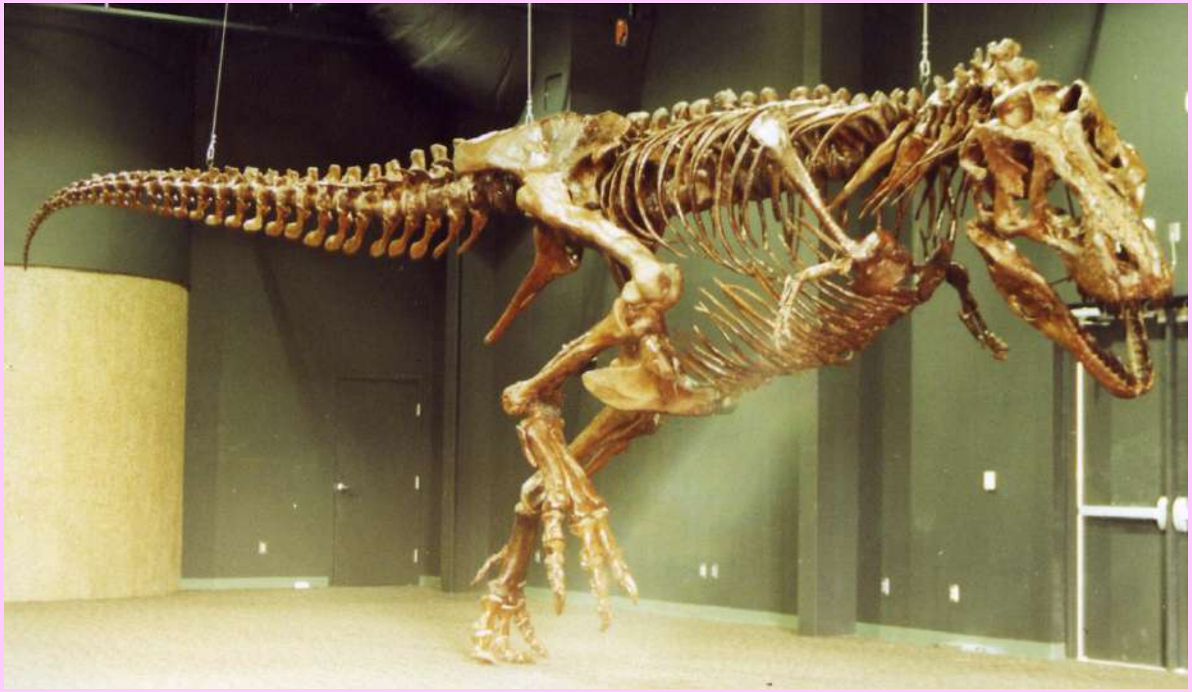
# PATTERNS OF EVOLUTION
# Chapter 16 & 17

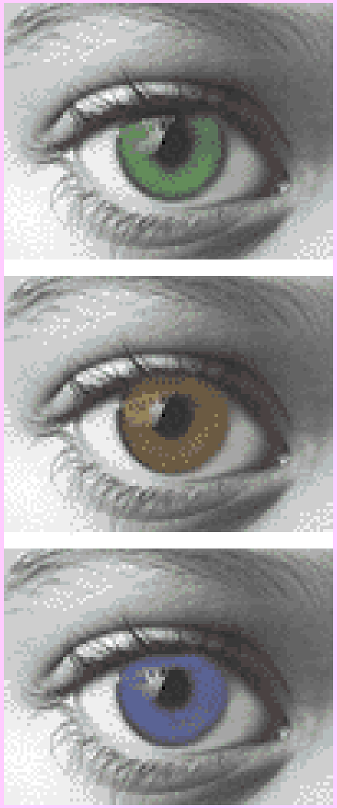


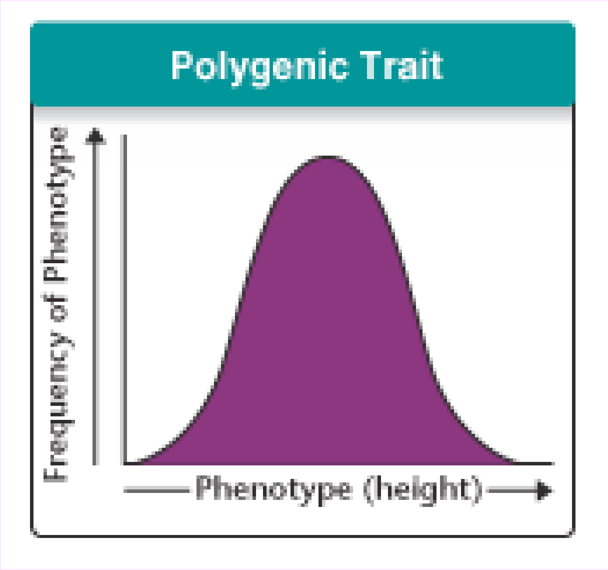
Slide show by Kelly Riedell/Brookings Biology

http://www.baystatereplicas.com/images/repro_dino_pecksrex3.jpg

**POLYGENIC** traits are controlled by two or more genes.

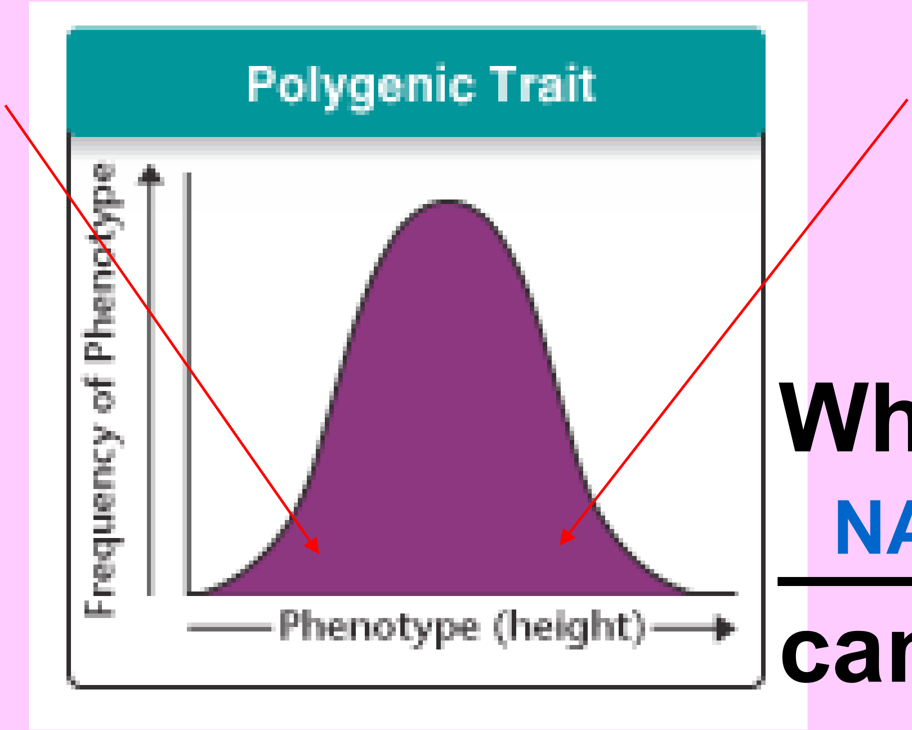
A bell shaped curve is typical of polygenic traits






Graph from BIOLOGY by Miller and Levine; Prentice Hall Publshing©2006

The __FITNESS__ of individuals near each other will not be very different, but fitness may vary from one end of curve to the other.




Where fitness varies, __NATURAL SELECTION__ can act!

Graph from BIOLOGY by Miller and Levine; Prentice Hall Publshing©2006

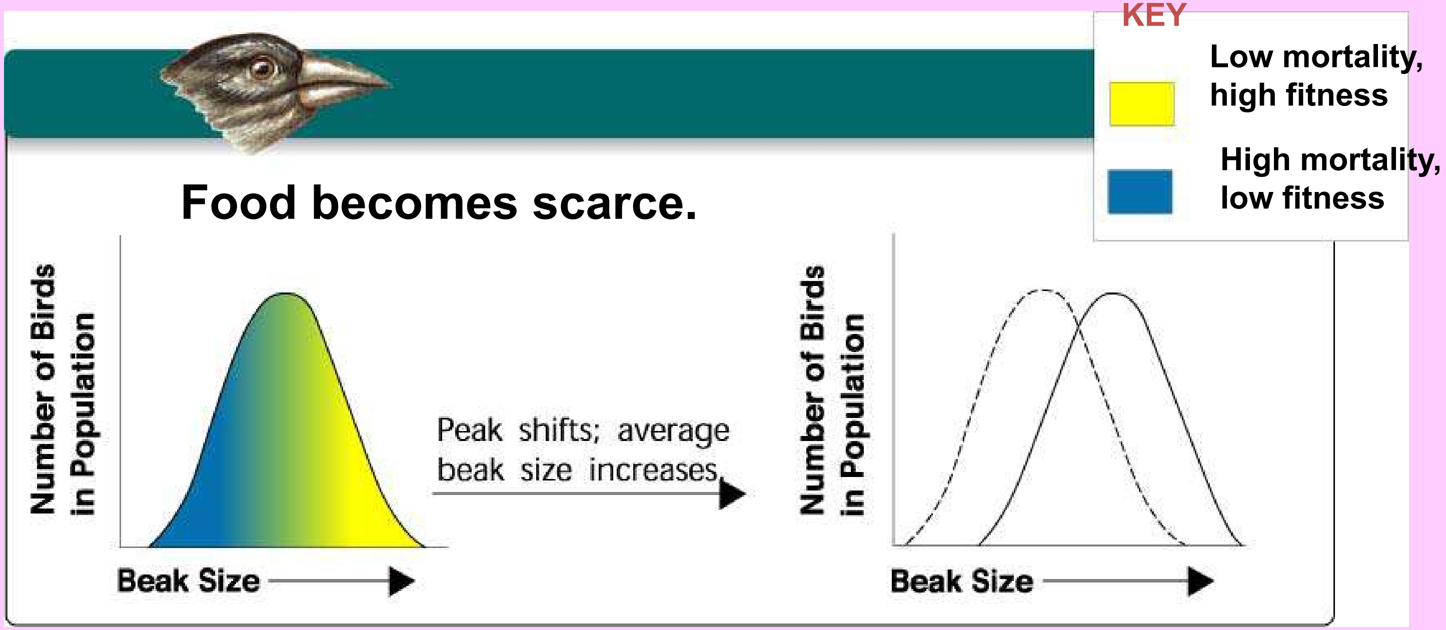
Natural selection can affect the distribution of phenotypes in 3 ways:

DIRECTIONAL selection

STABILIZING selection

DISRUPTIVE selection

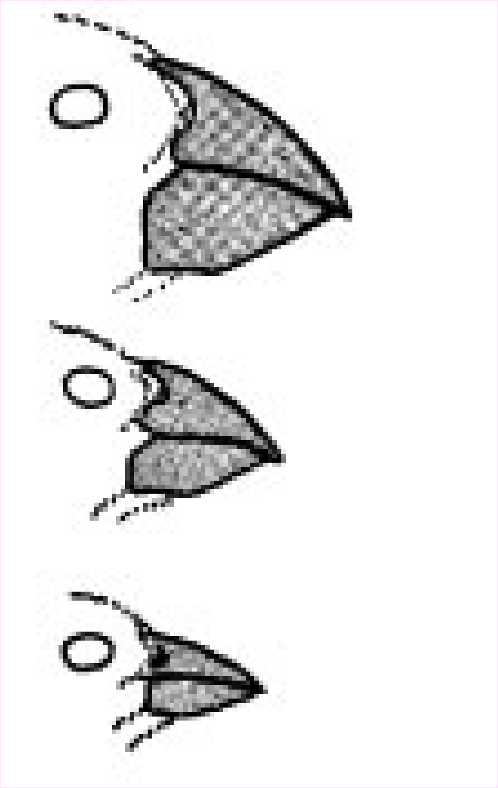
- **DIRECTIONAL SELECTION**

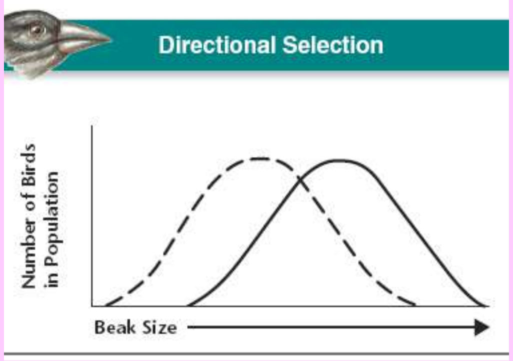



**Individuals at ___ONE END___ of the curve have higher fitness than individuals in middle or at other end.**

**Graph shifts as some individuals fail to survive at one end and succeed and reproduce at other**

# EXAMPLE OF DIRECTIONAL SELECTION






Beak size varies in a population

Birds with bigger beaks can feed more easily on harder, thicker shelled seeds.

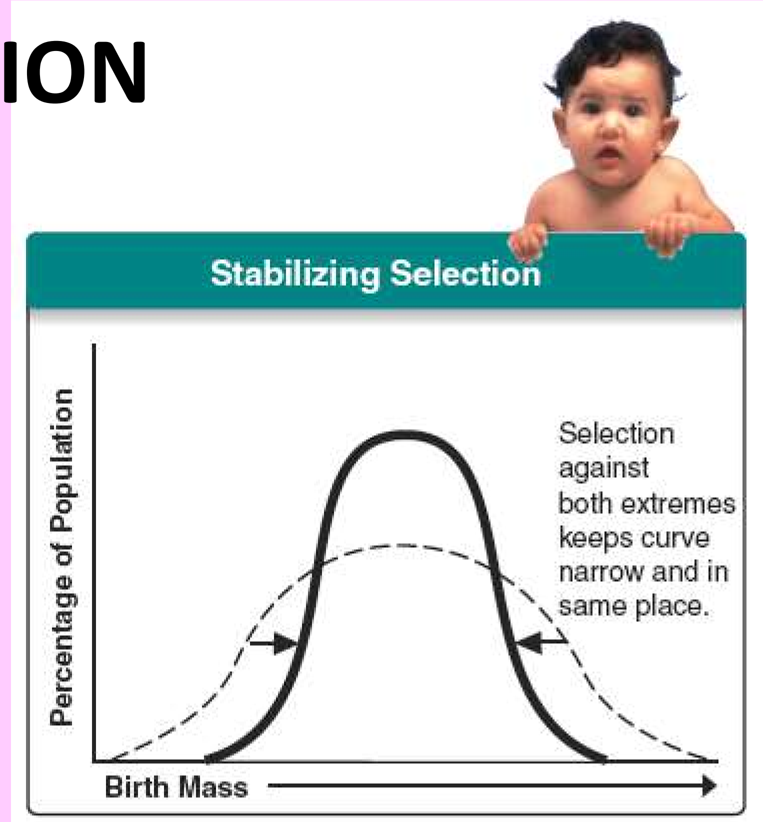
Suppose a food shortage causes small and medium size seeds to run low.

Birds with bigger beaks would be selected for and increase in numbers in population.

http://www.animalbehavior.org/ABS/Stars/ONI/Podos_-_finch_graphic.jpg

Graph from BIOLOGY by Miller and Levine; Prentice Hall Publshing©2006

- STABILIZING SELECTION



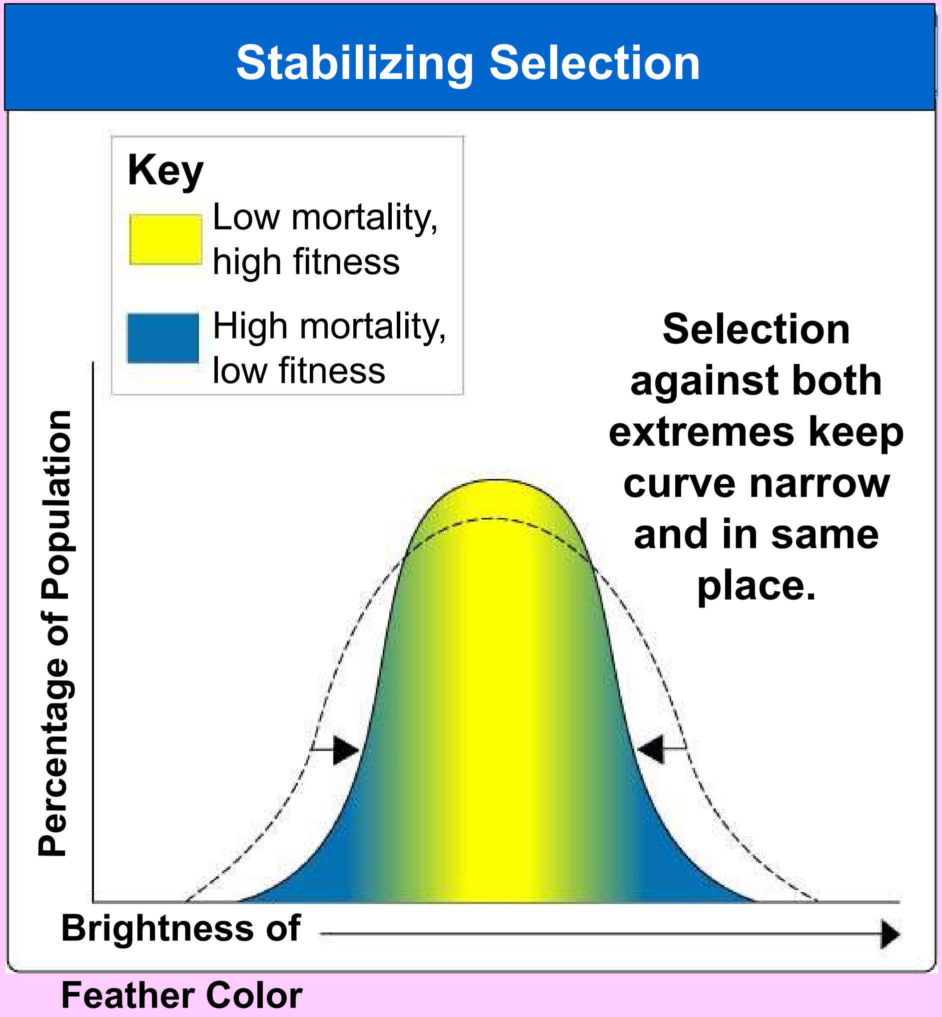

**Individuals in ____CENTER____ of the curve have higher fitness than individuals at either end**

**Graph stays in same place but narrows as more organisms in middle are produced.**

# STABILIZING SELECTION

Section 16-2

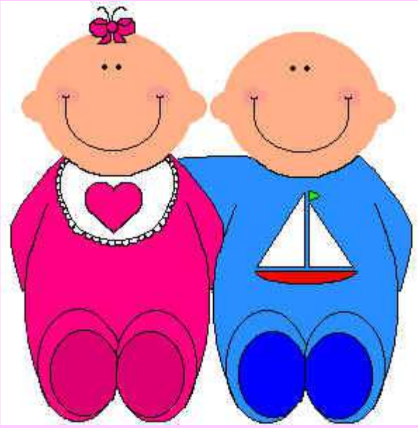
Male birds use their plumage to attract mates. Male birds in the population with less brilliant and showy plumage are less likely to attract a mate, while male birds with showy plumage are more likely to attract a mate.




Male birds with showier, brightly-colored plumage also attract predators, and are less likely to live long enough to find a mate.
The most fit, then, is the male bird in the middle-- showy, but not too showy.

Graph from BIOLOGY by Miller and Levine; Prentice Hall Publshing©2006

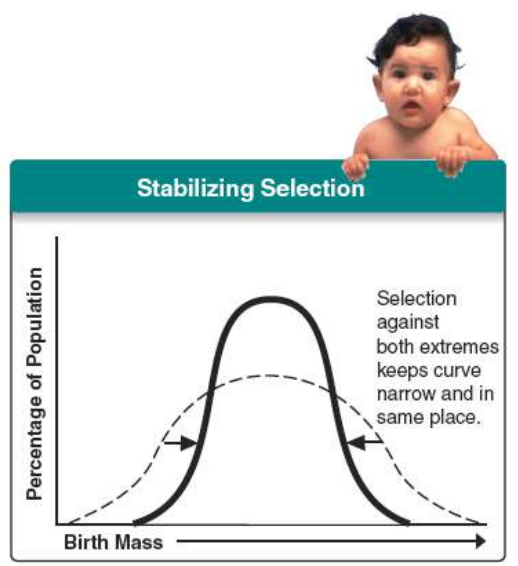
# EXAMPLE OF STABILIZING SELECTION



**Human babies born with low birth weight are less likely to survive.**

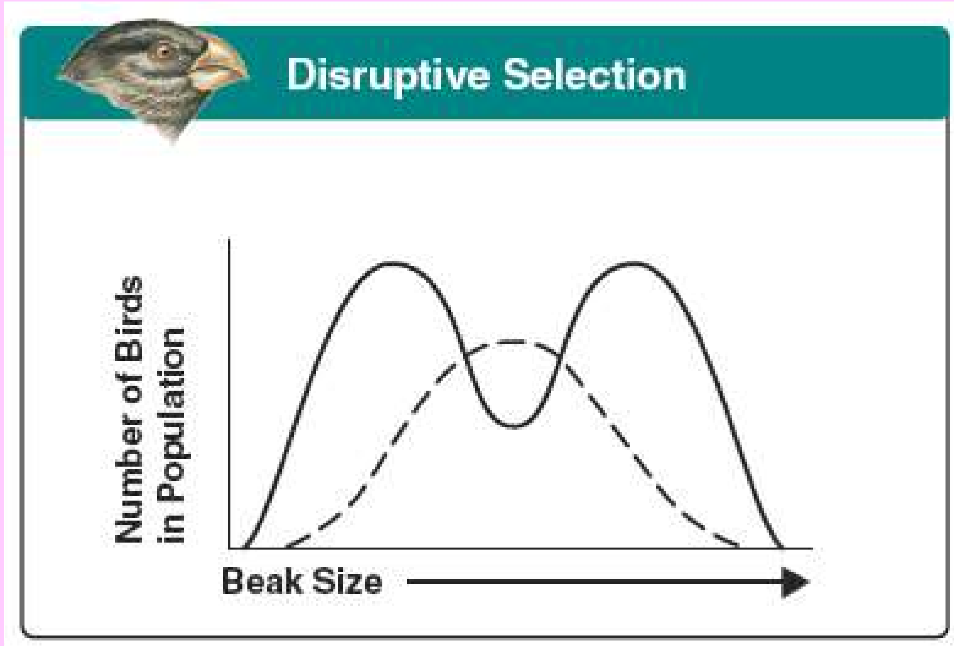
**Babies born too large have difficulty being born.**

**Average size babies are selected for.**




http://www.animalbehavior.org/ABS/Stars/ONI/Podos_-_finch_graphic.jpg

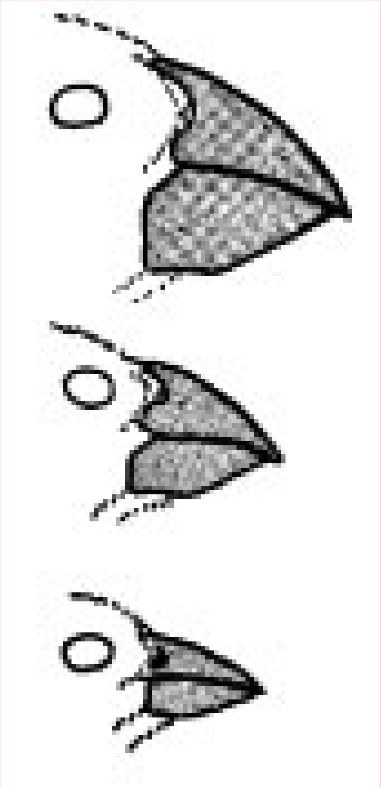
- **DISRUPTIVE SELECTION**




**Individuals at ___EXTREMES___ of the curve have higher fitness than individuals in middle.**

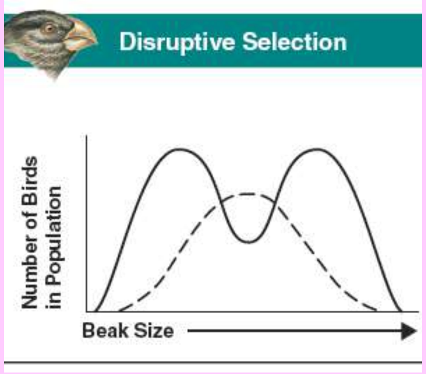
**Can cause graph to split into two.**
**Selection creates ___TWO DISTINCT___ PHENOTYPES**

# EXAMPLE OF DISRUPTIVE SELECTION



Suppose bird population lives in area where climate change causes medium size seeds become scarce while large and small seeds are still plentiful.

Birds with bigger or smaller beaks would have greater fitness and the population may split into TWO GROUPS. One that eats small seeds and one that eats large seeds.




http://www.animalbehavior.org/ABS/Stars/ONI/Podos_-_finch_graphic.jpg

**Large scale evolutionary patterns and processes that occur over long periods of time = __Macroevolution__________________________**

1. __Mass extinction________________________
2. __Adaptive radiation (Divergent evolution)__
3. __Convergent evolution___________________
4. __Coevolution___________________________
5. __Punctuated equilibrium_________________

# Mass Extinctions

**At several times in Earth's history large numbers of species became extinct at the same time**

**Caused by several factors:**

- **erupting volcanoes**
- **Plate tectonics (continents were moving)**
- **Changing sea levels**
- **Asteroids hitting the Earth**
- **Global climate change**

The 6th Extinction

**Example:**

**At the end of the __MESOZOIC Era-__**

**more than HALF of all plants and animals were wiped out… including the dinosaurs**

http://www.changbi.com/file_img/webzine/dinosaur02_02.jpg

## Effects of mass extinctions:

Opens habitats and provides opportunities for __remaining__ species

After mass extinctions there is often a _burst of evolution_ that produces many __new species__

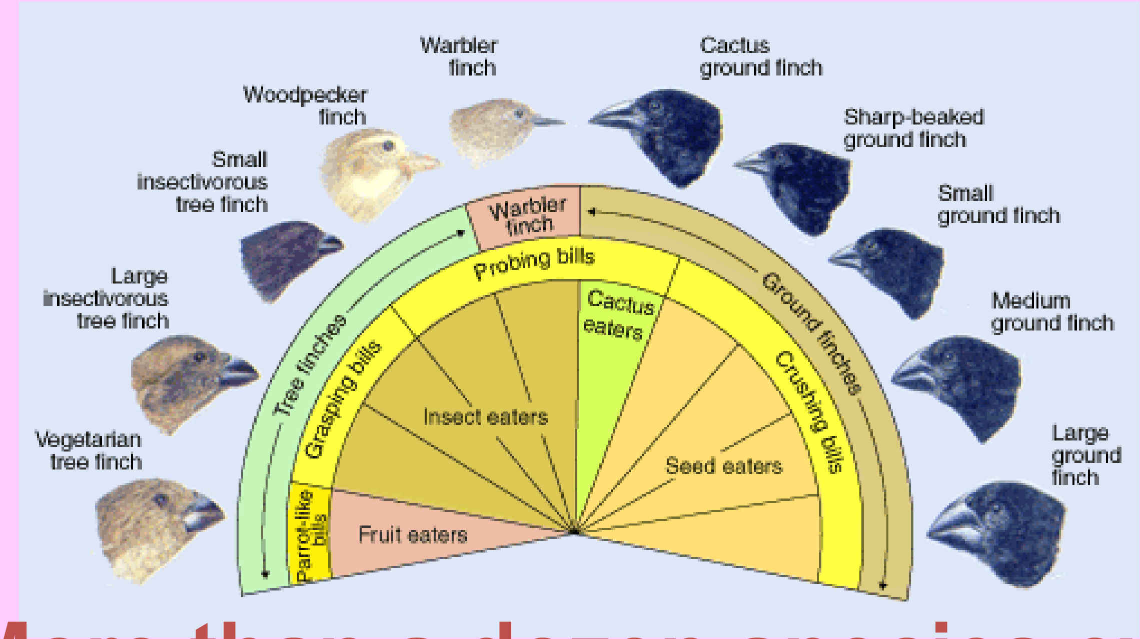
EX: Cenozoic era that followed = "_Age of Mammals_"

Mammals species increased dramatically

Image from: BIOLOGY by Miller and Levine; Prentice Hall Publishing©2006

When a single species or small group of species has evolved through **__natural selection__** into diverse forms that live in different ways =

**__adaptive radiation OR divergent evoluti__**




Ex:
Galápagos finche

More than a dozen species evolved from one s

http://www.pbs.org/wgbh/evolution/library/01/6/image_pop/l_016_02.h

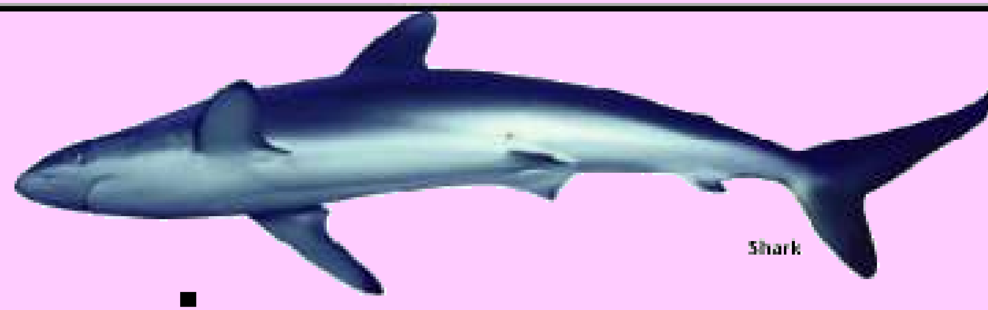
Sometimes different organisms evolution in different places or at different times but in

________ecologically similar________

environments…and end up looking very similar.

Process by which unrelated organisms come to resemble each other = convergent evolution

# Example:



Shark

**Sharks, penguins, dolphins have all developed <u>streamlined bodies</u> and appendages to move through water.**

Penguins

http://www.painetworks.com/photos/ii/ii1971.JPG

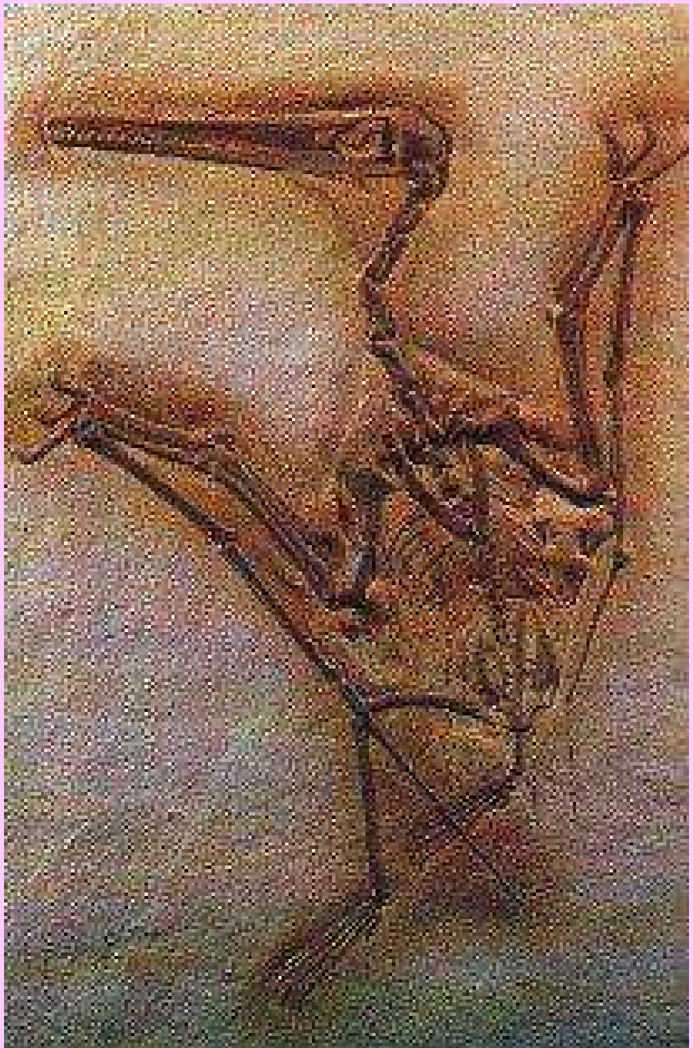
**The process by which tw**
**species evolve in respo**
**to changes in each othe**
**over time**

**= ____coevolution________**

[Bozeman Biology Coevolution]

http://biology.clc.uc.edu/courses/bio303/coevolution.htm

# How fast does evolution operate?



**Darwin believed evolutio happened slowly over a long time**

**If biological change is at a slow pace, it is called gradualism ________________.**

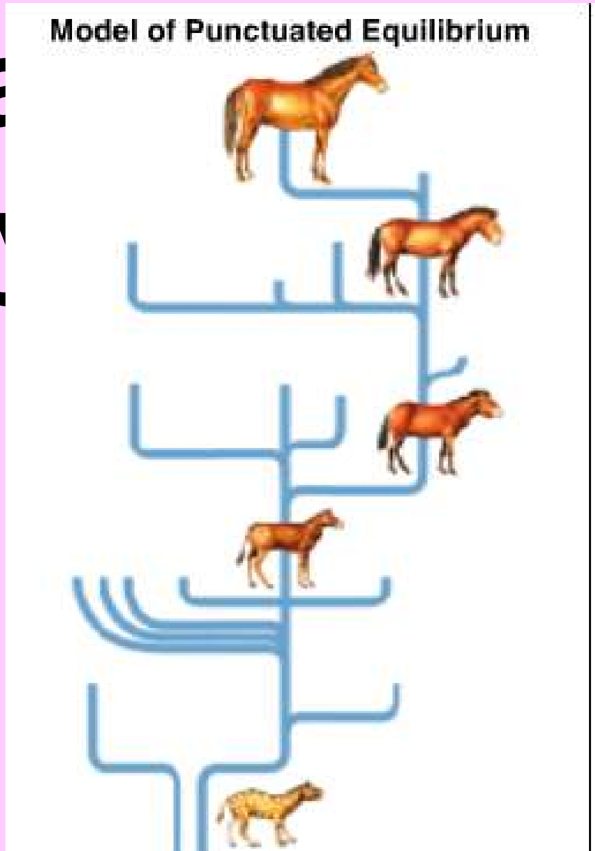
http://animals.timduru.org/dirlist/dino/FlyingDinosaurus-Pterodon-

Fossil record shows evolution happens more in ______.

bursts

Pattern of a long sta[...] period interrupted by brief period of more rapid change

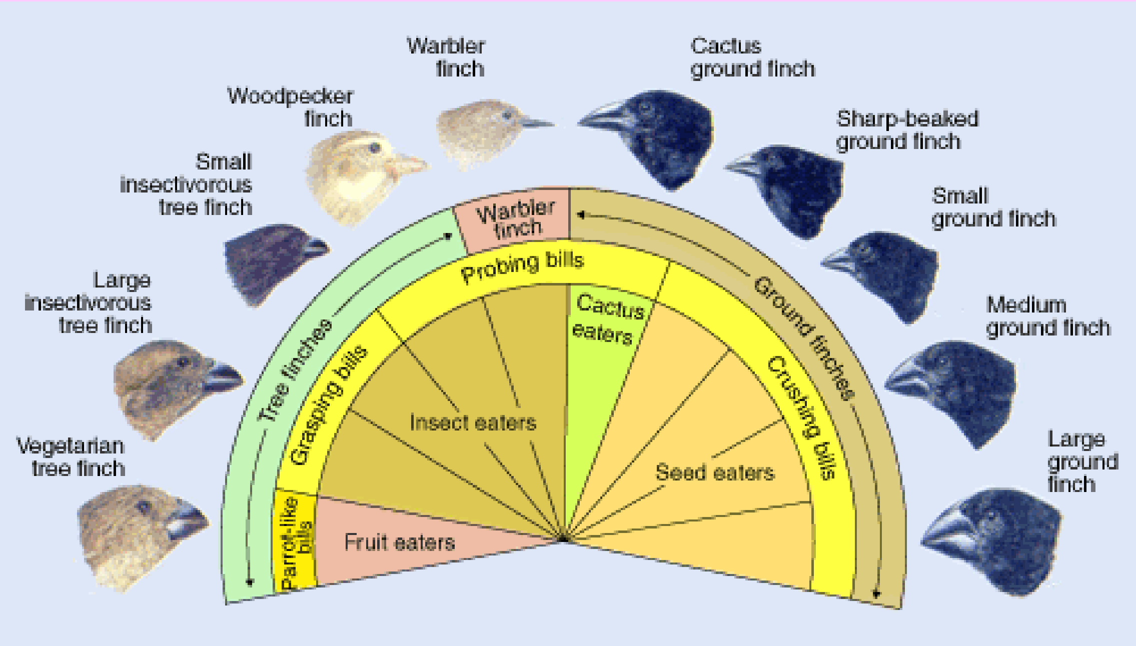
Punctuated Equilibrium

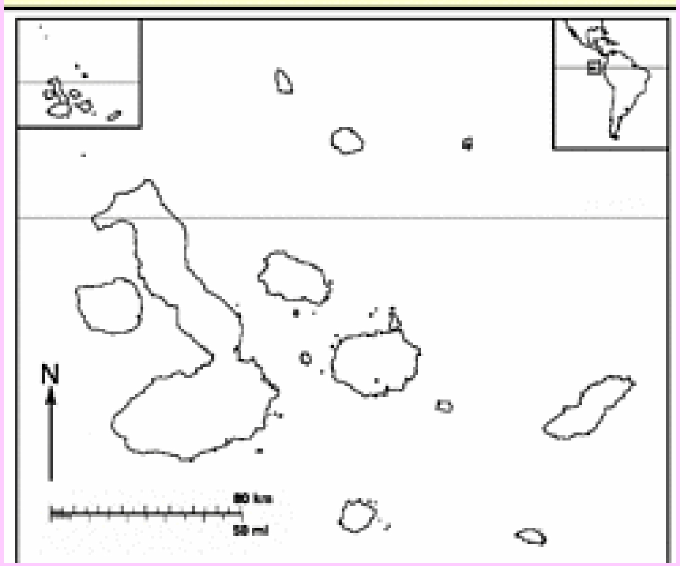


Rapid evolution after long periods of equilibrium can occur for several reasons:

1) Happens when a small population is ISOLATED from the main population OR

2) A small group MIGRATES to a new environment (like Galápagos finches)




http://www.pbs.org/wgbh/evolution/library/01/6/image_pop/l_016_02.html http://tolweb.org/tree/ToLimages/blank_map.250a.gif

## Chapter 16 – Evolution of Populations:

# The students will be able to:

- Explain Darwin's observations of population variation
- Compare contributions of scientists to our understanding of a changing population
- (9-12.S.1.2)
- Predict the results of complex inheritance patterns involving multiple alleles and genes (9-12.L.2.1A)
- Predict inheritance patterns using a single allele (9-12.L.2.1)
- Evaluate changes in gene frequencies in populations to determine if Hardy-Weinberg equilibrium exists or evolution has occurred (9-12.L.2.1A.)
- Describe how genetic recombination, mutations, and natural selection lead to adaptations, evolution, extinction, or emergence of new species (9-12.L.2.2)
- (Directional, stabilizing, disruptive selection, Genetic drift, Founder effect)
- Use comparative anatomy to support evolutionary relationships (9-12.L.2.2) (homologous structures, embryology)
- Predict the impact of genetic changes in populations (9-12.L.2.2) (mutation, natural selection, artificial selection, gene shuffling)
- Predict the results of complex inheritance patterns involving multiple alleles and genes (9-12.L.2.2) (SYNTHESIS)

# LIFE SCIENCE:
# Indicator 2: Analyze various patterns and products of natural and induced biological change

- **9-12.L.2.2. Students are able to describe how genetic recombination, mutations, and natural selection lead to adaptations, evolution, extinction, or the emergence of new species.**

- **Examples**:
- behavioral adaptations, environmental pressures, allele variations, bio-diversity

- Use comparative anatomy to support evolutionary relationships.

LIFE SCIENCE:

# Indicator 3: Analyze how organisms are linked to one another and the environment.

- **9-12.L.3.1. Students are able to identify factors that can cause changes in stability of populations, communities, and ecosystems.**
- Predict the results of biotic and abiotic interactions.
- Examples:
  Tolerances (temperature, weather, climate)
  Migration
  Fluctuation in available resources (water, food, shelter)
  Cooperation and competition in ecosystems

# SOUTH DAKOTA ADVANCED STANDARDS

## LIFE SCIENCE

**Indicator 2: Analyze various patterns and products of natural and induced biological change.**

- **9-12.L.2.1A. Students are able to predict the results of complex inheritance patterns involving multiple alleles and genes.**

- **Examples: human skin color, polygenic inheritance**
- **Relate crossing over to genetic variation.**

# SOUTH DAKOTA
# CORE SCIENCE STANDARDS

**LIFE SCIENCE:**
**Indicator 2: Analyze various patterns and products of natural and induced biological change.**

- **9-12.L.2.2. Students are able to describe how genetic recombination, mutations, and natural selection lead to adaptations, evolution, extinction, or the emergence of new species.**
  (SYNTHESIS)

# Core High School Life Science
# Performance Descriptors

| | |
|---|---|
| High school students performing at the ADVANCED level: | predict how traits are transmitted from parents to offspring; |
| High school students performing at the PROFICIENT level: | predict the impact of genetic changes in populations (mutation, natural selection and artificial selection, adaptation/extinction);<br>predict how life systems respond to changes in the environment;; |
| High school students performing at the BASIC level | identify DNA as the structure that carries the genetic code;<br>identify that genetic traits can be transmitted from parents to offspring; |