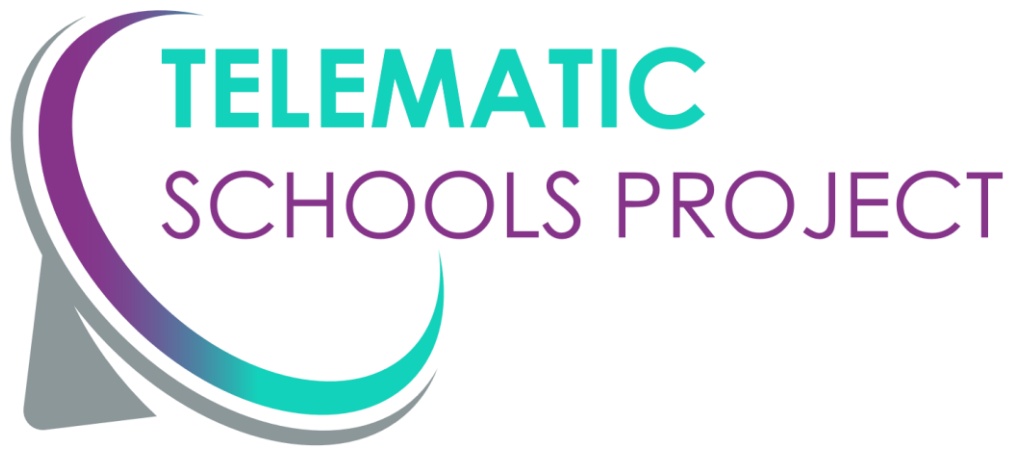




2024 SUBJECT WORKBOOK

Grade 10



LIFE SCIENCES

A joint initiative between the Western Cape Education Department and Stellenbosch University.



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BROADCAST SESSIONS

GRADE 10

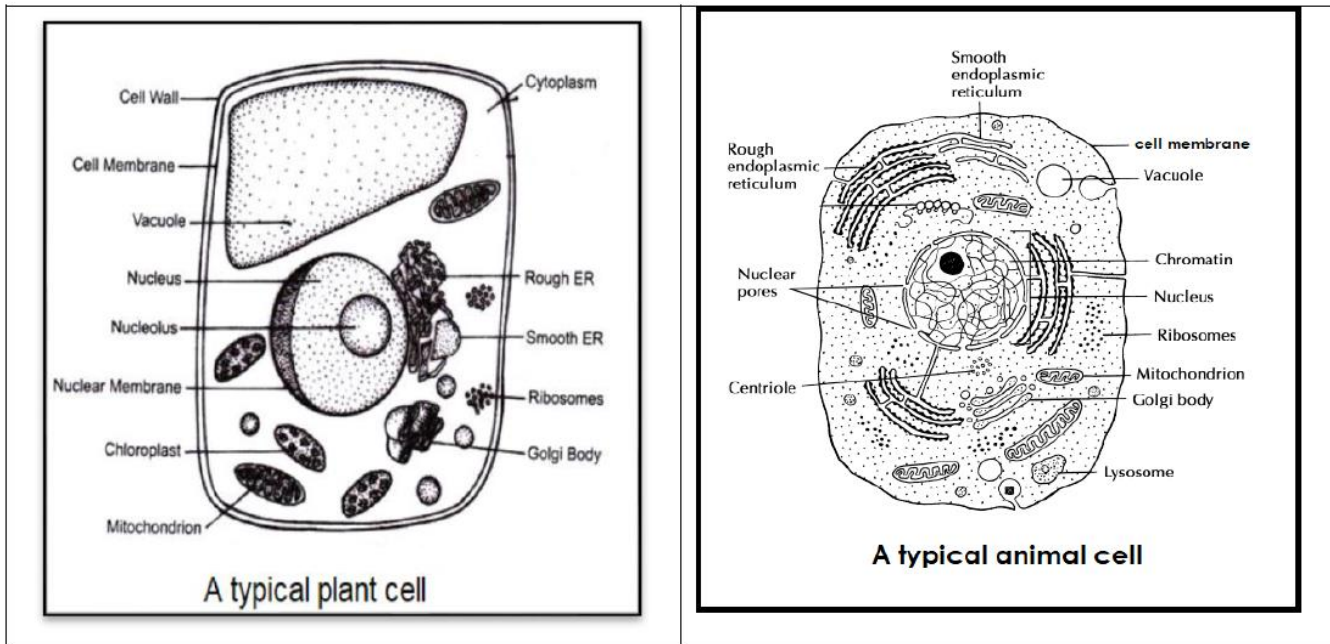
LIFE SCIENCES

Session	Date	Time	Topic
1	01/02/2023	15h00-16h00	Cell: basic unit of life
2	06/02/2023	16h00-17h00	Cell division: Mitosis
3	14/10/2023	16h00-17h00	Support systems in animals



SESSION 1 | CELL: BASIC UNIT OF LIFE

Cell structure and function: roles of the organelles:



Cell wall:

- The cell wall is a rigid, non-living layer that is found outside the cell membrane and surrounds the cell.
- The primary cell wall occurs on the outside of the cell membrane and consists of **cellulose**.
- A cell wall only occurs in plant cells.

Functions of the cell wall:

- The cell wall is a support structure that protects the living contents of the plant cell.
- It also gives rigidity to the plant cell.
- The cell wall is completely permeable to water and mineral salts.

Cell membrane:

- The cell membrane forms the outer living boundary of the cytoplasm.
- All plant and animal cells have cell membranes

Function of the cell membrane:

- The cell membrane is selectively/differentially permeable and controls the movement of substances into and out of the cell.



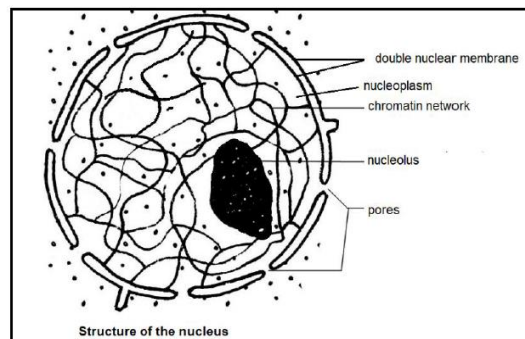
SESSION 1 | CELL: BASIC UNIT OF LIFE

Movement of substances e.g. water, gases and salts into and out of a cell:

- **Diffusion:** The spontaneous movement of molecules of a liquid or gas from an area of high concentration to an area of low concentration. Diffusion is a passive process, and no energy is required for this type of transport.
- **Osmosis:** The movement of water molecules from an area of high water potential to an area of low water potential through a selectively permeable membrane. Pure water has the highest water potential. Osmosis is a passive process and does not require energy. Plant cells use osmosis to absorb water from the soil and transport it to the leaves.
- **Active transport:** The movement of molecules from a low to a high concentration (against the concentration gradient) through membranes. Energy is needed for this type of transport.

Nucleus:

- The nucleus consists of a double nuclear membrane with pores, the nucleoplasm, the nucleolus and tangled threads known as the chromatin network.
- The chromatin network shortens and thickens to form chromosomes when a cell divides.



Functions of the nucleus:

- The nucleus controls the activities of the cell.
- The chromosomes carry hereditary characteristics

Cytoplasm:

- Some of the cytoplasm is in a liquid form and some is in a jelly-like state.
- It contains dissolved nutrients and waste products.
- In eukaryotic cells, all the organelles are contained within the cytoplasm except the nucleolus which is contained within the nucleus.

Functions of the cytoplasm:

- The cytoplasm stores substances.
- Substances circulate through the movement of the cytoplasm.

Mitochondria:

- Mitochondria occur in plant and animal cells and are found in the cytoplasm.
- It is cylindrically shaped and is enclosed by a double membrane.
- The inner membrane contains folds known as **cristae**.
- The cristae increase the inner surface area of the mitochondrion where chemical reactions take place.
- The mitochondrion is filled with a semi-fluid substance, the **matrix**.

Function of the mitochondrion:

- The mitochondrion releases energy during cellular respiration.



SESSION 1 | CELL: BASIC UNIT OF LIFE

Ribosomes:

- Ribosomes are small round structures that occur in plant and animal cells.
- Ribosomes may occur singly in the cytoplasm or in groups or may be attached to the endoplasmic reticulum thus forming the rough endoplasmic reticulum.
- It consists of RNA and proteins.

Function of the ribosomes:

- Ribosomes are the sites of protein synthesis.

Chloroplasts:

- Chloroplasts are mainly found in the photosynthesizing parts of a plant e.g. the leaves.
- A chloroplast is surrounded by a double membrane.
- A fluid matrix, the **stroma**, fills the chloroplast.
- In the stroma are disc-shaped membranes, the **lamellae** or **thylakoids**
- The lamellae form small stacks, the **grana**.
- The **chlorophyll** (green pigment) is embedded in the lamellae.

Chromoplasts:

- Chromoplasts occur in yellow, orange and red flowers, leaves and fruit.
- They contain pigments called **carotenoids**.

Leucoplasts:

- Leucoplasts are colourless plastids that occur mainly in cells that store food e.g. in potatoes.

Functions of the plastids:

- The process of photosynthesis occurs in the chloroplasts
- Chromoplasts give the yellow, orange and red colour to flowers, leaves and fruit
- Leucoplasts store food.

Vacuoles:

- Vacuoles are fluid-filled organelles that occur in the cytoplasm of most plant cells but are very small or completely absent in animal cells.
- A vacuole is enclosed by a selectively permeable membrane called the **tonoplast**.
- Vacuoles are filled with a liquid called **cell sap** consisting of water, mineral salts, sugars and amino acids.

Functions of vacuoles:

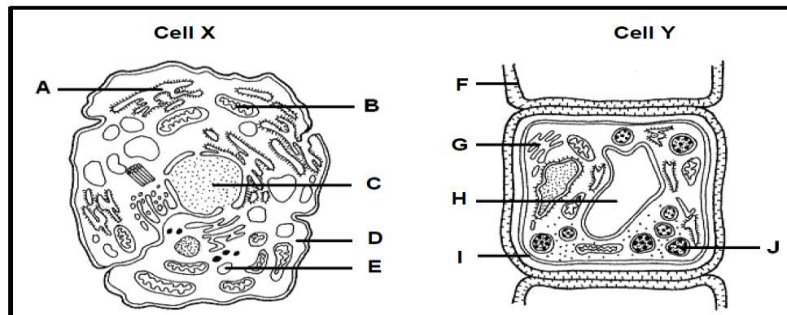
- The vacuole plays an important role in digestion and excretion of cellular waste and storage of water and organic and inorganic substances.
- The vacuole takes in and releases water by osmosis in response to changes in the cytoplasm, as well as in the environment around the cell.
- The vacuole is also responsible for maintaining the shape of plant cells. When the cell is full of water, the vacuole exerts pressure outwards, pushing the cell membrane against the cell wall. This pressure is called **turgor pressure**.



SESSION 1 | CELL: BASIC UNIT OF LIFE

Questions:

1.1. The diagrams below show two cells.

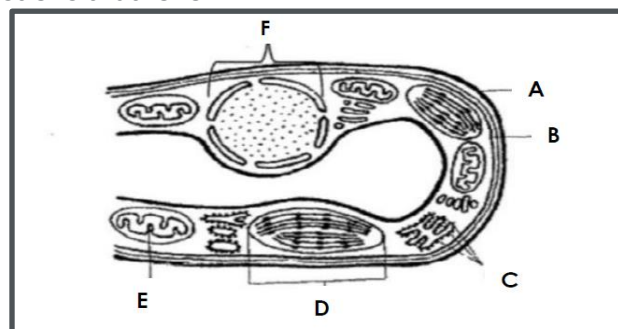


- 1.1.1 Which one of these diagrams (X or Y) represents a plant cell? (1)
- 1.1.2 List THREE visible reasons for your answer in QUESTION 1.1.1 (3)
- 1.1.3 What is the function of C in cell X? (1)
- 1.1.4 Name the process in cell X where B plays a role. (1)
- 1.1.5 Write down the **LETTER IN CELL Y** that can be associated with each of the following: (1)
- (a) Transport substances in the cytoplasm (1)
- (b) Turgor pressure (1)
- (c) Photosynthesis (1)

Answers to Question 1.1:

- 1.1.1 Y✓
- 1.1.2 Large vacuole✓ plastids✓ presence of cell wall✓ a rigid form✓ less mitochondria✓
- 1.1.3 Controls all cell activities/chromosomes carry heredity characteristics✓
- 1.1.4 Cell respiration✓
- 1.1.5 (a) G✓ (b) H✓ (c) J✓

1.2 The diagram below shows part of a cell as seen under an electron microscope. Study the diagram below and answer the questions that follow.



- 1.2.1 Give ONE function of: (1)
- (a) Part A (1)
- (b) Part D (2)
- 1.2.2 Explain ONE property of part B that helps it in carrying out its function. (2)
- 1.2.3 Explain why you would expect part E to be found in large numbers in muscle cells. (2)

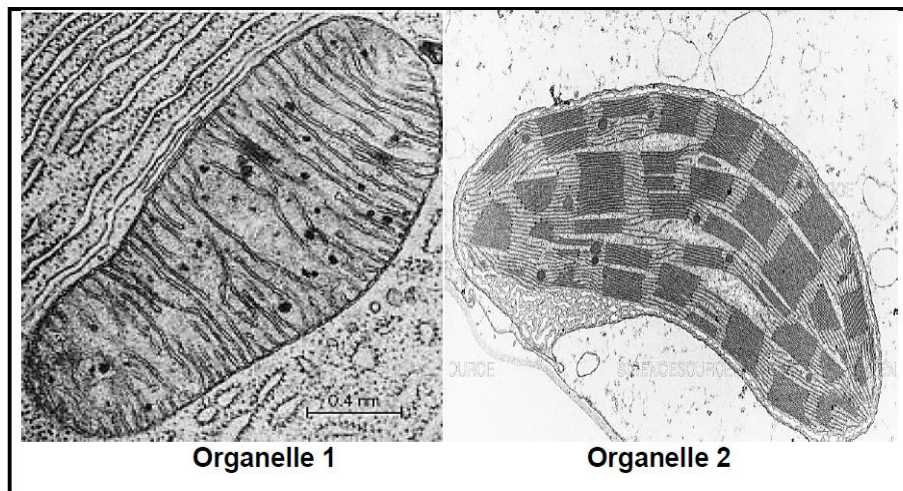
Answers to Question 1.2:

- 1.2.1 (a) Protection ✓ /Shape / support the cell / Allows entry of substances
- (b) Absorbs sunlight during photosynthesis ✓
- 1.2.2 It is selectively permeable ✓ therefore it is able to control the movement of substances in and out of the cell✓ / Allow only certain substances to move through.
- 1.2.3 A large amount of energy is required for muscle action✓ and mitochondria produce energy✓



SESSION 1 | CELL: BASIC UNIT OF LIFE

1.3 Study the micrographs below showing two organelles.



- 1.3.1 Identify organelles 1 and 2 respectively. (2)
 1.3.2 Which ONE of the organelles shown above is found in a plant cell only? (1)
 1.3.3 Draw a fully labelled diagram of organelle 2. (5)
 1.3.4 In which part of organelle 2 is the pigment responsible for the absorption of light found? (1)
 1.3.5 Which cell between a muscle cell and a skin cell contains more of organelle 1? (1)
 1.3.6 Calculate the actual size of the micrograph of organelle 2 in micrometres if the measured size of the image using a ruler is 86 mm and the electron microscopic magnification is 4000x. (3)

Answer to Question 1.3: ✓

1.3.1 Organelle 1 – mitochondrion ✓ Organelle 2 - chloroplast ✓

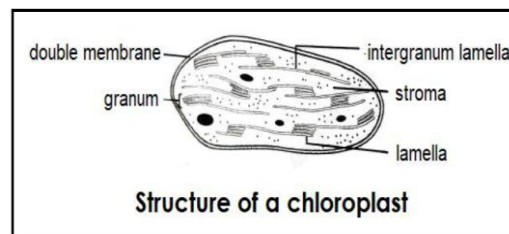
1.3.2 Organelle 2 ✓ /chloroplast

1.3.3 **Marking rubric**

Caption (C) ✓

Correct diagram ✓

Any 3 correct labels ✓ ✓ ✓



1.3.4 Grana lamella ✓

1.3.5 Muscle cell ✓

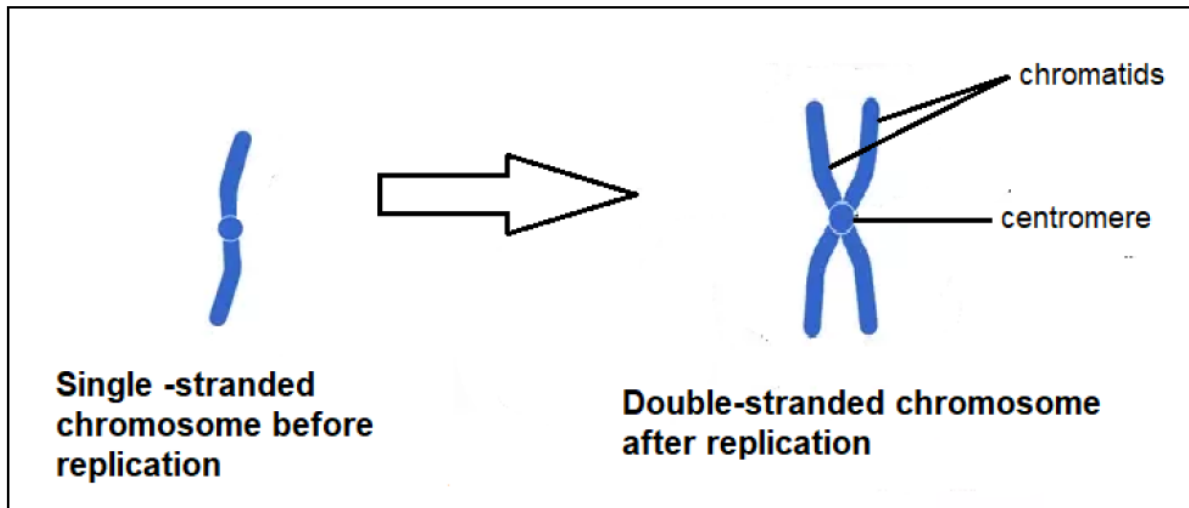
1.3.6 Actual size = Measured size (ruler)/ Magnification ✓
 = 86 mm / 4 000 ✓
 = 0,0215 ✓ micrometres



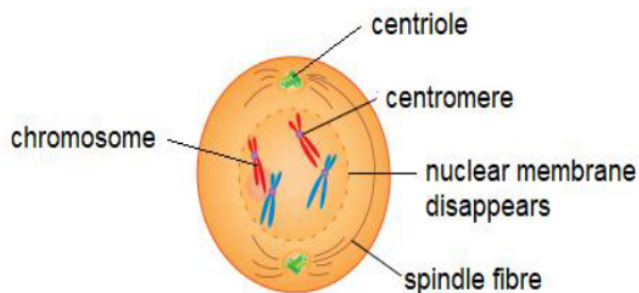
SESSION 2 | CELL DIVISION: MITOSIS

CELL DIVISION (MITOSIS)

- The period during which a cell grows, replicates genetic material and divides is known as the **cell cycle**.
- Interphase** is the period between two consecutive cell divisions. Cell growth and DNA replication take place during this phase. After replication has taken place, the chromosome now consists of two **chromatids** (double-stranded) joined by a **centromere**.



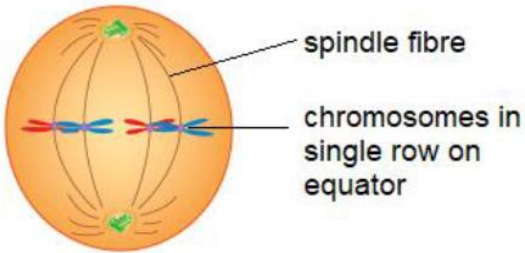
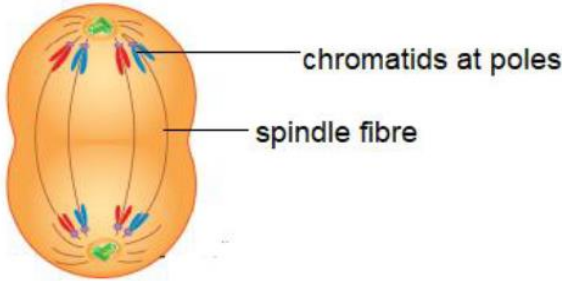
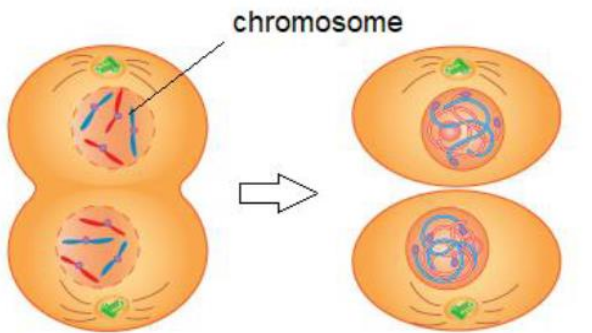
Prophase



- Chromatin network shortens and thickens to form individual chromosomes
- Each chromosome consists of two chromatids joined by a centromere
- Nuclear membrane and nucleolus disappear
- Centrioles separate and move to opposite poles of the cell
- Spindle fibre forms between the centrioles



SESSION 2 | CELL DIVISION: MITOSIS

Metaphase  spindle fibre chromosomes in single row on equator	- Chromosomes move to the equator and arrange themselves in a single row on the equator - Each chromosome is attached to the spindle fibres by its centromere
Anaphase  chromatids at poles spindle fibre	- The centromere of each chromosome divides into two - The two chromatids separate - The spindle fibre contracts and pulls the chromatids to opposite poles - The two chromatids move to opposite poles
Telophase  chromosome Two identical cells	- The chromatids now called chromosomes arrange themselves at the poles - The spindle fibres disappear - The nuclear membrane forms around each group of chromosomes at each pole and a nucleolus forms. - The cytoplasm divides (cytokinesis) - Two identical cells with the same chromosome number as the original cell are formed

The role of mitosis

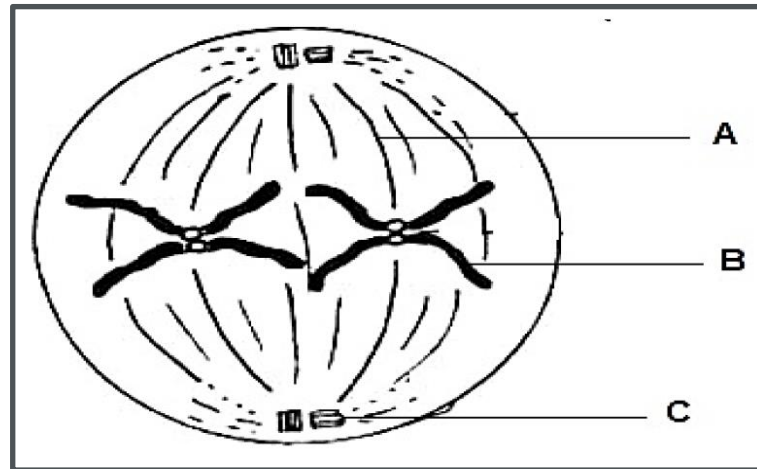
- Development and growth - The number of cells increase by mitosis enabling organisms to grow from a single cell to a complex multicellular organism.
- Reproduction - Some organisms use mitosis to produce genetically identical offspring.
- Cell replacement - Cells are constantly replaced by new ones in the body, for example in the skin.
- Replacement of damaged tissues - some organisms use mitosis to replace body parts.



SESSION 2 | CELL DIVISION: MITOSIS

Questions:

1.1 The diagram below shows a cell undergoing a phase in cell division.



- 1.1.1 Identify the phase of mitosis represented above. (1)
 1.1.2 Give ONE reason for your answer to QUESTION 1.1.1. (1)
 1.1.3 Identify parts labelled **A**, **B**, and **C**. (3)
 1.1.4 Name the phase that comes after the one shown above. (1)
 1.1.5 How many chromosomes will be present in the cell shown above at the end of mitosis? (1)
 1.1.6 What name is given to the abnormal and uncontrollable division of cells leading to the formation of a tumour? (1)
 1.1.7 State THREE biological importance of mitosis. (3)

Answers to Question 1.1:

- 1.1.1 Metaphase ✓ (1)
 1.1.2 Chromosomes line up at the equator ✓ (1)
 1.1.3 A – Spindle fibre ✓ (1)
 B – Chromosome ✓ / chromatid (1)
 C – Centriole ✓ (1)
 1.1.4 Anaphase ✓ (1)
 1.1.5 2 ✓ chromosomes (1)
 1.1.6 Cancer ✓ (1)
 1.1.7 - Growth ✓
 - Replace and repair worn out cell or tissue ✓
 - Asexual reproduction ✓ (3)



SESSION 2 | CELL DIVISION: MITOSIS

1.2 The root of an onion is a rapidly growing part of the onion. Many cells will be in different stages of mitosis. A sample of an onion tip was stained and studied under a microscope.

The various phases of mitosis were identified and the number of cells counted in each phase. The results are recorded in the table below.

	Number of cells			
	1	2	3	Total
Interphase	47	49	58	154
Prophase	5	7	18	30
Metaphase	2	4	1	7
Anaphase	10	10	2	22
Telophase	4	4	4	12

1.2.1 Which phase produced the:

(a) Highest number of cells

(1)

(b) Lowest number of cells

(1)

1.2.2 Calculate the percentage of cells produced during prophase. Show ALL calculations.

(3)

1.2.3 Assuming a cell takes 24 hours to complete one cycle. Calculate the duration of the interphase. Show ALL working.

(3)

1.2.4 Briefly describe what happens during anaphase of mitosis.

(2)

1.2.5 Draw a bar graph to represent the total number of cells in each phase of the cell cycle.

(6)

Answers to Question 1.2:

1.2.1 (a) Interphase ✓

(b) Metaphase ✓

1.2.2 $30/225 \times 100 = 13,3\%$ ✓

1.2.3 No. of cells in interphase = 154

Total cells = 225 (24 hours)

Time for interphase = $154 \times 24 / 225$ ✓

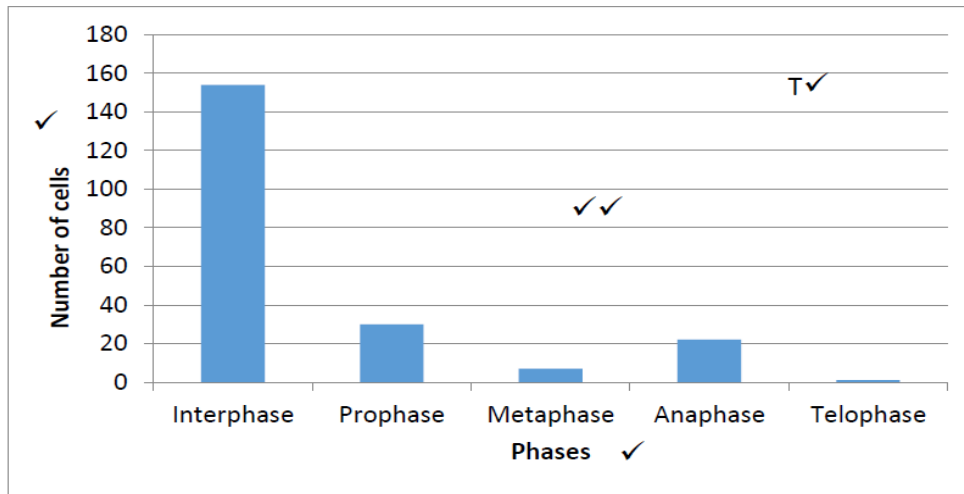
= 16,4 hours ✓

1.2.4 Chromatids ✓ pulled towards opposite poles ✓ of a cell by the spindle fibres.



SESSION 2 | CELL DIVISION: MITOSIS

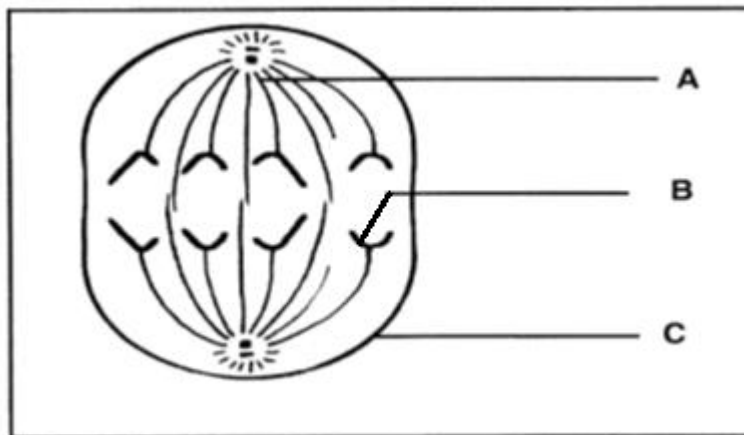
1.2.5 Graph to represent the total number of cells in each phase of the cell cycle ✓



Rubric: graph

Type of graph	1
Heading for graph	1
Correct label and scale <i>x</i> -axis	1
Correct label and scale of <i>y</i> -axis	1
Plotting of points	1–4 points plotted: 1 5 points plotted: 2
TOTAL	6

1.3 The diagram below shows a cell during a phase of mitosis.



1.3.1 Identify the phase of mitosis.

(1)

1.3.2 Give ONE observable reason for your answer to QUESTION 1.3.1

(1)

1.3.3 Identify the parts labelled A, B and C.

(3)

1.3.4 Name and describe the phase that occurs before the phase illustrated above.

(3)

1.3.5 How many chromosomes were there in this cell at the start of mitosis.

(1)

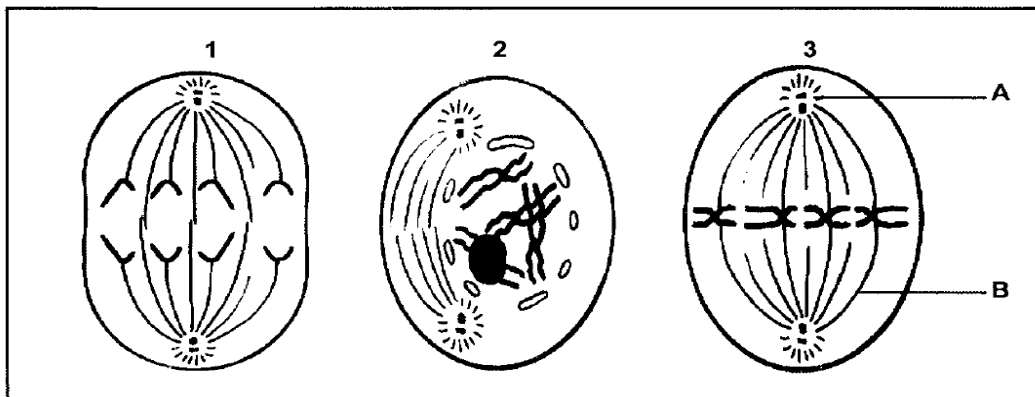


SESSION 2 | CELL DIVISION: MITOSIS

Answers to Question 1.3

- 1.3.1 Anaphase✓
 1.3.2 The spindle fibre contracts and pulls and the chromatids to opposite poles✓
 1.3.3 A – Spindle fibre✓
 B - Chromatid✓
 C – Cell membrane✓
 1.3.4 Metaphase✓ - Chromosomes move to the equator✓ and arrange themselves in a single row on the equator✓
 1.3.5 Four✓/4

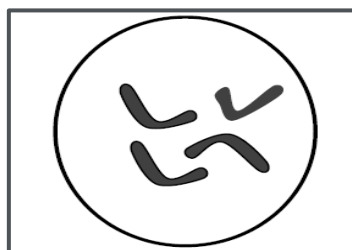
1.4 The diagrams below represent phases of mitosis.



- 1.4.1 Identify parts **A** and **B**. (2)
 1.4.2 Name the phase of mitosis that is represented by DIAGRAM 2. (1)
 1.4.3 Give TWO observable reasons for your answer to QUESTION 1.4.2 (2)
 1.4.4 Write down the numbers of the diagrams to show the correct sequence in which the phases occur. (2)
 1.4.5 Draw a diagram to show ONE of the cells that would be formed at the end of telophase (labels are not required) (2)

Answers to Question 1.4

- 1.4.1 A – Centriole ✓ /Centrosome
 B – Spindle fibre ✓
 1.4.2 Prophase ✓
 1.4.3 Nuclear membrane and nucleolus start disappearing ✓. Centrioles moving to opposite poles of the cell ✓
 1.4.4 2 – 3 - 1 ✓ ✓
 1.4.5



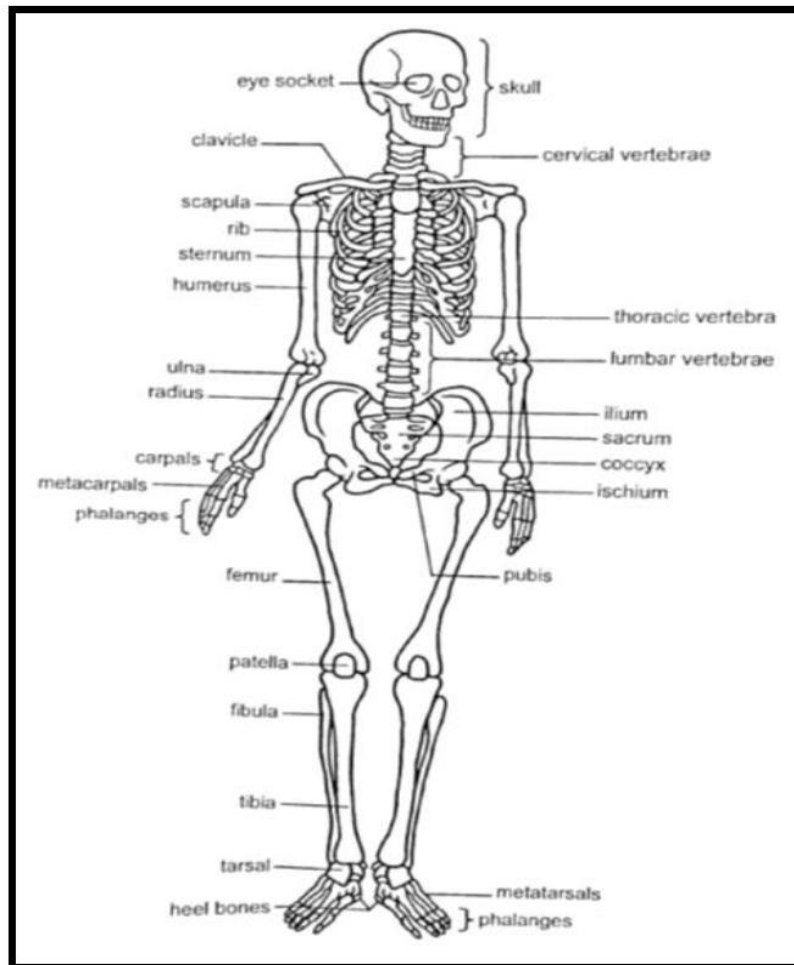
Criteria for marking

Cell contains single stranded chromosomes	1 mark
Cell contains 4 single stranded chromosomes	1 mark



SESSION 3 | SUPPORT SYSTEM IN ANIMALS

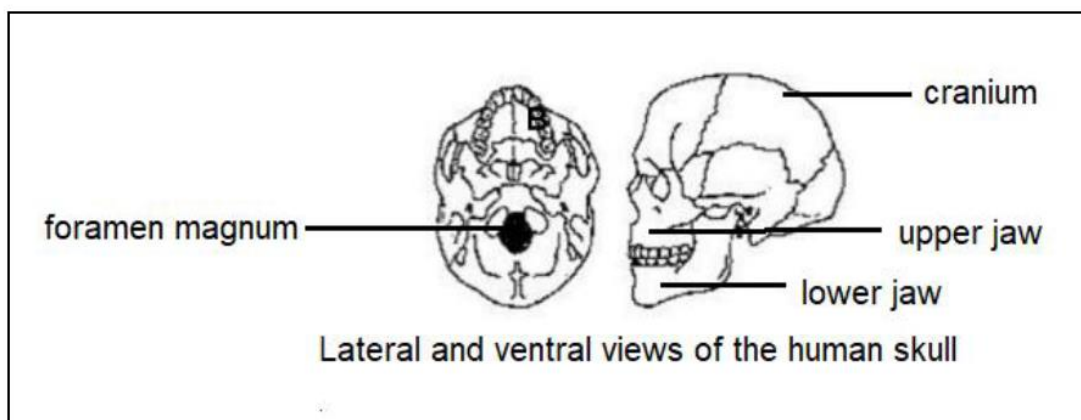
The human skeleton:



The human skeleton can be divided into two main sections:

- Axial skeleton
- Appendicular skeleton

The **axial skeleton** consists of the skull, vertebral column and rib cage:





SESSION 3 | SUPPORT SYSTEM IN ANIMALS

The skull:

- The skull consists of two groups of bones, namely the bones of the **cranium** and the **facial bones**. The cranium encloses the brain and protects it. The cranium of apes is smaller than that of humans. *(links with Human Evolution in Grade 12).*
- There is a large opening at the base of the skull called the **foramen magnum** for the spinal cord to pass through. *(links with Human Evolution in Grade 12).*
- In humans the foramen magnum is located in a **more forward position**, and this enables humans to walk on two legs, a characteristic called **bipedalism**. *(links with Human Evolution in Grade 12).*
- In African apes the foramen magnum is located in a **more backward position**.
- Apes generally use all four limbs for locomotion, and they are **quadrupedal**. *(links with Human Evolution in Grade 12).*
- The upper **jaw** of humans is fused to the skull and the lower jaw articulates with the base of the skull. The jaws of the human are smaller than that of apes. *(links with Human Evolution in Grade 12).*
- The **palate** in humans is rounded whilst the palate in for example chimpanzees is rectangular. *(links with Human Evolution in Grade 12).*
- The upper and lower **jaws** carry the teeth in humans. Humans have smaller teeth than apes. *(links with Human Evolution in Grade 12).*
- Humans have four types of **teeth** with different functions:

Type of teeth	Function
Incisors	Bite and cut off food
Canines	Hold food in place and tear it off
Premolars	Chew and grind the food
Molars	Chew and grind the food

Vertebral column:

- The vertebral column of humans consists of 33 bones (vertebrae).
- The first cervical vertebra articulates with the skull and is known as the **atlas**. This makes nodding movements possible.
- The second cervical vertebra is called the **axis** and makes the rotation of the head possible.
- The human **vertebral column** is **S-shaped** for flexibility and shock absorption. *(links with Human Evolution in Grade 12).*
- The vertebral column in apes is **C-shaped** *(links with Human Evolution in Grade 12).*
- The vertebral column supports the skull
- It surrounds and protects the spinal cord.
- It serves as attachment for the ribs, back muscles, pectoral and pelvic girdle.

Rib cage:

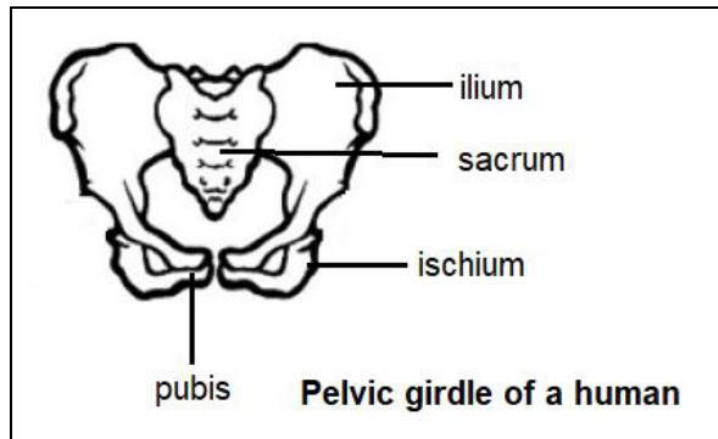
- The rib cage consists of 12 thoracic vertebrae, 12 pairs of ribs and the sternum.
- The rib cage protects the organs in the thoracic cavity e.g. heart and lungs.
- It plays a role in breathing as the movement of the rib cage increases and decreases the volume of the thoracic cavity *(links with Gaseous exchange in Grade 11).*



SESSION 3 | SUPPORT SYSTEM IN ANIMALS

Appendicular skeleton:

- The appendicular skeleton consists of the pectoral girdle, upper limbs, pelvic girdle and lower limbs.
- The pectoral girdle consists of the 2 scapulae and 2 clavicles.
- Each upper limb consists of different kind of bones i.e. the humerus (long bone), ulna (largest bone in the forearm), radius, carpals, metacarpals (bones that form the palm of the hand) and phalanges (bones that form the fingers).



- The pelvic girdle consists of 2 hip bones. The hip bones are made up of 3 fused bones i.e. the **ilium**, **ischium** and the **pubis**. The hip bones are attached at the back by the **sacrum**.
- The human pelvic girdle is **shorter and wider** to support the greater weight due to the upright posture of humans. Apes have a **long and narrow** pelvic girdle. (*links with Human Evolution in Grade 12*).
- Each lower limb consists of the femur (longest and largest bone in the human body), the patella (kneecap), tibia, fibula, tarsals, metatarsals and the phalanges (toe bones).
- Humans have shorter arms and longer legs while apes have shorter legs and longer arms. (*links with Human Evolution in Grade 12*).

Functions of the skeleton:

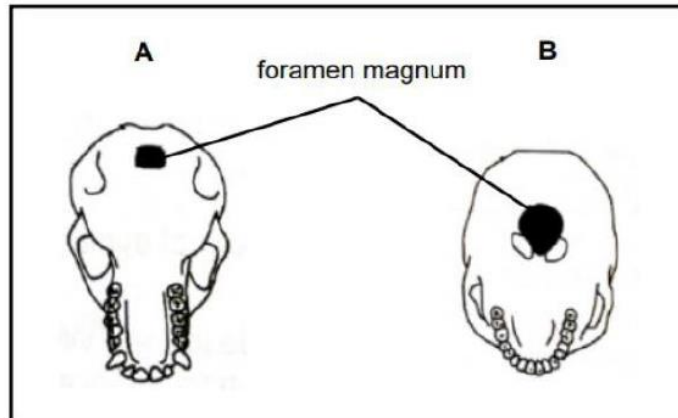
- **Support** – bones of the skeletal system support and give shape to the body and attach muscles and soft organs.
- **Movement** – the skeleton plays a role in movement together with the muscles and joints.
- **Protection** – Bones protect soft delicate organs e.g. the brain, the heart and lungs.
- **Mineral storage** – bone tissue stores reserve calcium and phosphorous.
- **Hearing** – three ear ossicles in each ear transmit sound waves to the internal ear to make hearing possible (*links with the ear in Grade 12*).
- **Production of blood cells** – white and red blood cells are formed in the red bone marrow.



SESSION 3 | SUPPORT SYSTEM IN ANIMALS

Questions:

1.1 Diagrams A and B show the ventral (bottom) view of the skulls of two organisms. The diagrams are NOT drawn to scale.



- 1.1.1 Which diagram represents the skull of a bipedal organism? (1)
 1.1.2 Give ONE visible reason for your answer to QUESTION 1.1.1. (1)
 1.1.3 Tabulate TWO visible differences between the upper jaws in the diagrams A and B that represent trends in human development over time. (5)
 1.1.4 Explain the significance of the shape of the spine that is associated with the skull in diagram B. (2)

Answers to Question 1.2:

- 1.1.1 B✓
 1.1.2 The foramen magnum is in a more forward position✓
 1.1.3

A	B
1. Large canines ✓	1. Smaller canines ✓
2. Jaws with teeth in a rectangular / U shape ✓	2. Jaws with teeth on a gentle / round curve ✓
3. More protruding jaw✓	3. Less protruding jaw✓

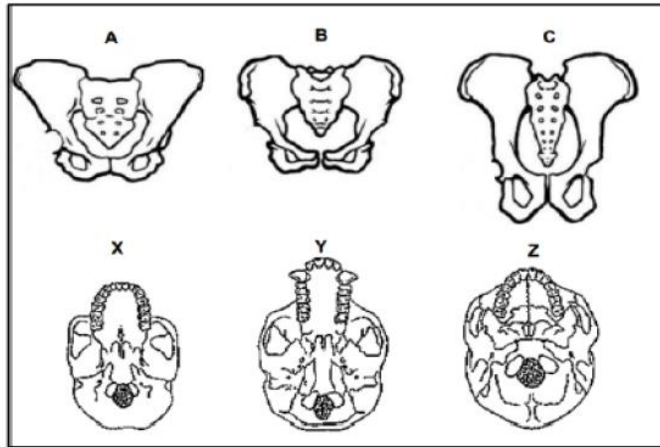
1 mark for table

- 1.1.4
 - The spine is S-shaped✓
 - for flexibility✓ and
 - shock absorption✓



SESSION 3 | SUPPORT SYSTEM IN ANIMALS

1.2 The diagrams below represent the pelvic structure and the ventral view of the skulls of three organisms. The diagrams are drawn to scale.



1.2.1 Write down the LETTER(S) of the diagram(s) that represent the:

(a) Skulls of bipedal animal. (2)

(b) Pelvic structure of a quadrupedal animal. (1)

1.2.2 Give a reason for your answer to QUESTION 1.2.1(b). (2)

1.2.3 Describe ONE other structural difference between a bipedal and a quadrupedal animal. (3)

Answers to Question 1.2:

1.2.1 (a) X ✓, Z ✓ (in any order)

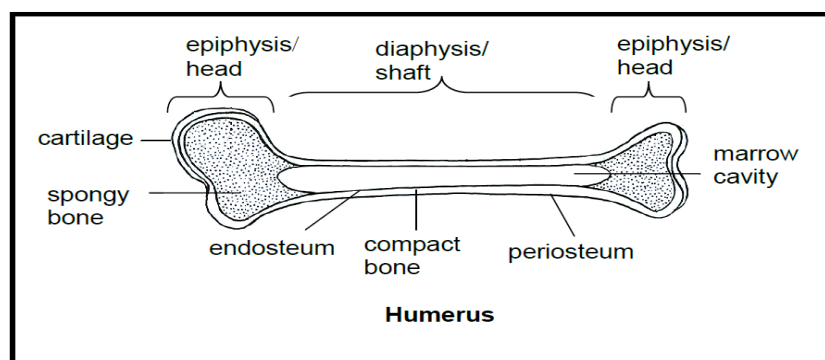
(b) C ✓

1.2.2 The pelvis is long ✓ and narrow ✓

1.2.3 - The spine ✓
- is S-shaped in bipedal organism ✓
- and C-shaped in quadrupedal organism ✓

1.3 Make a labelled drawing of a longitudinal section through a long bone. (6)

Answer to Question 1.3:



Mark allocation

- Caption ✓
- Epiphysis and diaphysis shown and labelled ✓
- Proportions of epiphysis and diaphysis ✓
- Any THREE other labels ✓ ✓ ✓



LINKS TO ONLINE RESOURCES

TOPIC	LINK/QR CODE/PowerPoint slides
Cell: Basic unit of life	https://bit.ly/3UBvfld 
Mitosis	https://bitly.ws/ZSuc
Support system in animals	https://bit.ly/3tsVLRD 