BHARATHIDASAN UNIVERSITY

Tiruchirappalli- 620024,
Tamil Nadu, India

Programme

M.Sc., Environmental Science & Sustainable Management

Course Title:

Environmental Pollution & Toxicology(Core Choice)

Course Code: 25PGCC03

Unit-5

Molecular and Population Effects of Contaminants

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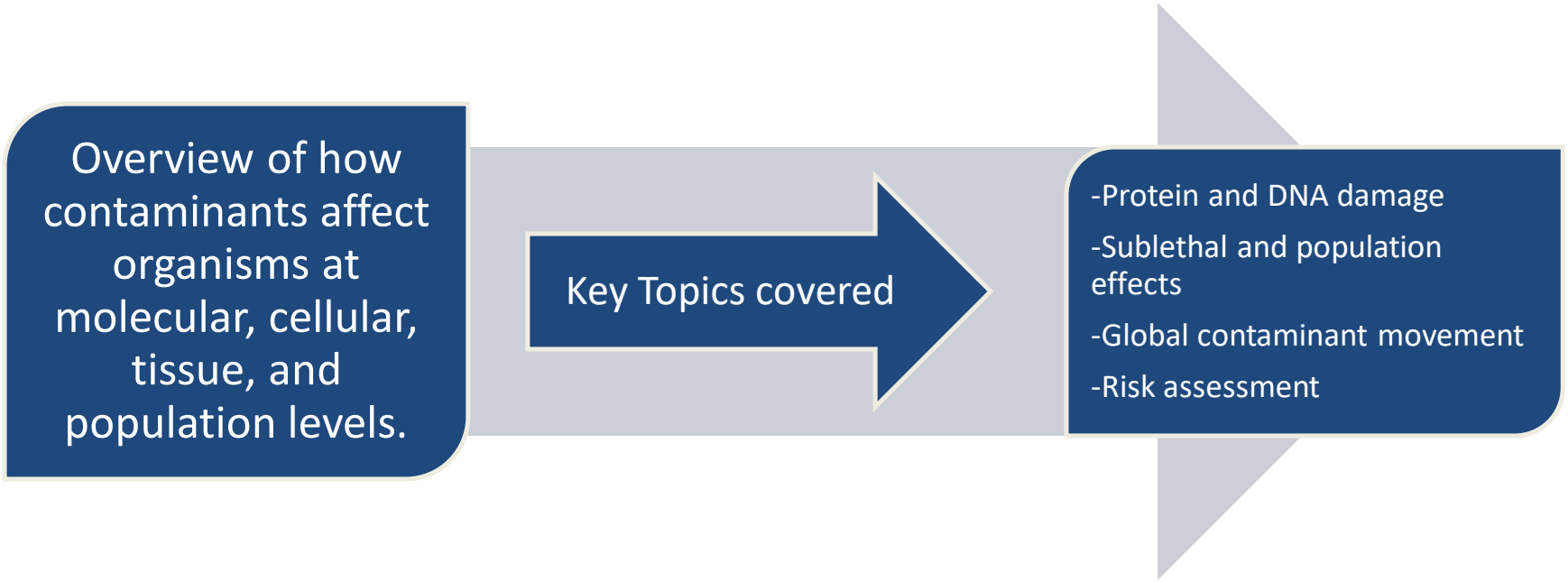
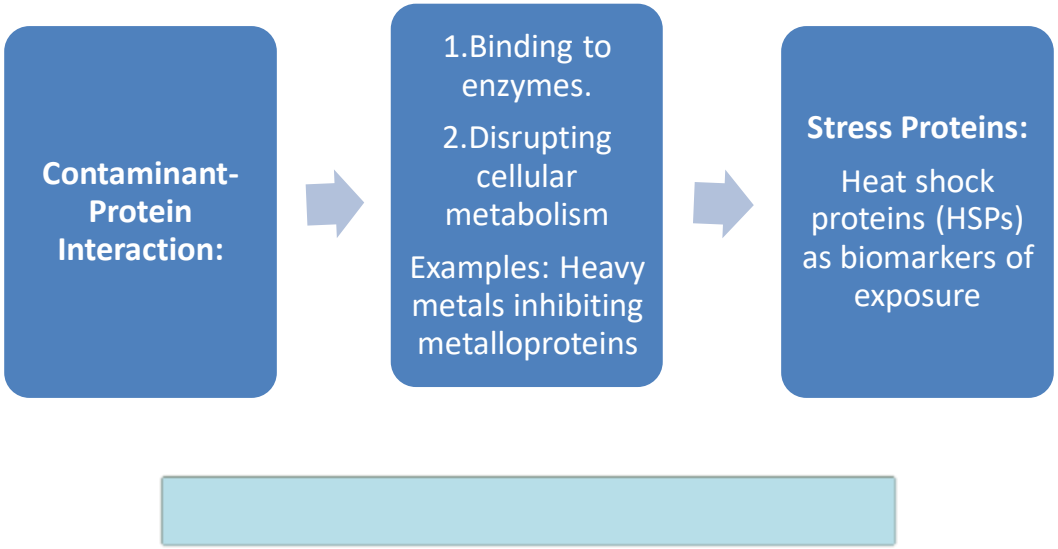
Introduction

MOLECULAR AND POPULATION EFFECTS OF CONTAMINANTS



MOLECULAR EFFECTS: PROTEIN RESPONSE



MOLECULAR EFFECTS: DNA DAMAGE AND DETOXIFICATION

MOLECULAR EFFECTS: DNA DAMAGE AND DETOXIFICATION

DNA Damage:

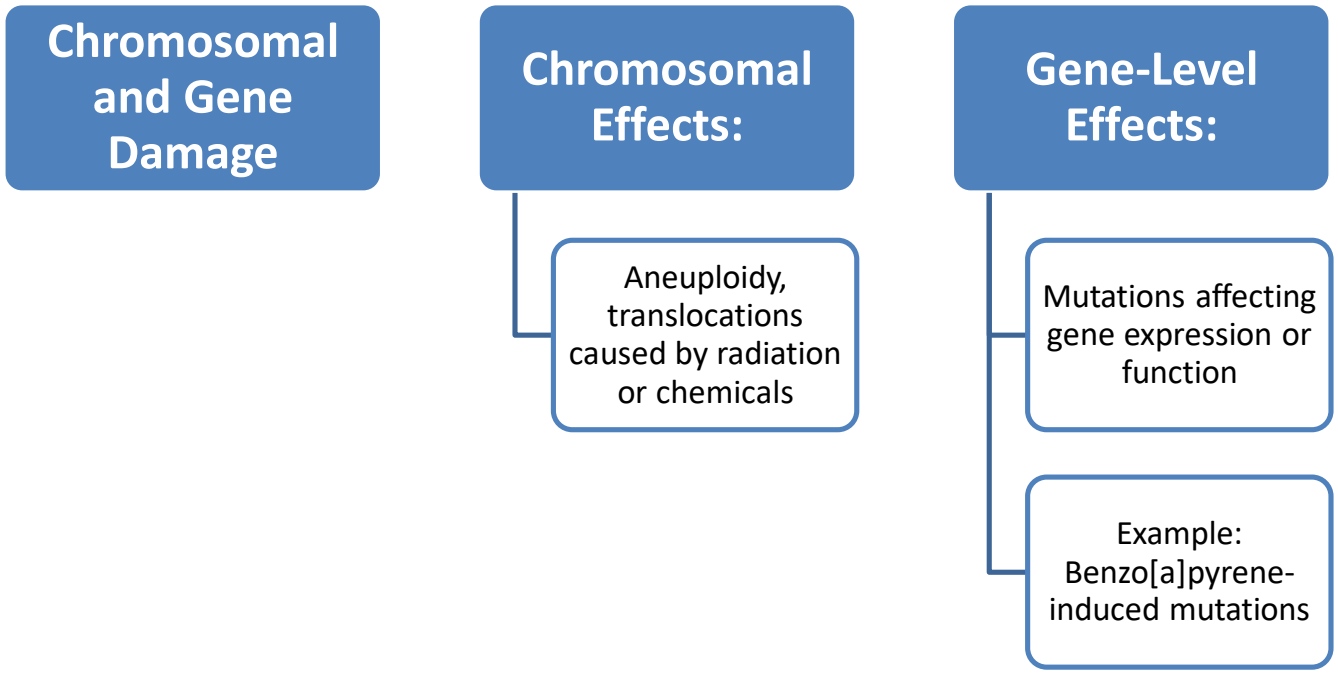
1. Mechanisms:
   - ✓ Oxidative stress
   - ✓ Adduct formation

Examples: UV radiation causing thymine dimers

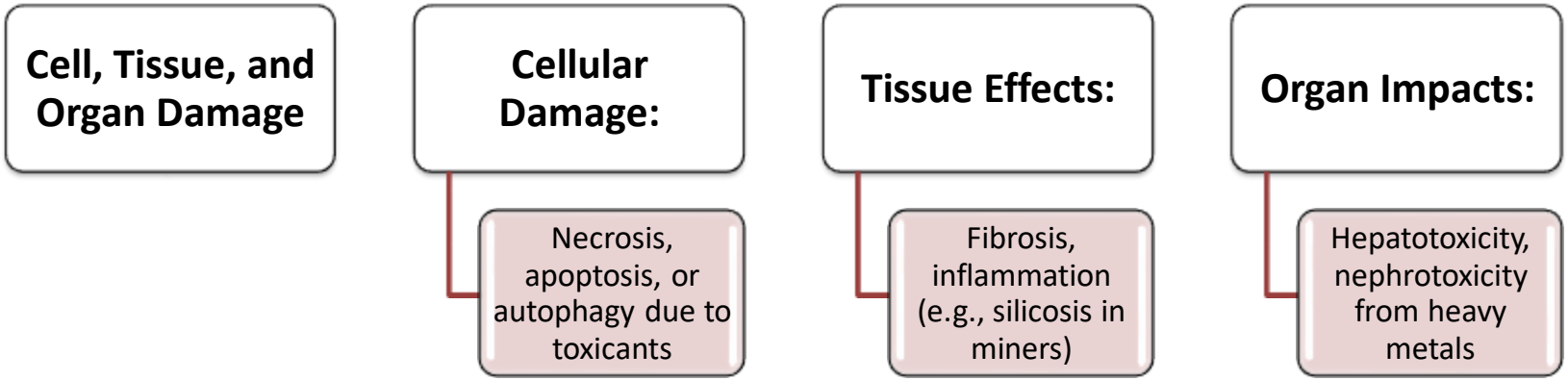
Detoxification:

- Phase I: Biotransformation (e.g., cytochrome P450 enzymes)
- Phase II: Conjugation reactions (e.g., glutathione transferase)

CHROMOSOMAL AND GENE DAMAGE



CELL, TISSUE, AND ORGAN DAMAGE



SUB LETHAL EFFECTS: REPRODUCTION, GROWTH, AND DEVELOPMENT

Reproductive Effects:

- Hormone disruption by endocrine-disrupting chemicals (EDCs)
- Example: Reduced fertility in fish exposed to PCBs

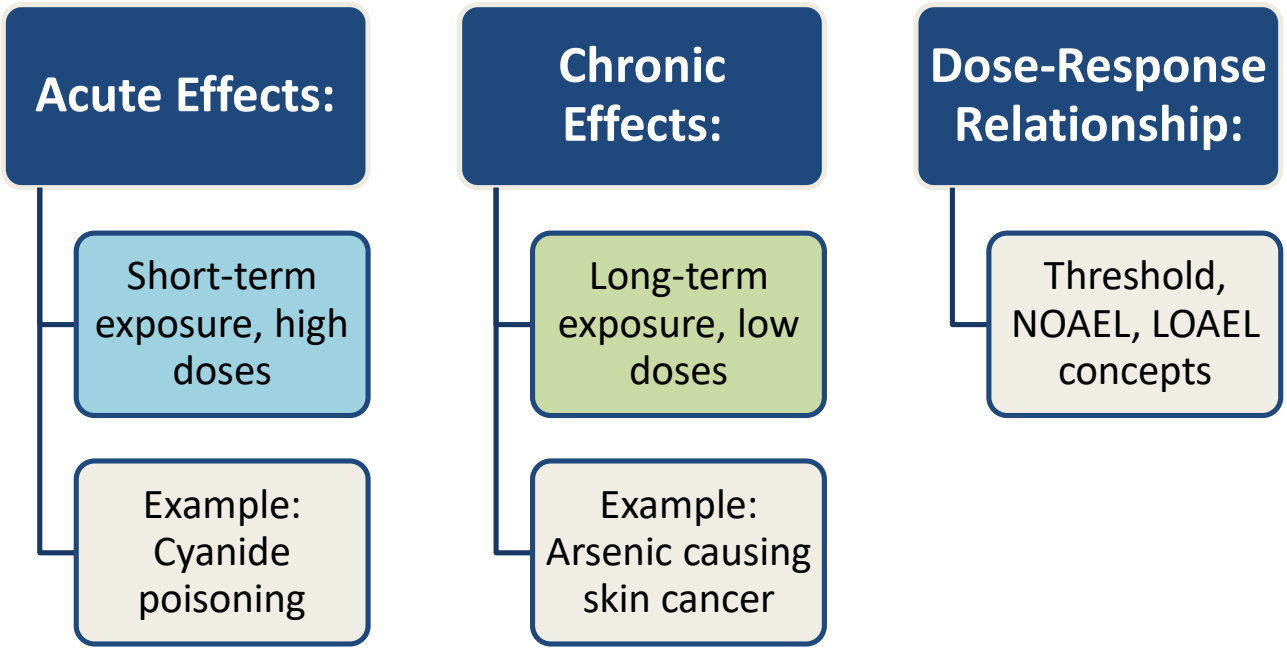
Developmental Impacts:

- Teratogenic effects like deformities caused by thalidomide

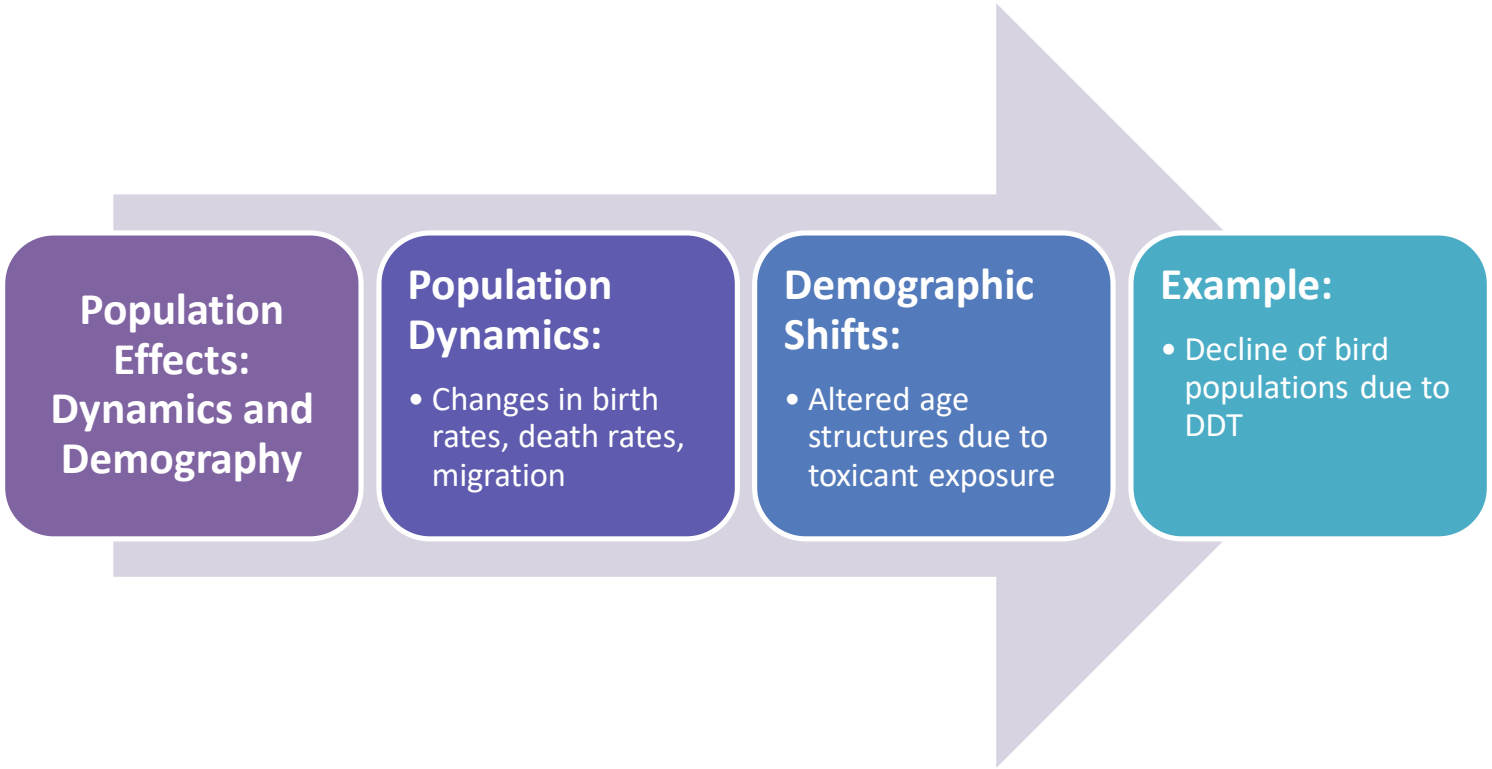
Growth:

- Stunted growth from nutrient uptake interference

ACUTE VS. CHRONIC EFFECTS



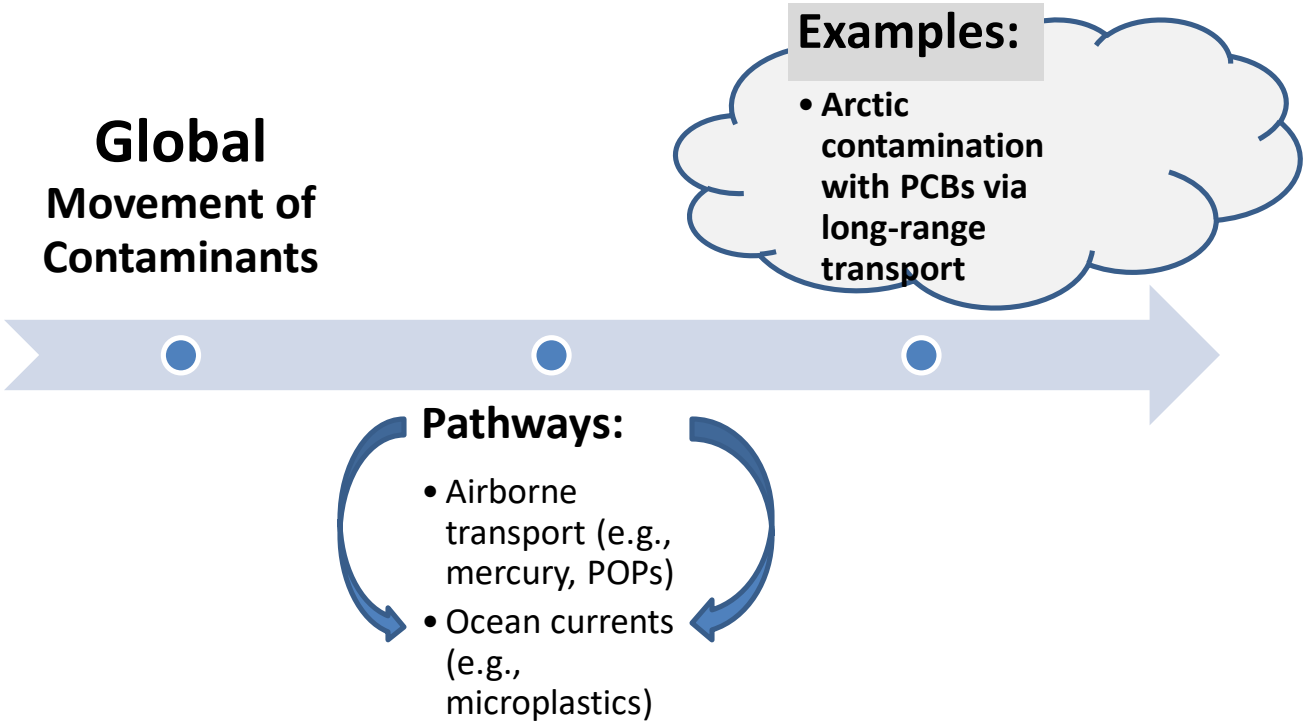
POPULATION EFFECTS



Interactive Question

IQ1:How do sub lethal effects, such as reproductive and developmental impacts, affect ecosystem health in the long term?

GLOBAL MOVEMENT OF CONTAMINANTS



PERSISTENT ORGANIC POLLUTANTS

Persistent Organic Pollutants (POPs)

Definition:

Long-lived, bioaccumulative chemicals

Examples:

PCBs, dioxins, DDT

Global Impact:

Stockholm Convention on POPs

Key Types:

- Endocrine Disrupting Chemicals (EDCs)
- Polychlorinated Biphenyls (PCBs)
- Polycyclic Aromatic Hydrocarbons (PAHs)
- Dioxins

Sources:

Industrial waste, pesticide runoff

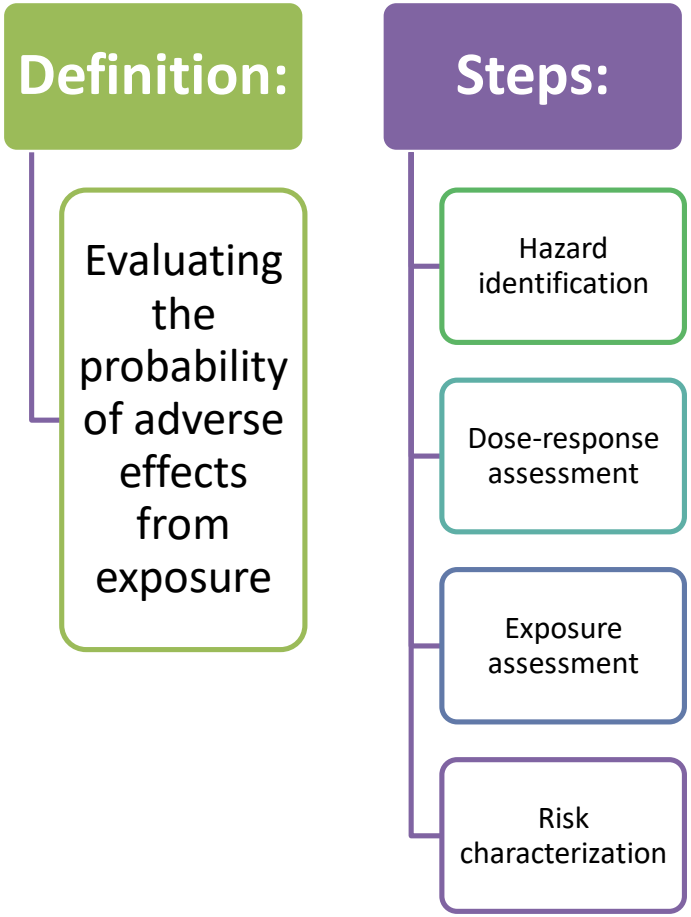
Impact:

Long-term persistence, bioaccumulation

PERSISTENT ORGANIC POLLUTANTS

PCBs
Synthetic organic chemicals consisting of chlorine atoms attached to biphenyl
-Historical use: Widely used in electrical equipment, hydraulic fluids, and plasticizers
-Current status: Production banned in many countries due to environmental persistence and toxicity
- Health effects: Potential carcinogen, impacts on immune, reproductive, and nervous systems

RISK ASSESSMENT OVERVIEW



HUMAN RISK ASSESSMENT AND EPIDEMIOLOGY

Human Health Risk Assessment:

- Estimating risk for carcinogens and non-carcinogens
- Example: Acceptable daily intake (ADI) for pesticides

Epidemiology:

- Studying exposure-response relationships in populations
- Example: Cancer clusters near industrial sites

CASE STUDY I

Case Study 1 – Minamata Disease (Japan)

Overview:

- Mercury pollution from industrial wastewater

Impacts:

- Severe neurological damage, bioaccumulation in fish

Lessons Learned:

- Importance of regulating industrial emissions

CASE STUDY II

Case Study 1 – Minamata Disease (Japan)

Overview:

- Mercury pollution from industrial wastewater

Impacts:

- Severe neurological damage, bioaccumulation in fish

Lessons Learned:

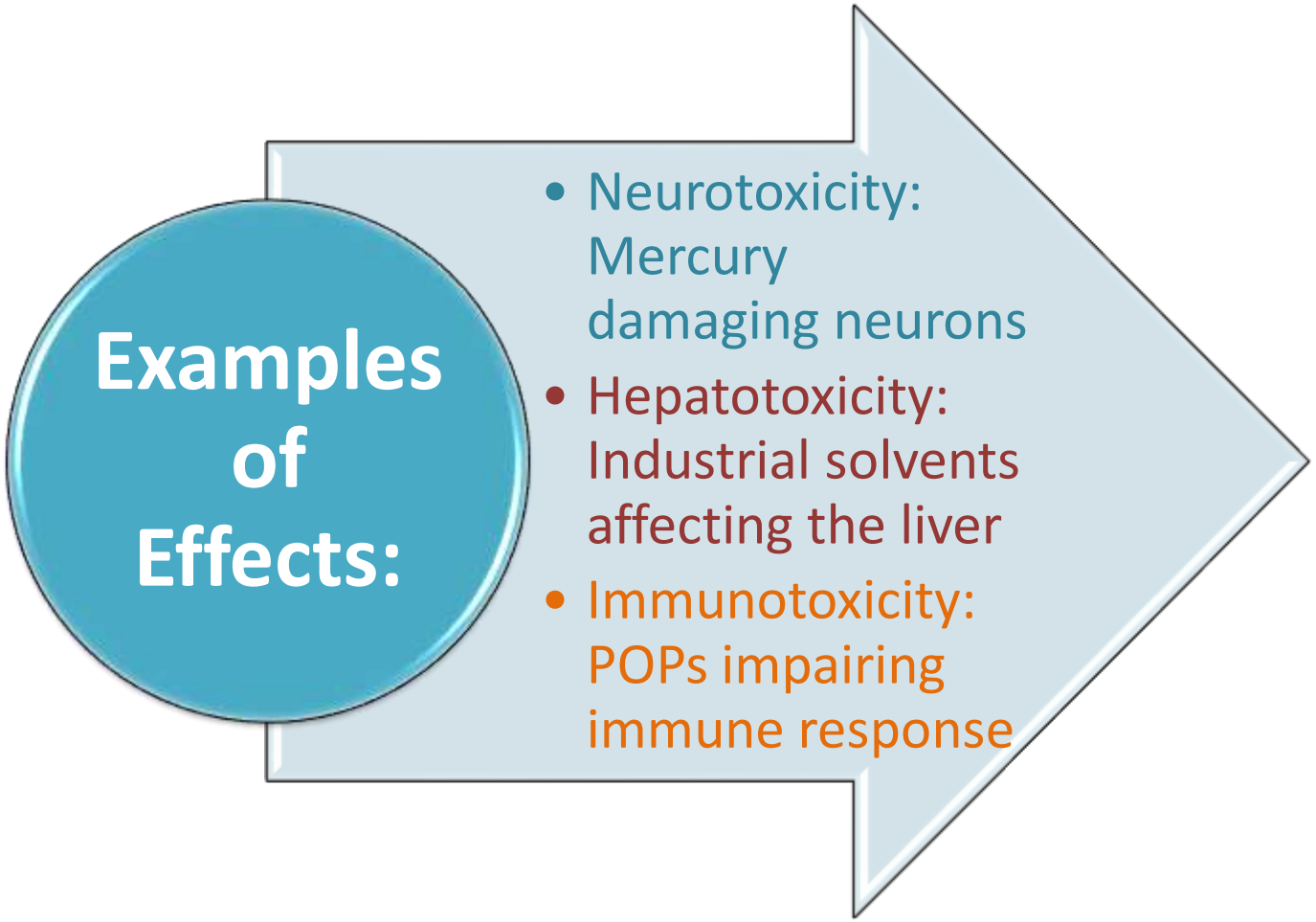
- Importance of regulating industrial emissions

Interactive Question

Interactive Question 2

Q: How does the persistence of POPs complicate global risk assessment and mitigation efforts?

PHYSIOLOGICAL EFFECTS OF POLLUTANTS



Interactive Question

- **I Q 3**

Why are persistent organic pollutants (POPs) challenging to remove from water systems?

Summary & Key Takeaways

Contaminants cause a range of molecular, physiological, and population-level effects.

Understanding their movement and bioaccumulation is crucial for risk assessment.

Case studies highlight the importance of prevention and mitigation strategies.

References

Books and Articles:

- "Environmental Toxicology" by Wright and Welbourn
- "Principles of Ecotoxicology" by Walker et al.

Reports and Guidelines:

- WHO Guidelines on POPs
- Stockholm Convention Reports

Websites:

- EPA Toxic Substance Guidelines
- CPCB Reports on Environmental Pollution

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