Chromosome Count

Trace chromosome number and DNA through a new generation

BIO.3A.1 "Model sex cell formation (meiosis) and combination (fertilization) to demonstrate the maintenance of chromosome number through each generation in sexually reproducing populations..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the steps that take chromosomes from a body cell to sex cells to a zygote, circle the chromosome count at each step, and box two reasons the DNA can differ.

A Beetle's Next Generation

1. Imagine a model beetle with six chromosomes in each body cell. These chromosomes form three pairs, with one member of each pair inherited from each parent. Before a cell makes sex cells, it copies its DNA, so each chromosome has two identical sister chromatids. Copying doubles the amount of DNA, but the cell still has six chromosomes because each copied chromosome remains joined at one centromere. A beetle cannot simply join two ordinary body cells to make an offspring. That would give the new cell twelve chromosomes, and the number could keep doubling in later generations.

2. Meiosis solves the counting problem. In the first division, members of each chromosome pair separate into different cells. In the second division, sister chromatids separate, producing four sex cells with three chromosomes each. Before the pairs separate, matching chromosomes can exchange DNA segments, an event called crossing over. Also, each pair can line up in either direction, so sex cells receive different mixes of chromosomes from the beetle's two parents. These changes make the sex cells genetically different from the original cell and often from one another, even though each sex cell carries the same number of chromosomes.

3. During fertilization, one sex cell from each of two beetles joins. Each brings three chromosomes, so the new cell, called a zygote, has six. It grows by ordinary cell division, which keeps the chromosome number at six in its body cells. The next generation can make sex cells with three chromosomes again. The zygote's DNA is not a copy of either parent's DNA: it contains chromosomes from both parents, and meiosis has shuffled and sometimes exchanged DNA segments within those chromosomes. A steady chromosome number does not mean an identical set of DNA instructions.

2 ANSWER WITH EVIDENCE

Use the passage

1. A beetle cell copies its DNA before meiosis. Why does it still have six chromosomes at that point?

2. Start with a beetle cell that has six chromosomes. What does each of the two meiotic divisions separate, and how many chromosomes does each resulting sex cell have?

3. Use chromosome numbers to explain how fertilization restores the beetle's body-cell count.

4. Why can two sex cells made by the same beetle have different DNA from the starting cell and from each other?

3 YOUR TURN

Your own words

Make a written model for an imaginary lizard with eight chromosomes in each body cell. Trace its chromosome count through DNA copying, meiosis, and fertilization, then explain why the sex cells and zygote can have DNA different from the starting cell.

ANSWER KEY

Chromosome Count

HIGH SCHOOL · BIO.3A.1

PART 1 · READ AND MARK

Underline the steps that take chromosomes from a body cell to sex cells to a zygote, circle the chromosome count at each step, and box two reasons the DNA can differ. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	A beetle cell copies its DNA before meiosis. Why does it still have six chromosomes at that point?	**Each copied chromosome has two sister chromatids joined at one centromere, so it still counts as one chromosome.**
2	Start with a beetle cell that has six chromosomes. What does each of the two meiotic divisions separate, and how many chromosomes does each resulting sex cell have?	**The first division separates the members of each chromosome pair. The second separates sister chromatids, leaving three chromosomes in each sex cell.**
3	Use chromosome numbers to explain how fertilization restores the beetle's body-cell count.	**One sex cell with three chromosomes joins another with three, producing a zygote with six chromosomes.**
4	Why can two sex cells made by the same beetle have different DNA from the starting cell and from each other?	**They receive only one chromosome from each pair. Crossing over can exchange DNA segments, and the pairs can line up in different ways, giving sex cells different DNA combinations.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

In my model lizard, a body cell has eight chromosomes arranged in four pairs. After DNA copying, it still has eight chromosomes because the sister chromatids remain joined. Meiosis separates the pairs and then the sister chromatids, making sex cells with four chromosomes each. Crossing over and different ways the pairs line up give the sex cells DNA combinations unlike the starting cell's. Fertilization joins sex cells from two lizards, restoring eight chromosomes in a zygote with DNA from both parents.

Accept any accurate written model that keeps the count at eight after DNA copying, reduces it to four per sex cell through meiosis, and restores eight at fertilization. The explanation should distinguish a stable chromosome number from identical DNA.