**Chapter 2 - Biodiversity**

**All Lectures Uploaded on YouTube:**

[**https://tinyurl.com/fkm9-biology**](https://tinyurl.com/fkm9-biology)



**MCQS**

1. C
2. B
3. D
4. D
5. B
6. A
7. D
8. C
9. C
10. A
11. D
12. D
13. A
14. A

**Short Answers:**

1. **a)** *Aristotle* – He was the first to classify organisms based on habitat and movement.

**b)** *Carolus Linnaeus* – Known as the father of modern taxonomy; developed the binomial nomenclature system.

**c)** *Carl Woese* – Proposed the three-domain system of classification based on genetic differences in rRNA.

1. **a. Biodiversity** – The variety of living organisms living on Earth.

**b. Classification** – Grouping organisms based on similarities and differences.

**c. Taxonomy** – The science of naming, describing, and classifying organisms.

**d. Systematics** – The study of evolutionary relationships among organisms.

**e. Domain** – The highest rank in classification above kingdom, grouping organisms based on genetic traits.

**f. Taxa** – Plural of taxon; any rank or group in classification (e.g., genus, family, phylum).

**g. Species** – A group of organisms that can interbreed and produce fertile offspring.

1. A domain is the broadest level of classification that groups life forms based on molecular and genetic evidence.  
   **Three domains are:**
2. Archaea
3. Bacteria
4. Eukarya

4. Life is classified into domains based on differences in **fundamental genetic and biochemical features**, especially the sequences of ribosomal RNA, the **structure of cell membranes**, and the **presence or absence of a nucleus**. For example, Archaea and Bacteria are both prokaryotic, but differ in membrane lipids and genetic sequences. Eukarya includes all organisms with eukaryotic cells, which have a nucleus and complex organelles. This classification helps scientists understand the evolutionary relationships and origins of life at the most fundamental level.

5. **a. Bacteria vs. Protists:** Bacteria are simple, unicellular prokaryotes that lack a true nucleus and organelles, while protists are mostly unicellular eukaryotes with a defined nucleus and membrane-bound organelles.

**b. Fungi vs. Plants:** Fungi are saprotrophs that absorb nutrients from decomposing material and have chitin in their cell walls, while plants are autotrophs that make their own food through photosynthesis and have cellulose in their walls.

**c. Plants vs. Animals:** Plants are autotrophic, have chlorophyll, and cannot move, while animals are heterotrophic, consume other organisms for energy, and are capable of movement and response to stimuli.

6. **a.** The simplest domain is **Bacteria** because they are unicellular prokaryotes with no nucleus and minimal internal structures.

**b.** The most complex domain is **Eukarya**, which includes organisms with complex cellular structures, nuclei, and organelles.

**c.** Most bacteria are **not harmful**; they play essential roles in digestion, nitrogen fixation, and decomposition, with only a small percentage causing disease.

**d.** The domain **Archaea** is known for thriving in harsh conditions like hot springs, salt lakes, or deep-sea vents, making them extremophiles.

7. The **2-kingdom system** (by Linnaeus) classified all organisms as either plants or animals, which became problematic as microscopic and fungal life was discovered. The **3-kingdom system** introduced Protista to include organisms that did not fit well into the plant or animal kingdoms. Later, the **5-kingdom system** by Whittaker separated life into Monera (prokaryotes), Protista (unicellular eukaryotes), Fungi (heterotrophic decomposers), Plantae (autotrophic multicellular organisms), and Animalia (heterotrophic multicellular organisms), giving a more accurate representation of evolutionary and structural differences.

8. A mule, which is the offspring of a male donkey and a female horse, is not considered a true species because it is sterile and cannot reproduce. According to the biological definition of species, organisms must be able to interbreed and produce fertile offspring. While a mule may have characteristics from both parents and can live a normal life, it fails the test of reproductive capability, which is why it cannot be classified as a species.

**Extensive Answer Questions:**

1. Biodiversity refers to the variety of living organisms—plants, animals, fungi, and microorganisms—present in a particular region or across the entire planet. It includes diversity within species, between species, and of ecosystems. Biodiversity is **essential** for the stability and sustainability of natural ecosystems, as it ensures the presence of species that perform various ecological roles such as pollination, decomposition, nutrient cycling, and maintaining food chains. Rich biodiversity also contributes to resilience against environmental changes, supports ecosystem productivity, and provides humans with food, medicine, raw materials, and cultural value. The loss of biodiversity can disturb ecosystems, reduce agricultural productivity, and affect human survival.
2. Classification is the scientific method of organizing living organisms into groups based on shared characteristics to make their study easier and more systematic. Organisms are classified using similarities and differences in **morphology** (structure), physiology, genetics, and evolutionary history. The classification system follows a hierarchical structure from broader to more specific ranks, including domain, kingdom, phylum, class, order, family, genus, and species. Modern classification also incorporates molecular biology and DNA analysis to understand evolutionary relationships. This method allows scientists to identify organisms, predict characteristics, and study their roles in nature more efficiently.
3. The main aim of biological classification is to organize the immense diversity of life into manageable and understandable categories. It helps in identifying organisms and understanding their evolutionary relationships and ecological roles. Classification allows scientists to predict characteristics of organisms based on their group, trace the lineage of species, and understand how different organisms are related to one another. It also facilitates accurate communication among scientists worldwide and provides a standardized system for naming organisms. Moreover, classification helps in conservation efforts by identifying endangered species and understanding their importance in ecosystems.
4. The history of classification began with **Aristotle**, who grouped organisms as either plants or animals and further subdivided animals based on their movement. This simple system lasted for centuries until **Carolus Linnaeus** introduced a more scientific and structured system in the 18th century, including binomial nomenclature and the hierarchical taxonomic ranks. Later, the invention of the microscope led to the discovery of microorganisms, which challenged the two-kingdom system. This gave rise to three-kingdom and then five-kingdom classifications. In the 20th century, Carl Woese used molecular data (rRNA sequences) to propose the three-domain system: Archaea, Bacteria, and Eukarya, which is widely accepted today for its reflection of evolutionary relationships.
5. **Domain Archaea** consists of **unicellular prokaryotes** that have distinct genetic and biochemical characteristics separating them from Bacteria. They lack a true nucleus and membrane-bound organelles but have unique cell membrane lipids and gene expression processes that resemble eukaryotes more than bacteria. Archaea can survive in **extreme environments,** such as high-temperature hot springs, salt lakes, and acidic or methane-rich habitats, earning them the name “extremophiles.” They reproduce asexually, usually by binary fission, and do not have **peptidoglycan** in their cell walls, which distinguishes them from true bacteria.
6. **a)** Domain **Bacteria** includes unicellular prokaryotic organisms with a simple cell structure lacking a nucleus and organelles. They reproduce asexually and have **peptidoglycan** in their cell walls. Bacteria are found in nearly every habitat and can be beneficial (like gut bacteria or decomposers) or pathogenic.

**b)** Domain **Eukarya** includes all eukaryotic organisms, whose cells contain a true nucleus and membrane-bound organelles. This domain includes four kingdoms: Protista, Fungi, Plantae, and Animalia. Eukaryotes can be unicellular or multicellular, and they exhibit great diversity in form, function, and modes of nutrition, including autotrophs, heterotrophs, and saprotrophs.

1. The **Kingdom Protista** includes mostly *unicellular eukaryotes* with diverse modes of nutrition—autotrophic, heterotrophic, or mixotrophic. **Fungi** are multicellular (except yeasts), heterotrophic organisms that absorb nutrients and have chitin in their cell walls. **Plantae** are multicellular autotrophs with cell walls made of cellulose, and they carry out photosynthesis. **Animalia** includes multicellular heterotrophs that lack cell walls and are capable of movement and complex behaviors. Each kingdom has evolved unique features, but they all share the basic structure of eukaryotic cells with nuclei and organelles.
2. The taxonomic ranks are a hierarchy used to classify organisms from the most general to the most specific category. The ranks, in descending order, are **Domain, Kingdom, Phylum, Class, Order, Family, Genus, and Species**. Each level groups organisms based on shared characteristics, with species being the most specific level representing a group of individuals that can interbreed and produce fertile offspring. As one moves up the hierarchy, the categories become broader and include more diverse organisms. This system helps in organizing biological information and understanding evolutionary relationships among organisms.
3. A species is the most specific and fundamental unit of classification in biology. It includes a group of organisms that share common characteristics, are genetically similar, and can interbreed to produce fertile offspring under natural conditions. Members of a species typically have the same number of chromosomes and similar DNA sequences. While reproductive isolation is a key defining feature, some exceptions like mules exist, which are hybrids but not true species. Recognizing species is important for studying biodiversity, conservation, and evolutionary biology.
4. Binomial nomenclature is the scientific system of naming organisms using two Latin or Latinized names: the **genus** name (capitalized) and the **species** name (lowercase), e.g., *Homo sapiens*. Introduced by Carolus Linnaeus, its **main aim** is to provide a universal, standardized name for every species, eliminating confusion caused by local names. The system follows **principles** such as using Latin, italicizing names, and ensuring uniqueness for each species. It is **important** because it allows scientists globally to communicate clearly, avoids duplication, and reflects the relationships between organisms.
5. Viruses pose unique challenges to classification because they do not fit neatly into the traditional definitions of living organisms. They lack cellular structure, do not carry out metabolism on their own, and require a host to reproduce. Their genetic material can be DNA or RNA, and they can infect all types of organisms, from bacteria to humans. Moreover, viruses do not follow typical evolutionary patterns, making it difficult to place them within standard classification systems. Due to these reasons, viruses are usually classified separately, based on factors like their genetic material, host range, and structure.



