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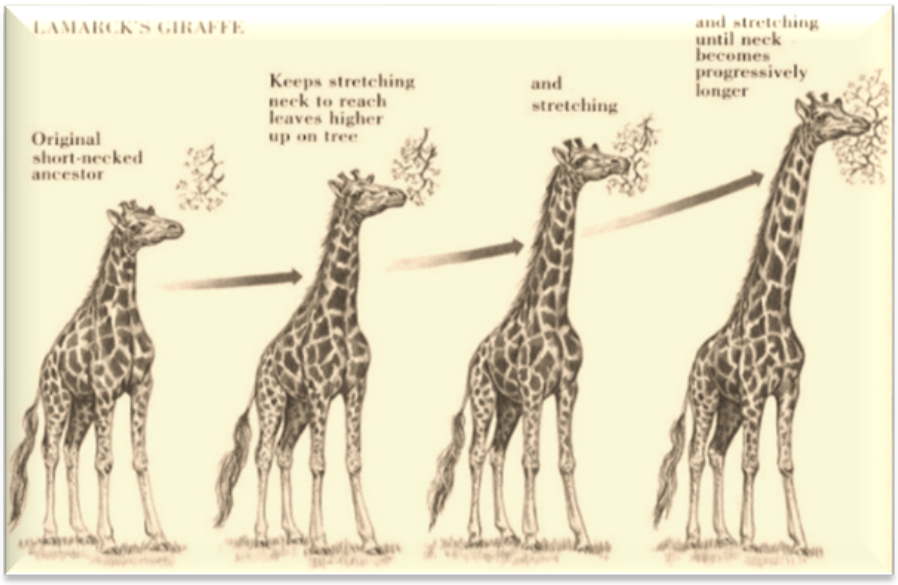


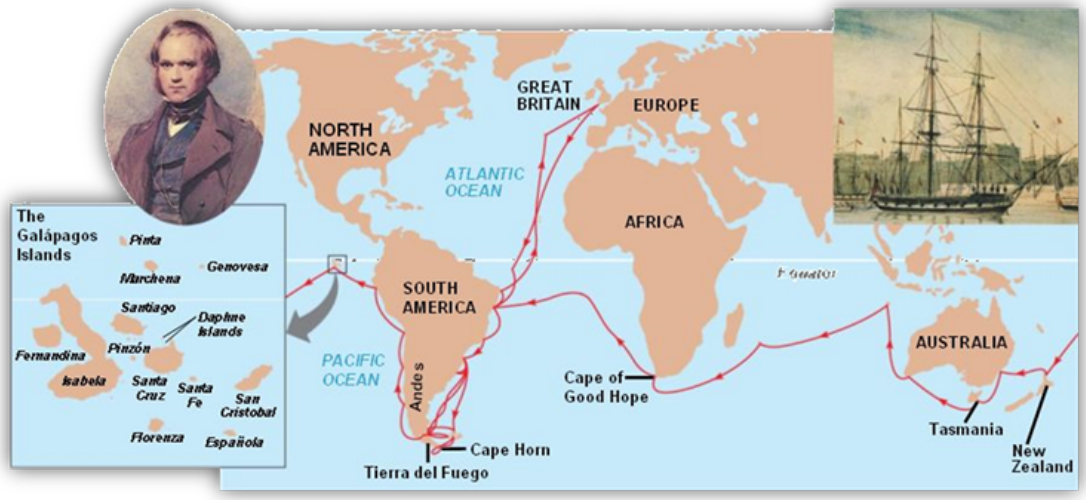
EVOLUTION

Evolution is the process by which species may change over a long period of time. Throughout history, scientists have known that living things evolve to survive. However, it wasn't completely understood how the process of evolution occurs, as there was no clear evidence and no strong theory to explain evolution. Charles Darwin eventually figured out an explanation of how living things evolve and he provided evidence for his new idea of evolution. Darwin was not the first to come up with the idea that evolution happens, but he was the first to provide evidence to support the idea convincingly.

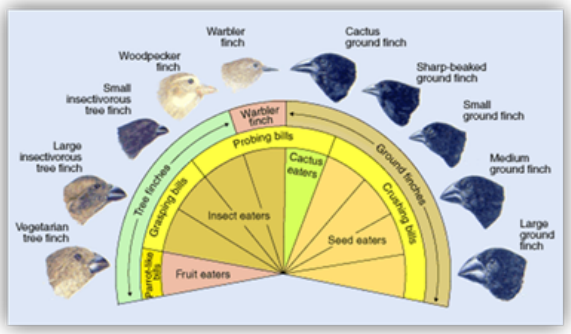
Charles Darwin

Charles Darwin was an English naturalist as he studied nature and the diversity of life within it. In 1859, Charles Darwin announced his theory of evolution called **Natural Selection**. Darwin's theory of *natural selection* which explains the evolution of living organisms, required evidence and a thorough and complete explanation of how and why organisms change over time.

In 1831, Darwin traveled, for approximately 5 years, aboard a ship called the *HMS Beagle*. The *Beagle* made the voyage from Europe, through the Atlantic Ocean, around South America, across the Pacific Ocean, along Australia, and back to Europe around Africa. While going around South America, Darwin collected fossils of extinct armadillos. The fossils were similar, but not identical to the living armadillos of that area. On the west side of South America, the Beagle made a stop at the Galapagos Islands. These islands greatly helped Darwin in his development of the theory of *natural selection*.



Darwin collected many different types of finches (birds). All of the finches he collected were very similar, but there were distinct differences in the birds' beak size and shape. The beaks were adapted to that particular finch's type of food. Furthermore, Darwin noticed that many of the organisms on the islands were similar but not identical to the organisms he found in South America. Upon that discovery, Darwin stated that the Galapagos Island organisms had descended from organisms that came from South America. As with the finches Darwin collected, he suggested that all of the finches on the islands descended from one finch species that migrated from South America. Then, with time, the finch species' beaks began to modify based on their food source. Darwin called this process "*Descent with Modification*".

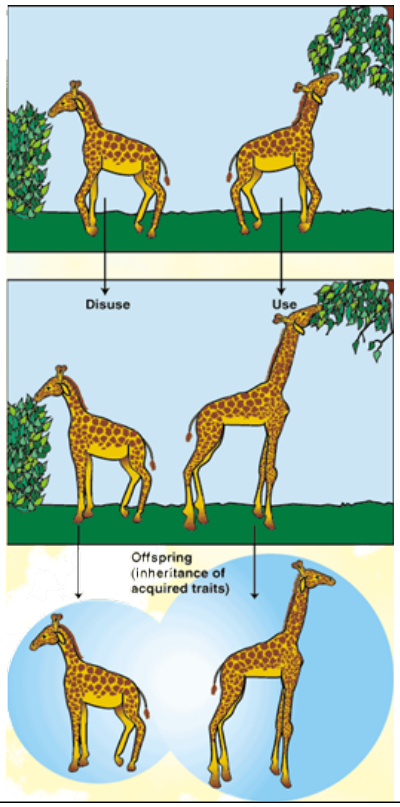


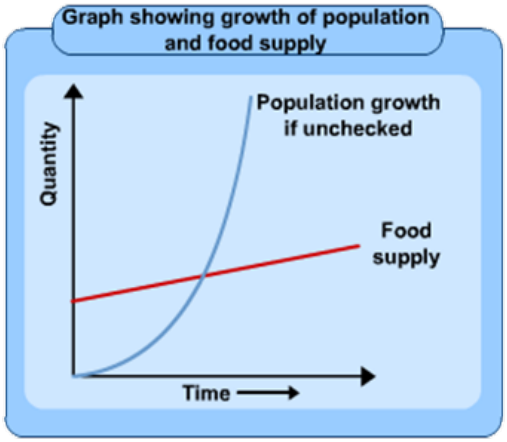
Darwin also studied the popular practice, in Europe, of breeding exotic pigeons. He also began to study the breeding of other plants and animals. Within these studies, breeders take advantage of variations in traits to obtain offspring with the desired traits. Darwin realized through this type of breeding, called *artificial selection*, traits can be inherited. (Remember, this is the mid-1800s and Gregor Mendel's work with pea plants and heredity was not discovered yet.) *Artificial selection* is the selection of traits for offspring performed by humans not nature.

After returning from his voyage, Darwin spent years studying his data and formulating his explanation. He did not report his ideas about evolution until a time much later in his life. He struggled with his ideas of evolution, because of public opinion and how controversial his new idea would be to society. In Darwin's time, many people did not believe that organisms changed over time. Public opinion was solely based on biblical beliefs. They believed living things were, at that time, the same as they always were, and Earth was the same as it always was and that both never changed. For Darwin to come forth with his theory of evolution would go straight against public belief, which may have possibly destroyed his professional life and lead to a life of continuous public criticism.

Contributions to Darwin's Theory	
Lamarck In 1809, Jean Baptiste Lamarck developed an explanation for evolution. Lamarck shared	

many of the same ideas as Charles Darwin, such as organisms are well adapted to their environment, and that organisms change over time as they adapt to changing environments. One other idea that Lamarck believed that Darwin initially accepted was that the use or disuse of a trait would be passed to offspring. For example, Lamarck believed that giraffes kept stretching their necks higher and higher to eat leaves high up in the tree. As the giraffes continued to stretch their neck, generation after generation, that the offspring of each generation continued to inherit longer and longer necks. Keep in mind that Lamarck also stated that the disuse of a trait would have it shrink away, generation after generation. This concept of Lamarck's theory of evolution was disproved and later rejected by Darwin.





Malthus

In 1838, Thomas Malthus, an economist, helped Darwin form his theory of natural selection. In 1798, Malthus made a connection between the food supply and the human population. He observed the food supply increasing linearly, as more food was being produced each year, and the human population growing exponentially. Malthus concluded that not all humans can survive in this way, because many humans would die from food shortage, war, and disease. Darwin applied this idea to his theory. Darwin stated that organisms tend to produce more offspring than can survive and that the environment limits the species types in a population. This is the basis of his theory of *natural selection*.

Cuvier, Hutton, and Lyell

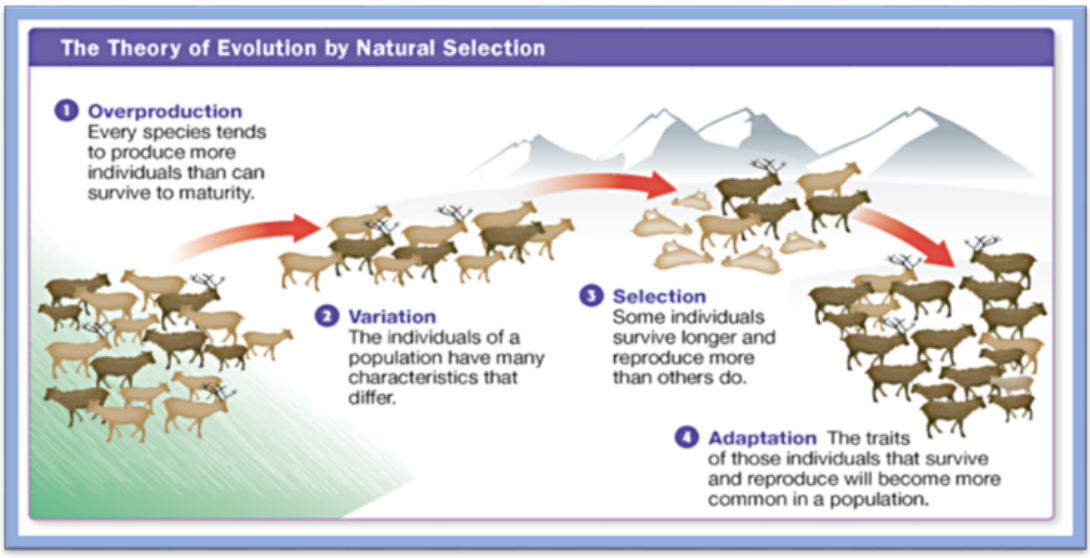
Georges Cuvier was a paleontologist that helped Darwin by explaining how the deeper a fossil remain was found in rock strata (layers), the more different it was from the similar species living in the present. James Hutton and Charles Lyell were geologists that developed the idea of uniformitarianism. *Uniformitarianism* basically states that current geologic processes occur at the same gradual rate and in the same gradual manner as geologic processes of the past. Darwin used this idea to help explain the changes in species over time, saying that these species'

changes took place gradually over long periods of time from generation to generation. ***[It should be noted that the opposite of uniformitarianism is catastrophism. Catastrophism is the theory that sudden, quick, and violent events occurred in Earth's past, changing Earth's crust. Catastrophism has been proven with events such as large volcanic eruptions which result in quick, sudden changes to Earth's geology.]***	

Natural Selection

Charles Darwin used all that he learned from his voyage on the Beagle and from all of the scientists before him to develop his theory of evolution known as *Natural Selection*. In 1859, Darwin published a book of his theory explanation and evidences entitled On the Origin of Species by Means of Natural Selection. *Natural Selection* focuses on one key idea that all offspring have the potential to survive and reproduce, but not all will survive and reproduce because of their environment. The emphasis is on being able to survive and reproduce.

The need to evolve arises from the environment presenting challenges that the species needs to overcome in order to survive and reproduce, such as a body of water formation, sunlight disappearance, or interaction changes. For example, if sunlight exposure on plants is suddenly limited, over time, only plants which require little light exposure will survive and reproduce.



The four overall steps of *Natural Selection* are as follows.

1. **Overproduction:** Every population is capable of producing more offspring than can possibly survive. When we use the term survive with Natural Selection, it refers to the ability to survive to maturity and have the ability to reproduce.
2. **Variation:** Within every offspring population there are many offspring of great diversity in the form of inherited traits.
3. **Selection:** The environment, or nature, chooses which offspring will survive and reproduce. Certain characteristics of the environment require certain characteristics of the organisms in order for the organisms to survive and reproduce. With all of the different types of offspring from step 2, some will have the necessary

traits to survive in a particular environment and some will not have the necessary traits to survive and reproduce.

4. **Adaptation:** Over long periods of time and several generations those traits that allowed a species to survive and reproduce will become more and more common within the population. Adaptation does not occur within a single organism, it occurs within a species or population.

The important ideas to remember about natural selection as a theory of evolution is that it is a slow gradual process, it occurs in species or populations and not individuals, and the goal of it is to survive and reproduce.

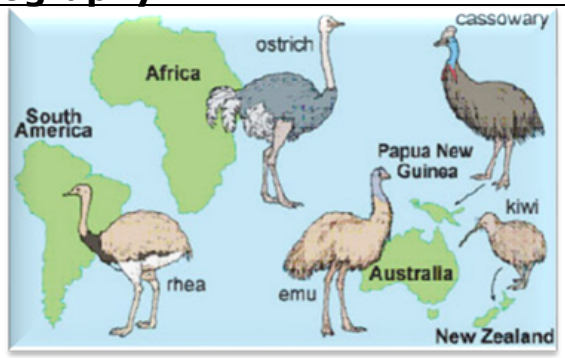
Darwin's Evidence

Fossil Record

A fossil is a trace of an organism that lived in the past. Comparing fossils and living organisms may present a pattern of gradual change within a species over a long period of time.

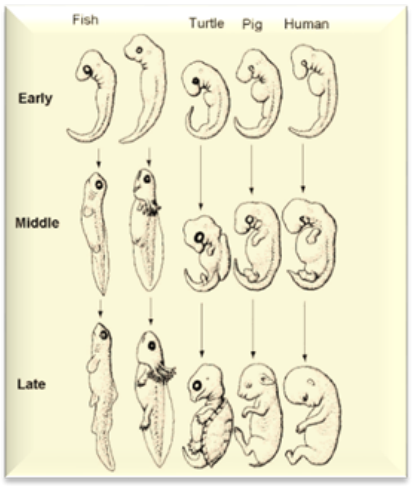
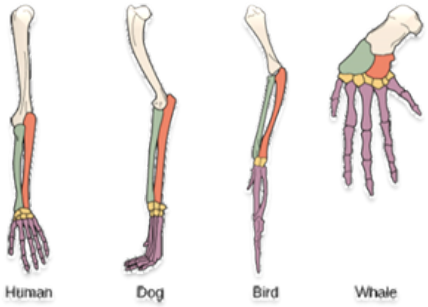
Biogeography

Biogeography is the study of the locations of organisms around the world. Sometimes, separated landmasses were once connected together. While connected together, one particular species may have lived on that landmass. When the landmass separates, the one original species then needs to evolve and adapt to the new conditions on each of the new landmasses. Examining the movement of landmasses can help explain similarities in living organisms and fossils.



Developmental Biology

Embryology is the study of development by way of embryo formation and development. Completing comparison studies of embryos can identify similar patterns and structures which can be used to show relationships among different species that may have evolved from one common ancestor.

	
Anatomy	
Anatomy is the study of bodily structure. Identifying similar bodily structures (homologous structures) among different species may help to discover a common ancestor of the different species in question.	
Biochemistry	
Biochemistry refers to the chemistry of a living organism, as in nucleotide sequences or amino acid sequences. Identifying similarities in the specific biochemistry of a group of organisms, may show a relationship among the organisms in question.	

Species	Sequence of Amino Acids in the Same Part of the Hemoglobin Molecules
Human	Lys–Glu–His–Iso
Horse	Arg–Lys–His–Lys
Gorilla	Lys–Glu–His–Lys
Chimpanzee	Lys–Glu–His–Iso
Zebra	Arg–Lys–His–Arg

Microevolution and Macroevolution

The basis of Charles Darwin's theory of natural selection has withstood the test of time, however, it was missing one essential element. Darwin's theory did not discuss the genetics of evolution, because it was not known of at the time of his theory development. When Gregor Mendel's laws of heredity were made known, this allowed new studies into Darwin's theory in the attempt to update it. The updated version of natural selection, by primarily adding genetics, is called the *Modern Synthesis of Evolutionary Theory*.

Evolution can be studied between two scales: microevolution and macroevolution. The link between the two scales is speciation.

Speciation
Speciation is the formation of new species and is the link between microevolution and macroevolution. Speciation can be seen as a process of genetic change or as a pattern of change in the form of organisms.
Microevolution

Microevolution focuses on how inherited traits change over time in a population, focusing on the kinds of genes that will exists in a population over several generations.	
Natural Selection	As you have already learned throughout this unit, can cause an increase or decrease in a particular allele in a population.
Migration	The movement of individuals into, out of, or between populations. Migration can change the number and types of alleles in a population.
Mate Choice	If mating is random, there will be great variation is the alleles of the offspring. If mating is limited or selective, then there will be a limited set of alleles in the offspring.
Mutation	Mutations are rare, but can cause a change in the number and type of alleles from one generation to the next.
Genetic Drift	Random events of everyday life can cause adaptations which result in some alleles becoming more or less common in a population.
Macroevolution	
Macroevolution focuses on how new species evolve, in terms of direction, diversity, or speed of change.	
Convergent Evolution	Different species living in the same environment evolve similar adaptations and become more and more alike.
Coevolution	Two species, living in close association or interaction, evolve together or one species evolves as a result of their counterpart evolving.
Adaptive Radiation	One species splits into two or more species which then can result in those new species splitting further. A line of descendants is called a lineage.
Extinction	All of the members of a lineage die off. The particular species is gone from existence forever.
Gradualism	Small gradual changes in species that occur over a long period of time.
Punctuated Equilibrium	Quick and sudden evolution of a species after a long period of species stability, when there was never a need to evolve. Some environmental change occurred, creating a new pressure for the species and forcing the species to quickly evolve.

Unit 33 Worksheet Evolution

UNIT VOCABULARY REVIEW

Click card to see term

The study of bodily structure.

View this study set

Choose a Study Mode