Evolution Notes Chapter 16-18

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Charles Darwin

- Born Feb 12 1809
- Country: England
- He developed a scientific theory of biological evolution that explains how modern organisms evolved over time
- Before Darwin, people believed that plants/animals were unchanging and Earth was about 6000 years old.
- In 1831, Darwin left England for the coast of South America aboard the HMS Beagle.
- Darwin was a naturalist and his job was to collect biological and geological specimens during the trip.
- The Galapagos **Islands** are off the coast of South America.
- Organisms on each island differed from organisms on the other islands.
- Darwin noticed that finches were different on each island and were also different from the finches that lived along the coast of South America.
- They must have changed once they reached the islands.
- Darwin hypothesized that a new species could change gradually over time
- In 1859, he published his book On the Origin of Species with 4 main principles of Natural Selection
- He believed that when given enough time, Natural selection could modify a population enough to produce a new species
- Evolution takes place because of natural selection.
- His book showed his evidence of natural selection as the mechanism for evolution.
- Evolution: change over time

Artificial selection: process of breeding (by humans) to produce offspring with desired traits
Examples: dog, horse, cattle, pigeon

If humans could select the traits they preferred in animals…then why couldn't nature do the same to create a new species?

Natural selection: survival of the fittest; the environment picks what lives
Four principles of natural selection:

1. Struggle for existence
   - Organisms will produce more offspring than can survive
   - Must compete for: food, living space, water
2. Variation and Adaptation
   - Organisms have natural variations among themselves
   - Some of those variations make them better suited for life in that environment
   - These variations are called Adaptations
     - This is a trait that increases an organisms ability to survive
     - Example: mimicry, camo, behavior, fur
3. Survival of the fittest
   - The more "suited" the more it will survive and pass on those traits
   - This is called Fitness
     - How well an organism can survive in that environment
     - If environment changes then that organism may not be "suited" for that environment
4. Natural Selection
   - Process by which organisms with variations most suited to their local environment survive and leave more offspring
   - Environment changes then so does that varied trait

Influences from other Scientists

1) **James Hutton and Charles Lyell**
   - Believed that the Earth is extremely old
   - Processes that changed Earth in the ___past___ are the same processes that are changing Earth in the ___present___
     - Examples: ___Mountain building, Volcanoes, Earthquake___
2) **Jean Baptiste Lamarck**
   - Believed that organisms could change during their lifetime by selectively ___using or not using___ various parts of their bodies
     - Organisms could just change the ___shape___ or ___size___ of their organs by using their bodies in certain ways
   - These acquired traits could be passed on to their ___offspring___
3) **Weismann**
   - Proved Lamarck incorrect
   - Took mice and cut off their ___tails___ (the offspring shouldn't have any ___tails___ if Lamarck was correct
4) **Thomas Malthus**
   - Worried about ___human___ populations growing unchecked (out of control)
   - Believed that there would not be enough ___living space___ or ___food___ for everyone
   - This can also be applied to certain animal populations
   - This led to the idea of ___artificial selection___
     - Humans selecting the traits of animals they want
     - Example: ___dogs cattle___

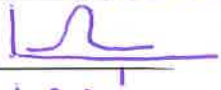
Evidence of Evolution

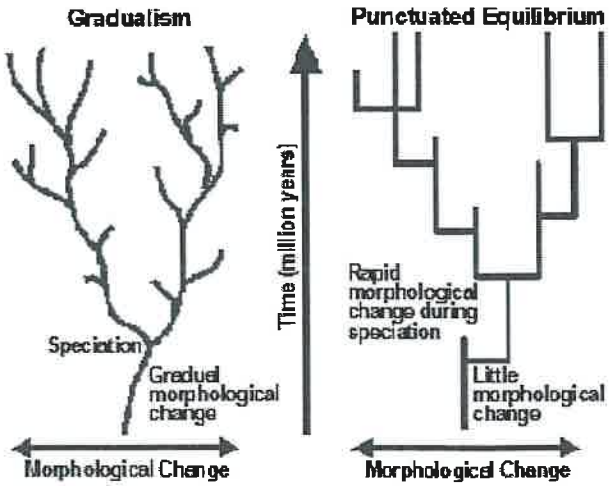
___Common Descent___: all species (living & extinct) are descended from a common ancestor

What proof has been found?

1) ___Homologous structure___
   - A structure that is similar in different species of common ancestry
   - Examples: ___front limb of reptile, bird, human___
2) ___Analogous structure___
   - Body parts that share a common function but NOT structure
   - Examples: ___bird wing & bee wing___
3) ___Vestigial structure___
   - Structure that is inherited from ancestors but has lost most of its function
   - Examples: ___appendix, tailbone, wisdom teeth___
4) ___Embryology___
   - Evolutionary relationships between vertebrates (have a backbone) in the embryo
   - Examples: ___in embro - verebrates are similar (rabbit, pig, turtle, human)___
5) ___Genetics___
   - Comparison of DNA, RNA and Protein Synthesis is very similar among many different species
   - The genetic code is almost universal
   - Examples: ___RNA, DNA sequences___

Genes and Variation

- The more favorable a ___phenotype___ the better suited for the environment and organism is and will then produce more ___offspring___
- Natural selection does ___NOT___ act on ___genes___ but on an entire ___organism___
  - Those favorable will ___survive & reproduce___
  - Those unfavorable will ___die without reproducing___
- ___Gene Pool___ this consists of all the genes that are present in a population
- Evolution involves changes in the frequency of ___alleles___ in a population
- This will increase ___Genetic Variation___ variation
  - 3 types of genetic variation
    - 1) ___mutations___
    - 2) ___meiosis (crossing over)___
    - 3) ___latent gene transfer___
- Some organisms become resistant
  - Farmers that spray ___pesticides___ on insects
    - Some will die but others are ___not___ affected and will then live to reproduce
    - Flu vaccine every year – why? ___flu virus changes___
  - **Directional selection**
    - ___moves to extremes___ 
  - **Stabilizing selection**
    - ___eliminates extreme___ 
  - **Disruptive selection**
    - ___acts against intermediate___ 
- ___Genetic Drift___ a random change in the allele frequency
- ___Bottleneck Effect___ a change in allele frequency due to a dramatic decrease in population
- **Hardy-Weinberg Principle**: In the absence of ___allele___ forces, a population will remain the ___same___.
  - If a population does not ___change___, then it is at genetic ___equilibrium___.
  - This principle states that ___allele___ frequencies in populations should remain constant.
  - Equations $p^2 + 2pq + q^2 =$
- ___Isolation___: when a species has become separated into 2 groups
  - These groups cannot reproduce and their gene pools become changed
  - Different types of isolation
    - ___reproductive___ isolation
    - ___behavioral___ isolation
    - ___geographic___ isolation
- ___Adaptive Radiation___ when 1 species gives rise to many species due to a new habitat
  - Examples: ___Finches___
- ___Co-evolution___ when species evolve in close relationships together
  - Examples: ___flowers + bees___
- Different rates of evolution
  - ___Gradualism___: evolution proceeds in small ___gradual___ steps
  - **Punctuated Equilibrium**: equilibrium interrupted with ___rapid___ change



Chapter 19 History of Life

- Fossils preserved remains from ancient organisms
  - Best if in sedimentary rocks
  - Only the hard parts will remain like bone, teeth, shell
  - paleontogist is the scientist who studies fossils
  - Radiometric dating: a method of determining the age of a rock
  - Half-life: the time required for half of the radioactive atoms to decay
    - Caben-14: 5,730 years
    - Potassium-40: 1.26 billion years
    - Uranium-238: 4.5 billion years
- When studying fossils and living organisms, a single species can show that they have diversified over time
  - Adaptive radiation: process when a species evolve over a short time into several different forms
    - Example: Finches
- Sometimes groups of species evolve in different places or different times but in similar environments
  - convergent evolution: process when unrelated organisms independently evolve similarities when adapting to similar environments
  - Example: mammals
- When species evolve together: co-evolution
  - Example: flower + Bee

Speciation - makes of earth spear)

Important changes in Earth's History

- 4.6 billion earth age
- At first it was a big ball of fiery molten rock
- Then it became to cool (about 4.2 billion years ago)
- This allowed oceans to form
- The atmosphere contained NO oxygen (thus no life yet)
- The atmosphere was composed of CO_2, H_2O vapor, N, CO, H_2S, HCN
- Over time RNA, amino acids began to form
- Around 3.5 billion years ago prokaryotes formed
- Then the ozone layer layer formed
- 1.5 billion years ago- eukaryotes began to evolve
- Life continued to evolve and evolve
- 65 million years ago – dinosaurs became extinct
- 60 million years ago – birds and mammals become the dominant life forms on Earth
- 36 million years ago – animals became Diurnal (active during the day)

Evolution of Humans

- Bipedal: ability to walk upright on 2 legs
- Opposable thumb
  - Gave the ability to grasp, manipulate objects
  - Use to tools
- Diurnal active during the day
- Brains became larger
  - Ability to think in complex terms
  - Form language

Homo Species	Nickname?	Time in fossil record	Characteristics
Homo habilis	handy man	2.4 – 1.4 million years ago	brain 650 cm^3 small brow climb trees flat face long arms
Homo erectus	upright man	1.8 – 400,000 years ago	brain 1000 cm^3 - tools - nose - scavenger - round skull
Homo neanderthalenis	Neanderthals	300,000 – 200,000 years ago	brain 1100 cm^3 short very muscular large ridge brow
Homo sapiens	wise man	195,000 - present	brain = 1350 cm^3 no brow ridge small chin language culture