

5.1 Replication and division of nuclei and cells

Name: _____ Class: _____ Date: _____

Total: 12 marks

KEY WORDS cell cycle 细胞周期 • telomere 端粒 • mitosis 有丝分裂 • mitotic cell cycle 有丝分裂细胞周期
• stem cell 干细胞

Objective

Build the skills to answer exam questions on **replication and division of nuclei and cells** — the structure of a **chromosome** 染色体, the **mitotic cell cycle** 有丝分裂细胞周期, **telomeres** 端粒, **stem cells** 干细胞 and **tumours** 肿瘤.

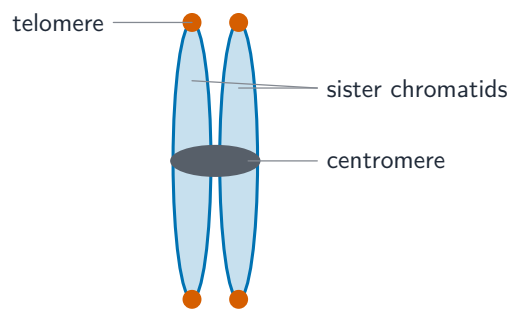
You must be able to:

- describe the structure of a chromosome (DNA, histones, sister chromatids, centromere, telomeres)
- explain the importance of mitosis and outline the cell cycle (interphase, mitosis, cytokinesis)
- outline the roles of telomeres and stem cells, and how a tumour forms

1 Worked examples

■ The structure of a chromosome

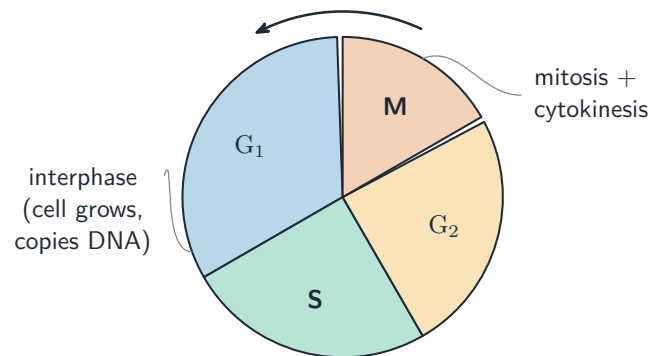
A chromosome is one long DNA molecule wound around **histone** 组蛋白 proteins. After **replication** 复制 it is two identical **sister chromatids** 姐妹染色单体 joined at the **centromere** 着丝粒, with **telomeres** capping the tips.



one chromosome = two identical copies after DNA replication

After replication: two sister chromatids joined at the centromere, telomeres at the tips

■ The mitotic cell cycle



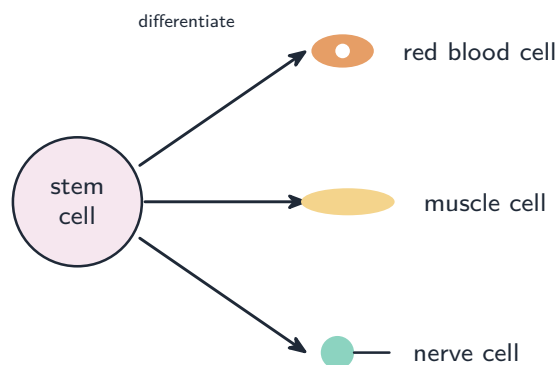
Most of the cycle is interphase (G₁, S, G₂); mitosis and cytokinesis are short

- **interphase** 间期 — growth (G₁), DNA replication (S), growth/preparation (G₂).
- **mitosis** 有丝分裂 — the nucleus divides into two **genetically identical** nuclei.
- **cytokinesis** 胞质分裂 — the cell splits into two daughter cells.

Mitosis matters for growth, replacement of dead cells, tissue repair and **asexual reproduction** 无性生殖.

■ Telomeres, stem cells and tumours

Telomeres carry **no genes**, so the small amount lost at each replication does not lose genes. A **stem cell** is unspecialised, keeps dividing, and can **differentiate** 分化 into specialised cells. If the control of the cycle is lost, a cell divides uncontrollably to form a **tumour**.



One stem cell can differentiate into many specialised cell types

2 Practice

2.1 Name the parts of a chromosome labelled by these descriptions: (a) where two sister chromatids are joined; (b) the protective caps at the tips. [2]

2.2 State what happens in the **S phase** of interphase. [1]

3 Exam-style questions

3.1 During which phase of the cell cycle is DNA replicated? [1]

- A G_1
- B S
- C G_2
- D mitosis

3.2 Why does the loss of a small length of telomere during replication **not** harm the cell? [1]

- A telomeres are made of protein
- B telomeres carry no genes
- C telomeres are replaced by histones
- D the lost DNA is copied later

3.3 Explain why mitosis produces two genetically identical daughter cells, and give **two** situations where this is important. [3]

3.4 (a) State what is meant by a stem cell. [2]

(b) Explain how the loss of control of the cell cycle can lead to a tumour. [2]

Solutions

2.1 (a) centromere; (b) telomeres.

2.2 the DNA is replicated / copied.

3.1 B. DNA is replicated in the S phase.

3.2 B. Telomeres carry no genes, so losing a little does not lose genes.

3.3 mitosis copies the DNA exactly (S phase) and separates identical sister chromatids, so each daughter gets an identical set of genes; any two of: growth / replacement of dead cells / tissue repair / asexual reproduction.

3.4 (a) an unspecialised cell that can keep dividing and can differentiate into specialised cells.

(b) the cell divides repeatedly without stopping, forming an uncontrolled mass of cells — a tumour.