



Biology 3201 Unit 4 Evolution
Ch. 19 - Introducing Evolution (part 1)

What is Evolution?

- Evolution: the relative change in the characteristics of a population over successive generations
- A population is the smallest unit that can evolve
- Any shift in a gene pool is also called evolution

How do characteristics change?

- The characteristics of a population change over time with the help of adaptations and variations
- Adaptation: a particular structure, physiology, or behavior that helps an organism survive and reproduce in a particular environment (ex. Camouflage, excellent sense of smell, hearing, vision, etc)
- Variation: a significant deviation from the normal biological form, function or structure.

The peppered moth: A case of natural selection and adaptation

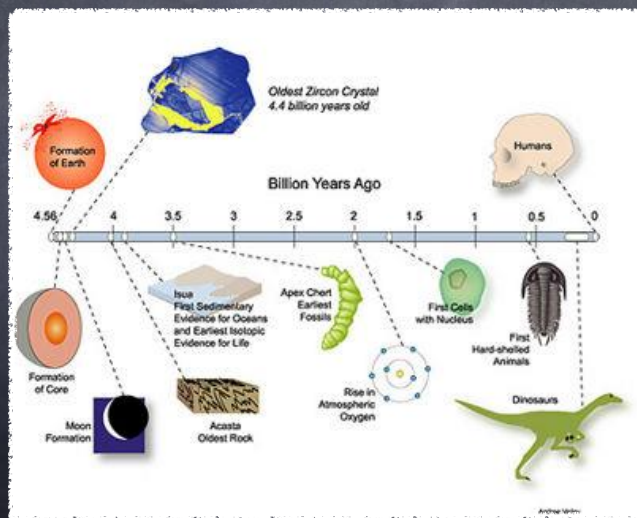
- The peppered moth occurs in two variations: flecked and black. They live and feed on birch trees in England (white bark)
- Before the 1900's, flecked moths had an advantage as they were harder to see against the white background of the trees. Predators would eat the black ones as they are easier to see.
- During the Industrial Revolution, pollution from factories turned the white trees black. The flecked moths were now easier to see so they began to be eaten by predators. As a result, the population of the black moths went up.
- In the mid 1950's, England began reversing the environmental damage and the trees turned white again. The population of white moths is increasing again.



Summary: the peppered moth and evolution

- 1) In the early 1850's moths in England were mostly flecked (some were white). Flecked ones survived because they were camouflaged.
- 2) By the 1900's air pollution made the trees black. Black moths were able to survive.
- 3) 1950's saw pollution controls and now the flecked moth is surviving again
- Natural selection is the process by which the characteristics of a population changes because individuals with certain heritable traits survive local environments and pass their traits to their offspring

A timeline of Evolution



Natural and artificial selection - mechanisms of evolutions

- Natural selection: the process whereby the characteristics of a population change because individuals with certain heritable traits survive local environments and pass their traits to their offspring
- The environmental conditions determine which individuals in a population are most fit to survive
- Genes from the surviving individuals are passed on to their offspring
- Fitness: a measure of how well an organism fits with the environment
- An organism that is said to be "fit" is well suited to the current environment and most likely will survive

Artificial selection

- This is the human selection of particular traits by breeding
- Human activity determines which individuals in a population have the desired traits to be passed on to the next generation
- Ex. Breeding dogs, breeding horses to produce the fastest possible horse, etc
- Not all breeding (artificial selection) brings positive results (ex. Pekinese and British Bulldogs are bred for flat faces, but this causes respiratory problems)

Historical contributions to evolutionary thought

- Our ideas on evolution have been shaped by many people throughout the course of history.
- 1) Greek philosophers
 - Philosophers such as Aristotle and Plato did not believe in evolution. They said that all organisms which could exist were already created

Historical contributions to evolutionary thought

- 2) George Cuvier (1769-1832)
 - Said to be the founder of paleontology
 - Opposed evolution
 - Studied the fossil record and noted that something was causing species to appear and disappear
 - Developed the idea of Catastrophism (idea that catastrophes account for the disappearance and appearance of species within the fossil record)

Historical contributions to evolutionary thought

- 3) James Lyell (1797-1875)
 - Expanded on Hutton's idea of Gradualism (idea that Earth's geological features are in a state of slow and continual change)
 - Lyell developed the theory of Uniformitarianism (idea that geological processes operate at the same rate today as they always did.)
 - Lyell did not believe in Catastrophism
 - Lyell said the Earth was millions of years old

Historical contributions to evolutionary thought

- 4) Thomas Malthus (1789)
 - An economist
 - Looked at populations. He studied animals and plants and noted that they often outgrow their food supply
 - Rapid growth such as this causes starvation and disease causing a reduction in population
 - Crowding and struggle for survival (competition for resources) is what keeps populations from exploding
 - Darwin borrowed Malthus' ideas on "struggle for survival" and realized that those organisms with the "best" traits for survival would pass on their genes

Historical contributions to evolutionary thought

- 5) Jean Baptiste Lamarck (1744-1829)
 - Published a theory of evolution in 1809 (year Charles Darwin was born)
 - Believed that organisms came from non living sources
 - Said that organisms respond to "needs in the environment"

Historical contributions to evolutionary thought

- Lamarck cont....
 - Proposed the idea that body parts used extensively to cope in the environment would become stronger and stronger (Idea of use and disuse)
 - Ex. Biceps of blacksmith, giraffes neck
 - Modifications acquired during a lifetime can be passed on to offspring. This was known as his theory of inheritance of acquired characteristics
 - Ex. A child would be strong because their dad was a weightlifter; a person who accidentally lost a finger would produce offspring with nine fingers

Historical contributions to evolutionary thought

- 6) Alfred Russell Wallace
 - British naturalist who did studies on a group of islands in Indonesia
 - Created the same theory as Darwin's theory of Natural Selection

Historical contributions to evolutionary thought

- 7) Charles Darwin
 - Wrote the book "On the Origin of Species" in 1859 in which he published his theory of evolutions
 - Did studies of Finch birds on the Galapagos islands
 - His theory of "Descent with modification" had two main ideas:
 1. Present life forms have arisen by descent and modification from an ancestral species
 2. Natural selection is the mechanism of modification over long periods of time

Darwin's theory of natural selection - main points

1. Organisms produce more offspring that can survive
2. Competition for limited resources causes a struggle to survive
3. Individuals in a population can have variations that are heritable (can be passed on to offspring)
4. Only the organisms best suited to their local environment survive to produce offspring (idea that the environment determines who survive)
5. Change is slow and gradual

Limitations of Darwin's original theory

- Darwin was unable to explain how the "best" traits are inherited by offspring. Why? Darwin knew nothing about Mendel's work and mutations which provides genetic variations within a population.
- Mendel's work supported Darwin's ideas.

The Modern Theory of Evolution or Modern Synthesis

- This is the theory of evolution commonly accepted today
 - A "meshing" of Mendel's and Darwin's ideas
 - Darwin says that variations exist in a population allowing certain organisms to adapt to their environment. These traits can be passed on to offspring
 - Mendel points out that mutation is the cause of variation within a population and it is the DNA that helps carry these "best" traits onto the next generation.