



* Changing and Evolving

Adaptive Progress

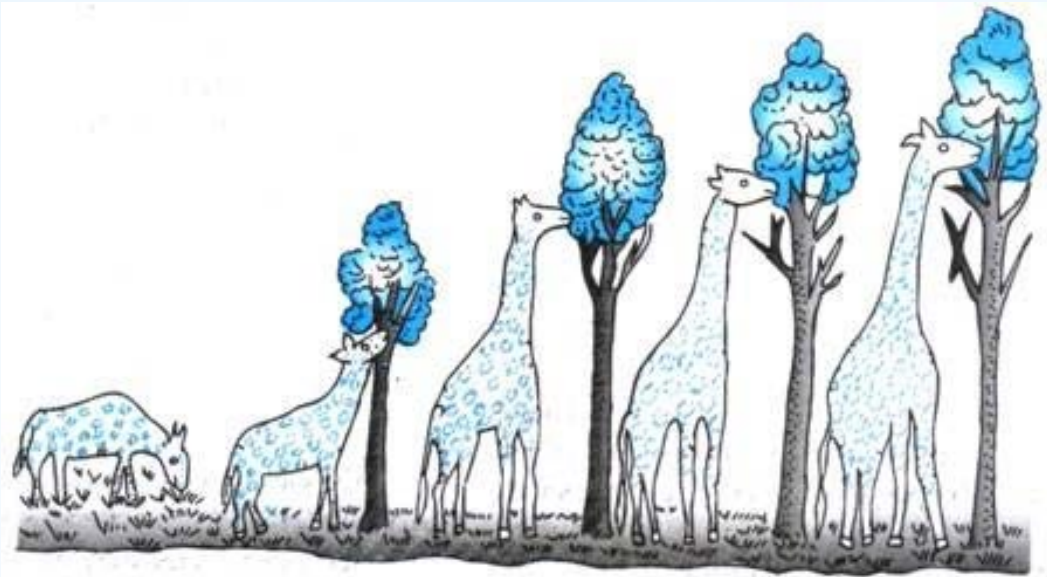
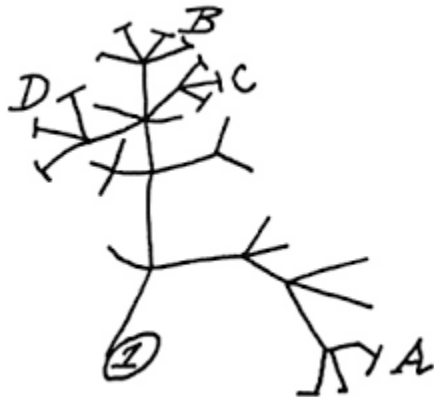


Fig. 7.35. Stages in the evolution of present-day giraffe.

*What does it mean to evolve?

- * Observations
- * Shared Characteristics
- * Ecological Niches
- * Adaptation
- * Patterns
- * Processes



Theories of Evolution

Jean Baptiste Lamarck- 1809 French Biologist

- Proposed that life evolves or changes.
- Explained evolution as a process of adaptation.
- Law of Use and disuse. -New organs arise according to the needs of an organism, and their size is determined by the degree to which they are used.
- Inheritance of acquired characteristics.- Useful characteristics acquired by an individual during its lifetime can be passed on to its offspring.
- No evidence to support this theory.

* Evolution Revolution

- * Linneus
- * Cuvier
- * Diderot
- * Lamarck
- * Lyell
- * Wells
- * **Wallace**
- * Chambers
- * Blyth
- * Vogt
- * Darwin (*Grandfather*)

- * Binomial system
- * Paleontology
- * One primeval organism
- * Inheritance
- * Principles of Geology
- * **Natural Selection**
- * *Zoonomia*
- * *Vestiges*
- * Advance/Regress

* Contributions

Paleontology
Cuvier

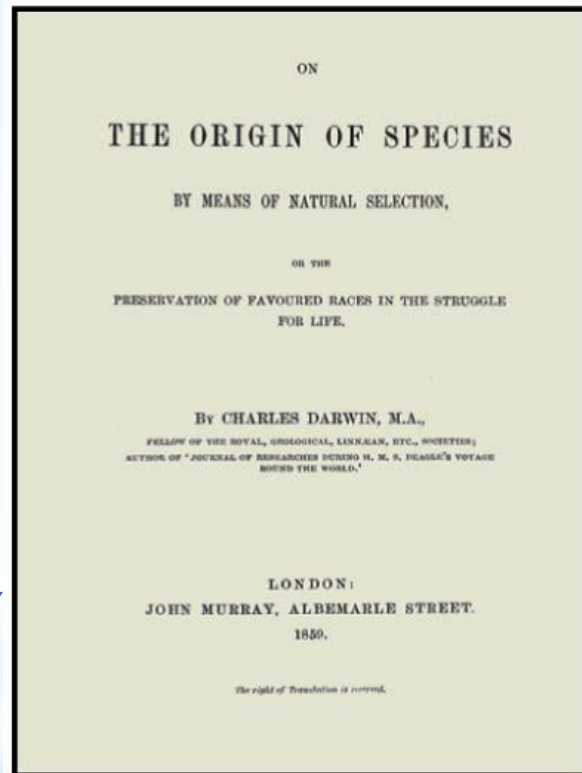
Natural Selection
Wallace

Geology
Hutton, Lyell

Inherited
characteristics
Lamarck

Advantageous Traits
Increase Survivability
Malthus

Evolution theory
Vestiges
Chambers



Unity
Diversity
Well suited for Environment

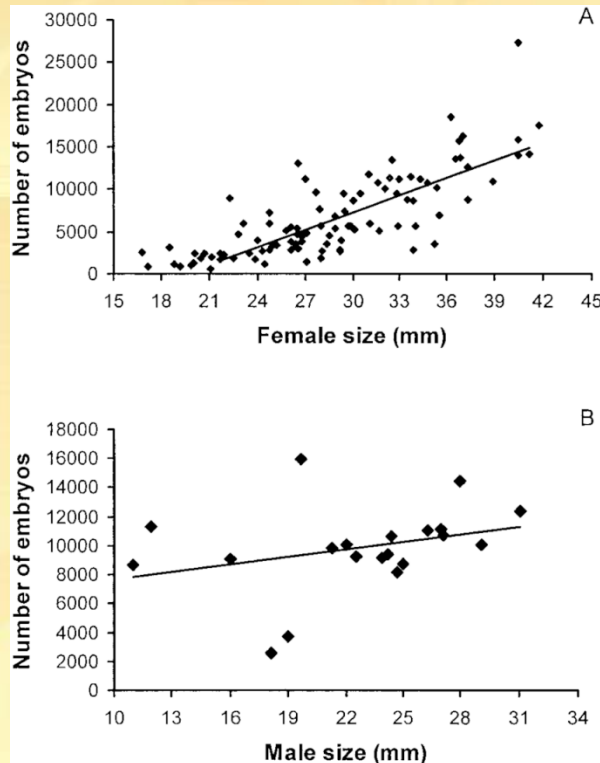
Charles Darwin (1809-1882) *Origin of Species*



- Charles Darwin (above) observed that pigeons, dogs, and horses were subjected to artificial selection in order to improve their breeding
- On Galapagos Islands in 1832, Darwin observed that 14 species of finches adapted in different niches descended from a common ancestor (next slide)
- He conceived the idea of natural selection and after years of dithering finally published his conclusions in *The Origin of Species* in 1859
- **Alfred Russel Wallace** (below) drew the same conclusions—but Darwin published the results first
- (Wallace made a bad career move: he sent his results to Darwin asking for comments. Oops!)



Evolutionary Theories: Natural Selection



- **Natural selection Defined:**
- Evolutionary change by
- Differential reproductive success of individuals
- within a **species** (group of organism able to reproduce fertile offspring)
- Through successful adaptation to an environment

Body size of *Crepidula* (snail)

Key Features of Natural Selection

- Individuals with certain heritable traits survive and reproduce at a higher rate than other individuals
- Natural selection increases the frequency of adaptations that are favorable in a given environment
- If an environment changes over time, natural selection may result in adaptation to these new conditions and may give rise to new species

Reproduction
Adaptation
Species

Figure 22.6



(a) Cactus-eater



(b) Insect-eater



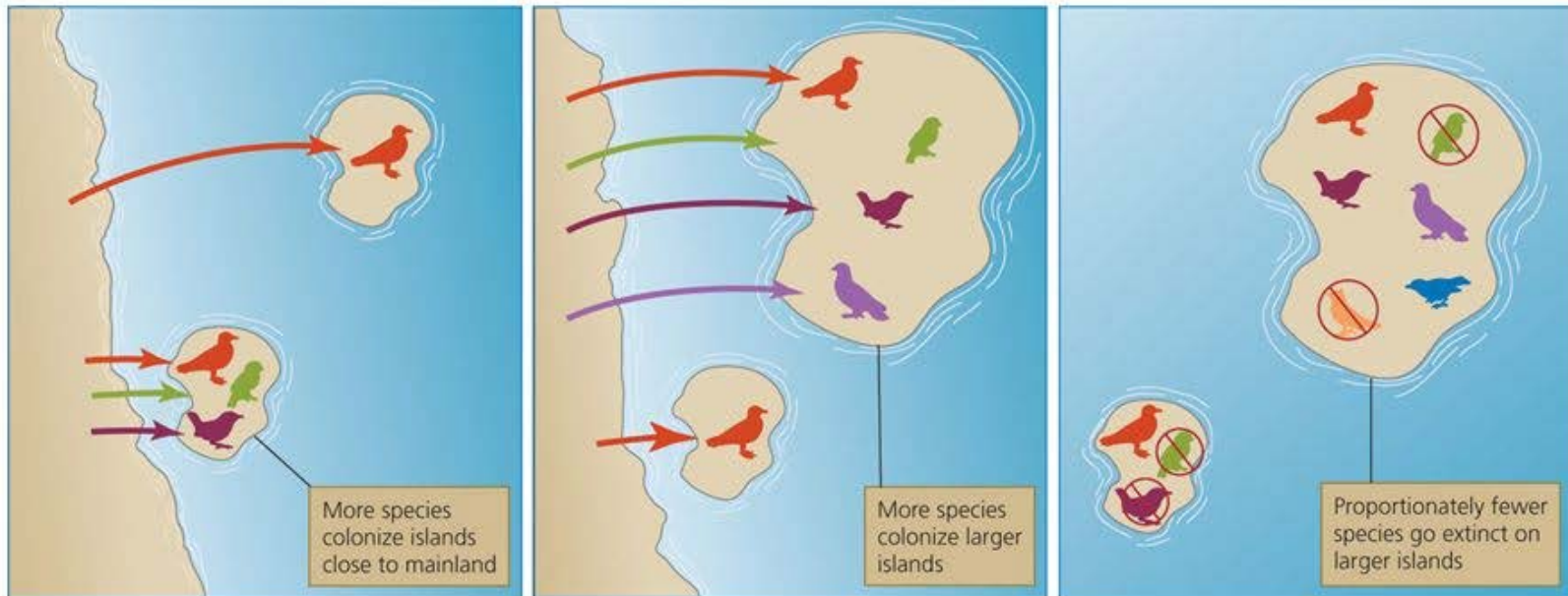
(c) Seed-eater



* Biogeography

Species richness results from island size and distance

- Fewer species colonize an island far from the mainland
- Large islands have higher immigration rates
- Large islands have lower extinction rates



(a) Distance effect




FIGURE 9.18

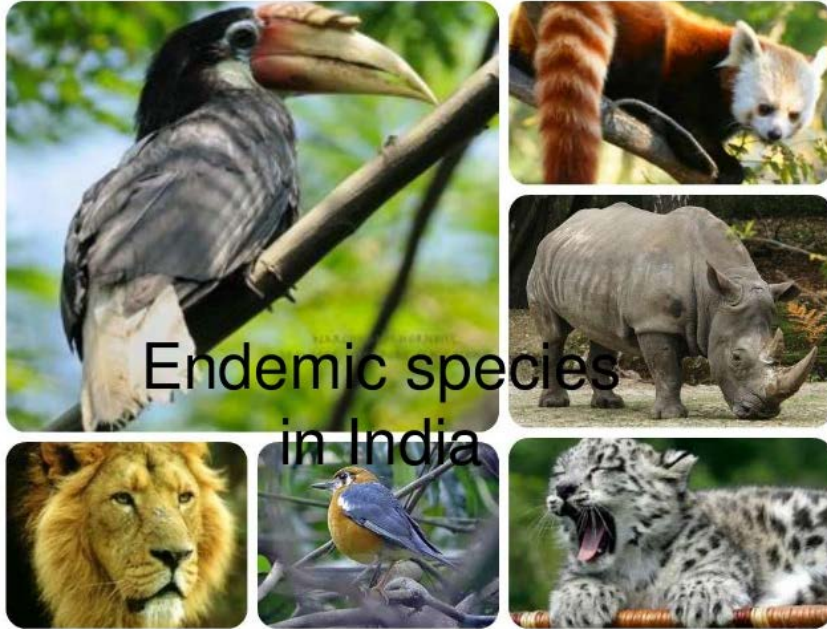
(b) Target size

(c) Differential extinction



Galápagos Islands Finches

Shape of Head and Beak			
Common Name of Finch Species	Cactus ground finch	Sharp-beaked ground finch	Large ground finch
Main Food	Cacti	Seeds	Seeds
Feeding Adaptation	Large crushing beak	Pointed crushing beak	Large crushing beak
Habitat	Ground	Ground	Ground



Malaysia



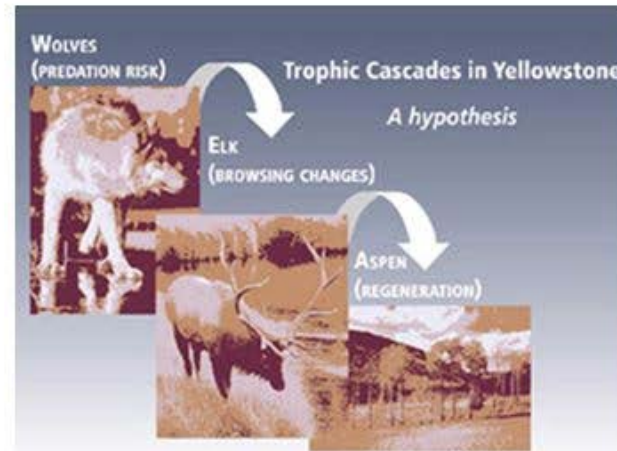
* Endemic Species

Categories of Biogeography

- **Historical biogeography**
– emphasizes the study of changes in species ranges that have taken place over evolutionary time.
- **Ecological biogeography**
– spatial investigation of current distributions and seeks to explain that interaction in terms of community-level interactions.



Sept 22, 2010



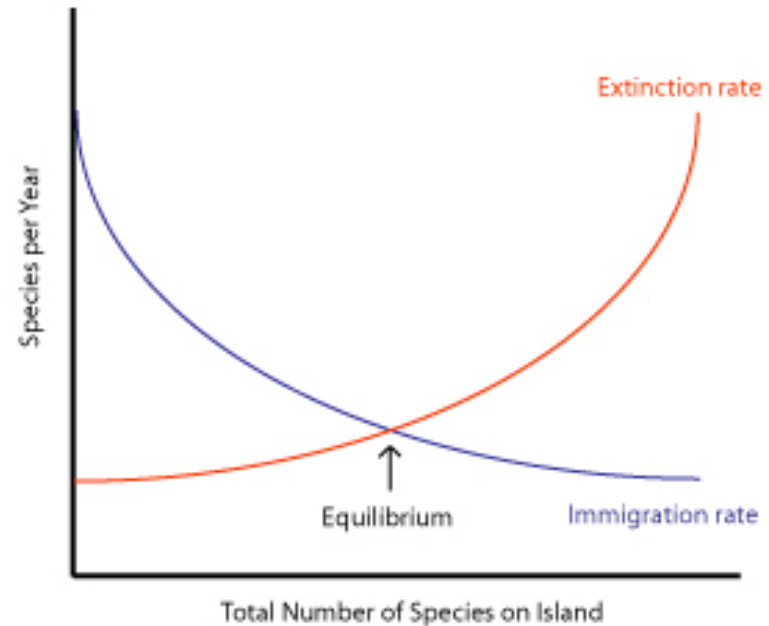
The Fossil Record

Fossils may be used to determine information about species:

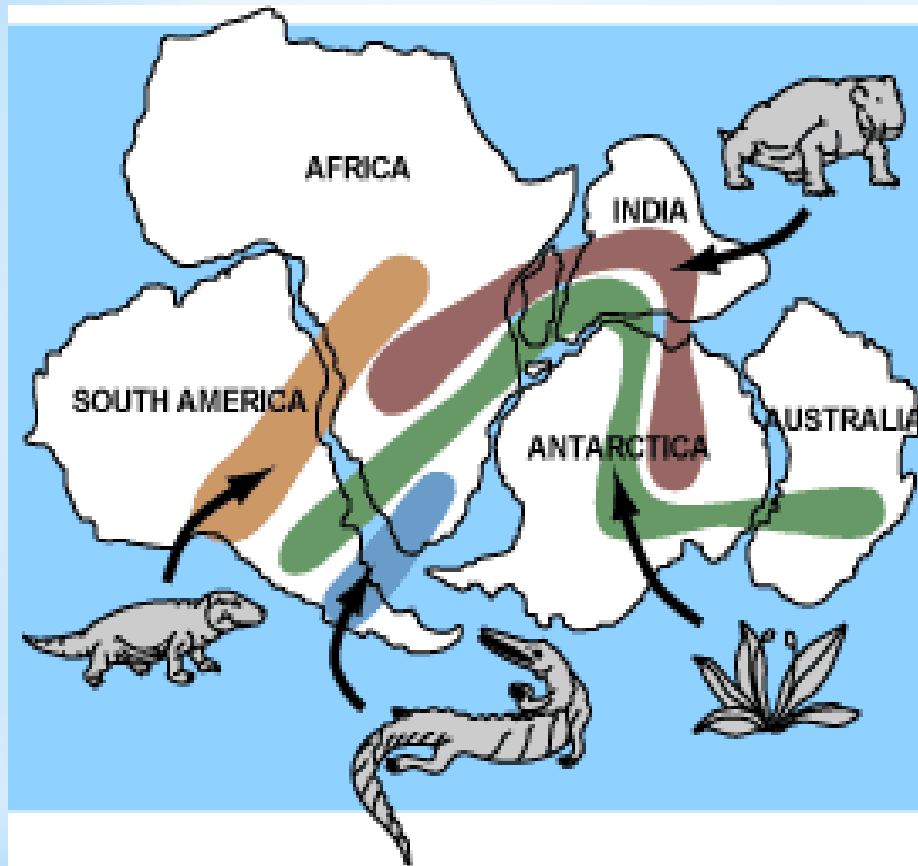
Size
Weight
Age
Location
Migration
Cause of extinction
Diet
Common origins







- * Stages of Development
- * Evolutionary Progression

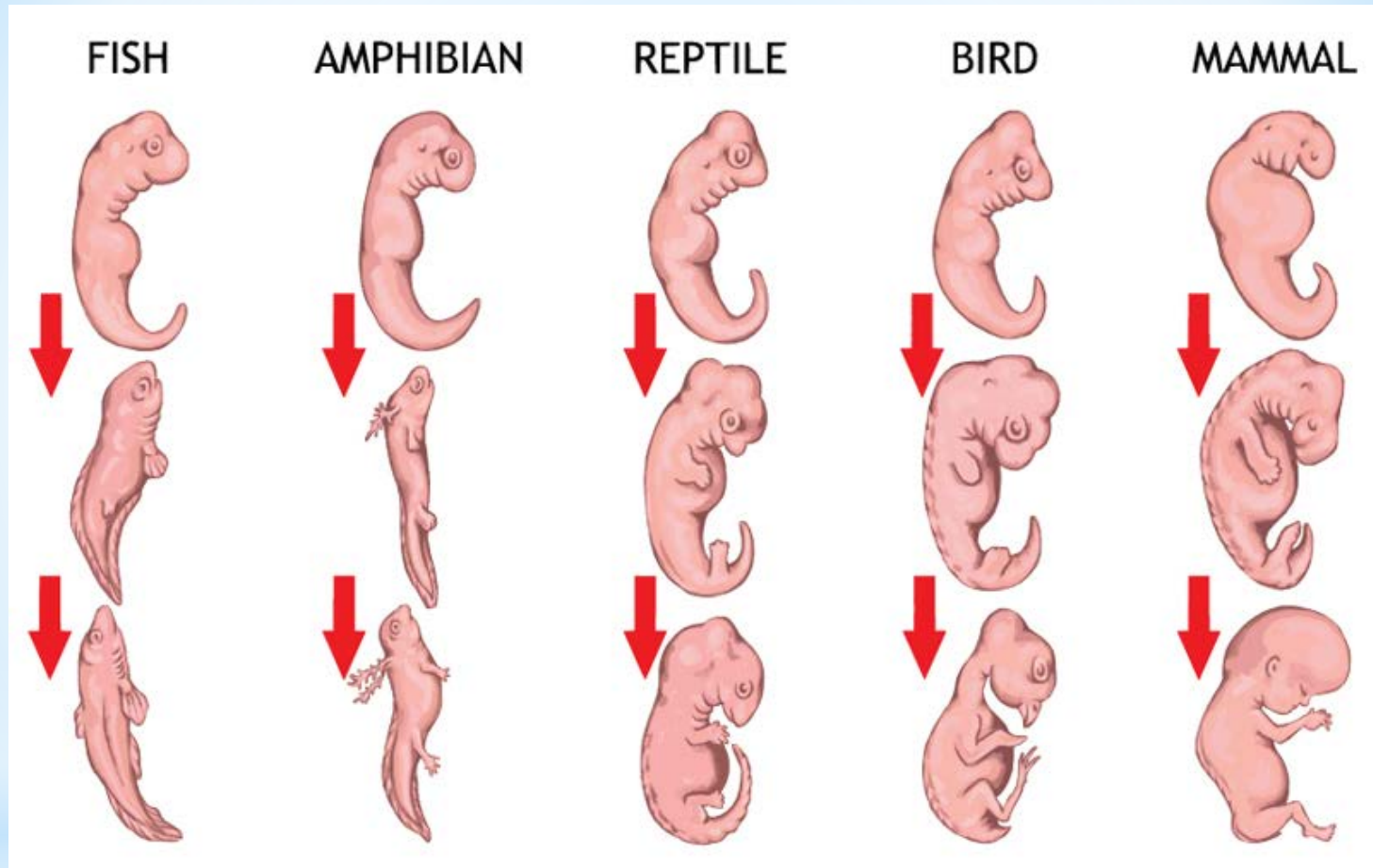


* Fossil Records



-  Fossil remains of the Triassic land reptile *Cynognathus*.
-  Fossil evidence of the Triassic land reptile *Lystrosaurus*.
-  Fossils of the fern *Glossopteris*.
-  Fossil remains of the freshwater reptile *Mesosaurus*.

* Pangaea



*Embryology

Vestigial Human Structures

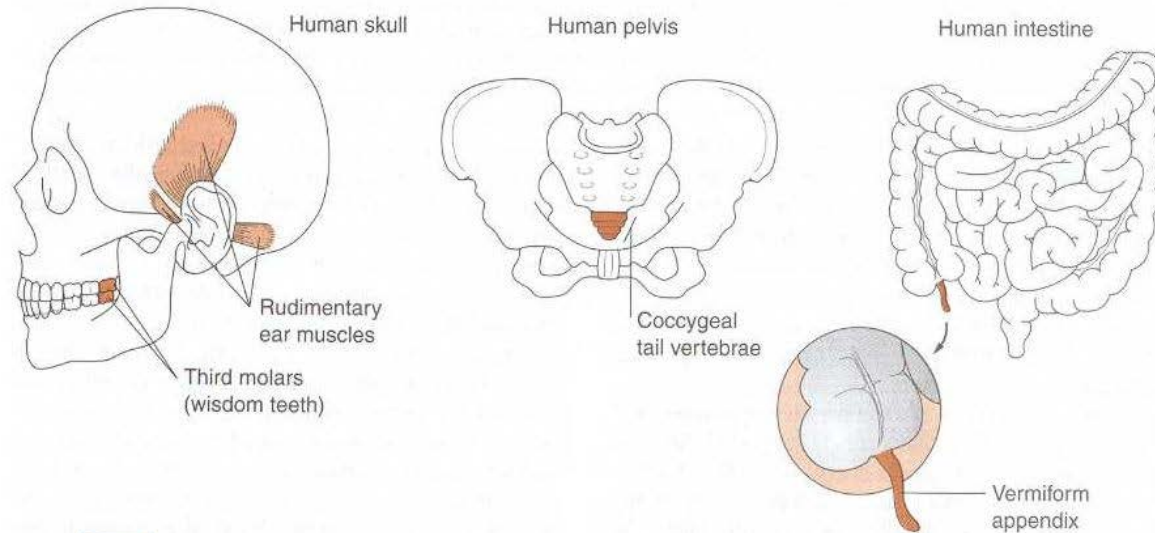
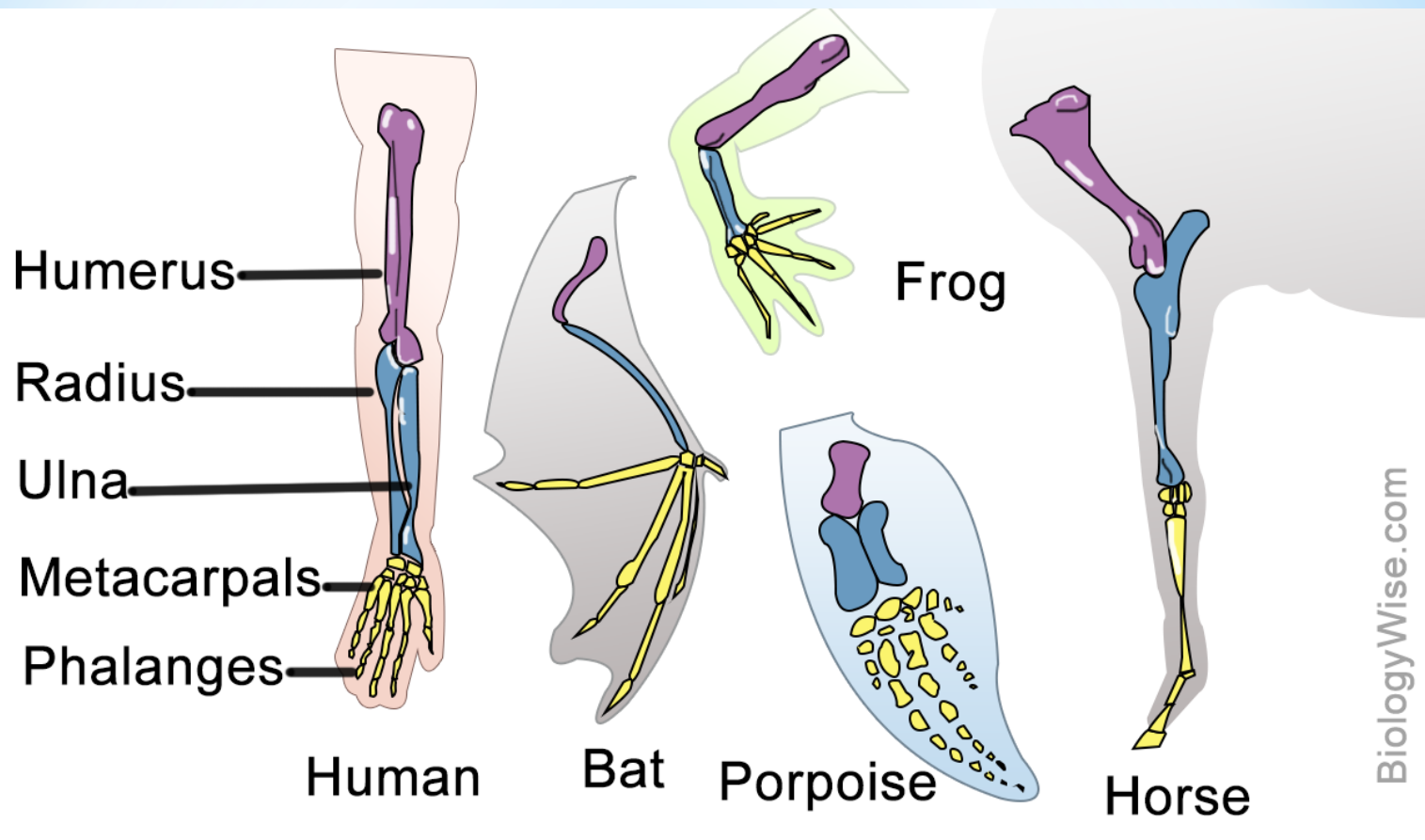


FIGURE 3-9 Some vestigial structures found in humans. (After Romanes, modified.)

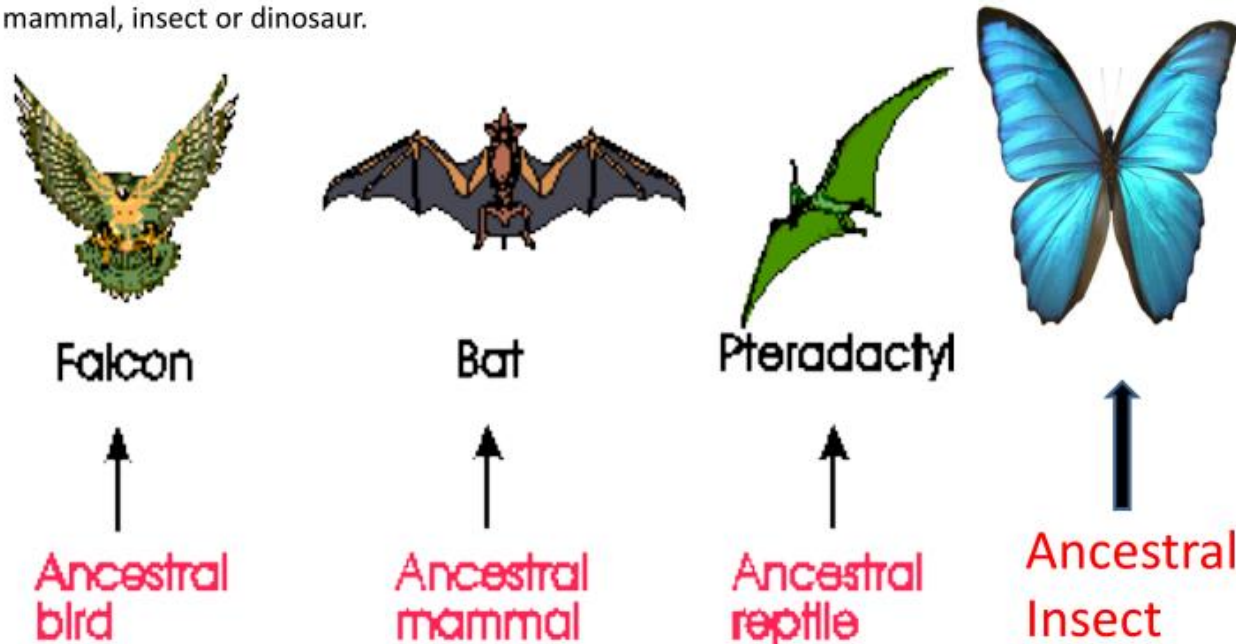
*Vestigial Organs



* Homologous Characteristics

During Convergent Evolution Analogous Structures are seen

Analogous structures are structures that have very different genetic origin, but they have very similar function. Example Wings are a great adaptation, regardless of whether you are a bird, mammal, insect or dinosaur.



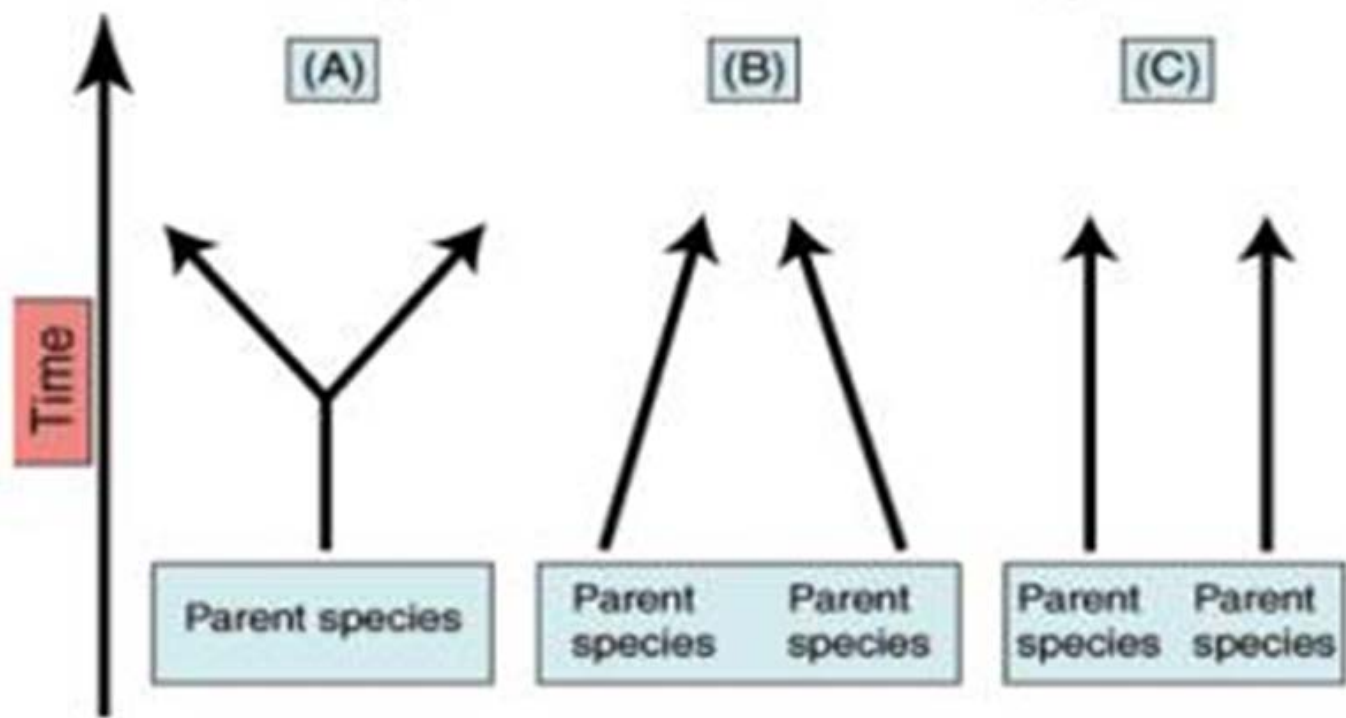
* Analogous Structures

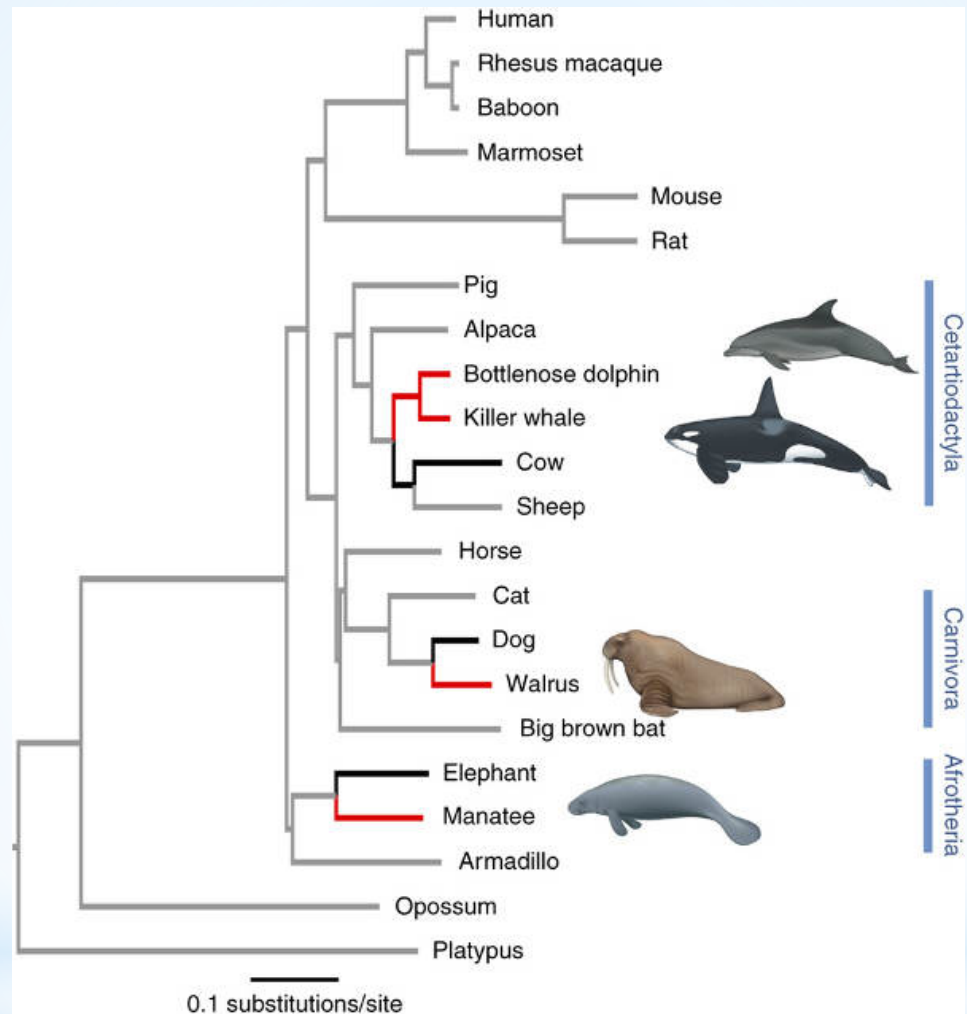
Convergent Evolution	Divergent Evolution
Different ancestor	Common ancestor
Converge to produce analogous structures	Diverge to produce homologous structures
Species appearance becomes more similar over time	Species appearance becomes more different over time
Species are unrelated (genetically different)	Species are closely related (share genetic homology)
Example: Wings in insects, birds and bats	Example: Pentadactyl limb structure (vertebrates)

*Evolutionary Comparison

Types of EVOLUTION

Divergent vs. Convergent





* Evolutionary Trees

Neo-Lamarckian Concept: 1800

Environment directly alters phenotypic traits generationally

Darwinian Evolution Theory: 1859

Natural selection acts on phenotypic trait variation

Neo-Darwinian Evolution Theory: 1900

Genetic mutations promote phenotypic variation on which natural selection acts

Unified Evolution Theory:

Environmental epigenetic alterations promote genetic mutations to alter genotype variation

Environmental epigenetics and genetic mutations both promote phenotypic variation on which natural selection acts

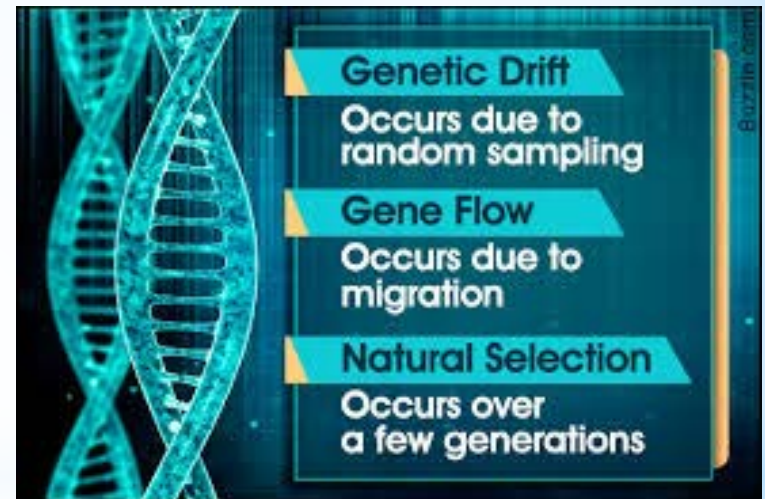
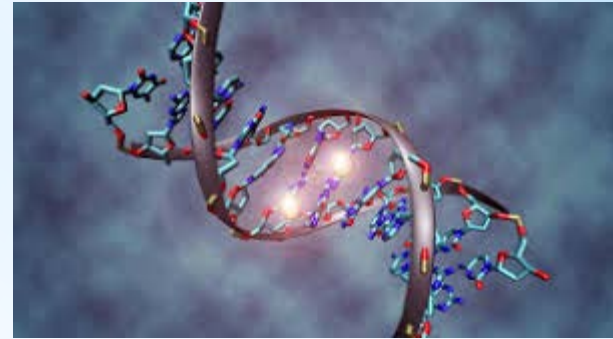
Evolutionary Laws	Darwin 1859	Modern Synthesis 1942 J. Huxley	Integral Model 2012 Ford Doolittle
V ariation Favorable characteristics	Unknown	<ul style="list-style-type: none"> • Changes in “genes” • Random mutations due to copy errors and damage 	<ul style="list-style-type: none"> • Changes in DNA • Mobile DNA • Changes in regulation • Dynamic Genome • Endosymbiosis • Hybridization • Random mutations
I nheritance	Vertical	Vertical	<ul style="list-style-type: none"> • Vertical • Horizontal
S election adapt	Natural, Artificial, Sexual	Natural, Artificial, Sexual, Drift	Natural, Artificial, Sexual, Drift, Kin. Group
T ime gradual	~ 500 million years	~ 2 billion years	~ 3.7 billion years

The Evolution of Evolution

Genetics

- Genetic science helps us understand the causes of biological variation
 - *Mendelian genetics*: studies the ways in which chromosomes transmit genes across generations
 - *Biochemical genetics*: examines structure, function, and changes in DNA
 - *Population genetics*: investigates natural selection and the causes of genetic variation, stability, and change

- * Changes over **time**
 - * Generations
 - * Populations
 - * Environment
- * Survive, Adapt, Reproduce
- * Gene
 - * Selection
 - * Mutation
 - * Variation
 - * Drift
 - * Changes in alleles
 - * Flow
 - * Migration



* Genetic Evolution

Genetic Variation

- Genetic variation are generally refers to the differences gene between individual members of a population which the various types gene are expressed.
- Genetic variation is important for the survival and adaptation of a species,as it helps in terms of natural selection and evolution.



Genetic variation is studied in populations.

A population is a group of individuals of the same species that interbreed.

A gene pool consists of all genes, including all the different alleles, that are present in a population.

*** Genetic Diversity**

* Genetic Diversity

* Mutations

- * Duplications

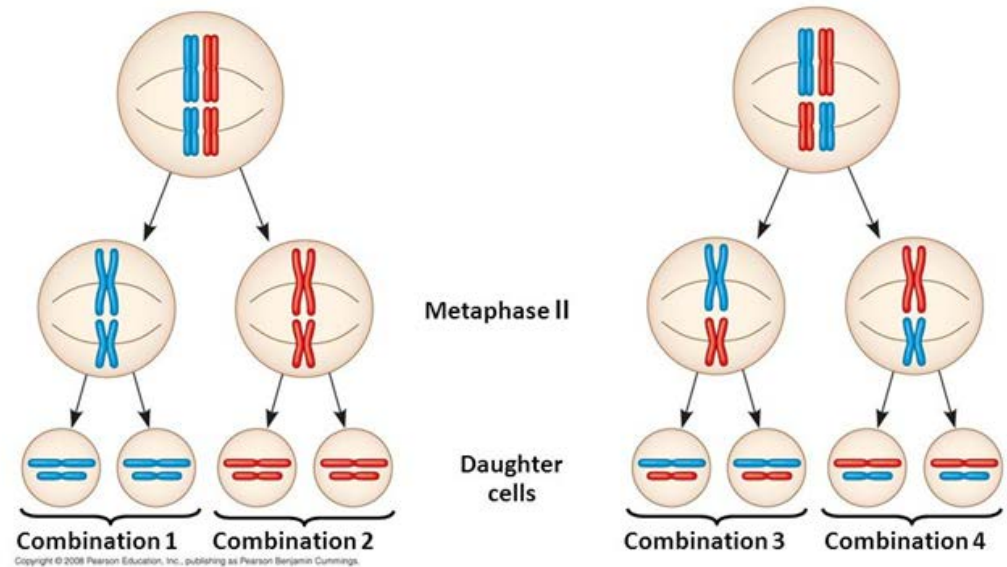
- * Deletions

- * Inversions

- * Meiosis crossing over

- * Fertilization

Without crossing over the 4 daughter cells below would have no genetic recombination.

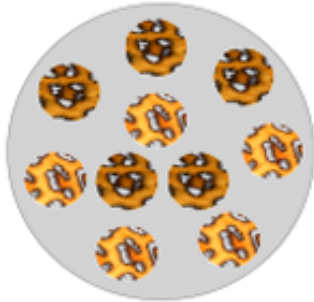


* Sexual Reproduction

Population bottleneck

Large genetic diversity

generation 1



Original population

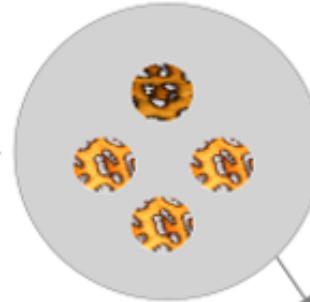


generation 2



Bottleneck event

generation 3

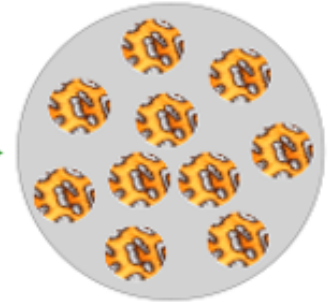


surviving population



Small genetic diversity

generation 4



Final population

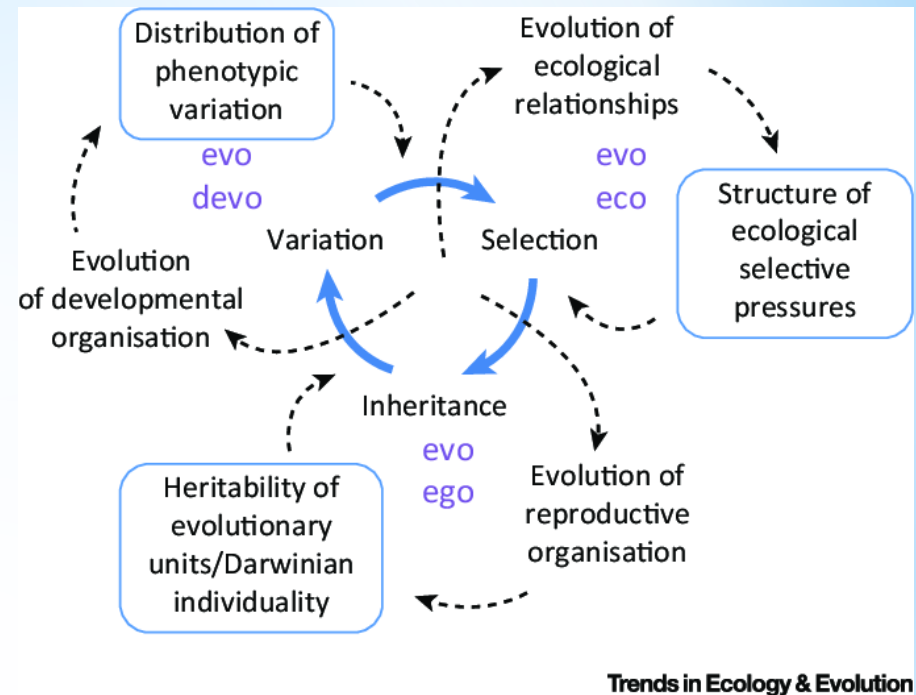
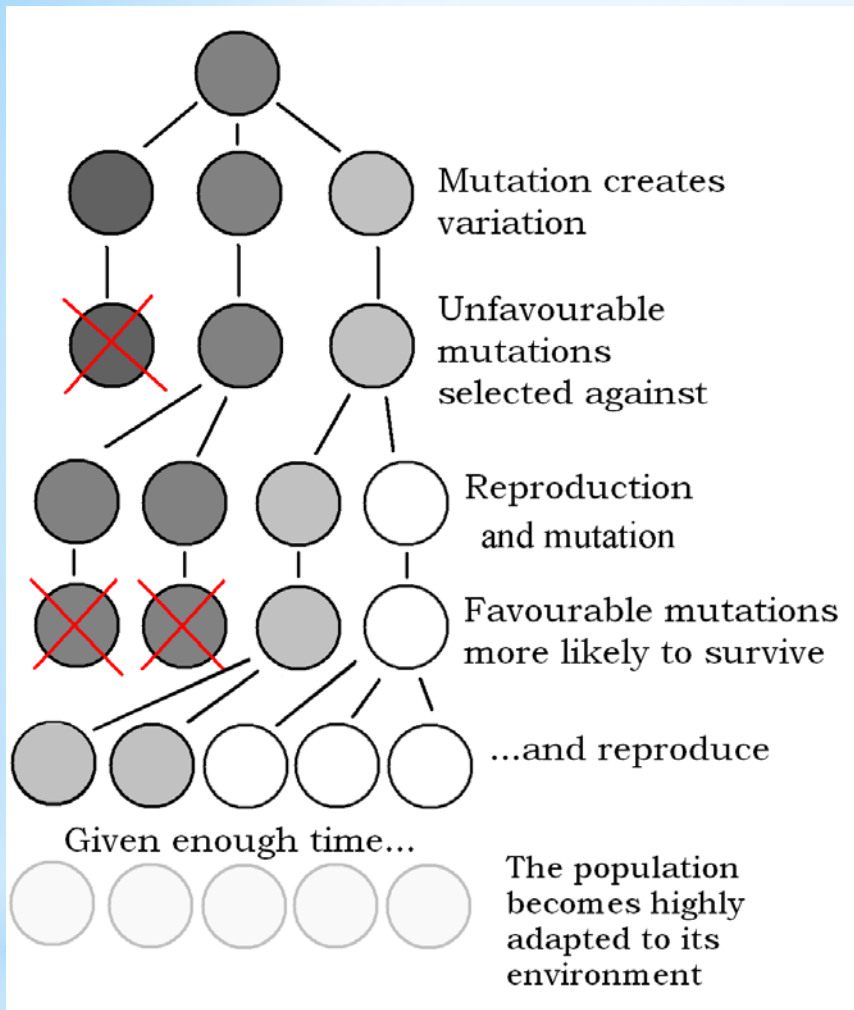
(recovery)

time

Image design: COSNET Lab

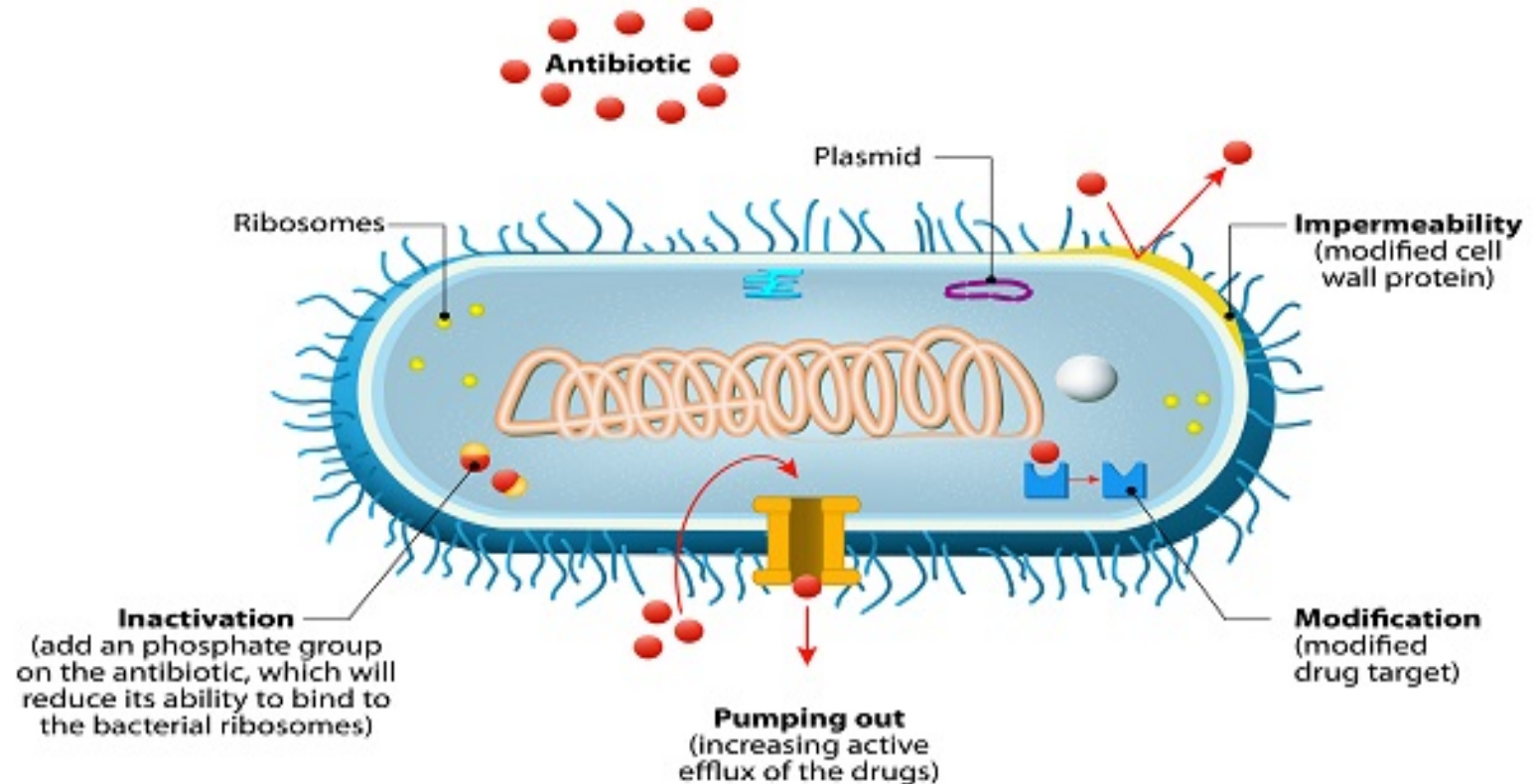
[You Tube](#)

*Population Changes



* Adaptive Selection

MECHANISMS OF ANTIMICROBIAL RESISTANCE



* Drug Resistance

When is artificial selection used?

- Domesticated animals such as dogs
- Farming crops and animals
- Pharmaceuticals (new drugs)
- Genetic engineering



*** Artificial Selection**

- * Non-native
- * Displace native
- * Invasive
 - * No natural competitors
 - * Disrupts ecosystem
 - * Threat to biodiversity
 - * Reproduces rapidly

- * Competition
- * Predation
- * Extinction

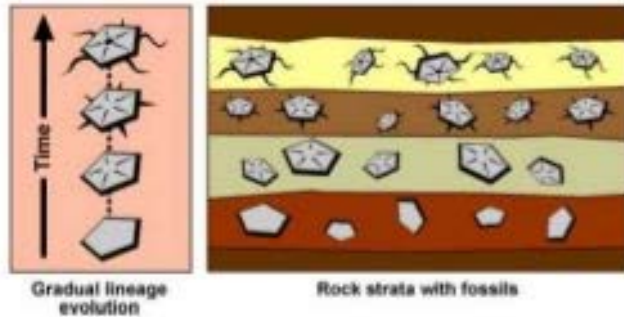


* Introduced Species

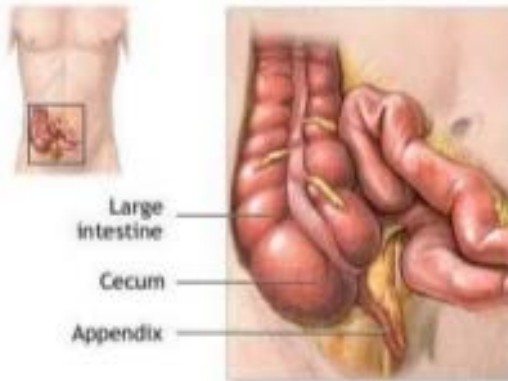
Summary

Evidence for Evolution

Fossil record

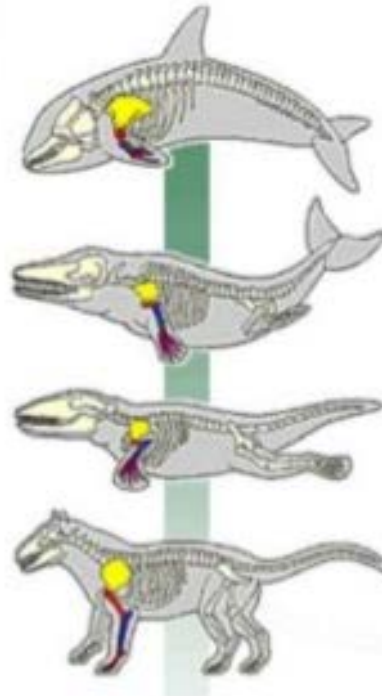


Vestigial structures



<http://www.nlm.nih.gov/MEDLINEPLUS/ency/imagepages/1128.htm>

Homologous structures



<http://evolution.berkeley.edu/evo101/VHAPaceevolution.shtml>

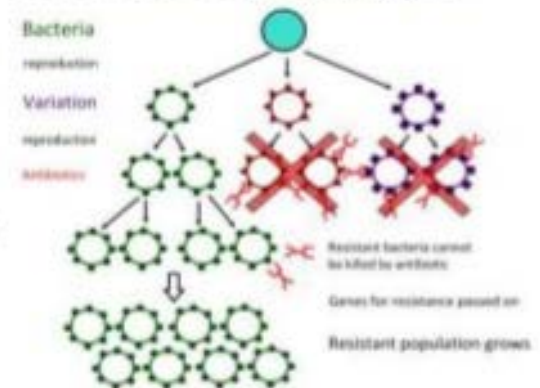
Selective breeding



http://www.bbc.co.uk/schools/ks3bitesize/science/images/bio_dogs.gif

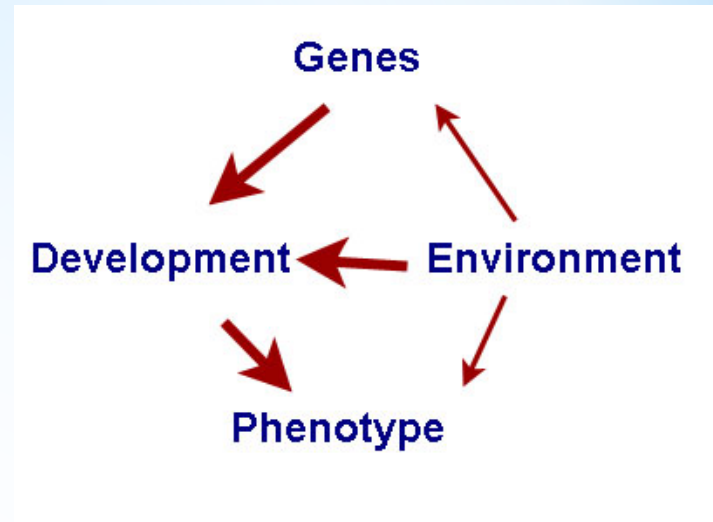
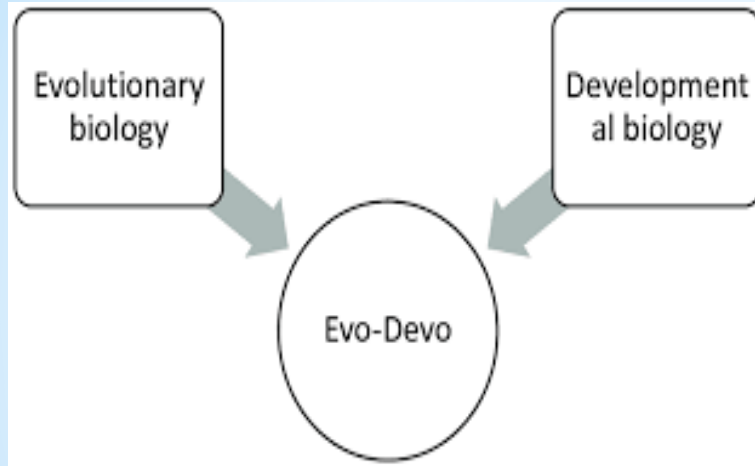


Observable changes



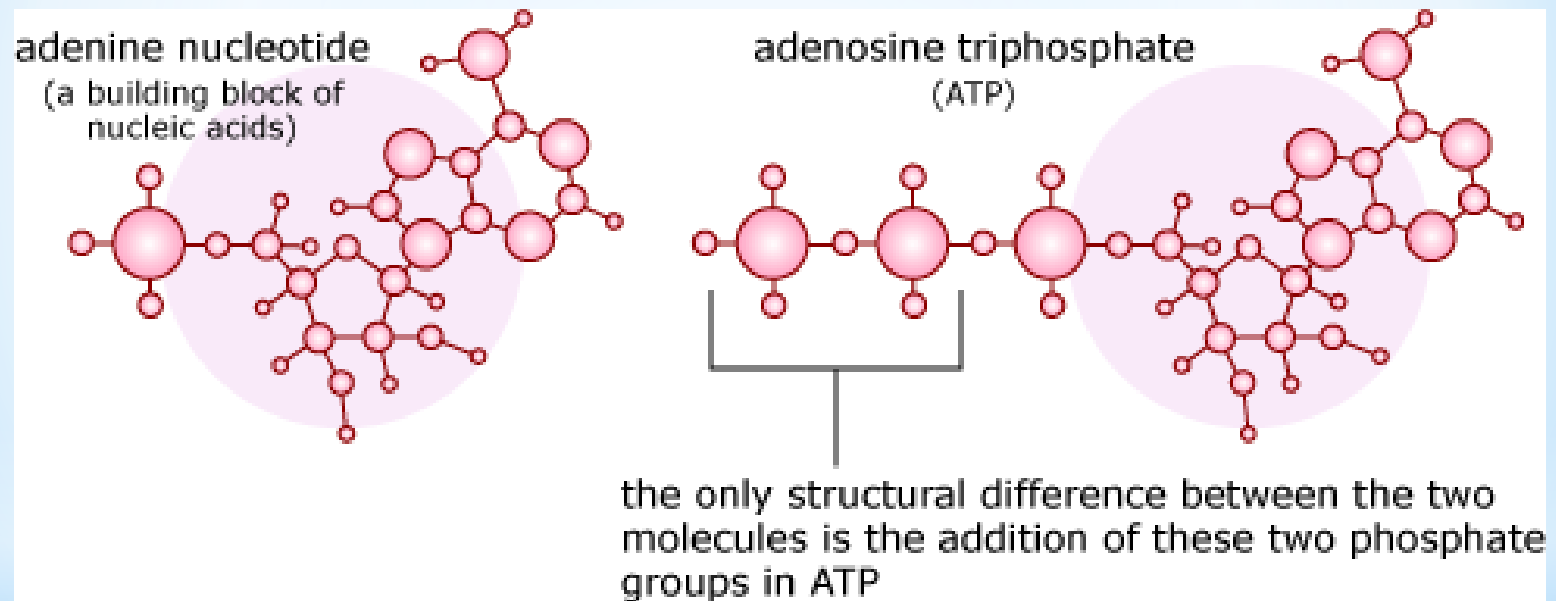


* Adaptations and Variations of Hawaiian Endemic Species



***New Fields of Study**

- * Cell Structure: Cell Membranes & Na^+/K^+ pumps
- * Cell Function: Enzymes, Macromolecules

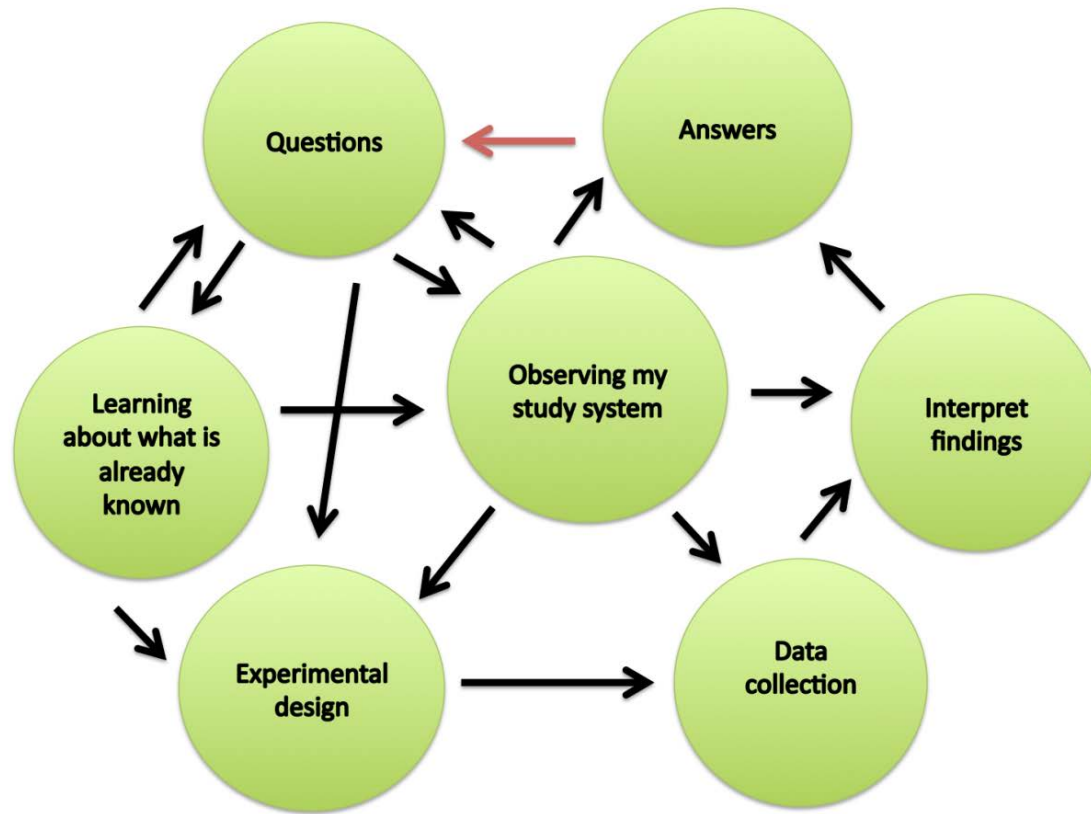


* Evolutionary Biochemistry

- * Evolution
- * Natural Selection
- * Adaptive Selection
- * Artificial Selection
- * Analogous
- * Homologous

- * Gene
- * Mutation
- * Genetic Drift
- * Genetic Shift
- * Bottle Neck
- * Founder Effect

* Important Terms



***Scientific Method**



hhmi: your inner fish

*Questions?