Grades 3-4: All About Bacteria!

What is Biology? What are bacteria? What is synthetic biology? What is iGEM? Growing bacteria cultures.
Duration: 2 days -- Day One: 1 hour and Day Two: 0.5 hour

Bacteria are all around us, and younger students are often under the impression that bacteria are all “bad”. The purpose of this activity would be to show them that the majority of bacteria are actually “not so bad”, and some are even “good”--in fact, bacteria all play roles in our world. We also hope to introduce biology and synthetic biology.

Day One

PART ZERO: INTRODUCTION

Time allocated: 1 minute

Hi everyone! We’re from the UW iGEM Team (we’ll tell you all about that later). And, today, we want to talk to you about what we do. *Introduce team members.*

PART ONE: WHAT IS BIOLOGY?

Time allocated: 3 minutes

Does anyone know what Biology is?

Biology is the study of living things--this means we biologists study how living things work and why they do what they do so they can stay alive.

Can anyone give us a few examples of what “living things” are?

We try to figure out what’s inside living things and how they work. There are many different specific things biologists study and since living things are so complicated, a lot of biologists focus on one part of what makes a living thing--so, there are lots of different kinds of biology: biology that focuses on studying *really* small living things, for example... or biology that focuses on studying plants or animals.

PART TWO: WHAT IS MICROBIOLOGY?

Time allocated: 2 minutes

Microbiology is one kind of biology. It involves studying really, really, really, *really* small livings things... things you can small things that you can’t see without a microscope! Get it? *Micro*biology? The word “micro” means really small.

Can anyone give us an example of microorganisms?

That’s right, bacteria is a microorganism!

PART THREE: WHAT ARE BACTERIA?

Time allocated: 10 minutes

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Has anyone heard of bacteria? What do you know about bacteria? Where can you find bacteria?

See, the truth is, bacteria are *all* around us. As a matter of fact, scientists estimated that if you put all the bacteria together in the entire world, their mass would actually more than the mass of all other livings--this includes plants and animals--put together! That's a lot of bacteria!

Who can tell us what a "cell" is?

Livings things are all made of "cells" -- billions and billions of cells -- and are, in fact, considered living things themselves. Depending on how they are made and how they're put together, cells make up all our organs and all the parts that make us go!

Now, bacteria... believe it or not... are living things that are made up of only *one cell*. This is why they're so small! They're really interesting living things because they can live just about everywhere on earth--even in places most other living things can't survive, like deep inside the Earth's crust or at the very bottom of the ocean... or inside other living things, like animals!

Scientists have actually figured out that there are usually about 40 *million* bacteria in *one single gram* of soil and about one *million* bacteria in a *single millilitre* of fresh water **[demonstrate these sizes with objects--show them something that weighs a gram and a droplet of water]**.

What this tells us is that though some bacteria can make us sick and are considered "bad"... most bacteria don't actually affect us! In fact, some bacteria are actually useful to us and other animals and livings things!

For example, cows depend on the bacteria that live in their stomach to help them digest the food they eat--if they didn't have the bacteria, they wouldn't be able to get the energy they need from their food! The same goes for us... bacteria live inside our stomachs and we depend on them as much as they depend on us.

You guys have studied plants, right? Did you know plants also depend on bacteria?

Nitrogen is very important for plant growth but they can't absorb the nitrogen in the air. Bacteria inside the soil turn nitrogen in the air into nitrogen that the roots of plants can absorb easily.

PART FOUR: HOW DO WE USE BACTERIA?

Time Allocated: 4 minutes

Now, because humans are really smart, we've figured out how to use the bacteria all around us for specific things. For example, we've figured out that some bacteria eat oil which makes them useful during oil spills. We also use bacteria to make certain foods like yogurt.

Bacteria are also very important in scientific research. In particular, one field in biology called *synthetic biology* depends on bacteria.

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Does anyone know what DNA is?

Synthetic biologists take the DNA of bacteria and re-arrange it, like with Lego blocks, to make something completely different. Imagine using Lego blocks from a pirate ship kit, and making a castle from it instead. Then, they put the DNA back into the bacteria and let them grow.

What would you *make if you were a synthetic biologist?*

PART FIVE: GROWING BACTERIA ACTIVITY

Time allocated: 35 minutes

Does anyone know how often or when we should wash our hands?

That's right, so, before we eat, after we use the toilet, after we play outside in the dirt...

Does anyone know why we have to wash our hands?

That's right! We wash our hands because of the bacteria that are on them. Bacteria are all around us, and some of them can be pretty "bad"--they're the kind of bacteria that make us sick. By washing our hands, we kill the bacteria.

Today, we'll show you why washing our hands is very important!

[Pass around prepared Petri dish.]

This is a Petri dish which we left open in our lab. The little things you see on it are groups of bacteria. We wanted to show you the different kinds of bacteria or fungi which are present around us. *Make sure you don't open it!*

Today, we're going to do something super cool. We'll be growing our own bacteria onto Petri dishes, just like that one you're passing around. We'll have to let the bacteria grow overnight, so you'll have to wait till tomorrow to see them, but you will get to see what kinds of bacteria live on two places: your hands and one other location of your choosing! We'll also test how well hand-sanitizer or soap work when killing bacteria on our hands.

Are you guys ready?

Procedure

Okay, let's get started!

Step one:

Hand out two halved ***Petri dishes*** *to each student.* ***The first plate will have one half labelled "un-sanitized", and the other half labelled "sanitized".***

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Bacteria need lots of food in their environment in order to grow. The jelly you see in your plates is delicious food for bacteria, and it provides the environment needed for the bacteria to grow.

Each of the plates has also been sanitized. This means that they are now sterile, or “free of living things”. We sanitize the plates because we do not want any other bacteria, except for the ones we put on today, to grow on there.

Step two:
*Have students take **a cotton swab** and wet it with **clean water**--a quick dip into the water, rather than a prolonged one is ideal since we do not want the swab to absorb more than what’s enough to pick up microorganisms from several areas.*

*Then, have students swab one of their unwashed palms, and spread it lightly along the “un-sanitized” half of the first plate. **Remind them to dispose of the cotton swabs in the designated bin.***

We’re doing this because we want to see what kinds of bacteria are on our hands during the day... right now! Next, we’ll see what happens when we “sanitize” our hands.

Step three:
Have students wash (with the sink) or sanitize (with a hand sanitizer) their hands very thoroughly. They can decide which one they want to try.

Remember, you need to rub your hands clean for at least 30 seconds for the soap or sanitizer to be effective. And *make sure you don’t* touch anything after you’ve washed your hands!

Step four:
Have students take another cotton swab and do what they did with the first swab. This time, however, they should lightly spread the swab on the “sanitized” half of the plate. Then, have them dip another cotton swab into hand sanitizer solution and spread it over the “sanitized” half again.

We’re doing this to be extra sure that we’ve sanitized everything properly. We would be able to tell if the hand sanitizer actually works to kill the bacteria from our hands based on the results of the experiment.
Does anyone have any guesses as to what might happen if we let the bacteria grow? Does anyone have a hypothesis*?*

That’s right, if there is no growth in the “sanitized” half tomorrow, then the bacteria were killed and couldn’t multiply. Now, write down your hypothesis on your handout. Guess what! You’re all being scientists right now! That’s how scientists learn and discover new things: they observe and make an intelligent guess about something--the guess is always based on information they presently have--then they design an experiment to test if their guess is right!

Step five:
Have students pick two more areas they’d like to swab to see what kind of bacteria grow there. Make sure that they swab each half of the second plate separately and that they label--both on the handout and on the plate itself--them properly.

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Have students tape up the plates along the side.

Now we'll let the bacteria grow overnight... for the best results, we will keep the plates somewhere with a temperature of 37˚C all night long. This is the temperature bacteria like best, and in combination with the nutrients we've given them on the plate, our bacteria will be able to grow nice and healthily!

PART SIX: CONCLUSION

Time allocated: 5 minutes

When you come back tomorrow, you will get to see your results. Remember, you cannot open the Petri dishes, and must look at them over the clear plastic. This is because we do not want any bacteria to escape from the plate.

Also, don't forget our hypothesis! *What was it again?*

Tomorrow, we'll also look at the different *kinds* of bacteria that exist--we can actually tell them apart based on the way they grow. You can see a picture in your handout. We'll talk about it more tomorrow!

Does anyone have any questions?

At the end of the day, remind the counsellors (and the kids themselves) to keep their handouts for tomorrow. They'll need it.

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Day Two

PART ZERO: INTRODUCTION

Time allocated: 5 minutes

Welcome back everyone! Remember us? *Re-introduce members.*

Today, we'll take a look at the bacteria we grew yesterday!
Return their plates.

PART ONE: RESULTS

Time allocated: 25 minutes

Does anyone remember what their hypothesis was?

As you are looking at your plates, you may notice that the colonies (little groups of many bacteria) on it may look slightly different from one to the other. This is called "bacterial morphology"--it is, basically, a way we sort the different ways bacteria grow with each other. They make all sorts of shapes and come in all sorts of sizes.

Why don't we try to describe the morphology on your plates?

You can use your handout as reference, or take a look at the screen here.

Notice the different shapes and colours of the colonies of bacteria or fungi? Each of these colonies came from a single bacterial cell, which replicated. So, first there was only that one colony, then that one divided into two, then those two into four and so on. This made a family of like-bacteria which we call a colony. Each different-looking colony means a different type of bacteria lives there.

The end!