Lecture Series 1

Introduction to Cellular and Molecular Biology 205

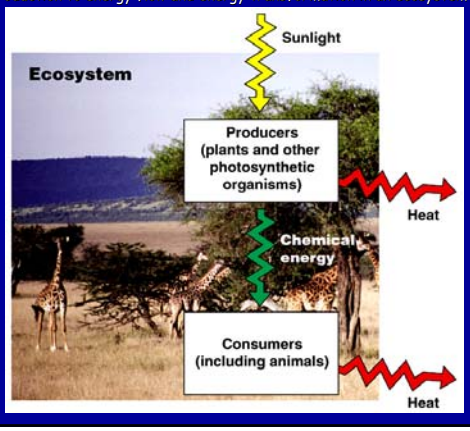
Reading Assignments

- Read Chapter 1
- Review Chapter 2
  (I am assuming you know this stuff!)

A. Evolutionary Milestones

- A major theme in evolution is increasingly diverse ways of capturing external energy for biologically useful reactions.
- This means many different ways to make ATP! Especially considering relatively recent discovery of microbial diversity.
- Microbiology is the original cell biology.

An introduction to energy flow and energy transformation in an ecosystem



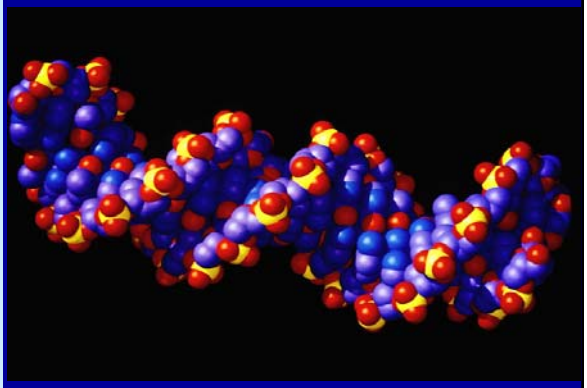
Magnified view of bacteria that inhabit vents.

Chemosynthesis: Hydrothermal Vents

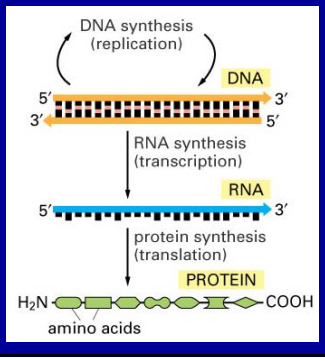
A. Evolutionary Milestones

- 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.

DNA



Languages of the cell

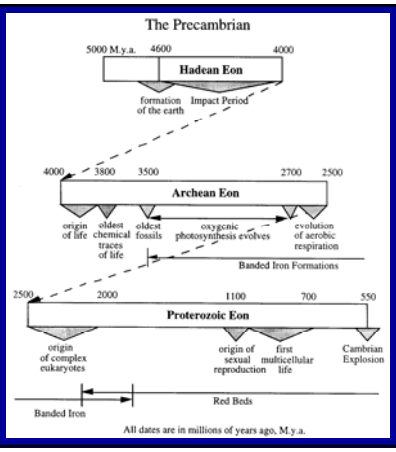


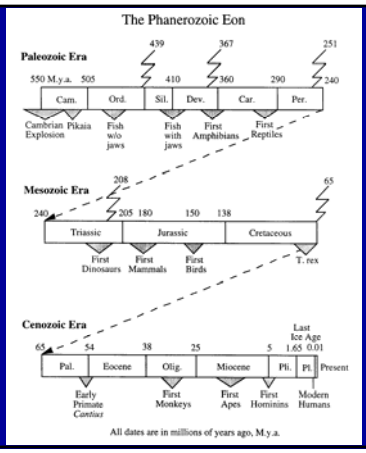
A. Evolutionary Milestones

- 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?

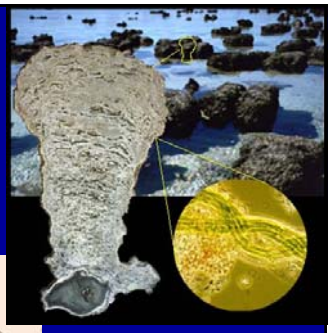
A. Evolutionary Milestones

- 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 occurred only after an Ozone shield.





Stromatolites

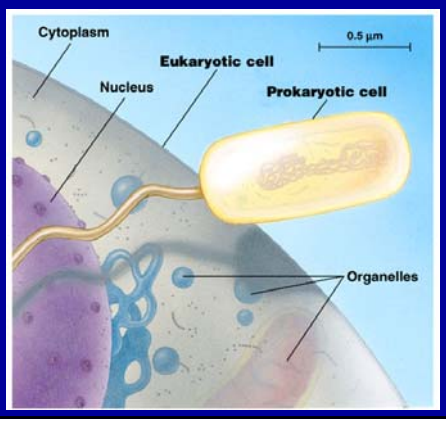


BIFs aka Banded Iron Formations

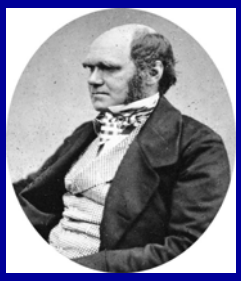
A. Evolutionary Milestones

- Complex eukaryotic cells evolved from bacterial 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

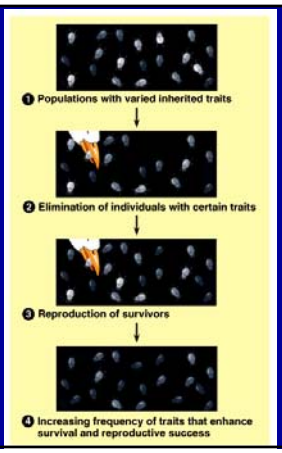


- The evolutionary view of life came into sharp focus in 1859 when Charles Darwin published *On the Origin of Species by Natural Selection*

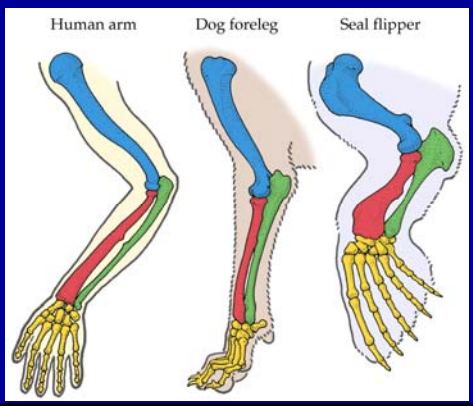


- *The Origin of Species* articulated two main points
  - Descent with modification
  - Natural selection

Natural selection

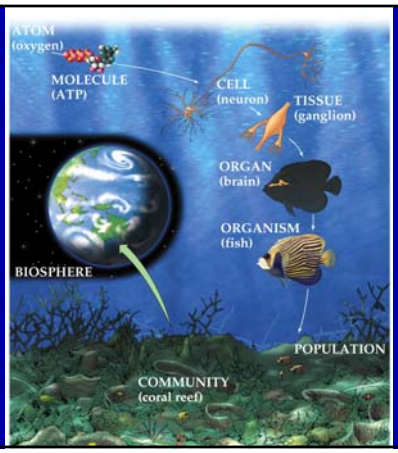


Descent with modification

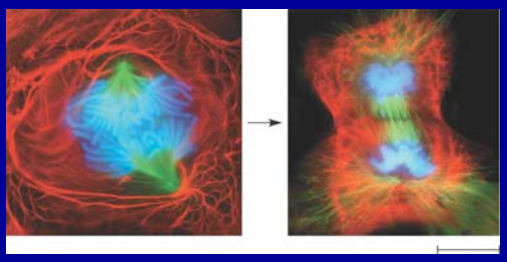


B. The Hierarchy of Life

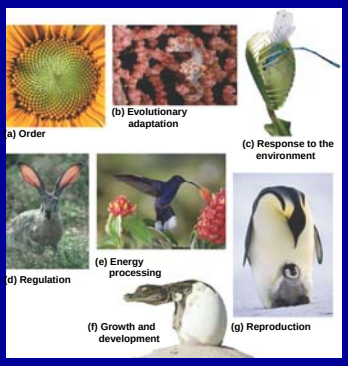
- Biology is organized into a hierarchy of levels. Each has "emergent properties" not found at lower levels.
- Emergent properties are where the sum is greater than the parts.
- Basic unit of biology is the "cell", we go up or down from there.



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



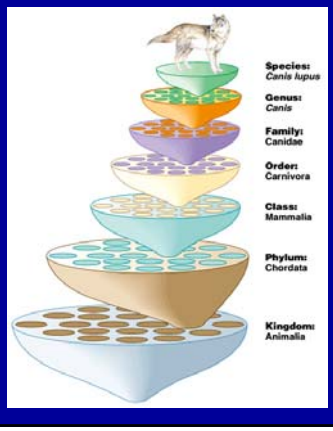
- Some emergent properties of life



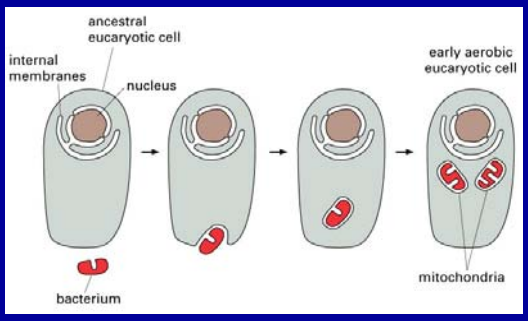
B. The Hierarchy of Life

- Domains vs Kingdoms…etc.
- Species are classified into the 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!

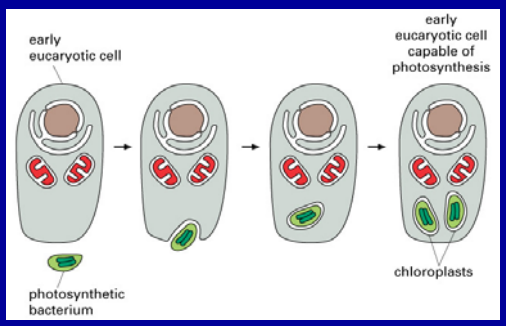
Classifying life



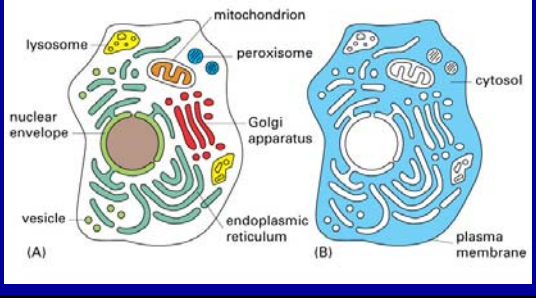
The first endosymbiotic jump

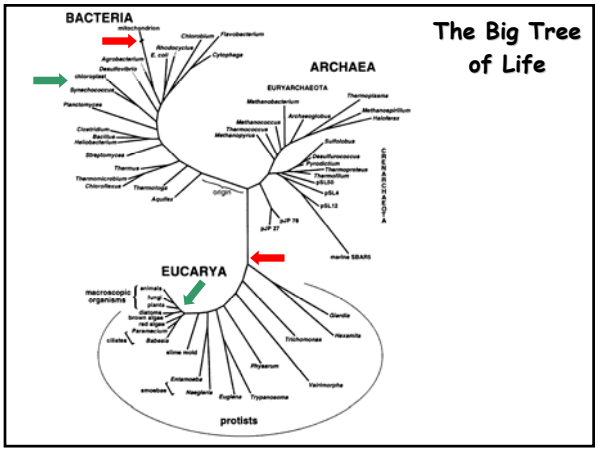


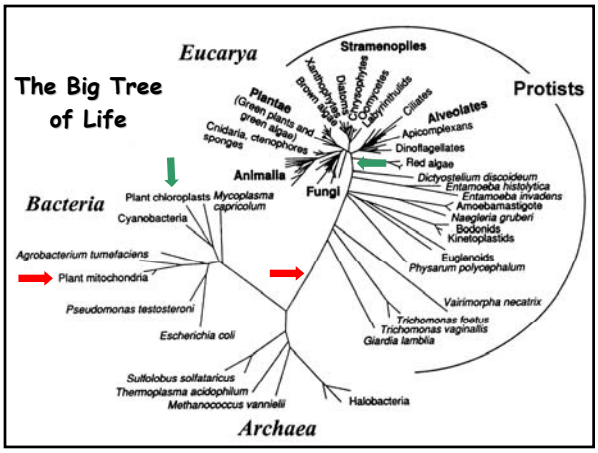
The second endosymbiotic jump



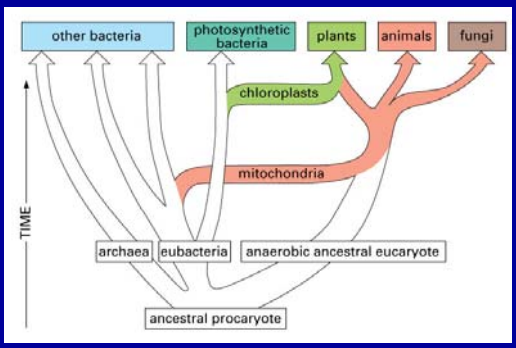
Complexity results in bags within bags



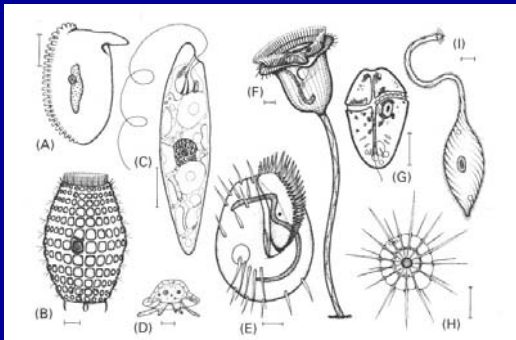




Complexity and Multicellularity

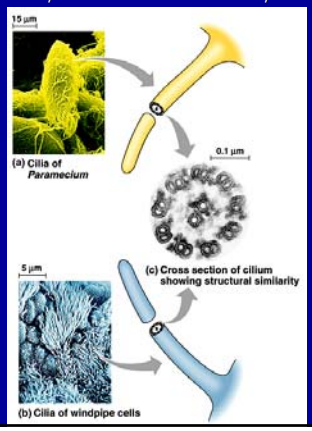


Protozoan Diversity



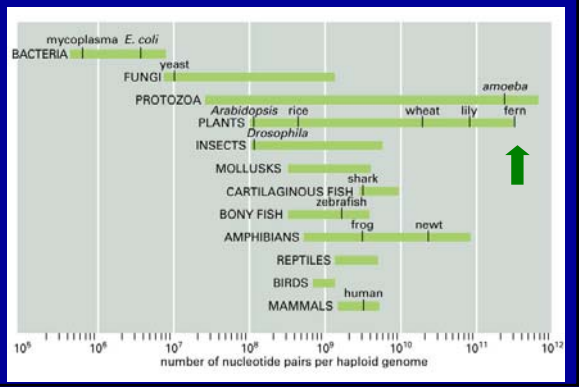
Examples of the three Domains of life

Unity underlying the diversity of life: the architecture of Eukaryotic cilia



9 + 2

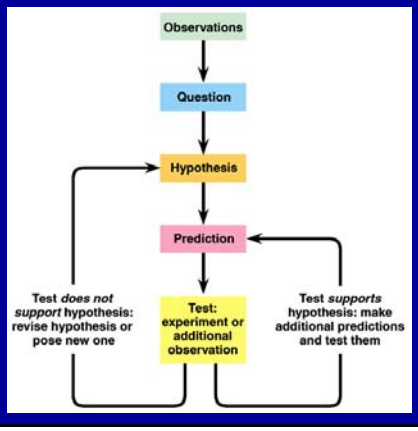
Complexity: Size isn't everything!



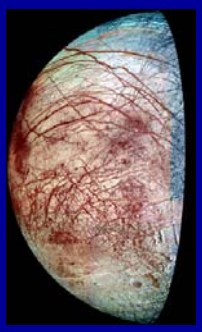
C. Fundamental Concepts Used Throughout Biology

- Evolution unites all of biology. It's mechanism is Natural Selection.
- Emergent Properties
- Hierarchical Organization
- Multicellularity accomplished by "terra forming"
- Hypothesis Testing/Deductive Reasoning

Idealized version of the scientific method



Astrobiology



Life on Europa?