

PROCESS SAFETY ENGINEERING (0905477) 04- TOXICOLOGY

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The superior man, when resting in safety, does not forget that danger may come.... When all is orderly, he does not forget that disorder may come. Confucius (551 BC – 479 BC)

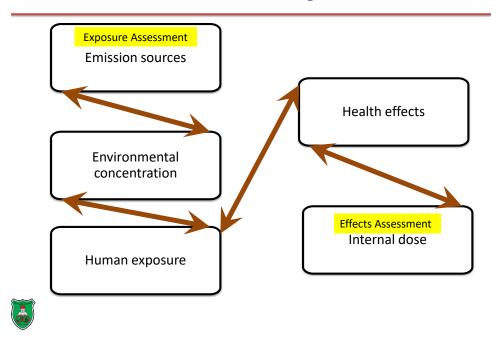
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Outline

- **##** Environmental Health Paradigm
- Industrial Hazards
- **What is Meant by Toxicity?**
- **Toxicants** (Toxins)
- **Entry Routes for Toxicants**
- **##** Pathways and Fate of Toxins
- **Elimination of Toxicants**
- **■** Toxic blood levels
- **Effects of Toxins**



Environmental Health Paradigm



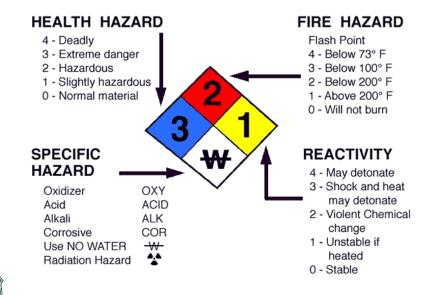
Industrial Hazards

!! The probability of injury or illness from **contact** or **use**.



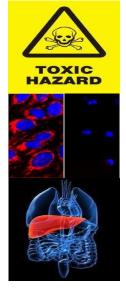
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National Fire Protection Association (NFPA) Diamond





- Toxicity is the degree to which a substance (Toxin or Toxicant) can cause harm to an organism.
- Toxicity can refer to the effect on
 - A whole organism, such as an animal, bacterium, or plant.
 - A substructure of the organism, such as a cell (cytotoxicity) or an organ such as the liver (hepatotoxicity).
- **Toxic hazard** is the likelihood of damage based on exposure.





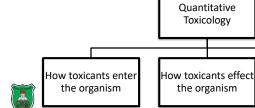
What is Meant by Toxicology?

- **Historically, toxicology was defined as the science of poisons.**
 - Unfortunately, the word *poison* could not be defined adequately.
 - Paracelsus (1493-1541), stated the problem: "All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy."
 - Harmless substances, such as water, can become fatal if delivered to the biological organism in large enough doses.
 - A fundamental principle of toxicology is there are no harmless substances, only harmless ways of using substances.

Today, toxicology is more adequately defined as the qualitative and quantitative study of the adverse effects of toxicants on biological organisms.

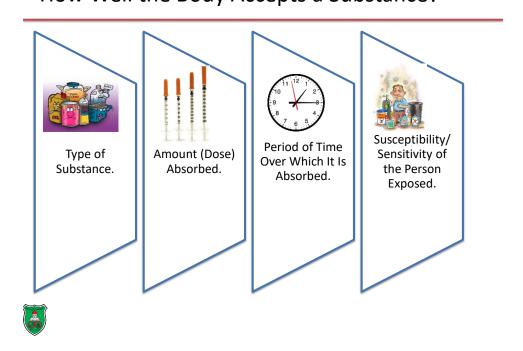




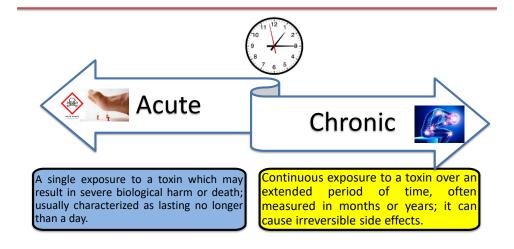


How toxicants are eliminated from (leave) the organism



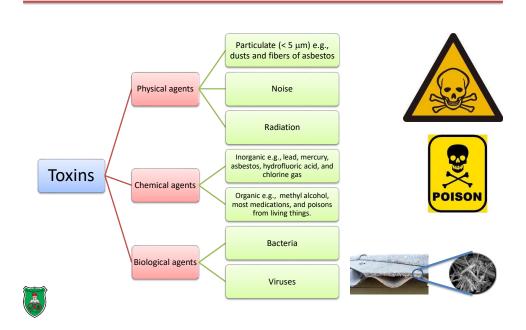


Toxic Effects As a Function of Time

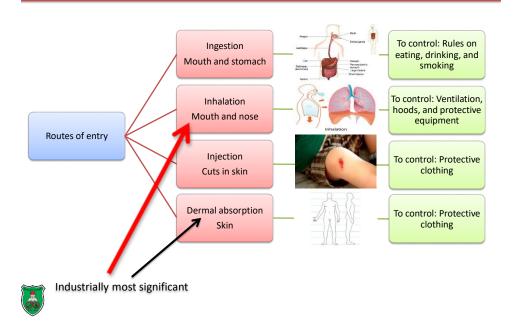




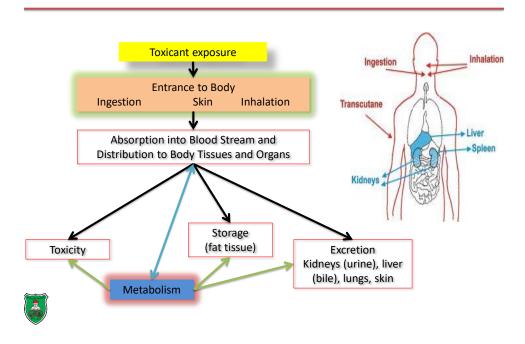
Toxicants (Toxins) in CPI



Entry Routes for Toxicants

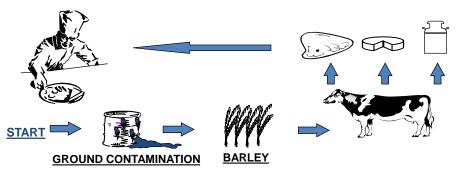


Pathways and Fate of Toxins



Food Chain Exposure

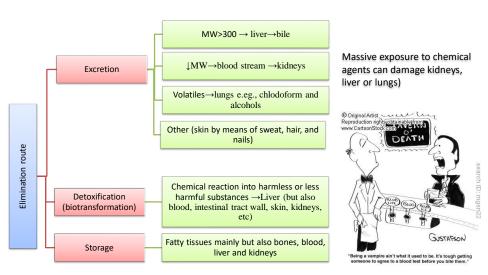
We Could Potentially Eat Toxic Food



Biomagnification- the accumulation or increase in concentration of a substance in living tissue (low excretion rate) as it moves through the food chain, e.g. cadmium, mercury, PCB.

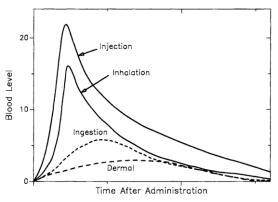


Elimination of Toxicants





Toxic blood levels

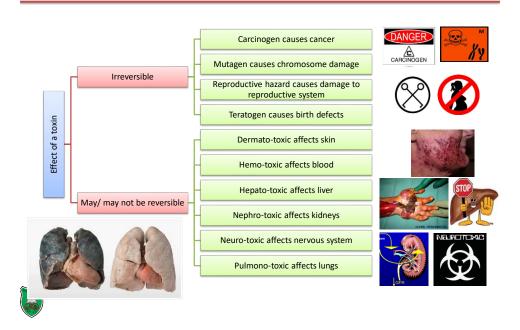


Pharmacokinetics – the absorption, distribution, metabolism and excretion of chemicals through the (human) system.

Toxic blood level concentration as a function of route of exposure. Wide variations are expected as a result of rate and extent of absorption, distribution, biotransformation, and excretion.



Effects of Toxins



Types of Toxic Effects Caused by Industrial Chemicals

Toxic property	Part of body affected	Time scale of appearence	Effect	Example
Irritant or corrosive	Any, but usually the eyes, lungs and skin		area. Frequently healed after acute exposure.	Ammonia, sulphuric acid, nitrogen oxides, caustic soda
Fibrogenic	Generally lungs	Years	Gradual cumulative loss of lung function leading to disability and death if there is chronic exposure.	Bauxite dust, asbestos, bagasse
Allergic	Any, but frequently lungs and skin	Days to years	,	Toluene, di-isocyanate (TDI), amine hardeners for epoxy resins.
Dermatitic	Skin	Days to years	agents, solvents or detergents.	Strong acids, alkalis, detergents, carbon tetrachloride, trichloroethylene.
Carcinogenic	Any organs, bu frequently skin, lungs, bladder	10 to 40 years	Cancer in affected organ or tissue. Ultimately this may cause premature death.	2-Naphthylamine, certain tars and oils, benzidine, asbestos
Poisonous	Any organs but frequently liver, brain, kidney	A few minutes to many years	Death of cells in vital organis with eventula failure of organ to carry out important biological functions. Ultimately can cause death.	Carbon tetrachloride, mercury, cadmium, carbon monoxide, hydrogen cyanide.
Asphyxiants	Lungs	Minutes	Gases replace normal oxygen content of air	Acetylene, carbon dioxide



