

LESSON 2: CHEMICAL FORMS AND EXPOSURE HAZARDS

INTRODUCTION

Many work processes require the use of hazardous chemicals. Having a safe and healthful work environment means that you must recognize potential chemical hazards and protect yourself from them. In this lesson you will see what forms chemicals take, and how chemicals can enter your body.

LEARNING OBJECTIVES

When you have completed this lesson, you should be able to do the following

Define physical hazards and health hazards.

Identify the forms that chemicals take.

Describe how liquids and solids become airborne.

Identify sources of mists, vapors, dusts, and fumes in the workplace,

List and describe the major routes of exposure for health hazards.

Identify factors that affect the degree of hazard associated with exposure to health hazards.

List the categories of chemicals not included in the Hazard Communication Standard.

LEARNING RESOURCES

- Videotape Segment 2A: Chemical Forms
- Workbook Application Exercise 2A-1: Recognizing Chemical Hazards
- Workbook Application Exercise 2A-2: Identifying Sources of Airborne Hazards
- Videotape Segment 2B: Exposure Routes and Degree of Hazard
- Workbook Application Exercise 2B: Routes of Exposure
- Lesson Summary

DIRECTIONS FOR PROCEEDING

Complete the following steps in order. You might want to check off each step as you complete it.

- ___ 1) Read the workbook introduction to Videotape Segment 2A.
- ___ 2) Watch Videotape Segment 2A.
- ___ 3) Complete Application Exercise 2A-1 in this workbook.
- ___ 4) Complete Application Exercise 2A-2 in this workbook.
- ___ 5) Read the workbook introduction to Videotape Segment 2B.
- ___ 6) Watch Videotape Segment 2B.
- ___ 7) Complete Application Exercise 2B in this workbook.
- ___ 8) Read the lesson summary.

INTRODUCTION TO VIDEOTAPE SEGMENT 2A: Chemical Forms

In Lesson 1, you saw that the Hazard Communication Standard helps protect your right to work in a safe and healthful environment. The Standard does this by requiring actions that contribute to the recognition, evaluation, and control of chemical hazards in the workplace. The Standard includes most chemical hazards, but not all. For example, the following are not covered:

- Hazardous wastes regulated by the Environmental Protection Agency (EPA)

Example: contaminated soils and waste solvents covered under EPA regulations

- Tobacco and tobacco products

Example: cigarettes

- Wood and wood products

Example: lumber, paper

- Manufactured articles with a specific shape or design, and an end-use function dependent on that shape or design — provided that such articles do not release or cause exposure to a chemical hazard under normal conditions of use.

Example: chairs, phonograph records, styrofoam cups

- Food, drugs, and cosmetics intended for personal consumption by employees while in the workplace.

Example: candy bars, aspirin, lipstick

As you watch this videotape segment, look for the many types of chemical hazards the Standard *DOES* cover.

Learn to distinguish between physical hazards and health hazards. Also notice the forms chemicals can take, and the ways that chemical hazards get into the air.

If you wish, you may take notes on the following pages as you watch the tape.

Now, watch Videotape Segment 2A,

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APPLICATION EXERCISE 2A-1: Recognizing Chemical Hazards

Directions: Check or circle your answer(s) to each question, or write your answer in the blank provided. When you complete the exercise, fold over the right side of the page to check your answers. Then turn the page to get more information about each question. Remember, there maybe more than one answer.

1) Which of the following terms identify a *HEALTH* hazard associated with exposure to hazardous chemical-s?

- A) Explosives
- B) Irritants
- C) Flammable gases
- D) Gasoline or asphyxiants

2) Which of the following terms describes a *PHYSICAL* hazard of a hazardous chemical?

- A) Compressed gas
- B) Water reactive
- C) Spontaneously combustible
- D) Corrosive

3) The caution label on a can of insect **killer** reads

**DO NOT USE NEAR FIRE OR FLAME. HARMFUL IF
SWALLOWED, INHALED, OR ABSORBED THROUGH SKIN.**

What type of hazard(s) does this chemical present?

- A) Health
- B) Physical

APPLICATION EXERCISE 2A-1: Recognizing Chemical Hazards

Answer Additional Information

1) B D *HEALTH HAZARDS* can cause illness or injury when you are exposed to hazardous chemicals by breathing, swallowing, skin contact, or eye contact.

Irritants can cause injury to whatever part of your body they contact — e.g., skin, eyes, lungs.

Repeated skin contact with igniting explosives or flammable liquids, such as gasoline, can cause skin irritation. Breathing the vapors slows down the central nervous system. Asphyxiants cause suffocation by displacing oxygen in the air.

2) A B C D Chemicals that are *PHYSICAL HAZARDS* can cause explosions, fires, violent chemical reactions, or other hazardous situations,

All compressed gases present a physical hazard because they contain stored energy which can turn the gas cylinder into a powerful rocket.

Some substances are water-reactive and create a hazardous chemical reaction when mixed with water (water-reactive).

Spontaneously combustible chemicals present a fire hazard.

Corrosives can cause a dangerous situation by eating through metals and other materials. They also present a *HEALTH* hazard because they can eat away body tissues, causing burns.

3) A B Many chemicals are both physical and health hazards. This label warns you of a physical hazard (flammability) by telling you not to use the chemical near fire or flame, It warns you of a health hazard by telling you that the chemical is harmful when it enters your body — i.e., when swallowed, inhaled, or absorbed through the skin.

4) Classify each substance as either a SOLID (S), a LIQUID (L), or a GAS (G).

_____ Glue

_____ Solvent

_____ Water

_____ Air

_____ Scouring powder

_____ Plastic

5) Which state of chemical can become airborne and inhaled in the workplace?

A) Solid

B) Liquid

C) Gas

Now go back to page 2-5, fold over the right side of the page, and check your answers. Look on the back of the question page for more information on each question. If you are taking this course as a self-study, continue to Application Exercise 2A-2, "Identifying Sources of Airborne Hazards." If you are taking this course in a classroom situation, wait for further instructions from your trainer when finished.

Answer	Additional Information
4)	Chemical materials exist in one of three basic physical forms,
<u>(L)</u> Glue	<ul style="list-style-type: none">• <i>SOLIDS</i>, such as plastic, hold their shape. Each small granular particle of scouring powder also holds its shape.
<u>(L)</u> Solvent	
<u>(L)</u> Water	
<u>(G)</u> Air	<ul style="list-style-type: none">• <i>LIQUIDS</i> take the shape of their container. Glue, water, and solvents are liquids.
<u>(S)</u> Scouring powder	
<u>(S)</u> Plastic	<ul style="list-style-type: none">• <i>GASES</i> have no definite shape. They can be compressed, and they expand to fill containers. Air is an example of a gas that is everywhere.
5) ABC	Chemicals in <i>ALL</i> physical forms can become airborne. ANY airborne chemical can be inhaled.
	<ul style="list-style-type: none">• Solids become airborne as fumes or dusts.• Liquids become airborne as mists or vapors• Gases become airborne if not contained

**APPLICATION EXERCISE 2A-2:
Identifying Sources of Airborne Hazards**

*Directions: Check or **circle your** answer(s) to each question, or write your answer in the blank provided. When you complete **the exercise**, fold over the right side of the page to check your answers. Then turn the page to get more information about each question.*

1) Which properties are common to all airborne hazards?

- A) Spread out from the source
- B) Settle quickly
- C) Easily seen and smelled
- D) Normally enter the body through breathing

2) What type of airborne hazard probably forms when a solvent such as gasoline is transferred from a drum to a can?

- A) Dust B) Fume C) Vapor D) Mist E) Gas

3) What type of airborne hazard probably results from grinding clean, dry metal parts?

- A) Dust B) Fume C) Vapor D) Mist E) Gas

**APPLICATION EXERCISE 2A-2:
Identifying Sources of Airborne Hazards**

Answer Additional Information

1) A D All airborne hazards —

- . spread out from their source; and
- . enter the body through breathing.

Not all airborne hazards settle quickly. Larger mist droplets and solid particles tend to settle, whereas smaller, lighter ones often remain airborne.

Most airborne hazards are NOT easily seen or smelled. Many are invisible and have no odor. The amount of airborne chemical that is hazardous to your health when inhaled maybe too small for you to see or smell.

2) C Vapors form above any exposed liquid surface.

When a container of liquid is opened or leaks, a vapor is formed. Most liquid transfer operations produce vapors.

3) A Dust (tiny solid particles) becomes airborne during mechanical operations like grinding, crushing, pulverizing, and abrasive cleaning.

Transfer of granular, fibrous, or powdered solids such as cement mix or asbestos, also produces dust.

Solids become airborne as fumes as well, but mechanical operations don't produce fumes. Fumes form when solids are melted.

4) Which airborne hazard(s) is (are) present in smoke?

- A) Dust B) Fume C) Vapor D) Mist E) Gas
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Now fold over the right side of the page, and check your answers. Look on the back of the question page for more information on each question. If you are taking this course as a self-study, proceed to the Lesson Summary when you have finished. If you are taking this course in a classroom situation, wait for further instructions from your trainer when finished.

**Answer****Additional Information**

4) ABE

Smoke is a mixture of fire gases and tiny airborne dust or fume particles.

The fire which produced the smoke can also produce vapors and mists, although these are not part of the smoke itself.

INTRODUCTION TO VIDEOTAPE SEGMENT 2B: Routes of Exposure

Exposure routes are ways that chemicals enter the body. This videotape segment describes four routes of exposure.

- Breathing/Inhalation
- Skin and eye contact
- Skin absorption
- Swallowing/Ingestion

Also look for the factors that affect degree of hazard when you are exposed by one of these routes.

If you wish, you may take notes on the following page as you watch the tape. Now, watch Videotape Segment 2B.

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**APPLICATION EXERCISE 2B:
Understanding How Chemicals Enter Your Body**

Directions: Check or circle your answer(s) to each question, or write your answer in the blank provided. When you complete the exercise, fold over the right side of the page to check your answers. Then turn the page to get more information about each question.

1) How can chemicals enter your bloodstream?

- A) Ingestion
- B) Inhalation
- C) Skin absorption
- D) Skin contact

2) Match the exposure route(s) to the effect most likely to appear immediately.

- | | |
|-------------------------------|--------------------|
| _____ Red, irritated skin | A) Inhalation |
| _____ Difficulty in breathing | B) Ingestion |
| _____ Burned esophagus | C) Skin absorption |
| _____ Headache, dizziness | D) Skin contact |

**APPLICATION EXERCISE 2B:
Understanding How Chemicals Enter Your Body**

Answer Additional Information

- 1) ABC (D) Ingested chemicals can enter the bloodstream from the intestines. Many inhaled chemicals can pass from the lungs into the bloodstream. Some chemicals enter the bloodstream by being absorbed through skin. Skin absorption cannot occur without skin contact, but skin absorption does not always follow skin contact.
Once in the bloodstream, chemicals can affect any part of your body.
- 2) D *RED, IRRITATED SKI...* Skin contact hazards can cause anything from mild irritation and redness to severe burns.
- ABC *DIFFICULTY IN BREATHING.* Inhalation hazards can affect the respiratory system on contact, making it hard to breathe. Chemicals that enter the bloodstream through skin absorption or ingestion can also affect the respiratory system.
- B *BURNED ESOPHAGUS.* Chemicals that are ingested travel from the mouth, down the esophagus, and into the stomach. Damage can occur anywhere along this route.
- ABC *HEADACHE, DIZZINESS.* Headache and dizziness occur when some chemicals enter the bloodstream — whether by inhalation, ingestion, or skin absorption.

- 3) Joe welds occasionally as part of his job in a repair shop. Harry does the same kind of welding all day as part of his job. The degree of hazard is higher for

_____.

Now fold over the right side of the page, and check your answers. Look on the back of the question page for more information on each question. When you have finished, either review the tape or proceed to the Lesson Summary.

Answer Additional Information

3) Harry The degree of hazard greatly depends on dosage —

- how *MUCH* you are exposed to each time;
- how *LONG* each exposure lasts; and
- . how *OFTEN* you are exposed.

Harry's dosage is higher because he is exposed eight hours a day, five days a week. Joe does not weld all day every workday.

LESSON 2 SUMMARY

The Hazard Communication Standard defines two main categories of chemical hazards:

- **PHYSICAL HAZARDS** are chemicals that cause explosion, fires, violent chemical reactions, or other hazardous situations.
- **HEALTH HAZARDS** are chemicals that can cause illness or injury when inhaled or swallowed, or through contact with the skin or eyes.

All chemicals exist in one of three basic forms:

- **SOLIDS** have a definite shape and can become airborne as dust or fume particles.
- **LIQUIDS** take the shape of their container and can become airborne as mists or vapors.
- **GASES** are easily compressed, expand to fill a container, and become airborne when not contained.

Both *DUSTS* and *FUMES* are made up of tiny solid particles. Mechanical operations like grinding and crushing produce dust, So does transfer of powdered or fibrous solids and abrasive cleaning. Fumes form by vapor condensation when solids are melted in operations like welding and metal casting.

VAPORS are formed above any exposed liquid surface. Heating a liquid makes it vaporize more quickly, *MIST* is made up of tiny droplets that become airborne when liquids are sprayed, agitated, or applied to a hot surface. Mists also form when hot vapors cool in air and condense.

Exposure routes are ways that chemicals enter your body, There are four main routes of exposure:

- *BREATHING/INHALATION* takes a chemical from your nose or mouth, down your windpipe, and into your lungs. Some chemicals get trapped in your lungs. Others leave when you breathe out. But many pass from your lungs into your bloodstream.
- *SKIN/EYE CONTACT* can cause anything from reddening or itching to severe rashes, burns, loss of eyesight or even death.
- *SKIN ABSORPTION* hazards pass through the skin on contact and enter the bloodstream. Once in your bloodstream, chemicals can spread throughout your body and cause injury or disease far away from the original site of contact. Chemicals can also be absorbed through the mucous membranes of the eye.
- *SWALLOWING/INGESTION* takes a chemical from your mouth, down your esophagus, and into your stomach. From your stomach, many chemicals enter the intestines, where they can be absorbed into the bloodstream and spread throughout your body, Damage can be done at any point along the way.

The *DEGREE OF HAZARD* associated with exposure to health hazards depends on the following,

. *TOXICITY* of the chemical

Toxicity	Effects of Exposure
Low	Minor symptoms that go away when exposure stops
Medium	Require medical attention, may be permanent
High	Can cause death or severely disabling conditions

• *EXPOSURE ROUTE*

Some chemicals are more toxic by one exposure route than by another. For example, onion juice vapor irritates the eyes, but skin contact with onion juice produces little or no effect.

. *DOSAGE*, which depends on —

- How *MUCH* you are exposed to each time;
- How *LONG* each exposure lasts; and
- How *OFTEN* you are exposed.

. *INDIVIDUAL DIFFERENCES*, such as the following:

- Work practices
- Age and size
- General physical and emotional health
- Allergies and sensitivities
- Level of exertion
- Combination of chemicals in the body, which depends on what medications you are taking and whether or not you smoke tobacco or drink alcoholic beverages.