**CHAPTERS 17-19**: **CREATION AND EVOLUTION**

**A) CREATION MODEL**

* Origins model that relies on God’s inerrant Word, in which an all-powerful God created the universe and everything in it (out of nothing), by simply speaking the words, for a specific purpose
* Genesis 1: 1-5
* Most Creationists agree that:
	+ God created everything in 6 literal, 24 hour days
	+ The age of the earth is about 6,000 years old (after reviewing the genealogies in Genesis 5 and 11)
	+ All living creatures formed instantaneously, fully functional, and genetically perfect when God spoke the words
	+ Noah’s Flood was a truly global event in which the entire earth was covered with water for about a year
	+ This event happened about 4,500 years ago
	+ This event dramatically changed the surface of the earth
	+ Most fossils were formed during this event
* There are many **“Nonliteral Interpretations of Creation”**.

**B) EVOLUTION MODEL**

* According to this model:
	+ All life is on earth **by chance**
	+ All life originated as a single-celled prokaryote, from non-living chemicals, about **3.5 billions of years** ago
	+ That over many billions of years, “less complex” prokaryotes have acquired new traits, by chance (**Naturalism**), and changed into new “more complex” eukaryotic organisms
* Creationists call this model **“amoeba to man”** or **“particle to person”** evolution
* Naturalists (evolutionists) believe that nature, and nature alone, has shaped the way life has originated and evolved on the planet
* This same process occurred many times over so that “less complex” organisms **gained new traits**, which caused them to transform into previously nonexistent types of “more complex” organisms (**fish 🡪 amphibian 🡪 reptile 🡪 birds and mammals**)
* This occurred via the completely **random processes** that drive evolution
* The foundation of this model was laid down in **1859** by **Charles Darwin** when he published his book **“On the Origin of Species”**

**C) INTELLIGENT DESIGN MOVEMENT (ID)**

* Loosely organized scientific effort between Christians and secular scientists to promote the concept of **intelligent design** in order to publicize the multiple scientific problems with evolution
* **Intelligent Design** = Because life displays properties of a designed system, an intelligent designer is responsible for the origin of life
* This movement believes that the random and purposeless processes of evolution do not explain the origin of life
* For the Christian, God is the Intelligent Designer
* But a belief in ID doesn’t automatically mean a belief that God is the intelligent designer
* **IRREDUCIBLE COMPLEXITY**
	+ A single system composed of several well matched, interacting parts that contribute to the basic function
	+ The removal of any one of the parts causes the system to effectively cease functioning

**D) ORIGIN OF LIFE (EVOLUTIONIST):**

* **BIG BANG**
	+ 15-20 billion years ago all of the matter in the universe was drawn together in an infinitely hot and dense mass.
	+ There was an explosion of cosmic proportions which caused all the units of matter to move away from one another at very fast speeds.
	+ As the matter moved, it formed galaxies, solar systems, stars, and asteroids over a few billion years.
	+ Earth started as a hot and barren rock about 5 billion years ago.
* **From Chemicals to Cells:**
	+ Scientists hypothesize that chemical and physical processes on early Earth could have produced very simple cells through a sequence of 4 main stages:
		1. Abiotic or nonliving synthesis of **small, organic molecules**, such as amino acids or nucleotides in a watery environment (“soup”).
		2. The joining of these small molecules into **macromolecules**, including proteins and nucleic acids.
		3. The packaging of these molecules into “**protocells**”, droplets with membranes that maintained an internal chemistry different from that of their surroundings.
		4. The origin of **self-replicating molecules (RNA)** that eventually made inheritance possible.
* **Simple Organic Molecules:**
* **Primordial Soup Hypothesis:**
	+ Suggested by **Oparin and Haldane** in the 1920s
	+ Earth’s early atmosphere had a mix of certain gases (CO2, Water, Nitrogen, CO, Hydrogen Sulfide, Hydrogen Cyanide, NO OXYGEN) that reacted in the early **oceans** using **sunlight and lightning** as energy sources to form organic molecules that were the precursors of life
* “Demonstrated” by **Miller and Urey** (1953)
	+ They built a glass apparatus to simulate the early Earth conditions proposed by Oparin
	+ The resulting mixture contained a variety of organic compounds including amino acids
	+ **“New Evidence”:**
		- It is currently thought that the first organic compounds were formed around **deep-sea hydrothermal vents** where conditions favor the complex reactions needed to form organic compounds.
		- The vent regions are rich in inorganic **sulfur and iron** compounds and conditions there might favor the production of organic compounds.
* **Proteins and Genetic Code:**
* Amino acids and nucleotides may have formed proteins and nucleic acids on **hot clay surfaces,** which would had been common sediment in early oceans
* **RNA World Theory:** proposes that RNA preceded formation of the first cells. Why?
	+ RNA stores genetic information
	+ Uses this information to make proteins
	+ It can duplicate on its own
	+ It has enzymatic functions (**Ribozymes**)
* Phospholipid membranes may have formed boundaries around proteins and nucleic acids forming “**protocells**” (cell precursors)
* **First Cells:**
* **Prokaryotes** were first cells, including **photosynthetic bacteria**
* During photosynthesis, bacteria produced **oxygen** that started accumulating in the atmosphere
* The rise of Oxygen helped other life forms to appear
* The first **Eukaryotes** came from prokaryotes that began to develop internal cell membranes
* **Endosymbiotic Theory:** explains the origin of **chloroplasts and mitochondria**
	+ Small bacteria would enter larger prokaryotes
	+ Instead of being digested, the small bacteria lived inside the host and functioned like specialized organelles…
	+ Such as **Mitochondria and Chloroplasts**

**E) FOSSILS AND THE GEOLOGICAL TIME SCALE**

* **Fossil Record**
* According to evolutionists the earliest clues about life on earth date to about **3.5 billion years ago**
* **Fossils** are the remains of a previously-living life form.
* Main kinds of Fossils are: (See PPT)
	+ 1. Trace:
		2. Molds and Casts:
		3. Replacement:
		4. Petrified:
		5. Amber:
		6. Original Material:
* There is a rich diversity of fossils, but the fossil record is like a book with many missing pages.
* More than 99% of the species that have ever lived are now extinct, but only a tiny percentage of these organisms are preserved as fossils
* Most organisms decompose before they have a chance to become fossilized
* Only those that are **buried rapidly in sediment** are preserved
* This occurs more frequently with organisms **living in water** because the sediment is constantly settling, covering, and preserving the remains of organisms
* **The Fossil Record documents the History of Life (According to Evolutionists)**
	+ It shows that there have been great changes in the kinds of organisms that dominated life on Earth at different points in time.

* + Many of the organisms of the past were unlike today’s organisms.
	+ Many of the organisms that were once common on Earth are now extinct.
	+ Fossils show how new groups of organisms arose from previously existing ones.
	+ The Fossil Record is an **Incomplete Record:**
		1. Many organisms of the past did not die in the right place at the right time to be preserved as fossils.
		2. Many organisms of the past did not die in the right place at the right time to be preserved as fossils.
		3. Only a fraction of the fossils have been found.
	+ As a result and according to evolutionists, the known fossil record is biased in favor of species that:
		1. Existed for a long period of time.
		2. Were abundant and widespread in certain environments.
		3. Had hard shells, skeletons or other structures that can be fossilized.
* **Fossil Formation**
* Nearly all Fossils are formed in **Sedimentary Rock** through the following process:
	1. Organism dies and is buried in sediments
	2. Sediments build up until they cover the organisms remains
	3. In some cases, minerals replace the organic matter or fill the empty pore spaces of the organism
	4. In other cases, the organism decays, leaving behind an impression of its body
	5. Sediments eventually harden into rock
* **Paleontologist** = scientist who studies fossils
* **Dating Fossils**

**A) Relative Dating:**

* 1. Method used to determine the age of rocks by comparing them with those in other younger and older layers
	2. Based on the **Law of Superposition:**
		+ Rock layers are deposited with the youngest undisturbed layers on top
		+ Fossils are found within these layers
* **Do currently observed processes support slow or rapid fossil formation?**
	+ - Evolutionists believe that fossils are formed slowly over time as they are slowly covered in bodies of water.
		- In order for life to have taken billions of years to evolve, slow fossil formation is necessary.
		- **The Law of Superposition** makes sense if rock layers forms slowly over time.
		- Currently observed processes do not support the fact that fossils are formed by being slowly covered by silt over hundreds to thousands of years
		- Creationists believe that the majority of fossils were formed rapidly, such as would occur during violent flooding conditions of Noah’s time.
		- Creationists believe that rapid fossil formation is a better explanation for how fossils form because of recent observations:
			* Sedimentation studies indicate that strata can be formed rapidly. (Mt. St. Helens Eruption - 1980)

**B) Radiometric Dating:**

* Uses the **decay of radioactive isotopes** to measure the **age of** a rock
* **Isotope** = form of an element that has the same atomic number but a different mass number
* The **HALF-LIFE** of the isotope needs to be known
	+ - How long it takes for 50% of the original radioactive isotope in a sample to decay.
* The relative amounts of the radioactive isotope and its decay product must also be known
* **Carbon-14** is used for younger fossils and **Uranium-238** for older fossils
* **Carbon-14** decays to **Nitrogen-14** with a half-life of **5,730 years**
* When testing a rock sample, scientists calculate the **ratio of the parent isotope to the daughter isotope** to determine the age of the sample
* Carbon-14 is used to test materials such as mummies, bones, and tissues
* The **most critical part** of radiometric dating is determining how much of a radioactive isotope a sample originally contained.
* **Also two critical assumptions** need to be made in order for radiometric dating to give accurate fossil ages:

**1) First**, that organisms in the past accumulated radioactive isotopes in **exactly** the same way and amounts as they do today.

* + - * + If they accumulated less radioactive material during their lifetimes than radio daters think, they would appear older than they actually are when dated.

**2) Second**, that nothing other than radioactive decay can change the amount of a radioactive isotope in a sample.

* + - * Other processes may be able to reduce the amount of radioactive isotope in a sample.
			* If this is true, then it would appear that more of the radioactive material had decayed than actually did.
			* This would lead to the rock being dated older than it actually is.
* Creationists believe it is likely that both critical assumptions evolutionary radioactive methods use are wrong.
* **GEOLOGICAL TIME SCALE**
* The geological time scale is a way in which the age of the earth is broken into subdivisions of Eras, Periods, Epochs, and others.
* These subdivisions are determined by events that supposedly took place during the times indicated.
* This time scale is **followed by evolutionists, not by creationists**. It was developed using faulty **radioactive decay** methods.
* It is divided into two main segments:
	+ **Pre-Cambrian Time**
	+ **Phanerozoic Eon**
* Other divisions:
	+ **Epochs:** smallest unit of geologic time
	+ **Periods:** consist of two or more epochs
	+ **Era:** consist of two or more periods; usually separated by environmental change
	+ **Eon:** longest unit of time
* **Descriptions using evolutionist worldview…**

**A) PRECAMBRIAN ERA**:

* Nearly 90% of Earth’s history occurred during the Precambrian.
* Simple anaerobic life appeared, followed by photosynthetic forms, which added oxygen to the atmosphere.
* Precambrian simply means “everything before the Cambrian Era”.

**B) PALEOZOIC ERA: (Ancient Life)**

* + **Cambrian Explosion 🡪** ancestors of most major animal groups diversified
	+ Highly diverse Marine Life
	+ Fossils of **Trilobites** are abundant
	+ First Life on Land emerged: Arthropods and Plants
	+ **Devonian:** Age of Fishes; First Land Vertebrates appear: Tetrapods
	+ **Carboniferus:** Dominated by Insects; Amphibians appear; Swampy Forests dominated the land
	+ **Permian:** First Reptiles appear; 95% of all life forms perished in **biggest Mass Extinction of all time**

**C) MESOZOIC ERA: (Age of Reptiles)**

* + **Triassic🡪** First Mammals and Dinosaurs appear
	+ **Jurassic** 🡪 **Dinosaurs** rule the land; First Birds appear
	+ **Cretaceous** 🡪 Flowering Plants appear; **Mass Extinction caused by Meteor** that wiped out all dinosaurs (among other creatures) except the ancestors of modern birds

**D) CENOZOIC ERA: (Age of the Mammals)**

* + Mammals diversify into distinct groups, including Primates
	+ **Quaternary**🡪 Flowering Plants are dominant; **Ice Ages** occur; **Modern Humans** appear; **CURRENT PERIOD WE LIVE IN**

**F) HISTORY OF EVOLUTIONARY THOUGHT:**

* **Charles Lyell**
* Proposed theory of **Uniformitarianism**
* The assumption that geological processes occur **at the same rates** in the past as they do in the present
* Proposed that the Earth was millions of years instead of a few thousand years old
* His book *“Principles of Geology”* read by Darwin in his voyage
* **Jean-Baptiste Lamarck**
* Tried to explain how change occurs over time
* Stated that changes are adaptations to environment **acquired** in an organism’s lifetime
* Proposed that by selective use or disuse of organs, organisms acquired or lost certain traits during their lifetime
* These **acquired changes were passed to offspring**
* Over time this led to new species
* Lamarck’s Mistakes:
* Lamarck did NOT know how traits were inherited (traits are passed through genes in gametes)
* Genes are NOT changed by activities in life
* **CHARLES DARWIN (1809)**
* Traditional View of his time: Young earth inhabited by unchanging species
* Joined Crew of HMS Beagle, 1831, as a Naturalist
* 5 Year Voyage around world
* Made extensive collection of Rocks, Fossils, Plants, and Animals
* Read a copy of Lyell’s *Principles of Geology*
* **The Galapagos Islands**
	+ - Volcanic islands off the coast of South America
		- Island species varied from mainland species and from island-to-island species: **Tortoises, Iguanas, Finches**
* **Finches** on the islands resembled mainland finches
* Different types of finches appeared on the islands where the available food was different (seeds, nuts, berries, insects…)
* Finches had different **types of beaks** adapted to their type of food gathering
* **Darwin Continued his Studies…**
* He hypothesized that new species could appear gradually through small changes in ancestral species, but he could not see how such a process would work
* He went to see Pigeon Breeders:
	+ Different breeds of pigeons have distinctive traits that are also present in these breeds’ offspring
	+ Breeders can promote these traits by selecting and breeding pigeons that have the most exaggerated expressions of those traits
	+ This process of directed breeding to produce offspring with desired traits is called **Selective Breeding**
	+ Darwin called the process **Artificial Selection**
* Darwin inferred that if humans could change species by Artificial Selection, then perhaps the same process could work in nature
* Further, maybe given enough time, perhaps this process could produce new species
* Then he read an essay by economist Thomas Malthus:
* It suggested the human population would eventually outgrow its food supply, leading to a competitive struggle for existence
* Darwin realized that this could be applied to the natural world
* He reasoned that some competitors in the struggle for existence would be better equipped for survival than others; those less equipped would die 🡪 **NATURAL SELECTION**
* **Natural Selection:**
* These principles try to explain how traits of a population can change over time **(Microevolution)**
* Darwin suggested that given enough time, natural selection could modify a population enough to produce a new species **(Macroevolution)**
* **Natural Selection does NOT equal Macroevolution**
* **Natural Selection is a mechanism of change within a population**
* **4 Basic Principles:**
	1. Individuals in a population show variations among others of the same species.
	2. Variations are inherited.
	3. Animals have more young than can survive on the available resources.
	4. Variations that increase reproductive success will be more common in the next generation.
* **How Does Natural Selection Work?**
* See PPT on Peppered Moths in 1800’s England
* **Publication of “On The Origin of Species”**
* Upon his return to England, Darwin developed his observations into the theory of evolution
* But he did not publish for 25 years – Why?
* Darwin knew that his theory would be extremely controversial and would be attacked
* His theory challenged established religious and scientific beliefs
* He refused to publish until he received an essay from **Alfred Wallace (1858)**
	+ Fellow naturalist
	+ Independently developed the same theory
	+ After 25 years, someone else had come to the same conclusions from their observations of nature
	+ When Darwin read Wallace’s essay, he knew he had to publish his findings
* Both men’s ideas were presented to the Linnaean Society of London in 1858
* One year later, Darwin published **“On the Origin of Species by Means of Natural Selection” (1859)**
* **A Summary of Darwin’s Theory of Evolution:**
1. Organisms produce more offspring than can survive. Of the offspring that do survive, many will never reproduce.

2) Because more organisms are produced than can survive, there is intense competition for limited resources, such as food, water, and shelter.

3) Individuals that are best suited to their environment survive, reproduce, and pass their traits on to their offspring.

4) Other organisms that are less suited for their environment often die, or will not be reproductively competitive.

5) This is the process of “Natural Selection” and causes the many species of organisms on Earth to change over time.

6) The species that are alive on Earth today are descended with modification from ancestral species that lived in the past.

**G) EVOLUTION: THE TERM**

* Today, biologists use the term **“Evolution”** to define cumulative changes in groups of organisms through time
* **Darwin described it as: “Descent with Modification”**
* Which implies that all organisms on earth have descended from one common ancestor
* Also described as **“MACROEVOLUTION”**
* It is the process by which one kind of organism transforms into a new and previously non-existent kind
* This implies the appearance of new genetic information that will provide previously non-existent traits that will result in the formation of a new and previously non-existent kind of organism
* For example, when you look at evolutionary trees, the point where the amphibian line breaks from the fish line, there needs to have been **genes added to the fish genome** which would code for legs, lungs, and a smooth non scaly skin (among other things)

**H) TERMS: SPECIES VS. KINDS**

* + - ***SPECIES***= term preferred by **evolutionists**, that refers to a group of populations whose members have the potential to interbreed in nature and produce viable, fertile offspring with members of other such groups
		- Even evolutionists admit that this is a poorly defined/undefined term relating to grouping organisms
		- ***KIND*** = a term preferred by **creationists**, that refers to a group of organisms that share the same defining characteristics, originally created by God; i.e. Dog kind, Human, kind, etc.
		- ***TYPE or VARIETY*** = terms preferred by **creationists**, that refers to a group of organisms within a kind that share the same traits of the kind’s defining characteristics
		- A new and previously nonexistent kind forming from a previously existing kind (i.e. fish to amphibian) is **Macroevolution = Speciation**
		- This is a very different process from new varieties or types forming within a kind, which is **Microevolution**
		- The variation within created kinds comes from “built-in” ability to vary given to the kinds by God at Creation in their **DNA**
		- **We need to be very careful because the evolution model uses the term “Evolution” to describe BOTH processes: Microevolution and Macroevolution**

**I) “MICROEVOLUTION”**

* Defined as a change in the genetic composition of a population from generation to generation
* **Microevolution** is the observed effects of natural selection due to genetic variation on populations
* **Creationists and Evolutionists (both) believe this process does happen in nature**
* Nevertheless, Creationists believe **it does NOT create new or previously non-existent genetic information or kinds of organisms**
	+ **In other words, it does NOT lead to Macroevolution**
* According to the evolution model, over long periods of time, the end effect of microevolution is macroevolution
* Evolutionists define Macroevolution as “microevolution over long periods of time”
* Evolutionists believe that a process that ONLY results in modifications of already-existing traits (MICROEVOLUTION), can over long periods of time, lead to the formation of entirely new traits that previously did not exist so that an entirely new kind of organism arises (MACROEVOLUTION)
* **What is the difference between evolution and creation if both evolutionists and creationists believe in *Natural Selection*?**
	+ It is easily observed in nature that traits of multiple generations of organisms can change and those changes are passed on to successive generations (***Microevolution***)
	+ However, creationists disagree with the notion that the changes in genetic traits over time can lead to the formation of an entirely different kind of organism (***Macroevolution***)
* **NATURAL SELECTION or “SURVIVAL OF THE FITTEST”**
* Creationists believe that **all organisms** are created with **much genetic potential to adapt to its environment as a result of Natural Selection**
* **Natural Selection simply acts through the built in genetic variability of all organisms**
* In other words, **Natural Selection** works upon the **genetic variation** that is present in the organism **at the moment it is created**

**J) NEODARWINISM (MODERN THEORY OF EVOLUTION)**

* Neo-Darwinism attempts to **explain evolutionary principles from a genetic standpoint.**
* Creationists do not believe this offers a valid explanation for evolution.
* According to neo-Darwinian theory, organisms evolved because they acquired new genes which coded for new traits, causing one species to evolve into another (Macroevolution)
* **Summary of NeoDarwinism (Modern Theory of Evolution)**
* All living things are descended from one or a few common ancestors.
* All features of living things are due to unguided natural processes such as random variation and natural selection.
* Genes (DNA) carry all the essential hereditary information.
* Mutations in DNA are the source of the new variations that provide the raw materials for evolution.
* According to Neo-Darwinism, species need to gain genetic material (genes) because less complex species evolve into more complex species.
* This cannot happen unless the less-complex species gains new genes coding for the more complex traits of the new species.
* Unfortunately, geneticists have **NEVER** been able to identify one gene-producing mutation.

**K) “SUPPORT” FOR EVOLUTION: DESCENT FROM COMMON ANCESTOR WITH MODIFICATION**

**1) FOSSIL RECORD**

* Fossils provides a record of species that lived long ago
* Evolutionists consider them some of the most significant evidence of evolutionary change:
	+ Show how ancient species are similar to current species
	+ Show that some species have remained unchanged for ages
	+ Considered an important source of information to determine the ancestry of an organism and patterns of evolution
* Darwin predicted the existence of fossils intermediate in form between species (**Transitional Fossils**)
	+ So far, **NONE** have been found

**2) COMPARATIVE ANATOMY: Homologous Structures**

* Evolutionists define **homologous structures** as anatomically similar structures inherited from a common ancestor, that have different functions.
* Example: Upper limb structure of mammals
* Creationists believe that homologous structures exist because God knew the best way to design a structure, so He used it in whatever organism needed it.
* Why don’t creationists think that homology indicates evidence for evolution?:
	+ Creationists believe that if homology were true, then the genes that code for the similar structures would also be similar, and that is NOT the case

**3) COMPARATIVE ANATOMY: Vestigial Structures**

* Vestigial structures are, by definition, structures that once had a function but now no longer do.
* Evolutionists use the presence of vestigial structures as proof that ancestors are shared by unrelated organisms.
* Unfortunately, the list of vestigial structures has grown from about 180 in the late 1800’s to nearly zero at present.
* Most current evolutionists do not use this argument anymore, but a lot of textbooks still do.

**4) EMBRYOLOGY:**

* Early on in evolutionary theory, **Haeckel** faked drawings of embryos of different types of organisms to make them look as almost the same
* Evolutionists used to use this as a strong argument that evolution is true until they all found out this was a lie
* Unfortunately, there are still modern textbooks that reproduce Haeckel’s drawings, even though they know they are not accurate.

**5) COMPARATIVE BIOCHEMISTRY:**

* Similarities in biochemical processes are used by evolutionists as an argument that evolution is true.
* Example: DNA content between organisms that are thought to be more closely related is more similar than that for organisms that are thought to be not as closely related.
* Creationists believe the similarities in biochemistry are not as close as evolutionists make them out to be. Also, they believe that God used similar biochemistry among different species because that is what worked the best.

**6) GEOGRAPHIC DISTRIBUTION (Biogeography):**

* Study of where organisms live now and where they and their “ancestors” lived in the past
* Two biogeographical patterns are significant to the evolution theory:
	1. Closely related species differentiate in slightly different climates. Ex. Galapagos Tortoises
	2. Very distantly related species develop similarities in similar environments. Ex. Rheas, Ostriches, Emus

**L)** **POPULATION GENETICS (Microevolution)**

* **Population** = A group of the same species (kind) living in an area
* No two individuals in a population are exactly alike (variations)
* More Fit individuals in a population survive and pass on their traits
* **Population Genetics** = The study of the traits of a specific population and how they change over time
* **Natural Selection in Action**
* **Gene Pool** = total amount of DNA that makes up a given population.
* **Hardy-Weinberg Principle**
	+ **Why dominant alleles do not overpower recessive alleles in a population?**
* Hardy and Weinberg showed mathematically (1908) that evolution will not occur in a population unless allelic frequencies are acted upon by forces that cause change
* In absence of these forces, the allelic frequency remains the same and evolution does not occur
* According to this principle, when allelic frequencies remain constant, a population is in genetic equilibrium
	+ **A population in equilibrium must meet 5 conditions:**

1) The population is very large.

2) There is no immigration or emigration.

3) Mating is random.

4) Mutations do not occur.

5) Natural Selection does not occur.

* **Hardly any population in nature meets all 5 conditions, therefore most populations are not in genetic equilibrium**
* **Violations to any of these 5 conditions are considered mechanisms of evolutionary change (Microevolution)**
* **Causes of Microevolution:**

1) **Genetic Drift**

* + the change in the gene pool of a population due to chance events
	+ **Bottleneck and Founder Effect**

2) **Gene Flow**

* + is genetic exchange due to the migration of fertile individuals or gametes between populations

3) **Non-random mating**

* + Mates are chosen on the basis of the best traits

4) **Mutation**

* + a random change in an organism’s DNA
	+ **Mutations in gametes can be transmitted to offspring**
	+ In stable environments, mutations often result in little or no benefit to an organism, or are often harmful or lethal
	+ Beneficial Mutations are rarely found in changing environments, but could be selected for, and become more common in subsequent generations
		- * Ex. HIV resistance to antiviral drugs

5) **Natural Selection**

* + “Acts” to select the individuals in a population that are best adapted for survival and reproduction
	+ “Acts”on an organism’s phenotype and changes allelic frequencies in the gene pool
	+ Three main ways in which Natural Selection alters phenotypes:

1) Stabilizing Selection – most common

2) Directional Selection – increases expression of extreme versions of a trait

3) Disruptive Selection – splits population in two groups; tends to remove individuals with average traits and favors the extremes at both ends

* + - **Examples of Genetic Drift**

**1) Bottleneck Effect**

* + a drastic reduction in population (volcanoes, earthquakes, landslides …), followed by rebound
	+ **Reduces genetic variation**
	+ Smaller population may not be able to adapt to new selection pressures (changes in environment)
	+ Example:
		- * Cheetahs have little genetic variation in their gene pool
			* This might contribute to the potential extinction of this endangered species
			* This can probably be attributed to a population bottleneck they experienced, barely avoiding extinction

**2) Founder Effect**

* + occurs when a new colony is started by a few members of the original population
	+ **Reduces genetic variation**

**M) SPECIATION AND ADAPTATION (Macroevolution)**

* **Speciation** = **Formation of new species (kind) 🡪MACROEVOLUTION**
* Requires very long periods of time
* This implies the appearance of **New Genetic Information** that will provide previously non-existent traits that will result in the formation of a new and previously non-existent kind of organism
* **Reproductive Isolation**
* The evolutionary concept of biological species emphasizes Reproductive Isolation in order to have a new species
* This results from barriers that prevent individuals of different species to produce viable, fertile offspring

1) **Prezygotic Barriers** – prevent mating between members of different species or successful fertilization

a) Physical Characteristics

 b) Geographical Barriers

 c) Behavioral Barriers

2) **Postzygotic Barriers** – prevent a zygote from developing into a viable fertile adult

 a) Mating occurs, but offspring do not survive.

 b) The offspring may survive but they are not fertile.

* **Types of Speciation:**
* **Allopatric Speciation** = occurs when geographic isolation interrupts gene flow between two subpopulations
* **Sympatric Speciation** = gene flow interrupted due to reproductive barriers between populations that share the same area
* **Rate of Speciation:**

**1) GRADUALISM =** belief that all species evolved slowly over a long period of time.

* Creationists think that gradualism is not a reasonable way to explain the origins of species because if it were true, then there should be a fossil record full of transitional fossil forms. That is NOT the case
* Plus, the appearance of species in the fossil record shows the abrupt appearance of fully formed species.

**2) PUNCTUATED EQUILIBRIUM =** Tries to explain the long periods of stasis and rapid explosions of new and fully-developed life forms with no intermediates from an evolutionary point of view

* Proposed by Stephen **Gould** and Niles **Eldredge** (1971)
* It explains the stasis and rapid change by natural selection slowly preparing the organism for a species change or mass adaptation change (the “equilibrium” part). It is if as nature “knows” the organism needs to undergo trait changes.
* Then all of the sudden, the traits explode out and new species are formed (the “punctuated” part).

**N) PATTERNS OF EVOLUTION:**

**1) CONVERGENT EVOLUTION**

* Describes the evolutionary process that causes completely different species to develop similar structures.
* Ex. The presence of wings on insects, birds, and mammals (bats).
	+ These species are completely unrelated, but all 3 evolved the ability to fly (**Analogous Structures**)
	+ According to evolutionists this a classic example

**2) DIVERGENT EVOLUTION**

* In divergent evolution, two or more related species become more and more dissimilar over time, leading to Speciation (Macroevolution)
* **Adaptive Radiation** = process of many related species originating from one common ancestor
* Ex. **Galapagos Finches**
	+ - There are 13 “species” found on the Galapagos Islands
		- Evolutionists say that all the finch species descended from one mainland finch species.
		- Through natural selection they became more different from one another and formed into 13 different species
* Creationist’s explanation:
	+ Most creationists agree that the 13 “species” of Galapagos finches most likely descended from a single common ancestor.
	+ However, **creationists do not agree that the finches are all different species**
	+ Creationists believe that the finches are simply displaying their God-given genetic diversity, which was designed into the DNA at creation. (Microevolution)