

Lec 02 – Evolution and Natural Selection

1. History of Evolutionary Thought

a. Essentialism

- i. Proposed by Aristotle
- ii. Species static, part of “great chain of being”
- iii. View was later incorporated into medieval and renaissance thinking

b. Taxonomy

- i. Carolus Linnaeus
- ii. Exhaustive classification of plants and animals
(Domain-Kingdom-Phylum-Class-Order-Family-Genus-Species)
- iii. Nested hierarchy

1. Binomial nomenclature: *Genus species*

c. Inheritance of Acquired Characters

- i. Jean-Baptiste Lamarck
- ii. Changes which an organism acquires over its lifetime are passed on to its offspring
 1. Complicated by “progressive alchemical life force” and “spontaneous generation”
 2. Totally bogus (... with some exceptions that aren’t important at this time)
 3. Ultimately disproven by August Weismann
- iii. Brought evolutionary thinking into the fore (or “transmutational thinking” as he would have called it)

d. Modern Understanding of Evolution

- i. Charles Darwin
- ii. “Descent with Modification”
 1. “On the Origin of Species by Means of Natural Selection” 1859
- iii. Natural Selection—a BIG idea
 1. Variants that survive and reproduce become more common
 2. Fitness is a measure of reproductive success
 - a. Higher fitness = greater representation in the next generation
 3. Blind, naturalistic, **non-random**

- a. Provided testable predictions and cohesive unifying theme
 - 4. Leads to adaptations
 - iv. Mystery of the lemming?
 - v. Major components of theory
 - 1. Species change over time (microevolution)
 - 2. Lineages split (speciation)
 - 3. New species develop from older species (macroevolution)
 - 4. All species share common ancestry
 - 5. Earth (and life) are old (billions of years)
 - e. Despite astounding progress in understanding evolution and life, persistent denial of evolution
 - i. As of 2019, ~40% of Americans believe that humans were created by special creation, did not evolve
- 2. Evidence for Evolution
 - a. Microevolution
 - i. Direct Observation
 - 1. Microevolution readily visible over short number of years
 - 2. Antibiotic resistance and soapberry bug examples
 - ii. Artificial Selection
 - iii. Selection Experiments
 - b. Macroevolution
 - i. Vestigial Traits
 - ii. Atavisms
 - iii. Fossil Records
 - 1. Evidence that organisms are not static, clearly different organisms live at different times
 - 2. Transitional Forms
 - iv. Homologies: Characters which are similar due to relatedness
 - 1. Structural: similarities in form, but perhaps not in function
 - 2. Developmental: similarities in embryonic form due to shared ancestry
 - 3. Molecular: similarities in genetic info between different species, often despite dramatically different physiology

- v. Historical Imperfections
- vi. Law of Succession
 - 1. Fossils of extinct species found in same region as similar living species
- 3. Myths and Misconceptions
 - a. Know why all of the following are NOT problems with modern evolutionary theory
 - i. “Evolution is just a theory”
 - ii. “If man evolved from apes, why are there still apes?”
 - iii. “If evolution is true, there must be no god”
 - iv. “Some structures are too complex to have evolved (irreducible complexity)”
 - v. “Evolution is not scientific, because it cannot be disproven”
 - vi. “No one has ever seen speciation occur”
 - vii. “What about the missing link?”
 - viii. “Evolution is controversial among scientists”
 - ix. “Random chance cannot lead to complex life forms”

Focal Questions:

1. What is essentialism? How does it differ from our modern understanding of evolution?
2. What is the inheritance of acquired characters? How does it differ from our modern understanding of evolution? How is it similar?
3. What is meant by “descent with modification”?
4. What is fitness?
5. What is natural selection?
6. What three features are required by natural selection? Why are they required?
7. What evidence do we have for our modern conception of evolution? (We discussed ~9 lines of evidence that you should be familiar with.) For each line of evidence, what is an example which illustrates that point?
8. Understand the myths/misconceptions about evolution