

Principles of toxicology

Principles of Toxicology

- **Toxicology** is the study of harmful effects of chemical, physical, or biological agents on living organisms and the environment.

Key principles include:

1. Dose-Response Relationship

- Toxicity depends on the dose — "the dose makes the poison."
- A dose-response curve shows how increasing exposure affects toxicity.

2. Toxicity Threshold

- Every substance has a threshold level, below which no harmful effects are observed.
- Exposure above this level may lead to toxicity.

3. Time-Response Relationship

- The duration and frequency of exposure affect the type and severity of toxic effects.
- Acute vs. chronic exposure can result in different outcomes.

4. Mode of Action

- Describes how a toxicant causes harm (e.g., enzyme inhibition, DNA damage).
- Helps identify affected organs/systems and predict effects of related substances.

5. Individual Variations

- Susceptibility varies with genetics, age, sex, diet, and health status.
- These factors influence absorption, metabolism, and elimination.

6. Synergistic Effects

- Combined substances may have greater (synergistic), equal (additive), or lesser (antagonistic) effects than when taken alone.

7. Risk Assessment

- A systematic approach to evaluate potential health risks from exposure.
- Includes hazard identification, dose-response analysis, and exposure assessment.

Acute toxicity

Definition:

- Acute toxicity refers to the harmful effects that occur following a single exposure or multiple exposures to a substance over a short period, typically less than 24 hours.

- It is commonly assessed using the **lethal dose (LD₅₀)**, which represents the dose required to kill 50% of a test population (often lab animals) under controlled conditions.

Characteristics:

- **Rapid onset of symptoms:** Effects appear quickly—within minutes, hours, or up to one day after exposure.
- **High dose over a short time:** Symptoms arise due to a relatively large amount of the toxicant being absorbed in a brief period.
- **Short-term exposure:** Usually results from a one-time or brief encounter with a toxic substance.

Causes:

- Accidental ingestion of toxic substances (e.g., household cleaners, pesticides).
- Inhalation of harmful gases or vapors (e.g., carbon monoxide, chlorine gas).
- Intravenous overdose or misuse of medications or illicit drugs.
- Dermal exposure to corrosive or toxic chemicals.
- Industrial accidents involving chemical spills or releases.

Examples:

- Swallowing bleach or rat poison.
- Breathing in ammonia fumes or smoke from a fire.
- Injecting a high dose of morphine or other drugs.

Factors Influencing Acute Toxicity:

- **Route of exposure:** Ingestion, inhalation, dermal contact, intravenous injection, etc.
- **Dose:** Larger amounts over a short period typically result in more severe effects.
- **Individual susceptibility:** Age, genetics, pre-existing health conditions, and immune status can influence how a person responds.
- **Chemical properties:** The nature and potency of the substance also determine toxicity levels.

Subacute toxicity

Definition:

- Subacute toxicity refers to the adverse effects resulting from repeated or continuous exposure to a toxic substance over a period of a few days up to about 28 days.
- It represents the intermediate phase between a single high-dose exposure (acute) and prolonged long-term exposure (chronic).

Characteristics:

- Repeated low or moderate doses over a short period (days to weeks).
- Gradual buildup of toxicity in the body due to continuous exposure.
- Subtle or delayed symptoms, unlike the immediate effects seen in acute toxicity.

Causes:

- Daily exposure to environmental toxins, such as indoor air pollutants or food contaminants.
- Short-term occupational exposure to industrial chemicals without proper protection.
- Frequent dosing of medications that may have cumulative effects within a few weeks.

Study and Testing:

- Typically involves 14 to 28-day animal studies.
- Evaluates biochemical markers, organ weights, and histopathological changes.
- Common organs assessed: liver, kidneys, lungs, heart, and reproductive organs.

Chronic Toxicity

Definition:

- Chronic toxicity results from continuous or repeated exposure to a toxicant over a long period—usually more than 3 months and often extending to years.
- It is associated with cumulative damage and may involve irreversible health effects.

Characteristics:

- Prolonged exposure to low or moderate doses.
- Slow buildup of toxins in tissues (bioaccumulation).
- Delayed onset of symptoms, often surfacing months or years after initial exposure.
- Potential for irreversible damage to organs and systems.

Causes:

- Occupational exposure to industrial chemicals (e.g., lead, mercury, benzene).
- Lifestyle factors, such as smoking or alcohol abuse.
- Contaminated water or food sources, such as arsenic in groundwater.
- Environmental pollution or long-term use of certain drugs.

Examples:

- Lead poisoning from prolonged contact with battery components.
- Smoking causing lung cancer or chronic obstructive pulmonary disease (COPD).
- Chronic alcohol consumption leading to liver cirrhosis.



FREE PREVIEW

[Click here to visit our website](#)

PHARMACY PREMIUM NOTES

Complete subject
and semesters are
available on
FirstHope app only.



[Scan or click here](#)

Click here to get the app



Available on Google Play

JOIN THE FIRSTHOPE COMMUNITY

Join our Telegram channel

Click here to join Telegram



[Scan or click here](#)

@FirstHopeNotes

Instagram

@firsthope.official

[Click here to follow >](#)

YouTube channel

FirstHope-Pharmacy / Live streams

[Click here to watch >](#)

WhatsApp channel

Follow FirstHope on WhatsApp

[Click here to join >](#)

FirstHope website

firsthopenotes.com

[Click here to visit >](#)

B.Pharm / D.Pharm / M.Pharm / Pharm.D

Preview notes. Complete subjects and semesters in the FirstHope app.