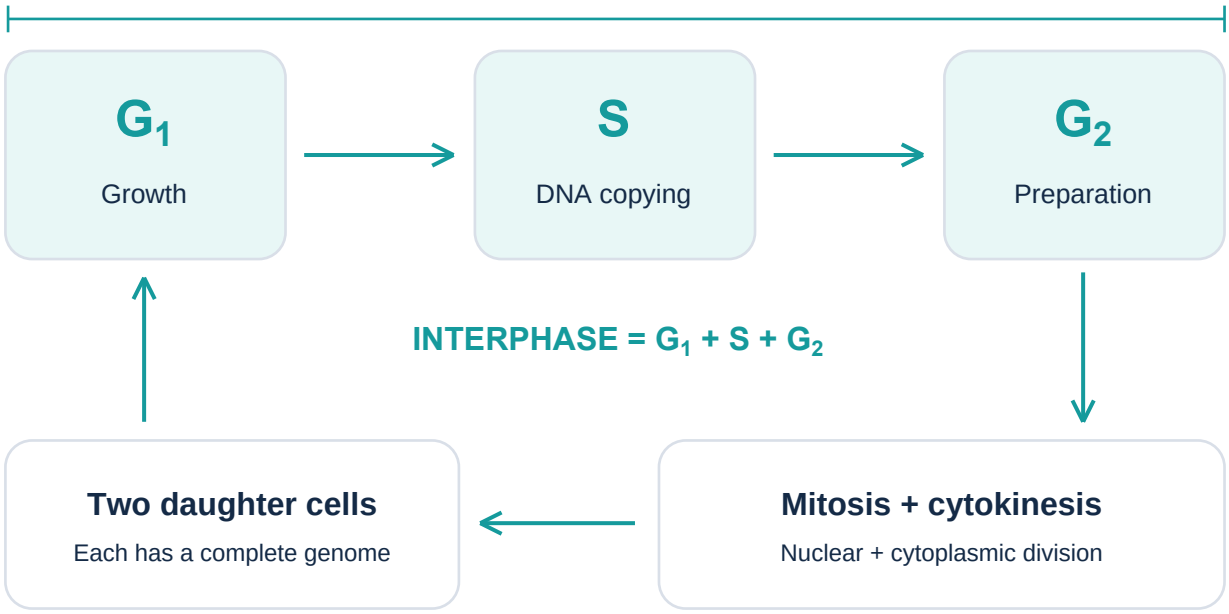
Grow, copy, divide, repeat

The mitotic cell cycle coordinates cell growth, DNA replication, nuclear division and division of the cytoplasm. Daughter cells may enter another cycle.

1. FOLLOW THE ORDER



2. INTERPHASE IS ACTIVE, NOT A REST

G_1, S and G_2 form interphase. The cell grows, carries out metabolism and prepares for division. DNA copying occurs in S phase, not throughout interphase and not during mitosis.

3. THE TWO DIVISION PROCESSES HAVE DIFFERENT JOBS

Mitosis distributes replicated chromosomes into two daughter nuclei. Cytokinesis partitions the cytoplasm into two cells. Cytokinesis often overlaps late mitosis; the names describe different processes, not an absolute timing boundary.

Diagram widths and arrow lengths do not represent duration. Cells differ in cycle length, and not every daughter cell immediately divides again.

Cycle sequence: NHGRI, Cell Cycle.
Interphase and division processes: OpenStax Biology 2e, section 10.2.

Scope: Cambridge Biology 9700 syllabus, section 5.1, outcome 3, p. 23.

What happens at each stage?

The key is to connect each phase with its job. Preparing DNA copies and distributing them are separate events.

1. G_1: GROW BEFORE COPYING

The cell increases in size and synthesises proteins and cellular components. Its chromosomes have not yet been replicated for this cycle. Normal cell activities continue.

2. S: SYNTHESISE DNA

Each chromosome's DNA is copied. By the end of S phase, each chromosome has two sister chromatids. DNA content has doubled, but chromosome number has not.

3. G_2: PREPARE FOR MITOSIS

Further growth and synthesis of materials needed for division occur. Replicated DNA is already present. G_2 is not a second round of DNA replication.

4. MITOSIS: DIVIDE THE NUCLEUS

Sister chromatids separate and are distributed to two daughter nuclei. Each receives the same chromosome complement, provided copying and segregation are accurate.

5. CYTOKINESIS: DIVIDE THE CYTOPLASM

The cytoplasm separates to form daughter cells. Animal cells usually pinch inward; in plant cells a cell plate develops between the daughter nuclei, contributing to the new partition.

M phase commonly includes both mitosis and cytokinesis. Mitosis alone means nuclear division. Detailed chromosome movements within mitosis are covered in later lessons.

Growth, replication and preparation: Alberts et al., An Overview of the Cell Cycle.

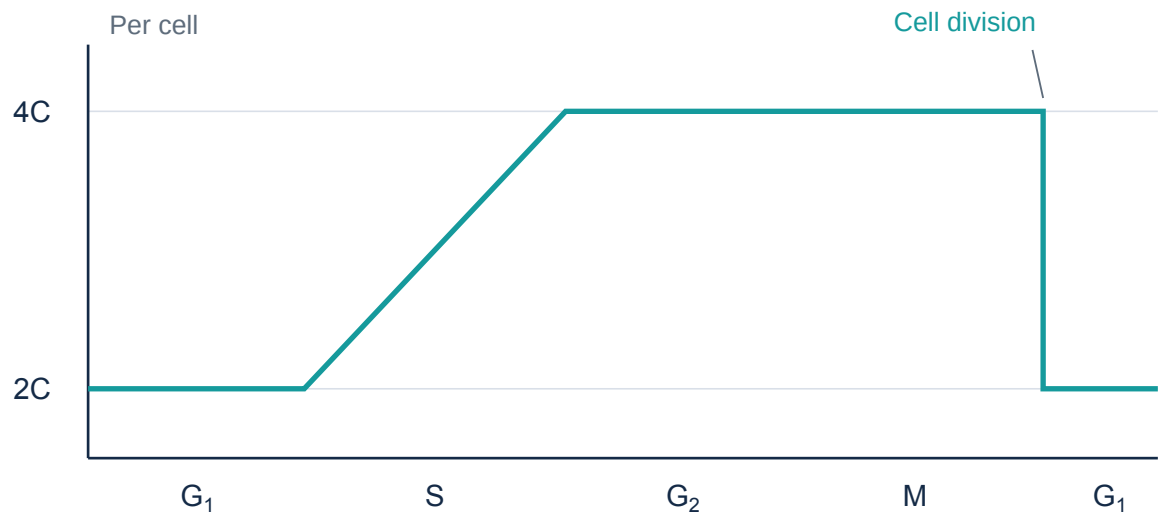
Mitosis and cytokinesis: OpenStax Biology 2e, section 10.2.

Scope: Cambridge Biology 9700 syllabus, section 5.1, outcome 3, p. 23.

DNA content is not chromosome number

Supporting graph: follow nuclear DNA content per cell in a typical diploid mitotic cycle. C means the DNA amount in one haploid genome, not a chromosome count.

1. COPY ONCE; SHARE BETWEEN TWO CELLS



Schematic progression through the cycle; not a time scale

2. WHY THE GRAPH RISES AND FALLS

S phase raises DNA content from 2C to 4C. It remains 4C through G_2 and in the whole cell during mitosis before cell separation. After cytokinesis, each daughter cell has 2C. DNA is distributed, not destroyed.

3. A HUMAN DIPLOID-CELL EXAMPLE

STAGE	CHROMOSOMES	DNA MOLECULES
G_1	46	46
G_2	46	92
Each daughter after division	46	46

Always state the counting unit: whole cell or each nucleus. After sister separation but before cell division, a human cell briefly contains 92 daughter chromosomes, with 46 destined for each new nucleus.

DNA content across the cycle: Alberts et al., An Overview of the Cell Cycle.

Scope: Cambridge Biology 9700 syllabus, section 5.1, outcome 3, p. 23.