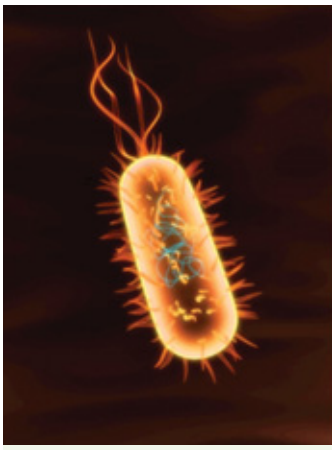
PROKARYOTIC AND EUKARYOTIC CELLS



How is this bacterium similar to a human?

reflect

Have you ever wondered how people are similar to bacteria? It may seem like a silly question. After all, humans and bacteria are very different in size and complexity. Yet scientists have learned that we also have much in common with our microscopic companions.

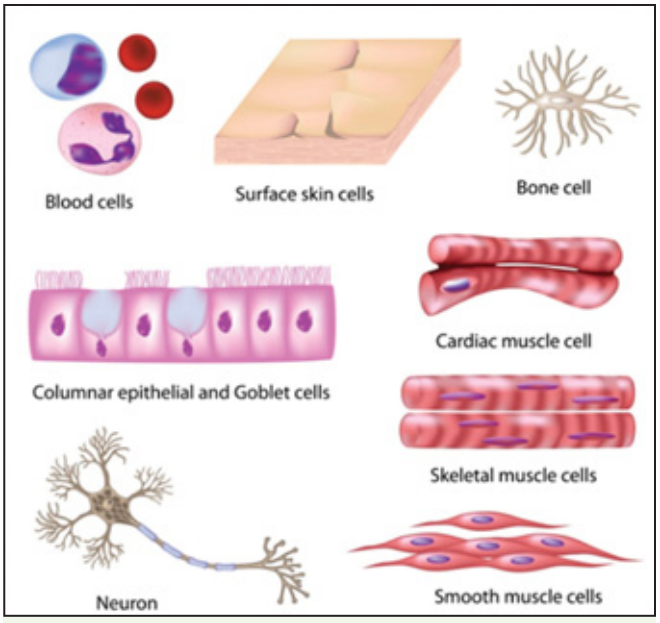
Scientists classify all **organisms** into groups based on their external characteristics. For example, some plants produce fruits with seeds, but other plants do not. Scientists also use internal characteristics to classify organisms. For example, some animals have backbones, but other animals do not. Can you think of some other external or internal characteristics that scientists can use to classify organisms?

organism: a living thing

The cell is the basic unit of life.

One of the most important internal characteristics that scientists use to classify organisms is the cell. All organisms are made up of one or more cells. A *cell* is the basic unit of life. Cells are surrounded by a cell membrane that keeps the cell intact. Inside all cells are specialized structures called *organelles* that carry out specific functions inside the cell. Organelles are suspended in a thick, gel-like fluid called *cytoplasm*.

All cells also have genetic material called *DNA.* DNA contains the instructions for making new organisms and for carrying out all functions that keep a cell alive. In some cells, DNA is packaged inside a membrane called a *nucleus*. In other cells, it floats freely in the cytoplasm.

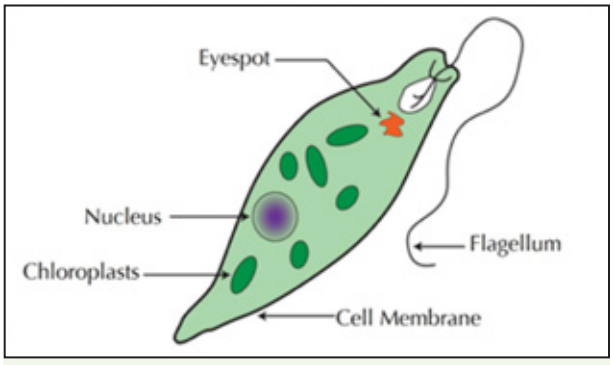


All of these different types of cells are found in the human body. Can you identify where you find these cells in the body?

PROKARYOTIC AND EUKARYOTIC CELLS

All living organisms are composed of one or more cells.
When you think about an organism, you might think of something very familiar, such as people, cats, or trees. These organisms are complex. They have different types of cells. They also have a lot of cells in their physical structures. Scientists estimate the average adult human has somewhere between 10 and 100 trillion cells in their body!

Cells come in many different sizes and types, and they are very different from each other in their shapes and functions. The diagram on the previous page shows examples of different types of cells in the human body.



Euglena are single-cell organisms that live in fresh and salt water.

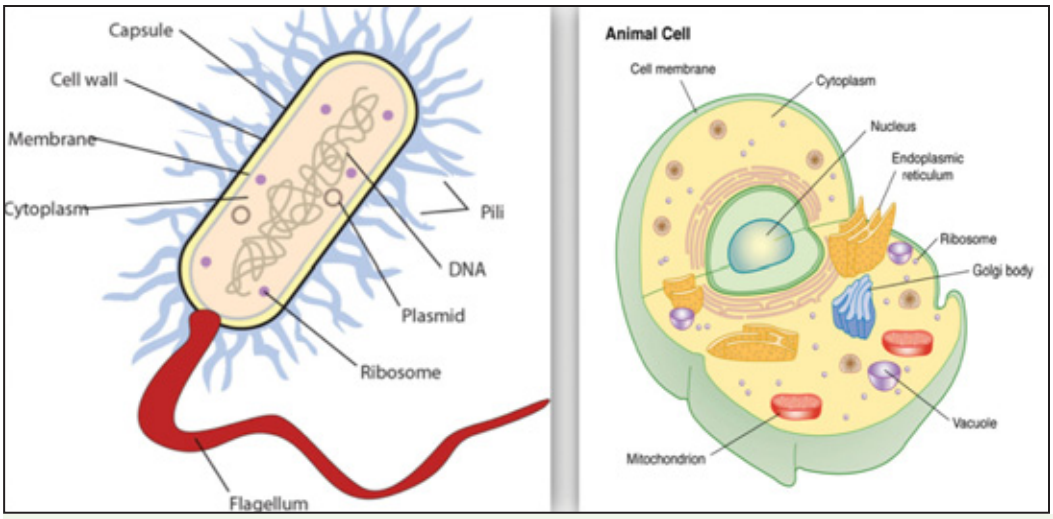
Not all organisms are complex. Some are very simple. In fact, some organisms are made up of only one cell. Take a look at this *euglena*. A euglena is an organism made up of a single cell. Unlike humans, it does not have specialized organs, such as a brain or stomach. However, it can move through its environment using its whip-like *flagellum*. It even has a primitive eye called an *eyespot* for sensing light levels. All this in a single cell!

There are two main types of cells: prokaryotic and eukaryotic.
All organisms are made up of cells. However, scientists separate cells into two categories: *prokaryotic* and *eukaryotic*. Examples of prokaryotic cells include bacteria. Eukaryotic cells include plants, animals, and fungi.

Scientists think prokaryotic cells were the first cells on Earth. The earliest records of prokaryotic cells date to around 4 3.8 billion years ago. Prokaryotic cells have the basic structures common to all cells. These structures include a plasma membrane surrounding cytoplasm. However, prokaryotic cells do not have membrane-enclosed organelles, such as mitochondria or a nucleus.

Eukaryotic cells are more complex. Similar to prokaryotic cells, eukaryotic cells have a cell membrane, cytoplasm, and DNA. However, they have something that prokaryotic cells do not. Eukaryotic cells have organelles surrounded by membranes. This includes mitochondria and a nucleus, where DNA is stored.

PROKARYOTIC AND EUKARYOTIC CELLS



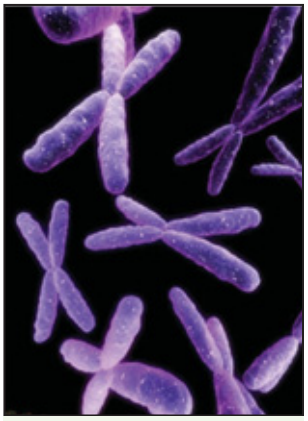
A prokaryotic cell (left) has a cell membrane, cytoplasm, and DNA. A eukaryotic cell (right) also has these features. Eukaryotic cells also have membrane-enclosed organelles such a mitochondria and a nucleus.

look out!

Prokaryotic cells were the first cells to evolve on Earth. However, this does not mean they disappeared when the eukaryotic cells evolved 1.5 billion years ago. Bacteria are prokaryotic cells that are very much still alive today. In fact, thousands of species may live in one spoonful of soil.

Prokaryotic and eukaryotic cells store DNA in different ways. Both eukaryotic and prokaryotic cells have DNA. DNA is the "blueprint" of an organism. In eukaryotic cells, the DNA is neatly organized inside a nuclear membrane. The combination of nuclear membrane and DNA is called the nucleus. Each eukaryotic cell has just one nucleus. When a cell is reproducing, the DNA organizes itself into *chromosomes* inside the nucleus.

Prokaryotic cells are less organized than eukaryotic cells. They lack a nuclear membrane around their DNA. Instead, their DNA floats in the cytoplasm. The DNA of a prokaryotic cell has a circular shape—it does not form X-shaped chromosomes.

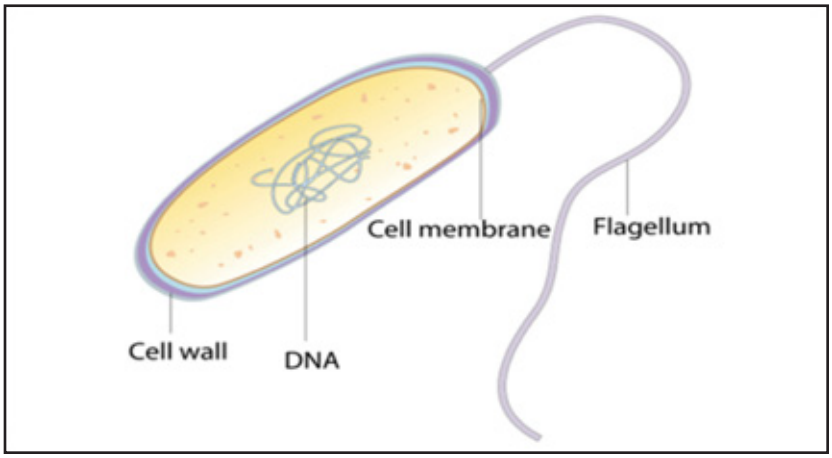


Eukaryotic cells organize their DNA into chromosomes.

PROKARYOTIC AND EUKARYOTIC CELLS

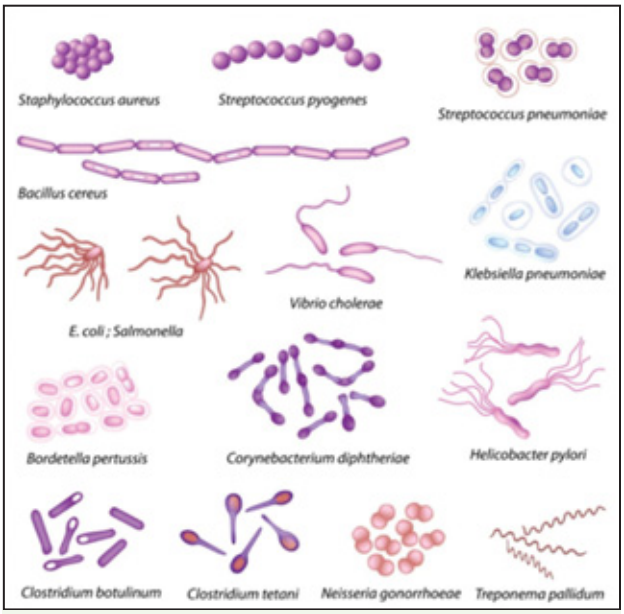
what do you think?

Does the following picture show a prokaryotic or eukaryotic cell? Why do you think this?



Prokaryotic and eukaryotic cells have other important similarities and differences. Both prokaryotic and eukaryotic cells have other things in common. Both have *ribosomes* in their cytoplasm. Ribosomes are responsible for making proteins in the cytoplasm. The ribosomes in eukaryotic cells are bigger and more complex than those in prokaryotic cells. However, they have the same function of making proteins.

Prokaryotic cells tend to be much smaller than eukaryotic cells. On average, eukaryotic cells are about 10 times larger than prokaryotic cells. Eukaryotic cells have much greater diversity in shape and size than prokaryotic cells. Organisms with prokaryotic cells are so small they can be seen only through a microscope. You also need a microscope to see eukaryotic cells. However, many organisms with eukaryotic cells are large enough to see without a microscope.



These pictures represent some of the bacteria that commonly infect humans. Can you identify the cells that are spherical (round), rod-shaped, and spiral?

PROKARYOTIC AND EUKARYOTIC CELLS

Both prokaryotic and eukaryotic cells can be single-celled organisms. However, there are no multicellular prokaryotes. Only eukaryotes can be multicellular.

Eukaryotic cells come in all sorts of shapes and sizes. Prokaryotic cells have just three possible shapes: rod, spherical, and spiral. The shape of the cell helps scientists identify prokaryotes using a microscope.

Career Corner: Knowing the different types of cells can save lives.
When a person is infected with a bacterium, it is important to know the identity of the infectious agent. Antibiotic drugs can be specific for particular organisms. If a doctor does not know which organism is causing an illness, the doctor may not be able to treat the patient.

Doctors will often take a small sample of an infected area. For example, a patient with symptoms for strep throat may be given a throat swab. The swab is then cultured to grow any microorganisms present in the patient. When there are enough microorganisms growing in the culture, the doctor may be able to identify which species is causing the illness. They can then prescribe an appropriate treatment.

What do you know?
Scientists classify cells as prokaryotic or eukaryotic. The table below has a list of cell structures. For each structure, circle the cell type(s) where you would find this cell structure.

Cell Structure	Cell Type		
Mitochondria	Prokaryotic	Eukaryotic	Both prokaryotic and eukaryotic
Ribosomes	Prokaryotic	Eukaryotic	Both prokaryotic and eukaryotic
Nucleus	Prokaryotic	Eukaryotic	Both prokaryotic and eukaryotic
DNA	Prokaryotic	Eukaryotic	Both prokaryotic and eukaryotic
Cell membrane	Prokaryotic	Eukaryotic	Both prokaryotic and eukaryotic

PROKARYOTIC AND EUKARYOTIC CELLS

connecting with your child

Prokaryotic and Eukaryotic Cells in Your Neighborhood

Students remember information best when they are able to associate new information with familiar topics. Take your student for a walk in their neighborhood. Take turns playing "I spy" to identify organisms you find. These may include animals, plants, and fungi. As you play the game, identify each organism as prokaryotic or eukaryotic. (All of the organisms that you "spy" will be eukaryotic, as prokaryotic cells can only be seen with a microscope.) Be careful not to touch or otherwise disturb any organisms that you observe.

Some questions you may wish to discuss include:

- Why did you find only eukaryotic organisms on your walk? (*Prokaryotic cells can only be seen with a microscope.*)
- Where might you expect to find prokaryotic organisms? (*Answers might include in the soil or in the water.*)
- Have you ever been sick because of an infection by a prokaryotic organism? (*Answers will vary. Keep in mind that bacteria are prokaryotes, whereas viruses are not. Children are often familiar with strep throat, which is caused by bacterial infection, and the common cold and flu, which are caused by viral infections.*)

Students might be tempted to classify organisms based on whether they can see them with their unaided eyes or with a microscope only. It is important to stress that eukaryotic and prokaryotic cells are not classified on the basis of whether a microscope is necessary to observe them. Instead, the classification of eukaryotic and prokaryotic cells is based primarily on whether the cell's DNA is organized in a nucleus (eukaryotic) or whether it floats in the cytoplasm (prokaryotic).