BASF
We create chemistry

Kids' Lab
Creating Fun with Chemistry!

Experiment Guide

What's Growing All Around You

Objective

Microorganisms are everywhere. In this activity, participants will grow bacteria and fungi in petri dishes by taking samples from common objects. This will help students understand where bacteria and fungus grows, as well as the importance of washing hands and overall cleanliness.

Introduction to Kids' Lab

Welcome to the BASF Kids' Lab. BASF is the world's largest chemical company and run Kids' Lab programs like this all around the world. Can anyone think why? BASF wants children all over the world to understand and enjoy experimenting with chemistry!

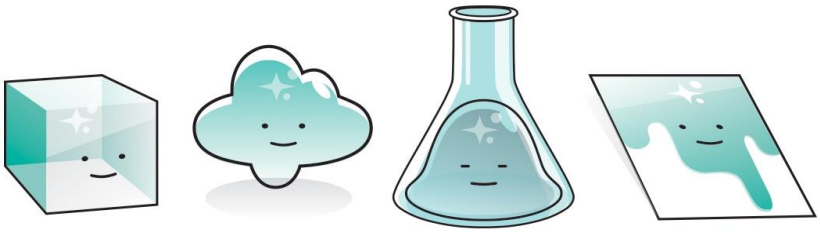
Has anyone heard that word before: Chemistry? What do you think it means?

Chemistry is the science of matter. Have you heard the word "matter" before? What is matter? Matter is anything that takes up space and has a weight here on earth. So basically, matter is a scientific word for stuff.
Chemistry is a science that explores the composition of substances and their properties and reactions. In other words, Chemistry is a science that explores how different stuff behaves.

Matter comes in a few different forms or states: Solids, Liquids and Gases are the most common.

Chemistry is all around us. For example:
Who takes a vitamin? How do vitamins help you? (Grow big and strong, boost immunity)
BASF makes chemicals that go into vitamins.
Raise your hand if you play a sport or ride a bike. What should you do to be safe? (Wear a helmet, pads, etc.) What materials make up the helmets that you wear? (Plastics and foam)
BASF makes chemicals that go into the plastics and foams in helmets and padding.
Besides helping you grow strong and keeping you safe when you are playing your favorite sport, BASF chemistry keeps farmers crops safe, cleans water for those in need and keeps babies clean and dry.

Let me introduce you to morpH, the face of Kids' Lab. morpH can move through the three states of matter with ease. Is there a substance that you know of, like morph that can easily shift from solid to liquid to gas (and back again)? Water! That's right! You know that water is usually liquid but what happens when you freeze water? Water becomes a solid ice cube. When you boil water, it becomes a gas. Water is one of the most important substances on earth. Not only does water make life possible, but it can be used to create interesting substances. We will be exploring some strange matter today!



Water is essential for all living things including microorganisms like bacteria and fungus. **morpH and I would like you to explore the microorganisms you may encounter every day!**

Experiment Introduction

Bacteria and **fungus** are **microorganisms** that grow everywhere, from your hands and feet to your desk and pencil. Bacteria and fungi exist almost everywhere and are very important to the ecosystem. For this activity, we will take samples from different objects and grow them in petri dishes prepared with a special substance called **agar**.

This experiment can be used to test the effectiveness of different soaps or hand sanitizers by putting different samples in petri dishes with dirty hands before and clean hands after washing. You can also see how much bacteria are growing on common objects like coins, tables, chairs and forks.

Some bacteria are good but some are also harmful. That's why it is important to take care of yourself and wash your hands with warm water and soap often so you don't get sick.

For this experiment, you will be a Microbiologist and take samples from your hands or other common objects. Make sure you are familiar with the following terms:

Bacteria*:* one-celled organism that have a cell wall but not organelles or nucleus; often times can cause disease.

Fungus*:* any group of spore-producing organisms that feed on organic matter; includes molds, yeast and mushrooms.

Microorganism*:* a microscopic organism; includes bacteria, viruses and fungi. Can also be called a microbe

Microbiology: the study of microscopic organisms like bacteria, viruses and fungi. Bacteriology is the study of bacteria; Virology is the study of viruses and Mycology is the study of fungi.

Agar*:* a gelatinous substance that is used in biological culture. Agar is made from a certain type of algae.

Additional Background Information

Bacteria and other microbes are extremely important because these organisms are very efficient at breaking down organic matter. When organic matter is decomposed by microbes like bacteria, elements and nutrients are released and available for other organisms to use. Without microorganisms, the earth would have no soil to grow plants, and humans would not be able to grow enough food to feed the population. Many organisms including humans rely

on microorganisms in or on their bodies to help digest food or fight off pathogens. In fact, human waste is made up of mostly dead and alive bacteria.

Bacteria have been on the earth for 3 billion years and thrive in many environments. When you view bacterial cells under a microscope, the shape of bacterial cells can be spherical, rod or even spiral shaped. In the right conditions, bacteria can grow really fast and in fact some can double their numbers in as little as ten minutes. There are between 10,000 and 10 million bacterial cells on each of your hands. Your body is also covered with a variety of fungus and yeasts. The Fungi kingdom includes really large mushrooms, visible molds and microscopic fungi like the fungus that causes athletes foot. While most microbial species on your body are not harmful, some cause diseases. So, it is important to wash your hands with warm soapy water to help prevent harmful bacteria from spreading and causing disease.

Robert Koch (1843-1910, Germany) is considered the father of microbiology and was awarded Nobel Prize in 1905 for his work to characterize the bacteria (*Mycobacterium tuberculosis)* that causes tuberculosis. He is also known for developing Koch's Postulates which outline the relationship between microbes and disease.

When Robert Koch began his research into microbial pathogens, he grew bacteria on potato slices. Later, he tried gelatin but this medium would melt in the summer and bacteria often consumed it and weakened the gelatinous structure. Angelina Hesse (1850-1934), the wife of Koch's assistant, Walther Hesse (1846-1911) who often worked alongside Walther, suggested Agar as an alternative to gelatin. Agar was discovered in Asia and used for a long time in food as a thickener for soups and gravies or to give a gelatin texture to deserts. Agar proved to be much more durable in bacterial culture. It could withstand heat better and remained stable as microbes grew. Using agar transformed microbial research and enabled many of the discoveries made by Robert Koch and Walther Hesse.

Julius Petri (1852-1921, Germany), who also worked with Robert Koch, invented the petri dish which has been used to grow and isolate microbial cultures ever since.

Microorganisms are important to agriculture. In addition to breaking down organic matter in the soil, soil bacteria are capable of converting nitrogen from the air into ammonia. This is called Nitrogen fixation. This is extremely important because plants cannot use atmospheric nitrogen, plants rely on these microbes to convert nitrogen to ammonia molecules which are easily taken up by plants. Some plants even have symbiotic bacteria living in or adjacent to their root systems in order to maximize this relationship. On the other hand, Bacteria like *Xanthomonas axonopodis* (citrus canker) and fungus like *Phakopsora pachyrhizi* (soybean rust) are examples of microbial plant pathogens that cause significant crop losses each year.

Penicillin is an example of an antibiotic that was isolated from a fungus (*Penicillium chryogenum*) that is used to treat bacterial infections. Interestingly, other species within the *Penicillium* genus are used in making blue cheeses.

Safety Guidelines

Lab safety is a must! In order to safely explore Chemistry, we need to follow proper lab safety. How do you think we are going to do this? Microbiologists follow very strict procedures to protect themselves and they include:

- Gloves
- Safety glasses
- Lab aprons or lab coats

Before we get started:

This activity requires preparation of agar plates ahead of time and follow up after 2-3 days to discuss observations. The agar plates should be prepared with potato dextrose agar (petri plates and agar or prepared plates available from VWR). These plates should be stored upside down to prevent condensation and kept refrigerated until ready to use. Allow the petri plates to come to room temperature before taking samples. Parafilm is also available from VWR and can be cut into strips (approximately 1" X 4") beforehand so that they are ready for wrapping the plate in step 2.

- Be sure everyone including instructors and helpers are wearing safety glasses and gloves. An apron or lab coat are also recommended for this activity.
- Point out any safety features in the classroom (ie. Eyewash or emergency shower; emergency exits).
- Mention housekeeping rules – NO EATING OR DRINKING.
- Mention location of bathrooms.

Materials

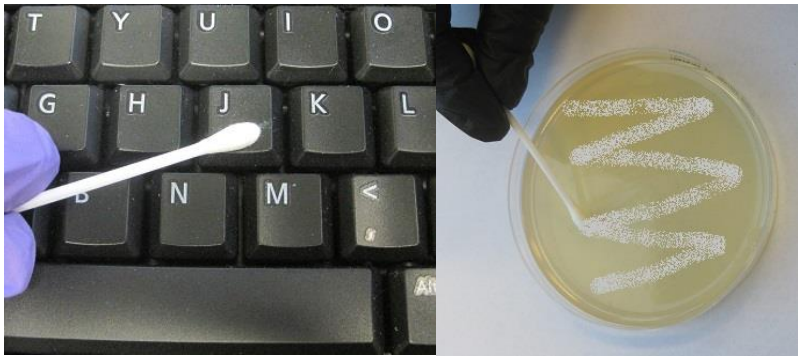
- Petri dishes prepared with potato dextrose agar (1 per student)
- Common household items to swab and take samples from. Examples include tables, writing utensils, coins, computers, phone, etc.
- Q-tips
- Water
- Masking tape or Parafilm
- Permanent markers
- Storage area
- Bleach and old newspaper (optional)
- Ziploc bag

Step 1: Decide what to sample

Each student or student team should have a plate and decide where to take a sample. Do not open the plate until ready to take a sample. The sample can be from their hands or other part of the skin (belly buttons and armpits are especially interesting), a pencil or pen, a handle of a faucet, a doorknob, coins, computer keys, a phone, glasses or any item that is commonly used. Use a permanent marker to write your name, date and where the sample will be taken on the underside of the plate.

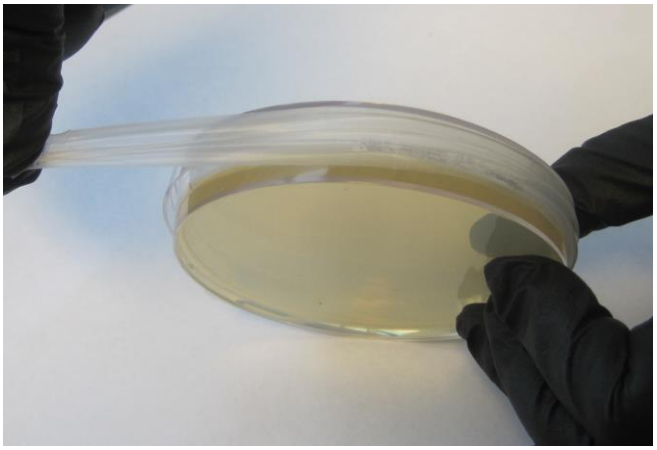
Step 2: Take a sample

Lightly moisten the end of your Q-tip (do not soak) and rub it over the body part or item to be sampled. To transfer the sample, remove the lid from the petri dish, apply the sample to the agar by rubbing the Q-tip across the surface of the agar in a zig-zag pattern. Replace the lid immediately and do not leave the lid off for longer than necessary. Discard the used Q-tip in the trash.



Step 3: Seal the plate

Hold the plate closed while you use masking tape or Parafilm to wrap around the sides of the petri dish. Make sure the tape or Parafilm sticks to both the top and bottom of the plate so that it is sealed all the way around. The plate does not need to be opened by the students to make observations.



Step 4: Let it grow

Once the samples are taken, the dishes should be placed in an undisturbed location at room temperature. The petri dishes should not be placed in sunlight or near heating elements. Store the dish upside down (to prevent condensation). Wait 24-72 hours to see the bacteria grow.

Bacteria grow best in warm and humid conditions. An ideal environment is around 98 degrees Fahrenheit or 37 degrees Celsius (this is the temperature of the human body), but bacteria can grow anywhere from 41 degrees Fahrenheit (5 degrees Celsius) to 140 degrees Fahrenheit (60 degrees Celsius). Maybe you can see what happens to your samples at different temperatures. A petri dish provides ideal humid conditions because it has agar and the moisture is sealed in by the tape or Parafilm. As the microorganisms grow, they consume the water, dissolved minerals, amino acids, sugars and salts present in the agar.

Step 5: Observations

Look at your plate after 24 hours and write down what you see.

- Which sample grew the most? How much of the plate is covered?
- Which sample grew the least? Do you see small colonies that are different?
- Describe your observations. What color are the microorganisms? Are they slimy or fuzzy? What is the shape? Is there more than one type of microorganism on the plate?
- Were there any similarities between the plates or were they all different?

Check your plate again in 48 and/ or 72 hours. Record your observations.

Step 6: Clean up and disposal

When ready to dispose of the plates, pour a small amount of bleach into the petri dish to destroy the microorganisms, wrap the petri dish in old newspaper and throw in a trashcan. If no bleach is available, wrap the petri dish in old newspaper and seal in a Ziploc bag before disposing.

Supplemental Activity:

This activity illustrates the importance of thorough handwashing. You must have access to handwashing area with soap and water. This could be conducted as a demonstration or a hands-on activity. Glo-Germ™ kits have a small UV lamp included. Glo-germ™ glows under UV light and is easier to see in a darkened room. Check with your classroom ahead of time to make sure the room can be safely darkened or has a space that is less illuminated.

Materials
Glo-Germ™ lotion or gel
Soap
Water
Hand dryer or paper towel for drying hands
UV lamp (avoid prolonged exposure)

Step 1: Apply Glo-Germ™
Apply approximately a nickel sized portion of the Glo-Germ™ lotion or gel to one hand and spread over both hands as if it is hand lotion. Make sure to cover the palm and the back of the hands as well as the fingers, fingernails and between fingers. Wipe off any excess with a paper towel if needed. Follow the instructions on the Glo-Germ™ product label.

Step 2: Look at your hands before you wash them
Explain that Glo-Germ™ is not really made of germs but it simulates the presence of germs on your skin. Germs are likely to accumulate on your hands because you touch many items throughout the day. What are some items that you touch during the day? If you are demonstrating this activity, direct the UV lamp towards your hands to show what the Glo-germ™ looks like before you wash your hands. Otherwise, allow each student to observe their hands under the UV lamp to see what their hands look like with the Glo-germ™ applied.

Step 3: Wash your hands for 20 seconds
The CDC (Centers for Disease Control and Prevention) recommends washing your hands with soap and water for at least 20 seconds. Have the participants wash their hands with soap and clean water for 20 or more seconds. Have them sing or hum “Happy Birthday” or their “ABCs” twice through as a guide for the length of time they should scrub their hands. Rinse hands with water and dry hands with a paper towel or air dryer.

Step 4: How well did you wash your hands?
Direct the UV lamp towards the hands of each participant and observe how well they washed their hands. The Glo-Germ™ that was not washed of completely will glow under the UV lamp and indicate how many germs remain on your hands after washing them. Observe in particular the areas around the nails and between the fingers. You may also observe that it is difficult to completely remove germs from dry or chapped skin. Allow the students to wash their hands again if they want to.

Step 5: When should you wash your hands?
Because you touch so many things and use your hands for nearly every task, you will come in contact with many germs throughout the day. Washing your hands is very important to prevent the spread of diseases and infections.
When should you wash your Hands?

- Before, during and after preparing food
- Before eating food
- Before and after caring for a sick person
- After going to the bathroom or changing a diaper
- After blowing your nose, sneezing or coughing
- After touching animals and pets or pet waste
- After touching garbage

Summary:

What did you observe on your plates? Were you surprised? It is a simple fact that microorganisms exist everywhere and are all over your body-inside and out. You will also find many microbes on common items like phones, computers, doorknobs and your desk. While most of these microorganisms are harmless, a few are pathogenic to humans, meaning they can cause diseases like the flu or pneumonia. That is why it is important to wash your hands so you do not spread potentially harmful diseases.