

17.3 Notes

Speciation Booklet

Name: _____

Period: _____

17.1 Notes

17-1 Genes and Variation

Darwin's original ideas can now be understood in genetic terms. Beginning with variation, we now know that traits are controlled by genes and that many genes have at least two forms, or alleles. We also know that individuals of all species are heterozygous for many genes.

To understand evolution, genetic variation is studied in populations. A population is defined as a group of individuals of the same species that interbreed. Members of a population share a common group of genes, called a gene pool. A gene pool consists of all the genes, including all the different alleles that are present in the population. In genetic terms, evolution is any change in the relative frequency of alleles in a population. The relative frequency of an allele is the number of times the allele occurs in a gene pool; compared with the number of times other alleles for the same gene occur.

The two main sources of genetic variation are mutations and gene shuffling. A mutation is any change in a sequence of DNA. Gene shuffling occurs during the production of gametes in sexual reproduction.

It can result in millions of different combinations of genes. Mutation and gene shuffling do not change relative allele frequencies. However, they increase genetic variation by increasing the number of different genotypes.

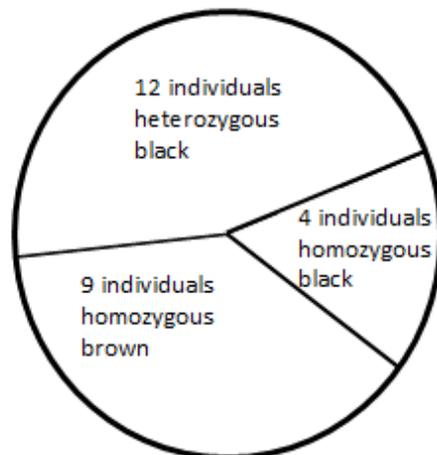
The number of different phenotypes for a given trait depends on how many genes control the trait. A single-gene trait is controlled by one gene. If there are two alleles for the gene, two or three different genotypes are possible. An example in humans is the presence or absence of widow's peak. A polygenic trait is controlled by two or more genes, and each gene may have more than one allele. An example of a human polygenic trait is height.

Polygenic traits such as height produce many different phenotypes. Variation in a polygenic trait in a population often produces a bell-shaped curve, with most people falling near the middle of the curve.

Gene Pool

A homozygous black mouse has two alleles for black fur. A heterozygous black mouse has one allele for black fur and one allele for brown fur. A homozygous brown mouse has two alleles for brown fur.

Sample Population ->



17-3 the Process of Speciation

Speciation means the formation of new species. For one species to evolve into two new species, the gene pools of two populations must become separated, or reproductively isolated. Reproductive isolation has occurred when the members of two populations cannot interbreed and produce fertile offspring. Reproductive isolation can involve behavioral, geographic, or temporal isolation.

Behavioral isolation occurs when populations have different courtship rituals or other behaviors involved in reproduction. Geographic isolation occurs when populations are separated by geographic barriers, such as mountains or rivers. Temporal isolation occurs when populations reproduce at different times.

Recently, Peter and Rosemary Grant proved that natural selection is still causing evolution of finches on the Galápagos Islands. The Grants showed that there was enough heritable variation in finch beaks to provide raw material for natural selection. They also showed that differences in beaks produced differences in fitness. These differences in fitness caused directional selection to occur.

Darwin thought that different finch species evolved on the Galápagos Islands from a single species of founding birds. We now know how this could have happened. A few finches may have traveled from mainland South America to one of the islands to found a new population. There, they survived and reproduced. Some birds crossed to a second island, and the two populations became geographically isolated. They no longer shared a gene pool. Seed sizes on the second island favored birds with larger beaks. The population on the second island evolved into a population with larger beaks. Eventually, the large-beaked birds on the second island became reproductively isolated and evolved into a new species.

Evolution continues today. For example, bacteria are evolving to have resistance to drugs. Evolutionary theory can help us understand these changes.

Describe the types of isolating mechanisms (use pages 404 – 405)

Behavioral Isolation: _____

Geographic Isolation: _____

Temporal Isolation: _____

- How is reproductive isolation related of the formation of new species?

Section Assessment 17.2

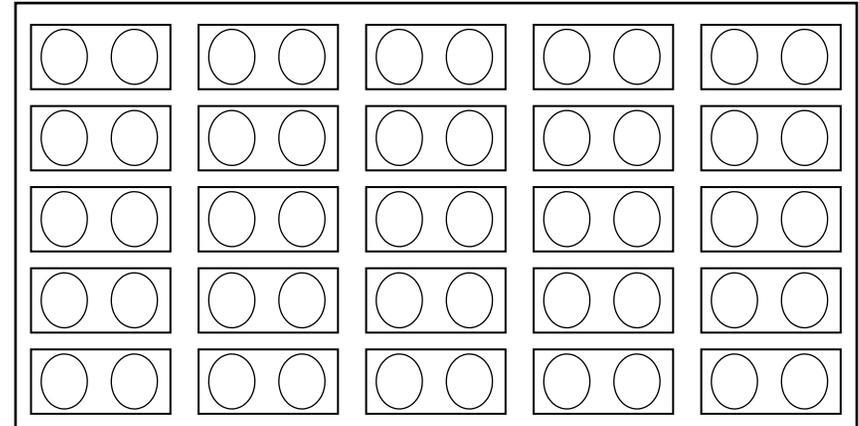
Answer questions 1-4 from page 492 in the textbook. Write both the question and the answer.

Gene Pool

Define gene pool: _____

Define relative frequency: _____

Each rectangle represents one mouse. Each mouse has two alleles, represented by circles, for fur color. Use the graph to color the gene pool of the sample population. Color alleles for black fur black and alleles for brown fur brown.



Use the diagram to answer the questions.

1. How many black alleles are in the gene pool? _____
2. How many brown alleles are in the gene pool? _____

Use pages 482-486 to take notes over Genetic Variation

- What are the two main sources of genetic variation?
- What is a single gene trait?
- What is a polygenic trait?

Sketch figure 17-4

Sketch figure 17-5

17-2 Evolution as Genetic Change

Natural selection acts on individuals. Evolution acts on populations. Natural selection acting on individuals leads to the evolution of populations.

Natural selection on a trait controlled by a single gene with two alleles can cause one allele to increase and the other allele to decrease. Natural selection on polygenic traits is more complicated. Natural selection on polygenic traits can occur as directional selection, stabilizing selection, or disruptive selection. Directional selection takes place when individuals at one end of the bell-shaped curve have higher fitness than individuals near the middle or at the other end of the curve. The result of directional selection is a shift in the curve toward the higher fitness end. Stabilizing selection takes place when individuals near the middle of the curve have higher fitness than individuals at either end. The result of stabilizing selection is a narrowing of the curve around the middle. Disruptive selection takes place when individuals at the upper and lower ends of the curve have higher fitness than individuals near the middle. As a result of disruptive selection, the curve develops a peak at each end and a low point in the middle.

17.2 Notes

Hardy-Weinberg and Genetic Equilibrium

(use pages 492)

State the Hardy-Weinberg principle:

Define genetic equilibrium:

List and describe the five conditions that can disrupt genetic equilibrium

- 1.
- 2.
- 3.
- 4.
- 5.

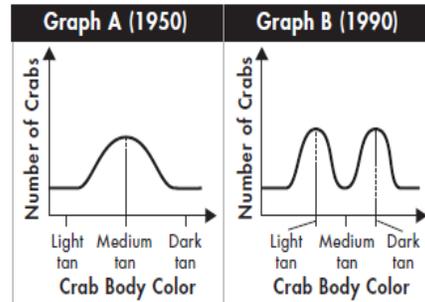
Multiple Choice

- Which of the following conditions is MOST likely to result in changes in allele frequencies in a population?
 - random mating
 - small population size
 - no migrations into or out of a population
 - absence of natural selection
- Mutations and the genetic recombination that occurs during sexual reproduction are both sources of
 - genetic variation.
 - stabilizing selection.
 - genetic equilibrium.
 - genetic drift.
- In a population of lizards, the smallest and largest lizards are more easily preyed upon than medium-size lizards. What kind of natural selection is MOST likely to occur in this situation?
 - genetic drift
 - sexual selection
 - stabilizing selection
 - directional selection
- Populations of antibiotic-resistant bacteria are the result of the process of
 - natural selection.
 - temporal isolation.
 - genetic drift.
 - artificial selection.
- If species A and B have very similar genes and proteins, what is probably true?
 - Species A and B share a relatively recent common ancestor.
 - Species A evolved independently of species B for a long period.
 - Species A is younger than species B.
 - Species A is older than species B.
- When two species reproduce at different times, the situation is called
 - genetic drift.
 - temporal selection.
 - temporal isolation.
 - lateral gene transfer.

- The length of time that two taxa have been evolving separately can be estimated using
 - genetic drift.
 - gene duplication.
 - a molecular clock.
 - Hox genes.

Questions 8–9

The graphs below show the changes in crab color at one beach.



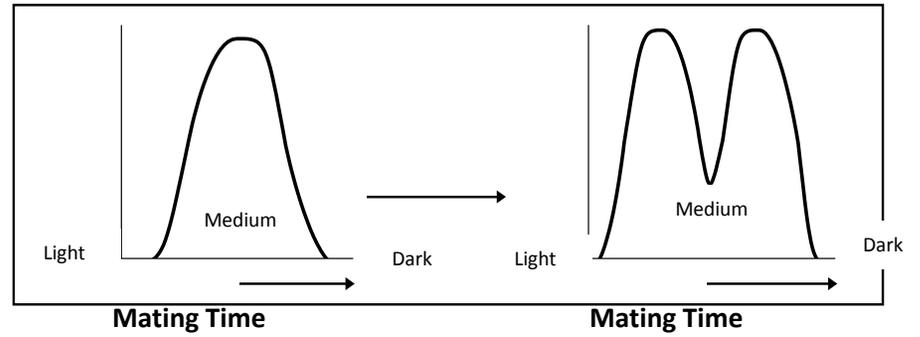
- What process occurred over the 40-year period?
 - artificial selection
 - directional selection
 - stabilizing selection
 - disruptive selection
- Which of the following is MOST likely to have caused the change in the distribution?
 - A new predator arrived that preferred dark-tan crabs.
 - A new predator arrived that preferred light-tan crabs.
 - A change in beach color made medium-tan crabs the least visible to predators.
 - A change in beach color made medium-tan crabs the most visible to predators.

Open-Ended Response

- How does evolution change the relative frequency of alleles in a gene pool? Why does this happen?

	<p>Type of Selection:</p> <p>The most common phenotype WAS (circle one: light, medium, dark). The most common phenotype IS NOW (circle one: light, medium, dark), because the graph _____.</p> <p>Describe what happened to the population: _____.</p>
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Vocabulary Review: The diagrams show the distribution curves for time of mating in a population of insects. The diagram on the left represents the starting population. The diagram below represents the population several generations later. Study the diagrams and answer the questions below. (Use Chapter 17 to answer all of the following questions.)

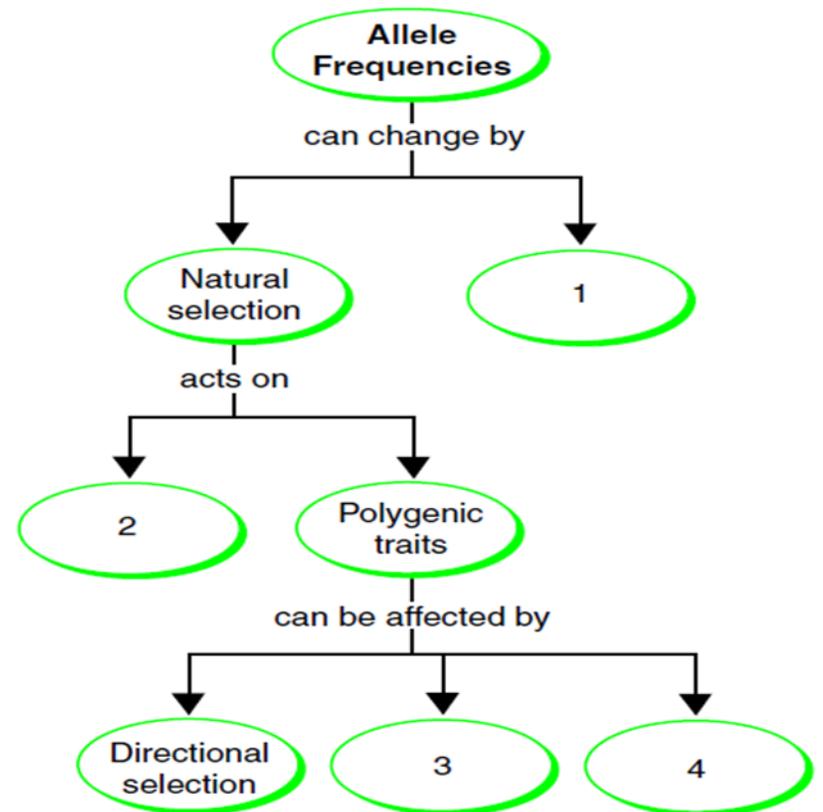
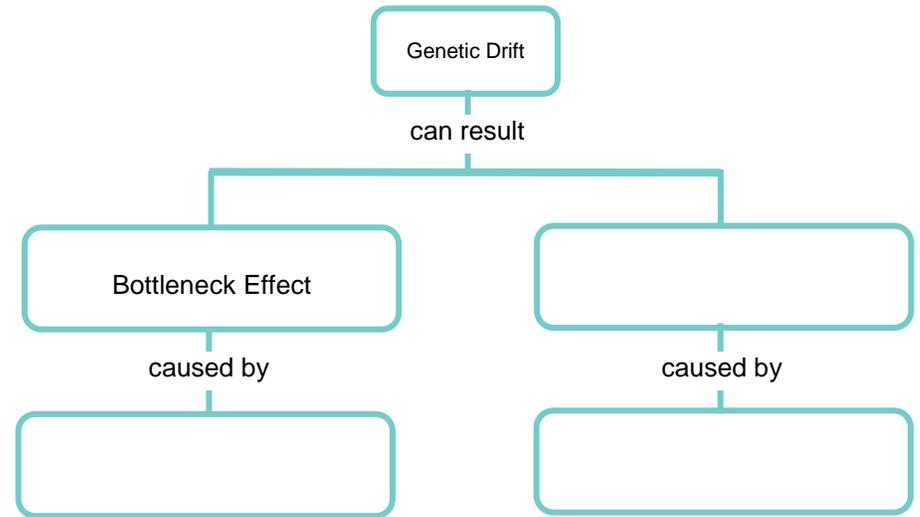


1. What type of natural selection has occurred? _____
2. Which phenotypes are selected against? _____
3. Which phenotypes have higher fitness? _____
4. If natural selection continues in this way, what may eventually happen to the population? _____
5. Any change in the relative frequency of alleles in a population is called _____.
6. A gene pool consists of all the genes in a(an) _____.
7. The two main sources of genetic variation are gene shuffling and _____.
8. A random change in allele frequency is called _____.
9. When birds cannot interbreed because they have different mating songs, they are characterized by _____ isolation.
10. A situation in which allele frequencies change as a result of the migration of a small subgroup of a population is known as the _____.
11. Research on Galápagos finches by Peter and Rosemary Grant showed that a type of natural selection called _____ selection was occurring.
12. Two related species that live in the same area but mate during different seasons are separated by _____ isolation.

Section Assessment 17.3

Answer questions 1-4 from page 497 in the textbook. Write both the question and the answer.

Thinking Visually

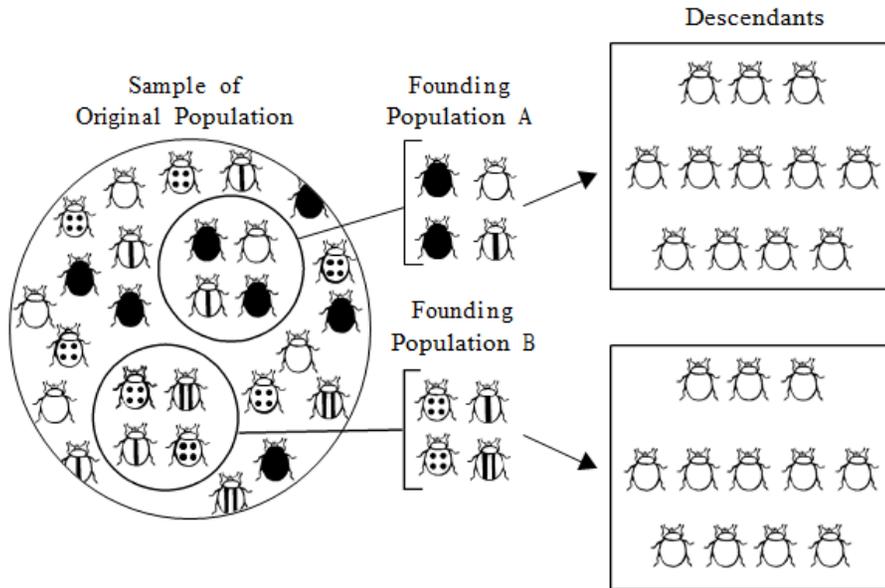


Genetic Drift

Define genetic drift: _____

In a small population, an individual with particular alleles may have more descendants than another individual, by chance. This kind of chance can, over time, lead to an allele's becoming more common in a population.

Draw what the descendants of these populations might look like. Draw 12 descendants for each population.



Use the diagrams to answer the questions 1 and 2.

1. Draw a beetle that could be found in both descendant populations.



2. Why are the beetles in the two descendant populations different?
3. Define Founder Effect.

Describe what types of populations may be susceptible (prone) to genetic drift.

Description of Speciation Events

Fill in the following data table using pages 496 and 497.

Process	How It Leads to Speciation
	A population arrives in a new place.
	Populations are separated by a geographic barrier and do not share a gene pool.
	Populations evolve new traits in response to natural selection in their environments.
	Populations reproduce only within their own group, leading to the development of new species.
	Species evolve in a way that reduces competition between them.

Do populations that are geographically isolated from one another share a gene pool? Explain.
