

The Mitotic Cell Cycle

A-Level Biology ■ Topic 5

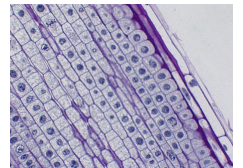
A-Level Biology



The Mitotic Cell Cycle

What we will cover

- 1 Chromosome structure
- 2 The cell cycle
- 3 The stages of mitosis
- 4 Telomeres
- 5 Stem cells
- 6 Tumours



cells caught dividing

1

Chromosomes and the cycle

The Mitotic Cell Cycle

└ Chromosomes and the cycle

Chromosome structure

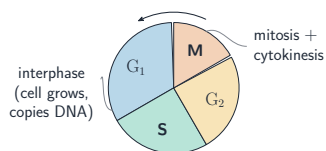
DNA wraps around **histone** 组蛋白 proteins to make **chromatin** 染色质. Before mitosis it condenses into a visible chromosome of two **sister chromatids** 姐妹染色单体 joined at the **centromere** 着丝粒.

A chromatid is one copy of the replicated DNA. Once the centromere splits they are chromosomes.

The Mitotic Cell Cycle

└ Chromosomes and the cycle

The cell cycle



■ **interphase** 间期: grow (G_1), copy DNA (S), grow (G_2)

■ **mitosis** 有丝分裂: the nucleus divides

■ **cytokinesis** 胞质分裂: the cell splits

Mitosis makes **identical** cells – for growth, repair & **asexual reproduction** 无性生殖.

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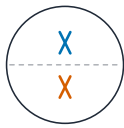
Mitosis

The four stages of mitosis

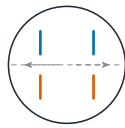
- **prophase** 前期 – chromosomes condense; **spindle** 纺锤体 forms
- **metaphase** 中期 – line up at the **equator** 赤道
- **anaphase** 后期 – chromatids pulled apart
- **telophase** 末期 – two new nuclei form



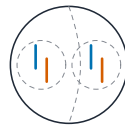
prophase



metaphase

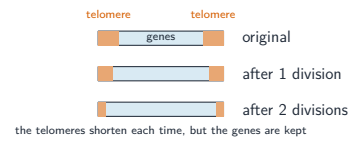


anaphase



telophase

Telomeres



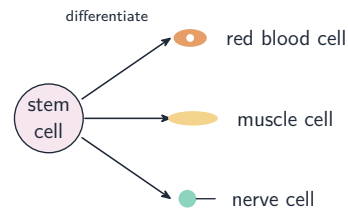
Copying cannot reach the very end of the DNA, so a little is lost each division.

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

3

Stem cells and tumours

Stem cells



A **stem cell** 干细胞 is unspecialised. It keeps dividing and can **differentiate** 分化 into many specialised cell types. They are the source of new cells for repair & replacement.

Uncontrolled division and tumours



controlled: cells stop dividing



uncontrolled: a tumour grows

The cell cycle is normally tightly controlled, so cells divide only when needed.

If that control is lost, a cell divides again and again, forming a lump of cells – a **tumour** 肿瘤.

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Recap

Worked example – mitotic index

In a root-tip sample, 8 of the 50 cells seen are in mitosis. Find the mitotic index.

- Mitotic index = $\frac{\text{cells in mitosis}}{\text{total cells}}$
- = $\frac{8}{50} = 0.16$ (or 16%)
- It is a *proportion*, so it has no units.
- A high index means a lot of division – normal in a root tip, but a warning sign in other tissue.

Count *every* cell in the field, not just the dividing ones. Cells with *visible chromosomes* are in mitosis; a plain nucleus means interphase.

Topic 5 – key takeaways

1 Chromosome

sister chromatids joined at a centromere

2 Cell cycle

interphase (G_1 , S, G_2) then mitosis

3 Mitosis

prophase, metaphase, anaphase, telophase

4 Control

stem cells differentiate; lost control → tumour

Check yourself

- 1 What joins two sister chromatids?
- 2 In which interphase stage is DNA copied?
- 3 At which stage do chromosomes line up at the equator?
- 4 What forms when cell-cycle control is lost?



Answers 1. the centromere 2. the S phase 3. metaphase 4. a tumour