Chapter 10
Classification of Microorganisms

Taxonomy
- The science of classifying organisms
- Provides universal names for organisms
- Provides a reference for identifying organisms

Systematics, or Phylogeny
- The study of the evolutionary history of organisms
- All Species Inventory (2001–2025)
  - To identify all species of life on Earth

Of what value is taxonomy and systematics? 10-1
Why shouldn’t bacteria be placed in the plant kingdom? 10-2, 10-3
✓

Placing Bacteria
1735 Kingdoms Plantae and Animalia
1857 Bacteria and fungi put in the Kingdom Plantae – “Flora”
1866 Kingdom Protista proposed for bacteria, protozoa, algae, and fungi
1937 Prokaryote introduced for cells “without a nucleus”
1961 Prokaryote defined as cell in which nucleoplasm is not surrounded by a nuclear membrane
1959 Kingdom Fungi
1968 Kingdom Prokaryotae proposed
1978 Two types of prokaryotic cells found

The Three-Domain System

A Model of the Origin of Eukaryotes
Endosymbiotic Theory
Fossilized Prokaryotes
Fossilized Prokaryotes
Fossilized Prokaryotes
Phylogenetics
- Each species retains some characteristics of its ancestor
- Grouping organisms according to common properties implies that a group of organisms evolved from a common ancestor
  - Anatomy
  - Fossils
  - rRNA

What evidence supports classifying organisms into three domains? 10-4
✓ Compare Archaea and Bacteria; Bacteria and Eukarya; and Archaea and Eukarya. 10-5
✓
✓
✓
✓

15 Scientific Nomenclature
- Common names
  - Vary with languages
  - Vary with geography
- Binomial Nomenclature (genus + specific epithet)
  - Used worldwide
  - Escherichia coli
  - Homo sapiens

16 Scientific Names

17 Taxonomic Hierarchy
Domain
  Kingdom
  Phylum
  Class
  Order
  Family
  Genus
  Species

18 The Taxonomic Hierarchy
✓ Using Escherichia coli and Entamoeba coli as examples, explain why the genus name must always be written out for the first use. Why is binomial nomenclature preferable to the use of common names? 10-6
✓ Find the gram-positive bacteria Staphylococcus in Appendix F. To which bacteria is this genus most closely related: Gemella or Streptococcus? 10-7
✓
✓
✓

19 Classification of Prokaryotes
- Prokaryotic species: A population of cells with similar characteristics
  - Culture: Grown in laboratory media
  - Clone: Population of cells derived from a single cell
  - Strain: Genetically different cells within a clone

20 Phylogenetic Relationships of Prokaryotes

21 Classification of Eukaryotes
- Eukaryotic species: A group of closely related organisms that breed among themselves

22 Classification of Eukaryotes
- Animalia: Multicellular; no cell walls; chemoheterotrophic
- Plantae: Multicellular; cellulose cell walls; usually photoautotrophic
- Fungi: Chemoheterotrophic; unicellular or multicellular; cell walls of chitin; develop from spores or hyphal fragments
- Protista: A catchall kingdom for eukaryotic organisms that do not fit other kingdoms
  - Grouped into clades based on rRNA

24 Classification of Viruses

- Viral species: Population of viruses with similar characteristics that occupies a particular ecological niche

25

- Use the terms species, culture, clone, and strain in one sentence to describe growing methicillin-resistant *Staphylococcus aureus* (MRSA). 10-8
- Assume you discovered a new organism: it is multicellular, is nucleated, is heterotrophic, and has cell walls. To what kingdom does it belong? 10-9
- Write your own definition of protist. 10-10
- Why wouldn’t the definition of a viral species work for a bacterial species? 10-11

26 Classification and Identification

- Classification: Placing organisms in groups of related species. Lists of characteristics of known organisms.
- Identification: Matching characteristics of an “unknown” organism to lists of known organisms.
  - Clinical lab identification

27 Identifying Bacteria

28

- Identifying *Klebsiella* doesn’t tell you it’s classified as gammaproteobacteria

29

- What is in *Bergey’s Manual*? 10-13

30 Identification Methods

- Morphological characteristics: Useful for identifying eukaryotes
- Differential staining: Gram staining, acid-fast staining
- Biochemical tests: Determines presence of bacterial enzymes

31 Identifying a Gram – Negative, Oxidase – Negative Rod

32 Numerical Identification
✓ Design a rapid test for a *Staphylococcus aureus*. 10-14

Serology
- Combine known antiserum plus unknown bacterium
- Slide agglutination test

ELISA
- Enzyme-linked immunosorbent assay
- Known antibodies
- Unknown type of bacterium
- Antibodies linked to enzyme
- Enzyme substrate

The Western Blot: Uses Proteins Vs DNA

Phage Typing of *Salmonella enterica*

Flow Cytometry
- Uses differences in electrical conductivity between species
- Fluorescence of some species
- Cells selectively stained with antibody plus fluorescent dye

Genetics
- DNA base composition
  - Guanine + cytosine moles% (GC)
- DNA fingerprinting
  - Electrophoresis of restriction enzyme digests
- rRNA sequencing
- Polymerase chain reaction (PCR)

Nucleic Acid Hybridization

A DNA Probe Used to Identify Bacteria

DNA Chip Technology

DNA Chip Technology

FISH
- Fluorescent in situ hybridization
  - Add DNA probe for *S. aureus*

Dichotomous Key

Dichotomous Key

Building a Cladogram

Building a Cladogram
Building a Cladogram

- What is tested in Western blotting and Southern blotting? 10-15
- What is identified by phage typing? 10-16
- Why does PCR identify a microbe? 10-17
- Which techniques involve nucleic acid hybridization? 10-18
- Is a cladogram used for identification or classification? 10-12, 10-19