

# 19-1 Bacteria



The **smallest and most common microorganisms** are **prokaryotes**—unicellular organisms that lack a nucleus.

# Classifying Prokaryotes

All prokaryotes were once placed in the Kingdom Monera.

Recently, biologists divided them into two different kingdoms: the Eubacteria and the Archaeobacteria.

## Eubacteria

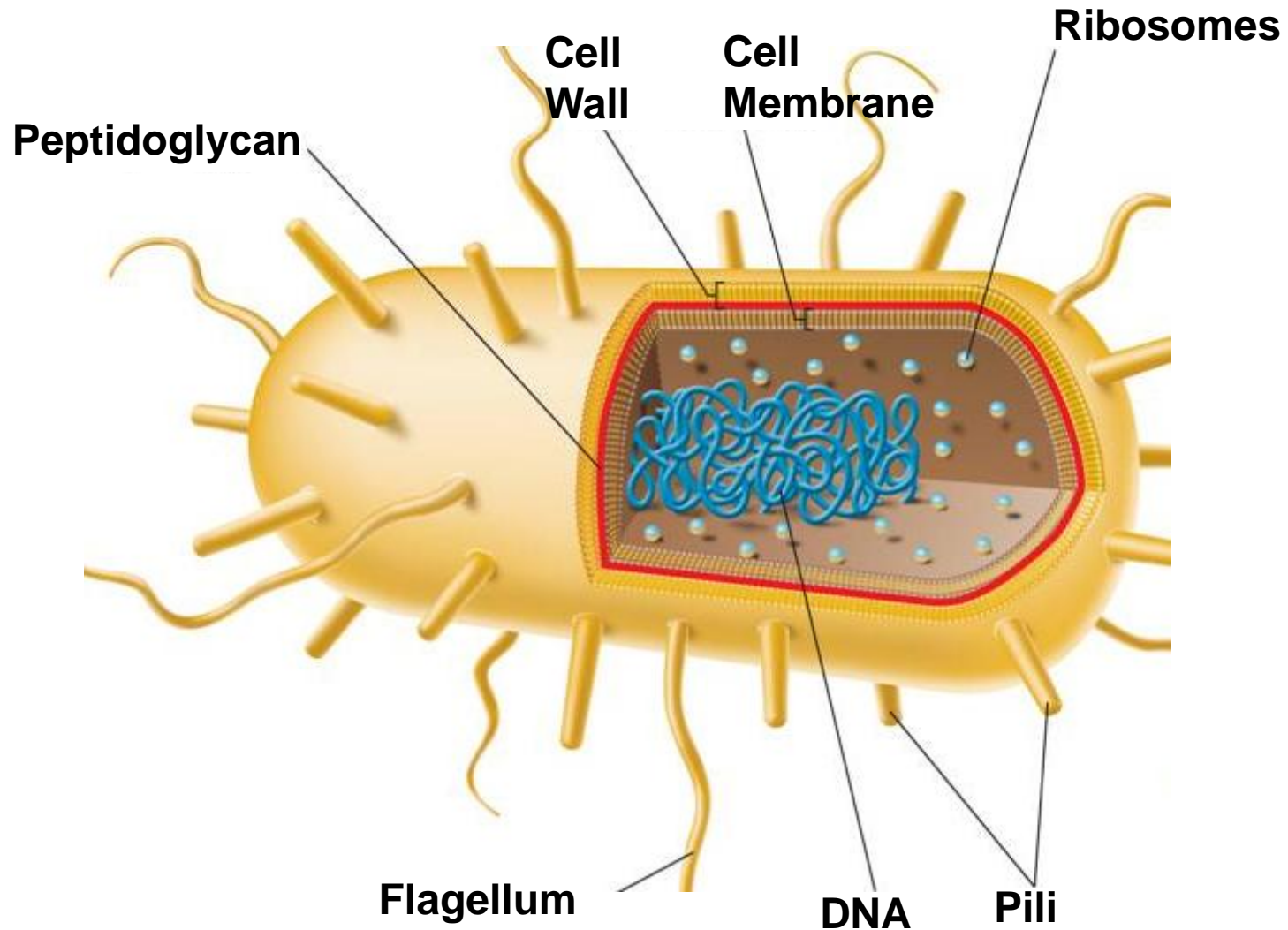
Eubacteria have a **cell wall** that **protects the cell** and **determines its shape**.

The **cell wall** of eubacteria **contain peptidoglycan**.

Eubacteria have a **cell membrane** that **surrounds the cytoplasm**.

**Some** eubacteria **have a second membrane** that **provides added protection**.

# *E. coli*, a Typical Eubacterium



Eubacteria **include organisms that live** in a variety of environments, including:

- in fresh and salt water
- on land
- in the human body

## Archaeobacteria



The **cells walls** of archaeobacteria **do not contain peptidoglycan**. Archaeobacteria have different membrane lipids. In addition, the **DNA sequences of key archaeobacterial genes are more like those of eukaryotes** than those of eubacteria.

Many archaeobacteria live in extreme environments.

- Methanogens live in oxygen-free environments, such as thick mud and animal digestive tracts.
- Other archaeobacteria live in salty environments or in hot springs where water temperatures approach the boiling point.





**Prokaryotes are identified by characteristics such as:**

- **shape**
- **the chemical nature of their cell walls**
- **the way they move**
- **the way they obtain energy**

## Shapes

Rod-shaped prokaryotes are called **bacilli**.



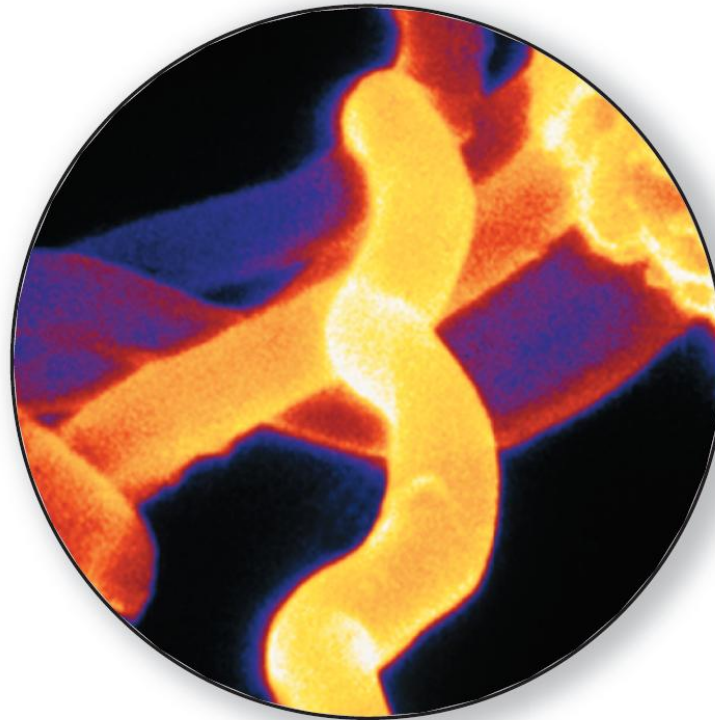
Bacilli

Spherical prokaryotes are called **cocci**.



Cocci

Spiral and corkscrew-shaped prokaryotes are called **spirilla**.



Spirilla

## Cell Walls

Two different types of cell walls are found in eubacteria. A method called gram staining tells them apart.

Gram-positive bacteria have thick cell walls with large amounts of peptidoglycan.

Gram-negative bacteria have thinner cell walls inside an outer lipid layer.

## Movement

Prokaryotes can be identified by **whether they move and how they move.**

# Metabolic Diversity

Prokaryotes are divided into **two main groups**:

- **Heterotrophs** get their energy by **consuming organic molecules** made by other organisms.
- **Autotrophs** make their own food from inorganic molecules.

## Heterotrophs

Prokaryotes that take in organic molecules for both energy and a supply of carbon are called **chemoheterotrophs**.

Prokaryotes that use sunlight for energy, but take in organic compounds as a carbon source are called **photoheterotrophs**.



## Autotrophs

**Photoautotrophs** use **light energy** to convert carbon dioxide and water to carbon compounds and oxygen.

**Chemoautotrophs** perform **chemosynthesis**. They make organic carbon molecules from carbon dioxide, but **do not require light as energy**.

**Obligate aerobes** require a constant supply of oxygen.

Bacteria that live without oxygen because they may be killed by it are called **obligate anaerobes**.

Bacteria that can survive with or without oxygen are known as **facultative anaerobes**.

# Growth and Reproduction

Most prokaryotes reproduce by **binary fission**.

**Some** prokaryotes **take part in conjugation**.

**Other** prokaryotes **produce spores**.

## Binary Fission

**Binary fission** is a **type of asexual reproduction** in which an organism **replicates its DNA and divides in half, producing two identical daughter cells.**



## Binary Fission

## Conjugation

During **conjugation**, a hollow bridge forms between two bacterial cells, and genes move from one cell to the other.

This transfer of genetic information increases genetic diversity in populations of bacteria.



## Conjugation

## Spore Formation

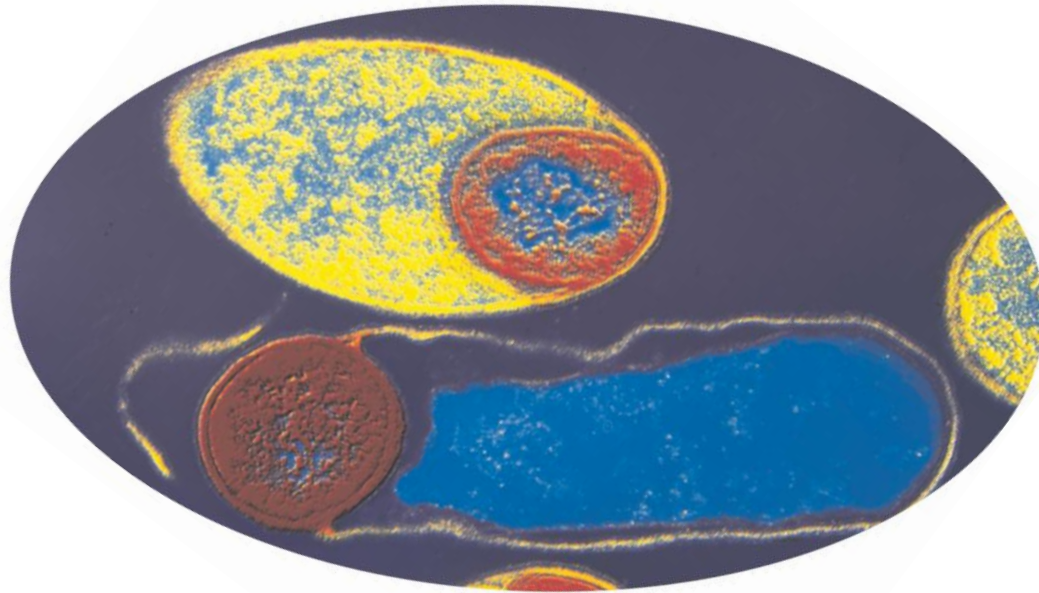
In **unfavorable growth conditions**, many bacteria form spores.

An **endospore** forms when a bacterium produces a **thick internal wall that encloses its DNA and some of its cytoplasm**.

Spores can **remain dormant for months or years**.

Spores allow bacteria to **survive harsh conditions**.





## Spore Formation

# Importance of Bacteria



**Bacteria are vital to the living world.**

- **Some are producers that capture energy by photosynthesis.**
- **Others are decomposers that break down the nutrients in dead matter.**
- **Still other bacteria have human uses.**

## Decomposers

Bacteria **recycle nutrients** and maintain equilibrium in the environment.

Bacteria also help in **the treatment of sewage**.

## Nitrogen Fixers

Plants need nitrogen gas to be changed chemically to ammonia or other nitrogen compounds, which certain bacteria produce.

The process of converting nitrogen gas into a form plants can use is known as **nitrogen fixation**.

Many plants have **symbiotic relationships** with nitrogen-fixing bacteria.

## Human Uses of Bacteria

We depend on bacteria for many things, including:

- foods and beverages
- removal of waste and poisons from water
- mining minerals from the ground
- synthesis of drugs and chemicals via genetic engineering
- production of vitamins in human intestines

# 19-1 Section QUIZ

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**Section QUIZ**

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## 19-1 Section QUIZ

**1** Which characteristic distinguishes eubacteria from archaeobacteria?

a. Eubacteria lack peptidoglycan in their cell walls.

**A** b. Eubacteria contain peptidoglycan in their cell walls.

c. Eubacteria lack a nucleus.

d. Eubacteria do not possess mitochondria.

## 19-1 Section QUIZ

2 Rod-shaped prokaryotes are called

A a. bacilli.

b. cocci.

c. spirilla.

d. streptococci.



## 19-1 Section QUIZ

**3** Bacteria that must live without oxygen are called

- a. obligate aerobes.
- b. facultative anaerobes.

**A** c. obligate anaerobes.

- d. facultative aerobes.

## 19-1 Section QUIZ

**4** Prokaryotes that make their own food molecules from carbon dioxide and water but live where there is no light are called

a. photoautotrophs.

b. photoheterotrophs.

**A** c. chemoautotrophs.

d. chemoheterotrophs.

## 19-1 Section QUIZ

**5** Bacteria that attack and digest the tissue of dead organisms are called

- A**
- a. decomposers.
  - b. nitrogen fixers.
  - c. chemoautotrophs.
  - d. archaebacteria.

**END OF SECTION**