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ESM 231

Introductory Toxicology
Course Guide

ESM 231 Introduction to Toxicology Course Guide

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Introduction

Life for each of us is an ongoing series of chemical reactions which allow our bodies to function. The food we eat, the air we breathe and the water we drink provide the raw material for these chemical reactions and our bodies usually are efficient enough to expel most waste products.

Recently, there has been concern that our food, water and air are introducing toxic chemicals into our bodies. Are these concerns justified? What is a toxic chemical? Are there toxic chemicals in our environment polluting water and air? If so, can our bodies cope with these things? How do toxic chemicals differ from other chemicals?

The simple answer to the last question is that all chemicals can be toxic. An old cliché states that "the dose makes the poison" and that is true. Toxicology is the study of the adverse effects of chemicals or physical agents on living organisms.

These adverse effects may occur in many forms, ranging from immediate death to subtle changes not realized until months or years later. They may occur at various levels within the body, such as an organ, a type of cell or a specific biochemical.

The science of toxicology which overlaps with and incorporates aspect of other sciences including chemistry, biochemistry, physiology, microbiology, statistics, public health and pharmacology, studies the quantitative effects of chemicals on living things.

In the science of toxicology, the impact of external substance or condition and its deleterious effects on living things, organ systems, individual organs, tissues, cells, cellular units is the subject of study.

Organisms respond to toxic substances according to the amount or dose of the substance that gets into the body. This is one of the basic principles of toxicology that is with increasing dose or exposure to substances, you get more effects. This is easily illustrated with some examples from the home. Bread contains alcohol produced by the fermentation of sugars by yeast. The amount of alcohol in a slice of bread, or a loaf of bread, for that matter, is too small to cause a response (drunkenness) in humans. However, a bottle of liquor, also made by the fermentation of sugars by yeast contains a large enough dose of alcohol to make most people drunk or even, in some cases, to kill them.

If we are to live comfortably and safely in a chemical world, we need to be informed. We need to know the effects of certain chemicals and the associated risks.

This course will introduce you to the effects of certain chemicals and the associated risks on human body.

What you will Learn in this Course

The course consists of eight units on the history of toxicology, the field of toxicology and its history, basic principles of toxicology, toxicity, toxic agents, biotransformation, and the major classes of toxic agents, effects of toxic substances on the human body, carcinogenesis, mutagenesis, and tetratogenesis.

Course Aims

The aim of this course is to provide you with knowledge on the fundamental principles of toxicology, toxic agents, toxic effects, and factors affecting toxicity.

Course Objectives

After reading through this course material, you should be able to:

- trace the history of toxicology
- mention the field of toxicology
- identify the major classes of toxic substances
- explain the basic principles of toxicology
- identify the different classes of environmental toxic substances
- identify the routes of toxic substances and biotransformation in our body
- explain the effects of different toxic substances on the organ systems and the whole body
- explain mutagenesis, carcinogenesis and tetratogenesis
- explain the term "pesticide"
- explain the fact that there are many different classes of pesticides
- mention some pesticides that are very acutely toxic in humans.

Working through this Course

This course is learner driven, not teacher driven; assignments have been designed to create an active learning environment in the course. You will frequently be engaged in learning each unit independently, you should collaborate with your peers, when appropriate, to discuss and complete assignments

Course Materials

You will be provided with the following materials:

- A course guide
- Study units

In addition, the course comes with a list of recommended textbooks which though are not compulsory for you to acquire or indeed read, are necessary as supplements to the course material.

Study Units

The following are the study units contained in this curse:

Module 1

Unit 1 Background and Principles of Toxicology
Unit 2 Dose-Response Concepts
Unit 3 Toxicity
Unit4 Routes of Entry of Toxic Agents and Bio Transformation of Toxic Agents
Unit 5 Toxic Inorganic Elements and Metals

Module 2

Unit 1 Toxic Organic Compounds
Unit 2 Teratogenesis, Mutagenesis, Carcinogenesis and Effects on the Immune and Reproductive Systems
Unit 3 Pesticides

Unit 1 serves as an introduction to the science of toxicology. This unit also traces the history of toxicology. The second unit discusses the underlying principles of toxicology, the connection between doses, exposure and effects. It introduces you to toxicology terms such as threshold dose, effective dose, toxic dose, NOEL and LDSO. Unit 3 introduces you to toxicity, factors that affect toxicity and types of toxicity. This unit also introduces you to physical form of toxic substances.

Unit 4 discusses the routes of entry of toxic agents, absorption of chemicals and biotransformation of toxic substances in the body. You will also learn about immunological reactions and mmunotoxicity. The fifth unit introduces you to toxicological aspects of inorganic elements and heavy metals.

You will also learn about the toxicity and hazards of toxic heavy metals and inorganic elements, such as beryllium, lead, mercury, cadmium, arsenic, ozone, white phosphorus and chlorine. Unit 6 is a continuation of Unit 5. This unit deals with the toxicity and hazards of some organic compounds, such as methane, ethane, methanol, ethanol, benzene, toluene, naphthalene, phenols, amines, ethers, ketenes and aldhydes.

Unit 7 discusses the interference of chemicals with the human body; tetratogenesis, mutagenesis, carcinogenesis, and effects of chemical on the immune and reproductive systems. In this unit you will acquire basic knowledge on cancer and tumour development, and effects of chemicals on the immune and reproductive systems. Unit 8 introduces you to the history and toxicology of pesticides.

Text books and References

Timbrell, J. (2000). *Principles of Biochemical Toxicology*. UK: Taylor and Francis.

Timbrell, J. (2002). *Introduction to Toxicology*, UK: Taylor and Francis.

Assignment File

There are two components of assessment for this course: The Tutor- Marked Assignment (TMA) and the end of course examination.

Self-Assessment Exercise

The TMA is the continuous assessment component of your course. It accounts for 30% of the total score. You will be given four TMAs to answer; three of these must be answered before you are allowed to sit for the end of course examination. The TMAs would be given to you by your facilitator. They should be returned after you have done the assignment.

Final Examination and Grading

The examination concludes the assessment for the course. It constitutes 70% of the whole course. You will be informed of the time for the examination. It may or may not coincide with the university semester examination.

Summary

These eight study units are intended to provide you with basic the principles in the science of toxicology. By the time you complete studying them, you will be able to answer the following type of questions:

- mention two scientists that were important in the development of toxicology
- what is toxicology?
- list the physical forms in which toxic substances can occur in our environment
- using your own words, define the term "toxicity"
- what are the routes of human exposure to potentially toxic chemicals?
- what is the importance of body fat in relation to potential toxic substances?
- what are the phase I reactions?
- mention four metals that are toxic to human body
- what do you understand by the term minamatal disease?
- mention the stages in carcinogenic process
- mention five organic compounds that are potentially toxic to human body
- what do you understand by the term tetratogenesis?
- mention different classes of pesticides.