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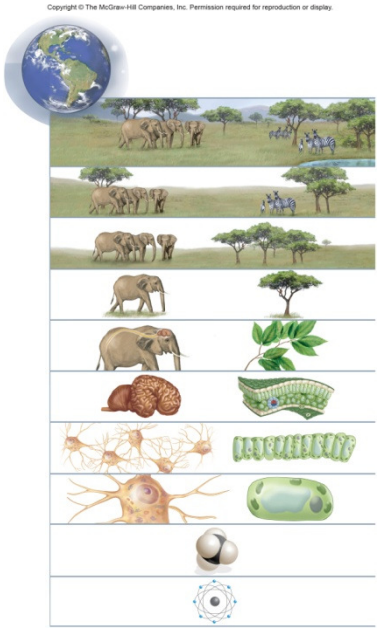
A View of Life



BIOLOGY

10th Edition

Sylvia S. Mader

PowerPoint® Lecture Slides are prepared by Dr. Isaac Barjis, Biology Instructor

Outline

- Defining Life - Emergent Properties
  - Materials and Energy
  - Reproduction and Development
  - Adaptations and Natural Selection
- Classification
  - Organization and Diversity

Defining Life

- Living things:
  - Comprised of the same chemical elements e.g. Carbon, Hydrogen, and Oxygen
  - Obey the same physical and chemical laws
  - Living organisms consist of cells (Unicellular or Multi-cellular).
    - The **cell** is the basic structural and functional unit of all living things e.g. plants, animals, and fungus
    - Cells are produced from preexisting cells
    - Cells are the smallest units that perform all vital physiological functions

Defining Life

Living organisms can be Microscopic:

- Bacteria
- Paramecium

Living organisms can be Macroscopic (Multi-cellular):

- Snow goose
- Humans

Bacteria

Paramecium

Morel

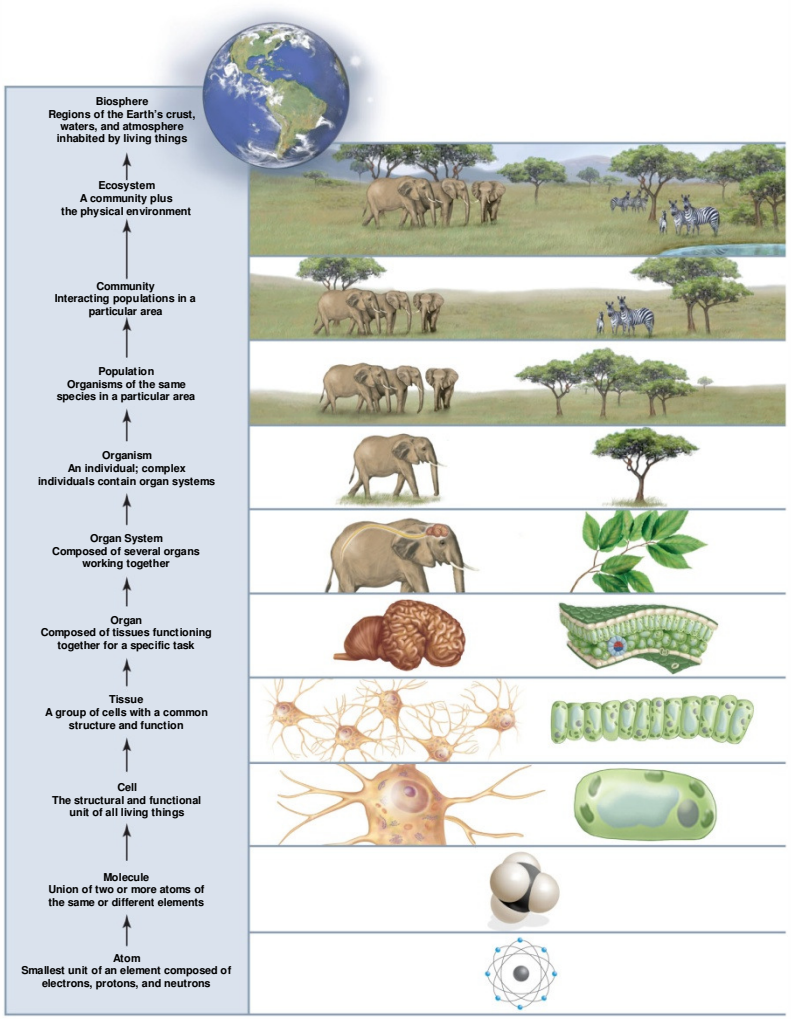
Sunflower

Snow goose

Defining Life

- Each level of organization has Emergent Properties
- Levels range from extreme micro (e.g. Atoms, Molecules and Cells) to global (e.g. Community, Ecosystem and Biosphere)
- Each level of organization is more complex than the level preceding it
  - *Emergent properties*:
    - Interactions between the parts making up the whole
    - All emergent properties follow the laws of physics and chemistry

Levels of Biological Organization



Living Things: Acquire & Process Food

- **Energy** – required to maintaining organization and conducting life-sustaining processes
  - The sun:
    - Ultimate source of energy for nearly all life on Earth
    - Certain organisms, such as plants, capture solar energy to carry on photosynthesis
      - Photosynthesis transforms solar energy into chemical energy (Organic Molecules)
      - Chemical energy is used by other organisms e.g. animals
  - **Metabolism** is all the chemical reactions that occur in a cell or in an organism.
    - **Homeostasis** - Maintenance of internal conditions within certain boundaries

Acquiring Nutrients

a.

b.

c.

d.

e.

f.

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Living Things: Respond to Stimuli

- Living things interact with the environment and respond to changes in the environment
- **Response** ensures survival of the organism and it often results movement
  - Vulture can detect and find carcass a mile away and soar toward dinner
  - Monarch butterfly senses approach of fall and migrates south
  - Microroganisms can sense light or chemicals
  - Even leaves of plants follow sun
- Activities as a result of Responses are termed **behavior**

Living Things: Reproduce and Develop

- Organisms live and die
- All living organisms must reproduce to ensure continued existence and maintain population
- In most multicellular organisms reproduction:
  - Begins with union of sperm and egg (fertilization)
  - Followed by cell division and differentiation
  - Developmental instructions encoded in genes
    - Composed of DNA
    - Long spiral molecule in **chromosomes**

Rockhopper Penguins & Offspring

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Living Things: Adapt to Change

- **Adaptation**
  - Any modification that makes an organism more suited to its way of life
  - Organisms become modified over long period time
    - Respond to environmental changes by developing new adaptations
  - However, organisms very similar at basic level
    - Suggests living things descended from same ancestor
    - Descent with modification - **Evolution**
    - Caused by **natural selection**

Evolution, the Unifying Concept of Biology

- Despite diversity, organisms share the same basic characteristics
  - Composed of cells organized in a similar manner
  - Their genes are composed of DNA
  - Carry out the same metabolic reactions to acquire energy
- This suggests that they are descended from a common ancestor

Classification

- Taxonomy:
  - Discipline of identifying and classifying organisms according to certain rules
  - Hierarchical levels (taxa) based on hypothesized evolutionary relationships
  - Levels are, from least inclusive to most inclusive:
    - Species, genus, family, order, class, phylum, kingdom, and domain
    - A level (e.g. phylum) includes more species than the level below it (e.g. class), and fewer species than the one above it (e.g. kingdom)

Levels of Classification

TABLE 1.1

Levels of Classification

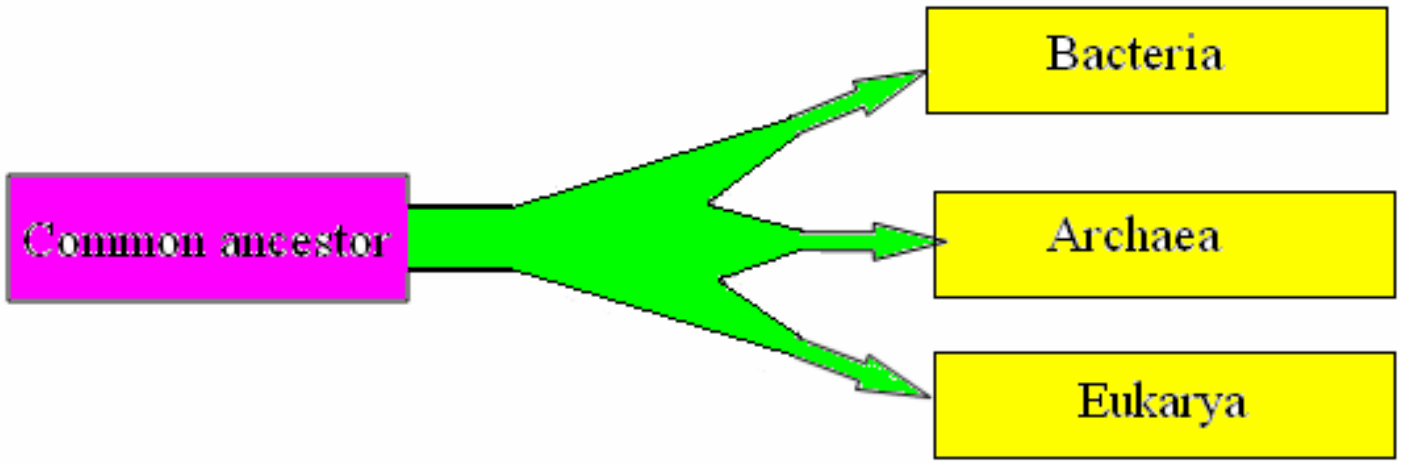
Category	*Human*	*Corn*
Domain	Eukarya	Eukarya
Kingdom	Animalia	Plantae
Phylum	Chordata	Anthophyta
Class	Mammalia	Monocotyledones
Order	Primates	Commelinales
Family	Hominidae	Poaceae
Genus	*Homo*	*Zea*
Species*	*H. sapiens*	*Z. mays*

*To specify an organism, you must use the full binomial name, such as *Homo sapiens*.

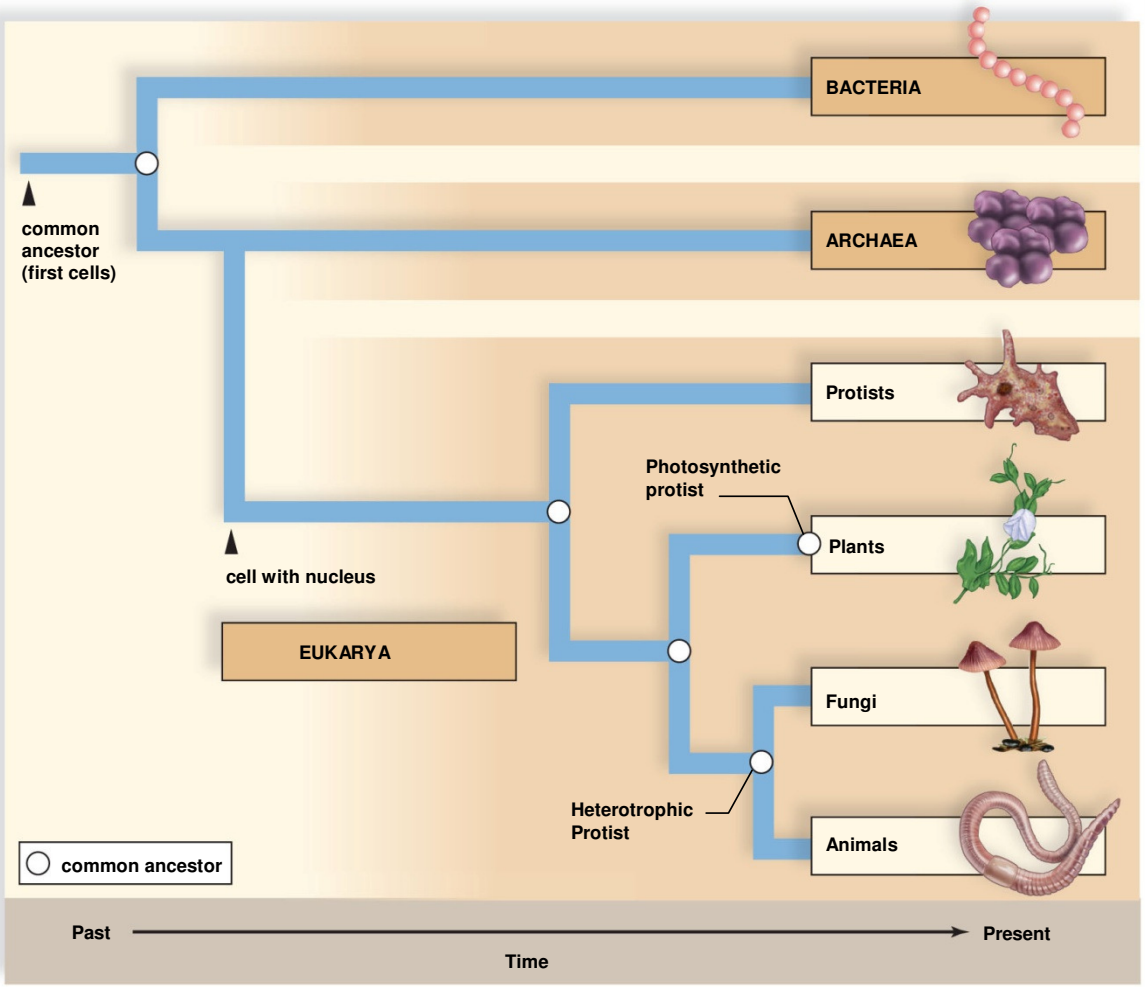
Domains

- Bacteria
  - Microscopic unicellular prokaryotes
- Archaea
  - Bacteria-like unicellular prokaryotes
  - Extreme aquatic environments
- Eukarya
  - Eukaryotes – Familiar organisms

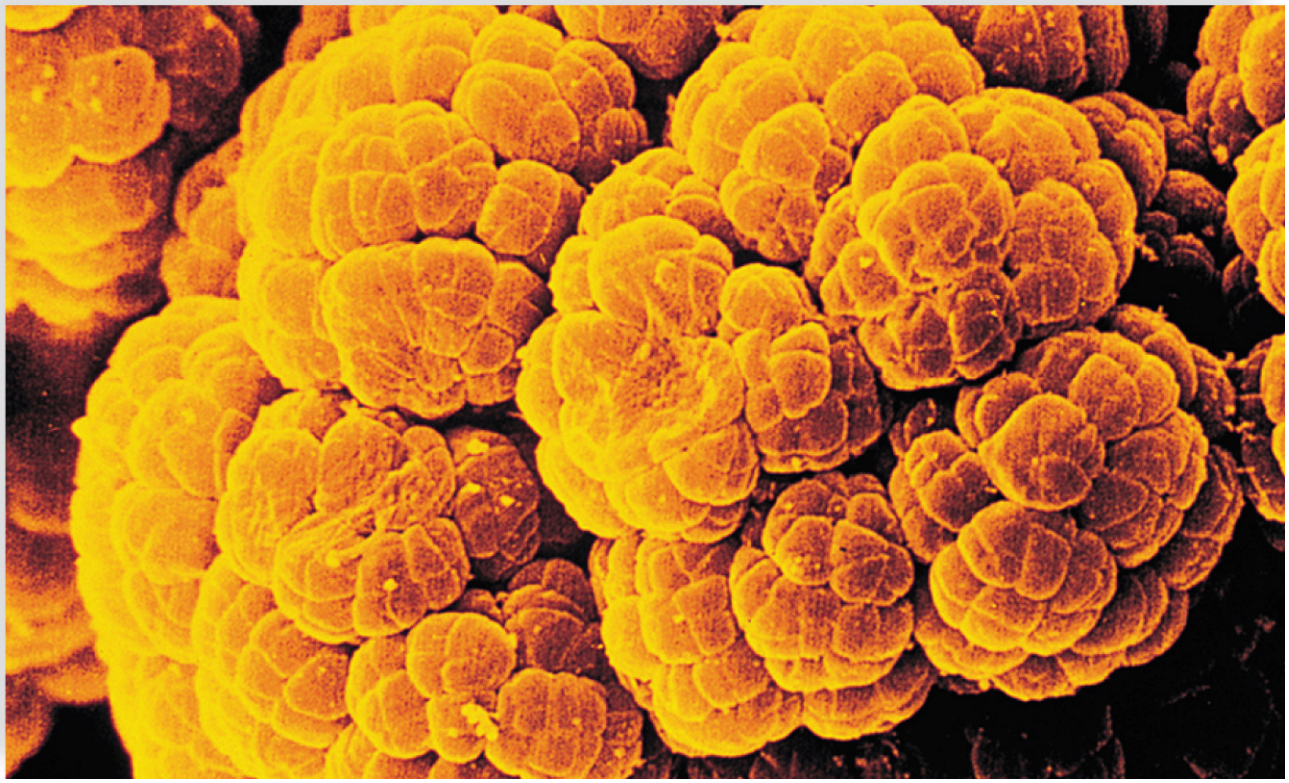
Domains



Evolutionary Tree of Life



Domains: The Archaea



Methanosarcina mazei, an archaeon

- **Prokaryotic cells of various shapes**
- **Adaptations to extreme environments**
- **Absorb or chemosynthesize food**
- **Unique chemical characteristics**

Domains: The Bacteria

Escherichia coli, a bacterium

1.5 μm

- **Prokaryotic cells of various shapes**
- **Adaptations to all environments**
- **Absorb, photosynthesize, or chemosynthesize food**
- **Unique chemical characteristics**

Kingdoms

- **Archaea** – Kingdoms still being worked out
- **Bacteria** - Kingdoms still being worked out
- **Eukarya**
  - Kingdom **Protista**
  - Kingdom **Fungi**
  - Kingdom **Plantae**
  - Kingdom **Animalia**

Domains: The Eukaryote Kingdoms

Protists

Paramecium, a unicellular protozoan

- Algae, protozoans, slime molds, and water molds
- Complex single cell (sometimes filaments, colonies, or even multicellular)
- Absorb, photosynthesize, or ingest food

KINGDOM: Plants

Passiflora, passion flower, a flo

- Certain algae, mosses, ferns, conifers, and flowering plants
- Multicellular, usually with specialized tissues, containing complex cells
- Photosynthesize food

KINGDOM: Fungi

Coprinus, a shaggy mane mushroom

- Molds, mushrooms, yeasts, and ringworms
- Mostly multicellular filaments with specialized, complex cells
- Absorb food1

KINGDOM: Animals

Vulpes, a red fox

- Sponges, worms, insects, fishes, frogs, turtles, birds, and mammals
- Multicellular with specialized tissues containing complex cells
- Ingest food

Scientific Names

- **Binomial nomenclature** (two-word names)- used to assign each organism with two part name e.g. *Homo sapiens*
- Universal
- Latin-based
  - First word represents **genus** of organism e.g. *Homo*
  - Second word is **specific epithet** of a species within the genus e.g. s*apiens*
  - Always italicized as a *Genus species* (*Homo sapiens*)
  - Genus may be abbreviated e.g. *Escherichia coli as E. coli*

Review

- Defining Life - Emergent Properties
  - Materials and Energy
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  - Adaptations
- Biodiversity
- Classification

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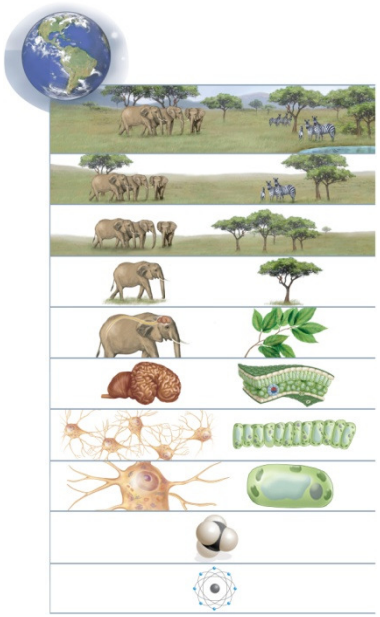

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