CHAPTER-1

Introduction to the Human Body

Core Resources

Tortora and Grabowski- Principles of Anatomy and Physiology

Chapter 1

Introduction

In this section we shall be introducing you to the disciplines of anatomy and physiology, and then looking at how living organisms, including humans are organised. We shall be introducing you to the concept of homeostasis.

Learning outcomes

The student should be able to:

- Understand the differences between anatomy and physiology
- List the characteristics of the living human organism
- Know the three principle non-invasive examination techniques
- Explain the principles of homeostasis

Anatomy and physiology

Anatomy is the study of structure and the relationships between structures.
Physiology is the study of how body structures interact and function.
Both disciplines are subdivided into specialised areas, which allow for greater and more detailed investigation in that particular field e.g. developmental anatomy or neurophysiology.

Examining the living body

Three non invasive techniques are used clinically to examine the body- palpation, auscultation and percussion. These are techniques which you will become familiar with, and will need to master over the duration of the course.

- Palpation is the examination of the body's surface with the hands
- Auscultation is listening to sounds the body produces, usually using a stethoscope

- Percussion is tapping on the body surface (usually via one of the examiners flattened finger) with the fingertips, and listening to the sound produced

Levels of organisation

The human body has six levels of structural organisation

1. Chemical- atoms and molecules.
2. Cellular- cells are the basic structural and functional units of the body
3. Tissues- collections of cells organised to perform a particular function.
4. Organs- structures with specific functions composed of two or more tissues.
5. Systems- organs and tissues working together to perform a common function (see below).
6. Organism- collection of structurally and functionally integrated systems- eg. the human body.

Task: look at the systems of the human body, and see which organs are involved in each system, and also try to learn their basic functions.

Activity 1.1		
System functions	**Primary components**	**Primary**
Integumentary		
Skeletal		
Muscular		
Nervous		
Endocrine		
Cardiovascular		
Lymphatic		
Respiratory		
Urinary		
Digestive		
Reproductive		
Time required: (60-90 minutes)		

Characteristics of the Living Body

Consider what it means to be alive. On a separate sheet of paper write down what separates a living thing from a non-living object.

Like all living organisms the human body performs processes that distinguish it from non-living things.

The most important basic life processes of human beings are:

- Metabolism- the total of all chemical processes within the body
- Responsiveness- the ability to detect and respond to changes in the internal or external environment
- Movement- both of the whole body, and internal structures within the body
- Growth- an increase in size either due to the number of cells, cell size or both
- Differentiation- unspecialised stem cells becoming specialised
- Reproduction- either the production of a new separate body, or the formation of new cells

Body fluids

Fluid inside cells is called intracellular fluid, whilst fluid outside the cell is called extracellular fluid.

Depending where it is found in the body, extracellular fluid is called:

- **Interstial fluid** in the narrow spaces between cells in tissues
- **Plasma** in blood vessels
- **Lymph** in lymphatic vessels
- **Cerebrospinal fluid** in the brain and spinal chord
- **Synovial fluid** in joints

Extracellular fluid is in constant motion around the body, and surrounds all cells, which is why it is often referred to as the body's internal environment. Body fluids contain substances, such as oxygen and nutrients, vital for proper cell function, and ultimately for life. As a result the composition of the body fluids is closely regulated, and this regulation or control is termed homeostasis.

Homeostasis

Homeostasis is the condition of equilibrium in the **composition** of the body's internal environment. The term literally means "unchanging", however in practice it is a dynamic, constantly changing state.

The body is surrounded by the **external environment,** over which it has no control other than behavioural adaptation (e.g. the shedding or putting on of clothes). The body's **internal environment** is the water-based medium in which body cells exist.

The composition of the internal environment (e.g. pH of body fluids; blood glucose levels) must be maintained within very narrow limits in order for it to be compatible with life. Homeostasis is subject to constant disturbance however, either due to external (e.g. changes in environmental temperature) or internal factors (e.g. fall in blood oxygen concentration).

Control systems:

Homeostasis is maintained by **control systems**, which detect changes in the internal environment and respond to them. Each system consists of three basic components: a **receptor**, a **control centre**, and an **effector.**

Homeostatic control systems take the form of feedback loops; these can be either **positive feedback** or **negative feedback** control systems.

The majority of control systems use negative feedback; in these systems the effector response reverses the effect of the original stimulus in order to restore homeostasis. E.g. maintenance of body temperature (preventing hypo-or hyperthermia).

There are comparatively few positive feedback systems (also known as amplifier or cascade systems). This time the effector reinforces the initial change in the control system. E.g. the coagulation cascade (preventing hypovolaemia through blood loss)

Homeostatic imbalances:

Provided the control systems maintain internal environmental conditions within the normal range, the body's metabolic functions can proceed efficiently and the organism remains healthy. When the fine control of one or more factors is inadequate, levels fall outside the normal range, disturbing the normal equilibrium.

Task:
Prepare a table of definitions for all the terms in bold in the above text. Take special note of the differences between positive and negative control mechanisms.

The nervous and endocrine systems, working together or independently, provide the corrective measures to restore homeostatic balance. Having detected deviations from the homeostatic state the nervous system corrects the deviation by sending nerve impulses to the effector organ, typically causing rapid changes. T

he endocrine system counteracts detected imbalances by releasing hormones, which then diffuse via the blood to the target organ or tissue. Hormones usually work more slowly than nervous impulses.

Comparison of the Nervous and Endocrine Systems

Characteristic	Nervous system	Endocrine system
Mediator molecules	Neurotransmitters released in response to nerve impulses	Hormones delivered to tissues throughout the body by the blood
Cells affected	Muscle cells, gland cells, other neurones	Virtually all body cells
Time to onset of action	Typically within milliseconds	Second to hours or even days
Duration of action	Generally briefer	Generally longer

Self-assessment questions

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1. Write a descriptive account on the means and mechanisms within the human body involved in homeostasis.

2. Identify the different types of body fluids, their composition and function.

3. Compare and contrast the control mechanisms of the human body paying particular attention to the endocrine and nervous systems