



Discovering Cells



What Are Cells?

7.3.1



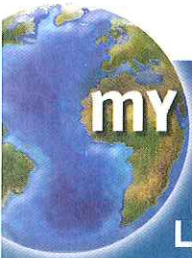
What Is the Cell Theory?

7.3.1



How Do Microscopes Work?

7.NS.1, 7.NS.3, 7.NS.8



my planet DiARY

Life at First Sight

Anton van Leeuwenhoek was the first researcher to see bacteria under a microscope. In his journal, he described how he felt after discovering this new and unfamiliar form of life.

"For me . . . no more pleasant sight has met my eye than this of so many thousand of living creatures in one small drop of water."

VOICES FROM HISTORY

Read the quote, and answer the question below.

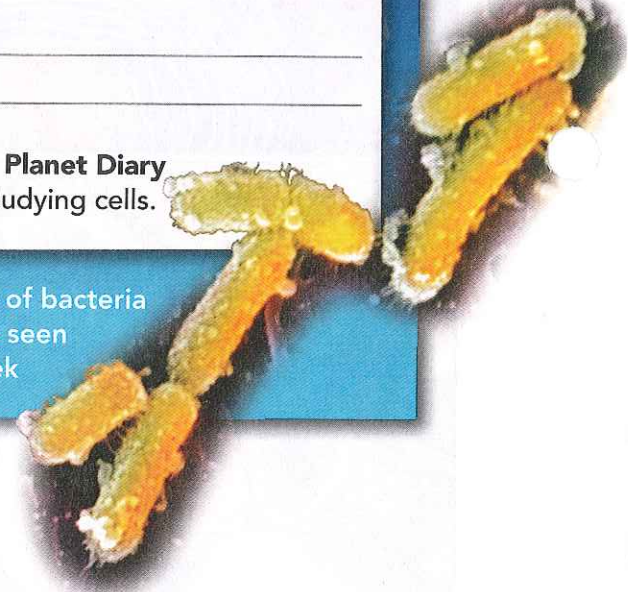
Why do you think Leeuwenhoek was so excited about what he saw?

PLANET DIARY Go to **Planet Diary** to learn more about studying cells.

A modern view of bacteria similar to those seen by Leeuwenhoek



Do the Inquiry Warm-Up
What Can You See?



Academic Standards for Science

7.3.1 Explain that all living organisms are composed of one or more cells and that the many functions needed to sustain life are carried out within such cells.

What Are Cells?

What do you think a mushroom, a tree, a spider, a bird, and you have in common? All are living things, or organisms. Like all organisms, they are made of cells. **Cells** form the parts of an organism and carry out all of its functions. **Cells are the basic units of structure and function in living things.**

Cells and Structure When you describe the structure of an object, you describe what it is made of and how its parts are put together. For example, the structure of a building depends on the way bricks, steel beams, or other materials are arranged. The structure of a living thing is determined by the amazing variety of ways its cells are put together.

Vocabulary

- cell
- microscope
- cell theory


Skills

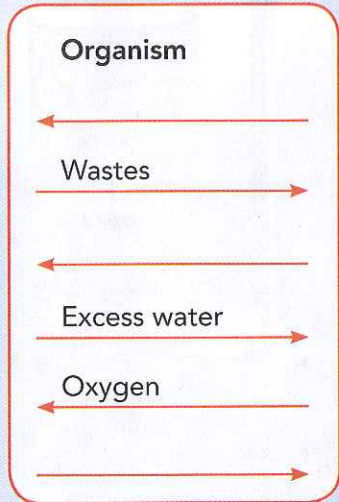
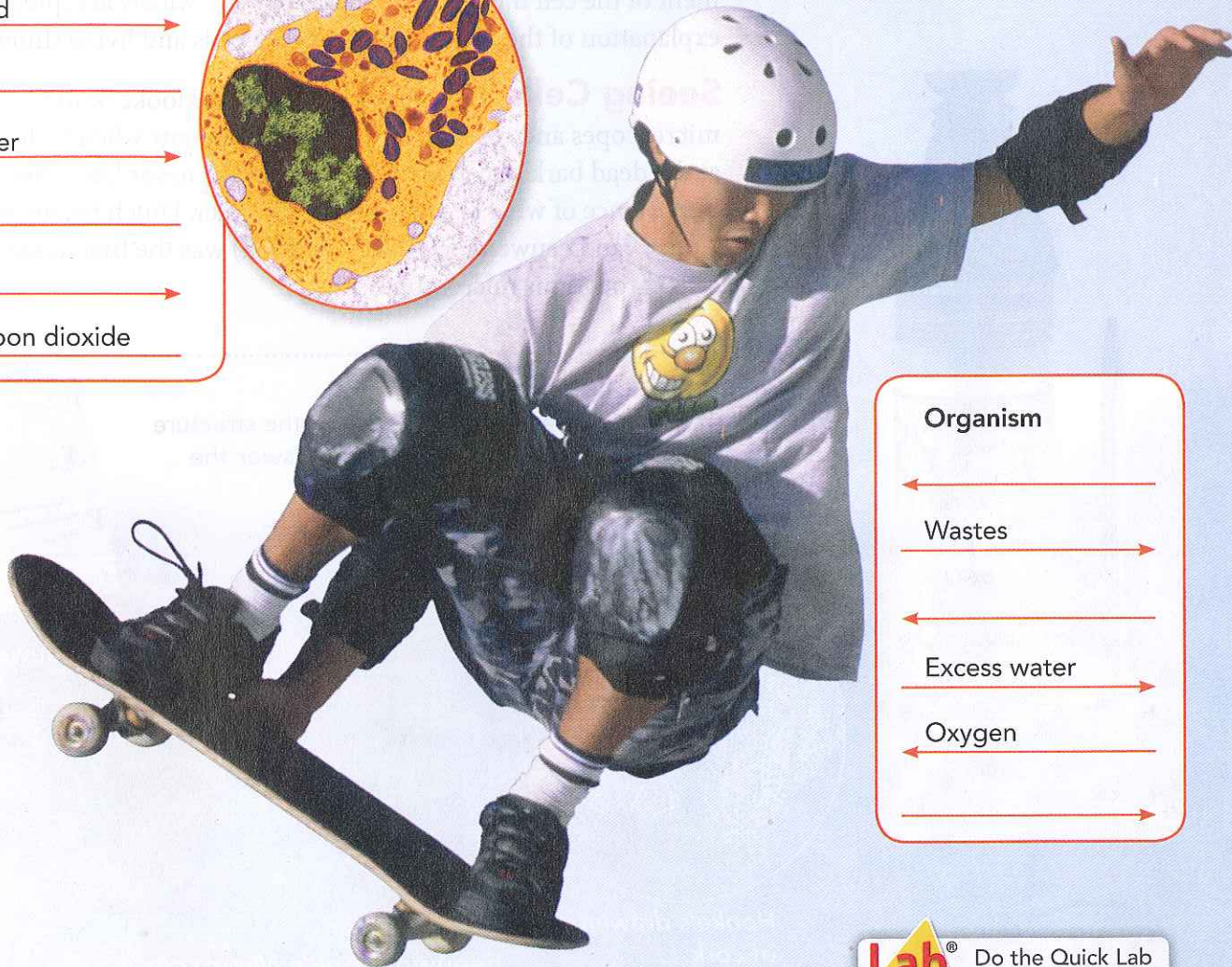
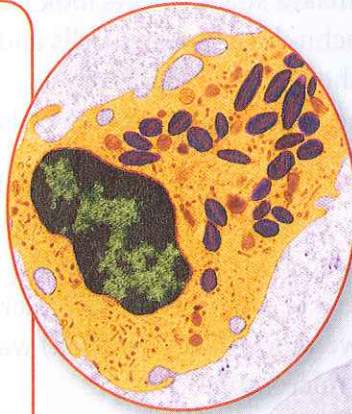
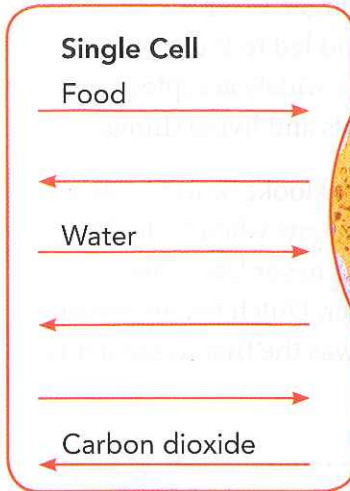
- 🌀 Reading: Sequence
- ▲ Inquiry: Measure

FIGURE 1

Needs of Cells

A single cell has the same needs as an entire organism.

 **Classify** On each blank arrow, write the name of a material that moves as shown.



Cells and Function An organism's functions are the processes that enable it to live, grow, and reproduce. Those functions include obtaining oxygen, food, and water and getting rid of wastes. Cells are involved in all these functions. For example, cells in your digestive system absorb food. The food provides your body with energy and materials needed for growth. Cells in your lungs help you get oxygen. Your body's cells work together, keeping you alive. And for each cell to stay alive, it must carry out many of the same functions as the entire organism.



Do the Quick Lab Comparing Cells.

 **Assess Your Understanding**
got it?

- I get it! Now I know that a cell is the basic unit of _____
- I need extra help with _____

Go to **my science**  **COACH** online for help with this subject.

7.3.1



7.3.1 Explain that all living organisms are composed of one or more cells and that the many functions needed to sustain life are carried out within such cells.

What Is the Cell Theory?

Until the 1600s, no one knew cells existed because there was no way to see them. Around 1590, the invention of the first microscope allowed people to look at very small objects. A **microscope** is an instrument that makes small objects look larger. Over the next 200 years, this new technology revealed cells and led to the development of the cell theory. The **cell theory** is a widely accepted explanation of the relationship between cells and living things.

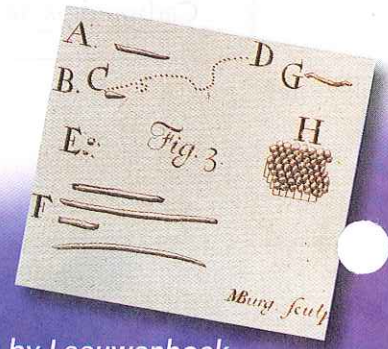
Seeing Cells English scientist Robert Hooke built his own microscopes and made drawings of what he saw when he looked at the dead bark of certain oak trees. Hooke never knew the importance of what he saw. A few years later, Dutch businessman Anton van Leeuwenhoek (LAY von hook) was the first to see living cells through his microscopes.



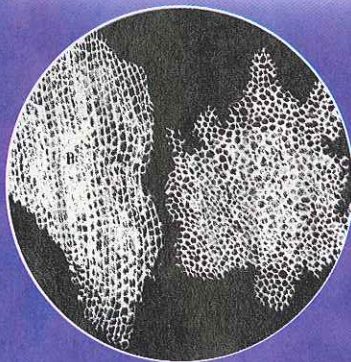
FIGURE 2

Growth of the Cell Theory

The cell theory describes how cells relate to the structure and function of living things. **Review** Answer the questions in the spaces provided.



Drawing by Leeuwenhoek

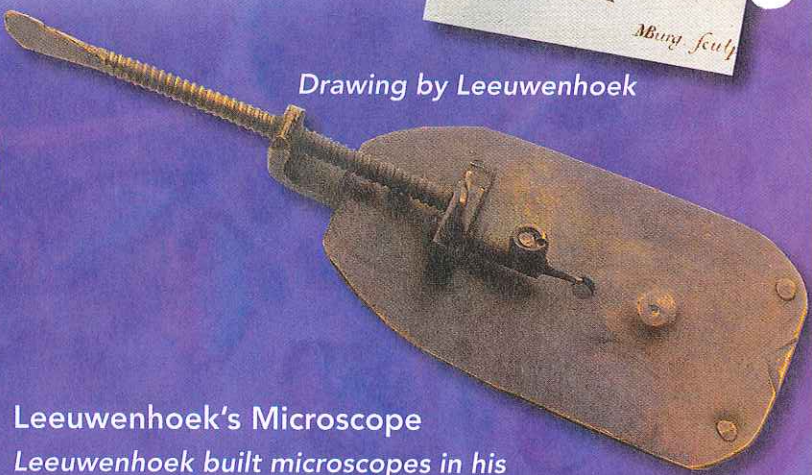


Hooke's drawing of cork

Hooke's Microscope

In 1665, Robert Hooke used his microscope to observe a thin slice of cork. Cork, the bark of the cork oak tree, is made up of cells that are no longer alive. To Hooke, the empty spaces in the cork looked like tiny rectangular rooms. Therefore, Hooke called the empty spaces cells, which means "small rooms."


What was important about Hooke's work?



Leeuwenhoek's Microscope

Leeuwenhoek built microscopes in his spare time. Around 1674, he looked at drops of lake water, scrapings from teeth and gums, and water from rain gutters. Leeuwenhoek was surprised to find a variety of one-celled organisms. He noted that many of them whirled, hopped, or shot through water like fast fish. He called these moving organisms animalcules, meaning "little animals."

What did Leeuwenhoek's observations reveal?

What the Cell Theory Says Figure 2 highlights people who made key discoveries in the early study of cells. Their work and the work of many others led to the development of the cell theory.  **The cell theory states the following:**

- All living things are composed of cells.
- Cells are the basic units of structure and function in living things.
- All cells are produced from other cells.

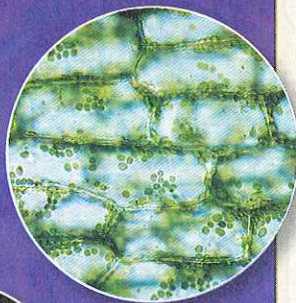
Living things differ greatly from one another, but all are made of cells. The cell theory holds true for all living things, no matter how big or how small. Because cells are common to all living things, cells can provide clues about the functions that living things perform. And because all cells come from other cells, scientists can study cells to learn about growth and reproduction.

Schleiden, Schwann, and Virchow

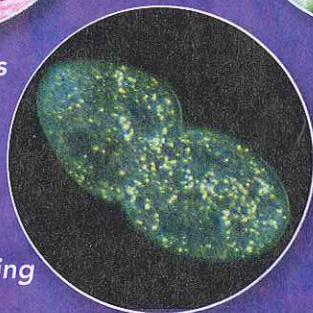
In 1838, using his own research and the research of others, Matthias Schleiden concluded that all plants are made of cells. A year later, Theodor Schwann reached the same conclusion about animals. In 1855, Rudolf Virchow proposed that new cells are formed only from cells that already exist. "All cells come from cells," wrote Virchow.



Animal cells




Plant cells



A cell reproducing

To which part of the cell theory did Virchow contribute?

 **Sequence** Fill in the circle next to the name of the person who was the first to see living cells through a microscope.

- Matthias Schleiden
- Robert Hooke
- Anton van Leeuwenhoek
- Rudolf Virchow
- Theodor Schwann



Do the Quick Lab
Observing Cells.

Assess Your Understanding

1a. Relate Cause and Effect Why would Hooke's discovery have been impossible without a microscope?

7.3.1

b. Apply Concepts Use Virchow's ideas to explain why plastic plants and stuffed animals are not alive.

7.3.1

got it?

I get it! Now I know that the cell theory describes

I need extra help with

Go to **my science COACH** online for help with this subject.

7.3.1




Academic Standards for Science

- 7.NS.1 Make predictions.
- 7.NS.3 Collect data with the appropriate tools and technologies.
- 7.NS.8 Analyze data, and use it to identify patterns and make inferences based on these patterns.

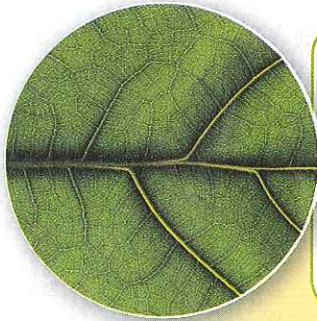


Vocabulary Prefixes The prefix *magni-* means "great" or "large." Underline all the words in the paragraph at the right that you can find with this prefix.

How Do Microscopes Work?

The cell theory could not have been developed without microscopes.  Some microscopes focus light through lenses to produce a magnified image, and other microscopes use beams of electrons. Both light microscopes and electron microscopes do the same job in different ways. For a microscope to be useful, it must combine two important properties—magnification and resolution.

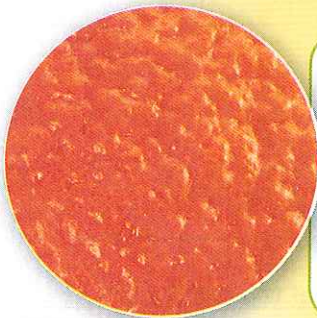
Magnification and Lenses Have you ever looked at something through spilled drops of water? If so, did the object appear larger? Magnification is the condition of things appearing larger than they are. Looking through a magnifying glass has the same result. A magnifying glass consists of a convex lens, which has a center that is thicker than its edge. When light passes through a convex lens and into your eye, the image you see is magnified. Magnification changes how you can see objects and reveals details you may not have known were there, as shown in **Figure 3**.



1 Leaf; green color and veins



2




3



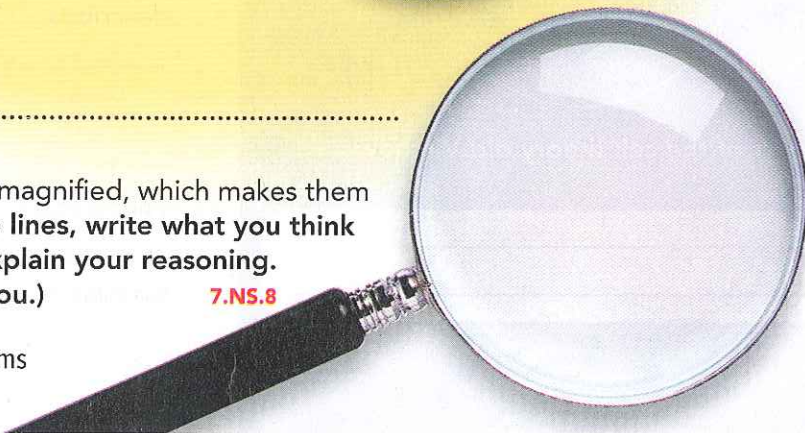
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FIGURE 3

Magnification

The images above have all been magnified, which makes them look unfamiliar.  **Infer** On the lines, write what you think each photograph shows, and explain your reasoning. (One answer is completed for you.)

7.NS.8



Magnification With a Compound Microscope

Figure 4 shows a microscope that is similar to one you may use in your classroom. This type of instrument, called a compound microscope, magnifies the image using two lenses at once. One lens is fixed in the eyepiece. A second lens is chosen from a group of two or three lenses on the revolving nosepiece. Each of these lenses has a different magnifying power. By turning the nosepiece, you can select the lens you want. A glass slide on the stage holds the object to be viewed.

A compound microscope can magnify an object more than a single lens can. Light from a lamp (or reflecting off a mirror) passes through the object on the slide, the lower lens, and then the lens in the eyepiece. The total magnification of the object equals the magnifications of the two lenses multiplied together. For example, suppose the lower lens magnifies the object 10 times, and the eyepiece lens also magnifies the object 10 times. The total magnification of the microscope is 10×10 , or 100 times, which is written as “100×.”

FIGURE 4

VIRTUAL LAB A Compound Microscope

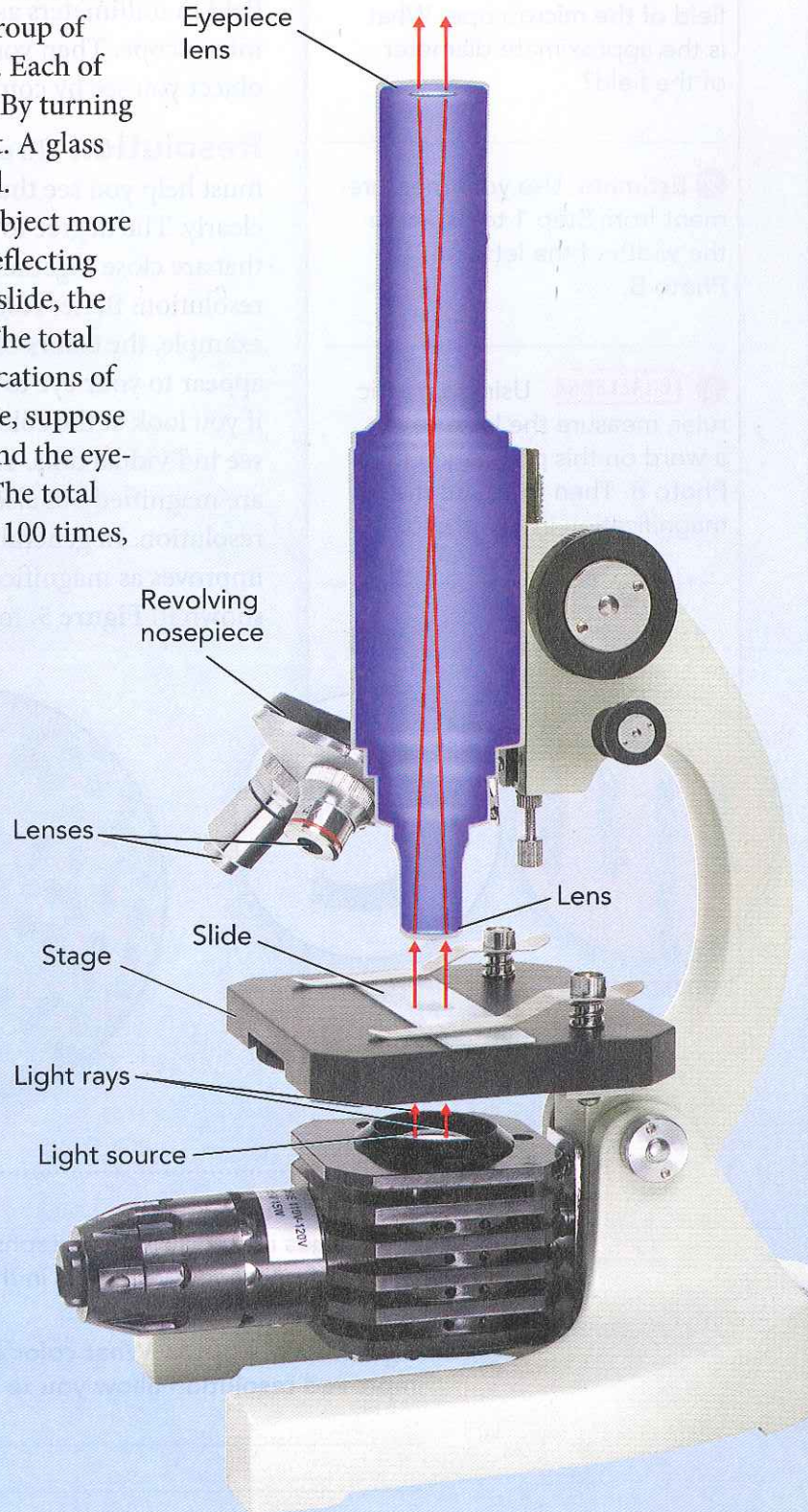
This microscope has a 10× lens in the eyepiece. The revolving nosepiece holds three different lenses: 4×, 10×, and 40×.

Complete these tasks.

- 1. Calculate** Calculate the three total magnifications possible for this microscope.

- 2. Predict** What would happen if the object on the slide were too thick for light to pass through it?

7.NS.1, 7.NS.8



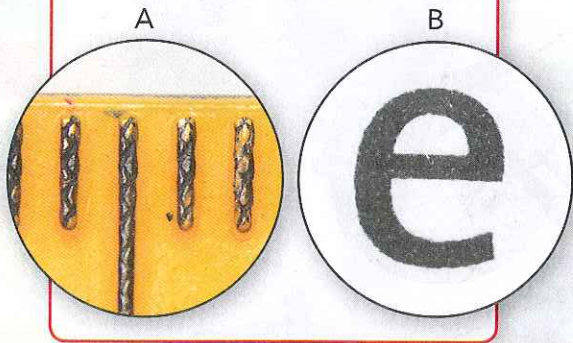
apply it!

7.NS.3, 7.NS.8

1 Measure In Photo A, you can see the millimeter markings of a metric ruler in the field of the microscope. What is the approximate diameter of the field?

2 Estimate Use your measurement from Step 1 to estimate the width of the letter in Photo B.

3 CHALLENGE Using a metric ruler, measure the letter **e** in a word on this page and in Photo B. Then calculate the magnification in the photo.



Measuring Microscopic Objects

When you see objects through a microscope, they look larger than they really are. How do you know their true size? One way is to use a metric ruler to measure the size of the circular field in millimeters as you see it through the microscope. Then you can estimate the size of the object you see by comparing it to the width of the field.

Resolution To create a useful image, a microscope must help you see the details of the object's structure clearly. The degree to which two separate structures that are close together can be distinguished is called resolution. Better resolution shows more details. For example, the colors of a newspaper photograph may appear to your eye to be solid patches of color. However, if you look at the colors through a microscope, you will see individual dots. You see the dots not only because they are magnified but also because the microscope improves resolution. In general, for light microscopes, resolution improves as magnification increases. Good resolution, as shown in Figure 5, makes it easier to study cells.

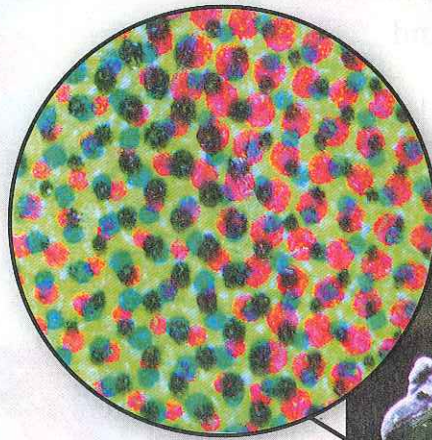


FIGURE 5

Resolution

The images in colorful photographs actually consist of only a few ink colors in the form of dots.

Interpret Photos What color dots does improved resolution allow you to see?






Electron Microscopes The microscopes used by Hooke, Leeuwenhoek, and other early researchers were all light microscopes. Since the 1930s, scientists have developed several types of electron microscopes. Electron microscopes use a beam of electrons instead of light to produce a magnified image. (Electrons are tiny particles that are smaller than atoms.) By using electron microscopes, scientists can obtain pictures of objects that are too small to be seen with light microscopes. Electron microscopes allow higher magnification and better resolution than light microscopes.

FIGURE 6

A Dust Mite

Dust mites live in everyone's homes. A colored image made with an electron microscope reveals startling details of a mite's body.

 **Observe** List at least three details that you can see in the photo.

Lab zone Do the Lab Investigation
Design and Build a Microscope.

 **Assess Your Understanding**

- 2a. **Define** Magnification makes objects look (smaller/larger) than they really are. 7.NS.3
- b. **Estimate** The diameter of a microscope's field of view is estimated to be 0.9 mm. About how wide is an object that fills two thirds of the field? Circle your answer.
1.8 mm 0.6 mm 0.3 mm 7.NS.3
- c. **Compare and Contrast** How are magnification and resolution different?

7.NS.3

- d. **Explain** How do the characteristics of electron microscopes make them useful for studying cells?

got it?

- I get it! Now I know that light microscopes work by _____
- I need extra help with _____

Go to **my science**  **COACH** online for help with this subject 7.NS.3