

Introduction to Pollution and Waste Management

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Designed as a quick-reference guide for students, educators, and anyone new to the subject.

1. What Is Pollution?

Definition	The introduction of harmful substances or energy into the environment that adversely affects living organisms and natural resources.
Key Characteristics	• Origin – natural (volcanic eruptions, wildfires) or anthropogenic (industry, transport). • Medium – air, water, soil, or noise. • Impact – health risks, ecosystem damage, economic loss.
Major Types	1. Air Pollution – gases, particulates, odors. 2. Water Pollution – chemicals, nutrients, pathogens. 3. Soil (Land) Pollution – heavy metals, pesticides, litter. 4. Noise & Light Pollution – unwanted sound/illumination. • Fossil fuel combustion (vehicles, power plants)
Common Sources	• Agricultural runoff (fertilizers, pesticides) • Industrial processes (manufacturing, mining) • Household waste (plastics, chemicals)

2. What Is Waste?

Definition	Materials or substances discarded because they are no longer useful, wanted, or safe for the original purpose.
Categories	1. Municipal Solid Waste (MSW) – household and commercial trash. 2. Industrial Waste – by-products of manufacturing. 3. Hazardous Waste – toxic, flammable, corrosive, or radioactive material. 4. Construction & Demolition (C&D) Waste – concrete, wood, metal. 5. Organic Waste – food scraps, yard trimmings.
Generation Drivers	• Population growth • Urbanization • Consumer culture • Technological advancement (e-waste)

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3. Why Pollution & Waste Management

Environmental Impact	Climate change acceleration, biodiversity loss, eutrophication, acid rain, ozone depletion.
Human Health	Respiratory diseases, waterborne illnesses, cancers, neurological disorders.
Economic Costs	Healthcare expenses, loss of productivity, cleanup & remediation budgets, reduced tourism.
Social Equity	Marginalized communities often bear disproportionate exposure (environmental justice).

4. Principles of Waste Management

Hierarchy (most to least preferred)

1. **Prevention** – Reduce waste generation at the source.
2. **Minimization** – Design products for less material use and longer life.
3. **Reuse** – Extend product life without processing (e.g., refillable containers).
4. **Recycling & Composting** – Convert waste into new materials or soil amendments.
5. **Energy Recovery** – Incineration with energy capture, anaerobic digestion.
6. **Disposal** – Landfill or deepwell injection (last resort).

4.1 Key Strategies

Strategy	What It Involves	Typical Applications
Source Separation	Sorting waste at the point of generation (e.g., separate bins for organics, recyclables).	Residential complexes, schools, hospitals.
Extended Producer Responsibility (EPR)	Manufacturers bear end	