

Introduction to Environmental Toxicology

Introduction to Environmental Toxicology

Key concepts, terminology, and foundational principles

1. What Is Environmental Toxicology?

Aspect	Description
Definition	The scientific study of the adverse effects of chemical, physical, or biological agents on living organisms and ecosystems.
Scope	• Human health (occupational, community, and consumer exposure) • Wildlife and plant health • Ecosystem functions (soil, water, air)
Goal	Identify hazardous substances, understand exposure pathways, assess risk, and develop strategies to prevent or mitigate damage.

2. Core Terminology

Term	Meaning
Toxin	A poisonous substance produced by a living organism (e.g., venom, mycotoxins).
Toxicant	A man-made or naturally occurring chemical that can cause toxicity (e.g., pesticides, heavy metals).
Dose/Exposure	Amount of a substance that reaches an organism (often expressed as mg/kg body weight).
Concentration	Amount of a substance per unit volume or mass (e.g., µg/L in water).
Bioaccumulation	Build-up of a chemical in an organism over time faster than it can be metabolized or excreted.
Biomagnification	Increase in contaminant concentration as it moves up the food chain.
LD ₅₀ / LC ₅₀	Lethal dose or concentration that kills 50% of a test population; a standard toxicity metric.
NOAEL / LOAEL	No-Observed-Adverse-Effect Level; Lowest-Observed-Adverse-Effect Level.

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Term	Meaning
Ecotoxicology	Sub?discipline focusing on effects of pollutants on ecosystems and non? human species.
Risk Assessment	Process that combines hazard identification, dose?response, exposure assessment, and risk characterization.

3. Routes of Exposure

Pathway	Typical Sources	Example Contaminants
Inhalation	Airborne gases, vapors, dust, aerosols	Volatile organic compounds (VOCs), asbestos fibers
Ingestion	Food, water, soil, contaminated hands	Pesticide residues, lead, mercury
Dermal Contact	Direct skin contact with liquids, solids, or gases	Industrial solvents, oil spills, sunscreen chemicals
Injection (rare in environment)	Bites, stings, contaminated needles	Venoms, pathogen?laden blood

4. Dose?Response Relationships

1. **Threshold Model** – No effect below a certain dose (common for many chemicals).
2. **Linear Non?Threshold Model** – Any dose carries some risk (used for carcinogens).
3. **Hormesis** – Low doses may stimulate a beneficial response, while higher doses are harmful.

Graphical tip: Plot **dose (x?axis)** vs. **response (y?axis)**; identify NOAEL, LOAEL, and LD?? points.

5. Key Toxicological Endpoints

Endpoint	What It Measures	Typical Tests
Acute Toxicity	Immediate effects (hours–days)	LD??, LC?? assays (rodents, fish)

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Endpoint

What It Measures

Typical Tests

Chronic Toxicity

Long-term effects
(months–years)

Cancer incidence, organ
pathology

**Reproductive/Developmental
Toxicity