

# 5.1 Replication and division of nuclei and cells

Name: \_\_\_\_\_ Class: \_\_\_\_\_ Date: \_\_\_\_\_

Total: 12 marks

**KEY WORDS** cell cycle • chromosome • mitosis • telomere  
• stem cell

## Objective

Build the skills to answer exam questions on **replication and division of nuclei and cells** – the structure of a **chromosome**, the **mitotic cell cycle**, **telomeres**, **stem cells** and **tumours**.

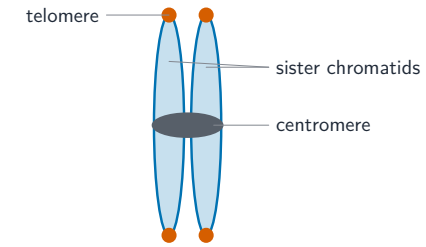
You must be able to:

- 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 Key knowledge and worked examples

### ■ The structure of a chromosome

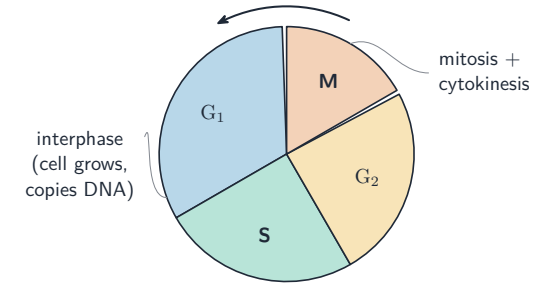
A chromosome is one long DNA molecule wound around **histone** proteins. After **replication** it is two identical **sister chromatids** joined at the **centromere**, with **telomeres** capping the tips.



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



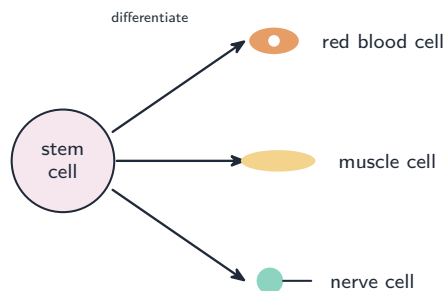
*Most of the cycle is interphase (G<sub>1</sub>, S, G<sub>2</sub>); mitosis and cytokinesis are short*

- interphase** – growth (G<sub>1</sub>), DNA replication (S), growth/preparation (G<sub>2</sub>).
- mitosis** – the nucleus divides into two **genetically identical** nuclei.
- cytokinesis** – the cell splits into two daughter cells.

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

### ■ 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** 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]