Chapter 23: THE EVOLUTION OF POPULATIONS

Must Know:

***How mutation and sexual reproduction each produce genetic variation**

•The conditions for Hardy-Weinberg equilibrium

•How to use the Hardy-Weinberg equation to calculate allele frequencies to test if a population is evolving

***What affects genetic drift, migration or selection may have on a population, and analyze data to justify**

23.1

Vocabulary

Genetic variation: differences among individuals in the composition of their genes or other DNA segments.

Average heterozygosity: the average percentage of loci that are heterozygosity.

Geographic Variation: differences in the genetic composition of separate populations

Cline: a graded change in a character along a geographic axis.

Genetic variation makes evolution possible

Darwin provided evidence that life on earth has evolved over time and that primary mechanism for change is natural selection.

He realised that variation in heritable traits was a prerequisite for evolution

Genetic variation

Individual variation occurs in all species and often reflect genetic variation.

Some phenotypic variation is not heritable and occurs by environmental influence. Example: caterpillar of the southwestern United States.

Variation within a population

Characters vary within a population may be discrete or quantitative.

Discrete characters can be classified on an either or basis.

Quantitative characters vary along a continuum within a population.

For both discrete and quantitative characters, biologists need to describe how much genetic variation there is in a particular population.

Variation between populations

In addition to variation observed within a population, species also exhibit geographical variation.

Example: Geographic variation in populations of house mice.

Geographic variation can also occur as a cline. Some clines are produced by a gradation in an environmental variable.

Sources of genetic variation

Originates when mutation, gene duplication, rapid reproduction, and sexual reproduction, produce new alleles and new genes.

Mutation can change the sequence of an organism's DNA.

23.2

Vocabulary:

Population genetics: the study of how populations change genetically over time.

Population: A group of individuals of the same species that live in the same area and interbreed, producing fertile offspring.

Gene pool: all of the alleles at all loci in all the members of a population.

lividual has two alleles for a particular gene, and the individual may be either
ous.

Five Conditions for Hardy Weinberg Equilibrium:

1. **No change in allelic frequency due to mutation**

2. **Random mating**
3. **No natural selection**
4. **The population size must be extremely large** (No genetic drift)
5. **No gene flow.** (Emigration, immigration, transfer of pollen, etc.)

The **Hardy-Weinberg principle** is used to describe a population that is *not* evolving. It states that the frequencies of alleles and genes in a population's gene pool will remain constant over the course of generations unless they are acted upon by forces *other* than Mendelian segregation and the recombination of alleles. That population is at Hardy-Weinberg equilibrium.

<u>**23.3**</u>

Vocabulary:

<u>Genetic Drift:</u> A process that chances events can also cause allele frequencies to fluctuate unpredictably from one generation to the next

<u>Founder Effect:</u> When a few individuals become isolated from a larger population, this smaller group may establish a new population

<u>Bottleneck Effect:</u> A severe drop in population size

<u>Gene Flow:</u> Allele frequencies can change by gene flow. The transfer of alleles into or out of a population due to the movement of tertile individuals or their gametes.

- The **THREE MAJOR FACTORS** that alter allele frequencies and bring about the most evolutionary change are natural selection, genetic drift, and gene flow.

Natural Selection: Results in alleles being passed to the next generation in proportions different from their relative frequencies in the present generation. Individuals with variations that are better suited to their environment tend to produce more offspring than those with variations that are less suited.

Genetic Drift: The unpredictable fluctuations in allele frequencies from one generation to the next. The smaller the population, the greater the chance is for genetic drift. This is a **random**, **non adaptive** change in allele frequencies. Genetic drift can lead to a loss of genetic diversity, even causing some genes to become fixed in new populations. HERE ARE SOME EXAMPLES:

- **Founder Effect:** A few individuals become isolated from a larger population and establish a new population whose gene pool is not reflective of the source population.
- **Bottleneck Effect:** A sudden change in the environment (earthquake, flood, or fires) drastically reduces the size of population. The few survivors that pass through the restrictive bottleneck may have a gene pool that no longer reflects the original populations gene pool.

Example: The population of California condors was reduced to nine individuals. This represent the bottleneck effect.

Gene Flow: Occurs when a population gains or losses alleles by genetic additions or subtractions from the population. This results from the movement of fertile individuals or gametes. **Gene flow tends to reduce the genetic differences between populations,** thus making populations more similar.

23.4 (LAYCE)

Relative fitness- the contribution an individual makes to the gene pool of the next generation relative to the contributions of other individuals.

Types of selection:

1. **Directional-** shifts the overall makeup of the population by favoring variants that are at one extreme of the distribution.
2. **Disruptive**-favors variants at both ends of the distribution
3. **Stabilizing**-Removes extreme variants from the population and preserves intermediate types

Sexual selection is a form of natural selection in which individuals with certain inherited characteristics are more likely than other individuals to obtain mates. It can result in **sexual dimorphism**, a difference between the 2 sexes in secondary sexual characteristics such as differences in size, color, ornamentation, and behavior.

Intrasexual selection- selection within the same sex, individuals of one sex compete directly for mates of the opposite sex.
Intersexual selection- Also called mate choice; individuals of one sex (usually the females) are choosy in selecting their mates from the other sex.

Heterozygous advantage is exhibited if individuals who are heterozygous at a particular locus have greater fitness than do both kinds of homozygous.

Why natural selection can't produce "perfect" organisms:
1. Selection can only act on existing variations
2. Evolution is limited by historical constraints
3. Adaptations are often compromises
4. Chance, natural selection, and the environment interact

23.3 (Glue in Tablets)

Figure 23.10-3

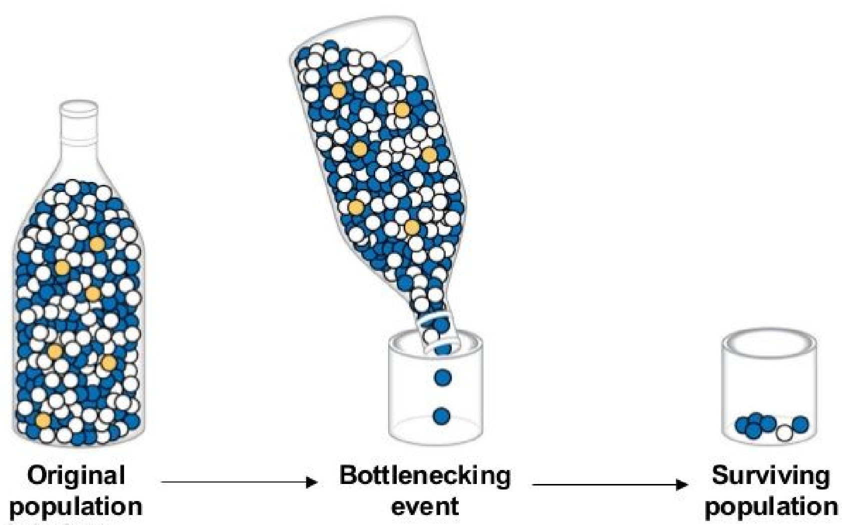
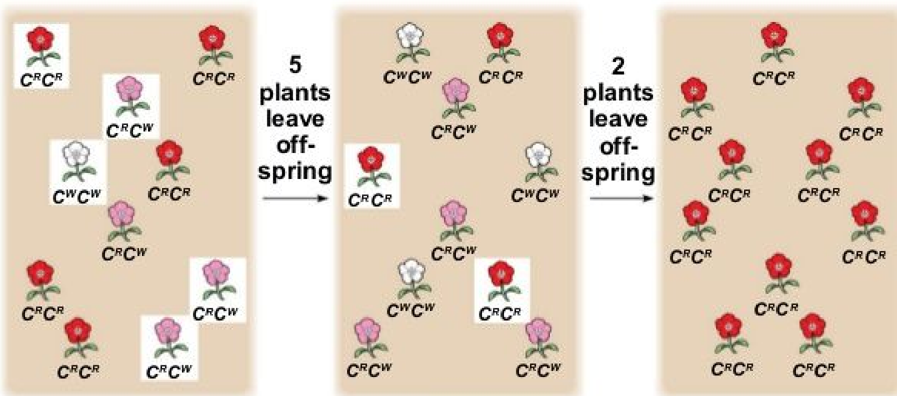


Figure 23.9-3

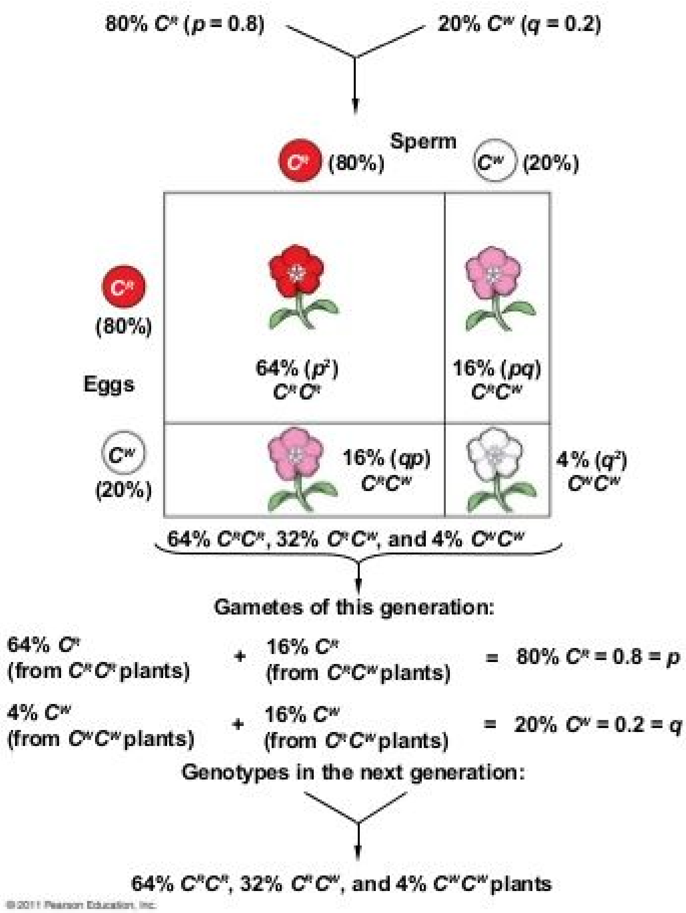


Generation 1
p (frequency of C^R) = 0.7
q (frequency of C^W) = 0.3

Generation 2
$p = 0.5$
$q = 0.5$

Generation 3
$p = 1.0$
$q = 0.0$

Figure 23.8


80% C^R (p = 0.8)
20% C^W (q = 0.2)
Sperm
C^R (80%)
C^W (20%)
Eggs
C^R (80%)
C^W (20%)
64% (p^2) C^RC^R
16% (pq) C^RC^W
16% (qp) C^RC^W
4% (q^2) C^WC^W
64% C^RC^R, 32% C^RC^W, and 4% C^WC^W
Gametes of this generation:
64% C^R (from C^RC^R plants) + 16% C^R (from C^RC^W plants) = 80% C^R = 0.8 = p
4% C^W (from C^WC^W plants) + 16% C^W (from C^RC^W plants) = 20% C^W = 0.2 = q
Genotypes in the next generation:
64% C^RC^R, 32% C^RC^W, and 4% C^WC^W plants
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