Section 1: Bacteria

MAINIDEA

Prokaryotes are diverse organisms that live in nearly all environments.

K *What I Know*	**W** *What I Want to Find Out*	**L** *What I Learned*

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Essential Questions

- What are the differences between archaea and bacteria and their subcategories?
- What are the survival methods of bacteria at both the individual and population levels?
- How are bacteria beneficial to humans?

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Vocabulary

Review

- prokaryotic cell

New

- bacteria
- nucleoid
- capsule
- pilus
- binary fission
- conjugation
- endospore

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Diversity of Prokaryotes

- Prokaryotes are divided into two domains: Bacteria and Archaea.
- Bacteria (eubacteria) belong to Domain Bacteria, exist in nearly every environment on Earth, important to human body, industry, and food production.
- Archaea tolerate extreme environments, have similar proteins to eukaryotic cells.

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Diversity of Prokaryotes

Bacteria

- Cell walls contain peptidoglycan
- Some have second cell walls
- Some are photosynthetic

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Diversity of Prokaryotes

Archaea

- Predominate in extreme environments
- Mostly anaerobic, cannot tolerate oxygen
- Include halophiles (salt-loving), methanogens (use CO_2 and give off methane), and thermoacidophiles (high temperature, low pH).

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Bacteria

BrainPOP

FPO

Add link to BrainPOP from page 517 here.

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Diversity of Prokaryotes

Differences between bacteria and archaea

- Different cell wall proteins
- Different lipids in plasma membrane
- Different ribosomal proteins an RNA
- Archaea ribosomal proteins resemble eukaryotic ribosomal proteins.

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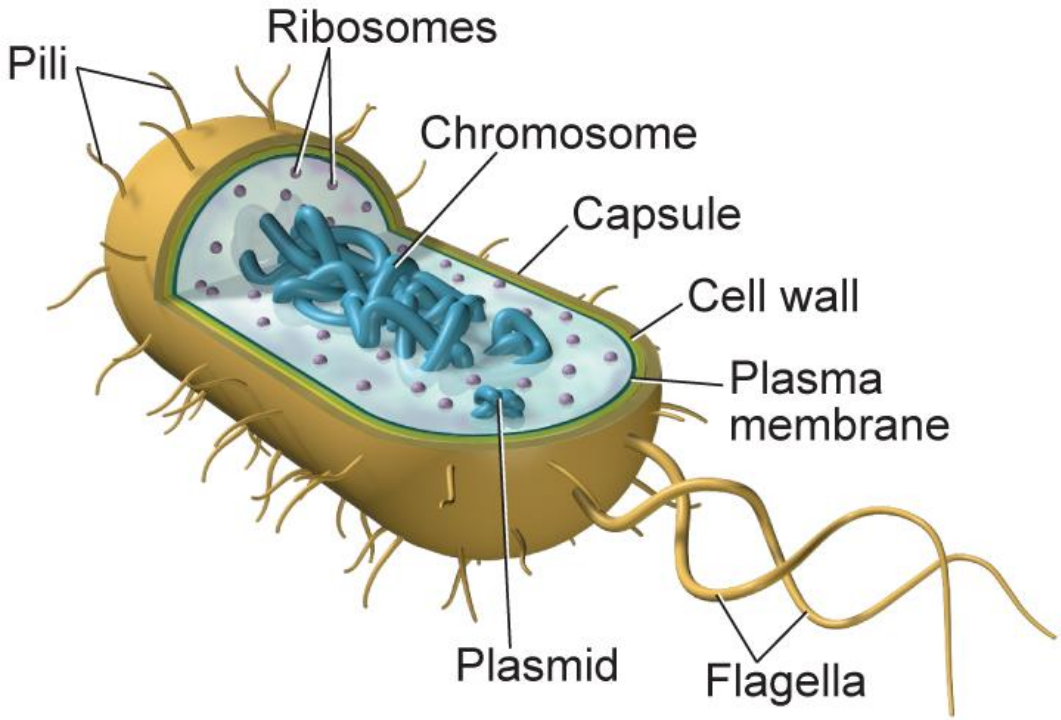
Prokaryote Structure

- Prokaryotes are microscopic, unicellular organisms.
- They have some characteristics of all cells, such as DNA and ribosomes.
- Lack a nuclear membrane and other membrane-bound organelles



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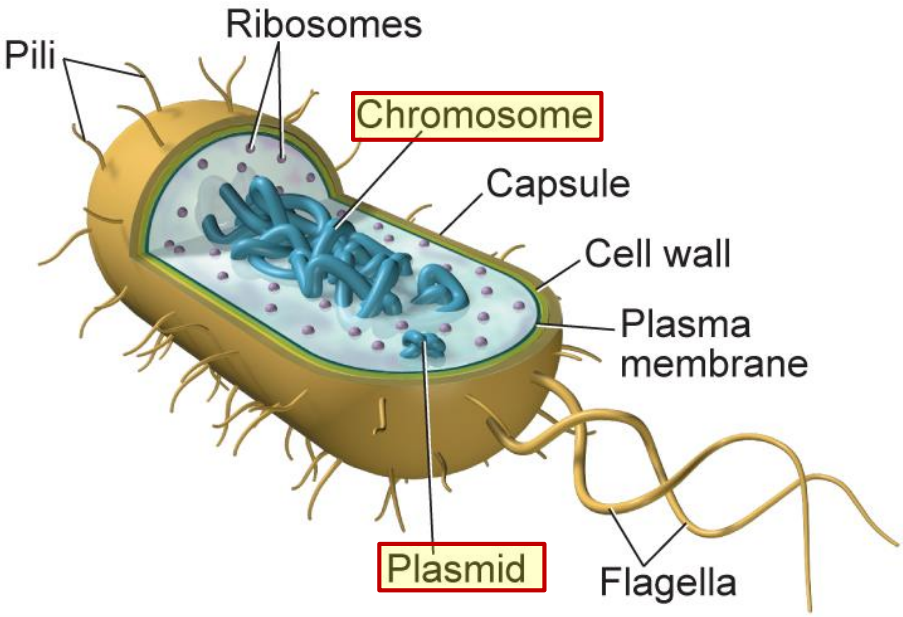
Prokaryote Structure

Chromosomes

- Have a long, circular chromosome found in the nucleoid.
- Usually have at least one smaller piece of DNA called a plasmid, which is also circular



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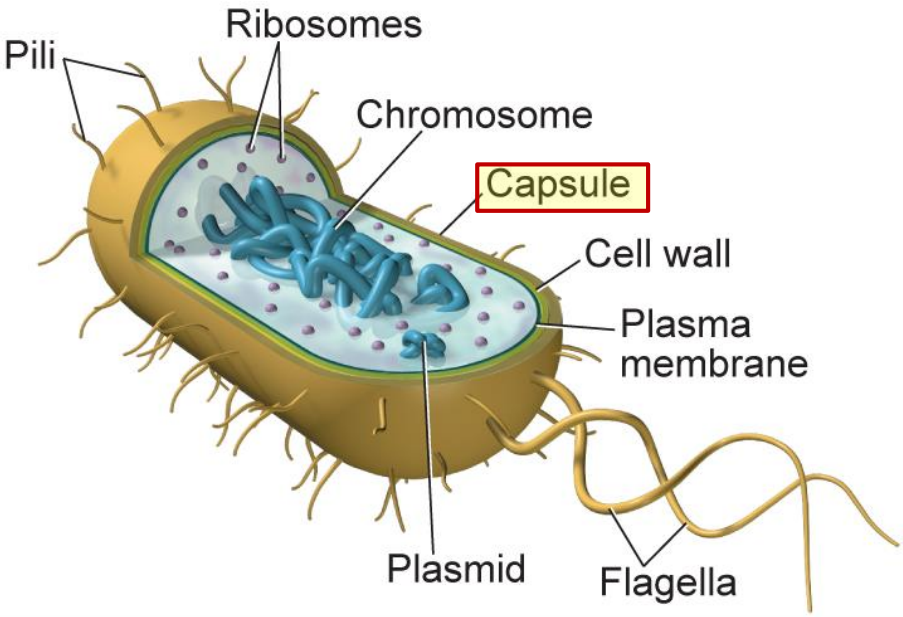
Prokaryote Structure

Capsule

- Some prokaryotes secrete a layer of polysaccharides around the cell well, forming the capsule.
- Prevents cell dehydration, helps with attachment to surfaces, protects from antibiotics



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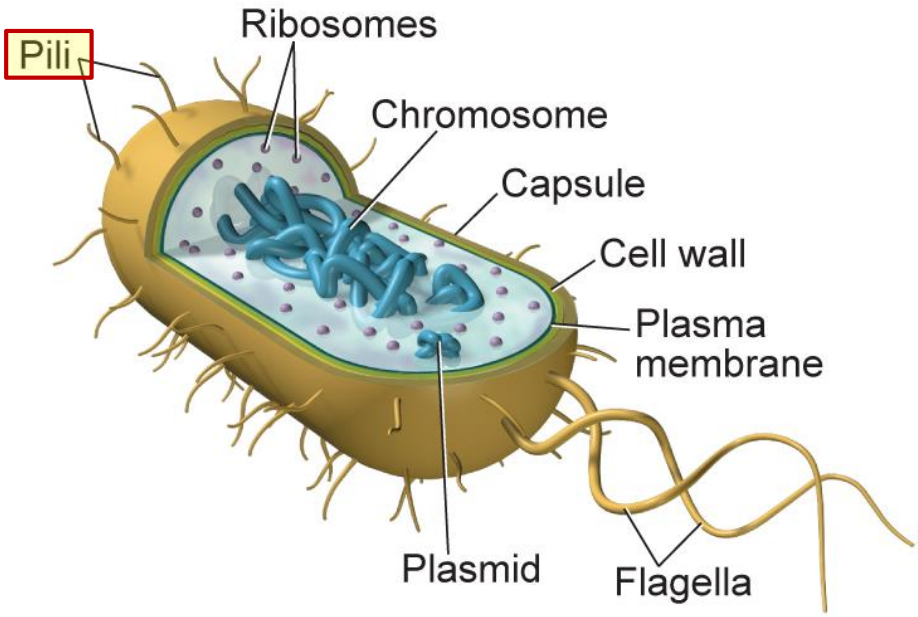
Prokaryote Structure

Pili

- A pilus is a submicroscopic hairlike structures made of protein.
- Pili help cells attach to surfaces, serve as bridges between cells to send plasmids to each other.



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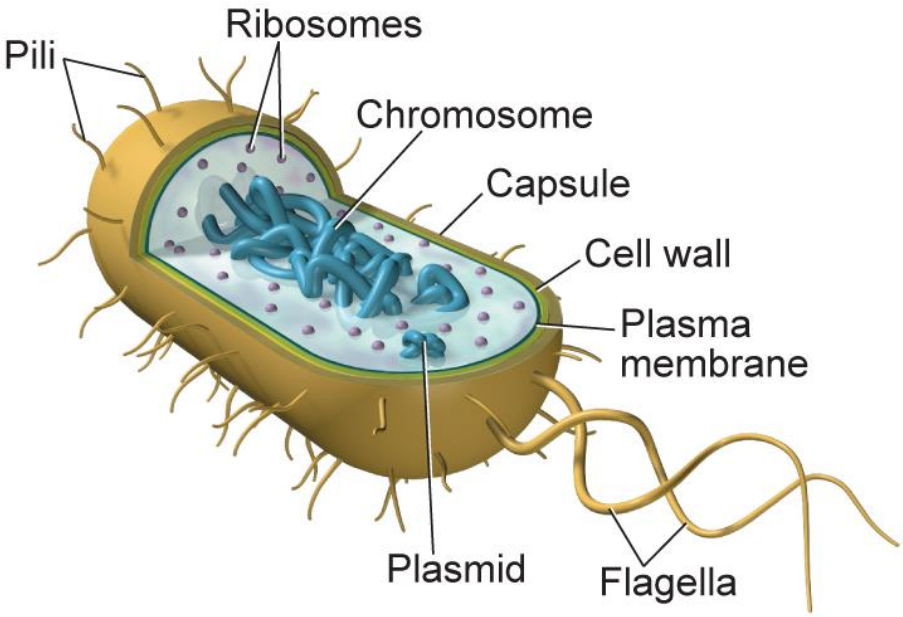
Prokaryote Structure

Size

- Typically only 1-10 micrometers long and 0.7 to 1.5 micrometers wide
- Small size makes nutrient diffusion easy



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Prokaryote Characteristics

Shape

- Cocci (spherical or round)
- Bacilli (rod-shaped)
- Spirilli (spiral-shaped)

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Prokaryote Characteristics

Cell walls

- Scientists classify bacteria based on the composition of their cell walls.
- All bacterial cells have peptidoglycan in their cell walls.
- Gram staining is a common procedure for identifying main kinds of bacteria.
  - Bacteria with large amounts of peptidoglycan appear purple when stained; Gram-positive.
  - Bacteria with lipid layers have less peptidoglycan and appear pink when stained; Gram-negative.
  - Important for antibiotic treatment

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Prokaryote Characteristics

Movement

- Some prokaryotes are stationary, others move with flagella.
- Flagella help prokaryotes to move toward materials that they need to survive – light, oxygen, chemicals.
- Other prokaryotes move by gliding over a layer of secreted slime.

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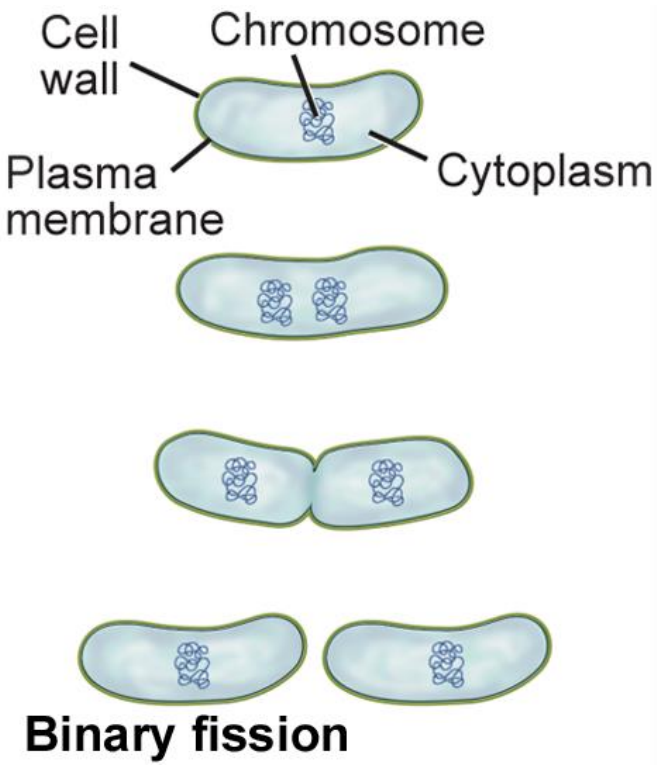
Reproduction of Prokaryotes

- Binary Fission is the asexual division of one cell into two identical cells.
- In conjugation, two prokaryotes attach to each other and exchange genetic information



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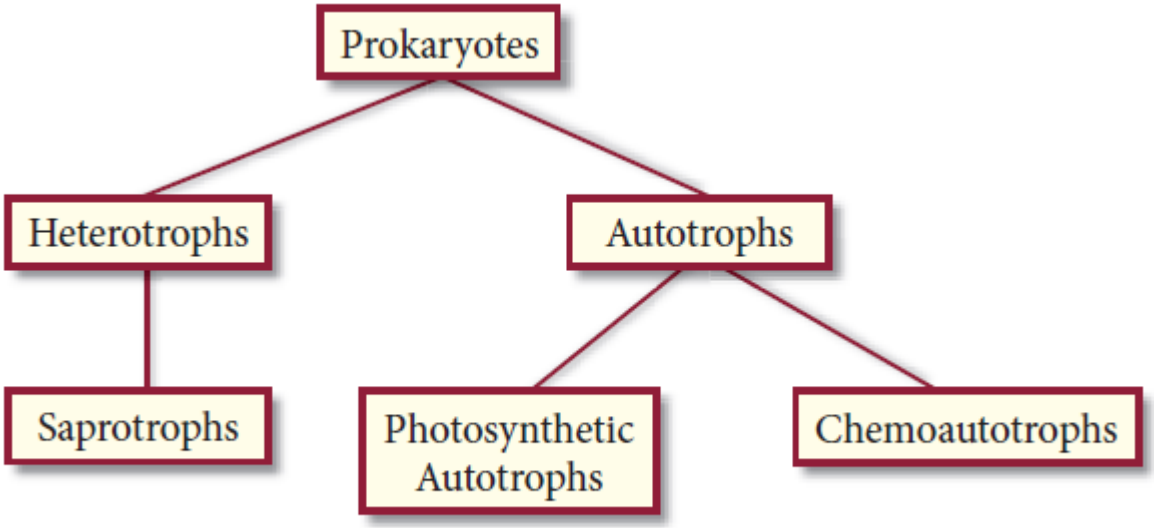
Metabolism of Prokaryotes

- Obligate anaerobes cannot live or grow in the presence of oxygen, and only obtain energy through fermentation.
- Facultative anaerobes can grow with or without oxygen.
- Obligate aerobes require oxygen.
- Prokaryotes also classified by how they obtain energy for cellular respiration or fermentation



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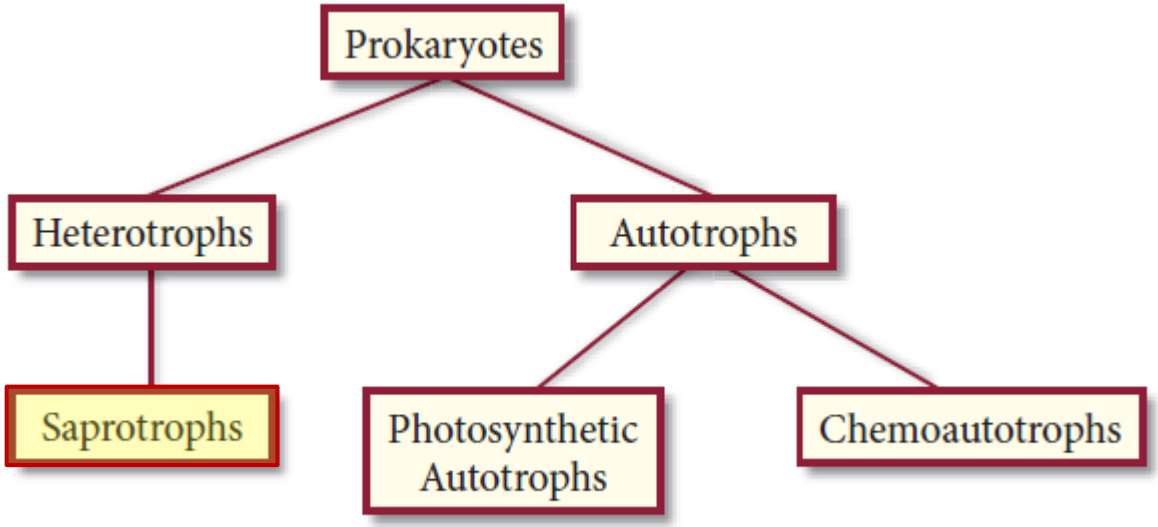
Metabolism of Prokaryotes

Heterotrophs

- Cannot synthesize their own food, must take in nutrients
- Many heterotrophic prokaryotes are saprotrophs – they decompose organic material associated with dead organisms or waste.



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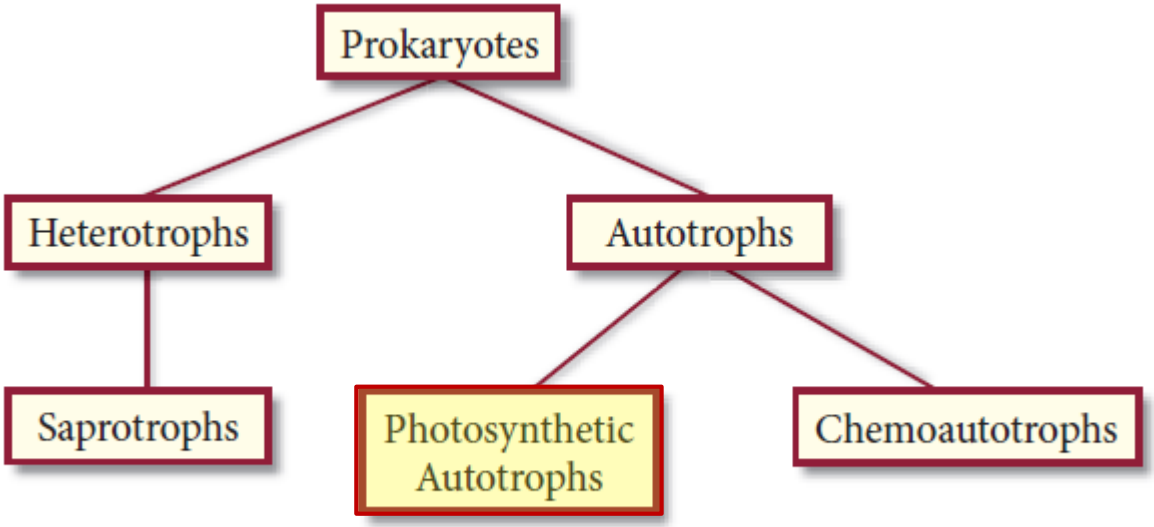
Metabolism of Prokaryotes

Photoautotrophs

- Photosynthetic autotrophs, or photoautotrophs, gain energy through photosynthesis.
- Photosynthetic bacteria are often cyanobacteria, an important food chain component.



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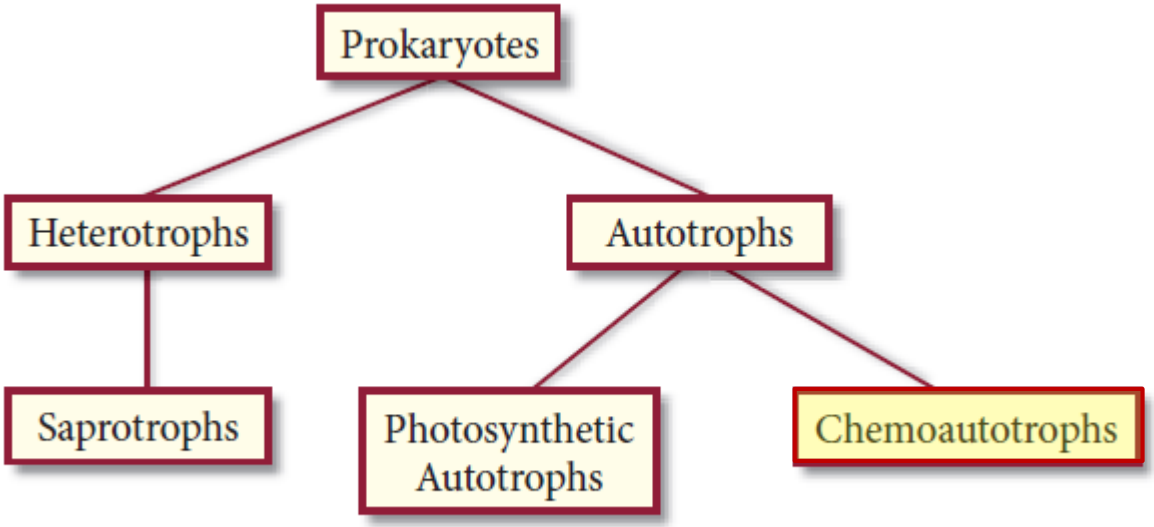
Metabolism of Prokaryotes

Chemoautotrophs

- Break down and release inorganic compounds that contain nitrogen or sulfur
- Important in cycling inorganic compounds, such as nitrogen, through ecosystems



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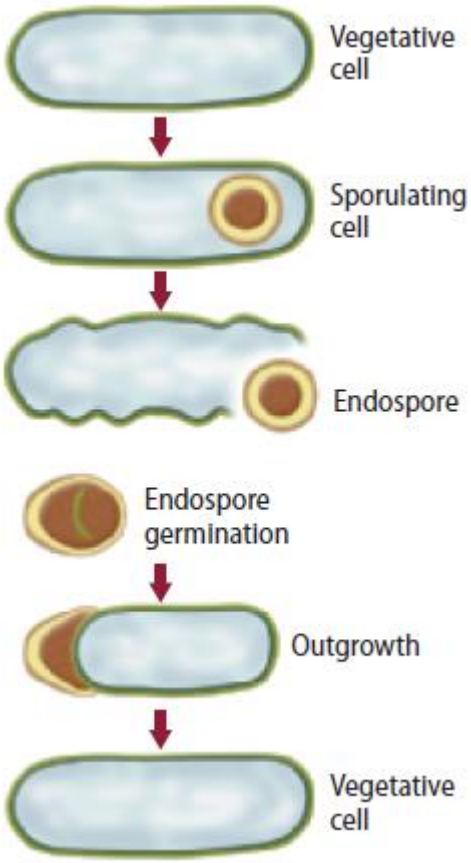
Survival of Bacteria

Endospores

- Endospores are dormant cells produced in response to harsh environmental conditions.
- Bad conditions: spore coat surrounds a copy of the cell's chromosome and a small part of the cytoplasm
- Favorable conditions: spore germinates, grows into new bacterial cell



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Survival of Bacteria

Mutations

- Genetic mutations can help bacteria survive in changing environments.
- Mutations allow for genetic diversity in an asexually reproducing population.
- Leads to changes like antibiotic resistance

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Ecology of Bacteria

Nutrient cycling and nitrogen fixation

- Bacteria are decomposers, returning vital nutrients to the environment
- Some soil bacteria fix nitrogen, vital for amino acid, DNA, and RNA synthesis.
- Some nitrogen-fixing bacteria live in symbiotic relationships with plants/crops.

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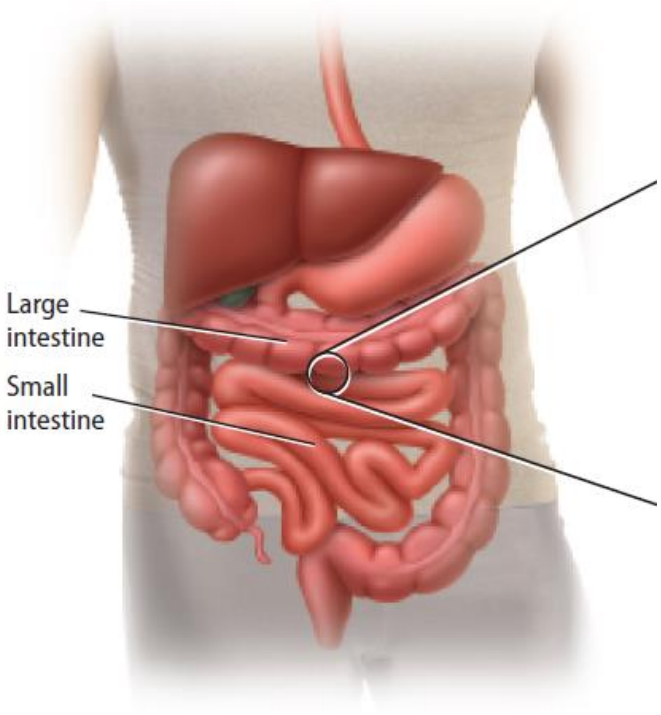
Ecology of Bacteria

Normal flora

- Your body is covered in bacteria inside and out.
- Normal flora have a symbiotic relationship with humans – prevent disease, aid with digestion, make vitamins



Normal gut flora: *E. coli* provide the body nutrients in exchange for a place to live

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Ecology of Bacteria

Foods and medicines

- Bacteria responsible for some food production (cheese, yogurt)
- Commercial production of vitamins
- Can be used to fight disease/produce antibiotics

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Ecology of Bacteria

Disease-causing bacteria

- A small percentage of bacteria cause disease.
- Cause disease in two ways:
  - Multiply quickly at site of infection before immune system responds
  - Secrete a toxin or harmful substance

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Human Bacterial Diseases

Interactive Table

FPO

Add link to interactive table from page 524 (Table 1) here.

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Review

Essential Questions

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- What are the survival methods of bacteria at both the individual and population levels?
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- capsule
- pilus
- binary fission
- conjugation
- endospore

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