

# The Microbial World

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## Bacteria/Prokaryotes

Earth's most abundant organisms – single celled.

- Structurally simple cells that *lack a nucleus*
- Evolved before eukaryotes
- Collectively, prokaryotes show great metabolic diversity
- They divide rapidly & exchange DNA by a variety of mechanisms

## Role of Bacteria

**Saprobies:** Organisms that break down wastes or remains aka decomposers.

- ✓ Most are harmless or benefit us by releasing oxygen, fixing nitrogen, or cycling nutrients
- ✓ Some bacterial chemoheterotrophs cause disease in humans.

## Nutritional Modes

Table 21.3 Prokaryotic Nutritional Modes

Mode of Nutrition	Carbon Source	Energy Source
Photoautotrophic	CO <sub>2</sub>	Light
Chemoautotrophic	CO <sub>2</sub>	Inorganic substances
Photoheterotrophic	Organic compounds	Light
Chemoheterotrophic	Organic compounds	Organic compounds

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- Prokaryotic cells are much smaller than eukaryotic cells (about the size of mitochondria)
- Prokaryotes have three typical shapes:



## Different Ways to Describe Bacteria

Shape/form (cocci, bacilli, spirilli)  
Staining method e.g. Gram Stain  
Aerobic (oxygen using) vs. Anaerobic (w/o oxygen)  
Endospore forming (dormant stage)  
Movement (some have whip like flagella)  
Capsule (jelly like adhering material to stick to surfaces)

## Examples of Human Disease that are caused by bacteria.

*E. coli* (intestinal bacteria) – obtained from food contaminated by fecal matter from other animals.

Some bacteria are sexually transmitted:

- Syphilis
- Gonorrhea

Tetanus

Staph infections (boils – infections of hair follicles)

Conjunctivitis – an eye infection

Gingivitis – infection/irritation of the gums.

Dental cavities

## Bacteria – the positive side

Bacteria also perform important ecological services:

Degrading wastes – e.g. composting

Adding oxygen to the air – cyanobacteria

Providing essential nutrients to plants  
e.g. nitrogen fixing bacteria

## Humans & Disease

### I. Sporadic diseases

Occur irregularly, affect few people e.g. Lyme disease

### II. Epidemic diseases

Spread quickly, then subside e.g. Ebola

### III. Endemic diseases

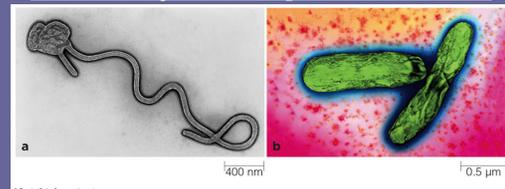
Occur continually, but don't spread far e.g. Ear infections in children

### IV. Pandemic diseases

Break out and spread worldwide e.g. Typhoid

## How do we determine priority?

Ebola kills up to 90% of those infected, but is sporadic; *Mycobacterium tuberculosis* kills 50%, but is widespread and drug resistant



**CDC – Center for Disease Control  
Monitors infections & dispenses information**

## Treatments

Since the early 20<sup>th</sup> century the pharmaceutical industry has actively conducted research to find cures to many bacterial diseases.

Generally prevention is the best approach:

- Improved hygiene e.g. Washing hands
- Avoiding infections by decreasing risk factors
- Increased monitoring of food & water to prevent food poisoning events.

Generally bacterial infections are treated with antibiotics AFTER an infection has occurred.

Few vaccinations prevail to fight bacterial exposure, notable exceptions are the tetanus immunization and the anthrax shot (administered to soldiers).

## The Archaeans

- Archaeans, the more recently discovered prokaryotic lineage, are the third domain – the closest prokaryotic relatives of eukaryotes
- Archaeans live everywhere – many live in very hot or very salty habitats
- Hardly any archaeans cause human disease

## Diversity of Archaeans

- **Methanogens** (methane producers)
- **Extreme halophiles** (salt lovers)
- **Extreme thermophiles** (heat lovers)

## Extremophiles – Archaeans survive where other bacteria cannot



Thermoacidophiles – live in hot, acidic environments e.g. hot springs



Hydrothermal vents – at the bottom of the ocean. Make a living off of intense chemical brew at extreme pressure.



Methanogens – inside the guts of cows