

Darwin's Evolutional Theory of Natural Selection



EQ: How are genetic variations caused and how do they lead to natural selection?

What is natural selection

 Individuals that have physical or behavioral traits that better suit their environment are more likely to survive and will reproduce more successfully than those that do not have such traits.

Survival of the fittest!!!!

Acts on a range of phenotypes in a population.
NOT Individuals!!!!!!!!

Population- all members of a species that live in an area.

So what is Evolution?

- **Evolution** occurs as a populations genes and frequencies change <u>overtime!</u>
 - Creating new phenotypes

But how can things change?????





Gene Pool

All the alleles in a population

- The frequency of a specific allele is called allelic frequency (how often it appears)
 - How many alleles are in the gene pool?
 <u>30</u>
 - How many alleles are red?
 - <u>5</u>
 - Allelic frequency?
 5/30 or 1/6

Now take the same gene pool

*What would happen to the pool if any individual that had a red allele didn't survive?



- 1. The allele would not be part of the population
- 2. The allele would not be passed down
- 3. The population would change



What can cause genetic changes? *Mutations *Environmental changes *Radiation *Chemicals

Some examples are:

Reproductive isolation-when populations cant breed due to geographic separation

Gradualism-gradual change over a long period of time leading to new species

Natural Selection is Survival of the Fittest

- Fitness
 - Ability of an individual to survive & reproduce
- Adaptation
 - Inherited characteristic that increases an organisms chance for survival

Orchid Mantis



Adaptation- a physical characteristic that better enables a species to survive.

An adaptation is an inherited trait that has become common in a population because the trait provides an advantage to the species.

Could be a behavior, sound, appearance, etc.

Natural Selection is Survival of the Fittest

• Adaptations can be:

- Physical
 - Speed, camouflage, claws, quills, etc.
- Behavioral
 - Solitary, herds, packs, activity, etc.



Mimicry

- When one species is able to resemble another
 - Species is harmless resembling something harmful





Camouflage

- To resemble its surroundings
 - A defense mechanism used by many animals!
 - Fish
 - Crabs
 - Bugs
 - Snakes
 - Frogs
 - Can you think of any others?





Can you find the animals in these 2 pictures?



In other words.....

- Natural Selection is:
 - When certain variations survive, reproduce and pass their variations to the next generation.

Examples?

Examples?

Examples?

• Take many generations to develop







Natural selection does not grant organisms what they "need".





Natural Selection IMPORTANT NOTES

- Adaptations are a "luck of the draw"- if a species does not adapt, it does not survive. Chances are slim.
- Any individual CANNOT change **during its lifetime**; it can however pass changes (**mutations within sex cells**) onto its offspring.
- Natural selection does not "give" organisms what they need; it is a long process that favors certain variations.
- The driving mechanism behind the process of natural selection is genetic variation.
 - Natural selection favors/acts upon PHENOTYPES (the physical quality of an organism)- which as a result causes a change in the gene pool – genes determine the phenotypes.

Natural Variation and Artificial Selection

- Abandoned the idea that species were perfect & unchanging.
- Observed significant variation in all species observed.
- Observed farmers use variation to improve crops & livestock.
- This is called selective breeding.

Natural Variation and Artificial Selection

- Natural Variation
 - Differences among individuals of a species
- Artificial Selection
 - Selective breeding to enhance desired traits among stock or crops





Examples of Selective Breeding









The Origin of Species

Darwin's *The Origin of Species* was published on November 24th, 1859.

(Full title: On the Origin of Species by Means of Natural Selection, or the Preservation of Favored Races in the Struggle for Life.)

Darwin initially only shared his research with a select few.

Darwin published because Charles Lyell urged him to after Alfred Russel Wallace published an article with ideas similar to Darwin's.

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Missing Link

 In Darwin's time, there was no mechanism to explain natural selection.

How could favorable variations be transmitted to later generations?

With the rediscovery of Mendel's work in the first half of the 20th century, the missing link in evolutionary theory was found.





This is NOT Evolution



Darwin and others were not suggesting that man evolved from apes. They were suggesting that apes and humans share a common ancestor.



 Evolution is more like a branch, or a tree, rather than a lineage.

"I think case must be that one generation should have as many living as now. To do this and to have as many species in same genus (as is) requires extinction . Thus between A + B the immense gap of relation. C + B the finest gradation. B+D rather greater distinction. Thus genera would be formed. Bearing relation" (next page begins) "to ancient types with several extinct forms"- **Darwin as written in his journal from the Voyage of the Beagle**

The between A. J. B. chans

Common Descent with Modification

- Darwin proposed that organisms descended from common ancestors
- Idea that as individuals of a species reproduce, they change over time. These changes could lead to a divergence from a common form
- Caused evolution of new species.



Descent With Modification

- Takes place over long periods of time
- Natural selection can be observed as changes in
 Understanding Biology, 3d ed., by Raven & Johnson, @ 1995 Time
 - Body Structures
 - Ecological Niches
 - Habitats
 - Behaviors



Descent With Modification

- Species Today Look Different From Their Ancestors
- Each living species has descended with changes from other species over time.



Descent With Modification



Divergence

Divergence is the accumulation of differences among two groups of the same species, which can then become so different that they can no longer interbreed, developing a new species.

Yet, the common ancestor remains (descent with modification).



Speciation

- The formation of a new species= speciation.
- Divergence is the driving force behind speciation.
- Species can have subspecies;
 - EXAMPLE

All dogs are the same species (Canis familiaris) Due to artificial selection, they are very different (Great Dane vs. Chihuahua) thus resulting in subspecies.



Subspecies- members of the same species that differ genetically because of different living conditions.

Two Models of Evolution

1. Gradualism: a model or hypothesis of evolution in which **gradual change** occurs over a long period of time.





2. Punctuated Equilibrium: a model of evolution in which periods of **rapid change** in species are separated by periods of little or no change. **Evolutionary Time Scales**

Macroevolution: Long time scale events that create and destroy species.



Evolutionary Time Scales

Microevolution: Short time scale events (generationto-generation) that change the genotypes and phenotypes of populations



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Figure 14.11 Individuals of a moth population that has undergone directional selection in response to changes in the environment. Light-winged and dark-winged peppered moths (*Biston betularia*) are resting on a lichen-covered tree trunk in (a) and on a soot-darkened tree trunk in (b).

Left Side Activity

To the terms below, define them, use in a sentence and draw a picture Natural selection Camouflage Survival of the Fittest Mimicry Fitness Natural Variation Adaptation Artificial Selection Divergence Speciation Microevolution Macroevolution