Introduction: Themes in the Study of Life

Chapter 1
AP Biology
Warm Up

- Please complete the pretest that you picked up when you came in.
Inquiring About Life

- **Biology** - the scientific study of life.
Biological Themes

- New Properties Emerge at Each Level in the Biological Hierarchy
- **Life Emergent Properties**
  - Regulation
  - Order
  - Energy Processing
  - Evolutionary Adaptation
  - Reproduction
  - Growth and Development
  - Response to the Environment
Biological Themes

- Organisms Interact with Other Organisms and the Physical Environment
  - Levels of Biological Organization
    - Biosphere
    - Ecosystems
    - Communities
    - Populations
    - Organisms
    - Organs and Organ Systems
    - Tissues
    - Cells
    - Organelles
    - Molecules
Biological Themes

- Life Requires Energy Transfer and Transformation
  - **Metabolism** - the sum of all the chemical processes in the body.
    - **Anabolism** - reactions that require energy.
    - **Catabolism** - reactions that release energy.
  - **Producers** (autotrophs) - make their own energy.
  - **Consumers** (heterotrophs) - feed on producers (and other consumers) to obtain energy.
Biological Themes

- Structure and Function are Correlated at All Levels of Biological Organization.
- Example: ?
Biological Themes

- The Cell is an Organism’s Basic Unit of Structure and Function.
  - A cell is the lowest level of organization that can perform all activities required for life.
    - **Eukaryote** - contains nucleus (that houses DNA) and membrane-bound organelles; includes many forms of life (plants, animals, fungi).
    - **Prokaryote** - does not have a nucleus (still has DNA-free floating in the cytoplasm); does not have organelles; smaller and less complex; includes bacteria and archea.
Biological Themes

- The Continuity of Life is Based on Heritable Information in DNA
- Chromosomes contain genes (which are passed from parent to offspring) that are made up of DNA.
Biological Themes

- DNA provides instructions for making proteins, which provide structure for cells/organisms, and help carry out cellular activities.
- **Gene Expression** - the process where info coded in DNA is used to make proteins.
- **Genome** - the entire library of genetic instructions in an organism.
- **Genomics** - studying sets of genes of an organism and comparing genomes between species.
Feedback Mechanisms Regulate Biological Systems

- **Negative Feedback** - reduces the stimulus.
  - Brings the body back to normal and helps restore homeostasis.

- **Positive Feedback** - amplifies the stimulus.
  - Not typically involved in homeostasis.
Warm Up - 2 tasks

- On your warm up sheet, explain the difference between positive and negative feedback.
- Please complete the “bug” worksheet that you picked up as you came in.
Evolution: Unity and Diversity of Life

- **Evolution** - change over time
  - Supports the idea that organisms living on Earth today are modified descendants of common ancestors.

- **Taxonomy** - the branch of biology that names and classifies species.
**FIGURE 1.14**

*Ursus americanus* (American black bear)
**Domains/Kingdoms**

- **Archaea** - prokaryotes
- **Bacteria** - prokaryotes
- **Eukarya** - multicellular eukaryotes
  - **Kingdom Plantae** - autotroph (photosynthesis)
  - **Kingdom Fungi** - absorb nutrients from surroundings
  - **Kingdom Animalia** - heterotrophs

*Protists* - single and multi-celled eukaryotes
(a) Domain Bacteria

(b) Domain Archaea

(c) Domain Eukarya

- Kingdom Animalia
- Kingdom Plantae
- Kingdom Fungi

Protists
Charles Darwin

- **On The Origin of Species (1859)**
  - Descent With Modification- contemporary species arose from a succession of ancestors.
  - Natural Selection- a mechanism where the environment selects certain traits among natural variant traits in the population.
Charles Darwin

- Darwin’s Observations
  - Individuals vary in their traits, many are inherited.
  - A population can produce far more offspring than can survive.
  - Species are generally adapted to fit their environments.
- Conclusion: individuals with traits best suited to the environment are more likely to survive and reproduce- creating more individuals with the advantageous traits.
Adaptive Radiation

- Green warbler finch
  *Certhidea olivacea*
- Gray warbler finch
  *Certhidea fusca*
- Sharp-beaked ground finch
  *Geospiza difficilis*
- Vegetarian finch
  *Platyspiza crassirostris*
- Mangrove finch
  *Cactospiza heliobates*
- Woodpecker finch
  *Cactospiza pallida*
- Medium tree finch
  *Camarhynchus pauper*
- Large tree finch
  *Camarhynchus psittacula*
- Small tree finch
  *Camarhynchus parvulus*
- Large cactus ground finch
  *Geospiza conirostris*
- Cactus ground finch
  *Geospiza scandens*
- Small ground finch
  *Geospiza fuliginosa*
- Medium ground finch
  *Geospiza fortis*
- Large ground finch
  *Geospiza magnirostris*
Exit Slip

- How is a mailing address analogous to biology’s hierarchical taxonomic system?
- Name the three domains of life, and the four kingdoms discussed today.
Warm Up Exercise

- Briefly describe Darwin’s general conclusions in his theory of evolution. (2-3 sentences)
Science As a Process

- **Data** - recorded observations
  - **Quantitative Data** - recorded measurements. (contains numbers - frequently organized in tables and graphs)
  - **Qualitative Data** - recorded descriptions. (no numbers)
Quantitative or Qualitative

- The following data were collected by scientists studying the feeding habits of the purple-throated hummingbird, *Eulampis jugularis*. 
Quantitative or Qualitative

- The males of the species are larger than the females.
- The males’ bills are shorter and less curved than those of the female.
- The hummingbirds in the landscaped garden spent 21% of the time feeding. Of that time, 20% was spent feeding on insects and 80% was spent feeding on nectar.
- The males get nectar from a species of *Heliconia* in which the flowers have shorter and less curved petals.
- The females get nectar from a species of *Heliconia* in which the flowers have longer and more petals.
- The hummingbirds in the forested area spent 23% of the time feeding. Of that time, 92% was spent feeding on insects and 8% was spent feeding on nectar.
Science As A Process

- **Hypothesis** - a proposed answer to a question.
  - Typically written in an “If...then” format.
    - If... independent variable, then....dependent variable
  - Must be testable.
  - Must be falsifiable.
Experimental Design

- **Controlled Experiment** - an experiment that is designed to compare an experimental group to a control group.
  - **Independent Variable** - what is changed.
    - When graphing, the independent variable is placed on the x axis.
  - **Dependent Variable** - what is measured.
    - When graphing, the dependent variable is placed on the y axis.

*Observations and experimental results must be repeatable in order for an experiment to be considered valid.*
Theory or Hypothesis?

- Scientific theories are much broader in scope than a hypothesis.
- Theories can be used to derive new hypotheses.
- Theories are supported by substantially more evidence than a hypothesis.
Facts About Science

- Scientists work together.
  - Peer Review - one scientist reading another’s work - checking it for validity.
- Science and technology are interdependent.
Exit Slip

- Explain the difference between an independent and dependent variable.