



Friends

Microorganisms!

Name _____

Grade _____ Teacher _____

School _____



UNIVERSITY OF
GEORGIA





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What are microorganisms?

Microorganisms or microbes are living things that are too small to be seen with the naked eye. Since they're too small to see, we use tools, like microscopes, to magnify them. Common microorganisms include bacteria, viruses and even fungi. Other types include algae, archaea, protozoa, and slime molds.

Even though they are tiny, they are important!

Join me, **Arch the Dawg**, as we learn more about the amazing world of microorganisms!



Georgia 4-H is a partner in public education and strives to incorporate Georgia Standards in the education materials produced for in-school use. The following Georgia Standards are correlated to the content delivery included in this publication:

SSL4. Obtain, evaluate, and communicate information about how microorganisms benefit or harm larger organisms.

- Construct an argument using scientific evidence to support a claim that some microorganisms are beneficial.
- Construct an argument using scientific evidence to support a claim that some microorganisms are harmful.

MGSE5.NBT.5 Fluently multiply multi-digit whole numbers using the standard algorithm (or other strategies demonstrating understanding of multiplication) up to a 3-digit by 2- digit factor.

Standards from Georgia Standards, www.georgiastandards.org

Think Green! Not just 4-H Green...but let's help do our part to recycle and reuse. Save this book, reread it or pass it along to a friend. If it's too worn, please recycle it.





LET'S GET MICROSCOPIC



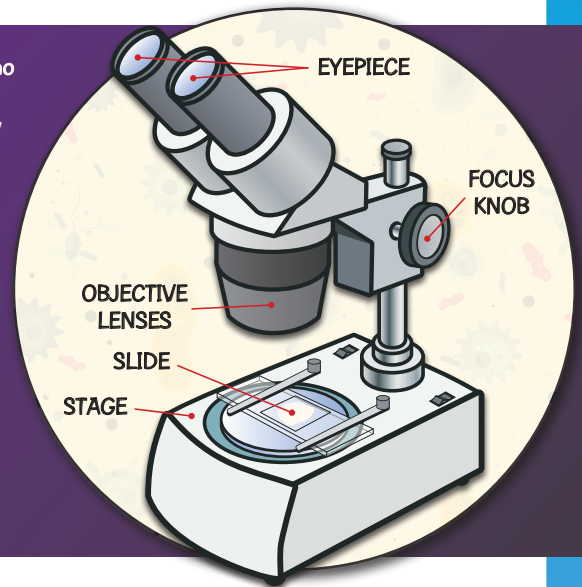
Antony Van Leeuwenhoek

A **microorganism** is a tiny living thing that may exist as a single cell or as a small colony of cells. Microorganisms can also be called microbes. They are very small and can be seen only through a microscope. Microorganisms include algae, archaea, bacteria, fungi, protozoa. Although viruses are not considered living organisms, they are sometimes classified as microorganisms. **Microbiology** is the science that studies microorganisms.

Antony Van Leeuwenhoek is known as the Father of Microbiology. He lived in the Dutch Republic from 1632-1723. He was originally a fabric merchant who created his own microscopes to inspect the quality of his fabrics. A **microscope** is an instrument that is used to magnify small objects. Due to his curious mind, he later used his microscope to look at different things, like water, blood, and saliva. He saw tiny things moving around and called them **animalcules**, which means little animals. Before this, no other scientist had reported seeing such things, so other scientists didn't believe him at first. However, after writing to England's Royal Society and showing them his discovery, other scientists started to listen to him. As he and other scientists began to use microscopes to see more animalcules, they realized they weren't actually tiny animals – instead, they were different types of tiny organisms, such as bacteria, viruses, and fungi.

Microbiologists use microscopes to study microorganisms. Although it is unknown who invented the first microscope, Zacharias Janssen is thought to have made one of the earliest compound microscopes around 1600. The earliest microscopes could magnify an object up to 20 or 30 times its normal size.

- At the top of the microscope are one or two tubes containing lenses, called the **eyepiece**. This part scientists look through to see their specimen.
- The **objective lenses** are the magnification lenses that directly observe the specimen the scientist is examining.
- Scientists usually look at specimens mounted on pieces of glass called **slides**. The slides are clipped onto a flat area called a **stage** that is beneath the objective lenses.
- Under the stage is a light that shines upward and illuminates the specimen.
- The side of the microscope has **focus knobs** that adjust the sharpness of the image by changing the focus of the lenses.



Calculate how strong a microscope is! To determine the overall magnification of a microscope, you multiply the strength of the eyepiece by the strength of the objective lens.

Microscope	Eyepiece Strength	Objective Lens Strength	Total Magnification
example	10x	10x	100 times magnification
A	5x	10x	
B	10x	20x	
C	10x	40x	

Answers: A = 50x magnification, 200x magnification, 400x magnification



BACTERIA

Bacteria are single-celled living organisms with no nucleus. Bacteria can come in a variety of shapes. The three common shapes of bacteria include (1) cocci bacteria that are spherical, (2) bacilli bacteria that are rods, and (3) spirilla bacteria that are spiral-shaped. They can exist as single cells or in pairs, chains, or clusters.

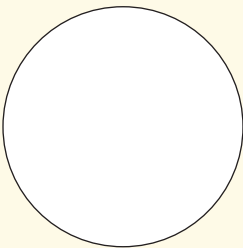
Bacteria are found in every habitat on Earth: in soils, on rocks, in the ocean, in arctic snow, and even in your body! Some are helpful, while other bacteria can cause us to become sick. **Try drawing the bacteria below!**



Staphylococcus aureus
("staph" infection)

Cocci Bacteria

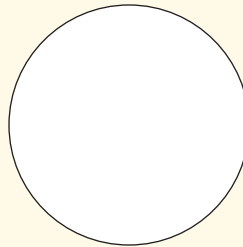
Spherical-Shaped



Bacillus anthracis
(anthrax agent)

Bacilli Bacteria

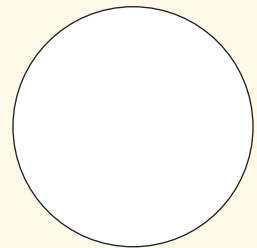
Rod-Shaped



Helicobacter pylori
(causes stomach ulcers)

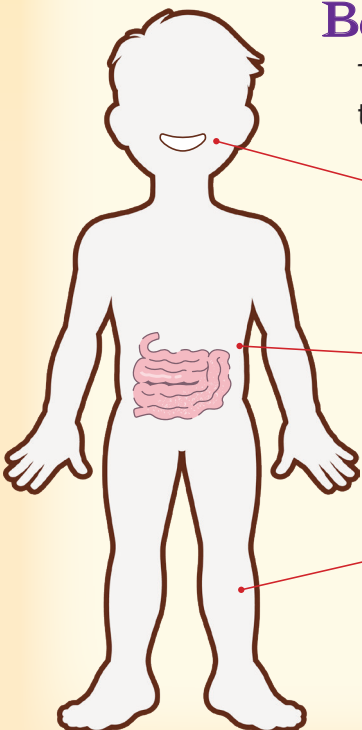
Spirilla Bacteria

Spiral-Shaped



Beneficial Body Bacteria

The human body contains trillions of microorganisms, but because of their small size, microorganisms make up about 1-3% of the body's mass!



The Mouth

A group of helpful bacteria called *lactobacilli* can fight several kinds of bad bacteria and may help restore a healthy balance in your mouth. They can also help prevent gum disease and reduce plaque, which causes cavities. There are other types of good bacteria in your mouth that help begin breaking down foods in the digestion process.

The Gut

The gut is also known as the digestive tract or gastrointestinal (GI) tract. It covers the parts of the body involved with food intake and output. Bacteria in the gut help us break down foods, absorb nutrients, and produce vitamins in the intestines. Good bacteria are just a natural part of your body. Eating a well-balanced diet rich in fiber every day helps to keep the number of good bacteria at proper levels.

The Skin

The skin is the largest organ of your body! Beneficial skin bacteria can prevent the growth of other, potentially harmful microbes. Studies have also shown that some skin bacteria interact with the immune system to help fight infection. Researchers have also discovered how a bacterium that lives on the skin, called *S. epidermidis*, helps protect the skin from water loss and damage.



VIRUSES



Bacteriophage virus
attacking host bacteria

Viruses are single-celled entities that can only survive and reproduce when they are inside the cells of other living things. Once they enter a living organism, they multiply and cause diseases. However, because they can only reproduce with a host, they are not considered to be alive. Examples of viruses include COVID-19, Influenza (the flu), and Varicella-zoster (chicken pox).

Most viruses are bad for us and can cause a lot of illnesses. One of the biggest things you can do to protect yourself against viruses is getting all your vaccines. When you get a vaccine, your immune system produces antibodies to get rid of the virus or bacteria. The immune system is made up of a network of cells, tissues, and organs that work together to protect the body. If you get a vaccine and then are ever exposed to the real virus, your body's immune system remembers the vaccine and is ready to fight off the real thing! Vaccines teach your body how to fight the virus before you get it, so you will get less



sick. Some vaccines require you to get a booster shot which gives your immune system a "memory boost" to remind it what to do if it sees the real germ again.

In addition to getting all your vaccines, other things you can do to stop the spread of viruses include washing your hands with warm water and soap, coughing into your sleeve/elbow, cooking your food to the right temperatures, getting sleep each night, exercising, and eating foods high in vitamins and minerals. You should also stay away from others when you feel sick and encourage your friends and family to do the same.



ARCH'S RUFF DAY

Read this short story about Arch the Dog. Record all the different ways he spreads germs throughout the day.

Next time, what could Arch do to prevent spreading his germs?

Arch wakes up in the morning with a sore throat, a stuffy nose, and cough. He isn't feeling very well, but he has basketball practice today, and he doesn't want to miss it. He gets ready for school and kisses his mom and dad on the cheek before catching the bus where he waves hello to the bus driver. He sits next to his best friend Regina, and they play a card game on the bus. While walking to class, Arch feels a sneeze coming on and sneezes into his hand. He gives his teacher a high-five at the door and goes to the sink to wash his hands. There is no soap or hot water, but he washes them anyway. He goes through the rest of the day doing his work and talking to his classmates. After school, he is starting to feel really tired. At basketball practice, Arch begins to feel really warm and stomach starts to hurt. The coach sends Arch to the nurse, where she calls his parents to come pick him up from practice early.

How did Arch spread his germs?

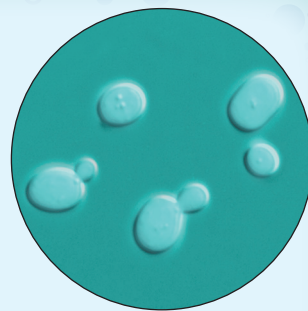
How could Arch have prevented spreading his germs?



FUNGI

Fungi can be single-celled or multi-celled organisms. They cannot produce their own food, so they rely on getting their nutrients from the environment. Most fungi are decomposers. **Decomposers** are organisms that break down organic material. **Yeasts** are tiny one-celled fungi organisms. Some yeasts are harmful to humans, but most are very useful, especially in making bread and other food and drinks like kombucha and soy sauce.

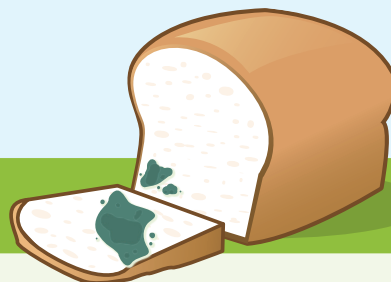
Molds are forms of fungi as well. Mold spores are often spherical or ovoid single cells, but some can be multicellular and variously shaped. They are usually larger than yeasts, but they do not have the large, visible structures that mushrooms (another kind of fungi) have. Some molds can be harmful if you breathe them or eat them. Other molds are beneficial. For example, blue cheese is semi-soft cheese with a sharp, salty flavor. It is made with cultures of the edible mold *Penicillium*, giving it spots or veins throughout the cheese in shades of blue or green.



bread yeast cells,
Saccharomyces cerevisiae



Grow your
OWN MOLD!



In this short experiment, you will get to grow your own mold and record your results.

Gather the following materials: clear plastic bag that seals, permanent marker, 1 slice of white bread, and water (preferably in a spray bottle).

- On the outside of the plastic bag, **write the date** and "**WARNING: Do not open. Growing mold.**"
- Place the slice of bread inside the bag.
- Spray the bread with water a few times until it is damp.
- Once it is damp, zip-close the bag. Make sure it is completely sealed.
- Choose where you want to leave your bread. It can be placed at room temperature on a table/counter, in a cool spot like the refrigerator, in a dark spot like the back of a closet, or even in a warm spot outside.
- Check on the bread each day for 2 weeks. You'll want to notice which day you start to see the mold begin growing and record it below. **At the end of two weeks, draw what you see below and answer the questions.**

Where did you place your bread? _____

How many days did it take for the mold to start to grow? _____

How do you think the location (temperature and/or amount of light) of the bread affected the mold growth? _____

You can also repeat the experiment multiple times to see in what environment mold grows on the bread the fastest and if they are different types of mold.



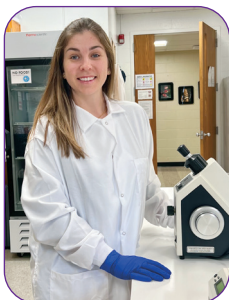
WARNING: Throughout the entire experiment, **DO NOT OPEN** the bag. Mold can be dangerous if you breathe or ingest it. It is safe inside the bag, but make sure it is sealed properly. Once you are done with the experiment, throw it away in the trash.



MEET THE EXPERTS

Learn more about different careers related to microbiology!

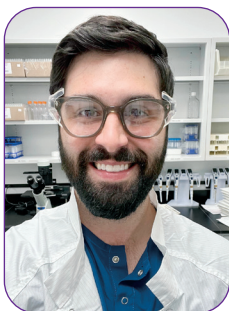
Dr. Carla Schwan, *Food Microbiologist*



Carla Schwan is a food scientist at the University of Georgia. Carla spends lots of time in the lab, exploring the world of microorganisms and how they interact with food. Part of her job is figuring out smart ways to keep harmful microbes away from your meals. Microbes are present in everything we use and consume. Carla's job is to observe and analyze how food is made, stored, and kept fresh using new ideas and machines in her lab to limit the number of harmful microbes that are present. But Carla's work goes beyond being in the lab. She also leads programs such as Science and Practice in Home Food Preservation, where she teaches people in the community how to keep their food safe at home too! As the leader of the National Center for Home Food Preservation, she responds to and helps people across the country learn how to preserve their foods, using methods like canning, drying, freezing, making jams and jellies, and pickling.

Carla also leads the ServSafe program, a certification that helps educate people in the food industry on storing food properly, so it stays safe at all stages of use! A **foodborne illness** is a very serious sickness caused by consuming contaminated food or beverages. She teaches important things about handling and storing food so you can avoid getting sick. Carla shares easy tips and tricks you can use daily and busts myths about food safety. Sometimes people believe things that aren't true, and Carla helps you understand the real facts. She even shows step-by-step instructions for keeping our food fresh and yummy for longer.

Jared White, *Vaccine Developer*



Jared White is a vaccine developer at Boehringer Ingelheim Animal Health in Athens, GA. Just like microorganisms can be harmful to people, microorganisms can be harmful to animals, too. A **zoonotic disease** is a disease that can be transmitted to humans by animals. Rabies is an example of a zoonotic disease caused by a virus that spreads to people through contact with infected saliva through bites or scratches. Each year, pets like dogs and cats need to get a rabies shot.

At the lab, Jared and a team of other scientists work on researching, developing, and manufacturing vaccines for pets. Boehringer Ingelheim is the second largest animal health business in the world, and they operate in more than 150 countries worldwide. They grow large amounts of different viruses (like rabies) and then harvest the antigen to make the vaccine. Before the shot is given to animals, Jared and others test the vaccine to make sure it is safe and effective. Thanks to Jared and his team, our pets are healthier than ever!

Careers related to microbiology sound awesome!

Why are careers related to microbiology important? _____

After reading about the two different careers above, which one seems interesting to you? Why?

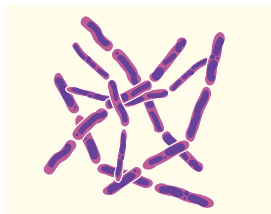


WHAT IS IT?

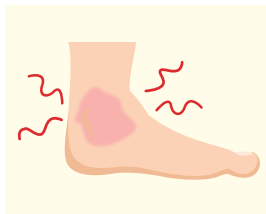
Throughout this book, you learned about different microorganisms. Label each of the images below as being either a **bacteria**, a **virus**, a **fungi**, or **none**. Afterward, check your answers!



Toothache _____



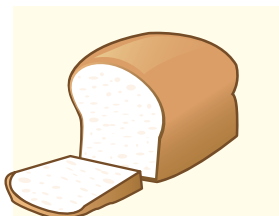
Anthrax Agent _____



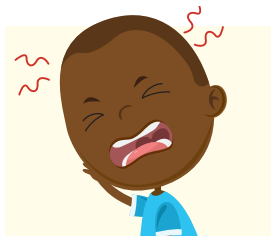
Sprained Ankle _____



Broken Arm _____



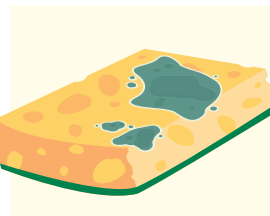
Yeast in Bread _____



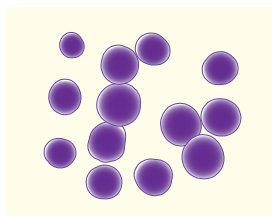
Headache _____



Chicken Pox _____



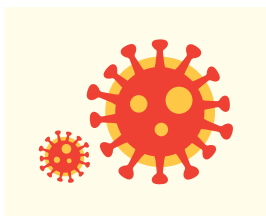
Moldy Sponge _____



Staph Infection _____



Flu _____



COVID-19 _____



Stomach Ulcer _____
caused by *H. pylori*

Answers: toothache – none, anthrax agent – bacteria, sprained ankle – none, broken arm – none, yeast – fungi, headache – none, chicken pox – virus, mold – fungi, staph infection – bacteria, flu – virus, COVID-19 – virus, stomach ulcer – bacteria.



REFERENCES AND RESOURCES



Georgia Performance Standards, www.georgiastandards.org

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