

Module One

Introduction to Toxicology

Module One

Introduction to Toxicology

Time Allotted: 90 Minutes

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 and its application when assessing health effects associated with toxic agents commonly found at hazardous waste sites
- Understand the roles and responsibilities of various agencies
- Identify potential sources for additional information

Presentation Outline

- I. Introduction to Toxicology
 - A. What is Toxicology?
 - B. The Field of Toxicology
 - C. Sub-Disciplines of Toxicology

- II. Classification of Toxic Agents
 - A. Heavy Metals
 - B. Solvents and Vapors
 - C. Radiation and Radioactive Materials
 - D. Dioxin/Furans
 - E. Pesticides
 - F. Plant Toxins
 - G. Animal Toxins
 - H. Subcategories of Toxic Substances
 - I. General Classifications of Interest to Communities

- III. Toxicological Information Sources
 - A. The Agency for Toxic Substances and Disease Registry
 - B. The United States Environmental Protection Agency
 - C. The Centers for Disease Control and Prevention
 - D. The Nuclear Regulatory Commission
 - E. The Food and Drug Administration
 - F. The American Conference of Governmental Industrial Hygienists
 - G. Electronic Databases

- IV. Contact Information

- V. Test Your Knowledge Quiz

- VI. Activity Lab

- VII. Question and Answer Period

Lecture Notes

I. Introduction to Toxicology (1)

A. What is Toxicology?

Toxicology is the study of how natural or man-made poisons cause undesirable effects in living organisms.

- **What are harmful or *adverse* effects?** Harmful or *adverse* effects are those that are damaging to either the survival or normal function of the individual.
- **What is Toxicity?** The word “toxicity” describes the degree to which a substance is poisonous or can cause injury. The toxicity depends on a variety of factors: dose, duration and route of exposure (see Module Two), shape and structure of the chemical itself, and individual human factors.

☛ Refer to Handout 1-1 - General diagram of routes of exposure and Module Two - Routes of Exposure

- **What is Toxic?** This term relates to poisonous or deadly effects on the body by inhalation (breathing), ingestion (eating), or absorption, or by direct contact with a chemical.
- **What is a Toxicant?** A toxicant is any **chemical** that can injure or kill humans, animals, or plants; a poison. The term “**toxicant**” is used when talking about toxic substances that are produced by or are a by-product of human-made activities. For example, **dioxin** (2,3-7,8-tetrachlorodibenzo-*p*-dioxin {TCDD}), produced as a by-product of certain chlorinated chemicals, is a toxicant. On the other hand, **arsenic**, a toxic metal, may

occur as a natural contaminant of groundwater or may contaminate groundwater as a by-product of industrial activities. If the second case is true, such toxic substances are referred to as toxicants, rather than toxins.

- **What is a Toxin?** The term “**toxin**” usually is used when talking about toxic substances produced naturally. A toxin is any poisonous substance of microbial (bacteria or other tiny plants or animals), vegetable, or synthetic chemical origin that reacts with specific cellular components to kill cells, alter growth or development, or kill the organism.
- **What is a Toxic Symptom?** This term includes any feeling or sign indicating the presence of a poison in the system.
- **What are Toxic Effects?** This term refers to the health effects that occur due to exposure to a toxic substance; also known as a poisonous effect on the body.
- **What is Selective Toxicity?** “Selective toxicity” 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.
- **How Does Toxicity Develop?** Before toxicity can develop, a substance must come into contact with a body surface such as skin, eye or mucosa of the digestive or respiratory tract. The dose of the chemical, or the amount one comes into contact with, is important when discussing how “toxic” an substance can be.

- **What is a dose?** The dose is the actual amount of a chemical that enters the body. The dose received may be due to either acute (short) or chronic (long-term) exposure. An acute exposure occurs over a very short period of time, usually 24 hours. Chronic exposures occur over long periods of time such as weeks, months, or years. The amount of exposure and the type of toxin will determine the toxic effect.
- **What is dose-response?** Dose-response is a relationship between exposure and health effect, that can be established by measuring the response relative to an increasing dose. This relationship is important in determining the toxicity of a particular substance (2). It relies on the concept that a dose, or a time of exposure (to a chemical, drug, or toxic substance), will cause an effect (response) on the exposed organism. Usually, the larger or more intense the dose, the greater the response, or the effect. This is the meaning behind the statement “the dose makes the poison.”
- **What is the threshold dose?** Given the idea of a dose-response, there should be a dose or exposure level below which the harmful or adverse effects of a substance are not seen in a population. That dose is referred to as the ‘threshold dose’. This dose is also referred to as the **no observed adverse effect level (NOAEL), or the no effect level (NEL)**. These terms are often used by toxicologists when discussing the relationship between exposure and dose. However, for substances causing cancer

(**carcinogens**), no safe level of exposure exists, since any exposure could result in cancer.

- **What is meant by ‘individual susceptibility?’** This term describes the differences in types of responses to hazardous substances, between people. Each person is unique, and because of that, there may be great differences in the response to exposure. Exposure in one person may have no effect, while a second person may become seriously ill, and a third may develop cancer.
- **What is a “sensitive sub-population?”** A sensitive sub-population describes those persons who are more at risk from illness due to exposure to hazardous substances than the average, healthy person. These persons usually include the very young, the chronically ill, and the very old. It may also include pregnant women and women of childbearing age. Depending on the type of contaminant, other factors (e.g., age, weight, lifestyle, sex) could be used to describe the population.

B. The Field of Toxicology

Toxicology addresses a variety of questions. For example, in agriculture, toxicology determines the possible health effects from exposure to pesticides or herbicides, or the effect of animal feed additives, such as growth factors, on people. Toxicology is also used in laboratory experiments on animals to establish dose-response relationships. Toxicology also deals with the way chemicals and waste products affect the health of an individual.

C. Sub-disciplines of Toxicology

The field of toxicology can be further divided into the following sub-disciplines or specialities:

- Environmental Toxicology is concerned with the study of chemicals that contaminate food, water, soil, or the atmosphere. It also deals with toxic substances that enter bodies of waters such as lakes, streams, rivers, and oceans. This sub-discipline addresses the question of how various plants, animals, and humans are affected by exposure to toxic substances.
- Occupational (Industrial) Toxicology is concerned with health effects from exposure to chemicals in the workplace. This field grew out of a need to protect workers from toxic substances and to make their work environment safe. 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 (1).
- Regulatory Toxicology gathers and evaluates existing toxicological information to establish concentration-based standards of “safe” exposure. The standard is the level of a chemical that a person can be exposed to without any harmful health effects.
- Food Toxicology is involved in delivering a safe and edible supply of food to the consumer. During processing, a number of substances may be added to food to make it look, taste, or smell better. Fats, oils, sugars, starches and other substances may be added to change the texture and taste of food.

All of these additives are studied to determine if and at what amount, they may produce adverse effects. A second area of interest includes food allergies. Almost 30% of the American people have some food allergy. For example, many people have trouble digesting milk, and are lactose intolerant. In addition, toxic substances such as pesticides may be applied to a food crop in the field, while lead, arsenic, and cadmium are naturally present in soil and water, and may be absorbed by plants. Toxicologists must determine the acceptable daily intake level for those substances.

- Clinical Toxicology is concerned with diseases and illnesses associated with short term or long term exposure to toxic chemicals. Clinical toxicologists include emergency room physicians who must be familiar with the symptoms associated with exposure to a wide variety of toxic substances in order to administer the appropriate treatment.
- Descriptive Toxicology is concerned with gathering toxicological information from animal experimentation. These types of experiments are used to establish how much of a chemical would cause illness or death. The United States Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), and the Food and Drug Administration (FDA), use information from these studies to set regulatory exposure limits.

- Forensic Toxicology is used to help establish cause and effect relationships between exposure to a drug or chemical and the toxic or lethal effects that result from that exposure.
- Analytical toxicology identifies the toxicant through analysis of body fluids, stomach content, excrement, or skin.
- Mechanistic Toxicology makes observations on how toxic substances cause their effects. The effects of exposure can depend on a number of factors, including the size of the molecule, the specific tissue type or cellular components affected, whether the substance is easily dissolved in water or fatty tissues, all of which are important when trying to determine the way a toxic substance causes harm, and whether effects seen in animals can be expected in humans.

II. Classification of Toxic Agents (2):

Toxic substances are classified into the following:

A. Heavy Metals

Metals differ from other toxic substances in that they are neither created nor destroyed by humans. Their use by humans plays an important role in determining their potential for health effects. Their effect on health could occur through at least two mechanisms: first, by increasing the presence of heavy metals in air, water, soil, and food, and second, by changing the structure of the chemical. For example, chromium III can be converted to or from chromium VI, the more toxic form of the metal.

B. Solvents and Vapors

Nearly everyone is exposed to solvents. Occupational exposures can range from the use of “white-out” by administrative personnel, to the use of chemicals by technicians in a nail salon. When a solvent evaporates, the vapors may also pose a threat to the exposed population.

- ☛ Have participants discuss possible solvents they use or may be exposed to during the course of a typical day.

C. Radiation and Radioactive Materials

Radiation is the release and propagation of energy in space or through a material medium in the form of waves, the transfer of heat or light by waves of energy, or the stream of particles from a nuclear reactor (3).

- ☛ An example for discussion purposes would be the dropping of the atomic bomb during World War II, or the Chernobyl Accident in Russia. These items can be provided by the presenter.

D. Dioxin/Furans

Dioxin, (or TCDD) was originally discovered as a contaminant in the herbicide Agent Orange. Dioxin is also a by-product of chlorine processing in paper producing industries.

E. Pesticides

The EPA defines pesticide as any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any pest. Pesticides may also be described as any physical, chemical, or biological agent that will kill an undesirable plant or animal pest (2).

- ☛ Have participants list pesticides they are familiar with either through personal use or in relation to hazardous chemicals in their community.

F. Plant Toxins (2)

Different portions of a plant may contain different concentrations of chemicals. Some chemicals made by plants can be lethal. For example, taxon, used in chemotherapy to kill cancer cells, is produced by a species of the yew plant.

G. Animal Toxins (2)

These toxins can result from venomous or poisonous animal releases. Venomous animals are usually defined as those that are capable of producing a poison in a highly developed gland or group of cells, and can deliver that toxin through biting or stinging. Poisonous animals are generally regarded as those whose tissues, either in part or in their whole, are toxic.

☛ Trainer may want to provide examples of venomous animals, such as snakes, spiders, etc., and poisonous animals, such as puffer fish, or oysters, which may be toxic to some individuals when contaminated with *vibrio vulnificus*.

H. Subcategories of Toxic Substance Classifications

All of these substances may also be further classified according to their:

- Effect on target organs (liver, kidney, hematopoietic system),
- Use (pesticide, solvent, food additive),
- Source of the agent (animal and plant toxins),
- Effects (cancer mutation, liver injury),
- Physical state (gas, dust, liquid),
- Labeling requirements (explosive, flammable, oxidizer),
- Chemistry (aromatic amine, halogenated hydrocarbon), or

- Poisoning potential (extremely toxic, very toxic, slightly toxic)

I. General Classifications of Interest to Communities

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

All chemicals (or any chemical) may be poisonous at a given dose and through a particular route. For example, breathing too much pure oxygen, drinking excessive amounts of water, or eating too much salt can cause poisoning or death (1).

III. Toxicological Information Sources (4)

A. The Agency for Toxic Substances and Disease Registry (ATSDR)

ATSDR is part of the U.S. Department of Health and Human Services. It was created by Congress in 1980 to provide health-based information for use in the cleanup of chemical waste disposal sites mandated by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). As the lead agency for implementing the health-related guidelines of CERCLA, ATSDR assesses the presence and nature of health hazards at specific Superfund Sites, to help prevent or reduce further exposure and the illnesses that result from such exposures, and to expand the knowledge-base about health effects from exposure to hazardous substances.

ATSDR is mostly concerned with the health effects that may occur from exposure to toxic chemicals. ATSDR's Hazardous Substances and Health Effects Database (HazDat)

discusses the issue. ATSDR also publishes Toxicological Profiles (which provide information on specific chemicals and possible health effects), Case Studies in Environmental Medicine (which are used to provide information to health care providers about the toxic effects of chemicals), and Public Health Statements (which contain information on toxic chemical exposures)(4).

ATSDR's Division of Toxicology also produces ToxFAQs™, a series of summaries about hazardous substances. Information for this series is excerpted from the ATSDR Toxicological Profiles and Public Health Statements. Each ToxFAQ summary is quick and easy to understand, and answers the most frequently asked questions (FAQs) about exposure to hazardous substances found around hazardous waste sites and the effects of exposure on human health. Medical Management Guidelines for Acute Chemical Exposures (Guidelines) were developed by ATSDR to aid emergency department physicians and other emergency healthcare professionals who manage acute exposures resulting from chemical incidents. The guidelines are intended to aid healthcare professionals involved in emergency response to effectively decontaminate patients, protect themselves and others from contamination, communicate with other involved personnel, efficiently transport patients to a medical facility, and provide competent medical evaluation and treatment to exposed persons.

B. The United States Environmental Protection Agency (EPA)

EPA is responsible for a number of activities, including enforcing federal laws designed to protect human health and the environment. There are ten regional EPA offices throughout the United States, with EPA headquarters located in Washington, D.C. Each regional office is responsible within selected states for implementing the agency's programs, considering regional needs and implementing federal environmental laws.

Following is a list of the regions and the states they cover.

☛ Refer to Figure 1.1 - Map of EPA Regional Offices.

- Region 1: Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, Vermont
- Region 2: New Jersey, New York, Puerto Rico, and the U.S. Virgin Islands
- Region 3: Delaware, Maryland, Pennsylvania, Virginia, West Virginia, the District of Columbia
- Region 4: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee
- Region 5: Illinois, Indiana, Michigan, Minnesota, Ohio, Wisconsin
- Region 6: Arkansas, Louisiana, New Mexico, Oklahoma, Texas
- Region 7: Iowa, Kansas, Missouri, Nebraska
- Region 8: Colorado, Montana, North Dakota, South Dakota, Utah, Wyoming

- Region 9: Arizona, California, Hawaii, Nevada, the territories of Guam and American Samoa
- Region 10: Alaska, Idaho, Oregon, Washington

The specific chemicals regulated by EPA and the standards associated with them are found in the Code of Federal Regulations or CFR. The different sections of the CFR are called Titles, and the ones that apply to EPA are in Title 40 (1). EPA has developed rules and regulations that activate the requirements of several environmental laws provided below.

☛ Trainer Note: Refer to Table 1.1 which is a list of selected EPA laws that regulate chemicals in the environment.

In addition, the following EPA Laws regulate chemicals in the environment:

- The Clean Air Act implements regulations that control and abate air emissions from stationary and mobile sources.
- The Clean Water Act regulates discharge of pollutants to surface waters.
- The Safe Drinking Water Act establishes standards for contaminants in drinking water; regulates discharges to underground injection wells, sole source aquifers, and public drinking water systems.
- The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) deals with cleanup of hazardous waste sites and definition of requirements for response to hazardous waste spills.

- The Resource Conservation and Recovery Act (RCRA) deals with identification and regulation of hazardous waste treatment, storage, and disposal.
- The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requires registration and testing of pesticides, regulates their sale, distribution, and use.
- The Toxic Substances Control Act (TSCA) requires testing and reporting of chemicals prior to manufacturing, distribution, and use; and restricts the use of chemicals that pose a threat to human health and the environment.
- The Emergency Planning and Community Right to Know Act (EPCRA) requires companies to report inventories of hazardous chemicals and toxic releases; and requires state and local governments to develop plans for responding to emergency releases.

In addition, EPA's Office of Research and Development (ORD) studies the effects of toxic exposure on people and the environment.

C. The Centers for Disease Control and Prevention (CDC)

CDC is an agency in the Department of Health and Human Services, its mission is to promote health and quality of life by preventing and controlling disease, injury, and disability. In the past, the CDC has focused on the study and prevention of infectious diseases such as malaria and smallpox. However, now its responsibilities have enlarged to include environmental and occupational hazards.

☛ Refer participants to Table 1.2 (Handout 1.3) – CDC Organizational Offices

The CDC Centers that deal with environmental health are the National Center for Environmental Health (NCEH) and the National Institute for Occupational Safety and Health (NIOSH) (2). NCEH addresses hazards associated with chemical exposure inside and outside the workplace. NIOSH was established by the Occupational Safety and Health Act of 1970. NIOSH has several functions, including investigating potentially hazardous work conditions, and evaluating chemical hazards in the workplace. NIOSH is the only federal institute responsible for conducting research and making recommendations for the prevention of work-related illnesses and injuries. NIOSH's responsibilities include:

- Investigating potentially hazardous working conditions as requested by employers or employees,
- Evaluating hazards in the workplace, ranging from chemicals to machinery,
- Creating and disseminating methods for preventing disease, injury, and disability,
- Conducting research and providing scientifically valid recommendations for protecting workers; and
- Providing education and training to individuals preparing for or actively working in the field of occupational safety and health.

Information gathered from these activities is used to help reduce disease, injury and disability in the workplace. The information is provided to OSHA, which uses it to establish standards to protect health in the workplace.

D. The Nuclear Regulatory Commission (NRC) (1)

NRC, established in 1974, regulates the use of nuclear materials for commercial, industrial, academic, and medical purposes. This includes regulating nuclear power plants, nuclear materials used in the diagnosis and treatment of cancer, and nuclear materials used in smoke detectors. NRC also regulates non-power research, test and training reactors; nuclear fuel cycle facilities (the production of nuclear fuel); and the transport, storage, and disposal of nuclear materials and waste. Like OSHA and EPA, NRC obtains and evaluates information about acceptable exposure levels for workers handling nuclear materials.

E. The Food and Drug Administration (FDA) (5)

FDA promotes and protects the public health by helping safe and effective products reach the market in a timely way, and monitoring products for continued safety after they are in use.

F. The American Conference of Governmental Industrial Hygienists (ACGIH)

ACGIH is a professional organization that produces a listing of Threshold Limit Values (TLV) and Biological Exposure Indices (BEI) for several hundred chemicals, updating

them every year. BEIs are recommended maximum concentrations of various types of toxic substances, and are guidelines to evaluate the potential health hazards associated with exposure. The maximum concentration may be measured in blood, urine, or exhaled air. The TLVs are guidelines for occupational exposure to hazardous chemicals and are published in a booklet called *Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices* (6).

G. Electronic Databases

Information on toxic chemicals is available at the following sites:

- Toxicology Data Network (TOXNET - www.toxnet.nlm.nih.gov). Several databases, such as the Hazardous Substances Data Bank (HSDB) and the Registry of Toxic Effects of Chemical Substances (RTECS), can be found in the TOXNET database. The HSDB has toxicological information on more than 4,000 chemicals, as well as information on emergency handling procedures, environmental data, regulatory status, and human exposure. The RTECS is maintained by NIOSH and contains information on the health effects for more than 90,000 chemicals.
- CHEMTREC (Chemical Transportation Emergency Center - www.chemtrec.org). CHEMTREC is provided by the American Chemistry Council (formerly known as the Chemical Manufacturer's Association) and provides information and assistance for emergency incidents involving chemicals and hazardous materials. CHEMTREC also

supplies basic information about the production, shipping, and use of chemicals and provides information about medical treatment in response to chemical exposures.

- Material Safety Data Sheets (MSDS) are available on the Occupational Safety and Health Administration website: www.osha.gov. MSDSs provide information such as physical and chemical properties of a substance, first aid information, emergency response, and disposal information.
- Hazardous Substances and Health Effects Database (HazDat), available on ATSDR's website at www.atsdr.cdc.gov, contains information on hazardous substances found at National Priorities List (NPL) and non-NPL waste sites and emergency events, and on the levels at which health effects from exposure to hazardous substances have been reported in humans and animals. HAZDAT contains environmental contamination and other data on more than 3,000 uncontrolled hazardous waste sites for which ATSDR has conducted public health assessments, prepared health consultations, or provided responses to emergencies involving releases of toxic substances into community environments. It contains toxicity information taken from the ATSDR's Toxicological Profiles for more than 200 substances most frequently found at sites (4).

IV. Contact Information

Agency for Toxic Substances and Disease Registry (ATSDR)
1600 Clifton Road, NE
Atlanta, Georgia 30333
1-888-42-ATSDR or 1-888-422-8737
Web site: <http://www.atsdr.cdc.gov>

American Conference of Government Industrial Hygienists (ACGIH)
1330 Kemper Meadow Drive, Suite 6000
Cincinnati, OH 45240
513-742-2020
Web site: <http://www.acgih.org>

Association of Occupational and Environmental Clinics (AOEC)
1010 Vermont Avenue, NW, Suite 513
Washington, DC 20005
(202) 347-4976
Web site: <http://www.aeoc.org>

Centers for Disease Control and Prevention (CDC)
1600 Clifton Rd.
Atlanta, GA 30333
1-800-311-3455
Web site: <http://www.cdc.gov>

National Institute of Environmental Health Sciences (NIEHS)
P.O. Box 12233
Research Triangle Park, NC 27709 or
111 Alexander Drive
Research Triangle Park, NC 27709
(919) 541-3345
Web site: <http://www.niehs.nih.gov>

National Toxicology Program (NTP)
P.O. Box 12233
M.D. B2-04
Research Triangle Park, NC 27709
(919) 541-0530
Web site: <http://ntp-server.niehs.nih.gov>

Occupational Safety and Health Administration (OSHA)
Directorate of Technical Support
Technical Data Center, Room N-2634
200 Constitution Avenue, N.W.
Washington, DC 20210
1-800-321-OSHA or 1-800-321-6742
Web site: <http://www.osha.gov>

U.S. Environmental Protection Agency (EPA)
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Washington, DC 20460
(202) 260-2090
Web site: <http://www.epa.gov>

U.S. Food and Drug Administration (FDA)
5600 Fishers Lane
Rockville, Maryland 20857
1-888-INFO-FDA (1-888-463-6332)
Web site: <http://www.FDA.Gov>

U.S. Nuclear Regulatory Commission (NRC)
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738
(301) 415-7000
Web site: <http://www.nrc.gov>

V. Test Your Knowledge Quiz

1. Which of these groups is usually designated as one of the most sensitive sub-populations for exposures to toxic substances?
 - a. Adult women
 - b. Infants
 - c. Adult men
 - d. Adolescents

2. You have worked at a chemical facility for 10 years. The facility does not require protective equipment, and you have developed a number of serious health affects in the last 7 years. You are possibly experiencing what type of exposure?
 - a. Chronic
 - b. Acute

3. You are worried about contamination of vegetables grown in contaminated soils. What type of toxicologist would you contact?
 - a. Descriptive
 - b. Environmental
 - c. Regulatory
 - d. Food

4. You are concerned about risks associated with growing vegetables in soil with high lead and arsenic concentrations. You are speaking of what type of substance?
 - a. Toxin
 - b. Toxicant

5. The larger the amount of exposure and the greater the dose, the greater the observed response, or effect.
 - a. True
 - b. False

6. What type of toxicologist takes samples of your blood, urine and hair for testing?
 - a. Descriptive
 - b. Analytical
 - c. Mechanistic
 - d. Forensic

7. Toxic agents can be classified in terms of their physical state, their effects, and their source.
 - a. True
 - b. False

8. Which agency deals with the health effects that may occur from environmental exposure to toxic chemicals?
 - a. The Environmental Protection Agency
 - b. The Centers for Disease Control and Prevention
 - c. The Agency for Toxic Substances and Disease Registry
 - d. The Nuclear Regulatory Commission

9. Which database has information on emergency handling procedures, environmental data, regulatory status and human exposure?
 - a. TOXNET
 - b. HazDat
 - c. IRIS
 - d. CHEMTREC

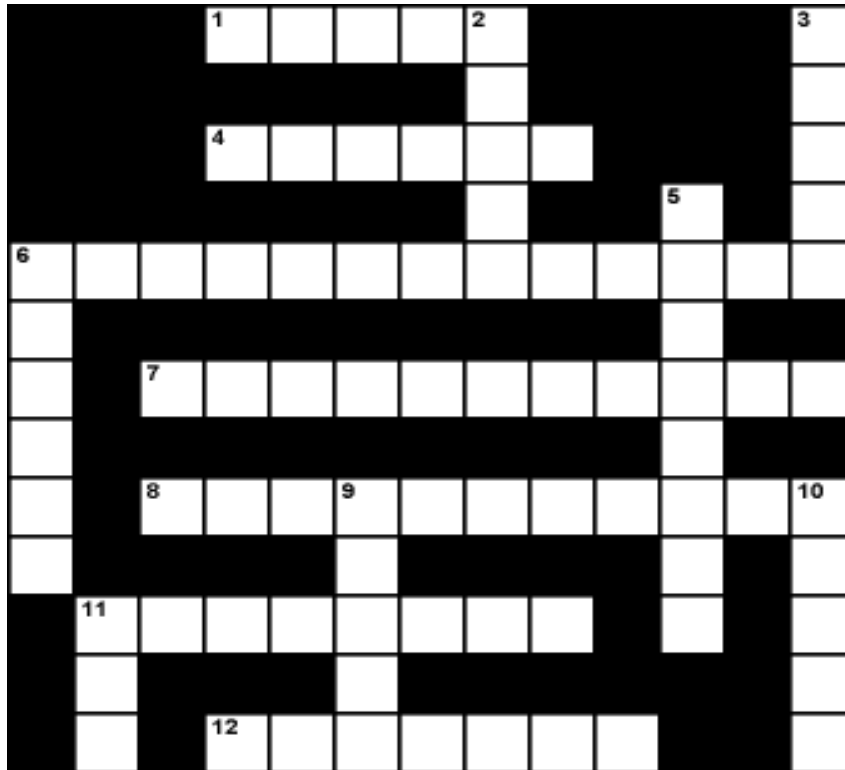
10. HazDat contains information on hazardous substances found at NPL and non-NPL waste sites, and on emergency events.
 - a. True
 - b. False

11. The no observed adverse effect level (NOAEL) is the same as the no effect level (NEL).
 - a. True
 - b. False

12. The term *toxicant* is used when talking about toxic substances that are produced by or are a by-product of human-made activities.
 - a. True
 - b. False

VI. Activity Lab

In small groups, complete the toxicology cross-word puzzle, using the knowledge gained through this module.



PUZZLE QUESTIONS

Across

- 1 toxic substances produced naturally
- 4 contains information on hazardous substances found at NPL and non-NPL sites
- 6 the dose or exposure level below which the harmful or adverse effects of a substance are not seen in a population
- 7 the differences between two or more persons in the level of their response to exposure
- 8 implements regulations that control and abate air emissions from stationary and mobile sources
- 11 the act of coming into contact with a hazardous substance
- 12 long-term exposure

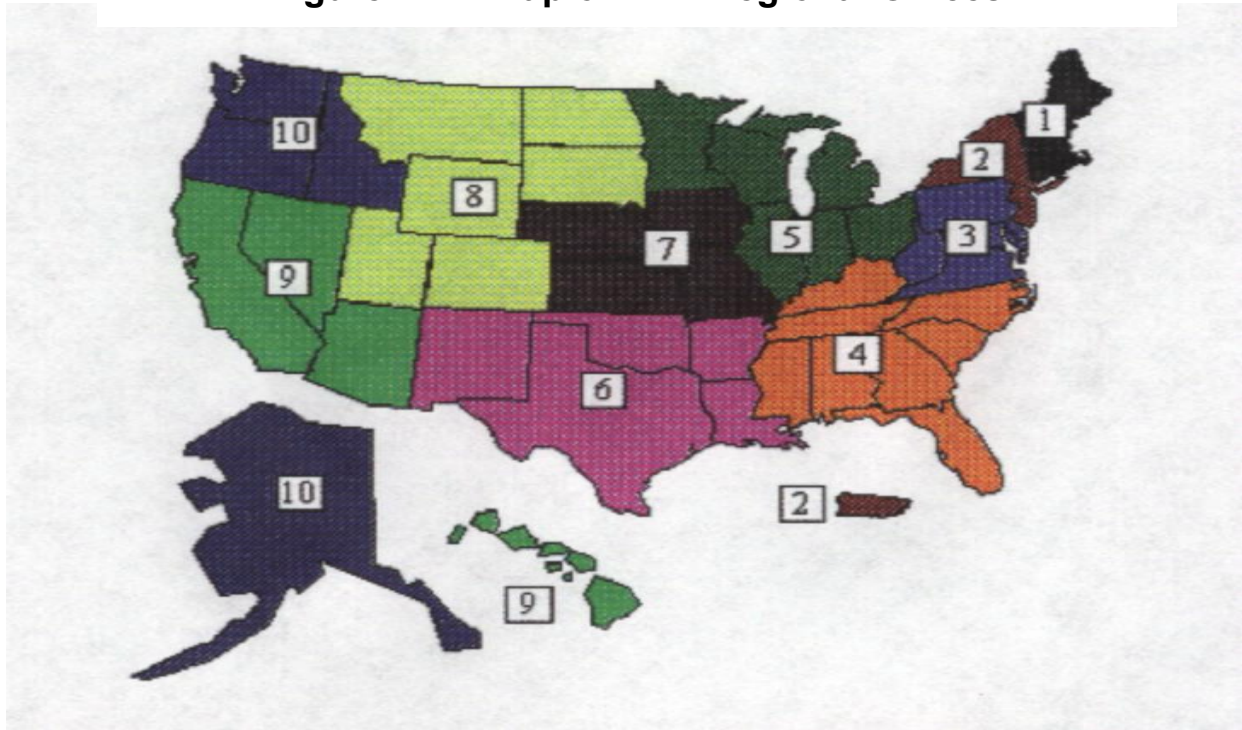
Down

- 2** no observed adverse effect level
- 3** short-term exposure, usually less than 24 hours
- 5** any chemical that can injure or kill humans, animals, or plants: a poison
- 6** toxicology data network
- 9** examines the health effects from exposure to contaminants at NPL and non-NPL sites
- 10** poisonous or deadly effects on the body by inhalation, ingestion, absorption, or contact with a chemical
- 11** deals with the environmental impacts of exposure to hazardous substances

VII. Question and Answer Period

HANDOUTS and VISUAL AIDS
MODULE I

Figure 1.1 – Map of EPA Regional Offices



Region 1 – Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont

Region 2 - New Jersey, New York, Puerto Rico and the U.S. Virgin Islands

Region 3 – Delaware, Maryland, Pennsylvania, Virginia, West, and the District of Columbia

Region 4 – Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, and Tennessee

Region 5 – Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin

Region 6 – Arkansas, Louisiana, New Mexico, Oklahoma, and Texas

Region 7 – Iowa, Kansas, Missouri, and Nebraska

Region 8 – Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming

Region 9 – Arizona, California, Hawaii, Nevada, and the territories of Guam and American Samoa

Region 10 – Alaska, Idaho, Oregon, and Washington

Table 1.1 Selected EPA Environmental Laws

Name	Acronym	Date	Purpose
Clean Air Act	CAA	1970	Implements regulations that control and abate air emissions from stationary and mobile sources
Clean Water Act	CWA	1972	Regulates discharge of pollutants to surface waters.
Safe Drinking Water Act	SDWA	1974	Establishes standards for contaminants in drinking water; regulates discharges to underground injection wells, sole source aquifers, and public drinking water systems.
Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)	CERCLA	1980	Cleanup of hazardous waste sites and definition of requirements for response to hazardous waste spills.
Resource Conservation and Recovery Act	RCRA	1976	Identification and regulation of hazardous waste treatment, storage, and disposal.
Federal Insecticide, Fungicide, and Rodenticide Act	FIFRA	1948	Requires registration and testing of pesticides; regulates their sale, distribution, and use.
Toxic Substances Control Act	TSCA	1976	Requires testing and reporting of chemicals prior to manufacturing, distribution, and use; restricts the use of chemicals that pose a threat to human health and the environment.
Emergency Planning and Community Right to Know Act	EPCRA	1986	Requires companies to report inventories of hazardous chemicals and toxic releases; requires state and local governments to develop plans for responding to emergency releases.

Table 1.2 Organizations Within the Centers for Disease Control and Prevention (CDC)

National Center for Chronic Disease Prevention and Health Promotion
National Institute of Occupational Safety and Health
National Center for Environmental Health
National Center for Health Statistics
National Center for Infectious Disease
National Center for Injury Prevention and Control
National Center for Prevention Services
National Institute for Occupational Safety and Health
Epidemiology Program Office
International Health Program Office
Public Health Practice Program Office
National Immunization Program