Evolution: Evidence and mechanisms

Organic Evolution

Definitions: The hypothesis that all organisms on Earth are connected by bonds of genealogy and have changed through time.

Darwin: “descent with modification”
The *Origin* tried to do 2 things:

- 1) Convince the reader that evolution has occurred and is an adequate explanation for observations about life.
- 2) Convince the reader that a particular mechanism – natural selection – is the main cause of evolution.
The occurrence of evolution ("the fact of evolution")

... mechanism by which evolution occurs.

Evidence for Evolution

• 1) Biogeography
• 2) Fossil record
• 3) Classification
• 4) Comparative Anatomy
• 5) Observed small-scale changes
• 6) Genetics
Evidence for Evolution

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Biogeography as evidence for evolution

• Species are distributed in patterns that indicate history.
  – 1) Species are different in widely separated similar environments.
  – 2) Species are absent from environments they could inhabit.
  – 3) Similar (closely related) species are often found near each other.
Toucan (Neotropics)  Hornbill (SE Asia)
Over the years, The Far Side has cultivated a following among some scientists. And, of course, I've found that especially flattering—but it does have its downside. A certain degree of accuracy is expected from these folks. After this "polar bear" cartoon was published, I received letters from several biologists reminding me that polar bears are strictly an Arctic species, and penguins strictly Antarctic. Damn.

“And now Edgar’s gone… Something’s going on around here.”

Philippines

Brazil
Great Barrier Reef
Australia

Florida Keys

Evidence for Evolution

• 1) Biogeography
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The Fossil Record as evidence for evolution

• Patterns of biological succession indicate continuity with change
  – 1) Large-scale patterns
  – 2) Small-scale patterns
Archaeopteryx and modern pigeon

Archaeopteryx

Compsognathus
Evidence for Evolution

• 1) Biogeography
• 2) Fossil record
• 3) Classification
• 4) Comparative Anatomy
• 5) Observed small-scale changes
• 6) Genetics
DOG COYOTE FOX WOLF CAT

DOG COYOTE FOX WOLF CAT LION LEOPARD SEAL
DOG COYOTE FOX WOLF CAT LION LEOPARD SEAL SEA LION WALRUS

ANTELope BUFFALO LLAMA CAMEL
Evidence for Evolution

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**Comparative anatomy** as evidence of evolution (features of organisms that do not seem to reflect current function: “imperfections”)

1) homologies
2) embryology
3) vestigial organs
The skeletal structure of vertebrates in various evolutionary periods showing the homologies between them. Comparative anatomical studies reveal that the forelimb and hindlimb in different species, whether in fish, amphibia, and reptiles, vary, but are essentially the same. Study the images closely to understand these variations. The diagrams illustrate the anatomical relationships in various evolutionary stages.
3-4 weeks

5-6 weeks

(a)

Femur

Pevis
Evidence for Evolution

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#2030 hip bones
Observed small-scale change as evidence of evolution

• 1) in domesticated organisms
• 2) in the lab
• 3) in nature
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