



Evolution

-Patterns

-Other Factors of Evolution



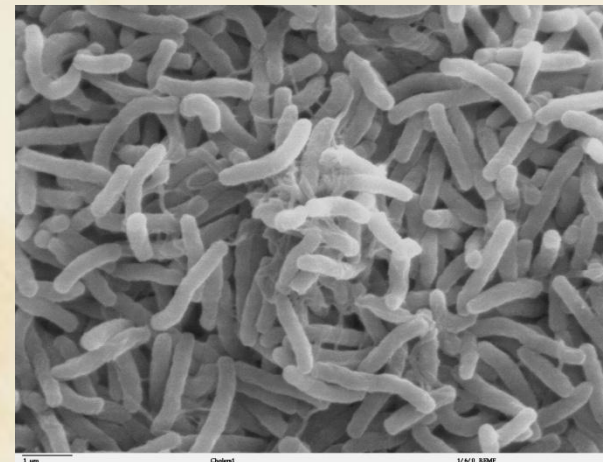
Patterns of Evolution

- There are several ways that species can change to adapt to their environment



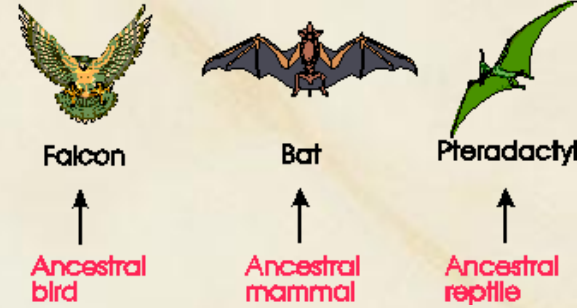
Coevolution

- Two or more species can evolve in close association with each other
- When two or more species have evolved adaptations to each other's influence, this is called **coevolution**
 - Some species evolve traits or strategies to avoid being eaten
 - On the other hand, the animals that eat them are evolving traits or strategies to keep eating them



Humans find ways to fight bacteria (antibiotics), while bacteria evolve ways to become resistant

Convergent Evolution



- Some organisms that appear to be similar are not closely related at all
- **Convergent evolution** - when the environment selects certain characteristics
 - ex. sharks and dolphins have similar body plans for swimming that evolved from *different* ancestors (sharks are fish and dolphins are mammals)

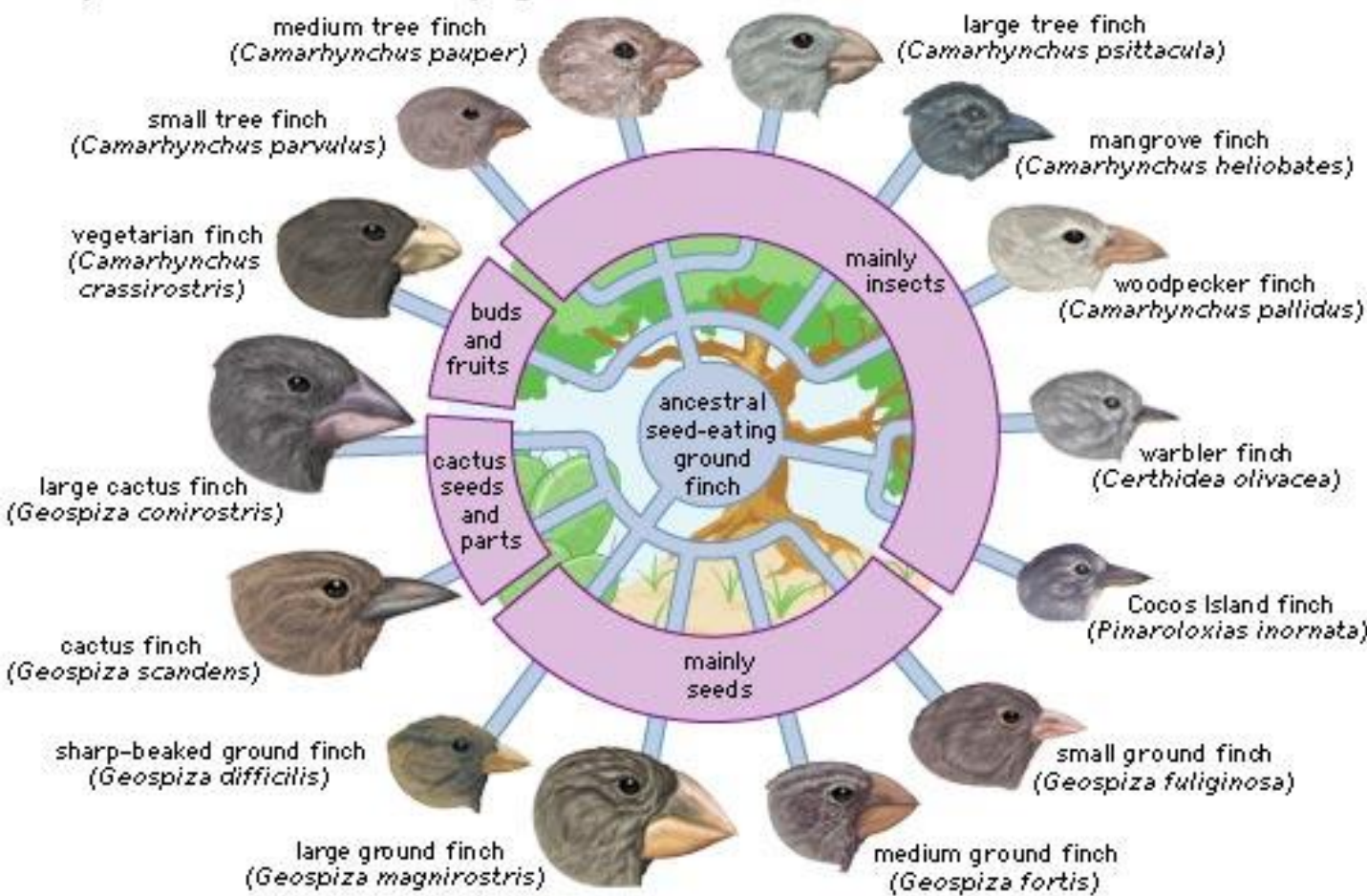


Divergent Evolution

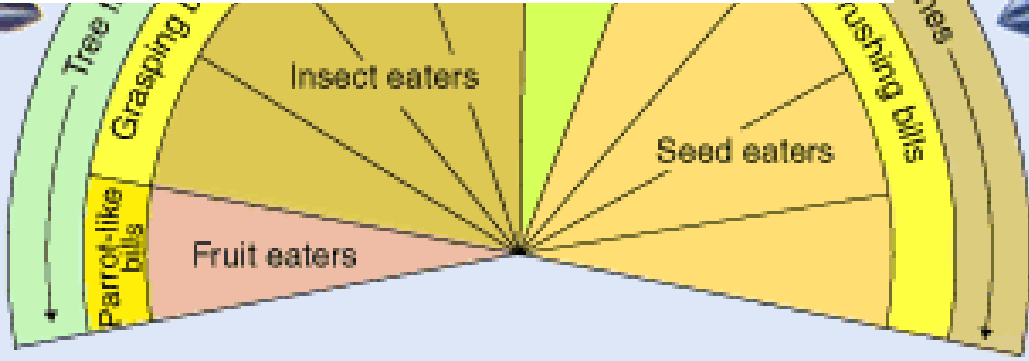
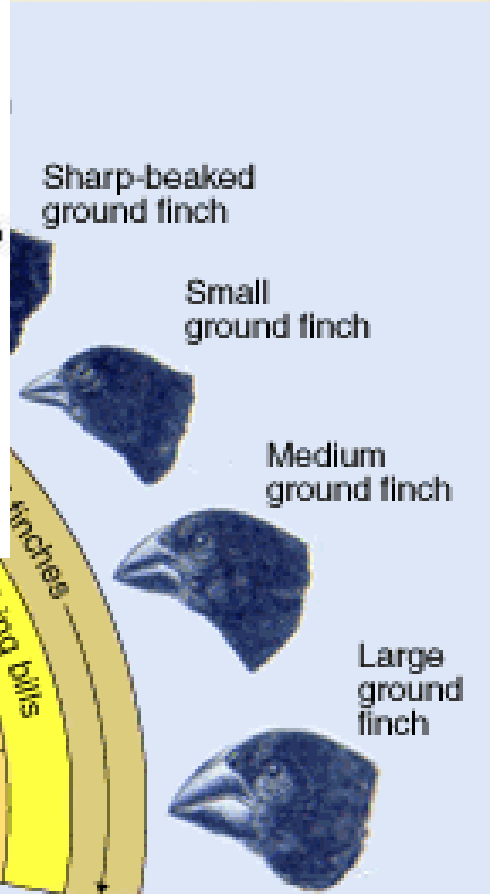
- **Divergent evolution** - when two or more related populations become more and more different
 - in response to differing environments
- One type of divergent evolution is **adaptive radiation**
 - related species evolve from a single ancestral species
 - ex. Darwin's finches
- Divergent evolution occurs in the selective breeding or artificial selection of dogs
 - ALL dogs are the same species
 - However, they have been bred for vastly different characteristics



Adaptive radiation in Galapagos finches



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A dried, pressed leaf is shown on the left side of the image, extending from the top left towards the center. The leaf is dark brown and appears to be a single leaf on a stem. The background is a light, textured surface, possibly paper or fabric, with some faint, irregular brown stains or patterns. The overall tone is warm and natural.

Video Clip:

“Making of the fittest,”

10minutes

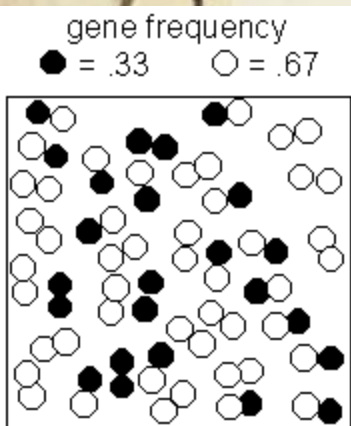
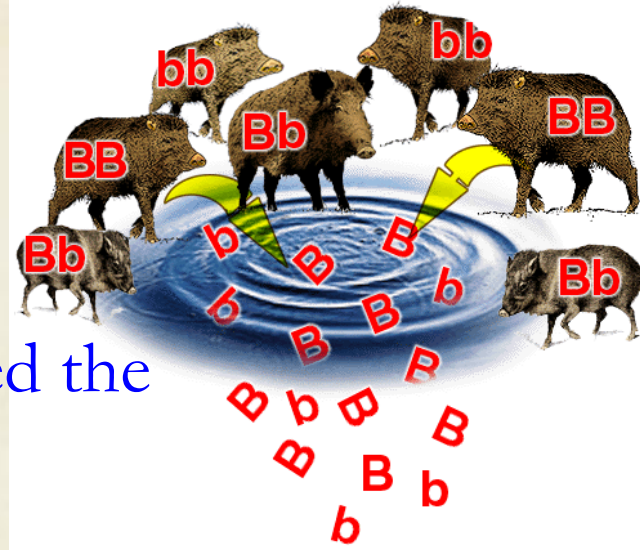


Other Factors in Evolution

- During natural selection the genetic makeup of organisms gradually changes and diversifies
- Variations in genes come in three ways
 - *Mutations*
 - *Recombination* (crossing- over and independent assortment during meiosis)
 - *Random pairing of sex cells* (each sex cell is genetically different)

Gene Pool

- The total genetic information available in a population is called the **gene pool**
- Evolution is based on **gene frequency**—the percentage of particular genes within a gene pool
- Genes that display advantageous traits (help survive and reproduce) are a major factor in evolution.



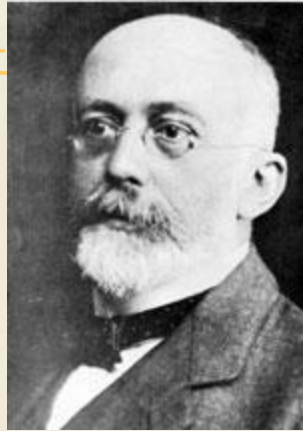
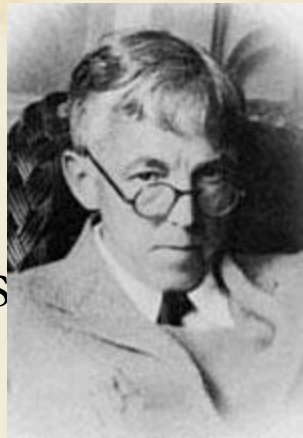
Hardy-Weinberg Genetic Equilibrium

- Wilhelm Weinberg and Godfrey Hardy both showed that genotype frequencies in a population tend to remain the same unless acting upon by outside forces
- A “non-evolving” population
- Conditions required to maintain equilibrium:
 - No mutations occur
 - No individuals enter or leave a population
 - The population is large
 - Individuals mate randomly
 - Natural selection does not occur



Hardy-Weinberg Genetic Equilibrium

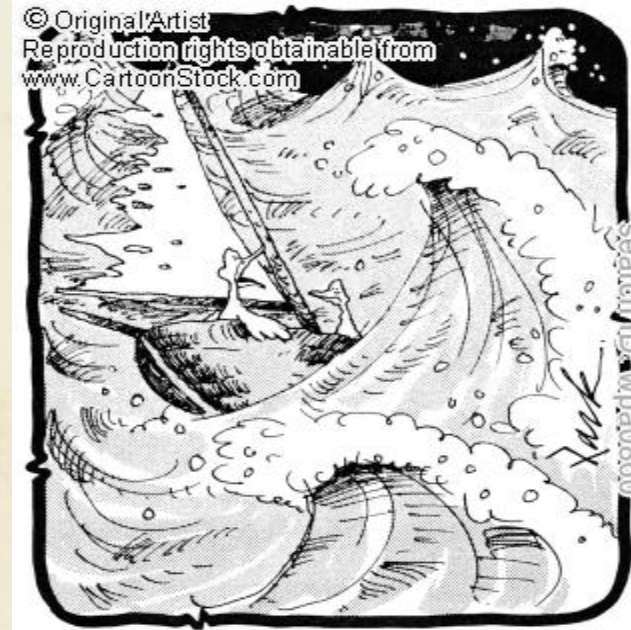
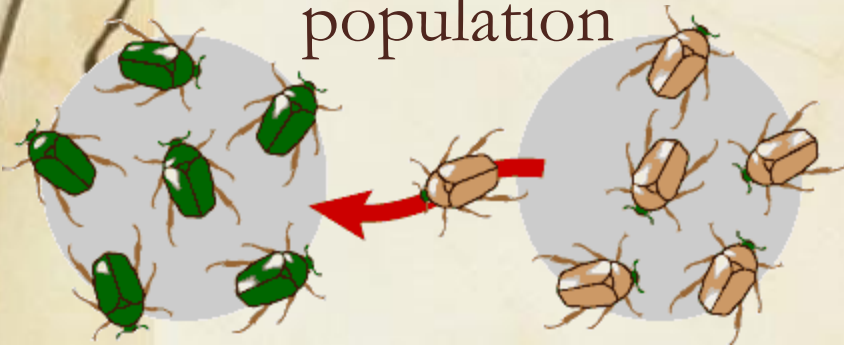
- Note: A failure of the Hardy-Weinberg Law is sign that evolution is occurring
- http://zoology.okstate.edu/zoo_lrc/biol1114_tutorials/Flash/life4e_15-6-OSU.swf



"It might be some sort of evolution thing.
Your baby's navel is an Ethernet port."

Migration

- A population may also change because of emigration or immigration
 - **Emigration** refers to the movement organisms out of a group
 - often leads to the formation of new species
 - **Immigration** is the movement of organisms into the group
- Gene flow occurs when an individual leaves a population or a new individual joins a population



"We're doomed! And all because you decided it would be better to sail than to fly south this year!"

Genetic Drift



- Genetic drift provides random changes in the occurrence of genes through chance events
- These chance events can take place when a few individuals of a population break off from the original group and start their own population
 - also known as the **founder effect**
 - This is what happened with Darwin’s finches
 - More than likely a few birds were blown to the Galapagos Islands during a storm
 - These “founder” birds remained on the island and reproduced, eventually developing into a distinct species

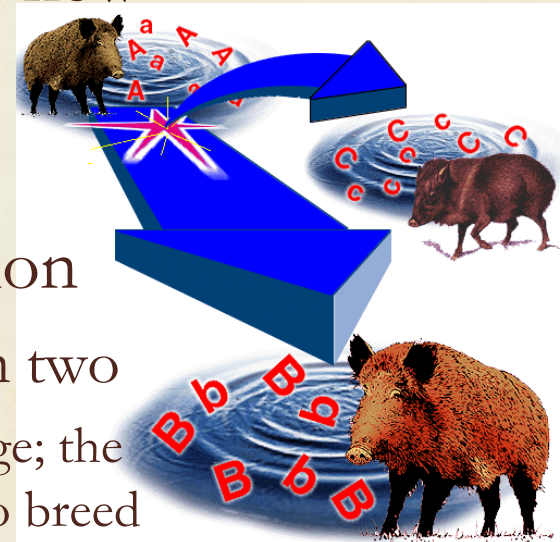
Nonrandom Mating

- Mating practices in a group can also affect its development and evolution
- In many groups, mating is not random, this is called **sexual selection**
 - Individuals with certain characteristics are more often selected as mates
 - ex. Plumage of turkeys and peacocks
- This affects which genes from the “gene pool” are passed on to the population’s offspring



Speciation

- A **species** is a group of organisms with similar structures and appearance who can mate and produce fertile offspring
- **Speciation** refers to the creation of a new species
- Evolutionary developments lead to speciation → GEOGRAPHIC isolation
 - ex. A species is geographically divided in two
 - the creation of a new river or mountain range; the two groups may not have the opportunity to breed together
 - each group will evolve independently
 - eventually the two groups become so different they can no longer interbreed, and each group becomes a new species



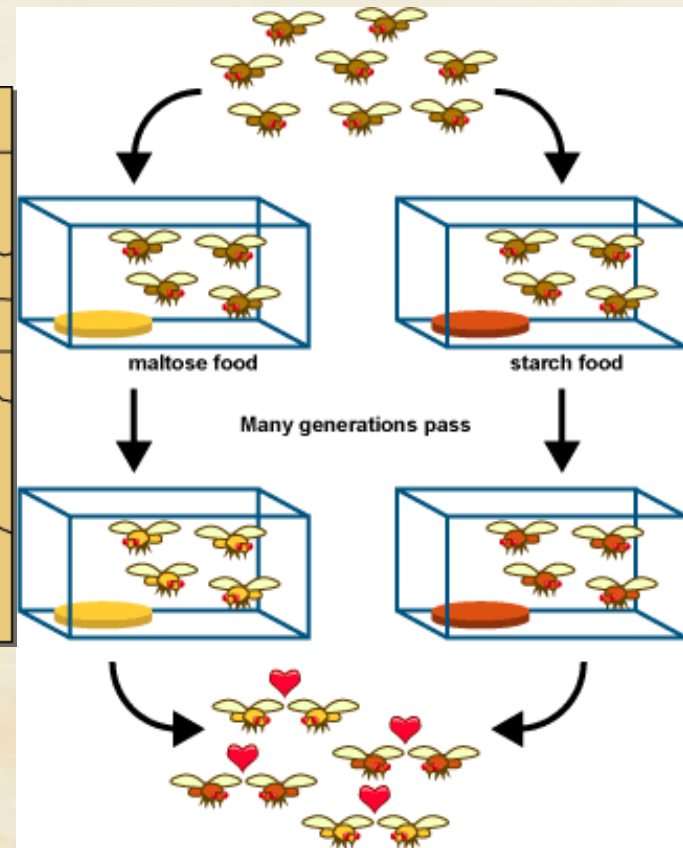
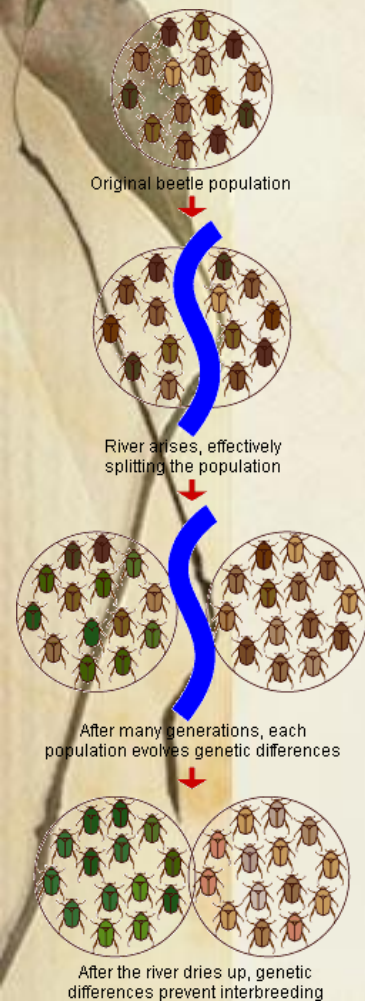


Speciation

- Even when there is no geographical separation, members with particular traits may restrict their mating to others with similar traits → **REPRODUCTIVE** isolation
- Eventually, two or more different groups develop and become a separate species

WHAT IS SPECIATION?

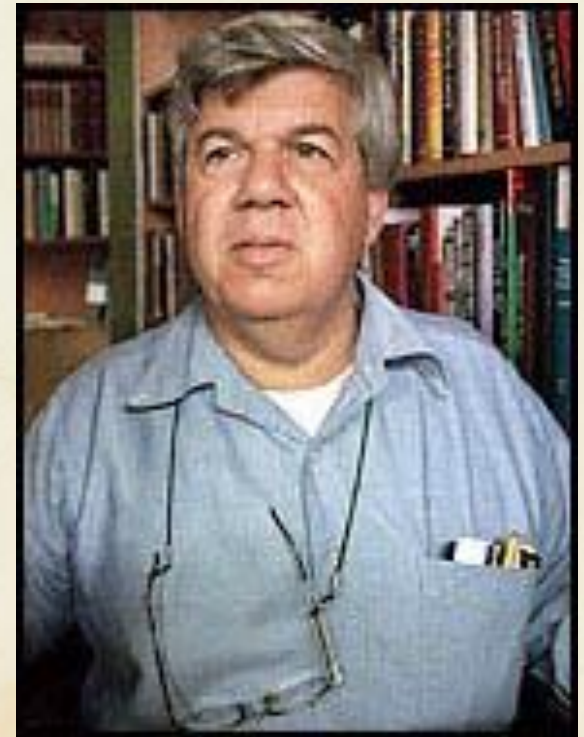
- GEOGRAPHIC ISOLATION
- REPRODUCTIVE ISOLATION



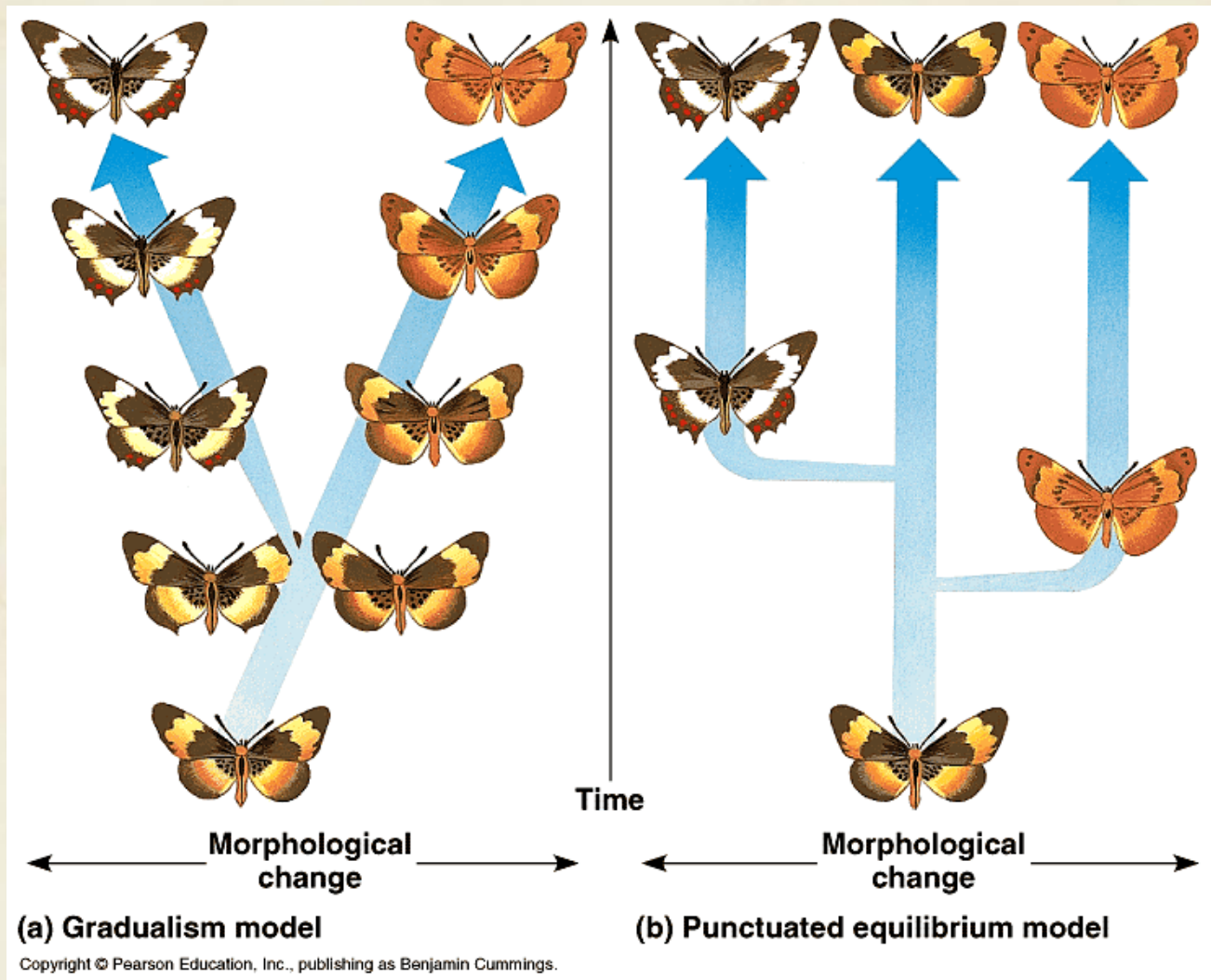
<http://evolution.berkeley.edu/evolibrary/home.php>

Rates of Speciation

- The idea that speciation occurs at a regular, gradual rate is called **gradualism**
- Some scientists believe that speciation can take place in “bursts” relative to the geologic time scale
 - May take place in *thousands* of years instead of *millions* of years
 - This pattern of speciation is called **punctuated equilibrium**
- However, one can make a point that thousands of years is still a gradual rate in relation to a human life span



Stephen J. Gould is one of the scientists who brought about the idea of punctuated equilibrium



Gradualism → Video Clip



Questions

- Contrast convergent and divergent evolution
- What is gene frequency?
- What is the “founder effect”?
- What is the difference between immigration and emigration?
- How can mating practices affect evolution?
- What is a species?
- When does gene flow occur?