

**Institution: University of Technology, Mauritius**

**Programme: Environmental and Public Health**

**Course title: Toxicology, Occupational Hazards & Monitoring**

**Course facilitator: Dr. Manish Putteeraj**

**Course description:**

This particular course is meant to improve knowledge in the field of toxicity and environmental determinants which are mostly detrimental to the human health. Students will acquire the required knowledge related to the adverse health effects potentiated by anthropogenic and natural toxicants.

Students will explore the properties of toxicants and its action at the neurologic and systemic level of the human body. This module covers key aspects of types and classification of toxicants which are of importance in the occupational setting.

**Learning objectives:**

After completion of this course, students will be able to:

- Characterize toxicants.
- Identify components of the body system important involved in toxicity.
- Interpret information from a dose-response curve.
- Formulate a risk assessment plan.
- Devise policies in line with toxicology and risk assessment.

**Introduction to Toxicology, Occupational Hazards & Monitoring**

This module aims at exploring the properties of toxicants and its action at the neurologic and systemic level of the human body. This module covers key aspects of types and classification of toxicants which is of important in the occupational setting to understand handling and pro-active measures against acute and chronic toxicity.

**Assessment:**

This module will be assessed through formative components which will be diversified across the different units and will relate to the following modes:

Group presentations

Multiple choice questions

Glossary terms

Reports

Successful completion of all the different units will lead to the award of a completion badge.

**Selected Resources:**

- Fan, A. (2015). Toxicology and [risk assessment](#). Singapore: Pan Stanford Publishing.
- Bengtson, D. and Henshel, D. (1996). Environmental toxicology and [risk assessment](#). West Conshohocken, Pa.: ASTM.
- Social Research Methods (2016), Canadian Edition, 4th Ed, Alan Bryman and Edward Bell
- Greim, H. and Snyder, R. (n.d.). Toxicology and [risk assessment](#).
- TORRES, J. (2016). Toxicological [risk assessment](#) for beginners. [Place of publication not identified]: SPRINGER INTERNATIONAL PU.
- Baker, D. (2012). Essentials of toxicology for health protection. Oxford: Oxford University Press.

**Facilitator:**

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Course developed/offered by: [School of Health Sciences \(SHS\) Archives - University of Technology, Mauritius \(utm.ac.mu\)](#)

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### **Ice breaker: Toxicity glossary**

You are expected to add a minimum of two entries to highlight the major contents surrounding toxicity.

### **Unit 1 - General concepts of toxicology**

In this unit you will explore the different terminologies surrounding toxicology, classify the toxicants based on their inherent properties, and outline the regulatory bodies mediating standards and guidelines for toxicants.

**After completion of this unit, you will be expected to:**

- **Define the toxicological variants and classify the toxicants.**
- **Apply the concepts of thresholds within an occupational setting.**
- **Differentiate between the enforcing and guiding regulatory agencies.**

## Outlook on toxicology Book

This workbook will expand on the features which are essential towards understanding the importance of dosage in toxicology and its general effects on the human system; focusing on the characterization of toxicants.

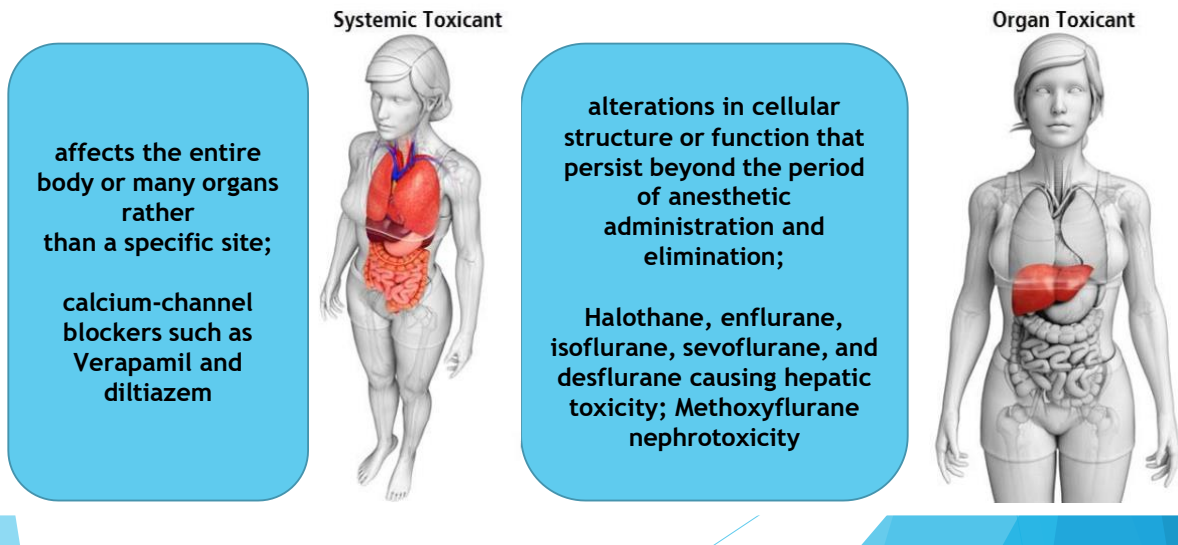
# Toxicology, Occupational Hazards & Monitoring

## History of toxicology:

- ❏ **Philippus Aureolus Theophrastus Bombastus von Hohenheim-Paracelsus (1493-1541) - Age of the enlightenment: “All substances are poisons, there is none which is not a poison. The right dose differentiates a poison and a remedy.”**
- ❏ **He developed the 4 main concepts of toxicology:**
  - 1. Experimentation is required for examining responses to chemicals.**
  - 2. A distinction should be made between the therapeutic and toxic properties of chemicals.**
  - 3. therapeutic and toxic properties are closely related and distinguished by dose.**
  - 4. possible to attribute chemical specificity and their therapeutic or toxic effects**

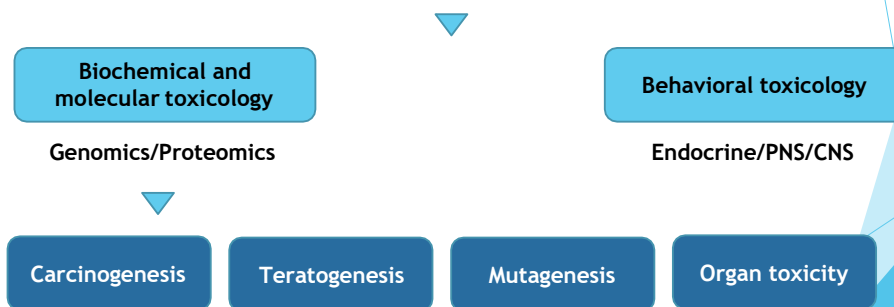


## Systemic toxicant versus organ toxicant:



## Modes of Toxic action:

- Includes at the fundamental level of organ, cell and molecular function, of all events leading to toxicity in vivo: uptake, distribution, metabolism, mode of action, and excretion.



Ex: Impacts of telomeres activity

## How toxicants generally cause harm:

- ▶ **Local versus systemic effect:** initial site of contact versus absorption in the body - circulated via blood until reaches target organ, i.e. away from exposure site.

Effect	Description	Type of effect	Examples
Irritation	A localized reversible inflammatory reaction at the site of contact.	Local	Dilute sodium hydroxide.
Corrosion	Causes "chemical burns" at the point of contact.	Local	Concentrated mineral acid.
Sensitizers (skin and respiratory)	Cause an allergic reaction.	Systemic	Epoxy resin.
Carcinogenic effects	Cause the development of tumors.	Systemic	Benzene.
Genotoxic toxicity	Damage to the genetic material of the cell.	Systemic	Dimethyl sulfate.
Reproductive and developmental toxicity	Causes effects on fertility or effects on the developing fetus.	Systemic	Thalidomide causes developmental effects. Dioxins can cause reproductive effects.

## Once 'poisoned' how long before effects are reflected?

- **Events from Hiroshima:**

***'The initial radiation emitted at the moment of detonation inflicted great damage to human bodies. Most of those exposed to direct radiation within a one-kilometer radius died. Residual radiation was emitted later. Roughly 80% of all residual radiation was emitted within 24 hours'.***

***Katsuji Yoshida, only a half mile from the explosion, recalled, "Blood was pouring out of my flesh. I know it sounds strange, but I felt absolutely no pain. I even forgot to cry"***

- 100,000 roentgens/rad (1,000 Gy) causes almost immediate unconsciousness and death within an hour.
- Total body exposure of 400 roentgens/rad (or 4 Gy) causes radiation sickness and death in half of the individuals who are exposed. Without medical treatment, nearly everyone who receives more than this amount of radiation will

## What does assessing toxicity/toxicants entail?

**A number of disciplines are involved in the study of toxicology and quantifying the effects of the toxicant or the exposure levels itself.**

Analytical toxicology

concerned with the identification and assay of toxic chemicals and their metabolites in biological and environmental materials

Toxicity testing

use of living systems to estimate toxic effects

Toxicologic pathology

deals with the effects of toxic agents manifested as changes in subcellular, cellular, tissue, or organ morphology

Structure-activity

relationship between the chemical and physical properties of a chemical and toxicity and, particularly, the use of such relationships as predictors of toxicity

Epidemiology

deals with the relationship between chemical exposure and human disease in actual populations rather than in experimental settings

## Assessment:

You are required to prepare a report which highlights the toxicologic profile of pollutants and its associated components. The focus here is to look at a potential source of pollution such as exhaust fumes from a factory and characterize its hazardous components, chemicals discharged in water and soil contaminants among other pollutants in the immediate environment. Highlights may include and should not be restricted to:

- Characterization of the selected pollutants
- Remedial actions taken to reduce or eliminate the pollutants
- Policies and treaties in place
- Innovative technologies to promote sustainable industrialization

Note: Arrangement is at your discretion to improve the flow of your presentation. You have to cover different sports according to their personality alignment.

The presentation should be fluid and impactful. Tools such as prezi or slidedog can be used to render the presentation more interesting in terms of transitioning from one point to another.

Follow the rules in terms of color patterning and word:graphics ratio as the slides have to contain the minimum relevant information while you deliver your speech elaborating on those keypoints.

Ideally it is good to start with the poster design on an A3 format on powerpoint or illustrator and then re-size it to A4. You should be careful of selecting the proper font size if this is the chosen process as when you resize from A3 the writings will definitely shrink. I would suggest a font size of 18pts for A3.

Unleash your creativity with the poster but do include concise and relevant writing

You are required to record the assessment using powerpoint presentation or any other apps such as Loom, and upload your assessment on the google drive platform and link shared in the discussion section of the assignment forum.

## Unit 2 - Molecular and Cellular Toxicity

This unit aims at providing key insights on cytotoxicity and mechanisms of cellular injury, demonstrating the local effects of toxicants, facilitate the differentiation of systemic from local effects of toxicants, and outlining the target organ toxicity (liver, kidney, immune system)

After completion of this unit, you will be expected to:

- Have a good understanding of the effects of toxicants on the cellular and molecular components in the human body.
- Demonstrate application of knowledge with respect to the toxicodynamic effect.
- Relate molecular and cellular cytotoxicity with disrupted cellular functionality.

### Protein adducts as a result of toxicant induced effect Page

This short video demonstrates the formation of protein adducts and the role of reactive oxygen species in the process.

[https://www.youtube.com/watch?v=9K-GuuvlhP4&ab\\_channel=CatalystUniversity](https://www.youtube.com/watch?v=9K-GuuvlhP4&ab_channel=CatalystUniversity)

### Review of Molecular and Cellular Toxicity Quiz

Complete all the 10 MCQs from this particular section to evaluate your understanding of cytotoxicity.

1. Elemental mercury is known to exert potent effect on the .....
  - a) Gastro intestinal tract
  - b) Central nervous system
  - c) Kidneys
  - d) Respiratory system
  
2. Which of the following is/are clinical features of aspirin overdose?
  - a) Bruising
  - b) Nausea
  - c) Ototoxicity
  - d) All of the above

3. .... toxicity is characterized by exposure to a chemical for more than 3 months.

- a) Sub-acute
- b) Sub-chronic
- c) Acute
- d) Chronic

4. .... can be described as inflammation reaction at the site of contact.

- a) Developmental toxicity
- b) Sensitizers
- c) Corrosion
- d) Irritation

5. Which of the following can be classified as a skin sensitizer?

- a) Benzene
- b) Dilute sodium hydroxide
- c) Epoxy resin
- d) Dioxins

6. .... is concerned with inheritance of genetic material affected by toxic substances.

- a) Mutagenesis
- b) Carcinogenesis
- c) Teratogenesis
- d) Lipogenesis

7. .... is a characteristic symptom of ozone pollution affecting plants.

- a) Glazing
- b) Dwarfing
- c) Flecking
- d) Tip burn

8. Silver ions can potentially react with the skin proteins to facilitate its absorption through the unbroken human skin layer.

- a) True.
- b) False.

9. Toxicologic pathology refers to the use of living systems to evaluate toxicity.

- a) True.
- b) False.

10. Virulent factors can determine the severity of immune reactions in food poisoning cases.

- a) True.
- b) False.