**NATURAL SELECTION—GUIDED NOTES**

**EVOLUTIONARY IDEAS**

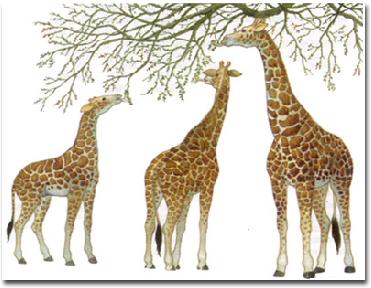
* Although Darwin is given much credit for evolutionary theory, he was not the first person to come up with the idea.
* Evolution is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by which descendants come to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from their ancestors.
  + The concept of evolution had been discussed for more than 100 years prior to Darwin’s theory.
    - Evolution is the central theme in all fields of biology.

Carolus Linnaeus

* Botanist (1700s)
* Developed a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ system for all known organisms (at the time).
  + Organisms are together based on their similarities.
    - Groupings in his classification system reflects evolutionary relationships.

Jean-Baptiste Lamarck

* French Naturalist (1809)
* Stated that all organisms evolve toward \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and complexity.
* He did not think that species became extinct, only evolved into different forms.

The Inheritance of Acquired Characteristics

* Larmark proposed that changes in an organism’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ caused an organism’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to change, leading to greater \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a structure or organ.
* This structure would become larger or smaller as a result, and these changes would be passed onto the organism’s offspring.
* This theory is ultimately \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**CHARLES DARWIN**

* In 1831, he took off on the HMS Beagle, and would explore the world (including the Galapagos Islands) for 5 years.
  + He collected numerous species and took meticulous notes. He would then send them to experts for analysis.

Variations

* Variation is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of an individual from those of other individuals in the group to which it belongs.
* Interspecific variation
  + Occurs among members of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ species.
* Intraspecific variation
  + Occurs among individuals of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ species.

Island Variations

* Darwin noted that the species found on one island looked different from those on nearby islands.
  + Ex. Areas with large, hard-shelled nuts, often had finches with strong, thick beaks. Conversely, areas with many insects and fruits, had finches with more delicate beaks.

Adaptation

* Darwin realized that species must be able to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to their \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and that those adaptations could \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ change in a population over time.
  + An adaptation is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that allows an organism to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in its environment.

Fossil Evidence

* Darwin also found \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of species changing over time.
* Ex. He found the fossils of *Glyptodon*, a giant armadillo. He hypothesized that it was related, in some way, to the modern armadillo.

The Oldest Living Tortoise

* Darwin collected three Galapagos tortoises from the islands, and brought them home. He named them Tom, Dick, and Harry, thinking that all were male.

Artificial Selection

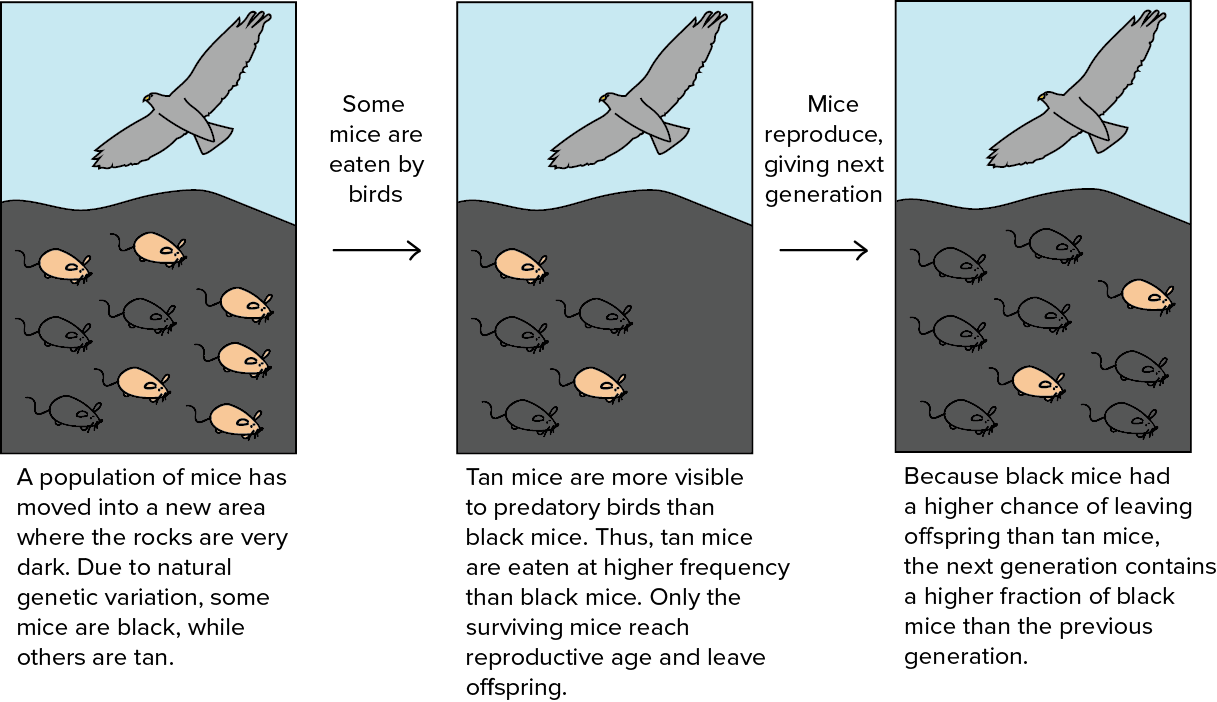
* Artificial selection is the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by which \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by breeding it for certain traits.
  + Humans determine which trait is favorable and then breed individuals that show those traits.
    - Darwin began to breed pigeons to understand artificial selection.
* Darwin compared what he learned from breeding pigeons to his ideas on adaptation.
  + In artificial selection, features such as reversed neck feathers, large crops, or extra tail feathers are selected over generations because breeders like these particular traits.
  + If a feature is not desirable, or “useful”, it would be selected against.

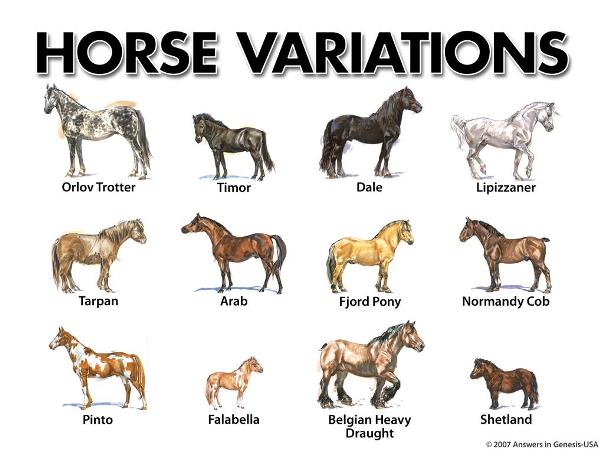
Natural Selection

* Natural selection is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by which \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that have inherited \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ adaptations produce \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on average than do other individuals.
  + In nature, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the selective agent.
    - Therefore, characteristics are selected only if they give advantages to individuals in the environment.

Struggle for Survival

* An English economist, Thomas Malthus, had proposed that resources such as food, water, and shelter were natural limits to population growth.
  + Darwin reasoned that this struggle took place in nature, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ were \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and organisms had \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ than could ever \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
    - Those individuals best suited to their environment would survive and breed.



**EVIDENCE FOR NATURAL SELECTION**

* There are four main principles to the theory of natural selection:
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Variation

* The differences among individuals result from differences in the genetic material of the organisms, whether \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from a parent or resulting from a genetic \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Adaptation

* Sometimes, a certain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ allows an individual to survive better than other individuals it competes against in its environment.
  + More \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ individuals are “naturally selected” to live \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and to produce \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ offspring that share those adaptations for their environment.

Descent with Modification

* Over time, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, will result in species with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ suited for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in an environment.
  + More individuals will have the trait in every following generation, as long as the environmental conditions continue to remain beneficial for that trait.

Fitness

* Fitness is a measure of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and produce \_\_\_\_\_\_\_\_\_\_\_\_\_ offspring relative to other members of the population in a given environment.
  + After the climate change, jaguars that had larger teeth and jaws had a higher fitness than other jaguars in the populations.

**THE EARTH’S HISTORY**

Geologic Change

* The age of the Earth was a key issue in the early debates over evolution.
  + The common view was that the Earth was 6000 years old.
  + Many scientists argued that the world had to be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ based on geologic changes (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_), and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ found within them.

Catastrophism

* The theory that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, such as floods and volcanic eruptions have happened often during Earth’s history.
  + These events shaped landforms and caused \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to become extinct in the process.

Gradualism

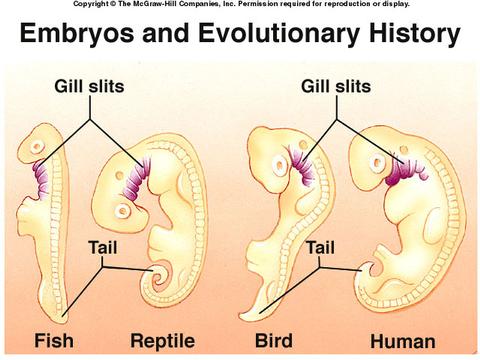
* The theory that landforms resulted from \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ over long periods of time.
  + The laying down of soil or the creation of canyons by rivers cutting through rock were not the result of large-scale events, but rather resulted from slow processes that had happened in the past.

Uniformitarianism

* This theory states that the geologic processes that shape Earth are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (constant) through time.
  + It proposes that both \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ AND \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (i.e. wind, rain, current, etc) shaped the Earth, these changes have occurred at a constant rate and are ongoing.

Transitional fossils

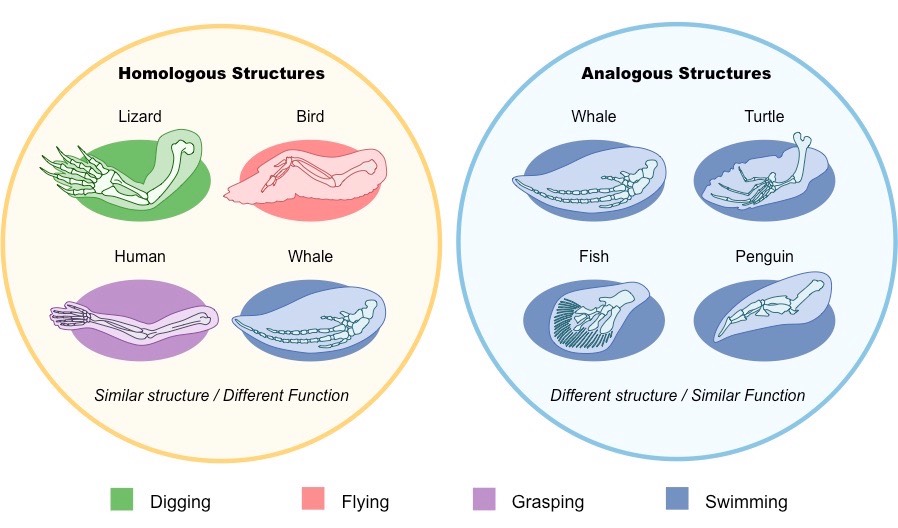
* Many transitional forms have been discovered between species.
  + The fossil record today includes many thousands of species that show the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ over time.
    - The mix of traits in transitional species often makes it difficult to tell where one species ends and another begins.

Embryology

* If you look at the larvae of a crab and a barnacle, they both swim and look alike, but the adult animals look and behave very differently.
* Embryos of vertebrates can also be very hard to tell apart.
  + Birds, fish, reptiles, and mammals all have gill slits and tails as embryos.
    - Such similar features in different organisms embryos suggests \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ from a distant \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ancestor.

Homologous Structures

Features that have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ but \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* + Their appearance across different species offers strong evidence for common\_\_\_\_\_\_\_\_\_\_\_.
* Forelimb anatomy
  + The forelimbs of humans, cats, whales and bats have several bones that are very \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to each other despite their different functions.

Analogous Structures

* Some structures found in different species have the same function, but \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ evolve from a common ancestor.
  + For example, two organisms need to be able to fly. Both can develop similar adaptations using different body parts, like the wings of bats and the wings of flying insects.
* Features that have the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ function but \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ structures.
  + The similar function of wings in bats and flying insects evolved separately. Their ancestors faced similar environmental challenges and came upon similar solutions.

Vestigial Structures

* Some organisms have structures that seem to lack any useful function, or at least are no longer used for their original purpose.
  + For example: snakes have tiny pelvic bones and stump-like limb bones, even though snakes don’t walk.
* Vestigial structures once had a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ but \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ do.
* Appendix
  + The appendix is a remnant of the large intestine in plant-eating animals. It helps to digest cellulose.
  + In humans, we don’t eat much cellulose, and the appendix performs a very limited function.