



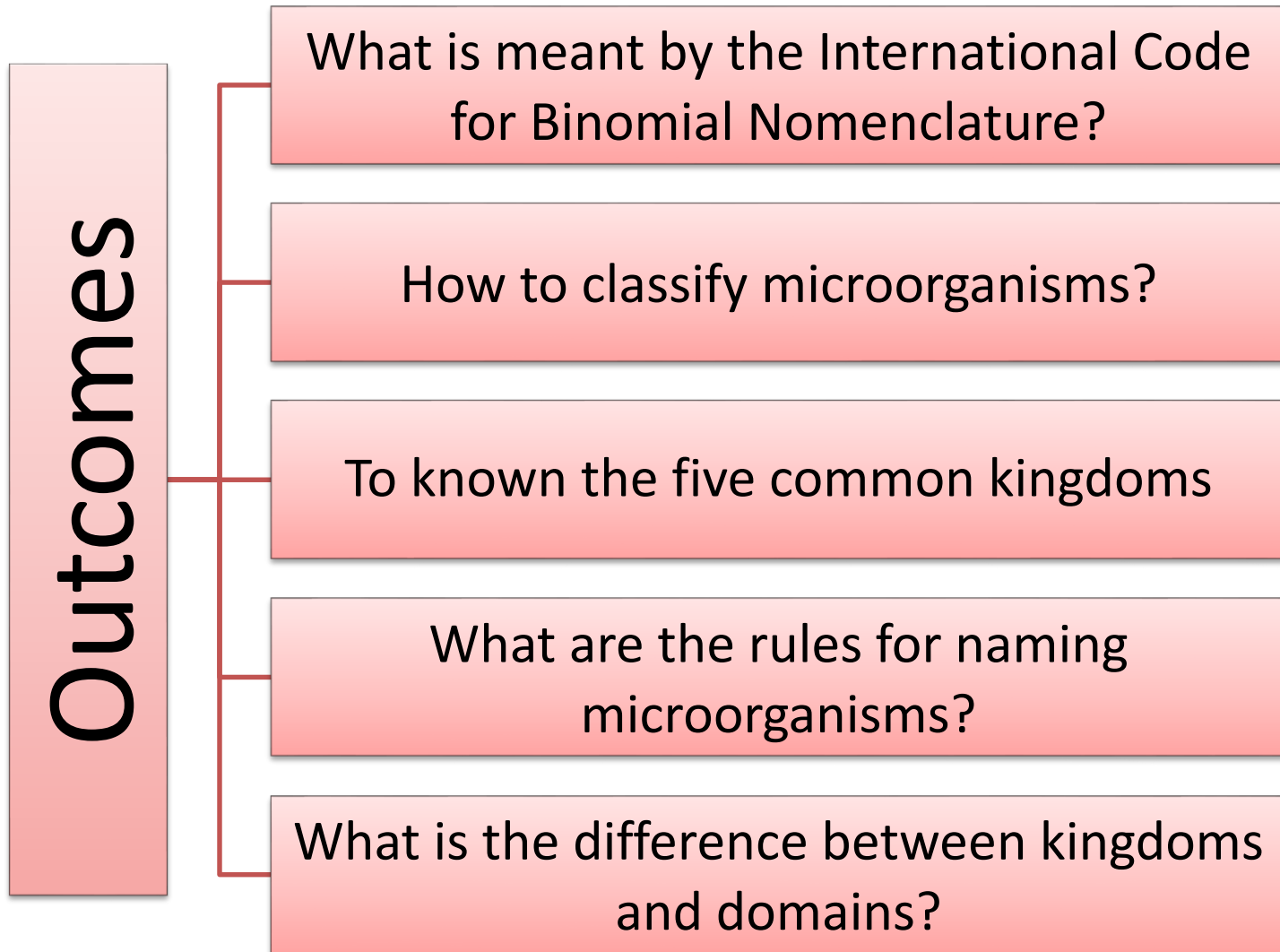
OPT0425
MICROBIOLOGY I

GAMAL EL-HITI

Types of Microorganisms and Nomenclature

Lecture Four

Learning Outcomes



Types of Microorganisms

- They are tiny living plants or animals.
- Can not be seen by naked eye.
- Several ways to classify microorganisms.
- Could be classified according to:
 - Harm they can cause
 - Need for oxygen
 - Number of cells
 - Significance (usefulness)
 - Characteristics

Types of Microorganisms

- Based on the harm that can cause, microorganisms can be classified to pathogenic and non-pathogenic.

Pathogenic

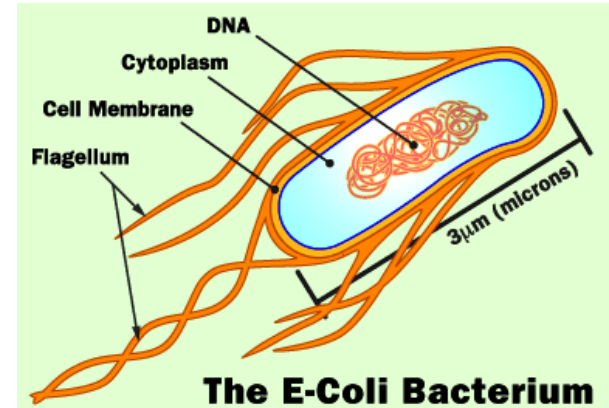
- Cause harm, infection and disease
- Can cause death

Non-pathogenic

- Mostly are harmless.
- Do not produce disease
- Could be beneficial

Types of Microorganisms

- Microorganisms may be pathogenic in one situation, and not in others.
- *e.g. Escherichia coli* bacterium can cause diarrhea.
- But, *Escherichia coli* in the intestinal tract, breaks down waste and can aid in the synthesis of **vitamin K** (helps thicken and control bleeding).



Types of Microorganisms

- Based on the requirement for oxygen, microorganisms can be classified to aerobic and anaerobic.

Aerobic

- Requires oxygen to live

Anaerobic

- Does not require oxygen to live

Types of Microorganisms

- Based on the number of cells present, microorganisms can be classified to unicellular or multicellular.

Unicellular

- Made up of a single cell

Multicellular

- Made up of many cells

Types of Microorganisms

- Based on the significance, microorganisms can be classified to useful or harmful to us.

Bacteria

- Useful (lactobacillus)
- Harmful (Haemophilus influenza)

Fungi

- Useful (Yeast)
- Harmful (Rhizopus)

Protozoa

- Useful (Tetrahymen pyriformis)
- Harmful (Plasmodium)

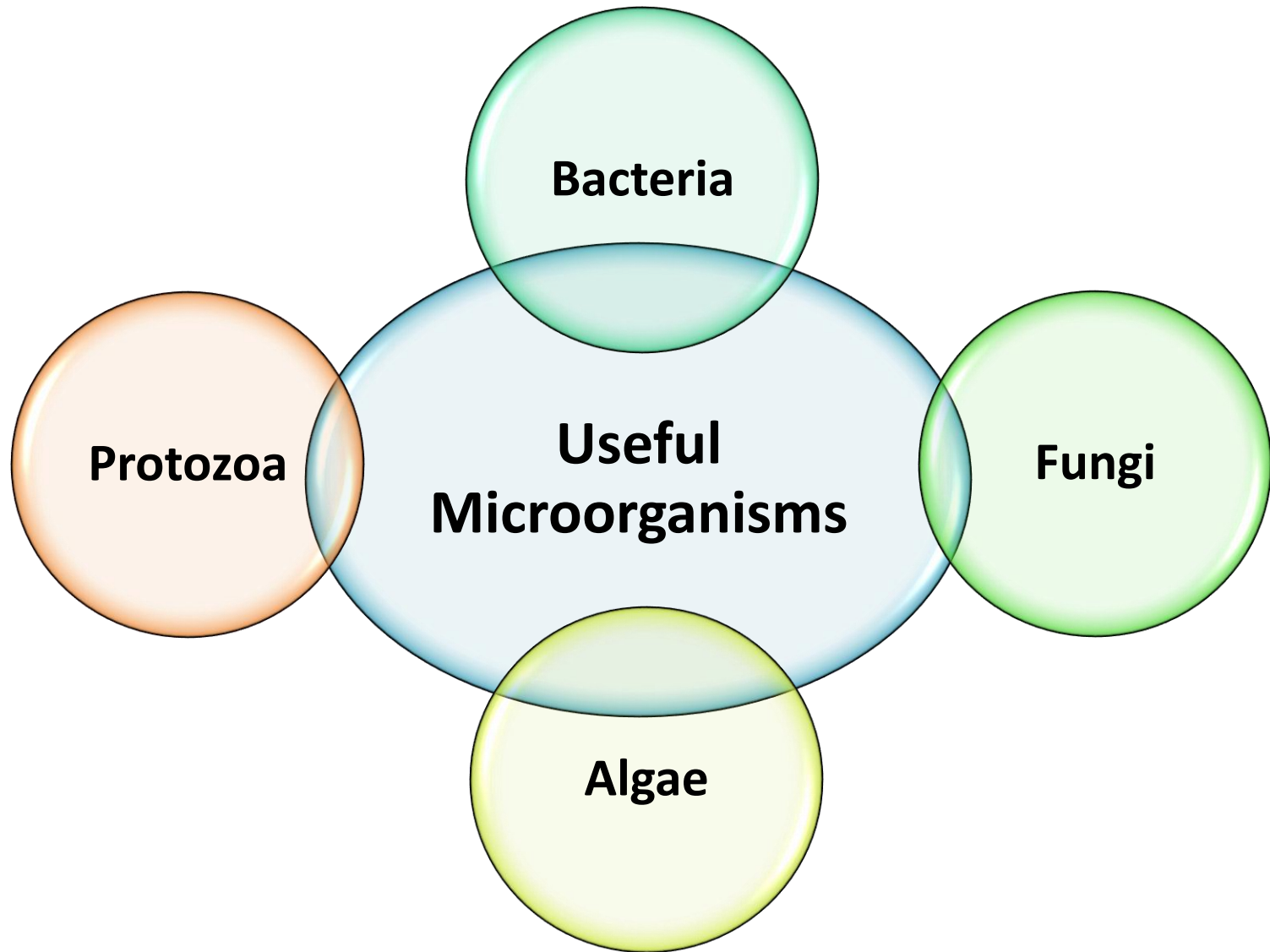
Algae

- Useful (Red algae)
- Harmful (Gymnodinium)

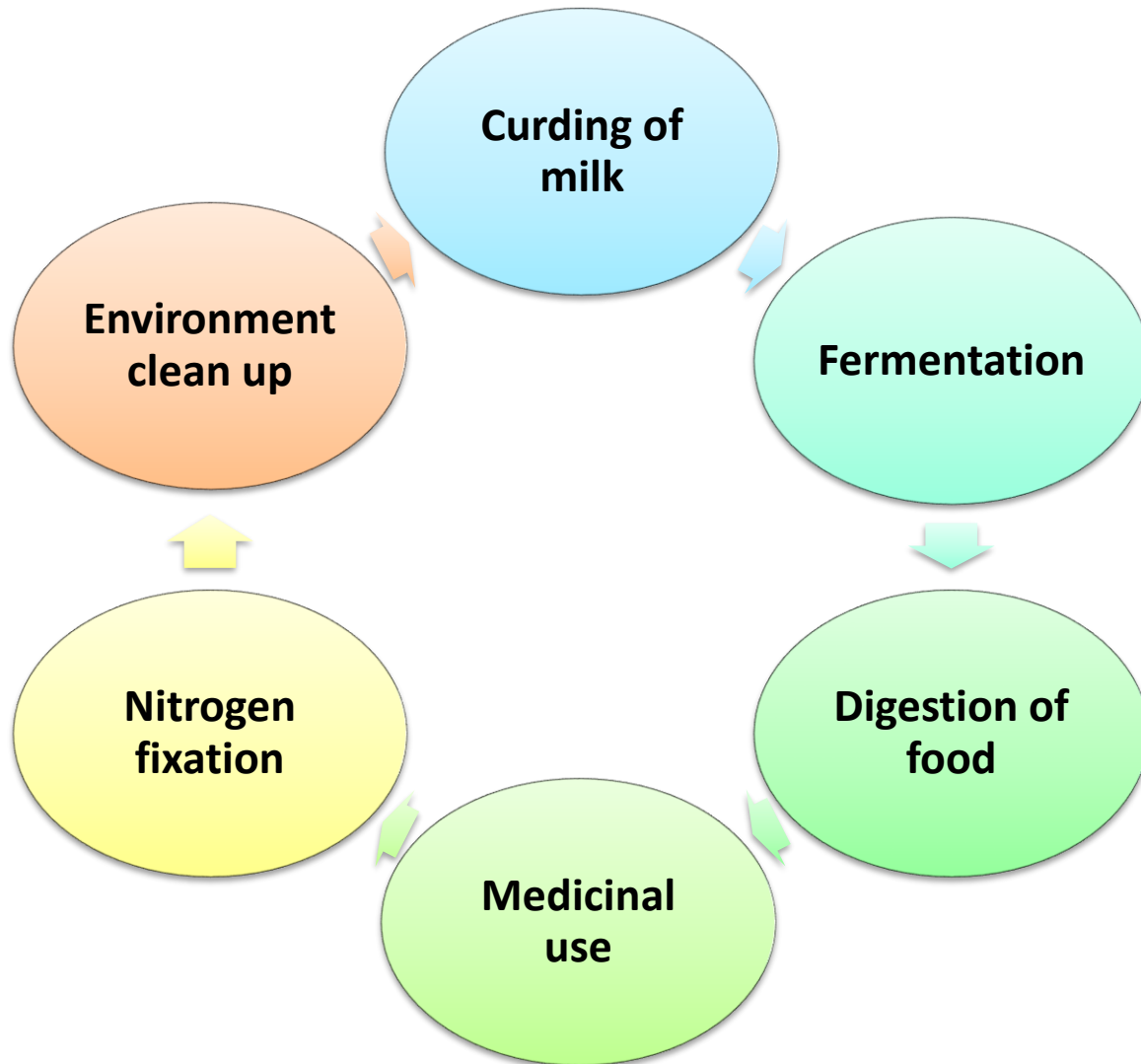
Virus

- Harmful

Types of Microorganisms



Types of Microorganisms



Types of Microorganisms

- Based on the characteristics, microorganisms can be classified into four groups.

Bacteria

- Unicellular, prokaryotic microorganisms which occur in various sizes and shapes

Fungi

- Saprophytic division of living organisms which can be unicellular or multicellular

Algae

- Photosynthetic microorganisms that can synthesize their own food

Protozoa

- Neither considered living or non-living microorganism but at the boundary

Nomenclature of Organisms

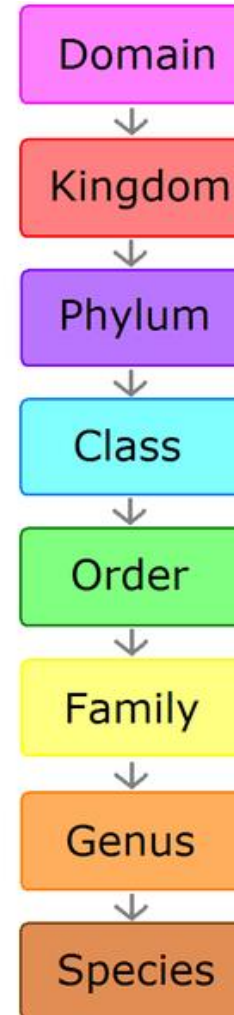
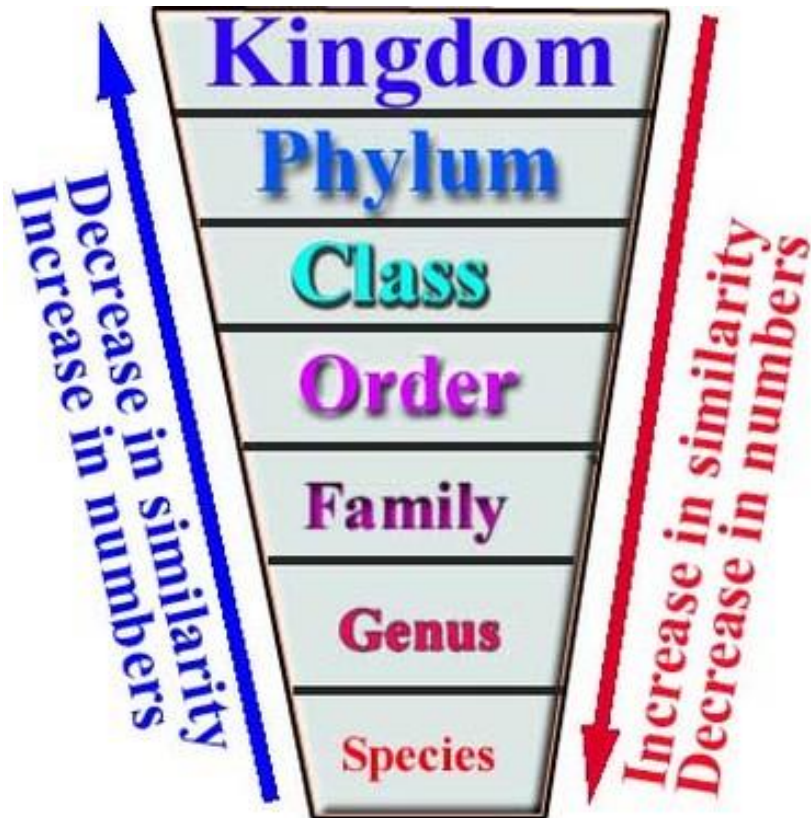
- **Taxonomy** is the science of classification of organisms.
- To show relationships among organisms.
- It is a way to provide **universal** identification of an organism.
- **Phylogeny** or **systematics** shows evolutionary relationships and history among organisms.
- **Phylogenetic tree** shows relationships between the archaea and other life's forms.

Nomenclature of Organisms

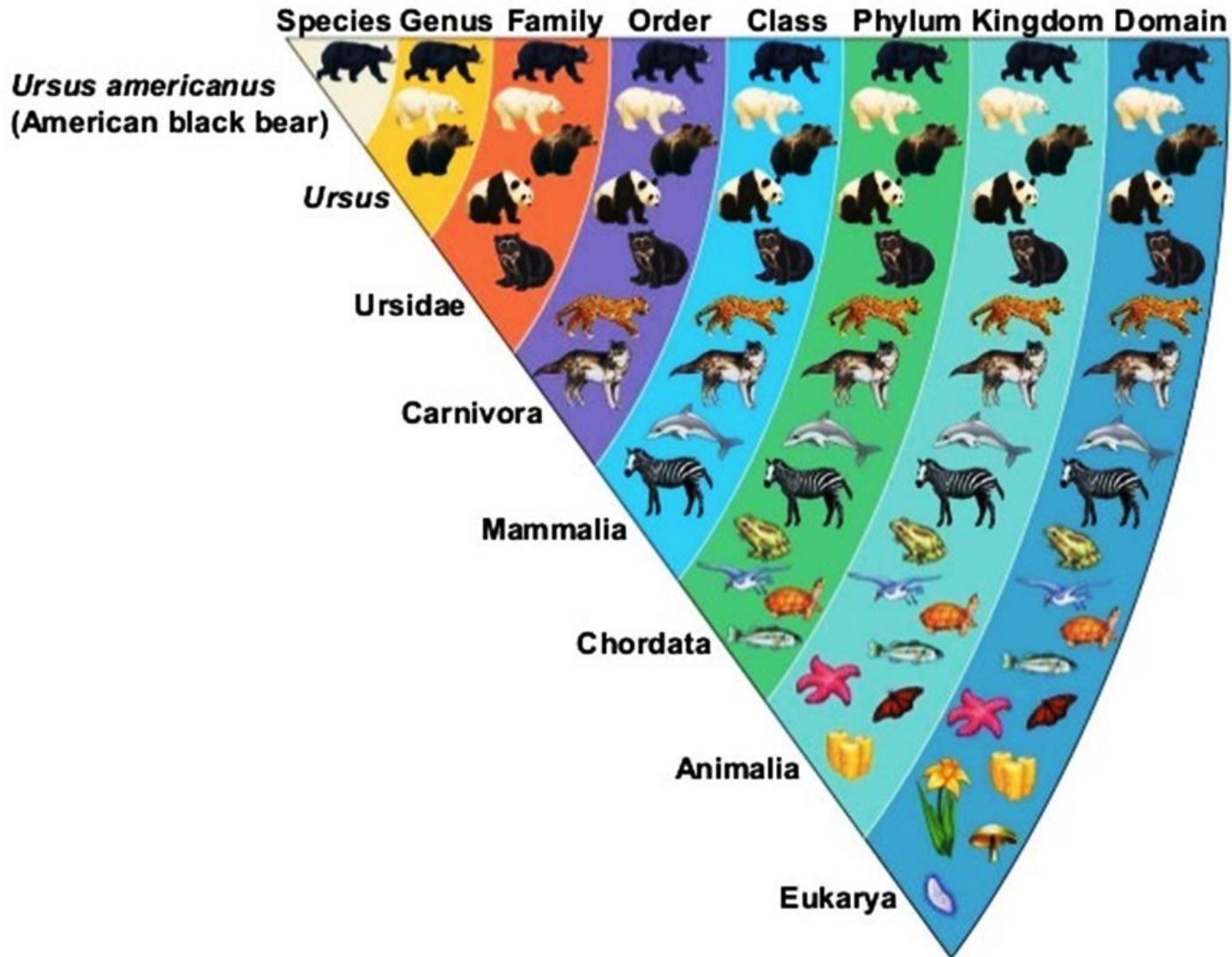
- The International Code for Binomial Nomenclature contains the rules for naming microorganisms.
- All names must be approved by the International Zoological Congress.
- This prevents duplicated names.
- **Taxon** (taxa-plural) is a category into which related organisms are placed.
- There is a **hierarchy** of groups (taxa) from broadest to most specific.

Nomenclature of Organisms

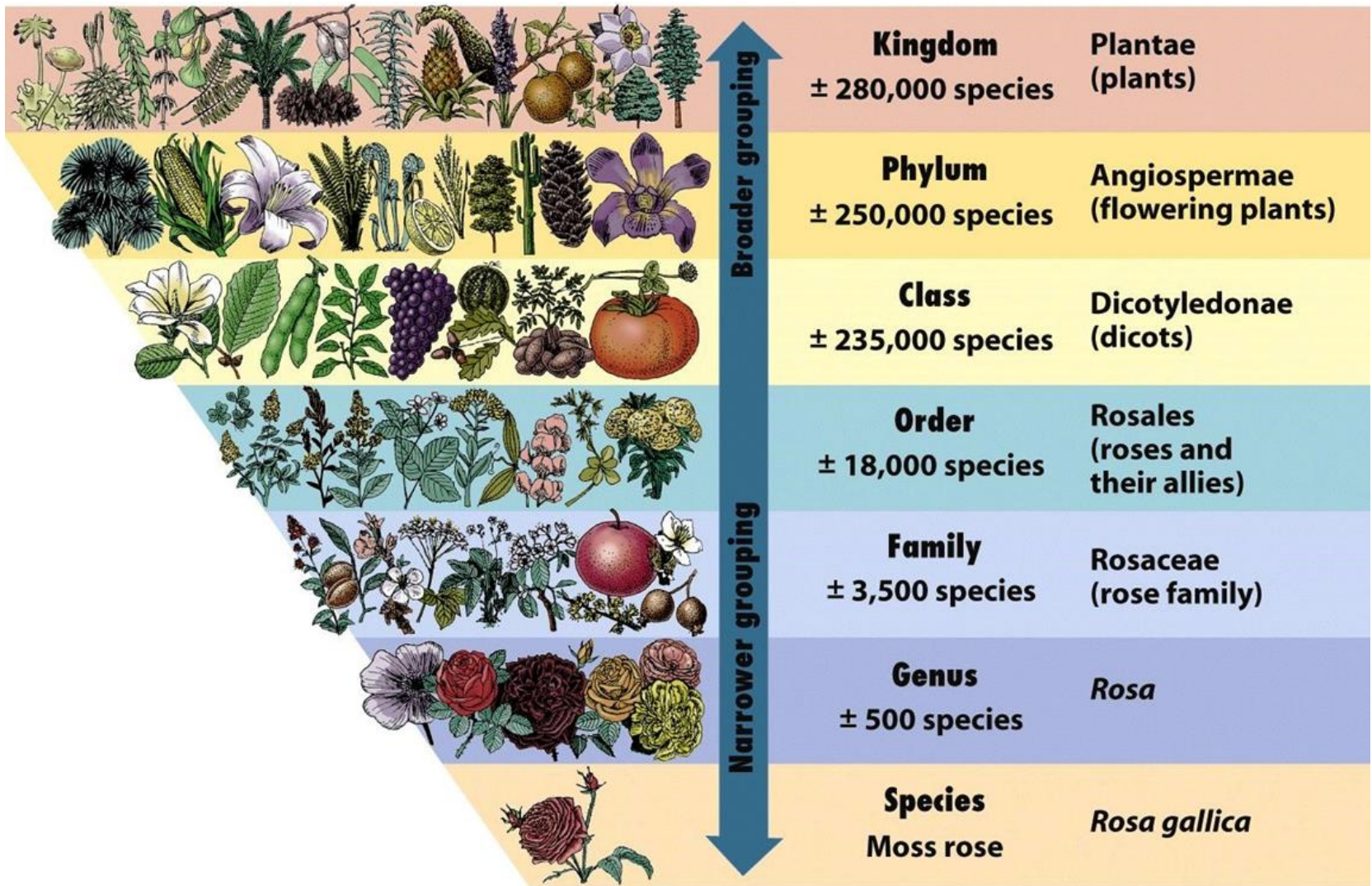
- e.g. Kingdom Plantae contain trees, grasses, bushes and flowers.



Nomenclature of Organisms



Nomenclature of Organisms



Nomenclature of Organisms

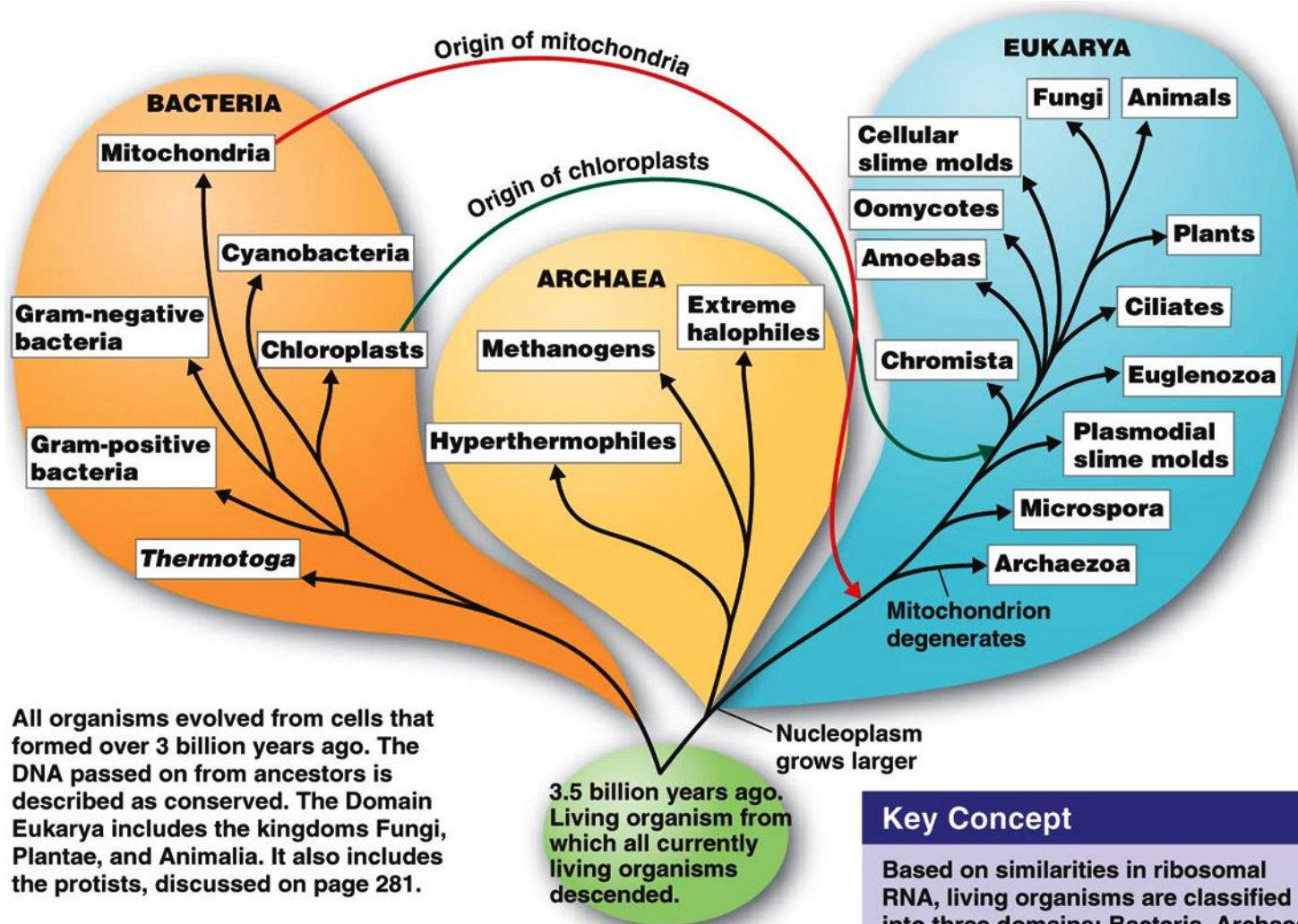
- The three-domain system is a biological classification introduced by Carl Woese *et al.* in 1977.

1) **Eukarya**: contain a membrane bound nucleus as in plants, animals, fungi and protozoa.

2) **Bacteria**: contain peptidoglycan in their membranes and most pathogenic prokaryotic organisms belong to bacteria.

3) **Archaea**: contain unusual cell walls and membranes.

Nomenclature of Organisms





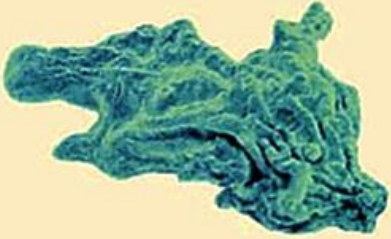
All organisms evolved from cells that formed over 3 billion years ago. The DNA passed on from ancestors is described as conserved. The Domain Eukarya includes the kingdoms Fungi, Plantae, and Animalia. It also includes the protists, discussed on page 281.

Key Concept

Based on similarities in ribosomal RNA, living organisms are classified into three domains: Bacteria, Archaea, and Eukarya.

Nomenclature of Organisms



| | Archaea | Bacteria | Eukarya |
|----------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------|
| |  <p><i>Methanosarcina</i></p> |  <p><i>E. coli</i></p> |  <p><i>Amoeba</i></p> |
| Cell Type | Prokaryotic | Prokaryotic | Eukaryotic |
| Cell Wall | Varies in composition; contains no peptidoglycan | Contains peptidoglycan | Varies in composition; contains carbohydrates |
| Membrane Lipids | Composed of branched carbon chains attached to glycerol by ether linkage | Composed of straight carbon chains attached to glycerol by ester linkage | Composed of straight carbon chains attached to glycerol by ester linkage |
| First Amino Acid in Protein Synthesis | Methionine | Formylmethionine | Methionine |
| Antibiotic Sensitivity | No | Yes | No |
| rRNA Loop | Lacking | Present | Lacking |
| Common Arm of tRNA | Lacking | Present | Present |

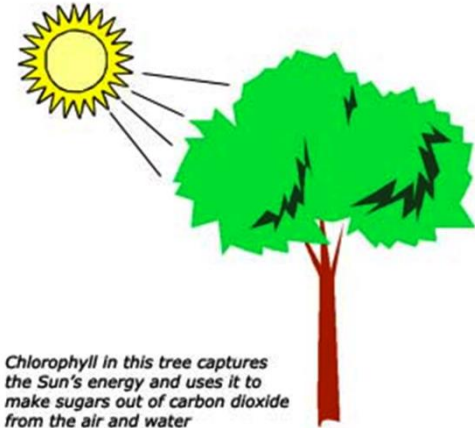
Nomenclature of Organisms

- Five common kingdoms based on nutrient:
 - 1) **Plantae**: multicellular photoautotrophs and cell wall made of cellulose.
 - 2) **Animalia**: heterotrophic, involving a digestive system and no cell wall.
 - 3) **Fungi**: absorptive heterotrophic and cell wall made of chitin.
 - 4) **Protozoa**: mostly single celled autotrophic and cell wall made of polysaccharide.
 - 5) **Prokaryotes**: unicellular autotrophic and cell wall made of murein.

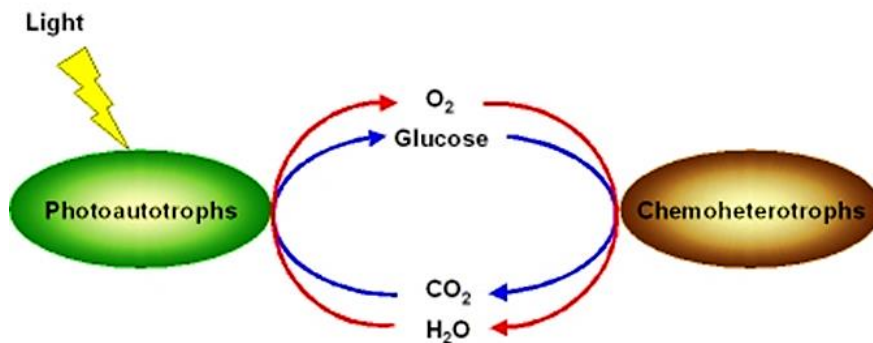
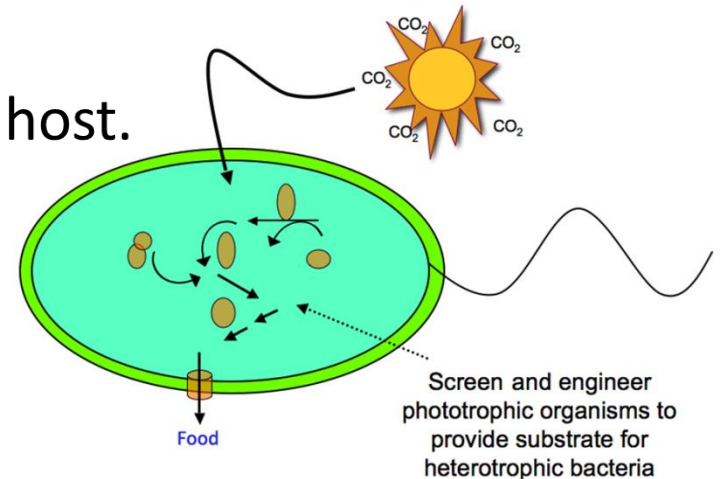
Nomenclature of Organisms

- **Carbon Sources**
- CO_2 : autotroph
- Organic: heterotroph
- **Energy Sources**
- Sunlight: phototroph
- Organic: chemotroph
- Saprobe: lives on organics of dead organisms.
- Parasite: lives on organics of living host.

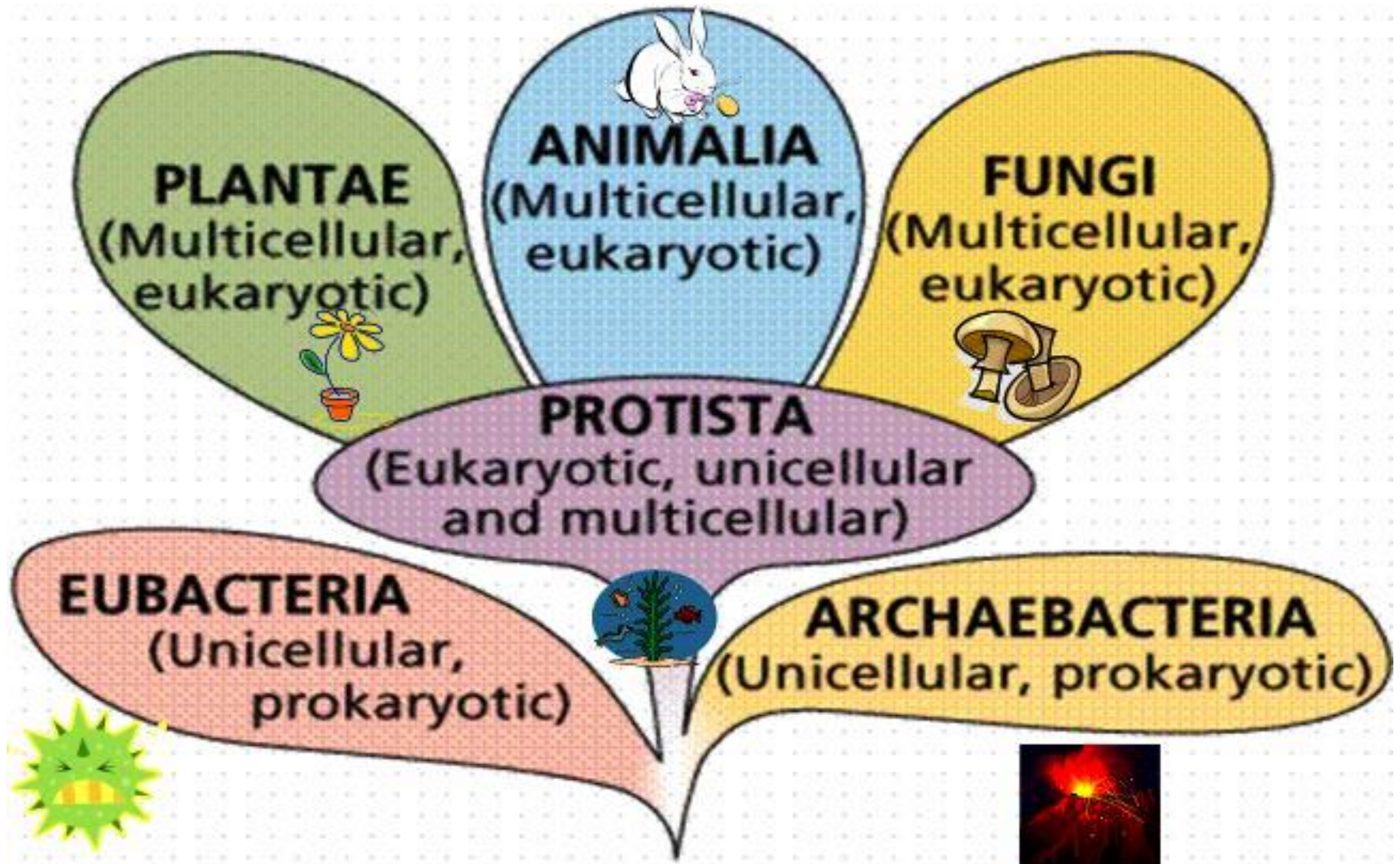
Autotroph



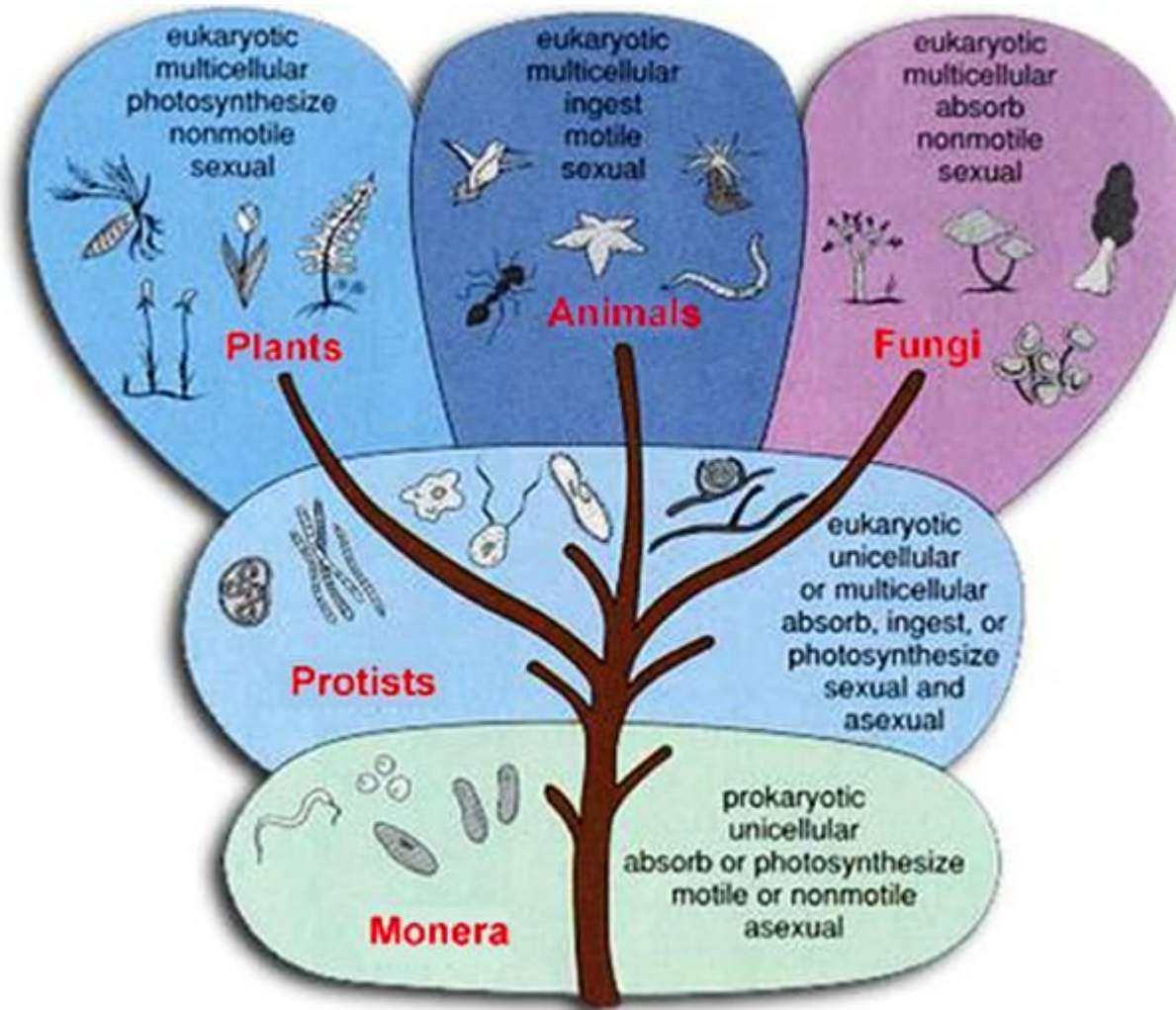
Phototroph



Nomenclature of Organisms



Nomenclature of Organisms



Nomenclature of Organisms

Kingdoms and Domains

The three-domain system



The six-kingdom system



The traditional five-kingdom system



Binomial Nomenclature

- Binomial nomenclature, also called binary nomenclature.
- It consists of two **Latinized** names, the genus and the species.
- All living things, and even some viruses, have a scientific name.
- Genus species
- Latin or Greek
- Italicized in print
- Capitalize “**genus**”, but NOT “**species**”
- Underline when writing

Binomial Nomenclature

- *Escherichia coli*, *E. coli*, *Escherichia spp.*
(spp. stands for species plural).
- The genus name (*Escherichia*) should be followed by the species name.
 - The genus name (*Escherichia*) is always *capitalized*.
 - The species name (*coli*) is *never capitalized*.
 - The species name is never used without the genus name (e.g. *coli* cannot stand alone by itself).

Binomial Nomenclature

- The genus name may be used without the species name (e.g. *Escherichia* may stand alone, but it is no longer actually describes a species).
- When both genus and species names are present, the genus name always comes first (e.g. *Escherichia coli*).
- Both the genus and species names are always *italicized* (or underlined)—always underline if writing binomials by hand.

Binomial Nomenclature

- The first time a binomial is used in a work, it must be spelled out in its entirety.
- *e.g.* *E. coli* is not acceptable unless you have already written *Escherichia coli* previously.
- The next time a binomial is used it may be abbreviated; *e.g.* *E. coli* for *Escherichia coli*.
- The species name is never abbreviated.

Binomial Nomenclature

- Abbreviate unambiguously if there is any potential for confusion (e.g. *Enterococcus* vs. *Escherichia*).
- Employ binomial nomenclature even in your speech.
- It is proper to refer to *Escherichia coli* as *E. coli* or even as *Escherichia*, but it is not proper to call it *coli* or *E.C.*
- When in doubt, write the full name out (and underline).

Binomial Nomenclature

- *Staphylococcus aureus* (*S. aureus*)
- *Streptococci pyogenes* (*S. pyogenes*)
- *Streptococci pneumoniae* (*S. pneumoniae*)
- *Corynebacterium diphtheriae*
(*C. diphtheriae*)
- *Streptococci agalactiae* (*S. agalactiae*)
- *Neisseria gonorrhoeae* (*N. gonorrhoeae*)
- *Pseudomonas aeruginosa* (*P. aeruginosa*)
- *Haemophilus influenzae* (*H. influenzae*).