

INCREASING ACCESS TO SECONDARY SCHOOL LEVEL EDUCATION THROUGH THE PRODUCTION OF QUALITY LEARNING MATERIALS

JUNIOR SECONDARY LEVEL

BIOLOGY

Module 6: Support, Movement and Control

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JUNIOR SECONDARY LEVEL SCIENCE - BIOLOGY

MODULE 1 – Introduction to Biology and the Classification of Living Things

Unit 1 The Science of Life

Unit 2 Biological Skills

MODULE 2 – The Living Cell

Unit 1 Cell Structure and Organisation

Unit 2 Levels of Organisation

Unit 3 Compounds of Life

MODULE 3 – Energy and Life

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MODULE 4 – Nutrition and Digestion

Unit 1 Nutrition in Living Organisms

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MODULE 5 – Transport

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MODULE 6 – Support, Movement and Control

Unit 1 Support and Movement

Unit 2 Hormonal and Nervous Control

Unit 3 Control and Regulation

MODULE 7 – Continuity of Life

Unit 1 Reproduction

MODULE 8 – Organisms and the Environment

Unit 1 Ecological Principles

Unit 2 Population Growth and Regulation

Unit 3 Human Influence on the Environment

MODULE 6

SUPPORT, MOVEMENT AND CONTROL

MODULE INTRODUCTION

Our skin is held in a definite shape on our body. Can you imagine what would happen to us if our skin wasn't supported on the body? You must have guessed, we would just be a pile of flesh that we could pick up and drop.

Likewise if plants weren't supported somehow, they would not be upright.

There must be structures to carry out this important function of **support**. These structures differ in different organisms.

The same structures assist in **movements** although the mechanisms of movement in plants are different.

Movements are responses to the environment i.e. something in the environment must trigger this response. This something must be detected for a response to occur. The mechanisms of detection and responses are under the control of the **hormonal and nervous systems**. The Module looks at support, movement and control in some named organisms.

MODULE OBJECTIVES

At the end of this Module you should be able to:

- explain the importance of support in plants and animals
- describe the types of movements in plants and animals
- discuss control mechanisms in movements
- discuss the ill-effects of alcohol and drugs.

UNIT 1

SUPPORT AND MOVEMENT

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UNIT 1

SUPPORT AND MOVEMENT

INTRODUCTION

All living things are supported in some way. Plants are supported by the strands of xylem and phloem that run in vascular bundles. Most animals are supported by a skeleton. Just think what would happen to your body without the support of your skeleton. It would collapse into a shapeless heap of flesh and you wouldn't be able to move.

Plants show growth movements but they don't move from place to place as we do. Their shoots always grow towards a source of light. Their roots grow vertically downwards towards the pull of gravity. Animals show locomotion by moving from place to place. To swim, fish push against water; to fly, birds push against air. Land animals move by walking and running. Their legs push against the ground and the body moves forward. This Unit will focus on how plants and animals are supported and how they move.

OBJECTIVES

At the end of this Unit you should be able to:

- explain the need for support and movement in plants and animals
- distinguish between hydro-, endo- and exoskeletons
- identify the main components of the human skeleton
- distinguish between different types of joints and their functions

- describe the action of the skeleton, joints and muscles to bring about movements
- name the different types of muscles in the body.

1.0 PLANT GROWTH MOVEMENTS

Plants show movements but not in the same way as animals. They commonly grow in response to stimuli. The environment changes all the time. These changes cause plants and animals to react. These reactions of plants and animals are called responses.

Plants respond by growing towards or away from stimuli in their environment. For example, shoots of plants grow towards light while their roots grow towards gravity. This enables the leaves to receive maximum light for photosynthesis and the roots to obtain water and mineral salts in the soil. A shoot growing towards light is illustrated in Fig 1. Notice how the shoot bends towards the stimulus i.e. the light source.

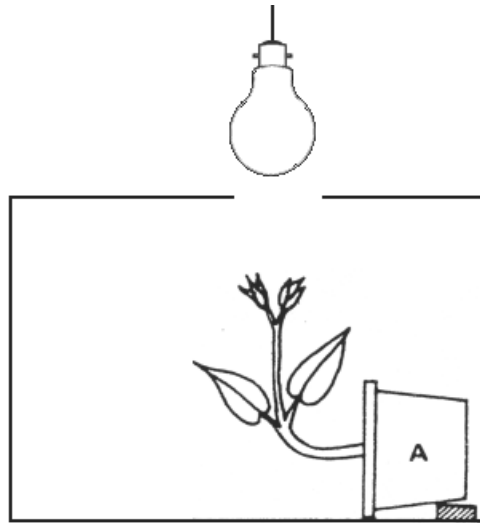


Fig. 1: Plant Growth Movement

 *Before proceeding further, complete the following activity.*

ACTIVITY 1

1. Name the structure which provides support in

(a) plants

.....

.....

(b) animals

.....

.....

2. How do plants respond to stimuli in their environment?

.....

.....

.....

3. Fill in the blanks.

(a) A plant's shoot grows towards _____ while its root grow towards _____. This allows the leaves to receive _____ for _____ and the roots to obtain _____ and _____ in the soil.

(b) In non-woody or herbaceous plants, the pressure of cell contents against the cell wall makes the plant cell _____. This provides _____ to hold the plant upright.

You will find the answer at the end of the Module.

1.1 SUPPORT IN PLANTS

The non-woody or herbaceous plants and seedlings are supported by the firmness of their cells. The pressure of the cell contents against the cell wall makes a plant cell turgid. Thus individual cells press against each other and hold the plant upright.

In woody plants like shrubs and trees the xylem tissue provides support. The walls of the xylem vessels are thickened by deposit of lignin. This strengthens the wall of the xylem cells.

1.2 SUPPORT AND MOVEMENT IN ANIMALS

Most animals are supported by a skeleton. There are three main types of skeleton:

- (i) Hydrostatic skeleton - These are found in soft bodied organisms. They consist of body spaces and cells filled with fluid under pressure. Such a skeleton is firm and flexible. The earthworm has a hydrostatic skeleton.

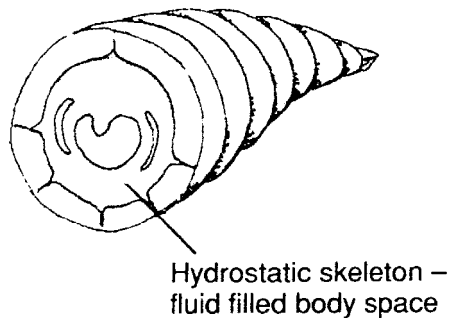


Fig. 2: Skeleton of a Worm

- (ii) Endoskeleton - This is found in vertebrates. Here the skeleton is inside the body. It consists of hard bone and cartilage. It is surrounded by muscles. Mammals have an endoskeleton. The next time you're at your butcher, notice the leg of lamb. You'll see muscles wrapping the bone.

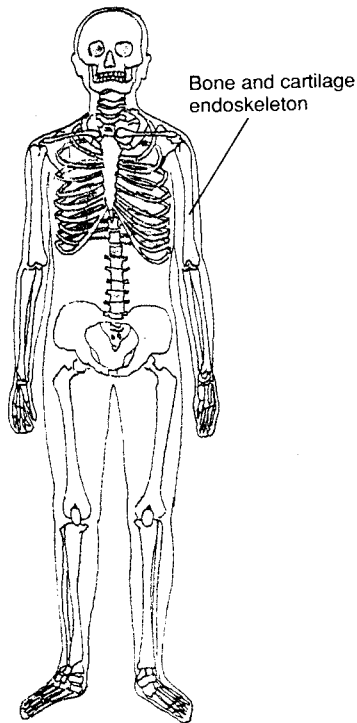


Fig. 3: Endoskeleton of a Human

- (iii) Exoskeleton - This is made of hard material which is outside the body. It often consists of hard chitin which covers the muscles. Insects and tortoises have an exoskeleton.

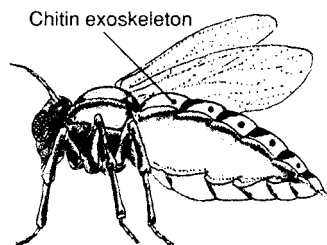


Fig. 4: Exoskeleton of an Insect

1.2.1 THE HUMAN SKELETON

The human skeleton is a framework of bones in your body. It is an endoskeleton. It encloses your internal organs and gives support, strength and shape to your body. An adult has 206 bones of different sizes and shapes. These bones are living tissues and they are supplied with blood and nerves.

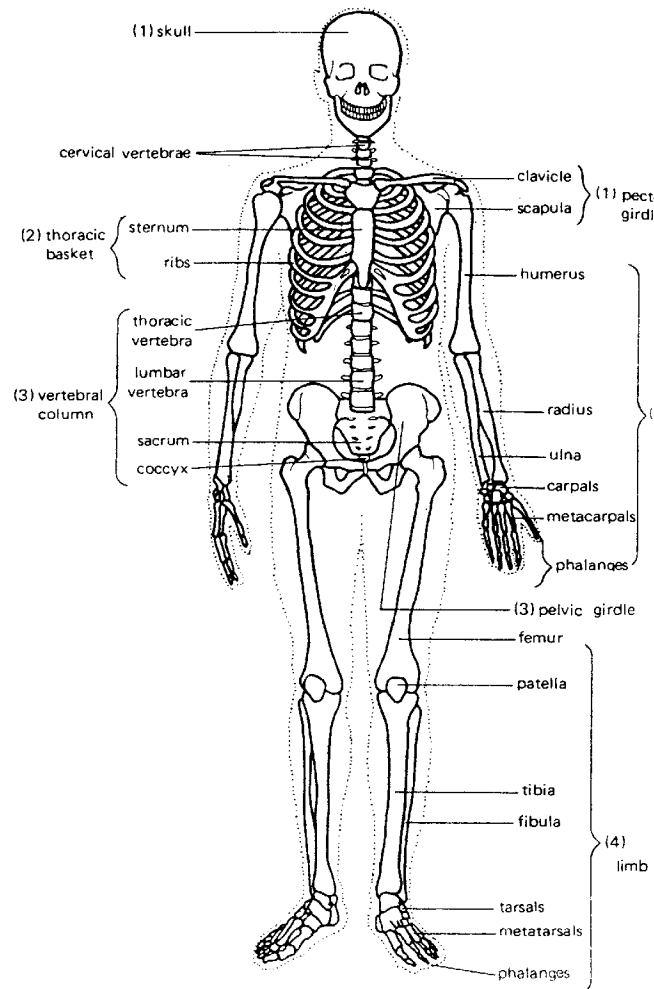


Fig. 5: The Human Skeleton

Your skeleton is made up of the skull, backbone or vertebral column, ribs and the breastbone. There are two pairs of limbs which are attached to two pairs of girdles.

The Skull

This consists of flat bones joined together. It encloses the brain and protects your eyes and ears.

The Backbone

This is also called the vertebral column. It is made of 33 small bones called vertebrae. The skull is attached to it. It is a strong column of bones which protects the spinal cord.

The Rib-Cage

You have twelve pairs of ribs forming a cage in your thorax. The ribs are curved bones which are joined to the backbone and to the breastbone. However, the last two pairs are joined to the backbone only and they are called floating ribs. The rib cage protects the heart and lungs and helps in breathing movements.

The Arms and the Legs

You have a pair of forelimbs or arms. These are joined to your shoulder-girdles. The shoulder-girdles consist of large, flat bones called shoulder-blades and collar bones. The fore limbs consist of the upper arm, lower arm and hand bones. You also have a pair of hind limbs or legs which are joined to your hip or pelvis. This consists of the pelvic girdle which forms a strong base to which your thigh bones are joined. The thighbone is connected to the lower leg bones at the knee. The lower leg bones are joined to the ankle, followed by the sole bones and the toes.

1.2.2 FUNCTIONS OF THE SKELETON

Your skeleton:

- (i) gives shape and strength to your body
- (ii) provides support to your body

- (iii) protects your internal organs. For example, the skull protects the brain; the rib cage protects your heart and lungs.
- (iv) provides a surface for muscle attachment. This helps in the body movements.
- (v) consists of bones which produce blood cells and also store minerals like calcium and phosphorous.

1.3 JOINTS

A joint is the meeting point of two or more bones. Bones forming joints are held together firmly in place by strong tissues called ligaments. There are several joints in your body. They are of three types:

- fixed joints
 - slightly movable joints and
 - freely movable joints.
- (a) Fixed joints are formed where the meeting bones cannot move. An example is the fixed joints between bones in your skull.
 - (b) Slightly movable joints are formed where the meeting bones can move a little. There are slightly movable joints between your vertebrae in the vertebral column or backbone.
 - (c) Freely movable joints are formed where the meeting bones can move easily. The ends of these bones are covered by cartilage. There are freely movable joints at your elbows and your knees. Your elbow is a hinge joint which allows the bones to move in only one direction. Ball and socket joints allow movement in all directions. An example is the joint between the hip girdle and your thigh bone at your hip.

 *Before proceeding further, complete the following activity.*

ACTIVITY 2

1. *Name three types of skeleton found in animals and give one example of each.*

.....

.....

.....

2. (a) *What is an endoskeleton?*

.....

.....

- (b) *Name the organ of the body which is protected by the*

(i) *skull*

(ii) *vertebral column*

(iii) *rib-cage*

3. *State three functions of your skeleton.*

.....

.....

.....

4. (a) *What is a joint?*

.....

.....

- (b) *Name a hinge joint and a ball and socket joint in your body?*

.....

.....

You will find the answer at the end of the Module.

1.4 MUSCLES

Muscles are special tissues. They work by getting shorter or contracting. When a muscle contracts it pulls what it is joined to. Muscles are attached to the bones by strong fibres called tendons. There are three kinds of muscles in your body. They are:

- voluntary
- involuntary and
- cardiac.

Voluntary muscles – are those muscles which you can control as you wish.

The muscles attached to your bones are voluntary. They are your skeletal muscles. They work quickly and powerfully, but they soon get tired.

Involuntary muscles – are those muscles which you cannot control. They are the smooth muscles. They work on their own. They do not get tired easily. Examples are muscles in the walls of blood vessels and the alimentary canal.

Cardiac muscle – is found in your heart. It does not get tired easily. It pumps blood around your body, all through life. This is a special kind of involuntary muscle.

We can now proceed with the following investigation.



INVESTIGATION 1: Examine some of the movements that your skeleton can make.

For each investigation you will require the materials indicated.

You should record your answers in the space provided.

Method:

1. Stand up and try to make the following movements with your fore limbs and hind limbs.
 - (a) movement in one direction or plane only
 - (b) movement in two different directions.
2. Record your results and present this information so that you can show the different types of movements in your arms and legs.

	Forelimbs (arms)	Hind limbs legs
<i>Movement in one direction</i>		
<i>Movement in two directions</i>		

1.5 HOW DO MUSCLES MOVE THE SKELETON?

To illustrate this, let us consider the arm. Two main muscles move the lower arm. The biceps muscles bend it and the triceps muscles strengthen it. This movement occurs at the elbow joint.

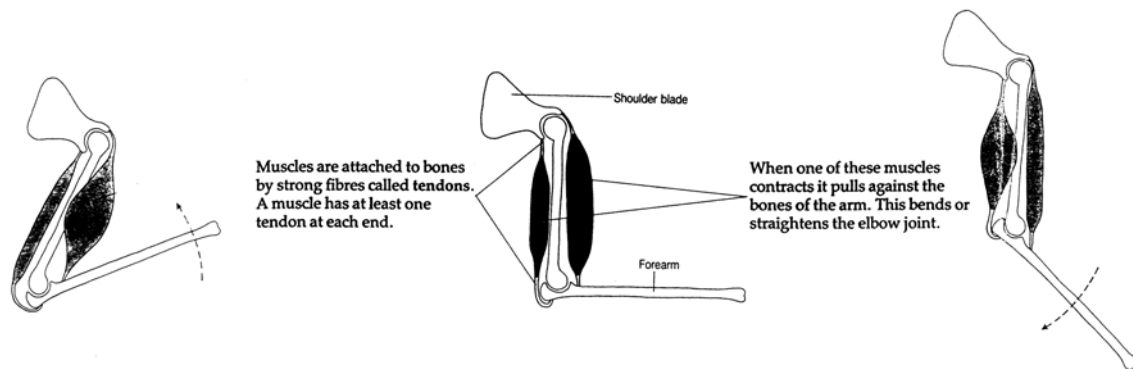



Fig. 6: Movement at the Elbow joint

When the biceps muscles contract, they bend the lower arm at the elbow joint. During this raising movement, triceps muscles relax. When the triceps muscles contract, they straighten the arm at the elbow joint. During this lowering movement, the biceps relaxes.

The biceps and triceps produce opposite effects. They must not contract at the same time, otherwise the arm would not move at all. The nervous system ensures this doesn't happen. When biceps contracts, the triceps relaxes and vice-versa. Pairs of muscles which work like this are called antagonistic muscles. Such muscles are also found in the legs and other parts of your body.

They allow you to perform different types of body movements, like walking, running, bending. Thus muscles produce movements in our body, by pulling on the bones.

 *Before proceeding further, complete the following activity.*

ACTIVITY 3

1. (a) What are muscles?

.....
.....

- (b) How are muscles attached to bones?

.....
.....

2. State three different kinds of muscles in your body and give one example of each.

.....
.....

3. Why are at least two muscles needed at a joint?

.....
.....

4. Describe one way in which your heart muscle is different from muscles in your arms.

.....
.....

5. Make a labelled drawing and describe the movement at your elbow joint.

You will find the answer at the end of the Module.



POINTS TO REMEMBER

- All living things need some kind of support.
- Plants show growth movements to changes in their surroundings.
- Shoots in plants grow towards light while their roots grow towards gravity.
- Turgid cells provide support in herbaceous plants.
- Xylem provides support in woody plants.
- Most animals are supported by a skeleton.
- Three main types of skeleton are: hydrostatic skeleton, endoskeleton and exoskeleton.
- The skeleton gives a definite shape to the body, provides support and protect some internal organs.
- A joint occurs wherever two or more bones meet. There are three kinds of joints in your body. Bones are held together by ligaments.
- Muscles are special tissues. They contract (shorten) to bring about movements in the body.
- There are three kinds of muscle in your body: voluntary, involuntary and cardiac.
- Voluntary muscles are under your control, whereas the involuntary muscles are not under your control.
- Muscles are attached to bones by tendons.
- The muscles at a joint work in pairs. They show opposite effects and are called antagonistic muscles.
- Muscles produce movement in your body by pulling on the bones.

UNIT 2

HORMONAL AND NERVOUS CONTROL

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UNIT 2

HORMONAL AND NERVOUS CONTROL

INTRODUCTION

All living organisms including ourselves are sensitive to the environment. Just reflect for a second. On a hot day we have the tendency to look for somewhere in the shade. We can detect changes in the environment and respond accordingly. The changes we detect are called stimuli. The part of the body that detects the stimulus is called a receptor or sense organ. Effectors are structures which react or respond to these stimuli.

Most animals have two methods of sending messages from receptors to effectors. The fastest is by means of nerves. The receptors and nerves make up the nervous system. Another method is by means of chemicals called hormones. Hormones are part of the endocrine system. Compared to the nervous system, the hormonal system is slower but has a lasting effect. In this Unit we address the mode of action of these two systems.

OBJECTIVES

At the end of this Unit you should be able to:

- define hormones and explain their role in the human body
- define a stimulus, receptor and effector
- describe the human nervous system
- define sense organs as groups of receptor cells
- identify motor and sensory neurones
- describe a simple reflex arc and a reflex action
- distinguish between voluntary actions in humans

- list the ill-effects of drug and alcohol abuse
- describe the personal and social problems arising from drug abuse.

Let's now turn to the hormonal system known as the endocrine system.

2.0 ENDOCRINE SYSTEM

This system consists of endocrine glands which produce hormones. Hormones are chemical messengers. They are carried in the blood to the effector or target organs where they act. Later the hormones are destroyed in the liver.

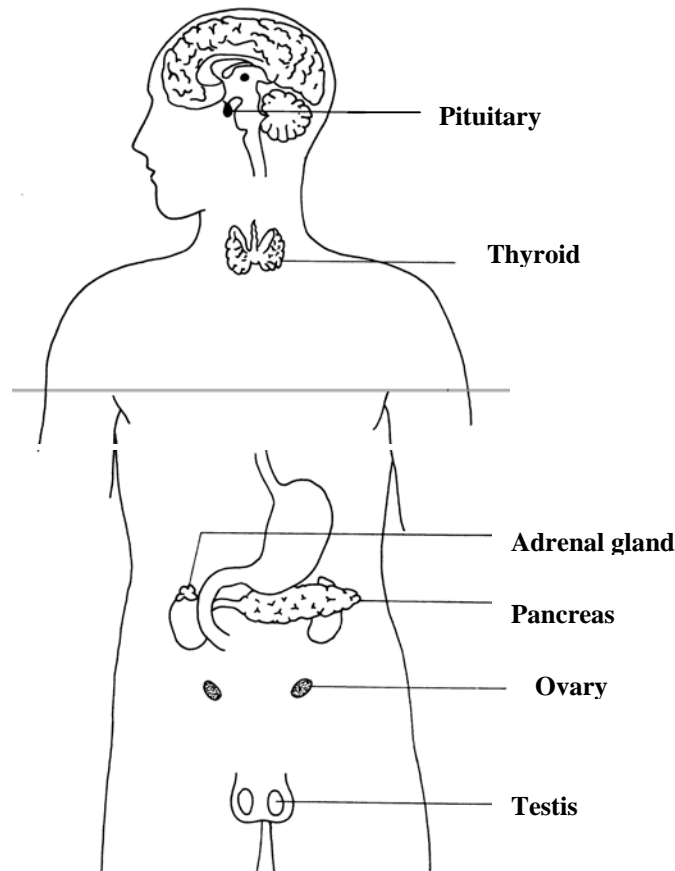


Fig. 7: The Endocrine System of the Human Body

Fig. 7 shows your main endocrine glands. You should note that some hormones act very fast and their influence might last a long time. We shall now consider a few hormones and their effects on your body.

2.1 HORMONES

Insulin

This is produced by the pancreas which is below the stomach. Insulin helps your liver to control the amount of glucose in your blood. If you eat a meal containing much sugar, the level of glucose in your blood goes up. The pancreas detects this and secretes insulin into the blood.

When insulin arrives at the liver and muscles, it makes them absorb glucose from the blood and use it up. Some of the glucose is used in respiration and some of it is converted to glycogen and stored in the liver and muscle cells.

When the blood glucose level drops to the right level, the pancreas stops producing insulin. Then the liver and muscles stop using up the glucose from the blood so quickly. This control of blood glucose level forms an important part of homeostasis.

Diabetes

If your pancreas becomes defective, it cannot produce enough insulin. Then excess blood glucose cannot be controlled. Your blood glucose level will be higher than normal. This condition is called diabetes. In this case glucose is lost in urine. Most diabetics can remain healthy by carefully controlling the amount of carbohydrate that they eat.

Glucagon

When blood glucose level falls below normal, such as during starvation or vigorous muscular activity, the pancreas releases another hormone called glucagon. This converts glycogen stored in the liver to glucose. Glucose is thus added to the blood. When blood glucose level returns to normal, the secretion of glucagon is stopped.

Adrenaline

You must surely have experienced a strange feeling before an examination or meeting a girl friend or boy friend for the first time. You're tense, your mouth dries up, you can hear your heart beat, you sweat etc. You feel ready to go. This is due to your hormone adrenaline.

Adrenaline is produced by the adrenal glands, which are found above the kidneys. The overall effect of adrenaline is to prepare your body for an emergency. It speeds up your heart beat and breathing, raises the blood pressure and allows more glucose to go into the blood, to give you energy.

Now that we've considered one way of relaying messages, we shall turn to the second and fastest way which is through the Nervous System.

 *Before proceeding further, complete the following activity.*

ACTIVITY 1

1. What is meant by

(a) a stimulus?

(b) a receptor?

(c) an effector?

(d) hormones?

2. Name two endocrine glands in your body and state the hormones they secrete.

.....
.....

3. Explain how insulin controls your blood glucose level.

.....
.....

4. (a) When is adrenaline secreted?

.....
.....

(b) State the effects of adrenaline on your body.

.....
.....

You will find the answer at the end of the Module.

2.2 THE NERVOUS SYSTEM

Your nervous system controls and co-ordinates the different parts of your body so that they work together, doing their jobs at the right time.

The nervous system has two main parts; they are the:

- Central Nervous System
- Peripheral Nervous System

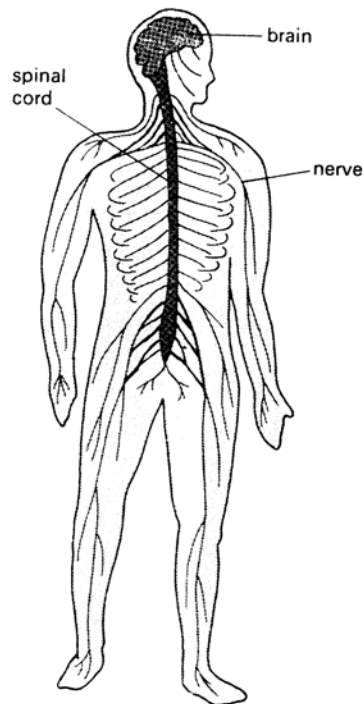


Fig. 8: The Nervous System

2.2.1 THE CENTRAL NERVOUS SYSTEM

The brain and spinal cord together make up the central nervous system.

2.2.2 THE PERIPHERAL NERVOUS SYSTEM

The nerves that arise from the brain and spinal cord connect the receptors and effectors with the central nervous system. These make up the peripheral nervous system.

2.2.3 NERVE CELLS

Your nervous system is made up of nerve cells. These consist of nerve fibres. They carry messages in the form of nerve impulses. The nerve impulses travel along nerve fibres in only one direction.

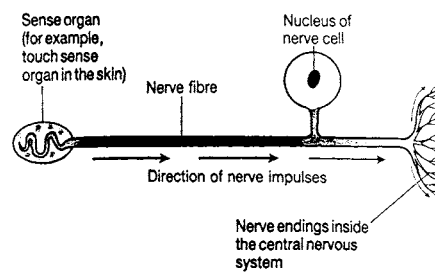


Fig. 9: Sensory Nerve Cell

Sensory nerve cells carry nerve impulses from receptors or sense organs like the eye, ear, nose, tongue, skin to the central nervous system.

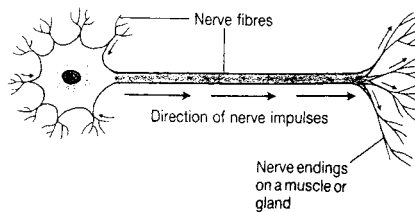


Fig. 10: Motor Nerve Cell

Motor nerve cells carry nerve impulses from the central nervous system to effectors like muscles and glands.

2.2.4 SENSE ORGANS

You can see, taste, smell, hear, balance and touch because of your sense organs. These consist of a group of sensory cells which respond to specific stimuli in your environment. Your sense organs are your:

- (i) skin - which is sensitive to heat, cold, pressure and gives you your sense of touch
- (ii) tongue - which is sensitive to chemicals in foods and drinks and gives you your sense of taste.
- (iii) nose - which is sensitive to chemicals in the air and gives you your sense of smell.
- (iv) ears - which are sensitive to sounds and movement and gives you your senses of hearing and balance.
- (v) eyes - which are sensitive to light and give you your sense of sight.

When a sense organ detects a stimulus, it sends messages in the form of nerve impulses. These nerve impulses travel along the nerve fibres to the brain. The brain then interprets the messages or impulses to give you feelings or sensations like hearing or sight.

We shall now turn to

- hearing and
- seeing

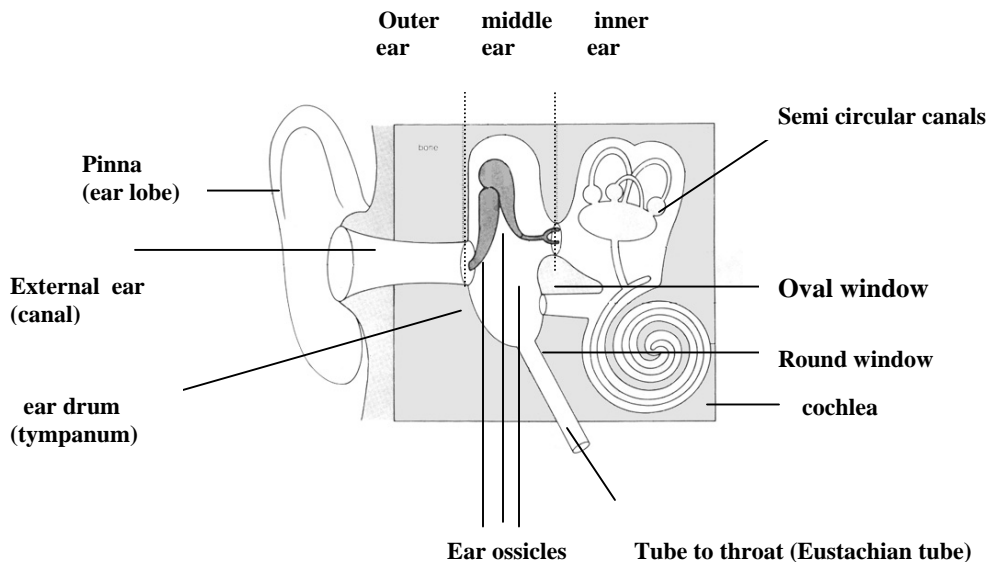
Ear

As mentioned earlier, the ear is an organ of hearing and balance. Through its structure, let's see how it performs these tasks

The ear is divided into 3 parts.

- Outer ear
- Middle ear
- Inner ear

Note: Also refer to Physics - Module 4 - 4.3 for transmission of sound waves in the ear.



The ear lobe picks up sound waves and directs them into the ear.

The hearing canal leads to the eardrum which vibrates with the sound waves.

The ear ossicles transmit the vibrations from the middle ear to the inner ear.

In the inner ear, the cochlea is stimulated by the vibrations and sends sound impulses to the brain along the auditory nerve for hearing. Impulses of balance travel from the semi-circular canals along the auditory nerve to the brain for balance.

Eye

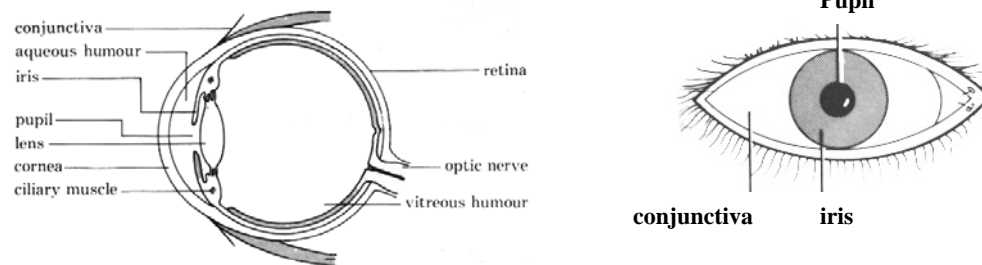
The eye is an important sense organ responsible for vision. In fact very few organisms have this ability i.e. forming pictures of the outside world.

Note: The nature of images formed are covered in Physics - Module 4, 4.4.4.

To do so, an eye has special structures. Let's look at them.

- The cornea and lens form a clear, upside-down full colour image on the retina at the back of the eye.
- The ciliary muscles hold the lens in place.
- The conjunctiva is a thin membrane covering the cornea.
- The iris is the coloured part of the eye which controls the amount of light entering the eye.
- Aqueous and vitreous humour are a transparent fluid.

- The retina is sensitive to light entering the eye. Nerve fibres from the retina form the optic nerve which goes to the brain. The brain then corrects the upside-down image to produce an upright one.



2.3 FUNCTIONING OF THE NERVOUS SYSTEM

If you accidentally sit on a pointed nail, you jump up immediately. This is a simple example of a stimulus and a response. The stimulus is the pain and the jumping up is the response. Your nervous system controls the response.

The diagram in Fig. 11 shows how your nervous system works.

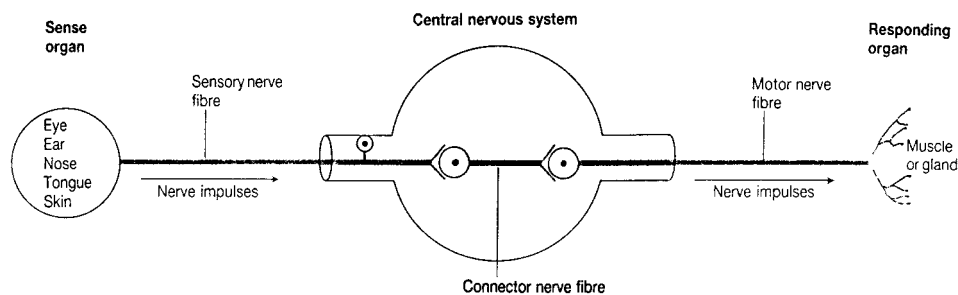


Fig. 11: Working of the Nervous System

2.3.1 REFLEX ARC

When a sense organ detects a stimulus it turns it into nerve impulses. The nerve impulses then travel along sensory nerve fibres to the central nervous system.

The central nervous system works out the best response to the stimulus. Then it sends impulses to the effectors, muscles or glands through motor nerve fibres.

The above is an example of a reflex arc. This is the pathway of nerve impulses during a reflex action.

2.3.2 REFLEX ACTIONS

These are actions you do without thinking, to protect yourself. They are involuntary actions. For example, coughing clears your throat, shivering keeps you warm, pupils in your eyes become smaller when exposed to bright light or you pull your hands away when it touches a hot object.

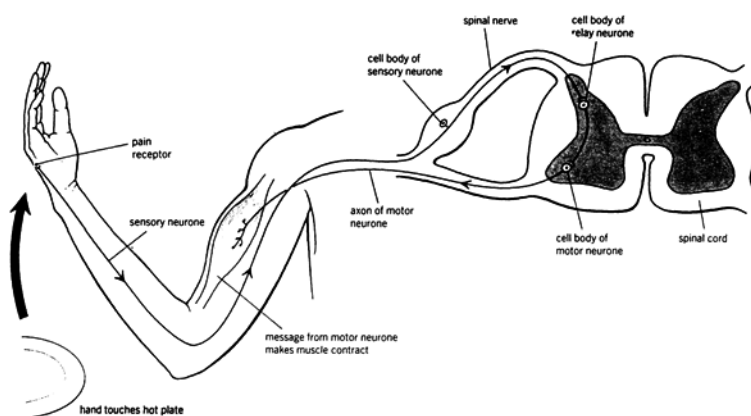


Fig. 12: Reflex is when hand touches a hot object

Let us consider what happens when you accidentally touch a hot object. The sensory cells in your fingers are stimulated by the heat. They send nerve impulses along sensory nerve fibres to the central nervous system. The central nervous systems work out the best response for this stimulus. It then sends nerve impulses along motor nerve fibre down the arm to the biceps muscles. These muscles contract pulling your arm away from the hot object. The whole response only takes a fraction of a second. This shows how quickly the nerve impulses travel through the nervous system.

2.4 VOLUNTARY ACTIONS

These are carried out according to your wish. They are initiated by the brain and they need thought. They involve mainly muscular actions. Walking across the street, speaking to a friend, writing a letter, opening doors are all examples of voluntary actions.

 *Before proceeding further, complete the following activity.*

ACTIVITY 2

1. Name the parts of your nervous system.

.....
.....

2. Name two kinds of nerve cells.

.....
.....

3. What is a nerve impulse?

.....
.....

4. Name the five sense organs in humans.

.....
.....

5. (a) What is a reflex action?

.....
.....

- (b) Give an example of a reflex action?

.....
.....

(c) *What is a reflex arc?*

.....
.....

6. (a) *What is a voluntary action?*

.....
.....

(b) *Give an example of a voluntary action.*

.....
.....

You will find the answer at the end of the Module.

2.5 DRUG ABUSE

The nervous system is easily affected by drugs. Drug abuse is the deliberate and excessive use of drugs which causes physical, mental, emotional and social harm to people and those close to them. This abuse damages a person's health and can become a social problem. It always brings misery and ill-health to the abusers. For example, people can easily become addicted to alcohol or the consumption of dagga.

2.5.1 ALCOHOL

Alcohol is a depressant of the central nervous system i.e. it slows down the nervous system. It reduces self-control and reaction time. It causes liver disease and depression. Heavy drinking over a long period causes brain damage, stomach ulcers, cancers of the digestive system and heart disease. It leads to addiction. The drinker cannot do without alcohol. If a woman is pregnant, alcohol in her blood is carried to the baby. It can damage the baby's brain and heart and slow its growth. Drinking may also lead to family problems as well as road accidents.

2.5.2 DAGGA


This is obtained from leaves of gandia plants. Abusing this substance affects thinking and learning abilities. It produces panic, anxiety and affects the respiratory system. It also increases the risk of heart disease and reduces resistance against infections.

2.6 DRUG ABUSE – ILL EFFECTS

You should note that drug abuse is one of the major causes of many social evils like:

- deterioration of family life
- domestic violence
- theft and crimes
- rape
- divorce
- high risks to AIDS and other STDs (Sexually Transmitted Diseases)
- accidents
- suicide
- absenteeism
- unemployment

The best alternative to drug abuse is to keep away from it.

 *Before proceeding further, complete the following activity.*

ACTIVITY 3

1. *What is meant by drug abuse?*

.....

.....

2. *Some drugs like alcohol and dagga lead to addiction. What does this mean?*

.....

.....

3. *State some effects of alcohol abuse on*
(a) *the person*

.....

.....

- (b) *the society*

.....

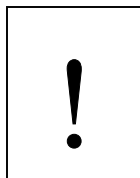
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4. *List the effects of dagga abuse on the body.*

.....

.....

You will find the answer at the end of the Module.



POINTS OF REMEMBER

- Living organisms detect changes called stimuli, in their environment by their receptors.
- Effectors respond to stimuli.
- The endocrine system consists of endocrine glands which produce hormones.
- Hormones are chemical messengers, which travel in the blood to their target organs.
- Insulin is secreted by the pancreas when the blood sugar level rises. It converts surplus blood glucose to glycogen. This is stored in liver and muscles.
- Excess blood glucose in the body leads to diabetes.
- When blood glucose level falls below normal, glucagon is produced.
- Adrenaline is the emergency hormones produced by adrenal glands. It changes glycogen to glucose.
- The nervous system controls and co-ordinates the different parts of your body.
- Sense organs are receptors. They change stimuli into nerve impulses.
- The pathway of nerve impulses during a reflex action is called reflex arc.
- Reflex actions are involuntary actions which are done without thinking.
- Drug abuse leads to personal as well as a social problems.
- The nervous system is easily affected by drugs.
- Alcohol abuse causes numerous health problems. It also reduces self-control and reaction time.
- Heavy drinking leads to addiction, family as well as social problems. Alcohol harms the baby if a pregnant woman drinks.
- Dagga abuse produces health problems and increases risks of heart diseases.
- It is better to keep away from drugs as they always bring misery and ill health.

UNIT 3

CONTROL AND REGULATION

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UNIT 3

CONTROL AND REGULATION

INTRODUCTION

All day long, even when you sleep, your body produces waste substances. This is because of the many reactions going on inside the cells. Your body must get rid of these substances because they are poisonous. Water is used by the body cells for them to work properly. It is also needed to carry dissolved substances through the body.

Your kidneys control the amount of water and salts in your body and they also help to remove harmful substances. In this Unit, we see how this balance is maintained by the body.

OBJECTIVES

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

- define homeostasis and excretion
- name the excretory organs in the human body
- list the excretory products
- describe the external features of kidneys and associated structures
- describe the functions of the kidneys.

3.0 HOMEOSTASIS

The cells in your body are bathed in a liquid called tissue fluid. This forms the internal environment in which the cells of your body live. This internal environment remains almost constant. Many organs in your body work day and night to make the correct changes to allow this to happen. This maintenance of a constant internal environment is called **homeostasis**.

Examples of homeostatic control are:

1. Water balance - your body controls the amount of water in the tissue fluid. This prevents body cells from being damaged.
2. Glucose level - The concentration of glucose in your blood is maintained within acceptable limits.
3. Body temperature - Your body temperature remains more or less constant at 37°C. This is necessary for the functioning of enzymes and for your own metabolic activities.

3.1 EXCRETION

Your body works like a chemical factory. The body produces many waste substances. Some of these are even toxic. The body must remove these toxic substances for it to function properly and healthily. The process of removing the waste products of metabolism from the body is called excretion. These metabolic waste products are mostly carbon dioxide, water, urea and excess salts in the body fluids. There are organs responsible for removing them in our body. Let's now turn to them.

3.1.1 EXCRETORY ORGANS

1. Lungs

Your lungs remove carbon dioxide when you breathe out.

2. Skin

Your skin contains sweat glands. These excrete small quantities of urea, salt and water in sweat.

3. Kidneys

Your kidneys are your main excretory organs. They remove urea, surplus water and salts as well as other unwanted substances from your blood.

3.1.2 THE URINARY SYSTEM

This system consists of your kidneys and related structures. It plays an important role in excretion.

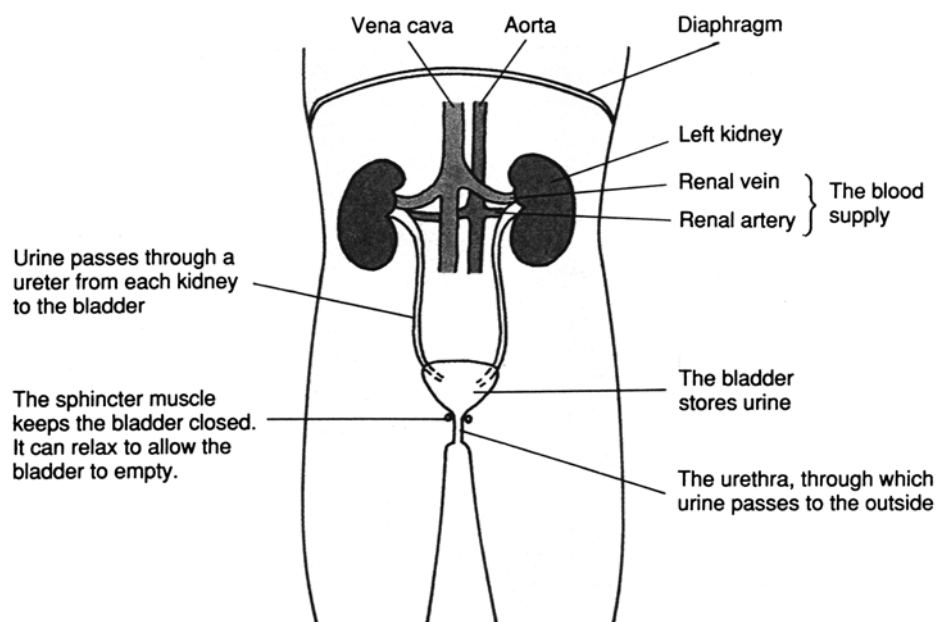


Fig. 13: The Urinary system of Man

This system consists of the following:

(i) Kidneys

You have a pair of kidneys towards the back of your body just above your waist. Each kidney is a red bean-shaped structure found on either side of the backbone in your lower abdomen. The kidney is supplied with blood through the renal artery. The renal vein returns blood from the kidney to the vena cava.

If the kidney is cut longitudinally, it is found to consist of

- (a) a dark outer layer called the cortex
- (b) a paler inner layer called the medulla.

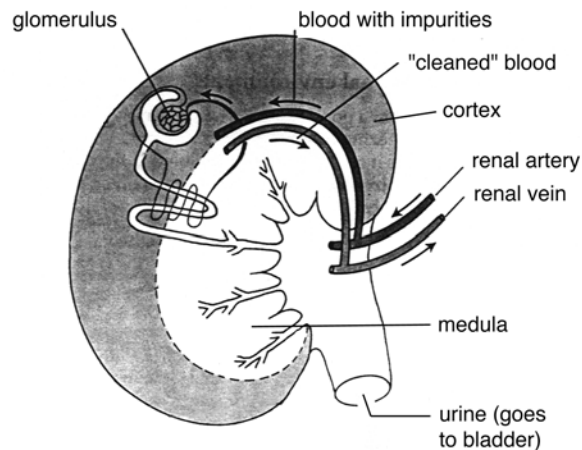


Fig. 14: Longitudinal Section through a kidney

Inside each kidney are millions of very tiny tubes called nephrons. These filter your blood and help to get rid of the metabolic wastes together with surplus salts and water. These become urine.

(ii) Ureters


These are muscular tubes which connect the kidneys to the urinary bladder. They carry urine to the bladder.

(iii) Bladder

It is a muscular bag situated in the lower abdominal cavity. It stores urine temporarily.

(iv) Urethra

This is a narrow, muscular tube. In males it passes through the penis while in females it opens close to the vagina. It carries urine out of your body.

 ***Before proceeding further, complete the following activity.***

ACTIVITY 1

1. Define homeostasis.

.....
.....

2. (a) What is meant by excretion?

.....

(b) *What would happen to you if excretion stops in your body?*

.....

3. (a) *Name three excretory organs in your body.*

.....

(b) *State the excretory waste removed by each of the organ you named in (a).*

.....

.....

.....

4. *Name the blood vessels which (i) bring blood to*

(ii) take blood away from the kidneys.

.....

.....

5. *State the function of the*

(a) *kidneys*

.....

(b) *ureters*

.....

(c) *urethra*

.....

(d) *bladder*

.....

You will find the answer at the end of the Module.

3.1.3 WORKING OF A NEPHRON

Your blood is filtered in a structure called the glomerulus found in the cortex of the kidney. The filtrate then passes into the nephron. This contains useful substances like glucose and vitamins as well as metabolic wastes like urea and excess salts.

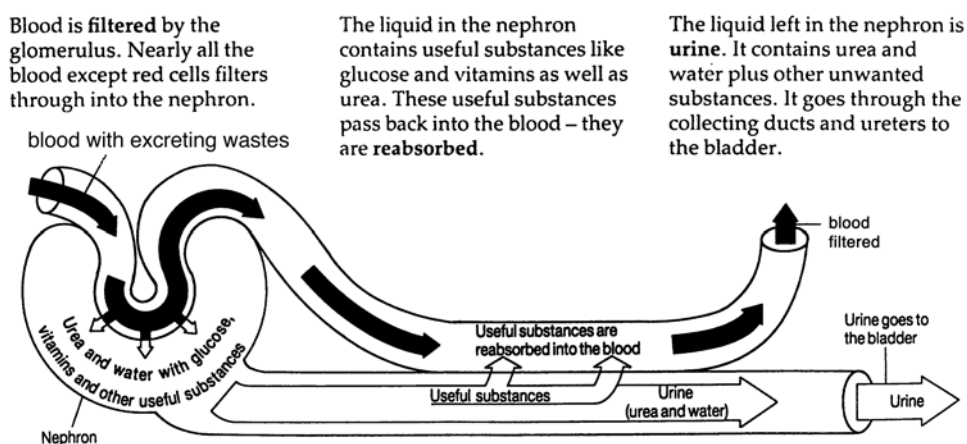


Fig. 15: Working of a Nephron

The useful substances such as glucose, amino acids, vitamins and mineral salts pass back into the blood by a process of selective reabsorption. The unwanted waste substance is left to form urine. This contains mostly urea, excess water and salts. It goes through the ureters to the bladder.

We can now proceed with the following investigation.



INVESTIGATION 1: To examine a mammalian kidney

For each investigation you will require the materials indicated.

**You should record
your answers in the
space provided.**

Materials needed:

- One half of a sheep's kidney
- hand lens

Method:


- 1. You are provided with half a kidney from a sheep*
Observe it carefully with the help of a hand lens.
Describe its appearance.

.....

.....

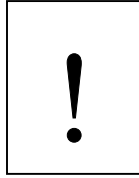
.....
- 2. In the space below, make a labelled drawing of the*
cut surface.

	<p>3. <i>Name the tube which takes urine from the kidney to the bladder.</i></p> <p>.....</p> <p>.....</p> <p>4. <i>State the function of the urethra.</i></p> <p>.....</p> <p>.....</p> <p>.....</p>
--	---

 *Before proceeding further, complete the following activity.*

<p style="text-align: center;"><u>ACTIVITY 2</u></p> <p>1. (a) <i>Where is your blood filtered?</i></p> <p>.....</p> <p>.....</p> <p>(b) <i>What prevents useful substances being lost from the body?</i></p> <p>.....</p> <p>.....</p>
--

You will find the answer at the end of the Module.



POINTS TO REMEMBER

- The maintenance of a constant internal environment in your body is called homeostasis.
- The removal of metabolic wastes from your body is known as excretion.
- The main excretory organs are the lungs, kidneys and skin.
- Common excretory products are carbon dioxide, urea, excess water and salts.
- Kidneys filter the blood. Metabolic wastes are excreted as urine while useful substances are reabsorbed from the filtrate.
- Ureters are tubes which carry urine to the bladder.
- The urinary bladder stores urine temporarily.
- The urethra is a narrow tube which carries urine out of your body.

ANSWER TO ACTIVITIES

UNIT 1

Activity 1

1. (a) xylem (b) skeleton
2. They show growth movements in response to these stimuli.
3. (a) light; gravity; light; photosynthesis; water; mineral salts.
(b) turgid; support.

Activity 2

1. Endoskeleton - found in mammals
 Exoskeleton - found in insects
 Hydrostatic skeleton - found in earthworms.
2. (a) It is found inside the body and is covered by muscles.
 (b) (i) brain (ii) spinal cord (iii) heart and lungs.
3. gives shape and strength to the body.
 provides support to the body.
 provides surface for muscle attachment.
4. (a) It is a meeting point of two or more bones.
 (b) hinge - elbow joint
 ball and socket joint – shoulder joint.

Activity 3

- Muscles are special tissues. They work by their contractions.
 - by strong fibres called tendons.
- | | | |
|---------------------|---|--|
| Voluntary muscles | - | skeletal muscles (biceps, triceps) |
| Involuntary muscles | - | muscles in wall of blood vessels and the alimentary canal. |
| Cardiac muscles | - | Heart muscles |
- They can only contract to show their action. Muscles work in antagonistic pairs to bring about body movements.
- | | |
|-----------------------------|--|
| <u>Heart muscles</u> | <u>Muscles in arm</u> |
| They respond by themselves. | They respond to changes in the surroundings. |
| Do not get tired easily. | Gets tired easily. |
- Refer to Fig 6 - 7.5

UNIT 2

Activity 1

1.
 - (a) A change in the environment is a stimulus.
 - (b) A receptor is the part of the body which detects stimuli.
 - (c) An effector is a structure which reacts or responds to stimuli.
 - (d) Hormones are chemical messengers in the body.
2. The pancreas secretes insulin.
Adrenal glands secrete adrenaline.
3. It promotes absorption of glucose by the liver and muscle cells. It converts glucose to glycogen. It increases the rate at which glucose is used up by body cells.
4.
 - (a) In emergency situations.
 - (b) It speeds up heart beat, breathing, raises blood pressure and increases the rate at which glucose is used by the body cells. It helps to give extra energy.

Activity 2

1. The brain, spinal cord, nerves.
2. The sensory nerve cell, motor nerve cell.
3. It is the form in which messages travel along nerve fibres.
4. The skin, tongue, nose, ears, eyes.
5.
 - (a) It is an automatic response to a stimulus. It is an involuntary action done without thinking.
 - (b) Removing the hand when one accidentally touches a hot object.
 - (c) It is the pathway of nerve impulses during a reflex action.

6. (a) These are actions initiated by the brain. They need thinking and are carried out according to our wish.
- (b) Writing a letter.

Activity 3

1. It is the deliberate and excessive use of drugs causing physical, mental, emotional and social harm to someone and those close to him or her.
2. It means that the abuser needs this substance to function. The abuser cannot do without this substance.
3. (a) Stomach ulcers, brain damage, cancers of the digestive system, heart diseases.
(b) Violence, theft, road accidents, family problems, financial hardship.
4.
 - affects thinking and learning
 - produces panic, anxiety and affects the respiratory system.
 - reduces resistance against infections.

UNIT 3

Activity 1

1. It is the maintenance of a constant internal environment in the body.
2.
 - (a) It is the process by which metabolic wastes are removed from one body.
 - (b) The body cells will be poisoned by excretory wastes. This may lead to death.
3.
 - (a) Lungs, skin, kidneys
 - (b) Lungs - carbon dioxide
Skin - excess salts, urea.
Kidneys - excess water, salts and urea.
4.
 - (i) renal artery (ii) renal vein
5.
 - (a) To filter blood and remove toxic wastes.
 - (b) To carry urine from kidneys to the urinary bladder.
 - (c) It carries urine out of the body from the urinary bladder.
 - (d) It stores urine temporarily.

Activity 2

1.
 - (a) In the glomerulus in the kidneys.
 - (b) Selective reabsorption prevents the loss of useful substances.

