CHAPTER ONE

HISTORICAL PERSPECTIVE OF HEALTH

Biblical Foundations for Health

God created a perfect universe and gave man specific instructions including diet. The purpose and plan of God, from beginning of time, was for man to prosper and be in health even as his soul prospers (3John 1:2). This plan of God is affirmed by World Health Organization's (WHO) definition of health which is not just the absence of disease but the state of physical, mental, social and psychological well-being. Wholesomeness of spirit, soul and body is predicated by the fact that man was made in the image of God.

God has never been reported to be sick therefore, man is not expected to be in ill-health. It was not long before man rebelled and brought upon himself sickness/ill-health and death. The current situation of illness and disease, as experienced by mankind, came as a result of sin (Rom. 3:23). We may be restored to God's original plan of wholeness by divine intervention of God's promises (1Peter 1:4) if we use the road map to health as laid out in the holy scriptures (Proverbs 3:8; 4:22). Paying attention to divine guidance promises to give health to the flesh and strength to the bones. Man has been instructed that if he follows the

commandments, diseases will be removed from him. While our world will continue to wrestle with the realities of a fallen nature, those who adhere to biblically based health principles will minimize the effects of illness and disease. In general terms, scripture provides guidelines for diet and nutrition (Lev.15), community sanitation (Deut. 23:13), mental health (Prov. 17:22), just to mention a few.

The combination of the practice of sound health principles and belief in divine intervention places a person in a position of optimum health.

Life and the source of life

Life is very difficult to define. When you say life, what comes to mind is "God" or existence. In this case, we need to review what life is and the genesis of life. This aspect begins with the Christian view of life and health. It can also be viewed from the scientific perspective. In this case, we will look at the Biblical-Christian perspective and science.

From the Christian perspective, the Lord God formed man out of the dust of the ground and breathed into his nostrils the breath of life and man became a living being (Genesis 2:7).

Let us take a critical look at this verse (i.e. Gen. 2:7).The breath of life from God energized and quickened the life body into a vibrant and active life. This awakens the consciousness and enables individuals to express fully intrinsic value which God has endowed on human persons' consciousness so as to be able to recognize or react or respond to stimuli around them. The following signify life:

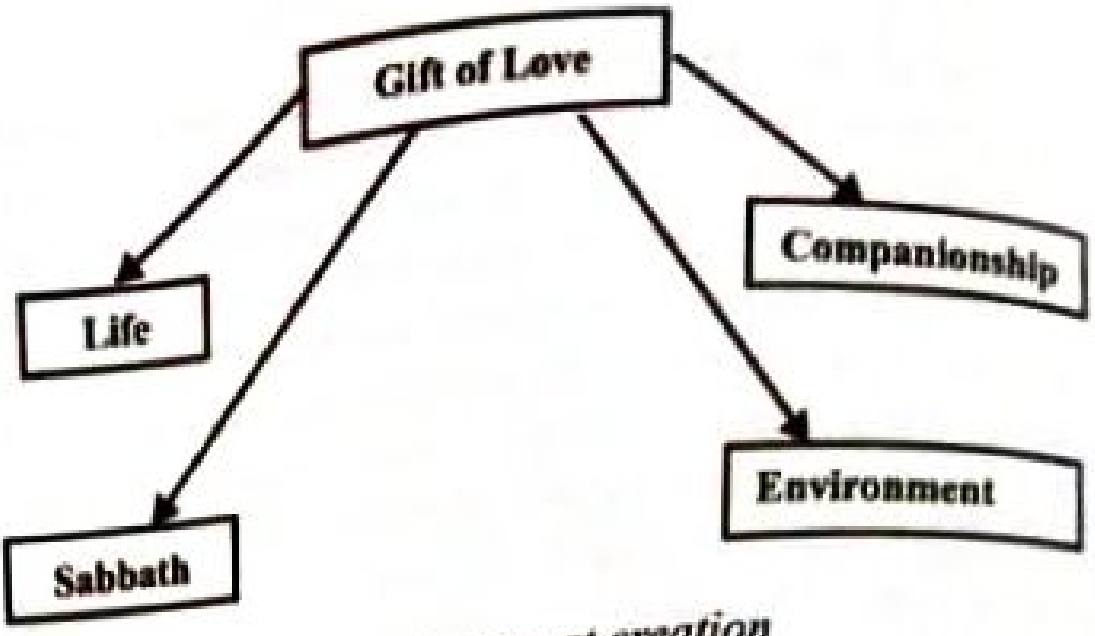
a. Breath
b. Movement
c. Speech

These factors are important but only speech distinguishes us from lower animals. We reason while lower animals have instinct–that is why they can run from danger. Therefore, man has a great perception of the use of the five senses i.e. sight, hearing, touch, smell and taste. They serve as a basis or avenue that shapes the cognitive faculty from which learning takes place. Through consciousness, learning begins, as well as reasoning and intellectual ability. Intrinsic knowledge acquired awakens and further expands consciousness. This is why learning and education are regarded as being very important to every human being as a right to life. Without life, there is no consciousness. As a matter of fact, life and health are linked together. In other words, only someone who is alive can be said to be healthy. God gave human beings four gifts when he created them:

a) Life
b) Companionship
c) Sabbath
d) Environment

All the four gifts are meant for human beings to enjoy. These gifts constitute the framework for which human beings exist and have total experience. Through the gift of life, human beings can enjoy companionship, the Sabbath and the environment.

All these were gifts of love for mankind to maintain and enjoy perfect health.



Gifts given to man at creation

Life

In Genesis 1:27 and 28, it was stated that God created man in His image, in the image of God created him; male and female created He them. And God blessed them and God said to them, "Be fruitful and multiply and replenish the earth and subdue it: and have dominion over the fish of the sea and over the fowl of the air and over every living thing that moves upon the earth." This indicates that the creation of human beings was not by accident but a deliberate act of the divine Godhead. The creation of male and female was the crowning glory of creation because God said everything He created was good, man and woman inclusive.

Companionship

And God made Adam a help meet (Genesis 2:18). 'Meet' in this sentence signifies a helper. Man can never be superior to woman because they were made to complement each other. The power of creation was transferred to man in form of procreation.

Sabbath

Sabbath means "rest." Because God had rested upon the Sabbath, "God blessed the seventh day, and sanctified it," –set it apart to a holy use. He gave it to man as a day of rest. It was a memorial of the work of creation, and thus a sign of God's power and His love. Sabbath helps man to look back at his origin which is God and the power of choice. By choosing God we are connected. By not choosing God, we are disconnected. The Bible says, *"Remember the Sabbath day, to keep it holy." "The seventh day is the Sabbath of the Lord thy God." "For in six days the Lord made heaven and earth, the sea, and all that in them is, and rested the seventh day: wherefore the Lord blessed the Sabbath day, and hallowed it"* (Exodus 20: 8-11). When we look on the sun and the stars, the trees and the beautiful flowers, we should remember that Christ made them all. And He made the Sabbath to help us keep in mind His love and power.

Environment

Environment has to do with ecology. Environment is one's surrounding or the air, water and land in or on which people, animals, and plants live while ecology is the relationship between the air, land, water, animals, plants and so on. We need to keep our environment clean so as to avoid health hazards.

THE MEANING AND DIMENSIONS OF HEALTH

WHO defined health as "a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity (WHO, 1974).

But this definition has received a lot of criticism over the years. This definition has been criticized that health

cannot be defined as a "state" but must be seen as a continuous adjustment to changing situations of life.

Limitations of WHO definition of health

- Health is dynamic and not a state.
- The dimensions are inadequate.
- The definition is subjective.
- Measurement is difficult.
- The definition is too ideal and not realistic.
- Health is not an end in itself but a means to an end.

Other definitions of health can also be given as a state of being well and free from all body illnesses. This implies that the body may not function well, if the system is bad. For example, fever, cancer and high blood pressure, show defects in the body system and will not allow the body to function well. This is best illustrated by the immune system. Every human being is prone to having disease which is predictable as this is part of human experience, what matters most is how to cope with it.

Nine Images of Health

These images explain the complexity of health and how they are related.

1. Health as an antithesis of disease: This means that health is the opposite of disease. When a person is sick in a society, (s)he is said to be unhealthy.
2. Health as a Balance of state: Yin and Yan, if not balanced, then health is not in a balanced state.
3. Health as Goodness of Fit: Being fit physically. i.e. frequency, intensity and time.
4. Health as Functionality: This is the ability to perform a given task at the right time.

5. Health as Growth: The right development of the human body at each stage of life.
6. Health as Wholeness: Totality of man. Holistic nature of health is central to healing.
7. Health as a Sense of well-being: Thought to include level of happiness.
8. Health as Transcendence: Growth and development are limitless.
9. Health as Empowerment: Enabling people to exert control over the determinants of health.

Dimensions of Health

1. Physical Dimension – Perfect functioning of the body.
2. Mental Dimension – Good mental health is the ability to respond to the many varied experiences of life and to adjust to them.
3. Social Dimension – This has to do with the relationship between individuals. It has to do with the level of social skills one possesses, social functioning and the ability to see oneself as a member of a larger society.
4. Spiritual Dimension – It is that part of the individual which reaches out and strives for meaning and purpose in life.
5. Emotional Dimension – Mental health has to do with knowing or cognition while emotional health relates to feeling.

Relationship between Health and Disease

Modern sciences and technologies have not really had hundred percent impact on diseases and poverty. Every second, minute, hour, day, week, month and year, human beings are threatened by different types of diseases that affect

the well-being of mankind. Sometimes it could be in the form of an outbreak (epidemic) that may affect individuals or the whole population consequently causing death. Hence, the world is battling with HIV/AIDS and hunger. These are common in Africa and Asia. It has been observed that some of these diseases are caused by our social environment, industrialization, urbanization, etc. Individuals, organizations, and non-governmental organizations (NGOs) are all trying to see that they create awareness so that everyone will have a healthy life.

Behavior means action and inaction, performed or observed by man, evoked or provoked by underlying, circumstances.

Behavior can include feelings, attitude, thoughts and other mental processes as well as all internal events which cannot be observed directly.

All behaviors are health-related; they can be enhanced or de-enhanced. Behaviors affect our health. When a person consumes foods that are high in sodium, there is an increased risk of high blood pressure. Therefore, behavior serves as a guide in health principles.

- ***Health–Enhancing Behavior*:** They are behaviors that prevent diseases, decrease morbidities, improve the quality of life, and decrease healthcare costs. Health enhancing behaviors include the following:

1. *Preventive health behavior*–Any activity undertaken by an individual who believes himself to be healthy, for the purpose of preventing illness and attaining an even greater level of health.
2. *Illness behavior* – any activity undertaken by an individual who perceives himself to be ill-geared

toward defining the state of his heath and to discover a suitable remedy. This may be regarded as health-seeking and may include visit to the hospital for check-up and diagnosis.

3. *Sick-role behavior* –Any activity undertaken by an individual who considers himself to be sick for the purpose of getting well. It includes receiving treatment from appropriate therapists.

Good health can be enhanced by the following:

- Good nutrition which should comprise 70% fruits and vegetables
- Exercise
- Balanced diet
- Water (4-6 sachet of water daily is recommended)
- Rest
- Keeping the skin clean

❖ ***Health–Depleting Behaviors***

The under listed behaviors are detrimental to human health:

- Consumption of alcohol
- Smoking
- Unwholesome entertainment
- Watching television all hours of the morning
- Going to disco parties
- Eating in- between meals.

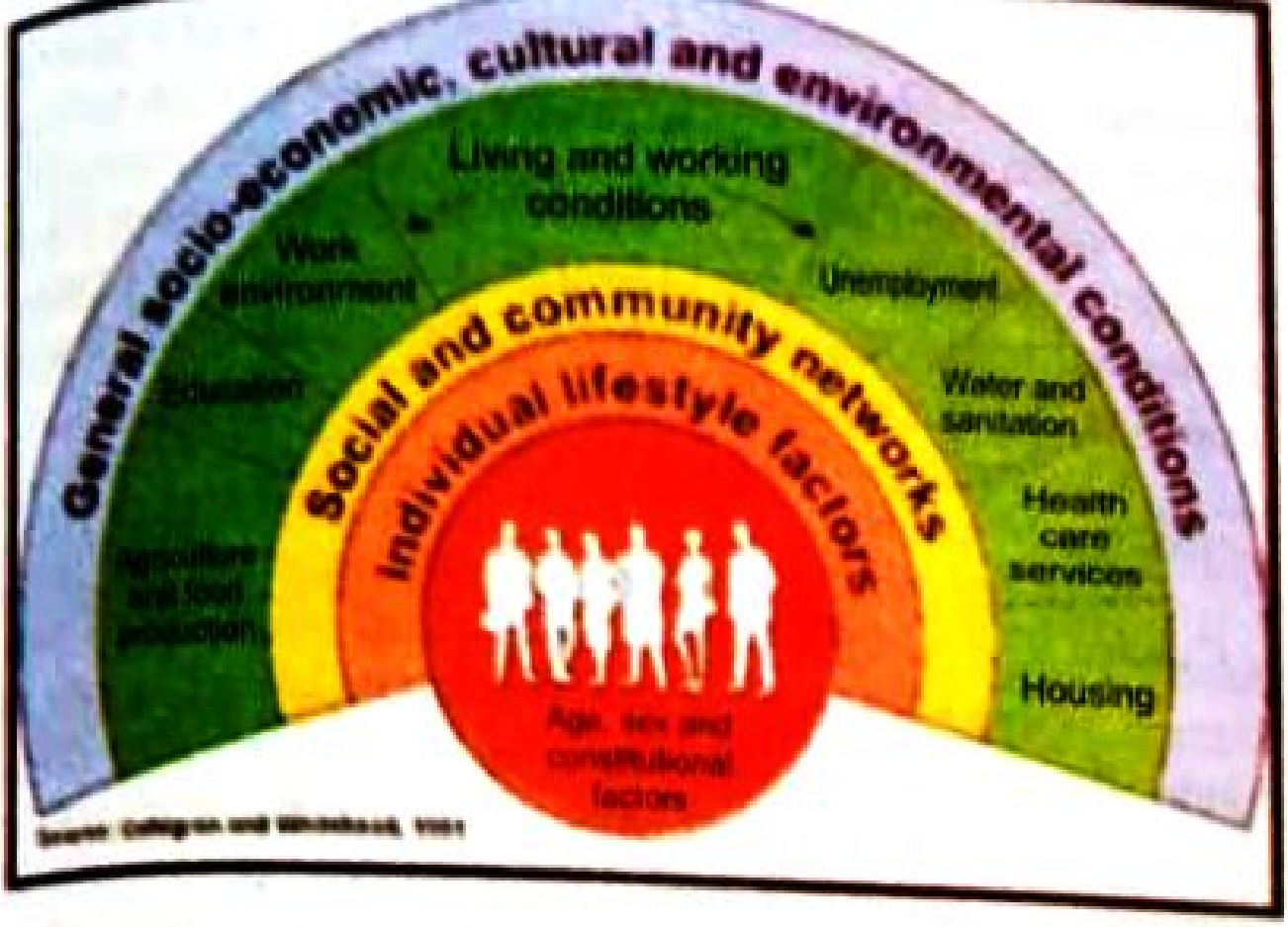
CHAPTER TWO

DETERMINANTS OF HEALTH

The range of personal, social, economic, and environmental factors that influence health status of individuals and communities are known as determinants of health. It is the inter-relationship among these factors that determines individual and population health. Because of this, interventions that target multiple determinants of health are most likely to be effective. Determinants of health reach beyond the boundaries of traditional health care and public health sectors; sectors such as education, housing, transportation, agriculture, and environment can be important allies in improving population health.

The determinants of health include

- Biology and genetics
- Gender
- Physical environment
- Social factors
- Health services
- Individual lifestyle or behavioral factors



Biology and Genetics

Inheritance plays a part in determining lifespan, healthiness and the likelihood of developing certain illnesses. Some biological and genetic factors affect specific populations more than others. For example, older adults are biologically prone to being in poorer health than adolescents due to the physical and cognitive effects of aging.

The physical and mental traits of every human being are, to some extent, determined by the nature of his genes at the moment of conception. The genetic make-up is unique in that it cannot be altered after conception. A number of diseases are now known to be of genetic origin, e.g. chromosomal anomalies, mental retardation, some types of diabetes, etc.

Sickle cell disease is a common example of a genetic determinant of health. Sickle cell is a condition that people inherit when both parents carry the gene for sickle cell. The gene is most common in people with ancestors from West African countries, Mediterranean countries, South or Central American countries, Caribbean Islands, India, and Saudi Arabia.

Gender

Gender refers to societal determined roles, attitudes, behaviors and values that are associated with males and females. Many health issues can be attributed to disparities in gender-based status. Females, for example, are more vulnerable to physical violence, low income and single parenthood. Males are more likely to die prematurely of certain diseases compared to females. Gender inequalities and gender bias addressed both within and outside the health system can improve population health.

Physical Environment

Environment is classified as "internal" and "external." The internal environment of man pertains to "each component part, every tissue, organ and organ-system and their harmonious functioning within the system." The external environment is defined as "all that which is external to the individual human host." It can be divided into physical, biological and psychosocial components, all of which can affect the health of man and his susceptibility to illness. Poor health outcomes are often made worse by the interaction between individuals and their social and physical environment. Safe water and clean air, healthy workplaces, safe houses, communities and roads all contribute to good health.

Studies indicate that geographic (e.g. natural and built environment) and social (e.g. civic life and cohesion) factors can contribute towards promoting good health. There are indications that certain community characteristics may play a role in differences in health status among similarly disadvantaged groups. Several physical characteristics such as the availability of open spaces, as well as social characteristics of the community such as community organizations, can possibly influence people's health.

Social determinants

The social determinants of health are the circumstances in which people are born; grow up, live, work and age, as well as the systems put in place to deal with illness. These circumstances are in turn shaped by a wider set of forces: economics, social policies and politics. They impact a wide range of health, functioning, and quality-of-life outcomes. Examples of these social determinants include:

- Availability of resources to meet daily needs, such as educational and job opportunities, living wages, or healthful foods – higher income and social status are linked to better health. The greater the gap between the richest and poorest people, the greater the differences in health.
- Education –Health status improves with education level. People with low education levels are more likely to be unemployed and poor, and suffer from poorer health than those with high levels of education. There are more opportunities for employment and higher income with higher education. Education

provides people with knowledge and skills to tackle issues and helps provide a sense of control and mastery over life situations. It enables people to access and understand information in order to be healthy.

- Occupation – Employment and working conditions also contribute to the health status of individuals. People in employment are healthier, particularly those who have more control over their working conditions. The unemployed usually show a higher incidence of ill-health and death. For many, loss of work may mean loss of income and status. It can cause psychological and social damage.
- Social norms and attitudes – The health of members of some ethnic or cultural groups can be vulnerable because of cultural differences and risk factors. Some persons or groups may face health risks due to lower socio-economic conditions and lack of access to culturally appropriate health care and services.

Health Services

Access and use of services that prevent and treat disease influence health. Lack of access, or limited access, to health service greatly impacts an individual's health status. For example, when individuals do not have health insurance, they are less likely to participate in preventive care and are more likely to delay medical treatment. Barriers to accessing health services include:

- Non-availability of health services
- High cost of treatment
- Poor social amenities
- Limited language access

- Inadequate supply of drugs, vaccines and other medical supplies
- Poor communication system
- Lack of good referral systems

These barriers to accessing health services lead to:

- Unmet health needs
- Delays in receiving appropriate care
- Inability to get preventive services
- Hospitalizations that could have been prevented

Individual lifestyle or behavioral factors

Personal health behavior refers to those actions taken by individuals that can either prevent or contribute to diseases. Personal behavior and coping skills, i.e. balanced eating, keeping active, smoking, drinking, and how we deal with life's stresses and challenges all affect health. People make a number of choices about what and how much they drink, smoke and eat. For example, some people choose to wear helmets while riding bicycles while others do not. It is being recognized that personal behaviors are influenced by several social, economic and environmental factors.

Examples of individual lifestyle determinants include:

- Diet
- Physical activity
- Alcohol, tobacco, cigarette and other drug use
- Handwashing

CHAPTER THREE

HUMAN ANATOMY AND PHYSIOLOGY INTRODUCTION

Organization and functions of the biological system

Living things are highly organized and structured into a hierarchy of different components and according to their functions. This Chapter identifies and describes the levels of organization in organisms, from the cell which is the basic unit of structure and function of all living things to the organ-system. The description of the functions of the cells for each organ-system will include the cellular processes that sustain life processes and the role of oxygen and food. The organization of organisms in the biological system is as follows from the simplest to the most complex.

- **Atom:** This is the smallest particle of an element that takes part in chemical reaction and retains the properties of that element. Atom is made up of small particles called electrons, protons and neutrons.
- **Molecules:** Several atoms interact to form molecules. The combination of two or more atoms, e.g. $H_2 + O = H_2O$; which is two atoms of hydrogen + one atom of oxygen, interact to form macromolecules. Such

macromolecules include enzymes like Deoxyribonucleic acid (DNA) – the genetic material of the cell.

- **Cell:** This is the basic unit of structure and function of all living things.
- **Tissue:** This is a collection of cells that are similar in structure and function working together to perform specific tasks. There are four types of tissues in humans. They are: Epithelial, Connective, Muscle and Nervous tissues.
- **Organ:** This is a structure that is composed of two or more tissues carrying out specific functions within the body. E.g. liver, kidney.
- **Organ-system:** This structure is composed of two or more organs working together to perform specific tasks within the body. E.g. Digestive system, Respiratory system.
- **Organism:** This is a member of a species and describes the overall form and function of that species. An organism can be:

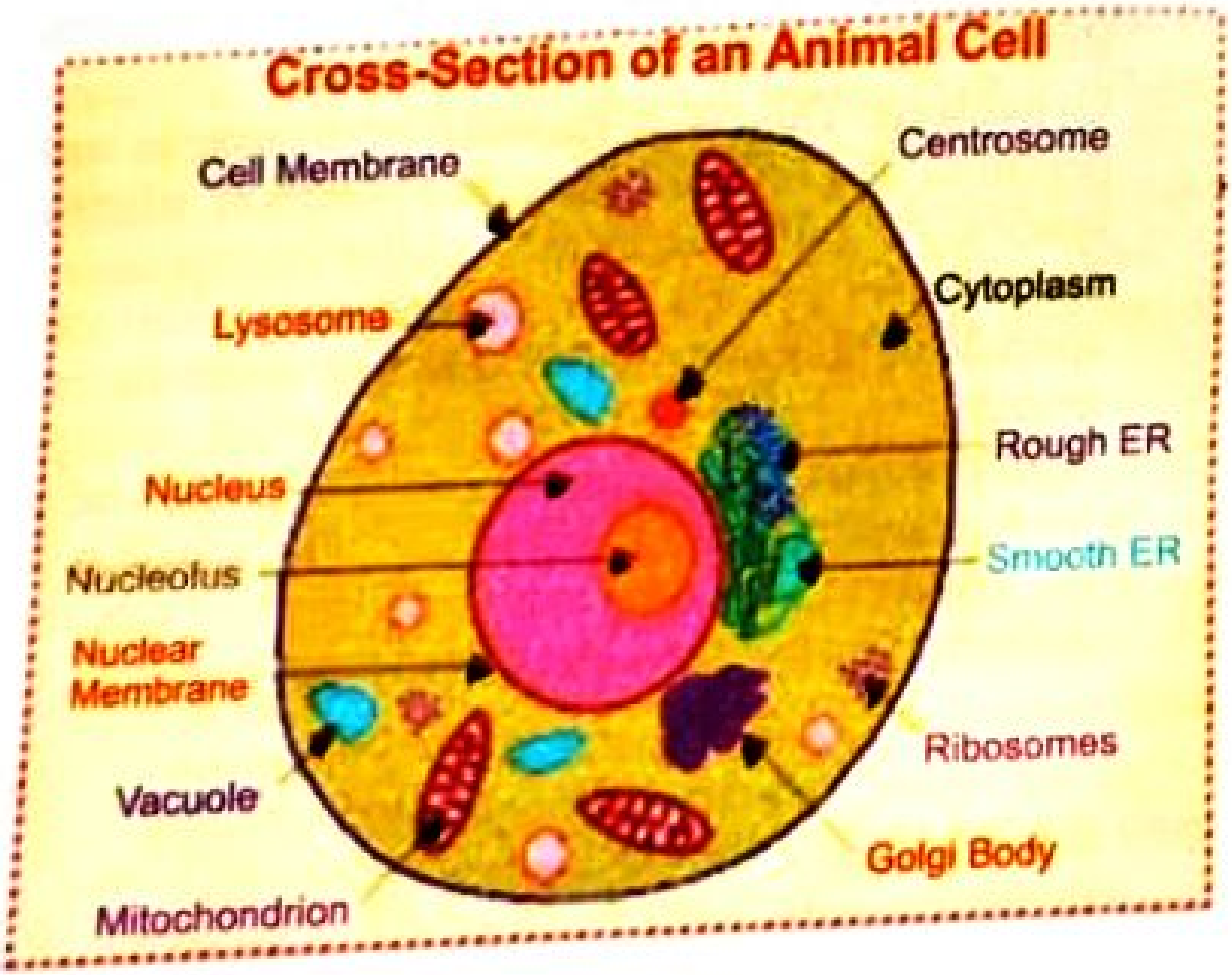
(I) ***Unicellular:*** i.e. has a single cell and carries out specialized functions within that single cell e.g. an amoeba.

(ii) ***Multicellular:*** is composed of multiple cells and is more complex than a unicellular organism e.g. a rat. Different cells in a multicellular organism are differentiated and have specialized functions.

THE CELL

The cell was discovered by Robert Hooke in 1665 Matthias Jakob Schleiden and Theodore Schwann first developed the cell theory in 1839 which states that all organisms are composed of one or more cells, all cells come from preexisting cells, vital functions of an organism occur within cells, and all cells contain the hereditary information necessary for regulating cell functions and for transmitting information to the next generation of cells.

The human body is composed of trillions of cells which are divided into about 200 different types. Our muscles, liver, blood and every part of our bodies are made of cells. They provide structure for the body, take in nutrients from food, convert those nutrients into energy, and carry out specialized functions.



The cell is the building block of life because it is the smallest unit of life that is classified as a living thing. Cells are the basic structural, functional and biological unit of all known living organisms. Cells have many parts called organelles, with each having different functions.

Table 1: Functions of Organelles

Organelle	Function
Plasma membrane	Covers the mammalian cell. It is referred to as gatekeeper because it separates the inner environment from the external environment.
Cytosol	This is the viscous fluid content of the cell in which other organelles are suspended.
Mitochondria	This is the power house of the cell because it generates energy in form of Adenosine Triphosphate (ATP).
Smooth endoplasmic reticulum	Synthesizes lipids and steroid hormones
Rough endoplasmic reticulum	Synthesizes proteins that are exported from the cells, i.e. enzymes and hormones that pass out of their parent cell to be used by other cells in the body
Golgi apparatus	Synthesizes exported proteins from the endoplasmic reticulum
Lysosomes	They contain powerful enzymes that digest bacteria and other substances that become engulfed by the cell.

Types of cells

There are two distinct types of cells with structural differences.

a. Prokaryotes – Bacteria
b. Eukaryotes – Animals, Plants

TISSUES OF THE HUMAN BODY

A tissue is a group of cells that have similar shapes and functions. Different organs have different types of tissues.

Types of Tissues

In humans, there are four types of tissues namely epithelial, muscle, connective and nervous tissues.

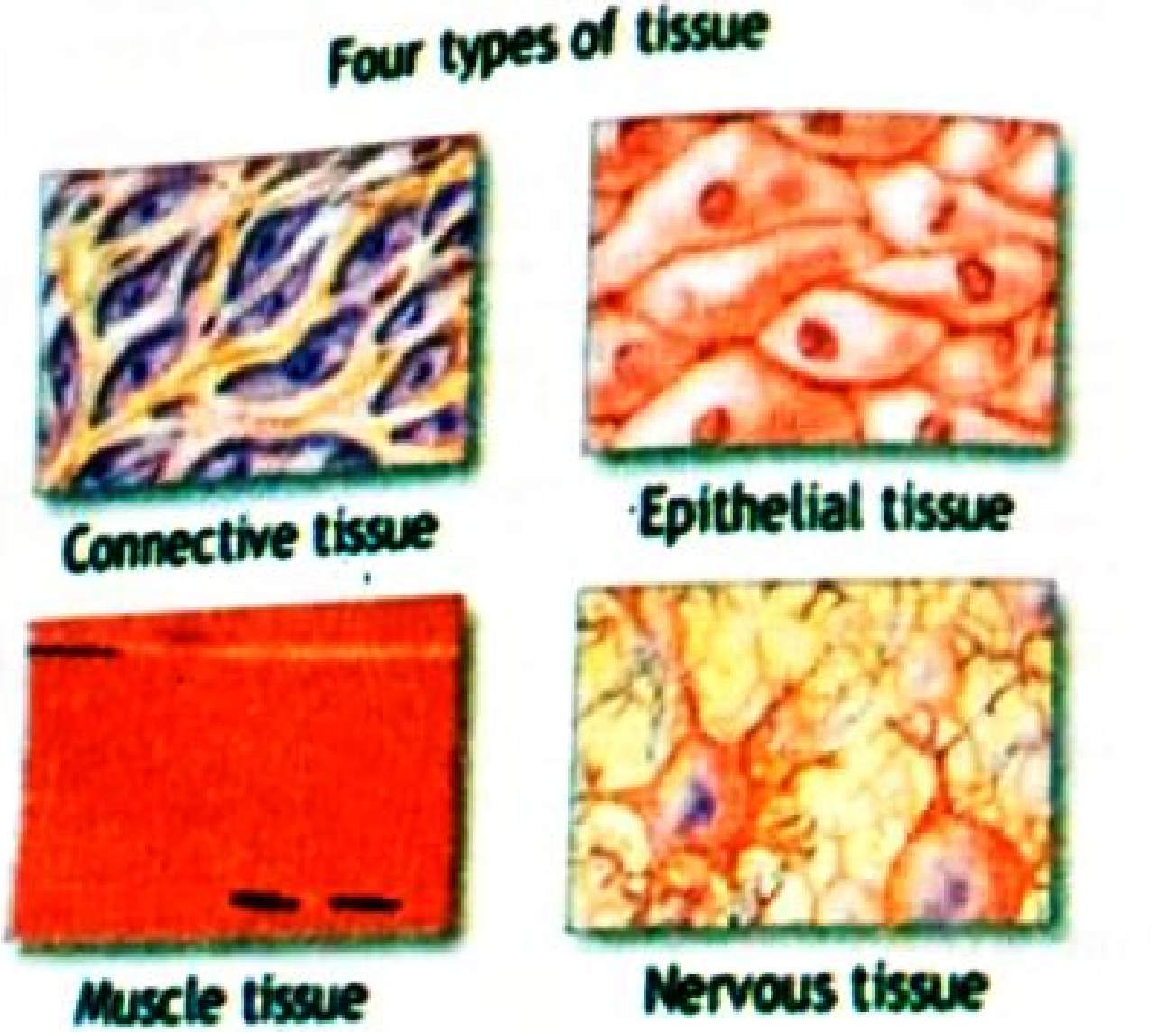


Table 2: Tissues and their functions

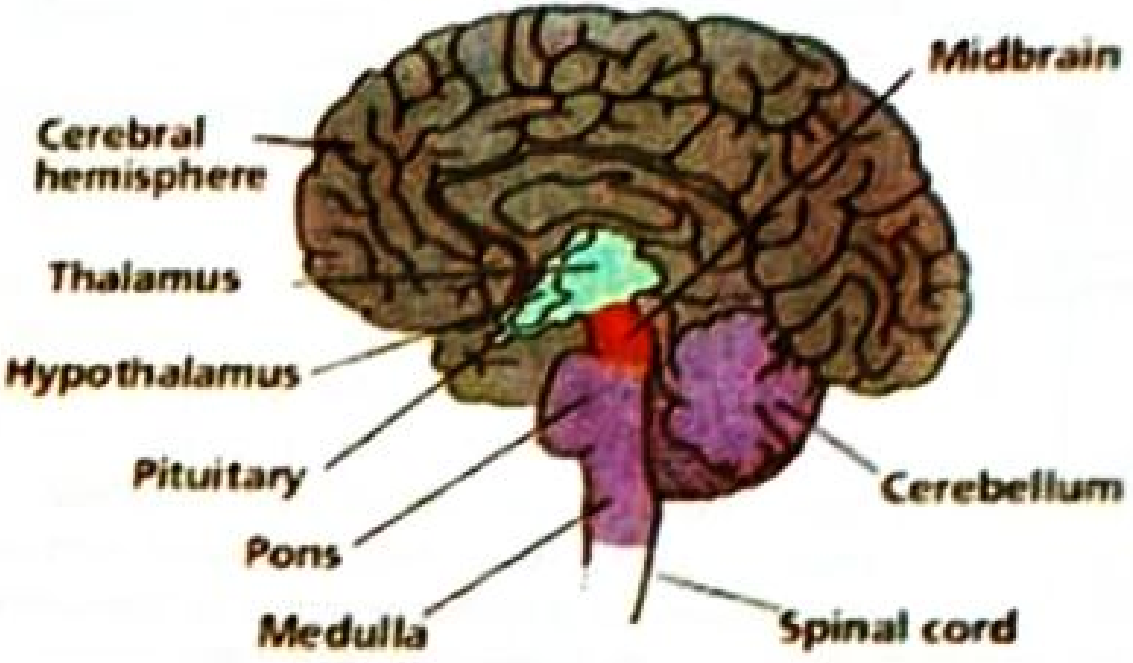
Tissue	Function
Epithelial	Act as protective linings and coverings. In some locales, absorption and secretion are important functions of these lining and covering cells. As secretory cells, epithelial form most glandular structures of the body. The skin is an organ made up of epithelial tissue which protects the body from dirt, dust, bacteria and other microbes that may be harmful.
Connective	Serve as connective and supportive tissues that bind and hold body structures together. Specialized fluid connective tissue types serve as liquid media important in transport, exchange, and body defense . The following tissues are found in the human body: ordinary loose connective tissue, fat tissue, dense fibrous tissue, cartilage, bone, blood, and lymph, which are all considered connective tissues.
Muscle	Tissues with the unique capability to contract or shorten. Smooth muscle is found in the walls of internal organs and blood vessels. It is an involuntary type. The cardiac muscle is found only in the walls of the heart and is involuntary in nature.
Nervous	Nerve cells are specialized for conduction. Nervous tissues therefore serve as the complex telecommunications network of the body. These tissues act in a sensory capacity, to receive, disseminate, and store information collected from receptors. In a motor capacity, nervous tissues provide response potential by controlling effectors such as muscles or glands.

ORGANS IN THE HUMAN BODY

Organs are made up of two or more tissues which perform a common function. For example, the heart contains all four types of tissues. There are about 78 organs in the human body which vary according to their sizes, functions or actions. Out of these 78 organs of a male or female body, skin is the largest with respect to its size and weight. The major organ in the body of human beings is the brain which is primarily responsible for performing all the functions and actions of the body. Organs within the human body:

The Brain

The human brain is the most complex organ in the body, which allows us to think, move, feel, see, hear, taste, smell and experience the world. It coordinates our body, receives information, analyzes information, and stores information (our memories). The brain lies within the skull and is shaped like a mushroom.



The electrical signals together with the chemical reaction produced by the brain sent by the nerves enable the various parts of the body to communicate. The average human brain weighs about 1.5kg which is only 2% of the body's weight. At birth, the human brain weighs less than a 2.2 kg which reaches its full size at about 6 years of age. Blood vessels supply the brain with oxygen and nourishment and take away wastes (20% of oxygen and 20% of blood flow). If the brain cells do not get oxygen for 3 to 5 minutes, they begin to die.

The brain is divided into two hemispheres – the left and right hemispheres; connected by a bundle of nerve fibers called the corpus callosum. The hemispheres are strongly, though not entirely, symmetrical. The left brain controls the muscles on the right side of the body; and the right brain controls the left side of the body. One hemisphere may be slightly dominant above the other which explains the reason for being right-handed or left-handed.

The brain is divided into three parts. They are:

i. ***Cerebrum:*** It is the largest portion of the brain and fills the skull almost entirely; it is responsible for problem solving, thinking, remembering, feelings and movement. The cerebrum which is commonly referred to as the brain itself has its outermost layer as the cortex. The cortex is where thinking and voluntary movements are initiated. It is divided into four lobes:

The *frontal lobe* which is for problem solving, judgment and the functioning of the motors. The *parietal lobe* manages sensation, handwriting, and body position.

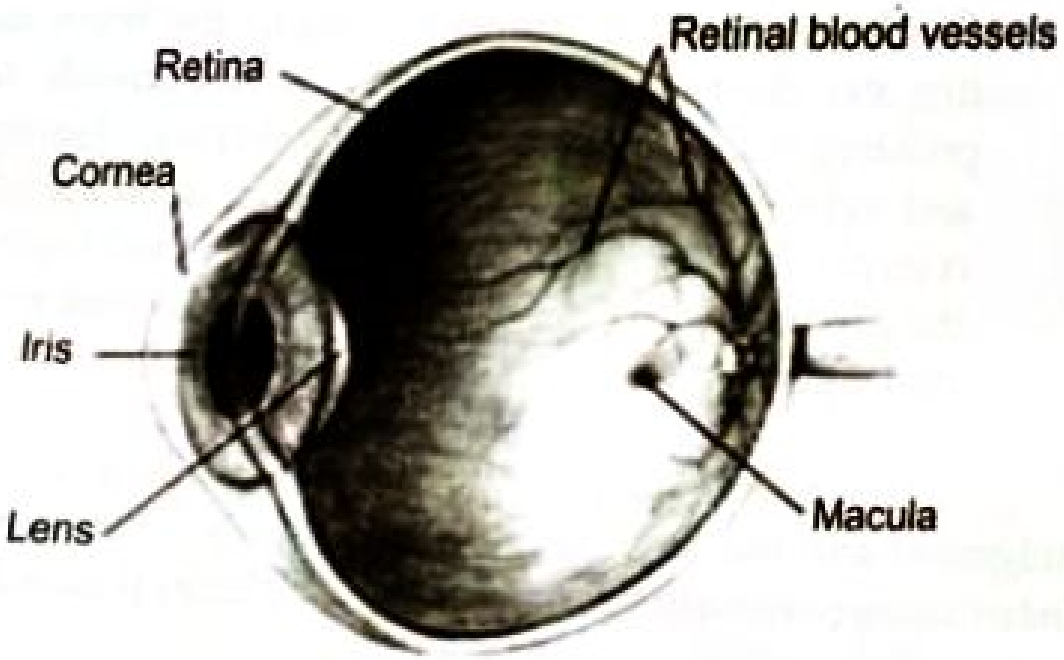
The *temporal lobe* is involved with memory and hearing. The *occipital lobe* contains the brain's visual processing system.

ii. ***Cerebellum:*** This is located behind the cerebrum just at the base of the skull and is responsible for coordination and balance.

iii. ***Brain stem:*** It connects to the spinal cord; it consists of medulla oblongata, pons and midbrain. It is responsible for the control of automatic functions such as breathing, digestion, heart rate and blood pressure.

The Human Eye

The human eye is the organ which enables us to see. The human eye does not only let us view our surroundings, but also enables us to differentiate between colors.



The eye structure:

Eyes exist in pairs, each one being approximately 2.5 cm in diameter. Each eye consists of the following main parts:

- ***Sclera:*** The white part of our eyes is known as sclera. It consists of fibrous tissues and protects the internal parts of the eye.
- ***Cornea:*** The transparent tissue through which light enters the eyes is called cornea. It exists in front of the eye.
- ***Iris:*** Iris is made up of muscles which contract or relax in order to adjust the amount of light which enters the eye.
- ***Pupil:*** Pupil is an aperture controlled by the iris muscles. For instance, when it is dark, the iris muscles relax, causing the pupil to open up wider. Therefore, more light enters them which enable us to see well. On the other hand, the pupil becomes narrow due to the contraction of the iris muscles in the presence of excessive light in order to protect the cells of the eyes.
- ***Lens:*** The lens is present behind the pupil. Light enters the pupil, passes through the lens and is focused on the retina of the eye. The lens is capable of changing its shape in order to help us see near or far off objects.
- ***Retina:*** The retina converts light into electrical signals which are transferred to the brain for processing. The retina contains two types of cells: rods and cones. These cells are sensitive to light. Rods are important for night-time vision when there is little light. On the other hand, cones play an important role in helping us see colors.

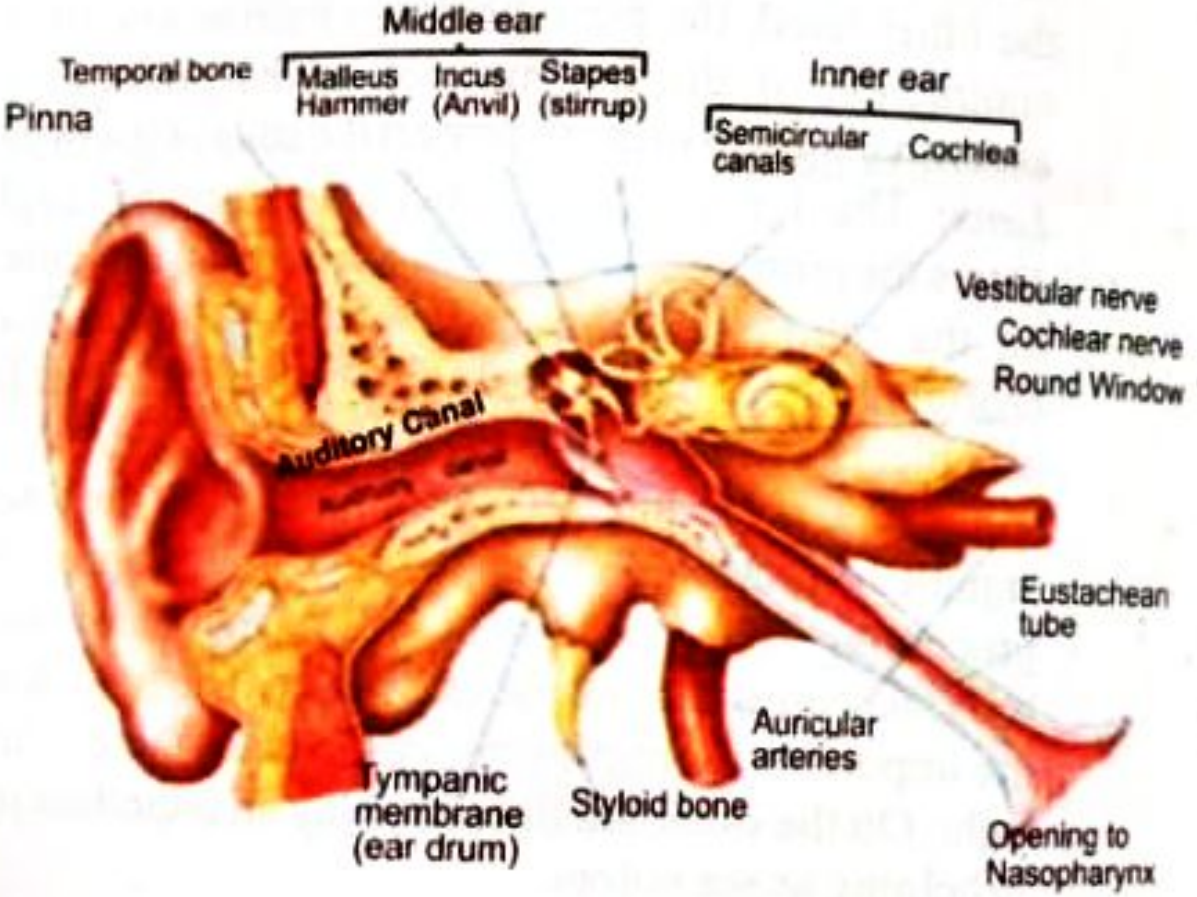
- ***Optic Nerve:*** The optic nerve takes electrical signals from the retina of the eye to the brain.

Functions of the Eyes

Eye functions are associated to our sense of sight. The eyes convert light into electrical signals which are deciphered by the brain into images.

i. They help us view our surroundings.
ii. Our eyes enable us to see colors. For instance animals, such as dogs, cannot see colors.
iii. Eyes help us see near as well as distant objects.

The Ear



The **ear** is the organ that detects sound. It does not only receive sound, but also aids in balance and body position. The ear is part of the auditory system. Physically, the ear consists of three parts: the outer ear, the middle ear, and the inner ear. All three parts of the ear are important for detecting sound by working together to move sound from the outer part through the middle and into the inner part of the ear. The outer and middle ears mostly collect and transmit sound. The inner ear translates those sound waves for transmission to the brain.

The outer ear is the part that is visible and is made of folds of skin and cartilage. It collects sound which travels through the auricle and the auditory canal; a short tube that ends at the eardrum.

The outer ear includes:

i. *Auricle* (cartilage covered by skin placed on opposite sides of the head).
ii. *Auditory canal* (also called the ear canal).
iii. *Eardrum outer layer* (also called the tympanic membrane).

The middle ear includes:

I. Eardrum
ii. Cavity (also called the tympanic cavity)
iii. Ossicles (three tiny bones that are attached):
a. *Malleus (or hammer)* – long handle attached to the eardrum.
b. *Incus (or anvil)* – the bridge bone between the malleus and the stapes.
c. *Stapes (or stirrup)* – the footplate; the smallest bone in the body.

The inner ear includes:

i. *Oval window* – connects the middle ear with the inner ear.

ii. *Semicircular ducts* – filled with fluid; attached to cochlea and nerves; send information on balance and head position to the brain.

iii. *Cochlea* – spiral-shaped organ of hearing; transforms sound into signals that get sent to the brain.

iv. *Auditory tube* – drains fluid from the middle ear into the throat behind the nose.

The Heart

The heart is the organ responsible for pumping and circulating blood to all parts of the human body. There are four chambers of the heart namely: the left and right atria; and the left and right ventricles divided into the left and right compartments.

- The right atrium receives blood from the veins and pumps it to the right ventricle.
- The right ventricle receives blood from the right atrium and pumps it to the lungs, where it is loaded with oxygen.
- The left atrium receives oxygenated blood from the lungs and pumps it to the left ventricle through the arteries.
- The left ventricle (the strongest chamber) pumps oxygen-rich blood to the rest of the body. The left ventricle's vigorous contractions create our blood pressure.

Note: The atria receive blood returning from the body through the veins while the ventricles pump out blood through the arteries.

The heart is made up of three layers:

i. ***Epicardium:*** This is the outermost covering of the heart wall. It is a thin layer of serous membrane that helps to lubricate and protect the heart.

ii. ***Myocardium:*** It is the middle layer of the heart. It makes up the majority of the thickness and mass of the heart wall and is the part of the heart responsible for pumping blood.

iii. ***Endocardium:*** It is the inner layer of the heart and prevents blood from clotting or sticking to the inside of the heart.

Four valves regulate blood flow through the heart:

i. The *tricuspid valve* regulates blood flow between the right atrium and right ventricle.

ii. The *pulmonary valve* controls blood flow from the right ventricle into the pulmonary arteries, which carry blood to the lungs to pick up oxygen.

iii. The *mitral valve* lets oxygen-rich blood from the lungs pass from the left atrium into the left ventricle.

iv. The *aortic valve* opens the way for oxygen-rich blood to pass from the left ventricle into the aorta, the body's largest artery.

The coronary arteries run along the surface of the heart and provide oxygen-rich blood to the heart muscle.

The cardiac cycle: The cardiac cycle is of two major phases: *systolic,* which is the period of active contraction and *diastolic*, which is the period of relaxation and dilation. The cycle is considered to begin at diastole.

The Kidney

The kidney is a bean-shaped organ for filtering blood, removing waste and controlling the balance of body fluid.

Functions of the kidney include:

1. It excretes wastes: The kidney gets rid of unwanted substances within the body by filtering out toxins, excess salts and urea, which is a nitrogenic waste produced by cell metabolism.
2. It balances water level: The kidney helps to balance the level of water in the body by reacting in response to increase or decrease in water intake. The kidney helps to maintain the water in the body when there is a decrease in water intake instead of excreting it.
3. It regulates acid: As cell metabolism occurs, acid is produced in the body and the food we eat either increases or neutralizes the acid in the body. To keep the body healthy, the kidney ensures a proper balance of these chemicals.
4. It regulates the red blood cells: A hormone called **erythropoietin** that stimulates bone marrow to produce oxygen-carrying red blood cells is produced when the kidneys do not get enough oxygen.
5. It regulates blood pressure: One way the kidney regulates blood pressure is by producing a blood vessel-constricting protein (**angiotensin**). This signals the body to retain sodium and water. Both the constriction and retention help restore normal blood pressure.

The Blood

There are four components of blood in the body. They are:

1. **Red blood cells or Erythrocytes**: Red blood cells (RBCs), also known as erythrocytes, have two main functions:
   i. To pick up oxygen from the lungs and deliver it to tissues elsewhere.
   ii. To pick up carbon dioxide from other tissues and unload it in the lungs.

   An erythrocyte is a disc-shaped cell with a thick rim and a thin sunken center. The plasma membrane of a mature RBC has glycoproteins and glycolipids that determine a person's blood type. The cytoplasm of a RBC consists mainly of a 33% solution of hemoglobin (Hb), which gives RBCs their red color. Hemoglobin carries most of the oxygen and some of the carbon dioxide transported by the blood.

2. **White blood cells or Leukocytes** have two main categories; they are *granulocytes* and *agranulocytes*. The granulocytes have cytoplasm that contains organelles that appear as colored granules through light microscopy, hence their name. Granulocytes consist of neutrophils, eosinophils and basophils. In contrast, agranulocytes do not contain granules. They consist of lymphocytes and monocytes.

Granulocytes

- *Neutrophils:* These contain very fine cytoplasmic granules that can be seen under a light microscope. Neutrophils are also called polymorphonuclear (PMN) because they have a variety of nuclear shapes. They release chemicals that destroy the growth of bacteria.

- *Eosinophils:* These have large granules and a prominent nucleus that is divided into two lobes. They function in the destruction of allergens and inflammatory chemicals, and release enzymes that disable parasites.
- *Basophils:* They have a pale nucleus that is usually hidden by granules. They secrete histamine which increases tissue blood flow via dilating the blood vessels, and also secrete heparin which is an anticoagulant that promotes mobility of other WBCs by preventing clotting.

Agranulocytes

- *Lymphocytes:* These are usually classified as small, medium or large. Medium and large lymphocytes are generally seen mainly in fibrous connective tissues and only occasionally in the circulation bloodstream. Lymphocytes function in destroying cancer cells, cells infected by viruses, and foreign invading cells. In addition, they present antigens to activate other cells of the immune system. They also coordinate the actions of other immune cells, secrete antibodies and serve in immune memory.
- *Monocytes:* They are the largest of the formed elements. Their cytoplasm tends to be abundant and relatively clear. They function in differentiating into macrophages, which are large phagocytic cells, and digest pathogens, dead neutrophils, and the debris of dead cells. Like lymphocytes, they also present antigens to activate other immune cells.

3. **Platelets**: Platelets are small fragments of bone marrow cells and are therefore not really classified as cells themselves.

Platelets have the following functions:

a) Secrete vasoconstrictors which constrict blood vessels, causing vascular spasms in broken blood vessels.

b) Form temporary platelet plugs to stop bleeding.

c) Secrete procoagulants (clotting factors) to promote blood clotting.

d) Dissolve blood clots when they are no longer needed.

e) Digest and destroy bacteria.

f) Secrete chemicals that attract neutrophils and monocytes to sites of inflammation.

g) Secrete growth factors to maintain the linings of blood vessels

h) The first three functions listed above refer to important haemostatic mechanisms which platelets play a role during bleeding: vascular spasms, platelet plug formation and blood clotting (coagulation).

4. **Plasma**: Blood plasma is a mixture of proteins, enzymes, nutrients, wastes, hormones and gases.

Functions of blood: The three main functions of blood are: Transportation, Protection and Regulation.

I. **Transportation:** Blood transports the following substances:

i. Oxygen and Carbon dioxide between the lungs and the rest of the body

ii. Nutrients from the digestive tract and storage sites to the rest of the body

iii. Waste products to be detoxified or removed by the liver and kidneys
iv. Hormones from the glands in which they are produced to their target cells
v. Heat to the skin so as to help regulate body temperature

II. Protection: Blood has several roles in inflammation:
i. Leukocytes, or white blood cells, destroy invading microorganisms and cancer cells.
ii. Antibodies and other proteins destroy pathogenic substances.
iii. Platelet factors initiate blood clotting and help minimize blood loss.

III. Regulation: Blood helps regulate:
i. pH by interacting with acids and bases
ii. Water balance by transferring water to and from tissues.