The Ministry of Health Care and Social Development
The Volgograd State Medical University
The Chair of hygiene and ecology

Lecture

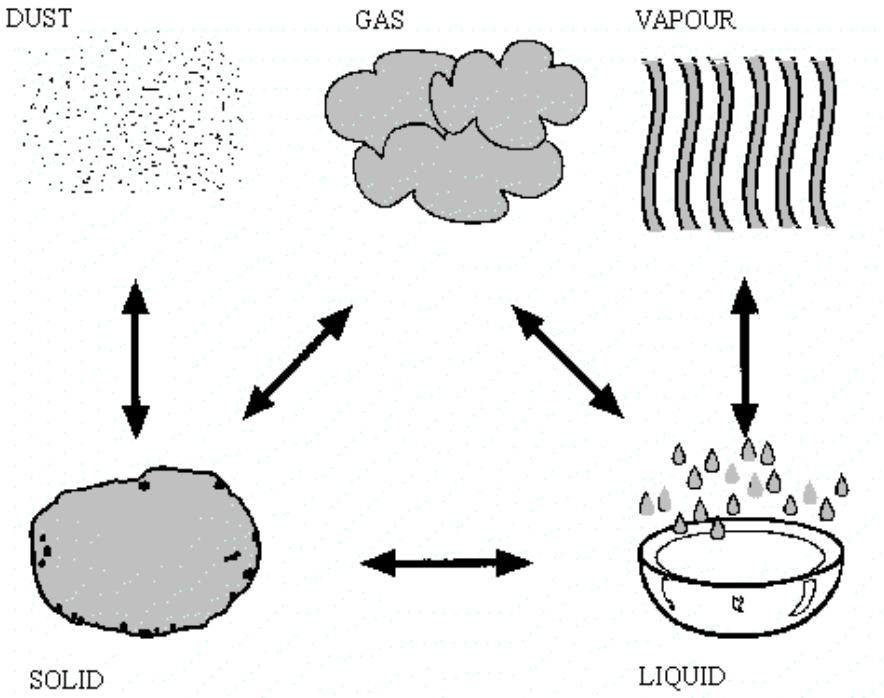
Chemical hazardous factors of working environment.

Their effects on the human health.

Preventive measures against occupational diseases.

Types of chemicals found in the workplace

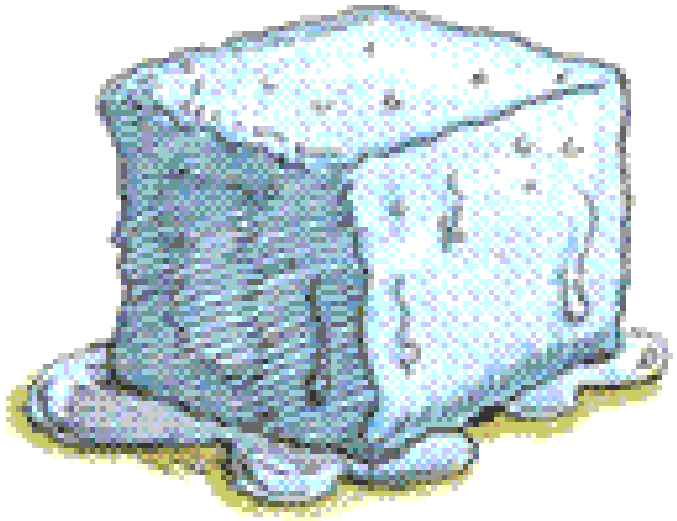
The main physical forms of chemicals are solids, dusts, liquids, vapours and gases.



Solids

Solids are the least likely of the chemical forms to cause chemical poisoning.

Dusts are tiny particles of solids.



Liquids

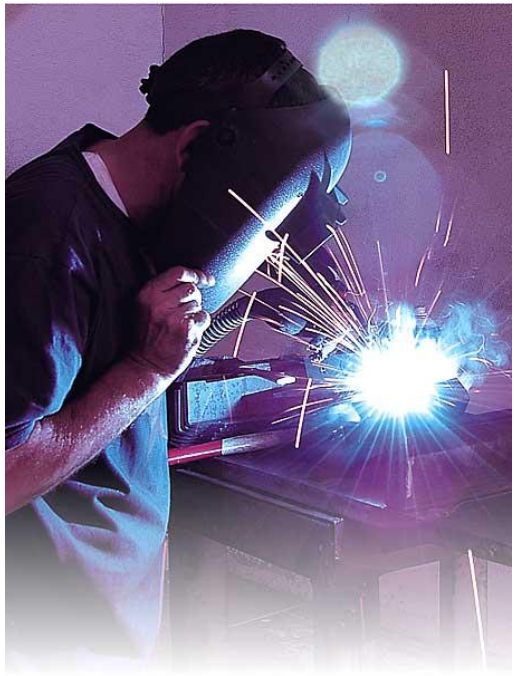
Many hazardous substances, such as acids and solvents, are liquids when they are at normal temperature.

- Many liquid chemicals give off vapours which you can inhale and which may be highly toxic, depending on the chemical.
- Liquid chemicals can be absorbed by y
- Some liquid chemicals may cause imm damage (they may or may not be absorl bloodstream as well).

Vapours

A vapour is the gas phase of a material which is normally liquid under standard conditions.

- The vapours from some chemicals can irritate eyes and skin.
- There can be a variety of serious health effects from inhaling certain toxic chemical vapours.
- Vapours can be flammable or explosive. To avoid fire or explosion, it is important to keep chemicals that vaporize away from any sparks, sources of ignition or incompatible chemicals.



Gases

Some chemical substances are in the form of a gas when they are at a normal temperature. However, some chemicals in liquid or solid form become gases when they are heated.

- Some gases produce irritant effects immediately.
- Gases may be flammable or explosive.
- Extreme caution should be used when working around flammable or explosive gases.

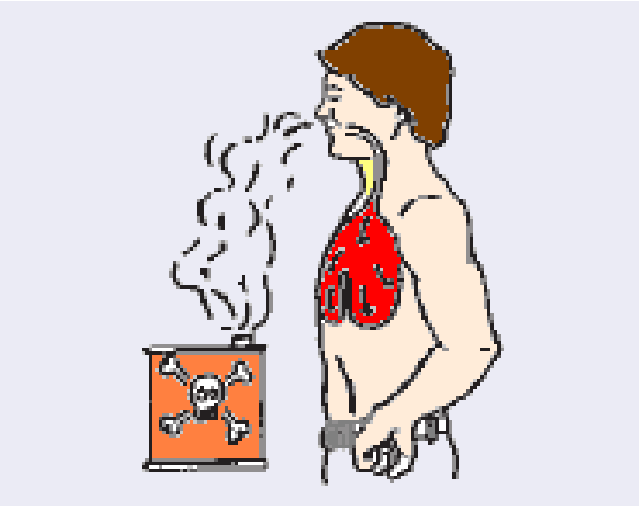
- The effect of a toxic chemical may develop immediately or may take months to years to develop.

- Toxic effects are dependent on the dose – how much exposure you have over what period of time.

- Often you can safely be exposed to low levels over a long time period.

ROUTES of ENTRY INTO THE BODY-1

Inhalation



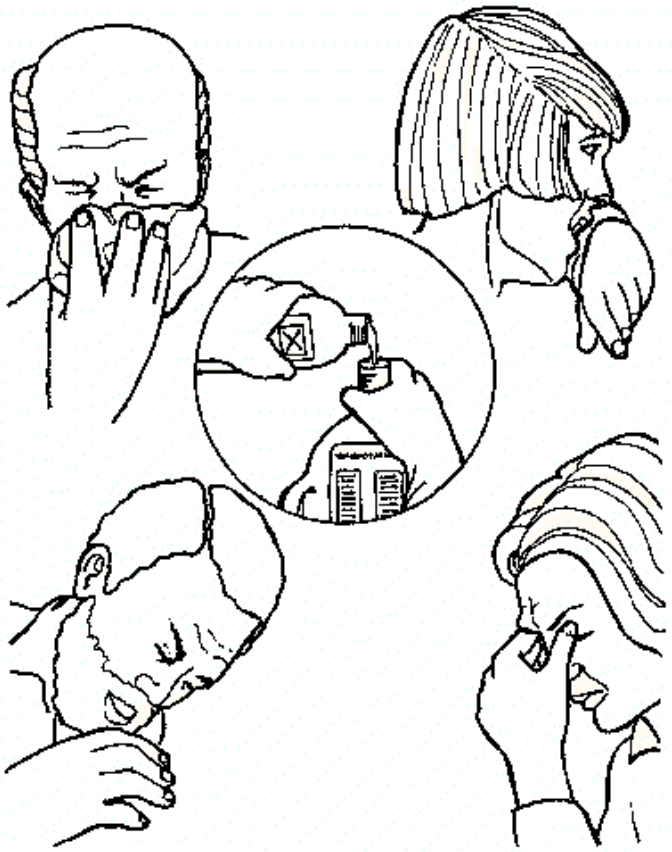
In the workplace, airborne chemicals may occur in different forms such as gases, vapors, dusts or mists

Generally, large dust particles can be filtered out of the respiratory system. But small dust particles are difficult to eliminate and can reach the deepest parts of the lungs. they can cause serious local respiratory problems.

How do you know whether you are being exposed to respiratory hazards at work?

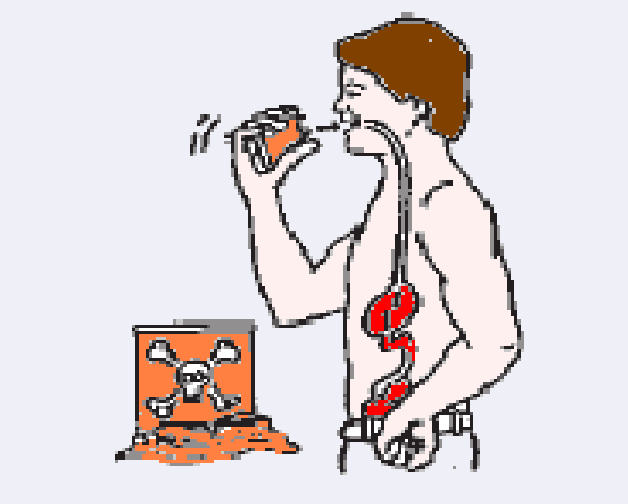
Warning signals are:

- ***smell***
- ***sneezing***
- ***coughing***
- ***a runny nose***



ROUTES of ENTRY INTO THE BODY-2

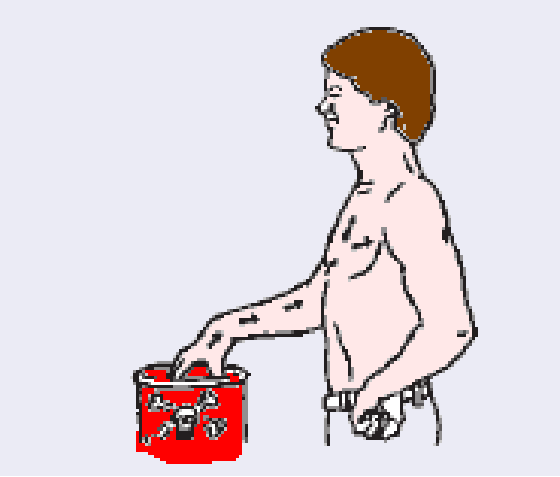
Ingestion



Workers can swallow hazardous agents by accident if they do not wash their hands before eating, drinking or smoking at work,
Or they keep their food, drink and cigarettes in a contaminated (dirty) area. It is also important that workers are educated about the importance of personal hygiene.

ROUTES of ENTRY INTO THE BODY-3

Absorption



Some chemicals (such as strong acids and alkalis) can damage your skin. Skin contact with chemicals can result in irritation, allergic response, chemical burns, and allergic contact dermatitis.

- Work practices involving the handling of chemicals or close contact with chemicals during maintenance, degreasing or cleaning activities can result in significant skin exposure for some chemicals.
- Even if inhalation exposure is controlled, a significant dose can be achieved from absorption through the skin.

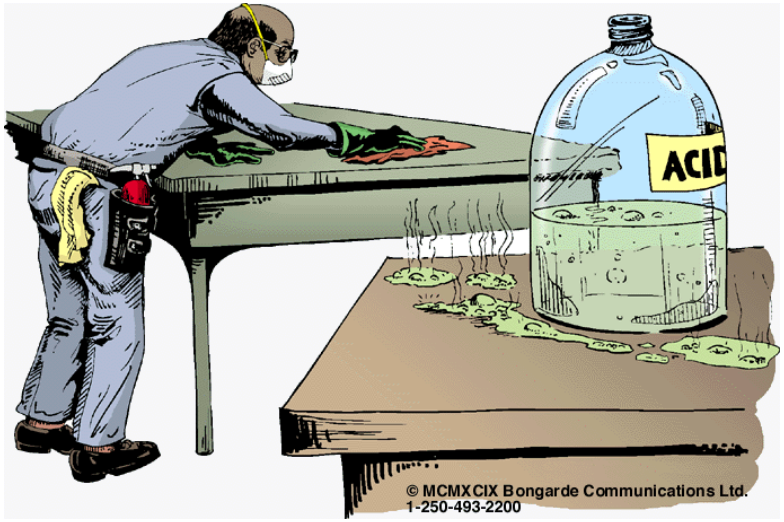
Contact dermatitis

Another common occupational skin disease is **contact dermatitis** — a type of allergic reaction.

A worker may be allergic to a particular chemical and, once he or she becomes sensitized to that chemical, every time he or she comes into contact with it, dermatitis will result.

Some of the chemicals that cause contact dermatitis are:

- formaldehyde;
- nickel compounds;
- epoxy resins and catalysts used in the plastics industry;
- germicidal agents used in soap and other cleaners
- chromates.



The chemical factors of working environment can be classified under different categories,

and according to different grounds.

- 1) according to the chemical classification of industrial poisons, all poisons are divided into
- organic,
- inorganic and
- poisons containing some organic elements;

2) According to the degree of toxicity and danger, all industrial poisons are divided into 4 classes.

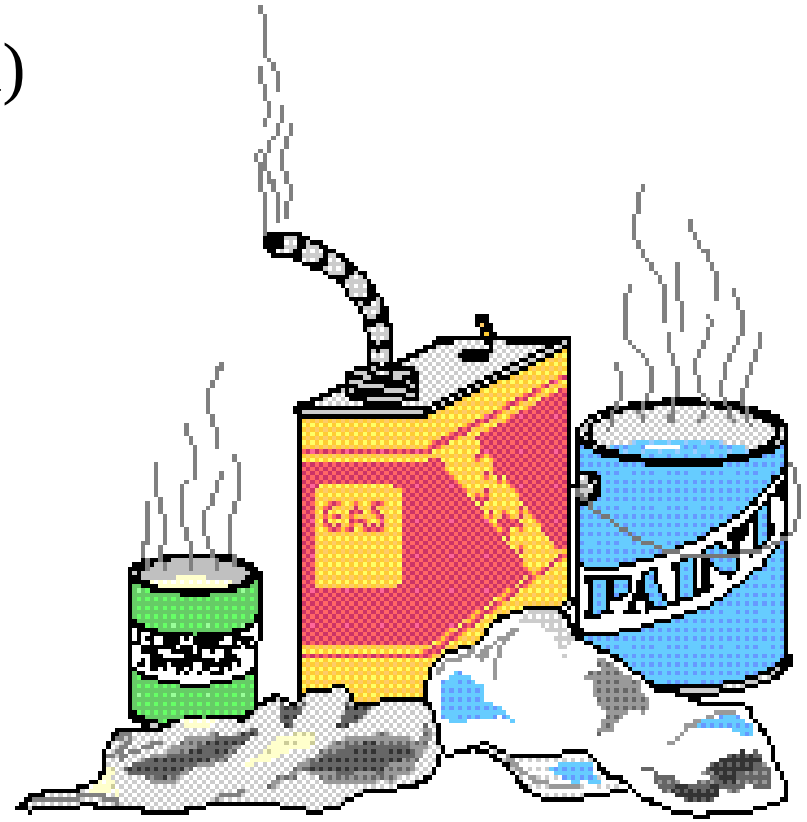
- The 1st class includes highly hazardous poisons, such as chromic anhydride fluorine hydrogen, etc.
- The 2nd class includes dangerous industrial poisons (for example, phosphoric anhydride, benzene, etc).
- The 3rd class of industrial poisons is composed of moderately dangerous industrial poisons (for example, sulfurous anhydride, acetic acid and so on).
- And, finally, the 4th class is composed of slightly dangerous Industrial poisons, such as sodium sulphate, grain alcohol.

Negative effect on the human body

- Acute.
  - Contact with a substance that occurs once or for only a short time, may develop very quickly under the influence of high concentrations of vapors and gases
- Chronic (distant).
  - Occurring over a long time usually, develop very slowly and progressively due to the accumulation of poisons in the body.
- Additive effect.
  - A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together.

Health Hazards

- Toxic poisons
- Corrosive or irritating (poisons of irritant action)
- Carcinogenic
- Reproductive
- Sensitizing
- Teratogenic
- Mutagenic
- Embryotoxic



Toxic poisons

- hepatotoxins,
- nephrotoxins,
- neurotoxins
- Osteototoxins

- **Carcinogenic** action is most commonly manifest by the development of tumors.
- **Teratogenic** action is most commonly manifest by the birth of the posterity with some congenital defects.
- **Mutagenic** action is manifest by the ability to cell mutation.
- **Embryotoxic** action is manifest by the ability to effect the developing fetus.

Carcinogens

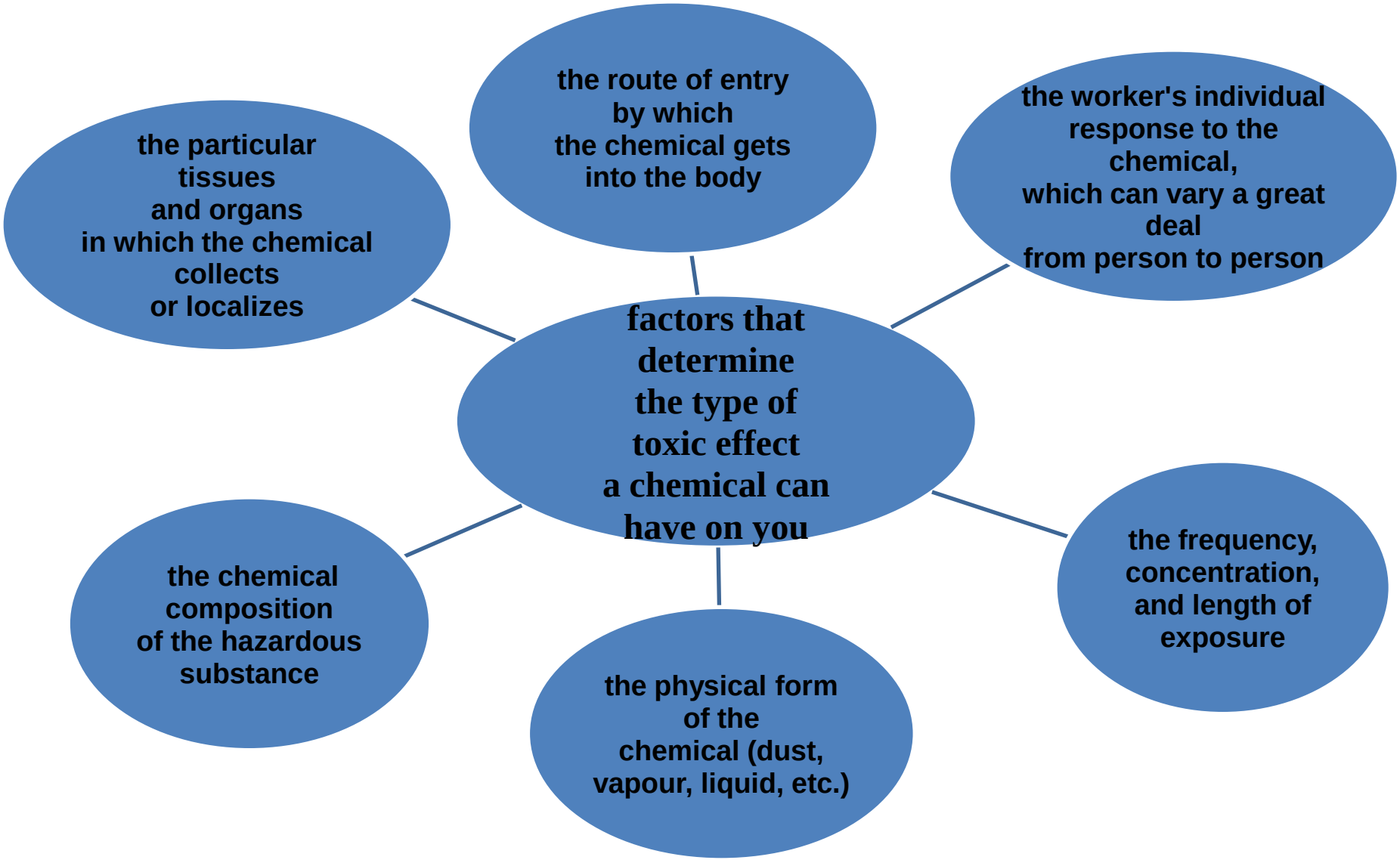
- Carcinogens are different than toxic chemicals in that their effect is less dependent on dose.
- Even a one-time exposure to some carcinogens can cause cancer years later.
- So preventing contact and exposure is especially important.
- Asbestos and lead are examples of carcinogens found in many workplaces and homes.

Reproductive

- Reproductive hazards affect the reproductive system directly (both male and female), depending on the chemical and its effect.

- They also, in some cases, affect the unborn child, particularly during the first 3 months of pregnancy.

Factors that determine the type of toxic effect a chemical can have on you

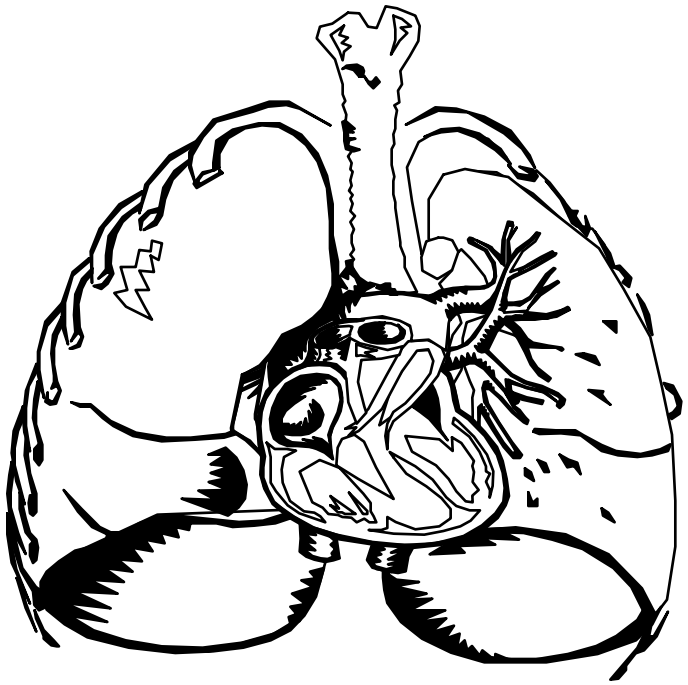


FACTORS INFLUENCING TOXIC ACTION

- ☑ **RATE OF ENTRY**
- ☑ **ROUTE OF EXPOSURE**
- ☑ **AGE OF INDIVIDUAL**
- ☑ **STATE OF HEALTH**
- ☑ **PREVIOUS EXPOSURE LEVELS**
- ☑ **WORKPLACE ENVIRONMENTAL FACTORS**
- ☑ **INDIVIDUAL SUSCEPTIBILITY AND HEREDITY**

FACTORS INFLUENCING TOXIC ACTION

ROUTE OF EXPOSURE

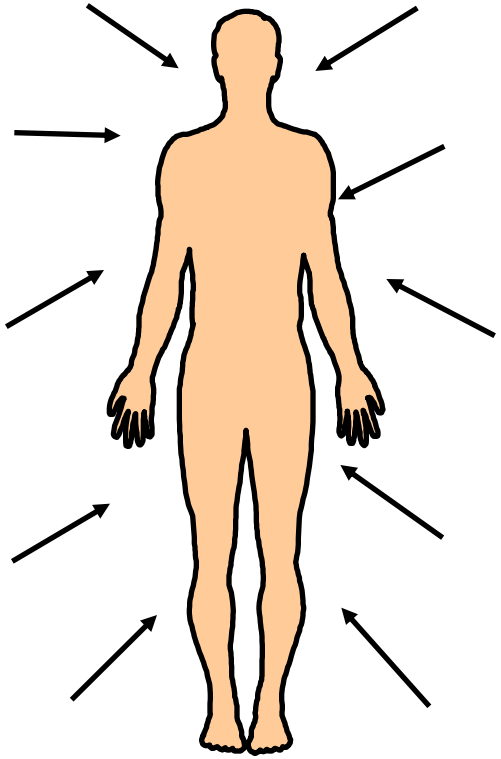


A Dose Absorbed Through the Skin Will Be Deposited in the Blood Much Slower Than a Dose Inhaled Through the Lungs and Transferred Directly Into the Blood. Four Routes:

- INHALATION
- INGESTION
- ABSORPTION
- INJECTION

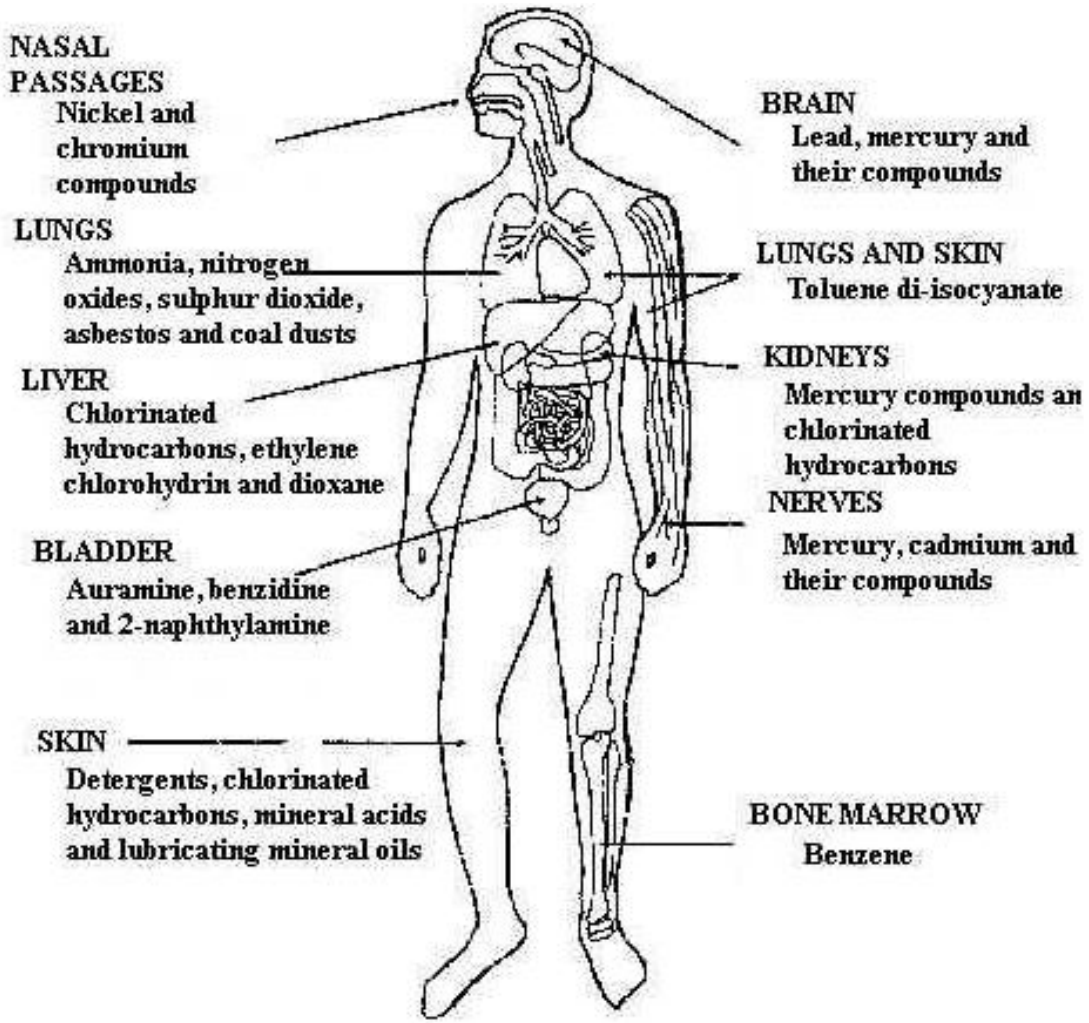
FACTORS INFLUENCING TOXIC ACTION

STATE OF HEALTH



Pre-Existing Disease or Other Medical Conditions Can Result in Greater Sensitivity to Toxic Agents. An Individual With a Pre-Existing Sensitivity to a Known Material Should Not Be Placed in a Work Environment That Might Compound the Condition.

Different organs and tissues that can be affected by certain toxic industrial chemicals



Heavy metals

- are toxic to human health
- Most common heavy metals are lead(Pb), mercury(Hg), cadmium(Cd) and arsenic(As)
- They are mainly produced by industrial activities, and deposit slowly in the surrounding water and soil

What is lead?

- Lead is a soft gray metal element that occurs naturally in the earth.

- For many years, lead was added to

  - paint,
  - gasoline,
  - ongoing or historic mining, and
  - commercial or industrial operations.

Lead- It's Everywhere

USES OF Pb

Storage batteries

Cable

Radiation shielding

Galvanizing

Annealing

Plating

Paint

Soldering

Glass

Insecticides

Automobile radiators

Brass and bronze Production

Construction

Ammunition

Printing

Plastics

Television electronics

Petroleum

Historic Use of Lead: Getting the Lead Out of Gas

- The historic uses of lead responsible for the most environmental exposure to humans are late 19th and 20th century developments. The key developments were:
- 1) The addition of lead to paint (which markedly improves the long-term adhesion of paint to surfaces, especially exterior surfaces); and
- 2) The use of lead as a fuel additive in “leaded gasoline”, beginning in 1923.
- Lead, added to gasoline, improves the refining and octane performance of gasoline.

Leaded-fuel bans

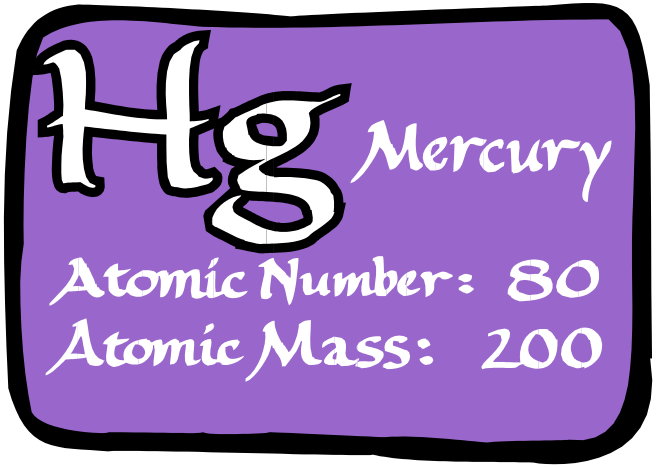
for road vehicles came into effect as follows:

- **Europe**
- Austria: 1989
- Bosnia and Herzegovina: 2009
- Germany: 1988
- Hungary: 1999
- Iceland:
- Monaco: 2000
- Norway:
- Poland: 2005
- Portugal: 1999
- Romania: 2005
- **Russia**: 2002
- Serbia: 2010
- Sweden: 1992
- Switzerland: 2000
- Turkey: 2006

Asia

- Japan: 1986
- Hong Kong: 1999
- Malaysia: 2000
- Singapore: 1998
- South Korea: 1993
- Sri Lanka: 1999
- Thailand: 1996
- Bangladesh:
- Taiwan: 2000
- China: 2000
- Philippines: 2000
- India: 2000
- Nepal: 2000
- Indonesia: 2006

Mercury

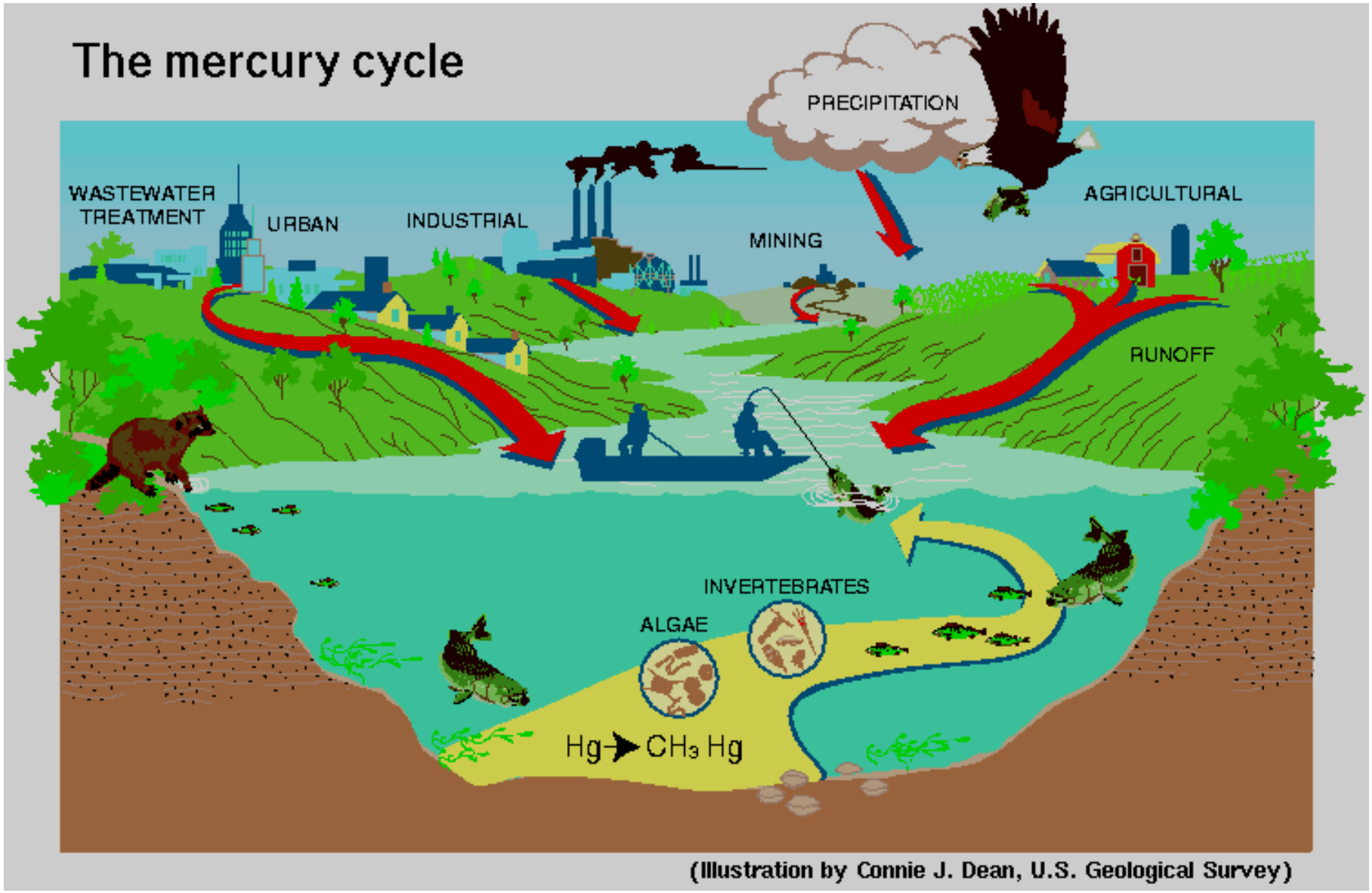


- Heavy, silvery metal
- Only metal to exist as liquid at room temperature
- Elemental state, Hg^0, found in waters and atmosphere
- Exists in two main oxidation states
  - Mercury (I)
  - Mercury (II) – most common

Sources

- Natural (accounts for 1/3 of mercury):
  - Volcanic Activity
  - Forest fires
  - Erosion
- Anthropogenic (accounts for 2/3 of mercury):
  - Metal production
  - Gold mining
  - Chlor-alkali and pulp industries
  - Waste handling and treatment
  - Coal, peat, and wood burning
  - Used in electrical switches, fluorescent light bulbs and mercury lamps
  - Emissions from mercury containing products :batteries, thermometers
  - Dental amalgams

The Mercury Cycle



Workplace Chemical Exposures

- **Recognize.**
- **Evaluate.**
- **Control.**
  - Engineering.
  - Administrative.
  - PPE.

Controls

- Engineering controls.
  - Substitution.
  - Process modification.
  - Enclosing or confining operation or worker (Enclosed systems where feasible)

Design and Installation

- Separate areas for hazardous processes to limit exposures
- Practices and equipment that minimize releases
- Local exhaust ventilation
- General ventilation

Controls

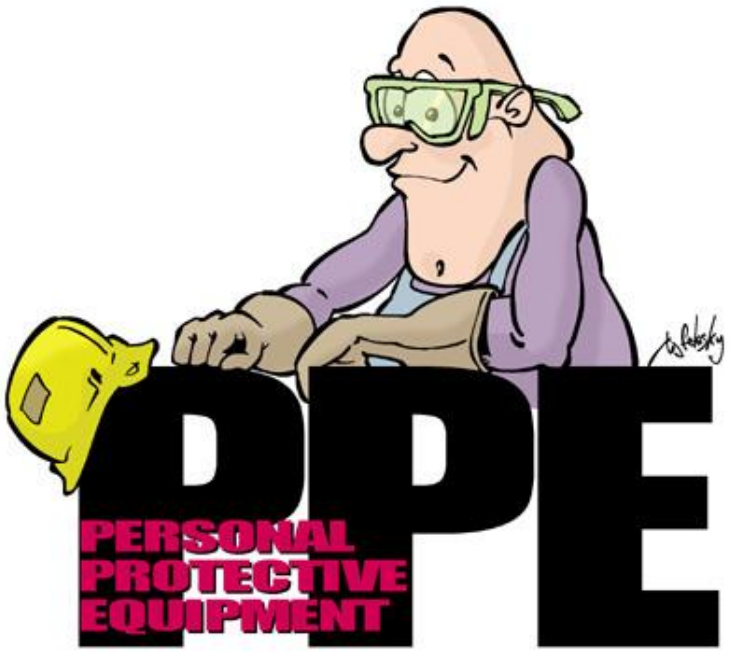
- Administrative controls.
- Work practice controls
- Cleaning and maintenance of control equipment
- Provision of safe storage for hazardous chemicals
- Job rotation
  - Task timing

- **Personal protective equipment**

– Equipment that creates a barrier against workplace hazards.

– Must provide employee training.

– Continuous program assessment.



Controlling Chemical Health Hazards

- You avoid inhaling chemicals by using a respirator if excessive airborne exposure will be present.

Controlling Chemical Health Hazards

- You avoid swallowing chemicals by wearing the correct gloves and washing your hands before eating, drinking or smoking.

- You avoid skin absorption by again wearing the correct gloves (especially if you have a cut or rash) and washing up frequently.

Controlling Chemical Health Hazards

- If you get an irritating chemical on the skin or in your eyes, immediate first aid is critical.
- Flush your eyes in an eyewash for at least 15 minutes, keeping the eyelids open.
- Wash your skin thoroughly with water immediately.

Information and Training

- Workers exposed to hazardous chemicals should be provided information about these chemicals (labels and safety data sheets),
- and be trained how to handle them safely, what to do in an emergency, and how to obtain additional information