



Figure E14-1 A painting of Charles Darwin as a young man

Central Principle of Biology
Evolution by Natural Selection

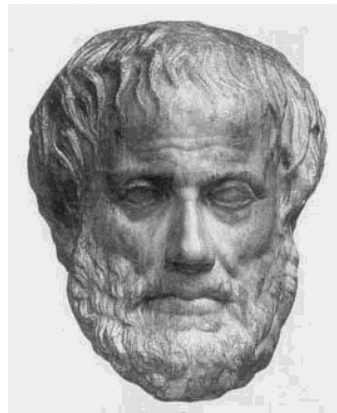
Charles Darwin
1809-1882

Evolution of Species

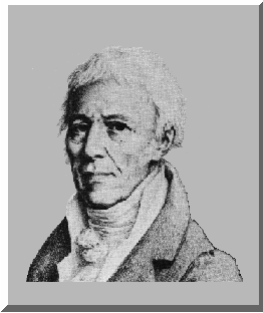


Anaximander
610-545 BCE

Fixed Species



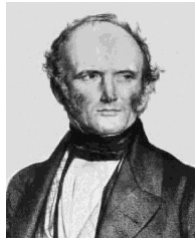
Aristotle
384-322 BCE



Jean-Baptiste Lamarck
1744-1829



- Theory of Evolution by Descent
 - Comparing fossils with current species
- Adaptation to Environment
- Inheritance of Acquired Traits



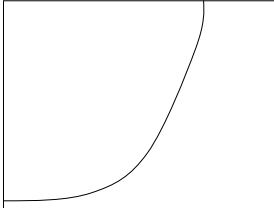
Charles Lyell
Geologists
1797-1875



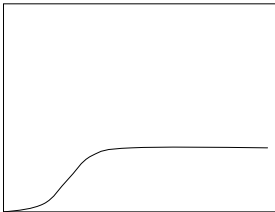
Gradualism – profound change is the result of cumulative slow but continuous processes

Uniformitarianist - The same forces that gradually shaped the geological structures have not changed and act the same today as in the past.

Theoretical Population Growth



Actual Population Growth



Thomas Malthus
1766-1834



Figure 16.3 Journey into History

Darwin's Observations



peccaries



Armadillos



(a) large ground finch, beak suited to large seeds



(b) small ground finch, beak suited to small seeds



(c) warbler finch, beak suited to insects



(d) vegetarian tree finch, beak suited to leaves

Darwin's Two Ideas

1. Evolution (Descent with Modification)
2. Natural Selection (Mechanism of Evolution)

Natural Selection

1. Populations have the potential to increase exponentially.
2. Populations are fairly constant size.
3. Natural resources are limited.

Deduction I. Only some organisms survive. There is a struggle for existence among individuals.

4. There is variation within a species which is heritable.

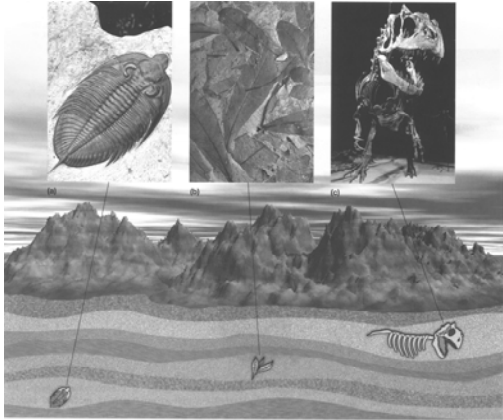
Deduction II. Individuals with favorable variation are more likely to survive and reproduce

Deduction III. Populations accumulate favorable variation over time.

Evidence for Evolution (Descent with Modification)

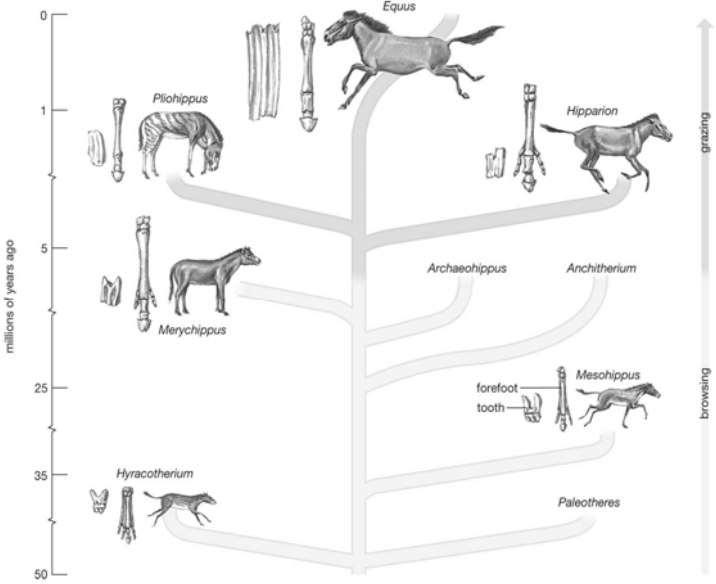
1. Fossil Evidence
2. Biogeography
3. Comparative Anatomy
4. Comparative Embryology
5. Molecular Biology

Fossil Record



- Striated
- Gradualism
- Punctuated Equilibrium

Gradualism In Fossil Record



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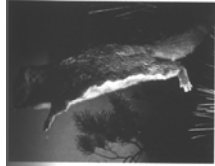
Biogeography



Coarse-haired wombat, *Vombatus*,
nocturnal and living in burrows

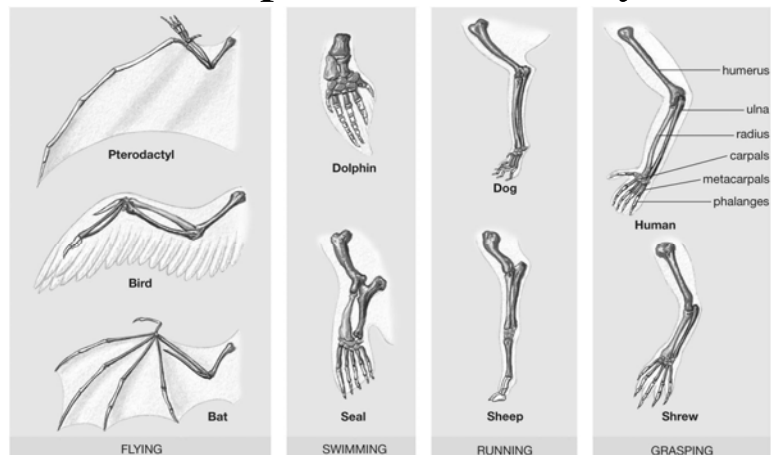


Australian native cat, *Dasyurus*,
a carnivore of forests



- Study of the geographical distribution of species
- Species from the same area tend to be more closely related
- Endemic species from islands closest relative come from near-by mainland or neighboring island

Comparative Anatomy



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Anatomical Similarities – see vertebrate forelimb

Anatomical Homologies – similarity due to common ancestor

Vestigial Structures – Remnant homologous structures

Analogous Structures



(a)



(b)



(c)



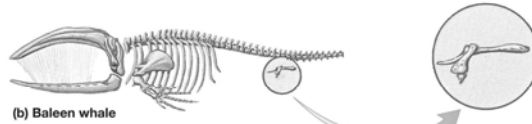
(d)

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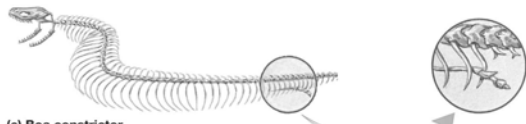
Vestigial Structures



(a) Salamander



(b) Baleen whale



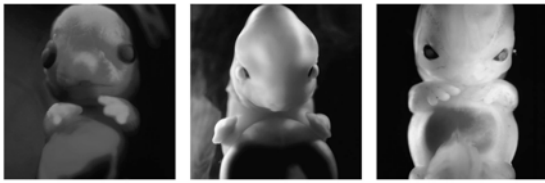
(c) Boa constrictor

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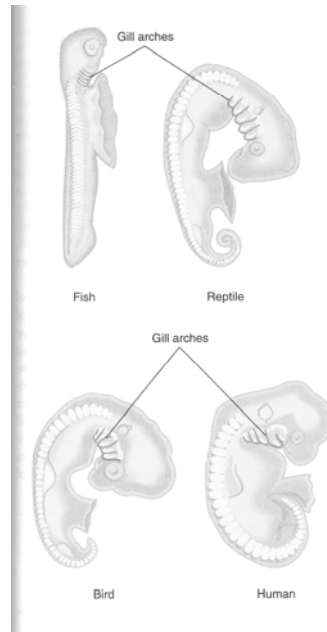
Comparative Embryology

Embryonic Homologies

Gill Slits – Eustachian Tubes



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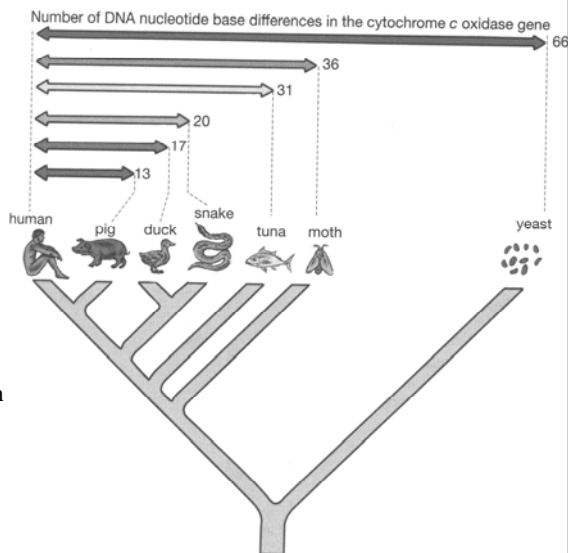
Molecular Biology

Molecular Clock

- Rare but steady mutation
- Separate evolutionary lines with common ancestor
- Number of DNA difference proportional to time since divergence from last common ancestor

Molecular evidence suggests a common ancestor to all life

Darwin's theory doesn't explain the origin of life, simply its diversity



Evidence for Natural Selection

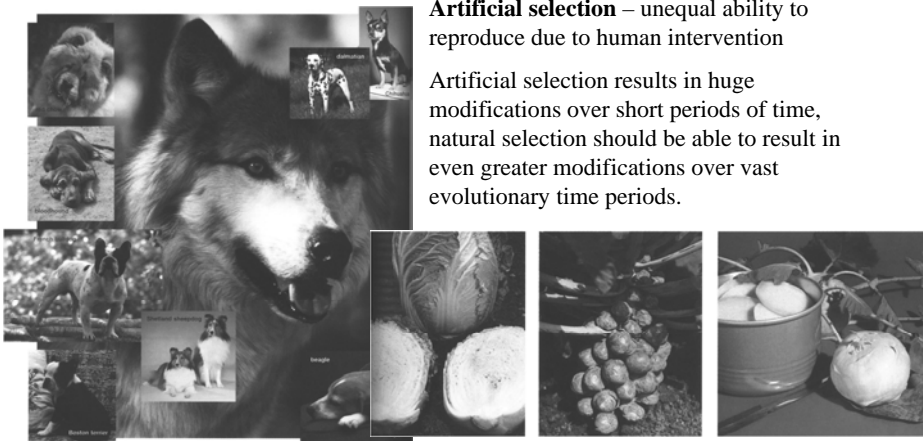
1. Artificial Selection
2. Evolving Populations
3. Adaptation is Common

Artificial Selection

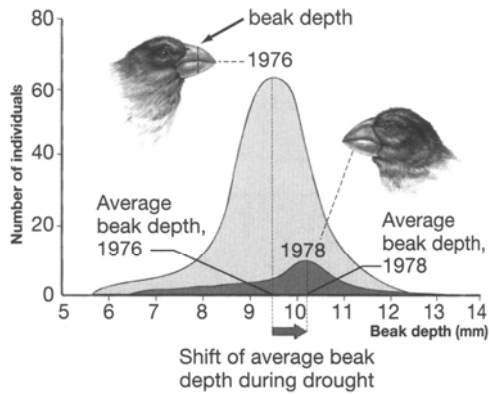
Natural Selection – unequal ability to reproduce due to interaction of phenotypes and environment.

Artificial selection – unequal ability to reproduce due to human intervention

Artificial selection results in huge modifications over short periods of time, natural selection should be able to result in even greater modifications over vast evolutionary time periods.



Evolving Populations



Daphne's Finches – on the Galapagos Islands

Seed Eaters with specialized beaks

1970's drought changed the plant population – fewer small seed, more large seed.

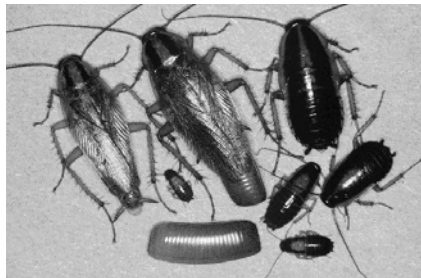
Evolution of beak size in population of finches in result to change in seed size.

Numerous Evolving Populations

- Trinidadian guppies



- Pesticide Resistance – Roach resistance to “Combat”.



Adaptation is Common Skin Pigmentations



- Skin pigmentation (melanin) absorbs UV light
- Different human populations differ in pigmentation
- UV light needed to make Vitamin D.
- Too much UV light destroys folic acid
- Differences in skin pigmentation represents an adaptation to the amount of UV radiation in an environments

Darwin Doubted

- A. False Notion of “Theory”
 - Set of principles, supported by evidence that explains some aspect of the natural world.
- B. Use of Historical Evidence
- C. No Appreciation of Abundance of Evidence
- D. Human’s special status in the universe.