

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.

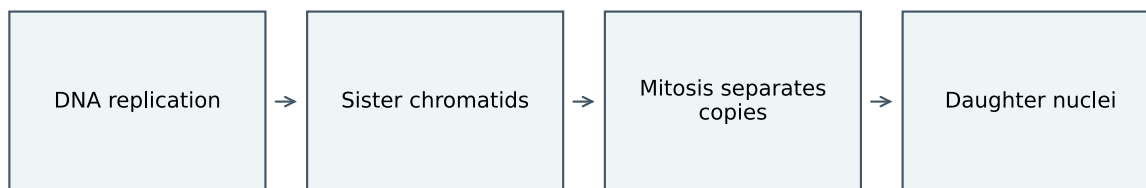
1 Key knowledge and worked examples

■ 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.
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■ 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 → model → relation → substitution → 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.

2 Practice

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]

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]
