Engage: Natural Selection Scenario

Instructions: Read the scenario below. Evaluate the scenario for the elements of natural selection.

Galapagos Finches

Charles Darwin observed many varieties of finches on the Galapagos Islands. He was amazed by the diversity of the finches living on the island. Each finch had a different type of beak adapted to eat a specific type of food. Environments often change; a drought hit one of the islands and seeds became scarce. As a result, most finches were not able to reproduce and the offspring of those that were able to reproduce often died. There were two main types of beaks found in finches on the islands. Finches with smaller beaks were unable to crack the tough outer layer of seeds. The vegetation that the finches with small beaks usually relied on perished during the drought. Finches with the largest, strongest beaks were able to survive and reproduce because they were able to eat the large, tough seeds that weren't typically part of their diet. Over time, the population of large-beaked finches increased in number, while the population of smaller beaked finches decreased in number.

There are four main elements of natural selection. Read the paragraph above and find evidence of the following:

1. Inherited variation (alternate forms of a trait that are carried in the organism's genes):

2. Potential of the population to produce more offspring than survive:

3. Limited resources in the environment:

4. The organisms have different reproductive success.

Explore: Investigating Natural Selection

Introduction: This experiment involves a fictitious organism known as the *Beanius rodentus*. *Beanius rodentus* is a small rodentlike organism that lives in desert areas. These organisms may have either black, black and white, or white coats. *Beanius rodentus* is often hunted by birds of prey. Birds of prey use their eyesight and talons to capture and ultimately consume the *Beanius rodentus*. The environment consists of light-colored pebbles and sand.

Problem: Which phenotypic variation of coat color in *Beanius rodentus* is advantageous for survival?

Materials

150 black-eyed peas
150 black beans
150 navy beans
1 paper cup to represent a mouth
resealable plastic bags
stopwatch
cardboard box lid
light-colored pebbles
graph paper

Procedure

First Hunt

1. Assign group roles
    a. Hunter: Acts as hawk (bird of prey) to find and feed on *Beanius rodentus*.
    b. Timekeeper: Responsible for timing the 25-second feeding intervals.
    c. Recorder: Records and tracks data for analysis.
    d. Materials Manager: Adds or removes *Beanius rodentus* according to data.
2. Cover the bottom of the cardboard box lid with light-colored pebbles.
3. Scatter 10 of each type of bean representing the *Beanius rodentus* into the box lid.
4. Record the initial populations on the data table.
5. Write a hypothesis and identify the independent and dependent variables for this activity.
6. Time the first hunting session for 25 seconds as the hunter searches for food and puts the organisms in the cup. The hawk can only capture one organism at a time and must place the bean in the paper cup representing the mouth. The cup representing the mouth must remain on the desk/lab table and may not be moved.
7. After the first hunt, count and record the number of each organism eaten and then calculate the number of surviving organisms by phenotype.
8. For every two individuals of each phenotype, add five offspring. Do not add offspring for single organisms.
9. Add the number of survivors to the number of offspring and record the totals in the last column of the data table.
10. Add the numbers in each column to determine the changes to the total population.

Second Hunt

1. Before the second hunt, enter the number of organisms for each phenotype from the first hunt (last column in the first data table) into the first column of the data table labeled “Second Generation.”
2. Add or remove the correct number of organisms to the habitat box.
3. Begin the next 25-second hunt.
4. Count and record the number of eaten prey and calculate the number of survivors.
5. Determine the number of offspring for every two survivors and calculate the number of organisms after the second hunt.
6. Add the numbers in each column to determine the changes to the total population.

Third Hunt

1. Use the data from the last column in the second hunt to fill in the first column in the data table labeled “Third Generation.”
2. Add or remove the correct number of organisms to the habitat box according to the population numbers from the second hunt.
3. Begin the last 25-second hunt.
4. Count and record the number of eaten prey and calculate the number of survivors.
5. Determine the number of offspring for every two survivors and calculate the number of organisms after the final hunt.
6. Add the numbers in each column to determine the changes to the total population.
7. Create a line graph to analyze the data and use the information to answer the questions and write a conclusion.

Data

First Generation					
Phenotype	# in initial population	# eaten	# survive	# of offspring	# organisms in next generation
Black	10				
White	10				
Black and White	10				
Total in population	30				

Second Generation					
Phenotype	# in initial population	# eaten	# survive	# of offspring	# organisms in next generation
Black					
White					
Black and White					
Total in population					

Third Generation					
Phenotype	# in initial population	# eaten	# survive	# of offspring	# organisms in next generation
Black					
White					
Black and White					
Total in population					

Conclusion
From your observations and analysis, explain the trends in your data. Explain how this information is related to natural selection.

Explain: Diversity of Species

Convergent Evolution	Divergent Evolution
Coevolution	The evolution of two species based on their interaction with one another. Each species places selective pressure on the other, so they evolve together. The two organisms depend on each other to survive in the environment.
Change over time where different species become more alike and display similarities in structure or body styles.	This type of evolutionary change results in different species. Species are organisms that can interbreed and produce fertile offspring. The speciation occurs as a result of different adaptations to varying environmental conditions.

Elaborate: Diversity and Natural Selection

For each scenario, identify the type of evolution occurring. In your science notebook, record a brief summary of the scenario. Justify the type of evolution you identified with evidence from the scenario.

Scenario 1: Honeycreepers

Hawaii is a chain of volcanic islands with a variety of habitats. There are many species of Hawaiian honeycreepers found on the islands. Each species of honeycreeper is adapted to the environment of its specific island. The honeycreepers have a variety of bill shapes and sizes. The bill shapes relate to each bird's diet. Honeycreepers with long, thin bills feed on nectar. Honeycreepers with short, thick beaks eat seeds. There are species of honeycreepers with bills adapted to eat snails. Scientists believe the honeycreepers evolved from a species of bird that may have originated in another country.

Scenario 2: Bullhorn Acacia Tree

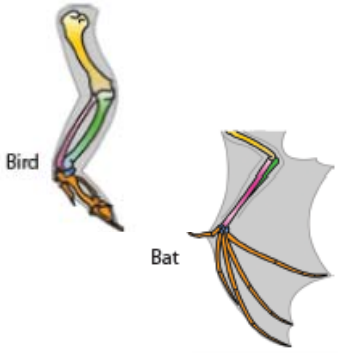
The bullhorn acacia tree is a tree with large thorns, but it does not produce the chemicals normally found on the leaves of trees that act as an insect and animal repellant. Instead, the acacia ant protects the tree from vines, insects, and animals. The ants evolved specific behaviors that include stinging potential predators and removing vines to protect the plants. The plants evolved to produce hollowed-out thorns that serve as the ants' nests and mechanisms to produce nectar. The nectar is produced on the underside of the leaf and provides nourishment for the ants. In nature, the tree is not able to survive in environments that lack the acacia ant.

Scenario 3: Squirrels

The Kaibab squirrel (*Sciurus kaibabensis*) and Abert's squirrel (*Sciurus aberti*) are two species of squirrels that live on opposite sides of the Grand Canyon. Abert's squirrel lives in the forests on the south rim of the Grand Canyon and has gray-colored fur and a white underbelly. The Kaibab squirrel is found in the forests of the North Rim and has black fur on its belly and a white tail. Geographic isolation can occur when physical barriers such as continents, mountains, canyons, or rivers keep members of the same population separated. Over time, the individuals may become so different that they can no longer reproduce.

Scenario 4: Birds and Bats

Birds and bats are very similar in structure yet very different organisms. Bats are winged mammals and belong to the Class Mammalia. Birds are members of the Class Aves and have feathers on their wings. The body shape of a bat is very similar to a bird. Both bats and birds have wings for flying yet they are structurally different. Structurally, the bat wing consists of skin that stretches to fill the area between the bones of the forelimb. The structure of a bird's wings is very different from a bat's, indicating that the bat and bird did not evolve from a common ancestor.



Elaborate: Diversity and Natural Selection*

Instructions: Read the scenarios below and determine which type of evolution is occurring in each scenario.

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1. What is occurring in this scenario?
    - Organisms use different structures for similar functions.
    - The organism evolves into two or more different species.
    - The organisms are dependent on each other for survival.
2. What type of evolution is occurring?

Scenario 2: Bullhorn Acacia Tree

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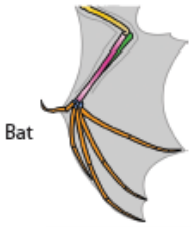

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Name: _____ Date: _____

Evaluate: Natural Selection

1 The variation of coat color in rodents is an example of —

(A) genetic diversity

(B) asexual reproduction

(C) individual effort

(D) increased chances for survival

2 Speciation can occur for many reasons. Geographical isolation occurs when physical barriers such as mountains or continents keep two organisms apart. During the formation of peninsulas, populations of fish may become separated. What type of evolution is described when a population of fish develops into two separate species as a result of geographical isolation?

(F) Coevolution

(G) Convergent evolution

(H) Divergent evolution

(J) Diversity within a species

3 Convergent evolution occurs when —

(A) unrelated species become more similar in structures or body styles

(B) two species evolve together and become dependent on each other

(C) species become so dissimilar that they can no longer interbreed

(D) species reproduce asexually and offspring are uniform

4 Which of the following statements supports the role of natural selection in finches?

F All finches survived because food was plentiful and the finches reproduced.

G Finch beaks changed as the birds chose to eat different food.

H The finches that survived were best adapted to the environment.

J There are many species of finches on the Galapagos Islands.

5 Explain the role of natural selection in convergent evolution, divergent evolution, and coevolution. Include the effects of each type of evolution on species diversity.