

Meiosis

Learning objective 5.1.A Describe the process of meiosis.

Name:

Date:

Period:

Use the tool **Two Divisions, One Copy**. Parts 1 and 2 use **Through both divisions** and **Which division halves what**; Part 3 uses **Against mitosis**. Throughout, the cell is **$2n = 6$** (three homologous pairs), and DNA is counted in units where one unreplicated chromosome is 1. The question this whole topic turns on is not **whether** the chromosome number halves but **where**.

Part 1 · Two counters through both divisions

Open **Through both divisions** and step from G1 to the end with **Forward**. Fill the table as you go, predicting each row before you read it.

Stage	Cells	Chrom. per cell	Chromatids each	DNA per cell
G1				
S				
Prophase I				
Metaphase I				
Anaphase I				
Telophase I				
Prophase II				
Metaphase II				
Anaphase II				
Telophase II				

1. Identify the one stage at which DNA is made, and state how many times the cell divides after it.

2. Identify the stage at which the chromosome number per cell first halves, and name the division it belongs to.

Part 2 · Which division halves what

Switch to **Which division halves what** and drag the highlight along the stages. Use the two graphs to complete this comparison of the two divisions.

	Meiosis I	Meiosis II
Chromosomes per cell at the start		
Chromosomes per cell at the end		
DNA per cell at the start		
DNA per cell at the end		
What separates in its anaphase		
Is this the reduction division?		

3. The chromosome graph rises at anaphase II. Explain why this is not the cell gaining chromosomes, and what has happened to that count by the end of telophase II.

4. A student says meiosis II is the reduction division because it is the step that ends with four cells. Evaluate that claim using the chromosome counts.

Part 3 · Against mitosis

Switch to **Against mitosis**. Both processes start from the same diploid cell that has replicated its DNA once.

	Mitosis	Meiosis
Cells produced		
Divisions		
Rounds of DNA replication		
Chromosomes per daughter cell		
Homologues pair up?		
Crossing over?		
What separates in the first anaphase		
Daughter cells genetically identical to the parent?		
What it is for		

5. Both processes replicate the DNA once. Explain how meiosis nevertheless produces cells with half the chromosome number.

6. State the one event in prophase I that has no equivalent anywhere in mitosis, and explain why anaphase I could not happen without it.

Part 4 · Putting it together

These do not need the tool.

7. A cell with 6 chromosomes begins meiosis. State the number of chromosomes and the DNA content (in units) of one cell at the end of meiosis I and at the end of meiosis II.

8. Explain why gametes must be haploid, referring to what happens at fertilisation.

9. You are given an unlabelled graph of DNA content per cell against time. Describe how you would tell whether it shows mitosis or meiosis.

10. A diagram shows chromosomes moving toward opposite poles of a cell. State what you would look at to decide whether it is anaphase I or anaphase II, and justify your answer.

What the model simplifies

The cell is drawn with $2n = 6$, so $n = 3$. A human cell has 46 chromosomes in 23 pairs; the counting rules are identical whatever the number, and three pairs is the largest number that stays readable.

DNA is measured in units where one unreplicated chromosome is 1, so the G1 cell holds 6 units and each gamete holds 3. Textbooks often write the same quantities as $2c$ and $1c$.

The two homologues of each pair are drawn in two colors to show which parent each came from. Real chromosomes carry no such label, and a microscope cannot tell them apart — the colors record where they came from, not what they look like.

Crossing over is described but not drawn on the chromosomes, and the arrangement of the pairs at metaphase I is shown as one fixed layout. Both are the subject of Topic 5.2, where they are counted rather than mentioned.

The stages are drawn as equal steps, and prophase I is drawn as one stage. Prophase I is by far the longest stage of meiosis and is conventionally subdivided further; the 2025 CED does not require those subdivisions.