

CHAPTER OVERVIEW

Section 3: Toxic Effects

Learning Objectives

After completing this lesson, you will be able to:

- Explain factors that influence the toxicity of a substance.
- Define types of systemic and organ-specific toxic effects.

In this section...

Topics include:

- 3.1: Types of Toxic Effects
- 3.2: Factors Affecting Toxicity
- 3.3: Systemic Toxic Effects
- 3.4: Organ Specific Toxic Effects

Did you know?

In December 1984, the world's worst industrial accident occurred in Bhopal, India. More than 40 tons of **methyl isocyanate** leaked from a pesticide plant, killing thousands of people and injuring hundreds of thousands. Follow-up studies have shown that the incident caused increased mortality and continued effects on health, including airway disease, eye diseases, and pregnancy losses.

The company involved in the leak tried to distance itself from the accident and prevent those affected from learning the true nature of the accident. The legal case went on for years. Eventually, families of the dead received an average of about \$2,200. While the company ceased operation at its Bhopal plant after the disaster, it did not clean up the site completely. The plant continues to leak several toxic chemicals and heavy metals into local aquifers.

 Survivors of the deadly industrial incident in Bhopal, India in 1984, protesting over the mishandling of the disaster

Figure 1. Survivors of the Bhopal disaster of 1984 protest over the mishandling of the disaster

Bhopal disaster protestors. [Photo]. In Encyclopædia Britannica. Retrieved from <http://www.britannica.com/event/Bhopal-disaster/images-videos/Survivors-of-the-1984-deadly-industrial-accident-in-Bhopal-India/192038>

What We've Covered

This section made the following main points:

- Toxicity can result from adverse cellular, biochemical, or macromolecular changes.
- Some chemicals affect only specific target organs; others can damage any cell or tissue they contact.
- Chemicals can affect organisms by multiple mechanisms and at the molecular level, leading to modern approaches such as Adverse Outcome Pathways (AOPs) and Mechanism of Actions (MOAs).
- Several factors influence toxicity, including form and innate chemical activity, dosage, exposure route, species, life stage, gender, absorption ability, metabolism, distribution, excretion, health and nutritional status, the presence of other chemicals, and circadian rhythms.
- Systemic toxic effects, which can occur at multiple sites, include:
 - Acute toxicity, which occurs almost immediately (seconds/minutes) after a single dose or series of doses within 24 hours.
 - Subchronic toxicity, which results from repeated exposure for several weeks or months.
 - Chronic toxicity, which damages specific organ systems over the course of many months or years.
 - Carcinogenicity, or abnormal cell growth and differentiation that can lead to cancer.
 - Developmental toxicity, which adversely affects the developing embryo or fetus.
 - Genetic toxicity, caused by damage to DNA and altered genetic expressions.
- Organ specific toxic effects include:

- Blood/cardiovascular toxicity, affecting the blood, bone marrow, or heart.
- Dermal toxicity, impacting the skin.
- Epigenetic alterations, changing genetic programming.
- Optical toxicity, adversely affecting the eyes.
- Hepatotoxicity, impacting the liver, bile duct, or gall bladder.
- Immunotoxicity, affecting the immune system.
- Nephrotoxicity, affecting the kidneys.
- Neurotoxicity, impacting the central nervous system.
- Reproductive toxicity, damaging the reproductive system.
- Respiratory toxicity, affecting the respiratory system.

Coming Up...

In the next section, we will look at effects that can occur when two or more chemicals interact.

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