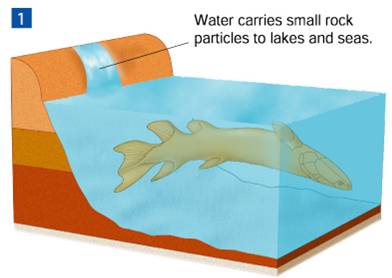
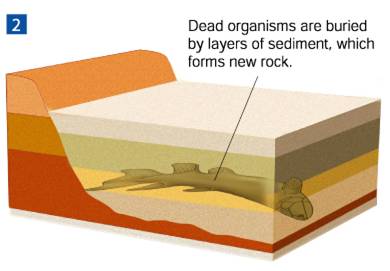
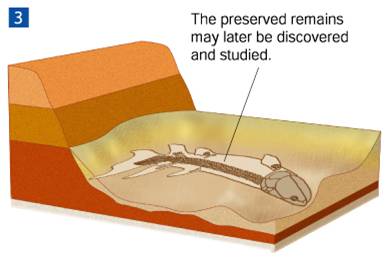
**Chapter 17 – The History of Life**

Section 1 – The Fossil Record (Part 1)

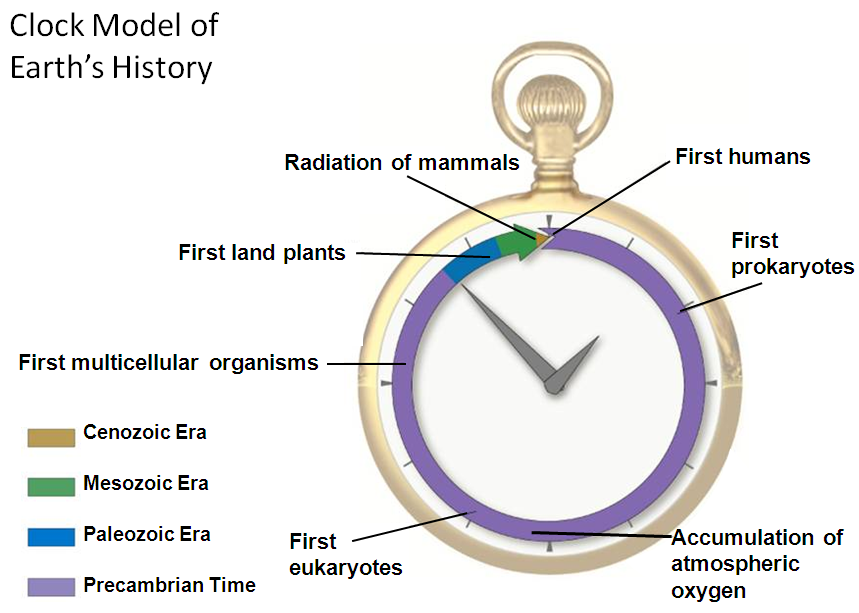
* Fossils and Ancient Life
  + **Paleontologists** are scientists who collect and study \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + All information about past life is called the **fossil \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
    - The fossil record includes information about the structure of organisms, what they \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, what ate them, in what environment they lived, and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in which they lived.
  + The fossil record provides evidence about the history of life on Earth. It also shows how different groups of organisms, including species, have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ over time.
  + The fossil record provides \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ information about the history of life.
    - Over \_\_\_\_\_\_\_\_\_\_% of all species that have lived on Earth have become **extinct**, which means that the species has died out.
* How Fossils Form
  + Fossils can be as large as a complete, preserved animals, or as small as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Most fossils form in sedimentary rock.
    - Sedimentary rock forms when exposure to the elements \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ down existing rock into small particles of sand, silt, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.





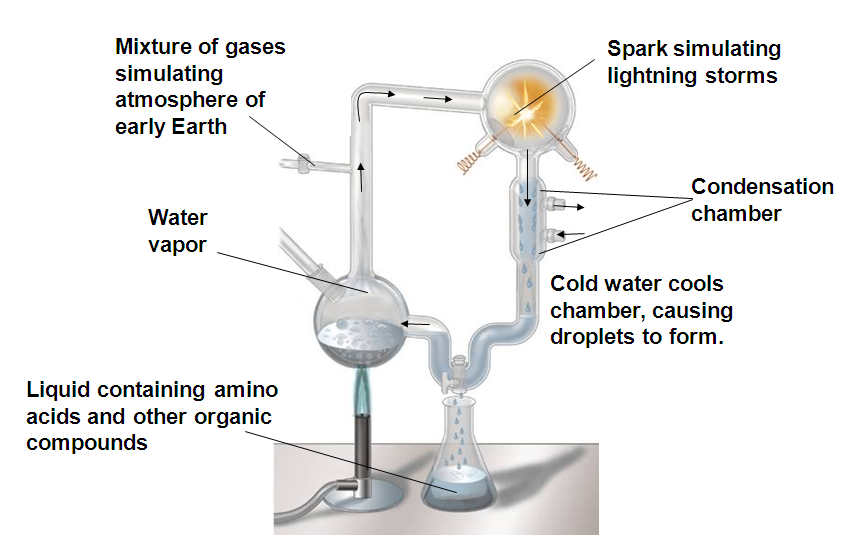
* Interpreting Fossil Evidence
  + Paleontologists determine the age of fossils using \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ dating or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ dating.
* What information do relative dating and radioactive dating provide about fossils?
* Relative Dating
  + In **relative dating**, the age of a fossil is determined by comparing its\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with that of fossils in other layers of rock.
  + Rock layers form in order by age—the oldest on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, with more recent layers on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Index fossils are used to compare the relative ages of fossils.
  + An**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fossil** is a species that is recognizable and that existed for a short period but had a wide geographic range.
  + **Relative dating allows paleontologists to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a fossil's age compared with that of other fossils.**
* Radioactive Dating
  + Scientists use radioactive decay to assign an absolute \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to rocks.
  + Some elements are radioactive and steadily break down into nonradioactive elements.
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ dating** is the use of half-lives to determine the age of a sample.
  + A **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-life** is the length of time required for half of the radioactive atoms in a sample to decay.
  + In radioactive dating, scientists calculate the age of a sample based on the amount of remaining radioactive isotopes it \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Carbon-14 begins to decay when an organism \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Carbon-12 is not radioactive and does not \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + By comparing the amounts of carbon-14 and carbon-12 in a fossil, researchers can determine when the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ lived.

Section 1 –The Fossil Record (Part 2)

* Geologic Time Scale
  + What are the main divisions of the geologic time scale?
* Paleontologists use a scale called the **geologic \_\_\_\_\_\_\_\_\_ scale** to represent evolutionary time.
  + Scientists first developed the geologic time scale by studying \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ layers and index fossils worldwide.
  + **\*\*\*The basic divisions of the geologic time scale are eras and periods.\*\*\***
* **Geologic Time** 
  + Geologic time begins with Precambrian Time, which covers about \_\_% of Earth’s history.
  + Eras
  + Geologists divide the time between Precambrian time and the present into three **eras**:
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Era
    - Mesozoic Era
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Era
  + The Paleozoic began about 544 million years ago.
    - Many vertebrates and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ lived during this time.
  + The Mesozoic began about \_\_\_\_\_\_\_\_\_\_\_ million years ago.
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ lived during this time.
    - Mammals began to evolve during this era.
  + The Cenozoic began about \_\_\_\_\_\_\_\_\_\_\_ million years ago and continues to the present.
    - Mammals became \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ during the Cenozoic.
  + Periods
    - Eras are subdivided into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which range in length from tens of millions of years to less than two million years.
    - Many periods are named for places around the world where geologists first discovered the rocks and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of that period.

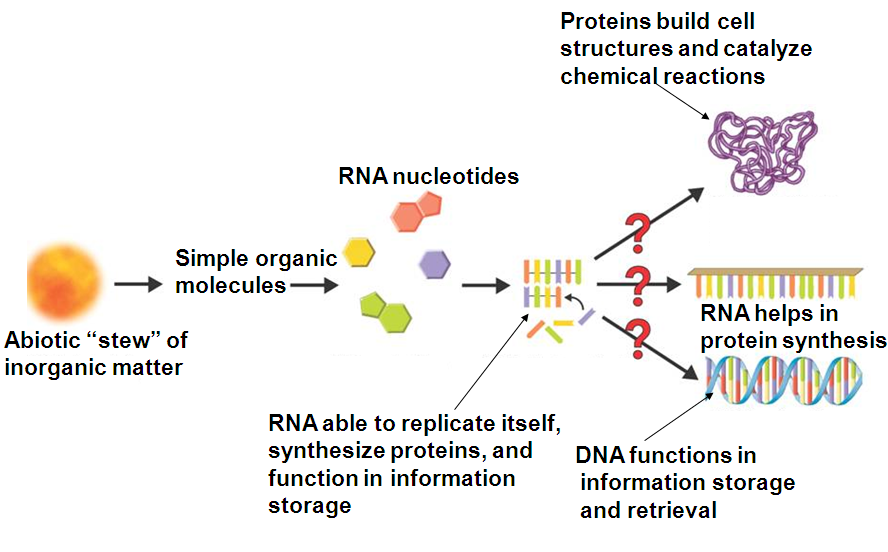
Section 2 – Earth’s Early History (Part 1)

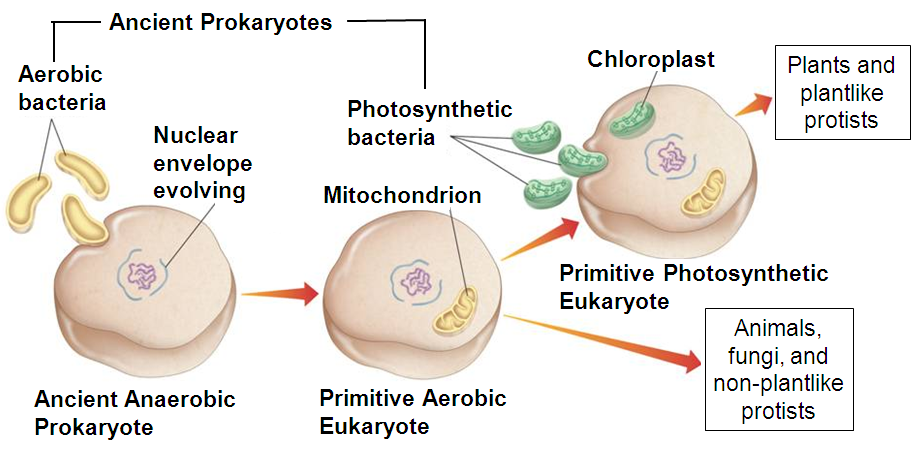
* **Formation of Earth**
  + Hypotheses about Earth’s early history are based on a relatively small amount of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Gaps and uncertainties make it likely that scientific ideas about the origin of life will \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Evidence shows that Earth was not “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” in a single event.
  + Pieces of cosmic debris were probably attracted to one another over the course of 100 million years.
  + While Earth was young, it was struck by one or more objects, producing enough heat to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the entire globe.
  + Once Earth melted, its elements rearranged themselves according to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + The most dense elements formed the planet’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Moderately dense elements floated to the surface, cooled, and formed a solid crust.
  + The least dense elements formed the first \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* What substances made up Earth's early atmosphere?
  + Earth's early atmosphere probably contained hydrogen cyanide, carbon dioxide, carbon monoxide, nitrogen, hydrogen sulfide, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Scientists infer that about four billion years ago, Earth cooled and solid \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ formed on its surface.
  + Millions of years later, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ activity shook Earth’s crust.
  + About 3.8 billion years ago, Earth’s surface cooled enough for water to remain a liquid, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ covered much of the surface.
* The First Organic Molecules
  + Could organic molecules have evolved under conditions on early Earth?
  + In the 1950s, Stanley \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and Harold Urey tried to answer that question by simulating conditions on the early Earth in a laboratory setting.
* What did Miller and Urey's experiments show?



* + Miller and Urey's experiments suggested how mixtures of the organic compounds necessary for life could have arisen from simpler compounds present on a primitive \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. \*\*\**The building blocks know as amino \_\_\_\_\_\_\_\_\_\_ formed.*
  + Although their simulations of early Earth were not accurate, experiments with current knowledge yielded \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ results.
* The Puzzle of Life's Origin
  + Evidence suggests that 200–300 million years after Earth had liquid water, cells similar to modern \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ were common.
* Formation of Microspheres
  + In certain conditions, large organic molecules form tiny bubbles called **proteinoid microspheres**.
    - Proteinoid = made up of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Microspheres are not cells, but they have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ permeable membranes and can store and release energy.
  + Hypotheses suggest that structures similar to microspheres might have acquired more characteristics of living \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Section 2 – Earth’s Early History (Part 2)

* Evolution of RNA and DNA
* How could DNA and RNA have evolved? Several hypotheses suggest:
  + Some RNA sequences can help DNA \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ under the right conditions.
  + Some RNA molecules can even grow and duplicate themselves suggesting RNA might have existed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ DNA.
* Free Oxygen
  + Microscopic fossils, or **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_fossils**, of unicellular prokaryotic organisms resembling modern bacteria have been found in rocks over 3.5 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ years old.
  + These first life-forms evolved without \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + About 2.2 billion years ago, photosynthetic bacteria began to pump oxygen into the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Next, oxygen gas accumulated in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* What occurred when oxygen was added to Earth's atmosphere?
  + The rise of oxygen in the atmosphere drove some life forms to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, while other life forms evolved new, more efficient metabolic pathways that used \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for respiration.
* What hypothesis explains the origin of eukaryotic cells?
* The Endosymbiotic Theory
  + The endosymbiotic theory proposes that eukaryotic cells arose from living communities formed by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organisms.



* + About 2 billion years ago, prokaryotic cells began evolving internal cell \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + The result was the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of all eukaryotic cells.
  + According to the endosymbiotic theory, eukaryotic cells formed from a symbiosis among several different \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Prokaryotes that use oxygen to generate energy-rich molecules of ATP evolved into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Prokaryotes that carried out photosynthesis evolved into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Sexual Reproduction and Multicellularity
  + Most prokaryotes reproduce \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Asexual reproduction:
    - yields daughter cells that are exact \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the parent cell.
    - restricts genetic variation to mutations in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Sexual reproduction shuffles genes in each generation. In sexual reproduction:
  + offspring \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ resemble parents exactly
  + there is an increased probability that favorable combinations will be produced
  + there is an increased chance of evolutionary \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ due to natural selection

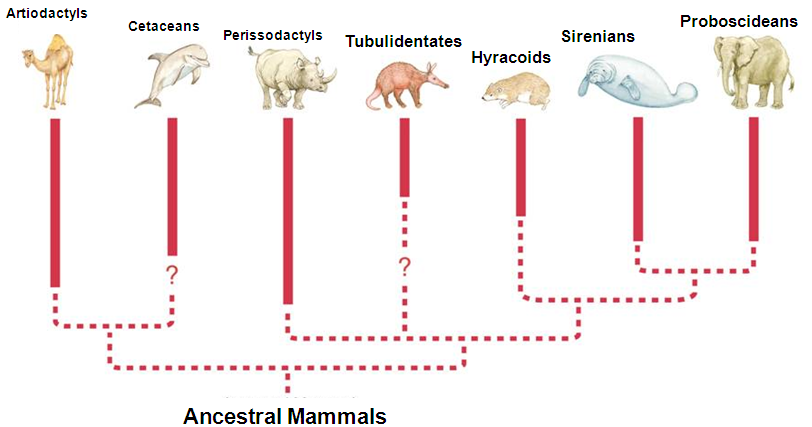
Section 3 – Evolution of Multicellular Life (Part 1)

* Precambrian Time
  + Few fossils exist from Precambrian time because the animals were all \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_-bodied.
  + Life existed only in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Paleozoic Era
  + What were the characteristic forms of life in the Paleozoic era?
  + Rich fossil evidence shows that early in the Paleozoic Era, there was a diversity of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ life.
  + The Paleozoic Era is divided into the following periods:
    - Cambrian
    - Ordovician
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Devonian
    - Carboniferous
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Cambrian Period
  + The diversification of life at this time is called the “Cambrian \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.”
  + The first known representatives of most animal phyla evolved. These included:
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\*\*\*\*
    - brachiopods
    - trilobites
* Ordovician and Silurian Periods
  + Some arthropods became the first \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ animals.
  + The first vertebrates appeared.
  + The first land \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ evolved from aquatic ancestors.
* Devonian Period
  + Some plants adapted to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ areas and invaded more habitats.
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ appeared on land.
  + The Devonian is often called the Age of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ because many groups of fishes were present in the oceans.
  + Most fishes had jaws, bony skeletons, and scales.
  + During the Devonian, vertebrates began to invade the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Some of these early four-legged vertebrates evolved into the first amphibians.
* Carboniferous and Permian Periods
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ evolved from certain amphibians.
  + Winged insects evolved into many forms.
  + Giant ferns and other plants formed vast swampy forests.
  + Remains of ancient plants formed thick deposits of sediment that changed into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ over millions of years.
  + At the end of the Permian Period, there was a mass \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in which many living things became extinct at the same time.
  + The mass extinction at the end of the Paleozoic affected both plants and animals on land and in the seas. As much as \_\_\_\_\_\_\_\_% of the complex life in the oceans disappeared.

Section 3 – Evolution of Multicellular Life (Part 2)

* Mesozoic Era
  + What were the characteristic forms of life in the Mesozoic era?
  + During the Mesozoic Era, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ became dominant. The Mesozoic is also marked by the appearance of flowering plants.
  + The Mesozoic Era is often called the Age of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Triassic Period
  + Organisms that survived the Permian mass \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ became the main life forms early in the Triassic.
  + These organisms included fishes, insects, reptiles, and \_\_\_\_\_\_\_\_\_\_\_-bearing plants.
* Jurassic Period
  + Dinosaurs became the dominant animals on land.
  + One of the first \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, *Archaeopteryx,* appeared.
  + Many paleontologists think that birds are close relatives of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Cretaceous Period
  + Dominant animals during this period included: reptiles, birds, turtles, crocodiles, fishes, and marine invertebrates.
  + New forms of plant life included leafy trees, shrubs, and small \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ plants.
  + The Cretaceous Period ended with a mass \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + More than half of all plant and animal groups were wiped out, including all of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Cenozoic Era
  + What were the characteristic forms of life in the Cenozoic era?
  + During the Cenozoic, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ evolved adaptations that allowed them to live in various environments—on land, in water, and even in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + The Cenozoic often is called the Age of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + The Cenozoic is divided into the Tertiary Period and the Quaternary \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Tertiary Period
  + The climate was generally \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and mild.
  + Marine mammals such as whales and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ evolved.
  + Grasses evolved, providing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for grazing mammals.
  + Some mammals became very \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, as did some birds.
* Quaternary Period
  + Earth’s climate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, causing a series of ice ages.
  + About 20,000 years ago, Earth’s climate began to warm and sea levels began to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + In the oceans, algae, coral, mollusks, fishes, and mammals thrived.
  + Insects, birds, and land mammals were \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + The fossil record suggests that the early ancestors of our species appeared about 4.5 million years ago.
  + The first fossils of *Homo \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* may have appeared as early as 200,000 years ago in Africa.
  + According to one hypothesis, members of our species migrated from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and ultimately colonized the world.

Section 4 – Patterns of Evolution (Part 1)

* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_evolution** refers to large-scale evolutionary patterns and processes that occur over long periods of time.
* **Six important topics in macroevolution are:**
  + **extinction**
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ radiation**
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ evolution**
  + **coevolution**
  + **punctuated \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
  + **changes in developmental genes**
* Extinction
  + More than \_\_\_\_\_\_\_% of all species that have ever lived are now extinct.
  + In the past, most researchers looked for a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, major cause for each mass extinction.
  + Many paleontologists now think that mass extinctions were caused by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ factors.
  + What effects have mass extinctions had on the history of life? Mass extinctions have:
    - provided ecological opportunities for organisms that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - resulted in bursts of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that produced many new species
* Adaptive Radiation
  + **Adaptive radiation** is the process by which a single species or a small group of species evolves into several different \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that live in different ways.
  + For example, in the adaptive radiation of Darwin's \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, more than a dozen species evolved from a single species.
  + Adaptive radiations can occur on a much larger scale.
  + The disappearance of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ then resulted in the adaptive radiation of mammals.

Section 4 – Patterns of Evolution (Part 2)

* Convergent Evolution
  + Different organisms undergo adaptive radiation in different places or at different times but in similar environments.
  + The process by which \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organisms come to resemble one another is called **convergent evolution**.
  + Convergent evolution has resulted in sharks, dolphins, seals, and penguins.
  + Structures that look and function similarly but are made up of parts that do not share a common evolutionary \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are called analogous structures.
  + A dolphin’s fluke and a fish’s tail \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are analogous structures.
* Coevolution
  + Sometimes organisms that are closely connected to one another by ecological interactions evolve \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + The process by which two species evolve in response to changes in each other over time is called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* Punctuated Equilibrium
  + Darwin felt that biological change was \_\_\_\_\_\_\_\_\_\_\_\_ and steady, an idea known as gradualism.
  + **Punctuated \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is a pattern of evolution in which long stable periods are interrupted by brief periods of more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ change.
  + \*\*\*\*\*\*The concept of punctuated equilibrium has generated debate and is still controversial among some biologists today.\*\*\*\*\*\*
  + Evolution has often proceeded at different \_\_\_\_\_\_\_\_\_\_\_\_\_\_ for different organisms at different times during the history of life on Earth.
* Developmental Genes and Body Plans
  + It is suspected that changes in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for growth and differentiation during embryological development could produce changes in body shape and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Small changes in the activity of control \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can affect many other genes to produce large changes in adult animals.
  + Small changes in the timing of cell differentiation and gene expression can make the difference between long legs and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ones.