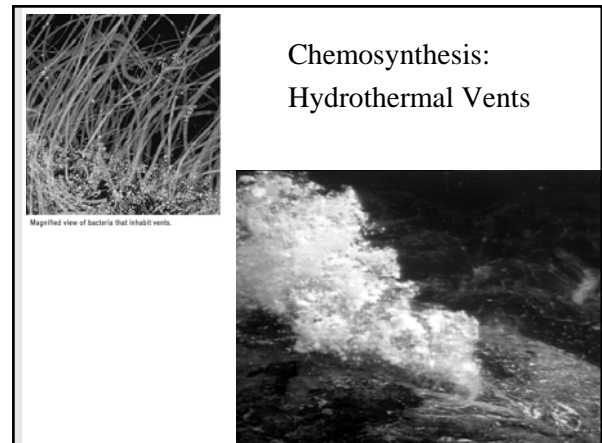
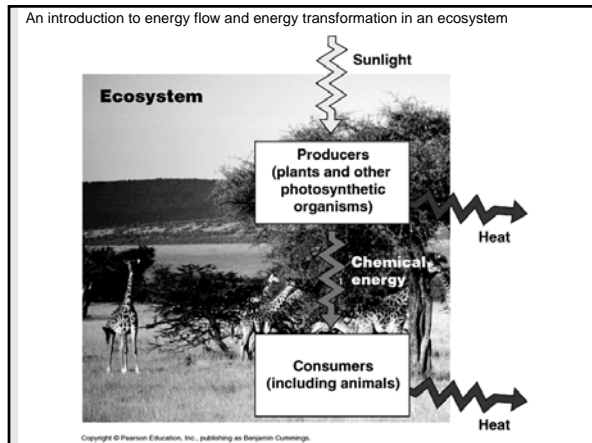


Lecture Series 1
**Introduction to Cellular
and Molecular Biology**
205

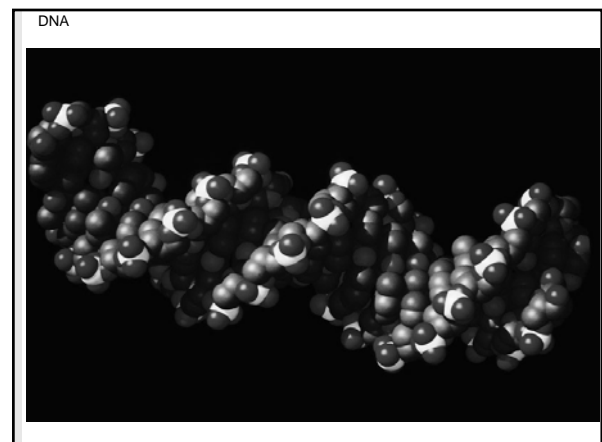
A. Evolutionary Milestones

- A major theme in evolution is increasingly diverse ways of capturing external energy for biologically useful reactions.



A. Evolutionary Milestones

- All living organisms contain the large molecules—carbohydrates, lipids, proteins, and nucleic acids.
- Ordered “bags of biochemistry” insulated from the chaos of the environment. Not a closed system.
- Storage, transfer and expression of genetic information.

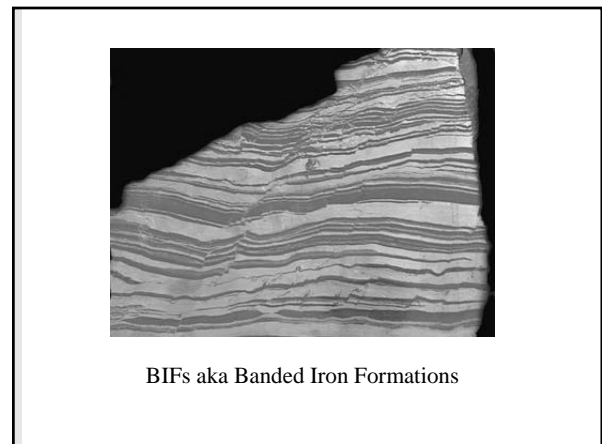
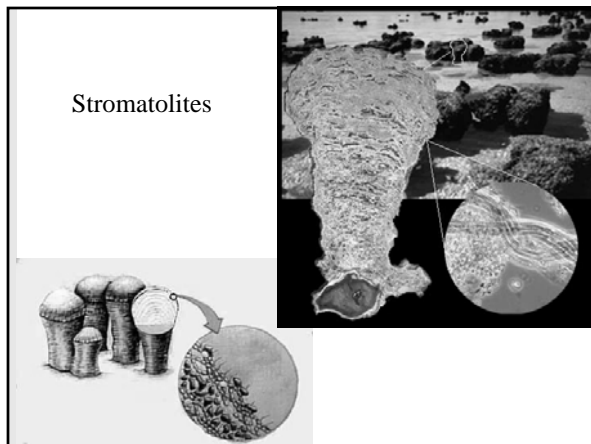
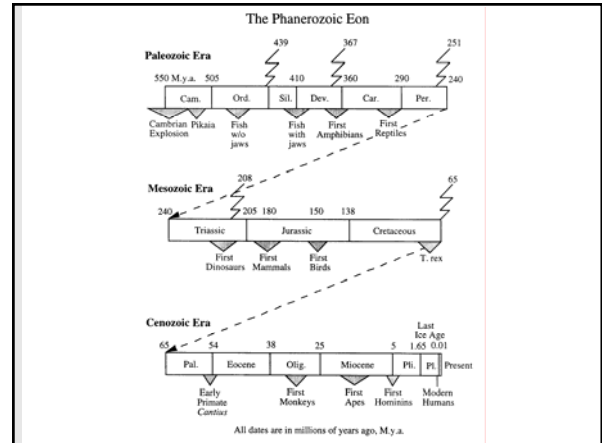
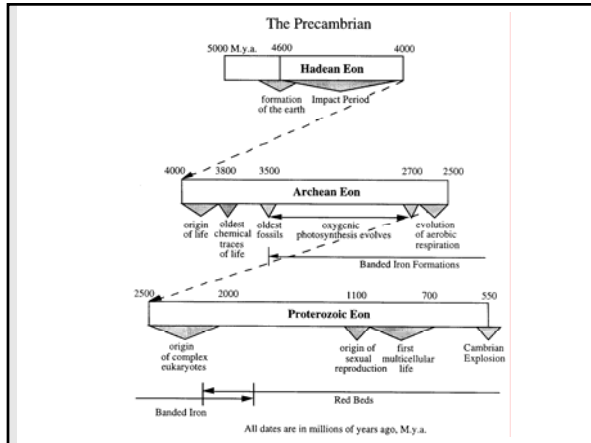


A. Evolutionary Milestones

- Life arose from nonlife about 3.8 to 4.0 billion years ago.
- This process occurred over only a couple hundred million years! Not 2 billion.
- Now all cells come from cells.....why?

A. Evolutionary Milestones

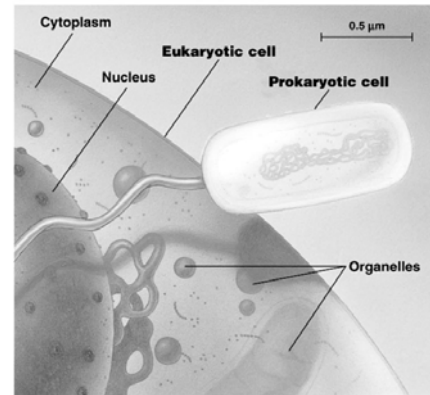
- Photosynthetic single-celled organisms released oxygen, allowing oxygen-based metabolism of large cells and eventually multicellular organisms.
- Oxygen began getting released very early on, but only accumulated in atmosphere after "Rust the Crust" and movement onto land only after Ozone shield.



A. Evolutionary Milestones

- Complex eukaryotic cells evolved from prokaryotic cells. Eukaryotic cells developed into multicellular organisms whose cells became modified for specific functions.
- The evolution of sexual reproduction enhanced the ability of organisms to adapt to changing environments.
- Adaptation to environmental change is the result of evolution by natural selection, the filter for innate variability.

Structural organization of Eukaryotic and Prokaryotic cells

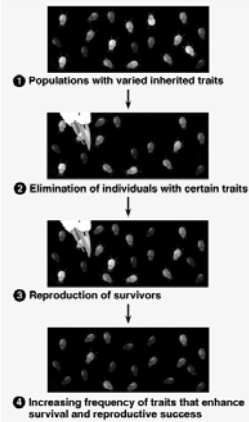


- The evolutionary view of life came into sharp focus in 1859 when Charles Darwin published *On the Origin of Species by Natural Selection*

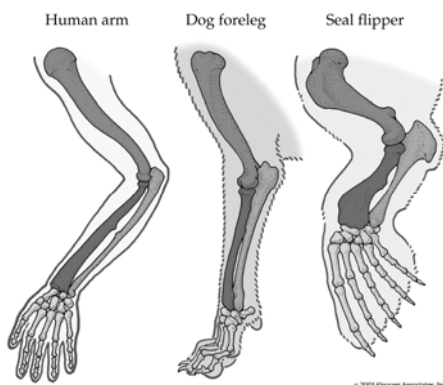


- *The Origin of Species* articulated two main points
 - ◆ Descent with modification
 - ◆ Natural selection

Natural selection

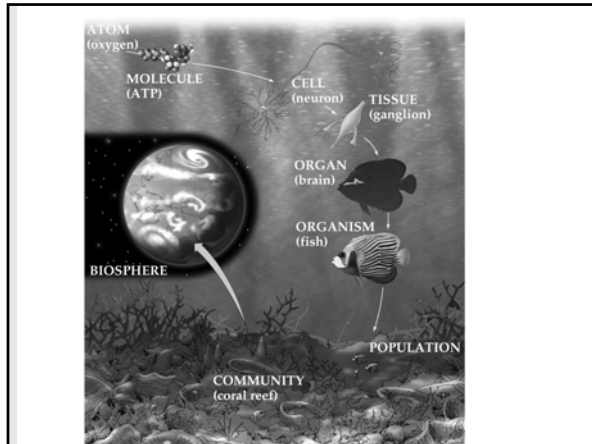


Descent with modification



B. The Hierarchy of Life

- Biology is organized into a hierarchy of levels. Each has “emergent properties” not found at lower levels.
- Emergent properties are where the sum is greater than the parts.
- Basic unit of biology is the cell, we go up or down from there.



- The cell is the lowest level of organization that can perform *all* activities required for life

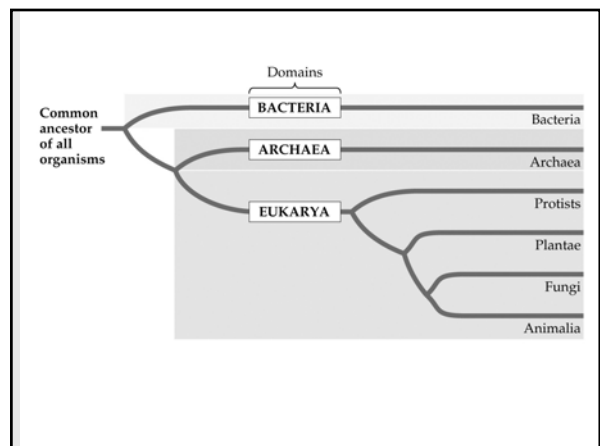
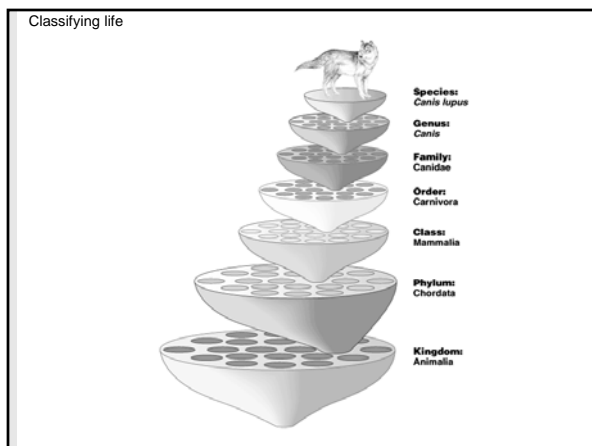
Two microscopic images of a cell. The left image shows a cell with a nucleus and various organelles. The right image shows a similar cell with a different internal structure. A scale bar at the bottom right indicates 25 μm.

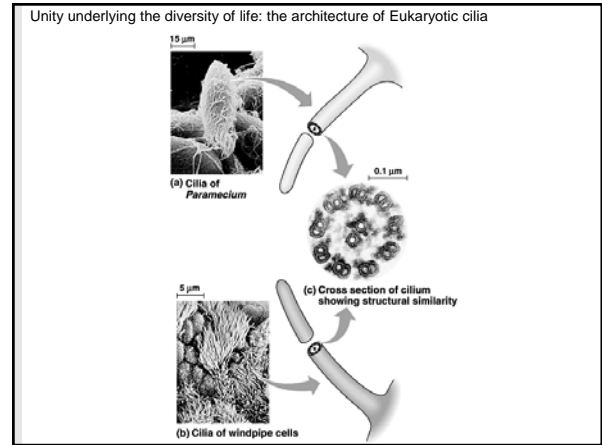
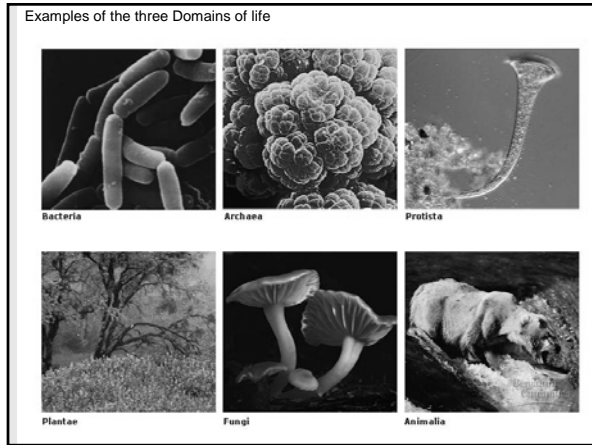
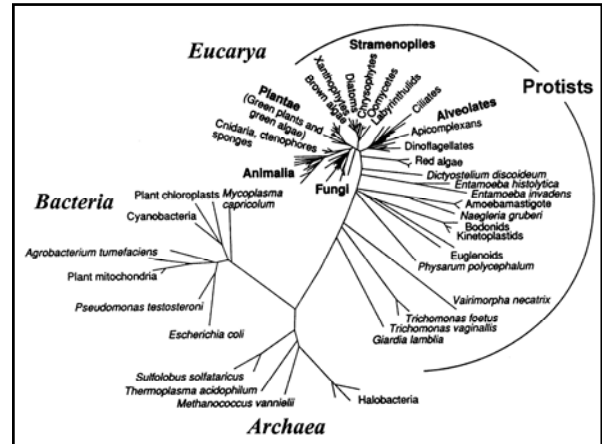
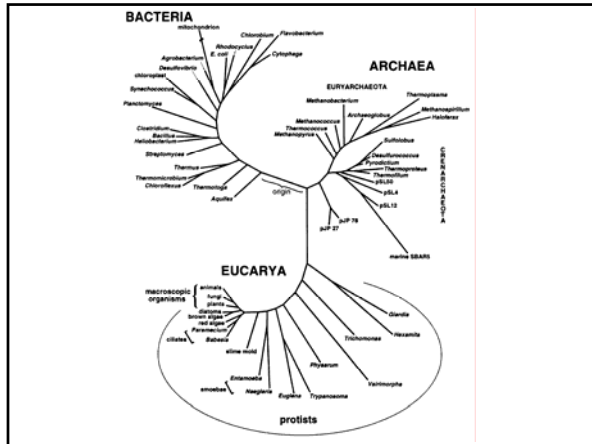
- Some emergent properties of life

Seven small images illustrating emergent properties of life: (a) Order: a sunflower head; (b) Evolutionary adaptation: a cactus; (c) Response to the environment: a bird's beak; (d) Regulation: a butterfly; (e) Energy processing: a hummingbird; (f) Growth and development: a penguin chick; (g) Reproduction: a penguin.

B. The Hierarchy of Life

- Domains vs Kingdoms...etc.
- Species are classified into domains Archaea, Bacteria, and Eukarya. Archaea and Bacteria consist of prokaryotic cells. Eukarya contain the protists and the kingdoms Plantae, Fungi, and Animalia.
- Crown Groups all require endosymbiosis!





C. Fundamental Concepts Used Throughout Biology

- Evolution unites all of biology. It's mechanism is Natural Selection.
- Emergent Properties
- Hierarchical Organization
- Hypothesis Testing/Deductive Reasoning

