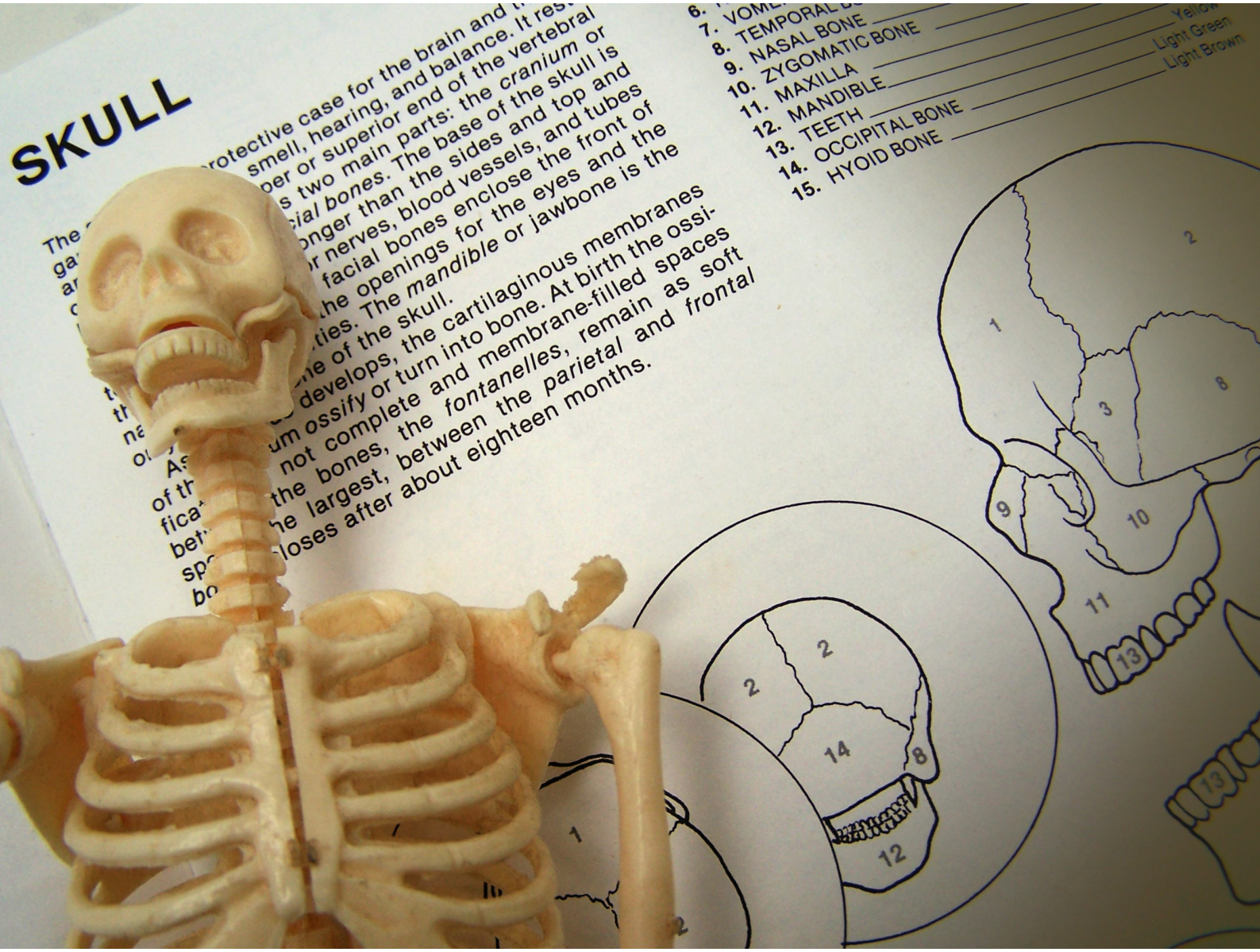

HEM 604

BASIC ANATOMY AND PHYSIOLOGY OF HUMAN BODY

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MODULE 1

UNIT 1 BASIC CONCEPTS IN ANATOMY AND PHYSIOLOGY

CONTENTS

1.0 INTRODUCTION

You have gone through the basic biology course where you learnt that all living things share basic characteristics, some of which include the followings:

- Responsiveness
- Growth and differentiation
- Reproduction
- Metabolism and excretion

That basic biology that you already know includes sub specialties. Examples of these sub-specialties are anatomy and physiology. They are biological subjects with slightly different perspectives.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- Define what Anatomy is:
- Define what physiology is:
- Describe the various specialties of each discipline
- Explain the relationship between anatomy & physiology

3.0 MAIN CONTENT

3.1 Definition of anatomy and physiology

The word ‘anatomy; has Greek origin. A literal translation would be “a cutting open” Anatomy is the study of internal and external structures of the body and the physical relationships among body parts for example studying how a particular muscle attaches to the skeleton while physiology which also has Greek origin, is the study of how organisms perform their vital functions. An example is the study of how a muscle contract or what kind of forces contracting muscles exert on the skeleton?

3.2 Relationship between anatomy and physiology

Anatomy and physiology are closely integrated both theoretically and practically Anatomical information provides clues about probable functions and physiological mechanisms can be explained only in terms of the underlying anatomy. This observation leads to a very important concept: All specific functions are performed by specific structures. Anatomists and physiologists approach the relationship between structure and function from different perspectives.

Please be attentive as we consider a simple non-biological analogy. Assume that this class is made up of Anatomists and physiologists and we are asked to consider an electric bulb. The anatomists may begin by describing and measuring the shape of the bulb and if possible, take it apart (“dissect it”) and put it back together. The physiologist could then explain its key structural relationships.

SELF-ASSESSMENT EXERCISE 1

i. What basic functions do all living things perform?
ii. a) Define anatomy
b) Define physiology

3.3 Divisions of anatomy

Anatomy can be divided into different specialties based on:

- Degree of structural detail under consideration
- Specific processes
- Medical application

On the basis of structural detail we have

(i) Microscopic Anatomy
(ii) Gross (Macroscopic Anatomy)

Microscopic anatomy

Microscopic anatomy deals with structures that cannot be seen without magnification. The limits of the equipment's used determine the boundaries of microscopic anatomy. For example with a light microscope, you can see basic details of cell structure, with an electron microscope, you can see individual molecules that are only a few nanometers a cross. It includes cytology and histology. As we go through the course, we will consider details at all levels, from macroscopic to microscopic.

Cytology is the analysis of the structure of individual **cells,** the simplest units of life. Cells are composed of chemical substances in various combinations, and our lives depend on the chemical processes occurring in the trillion cells in the body. **Histology** is the examination of tissues groups of specialized cells and cell products that work together to perform specific functions, tissues combine to form organs, such as the heart, kidney, liver or brain. Many organs are easily examined without a microscopic anatomy by using gross anatomy.

Gross anatomy (Macroscopic anatomy) is the examination of relatively large structures and features usually visible with the unaided eye. There are many ways to approach gross anatomy:

- Surface anatomy; Study of general form and superficial markings.
- Regional anatomy: focuses on anatomical organizational of specific areas of the body, such as the head, neck or trunk
- Systemic anatomy: study of the structure of organ systems, such as the skeletal system or the muscular system. Organ systems are groups of organs that function together in a co-ordinate manner. For example the heart, blood and blood vessels form the cardiovascular system, which distributes oxygen and nutrients through out the body. The human body has 11 organ systems, and they will be introduced later in this course.
- Developmental anatomy: This deals with the changes in form that occurs during the period between conception and physical

maturity. The study of these early developmental processes is called **EMBRYOLOGY.**

Other anatomical specialties with focus on clinical settings include:

(a) Mechanical anatomy (anatomical features that change during illness).
(b) Radiographic anatomy (anatomical structures as seen by using specialized imaging techniques.
(c) Surgical anatomy (anatomical landmarks important in surgery).

3.4 Divisions of physiology

As you learnt earlier, physiology is the study of the function of anatomical structures. Human physiology is the study of the functions of the human body. These functions are complex and much more difficult to examine than most anatomical structures. As a result, there are even more specialties in physiology than in anatomy, which includes:

i. Cell physiology: This is the cornerstone of human physiology; it is the study of the functions of cells. It deals with events at the chemical and molecular levels.
ii. Special physiology: this is the study of the physiology of special organs. For example, renal physiology is the study of kidney function.
iii. Systemic physiology: includes all aspects of the function of specific organ systems; cardiovascular physiology, respiratory physiology and reproductive physiology are examples of systemic physiology.
iv. Patho-physiology is the study of the effects of diseases on organ or system functions (pathos is the Greek word for "disease"). Modern medicine depends on an understanding of both normal physiology and patho-physiology

SELF-ASSESSMENT EXERCISE 2

i. Name the factors that determine the divisions of anatomy.
ii. The analysis of cell structure is called what?
iii. Define cell physiology.

4.0 CONCLUSION

Physicians normally use a combination of anatomical and psychological information when they evaluate patients.

5.0 SUMMARY

In this unit we have learnt that;

(i) Human beings share basic characteristics of living things.

(ii) Human anatomy is the study of body structures and the physical relationship among body parts of human beings.

(iii) Human physiology is the study of the functions of the human body.

(iv) Anatomy and physiology are closely integrated both theoretically and practically

(v) Modern medicine depends on an understanding of physiology and anatomy.

6.0 TUTOR MARKED ASSIGNMENT

1. Explain the differences between anatomy and physiology
2. List the Divisions of anatomy
3. List the Divisions of physiology

ANSWERS SELF-ASSESSMENT EXERCISE

SELF-ASSESSMENT EXERCISE 1

i. Basic functions of living things include: Movement, Respiration, Nutrition, Irritability, Growth, and reproduction.

ii. a. Anatomy is the study of the structure of living things.

b. Physiology is the science of the functioning of living organisms and their component parts.

SELF-ASSESSMENT EXERCISE 2

i. Factors that determine divisions in anatomy are:

a. Degree of structural detail under consideration

b. Specific processes
c. Medical application

ii. The analysis of cell structure is Cytology.

iii. Cell physiology is the study of the functions of cells.

7.0 REFERENCES/FURTHER READINGS

Hales D and Hales RE.Caring for the mind (1995): The comprehensive guide to mental health, Batam Books, New York.

Martini FC, Ober WC, Garrison CW, Welch K and Hutchings RT (2001) Fundamentals of anatomy and Physiology, 5th Ed, Prentice-Hall, Inc, New Jersey.

Oxford Concise Medical Dictionary.

Thibodeau GA and Patton KT (1996) Anatomy and Physiology, 3rd Ed, Mosby, 1996.

UNIT 2 LEVELS OF ORGANISATION

CONTENTS

1.0 INTRODUCTION

This "concept of Anatomy and Physiology" should be learned and *understood* (be able to explain the basis for the study) before continuing**.** Our study of the human body will begin with an overview of microscopic and then proceed to the gross anatomy of each organ system. When considering events from the microscopic to the macroscopic scale, we will examine several interdependent levels of organization.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- To have an overview of microscopic anatomy of the human body.
- To describe the basic gross anatomy of each organ system in the body.
- To describe the several independent level s of organization in the body.
- Identify the six levels of organization of the body

3.0 MAIN CONTENT

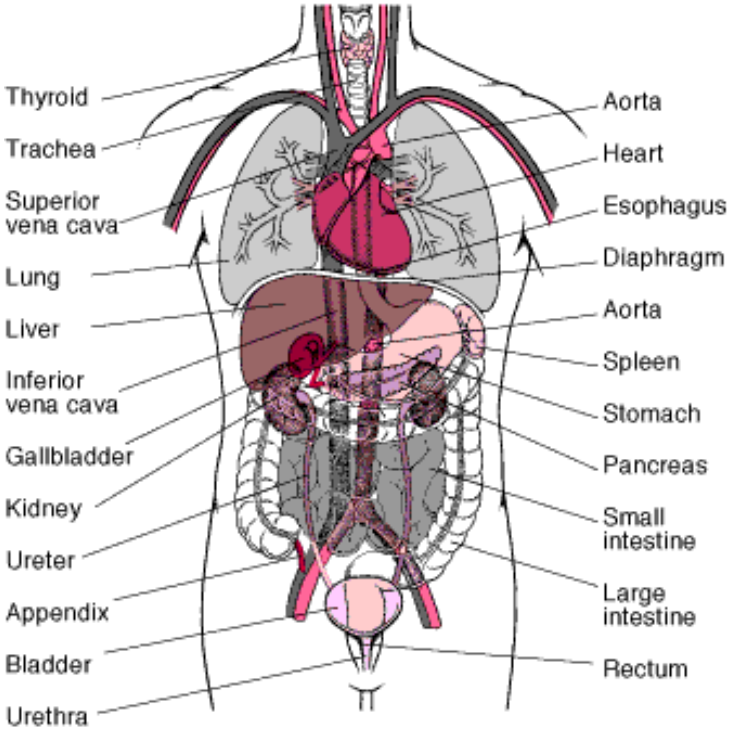

Fig 1: Organs of the human body.
Source: 1999 Encyclopaedia, Britanica,Inc

3.1 Different levels of organisation

The chemical or molecular level .Atoms, the smallest stable units of matter, can combine to form molecules with complex shapes. Even at this simplest level, the specialized shape of a molecule determines its function.

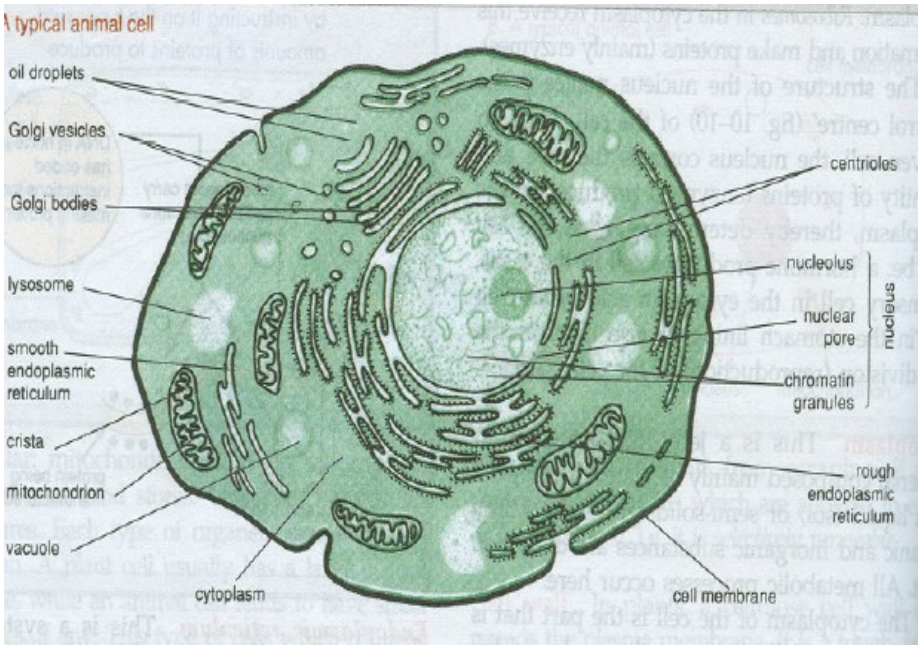

Fig 2 Diagram of a typical mammalian cell.

1999 Encyclopaedia, Britanica, Inc

The cellular level: Molecules can interact to form organelles, such as the protein filaments found in muscle cells. Each type of organelle has specific functions. For example, interactions among protein filaments produce the contractions of muscle cells in the heart. Cells are the smallest living units in the body, and organelles are their structural and functional components.

The tissue level: A tissue is a group of cells working together to perform one or more specific functions. Heart muscle cells, or cardiac muscle cells, interact with other cell types and with extra-cellular materials to form muscle tissue.

The organ level: Organs consist of two or more tissues working in combination to perform several functions. Layers of cardiac muscle tissue in combination with connective tissue, another tissue type, form the bulk of the wall of the heart, a hollow three-dimensional organ.

The organ system level: Organs interact in organ systems. Each time it contracts, the heart pushes blood into a network of blood vessels. Together the heart, blood and blood vessels form the cardiovascular system, one of 11 organ systems the body.

The organism level: All organ systems of the body work together to maintain life and health. This brings us to the highest level of organization, that of the organism – in this case, a human being.

3.2 Interrelationships between the levels of organization

The organization at each level determines the characteristics and functions of higher levels. For example, the arrangement of atoms and molecules at the chemical level creates the protein filaments that, at the cellular level, give cardiac muscle cells the ability to contract powerfully. At the tissue level, these cells are linked, forming cardiac muscle tissue. The structure of the tissue ensures that the contractions are coordinated, producing a heart-beat. When that beat occurs, the internal anatomy of the heart, an organ, enables it to function as a pump. The heart is filled with blood and connected to the blood vessels and the pumping action circulates to the blood vessels of the cardiovascular system. By interacting with the respiratory, digestive, urinary, and other systems, the cardiovascular system performs a variety of functions essential to the survival of the organism.

Something that affects a system will ultimately affect each component. For example, the heart cannot pump blood effectively after a massive blood loss. If the heart cannot pump and blood cannot flow, oxygen and nutrients cannot be distributed. Very soon, the cardiac muscle tissue begins to break down as individual muscle tissue cells die from oxygen and nutrient starvation. All cells, tissues, and organs in the body will be damaged.

SELF-ASSESSMENT EXERCISE 1

i. List the Six levels of organization in the human body.

ii. STATE TRUE OR FALSE: Something that affects a system will ultimately affect each component. Please explain your answers.

3.3 Organs Systems in the Body

This is an introduction to the organ systems in the human body. These organ systems are interdependent, interconnected, and packaged together in a relatively small space. The cells, tissues, organs, and organ systems of the body live together in a shared environment, like the

inhabitants of a large city. Just as city dwellers breathe the city air and drink the water provided by the local water company, cells in the human body absorb oxygen and nutrients from the fluids that surround them. If a city is blanketed in smog or its water supply is contaminated, the inhabitants will become ill. Similarly, if body fluid composition becomes abnormal, cells will be injured or destroyed. Suppose the temperature or salt content of the blood changes, the effect on the heart could range from a minor adjustment (heart muscle tissue contracts more often, so the heart rate goes up) to a total disaster (the heart stops beating, so the individual dies).

Various physiological mechanisms act to prevent potentially damaging changes in the composition of body fluid and the environment inside our cells.

Homeostasis

(*homeo,* unchanging + stasis, standing) refers to the existence of a stable internal environment. To survive, every organism must maintain homeostasis.

3.4 Some Organs Systems In The Body And Their Functions

Table 1: Functions of Organs of the Human Body

The Integumentary System	Protects against environmental hazards; helps control body temperature
Epidermis	Covers surface; protects deeper tissues.
Dermis	Nourishes epidermis; provides strength; contains glands
Hair follicles	Produce hair; innervations and provides sensations Provide some protection for the head Secrete lipid coating that lubricates hair shaft and epidermis Provides perspiration for evaporative cooling

Sebaceous glands	Protect and stiffen distal tips of digits
	Provide sensations of touch, pressure, temperature, pain
Sweat glands	
	Stores lipids; attaches skin to deeper structures
Nails	
Sensory receptors	
Subcutaneous layer	

THE SKELETAL SYSTEM	Protects tissues; stores minerals; forms blood Provides support;
Bones, cartilages and joints.	Support, protect soft tissues and store minerals.
Axial skeleton (skull, vertebrae, ribs, sternum, sacrum, cartilages, and ligaments)	Protects brain, spinal cord, sense organs, and soft tissues of thoracic cavity; supports the body weight.
Appendicular skeleton (limbs and supporting bones and ligaments).	Provides internal support and positioning of the limbs; supports and moves axial skeleton
Bone marrow	Acts as primary site of blood cell production (red blood cells, white blood cells)
Skeletal muscles	Provide skeletal movement; control entrances and exits of digestive tract; produce heat; support skeletal position; protect soft tissues

Axial muscles	Support and position axial skeleton
CENTRAL NERVOUS SYSTEM (CNS)	Acts as control center for nervous system; processes information; provides short-term control over activities of other systems
Brain	Performs complex integrative functions; controls both voluntary and autonomic activities
Spinal cord	Relays information to and from brain; performs less-complex integrative functions and directs many simple involuntary activities
Peripheral nervous system (PNS)	Links CNS with other systems and with sense organs
THE ENDOCRINE SYSTEM	Directs long-term changes in activities of other organ systems
Pineal gland	May control timing of reproduction and set day-night rhythms
Pituitary gland	Controls other endocrine glands; regulates growth and fluid balance
Thyroid gland	Controls tissue metabolic rate; regulates calcium levels
Parathyroid glands	Regulate calcium levels (with thyroid)
Thymus	Controls maturation of lymphocytes
	Adjust water balance, tissue metabolism, cardiovascular and respiratory activity

Adrenal glands	Control red blood cell production and elevate blood pressure
Kidneys	Regulates blood glucose levels
Pancreas	Support male sexual characteristics and reproductive functions
Testes	Support female sexual characteristics and reproductive functions
Ovaries	Transports cells and dissolved materials, including nutrients, wastes, and gases.
THE CARDIOVASCULAR SYSTEM	Propels blood; maintains blood pressure
HEART	Distribute blood around the body
BLOOD VESSELS	Carry blood from heart to capillaries
Arteries	Permit diffusion between blood and interstitial fluids
Capillaries	Return blood from capillaries to the heart
Veins	Transports oxygen, carbon dioxide, and blood cells; delivers nutrients and hormones; removes waste products; assists in temperature regulation and defense against disease.
BLOOD	

Source: Fundamentals of anatomy and Physiology, 5th Ed, Prentice-Hall, Inc,

SELF-ASSESSMENT EXERCISE 2

i. Define homeostasis.

ii. Mention 3 characteristics of organ system.

4.0 CONCLUSION

The relationship at each level determines the characteristics and functions of different organs in the human body.

5.0 SUMMARY

In this unit you have learnt that there are:

- Six levels of organization of the body.
- There are certain levels of relationships among these various levels of organization.
- The Structure and functions of the systems in the body.
- Definition of Homeostasis.

6.0 TUTOR MARKED ASSIGNMENTS

1 What are the components of the integumentary system?

2 Describe the function of the skeletal system

3 Describe the interrelationship between the different levels.

ANSWERS TO SELF-ASSESSMENT EXERCISE

SELF-ASSESSMENT EXERCISE 1

i. The six levels are:

- Chemical or molecular
- Cellular level
- Tissue level
- Organ level

- Organ system level
- Organism level

ii. True. Something that affects a system will ultimately affect each component. For example, the heart cannot pump blood effectively after a massive blood loss. If the heart cannot pump and blood cannot flow, oxygen and nutrients cannot be distributed. Very soon, the cardiac muscle tissue begins to break down as individual muscle tissue cells die from oxygen and nutrient starvation. All cells, tissues, and organs in the body will be damaged.

SELF-ASSESSMENT EXERCISE 2

i. Homeostasis: refers to the existence of a stable internal environment. To survive, every organism must maintain homeostasis.

ii. 3 characteristics of organ systems

- Interdependent
- Interconnected
- Packaged together

7.0 REFERENCES/FURTHER READINGS

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UNIT 3 FUNDAMENTAL ORGANIC CHEMISTRY

CONTENTS

1.0 INTRODUCTION

This is the study that describes chemical compounds containing carbon, hydrogen and in most cases oxygen. Organic compounds are found in all living cells.

2.0 OBJECTIVES

At the end of this study, you should be able to:

- Identify types of organic compounds and proteins.
- Explain types of channels
- Describe membrane carbohydrates

3.0 MAIN CONTENT

3.1 Types of organic compounds

- Carbohydrates.
- Lipids.
- Nucleic Acids.
- Proteins.

3.2 Organic Proteins

3.3 Types of Organic Proteins

1. **Anchoring proteins:** Membrane proteins called anchoring proteins attach the cell membrane to other structures and stabilize its position. Inside the cell, a network of supporting filaments in the cytoplasm is the cytoskeleton. Outside the cell, other membrane proteins may attach the cell to extracellular protein fibers or to another cell.
2. ***Recognition proteins (identifiers):*** The cells of the immune system recognize other cells as normal or abnormal on the basis of the presence or absence of characteristics recognition proteins. Many important recognition proteins are glycoproteins.
3. **Enzyme*s:*** Enzymes in cell membranes may be integral or peripheral proteins. In enzymatic reactions, the molecules at the beginning of the processes are called substrate, and the enzymes convert them to different molecules called the products. Almost all processes in a bilogical cell need enzymes in order to occur at significant rate. Enzymes are extremely selective for their substrates and speed up only a few reactions from among nany posssibilities, the set of enzymes present in a cell which determine which metabolic pathways occurred in that cell. These enzymes catalyze reactions in the extracellular fluid or in the cytosol, *depending on the location of the protein and its active site. For example* dipeptides are broken down into amino acids by enzymes on the exposed membranes of cells that line the intestinal tract.
4. ***Receptor proteins:*** They are present in the cell membrane and are sensitive to the presence of specific extracellular molecules called **ligands**. A receptor protein exposed to an appropriate ligand will bind to it, and that binding may trigger changes in the activity of the cell. For example, the binding of the hormone *insulin* to a specific membrane receptor is the key step that leads to an increase in the rate of glucose absorption by the cell. Cell membranes differ in the type and number of receptor proteins they contain, these differences account for their differing sensitivities to hormones and other solutes.
5. ***Carrier proteins:*** These bind to solutes and transport them across the cell membrane. The transport process involves a change in the shape of the carrier protein. The shape changes when solute binding occurs, and the protein returns to its original shape when the solute is released. Carrier proteins may require ATP as an energy source. For example, virtually all cells have carrier proteins that can bring glucose into the cytoplasm without expending ATP, but these cells must expend ATP to transport ions such as sodium and calcium

across the cell membrane and out of the cytoplasm.

6. ***Channels****:* Some integral proteins contain a central pore, or **channel,** that forms a passageway. The channel permits the movement of water and small solutes across the cell membrane. Ions do not dissolve in lipids, so they cannot cross the phospholipid bilayer. Thus, ions and other small water-soluble materials can cross the membrane only by passing through channels.

SELF-ASSESSMENT EXERCISE 1

i. List 4 Types of organic compounds.

ii. Describe carrier proteins.

3.3 Types of Channels

Physiologists speak of sodium channels, calcium channels, potassium channels, and so forth when referring to channel that permit the movement of only specific ions. There are two major kinds of channels:

(1) Leak channels, which permit water and ion movement at al times (although the rate can vary), and

(2) Gated channels, which open or close to regulate ion passage. Channels account for about 0.2 percent of the total membrane surface area.

Membrane structure is not rigid. The embedded proteins drift across the surface of the membrane like ice cubes in a bowl of punch. In addition, the composition of the cell membrane can change over time as components of the membrane are removed and recycled in the process of metabolic turnover. The inner and outer surface of the cell membrane differ in their protein and lipid compositions. For example, some cytoplasm enzymes are found only on the inner surface of the membrane, and some receptors are found exclusively on its outer surface.

3.4 Membrane Carbohydrates

Carbohydrates account for roughly 3 percent of the weight of a cell membrane. The carbohydrates in the cell membrane are components of complex molecules such as proteoglycans, glycoproteins, and

glycolipids. The carbohydrate portions of these large molecules extend beyond the outer surface of the membrane, forming a layer known as the glycocalyx .The glycocalyx has a variety of important functions, including the following:

- Lubrication and protection: The glycoproteins and glycolipids form a viscous layer that lubricates and protect the cell membrane.

- Anchoring and locomotion: Because the components are sticky, the glycocalyx can help anchor the cell in place. It also participates in the locomotion of specialized cells.

- Specificity in binding: Glycoproteins and glycolipids can function as receptors, binding specific extracellular compounds. Such binding can alter the properties of the cell surface and indirectly affect the cells behavior.

Recognition Glycoproteins and glycolipids are recognized as normal or abnormal by cells involved with the immune response. The characteristics of the glycocalyx are genetically determined. For example, your blood type (A, B, AB, or O) is determined by the presence or absence of membrane glycolipids on circulating red blood cells. The body immune system can recognize normal membrane glycoproteins and glycolipids as “self” rather then as “foreign”. This recognition system prevents your immune system from attacking your blood cells but enables it to recognize and destroy foreign blood cells should they appear in the bloodstream.

SELF-ASSESSMENT EXERCISE 2

i. Mention the 2 Types of channels.

ii. What are the important functions of glycocalyx?

4.0 CONCLUSION

Cell membranes possess different types of organic compounds in varying quantities, this account for their differing sensitivities to hormones and other solutes.

5.0 SUMMARY

In this unit, you have learnt:

- The types of organic compounds and proteins.
- The types of ion channels
- The importance of membrane carbohydrates

ANSWERS TO SELF-ASSESSMENT EXERCISES

SELF-ASSESSMENT EXERCISE 1

i. 4 Types of organic compounds:
   - Carbohydrates.
   - Lipids.
   - Nucleic Acids.
   - Protein

ii. Describe carrier proteins.

Carrier proteins are organic compounds that bind solutes and transport them across the cell membrane. The transport process involves a change in the shape of the carrier protein. The shape changes when solute binding occurs, and the protein returns to its original shape when the solute is released.

SELF-ASSESSMENT EXERCISE 2

i. The 2 Types of channels are leak channel and gated channel.

ii. The important functions of glycocalyx include;
   - Lubrication and protection
   - Anchoring and locomotion
   - Specificity in binding

6.0 TUTOR-MARKED ASSIGNMENT

1) Carbohydrate in the cell membrane is a component of ----------, ---------- and ----------.
2) List and discuss four types of organic proteins.
3) How do ions pass through the membrane barrier?
4) What are enzymes?

7.0 REFERENCES/FURTHER READINGS

Hales D and Hales RE.Caring for the mind (1995): The comprehensive guide to mental health, Batam Books, New York

Martini FC, Ober WC, Garrison CW, Welch K and Hutchings RT (2001) Fundamentals of anatomy and Physiology, 5th Ed, Prentice-Hall, Inc, New Jersey.

Oxford Concise Medical Dictionary

Thibodeau GA and Patton KT (1996) Anatomy and Physiology, 3rd Ed, Mosby, 1996.

UNIT 4 HAEMATOLOGY

CONTENTS

1.0 INTRODUCTION

Haematology is the science that deals with the nature, functions and diseases of blood and blood forming tissues. Blood is the fluid that circulates through out the body via the arteries and the veins, providing vehicles through which different substances are transferred between the various organs and tissues.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- Describe the characteristics of blood
- Highlight the function of blood.
- Explain homeostasis
- Describe the basis of blood grouping

3.0 MAIN CONTENT

3.1 Characteristics of Blood

Blood consists of liquid plasma in which float a mixture of Red blood cells (RBC). An average adult has about 5.5 litres of blood, with a temperature of approx. 38^{o}C and a pH of 7.35-7.45.Amount/Body weight is 8% of body weight and composition of 55% Liquid portion and 45% formed elements.

3.2 Types of Blood Cells

Blood cells are made up of:

a. Red blood cells (Erythrocytes)
b. White blood cells (Leucocytes)
c. Platelets.

3.2.1 Red blood cells (erythrocytes)

One cubic millimeter of blood contains about 5million Red blood cells.
They are circular, biconcave disc without nuclei.
They are located or found in the bone marrow after birth.
It has average life- span of about 120 days.

It contains haemoglobin and is responsible for the transport of oxygen in the blood.
They give the blood its characteristic red colour.

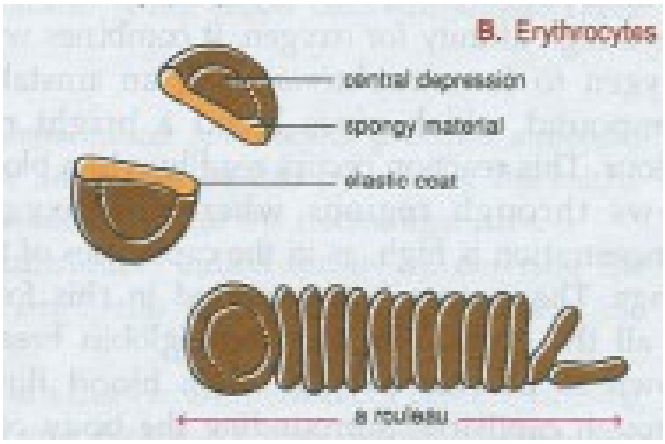

Fig 3: Erythrocytes
Fundamentals of Anatomy and Physiology, 5th Ed, Prentice-Hall, Inc,

3.2.2 White Blood Cells

White blood cells have nuclei but no pigment.
They produce antitoxins to neutralize bacteria toxin.
In the embryo, they are manufactured in the liver and the spleen.
In the adult, they are formed in the bone marrow, spleen and lymphatic glands.
They have a very short life- span.
One cubic millimeter of blood contains about 7,000 white blood cells (WBC).
They are larger than red blood cells in size.

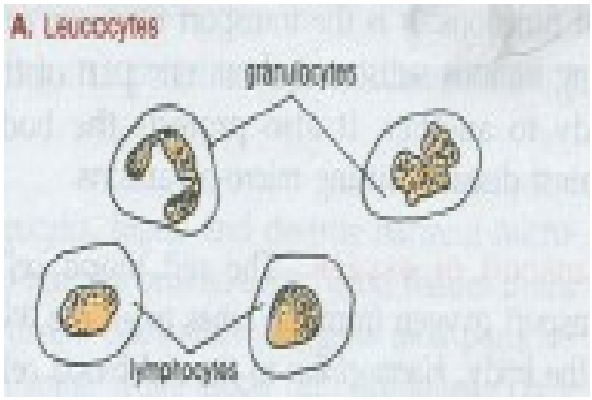

Fig 4: Leucocytes
Fundamentals of anatomy and Physiology, 5th Ed, Prentice-Hall, Inc,

3.2.3 Blood Platelets

They are tiny irregular cells fragments which are non- nucleated.
They may be round or oval in shape. They are concerned with clotting

SELF-ASSESSMENT EXERCISE 1

i List four characteristics of the human blood.
ii. Mention the types of blood cells that you know

3.3 Soluble components of blood

(1) Serum (liquid portion without clotting factors)
(2) Plasma (liquid portion + clotting factors).

Plasma is a pale yellow liquid made up mainly of water. Many substances that are dissolve in it including plasma proteins, antibodies, enzymes, gasses, salts, digested food materials and waste materials. The main function of the plasma is to transport these substances that are dissolved in it.

Plasma contains many sorts of proteins including albumins, globulins, clotting factors, complement, as well as electrolytes and hormones. Albumins: most abundant plasma proteins; carriers for many molecules (sterols, bilirubin, hormones and ions)

Globulins: many different types of proteins including immunoglobulins and..(a). $alpha_1$-anti-trypsin (AAT): major globulin; inactivates proteases; important in counteracting endogenous proteolytic activity such as during coagulation, inflammation; AAT-deficiency associated with emphysema and liver disease; (b). Haptoglobulin: binds free haemoglobin from lysed RBCs; increases under stress, acute inflammation, infections; decreases with massive hemolysis, burns, transfusion mismatches(c.) Transferrin: binds free Fe^{3+}, transports in blood,

3.4 Blood group

We have four distinct blood groups namely:

- Blood Group A,
- Blood Group B,
- Blood Group AB, and
- Blood Group O.

This depends on the antigens and antibodies that are present in the blood.

Antigens are foreign agents, which cause lymphocyte (white blood cell) to produce antibodies e.g. invading micro-organisms. There are two types of antigens: Antigen A and Antigen B.

Antibodies protect the body from the harmful effects of disease- causing micro- organism.

They give immunity against disease.

Clumping of red blood cells is called agglutination, caused by the reaction of either antigen.

Absence or presence of antigens forms the basis of blood group.

Group A – A agglutinogen
Group B – B agglutinogen
Group AB – Both A and B agglutinogen
Group O – No agglutinogen

GROUP O

Receive blood from Group O only.
Donates blood to any recipients
They are call universal donor

GROUP B

Person with blood group B can only receive blood from B and O.

GROUP A

Group A receive blood from O and A

GROUP AB

Group AB can only donate to AB. Receive small quantity of blood from the entire group.
Large quantity of mismatched blood can result to agglutination.

RHESUS FACTORS

Rhesus factors determine the positivity and negativity of the blood.
Rhesus positive (Rh+) if the blood has this factor
Rhesus negative (Rh-) if the blood does not have this factor.

3.5 Homeostasis

This is basically the prevention of blood loss.

The Stages are:

1. Contraction of the vessel
2. Formation of platelet plug
3. Blood coagulation
4. Growth of fibrous tissue into the blood clot to permanently close the vessel.

4.0 CONCLUSION

The general well being of the body is determined by the state and the function of the blood.

5.0 SUMMARY

In this unit we have learnt the physical and the chemical characteristics of blood. We also looked at the various components of blood and their roles.

SELF-ASSESSMENT EXERCISE 2

i. ---------- and ---------- are the two soluble components of the human blood.
ii. Mention the steps of blood clotting

6.0 TUTOR MARKED ASSIGNMENT

1. Describe plasma
2. What determines the divisions of blood groups? List the blood groups.
3. Mention 5 characteristics of leucocytes.

ANSWER TO SELF-ASSESSMENT EXERCISES

SELF-ASSESSMENT EXERCISE 1

i. Four characteristics of the human blood are:
- Blood consists of liquid plasma in which float a mixture of blood cells.
- An average adult has about 5.5 litres of blood,
- Temperature of about 38^{o}C
- pH of 7.35-7.45.
- Amount/Body weight is 8% of body weight
- Composition of 55% Liquid portion and 45% formed elements.

ii. The types of blood cells are:
   a. Red blood cells (Erythrocytes)
   b. White blood cells (Leucocytes)
   c. Platelets.

SELF-ASSESSMENT EXERCISE 2

i. Plasma and Serum are the two soluble components of the human blood.
ii. The steps of blood clotting are:
   a. Contraction of the vessel
   b. Formation of platelet plug
   c. Blood coagulation
   d. Growth of fibrous tissue into the blood clot to permanently close the vessel.

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MODULE 2

UNIT 1 THE INTEGUMENTARY SYSTEM

CONTENTS

1.0 INTRODUCTION

The integumentary system consists of the skin, which is the largest organ of the body. Alterations in the skin will affect the overall wellbeing of an individual. The skin is a highly underestimated organ. It performs many vital functions and has a complex structure which most people are unaware of. This unit provides a basic overview of the anatomy and physiology (structure and function) of the human skin which is essential to accurate patient assessment.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- Explain the functions of the skin.
- Describe the structure of the skin.
- Describe the appendages of the skin.

3.0 MAIN CONTENT

3.1 Anatomy of the skin

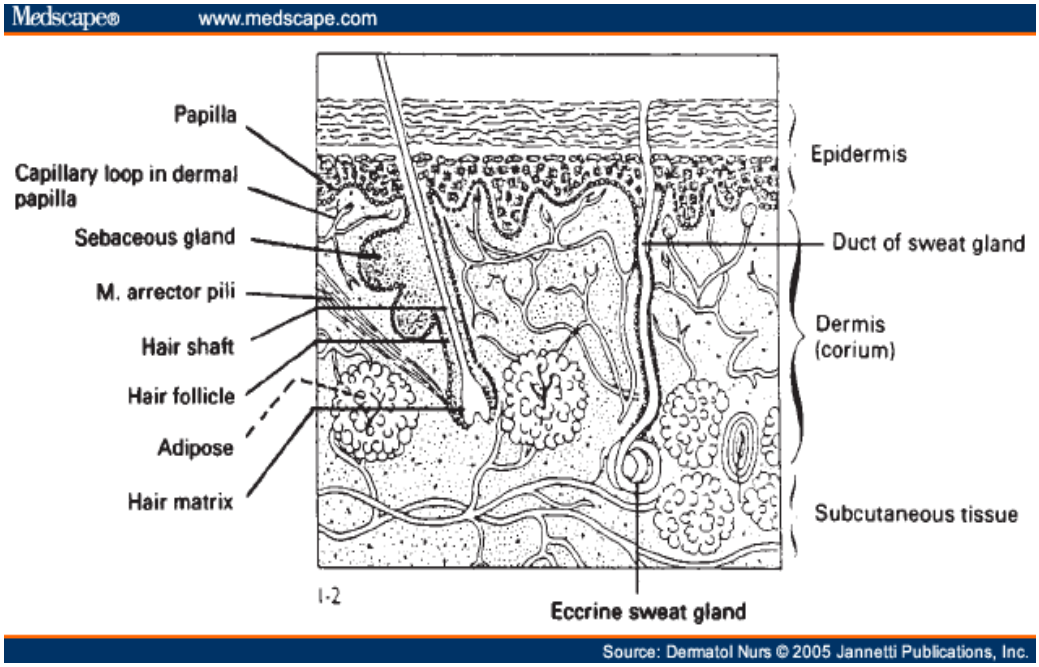

Fig 5A: Anatomy of the skin

The skin is an organ because it consists of different tissues that are joined to perform specific activities. It is one of the largest organs of the body in surface area and weight. In adults, the skin covers an area of about 2 square meters, and weighs 4.5 to 5 kg. It ranges in thickness from 0.5 to 4.0 mm, depending on location. The skin is not just a simple, thin coat that keeps the body together and provides protection. It performs several essential functions. Dermatology is the medical specialty that deals with diagnosing and treating skin disorders.

Structurally, the skin consists of two principal parts. The outer, thinner portion, which is composed of epithelium, is called the epidermis. The epidermis is attached to the inner, thicker, connective tissue part called the dermis. Beneath the dermis is a subcutaneous (subQ) layer. This layer, also called the superficial fascia or hypodermis, consists of areolar and adipose tissues. Fibbers from the dermis extend down into the subcutaneous layer and anchor the skin to it. The subcutaneous layer, in turn, attaches to underlying tissues and organs.

3.2 Functions of the skin

1) Regulation of Body Temperature

In response to high environmental temperature or strenuous exercise, the evaporation of sweat from the skin surface helps lower an elevated body temperature to normal. In response to low environmental temperature, production of sweat is decreased, which helps conserve heat. Changes in the flow of blood to the skin also help regulate body temperature.

2) Protection

The skin covers the body and provides a physical barrier that protects underlying tissues from shocks, physical abrasion, bacterial invasion, dehydration, and ultraviolet (UV) radiation. Hair and nails also have protective functions.

3) Sensation

The skin contains abundant nerve endings and receptors that detect stimuli related to temperature, touch, pressure, and pain and relate the information to the nervous system.

4) Excretion

Besides removing heat and some water from the body, sweat also is the vehicle for excretion of a small amount of salts and several organic compounds by integumentary glands.

5) Storage of Nutrients

Lipids are stored in adipocytes in the dermis and in adipose tissue in the subcutaneous layer. These are made available to the body when there is depletion which may be due to starvation.

6) Blood Reservoir

The dermis of the skin houses extensive networks of blood vessels that carry 8 to 10% of the total blood flow in a resting adult. In moderate exercise, skin blood flow may increase, which helps dissipate heat from the body. During hard exercise, however, skin blood vessels constrict (narrow) somewhat, and more blood is able to circulate to contracting muscles.

7) Synthesis of Vitamin D

Vitamin D is a group of closely related compounds. Synthesis of vitamin D begins with activation of a precursor molecule in the skin by ultraviolet (UV) rays in sunlight. Enzymes in the liver and kidneys then modify the molecule, finally producing calcitriol; the most active form of vitamin D. Calcitriol contributes to the homeostasis of body fluids by aiding absorption of calcium in foods. According to the synthesis sequence just described, vitamin D is a hormone, since it is produced in one location in the body, transported by the blood, and then exerts its effect in another location. In this respect, the skin may be considered an endocrine organ.

SELF-ASSESSMENT EXERCISE 1

i. List 5 functions of the skin.

ii. ---------- and ---------- are two principal parts of the skin.

3.3 Epidermis

The epidermis is composed of stratified squamous epithelium It contains four principal types of cells:

1) Keratinocytes: About 90% of the epidermal cells are keratinocytes. They produce the protein keratin that helps waterproof and protect the skin and underlying tissues.
2) Melanocytes: They produce the pigment melanin, which comprise about 8% of the epidermal cells. Their long, slender projections extend between and transfer granules of melanin to keratinocytes. Melanin (melan = black) is a brown-black pigment that contributes to skin colour and absorbs ultraviolet (UV) light.
3) Langerhans: These are the third type of cell in the epidermis. These cells arise from bone marrow and migrate to the epidermis. They interact with white blood cells called helper T cells in immune responses and are easily damaged by UV radiation.
4) A fourth type of cell found in the epidermis is called a Merkel cell. These cells are located in the deepest layer (stratum basale) of the epidermis of hairless skin, where they are attached to keratinocytes by desmosomes. Merkel cells make contact with the flattened portion of the ending of a sensory neuron (nerve cell), called a tactile (Merkel) disc, and are thought to function in the sensation of touch.

Four or five distinct layers of cells form the epidermis. In most regions of the body the epidermis is about O. 1 mm thick and has four layers. Where exposure to friction is greatest, such as in the palms and soles, the epidermis is thicker (l to 2 mm) and has five layers. Constant exposure of thin or thick skin to friction or pressure stimulates formation of a callus, an abnormal thickening of the epidermis.

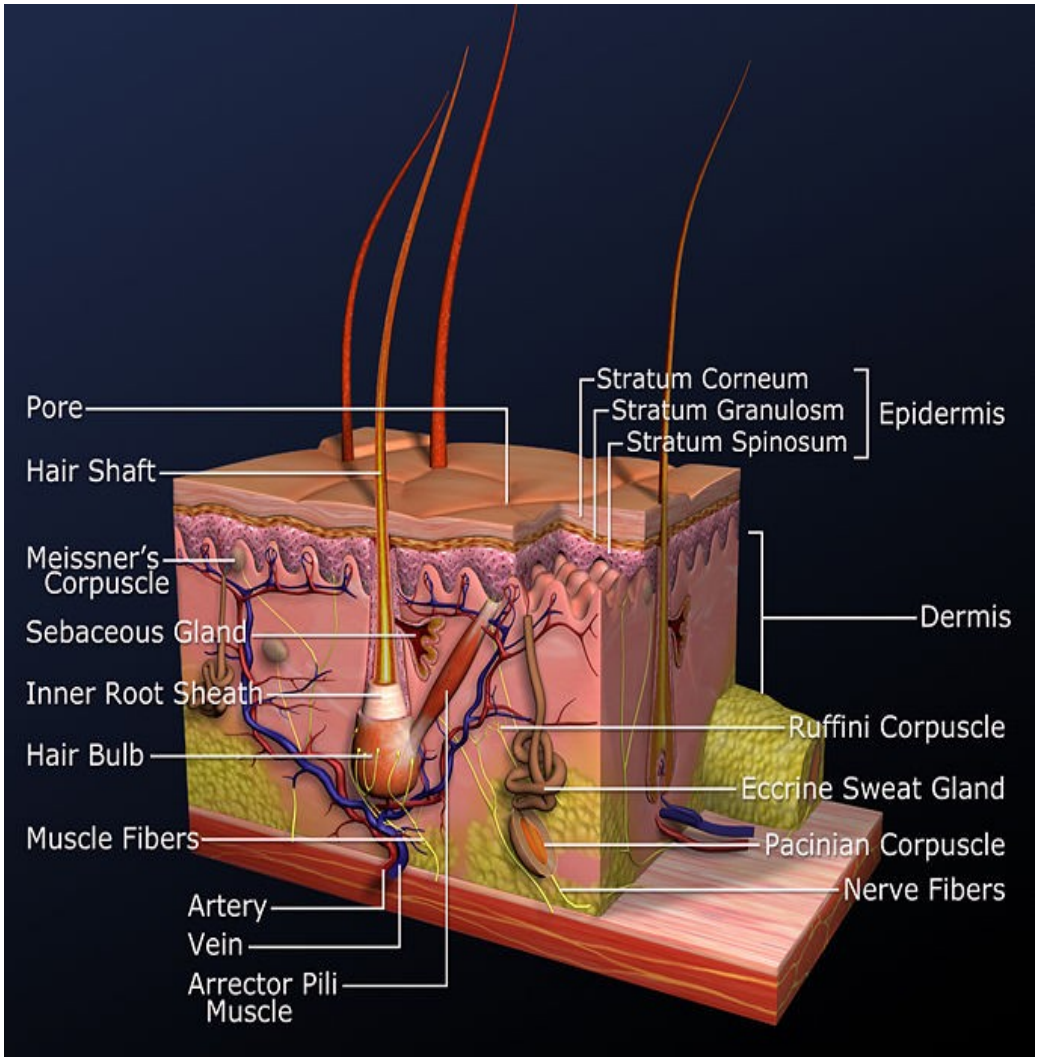

Fig 5B :The Structures of the Dermis and Epidermis
http://en.wikipedia.org/wiki/commons/a/a5

The names of the five layers (strata), from the deepest to the most superficial, are:

1. Stratum basale: This single layer of cuboidal to columnar cells contains stem cells, which are capable of continued cell division, and Melanocytes. The stratum basale also contains tactile (Merkel) discs that are sensitive to touch.
2. Stratum spinosum: This layer of the epidermis contains 8 to 10 rows (sheets) of polyhedral (many sided) cells that fit closely

together. The cells here appear to be covered with prickly spines (spinosum prickly) because the cells shrink apart when the tissue is prepared for microscopic examination.

3. Stratum granulosum. The third layer of the epidermis consists of three to five rows of flattened cells that develop darkly staining granules of a substance called keratohyalin (ker'-a-tb-HI -a-lin). This compound is the precursor of keratin, a protein found in the outer layer of the epidermis. Keratin forms a barrier that protects deeper layers from injury and microbial invasion and makes the skin waterproof.
4. Stratum lucidum. Normally, only the thick skin of the palms and soles has this layer. It consists of three to five rows of clear, flat, dead cells that contain droplets of an intermediate substance that is formed from keratohyalin and is eventually transformed to keratin.
5. Stratum corneum. This layer consists of 25 to 30 rows of flat, dead cells completely filled with keratin. These cells are continuously shed and replaced by cells from deeper strata. The stratum corneum serves as an effective barrier against light and heat waves, bacteria, and many chemicals.

In the process of keratinization, cells newly formed in the basal layers undergo a developmental process as they are pushed to the surface. As the cells relocate, they accumulate keratin. At the same time the cytoplasm, nucleus, and other organelles disappear, and the cells die. Eventually, the keratinised cells slough off and are replaced by underlying cells that, in tum, become keratinised. The whole process by which a cell forms in the basal layer, rises to the surface, becomes keratinised, and sloughs off takes two to four weeks. Epidermal growth factor (EGF) is a protein hormone that stimulates growth of ep ithelial and epidermal cells during tissue development, repair, and renewal.

3.4 The Dermis

The second principal part of the skin, the dermis, is composed of connective tissue containing collagen and elastic fibres. The few cells in the dermis include fibroblasts, macrophages, and adipocytes. The dermis is very thick in the palms and soles and very thin in the eyelids, penis, and scrotum. It also tends to be thicker on the dorsal than the ventral aspects of the body and thicker on the lateral than the medial aspects of the extremities. Blood vessels, nerves, glands, and hair follicles are embedded in the dermis.

The outer portion of the dermis, about one-fifth of the thickness of the total layer, is named the papillary region (layer). It consists of areolar

connective tissue containing fine elastic fibers. Its surface area is greatly increased by small, finger like projections called dermal papillae.

The deeper portion of the dermis is called the reticular region (layer). It consists of dense, irregular connective tissue containing interlacing bundles of collagen and coarse elastic fibres. Within the reticular region, bundles of collagen fibres interlace in a netlike manner. Spaces between the fibres are occupied by a small quantity of adipose tissue, hair follicles, nerves, oil glands, and the ducts of sweat glands. Varying thicknesses of the reticular region contribute to differences in the thickness of skin.

The combination of collagen and elastic fibres in the reticular region provides the skin with strength, extensibility, and elasticity. (Extensibility is the ability to stretch; elasticity is the ability to return to original shape after stretching.) The ability of the skin to stretch can readily be seen in pregnancy, obesity, and oedema. Small tears that occur in the dermis during extreme stretching are initially red and remain visible afterward as silvery white streaks called striae (STRI-e) or stretch marks.

The reticular region is attached to underlying organs, such as bone and muscle, by the subcutaneous layer, also called the hypodermis or superficial fascia. The subcutaneous layer also contains nerve endings called lamellated or Pacinian corpuscles that are sensitive to pressure. Nerve endings sensitive to cold are found in and just below the dermis, while those sensitive to heat are located in the middle and outer dermis.

SELF-ASSESSMENT EXERCISE 2

i. List the cells of the epidermis.
ii. Mention three cells found in the dermis.

4.0 CONCLUSION

The skin performs many vital functions and has a complex structure . It is hoped that you have gained a deeper understanding and respect for the skin and understand why it is so important to take care of the skin and maintain its health through the use of a regular skin care regime.

5.0 SUMMARY

In this unit, you have learnt that:

- The skin is the largest organ of the body.
- Alterations in the skin will affect the overall wellbeing of an

individual.

- Knowledge of the anatomy and physiology of the skin is essential to accurate patient assessment.
- Functions of the skin include protection, homeostasis, excretion, temperature regulation, vitamin D production, sensory perception, psychosocial function, and wound healing.
- Structure of the skin includes the epidermis, cells in the epidermis, basement membrane zone, dermis, and cells in the dermis, dermal vasculature, lymphatics, nerves, and subcutaneous tissue.
- Appendages of the skin include nail, hair, sebaceous glands,

6.0 TUTOR-MARKED ASSIGNMENT

1. The human skin is divided into the following layers----------
2. Illustrate the function of each layer of the human skin

ANSWER TO SELF-ASSESSMENT EXERCISE

SELF-ASSESSMENT EXERCISE 1

i. Regulation of body temperature. 2) Protection.3) Sensation.4) Excretion.5) Immunity.6) Blood reservoir.
ii. Epidermis and Dermis.

SELF-ASSESSMENT EXERCISE 2

i. Keratinocytes, Melanocytes, Langerhans and Merkel cell.
ii. Fibroblasts, macrophages, and adipocytes

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UNIT 2 THE SKELETAL SYSTEM

CONTENTS

1.0 INTRODUCTION

The Skeletal System serves many important functions; it provides the shape and form for our bodies in addition to supporting, protecting, allowing bodily movement, producing blood for the body, and storing minerals. The term skeleton comes from a Greek word meaning "dried up".

2.0 OBJECTIVES

At end of this unit, you should be able to:

- Describe the different types of bones.
- Explain the composition of bones.
- Explain the functions of the skeletal system.
- Describe divisions of the skeletal system.

3.0 MAIN CONTENT

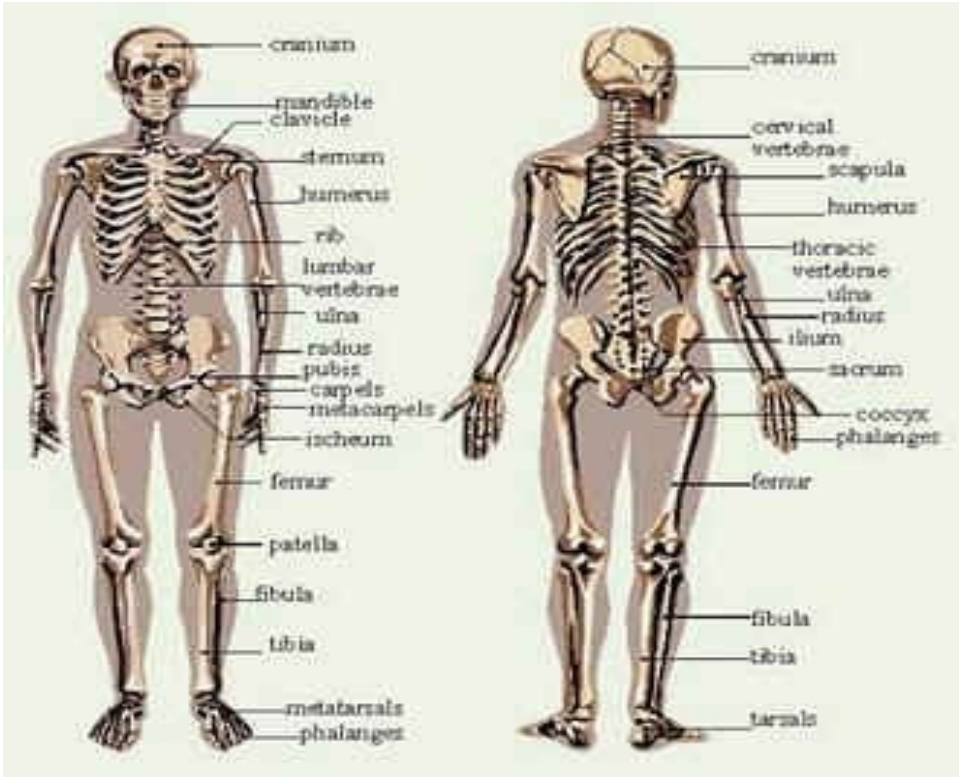

Fig 6:The human skeleton
http://en.wikipedia.org/wiki/skeleton

3.1 Functions of the skeletal system

1) Its 206 bones form a rigid framework to which the softer tissues and organs of the body are attached.
2) Vital organs are protected by the skeletal system. The brain is protected by the surrounding skull as the heart and lungs are encased by the sternum and rib cage.
3) Bodily movement is carried out by the interaction of the muscular and skeletal systems. For this reason, they are often grouped together as the musculo-skeletal system. Muscles are connected to bones by tendons. Bones are connected to each other by ligaments. Where bones meet one another is typically called a *joint.* Muscles which cause movement of a joint are connected to two different bones and contract to pull them together. An example would be the contraction of the biceps and a relaxation of the triceps. This produces a bend at the elbow. The contraction of the triceps and relaxation of the biceps produces the effect of straightening the arm.
4) Blood cells are produced by the marrow located in some bones. An average of 2.6 million red blood cells is produced each second by the bone marrow to replace those worn out and destroyed by the liver.

5) Bones serve as a storage area for minerals such as calcium and phosphorus. When an excess is present in the blood, buildup will occur within the bones. When the supply of these minerals within the blood is low, it will be withdrawn from the bones to replenish the supply.

The human skeleton is divided into two distinct parts: The axial skeleton and the appendicular skeleton.

3.2 The Axial Skeleton

The axial skeleton consists of bones that form the axis of the body and support and protect the organs of the head, neck, and trunk. It is made up of:

i) The Skull: The skull is the bony framework of the head. It consists of the eight cranial and fourteen facial bones.

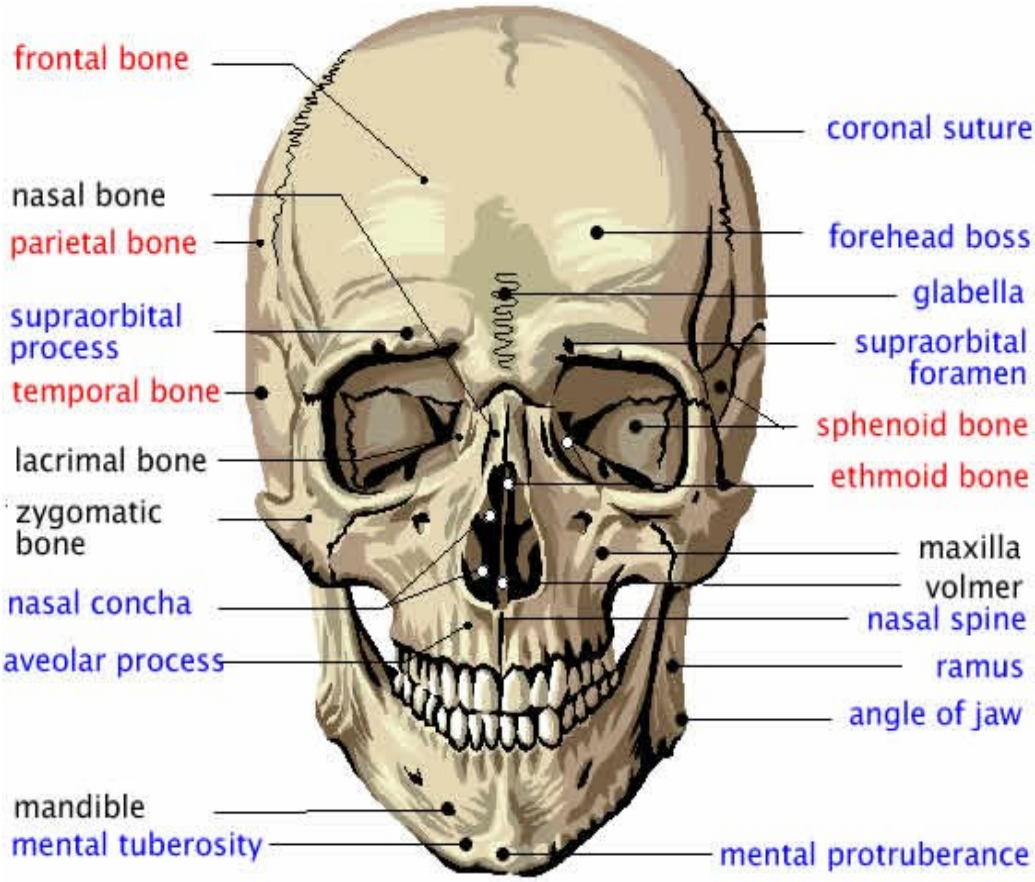

Fig 6B: The human Skull
http://en.wikipedia.org/wiki/Skull

A. The cranial bones makeup the protective frame of bone around the brain.

The cranial bones are:

- The frontal *f*orms part of the cranial cavity as well as the forehead, the brow ridges and the nasal cavity.
- The left and right parietal forms much of the superior and lateral portions of the cranium.
- The left and right temporal form the lateral walls of the cranium as well as housing the external ear.
- The occipital forms the posterior and inferior portions of the cranium. Many neck muscles attach here as this is the point of articulation with the neck.
- The sphenoid forms part of the eye orbit and helps to form the floor of the cranium.
- The ethmoid forms the medial portions of the orbits and the roof of the nasal cavity.

B. The facial bones makeup the upper and lower jaw and other facial structures.

The facial bones are:

- The mandible is the lower jawbone. It articulates with the temporal bones at the temporomandibular joints. This forms the only freely moveable joint in the head. It provides the chewing motion.
- The left and right maxilla are the upper jaw bones. They form part of the nose, orbits, and roof of the mouth.
- The left and right palatine form a portion of the nasal cavity and the posterior portion of the roof of the mouth.
- The left and right zygomatic are the cheek bones. They form portions of the orbits as well.
- The left and right nasal form the superior portion of the bridge of the nose.
- The left and right lacrimal help to form the orbits.
- The vomer forms part of the nasal septum (the divider between the nostrils).

ii) The Sternum:

The sternum is a flat, dagger shaped bone located in the middle of the chest. Along with the ribs, the sternum forms the rib cage that protects the heart, lungs, and major blood vessels from damage.

The sternum is composed of three parts:
- The manubrim, also called the "handle".
- The body, also called the "blade" or the "gladiolus", is located in the middle of the sternum and connects the third to seventh ribs directly

and the eighth through tenth ribs indirectly.

- The xiphoid process, also called the "tip", is located on the bottom of the sternum. It is often cartilaginous (cartilage), but does become bony in later years.

These three segments of bone are usually fused in adults.

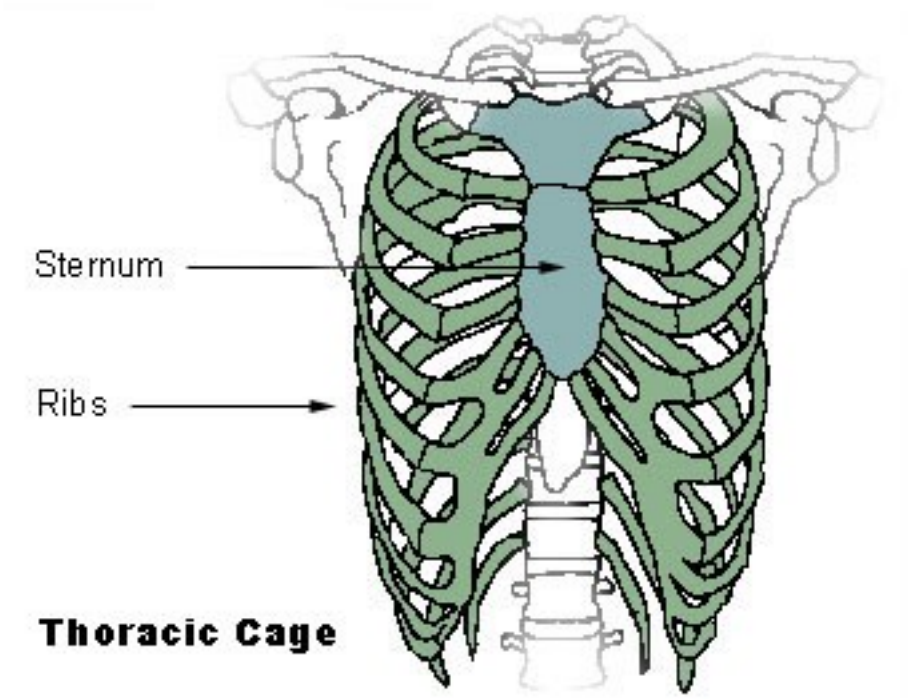

Fig 7: The thoracic cage
http://en.wikipedia.org/wiki/Thoracic

iii) The Ribs: The ribs are thin, flat, curved bones that form a protective cage around the organs in the upper body. They are comprised of 24 bones arranged in 12 pairs. These bones are divided into three categories:

- The first seven bones are called the true ribs.
- The next three pairs of bones are called false ribs
- The last two sets of rib bones are called floating ribs. Floating ribs are smaller than both the true ribs and the false ribs.
- The ribs form a kind of cage that encloses the upper body. They give the chest its familiar shape.

The ribs serve several important purposes:

- They protect the heart and lungs from injuries and shocks that might damage them.
- Ribs also protect parts of the stomach, spleen, and kidneys.
- The ribs help you to breathe. As you inhale, the muscles in between

the ribs lift the rib cage up, allowing the lungs to expand. When you exhale, the rib cage moves down again, squeezing the air out of your lungs.

iv) The Vertebral Column

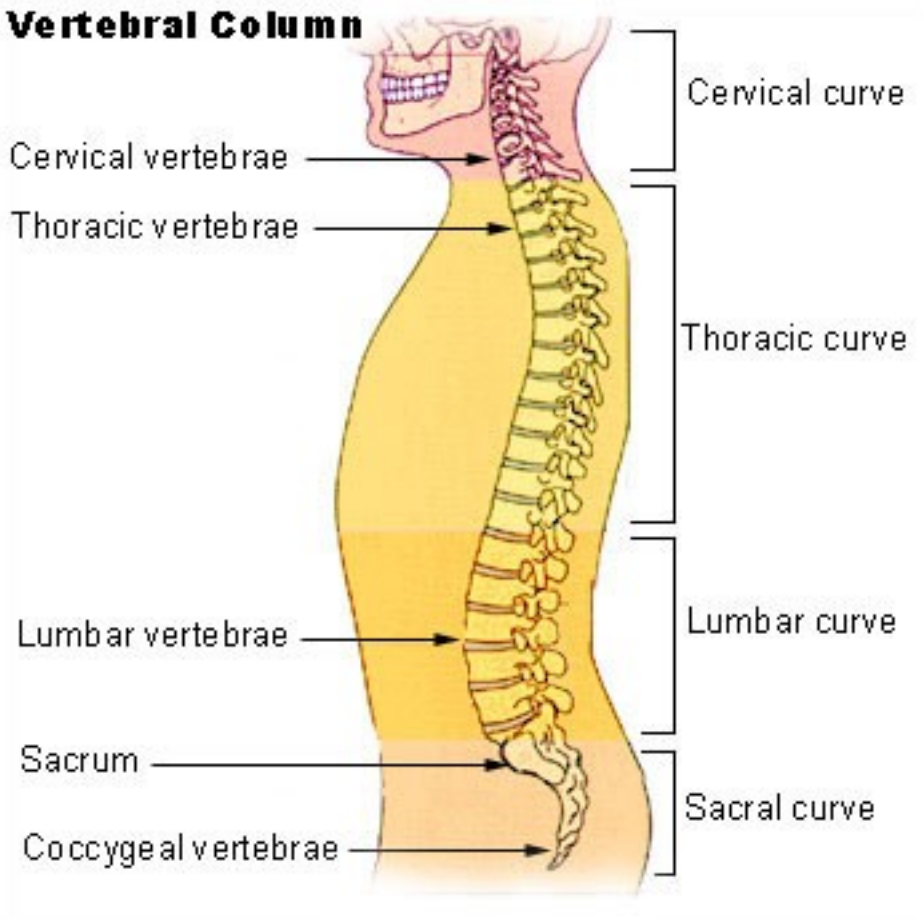

Fig 8: The Vertebral Column
http://en.wikipedia.org/wiki/vertebral column.

The vertebral column (also called the backbone, spine, or spinal column) consists of a series of 33 irregularly shaped bones, called vertebrae. These 33 bones are divided into five categories depending on where they are located in the backbone.

- The first seven vertebrae are called the cervical vertebrae. Located at the top of the spinal column, these bones form a flexible framework for the neck and support the head. The first cervical vertebrae is called the atlas and the second is called the axis.

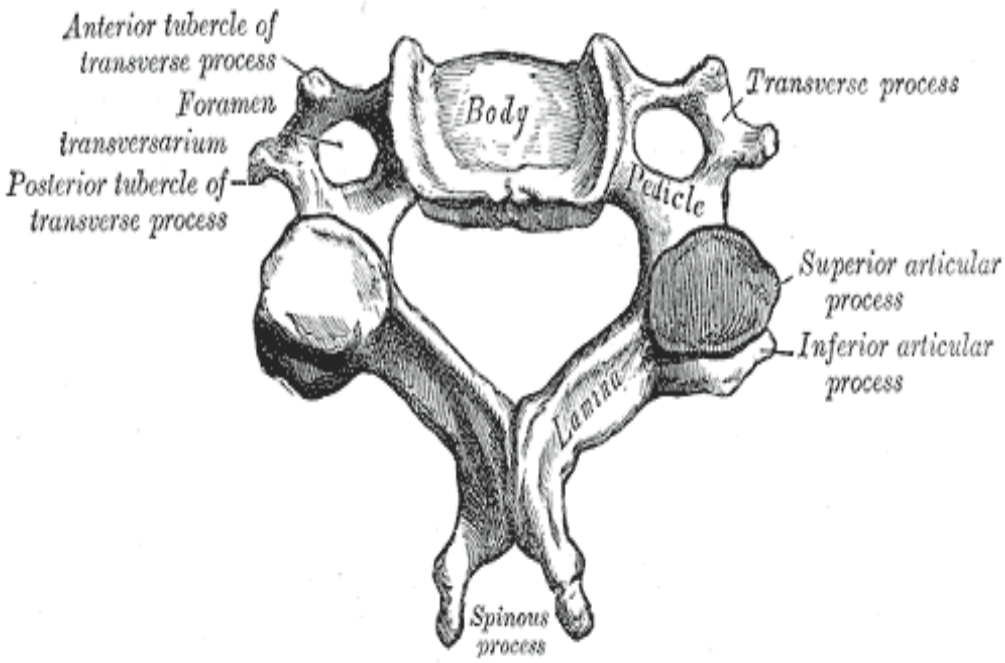

Fig 9: The cervical vertebrae
http://en.wikipedia.org/wiki/Cervical vertebra

- The next twelve vertebrae are called the thoracic vertebrae. These bones move with the ribs to form the rear anchor of the rib cage.
- After the thoracic vertebrae, come the lumbar vertebrae. These five bones are the largest vertebrae in the spinal column.
- The sacrum is a triangular bone located just below the lumbar vertebrae. It consists of four or five sacral vertebrae in a child, which become fused into a single bone after age 26.

The bottom of the spinal column is called the coccyx or tailbone. It consists of 3-5 bones that are fused together in an adult. Many muscles connect to the coccyx.

Fig 10: Intervertebral Disc

These bones compose the vertebral column, resulting in a total of 26 movable parts in an adult. In between the vertebrae are intervertebral discs made of fibrous cartilage that act as shock absorbers and allow the back to move. As a person ages, these discs compress and shrink, resulting in a distinct loss of height (generally between 0.5 and 2.0cm) between the ages of 50 and 55.
http://en.wikipedia.org/wiki/disc

When looked at from the side, the spine forms four curves. These curves are called the cervical, thoracic, lumbar, and pelvic curves. The cervical

and lumbar curves are not present in an infant. The cervical curves forms around the age of 3 months when an infant begins to hold its head up and the lumbar curve develops when a child begins to walk.

In addition to allowing humans to stand upright and maintain their balance, the vertebral column serves several other important functions. It helps to support the head and arms, while permitting freedom of movement. It also provides attachment for many muscles, the ribs, and some of the organs and protects the spinal cord, which controls most bodily functions.

SELF-ASSESSMENT EXERCISE 1

i. What basic functions of the human skeleton?
ii. ----------, ---------- and ---------- are the parts of the Sternum.

3.3 The Appendicular Skeleton

The Appendicular skeleton is composed of bones that anchor the appendages to the axial skeleton.

i) The Upper Extremities

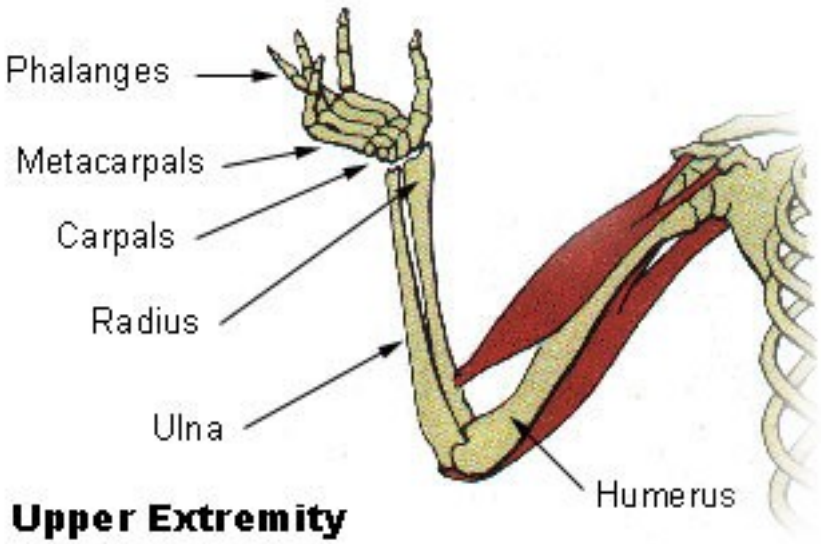

Fig 11:The Upper Extremities
http://en.wikipedia.org/wiki/Upper Extremity

The upper extremity consists of three parts: the arm, the forearm, and the hand.

The arm, or brachium, is technically only the region between the shoulder and elbow. It consists of a single long bone called the humerus. The humerus is the longest bone in the upper extremity. The top, or

head, is large, smooth, and rounded and fits into the scapula in the shoulder. On the bottom of the humerus, are two depressions where the humerus connects to the ulna and radius of the forearm. Together, the humerus and the ulna make up the elbow. The bottom of the humerus protects the ulnar nerve and is commonly known as the "funny bone" because striking the elbow on a hard surface stimulates the ulnar nerve and produces a tingling sensation.

The forearm is the region between the elbow and the wrist. It is formed by the radius on the lateral side and the ulna on the medial side when the forearm is viewed in the anatomical position. The ulna is longer than the radius and connected more firmly to the humerus. The radius, however, contributes more to the movement of the wrist and hand than the ulna.
The hand consists of three parts (the wrist, palm, and five fingers) and 27 bones.

The wrist, or carpus, consists of 8 small bones called the carpal bones that are tightly bound by ligaments. These bones are arranged in two rows of four bones.

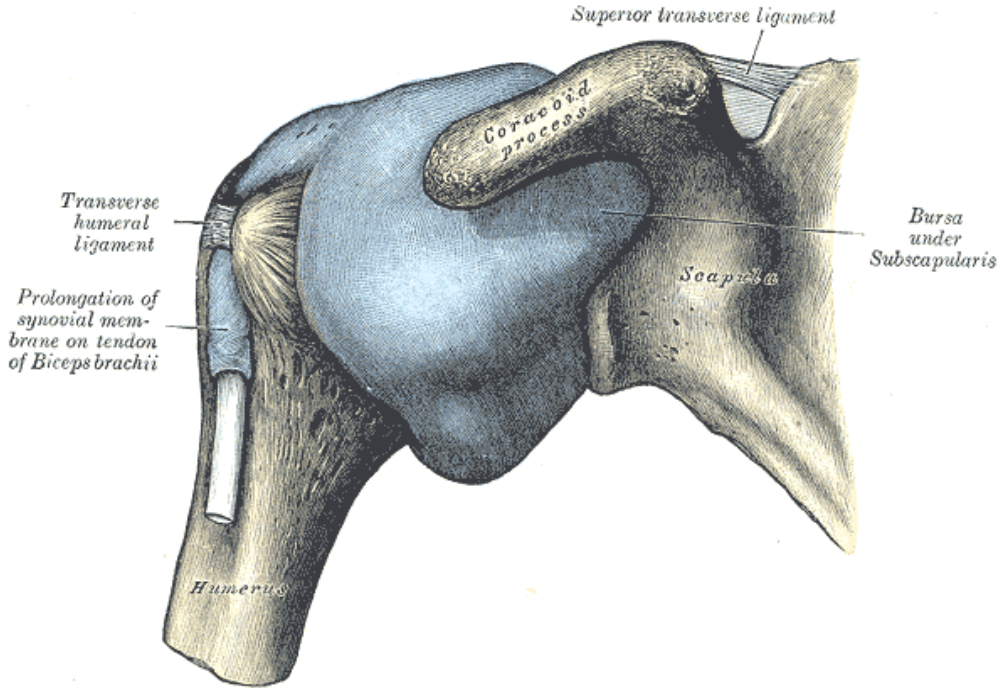

Fig 12 : The shoulder joint
Source:http://en.wikipedia.org/wiki/shoulder

ii) The Lower Extremities

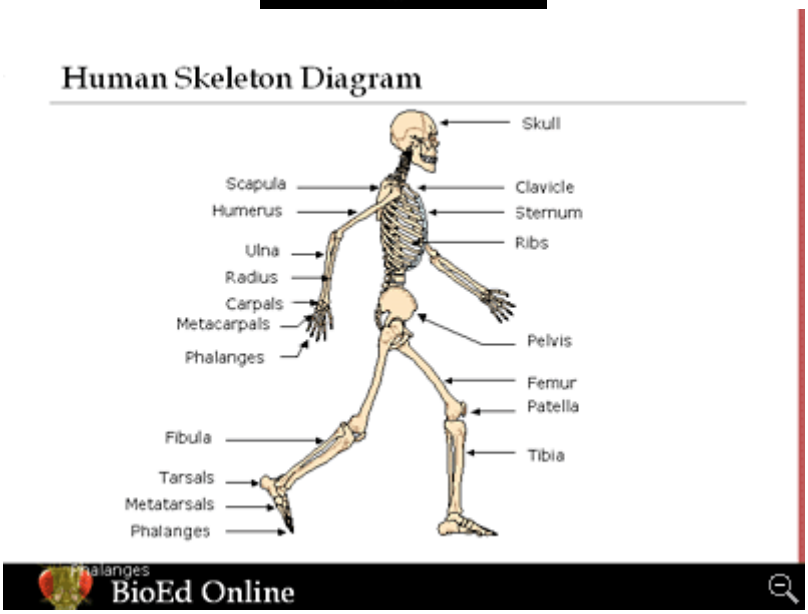

Fig 13: The Lower Extremities

The lower extremity is composed of the bones of the thigh, leg, foot, and the patella (commonly known as the kneecap).

The thigh is the region between the hip and the knee and is composed of a single bone called the femur or thighbone. The femur is the longest, largest, and strongest bone in the body.

The leg is technically only the region from the knee to the ankle. It is formed by the fibula on side away from the body (lateral side) and the tibia, also called the shin bone, on the side nearest the body (medial side). The tibia connects to the femur to form the knee joint and with the talus, a foot bone, to allow the ankle to flex and extend. The tibia is

larger than the fibula because it bears most of the weight, while the fibula serves as an area for muscle attachment.

The foot, or pes, contains the 26 bones of the ankle, instep, and the five toes. The ankle, or tarsus, is composed of the 7 tarsal bones which correspond to the carpals in the wrist. The largest tarsal bone is called the calcaneus or heel bone. The talus rests on top of the calcaneus and is connected to the tibia.The metatarsal and phalanges bones of the foot are similar in number and position to the metacarpal and phalanges bones of the hand.

The patella or kneecap is a large, triangular sesamoid bone between the femur and the tibia. It is formed in response to the strain in the tendon that forms the knee. The patella protects the knee joint and strengthens the tendon that forms the knee.

The bones of the lower extremities are the heaviest, largest, and strongest bones in the body because they must bear the entire weight of the body when a person is standing in the upright position.

iii) The Shoulder Girdle: also called the Pectoral Girdle, is composed of four bones: two clavicles and two scapulae.

The **clavicle**, commonly called the collarbone, is a slender S-shaped bone that connects the upper arm to the trunk of the body and holds the shoulder joint away from the body to allow for greater freedom of movement.

The **scapula** is a large, triangular, flat bone on the back side of the rib cage commonly called the shoulder blade. It has a shallow depression called the glenoid cavity that the head of the humerus (upper arm bone) fits into.

Usually, a "girdle" refers to something that encircles or is a complete ring. However, the shoulder girdle is an incomplete ring. In the front, the clavicles are separated by the **sternum**. In the back, there is a gap between the two scapulae.

The primary function of the pectoral girdle is to provide an attachment point for the numerous muscles that allow the shoulder and elbow joints to move. It also provides the connection between the upper extremities (the arms) and the axial skeleton

iv) **The Pelvic Girdle**--(the sacrum and coccyx are considered part of the vertebral column).

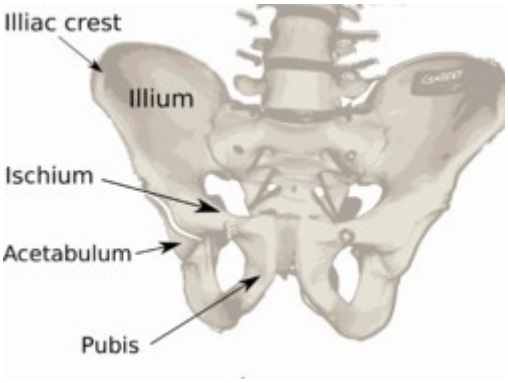

Fig 14: The Pelvic Girdle
Source: http://en.wikipedia.org/wiki/Pelvis

It is also called the hip girdle, is composed to two coxal (hip) bones. During childhood, each coxal bone consists of three separate parts: the ilium , the ischium , and the pubis . In an adult, these three bones are firmly fused into a single bone.

The pelvic girdle serves several important functions in the body. It supports the weight of the body from the **vertebral column**. It also protects and supports the lower organs, including the urinary bladder, the reproductive organs, and the developing fetus in a pregnant woman.
The pelvic girdle differs between men and woman. In a man, the pelvis is more massive and the iliac crests are closer together. In a woman, the pelvis is more delicate and the iliac crests are farther apart. These differences reflect the woman's role in pregnancy and delivery of children. When a child is born, it must pass through its mother's pelvis. If the opening is too small, a cesarean section may be necessary.

3.4.1 Types of Bones

The bones of the body fall into four general categories: long bones, short bones, flat bones, and irregular bones. Long bones are longer than they are wide and work as levers. The bones of the upper and lower extremities (ex. humerus, tibia, femur, ulna, metacarpals, etc.) are of this type. Short bones are short, cube-shaped, and found in the wrists and ankles. Flat bones have broad surfaces for protection of organs and attachment of muscles (ex. ribs, cranial bones, bones of shoulder girdle). Irregular bones are all others that do not fall into the previous categories. They have varied shapes, sizes, and surfaces features and include the bones of the vertebrae and a few in the skull.

3.4.2 Bone composition

Bones are composed of tissue that may take one of two forms. Compact, or dense bone, and spongy, or cancellous, bone. Most bones contain both types. Compact bone is dense, hard, and forms the protective

exterior portion of all bones. Spongy bone is inside the compact bone and is very porous (full of tiny holes). Spongy bone occurs in most bones. The bone tissue is composed of several types of bone cells embedded in a web of inorganic salts (mostly calcium and phosphorus) to give the bone strength, and collagenous fibers and ground substance to give the bone flexibility

4.0 CONCLUSION

Bones mass account for 20 percent of the body weight. The strength of bone comes from its inorganic components of such durability that they resist decomposition even after death. The clavicle in the shoulder is the most commonly broken bone in the body because it transmits forces from the arm to the trunk.

SELF-ASSESSMENT EXERCISE 2

i. Describe the patella.
ii. List the categories of bones in the human body.

5.0 SUMMARY

In this unit, you have been able to learn:

- The different types of bones
- The composition of bones
- The functions of the skeletal system
- The divisions of the skeletal system

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the differences between the pelvic girdles of men and women.
2. List the differences between compact bones and spongy bones.
3. Mention the spinal curves present in an infant of less than three months old.

ANSWERS TO SELF-ASSESSMENT EXERCISE

SELF-ASSESSMENT EXERCISE 1

i. The functions of the Skeletal System include the following;

- It provides the shape and form for our bodies.
- It provides support and protection for delicate body organs.
- It allows bodily movement.
- It produces blood for the body and stores minerals.

ii. The Sternum is made up of the manubrim, the body and xiphoid process.

SELF-ASSESSMENT EXERCISE 2

i. The patella or kneecap is a large, triangular sesamoid bone between the femur and the tibia.

ii. The bones of the body fall into four general categories: long bones, short bones, flat bones, and irregular bones.

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Silverstein, Alvin. The Skeletal System. Twenty-First Century Books. New York, NY. 1994.

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UNIT 3 NERVOUS SYSTEM

CONTENTS

1.0 INTRODUCTION

In the next two units, our attention will shift to mechanisms that coordinate the activities of the body's organ systems. These activities are adjusted to meet changing situations and environmental conditions. You sit, stand, or walk by controlling muscular activities; your body temperature remains stable on a cold winter day or in a warm kitchen because your rates of heat generation and heat loss are closely regulated.

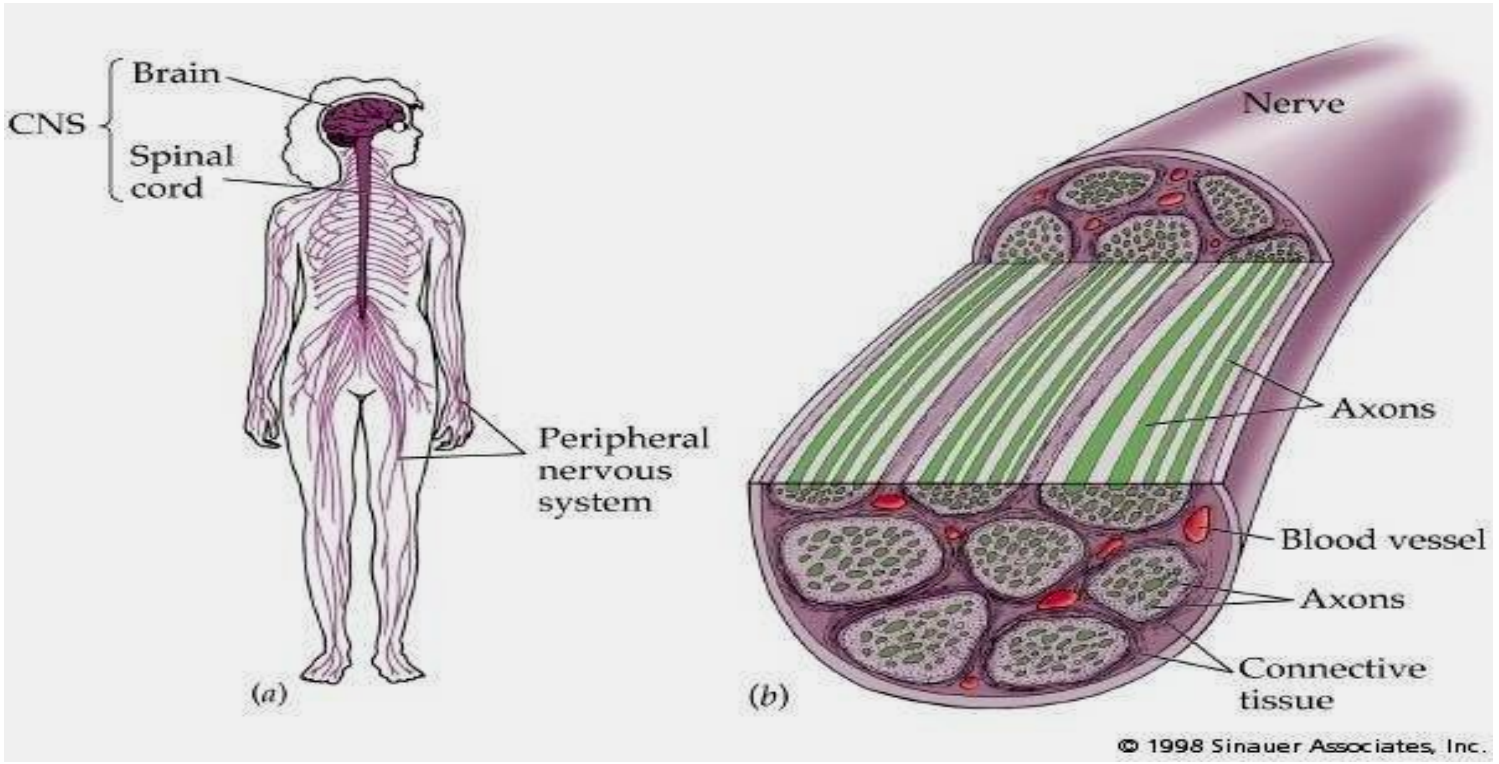
2.0 OBJECTIVES

- Understand the activities of the nervous system.
- Have a general overview of the nervous system.
- Know the anatomical divisions of the nervous system and their functions.
- Describe the structure of the brain

3.0 MAIN CONTENT

The nervous system, which accounts for a mere 3 percent of the total body weight, is the most complex organ system. It is vital not only to life but also to our appreciation of life. This unit details the structure and function of neural tissue and introduces principles of neurophysiology that are vital to an understanding of the nervous system's capabilities and limitations.

3.1 Overview of the Nervous system



AN OVERVIEW OF THE NERVOUS SYSTEM

Fig 15: Nervous System

http://en.wikipedia.org/wiki/CNS

The nervous system includes all the neural tissue in the body. The basic functional units of the nervous system are individual cells called neurons. Supporting cells or neuroglia separate and protect the neurons, provide a supportive framework for neural tissue, act as phagocytes, and help regulate the composition of the interstitial fluid. Neuroglia, also called glial cells, far out number neurons and account for roughly half the volume of the nervous system.

Neural tissue, with supporting blood vessels and connective tissues, forms the organs of the nervous system: the brain; the spinal cord; the receptors in complex sense organs, such as the eye and ear; and the nerves that interconnect these organs and link the nervous system with other systems. In Unit 2, we introduced the two major anatomical divisions of the nervous system; (1) the central nervous system and (2) the peripheral nervous system.

Nervous systems of man consist of 2 main parts:

1. The central Nervous System consisting of the brain and spinal cord.
2. Peripheral Nervous System consisting of;
    a. Sensory system.
    b. Motor system.
    c. Somatic nervous system.
    d. Autonomic nervous system, which is subdivided into parasympathetic system and sympathetic system.

The central nervous system

- Co-ordinate the activities of the nervous system.
- Receives constant input of impulses relating to changes in animals internal and external environment.
- Processes, integrate information and sends out impulse to relevant effectors for action.
- Impulses transmitted along sensory nerves are called sensory impulses.
-

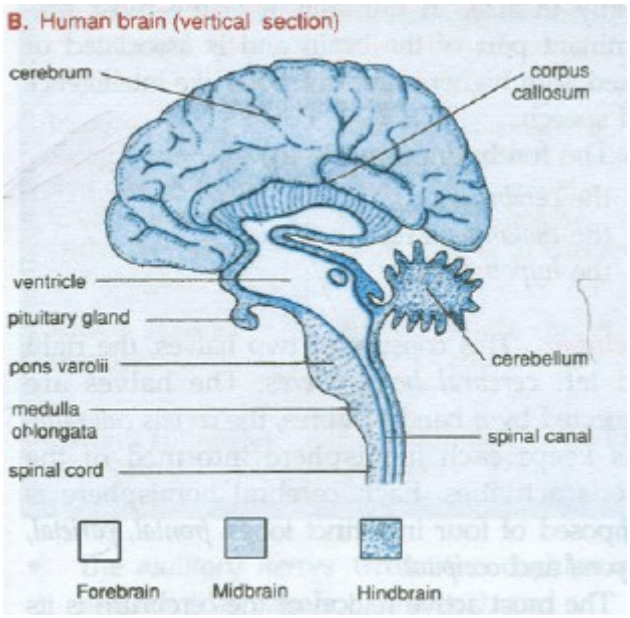


Fig 16:The features of the human brain
Source: NNmda Manual

The brain

- Human brain weighs about 1.2 to 1.4kg.
- It consumes 25% of the body oxygen supply to generate energy;
- It is covered by a membrane called the Meninges.
- It is enclosed in a bony case called the skull or cranium.
- It is made up of 2 types of nervous tissues, (Nerves cells or grey matter and Nerves fibers or white matter.)

Human brain is divided into 3 parts

a. Fore brain (i.e. Large, forward part).
b. Mid brain (i.e. narrow brain).
c. Hind brain (i.e. rare path).

Fore Brain: - it consist mainly cerebrum, thalamus and hypothalamus.

Midbrain: links the forebrain to the hindbrain. It controls auditory and visual reflexes.

Hindbrain: composed of 3 parts
(A) Cerebellum
(B) Pons varolii
(C) Medulla oblongota

SELF-ASSESSMENT EXERCISE 1

i. The autonomic nervous system consists of ---------- and ----------.

ii. Mention two portions of the hind brain.

3.3 Functions of the parts of the brain

i. Cerebrum controls all the bodies' voluntary action and consciousness.
ii. Frontal lobe – seat of intelligence, Memory, Imagination, thought, judgment, emotional reaction and movement of skeletal muscles.
iii. Parietal lobe – Receives and interprets the sensations of pressure, temperature and position.
iv. Temporal lobe is concerned with hearing, memory and understanding of speech.

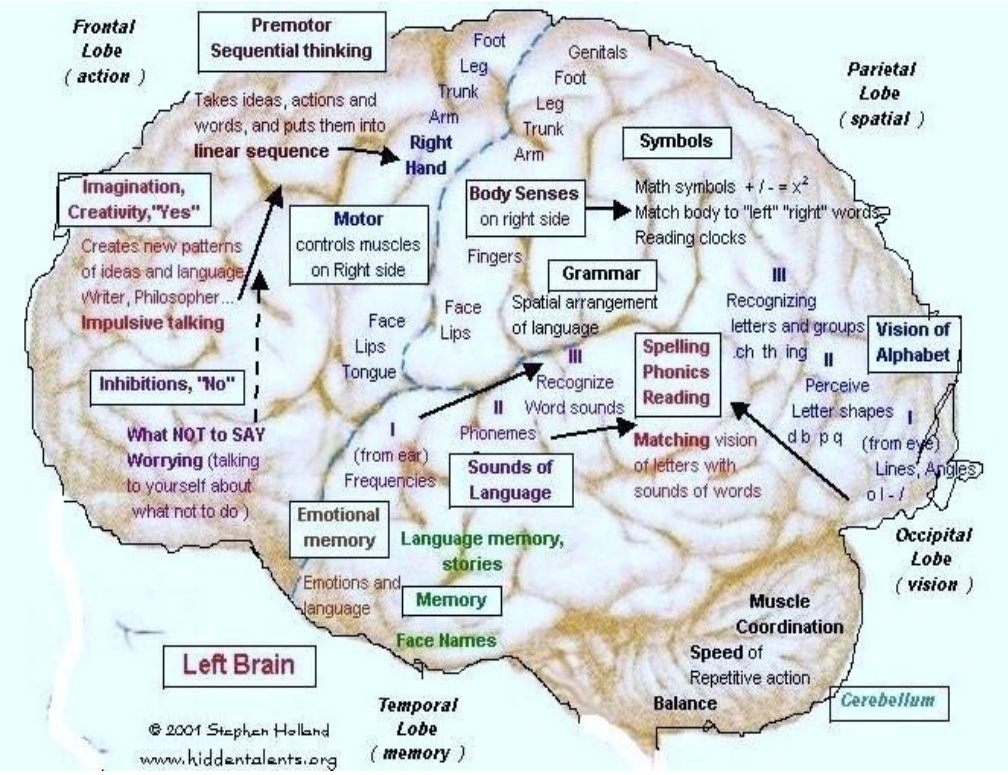


Fig 17:Functions of the different parts of the human brain.

3.4 Integration with other Systems

To function effectively, every cell in the body must communicate with its neighbors and with cells and tissues in distant portions of the body. In a few specialized cases, cellular activities are coordinated by the exchange of ions and molecules from one cell to the next across gap junctions. This direct communication occurs between cells of the same type, and the two cells must be in extensive physical contact. The two cells communicate so closely that they function as single entity. For example, gap junctions (1) coordinate ciliary movement among epithelial cells, (2) coordinate the contractions of cardiac muscle cells,

and (3) facilitate the propagation of action potentials from one neuron to the next at electrical synapses.

Direct communications is highly specialized and relatively rare. Most of the communications between cells involves the release and receipt of chemical messages. Each cell continuously "talks" to its neighbors by releasing chemicals into the extra cellular fluid. These chemicals tell what their neighbors are doing at any moment; the result is the coordination of tissue function at the local level. The use of chemical messengers to transfer information from cell to cell within a single tissue is called paracrine communications. The chemicals involved are called paracrine factors, also known as cytokines, or local hormones. Examples of paracrine factors include the prostaglandins.

SELF-ASSESSMENT EXERCISE B

(I) What is the function of the temporal lobe?
(II) ---------- is an example of paracrine factors.

4.0 CONCLUSION

The nervous system includes the neural tissues that make up the autonomic nervous system and the peripheral nervous system. The neurons are the basic functional unit. The nervous system and the endocrine systems are closely linked.

5.0 SUMMARY

In this unit we have learnt the two major anatomical divisions of the nervous system; (1) the central nervous system (II) peripheral nervous system; their divisions and various functions.

6.0 TUTOR MARKED ASSIGNMENT

1. ----------, ---------- and ---------- are three divisions of the brain.
2. Mention two functions of gap junction.
3. The nervous system is divided into ---------- and ---------

ANSWERS TO SELF-ASSESSMENT EXERCISE

SELF-ASSESSMENT EXERCISE 1

i. The autonomic nervous system consists of parasympathetic and sympathetic systems.
ii. Two portions of the hind brain are Cerebellum, Pons Varolii and Medulla Oblongata

SELF-ASSESSMENT EXERCISE 2

i. The Temporal lobe is concerned with hearing, memory and understanding of speech.
ii. Prostaglandin is an example of paracrine factors.

7.0 REFERENCES/FURTHER READINGS

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UNIT 4 ENDOCRINE SYSTEM

CONTENTS

1.0 INTRODUCTION

In this unit, we want to introduce the components and functions of the endocrine system and explore the interactions between the nervous and endocrine systems. We shall consider specific endocrine organs, hormones, and functions.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- Describe the endocrine system
- Explain the components of the endocrine system.
- Describe the three categories of hormones.
- Explain the integration between the endocrine system and the nervous system.

3.0 MAIN CONTENT

3.1 An overview of the endocrine system

The endocrine system includes all the endocrine cells, and tissues of the body. Endocrine cells are glandular secretory cells that release their secretions into the extracellular fluid. This characteristic distinguishes them from exocrine cells, which secrete their products onto epithelia's surfaces generally by way of duct. The chemicals released by endocrine cells may affect only adjacent cells, as in the case of most paracrine factors, or they may affect cells throughout the body.

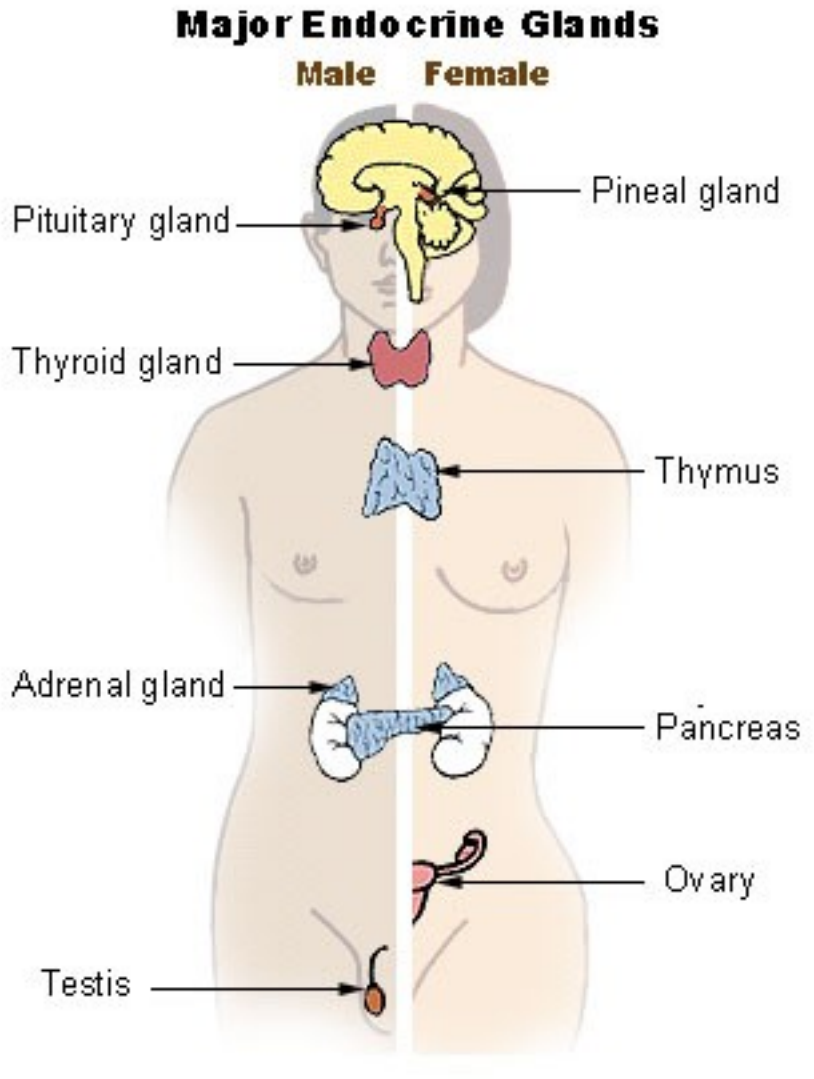

Fig 18: Major Endocrine Glands
Source:http://en.wikipedia.org/wiki/endocrine

3.2 The Components of the Endocrine System

The components of the endocrine system are introduced in the above diagram. Some of these organs, such as the pituitary gland, have endocrine secretion as a primary function others, such as the pancreas. Others have other functions in addition to endocrine secretion. Other endocrine organs include the hypothalamus ,the adrenal medullae, the heart, the thymus, the pancreas and digestive tract , the kidneys, the reproductive organs), and placenta .

Paracrine factors enter the bloodstream, but the concentrations are usually so low that distant cells and tissues are not affected. However, some paracrine factors, including several of the prostaglandin's and related chemicals, have primary effects in their tissues of origin and

secondary effects in other tissues and organs. When secondary effects occur, the paracrine factors are also acting as hormones.

SELF-ASSESSMENT EXERCISE 1

i. What are endocrine cells?

ii. List the four endocrine organs that you know.

3.3 Hormones

Hormones are chemical messengers that are released in one tissue and transported in the bloodstream to reach specific cells in other tissues. Whereas most cells release paracrine factors, typical hormones are produced only by specialized cells. In intercellular communications, hormones are letters and the circulatory system is the postal service. A hormone released into the bloodstream will be distributed throughout the body. Each hormone has target cells, specific cells that respond to its presence. These cells posses the receptors needs to bind and "read" the hormonal message. Although every cell in the body is exposed to the mixture of hormones in circulation at any moment, each individual cell will respond to only a few of the hormones present. The other hormones are treated like junk mail and ignored, because the cell lacks the receptors to read the messages they contain. The use of hormones to coordinate cellular activities in tissues in distant portions of the body is called *endocrine communications*

Because the target cells can be anywhere in the body, a single hormone can alter the metabolic activities of multiple tissues and organs simultaneously. These effects may be slow to appear, but they typically persist for days. Consequently, hormones are effective in coordinating cell, tissue, and organ activities on a sustained, long-term basis. For example, circulating hormones keep body water content and levels of electrolytes and organic nutrients within normal limits 24 hours a day throughout our entire lives.

While the effects of a single hormone persist, a cell may receive additional instructions from other hormones. The result will be a further modification of cellular operations. Gradual changes in the quantities and identities of circulating hormones can produce complex changes in physical structure and physiological capabilities. Examples include the processes of embryological and fetal development, growth, and puberty. Hormones can be divided into three groups on the basis of chemical structure (1) amino acid derivatives, (2) peptide hormones, and (3) lipid derivatives.

3.4 Integration between the Endocrine System and the Nervous System

The nervous system also relies primarily on chemical communication, but it does not use the bloodstream communications for message delivery like the endocrine system. Instead, neurons release a neurotransmitter at a synapse very close to the target cells that bear the appropriate receptors. The command to release the neurotransmitter rapidly travels from one location to another in the form of action potentials propagated along axons. The nervous system thus acts like a telephone company, carrying high-speed "messages" from one location in the body to another and delivering them to a specific destination. The effects of neural stimulation are generally short lived, and they tend to be restricted to specific target cells – primarily because the neurotransmitter is rapidly broken down or recycled. This form of synaptic communications is ideal for crisis management: if you are in danger of being hit by a speeding bus, the nervous system can coordinate and direct your leap to safety. Once the crisis is over and the neural circuit quiets down, things soon return to normal.

When viewed from a general perspective the differences between the nervous and endocrine systems seem relatively clear. In fact, these broad organizational and functional distinctions are the basis for treating them as two separate systems. Yet, when we consider them in detail, the two systems are organized along parallel lines. For example:

Both systems rely on the release of chemicals that bind to specific receptors on their target cells.

The two systems share many chemical messengers for example; nor epinephrine and epinephrine are called hormones when released into the bloodstream but neurotransmitters when released across synapses.

Both systems are regulated primarily by negative feed back control mechanisms.

The two systems share a common goal: to preserve homeostasis by coordinating and regulating he activities of other cells, tissues, organs, and systems.

SELF-ASSESSMENT EXERCISE 2

i. STATE TRUE OR FALSE: Saliva is a hormone. Please explain your answer.

ii. Hormones can be classified into 3 groups ----------, ---------- and ----------.

4.0 CONCLUSION

You have been able to learn that the endocrine system includes all the endocrine cells, and tissues of the body. They have glandular secretory cells that release their secretions into the extra cellular fluid. The main function of the endocrine system is to preserve homeostasis by coordinating and regulating the activities of other cells, tissues, organs, and systems.

5.0 SUMMARY

In this unit we have learnt that:

- Endocrine cells are different from exocrine cells; the later secrete their products onto epithelia's surfaces generally by way of duct.
- There are several similarities as well as distinction between the endocrine system and the nervous system.

6.0 TUTOR-MARKED ASSIGNMENT

1. Define endocrine communication.
2. List the similarities between the endocrine system and the nervous system
3. What is the difference between endocrine cells and exocrine cells?

ANSWERS TO SELF-ASSESSMENT EXERCISE

SELF-ASSESSMENT EXERCISE 1

i. Endocrine cells are glandular secretory cells that release their secretions into the extracellular fluid.

ii. Four endocrine organs include hypothalamus, the adrenal medullae, the heart, the thymus, the pancreas and digestive tract, the kidneys, the reproductive organs, and placenta.

SELF-ASSESSMENT EXERCISE 2

i. FALSE: Saliva is not an hormone because hormones are chemical messengers that are released in one tissue and transported in the bloodstream to reach specific cells in other tissues.

ii. Hormones can be classified into (1) amino acid derivatives, (2)

peptide hormones, and (3) lipid derivatives.

7.0 REFERENCES/FURTHER READINGS

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Martini FC, Ober WC, Garrison CW, Welch K and Hutchings RT (2001) Fundamentals of anatomy and Physiology, 5th Ed, Prentice-Hall, Inc, New Jersey.

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MODULE 3

Unit 1 The Digestive System
Unit 2 The Respiratory System Immune System
Unit 3 The Circulatory System Urinary System

UNIT 1 DIGESTIVE SYSTEM

CONTENTS

1.0 INTRODUCTION

The Digestive system is a group of organs and tissues involve in the breaking down of ingested food in the alimentary canal into a form that can be absorbed and assimilated by the tissues of the body.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- Describe the general anatomy of the digestive system
- Describe the major organs of digestion and absorption.
- Explain the mechanism of digestion.

3.0 MAIN CONTENT

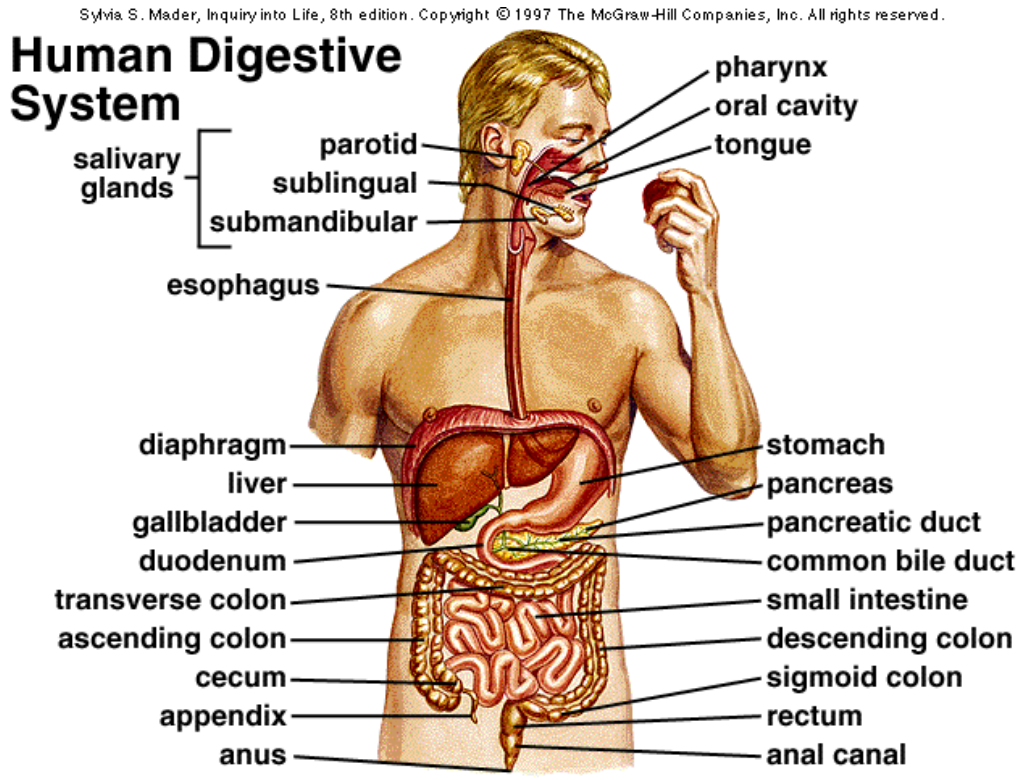
3.1 General anatomy of the digestive system

A) Gastrointestinal Tract, it is also known as "alimentary canal" .It consists of all organs through which food passes (mouth to anus)

B) Accessory Structures assist in digestion. They include teeth, salivary glands, liver, gall bladder, and pancreas.

C) Four Major Layers of GI Tract
1. Mucosa - innermost lining of GI organs
2. Submucosa
   a. areolarCT
   b. bloodvessels
   c. autonomic nerves
3. Muscularis
   a. smooth & skeletal muscles
4. Serosa-outermost

Fig 19: Human Digestive System



3.2 Major organs of digestion and absorption in man

A) Stomach

(1) General anatomic regions: *cardiac, fundus*, *body* and *pyloric region* (2)Stomach is important in the process of physical digestion (3) *Rugae* are undulations in stomach wall to help grind (4) *Gastric pits* contain four major secretory cells: (a) chief cells which produces pepsinogen, activation of pepsinogen by low pH to form pepsin (a protease for protein digestion), (b) parietal cells which produces hydrochloric acid (HCl),the secretion is enhanced by histamine via H2 receptors (c) G-cell which secretes gastrin hormone, gastrin activates gastric juice secretion and

gastric smooth muscle "churning". It also activates *gastroileal reflex* which moves chyme (liquefied digested material) from ileum to colon (d) mucus cell which plays protective role of mucus against acids and digestive enzymes (5) *Pyloric sphincter* regulates entry into the duodenum

B***) Small Intestine***

This is the major site of chemical digestion and absorption .It has three major segments: duodenum, jejunum and the ileum. The histology is as follows: (a) mucosa has intestinal glands (cavities) for secretion of intestinal juice
(b) mucosa also has *circular folds*, *villi* & *microvilli* for increased surface area

C) The Pancreas

Produces approx 1.5L/day pancreatic secretions, the secretions enter duodenum via two pancreatic ducts and there are many different components in these secretions like NaHCO3 (buffers pH of chyme), pancreatic amylase, trypsinogen, chymotrypsinogen and carboxypeptidase.

D***) The Liver it is the largest gland in body***

Its functions include: (i) To "filter" and process nutrient-rich blood delivered to it. (ii) Receives nutrient-rich blood from Small Intestine via the *hepatic portal vein*. (iii) Regulates carbohydrate metabolism

E) ***Large Intestine***

Major function to absorb water and eliminate indigestible matter. Major structures are :(a). Caecum with vermiform appendix (b). Ascending, transverse, descending colon (c). Sigmoid colon, rectum (d). Haustra are pouches in wall of large intestine.

SELF-ASSESSMENT EXERCISE 1

i. ----------, ---------- and ---------- are accessory structures in human digestion.

ii. ---------- regulates entry into the duodenum.

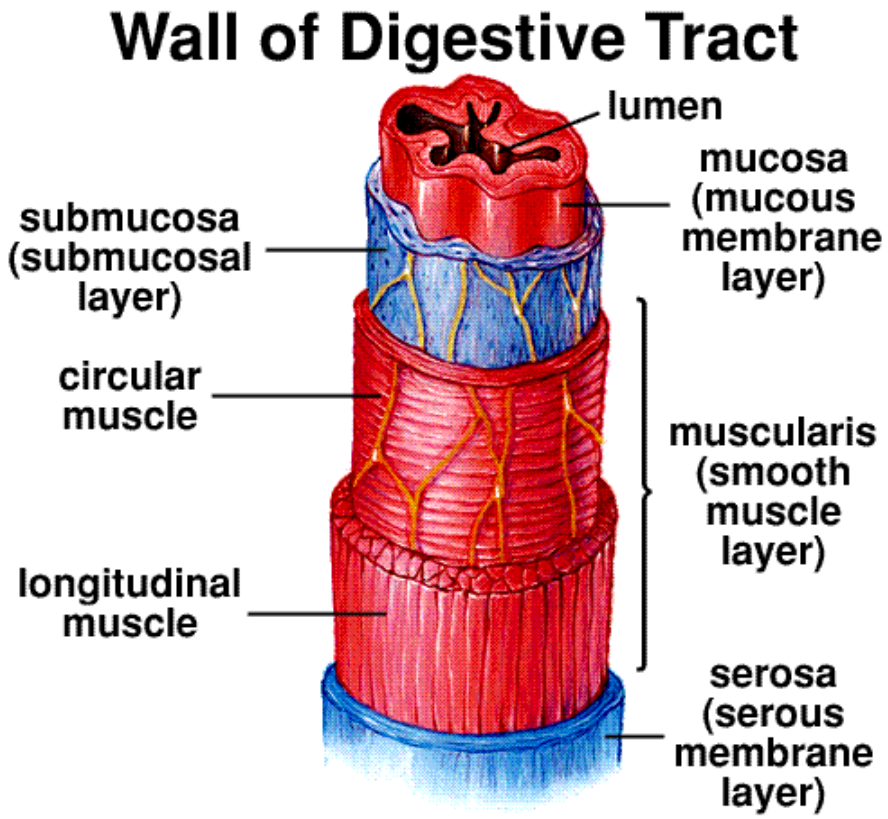


Fig 20: Wall of the human digestive tract

3.3 The process of digestion

Digestion of food starts in the mouth. Saliva is secreted by Salivary gland. It contains an enzyme called ptyalin. Ptyalin acts on cook starch converting it into complex sugars. It also helps to increase the surface area of the food substance.

Food passes down from the mouth through the gullet (oesophagus) into the stomach. In the stomach food is further broken down into smaller pieces by the action of enzymes mentioned above (c.f 3.2). Food is retained in the stomach for 3-4hours.

Food passes down from the stomach to small intestine where actual digestion, absorption and assimilation takes place by the action of some enzymes.

From the small intestine, undigested food passes into the large intestine. Here water is absorbed, these concentrate the waste product and makes them semi solid. In this state the waste product are called faeces. The faeces pass into the rectum and out of the body through the anus.

3.4 Nutrient absorption

Carbohydrates are enzymatically digested to form monosaccharides (glucose, fructose, and galactose). It is absorbed in small intestine by active transport or facilitated diffusion and enters the blood capillary in villi, then directed to *hepatic portal vein*

Proteins are enzymatically digested to amino acids or di- and tri-peptides, absorbed in SI by active transport or facilitated diffusion, enter blood capillaries in villi, then directed to hepatic portal vein

Lipids are enzymatically digested to short or long chain fatty acids; they are suspended in Small Intestine in form of micelles with bile salts, while inside the epithelial cells, lipids bound into chylomicrons for transport to *lacteal villi*; then into *lymphatics* and then to venous circulation.

SELF-ASSESSMENT EXERCISE 2

i. Describe the role of the saliva in digestion.
ii. Describe the absorption of lipids.

4.0 CONCLUSION

The digestive organs, tissues and enzymes are involved in the breaking down of ingested food in the alimentary canal into a form that can be absorbed and assimilated by the tissues of the body. Malfunctioning of any one of them will grossly affect the well being of an individual.

5.0 SUMMARY

In this unit we have learnt the:

- Definition of digestion.
- Organs involve in digestion.
- The enzymes that are involved in the digestion and absorption of nutrients.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the process of digestion.
2. What is the role of the liver in digestion and absorption?

ANSWERS TO SELF-ASSESSMENT EXERCISE

SELF-ASSESSMENT EXERCISE 1

i. Teeth, salivary glands, liver, gall bladder, and pancreas are the major accessory organs of digestion.
ii. Pyloric sphincter regulates entry of food into the duodenum.

SELF-ASSESSMENT EXERCISE 2

i. Role of the saliva in digestion: Saliva is secreted by Salivary gland. It helps to increase the surface area of the food substance.

   It contains an enzyme called ptyalin. Ptyalin acts on cook starch converting it into complex sugars.
ii. Description of the absorption of lipids: It is enzymatically digested to short or long chain fatty acids, it is suspended in Small Intestine in form of micelles with bile salts while inside epithelial cells, lipids bound into chylomicrons for transport to *lacteal villi*; then into *lymphatics* and then to venous circulation.

7.0 REFERENCES/FURTHER READINGS

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Oxford Concise Medical Dictionary.

Thibodeau GA and Patton KT (1996) Anatomy and Physiology, 3rd Ed, Mosby, 1996.

UNIT 2 RESPIRATORY SYSTEM

CONTENTS

1.0 INTRODUCTION

The Respiratory System is the combination of organs and tissues associated with breathing (gaseous exchange). It consists of a pair of lungs enclosed in the thorax and connected to the air outside by a series of branch air tubes (trachea, bronchi and bronchioles) and air pathways (nasal cavity, pharynx and larynx). The ribcage, intercostals muscles and diaphragm work together, to draw air into and out of the lungs.

2.0 OBJECTIVES

- Explain the respiratory process.
- Describe the types of respiration
- Explain the anatomy of the Respiratory system.
- Describe pulmonary ventilation.

3.0 MAIN CONTENT

3.1 Concept of Respiration

Respiration is the chemical breakdown of glucose accelerated by enzymes inside the body cells to liberate energy, carbon dioxide and water or alcohols is given off as waste products.

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + H_2O + 674Kcal$
Glucose Oxygen Carbon dioxide water Kinetic and heat

energy

Respiration can also be describe as

a) The intake and absorption of oxygen from the surrounding environment.
b) the transport of oxygen to individual cells of the body and
c) Using oxygen to release energy in the form of adenosine triphosphate (ATP).

System

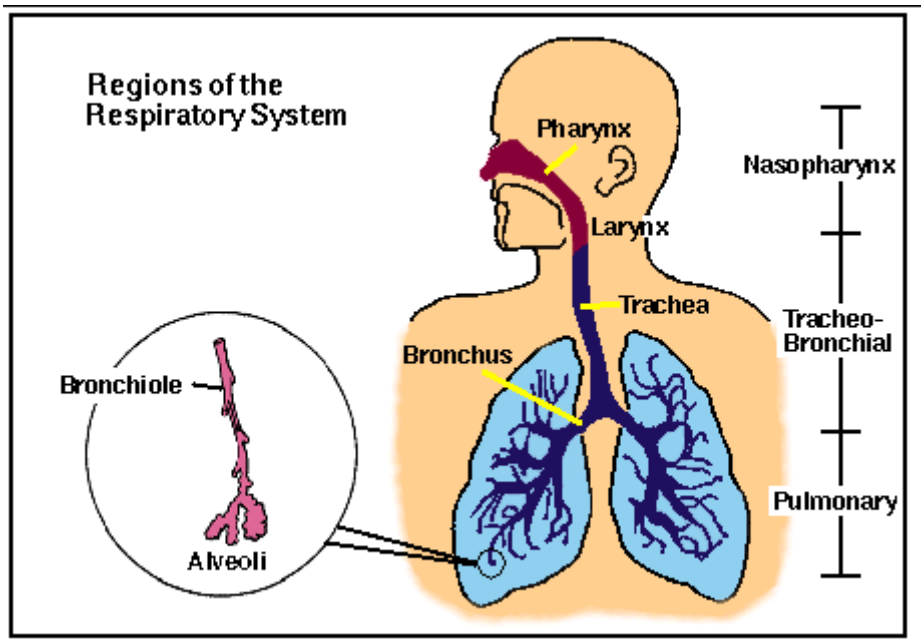

Fig 21:Regions of the Respiratory System
http://en.wikipedia.org/wiki/Respiratory.

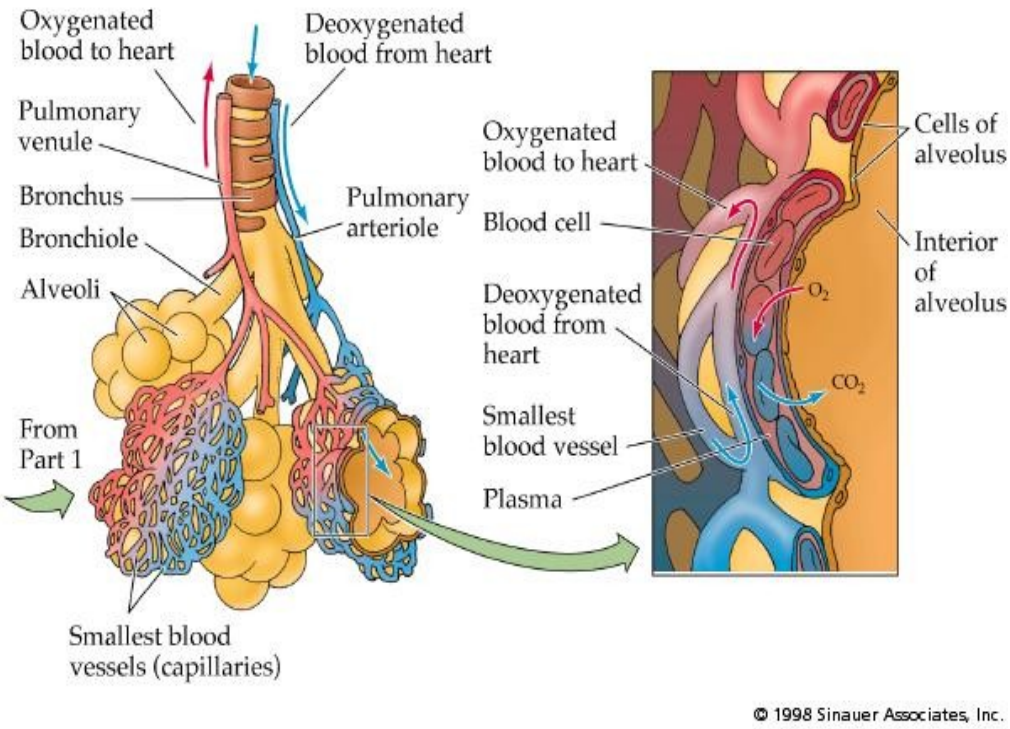

Fig 22: A cross section of the Alveoli and the Respiratory Process

3.2 Types of Respiration

1. Internal respiration
2. External respiration

Internal or Tissues Respiration

- Air (Oxygen) enters the body through the nostril where it is cleaned, moistened and heated to the body temperature and passes through: Trachea→ bronchi→ bronchioles→ alveoli. Internal respiration involves 2 breathing processes or mechanism. These are
    - **Inhalation or Inspiration**
    - **Exhalation or Expiration**
- In alveoli the oxygen combines with the haemoglobin in the red blood corpuscles to form oxyhaemoglobin. This is carried away in the pulmonary vein to the heart and then distributed to all parts of the body. When the blood reaches an active organ the oxyhaemoglobin dissociates again giving up its oxygen for respiration to produce energy.
- Carbon dioxide produced as one of the end products combines with sodium carbonates in the plasma to form bicarbonates.
- In the lungs the bicarbonates are broken down by the enzymes to liberate carbon dioxide.
- This diffuses into the alveoli and eventually expelled through the nostrils or the mouth.

SELF-ASSESSMENT EXERCISE 1

i. Internal respiration consists of ----------and----------.
ii. What is respiration?

3.3 Respiratory system anatomy

A) Upper Respiratory Tract (URT) (1) Para nasal structures like external nares, nasal cavity and septum, nasal conchae, nasal meatuses, olfactory epithelium, paranasal sinuses and ciliated pseudostratified epithelium (2) Pharynx: internal nares, auditory tubes, oropharynx and laryngopharynx

(B) Lower Respiratory Tract (LRT) (1), Larynx: thyroid & cricoid cartilage, vocal box and hyoid (2) trachea: Bronchi and other structures. (3) lungs (right lung = three lobes; left lung = two lobes),consists of pleural membranes, bronchi, bronchioles, terminal bronchioles, smooth muscles within bronchiole walls, alveolar ducts, alveolar sacs and alveoli.

3.4 Pulmonary ventilation

A) Inspiration: This process is influenced by Boyle's Law (air pressure in closed space inversely correlated with volume). Increase volume == decrease pressure; decrease volume == increase pressure.

Differences in air pressure between air and lungs drive the movement of air into/out of lungs. Normal inspiration is an active process.Inspiratory muscles involved are:
(a) Diaphragm (75% normal inspiratory action) .It is activated by phrenic nerve. (b) External intercostals (25% normal inspiratory action).It is activated by intercostal nerves. (c) Accessory muscles can also enhance inspiration. Examples are sternocleidomastoid and scalenes. Normal breathing ("eupnoea") consists of moving approx 0.5L (tidal volume) into/out of lungs. Not all air inspired actually enters lung because there is an anatomic "dead space" (approx 150ml) which includes URT and trachea & bronchi, only air within alveoli (approx 350ml) can exchange gases.

(B) Expiration: This is a passive process; it involves the relaxation of diaphragm and external intercostals. The ribs are depressed and diaphragm curves upwards. Expiration can become an active process by contraction of abdominals and internal intercostals. Major factors driving expiration are elastic recoil of lungs and

surface tension of alveolar fluid (lessened by surfactant) .These factors create high "compliance" that is ease of lung expansion. Low compliance results from pulmonary scarring, edema, surfactant deficiency (especially in premature babies).Compliance can become too high in conditions like emphysema.

(C) Intrapleural pressure: This is the pressure within the pleural cavity; it must stay approx 4mmHg LESS than intrapulmonary pressure. Any condition that equalizes Intrapleural and intrapulmonary pressures causes immediate lung collapse.

Certain terms associated with pulmonary ventilation include;

i) Dyspnea - painful difficult breathing (ii) Hypoxia - decrease oxygen delivery to tissues (iii)Hypercapnia - increase carbon dioxide levels in blood.

SELF-ASSESSMENT EXERCISE 2

i. The upper respiratory tract consists of ----------, ----------and----------.
ii. ---------- and---------- are inspiratory muscle involved in normal inspiration.

4.0 CONCLUSION

We can conclude this study by emphasizing that respiration is the exchange of gases (oxygen/carbon dioxide) from atmosphere between blood and tissues .It is made up of many physical and chemical processes.

5.0 SUMMARY

In this unit you have learnt the:

- Organs of the respiratory tract.
- The respiratory processes.
- Normal inspiration is an active process while expiration is a passive process.

6.0 TUTOR-MARKED ASSIGNMENT

1. Describe the process of tissue respiration.

2. List five organs of respiration.
3. What are the differences between inspiration and expiration?

ANSWERS TO SELF-ASSESSMENT EXERCISES

SELF-ASSESSMENT EXERCISE 1

i. Internal respiration consists of inhalation/inspiration and exhalation/expiration.
ii. Respiration is the chemical breakdown of glucose accelerated by enzymes inside the body cells to liberate energy, carbon dioxide and water or alcohols is given off as waste products.

SELF-ASSESSMENT EXERCISE 2

i. The upper respiratory tract consists of 1) Para nasal structures like external nares, nasal cavity and septum, nasal conchae, nasal meatuses, olfactory epithelium, paranasal sinuses and ciliated pseudostratified epithelium 2) Pharynx: internal nares, auditory tubes, oropharynx and laryngopharynx
ii. Diaphragm and External intercostals are muscles involved in normal inspiration.

7.0 REFERENCES/FURTHER READINGS

Martini FC, Ober WC, Garrison CW, Welch K and Hutchings RT (2001) Fundamentals of anatomy and Physiology, 5th Ed, Prentice-Hall, Inc, New Jersey.

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UNIT 3 THE CIRCULATORY SYSTEM

CONTENTS

1.0 INTRODUCTION

In this unit we will discuss how the composition of the interstitial fluid in tissues through out the body is kept stable through continuous exchange between the peripheral tissues and the blood stream. Blood can help to maintain homeostasis only if it stays in motion. Thus all the functions of the cardiovascular system ultimately depend on the heart which beats approximately 100,000 times each day, pumping roughly 8000 liters of blood.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- Describe the hierarchy of the vascular system.
- Describe Movement of materials across capillaries.
- Explain Blood Pressure.
- Describe the anatomy and the functions of the heart.

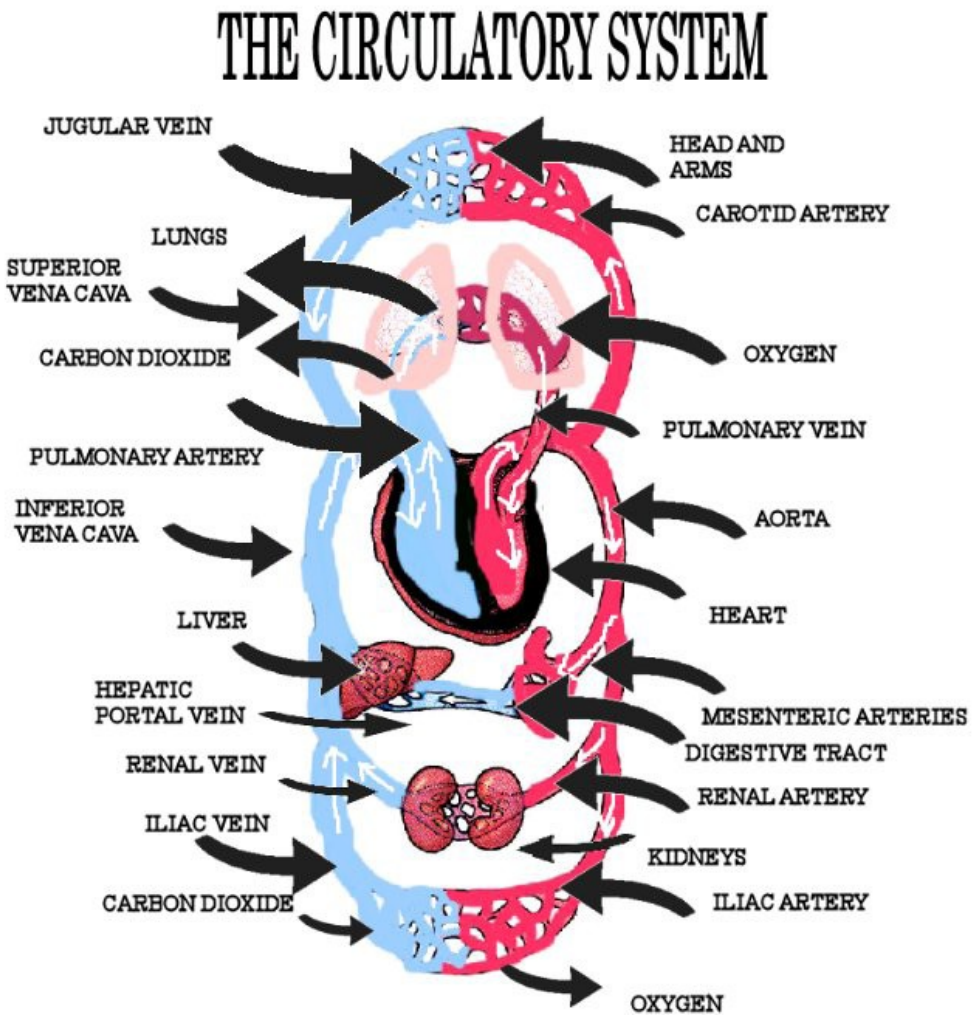

Fig 23: The Circulatory System
Source: http://en.wikipedia.org/wiki/circulatory system

3.0 MAIN CONTENT

3.1 Hierarchy of the Circulatory System

A) Arteries(1) outer coat (tunica externa) (2) middle coat (tunica media), usually thickest and it is made up of elastic fibers and smooth muscle which has sympathetic innervations.(3) Inner coat (tunica interna).It is made up of endothelium & basement membrane.(4) Large arteries (conducting) which have more elastic fibers. (5) Medium arteries (distributing) they have more smooth muscle, thicker and most vasodynamic. (6) Arterioles: regulate blood into capillaries

(B) Capillaries: These are endothelial site of nutrient/gas/waste exchange

(C) Venules and Veins: They have few smooth muscles

3.2 Movement of materials across capillaries

A) Diffusion: This is most important for solutes, it takes place through plasma membranes, fenestrations and clefts. It is concentration dependent.
B) Vesicular: This type of movement entails large hydrophilic molecules e.g. IgG.
C) Bulk flow: This regulates volume of plasma & interstitial fluid. Clinical implication of abnormal movement of Material across Capillaries is oedema.This is caused by: a) Increase venous flow b) cardiac failure c) poor circulation d) increase fluid uptake e) plasma protein loss (kidney disease) f) increase capillary permeability due to toxins

SELF-ASSESSMENT EXERCISE 1

i. ----------, ----------, and ---------- are the main hierarchy of the cardiovascular system.

ii. List the methods of the movement of materials across capillaries.

3.3 The human heart

This is a hollow muscular cone shaped organ, lying between the lungs, with pointed end directed downward, forward and to the left. It is about the size of a closed fist.

The normal functional capacity of the heart includes the following: (i) Approx. 100,000 heartbeats/day (ii) approx. 2,760,000,000 heartbeats/lifetime (iii) approx. 4,000 gallons (15,000 liters) blood pumped/day.

Blood that leaves the heart is called oxygenated blood because it contains oxygen.

Blood that comes back to the heart is called deoxygenated blood because it does not contain oxygen.

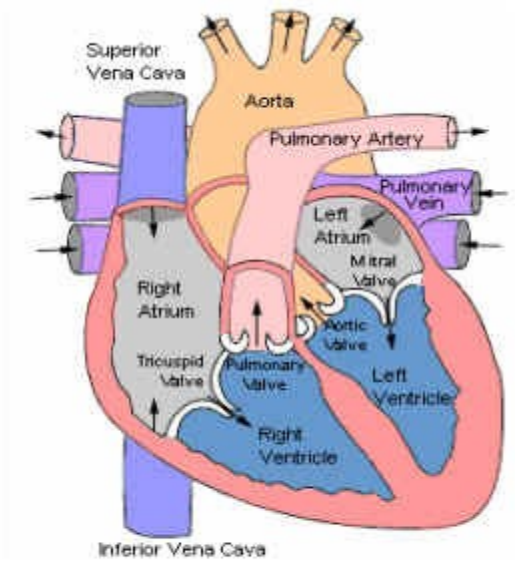

Figure 1: Diagram of the human heart showing the left and right ventricles along with the each of the four valves [HeartCenterOnline, 2002]

Fig 24: The Human Heart

Human heart works continuously throughout the life of a person. It weighs about 300grams. It is divided into four chambers. Two upper chambers, the left and right auricles (atria). Two lower chambers, the left and right ventricles. The chambers are separated by walls called septum. The walls are thick and muscular. The ventricles have thicker walls than the auricles to ensure that enough pressure is generated to pump the blood to the body and lungs. The left ventricle whose force of contraction pumps the blood to all parts of the body has the thickest wall compared to all other chambers.

3.4 Blood circulation within the heart

The contraction and relaxation of the heart to pump blood is called heartbeat.

At rest the average heart beat is about 70times per minute.

During exercise this rate goes up to over 100times thereby increasing the supply of oxygen that goes to the body cells.

a) Heart beats occurs in two stages. Systole and Diastole.
b) At systole, the two ventricles contract, while at diastole they both relax.
c) At systole deoxygenated blood enters right auricle (atrium) through the superior and anterior and inferior and posterior vena cavae.

d) Tricuspid valve is closed.
e) Right ventricles pumps deoxygenated blood to the lungs through pulmonary artery.
f) Oxygenated blood enters the left atrium from the lungs through the pulmonary veins.
g) Bicuspid valve is closed.
h) Left ventricle pumps oxygenated blood through semi- lunar valve and the aorta to the body.
i) Tricuspid and bicuspid valves auricles and ventricles (left and right) prevent back flow of blood into the auricles when the ventricles contract. Thick wall of left ventricles enables it pump blood with sufficient pressure around the body.
j) Ventricles relax at diastole.
k) Tricuspid and bicuspid valves open.
l) Deoxygenated blood enters the right ventricle from the right atrium.
m) Oxygenated blood enters the left ventricle from the left atrium.
n) Systole restarts when the ventricles are filled.

Circulation is divided into systemic and pulmonary circulation

Directions of blood circulation.

Blood from arteries → arteriole → capillaries
Venules → veins→ heart.

SELF-ASSESSMENT EXERCISE 2

i. ----------Blood enters the lungs through ---------- veins.

ii. Why are ventricles thicker than auricles?

4.0 CONCLUSION

We can see that all the functions of the cardiovascular system depend on the heart. The cardiovascular system is the most hardworking of all the systems in the body because unlike other systems its components do not rest. Not surprisingly, then, any substantial interruption or reduction on the flow of blood to this system has grave consequences: what we commonly call heart attack.

5.0 SUMMARY

In this unit we have learnt:

- The hierarchy of the vascular system.

- The Movement of materials across capillaries.
- The factors that affect Blood Pressure.
- The anatomy and the functions of the heart.

6.0 TUTOR-MARKED ASSIGNMENT

1. Describe the human heart.
2. List four causes of oedema.
3. Describe blood circulation within the heart.

ANSWERS TO SELF-ASSESSMENT EXERCISES

SELF-ASSESSMENT EXERCISE 1

i. Arteries, capillaries, venules and veins are the main hierarchy of the cardiovascular system.

ii. Methods of the movement of materials across capillaries diffusion and vesicular movement.

SELF-ASSESSMENT EXERCISE 2

i. Oxygenated blood enters the left atrium from the lungs through the pulmonary veins.

ii. The ventricles have thicker walls than the auricles to ensure that enough pressure is generated to pump the blood to the body and lungs. The left ventricle whose force of contraction pumps the blood to all parts of the body has the thickest wall compared to all other chambers.

7.0 REFERENCES/FURTHER READINGS

Martini FC, Ober WC, Garrison CW, Welch K and Hutchings RT (2001) Fundamentals of anatomy and Physiology, 5th Ed, Prentice-Hall, Inc, New Jersey.

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MODULE 4

Unit 1 The Immune System
Unit 2 The Urinary System
Unit 3 The Reproductive System

UNIT 1 THE IMMUNE SYSTEM

CONTENTS

1.0 INTRODUCTION

These are the organs responsible for the body's ability to resist infections afforded by the help of circulating antibodies and white blood cells (that was mentioned in the previous unit on hematology)

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- Describe the cells of the immune system.
- Define immunity and types of immunity
- Define transplant Immunology
- Describe autoimmunity and related conditions.

3.0 MAIN CONTENT

3.1 Cells of the immune system

Cells of the Immune System: (also covered in unit 4)

A) Leukocytes: 5-10,000cells/mm^3 in blood **B) Granulocytes**:

1) **Neutrophils** (50-70%); 3 day lifespan; major phagocyte & granulocyte; attracted by inflammatory factors and complement; granules with hydrolytic enzymes; cell dies after degranulation/phagocytosis
   a) **"Band"** is immature neutrophil (band-shape nucleus);
   b) **"Seg"** is mature neutrophil (segmented nucleus).
   c) **Neutrophilia**: increase percentage; common with acute bacterial infections
   d) **Neutropenia**: decrease percentage; common with anemias, viral infections, radiation/chemotherapy;

2) **Eosinophils** (2-4%); major anti-helminthes protection (**myelin basic protein** released); also contributes to some hypersensitivity reactions and phagocytosis of bacteria

3) **Basophils** (<1%); granulocytic, nonphagocytic; major inflammatory cell, releases histamines, proteases and granulocyte-attracting factors.

4) **Mast cells**; non-circulating, reside in connective tissues, similar function as basophils, initiate inflammatory reactions

B) **Monocytes** (2-8%); only last 8-12 hrs in circulation. then migrate to tissue = major function to become macrophage in tissue; play key role in "antigen presentation".

C) **Platelets** (240-400,000/mm^3); crucial to help activate blood clot formation; spleen acts as reserve site.

D) **Lymphocytes** (20-30%) mononuclear cells; mediate/regulate specific immune responses (antibody formation, anti- viral and anti-tumor protection)
   a) **B-cell**: produce immunoglobulins (mature in bone marrow)
   b) **T-cell**: activate/regulate B-cells, major immune regulatory cells (mature in thymus)
   c) **NK cell**: natural killer cell; non-specific anti-tumor cytolytic cell

3.2 Innate Immunity

Innate immunity is genetically determined. It is present at birth and has no relationship to previous exposures to the antigen involved .For example people do not get the same disease as fishes. Innate immunity

only breaks down in the case of AIDS or other conditions that depress all aspects of specific resistance.

SELF-ASSESSMENT EXERCISE 1

i. List the cells of the immune system.

ii. STATE TRUE OR FALSE: Innate immunity is genetically determined? Please explain your answers.

3.3 Types of specific immune response

Types of Specific Immune Response: Humoral and Cellular Immunity

A) Humoral Immunity

1) *Immunoglobulin* (Ig) production by activated B-cells

2) *Antigen (Ag)*: any molecule capable of eliciting a specific immune response

3) *Antigen presentation*: macrophage (or B-cell) ingests antigen, degrades into fragments, and re-expresses antigen fragments on surface in context of *major histocompatibility complex II (MHC class II)*. During this process, macrophage release *Interleukin 1*, a potent cytokine which acts as a *pyrogen* and activator of T-helper cells.

4) *T-helper (CD4+) cell* specific for that antigen binds to MHC-Ag using *T-cell receptor (TCR)* and is stimulated by binding and by Interleukin-1 released from antigen-presenting cell. This presentation usually occurs in lymph node or spleen. T-cell clone is activated, proliferates, and secretes *Interleukin-2* which enhances T-cell activation. B-cell bearing Ig specific for that antigen binds antigen, and presents it to T-cell in context of MHC-II. Binding of activated T-helper cell to B-cell and release of B-cell growth factors including *Interleukins 4 and 6* from T-cells activate B-cells to proliferated and produce more Ig.

5) *Clonal selection* of Ag-specific T-cell (with TCR) and B-cell (with Ig) provides specific immune response.

6) *Memory B- and T-cells* are also produced with ability to be activated easily upon 2nd exposure to Ag, provide long-term

"immune protection", allows for very large and rapid response to 2nd exposure (Secondary immune response)

7) *Immunoglobulins*: "Y" shape monomer, 2 *Ag-binding sites*, 1 "tail" region (Fc region), made of 2 *heavy chain* proteins, 2 *light chains* proteins, produced only by B-cells.The immunoglobulins include:
   a) *IgG:* most abundant Ig, long-lasting in serum, usually produced upon 2nd exposure to Ag, can cross placenta.
   b) *IgM:* 2nd most abundant Ig, pentamer, produced upon 1st exposure to Ag,
   c) *IgA:* most abundant Ig in secretions (saliva, tears and mucus)
   d) *IgE*: involved in allergic reactions by binding of mast cells & basophils and triggering to degranulate upon Ag exposure
   e) *IgD*: It is seen on resting B-cells, not seen in serum (<0.1%)

Neutralization: This is the binding of Ig to virus, toxins, bacteria to block activity or infectivity

Agglutination: clumping of cells by Ig binding, aids in phagocytosis

Opsinization = coating cell with Ig, enhances binding of macrophage by binding to the tail region of Ig (Fc region).

Precipitation: clumping of soluble molecules by Ig binding, aids in phagocytosis

Complement activation: Ig bound to cell surfaces activates complement cascade to attack targeted cell

B) Cellular Immunity

General Description: Specific anti-viral, anti-tumor immune response mediated by *cytolytic T-cells (CD8+)*. All normal cells express major histocompatibility complex I *(MHC-I)* (only antigen presenting cells express MHC-II) MHC-I is your molecular "ID card" and is used to present antigens produced within the cell (not brought in from outside). Virus-infected cells express viral antigens in context of MHC-I T-cytotoxic (CD8+) bearing TCR specific for a particular antigen bind to Ag/MHC-I on virus-infected cell and is activated T-cytotoxic cells release cytolytic molecules *(lymphotoxin, perforin*) to kill target cell. Activation of T-cytotoxic cells is enhanced by cytokines released by T-helper cells (IL-2, *gamma interferon*) T-cytotoxic cells also act against tumor cells in similar way; tumor cells express tumor-Ag in context of

MHC-I and become targets for T-cytotoxic cells. The immune system constantly checks all tissues for "altered cells" (foreign, virus-infected, tumors) in a process called *"immune surveillance*". The use (necessity) of expressing most antigens in the context of MHC (class I or II) to initiate an immune response is termed *"MHC Restriction"*.

3.4 Hypersensitivity Reactions

Hypersensitivity Reactions of Immune System

a) *Type I:* Anaphylactic Reactions (typical bee-sting or hay fever allergic responses)
b) *Type II:* Cytotoxic Reactions (as in mismatched ABO transfusion reaction)
c) *Type III:* Immune Complex Reactions (as in rheumatoid arthritis or in "serum sickness")
d) *Type IV*: Cell-mediated Reactions (seen with positive tuberculin (TB)-skin test reaction)

Autoimmunity

This is **"**Self/Non-self" discrimination (**self tolerance**) of immune system developed during thymic maturation. It consists of positive and negative selection processes. Autoimmunity can occur in the following conditions:

- Graves Disease
- Rheumatoid Arthritis
- Systemic lupus erythematosus (SLE)
- Myasthenia Gravis
- Insulin-dependant Diabetes: Auto-reactive T-cytotoxic cells destroy pancreatic beta-cells (the insulin producing cells).

SELF-ASSESSMENT EXERCISE 2

i. What are the two arms of specific immune response?
ii. List the four types of hypersensitive immune reactions of the immune system.

4.0 CONCLUSION

Cells of the immune system (Leucocytes and granulocytes) provide immunity that is resistance to injuries and diseases caused by foreign compounds, toxins or pathogens.

5.0 SUMMARY

In this unit we have learnt the cells of the immune system, immunity and types of immunity. We also discussed the various blood groups and their significance in blood-transfusion.

6.0 TUTOR-MARKED ASSIGNMENT

1. Explain the different hypersensitivity reactions of the immune system and give examples of each.
2. Describe autoimmunity and the conditions that can cause it.

ANSWER TO SELF-ASSESSMENT EXERCISES

SELF-ASSESSMENT EXERCISE 1

i. Cells of the immune system include the following:

- Neutrophils,
- Eosinophils
- Basophils,
- Mast cells
- Monocytes
- Platelets
- Lymphocytes

2) TRUE. Innate immunity is genetically determined. Explanation: It is present at birth and has no relationship to previous exposures to the antigen involved For example people do not get the same disease as fishes. Innate immunity only breaks down in the case of AIDS or other conditions that depress all aspects of specific resistance.

SELF-ASSESSMENT EXERCISE 2

i. The two arms of specific immune response are Humoral and Cellular Immunity

ii. The four types of hypersensitive immune reactions of the immune system are:
   a) Type I: Anaphylactic Reactions (typical bee-sting or hay fever allergic responses)
   b) Type II: Cytotoxic Reactions (as in mismatched ABO transfusion reaction)
   c) Type III: Immune Complex Reactions (as in rheumatoid arthritis or in "serum sickness")
   d) Type IV: Cell-mediated Reactions (seen with positive tuberculin (TB)-skin test reaction)

7.0 REFERENCES/FURTHER READINGS

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UNIT 2 URINARY SYSTEM

CONTENTS

1.0 INTRODUCTION

This is the entire system of ducts and channels that conduct urine from the kidneys to the exteriors .It includes the ureters, the bladder and the urethra. The main function of the Urinary System is to maintain homeostasis of blood composition, volume and pressure.

2.0 OBJECTIVES

At the end of this study, you should be able to:

- Discuss the overall Function of The Urinary System:
- Identify the Major Organs of the Urinary System and describe their Functions.
- Describe the mechanism of action of the urinary system.

3.0 MAIN CONTENT

3.1 The major organs of the urinary system

A) Kidneys
B) Ureters
C) Urinarybladder
D) Urethra

3.2 The structure and function of the kidney.

- Hilum –this is the entrance to renal sinus
- Renal pelvis – An expansion of the ureter, Calyces (major & minor)

– These are tubes emanating from renal pelvis. Inner medullary region – This contains renal columns and pyramids (site of nephrons)

- Outer cortex - forms the outer cover and renal columns.
- Renal columns –This is the portion of cortex extending between renal pyramids
- Renal pyramids – The number is approx 8-18 regions per kidney.

The major functions of the kidney include:

- Regulate blood volume and composition.
- Regulate blood pressure as it monitors renal blood pressure and the secretion of rennin.
- Regulate certain aspects of metabolism like gluconeogenesis.

SELF-ASSESSMENT EXERCISE 1

i. What are the three major functions of the kidneys?

ii. The four major organs of the urinary system are ----------, ----------, ---------- and ----------.

An overview of the Nephron

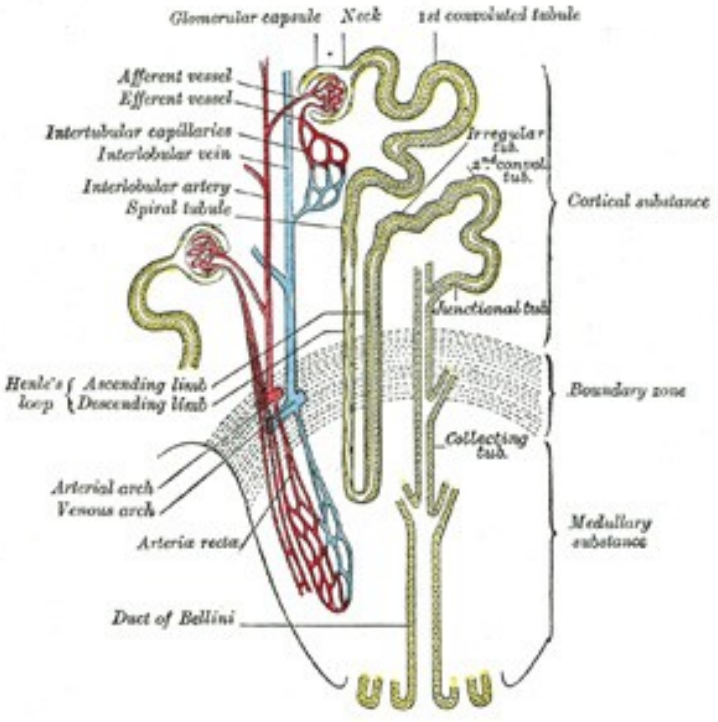

Fig 25:The Nephron of the human kidney
http://en.wikipedia.org/wik

There are two principle types of nephrons: Cortical nephron and Juxtamedullary nephron.

Each nephron has two major portions:

- renal corpuscle
- renal tubule.

The basic function of nephron is to filter blood and produce filtrate.

3.4 Filtrate Production

This is a three-step process:

1) Glomerular filtration
   - filters fluid and waste solutes out of blood

2) Tubular reabsorption
   - returns important solutes back to blood

3) Tubular secretion
   - selective secretion of more solutes into filtrate

One major factor affecting Glomerular Filtration Rate (GFR) is the Glomerular Hydrostatic Pressure (HPg) which is determined by the diameter of afferent/efferent arterioles. The major mechanisms regulating GFR are:

i) Renal autoregulation
ii) Hormonal regulation like aldosterone and ant diuretic hormone (ADH)
iii) Neuronal regulation

SELF-ASSESSMENT EXERCISE 2

i. What is the basic function of a nephron?
ii. Three steps of renal filtration are ----------, ----------, and ---------.

4.0 CONCLUSION

The kidney is very essential to life because it helps to get rid of substances that are toxic to the body and also helps to maintain homeostasis.

5.0 SUMMARY

In this unit we have learnt that the urinary system consists of the kidneys, the ureters, the urinary bladder and the urethra. The important role played by the neuron in the process of Glomerular filtration.

6.0 TUTOR-MARKED ASSIGNMENT

1. Describe the nephron
2. List three factors affecting glomerular filtration rate (GFR).

ANSWERS TO SELF-ASSESSMENT EXERCISES

SELF-ASSESSMENT EXERCISE 1

1. The major functions of the urinary system are is to maintain homeostasis of blood composition, volume and pressure.
2. The four major organs of the urinary system are Kidneys, Ureters, Urinary bladder and Urethra

SELF-ASSESSMENT EXERCISE B

i. The basic function of nephron is to filter blood and produce filtrate.

ii. Three steps of renal filtration are
- Glomerular filtration
- Tubular reabsorption
- Tubular secretion

7.0 REFERENCES/FURTHER READINGS

Martini FC, Ober WC, Garrison CW, Welch K and Hutchings RT (2001) Fundamentals of anatomy and Physiology, 5th Ed, Prentice-Hall, Inc, New Jersey.

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UNIT 3 REPRODUCTIVE SYSTEM

CONTENTS

1.0 INTRODUCTION

The reproductive system is the only system that is not essential to the life of the individual, although its activities do impact other systems. The system ensures the continuous existence of the human race. Sexually mature males and females produce individual reproductive cells that come together and produce new being.

2.0 OBJECTIVES

At the end of this unit, you should be able to:

- Explain reproduction
- Describe the mail reproductive organs
- Describe the female reproductive organs
- Describe the hormones involved in Reproduction.

3.0 MAIN CONTENT

3.1 Male reproductive organs

A) Testes: The structures include epididymis, straight tubules, ciliated rete testes, lobules and seminiforous tubules (2-3 per

lobule) which consists of the following:

- Leydig cells
- Sertoli cells
- Spermatogonia

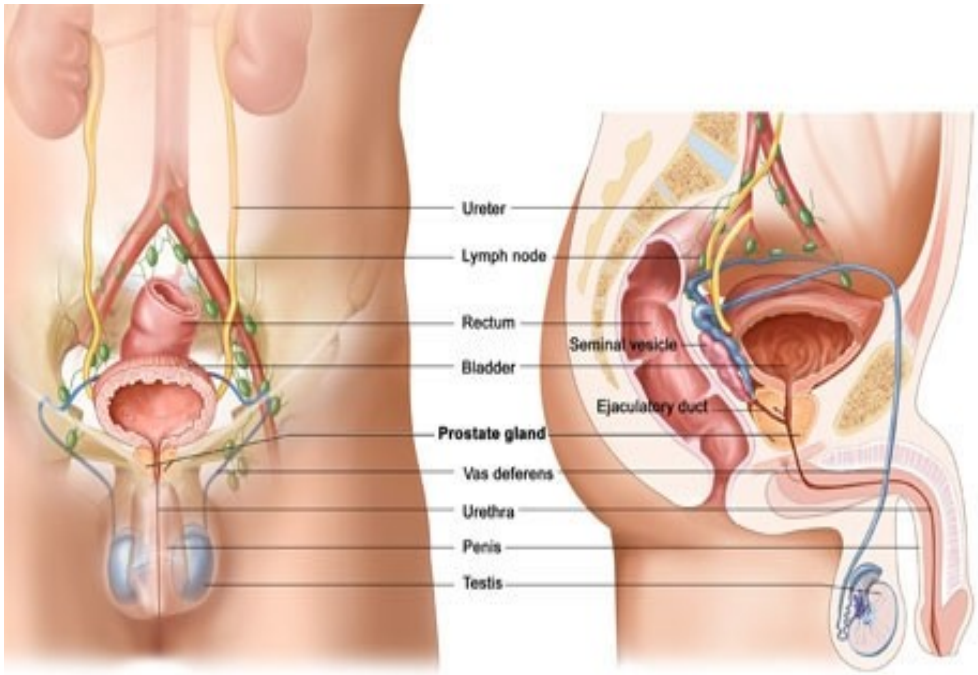

Fig 26: Male Reproductive Organs
Source: http://en.wikipedia.org/wiki/Reproductive

Other reproductive structures include:

- Vas deferens - muscular walls, propels spermatozoa towards urethra
- Seminal vesicle - contributes 60% seminal volume
- Prostate gland - contributes 25% of seminal volume
- Cowper's gland – produces mucus

Hormones of the male reproductive system include:

- Gonadotropin releasing hormone (GnRH) - triggers FSH & LH release from anterior pituitary.
- Follicle stimulating hormone (FSH) - triggers spermatogenesis, inhibin.
- Lutenizing hormone (LH) - stimulates testosterone secretion
- Testosterone - induces secondary male characteristics, stimulates late spermatogenesis steps.
- Androgen binding protein (ABP) - binds testosterone, concentrates it in seminal tubules

- Inhibin - inhibits FSH secretion (part of spermatogenesis negative feedback)

SELF-ASSESSMENT EXERCISE 1

i. Highlight the importance of the reproductive system
ii. What are the components of the testes?

3.2 Female reproductive organs

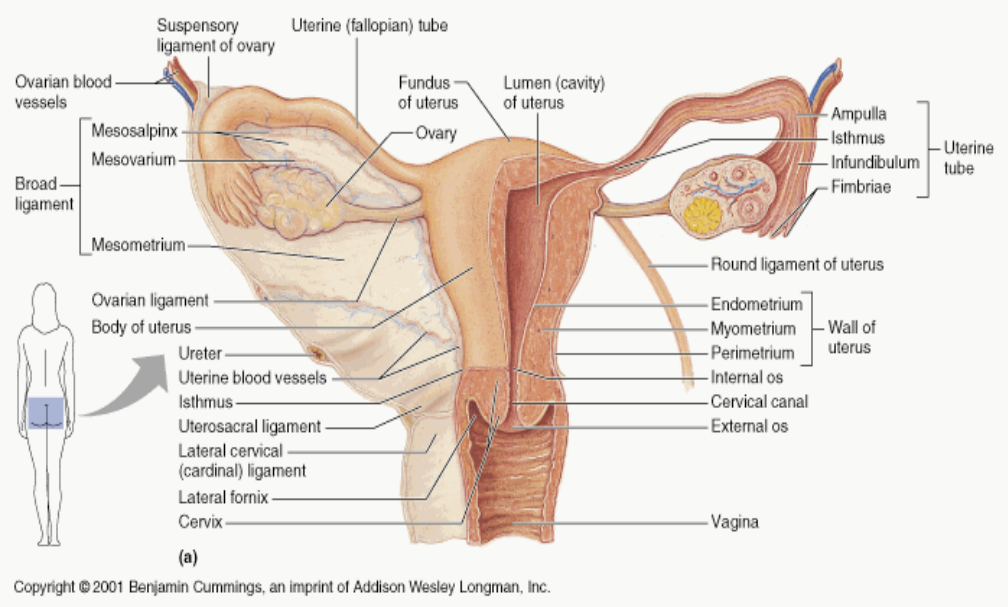

Fig 27: Female Reproductive Organs

- *Ovaries*: Produce oocytes and hormones: Oestrogens and Progesterone.
- *Uterine tubes*: Deliver oocytes or embryo to uterus; normal site of fertilization
- *Uterus*: Site of embryonic development and exchange between maternal and embryonic bloodstreams
- *Vagina*: Site of sperm deposition; acts as birth canal at delivery; provides passageway for fluids during menstruation
- *External genitalia* (Clitoris): Contains erectile tissue; produces pleasurable sensations during sexual activities
- *Labia*: Contain glands that lubricate entrance to vagina
- *Mammary glands*: Produce milk that nourishes newborn infant

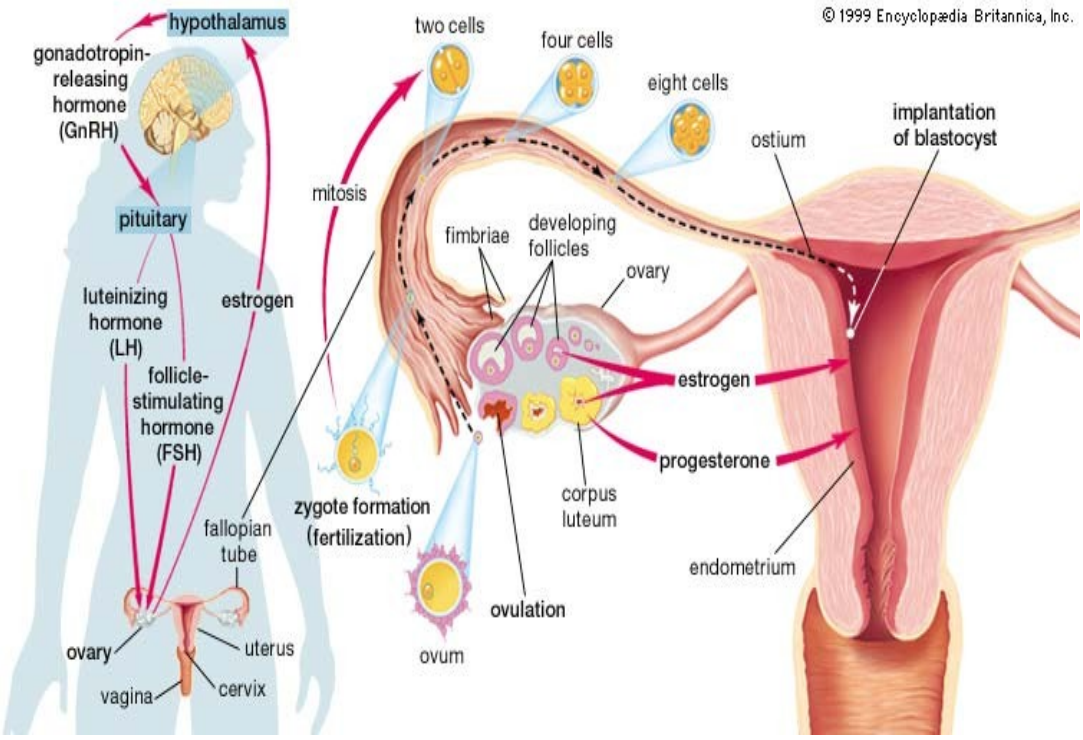

Fig 28: Female reproductive Hormones and their roles
Source: 1999 Encyclopedia Britannica, Inc

The reproductive process

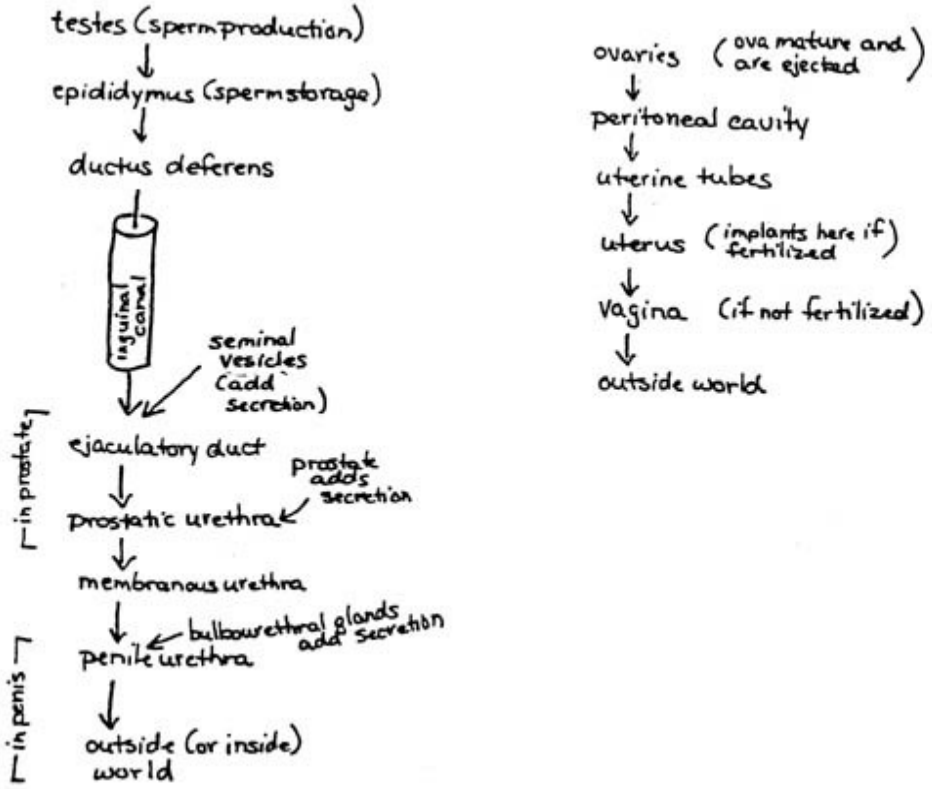

Fig 29: Illustration of the reproductive process
Source: www.relief/manual

SELF-ASSESSMENT EXERCISE 2

i. Name five parts of the female reproductive system.
ii. What is the role of the uterus?

4.0 CONCLUSION

The reproductive system, though not important to being alive, is very important for procreation**.**

5.0 SUMMARY

In this unit we have learnt that the Reproductive system is different for the male and female, the reproductive hormones are also different.

6.0 TUTOR-MARKED ASSIGNMENT

1. List four male reproductive hormones.
2. Describe the reproductive process.

ANSWERS TO SELF-ASSESSMENT EXERCISES

SELF-ASSESSMENT EXERCISE 1

i. The importance of the reproductive system includes ensuring the continuous existence of the human race. Sexually mature males and females produce individual reproductive cells that come together and produce new being.
ii. The components of the testes include epididymis, straight tubules, ciliated rete testes, lobules and seminiforous tubules.

SELF-ASSESSMENT EXERCISE 2

i. Five parts of the female reproductive system are ovaries, uterine tubes, uterus, vagina, external genitalia (Clitoris), labia and mammary glands.
ii. The uterus is the site of embryonic development and exchange between maternal and embryonic bloodstreams

7.0 REFERENCES/FURTHER READINGS

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