Introduction to human biology -- life and evolution

I. Introduction

- human biology involves more than study of body (see course goals)
    - relationships with society
    - relationship with environment

II. Characteristics of life

A. Life is diverse

- we share the planet with 30 million or more species

    - three major groups, domains:
        - Bacteria -- prokaryotes
        - Archaea -- prokaryotes
        - Eukarya -- eukaryotes
            - plants
            - animals
            - fungi
            - protozoans

- diversity is a result of evolutionary processes that have been occurring since life originated on planet more than a billion years ago
    - different habitats = different species

- evolution results in increasing complexity of species -- driven by accumulation and storage of genetic information

B. Life is variable

- within species there is variation from individual to individual
    - result from sexual reproduction
    - result from mutation
- variations allow species to adapt and evolve

C. Life is organized

- "Life is nothing more, nothing less, than the structural organization of certain molecules", Boyce Rensberger, Science 80.
    - dehydration experiments with brine shrimp, yeast
    - cryopreservation of cells
    - in both cases cells instate of suspended animation
- living organisms exhibit a high degree of organization of structure and function

- matter in universe can be organized hierarchically: atom, molecules, organelle, cell, tissue, organisms, organ systems (in multicellular organisms), organism, population, community, ecosystem, biosphere
    - each level must "obey" laws of levels below it
    - each level has unique properties that emerge from interaction at the lower levels -- emergent properties that cannot be predicted based on what we know about lower levels
- where on hierarchy does life begin?
    - molecules?
    - organelles?
- life is cellular -- cell theory
    - cells are structural and functional units of all living things
    - activities of an organism are dependent on individual/collective activities of all cell
    - activities of cells made possible by subcellular structures
    - continuity of life has a cellular basis
- are viruses alive?
- is the earth alive?

D. Life can move

- life shows movement at all levels of organization - atomic, molecular organismal

E. Life is self regulating

- homeostasis -- ability of living things to maintain ever changing internal conditions within a narrow tolerable range

- examples of homeostasis

F. Life is chemically unique

- organic compounds contains carbon
- 99% of all elements in living things are carbon, hydrogen, nitrogen, oxygen
- organic molecules - "life is polymeric"

G. Life is based on water

- 75% - 95% of most organisms made up of water

H. Life can reproduce

- reproduction at cellular level - mitosis, meiosis
- reproduction at organismal level -- sexual or asexual means (clones)

I. Life has a plan

- organisms contain genetic instructions -- DNA
- these instructions transmitted from parent to offspring

J. Life grows

- both in size, cell number

K. Life adapts and evolves -- life has a history

- lifeless earth --> chemical evolution (development of organic chemicals) --> life (prokaryotic) --> biological evolution (photosynthesis --> eukaryotic organisms --> multicellular organisms)

1. Evolution

- process by which one species gives rise to another
    - evolution is the process by which a species becomes adapted to its environment
    - concept of common ancestry for all species
    - explains both diversity and fact that many species share common features
- Charles Darwin
    - evolution by way of natural selection
    - drew on ideas of Rev. Thomas Malthus, 18th. century theologian/economist
        - populations increase exponentially, resorces increase arithmetically
        - populations grow faster and eventually use up resources
        - leads to competition for resources

- natural selection -- those individuals with traits that are most successful will increase in frequency over time
    - are better adapted
- example of natural selection -- peppered moths, England
    - dark colored or gray speckled
    - fly at night, on trees during day
    - trees had lichens until mid 1800's
        - gray speckled more common
    - from 1848 - 1898 dark colored variant increases in frequency
        - industrial revolution
- thus adaptation is end product of evolution

L. Life metabolizes

- capacity to obtain and convert energy from surroundings
- capacity to use energy in the maintenance and growth

L. Life dies

- Levine and Miller, 1994, "death is equilibrium with the environment"

M. Life interacts with environment

1. irritability
2. ecology

III. The interdependency of life

A. Autotrophs and heterotrophs

- autotrophs -- plants and other photosynthetic organisms
    - capture energy of sunlight and convert it to forms they can use to build organic compounds
- heterotrophs -- depend directly or indirectly on energy stored in tissues of producers

- B. Relationships between autotrophs, heterotrophs, abiotic environment

1. One way energy flow through ecosystems
   - second law of thermodynamics -- when energy converted from one form to another, some of the energy becomes unavailable to do work
     - no physical or chemical reaction is 100% efficient
     - " not all the energy can be used as it is converted from one form to another"
2. Nutrient flow through ecosystems
   - recycling
   - role of decomposers
   - implication with pollutants, toxins