

# **Principles of Organic Evolution**

**BI 432**

**Dr. Craig Moyer**

# 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

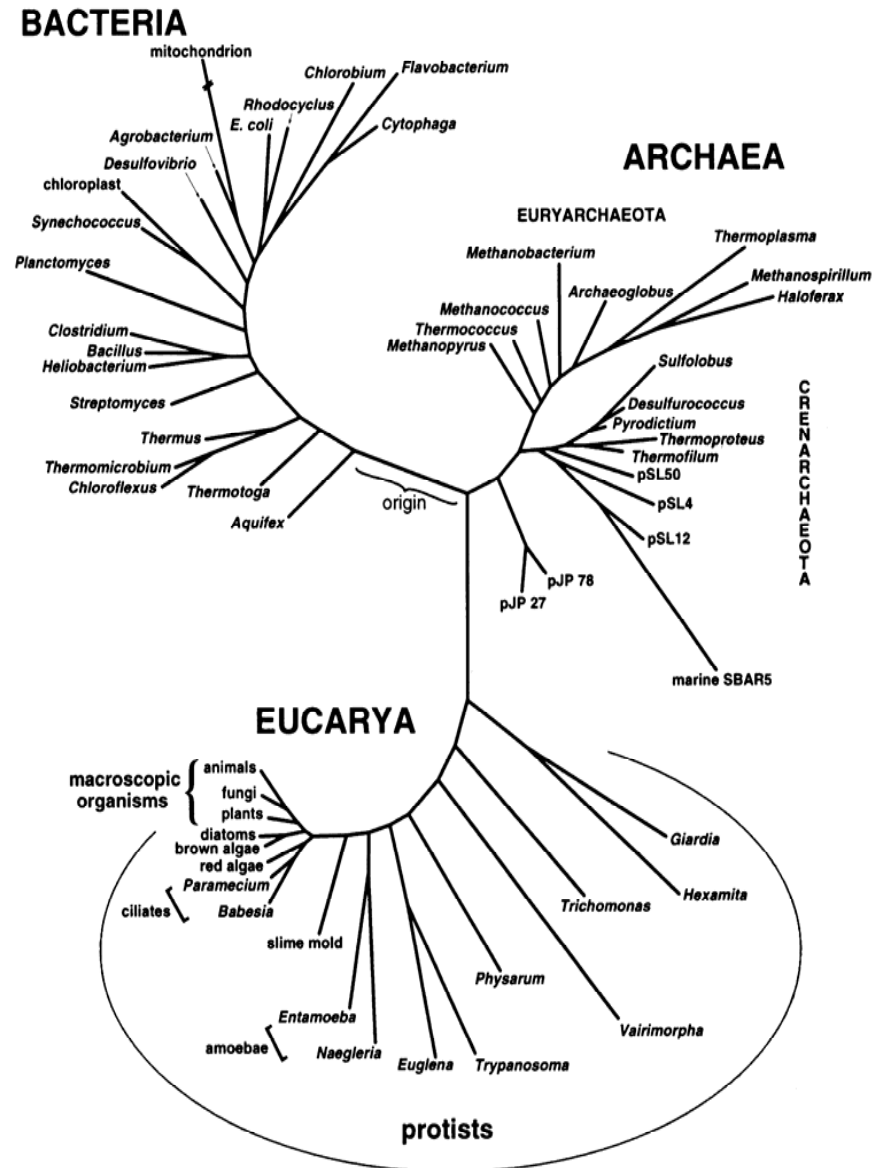


Figure 1. Diagrammatic "Universal" phylogenetic tree of life, based on small-subunit ribosomal RNA sequences. Based on analyses of Barns et al. (1996b), Olsen et al. (1994), and Sogin (1994).

## Examples of the three Domains of Life



**Bacteria**



**Archaea**



**Protista**



**Plantae**



**Fungi**



**Animalia**

# 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



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

Courtesy of R.F. Denno

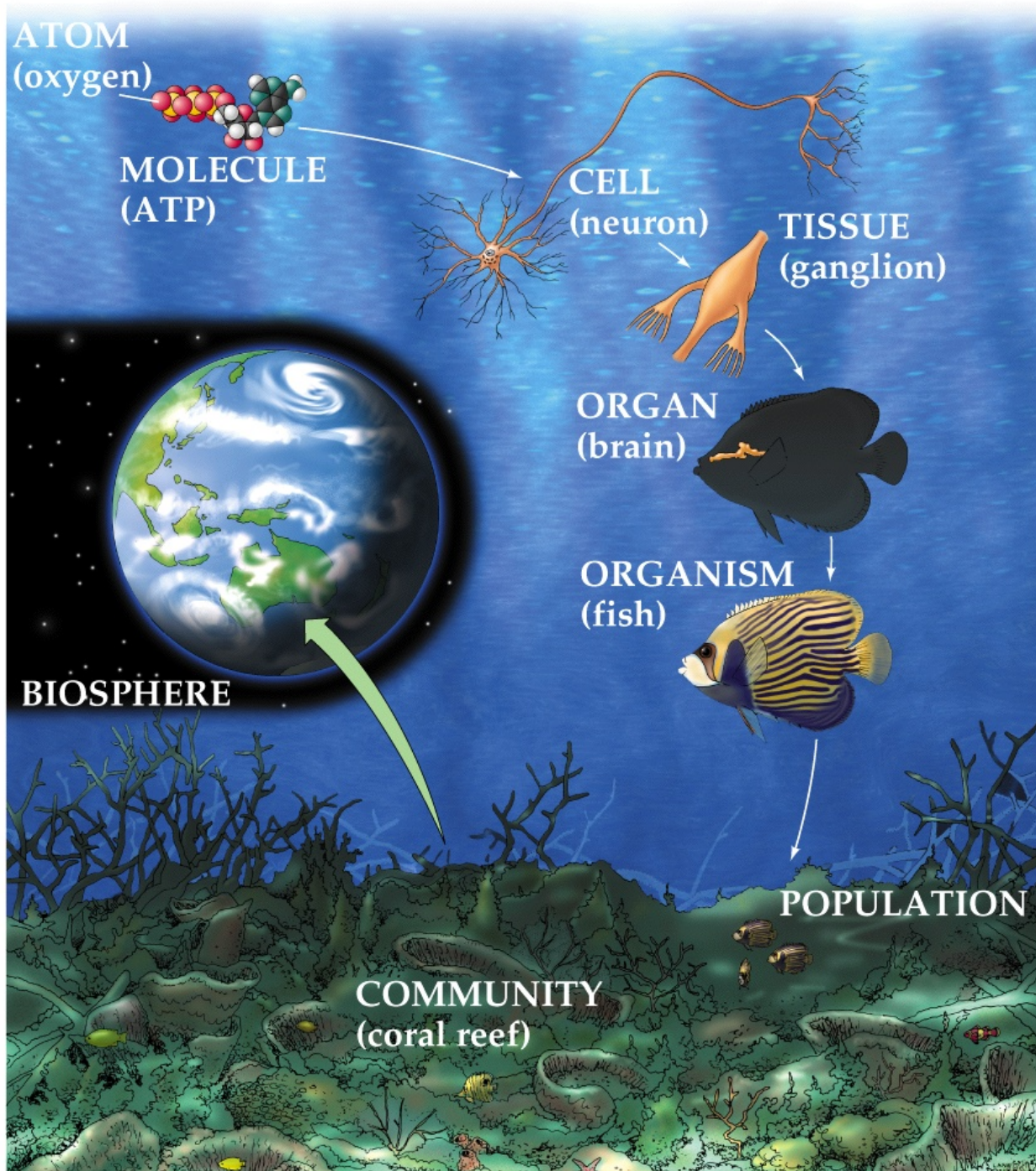
# Why do the form and function of organisms fit their environment so well?





# 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

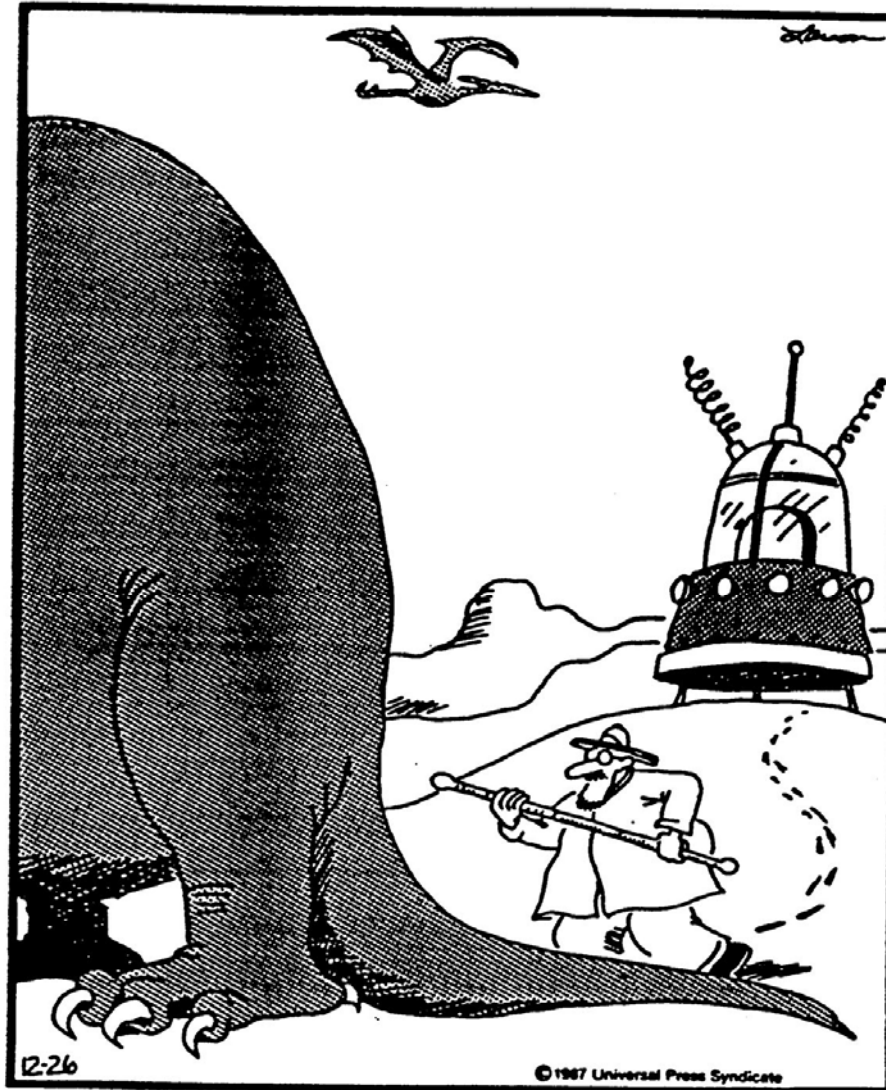
- Why do birds sing in the spring?



<http://www.birdphotography.com/>

# THE FAR SIDE

By GARY LARSON



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 natural selection

**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?

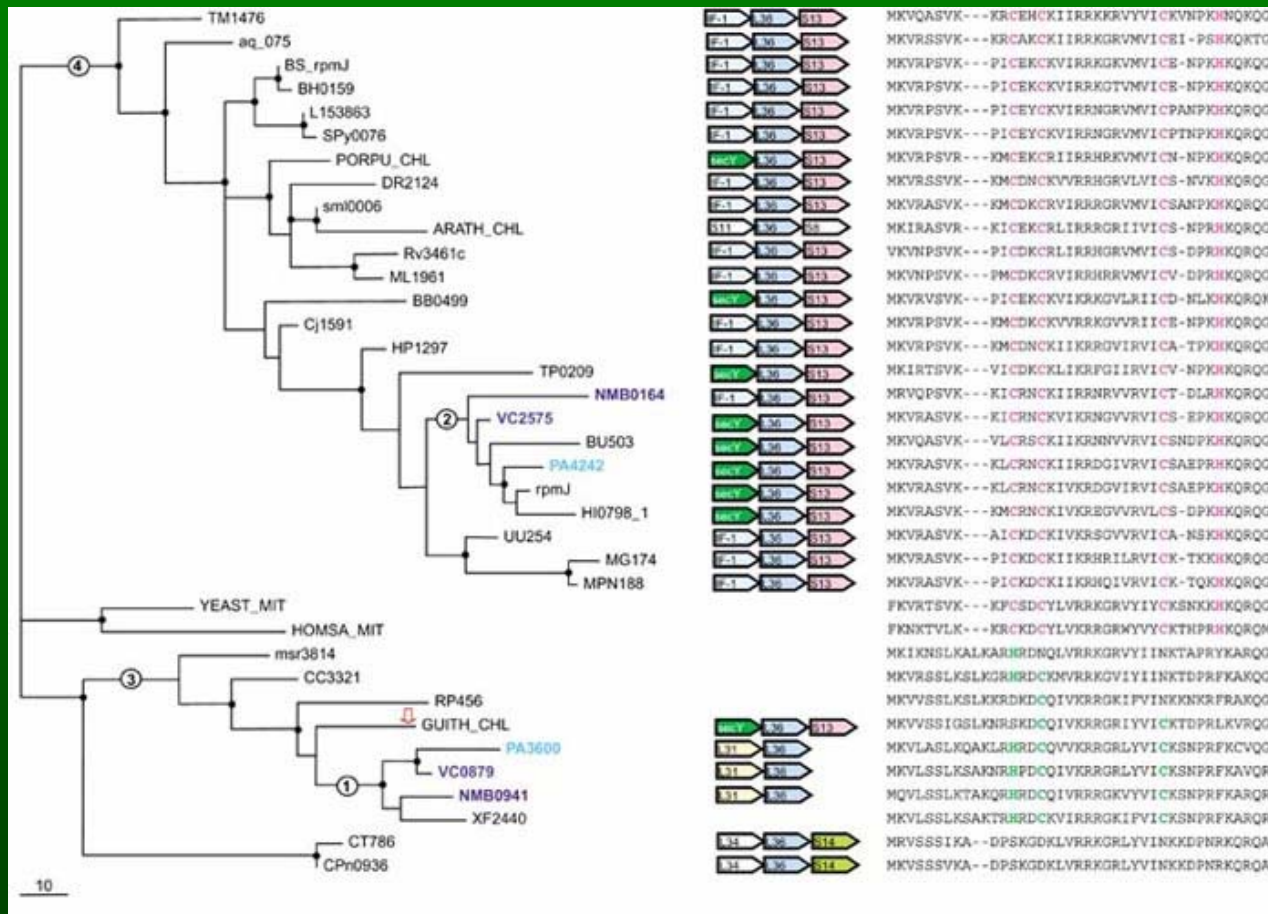
- It illuminates our understanding of nature.
- It illuminates our understanding of ourselves.
- It helps answer questions in conservation biology.
- An evolutionary understanding can be used to improve the human condition.



**How have the various animal body forms evolved?**



# Why are some genes remarkably similar among organisms?

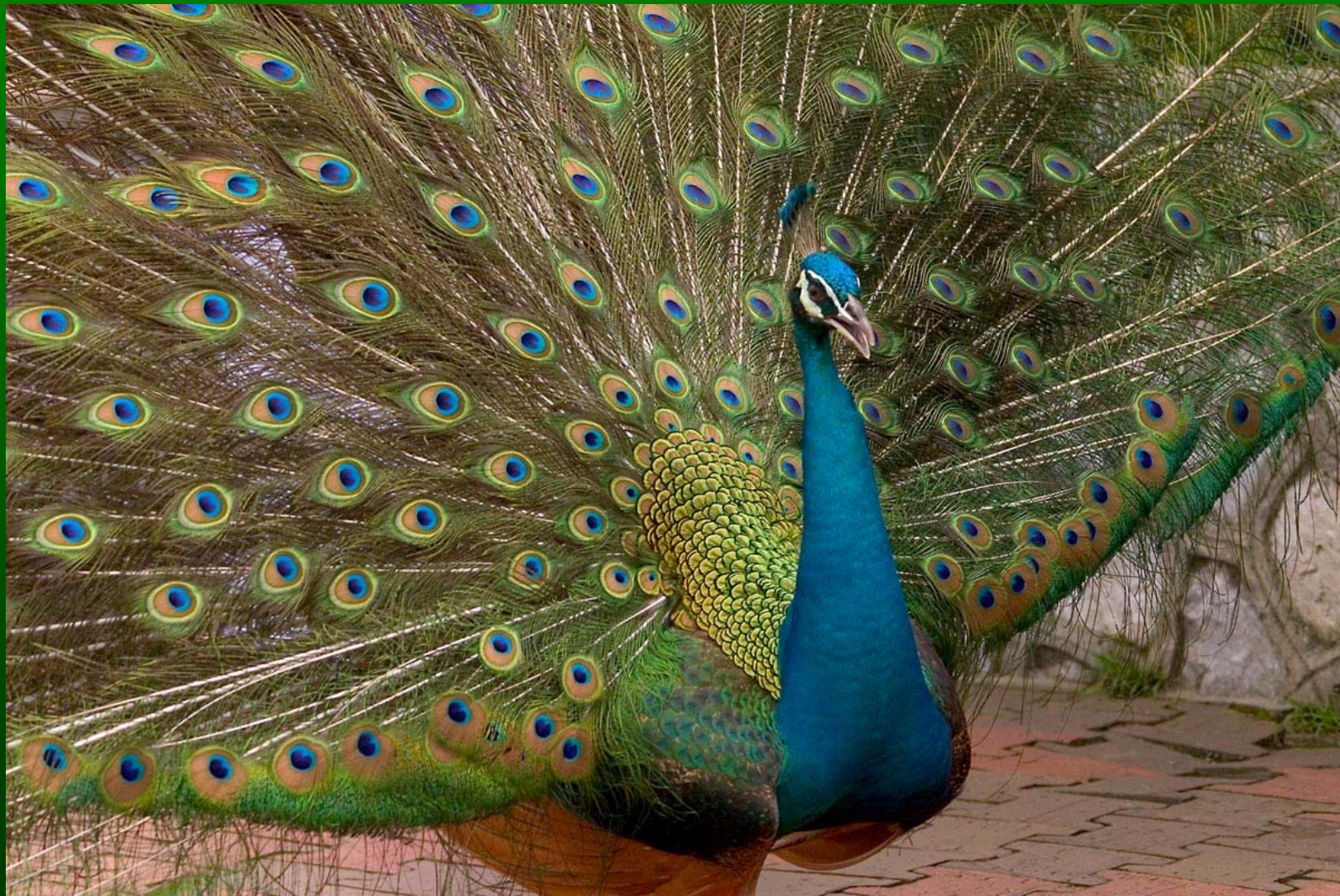


Phylogenetic tree, conserved gene context and multiple alignment of L36 ribosomal proteins. A maximum-likelihood unrooted tree was built using the MOLPHY program. Those branches that were supported by bootstrap probability greater than 70% are marked by small black circles.



**How did complex cell structures evolve?**

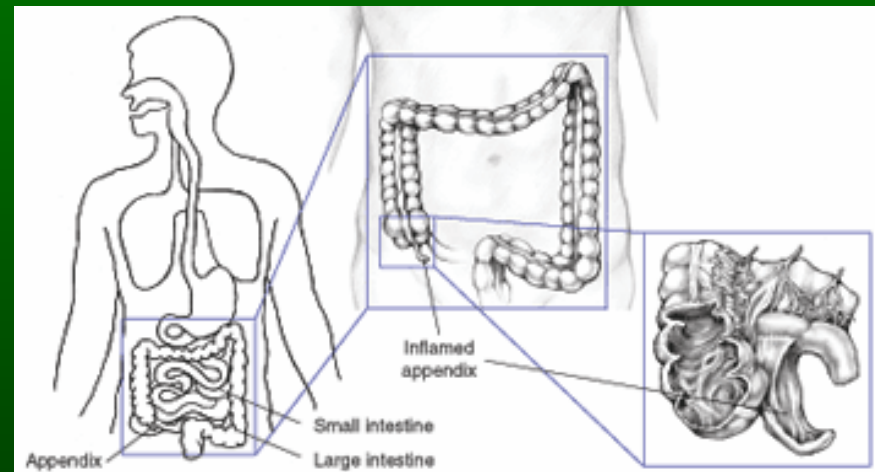
**Why do organisms have sex -  
sometimes at great cost?**



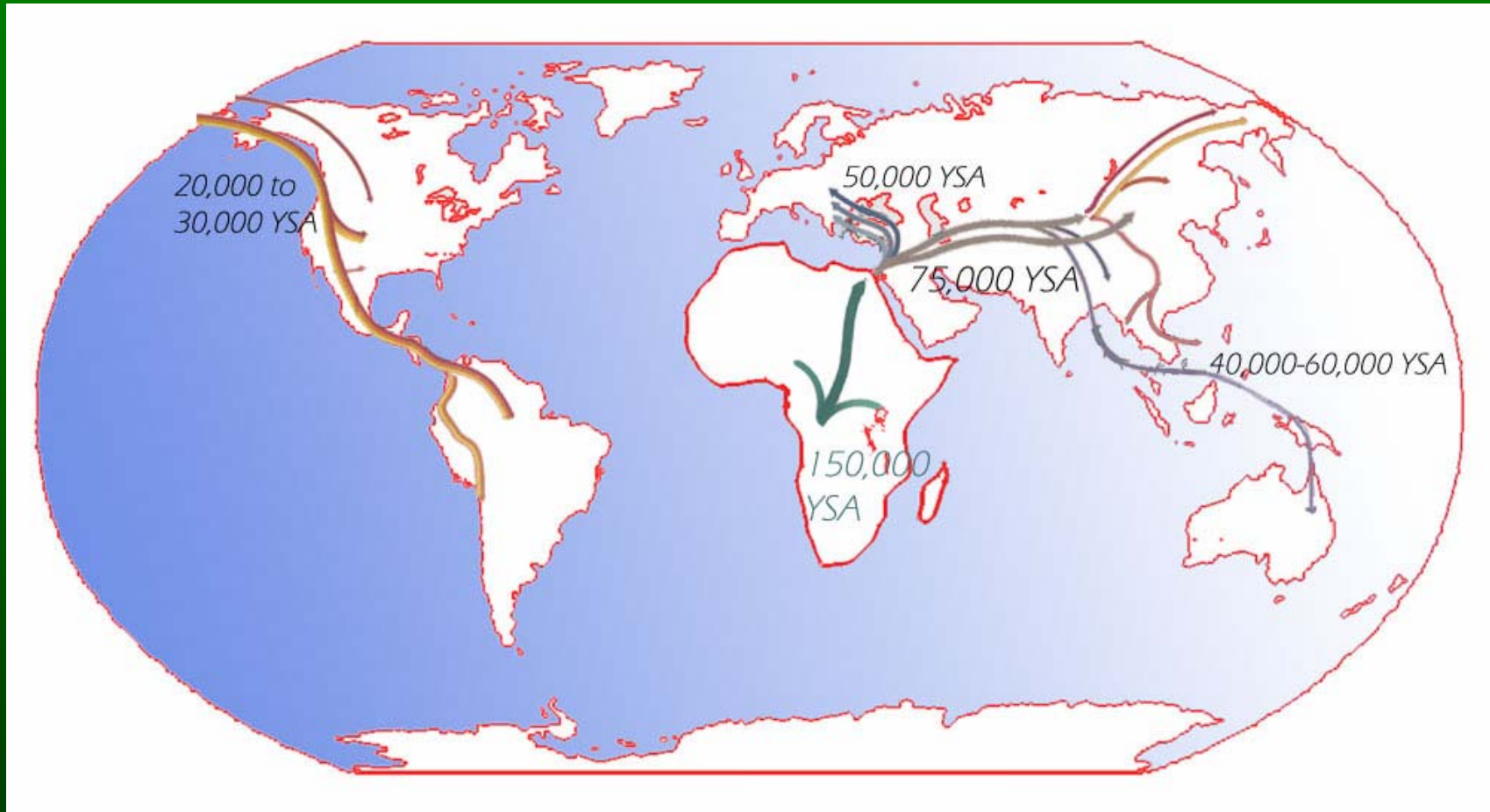


**Why do organisms get old  
and die?**

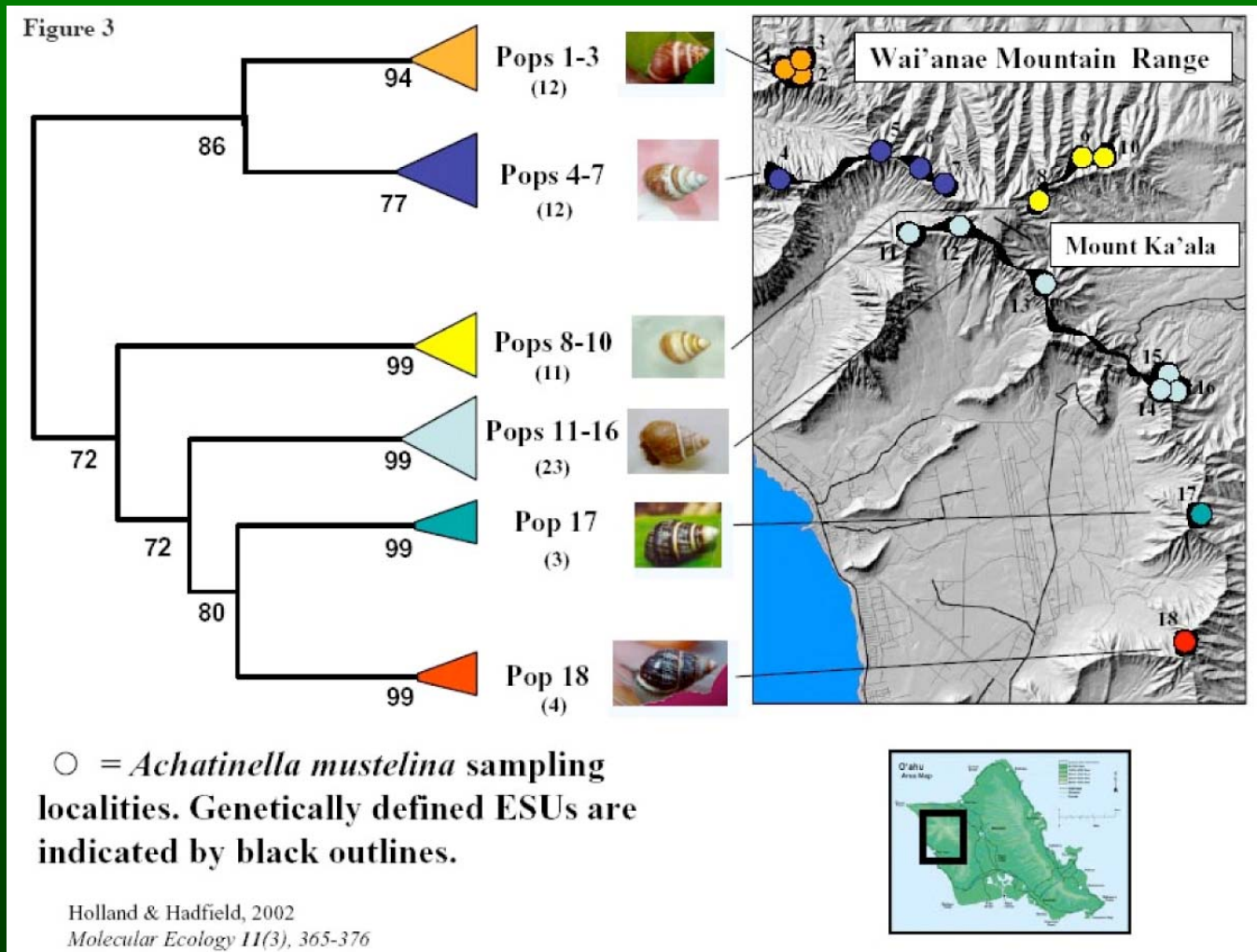
## Evolutionary biology helps us understand our quirks...



...and how we peopled the earth.



# Which organisms are distinct enough to warrant protection?



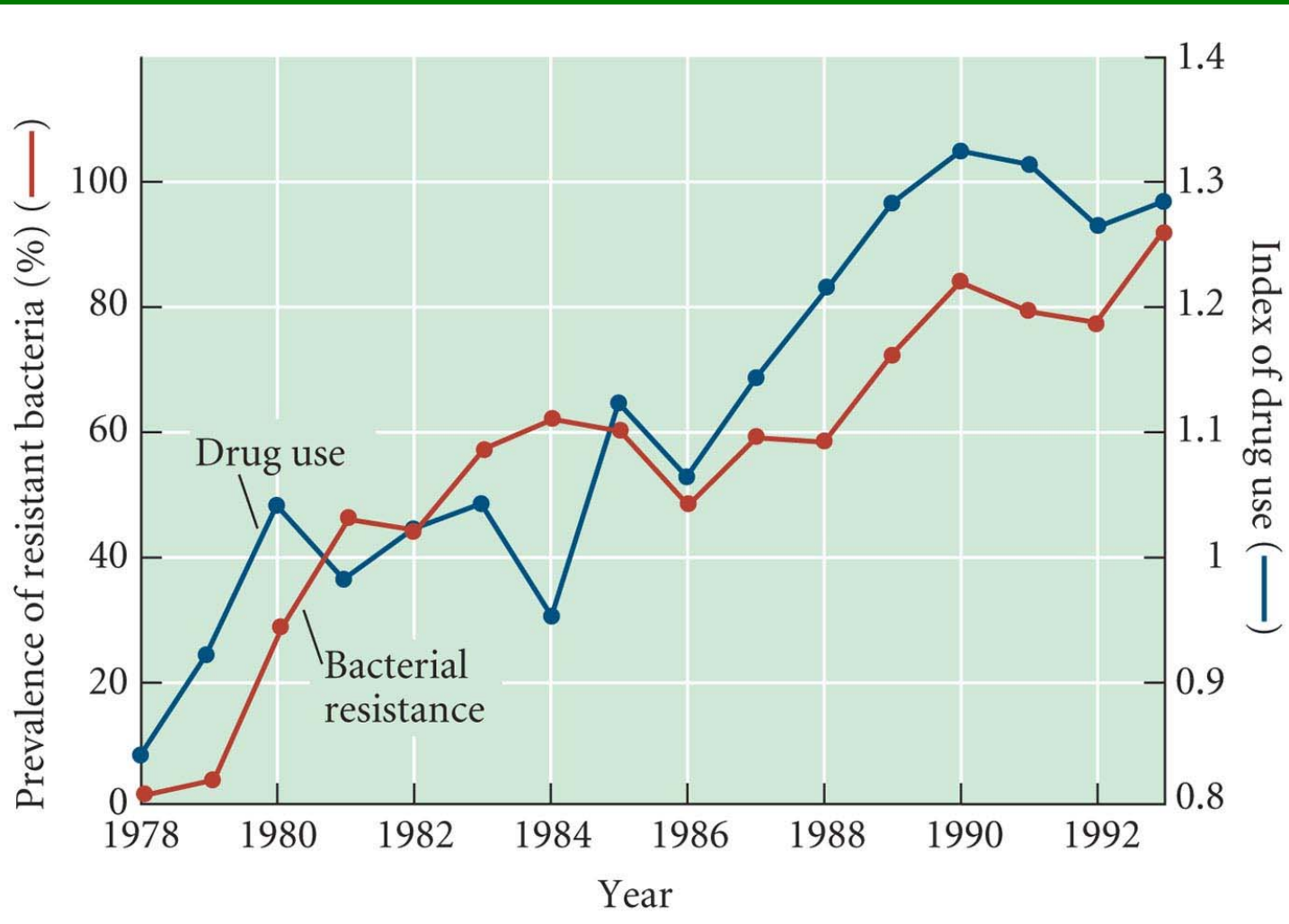
ESU = Evolutionary Significant Unit



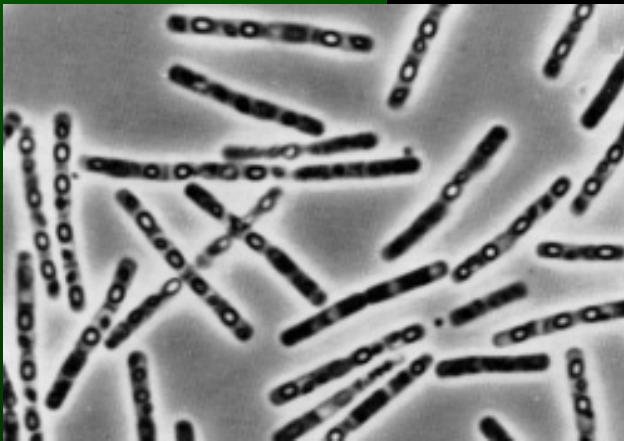
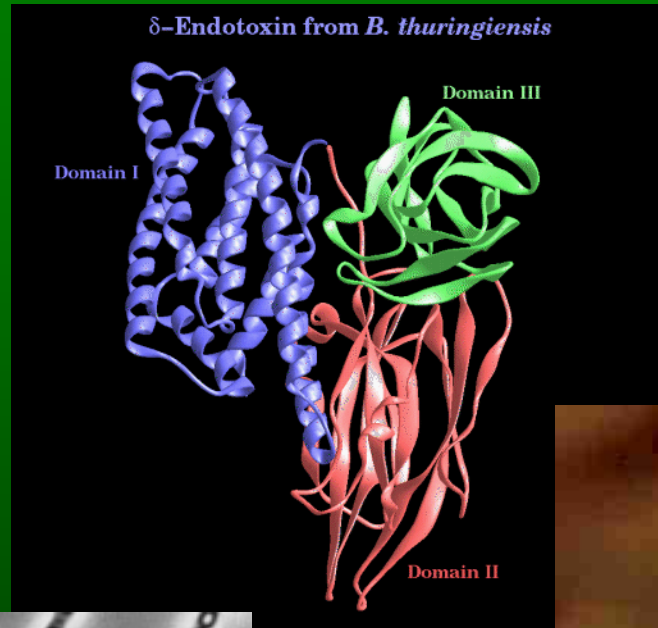
**How should we maintain genetic variation?**



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

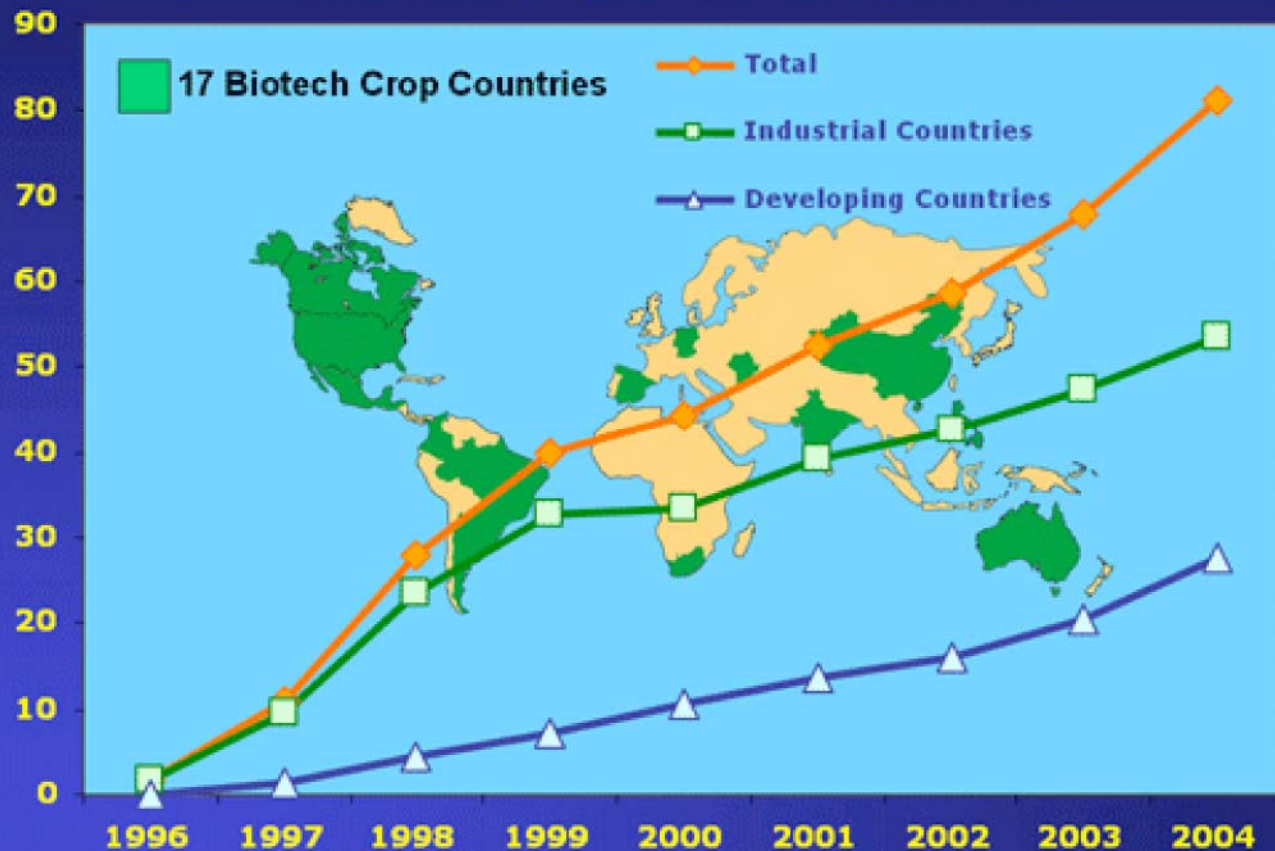


Similarly, evolutionary biology helps guide efforts to slow the evolution of pesticide resistance in insects.



# Evolutionary biology may help minimize the risks of transgenic crops.

## Global Area of Biotech Crops Million Hectares (1996 to 2004)



*Increase of 20%, 13.3 million hectares of 32.9 million acres between 2003 and 2004*

Source: Clive James, 2004