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# Hazardous Materials II

## Primary Knowledge Instructor Guide

### Note to Instructor

Hazardous Materials II is the second primary knowledge (PK) unit in the Hazardous Materials Learning Module. It is recommended that Hazardous Materials I be covered first.

### Description and Estimated Time

This purpose of this learning module is to provide information on hazardous materials and how these materials could affect one's health and the safety of the working environment. This information should provide students and employees with the knowledge and confidence needed to work in environments in which hazardous materials are used and stored.

This Hazardous Materials II unit provides information needed to safely work with and around hazardous materials used in microtechnology fabrication facilities and other manufacturing facilities.

Hazardous Materials II covers the characteristics of chemicals that are *health hazards*. It also covers how chemicals can enter the body and what one can do to prevent toxic exposure.

Hazardous Materials (HazMat) I, the first lesson of this learning module, provides information on the federal regulations for HazMat training and discusses the characteristics of chemicals that create physical hazards for the environment and the people working in that environment.

### Estimated Time to Complete HazMat II

Allow at least 20 minutes.

## Introduction

Chemicals pose a wide range of health hazards. Hazardous Materials II discusses the characteristics of chemicals that establish them as health hazards and the characteristics for establishing the toxicity of a chemical. It should precede all activities in which one is required to handle, work with or around chemicals.

*Health hazards* are associated with any chemical that may produce acute or chronic health effects to humans through exposure.

*Some chemicals require protective gear such as seen in this picture. This person is working with an acid and is dressed in appropriate acid gear. [Photo courtesy of Bob Willis]*



## Learning Module Objectives

- Describe at least five characteristics of chemicals that are physical hazards.
- Describe at least five characteristics of chemicals that are considered health hazards.
- Match the physical and health hazards to their warning symbols.

## Key Terms (These terms are defined in this unit)

corrosive  
dose  
flammable  
MSDS  
oxidizer  
PEL  
poison  
toxicity  
TLV

## Chemical Characteristics of Health Hazards

Below are chemical characteristics that are considered health hazards. The graphic illustrates the standard warning symbols for biohazards, corrosives and poisons.

*Asphyxiant* - Vapor or gas that can cause unconsciousness or death by suffocation.

*Biohazard* - Biological substance that poses a threat to human health, such as medical waste, samples of a microorganism, virus or toxin (from a biological source).

*Carcinogenic* - Substance that has been proven, or is suspected, of being able to produce cancer in a human being.

*Corrosive* - Chemical that causes visible destruction to human skin or some metals. Damage to skin is usually irreversible, leaving scars. Corrosives can be acids or bases.

*Irritant* - Chemical that causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

*Poison* - Substance that produces a toxic effect, illness or death, when ingested, inhaled or absorbed. This includes irritants that can irritate or inflame the skin, eyes or nose.

*Sensitizers* - Chemical that causes an allergic reaction or hypersensitivity to normal tissue of a substantial proportion of humans after repeated exposure. (e.g., pollen)

### Additional Health Hazards

The following chemicals can cause damage to specific organs or a fetus.

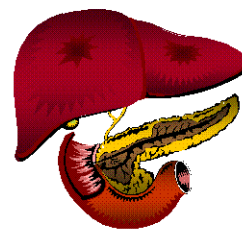
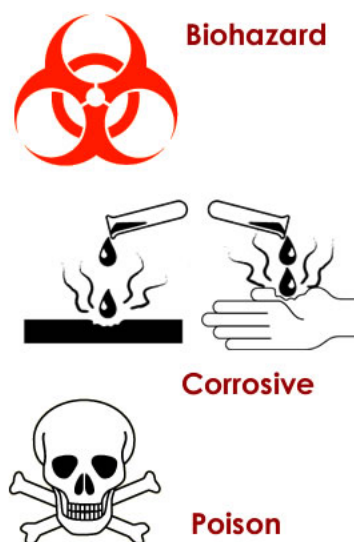
*Hepatotoxins* - Toxin that can have damaging effects on the liver.

*Mutagen* - Chemical agent that can induce or increase frequency of mutation in an organism.

*Nephrotoxins* - Toxin that can have damaging effects on the kidneys.

*Neurotoxins* - Toxin that can damage or destroy nerve tissue.

*Teratogen* - Substance that can cause malformation of an embryo or a fetus.



Human Organ (Liver)

## Matching Activity

Match the following chemical to the effect it can have on humans.

		Chemical		Effect
<b>E</b>	1	Mutagen	A	Effects the liver
<b>D</b>	2	Carcinogen	B	Causes visible destruction to skin
<b>F</b>	3	Poison	C	Causes allergic reaction
<b>B</b>	4	Corrosive	D	Proven to produce cancer
<b>A</b>	5	Hepatotoxin	E	Can induce mutation in an organism
<b>C</b>	6	Sensitizer	F	Produces toxic effect when ingested

**Table 1: Chemicals and Their Effects**

## Health Hazards Warning Symbols



These universal symbols are used to quickly warn of potential health hazards. These symbols are found on chemical labels, compressed gas bottles, facility doors, chemical storage units, and on any object that contains a chemical that causes a specific health hazard.

*Short exercise: Find at least one example of each of these health hazards.*

## So how does someone become exposed to a chemical?

There are three routes of exposure to a chemical:

- *Inhalation* - breathing through mouth or nose
- *Ingestion* - eating, swallowing
- *Absorption* - absorbing through the skin

There are two types of exposure:

- *Acute* - one time exposure, immediate or delayed effects
- *Chronic* - frequent exposures over a period of time

## Health Effects of Chemicals

Certain chemical characteristics can have a mild to serious health effects on humans. Such chemicals include flammables, corrosives, oxidizers and poisons.

### *Corrosives*

- Can cause severe and painful skin burns
- Burn the eyes and can cause blindness
- If inhaled, can burn the nose and lungs

### *Flammables*

- Dry the skin by removing body oils
- Irritate the eyes
- If inhaled in relatively high concentration, can cause headaches, dizziness, nausea, and unconsciousness

### *Oxidizer*

- Can cause severe and painful skin burns
- Burn the eyes and can cause blindness
- If inhaled, can burn the nose and lungs

### *Poison*

- Can be absorbed into the body through contact with the skin
- Very irritating to the eyes
- If inhaled in relatively large amounts, can cause internal damage or even death



## Matching Activity

Match the following components with their functions.

		Components		Function
<b>C</b>	1	Acute	A	swallowing
<b>A</b>	2	Ingesting	B	Painful burns
<b>B</b>	3	Corrosives	C	Immediate effect
<b>F</b>	4	Poison	D	Enters through the nose
<b>E</b>	5	Chronic	E	Long term effect
<b>D</b>	6	Inhaling	F	Can enter through the skin

**Table 2: Components and Functions**

### *Review Question*

A person develops cancer due to asbestos exposure. Is this chronic or acute exposure?

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***Answer: Cancer due to asbestos is from long term (chronic) exposure.***

## Chemical Toxicity

A material is considered toxic or poisonous when a small amount causes harmful effects to a normal, healthy human. However, almost all materials can produce harmful effects when exposed in excessive amounts.

*Toxicity* is the effect a chemical has on one's health under certain concentrations and exposure times. A chemical's toxicity level depends on

- the duration of exposure and
- the chemical's concentration.

The differentiation between a toxic substance or poison and any non-toxic substance is the dose.

*Dose* is the amount of material to which an organism is exposed. The greater the dose, the greater effect the exposure can have on your body. Chemicals that are considered to be toxins or poisons produce harmful effects at relatively low dosages.

The effect on humans from the same dosage or the same exposure differs from one person to another. There are many variables in determining the effect a particular chemical will have on a human:

- Race
- Variation in response among a people of the same race
- Gender
- Age
- Physiological conditioning
- State of health
- Medications, drugs, alcohol
- Heredity
- Synergistic effect
- Physical state of the chemical
  - gases are inhaled rapidly
  - solids are absorb slowly

## Review Questions

*What is an example of "different dosages" of the same chemical having "different effects" on the body?*

*What is an example that you have experienced in which two people had different effects from the same chemical and exposure?*

## Measuring Toxicity

The two common indicators for a chemical's toxicity are PEL and TLV.

*Permissible Exposure Limits (PEL)* – These indicators are set by Federal regulation (OSHA) for the maximum permissible concentration of a particular chemical to which one should be exposed without adverse effects. The duration of exposure and concentration of the chemical are considered in determining the PEL.

*Threshold Limit Value (TLV)* – This is the airborne concentration of a substance that represents conditions under which nearly all workers may be exposed day after day with no adverse effect. TLV's are advisory exposure guidelines, not legal standards. They are based on evidence from industrial experience, animal studies, or human studies when they exist. TLV's are revised yearly by the American Conference of Governmental Industrial Hygienists'.

## Matching Activity

Match the following terms with their meanings.

		Term		Meaning
<b>B</b>	1	Toxicity	A	Maximum permissible duration and concentration
<b>D</b>	2	Dose	B	Determined by duration of exposure and concentration
<b>A</b>	3	PEL	C	Permissible airborne concentration day after day
<b>C</b>	4	TLV	D	The amount of exposure

Table 3: Terms and Their Meanings



## Personal Protective Equipment (PPE)

Personal protective equipment (PPE) protects the worker from chemical, physical and biological hazards that may be encountered in the workplace.

Special PPE is available for protection of the following:

### *Respiratory system*

Several types of respirators protect from hazardous vapors / fumes and particles

### *Hands*

A variety of different types of gloves protect from skin absorption of harmful substances, severe cuts or lacerations, severe abrasions, punctures, chemical burns, thermal burns, and harmful temperature extremes

### *Eyes and face*

Safety glasses, goggles, face shields protect from flying particles, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation

### *Feet*

Special footwear protects from falling objects or chemical spills

### *Body*

Aprons, smocks protect from acid or caustic chemical spills or splashes



## Summary

In order to understand the information presented in MSDS's and on chemical labels, one must know and understand the terminology associated with hazardous materials.

Chemicals exhibit a variety of characteristics that are considered health hazards: corrosive, carcinogen, sensitizer, irritant.

The toxicity of a chemical is based on its concentration and exposure duration.

*Complete the related activities to ensure that you understand the information presented in HazMat I and II.*

## References

1. Occupational Safety and Health Association (OSHA) ([www.osha.gov](http://www.osha.gov))
2. OSHA Hazardous Communications Standard  
(<http://www.osha.gov/SLTC/hazardcommunications/index.html>)
3. The Material Safety Data Sheet (MSDS) HyperGlossary  
(<http://www.ilpi.com/msds/ref/index.html>)
4. Understanding Toxic Substances (<http://www.dhs.ca.gov/ohb/hesis/uts.htm>)

## Related SCME Lessons

- Hazardous Materials I
- Hazardous Materials I and II Activity
- Chemical and Lab Safety Rules
- Material Safety Data Sheets Learning Module
- Chemical Labels Learning Module

## Disclaimer

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