You can't see them with the naked eye.... but they're EVERYWHERE! An overview of prokaryotic life

- **Prokaryotes were the earliest organisms on Earth and evolved alone for 1.5 billion years.**
- **Today, prokaryotes still dominate the biosphere.**
  - **Their collective biomass (dry weight) outweighs ***all eukaryotes combined by at least tenfold.***
  - **More prokaryotes inhabit a handful of fertile soil or the mouth or skin of a human than the total number of people who have ever lived.**
- **Prokaryotes are found wherever there is life and they thrive in habitats that are too cold, too hot, too salty, too acidic, or too alkaline for any eukaryote.**
- **We are most familiar with the minority of prokaryote species that cause serious illness.**
  - **During the 14th century,a bacterial disease known as ***bubonic plague*** (*Yersinia pestis*), spread across Europe and killed about 25% of the human population.**
  - **Other types of diseases caused by bacteria include tuberculosis, cholera, many sexually transmissible diseases, and certain types of food poisoning.**
- **However, most bacteria are benign (not harmful) or beneficial.**
  - **Bacteria in our intestines produce important vitamins.**
  - **Prokaryotes recycle carbon and other chemical elements between organic matter and the soil and atmosphere (decomposing bacteria).**
- **Prokaryotes often live in close association among themselves and with eukaryotes in symbiotic relationships**
- **Mitochondria and chloroplasts evolved from prokaryotes that became residents in larger host cells (endosymbiotic theory).**
- **Modern prokaryotes are diverse in structure and in metabolism.**
- **About 5,000 species of prokaryotes are known, but estimates of actual prokaryotic diversity range from about 400,000 to 4 million species.**

Bacteria and Archaea are the two main ranches of prokaryote evolution

- Molecular evidence accumulated over the last two decades has lead to the conclusion that there are ***two major branches of prokaryote evolution***, not a single kingdom as in the five-kingdom system.
- These two branches are the ***bacteria*** and the ***archaea***.
  - The archaea inhabit extreme environments and differ from bacteria in many key structural, biochemical, and physiological characteristics.
- Current taxonomy recognizes two prokaryotic domains: domain Bacteria and domain Archaea.
  - A domain is a taxonomic level above the kingdom level.
  - The rationale for this decision is that bacteria and archaea diverged so early in life and are so fundamentally different.
  - At the same time, they both are structurally organized at the prokaryotic level.

Domain Archaea

- Most species of archaea have been sorted into the kingdom Euryarchaeota or the kingdom Crenarchaeota.
- However, much of the research on archaea has focused not on phylogeny, but on their ***ecology*** - their ability to live where no other life can.
- Archaea are **extremophiles**, "lovers" of extreme environments.
  - Based on environmental criteria, archaea can be classified into methanogens, extreme halophiles, and extreme thermophilies.
- **Methanogens** obtain energy by using CO_2 to oxidize H_2 replacing methane as a waste.
- They live in swamps and marshes where other microbes have consumed all the oxygen.
  - Methanogens are important decomposers in sewage treatment.
- Other methanogens live in the anaerobic guts of herbivorous animals, playing an important role in their nutrition.
  - They may contribute to the greenhouse effect, through the production of methane.
- **Extreme halophiles** live in such saline places as the Great Salt Lake and the Dead Sea.
- Some species merely tolerate elevated salinity; others require an extremely salty environment to grow.
- **Extreme thermophiles** thrive in hot environments.
  - The optimum temperatures for most thermophiles are 60°C-80°C.
  - *Sulfolobus* oxidizes sulfur in hot sulfur springs in Yellowstone National Park.
  - Another sulfur-metabolizing thermophile lives in 105°C water near deep-sea hydrothermal vents.
- All the methanogens and halophiles fit into **Euryarchaeota**.
- Most thermophilic species belong to the **Crenarchaeota**.
- Each of these taxa also includes some of the newly discovered marine archaea.

Most known prokaryotes are bacteria

- The name *bacteria* was once synonymous with "prokaryotes," but it now applies to just ***one*** of the two distinct prokaryotic domains.
  - However, most ***known*** prokaryotes *are* bacteria.
- The major bacterial taxa are now given kingdom status by most prokaryotic systematists.

- Take a look in your text at pages ***538-539*** for an explanation of the 5 major bacteria kingdoms!!