

Cell Cycle

Learning objective 4.5.A Describe the events that occur in the cell cycle.

Name:

Date:

Period:

Use the tool **Copy, Check, Divide**. Parts 1 and 2 use **Around the cycle** and **Two counters**; Part 3 uses **How long is each phase?**. Throughout, the cell has $2n = 6$ chromosomes, and DNA is counted in units where one unreplicated chromosome is 1 — so a G1 cell holds 6 units. Two counters are running the whole time, and they never change at the same moment.

Part 1 • Two counters, all the way round

Open **Around the cycle** and step through all eight stages with **Forward**. Fill the table in as you go. Before you look at the readout for a row, **predict** both numbers.

Stage	Chromosomes	Chromatids each	DNA (units)	Which counter moved?
G1				
S				
G2				
Prophase				
Metaphase				
Anaphase				
Telophase				
Cytokinesis				

1. State which stages make up interphase, and which make up M phase.

2. Identify the one stage at which the DNA counter goes up, and explain why the chromosome counter does not move at the same time.

Part 2 · The two doublings

Switch to **Two counters** and drag the highlight along the stages. The DNA graph steps up once and the chromosome graph steps up once, at **different stages**. Complete the comparison from what the two graphs show.

	S phase	Anaphase
What physically happens		
Chromosome number: before → after		
DNA amount: before → after		
Chromatids per chromosome: before → after		
Visible on a DNA-content graph?		

3. Explain why the number of chromosomes doubles in anaphase even though no DNA is made.

4. A DNA-content graph for one cell is flat from G2 through to telophase. Explain why anaphase cannot be located on that graph, and state what you would need instead.

Part 3 · Counting cells to get times

Switch to **How long is each phase?** with **Field A** selected and the cycle set to **24 h**. Work each row out yourself before you read it off the table: **duration = (cells in that phase ÷ total cells) × cycle length**.

Phase	Cells (of 200)	Fraction	Duration
G1	88		
S	52		
G2	30		
Prophase	16		
Metaphase	6		
Anaphase	3		
Telophase	5		

5. State the assumption about the cells that this whole method depends on.

6. Switch to Field B, which counts 400 cells. Describe what happens to the durations, and explain why.

Part 4 · Putting it together

These do not need the tool. Answer them from the two counters and the counting rule.

7. A cell has 6 chromosomes in G1. State the number of chromosomes and the DNA content (in units) at G2, at metaphase, at anaphase, and in each daughter cell.

8. Explain why the two cells produced by mitosis are genetically identical to the parent cell.

9. In a field of 200 root-tip cells, 3 are in anaphase. Calculate the length of anaphase for a 24-hour cycle, and explain why an estimate for anaphase is less reliable than one for G1.

What the model simplifies

The cell is drawn with $2n = 6$ so the chromosomes can be told apart. A human cell has 46, and no diagram of 46 chromosomes would be readable; the counting rules are identical whatever the number.

DNA is measured in units where one unreplicated chromosome is 1, so a G1 cell here holds 6 units. Textbooks often write the same quantity as $2c$ for the whole G1 cell and $4c$ after replication. The two notations say the same thing.

Prophase is drawn as one stage. Some courses split off prometaphase, when the nuclear envelope has gone and the spindle fibers attach to the centromeres; the 2025 CED lists four stages of mitosis, and that is what is shown.

The eight stages are drawn as equal steps, which they are not — Part 3 exists partly to correct that impression. Cytokinesis is drawn as a separate stage because it is a separate event; it overlaps telophase in a real cell.

The 200-cell field is a plausible set of counts for an onion root tip, not a record of one real slide. It is used because the arithmetic has to be checkable; a real count would carry sampling error, which question 9 raises.