air pollutants and thus the cool air will cause the moisture to condense in to fog.

London Type smog	Photochemical smog (Los Angeles Type Smog)
<p>This type of smog comes from coal smoke, combining with the water vapor and liquid water in cool, humid or foggy air.</p> <p>Coined by Dr Henry Antoine Des Voeux.</p>	<p>It requires clear, sunny skies(because it requires sunlight for one of the key chemical reaction $\text{NO}_x + \text{ROG} + \text{sunlight} \rightarrow \text{O}_3 + \text{NO}_2$) where ROG(reactive organic base) is obtained from unburned gasoline and NO_x are oxides of nitrogen.</p>

<p>The great smog of 1952 darkened the streets of London and killed approximately 4K ppl+ 8K</p>	<p>Verified by Haagen Smith. A smog so sudden and severe that the people believed that Japanene are attacking them with chemical warfare</p>
<p>It was formed due to presence of SO₂ AND HUMIDITY WHICH COMBINES TO FORM h₂so₄ FOG</p>	<p>Photochemical runs taking place when NO₂ reacts with hydrocarbons. It is a misnomer because it doesn't involve fog and smoke</p>

4. Dust has potential to influence monsoons, hurricanes and even fertilize rainforests.
5. USGS links dust event to a decline in the health of coral reefs across the Caribbean and Florida.

AEROSOLS

Aerosols are **micron sized particles of solid or liquid** phase dispersed in the atmosphere.

1. They are colloids of types **fluid or solid in gas**
2. They are not stable
3. They are produced by various physical and dynamical process which govern their formation and growth into the atmosphere.
4. **What will affect the deposition of Aerosols:**
 - Particle size,
 - Density,
 - Shape,
 - Hygroscopic or hydrophobic character, and
 - Chemical reactions of particles.
5. They are mixed with each other externally and internally changing their optical, physical and chemical properties
6. Depending upon size aerosols are

classified into three categories

Aitken nuclei mode	0.001 to 0.1 micro metre
Accumulation mode	0.1 to 1.0 micro metre
Large mode/giant particle	>1 micro metre

1. Aerosols caused by biomass burning

Adverse effects of aerosols

1. Affects human health mainly respiratory because they are unstable
2. Degradation of air quality and visibility- Sea salt, dust and volcanic ash are three types of aerosols
3. It causes severe attenuation of UV radiation which modifies the earth's atmospheres energy budget. (Direct aerosol affect) (which are tiny particles suspended in the atmosphere, scatter and absorb ultraviolet radiation, reducing the amount of UV light that reaches the Earth's surface.)
4. It also act as CLOUD

CONDENSTATION NUCLEI(CCN) for water vapor formation(indirect affect)

5. Affects the vertical temperature profile influence in the atmosphere stability
6. The various chemical and photochemical reactions that occur in the atmosphere are primarily determined by- **the temperature, composition, humidity and intensity of sunlight.**
7. The absorption of solar radiation in the UV region causes photochemical reactions. In the atmosphere
8. **Contributes in the changes of the cloud microphysical properties(albedo, lifetime , optical depth) as well as the hydrological cycle.**

MANAGING AIR POLLUTION

1. Two approaches for this:- **Effluent Control and Preventive Techniques**
2. Desulphurisation of coal, exhaust gases passed through a slurry of CaCO₃ or MgOH and removed (filters

3. Formation of nitrogen oxides are prevented by passing steam over sulphur free coal
4. Exhaust gases can be prevented by using catalytic converters (CO₂ is converted to CO)
5. Installation of electrostatic precipitator in the chimney and by using industrial filters
6. Use of renewable alternative sources (non polluted)

WATER POLLUTION

Freshwater in world	3%
Saline water	97%
Fresh surface water (liquid)	2%
other (groundwater and ice caps and glaciers)	0.9%

1. Water pollution is caused by organic and non organic industrial wastes

and affluents discharged into the river

2. It can be defined as the alteration in the physical, chemical or biological characteristics of water through natural or human activities and making it unsuitable for its designated use. It degrades its quality
3. The used water becomes contaminated and hence called waste water
4. Organic and inorganic nutrients causes eutrophication (excessive nutrients) that adds to the waste in the water bodies
5. Eutrophication: An increase in chemical nutrients typically compounds containing nitrogen or phosphorous in aquatic ecosystem.
6. An excess of oxygen depleting chemical in the water can lead to hypoxia and create a dead zone.
7. It can result in an increase in the ecosystems primary

productivity (Excessive plant growth and decay) and further effect include lack of oxygen and severe reactions in the water quality and fish and other animal population. More the nutrients more the biological activities

Parameter	Oligotrophic	Mesotrophic	Eutrophic
Nutrient Levels	Very low	Moderate	High
Water Clarity	Very clear	Somewhat clear	Murky/green
Biological Activity	Low	Moderate	High
Oxygen Levels	High throughout	Moderate	Low in deeper areas
Examples	Mountain lakes	Temperate lakes	Urban/agricultural lakes

- 8.
9. Radioactive pollutants enter into the food chain and cause genetic and both defects and can also cause cancer
10. Increase in temp lowers the solubility of oxygen in water reduction of biotic life in waterbodies.
11. It changes the physical water properties and makes it acid, alkaline or saline due to present od dissolved or suspended chemical substances
12. One of the disease: **ITAI-ITAI** by cadmium and **Minimata** by Mercury

toxicity.

13. Major threat is caused by mercury, cadmium, nitrate, fluoride (in excessive qty) and arsenic, lead pesticide, chromium and cobalt

NonPoint source water pollution	Point source Water pollution
<p>It is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away the natural and human made pollutants finally depositing them into lakes, rivers groundwater etc</p>	<p>It is a single, identifiable source of pollution such as a pipe or drain. Industrial wastes are commonly discharged to rivers and the sea in this way.</p>

Blackwater

Grey/Gray waste water

Waste water

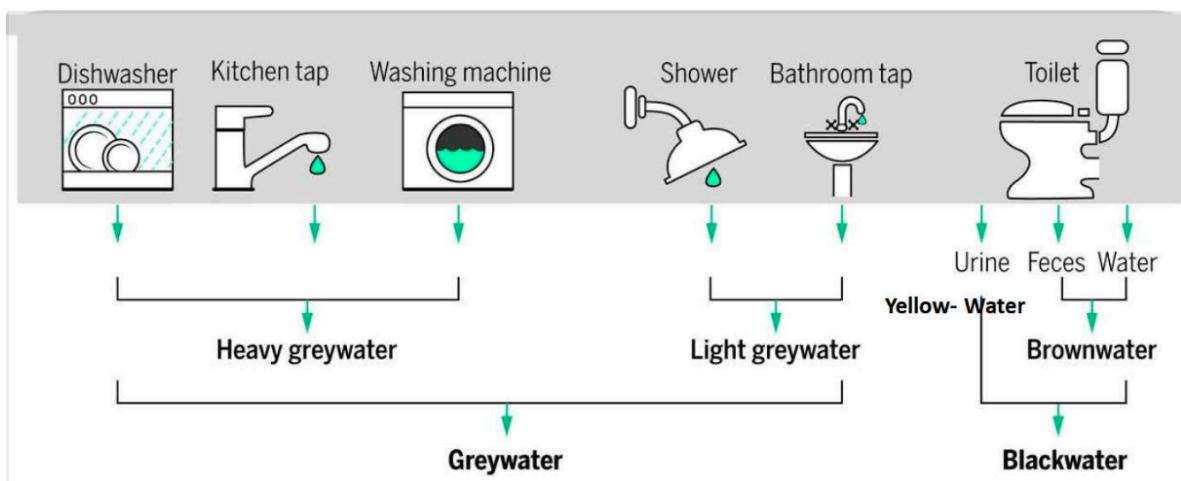
It is any waste from toilets or urinals

It is wastewater that has been used for washing, laundering bathing or showering

It includes both black and grey water

It doesn't decompose fast for use in domestic irrigation without risk of contamination

It contains some bacteria but can be filtered and reused in gardens or lawns. It can be broken down and safely reabsorbed into an active garden or lawn



Effects of water pollution

1. Diseases like cholera
2. Malaria
3. Typhoid(spreads during rainy season)
4. Aquatic life gets destroyed
5. Millions of people in developing countries die because of waterborne diseases

How to avoid water pollution

1. Rainwater should be harvested for meeting requirements
2. Dams and embankments should be created
3. Dead bodies should not be thrown in rivers

Water quality standards

1. **Desirable limits:** - It is the limit beyond which water is not acceptable for consumption but still may be tolerated in the absence of an alternative source
2. **Permissible limit:**- Such tolerance may be unto the permissible limit beyond which water is to be straightforwardly rejected.

3. The **desirable limit** is the **ideal target**, while the **permissible limit** is the **maximum acceptable boundary** that should not be crossed to ensure safety.

SOIL AND LAND POLLUTION

1. Top fertile soil is 6 inches deep only and it takes about 15 yrs to build 1 cm of soil

Alluvial soil	deposited by water	Transported by river and usually deposited along the rivers pathway either flood plain or river bed
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Aeolian soil	deposited by wind	Typically developed from sandy parent material through winds action they are transported by winds and deposited along its way ex sand dunes
Eluvial		Weathered material formed still at or near its point of formation

Colluvial soil	Deposited down due to gravitation force	Weathered material transported by gravity actions such as steep slopes
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2. **Exposure of soil containing high concentration of benzene increases the risk of leukemia**
3. Soil pollution is often accompanied by a decrease in availability of nutrients threats to micro diversity
4. Human activities, especially through **Land Use and Land Cover (LULC) changes**, significantly contribute to soil erosion by altering natural landscapes and making the soil more vulnerable.
5. **Leaching: contamination of soil due to landfills**
6. **Soil pollution affect lithosphere, atmosphere, hydrosphere and**

biosphere.

7. Soil pollutants can bio-accumulate and biomagnify at higher levels of food chain through run off and mixing with water and enter food chain

Bio accumulation	Bio magnification
Refers to the entry of a pollutant from the environment to the first organism in the food chain	It is the phenomenon of increase in the concentration of a pollutant from one link in food chain to another

Bioaccumulation refers to the gradual build-up of **toxic substances** in an organism's body over time, primarily through its diet, water, or environment. It occurs when the intake of a substance exceeds the organism's ability to eliminate it.

Biomagnification refers to the **increase in concentration** of toxic substances as they move up the food chain, from producers (e.g., plants or algae) to consumers (e.g., herbivores, carnivores, and apex predators).

Marine Pollution

1. Oceans are the final sink of all natural and manmade pollutants. Rivers discharge their pollutants into the sea. Garbage and sewage of costal cities are also dumped into the sea
2. Pollution of sea, estuaries, salt mashes etc is called Marine pollution

3. Over the globe 200 million gallons of petrol enter the sea each year as a result of extractions, transportation and consumption of oil and its products
4. In an oil spill the low- boiling aromatic hydrocarbons cause the immediate death of aquatic organisms(Poly acrylic Hydrocarbons) PAHs the components in the crude oil are very difficult to clean up and last for years in the sediment and marine environment
5. Floating oil can coat the feathers of marine birds and some mammals such as seals
6. Inland mining for copper gold is another source of marine pollution(due to mining waste like chemicals). Most of the pollution is simply soil which ends up in the rivers flowing to the sea

7. Minerals like **copper** can cause problems because it can **interfere with the life history and development of coral polyps**
8. In many instances vessels illegally discharge illegal wastes despite foreign and domestic regulations prohibiting such actions. Ships also create noise pollution that disturbs aquatic life
9. **Ballast water:** taken up at one port and released in other port(region) is a major source of unwanted exotic and invasive marine life. Ex **the invasive freshwater zebra mussels native to the black Caspian** and above seas were probably transported to the **Great Lakes in us** via ballast water from transoceanic vessels
10. Ocean mining are usually around large areas of "**poly metallic nodules**" or active and extinct "**hydrothermal vents**"

Hydrothermal vents

They are like geysers or hot springs on the ocean floor.

These vents create sulphide deposits which contains precious metals such as **silver gold copper magnates cobalt and zinc**

These minerals are mined using hydraulic pumps or bucket systems that take the ore to the surface to be processed which results in disturbances to benthic layer and increases the toxicity of water column and increases water temperature during mixing and also effect upwelling(nutrient cycle) and downwelling(oxygen exchange) phenomena

Near bottom plumes (cloud of suspended particles) occur when the tailings (waste materials) are pumped back down to the mining site

The floating particles also increase the turbidity or cloudiness of the water clogging the filter feeding apparatuses used by benthic organisms who feed mostly on organic matter

A report from [NOAA](#) scientists published in the journal Science in May 2008 found that large amount of relatively acidified water are **upwelling** (*an oceanographic phenomenon that involves wind-driven motion of dense, cooler, and usually nutrient-rich water towards the ocean surface, replacing the warmer, usually nutrient-depleted surface water.*) to within four miles of the [Pacific continental shelf area of North America](#)

11. Surface plumes can cause more serious problems depending upon the size of the particles ad water currents the plumes could spread over vast areas. These plumes could impact zooplankton and light penetration in turn affecting the food web of that area

CO₂ ACIDIFYING THE OCEANS

1. Climate change is raising the ocean temperatures and raising the levels of carbon dioxide oxide in the atmosphere. These high levels of CO₂ are acidifying the oceans

2. This, in turn alters the aquatic ecosystems and modifying the fish distributions which impacts the sustainability of the fisheries and the livelihood of the communities that depend on them
3. The oceans are normally a carbon sink absorbing co2 from the atmosphere and hence the acidity of the oceans is increasing.
4. Ocean acidification reduces carbonate ions needed by organisms like corals and shellfish to form calcium carbonate shells and skeletons, making them more vulnerable to dissolution and weakening their ability to grow.
5. Rising ocean temperatures and ocean acidification means that the capacity of the ocean sink will gradually get weaker
6. Continental shelf : this area is the critical one where most local marine life lives or is born
7. Aside from toxin affects when injected

some of these PCBs, DDT PAHs are mistaken by animal brain for **estradiol**, causing hormone disruption in the affected animals

8. Heavy metals are the metallic chemical that have relatively high density and are toxic at low or poisonous at low concentrations. **Mercury lead nickel arsenic cadmium** can accumulate in tissues of aquatic life in a process called **bioaccumulation**. They are also known to accumulate into benthic environments such as estuaries and bay muds.

9. Most effective way of cleaning up oil spills is suing oil eating bacteria

THERMAL POLLUTION

1. Caused by rise in the temperature of water. Main source thermal and nuclear power plants, power generating plants use water as coolant and release hot water to natural

source such sudden increase in temp kills the aquatic life

2. Natural causes: forest fires and volcanic eruptions
3. If the temp in oceans is increased by 1 degree then it becomes lethal to sensitive organisms because hot water decreases the concentration of oxygen In water.

NOISE POLLUTION

1. Sound waves are mechanical longitudinal waves. Propagation of vibrations is parallel to the energy wave directions, Speed of sound is lowest in gas
2. Doubling sound level means sound will increase by $10 \times \log 2 = 3 \text{db}$ and 10 times the sound lvl = $10 * \log_{10} \text{db}$

Infrasonic	Low frequency for humans to hear
Audible	Audible to hear

Ultrasound

Too high fry for humans to hear

3. Noise pollution can damage physiological and psychological health
4. High BP , stress related illness, sleep distrptions , hearing loss, productivity loss are all problems related to noise pollution. It can also cause memory loss, severe depression and panic attacks.
5. It is neglected because of invisible affects, indirect effects and inefficient awareness. And we also can't see, smell or taste it.
6. Sound that is unwanted or disrupts the quality of life is noise and when there's lot of noise in the environment it is termed as noise pollution.
7. According to WHO "noise must be recognised as a major threat to human wellbeing"
8. Excessive noise causes adrenalin to be released in the body resulting in

faster heartbeat, high BP and tense muscles, cardiovascular problems, birth defects abortion

9. Sound intensity is measured using sound pressure on decibel scale. Decibel measures the loudness of a sound or the strength of a signal.

10. Wisper- lowest decibel lvl of human speech

11. Sound is described in terms of loudness(amplitude) and pitch(frequency). High pitch sound seems louder than a low pitch sound at the same pressure.

12. Marine life can be affected by noise pollution bypassing ships oil exploration oil seismic surveys and naval low frequency active sonar. Sound travels more rapidly and over large areas in seas

13. Marine animals such as **cetaceans(a whale , dolphin or porpoise)** often have weak eyesight and live in a world defined by acoustic information. They use to sense their

surroundings through echolocations

14. Whale songs are longer when submarine detectors are on and if creatures don't speak loud enough then their voice can be masked by anthropogenic sounds
15. When one species begins to speak louder it all mask other species voice which will eventually cause the whole ecosystem to eventually speak louder. The unheralded voices might be of warnings, finding prey or preparations of nest building
16. Zoning is one of the ways to control noise pollution: increasing the distance between industrial areas like bus stands and railway stations away from silence zones near residential areas, educational institutes and hospitals.
17. Planting of trees also help reduce noise pollution
18. Regular servicing and tuning of automobiles can effectively reduce the noise pollution

19. Buildings can be designed with suitable noise absorbing materials for walls windows and ceiling

RADIOACTIVE POLLUTION

It is the emission of high energy particles or radioactive substances into air , water, or land due to human activities in the form of radioactive waste

1. Radioactivity:- it is the spontaneous decay of certain atomic nuclei accompanied by emission of alpha particles(helium nucleus), beta particles(electrons or positrons) or gamma rays.
2. Bequerel(Bq) quantity of the element that produces one disintegration per second
3. Natural sources: rocks with radioactive nuclides.

particles	Penetrating power	Stopped by	
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Alpha(2 He 4)	Lowest	Paper	Neutron —> proton and electron
Beta(electron or positron)	Moderat e	Aluminiu m	

gamma	highest	Thick lead or steel	Uncharged. They are EM waves with high frequency. Excess energy released by an atom during decay to become stable
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4. **Tailing:** waste materials generated from mining are known as tailing.
5. Radioactive substances can alter the structure of DNA or other biomolecules causing cancer and genetic defects
6. Uranium mining as a fuel for nuclear power plants. It is mined by **in-situ leaching** or by **conventional**

underground or open pit mining of ores.

7. **In-Situ leaching:** a leaching solution is pumped down the drill hole into the uranium ore deposit where it dissolves the ore minerals and then the uranium rich fluid is then pumped back to the surface .
8. Uranium can be extracted from sea water. Present in sea water in low concentrations but **halted due to low recovery efficiency.**
9. India has uranium reserves in Rajasthan, Jharkhand, Chattyishgarh, Meghalaya , Teangana, Ahndhrapradesh and Karnataka
10. **Jaguada Mines**, a uranium mine in jaguar village in Purbi Singhbum dstrict of Jharkhand produces unto 25% of the raw materials needed to fuel inidias nuclear reactors
11. **Largest uranium mine in India and world:** Tummalapalle in Tumalapalli village n Kadapa , Andhra Pradesh .

Research says that this mine has one of the largest reserves of uranium in the world

12. India is the largest producer of radioactive Thorium in the World
13. Thorium cannot in itself power a reactor unlike natural uranium it doesn't contain enough fissile material to initiate a nuclear chain reaction as a result it must be bombarded with neutrons to produce highly radioactive isotope uranium so these are really "U-233 reactors"
14. The beach sand on the west coast of India particularly kerela contains one of the rich deposits of uranium in the world+ ahndra Pradesh

Continuous Pollution	Exist in uranium mines where humans are under continuous exposure to radioactive contaminants
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Accidental Pollution	During accidental exposure to radiations by the virtue of equipment failure or radiation leak
Occasional Pollution	This condn exists during isolated experiment or test of nuclear substance.

15. Effects depends upon lvl of exposure and duration of exposure: low lvl of localized exposure may have only superficial affects such as mild skin irritation while the long term exposure or exposure to high radiation can cause irreparable damage to DNA molecules and can lead to life threatening. Condition

16. The rapidly growing or dividing cells such as of bone marrow or skin cells are more prone to radioactive emissions. Otherwise the cells that

don't undergo cell division such as bone cells nervous cells aren't damaged so easily. Skin cancer lung cancer and thyroid cancer are some of the common types of cancer caused by radiation

17. **99 radioactive accidents have honed out of which 56 in US.**

Fukushima , japan	Due to earthquake a tsunami hit the coast of Japan which hit the power plant and experienced meltdown
Chernobyl ukraine	A series of events led to the explosion of the reactor number four

Three Mile island	One of the elements of the power plant system malfunctioned
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- 18. **Fallout** : Radioactive pollution that is spread throughout the atmosphere
- 19. 25 rems does nth 100 rems also does nth above 100 rems causes radiation sickness

SOLID WASTE MANAGEMENT

- 1. **Municipal Solid Waste(MSW)** is the term used to describe most of the **non hazardous solid waste disposed** in a city or town or village . Sources includes, homes commercial establishments , institutions, hospitals. It doesn't include industrial affluents, agricultural run off debris from construction and demolition acitivities sewage and mining waste.
- 2. **Waste minimization:** using techniques of evaporation and precipitation the amount of hazardous waste can be

reduced considerably, segregation of waste hazardous from non hazardous makes it easier to handle and treat

3. Strategy for waste minimization include: **Avoid- minimize-reduce-reuse-replace-recycle-treat-decompose**
4. **Manure- vermi-composting:** useful to separate vegetable and perishable waste and convert it into manure. The final products is obtained to form soil which is rich in nutrients and can replace chemical fertilizers.
5. Waste Is considered hazardous if it contains: **instability, corrosiveness, reactivity, radioactivity and toxicity**

DISPOSAL OF WASTE

1. **Landfill:** the areas must be properly lined with non porous substance such as clay or HDPE to prevent leaking into surrounding areas and pollution underground water
2. **Ariel Sharon Park , Israel:** it was formerly a waste dump site that was

converted to a beautiful garden

an environmental park along the lines of Ayalon river, in the area between Ben Gurion Airport and Highway.

area is 8.5 square km big, and was intended to be the "green lung".

established on the former **Hiriya** (waste dump site at Tel Aviv, Israel)

After accumulating 25 million tons of waste, the Hiriya facility was shutdown in August 1998. Disturb air traffic and pose threats to life.

Hiriya is visible on approach into Ben Gurion International Airport as a flat-topped hill.

Three recycling facilities have been established at the foot of the mountain:

- a waste separation center,
- a green waste facility that produces mulch and
- a building materials recycling plant.

The waste dump and its surrounding area have been renovated into a large park that is still under construction.

3. Landfill gas is a principal component of emissions to air from landfills it is an end product of the anaerobic process of degradation of biodegradable waste once the waste has been deposited to landfill. Methane is released from landfill sites. **New landfill systems have clay or synthetic liners and leachate: a liquid from a landfill contaminants) collection system to protect groundwater**

4. Landfills are partially responsible for climate change because it produces

methane gas which burns easily

Incineration: In this process the waste is burnt, which detoxifies it.

The flue gases are released to the atmosphere, and the slag or ash produced is deposited in a landfill. The wastes having inflammable material are incinerated.

Flue gas is the gas exiting to the atmosphere via a **flue**, which is a pipe or channel for conveying exhaust **gases** from a fireplace, oven, furnace, boiler or steam generator.

Quite often, the **flue gas** refers to the combustion exhaust **gas** produced at power plants.

5. Incineration converts the solid into ash, flue gas and heat. The ash is mostly due to inorganic components and gases due to organic waste. The heat generated by incineration is used to generate electric power. Such as steam used to rotate turbines

Dumping at sea: Hazardous waste has to be put in sealed containers before dumping into deep seas.

Disposal of waste into sea is governed by international and national legislation.

The direct dumping into sea is prohibited, particularly waste containing organo-silicon compounds, halogenated organics, mercury, cadmium, carcinogenic waste and plastics.

6. A **waste to energy plant / trash to energy plant/ energy recover/ municipal waste incineration or resource recovery** is a waste management facility that combusts waste to produce electricity

7. Sweden is a leader un waste-to-energy production over past 20 yrs

PROJECT HIGHLIGHTS

- The largest integrated waste to power project in India
- The 1st of its kind with a 16 MW power project
- State-of- the-art technology and environment friendly
- Real, measurable and long term benefits in terms of climate change and mitigation
- Generate renewable power and reduce the need for landfills
- Lowers the risk of groundwater contamination.
- Reduces dependence on fossil fuels, a major contributor to greenhouse gas emissions.
- Maximizes the recycling and re-use of resources (water, metals, ashes)

The **24 megawatt (MW) Narela-Bawana waste-to-energy plant** of the North Delhi Municipal Corporation was inaugurated by Union Urban Development Minister M. Venkaiah Naidu at the Civic Centre.

Another **Waste-to-energy plant** is coming up at **Ghazipur** to produce **12 MW** power by processing **2,000 tonnes waste per day**,

Several research has been carried out in the FSTP for effective and sustainable management of fecal sludge.

1. The London Educational institution of Hygiene and Tropical Medicine

- Introduced the **larvae of black soldier fly** (BSFL).- a non-disease spreading, non-nuisance fly species (*Hermetiaillucens*).
- to feed on pit latrine waste.
- As the larvae develop on the faecal material, they increase in size, reducing the mass of the waste, and converting the dangerous pit material into a potentially useful soil conditioner or **fertiliser**.
- Once the larvae have developed into pre-pupae, they can be harvested. These pre-pupae are high in fat and protein and have an economic value as a suitable replacement for conventional protein sources in **animal feeds**.

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232

GenRobotics, a Kerala research team:

- A tech start-up has launched an Iron-Man style semi-automatic robot named '**Bandicoot**'.
- The first of its kind exoskeleton robot in the country to clean manholes without the need for human beings having to enter the pits (manual scavenging eradication).

Their invention made waves in the state due to its huge potential social impact **against manual scavenging – a practice banned in India** nearly two decades ago, yet actively practiced in almost every state.

Thanks to the Bandicoot, sanitary workers to stop endangering their lives on a daily basis. They no longer have to enter clogged manholes filled with hazardous gases.



INDIA IS ONE OF THE MOST WORLD MOST DISPOSED AREA

As per Rule 4 of the Municipal Solid Wastes (Management and Handling) Rules, 2000,

- "every municipal authority is responsible for infrastructure for segregation and processing of municipal solid waste (MSW), commonly known as garbage"

What can we do? Preventive measures

- Industrial and municipal treatment plants should be used.
 - The sludge left should be converted into bio-fertilizers.
 - Industrial effluents should be treated at the factory site only and the effluents that are free from pollutants should be discharged into water bodies.
 - If water is used in any industrial operation, it should be treated and should be reused in the same industry after removal of pollutants.
 - Any gaseous effluents should be passed through electrostatic precipitators (to remove suspended particulate matters) and scrubbers (to remove oxides of carbon, nitrogen and sulphur).
-
- In any chemical process, all starting material should be incorporated into the final product.
 - Chemical fertilizers should be used in bare minimum amount.
 - Any nuclear waste should be disposed following the standard procedures.

Humans are responsible for increasing atmospheric concentration of CO₂ by about 30%.

We use more than half of the accessible freshwater resources.

Over 50% of terrestrial nitrogen fixation is due to human activities.

Top ten plants for removing formaldehyde, benzene, and carbon monoxide from the indoor air:

- Areca Palm (*Chrysalidocarpus lutescens*)
- Lady Palm (*Rhapis excelsa*)
- Bamboo palm (*Chamaedorea seifrizii*) .
- Rubber Plant (*Ficus robusta*)
- Dracaena "Janet Craig" (*Dracaena deremensis*)
- Philodendron (*Philodendron* sp.)