

# **Welcome to The HAZWOPER 8-Hour Refresher Training**



# Introduction

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# Agenda

- Regulations
- Toxicology
- Hazard Recognition
- Respirator
- Chemical Toxicology
- Biological and Radiological Toxicology
- Personal Protective Equipment
- Review
- Written Test



# Regulations



# Occupational Safety and Health ACT

Effective April 28, 1971

Requires:

- All workers have a safe and healthy work environment.
- All employers to take steps to protect employees from recognized hazards or eliminate such hazards.
- Provides employee rights and responsibilities.



# What is HAZWOPER?

## Hazardous Waste Operations and Emergency Response

- Standards issued by OSHA in 1989
  - [29 CFR 1910.120](#) - General Industry
  - [29 CFR 1926.65](#) - Construction



# What is HAZWOPER?

## EPA HAZWOPER versus OSHA HAZWOPER

- Fed OSHA
- State Plans
- EPA – 40 CFR 311
  - State and Local Government
  - Employees and Volunteers



# What is HAZWOPER?

To protect workers and enable them to handle hazardous substances safely and effectively.



# What is HAZWOPER?

- Hazardous Waste Sites
- Treatment, Storage and Disposal Sites
- Emergency Response regardless of location



# What is HAZWOPER?

- Hazardous Waste Sites
- Treatment, Storage and Disposal Sites
- Emergency Response regardless of location



# CERCLA

## **Comprehensive Environmental Response Compensation Liability Act**

- Commonly referred to as the Superfund law, requires cleanup of releases of hazardous substances in the air, water, groundwater, and on the land.
- Both new spills and leaking or abandoned dumpsites are covered.



# RCRA

## Resource Conservation and Recovery Act

*- Effective October 21, 1976, with three distinct goals.*

- To protect human health and the environment
- To reduce waste and conserve energy and natural resources
- To reduce or eliminate the generation of hazardous waste as efficiently and quickly as possible
- Governs wastes from “cradle to grave”



# SARA

## Superfund Amendments and Reauthorization Act

- Effective 1986, Gave more authority to the EPA and reauthorized funding
- Mandated OSHA to develop health and safety standards for hazardous waste workers. (HAZWOPER regulations)
- SARA Title III - Community Right to Know



# TSCA

## Toxic Substance Control Act

- Sets standards for the manufacturing, handling and use of toxic chemicals.
- Requires employees to be trained on the hazards associated with handling and use of toxic chemicals.



# Regulations

Work Operation	HAZWOPER Standard	Examples of Work Activities
<p><b>CLEANUP OPERATIONS</b></p> <ul style="list-style-type: none"> <li>▪ Cleanup operations required by a governmental body or other operations involving hazardous substances conducted at uncontrolled hazardous waste sites.</li> <li>▪ Voluntary cleanup operations at sites recognized by federal, state, local, or other governmental bodies as hazardous waste sites.</li> </ul> <p><b>Corrective Actions</b></p> <ul style="list-style-type: none"> <li>▪ Corrective actions involving cleanup operations at sites covered by RCRA.</li> </ul>	<p><a href="#">29 CFR 1910.120(b)-(o)</a></p>	<ul style="list-style-type: none"> <li>▪ Site characterization of hazardous waste site</li> <li>▪ Drum removal</li> <li>▪ Contaminated soil removal</li> <li>▪ Underground Storage Tank (UST) removal</li> </ul>



# Regulations

Work Operation	HAZWOPER Standard	Examples of Work Activities
<p><b>OPERATIONS at TSD FACILITIES</b></p> <ul style="list-style-type: none"><li>▪ Operations involving hazardous waste conducted at TSD facilities regulated by 40 CFR 264 and 265 pursuant to RCRA or by agencies under agreement with EPA to implement RCRA regulations.</li></ul>	<p><a href="#">29 CFR 1910.120(p)</a></p>	<ul style="list-style-type: none"><li>▪ Treating waste for disposal at RCRA landfill</li><li>▪ Handling waste at RCRA landfill</li></ul>



# Regulations

Work Operation	HAZWOPER Standard	Examples of Work Activities
<p><b>OPERATIONS that GENERATE HAZARDOUS WASTE but are not TSD FACILITIES</b></p> <ul style="list-style-type: none"><li>▪ Businesses generating hazardous waste as a by-product of their production operations, store it for a short time, and then send to a TSD facility.</li></ul>	<p><a href="#">29 CFR 1910.120(p)(8)</a> and/or <a href="#">(q)</a></p>	<ul style="list-style-type: none"><li>▪ Response by facility's workers to spill of hazardous substance in production area</li><li>▪ Response by facility's workers to leaking hazardous waste in storage area</li></ul>

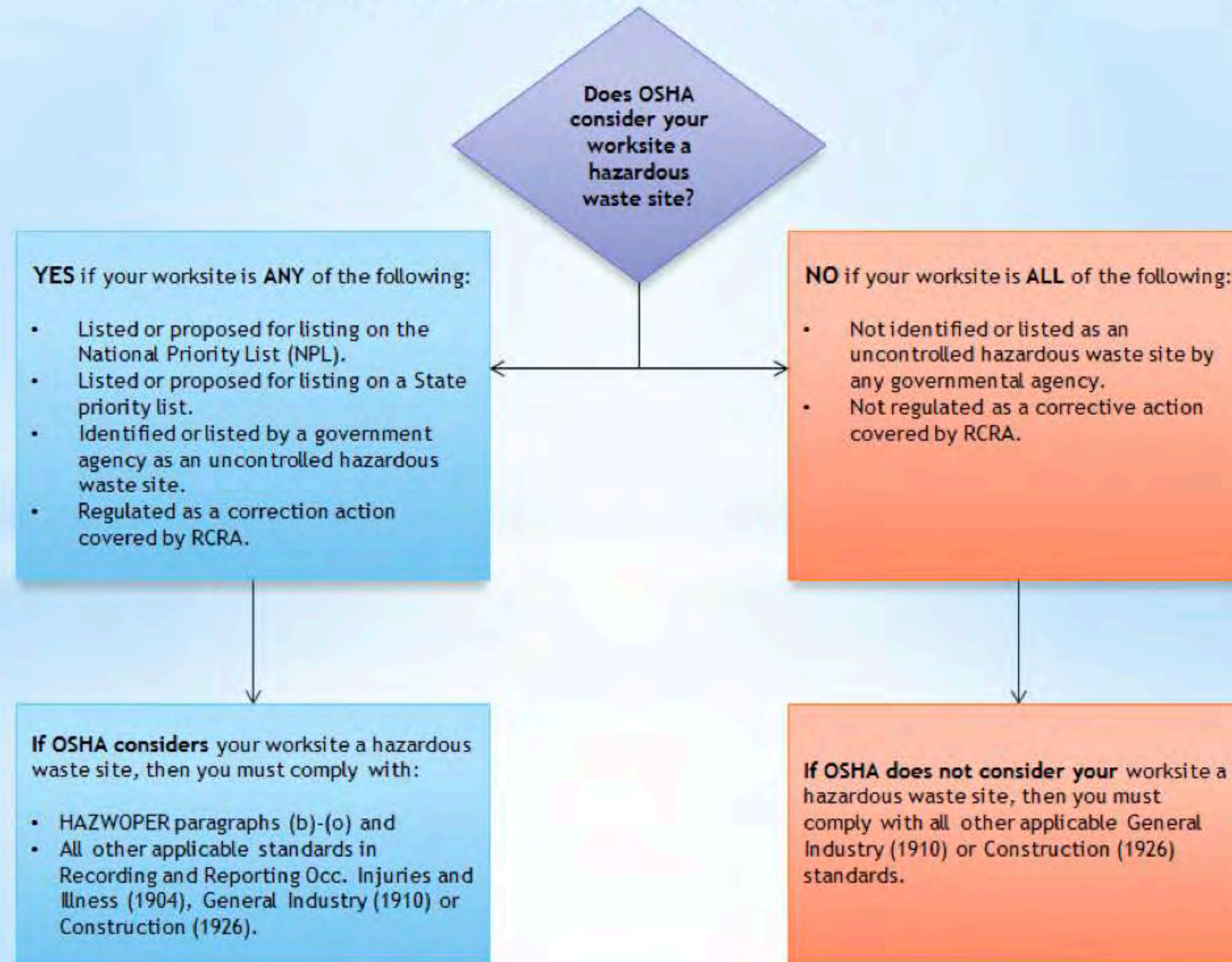


# Regulations

Work Operation	HAZWOPER Standard	Examples of Work Activities
<p data-bbox="369 643 1052 765"><b>EMERGENCY RESPONSE OPERATIONS</b></p> <ul data-bbox="336 784 1096 1191" style="list-style-type: none"><li data-bbox="336 784 1096 1191">▪ Emergency response operations for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazards.</li></ul>	<p data-bbox="1226 643 1745 699"><a href="#"><u>29 CFR 1910.120(q)</u></a></p>	<ul data-bbox="1875 643 2638 1303" style="list-style-type: none"><li data-bbox="1875 643 2638 774">▪ Response to a leaking storage tank</li><li data-bbox="1875 793 2638 999">▪ Response to an overturned truck carrying hazardous materials</li><li data-bbox="1875 1018 2638 1074">▪ Response to a chemical fire</li><li data-bbox="1875 1093 2638 1303">▪ Response to ruptured railroad tank car loaded with hazardous substance(s)</li></ul>



## HAZARDOUS WASTE SITE CLEANUP OPERATIONS





# OSHA Regulations



# Rights & Responsibilities

## Rights

- To a safe work place
- To request an inspection
- To request information on safety and health hazards in the work place
- To exercise your rights without discrimination

## Responsibilities

- Comply with all OSHA Standards
- Follow all safety rules and wear appropriate PPE
- Report hazardous conditions to your supervisor
- Report any illness or injury promptly



# 29 CFR 1910.120

- Hazardous Waste Sites
  - a. Superfund Sites
  - b. Corrective action/Clean up at RCRA Sites
  - c. Voluntary Clean up recognized by Governmental agencies
- Treatment, Storage and Disposal Sites
- Emergency Response



# HAZWOPER Standard

- Scope, Application and Definitions
- Safety and Health Program
- Site Characterization
- Site Control
- Training
- Medical Surveillance
- Engineering Controls
- Monitoring
- Informational Programs
- Handling Drums and Containers
- Decontamination
- Emergency Response
- Illumination
- Sanitation
- New Technology



# Safety & Health Program

- Organizational Structure
- Comprehensive Work plan
- Site-Specific Health and Safety Plans (HASP)
- Health and Safety Training Program
- Medical Surveillance Program
- Standard Operating Procedures
- Coordination/Interface Procedures



# Toxicology



# Toxicology

## Introduction

- According to the CDC, diseases caused by industrial chemical exposure on the job account for an estimated 50,000-70,000 deaths, and 350,000 new cases of illness  
CERCLA
- It has been estimated that about 70,000 chemicals are used worldwide, and the chemical industry introduces about 200 to 1,000 new chemicals each year





# Toxicology

- Define "toxicology" and other terms
- Explain exposure routes
- Understand physiological effects that occur after exposure
- Discuss excretion pathways
- Identify toxic agent classifications and effects of substances





# Toxicology

## Toxicology

The study of how natural or man-made poisons cause undesirable effects in living organisms

## Occupational (Industrial) Toxicology

The study of health effects from exposure to harmful substances in the workplace

## Toxicity

- The degree to which a substance is harmful.
- Depends on:
  - Dose
  - Duration
  - Route of exposure
  - Chemical structure
  - Individual human condition





# Toxicology

## Toxicant

- Any chemical that can harm living organisms
- Used to discuss substances that are the product of man-made activities
- Ex: Acetone, a cleaning agent

## Toxin

- Any chemical that can harm living organisms
- Used to discuss substances that are naturally occurring Mycotoxins, found in some molds



# Toxicology

## Dose

- The amount of a chemical that enters the body

## Acute exposure

- Occurs in a short amount of time
- Typically less than 24 hours

## Chronic exposure

- Occurs over a longer period of time
- Can range from a week to several years



# Toxicology

## Dose-Response

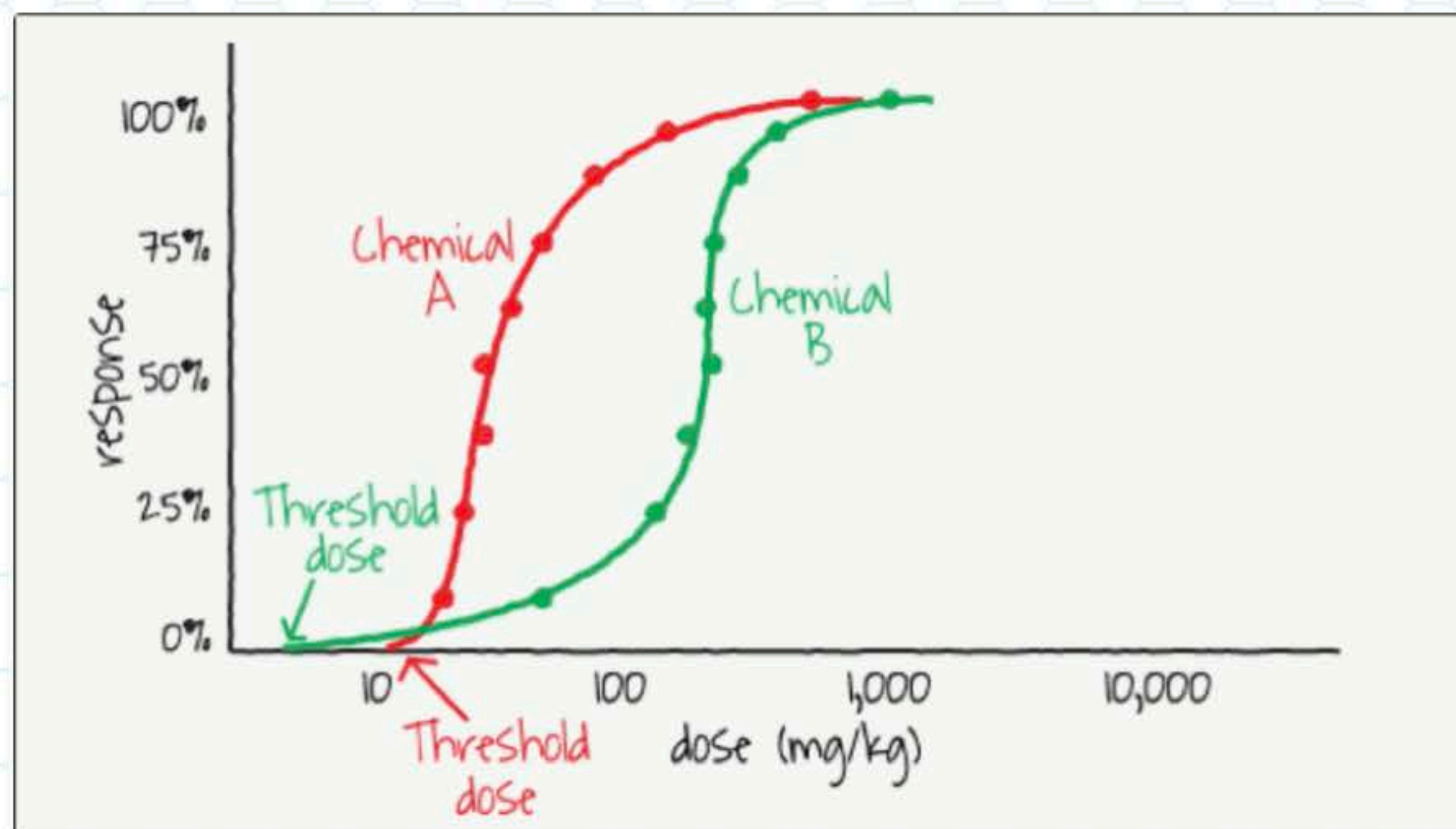
- The relationship between exposure and subsequent health effects
- Helps determine the actual amount of a substance required to cause harm Paracelsus





# Toxicology

## Dose-Response Curve





# Toxicology

## IDLH

- Concentration Immediately Dangerous to Life and Health

## LD<sub>50</sub>

- LD stands for "Lethal Dose".
- The amount of a material, given all at once, which causes the death of 50% (one half) of a group of test animals.

## LC<sub>50</sub>

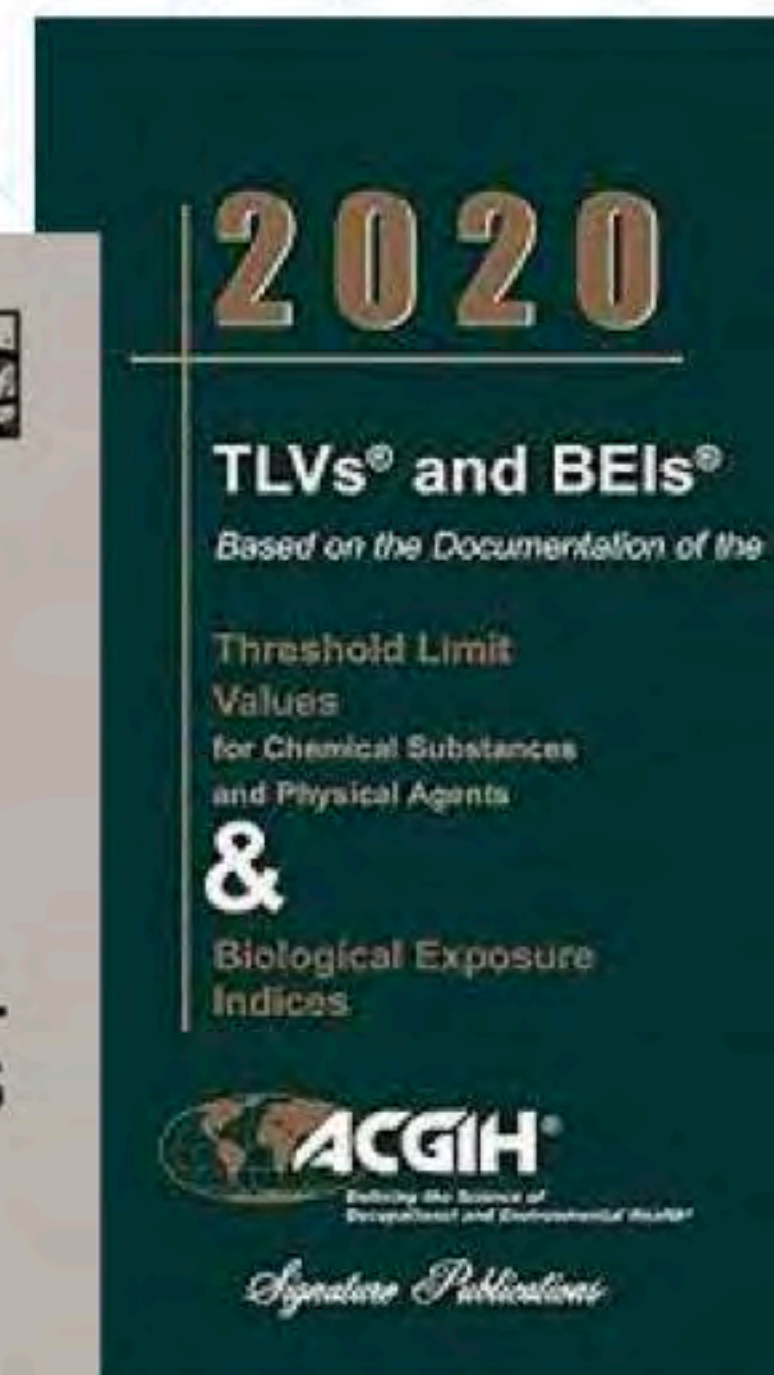
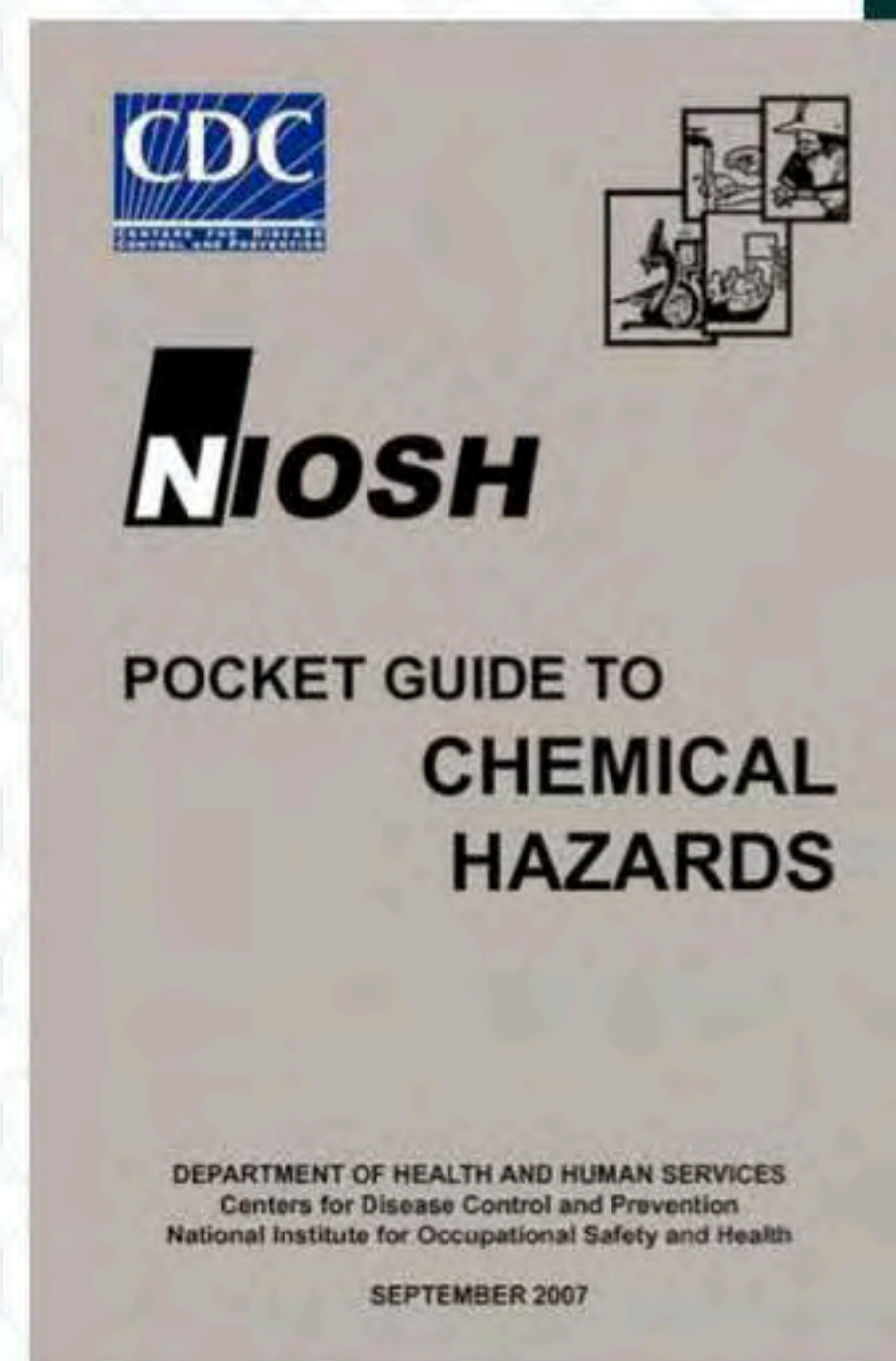
- LC stands for "Lethal Concentration".
- The concentrations of the chemical in air that kills 50% of the test animals during the observation period is the LC<sub>50</sub> value.



# Toxicology

## Occupational Exposure Limits

- **Permissible Exposure Limit (PEL)**
  1. OSHA
- **Threshold Limit Value (TLV)**
  2. ACGIH
- **Recommended Exposure Limit (REL)**
  3. NIOSH





# Toxicology

## Occupational Exposure Limits

### TWA – Time Weighted Average

- Usually in ppm or mg/m<sup>3</sup>

1% = 10,000 ppm

- Concentration averaged over the work shift – usually 8 hours

### Worker Exposure to Chemical X During an 8 Hour Shift

4 hours – 20 ppm

2 hours – 10 ppm

2 hours – no exposure

$$\frac{(4 \times 20) + (2 \times 10) + (2 \times 0)}{8} = 12.5 \text{ ppm}$$



# Toxicology

## Occupational Exposure Limits

### STEL – Short Term Exposure Limit

- 15-minute time weighted average exposure
- Should not be exceeded at any time during a workday
- Not to be exposed more than 4 times per day
- At least a 60 minute interval between exposures

### Ceiling

- Concentration that must not be exceeded at any time during the work shift.



# Toxicology

Acute exposure occurs in a \_\_\_\_\_ amount of time.

Long

Moderate

Short

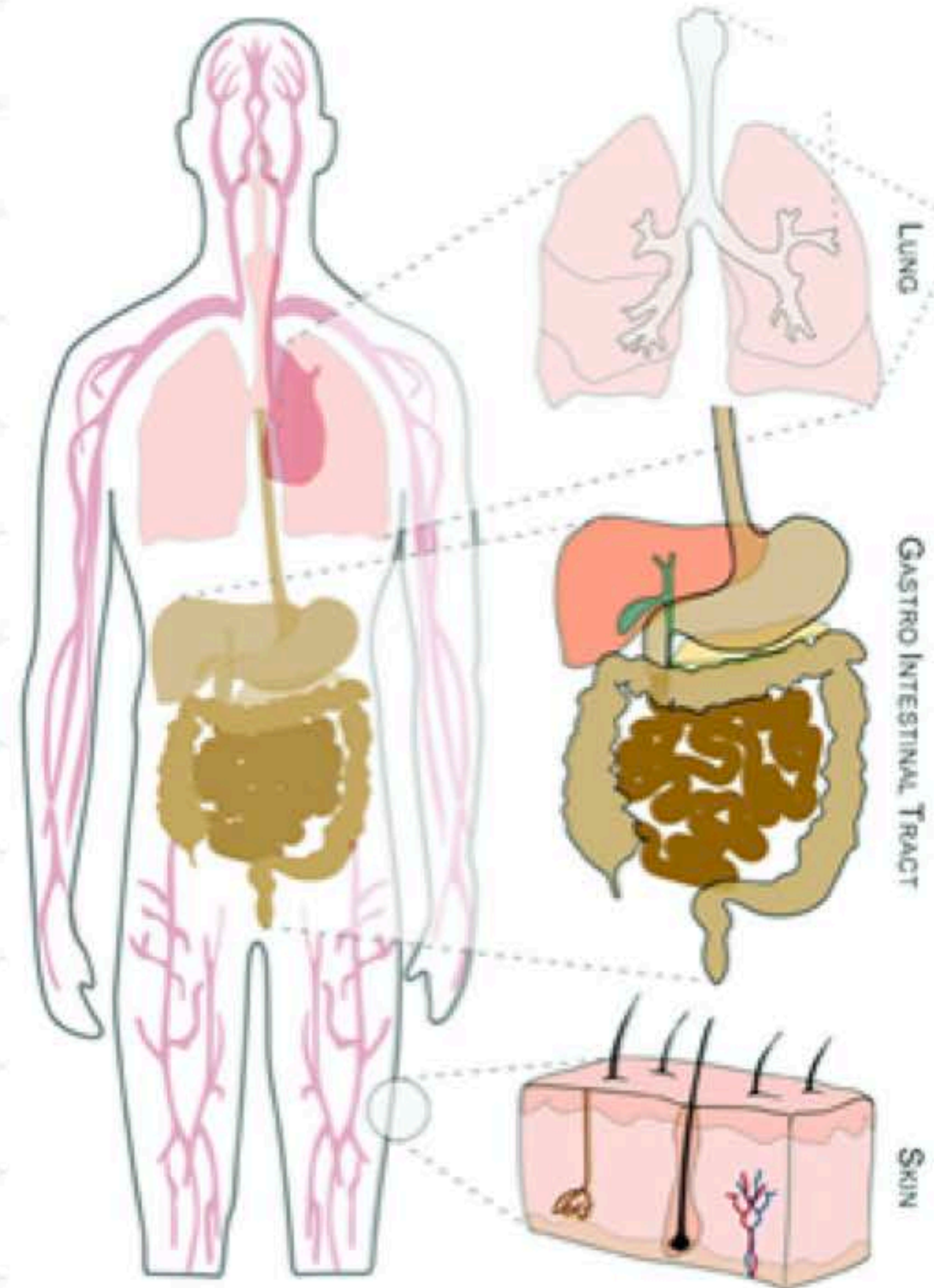
None of the above



# Toxicology

## Exposure Routes

- Inhalation
- Ingestion
- Absorption
- Injection

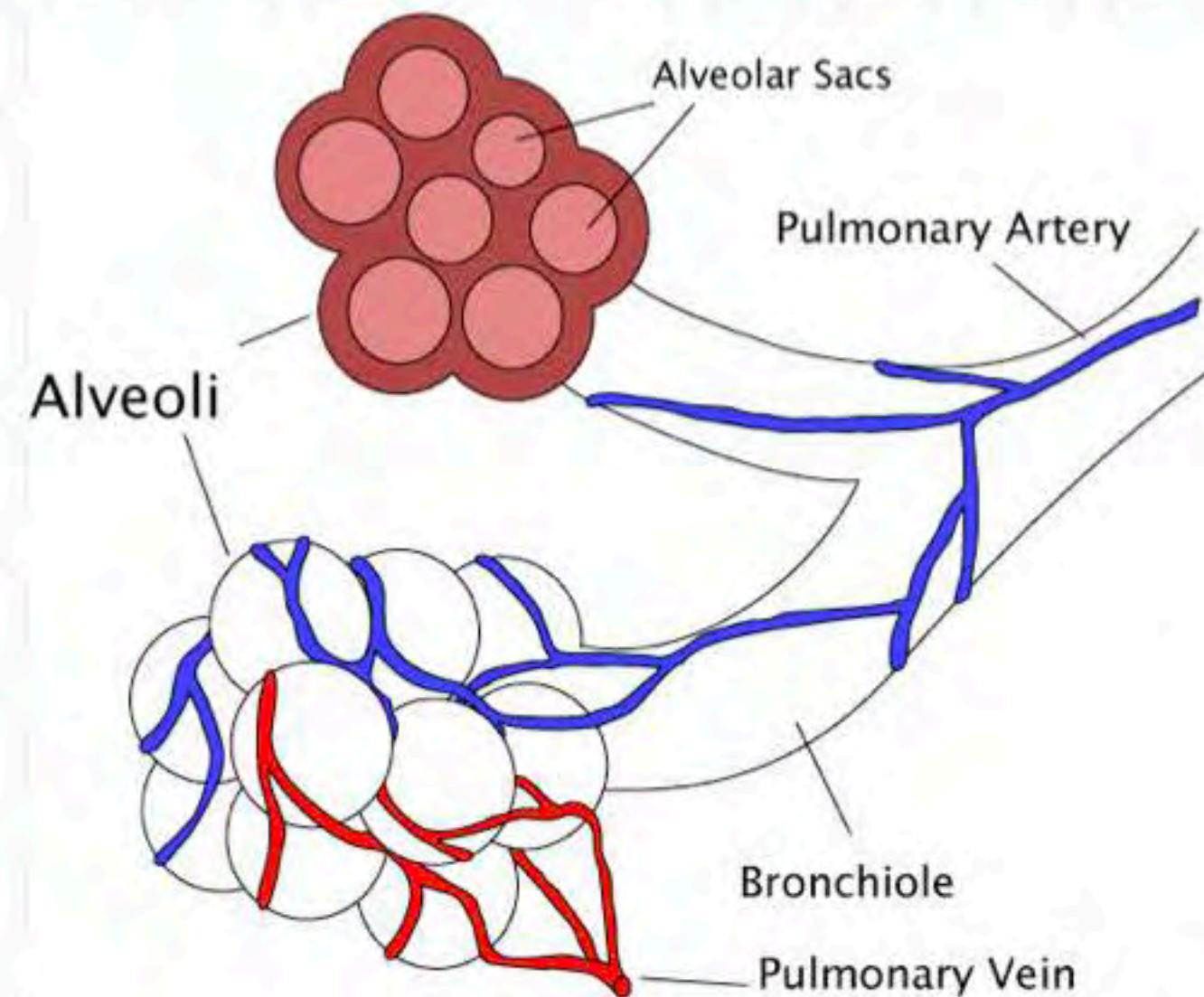




# Toxicology

## Inhalation

- When a substance enters the body via the mouth or nose and travels through the respiratory tract to the lungs
- The fastest exposure route



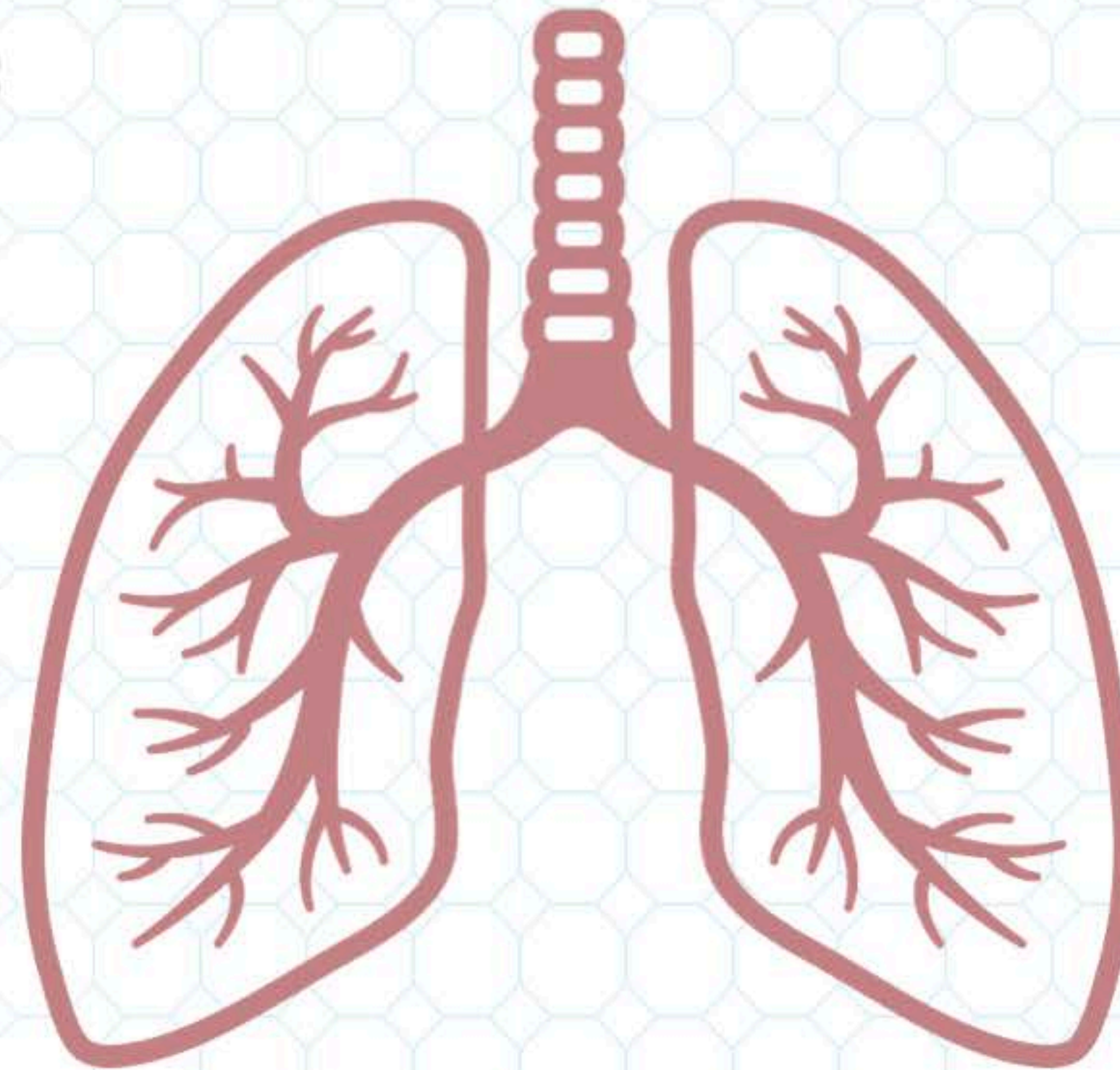


# Toxicology

## Inhalation

### Factors that affect exposure by inhalation:

- Concentration of substance
- Solubility of substance in the bloodstream
- Respiration Rate
- Length of exposure time
- Physical condition of workers
- Size of substance particles

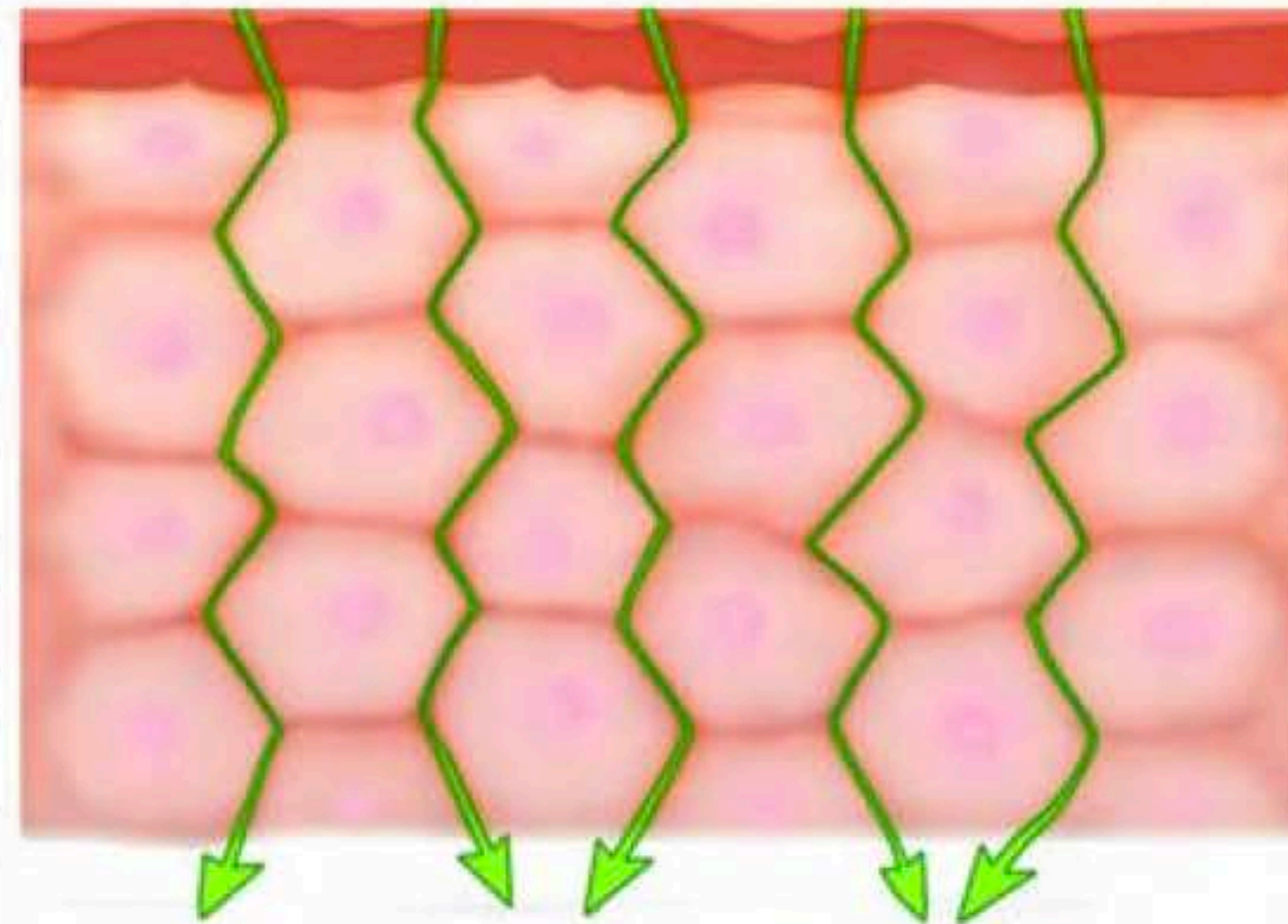




# Toxicology

## Dermal Absorption

- The transport of a chemical from the outer surface of the skin both into the skin and into the body.

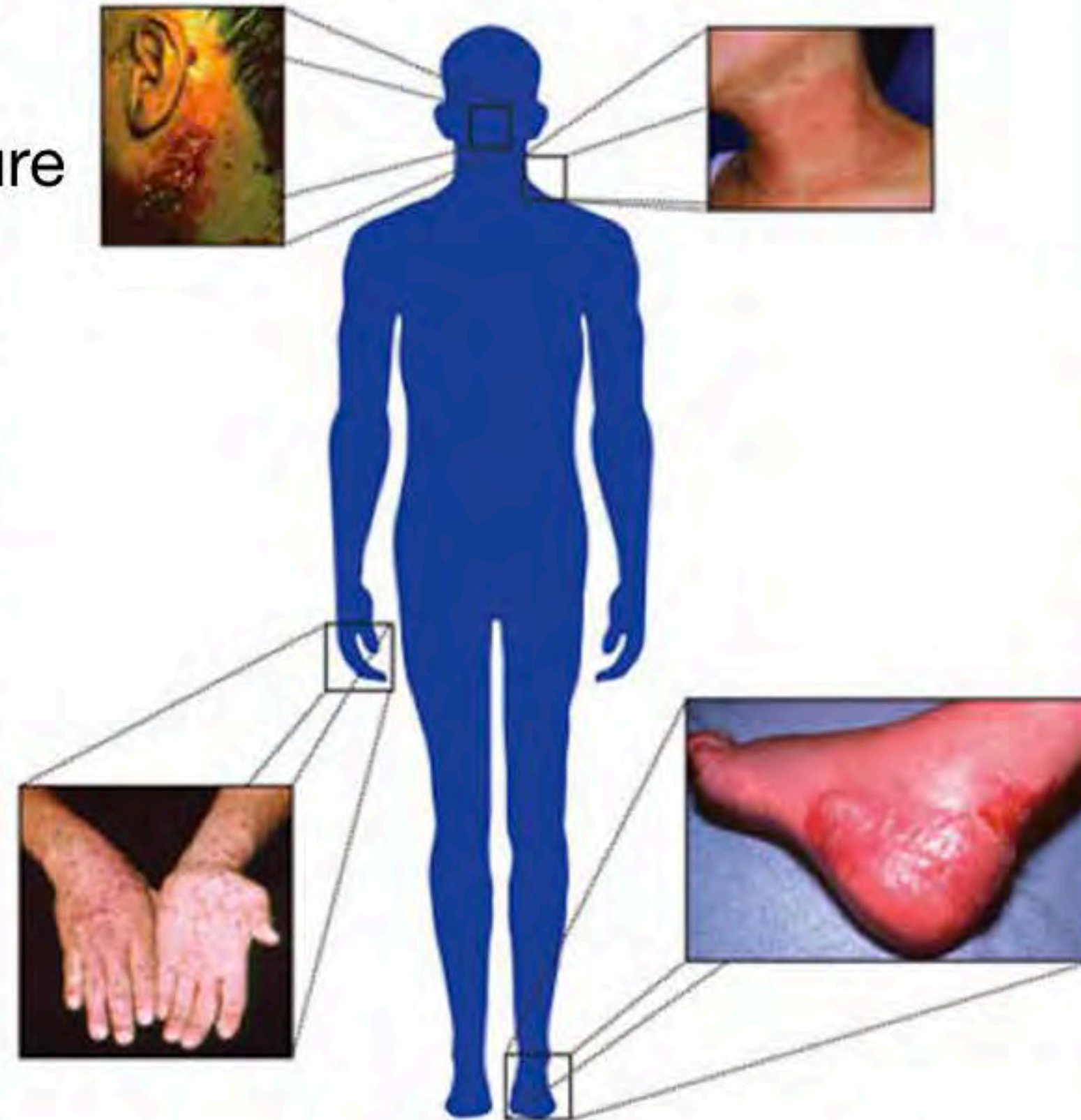




# Toxicology

## Dermal Absorption Into the Skin - Contact Dermatitis

- Inflammation of the skin resulting from exposure to a hazardous agent.
- Common symptoms of dermatitis include:
  1. Itching
  2. Pain
  3. Redness
  4. Swelling
  5. Formation of small blisters





# Toxicology

## Dermal Absorption

Occupational contact dermatitis is frequently divided into two categories:

- **Irritant contact dermatitis (ICD)**

- A non-immunologic reaction that manifests as an inflammation of the skin caused by direct damage to the skin following exposure to a hazardous agent. The reaction is typically localized to the site of contact.

- **Allergic contact dermatitis (ACD)**

- Caused by an immunologic reaction triggered by dermal contact to a skin allergen.
- A worker must be first sensitized to the allergen. Subsequent exposures of the skin to the allergenic agent may elicit an immunologic reaction resulting in inflammation of the skin.



# Toxicology

## Dermal Absorption – Into the Body

The extent of absorption into the body is dependent on the following factors:

- Skin integrity (damaged vs. intact)
- Location of exposure (thickness and water content; skin temperature)
- Physical and chemical properties of the hazardous substance
- Concentration of a chemical on the skin surface
- Duration of exposure
- The surface area of skin exposed to a hazardous substance

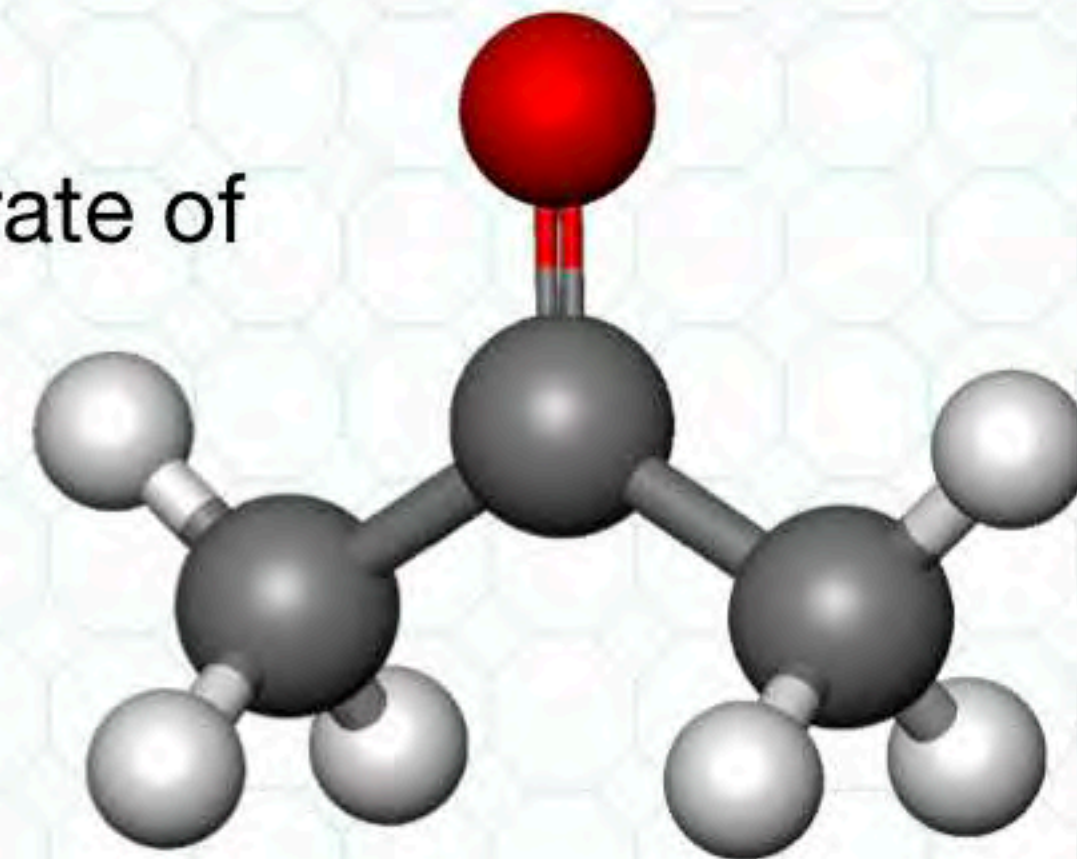




# Toxicology

## Chemical structure

- Inorganic substances (lead, mercury, chromium) are not readily absorbed
- Organic substances that are part of aqueous solutions are not absorbed because skin is water resistant
- Organic solvents (acetone, gasoline) easily penetrate skin
- Increased concentration and/or exposure time increases rate of absorption





# Toxicology

Occurs when a substance enters the body through the mouth and then travels through the digestive track to the stomach and Intestines

Factors that affect ingestion include:

- Individual worker metabolism
- Chemical structure of the substance determines how easily It can be broken down by the body

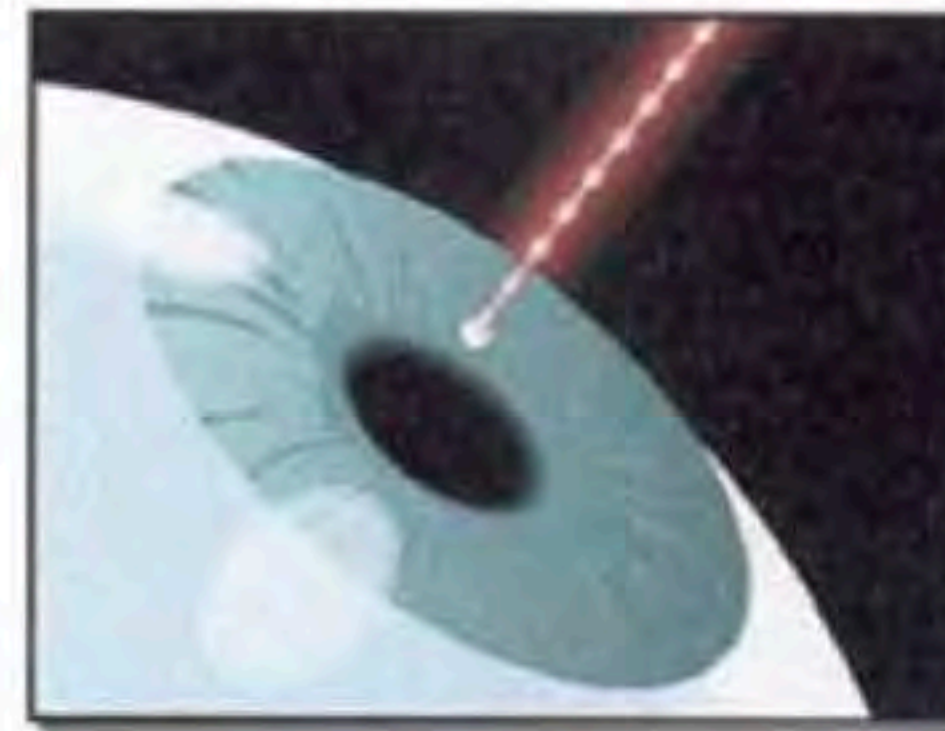




# Toxicology

## Corneal Absorption

- Cornea the transparent front of the eye that covers the iris, pupil and anterior chamber
- Compounds that are acidic or basic are the most common eye irritants
- Cornea can often repair itself
- Factors that can affect extent of damage:
  1. pH of substance
  2. Amount of substance
  3. Duration of exposure time





# Toxicology

## Injection

- Mechanical injury from glass or metal contaminated with chemicals
- When chemicals are handled in syringes
- High pressure release of chemical

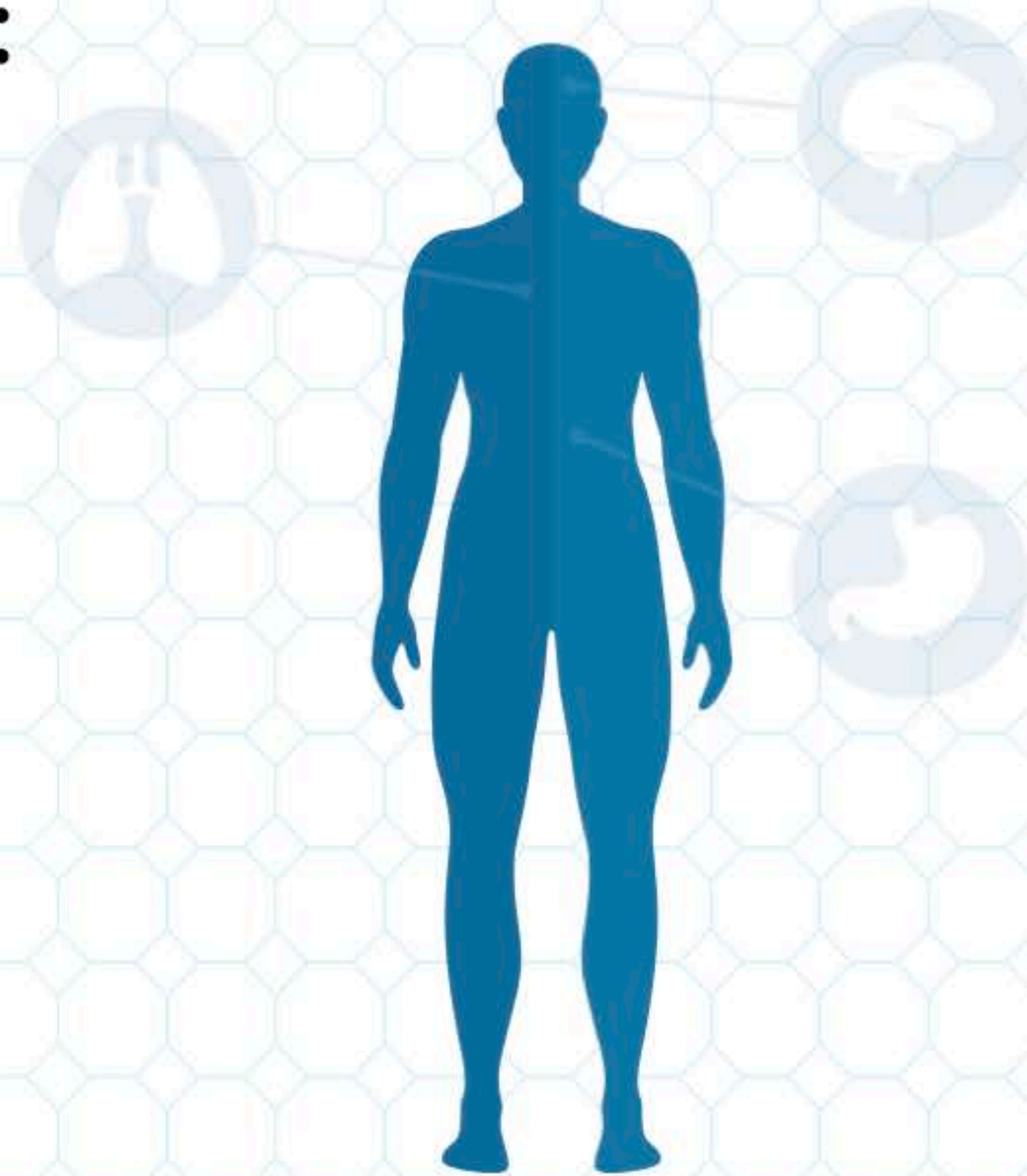




# Toxicology





**The fastest exposure route is:**

- Inhalation
- Ingestion
- Absorption
- Injection





# Toxicology

Pictogram	Hazard Class	Category	Description
	Skin corrosion	Category 1A, 1B, 1C	Irreversible skin damage
	Serious eye damage	Category 1	Irreversible eye damage
	Acute toxicity, oral	Category 1, 2, 3	Highly toxic in small amounts, serious health effects or death
	Acute toxicity, dermal	Category 1, 2, 3	
	Acute toxicity, inhalation	Category 1, 2, 3	
	Aspiration Hazard	Category 1, 2	May be fatal if aspirated
	Sensitization, respiratory	Category 1, 1A, 1B	Induces hypersensitivity of the airways
	Germ cell mutagenicity	Category 1A, 1B, 2	May cause genetic defects
	Carcinogenicity	Category 1A, 1B, 2	May cause cancer
	Reproductive Toxicity	Category 1A, 1B, 2	May damage fertility; may damage the unborn child
	Specific target organ toxicity, single exposure	Category 1, 2	Causes damage to organs
	Specific target organ toxicity, repeated exposure	Category 1, 2	Causes damage to organs through prolonged or repeated exposure
	Eye irritation	Category 2A	Causes serious eye irritation
	Skin irritation	Category 2	Causes skin irritation
	Acute Toxicity, oral	Category 4	Harmful if swallowed
	Sensitization, skin	Category 1	May cause an allergic skin reaction
	Acute toxicity, dermal	Category 4	Harmful in contact with skin
	Specific target organ toxicity, single exposure, Respiratory tract irritation	Category 3	May cause respiratory irritation
	Specific target organ toxicity, single exposure, Narcotic effects	Category 3	May cause drowsiness or dizziness



# Recognizing Hazardous Materials

Understanding the nature of potentially  
harmful substances

- Chemical Properties Determine type of dangers
- Dictate the way substances should be handled
- Hazard Communication





# Recognizing Hazardous Materials

## Workplace vs Transportation

- Department of Labor (DOL)
- Occupational Safety and Health Administration (OSHA)
- Department of Transportation (DOT)
- Pipeline and Hazardous Materials Safety Administration (PHMSA)



# Recognition

## Hazard Communication OSHA 1910.120 - HazCom

- Hazards of all chemicals produced or imported are classified
- Information concerning the classified hazards is transmitted to employers and employees.





# Recognition

## US DOT – PHMSA 49 CFR 172.101 Hazardous Materials Regulation (HMR)

- Table of more than 3500 Hazardous Substances
- Forbidden or demand special Transportation requirements





# Recognition



U.S. Department of Transportation

Pipeline and Hazardous Materials  
Safety Administration

## **PHMSA/OSHA** Hazard Communications



[https://www.youtube.com/watch?  
v=g9EesPwskkl&ab\\_channel=PipelineandHazardousMaterialsSafetyAdministration](https://www.youtube.com/watch?v=g9EesPwskkl&ab_channel=PipelineandHazardousMaterialsSafetyAdministration)



# Recognition

## Hazard Communication Standard (HCS)

- 29 CFR 1910.1200(g)
- Revised in 2012
- Safety Data Sheets (SDS)
- Labels



# Recognition

## SDS vs MSDS



# Recognition

## SDS

### Section 1: Identification

- Product Identifier
- Manufacturer Info
- Recommended Use



# Recognition SDS

## Section 2: Hazard Identification

- The hazard classification of the chemical.
- Signal word.
- Hazard statement(s).
- Pictograms.
- Precautionary statement(s).
- Hazard not otherwise classified.
- Unknown Toxicity



# Recognition

## SDS

### Section 3: Composition/Information on Ingredients

- Substances
- Mixtures
- Trade Secrets



# Recognition

## SDS

### Section 4: First Aid Measures

- First Aid Instructions
- Symptoms
- Medical Care



# Recognition

## SDS

### **Section 5: Fire Fighting Measures**

- Extinguishing Equipment
- Specific Hazards with Fire
- Precautions for Firefighters



# Recognition

## SDS

### **Section 6: Accidental Release Measures**

- Personal Precautions
- Emergency Procedures
- Methods for Containment
- Cleanup Procedures



# Recognition

## SDS

### **Section 7: Handling and Storage**

- Precautions for Safe Handling
- Conditions for Safe Storage



# Recognition

## SDS

### **Section 8: Exposure Controls/Personal Protection**

- PELs, TLVs, other exposure limits
- Engineering Controls
- Personal Protective Measures
- Special Requirements for PPE



# Recognition

## SDS

### Section 9: Physical and Chemical Properties

- Appearance (physical state, color, etc.)
- Odor
- Odor threshold
- pH
- Melting/freezing point
- Initial boiling point and boiling range
- Flash point



# Recognition SDS

## Section 9: Physical and Chemical Properties

- Evaporation Rate
- Flammability (solid, gas)
- Upper/lower flammability/explosive limits
- Vapor pressure/Vapor density/Relative density
- Solubility(ies)
- Partition coefficient: n-octanol/water
- Auto-ignition temperature/Decomposition temperature
- Viscosity



# Recognition

## SDS

### **Section 10: Stability and Reactivity**

- Reactivity
- Chemical Stability
- Other



# Recognition

## SDS

### **Section 11: Toxicological Information**

- Routes of Exposure
- Effects from Exposures
- Measures of Toxicity
- Symptoms
- Carcinogen Listing



# Recognition

## SDS

### **Section 12: Ecological Information**

- Toxicity Tests for Organisms
- Biodegradation
- Bioaccumulation
- Soil to Groundwater Movement
- Other Adverse Environmental Effects



# Recognition

## SDS

### **Section 13: Disposal Considerations**

- Disposal Containers
- Disposal Methods
- Properties that Effect Disposal Activities
- Language Discouraging Sewage Disposal
- Special Precautions for Landfills or Incineration



# Recognition SDS

## Section 14: Transportation Information

- UN Number
- UN Proper Shipping Name
- Transport Hazard Class(s).
- Packing Group Number
- Environmental Hazards
- Guidance on Transport



# Recognition

## SDS

### **Section 15: Regulatory Information**

- Safety, health, and environmental regulations specific for the product that are not indicated anywhere else on the SDS.



# Recognition

## SDS

### **Section 16: Other Information**

- Preparation or Revision Date
- Other Information from Manufacturer



# Recognition

**Review SDS for Picric Acid and tell story about bomb squad response to school chemistry lab storage room.**

**<https://www.weizmann.ac.il/safety/sites/safety/files/uploads/MSDS/Picric%20acid.pdf>**



# Recognition

# Labels



## SAMPLE LABEL

CODE \_\_\_\_\_  
Product Name \_\_\_\_\_ } **Product Identifier**

Company Name \_\_\_\_\_  
Street Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_  
Postal Code \_\_\_\_\_ Country \_\_\_\_\_  
Emergency Phone Number \_\_\_\_\_ } **Supplier Identification**

### Hazard Pictograms



**Signal Word**  
Danger

Keep container tightly closed. Store in a cool, well-ventilated place that is locked.  
Keep away from heat/sparks/open flame. No smoking.  
Only use non-sparking tools.  
Use explosion-proof electrical equipment.  
Take precautionary measures against static discharge.  
Ground and bond container and receiving equipment.  
Do not breathe vapors.  
Wear protective gloves.  
Do not eat, drink or smoke when using this product.  
Wash hands thoroughly after handling.  
Dispose of in accordance with local, regional, national, international regulations as specified.

### Precautionary Statements

Highly flammable liquid and vapor.  
May cause liver and kidney damage.

### Hazard Statements

**In Case of Fire:** use dry chemical (BC) or Carbon Dioxide (CO<sub>2</sub>) fire extinguisher to extinguish.

### First Aid

If exposed call Poison Center.  
If on skin (or hair): Take off immediately any contaminated clothing. Rinse skin with water.

### Supplemental Information

#### Directions for Use

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Fill weight: \_\_\_\_\_ Lot Number: \_\_\_\_\_  
Gross weight: \_\_\_\_\_ Fill Date: \_\_\_\_\_  
Expiration Date: \_\_\_\_\_



# Recognition

## Hazard Communication Standard (HCS)

- **Carcinogen**
- **Mutagenicity**
- **Reproductive Toxicity**
- **Respiratory Sensitizer**
- **Target Organ Toxicity**
- **Aspiration Toxicity**

## Health Hazard





# Recognition

## Hazard Communication Standard (HCS)

- **Flammables**
- **Pyrophorics**
- **Self-Heating**
- **Emits Flammable Gas**
- **Self-Reactives**
- **Organic Peroxides**

## Flame





# Recognition

## Hazard Communication Standard (HCS)

- Irritant (skin and eye)
- Skin Sensitizer
- Acute Toxicity
- Narcotic Effects
- Respiratory Tract Irritant
- Hazardous to Ozone Layer  
(Non-Mandatory)

## Exclamation Mark





# Recognition

## Hazard Communication Standard (HCS)

- **Gases Under Pressure**

## Gas Cylinder





# Recognition

## Hazard Communication Standard (HCS)

- **Skin Corrosion/Burns**
- **Eye Damage**
- **Corrosive to Metals**

## Corrosion





# Recognition

## Hazard Communication Standard (HCS)

- **Explosives**
- **Self-Reactives**
- **Organic Peroxides**

## Exploding Bomb





# Recognition

## Hazard Communication Standard (HCS)

- **Oxidizers**

## Flame Over Circle





# Recognition

## Hazard Communication Standard (HCS)

- **Aquatic Toxicity**

**Environment  
(Non-Mandatory)**





# Recognition

## Hazard Communication Standard (HCS)

- **Acute Toxicity (fatal or toxic)**

**Skull  
and Crossbones**





# Recognition

US DOT 49 CFR 172.101

Methyl chloroformate

49 CFR 172.101 HAZARDOUS MATERIALS TABLE													
Symbol (1)	Hazardous materials descriptions and proper shipping names (2)	Hazard class or division (3)	Identification Numbers (4)	PG (5)	Label Codes (6)	Special provisions (172.102) (7)	(8) Packaging (173.***)			(9) Quantity Limitations (see §§172.27 and 175.75)		(10) Vessel storage	
							Exceptions (8A)	Non-bulk (8B)	Bulk (8C)	Passenger aircraft/rail (9A)	Cargo aircraft only (9B)	Location (10A)	Other (10B)
	Methyl chloroformate	6.1	UN1238	I	6.1, 3, 8	1, 59, B14, B30, N34, T22, TP2, TP13, TP38, TP44	None	228	244	Forbidden	Forbidden	□	21, 40, 100



# Recognition

## Chemical Properties

Characteristics of a substance that are brought out during a chemical reaction

Used to Classify hazardous Substances

49 CFR 172.101 HAZARDOUS MATERIALS TABLE													
Symbol (1)	Hazardous materials descriptions and proper shipping names (2)	Hazard class or division (3)	Identification Numbers (4)	PG (5)	Label Codes (6)	Special provisions (172.102) (7)	Packaging (173.***) (8)			Quantity Limitations (see §§172.27 and 175.15) (9)		Vessel stowage (10)	
							Exceptions (8A)	Non-bulk (8B)	Bulk (8C)	Passenger aircraft/rail (9A)	Cargo aircraft only (9B)	Location (10A)	Other (10B)
	<b>Methyl chloroformate</b>	6.1	UN1238	1	6.1, 3, 8	1, 89, 814, 830, N34, T22, T72, TP15, TP38, TP44	None	226	244	Forbidden	Forbidden	D	21, 40, 100



# Recognition

## Chemical Properties

### pH

- Measures the acidity of a solution
- Pure water is considered neutral
- Solutions with a pH of less than 7 are acidic
- Solutions with a pH of more than 7 are alkaline or a base



# Recognition

## Chemical Properties

### Flash Point

A flashpoint is the minimum or lowest temperature at which a liquid gives off enough vapor to form an ignitable mixture.

The flashpoint of a liquid is identified by slowly heating the liquid in a test container and introducing a small flame to the vapor area above the surface of the liquid. The lowest temperature at which a flash occurs from the flame is the flashpoint of the liquid.



# Recognition

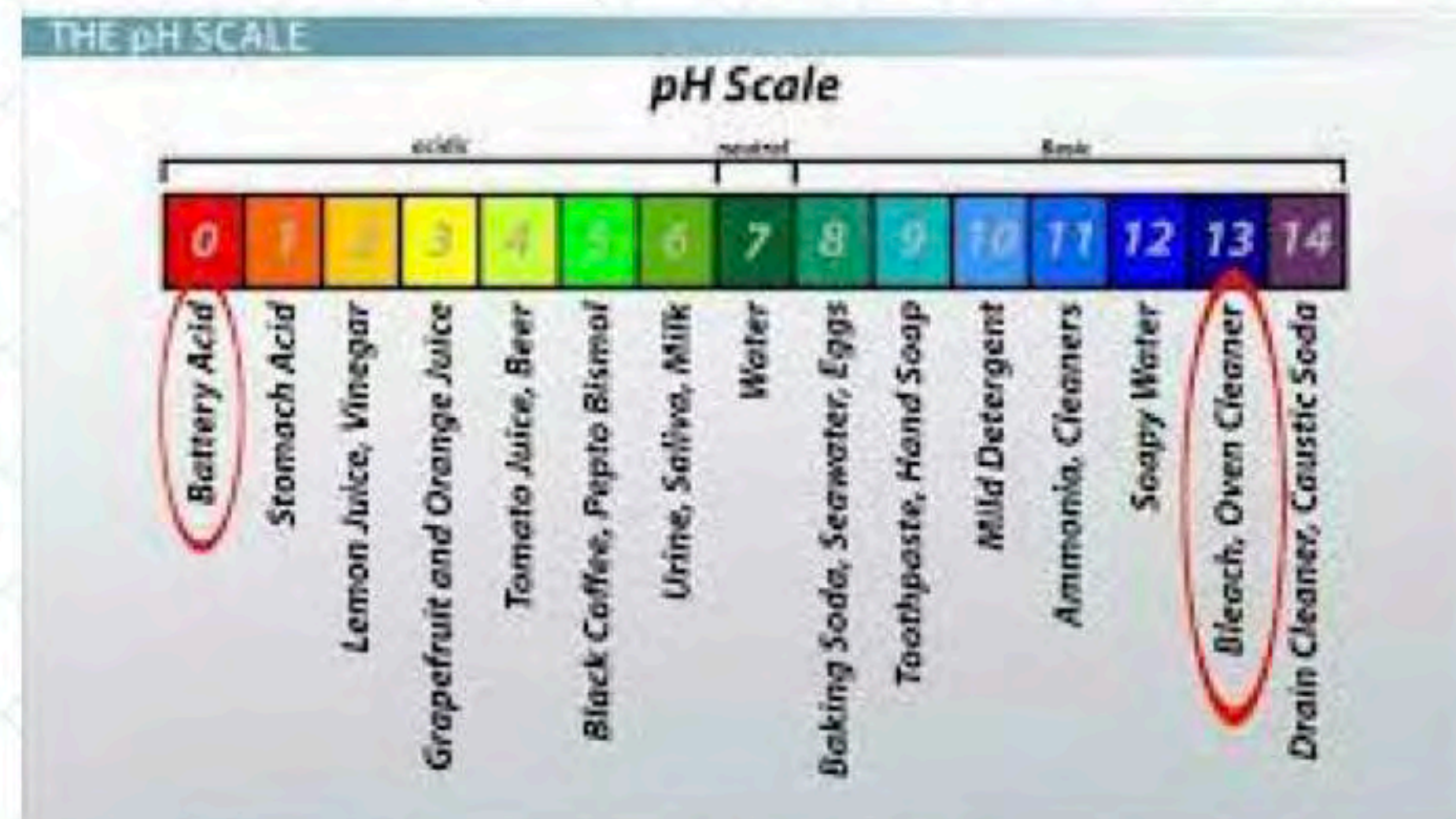
## Chemical Properties

### Highly Acidic Solutions

Corrosive substances eat away at surfaces

Sulfuric Acid has a pH of 3

- Car batteries
- Fertilizer
- Oil Refining
- Wastewater treatment
- Can damage skin and clothing





# Recognition

## Chemical Properties

### Alkaline Solutions

#### Are Caustic

- Caustic solutions burn surfaces

#### Potassium Hydroxide pH of 13.5

- Liquid Soap
- Can burn skin





# Recognition

## Chemical Properties

### Flash Point

- The lowest temperature at which a substance can ignite
- The lower the flashpoint the easier it is to ignite





# Recognition

## Chemical Properties

### Flammable Liquids

A flammable liquid is a liquid that has a flashpoint at or below 199.4 °F (93 °C).



# Recognition

## Chemical Properties

### Flammable Liquids

#### Category 1

- Flammable liquids have a flashpoint  $< 73.4\text{ }^{\circ}\text{F}$  ( $23\text{ }^{\circ}\text{C}$ )
- A boiling point  $95\text{ }^{\circ}\text{F}$  ( $35\text{ }^{\circ}\text{C}$ )



# Recognition

## Chemical Properties

### Flammable Liquids

#### Category 2

- Flammable liquids have a flashpoint  $< 73.4\text{ }^{\circ}\text{F}$  ( $23\text{ }^{\circ}\text{C}$ )
- A boiling point  $> 95\text{ }^{\circ}\text{F}$  ( $35\text{ }^{\circ}\text{C}$ )

#### Category 3

- Flammable liquids have a Flash point  $\geq 73.4^{\circ}\text{F}$  ( $23^{\circ}\text{C}$ )  
and  $\leq 140^{\circ}\text{F}$  ( $60^{\circ}\text{C}$ )



# Recognition

## Chemical Properties

### Flammable Liquids

#### Category 4

- Flammable liquids have a Flash point  $> 140^{\circ}\text{F}$  ( $60^{\circ}\text{C}$ ) and  $\leq 199.4^{\circ}\text{F}$  ( $93^{\circ}\text{C}$ )



# Recognition

## Chemical Properties

### Poisonous Gases

Hazardous materials in a gas state can present serious risks for workers if inhaled or touched, including irritation, injury, or even death. If hazardous substances are known to be present in a workplace, then air sampling and other testing is required to monitor levels and prevent exposure risks.

Hydrogen sulfide is a common example of a poisonous gas. It's often described as having an egg smell. Typically, hydrogen sulfide is created in a natural environment, but industrial activities can also produce the gas.

This potentially dangerous gas can be absorbed quickly through the lungs and can result in adverse health effects. Short exposure to low levels of the gas can cause effects such as eye irritation and coughing, while concentrated exposure to high levels can cause convulsions, breathing difficulty, and can ultimately lead to death.

Primary sources of protection against poisonous gases or airborne pathogens include the use of gas masks, protective clothing, and appropriate workplace ventilation.



# Recognition

## Chemical Properties

### Radioactive Materials

Radiation is used in a wide range of occupations and can pose as a potentially hazardous to the health of workers.

Radiation harms workers by depositing energy into body tissue. Such energy deposits can result in cell damage. Depending on the amount and period of exposure, radiation can be deadly.

In some exposure incidents, the cells might survive but become briefly or permanently damaged over an extended period. These abnormal cells can become malignant and cause related health risks. The type and degree of cell damage is determined by the amount and period of absorption, dose, and the exposed body parts.

The two types of radiation are:

**Ionizing radiation** - has a significant amount of energy and can push electrons from atoms in a process called ionization. Examples include x-rays and radioactive elements. Ionizing radiation can harm the atoms of humans and therefore pose some health risks such as destroyed tissue or damaged DNA.

**Non-ionizing radiation** - has less energy than ionizing radiation but can move atoms in a molecule around or cause them to vibrate but cannot remove electrons. Examples include visible light, microwaves, and lasers.



# Recognition

## Chemical Properties

### Ignition and Explosion

Flammable substances are not necessarily dangerous by themselves. It takes an ignition source to make them catch fire or explode.

#### Flammable Range

Flammable range, also known as explosive range, is the range of a concentration of a vapor or gas from a flammable liquid that will burn or explode if an ignition source is present.

- Upper Flammable Limit (UFL) or Upper Explosive Limit (UEL) is the maximum percentage of vapor in air above which spread of flame does not occur in the presence of a source of ignition
- Lower Flammable Limit (LFL) or Lower Explosive Limit (UEL) is the minimum percentage of vapor in air below which spread of flame does not occur in the presence of a source of ignition

These boundary line limits are usually expressed in terms of proportion by volume of vapor in air. The terms "flammable" and "explosive" are used interchangeably in the description of this range.



# Recognition

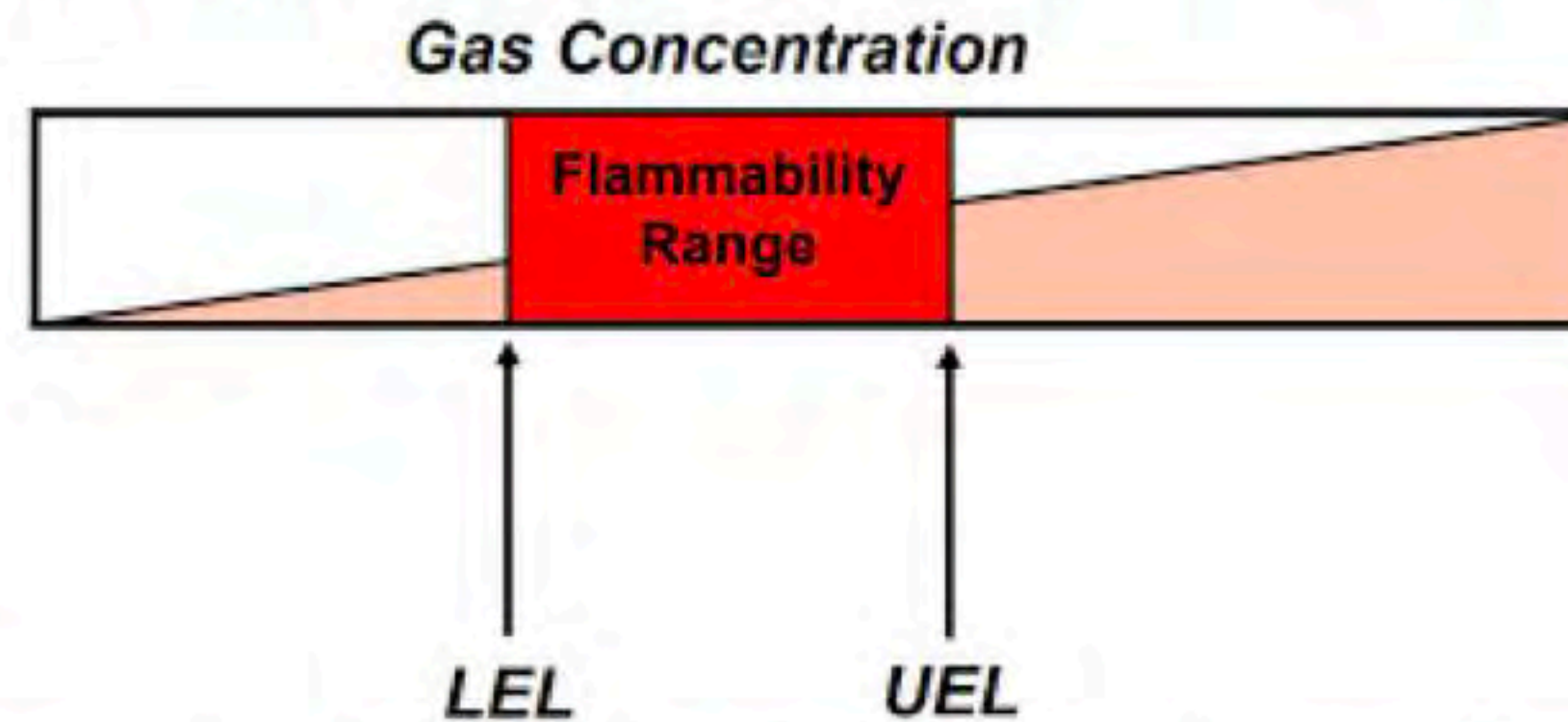
## Chemical Properties

### Flammable Range

- A vapor or air mixture below the lower flammable limit is too thin to ignite
- A mixture above the upper flammable limit is too dense to ignite

### Some sources of ignition are:

- Open flames
- Static electricity
- Cutting and welding
- Hot surfaces Electrical and mechanical sparks
- Lightning



Employers and employees must take all adequate precautions to prevent the ignition of flammable vapors.



# Recognition

## Chemical Properties

### Ignition and Explosion

Flammable substances are not necessarily dangerous by themselves. It takes an ignition source to make them catch fire or explode.





# Recognition

## Chemical Properties

### Explosives and Blasting Agents

- materials, mixtures, or devices used to blast or explode structures or substances.
- The difference between an explosive agent and a blasting agent is that a blasting agent requires a primer to explode.
- Department of Transportation classifies explosive agents into 3 types.





# Recognition

## Chemical Properties

### Ignition and Explosion cont.

- Class A Explosives have detonating powers and are the most dangerous
- Class B Explosives are flammable hazards
- Class C Explosives have a mixture of Class A and/or Class B explosives but in restricted amounts





# Recognition

## Chemical Properties

### Explosive and Blasting Agents

- Highly volatile substances that must be stored securely in specific structures called magazines.
- Magazines must be protected from possible ignition sources, ventilated, and maintained.





# Recognition

United Nations (UN) Hazard Class System

Class 1 Explosives

Class A, B, C Explosives



- |              |   |
|--------------|---|
| Division 1.1 | Explosives with a mass explosion hazard     |
| Division 1.2 | Explosives with a projection hazard         |
| Division 1.3 | Explosives with predominantly a fire hazard |
| Division 1.4 | Explosives with no significant blast hazard |
| Division 1.5 | Very insensitive explosives                 |
| Division 1.6 | Extremely insensitive explosive articles    |



# Recognition

## United Nations (UN) Hazard Class System

### Class 2 – Non-Flammable and Flammable Compressed Gases

- Division 2.1 – Flammable gases
- Division 2.2 – Nonflammable gases
- Division 2.3 – Poison Gases
- Division 2.4 – Corrosive Gases





# Recognition

## United Nations (UN) Hazard Class System

### Class 3 Flammable Liquids

Division 3.1: Flashpoint below  $-18^{\circ}\text{C}$  ( $0^{\circ}\text{F}$ )

Division 3.2: Flashpoint below  $-18^{\circ}\text{C}$  and above, but less than  $23^{\circ}\text{C}$  ( $73^{\circ}\text{F}$ )

Division 3.3: Flashpoint  $23^{\circ}\text{C}$  and up to  $61^{\circ}\text{C}$  ( $141^{\circ}\text{F}$ )





# Recognition

## United Nations (UN) Hazard Class System

Class 4 Flammable Solids, Spontaneously combustible substances, and water reactive substances

Division 4.1: Flammable Solids

Division 4.2: Spontaneously combustible materials

Division 4.3: Materials that are dangerous when wet





# Recognition

## United Nations (UN) Hazard Class System

**Class 5 Oxidizing materials, Including Organic Peroxides**

**Division 5.1: Oxidizers**

**Division 5.2: Organic Peroxides**





# Recognition

United Nations (UN) Hazard Class System

Class 6 Class A and B poisons, irritants, and etiologic materials

Division 6.1: Poisonous materials

Division 6.2: Etiologic (infectious) materials





# Recognition

United Nations (UN) Hazard Class System

Class 7 Radioactive Materials





# Recognition

## United Nations (UN) Hazard Class System

Class 8 Corrosive Materials





# Recognition

United Nations (UN) Hazard Class System

Class 9 Miscellaneous Hazardous Materials

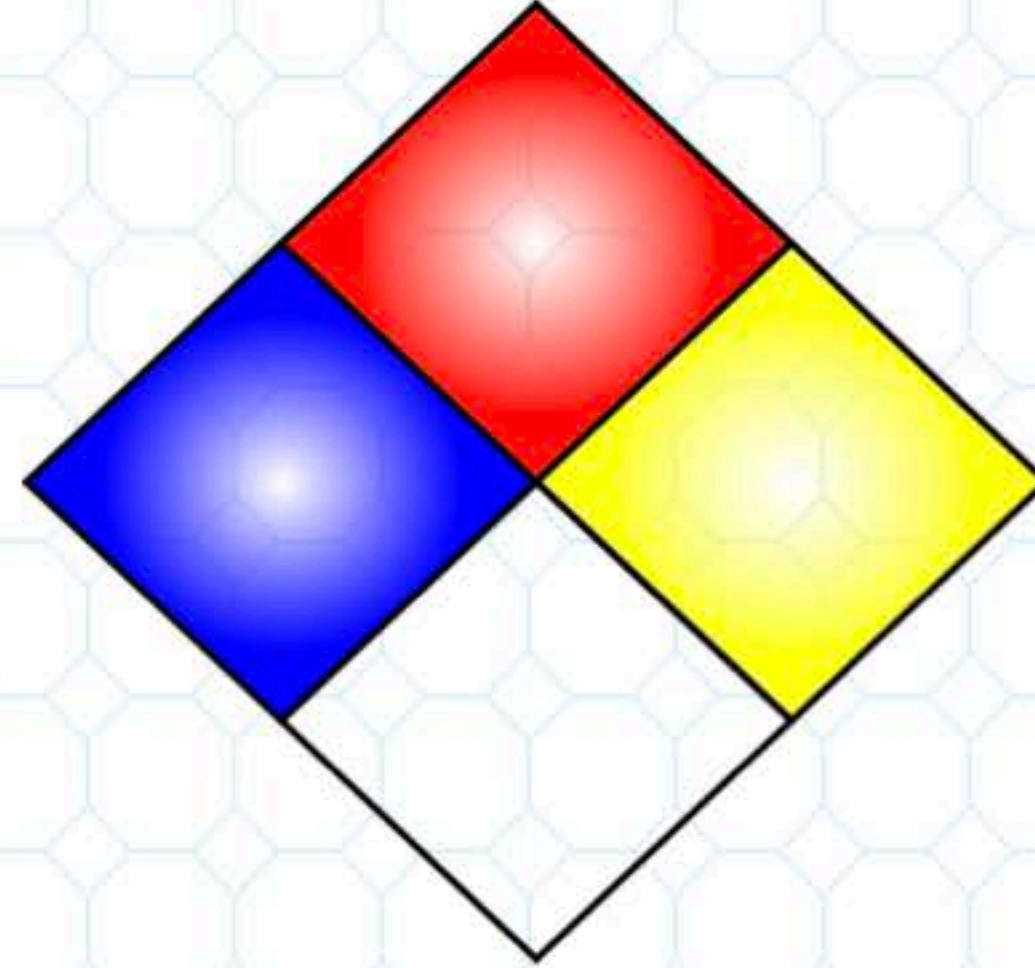




# Recognition

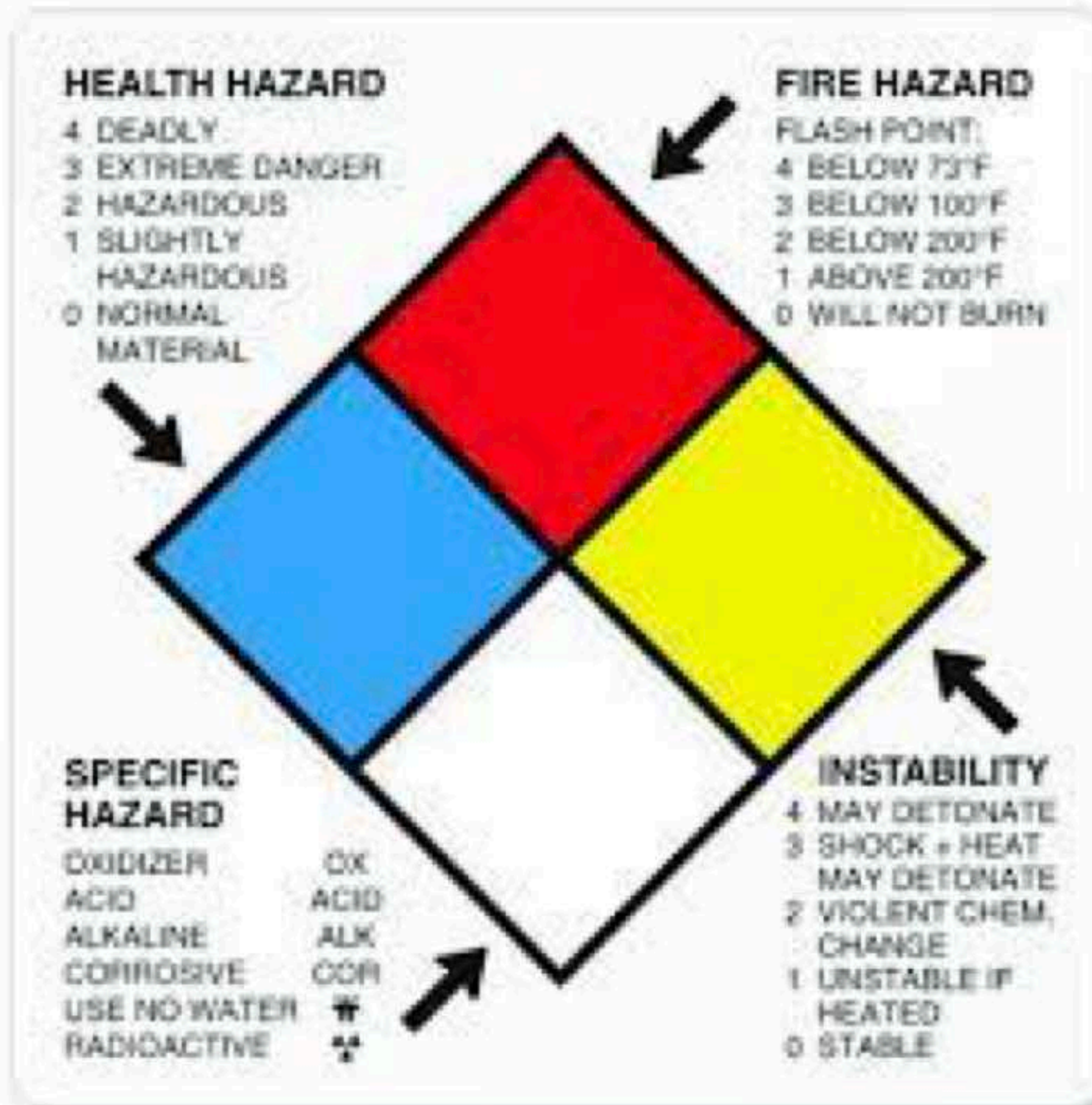
## National Fire Protection Agency (NFPA)

- NFPA 704 Diamond





# Recognition





# Recognition

NFPA 704M system – Blue Diamond

## Health Hazards

- 0 – No health hazard – no precaution
- 1 – Mild Reaction or Injury
- 2 – Temporary Incapacitation
- 3 – Temporary or Moderate Residual Injury
- 4 – Serious Injury or Death





# Recognition

NFPA 704M system – Red Diamond

Flammability

0 – Will not burn

1 – Will burn when heated significantly

Flash Point  $\geq 200^{\circ}\text{F}$

2 – Will ignite at relatively high temperature

Flash Point between  $100^{\circ}\text{F}$  and  $200^{\circ}\text{F}$

3 – Ignite under ambient temperatures

4 – Readily burn

Flash Point  $<73^{\circ}\text{F}$





# Recognition

NFPA 704M system – Yellow Diamond

## Chemical Stability

- 0 – Normally very Stable
- 1 – Stable in Most Situations
- 2 – Violent chemical change when exposed to elevated pressures, temperatures, or water
- 3 – Can explode or detonate after an initiation, when exposed to heat, water or shock.
- 4 – React or detonate easily





# Recognition

NFPA 704M system – White Diamond

Special Precautions

W – Strong Reaction to Water

OX – Strong Oxidizers

SA – Asphyxiant Gases





# **Risks And Hazards**



# **Hazardous Materials Present Three Main Risks:**

- Health
- Fire
- Reactivity



# Health

Health hazards are dependent on the materials involved and the routes of entry.

- Inhalation
- Ingestion
- Absorption
- Skin Contact



# Fire

- Fires can develop as a result of leaks or spills.
- Liquids or vapors that readily ignite can cause burns and other heat related injuries



# Reactivity

- Some chemicals will react when placed in contact with others.
- Reactions can vary from generation of toxic gases to polymerization to violent explosions.
- Due to the threat of explosions, reactivity is the most feared.



# Identification and Hazard Assessment



# Assessment

- The **MOST** critical aspect of a hazardous substance response is the identification of the substances and a thorough assessment of the hazards that are presented.
- You can't manage the site/incident if you can't identify and assess the problem.



# Assessment

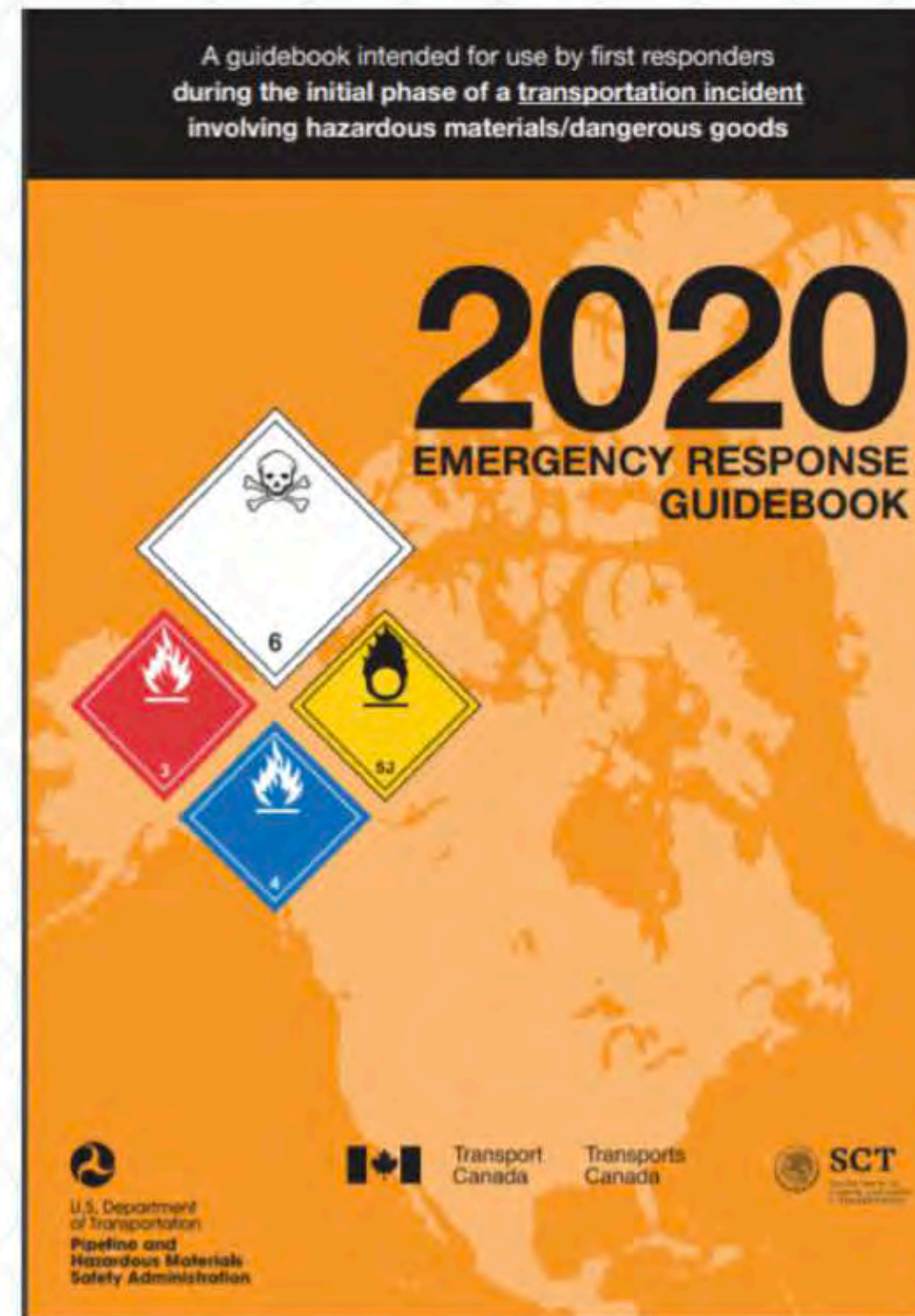
- This process is the basis for the selection of PPE, control measures, engineering controls, monitoring devices, decontamination methods, disposal and everything associated with this incident/site.
- At least three sources are preferred to perform an identification and hazard assessment.



# Identification

## Information Sources:

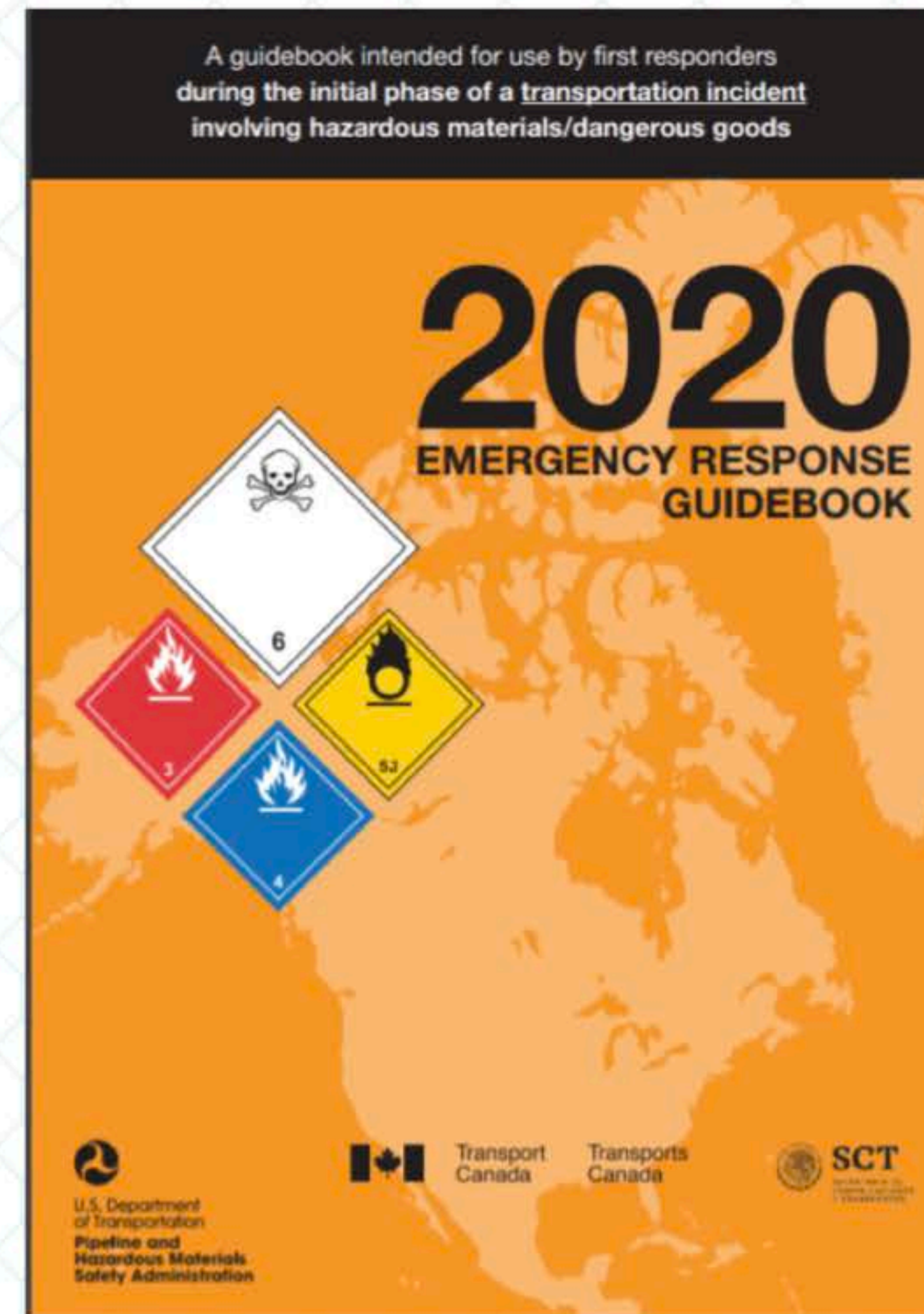
- SDS (MSDS)
- Placards and Labels
- Shipping Papers
- Reference Guides
- Technical Information Centers
- NFPA 704 System
- Computer Data Bases
- Other (Monitoring results, witnesses, process knowledge, etc.)





# Identification

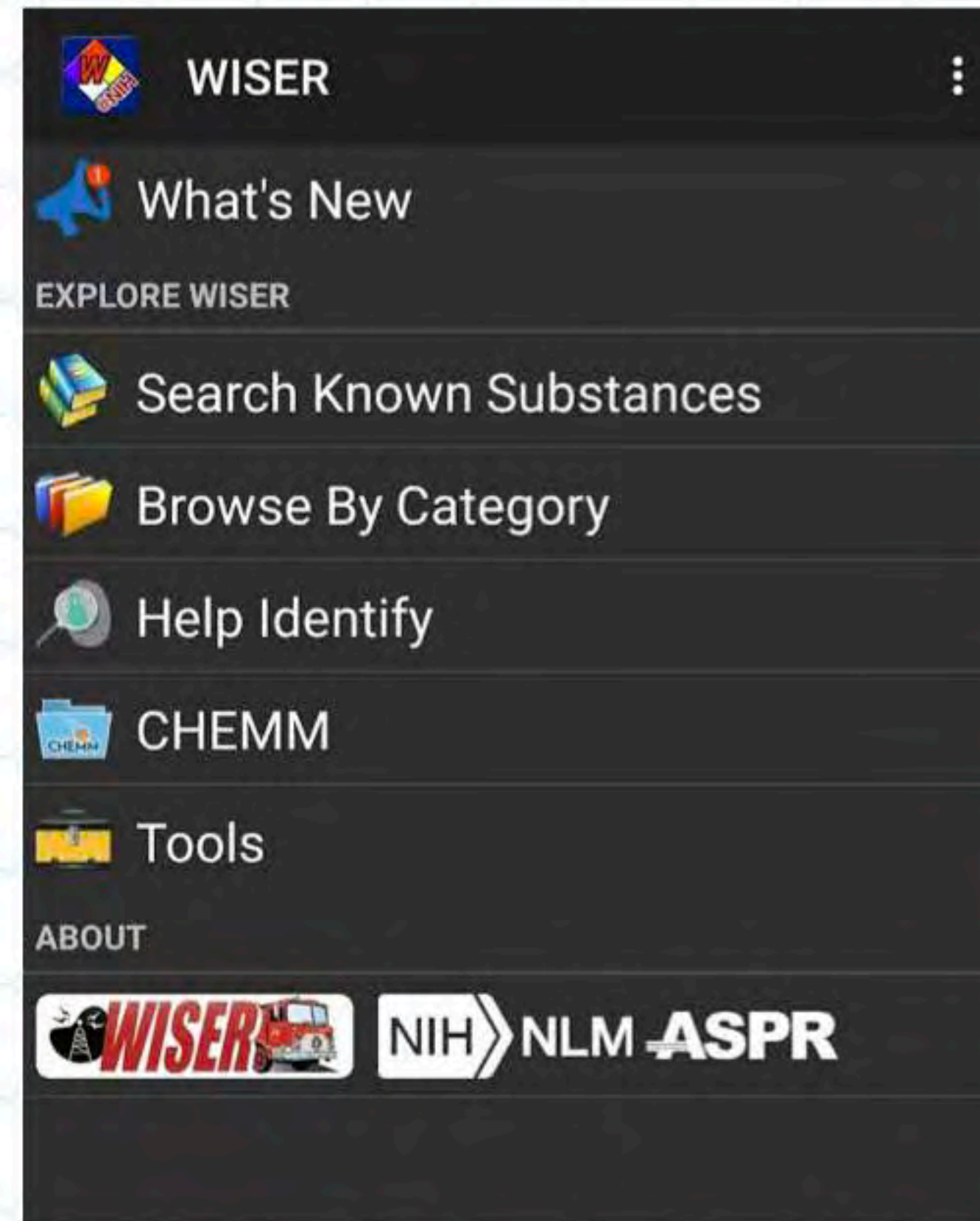
## Emergency Response Guidebook (ERG)





# Identification

**WISER**  
**(Wireless Information  
System for Emergency  
Responders)**





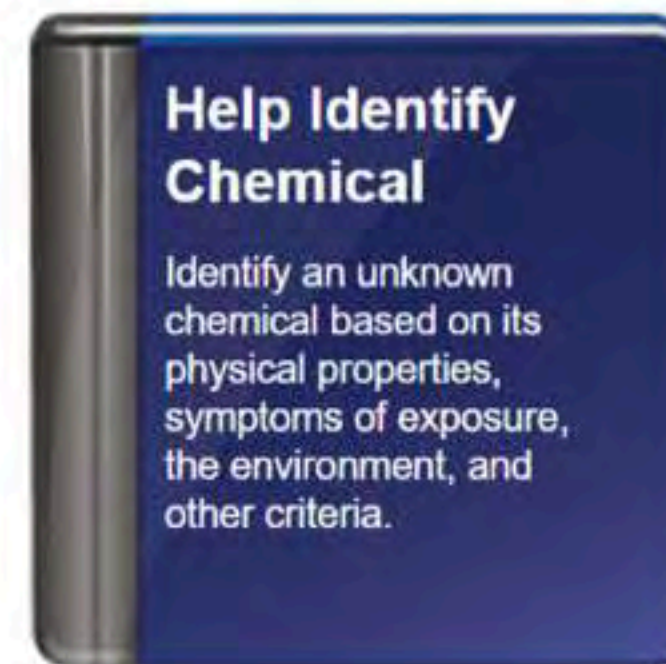
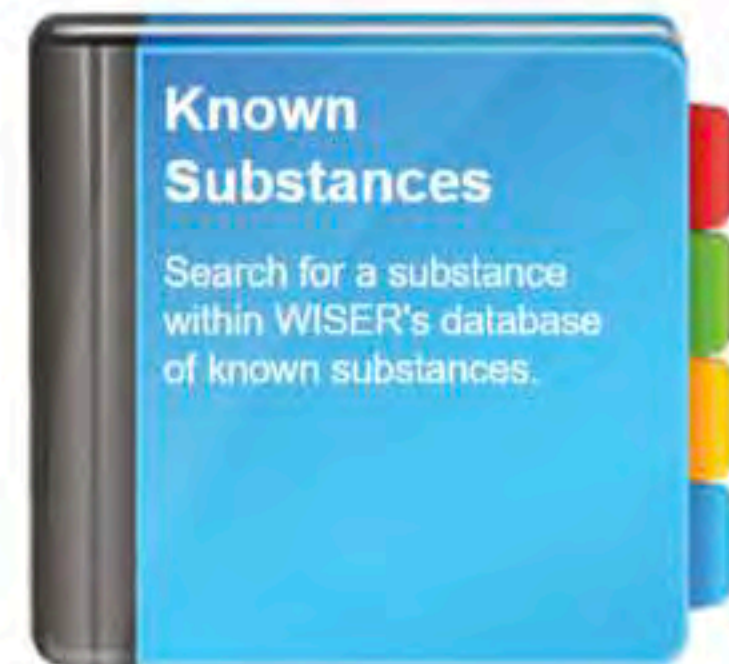
# Identification

## Download WISER or open WebWISER

[WebWISER Home](#) | [Substance List](#) | [Help Identify](#) | [Tools](#) | [Help](#)

### Welcome to WebWISER

WISER is a system designed to assist emergency responders in hazardous material incidents. WISER provides a wide range of information on hazardous substances, including substance identification support, physical characteristics, human health information, and containment and suppression advice. To get started, configure your profile and select an item below.





# Identification

## Search Known Substances

[WebWISER Home](#)

[Substance List](#)

[Help Identify](#)






[Tools](#)

[Help](#)

### Search Known Substances

#### Search Text

#### Browse By Category

-  [Substance Type](#)
-  [DOT Hazard Classifications](#)
-  [CDC Bioterrorism Agents/Diseases](#)
-  [WMDs](#)
-  [Miscellaneous Categories](#)

#### Search for hazardous materials and dangerous goods by identifier

##### Search by Name

for example, 'Chlorine' or 'Ammonia'

##### Search by UN

for example, '1017' or '1005'

##### Search by STCC

for example, '49 041 20' or '4904210'

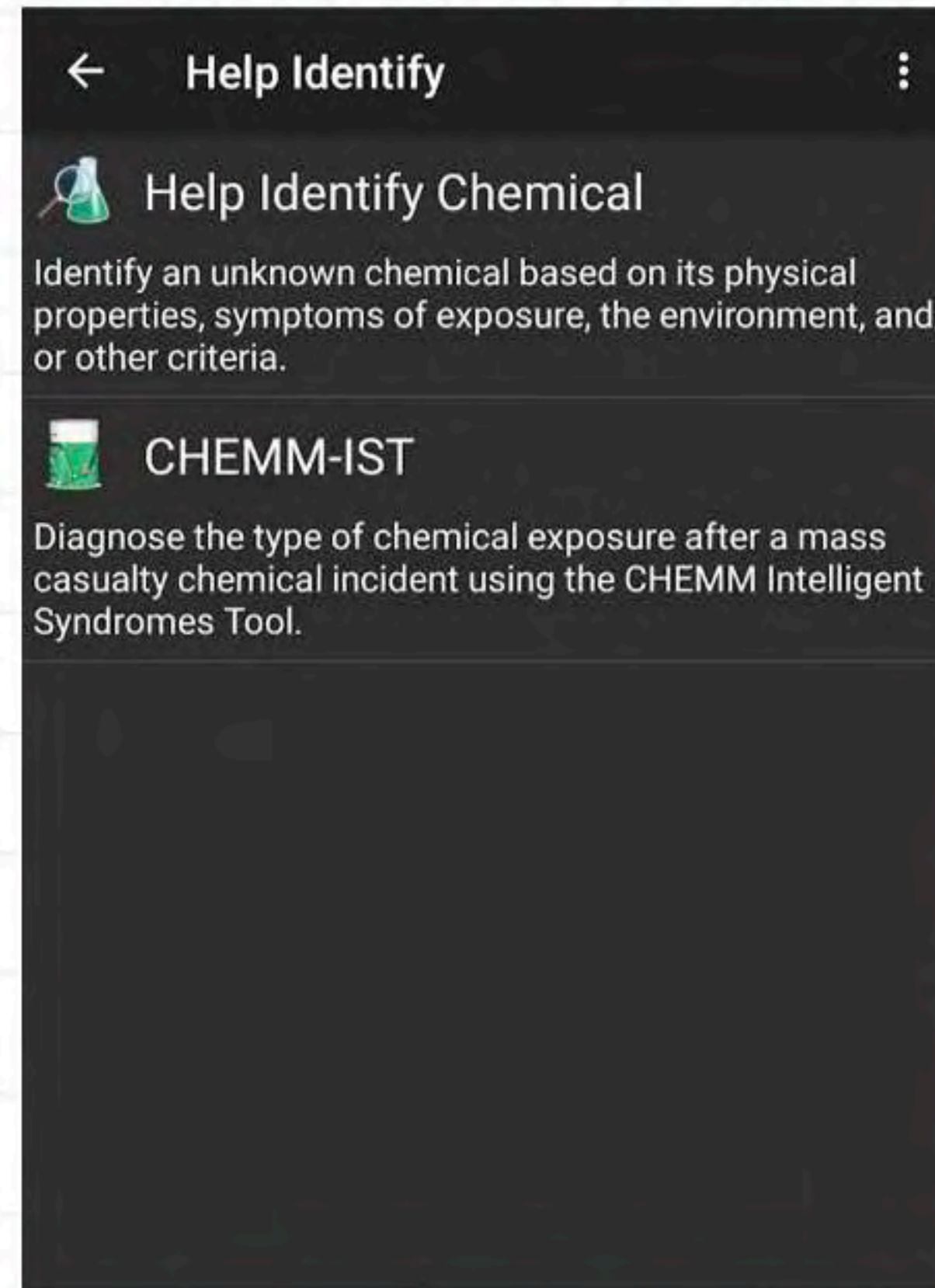
##### Search by CAS RN

for example, '7790-91-2' or '7664417'



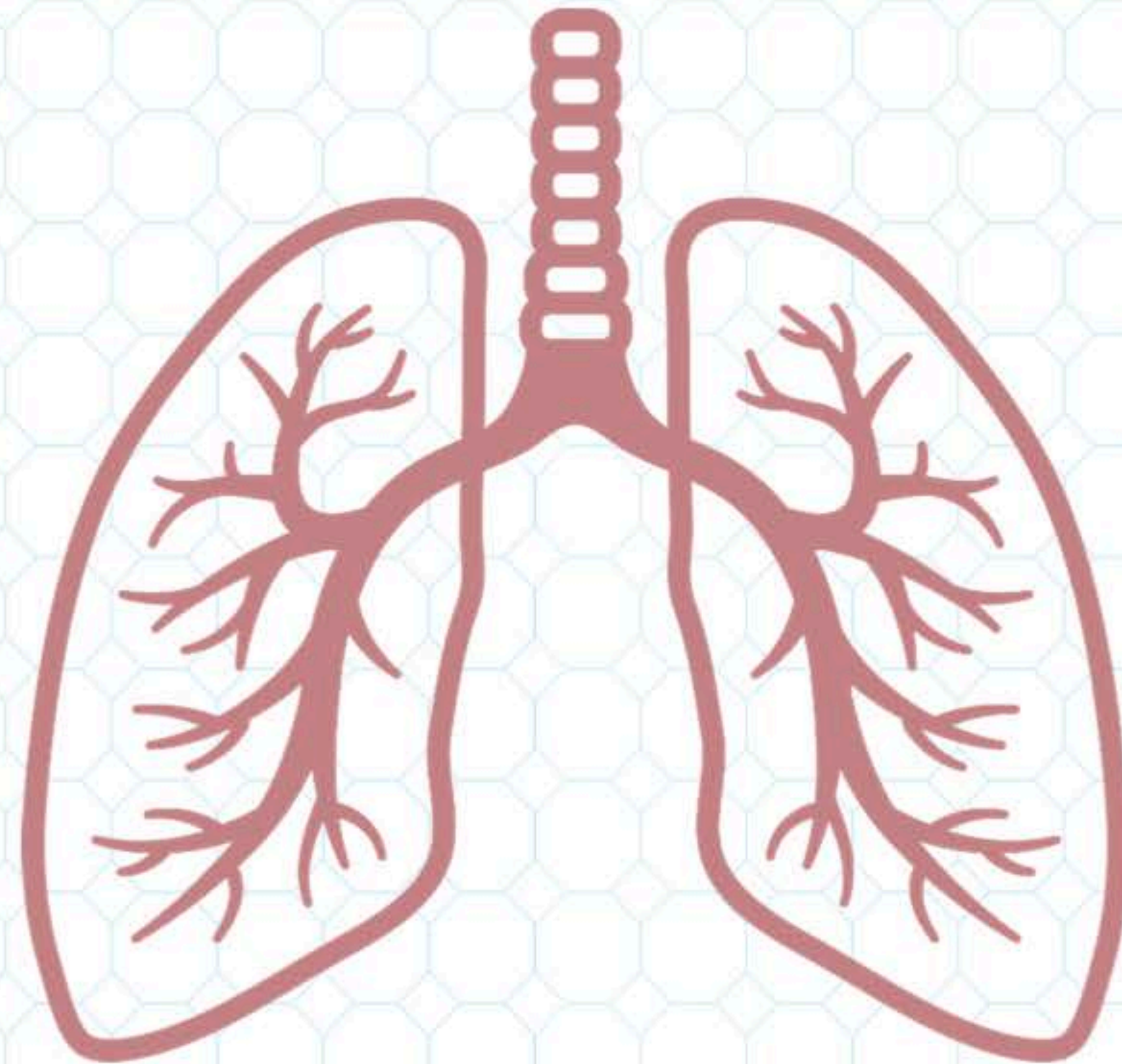
# Identification

## Protective Distance





# Respiratory Protection





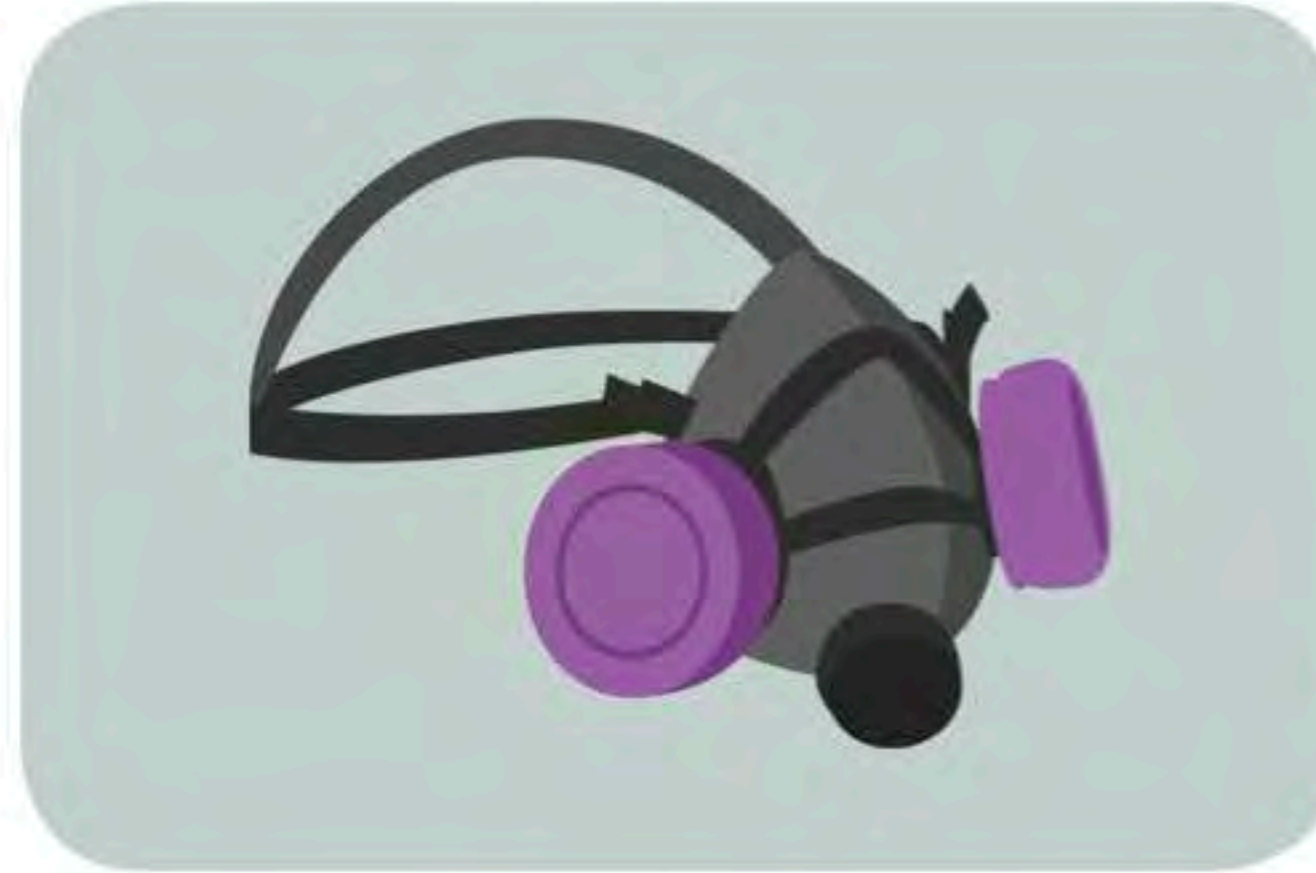
# Respiratory Protection



**Filtering Facepiece Respirators** are disposable half facepiece respirators that filter out particles such as dusts, mists, and fumes. They do NOT provide protection against gases and vapors.



# Respiratory Protection



**Elastomeric Half Facepiece Respirators** are reusable and have replaceable cartridges or filters. They cover the nose and mouth and provide protection against gases, vapors, or particles when equipped with the appropriate cartridge or filter.



# Respiratory Protection



**Elastomeric Full Facepiece Respirators** are reusable and have replaceable canisters, cartridges, or filters. The facepiece covers the face and eyes, which offers eye protection.



# Respiratory Protection



**Powered Air-Purifying Respirators (PAPRs)** have a battery-powered blower that pulls air through attached filters, canisters, or cartridges. They provide protection against gases, vapors, or particles, when equipped with the appropriate cartridge, canister, or filter. Loose-fitting PAPRs do not require fit testing and can be used with facial hair.



# Respiratory Protection



**Supplied-Air Respirators** are connected to a separate source that supplies clean compressed air through a hose. They can be lightweight and used while working for long hours in environments not immediately dangerous to life and health (IDLH).



# Respiratory Protection



**Self-Contained Breathing Apparatus (SCBAs)** are used for entry into or escape from environments considered to be IDLH. They contain their own breathing air supply and can be either open circuit or closed circuit.



# Respiratory Protection

Fit Testing

Medical Monitoring

Cleaning and Maintenance



# Chemical Toxicology

## · Routes of Entry

- Inhalation
- Ingestion
- Injection
- Contact



# Chemical Toxicology

## Toxicology

The degree to which a chemical or substance has a harmful effect on humans or other living things.

### Based on information gained from:

- Epidemiological studies
- Animal Studies



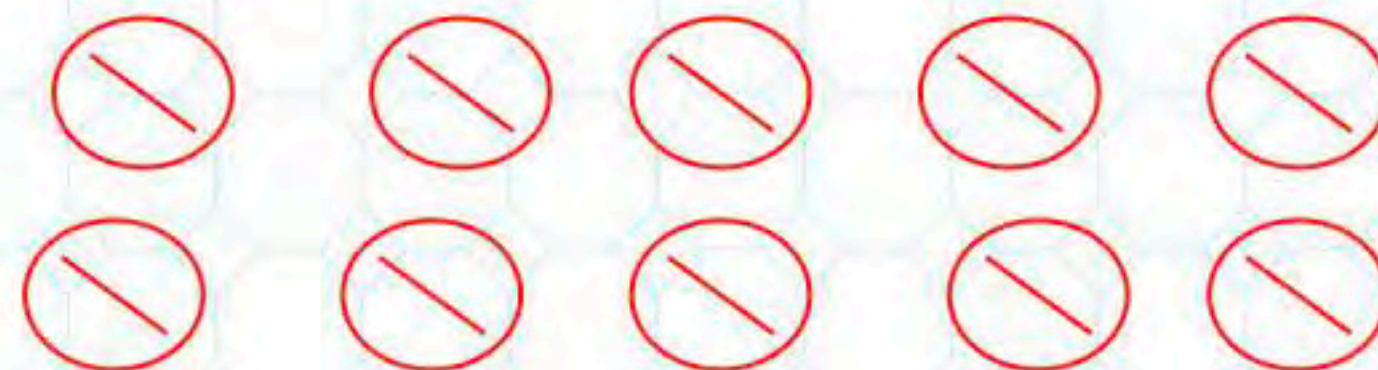
# Chemical Toxicology

## Dose

- It is the dose that kills not the material.
- Water is toxic at a certain dose as well as table salt.
- Synergistic Effects
  - Asbestos & Smoking

## LD50 and LC50

The amount of material that results in the deaths of 50% of a sample group of laboratory animals





# Biological Hazards





# Biological Hazards



## (Definition From the ERG)

**Pathogens (bacteria, viruses, etc.) or the toxins they produce (such as anthrax) that are dispersed with criminal intent. They can cause disease or death in otherwise healthy humans. Refer to GUIDE 158.**



# Biological Hazards

## DOT Infectious Substance Classification Categories



**Category A – An infectious substance in a form capable of causing permanent disability or life-threatening or fatal disease in otherwise healthy humans or animals when exposure to it occurs.**



# Biological Hazards

## Examples of Category A

Qualifying materials vary by pathogen

**Bacillus anthracis (cultures only)**

**Clostridium botulinum (cultures only)**

**Coccidioides immitis (cultures only)**

**Dengue virus (cultures only)**

***Escherichia coli,***

***Hantaviruses causing hemorrhagic fever with renal syndrome***

**Human immunodeficiency virus (cultures only)**

**Highly pathogenic avian influenza virus (cultures only)**





# Biological Hazards

## DOT Infectious Substance Classification Categories

**Category B** – An infectious substance not in a form generally capable of causing permanent disability or life-threatening or fatal disease in otherwise healthy humans or animals when exposure to it occurs.





# Biological Hazards

**Regulated Medical Waste** – a waste or reusable material derived from the medical treatment of an animal or human.





# Biological Hazards

**ERG - GUIDE 158**



## **POTENTIAL HAZARDS - HEALTH**

- Inhalation or contact with substance may cause infection, disease or death.
- Category A Infectious Substances (UN2814, UN2900 or UN3549) are more hazardous, or are in a more hazardous form, than infectious substances shipped as Category B Biological Substances (UN3373) or clinical waste/medical waste (UN3291).



# Biological Hazards



**ERG - GUIDE 158 (cont.)**

## **POTENTIAL HAZARDS - HEALTH**

- Runoff from fire control or dilution water may cause environmental contamination.
- Damaged packages containing solid CO<sub>2</sub> as a refrigerant may produce water or frost from condensation of air. Do not touch this liquid as it could be contaminated by the contents of the parcel.
- Contact with solid CO<sub>2</sub> may cause burns, severe injury and/or frostbite.



# Radiation

- Radiation is simply a form of energy.
- Radiation travels through space in form of photons (packets of energy)
- Photons travel at speed of light



# Radiation

- Ionizing
- Non-ionizing

All Radiation interacts with matter.



# Ionizing

- Alpha
- Beta
- Gamma
- Neutron  
(Unstable, decays to alpha, beta, and gamma)



# Radiological Toxicology-Ionizing Radiation

## Alpha

- Largest particle
- Health hazard if inhaled or ingested
- Only travel a few centimeters in the air
- Stopped by paper/clothing

**Hazardous?**



# Radiological Toxicology

## Alpha Radiation

*Alexander Litvinenko*





# Common Alpha Emitters

- Man-made
  - Polonium 210
    - Anti-static
  - Americium 241
    - Smoke detectors
- Naturally occurring
  - Uranium-238
    - Radon



# Beta Radiation

- Smaller particles than alpha
- Travel up to ~2 meters
- Health hazard to the skin, eyes and internal organs if ingested or inhaled
- Stopped by thin metal, a thickness of wood, plastic or glass.



# Beta Radiation

- Common sources (Industrial)
  - Strontium 90
    - Heat generating power packs
  - Decay daughters of Uranium (Nuclear fission)



# Gamma Radiation

- Most dangerous\*
- NO mass, just pure energy
- Travel great distances
  - 50% “strength” at 500 feet
- Will pass through the human body and interact with all living cells in its path
- Stopped by lead, concrete, and other dense materials

**\*See next slide**



# Radiological Toxicology

## Ionization Potential

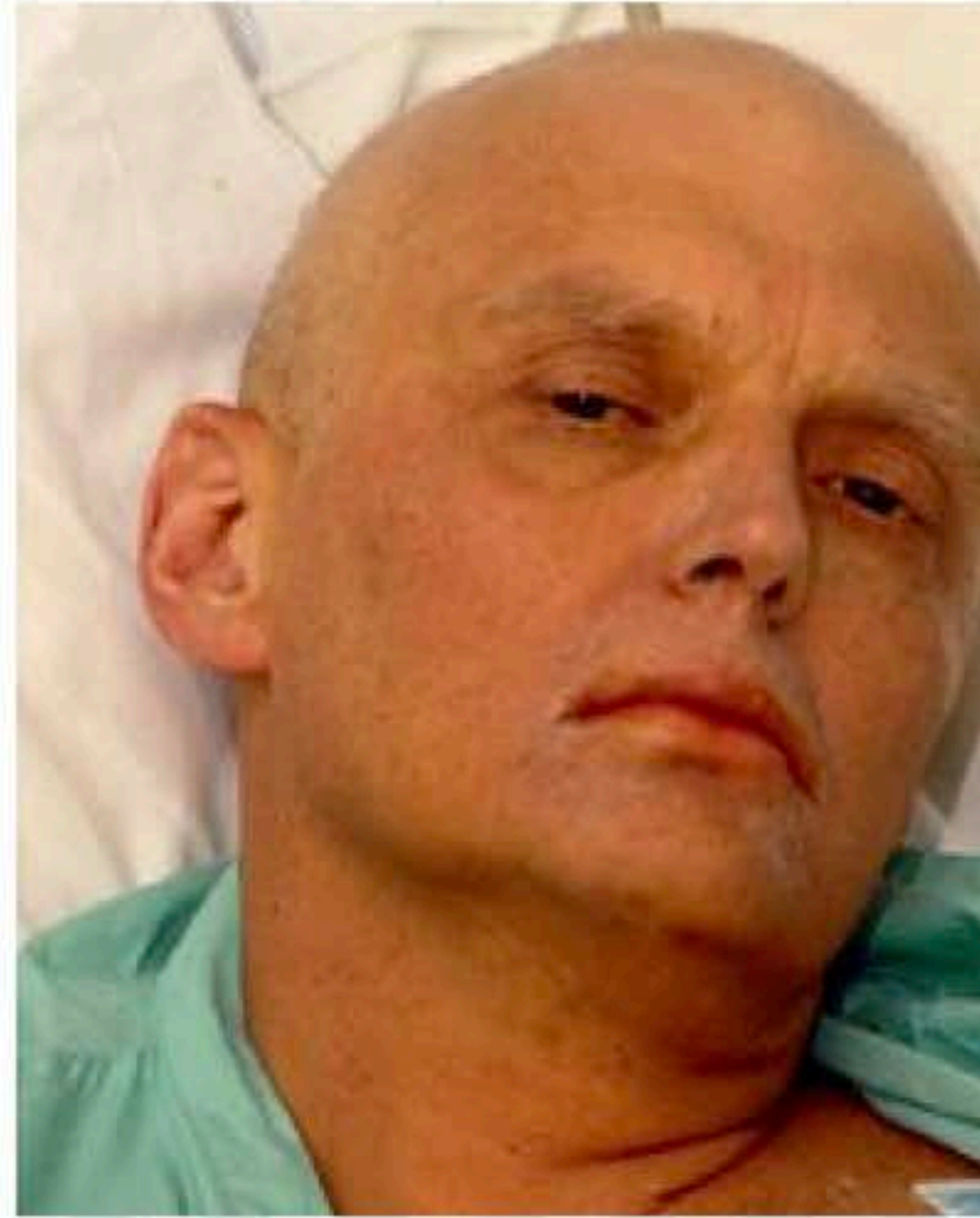
Alpha > Beta > Gamma

## Distance travelled

Gamma > Beta > Alpha

**Which is a greater Hazard?**







# Day 9





**10 Months**





# **Radiological Toxicology**

## **Non-Ionizing**

### **Ultraviolet Radiation**

- Sunlight
- Product Curing

### **Visible Light Radiation**

- Sunlight
- Arc-Welding
- Artificial Light



# **Radiological Toxicology**

## **Non-Ionizing**

### **Infrared Radiation**

- Drying / Dehydrating Operations
- Forging
- Brazing



# Radiological Toxicology

## Non-Ionizing

### Microwave/Radio Wave Radiation

- Television/FM/Radar Transmitters
- Microwave Ovens



# Radiological Toxicology

- Measuring/Monitoring
  - RAD - radiation absorbed dose
    - 0.01 J/Kg Body weight
  - REM – **roentgen\*** equivalent man
    - RAD multiplied by “quality factor”
- mrad/hr, rad/hr or mrem/hr, rem/hr
- What measuring devices do you have?

**\*pronounced “REN-kin”**



Film badge (measures gamma, x-ray, and beta radiation)

Thermoluminescence detectors (measures gamma, x-ray, and beta radiation)

Pocket dosimeter (measures x-ray and gamma radiation)

Ionization chambers (measures gamma, x-ray, beta, and alpha radiation)

Geiger-Mueller counters (measures gamma, x-ray, and beta radiation)







# Control of Hazard

- Protection
- Time
- Distance
- Shielding



# A-L-A-R-A

- As
- Low
- As
- Reasonably
- Achievable



# Personal Protective Equipment (PPE)



# Written PPE Program

- Number of person-hours that workers will wear various PPE
- Levels of exposure
- Adequacy of the PPE
- Operational Guidelines
- Training and Fitting Procedures
- Decon, cleaning, inspection, maintenance and storage procedures
- Accident and Illness experience
- Selection Procedures



# Respiratory Protection





# Air Purifying Respirators

## Powered Air-Purifying Respirator

- Positive Pressure

## Full Face/Half Face Respirator

- Negative Pressure

Particulate Filter

Sorbent Cartridges/Canisters

Combination





# Air Supplying Respirators

- SCBA
  - Positive or Negative Pressure
  - Open Circuit
    - Time limitations
  - Closed Circuit
    - Weight
- SAR
  - Positive Pressure
  - Escape SCBA
  - Air line length
    - 300 feet





# PPE Selection

- Based on Hazard assessment.
- Compatible with exposure.
- Sufficient durability.
- Temperature effects.
- Decon Methods

## Permeation

- Chemical/material moves through protective clothing.

## Degradation

- Loss of or change in the fabric's chemical resistance.

## Penetration

- Movement of contaminants through zippers, seams, tears, etc.



# Emergency Situations

- Emergency alarm signals
- Puncture wounds, scrapes or abrasions
- Sickness
- Air supply disruption



# Levels of PPE



# Level D PPE

- Minimal Skin Protection
- No Respiratory Protection
- Normal work clothes, fire fighting turnout gear are level D



# Level D PPE

## **RECOMMENDED:**

- Hard Hat
- Coveralls
- Safety Glasses
- Safety shoes

## **OPTIONAL:**

- Hearing protection
- Face shield
- Disposable Gloves
- Boot Covers
- Long Cotton Underwear



# Level C PPE

## **RECOMMENDED:**

- Air Purifying Respirator (APR)
- Chem. Resistant Clothing
- Chem. Resistant Inner and Outer Gloves & Boots

## **OPTIONAL:**

- Hard Hat
- Coveralls
- Face shield
- Disposable Gloves
- Boot Covers
- Long Cotton Underwear



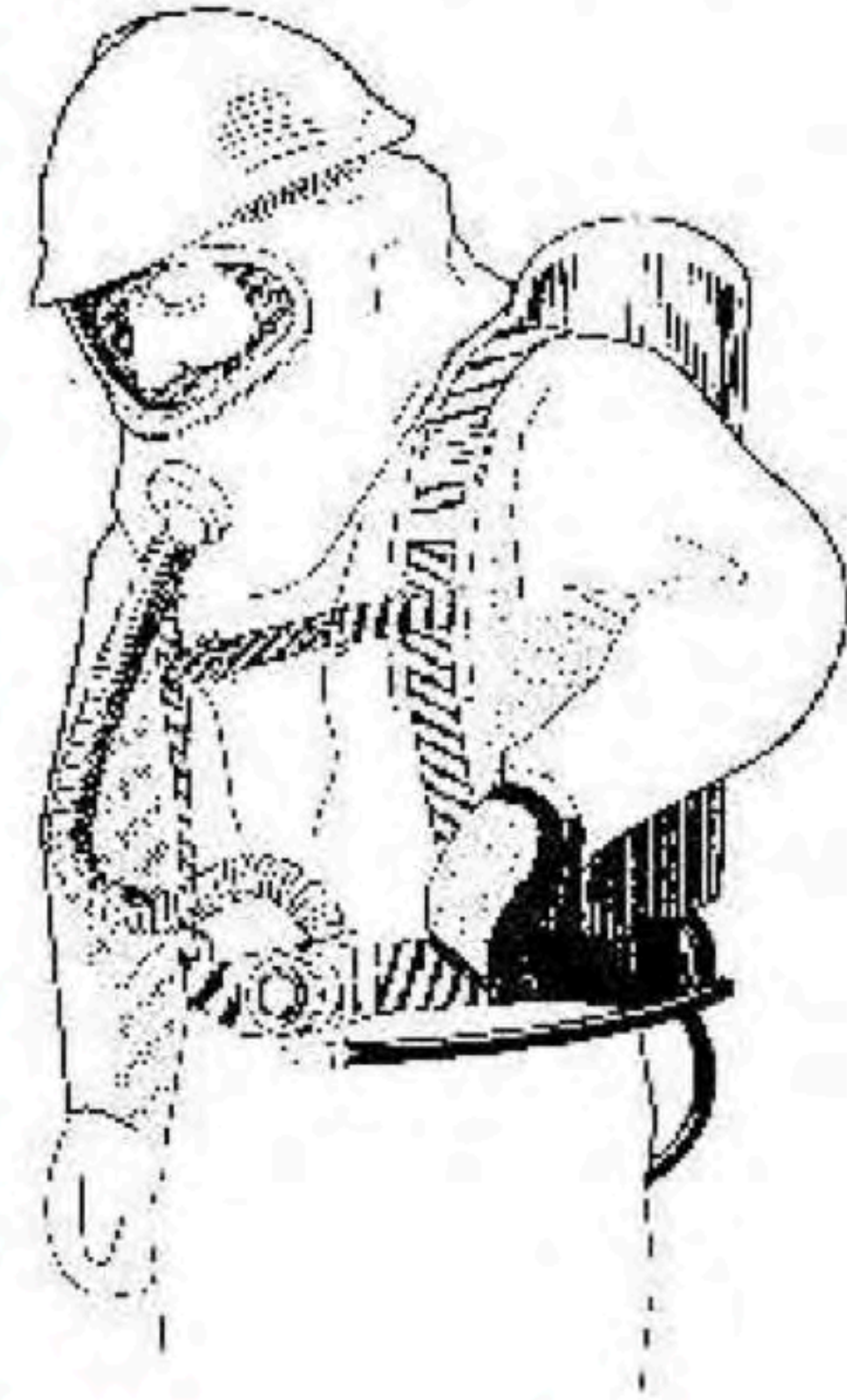
# Level C PPE

- Same skin protection as Level B PPE
- Lesser degree of respiratory protection, the contaminants are known.
- Air Purifying Respirators (APR's) with compatible cartridges.



# Level B PPE

- Maximum Respiratory Protection
- Lesser Degree of Skin Protection
- Minimal Level Recommended for Initial Site Entry Until Hazards Are Identified





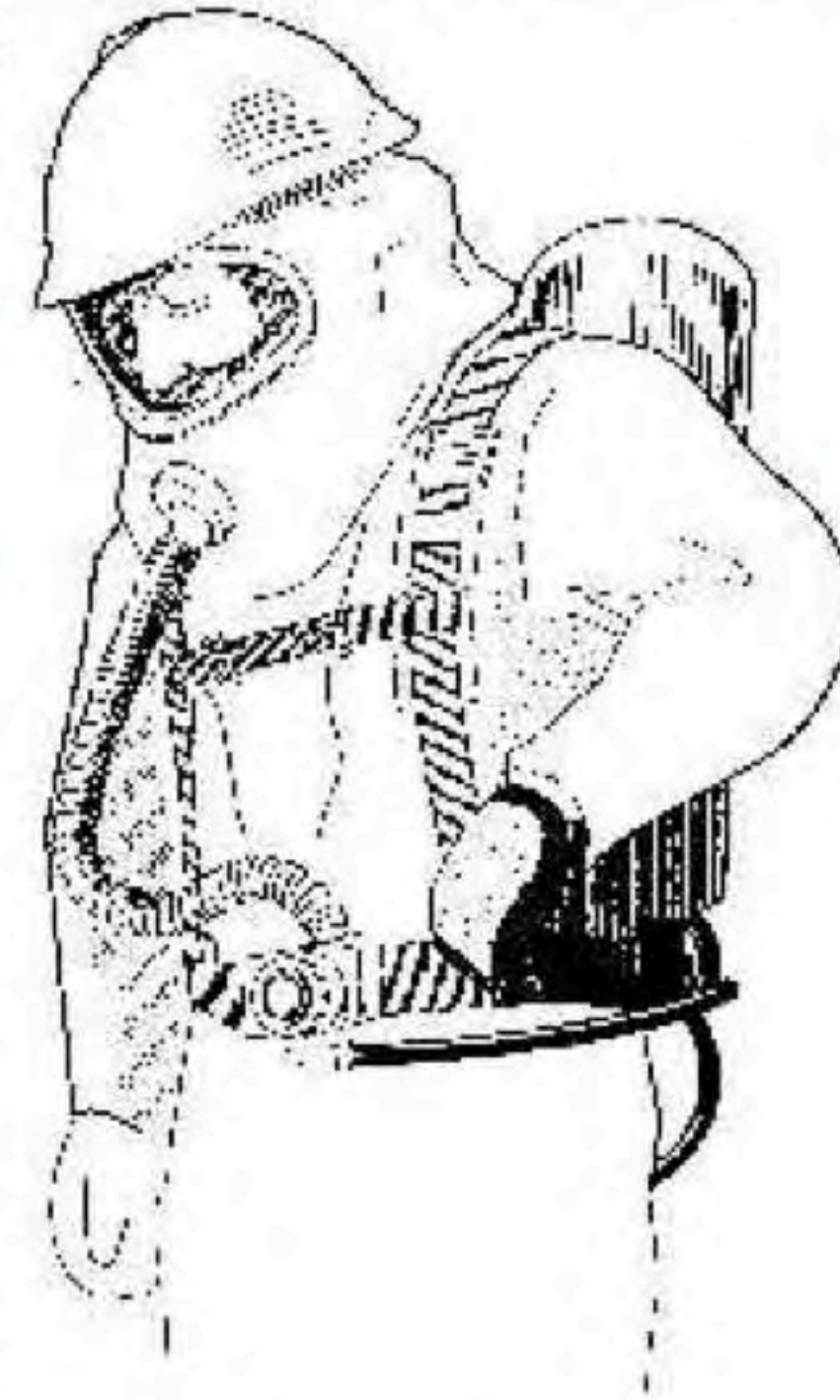
# Level B Equipment

## RECOMMENDED:

- SCBA or Supplied-Air Respirator with Escape SCB
- Chem. Resistant Clothing
- Chem. Resistant Inner and Outer Gloves & Boots

## OPTIONAL:

- Hard Hat
- Coveralls
- Face shield
- Disposable Gloves
- Boot Covers
- Long Cotton Underwear





# Level A PPE

Highest Protection Provided for:

- Respiratory Tract
- Skin
- Eyes





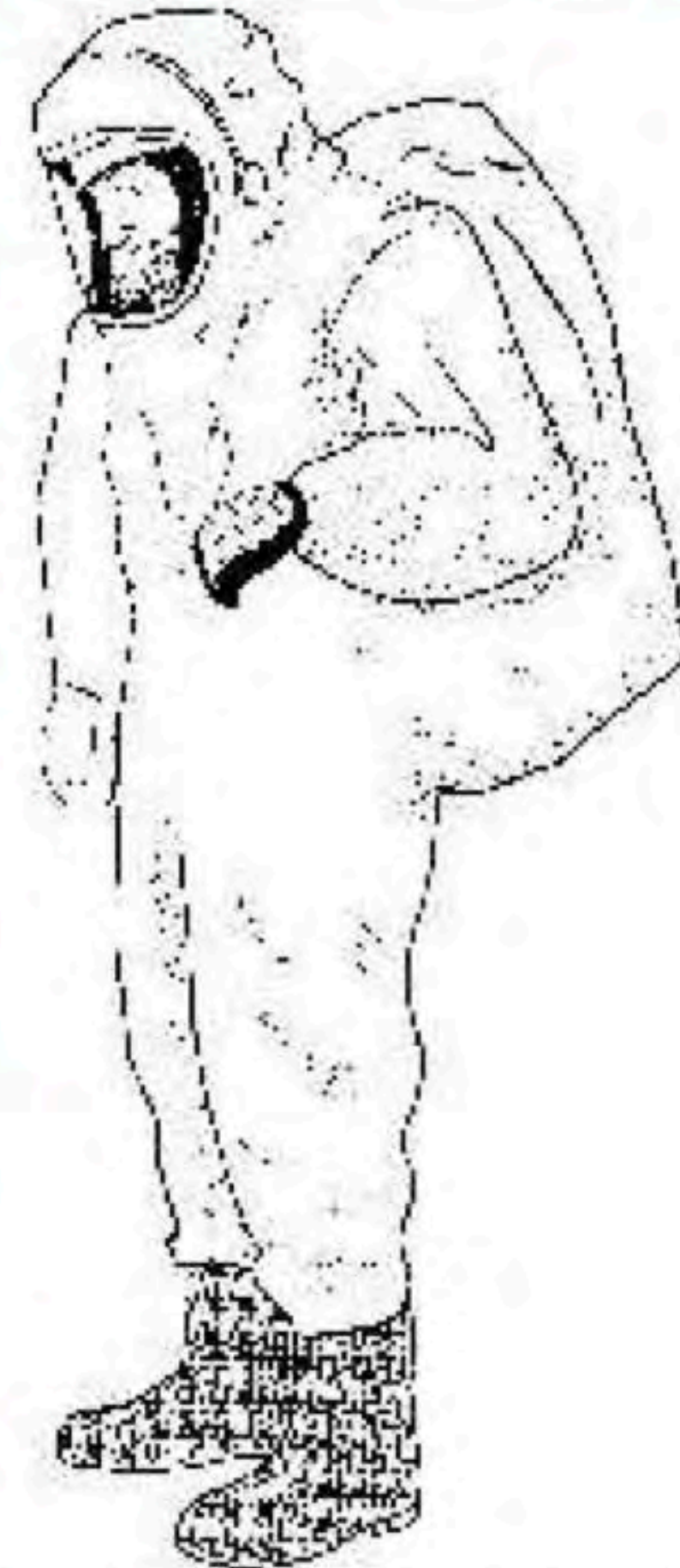
# Level A Equipment

## Recommended:

- SCBA or SAR
- Totally Encapsulating Chem.Resistant Suit
- Chem. Resistant Inner & Outer Gloves & Boots

## Optional:

- Cooling Unit
- Coveralls
- Hard Hat
- Disposable Gloves
- Boot Covers





# Limitations

Each level of PPE has limitations.

- Visibility
- Mobility
- Heat Stress
- Protection

All PPE must be compatible with the substance that you are working with, based on hazard assessment.



# Decontamination

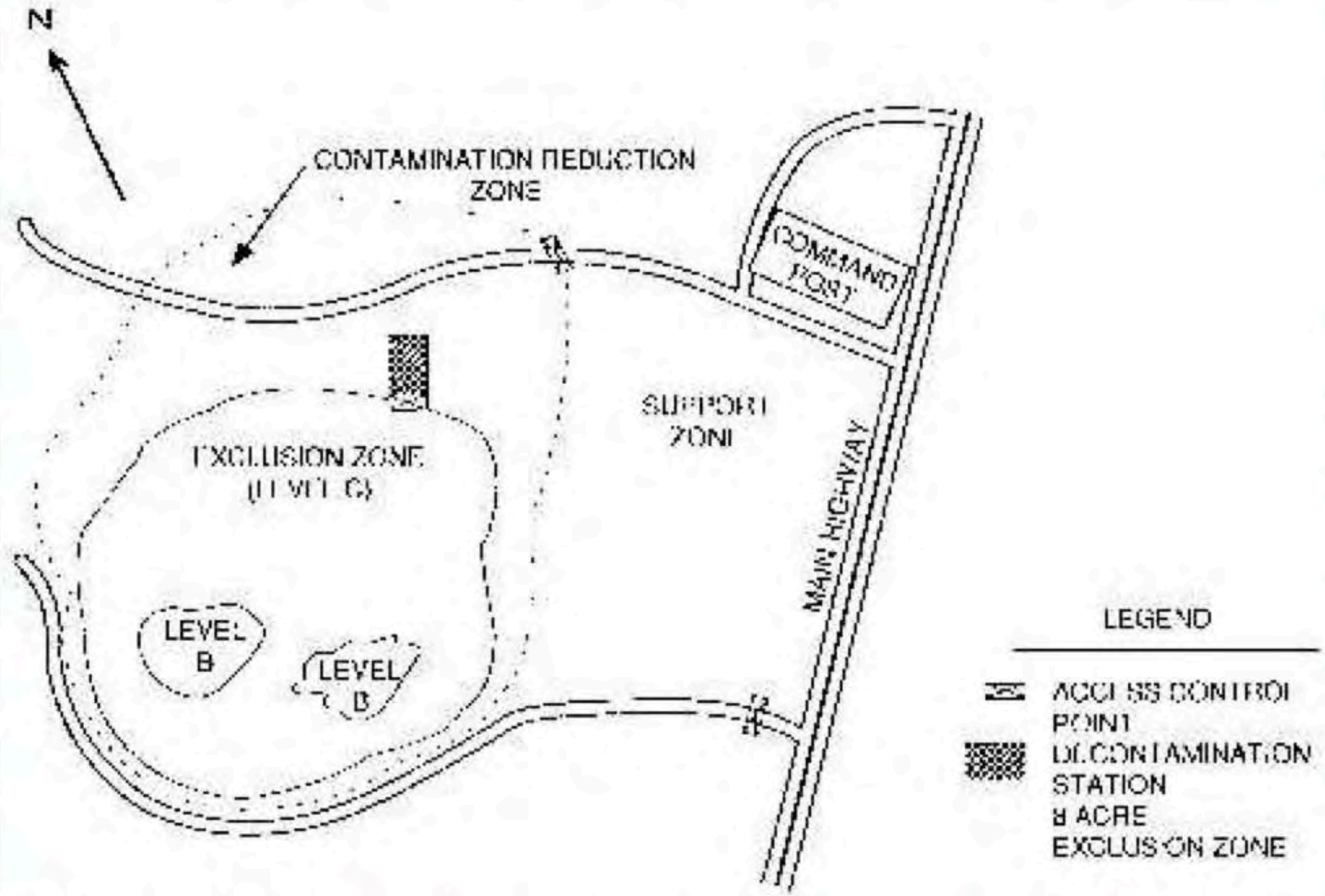


# Purpose Of Decontamination

- Cleans PPE & equipment
- Protects workers
- Prevents further contamination
- Protects environment
- Protects community

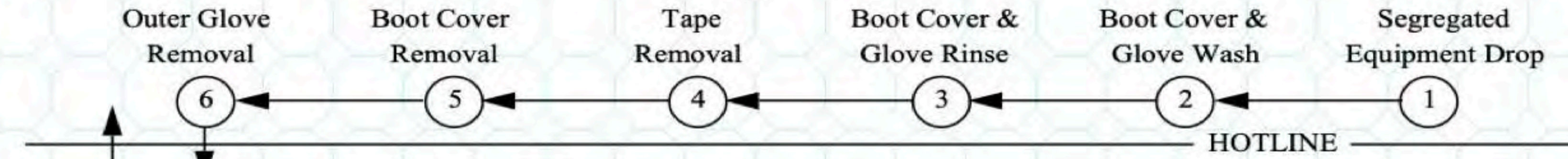


# Zones





# EXCLUSION ZONE



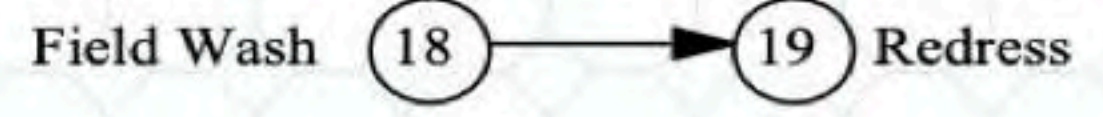
# MAXIMUM DECONTAMINATION LAYOUT

## Level B Protection

# CONTAMINATION REDUCTION ZONE



CONTAMINATION CONTROL LINE



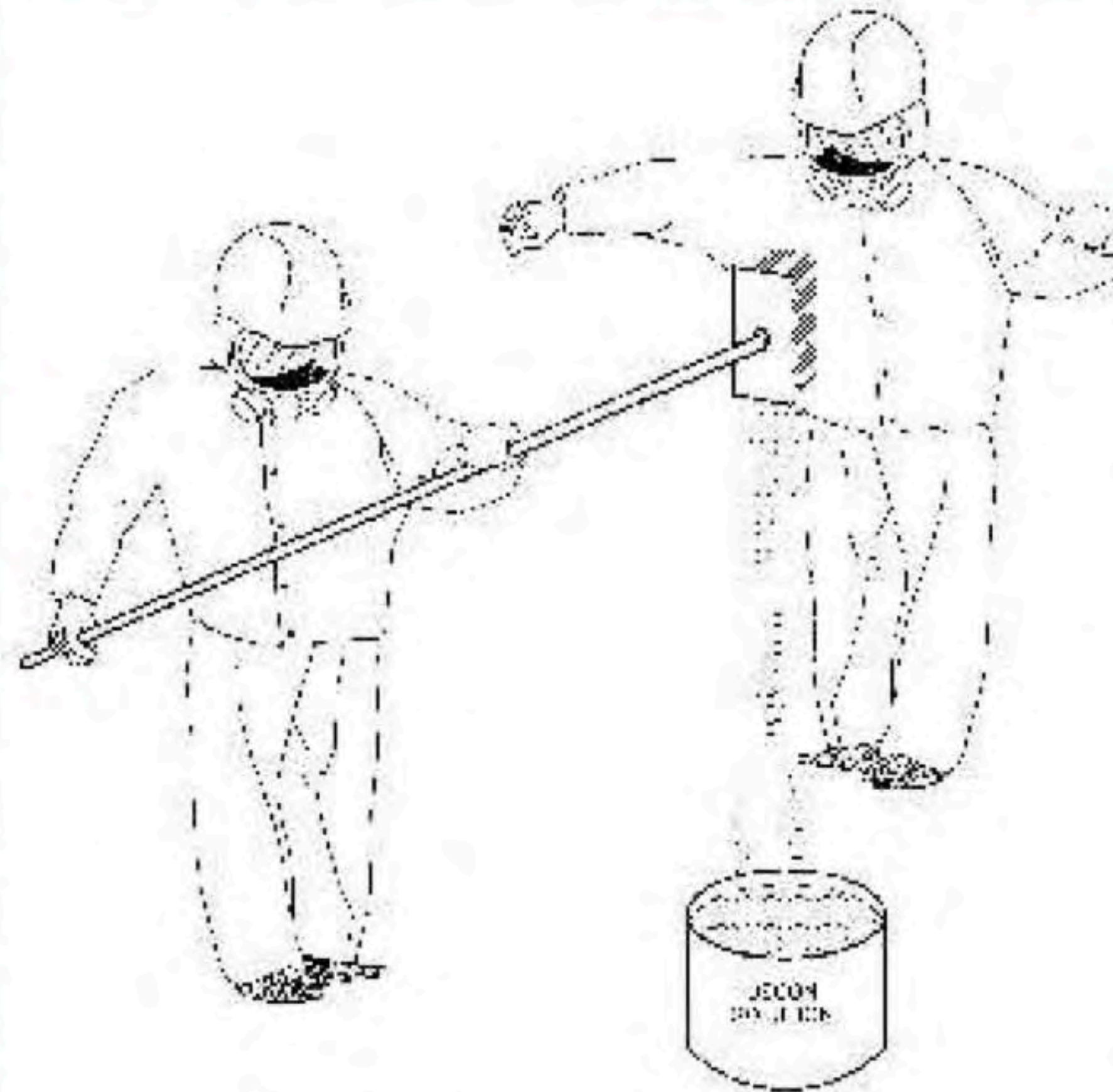
# SUPPORT ZONE





# Decontamination Methods

- Physical
- Chemical
- Combination





# Health And Safety

## Decontamination methods may:

- Be incompatible with hazardous substances.
- Be incompatible with equipment.
- Pose a direct health hazard to workers.



# Decontamination Equipment

- Tanks
- Brushes
- Buckets
- Storage Containers



# Medical Surveillance

## Protection of Employee's Health

- Detecting pre-existing disease or medical conditions that may place an employee performing certain tasks in risk.
- Minimizing individual exposures at the workplace, so that the disease process is never initiated.



# Medical Surveillance

## Site Medical Program Components

- Surveillance
- Treatment
- Record keeping
- Program review



# Medical Surveillance

- Pre-employment screenings
- Periodic medical exams
- Follow up exams
- After injury or overexposure
- Exam after notifying employer of symptoms which may be related to exposure.
- Termination exam



# Medical Surveillance

## Affected Employees

- Employees who are, or may be exposed to PELs of hazardous substances or health hazards for 30 days or more per year
- Employees who wear a respirator for 30 days or more per year
- Members of organized HAZMAT teams
- Employees who are injured as a result of overexposure during a site.



# Monitoring & Sampling

## Hazardous Atmospheres

- Explosive
- Toxic
- Oxygen deficient
- Oxygen enriched
- Radioactive



# Monitoring & Sampling

- Identify and quantify airborne contaminants on and off site.
- Track changes in air contaminants that occur over the lifetime of the incident.
- Assist in defining work zones
  - Ensure proper selection of work practices and engineering controls.
  - Determine the level of worker protection needed
  - Identify additional medical monitoring needs



# Monitoring & Sampling

## Direct Reading Instruments

- Multi-gas detectors
- Dose-rate meters
- Colormetric tubes
- PID

## Laboratory Analysis

- Gas sampling bags
- Filters
- Sorbents
- Wet collection methods



# Monitoring & Sampling

## Perimeter monitoring

- Zone requirements

## Periodic monitoring

- Work in a different area
- Different operations, i.e. demolition vs. collection
- Different contaminants
- Obvious liquid contamination, spills or lagoons

## Personal Monitoring

- High risk employees
- Area samples
- Industrial hygiene techniques
- Medical surveillance requirements



# Illumination

## FOOT CANDLES

5

3

5

10

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## AREA OR OPERATIONS

General Site

Excavation, Storage

Warehouses, Tunnels

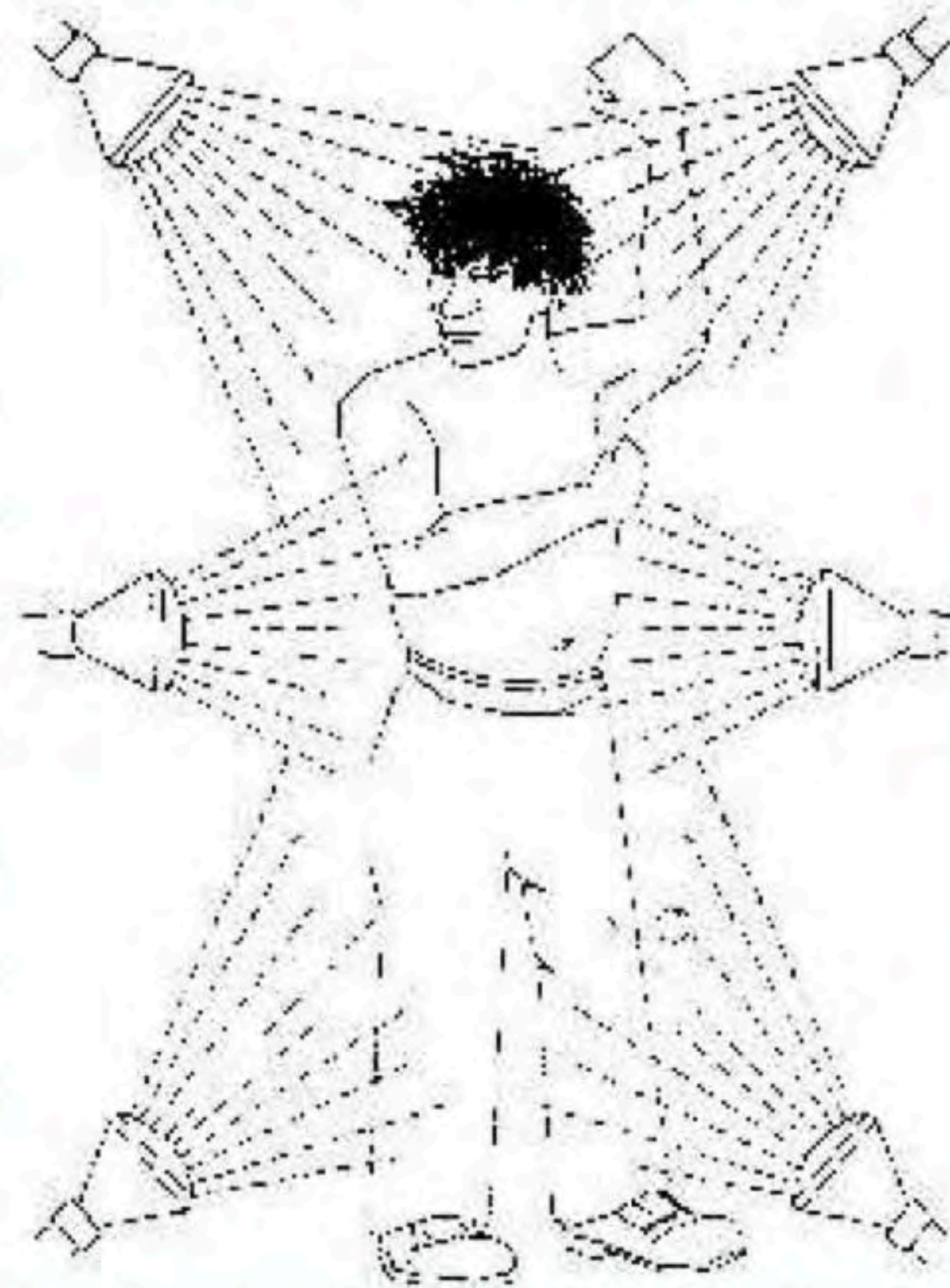
General Shops

Offices



# Sanitation

- Potable Water
- Nonpotable Water
- Toilet facilities
- Food handling
- Washing facilities
- Shower and change rooms





# Safe Work Practices

- Confined Space Procedures
- Control of hazardous energy (Lock out)
- Fall Protection
- Material/Waste Handling



# Confined Space

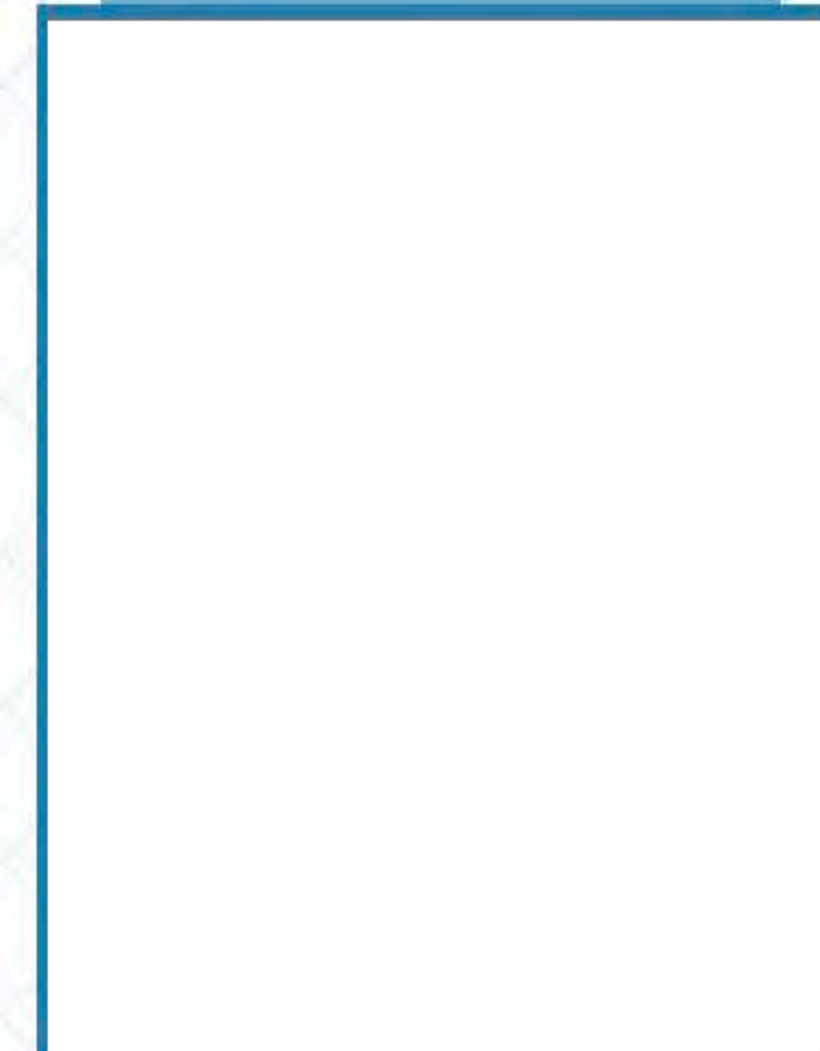
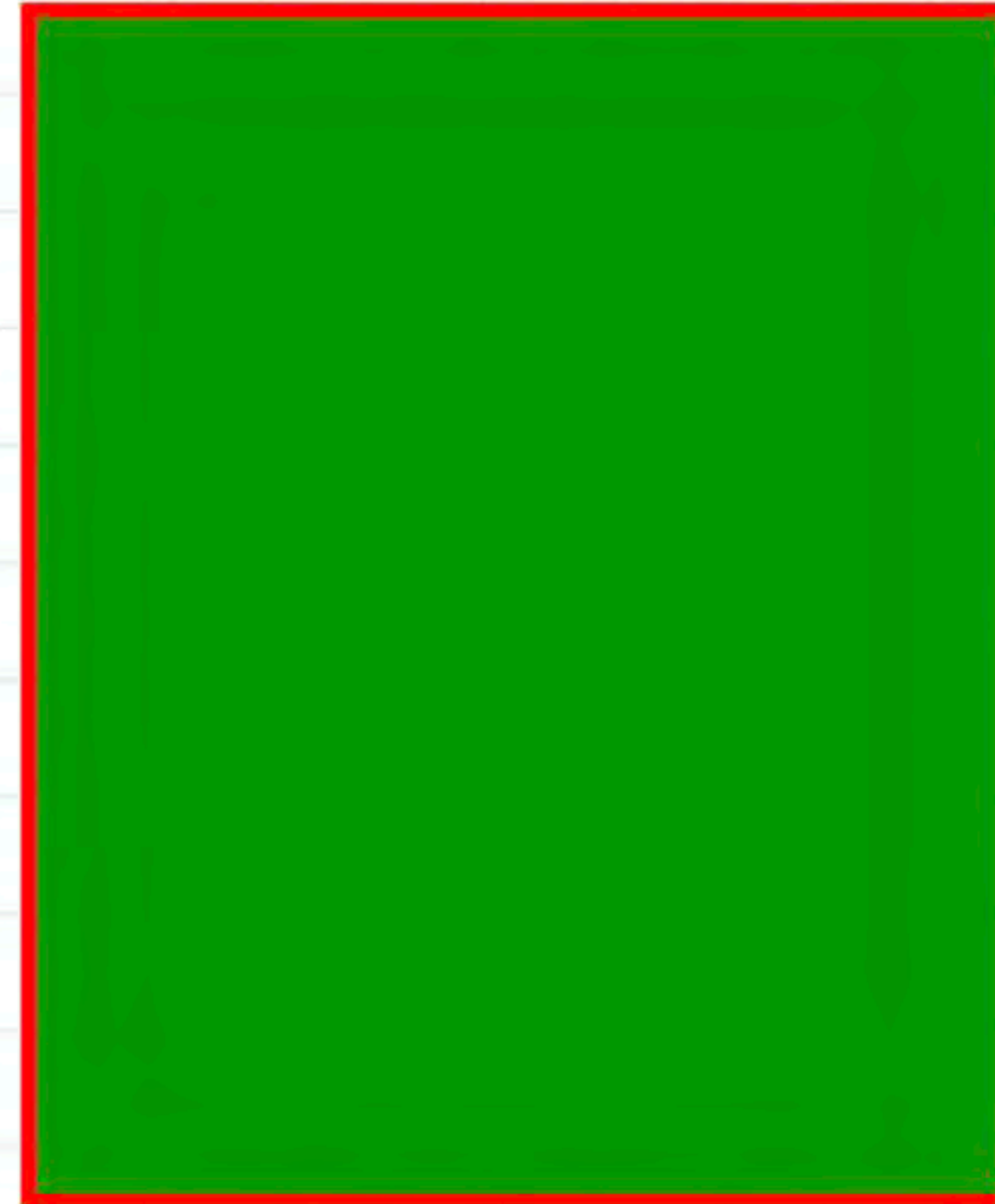
- Limited entry and exit
- Large enough and so configured to allow a person to enter and perform work
- Not designed for continuous human occupancy



# Confined Space

## “Permit Required”

- Contains or has the potential to contain a hazardous atmosphere
- Potential for engulfment
- Inwardly converging walls
- Any other recognized serious safety or health hazard.





# Confined Space

## Training Requirements

- Entrant
- Attendant
- Supervisor
- Rescue Team

## Permit Requirements

- Define the work
- Evaluate all hazards
- Monitoring requirements
- Protection from all hazards
- Names and number of entrants
- ETC.



# Material Handling



# Hazards





# Drum Handling

- 29 CFR 1910 and 1926 contain OSHA standards for chemical containers and their handling.
- 40 CFR 265 contains EPA requirements for waste containers and storage areas.
- 49 CFR 171-178 (DOT) specifies container standards and shipping procedures for hazardous wastes.



# Drum Inspection

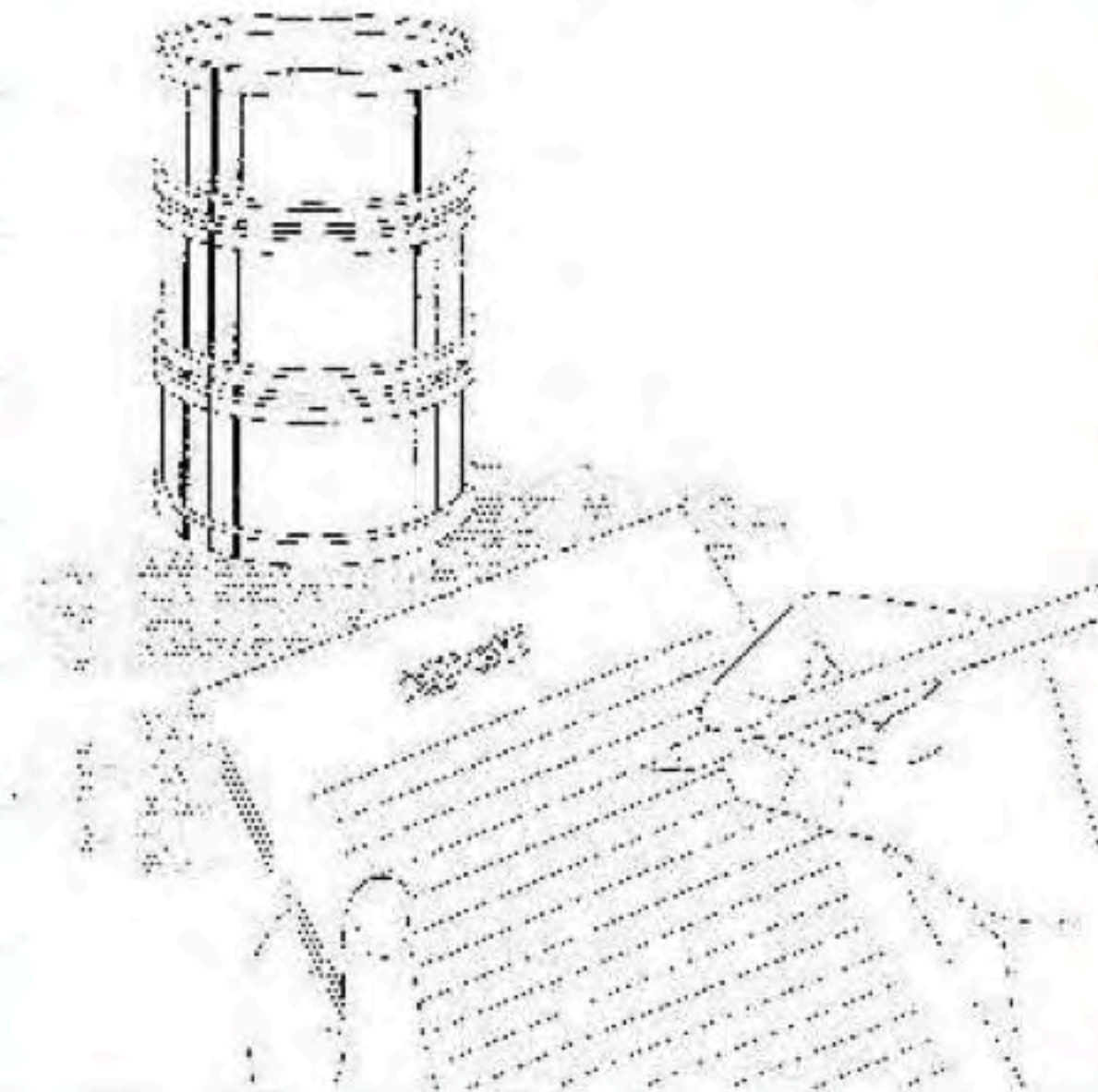
- Monitor conditions in the immediate vicinity of drums.
- Perform visual inspection of drums.
- Classify drums into preliminary hazard categories.



# Drum Inspection

## Look for:

- Symbols, words, marks indicating contents
- Signs of deterioration
- Signs that the drum is under pressure
- Drum type
- Configuration of drum head





# Handling

## **The purpose of handling is to:**

- Respond to any obvious safety problems
- Unstack and orient drums for sampling
- Organize drums into different areas



# Planning

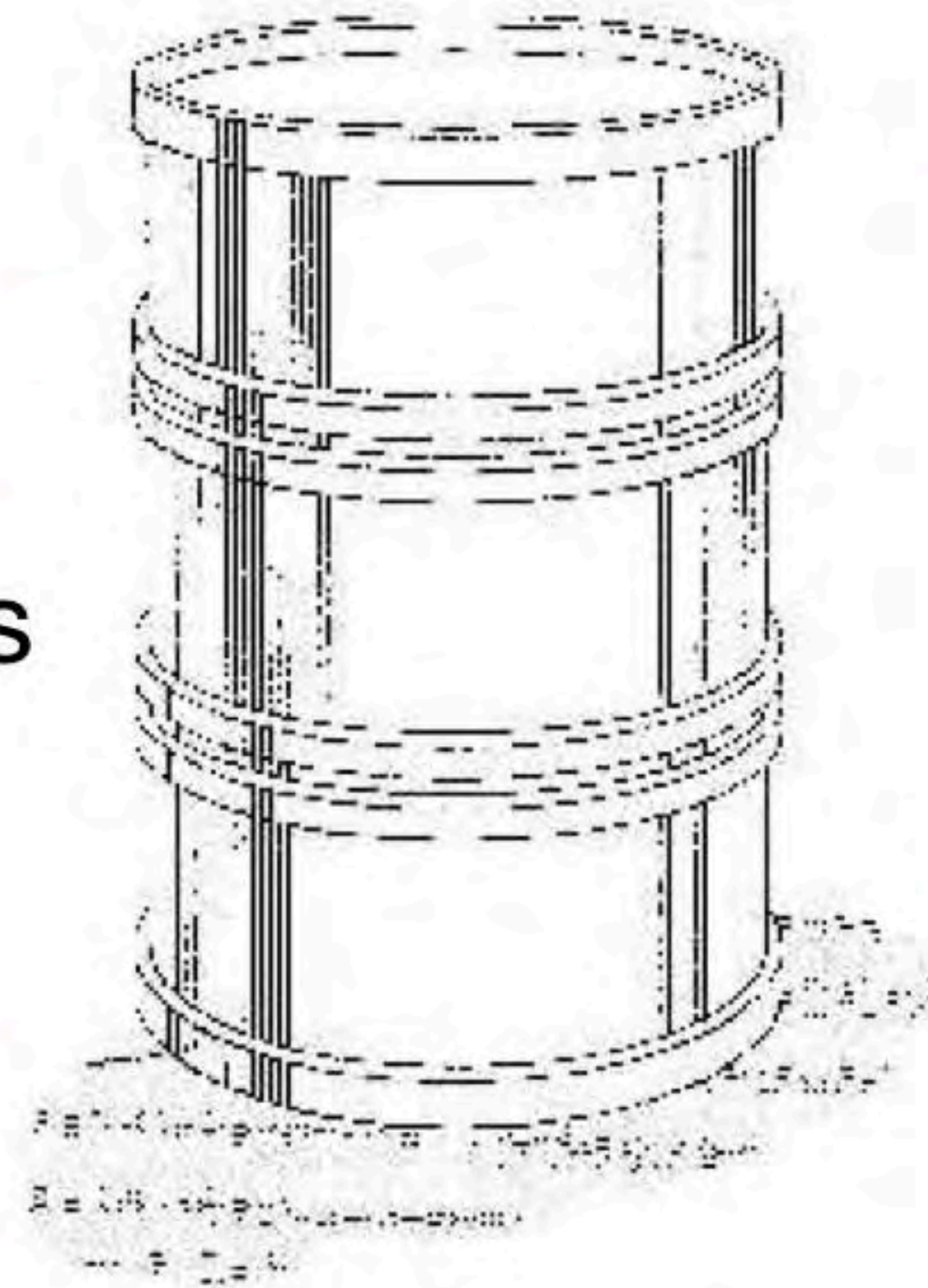
## **A preliminary plan should contain:**

- Extent of handling necessary
- Personnel selected for the job
- Appropriate procedures based on the hazards associated with the probable drum contents



# Types Of Containers

- Radioactive Waste
- Explosive or Shock Sensitive Waste
- Bulging Drums
- Lab Pack Drums
- Leaking, Open and Deteriorated Drums
- Buried Drums

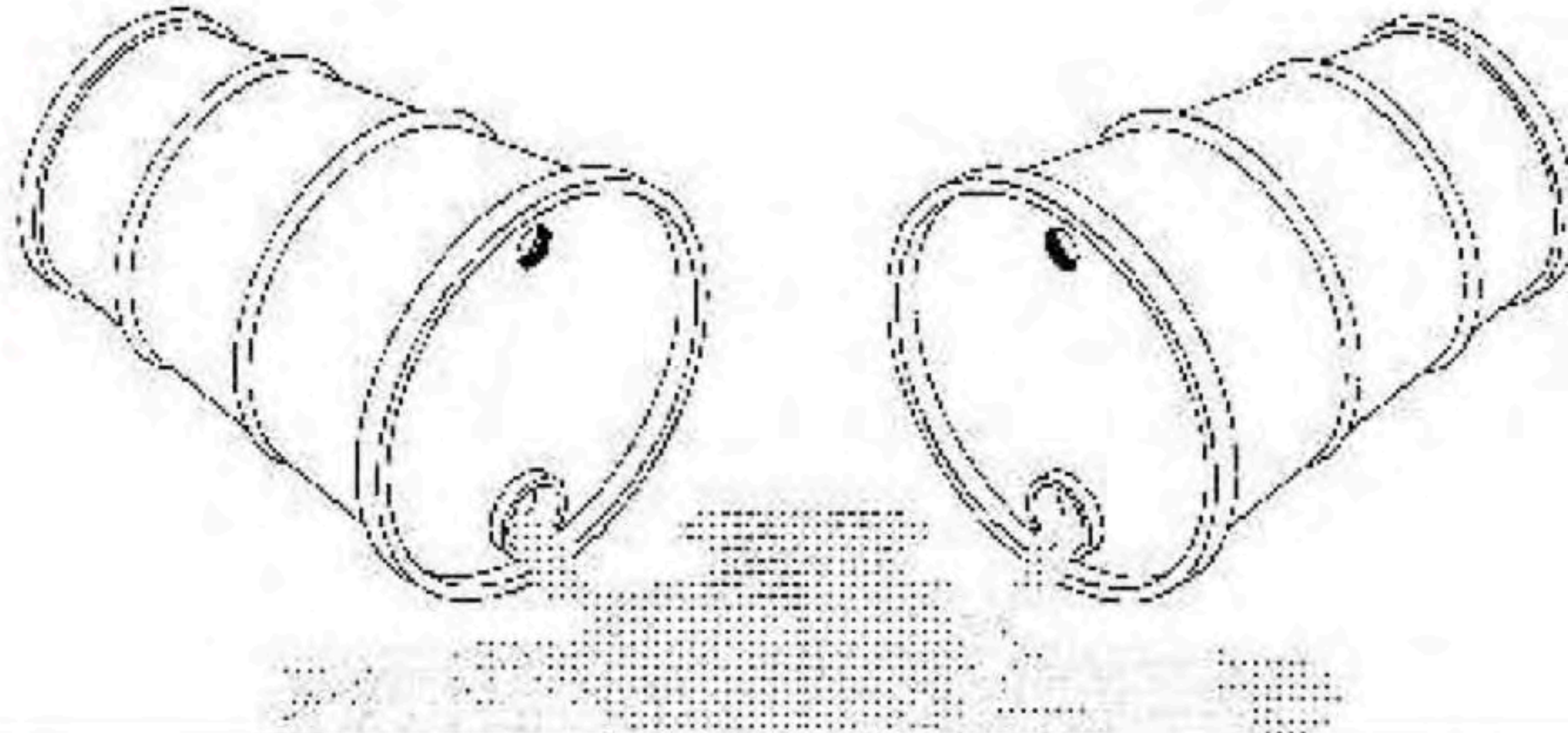




# Spill Response



# Assume that...



**ALL SPILLED MATERIALS  
ARE DANGEROUS!**



# Review

## HAZWOPER

**Hazardous Waste Operations and Emergency Response**



# Review

Where does HAZWOPER Apply?

Hazardous Waste Sites

Treatment, Storage and Disposal Sites

Emergency Response - regardless of location



# Review











## Regulations

RCRA  
CRCLA  
OSH Act



# Review

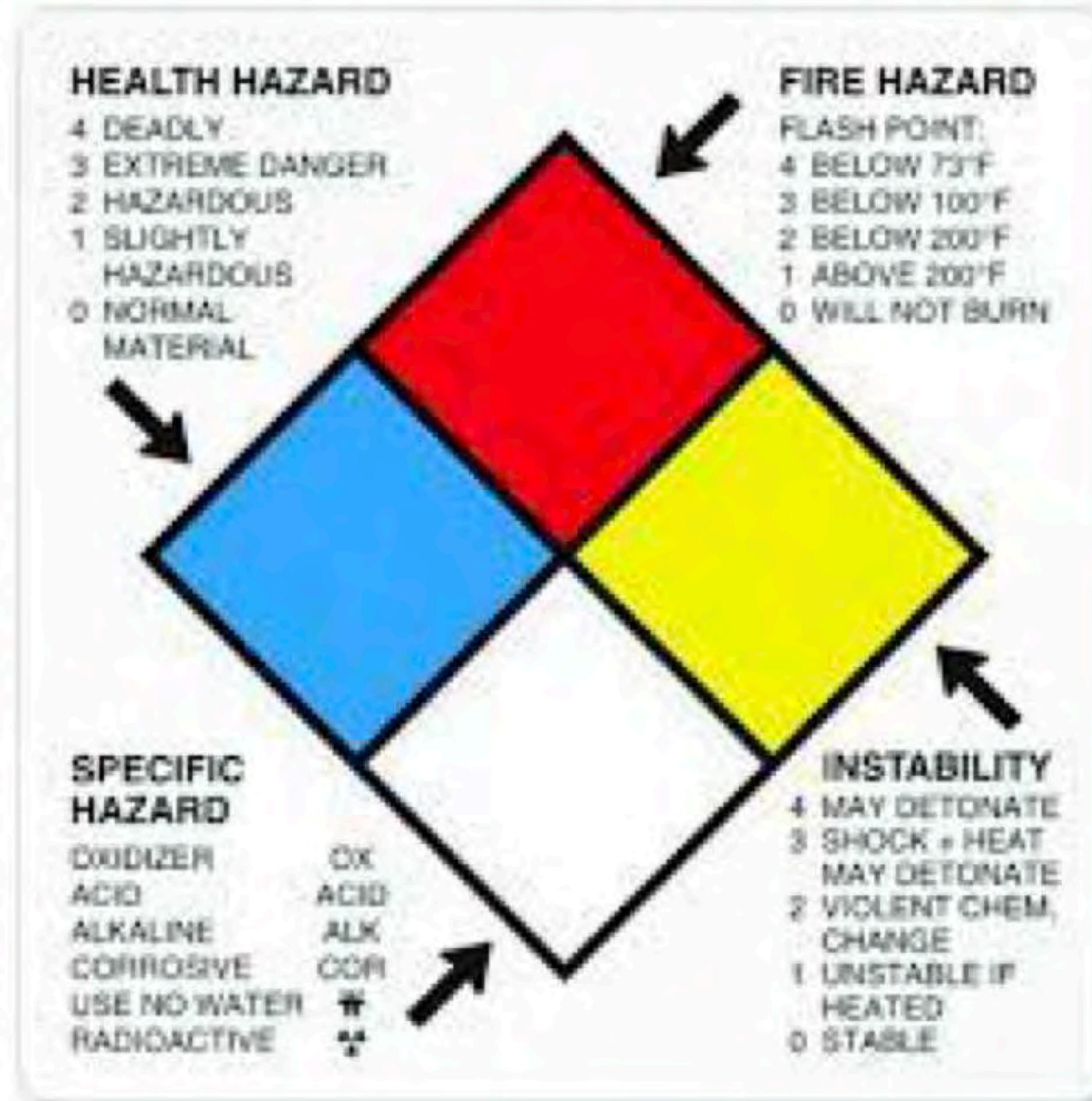
# Recognition

GHS Pictograms	Physical hazards	GHS Pictograms	Health and Environmental hazards
	Explosive; Self-reactive; Organic peroxide		Skin corrosion; Serious eye damage
	Flammable; Pyrophoric; Self-reactive; Organic peroxide; Self-heating; Emits flammable gases when in contact with water		Acute toxicity (harmful); Skin sensitizer; Irritant (skin and eye); Narcotic effect; Respiratory tract irritant; Hazardous to ozone layer (environment)
	Oxidizer		Respiratory sensitizer; Mutagen; Carcinogen; Reproductive toxicity; Target organ toxicity; Aspiration hazard
	Gas under pressure		Hazardous to aquatic environment
	Corrosive to metals		Acute toxicity (fatal or toxic)



# Review

## Recognition





# Review

## Respirators

NIOSH Certified



Example of an open-circuit SCBA





# Review

## Infectious Substances Categories

Category A

Category B

Regulated Medical Waste



# Review

## Radiation

Time  
Distance  
Shielding



# Review

As

Low

As

Reasonably

Achievable



# Review

## PPE Selection

Based on Hazard assessment

Permeation

Degradation

Penetration



# Review

## Personal Protective Equipment

Level D

Level C

Level B

Level A



# Illumination

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