



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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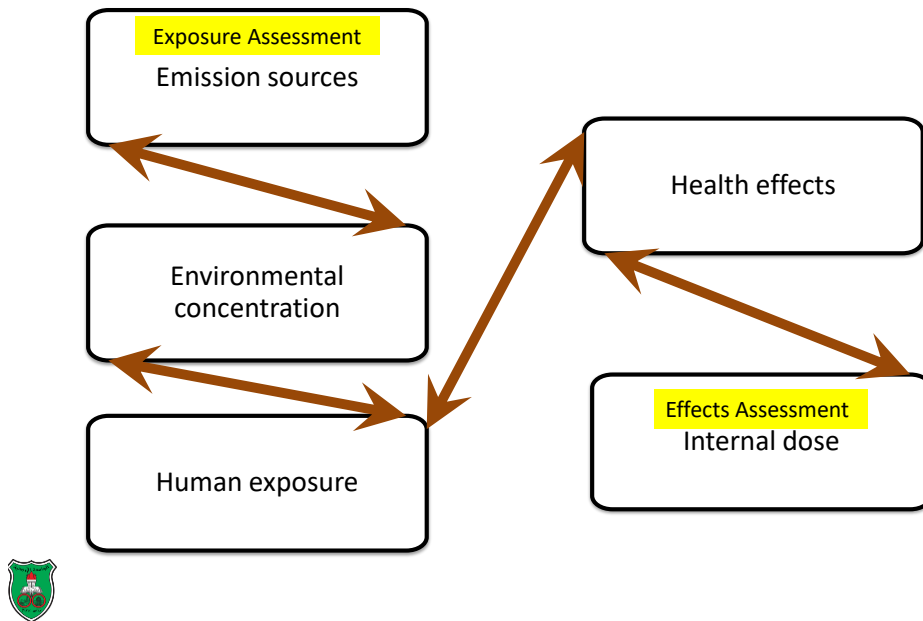
## Outline

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- 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

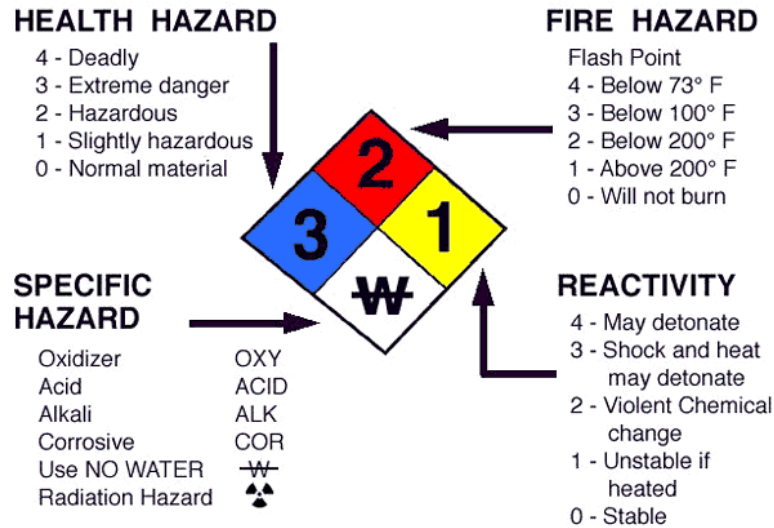


## Industrial Hazards

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

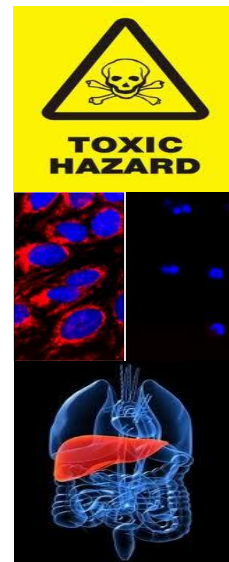


## National Fire Protection Association (NFPA) Diamond



## What is Meant by Toxicity?

- **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.

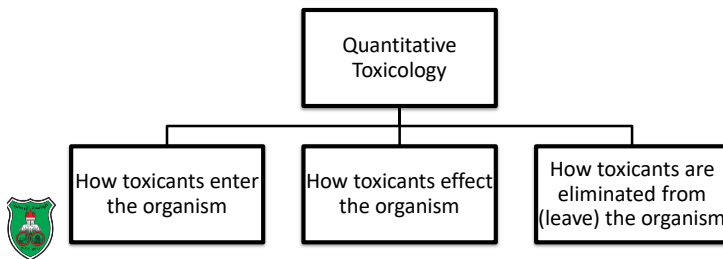


# What is Meant by Toxicology?

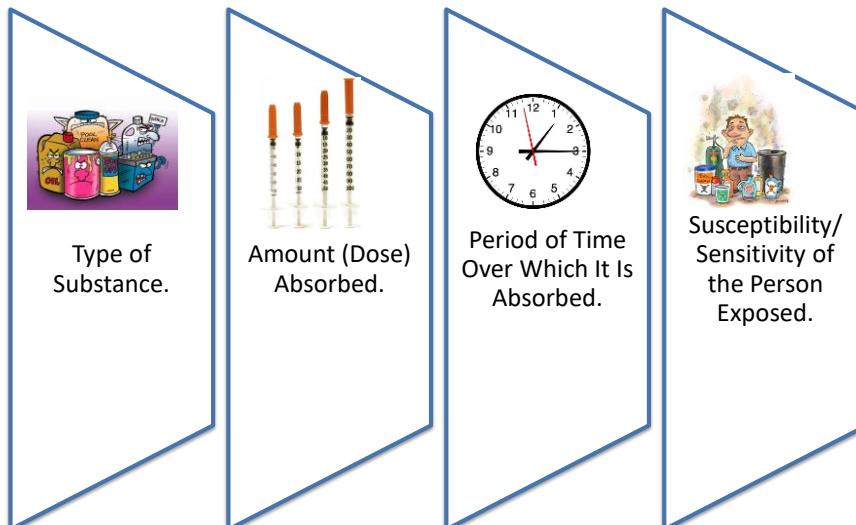
- Historically, toxicology was defined as the science of poisons.
  - Unfortunately, the word *poison* could not be defined adequately.
  - Paracelsus (1493-1541), stated the problem: "**All substances are poisons; there is none which is not a poison. The right dose differentiates a poison and a remedy.**"
  - 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.



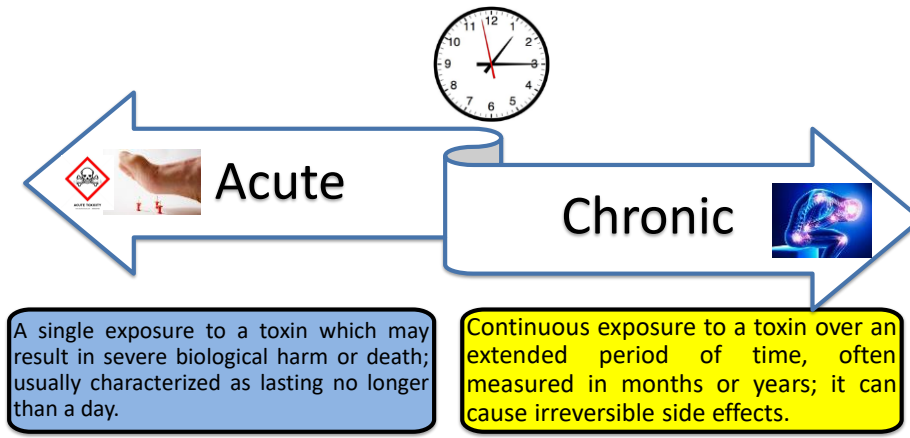
Today, toxicology is more adequately defined as the qualitative and quantitative study of the adverse effects of toxicants on biological organisms.



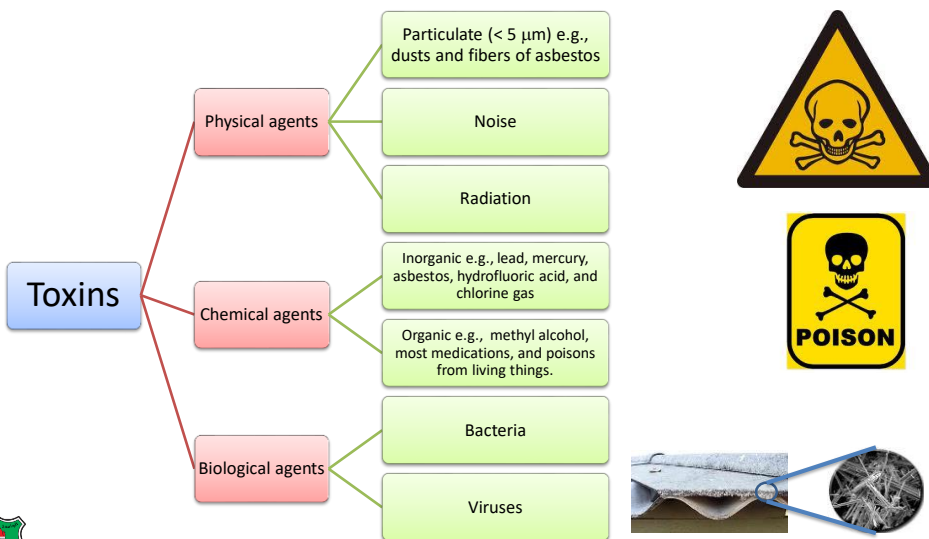
## How Well the Body Accepts a Substance?



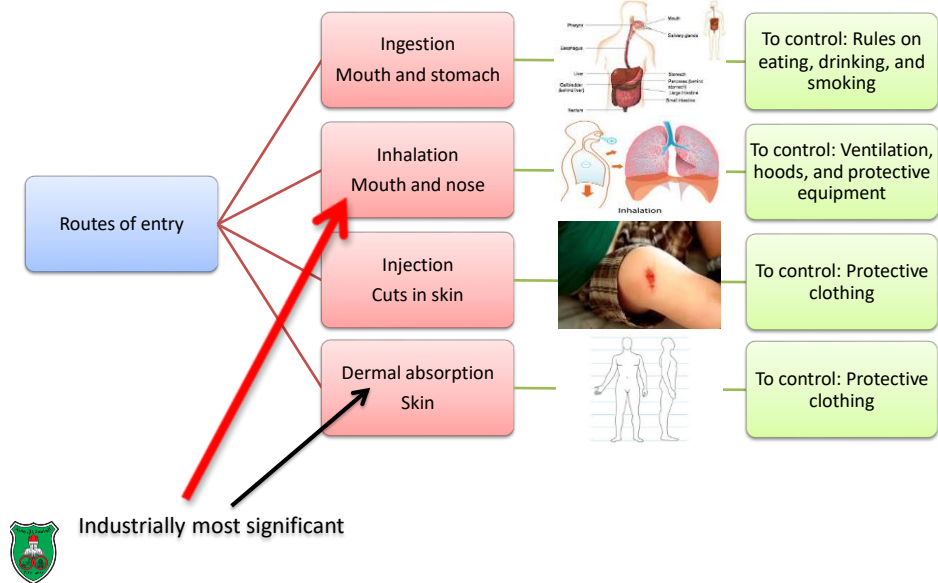
## Toxic Effects As a Function of Time



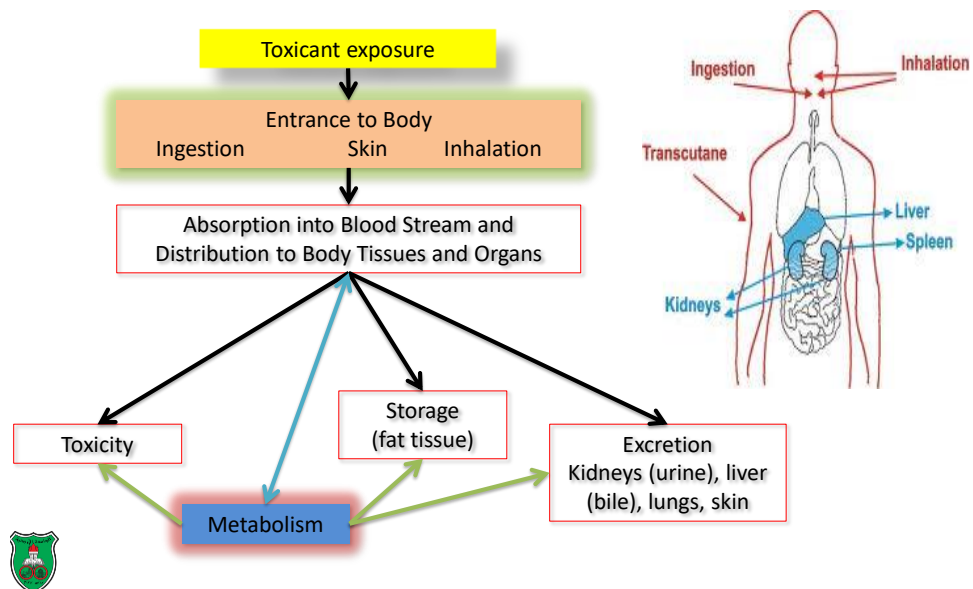
## Toxicants (Toxins) in CPI



## Entry Routes for Toxicants

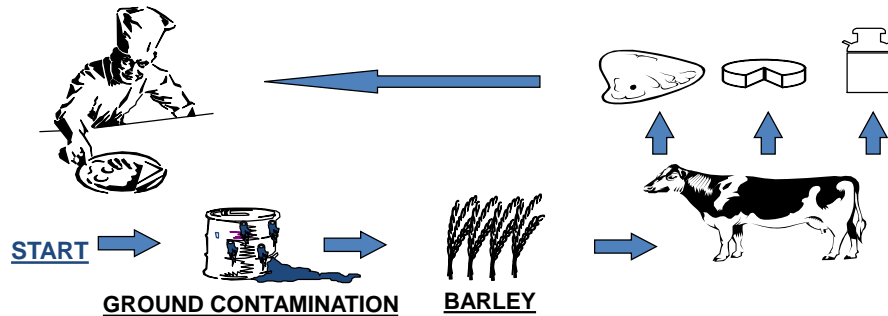


## Pathways and Fate of Toxins



## Food Chain Exposure

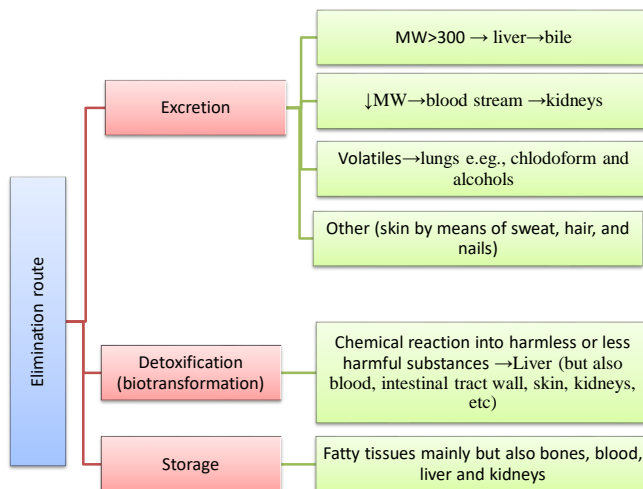
### *We Could Potentially Eat Toxic Food*



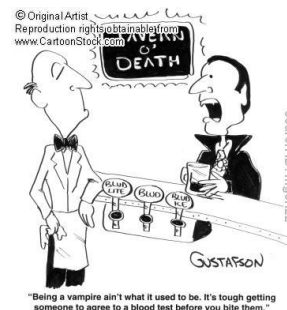
**Biomagnification-** the accumulation or increase in concentration of a substance in living tissue (low excretion rate) as it moves through the food chain, e.g. cadmium, mercury, PCB.



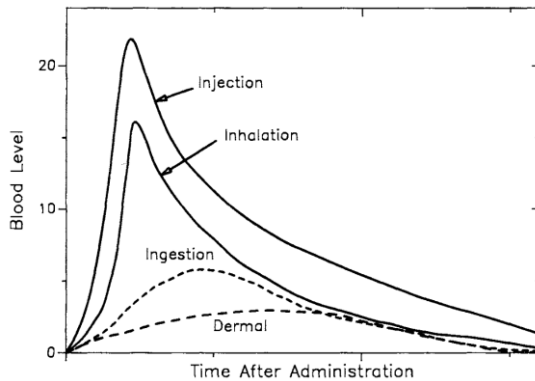
## Elimination of Toxicants



Massive exposure to chemical agents can damage kidneys, liver or lungs)



## Toxic blood levels

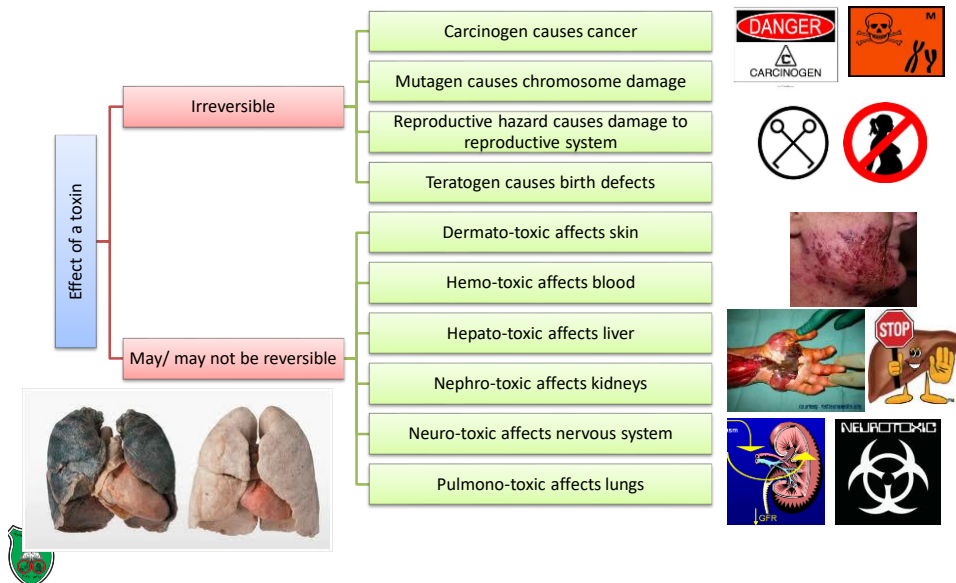


Pharmacokinetics – the absorption, distribution, metabolism and excretion of chemicals through the (human) system.

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







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