

# Evolution Notes

# What is Evolution?

- Evolution = \_\_\_\_\_

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- Most changes occur gradually, but can happen on a shorter time scale
  - Variations in populations come from
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# Time Line of Scientists

- 1785 – \_\_\_\_\_ proposes that the Earth is shaped by geologic forces that occurred over \_\_\_\_\_ of years
- 1798 – \_\_\_\_\_ predicts that \_\_\_\_\_ population will grow faster than the space and food supplies needed to sustain it

# Time Line of Scientists

- 1809 – \_\_\_\_\_ hypothesized that \_\_\_\_\_ could be passed to offspring
  - Was found to NOT be correct; behavior can't determine the traits that are passed to offspring
- 1831 – Darwin sails around the world
- 1833 – \_\_\_\_\_ explains that geologic processes observed today have always been occurring...Earth is very old

# Time Line of Scientists

- 1858 – \_\_\_\_\_ discusses the idea of evolution by natural selection
- 1859 – Darwin publishes his book *On the Origin of Species*
- 1866 – \_\_\_\_\_ does experiment with pea plants and starts to determine the role of genes in an organism's appearance

# Darwin's Voyage

- At age 22, Darwin joined a voyage around the world on the \_\_\_\_\_
- He made \_\_\_\_\_ and collected fossils that helped shape his hypothesis about the way life changes over time
- He saw great \_\_\_\_\_ from one island to the next in the Galapagos islands
  - Organisms shared similarities with those on the \_\_\_\_\_
- He compared \_\_\_\_\_ to living organisms – they resembled living organisms

# Darwin's Ideas

- \_\_\_\_\_  
over generations populations change
  - Newer forms appearing in the fossil record are \_\_\_\_\_ of older species
  - All species came from a few original types of life
- \_\_\_\_\_  
\_\_\_\_\_ – populations change by having good traits for an environment, survive, and pass on genes
  - Explains \_\_\_\_\_ evolution occurs

# Darwin's Ideas

- Reproductive Isolation – when species are not able to \_\_\_\_\_ because they are geographically separated (different islands)
  - This causes the appearance of \_\_\_\_\_ to the environments and over time it would cause big differences \_\_\_\_\_ on different islands
- Geographic isolation = \_\_\_\_\_ separation of species that can lead to reproductive isolation



# Darwin's 4 Ideas

- Populations \_\_\_\_\_ offspring
- \_\_\_\_\_ exists among those offspring
- Having a particular trait makes individuals more or less likely to \_\_\_\_\_ in an environment
- Over time, those traits become adaptations
  - \_\_\_\_\_ = inherited trait that is present in a population because the trait helps individuals survive and reproduce in an environment

# Strengths and Weaknesses of Darwin's Theory

- Strengths
    - Many types of evidence
    - Logical and testable mechanism for how evolution occurs: natural selection
    - Variation in individuals is important
  - Weaknesses
    - Darwin didn't know very much about
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# Types of Evolution

- Macroevolution – over \_\_\_\_\_  
periods of time that results in a  
\_\_\_\_\_  
– Helps to create higher order organisms
- Microevolution – over a \_\_\_\_\_  
period of time and occurs \_\_\_\_\_  
a population  
– Antibiotic resistance bacteria and insects that  
are resistant to pesticides

# Antibiotic Resistance or Pesticide Resistance

# Natural Selection

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- Organisms with traits that are not beneficial in the environment will die off
- \_\_\_\_\_ DO NOT evolve; Populations evolve

# Types of Natural Selection

- Stabilizing Selection – maintaining an organisms  

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in an environment
  - Occurs when environment has \_\_\_\_\_ changed much or if species are very well adapted
  
- Directional Selection – change from one  

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\_\_\_\_\_ to another  
within an environment

# Graphs

- Disruptive Selection – when intermediate phenotypes \_\_\_\_\_ and extreme phenotypes remain
- Diversifying Selection – when no single phenotype is \_\_\_\_\_ than another



# Graphs

# Artificial Selection



1875



1925



1975

- reproduction of organisms in a population that have desirable traits



Labradoodle puppies

# Evidence - Fossils

- Fossil Record

- Age of fossils determined by

\_\_\_\_\_ and

\_\_\_\_\_

- Radioactive dating = uses an element's half-life to determine the \_\_\_\_\_ age
    - Half-life = the amount of time for \_\_\_\_\_ of an unstable element to break down into a stable one
    - Ex: Carbon-14 is radioactive

# Evidence

- Fossil Record

- \_\_\_\_\_ – determining age of fossils based on rock layers they are found in
- Fossils in rock layers near the surface are \_\_\_\_\_ than fossils found in rock layers deeper down

– \_\_\_\_\_ record – not all animals will leave fossils and not all fossils have been found

# Evidence

- homologous structures – same basic structures (bones) which are shared by related species because they have been inherited from a common ancestor
  - Ex) bat wing, dog leg, and human arm all have similar bone structure
- vestigial structures – organs that had a function in the past but serves no function in the current organism
  - Ex) appendix and wisdom teeth in humans; pelvic bone in whales

- Embryology – organisms appear \_\_\_\_\_ in their embryo stage of development
  - Many animals have backbones
  - Same group of embryonic cells develop in the same order and in similar patterns in all vertebrates
- Similar \_\_\_\_\_ genes – genes that control the structures that form in the adult form of an organism

# Evidence - Molecular

- Comparison of \_\_\_\_\_  
\_\_\_\_\_ can be used to determine relationships between organisms
  - The more similarities between organisms, the \_\_\_\_\_ they are related
  - The more differences, the \_\_\_\_\_ they are related

# Evidence - Biogeography

- Distribution of \_\_\_\_\_ across different areas of \_\_\_\_\_
  - Can see \_\_\_\_\_ of organisms that live in similar \_\_\_\_\_ on \_\_\_\_\_ different continents
  - Ex: sugar glider and the flying squirrel
  - Ex: muskrat and carybara



# Patterns of Macroevolution

- Convergent evolution – unrelated species become more and more \_\_\_\_\_ to each other
  - Occurs because they are under the same \_\_\_\_\_
  - Ex) sharks (fish) and dolphins (mammals)

- Convergent evolution can lead to the appearance of analogous structures
- Analogous structures = similar structures that have the same function but organisms are \_\_\_\_\_ related
  - Structures appeared because organisms live in similar environments with the same selective pressures
  - Ex) Wings of a bat versus wings of a bird

# Patterns of Macroevolution

- Divergent evolution – related species become more and more \_\_\_\_\_
  - Under go \_\_\_\_\_ = split of species into 2 or more \_\_\_\_\_ when they enter a \_\_\_\_\_ environment with few other species in order to fill a large variety of ecological \_\_\_\_\_
  - Leads to \_\_\_\_\_ = many forms of life
  - Ex) Finches or orchids



# Patterns of Macroevolution

- Extinction – \_\_\_\_\_  
loss of a species
  - Endangered species
- Scientist use fossils to construct the Geologic Time Scale
  - Shows when each type of organisms first appeared on Earth and in what order they appeared

# Microevolution Processes

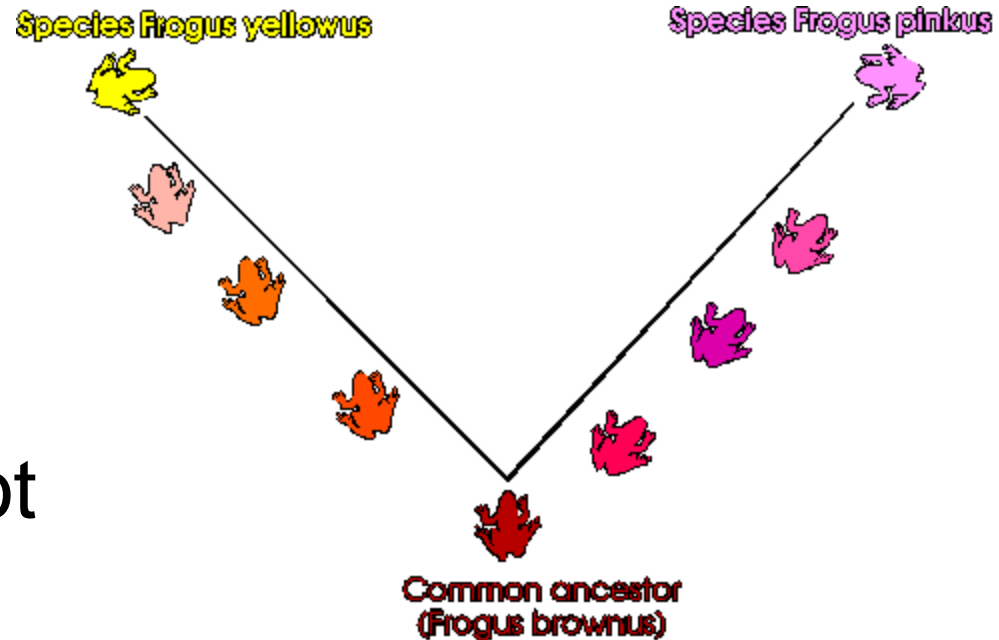
- Natural selection
- \_\_\_\_\_ = movement of individuals into, out of, or between populations
  - Creates **Gene flow** = movement of alleles into or out of an area
- \_\_\_\_\_ = random mating creates random arrangement of traits
- \_\_\_\_\_ = changes the # of alleles in the population
- \_\_\_\_\_ = random change in alleles in a population due to differences in survival and reproduction

# Speciation

- Formation of a \_\_\_\_\_
  - Occurs because of geographic or reproductive isolation
- 2 Rates that speciation can occur:
  - Gradualism = \_\_\_\_\_
  - Punctuated Equilibrium = \_\_\_\_\_

# Rate of Speciation

- \_\_\_\_\_ —  
gradual adaptive  
changes over time  
in a **population**, not  
an organism

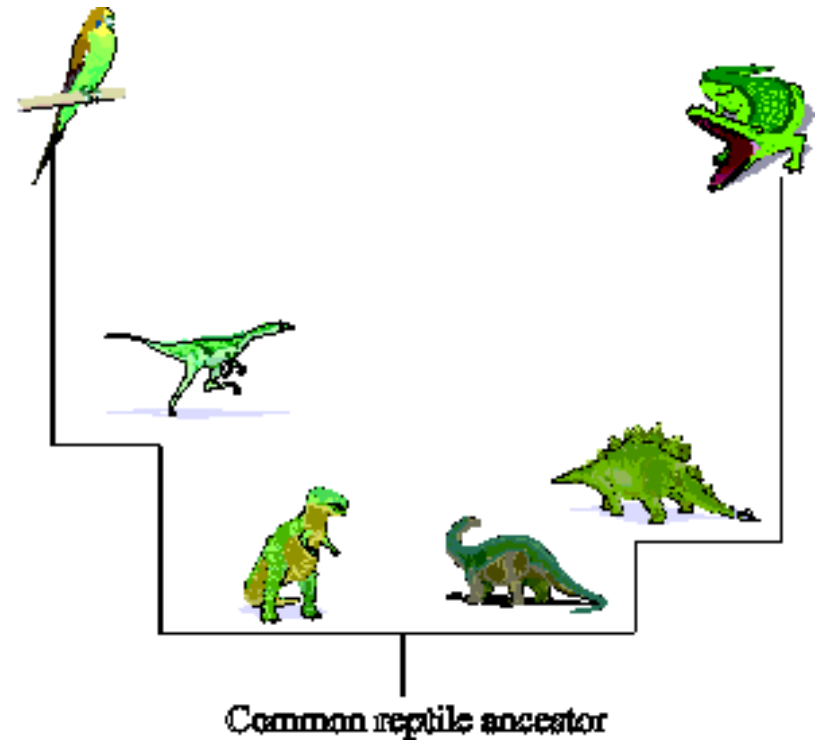


*Gradualism in a hypothetical  
Frogus family*



# Rate of Speciation

- \_\_\_\_\_  
\_\_\_\_\_ changes occur quickly in rapid bursts with long periods of stability in between



# Key Points

- Individual organisms do not evolve – Populations evolve
- Organisms in a population do not CHOOSE to adapt – random mutations occur and they are either good or bad for the environment
- Change in populations can occur over a short period of time (within a species) or over long periods of time (creates new species)

# History of Life on Earth

- Earth formed \_\_\_\_\_ years ago
- As the Earth grew, pools of water started to form and the atmosphere lacked  
\_\_\_\_\_  
– \_\_\_\_\_ experiment tested whether \_\_\_\_\_ could be formed in the lab from molecules that were present in the Earth's early atmosphere
- Many other scientists have tested this and have formed: \_\_\_\_\_, macromolecules, RNA, and \_\_\_\_\_ structures
- No one has been able to create a functioning cell in the lab

# History of Life on Earth

- \_\_\_\_\_ cells were believed to be the first life to evolve on Earth
  - Bacteria started producing oxygen through photosynthesis which added O<sub>2</sub> to the \_\_\_\_\_
- Then, eukaryotic cells arose in the geologic time scale
  - Lots of fossils of \_\_\_\_\_ organisms
- Then,  
\_\_\_\_\_  
organisms started to show up in the fossil record

# History of Life on Earth

- Photosynthetic prokaryotes eventually increased the oxygen levels and other prokaryotes evolve to do
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- \_\_\_\_\_ theory = one bacteria cell was taken up by another cell and the result was a mitochondria and chloroplast
  - Explains how eukaryotic cells developed from prokaryotic cells
  - Evidence: \_\_\_\_\_ in mitochondria and chloroplasts, both can reproduce independently of the cell, and both have \_\_\_\_\_

# Kingdom Review

- Archaeobacteria
- Eubacteria
- Protista

# Kingdom Review

- Fungi
- Plantae
- Animalia

# Plant Adaptations

- Tropisms = plant's response to a stimulus
  - \_\_\_\_\_ = response to light
  - Hydrotropism = response to \_\_\_\_\_
  - Thigmotropism = response to \_\_\_\_\_
  - Gravitropism = response to \_\_\_\_\_
- Plants close stomata (holes in leaves) when it is dry
- Plants produce chemicals to keep predators from eating them



# Animal Adaptations

- Size of beak (birds) or neck (giraffes or Galapagos tortoise) determines
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- Thick fur to live in cold biomes
  - Mimic another \_\_\_\_\_ animal to get protection from predators
  - Hibernation and migration
  - Adaptive behaviors to enhance survival
    - Pill bugs roll up when you touch them
    - Porcupines puff out quills when in danger
    - Courtship behaviors