Lecture 1

AP Biology vMIT

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Campbell Chapter 1: Exploring Life

Concepts

* Concept 1.1: Biologists explore life from the microscopic to the global scale
* Concept 1.2: Biological systems are much more than the sum of their parts
* Concept 1.3: Biologists explore life across its great diversity of species
* Concept 1.4: Evolution accounts for life’s unity and diversity
* Concept 1.5: Biologists use various forms of inquiry to explore life

**What is Biology?** Is the scientific study of life

**Properties of Life:**

-order

-evolutionary adaption

-response to environment

- regulation

-energy processing

-growth and development

-reproduction

**1.1 Biologists explore life from the microscopic to the global scale**

* The study of life
  + Extends from the microscope scale of molecules and cells to the global scale of the entire living planet
* The hierarchy of life
  + Extends through many levels of biological organization

|  |  |
| --- | --- |
| *A-cellular level and Pre-cellular level* | \* The [atom](http://en.wikipedia.org/wiki/Atom) |
| \* The [molecule](http://en.wikipedia.org/wiki/Molecule), a grouping of atoms |
| *Sub-cellular level* | \* The [organelle](http://en.wikipedia.org/wiki/Organelle), a functional grouping of biomolecules; biochemical reactions and interactions |
| *Cellular level* | \* The [cell](http://en.wikipedia.org/wiki/Cell_(biology)), the basic unit of all life and the grouping of organelles |
| *Super-cellular level (Multicellular level)* | \* The [tissue](http://en.wikipedia.org/wiki/Tissue_(biology)), a functional grouping of cells |
|  | \* The [organ](http://en.wikipedia.org/wiki/Organ_(biology)), a functional grouping of tissues |
| \* The [organ system](http://en.wikipedia.org/wiki/Organ_system), a functional grouping of organs |
| \* The [organism](http://en.wikipedia.org/wiki/Organism), the basic living system, a functional grouping of the lower-level components, including at least one cell |
| \* The [population](http://en.wikipedia.org/wiki/Population), a grouping of organisms of the same [species](http://en.wikipedia.org/wiki/Species) |
| \* The [biocoenosis](http://en.wikipedia.org/wiki/Biocoenosis) or community, an [interspecific](http://en.wikipedia.org/wiki/Biological_interaction) grouping of interacting populations |
| \* The [ecosystem](http://en.wikipedia.org/wiki/Ecosystem), a grouping of organisms from all biological [domains](http://en.wikipedia.org/wiki/Domain_(biology)) in conjunction with the physical ([abiotic](http://en.wikipedia.org/wiki/Abiotic)) environment |
| \* The [biosphere](http://en.wikipedia.org/wiki/Biosphere), the complete set of communities |
| \* The [ecosphere](http://en.wikipedia.org/wiki/Earth%27s_spheres), the complete set of ecosystems |

**A Closer Look at Ecosystems**

* Each organism
  + Interacts with its environment
* Both organism and environment
  + Are affected by the interactions between them
* The dynamics of any ecosystem include **two major processes**
  + Cycling of nutrients, in which materials acquired by plants eventually return to the soil
  + The flow of energy from sunlight to producers to consumers

***Energy Conversion***

* Activities of life
  + Require organisms to perform work, which depends on an energy source
* The exchange of energy between an organism and its surroundings
  + Often involves the transformation of one form of energy to another
* Energy flows *through* an ecosystem
  + Usually entering as sunlight and exiting as heat

**A Closer Look at Cells**

* The cell
  + Is the lowest level of organization that can perform *all* activities required for life
* Cells contain chromosomes made partly of DNA, the substance of genes
  + Which program the cells’ production of proteins and transmit information from parents to offspring
* The molecular structure of DNA
  + Accounts for it information-rich nature

***Two Main Forms of Cells***

* All cells share certain characteristics
  + They are all enclosed by a membrane
  + They all use DNA as genetic information
* There are two main forms of cells
  + Eukaryotic
    - Are subdivided by internal membranes into various membrane-enclosed organelles
  + Prokaryotic
    - Lack the kinds of membrane-enclosed organelles found in eukaryotic cells

**Concept 1.2: Biological systems are much more than the sum of their parts**

* System
  + Is a combination of components that form a more complex organization
  + due to increasing complexity
  + New properties emerge with each step upward in the hierarchy of biological order
* Reductionism
  + Involves reducing complex systems to simpler components that are more manageable to study
* Systems biology
  + Is now taking hold in the study of life at the cellular and molecular levels
  + Includes three key research developments: high-throughput technology, bioinformatics, and interdisciplinary research teams

**Concept 1.3: Biologists explore life across its great diversity of species**

* Taxonomy
  + Is the branch of biology that names and classifies species according to a system of broader and broader groups
  + Domain, kingdom, phylum, class, order, family, genus, species
  + (King Phillip Came Over For Great Spaghetti)
* The Three Domains of Life
* At the highest level, life is classified into three domains
  + Bacteria
  + Archaea
  + Eukarya
* Domain Bacteria and domain Archaea
  + Consist of prokaryotes
* Domain Eukarya, the eukaryotes
  + Includes the various protist kingdoms and the kingdoms Plantae, Fungi, and Animalia

**Concept 1.4: Evolution accounts for life’s unity and diversity**

* Many related organisms
  + Have very similar anatomical features, adapted for their specific ways of life
* Such examples of kinship
  + Connect life’s “unity in diversity” to Darwin’s concept of “descent with modification”

**Concept 1.5: Biologists use various forms of inquiry to explore life**

* Biology blends two main processes of scientific inquiry
  + Discovery science
    - Describes natural structures and processes as accurately as possible through careful observation and analysis of data
    - **In inductive reasoning**, scientists derive generalizations based on a large number of specific observations
  + Hypothesis-based science
    - In science, a hypothesis is a tentative answer to a well-framed question, an explanation on trial
    - Makes predictions that can be tested
    - **Deductive reasoning**
      * The logic flows from the general to the specific
      * If a hypothesis is correct:
        + then we can expect a particular outcome
    - A scientific hypothesis must have two important qualities
      * It must be testable
      * It must be falsifiable