

# Chapter 10 Identification and Classification of Prokaryotes

## Summary Outline

### 10.1. Taxonomy

- A. **Taxonomy** consists of three interrelated areas:
  1. **Identification**
  2. **Classification**
  3. **Nomenclature**
- B. **Identification** of prokaryotes
  1. **microscopic examination**
  2. **cultural characteristics**
  3. **biochemical tests**
  4. **nucleic acid**
  5. **patient's disease symptoms**
- C. Taxonomic categories in a hierarchical order include species, genus, order, class, division or phylum, kingdom and domain.

### 10.2. Using **phenotypic characteristics** to identify prokaryotes

- A. **Microscopic morphology**: **Size, shape, and staining** characteristics of a microorganism
  1. The **Gram stain** is a **differential stain** that distinguishes the Gram-positive and Gram-negative bacteria.
  2. Certain microorganisms have unique identifying characteristics that can be detected by using **special staining procedures**.
- B. **Metabolic differences**
  1. The use of **selective** and **differential**.
  2. Most **biochemical tests** rely on a pH indicator or chemical reaction that results in a color changer when a compound is degraded.
  3. Identification using biochemical tests relies on the use of a dichotomous key.
- C. **Serology**: The **proteins** and **polysaccharides** that make up a prokaryote are sometimes unique enough to be considered **identifying markers**.
- D. Fatty acid analysis: Cellular **fatty acid composition** can be used as an **identifying marker**.

### 10.3 Using **genotypic characteristics** to identify prokaryotes

- A. **Nucleic acid probes** to detect specific DNA sequences
- B. **Amplifying specific DNA** using the **polymerase chain reaction**
- C. **Sequencing ribosomal RNA genes**

### 10.4 Characterizing **strain differences**

- A. **Biochemical typing**: A strain that has a characteristic **biochemical variation** is called a **biovar** or **biotype**.
- B. **Serological typing**: A strain that differs **serologically** from other strains is called a **serovar** or **serotype**.
- C. **Genomic typing**: **Genomic differences** detected by probes
  1. **Different isolates** of the same species that have **different restriction fragment length polymorphisms (RFLPs)** are considered **different strains**. **RFLPs** can be detected by **pulsed-field gel electrophoresis** and by **ribotyping**.
- D. **Phage typing** based on the patterns of susceptibility to various types of **bacteriophage** can be used to demonstrate strain differences.
- E. **Antibiogram**: Antibiotic susceptibility patterns can be used to distinguish strains.

- 10.5 Difficulties in classifying prokaryotes: **Prokaryotes have few differences in size and shape and do not undergo sexual reproduction** so it is **difficult to determine their genetic relatedness**.
- 10.6 **Numerical taxonomy** relies on a battery of **phenotypic characteristics** and classifies bacteria based on their similarity coefficient.
- 10.7 Using **genotypic characteristics** to classify prokaryotes
- A. Based on the comparison of the **nucleotide sequence of the DNA** of different organisms.
  - B. **DNA base composition** usually expressed as the G + C content. If the G + C content of two organisms differs by more than a few percent, then they are not closely related.
  - C. **DNA hybridization**: The extent of nucleotide sequence similarity can be determined by measuring how completely single strands of their DNA will anneal to one another.
  - D. Comparing the **sequences of 16S ribosomal nucleic acid**