JENN

Training and Consultancy

The path to enlightened education

SUBJECT: LIFE SCIENCES

GRADE 12

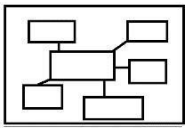
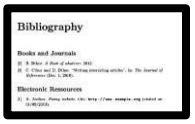
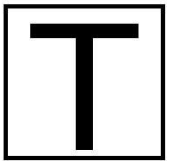
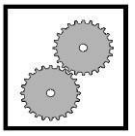
AUTUMN CLASSES

TEACHER AND LEARNER CONTENT MANUAL

TOPIC(S)

1. DNA: THE CODE OF LIFE
2. MEIOSIS
3. REPRODUCTION IN VERTEBRATES
4. HUMAN REPRODUCTION

ICON DESCRIPTION

 MIND MAP	 EXAMINATION GUIDELINE	 CONTENTS	 ACTIVITIES
 BIBLIOGRAPHY	 TERMINOLOGY	 WORKED EXAMPLES	 STEPS

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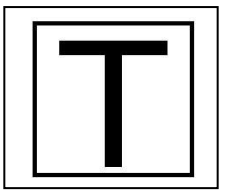
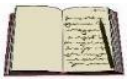
TERMINOLOGY



TERM	EXPLANATION
Amino acid	The monomer of a protein molecule
Anticodon	The three adjacent nitrogenous bases found on tRNA molecule that will determine which amino acid will be brought to the ribosome
Base triplet	The three adjacent nitrogenous bases found on a DNA strand
centromere	The structure that holds the two chromatids together to form a chromosome
Chromatid	The individual threads that form a chromosome
chromatin	Tangled network of chromosome located within the nucleus before the division
codon	Three adjacent nitrogenous bases found on the mRNA that code for a specific amino acid
DNA profile	Barcode pattern formed by the base sequence of prepared, processed DNA
DNA profiling	The process where a specific DNA pattern, called DNA profile, is obtained from a person or sample of bodily tissue
DNA replication	The formation of an exact copy of the DNA in a cell
DNA	Deoxyribonucleic acid (DNA) consists of genes that characterise for all the traits
Double helix	DNA is made up of two strands that are twisted together. (the natural shape of DNA)
Gene	Segment of DNA molecule that codes for a specific characteristics.
Genome	It is a full set of genes/all the genes found in a particular organism.
Hydrogen bond	A weak bond which links nitrogenous base pairs in the DNA molecule.
Interphase	Phase of the cell cycle during which DNA replication occurs
Messenger RNA(mRNA)	A type of RNA involved in protein synthesis. DNA is transcribed into mRNA

Mitochondrial DNA	**The type of DNA found only in the mitochondrion**
Monomer	**A single unit that makes up a larger molecule.**
mutation	**A sudden and relatively permanent gene/chromosomal change**
Chromosomal mutation	**Changes in the chromosomes number or structure of the chromosomes**
Gene mutation	**Is a change in the sequence of a nitrogenous bases/nucleotides in DNA monomers**
Nitrogenous bases	**The (adenine and Guanine) and (thymine, cytosine, and uracil) that construct DNA and RNA molecules**
Nucleolus	**Structure in the nucleus responsible for forming ribosomal RNA**
Nucleoplasm	**That part of the protoplasm within the nucleus**
Nucleotide	**A monomer (building block) of DNA and RNA (nucleic acid), consisting of a nitrogenous base, a deoxyribose, and a phosphate group**
Peptide bond	**A bond between two adjacent amino acids**
Ribosome	**An organelle where protein synthesis takes place. (translation)**
RNA	**A nucleic acid that occurs as a single strand which contains uracil.**
Synthesis	**Is an anabolic process where monomers are combined into macro molecules**
Transcription	**The synthesis of mRNA from a DNA template**
tRNA	**An RNA molecule that carries amino acids to the ribosomes to form a protein**
Translation	**The process of converting in the information carried by mRNA to the correct sequence of amino acids acids at the ribosome**

ACTIVITY 1



1.1 Give the correct **biological term** for each of the following descriptions

1.1.1. Monomers of nucleic acids

1.1.2. The natural shape of the DNA molecule

1.1.3. Type of sugar found in a nucleotide of DNA

1.1.4. The stage of protein synthesis that occurs in the cytoplasm

1.1.5. The type of RNA containing anticodons

1.1.6. The organelle in a cell where translation occurs

1.1.7 Produced the first X-ray image of the DNA molecule

1.1.8. The bond between amino acids in a protein molecule

1.1.9. The location of DNA molecule in an animal cell

1.1.10 Nitrogenous base found only in RNA molecules

1.1.11. The process whereby DNA makes an exact copy of itself

1.1.12. The sugar found in RNA

1.1.14. A nucleic acid that carries amino acids to the ribosome for protein synthesis

INTRODUCTION

Pre – Knowledge (cell structure (nucleus, cytoplasm, ribosomes, mitochondrion, nucleic acids)

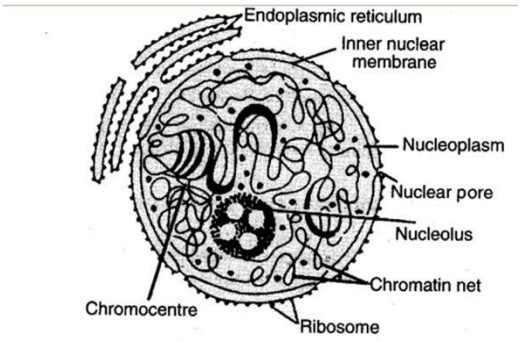
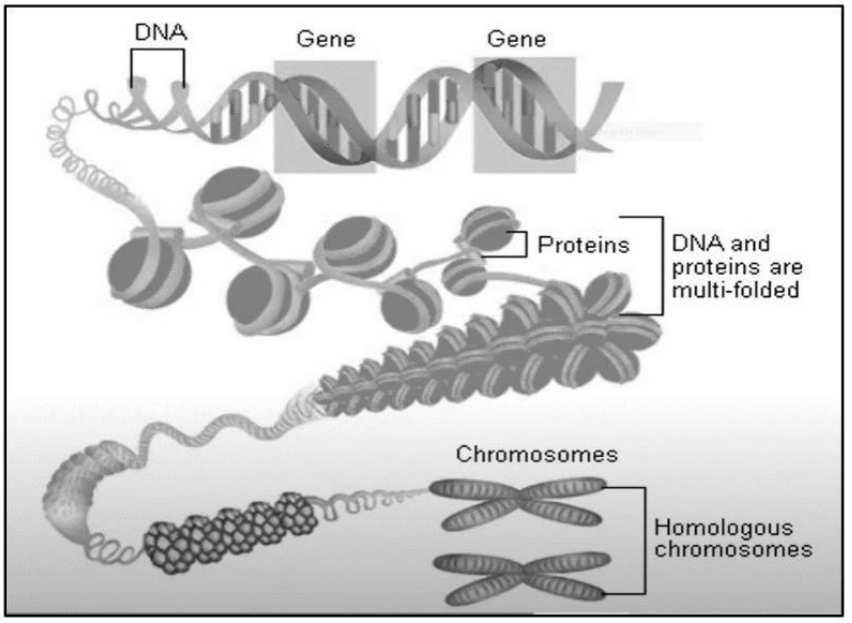


Fig. Eukaryotic nucleus

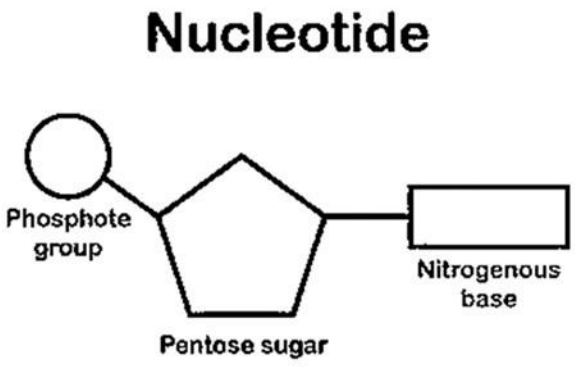


- Chromosomes are found in the nucleus of every living cell.
- A chromatin network is made of DNA wrapped around proteins called histones.
- DNA is divided into sections called genes.
- Each gene controls a specific inherited characteristic.
- Before cell division, DNA replicates (duplicates).
- When a cell divides, chromatin network condenses into visible chromosomes.
- After replication, each chromosome consists of two identical chromatids joined by a centromere.
- All somatic (body) cells of a species have the same number of chromosomes.
- In sexually reproducing organisms, chromosomes occur in pairs (diploid number, 2n).
- Humans have 46 chromosomes (2n = 46).

STRUCTURE OF DNA NUCLEOTIDE (monomer of nucleic acids)

Each DNA nucleotide consists of three components:

1. A nitrogenous base
2. A deoxyribose sugar
3. A phosphate group



CONTENT	ELABORATION
DNA: Location, structure and function (in eukaryotes)	❑ Location of DNA: • Present in the nucleus (nuclear DNA) – makes up genes on chromosomes • Present in mitochondria (mitochondrial DNA) • Present in chloroplasts (plants) ❑ Brief role of each scientist in the discovery of the DNA molecule: • Rosalind Franklin and Maurice Wilkins produced the first images of DNA using X-ray diffraction. • James Watson and Francis Crick used these images to propose the double helix structure of the DNA molecule. • Watson, Crick and Wilkins were awarded the Nobel Prize for their work. ❑ Structure of DNA • The natural shape of the DNA molecule is a double helix • Each strand of the helix is made up of a sequence of DNA nucleotides ❑ Three components of a DNA nucleotide: • Nitrogenous bases linked by weak hydrogen bonds: o Four nitrogenous bases of DNA: adenine (A), thymine (T), cytosine (C), guanine (G) o Pairing of bases in DNA occurs as follows: A with: T and G with C • Sugar portion (deoxyribose in DNA) • Phosphate portion ❑ Stick diagram of DNA molecule to illustrate its structure ❑ Functions of DNA: • DNA makes up genes which carry hereditary information • DNA contains coded information for protein synthesis

LOCATION OF DNA

- Most DNA is found in the nucleus, (nuclear DNA).
- A small amount of DNA is found in the chloroplasts (chloroplastic DNA).
- A small amount of DNA is also found in the mitochondria (mitochondrial DNA or mtDNA).

DNA STRUCTURE

- DNA has a natural shape called a double helix.
- The double helix consists of two strands twisted around each other.
- Each strand is made up of repeating units called nucleotides.

NITROGENOUS BASES IN DNA

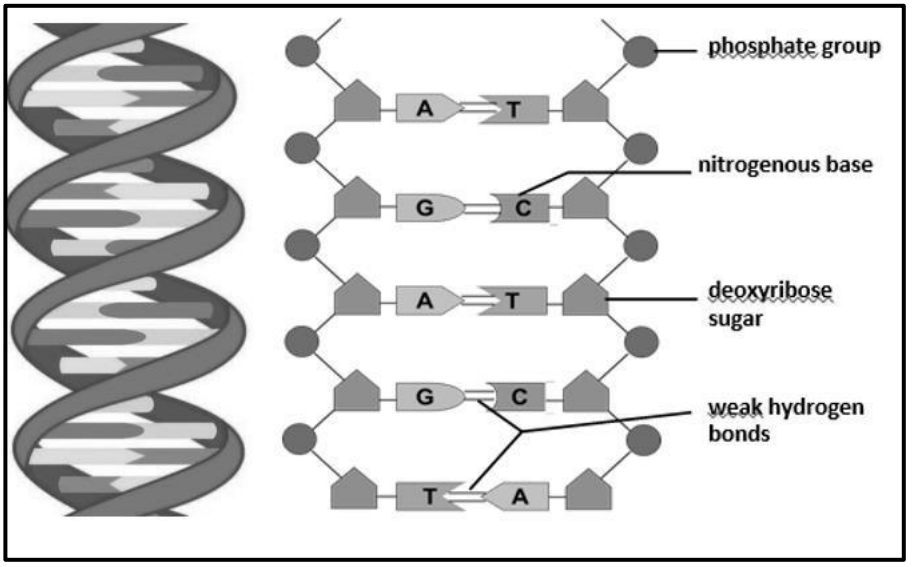
DNA contains four nitrogenous bases:

- Adenine (A)
- Thymine (T)
- Cytosine (C)
- Guanine (G)

Bases pair specifically as follows:

- A pairs with T
- G pairs with C

The bases are held together by weak hydrogen bonds.

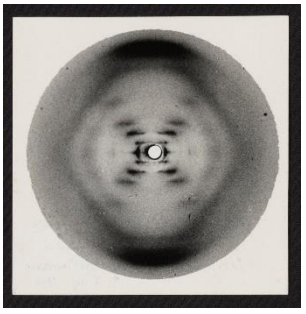


DNA FUNCTIONS

- DNA codes for the formation of proteins.
- Nuclear DNA transmits hereditary characteristics from parents to offspring.

BRIEF ROLE OF EACH SCIENTIST IN THE DISCOVERY OF THE DNA MOLECULE:

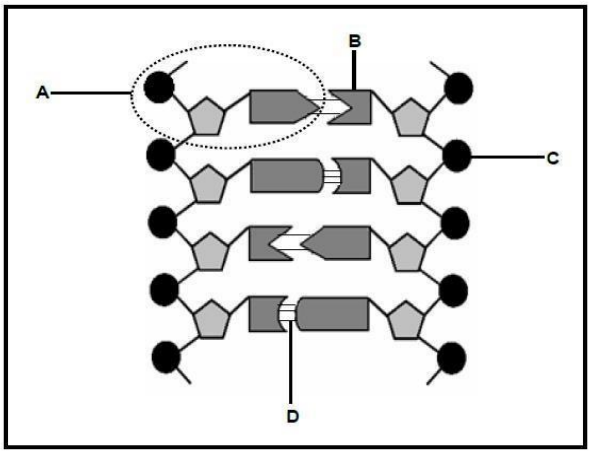
Rosalind Franklin and Maurice Wilkins produced the first images of DNA using X-ray diffraction.



James Watson and Francis Crick used these images to propose the double helix structure of the DNA molecule.
Watson, Crick and Wilkins were awarded the Nobel Prize for their work.

ACTIVITY 2

2.1 The diagram below represents a portion of a DNA molecule



2.1.1 Identify B and C and D (3)

2.1.2 Name:

(a) Monomer A (1)

(b) TWO scientists who received a Nobel prize for discovering the DNA molecule (2)

(c) ONE organelle in a cell where DNA is located (1)

(7)

2.2 A section of a DNA molecule has the following base sequence (NSC P2 June 2019)

C T T A C A

2.2.1 (a) Nitrogenous basis in this section of DNA? (1)

(b) Codons will this section of DNA code for? (1)

(C) Nucleotides are contained in this section of DNA? (1)

2.2.2 Name the nitrogenous base represented by **C** in the DNA molecule (1)

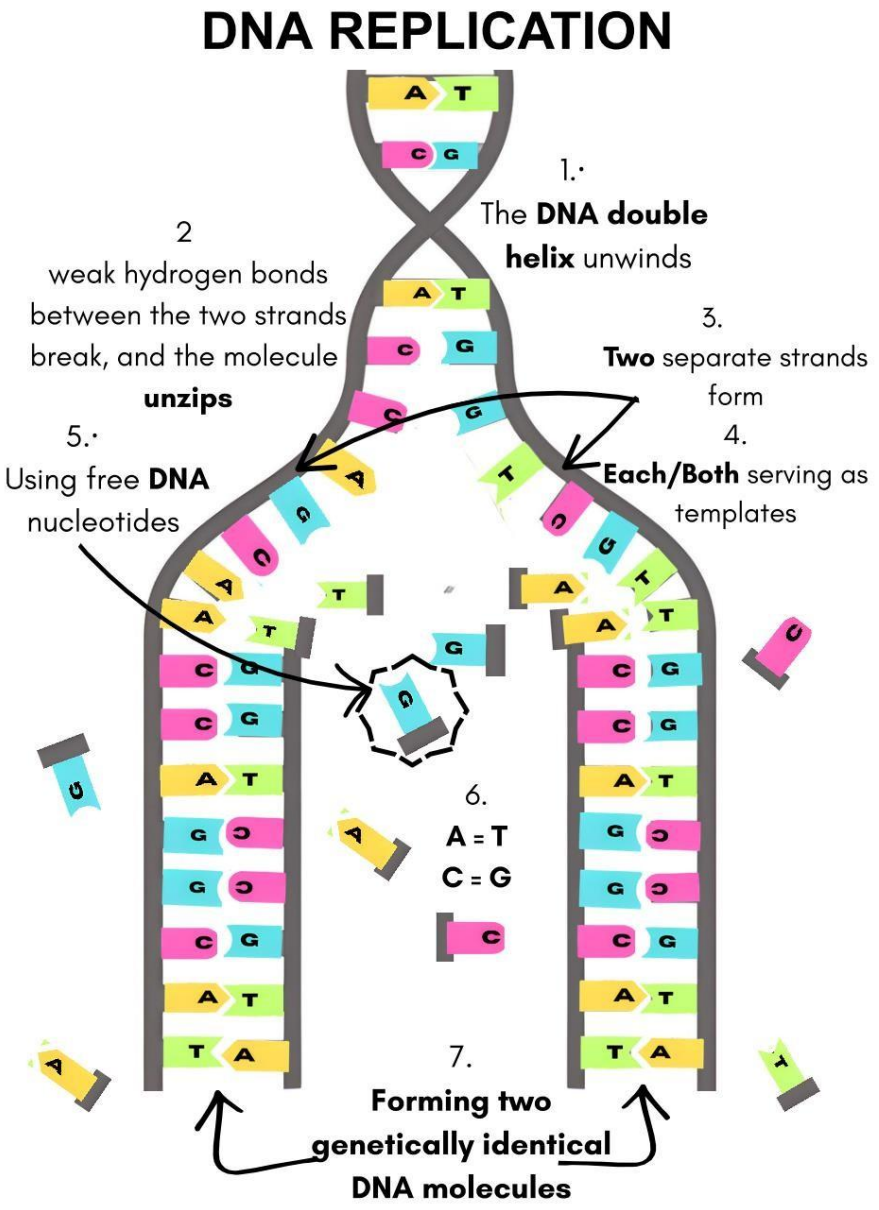
2.2.3 The percentage of guanine in this DNA molecule is 30%. (2)
Give the percentage of thymine in the same molecule.

(6)

CONTENT	ELABORATION
DNA replication	❑ Process of DNA replication: • When in the cell cycle it takes place • Where in the cell it takes place

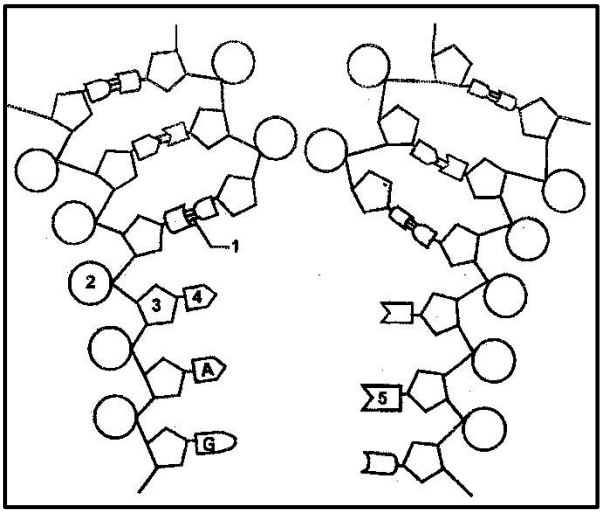
DNA REPLICATION

- The DNA double helix unwinds and
- weak hydrogen bonds between the two strands break, and the molecule unzips
- Two separate strands form
- both strands serves as templates,
- to build a complementary DNA molecule (A to T and C to G)
- Using free DNA nucleotides from the nucleoplasm
- This results in two genetically identical DNA molecules
- Each consisting of one original strand and one new strand



ACTIVITY 3

The diagram below represents a DNA molecule undergoing an important process



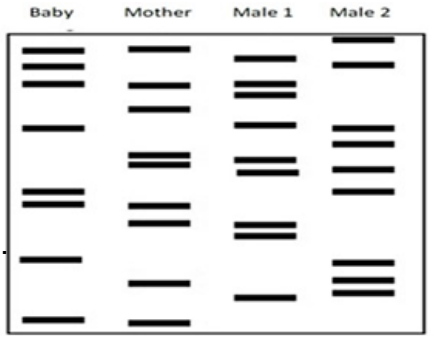
3.1 Identify the (1)
(a) Process shown in the diagram
(b) Chemical bond labelled 1 (1)

3.2 Give the:
(a) Collective name for the parts labelled 2, 3 and 4 (1)
(b) Full name of the nitrogenous base labelled 5 (1)

3.3 Where in the cell does this process occur? (1)
(5)

CONTENT	ELABORATION
DNA profiling	❑ Interpretation of DNA profiles ❑ Uses of DNA profiles

DNA PROFILING



- A DNA profile is a pattern of black bars produced on X-ray film.
- This pattern consists of lines which are of different lengths and thicknesses and in different positions, as shown in the figure below.

All individuals, except identical twins, have a unique DNA profile.

INTERPRETATION OF DNA PROFILES

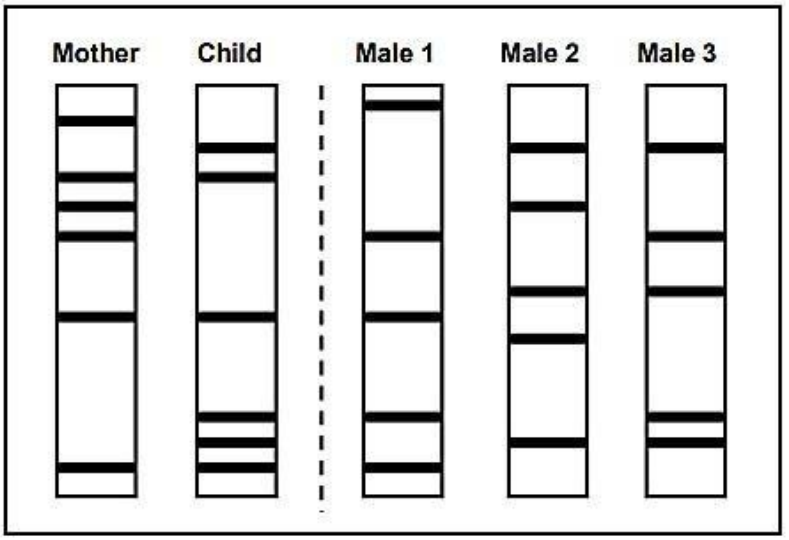
- Look at the DNA profile bands of the baby and first compare them to the DNA profile bands of the mother
- Eliminate all DNA profile bands that are common with that of the mother
- If ALL the REMAINING DNA profile bands of the baby correspond with that of the of one male, then that male is the father.

USES OF THIS TECHNIQUE

- identify crime suspects in forensic investigations
- prove paternity (father) and maternity (mother) (biological parents)
- determine the probability or causes of genetic defect
- establish the compatibility of tissue types for organ transplants
- identify relatives

ACTIVITY 4

The diagram below shows a technique used in paternity testing



4.1.1. Identify the technique shown above. (1)

4.1.2 Which male is the biological father of the child? (1)

4.1.3. Explain your answer to QUESTION 5.1.2 (3)

4.1.4 State TWO other uses of this technique (2)

(7)

	ELABORATION
RNA: Location, Structure and function (in eukaryotes)	❑ Location of RNA: • mRNA is formed in the nucleus and functions on the ribosome • tRNA is located in the cytoplasm • rRNA is located in the ribosomes and nucleolus - (function not required) ❑ Structure of RNA • A single-stranded molecule consisting of nucleotides ❑ Three components of an RNA nucleotide: • Nitrogenous bases ○ Four nitrogenous bases of RNA: adenine (A), uracil (U), cytosine (C), guanine (G) • Sugar portion (ribose in RNA) • Phosphate portion ❑ Stick diagram of mRNA and tRNA molecules to illustrate their structure ❑ Function of RNA: • RNA plays a role in protein synthesis

RNA: Location

- Ribosomal RNA (rRNA) is found in the ribosomes in the cytoplasm.
- Messenger RNA (mRNA) is found in the nucleus and the cytoplasm.
- Transfer RNA (tRNA) is found in the cytoplasm.
- All three types of RNA play important roles in protein synthesis.

Structure of RNA

- RNA is a single-stranded long straight molecule.
- It is made up of nucleotides.
- Contains Uracil instead of thymine

Nitrogenous Bases in RNA

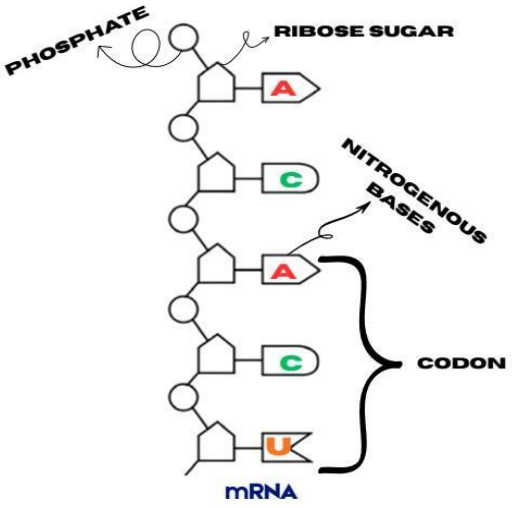
- Adenine (A)
- Uracil (U)
- Cytosine (C)
- Guanine (G)

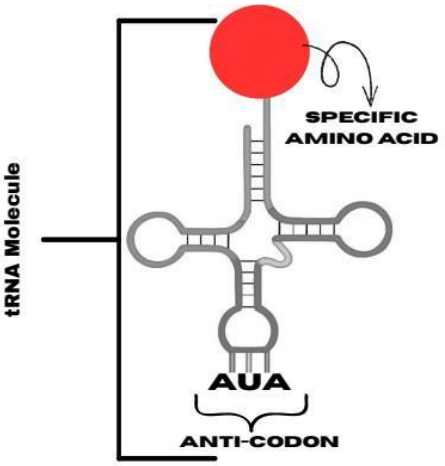
Components of an RNA Nucleotide

- A nitrogenous base
- A ribose sugar
- A phosphate group

Function of RNA

- RNA plays an essential role in protein synthesis.

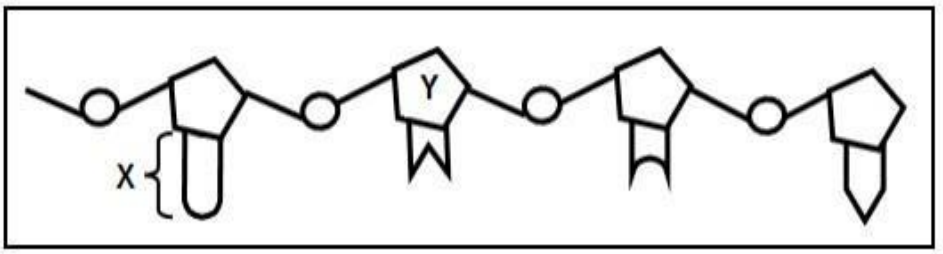




DNA	RNA
contains deoxyribose sugar	contains ribose sugar
double helix and coiled	single stranded
contains the nitrogenous base thymine	contains the nitrogenous base uracil
found in the nucleus only	found in the nucleus, ribosomes and cytoplasm of cells

ACTIVITY 5

The diagram below represents a single-stranded nucleic acid found in the nucleus



5.1.1 Identify the molecule represented in the diagram. (1)

5.1.2 Identify:

(a) Part **X** (1)

(b) Sugar **Y** (1)

5.1.3 A section of mRNA has the following base sequence and is read from left to right:

GAU CUC GAC AGC AUG ACC

Give the DNA base triplet for the LAST codon on this section of mRNA (2)

5.1.4 A mutation occurred which resulted in the following base sequence on the mRNA molecule:

GAU CUC GAC AGU AUG ACC

(a) Describe the mutation that occurred. (4)

(9)

THE INVOLVEMENT OF DNA AND RNA IN PROTEIN SYNTHESIS:

CONTENT	ELABORATION
Protein synthesis	❑ The involvement of DNA and RNA in protein synthesis: • Transcription o A section of the double helix DNA unwinds o The double-stranded DNA unzips/weak hydrogen bonds break o to form two separate strands o One strand is used as a template o to form mRNA o using free RNA nucleotides from the nucleoplasm o The mRNA is complementary to the DNA o mRNA now has the coded message for protein synthesis mRNA moves from the nucleus to the cytoplasm and attaches to the ribosome • Translation o Each tRNA carries a specific amino acid o When the anticodon on the tRNA o matches the codon on the mRNA o the tRNA brings the required amino acid to the ribosome (Names of specific codons, anticodons and their amino acids are not to be memorised) o Amino acids become attached to each other by peptide bonds o to form the required protein ❑ Simple diagram to illustrate transcription and translation in protein synthesis

TRANSCRIPTION

- **A section** of the DNA **double helix unwinds.**
- The double-stranded DNA **unzips**/weak hydrogen bonds break
- Two separate stands are formed
- **One strand** is used as a **template**
- to form **mRNA**
- using **free RNA nucleotides** from the nucleoplasm.
- The mRNA is **complementary to the DNA.**
- mRNA now has the **coded message** for protein synthesis

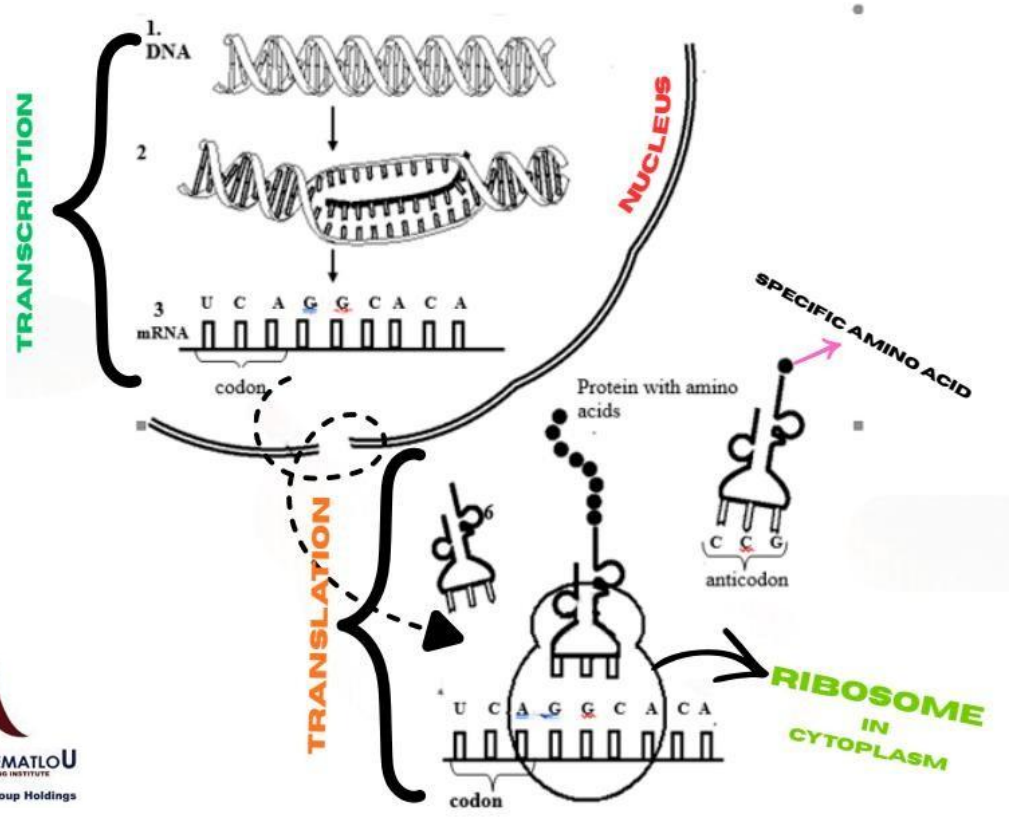
DIFFERENCES TRANSCRIPTION AND DNA REPLICATION

Transcription	DNA replication
Only one strand acts as a template✓	Both strands act as templates✓
Free RNA nucleotides are complementary✓	Free DNA nucleotides are complementary✓
Adenine complements uracil✓/(A-U)	Adenine pairs with thymine✓/ (A-T)
A mRNA molecule is formed✓	Two identical DNA molecules are formed✓

TRANSLATION

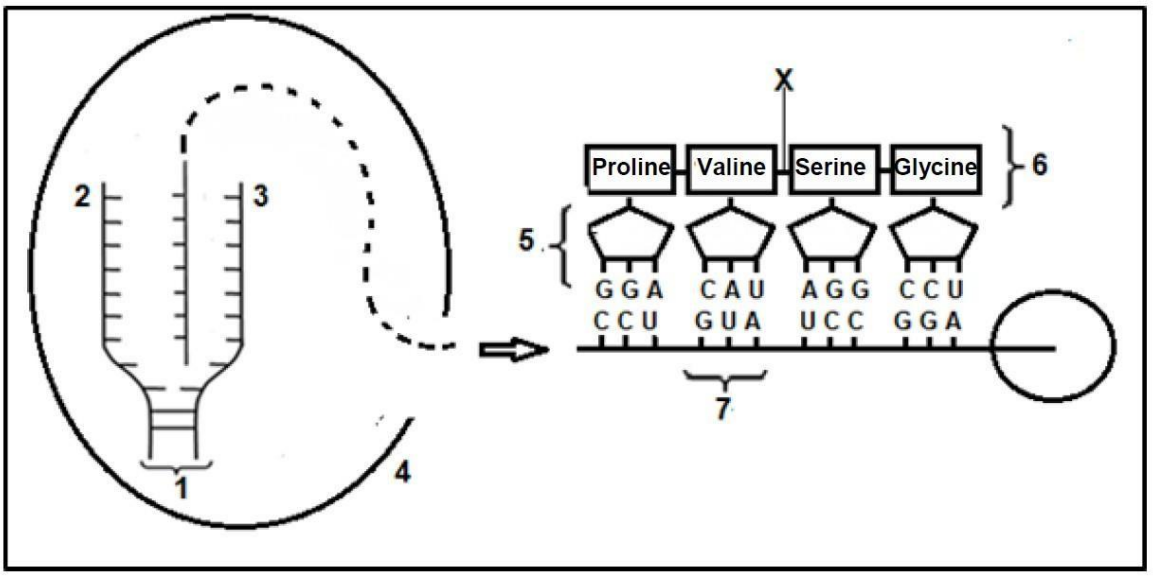
- Each **tRNA carries a specific amino acid.**
- When the **anticodon on the tRNA**
- matches the **codon on the mRNA**
- then **tRNA brings the required amino acid** to the **ribosome.**
- Amino acids become **attached** to each other by **peptide bonds**
- to form the **required protein.**

SIMPLE DIAGRAMS TO ILLUSTRATED PROTEIN SYNTHESIS



ACTIVITY 6

The diagram below represents two stages of protein synthesis



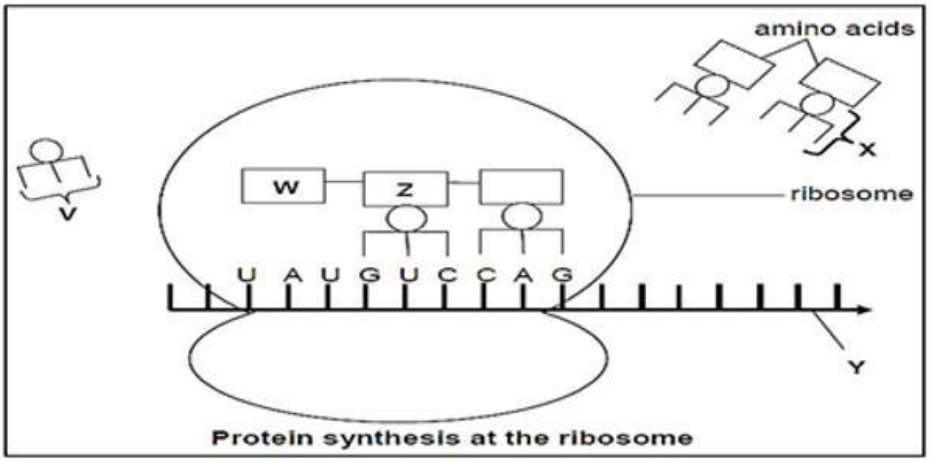
6.1.1 Provide labels for:
(a) The bond at **X** (1)
(b) Organelle **4** (1)
(c) Molecule **1** (1)
(d) Molecule **5** (1)

6.1.2 Does strand **2** or strand **3** serve as the template for the process that is taking place? (1)

6.1.3 Write down the DNA base triplet that corresponds to the codon numbered **7.** (2)

ACTIVITY 7

Study the diagram below which shows a part of the process of protein synthesis.



Protein synthesis at the ribosome

tRNA	Amino acid
GUC	Glutamine
UAA	Isoleucine
AUA	Tyrpsine
CCC	Glycine
GGG	Proline
CAG	Valine

7.1.1 Identify the stage of protein synthesis that is shown in the diagram above. (1)

7.1.2 Identify molecules X and Y. (2)

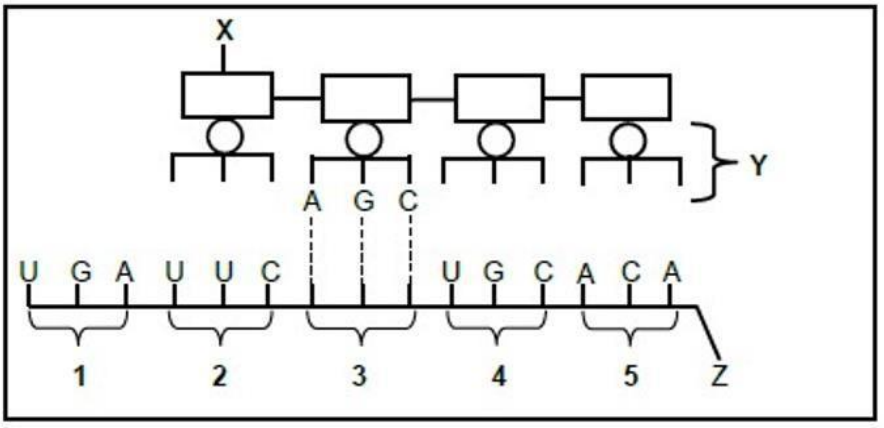
7.1.3 State the term for the group of three nitrogenous bases indicated by V. (1)

7.1.4 Give the nitrogenous bases on the DNA strand that codes for the bases UAU on molecule Y. (1)

7.1.5 Use the table below to identify amino acid W. (2)

ACTIVITY 8

The diagram below shows a stage in protein synthesis



8.1.1 Identify molecule
(a) X (1)
(b) Y (1)

8.1.2 Name the stage of protein synthesis represented by the diagram above. (1)

8.1.3 Give the:
(a) DNA base triplet that correspond to the codon numbered 3 (1)
(b) Anticodon for the codon numbered 5 (1)

8.1.4 Name the organelle in a cell where the process shown in the diagram above occurs (1)

8.1.5 From which molecule does **Z** copy the coded message during protein synthesis? (1)

(7)

MEIOSIS

CONTENT	ELABORATION
Introduction	❑ Revision of the structure of a cell, with an emphasis on the parts of the nucleus, the centrosome and the cytoplasm ❑ Structure of chromosomes: • Chromosomes consist of DNA (which makes up genes) and protein • The number of chromosomes in a cell is a characteristic of an organism (e.g., humans have 46 chromosomes) • Chromosomes which are single threads become double (two chromatids joined by a centromere) as a result of DNA replication ❑ Differentiate between: • Haploid (n) and diploid (2n) cells in terms of chromosome number • Sex cells (gametes) and somatic cells (body cells) • Sex chromosomes (gonosomes) and autosomes using a karyotype • Homologous chromosome pairs and chromosomes ❑ Revision of the process of mitosis

TERMINOLOGY

NB!!!! Meiosis **ONLY** takes place in sex organs (Male and Female reproductive organs) **Mitosis takes place in Somatic (Body) cells.**

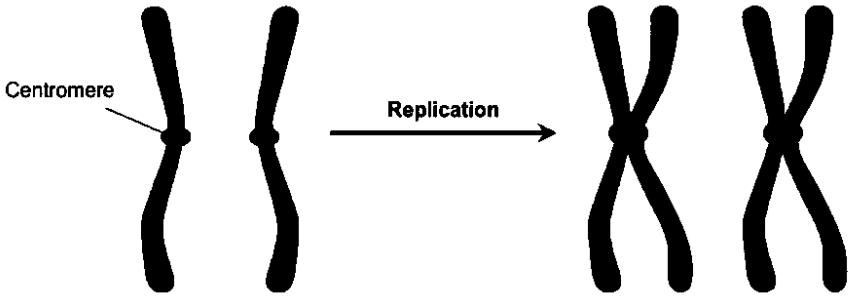
TERMS (Alphabetical)	EXPLANATION
Anaphase I	Phase in meiosis in which chromosomes are pulled apart
Anaphase II	Phase in meiosis in which chromatids are pulled apart
Bivalent	A pair of homologous chromosomes involved in crossing over
Centrioles	Structures that form spindle threads during meiosis
Centrosome	Structure that splits to form two centrioles in animal cells during meiosis
Chiasma	Point of overlap of chromatids during crossing over
Chromatids	The two strands that make up a chromosome
Crossing over	The exchange of genetic materials between the non-sister chromatids of homologous chromosomes
Diploid	Chromosome condition describing the presence of two sets of chromosomes in each cell
DNA replication	Process by which a single stranded chromosome becomes double stranded
Down syndrome	Genetic disorder caused by the presence of an extra chromosome on chromosome pair 21

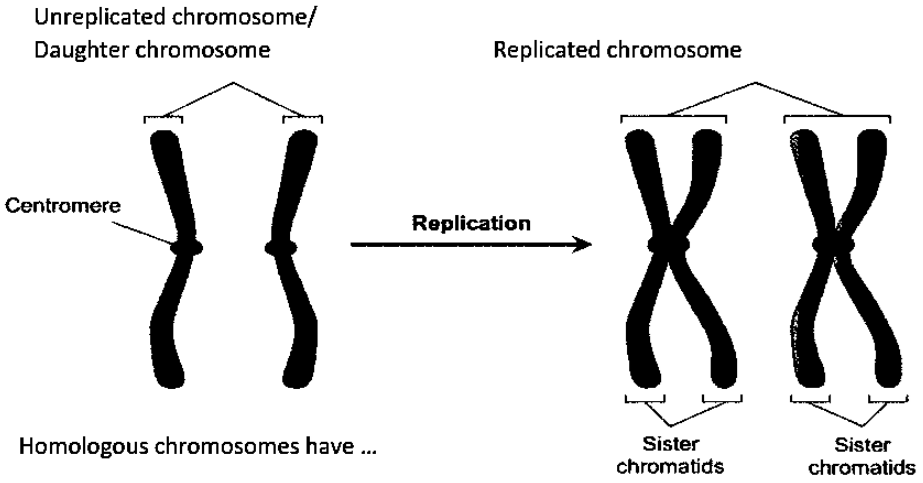
Haploid	Chromosome condition describing the presence of a single set of chromosomes in each cell.
Homologous	Chromosomes that are identical in shape/height/length and size, with the same location of the centromere and position of genes
Interphase	Phase during which DNA replication takes place
Karyotype	The complete diploid set of homologous chromosomes arranged according to their shape, size and numbering possessed of a body cell
Meiosis	The type of cell division that results in halving of the chromosome number
Meiosis	Cell division producing daughter cells that are not similar
Metaphase I	Phase in meiosis in which chromosomes line up at the equator in pairs
Metaphase II	Phase in meiosis in which chromosomes are arranged singly at the equator
Mitosis	Cell division producing identical cells
Non-disjunction	Non-separation of chromosomes or chromatids during meiosis
Prophase I	Phase in meiosis in which crossing over occurs
Spindle threads	Structures to which chromosomes are attached during Metaphase I and Metaphase II
Telophase I	Phase in meiosis in which two cells are formed having half the chromosome number as the original
Telophase II	Phase in meiosis in which four cells are formed having half the chromosome number as the original cell

INTRODUCTION

- Meiosis is when one cell divides to form four daughter cells.
- Each daughter cell has half the chromosome number of the parent cell.
- The parent cell is diploid (2n) and the new cells are haploid (n).
- The four cells are genetically different from each other and from the parent cell.
- Meiosis forms gametes (sex cells) in animals and spores in plants.
- In males, it produces sperm cells in the testes.
- In females, it produces ova (egg cells) in the ovaries.
- Humans have 46 chromosomes (2n = 46).
- Gametes have 23 chromosomes (n = 23).
- Meiosis is important because it prevents the chromosome number from doubling at fertilisation.
- When two haploid gametes fuse, the diploid number is restored.
- This keeps the chromosome number constant from generation to generation.
- Meiosis only occurs in sex cells in the gonads.
- Mitosis occurs in somatic (body) cells.

STRUCTURE OF CHROMOSOMES *Before meiosis begins (during interphase) DNA replication takes place. The result is two sets of chromosomes consisting of two identical chromatids joined together with a centromere.*





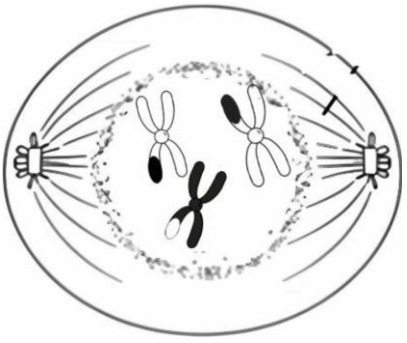
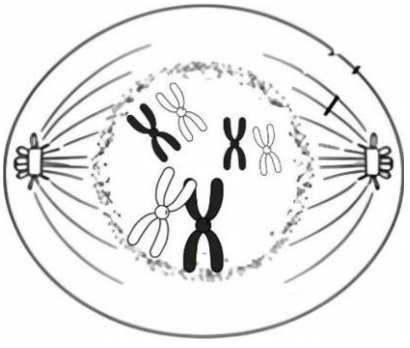
Homologous chromosomes have ...

- the same shape, size/length/height.
- The same position of genes/alleles
- The same genes coding for the same characteristics
- The same location of the centromere

Sister chromatids are identical in every way. Sister chromatids only appear before the point of cell division (S phase of interphase)

Haploid (n); Diploid (2n); Sex cells (gametes) somatic cells (body cells)

Differentiate between:

Haploid (n)	**Diploid (2n)**
Contains half the number of chromosomes	Contains a full set of chromosomes.
Sex cells (gametes)	**Somatic (body cells)**
	

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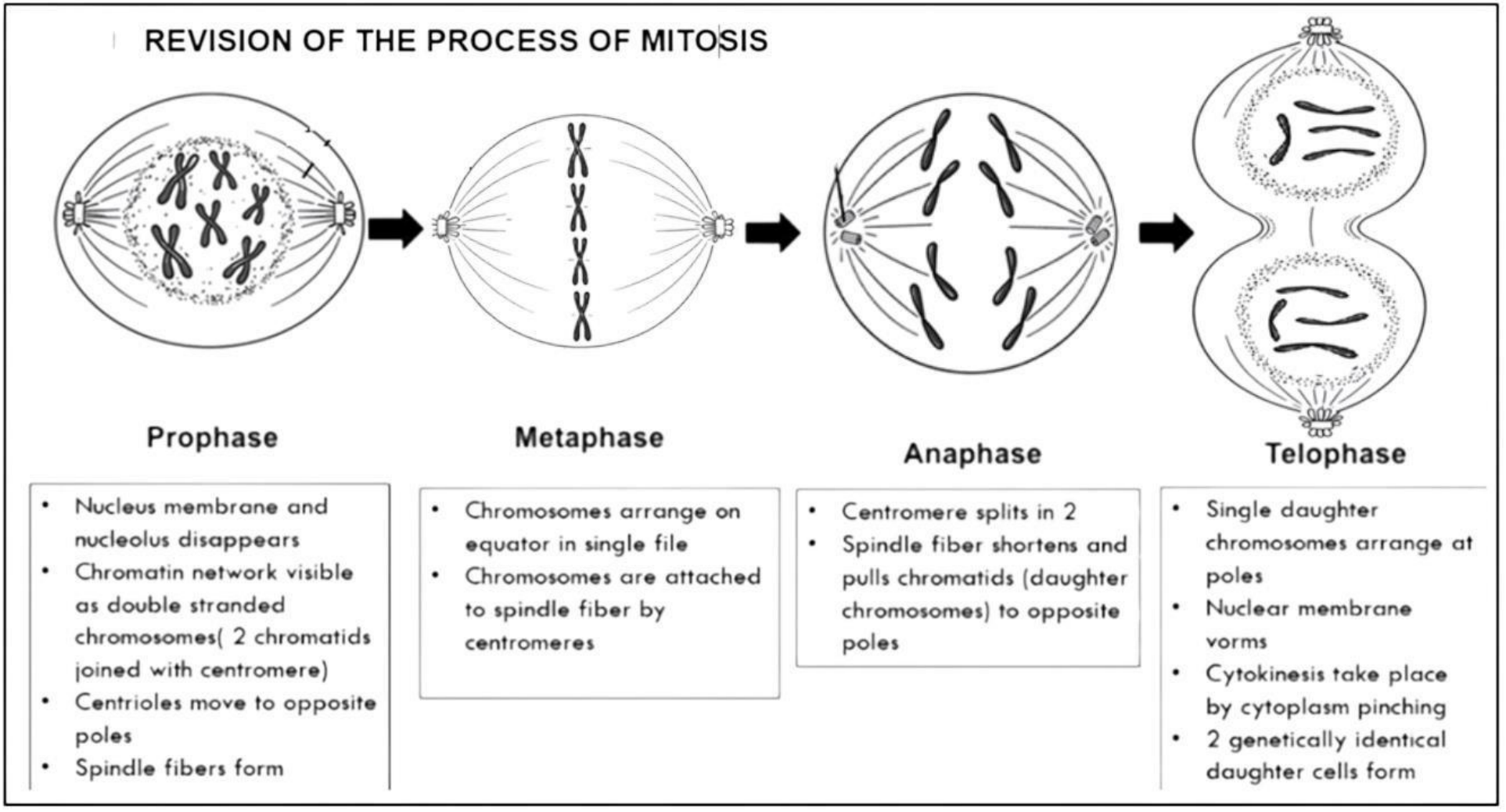
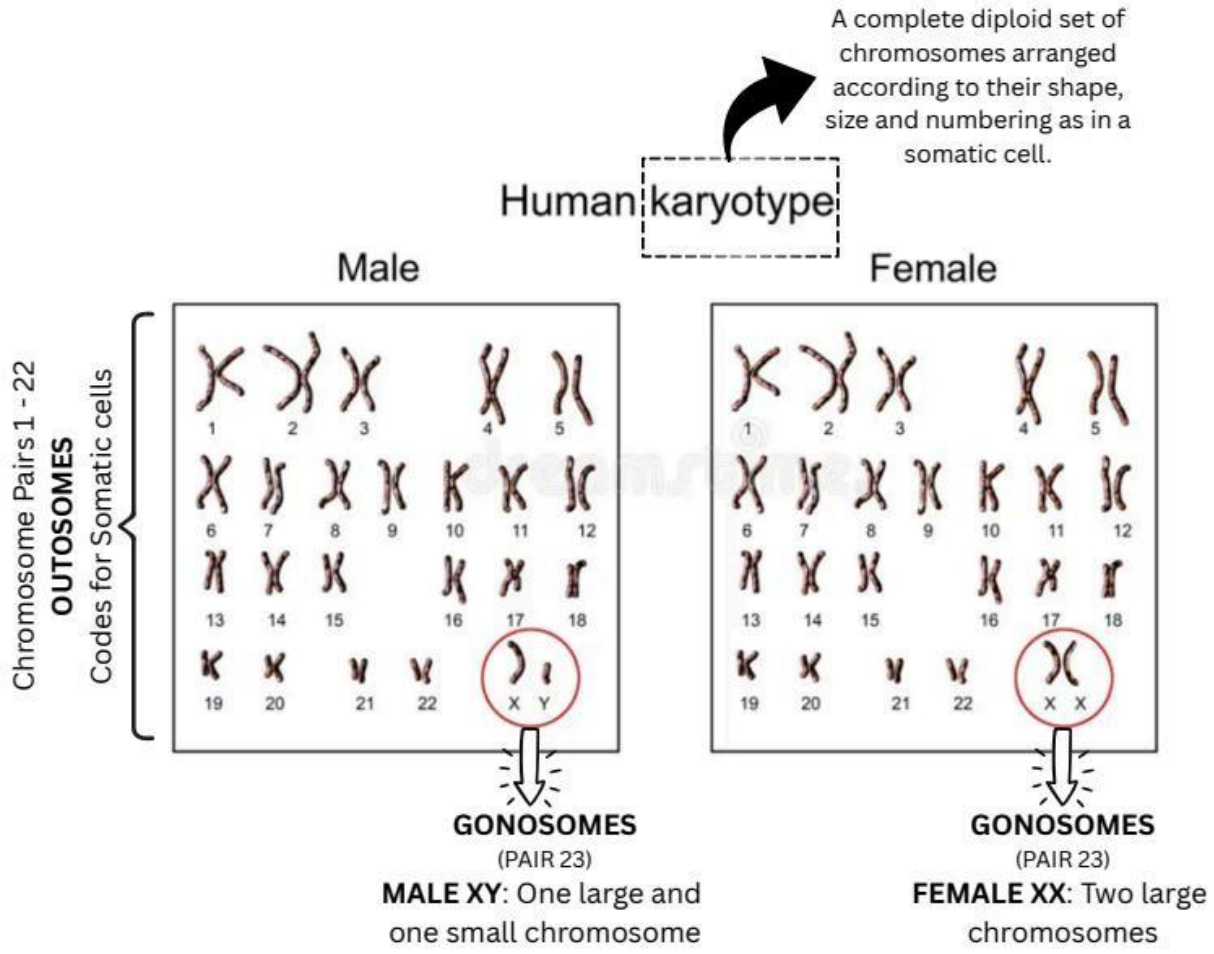
MITOSIS

- Creating genetically identical somatic cells
- Growth and replacement of damaged somatic cells



CONTENT	ELABORATION
Meiosis – The process	❑ Definition of meiosis ❑ Site of meiosis in flowering plants and in mammals ❑ Meiosis is a continuous process, but the events are divided into different phases for convenience. ❑ Events of interphase: • DNA replication takes place ○ Chromosomes which are single threads, become double ○ Each chromosome will now consist of two chromatids joined by a centromere ○ DNA replication helps to double the genetic material so that it can be shared by the new cells arising from cell division ❑ The events of the following phases of Meiosis I, using diagrams: • Prophase I – including a description of crossing over • Metaphase I – including the random arrangement of chromosome pairs • Anaphase I – including the movement of chromosomes to opposite poles • Telophase I ❑ The events of each phase of Meiosis II, using diagrams: • Prophase II • Metaphase II – including the random arrangement of chromosomes • Anaphase II – including the movement of chromatids to opposite poles • Telophase II



FIRST MEIOTIC DIVISION

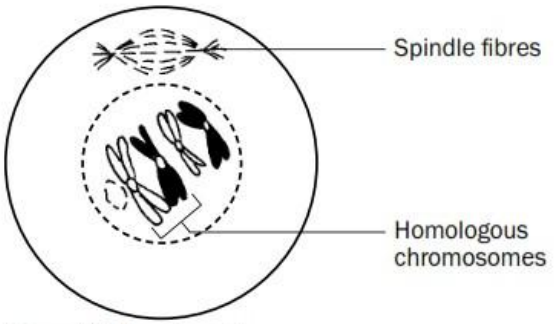


Figure 2.2 Prophase 1

Prophase 1

- Chromosomes shorten and become visible as two chromatids joined by a centromere.
- Homologous pairs of chromosomes are now visible.
- The nuclear membrane and nucleolus disappear.
- The spindle starts to form.
- Chromatids from each homologous pair touch. The point where they touch is called a chiasma.
- DNA is crossed over (swopped) at the chiasma.
- The spindle continues to form.

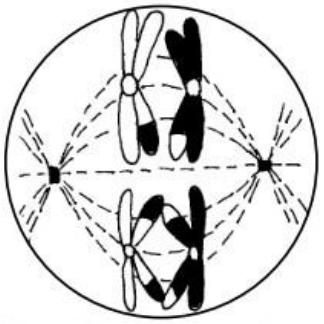


Figure 2.3 Metaphase 1

Metaphase 1

- The spindle extends across the whole cell.
- The homologous chromosomes line up along the equator of the spindle in their homologous pairs.
- One chromosome of each pair lies on either side of the equator.
- The centromere of each chromosome attaches to the spindle fibres.

Figure 2.4 Anaphase 1

Anaphase 1

- The spindle fibres shorten and pull each chromosome of each chromosome pair to opposite poles of the cell.

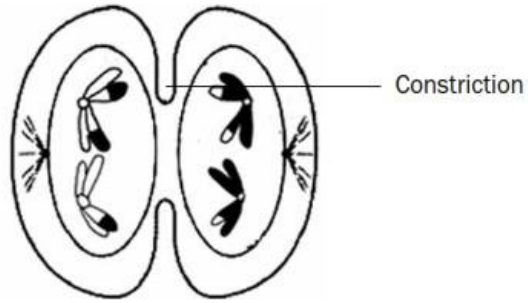


Figure 2.5 Telophase 1

Telophase 1

- The chromosomes reach the poles of the cell.
- Each pole has half the number of chromosomes present in the original cell.
- The cell membrane constricts and divides the cytoplasm in half to form two cells.

SECOND MEIOTIC DIVISION

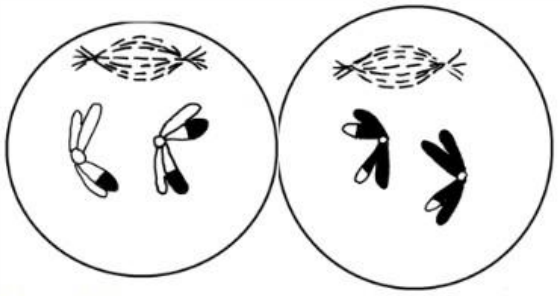


Figure 2.6 Prophase 2

Prophase 2

- Each cell formed during meiosis I now divides again.
- A spindle forms in each of the new cells.

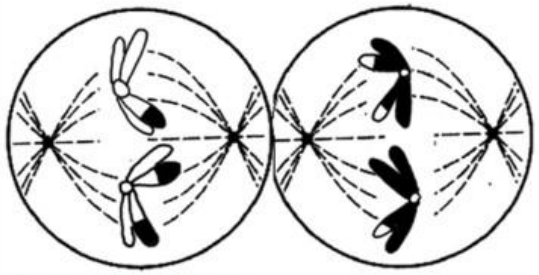


Figure 2.7 Metaphase 2

Metaphase 2

- Individual chromosomes line up at the equator of each cell, with the centromeres attached to the spindle fibres.

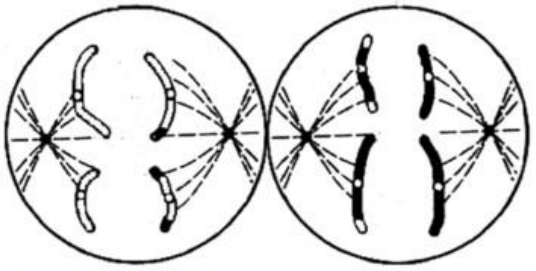


Figure 2.8 Anaphase 2

Anaphase 2

- The spindle fibres start to contract.
- The centromeres split and daughter chromosomes/ chromatids are pulled to the opposite poles of each cell.

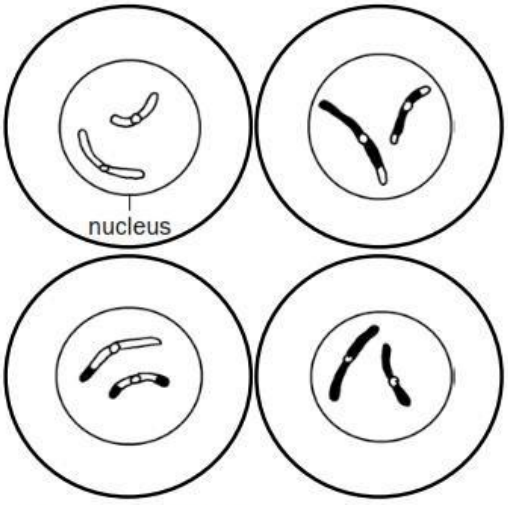


Figure 2.9 Telophase 2

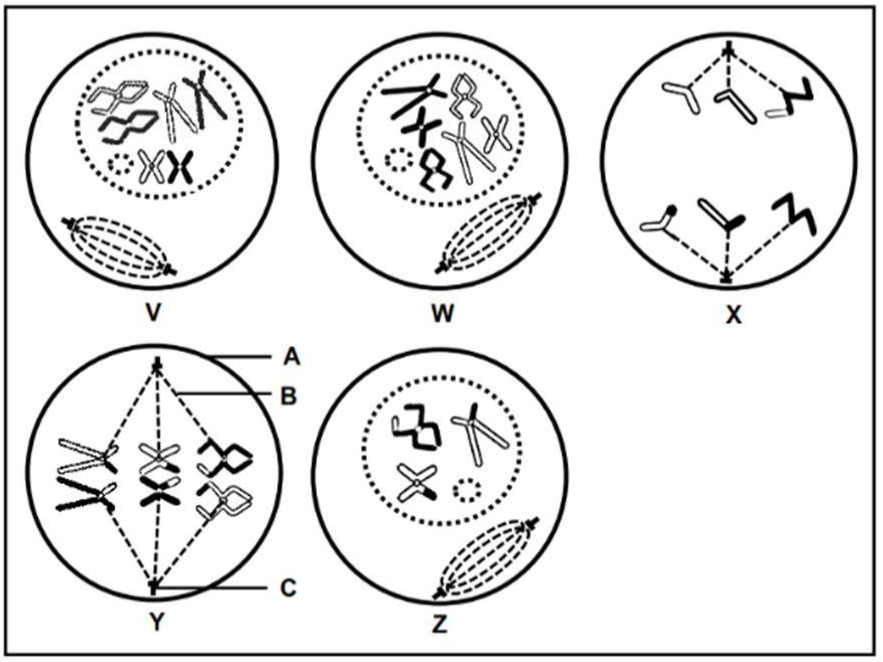
Telophase 2

- The daughter chromosomes/chromatids reach the poles and a new nucleus forms.
- The cell membrane of each cell constricts and the cytoplasm divides into two cells.
- Four haploid daughter cells are formed.
- Each daughter cell has half the number of chromosomes of the original cell.
- The daughter cells are genetically different from each other.

Meiosis I	Meiosis II
The chromosomes arrange at the equator of the cell in homologous pairs.	Chromosomes line up at the equator of the cell individually.
Whole chromosomes move to opposite poles of the cell.	Daughter chromosomes/chromatids move to opposite poles of the cell.
Two cells form at the end of this division.	Four cells are formed at the end of this division.
The chromosome number is halved during meiosis I.	The chromosome number remains the same during meiosis II.
Crossing over takes place.	Crossing over does not take place.

Activity 1: Meiosis and Mitosis

The following diagrams represent a cell from the same organism during different phases of Meiosis and Mitosis.



1.1 Identify part:
- (a) A (1)
- (b) B (1)
- (c) C (1)

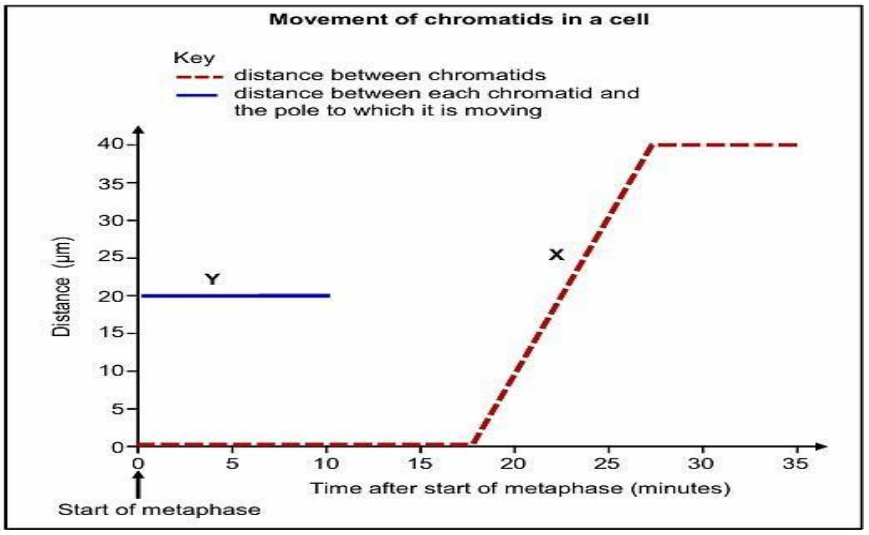
1.2 Which diagram (V,W,X,Y or Z) represents a cell during:
- (a) Prophase of mitosis (1)
- (b) Metaphase I (1)
- (c) Prophase I (1)

1.3 How many chromosomes will there be in each cell at the end of:
- (a) Mitosis (1)
- (b) Meiosis I (1)

(8)

Activity 2: Meiosis investigation

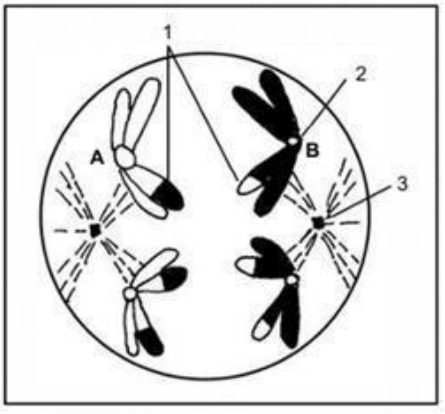
The graph shows information about the movement of chromatids in a cell that has just started Metaphase II.



2.1.1 Name one difference between Metaphase I and Metaphase II. (2)
2.1.2 What is the duration of Metaphase II in this cell? (1)
2.1.3 Use line X to calculate the duration of Anaphase II in this cell. (2)
(5)

Activity 3: Meiosis Phases

Study the diagram below and answer the questions that follow.



3.1.1 What type of cell division is occurring? (1)
3.1.2 What phase is depicted? (1)
3.1.3 Provide labels for parts labelled 2 and 3. (1)
3.1.4 What process resulted in the exchange of segments labelled 1? (1)
3.1.5 Explain why the process mentioned in 3.1.4 is important (1)
(5)

CONTENT	ELABORATION
Importance of meiosis	❑ The importance of meiosis: • Production of haploid gametes • The halving effect of meiosis overcomes the doubling effect of fertilisation, thus maintaining a constant chromosome number from one generation to the next • Mechanism to introduce genetic variation through: ○ Crossing over ○ The random arrangement of chromosomes at the equator

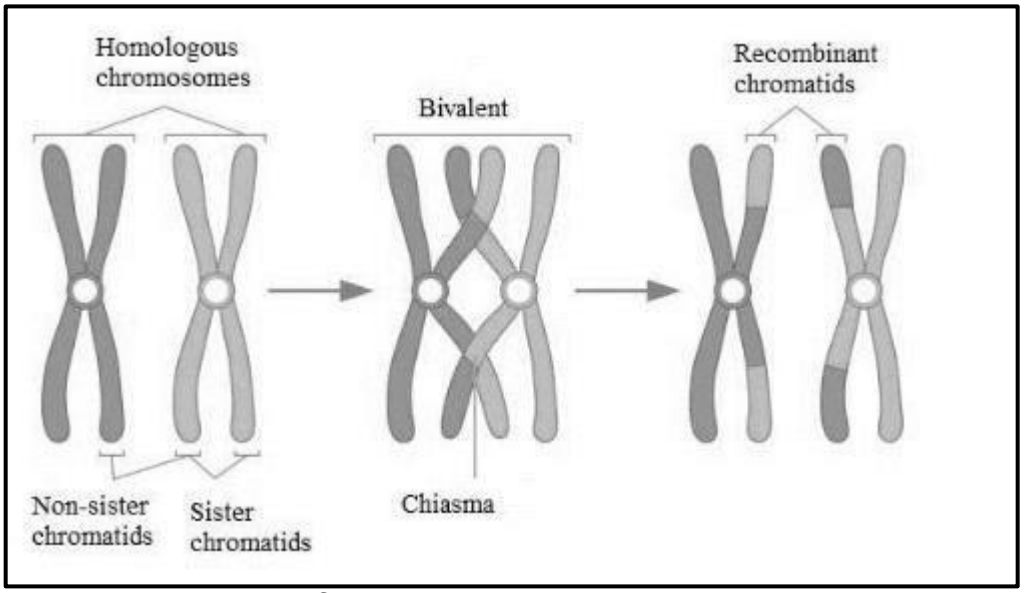
THE IMPORTANCE OF MEIOSIS:

- Leads to the formation of Haploid gametes
- The halving effect of meiosis overcomes the doubling effect of fertilization to maintain the constant chromosome number from one generation to the next
- Crossing over in Prophase I and random arrangement of chromosomes at the equator during metaphase I and II ensure genetic variation.

HOW MEIOSIS CONTRIBUTES TO GENETIC VARIATION:

Crossing over

- Occurs during Prophase 1
- Homologous chromosomes form a bivalent
- Non-sister chromatids of homologous chromosomes/adjacent chromatids overlap
- at a point called chiasma / chiasmata
- to exchange genetic material
- Resulting in genetically different chromosomes from both parents



Random arrangement of chromosomes

- Occurs during metaphase I / II
- Each pair of homologous chromosomes / each chromosome
- may line up randomly on the equator
- so that they separate in a random / independent manner
- allowing the gametes to have different combinations of maternal and paternal chromosomes
- resulting in new combinations of genetic material in different gametes

HOW MUTATIONS CONTRIBUTE TO GENETIC VARIATION

Two types of mutations:

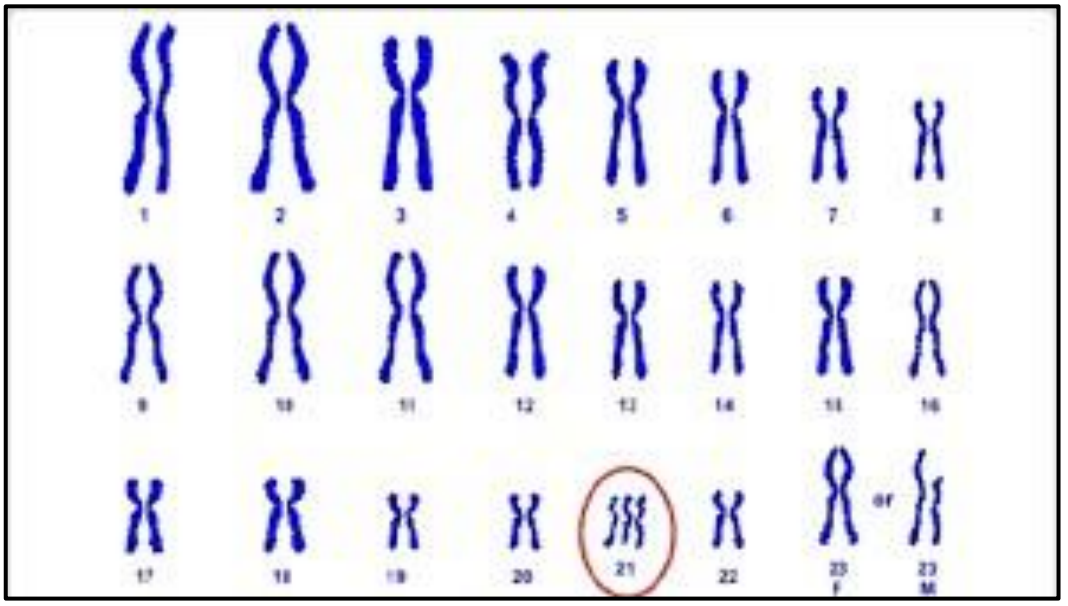
- gene mutation and
- chromosome mutations

- A **gene**✓ **mutation** occurs
- as a result of a change in sequence of nitrogenous bases✓ in the DNA molecule

- A **chromosome**✓ **mutation** occurs as a
- result of a change in the structure of a chromosome✓ OR
- a change in the number of chromosomes during meiosis✓

- **Mutations that occur in sex cells**✓
- are passed on to the new generations✓
- creating new characteristics✓

KARYOTYPE OF A PERSON WITH DOWN SYNDROME



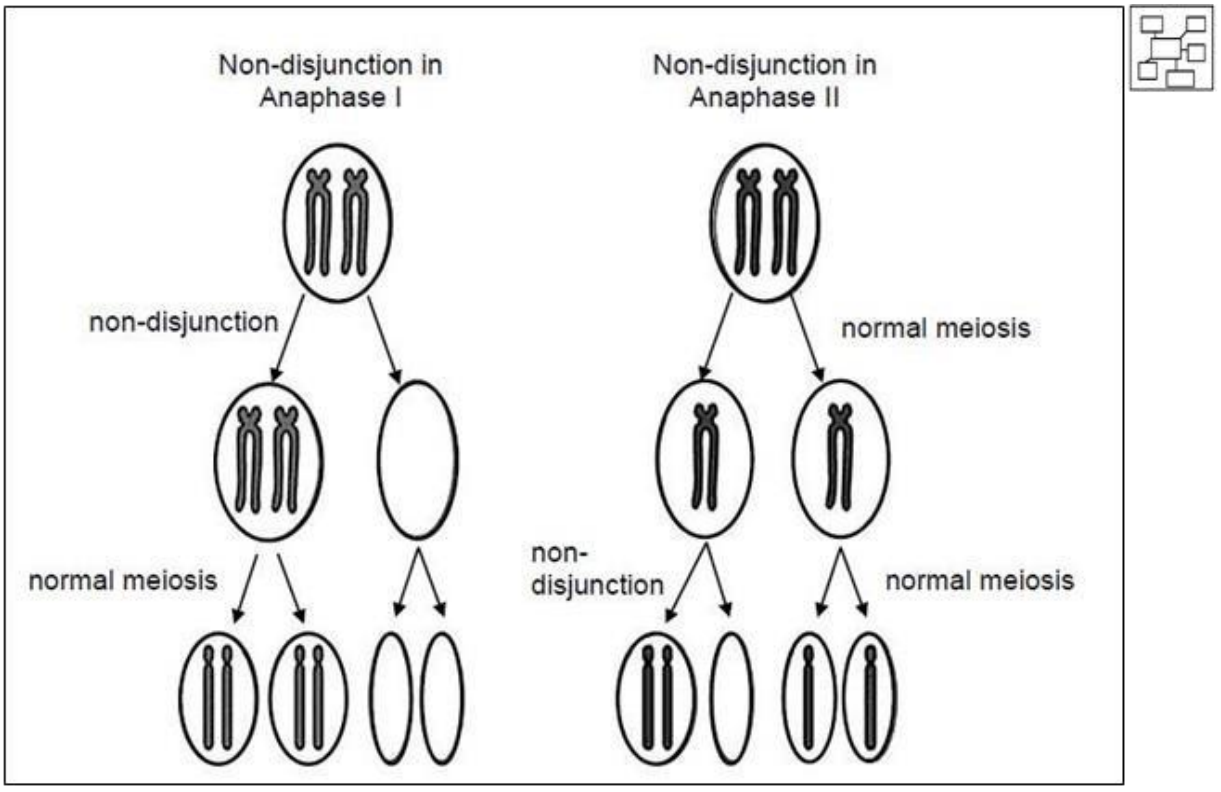
KARYOTYPE

ABNORMAL MEIOSIS (CHROMOSOME MUTATION)

- Mistakes can occur during meiosis.
- Non-disjunction can happen in Anaphase I.
- Homologous chromosomes fail to separate properly.
- Non-disjunction can also occur in Anaphase II.
- Sister chromatids fail to separate.
- If chromosome pair 21 does not separate, an abnormal gamete forms.
- This gamete has an extra copy of chromosome 21.
- If it fuses with a normal gamete (23 chromosomes), the zygote has 47 chromosomes
- This results in Down syndrome.

EVENTS THAT LEAD TO DOWN SYNDROME

- Non-disjunction occurred when a homologous pair of chromosomes at position 21 / chromatids
- failed to separate
- during anaphase I / II
- resulting in one gamete with 24 chromosomes / an extra chromosome /
- at position 21
- The fertilisation of this gamete with a normal gamete /gamete with
- 23 chromosomes
- results in a zygote with 47 chromosomes
- There are 3 chromosomes/an extra chromosome at position 21/ this is Trisomy 21



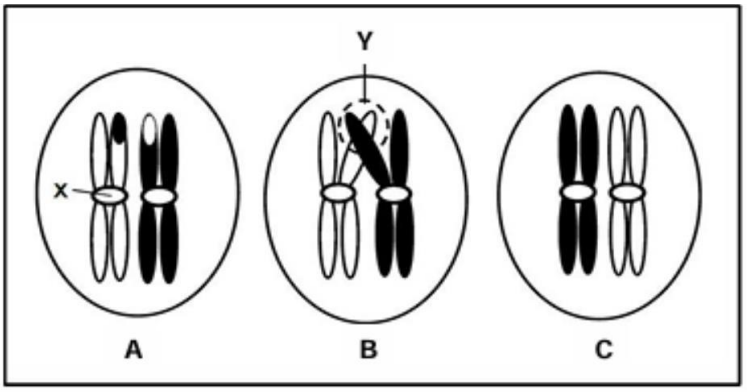
Activity 4: Biological terms

4.1	The division of the cytoplasm after a cell nucleus has divided.	(2)
4.2	The point of crossing over between two adjacent chromosomes.	(2)
4.3	The name of the process when homologous chromosome pairs fail	(2)
4.4	Region where the two chromatids of a chromosome are held together.	(2)
4.5	Chromosome condition describing the presence of a single set of Chromosomes in a cell.	(2)
4.6	The structure responsible for pulling chromosomes to the poles of an animal cell during cell division	(2)
4.7	The DNA in a nucleus of a non-dividing cell.	(2)
4.8	The structure that is made up of two chromatids joined at the center.	(2)
4.9	A phase in the cell cycle that occurs before cell division.	(2)
4.10	A source of genetic variation that arises during Metaphase I.	(2)
		(20)

Activity 5: Meiosis and crossing over

5.1 The diagrams below represent a chromosome pair in a female human cell.

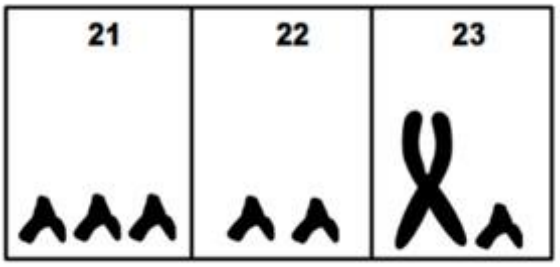
The cells (A, B and C) show different events in a phase of meiosis, which are not necessarily in the correct sequence.



5.1.1	How many pairs of chromosomes occur in a normal human cell?	(1)
5.1.2	Give labels for:	
	(a) region **X**	(1)
	(b) Area **Y**	(1)
5.1.3	Name the organ in the human female where meiosis occurs.	
	(a) Process occurring in diagram **B**	(1)
	(b) Phase represented by the diagrams above.	(1)
	(c) Type of cell that would result from meiosis of this cell	(1)
5.1.4	Arrange letters **A, B** and **C** to show the correct sequence of the events	(1)
5.1.5	What is the biological importance of meiosis?	(2)
		(9)

Activity 6: Abnormal Meiosis

6.1 The diagram below represents part of an abnormal human karyotype.

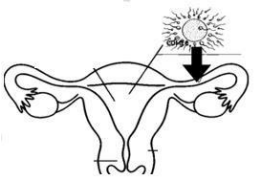
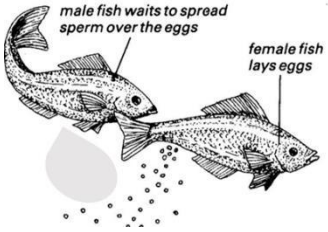


6.1.1 How many autosomes are shown in the diagram? (1)
6.1.2 Name the type of chromosomes represented by pair 23. (1)
6.1.3 Name the:
(a) Disorder represented in the diagram (1)
(b) Process during anaphase of meiosis that resulted in the abnormal number of chromosomes (1)

(4)

REPRODUCTION IN VERTEBRATES

CONTENT	ELABORATION
Diversity of reproductiv e strategies	❑ The role of the following reproductive strategies in animals in maximising reproductive success in different environments (using relevant examples): • External fertilisation and internal fertilisation • Ovipary, ovovivipary and vivipary • Amniotic egg: structure and functions of parts, using a diagram • Precocial and altricial development • Parental care

Location of fertilization (Location where nucleus of sperm and nucleus of Ovum fuse)		
Inside the female body	**Internal fertilisation**	
Outside the female body	**External fertilisation**	

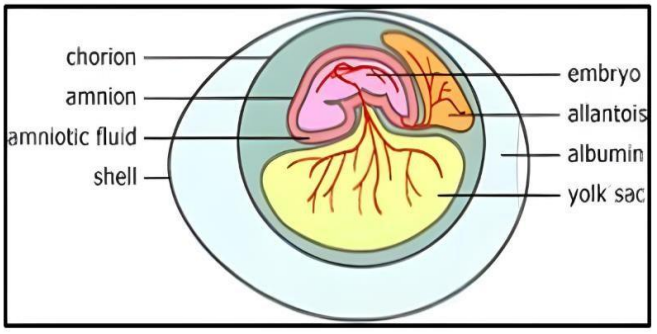
EMBRYONIC DEVELOPMENT: WHERE DOES THE EMBRYO DEVELOP

LOCATION AND NOURISHMENT	Term
Inside the female body, in the uterus Embryo is **nourished by the placenta**.	**Vivipary**
Inside an egg, but *outside* the female body **Nourished by the yolk**	**Ovipary**
Inside an egg, and *inside* the female body Embryo is **nourished by the yolk**	**Ovovivipary**

AMNIOTIC EGG:

It is like a small incubator which provides oxygen, required temperature and nutrients for a developing embryo.

It contains 3 extra embryonic membranes:	
Amnion	shock absorber
Chorion	helps with gaseous exchange
Allantois	contains all waste products



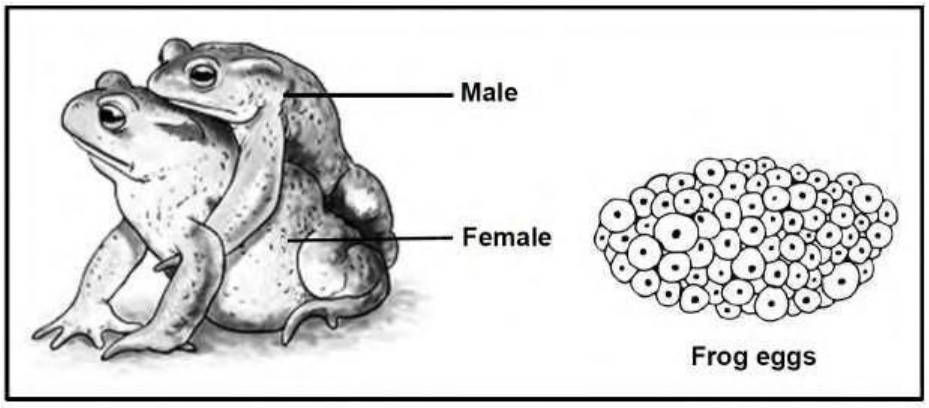
The yolk sac is energy-rich food = nutrients for the baby.
The more the embryo develops, the smaller the yolk sac becomes and the larger the allantois

DEVELOPMENT

PRECOCIAL DEVELOPMENT	Well-developed young that can walk and feed themselves soon after birth eyes are open and body covered with feathers Low degree of parental care
ALTRICIAL DEVELOPMENT	Have poorly developed young that can't walk/fly Eyes are closed **(NOT BLIND),** no feathers **(NOT NAKED)** High degree in Parental Care is required as young can't feed themselves

ACTIVITY 1 Reproduction in Vertebrates

In some frog species, during mating, the male climbs onto the back of the female and grasps her with his front legs. During this time, the female will release about 6 000 ova, while the male releases sperm onto them. This mating behavior is called amplexus.



1.1. Name the type of fertilisation that occurs during reproduction in frogs. (1)

1.2. Explain why the fertilised eggs of these frogs do not survive on land.

1.3. Explain how amplexus increases the chances of fertilisation in frogs. (2)

1.4. From the information above, explain ONE other strategy that contributes to the reproductive success of the frog species. (2)

(7)

HUMAN REPRODUCTION Paper 1: 41 marks	**Term 1**	**3 weeks**

CONTENT	**ELABORATION**
Structure of the male reproductive system	Structure of the male reproductive system, using a diagram • Functions of the scrotum, testis, epididymis, vas deferens, penis and the urethra • The seminal vesicles, prostate gland and Cowper's glands secrete fluids that contribute to semen and collectively perform the following functions: ○ Ensure maximum motility of sperm ○ Neutralise the acidic pH in the urethra and the vagina ○ Provide nutrients for sperm

MALE REPRODUCTIVE SYSTEM:

Reasons These 3 Are Exocrine Glands:

1. Presence of Ducts – These glands release their secretions into ducts that transport the fluids to the urethra. The prostate gland and seminal vesicles secrete into the ejaculatory ducts. The Cowper's glands secrete into the urethra.
2. External Secretion – Their secretions exit the body through the urethra, rather than being released into the bloodstream like endocrine glands (e.g., the testes producing testosterone).
3. Role in Reproduction – Their fluids contribute to semen production and sperm protection, which are external functions rather than internal regulatory processes like hormones.

Seminal Vesicle
Providing Energy for Sperm – The fluid contains fructose, which serves as an energy source for sperm, helping them swim and survive.
Makes up a major part of semen.

Cowper's glands
Producing Pre-ejaculatory Fluid – These glands secrete a clear, slippery fluid. This fluid helps lubricate the urethra and the tip of the penis.
This fluid can mix with semen during ejaculation, but its primary role is to lubricate.

Epididymis

1. Sperm Maturation – Sperm produced in the testes are immature and unable to swim. The epididymis provides an environment for sperm to mature and gain motility, which takes about 2-3 weeks.
2. Sperm Storage – The epididymis temporarily stores mature sperm until they are needed for ejaculation. Sperm can remain viable here for several weeks.
3. Sperm Transport – During ejaculation, the epididymis contracts and pushes sperm into the vas deferens, which carries them toward the ejaculatory ducts.

Prostate gland
Neutralizing Vaginal Acidity – The alkaline nature of prostate fluid helps neutralize the acidic environment of the female reproductive tract, increasing the chances of fertilization.
Makes up a major part of semen.

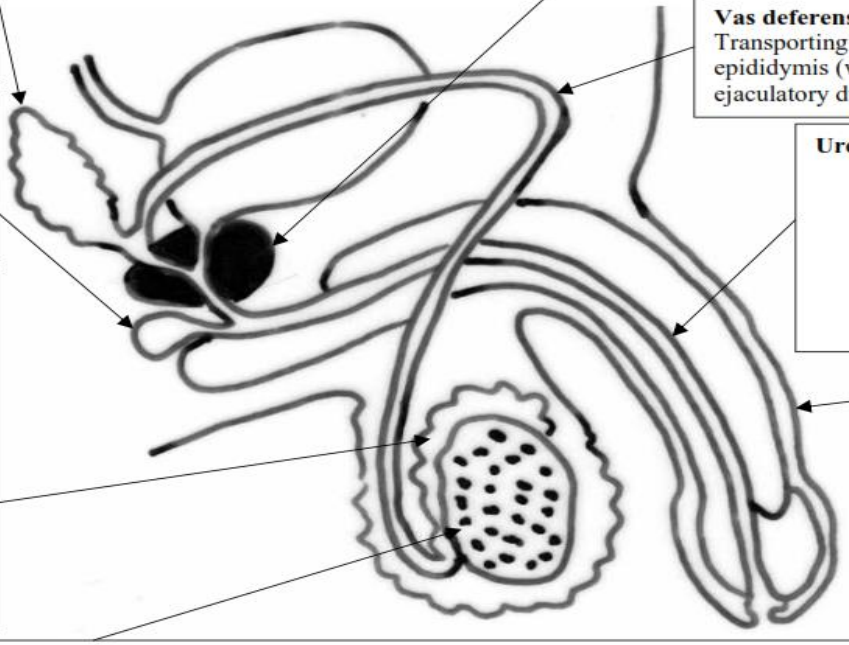
Vas deferens
Transporting Sperm – It carries mature sperm from the epididymis (where sperm is stored and matured) to the ejaculatory ducts (urethra) in preparation for ejaculation.

Urethra

1. Transporting Semen – During ejaculation, the urethra carries semen (which contains sperm and fluids from accessory glands) out of the body through the penis.
2. Excreting Urine – The urethra also serves as the passageway for urine to exit the body from the bladder.

Penis

1. Sperm Delivery (Copulation) – During sexual intercourse, the penis becomes erect and delivers semen into the female reproductive tract through ejaculation, aiding fertilization.
2. Urine Excretion

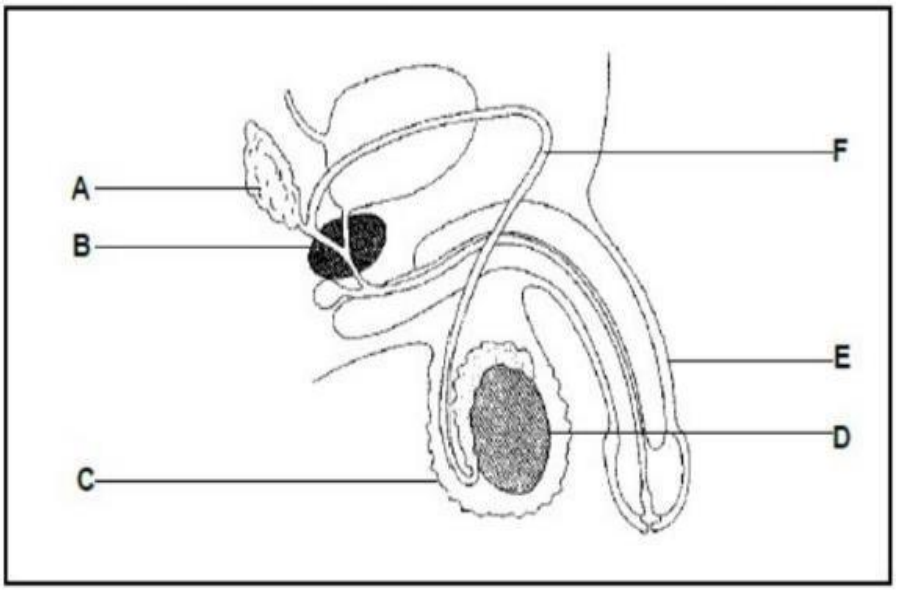


The **testes** (or **testicles**) are the primary male reproductive organs responsible for:

1. Sperm Production (**Spermatogenesis**) – The testes produce sperm cells in tiny structures called seminiferous tubules. **Sertoli cells** in seminiferous tubules provide structural and nutritional support to developing sperm cells. They help in the process of spermatogenesis, the production of sperm, by nourishing and guiding the development of sperm cells as they mature. This process occurs continuously after puberty.
2. Hormone Production (**Testosterone** Secretion) – **The Leydig cells** in the testes produce testosterone, the primary male sex hormone. Testosterone is essential for: Development of male secondary sexual characteristics (deep voice, facial hair, muscle growth) and Regulating sperm production.
3. Supporting Sperm Maturation – The testes work closely with the epididymis, where sperm mature before ejaculation.
4. Maintaining Proper Temperature for Sperm Development – The testes are housed in the scrotum, which helps regulate temperature (**about 2-3°C lower than body temperature**) for optimal sperm production.

ACTIVTY 2 HUMAN REPRODUCTIVE SYSTEM

The diagram below represents the human male reproductive system.



2.1 Identify part A. (1)

2.2 Write down the LETTERS only of TWO parts that contribute to the formation of semen. (2)

2.3 Explain the consequence on human reproduction if a male wear tight-fitting underwear all the time. (3)

(6)

STRUCTURE OF THE FEMALE REPRODUCTIVE SYSTEM

CONTENT	ELABORATION
Structure of the female reproductive system	Structure of the female reproductive system, using a diagram • Functions of the ovary, Fallopian tubes, uterus lined by the endometrium, cervix, vagina with its external opening and the vulva • Structure of the ovary, using a diagram, showing the primary follicles, the Graafian follicle and the corpus luteum

FEMALE REPRODUCTIVE SYSTEM:

FALLOPIAN TUBES: **two thin, muscular tubes** that connect the ovaries to the uterus.
Egg Transport:
After ovulation, the fallopian tubes use tiny hair-like structures (cilia) and muscle contractions (peristalsis) to move the egg from the ovary toward the uterus.
Site of Fertilization:
Fertilization occurs in fallopian tubes
Sperm Guidance:
The fallopian tubes help direct sperm toward the egg
Early Embryo Transport:
If fertilization occurs, the fallopian tubes gently transport the developing embryo to the uterus for implantation.
If the fallopian tubes are blocked or damaged, it can lead to infertility or ectopic pregnancy (when an embryo implants outside the uterus in fallopian tube).

UTERUS: hollow, muscular organ

The endometrium (uterine lining) thickens each month to prepare for embryo implantation.

If pregnancy occurs, the uterus nourishes and protects the developing fetus.

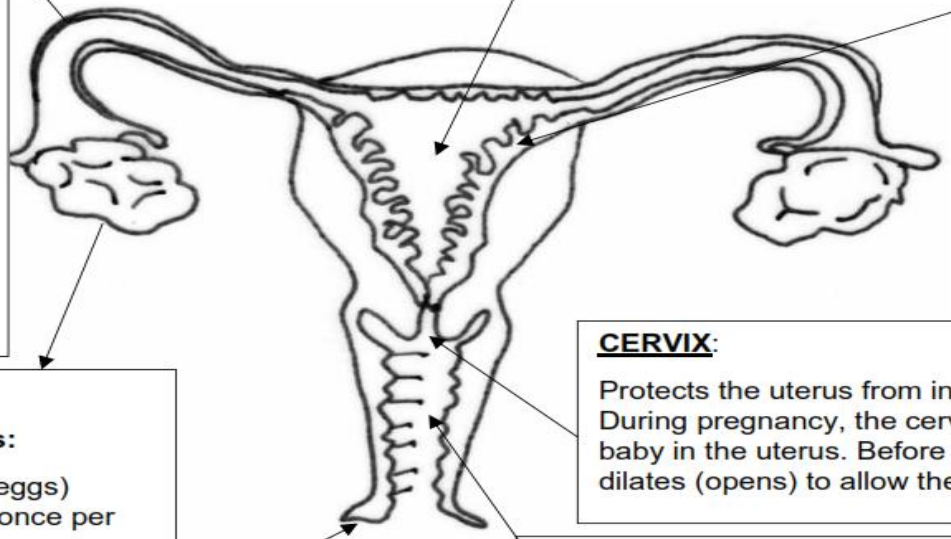
The uterus expands as the baby grows and contracts during labor to help with childbirth.

ENDOMETRIUM: inner lining of the uterus that plays a key role in the menstrual cycle, pregnancy

Each month, the endometrium thickens in preparation for a fertilized egg to implant and develop into a pregnancy.

If fertilization does not occur, the endometrium breaks down and sheds, leading to menstruation

Contains blood vessels and glands that supply nutrients to support early pregnancy before the placenta fully develops.



OVARY:

Production of Ova, site of Oogenesis:

The ovaries produce and release ova (eggs) during ovulation, which occurs roughly once per menstrual cycle.

Hormone Production:

Estrogen: Regulates the menstrual cycle, supports secondary sexual characteristics, and thickens the endometrium

Progesterone: Prepares the uterus for pregnancy by making the endometrium more vascular and glandular and sustains pregnancy.

CERVIX:

Protects the uterus from infections, Regulates Sperm Entry, During pregnancy, the cervix remains firm and closed to hold the baby in the uterus. Before childbirth, it softens, shortens, and dilates (opens) to allow the baby to pass through the birth canal.

LABIA:

Protection:

The labia protect the vaginal and urethral openings from infection and physical trauma.

VAGINA:

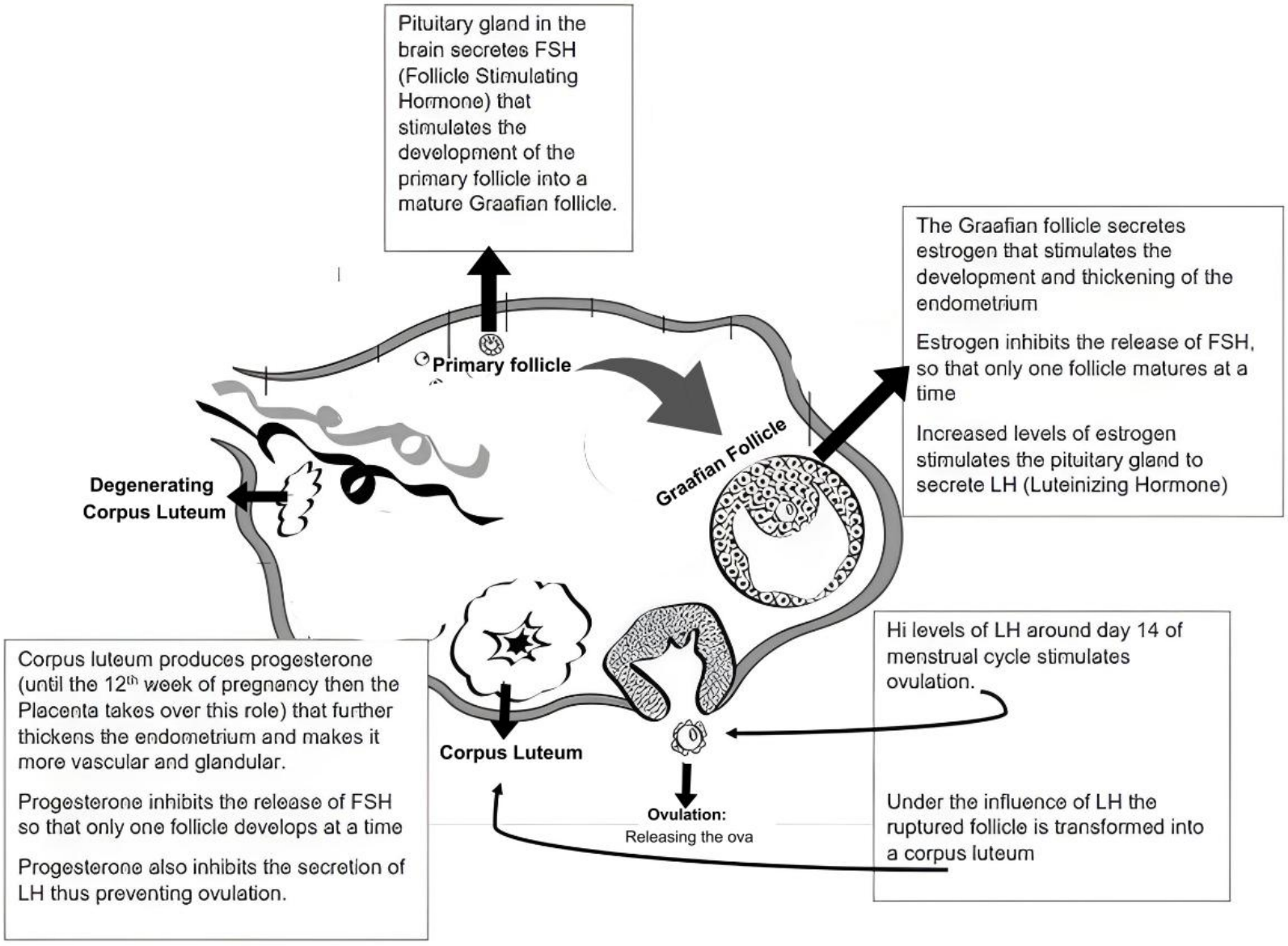
The vagina is a flexible, muscular tube that connects the external genitals to the uterus. Its functions include:

Birth Canal: Expands during childbirth to allow the passage of the baby.

Menstrual Flow Exit: Allows menstrual blood to leave the body.

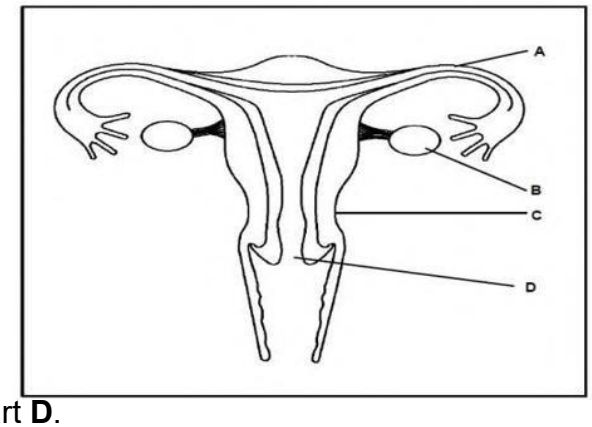
Sexual Intercourse: Receives the penis during intercourse and facilitates sperm transport.

STRUCTURE OF THE OVARIA:



ACTIVITY 3

The structure below represents a part of the female reproductive system.



3.1 Identify part **D**. (1)

3.2 State ONE function of part **A**. (1)

3.3 Describe the process of oogenesis as it occurs in part **B**. (4)

3.4 State ONE way in which structure **C** is suited for its function during pregnancy. (1)

3.5 A person undergoes a surgical operation to remove part **B** on both sides. Explain why this person will not menstruate. (3)

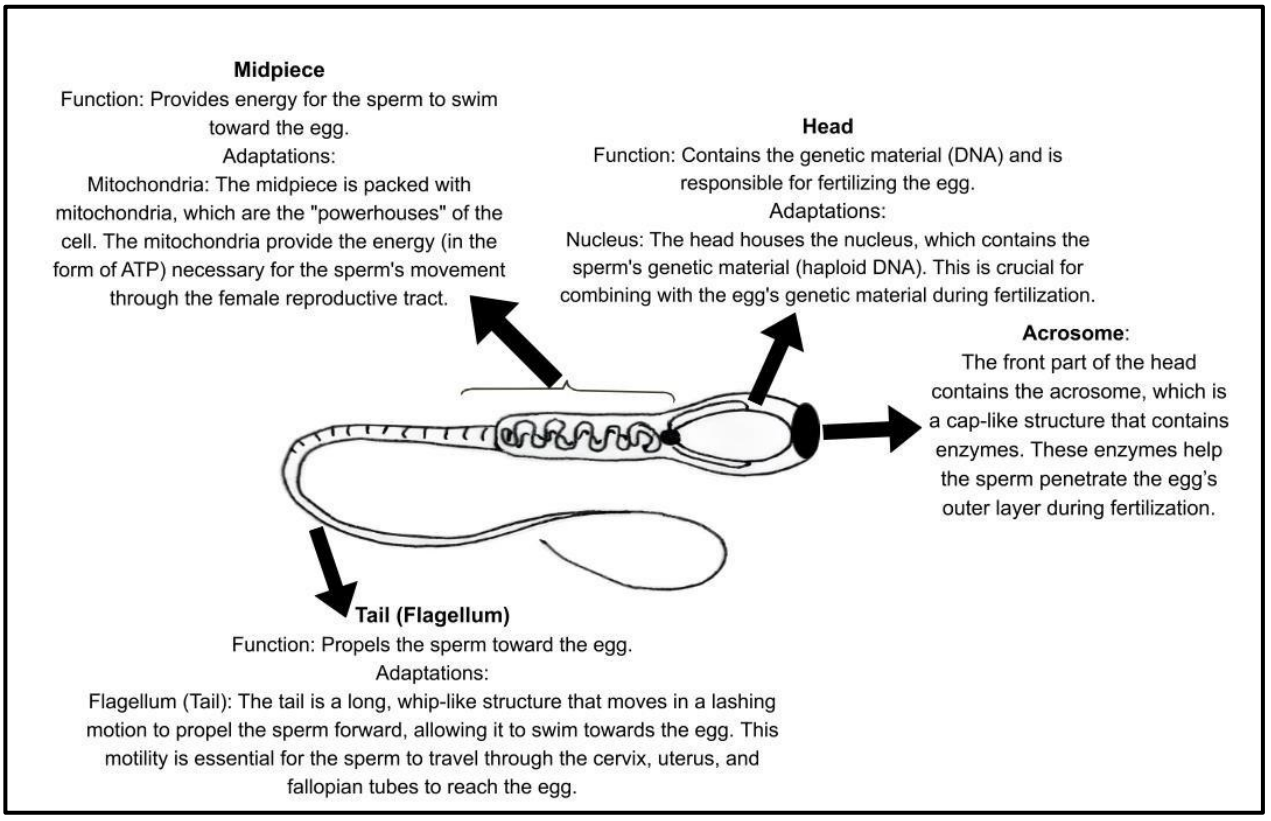
GAMETOGENESIS

CONTENT	ELABORATION
Gametogenesis	Formation of gametes (gametogenesis) by meiosis • Male gametes formed by spermatogenesis • Female gametes formed by oogenesis Spermatogenesis: • Under the influence of testosterone • Diploid cells in the seminiferous tubules of the testes undergo meiosis to form haploid sperm cells • This occurs continuously from puberty Structure of a sperm, using a diagram • Functions of the parts of a sperm cell (acrosome, head with haploid nucleus, middle portion/neck with mitochondria and a tail) Oogenesis: • Diploid cells in the ovary undergo mitosis to form numerous follicles • At the onset of puberty and under the influence of FSH, one cell inside a follicle enlarges and undergoes meiosis • Of the four cells that are produced, only one survives to form a mature haploid ovum • This occurs in a monthly cycle Structure of an ovum, using a diagram • Functions of different parts of an ovum (jelly layer, haploid nucleus, cytoplasm)

SPERMATOGENESIS:

- Under the influence of testosterone
- Diploid cells in the seminiferous tubules of the testes undergo meiosis to form haploid sperm cells
- **This occurs continuously from puberty**

STRUCTURE OF A SPERM



ACTIVITY 4

Male hormone contraceptive (birth control) pills have been in development for over 50 years. The pills contain a substance called TU, which inhibits the secretion of testosterone. There is, however, no product available on the market yet, mainly due to many side effects associated with the product.

An investigation was done to determine how TU affects male fertility.

The procedure was as follows:

- 308 healthy, male volunteers were selected.
- A sperm count for each volunteer was done initially.
- Each volunteer was given 500 mg of TU monthly over a period of 12 months.
- During the period of the investigation, the volunteers were asked to wear loose-fitting trousers and underwear made of the same light fabric.
- A sperm count was done weekly over a period of 24 months.

The average sperm count was calculated per volunteer. **NOTE:** Sperm count refers to the total number of healthy sperm per ml of Semen and is an indication of male fertility.

4.1 Identify the dependent variable in the investigation. (1)
4.2 State how the dependent variable in QUESTION 4.1 was measured. (1)
4.3 Name TWO other factors that should be considered when selecting volunteers. (2)
4.4 Explain how TU reduces fertility. (2)
4.5 Explain why wearing tight-fitting trousers will decrease male fertility. (2)
4.6 Suggest ONE reason for doing the sperm count for an additional 12 months after stopping the TU treatment. (1)

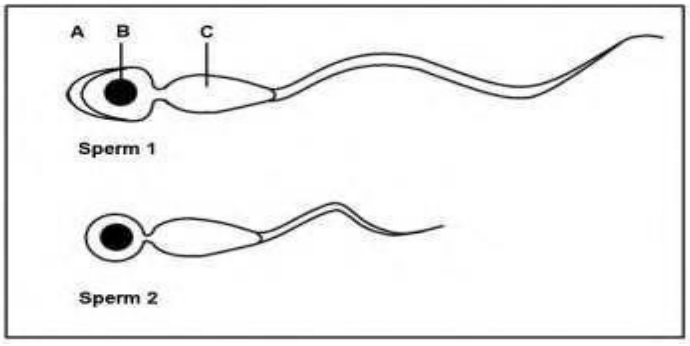
The contraceptive options that are currently available for men are limited to condoms and vasectomy. Vasectomy involves the cutting and tying of both the vas deferens.

4.7 Explain how a vasectomy prevents pregnancy. (2)

(11)

ACTIVITY 5

The diagrams below show the structure of a normal and an abnormal sperm. (The diagrams are drawn to scale.)



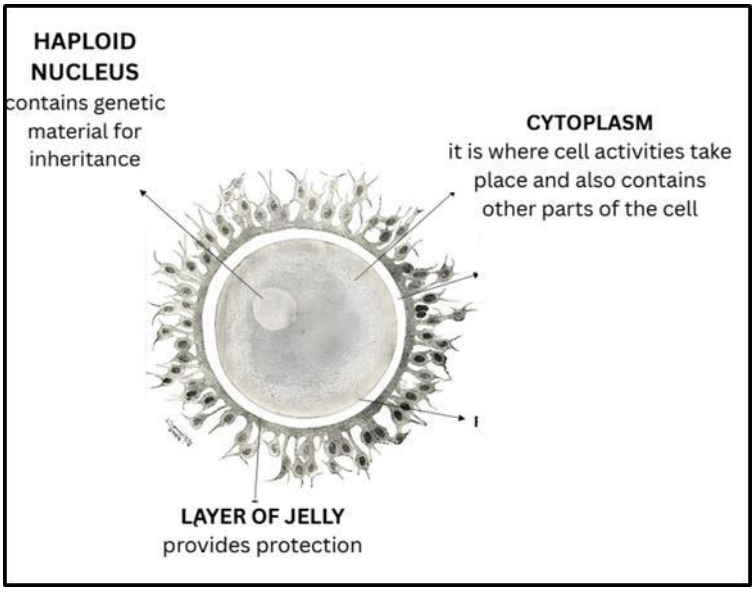
5.1 Identify part **A.** (1)
5.2 Describe the role of structure **B** during fertilisation. (1)
5.3 Explain the role of the organelles found in large numbers in part **C**. (2)
5.4 Explain TWO reasons why sperm **1** is structurally better suited for fertilisation than sperm **2**. (4)

(8)

OOGENESIS

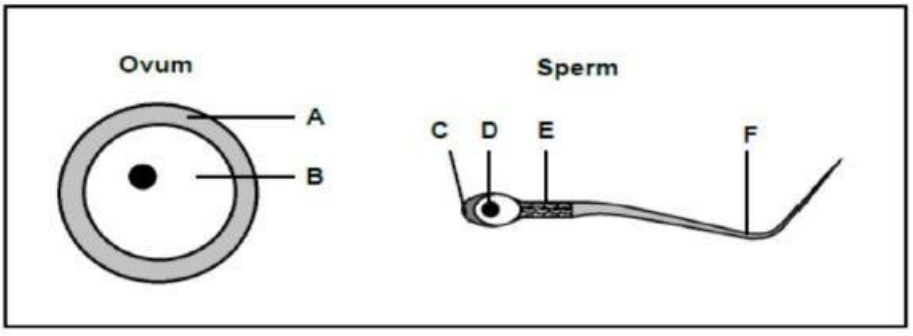
- Diploid cells in the ovary undergo mitosis to form numerous follicles
- At the onset of puberty and under the influence of FSH, one cell inside a follicle enlarges and undergoes meiosis
- Of the four cells that are produced, only one survives to form a mature haploid ovum
- This occurs in a monthly cycle

STRUCTURE OF AN OVUM



ACTIVITY 6 HUMAN REPRODUCTIVE SYSTEM

The diagrams below represent the structures of an ovum and a sperm.



6.1 Identify part:
(a) A
(b) B
(c) C

6.3 Write down only the LETTER of the part of the sperm that enters the ovum. (1)

6.4 Write down only the LETTERS of TWO parts that enable the sperm to move towards the ovum. (2)

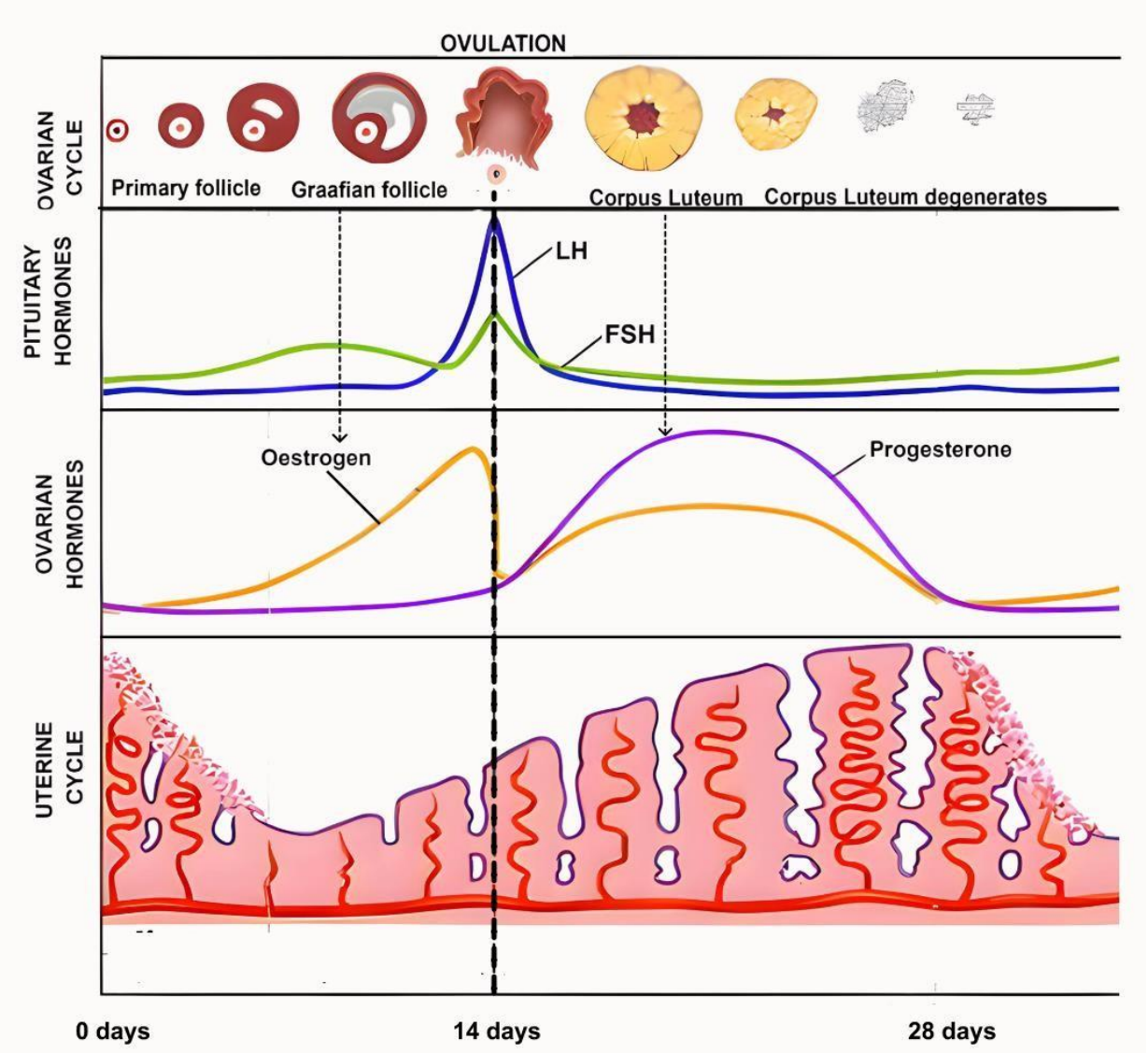
(7)

MENSTRUAL CYCLE

CONTENT	ELABORATION
Menstrual cycle	The menstrual cycle includes the uterine and ovarian cycles. Events in the ovarian cycle: • Development of the Graafian follicle • Ovulation • Formation of the corpus luteum Events in the uterine cycle: • Changes that take place in the thickness of the endometrium • Menstruation Hormonal control of the menstrual cycle (ovarian and uterine cycles) with reference to the action of FSH, oestrogen, LH and progesterone. Negative feedback mechanism involving FSH and progesterone in controlling the production of ova.

EVENTS IN THE OVARIAN and UTERINE CYCLE:

1. Under the influence of the FSH produced by pituitary gland
2. The Primary follicle in the ovary develop into a Graafian follicle
3. The Graafian follicle produces a hormone oestrogen
4. Oestrogen increases the thickness of endometrium making it more glandular and vascular
5. On day 14 under the influence of LH produced by the pituitary gland the Graafian follicle raptures to release an ovum,
6. this is called ovulation
7. The ovum is release into the fallopian tube
8. The LH, helps convert empty Graafian follicle into a corpus luteum
9. The corpus luteum secretes hormone progesterone which maintains pregnancy and thickens the endometrium further making it more glandular and vascular.
10. If fertilisation does not take place, the corpus luteum degenerates and progesterone levels drops
11. The unfertilised ovum passes down the fallopian tube into the uterus and leaves the body.



ACTIVITY 7

Read the extract below.

PLASTIC LINKED TO FEMALE INFERTILITY

Several studies indicate that bisphenol A (BPA), a chemical used in the production of many household plastic products, may be linked to female infertility (inability to get pregnant naturally and to deliver a healthy baby). BPA can be ingested or absorbed through the skin when using plastic products.

BPA seems to interfere with the normal secretion of FSH by the pituitary gland and is linked to abnormal menstrual cycles and reduced implantation rates. These studies also show a link between high BPA levels and a decrease in the development and maturation of ovarian follicles.

(1)

7.1 State ONE function of FSH.

7.2 Name ONE other hormone in females that is secreted by the pituitary gland during the menstrual cycle. (1)

7.3 Explain how an under secretion of the hormone in QUESTION 7.1 may lead to infertility (2)

(4)

NEGATIVE FEEDBACK BETWEEN FSH AND PROGESTERONE

After ovulation, the corpus luteum forms in the ovary and begins to secrete progesterone.
As progesterone levels rise, it sends a signal to the pituitary gland to reduce the secretion of FSH (Follicle-Stimulating Hormone).

Why does this happen?
FSH stimulates the development of new follicles.
After ovulation, the body does not want another follicle to mature immediately.

High progesterone tells the pituitary:
"Stop making FSH — we already released an egg."

What is the effect?
FSH levels drop.
No new follicles mature while progesterone remains high.
This helps maintain the menstrual cycle in the correct sequence.
High progesterone inhibits (decreases) FSH production through negative feedback, preventing the development of new follicles after ovulation.

CONTENT	ELABORATION
Fertilisation and development of zygote to blastocyst	• Definition of copulation and fertilisation • Process of fertilisation • Development of zygote → embryo (morula and blastula/blastocyst) → foetus

ACTIVITY 8
The diagram below represents an endocrine gland A and the events that take place in the ovary during the menstrual cycle in humans.

8.1 Identify:

	(a)	Gland A	
	(b)	Structure B	

(c) Process C
(d) Structure D

8.2 State the effect on the oestrogen levels in the blood if gland A stops secreting FSH

8.3 State ONE function of LH

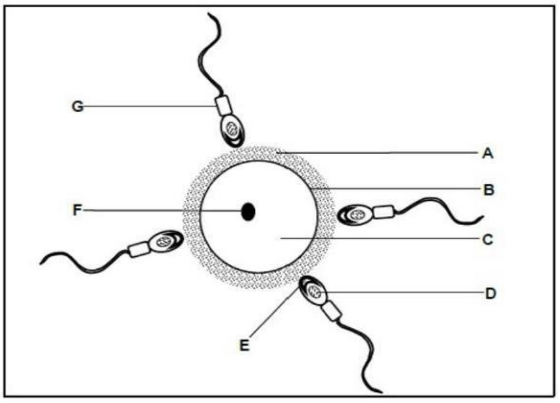
(6)

PROCESS OF FERTILIZATION

- Fertilisation occurs when the haploid sperm nucleus fuses with the haploid ovum nucleus to form a diploid zygote.
- Sperm (23 chromosomes) + ovum (23 chromosomes) = zygote (46 chromosomes).
- The zygote contains genetic material from both parents.
- As it moves down the fallopian tube, the zygote divides by mitosis to form a solid ball of cells called the morula.
- The morula develops into a hollow ball of cells called a blastocyst, which continues dividing to form an embryo.
- The blastocyst implants into the softened endometrium.
- Its outer layer forms two membranes: the amnion and the chorion.
- The chorion grows chorionic villi into the endometrium, forming part of the placenta, which secretes progesterone.
- The embryo attaches firmly to the uterine wall and later develops into a foetus.

ACTIVITY 9

The schematic diagram below shows a human ovum that is about to be fertilized. The diagram is not drawn to scale.



9.1 Identify part:

(a) **A** (1)

(b) **B** (1)

(c) **C** (1)

(d) **F** (1)

9.2 Give the LETTER and NAME of the part that:

(a) Contains the mitochondria (2)

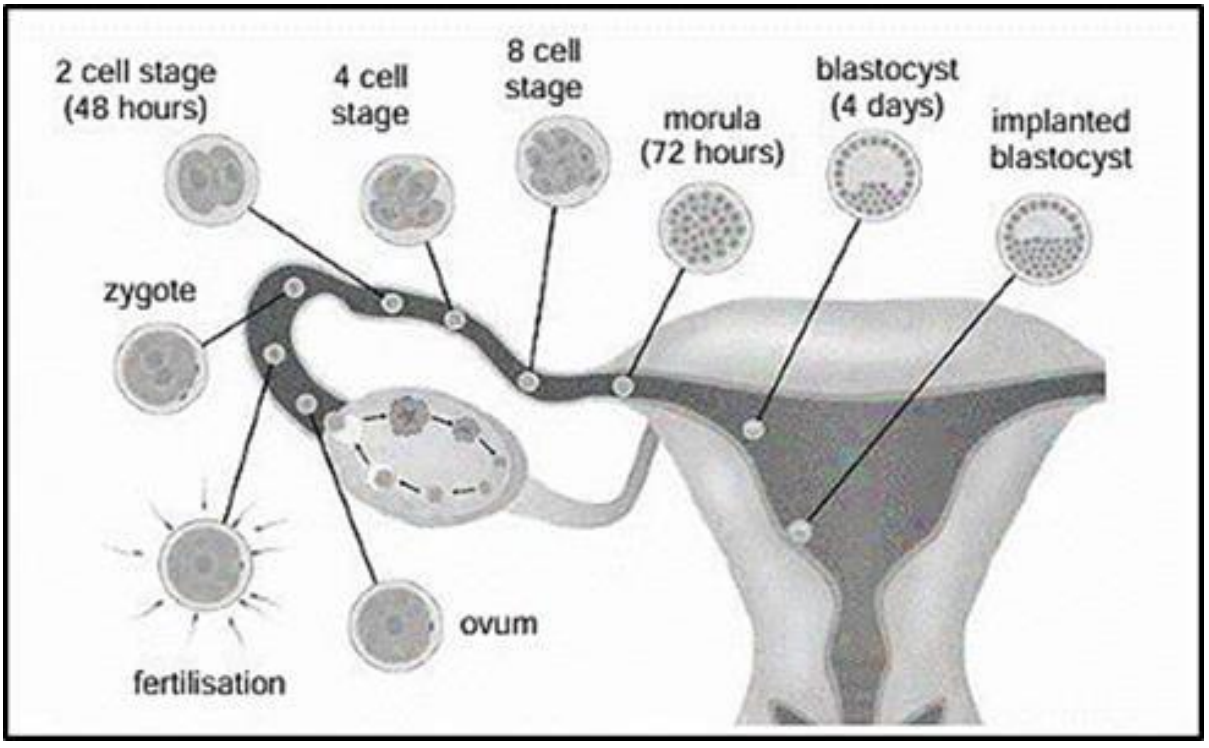
(b) Contains enzymes required to penetrate the ovum (2)

(c) Will enter the ovum during fertilization (2)

(10)

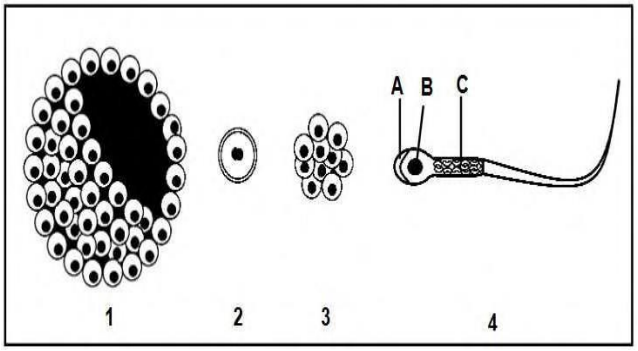
DEVELOPMENT OF ZYGOTE → EMBRYO (MORULA AND BLASTULA/BLASTOCYST) → FOETUS

- The zygote divides by mitosis
- To form a ball of cells Called the morula
- More mitotic divisions of the morula occur to form a hollow ball of cells
- Called blastocyst
- The blastocyst attaches to the endometrial lining
- The outer wall of the blastocyst called the chorion Develops projections called chorionic villi which implant to the into the uterine wall
- Embryo develops
- The cells of the embryo continue to divide and differentiate
- To form different organs and limbs and is now called foetus



ACTIVITY 10

The diagrams below show structures formed during human reproduction.



10.1 Identify part A (1)

10.2 Name the organelle found in large numbers in part C. (1)

10.3 Give the NUMBER (1, 2, 3 or 4) only of the diagram that represents the following:

(b) Morula (1)

(c) Structure that will implant in the uterus (1)

(d) Blastula/Blastocyst (1)

10.4 Give the LETTER and NAME of the part that will enter the ovum during fertilisation. (2)

10.5 Name the type of cell division that occurred to produce the structure in diagram **3**. (1)

10.6 Describe the development of the placenta and umbilical cord from the time of implantation. (6)

(14)

CONTENT	**ELABORATION**
Implantation, gestation and the role of the placenta	• Definition of implantation and gestation • The role of oestrogen and progesterone in maintaining pregnancy • Structure of the developing foetus in the uterus, using a diagram • Structure and functions of the following parts: - Chorion and chorionic villi - Amnion, amniotic cavity and amniotic fluid - Umbilical cord (including umbilical artery and umbilical vein) - Placenta (including oestrogen and progesterone secretion)

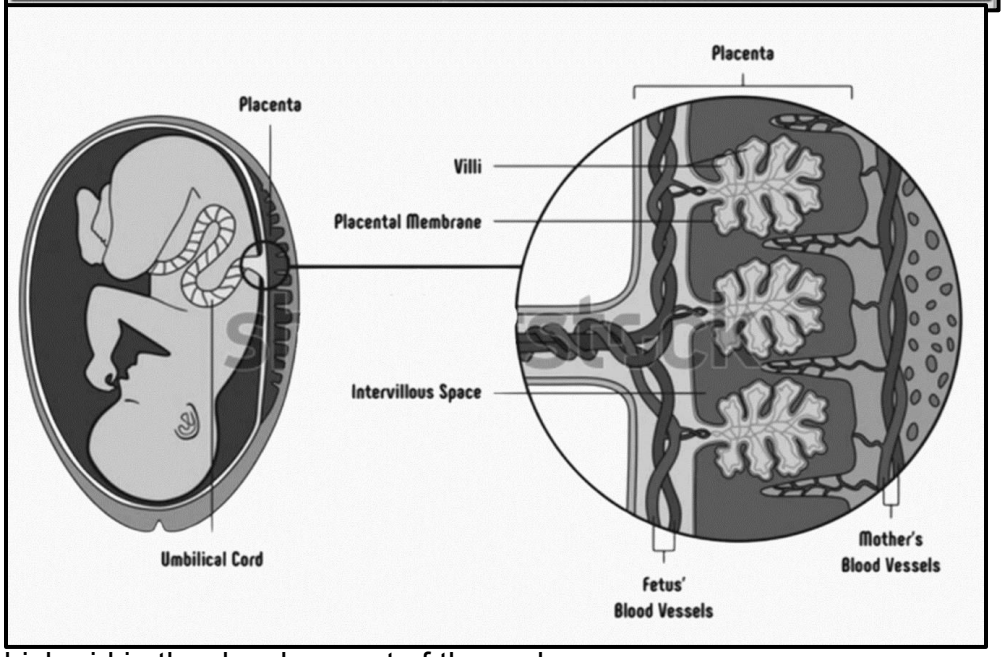
IMPLANTATION AND PREGNANCY

- After implantation, extra-embryonic membranes develop from the developing embryo.
- These are the chorion and the amnion.
- Chorionic villi (finger-like projections) from the chorion of the embryo will grow into the uterus tissue of the mother to form the placenta.

The placenta is attached to the embryo by the umbilical cord.

- Diffusion of nutrients from the mother to the foetus
- Diffusion of oxygen from the mother to the foetus and for the diffusion of carbon dioxide from the foetus to the mother (gas exchange)
- Diffusion of waste products from the foetus to the mother
- After 12 weeks, the placenta secretes progesterone to maintain the pregnancy.

GESTATION	PREGNANCY
The period of development of the foetus in the uterus which takes place from conception to birth.	Pregnancy refers to all the changes (hormonal, physical, emotional) that take place in the body of a female as a result of the developing foetus.



The gestation period, also known as pregnancy, is the time in which the embryo develops inside the uterus.
Gestation and the development of the embryo lasts for about 40 weeks or 280 days.
After 12 weeks the embryo is known as a fetus.
The fetus contains extra-embryonic membranes and other structures which aid in the development of the embryo.
The chorion, on the outside, forms the chorionic villi.
The inner membrane, the amnion, becomes filled with amniotic fluid to form the amniotic sac.

The amniotic fluid has the following functions:

- Protects the fetus against mechanical injury (mechanical shock-absorber)
- Prevents dehydration
- Maintains the temperature of the fetus
- Allows for free movement of the fetus as it grows

Placenta
Structure: An oval, vascular structure in the uterus that nourishes the foetus.
Function: - Gaseous exchange between mother and foetus
- Providing nutrients to foetus
- Secreting progesterone

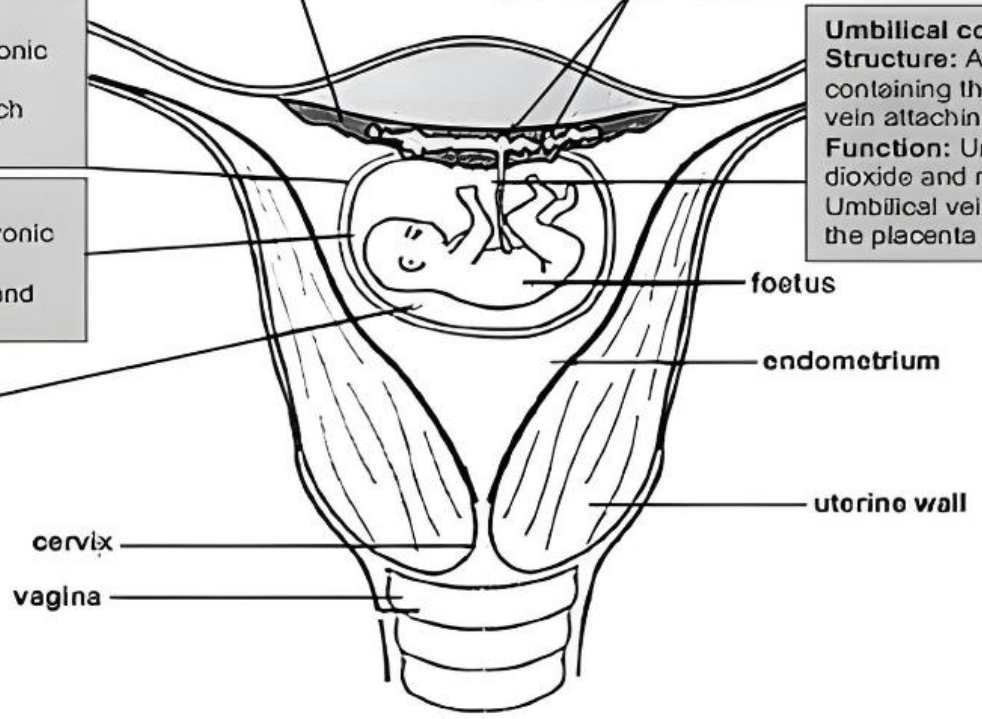
Chorionic villi
Structure: Finger-like projections of the chorion which project into blood spaces in the uterus of the mother.
Function: Provide maximum contact with maternal blood. Forms part of the placenta.

Chorion
Structure: The outermost extra-embryonic membrane covering the amnion.
Function: Forms the chorionic villi which forms part of the placenta.

Umbilical cord
Structure: A flexible cordlike structure containing the umbilical arteries and umbilical vein attaching the foetus to the placenta.
Function: Umbilical arteries carry carbon dioxide and metabolic waste to the placenta. Umbilical vein carries oxygen and nutrients from the placenta to the foetus.

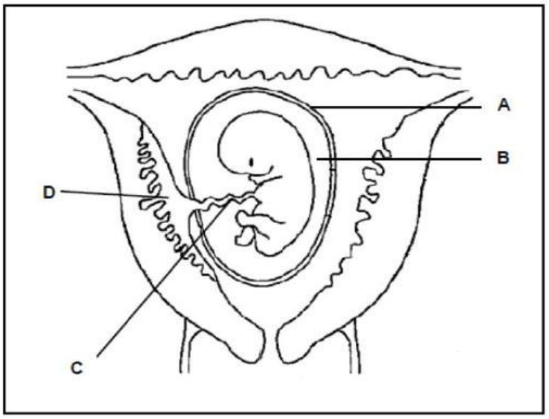
Amnion
Structure: The inner most extra-embryonic membrane.
Function: Secretes the amniotic fluid and protects the developing foetus.

Amniotic fluid
Structure: The fluid contained inside the amniotic sac.
Function: - Shock absorber
- Protect foetus against large temperature changes
- Protects foetus against desiccation



ACTIVITY 11

The diagram below represents a developing foetus in the human body.



11.1 Identify:

(a) **A** (1)

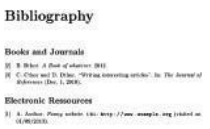
(b) **C** (1)

11.2 State TWO functions of the fluid in part B. (2)

11.3 Name ONE system in the baby's body that takes over the function of part D once the baby is born. (1)

11.4 Explain ONE negative impact on foetal development if part D is reduced significantly. (2)

(7)



BIBLIOGRAPHY

1	The following sources are acknowledged for using their information
1.1.	Study and master Agricultural Sciences – Grade 12
1.2.	Focus on agricultural Sciences – Grade 12
3	National Senior Certificate, 2023 diagnostic report
4	Department of Basic Education 2021: Life Sciences Examination Guidelines Grade 12 2021
5	All the questions in this study guide are adapted from Question Bank compiled by Free State Subject Advisors.
6	Content adapted from - MD Watson, with assistance of: J Brümmer; A Esterhuizen and C van Heerden.
7	https://bit.ly/hlayiso
8	3 in 1 Answer series Caps Diagnostic report 2023 On Meiosis
9	Understanding Life Sciences, T. Isaac, S.Chetty, Second Addition
10	Life Sciences Grade 12 Textbook, Nelson Mandela University
11	Almost all the information in the notes was compiled using the above-mentioned sources. Therefore, the notes are **NOT FOR SALE.** We, the compilers apologize for any errors or omissions and invite copyright holders the to contact us if any have occurred, so that we can rectify them.
12	CAPE WINELANDS EDUCATION DISTRICT 2026
13	KZN-JIT-Life-Sciences-Grade-12-LEARNER-Revision-Document-2024 (1)
14	LIFE SCIENCES Grade 12 Textbook, Nelson Mandela University
15	**LIFE SCIENCES CAPS** By: NP Mbhele DIAGRAMS, LABELS & FUNCTIONS BOOK GRADE 12