I. Bacteria
   A. Microscopic life covers almost all of the Earth
   B. The smallest and most common form of life are **prokaryotes** – unicellular organisms that lack a nucleus
      1. Bacteria are one example of prokaryotes

II. Classifying Prokaryotes
   A. All types of prokaryotes used to be in the kingdom Monera
   B. Now, scientists put prokaryotes into two groups
      1. Eubacteria
      2. Archaebacteria
   C. Each group is now considered to be a separate kingdom.

III. Eubacteria
   A. A very diverse group, many different types
   B. Can live almost anywhere
      1. Freshwater
      2. Saltwater
      3. On land
      4. In our bodies
   C. Characteristics of Eubacteria:
      1. Surrounded by a cell wall that:
         a. protects from injury
         b. determines shape
         c. contains **peptidoglycan** – a carbohydrate
      2. Inside the cell wall is a cell membrane
         a. The cell membrane surrounds cytoplasm
      3. Some Eubacteria contain a second cell membrane to further protect them from damage
      4. Some have flagella for movement

IV. Archaebacteria
   A. Similar in shape and form to Eubacteria
      1. Chemically different from Eubacteria
      2. Cell walls lack peptidoglycan
      3. Contain different membrane lipids
   B. Have DNA sequences similar to eukaryotic cells
   C. Exist in extreme environments such as:
      1. Anaerobic environments (no oxygen)
      2. Extremely salty environments
      3. Extremely hot environments

V. Identifying Prokaryotes
   A. Prokaryotes are identified by 6 characteristics:
      1. Their shape
         a. 3 major groups
            ★ Cocci – spherical cells – *streptococcus*/strep throat
            ★ Bacilli – rod shaped cells, pairs or chains – anthrax or tetanus
            ★ Spirilla – spiral or coiled cell/corkscrew, appears as single cell only – *cholera*
      2. The chemical nature of their cell walls
         a. Two different types of cell walls are found in eubacteria.
         b. A method called Gram staining is used to tell them apart.
**Gram Positive Bacteria**

i. Stay the same color as the stain, appear purple under a microscope after staining

ii. Have thick peptidoglycan walls → Eubacteria

iii. These bacteria can be harmed by antibiotics such as penicillin.

**Gram Negative Bacteria**

i. Do not hold stain, look pink or red under the microscope

ii. Have thin walls inside an outer lipid layer → Archaebacteria

iii. These bacteria are not easily harmed and are more difficult to treat.

3. The way they move

a. Some move with the aide of flagella or cilia

b. Some move by “snaking” or curling forward

c. Some move by secreting slime and then gliding over it

4. Metabolic Diversity - the way they obtain energy

a. Two Main groups of bacteria

   **Heterotrophs** – gain nutrients from the environment

   i. Chemoheterotrophs - take in organic molecules for energy

      1. Example: Humans and most animals

   ii. Photoheterotrophs – use sunlight for energy, but they also need to take in organic compounds as a carbon source.

   **Autotrophs** – make their own food

   i. Photoautotrophs- use light energy to convert carbon dioxide and water to carbon compounds and oxygen in a process similar to that used by green plants.

      1. Example: cyanobacteria

   ii. Chemoautotrophs - make organic carbon molecules from carbon dioxide, do not require light as a source of energy. Use energy directly from chemical reactions.

      1. Example: some live in the darkness deep in the ocean

5. They way they release energy

a. Energy may be released in cellular respiration or fermentation or both.

b. Three types of bacteria:

   **Obligate aerobes** – require oxygen

   **Obligate anaerobes** – does not require oxygen, can’t live in the presence of oxygen

   **Facultative anaerobes** – can live in either presence or absence of oxygen.

6. They way they grow and reproduce

a. Binary fission – the cell splits in two

   DNA replicates; parent cell divides into 2 identical independent daughter cells.

b. Conjugation – a hollow bridge forms between 2 bacteria cells and genes move from 1 cell to the other

   increases genetic diversity

c. Spore formation – a mechanism for survival

   **Endospore** – a tough protective coat surrounding DNA and a small amount of cytoplasm.

   i. Can survive for years and withstand extreme conditions

   ii. Once conditions are favorable, the endospore returns to an active, growing bacteria cell
VI. The Importance of Bacteria
   A. Bacteria are vital to maintaining the living world:
   B. Producers that capture energy by photosynthesis.
   C. Decomposers that break down the nutrients in dead matter
      1. Recycle nutrients in the ecosystem
      2. Important for sewage treatment
   D. Nitrogen fixers that convert nitrogen for use by plants
      1. Convert nitrogen gas into a form that plants can use as fertilizer
      2. Helps recycle nitrogen from the atmosphere
   E. Other bacteria have human uses.
      1. Make milk into yogurt
      2. Help decompose food wastes in the intestines
      3. Produce certain vitamins in the large intestine
      4. Breakdown chemical and oil spills