



### **Microbe Adventures**

Thank you for scheduling an educational experience at the Putnam Museum. This 35-minute program will help your students become aware of the following:

1. What microbes are, where they are located, and the difference between viruses and bacteria.
2. That there are good bacteria and what role good bacteria play in our everyday lives.
3. How germs spread from one person to another, and how to prevent illness with good hygiene.

The Putnam Museum's Education Specialist will lead a hands-on program in which your students will learn about the micro world around us and its various inhabitants and how these microbes affect our lives. The pre-visit activities have been developed to provide background materials and to make your field trip a more valuable experience. The content described above helps meet:

#### **Illinois Learning Standards:**

22A — Students who meet the standard can explain the basic principles of health promotion, illness prevention, and safety.

1. Explain how good hygiene can prevent illness.
2. Realize how bacteria grow.
3. Describe ways that viruses are transmitted.
4. Compare and contrast the feelings of being well and sick.

22B — Students who meet the standard can describe and explain the factors that influence health among individuals, groups, and communities.

1. Record daily personal hygiene behaviors.
2. Cite ways that the media influences health-related behavior

**Iowa Core:**

**Essential Concepts and/or Skills: Grade 3-5**

- + Understand and apply knowledge of organisms and their environments, including:**
  - Structures, characteristics, and adaptations of organisms that allow them to function and survive within their habitats.
  - How individual organisms are influenced by internal and external factors.
  - The relationships among living and non-living factors in terrestrial and aquatic ecosystems.
  
- + Understand and apply knowledge of environmental stewardship.**
  
- + Understand and apply knowledge of basic human body systems and how they work together.**
  
- + Understand and apply knowledge of personal health and wellness issues.**

**Essential Concepts and/or Skills: Grade 6-8**

- + Understand and apply knowledge of the basic components and functions of cells, tissues, organs, and organ systems.**
  
- + Understand and apply knowledge of how different organisms pass on traits (heredity).**
  
- + Understand and apply knowledge of the complementary nature of structure and function and the commonalities among organisms.**
  
- + Understand and apply knowledge of:**
  - interdependency of organisms, changes in environmental conditions, and survival of individuals and species.

- the cycling of matter and energy in ecosystems.

**+ Understand and demonstrate knowledge of the social and personal implications of environmental issues.**

**+ Understand and apply knowledge of the functions and interconnections of the major human body systems including the breakdown in structure or function that disease causes.**

We look forward to seeing you and thank you for your interest in the Putnam's education programs.

Sincerely,

Jen Ong  
Education Specialist  
The Putnam Museum of History and Natural Science

## **Background Information**

We are not alone! On this planet there are millions of tiny inhabitants, some that we cannot even see with the naked eye. These groups of residents are called microbes. Microbes are everywhere; they live on land, in the sea, and even on us. Microbes can live in the most inhospitable environments, including extreme heat and cold. Microbes were the first living creatures on Earth, first appearing over 3.7 billion years ago, long before plants and animals, which appeared 600 million years.

Microbes help create many of the things that we enjoy, such as yogurt, cheese, leather, gum, soda, laundry detergent, soy sauce, and bread. They are an important part of our world and aid in such areas as digestion by breaking up our food, recycling, and oil spills. Thank goodness for microbes!

There are various categories of microbes; these include bacteria, viruses, fungi, and protists. These microbes are distinguished by their physical characteristics; there are many shapes and sizes, viruses being the smallest of them all. They spend their lives trying to multiply and produce energy. Only a small fraction of microbes are harmful to people, which is good because there are many varieties and it is believed that we are only aware of 1% of the microbes that actually exist!

It is because of the bad microbes, that the world is becoming so conscience of good hygiene. Between 1346 and 1350 AD about 1/3 of the European population died. During this time people did not understand what germs are or how they spread. Throughout the centuries, our understanding of microbes has grown immensely. Now we know that humans can spread germs that cause sickness through coughing, sneezing, and by touch. It is important that teach about microbes and how people spread these germs, in order to help prevent epidemics. The creation of vaccinations has helped us combat the spread of viruses and bacteria, many illnesses of the past are now rarely seen.

We hope that by viewing and interacting with the exhibit “Microbes” and by taking part in the Putnam’s “Microbe Adventures” program, you and your students will better understand and appreciate the world of microbes and their impact on our everyday lives.

## **Important Words**

Antibiotics – A medicine that kills microbes or stops their growth. Some are made by humans, others are made by microbes.

Bacteria – Is a microbe that lives in between cells and can grow on surfaces that are living and non-living. They are just one cell that has the ability to multiply.

Cell Wall - The strong layer or structure that lies outside the plasma membrane; it supports and protects the membrane and gives the cell shape.

Disease – A condition that has a specific cause and specific symptoms, and that weakens the normal functioning of an organism.

Epidemic – The rapid spreading of an infectious disease to many individuals in an area.

Germ – A microbe, usually one that causes disease.

Hygiene - the science concerned with the prevention of illness and maintenance of health.

Immune System - A complex system that is responsible for distinguishing us from everything foreign to us, and for protecting us against infections and foreign substances. The immune system works to seek and kill invaders.

Microbes – Are tiny organisms that are so small we cannot see them without a microscope. They include bacteria, fungi, and viruses.

Vaccinations – A shot consisting of dead or weakened viruses or bacteria injected in order to stimulate the production of antibodies in order to protect the body from getting the disease.

Viruses – Is a microbe that cannot reproduce on their own. They are the smallest and simplest life form known.

White blood cell – One of your immune system's main microbe killers.

### Interesting microbe information

- Microbes live almost everywhere: in the soil, water, air, plants, and animals, including humans.
- Your mouth is a habitat for millions of microbes. There are also microbes in your intestines to help with digestion. There are microbes all over your body.
- In a handful of soil, there are hundreds to thousands of different types of microbes.
- Some microbes live in hot springs, volcanoes, and glaciers. Some scientists believe there could be microbes on Mars.
- There are four main types of microbes: viruses, bacteria, protists, and fungi.
- **Viruses:** Examples are those that cause the flu, common cold, chickenpox, HIV, measles, mumps, and Rabies. Scientists do not agree on whether to consider viruses as living or non-living organisms.
- **Bacteria:** Examples are those that cause strep throat, scarlet fever, tetanus (lockjaw), Lyme disease, and meningitis. A small percentage of bacteria cause sickness. Many bacteria are helpful. For example, one type of bacteria causes milk to turn to yogurt. Another type produces an antibiotic that can be used to treat infections.
- **Protists:** Examples are slime mold, paramecium, volvox, and euglena.
- **Fungi:** Examples are mold, mildew, mushrooms, and yeast.

## Pre-Visit Activity

### **Mighty Microbes**

**Microbiology** is the study of microorganisms. Micro means small. There is a variety of organisms, but we will focus on bacteria. Bacteria are composed of single, **prokaryotic** cells. Prokaryotic cells are characterized by their lack of a nucleus. Prokaryotic cells also have a cell wall in addition to a cell membrane. Many prokaryotic cells are motile, which means they can move. This is usually done by way of **flagella**. Flagella are whip-like structures that may be scattered over the surface of a cell or concentrated at the ends.

One of the most valuable ways to identify specific bacteria is to study their Gram reaction.

**Gram staining** is a method used to place bacteria into one of two categories: **Gram-positive** or **Gram-negative**. This method of staining requires a series of steps and the application of two different dyes, but the end result is that Gram-positive bacteria are stained purple while Gram-negative bacteria are stained pink. The reason the bacteria take the stains differently and ultimately are stained purple or pink is based on the composition of their cell wall.

Bacterial cell walls contain a unique material called **peptidoglycan**, which is made of both sugars and protein. Gram-positive bacteria have simpler walls with large amounts of peptidoglycan. Gram-negative bacteria are more complicated with less peptidoglycan.

Another characteristic that microbiologists use to classify bacteria is the shape of the cells.

Bacteria must first be stained and then viewed under a microscope so individual cells can be seen. The most common bacterial cell shapes are **round** (cocci), **rods** (bacilli), and **spirals**.

Many bacterial names reflect the shape of their cells. For example, Streptococcus bacteria have round cells.

Microbiologists grow cultures of bacteria in the laboratory using either liquid or solid **media**.

The particular ingredients of the media are chosen depending on the nutritional requirements of the bacteria. Liquid media is called **broth** while solid media is called **agar**. Microbiologists apply bacteria to sterile agar in Petri dishes, sometimes just a single cell, and then incubate them in the lab under ideal temperature conditions. After a few days of growth on solid media, bacterial **colonies** made of many cells are visible to the naked eye. These colonies are studied based on their size, shape, texture, color, and nutritional requirements.

## Mighty Microbes

### Questions

1. Bacteria are composed of single, \_\_\_\_\_ cells.
2. True or False: Prokaryotic cells do not have a nucleus.
3. Gram-positive bacteria stain \_\_\_\_\_ while gram-negative bacteria stain \_\_\_\_\_.
4. Different gram-staining reactions are based on differences in bacterial \_\_\_\_\_.
  - a. cell walls
  - b. cell membranes
  - c. nuclei
  - d. flagella
5. \_\_\_\_\_ is the unique material found in bacterial cell walls.
6. The most common bacterial cell shapes are round, rod, and \_\_\_\_\_.
7. Bacteria with bacilli in their name would have \_\_\_\_\_ shaped cells.
8. Streptococcus bacteria have \_\_\_\_\_ shaped cells.
9. Liquid media is called \_\_\_\_\_.
  - a. agar
  - b. Petri dish
  - c. broth
  - d. inoculate

True or False: Bacterial colonies composed of many bacterial cells can be seen with the naked eye.

## Mighty Microbes

### Answer Key

1. Bacteria are composed of single, **prokaryotic** cells.
2. **True** or False: Prokaryotic cells do not have a nucleus.
3. Gram-positive bacteria stain **purple** while gram-negative bacteria stain **pink**.
4. Different gram-staining reactions are based on differences in bacterial \_\_\_\_\_.
  - a. **cell walls**
  - b. cell membranes
  - c. nuclei
  - d. flagella
5. **Peptidoglycan** is the unique material found in bacterial cell walls.
6. The most common bacterial cell shapes are round, rod, and **spiral**.
7. Bacteria with bacilli in their name would have **rod** shaped cells.
8. Streptococcus bacteria have **round** shaped cells.
9. Liquid media is called \_\_\_\_\_.
  - a. agar
  - b. Petri dish
  - c. **broth**
  - d. inoculate
10. **True** or False: Bacterial colonies composed of many bacterial cells can be seen with the naked eye.