

[illegible]

Evolution and Diversity of Life

Lecture 01

Biology Definition

- Biology Comes from two Greek words:
 - Bios, means life and
 - Logos, means study
- Thus **Biology** is the study of life, i.e the study of living things , their environment and the interaction between them

Importance of Biology

- Find cure for diseases
- Preserve the environment
- Appreciate the diversity of nature
- Develop technologies
- Improve agriculture
- Understand evolution

In a whole, it helps you develop, modify, and refine your ideas about life and thus ensures a better environment for living.

The diagram features a central white oval with a green border containing the text 'Field of study in biology'. Surrounding this central oval are twelve blue rectangular boxes, each containing the name of a biological sub-field in yellow text and its definition in white text. The boxes are arranged in a circular pattern around the center. The background is a dark teal color with a subtle gradient and a curved shape on the right side.

Field of study in biology

virology
Study of viruses

anatomy
Study of org. structure

Genetic
Study of heredity

entomology
Study of insects

ecology
Study of envi. and relationship

zoology
Study of animal

microbiology
Study of microorg.

embryology
Study of embryonic dev.

biochemistry
Study of biochemical process in body

botany
Study of plant

bacteriology
Study of bacteria

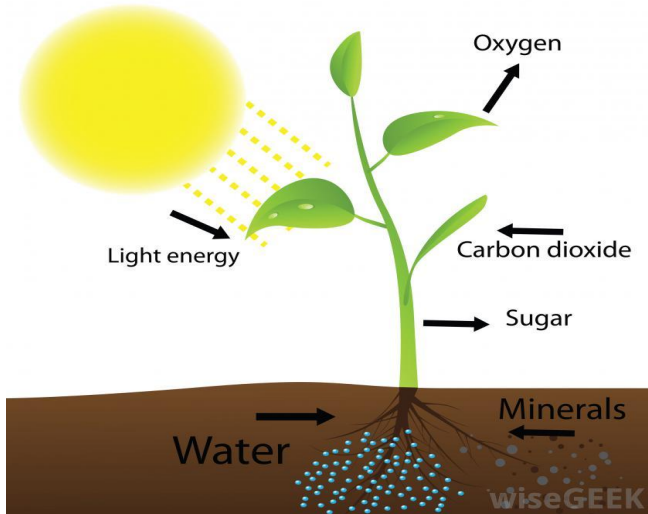
mycology
Study of fungi

histology
Study of tissues

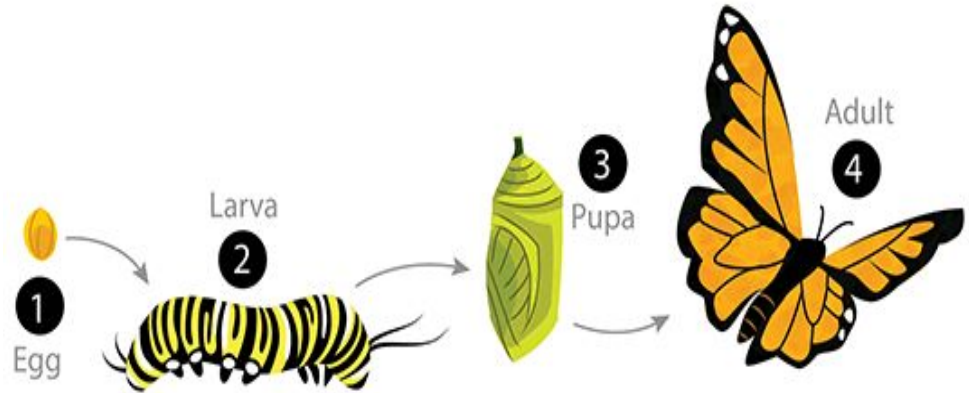
taxonomy
Study of classifying plants & animals

Life

- Life is something that **captures and uses energy and raw materials**, this energy is the capacity to do work.

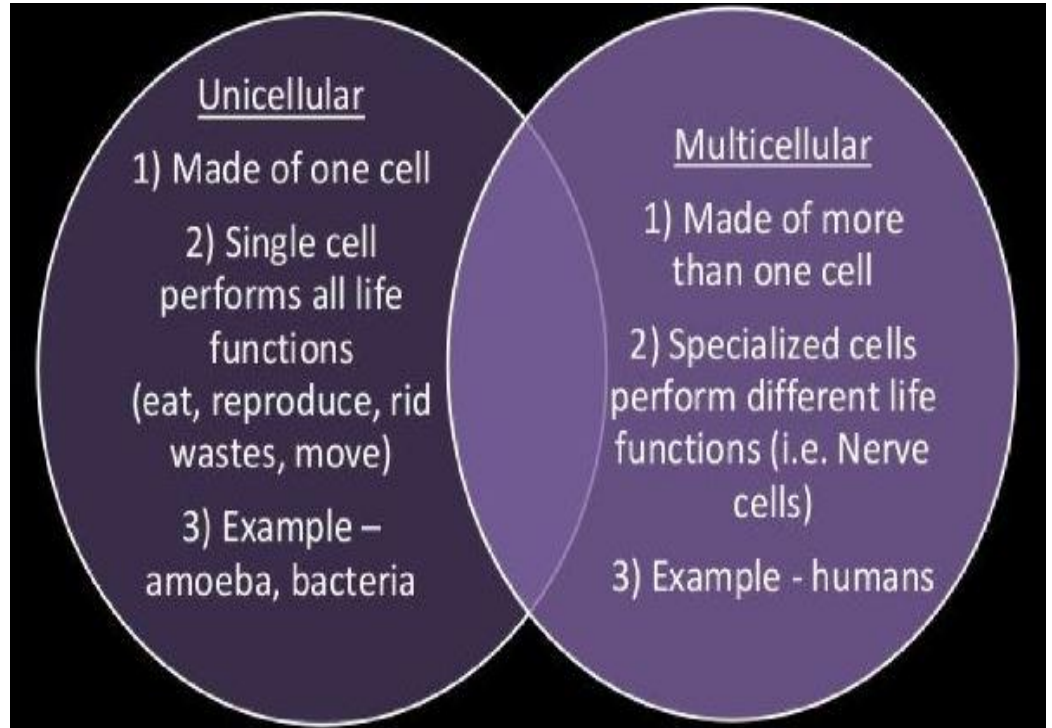


- Living organisms have the capacity to do metabolism and this is a set of reactions where cells acquire and use energy to **grow, survive, reproduce and develop**.



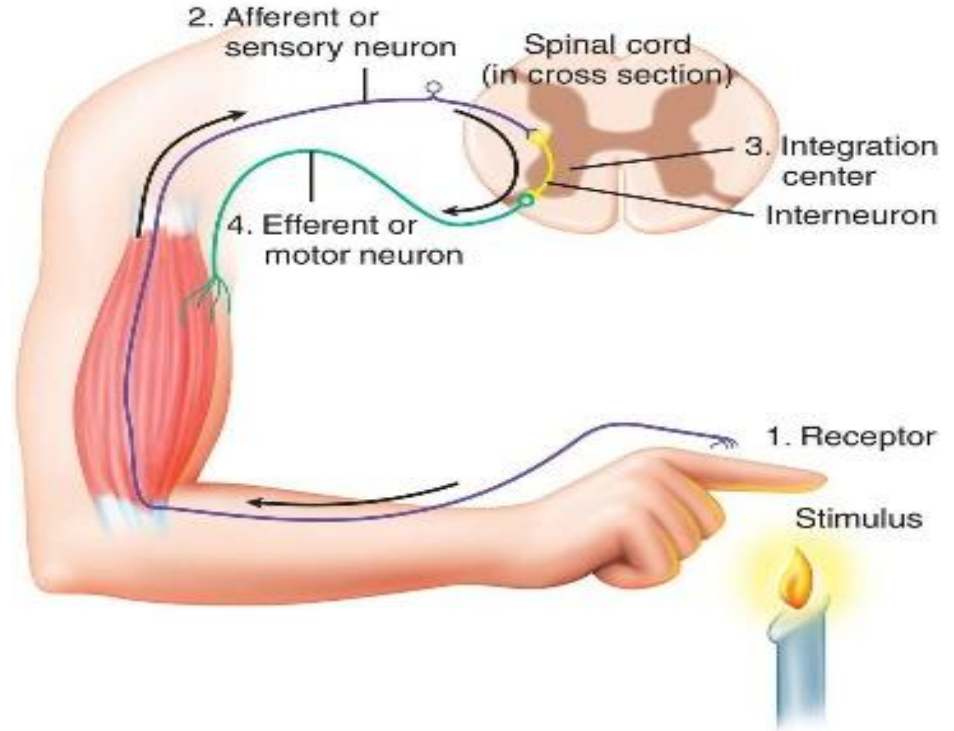
Characteristics of Life

1. Made of one or more cells



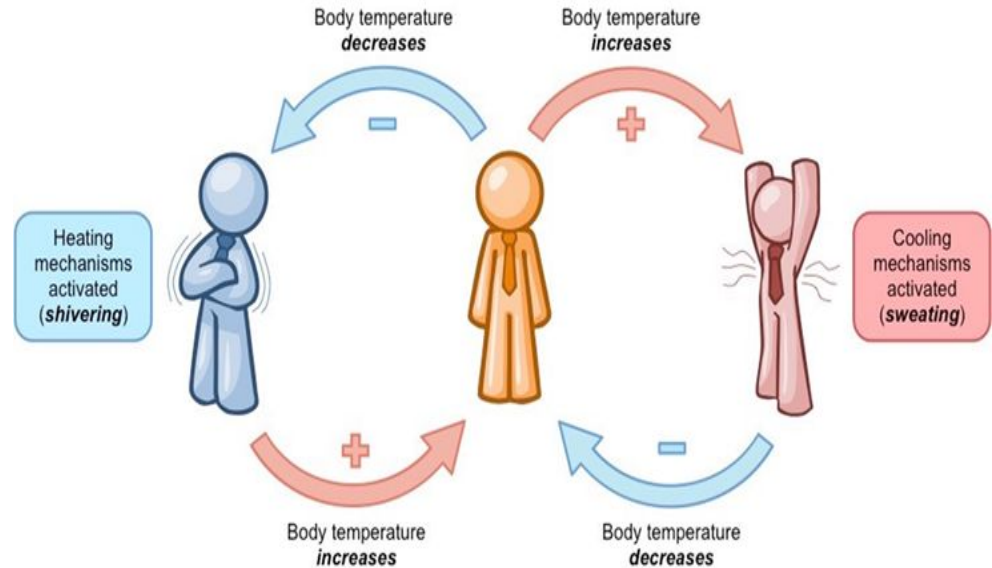
Characteristics of Life

2. Living organisms can **sense changes in the environment and respond according to the changes**. Organisms have receptors that detect specific forms of energies which then are called stimuli (Singular stimulus).



Characteristics of Life

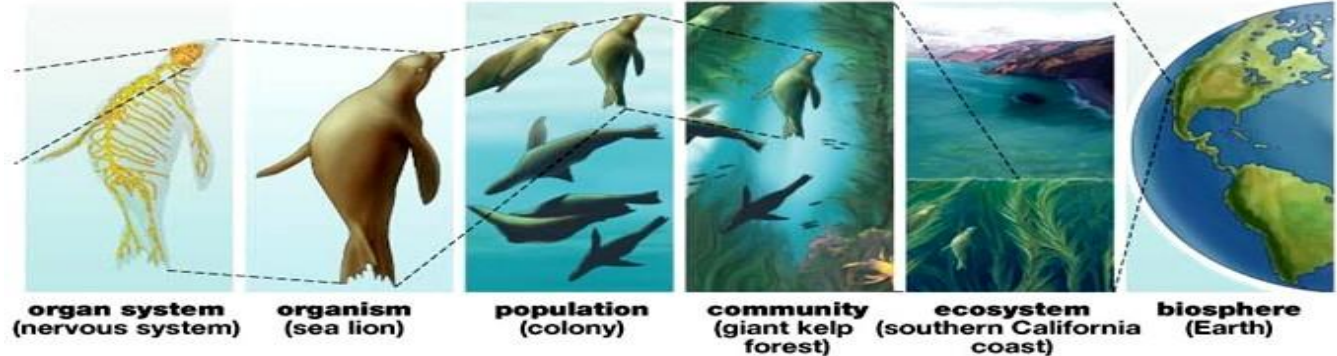
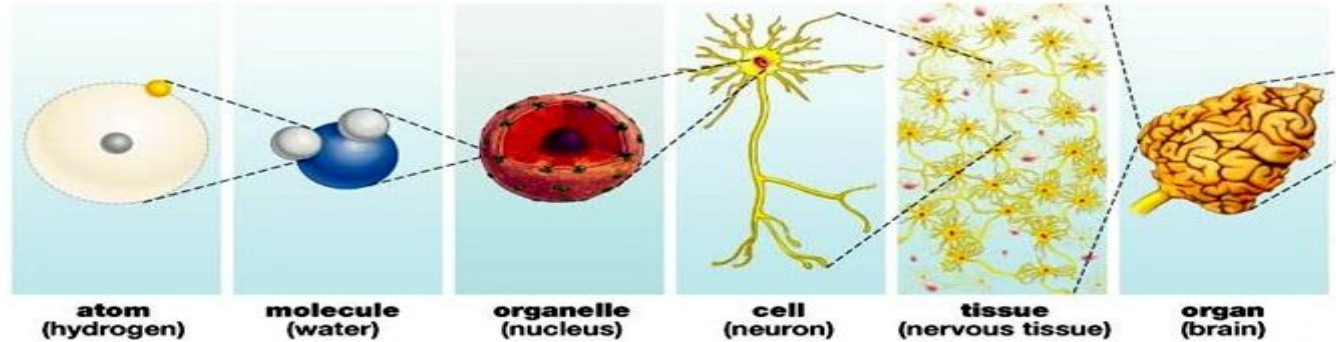
3. Maintains **homeostasis** that is the **maintenance of internal environment within range suitable for cell activities**. Example: Maintenance of blood sugar level by pancreas or balancing the temperature of the body.



Characteristics of Life

Cell Multi Cell Organism Population Community Ecosystem Biosphere

4. Displays Higher level of organization



Characteristics of Life

5. Grows, Develops and Reproduce

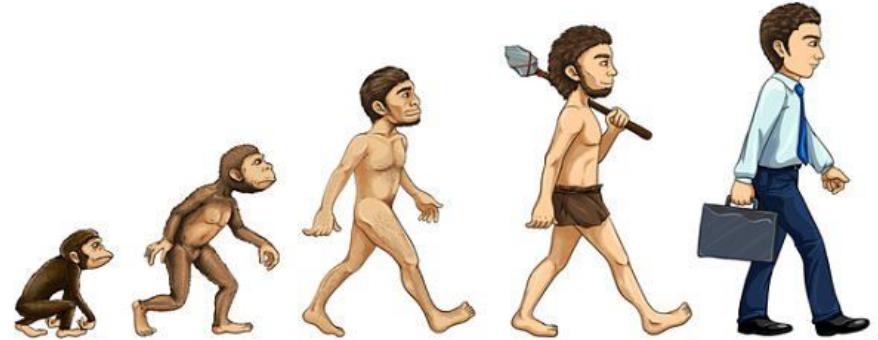
Growth: Adding mass and new cells or structures

Development: Natural changes over the lifetime of an organism

Reproduction: Production of new offspring. It is essential for the continuation of life.

6. Life has the tendency to evolve which we call **evolution**.

- Evolution is the genetically based change in a line of descent over time.
- Life also adapts with time and the organisms best adapted to the environment are more likely to survive and reproduce.
- That is the “**survival of the fittest**”



Interdependencies Among Organisms

Producers

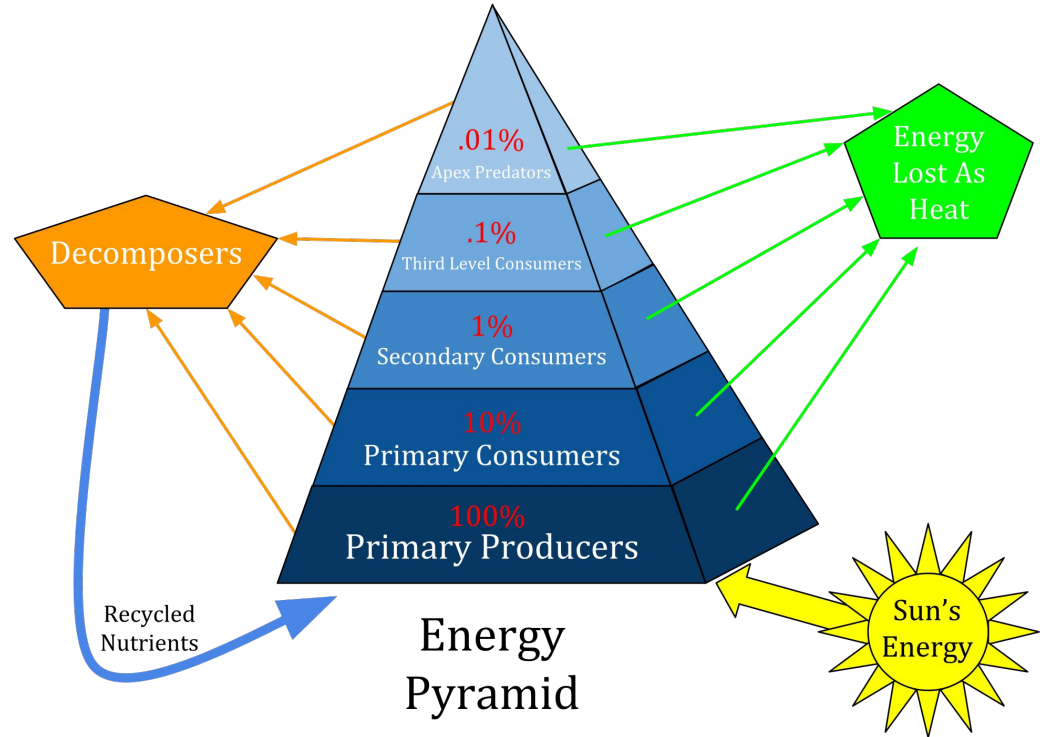
- Make their own food

Consumers

- Depend on energy stored in tissues of producers

Decomposers

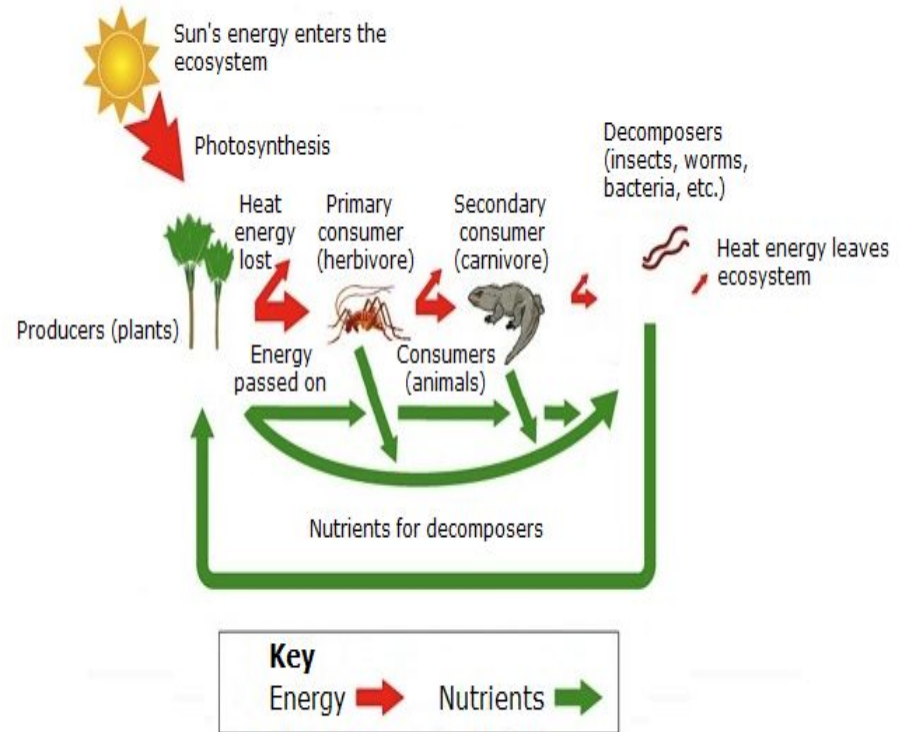
- Break down remains and wastes



Living things + Nonliving things = Ecosystem

- The study of how living and nonliving things interact called **ecosystem**.
- Living things in an ecosystem are called a **community**
- There are three members in every community-
 - Producers- can make their own food
 - Consumers- feed on producers/other consumers
 - Decomposers-breaks down wastes and remain of other organisms
- A **population** is only one type of organism.
- A **food web** is a pattern that shows the transfer energy between producers and consumers.

A simple ecosystem



Living things + Nonliving things = Ecosystem

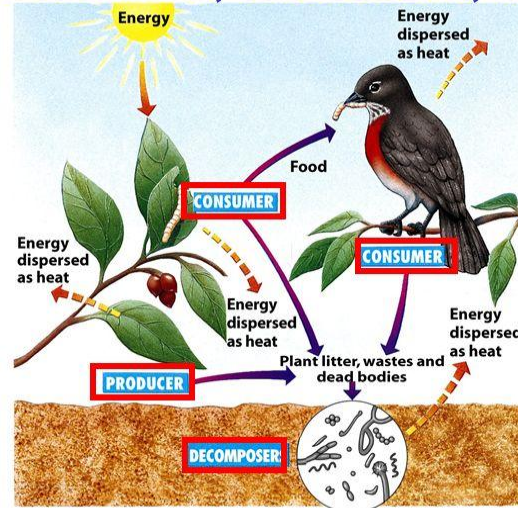
- A **habitat** is the home of an organism.
- The size of the habitat depends on the organism's needs.
- An organism's habitat provides food, water, shelter, and space.
- The role of an organism in its environment is called **niche**.
- No two types of organisms occupy exactly the same niche in a community.
- During its life cycle, an organism's niche may change.

Energy Flow Among Living Organisms in Ecosystem

- Usually starts with energy from sun
- Transfer from one organism to another
- Energy flows in one direction
- Eventually, all energy flows back to the environment

The Flow of Energy Through Ecosystems

Producers, Consumers, and Decomposers



Energy flows
from Producers

To Consumers

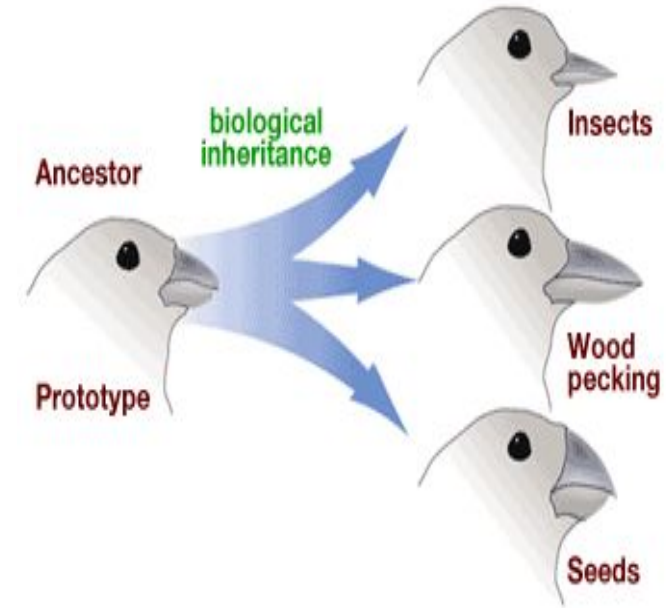
And finally to
Decomposers

Figure 3-8b Environment, 5/e
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Individual organisms and species change over time

Adaptive trait

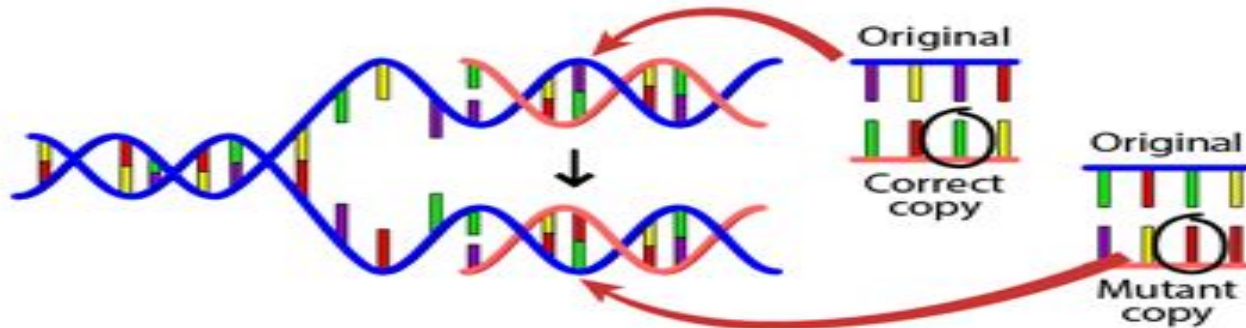
- A trait that gives the individual an advantage in survival or reproduction, under a given set of circumstances
- For example,
 - In **hummingbirds**, a long bill can be an adaptive trait since it is both heritable and adaptive. And for over a long time, more and more hummingbirds possess a long bill since it maximizes the reproductive success of these birds.
 - **Zebras** are chased by lions. Their striped bodies makes lions hard to focus on one during the chase!
 - **Baby deer** has light brown fur and white spots to hide on leafy forest floors



Mutation

- When someone is born with a trait none of its ancestors has, it has a **mutation!**
- Mutations- are changes in the predicted genetic pattern of organisms!
- They are caused by 2 reasons: random and harmful stuff in the environment.
- Harmful stuff in the environment includes: **nuclear radiation, X-ray, etc!**

- vestock



Natural Selection

- Organisms with favorable variations are better able to survive and reproduce than organisms without them.
- The process of natural selection causes organisms to evolve.

Antibiotic Resistance!

A common example of Natural selection

- Antibiotics are used to kill bacteria
- Mutations for antibiotic resistance exist or arise in bacterial population
- Antibiotic-resistant bacteria survive and reproduce better than non-resistant
- Over time, proportion of antibiotic-resistant bacteria increases

How does antibiotic resistance occur?



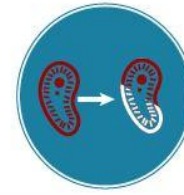
1 Some bacteria in the human body are drug resistant.



2 Antibiotics kill bacteria, but not those resistant to drugs.



3 Resistant bacteria then have space to multiply.



4 Bacteria can even transfer their drug resistance to other bacteria.

Artificial Selection

Selective breeding of organisms to promote the appearance of desirable traits in offspring is called artificial selection.

- Breeders favor some form of traits over others
- Individuals exhibiting favored traits are bred
- Favored traits increase in the population



Classification of Life

The **three-domain system** is a biological classification introduced by Carl Woese, Otto Kandler, and Mark Wheelis in 1990 that divides cellular life forms into three domains, namely Archaea, Bacteria, and Eukarya.

Domain Archaea

The Archaea are prokaryotic. The Archaeans possess unique, ancient evolutionary history for which they are considered some of the oldest species of organisms on Earth, most notably their diverse, exotic metabolisms. For example:

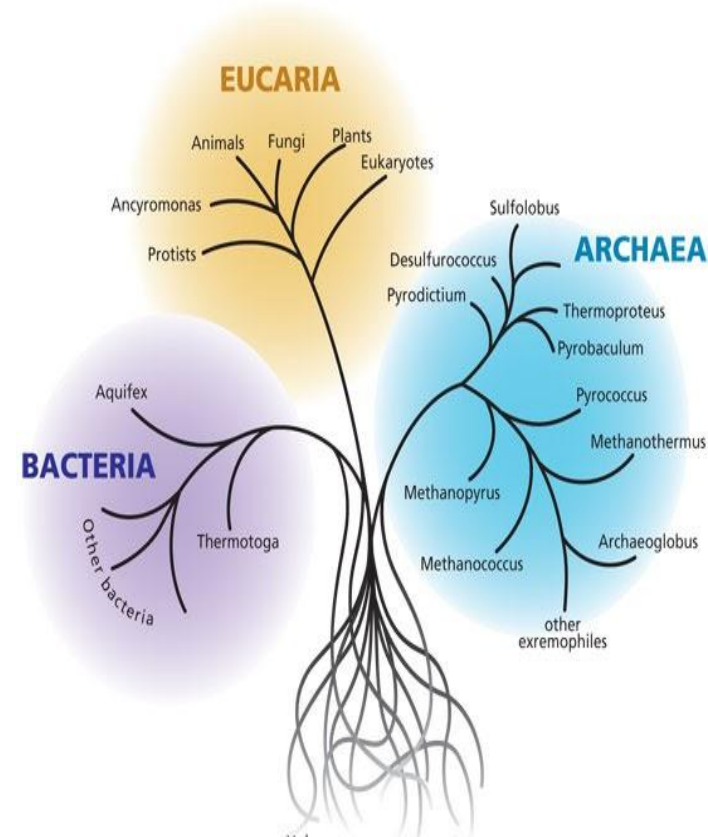
- methanogens – which produce the gas methane
- halophiles – which live in very salty water

Domain Bacteria

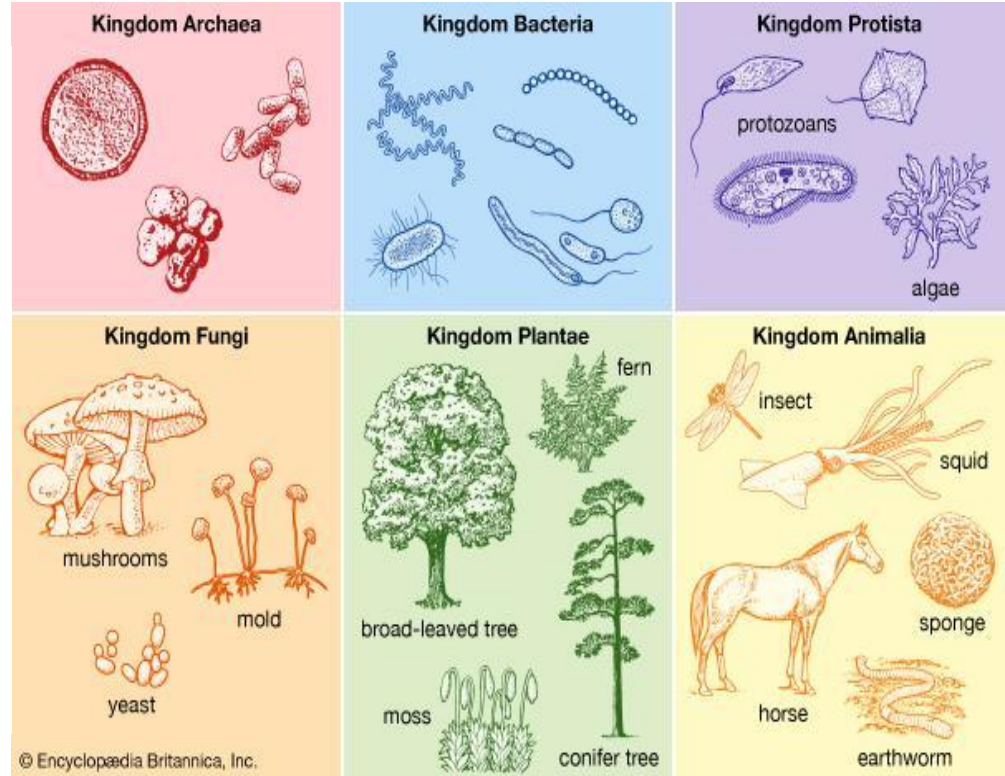
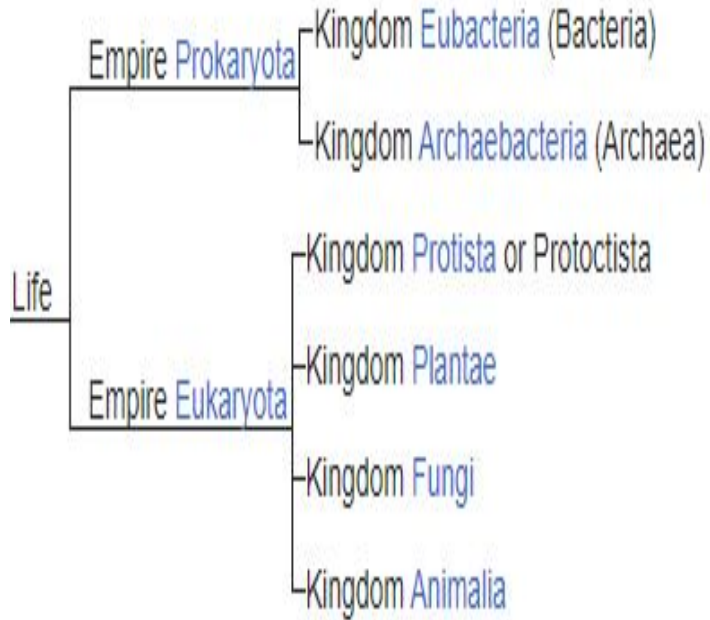
The Bacteria are also prokaryotic; their domain consists of cells with bacterial rRNA, no nuclear membrane. Traditionally classified as bacteria, many thrive in the same environments favored by humans, and were the first prokaryotes discovered; they were briefly called the **Eubacteria** or "true" bacteria.

Domain Eukarya

Eukaryota are organisms whose cells contain a membrane-bound nucleus. They include many large single-celled organisms and all known non-microscopic organisms.

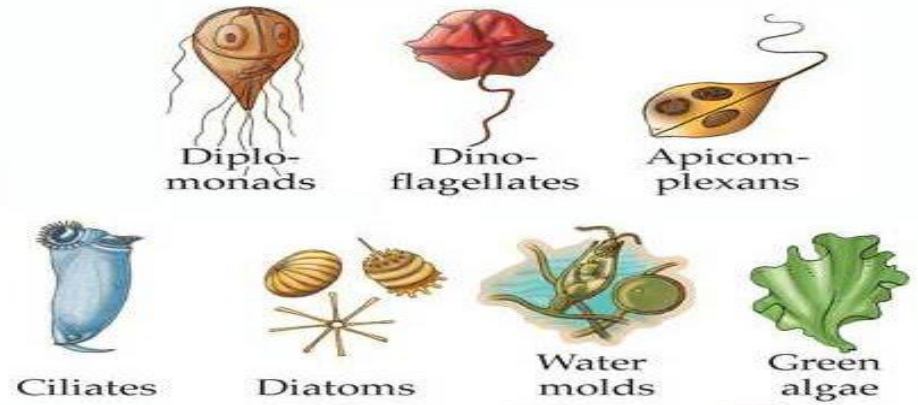


Classification of Life



Protistans

- Not an easily defined group
- Producers and consumers
- Single-celled and multicellular species



Fungi

- Most are multi celled
- Consumers and decomposers
- Extracellular digestion and absorption



Plants

- All are multi celled
- Most are photosynthetic producers
- Make up the food base for communities, especially on land



Animals

- Multi Celled consumers
- Herbivores
- Carnivores
- Parasites
- Scavengers



Scientific Names

- Every known living organism on Earth is classified and named by a set of rules. Those rules are used by all scientists around the planet. The names are called scientific names, not common names.
- **Common names** are the ones you might use when talking with your friends. You call your pet a dog or a cat (the common name). Scientists call those animals by a set of several names like *Canis familiaris*. That's a dog. And this kind of name is called the **Scientific Names**.

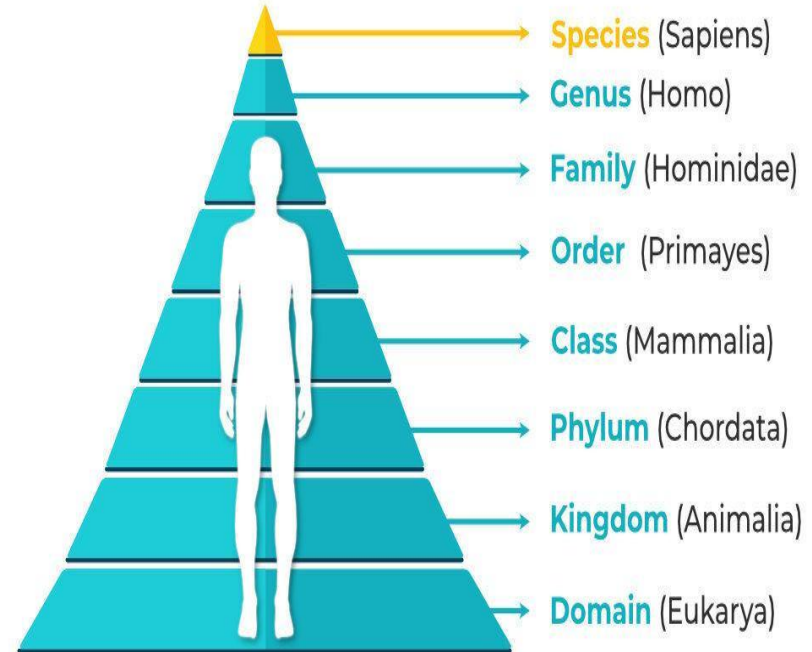
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NOMENCLATURE
FOR
ALGAE, FUNGI, AND PLANTS
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2018

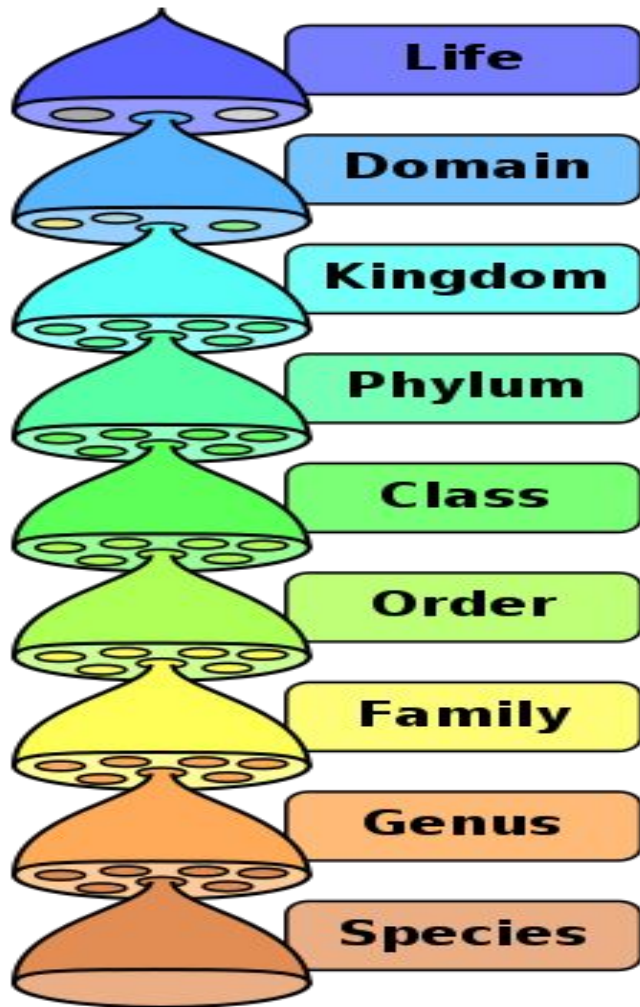


Taxonomy

- ✓ Taxonomy is the science of classification and organization of living organisms based on their
 - evolutionary relationships,
 - morphological characteristics,
 - genetic information, and
 - other factors.
- ✓ Its primary purpose is to categorize and study the diversity of life on Earth systematically.
- ✓ Carolus Linnaeus started this naming system.

Taxonomy of Human





Phylum

Phylum is the primary division of kingdom. It includes one or more related classes of animals. In plants, instead of phylum, the term 'division' is used.

Class

Class is a taxonomic group consisting of one or more related orders. For example, the class, Mammalia, includes many orders.

Family

Family is a taxonomic group containing one or more related genera. In plants, families are categorized on the basis of vegetative and reproductive features.

Order

Order is a taxonomic group containing one or more families. For example, the order, Carnivora, includes many families like Felidae and Canidae.

Genus

Genus is a taxonomic group including closely related species. For example, the genus, Solanum, includes many species such as nigrum, melongena, tuberosum, etc.

Binomial Naming System

- Scientist use a two-name system called a **Binomial Naming System**.
- **Binomial System:** Each species is assigned a unique two-part Latin name
- **International Code of Nomenclature:** Rules for naming organisms are governed by the International Code of Nomenclature for algae, fungi, and plants (ICN) and the International Code of Zoological Nomenclature (ICZN).
- The binomial naming system is a specific component of taxonomy.
- Its primary purpose is to provide a standardized and universally accepted way to assign unique names to species of organisms.

Rules of Scientific Naming (Binomial Nomenclature)

- **Genus and Species:** The first part is the genus name (capitalized), and the second part is the species epithet (lowercase).
- **Italicize or Underline:** The entire binomial name is typically italicized (or underlined if handwritten).
- **Authorship:** The name of the author who first described the species is often included in parentheses after the binomial name.
- **Genus Pluralization:** The genus name remains the same in both singular and plural forms (e.g., one "Homo sapiens" or multiple "Homo sapiens").
- **Abbreviation:** After the initial use, the genus name can be abbreviated using its initial letter followed by a period (e.g., "*E. coli*" for *Escherichia coli*).
- **Hierarchy:** Binomial nomenclature is part of a hierarchical system of classification that includes domain, kingdom, phylum, class, order, family, genus, and species.
- **Uniformity:** Scientific names facilitate clear and consistent communication about organisms, regardless of language differences.
- **Evolutionary Relationships:** The system aims to reflect evolutionary relationships, grouping species more closely related to each other within the same genus.

Taxonomy vs Binomial Nomenclature

- Taxonomy is the broader field of classifying and categorizing living organisms into hierarchical groups, while the binomial naming system is a specific naming convention within taxonomy used to uniquely name species.
- Taxonomy provides a systematic framework for understanding the diversity of life, while binomial nomenclature provides a standardized way to refer to individual species.
- Examples:
 - Taxonomy: Taxonomy might involve classifying a lion as follows: Kingdom: Animalia, Phylum: Chordata, Class: Mammalia, Order: Carnivora, Family: Felidae, Genus: *Panthera*, Species: *Panthera leo*.
 - Binomial Naming System: Using the binomial naming system, a lion is named "*Panthera leo*."

