11.1 Genetic Variations within Populations
KEY CONCEPT
A population shares a common gene pool.
What are gene pools?
NEW VOCABULARY

- **POPULATION** – GROUP OF INDIVIDUALS OF SAME SPECIES THAT INTERBREED

- **GENE POOL** – COMMON GROUP OF ALL GENES PRESENT IN A POPULATION
Genetic variation in a population increases the chance that some individuals will survive.

- Genetic variation leads to phenotypic variation.
- Phenotypic variation is necessary for natural selection.
- Genetic variation is stored in a population’s gene pool.
  - made up of all alleles in a population
  - allele combinations form when organisms have offspring
Gene Pool

Combined genetic info. of all members
Allele frequencies measure genetic variation.

- measures how common allele is in population
- can be calculated for each allele in gene pool

**Calculating Allele Frequencies**

- G codes for green
- 7 Gs in gene pool
- 12 total alleles for skin color trait in gene pool
- Frequency of allele $G = \frac{7}{12} = 0.583 \approx 58.3\%$

- g codes for brown
- 5 g's in gene pool
- Frequency of allele $g = \frac{5}{12} = 0.417 \approx 41.7\%$
Sources of Genetic Variation:

Mutations: Any change in a sequence of DNA.

Mutations can occur because of:

• Mistakes in the replication of DNA.
• Radiation or chemicals in the environment.
• Random.
• Viruses.
Genetic variation comes from several sources.

- Mutation is a random change in the DNA of a gene.
  - can form new allele
  - can be passed on to offspring if in reproductive cells

- Recombination forms new combinations of alleles.
  - usually occurs during meiosis
  - parents’ alleles arranged in new ways in gametes
Genetic variation comes from several sources.

- Hybridization is the crossing of two different species.
  - occurs when individuals can’t find mate of own species
  - topic of current scientific research
11.2 Natural Selection in Populations
KEY CONCEPT
Populations, not individuals, evolve.
Natural selection acts on distributions of traits.

- A normal distribution graphs as a bell-shaped curve.
  - highest frequency near mean value
  - frequencies decrease toward each extreme value

- Traits not undergoing natural selection have a normal distribution.
Examples of selection pressures... Can change a population’s physical traits

- **Predators** - variants with adaptations allowing them to escape predators have more offspring
  - e.g. speed, defensive weapons, camouflage, mimicry
- **Prey/Food** - variants with adaptations allowing them to obtain food have more offspring
  - e.g. Speed, senses for finding prey/food, weapons for killing prey or obtaining food, camouflage for stealth
- **Climate** - those who can survive new climate best have more kids
  - e.g. ice age, change in climate due to migration.
- **Mates** - variants with adaptations allowing them to attract a mate to have offspring
  - e.g. strong, attractive, good provider
Example #1: Escaping Predation
Peppered Moth (see video clip)

- Early trees had light-colored bark
- Only the light-colored moths survived. Selection was for less melanin.
- After industrialization, the tree bark was darker.
- Only the darker colored moths now survived. Selection was for more melanin.

New info on the Pepper Moth experiment
Example #2

- The leaf bug
- The selection pressure is predators
- It’s strategy is to mimic a leaf

Pray Mantis Camouflage
Main Types of Selection Pressures

- **Directional Selection**
  - Natural selection favors one extreme of the population for that trait
  - Often happens when environment changes in a consistent way—e.g., climate gets colder.

- **Disruptive Selection**
  - Natural selection favors both extremes selected
  - Causes species to diverge

- **Stabilizing Selection**
  - Natural selection favors the average for population selected

- **Sexual Selection**
Natural selection can change the distribution of a trait in one of three ways.

- Microevolution is evolution within a population.
  - observable change in the allele frequencies
  - can result from natural selection
Natural selection can take one of three paths.

- Directional selection favors phenotypes at one extreme.

Diagram:
- Antibiotic drugs put pressure on bacteria populations.
- Normal distribution
- Distribution after directional selection
Directional Selection

- Neck of Giraffe
- Antibiotic resistance of bacteria
- Moth color (melanin)
- Camouflage/Mimics
- Many sexually selected traits
Directional Selection: Mimicry
(mimic environment)
Natural selection can take one of three paths.

- Stabilizing selection favors the intermediate phenotype.

**Diagram:**
- Woodpeckers and wasps put pressure on gall-fly populations.
- Normal distribution
- Distribution after stabilizing selection
Stabilizing Selection

- When the extremes of the trait aren’t as well suited

Examples
- bird clutch size
- Elk Antlers size
- Giraffe neck length
- Tail length in birds
Natural selection can take one of three paths.

- Disruptive selection favors both extreme phenotypes.
Disruptive Selection

- Causes divergence within the species
- Occurs when two different types of resources in one area
- Results in specialization for each branched group
- May lead to formation of new species
- E.g. Darwin’s Finches
Stabilizing selection
- selection against the two extremes in a population (e.g., birth weight in humans, clutch size in birds)
Directional selection
- selection for one extreme in a population, against the other extreme
(e.g., pesticide resistance in insects antibiotic resistance in bacteria)
Disruptive selection
- selection for the two extremes in a population, against the average forms (e.g., limpets with 2 color forms: light & dark in mosaic environment; flies on two hosts: apple & hawthorn)
11.3 Other Mechanisms of Evolution
KEY CONCEPT
Natural selection is not the only mechanism through which populations evolve.
Gene flow is the movement of alleles between populations.

- Gene flow occurs when individuals join new populations and reproduce.
- Gene flow keeps neighboring populations similar.
- Low gene flow increases the chance that two populations will evolve into different species.
Genetic drift is a change in allele frequencies due to chance.

- Genetic drift causes a loss of genetic diversity.
- It is most common in small populations.
- A population bottleneck can lead to genetic drift.
  - It occurs when an event drastically reduces population size.
  - The bottleneck effect is genetic drift that occurs after a bottleneck event.
Genetic Drift

CHANGE IN GENOTYPE SOLELY BY CHANCE EFFECTS! RANDOM!

promoted by:

Population Bottleneck - drastic reduction in population size

Founder Effect - isolated colonies founded by small number of individuals
Population Bottleneck

Original population $\rightarrow$ Bottlenecking event $\rightarrow$ Surviving population

Pre-bottleneck (Illinois, 1820) $\rightarrow$ Post-bottleneck (Illinois, 1993)

Fig. 23-9

(a) Range of greater prairie chicken
The founding of a small population can lead to genetic drift.

- It occurs when a few individuals start a new population.
- The founder effect is genetic drift that occurs after start of new population.
Founder Effect
Example: Silverswords in Hawaii

Tarweeds (Mainland)  Silverswords (Hawaiian Islands)
Genetic drift has negative effects on a population.

- less likely to have some individuals that can adapt
- harmful alleles can become more common due to chance
Summary: Evolution can occur by two major mechanisms:

- Natural Selection (non-random)
- Genetic Drift (random)
Sexual Selection

Selection resulting in greater reproductive fitness in certain individuals of one sex
Sexual selection occurs when certain traits increase mating success.

- Sexual selection occurs due to higher cost of reproduction for females.
  - males produce many sperm continuously
  - females are more limited in potential offspring each cycle
There are two types of sexual selection.

- intrasexual selection: competition among males
- intersexual selection: males display certain traits to females
Sexual Selection

Intrasexual selection – within one sex; competition between members of one sex (usually males)
Sexual Selection

Intersexual selection – between two sexes; preference by one sex for features of the other sex. Usu. female choice.