



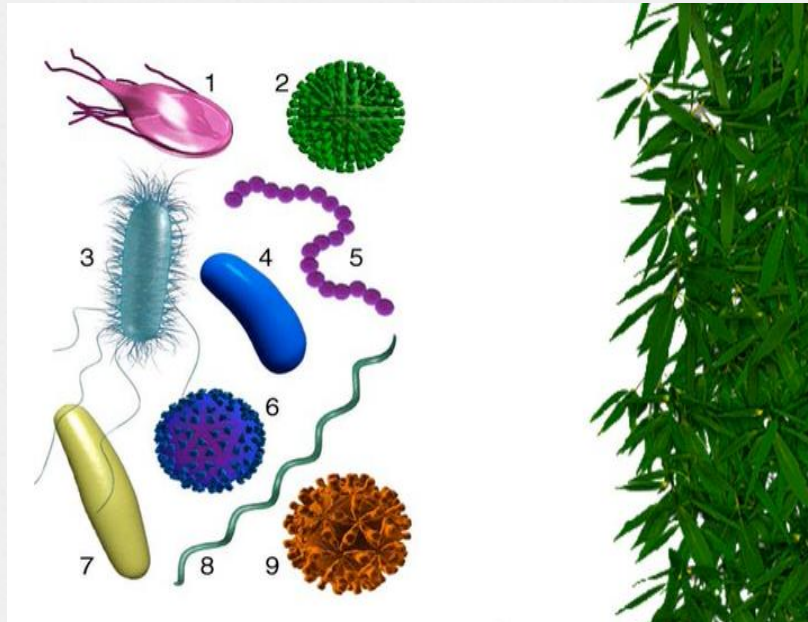
**Basrah University**  
**Al-Qurna Education college**  
**Biology department: postgraduate**



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## **2<sup>nd</sup> Course -Lecture # 1**

# **Introduction & Microbial Taxonomy**



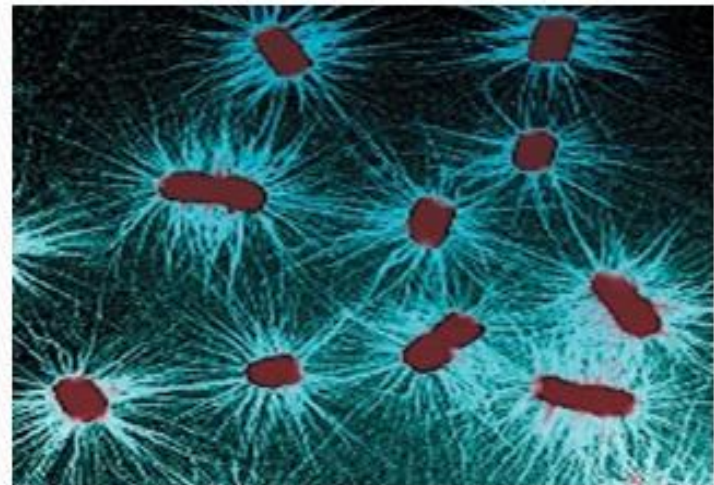
**Dr. Kawakib I. Al-Zubaidy**

# Objectives

- Introduction (history of the microbiology; understand the fields of microbiology)
- To explain some terms ( taxonomy , taxa, phylogeny, classification , identification )
- To explain the classification systems

# The Scope of Microbiology

- ▶ **Microbiology:** The study of living things too small to be seen without magnification
  - **Microorganisms** or **microbes**—these microscopic organisms
  - Commonly called “germs, viruses, agents...” but not all cause disease and many more are useful or essential for human life



# Highlights in the History of Microbiology

1677

- 📖 Observed "little animals" (Antony Leeuwenhoek)

1796

- 📖 First scientific Small pox vaccination (Edward Jenner)

1850

- 📖 Advocated washing hands to stop the spread of disease (Ignaz Semmelweis)

1861

- 📖 Disproved spontaneous generation (Louis Pasteur)

1862

- 📖 Supported Germ Theory of Disease (Louis Pasteur)

1867

- 📖 Practiced antiseptic surgery (Joseph Lister)



# Highlights in the History of Microbiology

1876

- 📖 First proof of Germ Theory of Disease with *B. anthracis* discovery (Robert Koch)

1881

- 📖 Growth of Bacteria on solid media (Robert Koch)

1882

- 📖 Outlined Kochs postulates (Robert Koch)

1882

- 📖 Developed acid-fast Stain (Paul Ehrlich)

1884

- 📖 Developed Gram Stain (Christian Gram)

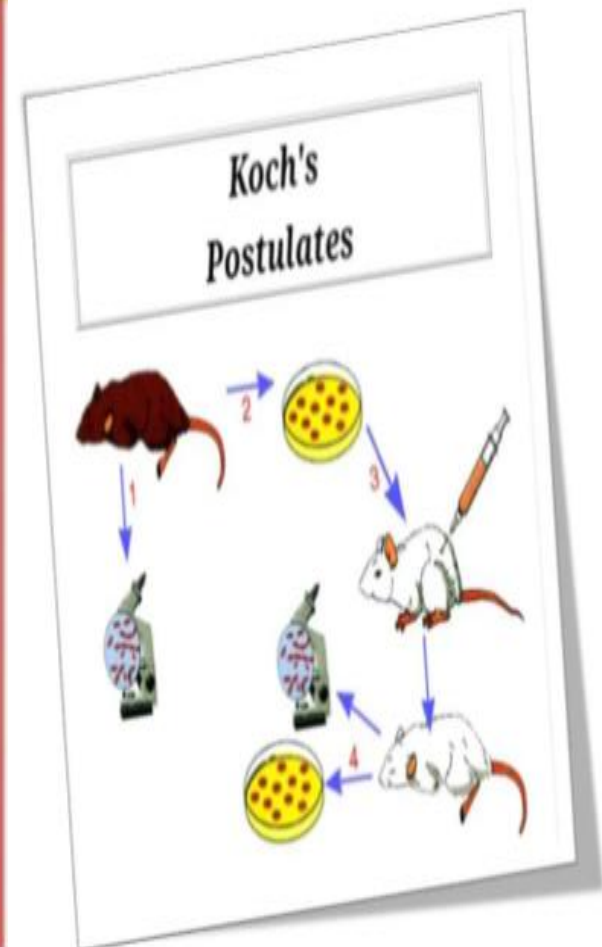
1885

- 📖 First Rabies vaccination (Louis Pasteur)



## ***Koch's postulates:***

1. The microorganism must be present in every instance of the disease and absent from healthy individuals.
2. The microorganisms must be capable of being isolated and growth in pure culture.
3. When the microorganisms is inoculated into a healthy host, the same disease condition must result.
4. The same microorganisms must be re-isolated from the experimentally infected host.



# What are Some Exceptions to Koch's Postulates

I. Some microorganisms that cause diseases have never been cultivated under laboratory conditions;

II. Some diseases are caused by several microorganisms;

III. Some microorganisms cause several diseases;

IV. Some diseases have variable signs and symptoms between patients;

V. Ethical considerations prohibit experiments when humans are the only host for a particular disease.

# Introduction to Microbial Taxonomy

- Taxonomy
  - science of biological classification
  - consists of three separate but interrelated parts
    - classification – arrangement of organisms into groups (taxa; s., taxon)
    - nomenclature – assignment of names to taxa
    - identification – determination of taxon to which an isolate belongs

**Carl Linnaeus** was a Swedish botanist, zoologist, taxonomist, and physician who formalized binomial nomenclature, the modern system of naming organisms. He is known as the "father of modern taxonomy".



## **Polyphasic Taxonomy**

- Used to determine the genus and species of a newly discovered prokaryote
- Incorporates information from genetic, phenotypic, and phylogenetic analysis

## **Phenetic Classification**

- Groups organisms together based on mutual similarity of phenotypes
- Can reveal evolutionary relationships, but not dependent on phylogenetic analysis

## **Phylogenetic Classification**

- Also called phyletic classification systems
- Phylogeny
  - evolutionary development of a species
- Usually based on direct comparison of genetic material and gene products

## **Genotypic Classification**

- Comparison of genetic similarity between organisms
  - individual genes or whole genomes can be compared
  - 70% homologous belong to the same species

# Taxonomic Ranks - 1

- Microbes are placed in hierarchical taxonomic levels with each level or rank sharing a common set of specific features
- Highest rank is domain
  - *Bacteria* and *Archaea* – microbes only
  - *Eukarya* – microbes and macroorganisms
- Within domain
  - phylum, class, order, family, genus, species epithet, some microbes have subspecies

# Techniques for Determining Microbial Taxonomy and Phylogeny

- Classical characteristics
  - morphological
  - physiological
  - biochemical
  - ecological
  - genetic

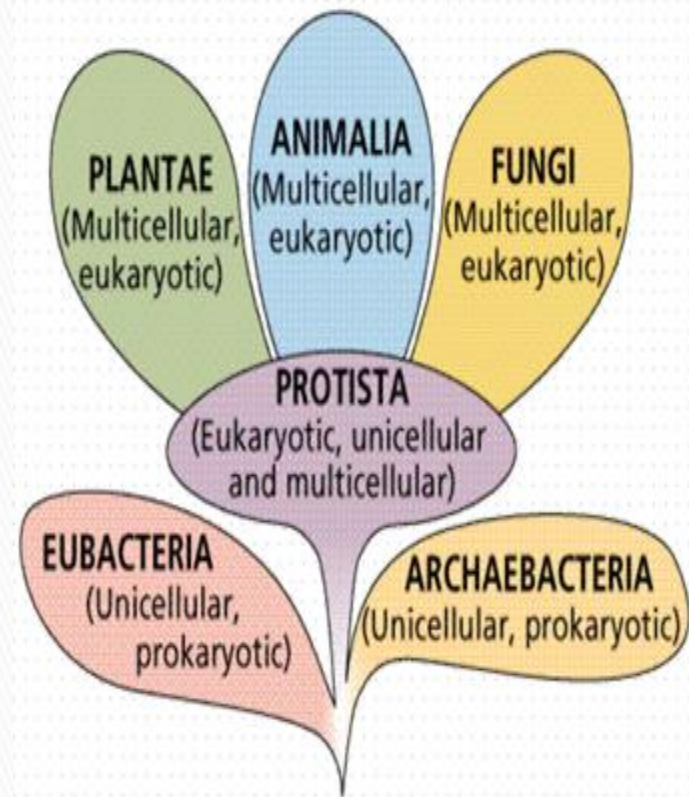
# Traditional Whittaker Classification

## Five Kingdoms

- Prokaryotae (Monera)
- Protista
- Fungae
- Plantae
- Animalia

## Based on:

- Morphology
- Metabolism (Biochemical Activity)
- Molecular Techniques
  - Fatty Acid Profiles
  - Protein Differentiation
  - DNA Finger Printing



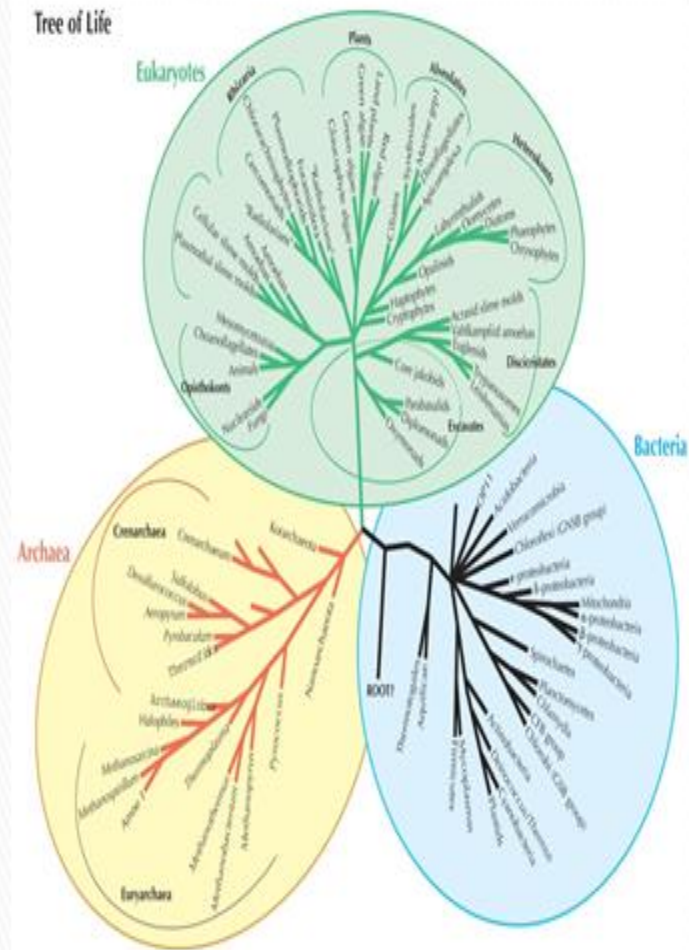
# Classification

Woese-Fox Classification

Three Super Kingdoms

Eubacteria  
Archaeobacteria  
Eukarya

System is based on rRNA.



## Some Morphological Features Used in Classification and Identification

Feature	Microbial Groups
Cell shape	All major groups <sup>1</sup>
Cell size	All major groups
Colonial morphology	All major groups
Ultrastructural characteristics	All major groups
Staining behavior	Bacteria, some fungi
Cilia and flagella	All major groups
Mechanism of motility	Gliding bacteria, spirochetes, protists
Endospore shape and location	Some Gram-positive bacteria
Spore morphology and location	Bacteria, protists, fungi
Cellular inclusions	All major groups
Colony color	All major groups

## **Ecological Characteristics**

- Life-cycle patterns
- Symbiotic relationships
- Ability to cause disease
- Habitat preferences
- Growth requirements

## **Molecular Characteristics**

- Nucleic acid base composition
- Nucleic acid hybridization
- Nucleic acid sequencing
- Genomic fingerprinting
- Amino acid sequencing



## ***Bergey's Manual of Systematic Bacteriology***

- Accepted system of bacterial taxonomy
  - Detailed work containing descriptions of all bacterial species currently identified
  - First edition published in 1984, with significantly updated editions since
- ◆ **Bergey's Manual:** Provides a reference for identifying and classifying bacteria.
- ◆ Classification initially based on cell morphology, staining, metabolism, biochemistry, serology, etc.
  - ◆ More recently, DNA, RNA, and protein sequence analysis are being used to study evolutionary relationships



Thank you...