Unit 2 Characteristic and Classification of Living Organisms

Characteristics of living things

The properties that are shared by all living things are listed below:

- **All living things are made up of one or more cells:**

Those made up of one cell are termed 'unicellular' and those made up of more than one cell are termed 'multi-cellular'.

- **All living things require energy:**

All organisms use a source of energy for their metabolic activities.
heterotrophs obtain energy from diet and autotrophs from the sunlight through the process of photosynthesis.

- **All living organisms respond to stimuli:**

organisms can detect or sense stimuli (change) in the internal or external environment and make appropriate responses.

All living things can grow:

Growth is a permanent increase in size and mass due to an increase in cell number or cell size or both. Even bacteria and single-celled creatures show an increase in size.

All living things can reproduce:

Reproduction is the process that makes more of the same kind of organism.
Single-celled organisms may simply keep dividing into two.
Multicellular may reproduce sexually or asexually.

All living things can excrete:

Excretion is the removal of the metabolic wastes produced in cells as a result of chemical reactions (metabolism).

All living things display ordered complexity:

All living things are both complex and highly ordered. The levels of organization in biological systems begin with atoms and molecules and increase in complexity.

Most living things maintain homeostasis:

Homeostasis is the regulation of an organism's internal
conditions to maintain stability.
For example, our body temperature remains stable despite changes in outside temperatures.

All living things possess adaptations that evolve overtime:

All organisms interact with other organisms and their environment in ways that influence their survival, and as a result, organisms evolve adaptations to their environments.

Taxonomy of Living things

There are many types of living things on the earth.

- This great variety of life is called **biodiversity**.

Taxonomy

- Taxonomy is the science of naming, identifying and classifying organisms.
- In taxonomy organisms are categorized by the degrees of their apparent similarities and differences.
- The term 'taxonomy' is Greek word first coined by French man De Candolle, to mean **law of arrangement** to classify living diversity into group called **taxa**.
  - ✓ **Taxa**-(Taxon- singular) are group of organisms to which any taxonomic name is given indicating group of similarly categorized organisms
- **Taxonomist is** biologist who studies and classifies organism.
- Greek Philosopher **Aristotle** began classification system for the living things.
- He classified **plants** into trees, shrubs and herbs and **animals** into two groups as red blooded and those that did not have blood.
- He even tried to give everything a scientific name
  E.g. humans as '**rational animals'**
- However, he grouped some organisms that had very little in common and his system was never finished.
- Later Swedish Botanist **Carolus Linnaeus** known as the father of taxonomy introduced a taxonomic hierarchy of classification.
- He was the first person to propose an orderly system of classifying organisms which still used.
- In the Linnaean system, all organisms are placed in a ranked hierarchy.
- The kingdom is ranked the highest followed by Phylum (division), class, order, family, genus, and species.
- Based on gross morphological characteristics he classified all living organisms under kingdoms Plantae and Animalia
- But a large number of organisms did not fall into either category.

By Erena B.

- Because Linnaeus system did not consider many characteristics of organisms.
- He also refined and popularized the binomial system of naming organisms, in which the first name represents the genus and the second name represents the species' apithet
- Besides morphology, the external and internal structures of the organism, modern classification uses other characteristics like cell structure, nature of cell wall, genetic makeup, mode of nutrition, behavior, ecological places, methods of reproduction and evolutionary relationships.
- The genetic makeup of organisms is used by the assumption that the greater the degree of physical similarity between organisms, the closer their biological relationship is.
- Biologists uses **species** as basic criteria for grouping living things
  - Species is smallest natural group of organisms *often resemble each other very closely in appearance.*
  - **Specie** is defined as a group of organisms that can interbreed successfully with one another to produce fertile offspring.
  - E.g. **horses** + **donkeys** produces a sterile offspring called a **mule**,
  - A cross b/n a Borena and a British Friesian cattle produces fertile calf.
  - **Which pair is of the same specie and which is not?**
  - Borena and a British Friesian cattle breeds are variants of the same species.
  - The difference in species is called variation of the same species
- Classification organism is relevant to:
  - Identify beneficial and harmful organisms
  - Example1
  - agriculturalists can discover new source of food, *foresters discover new* timber/ *lumber, physicians discover new medicines and biofuel engineers discover new* source of energy
  - *Classification help to find a closely related species with a known species having the same useful substances as in Moringa stenopetala is good source of disinfectants*
  - Reduce energy and time to study organisms
  - Simplify study and understanding of living things.
  - Help to understand how life was originated.
  - Create an internationally accepted way of referring to a particular living thing.
  - To avoid confusion created by different languages

Binomial Nomenclature:

- It is the naming of living organisms and the rules governing the application of the names
- Naming is giving conventional symbol or code that serves as a means of referring to specific specie
- Regardless language barrier it universalizes the organism and avoid the defects of vernacular names
- Universally it gives only one correct name for each organism
- Vernacular name is local/common word with varying meaning from place to place
  - For example, the Ethiopian wolf is known as the Abyssinian wolf, Simien fox, Ethiopian jackal, red jackal and Simien jackal in English, *Qey kebero* in Amharic, *jeedala diimtuu* in Afan Oromo and *Keyih Wukaria* in Tigrigna
  - This makes communication difficult for one scientist to know what organism another scientist is talking about!
  - This problem is solved by giving one universal name as *Canis simensis* following the nomenclature rules

There are rules for writing names in binomial approach

1. Uses two words (binomial) system of naming
2. The first name is the name of the genus to which the organism belongs to
3. Initial letter is written in capital.
4. The second name is the name of a species epithet to which the organism belongs is fully written with a small letter.
5. The names are underlined when hand written or italized when printed.

For example;

Common name	**Scientific name**

1. Human beings *Homo sapiens*
   Dog *Canis familiaris*
2. Pumpkin *Cucurbita maxima*
3. Mustard *Brassica juncea*
4. Teff *Eragrostis tef*
5. Enset *Ensete ventricosum*

Epithet is the word that only distinguishes one species from anther of the same genera

Common Ethiopian Plant and Animals

- Ethiopia is rich in biodiversity due to its;
  - geographical location,
  - topographic diversity and
  - Diverse climatic features.
- there are between 6500 and 6700 plant species in Ethiopia
- About 1150 plant species endemic to Ethiopia For example Ethiopia is a **primary centre** of diversity for the following **Field crops**
  1. Teff ----------*Eragrostis tef*
  2. Coffee ----------*Coffea arabica*
  3. Mustard----------*Brassica carinata*
  4. Ensete ----------*Ensete ventriculum*
  5. Anchote--------- *Coccinia abyssinica*
  6. Niger seed ------*Guizotia abyssinica*
  7. Safflower ------*Carthamus tinctures*
  8. Sorghum -------*Sorghum* Spp.
  9. Barley ---------*Hordeum vulgare*
  10. Linseed ------ *Linum usitatissimum*
  11. Castor bean ---- *Ricinus communis*
- Gateway of domestic animals from Asia to Africa

Biological Dichotomous key

- To sort out organisms, biologists have developed a special method known as a **biological key** or **identification key**.
- The simplest key is the dichotomous key developed by Carolus Linnaeus.
- It is description of the external features of specimens
- Each key is made up of pairs of contrasting features
- Starts from quite general characteristics and progress to specific ones.
- Makes successive choices between two statements or alternatives.

E.g. yes/no, Present/absent, poikilothermic /homoeothermic, limbs/no limbs, fore limb hand/fore limb fin, bipedal/quadric-pedal etc.

Robert Whittaker's five-kingdom scheme

Robert Whittaker's five-kingdom scheme tend to solve the classification problems biologists are trying to answer for generations

- The main criteria for classification used by Whittaker include cell structure, body organization, modes of nutrition, method of reproduction and phylogenetic relationships.

His main taxonomic categories are;

- Kingdom, Phylum , Class, Order, Family, Genus and Species (KPCOFGS) as in Linnaeus.
- The kingdoms include Monera, Protista, Fungi, plantae and animalia

His drawbacks are

- It begins from kingdom and no domains
- Algae are grouped under plantae
- Protophyta lacks clarity of classification
- The evolutionary relationship is not adequately reflecting the relationship because data from molecular biology is not used
- The difference between archaea and bacteria are not addressed

Taxonomic categories and hierarchies in modern biological classification

- Taxonomic hierarchy is the process of arranging various organisms into successive levels of the biological classification.
- They are ranked either in a decreasing or increasing order.
- All organisms are ranked in Domain, kingdoms, Phylum (division), class, order, family, genus, and species in decreasing order.
- The higher taxa subdivided into the lower one
- Down in taxa similarity increases and number of organism decreases and vice verses
- There are three domains and Five kingdoms of organisms excluding viruses:

Domains	**Kingdoms**
1. Archaea	1. Animalia
2. Bacteria	2. Monera
3. Eukarya	3. Protista
	4. Fungi

The Kingdoms Monera

- Archaean and eubacteria makes the kingdom monera
- Both Known as decomposers and mineralizers in the biosphere

Archaebacteria:

- a group of microorganisms considered to be an ancient form of life that evolved separately from the bacteria
- all are unicellular or colonial prokaryotes
- DNA exists as a circular,
- Have haploid chromosome
- Ribosomes are similar to bacteria.
- their cell walls are called pseudopeptidoglycan
- most archaea are extremophiles that found on earth, where there is very cold/ hot, very basic/acidic
- *They live in places such as swamps, deep-ocean hot water vents and seawater evaporating ponds.*
- *The environments in which the archaebacteria live often have no oxygen*
- some are mesophiles, found in normal flora
- They are three groups of archaea termed as thermophilic, methanogens and halophilic archaea.
  methanogens are strict anaerobes that produce methane (CH_4)
- The supplies of natural gas used today come from the metabolism of methanogens,
- They use ammonium (NH_4^+) as a nitrogen source and get their carbon from CO_2.
  halophiles are chemoorganotrophs that require salt to grow
- **thermophiles** grows best at temperatures over 80° C
- *They are chemosynthetic, photosynthetic and heterotrophs*
- Reproduction is by binary fission
- Archaea differs from bacteria in evolutionary history, genetics, metabolic pathway, cell wall & cell membrane composition.
- Some archaea live in the human body,
- But no archaea have been identified as human pathogens
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By Erena B.