

Chapter 2 – Evolution

Key Concepts Section 2.1-2.3

- Prior to Darwin there were many views about the mutability of species.
 - Immutable – unchanging
 - Mutable – changing
 - Transmutation – process of change
- Prior to Darwin there were many views about the nature of change if it occurred
 - No change
 - Extinction occurs but no speciation
 - Extinction with new creations but no change
 - Extinction with progressive (goal oriented) change

Key Concepts Section 2.1-2.3

- Darwin's model predicted
 - Extinctions
 - Evolution of new species
 - Analogy – was a tree of life
 - Branches represent the formation of new species
 - Short branches indicate that line went extinct before now
 - Longest branches represent extant groups

Parsimony

- The Principle of Parsimony – states all else being equal, the better explanation is the one that has the fewest assumptions.
- Occam's Razor – William of Occam (1285-1345) – “do not multiply entities unnecessarily”
- Crude modern equivalent – “Keep it simple stupid”

Laws of Probability

- Additive Law
 - Assuming event A and event B are independent.
 - The probability of event A **or** event B happening is the probability of event A occurring plus the probability of event B occurring minus the probability of both occurring
 - Mathematically
$$p(A \text{ or } B) = p(A) + p(B) - p(AB)$$

Additive Law.

Example

If the probability of rolling single die and getting a "6" is $1/6$ and the probability of rolling a die and getting a "5" is $1/6$ then the probability of rolling a die and getting a "5" or a "6" would be...

$$p = 1/6 + 1/6 - 0 = 2/6 = 1/3 \approx 0.333$$

Note: in the case the two events are mutually exclusive (i.e. you can not role a single die and get both a "6" and a "5")

Laws of Probability

• Multiplicative Law

- Assuming event A and event B are independent.
- The probability of event A **and** event B happening is the probability of event A occurring times the probability of event B occurring. Mathematically

$$p(\text{A and B}) = p(\text{A}) * p(\text{B})$$

– Multiplicative Law.

Example

- The probability of rolling a single die twice and getting two "1"s would be the probability of rolling a "1" on the first role ($1/6$) times the probability of rolling a "1" on the second role ($1/6$).

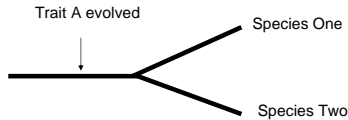
$$p = 1/6 * 1/6 = 1/36 \approx 0.0278$$

Parsimony and Evolution

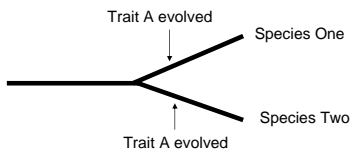
- Consider two species that share a single trait A. (i.e. both species have the trait)
- Assume that its is known the at least one common ancestor did not possess trait A.
- There are two evolutionary explanations of how the two species could of came to possess the trait.

Explanation of how two species come to share a common trait

1. A recent common ancestor evolved the trait and that ancestor then gave rise to both species.



2. Both species evolved the trait independently



The probability of a given trait evolving is small.

Because of the multiplicative law the probability of the same trait evolving twice would be even smaller.

Therefore parsimony would suggest that the second explanation is the poorer explanation.

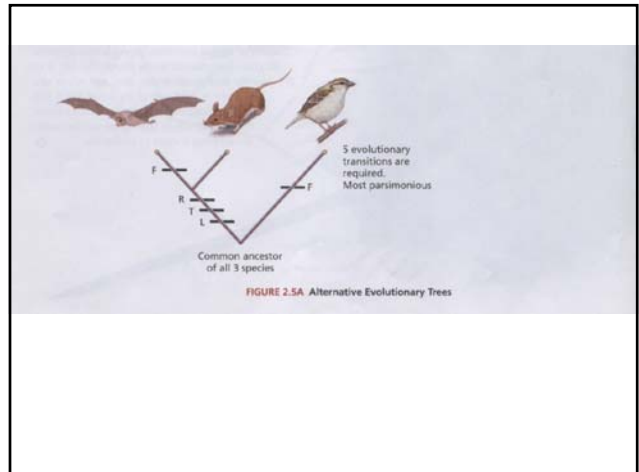
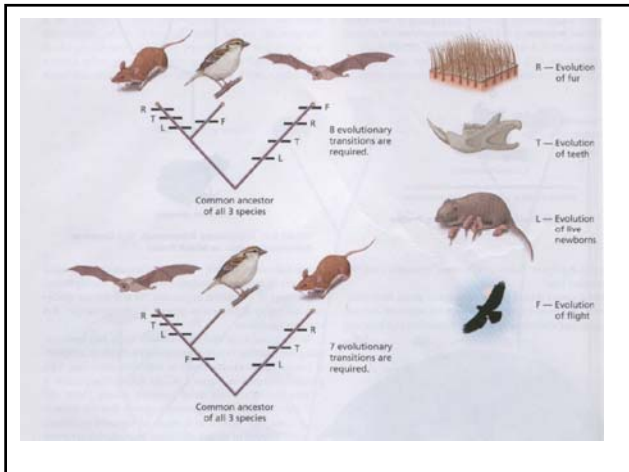
Parsimony and Creation of Cladograms

- A cladogram is a stick figure representing a ancestral tree of a group of organisms
- The evolution of adaptations (wings, furs etc) can be viewed as rare but finitely possible events
- The probability of the same adaptations evolving multiples times would be unlikely.
- If a number of adaptations are shared between species, minimizing the total number of times that rare evolution events occurred can create a most parsimonious cladogram.

Two Terms Traits

- Relictual traits
 - Traits that were possessed by a common ancestor
- Derived traits
 - Traits not possessed by a common ancestor

Avoids using the terms primitive and advanced



Analogy and Homology

Homologous traits are traits shared because they are derived from a common ancestor.

Homologous are often similar in structure and development but may differ in function.

Analogous traits are shared traits that not derived from a common ancestor.

Convergent Evolution may select for similar traits.

Parsimony

- Mutations as a source variation
- DNA sequences as adaptations
- Neutral and Selectively
- Conserved and Variable Sequences
- Equally parsimonious trees