

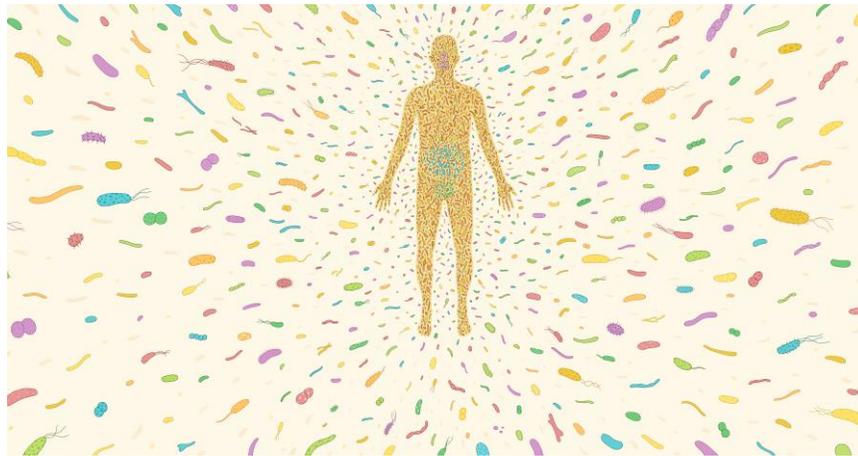
Human Microbiome: The Role of Microbes in Human Health

This StepRead is based on an article provided by the American Museum of Natural History.

You Are an Ecosystem

An ecosystem is a community of living things that interact with each other and with the non-living things in their environment. A forest is an example of an ecosystem. Every forest has a unique mix of living things, like plants and animals, and non-living things, like air, sunlight, rocks, and water.

The human body is also an ecosystem. It is home to trillions of bacteria, viruses, fungi, and other tiny organisms. These organisms are known as microbes. Together they form communities that make up the human microbiome. Like fingerprints, no two human microbiomes are the same. That makes each person not just an ecosystem, but a *unique* ecosystem.



The human body is an ecosystem. We are home to trillions of microbes.

Photo Credit: AMNH

Microbes have been around for more than 3.5 billion years. That makes them the oldest form of life on Earth. For the past six million years they have been evolving together with humans. As they have changed over time, microbes and humans have formed complex relationships with each other. Humans need microbes to stay healthy, and many microbes need the environments provided by the human body to survive.

Just like bigger organisms, the species that make up a microbiome interact with each other. They rely on these interactions to grow and stay healthy. Different species live in different places in and on our bodies, and they are adapted to the conditions in these places.

Scientists are studying how these microbes work in our bodies and learning about the balance among different bacterial communities. Some of what they have learned about bacteria has come from their study of fungi. Fungi have been competing with bacteria for millions of years. During that time, fungi evolved the ability to produce chemicals that kill bacteria. By studying fungi, scientists learned how to make these antibacterial chemicals themselves and turn them into antibiotic drugs. These drugs have saved millions of lives by killing harmful bacteria. However, they also kill helpful bacteria. Products like antibacterial hand sanitizers have the same effect on a patch of skin. They kill both the good and bad bacteria there. Studies suggest that the increasing use of antibiotics in the United States has made our microbiomes less diverse. There seem to be fewer kinds of bacteria living in them than there used to be.

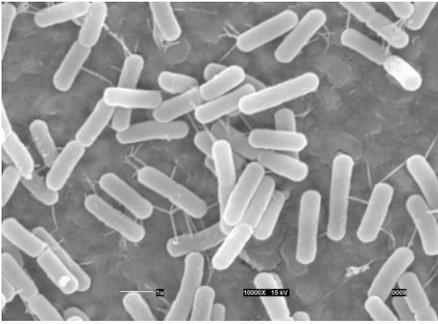
Supporting Players

Are the bacteria in your body your friends or your enemies? Do they cause disease or protect you? It depends.

Thousands of species of bacteria live in and on our bodies. Scientists are only beginning to understand the complex relationships among them, and the relationships between them and us. We know that some of these species can cause disease. However, scientists are discovering that most bacteria are not harmful. Rather, many help us in a variety of ways. For example, some help us digest food and protect our teeth.

Scientists are just beginning to understand what roles these organisms play in human health. Their relationship with humans is complicated. The effects they have on people depend on how many of them there are and on the conditions in the human body where they are living. What is the key to this relationship? Balance. Here are some of the species that play an important part in maintaining a healthy state of balance.

Skin Deep



This bacterium releases chemicals to kill fungus, possibly including species of fungus that cause athlete's foot.

Photo Credit: iGEM

It may be no surprise that many of our body's most diverse populations of bacteria live on the skin, which is our point of contact with the world. There are at least 1,000 different species of skin bacteria, along with dozens of fungi and other microbes. Most aren't harmful, and many protect us. They live among the dead skin cells that make up our skin's outside layer, and they defend where they live against other microbes. One example of bacteria that protect us is a strain, or type, of the bacterium *Bacillus subtilis*. It can be found on the skin, and it makes bacitracin, a poison that helps it fight off other microbes. Scientists have taken advantage of bacitracin's antibiotic qualities and used it in antibiotic ointments.

Gut Feeling



***H. pylori* can cause diseases like gastritis. It also helps protect against diseases like asthma, allergies, and even cancer.**

Photo credit: AMNH

In the 1980s, a doctor infected himself with a bacterium called *Helicobacter pylori*. He and another doctor made several discoveries about this common organism. They discovered that it causes gastritis, which is an irritation or inflammation of the stomach lining. They also discovered that it caused ulcers in the stomach and elsewhere. As a result of their discoveries, the doctors were given the Nobel Prize. For a long time, people had

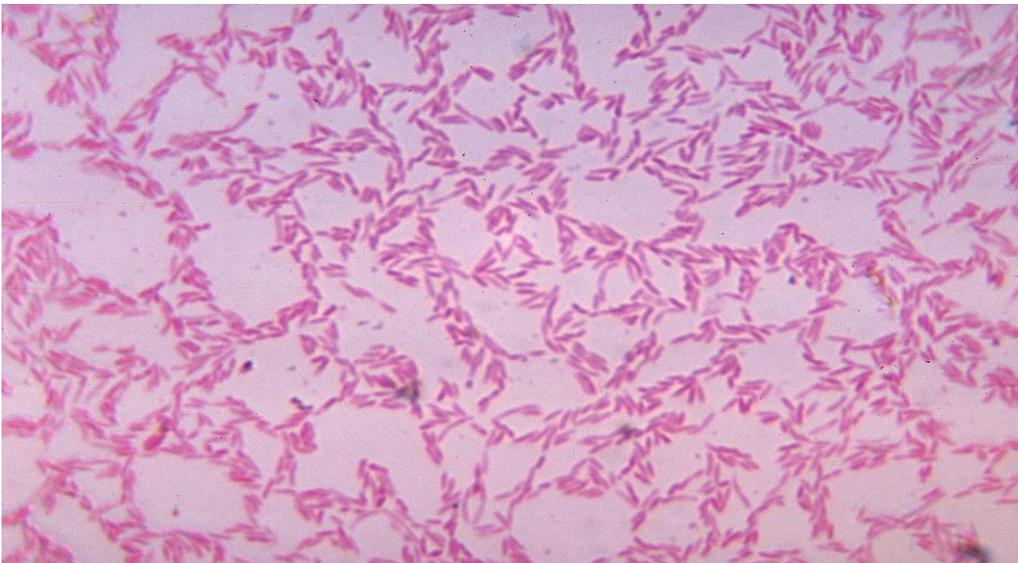
thought that these ulcers and gastritis were caused by too much acid from stress. Today, treatment with antibiotics has almost gotten rid of stomach ulcers in developed countries. It has also led to a drop in stomach cancers, which gastritis makes people more likely to get. But, as welcome as these cures are, scientists now think that *H. pylori* also plays a positive role in human health. New diseases related to the loss of *H. pylori* are on the rise. Studies suggest that it is important to the prevention of asthma, allergies, cancer, and digestive disease.

Look, Mom, No Cavities!

Who hasn't heard of the terrible strep throat? It's a very painful inflammation of the back of the throat that is caused by a bacterium. The bacterium is called *Streptococcus pyogenes*, which is where the name "strep" throat comes from. The same bacterium also causes a type of heart disease.

There are actually more than 50 species of *Streptococcus*. Many of them are found in the human mouth, respiratory tract, and other organs. Some, like *Streptococcus pyogenes*, cause disease. The diseases they cause range from cavities to pneumonia. But others seem to do no harm and may even work against harmful strains of *Streptococci*. *Streptococcus salivarius* is one example of a harmful strain. It's found in the human mouth and respiratory tract, and it can be dangerous to people with weakened immune systems if it gets outside the mouth. But in the mouth it seems to help prevent both gum disease and tooth decay.

Colon Colony



***Bacteroides* are by far the most numerous bacteria in the human body. They help the human body digest food.**

Photo Credit: AMNH

Many more bacteria live in your colon than anywhere else in your body. Most of them don't need oxygen. That includes species in the genus *Bacteroides*, which are among the most common kinds of bacteria. Outside

of the gut, strains of *Bacteroides* can cause painful swelling in the abdomen, brain, liver, pelvis, and lungs. They can also cause an infection of the bloodstream. But in the colon they break down carbohydrates, make enzymes for specific foods, and get energy out of those foods. One of these species seems to stimulate immune cells called regulatory T-cells. These cells hold back inflammatory T-cells that can cause colitis and other disorders. Scientists are also beginning to identify a possible relationship between what is in our gut microbiome and the tendency of some people to be very overweight. Studies have even found that microbiomes have an effect on the moods of mice. These studies suggest that the bacteria in our gut could play a role in conditions like depression. It's clear that the bacteria in our colon are extremely useful.

Being Healthy Means Having a Balanced Microbiome

We're covered in bacteria and other microorganisms from the time we are born. Our microbiome grows and changes with us throughout our lives. It reflects the places we go, the things we do, and the food we eat. We now understand that a diverse and balanced microbiome is necessary for a strong immune system. Some scientists think that babies who do not have much contact with microbes get more allergies, asthma, eczema, and other health problems. In fact, the microbiome is so important that it is like another organ. It is a part of the body that serves a necessary function, just as the skin and kidneys do. Taking care of it helps to keep our bodies functioning properly.