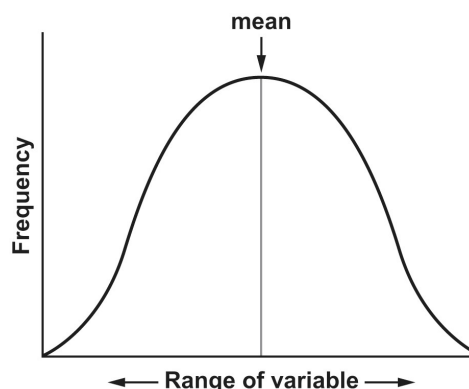


Unit Test: Patterns of Evolution

Read each question. Circle the letter of the correct answer.

1. An insect that lives on an island can have either a light blue or a dark blue color. A researcher has found that the percent of the population that is light blue has increased from 35% to 72% in the last decade. Which of these statements, if true, would least help to explain this change?
 - A. Darker-colored females are able to lay more eggs than lighter-colored females.
 - B. Female insects have shown increasing preference for light blue males when mating
 - C. The temperature has gotten warmer, and dark blue insects become overheated more easily.
 - D. The coloration of the plants on the island has become lighter, making darker-colored insects less able to hide.
2. A species of newt defends itself against predators by producing a toxic compound in its skin cells. Biologists observed that only snakes living in regions that overlap with the newt had a resistance trait to the toxin. Which statement best explains the cause of this resistance?
 - A. After biting the newts the snakes developed resistance and then passed this trait on to their offspring.
 - B. Snakes without the resistance migrated to different areas to avoid the newts, leaving snakes with the resistance in the same area as the newts.
 - C. All snakes had resistance to the toxin long ago, but those snakes living outside the range of the newt did not need the trait and eventually lost it.
 - D. Some snakes living in the area of the newt happened to have resistance to the toxin, which allowed these few to survive and pass on the resistance trait to their offspring.

3. The graph shows the distribution of a trait in an animal population.



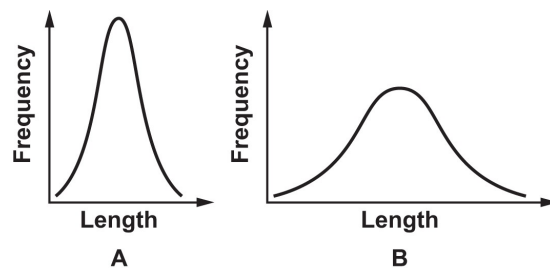
If the species were to undergo stabilizing selection in which extreme phenotypes were selected against, how would the graph be expected to change?

- A. The peak would move to the left.
- B. The peak would move to the right.
- C. The peak would become taller and narrower.
- D. The peak would become lower and more rounded.

4. A biologist studying wolves has collected data on the mass of meat caught per day from hunts by packs varying in size from 2 to 15 wolves. The data show that as pack size increases, the mass of meat available per pack member per day increases. Which additional study would provide evidence that pack hunting provides an advantage?
- A. Measure and compare the ability of wolves of varying ages to successfully engage in hunting.
 - B. Observe whether an individual wolf hunts different types of prey than a pack of wolves hunts.
 - C. Measure the ratio of male to female wolves engaging in hunting to see if it varies with pack size.
 - D. Compare the average number of pups per litter that reach reproductive age for wolf packs of different sizes.
5. Many changes in the environment can benefit some species while causing others to go extinct. Which of these is not an example of how environmental change can be both beneficial and detrimental?
- A. Increased temperatures can expand the habitat of equatorial animals while shrinking the habitat of arctic animals.
 - B. Forest fires can destroy the habitats of many bird species while helping certain trees reproduce.
 - C. High concentrations of carbon dioxide can help the metabolism of many trees but reduce the rate of cellular respiration.
 - D. Increased phosphate in rivers increases algae growth while providing more food for certain fish.
6. Certain lizards dig burrows to avoid the heat of the day and emerge at night to hunt. When there are large numbers of these lizards, their burrows may intersect with each other. Raccoons are beginning to prey mainly on these lizards. The raccoons catch the lizards as they emerge from their burrows. Which change could occur if this continues?
- A. The lizards will adapt by shifting their own hunting behavior to the daytime when their main predator, the raccoon, is not active.
 - B. Lizards will adapt to the new conditions by digging more interconnections between their burrows, which will allow multiple entrances and exits for the entire population.
 - C. The lizards will begin feeding on plant roots that they can access from extensive and interconnected underground burrows so that they do not have to emerge above ground.
 - D. Lizards that use interconnected burrows to avoid raccoons will be more likely to survive and pass on their genes to offspring, thus increasing traits in the population that promote group living.
7. A flowering plant varies in color from white to deep red. A deer population that feeds on the plant is increasing. The deer are attracted to red flowers and consume fewer of the white flowering plants. Which type of selection occurs in this case?
- A. sexual selection
 - B. disruptive selection
 - C. stabilizing selection
 - D. directional selection

8. A guard bee's job is to protect the hive from intruders, a job that can lead the guard bee to sacrifice its own life. If the guard bee cannot reproduce, how do genes for altruism increase in the population?
- A. Altruism genes are dominant, so they can be inherited more easily.
 - B. Bee colonies are so large that the loss of a few individuals will not affect the gene pool.
 - C. Genes controlling altruism are linked to other beneficial traits and are inherited together, therefore, increasing their likelihood of inheritance.
 - D. Other members of the colony with the same genes will be able to survive as a result of the guard bee's efforts and reproduce, thus, passing on the genes.

9. Curves A and B represent the frequency and length of two populations of earthworms.



How are these two populations different?

- A. There are more individuals in population A than in population B.
 - B. There are more phenotypes in population A than in population B.
 - C. There is less variation in individuals found in population A than in population B.
 - D. Individuals found in population A are shorter on average than those found in population B.
10. In a species of fish, having stripes (S) is dominant to not having stripes (s). In one population of the fish, 35% of the fish have genotype SS, 15% have genotype ss, and 60% have genotype Ss. What percent of the fish population have stripes? Write your answer on the line.
- _____ % of the population has stripes
11. Populations can become extinct for many reasons. Which of these occurrences may cause a population to become extinct? Circle the letters of all the correct answers.
- A. extensive flooding from unusually heavy rainfall
 - B. a decrease in dissolved oxygen in a lake ecosystem
 - C. a decrease in the number of predator species living in an area
 - D. an increase in average ocean temperatures throughout the year
 - E. an extreme drought that results in 90% less rainfall than average
 - F. an increase in environmental resources necessary for the species to reproduce

12. Write one letter in each blank to correctly complete the sentences.

Individual meerkats expose themselves above the colony's burrow to watch for predators. This behavior has primarily a 1. _____ cost for the individual but increases 2. _____ for the colony as a whole.

1.	2.
A. energy	D. reproduction
B. opportunity	E. resources
C. risk	F. survivorship

13. Predict whether each of these selective pressures would result in directional or diversifying selection in a population of mice. Write the letters of the descriptions in the correct boxes.

Directional selection	Diversifying selection

- A.** a virus that targets the heterozygous phenotype of a trait
- B.** frequent flooding that favors animals with a lower body density
- C.** a change in climate that reduces ambient temperature by 5 degrees
- D.** the growth of an invasive nut-bearing tree that is displacing other vegetation
- E.** the emergence of a predator that eats brown mice at a much higher rate than white or black mice

14. Classify each change by writing an X in the correct box.

Change	Mutation	Natural selection	Sexual selection
A. A nucleic acid sequence is copied incorrectly during DNA replication.			
B. The average size of an individual in a population decreases in response to predation.			
C. Female frogs select only male frogs with the deepest croaks, resulting in male frogs with very deep croaks.			

15. A lizard species lives on an island. The average length of the lizard is 30 cm, with 65% of adult lizards being between 25 and 35 cm. An earthquake causes the island to be divided into two smaller islands, with some of the lizards on each island. The lizards are unable to cross between the islands. A scientist has found that the populations on both of the islands still have an average length of 30 cm. However, on the first island, 80% of adult lizards are between 25 and 35 cm in length. On the second island, only 20% of the adult lizards are between 25 and 35 cm in length. Write one letter in each box to correctly complete the sentences.

Based on these data, the population of lizards on the first island has undergone _____ selection, while the population of lizards on the second island has undergone _____ selection.

- A. directional

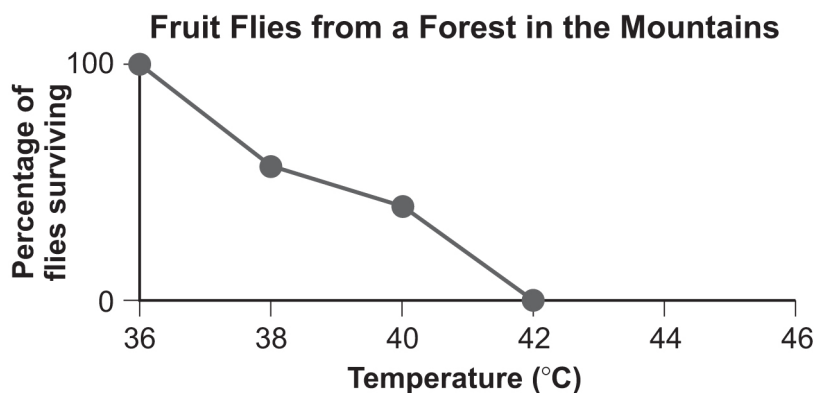
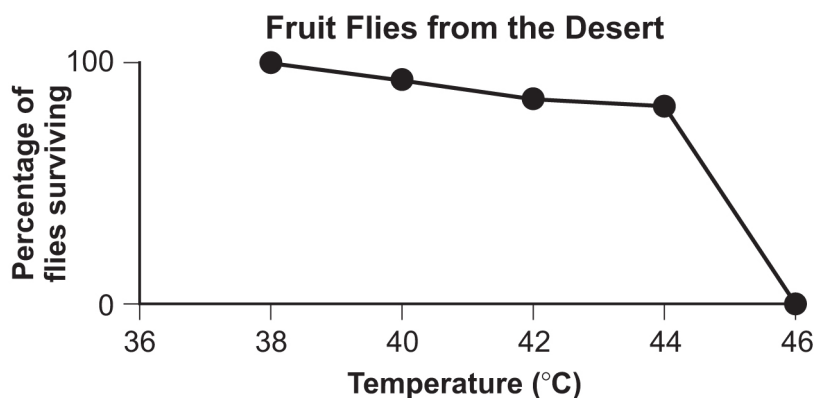
B. disruptive

C. stabilizing

16. Circle the letters of the three examples of innate behavior.

- A. All spiders of a certain species make webs of a similar shape.
- B. A bear returns every year to a river in which many salmon spawn.
- C. A turtle immediately crawls to the ocean after hatching from an egg.
- D. A cheetah develops the ability to hunt from observing his mother hunt.
- E. A chimpanzee puts a stick into a hole in a termite mound to obtain the termites.
- F. Male penguins know how to care for an egg, although they have never observed this behavior.

17. Biologists collected one group of fruit flies from the desert and another from a forested region in the mountains. They tested the flies to see how well they survived at different temperatures. The two graphs show the percentage of flies surviving as temperature was gradually increased from 36 °C to 46 °C.



Number the steps in the correct order to explain how these two groups of flies could have evolved from the same ancestral species.

- _____ The surviving fruit flies reproduce and pass on their heat tolerance trait to their offspring.
- _____ The fruit flies begin to migrate to new regions where temperatures become very hot in summer.
- _____ Fruit flies that are members of a population living in a temperate region differ in the range of temperatures that they can tolerate.
- _____ Fruit flies with high heat tolerance survive the high temperatures while flies with moderate or low heat tolerance die.

Read each statement. Write your answer on the lines.

18. Two lizard populations live on an island. One of the populations has over 100,000 individuals on the island. The other population has only about 1,000 individuals on the island. A storm passing over the island caused the deaths of about 75% of each of the lizard populations. The resulting populations then suffered from the bottleneck effect.

Describe the bottleneck effect.

Explain which population of lizards would be more affected by the bottleneck effect.

19. A dominant allele in rabbits codes for gray fur color, while a recessive allele codes for white fur color. Biologists have been studying a population of rabbits in an arctic region where the landscape is primarily gray during most of the year. The data are summarized in the table.

Genotype	Phenotype	Percentage in population in 2000	Percentage in population in 2015
AA	gray fur	52	57
Aa	gray fur	32	37
aa	white fur	16	6

Describe a mechanism that can explain how climate change could have led to the observed changes in fur genotypes and phenotypes in the rabbit population.

The biologists plan to refer to weather records for 2000 and 2015 to determine the amount of snowfall for the region where the rabbits live. Explain why this information could be used to show a correlation between climate change and the genetics of the rabbits.

20. Starlings are small birds that form flocks. Hawks are natural predators of starlings. To investigate anti-predator behavior of starlings, a research group captured adult starlings and placed them in cages. Some cages contained one starling, while other cages contained a large group of starlings. The researchers observed the behavior of the starlings before and after they released a model of a hawk so that it passed over top of the cages. The following observations were made.

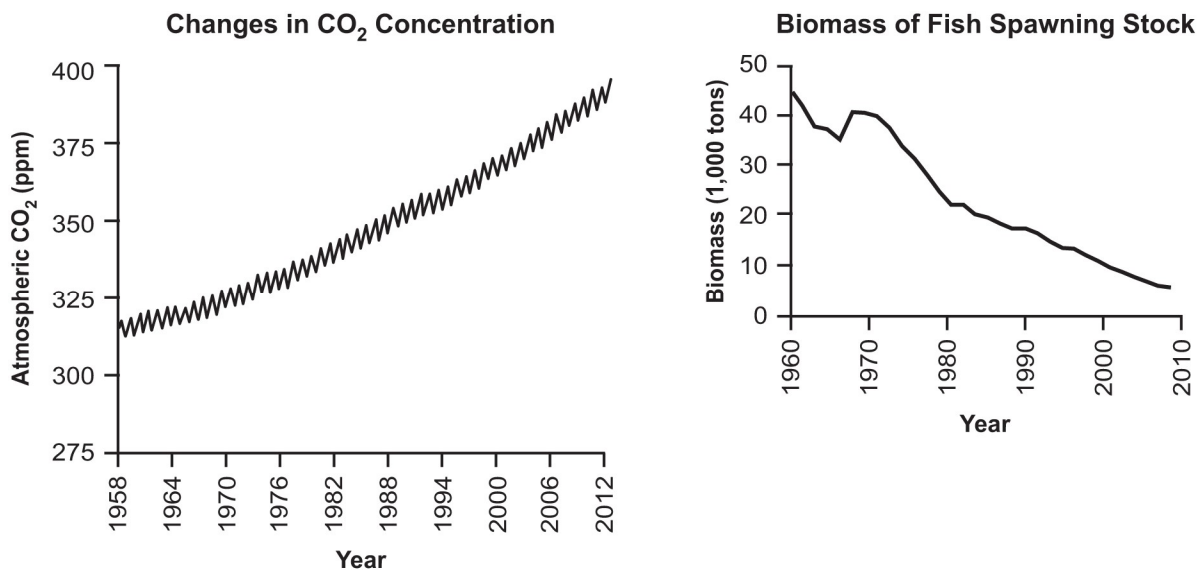
1. Before the model hawk appeared, single birds spent more time looking around than birds in groups.
2. After the model hawk appeared, single birds took longer to fly than birds in groups.

Describe what the observations imply about how starlings are affected by flocking behavior in the wild.

Explain how evidence suggests that flocking behavior provides an advantage to starlings.

Explain how the flocking behavior of starlings became established through the process of natural selection.

21. The population of a fish species in the Pacific Ocean has declined severely over the past several decades. An oceanographer noticed that during the fish population's decline, the concentration of atmospheric carbon dioxide has increased as shown. He hypothesizes that these changes in the environment are responsible for changes in the fish population.



Explain how changes in the environment can lead to the extinction of a species.

Explain whether the oceanographer's observations are causal or correlational.

Many governments are currently working on efforts to reduce the amount of atmospheric carbon dioxide. Based on the data here, predict whether reductions in carbon dioxide would result in a recovery of the fish population. Explain your reasoning.

Directions: Read the passage, then answer the questions that follow.

Songbird Calls

A small songbird uses three different types of calls to communicate with members of its species and with other species. The table summarizes information about these different calls.

Call type	Purpose of call	Call sound frequency
mobbing call	used by a group of adults in defense of their nests as they swoop down on a predator bird	4.5 kHz
scolding call	used by a single bird to scold a predator bird when it attacks	4 kHz
warning call	used by a single bird to warn other birds when a predator bird flies into the vicinity	8 kHz

The main predator of this songbird is the sparrowhawk, a large bird that preys on both adults and young nestlings of the songbird species. Additional information collected through research on both species includes the following:

- The small songbird can detect sounds within the frequency range of 1 to 10 kHz.
- The predator sparrowhawk can detect sounds within the frequency range of 1 to 4 kHz.

22. Which statement best explains how the warning call behavior came to be established in this species? Circle the letter of the correct answer.

- A. Through experience, a few birds learned that predators could not hear high-frequency calls and adapted a warning call based on their experience.
- B. The birds gradually changed their warning call over time, perfecting it with each generation until they developed the highly successful warning call that they use today.
- C. Birds that used a high-frequency warning call were better able to survive because predator birds could not hear them, which increased their ability to survive and pass the trait to their offspring.
- D. When the sparrowhawk first began preying on this songbird species, the songbirds developed the warning call because they needed a means of protecting themselves against this new predator.

23. Scientists use reasoning to evaluate the merits of explanations. Determine whether each claim is reasonable or not reasonable based on the evidence provided. Write one letter in the “Merit” column next to each claim to identify whether it is reasonable or not reasonable.

Claim	Merit
Having the ability to make a warning call that cannot be detected by a predator gives birds a survival advantage; therefore, this trait would likely increase in the population over time.	
Birds with a mobbing call trait increase the risk of predation for the whole population, which makes it unlikely that the trait will persist in the population in the future.	
Some group defensive behaviors can be advantageous to the survival of adults, others to the survival of young, and still others to the survival of both adults and young.	
A songbird born with defective hearing would be at an advantage with respect to defensive call behaviors made by others of its own species.	

- A.** reasonable
B. not reasonable

24. Write the letter of each description in the box next to the type of call that it matches.

mobbing call	
scolding call	
warning call	

- A.** poses the least risk cost to the bird making the call
B. defends adult birds only
C. carried out while the bird making the call is flying

25. In studies conducted on nestlings (young songbirds still in the nest), researchers found the following:

1. Nestlings do not change their begging behavior when presented with a model of a predator sparrowhawk.
2. Nestlings respond to the warning call of adult songbirds by ceasing to beg and halting their body movements.
3. After nestlings leave the nest and begin maturing into adults, they learn to recognize sparrowhawks and give the warning call when the sparrowhawks appear.

Write your answer on the lines.

Explain how this information provides evidence for the claim that learning was involved in this example of group behavior.

Explain how natural selection would have been involved in establishing this group behavior.
