



PAPER 2

2025

DIAGNOSTIC REPORT

LIFE SCIENCES

SUMMARY &  
TEACHING TOOL



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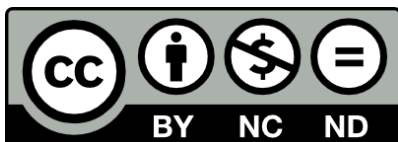


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# 2025 LIFE SCIENCES NSC PAPER 2

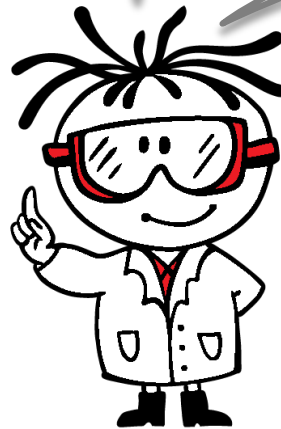
# Life Sciences Paper 2

## SUMMARY & TEACHING TOOL

Let's work through the paper and look at the problem areas as identified in the 2025 NSC Diagnostic Report.

Commentary from the Diagnostic Report is noted in grey blocks like the one below. Use these to guide discussions.

Candidates confused the centromere with the centrosome.



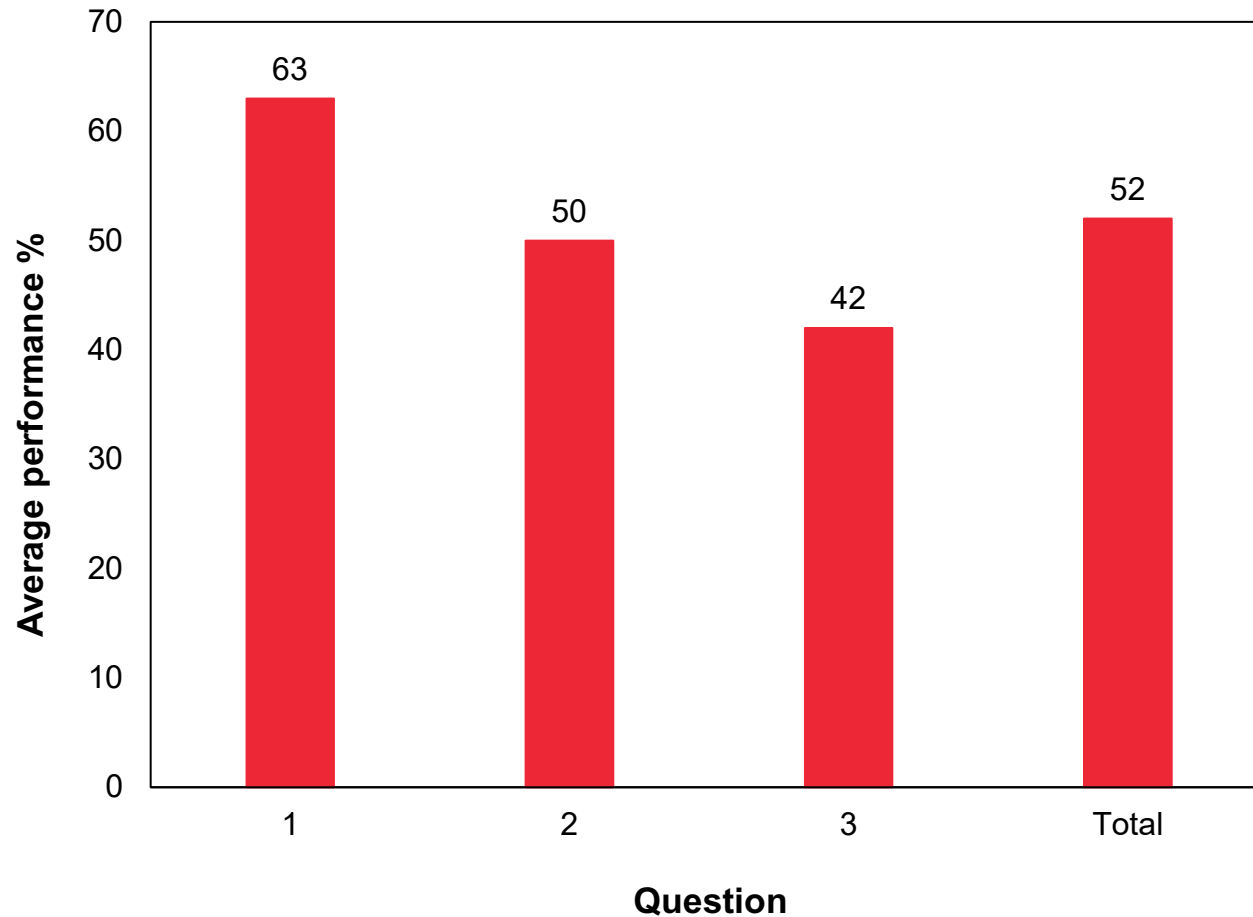
In some cases, revision or application options will be provided and can be identified by this symbol:



Click to go to the specific section.

# 2025 LIFE SCIENCES NSC PAPER 2

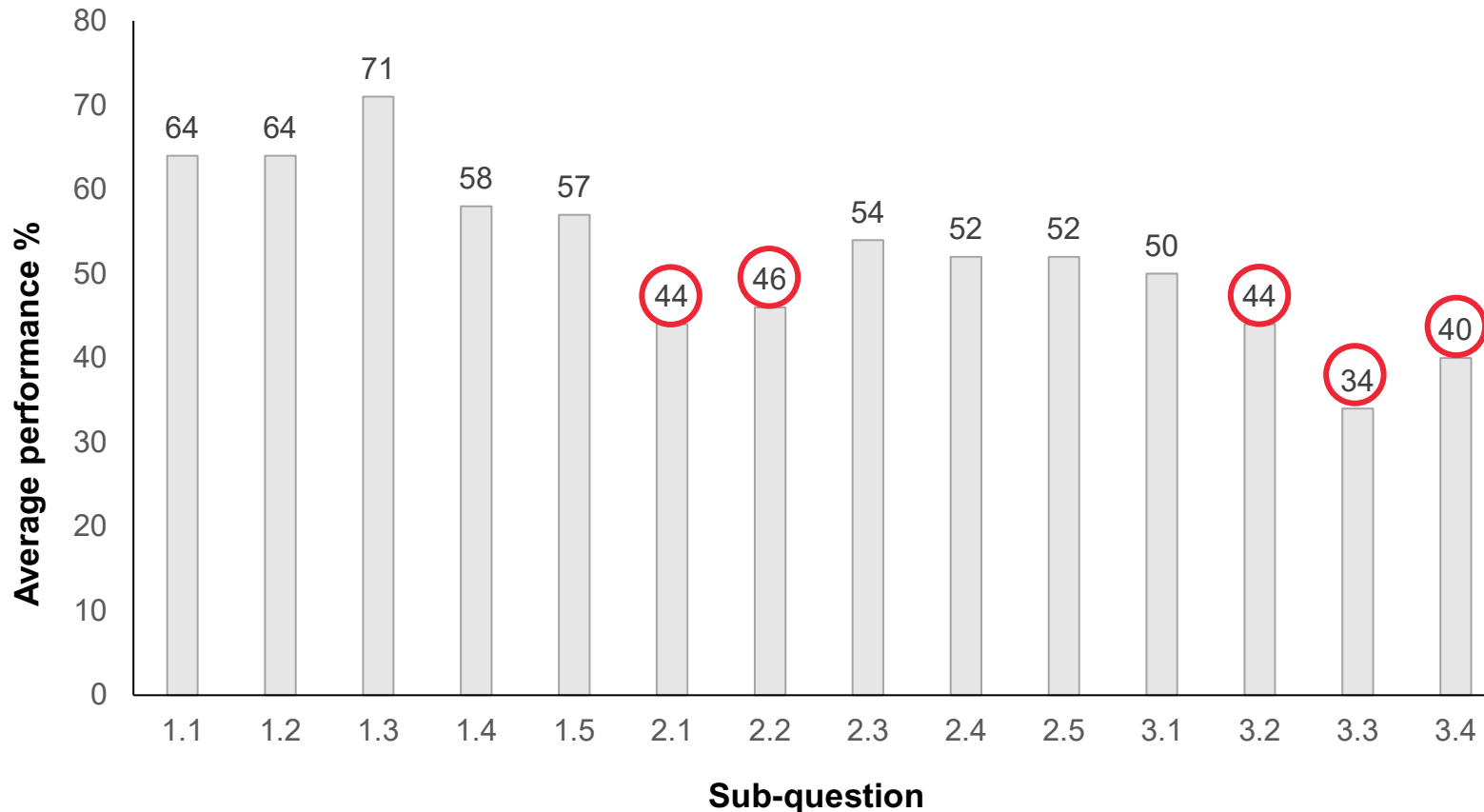
Average performance **per question**



Question	Topics
1	MCQs, Terminology, Matching items, Meiosis, Protein synthesis
2	Meiosis, DNA Code of Life, Genetics
3	Evolution

# 2025 LIFE SCIENCES NSC PAPER 2

## Average performance **per sub-question**



### Problem areas

2.1 Meiosis

2.2 DNA Profiling

3.2 Human evolution – Fossils

3.3 Biogeography – Speciation

3.4 Investigation – Natural selection

# 2025 LIFE SCIENCES NSC PAPER 2

## General Comments

! Correct **spelling** is very important

- *locus* ✓ vs *locust* ✗

! Emphasise difference between commonly **confused terms**

- *mitochondria* vs *mitochondrial DNA*
- *continuous variation* vs *discontinuous variation*
- *cell membrane* vs *nuclear membrane*



Let's revise this

! Emphasise difference between commonly **confused processes**

- *transcription* vs *translation*
- *Mitosis* vs *Meiosis I* vs *Meiosis II*



Let's revise this

! **Always give full answers**, e.g.:

- 'stem cells', not just 'stem'
- 'genetic variation' or 'continuous variation', not just 'variation'

! **Scientific investigations** still require attention

- do not give generic answers, e.g. a large sample size was used
- give specific information for the investigation provided, e.g. a large sample of 150 volunteers/participants was used

# SECTION A – Multiple Choice

1.1.1

A gene is ...

Gr 12 LS  
Part 2 p. 3  
(2024 ed.)

- A the complete set of chromosomes of an organism
- B a segment on a chromosome, coding for a characteristic
- C the haploid number of chromosomes in a cell
- D a triplet of bases that codes for an amino acid

1.1.2

The significance of DNA replication is that the cells formed at the end of Mitosis will ...

Gr 12 LS  
Part 2 p. 8  
(2024 ed.)

- A be genetically identical
- B contain half the number of chromosomes
- C be genetically different
- D have double the number of chromosomes

1.1.3

Which ONE of the following statements is a feature of punctuated equilibrium?

Gr 12 LS  
Part 2 p. 152  
(2024 ed.)

- A Individual organisms adapt to changes in the environment
- B The inheritance of acquired characteristics
- C There are long periods of little or no change in a population
- D The more a structure is used, the more it develops

1.1.4

Haemophilia is ...

Gr 12 LS  
Part 2 p. 61  
(2024 ed.)

- A characterised by the inability to distinguish between red and green
- B caused by a mutation of an allele on the X-chromosome
- C caused by non-disjunction of chromosomes during Meiosis
- D caused by an allele carried on an autosome

1.1.5

Which ONE of the following is an example of a heterozygous genotype?

Gr 12 LS  
Part 2 p. 43  
(2024 ed.)

- A  $X^rX^r$
- B BB
- C RW
- D aa

# SECTION A – Multiple Choice

1.1.1

A gene is ...

- A the complete set of chromosomes of an organism
- B a segment on a chromosome, coding for a characteristic
- C the haploid number of chromosomes in a cell
- D a triplet of bases that codes for an amino acid

1.1.2

The significance of DNA replication is that the cells formed at the end of Mitosis will ...

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- B contain half the number of chromosomes
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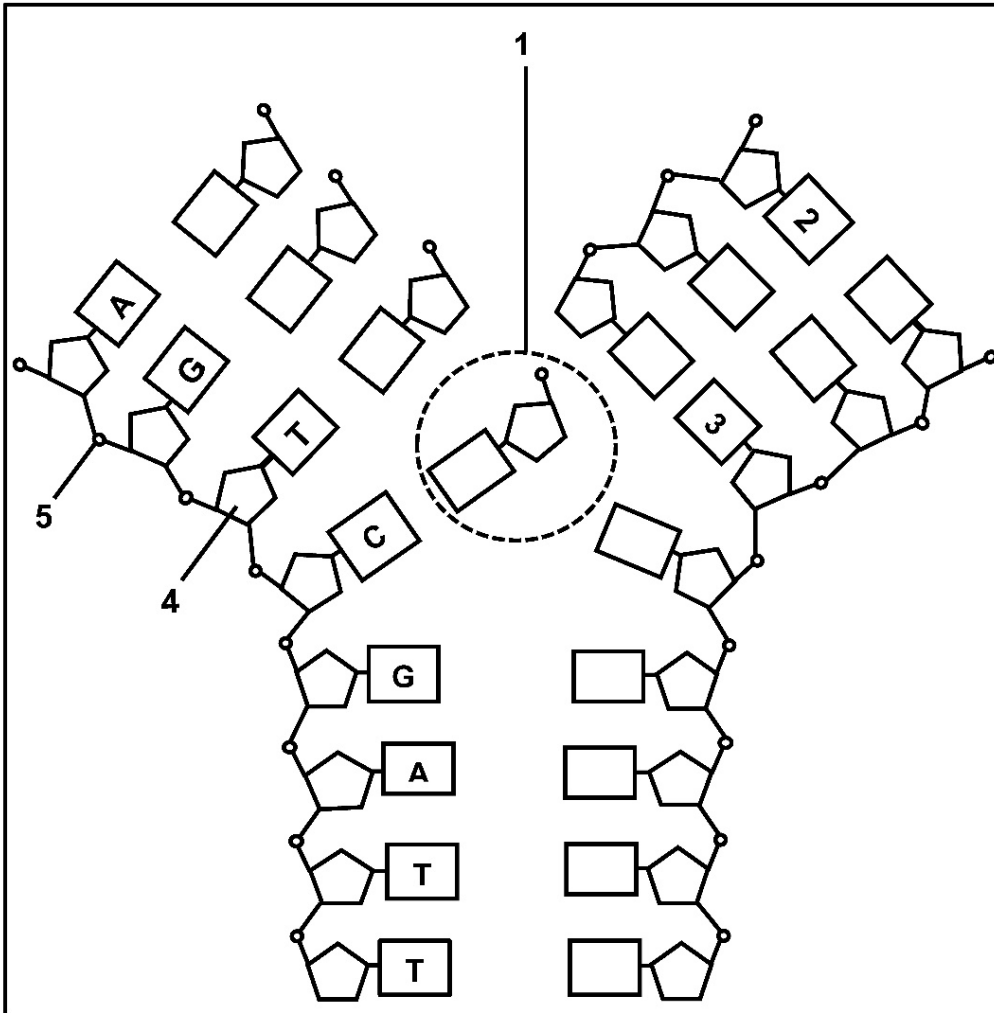
1.1.5

Which ONE of the following is an example of a heterozygous genotype?

- A  $X^rX^r$
- B BB
- C RW
- D aa

# SECTION A – Multiple Choice

QUESTIONS 1.1.6 AND 1.1.7 REFER TO THE DIAGRAM BELOW THAT REPRESENTS DNA REPLICATION.



**1.1.6**

*Gr 12 LS  
Part 2 p. 4 – 6  
& 13 – 15  
(2024 ed.)*

Which ONE of the following combinations CORRECTLY identifies molecules 1, 4 and 5?

	Molecule 1	Molecule 4	Molecule 5
A	Nucleotide	Deoxyribose	Phosphate
B	Nitrogenous base	Phosphate	Deoxyribose
C	Nucleotide	Phosphate	Deoxyribose
D	Nitrogenous base	Deoxyribose	Phosphate

**1.1.7**

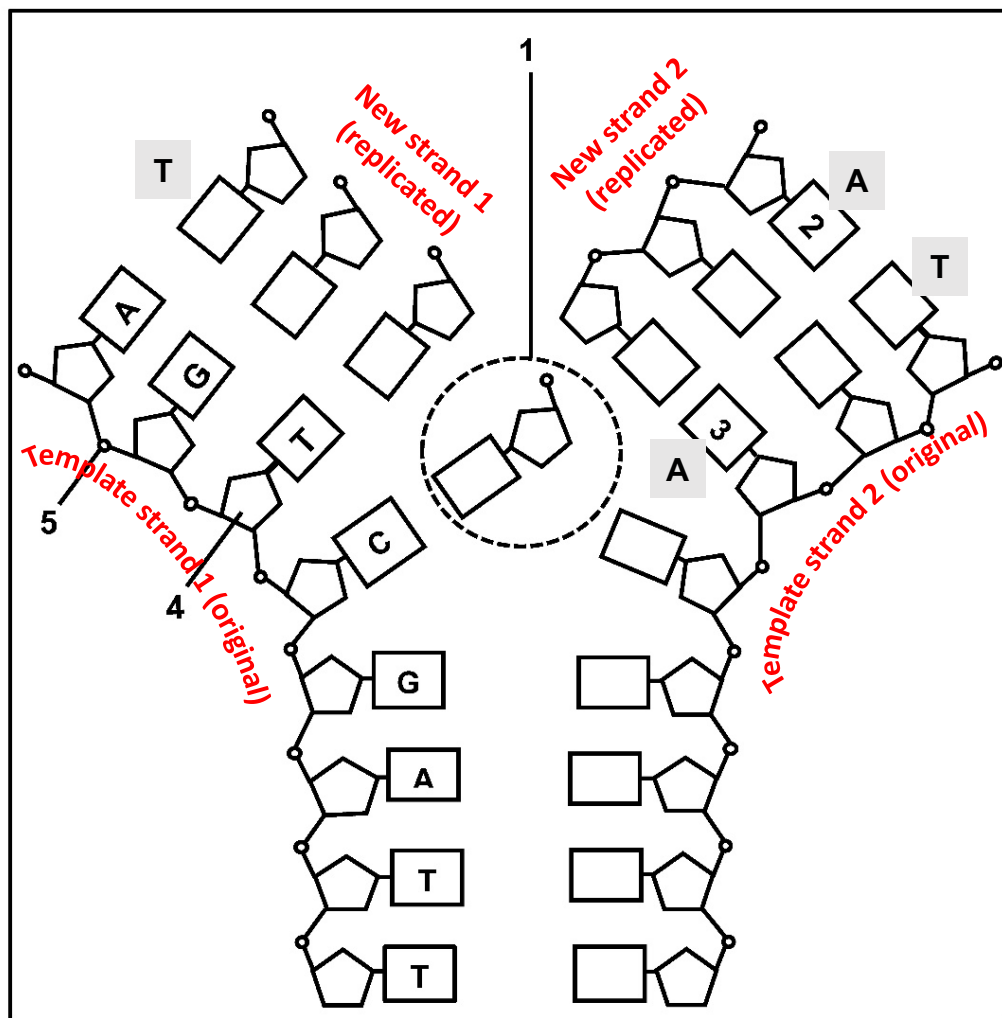
*Gr 12 LS  
Part 2 p. 4 – 6  
& 13 – 15  
(2024 ed.)*

Which ONE of the following combinations is CORRECT for molecules 2 and 3?

	Molecule 2	Molecule 3
A	T	A
B	A	A
C	T	G
D	A	C

# SECTION A – Multiple Choice

QUESTIONS 1.1.6 AND 1.1.7 REFER TO THE DIAGRAM BELOW THAT REPRESENTS DNA REPLICATION.



1.1.6

Which ONE of the following combinations CORRECTLY identifies molecules 1, 4 and 5?

	Molecule 1	Molecule 4	Molecule 5
<input checked="" type="radio"/> A	Nucleotide	Deoxyribose	Phosphate
<input type="radio"/> B	Nitrogenous base	Phosphate	Deoxyribose
<input type="radio"/> C	Nucleotide	Phosphate	Deoxyribose
<input type="radio"/> D	Nitrogenous base	Deoxyribose	Phosphate

You had to use the complementary strand on the left (template strand 1) to determine the sequence of the strands on the right.



1.1.7

Which ONE of the following combinations is CORRECT for molecules 2 and 3?

	Molecule 2	Molecule 3
<input type="radio"/> A	T	A
<input checked="" type="radio"/> B	A	A
<input type="radio"/> C	T	G
<input type="radio"/> D	A	C

Candidates had difficulty providing correct combination of nitrogenous bases during DNA replication.

# SECTION A – Multiple Choice

QUESTIONS 1.1.8 AND 1.1.9 REFER TO THE INFORMATION IN THE DIHYBRID CROSS BELOW.

In a certain plant species, one gene controls stem colour and another controls plant height. The stem colour can be brown (**B**) or red (**b**), while the plant height can be tall (**T**) or short (**t**).

	STEM COLOUR	PLANT HEIGHT
Plant 1	Brown	Short
Plant 2	Red	Tall

When plant 1 was crossed with plant 2, some of their offspring were red and short.

1.1.8

Which ONE of the following represents the genotypes of plant 1 and plant 2?

Gr 12 LS  
Part 2 p. 55 –  
59 (2024 ed.)

	PLANT 1	PLANT 2
A	bbtt	BbTt
B	Bbtt	bbTt
C	BbTt	bbtt
D	bbTt	Bbtt

1.1.9

Gr 12 LS  
Part 2 p. 55 –  
59 (2024 ed.)

The number of possible different genotypes expected in the offspring from this cross is ...

- A 4
- B 8
- C 9
- D 16

1.1.10

Gr 12 LS  
Part 2 p. 68  
(2024 ed.)

A rare form of rickets is caused by a dominant allele on the X-chromosome.

Which ONE of the following statements is TRUE about the inheritance of this form of rickets?

- A If the father is affected, all his sons will be affected.
- B It will be expressed more frequently in males than in females, since males have only one X-chromosome.
- C If the father is affected, all his daughters will be affected.
- D It will only be expressed in females, since they have two X-chromosomes.

# SECTION A – Multiple Choice

QUESTIONS 1.1.8 AND 1.1.9 REFER TO THE INFORMATION IN THE DIHYBRID CROSS BELOW.

In a certain plant species, one gene controls stem colour and another controls plant height. The stem colour can be brown (**B**) or red (**b**), while the plant height can be tall (**T**) or short (**t**).

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When plant 1 was crossed with plant 2, some of their offspring were red and short.

**1.1.8** Which ONE of the following represents the genotypes of plant 1 and plant 2?

A	bbtt	BbTt
<input checked="" type="radio"/> B	Bbtt	bbTt
C	BbTt	bbtt
D	bbTt	Bbtt

**1.1.9**

The number of possible different genotypes expected in the offspring from this cross is ...

- A 4
- B 8
- C 9
- D 16

Candidates could not determine the number of genotypes in a dihybrid cross.

**1.1.10**

A rare form of rickets is caused by a dominant allele on the X-chromosome.

Which ONE of the following statements is TRUE about the inheritance of this form of rickets?

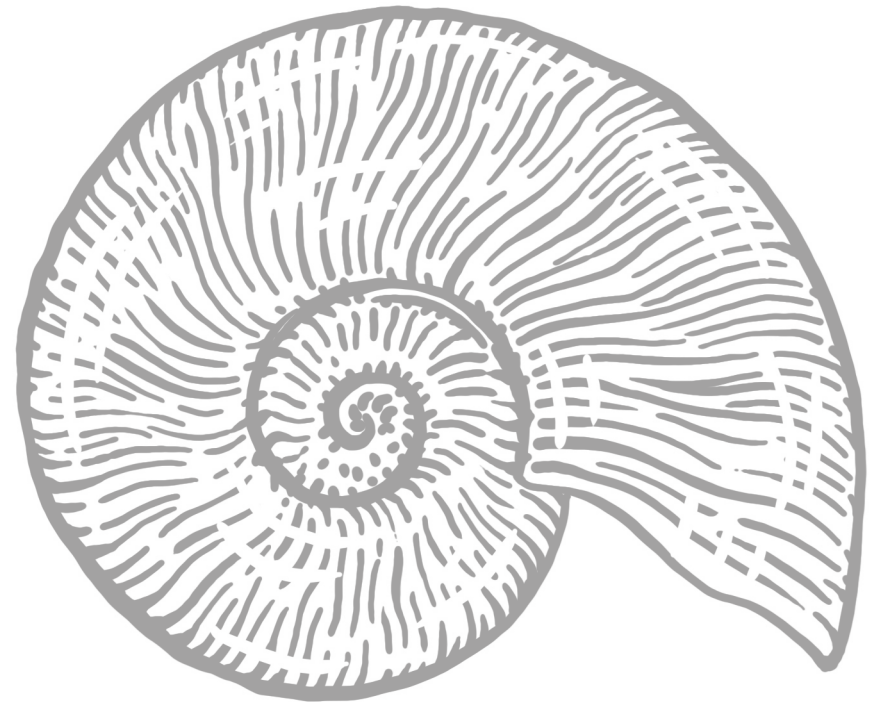
- A If the father is affected, all his sons will be affected.
- B It will be expressed more frequently in males than in females, since males have only one X-chromosome.
- C If the father is affected, all his daughters will be affected.
- D It will only be expressed in females, since they have two X-chromosomes.

Candidates could not apply their knowledge of sex-linked inheritance to a disorder caused by a dominant allele.

# SECTION A – Terminology

Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (1.2.1 to 1.2.9) in the ANSWER BOOK.

- 1.2.1 The bond formed between two amino acids during protein synthesis.
- 1.2.2 An organelle that contains DNA which is used in tracing female ancestry.
- 1.2.3 Undifferentiated cells in animals that have the potential to become any type of tissue.
- 1.2.4 A change in the sequence of nitrogenous bases resulting in the formation of a different protein.
- 1.2.5 The natural shape of a DNA molecule.
- 1.2.6 The permanent disappearance of a species from Earth.
- 1.2.7 A type of variation with a range of intermediate phenotypes.
- 1.2.8 An allele that is expressed in a phenotype in the heterozygous condition.
- 1.2.9 The position of an allele on a chromosome.



# SECTION A – Terminology

Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (1.2.1 to 1.2.9) in the ANSWER BOOK.

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- 1.2.6 The permanent disappearance of a species from Earth.
- 1.2.7 A type of variation with a range of intermediate phenotypes.
- 1.2.8 An allele that is expressed in a phenotype in the heterozygous condition.
- 1.2.9 The position of an allele on a chromosome.

## Memorandum

peptide✓ bond

mitochondrion✓

stem cells✓

(gene) mutation✓

double helix✓

extinction✓

continuous✓ variation

dominant✓ allele

locus✓

## Common misconceptions & Errors

Provided *mitochondrial DNA*✗

Provided only *stem*✗ /  
*stem cell research*✗

Provided only *helix*✗ / *double strand*✗

Afrikaans learners provided  
*uitwisseling*✗ instead of *uitwissing*✓

Provided *discontinuous variation*✗

Provided *locust*✗

# SECTION A – Item/statement columns

Indicate whether each of the descriptions in COLUMN I apply to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question number (1.3.1 to 1.3.3) in the ANSWER BOOK.

	COLUMN I	COLUMN II
1.3.1	The phase of Meiosis during which non-disjunction can occur.	A: Anaphase I B: Anaphase II
1.3.2	A representation of the number, shape and arrangement of all the chromosomes in the nucleus.	A: Phylogenetic tree B: Karyotype
1.3.3	The alleles of a gene separate into different gametes during Meiosis.	A: Law of independent assortment B: Law of segregation

*Grade 12 Life Sciences  
Part 2 p. 35 (2024 ed.)*

*Grade 12 Life Sciences Part 2  
p. 23 & 167 (2024 ed.)*

*Grade 12 Life Sciences Part 2  
p. 44 & 59 (2024 ed.)*



# SECTION A – Item/statement columns

Indicate whether each of the descriptions in COLUMN I apply to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question number (1.3.1 to 1.3.3) in the ANSWER BOOK.

COLUMN I		COLUMN II
1.3.1	The phase of Meiosis during which non-disjunction can occur.	A: Anaphase I B: Anaphase II
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1.3.3	The alleles of a gene separate into different gametes during Meiosis.	A: Law of independent assortment B: Law of segregation

Memorandum

Common misconceptions & Errors

Both A and B ✓✓

B only ✓✓

B only ✓✓

# SECTION A – Meiosis

1.4

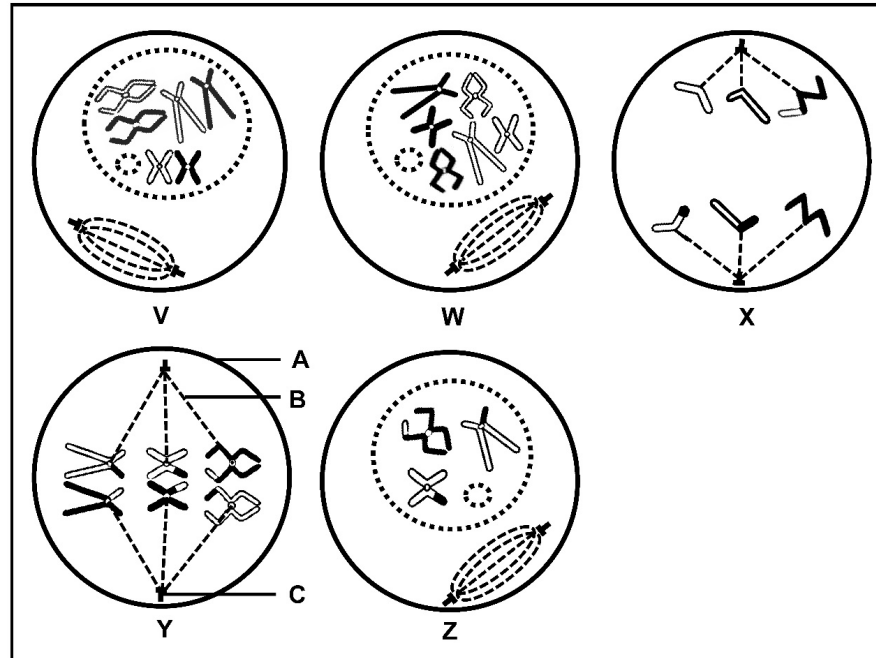
The diagrams represent cells from the same organism during different phases of Mitosis and Meiosis.

1.4.1 Identify part:

(a) **A**

(b) **B**

(c) **C**



1.4.2 Which diagram (**V**, **W**, **X**, **Y** or **Z**) represents a cell during:

(a) Prophase of Mitosis

(b) Metaphase I

(c) Prophase I

Common misconceptions & Errors

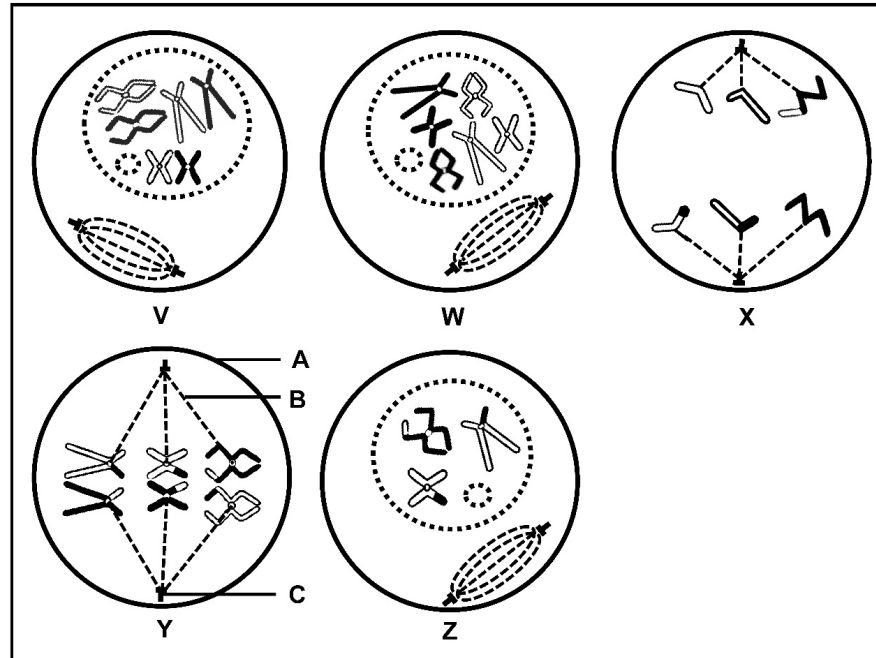
# SECTION A – Meiosis

1.4

The diagrams represent cells from the same organism during different phases of Mitosis and Meiosis.

1.4.1 Identify part:

- (a) **A**  
cell membrane ✓ (1)
- (b) **B**  
spindle fibre ✓ (1)
- (c) **C**  
centriole ✓ / centrosome (1)



1.4.2 Which diagram (V, W, X, Y or Z) represents a cell during:

- (a) Prophase of Mitosis **W** ✓ (1)
- (b) Metaphase I **Y** ✓ (1)
- (c) Prophase I **V** ✓ (1)

## Common misconceptions & Errors

1.4.1 (a) Candidates provided **nuclear membrane** ✗.

1.4.2 Candidates **could not identify** the **phases** of Mitosis and Meiosis as **required**.

# SECTION A – Meiosis

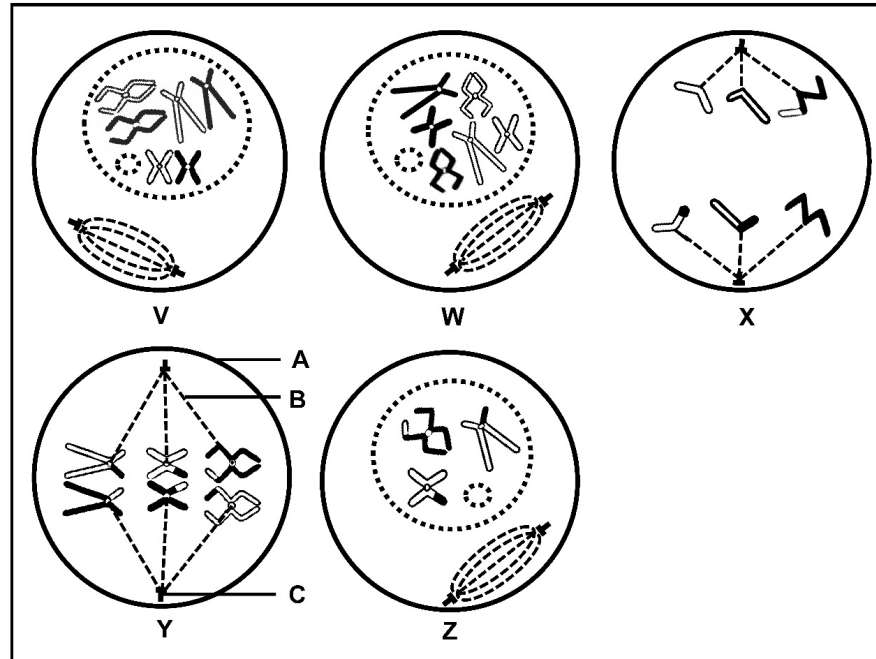
1.4

The diagrams represent cells from the same organism during different phases of Mitosis and Meiosis.

1.4.3 How many chromosomes will there be in each cell at the end of:

(a) Mitosis

(b) Meiosis I



Common misconceptions & Errors

# SECTION A – Meiosis

1.4

The diagrams represent cells from the same organism during different phases of Mitosis and Meiosis.

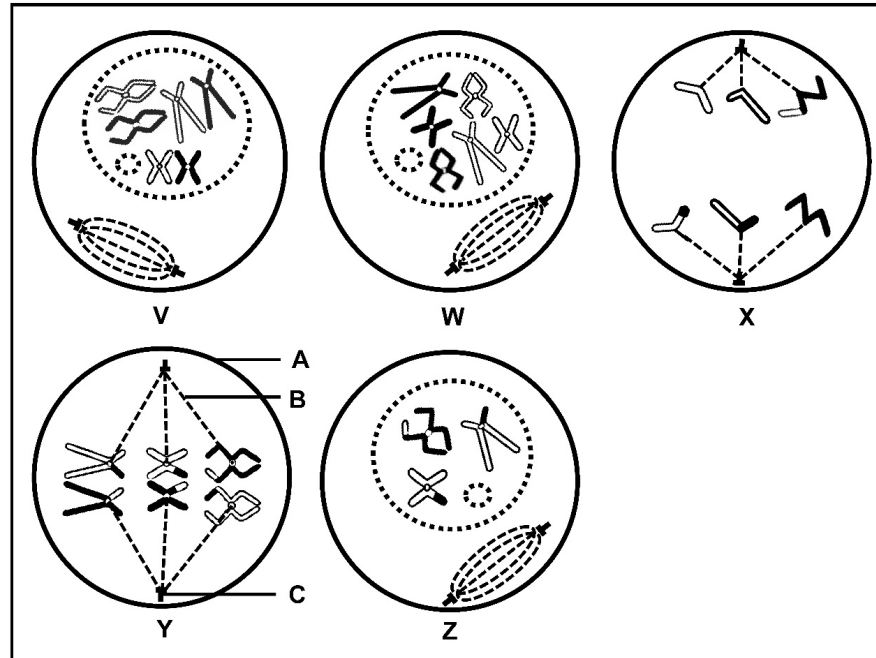
1.4.3 How many chromosomes will there be in each cell at the end of:

(a) Mitosis

6✓ (1)

(b) Meiosis I

3✓ (1)



## Common misconceptions & Errors

1.4.3 Candidates assumed the cell was human instead of looking at the diagram provided to count the number of chromosomes.

# SECTION A – Protein Synthesis

1.5

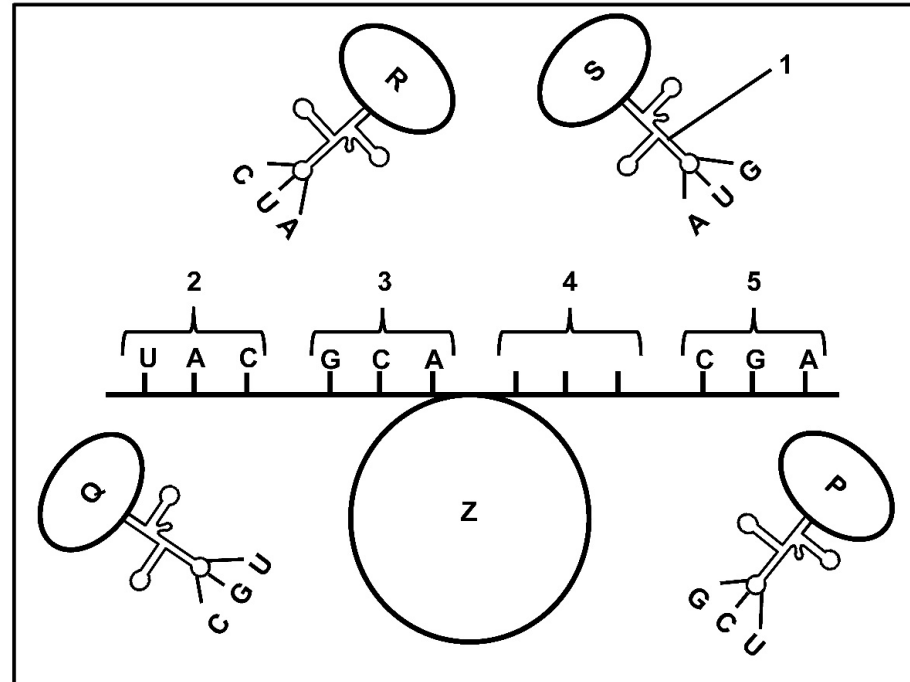
The diagram below represents a stage of protein synthesis. Each amino acid (**P**, **Q**, **R** and **S**) is coded for by a different codon on this mRNA molecule.

1.5.1 Identify:

(a) the stage of protein synthesis represented

(b) molecule 1

(c) organelle Z



Common misconceptions & Errors

1.5.2 State the sequence of nitrogenous bases on the DNA molecule for codon:

(a) 3

(b) 4

# SECTION A – Protein Synthesis

1.5

The diagram below represents a stage of protein synthesis. Each amino acid (**P**, **Q**, **R** and **S**) is coded for by a different codon on this mRNA molecule.

1.5.1 Identify:

(a) the stage of protein synthesis represented

translation ✓ (1)

(b) molecule 1

tRNA ✓ / transfer RNA (1)

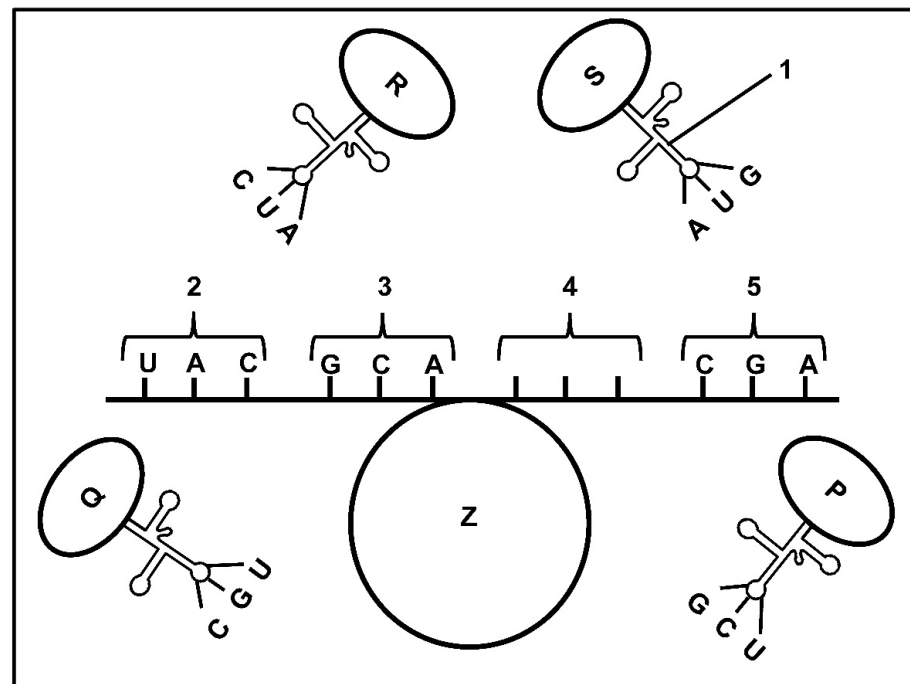
(c) organelle Z

ribosome ✓ (1)

1.5.2 State the sequence of nitrogenous bases on the DNA molecule for codon:

(a) 3 CGT ✓ (1)

(b) 4 CTA ✓✓ (2)



Common misconceptions & Errors

1.5.1 (a) Candidates still confuse **transcription** and **translation**.

1.5.2 (b) Candidates **could not work backwards** by first determining the tRNA anticodon complementary to codon 4 and then deduce the complementary DNA to codon 4.



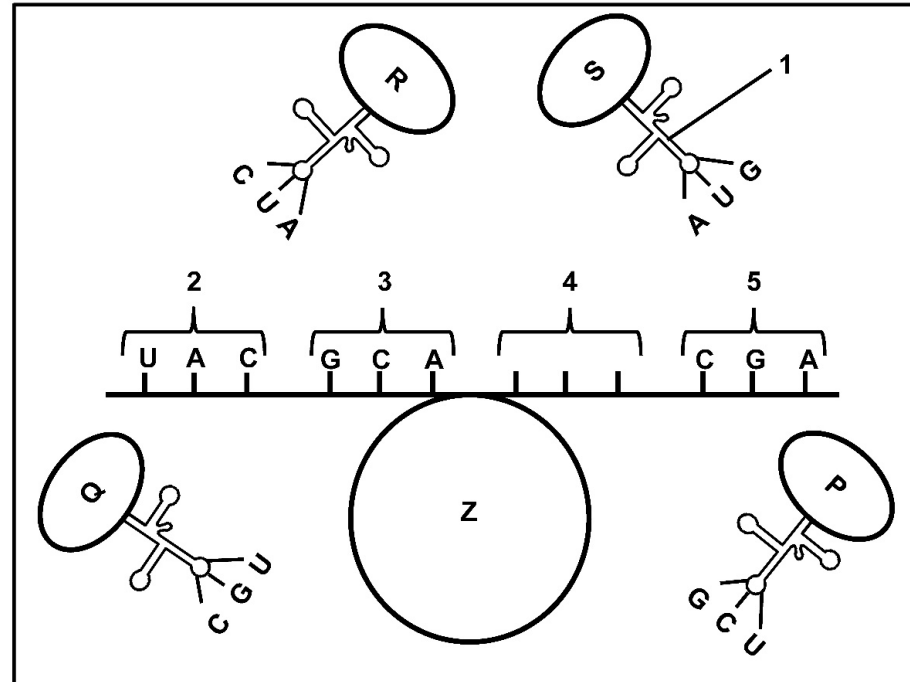
Let's understand and practice this

# SECTION A – Protein Synthesis

1.5

The diagram below represents a stage of protein synthesis. Each amino acid (**P**, **Q**, **R** and **S**) is coded for by a different codon on this mRNA molecule.

1.5.3 Which amino acid (**P**, **Q**, **R** or **S**) is coded for by codon 5?



Common misconceptions & Errors

# SECTION A – Protein Synthesis

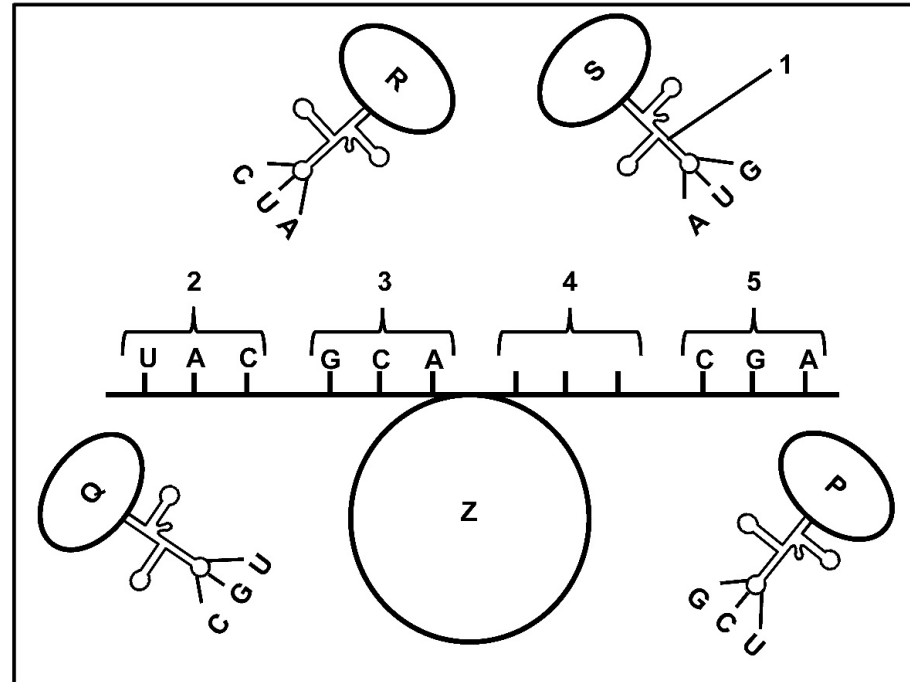
1.5

The diagram below represents a stage of protein synthesis. Each amino acid (**P**, **Q**, **R** and **S**) is coded for by a different codon on this mRNA molecule.

1.5.3 Which amino acid (**P**, **Q**, **R** or **S**) is coded for by codon 5?

**P** ✓

(1)



Common misconceptions & Errors

# SECTION A – Suggestions for improvement

- ✓ Use hands-on models (DNA base-pairing cards or beads) to reinforce the formation of the complementary strand when teaching DNA Replication.
- ✓ Dihybrid crosses should be taught by using Punnett squares.
  - The difference between genotype and phenotype should also be emphasised.
- ✓ Strict marking of spelling at school level will teach learners to spell correctly in NSC exams.
- ✓ Teaching Mitosis and Meiosis should include diagrams with different chromosome numbers so that learners can apply their knowledge.
  - Proper revision of Mitosis is essential in understanding Meiosis.



**NOTE**  
The Diagnostic Report of 2024 provided many suggestions on the teaching of Mitosis/Meiosis. This was thoroughly covered (with practice questions) on slide 46 of the [2024 Paper 2 Diagnostic Report Teaching & Learning Tool](#).



# SECTION B – Meiosis

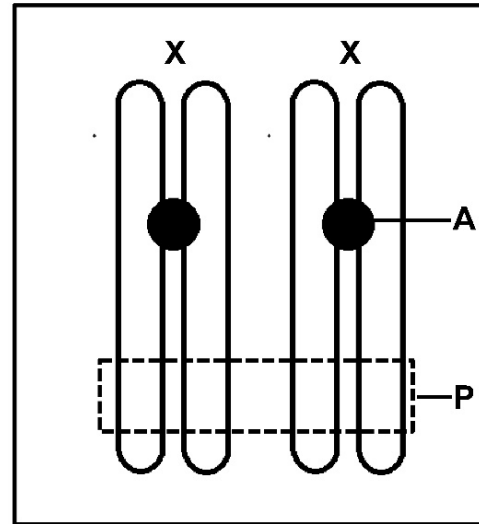
2.1

The diagram represents the sex chromosomes in a female.

2.1.1 Identify structure **A**.

2.1.2 Give the biological term for the sex chromosomes.

2.1.3 Describe how these chromosomes would differ in the somatic cells of a male.



2.1.4 An exchange of genetic material takes place at region **P**.

(a) Name the process above.

(b) Identify the phase during which the process named in QUESTION 2.1.4(a) takes place.

(c) Give ONE reason why the process named in QUESTION 2.1.4(a) is important.

Common misconceptions & Errors

# SECTION B – Meiosis

2.1

The diagram represents the sex chromosomes in a female.

2.1.1 Identify structure **A**.

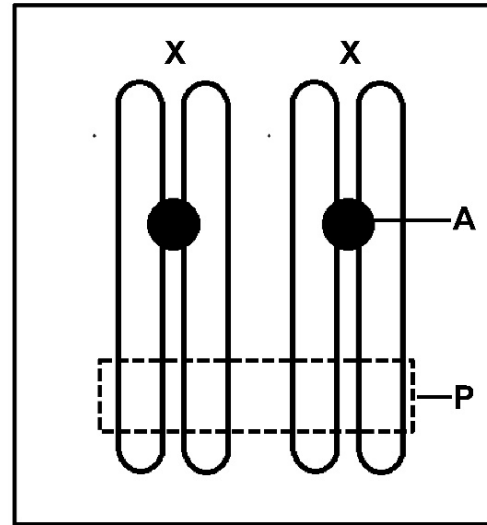
centromere ✓ (1)

2.1.2 Give the biological term for the sex chromosomes.

gonosomes ✓ (1)

2.1.3 Describe how these chromosomes would differ in the somatic cells of a male.

There will be one X-chromosome and one Y-chromosome ✓ (1)



2.1.4 An exchange of genetic material takes place at region **P**.

(a) Name the process above. crossing over ✓ (1)

(b) Identify the phase during which the process named in QUESTION 2.1.4(a) takes place.

Prophase I ✓ (1)

(c) Give ONE reason why the process named in QUESTION 2.1.4(a) is important.

Leads to (increased) genetic variation ✓ (1)

## Common misconceptions & Errors

2.1.4 (c) Candidates **described** the process of crossing over rather **than stating its importance** in increasing genetic variation.

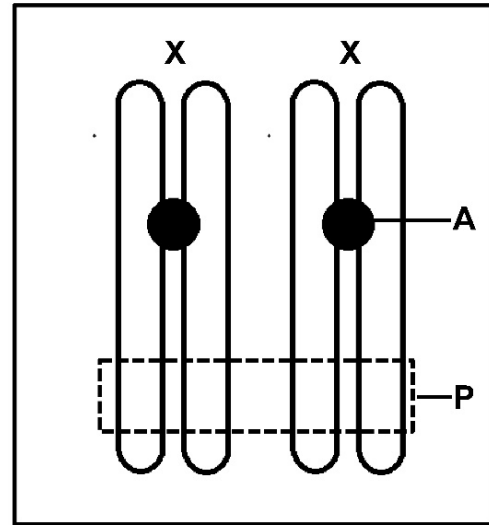
They often referred to 'variation' × instead of 'genetic variation' ✓.

# SECTION B – Meiosis

2.1

The diagram represents the sex chromosomes in a female.

2.1.5 Explain how the structure of the chromosomes would differ at the end of Meiosis II.



2.1.6 Non-disjunction of these chromosomes occurred during Meiosis and a gamete with an extra chromosome is formed. If this gamete is fertilised by normal gametes, the resulting zygotes will not be normal.

Explain the genetic composition of these zygotes.

Common misconceptions & Errors

# SECTION B – Meiosis

2.1

The diagram represents the sex chromosomes in a female.

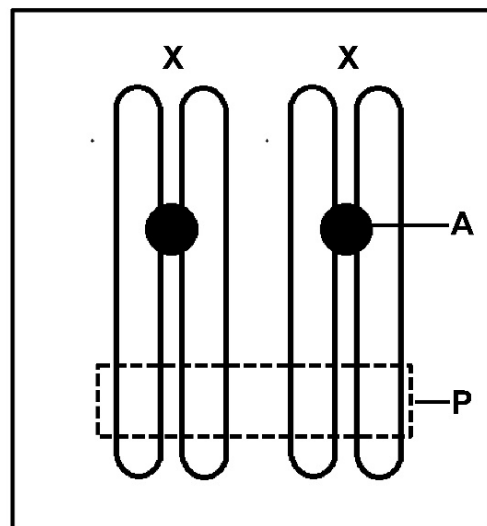
2.1.5 Explain how the structure of the chromosomes would differ at the end of Meiosis II.

- They will appear as **chromatids** ✓ i.e. single-stranded chromosomes
- due to the splitting of the centromere ✓ / the chromosome separating

OR

- Each chromosome will have some genetic material of the other chromosome ✓
- because of crossing over ✓

(2)



2.1.6 Non-disjunction of these chromosomes occurred during Meiosis and a gamete with an extra chromosome is formed. If this gamete is fertilised by normal gametes, the resulting zygotes will not be normal.

Explain the genetic composition of these zygotes.

- The zygote will have **XXY chromosomes** ✓ / **XXX chromosomes** / an extra gonosome
- since the ovum with **XX chromosomes** ✓
- fused with a sperm with a **Y-chromosome** ✓ / **X-chromosome**

(3)

## Common misconceptions & Errors

2.1.5 Candidates **confused** a 'single chromosome' ✗ with a 'single-stranded chromosome' ✓.

2.1.6 Candidates **confused non-disjunction of gonosomes** with non-disjunction of **autosomes**.

They were **unable to apply their understanding of abnormal Meiosis** to a new scenario.

The **question focused on gonosomes** (sex chromosomes), yet many gave an **account of the inheritance of Down's syndrome/Trisomy 21 (autosomes)**.



Let's understand this better...

# SECTION B – DNA Code of Life

2.2

The diagram shows the DNA analysis of a sample obtained at a crime scene, a sample from the victim and samples from two suspects. In their investigation, police conducted a comparison of the DNA to identify the criminal.

2.2.1 Name the technique used in this criminal investigation.



2.2.2 Which ONE of the suspects (1 or 2) was at the crime scene?

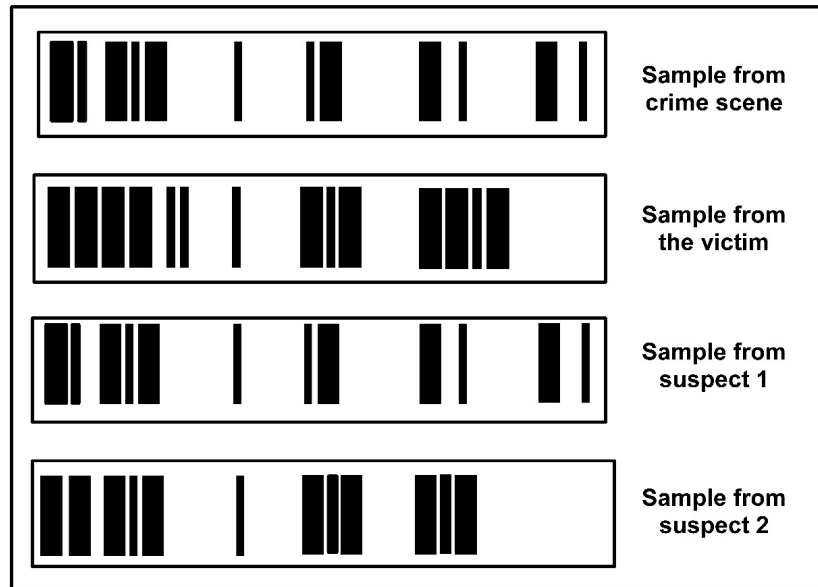
2.2.3 Give ONE observable reason for your answer to QUESTION 2.2.2.

Common misconceptions & Errors

# SECTION B – DNA Code of Life

2.2

The diagram shows the DNA analysis of a sample obtained at a crime scene, a sample from the victim and samples from two suspects. In their investigation, police conducted a comparison of the DNA to identify the criminal.



2.2.1 Name the technique used in this criminal investigation.

DNA profiling ✓ (1)

2.2.2 Which ONE of the suspects (1 or 2) was at the crime scene?

(Suspect) 1 ✓ (1)

2.2.3 Give ONE observable reason for your answer to QUESTION 2.2.2.

The DNA profile/bands of suspect 1 is/are identical to the DNA profile of the sample from the crime scene ✓ (1)

## Common misconceptions & Errors

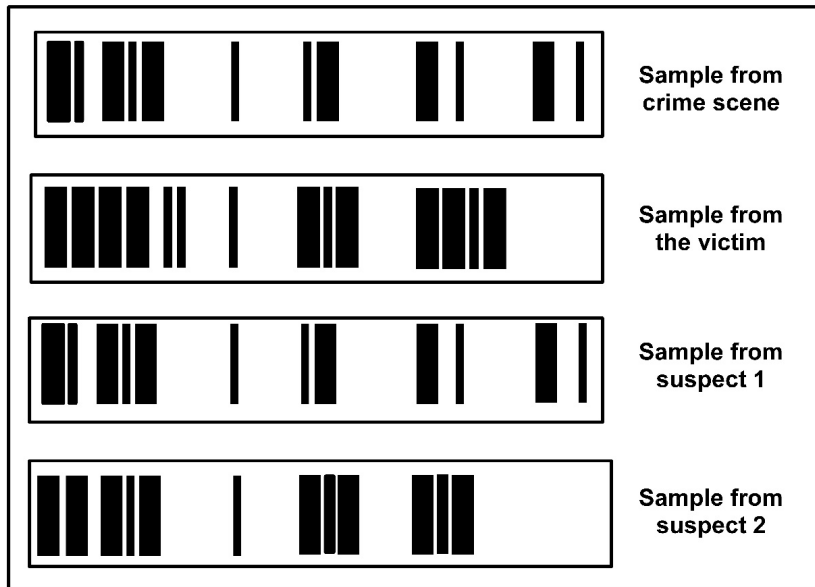
2.2.3 Candidates referred to 'DNA'× and 'DNA sample'× instead of 'DNA bands'✓ or 'DNA profile'✓.

# SECTION B – DNA Code of Life

2.2

The diagram shows the DNA analysis of a sample obtained at a crime scene, a sample from the victim and samples from two suspects. In their investigation, police conducted a comparison of the DNA to identify the criminal.

2.2.4 Give TWO possible reasons why the suspect identified in QUESTION 2.2.2 might NOT be convicted if only this evidence is used.



Common misconceptions & Errors

# SECTION B – DNA Code of Life

2.2

The diagram shows the DNA analysis of a sample obtained at a crime scene, a sample from the victim and samples from two suspects. In their investigation, police conducted a comparison of the DNA to identify the criminal.

2.2.4 Give TWO possible reasons why the suspect identified in QUESTION 2.2.2 might NOT be convicted if only this evidence is used.



Common misconceptions & Errors

- Evidence could have been planted at the crime scene ✓
- Suspect could've been at the crime scene before the crime was committed ✓
- Human error might occur during the procedure ✓
- Manipulation of results can occur ✓
- Contamination of the DNA sample ✓
- DNA sample too small ✓
- Suspect may have an identical twin ✓

(first 2 only)

# SECTION B – DNA Code of Life

2.2

The diagram shows the DNA analysis of a sample obtained at a crime scene, a sample from the victim and samples from two suspects. In their investigation, police conducted a comparison of the DNA to identify the criminal.

2.2.5 Explain how the technique named in QUESTION 2.2.1 is used in paternity testing.



Common misconceptions & Errors

# SECTION B – DNA Code of Life

2.2

The diagram shows the DNA analysis of a sample obtained at a crime scene, a sample from the victim and samples from two suspects. In their investigation, police conducted a comparison of the DNA to identify the criminal.

2.2.5 Explain how the technique named in QUESTION 2.2.1 is used in paternity testing.



- The DNA profile of the child, mother and possible father are compared ✓ since
- the child inherits 50% of their DNA from each parent ✓
- All the DNA bands that are identical to the mother in the child's DNA profile are eliminated ✓
- The remaining DNA bands are checked against the possible fathers' ✓
- for possible matches with the child ✓

(any 4)

## Common misconceptions & Errors

2.2.5 Candidates could not explain the process used to determine paternity and how DNA profiling was applied.

They only explained matching DNA profiles of the father and the child.

They failed to explain that the DNA profiles/bands of both parents must be compared with that of the child.

# SECTION B – Genetics

2.3

CADASIL is an autosomal genetic disorder caused by a dominant allele (D). It results in the thickening of the walls of blood vessels.

The diagram shows the inheritance of CADASIL in a family.

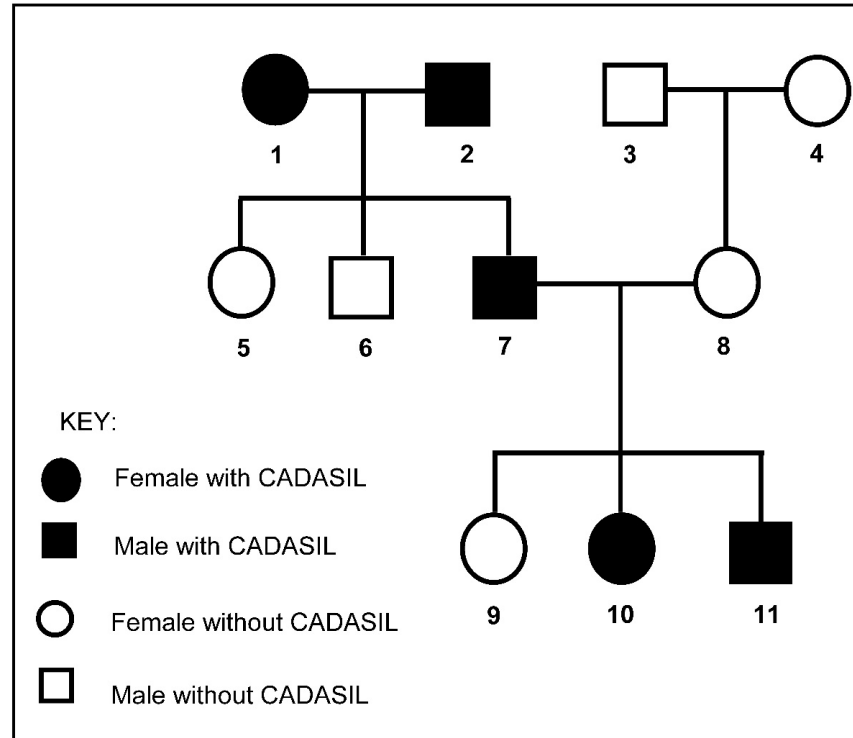
2.3.1 Name the type of diagram represented.

2.3.2 How many offspring do parents **3** and **4** have?

2.3.3 Give the:

(a) Phenotype of individual **10**

(b) Genotype of individual **5**



Common misconceptions & Errors

# SECTION B – Genetics

2.3

CADASIL is an **autosomal genetic disorder** caused by a dominant allele (D). It results in the thickening of the walls of blood vessels.

The diagram shows the inheritance of CADASIL in a family.

2.3.1 Name the type of diagram represented.

Pedigree ✓ diagram (1)

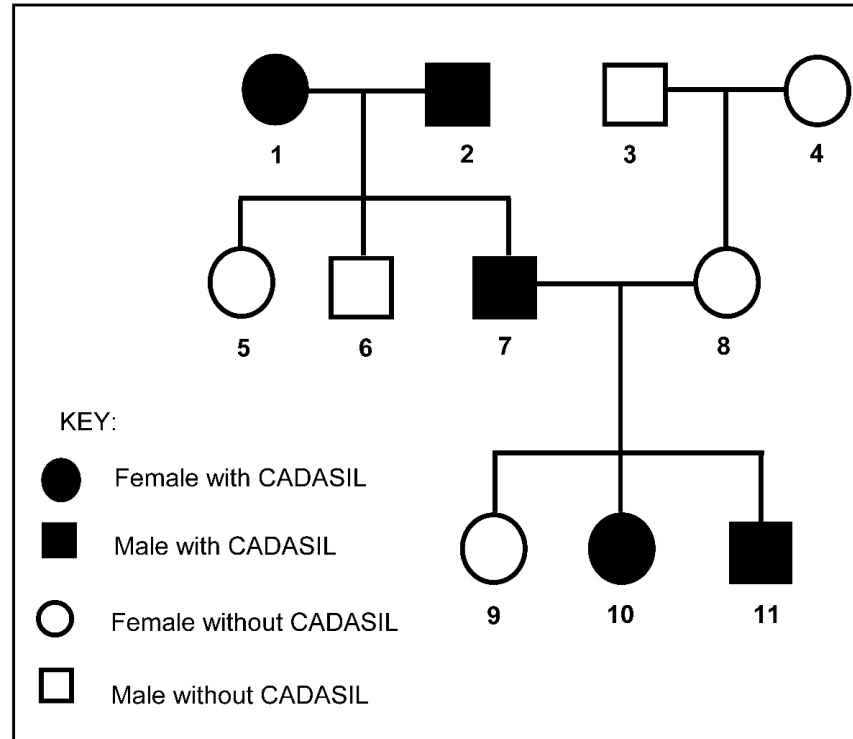
2.3.2 How many offspring do parents 3 and 4 have?

1 ✓ / one (1)

2.3.3 Give the:

(a) Phenotype of individual 10 Female with CADASIL ✓ (1)

(b) Genotype of individual 5 dd ✓ (1)



## Common misconceptions & Errors

2.3.3 (a) Candidates did not use the key provided in the pedigree diagram.

The key clearly stated 'female with CADASIL' ✓, yet some candidates wrote 'female with defect' ✗ instead of naming the specific condition as shown in the key.

2.3.3 (b) Candidates used sex-linked alleles ( $X^dX^d$ ) ✗ while this question was clearly about an **autosomal genetic disorder** as indicated in the stem of the question.



## NOTE

TAS provides step-by-step instructions on how to analyse a pedigree diagram on p. 64 - 68 of our [Gr 12 Life Sciences PART 2 Class Text & Study Guide](#). Alternatively, this was also covered on page 163 of the [2021 DBE Diagnostic Report](#).

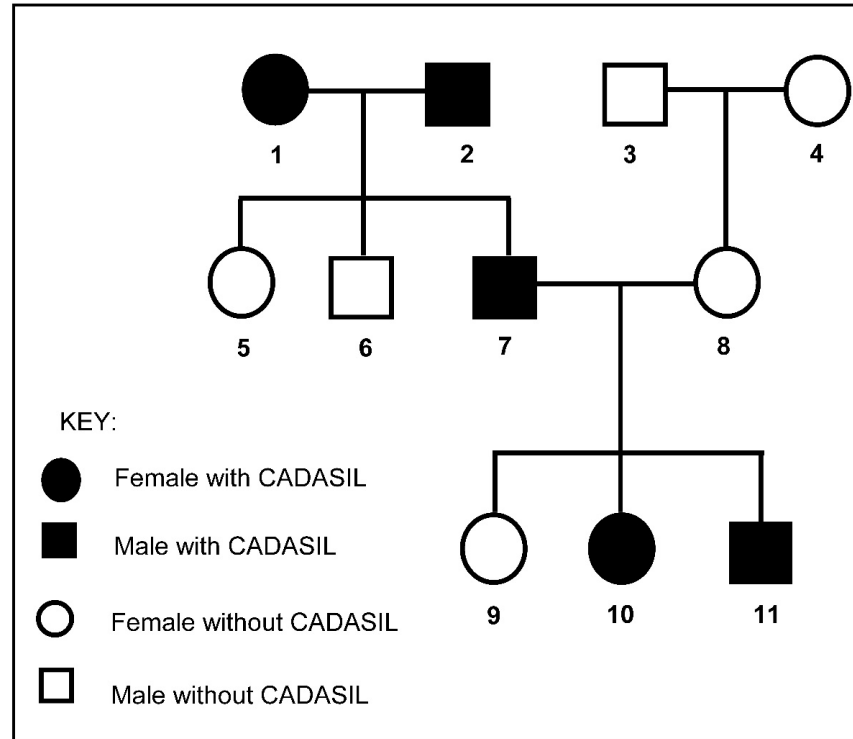
# SECTION B – Genetics

2.3

CADASIL is an autosomal genetic disorder caused by a dominant allele (D). It results in the thickening of the walls of blood vessels.

The diagram shows the inheritance of CADASIL in a family.

2.3.4 Using evidence from the diagram, explain why individuals **1** and **2** are both heterozygous.



Common misconceptions & Errors

2.3.5 What is the percentage chance of parents **7** and **8** having another child with CADASIL?

# SECTION B – Genetics

2.3

CADASIL is an autosomal genetic disorder caused by a dominant allele (D). It results in the thickening of the walls of blood vessels.

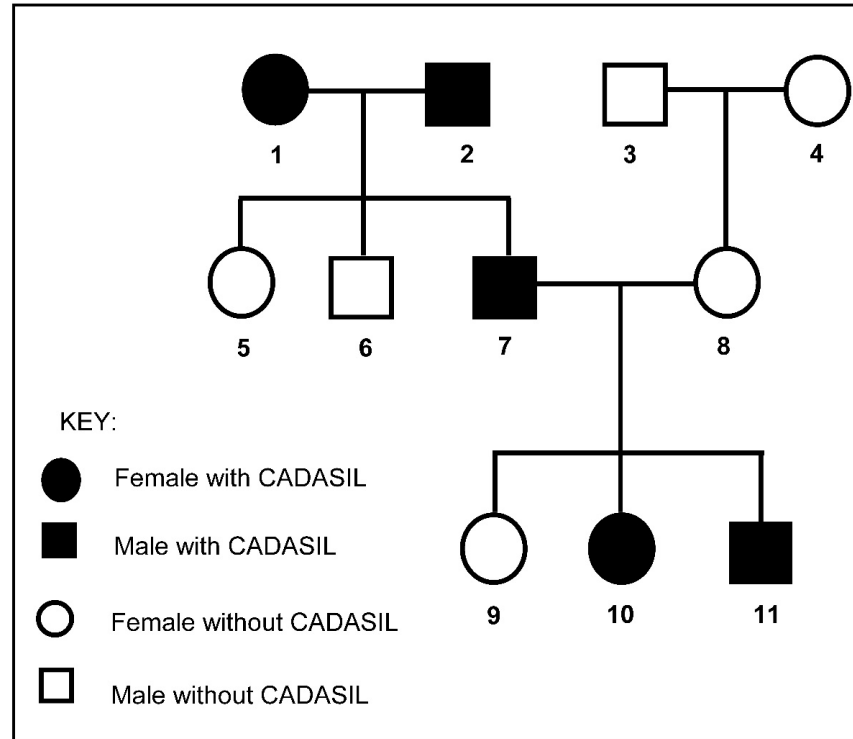
The diagram shows the inheritance of CADASIL in a family.

2.3.4 Using evidence from the diagram, explain why individuals 1 and 2 are both heterozygous.

- Both individual 1 and 2 have CADASIL ✓
- indicating they have a dominant allele ✓ / (the genotype) Dd
- but have children who do not have CADASIL ✓ / are homozygous recessive
- indicating that they inherited a recessive allele from each parent ✓ (4)

2.3.5 What is the percentage chance of parents 7 and 8 having another child with CADASIL?

50 ✓ % (1)



## Common misconceptions & Errors

2.3.4 Candidates failed to use the phenotypes and genotypes of individuals 1 and 2 and their children to explain why they were heterozygous.

They described the phenotypes of the individuals in the pedigree diagram again using the words 'affected' and 'unaffected', thus earning **no marks**.

Some also included individual 7 in the explanation, which was **incorrect**.



Let's revise the 4 types of genetic conditions

# SECTION B – Blood groups

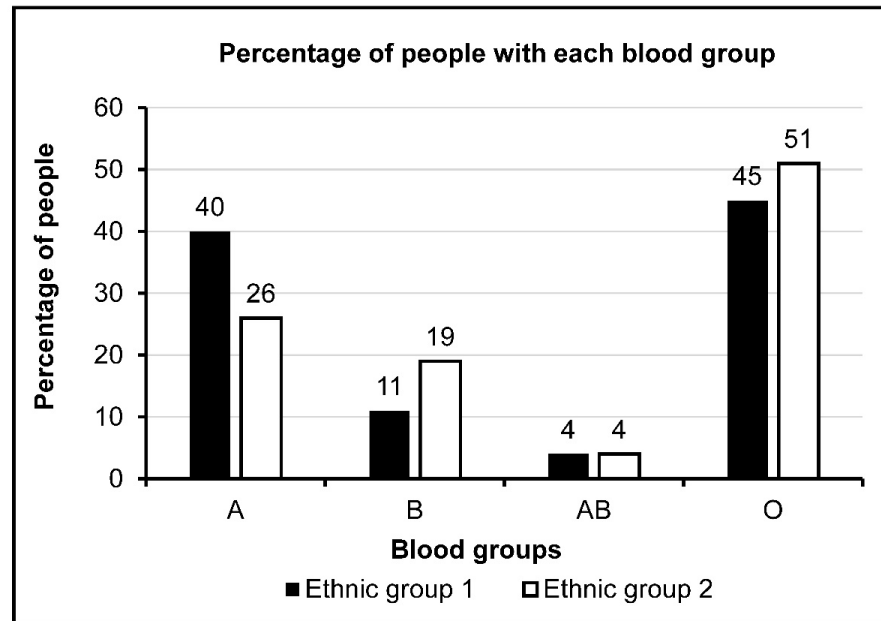
2.4

The graph shows the distribution of blood groups for two ethnic groups (1 and 2) in a certain country during 2021.

2.4.1 Which blood group:

(a) is most common in both ethnic groups

(b) has a higher percentage in ethnic group 1 than in ethnic group 2



Common misconceptions & Errors

2.4.2 State ALL the possible genotypes of 11% of the people in ethnic group 1.

# SECTION B – Blood groups

**2.4** The graph shows the distribution of blood groups for two ethnic groups (1 and 2) in a certain country during 2021.

2.4.1 Which blood group:

(a) is most common in both ethnic groups

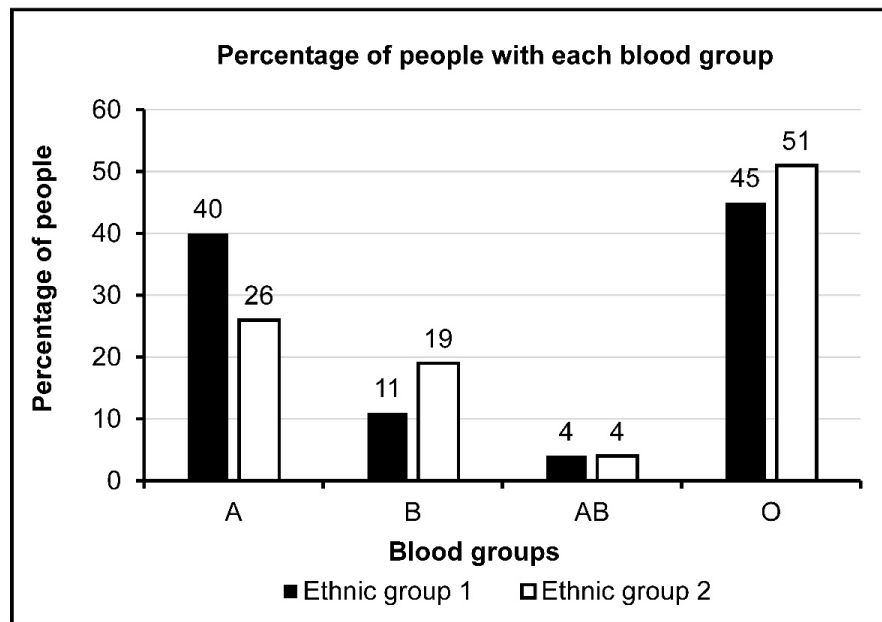
(Blood group) O ✓ (1)

(b) has a higher percentage in ethnic group 1 than in ethnic group 2

(Blood group) A ✓ (1)

**2.4.2** State ALL the possible genotypes of 11% of the people in ethnic group 1.

–  $I^B I^B$  ✓  
–  $I^B i$  ✓ (2)



## Common misconceptions & Errors

2.4.2 Candidates provided incorrect notations given for the genotype of blood group B, e.g.  $i^B i$ ,  $i^B i^O$ ,  $i^B i^B$ .

### NOTE

The correct genetic notation for blood groups was also mentioned in the 2024 Diagnostic Report and was thoroughly covered on slide 47 of our [2024 Paper 2 Diagnostic Report Teaching & Learning Tool](#).

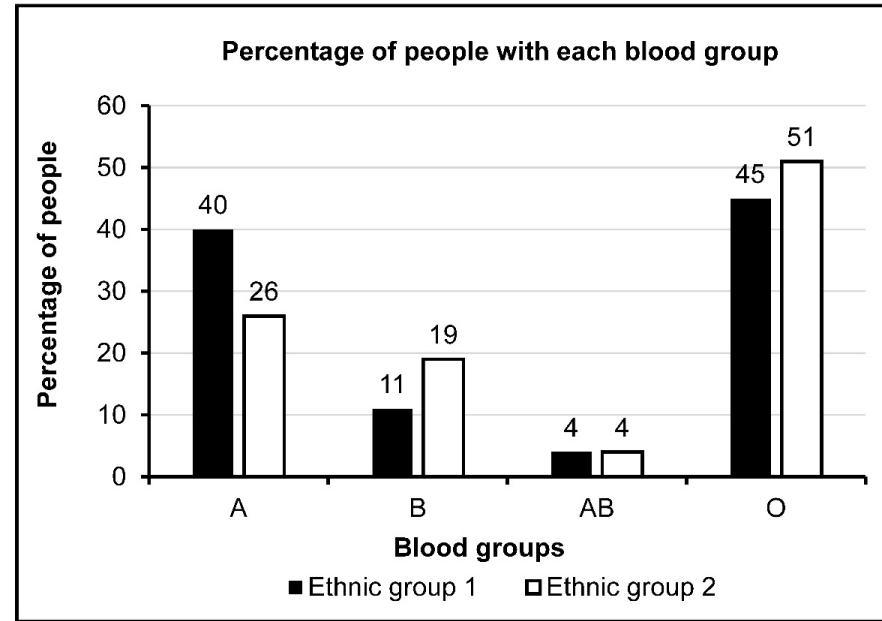


# SECTION B – Blood groups

2.4

The graph shows the distribution of blood groups for two ethnic groups (1 and 2) in a certain country during 2021.

2.4.3 Ethnic group 1 had a population of 360 000 people in 2021. Which blood group (**A**, **B**, **AB** or **O**) had 39 600 people?



Common misconceptions & Errors

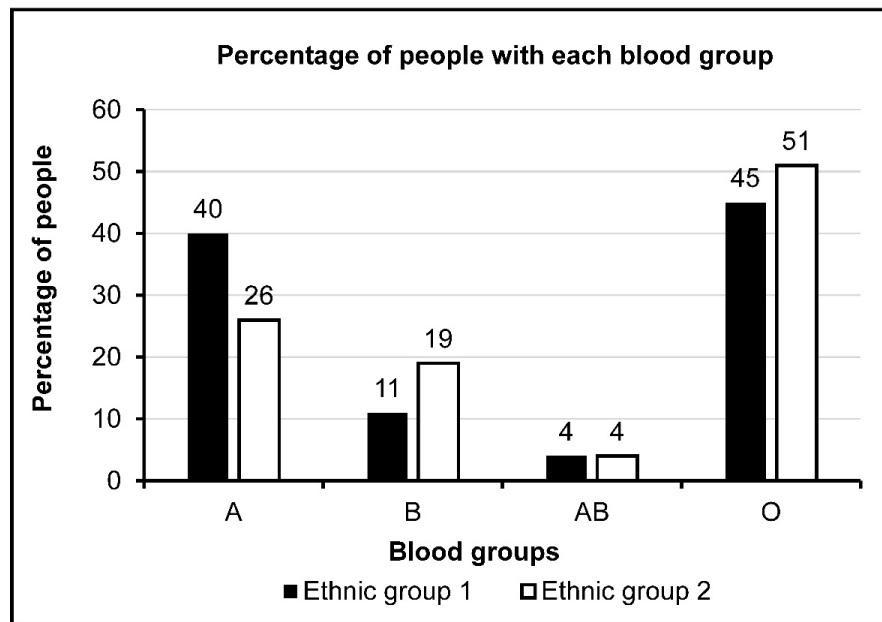
2.4.4 Explain the inheritance of blood group **AB**.

# SECTION B – Blood groups

2.4 The graph shows the distribution of blood groups for two ethnic groups (1 and 2) in a certain country during 2021.

2.4.3 Ethnic group 1 had a population of 360 000 people in 2021. Which blood group (A, B, AB or O) had 39 600 people?

(Blood group) B ✓✓ (2)



2.4.4 Explain the inheritance of blood group AB.

- Allele  $I^A$  / allele for blood group A is inherited from one parent ✓ and
- Allele  $I^B$  / allele for blood group B from the other parent ✓
- the alleles are co-dominant ✓ / equally dominant and are
- equally expressed in the phenotype ✓ / the child will have the genotype  $I^A I^B$



(any 3)

## Common misconceptions & Errors

2.4.4 Candidates:

- referred to the 'inheritance of a blood group' ✗ instead of the 'inheritance of an allele' ✓
- described a 'dominant blood group' ✗, instead of a 'dominant allele' ✓
- failed to describe the inheritance of alleles from both parents
- used the incorrect notation for the alleles
- incorrectly stated a child 'receives blood group A from one parent and B from the other' ✗

## NOTE

Blood groups are not inherited – their ALLELES are!  
The child will inherit the  $I^A$  allele from the parent with blood group A (phenotype) and the  $I^B$  allele from the parent with blood group B (phenotype).

# SECTION B – Genetic cross

2.5

Palomino horses are bred by horse breeders for their coat colour. A palomino has a golden-coloured coat. It is the offspring of a horse with a cream-coloured coat (**A**) and a horse with a chestnut-coloured coat (**G**).

2.5.1 Name the type of dominance displayed in the inheritance of coat colour in palomino horses.

2.5.2 Explain your answer to QUESTION 2.5.1.

2.5.3 The breeding of horses with desired characteristics is a type of biotechnology.

(a) Name this type of biotechnology.

(b) Name the TWO phenotypes of the horses that must be interbred for a 100% chance of palomino offspring.

Common misconceptions & Errors

# SECTION B – Genetic cross

**2.5** Palomino horses are bred by horse breeders for their coat colour. A palomino has a golden-coloured coat. It is the offspring of a horse with a cream-coloured coat (**A**) and a horse with a chestnut-coloured coat (**G**).

**2.5.1** Name the type of dominance displayed in the inheritance of coat colour in palomino horses.

Incomplete✓ dominance (1)

**2.5.2** Explain your answer to QUESTION 2.5.1.

- Neither the allele of cream-coloured coat and chestnut-coloured coat is dominant✓
- resulting in the intermediate phenotype which is the golden-coloured coat✓/palomino (2)

**2.5.3** The breeding of horses with desired characteristics is a type of biotechnology.

(a) Name this type of biotechnology.

Artificial selection✓/ selective breeding (1)

(b) Name the TWO phenotypes of the horses that must be interbred for a 100% chance of palomino offspring.

- Chestnut (coloured) coat✓
- Cream (coloured) coat✓ (2)

## Common misconceptions & Errors

2.5.1 & 2.5.2 Candidates lost marks because:

- confused incomplete dominance with co-dominance
- failed to link the explanation with the example in the question / were too general, i.e. stating only that 'neither allele is dominant' without referring specifically to the cream-coloured allele / chestnut-coloured allele and golden-coloured phenotype

2.5.3 (a) Candidates wrote:

genetic engineering✗ / artificial breeding✗ / artificial selection✗

2.5.3 (b) Candidates

- did not include 'coat' in the answer
- included heterozygous/homozygous✗ which refers to a genotype

# SECTION B – Genetic cross

**2.5** Palomino horses are bred by horse breeders for their coat colour. A palomino has a golden-coloured coat. It is the offspring of a horse with a cream-coloured coat (**A**) and a horse with a chestnut-coloured coat (**G**).

2.5.4 A horse with a cream-coloured coat was crossed with a palomino horse.  
Use a genetic cross to show the expected phenotypic ratio of the offspring.

Common misconceptions & Errors

# SECTION B – Genetic cross

**2.5** Palomino horses are bred by horse breeders for their coat colour. A palomino has a golden-coloured coat. It is the offspring of a horse with a cream-coloured coat (**A**) and a horse with a chestnut-coloured coat (**G**).

**2.5.4** A horse with a cream-coloured coat was crossed with a palomino horse. Use a genetic cross to show the expected phenotypic ratio of the offspring.

**P<sub>1</sub>**

Phenotype	cream-coloured coat	x	palomino / golden-coloured coat	✓
Genotype	AA	x	AG	✓
Gametes	A; A	x	A; G	✓

*Meiosis* (indicated by a red arrow pointing from the P<sub>1</sub> genotypes to the gametes)

*Fertilisation* (indicated by a red arrow pointing from the gametes to the Punnett square)

Gametes	A	G
A	AA	AG
A	AA	AG

✓ correct gametes

✓ correct genotypes

**F<sub>1</sub>**

Phenotype	50% cream-coloured coat	} ✓
	50% palomino / golden-coloured coat	

∴ phenotypic ratio of 1:1 ✓\*

\*1 compulsory mark + any 5 = (6)

## Common misconceptions & Errors

2.5.4 Candidates **did not give** the **smallest/simplified ratio**, i.e. left it as 2:2~~x~~  
**OR**  
 gave **incorrect ratios**, i.e. 1:1:1:1~~x~~ or 4:4~~x~~  
**OR**  
**left out the ratio completely**

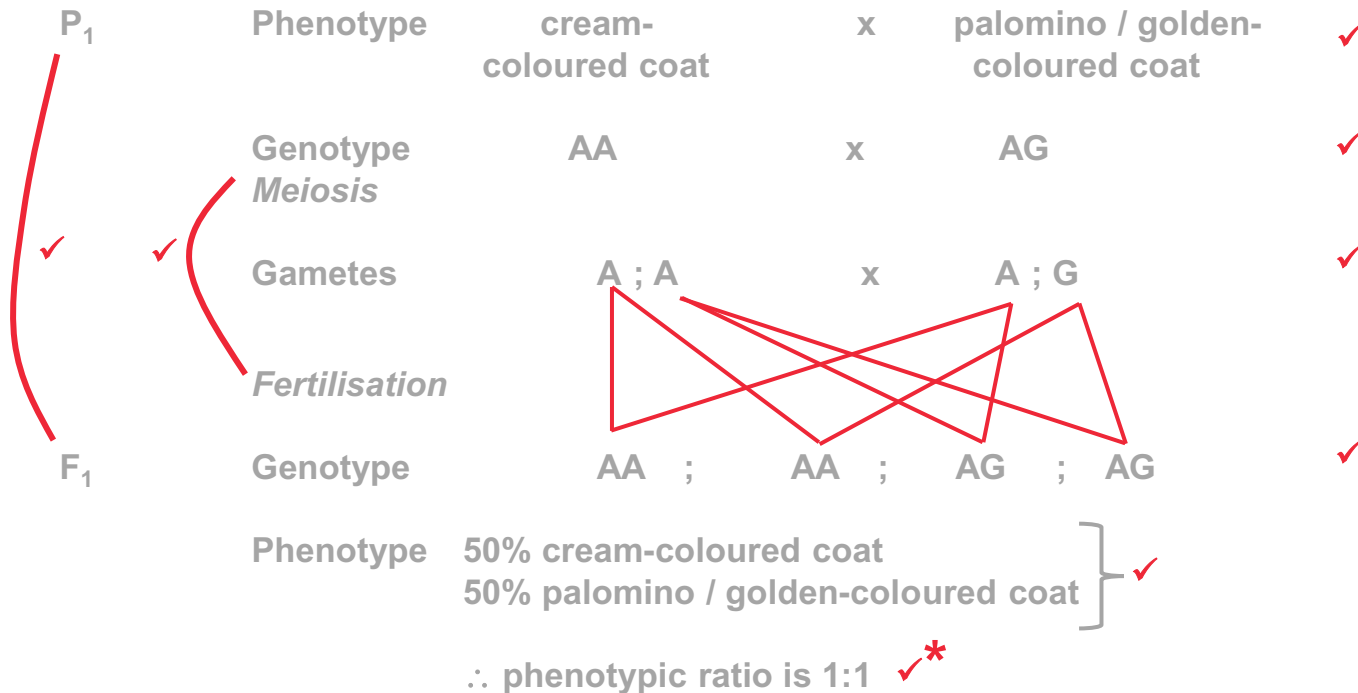
Candidates:

- **mislabeled P<sub>1</sub> and F<sub>1</sub>/F<sub>2</sub> generations**
- wrote **'fusion'**~~x~~ not **'fertilisation'** ✓
- **included homozygous/heterozygous in the phenotypes**
- used their **own letters** instead of the ones provided in the question
- used **incorrect notation**, e.g. C<sup>A</sup>C<sup>G</sup>~~x~~

# SECTION B – Genetic cross

**2.5** Palomino horses are bred by horse breeders for their coat colour. A palomino has a golden-coloured coat. It is the offspring of a horse with a cream-coloured coat (**A**) and a horse with a chestnut-coloured coat (**G**).

**2.5.4** A horse with a cream-coloured coat was crossed with a palomino horse. Use a genetic cross to show the expected phenotypic ratio of the offspring.



\*1 compulsory mark + any 5 = (6)

## Common misconceptions & Errors

2.5.4 Candidates **did not give** the **smallest/simplified ratio**, i.e. left it as 2:2<sup>x</sup>  
**OR**  
 gave **incorrect ratios**, i.e. 1 : 1 : 1 : 1<sup>x</sup> or 4 : 4<sup>x</sup>  
**OR**  
**left out the ratio completely**

Candidates:

- **mislabeled P1 and F1/F2 generations**
- wrote **'fusion'**<sup>x</sup> not **'fertilisation'**<sup>✓</sup>
- **included homozygous/heterozygous in the phenotypes**
- used their **own letters** instead of the ones provided in the question
- used **incorrect notation**, e.g. C<sup>A</sup>C<sup>G</sup><sup>x</sup>

## SECTION B – Suggestions for improvement

☑ Learners should be exposed to different examples of non-disjunction (sex chromosome abnormalities like Turner or Klinefelter's) to broaden understanding.

- The genetic combination of the zygotes, e.g.  $XX + X/Y = XXX/XXY$ , must be emphasised



Return to Q 2.1 to practice this

☑ Not all genetic disorders are caused by recessive alleles!

- Disorders can be caused by dominant alleles too
- Include more case studies of real-life examples of genetic conditions to contextualise learning
- Encourage learners to draw pedigree diagrams to visualise inheritance patterns



Return to Q 2.3 to practice this

☑ DNA fingerprinting~~x~~ is not an accepted term – only teach 'DNA profiling'~~✓~~.

- Use the **correct terminology** when explaining DNA profiling
- Emphasise the **difference** in using DNA profiles for forensics vs paternity testing



Let's revise this

# SECTION B – Human evolution

**3.1** Theories of human evolution are based on the similarities between humans and African apes and also on the anatomical differences between them.

3.1.1 State TWO characteristics related to vision that humans share with African apes.

3.1.2 Describe TWO differences between the jaws of humans and African apes.

3.1.3 Explain the significance of the position of the foramen magnum, the shape of the spine and the size of the pelvis in bipedalism.

Common misconceptions & Errors

# SECTION B – Human evolution

3.1

Theories of human evolution are based on the similarities between humans and African apes and also on the anatomical differences between them.

3.1.1 State TWO characteristics related to vision that humans share with African apes.

- Eyes in front✓
- Binocular vision✓
- Stereoscopic vision✓
- Colour vision✓/ presence of cones

(first 2 only)

3.1.2 Describe TWO differences between the jaws of humans and African apes.

- Smaller jaws in humans✓ ; larger jaws in African apes✓
- Smaller teeth/canines in humans✓ ; larger teeth/canines in African apes✓
- C-shaped palate in humans✓ ; U-shaped palate in African apes✓
- Humans are non-prognathous✓ ; African apes are prognathous✓
- Humans do not have diastema✓ ; African apes have diastema✓
- Well-developed chin in humans✓ ; underdeveloped chin in African apes✓

(any 2 x 2 ; first 2 only)

3.1.3 Explain the significance of the position of the foramen magnum, the shape of the spine and the size of the pelvis in bipedalism.

- The foramen magnum is in a more forward position✓  
to allow the vertebral column to attach below it✓
- The spine is S-shaped✓  
for better distribution of upper body weight✓/ to absorb shock when walking upright / to allow flexibility
- The pelvis is short and wide✓  
to support the weight above the pelvis✓/ upper body

(6)

## Common misconceptions & Errors

3.1.3 Candidates failed to explain the significance of an S-shaped spine for bipedalism. If a reason was provided, it was incorrectly stated, e.g. 'the S-shaped spine allows an upright posture'✗ instead of 'better distribution of body weight/to absorb shock/allow flexibility'✓.

Incomplete descriptions were given, e.g.

- foramen magnum in 'a forward position'✗ vs 'a **more forward** position'✓
- 'a short and narrow pelvis'✗ vs 'short and **wide** pelvis'✓

# SECTION B – Human evolution (Hominids)

3.2 The table below shows the average brain volume of different hominid species.

SPECIES	AVERAGE BRAIN VOLUME (mℓ)
<i>Ardipithecus ramidus</i>	350
<i>Australopithecus africanus</i>	461
<i>Homo habilis</i>	609
<i>Homo erectus</i>	959
<i>Homo sapiens</i>	1 330

- 3.2.1 How many genera are represented in the table?
- 3.2.2 Give TWO examples of fossils of *Australopithecus africanus* found in South Africa.
- 3.2.3 Give the average brain volume (mℓ) of the species that was the first to use tools.
- 3.2.4 Calculate the percentage increase in the average brain volume between *Homo habilis* and *Homo sapiens*. Show ALL working and round off the answer to TWO decimal places.

## Common misconceptions & Errors

# SECTION B – Human evolution (Hominids)

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<i>Homo sapiens</i>	1 330

3.2.1 How many genera are represented in the table? 3/three✓ (1)

3.2.2 Give TWO examples of fossils of *Australopithecus africanus* found in South Africa.

- Taung child✓
- Mrs Ples✓
- Little foot✓

(first 2 only)

3.2.3 Give the average brain volume (ml) of the species that was the first to use tools.

609✓ m

(1)

3.2.4 Calculate the percentage increase in the average brain volume between *Homo habilis* and *Homo sapiens*. Show ALL working and round off the answer to TWO decimal places.

$$\left( \frac{3552 - 609}{609} \right) \times 100 = 582.28\%$$

(3)

## Common misconceptions & Errors

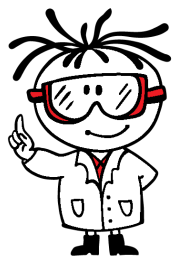
3.2.2 Candidates lost marks for writing:

- 'Miss Ples'× instead of 'Mrs Ples'✓
- only 'Taung'× instead of 'Taung child'✓

3.2.4 Candidates were unable to calculate the percentage increase. Some incorrectly stated 'x 100%'× instead of 'x 100'✓. Many did not round off to TWO decimal places as requested.

## NOTE

Calculations for Life Sciences were thoroughly revised on slide 128 of the [2023 Paper 1 Diagnostic Report Teaching & Learning Tool](#).



# SECTION B – Human evolution (Hominids)

**3.2** The table below shows the average brain volume of different hominid species.

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3.2.5 The brain decomposes after the organism dies. Explain how scientists are able to determine the brain volume of fossils.

3.2.6 Explain the relationship between average brain volume and cultural evidence for human evolution.

## Common misconceptions & Errors

# SECTION B – Human evolution (Hominids)

3.2

The table below shows the average brain volume of different hominid species.

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3.2.5 The brain decomposes after the organism dies. Explain how scientists are able to determine the brain volume of fossils.

- The cranium remains ✓ / becomes fossilised
- The cranium houses the brain ✓, therefore
- measuring the cranial capacity ✓ gives the brain volume

(3)

3.2.6 Explain the relationship between average brain volume and cultural evidence for human evolution.

- The brain volume increased ✓
- leading to more intelligence ✓ and
- the development of (complex) tools ✓

(3)

## Common misconceptions & Errors

3.2.5 Candidates referred to the 'skull' ✗ instead of the 'cranium' ✓, failing to link cranial capacity to brain volume.

Many responses simply stated 'measure the cranium' without explaining how this relates to determine brain volume. They also failed to mention that the cranium houses the brain in their explanation.

3.2.6 Candidates simply referred to 'intelligence' ✗ without explaining that 'increased brain volume' results in 'greater intelligence' ✓ and, instead, linked it to advanced tool usage, language development or complex social behaviour.

# SECTION B – Biogeography

3.3

The extract and diagram are based on ratites.

3.3.1 The ratites shown in the map are classified as different biological species.

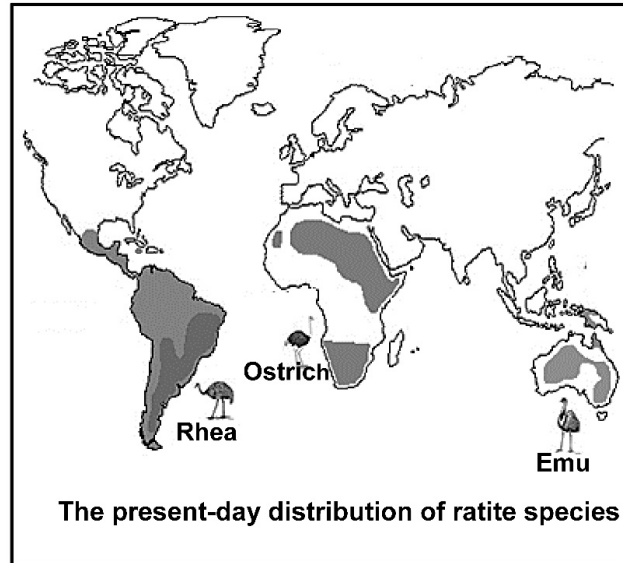
(a) State what is meant by a *biological species*.

(b) Using the information in the extract, explain why the ostrich and emu are considered different species.

(c) Name TWO other reproductive isolation mechanisms that would have prevented the rhea and ostrich from interbreeding if they were in the same habitat.

## BREEDING MONTHS IN RATITES

Ratites are egg-laying flightless birds. The egg-laying months are influenced by many factors such as the temperature, length of the day and availability of food. Ostriches normally lay their eggs in September, rheas between October and March, while emus lay their eggs from November to April.



## Common misconceptions & Errors

# SECTION B – Biogeography

3.3

The extract and diagram are based on ratites.

3.3.1 The ratites shown in the map are classified as different biological species.

(a) State what is meant by a *biological species*.

- A group of organisms with similar characteristics ✓
- that can interbreed and produce fertile offspring ✓

(2)

(b) Using the information in the extract, explain why the ostrich and emu are considered different species.

- They breed at different times of the year ✓ / ostriches lay their eggs mainly in September while emus lay their eggs from November to April
- Therefore, they cannot interbreed ✓

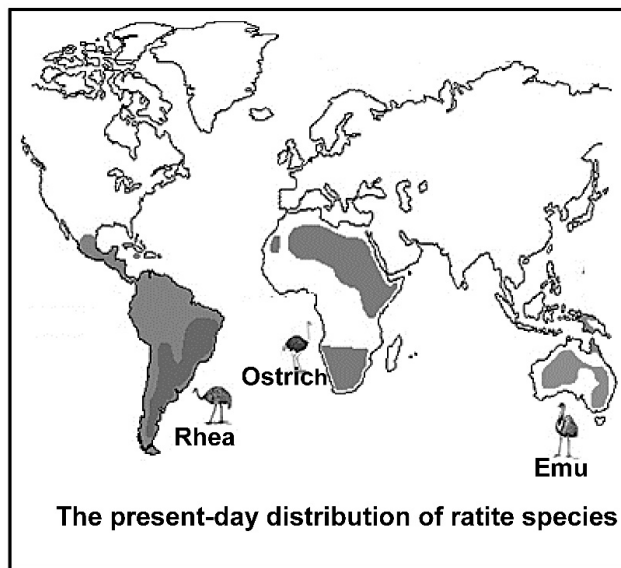
(c) Name TWO other reproductive isolation mechanisms that would have prevented the rhea and ostrich from interbreeding if they were in the same habitat.

- Species-specific courtship behaviour ✓
- Infertile offspring ✓
- Prevention of fertilisation ✓

(first 2 only)

## BREEDING MONTHS IN RATITES

Ratites are egg-laying flightless birds. The egg-laying months are influenced by many factors such as the temperature, length of the day and availability of food. Ostriches normally lay their eggs in September, rheas between October and March, while emus lay their eggs from November to April.



(2)

## Common misconceptions & Errors

3.3.1 (a) Candidates:

- confused 'biological species' with definition for 'population'
- wrote a 'group of species × that can interbreed...'
- wrote 'viable offspring' × instead of 'fertile offspring' ✓

## TERMS

**viable:** capable of surviving or living successfully  
**fertile:** able to conceive young or produce seed



3.3.1 (b) Candidates gave the first part of the answer but omitted the second, i.e. organisms cannot interbreed.

# SECTION B – Biogeography

3.3

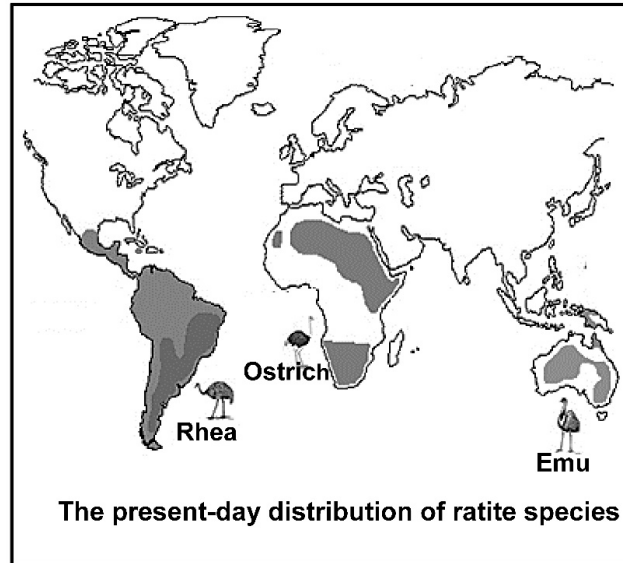
The extract and diagram are based on ratites.

3.3.2 Identify the evidence for evolution represented in the diagram.

3.3.3 Describe how the evidence identified in QUESTION 3.3.2 supports the theory of evolution.

## BREEDING MONTHS IN RATITES

Ratites are egg-laying flightless birds. The egg-laying months are influenced by many factors such as the temperature, length of the day and availability of food. Ostriches normally lay their eggs in September, rheas between October and March, while emus lay their eggs from November to April.



## Common misconceptions & Errors

# SECTION B – Biogeography

3.3

The extract and diagram are based on ratites.

3.3.2 Identify the evidence for evolution represented in the diagram.

Biogeography ✓

(1)

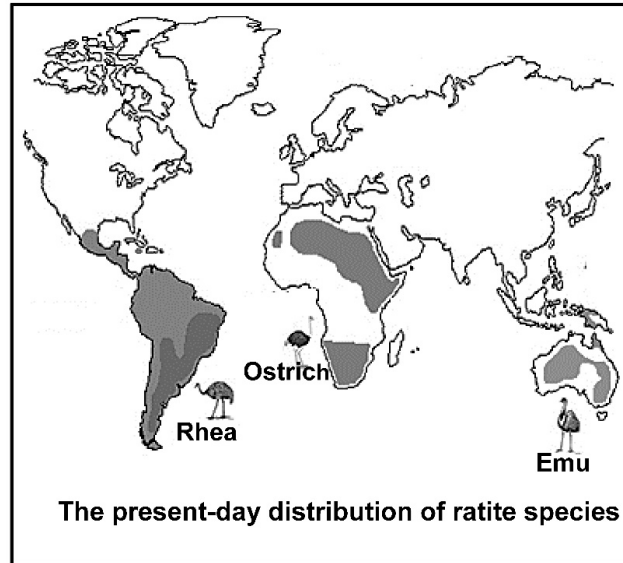
3.3.3 Describe how the evidence identified in QUESTION 3.3.2 supports the theory of evolution.

- The ratites all had one common ancestor ✓
- When continental drift ✓ occurred
- the (population of) ratites was separated ✓
- The sub-populations were faced with different environmental conditions ✓ and
- underwent natural selection independently ✓
- to form different species ✓

(any 5)

## BREEDING MONTHS IN RATITES

Ratites are egg-laying flightless birds. The egg-laying months are influenced by many factors such as the temperature, length of the day and availability of food. Ostriches normally lay their eggs in September, rheas between October and March, while emus lay their eggs from November to April.



## REMEMBER

In biogeography a common ancestor population becomes separated generally due to continental drift and this further leads to speciation.

## Common misconceptions & Errors

3.3.3 Candidates **did not link biogeography to speciation**, even though **the two concepts must be explained together**.

Responses failed to mention that **continental drift separates original populations**.

Most gave a **general description of speciation** – **unable to apply knowledge to the example** provided in the question.



# SECTION B – Scientific Investigation (Natural Selection)

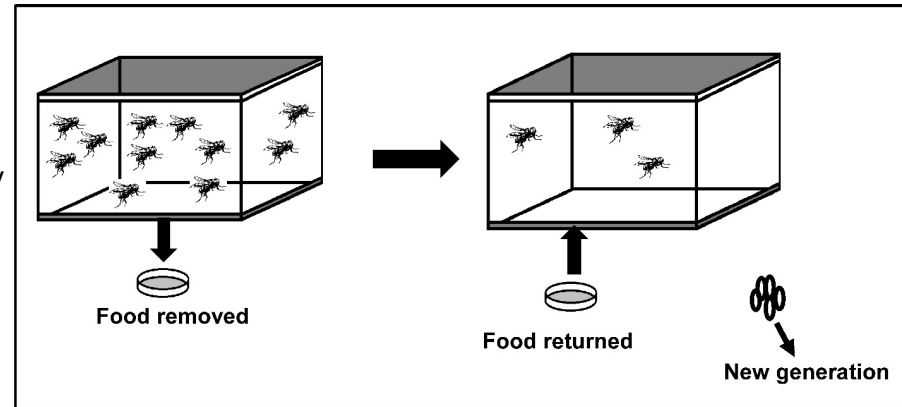
3.3

Starvation resistance refers to the period for which an organism can go without food before it dies.

An investigation was conducted to determine the effect of the availability of food on the starvation resistance in fruit flies.

The procedure was as follows:

- 5 000 fruit flies of the same age were used.
- They were all placed in a container suitable for the growth of fruit flies and were given a maltose-based food source.
- The food source was removed after an hour.
- The time it took for 80% of the fruit flies to die from starvation was recorded.
- The dead fruit flies were removed from the container.
- The food source was then returned to the container.
- The remaining fruit flies were allowed to interbreed.
- Their eggs were collected and transferred to a new container with a food source where they were allowed to hatch.
- These fruit flies were allowed to grow to the same age as the 1st generation.
- The food source was then removed again.
- The time it took for 80% of the fruit flies to die from starvation was recorded again.
- This procedure was repeated until the 60th generation of fruit flies was reached.



## Common misconceptions & Errors

# SECTION B – Scientific Investigation (Natural Selection)

**3.3** An investigation was conducted to determine the effect of the availability of food on the starvation resistance in fruit flies.

The procedure was as follows:

Shortened procedure

- 5 000 fruit flies of the same age
- all placed in a container suitable for growth and given a maltose-based food source
- food source removed after an hour
- time it took for 80% of the fruit flies to die from starvation recorded
- dead fruit flies were removed
- food source then returned to the container
- remaining fruit flies allowed to interbreed
- eggs were collected; transferred to new container with food and allowed to hatch
- fruit flies allowed to grow to the same age as the 1st generation
- food source removed again
- time it took for 80% of the fruit flies to die from starvation recorded again
- procedure was repeated until 60th generation reached

3.4.1 State the independent variable for this investigation.

3.4.2 Describe how the dependent variable was measured.

Common misconceptions & Errors

# SECTION B – Scientific Investigation (Natural Selection)

3.3 An investigation was conducted to determine the effect of the **availability of food** on the **starvation resistance** in fruit flies.

The procedure was as follows:

Shortened procedure

- 5 000 fruit flies of the same age
- all placed in a container suitable for growth and given a maltose-based food source
- food source removed after an hour
- **time it took for 80% of the fruit flies to die from starvation recorded**
- dead fruit flies were removed
- food source then returned to the container
- remaining fruit flies allowed to interbreed
- eggs were collected; transferred to new container with food and allowed to hatch
- fruit flies allowed to grow to the same age as the 1st generation
- food source removed again
- time it took for 80% of the fruit flies to die from starvation recorded again
- procedure was repeated until 60th generation reached

3.4.1 State the **independent variable** for this investigation.

Availability of food ✓ (1)

3.4.2 Describe how the **dependent variable** **was measured**.

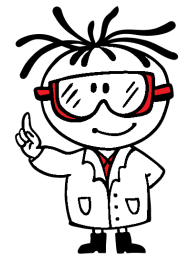
They measure the time it took for 80% of the flies to die from starvation ✓ (1)

## Common misconceptions & Errors

3.4.1 Candidates **lost a mark for** writing **'the effect of food availability'**.

### NOTE

Watch out for 'effect of' as this indirectly refers to the dependent variable!



3.4.2 Candidates only wrote **'time taken for flies to die'x** and **omitted the '80%'**.

# SECTION B – Scientific Investigation (Natural Selection)

**3.3** An investigation was conducted to determine the effect of the availability of food on the starvation resistance in fruit flies.

The procedure was as follows:

Shortened procedure

- 5 000 fruit flies of the same age
- all placed in a container suitable for growth and given a maltose-based food source
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- eggs were collected; transferred to new container with food and allowed to hatch
- fruit flies allowed to grow to the same age as the 1st generation
- food source removed again
- time it took for 80% of the fruit flies to die from starvation recorded again
- procedure was repeated until 60th generation reached

3.4.3 State ONE controlled variable that was considered when selecting the fruit flies at the beginning of the investigation.

Common misconceptions & Errors

# SECTION B – Scientific Investigation (Natural Selection)

3.3

An investigation was conducted to determine the effect of the availability of food on the starvation resistance in fruit flies.

The procedure was as follows:

- 5 000 fruit flies of the same age
- all placed in a container suitable for growth and given a maltose-based food source
- food source removed after an hour
- time it took for 80% of the fruit flies to die from starvation recorded
- dead fruit flies were removed
- food source then returned to the container
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- eggs were collected; transferred to new container with food and allowed to hatch
- fruit flies allowed to grow to the same age as the 1st generation
- food source removed again
- time it took for 80% of the fruit flies to die from starvation recorded again
- procedure was repeated until 60th generation reached

Shortened procedure

Common misconceptions & Errors

NOTE

Even though other controlled variables included the same container/environment and the same type of food source, the question specifically asked for a controlled variable that related to selecting the fruit flies. Therefore, only 'the same age' was accepted.



3.4.3 State ONE controlled variable that was considered when selecting the fruit flies at the beginning of the investigation.

Age ✓

(1)

# SECTION B – Scientific Investigation (Natural Selection)

**3.3** An investigation was conducted to determine the effect of the availability of food on the starvation resistance in fruit flies.

The procedure was as follows:

Shortened procedure

- 5 000 fruit flies of the same age
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- procedure was repeated until 60th generation reached

3.4.4 Explain why the investigator gave the fruit flies the same type of food throughout the investigation.

Common misconceptions & Errors

# SECTION B – Scientific Investigation (Natural Selection)

**3.3** An investigation was conducted to determine the effect of the availability of food on the starvation resistance in fruit flies.

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- fruit flies allowed to grow to the same age as the 1st generation
- food source removed again
- time it took for 80% of the fruit flies to die from starvation recorded again
- procedure was repeated until 60th generation reached

**3.4.4** Explain why the investigator gave the fruit flies the same type of food throughout the investigation.

- To improve the validity✓ of the investigation
- by ensuring that the availability of food is the only independent variable✓
- so that any changes that occur are only due to the availability of food✓ (any 2)

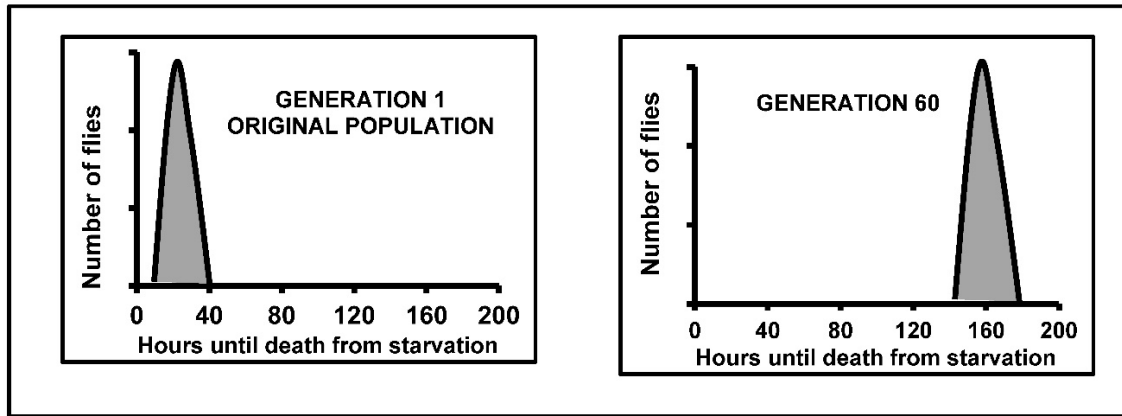
## Common misconceptions & Errors

3.4.4 Candidates mentioned both validity and reliability in their answer. This indicates their inability to differentiate between the two concepts. They could not explain why the investigation was valid.

# SECTION B – Scientific Investigation (Natural Selection)

3.3

The graphs below show the results obtained for the 1st generation and the 60th generation.



3.4.5 Describe the results obtained in this investigation.

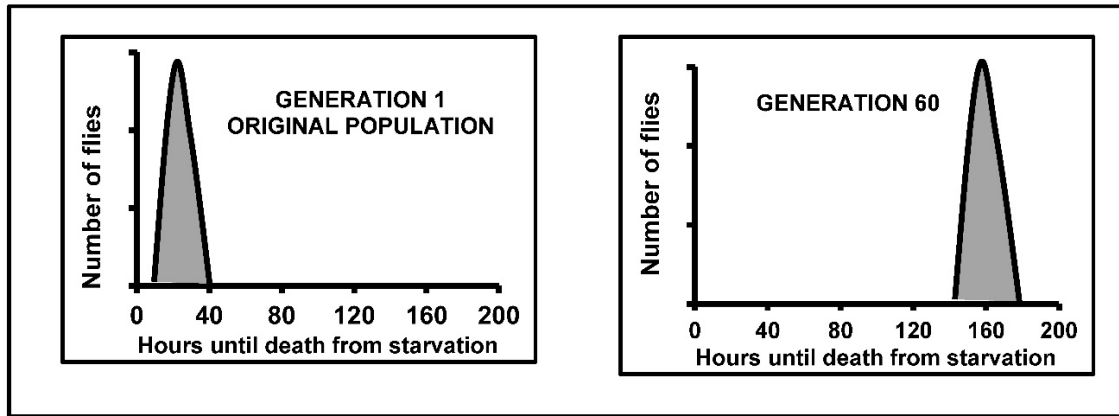
3.4.6 Using Darwin's theory of natural selection, explain the increase in starvation resistance in fruit flies.

Common misconceptions & Errors

# SECTION B – Scientific Investigation (Natural Selection)

3.3

The graphs below show the results obtained for the 1st generation and the 60th generation.



3.4.5 Describe the results obtained in this investigation.

- The hours until death in the 1st generation was shorter✓ / between 8 and 40 hours
- The hours until death in the 60th generation was longer✓ / between 140 and 180 hours (2)

3.4.6 Using Darwin's theory of natural selection, explain the increase in starvation resistance in fruit flies.

- There was variation in the population of fruit flies✓
- some were starvation resistant while some were not starvation resistant✓
- When the food source was removed✓
- the fruit flies that were not starvation resistant died✓
- those that were starvation resistant survived and reproduced✓
- and passed on the allele for starvation resistance to their offspring✓
- The next generation had a higher proportion of fruit flies that were starvation resistant✓

(any 6)

## Common misconceptions & Errors

3.4.5 Candidates:

- answered the question in terms of 'starvation resistance' rather than the 'time until death', thus stating a conclusion rather than describing the results
- used the incorrect range to indicate hours until death for each generation

3.4.6 Candidates provided a generic account of Darwin's theory and did not apply it to the scenario given.



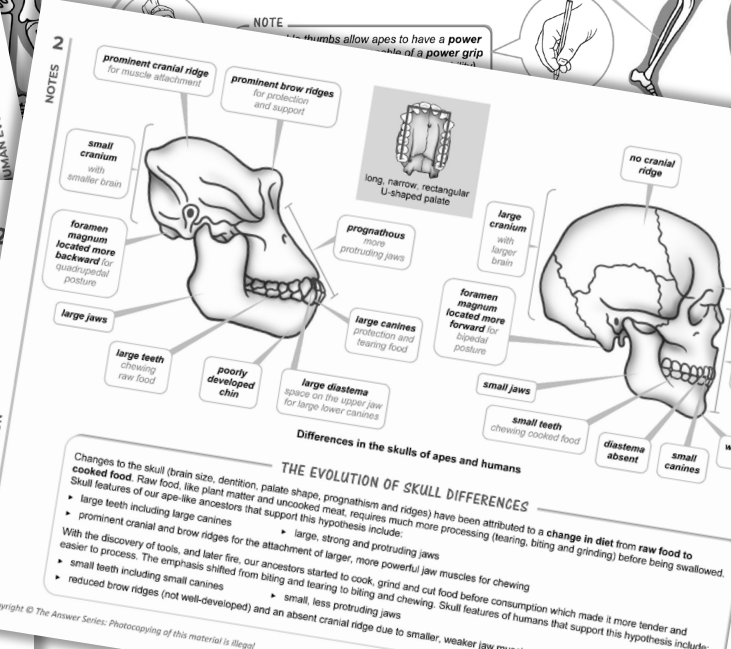
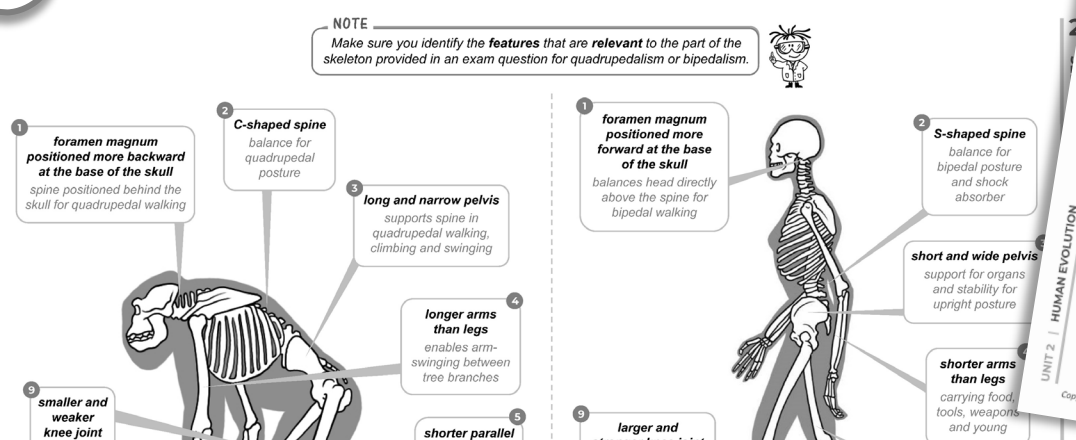
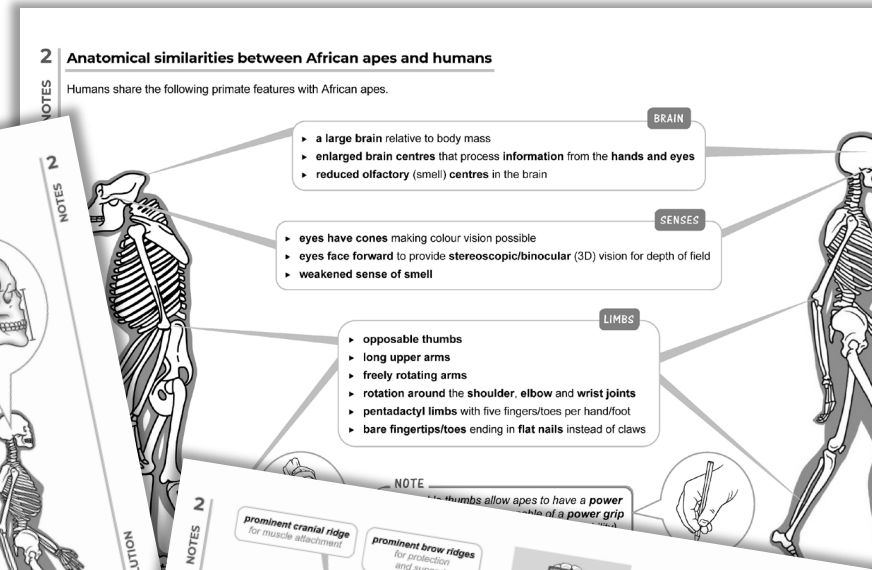
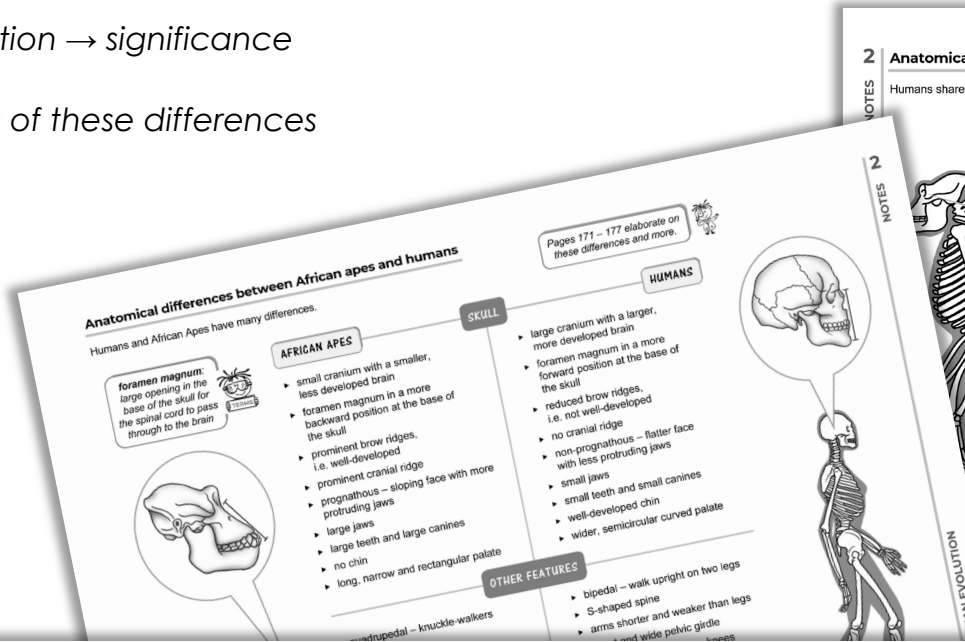
Let's revise this

# SECTION B QUESTION 3 – Suggestions for improvement

☑ Use **comparative diagrams** of primate vs human skulls/spines, to show structural differences:

- Teach learners to link feature → function → significance
- This will enhance their understanding of these differences
- focus on the anatomical differences between the African apes and humans with the aid of diagrams

The newly revised [Gr 12 Life Sciences Part 2](#) offers many useful one-pager summaries with diagram to highlight these differences and their significance.



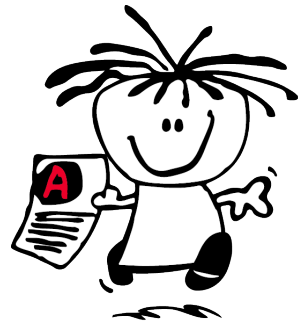
## SECTION B QUESTION 3 – Suggestions for improvement

- ☑ Expose learners to numerous **case studies and real-world examples** when teaching **speciation** and **natural selection**.
  
- ☑ See **2021 NSC NOVEMBER PAPER 2 QUESTION 3.2** for a **similar question on Biogeography and speciation**.
  - *The use of previous examination papers as daily activities/assessment tasks can expose learners to questions based on difficult content.*
  - *This will give them the opportunity to apply their knowledge and, in so doing, prepare them for the final examination.*
  
- ☑ Place more **emphasis on scientific investigations** and their design.



Let's revise this

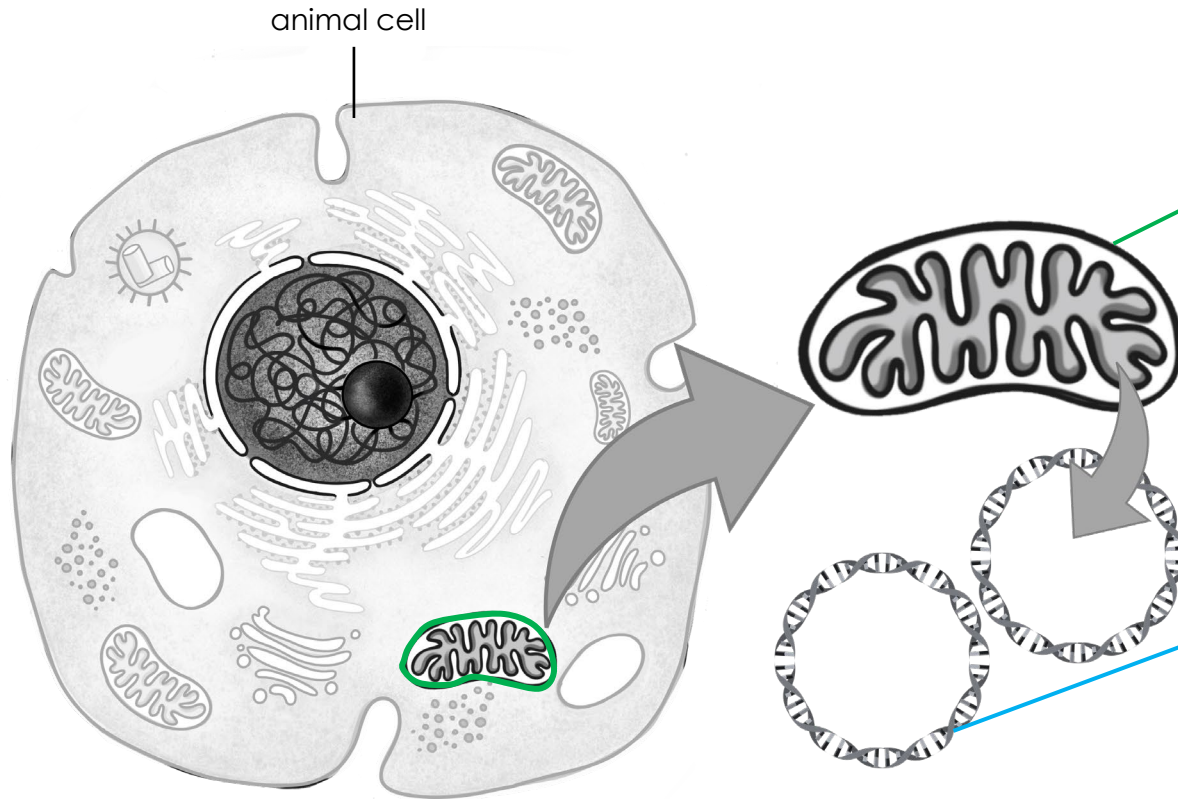
END



THE  
**ANSWER**  
SERIES *Your Key to Exam Success*

# COMMONLY CONFUSED TERMS – mitochondria vs mitochondrial DNA

Extract from *The Answer Series*  
Grade 12 Life Sciences Part 2  
(2024 ed.) p. 73 & 178



## Mitochondria

- ✓ Organelles found in plant and animal cells.
- ✓ Responsible for performing cellular respiration to produce energy (ATP).
- ✓ Contains its own DNA called mitochondrial DNA (mtDNA).

## Mitochondrial DNA (mtDNA)

- ✓ A short, circular segment of DNA that only occurs in the mitochondria.
- ✓ Mitochondrial DNA:
  - is not related to chromosomal DNA in the nucleus
  - Is inherited from the mother only
  - Carries genes that code for enzymes involved in cellular respiration

↩ 'ial' means 'belonging to'

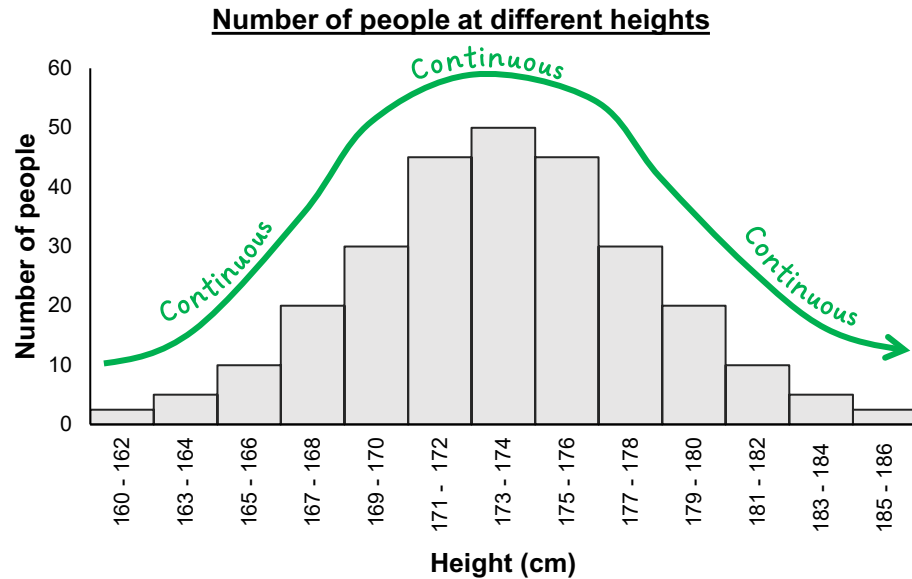


Continue learning – continuous vs discontinuous variation



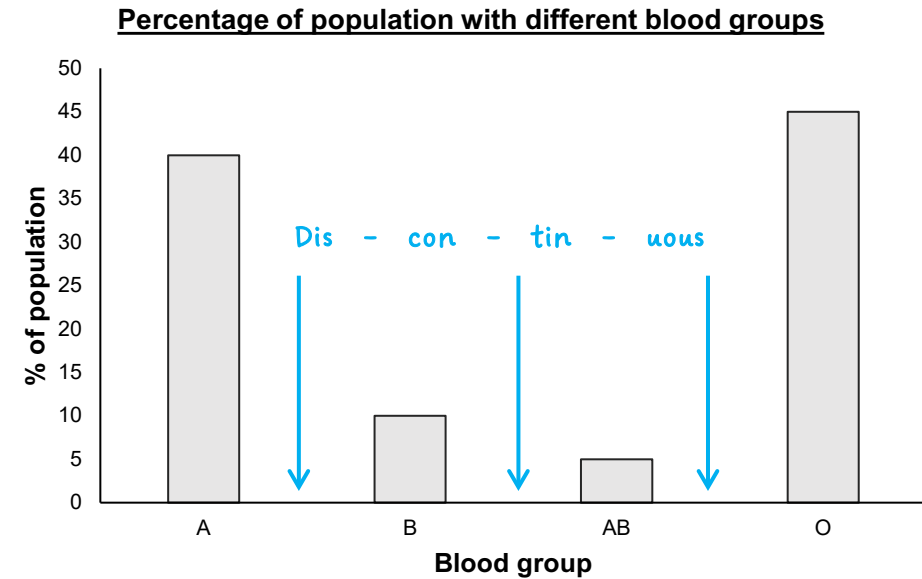
THE  
**ANSWER**  
SERIES Your Key to Exam Success

# COMMONLY CONFUSED TERMS – continuous vs discontinuous variation



## Continuous variation

- ✓ A type of variation that has **a range of phenotypes** for the **same characteristic** – a **continuous spectrum** from **one extreme to another**.
- ✓ Often appears as a **histogram with no gaps** between the bars **OR** a **line graph with a continuous line of points**.



↩ 'Dis-' means 'not'

## Discontinuous variation

- ✓ A type of variation where **phenotypes fit into distinct categories/groups** with **no intermediate forms**.
- ✓ Often appears as a **bar graph with gaps** between the bars.

Extract from *The Answer Series*  
Grade 12 Life Sciences Part 2  
(2024 ed.) p. 144 & 145

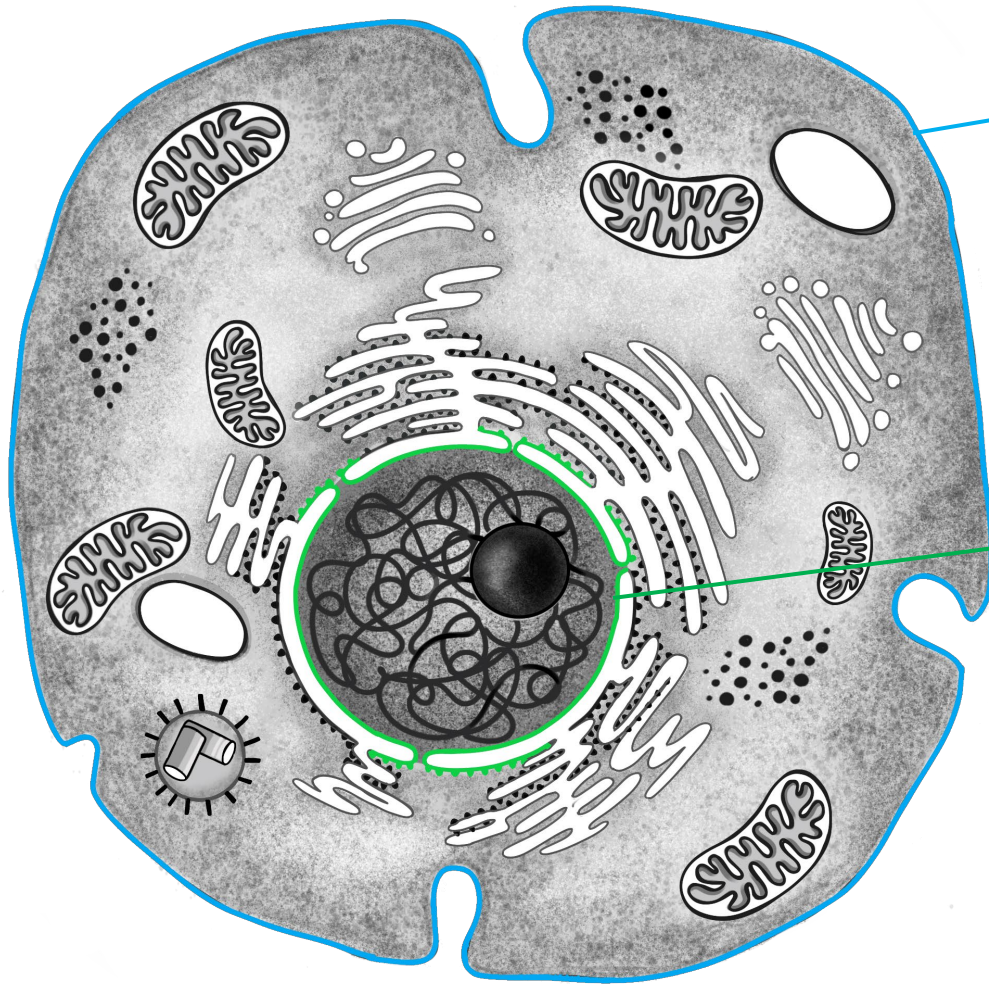


Continue learning – cell membrane vs nuclear membrane



# COMMONLY CONFUSED TERMS – cell membrane vs nuclear membrane

Extract from *The Answer Series*  
Grade 12 Life Sciences Part 2  
(2024 ed.) p. 2



## Cell membrane

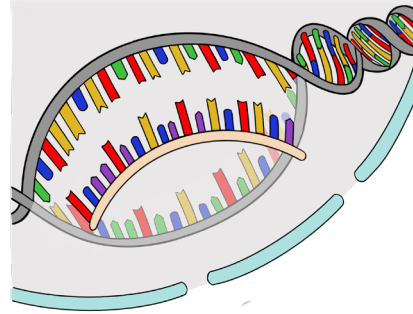
- ✓ Membrane **surrounding** the **cell** and all its contents.
- ✓ **NEVER** disappears.

## Nuclear membrane

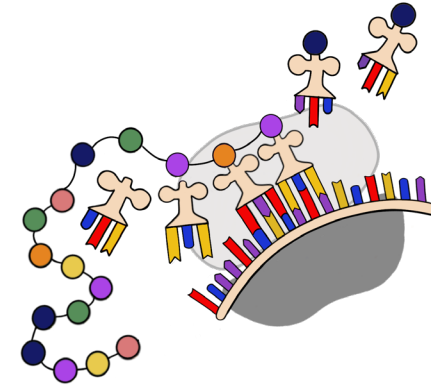
- ✓ Membrane **surrounding** the **nucleus** and its DNA content.
- ✓ **Disappears** during **Prophase** of cell division, i.e. **Mitosis** and **Meiosis**.



# COMMONLY CONFUSED PROCESSES – transcription vs translation



**Transcription**



**Translation**

<b>What?</b>	DNA sequence (base triplets) → mRNA sequence (codons)	mRNA sequence (codons) → tRNA sequence (anticodons) → amino acid sequence (protein)
<b>When?</b>	Protein synthesis	Protein synthesis
<b>Why?</b>	DNA cannot leave the nucleus mRNA is small enough to leave the nucleus and can carry the protein's code to the ribosome	tRNA carries the amino acids that are required to produce the protein
<b>Hint</b>	<i>Transcription means 'to rewrite' or 'carry over'</i>  <i>Transcribe = <b>codon</b></i>	<i>Translation means 'to change something from one form to another'</i>  <i>Translate = <b>anticodon</b> = <b>amino acid</b></i>

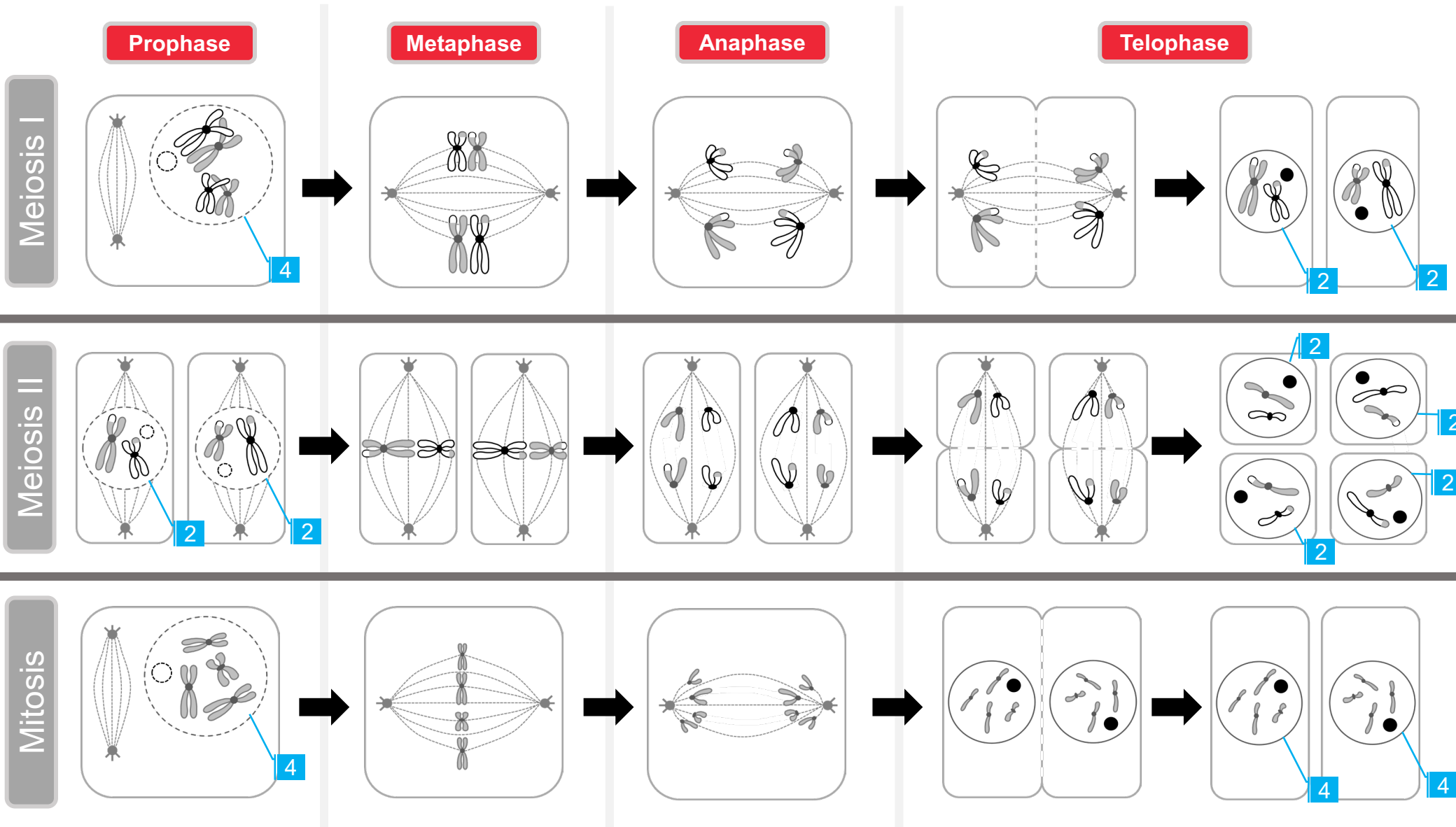
Extract from *The Answer Series* Grade 12  
Life Sciences Part 2 (2024 ed.) p. 16 & 17



Continue learning – Mitosis vs Meiosis I vs Meiosis II



# COMMONLY CONFUSED PROCESSES – Mitosis vs Meiosis I vs Meiosis II



Extract from *The Answer Series*  
Grade 12  
Life Sciences Part 2  
(2024 ed.) p. 38

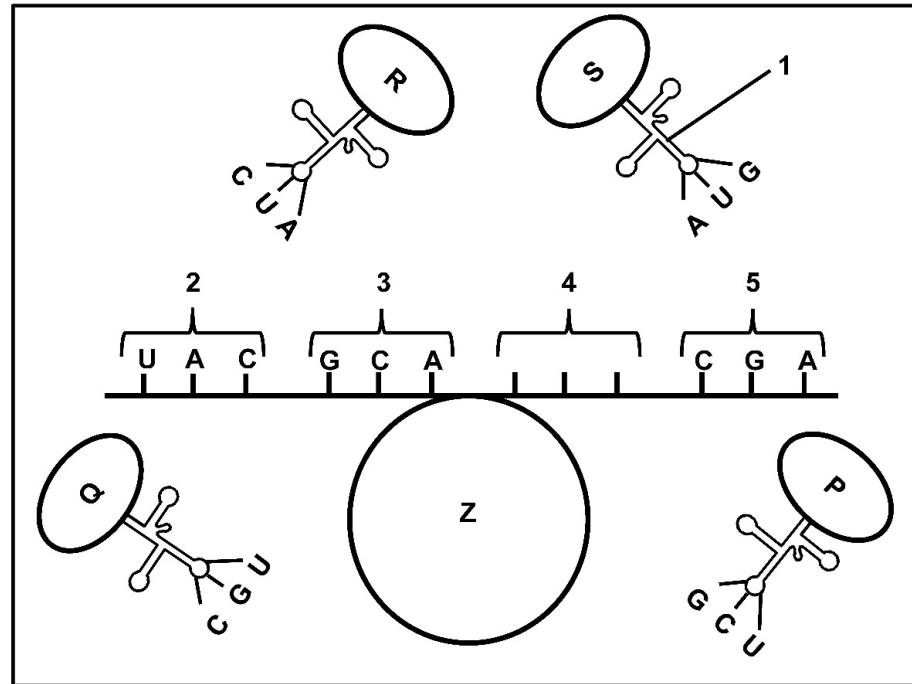
number of chromosomes

Back to Slide 26



# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

The diagram represents a stage of protein synthesis. Each amino acid (**P**, **Q**, **R** and **S**) is coded for by a different codon on this mRNA molecule.

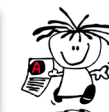


1 Read the question carefully to understand what you are looking at.

State the sequence of nitrogenous bases on the DNA molecule for codons **3** and **4**.



Continue learning



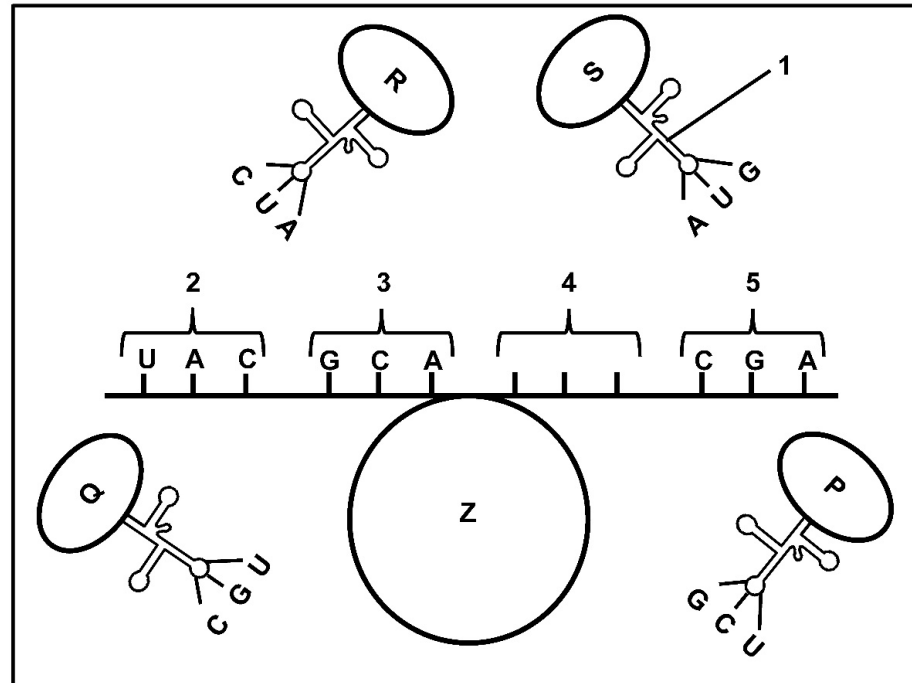
THE  
**ANSWER**  
SERIES Your Key to Exam Success

# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

The diagram represents a stage of protein synthesis. Each amino acid (**P**, **Q**, **R** and **S**) is coded for by a different codon on this mRNA molecule.

DNA and/or RNA may be shown.

State the sequence of nitrogenous bases on the DNA molecule for codons **3** and **4**.



1 Read the question carefully to understand what you are looking at.

 Continue learning

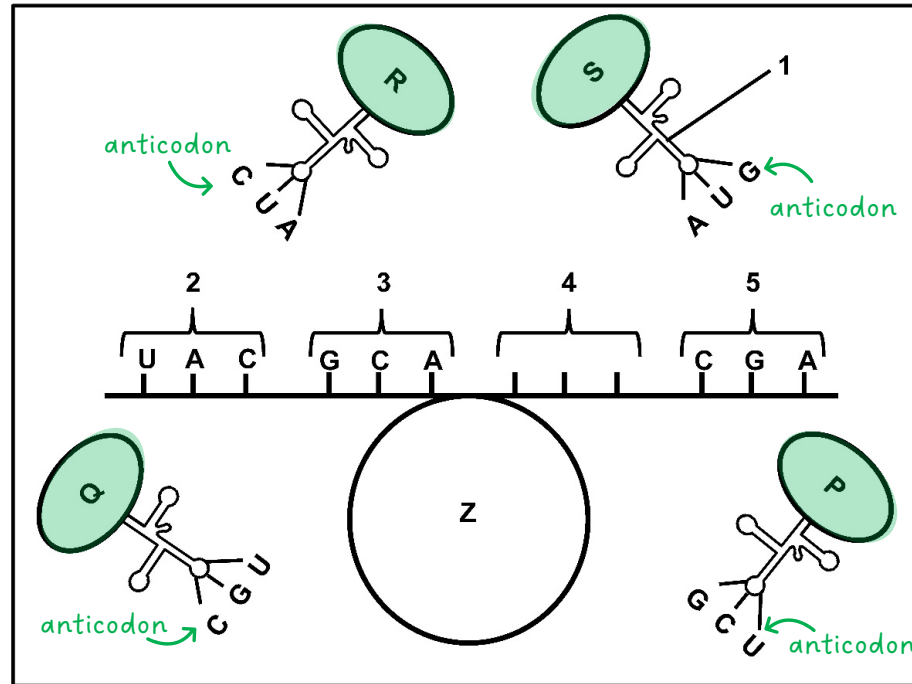
# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

The diagram represents a stage of protein synthesis. Each amino acid (P, Q, R and S) is coded for by a different codon on this mRNA molecule.

DNA and/or RNA may be shown.

Amino acids are attached to tRNA molecules with anticodons.

State the sequence of nitrogenous bases on the DNA molecule for codons 3 and 4.



1 Read the question carefully to understand what you are looking at.

 Continue learning

# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

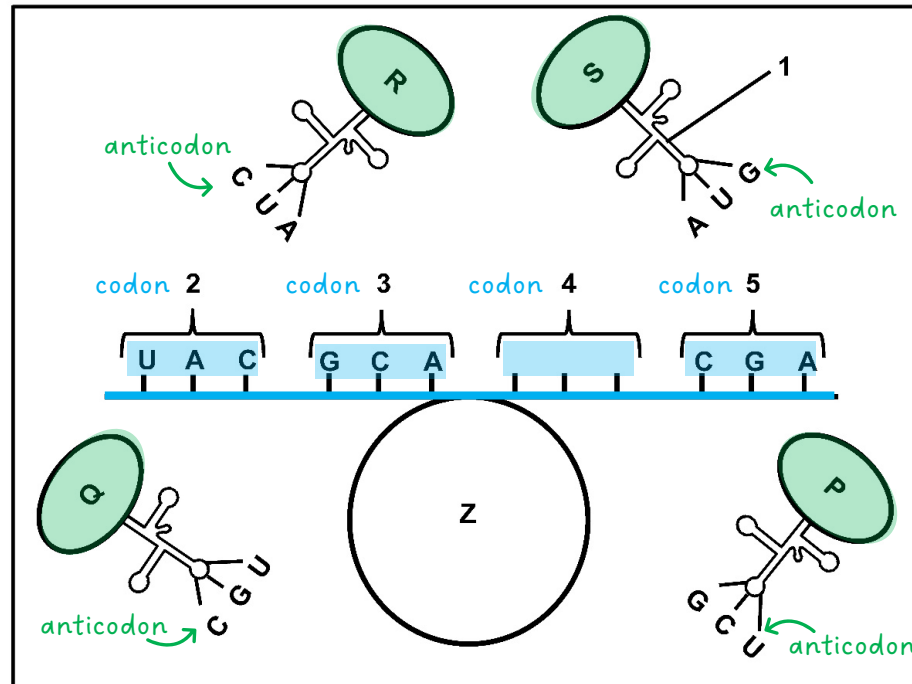
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The straight single strand in the image is an mRNA molecule with codons 2 to 5.

State the sequence of nitrogenous bases on the DNA molecule for codons 3 and 4.



1 Read the question carefully to understand what you are looking at.

 Continue learning

# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

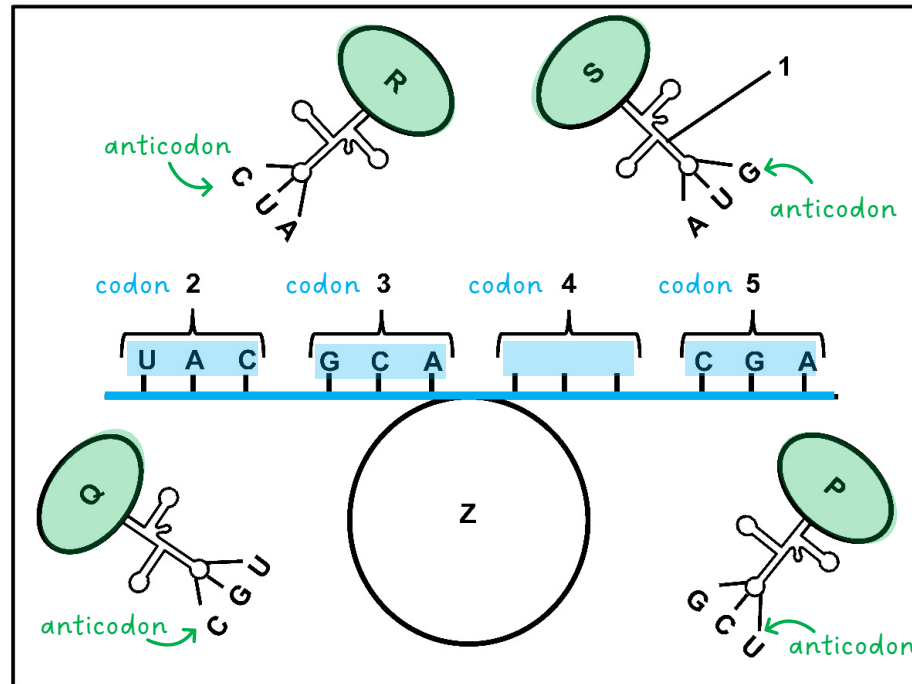
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State the sequence of nitrogenous bases on the DNA molecule for codons 3 and 4.



1 Read the question carefully to understand what you are looking at.

2 To answer the sub-question, write out the sequence of protein synthesis.



▶ Continue learning

# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

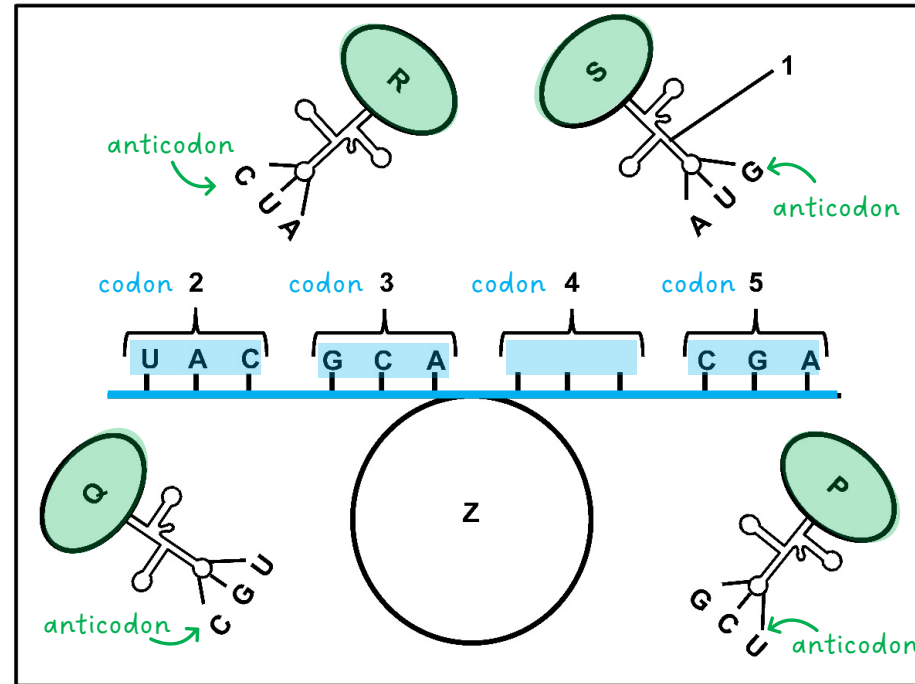
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 Continue learning



# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

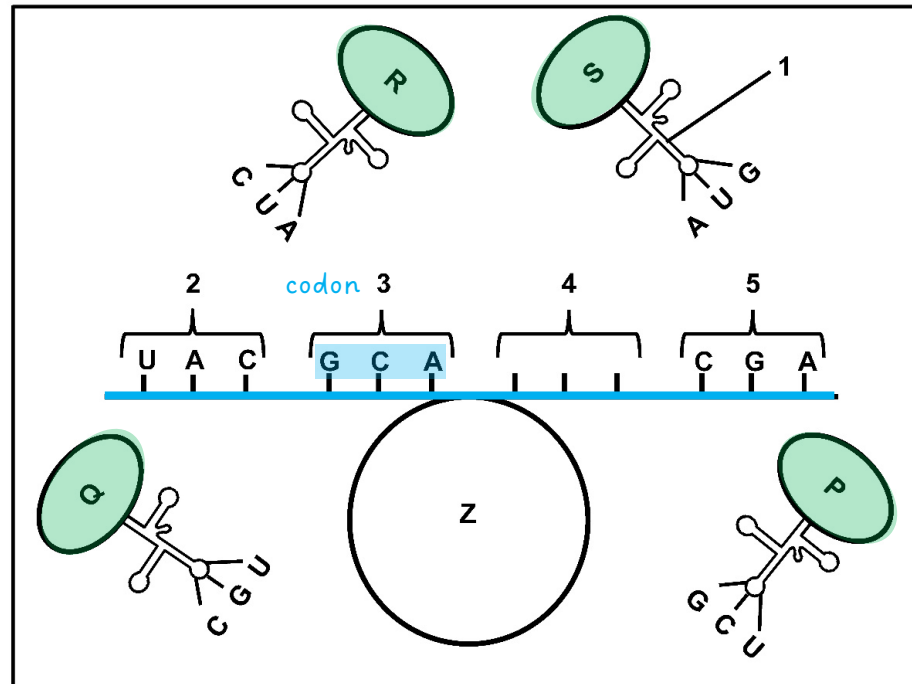
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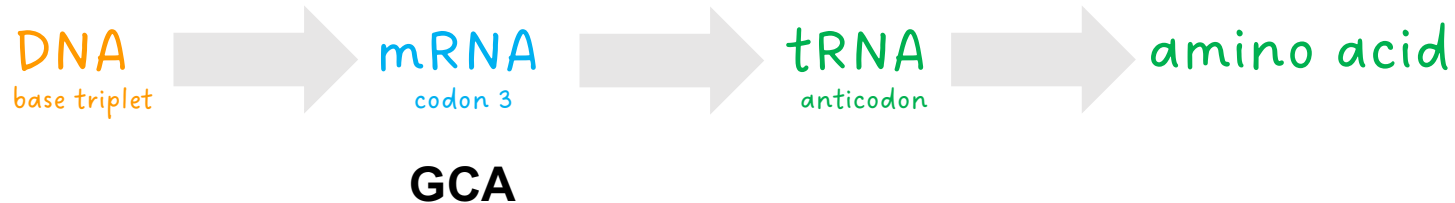
State the sequence of nitrogenous bases on the DNA molecule for codons 3 and 4.



1 Read the question carefully to understand what you are looking at.

2 To answer the sub-question, write out the sequence of protein synthesis.

3 Fill in what you know for CODON 3.



▶ Continue learning

# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

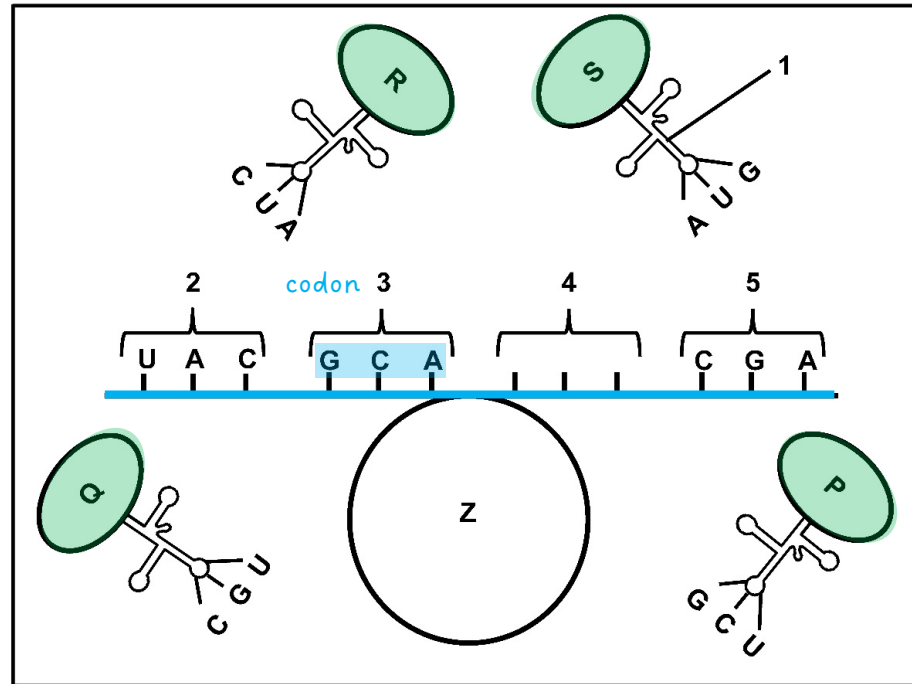
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State the sequence of nitrogenous bases on the DNA molecule for codons 3 and 4.



1 Read the question carefully to understand what you are looking at.

2 To answer the sub-question, write out the sequence of protein synthesis.

3 Fill in what you know for CODON 3.

4 Now work backwards to get the complementary DNA sequence.



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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

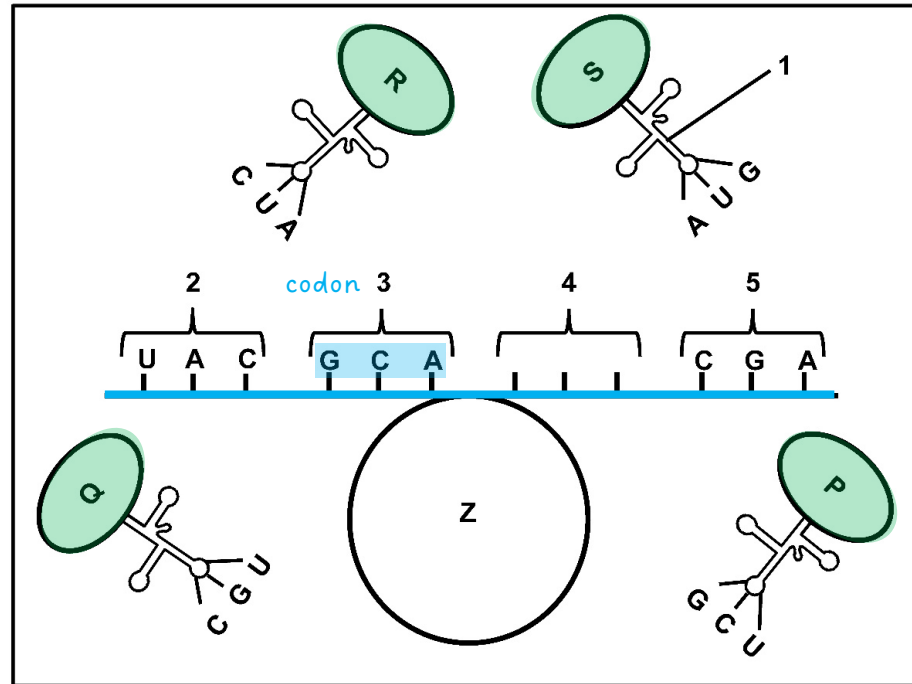
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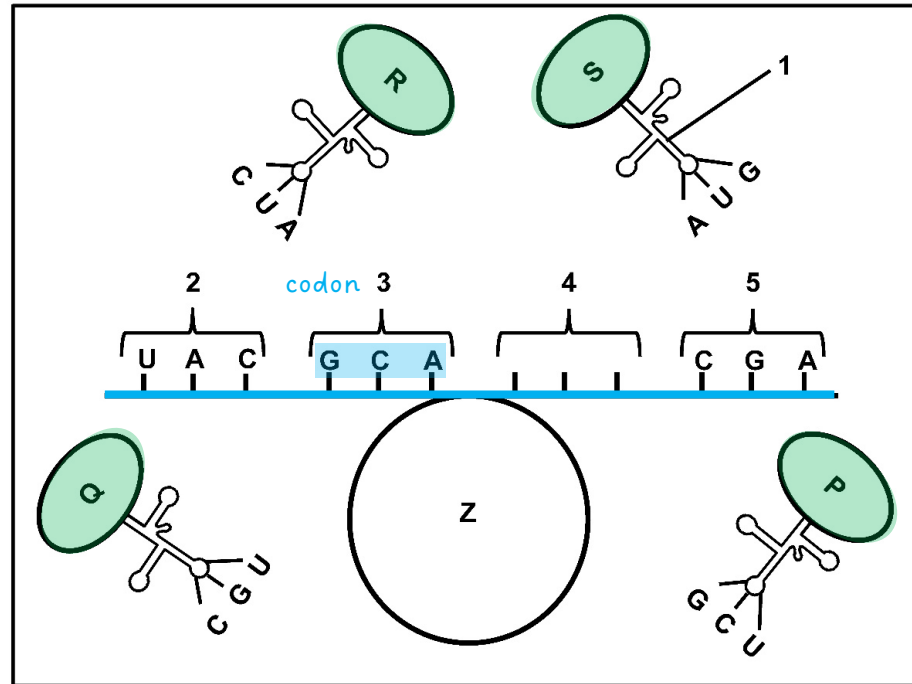
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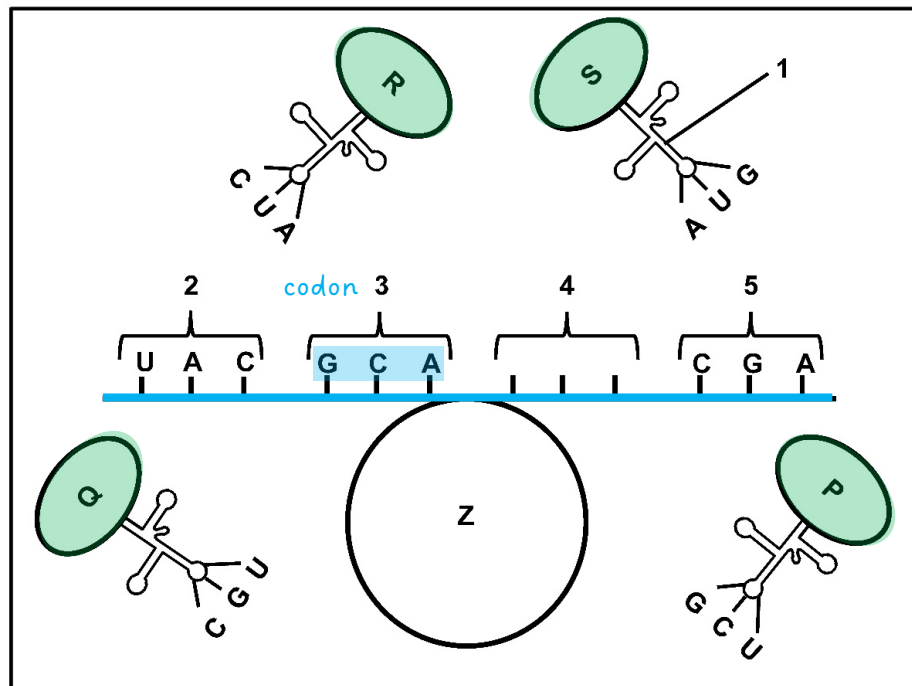
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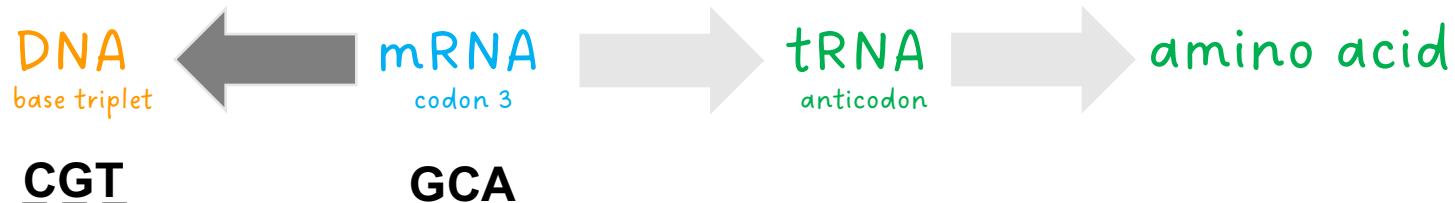


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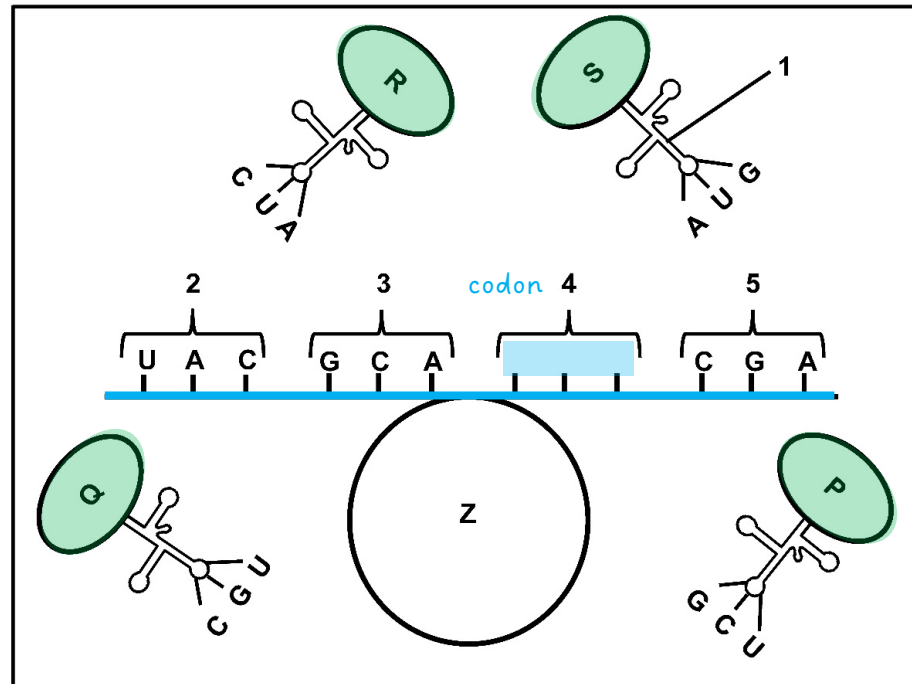
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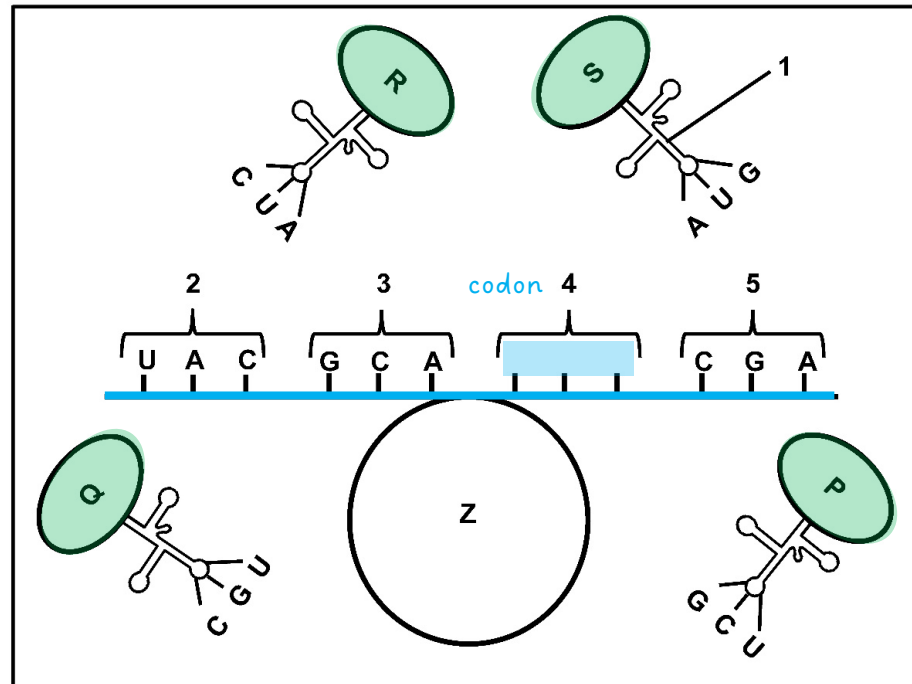
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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

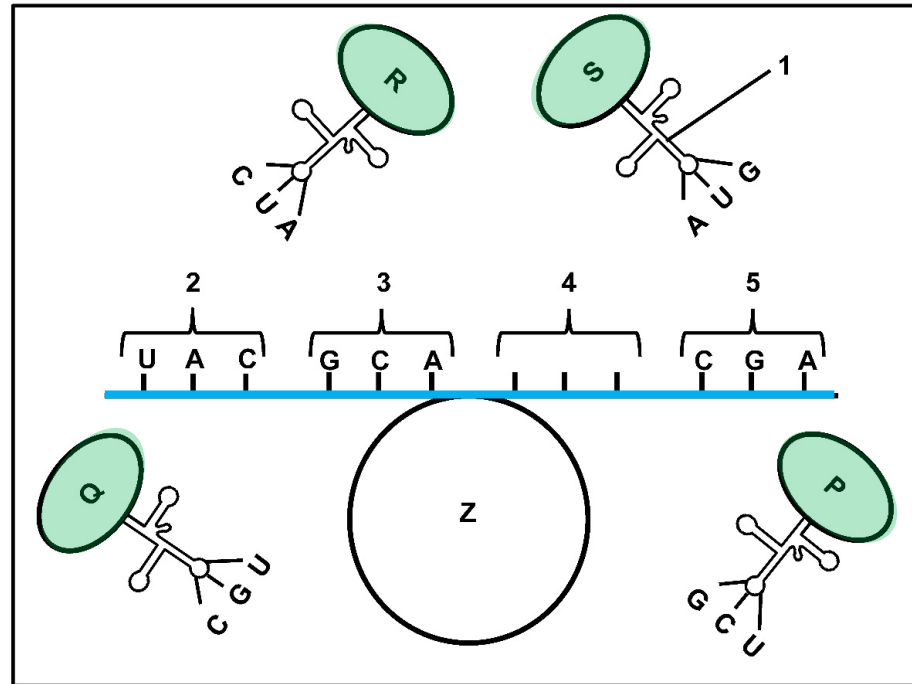
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We have 4 tRNA molecules with their amino acids. Working forwards, we can identify which 3 tRNA molecules already fit on the mRNA strand. First codon 2 ...



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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

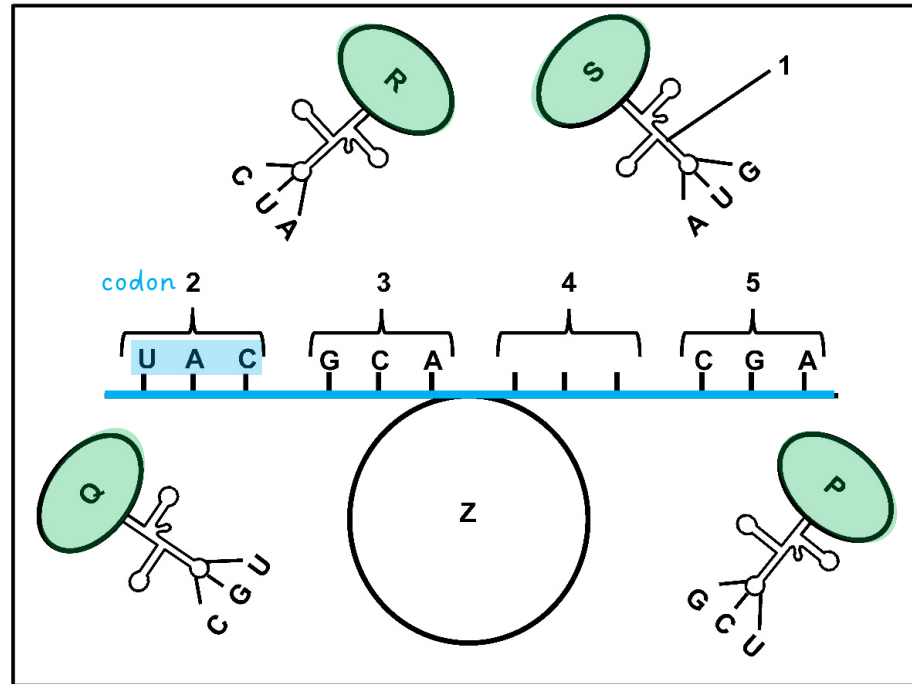
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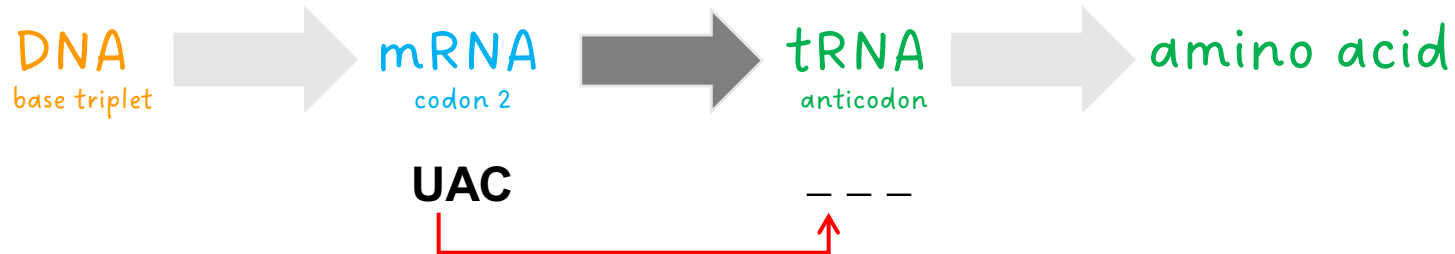
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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

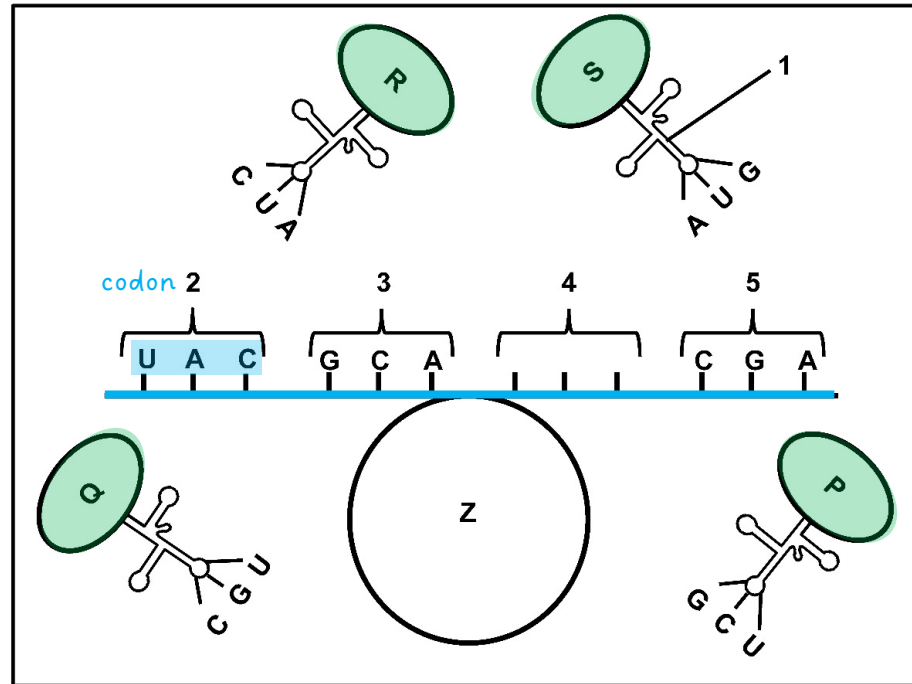
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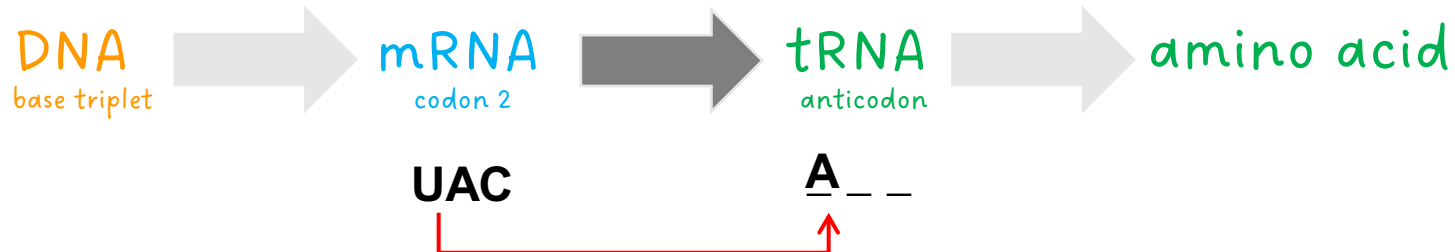
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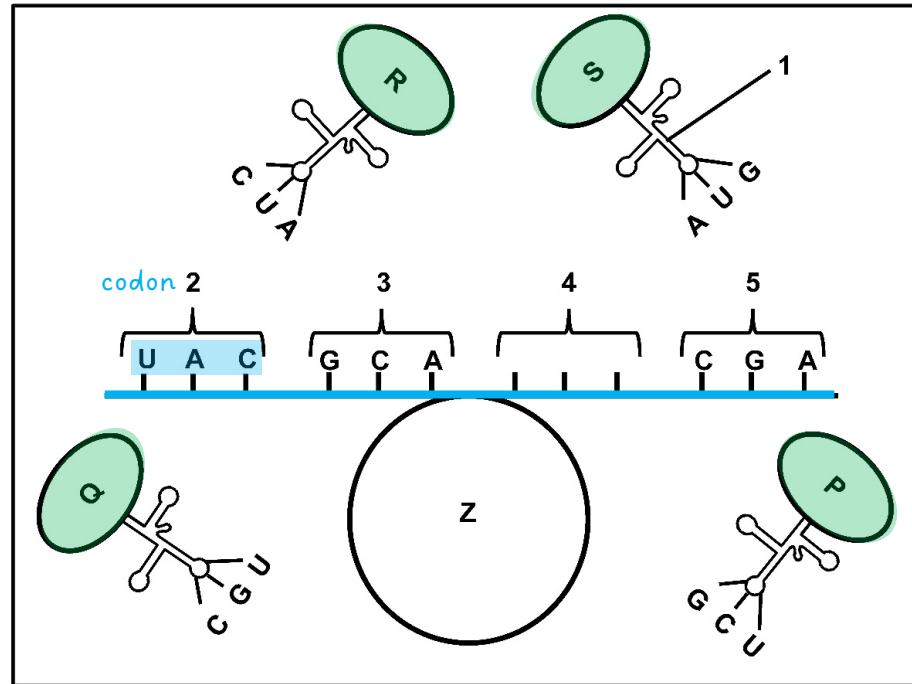
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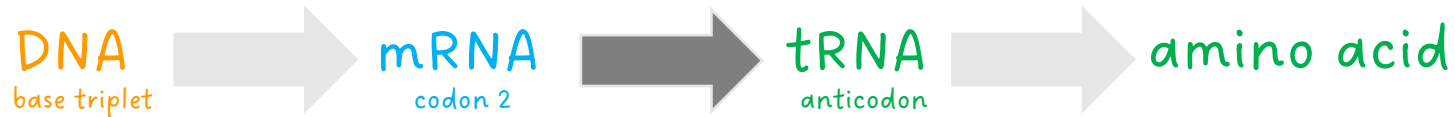
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We have 4 tRNA molecules with their amino acids. Working forwards, we can identify which 3 tRNA molecules already fit on the mRNA strand. First codon 2 ...



UAC

AU \_

Remember -  
Uracil replaces  
Thymine in RNA!

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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

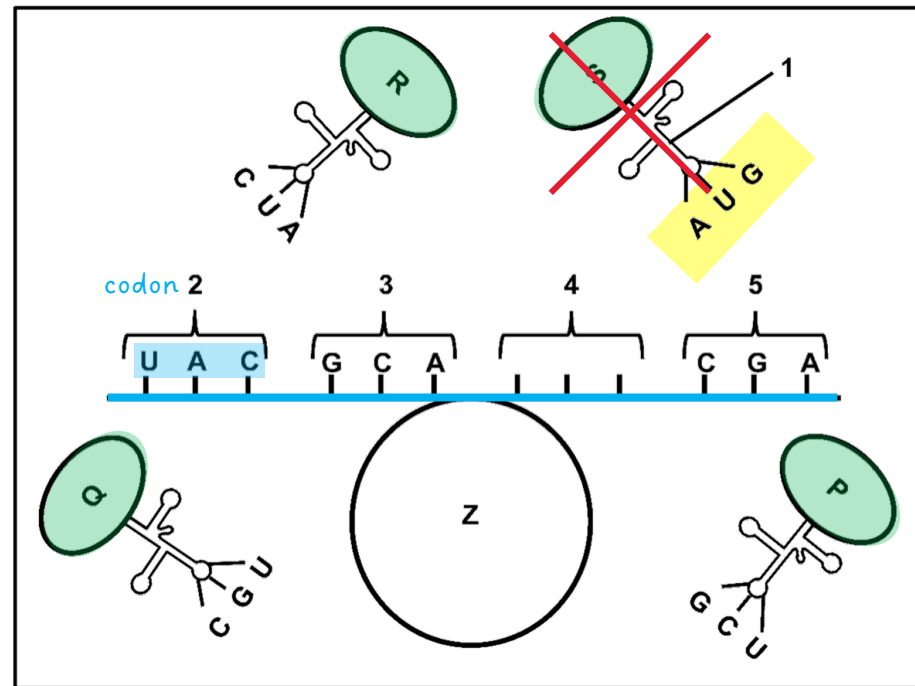
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Codon 2 fits with the tRNA that carries amino acid S, so that one can be crossed out.

DNA  
base triplet



mRNA  
codon 2



tRNA  
anticodon



amino acid

UAC

AUG

S



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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

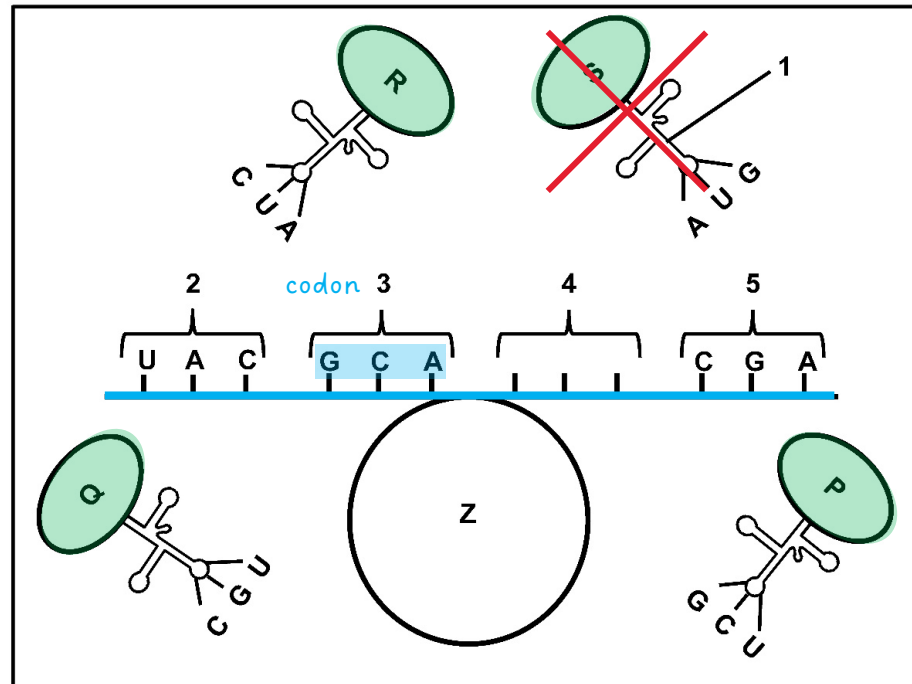
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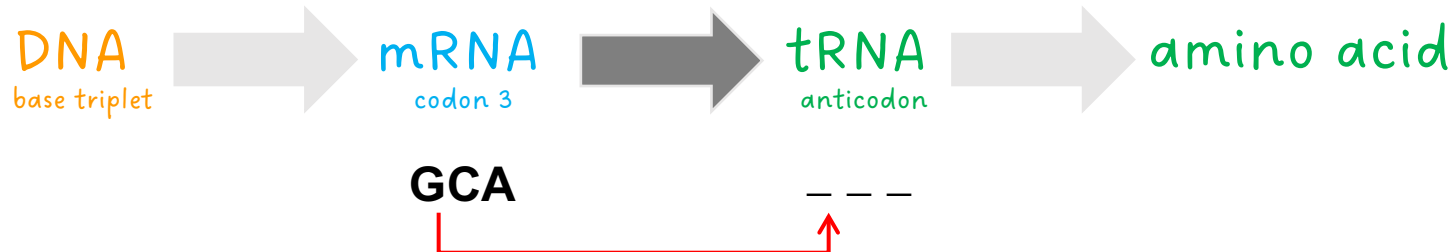
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Next, codon 3.



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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

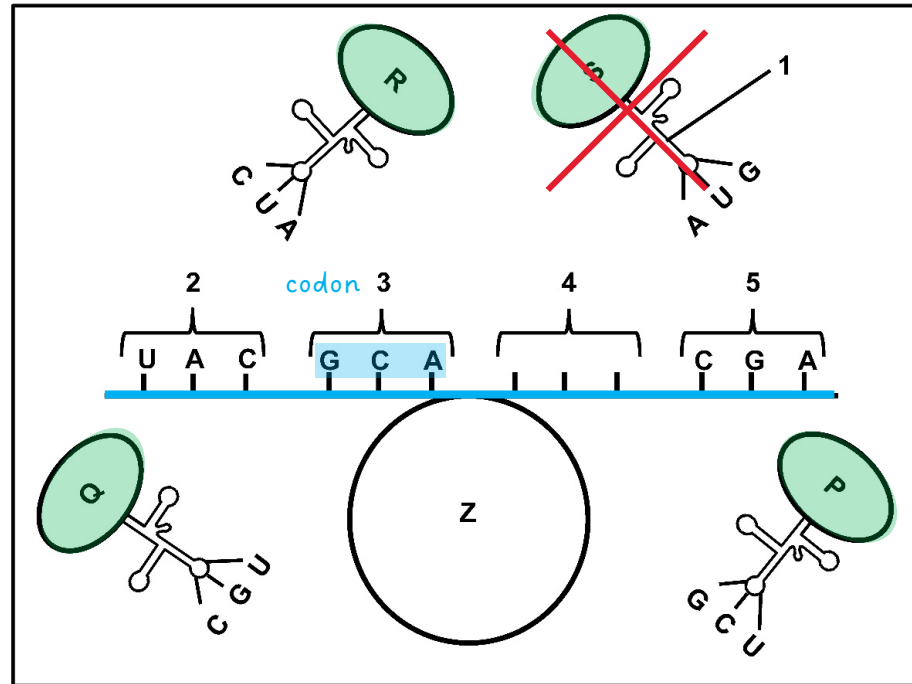
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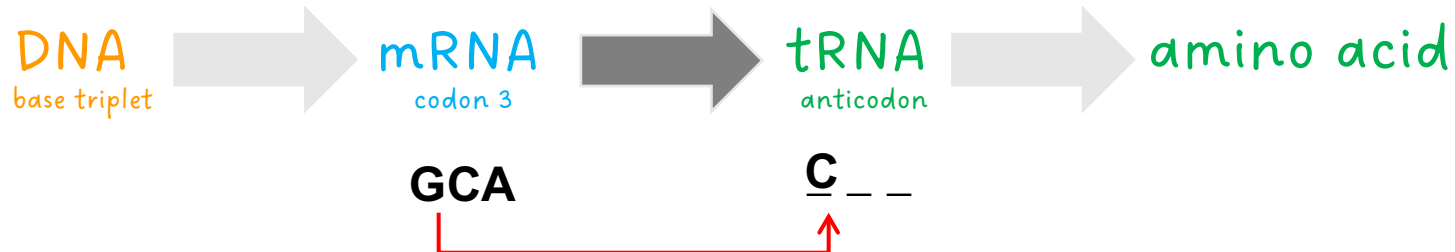
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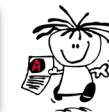
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Next, codon 3.



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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

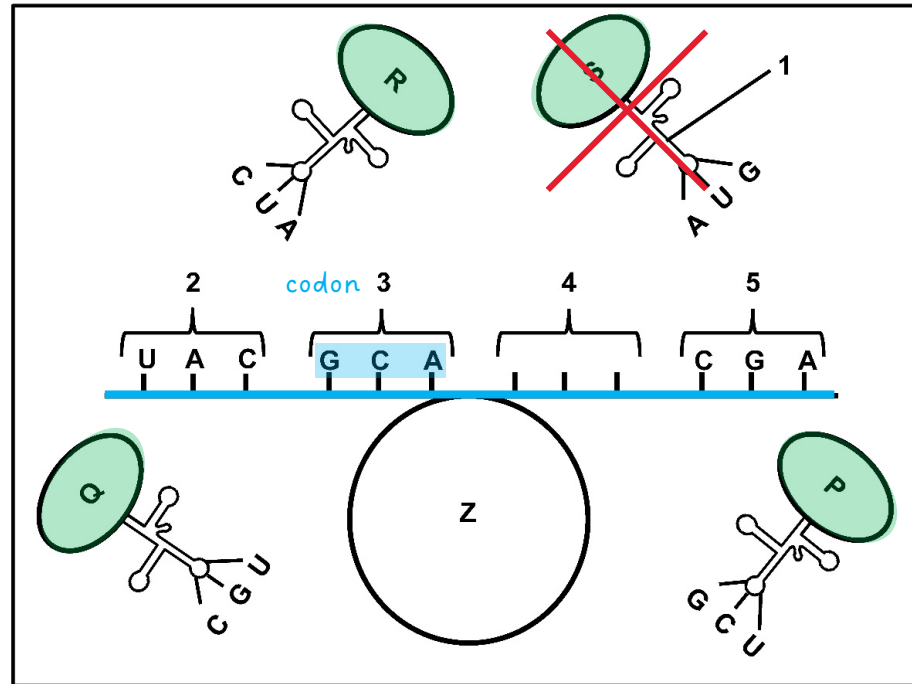
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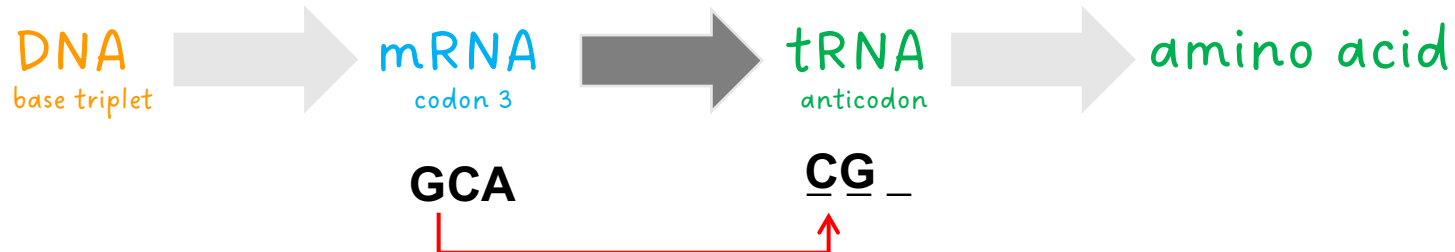
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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

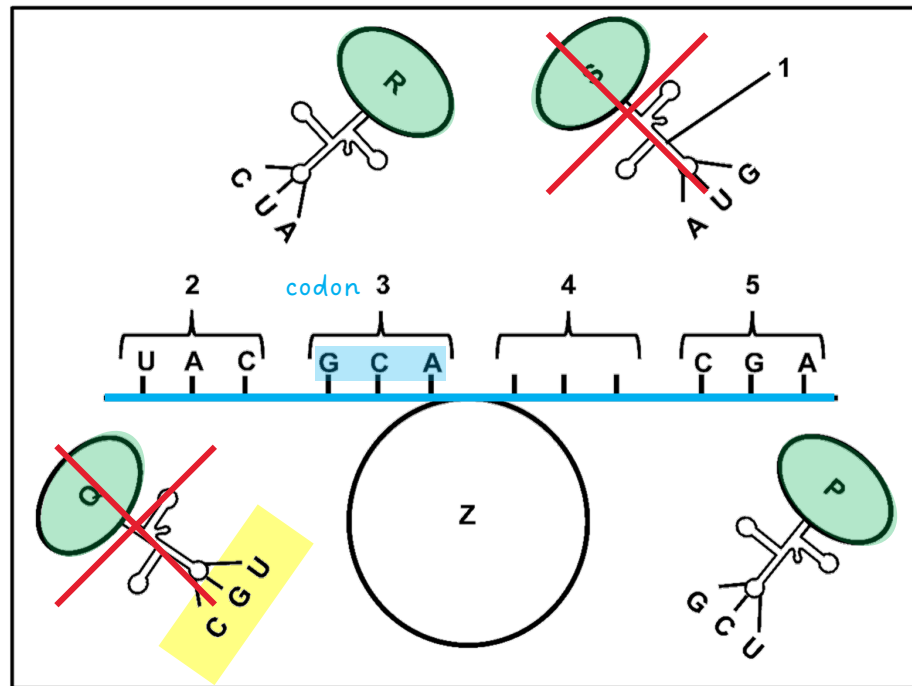
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Codon 3 fits with the tRNA that carries amino acid Q, so that one can be crossed out.

DNA  
base triplet



mRNA  
codon 3



tRNA  
anticodon



amino acid

GCA

CGU

Q

Remember -  
Uracil replaces  
Thymine in RNA!

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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

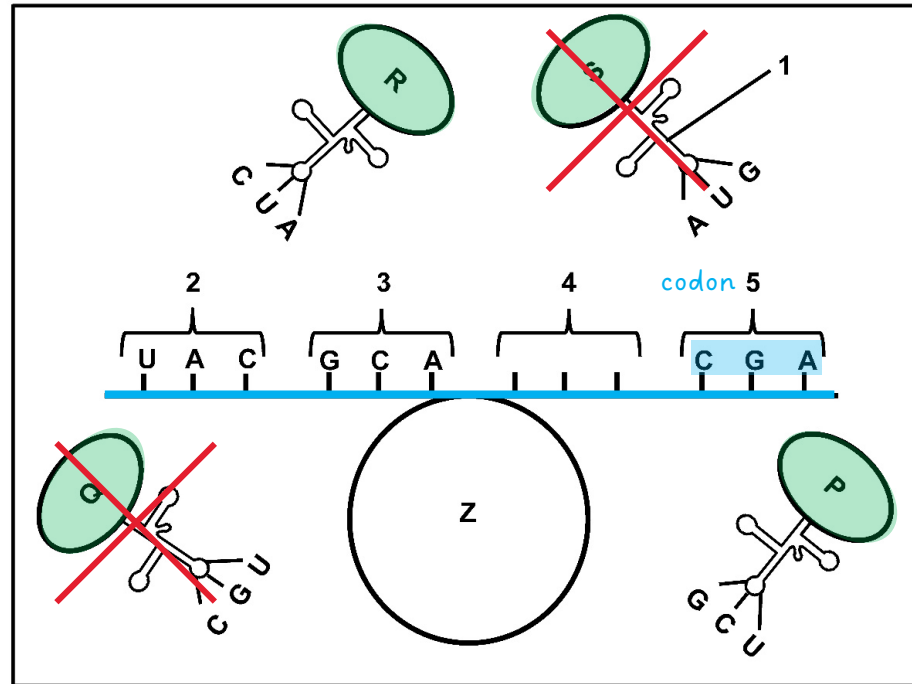
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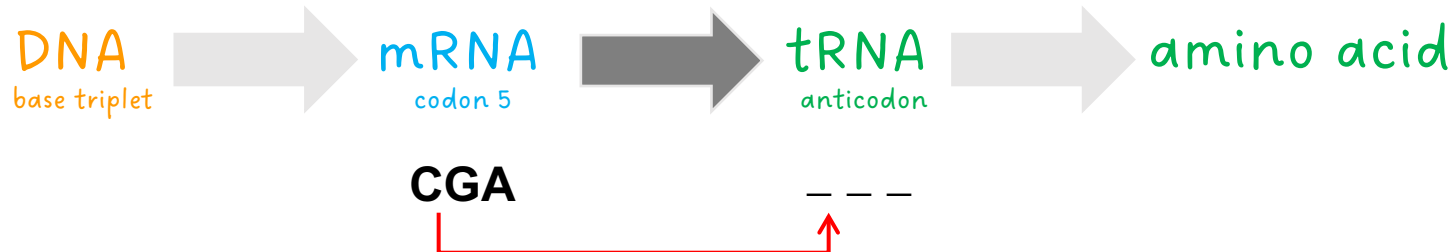
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Lastly, codon 5.



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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

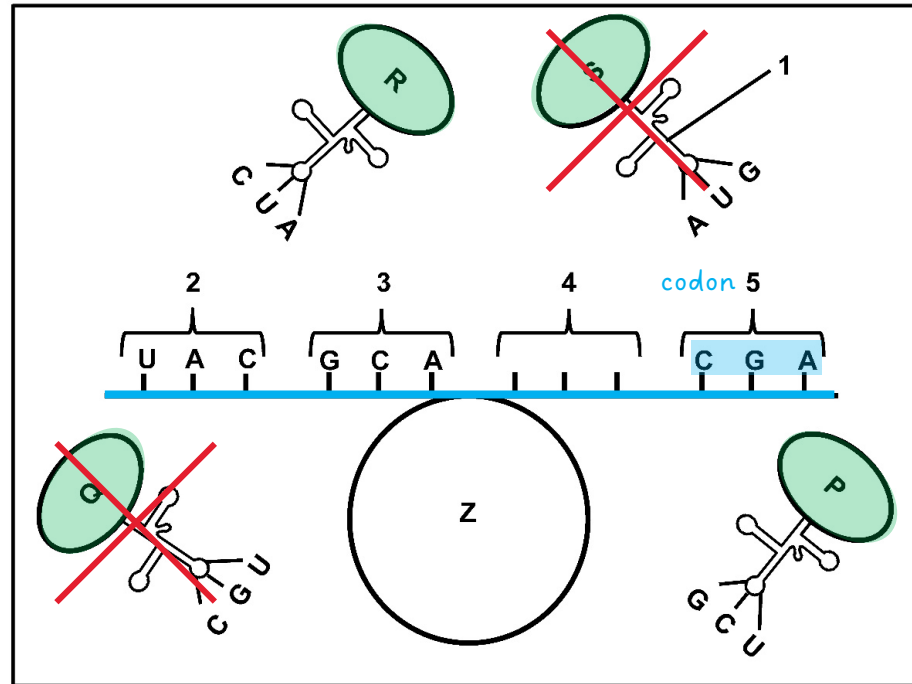
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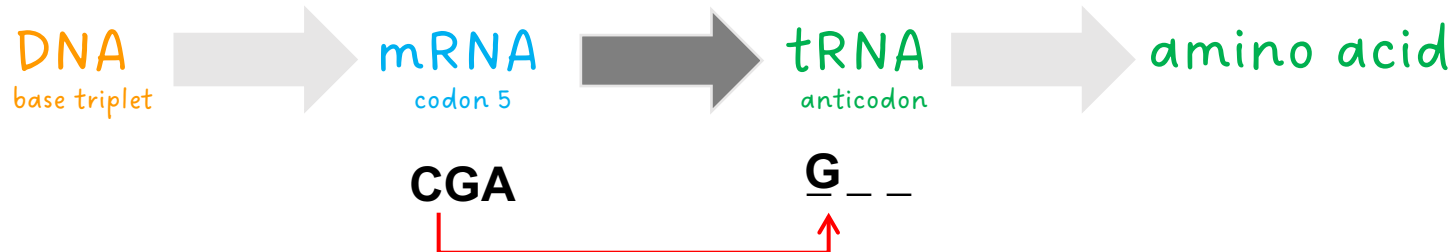
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Lastly, codon 5.



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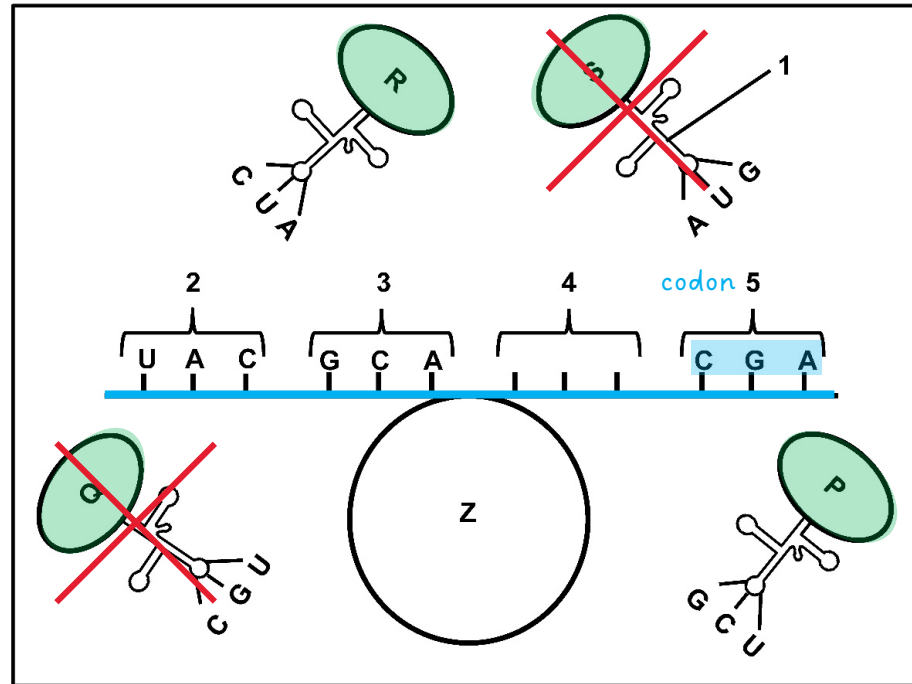
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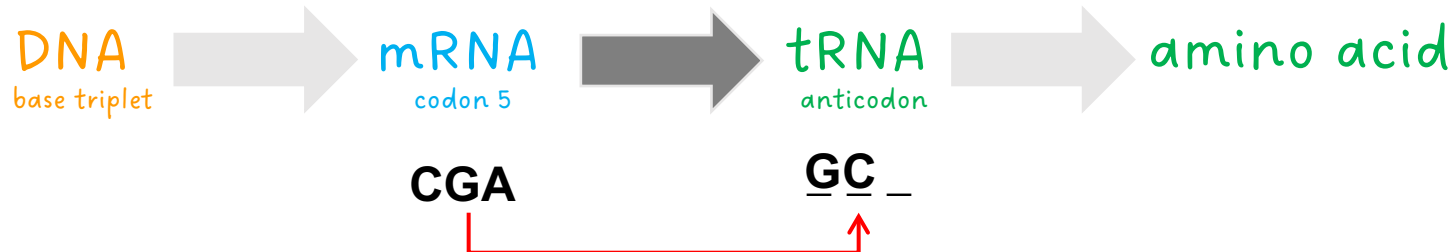
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Lastly, codon 5.



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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

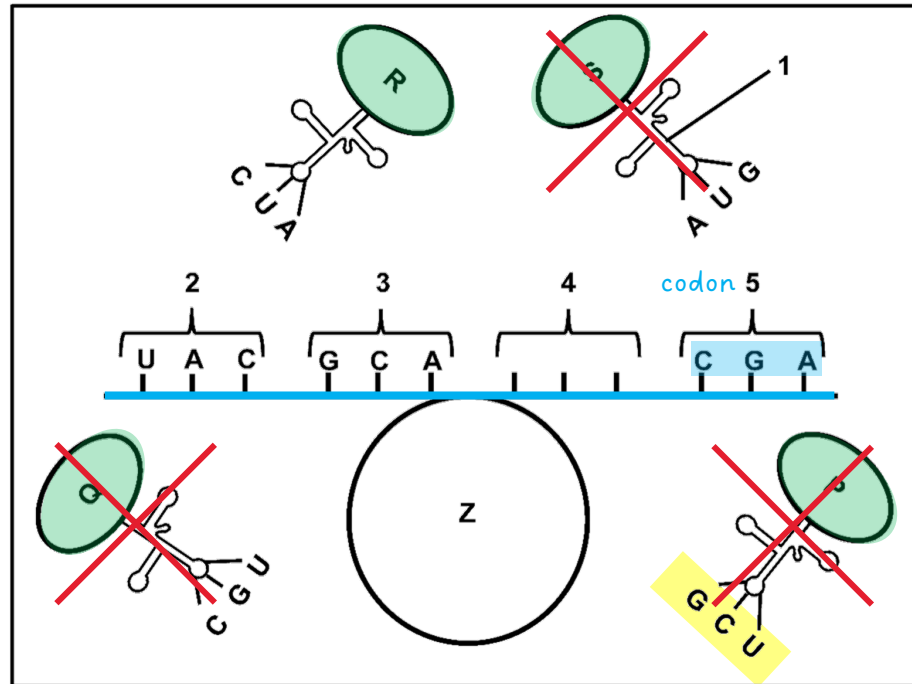
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Codon 5 fits with the tRNA that carries amino acid P, so that one can be crossed out.

DNA  
base triplet



mRNA  
codon 5



tRNA  
anticodon



amino acid

CGA

GCU

P

Remember -  
Uracil replaces  
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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

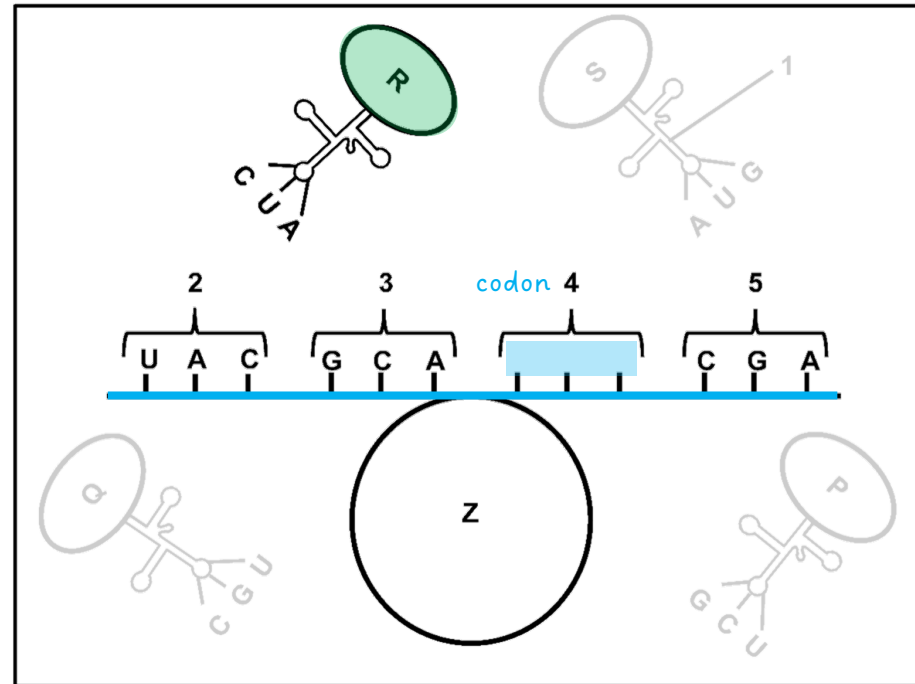
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3 Note, that we KNOW NOTHING for CODON 4. It is blank. So now we must work through a process of elimination for the OTHER CODONS, based on what we have.



So, we are left with only amino acid R. Therefore, it's tRNA anticodon MUST fit with codon 4.



R

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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

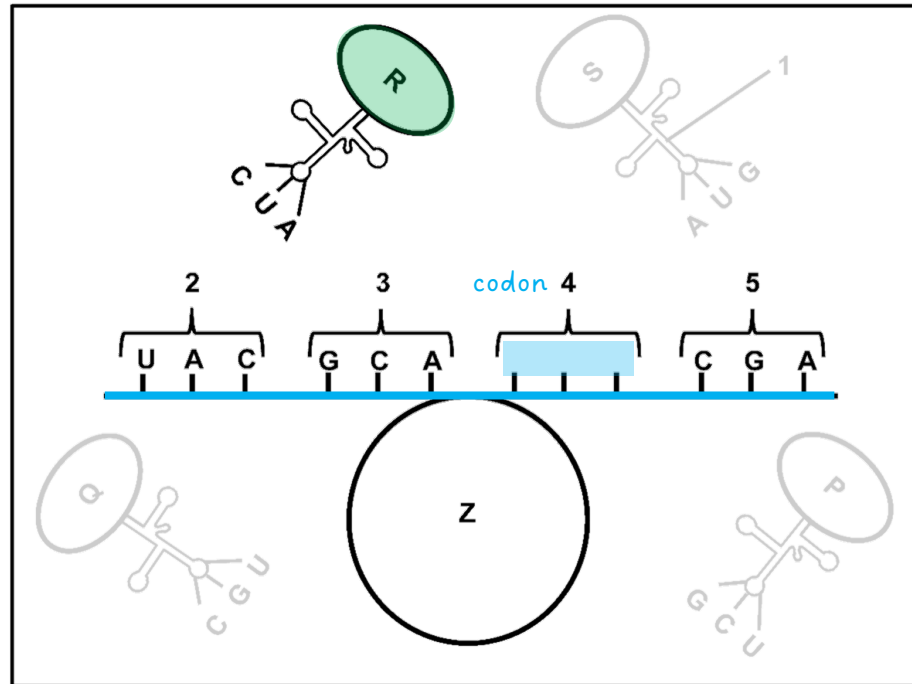
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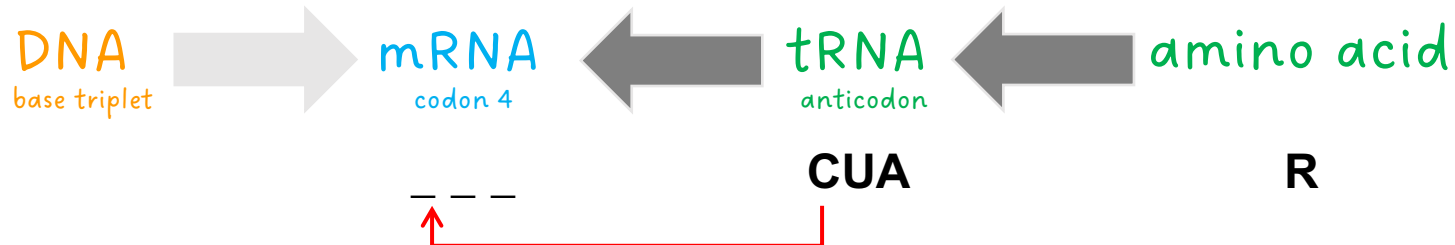
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So, we are left with only amino acid R. Therefore, it's tRNA anticodon MUST fit with codon 4.



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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

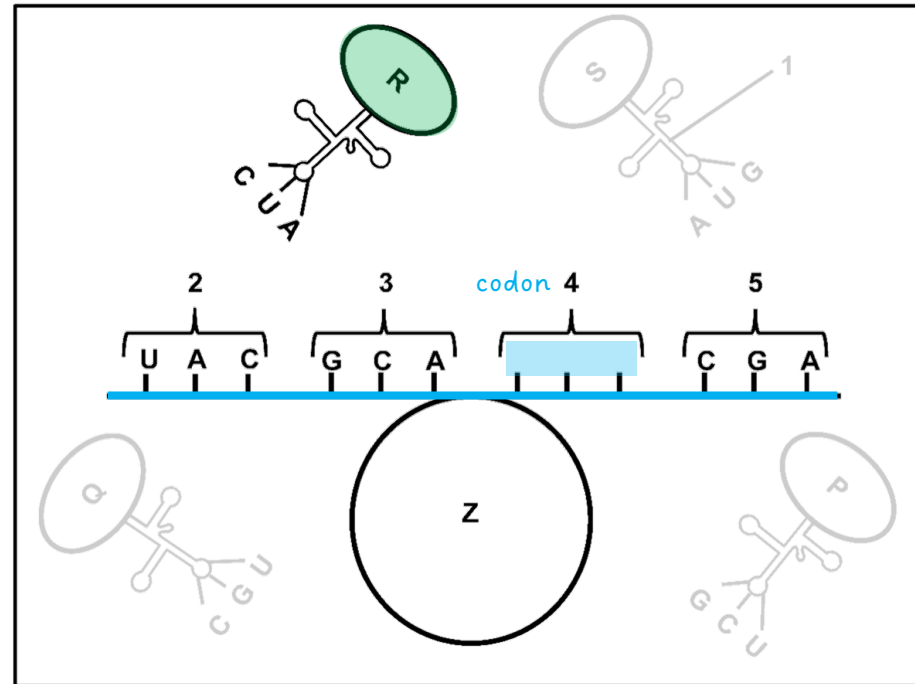
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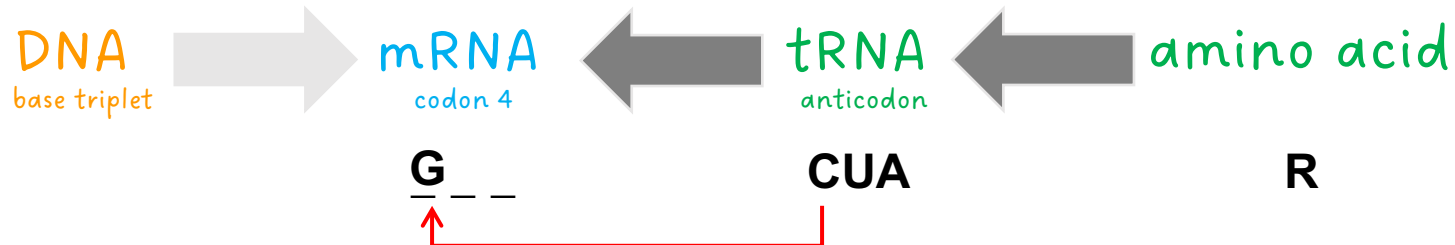
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So, we are left with only amino acid R. Therefore, it's tRNA anticodon MUST fit with codon 4.



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# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

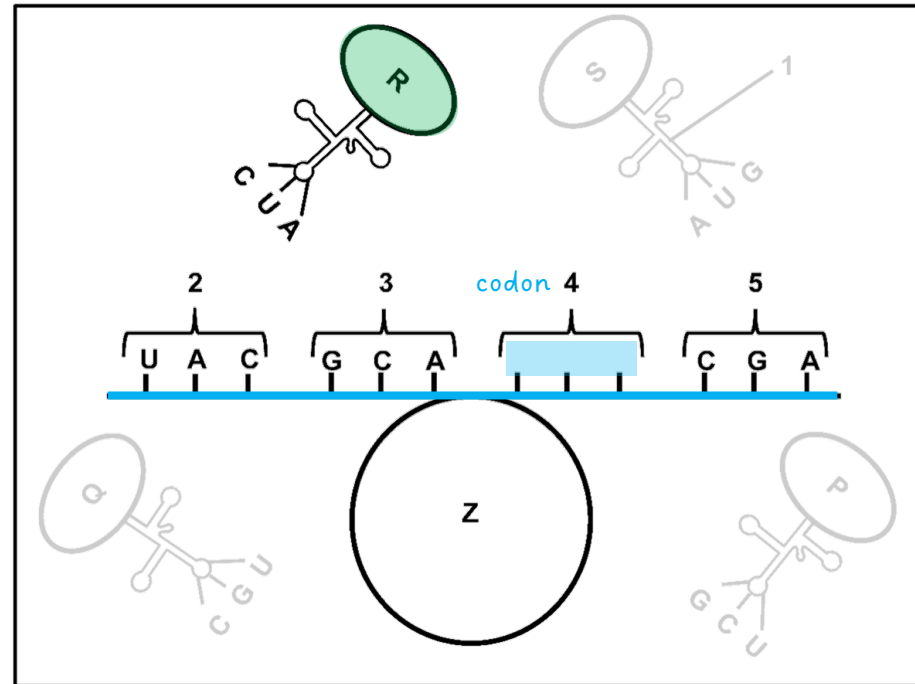
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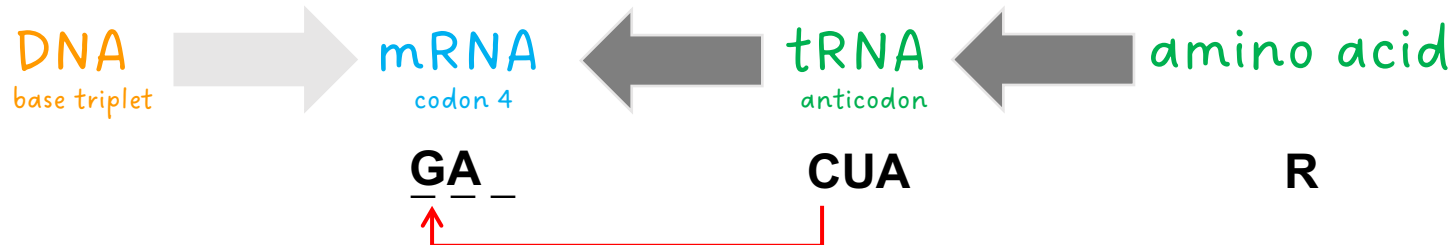
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3 Note, that we KNOW NOTHING for CODON 4. It is blank. So now we must work through a process of elimination for the OTHER CODONS, based on what we have.



So, we are left with only amino acid R. Therefore, it's tRNA anticodon MUST fit with codon 4.



▶ Continue learning

# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

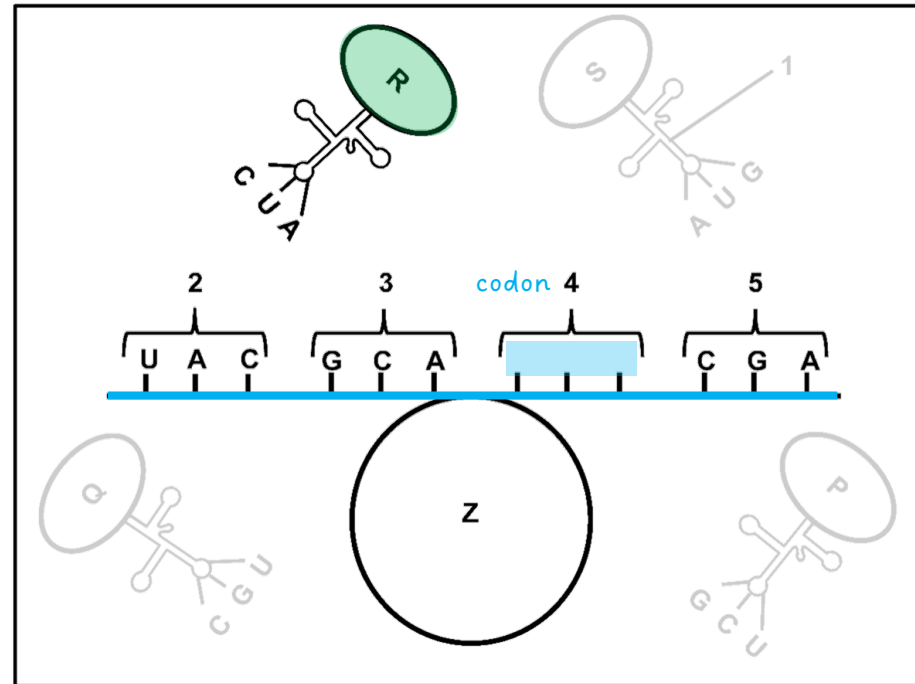
The diagram represents a stage of protein synthesis. Each amino acid (P, Q, R and S) is coded for by a different codon on this mRNA molecule.

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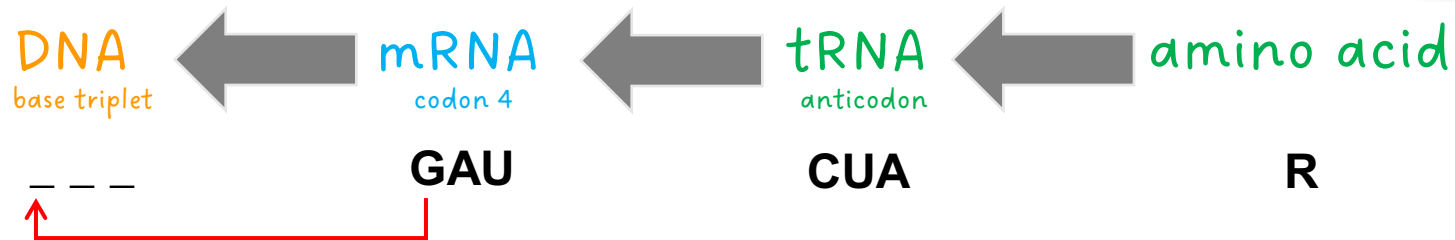


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4 Now work backwards to get the complementary DNA sequence.



▶ Continue learning

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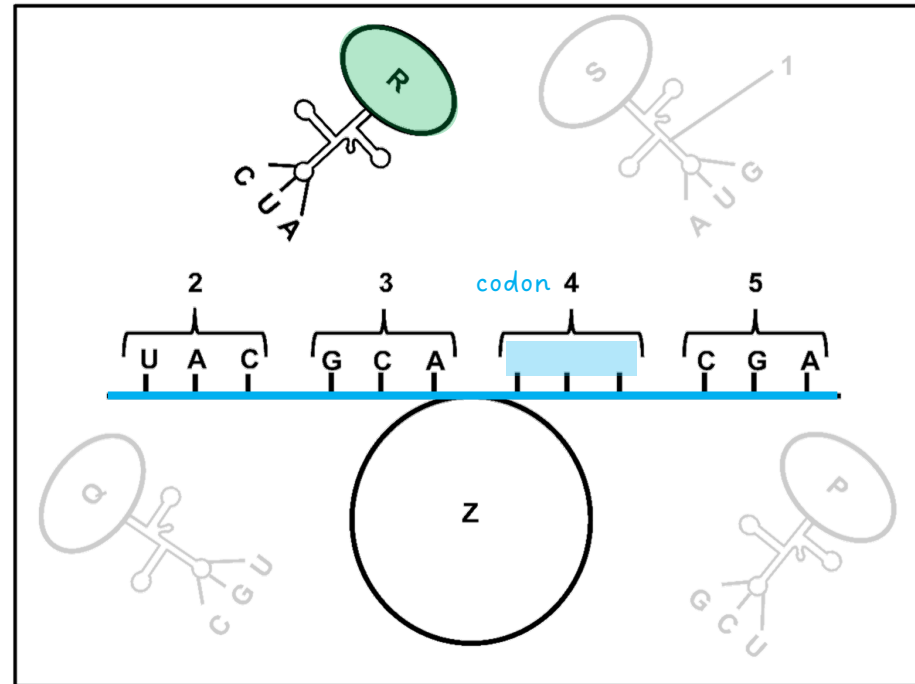
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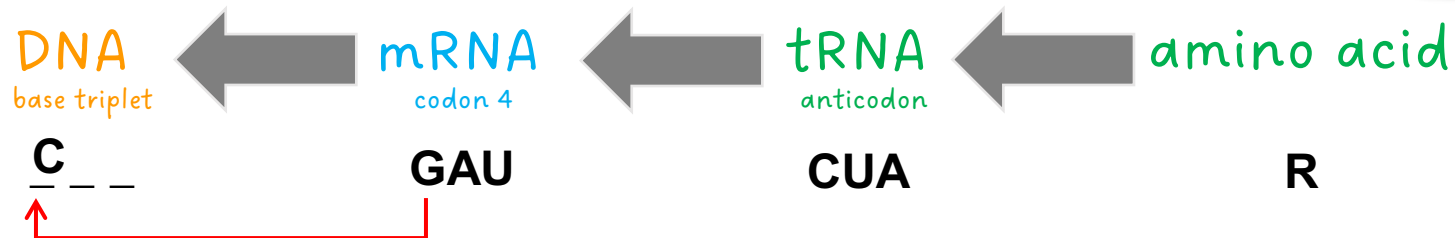


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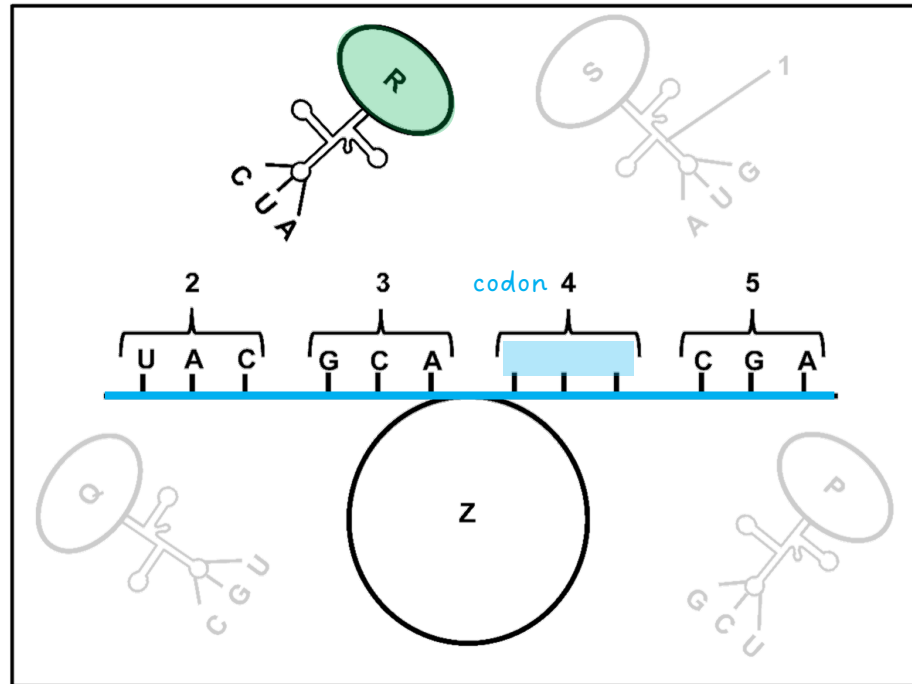
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DNA  
base triplet

mRNA  
codon 4

tRNA  
anticodon

amino acid

CT

GAU

CUA

R

Remember -  
Thymine in  
occurs in DNA!  
Not Uracil!

Continue learning



THE  
**ANSWER**  
SERIES Your Key to Exam Success

# PROTEIN SYNTHESIS DIAGRAMS – understanding the back and forth

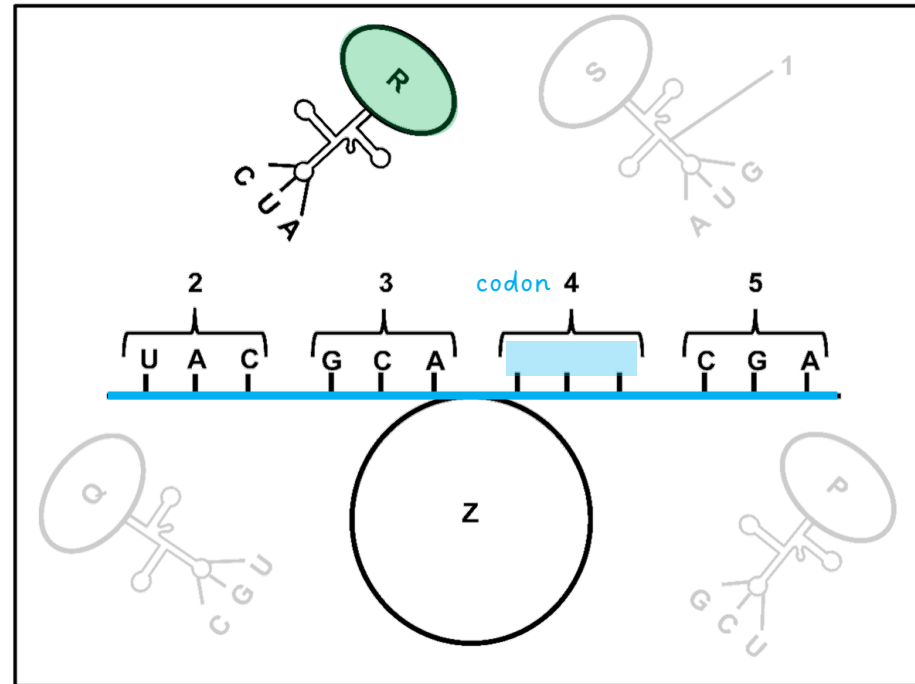
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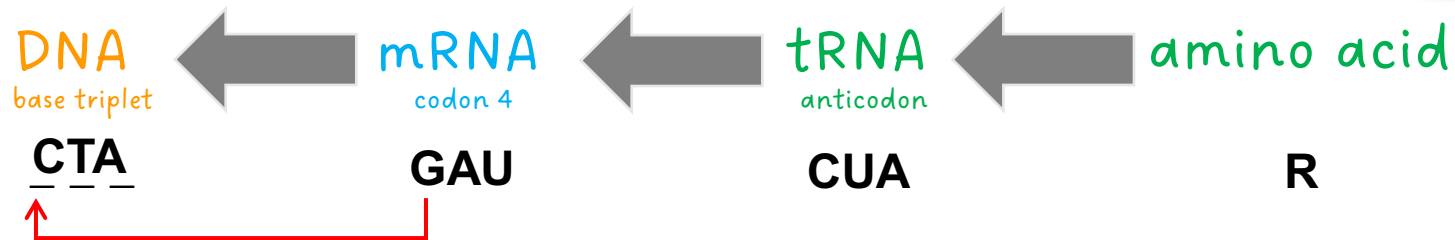


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▶ Let's try ONE more...Continue learning

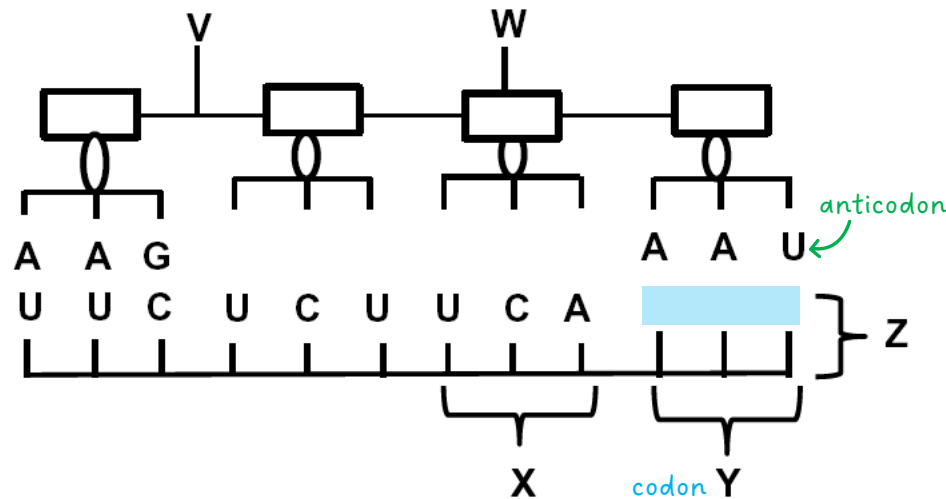


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The diagram shows part of the process involved in protein synthesis.

Give the DNA base triplet sequence that would code for Y.

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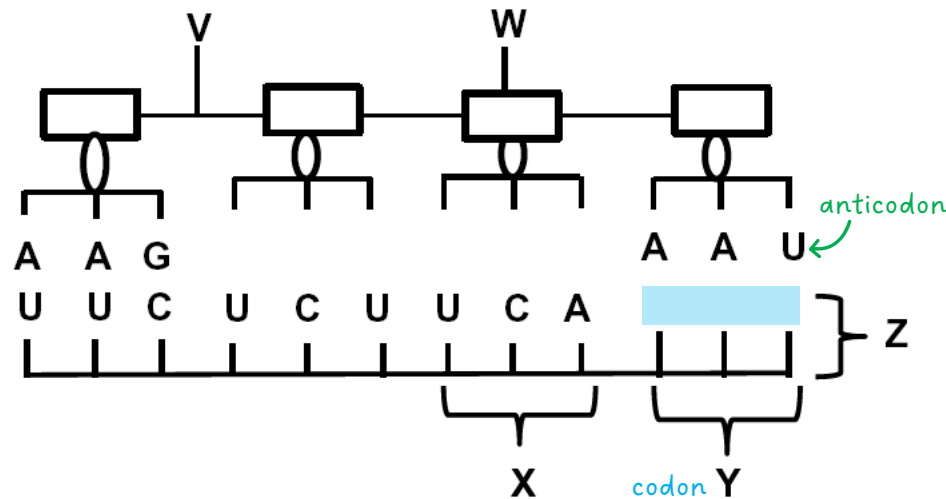
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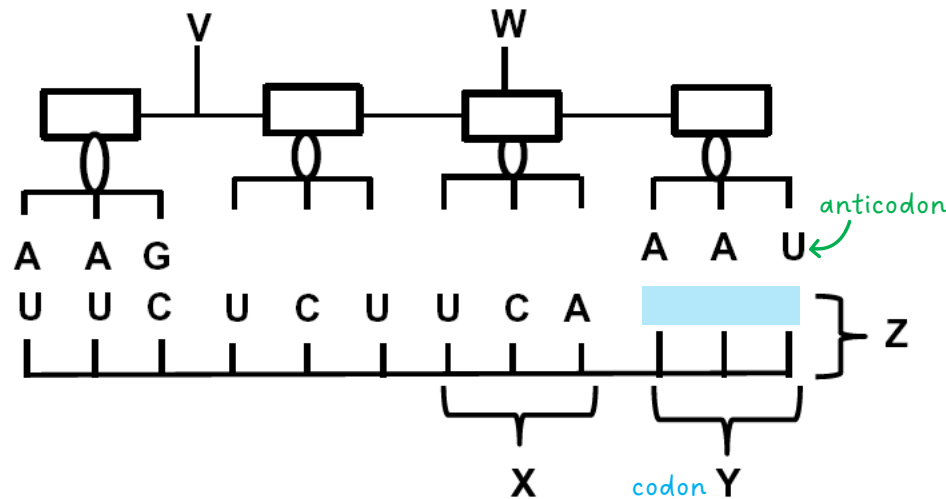
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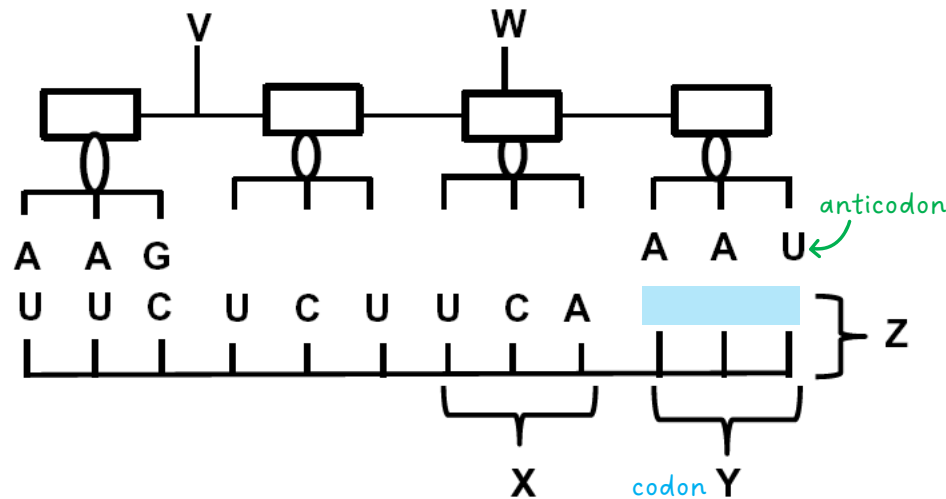
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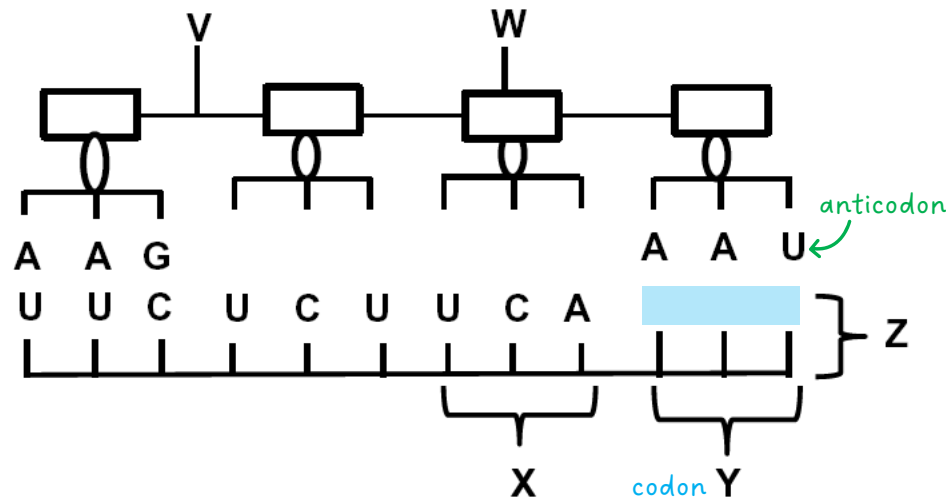
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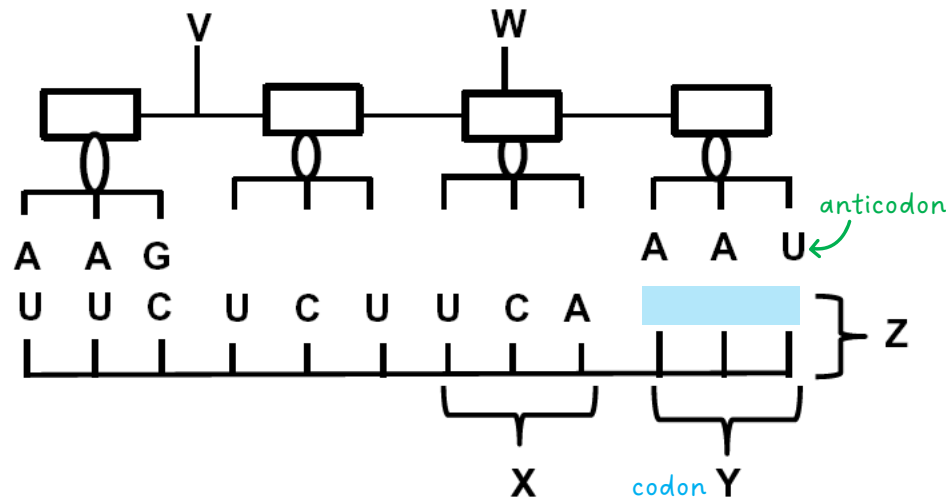
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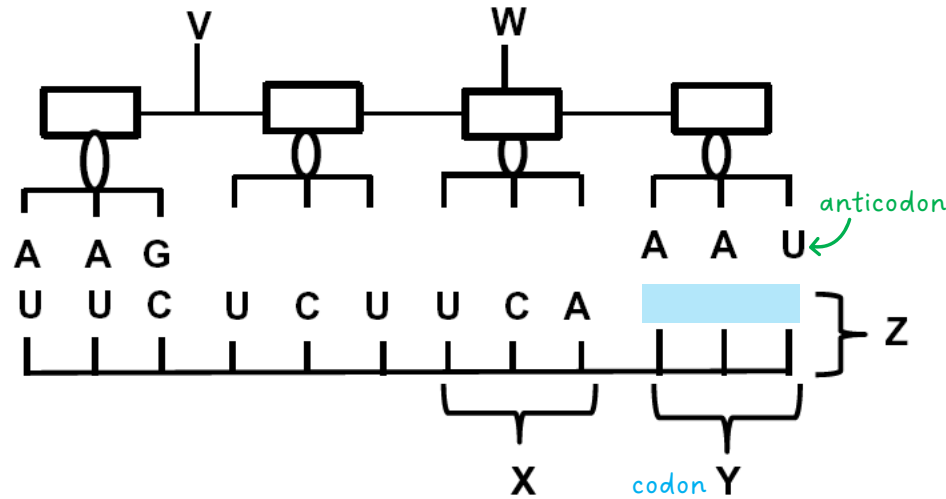


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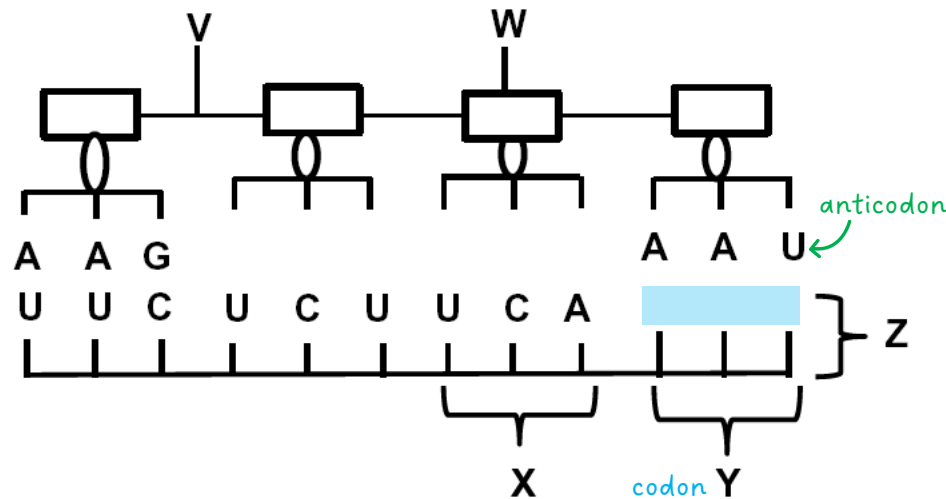


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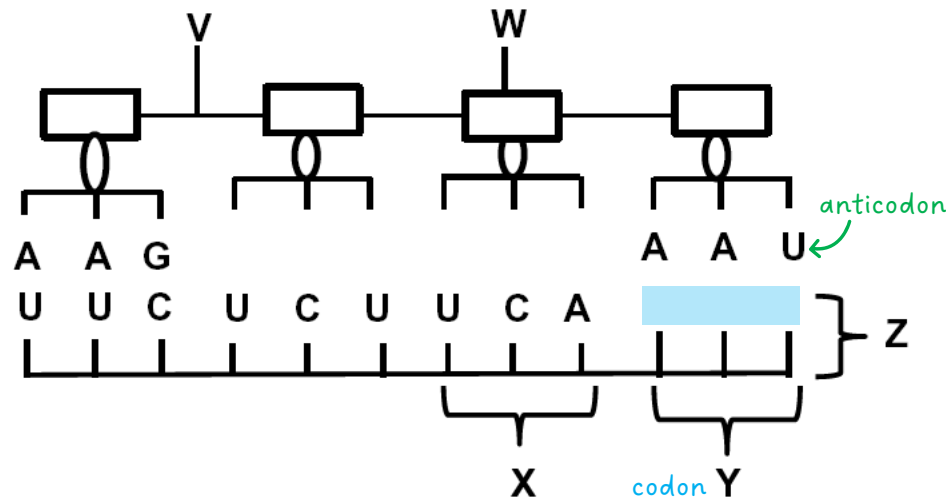
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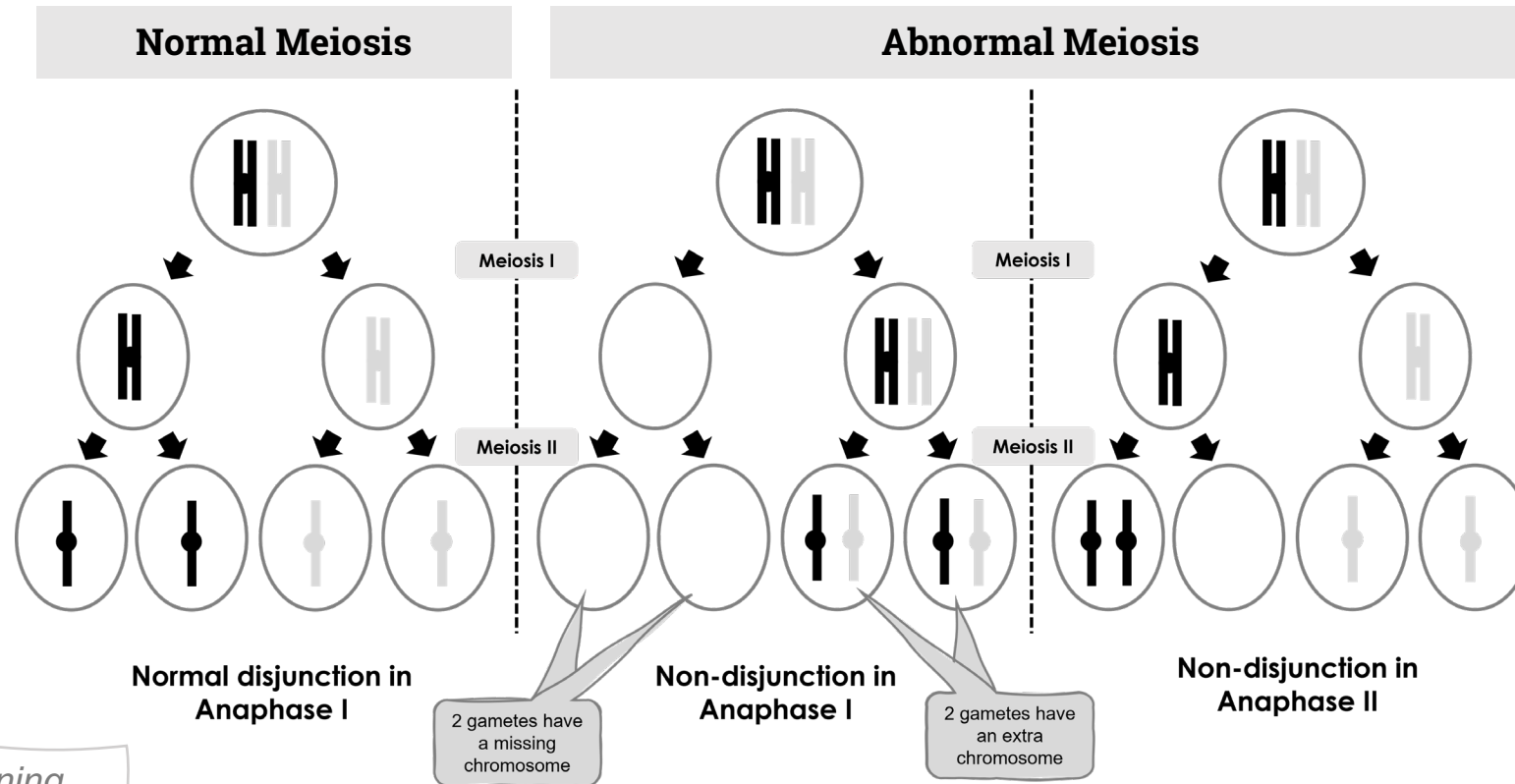
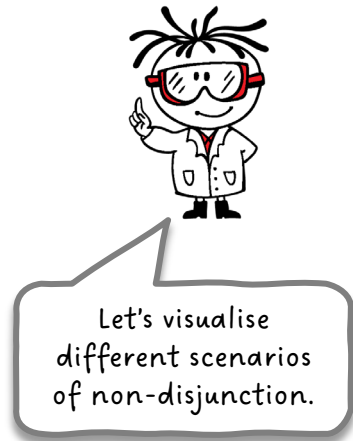
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# ABNORMAL MEIOSIS – understanding non-disjunction scenarios

- ✓ When Meiosis does not proceed normally, changes in the **number** or **structure** of the **chromosomes** may occur.
- ✓ These abnormalities are known as **chromosome mutations** where there are **extra chromosomes** or **missing chromosomes** in a cell.
- ✓ A common cause of chromosome mutations is **non-disjunction** – chromosome pairs or chromatids **do not separate** during Meiosis.
- ✓ Non-disjunction can occur during **Anaphase I** or **Anaphase II** and will have different consequences.



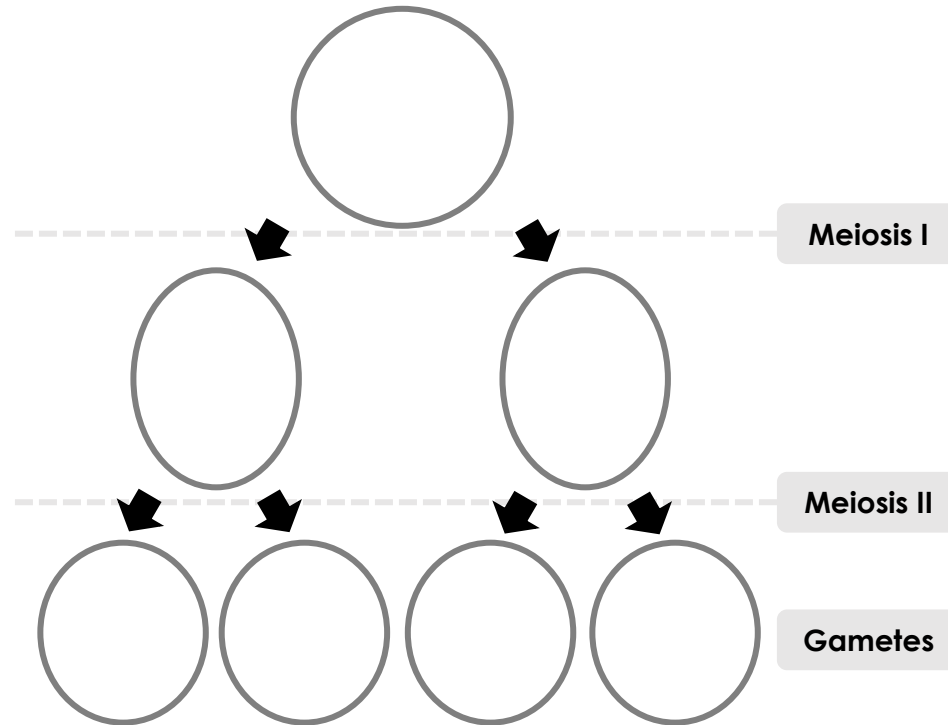
Extract from *The Answer Series* Grade 12 Life Sciences Part 2 (2024 ed.) p. 35



# ABNORMAL MEIOSIS – understanding non-disjunction scenarios



When you are asked about non-disjunction, **visualise the effects** in this simple way...



Extract from *The Answer Series* Grade 12  
Life Sciences Part 2  
(2024 ed.) p. 35

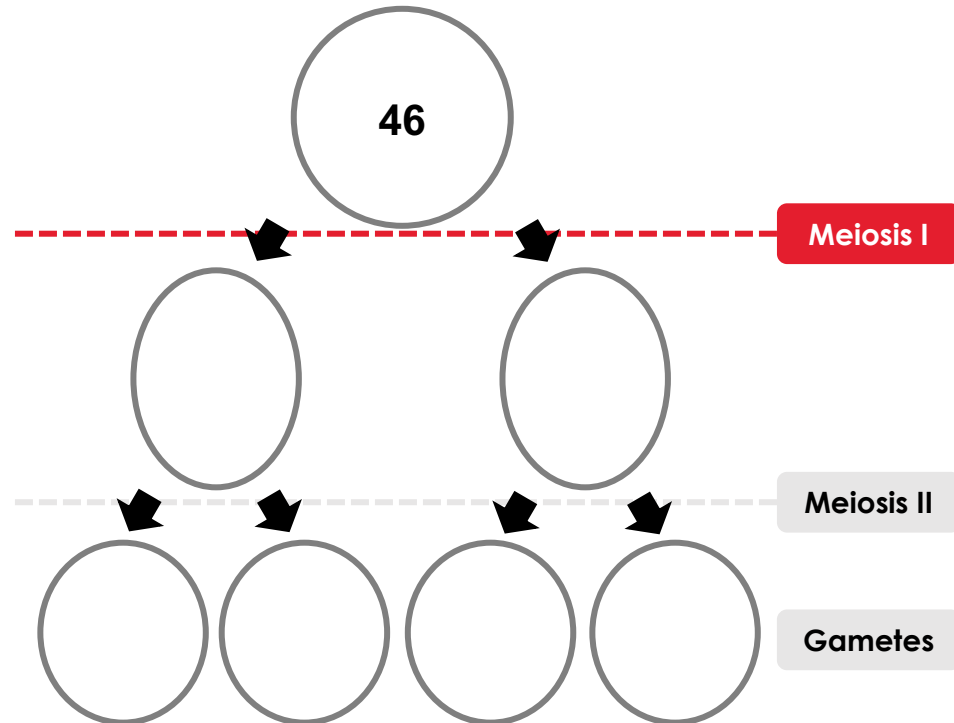


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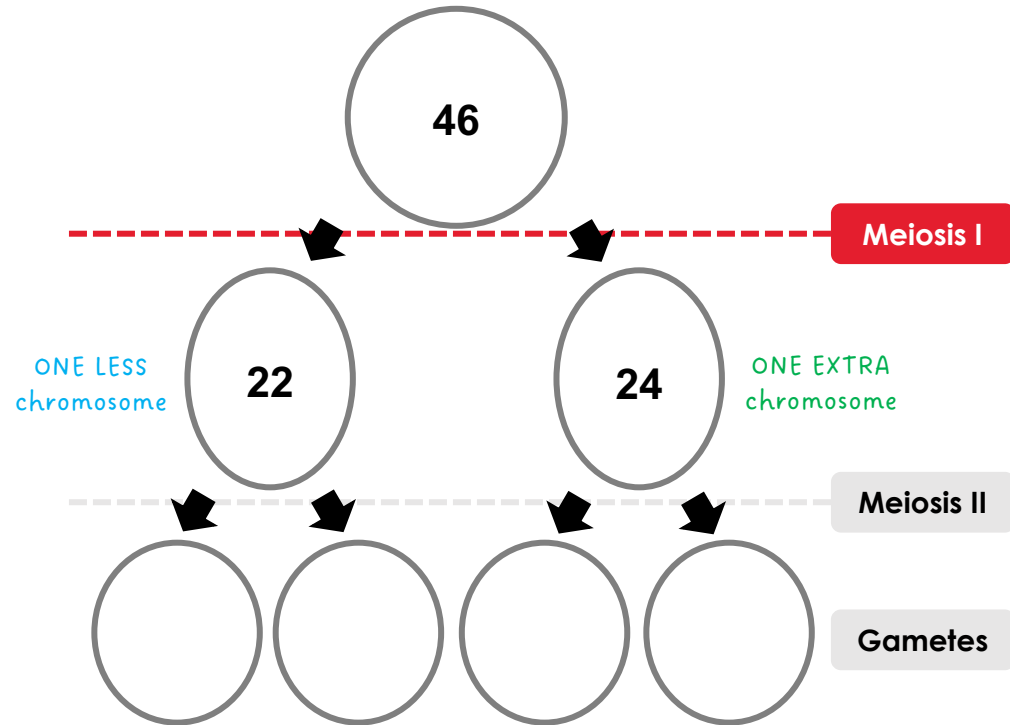


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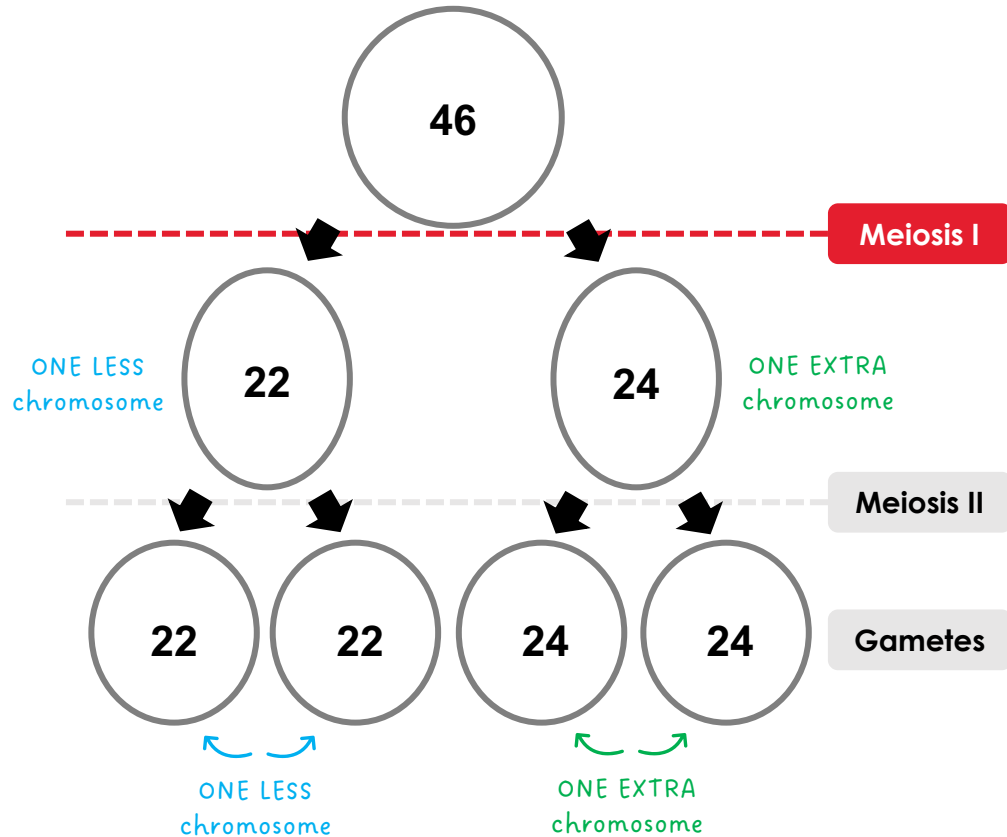
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**Continue** with that logic through **MEIOSIS II**...



These could represent **sperm cells** or **egg cells**, it doesn't matter.

Extract from *The Answer Series* Grade 12 Life Sciences Part 2 (2024 ed.) p. 35



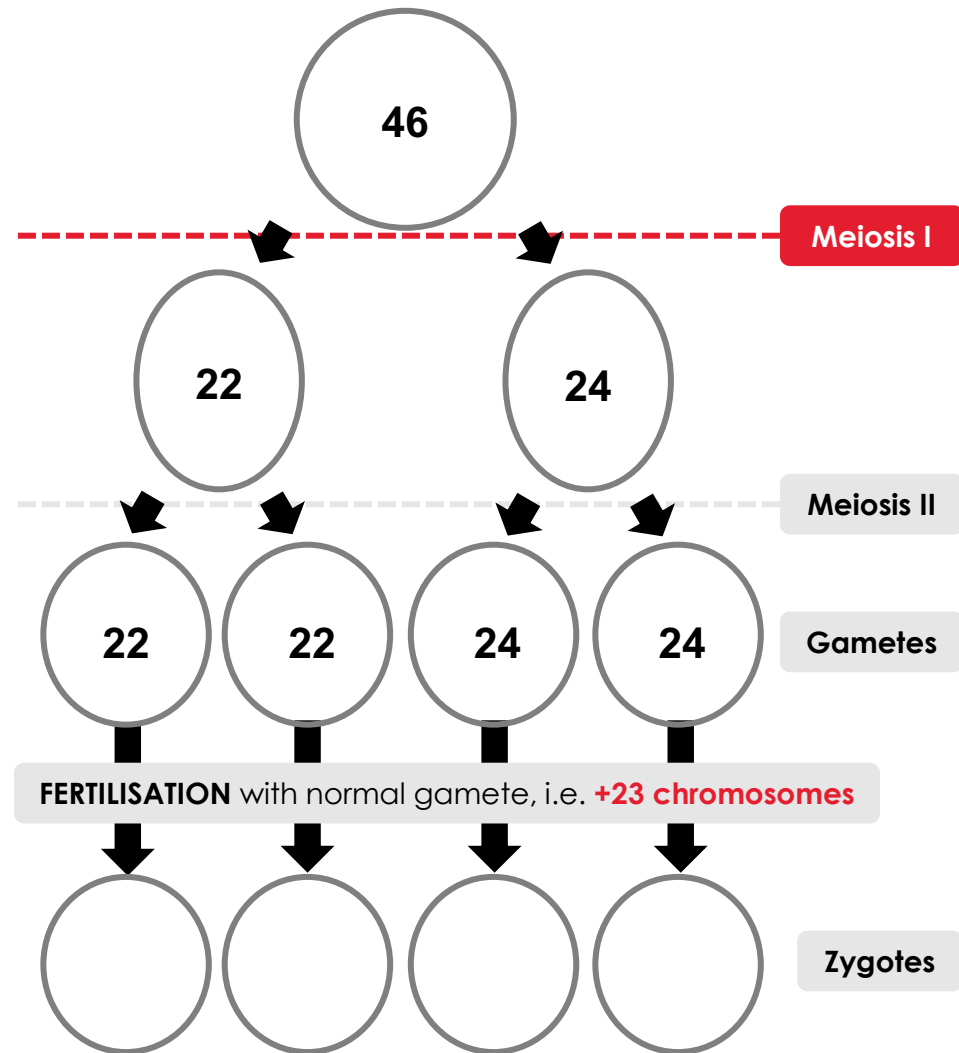
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Then **fertilise** these **gametes**...



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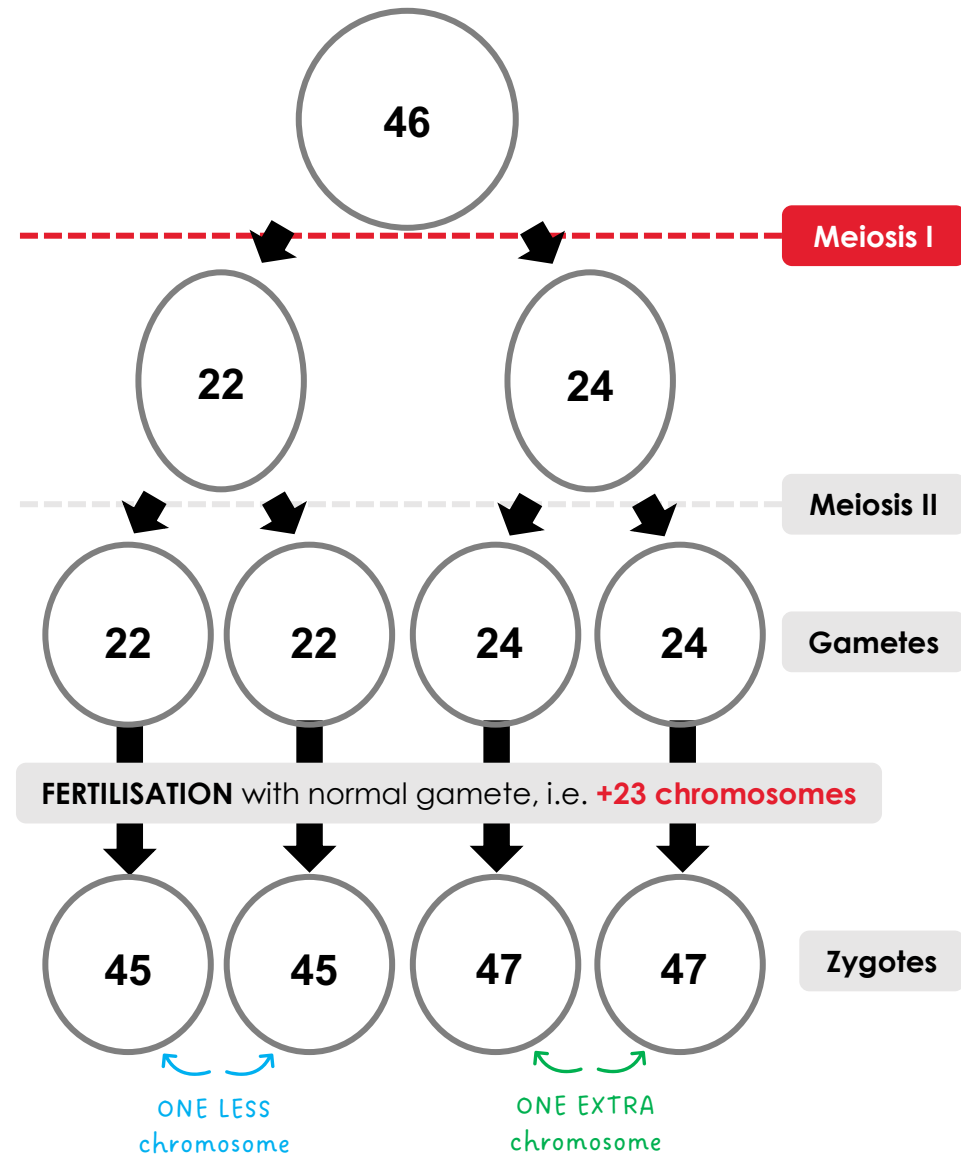
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Let's assume **ONE pair of AUTOSOMES** does not separate during **ANAPHASE I**...

**Continue** with that logic through **MEIOSIS II**...

Then **fertilise** these **gametes**...

To see the resultant **zygotes**.



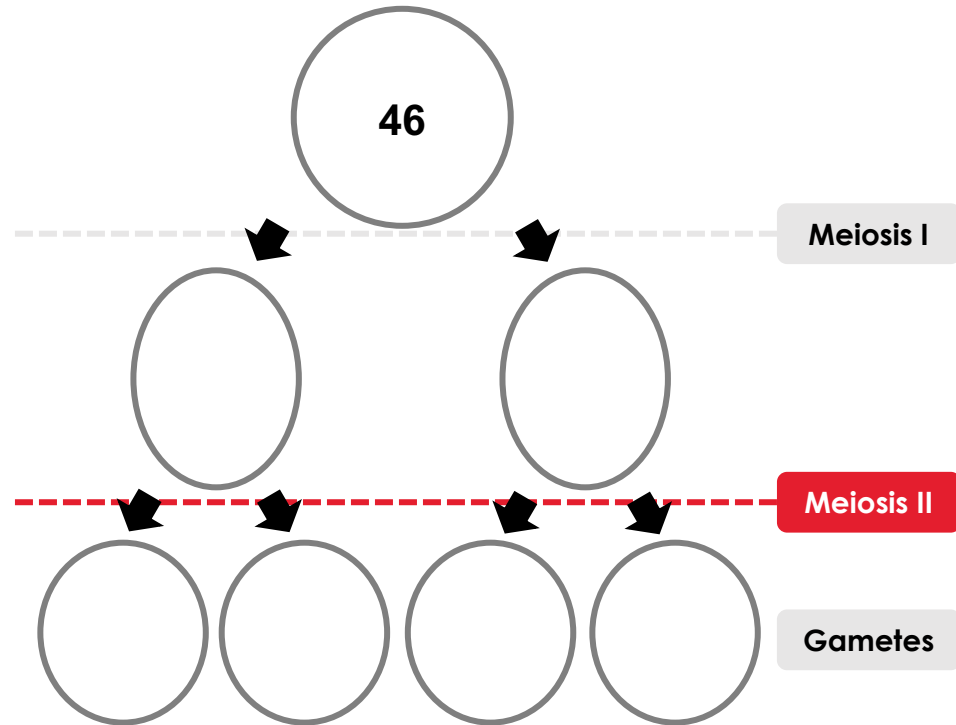
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# ABNORMAL MEIOSIS – understanding non-disjunction scenarios



Let's run through **non-disjunction** during **ANAPHASE II**...



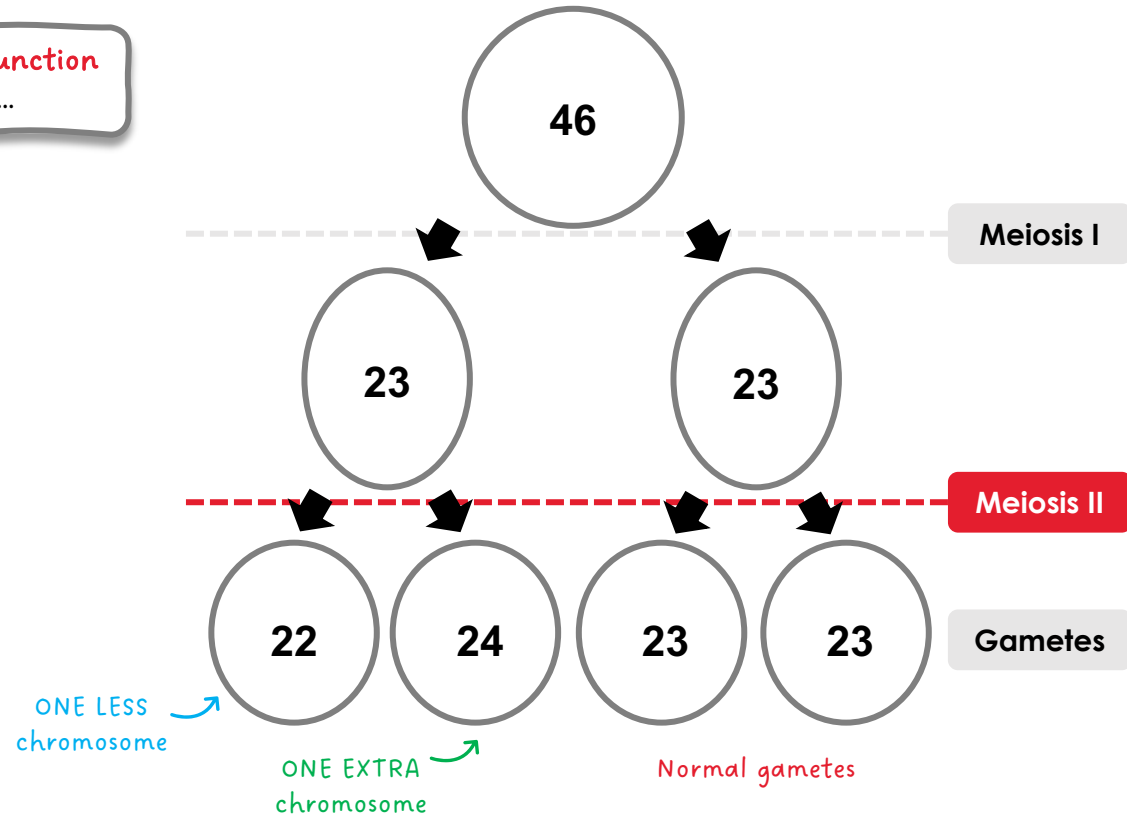
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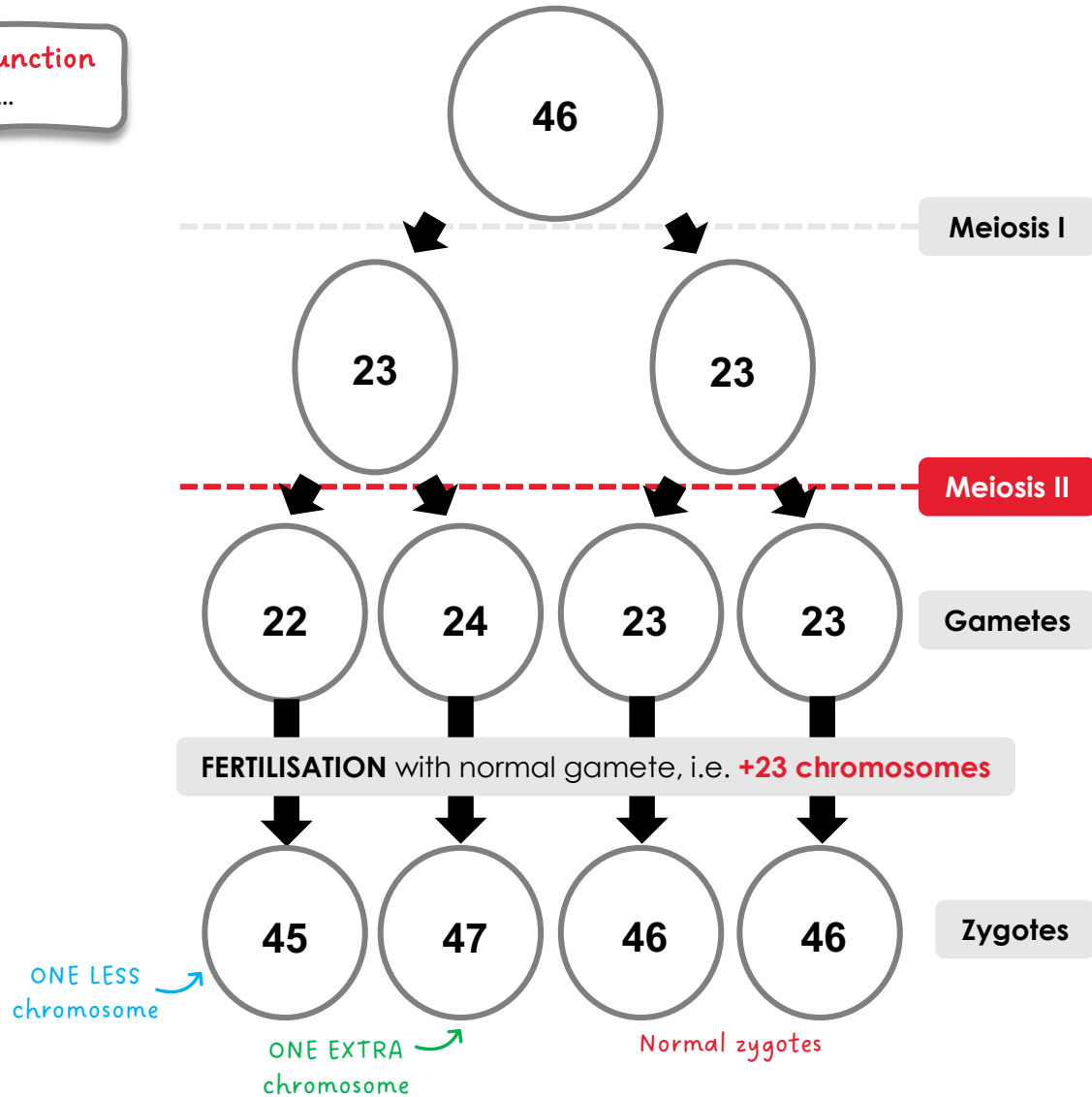
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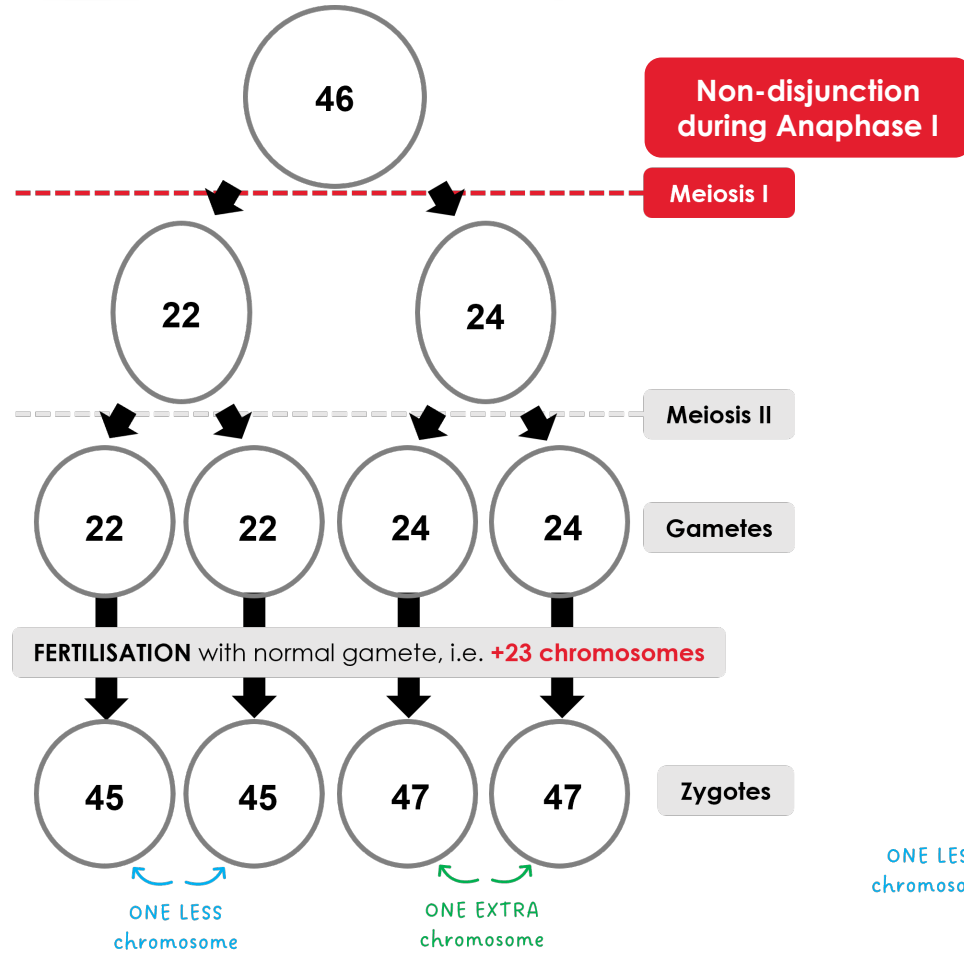
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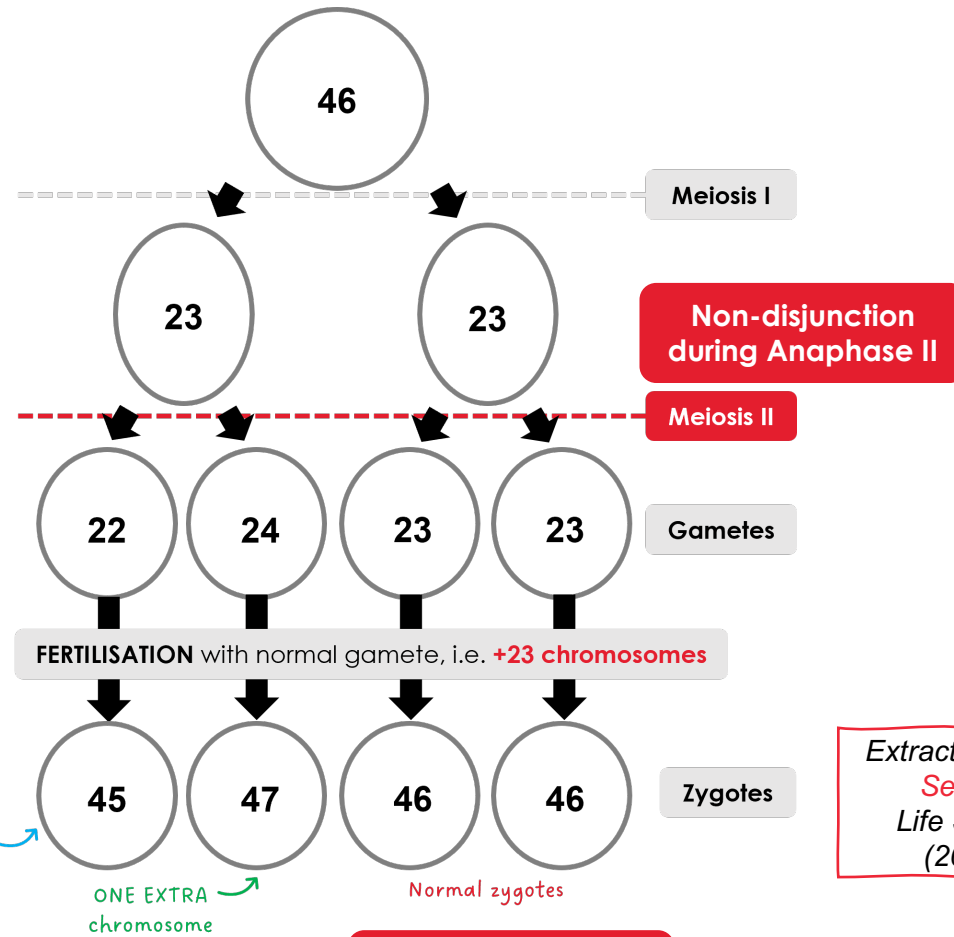
# ABNORMAL MEIOSIS – understanding non-disjunction scenarios



Note that the consequences of non-disjunction in MEIOSIS II is less devastating as fewer gametes would be affected.



All 4 gametes affected



Half of the gametes affected

Extract from *The Answer Series* Grade 12 Life Sciences Part 2 (2024 ed.) p. 35

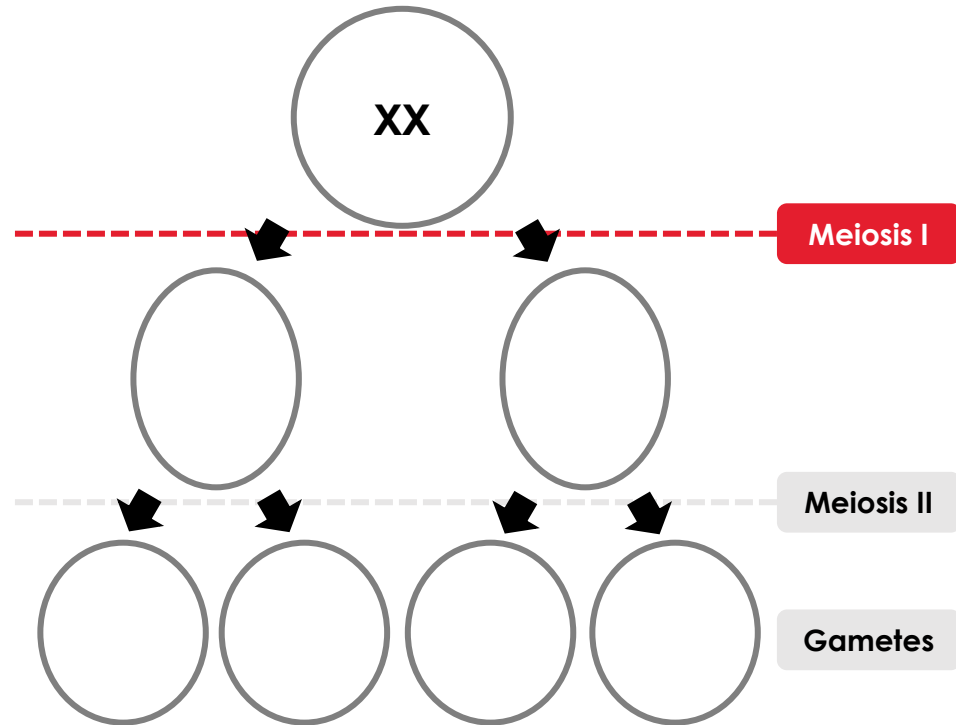
Continue learning



# ABNORMAL MEIOSIS – understanding non-disjunction scenarios



Now let's assume an **XX gonosome pair** does not separate during **ANAPHASE I**...



These could only be **egg cells** in this case due to XX gonosome pair.

Extract from *The Answer Series* Grade 12 Life Sciences Part 2 (2024 ed.) p. 35



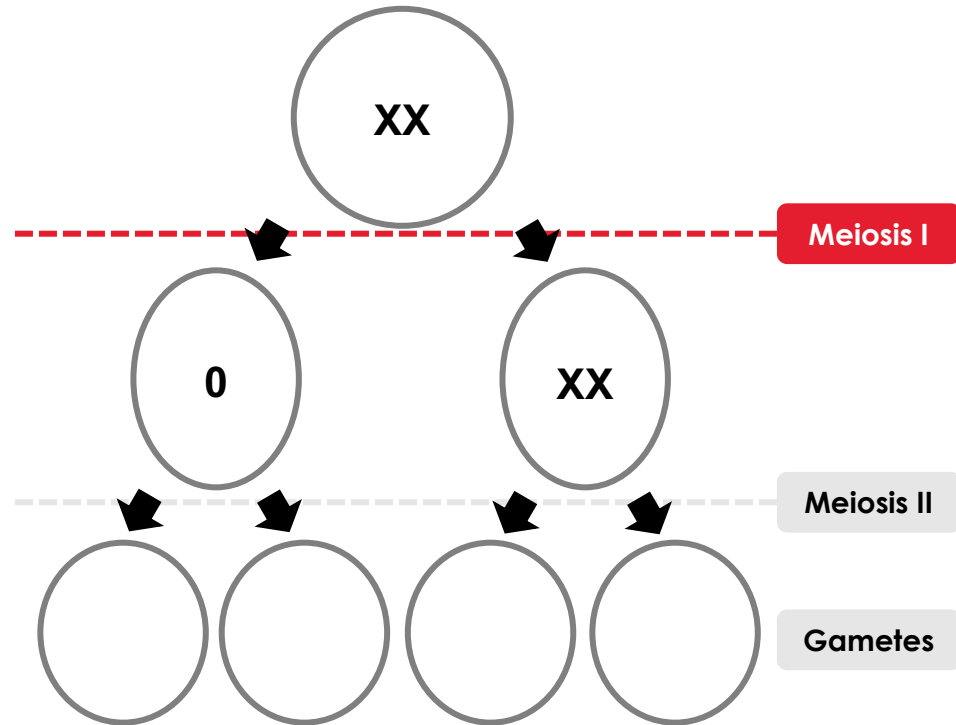
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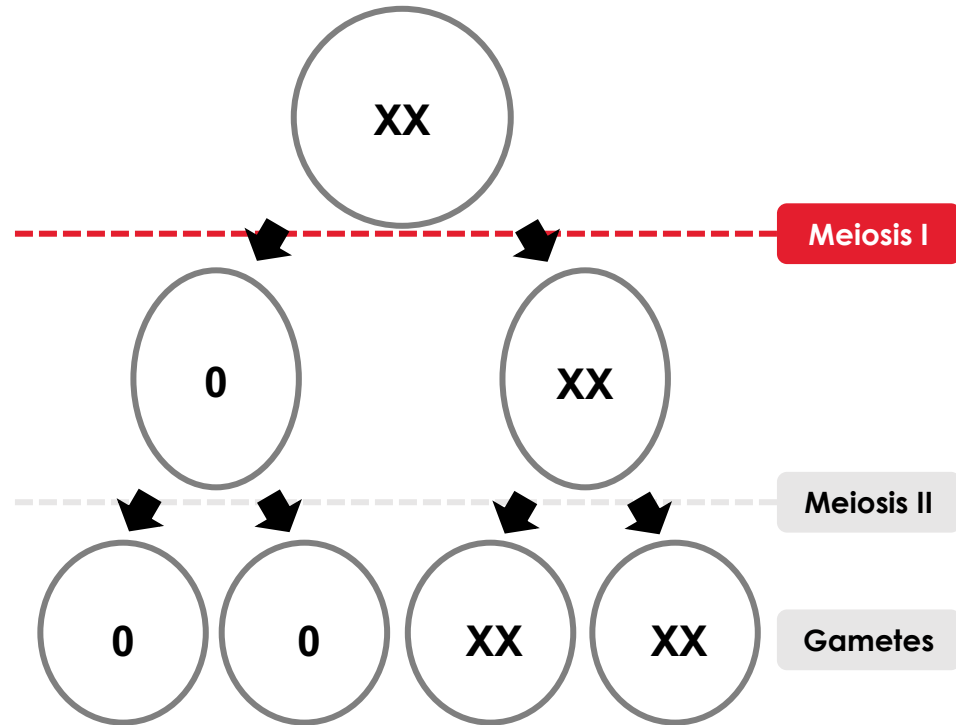
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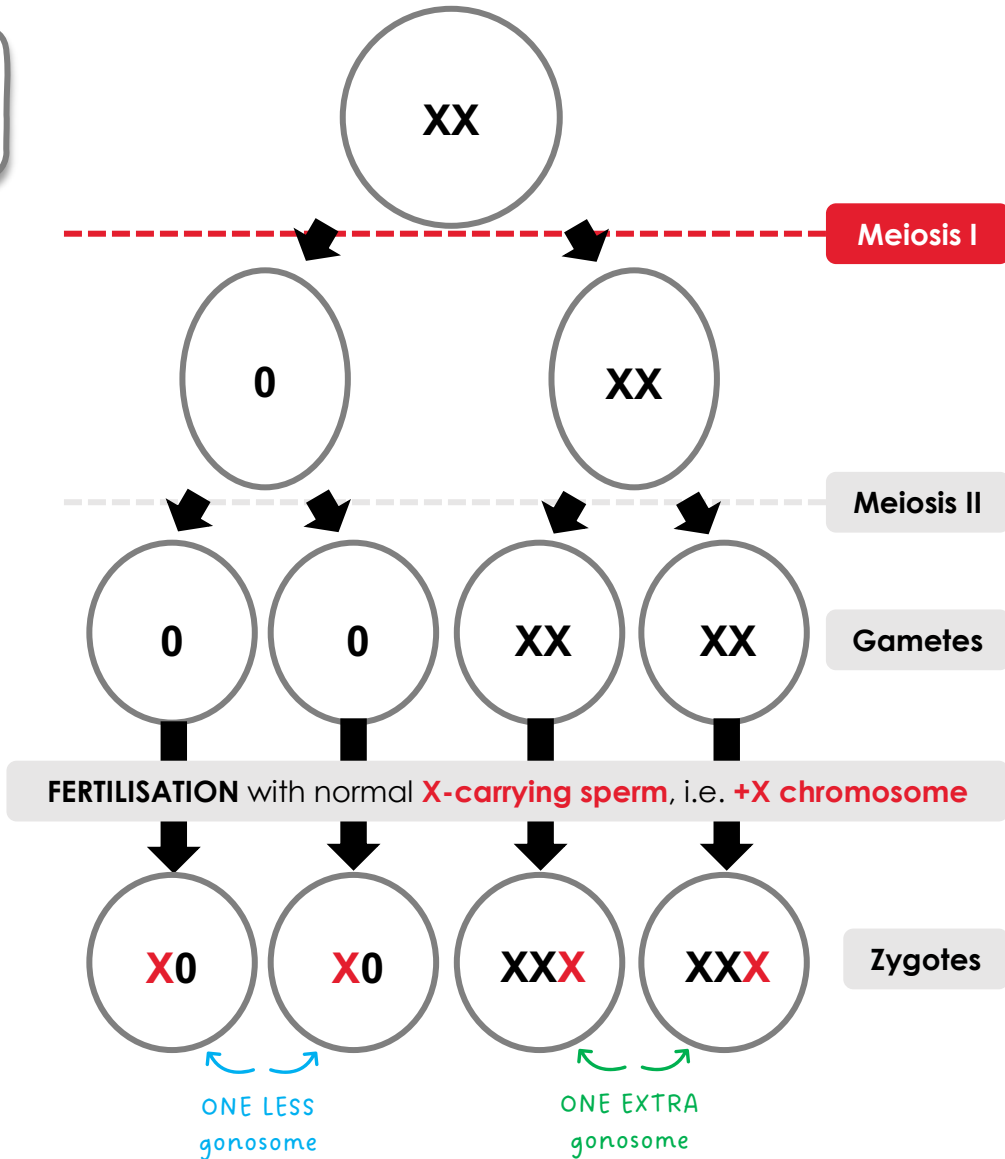
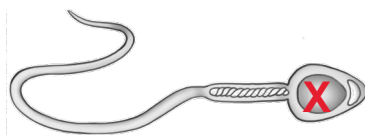
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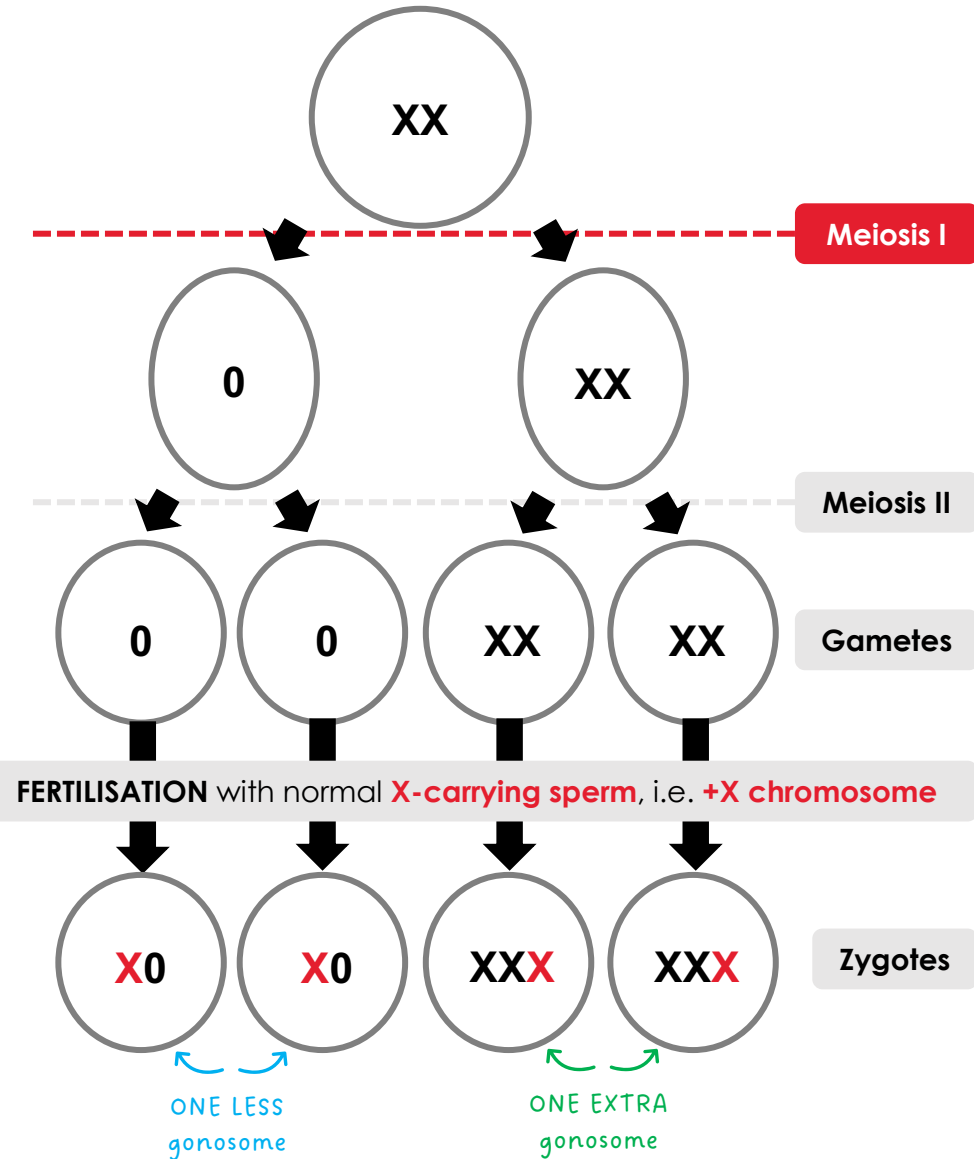
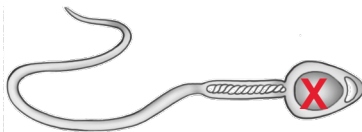
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# ABNORMAL MEIOSIS – understanding non-disjunction scenarios

Now let's assume an **XX gonosome pair** does not separate during **ANAPHASE I**...

OR...



These could only be **egg cells** in this case due to XX gonosome pair.

Extract from *The Answer Series* Grade 12 Life Sciences Part 2 (2024 ed.) p. 35

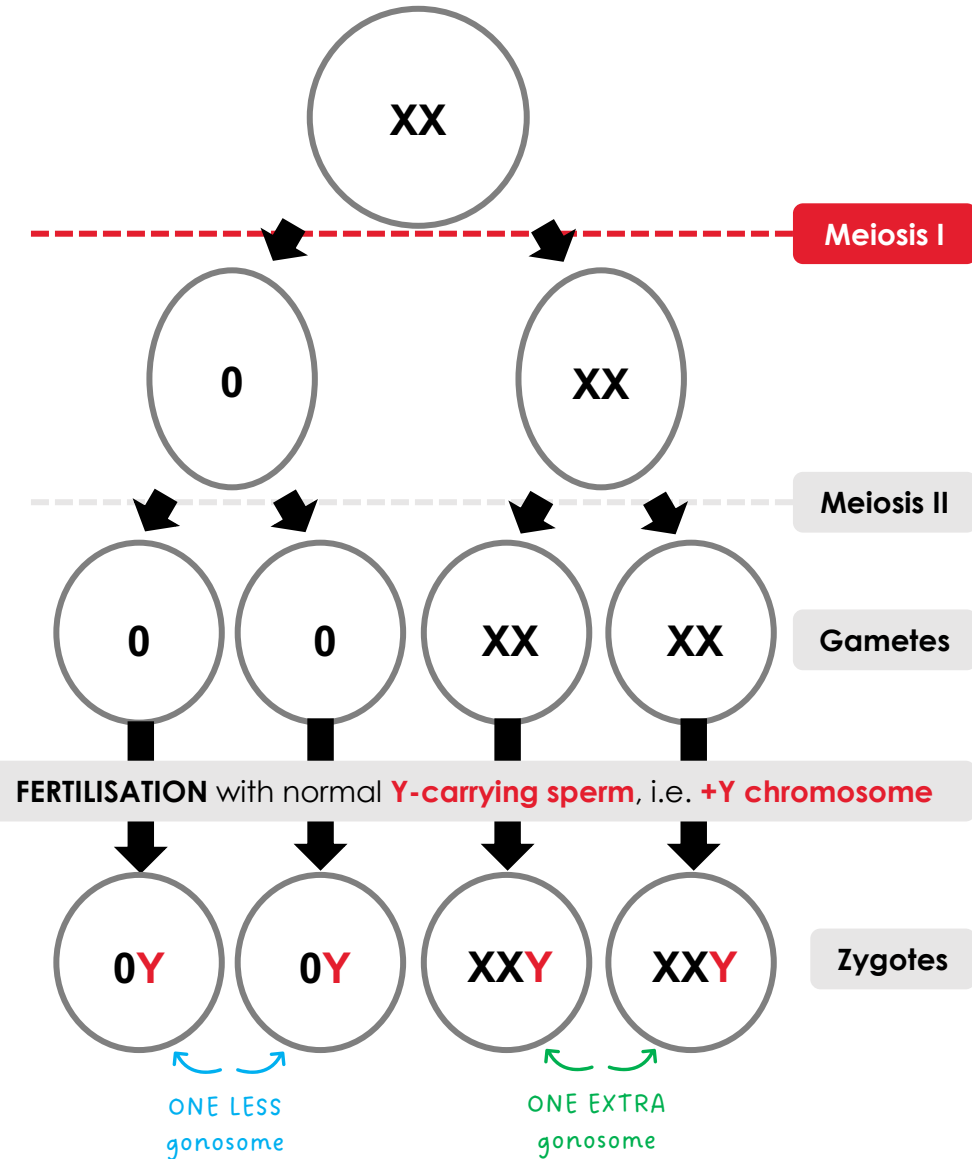
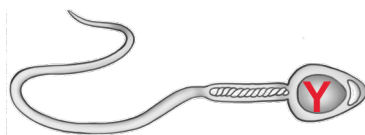


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Fertilisation occurs with a **Y-carrying sperm**...



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Extract from *The Answer Series* Grade 12 Life Sciences Part 2 (2024 ed.) p. 35



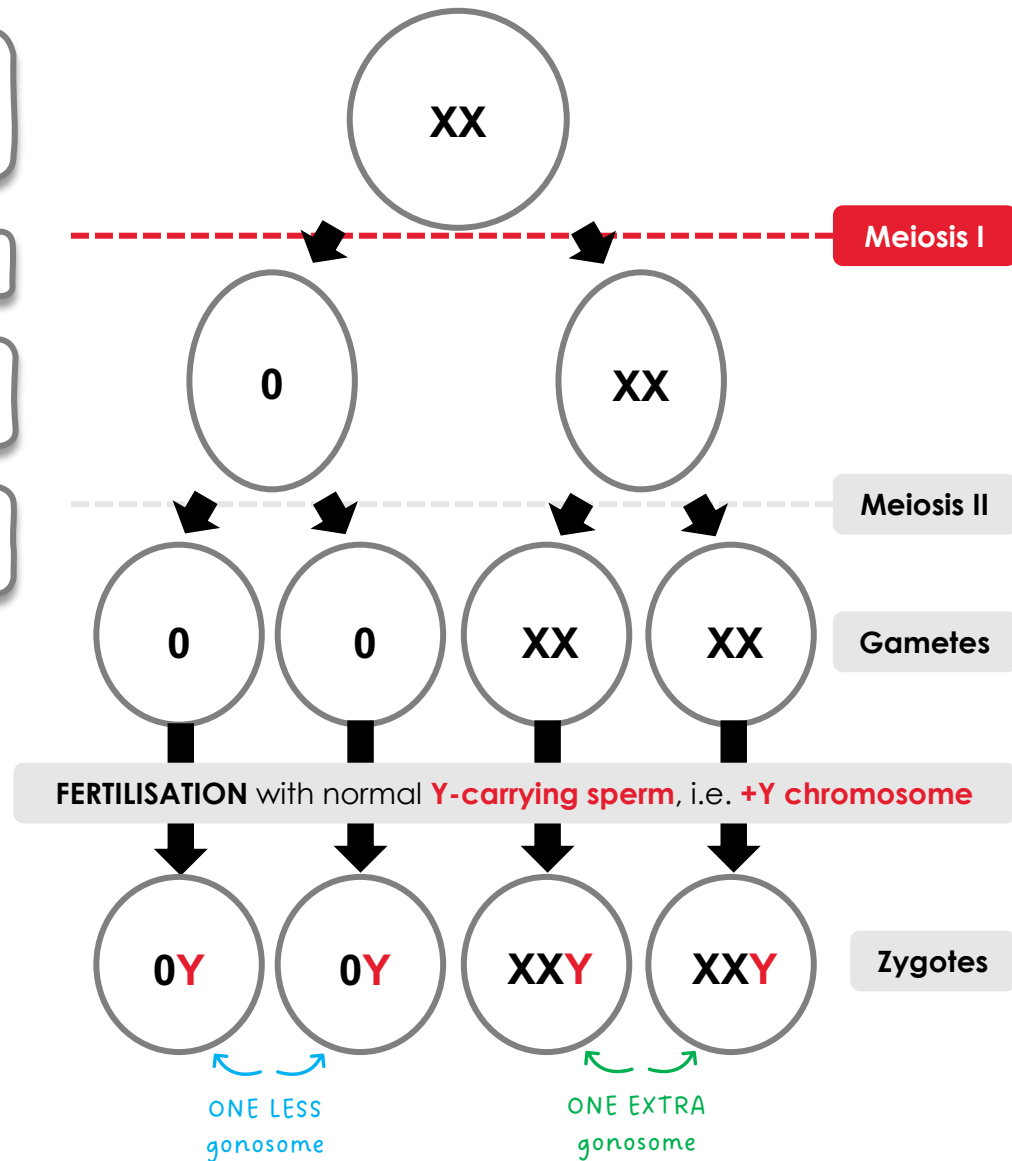
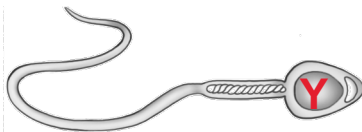
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Now let's assume an **XX gonosome pair** does not separate during **ANAPHASE I**...

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Fertilisation occurs with a **Y-carrying sperm**...

And that is how you get to the answers of Q 2.1.6.



These could only be **egg cells** in this case due to **XX gonosome pair**.

Extract from *The Answer Series* Grade 12 Life Sciences Part 2 (2024 ed.) p. 35



# GENETICS – inheritance patterns for different disorders

For simplicity let's use the letters D and d to represent all the alleles. The affected allele is indicated in **RED**.

**NOTE**  
Genetic notations for disorders were also covered in more detail on slides 84 to 87 in the [2023 Paper 2 Diagnostic Report Teaching & Learning Tool](#).



Disorder Type	Genotype Notations			
	Affected female	Unaffected female	Affected male	Unaffected male
<b>Autosomal Recessive</b>	<b>dd</b>	Dd or DD	<b>dd</b>	Dd or DD
<b>Autosomal Dominant</b>	<b>DD or Dd</b>	dd	<b>DD or Dd</b>	dd
<b>X-linked Recessive</b>	<b>X<sup>d</sup>X<sup>d</sup></b>	X <sup>D</sup> X <sup>D</sup> or X <sup>D</sup> X <sup>d</sup>	X <sup>d</sup> Y	X <sup>D</sup> Y
<b>X-linked Dominant</b>	X <sup>D</sup> X <sup>D</sup> or X <sup>D</sup> X <sup>d</sup>	X <sup>d</sup> X <sup>d</sup>	X <sup>D</sup> Y	X <sup>d</sup> Y

the allele is located somewhere on **chromosome pairs 1 to 22** (autosomes)

the allele is **linked to the X-chromosome** of pair 23 (gonosomes)

**NOTE**  
No X/Y annotation for autosomal disorders!



# DNA PROFILING – different applications

USE OF DNA PROFILE	WHAT TO LOOK FOR
<p><b>Forensics</b> <i>(Identification of a criminal, family member or a deceased person)</i></p>	<ul style="list-style-type: none"><li>• All the DNA bands of the suspect/family member</li><li>• must be <b>identical</b> to the DNA profile</li><li>• of the sample from the crime scene/missing person</li></ul>
<p><b>Paternity Testing</b></p>	<ul style="list-style-type: none"><li>• Each band of the child</li><li>• must <b>match either</b> that of the <b>mother</b></li><li>• or of the potential <b>father</b></li><li>• If the child has a band that does not match that of either parent</li><li>• then that excludes that male as the father</li></ul>

Extract from [2025 Diagnostic Report](#) p. 206



# NATURAL SELECTION – Format of steps



Explain the increase in starvation resistance in fruit flies using Darwin's Theory of Natural Selection.

- 1 Describe the **variation** in the original population.
- 2 Describe a **selection pressure**.  
(Think 'Then something happens...')
- 3 Describe the **struggle for survival**.
- 4 State Darwin's **theory**.
- 5 Describe the **inheritance of traits**.
- 6 What happens **after** a long **time**?

- 1 There was variation in the population of fruit flies – some were starvation resistant while some were not starvation resistant.
- 2 The food source was removed.
- 3 The fruit flies that were not starvation resistant died. Those that were starvation resistant survived and reproduced.
- 4 This is called Natural Selection.
- 5 Starvation resistant fruit flies survived and passed on the allele for starvation resistance to their offspring.
- 6 Eventually, the next generations will have a higher proportion of fruit flies that are starvation resistant.

# SCIENTIFIC INVESTIGATIONS - Components

3.4 Starvation resistance refers to the period for which an organism can go without food before it dies.

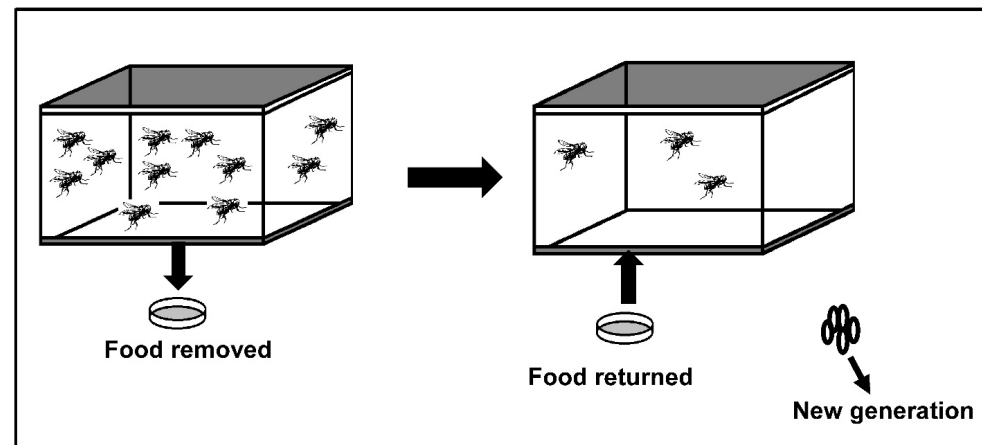
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## Aim of the investigation

Look for a 'TO', i.e. 'to determine...', 'to investigate...', 'to compare...' The aim will contain both variables and can be used for the hypothesis, variables and conclusion. *\*be careful of exceptions.*



 Continue learning



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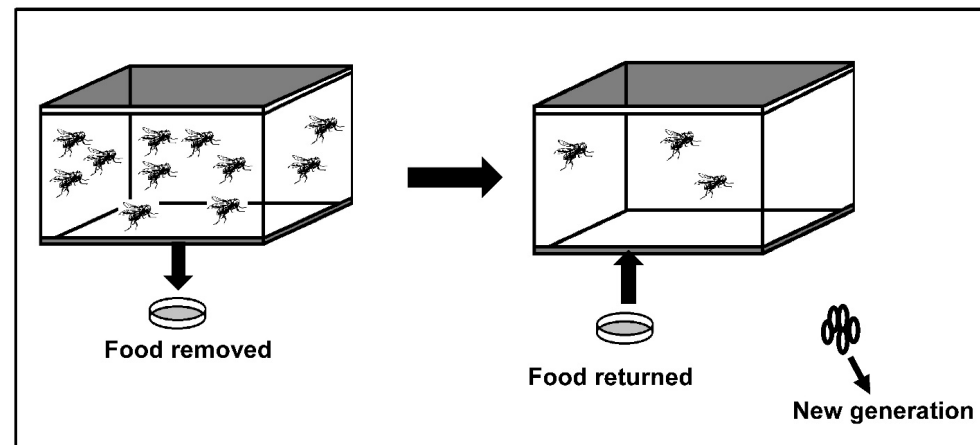
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## Dependent variable

the variable that is **measured**

## Independent variable

the variable that is **manipulated**



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# SCIENTIFIC INVESTIGATIONS - Components

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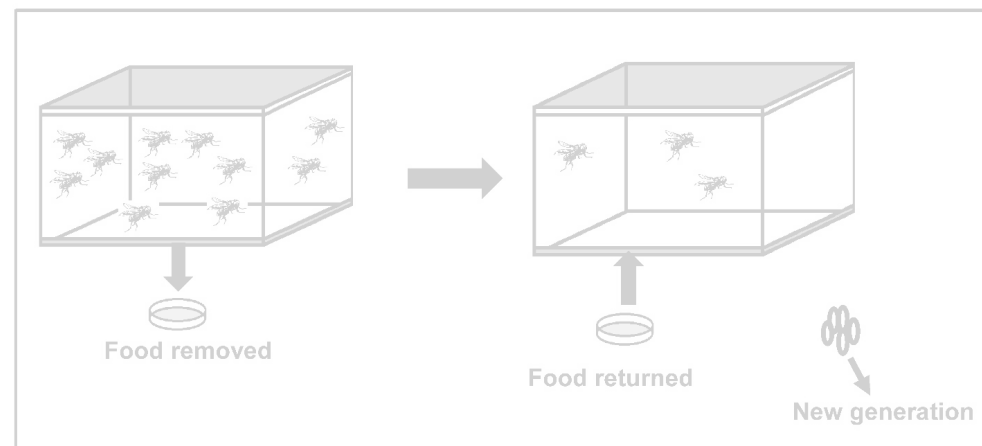
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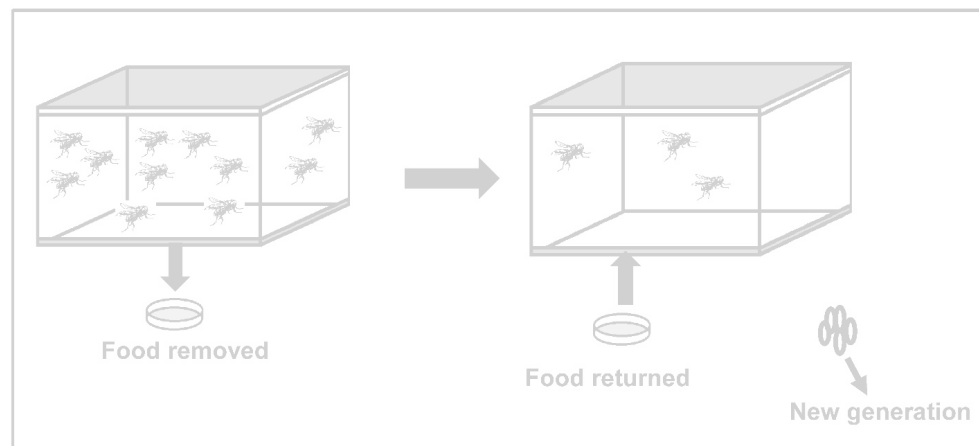
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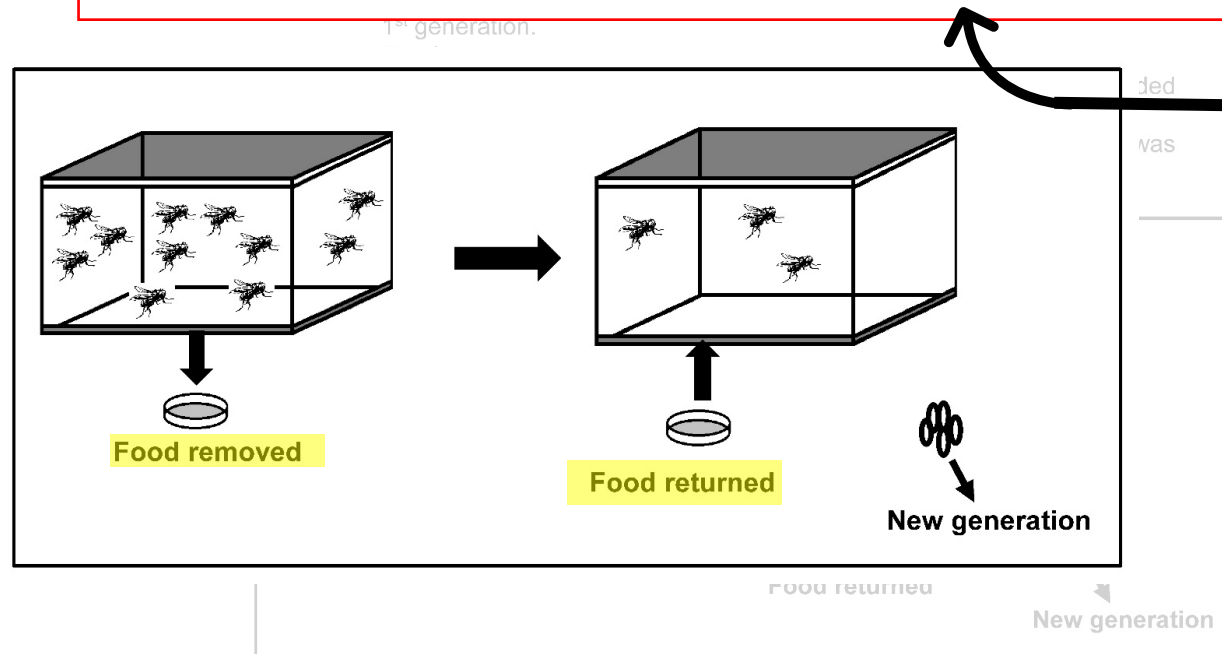
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i.e. the availability of food (look at what was manipulated in the setup)



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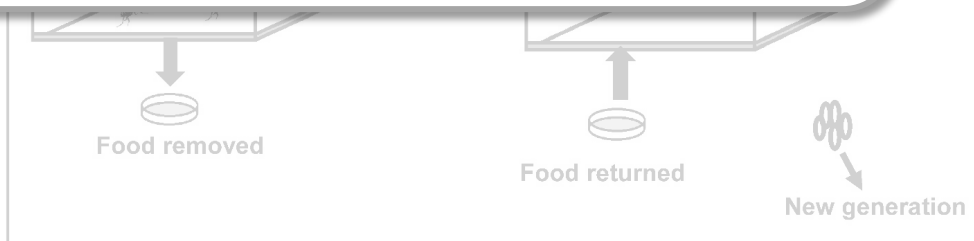
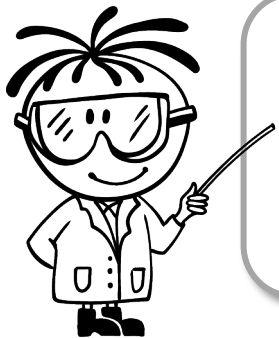
i.e. the availability of food (look at what was manipulated in the setup)

## NOTE

**What was measured?** – The effect of food availability

**How was it measured?** – By determining the time it took for 80% of the fruit flies to die from starvation

Watch out for **'effect of'** as this indirectly refers to the **dependent variable**. Look at the setup for what was manipulated regarding the food.



# SCIENTIFIC INVESTIGATIONS - Components

## Procedure

Detailed steps regarding how the experiment was conducted. Valuable information given includes:

- Sample size
- Duration
- Constant variables
- How measurements were taken

2.4

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## Aim of the investigation

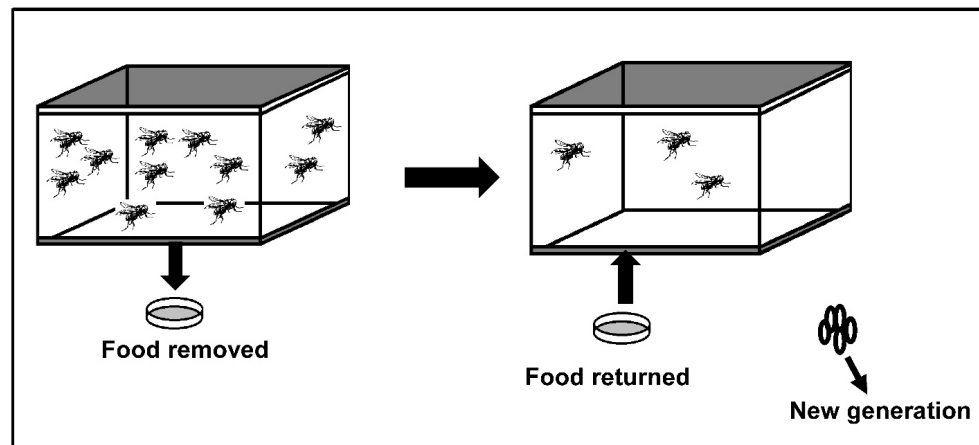
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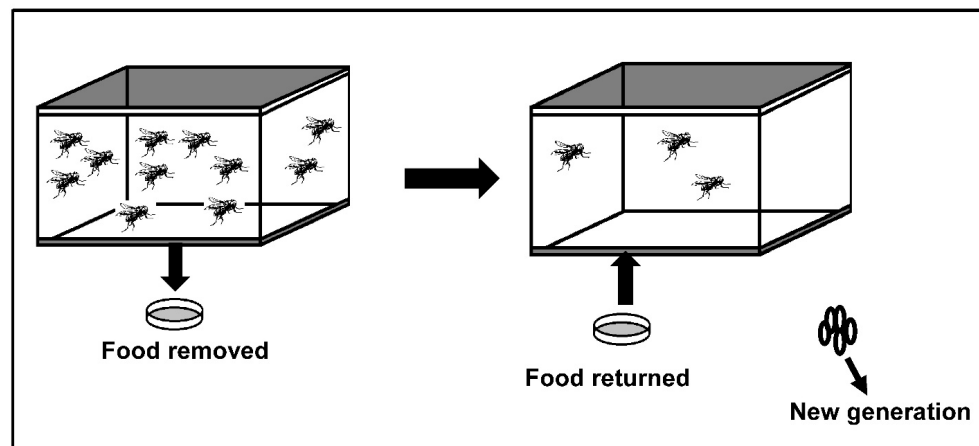
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Factors that have been kept the same. This ensures that the investigation is valid.

**IMPORTANT:** These factors are the ones explicitly mentioned, but there could be other factors that **should have been** kept constant but are not given in the question.



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# SCIENTIFIC INVESTIGATIONS - Components

## Procedure

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## Results

Can be given in table, graph or paragraph form. Look for a relationship or trend between the two variables.

**\*Be careful of using the results to extract the variables.**

Sometimes the results (table/graph) indicate how the dependent variable was measured and not exactly what the dependent variable is.

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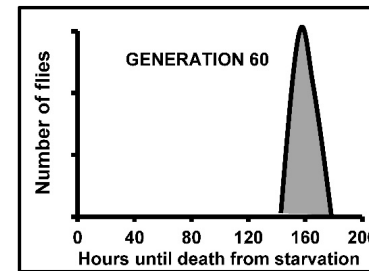
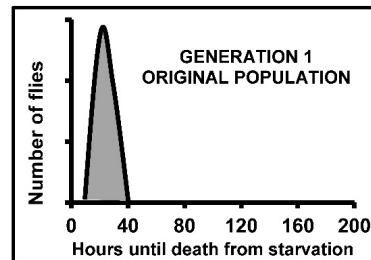
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## Drawing a conclusion

Look at the results and the aim. **Change the wording of the aim to show the relationship between the variables:**

### Results

In **generation 1**: the hours until death of all of the fruit flies was very short / less than 40 hours.

In **generation 60**: the hours until death of all of the fruit flies was very long / between 140 and 180 hours.

### Aim

To determine the effect of **food availability** on the **starvation resistance** of fruit flies.

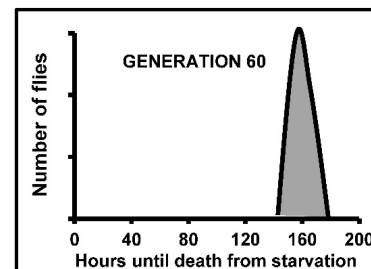
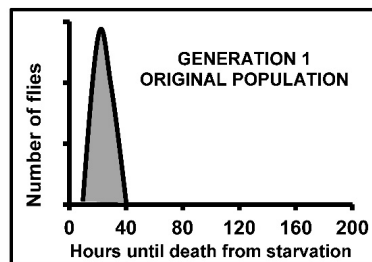
**Conclusion** ('So what is the effect of food availability on the starvation resistance of fruit flies?')

**Decreased/intermittent food availability** over successive generations of fruit flies **increases the starvation resistance** due to natural selection.



## NOTE

State an **explicit conclusion** and **do not use words** like '**directly proportional**' or '**indirectly/inversely proportional**' in Life Sciences!



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# SCIENTIFIC INVESTIGATIONS - Components

## Validity

Are your conclusions/data/observations valid ('correct') because you ensured that NOTHING BUT food availability could have influenced the investigation?

What about the species of fruit fly?

– **Maybe**, this is not explicitly mentioned in the procedure (✗ Valid)

What about the age of the fruit flies?

– **No**, this was kept constant (✓ Valid)

What about the environmental conditions?

– **No**, this was kept constant (they were all in the same container) (✓ Valid)

If all the answers were 'No', we could safely say that only the availability of food could have affected the starvation resistance of the fruit flies.

Remember the **V** in **Validity** for ensuring there are enough constant **V**ariables.

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## Reliability

When the investigation is repeated by someone else or the sample size is increased, will the results remain the same? Can we trust your conclusions/data/observations?

Was a large enough sample used? – Yes, 5 000 fruit flies is a large sample (✓ Reliable)

Was the investigation repeated? – Yes, up to the 60<sup>th</sup> generation (✓ Reliable)

Were multiple measurements of the dependent variable taken? – Yes, 60 times, i.e. with each repetition (✓ Reliable)

Therefore, we can say that this investigation was very reliable and may provide the same results time after time.

Remember the **R** in **Reliability** for **R**epeat the investigation, **R**aise the sample size, take more **R**eadings and **R**andom sampling.

