Beetles After Birds

Trace how survival can change allele frequencies.

GEN.5 "Students will apply population genetic concepts to explain the variability of organisms within a population. Model the inheritance of chromosomes through meiotic cell division and demonstrate how meiosis and sexual reproduction lead to..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the sentences that explain how offspring get different genotypes. Circle the numbers or formulas you need to track the B allele, then number two possible causes of allele-frequency change.

A Season on the Rocks

1. On a rocky beach, dark-shelled beetles can blend into wet stones, while pale-shelled beetles stand out to hunting birds. A beetle inherits one copy of a shell-color gene from each parent. The B allele produces dark shells in BB and Bb beetles; bb beetles are pale. These inherited differences may give birds different chances of spotting beetles.

2. Researchers counted 100 adult beetles before a season of heavy bird hunting. They later recorded which of those same beetles survived. The table separates genotypes, allowing a comparison of survival without counting new births. Each beetle has two alleles: B frequency equals (2 × BB + Bb) divided by twice the number of beetles.

SHELL-COLOR GENOTYPES BEFORE AND AFTER BIRD HUNTING

Count	BB	Bb	bb
Before hunting	36	48	16
Survived hunting	36	40	4

3. During meiosis, chromosomes separate and crossing over reshuffles alleles. Fertilization joins chromosomes from two parents, creating varied offspring. Under Hardy-Weinberg conditions, the predicted fraction of bb offspring is q^2, where q is the b frequency among breeding adults. Immigration, mutation, or chance losses in a small population can change allele frequencies too.

2 ANSWER WITH EVIDENCE

Use the passage

1. If two Bb beetles mate, how could meiosis and fertilization produce a pale offspring?

2. Calculate the B allele frequency before hunting and among the survivors. How did it change?

3. Using the survivors' allele frequencies, what fraction of their offspring would the Hardy-Weinberg model predict to be pale? Show your calculation.

4. Which survival pattern supports selection favoring dark beetles? Why does this count alone not prove birds caused it?

3 YOUR TURN

Your own words

In a new plant population, RR and Rr plants resist an insecticide, while rr plants do not. There are 20 RR, 40 Rr, and 40 rr plants. In four sentences, calculate the starting R allele frequency, predict its direction over generations if the insecticide remains, explain how meiosis can produce varied offspring, and name one other process that could change the outcome.

Beetles After Birds

PART 1 · READ AND MARK

Underline the sentences that explain how offspring get different genotypes. Circle the numbers or formulas you need to track the B allele, then number two possible causes of allele-frequency change. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	If two Bb beetles mate, how could meiosis and fertilization produce a pale offspring?	**Meiosis can place a b allele in each parent's reproductive cell. If those cells join, the offspring is bb and pale.**
2	Calculate the B allele frequency before hunting and among the survivors. How did it change?	**Before: (2 × 36 + 48) ÷ 200 = 0.60. Survivors: (2 × 36 + 40) ÷ 160 = 0.70. The B frequency increased by 0.10.**
3	Using the survivors' allele frequencies, what fraction of their offspring would the Hardy-Weinberg model predict to be pale? Show your calculation.	**The b frequency is 1 − 0.70 = 0.30. The predicted bb fraction is $q^2 = 0.30^2 = 0.09$, or 9%.**
4	Which survival pattern supports selection favoring dark beetles? Why does this count alone not prove birds caused it?	**All 36 BB beetles survived, but only 4 of 16 bb beetles survived. The counts show different survival rates, but do not establish the cause of each death.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The starting R frequency is (2 × 20 + 40) ÷ 200 = 0.40. If resistant plants survive and reproduce more often, R will likely become more common over generations. During meiosis, alleles separate into reproductive cells, so offspring can inherit different combinations when those cells join. Immigration could bring in plants with different allele frequencies and change that trend.

Accept equivalent calculations and explanations. For the final question, students may name mutation, immigration, emigration, genetic drift, or nonrandom mating if they explain how it could affect the predicted trend.