The invention of the microscope has opened to us a world of extraordinary numbers. A singular drop of pond water reveals countless life forms.

I. Classifying Prokaryotes
   A. Eubacteria
      1. *e-coli* lives in the human gut
      2. **cells walls contain peptidoglycan** - a carbohydrate structure that gives shape to the cell.
B. Archaebacteria
1. Chemically different to eubacteria
2. lacks peptidoglycon
3. DNA sequences is more like eukaryotes than eubacteria
4. live in harsh environments
   a. Oxygen free
   b. hot springs

II. Identifying Prokaryotes
A. Shape
1. Rods - *Bacilli* - botulism
2. Spiral - *Cocci* - Staph infection
3. Corkscrew - *spirilla* - strep infection
B. Cell walls
   1. Thick peptidoglycan stains violet
   2. Thin peptidoglycan stains red to pink

C. Movement
   1. Some do not move
   2. Whip-like flagella

III. Metabolic Diversity - How prokaryotes obtain energy
A. Heterotrophs - energy form other organisms
   1. Chemoheterotrophs - breaks down food to make energy (eats food)
   2. Photoheterotrophs - uses sunlight to make food (Euglena - single celled organism that has a whip-like tail to move and has chloroplast to capture sun for energy)

B. Autotrophs -
   1. chemoautotrophs - uses chemical reactions to make energy - uses hydrogen sulfide gas near ocean vents
   2. Photoautotrophs - uses sunlight to make energy - cyanobacteria
C. Releasing energy - All organisms need energy

1. Obligate aerobes - organisms that need a constant supply of Oxygen to live
   Micro-bacterium - *tuberculosis*

2. Obligate anaerobes - organisms not requiring oxygen to live
   *clostridium botulinum*

3. Facultative anaerobes - Able to function different ways. Does not require oxygen, but is not killed in the presence of oxygen - can live anywhere *e.coli*

IV. Growth and Reproduction - bacteria growth can be exponential. Bacteria growth is kept in check because of available food and production of wastes.

A. Binary fission - no exchange of genetic information - simple dividing in half
B. Conjugation - exchange of DNA between two cells, then divide in half - Increased genetic diversity

C. Spore formation - allows bacteria to survive harsh environments which would otherwise kill them. Endospore protects bacteria’s DNA
V. Importance of bacteria
   A. Decomposers - All life needs to break down it’s component parts after death. If not, new life would not exist.
      1. Recycle nutrients - to maintain ecological balance
      2. Breaks down complex compounds in sewage

   B. Nitrogen fixer - Bacteria fixes nitrogen so it can be used by plants to maintain growth - (NH₃) \( Rhizobium \) in nodes of legumes - nitrogen fixation
Viruses

I. What is a virus - original theft organism
   A. Particles of nucleic acid with a protein coat (capsid)
   B. Can only live inside another living cell
   C. Bacteriophages - viruses that infect bacteria
   D. Three different kinds of viruses

*Trace and label fig 19-9 p. 479*
E. Viral Infection -
1. Lytic infection - virus enters cell, makes self copies then bursts (lysis) the cell
2. Lysogenic infection - virus enters cell, integrates host DNA, make self copies, on lysis of cell
   a. virus remains inactive for a period of time
   b. called prophage

Trace and label fig 19-10 p. 481

Bacteriophage Life Cycle Overview

Lytic = steps 1, 2, 5, 6
Lysogenic = steps 1, 2, 3, 4 (5 & 6 occur later)
F. Retrovirus
1. Contains RNA or DNA
2. Copies genetic information backwards
3. May lay dormant a long time
4. AID’s is a retrovirus

G. Viruses and living cells
1. Viruses are parasites
2. Must live on host sell or cannot exist
3. Viruses are not considered living because they can’t live independently.
4. *Copy Fig 19-11*
II. Diseases caused by bacteria and viruses
   A. Pathogens are disease causing agents
   B. Bacterial disease in humans
      1. Louis Pasteur showed that bacteria can cause disease
      2. Destroys cells two ways
         a. Attacks cells directly to get cell’s foods
         b. Releases toxins that travel through body that can cause death, breathing problems, heart failure, paralysis.
      3. Preventing bacterial disease
         a. Stimulating bodies immune system - vaccines are weakened or killed pathogens
         b. Antibodies - drugs that destroy bacteria - *Penicillin* and *tetracycline*
III. Bacterial Disease in animals - *Anthrax*
   A. Found in sheep
   B. Tough, resistant spores ideal for biological warfare

IV. Controlling Bacterial - Most bacteria are harmless some are not.
   A. Sterilization by heat - bacteria cannot survive when exposed to high temperatures for a long time.
   B. Disinfectants - chemical solutions that kill pathogens
   C. Food storage and processing
      1. Refrigerator - cold, short period
      2. Canning - not indefinitely.
V. Viral disease in Humans
   A. Cannot be treated with antibiotics
   B. Good hygiene best prevention
   C. Some vaccinations for measles or small pox

TABLE 24-4 A Summary of Bacterial Diseases

<table>
<thead>
<tr>
<th>Disease</th>
<th>Pathogen</th>
<th>Areas affected</th>
<th>Mode of transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botulism</td>
<td>Clostridium botulinum</td>
<td>nerves</td>
<td>improperly preserved foods</td>
</tr>
<tr>
<td>Cholera</td>
<td>Vibrio cholerae</td>
<td>intestine</td>
<td>contaminated water</td>
</tr>
<tr>
<td>Dental caries (tooth decay)</td>
<td>Streptococcus mutans, sanguis, and salivarius</td>
<td>teeth</td>
<td>bacteria enter the mouth from the environment</td>
</tr>
<tr>
<td>Gonorrhea</td>
<td>Neisseria gonorrhoeae</td>
<td>urethra, fallopian tubes, epididymis</td>
<td>person-to-person by sexual contact</td>
</tr>
<tr>
<td>Lyme disease</td>
<td>Borrelia burgdorferi</td>
<td>skin, joints, heart</td>
<td>tick bite</td>
</tr>
<tr>
<td>Rocky Mountain spotted fever</td>
<td>Rickettsia rickettsii</td>
<td>blood, skin</td>
<td>tick bite</td>
</tr>
<tr>
<td>Salmonella food poisoning</td>
<td>Salmonella</td>
<td>intestine</td>
<td>contaminated water and food</td>
</tr>
<tr>
<td>Strep throat</td>
<td>Streptococcus pyogenes</td>
<td>upper respiratory tract, blood, skin</td>
<td>person-to-person by sneezes, coughs, or direct contact</td>
</tr>
<tr>
<td>Tetanus</td>
<td>Clostridium tetani</td>
<td>nerves at synapses</td>
<td>contaminated wounds</td>
</tr>
<tr>
<td>Tuberculosis</td>
<td>Mycobacterium tuberculosis</td>
<td>lung, bones, other organs</td>
<td>person-to-person by coughs</td>
</tr>
</tbody>
</table>