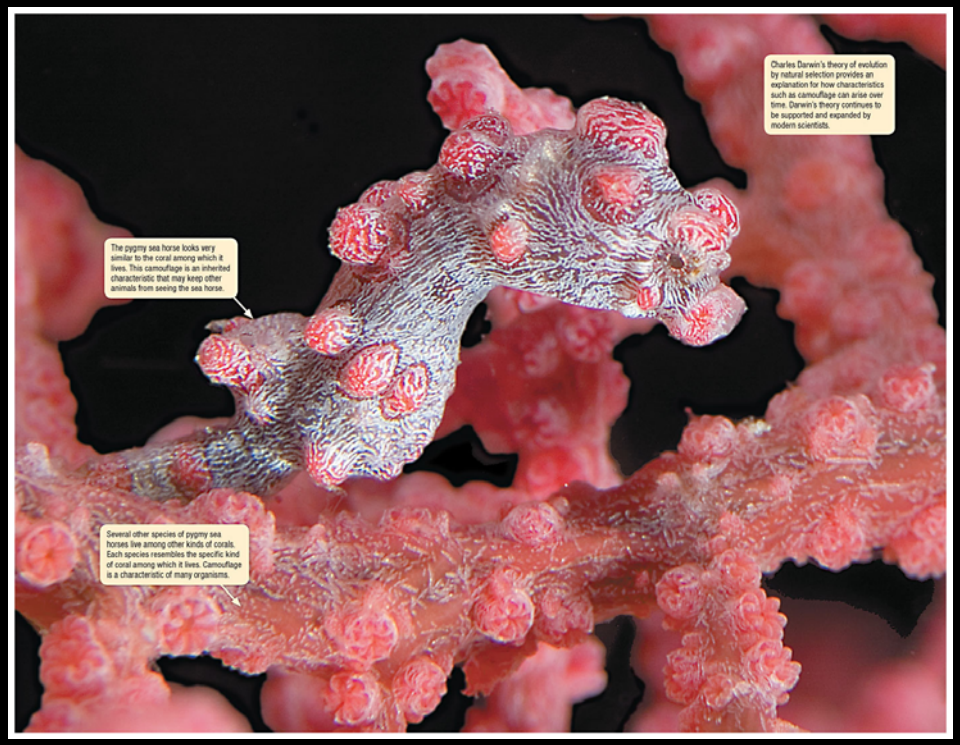
Evolutionary Theory



Biology Chapter 16 Section 3

Open Activity

Write a sentence in which you relate an organism's life span to the potential rate of evolution of its species.

Adapted from Holt Biology 2008

Objectives Section 3

I will be able to identify:

- How has Darwin's theory been has updated.
- At what scales evolution can be studied.

Adapted from Holt Biology 2008

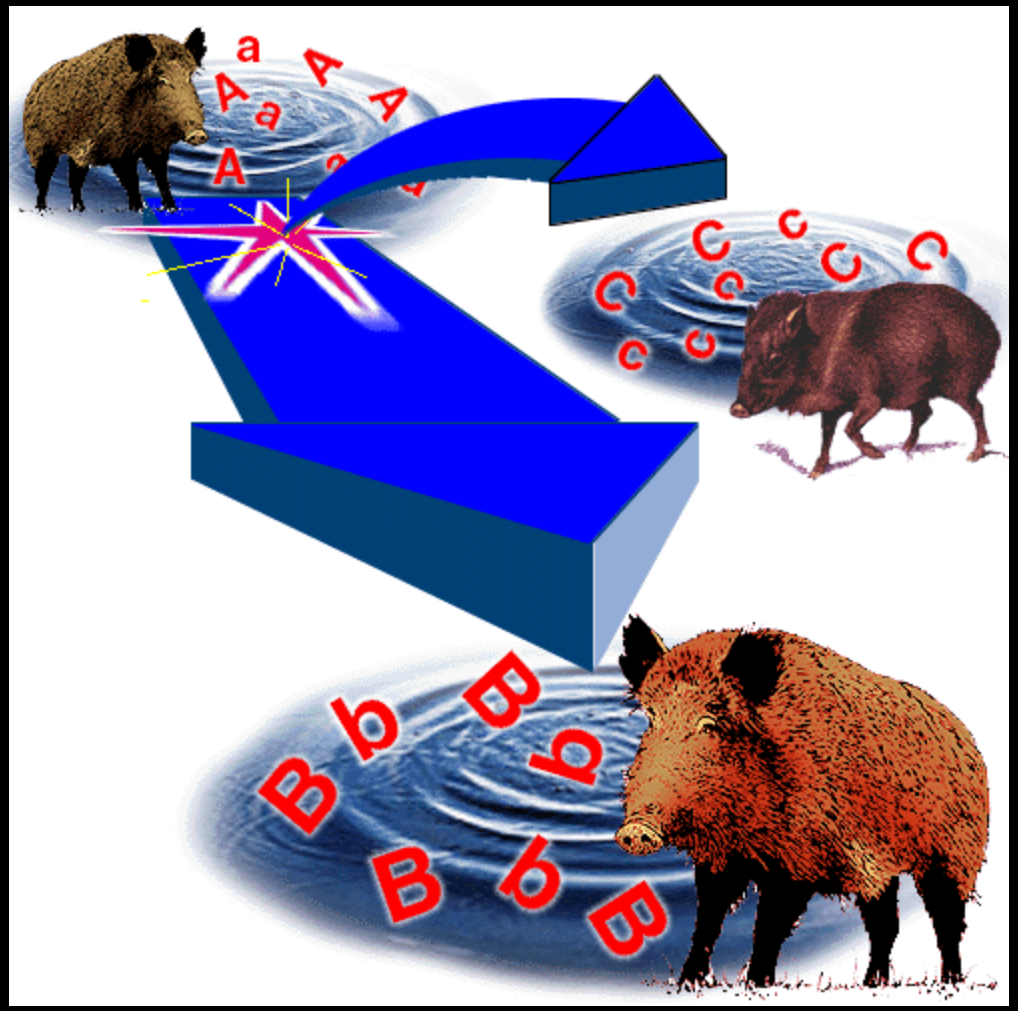
Chapter 16 Section 3: Beyond Darwinian Theory

Key Vocabulary Terms

Adapted from Holt Biology 2008

Speciation

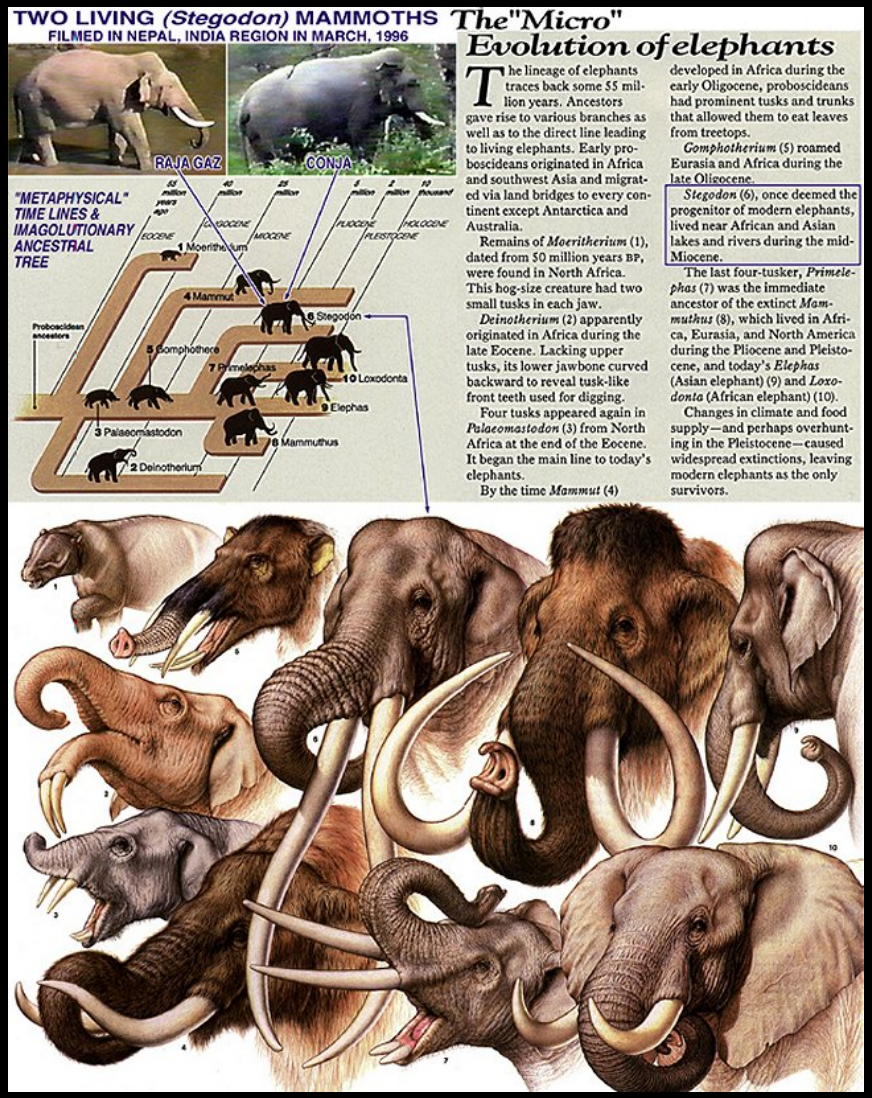
The formation of new species as a result of evolution.



Adapted from Holt Biology 2008

Microevolution

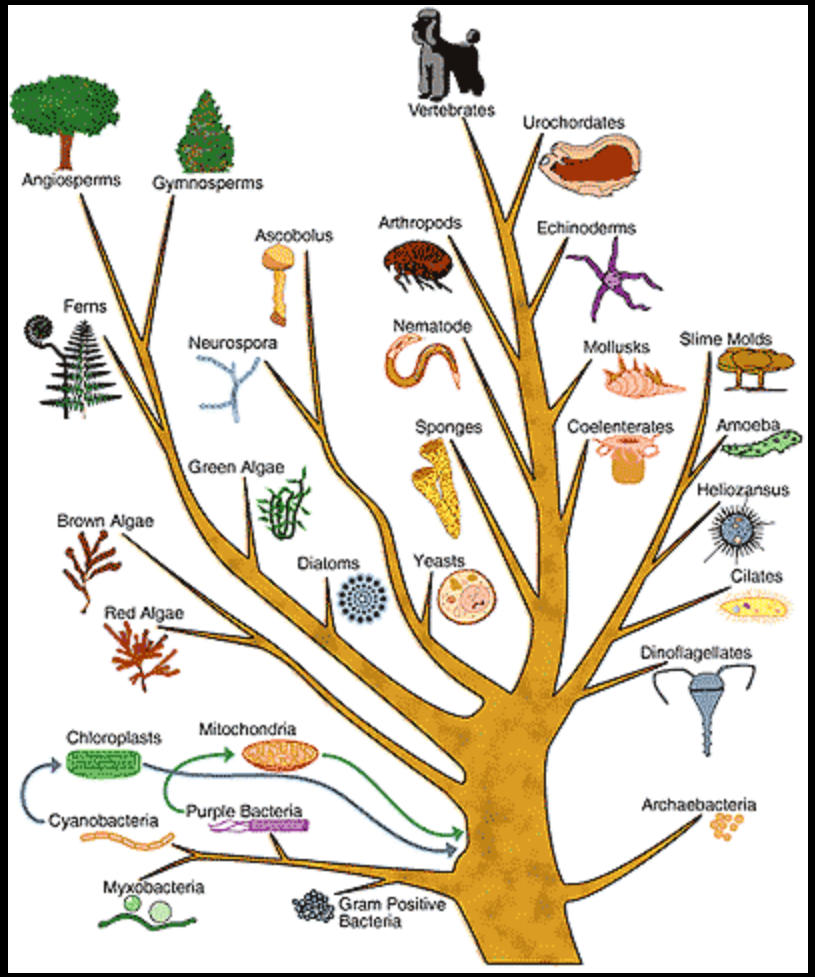
Refers to evolution as a change in the genes of populations.



Adapted from Holt Biology 2008

Macroevolution

Refers to the appearance of new species over time.



Adapted from Holt Biology 2008

Species

A group of organisms that are closely related and that can mate to produce fertile offspring.

Adapted from Holt Biology 2008

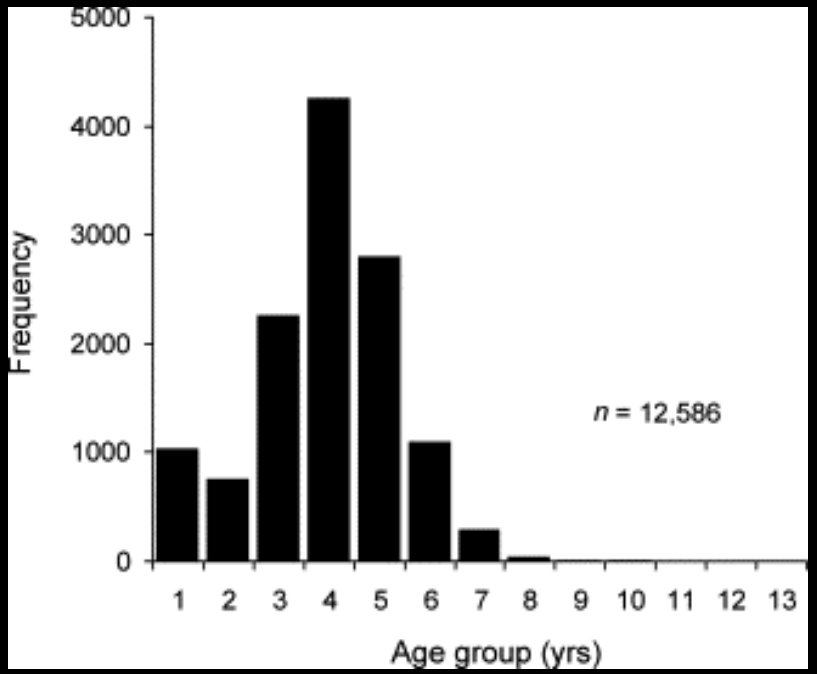
Diversity

The number and variety of species present in an area and their spatial distribution.

Adapted from Holt Biology 2008

Frequency

The number of occurrences of a periodic or recurrent process per unit time.



Adapted from Holt Biology 2008

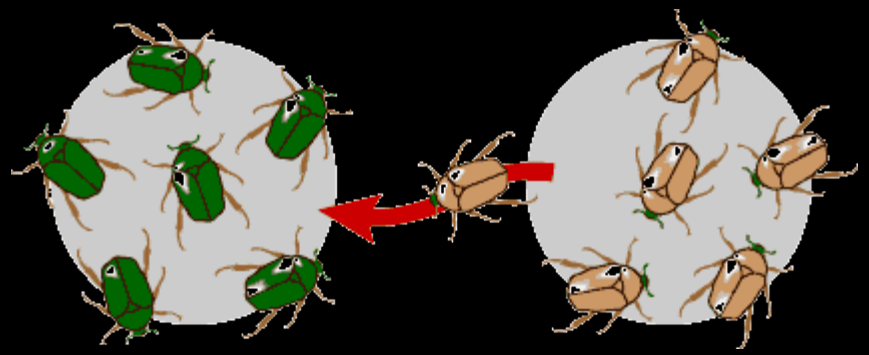
Genetic Drift

The process of change in the genetic composition of a population due to chance or random events rather than by natural selection, resulting in changes in allele frequencies over time.

Adapted from Holt Biology 2008

Gene Flow

The movement of genes into or out of a population due to interbreeding.



Adapted from Holt Biology 2008

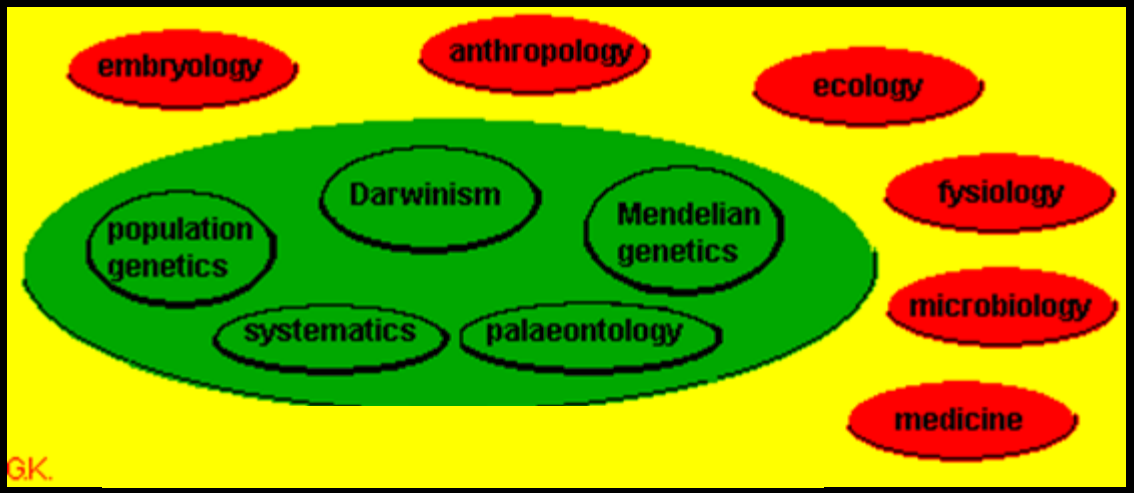
Chapter 16 Section 3: Beyond Darwinian Theory

Supplementary Words

Adapted from Holt Biology 2008

Modern synthesis of evolutionary theory

The weaving together or unification of Darwin's theory with newer studies of fossils, anatomy, genetics, and more.



Adapted from Holt Biology 2008

Migration

The movement of individuals into, out of, or between populations.

Adapted from Holt Biology 2008

Random

Without aim or plan; purposeless

Adapted from Holt Biology 2008

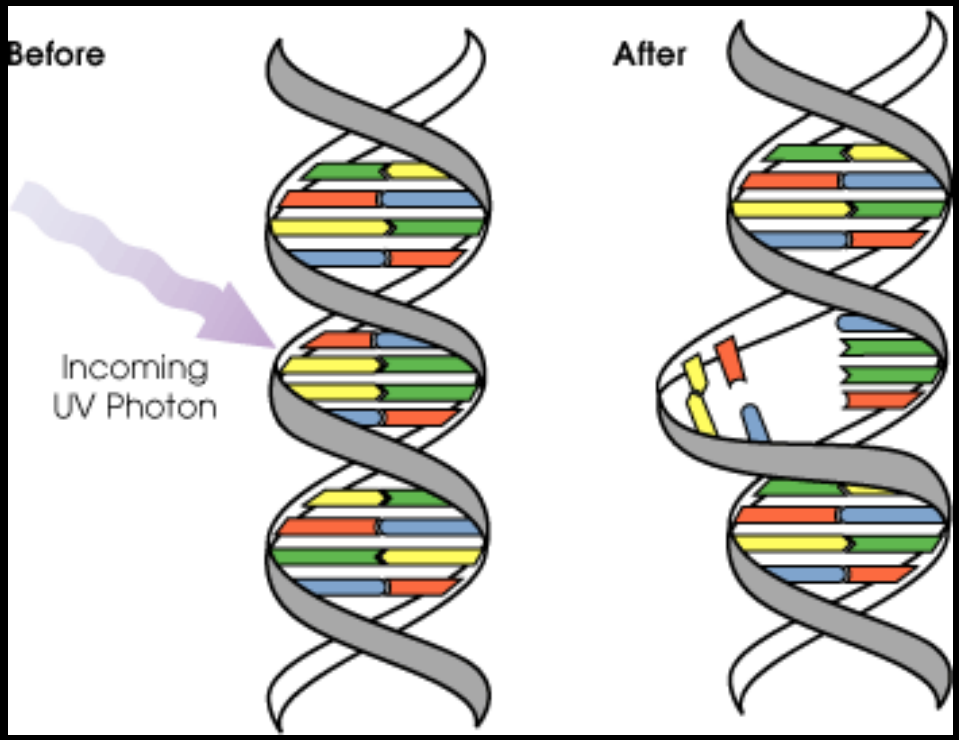
Mate Choice

The process of pairing parents of offspring or choosing a mate for reproduction.

Adapted from Holt Biology 2008

Mutation

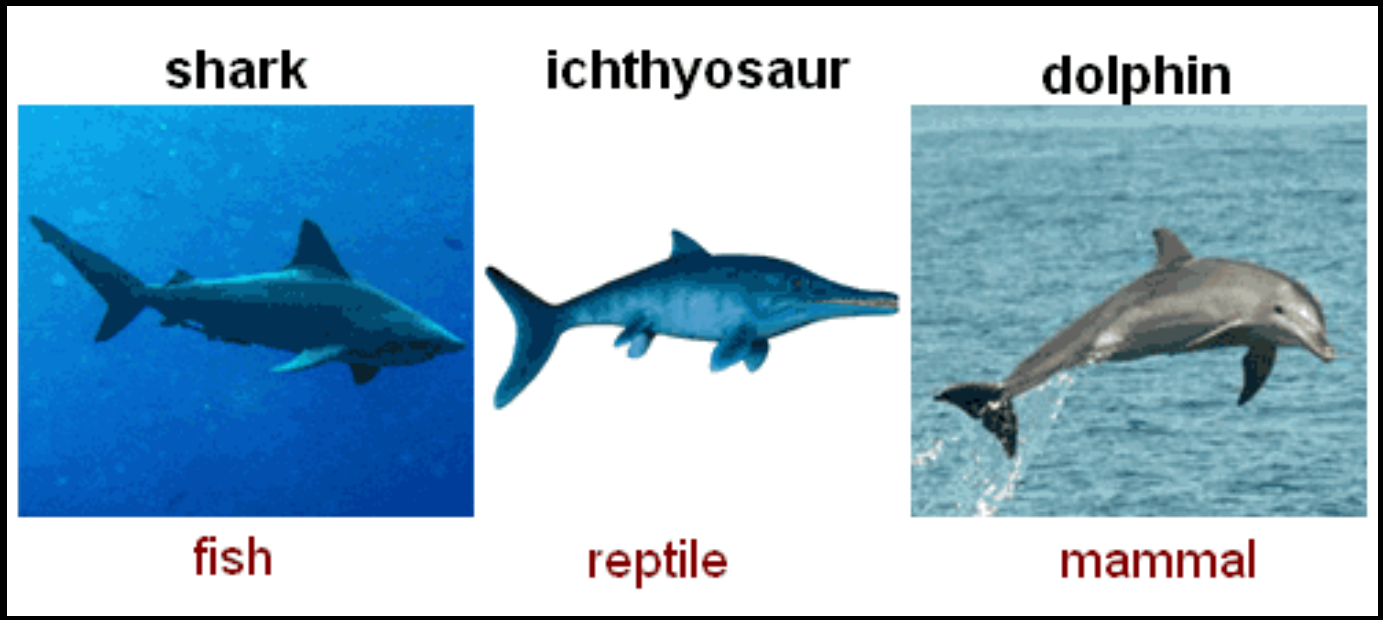
A change in the nucleotide-base sequence of a gene or DNA molecule.



Adapted from Holt Biology 2008

Convergent Evolution

The process by which unrelated species become more similar as they adapt to the same kind of environment.



Adapted from Holt Biology 2008

Divergent Evolution

The process by which two or more related but reproductively isolated populations become more and more dissimilar.

Adapted from Holt Biology 2008

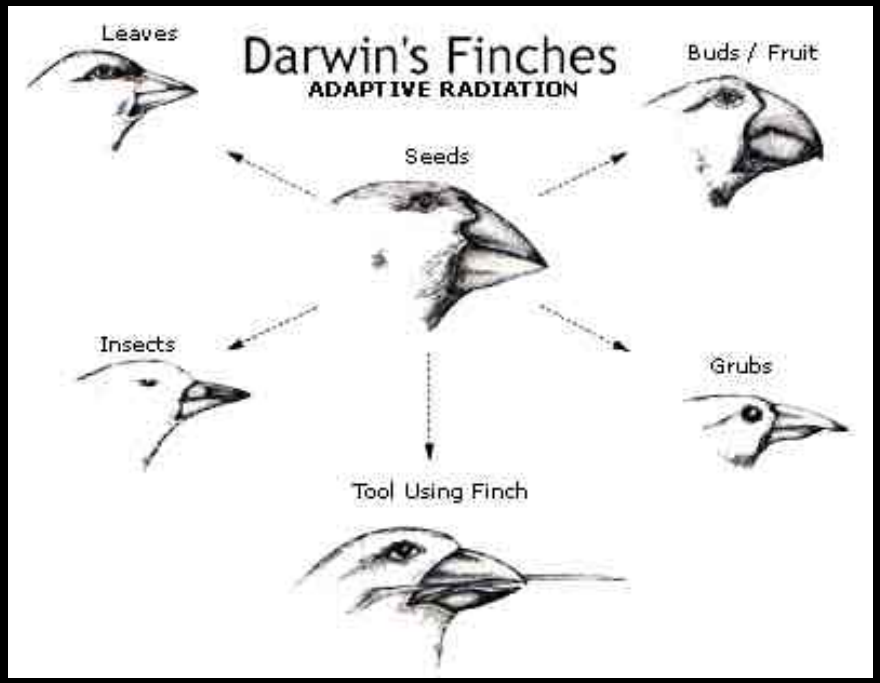
Coevolution

The evolution of two or more species that is due to mutual influence, often in a way that makes the relationship more mutually beneficial.

Adapted from Holt Biology 2008

Adaptive Radiation

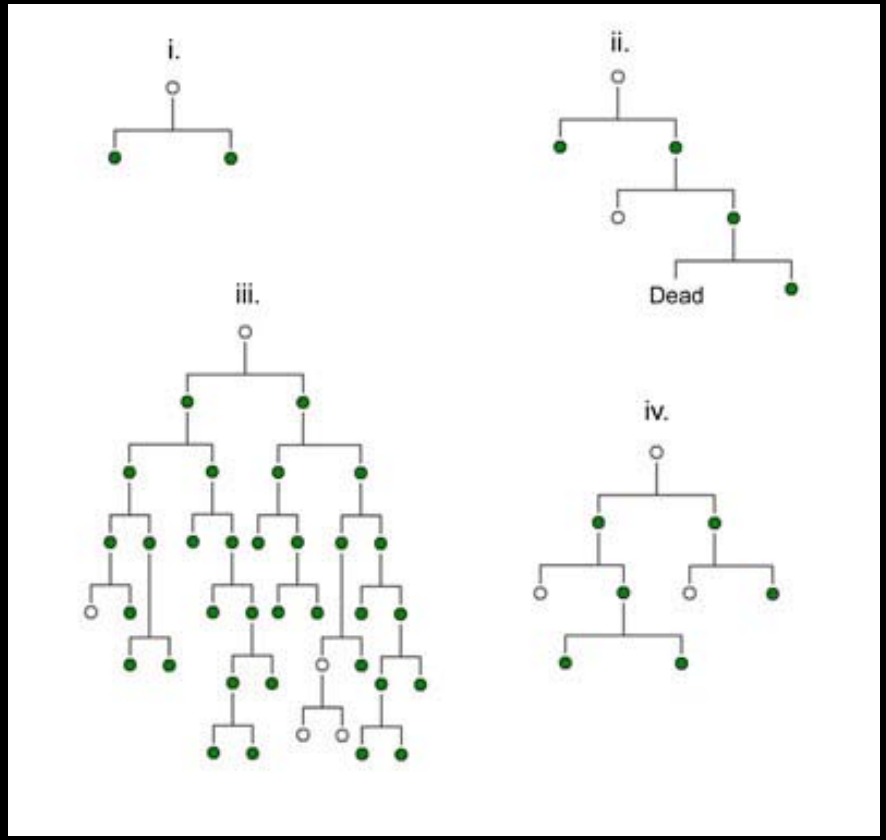
An evolutionary pattern in which many species evolve from a single ancestral species.



Adapted from Holt Biology 2008

Lineage

Direct descent from an ancestor, esp a line of descendants from one ancestor



Adapted from Holt Biology 2008

Extinct

Describes a species that has died out completely

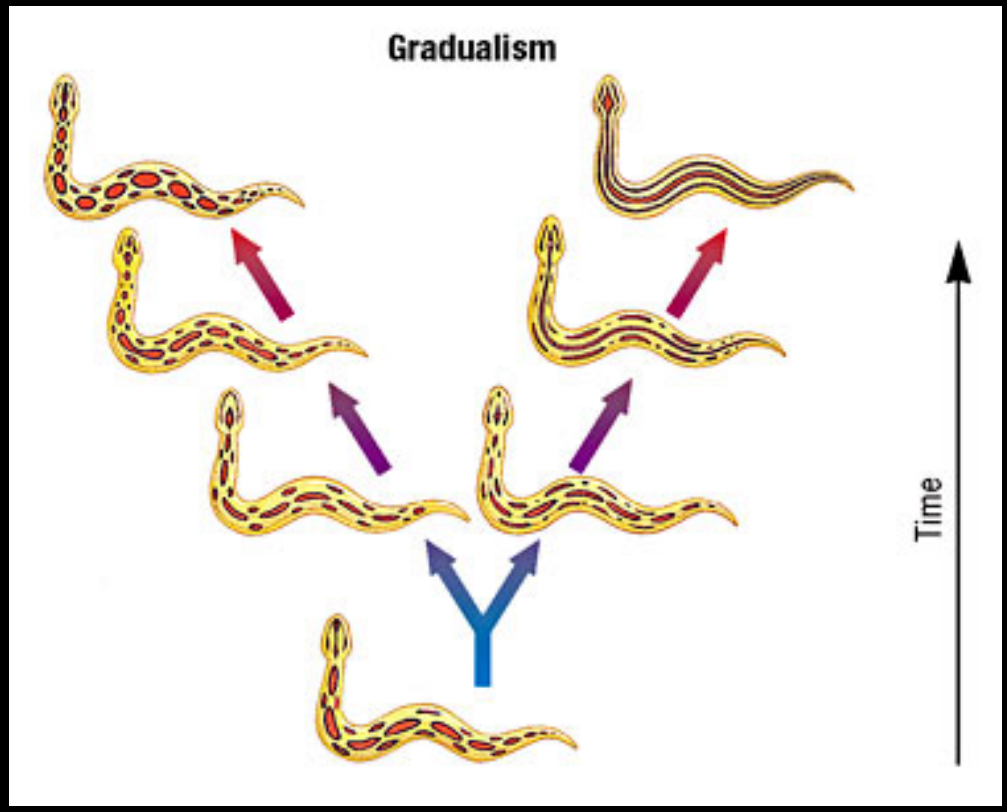
Extinction

The death of every member of a species

Adapted from Holt Biology 2008

Gradualism

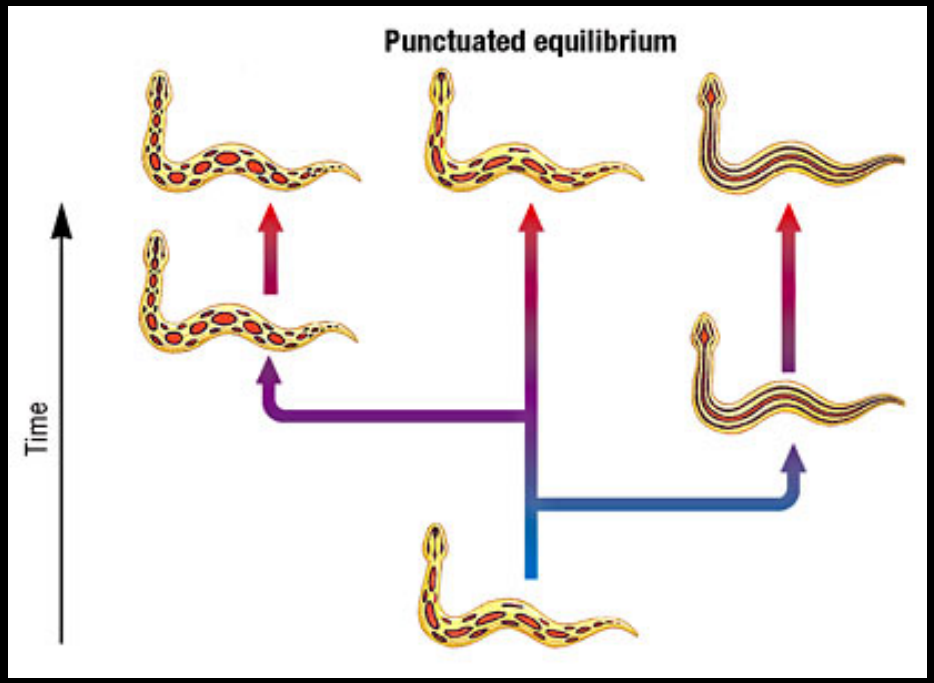
A model of evolution in which gradual change over a long period of time leads to biological diversity



Adapted from Holt Biology 2008

Punctuated Equilibrium

A model of evolution in which short periods of drastic change in species, including mass extinctions and rapid speciation, are separated by long periods of little or no change



Adapted from Holt Biology 2008

Chapter 16
Section 3:
Beyond Darwinian Theory

Notes

Adapted from Holt Biology 2008

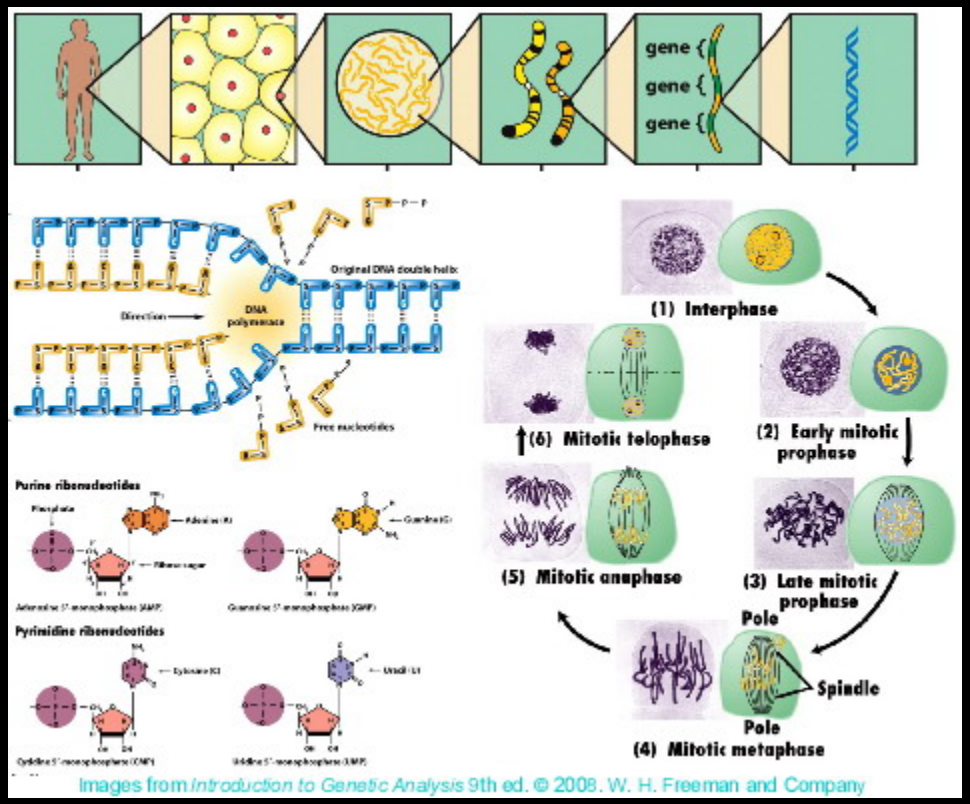
Chapter 16 Section 3: Beyond Darwinian Theory

Darwin's Theory Updated

Adapted from Holt Biology 2008

Darwin's Theory Updated

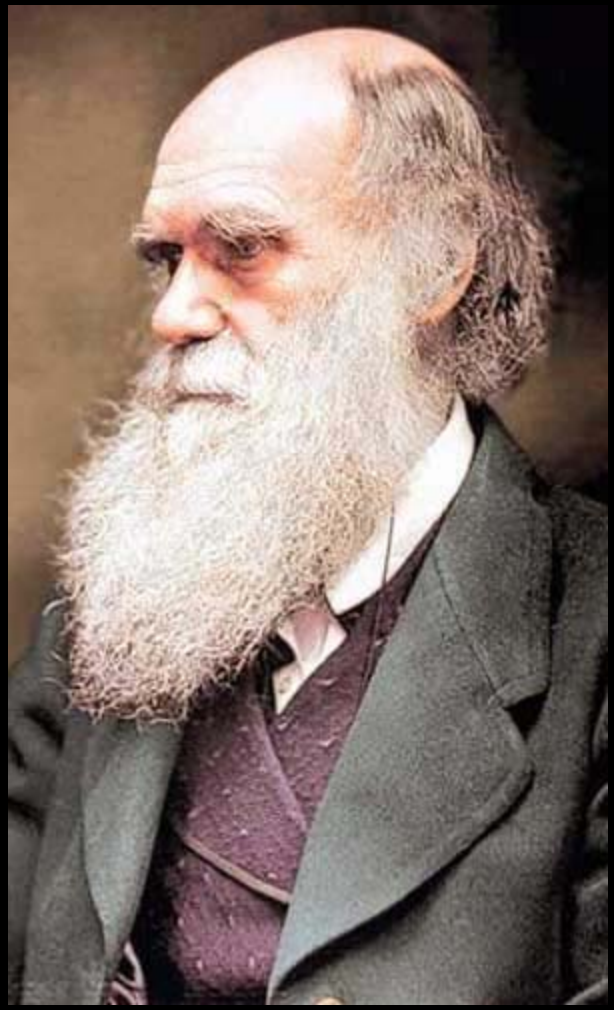
Discoveries since Darwin's time, especially in genetics, have been added to his theory to explain the evolution of species.



Adapted from Holt Biology 2008

Darwin's Theory Updated

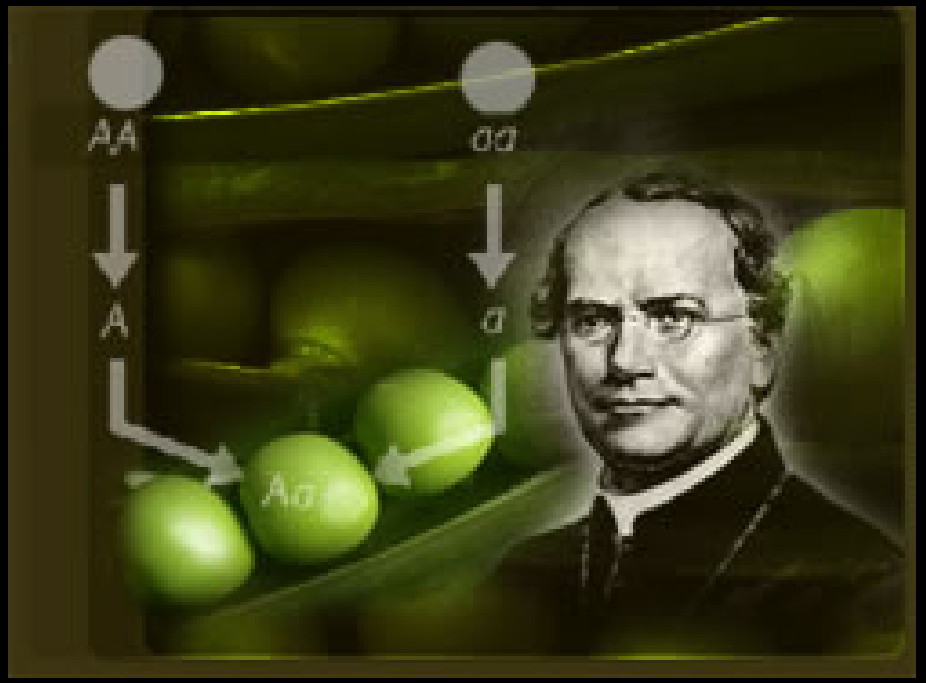
Some parts of Darwin's theory have been modified, and new parts have been added. But mostly, Darwin's theory has been supported..



Adapted from Holt Biology 2008

Darwin's Theory Updated

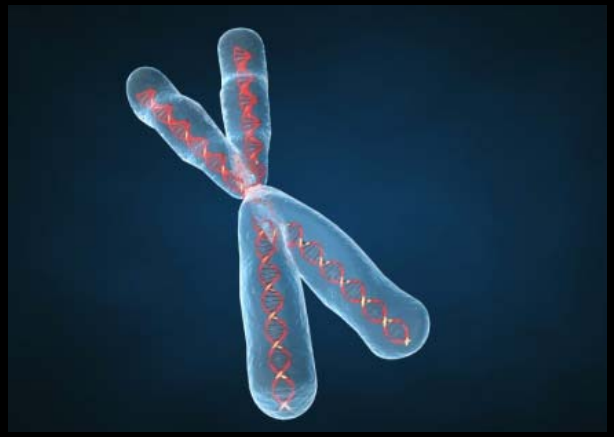
The first major advance beyond Darwin's ideas was the rediscovery, in 1900, of Mendel's *Laws of Heredity*.



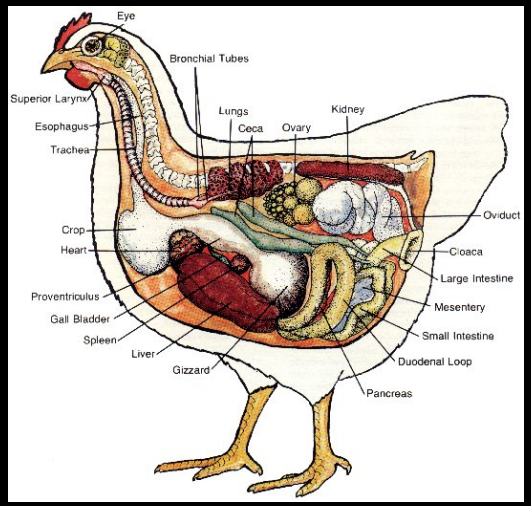
Adapted from Holt Biology 2008

Darwin's Theory Updated

By the 1940s, scientists began to weave Darwin's theory together with newer studies of fossils, anatomy, genetics, and more.

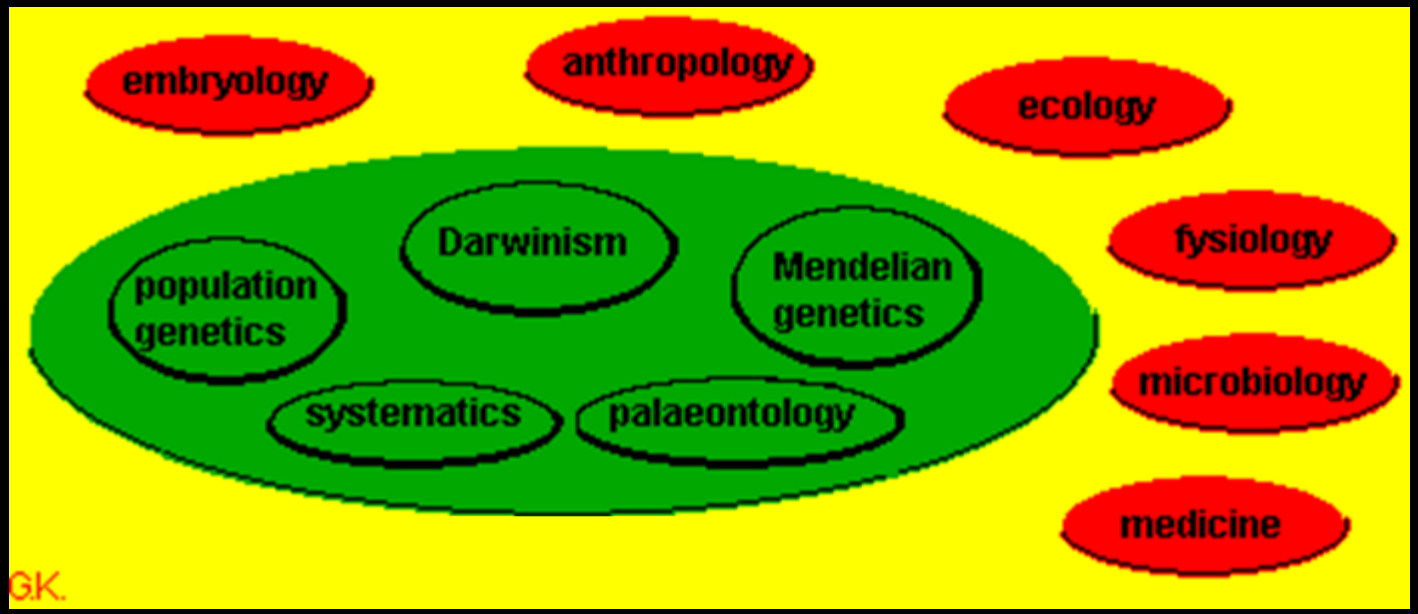


Adapted from Holt Biology 2008



Darwin's Theory Updated

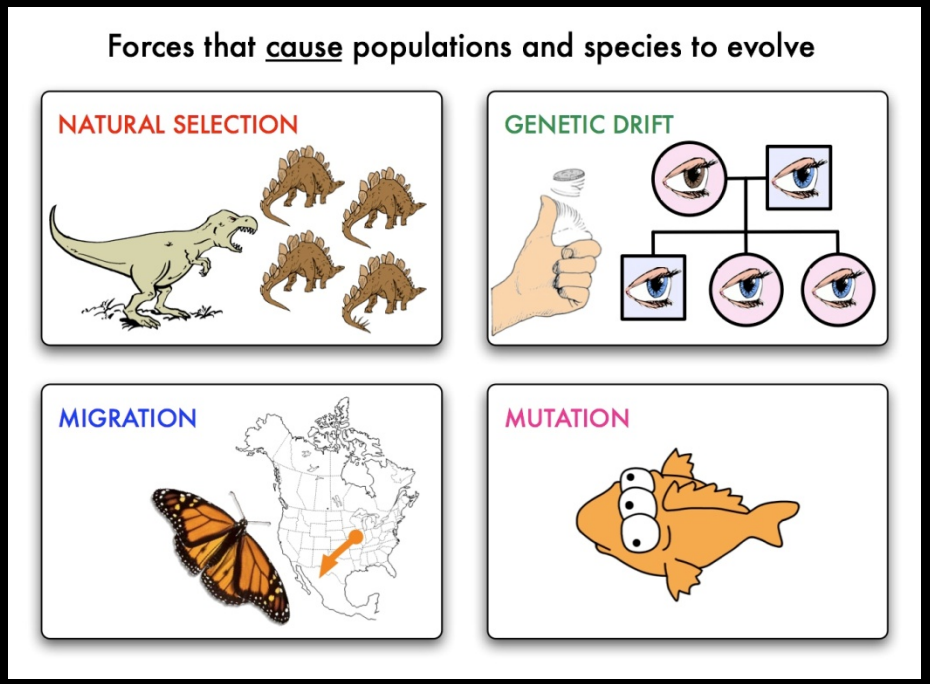
This unification is called the *modern synthesis* of evolutionary theory.



Adapted from Holt Biology 2008

Darwin's Theory Updated

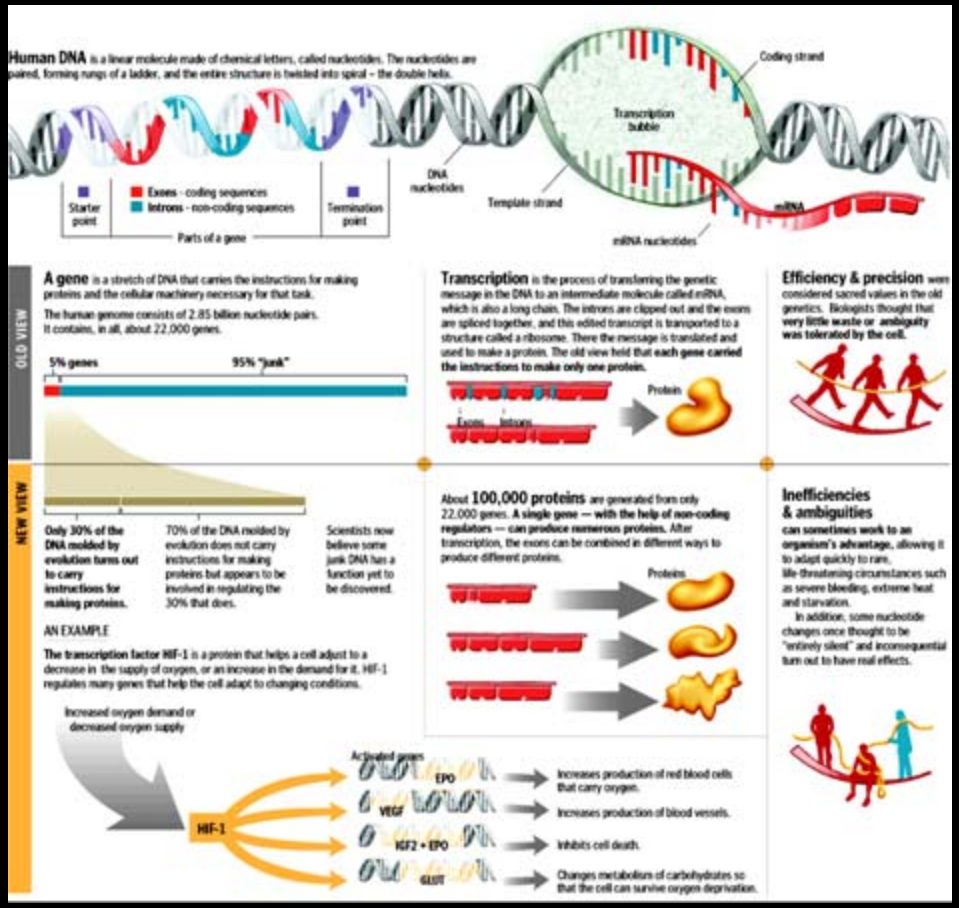
In particular, biologists have learned that evolution can result from processes other than natural selection.



Adapted from Holt Biology 2008

Darwin's Theory Updated

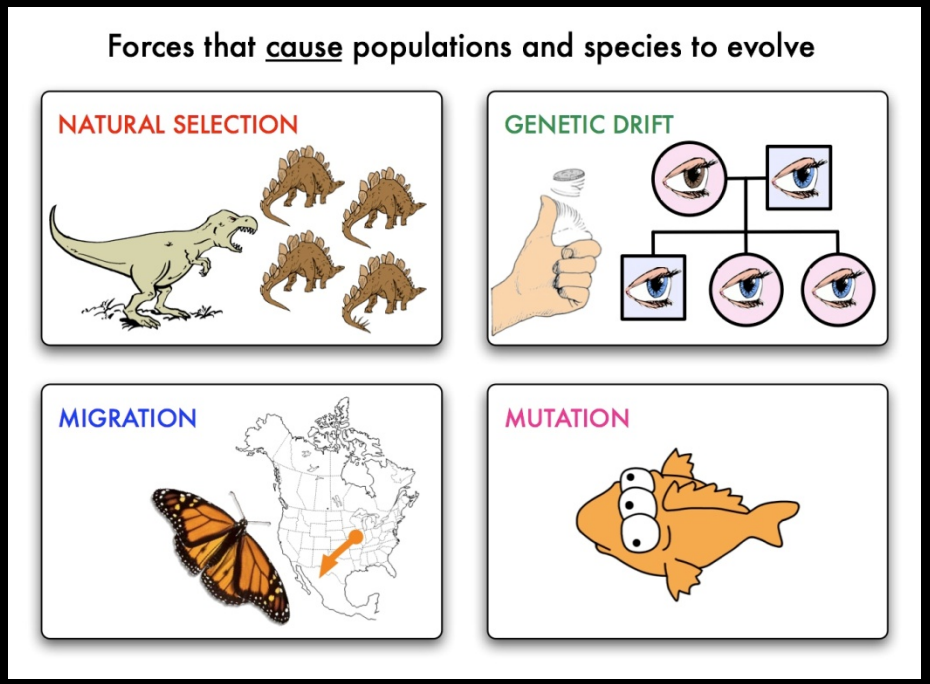
Survival and reproduction can be limited by chance or by the way that genes work.



Adapted from Holt Biology 2008

Darwin's Theory Updated

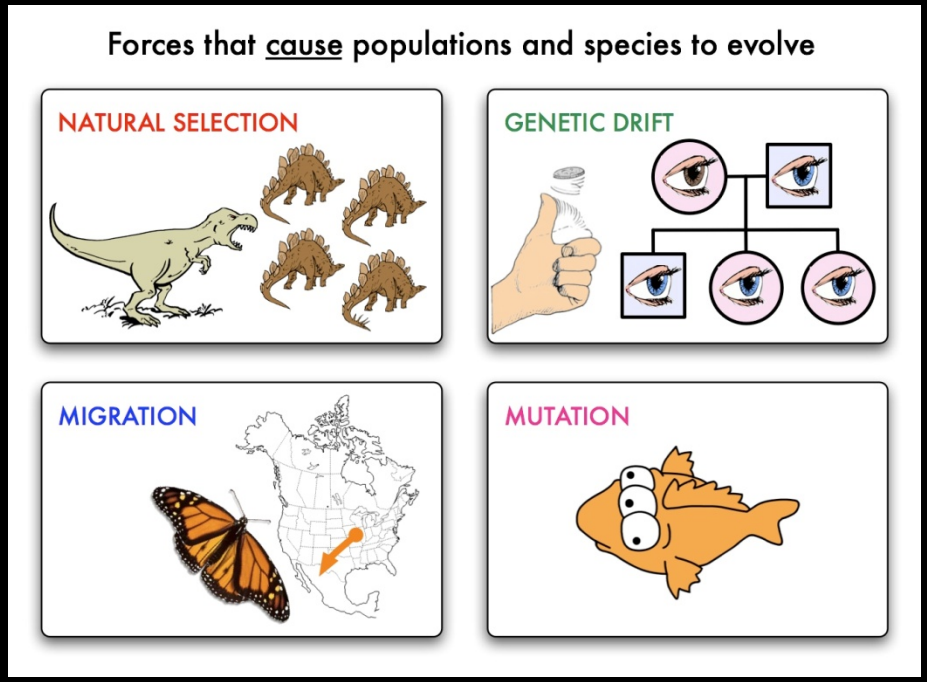
In the modern view, any or all of these forces may combine with natural selection (as described by Darwin).



Adapted from Holt Biology 2008

Darwin's Theory Updated

This synthesis helps explain some of the patterns of evolution that were unexplained by natural selection alone.



Adapted from Holt Biology 2008

Remaining Questions

Modern biologists have tentative answers to the following questions:

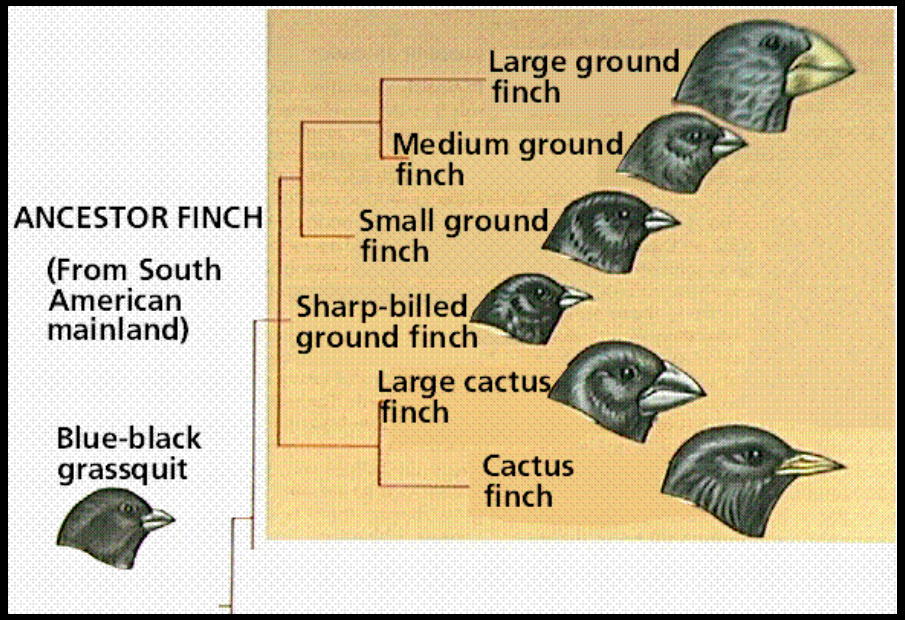
- **Can an individual evolve?**
- **Is evolution the survival of the fittest?**
- **Is evolution predictable?**

YOUR TURN

Adapted from Holt Biology 2008

Can an individual evolve?

Darwin correctly inferred that individuals do not evolve. They may respond to outside forces, but individuals do not pass on their responses as heritable traits. Rather, populations evolve when natural selection acts (indirectly) on genes.



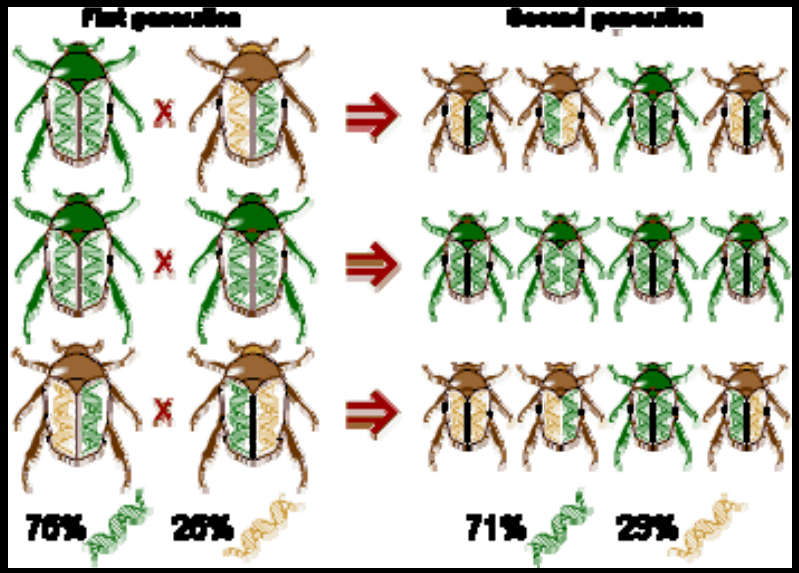
Adapted from Holt Biology 2008

YOUR TURN

Adapted from Holt Biology 2008

Is evolution the survival of the fittest?

Natural selection can act only on the inheritable variation that exists in a population. Chance variations do not always provide the best adaptation for a given time and place. So, evolution does not always produce the “fittest” forms, just those that “fit” well enough to leave offspring.



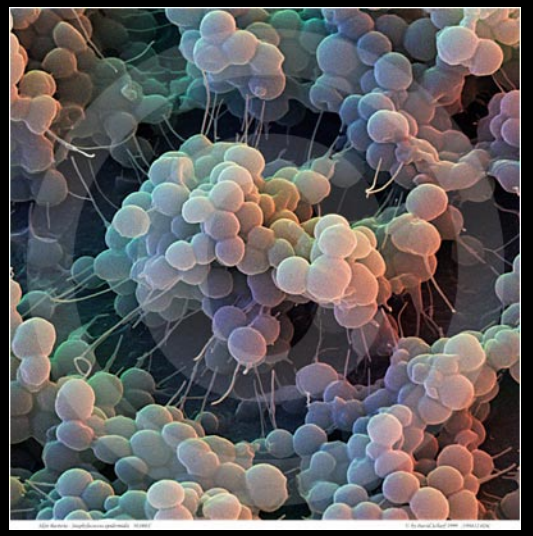
Adapted from Holt Biology 2008

YOUR TURN

Adapted from Holt Biology 2008

Is evolution predictable?

Evolution sometimes results in larger or more-complex forms of life, but this result cannot be predicted. Many forms of life are simple yet successful. Mostly, scientists cannot predict the exact path that evolution will take.



Adapted from Holt Biology 2008

Chapter 16
Section 3:
Beyond Darwinian Theory

Studying Evolution at All Scales

Adapted from Holt Biology 2008

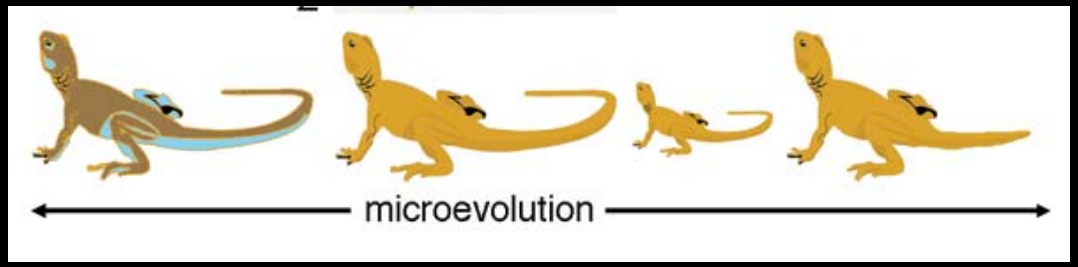
Studying Evolution at All Scales

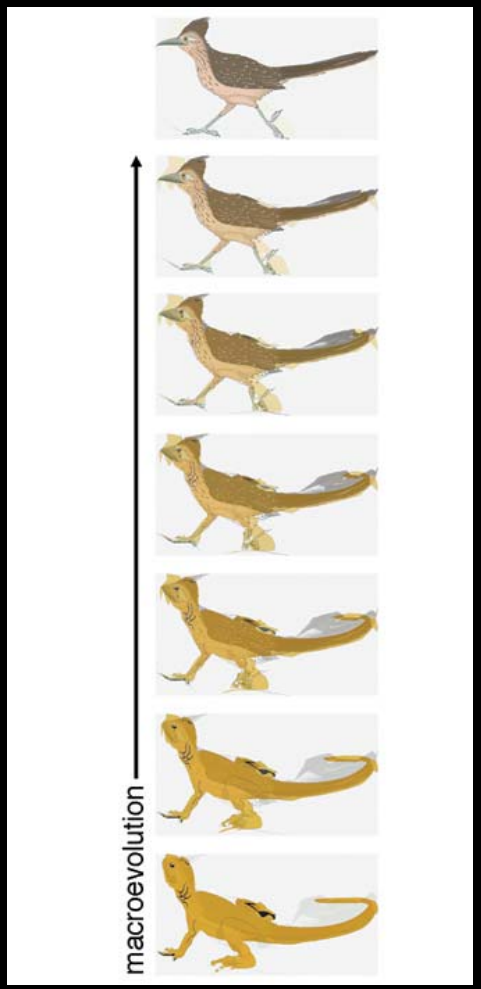
Because it affects every aspect of biology, scientists can study evolution at many scales.

Adapted from Holt Biology 2008

Studying Evolution at All Scales

Generally, these scales range from microevolution to macroevolution, with speciation in between.

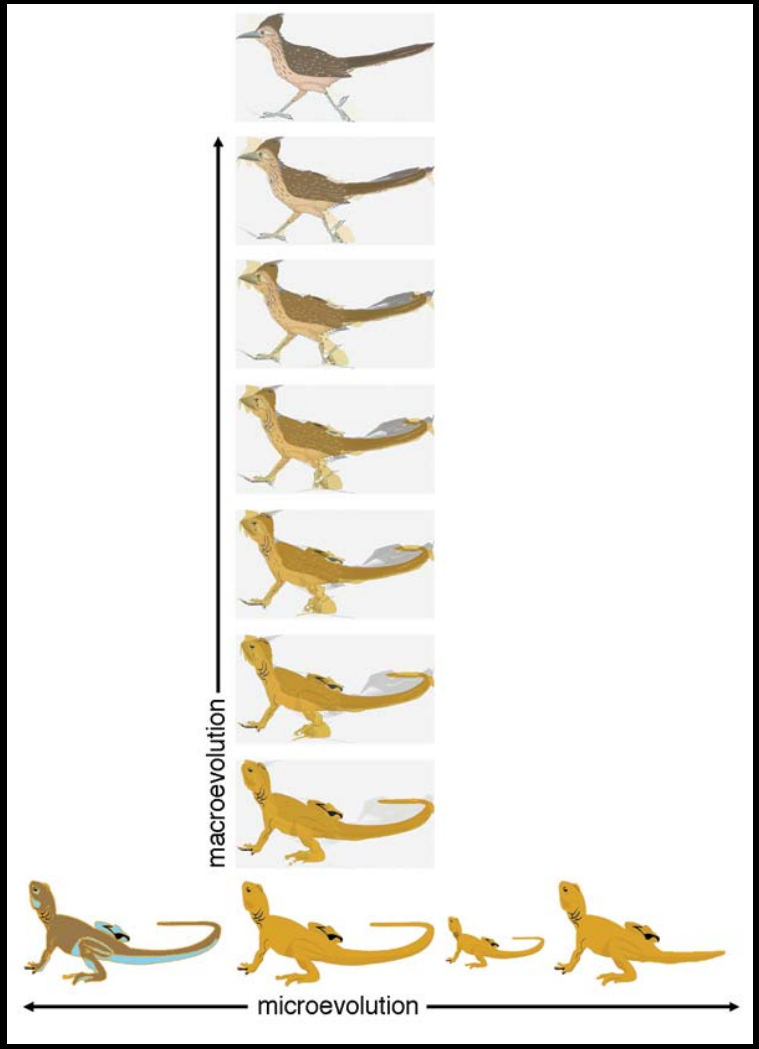




Adapted from Holt Biology 2008

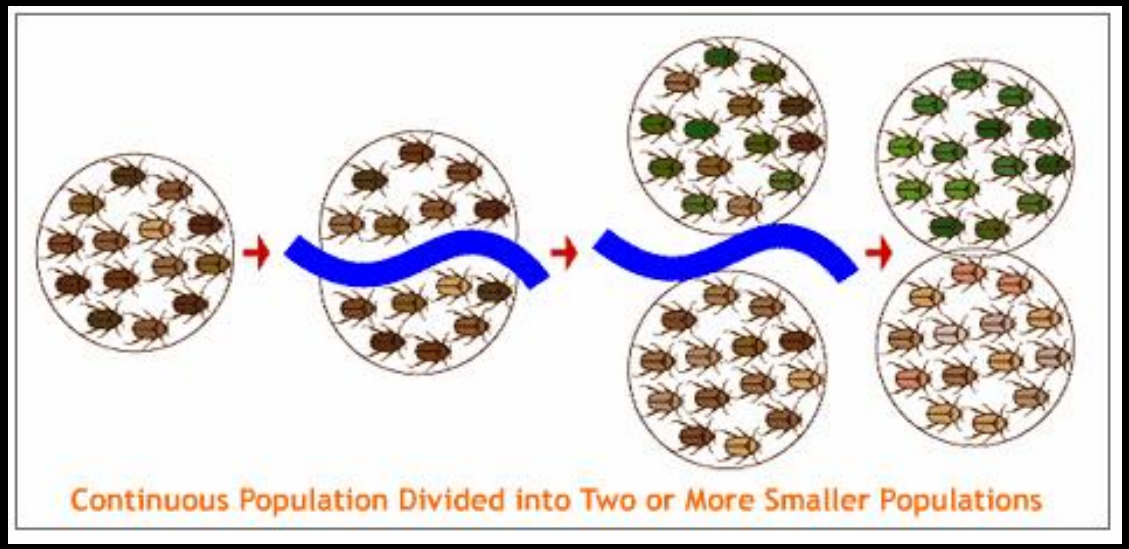
Studying Evolution at All Scales

Informally, *microevolution* refers to evolution as a change in the genes of populations, whereas *macroevolution* refers to the appearance of new species over time.



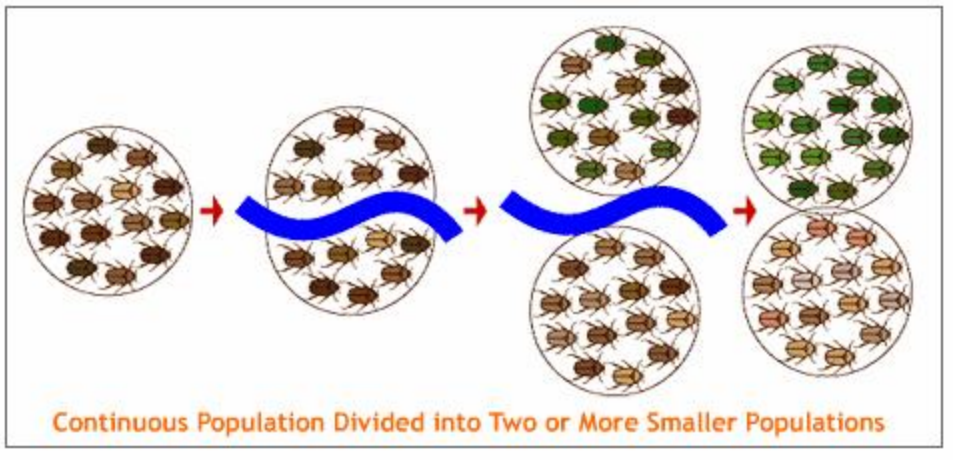
Adapted from Holt Biology 2008

Speciation



The link between microevolution and macroevolution is speciation.

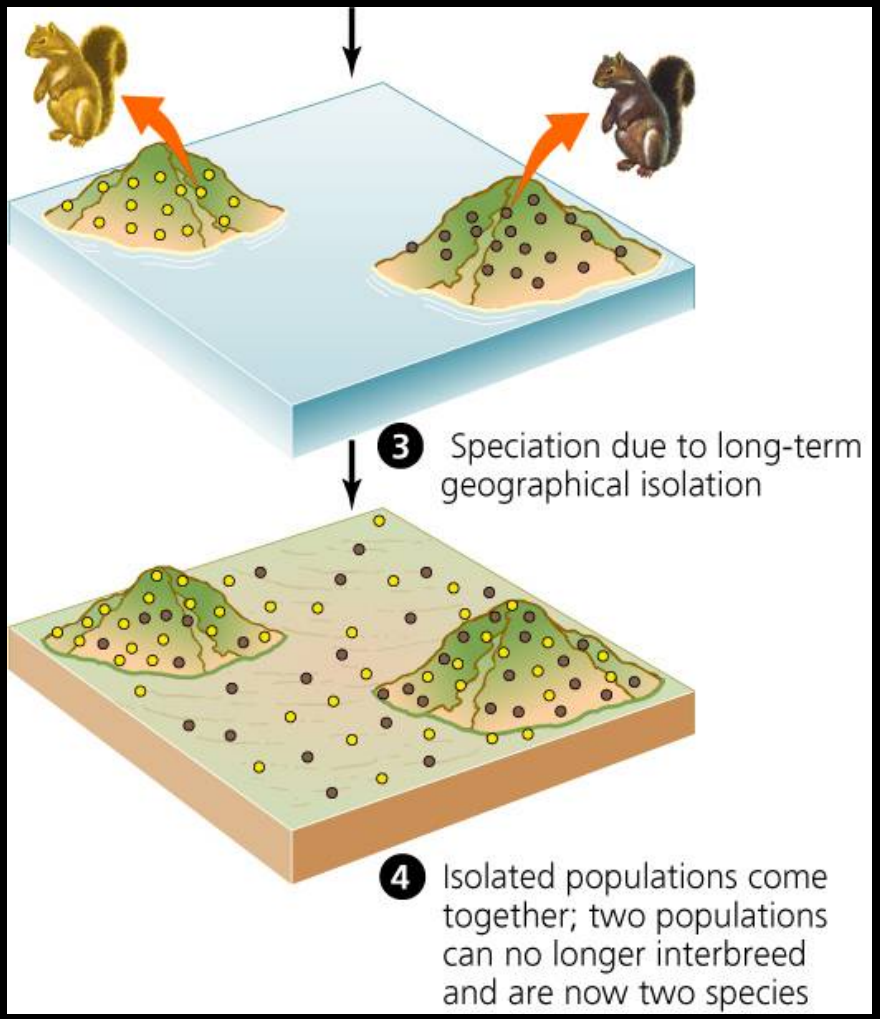
Speciation



Speciation, the formation of new species, can be seen as a process of genetic change or as a pattern of change in the form of organisms.

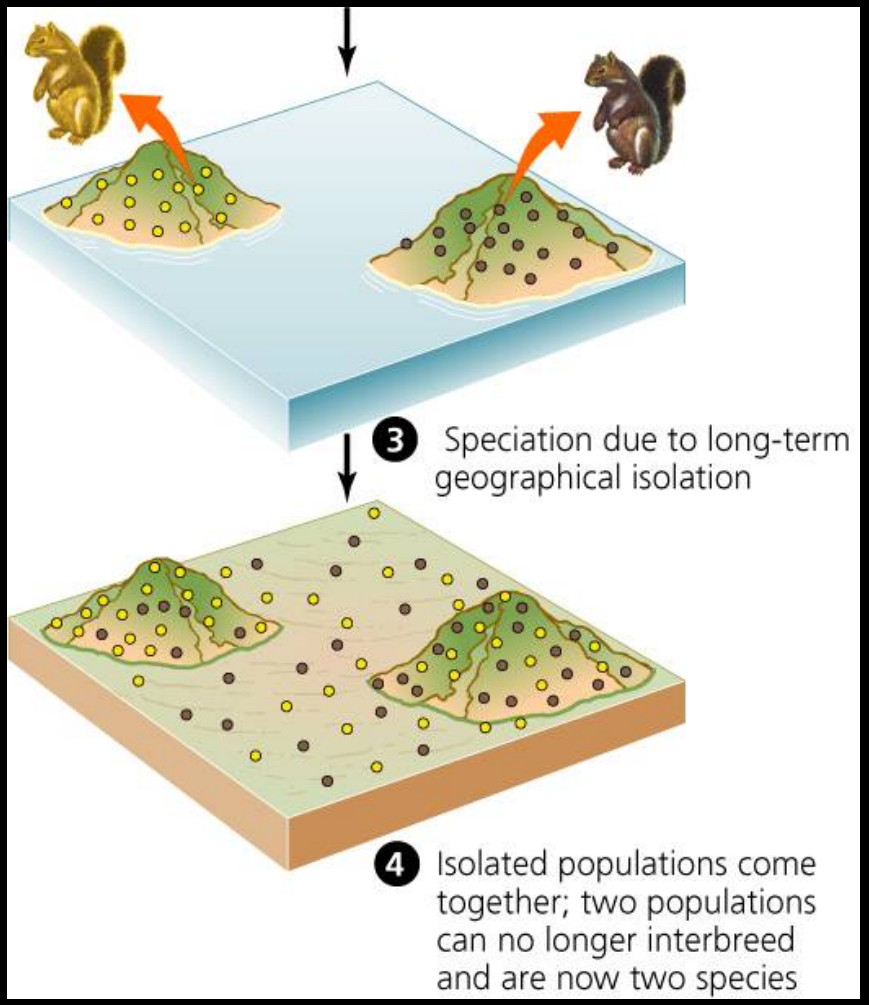
Speciation

Recall that a *species* is a group of organisms that are closely related and that can mate to produce fertile offspring.



Speciation

So, speciation can begin with the separation of populations of the same species.



Speciation

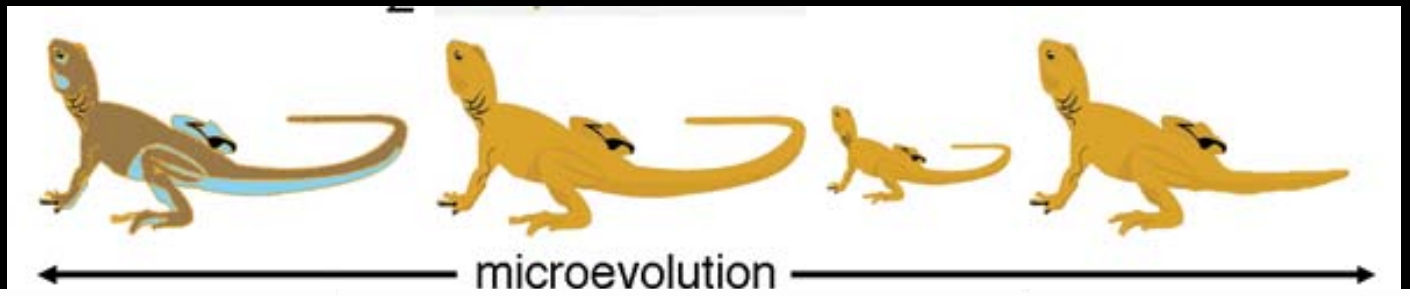
For example, the two kinds of squirrels shown seem to be evolving from one species into two because of separation.

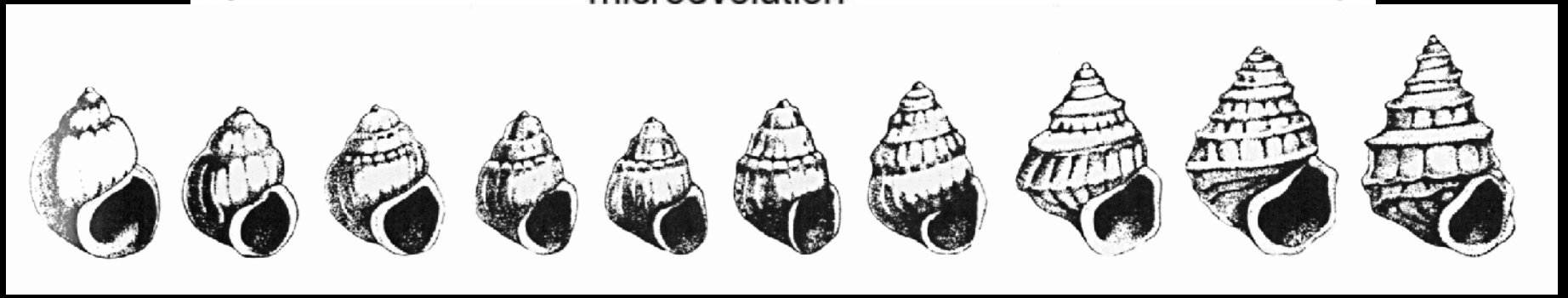
YOUR TURN
Active Reading
Section 3 - Beyond Darwinian Theory

Adapted from Holt Biology 2008

Processes of Microevolution

To study microevolution, we look at the processes by which inherited traits change over time in a population.



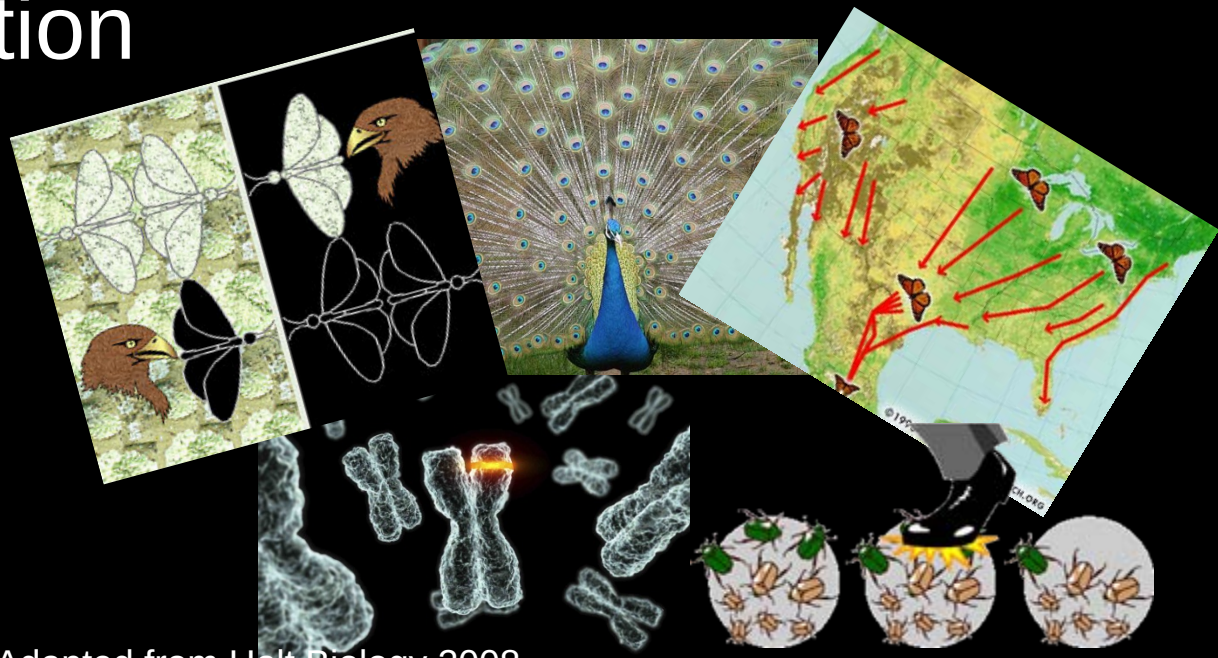


Adapted from Holt Biology 2008

Processes of Microevolution

Five major processes can affect the kinds of genes that will exist in a population from generation to generation—

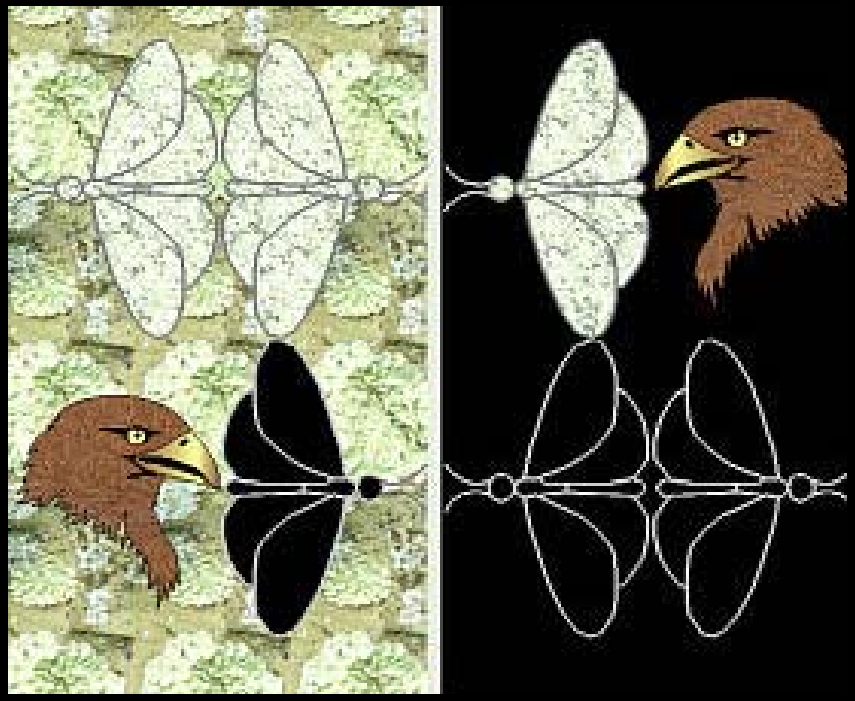
- Natural selection
- Migration
- Mate choice
- Mutation
- Genetic drift.



Adapted from Holt Biology 2008

Natural Selection

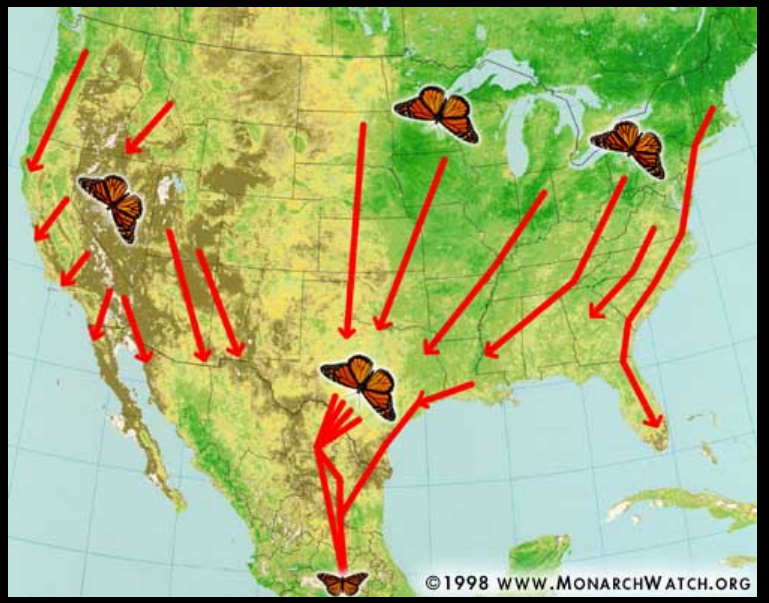
Natural selection can cause an increase or decrease in certain alleles in a population.



Adapted from Holt Biology 2008

Migration

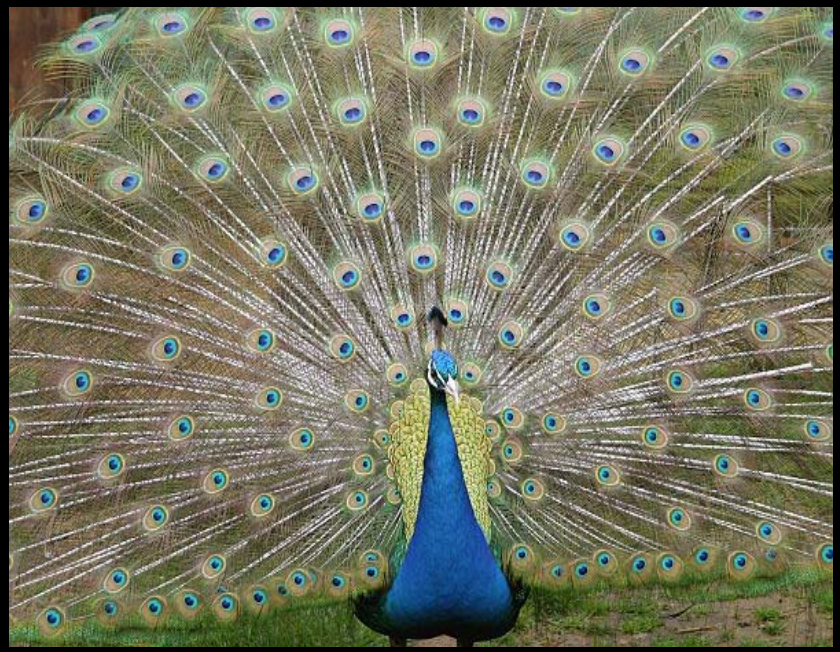
Migration is the movement of individuals into, out of, or between populations. Migration can change the numbers and types of alleles in a population.



Adapted from Holt Biology 2008

Mate Choice

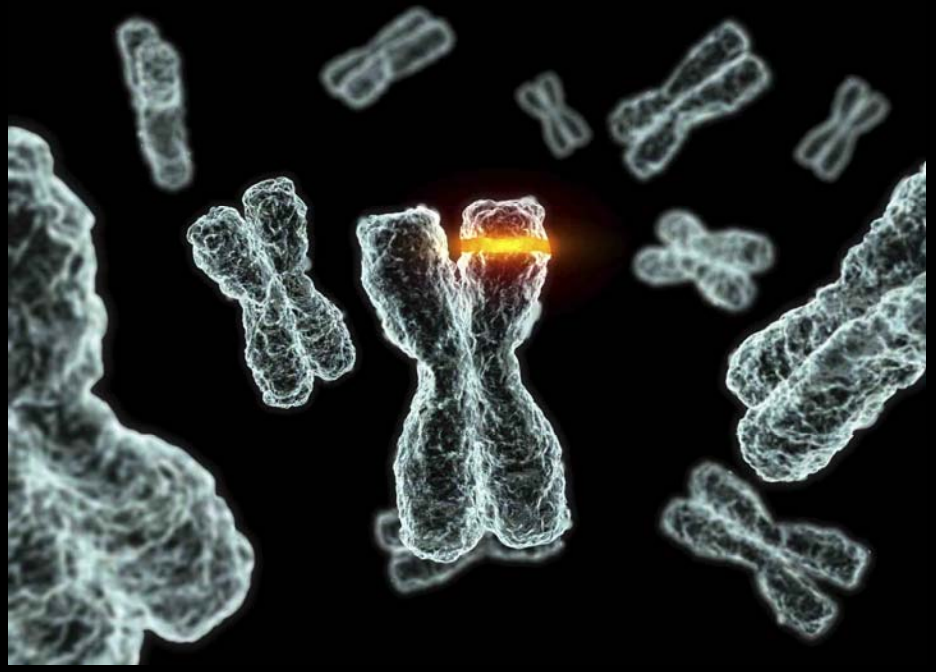
If parents are paired up randomly in a population, a random assortment of traits will be passed on to the next generation. However, if parents are limited or selective in their choice of mates, a limited set of traits will be passed on.



Adapted from Holt Biology 2008

Mutation

Mutation can change the numbers and types of alleles from one generation to the next. However, such changes are rare.



Adapted from Holt Biology 2008

Genetic Drift

The random effects of everyday life can cause differences in the survival and reproduction of individuals through. Because of these differences, some alleles may become more or less common in a population, especially in a small population.

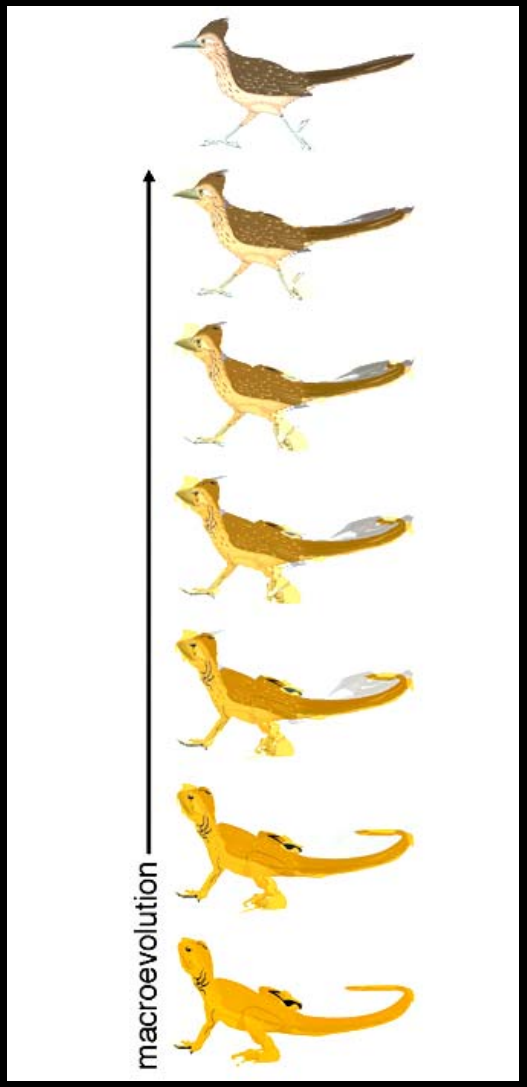
Adapted from Holt Biology 2008

YOUR TURN

Adapted from Holt Biology 2008

Patterns of Macroevolution

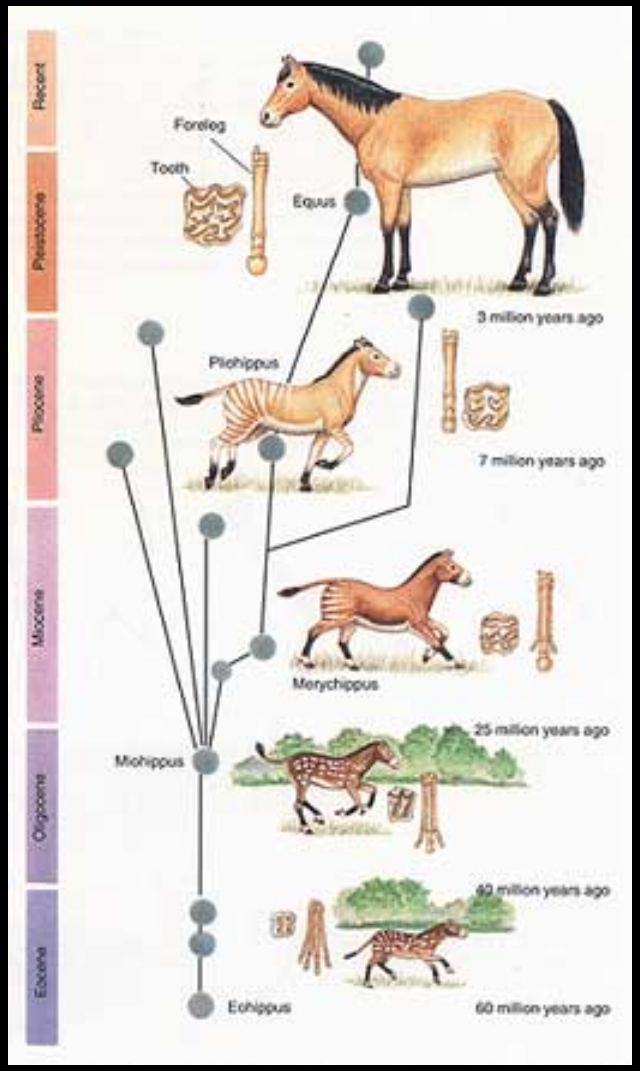
To study macroevolution, we look at the patterns in which new species evolve.



Adapted from Holt Biology 2008

Patterns of Macroevolution

We may study the direction, diversity, or speed of change. Patterns of change are seen when relationships between living and fossil species are modeled.



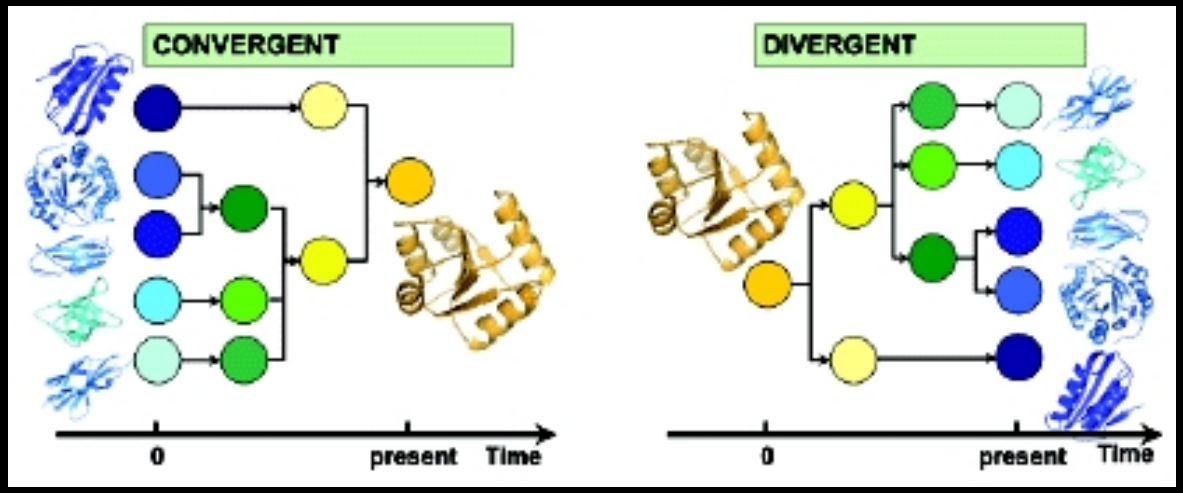
Adapted from Holt Biology 2008

YOUR TURN

Adapted from Holt Biology 2008

Comparing convergent and divergent evolution

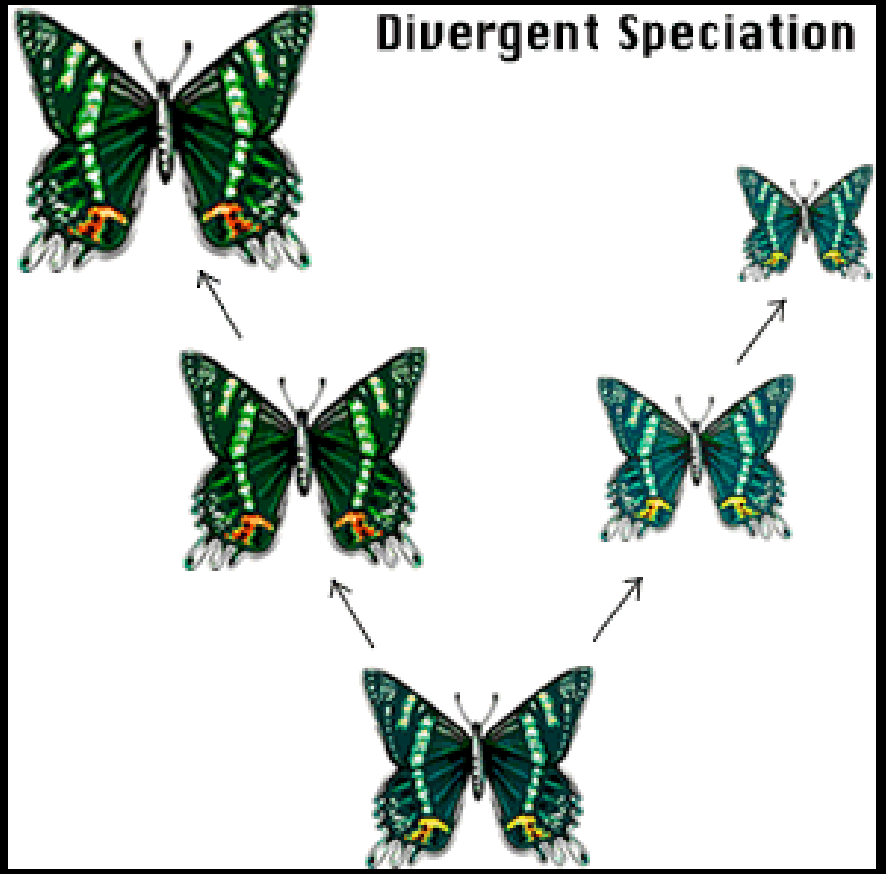
Some organisms appear to be similar but are not closely related at all. This is the result of convergent evolution, the process by which unrelated species become similar as they adapt to similar environments.



Adapted from Holt Biology 2008

Comparing convergent and divergent evolution

In contrast, divergent evolution is the process by which two or more related species become more and more dissimilar.



Adapted from Holt Biology 2008

YOUR TURN

Adapted from Holt Biology 2008

Coevolution

Organisms are part of one other's environment, so they can affect one another's evolution. Species that live in close contact often have clear adaptations to one another's existence.

Adapted from Holt Biology 2008

YOUR TURN

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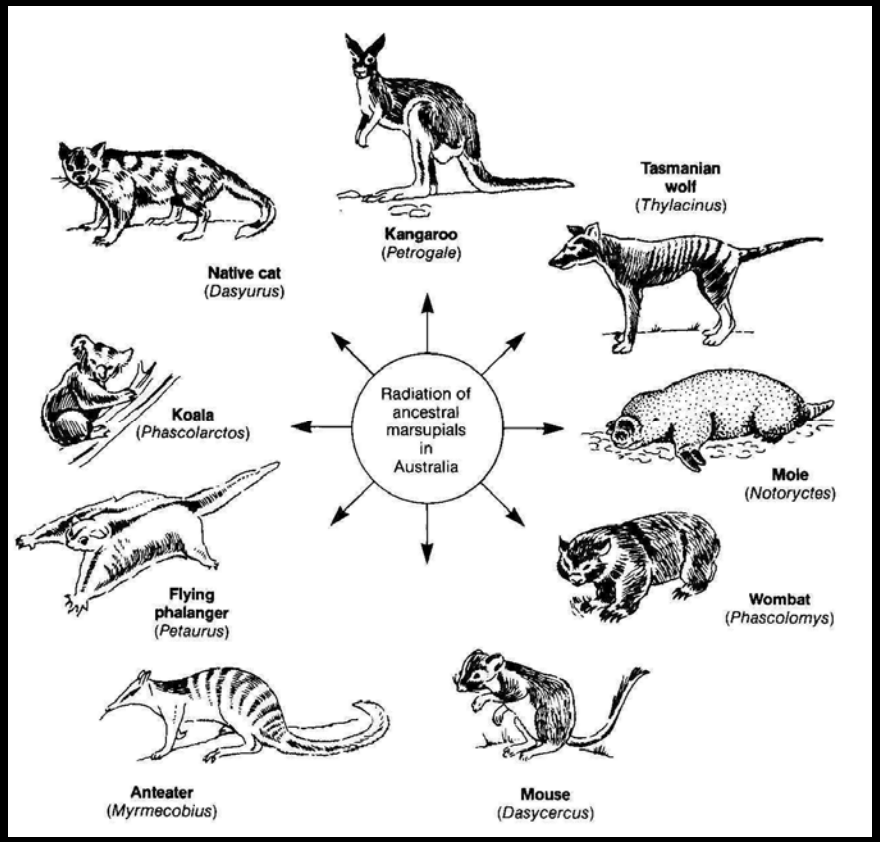
Adaptive Radiation

Over time, species may split into two or more lines of descendants, or *lineages*. As this splitting repeats, one species can give rise to many new species. The process tends to speed up when a new species enters an environment that contains few other species.



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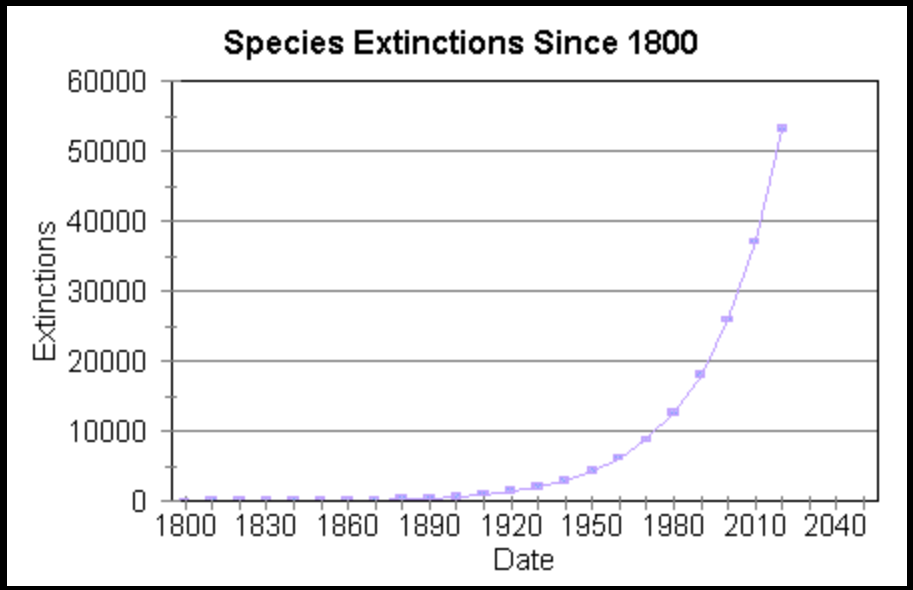
Extinction

If all members of a lineage die off or simply fail to reproduce, the lineage is said to be *extinct*. The fossil record shows that many lineages have arisen and radiated, but only a few of their descendants survived and evolved into the species present today.



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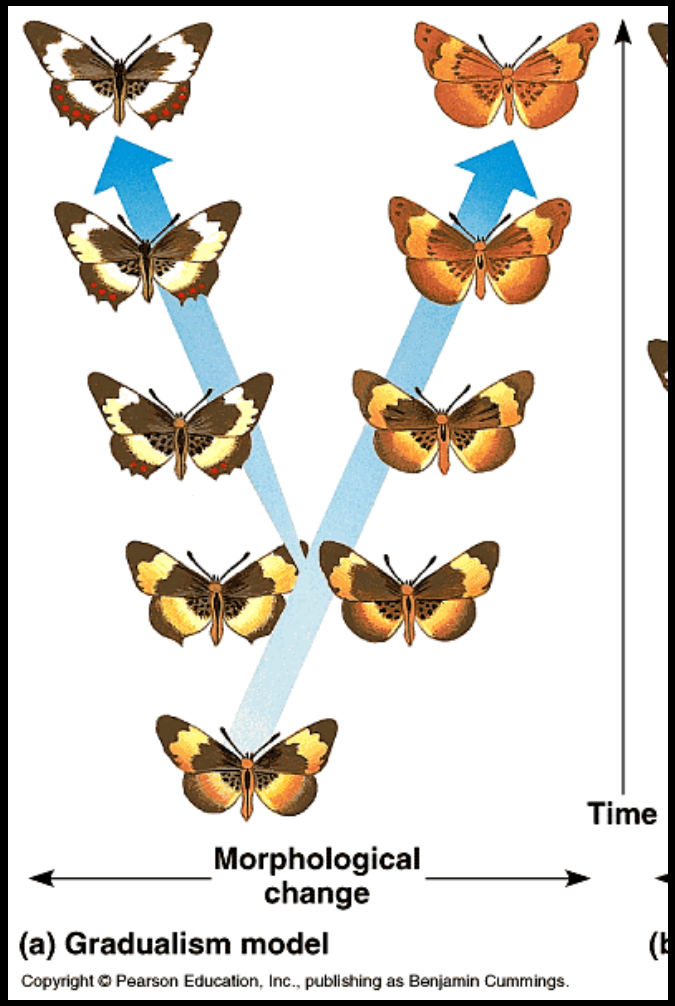
Gradualism

In Darwin's day, the idea of slow, gradual change was new to geology as well as biology. Darwin had argued that large scale changes, such as the formation of new species, must require many small changes to build up gradually over a long period of time. This model is called *gradualism*.



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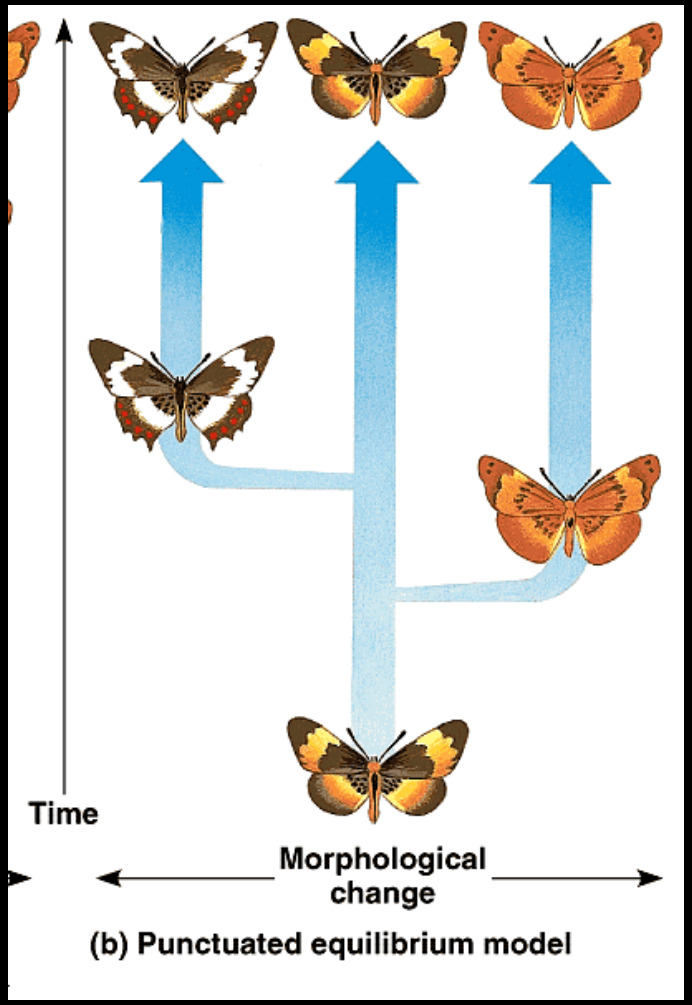
Punctuated Equilibrium

Some biologists argue that species do not always evolve gradually. Species may remain stable for long periods until environmental changes create new pressures. Then, many new species may “suddenly” appear. This model is called *punctuated equilibrium*.



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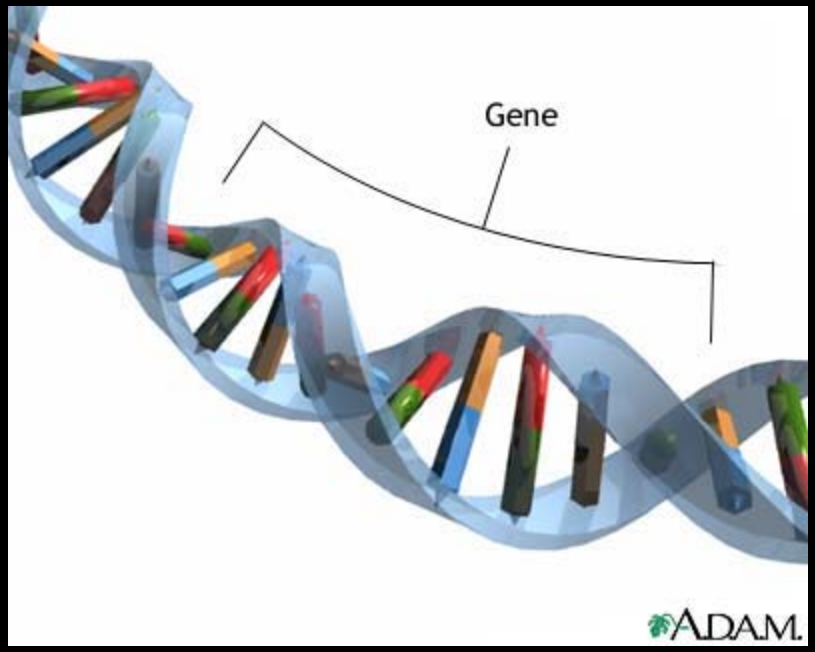
Summary



Discoveries since Darwin's time, especially in genetics, have been added to his theory to explain the evolution of species.

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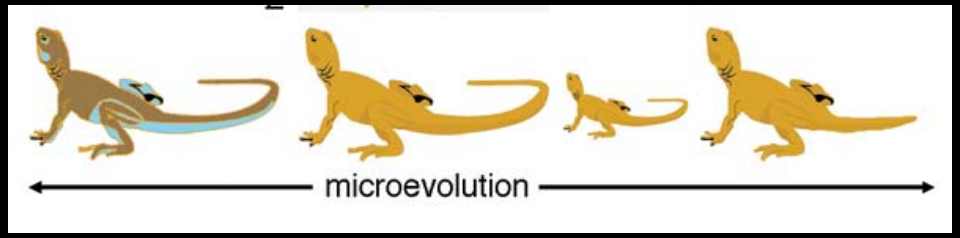
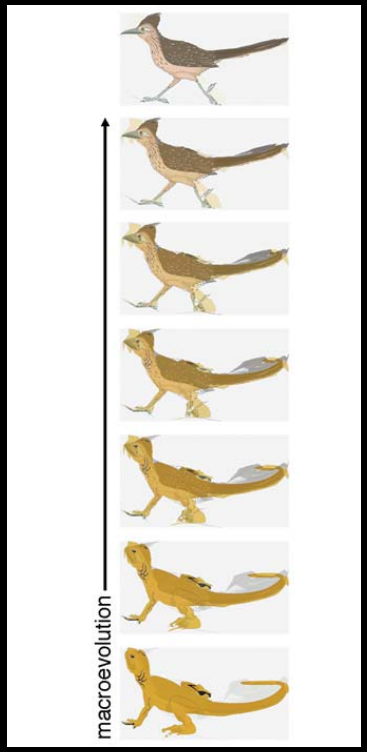
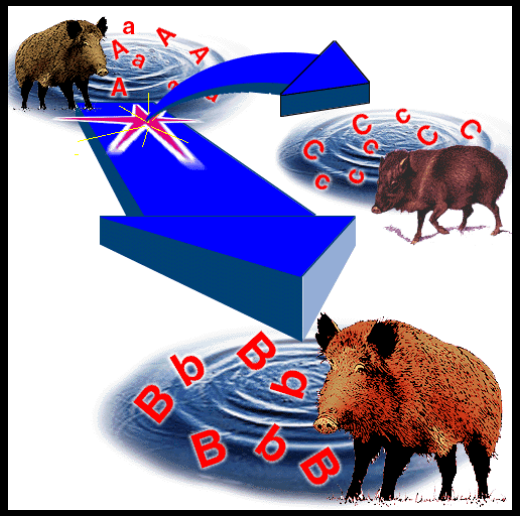
Summary

Because it affects every aspect of biology, scientists can study evolution at many scales. Generally, these scales range from microevolution to macroevolution, with speciation in between.







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