



# Evidence of Macroevolution

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Honors Biology

# Fossils

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- Recognizable, physical evidence of organisms that lived long ago
    - Bones, shells, seeds, petrified wood, etc.
    - Trace fossils – imprints and tracks
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Benjamin  
Cummings



Benjamin  
Cummings



Benjamin  
Cummings



# *The Fossil Record*

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- Succession of forms observed in fossils
  - Not complete record
    - Hard things preserved more
    - Only preserved if buried with little oxygen and undisturbed
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# Dating of Fossils

- Relative dating – dating rock by its depth in layers of rock
  - Deeper = older and use index fossils
- Absolute dating – radioactive dating
  - Many isotopes used, not just carbon
  - Isotopes incorporated while organism alive, then decay at constant rate after death
  - Compare amt. Isotope to amt. of decay product

# *Homology*

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- Structures that have the same embryological source, similar structure, and yet serve different function in the adult organism
  - Similarity resulting from common ancestry
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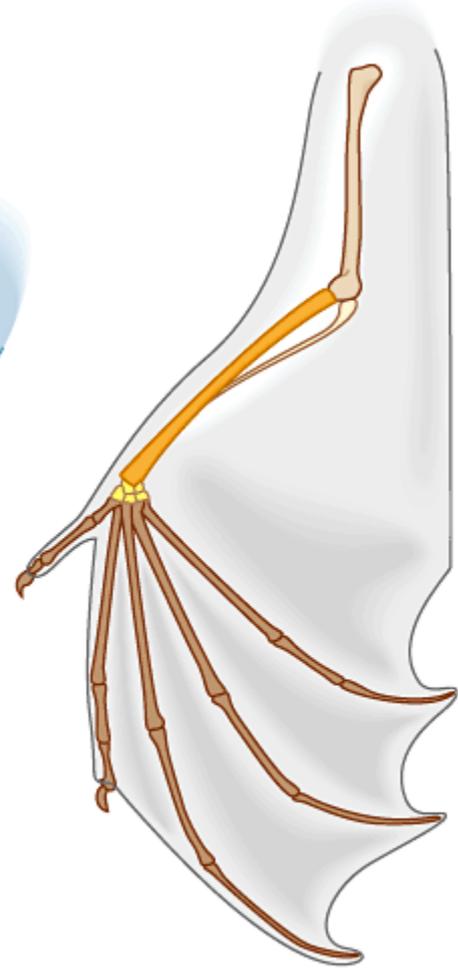
**Human**



**Cat**



**Whale**



**Bat**

# Homology

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- Vestigial Structures

- Structures that have no function in an organism but are homologous with a useful structure in other organisms

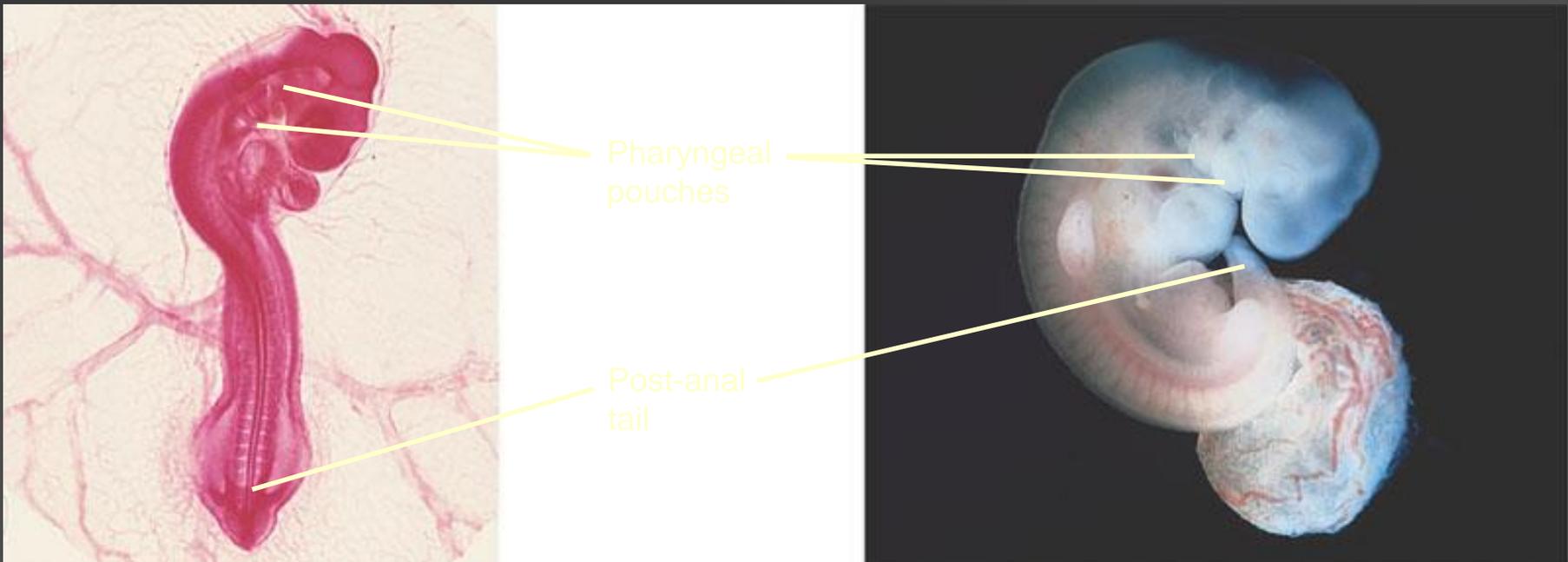
- Ex: our tailbone and appendix, snake pelvic girdle and tiny legs in some

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# Comparative embryology

## ■ Ontogeny

- Embryos are more similar for longer in more closely related organisms
- Reveals homologies not visible in adult organisms



# Convergent Evolution

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- Selection of unrelated organisms by a similar environment/niche
  - Leads to Analogous Structures
    - Similar function of unrelated structures
  - Example: Body structure of sharks, penguins, and dolphins – butterfly wings and bird wings
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# Molecular Homologies

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- Similar molecules in organisms
    - Proteins
  - Genes that are shared among organisms inherited from a common ancestor
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- Anatomical resemblances among species
  - Are generally reflected in their molecules, their genes, and their gene products

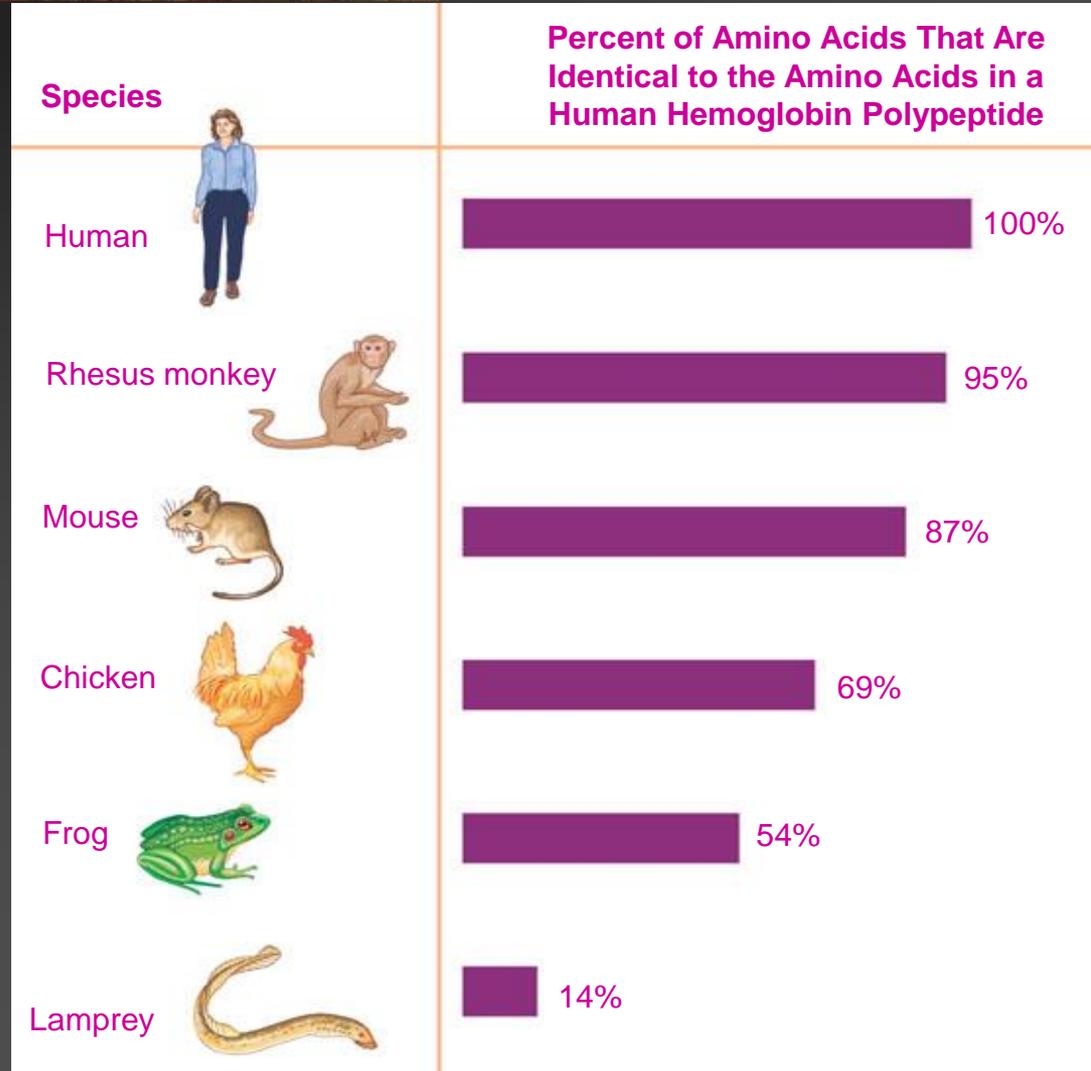


Figure 22.16

# Comparative Biochemistry

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- Comparing amino acid sequences in common proteins allows us to use the number of differences as a rough measure of relatedness
  - Now we compare DNA sequence differences
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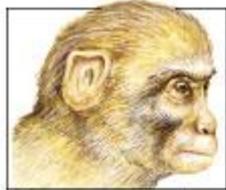
# Molecular Clocks

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- Neutral mutation differences accumulate over time if organisms don't mate
  - # of DNA sequence differences were used to estimate time of species divergence
  - Now we know:
    - mutations happen at different rates
    - mutations we think are neutral may not be
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Human



Rhesus monkey



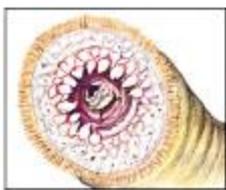
Mouse



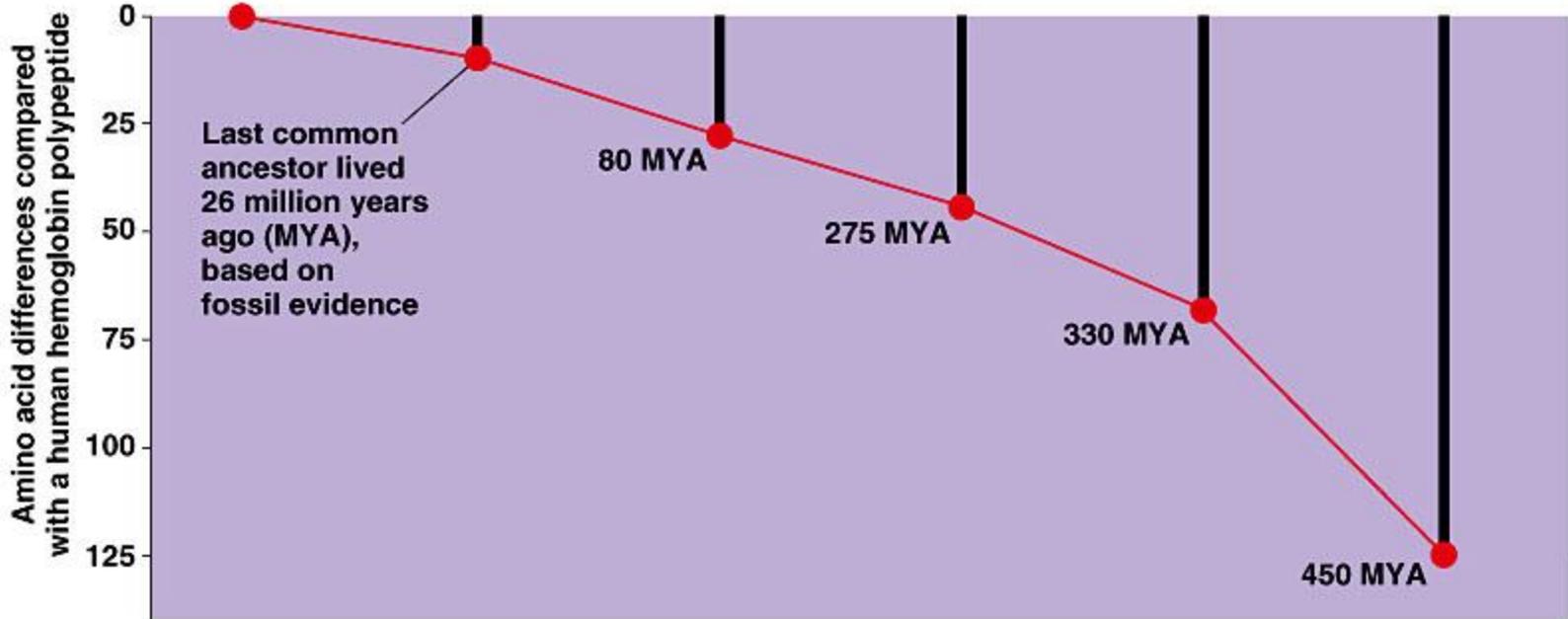
Chicken



Frog



Lamprey



# Biogeography

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- Organisms in nearby areas are more alike than organisms in similar habitats that are not nearby
    - Ex: Ecuador and the Galapagos have similar creatures vs the Galapagos and similar islands in another part of the world
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# The Rate of Macroevolution

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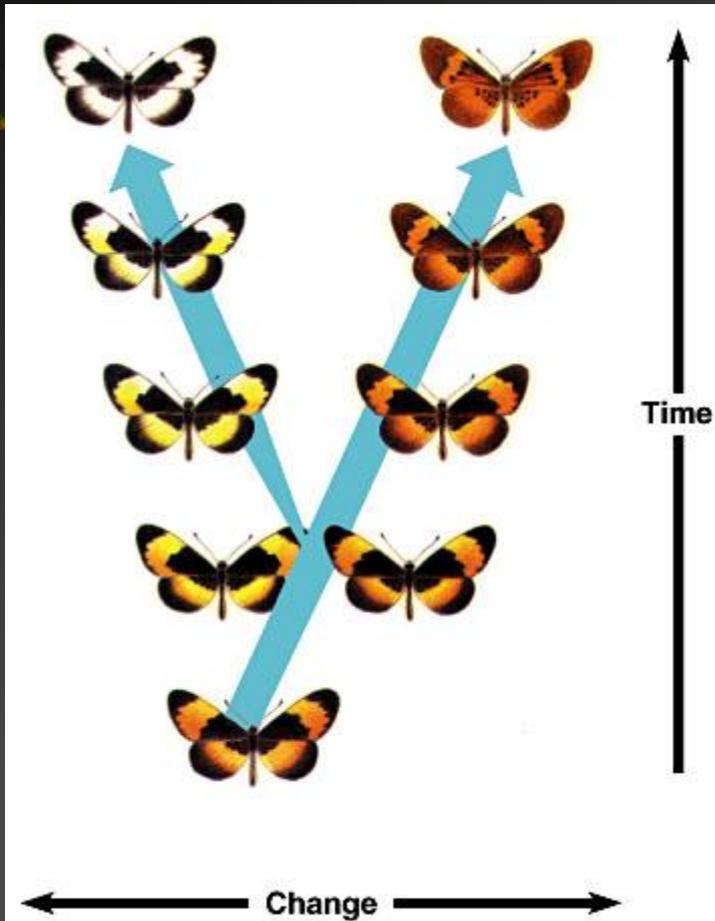
## ■ Gradualism is Classic Darwin

- Changes accumulate slowly, gradually, at a steady pace over time
- This doesn't fit the fossil record in many cases

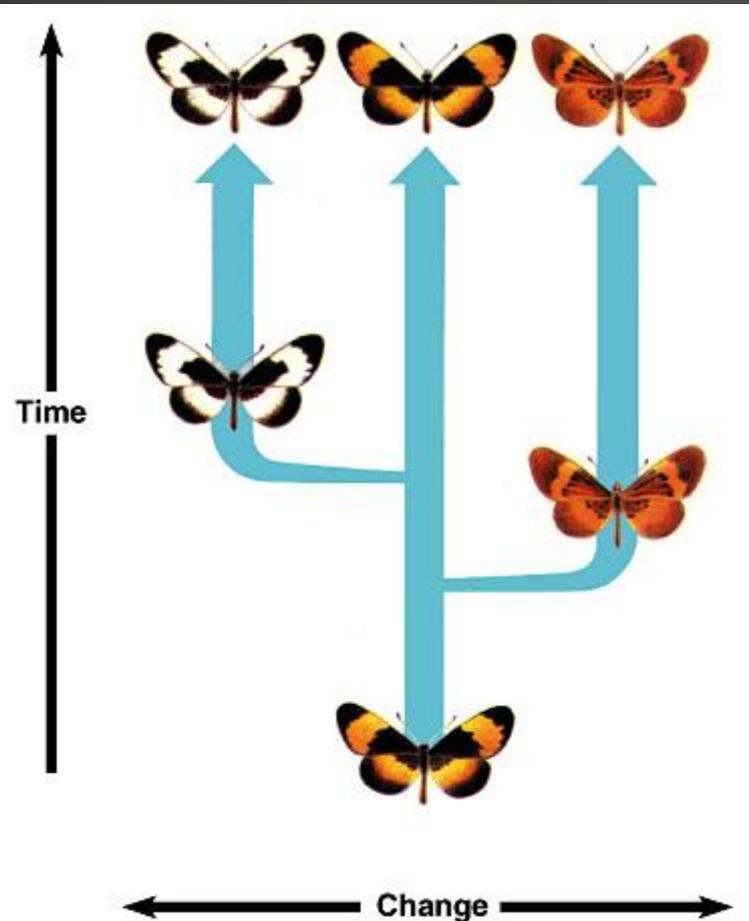
## ■ Punctuated Equilibrium

- Little change happens for long periods, then lots of change happens in a short (few thousand years) burst, then no change again
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# Gradualism



# Punctuated Equilibrium



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