

Darwin: Evolution By Means of Natural Selection (Chapter 16 and 19-1; a bit of 19-2, 19.3)

- I. **(16.2) Historical Thoughts and Influence on Evolutionary Thought**
- a. Historical Thoughts
- **Greeks** -Aristotle (3rd c. BC) “Scala Naturae - “great chain of being” or “the ladder of life.” Connects all living things toward a goal.
 - **Literal Biblical view** -Many Europeans in Darwin’s Day believed the Earth was only a few thousand years old and had not changed very much. The World was created 6 days and Earth is now 6000 yrs old. All species were created as they are today.
- b. Influence of Geology-
- **James Hutton 1785** - “Gradualism.” “Deep Time - the Earth’s history stretched way back.”
 - Things that change the earth are very slow and take a long time.
 - **Charles Lyell 1830** -scientists must explain past events in terms of processes that they can actually observe. Current Earth shaping processes are the same as those in the past. Lyell argued that the Laws of Nature are constant over time, “Uniforitarianism.” He wrote “Principles of Geology,” read by Darwin on The Voyage of the Beagle.
 - Stressed that scientists must explain past events in terms of processes that they can actually observe.
- c. Influence of Paleontology-(the study of collecting and studying fossil)
- **William Smith** - Each layer (stratum) of rock had unique fossil records. The older the strata, the more dissimilar the organisms are to present forms.
 - **George Cuvier** - Documented extinction as a common occurrence.
- d. Influence of Economics/Sociology
- **Thomas Malthus - 1798** If human population grew unchecked, there wouldn’t be enough space, food, etc., for everyone. War, famine, and disease work against population growth. 1. Population size (growth) was linked to poverty and disease. 2. If human population continued to grow, unchecked (grows exponentially - geometrically), it would be limited by space, food supply, etc. (grows arithmetically - linearly) 3. Population outgrows resources and competition kicks in.
- e. Influence of Naturalists
- **Jean Baptiste Lamarck: Published his ideas in 1809-The year before Darwin was born.**
 - Tendency toward perfection - All organisms are continually changing and acquiring features that help them live more successfully in their environments - re-visit “Scala Naturae:” - the ladder of life - all things moving toward a goal of perfectionism.
 - Use and Disuse - organisms could alter the size or shape of particular organs by using their bodies in new ways.
 - Inheritance of Acquired Characteristics - Lamarck also suggested that if during its lifetime an organism altered a body structure, it would pass that change on to its offspring.
 - Why it is wrong? Because only genes (genetic information) can be passed on to offspring, not physical changes to the parent’s body structure (these are acquired traits). Acquired traits cannot be inherited. Ex: Male Fiddler Crabs and Lamarck’s Giraffes.
 - How did he positively influence modern evolutionary thought? He was one of the 1st to develop a scientific hypothesis of evolution and realize that organisms are adapted to their environments. He paved the way for the work of later Biologists like Charles Darwin.

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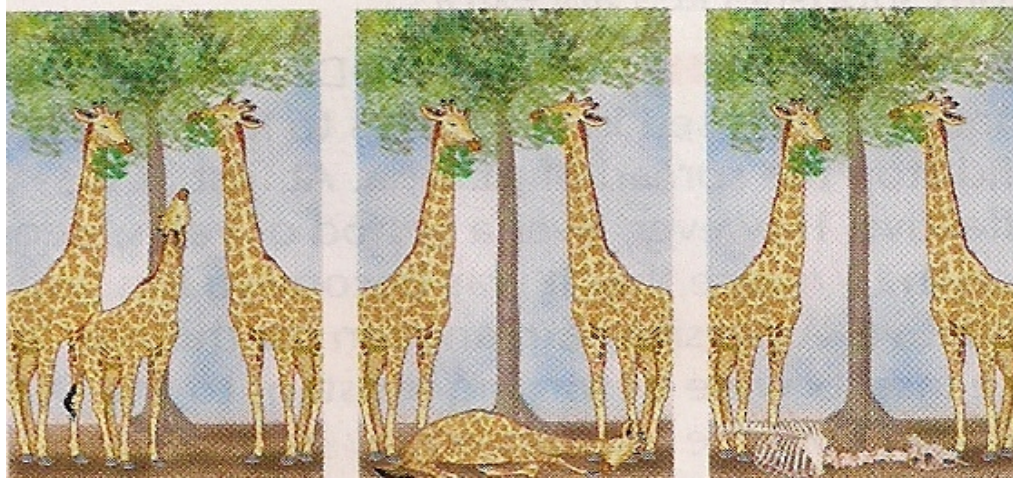
- **Charles Darwin:** Took epic journey on the HMS Beagle as a resident Naturalist. Collected plants, animals, fossils. OBSERVED species on Galapagos Islands that were similar to mainland species, but different in each environment. Variation exists within a natural and domesticated population and some of that variation is inheritable. Similar habitats around the world do NOT have the same animals and plants, but they have similar characteristics for that environment. SPECIES ARE NOT FIXED. THEY CHANGE OVER TIME - EVOLVE!
- **Alfred Wallace:** BRITISH naturalist, explorer, geographer, anthropologist. He also independently conceived the theory of evolution through Natural Selection. “The father of Biogeography.”

II. (16.3) **How does Natural Selection Drive Evolution?**

III. a. Individual organisms of a population differ and much of this variation is heritable.

DEFINITIONS AND CONCEPTS:

- **Morphology**- The form or shape of an organism.
 - **Physiology**- The mechanical, physical, and biochemical functions of living organisms.
EX: Muscles are the morphology and how they work is the physiology.
 - **Adaptation** - Any inherited characteristic that increases an organism’s chance of survival and ability to reproduce.
 - **Fitness** - The ability of an organism to survive and reproduce.
 - **Selective Pressure** - Any phenomenon which alters the fitness of organisms within a given environment. It is the driving force of Natural Selection and it can be divided into two types of pressure: biotic and abiotic pressure. EX: predation, food supply, and temperature.
- a.
- b. Organisms produce more offspring than can possibly survive and those that do not survive are not able to reproduce. They are not able to pass down genes. They are not as fit or, are not suited best for the environment. They may die due to selective pressure. That genome is then wiped from the population. **Thomas Malthus on “Population Growth” stated this!**
- c. Each unique organism has different advantages and disadvantages in the struggle for existence. Individuals best suited to their environment survive and reproduce most successfully. **“Theory of Biological Evolution by means of Natural Selection” as stated in “On The Origin of the Species” by Charles Darwin who combined his ideas with Malthus and Lamarck: p. 460-464: Summary of Darwin’s Theory:**
- “Struggle for Existence” - if more organisms are produced than can survive, members of a population must compete for food, living space, and necessities of life if they are to survive.
 - “Survival of the Fittest” (Natural Selection)
 - Fitness - the ability to survive and reproduce.
 - Adaptation - can be morphological, behavioral, or physiological. An adaptation may be an advantage in one environment and a disadvantage in another.
 - Natural Selection- be careful with your wording not to sound Lamarckian!
 - only acts on heritable traits
 - does not form NEW characteristics (only mutations can do this).
 - is backward looking, not planned - every organism alive today is descended from parents who survived, reproduced, and passed on their traits. Those parents are descended from parents who survived, reproduced, and passed on their traits, and so forth back through time.
 - acts on the individual, but the effect is on the POPULATION.



- d. Species alive today are descended with modification from ancestral species that lived in the distant past.
- This process by which diverse species evolved from common ancestors unites all organisms on Earth into a single tree of life.
- e. The Modern Theory of Biological Evolution unites the work of Charles Darwin and Alfred Wallace.

IV. (16.4) Evidence of Evolution

a. Geographical Distribution of Living Species: Biogeography (p. 465)

- can indicate common ancestry from fossil forms that occupied continuous area. Closely related species develop similarities in similar environments.
- Can indicate similar structures forming in different species due to similar habitats (and therefore similar selective pressures).

b. Fossil Data: What does it show us? (16.4, 19.1, a bit of 19.2)

- The history of life on Earth as well as the relative age of the Earth
- How different species of organisms have changed over time: the rate of evolution (how fast evolution takes place).
- The structure of ancient organisms including transitional forms, their environment, and the ways in which they lived:
- **Transitional Forms** - fossils or organisms that show the intermediate states between an ancestral form and that of its descendants. ALSO CALLED INTERMEDIATE FOSSILS.
- **Gradualism** - slight changes within a population over time (subtle).
- **Punctuated Equilibrium** - a quick change in a population (dramatic - indicates a

major event).

population.

Stasis - the idea that during periods of time, little if any change is observed in a

Relative Dating – p. 540 method of determining the age of a fossil by comparing its placement with that of fossils in other rock layers. older fossils are found below more recent ones.

Radioactive (Radiometric) Dating - using carbon dating of rocks and fossils to determine a more accurate time frame in which the organism lived.

- c. Embryology
 - Related organisms share a common, early embryology.
 - The more closely related, the more related their embryological stages are.
- d. Homologous Structures - structures that arise from the same area of the embryo, but give rise to different, mature forms.
- e. Analogous Structures (not evidence of evolution, but evidence of selective pressure causing organisms to resemble each other in response to their similar environment)

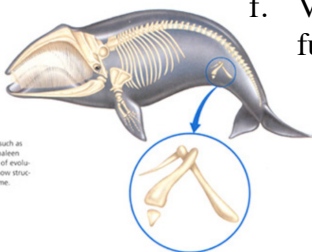
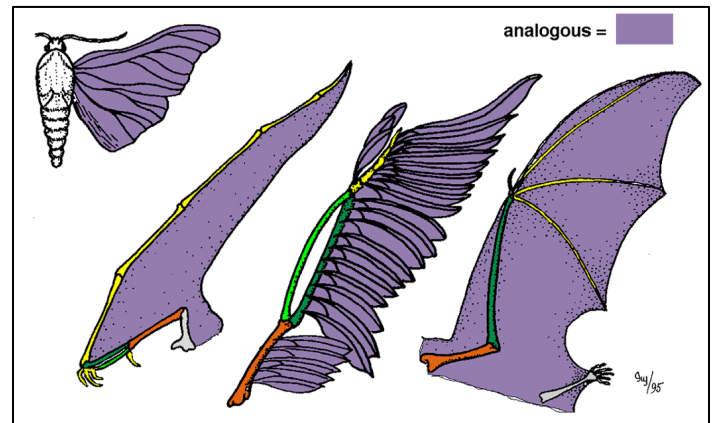
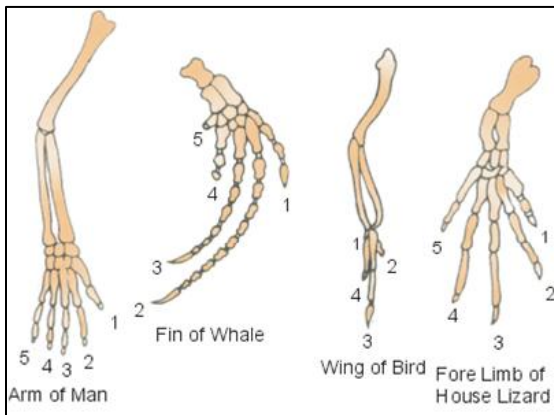


Figure 15.8
Vestigial structures, such as pelvic bones in the baleen whale, are evidence of evolution because they show structural change over time.

- f. Vestigial Organs - Inherited structures that have lost much or all of their original function due to different selection pressures acting on the descendants.
- g. Genetic Data- can confirm what we thought based on morphology, or challenge what we thought...

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Vocabulary Practice

Matching *On the line provided, write the letter of the definition that best matches each term on the left.*

- | | | |
|-------|---------------------------|---|
| _____ | 1. evolution | a. change over time |
| _____ | 2. fossil | b. differences among individuals within a species |
| _____ | 3. natural variation | c. preserved remains of an ancient organism |
| _____ | 4. struggle for existence | d. survival of the fittest |
| _____ | 5. fitness | e. all species are derived from common ancestors |
| _____ | 6. adaptation | f. structures that develop from the same embryonic tissues, but have different mature forms |
| _____ | 7. natural selection | g. ability of an individual to survive and reproduce in a specific environment |
| _____ | 8. common descent | h. organ with little or no function |
| _____ | 9. homologous structures | i. competition for food, space, and other resources among members of a species |
| _____ | 10. vestigial organ | j. inherited characteristic that increases an organism's chance of survival |

1. **A**

2. **C**

3. **B**

4. **I**

5. **G**

6. **J**

7. **D**

8. **E**

9. **F**

10. **H**