1. **Chapter 10**

   Classification of Microorganisms

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

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

4.
   - ✓ Of what value is taxonomy and systematics? 10-1
   - ✓ Why shouldn't bacteria be placed in the plant kingdom? 10-2, 10-3
   - ✓

5. **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

6. **The Three-Domain System**

7.

8. **A Model of the Origin of Eukaryotes**

9. **Endosymbiotic Theory**

10. **Fossilized Prokaryotes**

11. **Fossilized Prokaryotes**

12. **Fossilized Prokaryotes**

13. **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

14.
   - ✓ 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**

19 ◼

✓ 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
✓
✓
✓
✓

20 ◼ **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

21 ◼ **Phylogenetic Relationships of Prokaryotes**

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

23 ◼ **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

33 ▪

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

34 ▢ Serology

- Combine known antiserum plus unknown bacterium
- Slide agglutination test

35 ▢ ELISA

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

36 ▢ The Western Blot: Uses Proteins Vs DNA

37 ▢ Phage Typing of *Salmonella enterica*

38 ▢ Flow Cytometry

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

39 ▢ Genetics

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

40 ▢ Nucleic Acid Hybridization

41 ▢ A DNA Probe Used to Identify Bacteria

42 ▢ DNA Chip Technology

43 ▢ DNA Chip Technology

44 ▢ FISH

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

45 ▢ Dichotomous Key

46 ▢ Dichotomous Key

47 ▢ Building a Cladogram

48 ▢ Building a Cladogram

49 ◻ **Building a Cladogram**

50 ◻

✓ 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