Cellular Evolution

- The first cells were prokaryotic

- They did not need oxygen (the atmosphere did not contain oxygen until 1.8 billion years ago)

- Eukaryotic cells were found in the fossil record about 2 million years after life first formed

- Eukaryotic cells have complex membranes and organelles

↳ Have nucleus + organelles prokaryotes → no nucleus no organelles

Endosymbiont Theory

- Proposed by Lynn Margulis

** According to the theory, the ancestors of eukaryotic cells lived in association with prokaryotic cells

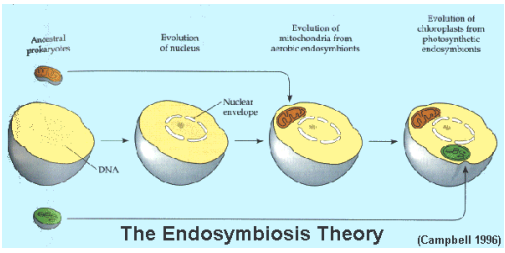
** Prokaryotes may have lived inside eukaryotes

Evidence for the theory

- mitochondria and chloroplasts formed by endosymbiosis

- mitochondria and chloroplasts have their own DNA

- mitochondria and chloroplasts reproduce by fission which is independent from the rest of the cell



Jean Baptiste de Lamarck

- Proposed an mechanism to explain evolution and adaptation of organisms

Lamarck's Process

* Organisms strive to improve themselves and become more advance
  - environment determines what organisms do

- This strive to improve causes used body parts to develop and unused body parts to waste away (Principle of Use and Disuse)

- if you don't use it you lose it

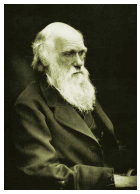
- The modification of a body part is inherited
* (Inheritance of Acquired Characteristics) *

Problems with Lamarck

- Acquired characteristics are not inherited

- Changing your body will not change your offspring

Charles Darwin



- 1809-1882

-Wrote On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life (1859)

- Proposed a mechanism for evolution and provided a wealth of evidence to support it; argued common descent (all organisms are related)

natural selection

HMS

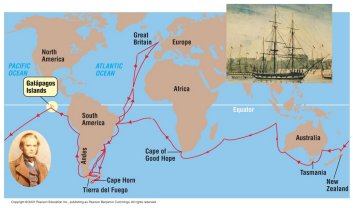
Voyage of the Beagle (1831-1836)

- 5 year voyage around the world.

- Collected specimens (fossils and living).

- Noticed adaptations of organisms and similarities of organisms in certain regions.

- When returned home, began writing on how organisms adapt to environments



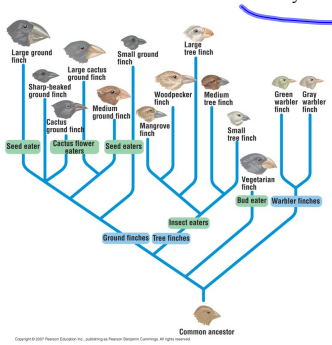
The Origin of Species

- Published in 1859

- Presented two main points

1. Mechanism for evolution - Natural Selection

2. Descent with Modification / Common Ancestry - all life is related



Natural Selection

- Variation exists in a population (because of genotypes).

1. Competition for resources exists.
2. Some variation is favorable (because of phenotypes)- advantages to obtain resources over others.
3. Individuals with favorable variations have a higher chance of surviving and reproducing.
4. Favorable traits (genes) can be passed on.

- Over time, changes in a population accumulate and populations change.

Note: Only populations can evolve over time...individuals can not.

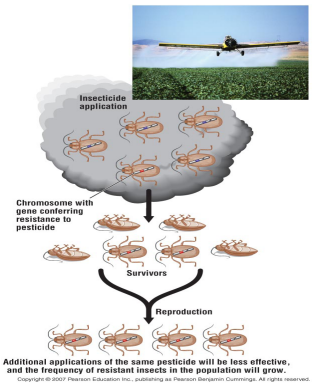
- Environmental pressures determine what variation is fit

- What is fit in one environment may not be fit in another

Examples of Natural Selection and Evolution

Antibiotic Resistance - use of antibiotics has resulted in bacteria that can survive in the presence of the drugs (MRSA - methicillinresistant Staphylococcus aureus).

Pesticide Resistance - insects can survive in the presence of chemicals that normally would kill them.



Types of Selective Pressures

Climate - temperature, sunlight, precipitation, etc.

Predators

Competitors

Invasion of Niches - role in the environment

Extinctions of Other Organisms

Disease

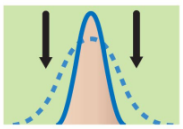
Disasters

Non-Random Mating

Outcomes of Selection

- Stabilizing selection → the population will remain stable (extreme phenotypes at a disadvantage).

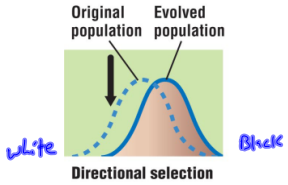
** babies that are above or below normal birth weight



Average has advantage

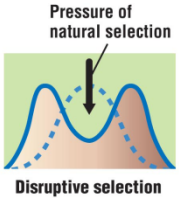
- Directional selection → the population will shift towards a phenotypic extreme.

** England's peppered moths (white wings before industrial revolution and black wings after)



- Disruptive selection → the extremes have the advantage.

** a new predator finds small rabbits as not enough food and large rabbits as too hard to catch



Average is at disadvantage

Evidence of Evolution

1. Fossil Record

- a fossil is any evidence of a once living thing

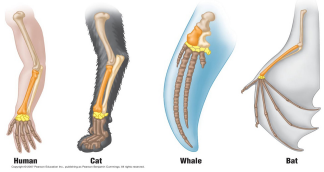
- older rocks have fossils of simple organisms while younger rocks show more complex organisms

2. Comparative Anatomy

- similarities or differences in the anatomy or structure of organisms

1. *Homologous structures* - structures inherited from a common ancestor

- "same structure, different function"



2. *Analogous structures* - structures inherited from different ancestors

- "same function, different structure"

3. *Vestigial structures* - structures that have been inherited from a common ancestor, but no longer have any purpose or function

ex. Appendix, tail bone

Comparative Embryology - closely related organisms move through similar developmental stages.

- suggests that vertebrates evolved from a common ancestor

3. Comparative Biochemistry - similarities in genetic code, similar amino acid sequences

- all organisms are composed of same essential elements (C,H,O,P,N)
- all organisms share the same 4 DNA bases (A, G, C, T)
- all organisms share the same 20 amino acids used to make protein
- the whole process of protein synthesis is the same among all organisms

DNA → RNA → protein

Biogeography - the geographical distribution of species; species are found where they are because they evolved from ancestors that inhabited that region

ex. Australia is home to many marsupial (pouched) mammals, but very few placental mammals

Madagascar is the only place where certain animals, such as lemur are found

Mechanisms of Evolution - HOW Evolution occurs

- Evolution will NOT occur in a population unless something happens to change the allele frequency of the population

the # of dominant and recessive alleles

- The total # of alleles in a population is called the gene pool

Genetic drift - changes in allele frequencies of a population

→ leads to evolution

In order for NO EVOLUTION to occur the following conditions must all be followed at the same time in a population

1. No Mutations
2. Mating is random - all traits are equal in attractiveness
3. No immigration or emigration
4. Large Population
5. Natural Selection does not occur - all variations are equal in favorability

3 NO's 2 others

What causes Evolution

1. Mutations - create new traits or variations

- these new traits may be more or less favorable to surviving withing the environment. The ability to survive is key to passing on traits

2. Non-Random Mating - when one trait becomes more attractive than another, that trait will be passed on at a higher rate than the unattractive trait leading to a change in allele frequency

Attractive vs. Unattractive

3. Gene Flow - when traits are gained or lost through immigration or emmigration

move in → / move out

* *Geographic isolation* - populations are separated by rivers, mountains, etc.

* *Reproductive isolation* - similar populations cannot reproduce with one another

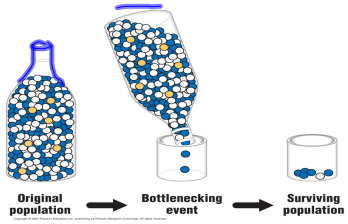
4. Change in Size of the population

Founder effect - when small populations separate from large populations

- alleles that were uncommon in the large population may now become common in the smaller population

ex. Amish and Menonite populations

Bottleneck effect - a sudden reduction in population size followed by a rebound



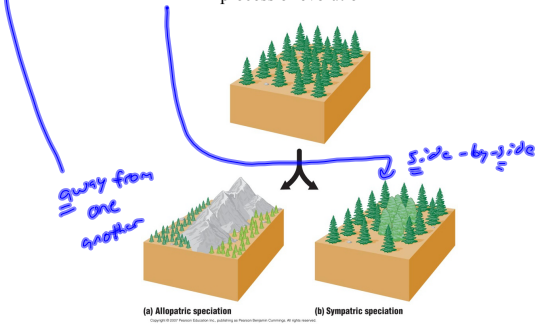
5. Natural Selection - stabilizing, directional, and disruptive selection

Speciation

The evolution of one or more new species from a parent species. This occurs when one population evolves into new populations that are unable to interbreed. Caused by environmental conditions and geographic or reproductive barriers

2 types of Speciation

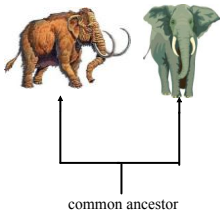
1. *Allopatric speciation* - physical barrier divides on population into two
2. *Sympatric speciation* - the new species live side by side during the process of evolution



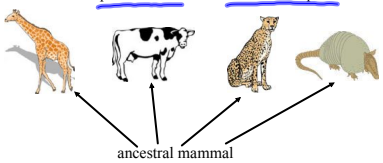
Types of Evolution

1. Divergent evolution - occurs when populations changes as they adapt to different environmental conditions (isolation)

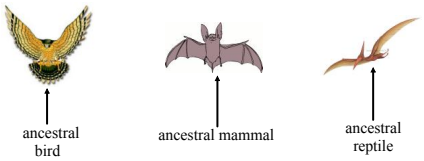
ex. Elephants and Wooly Mammoths



2. Adaptive Radiation - a type of divergent evolution where one ancestral species evolves into several new species



3. Convergent Evolution - when unrelated species occupy roles in their environments and thus evolve similar variations and traits

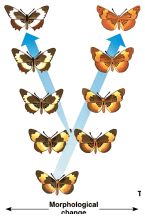


4. Coevolution - when changes in one species cause changes in another species

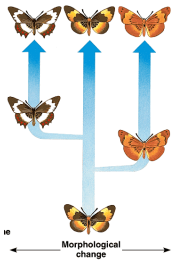
ex. antibiotic resistance

Rates of Speciation

Gradualism - the idea that evolution occurs at a slow and steady rate with small adaptive changes accumulating over time



Punctuated Equilibrium - the idea that evolution occurs in rapid bursts or change with long periods of no change in between



Attachments

Jeopardy1.ppt