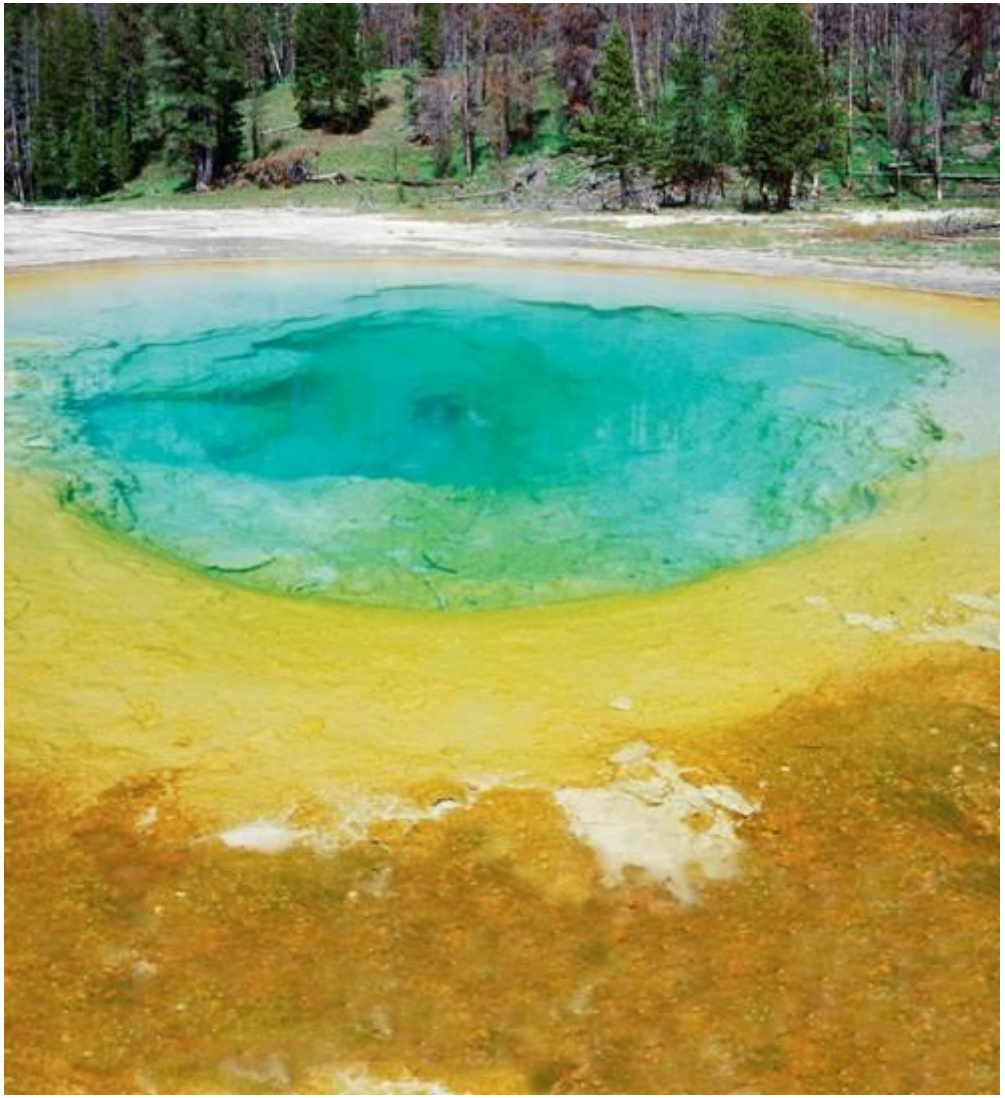
# 19–1 Bacteria



# Classifying Prokaryotes

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

All prokaryotes were once placed in the Kingdom Monera.

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

## How do the two groups of prokaryotes differ?

# Eubacteria

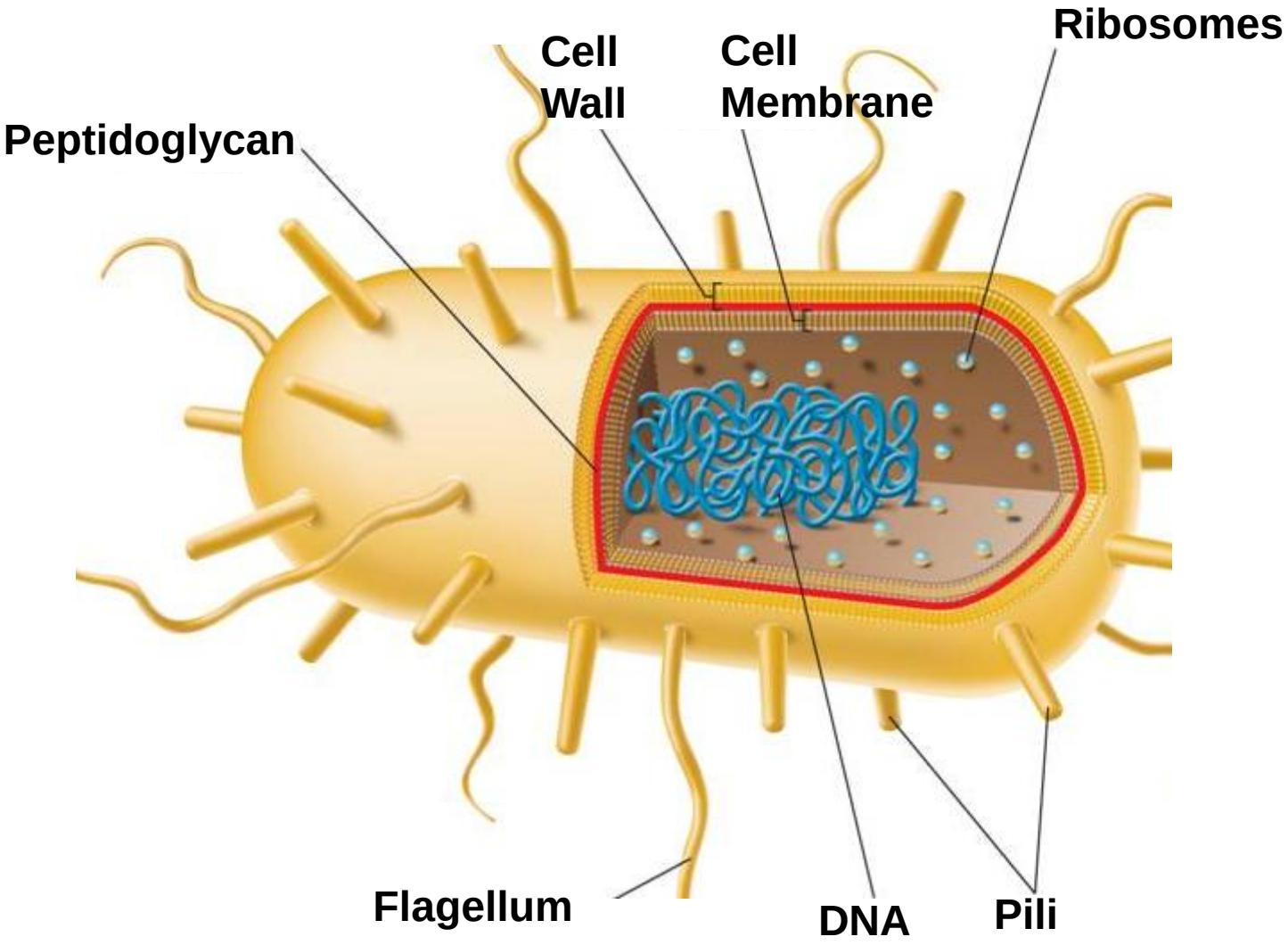
Eubacteria have a cell wall that protects the cell and determines its shape.

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

# Archaebacteria

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

Many archaebacteria live in extreme environments.

- Methanogens live in oxygen-free environments, such as thick mud and animal digestive tracts.
- Other archaebacteria 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

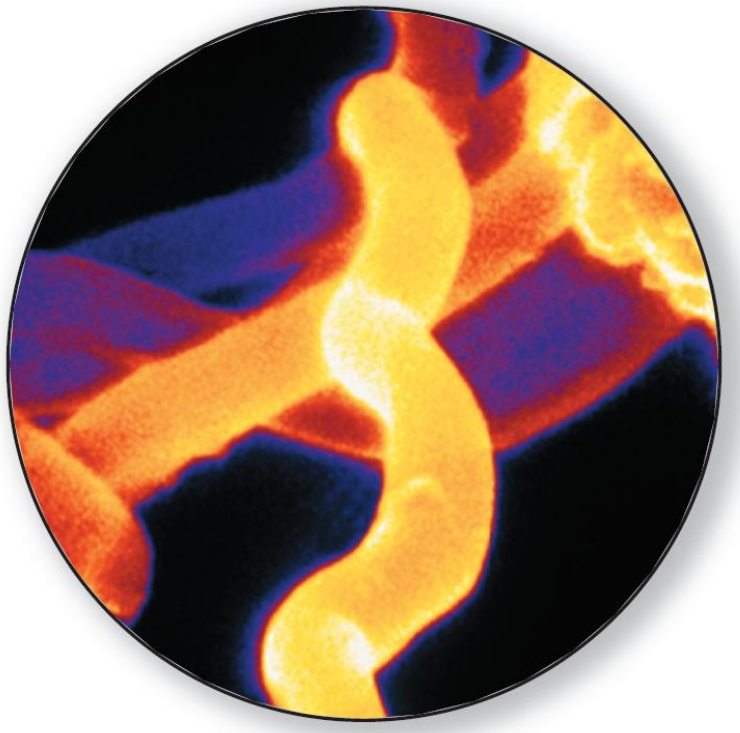
Rod-shaped prokaryotes are called **bacilli**.

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.

Some don’t move at all, some use flagella, some have cilia and some secrete a ‘slime’ like substance they ooze forward on.

# 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.

# Releasing Energy

Bacteria need a constant supply of energy, which is released by the processes of cellular respiration or fermentation or both.

**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

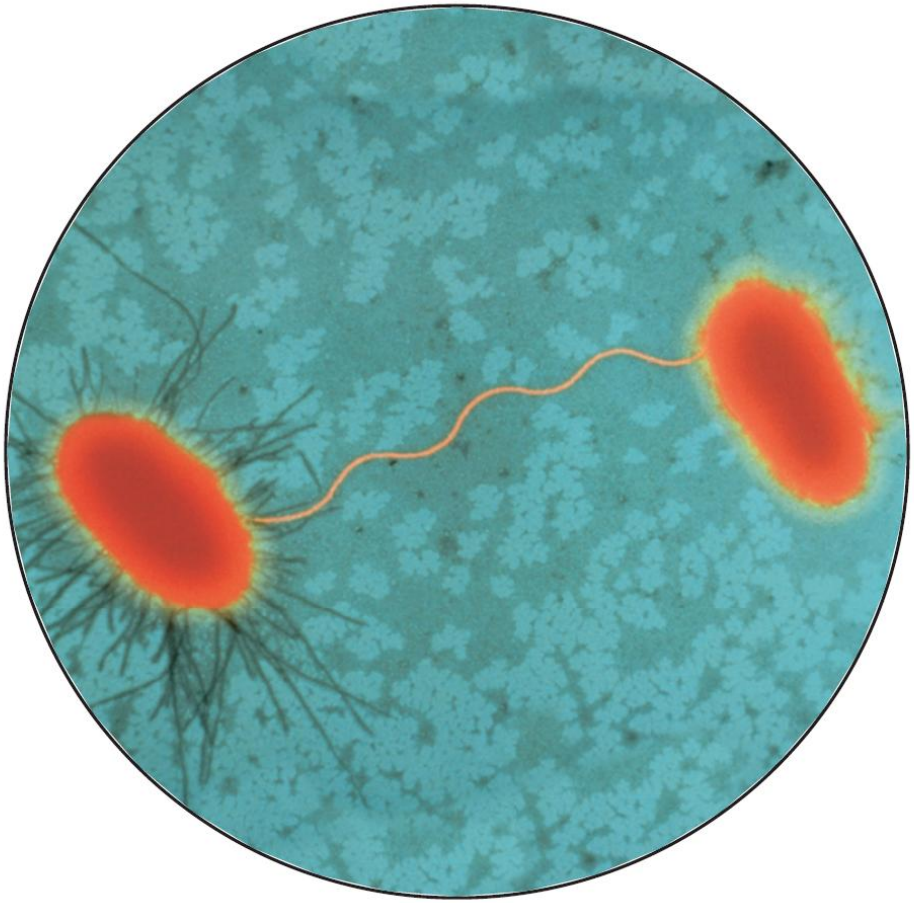
**Binary fission** is a type of asexual reproduction in which an organism replicates its DNA and divides in half, producing two identical daughter cells.

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

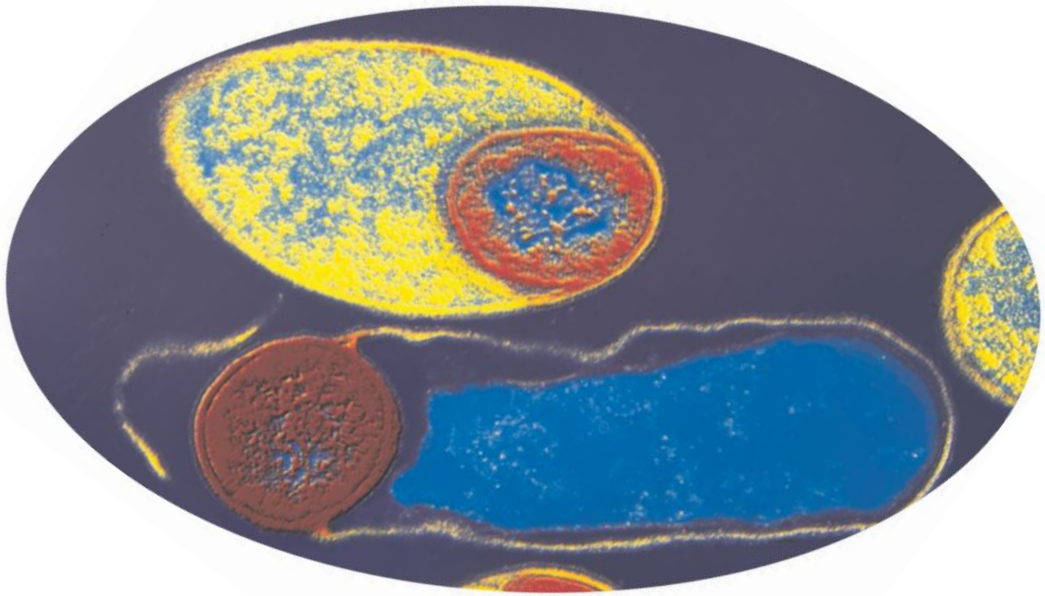
# Spore Formation

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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1 Which characteristic distinguishes eubacteria from archaebacteria?

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.

2 Rod-shaped prokaryotes are called

A a. bacilli.

b. cocci.

c. spirilla.

d. streptococci.

3 Bacteria that must live without oxygen are called

a. obligate aerobes.

b. facultative anaerobes.

A c. obligate anaerobes.

d. facultative aerobes.

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.

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