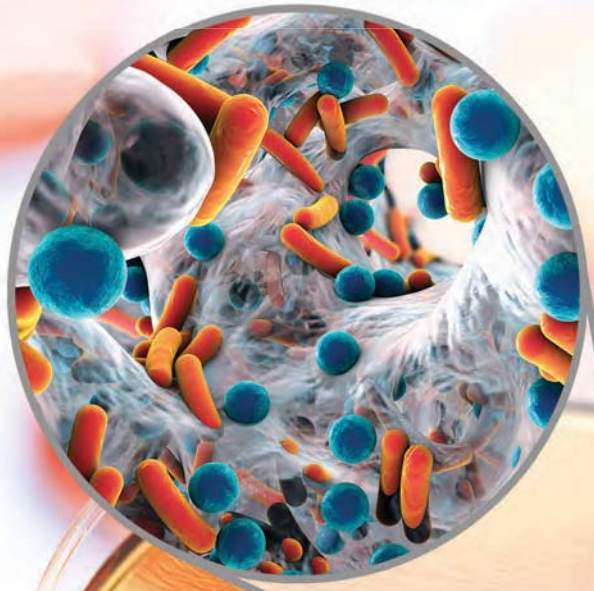
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The Hidden World of BACTERIA

Multiplying Mixed Numbers



Georgia Beth



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For Review Only

A Microscopic Mystery

Bacteria are invisible to the human eye. But, they are all around! The world is crawling with over five nonillion (noh-NIL-yuhn) of them. What does that number look like? It is the digit 5 followed by 30 zeros! There's no question that these microscopic creatures have taken over Earth.

Bacteria are one-celled organisms. They are found everywhere. They live underground. They live in human bodies. Bacteria are even strong enough to live deep in the sea. Some types of bacteria have **adapted** to cold temperatures. They can be found in the frozen tundra.

Every person on Earth is covered with bacteria. They can be found on skin and on hair. They live in people's digestive systems, too. They can even affect a person's mood or weight.

Bacteria were first discovered in the late 1600s by Antonie van Leeuwenhoek (AN-tuh-nee vahn LAY-vuhn-huhk). He observed bacteria under a microscope. He took notes about what he saw. He recorded their sizes and shapes. But, he was only just beginning to understand their secrets.

For Preview Only



Antonie van Leeuwenhoek

For Review Only



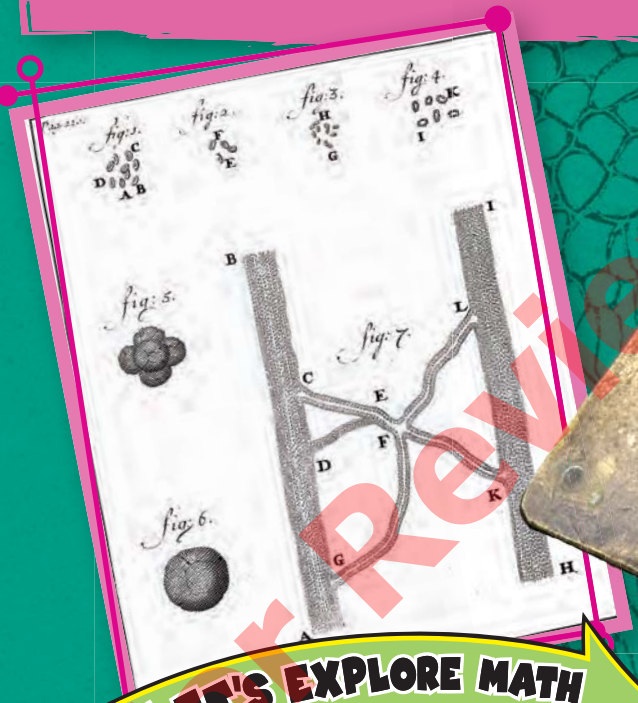
These illustrations by van Leeuwenhoek show the animalcules he observed.

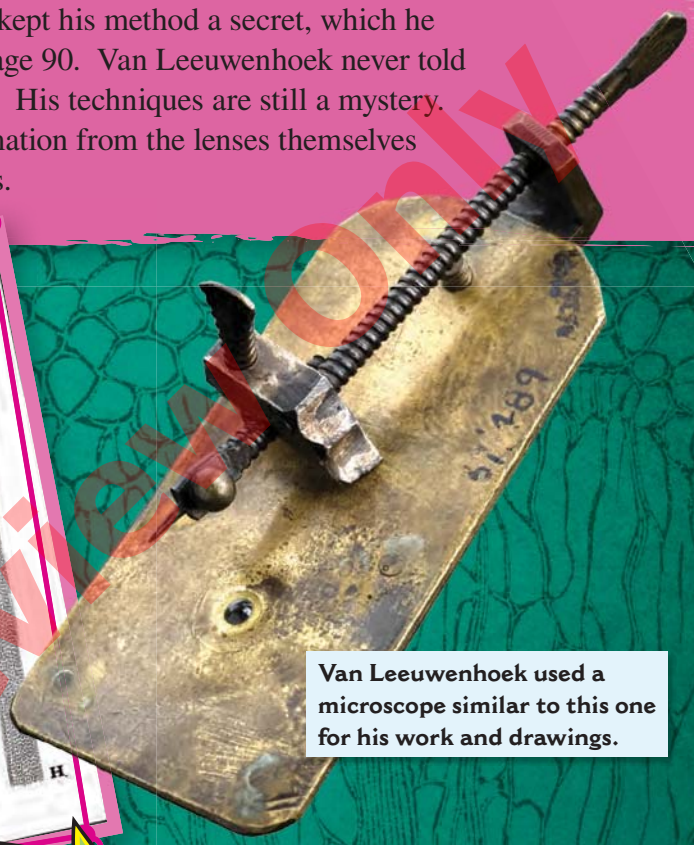
Van Leeuwenhoek did not know what he had found. He called them "very little animalcules." He compared samples of **microbes** from rainwater, saliva, and other sources.

Today, people know that bacteria are 0.2 to 10 microns wide. That means they are less than $\frac{1}{100}$th of an inch (0.2 millimeters)! They can only be seen with certain magnifying glasses. The lenses magnify bacteria 300 to 1,000 times their actual size. This makes a cell that is smaller than a dot look as big as a word on this page!

For Review Only

The lenses van Leeuwenhoek used have confused experts. He did not have the powerful lenses that scientists have today. They believe that his lenses would have enhanced **cells** only 50 to 300 times their size. So, experts think he used something else. But, they are not exactly sure what that was. He kept his method a secret, which he took with him when he died at age 90. Van Leeuwenhoek never told anyone how he made his lenses. His techniques are still a mystery. But, scientists can gather information from the lenses themselves and through his written journals.





Van Leeuwenhoek used a microscope similar to this one for his work and drawings.

LET'S EXPLORE MATH

Van Leeuwenhoek's microscope was about 8 centimeters long. A modern microscope for students is about $4\frac{1}{4}$ times as tall.

Which of the following is the best estimate for the height of a modern microscope? Explain your reasoning.

A. a little less than 32 centimeters

B. exactly 32 centimeters

C. a little more than 32 centimeters

For Review Only

Bacteria Cell

Bacteria are one of the oldest life forms on Earth. Bacteria fossils have been found in rocks. These fossils date back 419.2 million to 358.9 million years. Scientists think that some bacteria have survived over 3 billion years.

Form and Function

In just one cell, bacteria have what they need to live and grow. Most have a spherical, rodlike, or spiral shape. Many have long thin tails called flagella (fluh-JEL-luh). They help the cell move. A membrane holds the cell together. Ribosomes produce proteins that fuel the cells so they can function. Like all life, bacteria have **DNA**. DNA is the material that contains all of the information about how a particular living thing looks and functions. But unlike other life forms, bacterial DNA isn't stored in a **nucleus**. Instead, it's found throughout the cell.

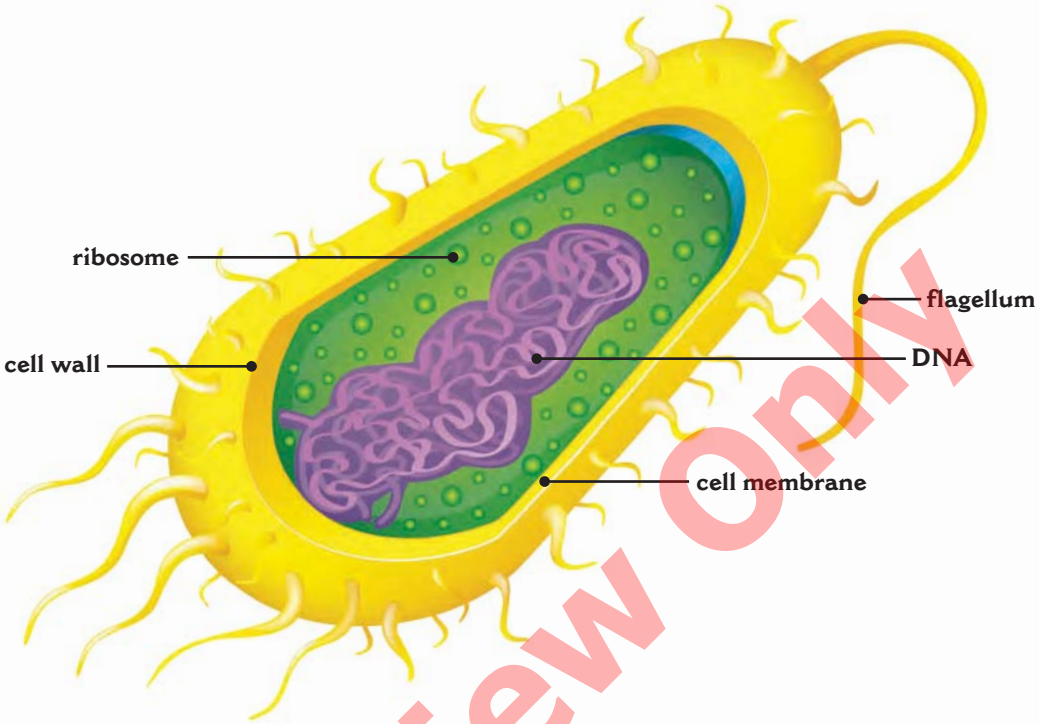
Most bacteria use **binary fission** to reproduce. A single cell grows until it is large enough to split into two identical daughter cells.

The process of dividing cells continues. Two cells split into 4 cells. Soon 4 cells become 8, and 8 cells become 16. This continues until there are countless cells.



This photo, taken with a microscope, shows a bacterial cell splitting into two cells during binary fission.

Review Only



LET'S EXPLORE MATH

Flagella can be longer than their bacteria cells. But, flagella and bacteria are still so small they are measured in *micrometers*. This is a unit of measurement equal to one-millionth of a meter!

Suppose a bacteria cell is 10 micrometers long. Its flagellum is $2\frac{1}{2}$ times as long. How long is the flagellum? Complete the strategy shown.

$10 \times 2\frac{1}{2} = (10 \times$ _____ $) + ($ _____ $\times \frac{1}{2})$

$=$ _____ $+$ _____

$=$ _____ micrometers

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Math Talk

1. How are mixed numbers and improper fractions related?
2. How is multiplying mixed numbers similar to multiplying fractions? How is it different?
3. How can area models help you multiply mixed numbers?
4. When multiplying mixed numbers, how can estimation help you decide whether products are reasonable?
5. Do you think it is more efficient to calculate with mixed numbers or improper fractions? Why?
6. How might microbiologists use fractions and mixed numbers when studying bacteria?

For Review Only