# Training Program for Health Protection in the Mining Industry

*Module II*

## ***Protect Yourself When Using Chemicals***

# Training Program for Health Protection in the Mining Industry

# *Protect Yourself When Using Chemicals*


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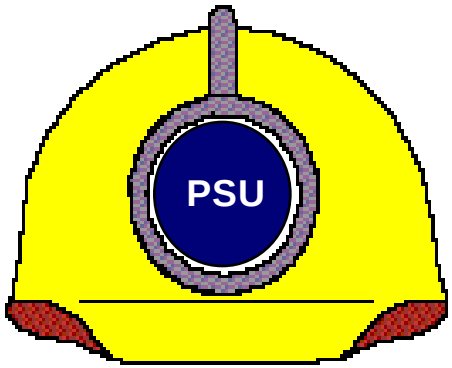
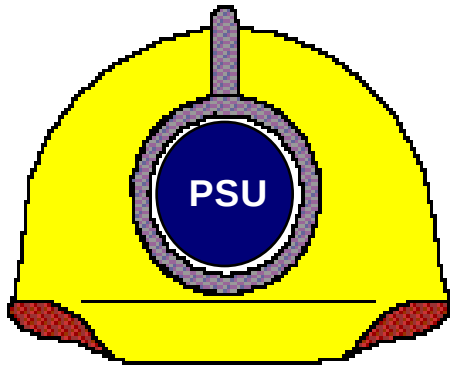
## September, 1999



# Module II

# Protect Yourself When Using Chemicals

# Introduction

Hazardous materials are often referred to as chemical hazards in the workplace

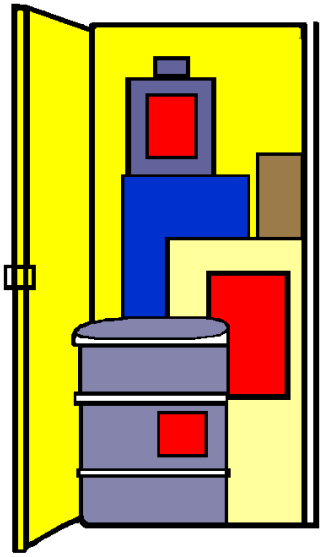
Hazardous materials exist in one form or another in nearly all homes and workplaces in the United States

There is potential exposure to hazardous materials/chemicals in all workplaces, including mining

MSHA's
Proposed Hazard
Communication Standard
stated
that all miners
are exposed
to the hazards of chemicals
in all mining environments

Used properly, chemical substances can be of great benefit

Used improperly, chemicals have the ability to cause major safety, health, and environmental problems



Chemical hazards in the workplace have been around for a long time, but it is only in the last several decades that special safety emphasis has been placed upon them

# Recent occurrences that promoted chemical safety in the workplace

- Agent Orange
- Love Canal
- Fluoride in water
- Sodium Cyclamate
- DDT (insecticide)
- Bhopoul, India
- Black Lung
- Silicosis

# What are hazardous materials?

Solids, gases, liquids,
or chemical substances
that are capable
of causing
physical and/or health hazards
or substances that have
been declared as hazardous
by a regulatory authority.

# Physical Hazard

Combustible liquids, compressed gases, explosives, flammables, organic peroxides, oxidizers, pyrophorics,unstable reactives, or water reactives.

Physical Hazards
can cause explosions, fires,
or violent reactions.

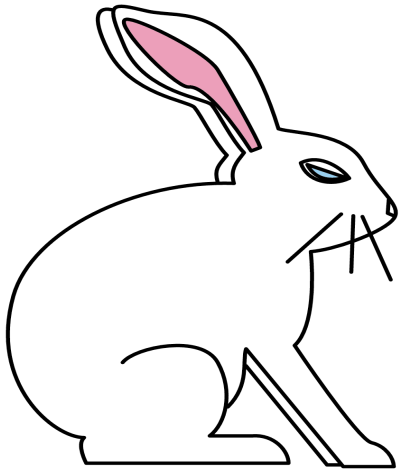
# Health Hazard

A chemical that can cause
acute or chronic
health effects in
exposed employees.

Health Hazards
can cause illness
or injury.

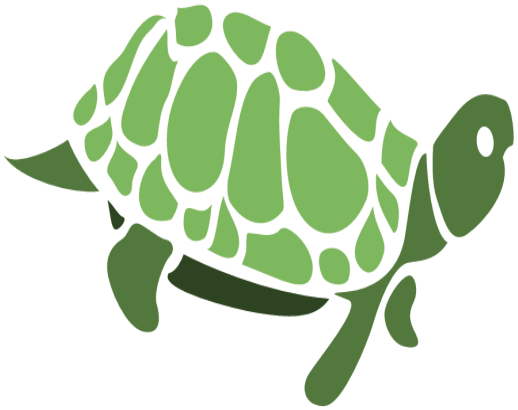
# Acute Health Effects

## Signs or symptoms that usually occur or develop rapidly



# Chronic Health Effects

## Signs or symptoms that usually occur or develop slowly



# Examples of chemical hazards in the mining industry

**Gasoline**

**Ammonium Nitrate**

**Acetylene**

**Exhaust fumes**

**Fuel oil**

**Motor oil**

**Coal dust**

**Ether**

**Antifreeze**

**Silica dust**

**Alkalines**

**Solvents**

**Blasting aftergases**

**Cements**

**Acids**

**Welding fumes**

# Types of Physical and Health problems associated with hazardous chemicals

- Fires/explosions
- Skin disorders
- Liver damage
- Nervous system damage
- Lung diseases
- Cancers

What are the advantages of increased knowledge of hazards posed by chemicals in the workplace? (MSHA, 1990)

- Safer work conditions and practices
- A decreased incidence of chemical related injuries and illnesses
- Increased use of Personal Protective Equipment
- Increased awareness, resulting in earlier medical treatment of chemical illnesses

The mining industry is no different than any other type of industry regarding the use of hazardous materials in the workplace

- All miners face potential exposure to hazardous materials.
- Hazardous materials in the mining environment can cause health and/or physical problems.
- A more informed miner will most probably be a safer miner miner.

# The bottom line is:

Chemicals are
all around us.
If we misuse them,
they can cause
major problems.

The idea of this program is to help you become more aware of

- How chemicals exist in the mining workplace
- Types of hazards posed by chemicals
- Types of body systems affected by chemicals
- The basic contents of MSDS's
- The fundamentals of warning labels

# On with the show!

# How Chemicals Exist In The Workplace

Chemicals in the workplace can exist in one of three basic forms of matter

Solid

Liquid

Gas

# Hazards of solids

- Solids can be combustible
  Example:  Wood

- Solids can give off hazardous gases or vapors
  Example:  Calcium Carbide

- Solids can cause heath hazards through accidental contact
  Example:  Accidental ingestion, inhalation, or skin contact

- Solids can be changed to fumes,
  by burning or melting
  Example:  Metal fumes from welding

- Solids can be changed to dusts
  by grinding, cutting, or abrasion
  Example:  Coal dust

- Solids can become dispersed in the air,
  creating physical and/or health hazards
  Example: Haulage road dust

# Fume

An extremely small condensation particle, generated when solids are melted

# Dust

A very tiny particle of a solid

# How liquids can exist and pose hazards

- Liquids can be combustible or flammable
  Example: Fuel oil and gasoline

- Liquids can cause health problems through accidental contact
  Example: Accidental ingestion or accidental splashing

- Liquids can be changed to mists, or give off vapors, and become airborne, creating physical and/or health hazards
  Example: Solvent vapors

## Mist

Suspended liquid droplets generated by condensation or by breaking up a liquid such as splashing, foaming, or atomizing

## Vapor

The gaseous form of a solid or liquid substance as it evaporates. Vapors generally exist above the surface of a liquid

# How gases can exist and pose hazards

- Gases can be flammable / explosive in the right concentrations in air
  Example:  Methane

- Gases can be poisonous
  Example:  Carbon Monoxide

- Gases can displace oxygen in the air and act as simple asphyxiants
  Example:  Carbon Dioxide and Nitrogen

- Gases compressed in cylinders can cause fires and/or explosions if used/stored improperly
  Example:  Oxygen and acetylene cylinders

# Examples of Physical and Health Hazards

Both Physical Hazards and Health Hazards have different categories

Categories of Physical Hazards

- Combustible Liquids
  Example: Fuel Oil with flash point at or above 100˚F

- Compressed Gases
  Example:  Cylinders of Oxygen, Acetylene, and Propane

- Flammable Liquids
  Example:  Gasoline

- Flammable Solids

- Flammable Aerosols
  Example:  Many home spray products

- Flammable Gases
  Example:  Methane

- Organic Peroxides
  Example:  Benzoyl Peroxide

- Oxidizers
  Example:  Oxygen

- Pyrophoric (Self-igniting) Materials
  Example: Sodium, Lithium, and Potassium

- Unstable Reactives (Sensitive to shock, pressure or temperature)
  Example:  Nitroglycerin

- Water Reactives
  Example:  Calcium Carbide

# Categories of Health Hazards

- Carcinogens
  Example: Cadmium

- Corrosives
  Example: Sulfuric Acid and
  Sodium Hydroxide

- Irritants
  Example: Organic Solvents,
  Lime, and Cement

- Sensitizers (Causes allergic reactions)
  Example: Nickel, Oils, and Solvents

- Toxic or Highly Toxic (Very poisonous)
  Example:  Methyl Alcohol

- Chemicals that cause damage to specific body systems such as:

  -- Liver
  -- Kidneys
  -- Nervous system
  -- Reproductive system
  -- Blood
  -- Lungs

# How Chemicals Can Enter the Body

Chemicals can enter the body through four major routes

- Absorption through the skin, eyes, or mucus membranes
- Inhalation through breathing
- Ingestion through swallowing
- Injection by puncture type wounds

The fact is,
chemicals are all around us.
They come in various
types and forms,
and can affect us
in various ways.
We must select, handle
and use them in the
safest manner possible.

# Factors That Affect Chemical Injury or Illness

Factors that affect the way a chemical will effect a person exposed to the substance depend on many variables

- The degree of toxicity of the chemical
- The route of exposure of the chemical
- The nature of the exposure to the chemical

- How much was the person exposed to?
- How long was the person exposed?
- How often was the person exposed?
- Individual differences:
  - -- Age / Size / Weight
  - -- General level of health
  - -- Individual sensitivities
  - -- Level of exertion following exposure

# Chemical Safety

Make it a part of your daily work routine!

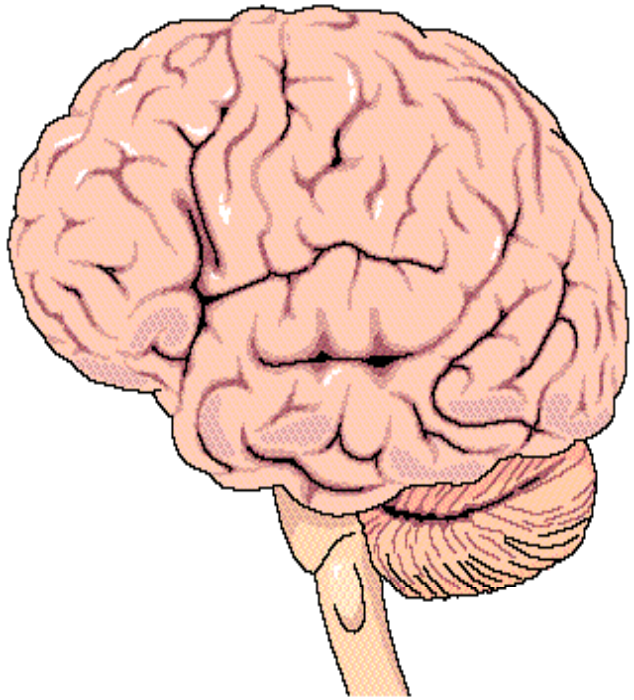
Some chemicals can seek out and affect specific body organs or functions, while not affecting other organs or functions. This is known as the

# Target Organ Effect

# Overview of Specific Body Systems Affected by Chemicals

- Nervous System
- Skin
- Liver
- Kidneys
- Lungs / Respiratory System
- Reproductive System
- Blood and/or Blood Forming Organs

Overview of the nervous system, and related chemical hazards



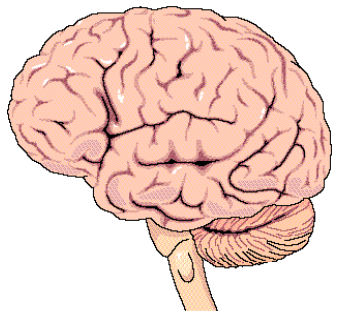
The nervous system is the command and control center of the body

The nervous system includes the brain, spinal cord, and nerves

The nervous system regulates automatic body responses like breathing and heart beat

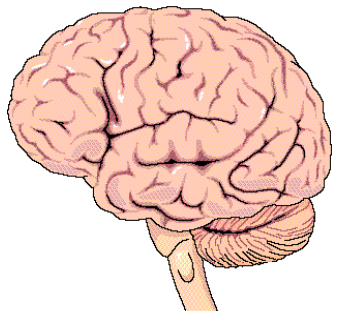
The nervous system regulates feelings and sensations

# Several ways chemicals can affect the nervous system



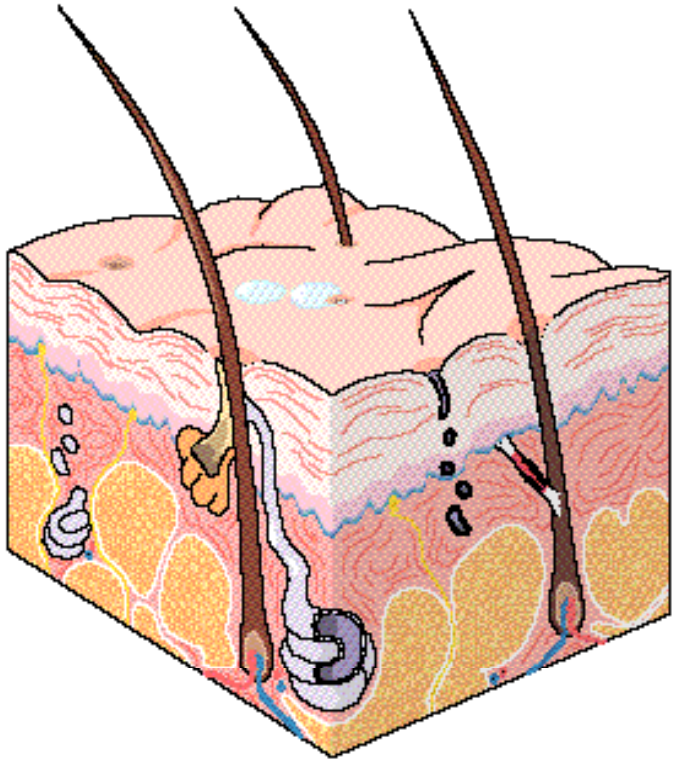
- Slowing or speeding nerve impulses– nerve impulses may travel faster or slower than normal
- Interfering with a nerve's ability to carry an impulse
- Interfering with the brain's ability to function, or send nerve impulses

# Examples of chemicals which can affect the nervous system



- Pesticides
- Methanol
- Lead
- Hexane
- Mercury
- Alcohol
- Asphyxiant gases
- Methylene chloride
- Butane

Overview of the skin
and related chemical hazards

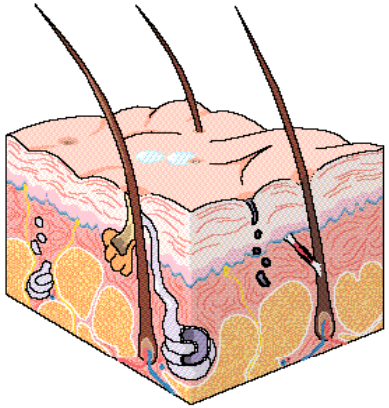


The skin is the largest
organ of the body

The skin protects internal
body systems

Average-size people have
about twenty square feet of skin

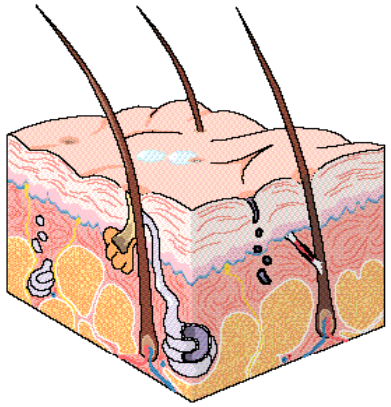
The skin is composed of several different layers



The skin helps the body regulate temperature through sweating

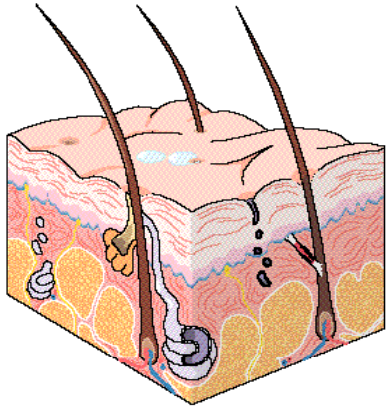
Toxic chemicals can pass through the skin to be absorbed and be carried throughout the body by blood vessels

# Several ways that chemicals can affect the skin



- Burns to the skin
  - -- Acids
  - -- Alkalines
  - -- Other Corrosives
- Dermatitis
  - -- Skin becomes inflamed, swollen, itchy, scaly, and crusty

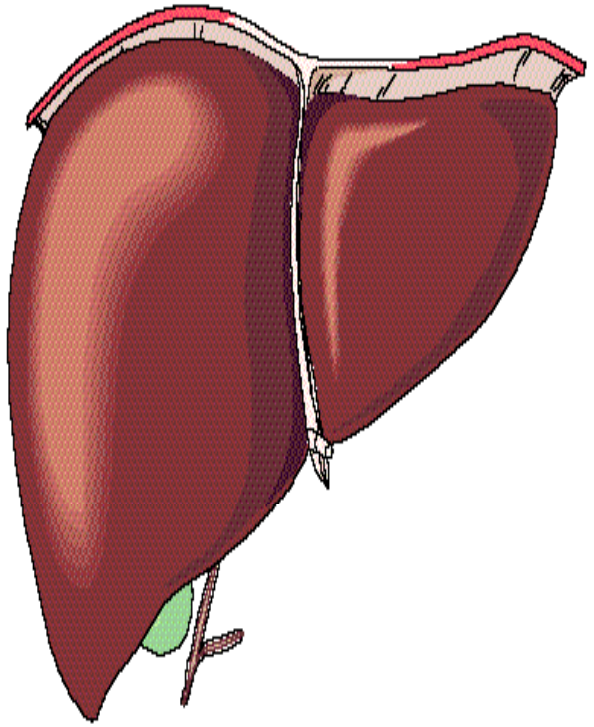
- Allergic Contact Dermatitis
  -- allergic reaction to a chemical substance



- Common chemical causes of Contact and Allergic Contact Dermatitis

| | |
|---|---|
| -- Nickel | -- Oils |
| -- Mercury | -- Solvents |
| -- Dyes | -- Cements |
| -- Cleansers | -- Acids and Alkalines |
| -- Soaps | -- Chromates |

Overview of the liver
and related chemical hazards



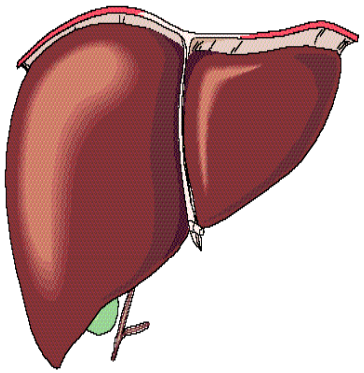
The liver is the largest
gland, and largest
internal body organ

The liver is a miniature chemical
refinery, and metabolizes substances

The liver weighs about four pounds

The liver is  composed of 2 major segments

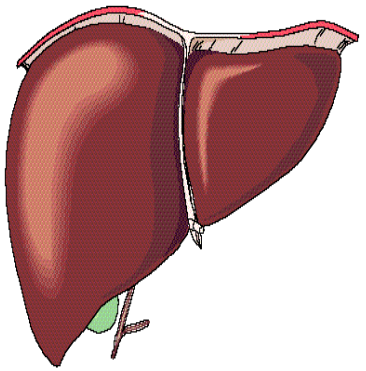
# Several ways in which chemicals can affect the liver



- Because the Liver's job is to metabolize substances, it is an organ which can be injured by toxic substances

- During the breakdown of some toxic substances, a more toxic substance can be created as a by-product

- Certain chemicals can cause liver problems such as



-- A build-up of fats in the Liver

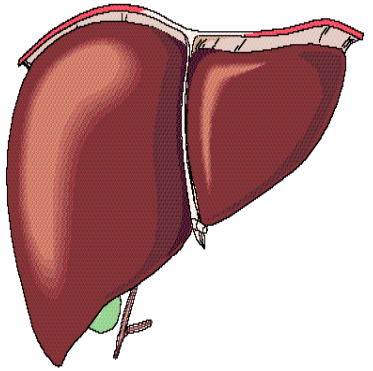
-- Hepatitis (liver inflammation)

-- Cirrhosis (fibrosis)

-- Nodules and/or tumors

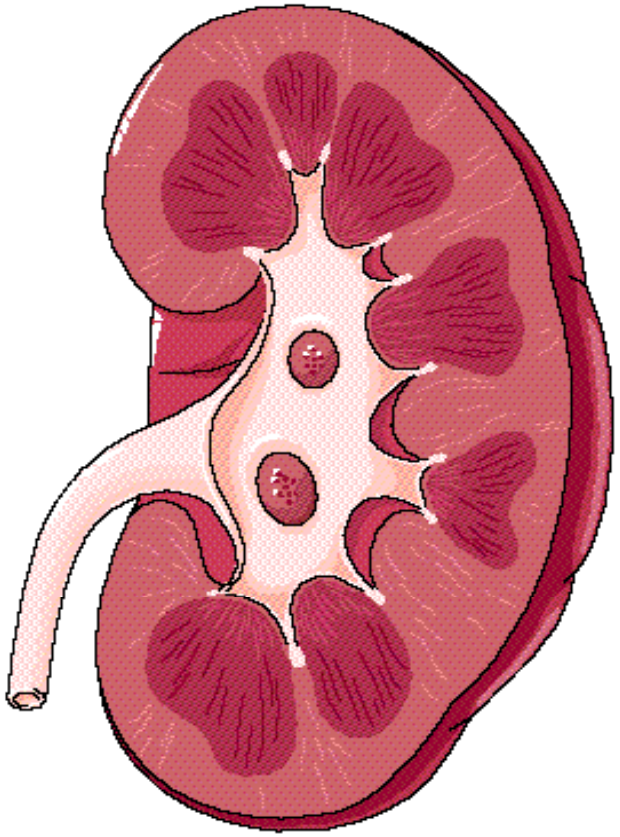
-- Liver cell death

# Examples of chemicals which can cause liver damage



- Ethanol
- Manganese
- Ketones
- Chloroform
- Beryllium
- Carbon Tetrachloride
- PCB Compounds
- Phosphorus

Overview of the kidneys,
and related chemical hazards



Kidneys are the main filtering
and excretory organs in the body

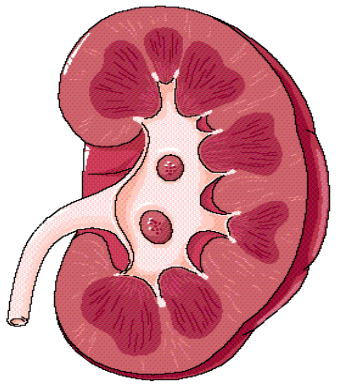
The kidneys filter the blood

The Kidneys filter about 1700
quarts of blood per day

The Kidneys and urinary tract work together

Each Kidney weighs about one-half pound

# Several ways in which chemicals can affect the kidneys



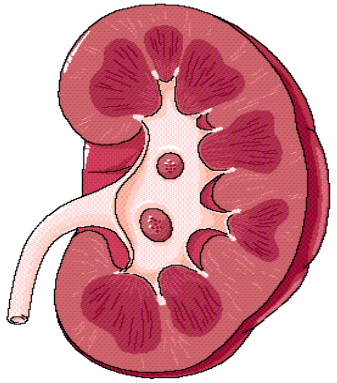
- Certain chemicals affect the kidney's ability to filter out waste products from the blood

- Certain chemicals can cause kidney problems such as

  -- The formation of crystallized products in the kidneys

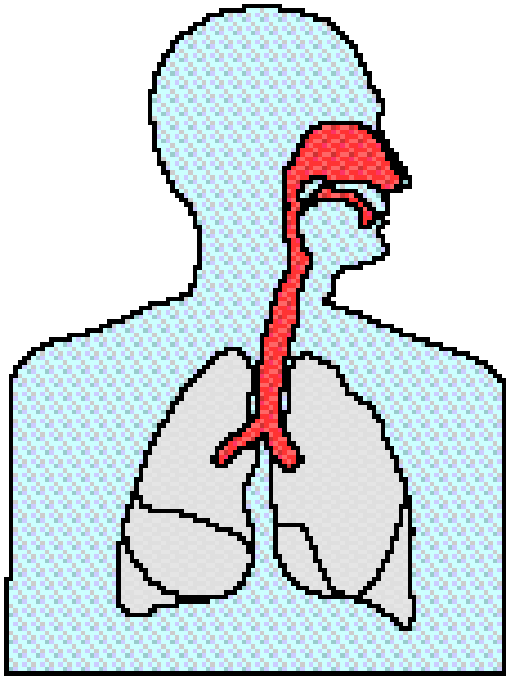
  -- Increased or decreased urine output

# Examples of chemicals that can cause kidney damage



- Lead
- Cadmium
- Mercury
- Chloroform
- Platinum
- Ethylene glycol

Overview of the respiratory system, and related chemical hazards

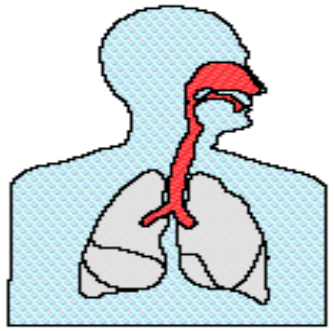


The main function of the lungs is to provide oxygen to the body and eliminate Carbon Dioxide

An average person breathes about 12-20 times per minute

Chemical substances can cause various problems either to the lung itself, or the way in which the body uses oxygen

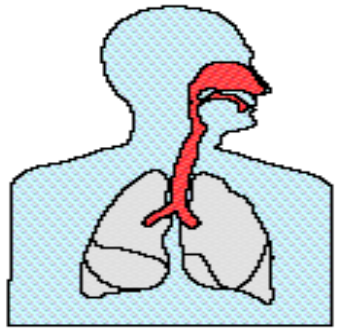
# Several ways in which the lungs and/or body can be damaged by an inhaled substance



- Some chemical gases, vapors, and mists can be systemically absorbed in the respiratory tract

- Inhaled chemical substances can irritate the respiratory tract, causing respiratory tract damage at the site of contact

- Some very small particles of substances like coal, silica, or asbestos can get into the small air passages and air sacs of the lung and cause debilitating or fatal types of lung diseases such as:



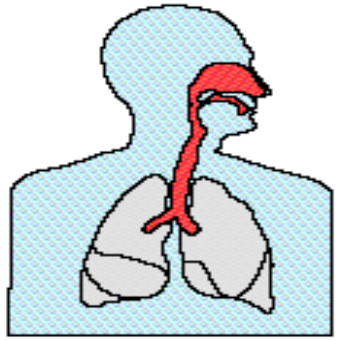
  -- Coal Workers Pneumoconiosis

  -- Silicosis

  -- Asbestosis

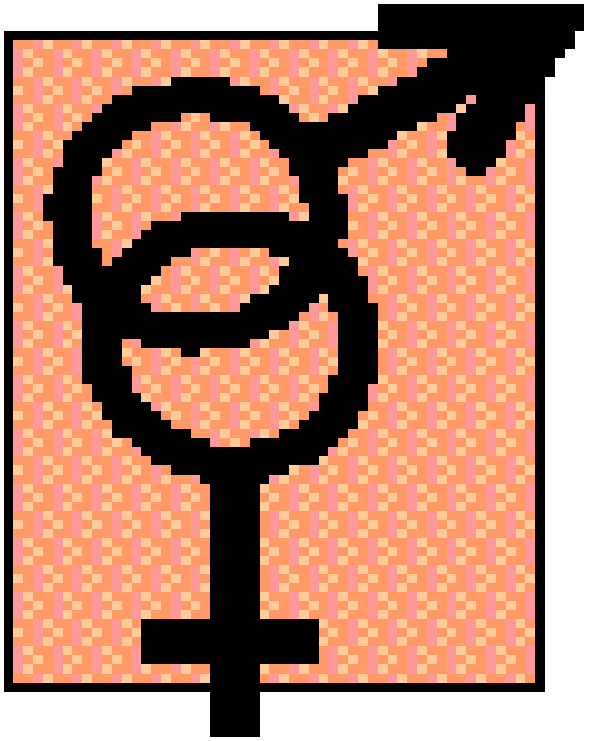
- Inhalation of certain types of fumes, like welding fumes, can make a worker ill

# Examples of chemicals which can affect the lungs



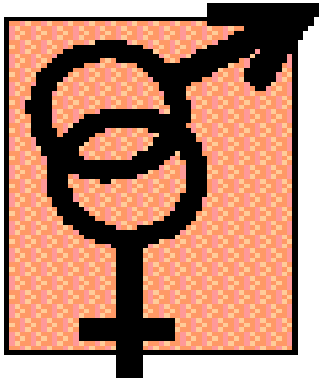
- Chlorine
- Oxides of Sulfur
- Metal Fumes
- Chemical Dusts
- Ammonia
- Oxides of Nitrogen
- Mineral Dusts
- Smoke

# Overview of the reproductive system, and related chemical hazards



- Exposure to certain chemical substances can affect the reproductive systems of both men and women

# Several ways that chemicals can affect the reproductive system



- Certain chemicals can cause reproductive problems such as:

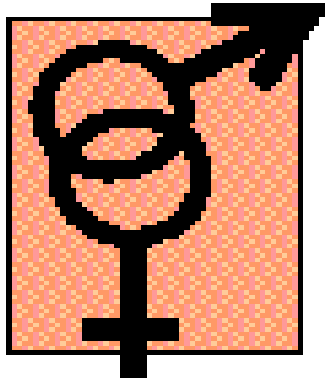
  -- Reduced male sperm count

  -- Miscarriage

  -- Birth defects in developing fetuses

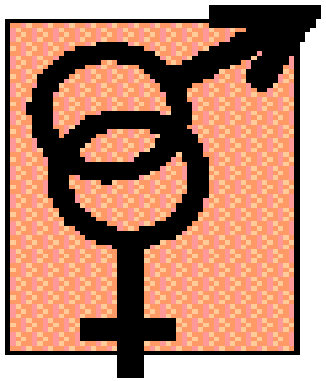
Full and complete evaluation by a qualified physician is necessary to best analyze, and advise, regarding past, present and future exposures to specific chemicals, and the reproductive health risks involved.

# Examples of chemicals that can affect the male reproductive system



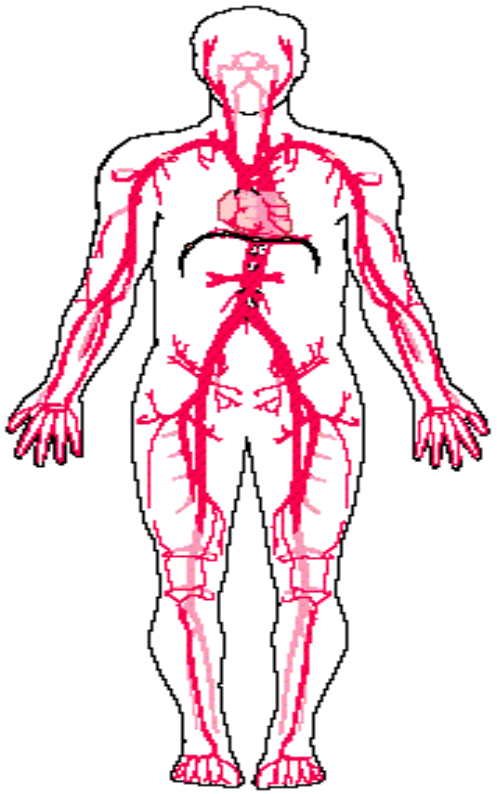
- Lead
- Kepone
- Vinyl Chloride
- DDT
- Cadmium
- Carbon Disulfide

# Examples of chemicals that can affect the female reproductive system



- Ethyl alcohol
- Tellurium
- Various pesticides
- Lead
- Methyl mercury

Overview of blood/blood forming organs, and related chemical hazards



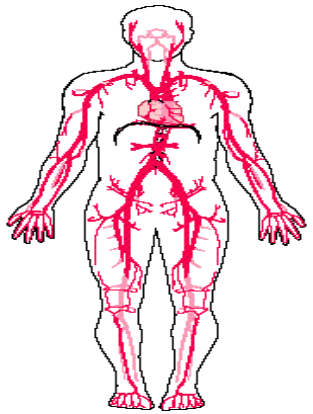
The average adult has about ten to twelve pints of blood

Blood is formed in the bone marrow

Certain chemical substances can have toxic effects on the development of blood, or the ability of blood to function properly

Blood is composed of different components, each having a different and specific function

# Several ways in which chemicals can affect the blood



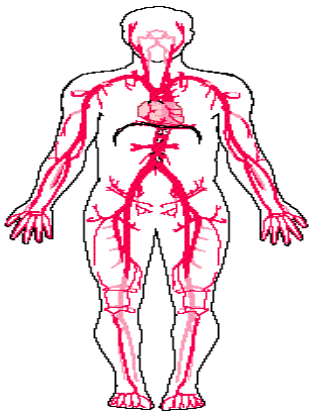
- Certain chemicals can cause blood-related problems such as:

  -- Hypoxia, resulting in inadequate oxygen supply to body cells

  -- Interference with the body's ability to use oxygen, even if it is present

  -- A reduction in the number of the blood cells or components

# Examples of chemicals which can affect the blood

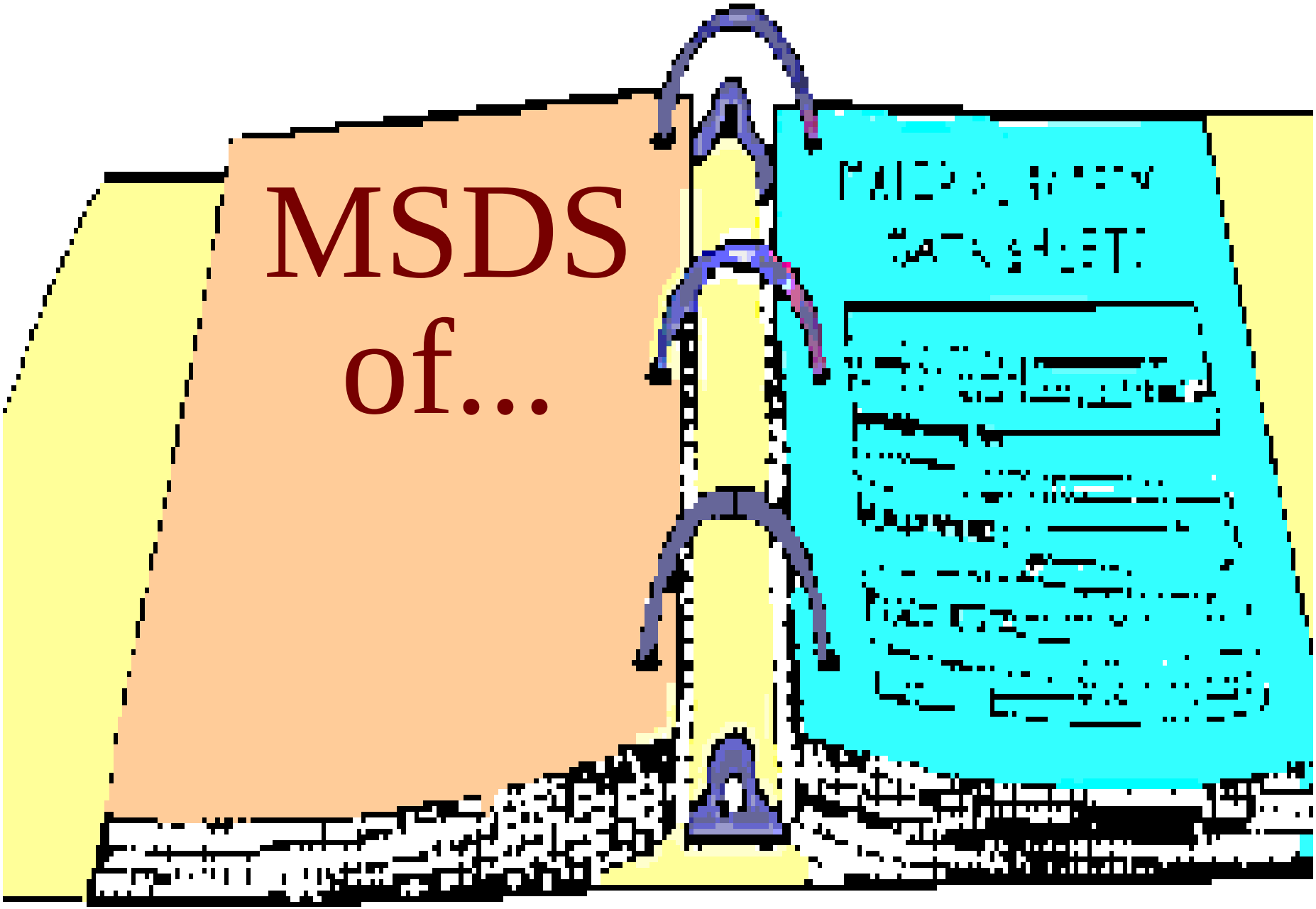


- Carbon Monoxide
- Hydrogen Sulfide
- Nitrates, Nitrites
- Carbon Tetrachloride
- Various Insecticides
- Simple asphyxiants
- Benzene
- Cyanide
- Napthalene

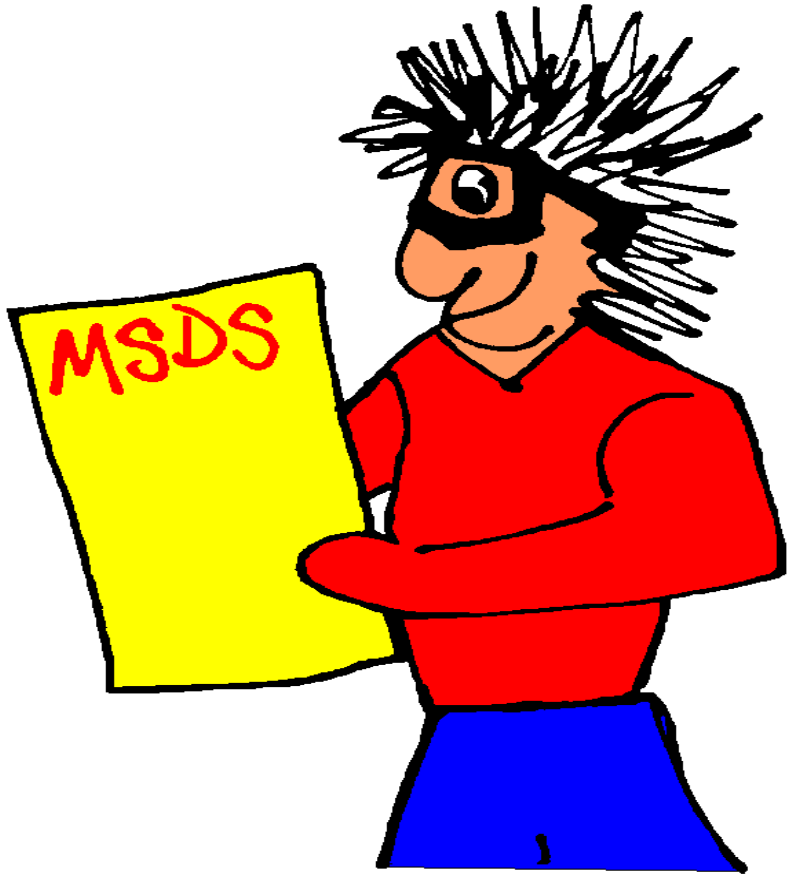
All parts of our bodies can be affected by chemicals.
Learn what types of chemicals are in your work area, and how they could affect you.

# Overview of the "MSDS"

# Material Safety Data Sheet


MSDS
of...

A MSDS is a formal advisory bulletin written to describe the hazards, control measures, safe use/handling procedures, and emergency procedures for a specific substance or product




Manufactures, suppliers, and importers prepare MSDS's for the hazardous substances and mixtures that they produce or import

The manufacturer, supplier, or importer of a chemical substance should supply a MSDS to a purchaser upon initial purchase of the substance, and after any changes or modifications have been made to the existing MSDS

The purchaser/user of a chemical substance should have a copy of a MSDS for all substances that are deemed to be hazardous.

All employees are permitted to consult a MSDS at any time.

The MSDS
can provide
a great deal of
"on-the-job"
information
about a substance...

USE IT!!!!

# Basic information contained in the MSDS


A typical MSDS has eight sections

- The Chemical Name of a product, and the manufacturer of the product
- Hazardous ingredient information
- Physical and chemical characteristics of the product

- Fire and explosion information
- Reactivity information and warnings
- Health hazard information
- Precautions for safe handling and use
- Control measures

# Highlights of Section 1 of the MSDS
## Identity Information


- Name address, and phone number of the manufacturer

- Name of the substance in chemical, trade, or common names

# Highlights of Section 2 of the MSDS
# **Hazardous Ingredient Information**


- Chemical name of the substance
- Components of the substance
- Chemical ID# of the substance
- Worker exposure limits

# Highlights of Section 3 of the MSDS
# **Physical & Chemical Characteristics**


- Physical and chemical characteristics regarding:

  -- Boiling point
  -- Vapor pressure
  -- Vapor density
  -- Melting point
  -- Appearance and odor
  -- Evaporation rate
  -- Specific gravity
  -- Water solubility

# Highlights of Section 4 of the MSDS
## Fire and Explosion Data


- Flash point
- Lower & Upper explosive levels
- Specific fire fighting procedures
- Unusual fire & explosion hazards

# Highlights of Section 5 of the MSDS
# **Reactivity Information**


- How stable/unstable substance is
- What materials the substance is incompatible with
- What hazardous by-products the substance may give off

# Highlights of Section 6 of the MSDS
# **Health Hazard Information**


- Ways the substance may enter your body
- Descriptions of health hazard(s)
- Descriptions of signs and symptoms from exposure/overexposure
- Medical conditions aggravated by exposure/overexposure
- Emergency first aid procedures

Highlights of Section 7 of the MSDS

## Precautions for Safe Handling and Use


- What to do if the substance spills or is leaked
- Proper clean-up procedures and equipment
- Specific directions for handling and storage
- Directions to prevent spilled material from contacting other dangerous material

# Highlights of Section 8 of the MSDS

## Control Measures


- The proper type of personal protective equipment to wear such as gloves, respirators, eye protection, and/or other clothing

- Proper ventilation or other safety systems to use

# Several terminologies of the MSDS

- PEL (Permissible Exposure Limit)

  Either expressed as a time-weighted average, or a maximum concentration exposure limit

- TLV (Threshold Limit Value)

  A term used by the American Council of Governmental Industrial Hygienists to express the airborne concentration of a material to which most people can be exposed day after day without adverse effects

- TLV-TWA

  The Time-Weighted Average concentration for a normal eight hour day

- TLV-STEL

  The Short Term Exposure Limit that represents a fifteen minute concentration that should not be exceeded in an eight hour day. There should be no more than four exposure periods per day, and at least sixty minutes between such exposures. Also, the daily TLV-TWA should not be exceeded.

- TLV-C (Ceiling Exposure Limit )

  A concentration that should never be exceeded under any conditions.

- Boiling Point

  The temperature at which a liquid changes to a vapor state.

- Vapor Pressure

  The pressure exerted by a saturated vapor above its own liquid in a closed container. Vapor pressures on MSDS's are often reported in millimeters of Mercury (mm Hg) at 68˚F. Standard atmospheric pressure may be reported as
  -- 14.7 psi,
  -- 760 mm Hg,
  -- 1 atmosphere, or
  -- 101 kilopascals
  -- The lower the boiling point of a substance, the higher its vapor pressure will be

- Vapor Density

  The weight of a vapor or gas compared to the weight of an equal volume of air at the same temperature and pressure. Substances with Vapor Densities of less than 1.0 will be lighter than air, and substances with Vapor Densities greater than 1.0 will be heavier than air.

- Specific Gravity

  The weight of a liquid or solid compared to the weight of an equal amount of water. Insoluble materials with a Specific Gravity of less than 1.0 will float on water, and insoluble materials with a Specific Gravity of greater than 1.0 will sink in the water. Most (BUT NOT ALL!) flammable liquids will float on water.

- Flash Point

  The minimum/lowest temperature at which a liquid gives off enough of a vapor to ignite near the surface of the liquid or within a vessel containing the liquid when a heat or an ignition source is present.

- LEL or LFL

  Lower Explosive/Flammable Limit
  The lowest concentration or percentage of the substance in the air that will produce a flash of fire when an ignition source is present. Example: Methane 5.0%.

- UEL or UFL

  Upper Explosive/Flammable Limit
  The highest concentration or percentage of the substance in the air that will produce a fire when an ignition source is present.

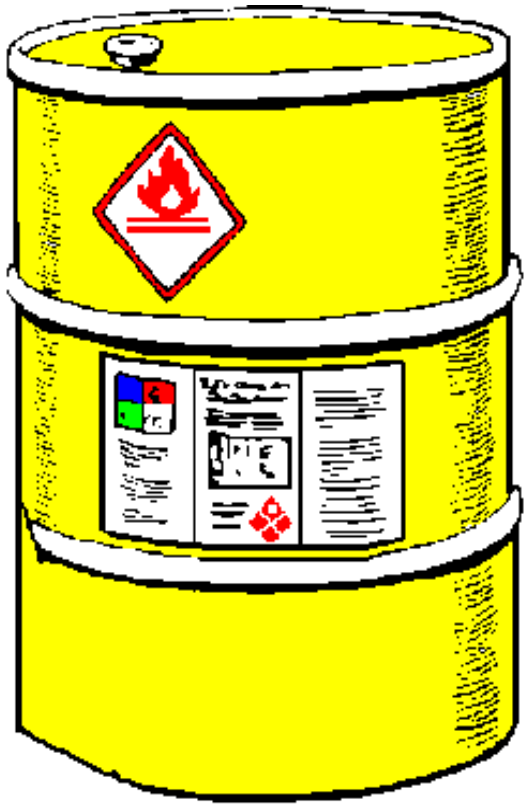
The MSDS can help
you learn more about
a substance,
but only if it is used.

The MSDS won't
help anyone if it
stays in a desk drawer!

# Basics of Warning Labels

A label is a notice affixed to a container that provides information about the contents inside the container

When the contents of the container are classified as a hazardous substance a label should be provided



Basic information on warning labels

- The name of the chemical substance in the container that can be cross-referenced to a MSDS
- A hazard warning that describes the physical and health hazards of the substance in the container
- The name, address and phone number of the manufacturer

Physical and Health Hazard Information

# Physical and Health Hazard Information

A common form of listing physical and heath hazards involves the use of a color scheme


- The red color denotes the Fire Hazard
- The blue color denotes the Health Hazard
- The yellow color denotes

- The yellow color denotes the Reactivity Hazard
- The white color denotes any Special Hazards or Directions


There is a numerical rating system

There is a numerical rating system
for each category to describe
the degree of seriousness

- A number zero (0)
  in any category means
  a minimal hazard
  for that category

- A number one (1)
  in any category means
  a slight hazard
  for that category

- A number two (2) in any category means a moderate hazard for that category

- A number three (3) in any category means a serious hazard for that category

- A number four (4) in any category means an extreme hazard for that category

Labels can help alert you about

**4 EXTREME**

**3 SERIOUS**

**2 MODERATE**

**1 SLIGHT**

**0 MINIMAL**

Labels can help alert you about
the physical or health hazards of
the substance in the container

Labels can help you to cross reference
the contents of a container with a MSDS
to get more detailed information

Label information may be given in words,
pictures, or symbols. The important point
is that the correct information is provided,
and is understandable

Never remove a hazard warning label

Never remove a hazard warning label

Use the hazard warning label to identify possible hazards.  Use the MSDS to get more specific information

When a label says something is hazardous, believe it, and follow proper safety precautions

The time to
read a label
is
BEFORE
you use the substance

# Suggestions to reduce the chances of a chemical injury or illness

The primary method to control chemical exposures should be through engineering or administrative controls

Substitute a less hazardous chemical that poses less risk in place of a more hazardous chemical

Adhere to all corporate safety procedures

Adhere to all corporate safety procedures regarding the selection, handling, and use of chemicals

Maintain a clean work area

Clean up spills immediately

Use a vacuum device instead of sweeping during cleaning to avoid dispersing particles into the air

Do not tamper with splash guards, and advise management if any type of guard is damaged or defective

Shower after each shift

Keep all lunch buckets and thermos bottles away from the work area

Wear overclothes such as coveralls to prevent direct skin contact with a substance

Change into clean work clothes regularly

Avoid leaning over open containers of fluids or fine particles

Avoid storing caustics and acids at levels where you have to reach up to get them–if they fall, they could cause burns

Don't transfer the contents of materials from one container to another, without knowing the contents of both containers, and possible reaction hazards

Recap containers quickly to avoid the release of gases, vapors, and to lessen the chance of a spill if the container is tipped over

Don't put chemicals into unlabeled containers

Read labels before using substances

Do not smoke or use open flames when handling chemicals

Wear all appropriate personal protective equipment when handling chemicals

Consult the MSDS of any chemical that you are not familiar with

Keep the work area well ventilated

Practice chemical safety at home

Ask questions about chemical safety

# Discussion Points

- What types of chemical substances do you use that could be considered hazardous?
- How could those chemical substances enter your body?
- What types of physical and health hazards do those chemical substances pose?

- What procedures do you have to protect yourself while using those chemical substances?

- What factors influence the way a chemical substance may affect the body?

- Describe how chemical substances may affect the following body systems:

  -- Nervous system
  -- Skin
  -- Liver
  -- Kidneys
  -- Respiratory system
  -- Reproductive system
  -- Blood and blood forming system

- Where are the Material Safety Data Sheets (MSDS's) located at your facility?
- For what chemical substance have you ever consulted a MSDS?
- What did you learn from consulting the MSDS?
- What questions do you have about the use of a MSDS?

- What type of labeling system do you use at your facility?
- What can you tell by looking at a label that is affixed to a container at your facility?
- What suggestions do you have that could help someone work more safely with a chemical substance?

- Where can you obtain the necessary personal protective equipment for working with chemical substances at your facility?

- List and discuss five chemical substances commonly used in the home that could be hazardous.

- Since participating in this program, what have you learned about chemical substances both at home and at work?

Thanks for participating,
and

# PROTECT YOURSELF WHEN USING CHEMICALS!!!!

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