Cell and nuclear division

International Baccalaureate · IB Diploma · Biology · SL

Scope and prerequisites

This handout covers selected SL topics for the course first assessed in 2025; it is not the whole syllabus.

Prerequisites: read the stated quantities and units, and use arithmetic and the model conditions below.

The examples are original and fictional: they are not real measurements or real student investigations.

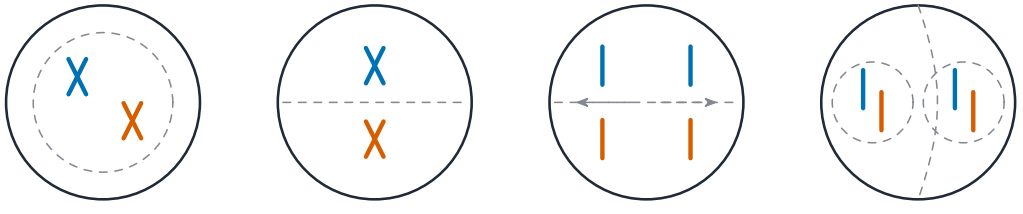
Cell division: count nuclei and chromosomes carefully

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.

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.



Two chromosomes in the parent nucleus, two in each daughter nucleus: mitosis keeps the number

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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.

In the lab: 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

- 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.

Your turn: 18 of 120 scored cells are dividing. Calculate mitotic index as a percentage.

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.

Not true: DNA replication immediately doubles chromosome number under the centromere convention. Under the centromere convention a chromosome with two sister chromatids still counts as one chromosome. Replication doubles DNA content; only sister-chromatid separation later doubles the chromosome count.

Key:

- DNA replication occurs before mitosis.
- Count chromosomes by centromeres under the stated convention.
- Watch for: replication doubles DNA amount without immediately doubling the chromosome count.

Write from a mitotic index of 12 percent

- 9 of 75 scored cells are dividing.
- Find the mitotic index. Under the centromere convention, replication does not immediately double the chromosome number.