A Toxicology Curriculum For Communities

Module One

Introduction to Toxicology

Objectives

Upon completion of this module, the learner will be able to:

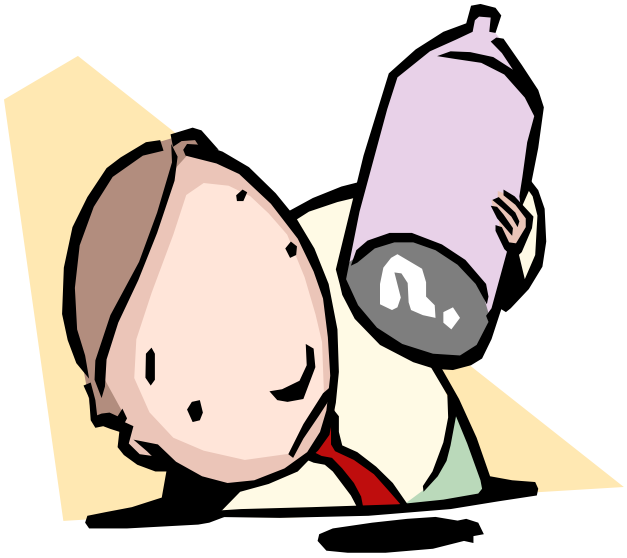
- Define toxicology and commonly associated terms
- Differentiate the sub-disciplines of toxicology
- Describe the classifications of toxic agents
- Describe the field of toxicology
- Understand the roles of various agencies
- Identify potential sources for additional information

What is Toxicology?

Toxicology

Involves all aspects of the adverse effects of chemicals on living systems.

General Toxicology Questions



What are Harmful or Adverse Effects?

Those effects which are damaging to either the survival or normal function of the individual

What is Toxicity?

The term "*toxicity*" is used to describe the nature of adverse effects produced and the conditions necessary for their production.

Before toxicity can develop, a substance must come into contact with a body surface such as skin, eye or mucosa of the alimentary or respiratory tract.

What is Toxic?

This term relates to poisonous or deadly effects on the body

What is a Toxicant?

The term *"toxicant"* refers to toxic substances that are produced by or are a by-product of human-made activities.

What is a Toxin?

The term *"toxin"* refers to toxic substances that are produced naturally.

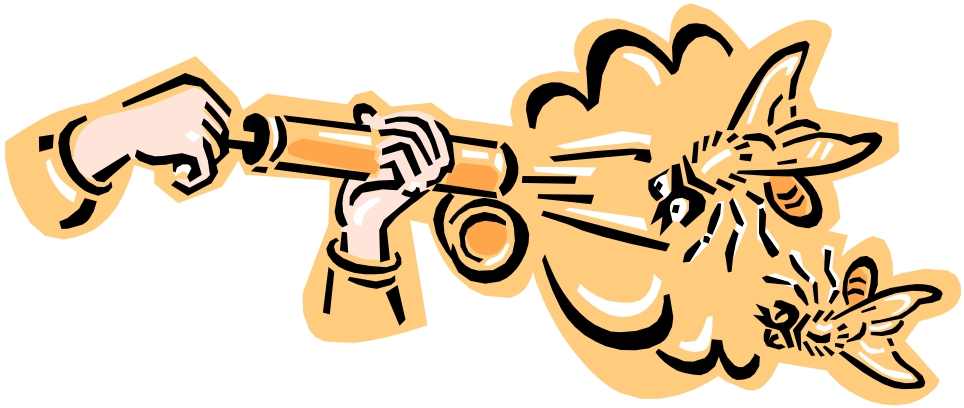
What is a Toxic Symptom?
What is a Toxic Effect ?

A toxic symptom is any feeling or sign indicating the presence of a poison in the system.

Toxic effects refers to the health effects that occur due to exposure to a toxic substance.

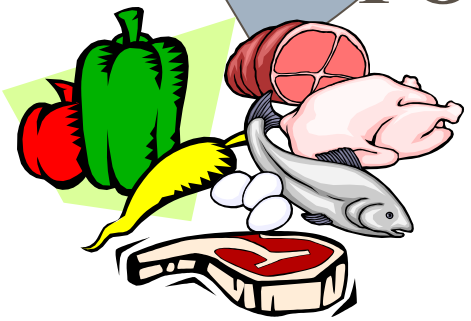
What is Selective Toxicity?

This means that a chemical will produce injury to one kind of living matter without harming another form of life, even though the two may exist close together.



Pathways of Exposure

FOOD



SOIL

What is a dose?
What is dose-response?

- The dose is the actual amount of a chemical that enters the body.

- Dose-response suggests that a dose, or a time of exposure (to a chemical, drug, or toxic substance), will cause an effect (response) on the exposed organism.

What is the threshold dose?

Threshold dose suggests that there should be a dose or exposure level below which harmful or adverse effects are not seen in a population.

What is 'individual susceptibility'? What is a 'sensitive sub-population'?

- Individual susceptibility describes the differences between people. Some people may be more at risk for certain health conditions than others.

- The sensitive sub-population are more at risk from illness due to exposure than the average healthy person.

Sub-disciplines of Toxicology

- Environmental Toxicology
- Occupational (Industrial) Toxicology
- Regulatory Toxicology
- Food Toxicology
- Clinical Toxicology
- Descriptive Toxicology
- Forensic Toxicology
- Analytical Toxicology
- Mechanistic Toxicology

Environmental Toxicology

- Studies chemicals that are contaminants of food, water, soil, or the air.
- Deals with toxic substances that enter the waterways, such as lakes, streams, rivers and oceans.

Fact: Most common problems include water-borne bacteria and viruses, waste heat from electrical plants, radioactive wastes, sewage, and industrial pollution.

Occupational (Industrial) Toxicology

- Protects workers from toxic substances and makes their work environment safe.

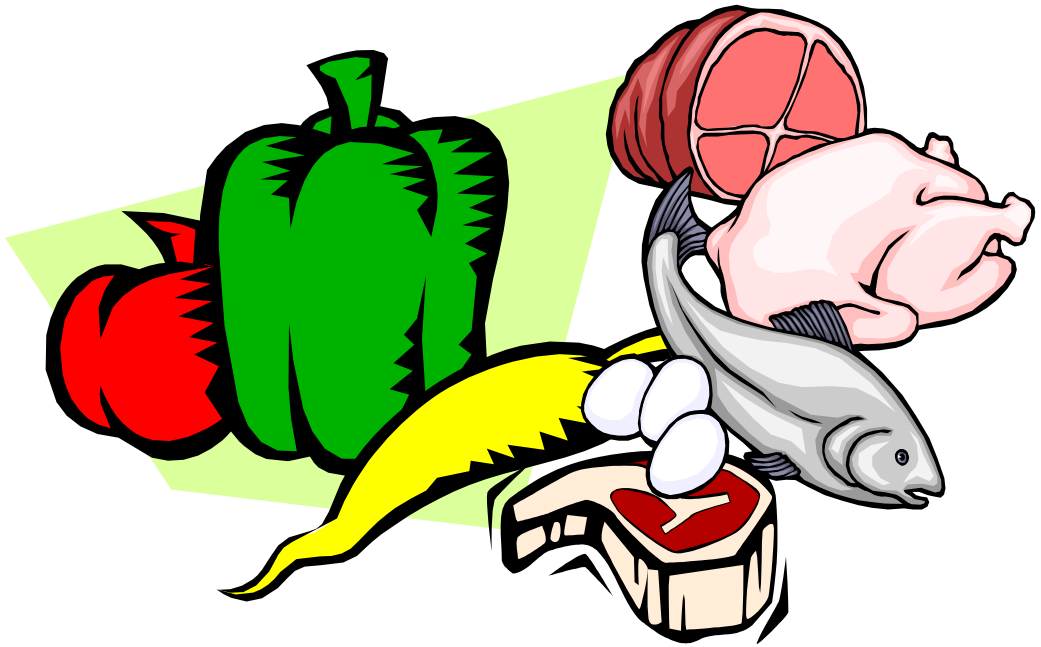
Fact: Occupational diseases caused by industrial chemicals account for an estimated 50,000 to 70,000 deaths and 350,000 new cases of illness each year in the United States.

Regulatory Toxicology

- Gathers and evaluates existing toxicological information to establish concentration-based standards of “safe” exposure.

Food Toxicology

Involves delivering a safe and edible supply of food to the consumer.



Clinical Toxicology

Is concerned with diseases and illnesses associated with short term or long term exposure to toxic chemicals.

Descriptive Toxicology

- Is concerned with gathering toxicological information from animal experimentation.
- These type of experiments are used to establish the chemical dosage that would cause illness and death.

Forensic Toxicology

Helps to establish cause and effect relationships between exposure to a drug or chemical and the toxic or lethal effects that result.

Analytical Toxicology

- Identifies the toxicant through analysis of body fluids, stomach content, excrement, skin, or suspected containers.

Mechanistic Toxicology

Makes observations on how toxic substances cause their effects.

Classification of Toxic Agents

- Heavy Metals
- Solvents and Vapors
- Radiation and Radioactive Materials
- Dioxin/Furans
- Pesticides
- Plant Toxins
- Animal Toxins

Subcategories for Classifications

- Their effect on target organs (liver, kidney, hematopoietic system, etc.)
- Their use (pesticide, solvent, food additive, etc.)
- The source of the agent (animal and plant toxins)
- Their effects (cancer mutation, liver injury, etc)

Subcategories of Classifications (continued)

- Physical state (gas, dust, liquid)
- Labeling requirements (explosive, flammable, oxidizer)
- Chemistry

More General Classifications for Communities

- Air pollutants
- Occupation-related agents
- Acute and chronic poisons

Toxicological Information Sources

The Agency for Toxic Substances and Disease Registry (ATSDR)

- Part of the U.S. Department of Health and Human Services
- Established in 1983 to provide health-based information for use of cleanup of chemical waste disposal sites mandated by CERCLA
- Concerned with the health effects that may occur from exposure to toxic chemicals.

The Agency for Toxic Substances and Disease Registry (ATSDR) (continued)

The Agency publishes

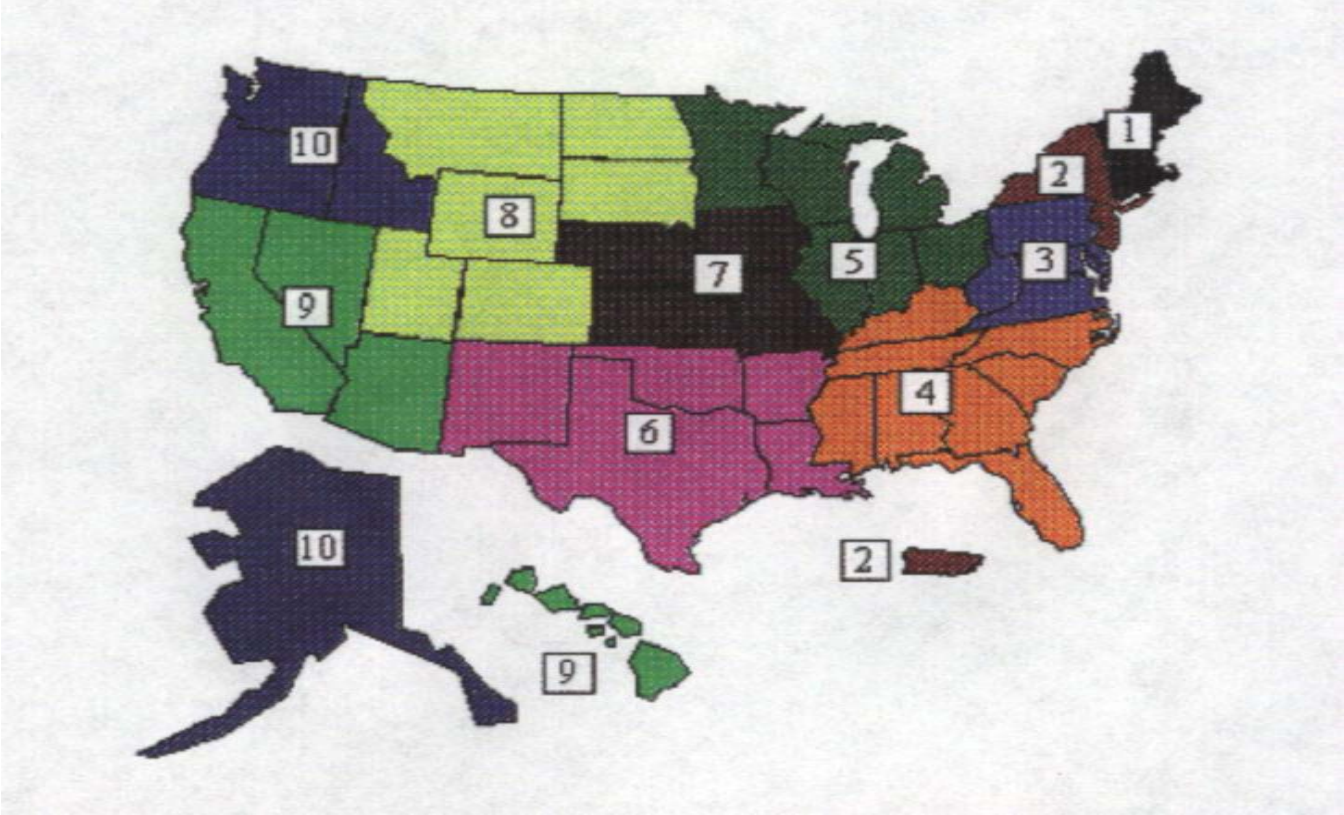
- ***Toxicological Profiles*** – which provide information on specific chemicals and possible health effects
- ***Case Studies in Environmental Medicine*** – which provide information to health care providers about the toxic effects of chemicals
- ***Public Health Statements*** – which contain information on toxic chemical exposures
- ***ToxFAQ's*** – which are fact sheets summarizing hazardous substances

The United States Environmental Protection Agency (EPA)

EPA's Responsibilities are to

- **Enforce federal laws designed to protect human health and the environment**
- **Oversee cleanup of hazardous waste sites**
- **Regulate specific chemicals**
- **Develop rules and regulations that activate the requirements of environmental laws**

EPA Regional Offices



The Centers for Disease Control and Prevention (CDC)

- Part of the U.S. Department of Health and Human Services

- Mission is to promote health and quality of life by preventing and controlling disease, injury, and disability.

Centers for Disease Control and Prevention (CDC) (continued)

CDC's responsibilities include environmental and occupational hazards through the National Center for Environmental Health (NCEH) and the National Institute for Occupational Safety and Health (NIOSH)

The National Center for Environmental Health (NCEH)

- Address hazards associated with chemical exposure inside and outside the workplace

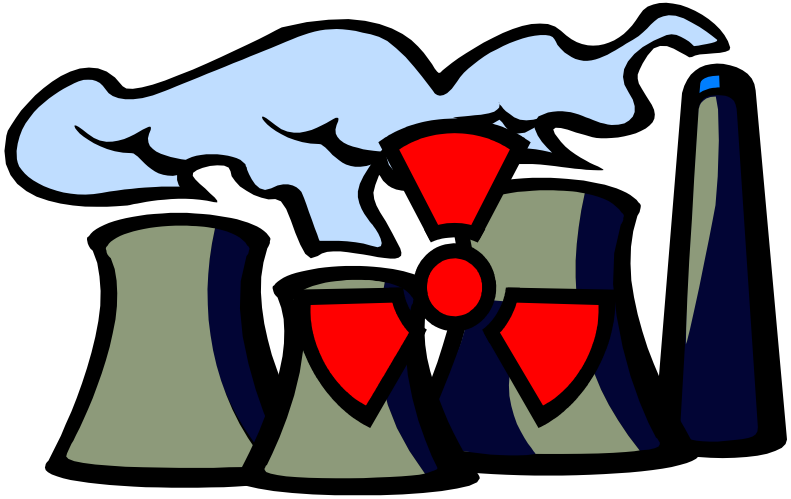
- Establish standards, guidelines, and recommendations for toxic chemicals

The National Institute for Safety and Health (NIOSH)

- Investigates potentially hazardous work conditions
- Evaluates chemical hazards in the workplace
- Conducts research on chemicals
- Provides information to OSHA for use in setting standards

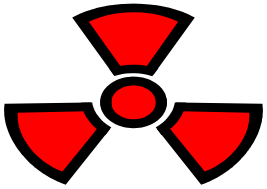
The Nuclear Regulatory Commission (NRC)

- Established in 1971
- Regulates the use of nuclear materials for commercial, industrial, academic and medical purposes



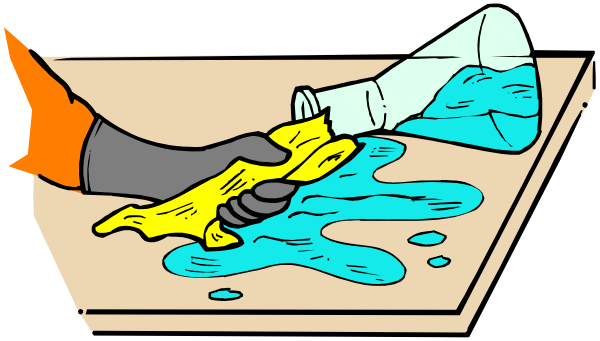
The Nuclear Regulatory Commission (NRC) (continued)

- Regulates
  - Nuclear power plants
  - Nuclear materials used in the diagnosis and treatment of cancer
  - Nuclear materials used in smoke detectors
  - Non-power research, test- and training reactors
  - Nuclear fuel cycle facilities (the production of nuclear fuel)
  - The transport, storage, and disposal of nuclear materials and waste



The Nuclear Regulatory Commission (NRC) (continued)

Like OSHA and EPA, NRC is involved in obtaining and evaluating information about acceptable exposure levels for workers handling nuclear materials



The Food and Drug Administration (FDA)

- FDA promotes and protects the public health by helping safe and effective products reach the market.

- FDA monitors products for continued safety after they are in use.

The American Conference of Governmental Industrial Hygienists (ACGIH)

Produces a listing of **Threshold Limit Values (TLV)** and **Biological Exposure Indices (BEI)** for several hundred chemicals. The lists are updated every year.

Electronic Databases

Places where you can get information include:

- Toxicology Data Network (TOXNET)
- CHEMTREC (Chemical Transportation Emergency Center)
- MEDTREC (Medical Transportation Emergency Center)
- Material Safety Data Sheets (MSDS)
- HazDat (Hazardous Substances and Health Effects Database)

Question and Answer Period