

Unit 7: Evolution

Content Outline: History of Darwin's Theory of Evolution (7.1) – Part 1

- I. November 24, 1859 Darwin publishes *On the Origin of Species by Means of Natural Selection*.
 - A. This book deals with the *biodiversity* seen on Earth. It has three main themes:
 1. The similarities and differences that exist among species.
 2. The adaptations that evolved in species in order to survive in an environment.
 3. The geographic distribution of species around the world.
 - B. Ancestry and common ancestors among species are discussed throughout the book; thus helping support Darwin's **Theory of Natural Selection**.
 1. Natural Selection and competition are major driving forces to the evolution of species over time. "Nature" decides what species are able to survive and reproduce within an environment. Those with favorable traits for that environment survive and reproduce; those with unfavorable traits struggle to survive and rarely reproduce. Over time, because of the struggle, the weaker species eventually goes extinct in that environment or moves "migrates" to a different more favorable environment, if possible.

Darwin's Predecessors:

- II. Plato (427 B.C. – 347 B.C.) develops the first attempted organization of nature.
 - A. Plato believes that two distinctly *different worlds* exist based upon the Gods of Olympus and Earth.
 1. There exists the Real and perfect world. (This is the World of the Gods.)
 2. The other that exists is the Illusory and Imperfect world. (This is Earth...you can see birth defects in all species, including man.)
- III. Aristotle (384 B.C. – 322 B.C.) is a student of Plato who modifies Plato's organization.
 - A. He develops the **Scala Naturae**. (It means "scale of nature".)
 1. Aristotle believes that each species has its own "rung" on the "ladder of life".
 2. The species' position is permanent and perfect. (Man is at the top, just below the gods.)
- IV. Carolus Linnaeus (1707 – 1778)
 - A. He is considered the Father of **Taxonomy**. (Taxonomy is the Science of species classification.) There were originally only two Kingdoms in his system: Plantae & Animalia.
 - B. His system uses Binomial Nomenclature. (This term means "Two name Naming system".)
 1. Rules of Binomial Nomenclature:
 - a. The **Genus** name is written *first and has a capitalized first letter*.
 - b. The **Species** name is written *second and is not capitalized*.
 - c. *The whole name is written in Latin and italicized*. (Latin is used because Latin is considered a "dead" language. Therefore, the meaning of words will not change over time.)
 - C. The current levels (called "taxons") of classification.
 1. Domain (This is the *most* inclusive; yet *least* specific taxon.)
 - a. Domains are composed from *similar Kingdoms*.
 2. Kingdoms
 - a. Kingdoms are composed from *similar Phylums or Divisions* (if it is plants).
 3. Phylums or Divisions (plants)
 - a. Phylums or Divisions are composed of *similar Classes*.
 4. Classes
 - a. Classes are composed of *similar Orders*.
 5. Order
 - a. Orders are composed of *similar Families*.
 6. Family
 - a. Families are composed of *similar Genus*.
 7. Genus
 - a. Genus is composed of *similar Species*.
 8. Species (This is the *least* inclusive; yet *most* specific taxon)
 - Breeds is a sub category of species. (Like for dogs, cats, horses, etc.)
 9. Easy way to remember the order of system: **D**ominating **K**ing **P**hillip **C**ame **O**ver **F**or **G**reen **S**alad.

- V. Georges Cuvier (1769 – 1832)
- A. Famous **Paleontologist** (This is someone who studies fossils. “paleo” means “old”; “onto” means “bones”)
 - B. Fossils are mostly found in *Sedimentary* rock, but some are found in plant sap (called Amber... like in the movie *Jurassic Park*.) or ice. Sedimentary rock is mostly formed by being at the *bottom of a body of water* (Such as a lake, swamp, river, or ocean.). When organisms die and settle to the bottom of that body of water, they get covered up by *layers* of sediment (eroded earth). The weight (pressure) of the sediment and water *preserves the organism* in a fossilized state. Without the body of water and sediment in the water, it is very hard to have the process of fossilization occur and this is why we do not have fossils for every species that has ever occurred on earth. Also some are still hidden in the dirt.
 1. Must have water, pressure, and lots of time to create a fossil.
 2. The term “Strata” means “layer”.
 3. We can tell the age of rocks and fossil based on location of the strata. (The oldest layers are on the bottom and the youngest layers are on top.)
 - C. He proposed the **Theory of Catastrophism**. (This theory tries to explain why organisms seem to *suddenly* disappear from existence on earth, such as the extinction of the dinosaurs. Some catastrophic event must have occurred to cause their sudden, in geologic terms, extinction to occur.)
- VI. Jean Baptiste Lamarck (1744 – 1829)
- A. He proposes a theory of evolution in 1809 (the year that Darwin is born) that turns out to be only partially correct. (He got the part about evolution needing long periods of time to occur.)
 - B. His theory is called **Inheritance of Acquired Characteristics by means of use versus disuse** (This will become referred to as Lamarckian Evolution.) This basically states that if an organism uses a body part routinely it must be of importance and therefore that body part will be passed on to the next generation. If an organism does not use a body part, it will disappear over time because it must not be important. (This is the part he got wrong... if it were true, think about body builders with their massive muscles. If it were true, their children would be born with massive muscles, but that is not the case. Also if someone lost a leg, their children should be missing that leg when born, as it was not being “used”.. The change must occur in the DNA of a sperm or egg [gametes] to be passed on to the next generation.)
 - C. Lamarck also makes no mention of the *environment*'s role in evolution. (Which he had wrong too.)

Students should be very familiar with Classification as that is always on tests. They should as understand the scale of inclusion for each taxon as well. Students should be familiar with the individuals names and their contribution. Also that they were important to Darwin developing his theory. Lastly students should understand that classification is just human nature. It makes difficult large concepts easier to understand.

History of Darwin's Theory of Evolution (7.1) – Part 2

- I. Feb. 12, 1809 in Shrewsbury, England Charles Darwin is born. (Same day that Abraham Lincoln was born too.)
 - A. Darwin attends University of Edinburgh at age of 16 to become a doctor. (Like his father and grandfather.)
- II. December 1831
 - A. Darwin has graduated college and instead of entering the seminary, he decides to join Captain Robert Fitzroy on the H.M.S. Beagle as doctor and naturalist of the ship. (All ships at this time were required to have a naturalist onboard in case a new species was found.)
 - B. This journey takes him around the world in five years. (Darwin returns in 1836.)
 - C. Darwin collects plants, animals, and fossils at every stop on this journey and sends them back to England.
- III. 1840 London
 - A. Darwin has a working manuscript on his Theory of Natural Selection.
- IV. 1844
 - A. Darwin's manuscript is completed. He will continue to tinker with it though.
- V. November 24, 1859
 - A. *On the Origin of Species by Means of Natural Selection* is published.
 - B. "Descent with Modification" is used instead of the word "evolution". The word "evolution" is only used once in the whole book and it is the last word in the whole book. Descent indicates that long periods of time are required to bring about the modifications within a species that occur to be better able to survive and reproduce within that environment. "Evolve" just means "to change over time".
- VI. **Natural Selection**
 - A. This theory of Darwin's basically states that in Nature there are *different levels of success* in reproduction based on the ability to survive in that environment. (The differing rates of success act as a "filtering out" effect on "weak" traits.)
 1. "weak" vs. "strong" (*Strong traits* would be *beneficial* in surviving and reproducing; whereas, *weak traits* would *not be beneficial* to reproducing or surviving the harsh characteristics of that environment.)
 - B. *Environmental* stresses affect the success rate of individuals in a population in different ways. (For example, some people work well under pressure and others fail when there is pressure.)
 - C. *Populations evolve not individuals.*
 1. Somatic cells (cells that make up the body) vs. germ cells (the cells of sperm and eggs).
 2. Germ cells are passed on to "create" the next generation of organisms... so the change must occur *in these cells* if it is going to affect the future of the species.
 - D. Life is a *struggle for existence* and "nature" ultimately decides who gets to survive and reproduce and who doesn't by excessive environmental "forces" killing them off.
 - E. This concept came to Darwin in reading Thomas Malthus's *Principles of Populations*
 1. The book basically states that more organisms are born than nature can allow to survive.
 2. Remember, carrying capacity? So "who" chooses... nature... based on the traits an organism possesses. Remember variation is important.

VII. Artificial Selection

- A. This is where *man selects* what traits are desirable (beneficial) in a species.
 1. Plants (Which ones make the best or most fruit or are the most appealing in the yard or garden.)
 2. Domestic animals (Which ones are the most valuable in terms of food or other characteristics.)
- B. Man can "erase" what Nature took thousands of years to "create" (gradualism) by *controlling* which organisms get to reproduce and which don't.
- C. This is not always the best outcome for that environment.

Please make sure students understand the differences between Natural and Artificial selection but also that Darwin's understanding of Artificial helped him develop the Theory of Natural Selection.

VIII. Populations

- A. Four items that define a population:
 1. *Same species* of organism.
 2. In the *same place*.
 3. At the *same time*.
 4. and *showing signs of reproduction*. (Young are visible within the group.)

- IX. Supporting evidence for Common Ancestry among organisms includes:
- A. **Homologous** (means “same”) **Structures** - Examples include skeletal structure, limb structure, or cephalization. (Darwin wrote about these in his book.)
 1. **Vestigial organs** are organs that appear to have been needed in the past, but are slowly disappearing.
 - B. **Embryological Homologies** are seen as common stages of development that embryos go through. (Darwin wrote about these in his book too.)
 - C. **Molecular Homologies** - refers to DNA nucleotide sequences being exact in order and function. (Darwin could not write about these, as they had not been discovered yet.)
 - D. All these homologies parallel the classification taxon levels.

These are important concepts to help see the similarity among all life. These will be helpful when you get to the Biodiversity Unit and are talking about organ systems.

X. **Biogeography**

- A. This is the geographic distribution of species. (Where a species is found, basically.)
- B. **Endemic** –refers to a species that is only found in one place on earth. (Usually refers to organisms on islands.)
- C. **Convergent Evolution**
 1. This term is used for organisms that only visually appear to be to be closely related simply because they evolved in *similar environments* under *similar environmental pressures*. The reality is they maybe distantly related to each other.
 2. **Analogous Structures** have the *same function*. Such as a bat wing (which has bones and muscles) and an insect wing (which doesn't have muscles and bones in it); but they both produce flight.
 - a. Do not confuse with homologous structures
 - b. Homologous *indicates* common ancestry and analogous does not.

- XI. Fossil Evidence* supports the theory of natural selection by displaying common structures between species. The fossil record is incomplete because of the nature of how a fossil is made (only under certain conditions) and the fact that some are still undiscovered in the dirt or at the bottom of some body of water.