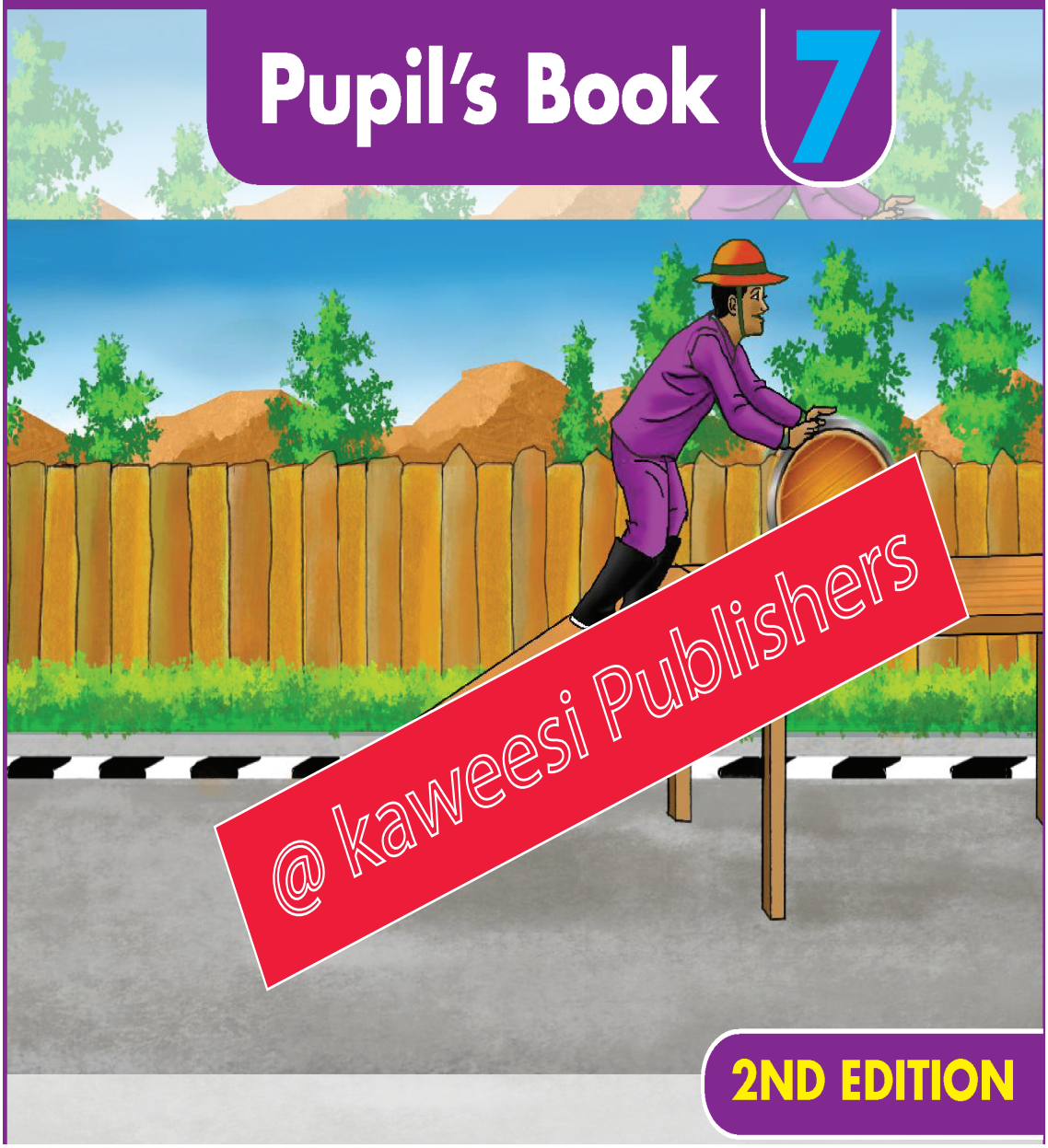
UNDERSTANDING SCIENCE

Pupil's Book 7



2ND EDITION

Contents

Topic 1: Muscular-skeletal system

The skeletal system is the support system of the body.

Skeleton
A skeleton is a structure that gives support and protection to the body of an organism.

Types of skeletons
- Hydrostatic skeleton
- Endoskeleton
- Exoskeleton

Hydrostatic skeleton
Hydrostatic skeleton is the type of skeleton where the body cavity of an organism is filled with a fluid under pressure. The pressure enables the body to maintain shape. Organisms that have a hydrostatic skeleton include;
- Earthworms
- Octopus
- Snails
- Oyster
- Slugs
- Leeches

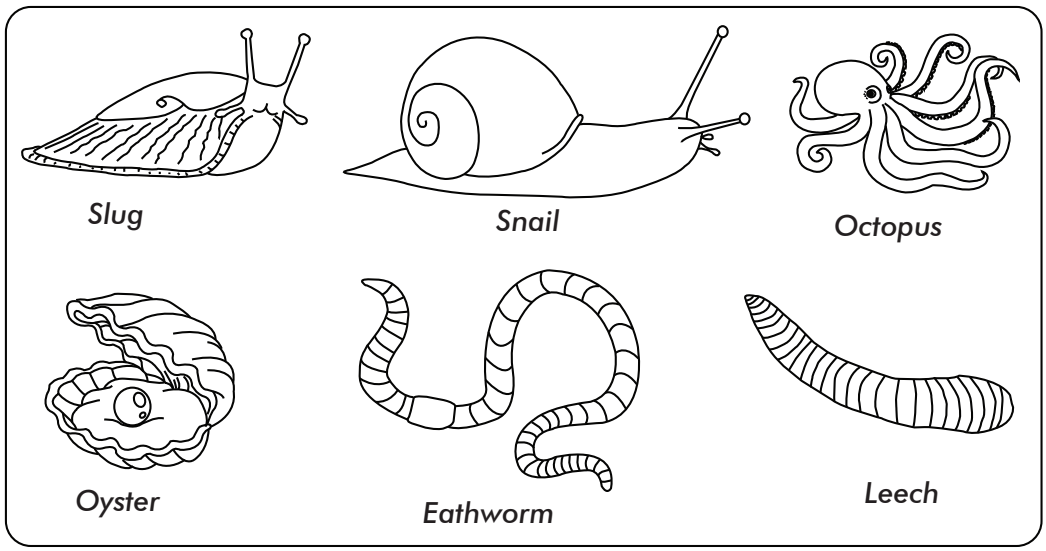


Figure 1.1: Examples of organisms with hydrostatic skeleton.

Exoskeleton
Exoskeleton is the type of skeleton found as a hard covering on the outside of the body of an organism. The hard outer covering is called **cuticle**. It is mainly found in **arthropods** such as insects. The exoskeleton provides effective protection and support for the soft parts of the body.

The exoskeleton limits the size of an organism and therefore, such organisms only grow by ecdysis or moulting. **Moulting** is the process by which organisms shed their exoskeleton in order to grow.

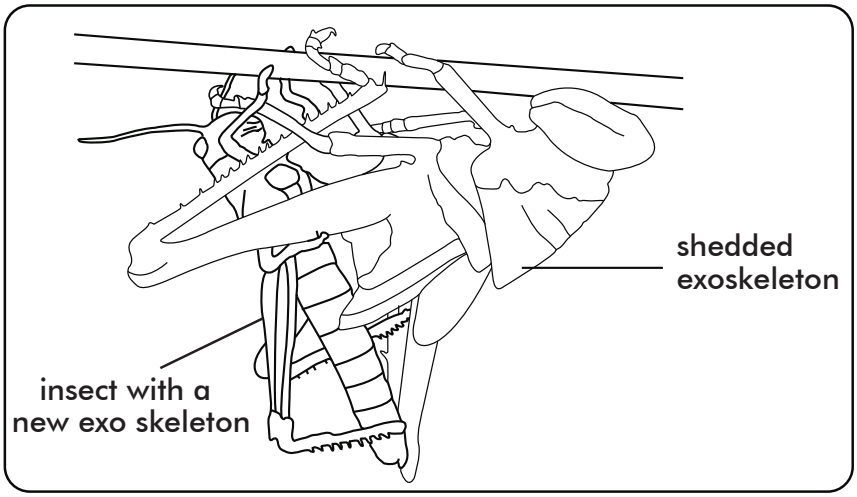


Figure 1.2: Illustration of an insect undergoing moulting.

Organisms that have exoskeleton

These are the arthropods. They include insects like;

- Butterfly
- Tsetse fly
- Mosquito
- Cricket
- Housefly
- Crab
- Grasshopper
- Moth
- Tick

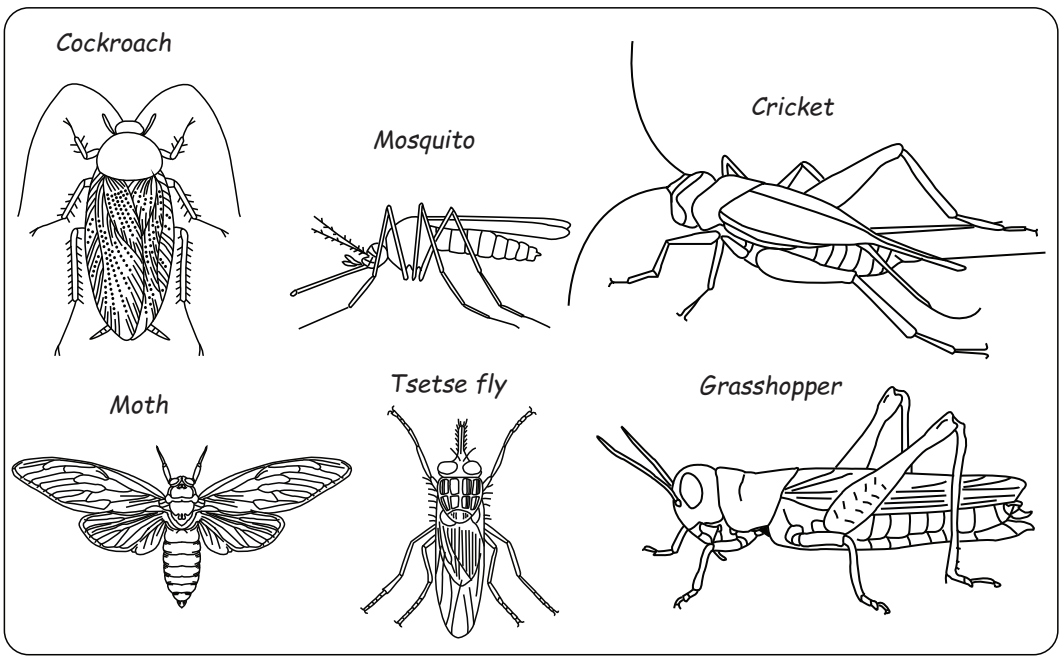


Figure 1.3: Examples of organisms with exo skeleton.

Endoskeleton

Endoskeleton is the type of skeleton found as a main supporting frame inside the body of an organism. Endoskeleton is made of bones and cartilage. All vertebrates have endoskeleton. Organisms that have endoskeletons include; birds, amphibians, reptiles and mammals such as dogs and monkeys.

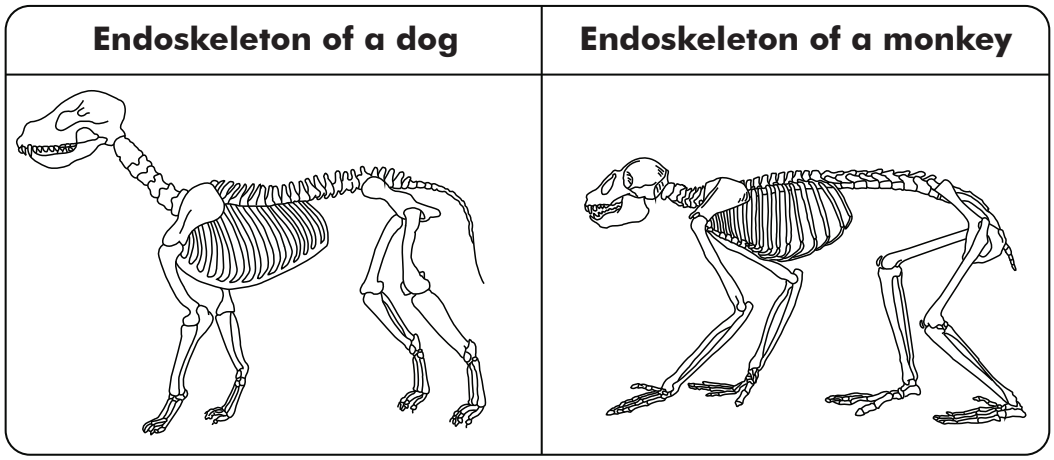


Figure 1.4 A skeleton of a dog and a monkey.

Structure of the human skeleton

The human skeleton is the framework of bones in the body. The skeleton of a newly born baby consists 270 bones. As a person grows, different bones fuse together reducing the number to 206 bones in adults. Human skeleton is an example of endoskeleton.

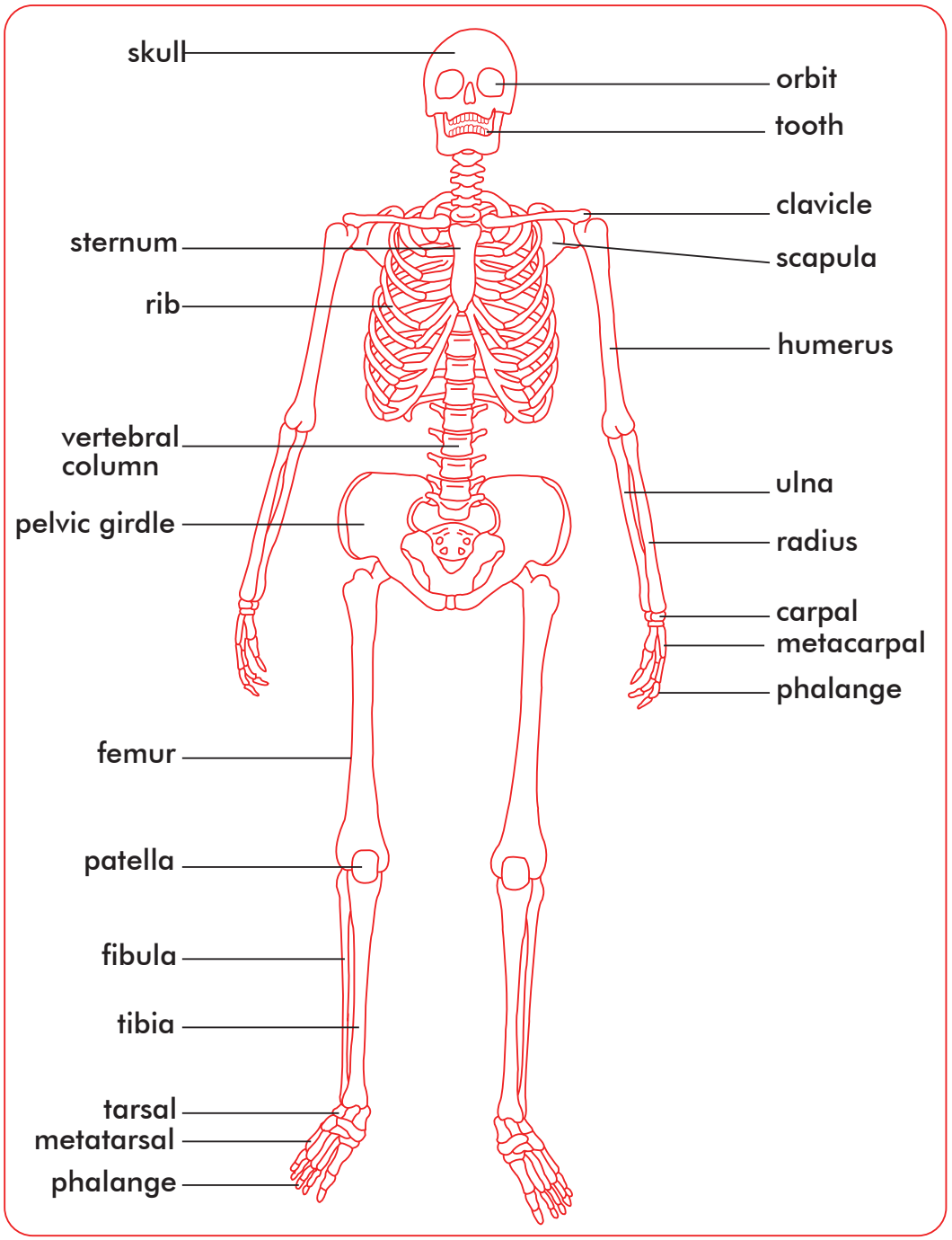


Figure 1.5: The human skeleton

Regions of the human skeleton

Endoskeleton is composed of two divisions (regions) which include;

- Appendicular skeleton
- Axial skeleton

Appendicular skeleton

Appendicular skeleton is the part of the skeleton that consists of the **girdles** (pelvic girdle and pectoral girdle) and the **limbs** (legs and arms).

The pectoral girdle is made up of the **scapula** and **clavicle**. Pelvic girdle is made up of three small bones, that is, **ilium**, **pubis** and **ischium**.

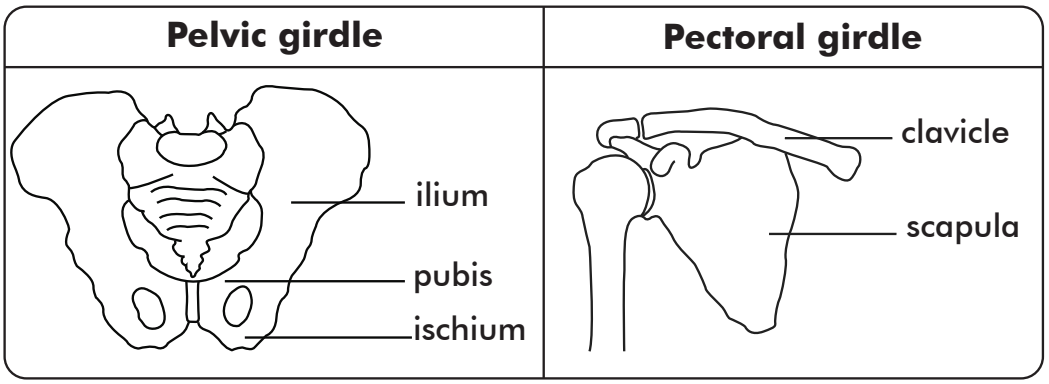


Figure 1.6: The pelvic girdle and pectoral girdle.

The arms are composed of:

- Long bone of the upper arm called **humerus**.
- Fore arm bones namely **ulna** and **radius**.
- Wrist bones called **carpals**.
- Palm bones called **metacarpals**.
- Finger bones called **phalanges**.

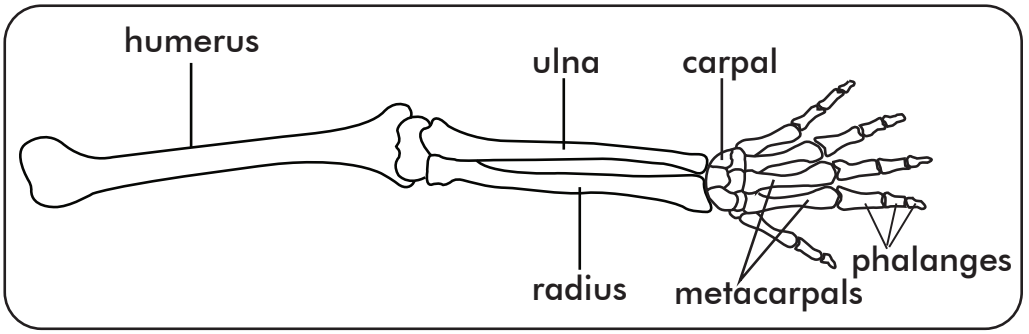


Figure 1.7: Structure of bones of the arm.

Axial skeleton

Axial skeleton is composed of the skull, ribs, sternum and the vertebral column. The skull is composed of many flat bones joined together by immovable joints at sutures to form a case.The vertebral column is composed of different types of small bones called **vertebrae**.

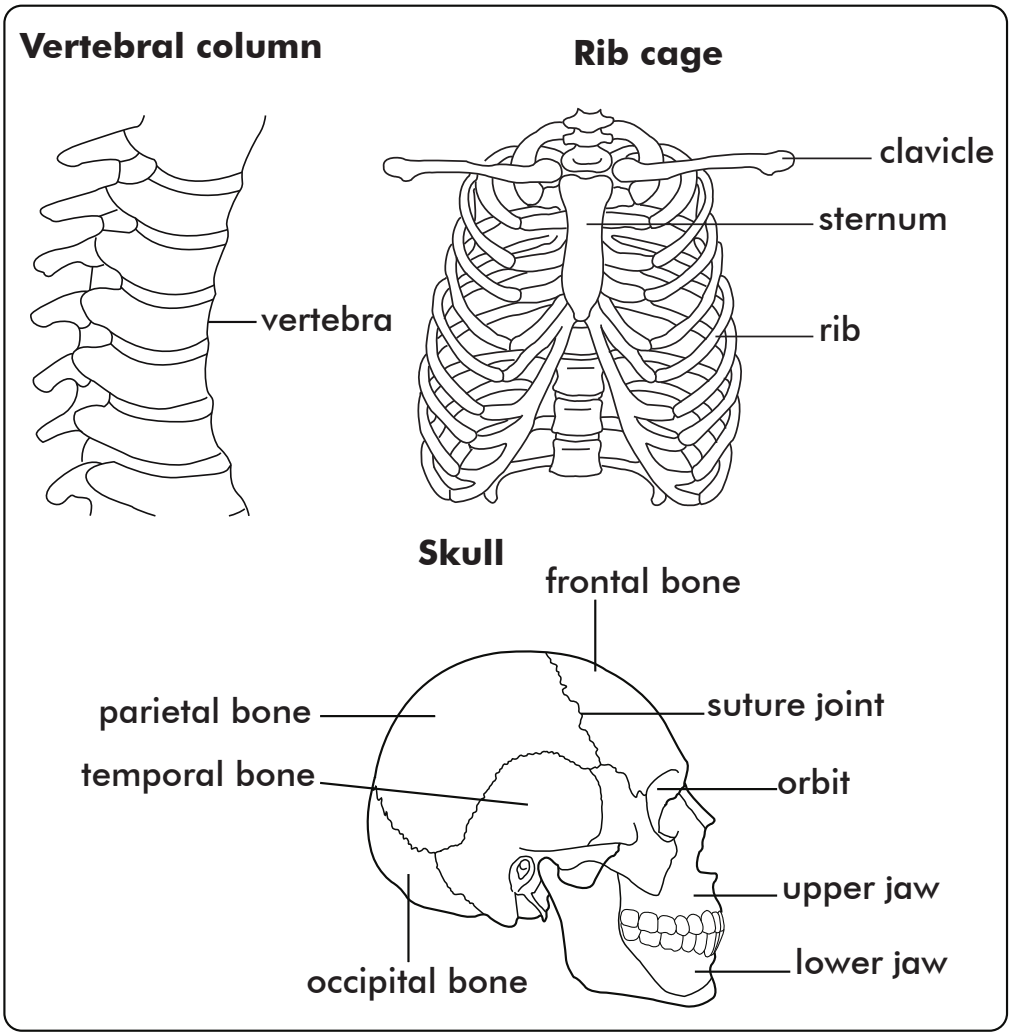


Figure 1.8: Parts of the axial skeleton.

Bones

Bones are hard tissues found inside the body of vertebrates. The adult human skeleton is made up of 206 bones. The young people or animals have more bones but they join as they grow.

Importance of bones in the body

- Bones produce red and white blood cells.
- Bones store minerals in the body.
- Bones provide surfaces for muscle attachment.
- Bones aid in body movement.

Types of bones

- Long bones
- Flat bones
- Short bones
- Irregular shaped bones
- Sesamoid bones

Long bones

Long bones are bones which are longer than they are wide. Examples of long bones include;

- Femur
- Humerus
- Tibia
- Metatarsals
- Radius
- Fibula
- Ulna
- Metacarpals
- Phalanges

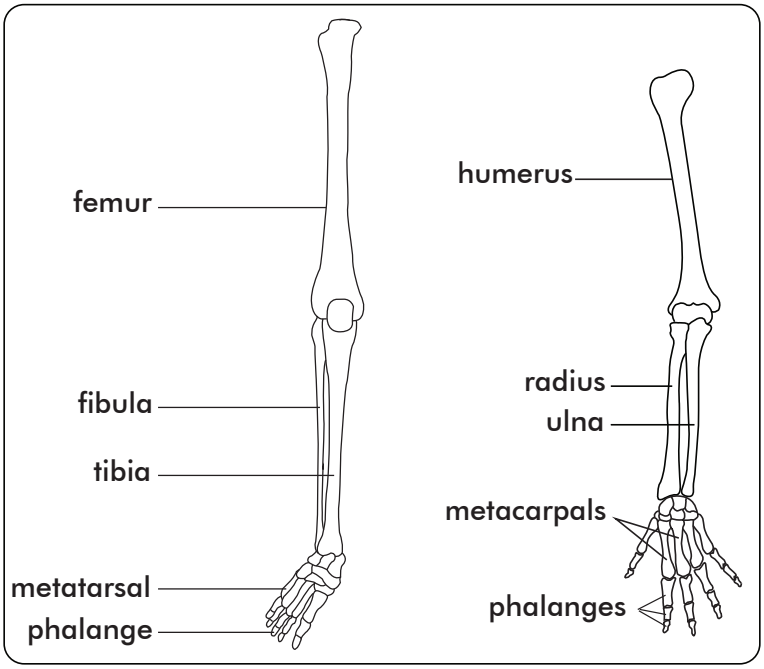


Figure 1.9: Illustration of long bones.

Femur and humerus

The longest bone in the body is **femur**. The femur is found in the thigh. This is why it is called a femur bone. The femur and humerus look alike. The difference is that the humerus is shorter. The humerus is found in the upper part of the arm.

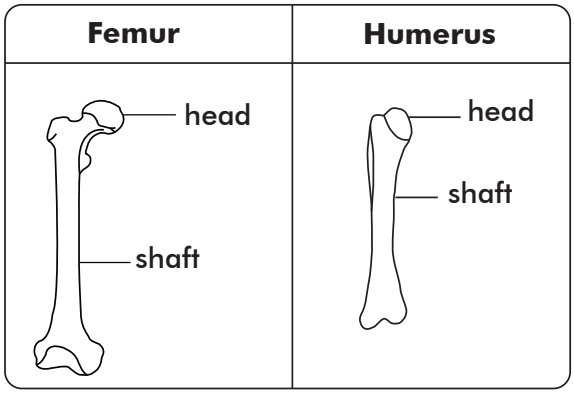


Figure 1.10: Structure of the femur and humerus.

Short bones

Short bones are bones which are as wide as their length. The common examples of short bones include;

- Carpal
- Tarsal

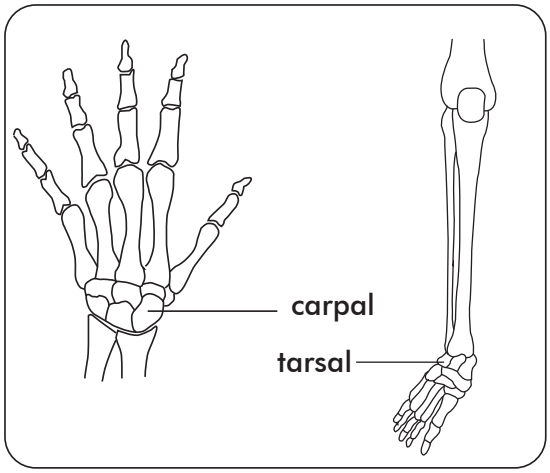


Figure 1.11: Illustration of short bones.

The flat bones

The flat bones are plate-like bones. They are commonly found in the skull, ribcage and the pelvis. The main function of flat bones is to protect internal body organs. Examples of flat bones include;

- Ribs
- Sternum
- Scapula
- Occipital bone
- Frontal bone
- Parietal bone
- Ilium
- Pubis
- Ischium

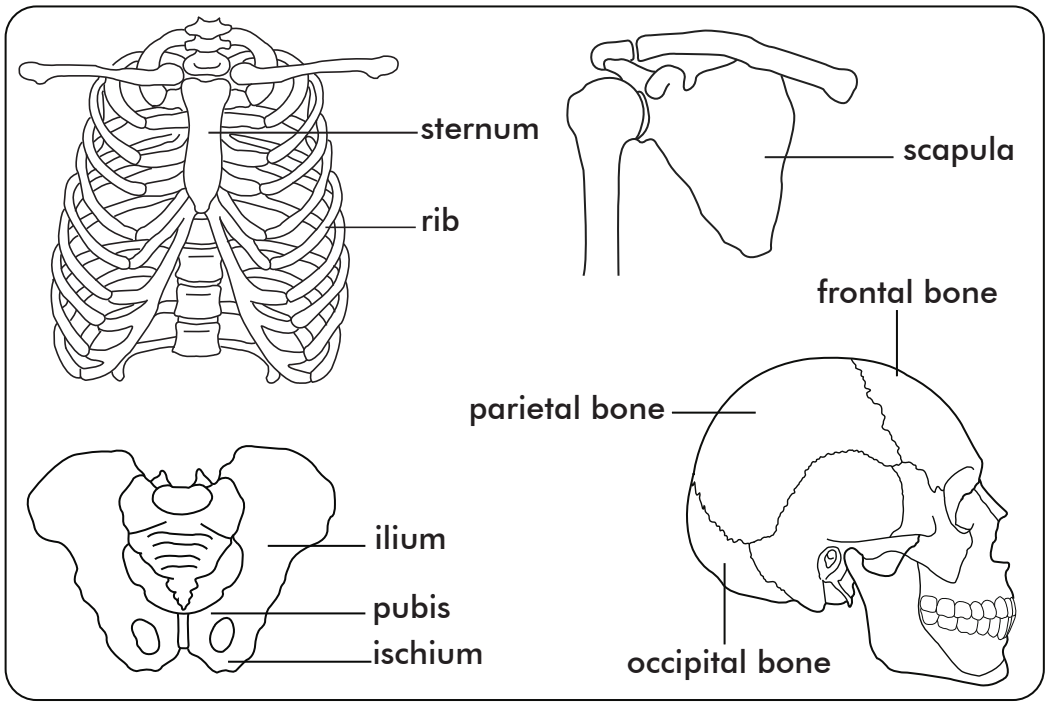


Figure 1.12: Illustration of flat bones.

The irregular shaped bones

Examples of irregular shaped bones are vertebrae, sacrum and temporal bone.

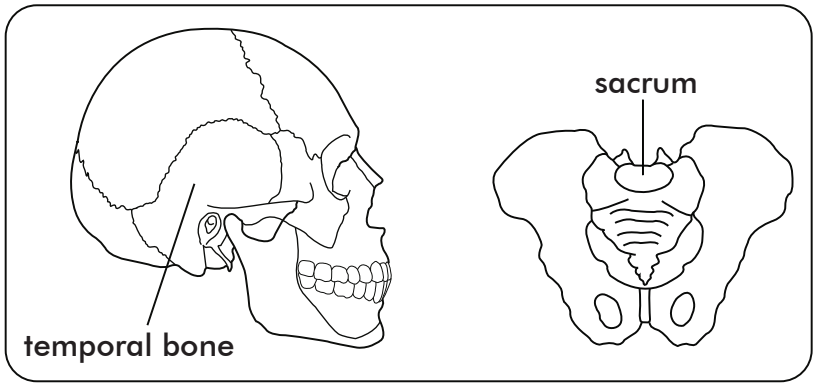


Figure 1.13: Irregular shaped bones.

Sesamoid bones

Sesamoid bones are bones surrounded by tendons. For example, patella (knee cap).

Protective functions of the skeleton

- The skull protects the brain, inner ear and eyes.
- The rib cage protects the lungs and heart.
- The vertebrae protect the spinal cord.
- The pelvic girdle protects the female reproductive organs.

Joints

A joint is a point where two or more bones meet in the body. Joints aid body movement.

Classification/types of joints

Joints are classified into two main groups.

- Movable joints
- Immovable joints

Immovable joints

Immovable joints are joints that do not allow any movement at all. They are mainly important for mechanical strength. Examples of types of immovable joints include;

- Suture joints in the skull.
- Gomphosis joint between the root of a tooth and the sockets

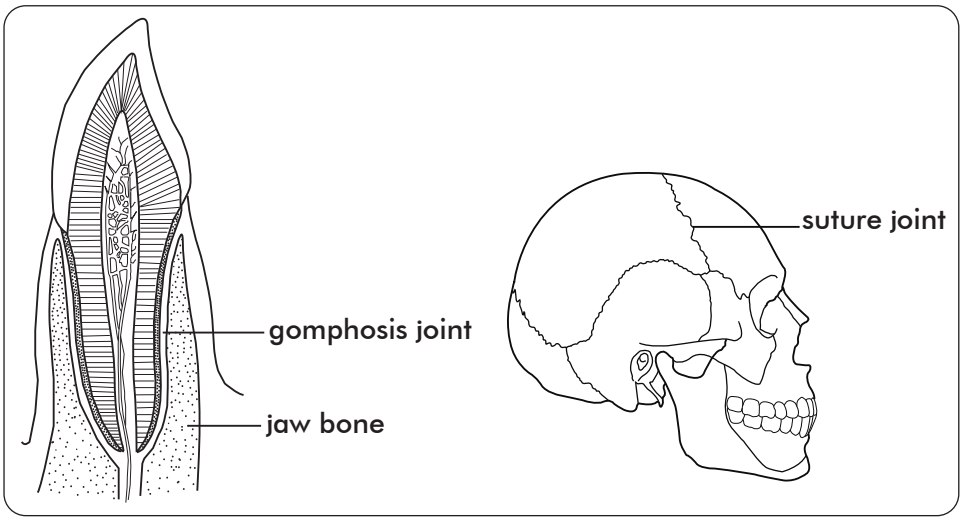


Figure 1.14: Illustration of immovable joints.

Movable joints

Movable joints are also called **synovial joints**. Movable joints are joints which allow movement between bones. Movable joints are classified into four types;

- Hinge joints
- Ball and socket joints
- Pivot joints
- Gliding joints

The hinge joint

The hinge joint is the type of joint that allows free movement in only one plane or direction.

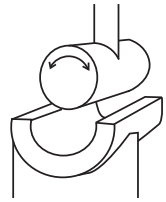


Figure 1.15: Movement of the hinge joint.

Common examples of hinge joints include;

- Knee joint
- Elbow joint
- Finger joints

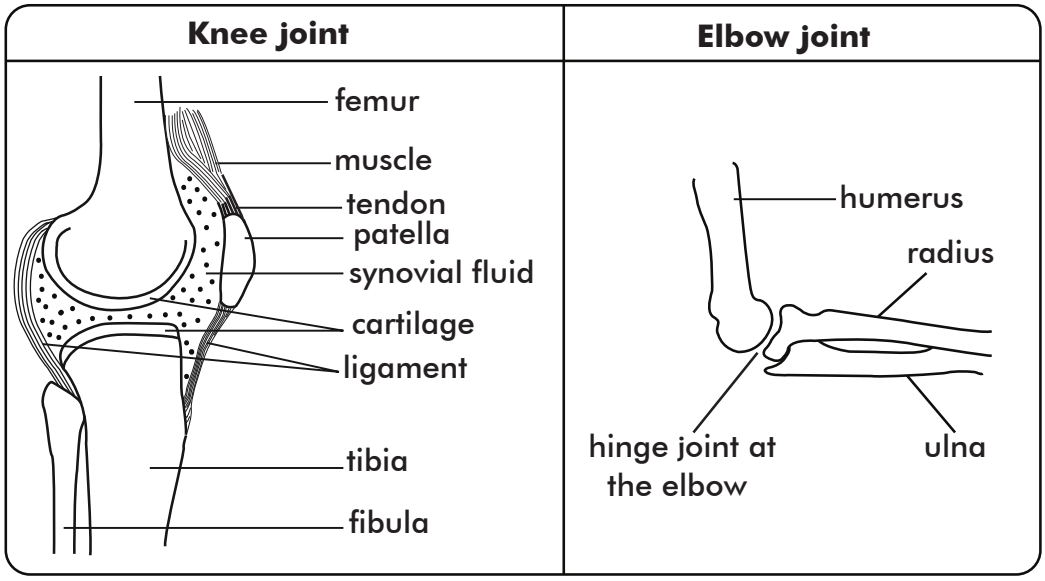


Figure 1.16: Examples of hinge joint.

Parts of a knee joint

- **Synovial fluid:** It reduces friction by lubricating the joints.
- **Ligament:** It joins a bone to a bone at a joint.
- **Tendon:** It joins a muscle to a bone at a joint.
- **Cartilage:** Cartillages are soft, flexible and elastic parts found on bones at joints.
  (i) It absorbs shock at a joint.
  (ii) It reduces friction at a joint.
  Organs that are made up of cartilage include; nose, outer ear and and wind pipe/trachea.

Ball and socket joint

A ball and socket joint is a type of joint that allows movement in many planes/directions.

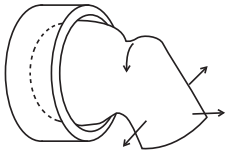


Figure 1.17: Movement of the ball and socket joint.

Examples of ball and socket joint include;.

- **The shoulder joint:** It is found between the scapula and humerus
- **The pelvis (hip) joint:** It is found between the femur and pelvic girdle.

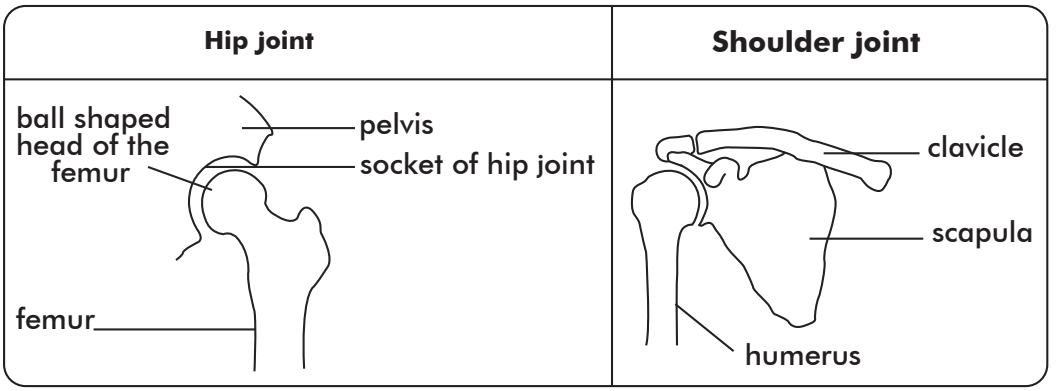


Figure 1.18: Examples of ball and socket joint.

Pivot joint

The pivot joint is the type of joint that allows rotation of certain bones in the body on another fixed bone.

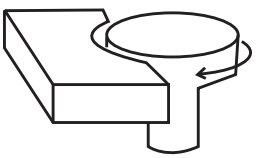


Figure 1.19: Movement of the pivot joint.

The pivot joint in the neck is found between the atlas and the axis bones. The pivot joint enables the nodding and rotation of the head. The atlas vertebra rotates on the axis vertebra.

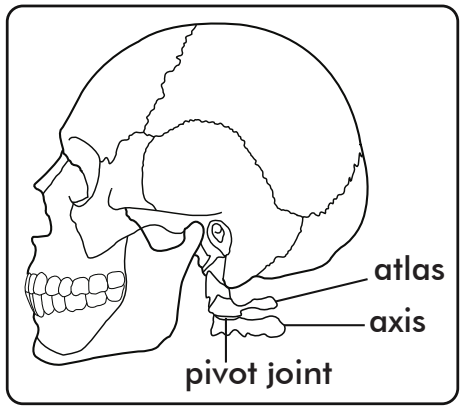


Figure 1.20: Illustration of the pivot joint.

Gliding joint

Gliding joint is a joint where two flat bones slide over one another to allow movement. The common examples of gliding joints are;

- Wrist joint
- Ankle joint

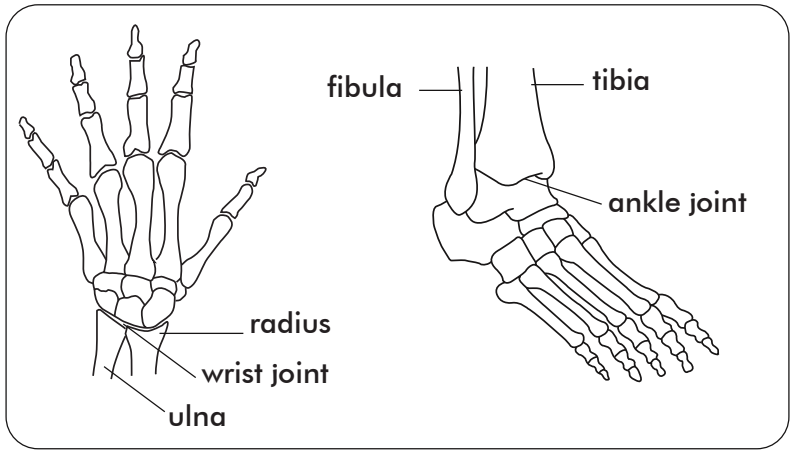


Figure 1.21: Illustration of gliding joint.

Muscles

A muscle is a fibrous tissue which contracts to cause movement of a part or entire body.

Importance of muscles

- Muscles aid body movement. They contract and relax to allow body movement.
- Muscles store oxygen for the body in form of myglobin. This oxygen is released during vigorous exercise when the supply of oxygen is limited.

- Heart muscles pump blood in the body.
- Intercostal muscles aid breathing.
- They aid movement of food in the alimentary canal.

Types of muscles

- Voluntary muscles
- Involuntary muscles
- Cardiac muscles

Voluntary muscles

They are also called **skeletal muscles**. They are called skeletal bones because they are attached to bones and concerned with locomotion. Voluntary muscles are muscles that are controlled by the brain. They aid movement in the body. Examples of voluntary muscles include; **Biceps muscles** and **triceps muscles**.

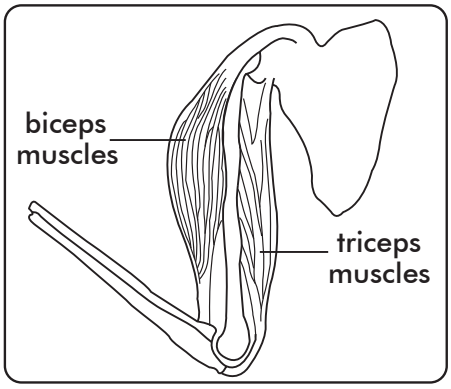


Figure 1.22: Biceps and triceps muscles

Involuntary muscles

They are also called **smooth muscles**. Involuntary muscles are muscles whose movement is automatic. They are found in the walls of hollow organs of the body. For example, muscles of gut (alimentary canal), uterus and bladder. They are concerned with movement of materials through these organs. Examples of smooth muscles are **cardiac sphincter muscles** and **pyloric sphincter muscles** of the stomach.

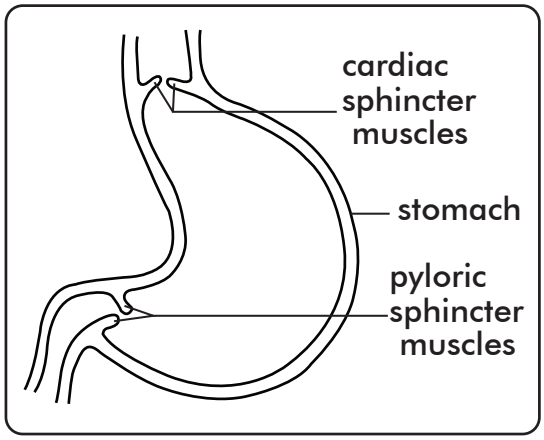


Figure 1.23: Examples of smooth muscles.

Cardiac muscles

Cardiac muscles are found in the heart.

Note: Smooth and cardiac muscles operate automatically (involuntary).

Antagonistic muscles

Antagonistic muscles are muscles that work in pairs and have opposite effect to each other. The biceps muscles and triceps muscles are examples of antagonistic muscles.

When the arm is straight, the biceps relax and the triceps contract. When the arm is raised or bent the biceps muscles contract and the triceps muscle relax. This enables the lower part of the arm to bend and straighten.

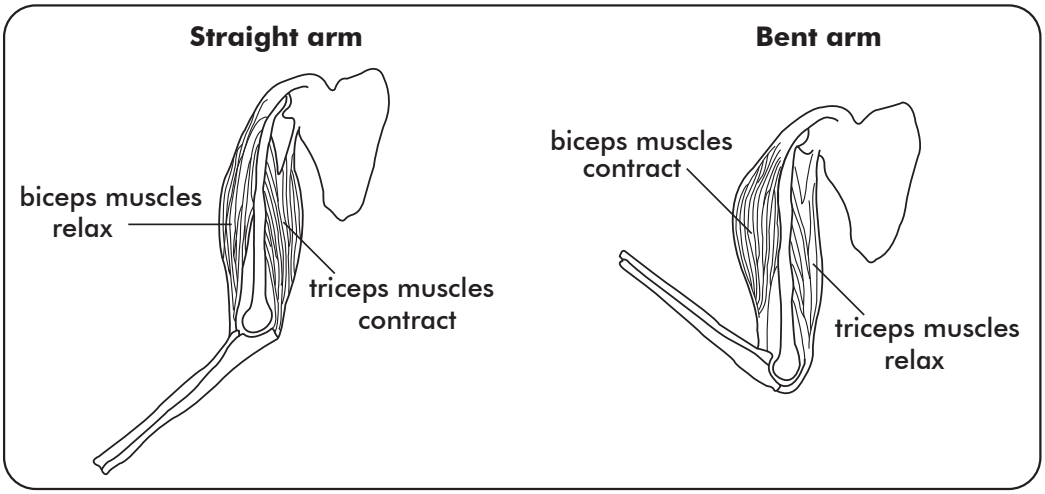


Figure 1.23: Examples of smooth muscles.

Functions of the skeleton

- It gives shape to the body of an organism. It forms a frame on which the internal organs are suspended and kept in position.
- The skeleton aids body movement. It provides areas where muscles can be attached to the body parts especially at the joint.
- It manufactures red blood cells and white blood cells. The red blood cells are made in the bone marrow of short bones whereas white blood cells are made in the bone marrow of long bones.
- It stores calcium and phosphorus in the bones.
- It aids transmission of sound in the ear by the ear ossicles.
- It protects delicate body organs such as lungs and the heart.
- It is used in nutrition. The teeth are body structures used for tearing, cutting and grinding food.
- It is used in breathing. The rib cage adjusts the volume of the thoracic cavity during breathing.

Parts of the skeleton and the body organs they protect

Part of skeleton	**Body organs it protects**
Skull	Brain, eyes and inner ear.
Vertebral column	Spinal cord
Rib cage	Lungs and heart

Diseases of the skeletal and muscular system

- **Rickets:** It is a food deficiency disease caused by lack of vitamin D in the body. It occurs in young children. It affects **bones** and **teeth**.
- **Poliomyelitis:** It is caused by a virus that is transmitted through contaminated water and food, that is, it is a water borne disease. It affects **bones** and **muscles**.
- **Tuberculosis (T.B):** It is caused by a bacterium called mycobacterium. It affects **lungs** or **bones** and **muscles**.
- **Tetanus:** Tetanus is caused by a bacterium called clostridium tetani and it spreads through cuts and wounds. It affects **muscles**.
- **Arthritis:** It affects **joints**.
- **Bone cancer:** It affects the **bones**.

Disorders of the skeletal and muscular system

A **disorder** is a condition which prevents part of the body from performing its function properly. The following are disorders of the skeletal system;

- **Sprain:** It is an injury on a ligament. It can also be defined as a stretched or torn ligament.
- **Strain:** It is an injury on a muscle or tendon. It can also be defined as a torn or stretched muscle or tendon.
- **Dislocation:** This is when a bone is displaced from its normal position.
- **Cramps:** These are painful involuntary skeletal muscle contractions.
- **Fracture:** It is a broken or cracked bone in the body.

Types of fractures

- **Simple fracture:** This is when the bone breaks and remains inside the skin.
- **Compound fracture:** This is when the bone breaks and comes out of the skin.
- **Greenstick fracture:** It is a fracture in which the bone bends and cracks. Greenstick fractures occur most often during childhood when bones are soft.
- **Comminuted fracture:** It is a fracture in which the bone breaks into more than two fragments.

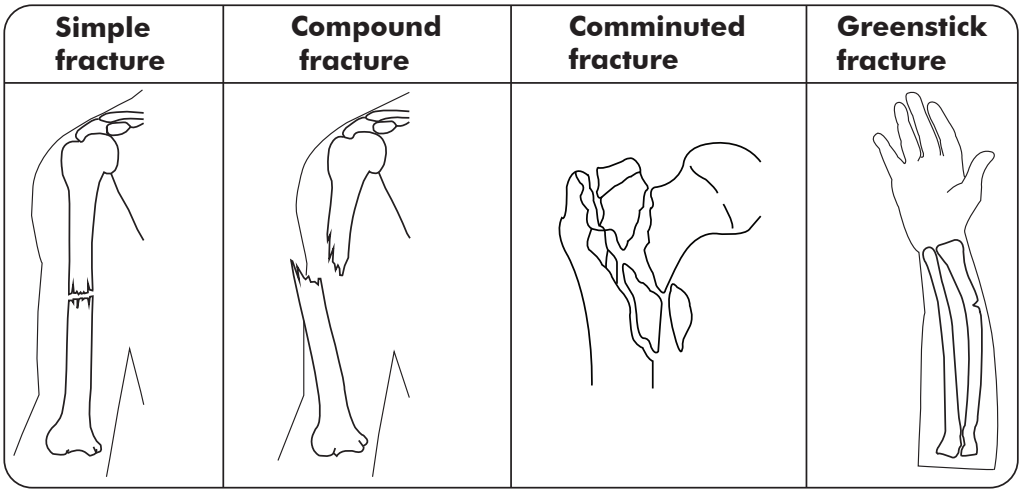


Figure 1.25: Types of fractures.

Posture

Posture is the positioning of the body in everything we do.

The correct sitting posture

- Sit up straight on the chair.
- Place both feet on the floor.
- Put all your weight on both bottoms.
- Do not tighten your ankles and knees.

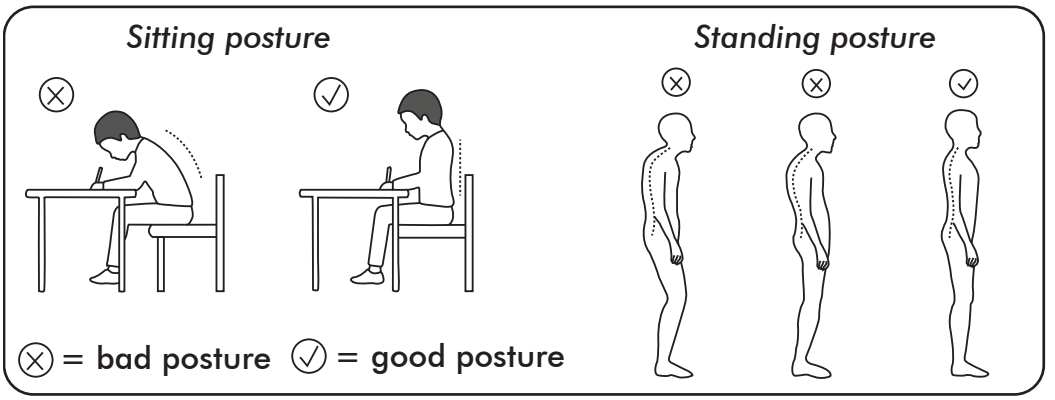


Figure 1.26: Illustration of good and bad posture.

Importance of good posture
- It controls strains and sprains.
- It aids digestion of food.
- It enables proper growth of bones.

Dangers of bad posture
- It hinders digestion of food.
- It deforms bones.
- It causes back and back pains.

Testing exercise 1

1. Name one organism that has hydrostatic skeleton.
2. Which part of the skeleton protects the eyes?
3. Give the meaning of a skeleton.
4. State one way the skeleton is useful to the body.
5. Where in the body are white blood cells manufactured?
6. Which type of skeleton does a snake have?
7. Why does a butterfly moult?
8. What is ecdysis?
9. Which part of the human skeleton consists of the girdles and limbs?
10. Which type of bone is the humerus?
11. How are bones useful in the body?
12. Name the longest bone in the human body.
13. Which type of joint do we find in the skull?

The diagram below shows a joint. Use it to answer questions 14-18.

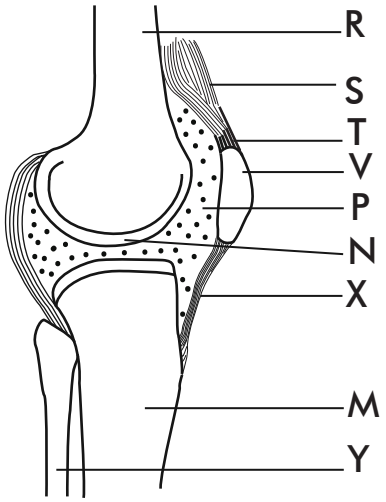


Figure 1.27

14. Name parts;
    (i) R (ii) S (iii) T (iv) V (v) P
    (vi) N (vii) X (viii) M (ix) Y
15. How does part P reduce friction at a joint?
16. State the use of part N.
17. Name one disease that affects part M.
18. Which type of joint is shown above?
19. Give the difference between hinge and ball and socket joints.
20. State one difference between a ligament and a tendon.
21. Which type of joint is found in the shoulder?
22. How are pivot joints useful in the body?
23. Name one disease of the skeletal system.
24. Name one disorder of the skeletal system.
25. How are muscles useful in the body?
26. Which type of muscles aid movement of the limbs?
27. Give one difference between voluntary and involuntary muscles.
28. Name one disease that affects muscles.
29. Why should school children maintain proper posture when writing work in class?
30. Give one example of antagonistic muscles.

31. Name the part of the skeleton that protects the spinal cord.

32(a) What is a joint?

(b) Give one difference between movable and immovable joints.

33. What happens to biceps and triceps muscles when the;

(i) hand is bent?

(ii) hand is straight?

34. Tom was riding a bicycle and got an accident. One of the bones of his leg came out of the skin and there was a lot of bleeding. What type of fracture did Tom get?

Topic 2: Electricity and magnetism

Electricity

Electricity is a form of energy produced by charged particles. **Electrons** are negatively charged particles of an atom. Atoms are the smallest particles that make up matter.

In an atom, there are three major particles, electrons, protons and neutrons. The nucleus of an atom has protons and neutrons. **Protons** are positively charged particles found in the nucleus of an atom. Electrons are situated along the energy levels of the atom. Neutrons are neutral particles in the atom.

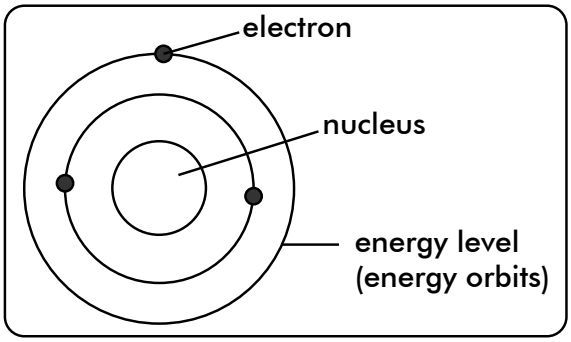


Figure 2.1: Illustration of an atom.

Atoms become electrically charged when they lose or gain electrons, that is, a body gets charged when its atoms gain or lose electrons. This leads to production of electricity.

Types of electricity

There are two types of electricity;

- Current electricity
- Static electricity

Static electricity

Static electricity is the type of electricity in which electrons do not move. Static electricity is produced by friction and occurs on the surface of insulators. Because of friction, some atoms in insulators become negatively charged and others become positively charged. The attraction between the two oppositely charged atoms in the insulators causes electricity. This electricity cannot be transferred from one place to another and that is why it is called static electricity. Lightning is caused by a build-up of static electricity inside a cloud.

Experiment on the production of static electricity

- Rub a plastic material on wool, hair or cloth.
- The plastic material will lose electrons and become positively charged.
- The plastic material will attract small pieces of paper.
- The plastic material will become charged by electrostatic induction.

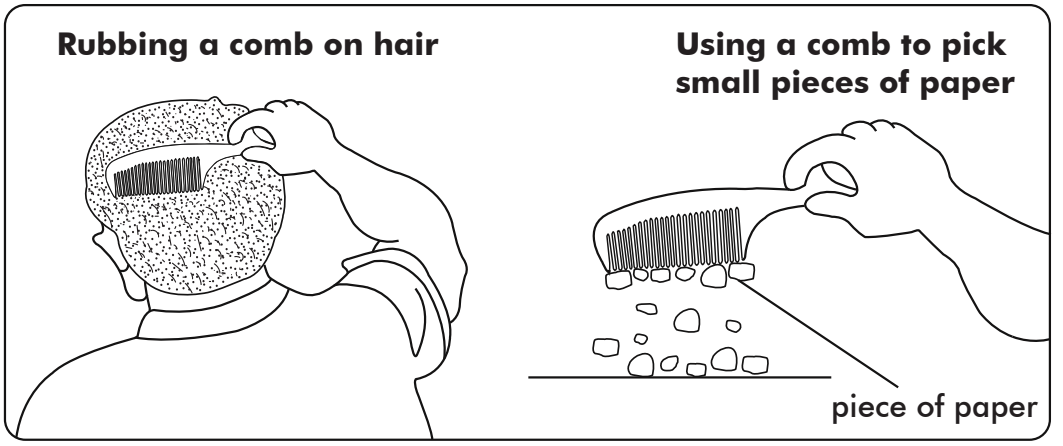


Figure 2.2: Production of static electricity.

Combing transfers electrons from the hair to the comb by friction resulting in the negative charges on the comb and positive charges on the hair.

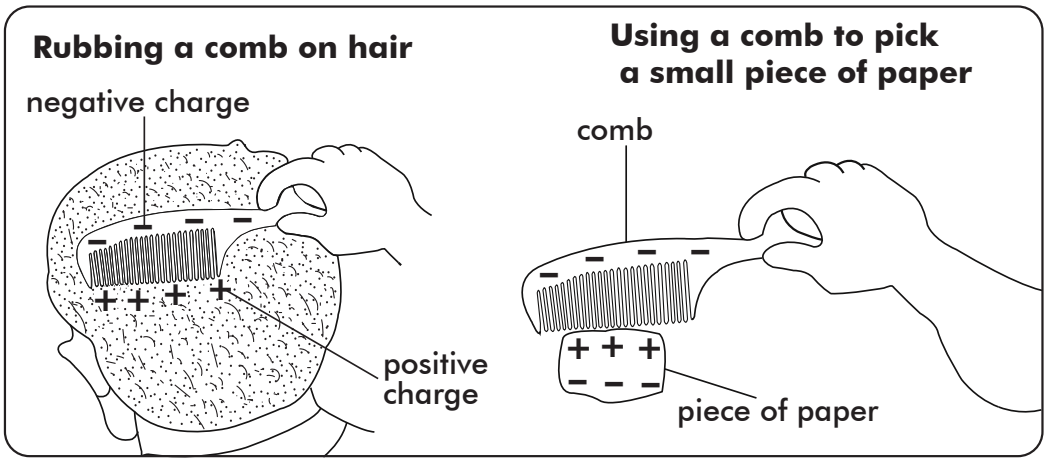


Figure 2.3: Production of static electricity.

Lightning

When clouds move, they get charged by rubbing with air. Lightning is a huge spark produced when a negatively charged cloud meets a positively charged cloud resulting in a spark which is seen as lightning.

When air between the oppositely charged clouds get heated and it expands, it results into thunder. Thunder and lightning occur at the same time but we see lightning before we hear the thunder. This is because light travels faster than sound. Lightning strikes the highest object in the place since it is nearest to the static charges.

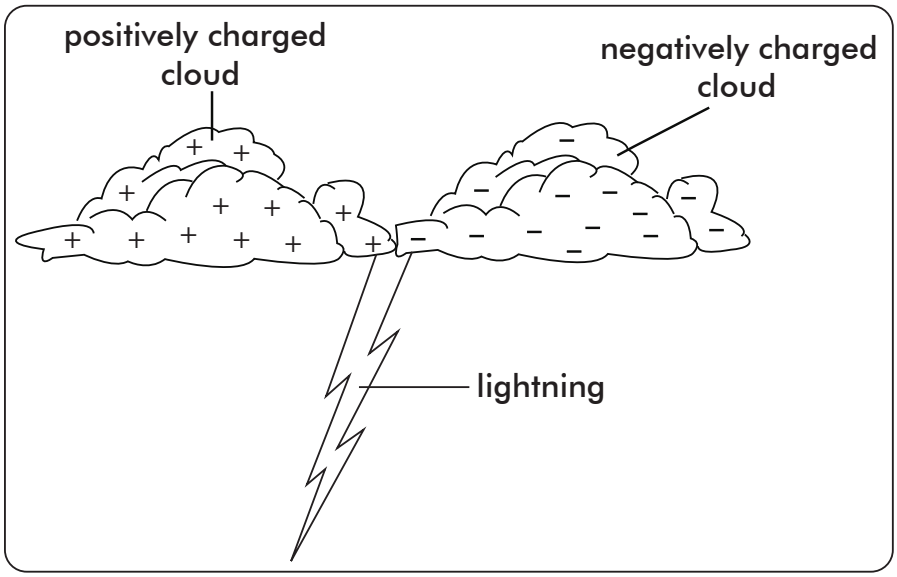


Figure 2.4: Lightning

Importance or advantages of lightning

Lightning changes nitrogen in the atmosphere into nitrates and fixes it into the soil. This makes the soil fertile.

Dangers of lightning

Lightning causes death.
Lightning causes injuries and burns.
Lightning destroys crops, buildings and electronic gadgets.

Protection against lightning

- Avoid taking shelter under trees. Lightning may strike you as charges are passing through the tree.
- Avoid walking barefooted in rain. Charges may pass through you to the ground hence killing you.
- Hold the umbrella by the insulated handle and not on the metallic part.
- Place lightning conductors on tall buildings. The lightning conductors or arrestors will transfer the charges into the ground where they will be neutralized.

- Switch off electric appliances during thunderstorm.
- Do not swim in open pools during thunderstorm.
- Do not fly kites during thunderstorm.

Diagram showing a lightning conductor

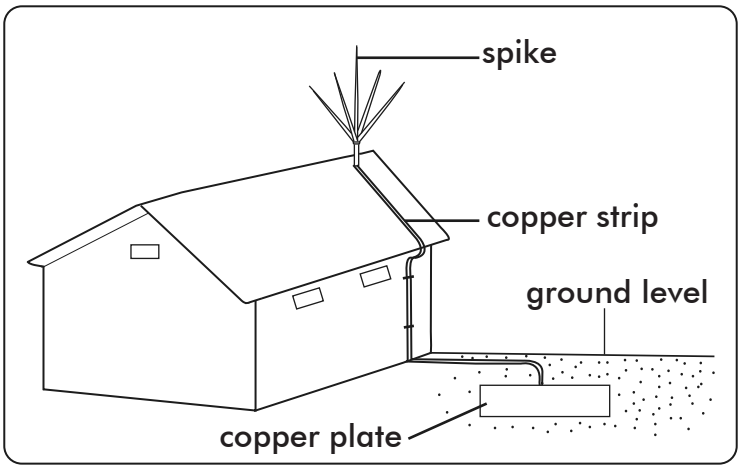


Figure 2.5: A lightning conductor.

The spike attracts the charges as they move from the clouds to the ground. The copper wire directs the charges to the ground. When the charges reach the ground, they are neutralised.

Testing exercise 2.1

1. How does the use of electricity conserve the environment?
2. Give any two characteristics of energy.
3. How is the use of electricity an advantage to people?

4(a) What is static electricity?
(b) How is static electricity produced?
(c) Name the static electricity in nature.

5(a) Why do we see lightning before we hear thunder during thunderstorms?
(b) Give any two ways of controlling the effects of lightning to people.

6(a) How is lightning useful to farmers?
(b) How is lightning dangerous to farmers?

7. Name any one type of electricity you know.
8. Name the positively charged particles found in the nucleus of an atom.

9. State any two dangers of electricity.
10. Why is electricity called a form of energy?
11. How is electricity useful at school?
12. Give the meaning of electricity.
13. How does the use of electricity control deforestation?
14. Which type of electricity is produced by friction?
15. Why are lightning arresters installed on tall buildings?
16(a) Which term refers to the smallest particles of an atom?
(b) Mention the three components of an atom.

Current electricity

Current electricity is the type of electricity in which electrons flow from the source to the appliance through a conductor.

Sources of electricity

A source of electricity is anything that produces electricity. There are many sources of electricity which include;

- Dry cells
- Batteries
- Tidal waves
- Uranium
- Steam from hot springs
- Wet cells
- Fossil fuels
- Fast flowing water
- The sun
- Wind

Appliances

An appliance is anything that uses electricity. The following are some of the electrical appliances in our homes.

- Television
- Flat iron
- Refrigerator
- Torch
- Radio
- Electric cooker.