AP BIOLOGY · UNIT 5 · TOPIC 5.1

Meiosis

Learning objective 5.1.A Describe the process of meiosis.

Name: Date: Period:

Use the tool **Two Divisions, One Copy**. Each Part names the tab it uses, and Part 4 does not use the tool. Throughout, the cell is **2n = 6** (three homologous pairs), and DNA is counted in units where one unreplicated chromosome is 1.

Part 1 · Two counters through both divisions

Open **Through both divisions** and press **Forward** to step from G1 to Telophase II. At each stage, record the values that the tool shows.

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. (a) Identify the stage at which the DNA is replicated.

(b) Identify the number of times the cell divides after this stage.

2. (a) Identify the stage at which the number of chromosomes per cell first decreases by half.

(b) Identify the division, meiosis I or meiosis II, that this stage 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. On the Which division halves what tab, the graph of chromosomes per cell rises at anaphase II, although no DNA is made.
(a) Explain why the number of chromosomes per cell increases at anaphase II.

(b) Compare the number of chromosomes per cell at the end of telophase II with the number at the start of meiosis II.

4. A student claims that meiosis II is the reduction division because meiosis II ends with four cells. Using the chromosome counts in the Part 2 table, evaluate the student's claim.

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		
Homologs pair up?		
Crossing over?		
What separates in the first anaphase		
Daughter cells genetically identical to the parent?		
What it is for		

5. Mitosis and meiosis each replicate the DNA once. Explain how meiosis produces cells with half the chromosome number of the parent cell.

6. (a) Identify the event in prophase I that does not occur in mitosis.

(b) Explain why anaphase I depends on this event.

Part 4 · Putting it together

These do not need the tool.

7. A cell with 6 chromosomes begins meiosis. DNA is counted in units, where one unreplicated chromosome is 1.
(a) Identify the number of chromosomes and the DNA content of one cell at the end of meiosis I.

(b) Identify the number of chromosomes and the DNA content of one cell at the end of meiosis II.

8. Explain why gametes must be haploid. In your answer, refer to fertilization.

9. A student is given an unlabeled graph of DNA content per cell over time. Describe how the student could determine whether the graph shows mitosis or meiosis.

10. A diagram shows chromosomes moving toward opposite poles of a cell.
(a) Identify a feature of the moving chromosomes that indicates whether the cell is in anaphase I or anaphase II.

(b) Provide reasoning to justify your identification.

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 homologs 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.