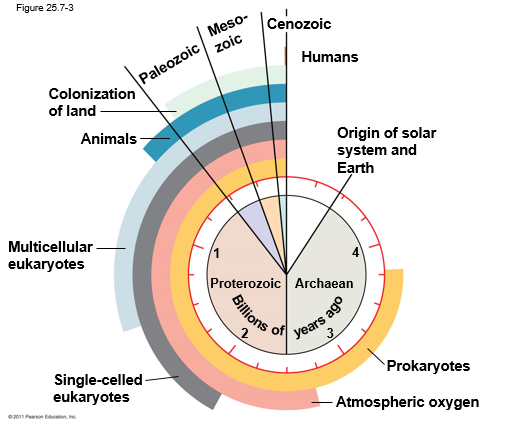
Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Unit 8

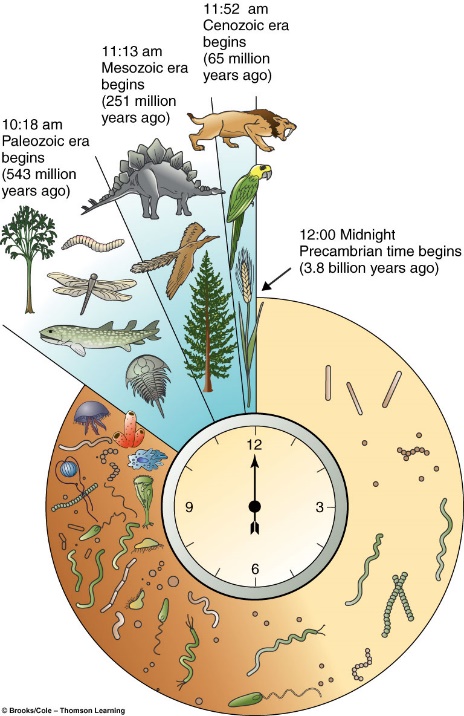
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**Unit 8 Notes: Evolution & Classification**

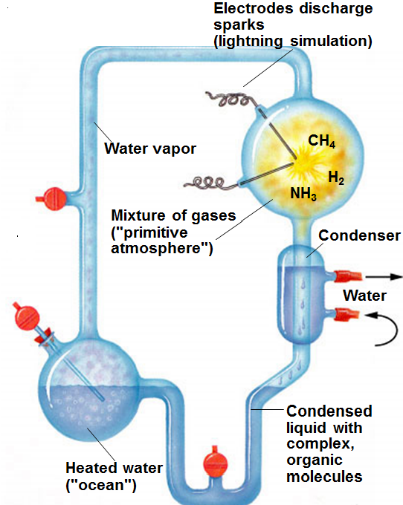
***Topic 1: History of Life***

*By the end of this topic, I will be able to…*

1. *Match the origin of life experiments to the person that conducted them*
2. *Explain the various origin of life experiments*
3. *Sequence the order of life on earth*
4. *Explain how eukaryotic cells evolved from prokaryotic cells*
5. **The History of Life & Origin of Life Experiments**

* Earth + solar system formed about \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Bombardment of Earth by rocks and ice likely vaporized water and prevented seas from forming before 4.2 to 3.9 BYA
* Earth’s early atmosphere likely contained:
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and chemicals released by volcanic eruptions like \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, nitrogen oxides, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, methane, ammonia, hydrogen, hydrogen sulfide.
* NO \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in atmosphere!
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ evolution occurred prior to biotic (living) evolution
  + *Energy from sun, volcanoes and lightning combined w/ gases to form chemical substances (sugars, nucleotides, amino acids) which then combine to form all life on Earth*

***Origin of Life Experiment #1: Miller-Urey***

* In the 1950s, scientists Miller & Urey set out to demonstrate that it was possible for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to appear on earth, given the early atmospheric conditions, without organisms actually present yet
  1. *Recreate earth’s early atmosphere (H, CH4, NH3, H2)*
  2. *Add electric sparks (simulate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)*
  3. *Gasses cooled, leaving \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
     + ****Water droplets contained \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_!
       - *This meant that yes, amino acids and nucleotides could have formed under early conditions on earth!*
* Bottom line: Organic molecules CAN form from inorganic molecules
* RNA evolved before DNA. Why does this make sense?
  1. *RNA codes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (makes inheritance possible)*
  2. *It can \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
  3. *First step of evolution in the Central Dogma*
     + \_\_\_\_\_\_\_\_\_🡪RNA🡪\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Spontaneous Generation v. Biogenesis***

|  |  |
| --- | --- |
| ***Image result for spontaneous generationSpontaneous Generation*** | * Until about \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, many people believed life could arise from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ matter. * Spontaneous Generation: belief that life can arise from nonliving things * *Frogs arise from mud* * *Flies arise from rotting meat* * *Mice arise from dirty underwear* * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ approved this belief – people trust the church, so they thought this must be right * Francesco Redi is the first big name to say something different (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) * This led to a battle of experiments to determine how life actually comes to be |
| ***Biogenesis***  ***Image result for frog life cycle*** | * The belief that life can only come from \_\_\_\_\_\_\_\_\_\_ matter   + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ * Now widely accepted, but was not until about \_\_\_\_\_\_\_\_\_ * In the life cycle of a frog, tadpoles hatch from eggs, eventually are frogs * Flies were previously larvae, which hatched from eggs (deposited on the meat) * Mice are born from other mice |

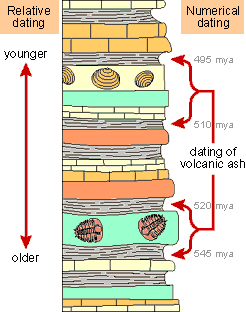
***Origin of Life Experiments***

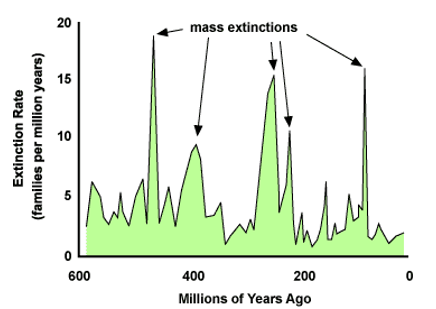
|  |  |
| --- | --- |
| **Francesco Redi (1668)**  **Image result for francesco redi** | * Designed an experiment to test spontaneous generation   + *In support of: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*   ***Setup****: three jars, each holding meat*   * + - **Control**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_       * *Flies and air have access to meat*     - **Experimental setup 1**: \_\_\_\_\_\_\_\_\_\_ lid       * *Neither flies nor air can access meat*     - **Experimental setup 2**: \_\_\_\_\_\_\_ lid (cheesecloth)       * *Flies cannot access meat, air can*   ***Findings****: the only jar with flies was the control!* |
| **John Needham (1748)** | * John Needham, an Englishman, wanted to prove Redi wrong   + *In support of: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*   ***Experiment****: heat broth to remove \_\_\_\_\_\_\_\_\_\_\_\_; seal and let sit… check for life*  ***Findings****: there is bacteria in the broth! Spontaneous generation must be right.*  ***Problem****: did not \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to remove all microbes* |
| **Lazzaro Spallanzani (1770)**  **Image result for needham and spallanzani** | * Lazzaro Spallanzani, an Italian doctor, was sure Needham made a mistake when attempting to remove all microbes and repeated his experiment   + *In support of: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*   ***Experiment****: pour broth in two flasks; heat broth (kill microbes); seal one flask and leave the other open*  ***Findings****: only the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ contained microbes* |
| **Louis Pasteur (1864)** | * French scientist that ended the debate   + *In support of: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*   + *built upon the work of Needham and Spallanzani, but with a twist.*   **Control**: flask with broth that had been heated to kill microbes  **Experimental setup**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_ with broth heated to kill microbes   * + - * *Air has access to the broth!*   ***Findings****: swan-neck flask remained microbe-free until tilting the flask, allowing the broth to pick up microbes from the bend… spontaneous generation is not real!* |

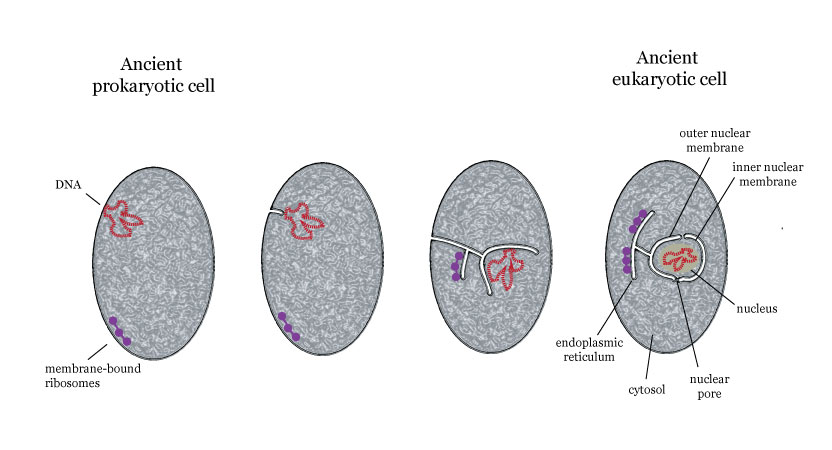
1. **Sequencing Life on Earth**

* Earth: 4.6 billion years old

|  |  |
| --- | --- |
| **Relative Dating**  **Image result for relative dating**  Oldest to youngest: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ age based on the position in the \_\_\_\_\_\_\_\_\_\_\_\_ of the sedimentary rock * \_\_\_\_\_\_\_\_\_\_\_\_\_ form when fine sediment buries organisms, but if they are not buried, it is possible to decay before fossilizing * Areas with wet lowlands or slow moving water are excellent for fossil formation |
| **Absolute (Radioactive) Dating** | * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ based on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of remaining fossil using radioactive dating (carbon-14) * **Half-life:** amount of time it takes for ½ of the radioisotope to decay * Remember: isotopes are the same \_\_\_\_\_\_\_\_\_\_\_\_ with different numbers of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ * Carbon Dating: You want to determine how long it is taking for half of the sample of the isotope to decay. |

* Method of aging: radioactive/absolute dating v. relative dating
* Early atmosphere: CO2, SO2, Methane, ammonia… **no free O2**
  + *****RNA and amino acids form and lead to first cells*



1. ***Precambrian Era (3.5 billion years ago- oldest life)***
2. **Prokaryotes**

* Atmosphere lacked \_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_
  + Organisms had to be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **First cells** were archaebacteria (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)
  + Cell walls lack peptidoglycan
  + Methanogens, halophiles, thermophiles
* **First cells** were \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + There were autotrophic archaebacteria (chemosynthesis, not photosynthesis)
    - As autotrophs began living, they put oxygen into the environment (produce ozone layer)
    - Oxygen began accumulating 2.7 BYA (banded iron/rust in rocks)
* Blue green algae, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, were the first photosynthetic organisms
  + Produce: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which is a carbohydrate (and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)
  + Require: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Significant oxygen in the atmosphere \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ years ago

1. **Eukaryotes Evolve (2.7 BYA)**

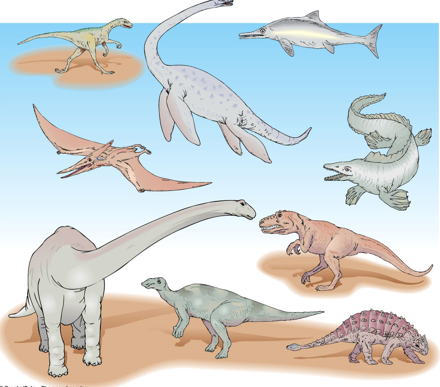
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_, more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than prokaryotes
  + Can reproduce sexually, increasing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Contain a nucleus and other membrane-bound organelles (golgi, lysosomes) for specific jobs in the cell
  + Internal membranes increase \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* How eukaryotic cells evolved: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Ancestral cell \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a smaller cell (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bacteria or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ bacteria), but did not \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Origin of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Mitochondria and chloroplast contain their own (circular) \_\_\_\_\_; have bacterial shape/structure
  + Formed a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ relationship



1. ***Paleozoic Era (245-542 MYA)***

* The first \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organisms evolve: \_\_\_\_\_\_\_\_\_!
  + *Fish are vertebrate (have a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)*
* First plants evolve from seaweed and over many generations, some species evolve and move to land
* Traces of complex burrows have been found meaning that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **Dominant animal life**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + *Vertebrate that spends half its life in the water, the other half on land*
  + *Certain fish evolved limbs and lungs for land life around 380 MYA*
* Conifer evolves (a type of plant that has cones for seeds)
  + *Better adapted to drier climates*
  + *Flowering plants not yet established (all other major plant groups are)*
* Mass extinction to close this period ended \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on earth

1. ***Mesozoic Era (65-245 MYA)***

* ****\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ breaks and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ begin forming
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ begin to **dominate**
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ roamed in this period
  + *First 150 MY of period is ruled by dinosaurs*
* Birds evolve from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ about 155 MYA
* Mammals evolve at the same time as dinosaurs, but do not dominate
  + *Many were very small, nocturnal insect eaters*
    - Nocturnal: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (warm-blooded)
* Flowering plants and insects \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + *When two organisms evolve at the same rate, same time, most often because of each other.*
* Leafy trees and shrubs also evolve

1. ***Cenozoic Era (present/current)***

* Comparatively short when compared to other eras, but full of fossils! (deep record)
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ replace reptiles as the **dominating** group
  + *Mammals: fur, fat, mammary glands, vertebrates*
  + *Angiosperm dominance (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) influenced faster evolution of birds and mammals*
* ~35 MYA– climate became cooler/drier
  + *Remember, mammals are warm-blooded*
* ~2 MYA, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ evolved
  + *Use of fire*
  + *Society and culture*
  + *Tools to control world*

***Topic 2: Evolution***

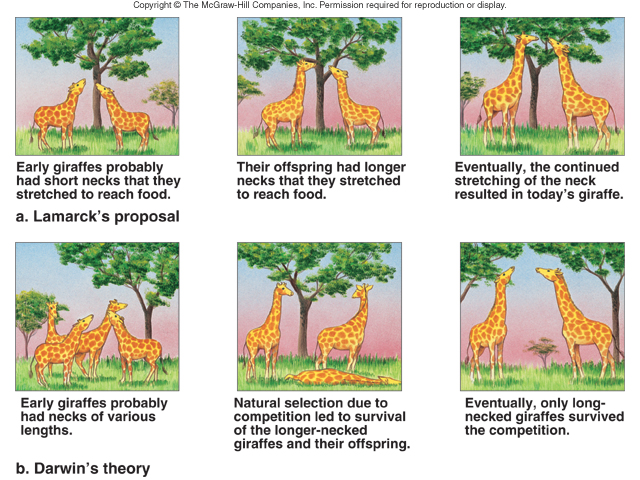
*By the end of this topic, I will be able to…*

1. *Compare and contrast the theories of Darwin and Lamarck*
2. *Explain the evidence for and of evolution*
3. *Describe the process of speciation*
4. **Key Vocabulary:**

* Inference: interpretation based on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Hypothesis: a scientific explanation that can be \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (research based, written \_\_\_\_\_\_\_\_\_\_\_\_\_\_)
* Theory: a well-tested explanation that unifies a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of observations and hypotheses
  + *About the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
  + *Lots of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in support*
* Law: a statement based on repeated experimental observations
  + *\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
* Evolution is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ [of species] over a period of time
  + *Genotypic v. phenotypic changes*
* Evolution acts on populations, **not** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + *A population is a group of individuals of the same species in an area (can interbreed)*
* Populations share a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + *Gene pool: all of the genes (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) for all of the traits in a given population at any time*
  + *If all members of a population are homozygous for a particular allele, then the allele is \_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the gene pool*
* Microevolution: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ scale (molecular)
  + *Seen in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ populations*
* Macroevolution: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ scale (speciation)
  + *Seen in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ record*

1. **Scientists**

|  |  |
| --- | --- |
| Jean Baptiste Lamarck (1744-1829) | **Acquired Traits**   * Theory of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   + *If an organ is used, it becomes stronger and better developed*   + *If an organ is not used, it becomes weaker and withers away* * Believed an organism acquires traits based on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, not from genes * This is WRONG |
| Charles Darwin (1809-1882) | **Natural Selection**  **Descent by Modification**   * Nature will select the organisms that have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that allow them to better \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (survival of the fittest) * Found that species vary locally/globally/over time * Studied finches and other animals in the Galapagos while on board the HMS Beagle (naturalist on voyage) |



1. **Natural Selection**
2. There is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in every population
3. Some variations are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ *(these organisms live and can reproduce, the others die)*
4. More young are produced in each generation than can survive *(\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)*
5. There is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for resources (food, water, shelter, space) *(struggle for existence)*
6. Those that are successful go on to reproduce
7. Overtime, small changes accumulate in a population because the best traits continue to be passed on

* **What leads to these changes?**
  + *Random \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
    - Organisms w/ shorter generation times have higher mutation rates & so evolve quicker than animals w/ longer generation times

***Examples:***

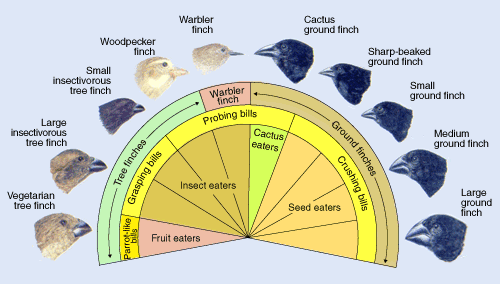
1. **Industrial Revolution vs. Peppered Moth** 
   * Explain: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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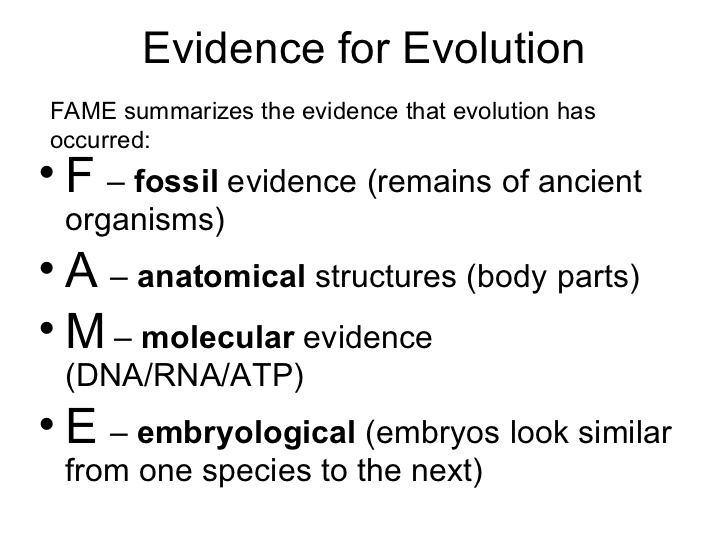
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1. **Darwin’s Finches** 
   * Explain: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. **Evidence of Evolution**

* Fossils
  + *Trace of long-dead organism found in layers of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ rock; \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
* Comparative anatomy
  + *Compare \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in modern organisms with ancient organisms (homologous, analogous, and vestigial structures)*
* Comparative embryology
  + *Finding similarities in embryos; organisms with a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*
* Comparative biochemistry
  + *Finding similarities in protein and DNA sequences (the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ differences, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ related two organisms are)*

1. **Fossils**

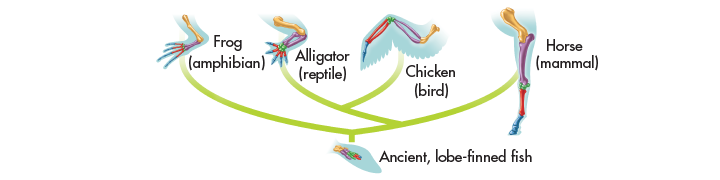
*(tell us age, diet, habitat, lifestyle)*

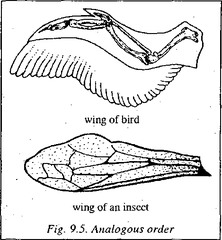
Types of Fossils

* Mold = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in rock
* Cast = a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ filled with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Trace Fossils = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (footprints, burrowing, etc.)
* Resin Fossils = organisms that have been \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ nearly perfectly in plant resin (amber)
* “Living Fossils” = any living species that is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to species previously known only from fossils

1. **Comparative Anatomy**

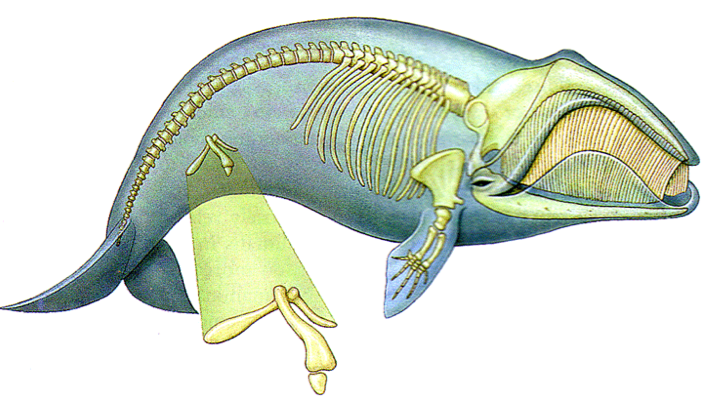
**Anatomy: HOMOLOGOUS Structures**

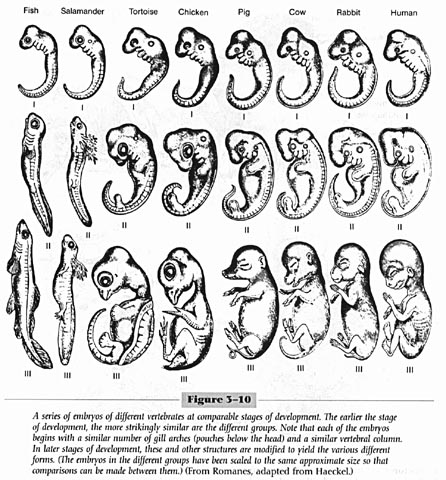
* Darwin proposed that animals with similar structures evolved from a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with a basic version of that structure.
* Structures that are shared by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and that have been inherited from a common ancestor are called ***homologous structures***.
* *Homologous structures* are similar in structure because they develop from same \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ early in development
  + *may or may not have different functions.*

**Anatomy: ANALOGOUS Structures**

* The clue to common descent is common structure, NOT common \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. A bird’s wing and a horse’s front limb have different functions but similar structures/bone configuration (homologous structures).
* Body parts that share a common function, but NOT structure, are called ***analogous structures***. Analogous structures are used for the same purpose but are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The wing of a bee and the wing of a bird are analogous structures.

**Anatomy: Vestigial Structures**

* Not all homologous structures have important functions.
* **Vestigial structures are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from ancestors, but have lost much or all of their \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ function due to different selection pressures acting on the descendant.
  + *The* ***hipbones of bottlenose dolphins*** *or any* ***whale*** *are vestigial structures. In their ancestors, hipbones played a role in terrestrial locomotion. However, as the dolphin or whale lineage adapted to life at sea, this function was lost.*
  + *The human tailbone and appendix are vestigial structures.*

****

1. **Comparative Embryology**

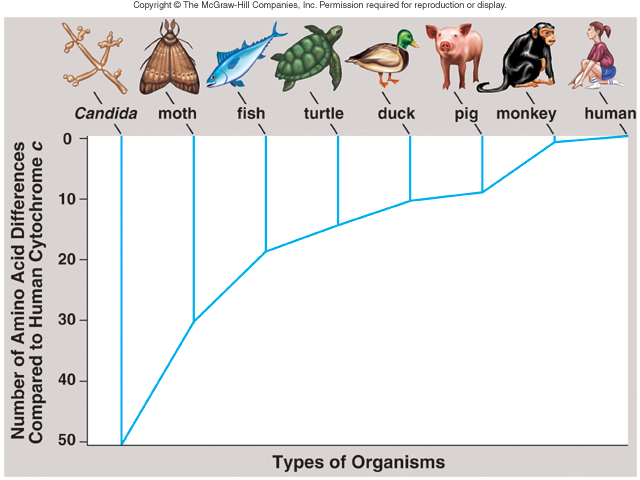
* Explain the image to the right in your own words:

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

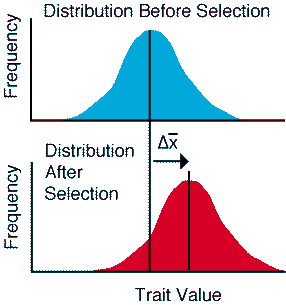
**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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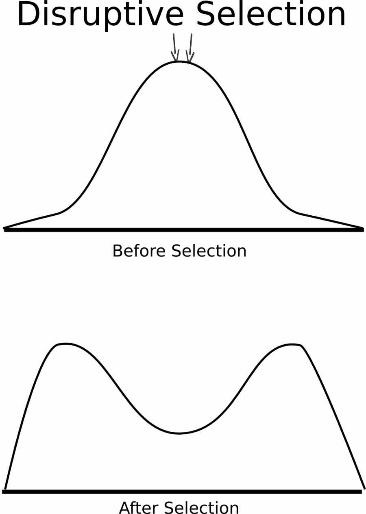
1. **Comparative Biochemistry**

* Universal \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – organisms use the same triplet code (***codons***) and the same 20 amino acids to build all proteins
* All organisms have certain organic molecules in common.
  1. *Hemoglobin - carries oxygen in blood*
  2. *Cytochrome c - protein for cell respiration found in almost all living cells (see graph)*
  3. *HOX genes – control development*

1. **Types of Natural Selection**
2. Stabilizing
3. Directional
4. Disruptive *(AKA diversifying)*
5. Sexual

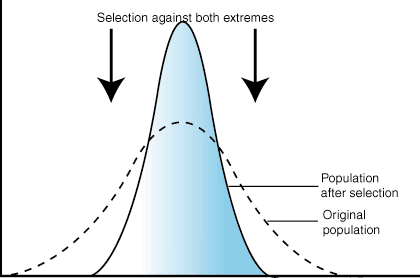
***Directional Selection:*** *Individuals at* ***one*** *\_\_\_\_\_\_\_\_ of the curve (those who have an “extreme” trait in one direction) have higher fitness than those in the middle or at the other end. Over \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the variation of the population’s traits will shift in that* ***direction****.*

* + *Examples: Largest beak size in finches, or longest necks in giraffes are favored in a particular environment.*

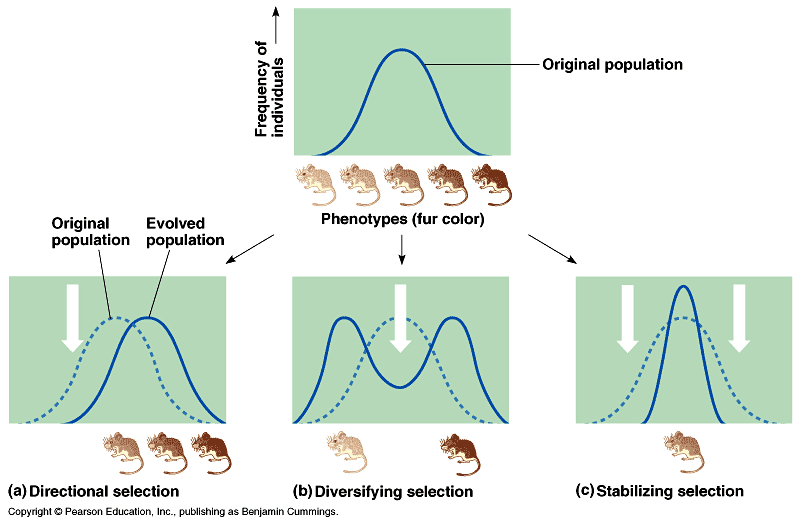
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***Disruptive Selection****: Individuals at* ***both*** *\_\_\_\_\_\_\_\_\_\_ of the curve have higher fitness than those near the middle (the extreme traits are more favorable over the intermediate trait)*

* + *Creates two different \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_* *.*
  + *Examples: In mice that are brown, white, and tan, the brown and white mice are more often chosen as mates because they \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in coloration. The tan intermediate color is not chosen as often, as thus is not favored by the “environment” (the female mice).*

*****Stabilizing Selection****: Individuals near the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the curve (with an “intermediate” trait) have higher fitness / stronger advantage than those at either end of the curve.*

* + *This usually occurs in a very stable environment*
  + *Example: Out of black, tan, and white beetles that live in the desert, the intermediate trait (TAN) would be favored by the environment since they would \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_ and be harder for predators to see.*

**

**Which type of selection could lead to one species splitting up into 2 separate species? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Why?**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

***Sexual Selection****: Females choose males based on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.*

* *Males with these traits have higher fitness, meaning they reproduce more and pass on their traits to offspring*
  + *“Reproductive success”*
  + ***Examples:*** *Female gorillas choose male gorillas as mates based on their \_\_\_\_\_\_\_\_\_\_ and peahens (female peacocks) choose their mate based on their \_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.*

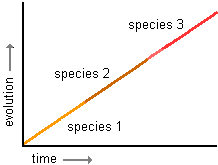
***Artificial Selection:***

* To find an explanation for change in nature, Darwin studied change produced by **plant and animal breeders**.
* Breeders knew that individual organisms vary, and that some of this variation could be passed from parents to offspring and used to improve crops and livestock – **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
  + For example, farmers would select for breeding only trees that produced the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ or cows that produced the \_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Over time, this **selective breeding** would produce trees with even bigger fruit and cows that gave even more milk.
* **Artificial Selection** = humans “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” certain characteristics in plants, dogs, etc., that they find favorable

1. **Speciation**

First off, how do we define a species? Not all scientists agree!

* **Morphological Species Concept** – \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ structures are used to group organisms into species
* **Biological Species Concept**– defines a species as a population of organisms that can successfully \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **Speciation =** formation of a \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

***Reasons for Speciation***

1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Isolation

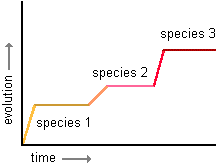
2) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Isolation

-prezygotic (before fertilization)

-postzygotic (after fertilization)

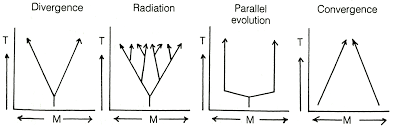
***Two Models of Speciation***

1. **Model #1:** **Gradualism**: change happens \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and new species are made at a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   * 1. *See the graph on top*



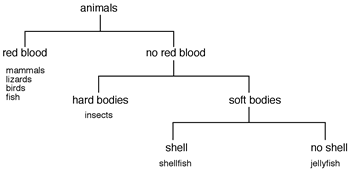
1. **Model #2:** **Punctuated Equilibrium**: there are times of little or no change followed by times of \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – often due to major changes in the environment
   * 1. **Stephen Jay Gould** came up with this model!
     2. *See the graph on the bottom*
2. **Patterns of Evolution:**

* **Co-evolution**: change of two or more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in response to one another (they evolve together over time)
* **Convergent**: organisms with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ancestors become very \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ due to environment (they become more alike)
* **Divergent**: two or more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ populations/species become \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + **Adaptive Radiation**: an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ form of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ evolution where many related species evolve from a single ancestor species (Darwin’s finches)

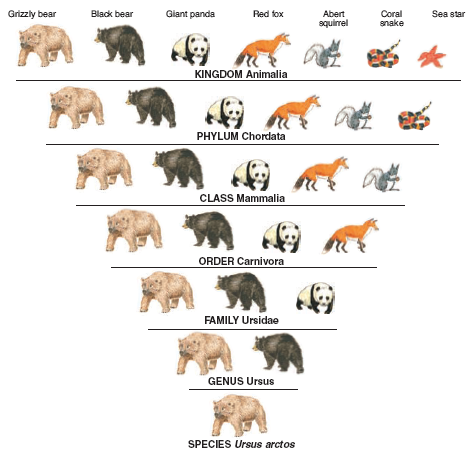


***Topic 3: Classification***

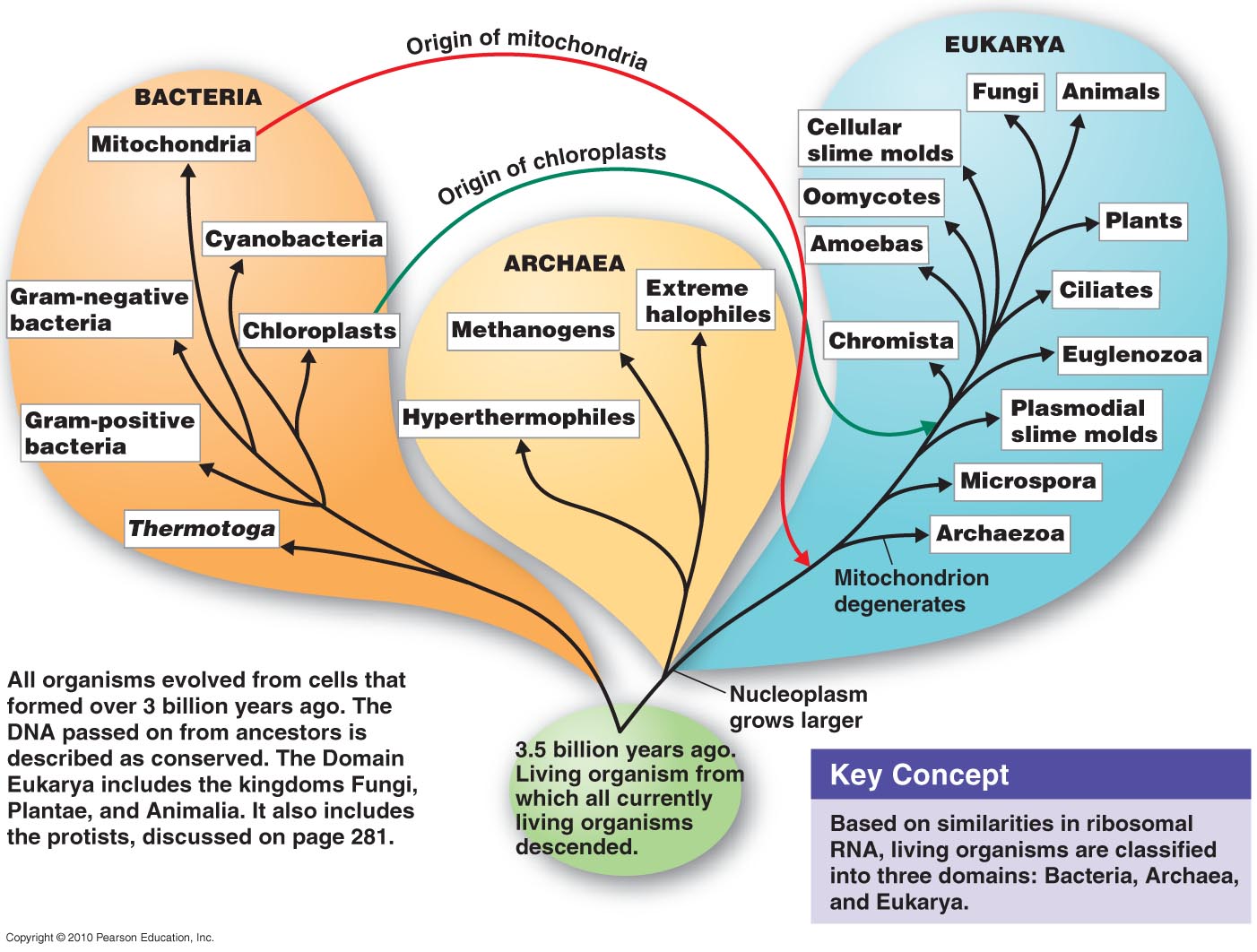
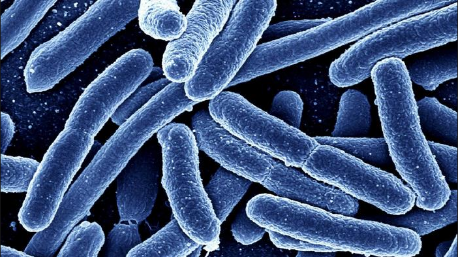
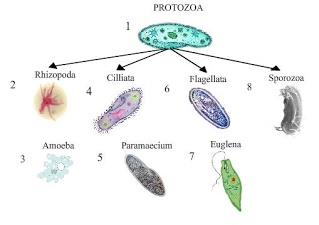
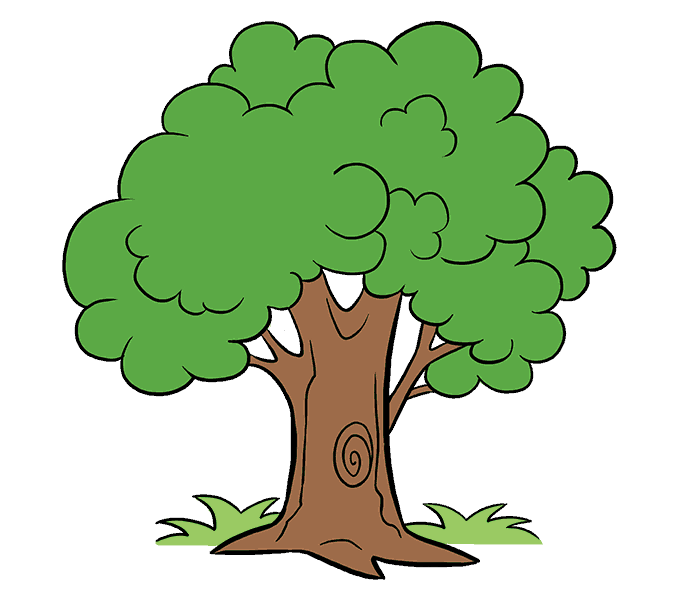
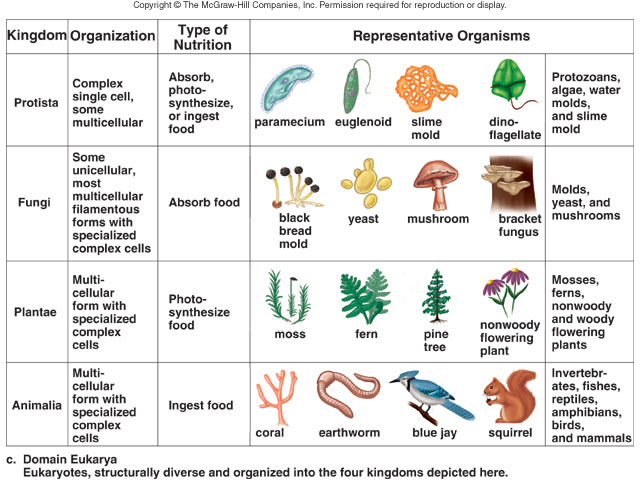
*By the end of this topic, I will be able to…*

1. *Name the three domains and describe common characteristics for each*
2. *Identify the kingdom an organism belongs to when provided characteristics*
3. *Interpret a cladogram*
4. *Use a dichotomous key to name an organism*
5. **What is Classification?**
6. Definition: putting organisms into groups based on their \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
7. How? – Using \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. When comparing the anatomies of different organisms, researchers look at:
   * Homologous structures: common \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; different environments + functions
   * Analogous structures: different ancestors; same \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ + functions
   * Vestigial structures/organs: organs that were useful in an ancestor, but are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
8. The science of classifying organisms is called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
9. First scientist to use modern system of taxonomy = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   * He is called the Father of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
10. 2000 years ago, Aristotle was the first taxonomist
    * Aristotle divided organisms into plants & animals
    * He subdivided them by their habitat ---\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
11. Linnaeus developed a naming system using the following:
    * Levels of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    * Based groupings on morphological (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_) differences of organisms
    * Divided organisms into two groups: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
12. Today, scientists use Linnaeus’s system – the binomial system of nomenclature.
    * *Nomenclature = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (putting organisms into named groups!)*
13. This system is based on a ranking system or hierarchy
    * Modern system is called the binomial system (bi = \_\_\_\_\_\_\_\_\_ ; nom = \_\_\_\_\_\_\_\_\_\_\_\_)
    * These names include the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
14. When writing the scientific name of an organism, both words must be underlined or *italicized*. The genus is always \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and the species always begins with a \_\_\_\_\_\_\_\_\_\_\_\_\_ case letter.
    * *Homo sapiens* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    * *Felis domesticus* = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
15. Scientific names are always written in \_\_\_\_\_\_\_\_\_\_\_\_\_\_ or ancient \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ so that they have the same name everywhere!
    * Can abbreviate the genus with one letter (ex: *H. sapiens)*
16. Genus = a group of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    * How did we define a species in our evolution notes? (*organisms able to interbreed)*
17. Scientific names may \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the organism (Ex: *Chaos chaos)*
18. They may also honor a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or suggest the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the organism *(Linnaea borealis)*
19. Accurately & uniformly names organisms
20. Prevents misnomers such as starfish & jellyfish that aren't really fish
21. **Classification Groups**
22. Taxon ( taxa-plural) is a category into which \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organisms are placed
23. There is a hierarchy of groups (taxa) from broadest to most specific:

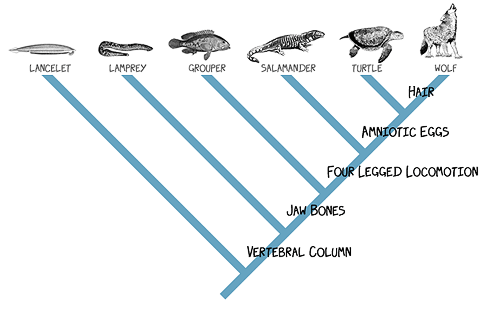
**Domain, Kingdom, Phylum, Class, Order, Family, *Genus, species***

* + - **The largest group is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and the smallest group is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_
      * *Each kingdom (plant and animal) was divided into phyla (plural for phylum)*
      * *Each phylum into a smaller groups called class.*
      * *Each class was divided into orders.*
      * *Each order was divided into families.*
      * *Each family was divided into genera (plural for genus)*
      * *Each genus was divided into species. (scientific name)*

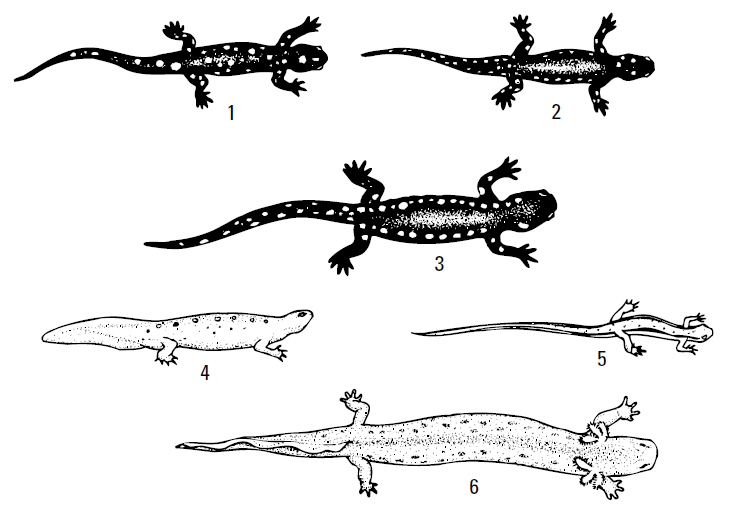
Memory Trick: **K**ing **P**hillip **C**ame **O**ver **F**or **G**ood **S**oup

1. **Domains**
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, most inclusive taxon
3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ domains
4. Archaea and Bacteria are unicellular \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (no nucleus or membrane-bound organelles)
5. Eukarya are more complex and have a nucleus and membrane-bound organelles
6. **The Kingdoms**
7. *Archaebacteria*
   * Probably the 1st cells to evolve
   * Live in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ environments
   * Found in:
     + Sewage Treatment Plants (Methanogens)
     + Thermal or Volcanic Vents (Thermophiles)
     + Hot Springs or Geysers that are acid
     + Very salty water (Dead Sea; Great Salt Lake) – Halophiles
8. *Eubacteria*
   * Some may cause \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   * Found in ALL HABITATS except harsh ones
   * Are both \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   * Important \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for environment
   * Commercially important in making cottage cheese, yogurt, buttermilk, etc.
9. *Protista*
   * Most are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   * Some are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
   * Some are autotrophic, while others are heterotrophic
   * Aquatic
10. *Fungi*
    * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, except yeast
    * Absorptive \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (digest food outside their body & then absorb it)
      + obtain their nutrients by releasing digestive enzymes into a food source.
      + They absorb their food after it has been digested by the enzymes.
    * Cell walls made of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
11. *Plantae*
    * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 🡪 Absorb sunlight to make glucose (photosynthesis)
    * Cell walls made of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    * Kingdom Plantae includes mosses, ferns, cone-bearing plants (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_), and flowering plants (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_).
12. *Animalia*
    * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    * Ingestive \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (consume food & digest it inside their bodies)
      + Feed on plants or animals
    * Most members of the Animal Kingdom can move from place to place.
      + Some are permanently attached to surfaces such as sponges and barnacles.
    * Fish, Birds, Reptiles, Amphibians, and mammals-including humans belong to the Kingdom Animalia.
    * This Kingdom also includes sponges, jellyfish, worms, sea stars, and insects.
13. **Cladograms**

* Diagram showing how organisms are related based on shared, derived characteristics such as feathers, hair, or scales

Using the cladogram to the left…

1. Which organisms have jaw bones? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Which organisms have amniotic eggs? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. What organism is most closely related to the wolf? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. **Dichotomous Key**

* Used to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organisms
* Characteristics given in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (di = 2)
* Read both characteristics and either go to another set of characteristics OR identify the organism

#1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#3: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#4: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#5: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

#6: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_