Evolutionary Biology

BI 432

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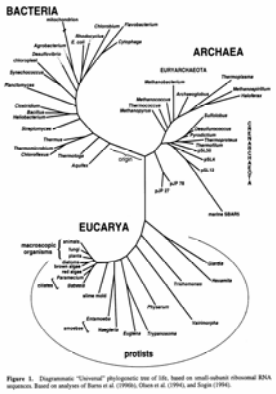
What is Evolution?

- Change over time via descent with modification and often diversification from common ancestors.
- Latin for unfold or unroll
- English for change
- Unifying theory of biology

The Universal Tree of Life



Examples of the three Domains of Life

What is Evolutionary Biology, and Why Is It Important?

- Fundamental Observations: Diversity and Adaptation
- Evolution as Explanation of Biology
- Evolution as Fact and Theory

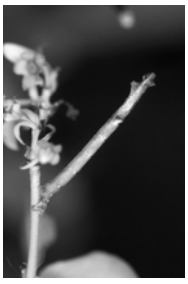
Fundamental Observations: Diversity and Adaptation

1. Diversity of all characteristics & forms
2. Changes in diversity
3. Apparent "good fit" of organisms to the environment

Courtesy of R.F. Denno

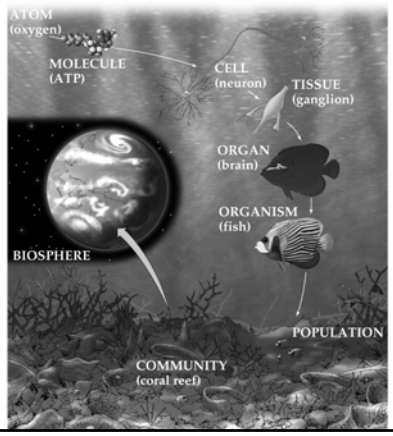
Why do some species vary so much from place to place, while others hardly vary at all?

Why do the form and function of organisms fit their environment so well?



Evolution as Explanation of Biology:

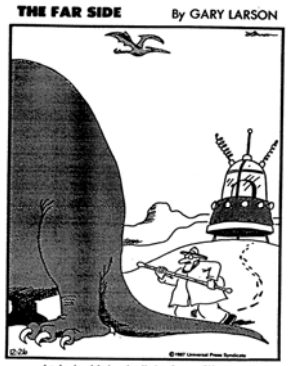
1. Levels of organization in biology: From molecules to populations and beyond
2. Proximate and ultimate causation
3. The concept of fortuitous contingency
4. Testable hypothesis using scientific method



Proximate vs. Ultimate Causation

- **Why do birds sing in the spring?**

http://www.birdphotography.com/



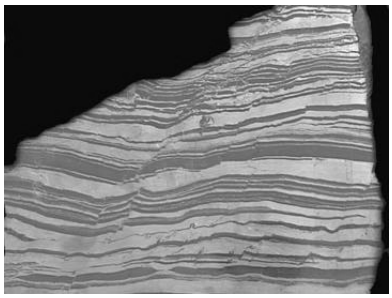
An instant later, both Professor Waxman and his time machine are obliterated, leaving the cold-blooded/warm-blooded dinosaur debate still unresolved.

Evolution as Fact and Theory:

1. Change over time
2. Descent with modification
3. Evolution by <u>natural selection</u>

N.S. = Mechanism of sorting individuals among hereditary variations.

Why do fossils from different sedimentary layers differ as they do?

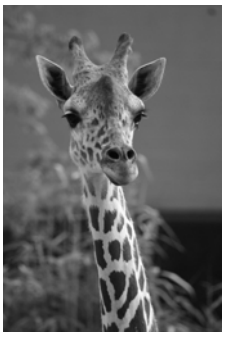


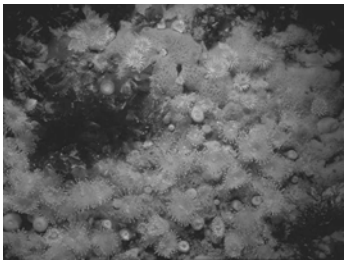
BIFs aka Banded Iron Formations

Why Should We Care about Evolutionary Biology?

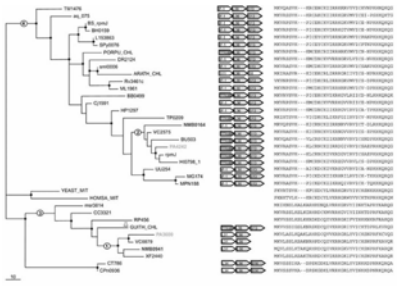
- It illuminates our understanding of nature.
- It illuminates our understanding of ourselves.
- It helps answer questions in conservation biology.
- An evolutionary understanding can be used to improve the human condition.

How have the various animal body forms evolved?





Why are some genes remarkably similar among organisms?



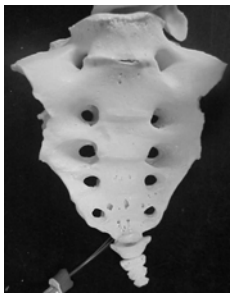
Phylogenetic tree, conserved gene context and multiple alignment of L36 ribosomal proteins. A maximum-likelihood unrooted tree was built using the MOLPHY program. Those branches that were supported by bootstrap probability greater than 70% are marked by small black circles.

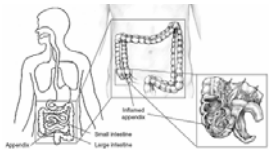
How did complex cell structures evolve?

Why do organisms have sex - sometimes at great cost?

Why do organisms get old and die?

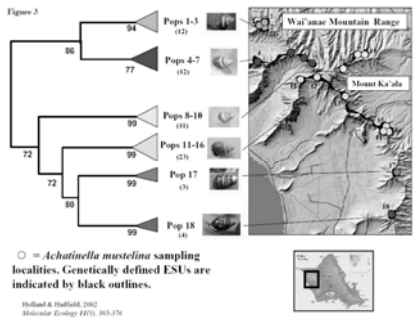
Evolutionary biology helps us understand our quirks...





…and how we peopled the earth.

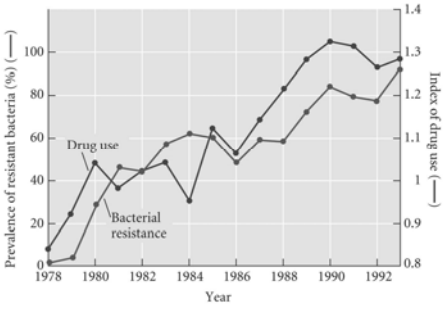
Which organisms are distinct enough to warrant protection?



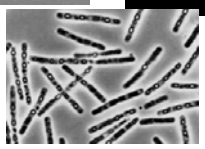
ESU = Evolutionary Significant Unit

How should we maintain genetic variation?

Evolutionary biology explains why *Moraxella* bacteria become resistant to antibiotics so quickly.



Similarly, evolutionary biology helps guide efforts to slow the evolution of pesticide resistance in insects.



Evolutionary biology may help minimize the risks of transgenic crops.