

Exercise walk-through

27.1

Cell division: count nuclei and chromosomes carefully

International Baccalaureate · IB Diploma · Biology · SL

27.1 Cell division: count nuclei and chromosomes carefully

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

KEY WORDS chromatid • mitotic index

Objective

Cell division: count nuclei and chromosomes carefully. Supported SL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

1 Key knowledge and worked examples

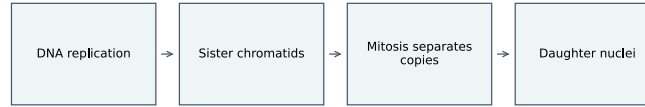
■ What would explain this observation?

- A root-tip image contains cells at different stages of mitosis. A snapshot can estimate the fraction of cells dividing, but it does not time one observed cell directly.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- DNA replication occurs before mitosis. Mitosis separates sister **chromatids**, preserving chromosome number in daughter nuclei. Meiosis includes homologous chromosome separation and normally halves the chromosome number while generating variation.
- **mitotic index** : Fraction of scored cells undergoing mitosis; chromatid:

One copy of a replicated chromosome before separation.



■ Choose evidence that can test it

- Count chromosomes by centromeres under the stated convention. DNA amount and chromosome number are different quantities. Crossing over and independent assortment contribute to meiotic variation.
- Use a prepared root-tip slide or a labelled image. Define a counting rule and field selection before counting. Distinguish dividing cells from damaged or ambiguous cells and report exclusions.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: 25 dividing cells among 200 scored cells. Mitotic index = $25/200 = 0.125$, or 12.5%. Estimating phase duration from this proportion requires assumptions about a steady, representative cell population.

Example:

18 of 120 scored cells are dividing. Calculate mitotic index as a percentage. Use the same sequence: known quantities $\rightarrow$ model $\rightarrow$ relation $\rightarrow$ substitution $\rightarrow$ unit and interpretation.

■ Check the conclusion and its limits

- Replication doubles DNA amount without immediately doubling the chromosome count. Meiosis does not simply produce two identical diploid cells.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

DNA replication immediately doubles chromosome number under the centromere convention. This claim is false: Replication doubles DNA amount without immediately doubling the chromosome count. Meiosis does not simply produce two identical diploid

cells.

Key:

Cell division: count nuclei and chromosomes carefully: Count chromosomes by centromeres under the stated convention. DNA amount and chromosome number are different quantities. Crossing over and independent assortment contribute to meiotic variation.

Exercises 2.1·2.3

2.1 What happens to DNA amount during replication before mitosis? Choose one answer.

- **A** It doubles
- **B** It disappears
- **C** It always halves

[1]

2.2 18 of 120 scored cells are dividing. Calculate mitotic index as a percentage. Show the relation, substitution and units. [2]

2.3 Decide whether this claim is true and justify: DNA replication immediately doubles chromosome number under the centromere convention. [2]

Exercises 2.1-2.3

2.1 What happens to DNA amount during replication before mitosis? Choose one answer.

- **A** It doubles
- **B** It disappears
- **C** It always halves

[1]

2.1 A Count chromosomes by centromeres under the stated convention. DNA amount and chromosome number are different quantities. Crossing over and independent assortment contribute to meiotic variation.

2.2 18 of 120 scored cells are dividing. Calculate mitotic index as a percentage. Show the relation, substitution and units.

[2]

2.2 mitotic index = $18/120 \times 100 = 15\%$.

2.3 Decide whether this claim is true and justify: DNA replication immediately doubles chromosome number under the centromere convention.

[2]

2.3 False. Replication doubles DNA amount without immediately doubling the chromosome count. Meiosis does not simply produce two identical diploid cells.

Exercises 2.4·3.1

2.4 Fraction of scored cells undergoing mitosis: write the technical term. [1]

3 Exam-style questions

3.1 In fictional snapshots, 30/200 cells and 18/120 cells are dividing. Does the smaller dividing count imply slower division? Could these observations establish phase duration?[4]

Exercises 2.4·3.1

2.4 Fraction of scored cells undergoing mitosis: write the technical term. [1]

3 Exam-style questions

2.4 mitotic index. mitotic index means Fraction of scored cells undergoing mitosis.

3.1 In fictional snapshots, 30/200 cells and 18/120 cells are dividing. Does the smaller dividing count imply slower division? Could these observations establish phase duration?[4]

3.1 Both indices are 15%. Counts have different denominators. Duration inference additionally needs a representative asynchronous steady population and cycle information; a snapshot alone is insufficient.