

| MS-LS4 Biological Evolution: Unity and Diversity | | |
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| <p>MS-LS4-4. Construct an explanation based on evidence that describes how genetic variations of traits in a population increase some individuals' probability of surviving and reproducing in a specific environment. [Clarification Statement: Emphasis is on using simple probability statements and proportional reasoning to construct explanations.]</p> | | |
| Science and Engineering Practices | Disciplinary Core Ideas | Crosscutting Concepts |
| <p>Constructing Explanations and Designing Solutions</p> <p>Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.</p> <ul style="list-style-type: none"> Construct an explanation that includes qualitative or quantitative relationships between variables that describe phenomena. (MS-LS4-4) | <p>LS4.B: Natural Selection</p> <p>Natural selection leads to the predominance of certain traits in a population, and the suppression of others. (MS-LS4-4)</p> | <p>Cause and Effect</p> <p>Phenomena may have more than one cause, and some cause and effect relationships in systems can only be described using probability. (MS-LS4-4),(MS-LS4-5),(MS-LS4-6)</p> |

TASK 1

A certain species of snail shows variation in its shell coloring, from solid yellow shells to brown, banded shells. Birds are the main predator of this snail. A scientist observes populations of this snail in various habitats. She hypothesizes that the yellow-shelled snails are better camouflaged in grasslands than the brown-shelled snails are.

- A. Based on the scientist's hypothesis, describe how the percentage of yellow-shelled snails most likely compares with the percentage of brown-shelled snails in grasslands.
- B. Assuming the scientist's hypothesis is correct, explain how natural selection could have acted over time to produce the relative percentages of snails you described in part (A).

The scientist observes two new grassland habitats. In one grassland habitat, the percentages of yellow-shelled snails and brown-shelled snails match what the scientist expected based on her hypothesis. In the other grassland habitat, the percentages of yellow-shelled snails and brownshelled snails are different from what she expected. The scientist plans to study the size of the bird populations in each habitat to try to explain her observations.

- C. Explain the reasoning that supports the scientist's plan to study the bird population sizes.

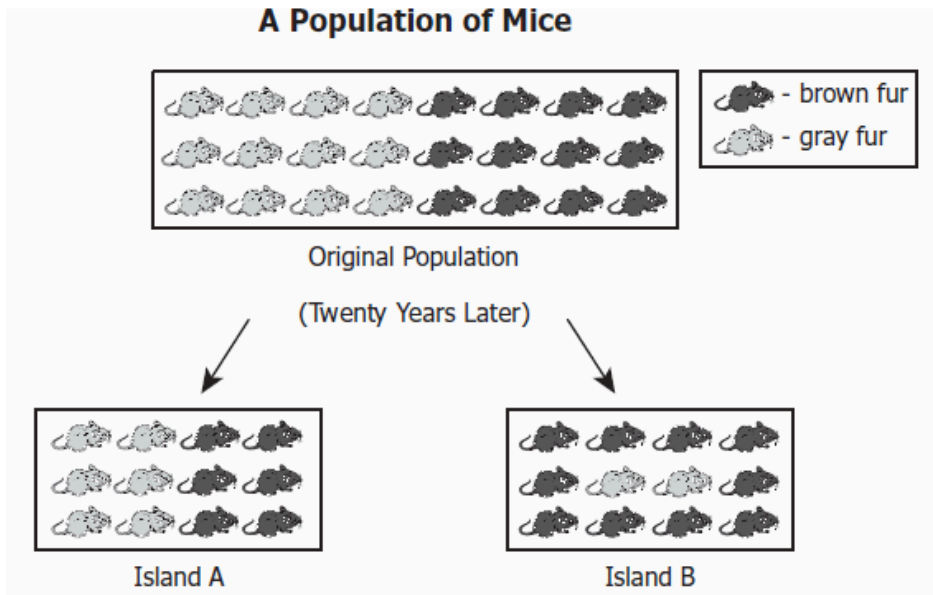
Adapted from: Massachusetts MCAS Biology

TASK 2

A population of termites initially consists of darkly colored and brightly colored members. After several generations, the termite population consists almost entirely of darkly colored members because the brightly colored termites are easier for a predatory species of insectivores to locate. This situation is an example of:

- A. the evolution of a new species.
- B. natural selection.
- C. artificial selection.
- D. adaptive radiation.

TASK 3



A population of mice is evenly divided into two groups, and each group is placed on an isolated island with no existing mouse population. Which statement best explains the difference in mouse populations on Island A and Island B at the end of 20 years?

- A. Conditions on Island B favored the brown-furred individuals, while both fur colors were evenly advantaged on Island A.
- B. On Island A, the allele for gray fur was dominant, while on Island B, the allele for brown fur was dominant.
- C. More brown mice were in the half of the original population that was sent to Island B than the group sent to Island A.
- D. The recapturing of mice on Island A and Island B was done differently.

TASK 4

The factor that causes the greatest change in gene pools is _____.

TASK 5

The red wolf and coyote are two animals that look similar to one another, but do not belong to the same species. Some of their differences are outlined on the chart below. When the environment changes because cities or towns are being built, which organism do you think has a better chance to remain in the same area? Explain your answer.

| | Red Wolf | Coyote |
|---|---|---|
| 1 | Shy, secretive | Can change social habits to survive in various habitats. |
| 2 | Eats small animals such as rodents and rabbits, occasionally eats berries, insects, and deer. | Are scavengers, will eat almost anything including garbage, meat, fish, vegetables, berries, or whatever they can find. |
| 3 | Makes shelter in a pile of logs, digs a hole in the dirt, or uses an abandoned cave. | Needs very little shelter, prefers abandoned dens of badgers, or any other natural den instead of digging their own. |

TASK 6

Bacterial genes are found on one circular chromosome containing a few thousand genes. Bacteria reproduce asexually. Reproduction involves only one parent rather than two parents. The single chromosome is copied and the cell divides into two daughter cells that are genetically identical to the original cell unless a mutation occurs. When a mutation does occur, it can cause a new genetic trait that could equally harm or help the bacteria depending on the environment it is living in. One example of a genetic trait that can provide an advantage to bacteria is the development of antibiotic resistance. Bacteria can die or their growth can be inhibited when they are exposed to an antibiotic. If a mutation causes a trait to develop in a bacterium that blocks an antibiotic, then the bacterium is protected from the harming effects of that antibiotic. There are many different types of antibiotics, so the development of resistance to one type does not guarantee resistance to other types. The data provided below show the change in the frequency of different genetic traits within a bacterial population that was exposed to the antibiotic streptomycin. Each trait represents two different variations of the same gene (Variant X and Variant Y) that at the start were equally distributed in the population.

I. Create a scatterplot showing the change in the frequency of the two traits over many generations. The scatterplot should include symbols that distinguish between those bacteria that carry Variant X and those that carry Variant Y as well as include a title, scale, axis labels, unit labels, and legend. Describe how the frequencies of the traits in the population change over the 26 generations due to the change in the environment caused by the introduction of the antibiotic streptomycin. In your description:

- A. Discuss whether the data can be modeled by a function, including any features of the function (linear/nonlinear, increasing/decreasing, etc.).
- B. Describe any proportional relationships that could be inferred from the data.
- C. Discuss the probability that one of the gene variants provides streptomycin antibiotic resistance to bacteria in the population.

II. Construct an explanation for how natural selection is acting over generations in the new environment to lead to a change in the frequency of the genetic traits in the population. Be sure to address how the specific traits may increase some bacteria's chance of surviving in the new environment. Cite the plots and relationships in the data to support your explanation.

| Generation | Frequency of Variant X in the Population | Frequency of Variant Y in the Population |
|-------------------|---|---|
| 1 | 51 | 49 |
| 2 | 55 | 45 |
| 3 | 60 | 40 |
| 4 | 64 | 36 |
| 5 | 68 | 32 |
| 6 | 72 | 28 |
| 7 | 75 | 25 |
| 8 | 79 | 21 |
| 9 | 82 | 18 |
| 10 | 84 | 16 |
| 11 | 86 | 14 |
| 12 | 88 | 12 |
| 13 | 90 | 10 |
| 14 | 92 | 8 |
| 15 | 93 | 7 |
| 16 | 94 | 6 |
| 17 | 95 | 5 |
| 18 | 96 | 4 |
| 19 | 96 | 4 |
| 20 | 97 | 3 |
| 21 | 98 | 2 |
| 22 | 98 | 2 |
| 23 | 98 | 2 |
| 24 | 99 | 1 |
| 25 | 99 | 1 |
| 26 | 99 | 1 |

Source: Achieve, Inc. (adapted)