**History of Life on Earth**

**Why Its Important :**

Learning about the history of life gives us a basis for studying and understanding the theory of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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| Objectives | Vocabulary |
| * **Summarize** how radioisotopes can be used in determining Earth’s age. * **Compare** two models that describe how the chemicals of life originated. * **Describe** how cellular organization might have begun. * **Recognize** the importance that a mechanism for heredity has to the development of life. | * Radiometric Dating * Radioisotopes * Half-life * Microsphere |

Review: What is a scientific theory?

**The age of earth**

* Scientists estimate that the earth formed approximately 4.5 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ years ago
  + *Other texts say \_\_\_\_\_\_ billion years ago*
* When it first formed, it was probably a fiery ball of \_\_\_\_\_\_\_\_\_\_\_\_\_ rock.
* Eventually, scientists hypothesize that the planet’s surface \_\_\_\_\_\_\_\_\_\_ enough to form a rocky crust
* Many volcanoes may have released gases that helped to form earth’s early \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Water vapor in the atmosphere \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, leading to millions of years of \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* This rain collected to form vast \_\_\_\_\_\_\_\_\_\_\_\_\_\_
* What is water vapor?
  + What is it’s chemical formula?
  + Will physical changes like evaporation, condensation, or freezing change this chemical formula?
* So the oxygen in water vapor is not considered \_\_\_\_\_\_\_\_\_\_ oxygen (O2) until a chemical reaction splits water
  + We have studied this before….
    - during \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, water is split to release oxygen in a process called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* So if early earth was very hot and contained no life forms, is it likely that oxygen gas (O2) was present?

**Measuring Earths Age**

* Scientists have estimated the age of Earth using a technique called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ dating.
  + A process that determines the age of an object by measuring its content of certain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ isotopes.
    - Also called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* A radioisotope has an \_\_\_\_\_\_\_\_\_\_\_\_ nucleus that breaks down or \_\_\_\_\_\_\_\_\_\_\_ and give off energy in the form of charged particles or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* As the radioisotopes decay, they turn into other isotopes that are more \_\_\_\_\_\_\_\_\_\_\_\_
* Tracking the presence of radioisotopes is helpful for aging layers of rock, \_\_\_\_\_\_ cores, and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* *Example*
  + Certain rocks contain traces of the radioisotope \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Over time, it decays into \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* The time it takes for one-half of a given amount of a radioisotope to decay is a \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_**.**
  + The half-life of potassium-40 is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ years

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| **How much potassium - 40 is left after 1 half life?**  **How much potassium-40 is left after 2 half lives?**  **If only 1/8 of potassium-40 is remaining, how old is the rock?** | Untitled-1 copy |

* The half-life of carbon-14 is 5,730 years…if 1/16 of carbon-14 is present, how many half-lives have occurred?
* How long did this take?
* The oldest rocks found and dated are \_\_\_\_\_\_ billion years old
* Why is it impossible to date rocks from the earliest history of the planet?
  + The rocks were too \_\_\_\_\_\_\_\_\_\_\_\_\_
  + Rocks \_\_\_\_\_\_\_\_\_\_ away
* Another dating method called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ dating compares the \_\_\_\_\_\_\_\_\_\_\_\_\_ of rock layers to determine a relative age.
  + Since sediment layers build on top of each other, younger layers should be found at the \_\_\_\_\_\_\_\_, while older layers should be found at the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Most scientists think that life originated in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* While scientists have \_\_\_\_\_\_\_ been able to determine how life originated, they have done many studies focusing on the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ needed to support life

**Formation of the Basic Chemicals of Life**

* It is thought that the path to the development of living things began when the molecules of \_\_\_\_\_\_\_\_\_\_\_\_\_\_ matter reacted chemically to produce many different, \_\_\_\_\_\_\_\_\_\_\_\_\_\_ organic molecules
* What element must organic molecules contain?
* Next these simple organic molecules went through further reactions to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organic molecules
* What are the four types of complex organic molecules that are essential for life?
* There are two models explaining how these organic molecules ended up in the oceans…
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ theory
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ theory

**Primordial Soup Model**

* Suggested in the 1920s by the Russian scientist Alexander \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the British scientist John \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Basically, they thought that energy from the \_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and earth’s own \_\_\_\_\_\_\_\_\_\_ triggered \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ gases to go through chemical reactions, forming \_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules
  + These organic molecules were then washed into the oceans by \_\_\_\_\_\_\_\_\_
* Oparin and Haldane thought this scenario was similar to how a \_\_\_\_\_\_\_\_\_ is filled by many vegetables and meats
* At the time, scientists also proposed that earth’s atmosphere lacked \_\_\_\_\_\_\_\_\_\_\_\_\_\_ but was rich in other gases such as…
  + Nitrogen gas \_\_\_\_\_
  + Hydrogen gas \_\_\_\_\_
  + Water vapor \_\_\_\_\_
  + Ammonia \_\_\_\_
  + Methane \_\_\_\_\_
* Energy may have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ electrons in these gases, allowing them to form a variety of organic compounds

**Miller Urey Experiment**

* In 1953, the primordial soup model was tested by Stanley \_\_\_\_\_\_\_\_\_\_\_\_ and Harold \_\_\_\_\_\_\_\_\_\_\_
* In the laboratory, they tried to recreate the \_\_\_\_\_\_\_\_\_\_\_\_ on early earth to see if organic molecules would form

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| http://www.biology.iupui.edu/biocourses/N100/images/19millerurey.jpg | 1. Heated water to recreate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ temps. and form water \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2. Added \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ gases 3. Added \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ sparks to simulate lightning 4. Condensed steam to form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 5. Tested the solution and it \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organic molecules! |

**Recent discoveries have caused scientists to\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the Miller-Urey experiment**

* The mixture of gases used in Miller’s experiment could not have \_\_\_\_\_\_\_\_\_\_\_\_\_ on early Earth.
* Four billion years ago, Earth did not have a protective layer of \_\_\_\_\_\_\_\_\_\_ gas, which consists of \_\_\_\_\_.
* Without ozone, ultraviolet radiation would have destroyed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, preventing the production of organic molecules

**The Bubble Model**

* In 1986, the geophysicist Louis \_\_\_\_\_\_\_\_\_\_ suggested that the key processes that formed the chemicals needed for life began in underwater \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that were protected from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ radiation
* These bubbles contained gases that came from underwater \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Precursors of 1st Cells**

* Most scientists accept that under certain conditions, the basic molecules of life could have formed spontaneously through simple \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + The formation of organic molecules is sometimes called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ evolution
* Interestingly enough, scientists have also been able to make short chains of \_\_\_\_\_\_\_ form spontaneously in water
* What do we know about RNA?
* In the 1980s, Thomas \_\_\_\_\_\_\_ and Sidney \_\_\_\_\_\_\_\_\_\_\_ hypothesized that RNA was the first self \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecule rather than \_\_\_\_\_\_
* This is supported by the fact that some viruses contain only \_\_\_\_\_\_\_\_, which is actually used to create DNA in a host cell….this is done by a process called \_\_\_\_\_\_\_\_\_\_\_ transcription
* Experiments have also shown that organic molecules tend to \_\_\_\_\_\_\_\_\_\_\_\_ together in water, forming droplets that look like \_\_\_\_\_\_\_\_
  + For example, when a lipid, like oil, is added to water, what does the oil do?
* Similar experiments have shown that short chains of \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_ gather in water to form droplets called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Microspheres resemble cells and can \_\_\_\_\_\_\_\_\_\_\_, but they are not actual cells
  + Sometimes they are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and were discovered by Sidney \_\_\_\_\_\_\_ in 1992.
  + Another similar droplet, formed from linked amino acids and sugars is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
  + Some scientists think that protocells may have evolved into real cells, but there is \_\_\_\_ scientific data to support this…
  + But still, scientists hypothesize that if protocells acquired \_\_\_\_\_\_, they could pass on characteristics to new protocells
* Back in chapter 1, we discussed how the theory of biogenesis replaced the theory of spontaneous generation
* What did these theories state…
  + Spontaneous generation?
  + Biogenesis?
* So if protocells really did evolve into actual cells, which theory does this align with?

1. Summarize how radioisotopes can be used in determining Earth’s age.
2. Compare two models that describe how the chemicals of life originated.
   1. Primordial Soup Model
   2. Bubble Model
3. Describe how cellular organization might have begun.
4. Recognize the importance that a mechanism of heredity has to the development of life.

**The Evolution of Cellular life**

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| Objectives | Vocabulary | |
| * **Distinguish** between the two groups of prokaryotes. * **Describe** the evolution of eukaryotes. * **Recognize** an evolutionary advance first seen in protists. * **Summarize** how mass extinctions have affected the evolution of life on Earth. * **Relate** the development of ozone to the adaptation of life to the land. * **Identify** the first multicellular organisms to live on land. * **Name** the first animals to live on land. * **List** the first vertebrates to leave the oceans | Fossil  Cyanobacteria  Eubacteria  Archaebacteria  Endosymbiosis  Protist  Extinction  Mass Extinction | Mycorrhizae  Mutualism  Arthropod  vertebrate  Continental drift |

When did the 1st Organisms form?

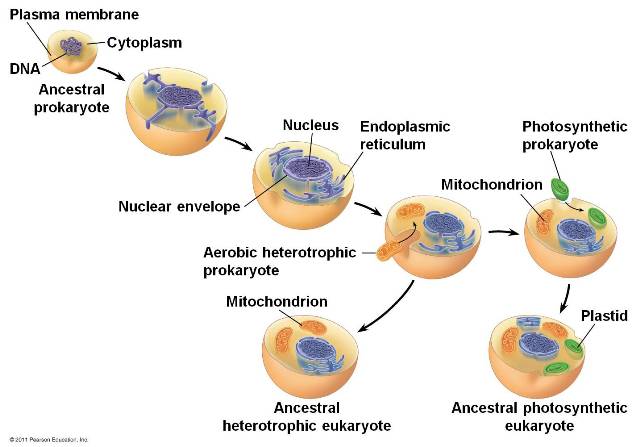
* To find out, scientists study \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + which may be…
    - preserved or mineralized remains of \_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_, or \_\_\_\_\_\_\_\_\_\_\_
    - an \_\_\_\_\_\_\_\_\_\_\_\_\_ of an organism that lived long ago.
* Based on the types of fossils present in earth’s rock layers, scientists have created a timeline of earth’s history, called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ time scale

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| * The time scale is made up of four main divisions called…   + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ time   + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ era   + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ era   + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ era * These eras are further subdivided into \_\_\_\_\_\_\_\_\_\_\_\_ according to the \_\_\_\_\_\_\_\_\_ of organisms living during that time   **The Precambrian**   * First and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ division * Comprises \_\_\_\_\_% of earth’s history * Scientists have discovered \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fossils of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from this time * The first prokaryotes were probably \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that ate the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules in the “primordial soup” * When this food source began running out, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bacteria may have evolved next   + What can autotrophs do? * The first autotrophs were probably \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, meaning that they made food while using the energy stored in chemical \_\_\_\_\_\_\_\_\_ * Chemosynthetic prokaryotes may have been similar to modern day \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which can survive in \_\_\_\_\_\_\_\_\_\_\_ environments like hot springs and deep sea \_\_\_\_\_\_\_\_ * Another group of bacteria, called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ live in more common environments   + They contain a complex carbohydrate in their cell walls called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, while archaebacteria contain unique \_\_\_\_\_\_\_\_\_\_\_\_\_\_ in their cell walls.   + Scientists have hypothesized that these two groups of prokaryotes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ early | C 14 era framed |

* Approximately \_\_\_\_\_\_\_ billion years ago, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ autotrophs evolved
  + For example, scientists have found fossils of marine cyanobacteria (blue green) in mounds called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* What gas do photosynthetic organisms release into the atmosphere?
  + This would allow \_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells to exist and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ layer, consisting of \_\_\_\_\_\_\_ to form

**The Evolution of Eukaryotes**

* About \_\_\_\_\_ billion years ago, the first eukaryotes appeared.
* A eukaryotic cell is much \_\_\_\_\_\_\_\_\_\_\_\_\_ than a prokaryote is, has a complex system of \_\_\_\_\_\_\_\_\_\_\_\_\_ membranes, and its DNA is enclosed within a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Almost all eukaryotic cells have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, while eukaryotic plant cells have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* So how did eukaryotic cells acquire all of these extra organelles?
  + Scientists hypothesize that ancient \_\_\_\_\_\_\_\_\_\_\_\_ began working together in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ relationships, and eventually became \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ upon one another
* For example, a large prokaryote may have ingested a smaller \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ prokaryote that started acting as a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* They also may have ingested photosynthetic bacteria, which started acting as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* This idea is called the theory of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and was proposed by Lynn \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the 1960s
  + “Endo” means \_\_\_\_\_\_ and refers to smaller prokaryotes moving into larger ones

[](http://www.google.com/url?sa=i&rct=j&q=endosymbiosis&source=images&cd=&docid=b4sbORnqZDAIaM&tbnid=uit4rPkh73DV1M:&ved=0CAUQjRw&url=http://www.esu7.org/~leiweb/Staff/DSchmidt/Biology/Internet/Cellular_Energy/Endosymbiosis.htm&ei=y7BjU8P4B4yPyASA1YDQBQ&psig=AFQjCNHvH7ZwruLkRgCxO0UCpK_zPT0dIg&ust=1399128607780204)

**Endosymbiosis**

The following four observations support the theory of endosymbiosis

**1.** Mitochondria are about the same \_\_\_\_\_\_\_ as most eubacteria, and chloroplasts are the same size as some cyanobacteria.

**2.** Mitochondria and chloroplasts have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ DNA similar to the DNA found in bacteria.

**3.** Mitochondria and chloroplast both have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that are similar to bacterial ribosomes.

**4.** Like bacteria, chloroplasts and mitochondria \_\_\_\_\_\_\_\_\_\_\_\_\_ by simple \_\_\_\_\_\_\_\_\_\_\_. This replication takes place \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the cell cycle of the host cell.

**Multicellularity**

* Towards the \_\_\_\_\_\_\_\_ of Precambrian time, multicellular life evolved
* While the unicellular body plan has been very successful, multicellularity has several \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Multicellular organisms contain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells that can carry out more \_\_\_\_\_\_\_\_\_\_\_\_ activities
* For example, specialized cells are used to….
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_ off disease
* Prevent \_\_\_\_\_\_\_\_\_\_\_\_\_\_ out
* Find \_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_
* Multicellular life was first present in Kingdom \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Most protists are unicellular \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, but some multicellular organisms, like \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are classified as protists

**Paleozoic Era**

* The Paleozoic era began with the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ period
* This era is marked by an explosion of \_\_\_\_\_\_\_\_\_\_\_, or the evolution of many \_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + As a result the Cambrian period is often called the Cambrian \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Many unusual marine organisms lived in the shallow Cambrian \_\_\_\_\_\_\_\_\_
* Their fossils have been found in an area of Canada called the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Shale
* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_ period followed the Cambrian period…
  + Many different animals continued to abound in the seas , including \_\_\_\_\_\_\_\_\_\_
  + At the end of this period, the \_\_\_\_\_ of five \_\_\_\_\_\_ extinctions occurred, meaning that a \_\_\_\_\_\_\_\_\_\_\_ number of different species became extinct at the same time
* Mass extinctions are observable in rock layers when fossils \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from one layer to the next
* Scientists speculate that global events and \_\_\_\_\_\_\_\_\_\_\_\_\_ changes cause mass extinctions
* It is also argued that a sixth mass extinction is occurring \_\_\_\_\_\_\_\_\_\_\_\_\_ due to the destruction of the \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and all of the species that it contains

**The Ozone Layer**

* Earth’s \_\_\_\_\_\_\_\_ gradually became a \_\_\_\_\_\_\_\_\_\_\_\_\_

place to live because the ozone layer protects the

earth from the sun’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ rays

* The first multicellular organisms

to live on land appeared \_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_ years ago

* They are thought to have been \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_ living together in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_ symbiotic relationship. In mutualism, \_\_\_\_\_\_\_ species living together benefit
* Early plants and fungi formed \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which enabled them to live on the harsh habitat of bare \_\_\_\_\_\_\_\_\_\_\_\_\_ Fungi living on plant roots

Arthropods

* + The first \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to successfully invade land from the sea were arthropods
  + An arthropod is a kind of animal with a hard outer skeleton, called an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ body and paired, jointed \_\_\_\_\_\_
  + They do not have a backbone so they are classified as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Examples of arthropods are \_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and \_\_\_\_\_\_\_\_\_\_\_\_
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  + Insects were the first \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ animals
  + Allowed them to efficiently search for \_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_, and \_\_\_\_\_\_\_\_sites
  + Also lead to a partnership between insects and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ plants
  + The first vertebrates to inhabit the land did not come out of the sea until \_\_\_\_\_ million years ago
  + They were early \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which are \_\_\_\_\_\_\_\_\_\_\_- skinned, four-legged animals that today include frogs, toads, and salamanders

Reptiles

* Reptiles evolved after amphibians and are better suited to dry land because their \_\_\_\_\_\_\_\_\_\_\_\_\_\_ skin slows the loss of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Reptiles also have a water-tight \_\_\_\_\_\_\_ which can survive on land

**Mesozoic Era**

* Consists of three periods
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + At the beginning of this era, reptiles with complex \_\_\_\_\_\_\_\_\_\_\_\_ and legs positioned \_\_\_\_\_\_\_\_\_\_ their bodies gave rise to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ around the same time \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ evolved

Mammals &Birds

* Birds may have evolved from \_\_\_\_\_\_\_\_\_\_\_\_\_ dinosaurs during or after the Jurassic period.
* After the dinosaurs became extinct, birds and mammals became the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ vertebrates on land
* After mass extinctions, competition temporarily \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, allowing different organisms to survive and evolve
* Both extinctions and continental \_\_\_\_\_\_\_\_\_\_\_ played important roles in evolution



Continental drift is the movement earth’s land masses over Earth’s surface through geologic time

Based on the theory of \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_, which states that earth consists of rigid \_\_\_\_\_\_\_\_\_\_\_ slowly moving over a \_\_\_\_\_\_\_\_\_\_\_\_\_ layer of rock

* At the beginning of the Mesozoic, the continents were grouped together into one super continent called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* By the \_\_\_\_\_\_\_ of the Mesozoic, the continents were much closer to their modern positions

**Cenozoic Era**

* \_\_\_\_\_\_\_\_\_\_\_\_ and shortest era so far
* The modern human species, \_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_

may have appeared as recently as \_\_\_\_\_\_\_\_\_\_\_ years ago

1. Distinguish between the two groups of prokaryotes
   1. Archaebacteria
   2. Eubacteria
2. Describe the evolution of eukaryotes
3. Recognize an evolutionary advance first seen in protists.
4. Summarize how mass extinctions have affected the evolution of life on earth
5. Relate the development of ozone to the adaptation of life on land
6. Identify the first multicellular organisms to live on land
7. Name the first animals to leave the oceans
8. List the first vertebrates to leave the oceans