

Microbiology  
Bacteria, Protists, and Fungi  
Ex 23 – 26

- I. Introduction – **Taxonomy** = Science of classification
- a. Classification categories:  
**Domain** ↗ **Kingdom** ↗ **Phylum** ↗ **Class** ↗ **Order** ↗ **Family** ↗  
**Genus** ↗ **Species**
  - b. Dear King Philip Come Over For Good Soup.
  - c. Scientific name ↗ *Genus species*
  - d. **Three Domains**
    - i. Domain Archaea
    - ii. Domain Bacteria
    - iii. Domain Eukarya
- II. **Domain Archaea** ↗ Inhabit in hostile conditions.
- a. Prokaryotic
  - b. Examples are thermophiles, halophiles, etc
  - c. When scientists found these creatures they were so excited about them. ↗ Why?
  - d. Little known ↗ Why?
  - e. Have you heard about the Polymerase Chain Reaction (PCR)? ↗ A DNA replication method in lab ↗ An enzyme used for PCR is extracted from thermophiles.
- III. **Domain Bacteria**
- a. Prokaryotic
  - b. Unicellular
  - c. **Eubacteria** – Regular bacteria
    - i. Usually very small – less than 1 μm.
    - ii. Asexual reproduction via fission
    - iii. Other ways of reproduction – Bacterial conjugation, endospore, transposon, etc.
    - iv. Two major classifications
    - v. Shape – Coccus (spherical), Bacillus (rod), and Spirillum (spiral)
    - vi. Gram Stain – Special staining method to distinguish bacteria into two groups via structure of cell walls. (Gram-positive and Gram-negative bacteria)
      1. Gram<sup>+</sup>: Purple (violet)
      2. Gram<sup>-</sup>: Pink
        - a. Penicillin inhibits cell wall formation of Gram<sup>+</sup>.
      3. On the exam, your task is to ID bacteria based on shape and type of bacteria via Gram stain.

- vii. **Antibiotics** – Biological chemical compounds that inhibit growth of or destroy bacterial cells. ⚡ They won't do anything to prokaryotic cells!
  - viii. Activities:
    1. Look at three shaped bacteria and Gram stained bacteria.
    2. Make a bacterial plate
    3. Look for bacteria in normal life. (at home)
- d. **Cyanobacteria** – Photosynthetic algae like prokaryotes
- i. Common name = blue-green algae
  - ii. No chloroplast
  - iii. Possess chlorophyll-a, and photosynthetic membrane for photosynthesis.
  - iv. Activity:
    1. Observe *Oscillatoria* and *Gleocapsa* under microscope
- e. **Nitrogen fixing bacteria**
- i. Atmospheric N is unavailable to plants and algae ⚡ Nitrogen is often the limit factor.
  - ii. Some bacteria and cyanobacteria can convert atmospheric Nitrogen into usable form of nitrogen
  - iii. Why they are important?
  - iv. Activity – observe root nodules
- IV. **Domain Eukarya** – Eukaryotic cells
- a. Uni- or multi cellular
  - b. Possess membrane bound organelles and organized nucleus
  - c. May be autotrophic, saprotrophic, or heterotrophic
  - d. **Kingdoms**:
    - i. Protista
    - ii. Fungi
    - iii. Plantae
    - iv. Animal
- V. **Kingdom Protista** - Eukaryotic cells, but no definitive characteristics to be animals, plants, or fungi. ⚡ Often called xxx-like protests.
- a. Algae ⚡ Plants like protests
  - b. Protozoans ⚡ animal like protests
  - c. Slime molds ⚡ Fungi like protests
- VI. **Algae (plant like protests)**
- a. Autotrophic
  - b. Classified by colors/ pigments
  - c. **Phylum Chlorophyta** (green algae)

- i. May be ancestral to the first plant b/c both have:
  1. Chlorophyll a and b
  2. Store reserve food as starch
  3. Cellulose based cell walls
- ii. Representatives:
  1. *Spirogyra* – filamentous freshwater algae. Often called “pond scum.”
  2. *Volvox* – colonial green algae, capable of movement via flagella
    - a. Both sexual and asexual reproduction
      - i. Sperm and eggs ≠ sexual
      - ii. Daughter colony ≠ asexual
- iii. Activity – Observe *Spirogyra* and *Volvox* under microscope

**d. Phylum Phaeophyta (Brown algae)**

- i. Brown color via accessory pigment fucoxanthin
- ii. Algin – makes ice cream, cosmetics smooth texture
- iii. Representatives:
  1. Sea weeds (sea kelps), *Fucus*
- iv. Activity:
  1. Eat sea weed
  2. Look at sea weeds
  3. Observe *Fucus*

**e. Phylum Rhodophyta (Red Algae)**

- i. Agar – solidifying agent
  1. Medium for microorganism cultivation
  2. Vegetarian jello ≠ Have you had Chinese almond pudding?

**f. Phylum Bacillariophyta (Diatoms)**

- i. Silica based cell wall
- ii. Many different shapes
- iii. Used to filters and natural insecticides
- iv. Activity – Observe Diatoms

**VII. Protozoans (Animal like protists)**

- a. Unicellular
- b. Heterotrophic – Ingest food via food vacuoles
- c. Classified by mode of locomotion
- d. **Phylum Rhizopoda (Amoebas)**
  - i. Move via pseudopodia = false foot
  - ii. Can be pathogenic
    1. Amoebic dysentery – infected via ingesting water
    2. Amoebic meningitis – infection via ingesting water

## 3. Activity – observe amoeba

- e. **Phylum Ciliophora** (ciliated)
    - i. Relatively large cells covered with cilia = mode of locomotion
    - ii. Representative and activity – observe *Paramecium*.
  - f. **Phylum Zoomastigophora** (flagellated)
    - i. Flagella for locomotion
    - ii. Smaller than ciliated protozoans bigger than non-motile.
    - iii. Representatives and importance:
      - 1. *Trichomonas vaginalis* (STD)
      - 2. *Trypanozoma* – African sleeping sickness
      - 3. Giardiasis – from drinking contaminated water
    - iv. Activities
      - 1. Observe *Trypanozoma* w/ blood smear.
  - g. **Phylum Apicomplexa** (non-motile/ Sporozoans)
    - i. Non-motile
    - ii. Very small
    - iii. Some cause malaria through mosquito bite.
    - iv. Activity
      - 1. Observe *Plasmodium* (malaria) infected blood smear.
      - 2. Compare w/ *Trypanozoma* b/c you got to recognize them on the exam.
- VIII. **Slime molds & Water molds** (fungi like protists)
- a. **Slime molds**
    - i. Possess both animal and plant like characteristics
      - 1. Engulf their food and no cell walls during non-reproductive state
      - 2. produce spores and develop cell walls during reproductive state.
  - b. **Water molds**
    - i. Plant pathogens
    - ii. ex. *Phytophthora infestans* caused the late blight of potato in Ireland from 1845 – 1847. The disease wiped out potato plants and let many people starved to death or emigrated to the US.
  - c. Activities – observe slime mold on a late (demo).

IX. **Kingdom of Fungi**

- a. Primary multicellular
- b. Fungi are heterotrophic by absorption.
- c. Fungi are important decomposers, parasites, and foodstuffs

- d. Terminology
  - i. Mycellium – body portion of fungi, composed with many strands.
  - ii. Hyphae – single strand of filament. Some hypha have cell walls, and some don't.
  - iii. Spores – small haploid bodies with protective covering when they produced sexually or asexually.
  - iv. Fruiting body – collection of specialized hyphae following sexual union found in some fungi groups. The fruiting bodies produce and release spores.
- e. Classification – differences in their life cycles and their sexual reproductive structures.
- f. Phylum Zygomycota (bread, soil, and dung fungi)
  - i. Produce a thick-walled zygote called a zygosporangium.
  - ii. Reproduction
    - 1. Asexual – Release a sporangia
      - a. When would it be beneficial to reproduce asexually?
    - 2. Sexually – Two different mycelia grow close together. As mycelia grow close, gametangia are produced at their tips. When two gametangia meet, cell wall between two will dissolve and cytoplasm mix resulting in a zygospore.
  - iii. Representative – *Rhizopus* – common black bread mold
  - iv. Activities – observe *Rhizopus*.
- g. Phylum Ascomycota (Sac fungi)
  - i. Ex. Wood-decaying fungi, yeast, morels, cup fungi, truffles, mildews, etc.
  - ii. Asexual
    - 1. Via mitosis and cell division, or budding
    - 2. Asexual spore – conidia
      - a. *Yeast*
  - iii. Sexual
    - 1. Production of spores in sac, known as ascus.
    - 2. The top of cup-fungi is actually the fruiting body
  - iv. Activity – observe cup fungi *Peziza*.
- h. Phylum Basidiomycota (club fungi)
  - i. Ex. Mushrooms, puffballs, bracket and shelf fungi, rust and smuts.
  - ii. Terminology
    - 1. Stalk – upright portion that supports the cup
    - 2. Annulus – membrane surrounding the stalk where immature mushroom was attached
    - 3. cap – umbrella shaped portion
    - 4. gills – located on the underside of the cap – house the basidia

5. basidia – club-shaped structures that house the basidiospores
6. basidiospores – spores
- iii. Activity – observe *Coprinus* and other mushrooms
- i. Phylum Deuteromyota (fungi imperfect)
  - i. Ex. Athlete's foot, ringworm, candidiasis, *Penicillum*, *Aspergillus*.
  - ii. No means of sexual reproduction
  - iii. Asexual reproduction
    1. Produce spores called conidia and upright hyphae known as conidiophores
  - iv. Biochemistry and cell structures indicate that these fungi are sac fungi which lost ability to reproduce sexually.
  - v. Activity
    1. Observe *Penicillum* – produce penicillin
    2. Observe *Aspergillus* – used to produce soy sauce and chewing gum.
- j. Lichens
  - i. Symbiotic organisms between photosynthetic organisms (algae or cyanobacteria) and fungi
    1. Algae (cyanobacteria) – feed fungi
    2. Fungi – provide moist protected housing
  - ii. Via Shapes lichens are classified into three groups
    1. Crustose
    2. Foliose
    3. Fruticose
  - iii. Lichen and air quality