Lecture: Bacteria **Ch. 11**

Overview of Bacterial Groups

Group	Gram Rxn	Characteristics	Examples
Spirochetes	--	helical (flexible spirals), motile, axial filaments (endoflagella), some pathogens	*Treponema pallidum* *Borrelia burgerdoferi*
Aerobic/Microaerophilic Spirals	--	helical or curved (rigid spirals), motile, flagella, some pathogens	*Campylobacter* *Helicobacter pylori* *Azospirillum*
Aerobic Rods/Cocci	--	important medically, environmentally, industrially	*Pseudomonas Legionella, Neisseria, Rhizobium, Agrobacterium*
Facultatively Anaerobic Rods	--	important pathogens, motile and nonmotile	*E. coli, Salmonella, Shigella, Klebsiella, Yersinia, Vibrio chlorae, Serratia, Proteus, Enterobacter*
Rickettsias and Chlamydias	--	obligate intracellular	*Rickettsia rickettsii* *Chlamydia trachomatis,* *C. psittaci*
Mycoplasmas	--	lack cell walls, pleomorphic	*M. pneumoniae*
Gram Positive Cocci	+	important pathogens	Staph and Strep
Endospore-Forming Rods and Cocci	+	endospores, aerobic, facultative anaerobic and strict anaerobes	*Bacillus sp., Clostridium sp. (tetani, perfringens, botulinum)*
Regular Nonsporing Rods	+	no endospores, important flora, commercial	*Lactobacillus acidophilus*
Irregular Nonsporing Rods	+	pleomorphic, some pathogens	*Corynebacterium sp. (diphtheriae, xerosis), Proprionibacterium acnes*
Mycobacteria	+, not easy to gram stain	thick waxy CW, acid fast, slow growing, antimicrobials hard to get in, pathogens	*Mycobacterum tuberculosis, M. leprae, M. phlei*
Appendaged Bacteria	--	stalk (prostheca), unusual binary fission: stalked cell $\rightarrow$ nonmotile stalked cell + motile flagellated swarmer cell	*Caulobacter*
Chemoautotrophic Bacteria	--	important environmental flora, soil,	*Nitrosomonas, Nitrobacter,*

		water, nitrifying bacteria ($NH_4^+ \rightarrow NO_2^- \rightarrow NO_3^-$)	*Nitrococcus*
Archaea	varies	bizarre, extremophiles, CW lack peptidoglycan	
Anoxygenic Phototrophic Bacteria	--	photosynthetic but do not produce oxygen; some use H_2S, others use organic acids and carbohydrates	purple and green sulfur bacteria, purple and green nonsulfur bacteria, *Rhodospirillum rubrum*
Oxygenic Phototrophic Bacteria	--	produce oxygen, some fix nitrogen	cyanobacteria (blue-green algae)

Human Pathogen

- *Neisseria*
  - Chemoheterotrophic, Gram (-) cocci
  - *N. meningitidis*
  - *N. gonorrhoeae*

- Vibrionales
  - Found in coastal water
    - *Vibrio cholerae* causes cholera
    - *V. parahaemolyticus* causes gastroenteritis

- *Campylobacter*
  - One polar flagellum
  - Gastroenteritis (food poisoning)

- *Helicobacter*
  - Multiple flagella
  - Peptic ulcers
  - Stomach cancer

Enterics (Enterobacteriaceae)

- gram (-) rods
- facultative anaerobes
- medically important pathogens
- inhabit intestines of humans and animals
- motile and non-motile - can be variable within a species
- many produce bacteriocins - proteins that kill other related species
- many produce toxins - exotoxins = produce disease symptoms
- some ferment lactose, some don't - important for ID for contamination
- examples:
    - *Enterobacter* - UTI
    - *E. coli* - normal flora
        - 0157:H7 - produces potent enterotoxin (exotoxin)
    - *Klebsiella* - pneumonia
    - *Proteus* - UTI, wound infections
    - *Salmonella* - salmonellosis, typhoid fever, food poisoning
    - *Serratia*
        - nosocomial urinary tract infections (UTI), respiratory tract infections (RTI)
    - *Shigella*
        - dysentery / shigellosis
        - shiga toxin (enterotoxin)

    - *Yersinia pestis* - plague (flea vector)

Bacterial Predator

Bdellovibrio: Prey on other bacteria

Clostridiales

- *Clostridium*
    - Endospore-producing
    - Obligate anaerobes
    - Gram (+) rod

Gram (+) Cocci

- *Staphylococcus* and *Streptococcus* medically important
- *Staph. aureus*
    - nosocomial infections
    - antibiotic resistance
    - toxins including enterotoxins $\rightarrow$ food poisoning

- *Streptococcus*
    - nosocomial infections
    - cause many diseases - sore throat, scarlet fever, pneumonia, "flesh eating strep"
    - produces toxins - hemolysins
        - worst is β-hemolysin - lyses RBCs
    - antibiotic resistance

Mycoplasmatales

- Wall-less, pleomorphic
- 0.1 - 0.24 µm (small!)
- *M. pneumoniae*

Chlamydias

- *Chlamydia trachomatis*
  - Trachoma
  - STD, urethritis

Spirochaetes

- *Borrelia* – Lyme disease
- *Treponema* - Syphilis

Microbial Diversity

- Bacteria size range
  - *Thiomargarita* (750 µm)
  - Nanobacteria (0.02 µm) in rocks
  - *Epulopiscium*
    - Huge bacterium
    - ~500 µm long! (= bigger than a Paramecium)

- PCR indicates up to 10,000 bacteria/gm of soil. Many bacteria have not been identified or characterized because they
  - Haven't been cultured
  - Need special nutrients
  - Are a part of complex food chains requiring the products of other bacteria
  - Need to be cultured to understand their metabolism and ecological role

Domain Archaea

- Hyperthermophiles
  - *Pyrodictium*
  - *Sulfolobus*

- Methanogens
  - *Methanobacterium*

- Extreme halophiles
  - *Halobacterium*

- Extremophiles live in
  - High pressure
  - High temperature
  - Inhospitable environments

Study Objectives

1. Emphasize underlined items in chart including diseases associated with those organisms.

2. Describe major characteristics of the enterics.

3. List and describe the major gram (-) rods and the diseases/conditions they cause.

4. List and describe the major characteristics of *Staphylococus* and *Streptococcus.*