

Phylum Actinobacteria

- Form associations with plants
- **Nodules**- structures on plant that are growth on roots filled with bacteria
- Symbiotic relationship- mutualism (+,+)
 - Bacteria growing in these nodules gain carbon and structure for colonization → enhances growth and reproductive rates
 - Plant benefits → actinobacteria are N-fixers (convert N₂ to ammonia) which is a great fertilizer for the plant → increases plant growth and reproduction
- Common in dental plaque
 - Form biofilms- matrix of polysaccharides with aggregated bacteria, archaea, fungi, algae, and viruses
- Many actinobacteria produce antifungal/antibacterial compounds
 - Very energy expensive to make, however, they can greatly decrease competition for food/space

Gram Negative Bacteria

Phylum Spirochaete

- Helical shaped (spiral/corkscrew) cells
- They live in aquatic environments (blood too)

Example: Treponema → Syphilis

Example: Barrelia Burgdorferi → Lyme disease- blood pathogen spread through the very tiny deer tick

Cycle: High rain → increases plant growth → increases oak tree growth → increased acorns → deer and mice benefit and increase → more hosts → more ticks → increased contact with other organisms (humans)

Ticks are the *reservoir species*

Phylum Cyanobacteria

Example: Microcystis

- Toxin = microcystin
- Blue-green algae- but they are not algae
- Bloom- forming carpet across water
- Photo autotrophs - use sunlight (energy) and inorganic carbon (CO₂ = used for growth)
- N- fixers → atmospheric N₂ → NH₄ (ammonia)
 - Fertilizing photosynthetic eukaryotes (algae, diatoms) directly benefit

This is not a big deal in North America but other places where they rely on a lake can be stressed.

Phylum Proteobacteria

- Largest, most diverse bacterial phylum
- Found everywhere
- Alpha negative, beta negative, epsilon negative, gamma negative
 - Grouping based upon physiological characteristics (metabolism or environmental tolerances like temperature and moisture)

Escherichia coli (E. coli)

- Found in mammalian guts (gastrointestinal tracts)
- Critical to effective digestion
- Mutualist symbiote (+,+)
- Common in feces (sewage too)
 - Fecal coliform can be dangerous
 - Has gone from mutualist (+,+) to potential pathogen (+,-)
- Many different strains
 - Each has unique characteristics coded by unique gene sequences
 - Helpful gut-bacteria (+) → *E. coli* O157:H7 (-) (pathogen)

Wolbachia species (still proteobacteria)

- A heritable bacteria
- Intracellular bacteria (lives inside cells) → very similar to mitochondria
- “MALE-KILLER”
- Found only in insects → Reproductive cells
- 25% - 30% of all insects carry it
- Mechanisms of removing males (resulting in an all-female species)
 - Kills males in utero (before birth)
 - Feminize males
 - 1) Sterilize male so they act as pseudo-female → behavioral changes
 - 2) Become true females → act and breed like females

How do they reproduce without males?

- Parthenogenesis (virgin birth)
 - No genetic input from male
 - Produce clones of female

Helicobacter pylori → epsilon proteobacteria

- Found in gastrointestinal tracts
- Thrives in stomach acid through burrowing into stomach lining
- Causes gastritis, stomach ulcers → leads to stomach cancer
- Barry Marshall → Australian scientist fascinated by ulcers → looked at biopsies and saw bacteria but nobody believed him so he drank a strain of the bacteria and ultimately got stomach ulcers which proved his idea to be true

Yersinia pestis → Gamma proteobacteria

- 5-30 million killed by this
- "Black Plague" "Black Death" "Bubonic Plague"
- Rat → increase chance of humans getting the disease
- Flea → feed on rats (infected with *Y.p.*)
 - This disease blocks the flea's digestive tract so the flea isn't getting nutrients from feeding → increases bite rates → increases spread of *Y.p.* → plague conditions → death
- Now → treated with antibiotics
- Maybe the disease selected for people who were resistant to the disease since everyone had the opportunity to be bitten

End of Lecture