Aquatic and Terrestrial Pollution

AP Environmental Science

Sources of Pollution

Pollution sources are **point** or **nonpoint**. A **point source** comes from a single, identifiable place (a factory pipe, a sewage outfall) – easy to locate and regulate. A **nonpoint source** is spread out (farm runoff, urban street runoff, car exhaust) – much harder to control because it comes from everywhere.

Human Impacts on Ecosystems

Human activities – pollution, habitat destruction, overharvesting, introducing species – degrade ecosystems and reduce biodiversity. Because species are interconnected, harming one part can ripple through the whole system.

Endocrine Disruptors

Endocrine disruptors are chemicals (some pesticides, plasticizers like BPA) that mimic or block hormones, disrupting growth, reproduction, and development in wildlife and humans even at very low doses.

Human Impacts on Wetlands and Mangroves

Wetlands and **mangroves** filter pollutants, store floodwater, and nurse young fish, but they are drained and cleared for farms, shrimp ponds, and development. Losing them removes valuable ecosystem services and coastal protection.

Mangrove roots: this tangle traps sediment, calms waves, and shelters young fish, all services lost when mangroves are cleared

Eutrophication

Eutrophication happens when excess nutrients (nitrogen, phosphorus from fertilizer and sewage) trigger **algal blooms**. When the algae die, decomposers use up the oxygen, creating **hypoxic** "dead zones" that suffocate fish.

A pond choked by an algal bloom: extra nutrients let algae cover the whole surface. When they die and rot, the water loses its oxygen

Extra fertiliser makes algae bloom, then the water loses its oxygen

Thermal Pollution

Thermal pollution is heat added to water, usually from power-plant cooling. Warm water holds **less dissolved oxygen** and stresses aquatic life adapted to cooler temperatures.

Persistent Organic Pollutants (POPs)

Persistent organic pollutants (POPs, like DDT and PCBs) resist breakdown, so they last for decades, travel far, and are **fat-soluble**, so they build up in organisms. This sets up bioaccumulation and biomagnification.

Bioaccumulation and Biomagnification

Bioaccumulation is the build-up of a toxin **within one organism** over its life. **Biomagnification** is the increase in concentration **up the food chain** – top predators end up with the highest levels, which is why large predatory fish carry the most mercury.

> **Worked example.** Suppose lake water holds DDT at just 0.01 ppm. Plankton concentrate it to 0.5 ppm, small fish to 2 ppm, large fish to 10 ppm, and a fish-eating eagle to 25 ppm. From water to eagle the concentration has multiplied about $\frac{25}{0.01} = 2500$-fold – which is why a top predator can be poisoned even when the water itself looks only lightly polluted.

Solid Waste Disposal

Solid waste is any discarded material that is not a liquid or gas, generated by homes, industry, business, and agriculture. It is buried in **sanitary landfills** (lined to limit leachate) or burned in **incinerators** (reduces volume but emits pollutants). Landfills take space and can leak; both have environmental costs, so reducing waste is preferred.

Two categories the exam names specifically: **e-waste** (discarded electronics - phones, computers, televisions - which contain toxic metals), and ocean dumping, where plastic and other waste collect into vast floating **garbage patches** far out at sea.

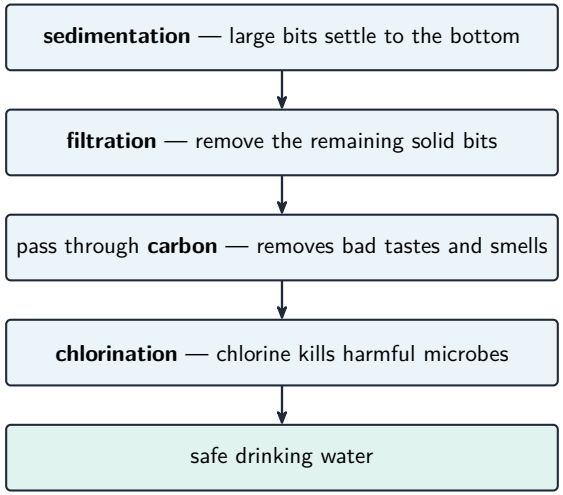
A landfill: solid waste is buried here in lined cells. It takes up land and can leak, which is why reducing waste comes first

Waste Reduction Methods

The waste hierarchy is **reduce, reuse, recycle** 、 、 , plus **composting** for organic waste. Reducing consumption is best (no waste to manage); recycling and composting recover materials and cut landfill use.

Sewage Treatment

Sewage treatment cleans wastewater in stages: **primary** (settling out solids), **secondary** (bacteria break down organic matter), and sometimes **tertiary** (removing nutrients and disinfecting). This protects waterways from pathogens and nutrient pollution.



Treating water to make it safe: sedimentation, filtration, then disinfection

Lethal Dose 50% (LD50)

The **LD50** is the dose of a substance that kills **50%** of a test population. A **lower** LD50 means a **more toxic** substance (less is needed to be deadly). It is a standard way to compare toxicity.

> **Worked example.** Chemical A has an LD50 of 5 mg per kg of body weight; chemical B, 500 mg/kg. Because A's value is 100 times smaller, A is about 100× **more toxic**. For a 70 kg adult, the dose of A expected to be lethal to half of people is 5 mg/kg × 70 kg = 350 mg – a tiny amount, whereas B would take $500 \times 70 = 35{,}000$ mg (35 g).

Dose Response Curve

A **dose–response curve** plots the effect against the dose. Generally, a higher dose causes a greater effect. Some chemicals have a **threshold** (no effect below it); for others any exposure carries risk. These curves guide safety limits.

Pollution and Human Health

Pollution harms health directly (respiratory disease from air pollution, poisoning from contaminated water) and indirectly. **Dose, duration, and individual sensitivity** all affect the outcome. The poor are often most exposed and least protected.

Pathogens and Infectious Diseases

Pathogens (bacteria, viruses, parasites) spread through contaminated water and food. The exam names specific diseases and expects you to know **how each one is transmitted**, because the transmission route decides the defence:

Disease	Type	How it spreads
Cholera	bacterial	drinking water contaminated with sewage
Dysentery	bacterial	untreated sewage in streams and rivers
Plague	bacterial	bite of an infected organism (e.g. fleas) or contact with infected fluids
Tuberculosis (TB)	bacterial	breathing in bacteria from an infected person's bodily fluids
Malaria	parasitic	bite of an infected **mosquito** (mostly sub-Saharan Africa)
West Nile / Zika /	viral	bite of an infected mosquito (Zika also via sexual contact)
SARS / MERS	viral	inhaling or touching infected fluids; MERS passes from animals to humans

Two big-picture ideas carry marks. **Poverty** deepens the problem - low-income areas often lack sanitary waste disposal and clean water, giving water-borne diseases a haven. And **climate change spreads disease**: as warm equatorial climate zones expand toward the poles, mosquitoes and other **vectors** - and the diseases they carry - move into temperate regions that never had them before. Clean water, sanitation, and vector control remain the main defences.

Exam tips

- Trace **eutrophication** step by step: nutrient runoff → algal bloom → decay → oxygen depletion → fish die.
- **Bioaccumulation** builds up in one organism; **biomagnification** increases up the food chain, so top predators are hit hardest.
- Read an **LD50**: a **lower** value means **more** toxic; multiply by body mass for a lethal dose.
- Order the waste hierarchy **reduce > reuse > recycle**, and the stages of sewage treatment.
- Link pathogens to contaminated water and to clean-water/sanitation defences.