

Principles of Evolution

MR. ISON'S NOTES
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HOLT MCDUGAL BIOLOGY
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CHAPTERS 10 & 11

Introduction

- **Evolution** is the process of biological change by an organism over time.
- Evolutionary theory is a concept that has developed over time through extensive research and experimentation.
- Many scientists contributed in the development of the **theory**.
 - Unlike the world's definition of "theory" a scientific theory is not just a hunch, speculation, or assumption.
 - In science, a theory is based off of a wide variety of observations and experimental data and results.

Ideas that Shaped Evolutionary Theory

- **Carolus Linnaeus** (1735) – proposed a system of organization for plants and animals based on their similarities.
- **Georges Buffon** (1749) – discussed ideas about the relationships between organisms, the possible sources of variation, and the possibility of evolution.
- **Erasmus Darwin** (1794) – considered that competition may have been a mechanism for evolutionary change in organisms.
- **James Hutton** (1795) – proposed that changes in landforms were due to slow changes over a long period of time (**gradualism**).

Ideas that Shaped Evolutionary Theory

- **Georges Cuvier** (1796) – argued that new life forms moved in from other areas, causing the abrupt changes in the fossil record (**catastrophism**).
- **Thomas Malthus** (1803) – stated that man had the potential to overpopulate if not kept in check by war, disease and famine.
- **Jean-Baptiste Lamarck** (1809) – presented that environmental changes over time caused evolutionary change in organisms.
- **Charles Lyell** (1830-1833) – expanded gradualism stating that changes in the Earth are uniform through time and still ongoing (**uniformitarianism**).

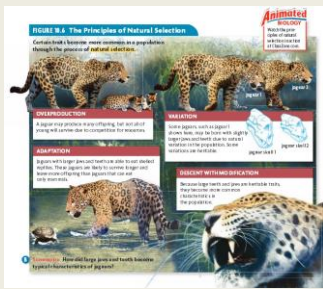
Mechanism of Evolution

- Darwin spent nearly 20 years after his voyage researching the mechanism for evolution.
 - Breeders and farmers produced domestic plants and animals with traits not shown in the wild (**artificial selection**).
 - Darwin bred pigeons, noticing that traits were passed from one generation to the next (**heritability**).
 - Darwin reasoned that if humans could artificially select for traits, then nature could create a selective pressure to determine whether traits were passed on (**natural selection**).

Mechanism of Evolution

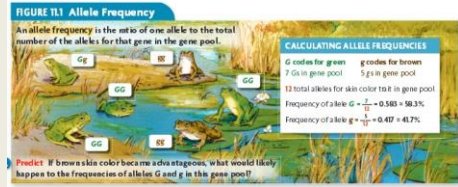
- Natural selection is the mechanism for evolutionary change.
 - The differences (**variations**) inherited by offspring are existent in every **population**, the total of all the organisms of one species in a given area.
 - Overproduction causes competition between organisms for resources.
 - Adaptations that are inherited will allow for some offspring advantage in surviving and reproducing in a specific environment (**fitness**).
 - The cycle will repeat resulting in an a species with adaptations specific for that given environment (**descent with modification**).

Mechanism of Evolution



Genetic Variation

- The genetic variation of a population is stored in its **gene pool**, the total of all the alleles in the population.
- Each allele in the population exists in a certain frequency (**allele frequency**).



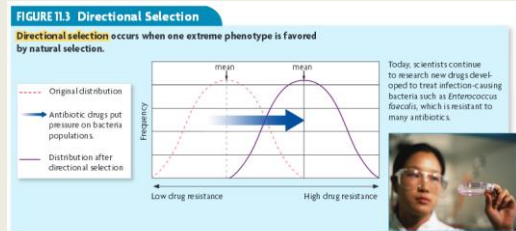
Microevolution

- Allele frequency of a population can change over time.
- Microevolution** is the small scale change of a population over time and can occur in one of three ways:
 - Directional Selection** – Shifts the population distribution to favor one extreme of a specific trait.
 - Stabilizing Selection** – Keeps the population constant by selecting against the extremes of a specific trait.
 - Disruptive Selection** – Occurs when the intermediate trait is selected against of a specific trait.

Microevolution

- Directional Selection (example):**
 - Before the 1940s there was a trait present for drug resistance among bacteria, however, the trait had no real advantage.
 - Once antibiotics were introduced bacteria with the drug resistance trait had an advantage.
 - Overuse of antibiotics favored more resistant phenotypes.
 - New antibiotics were introduced, resulting in the gradual development of the “superbugs.”
 - Over 200 types of bacteria show some antibiotic resistance.

Microevolution



Microevolution

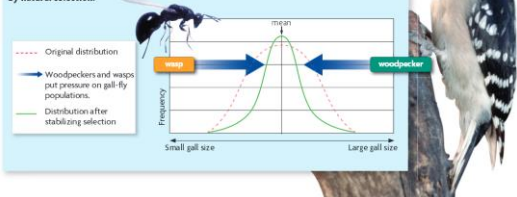
- Stabilizing Selection (example):**
 - Gall flies lay eggs in the developing shoots of tall goldenrods.
 - The larvae of the gall flies produce chemicals causing the shoots to swell.
 - Both small and large galls have a disadvantage:
 - Woodpeckers feed on large galls feeding on the larvae.
 - Wasps lay their eggs inside small galls and when the eggs hatch they feed on the gall-fly larvae.



Microevolution

FIGURE 11.5 Stabilizing Selection

Stabilizing selection occurs when intermediate phenotypes are favored by natural selection.



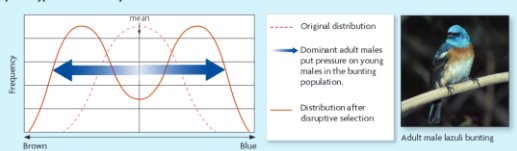
Microevolution

- Disruptive Selection (example):
 - Lazuli buntings vary in their feathers, ranging from dull brown to bright blue.
 - Bright blue feathers are the dominant trait, having the pick of the best territories and most success at attracting females.
 - Dominant adult males are more aggressive to the young bright blue and bluish-brown lazuli, disrupting their ability to attract a mate.
 - The duller brown males can win a mate because the dominant males leave them alone.
 - The brightest males eventually mate as they grow stronger because they attract simply due to their color.

Microevolution

FIGURE 11.6 Disruptive Selection

Disruptive selection occurs when both extreme phenotypes are favored by selection.



Factors Causing Evolution

1. **Mutations** may occur introducing new variation in the gene pool.
2. **Natural selection** occurs, where the organism with the greatest fitness passes its traits on.
3. Sometimes the allele frequency can change in a population due to just random chance (**genetic drift**).
 - **Bottleneck Effect** – an event, such as overhunting or a natural disaster, greatly reduces a population's number and genetic variation.
 - **Founder Effect** – a small number of individuals populate a new area, providing less variation than its former population.

Factors Causing Evolution

4. Organisms can move populations, meaning their alleles will leave one gene pool and move into a new gene pool (**gene flow**).
 - When an organism leaves a population (**emigration**) it reduces the genetic variation of its former population.
 - When an organism enters a new population (**immigration**) it increases the genetic variation of its new population.
5. Traits can also give a mating advantage to individuals in a population increasing its mating success (**sexual selection**).

Isolation Causes Speciation

- **Reproductive isolation** occurs when members of different populations can no longer mate with each other.
 - Two individuals may appear similar to each other, have many of the same traits, however a mating routine or frequency of mating songs/sound may be different (**behavioral isolation**).
 - Two groups of organisms may have the ability to mate, but do not due to a geographic factor, such as a river, mountain, canyon, etc (**geographic isolation**).
 - Mating or breeding cycles do not overlap causing two groups of organisms not to be able to breed (**temporal isolation**).