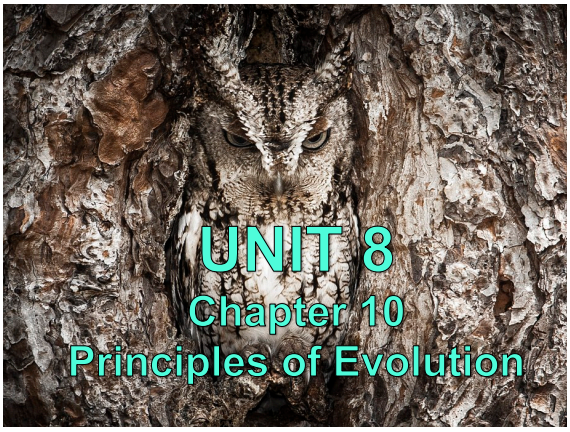
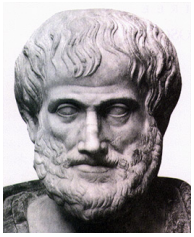


UNIT 4: EVOLUTION
Chapter 10: Principles of Evolution

I. Early Ideas about Evolution (10.1)

A. Early scientists proposed ideas about evolution

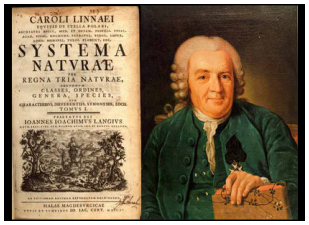


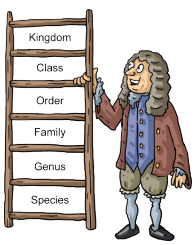
1. **Evolution-** process of biological change by which descendants come to differ from their ancestors
2. Other scientists besides Darwin came up with idea

Around 350 BC - Aristotle
The Greek philosopher, Aristotle, studied marine animals and developed an epigenetic model of evolution. He also developed a classification system for all animals.

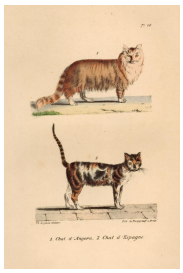
B. Four scientists important in development of evolution theory

1. **Carolus Linnaeus (**1700's)- developed classification system to name living things (grouped by similarities)

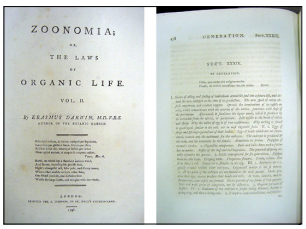


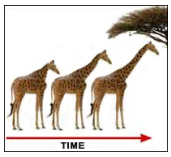


2. **Georges Louis Leclerc de Buffon** (1700's)- proposed species shared ancestors instead of arising separately



3. **Erasamus Darwin**- Darwin's grandfather. Proposed that all living things were descended from a common ancestor

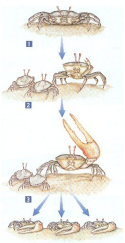




4. **Jean-Baptiste Lamarck** -proposed theory that all organisms evolved toward perfection and complexity.

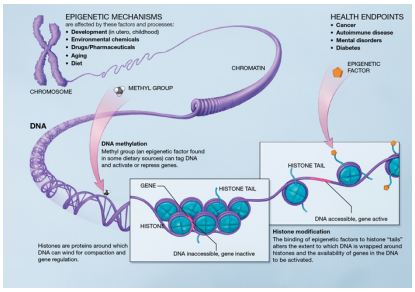
a. Proposed changes in environment caused an organism behavior to change, leading to greater use or disuse of a structure or organ

b. Organism then passed changes on to offspring



NEW DISCOVERIES

Epigenetics- functionally relevant changes to the genome that do not involve a change in the nucleotide sequence.



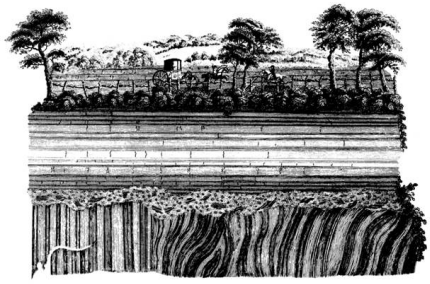
C. Theories of geologic change set stage for Darwin's Theory

1. **Age of the Earth** was key issue in early debates

a. Many thought Earth on 6000 years old

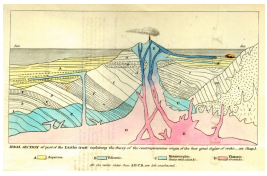
b. Discovery of **fossils** created controversy

2. **James Hutton** (late 1700's)- proposed that Earth very old. Said **geologic** change occurred gradually (called **gradualism**)



3. **Charles Lyell** (1830)- published "Principles of Geology". Also said Earth must be very old. Said changes in Earth occurred at constant rate over time
   a. Same changes we see happening today

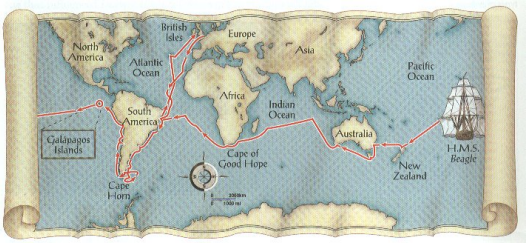
   b. Greatly affected Darwin's thinking.



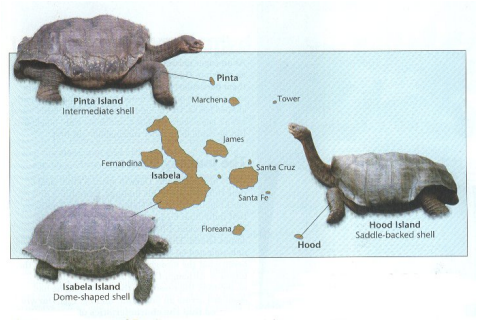
II. Darwin's Observations (10.2)

A. Darwin observed differences among island species

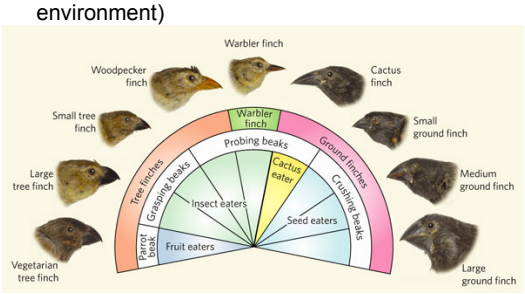
1. Differences between species studied on **Galapagos Islands**



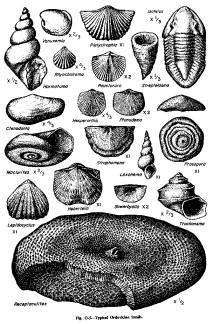
2. Noticed variations well suited to animals environment (**variation**- differences in physical traits)



3. Studied birds, tortoises and said some how adapt to their surroundings (**adaptation**- a feature that allows an organism to better survive in environment)



B. Darwin observed **fossil** and **geologic** evidence supporting ancient Earth

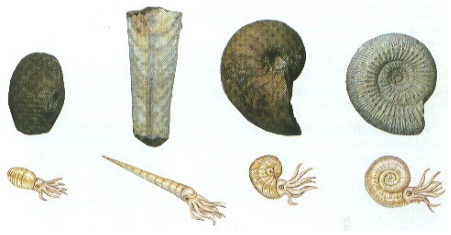


1. Discovered fossil evidence of species changed over time

2. Suggested that modern organisms have relationship to fossil forms

3. Earth must be very old (supported Lyell's theory)

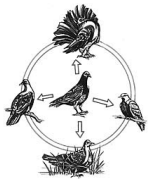
4. Darwin said, like the Earth, organisms must change gradually over time



III. Theory of Natural Selection (10.3)

A. Several key insights led to Darwin's idea for natural selection

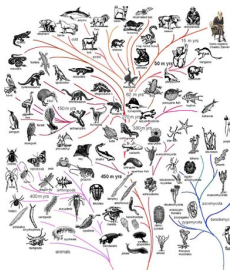
1. **Artificial Selection**- process by which humans changes a species by breeding it for certain traits



a. Darwin compared what he learned about breeding to his idea of adaptation
b. Said that in nature, environment creates selective pressure instead of humans in artificial selection

2. **Natural Selection**- mechanism by which environment is selective agent

a. Darwin used work of others to develop theory

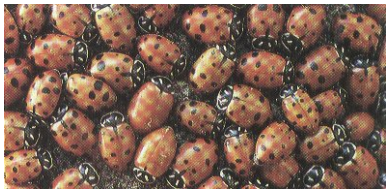


b. Said adaptations arose over many generations (called process "**decent with modification**)

B. Natural selection explains how evolution can occur

1. **4 main principles** to theory of natural selection

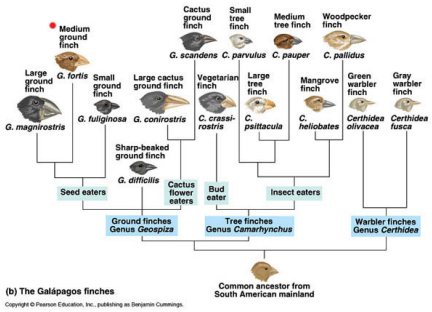
a. **Variation**- variations in populations are basis for natural selection.



b. **Overproduction**- organisms produce more offspring than will survive (creates competition)

c. **Adaptation**- Some adaptations allow organism to survive at higher rate and individuals are "naturally selected" to survive and produce offspring

d. **Descent with Modification**- Over time, natural selection will result in species with adaptations that are well suited for survival



Before the industrial revolution, soot was rare in the English countryside. A light-colored moth was difficult to see against the clean bark.

Which moth would most likely be noticed by a hungry bird?

C. Natural selection acts on existing variation

1. **Natural selection acts on phenotypes** (not genetic material itself)

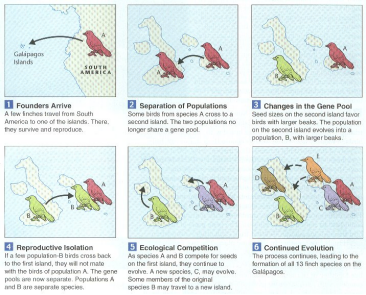
2. As environment changes, different traits will become beneficial.

IV. Evidence of Evolution (10.4)

A. Evidence for evolution in Darwin's time came from several sources

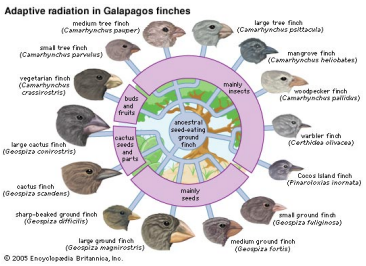
1. **Fossils**- supported Darwin's "descent with modification"

2. **Geography**- Darwin realized that finches found on Galapagos Islands closely resembled those found on mainland.

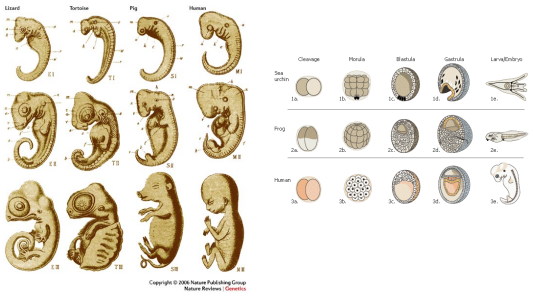


a. Over time new traits became well established in separate island populations

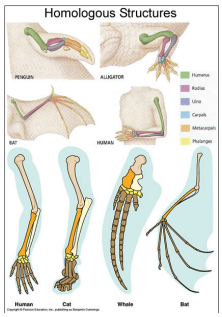
b. The different environments on each island led to specific adaptations in diets, habits, and beak shapes



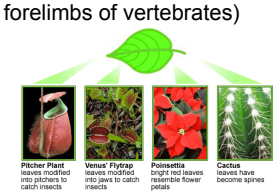
3. **Embryology**- Similarities in embryos showed relation-ships between organisms and possible common ancestor



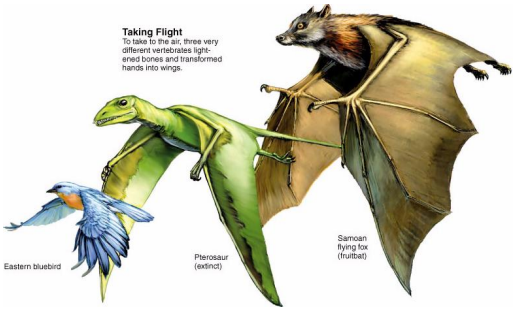
4. **Anatomy**- Some of Darwin's best evidence came from comparing body parts of different species



a. **homologous structures**- features that are similar in structure but have different functions (**suggested common ancestor**) (i.e. forelimbs of vertebrates)

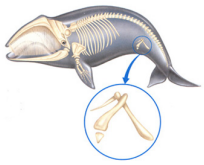


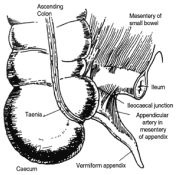
b. **analogous structures**-structures that perform similar function but are not similar in origin (i.e. wings of bats and insects)



B. Structural patterns are clues to the history of a species

1. **vestigial structures**- structures or organs that seem to lack any useful function that had a function in early ancestor
2. Examples of vestigial structures found in many organisms. (e.g. human appendix, wings of Ostriches)





V. Evolutionary Biology Today (10.5)

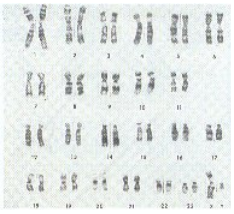
A. **Fossils** provide a record of evolution

1. **Paleontology**- study of fossils or extinct organisms

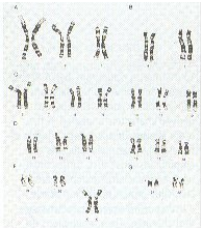
2. Fossil evidence shows change in forms over time.

3. New fossils found that fill in "gaps" (transitional forms)

B. **Molecular** and **genetic** evidence support fossil and anatomical evidence

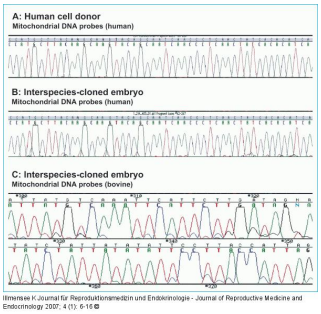


Chimp chromosomes (24 pair)



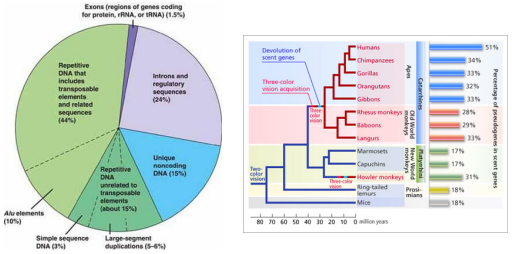
Human chromosomes (23 pair)

1. **DNA sequence analysis**- more closely related have more similar DNA

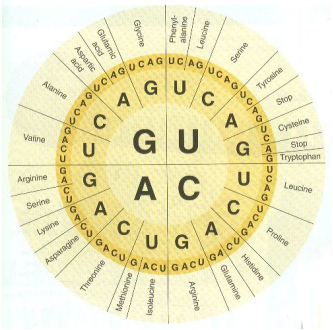


Ilmensee K. Journal für Reproduktionsmedizin und Endokrinologie - Journal of Reproductive Medicine and Endocrinology 2007; 4 (1). 6-16

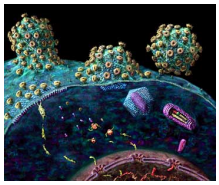
2. **Pseudogenes**- genes that no longer function. Similarities in organisms suggest common ancestor



3. **Protein comparisons**- Similarities in **proteins** found in specific cell types suggest common ancestor



C. Evolution unites all fields of biology
   1. New discoveries and tools helping to study mechanisms of evolution
   2. Principles used to study medicine, disease, ecology, etc.



To avoid going extinct a population must not only survive, but also reproduce. Yale's Paul Turner, associate professor of ecology and evolutionary biology, tested the practicality of luring a virus population into the wrong cells within the human body, thus preventing virus reproduction and alleviating disease.