

Bacteria

PREPARED BY: BESIR ZENELI

Lesson objectives

- Identify the characteristics of bacterial cells.
- Compare and contrast aerobic and anaerobic organisms.
- Identify some ways bacteria are helpful.
- Determine the importance of nitrogen-fixing bacteria.
- Explain how some bacteria can cause human disease.

Bacteria - Overview

Bacteria are microscopic, single-celled organisms that belong to the domain of prokaryotes.

Prokaryotes lack a true nucleus and membrane-bound organelles, distinguishing them from eukaryotic cells.

Abundance: Bacteria are incredibly abundant and diverse, existing in virtually every environment on Earth, from the depths of oceans to the highest mountains.

Ecosystem Functioning: They play a crucial role in various ecosystems, participating in **nutrient cycles** and **decomposition processes**.

Symbiosis: Bacteria form symbiotic relationships with plants and animals, contributing to their growth and well-being.

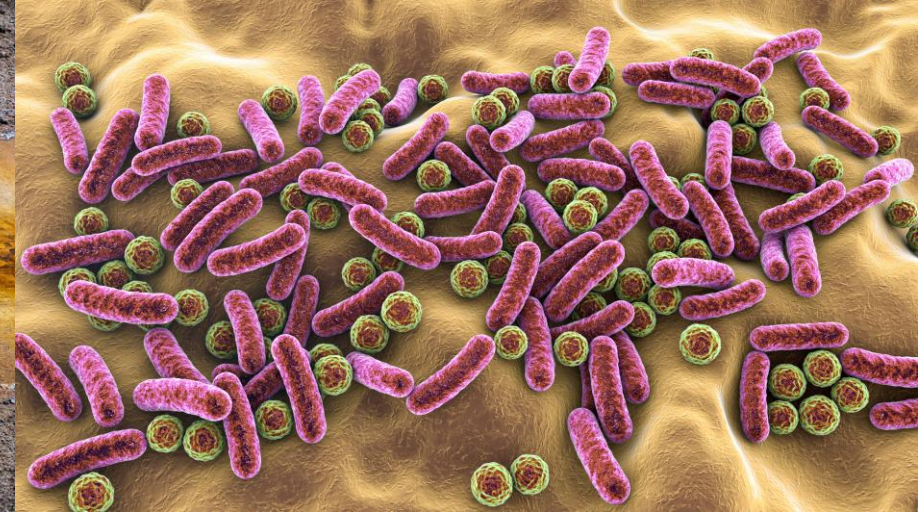
Biotechnological Applications: Bacteria are used in various biotechnological processes, including the production of food, medicine, and environmental cleanup.

Where do bacteria live?

Bacteria are almost everywhere— in the air, in foods that you eat and drink, and on the surfaces of things you touch. They are even found thousands of meters underground and at great ocean depths. A shovelful of soil contains billions of them.

Your skin has about 100,000 bacteria per square centimeter, and millions of other bacteria live in your body

Some heat-loving bacteria live in **hot springs** or **hydrothermal vents**— places where water temperature exceeds 100°C. Others can live in cold water or soil at 0°C. Some bacteria live in very salty water, like that of the Dead Sea. One type of bacteria lives in water that drains from coal mines, which is extremely acidic at a pH of 1.



Structure of bacteria - Shapes

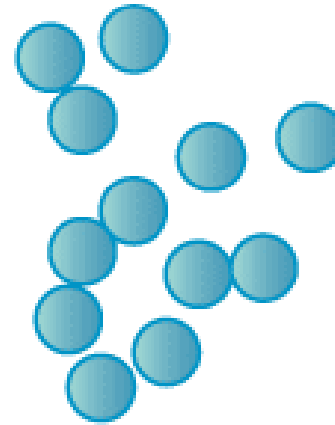
Bacteria normally have three basic shapes—spheres, rods, and spirals.

Sphere-shaped bacteria are called cocci (singular, coccus), rod-shaped bacteria are called bacilli (singular, bacillus), and spiral-shaped bacteria are called spirilla (singular, spirillum)

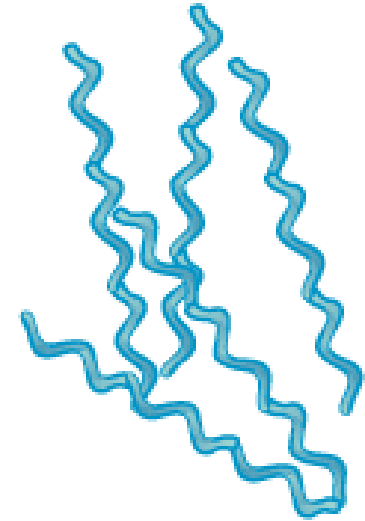
Bacterial Shapes



bacillus
(rod)



coccus
(sphere)



spirillum
(spiral)

Structure of bacteria

Bacteria are smaller than plant or animal cells.

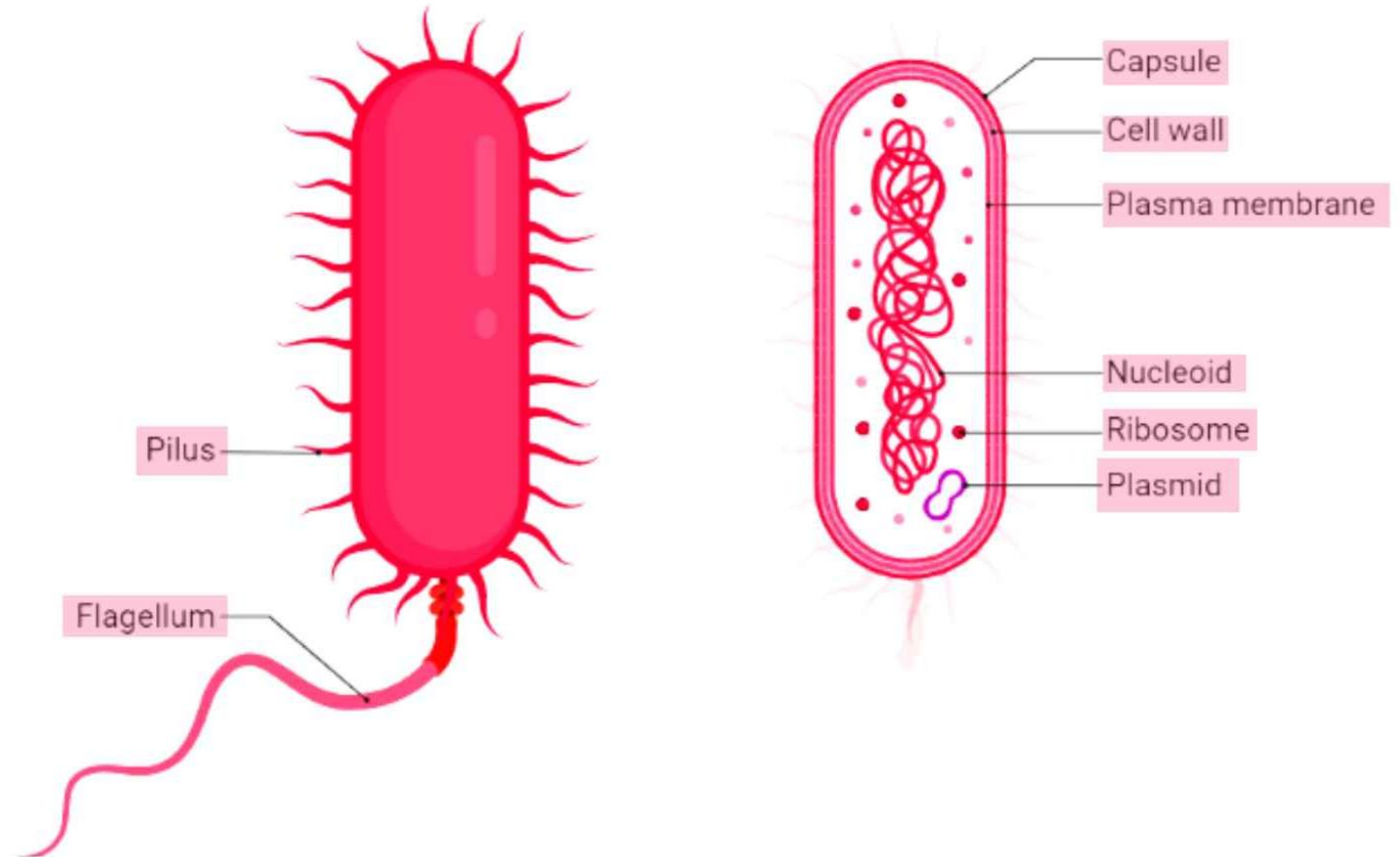
They are **one-celled organisms** that occur alone or in chains or groups. A typical bacterial cell contains **cytoplasm** surrounded by a **cell membrane (plasma membrane)** and a **cell wall**.

Bacterial cells are classified as prokaryotic because they do not contain a membrane-bound nucleus or other membrane-bound internal structures called organelles.

Most of the genetic material of a bacterial cell is in its **one circular chromosome (Nucleoid)** found in the cytoplasm. Many bacteria also have a **smaller circular piece of DNA called a plasmid**.

Ribosomes also are found in a bacterial cell's cytoplasm

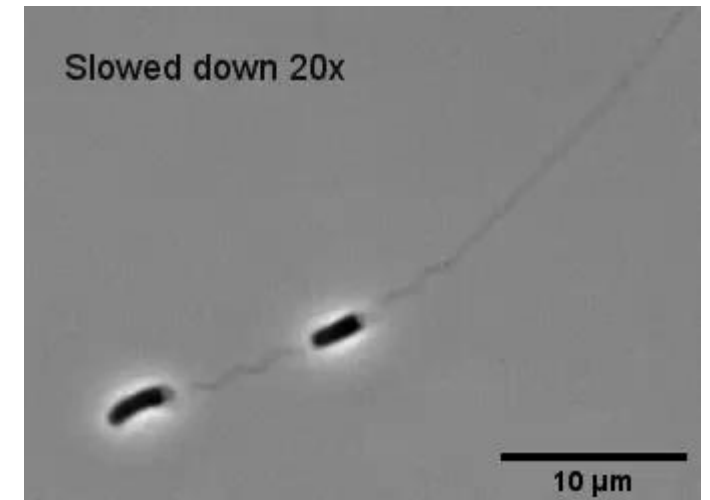
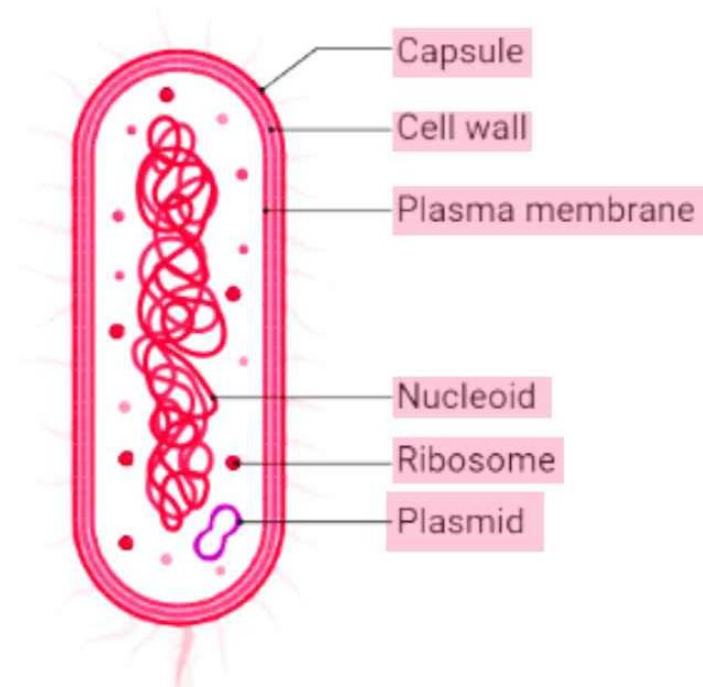
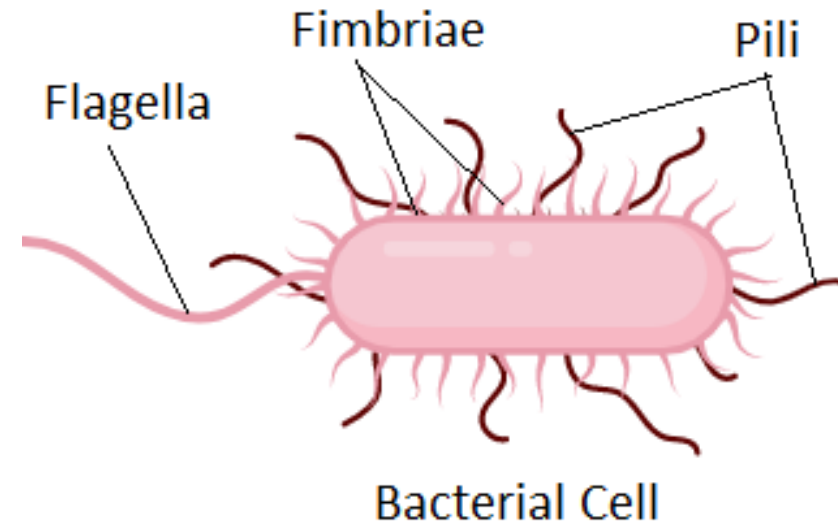
Structure of Bacterial Cell



Structure of bacteria – Special features

Some bacteria, like the type that causes pneumonia, have a **thick, gelatinlike capsule** around the cell wall. A capsule can help protect the bacterium from other cells that try to destroy it. The capsule, along with **hairlike projections (fimbriae)** found on the surface of many bacteria, also can help them stick to surfaces.

Many bacteria that live in moist conditions also have **whiplike tails called flagella** to help t

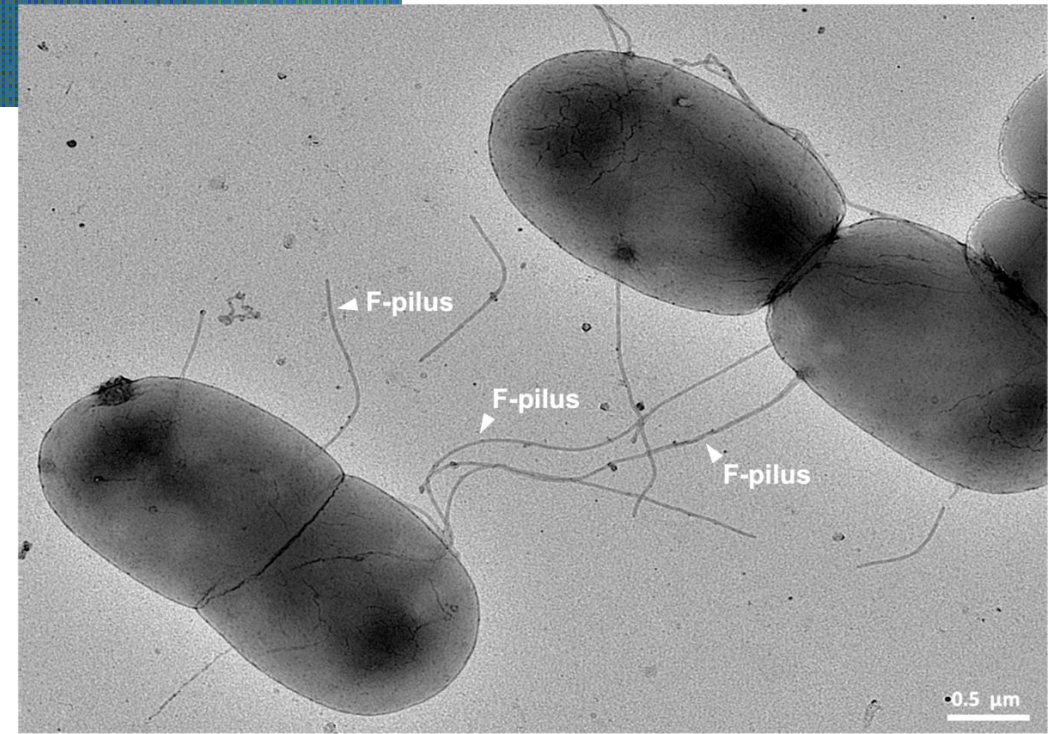
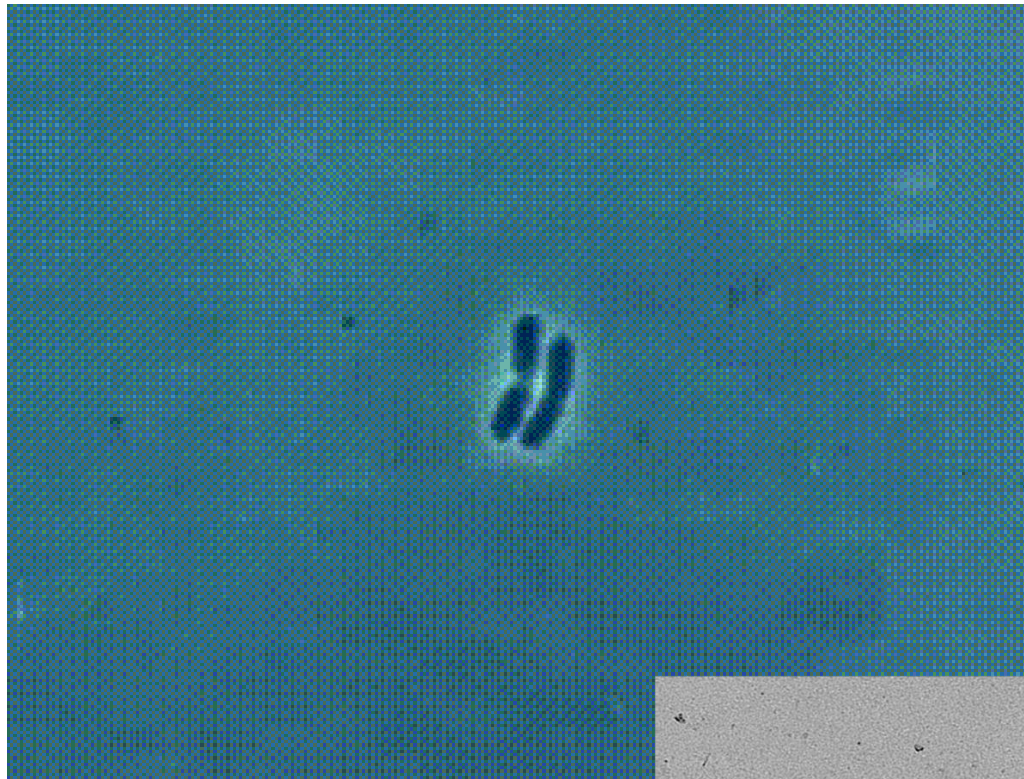


Reproduction

Bacteria usually reproduce by fission. **Fission is a process that produces two new cells with genetic material identical to each other and that of the original cell.** It is the simplest form of asexual reproduction.

Some bacteria exchange genetic material through a process similar to sexual reproduction.

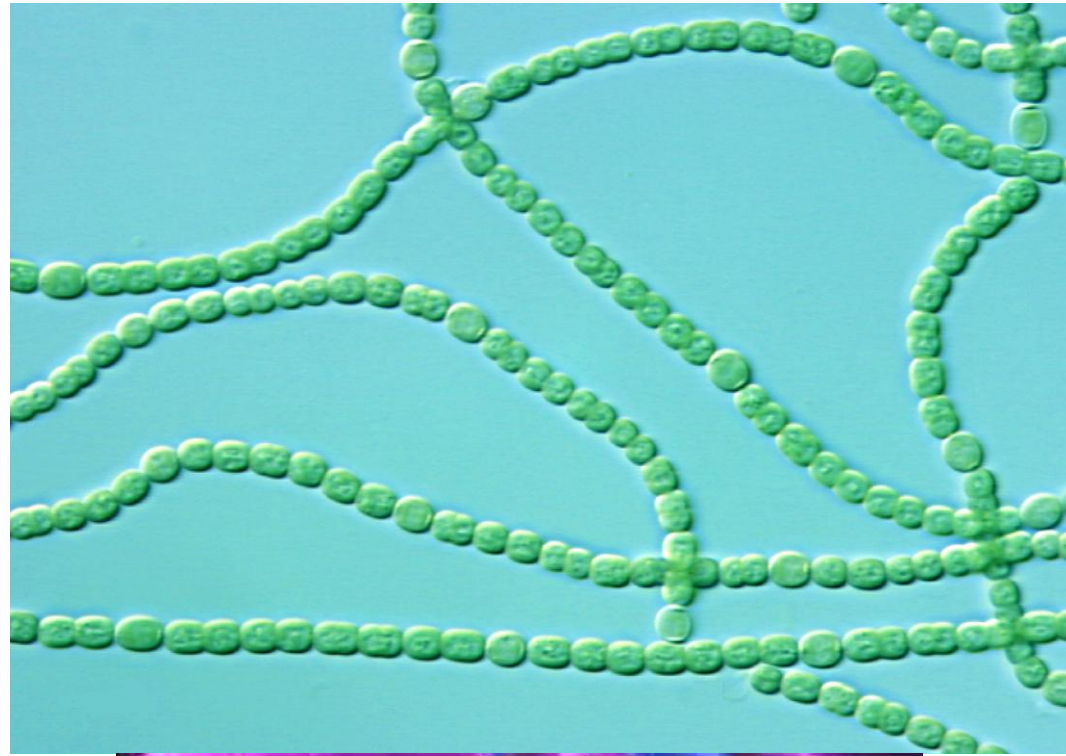
Two bacteria line up beside each other and exchange DNA through a **pilus**. This results in cells with different combinations of genetic material than they had before the exchange. As a result, the bacteria may acquire variations that give them an advantage for survival.



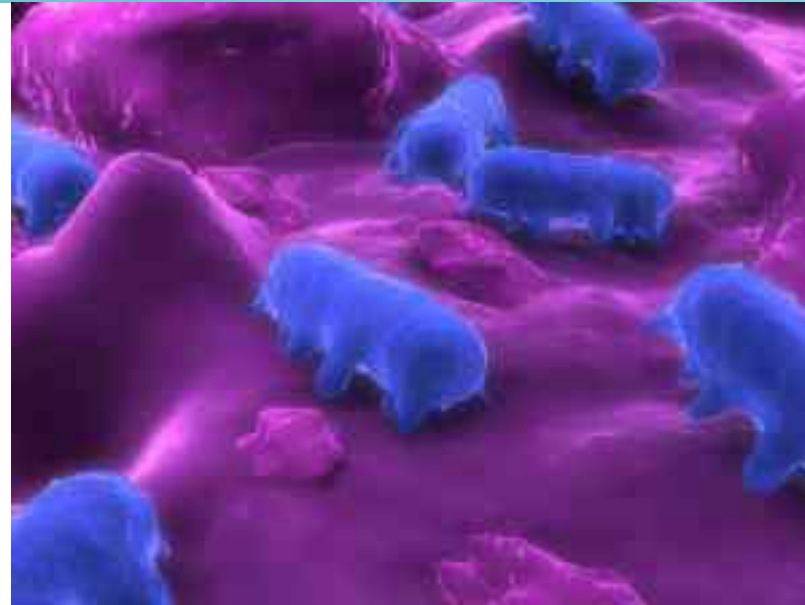
How bacteria obtain food and energy

Bacteria that contain **chlorophyll** or other pigments make their own food using energy from the Sun. These are known as **producers**. They produce Oxygen the same as plants.

Other bacteria use energy from chemical reactions to make food. These are known as **consumers**. They do not make their own food. Some break down dead organisms to obtain energy. Others live as parasites of living organisms and absorb nutrients from their host.



Cyanobacteria



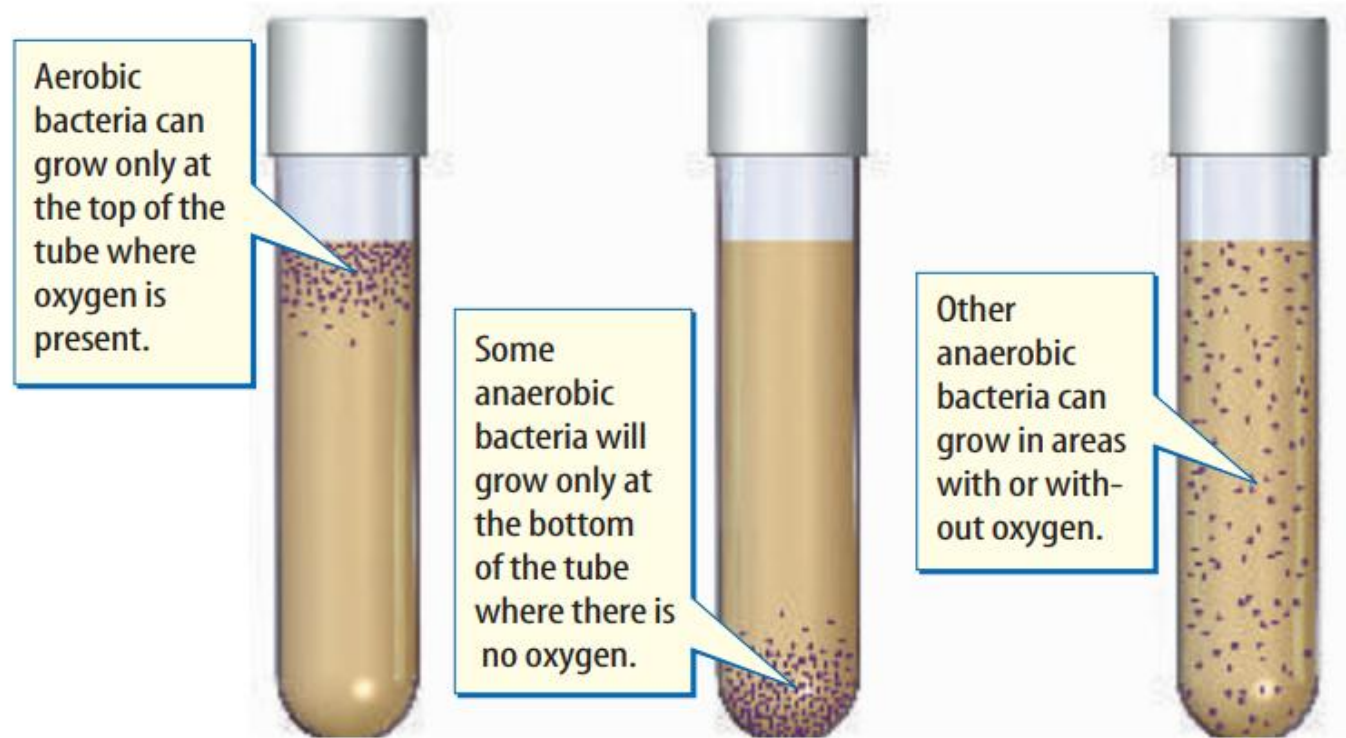
Consumer bacteria

Aerobe and Anaerobe

Most organisms use oxygen when they break down food and obtain energy through a process called respiration. An organism that uses oxygen for respiration is called an **aerobe**.

You are an aerobic organism and so are most bacteria. In contrast, an organism that is adapted to live without oxygen is called an **anaerobe**.

Several kinds of anaerobic bacteria live in the intestinal tract of humans. Some bacteria cannot survive in areas with oxygen.



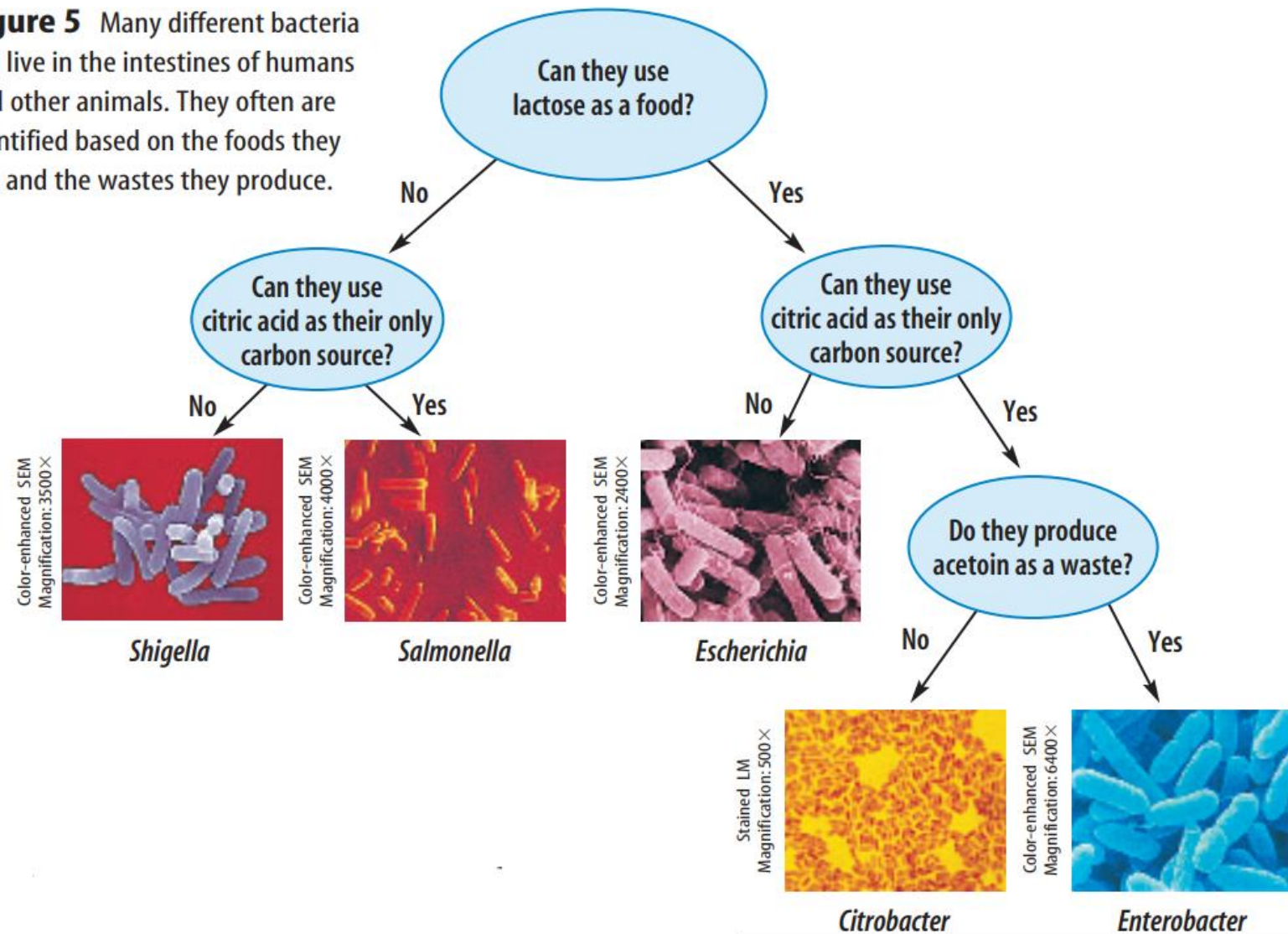
Eubacteria

Eubacteria are most common type of bacteria. Scientists must study many characteristics in order to classify eubacteria into smaller groups. Most eubacteria are grouped according to their **cell shape and structure**, the **way they obtain food**, the **type of food they consume**, and the **wastes they produce**.

Producer eubacteria

Consumer eubacteria

Figure 5 Many different bacteria can live in the intestines of humans and other animals. They often are identified based on the foods they use and the wastes they produce.



Producer eubacteria (Cyanobacteria)

They are an important source of food for some organisms in lakes, ponds, and oceans. The oxygen produced by cyanobacteria is used by other aquatic organisms.

Sometimes cyanobacteria can cause problems?

1. When a large number of nutrients enter a pond
2. Cyanobacteria increase in number
3. Population grows, bloom
4. Bloom looks like bubbly green slime water
5. Resources used up
6. Cyanobacteria die
7. Other bacteria feed on dead Cyanobacteria
8. Use up oxygen in water
9. Reduced oxygen leads to fish and organisms dying



Consumer Eubacteria

Gram-Positive

Stain purple – because of thick peptidoglycan layer.

Gram-Negative

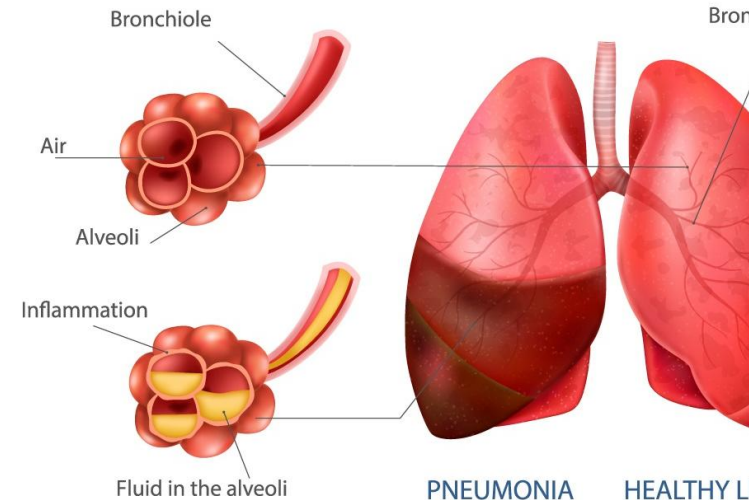
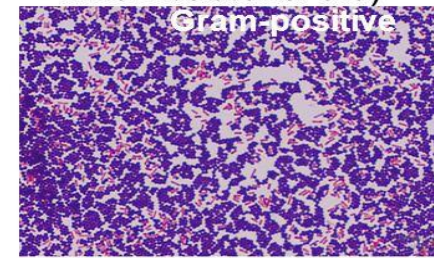
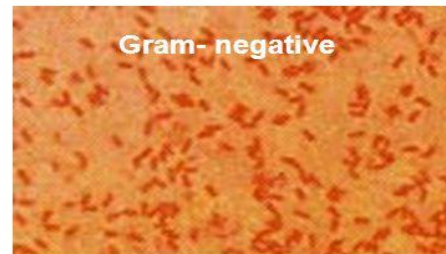
Stain pink – because of thin layer of peptidoglycan layer.

Some antibiotics will be more effective against gram-negative bacteria than they will be against gram-positive bacteria

One group of eubacteria is unique because they do not produce cell walls. This allows them to change their shape. They are not described as coccus, bacillus, or spirillum. One type of bacteria in this group, **Mycoplasma pneumoniae**, causes a type of pneumonia in humans

Most Species of bacteria may be Grouped Based on Staining

- Gram-Negative
 - Lack thicker layer of peptidoglycan
 - Stain pink
 - Endotoxins
- Gram-Positive
 - Thicker layer of peptidoglycan
 - Stain purple
 - Exotoxins (released when bacteria die)



Representation of pneumonia infection in the lungs

Archaeobacteria

Kingdom Archaeobacteria contains certain kinds of bacteria that often are found in extreme conditions, such as hot springs.

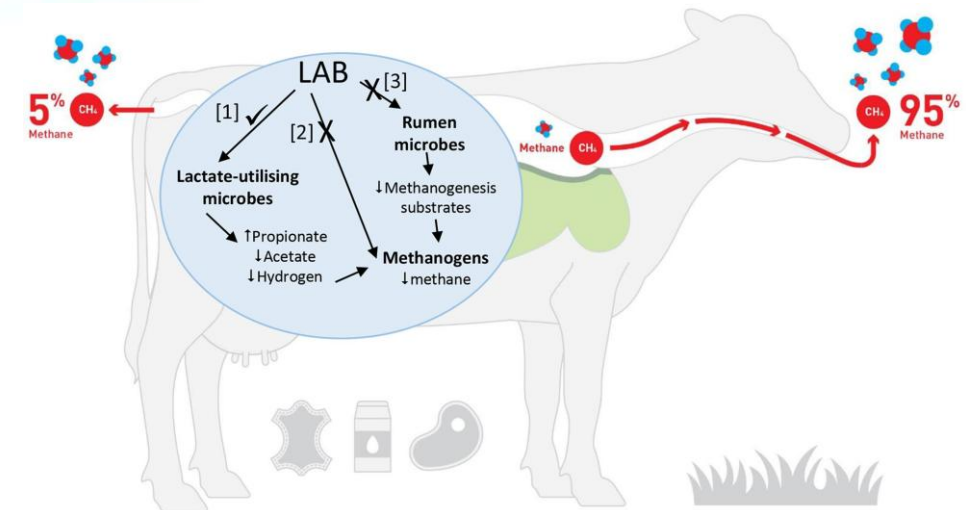
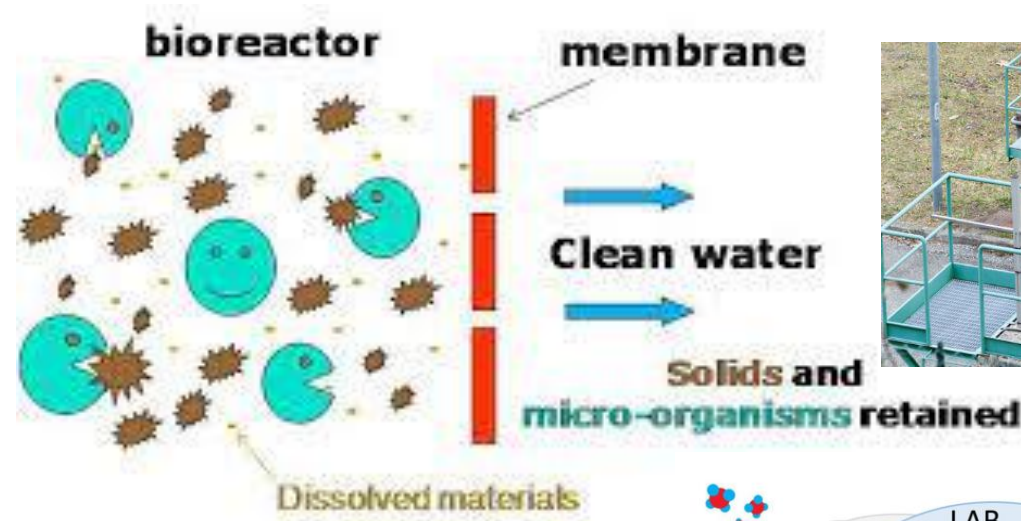
Archaeobacteria are divided into groups based on where they live or how they get energy.

Salt-, Heat-, and Acid-Lovers

- Great Salt Lake in Utah and Dead Sea.
- Acidic and Hot environments. (pH 1 and 100°C.)

Methane Producers

- Anaerobic; muddy swamps, intestine of cattle's and humans.
- Use CO₂ for energy and release methane gas as a waste. (bubbles up out of swamps and marshes)
- Sewage treatment. (Breaking down waste material in an oxygen-free tank)



Animation

Sewage treatment:

<https://www.youtube.com/watch?v=s8IVjQg7yno>

Bacteria animation:

<https://www.labxchange.org/library/pathway/lx-pathway:087f7cb8-09cf-406e-bc60-5193fee3512e/items/lb:LabXchange:b5022290:video:1/51274>