Chromosome Shuffle

Trace how meiosis and fertilization produce varied offspring

GEN.5.1 "Model the inheritance of chromosomes through meiotic cell division and demonstrate how meiosis and sexual reproduction lead to genetic variation in populations."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline where the chromosome number changes, circle the possible gamete combinations, and number the events from chromosome copying through fertilization. Use your marks to trace how offspring can inherit different allele combinations.

Two Pairs, Many Possibilities

1. Imagine a flowering plant with four chromosomes in each body cell, arranged as two homologous pairs. One chromosome in the first pair carries allele A, while its partner carries a. In the second pair, one carries B and its partner carries b. This simple model tracks two gene locations, one on each pair, rather than every gene in the plant. The plant's chromosome set can be written AaBb. A body cell contains both members of each pair, but an egg or pollen cell must receive only one member from each pair. That difference matters when two parents produce offspring.

2. Before meiosis, each chromosome copies itself, producing two sister chromatids. During meiosis I, the homologous pairs line up independently. One possible alignment sends the chromosome carrying A and the chromosome carrying B toward the same side; another sends A with b. Homologous chromosomes separate in meiosis I. Sister chromatids separate in meiosis II, leaving four cells, each with two chromosomes. Without tracking crossing over, this AaBb parent can make eggs or pollen with AB, Ab, aB, or ab. Crossing over can also exchange matching sections between homologous chromosomes, creating new combinations of alleles carried along the same chromosome.

3. When an egg and a pollen cell fuse, their chromosome sets combine in a new plant. If this parent's Ab egg joins an aB pollen cell from another plant, the offspring receives A and a on its first pair and b and B on its second pair: AaBb. If an ab egg joins an ab pollen cell instead, the offspring is aabb. Both offspring have four chromosomes, yet their allele combinations differ. Across many matings, independent assortment, crossing over, and the random joining of gametes produce varied offspring. Sexual reproduction reshuffles existing alleles; it does not create new alleles by itself.

2 ANSWER WITH EVIDENCE

Use the passage

1. List the gamete allele combinations the AaBb parent can make through independent assortment without tracking crossing over.

2. If the chromosomes carrying A and b move toward the same side in meiosis I, which chromosomes move toward the opposite side? Explain why.

3. Trace the chromosome number from the AaBb parent's body cell to one gamete to an offspring formed by fertilization.

4. Compare the offspring from an Ab egg joined with aB pollen and an ab egg joined with ab pollen. How do they show variation without a change in chromosome number?

3 YOUR TURN

Your own words

In panel 1, model a CcDd parent with C/c and D/d on separate chromosome pairs: show one meiosis I alignment and label the gametes it produces after meiosis II, ignoring crossing over. In panel 2, fuse one gamete with a cd gamete and show the offspring's paired chromosomes; write one sentence explaining how a different alignment could change the offspring's genotype.

ANSWER KEY

Chromosome Shuffle

PART 1 · READ AND MARK

Underline where the chromosome number changes, circle the possible gamete combinations, and number the events from chromosome copying through fertilization. Use your marks to trace how offspring can inherit different allele combinations. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	List the gamete allele combinations the AaBb parent can make through independent assortment without tracking crossing over.	**AB, Ab, aB, and ab.**
2	If the chromosomes carrying A and b move toward the same side in meiosis I, which chromosomes move toward the opposite side? Explain why.	**The chromosomes carrying a and B move toward the opposite side because homologous chromosomes separate in meiosis I.**
3	Trace the chromosome number from the AaBb parent's body cell to one gamete to an offspring formed by fertilization.	**The body cell has four chromosomes. Meiosis produces gametes with two chromosomes, and fertilization restores four in the offspring.**
4	Compare the offspring from an Ab egg joined with aB pollen and an ab egg joined with ab pollen. How do they show variation without a change in chromosome number?	**The first offspring is AaBb and the second is aabb. Both have four chromosomes, but they inherited different allele combinations.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1: In meiosis I, C and D move to one side; c and d move to the other. After meiosis II, the four gametes are CD, CD, cd, and cd. Panel 2: CD joins cd, making an offspring with C/c and D/d chromosome pairs, or CcDd. A different alignment could make a Cd gamete, which would produce Ccdd when joined with cd.

Accept either meiosis I alignment if the gametes and offspring match it. The explanation should connect a different alignment to a different possible allele combination in the offspring.