

Classification of Organisms

- Classification is the process by which anything is grouped into convenient categories based on some easily observable characters.
- Biological classification is a critical step in the taxonomical process.
- Three basic methods for the classification of the organisms
 - **Phenetics**
 - **Numerical Taxonomy**
 - **Phylogenetic classification**

Phenetics

- Also known as taximetrics
- Organisms classified based on the mutual similarity of their phenotypic characteristics.
- Are not dependent on evolutionary relations
- Organisms sharing many characteristics make up a single group or taxon

Numerical Taxonomy

- It is the quantitative approach of taxonomy.
- Peter H. A. Sneath and Robert Sokal have defined numerical taxonomy as 'the grouping by numerical methods of taxonomic units into taxa on the basis of their character states'.
- At least 50 and preferably several hundred characters should be compared from morphological, biochemical and physiological data.
- The characters possessed by two organisms were compared and simple matching coefficient were calculated in the scale of 0.0 (no match) to 1.0 (100% match).

Phylogenetic classification

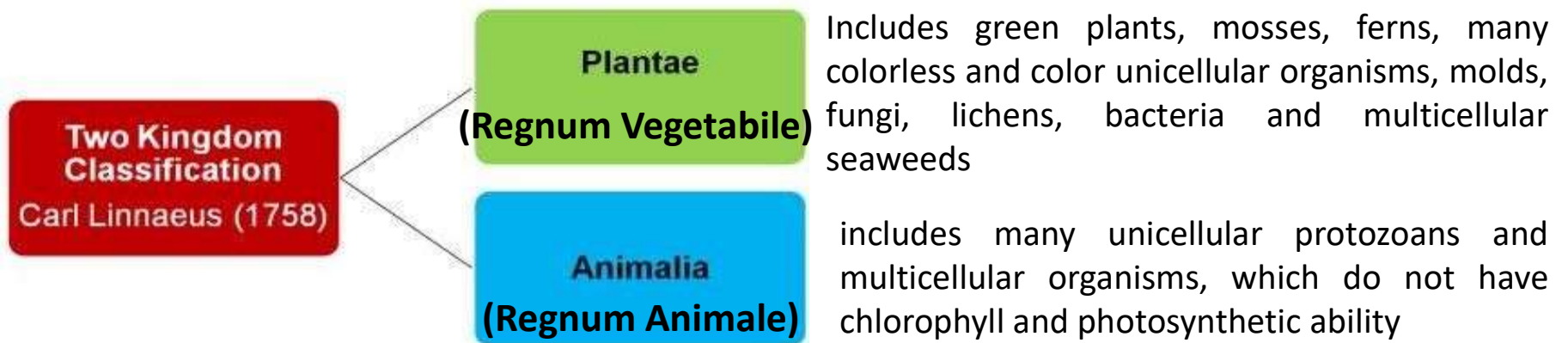
- These are systems based on evolutionary relationships rather than general resemblance.
- The result of phylogenetic studies is a hypothesis about the evolutionary history of taxonomic groups.
- The direct compare of genetic material and gene products such as RNA and protein were used for this study.

Systems of classification

- The history of classification holds back to 2000 years ago when Aristotle and his pupil classified the entire living organisms in to two broad classes the animals and the plants.

Two kingdom classification

Carlous Linnaeus is known as the father of classification. He classified the living organisms in a systematic way. He put-forth the two kingdom classification system in 1758 based on their anatomical characteristics



Merits:

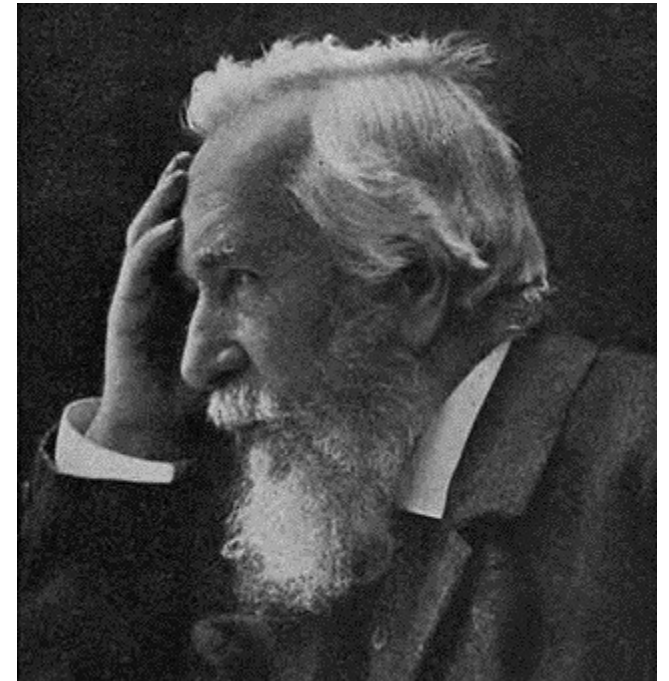
- Organisms were classified into plant kingdoms and animal kingdom based on their specific characters.
- This system initiated systematic methods to classify living organisms.

Demerits:

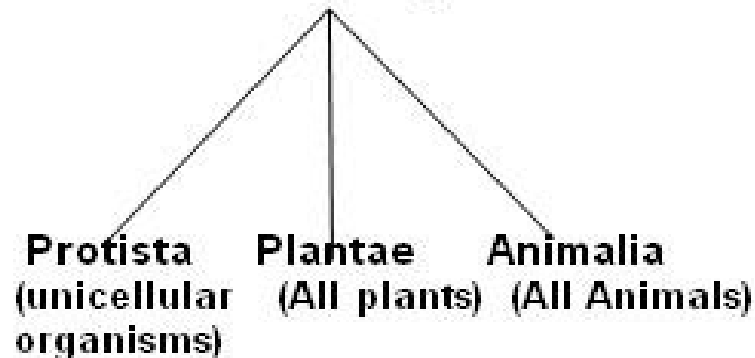
- Unable to distinguish between unicellular and multicellular organism
- There is no proper distinction between prokaryotes and eukaryotes. Like in the case of bacteria without a nuclear envelope and cellular organelles are placed in the plant kingdom.
- In the system both photosynthetic and non-photosynthetic organism are placed together in the kingdom plantae. For example the fungi lack chlorophyll and are saprophytic in nature, they are placed in the plant kingdom.
- Organisms like the lichens do not fall either in the animal or plant kingdom.
- Organisms like the diatoms are placed under the plant kingdom while the protozoans are placed under the animal kingdom, these organisms are of the same level of organization and they reproduce by fission yet they are placed in different kingdoms.
- Some organisms possess characters of both plants and animals like Euglena and Chlamydomonas, so they can belong to any kingdom.
- Modes of nutrition considered in this system are assimilation and ingestion, absorption type of nutrition is not recognized.

Three kingdom classification

- The German biologist **Ernst Haeckel** (1866) in his book **Generelle Morphologie der Organismen** suggested a three-kingdom system.
- In the third kingdom Protista, he grouped all the single-celled organisms that are intermediate in many respects between plants and animals.

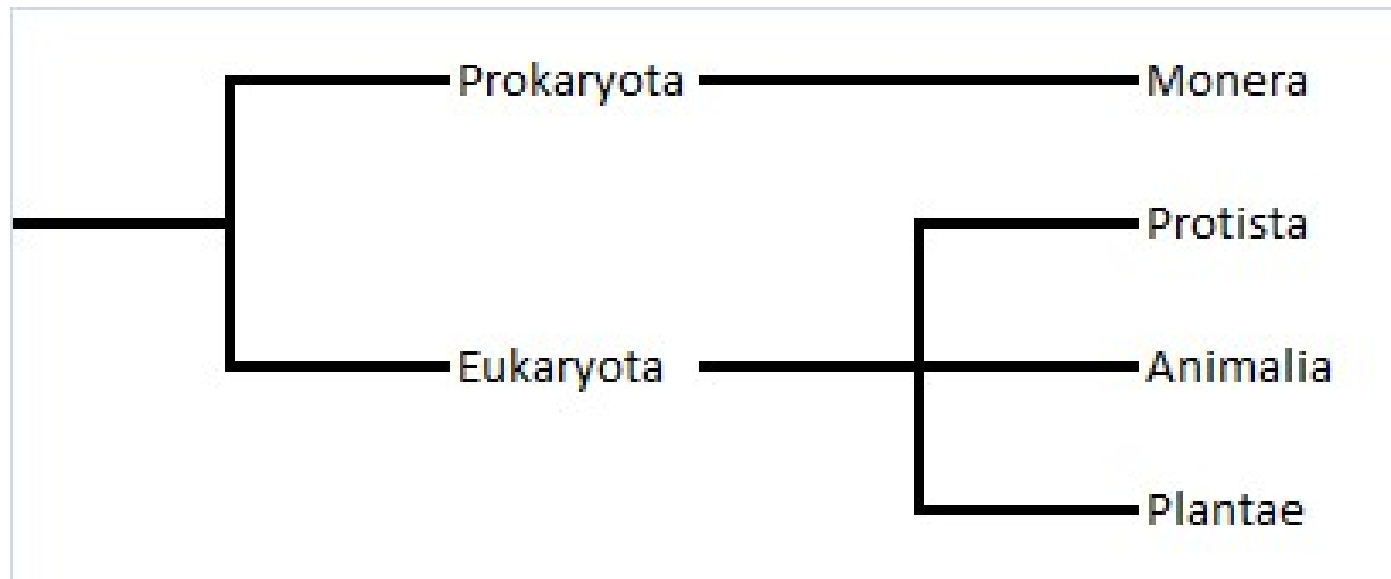


Three kingdom Classification (Ernst Haeckel-1866)



Four kingdom classification

With the discovery of electron microscope, **Herbert Copeland** (1956) proposed the fourth kingdom, originally called **Mycota** but later referred to as the **Monera**, to include the prokaryotes like bacteria and blue-green algae, which have many characteristics in common.

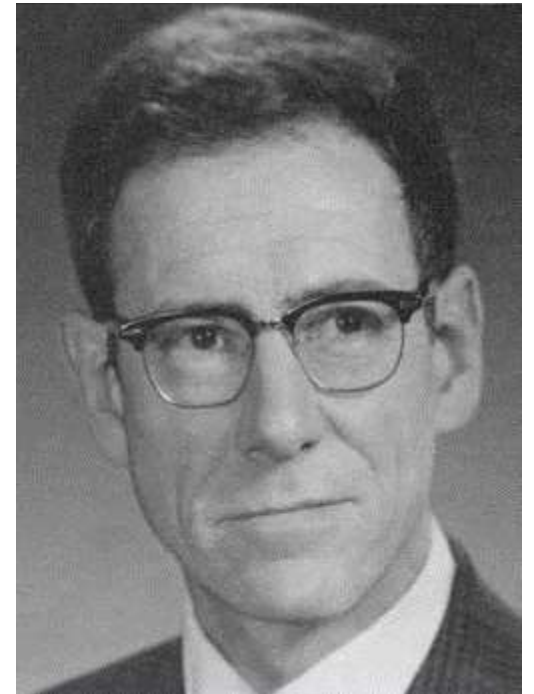


Five kingdom classification

In the year 1969 a scientist named **R.H. Whittaker** divided organisms into five kingdoms.

The classification of organisms was based on

- Complexity of cell structure: prokaryotic and eukaryotic
- Complexity of organisms; unicellular or multicellular
- Mode of nutrition: autotrophs, heterotrophs and saprotrophic, heterotrophs and ingestion
- Life style: producer, consumer and decomposer
- Phylogenetic relationships: prokaryotes to eukaryotes, unicellular to multicellular organisms.



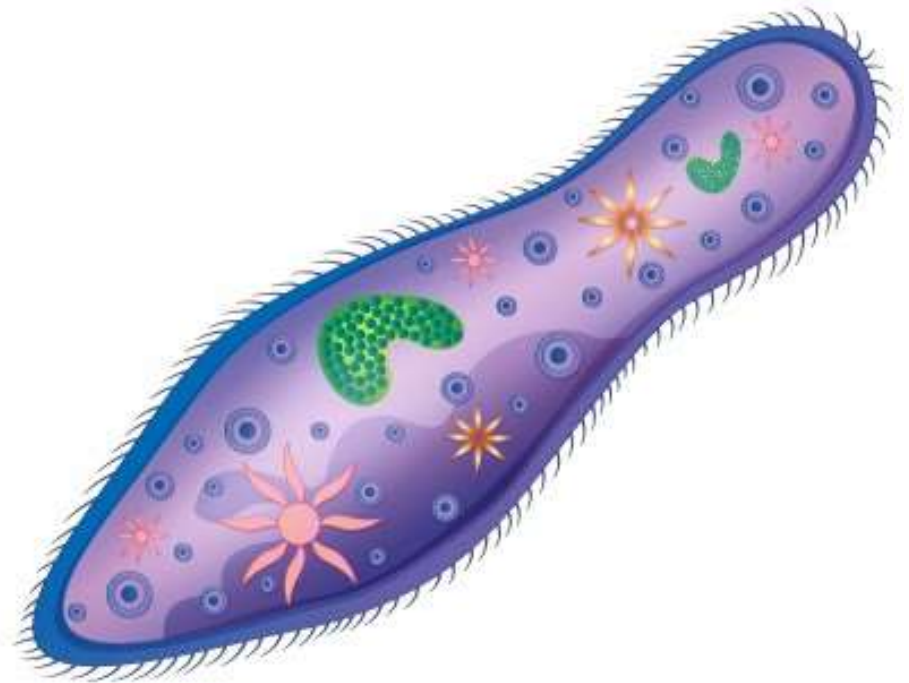
Kingdom Monera

- The kingdom consists of very small and single-celled organisms.
- They are prokaryotes, which includes organism such as cyanobacteria, bacteria, archaeobacteria and Mycoplasma.
- They may or may not move.
- They are unicellular organisms with no specific mode of nutrition.
- They are both aerobic and anaerobic.
- The presence of cell wall, which are composed of peptidoglycan. They have naked DNA with the absence of membrane bound organelles.
- Cytoskeleton absent. Flagella if present consists of flagellant proteins.
- Reproduction is through binary fission.



Kingdom Protista

- They are single-celled, eukaryotes and mainly aquatic.
- It includes diatoms, golden algae, euglena and protozoans like amoeba, paramecium Plasmodium, Slime mold etc.
- In this kingdom, cell walls form two thin overlapping shells.
- Locomotion by cilia, flagella or by amoeboid mechanism
- Nutrients acquired by photosynthesis, ingestion of other organisms or both.
- Both asexual and sexual modes of reproduction are present



Kingdom Fungi

- Fungi are multicellular, bodies consist of long, thread like structures, which are called as hyphae. Network of this threadlike structures are called as mycelium.
- Cell walls are made of chitin and polysaccharides.
- Cell organelles present including nucleus but no chloroplast.
- Mode of nutrients: absorption. They are saprophytes or parasites.
- This kingdom of fungi also includes lichens, mycorrhiza, etc.
- Reproduction is mainly through sexual, asexual and vegetative.



Kingdom Plantae

- They are multicellular, eukaryotic and chlorophyll containing organisms.
- Most don't move, although gametes of some plants move using cilia or flagella.
- Lifecycle has two phases- diploid sporophytic and haploid gametophyte that alternate with each other.
- They are multicellular organisms, which produce their food by photosynthesis.
- Cell walls are made of cellulose.
- It includes all types of plants such as herbs, shrubs, trees, flowering and non flowering plants, etc



Kingdom Animalia

- They are heterotrophic, eukaryotic, multicellular organisms, which lack cell walls and chloroplasts.
- They feed on plants or on animals by ingestion.
- They move with the aid of cilia, flagella or muscular organs based on contractile proteins.
- It includes all types of animals



Merits:

- Kingdom Animalia become more homogenous with the separation of protozoa.
- Kingdom Plantae also become more homogeneous with the exclusion of bacteria, fungi and some unicellular algal forms.
- Separation of prokaryotes into a separate kingdom – Monera is due for long time.
- Separation of fungi from plants is a wise step.
- Separation of intermediate or transitional forms of unicellular eukaryotes into kingdom – Protista is well described. Thus, the plant and animal kingdoms become more systematic.
- It brings the phylogenetic relationships in the living world.

Demerits:

- The Monera and Protista kingdoms are still heterogeneous because both include autotrophic and heterotrophic forms and some with or without cell wall.
- Phylogeny in lower organisms is not fully reflected.
- Slime moulds don't fit in kingdom Protista.
- Red and brown algae are not related to other members of kingdom Plantae.
- Viruses have not been included in this system of classification.

1. Two Kingdom Classification
(Carolus Linnaeus, 1758)

- Kingdom: Plantae (All plants)
- Kingdom: Animalia (All animals)

2. Three Kingdom Classification
(Ernst Haeckel, 1866)

- Kingdom: Protista (Unicellular organisms)
- Kingdom: Plantae (Multicellular plants)
- Kingdom: Animalia (Multicellular animals)

3. Four Kingdom Classification
(Copeland, 1966)

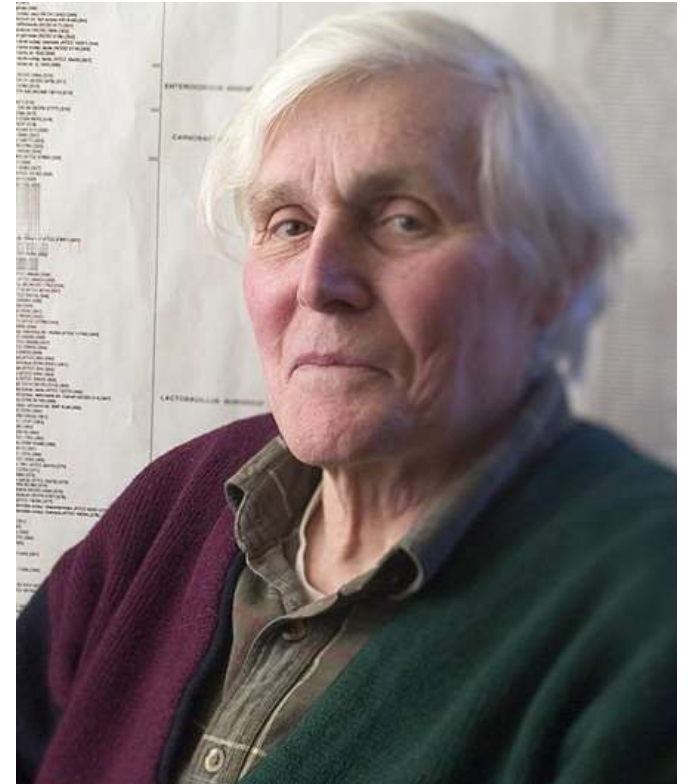
- Kingdom: Monera (Prokaryotic organisms)
- Kingdom: Protista (Primitive eukaryotes)
- Kingdom: Metaphyta (Advanced eukaryotic plants)
- Kingdom: Metazoa (Advanced eukaryotic animals)

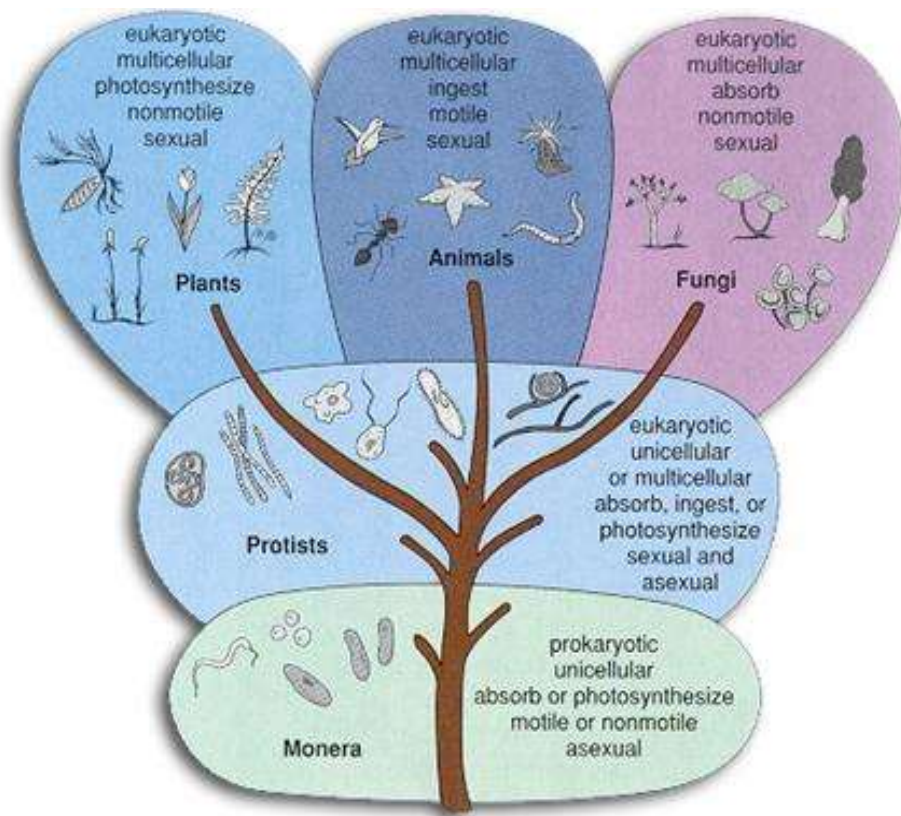
4. Five Kingdom Classification
(Whittaker R.H., 1969)

- Kingdom: Monera
- Kingdom: Protista
- Kingdom: Mycota (Exclusively for fungi)
- Kingdom: Metaphyta
- Kingdom: Metazoa

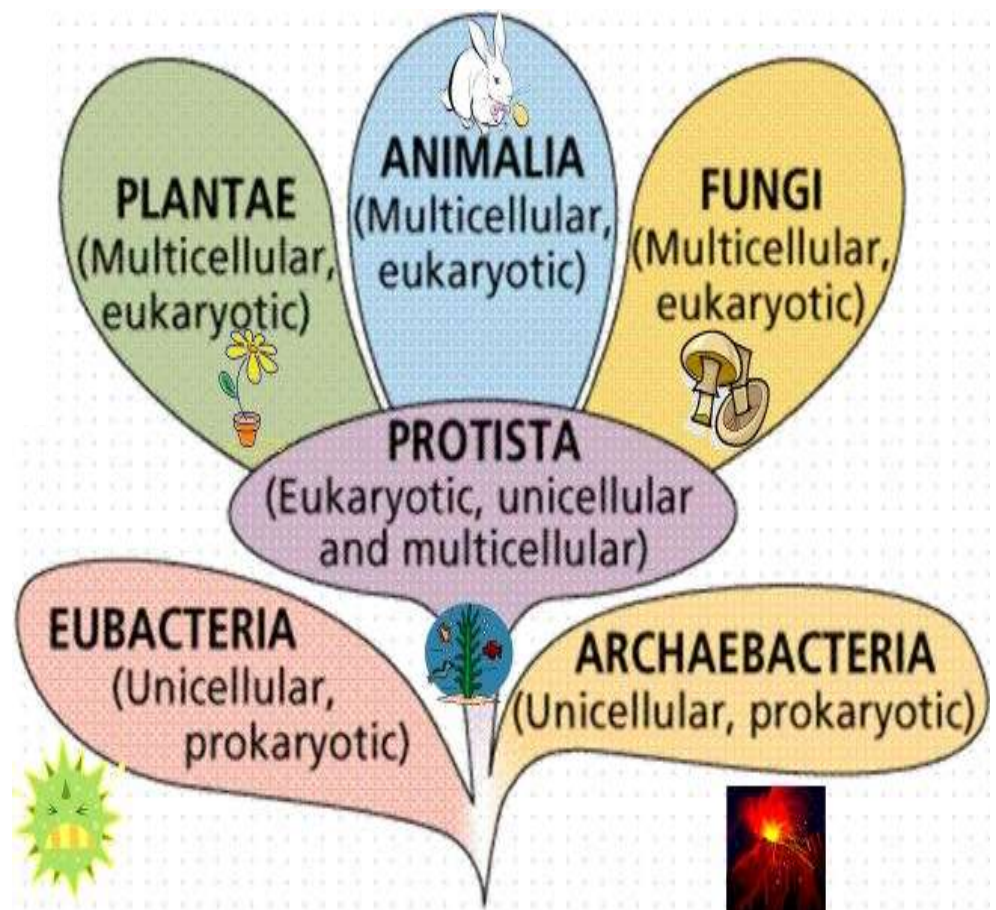
Six kingdom classification

- In the years around 1980 there was an emphasis on phylogeny and redefining the kingdoms to be monophyletic.
- Based on rRNA studies **Carl Woese** divided the prokaryotes into two kingdoms, called Eubacteria and Archaeobacteria. Thus it became six kingdom.



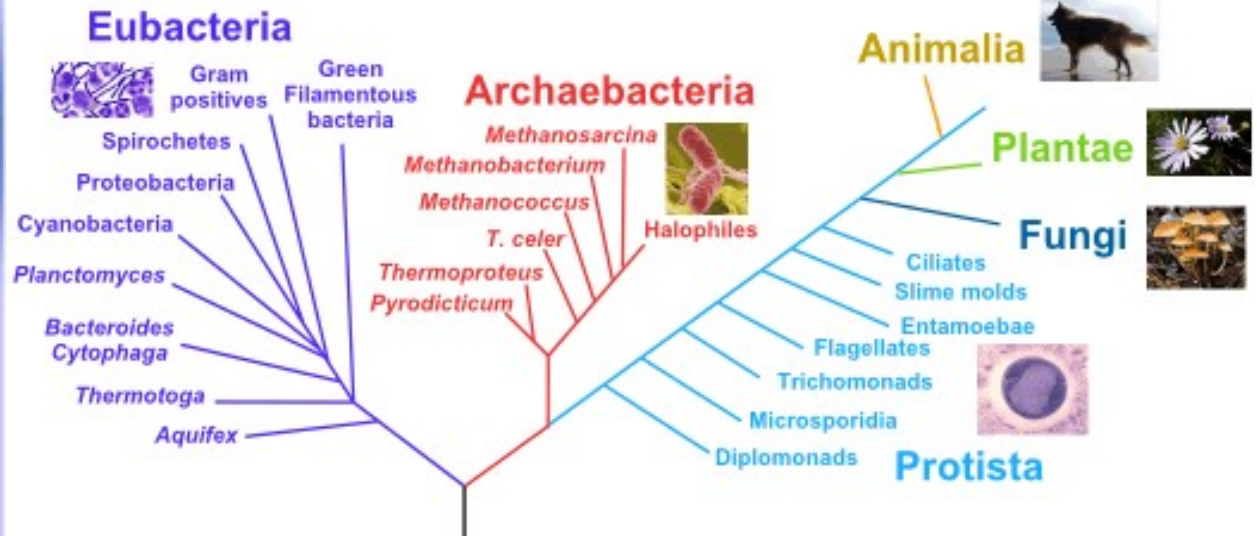


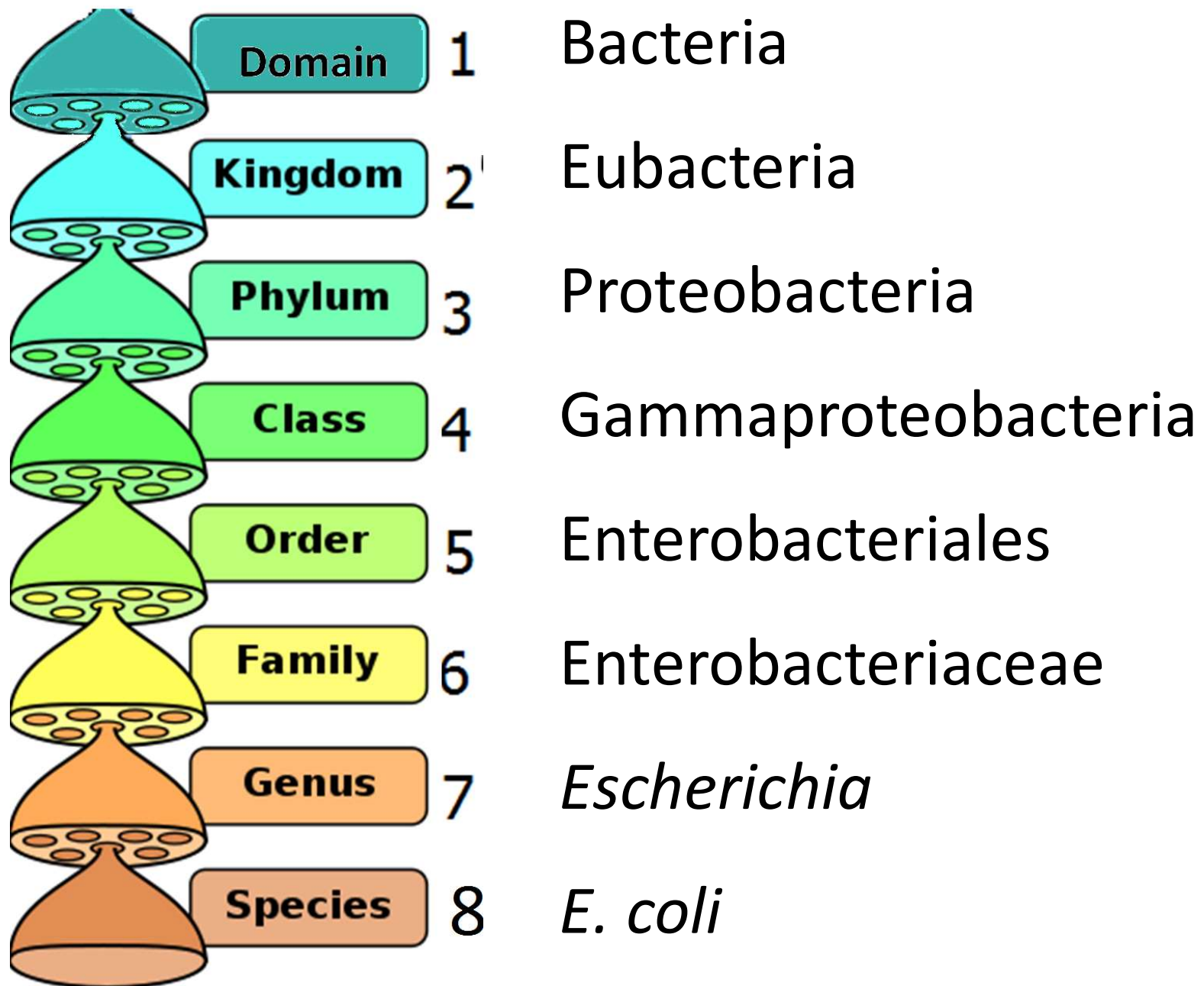
Five Kingdom vs Six Kingdom



Three Domains system

- In 1990, Carl Woese proposed that the Eubacteria, Archaeobacteria, and Eukaryota represent three primary lines of descent.
- Therefore he established a new superior concept of domains over the kingdom and proposed three domains, Bacteria, Archaea, and Eukarya.





Microbiology

In a modern sense

- Bacteria, cyanobacteria and actinomycetes, etc are distributed in the **domain Bacteria**
- Methanogens, extremely thermophilic, halophilic organisms, etc are in the **domain Archaea**
- Molds, yeasts, basidiomycetes, algae and protozoa, etc are in the **domain Eukarya**

THANK YOU