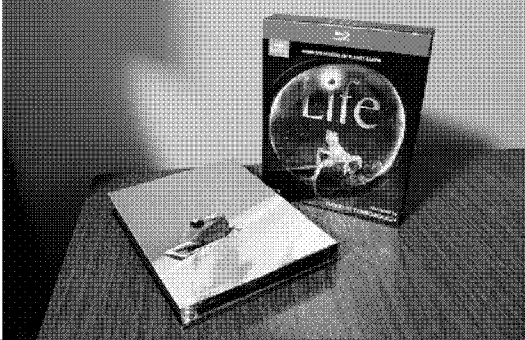


Monday, October 11
Defining Life



Problem Set #1

Due Monday, October 18, at class time.

Please write your answers neatly in the space provided on the paper copy.

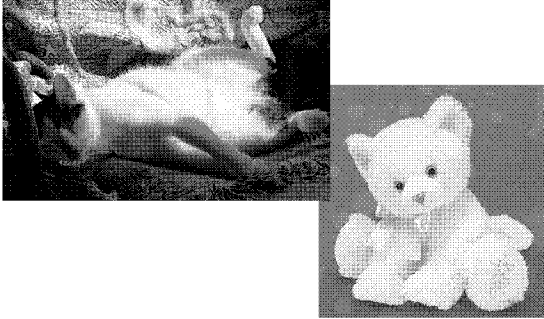
Extra copies of the problem set available from the professor or from the course website.

Defining Life Key Concepts

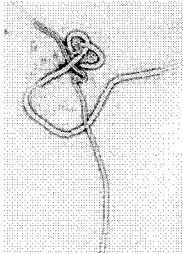
Characteristics common to all life on Earth:

- 1) Order (or structure)
- 2) Reproduction
- 3) Growth and development
- 4) Utilization of energy
- 5) Response to environment
- 6) Evolutionary adaptation

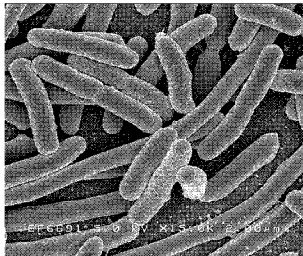
How do we distinguish living beings from non-living things?



The distinction is not always obvious.

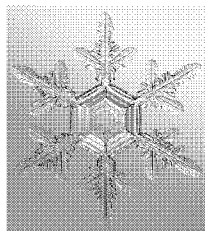
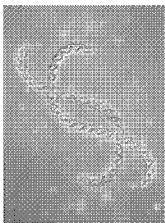


Ebola virus



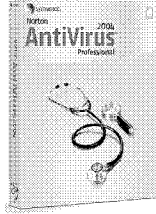
E. coli bacteria

1) Order: molecules in living things are not randomly scattered, but form patterns.



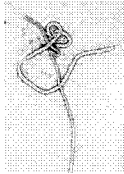
All living things have order; not everything with order is alive (think "snowflake").

2) Reproduction: living beings can make copies of themselves, either sexually or asexually.



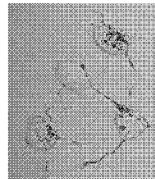
Not every living being can reproduce itself; some non-living things can make copies of themselves (think "computer virus").

Viruses and **prions** are on the borderline between life and non-life.



Ebola virus

Viruses can't reproduce on their own. They replicate by infecting living cells and hijacking their reproduction mechanisms.



Prions in mouse cells

Prions are infectious proteins. They replicate by inducing normal proteins to fold abnormally(?).

3) Growth & Development: living beings can increase in mass and add capabilities.

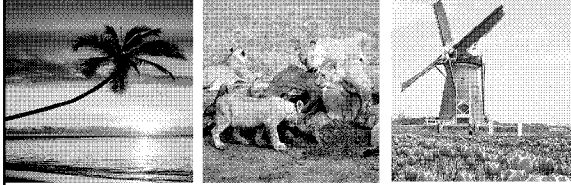
Growth is controlled in part by heredity, passed on through DNA.



All living things grow and develop; not everything that grows in size is alive (think "stalactite").

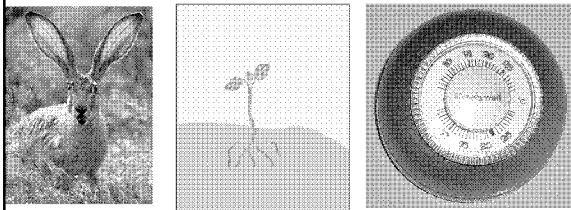
4) Energy utilization: living beings use energy drawn from their environment.

Living beings use energy to grow, reproduce, react, develop, and counteract the tendency to decay.



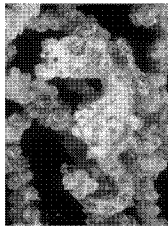
All living things use energy; not everything that uses energy from its environment is alive (think "windmill").

5) Response to environment: living beings sense and react to their surroundings.



All living things respond to their environment; not everything that senses & responds to its environment is alive (think "thermostat").

6) Evolutionary adaptation: living beings evolve over successive generations to be better suited to their environment.



Pygmy seahorse (camouflaged in coral)

Adaptations accrue to **populations**, not individuals, over many generations.

Significant adaptations can result in the emergence of new species.

The idea of evolutionary adaptation is ancient.

Anaximander (c. 610-547 BC)

Life arose in water and developed into more complex forms.



Aristotle (c 384-322 BC)

Species are fixed and unchanging. **WRONG**

Jean-Baptiste Lamarck (1744-1829)

Traits acquired by an organism during its lifetime can be passed on to offspring.

WRONG



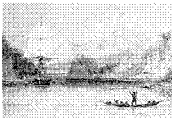
Charles Darwin proposed that **Natural Selection** was the primary mechanism of evolution.



Charles Darwin (1809-1882)



On The Origin of Species
(London, 1859)



HMS *Beagle* in
Tierra del Fuego

Natural Selection is based on “two undeniable facts and an inescapable conclusion”.

Fact 1:

Any population can produce more offspring than the environment can support. This leads to competition for resources.

Fact 2:

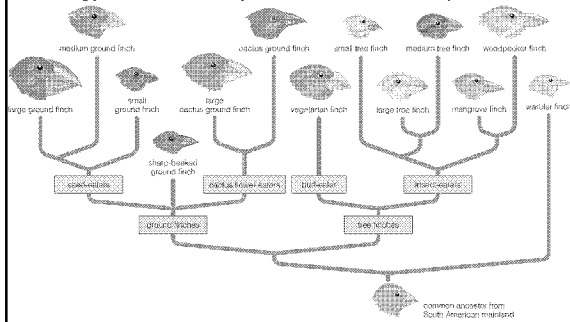
Different individuals have different traits, passed from parents through the mechanism of heredity.

The inescapable conclusion:

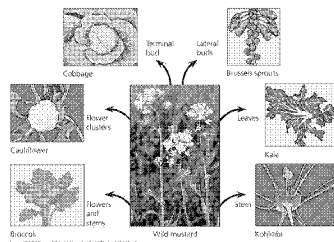
Those individuals whose hereditary traits best enable them to survive and reproduce will pass on those favorable traits to larger numbers of offspring.

This leads naturally to the selection of favorable traits.

Evidence for Natural Selection is found throughout biology in the diversity and similarities of species.



Artificial Selection, the breeding of plants and animals for desired traits, works similarly.



The difference is that **humans** are the agents of selection, rather than environmental factors.

Of the six characteristics of life, the ability to **reproduce** and **evolve** are the most central.

A working definition of life:

A living organism is something that can reproduce and evolve to adapt to its environment.

Tomorrow's Lecture:

Cells: Building Blocks of Life

This Week's Reading:

Chapter 5

