

Exercise walk-through

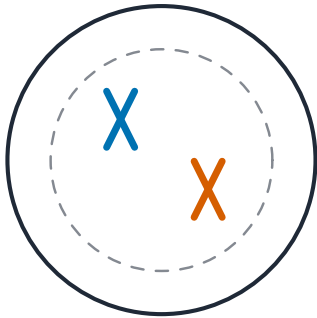
5.2

Chromosome behaviour in mitosis

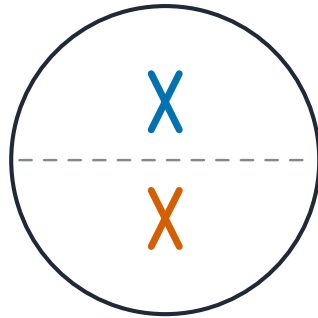
A-Level Biology

The four stages of mitosis

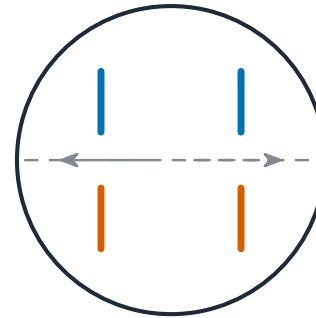
- **prophase** – chromosomes condense; **spindle** forms
- **metaphase** – line up at the **equator**
- **anaphase** – chromatids pulled apart
- **telophase** – two new nuclei form



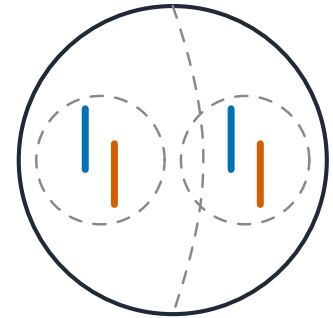
prophase



metaphase

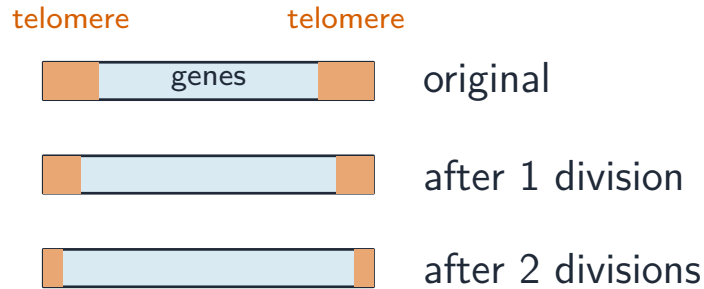


anaphase



telophase

Telomeres



the telomeres shorten each time, but the genes are kept

Copying cannot reach the very end of the DNA, so a little is lost each division.

Telomeres carry **no genes**, so they shorten instead – protecting the genes in the middle.

Exercises 2.1·2.2

2.1 Name the stage of mitosis in which: (a) chromosomes line up at the equator; (b) sister chromatids are pulled to opposite poles. [2]

2.2 State what happens to the nuclear envelope during (a) prophase and (b) telophase.[2]

Exercises 2.1-2.2

2.1 Name the stage of mitosis in which: (a) chromosomes line up at the equator; (b) sister chromatids are pulled to opposite poles. [2]

2.1

(a)

- metaphase

(b)

- anaphase

2.2 State what happens to the nuclear envelope during (a) prophase and (b) telophase.[2]

2.2

(a)

- it breaks down / disappears

(b)

- it re-forms around each set of chromosomes

Exercises 3.1-3.2

3.1 In which stage of mitosis do the centromeres split and the chromatids move apart?^[1]

☐

- A** anaphase
- B** metaphase
- C** prophase
- D** telophase

3.2 A cell is seen with its chromosomes lined up single-file across the centre of the cell.
This cell is in: ^[1]

☐

- A** anaphase
- B** interphase
- C** metaphase
- D** telophase

Exercises 3.1-3.2

3.1 In which stage of mitosis do the centromeres split and the chromatids move apart?[1]

☐

- A** anaphase
- B** metaphase
- C** prophase
- D** telophase

3.1 A

- In anaphase the centromeres split and chromatids move to opposite poles

3.2 A cell is seen with its chromosomes lined up single-file across the centre of the cell.
This cell is in: [1]

☐

- A** anaphase
- B** interphase
- C** metaphase
- D** telophase

3.2 C

- Chromosomes lined up across the centre is metaphase

Exercise 3.3 (a)

3.3 A student examines a root tip and counts the cells in each stage:

stage	interphase	prophase	metaphase	anaphase	telophase
number of cells	84	9	4	2	1

(a) Calculate the mitotic index for this sample. Show your working.

[2]

Exercise 3.3 (a)

3.3 A student examines a root tip and counts the cells in each stage:

stage	interphase	prophase	metaphase	anaphase	telophase
number of cells	84	9	4	2	1

(a) Calculate the mitotic index for this sample. Show your working. [2]

(a)

- cells in mitosis = $9 + 4 + 2 + 1 = 16$; total = $84 + 16 = 100$. mitotic index = $\frac{16}{100} = 0.16$

Exercise 3.3 (b)

3.3 A student examines a root tip and counts the cells in each stage:

stage	interphase	prophase	metaphase	anaphase	telophase
number of cells	84	9	4	2	1

(b) The cells of a tumour have a much higher mitotic index than normal tissue. Explain why. [2]

Exercise 3.3 (b)

3.3 A student examines a root tip and counts the cells in each stage:

stage	interphase	prophase	metaphase	anaphase	telophase
number of cells	84	9	4	2	1

(b) The cells of a tumour have a much higher mitotic index than normal tissue. Explain why. [2]

(b)

- the tumour cells divide uncontrollably / continuously, so at any moment a larger fraction are in mitosis

Exercise 3.4

3.4 Describe the behaviour of the chromosomes and the spindle during metaphase and anaphase. [4]

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3.4

- metaphase: chromosomes line up at the equator; spindle fibres attach to the centromeres; anaphase: centromeres split; sister chromatids are pulled by the spindle to opposite poles

Exercise 3.5 (a)

3.5 Four cells from a root tip were each seen in a different stage of mitosis.

- **W** chromosomes lined up singly along the equator
- **X** chromatids being pulled towards opposite poles
- **Y** chromosomes at the poles, nuclear envelopes re-forming
- **Z** chromosomes condensing and becoming visible, nuclear envelope breaking down

(a) Name the stage shown by each cell, and put the four in the correct order. [5]

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(a) Name the stage shown by each cell, and put the four in the correct order. [5]

(a)

- **Z** prophase, **W** metaphase, **X** anaphase, **Y** telophase; the order is Z, W, X, Y

Exercise 3.5 (b)

3.5 Four cells from a root tip were each seen in a different stage of mitosis.

- **W** chromosomes lined up singly along the equator
- **X** chromatids being pulled towards opposite poles
- **Y** chromosomes at the poles, nuclear envelopes re-forming
- **Z** chromosomes condensing and becoming visible, nuclear envelope breaking down

(b) Describe what the spindle does in stages **W** and **X**.

[3]

Exercise 3.5 (b)

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(b) Describe what the spindle does in stages **W** and **X**. [3]

(b)

- In metaphase (**W**) the spindle fibres attach to the centromere of each chromosome and pull until the chromosomes lie on the equator. In anaphase (**X**) the fibres shorten, the centromeres split, and the sister chromatids are dragged to opposite poles

Exercise 3.5 (c)

3.5 Four cells from a root tip were each seen in a different stage of mitosis.

- **W** chromosomes lined up singly along the equator
- **X** chromatids being pulled towards opposite poles
- **Y** chromosomes at the poles, nuclear envelopes re-forming
- **Z** chromosomes condensing and becoming visible, nuclear envelope breaking down

(c) A root tip contained 240 cells, of which 12 were in stage **X**. The whole cell cycle takes 20 hours. Estimate how long stage **X** lasts, showing your working. [3]

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(c)

- The proportion of cells seen in a stage is proportional to the time spent in it; $\frac{12}{240} = 0.05$; $0.05 \times 20 \text{ h} = 1 \text{ hour}$

Exercise 3.5 (d)

3.5 Four cells from a root tip were each seen in a different stage of mitosis.

- **W** chromosomes lined up singly along the equator
- **X** chromatids being pulled towards opposite poles
- **Y** chromosomes at the poles, nuclear envelopes re-forming
- **Z** chromosomes condensing and becoming visible, nuclear envelope breaking down

(d) Explain why mitosis must produce genetically identical daughter nuclei, and name **one** process in the cell cycle that ensures this. [2]

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(d)

- Growth, repair and asexual reproduction all need daughter cells carrying the same genes as the parent, so they work in the same way; **semi-conservative DNA replication** during interphase makes an exact copy of every chromosome before division