ExoBiology

LECTURE 4

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What does it mean to be “Alive”
What is Life?
Since there is no unequivocal definition of life, the current understanding is descriptive. Life is considered a characteristic of organisms that exhibit all or most of the following characteristics or traits:

**Homeostasis:** Regulation of the internal environment to maintain a constant state; for example, electrolyte concentration or sweating to reduce temperature.

**Organization:** Being structurally composed of one or more cells — the basic units of life.

**Metabolism:** Transformation of energy by converting chemicals and energy into cellular components (anabolism) and decomposing organic matter (catabolism). Living things require energy to maintain internal organization (homeostasis) and to produce the other phenomena associated with life.
Growth: Maintenance of a higher rate of anabolism than catabolism. A growing organism increases in size in all of its parts, rather than simply accumulating matter.

Adaptation: The ability to change over time in response to the environment. This ability is fundamental to the process of evolution and is determined by the organism's heredity, diet, and external factors.

Response to stimuli: A response can take many forms, from the contraction of a unicellular organism to external chemicals, to complex reactions involving all the senses of multicellular organisms. A response is often expressed by motion; for example, the leaves of a plant turning toward the sun (phototropism), and chemotaxis.

Reproduction: The ability to produce new individual organisms, either asexually from a single parent organism, or sexually from two parent organisms.

Entropy and life
Life

Life (def): a “self-sustained chemical reaction capable of undergoing neo-Darwinian evolution”; i.e., one capable of replication with mutations which are able to be culled by natural selection.

In some definitions, anti-entropic, complex organization is also required.
DNA Structure
http://www.youtube.com/watch?v=qy8dk5iS1f0

http://www.youtube.com/watch?v=ZGHkHMoyC5I

DNA and Genes (skip)

http://www.youtube.com/watch?v=yqESR7E4b_8

http://www.youtube.com/watch?v=S8DMoDJ8FWA
Protein Structure

http://www.youtube.com/watch?v=lijQ3a8yUYQ

Transcription and Translation

http://www.youtube.com/watch?v=D3fOXt4MrOM

Protein Folding

http://www.youtube.com/watch?v=meNEUTn9Atg&feature=related
Growth of GenBank:

Since 1982 to present, the number of bases in GenBank has approximately doubled every 18 months.
Principal Protein Fold Classes

- **All alpha**
- **All beta**
- **alpha + beta**
- **alpha / beta**
Major Application: Designing Drugs

- Understanding How Structures Bind Other Molecules (Function)
- Designing Inhibitors
- Docking, Structure Modeling

(From left to right, figures adapted from Olsen Group Docking Page at Scripps, Dyson NMR Group Web page at Scripps, and from Computational Chemistry Page at Cornell Theory Center.)