Island Gene Pool

Trace what changes allele frequencies in a lizard population

GEN.5.3 "Describe processes that cause changes in allelic frequencies (e.g., nonrandom mating, small population size, immigration and emigration, genetic drift, and mutation)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each process that could change an allele frequency. Circle the event or condition that explains how each process has its effect.

The Lizards on the Rocks

1. On a chain of rocky islands, a lizard population carries two versions of a gene, or alleles, for a scale pattern: S and s. Suppose 40 of every 100 copies of this gene are S. The frequency of S is 40 percent, and the frequency of s is 60 percent. These percentages describe alleles, not the number of lizards with each pattern. One spring, lizards arriving from a nearby island carry mostly S alleles. If they breed with the residents, immigration adds S copies to the population and can raise the frequency of S over later generations.

2. Later, a storm randomly kills several lizards before they reproduce. By chance, many of the lost lizards carry S. This is genetic drift: a chance event changes allele frequencies, even though S did not make the lizards less fit. Drift can be especially strong in a small population, where each lost breeder represents a large share of the gene pool. Emigration can also shift the frequencies left behind if the departing lizards carry a different mix of alleles from those that stay. If leavers and residents carry the same mix, emigration alone need not change the frequencies.

3. Years later, a copying error in a reproductive cell creates a new allele, T. Mutation introduces new genetic variation; T could spread only if it is passed to offspring. Meanwhile, suppose lizards choose mates with a scale pattern linked to S. If S carriers leave more offspring because of that preference, S can become more common through sexual selection. Nonrandom mating by itself, however, does not always alter allele frequencies. For example, if S carriers pair only with other S carriers but all lizards produce the same number of surviving young, the pairing pattern can change genotype frequencies without changing the overall frequency of S.

2 ANSWER WITH EVIDENCE

Use the passage

1. How could immigration change the frequency of S in the island population?

2. Why could the storm change the frequency of S more in a small population than in a large one?

3. When could emigration change the allele frequencies of the lizards that stay?

4. How could mate choice raise the frequency of S? Why might nonrandom mating leave that frequency unchanged?

3 YOUR TURN

Your own words

Invent a moth population with two wing-color alleles. In four or five sentences, describe a mutation that creates a third allele and one other process from the passage that changes the new allele's frequency. Explain why its frequency changes in each case.

ANSWER KEY

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PART 1 · READ AND MARK

Underline each process that could change an allele frequency. Circle the event or condition that explains how each process has its effect. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How could immigration change the frequency of S in the island population?	**Arriving lizards carry mostly S alleles. If they breed with residents, they add S copies and can raise its frequency.**
2	Why could the storm change the frequency of S more in a small population than in a large one?	**The storm randomly kills breeders, many of which carry S. In a small population, each lost breeder represents a larger share of the gene pool.**
3	When could emigration change the allele frequencies of the lizards that stay?	**Emigration could change the frequencies if departing lizards carry a different mix of alleles from the lizards that remain.**
4	How could mate choice raise the frequency of S? Why might nonrandom mating leave that frequency unchanged?	**If a preference causes S carriers to leave more offspring, S can become more common. If mating pairs differ but all lizards leave the same number of surviving young, the frequency of S need not change.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

In a small moth population with black and gray wing-color alleles, a mutation in a reproductive cell creates a new silver allele. A moth inherits the silver allele, so it enters the population at a very low frequency. A storm randomly kills several moths without the silver allele before they breed. Because fewer copies of the other alleles remain, genetic drift raises the silver allele's frequency even though silver wings offer no advantage.

Accept other plausible processes if the response explains the direction of the frequency change and the condition that causes it. Mutation must produce an inherited allele to add it to the population.