

Natural Selection

SC.F.2.4.3



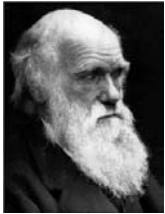
Integrated Science I & Honors
Mrs. King

Jean-Baptiste Lamarck



- French botanist
- among the first scientists to recognize
 - living things have **changed over time**
 - all species were **descended from other species**
- He also recognized organisms were somehow adapted to their environments

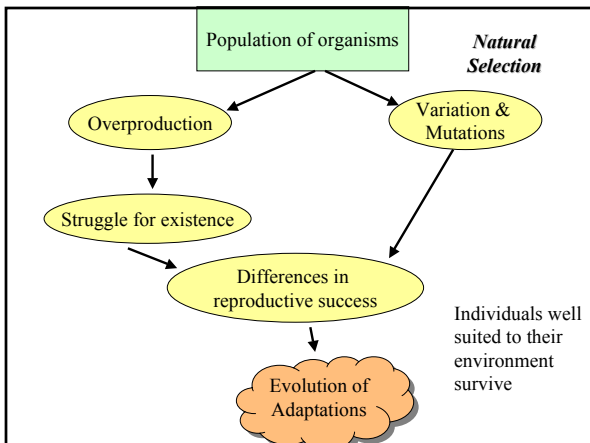
Charles Darwin



- British Naturalist
- *On the Origin of Species*
 - Proposed a mechanism for evolution
 - **natural selection**
 - Presented evidence demonstrating process of evolution has been taking place for millions of years
 - continues in all living things

Darwin's Two Main Points

- **Descent with modification**
 - descendants of earliest organisms spread into various habitats over millions of years.
 - i.e. fur that blends with different environments, protective camouflage
- **Natural Selection**
 - Process by which individuals with inherited characteristics well suited to the environment leave more offspring on average than do other individuals.



Natural Selection

- Does not act directly on genes, but on phenotypes
- Affects which individuals having different phenotypes survive and reproduce and which do not.
 - reproducing individuals add to the population
 - Non-reproducing individuals die without passing on their genetic material (genes)

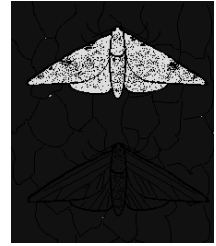
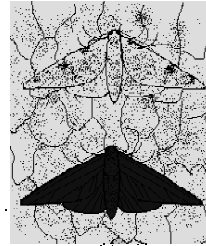
Peppered Moth

Biston betularia



- Reproduce with each other
- Color difference depends primarily on alternate alleles for a single gene
 - BB Bb bb
- Black moths presumably produced by **mutation**
 - change in DNA that makes up the genes for a trait

Normal Environment vs. Industrial Pollution



Darwin's Four Postulates Illustrated

- Not all offspring in a generation survive to reproduce
 - many more moth eggs are produced than can survive
 - many moths will be eaten by birds before they reproduce
- Variation among individuals
 - black
 - gray

- Variation is genetic
 - black moths have different alleles for color than do gray moths
- Different forms differ in fitness
 - in industrial environments black moths survive to reproduce better than do gray moths since gray moths get eaten by birds.

- Note also that an individual moth does not adapt -- it is genetically either black or gray and can not change.
- Individuals do not adapt.



Passing On

- Population of moths adapts
 - individuals with lower fitness traits do not reproduce as much
- Genes are not carried on from generation to generation as much as the genes for higher fitness traits
 - traits coded for gray moth die out over time
 - traits with high fitness (*black moth*) become common

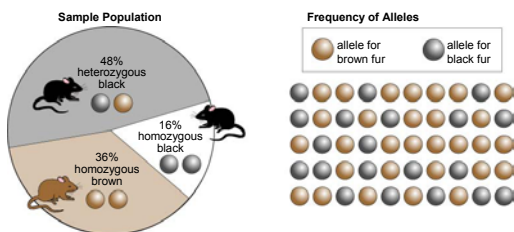
Natural Selection

- Multi-drug resistant TB (6 min video clip)
<http://www.teachersdomain.org/9-12/sci/life/evo/whymatters/index.html>
- Bird Beaks (4 min video clip)
<http://www.teachersdomain.org/9-12/sci/life/evo/hummingbird/index.html>
- Camouflage (1 min video clip)
<http://www.teachersdomain.org/9-12/sci/life/evo/camouflage/index.html>

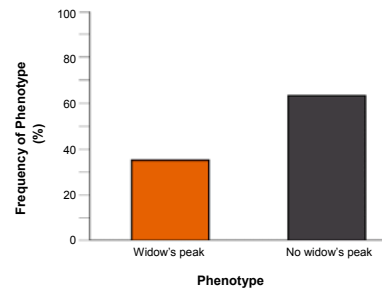
Natural Selection on Polygenic Traits

- Directional Selection
- Stabilizing Selection
- Disruptive Selection

Relative Frequencies of Alleles

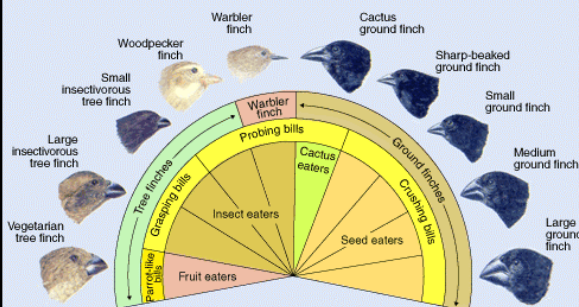


Phenotypes for Single-Gene Trait



Evolution

Acts on populations, not individuals

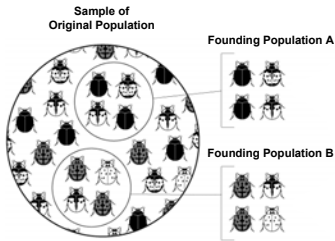


each species' variation makes it well adapted for its food supply

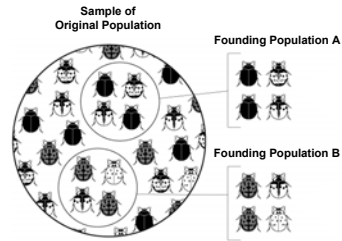
Evolution as Genetic Change

- Natural Selection on Single-Gene Traits
- Natural Selection on Polygenic Traits
 1. Directional Selection
 2. Stabilizing Selection
 3. Disruptive Selection
- Genetic Drift

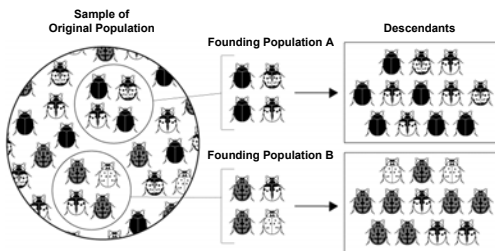
Genetic Drift



Genetic Drift



Genetic Drift



Genetic Drift

A change in the gene pool due to chance

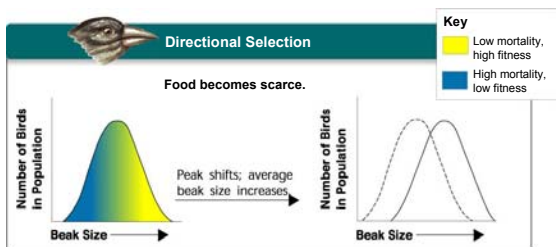
- **Bottleneck Effect**

- reduction due to natural disasters and hunting,
- reduce the size of the population

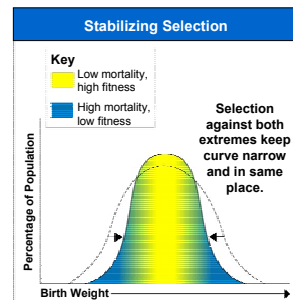
- **Founder Effect**

- few individuals colonize an isolated island, lake or some other new habitat
- The smaller the colony, the less its genetic makeup will represent the original colony
- Chance reduces genetic variation

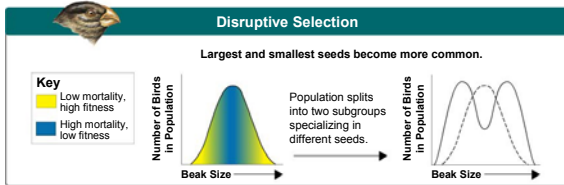
Directional Selection



Stabilizing Selection

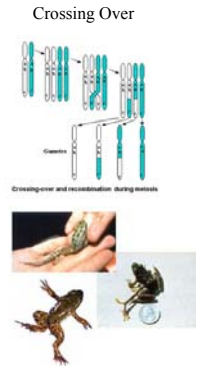


Disruptive Selection



Types of Variation

- Genes carry inheritable characteristics,
 - source of random variation
 - **crossing over**
- Mutations cause variation
 - *missing letters in DNA*



Microevolution

- Generation to generation change in frequencies of alleles within a population
- A change in a population's gene pool
 - Genetic Drift
 - Gene Flow
 - Natural Selection
- **Evolution Case Studies** (14m video clip)

Gene Pools

- Consists all the alleles in all the individuals that make up a population
- Mutations and sexual recombination are random
- Natural selection (thus evolution) is not random.
- The environment favors certain genetic combinations that contribute to survival and reproduction success.
- Change in frequency of alleles (how often they occur).

Hardy-Weinberg equilibrium

Two alleles, **A** and **a**, the dominant allele is represented by **p** and the recessive allele by **q**.

Mathematical Definitions:

1) Allele Frequencies = p (**A**) + q (**a**) = 1

2) Genotypic Frequencies = $(p + q)^2 = p^2$ (**AA**) + $2pq$ (**2Aa**) + q^2 (**aa**) = 1

Hardy-Weinberg equilibrium assumes random mating each generation and no disruption of allele frequencies or genotypic frequencies.

Works Cited

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