Chapter 7 Organizer

Refer to pages 4T-5T of the Teacher Guide for an explanation of the National Science Education Standards correlations.

Section	Objectives	Activities/Features
Section 7.1 **The Discovery of Cells** National Science Education Standards UCP.1, UCP.5; B.2; C.1, C5; E.1, E.2; G.1-3 (1 session, 1/2 block)	**1. Relate** advances in microscope technology to discoveries about cells and cell structure. **2. Compare** the operation of a compound light microscope with that of an electron microscope. **3. Identify** the main ideas of the cell theory.	**MiniLab 7-1:** Measuring Objects Under a Microscope, p. 177 **Focus On** Microscopes, p. 178 **Investigate BioLab:** Observing and Comparing Different Cell Types, p. 194
Section 7.2 **The Plasma Membrane** National Science Education Standards UCP.1-3, UCP.5; A.1, A.2; B.2; C.1, C.5; G.1 (2 sessions, 1 block)	**4. Explain** how a cell's plasma membrane functions. **5. Relate** the function of the plasma membrane to the fluid mosaic model.	**Problem-Solving Lab 7-1,** p. 182
Section 7.3 **Eukaryotic Cell Structure** National Science Education Standards UCP.1-3, UCP.5; A.1, A.2; C.1, C.5; E.1, E.2; G.1-3 (3 sessions, 1 1/2 blocks)	**6. Understand** the structure and function of the parts of a typical eukaryotic cell. **7. Explain** the advantages of highly folded membranes in cells. **8. Compare and contrast** the structures of plant and animal cells.	**Problem-Solving Lab 7-2,** p. 186 **MiniLab 7-2:** Cell Organelles, p. 187 **Inside Story:** Comparing Animal and Plant Cells, p. 192 **Literature Connection:** *The Lives of a Cell* by Lewis Thomas, p. 196

Need Materials? Contact Carolina Biological Supply Company at 1-800-334-5551 or at **http://www.carolina.com**

MATERIALS LIST

BioLab

p. 194 microscope, microscope slide, coverslip, water, dropper, forceps, prepared slides of *Bacillus subtilus*, frog blood, and *Elodea*

MiniLabs

p. 177 microscope, microscope slide, coverslip, human hair, water

p. 187 microscope, microscope slide, coverslip, onion, water

Alternative Lab

p. 188 microscope, microscope slide, coverslip, dropper, forceps, *Elodea* plant, prepared slide of human cheek cells

Quick Demos

p. 176 cork

p. 183 water, alcohol, salad oil, beaker, stirring rod

p. 191 gelatin, grapes, assorted fruit, water

Key to Teaching Strategies

L1 Level 1 activities should be appropriate for students with learning difficulties.

L2 Level 2 activities should be within the ability range of all students.

L3 Level 3 activities are designed for above-average students.

ELL ELL activities should be within the ability range of English Language Learners.

COOP LEARN Cooperative Learning activities are designed for small group work.

P These strategies represent student products that can be placed into a best-work portfolio.

These strategies are useful in a block scheduling format.

A View of the Cell

Teacher Classroom Resources

Section	Reproducible Masters	Transparencies
Section 7.1 **The Discovery of Cells**	Reinforcement and Study Guide, p. 29 L2 BioLab and MiniLab Worksheets, p. 31 L2 Laboratory Manual, pp. 47-54 L2 Content Mastery, pp. 33-34, 36 L1	Section Focus Transparency 15 L1 ELL Reteaching Skills Transparency 9 L1 ELL
Section 7.2 **The Plasma Membrane**	Reinforcement and Study Guide, p. 30 L2 Tech Prep Applications, pp. 11-14 L2 Content Mastery, pp. 33, 35-36 L1	Section Focus Transparency 16 L1 ELL Basic Concepts Transparency 6 L2 ELL
Section 7.3 **Eukaryotic Cell Structure**	Reinforcement and Study Guide, pp. 31-32 L2 Concept Mapping, p. 7 L3 ELL Critical Thinking/Problem Solving, p. 7 L3 BioLab and MiniLab Worksheets, pp. 32-34 L2 Content Mastery, pp. 33, 35-36 L1 Inside Story Poster ELL	Section Focus Transparency 17 L1 ELL Basic Concepts Transparency 7 L2 ELL Reteaching Skills Transparency 10 L1 ELL

Assessment Resources

Chapter Assessment, pp. 37-42
MindJogger Videoquizzes
Performance Assessment in the Biology Classroom
Alternate Assessment in the Science Classroom
Computer Test Bank
BDOL Interactive CD-ROM, Chapter 7 quiz

Additional Resources

Spanish Resources ELL
English/Spanish Audiocassettes ELL
Cooperative Learning in the Science Classroom COOP LEARN
Lesson Plans/Block Scheduling

NATIONAL GEOGRAPHIC Teacher's Corner

Products Available From Glencoe

To order the following products, call Glencoe at 1-800-334-7344:

CD-ROM
NGS PictureShow: The Cell

Curriculum Kit
GeoKit: Cells and Microorganisms

Transparency Set
NGS PicturePack: The Cell

Products Available From National Geographic Society

To order the following products, call National Geographic Society at 1-800-368-2728:

Video
Discovering the Cell

Index to National Geographic Magazine

The following articles may be used for research relating to this chapter:

"Life Grows Up," by Richard Monastersky, April 1998.
"The Rise of Life on Earth," by Richard Monastersky, March 1998.

GLENCOE TECHNOLOGY

The following multimedia resources are available from Glencoe.

Biology: The Dynamics of Life
CD-ROM ELL
Video: *Light Microscope*
Video: *The SEM*
Exploration: *Parts of a Cell*
BioQuest: *Cellular Pursuit*

The Infinite Voyage
Unseen Worlds

The Secret of Life Series
Cells: *Microscopy*
Prokaryotic Cell
Eukaryotic Cell
Cell Membranes: *Membranes and Transport*

Getting Started Demo

Measure the height of the shortest and tallest students. Magnify the height of the shortest student by 1.5, then by 10. Compare these heights to the height of the tallest student. Ask students how does perspective change as an object is magnified? *As you look at magnification of cells, the cell becomes larger as you stay the same.* Point out that it is important to remember that the cell is very, very, small. L2 ELL

Theme Development

The first section of the chapter stresses the **nature of science** through a discussion of the development of the microscope and the cell theory. **Evolution** is apparent in the discussion of the number, variety, and complexity of cellular organelles, particularly as these factors relate to cell structure and function.

0:00 Out of Time?

If time does not permit teaching the entire chapter, use the BioDigest at the end of the unit as an overview.

Resource Manager

Section Focus Transparency 15 and Master L1 ELL
BioLab and MiniLab Worksheets, p. 31 L2
Laboratory Manual, pp. 47-50 L2

Chapter 7 A View of the Cell

What You'll Learn

- You will distinguish eukaryotic and prokaryotic cells.
- You will learn the structure and function of the plasma membrane.
- You will relate the structure of cell parts to their functions.

Why It's Important

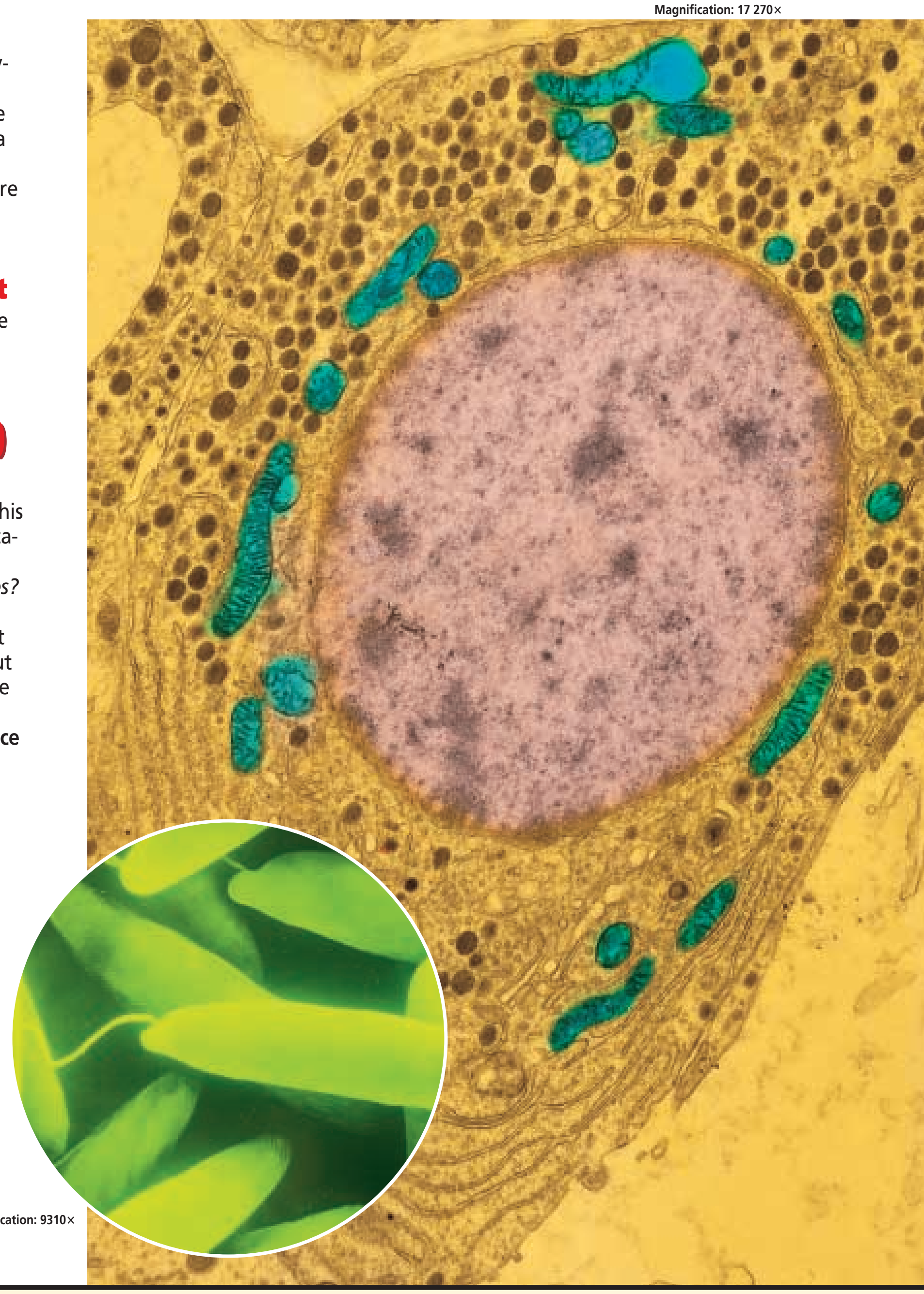
A knowledge of cell structure and function is essential to a basic understanding of life.

Getting Started

Magnification

Use some of the pictures in this chapter to examine magnification. *What does it mean to magnify something 250 times?*

interNET CONNECTION To find out more about cells, visit the Glencoe Science Web Site. **www.glencoe.com/sec/science**


Magnification: 17 270×

Cells are amazingly diverse. Yet for all their diversity, cells such as this nerve cell and the protist *Euglena* share many common features.

Magnification: 9310×

Section 7.1 The Discovery of Cells

Have you ever used a magnifying glass to examine something you'd found? Hundreds of years ago, scientists, too, were fascinated and motivated to study their environment. The first microscopes were not much different from hand-held magnifying glasses, consisting of only one lens. Through a single-lens microscope, the Dutch scientist Anton van Leeuwenhoek in the mid-1600s was the first person to record looking at water under a microscope. He was amazed to find it full of living things.


Magnification reveals minute details.

Section Preview

Objectives

Relate advances in microscope technology to discoveries about cells and cell structure.

Compare the operation of a compound light microscope with that of an electron microscope.

Identify the main ideas of the cell theory.

Vocabulary

cell
compound light microscope
cell theory
electron microscope
prokaryote
eukaryote
organelle
nucleus

The History of the Cell Theory

Before microscopes were invented, people believed that diseases were caused by curses and supernatural spirits. They had no idea that organisms such as bacteria existed. As scientists began using microscopes, they quickly realized they were entering a new world—one of microorganisms (my kroh OR guh nihz umz). Microscopes enabled scientists to view and study **cells,** the basic units of living organisms.

Development of light microscopes

The microscope van Leeuwenhoek (LAY vun hook) used is considered a simple light microscope because it contained one lens and used natural light to view objects. Over the next 200 years, scientists greatly improved microscopes by grinding higher quality lenses and creating the compound light microscope. **Compound light microscopes** use a series of lenses to magnify objects in steps. These microscopes can magnify objects up to 1500 times. As the observations of plants and animals viewed under a microscope expanded, scientists began to draw conclusions about the organization of living matter. With the microscope established as a valid scientific tool, scientists had to learn the size relationship of magnified objects to their true size. Look at *Focus on Microscopes* to see what specimens look like at different magnifications.

Word Origin

microscope
From the Greek words *mikros,* meaning "small", and *skopein,* meaning to "look." A microscope is used to examine small objects.

Prepare

Key Concepts

Students are provided with an overview of the historical development of the microscope and the events that led to the formation of the cell theory.

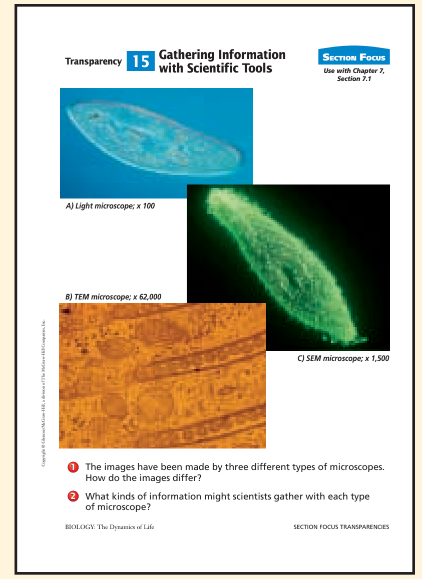
Planning

- Collect pictures of microscopes for the microscope collage.
- Gather cork for the Quick Demo.
- Collect materials needed for the microscopy project. Some cells should be purchased in advance.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 15** on the overhead projector and have students answer the accompanying questions. L1 ELL


Transparency 15 Gathering Information with Scientific Tools

SECTION FOCUS
Use with Chapter 7, Section 7.1

A) Light microscope; x 100
B) TEM microscope; x 62,000
C) SEM microscope; x 1,500

1. The images have been made by three different types of microscopes. How do the images differ?
2. What kinds of information might scientists gather with each type of microscope?

BIOLOGY: The Dynamics of Life — SECTION FOCUS TRANSPARENCIES

Multiple Learning Styles

Look for the following logos for strategies that emphasize different learning modalities.

Kinesthetic Quick Demo, p. 176; Portfolio, p. 177; Tech Prep, p. 181; Portfolio, p. 190

Visual-Spatial Portfolio, p. 183; Biology Journal, p. 191; Portfolio, p. 186; Quick Demo, p. 191

Intrapersonal Extension, p. 180; Activity, p. 180

Interpersonal Reteach, p. 193; Extension, p. 193

Linguistic Biology Journal, p. 176; Enrichment. p. 176; Biology Journal, p. 183; Extension, p. 184

Assessment Planner

Portfolio Assessment
Problem-Solving Lab, TWE, p. 186
BioLab, TWE, p. 195

Performance Assessment
Assessment, TWE, p. 184
Alternative Lab, TWE, p. 189
MiniLabs, TWE, pp. 177, 187
BioLab, SE, p. 195

Knowledge Assessment
Assessment, TWE, pp. 180, 183
Problem-Solving Lab, TWE, p. 182
Section Assessments, SE, pp. 180, 184, 193
Chapter Assessment, SE, pp. 197-199

Skill Assessment
MiniLab, TWE, p. 187
Assessment, TWE, p. 193

2 Teach

Enrichment

Linguistic Have students do library research on how various electron microscopes work. Students can write a report or make an oral presentation to the class. L3

Quick Demo

Kinesthetic Show students a piece of cork and have them examine the cellular structure. Emphasize that cork was a living part of an organism. It is the dead cells of oak bark.

Visual Learning

Figure 7.1 Have students examine this figure and determine whether organelles are present in the cork cells.

Assessment

Performance Have students study a cell under the microscope at increasing magnifications (or use appropriate photographs). Have them describe as much detail as possible at each magnification and draw diagrams of the cells at different magnifications. L2 ELL

GLENCOE TECHNOLOGY

VIDEODISC
The Secret of Life
Cells: Microscopy

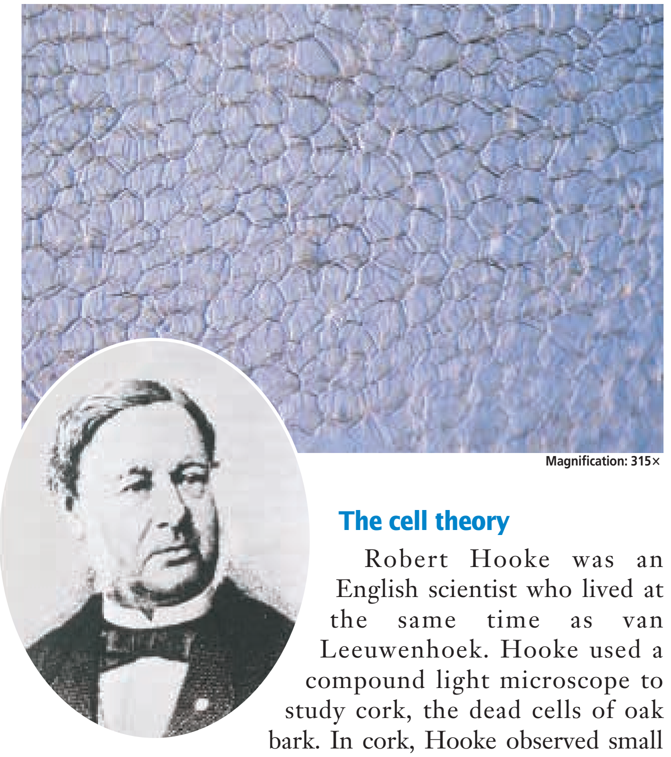


Figure 7.1
Cork cells (top) were observed by Robert Hooke using a crude compound light microscope that magnified structures only 30 times. Theodore Schwann (inset) made similar observations in animals.

The cell theory

Robert Hooke was an English scientist who lived at the same time as van Leeuwenhoek. Hooke used a compound light microscope to study cork, the dead cells of oak bark. In cork, Hooke observed small geometric shapes, like those shown in *Figure 7.1.* Hooke gave these box-shaped structures the name cells because they reminded him of the small rooms monks lived in at a monastery. Cells are the basic building blocks of all living things. Hooke published his drawings and descriptions, which encouraged other scientists to search for cells in the materials they were studying.

Several scientists extended Hooke's observations and drew some important conclusions. In the 1830s, the German scientist Matthias Schleiden observed a variety of plants and concluded that all plants are composed of cells. Another German scientist, Theodore Schwann, ***Figure 7.1***, made similar observations on animals. The observations and conclusions of these scientists are summarized as the cell theory, one of the fundamental ideas of modern biology.

The **cell theory** is made up of three main ideas:

1. *All organisms are composed of one or more cells.* An organism may be a single cell, such as the organisms van Leeuwenhoek saw in water. Others, like most of the plants and animals with which you are most familiar, are multicellular, or made up of many cells.
2. *The cell is the basic unit of organization of organisms.* Although organisms can become very large and complex, such as humans, dogs, and trees, the cell remains the simplest, most basic component of any organism.
3. *All cells come from preexisting cells.* Before the cell theory, no one knew how cells were formed, where they came from, or what determined the type of cell they became. The cell theory states that a cell divides to form two identical cells.

Development of electron microscopes

The microscopes we have discussed so far use a light source and can magnify an object up to about 1500 times its actual size. Although light microscopes continue to be valuable tools, scientists knew another world existed within a cell that they could not yet see. In the 1940s a new type of microscope, the **electron microscope**, was invented. This microscope uses a beam of electrons instead of natural light to magnify structures up to 500 000 times their actual size, allowing scientists to see structures within a cell.

There are two basic types of electron microscopes. Scientists commonly use the scanning electron microscope (SEM) to scan the surfaces of cells to learn their three-dimensional shape. The transmission electron microscope (TEM) allows scientists to study the structures contained within a cell.

New types of microscopes and new techniques are continually being designed. The scanning tunneling microscope (STM) uses the flow of electrons to investigate atoms on the surface of a molecule. New techniques using the light microscope have increased the information scientists can learn with this basic tool. Most of these new techniques seek to add contrast to structures within the cells, such as adding dyes that stain some parts of a cell, but not others. Try the *Minilab* on this page to practice measuring objects under a microscope.

Two Basic Cell Types

With the invention of light microscopes, scientists noticed that cells could be divided into two broad groups: those with internal, membrane-bound structures and those without. Cells lacking internal membrane-bound structures are called prokaryotic (proh KER ee oh tik) cells. The cells of most unicellular organisms such as bacteria do not have membrane-bound structures and are therefore called **prokaryotes.**

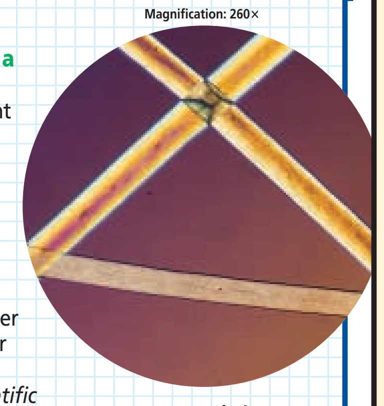
Cells of the basic second type, those containing membrane-bound structures, are called eukaryotic (yew KER ee oh tik) cells. Most of the multicellular plants and animals we know have cells containing membrane-bound structures and are therefore called **eukaryotes.** It is important to note, however, that some eukaryotes, such as some algae and yeast, are unicellular organisms.

The membrane-bound structures within eukaryotic cells are called **organelles.** Each organelle has a specific function for cell survival.

MiniLab 7-1 Measuring in SI

Measuring Objects Under a Microscope Knowing the diameter of the circle of light you see when looking through a microscope allows you to measure the size of objects that are being viewed. For most microscopes, the diameter of the circle of light is 1.5 mm, or 1500 μm (micrometers), under low power and 0.375 mm, or 375 μm, under high power.

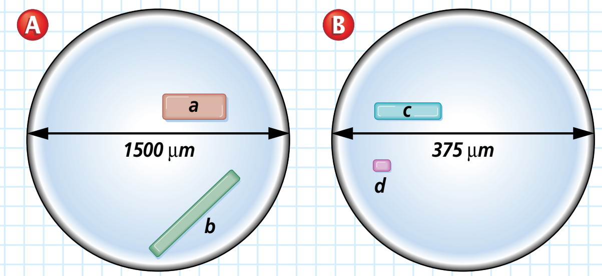
Refer to *Practicing Scientific Methods* in the Skill Handbook if you need help with SI units.



Human hair

Procedure

1. Look at diagram A that shows an object viewed under low power. Knowing the circle diameter to be 1500 μm, the estimated length of object (a) is 400 μm. What is the estimated length of object (b)?
2. Look at diagram B that shows an object viewed under high power. Knowing the circle diameter to be 375 μm, the estimated length of object (c) is 100 μm. What is the estimated length of object (d)?
3. Prepare a wet mount of a strand of your hair. Your teacher can help with this procedure. **CAUTION:** *Use caution when handling microscopes and glass slides.* Measure the width of your hair strand while viewing it under low and then high power.



Analysis

1. An object can be magnified 100, 200, or 1000 times when viewed under a microscope. Does the object's actual size change with each magnification? Explain.
2. Do your observations of the size of your hair strand under low and high power support the answer to question 1? If not, offer a possible explanation why.

MiniLab 7-1

Purpose
Students will learn how to estimate an object's size under the microscope.

Process Skills
measure in SI, observe and infer, use numbers, estimate

Safety Precautions
Remind students to handle slides carefully and dispose of broken glass properly.

Teaching Strategies
- Review the procedure for making a wet mount.
- Give students some sample problems to practice estimating size and converting from mm to μm
- Provide other objects, such as diatoms and yeast cells, for viewing and measuring.

Expected Results
The size of object (b) is 700 μm and object (d) is 25 μm. Hair width may be within the range of 60–100μm (depending on race and/or hair color) and will be the same (or very close) under low and high power magnification.

Analysis
1. No. An object's size does not change, only its magnification changes.
2. Answers will vary, but observations under low and high power should be close. Error in estimating may be the cause of differing measurements.

Assessment

Performance Have students compare the width of cranial and arm hair; blonde and black hair; Asian and Caucasian hair; and Caucasian and African American hair. Ask them to prepare a data table with their results. Use the Performance Task Assessment List for Data Table in **PASC**, p. 37. L2 ELL

Biology Journal

Building Vocabulary

Linguistic Have students define the following Greek and Latin words: *micro, scop, eu, karyon, pro, plasma, chrom, endo, lysis, mitos, chondros, chloros,* and *plastos.* Ask students to identify words from the chapter that use these and explain how the Greek or Latin meaning relates to the meaning of the term. L2 ELL

GLENCOE TECHNOLOGY

VIDEODISC
The Infinite Voyage
Unseen Worlds
Technology Reconstructs Egyptian Mummies
(Ch. 1) 6 min. 30 sec.

Portfolio

Microscopy and Staining

Kinesthetic Have students examine various types of cells to develop their microscope skills. Set out iodine solution and methylene blue and encourage students to experiment with the stains. For iodine solution preparation instructions, see page 40T of the Teacher Guide. Possible cells to examine might include: onion, *Elodea* leaf, cheek, potato, *Lactobacillus* in cultured yogurt, teeth bacteria, *Paramecium*, amoeba, *Volvox*, tomato skin, tomato pulp, and pear pulp. You may wish to have students work in their cooperative groups to prepare their stained slides. Have students review the proper procedures for using the microscope in the **Skill Handbook**. L2 ELL
COOP LEARN

Focus On

Microscopes

Purpose

Students will be provided with an historical perspective of the events that led to the development of the compound microscope, transmission electron microscope (TEM), and scanning electron microscope (SEM) and the uses of each microscope type.

Background

Magnifying lenses were developed hundreds of years ago but required live specimens. Further progress was delayed due to a lack of knowledge about how to prepare specimens.

Teaching Strategies

- Ask students whether they think the development of a successful microscope was delayed because of problems with creating lenses or a lack of knowledge about how to prepare specimens for study. *Problems resulted more from a lack of knowledge about how to prepare specimens since lens construction dates back to the time of Galileo.*
- Discuss the techniques involved in preparing specimens for electron microscopy studies. The use of metals for shadowing, freeze-fracture techniques, and ultramicrotomes are all good topics for discussion.
- Have students research the backgrounds and training of the individuals involved in the development of the microscope *or* the scientists who contributed to the development of the cell theory. L3

FOCUS ON Microscopes

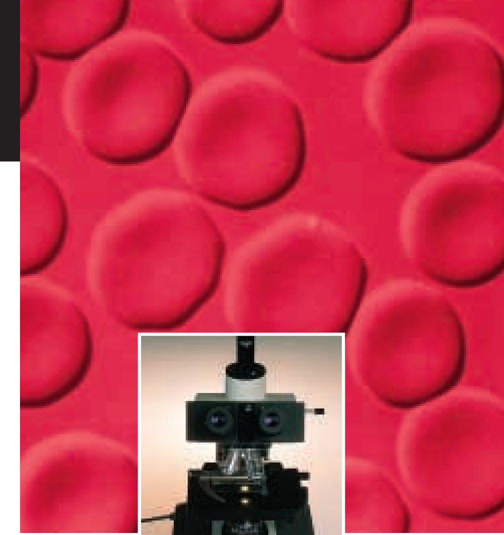
The invention and development of the light microscope some 300 years ago allowed scientists to see cells for the first time. Improvements have vastly increased the range of visibility of microscopes. Today researchers can use these powerful tools to study cells at the molecular level.

THIS EARLY COMPOUND MICROSCOPE, housed in a gold-embossed leather case, was designed by English scientist Robert Hooke about 1665. Using it, he observed and made drawings of cork cells. Although the microscope has three lenses, they are of poor quality and Hooke could see little detail.


ANTON VAN LEEUWENHOEK

THIS HISTORIC MICROSCOPE—held by a modern researcher—was designed by Anton van Leeuwenhoek (above). By 1700, Dutch scientist Leeuwenhoek had greatly improved the accuracy of microscopes. Grinding the lenses himself, Leeuwenhoek built some 240 single-lens versions. He discovered—and described for the first time—red blood cells and bacteria, taken from scrapings from his teeth. By 1900, problems with lenses that had once limited image quality had been overcome, and the compound microscope had evolved essentially into its present form.


HOOKE'S MICROSCOPE



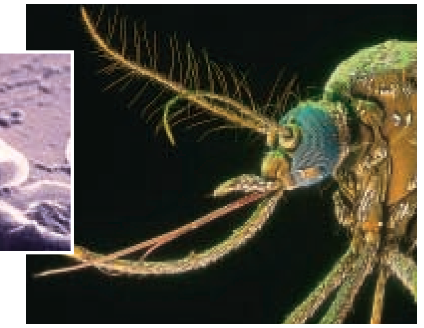
RED BLOOD CELLS UNDER A COMPOUND LIGHT MICROSCOPE Magnification: 800x

HOW IT WORKS The magnifying power of a microscope is determined by multiplying the magnification of the eyepiece and the objective lens.

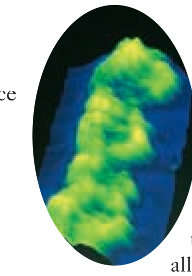
A COMPOUND LIGHT MICROSCOPE (above) uses two or more glass lenses to magnify objects. Light microscopes are used to look at living cells, such as red blood cells (top), small organisms, and preserved cells. Compound light microscopes can magnify up to about 1500 times.

RED BLOOD CELLS UNDER A SCANNING ELECTRON MICROSCOPE Magnification: 10 000x

SCANNING ELECTRON MICROSCOPE IMAGE OF A MOSQUITO Magnification: 50x



SCANNING ELECTRON MICROSCOPE An SEM sweeps a beam of electrons over the surface of a specimen, such as red blood cells (above), causing electrons to be emitted from the specimen. SEMs produce a realistic, three-dimensional picture—but only the surface of an object can be observed. An SEM can magnify about 60 000 times without losing clarity.


SCANNING TUNNELING MICROSCOPE IMAGE OF A DNA FRAGMENT Magnification: 2 000 000x

SCANNING TUNNELING MICROSCOPE The STM revolutionized microscopy in the mid-1980s by allowing scientists to see atoms on an object's surface. A very fine metal probe is brought near a specimen. Electrons flow between the tip of the probe and atoms on the specimen's surface. As the probe follows surface contours, such as those on this DNA molecule (above), a computer creates a three-dimensional image. An STM can magnify up to one hundred million times.

RED BLOOD CELLS UNDER TRANSMISSION AN ELECTRON MICROSCOPE Magnification: 40 000x


RESEARCHER USING A TEM

TRANSMISSION ELECTRON MICROSCOPE A TEM aims a beam of electrons through a specimen. Denser portions of an object allow fewer electrons to pass through. These denser areas appear darker in the image. Two-dimensional TEM images are used to study details of cells such as these red blood cells (above). A TEM can magnify hundreds of thousands of times.

EXPANDING Your View

1. **THINKING CRITICALLY** Can live specimens be examined with an electron microscope? Explain. Consider how the specimen must be prepared for viewing.
2. **COMPARING AND CONTRASTING** Compare the images seen with an SEM and with a TEM.

Portfolio

The Compound Microscope

Visual-Spatial Have students draw and label the parts of their microscope. Under each label have them describe the function of the part. For the objective lenses, have students calculate and identify the power of magnification for an object viewed with each lens. L1 ELL P

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Video: *The SEM*
Disc 1
Video: *The Light Microscope*
Disc 1

MEETING INDIVIDUAL NEEDS

Learning Disabled/Gifted

Students who have difficulty with mathematical concepts may need extra help with the SI calculations and measurements in this chapter. Hands-on manipulations with metric rulers can increase their understanding of the mathematical concepts involved. Have students who are having difficulty with mathematics work cooperatively with students possessing strong math skills to make a variety of calculations related to microscopy. Calculations should include determining magnification, calculating field of view, and using the microscope as a measuring tool. L1 L3

Visual Learning

- **Demonstration** Show students a series of photomicrographs of the same organelle as it appears with a light and an electron microscope. Also show them artists' sketches of cells and their organelles to aid students in recognizing two- and three-dimensional representations. Photomicrographs and drawings may be obtained from college-level texts.
- **Display** Create a display consisting of pictures of the many types of early microscopes. Such pictures may be obtained from a museum or history of science text. Large displays of various types of modern microscopes are available from scientific supply houses. Use the pictures to contrast the location of the specimen, the methods of illumination, the types of lenses used, and how light passes through each (using light-ray optical diagrams). If possible, also show examples of specimens as they appear under each microscope.

Answers to Expanding Your View

1. **Thinking Critically** Live specimens cannot be viewed with an electron microscope because specimens must be dehydrated and placed in a vacuum.
2. **Comparing and Contrasting** Images in the SEM are three-dimensional, while TEM images are two-dimensional. Images in the TEM can be magnified greater than those in the SEM.

3 Assess

Check for Understanding

Quiz students orally about the importance of the cell theory and its acceptance by the scientific community.

Reteach

Review the parts of the cell theory and the significance of each statement making up the theory as a reinforcement exercise.

Extension

Intrapersonal Have interested students research new types of microscopes, such as the atomic force microscope. L3

Assessment

Knowledge Quiz students on the names and functions of the parts of the compound microscope. L2

4 Close

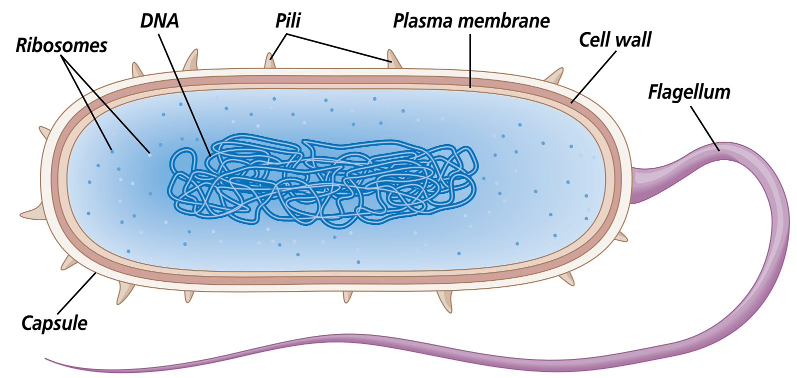
Activity

Intrapersonal In a class discussion, summarize the contributions of each scientist mentioned in this section. Have students make a table that lists the name of each scientist and his contributions. Encourage students to retain their tables in their journals and to add information about other scientists throughout the remainder of the course. L2

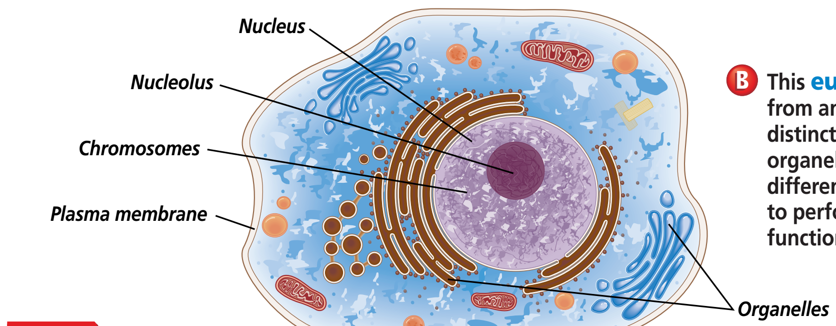
Resource Manager

Reinforcement and Study Guide, p. 29 L2
Content Mastery, p. 34 L1
Reteaching Skills Transparency 9 and Master L1 ELL
Laboratory Manual, pp. 51-54 L2

Figure 7.2
Bacteria and archaebacteria are prokaryotes. All other organisms are eukaryotes.



A A **Prokaryotic cell** does not have internal organelles surrounded by a membrane. Most of a prokaryote's metabolic functions take place in the cytoplasm.



B This **eukaryotic cell** from an animal has distinct membrane-bound organelles that allow different parts of the cell to perform different functions.

Word Origin

organelle
From the Greek words *organon*, meaning "tool" or "implement" and *ella*, meaning "small." Organelles are small, membrane-bound structures in cells.

Compare the prokaryotic and eukaryotic cells in ***Figure*** *7.2*. Separation of organelles into distinct compartments benefits the eukaryotic cell. One benefit is that chemical reactions that would normally not occur in the same area of the cell can now be carried out at the same time.

Robert Brown, a Scottish scientist, first observed a prominent structure in cells that Rudolf Virchow later concluded was the structure responsible for cell division. We now know this structure as the **nucleus,** the central membrane-bound organelle that manages cellular functions.

Section Assessment

Understanding Main Ideas

1. Why was the development of microscopes necessary for the study of cells?
2. How does the cell theory describe the organization of living organisms?
3. Compare the light sources of light microscopes and electron microscopes.
4. How are prokaryotic and eukaryotic cells different?

Thinking Critically

5. Suppose you discovered a new type of fern. Applying the cell theory, what can you say for certain about this organism?

Skill Review

6. **Care and Use of a Microscope** Most compound light microscopes have four objective lenses with magnifications of 4×, 10×, 40×, and 100×. What magnifications are available if the eyepiece magnifies 15 times? For more help, refer to *Practicing Scientific Methods* in the **Skill Handbook**.

Section Assessment

1. Microscopes were needed because most cells are not visible with the unaided eye.
2. Cells are the basic unit of organization of living organisms. All organisms are composed of cells. Cells are derived from preexisting cells.
3. Light microscopes use natural light to penetrate objects. Electron microscopes use a beam of electrons.
4. Eukaryotic cells have membrane-bound organelles and a nucleus surrounded by a double bilayer. Prokaryotic cells have neither.
5. The fern is made of one or more cells, which are the basic units of its organization. The fern's cells came from preexisting cells.
6. 60×, 150×, 600×, 1500×

Section

7.2 The Plasma Membrane

Think of trudging home from school on a cold wintry day. When you finally arrive, you enter a room where you are sheltered from the wind and surrounded by a warm, comfortable environment. Your house is a controlled environment just like the cells in your body. Similar to the way the walls of your home act as a barrier against the elements, the plasma membrane provides a barrier between the internal components of a cell and its external environment.

Cells, like your entire body, require a constant environment.

SECTION PREVIEW

Objectives

Explain how a cell's plasma membrane functions.

Relate the function of the plasma membrane to the fluid mosaic model.

Vocabulary

plasma membrane
homeostasis
selective permeability
phospholipid
fluid mosaic model
transport protein

Maintaining a Balance

You are comfortable in your house largely because the thermostat maintains the temperature within a limited range regardless of what's happening outside. Similarly, all living cells must maintain a balance regardless of internal and external conditions. Survival depends on the cell's ability to maintain the proper conditions within itself.

Why cells must control materials

Your cells need nutrients such as glucose, amino acids, and lipids to function. It is the job of the **plasma membrane,** the boundary between the cell and its environment, to allow a steady supply of these nutrients to come into the cell no matter what the external conditions are. However, too much of any of these nutrients or other substances, especially ions, can be harmful to the cell. If levels become too high, the plasma membrane removes the excess. The plasma membrane also allows waste and other products to leave the cell. This process of maintaining the cell's environment is called **homeostasis.**

How does the plasma membrane maintain homeostasis? One mechanism is **selective permeability,** a process in which the plasma membrane of a cell allows some molecules into the cell while keeping others out. Thinking back to your home, a screen in a window can perform selective permeability in a similar way. When you open the window, the screen lets fresh air inside and keeps

Word Origin

permeable
From the Latin words *per*, meaning "through," and *meare*, meaning "to glide." Materials move easily (glide) through permeable membranes.

Section 7.2

Prepare

Key Concepts

Students will examine the fluid mosaic model of the plasma membrane and discover how this model explains the functions of the membrane.

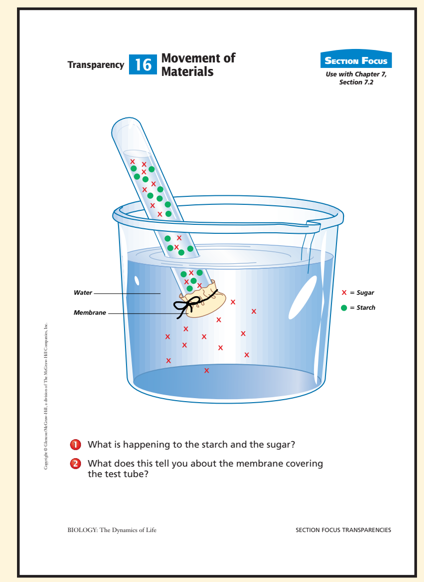
Planning

- Collect the materials for the Tech Prep modeling project.
- Obtain glass jars, water, alcohol, food coloring, and salad oil for the Quick Demo.
- Purchase Ping-Pong balls or apples for the Reteach. Also obtain a suitable tub.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 16** on the overhead projector and have students answer the accompanying questions. L1 ELL



TECHPREP

Kinesthetic Group students and have them build models of a plasma membrane using materials such as Styrofoam "peanuts," yarn, pipe cleaners, and popsicle sticks. Encourage students to be creative. L2 ELL

Resource Manager

Section Focus Transparency 16 and Master L1 ELL
Tech Prep Applications, pp. 11-12 L2

2 Teach

Problem-Solving Lab 7-1

Purpose

Students will determine how the plasma membrane of living cells is a selective barrier to certain molecules.

Process Skills

compare and contrast, interpret scientific illustrations, recognize cause and effect, think critically

Teaching Strategies

■ Remind students that yeast cells are living organisms. Elicit the composition of a blue stain (molecules of a chemical compound).

■ Have students describe some of the organelles that should be present in yeast and verify that the plasma membrane is included in the discussion. L2

Thinking Critically

1. Boiling killed the cells; it disrupted the intact plasma membrane.
2. Answers will vary. For example, if yeast cells are boiled and killed, then their membrane can no longer serve as a barrier to the blue stain.
3. Yes, while alive, yeast cell membranes prevent the blue stain from entering the interior. Once cells are killed, the membranes can no longer keep the blue stain out.

Assessment

Knowledge Have students make diagrams depicting the before and after appearance of the yeast cell membranes. Have them show the blue stain in both diagrams. Students are to assume that no carrier molecules were involved. Use the Performance Task Assessment List for Scientific Drawing in **PASC**, p. 55. L2 ELL

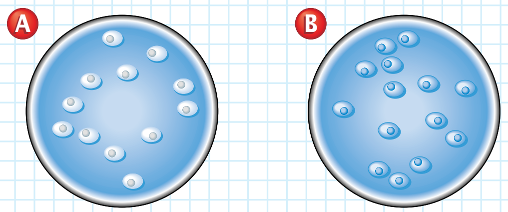
Problem-Solving Lab 7-1 — Recognizing Cause and Effect

Is the cell membrane a selective barrier? Yeast cells are living and contain a plasma membrane. How is it possible to show that living yeast plasma membranes are capable of limiting what enters the cell? Conduct an experiment to find an answer.

Analysis

Diagram A shows the appearance of yeast cells in a solution of blue stain. Note their color as well as the color of the surrounding stain.

Diagram B also shows yeast cells in a solution of blue stain. These cells, however, were boiled for 10 minutes before being placed in the stain. Again, note the color of the yeast cells as well as the color of the surrounding stain.



Thinking Critically

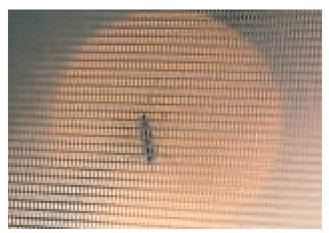
1. Explain how boiling affected the yeast cells.
2. Hypothesize why the color of the cells differs under different conditions. Be sure that your hypothesis takes the role of the plasma membrane into consideration.
3. Are plasma membranes selective barriers? Explain.

most insects out. Some molecules, such as water, freely enter the cell through the plasma membrane, as shown in *Figure 7.3*. Other particles, such as sodium and calcium ions, must be allowed into the cell only at certain times, in certain amounts, and through certain channels. The plasma membrane must be selective in allowing these ions to enter. Use the *Problem-Solving Lab* here to evaluate the plasma membrane of a yeast cell.

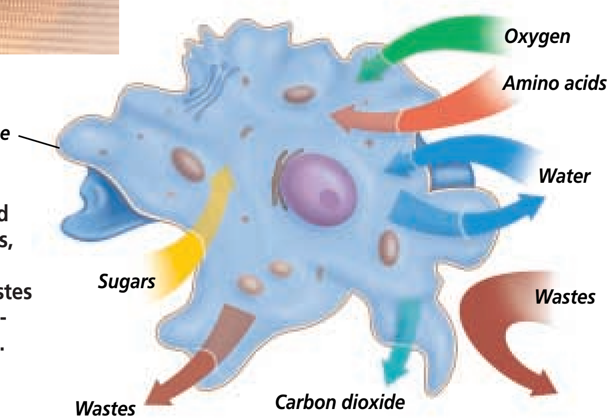
Structure of the Plasma Membrane

Now that you understand the basic function of the plasma membrane, you can study its structure. Recall that lipids are insoluble molecules that are the primary components of cellular membranes. The plasma membrane is composed of a phospholipid bilayer, which is two layers of phospholipid back-to-back. **Phospholipids** are lipids with a phosphate group attached to them. The lipids in a plasma membrane have a glycerol backbone, two fatty acid chains, and a phosphate group.

Figure 7.3
The selectively permeable plasma membrane controls substances entering and leaving a cell.

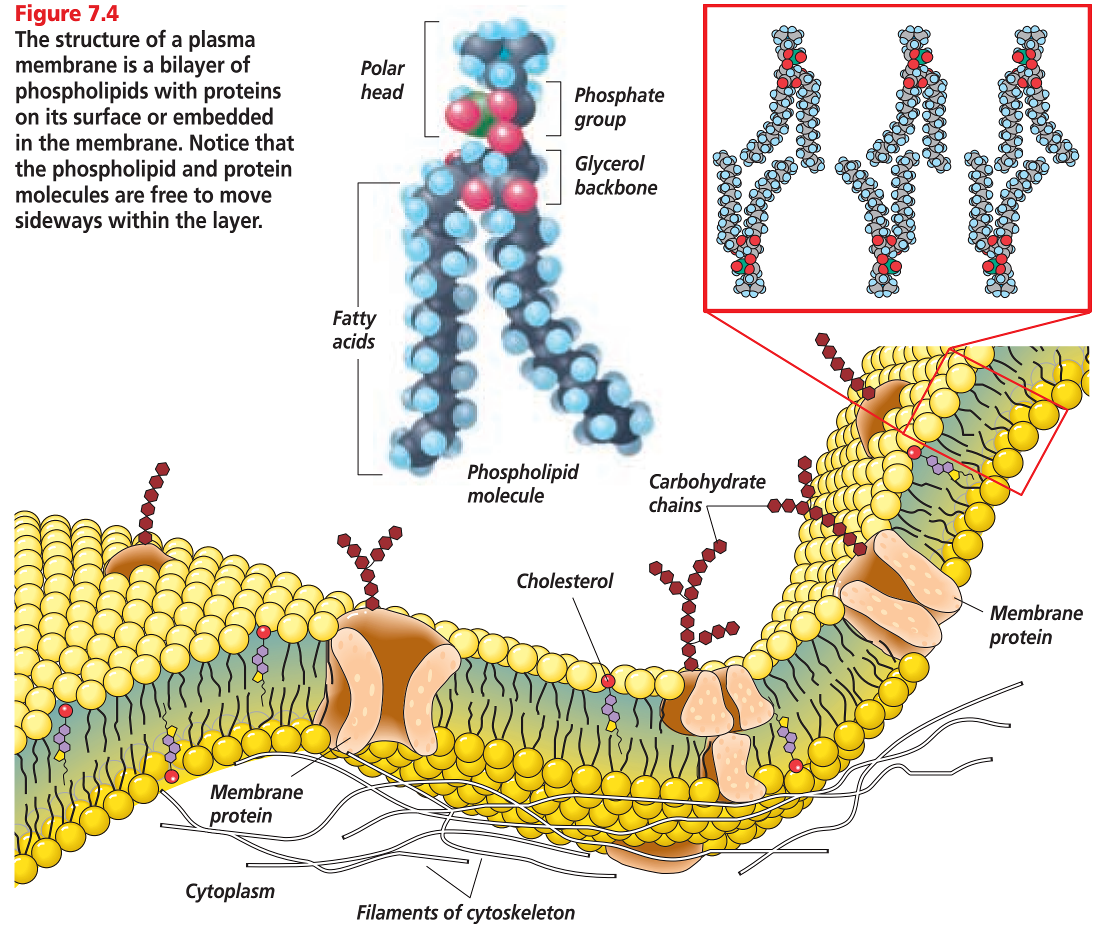


A Screens in your windows are selectively permeable because they allow air inside and keep bugs out.



B A cell must take in and keep needed materials, such as glucose. A cell must also remove wastes and keep harmful substances from entering.

Figure 7.4
The structure of a plasma membrane is a bilayer of phospholipids with proteins on its surface or embedded in the membrane. Notice that the phospholipid and protein molecules are free to move sideways within the layer.



Makeup of the phospholipid bilayer

The addition of the phosphate group does more than change the name of the lipid. The phosphate group is critical for the formation and function of the plasma membrane. *Figure 7.4* illustrates phospholipids and their place within the structure of the plasma membrane. The two fatty acid tails of the phospholipids are nonpolar, whereas the head of the phosphate molecule is polar.

Water is a key component of living organisms, both inside and outside the cell. The polar phosphate group allows the cell membrane to interact with its watery environment because, as you recall, water is also polar. The fatty acid tails, on the other hand, avoid water. The two layers of phospholipid molecules make a sandwich with the fatty acid tails forming the interior of the membrane and the phospholipid heads facing the watery environment outside the cell. When many phospholipid molecules come together in this manner, a barrier is created that is water-soluble at its outer surfaces and water-insoluble in the middle. Water-soluble molecules will not easily move through the membrane because they are stopped by this water-insoluble layer.

Assessment

Knowledge Quiz students on how the plasma membrane controls the passage of materials into and out of the cell. L1

Quick Demo

Mix polar substances such as colored water and alcohol to show that the substances dissolve in each other. Then add a small amount of salad oil to the colored water. Point out that the oil is nonpolar. Stir the mixture vigorously. Explain that the oil forms spheres because the oil molecules have an affinity for each other but not for the water molecules.

3 Assess

Check for Understanding

Ask students to write a description of the fluid mosaic model including in their descriptions the following terms: plasma membrane, phospholipid, bilayer, polar, nonpolar, and proteins. Ask volunteers to present their summaries to the class. L2

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Exploration: *Parts of a Cell*
Disc 1

Cultural Diversity

Ernest Everett Just

Discuss the history of the study of the plasma membrane and the important contributions of African American embryologist Ernest Everett Just (1883–1941). Just is best known for his experimental studies on fertilization in sea urchins.

GLENCOE TECHNOLOGY

VIDEODISC
The Secret of Life
Cell Membranes: Membranes and Transport 1 min. 4 sec.

Biology Journal

Biology and Art

Linguistic Have students use a dictionary to define *mosaic*. Ask them to describe how this term applies to a piece of art and to the plasma membrane. Have students write about the fluid nature of the membrane and explain why its fluidity is important to living cells. L2 ELL

Portfolio

Plasma Membrane Structures

Visual-Spatial Have students draw and label the parts of the plasma membrane. For the lipids, have the students identify whether the parts are polar or nonpolar. For the proteins, have the students indicate some possible functions. L2 ELL P

Reteach

Model the action of a fluid mosaic by filling a plastic tub half full with water. Add just enough Ping-Pong balls to the tub to completely cover the water's surface. Move one ball across the surface and have students note how the other balls jostle each other to make way for the moving ball. A similar demonstration could be done with a tub of red apples and one yellow apple.

Extension

Linguistic Have students research and report on the development of the fluid mosaic model. Ask them to include the work of Gorter and Grendel, Danielli and Davison, and Singer and Nicholson in their reports. L3

Assessment

Performance Ask a volunteer to use colored chalk to draw the fluid mosaic model on the chalkboard and describe it to the class. L2 ELL

4 Close

Discussion

Ask students to evaluate the strengths and weaknesses of the analogy that a plasma membrane is similar to the walls of a house. L1

Resource Manager

Basic Concepts Transparency 6 and Master L2 ELL
Reinforcement and Study Guide, p. 30 L2

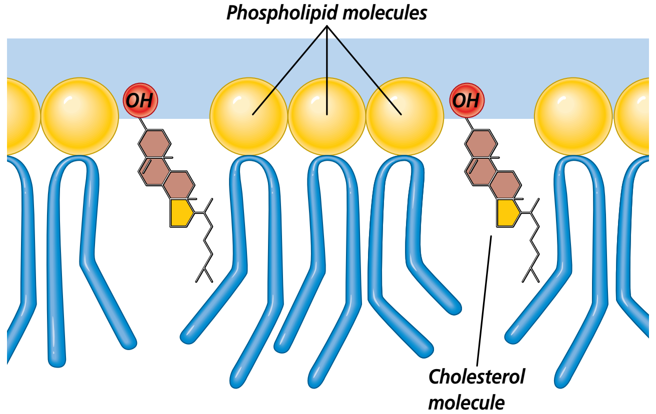


Figure 7.5
Eukaryotic plasma membranes can contain large amounts of cholesterol—up to one molecule for every phospholipid molecule.

This model of the plasma membrane is called the **fluid mosaic model.** It is fluid because the membrane is flexible. The phospholipids move within the membrane just as water molecules move with the currents in a lake. At the same time, proteins embedded in the membrane also move among the phospholipids like boats with their decks above water and hulls below water. These proteins create a "mosaic," or pattern, on the membrane surface.

Other components of the plasma membrane

Cholesterol, shown in *Figure 7.5,* is also found in the plasma membrane where it helps stabilize the phospholipids. Cholesterol is a common topic in health issues today because high levels are associated with reduced blood flow in blood vessels. Yet, for all the emphasis on cholesterol-free foods, it is important to recognize that cholesterol plays a critical role in the stability of the plasma membrane. Cholesterol prevents the fatty acid chains of the phospholipids from sticking together.

You've learned that proteins are found within the lipid membrane. Some proteins span the entire membrane, creating the selectively permeable membrane that regulates which molecules enter and which molecules leave a cell. These proteins are called transport proteins. **Transport proteins** allow needed substances or waste materials to move through the plasma membrane. Other proteins and carbohydrates that stick out from the cell surface help cells identify each other. As you will discover later, these characteristics are important in protecting your cells from infection. Proteins at the inner surface of a plasma membrane play an important role in attaching the plasma membrane to the cell's internal support structure, giving the cell its flexibility.

Section Assessment

Understanding Main Ideas

1. How is the plasma membrane a bilayer structure?
2. Explain how selective permeability maintains homeostasis within the cell.
3. What are the components of the phospholipid bilayer, and how are they organized to form the plasma membrane?
4. Why is the plasma membrane referred to as a fluid mosaic?

Thinking Critically

5. Suggest what might happen if cells grow and reproduce in an environment where no cholesterol is available.

Skill Review

6. **Recognizing Cause and Effect** Consider that plasma membranes allow materials to pass through them. Explain how this property contributes to homeostasis. For more help, refer to *Thinking Critically* in the **Skill Handbook.**

Section

7.3 Eukaryotic Cell Structure

When you work on a group project, each person has his or her own skills and talents that add a particular value to the group's work. In the same way, each component of a eukaryotic cell has a specific job, and all of the parts of the cell work together to help the cell survive.

Cell structures, like this team of students, work together for a common purpose.

SECTION PREVIEW

Objectives

Understand the structure and function of the parts of a typical eukaryotic cell.

Explain the advantages of highly folded membranes in cells.

Compare and contrast the structures of plant and animal cells.

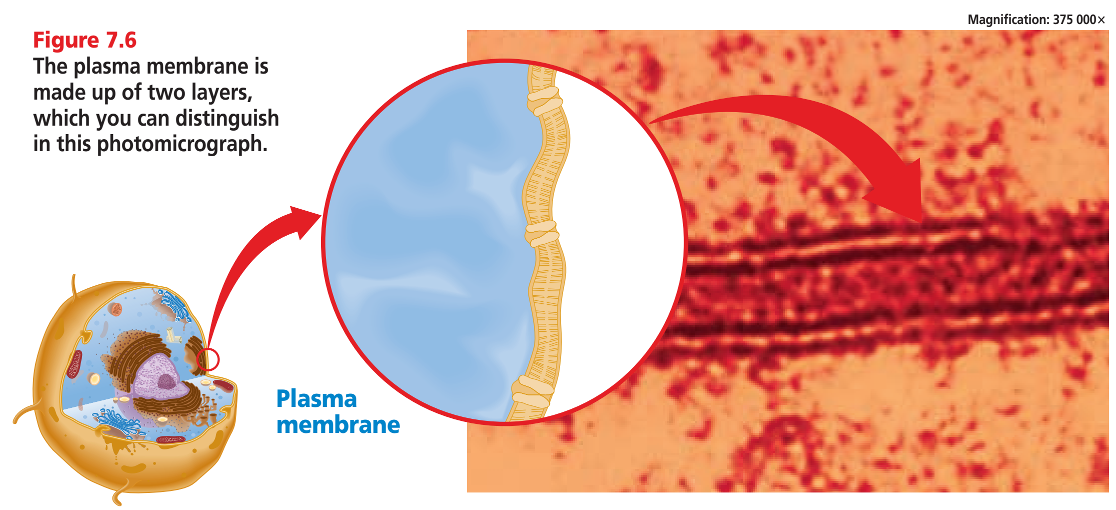
Vocabulary

cell wall
chromatin
nucleolus
ribosome
cytoplasm
endoplasmic reticulum
Golgi apparatus
vacuole
lysosome
chloroplast
plastid
chlorophyll
mitochondria
cytoskeleton
microtubule
microfilament
cilia
flagella

Cellular Boundaries

When a group works together, someone on the team decides what resources are necessary for the project and provides these resources. In the cell, the plasma membrane, shown in *Figure 7.6,* performs this task by acting as a selectively permeable membrane. The fluid mosaic model describes the plasma membrane as a flexible boundary of a cell. However, plant cells, fungi, most bacteria, and some protists have an additional boundary. The **cell wall** is a fairly rigid structure located outside the plasma membrane that provides additional support and protection.

Figure 7.6
The plasma membrane is made up of two layers, which you can distinguish in this photomicrograph.



Section 7.3

Prepare

Key Concepts

The section describes the structure and function of eukaryotic cells. Detailed art and photos illustrate organelles and show the complexity of eukaryotic cells.

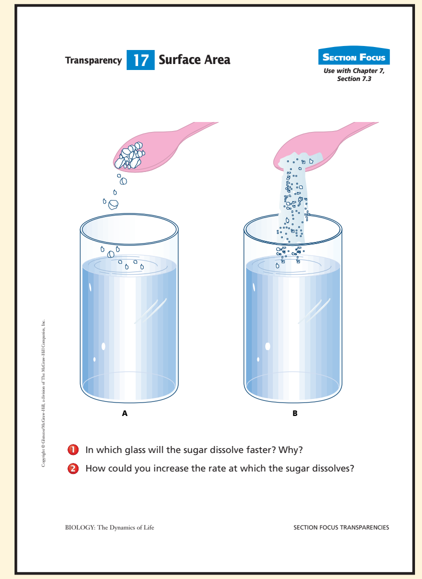
Planning

- Obtain an onion and iodine solution for the MiniLab.
- Purchase *Elodea* for the Alternative Lab.
- Gather materials for the classroom "cell" as suggested in the Portfolio strategy.
- Purchase gelatin and fruit for the Quick Demo.
- Collect materials for the BioLab.

1 Focus

Bellringer

Before presenting the lesson, display **Section Focus Transparency 17** on the overhead projector and have students answer the accompanying questions. L1 ELL



Section Assessment

1. Phospholipids that form the membrane consist of a double layer.
2. Selective permeability lets cells get rid of wastes, lets critical molecules in, and keeps harmful molecules out.
3. Two lipid layers consisting of a glycerol backbone, two fatty acid tails, and a phosphate group are positioned with the heads facing out and the tails facing in.
4. The lipids and proteins in the membrane are free to move, making a pattern like a mosaic.
5. The membranes would be very fragile and would not hold together.
6. Selective permeability allows materials that are needed for metabolism and survival to enter the cell.

Internet Address Book

interNET CONNECTION Note Internet addresses that you find useful in the space below for quick reference.

Resource Manager

Section Focus Transparency 17 and Master L1 ELL

2 Teach

Problem-Solving Lab 7-2

Purpose
Students will become familiar with the role of the nucleus in directing cell activities.

Process Skills
relate cause and effect, interpret data

Background
Two species of *Acetabularia* both have nuclei in their feet but produce different caps. Cutting and replacing the caps allows one to determine the role the nucleus plays in directing production of cellular proteins.

Teaching Strategies
■ You may wish to draw diagrams of the *Acetabularia* species used in this study on the chalkboard or show a transparency and review the results as a class. Lead a discussion about why the final cap ended as it did.

Thinking Critically
The nucleus produces substances that control the type of cap the cell has. The first cap was of intermediate form because the cytoplasm contained substances from both the previous nucleus and the present nucleus. The cytoplasm of the second cap had only substances from the present nucleus.

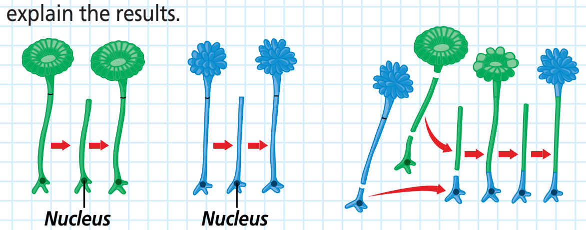
Assessment
Portfolio Ask students to write a summary of this lab. Encourage them to include diagrams with their summaries. Use the Performance Task Assessment List for Lab Report in **PASC,** p. 47. L2 P

Problem-Solving Lab 7-2 — Interpret the Data

What organelle directs cell activity? *Acetabularia,* a type of marine alga, grows as single, large cells 2 to 5 cm in height. The nuclei of these cells are in the "feet." Different species of these algae have different kinds of caps, some petal-like and others that look like umbrellas. If a cap is removed, it quickly grows back. If both cap and foot are removed from the cell of one species and a foot from another species is attached, a new cap will grow. This new cap will have a structure with characteristics of both species. If this new cap is removed, the cap that grows back will be like the cell that donated the nucleus.

The scientist who discovered these properties was Joachim Hämmerling. He wondered why the first cap that grew had characteristics of both species, yet the second cap was clearly like that of the cell that donated the nucleus.

Analysis
Look at the diagram below and interpret the data to explain the results.



Thinking Critically
Why is the final cap like that of the cell from which the nucleus was taken? (HINT: Recall the function of the nucleus.)

The cell wall

The cell wall forms an inflexible barrier that protects the cell and gives it support. *Figure 7.7* shows a plant cell wall that is made up of a carbohydrate called cellulose. The fibers of cellulose form a thick mesh of fibers. This fibrous cell wall is very porous and allows molecules to pass through, but unlike the plasma membrane, it does not select which molecules can enter into the cell.

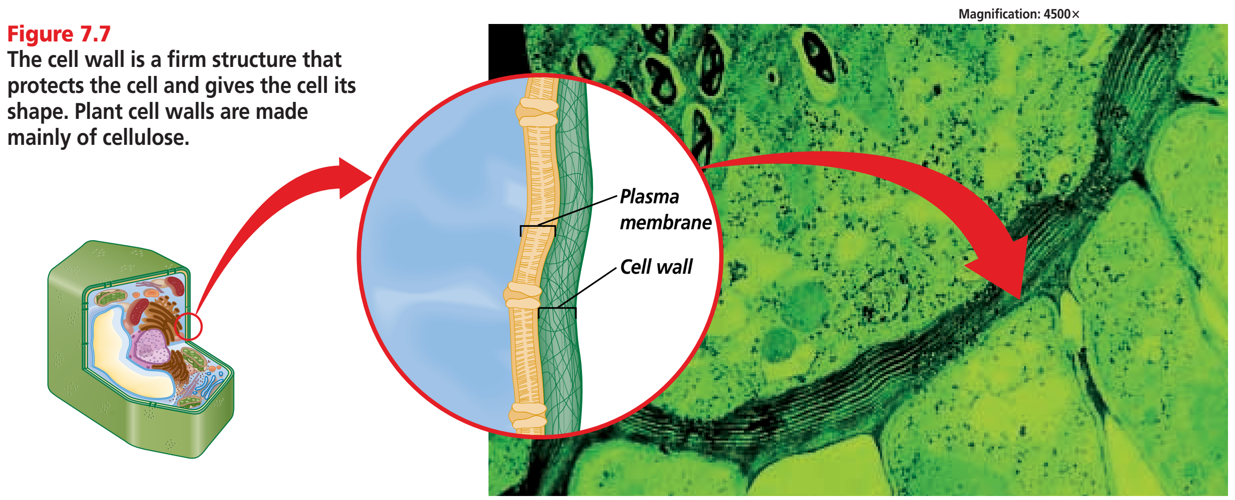
Nucleus and cell control

Just as every team needs a leader to direct activity, so the cell needs a leader to give directions. The nucleus is the leader of the eukaryotic cell because it contains the directions to make proteins. Every part of the cell depends on proteins to do its job, so by containing the blueprint to make proteins, the nucleus controls the activity of the organelles. Read the *Problem-Solving Lab* on this page and consider how the *Acetabularia* nucleus controls the cell.

The master set of directions for making proteins is contained in **chromatin,** which are strands of the genetic material, DNA. When the cell divides, the chromatin condenses to form chromosomes. Within the nucleus is another organelle called the **nucleolus** that makes ribosomes. **Ribosomes** are the sites where the cell assembles enzymes and other proteins according to the directions of DNA. Unlike other organelles, ribosomes are not bound by a membrane within the cell. Look at some cells as described in the *MiniLab* shown here and try to identify the nucleus in cells of an onion.

For proteins to be made, ribosomes must move out of the nucleus and into the cytoplasm, and the blueprints contained in DNA must be copied and sent to the cytoplasm. **Cytoplasm** is the clear, gelatinous fluid inside a cell. As the ribosomes and the copied DNA are transported to the cytoplasm, they pass through the nuclear envelope—a structure that separates the nucleus from the cytoplasm as shown in *Figure 7.8.* The nuclear envelope is a double membrane made up of two phospholipid bilayers containing small nuclear pores for substances to pass through. Ribosomes and the DNA copy pass into the cytoplasm through the nuclear envelope.

Figure 7.7
The cell wall is a firm structure that protects the cell and gives the cell its shape. Plant cell walls are made mainly of cellulose.

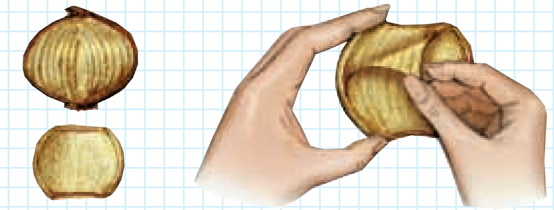


MiniLab 7-2 — Experimenting

Cell Organelles Adding stains to cellular material helps you distinguish cell organelles.

Procedure
CAUTION: *Be sure to wash hands before and after this experiment.*

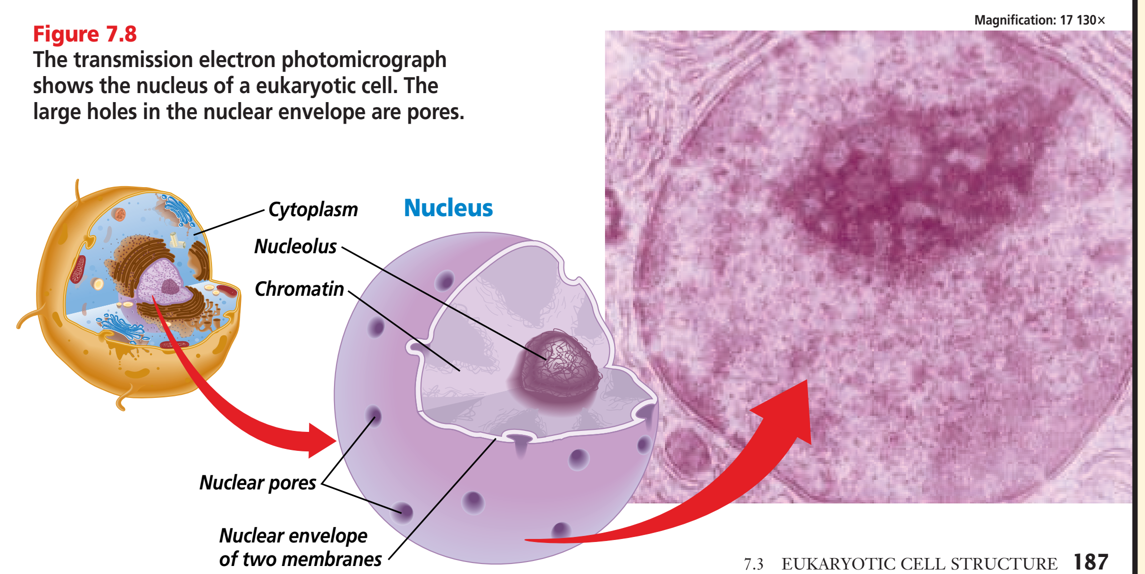
1. Prepare a water wet mount of onion skin. Do this by using your finger nail to peel off the inside of a layer of onion bulb. The layer must be almost transparent. Use the following diagram as a guide.



2. Make sure that the onion layer is lying flat on the glass slide and not folded.
3. Observe the onion cells under low- and high-power magnification. Identify as many organelles as possible.
4. Repeat steps 1 through 3, only this time use an iodine stain instead of water.

Analysis
1. What organelles were easily seen in the unstained onion cells? Cells stained with iodine?
2. How are stains useful for viewing cells?

Figure 7.8
The transmission electron photomicrograph shows the nucleus of a eukaryotic cell. The large holes in the nuclear envelope are pores.



MiniLab 7-2

Purpose
Students will learn the technique and value of using stains for doing microscope observations.

Process Skills
compare and contrast, experiment, observe and infer

Teaching Strategies
■ Review the procedure for making a wet mount.
■ Review proper microscope procedures. Emphasize that reducing light may be critical for viewing onion tissue.
■ Demonstrate how to peel an onion epidermis from the bulb.
■ Iodine stain may be placed in dark dropper bottles—add 1.5 g potassium iodide and 0.3 g iodine to 1 L water.

Expected Results
Students will observe more organelles when cells are stained than when cells are unstained.

Analysis
1. cell wall, cytoplasm; cell wall, cytoplasm, nucleus
2. Staining allows certain organelles to be more easily observed.

Assessment
Skill Ask students to diagram two onion cells, one with and one without stain. Have them label the organelles that were visible under each condition. Use the Performance Task Assessment List for Scientific Drawing in **PASC,** p. 55. L1 ELL

Resource Manager
BioLab and MiniLab Worksheets, p. 32 L2
Basic Concepts Transparency 7 and Master L2 ELL

Portfolio

Observing Plant and Animal Cells

Visual-Spatial Have students observe several kinds of plant and animal cells with a microscope. Ask them to make labeled diagrams of each cell they observe. Beside each label, have them describe the function of each organelle. Have students use their observations to create a table in which they compare the organelles of plant and animal cells. Students' tables should include all organelles shown in their diagrams and identify whether the organelle is common to both plant and animal cells or unique to only one kind of cell. L2 P

Cultural Diversity

Santiago Ramón y Cajal

Introduce Spanish cell biologist Santiago Ramón y Cajal and his work on nerve cells in the early 1900s. Cajal, together with Italian biologist Camillo Golgi, received the Nobel Prize for Physiology in 1906 for establishing that neurons are the basic units of the nervous system. This research was important to understanding the transmission of nerve impulses. Ramón y Cajal was also responsible for developing cell staining techniques that are still used in today's laboratories.

Chalkboard Activity

Have students list body systems they need to live. Write their responses on the chalkboard. Use this list to introduce cell organelles as the structures that perform or help to perform the life functions of cells. L1

Revealing Misconceptions

Students often think of a cell as being solid and impenetrable. Point out that most of a cell (almost 80%) is liquid water. The water is enclosed within a membrane that permits certain materials to enter and exit the cell.

GLENCOE TECHNOLOGY

VIDEODISC
The Secret of Life
Cell Organelles: Endoplasmic Reticulum/ Golgi Apparatus
1 min. 5 sec.

NATIONAL GEOGRAPHIC

VIDEODISC
STV: The Cell
Cell Wall of Onion Cell

Assembly, Transport, and Storage

You have begun to follow the trail of protein production as directed by the cell manager—the nucleus. But what happens to the blueprints for proteins once they pass into the cytoplasm?

Structures for assembly and transport of proteins

The cytoplasm suspends the cell's organelles. One particular organelle in a eukaryotic cell, the **endoplasmic reticulum** (ER), is the site of cellular chemical reactions. *Figure 7.9* shows how the ER is a series of highly folded membranes suspended in the cytoplasm. The ER is basically a large workspace within the cell. Its folds are similar to the folds of an accordion in that if you spread the folds out it would take up tremendous space. But by pleating and folding it up, the accordion fits its surface area into a compact unit. So by folding the membrane over and over again, a large amount of membrane is available to do work.

Ribosomes in the cytoplasm attach to areas on the endoplasmic reticulum, called rough endoplasmic reticulum, where they carry out the function of protein synthesis. The ribosome's only job is to make proteins. Each protein made in the rough ER has a particular function; it may become the protein that forms a part of the plasma membrane, the protein released from the cell, or the protein transported to other organelles. Ribosomes can also be found floating freely in the cytoplasm where they make proteins that perform tasks within the cytoplasm itself.

Areas of the ER that are not studded with ribosomes are known as smooth endoplasmic reticulum. The smooth ER is involved in numerous biochemical activities, including the production and storage of lipids.

After proteins are produced, they are transferred to another organelle called the **Golgi apparatus** (GAWL jee). The Golgi apparatus as shown in *Figure 7.10* is a flattened system of tubular membranes that modifies the proteins. The Golgi apparatus and membrane-bound structures called vesicles sort the proteins into packages to be sent to the appropriate destination, like mail being sorted at the post office.

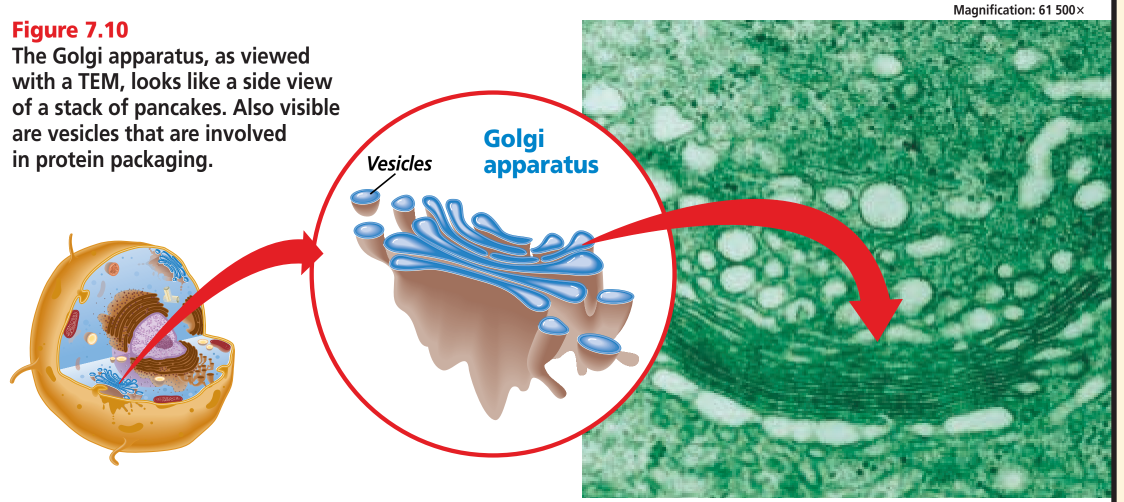


Figure 7.10
The Golgi apparatus, as viewed with a TEM, looks like a side view of a stack of pancakes. Also visible are vesicles that are involved in protein packaging.

Vacuoles and storage

Now let's look at some of the other members of the cell team important to the cell's functioning. Cells have membrane-bound spaces, called **vacuoles,** for temporary storage of materials. A vacuole, like those in *Figure 7.11,* is a sac surrounded by a membrane. Vacuoles often store food, enzymes, and other materials needed by a cell, and some vacuoles store waste products. Notice the difference between vacuoles in plant and animal cells.

Lysosomes and recycling

Did anyone ever ask you to take out the trash? You probably didn't consider that action as part of a team effort, but in a cell, it is. **Lysosomes** are organelles that contain digestive enzymes. They digest excess or worn out organelles, food particles, and engulfed viruses or bacteria. The membrane surrounding a lysosome prevents the digestive enzymes inside from destroying the cell. Lysosomes can fuse with vacuoles and dispense their enzymes into the vacuole,

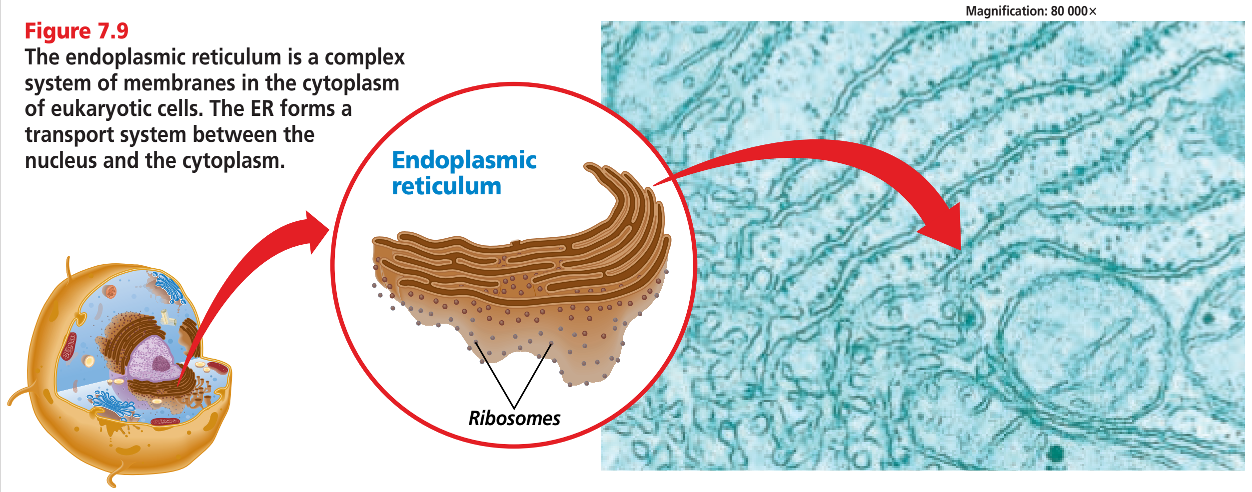


Figure 7.9
The endoplasmic reticulum is a complex system of membranes in the cytoplasm of eukaryotic cells. The ER forms a transport system between the nucleus and the cytoplasm.

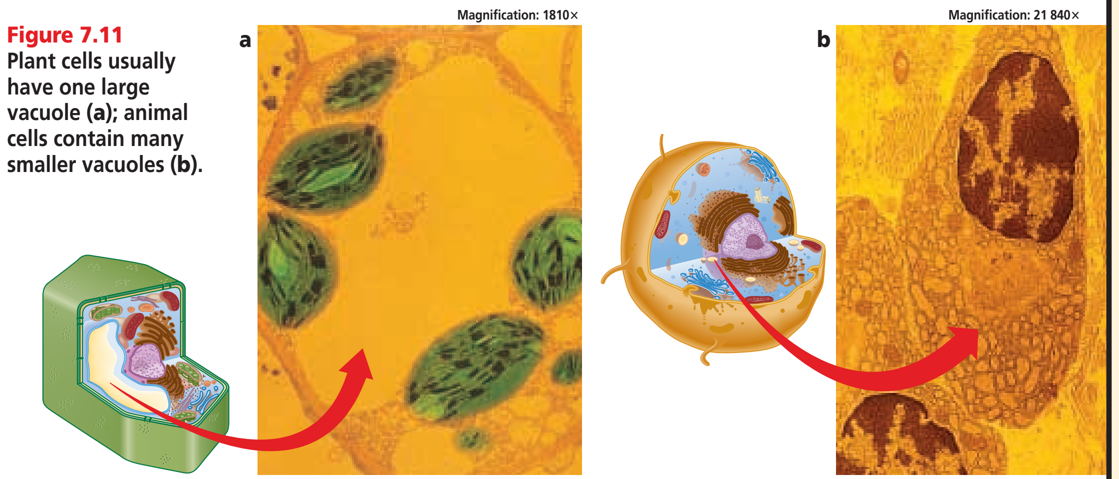


Figure 7.11
Plant cells usually have one large vacuole (a); animal cells contain many smaller vacuoles (b).

Visual Learning

Figure 7.10 Discuss how showing cell organelles both in photographs and in art is useful. Point out that illustrations can often accentuate structures to make them clearer than they appear in photographs.

Reinforcement

Use models of plant cells and animal cells (available from biological supply houses) to review and reinforce knowledge of cell parts.

Assessment

Performance Divide students into groups of three or four. Assign each group a cell part and have students develop a commercial to "sell" their cell part. L2 ELL COOP LEARN

Resource Manager

Concept Mapping, p. 7 L3 ELL
Critical Thinking/Problem Solving, p. 7 L3

Alternative Lab

Differences Between Plant and Animal Cells

Purpose
This lab will allow students to compare plant and animal cells.

Safety Precautions
Students should wear aprons and goggles. Remind students to handle glass slides carefully and dispose properly.

Materials
microscope, glass slides and coverslips, droppers, forceps, *Elodea* plant, prepared slide of human cheek cells.

Procedure
Give students the following directions.

1. Use a dropper to place a drop of water in the center of a slide. Use the forceps to remove a leaf from the tip of an *Elodea* sprig and place it in the water on your slide. Add a coverslip.
2. Under low power, look for a thin area of the leaf where you can see the cells most clearly. Change to high power and locate a single cell. Observe carefully for a minute.
3. Draw the cell and label the structures you see.
4. Place the prepared slide of human cheek cells on the microscope stage and view under low power, moving the slide to center a single cell. Change to high power and observe the cell. Draw the cell and label the structures.

Analysis

1. What structures did you see in each cell? What are their functions? *Likely responses may include cell walls, cell membranes, vacuoles, and nuclei. Accept all logical descriptions of the functions of each cell part named.*
2. Methylene blue is one of many stains used when observing cells. What is the function of this stain? *Stain makes it possible to see some parts of the cell that might not be visible.*

Assessment

Performance Have students prepare a lab report describing what they have seen. They should include drawings of both the *Elodea* and cheek cell and the answers to the analysis questions. Use the Performance Task Assessment List for Lab Report in **PASC,** p. 47. L2

Revealing Misconceptions

Students often believe that because plants carry on photosynthesis, they do not respire. Point out that, like animals, the cells of plants contain mitochondria. Mitochondria present in all eukaryotic cells produce the ATP that provides the energy for the cells. Therefore, plant cells carry on respiration as well as photosynthesis.

NATIONAL GEOGRAPHIC

VIDEODISC
STV: The Cell
Parts of the Cell
Unit 2, 7 min. 7 sec.
Parts of the Cell (in its entirety)

Chloroplasts

Word Origin

chloroplast
From the Greek words *chloros*, meaning "green," and *platos*, meaning "formed object." Chloroplasts capture light energy and produce food for plant cells.

digesting its contents. For example, when an amoeba engulfs a food morsel and encloses it in a vacuole, a lysosome fuses to the vacuole and releases its enzymes, which helps digest the food. Sometimes, lysosomes digest the cells that contain them. For example, when a tadpole develops into a frog, lysosomes within the cells of the tadpole's tail cause its digestion. The molecules thus released are used to build different cells, perhaps in the newly formed legs of the adult frog.

Energy Transformers

Now that you know about a number of the cell parts and have learned what they do, it's not difficult to imagine that each of these cell team members requires a lot of energy. Protein production, modification, transportation, digestion—all of these require energy. Two other organelles, chloroplasts and mitochondria, provide that energy.

Chloroplasts and energy

When you walk through a field or pick a vegetable from the garden, you may not think of the plants as energy generators. In fact, that is exactly what you see. Located in the cells of green plants and some protists, chloroplasts are the heart of the generator. **Chloroplasts** are cell organelles that capture light energy and produce food to store for a later time.

A chloroplast, like a nucleus, has a double membrane. A diagram and a TEM photomicrograph of a chloroplast with an outer membrane and a folded inner membrane system are shown in ***Figure 7.12.*** It is within these thylakoid membranes that the energy from sunlight is trapped. These inner membranes are arranged in stacks of membranous sacs called grana, which resemble stacks of coins. The fluid that surrounds the grana membranes is called stroma.

The chloroplast belongs to a group of plant organelles called **plastids,** which are used for storage. Some plastids store starches or lipids, whereas others contain pigments, molecules that give color. Plastids are named according to their color or the pigment they contain. Chloroplasts contain the green pigment chlorophyll. **Chlorophyll** traps light energy and gives leaves and stems their green color.

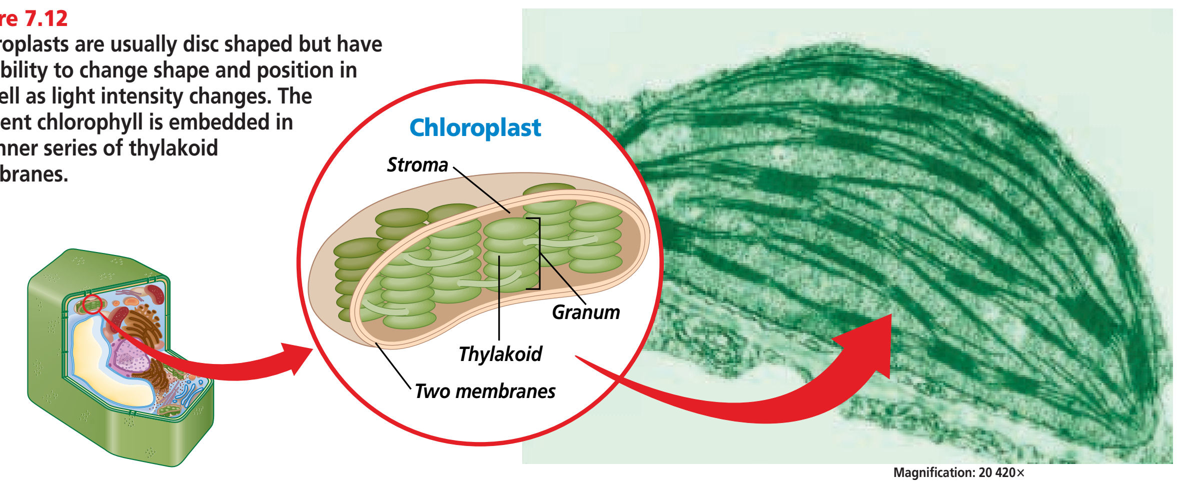


Figure 7.12
Chloroplasts are usually disc shaped but have the ability to change shape and position in the cell as light intensity changes. The pigment chlorophyll is embedded in the inner series of thylakoid membranes.

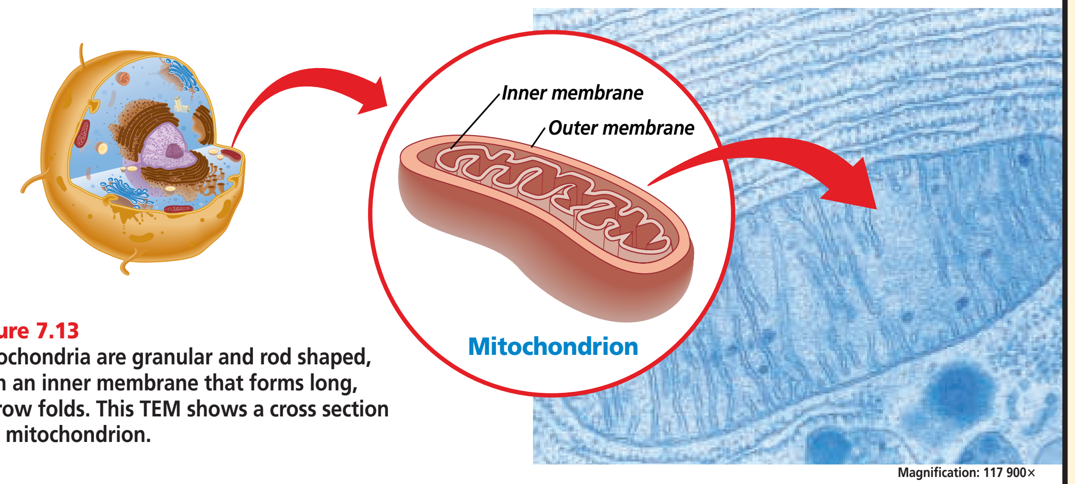


Figure 7.13
Mitochondria are granular and rod shaped, with an inner membrane that forms long, narrow folds. This TEM shows a cross section of a mitochondrion.

Mitochondria and energy

The food energy generated by chloroplasts is stored until it is broken down and released by mitochondria, shown in ***Figure 7.13.*** **Mitochondria** are membrane-bound organelles in plant and animal cells that transform energy for the cell. This energy is then stored in other molecules that allow the cell organelles to use the energy easily and quickly when it is needed.

A mitochondrion has an outer membrane and a highly folded inner membrane. As with chloroplasts, the folds of the inner membrane provide a large surface area that fits in a small space. Energy-storing molecules are produced on the inner folds. Mitochondria occur in varying numbers depending on the function of the cell. For example, liver cells may have up to 2500 mitochondria.

Although the process by which energy is produced and used in the cells is a technical concept to learn, the *Literature Connection* at the end of this chapter explains how cellular processes can also be inspiring. Look at the *Inside Story* on the next page to compare plant and animal cells. Notice how similar they are.

Structures for Support and Locomotion

Scientists once thought that cell organelles just floated in a sea of cytoplasm. More recently, cell biologists have discovered that cells have a support structure called the **cytoskeleton** within the cytoplasm. The cytoskeleton is composed of a variety of tiny rods and filaments that form a framework for the cell, like the skeleton that forms the framework for your body. However, unlike your bones, the cytoskeleton is a constantly changing structure.

Cellular support

The cytoskeleton is a network of thin, fibrous elements that acts as a sort of scaffold to provide support for organelles. It maintains cell shape similar to the way that poles maintain the shape of a tent. The cytoskeleton is composed of microtubules and microfilaments that are associated with cell shape and assist organelles in moving from place to place within the cell. **Microtubules** are thin, hollow cylinders made of protein. **Microfilaments** are thin, solid protein fibers.

Word Origin

cytoskeleton
From the Latin word *cyte*, meaning "cell." The cytoskeleton provides support and structure for the cell.

Quick Demo

Visual-Spatial To aid students in understanding the orientation of organelles in a cell, create a cell model from gelatin containing whole grapes and chunks of different fruits. Have students compare cell parts suspended in cytoplasm to the fruit suspended in the gelatin. Have students speculate how the angle on which the cell is cut relates to the shapes organelles may take in an electron micrograph. L2 ELL

Using Science Terms

Explain that the base word *plasto* means "formed body" and the prefix *chloro* means "green." Relate the meanings of these word parts to the chloroplast organelle.

Portfolio

Formulating Models

Kinesthetic Turn part of your classroom into a giant animal cell. From the ceiling, hang four strings to define the size of your cell. For ease in calculation, make the cell a cube. Have students calculate the magnification factor by dividing the length of a side (in μm) by 20 μm (the length of a liver cell). Have students research the sizes of organelles and calculate how large they need to make each organelle using the magnification factor (cell organelle size × magnification factor). Have students use paper and other materials to build cell organelles to scale and then hang them inside the classroom cell. L2 ELL P

Meeting Individual Needs

Visually Impaired

Ask sighted students to describe what they see in microscope labs. You can also prepare slides for a projection microscope or provide 3-dimensional replicas to help visually impaired students. L2

Biology Journal

Visual-Spatial Have students make a large drawing of a mitochondrion or a chloroplast. Drawings should illustrate the internal and external shapes of the organelles. L1 ELL

INSIDE STORY

INVESTIGATE BioLab The BioLab at the end of the chapter can be used at this point in the lesson.

Purpose

Students will compare plant and animal cells and discover the similarities.

Teaching Strategies

- Review cell organelles with your class, then use this Inside Story to compare plant and animal cells with regard to organelles. Be sure to point out the number and type of organelles these cells have in common. Also emphasize the organelles and structures that are unique to plant and animal cells.

Visual Learning

- Have students draw an animal cell and a plant cell on the board. Label the cell wall, vacuole, and centrioles.
- Make a table with the headings: nucleus, ribosomes, centrioles, endoplasmic reticulum, vacuoles, mitochondria, plasma membrane, and cell wall. Underneath the headings list animal cell and plant cell. Have the class complete the table using this Inside Story.

Critical Thinking

Most cells, regardless of whether they belong to a plant or an animal, must perform the same critical functions to survive, grow, and reproduce. Therefore, plant *and* animal cells have many of the same organelles to meet these needs.

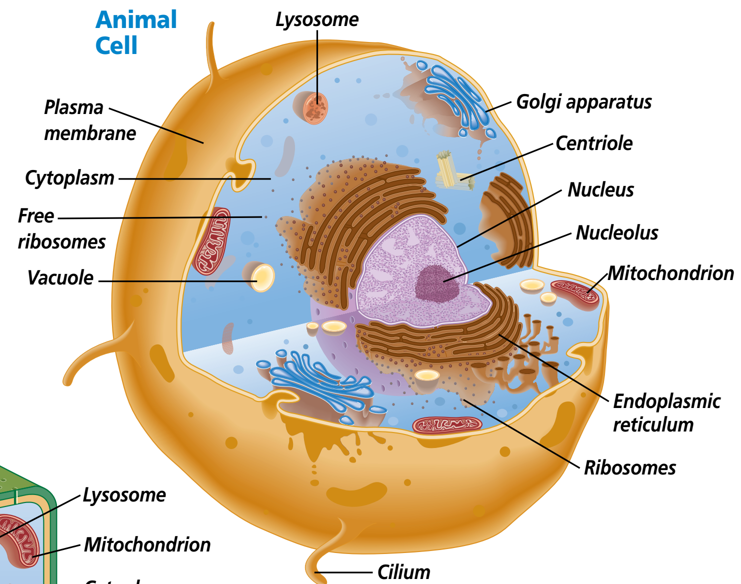
INSIDE STORY

Comparing Animal and Plant Cells

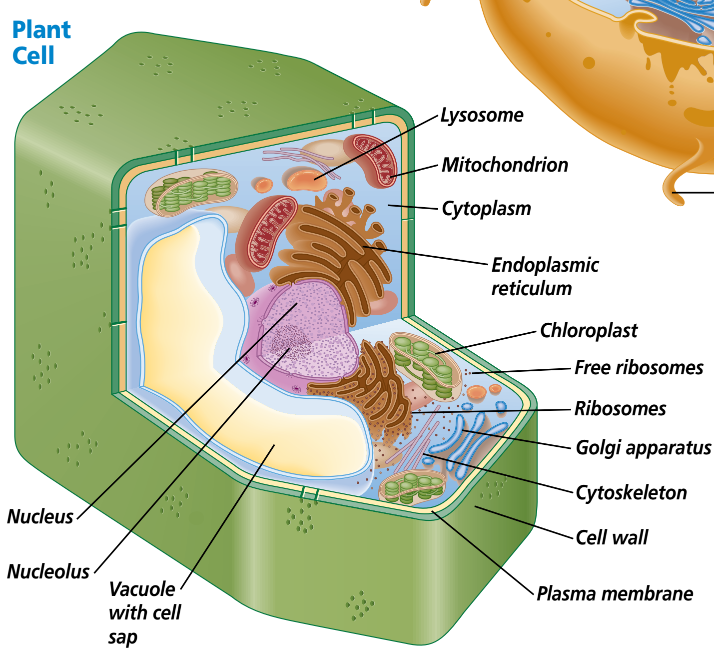
You can easily recognize that a person does not look like a flower and an ant does not resemble a tree. But at the cellular level under a microscope, the cells that make up all of the different animals and plants of the world are very much alike.

Moose eating water plants

Critical Thinking *Why are animal and plant cells similar?*



1 Animal Cells The centriole is the only organelle unique to animal cells. Animal cells typically have many small vacuoles.



2 Plant Cells Plant cells, in general, are larger than animal cells and are characterized by a cell wall and chloroplasts. Plant cells usually have one large vacuole.

A In eukaryotic cells, both cilia and flagella are composed of microtubules arranged in a ring.

B Cilia in the windpipe beat and propel particles of dirt and mucus toward the mouth and nose where they are expelled.

C The flagella of these *Euglena* cells move the organisms forward with their whiplike action.

Figure 7.14 Many cells of animals and protists are covered with cilia or flagella.

Cilia and flagella

Some cell surfaces have cilia and flagella, which are structures that aid in locomotion or feeding. Cilia and flagella are composed of pairs of microtubules, with a central pair surrounded by nine additional pairs, as shown in ***Figure 7.14.*** The entire structure is enclosed by the plasma membrane. The outer microtubules have a protein that allows a pair of microtubules to slide along an adjacent pair. This causes the cilium or flagellum to bend.

Cilia and flagella can be distinguished by their structure and by the nature of their action. **Cilia** are short, numerous, hairlike projections that move in a wavelike motion. **Flagella** are longer projections that move with a whiplike motion. In unicellular organisms, cilia and flagella are the major means of locomotion.

Section Assessment

Understanding Main Ideas

1. What is the advantage of highly folded membranes in a cell? Name an organelle that uses this strategy.
2. What organelles would be especially numerous in a cell that produces large amounts of a protein product?
3. Why are digestive enzymes in a cell enclosed in a membrane-bound organelle?
4. Why might a cell need a cell wall in addition to a plasma membrane?

Thinking Critically

5. How do your cells and the cells of other organisms that are not green plants obtain food energy from the chloroplasts of green plants?

SKILL REVIEW

6. **Observing and Inferring** Some cells have large numbers of mitochondria with many internal folds. Other cells have few mitochondria and, therefore, fewer internal folds. What can you conclude about the functions of these two types of cells? For more help, refer to *Observing and Inferring* in the **Skill Handbook**.

3 Assess

Check for Understanding

Ask students what would happen if a cell had a decreased number of mitochondria. *The cell would probably not have enough energy to carry out all life functions.* L2

Reteach

Interpersonal Ask students working in groups to role-play the organelles of a typical animal cell. Students should show how organelles work together to keep the entire cell functioning. L1 ELL COOP LEARN

Extension

Interpersonal Have students play vocabulary football with cell terms. Divide class into two teams. Ask a question of one team. If they answer correctly, advance the ball 10 yards on a football field drawn on the chalkboard. If they miss the question, the question should be given to the other team. The team that scores the most touchdowns wins. L2

Assessment

Skill Have students construct a table to show cell structures and their functions. Working in pairs, students can quiz each other on information in their tables. L2

4 Close

Discussion

Discuss the analogy of comparing a cell to a team. Have students explain where it is accurate and where it fails. L1

GLENCOE TECHNOLOGY

VIDEODISC
The Secret of Life

Animal Cell

Plant Cell

Resource Manager

Reinforcement and Study Guide, pp. 31-32 L2
Content Mastery, pp. 33, 35-36 L1
Reteaching Skills Transparency 10 and Master L1 ELL

Section Assessment

1. The folding increases the surface area where chemical reactions occur. Examples: endoplasmic reticulum and mitochondria.
2. rough endoplasmic reticulum and Golgi apparatus
3. If these enzymes were free in the cytoplasm, they could damage the cell.
4. Cell walls provide additional support and protection for plant cells.
5. Organisms that are not green plants obtain the food energy of green plants by eating them. For example, humans eat salads or other animals that have ingested green plants.
6. The cells with many mitochondria produce more energy and perform more work than the cells with fewer mitochondria.

GLENCOE TECHNOLOGY

CD-ROM
Biology: The Dynamics of Life
Bioquest: *Cellular Pursuit* Disc 1

INVESTIGATE BioLab

Time Allotment
One class period

Process Skills
observe and infer, measure in SI, hypothesize, compare and contrast, use numbers

Safety Precautions
Students must handle prepared slides, glass slides, and especially cover slides with care.

Preparation

Gather the materials for the lab and review microscopy procedures prior to performing the lab.

Alternative Materials
- *Elodea* is available in pet shops. Prepared slides may be substituted.
- Epithelium slides are available as prepared frog skin or human cheek cells in place of frog blood. Do not substitute human blood.
- Any prepared slide of stained bacteria may be used.

INVESTIGATE BioLab

Observing and Comparing Different Cell Types

Are all cells alike in appearance, shape, and size? Do all cells have the same organelles present within their cell boundaries? One way to answer these questions is to observe a variety of cells using a light microscope.

Preparation

Problem
Are all cells alike in appearance and size?

Objectives
In this BioLab, you will:
- **Observe, diagram,** and **measure** cells and their organelles.
- **Hypothesize** which cells are from prokaryotes, eukaryotes, unicellular organisms, and multicellular organisms.
- **List** the traits of plant and animal cells.

Materials
microscope	dropper
glass slide	coverslip
water	forceps

prepared slides of *Bacillus subtilus*, frog blood, and *Elodea*

Safety Precautions
Always wear goggles in the lab.

Skill Handbook
Use the **Skill Handbook** if you need additional help with this lab.

Procedure

1. Copy the data table.
2. Examine a prepared slide of *Bacillus subtilus* using both low- and high-power magnification. (NOTE: this slide has been stained. Its natural color is clear.)

Data Table

	Bacillus subtilus	*Elodea*	Frog blood
Organelles observed			
Prokaryote or eukaryote			
From a multicellular or unicellular organism			
Diagram (with size in micrometers, µm)			

CAUTION: *Use care when handling slides. Dispose of any broken glass in a container provided by your teacher.*

3. Look for and record the names of any observed organelles. Hypothesize if these cells are prokaryotes or eukaryotes. Hypothesize if these cells are from a unicellular or multicellular organism. Record your findings in the table.
4. Diagram one cell as seen under high-power magnification.
5. While using high power, determine the length and width in micrometers of this cell. Refer to *Practicing Scientific Methods* in the **Skill Handbook** for help with determining magnification. Record your measurements on the diagram.
6. Prepare a wet mount of a single leaf from *Elodea* using the diagram as a guide.
7. Observe cells under low and high power magnification.
8. Repeat steps 3 through 5 for *Elodea*.

9. Examine a prepared slide of frog blood. (NOTE: This slide has been stained. Its natural color is pink.)
10. Observe cells under low- and high-power magnification.
11. Repeat steps 3 through 5 for frog blood cells.

Leopard frog

Analyze and Conclude

1. **Observing and Inferring** Which cells were prokaryotes? How were you able to tell?
2. **Observing and Inferring** Which cells were eukaryotes? How were you able to tell?
3. **Predicting** Which cell was from a plant, from an animal? Explain your answer.
4. **Measuring** Are prokaryote or eukaryote cells larger? Give specific measurements to support your answer.
5. **Defining Operationally** Describe how plant and animal cells are alike and how they differ.

Going Further

Application Prepare a wet mount of very thin slices of bamboo (saxophone reed). Observe under low and high power. Explain what structures you are looking at. Explain the absence of all other organelles from this material.

interNET CONNECTION To find out more about microscopy and cell types, visit the Glencoe Science Web Site. **www.glencoe.com/sec/science**

INVESTIGATE BioLab

Analyze and Conclude

1. *Bacillus subtilus* was a prokaryote—no internal organelles were visible.
2. *Elodea* and epithelium cells were eukaryotic—internal organelles were observed.
3. *Elodea* was from a plant—cell wall and chloroplasts were visible. Blood cells were from an animal—no cell wall or chloroplasts were visible.
4. Eukaryote cells are larger—the prokaryotic cell was only about 10 µm while both eukaryotic cells were in the range of 50–80 µm.
5. Both plant and animal cells are eukaryotic, both have organelles such as plasma membranes, nucleus, and cytoplasm. Plant cells have cell walls and chloroplasts.

Assessment

Portfolio Have students draw *Bacillus subtilus* as they think it would look through a TEM. Use the Performance Task Assessment List for Scientific Drawing in **PASC,** p. 55.

Going Further

Visual-Spatial Ask students to observe the following under the microscope and determine if cells are prokaryotes or eukaryotes: *Gloeocapsa, Euglena, Spirogyra,* liver tissue, frog blood cells. (*Gloeocapsa* is the only prokaryote.) L2

Procedure

Teaching Strategies
- Review the technique used for preparing a wet mount.
- Review the technique used for measuring objects under the microscope (see MiniLab 7-1). Review the conversion of millimeters to micrometers.
- Do not tell students in advance the nature of each cell type being observed. That is, do not tell them that *Bacillus subtilus* is a bacterium.

Troubleshooting
- Individual *Elodea* cells are best observed along the leaf edge where the thickness of tissue is usually one cell.
- If students cannot see organelles, have them practice changing their depth of view by rapidly moving the fine adjustment back and forth while viewing a cell under high-power magnification.
- Mark the diameter of this circle as 1500 µm. Draw several objects in the circle and have students estimate the size of each.

Data and Observations
Bacterial cells are prokaryotic with no visible internal organelles; size ranges between 10 and 20 µm. *Elodea* cells are eukaryotic with visible organelles such as chloroplasts and a nucleus; size ranges between 40 and 80 µm. Blood cells are from a multicellular, eukaryotic organism–and are approximately 40–50 µm.

Resource Manager
BioLab and MiniLab Worksheets, p. 33 L2

Literature Connection

Purpose

Students will be introduced to the thoughts and scientific writings of Lewis Thomas.

Teaching Strategies

- Lewis Thomas said that his writings are "Notes of a Biology Watcher." Have students discuss what this phrase means and explain how all people are "Biology Watchers."
- Have students read all of Lewis Thomas's *Lives of a Cell* or his book *Medusa and the Snail*. Ask students to prepare a written report on the book they read.

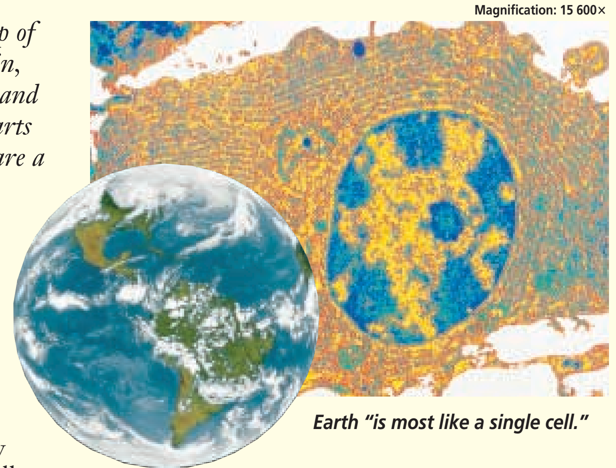
Connection to Biology

Writing and expressing scientific ideas are important to every branch of science, including biology. Although much of science reporting is done in a technical language, creative and expressive language also has a place in science communication. L2

Literature Connection

The Lives of a Cell by Lewis Thomas

You may think of yourself as a body made up of parts. Arms, legs, skin, stomach, eyes, brain, heart, lungs. Your mind controls the whole, and you probably believe that you own all the parts that make up your body. In actual fact, you are a community of living structures that work together for growth and survival.



Earth "is most like a single cell."

Your body is made up of eukaryotic cells with organelles that work together for each cell's survival. Organelles may work closely together, such as a ribosome and the endoplasmic reticulum, or they may perform a unique function within the cell, such as the mitochondrion.

An organism is similar to a cell in that several parts work together. Groups of cells work together as tissues. Several tissues form an organ and many organs form an organ system. For example, in an organ system such as the digestive system, cells and tissues form an organ such as the stomach, but several organs such as the intestines, the pancreas, and the liver, are needed to completely digest and absorb the food you eat.

In the same way, you might also consider how all the organisms in a community are interconnected and how the whole planet Earth is a collection of interdependent ecosystems. Lewis Thomas pondered this thought.

> *"I have been trying to think of the earth as a kind of organism, but it is no go. I cannot think of it this way. It is too big, too complex, with too many working parts lacking visible connections.... I wondered about this. If not like an organism, what is it like, what is it most like? Then, satisfactorily for that moment, it came to me: it is most like a single cell."*

Words are like organelles Just as a cell is a group of organelles working together, so is a paragraph composed of words that together convey thoughts and ideas. Despite all his technical knowledge, Dr. Thomas, a physician and medical researcher, writes simply and engagingly about everything from the tiny universe inside a single cell to the possibility of visitors from a distant planet.

Medicine, a young science Dr. Thomas grew up with the practice of medicine. As a boy, he accompanied his father, a family physician, on house calls to patients. Years later, Dr. Thomas described those days in his autobiography, *The Youngest Science*. The title reflects his belief that the practice of medicine is "still very early on" and that some basic problems of disease are just now yielding to exploration.

Connection to Biology

After you have studied this chapter, write a paragraph using Dr. Thomas's style to describe how the organelles of a cell work together for cell survival.

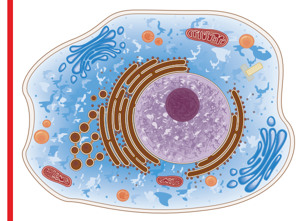
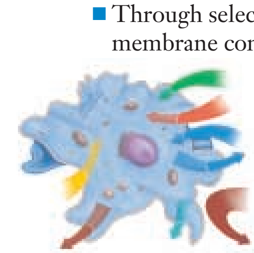
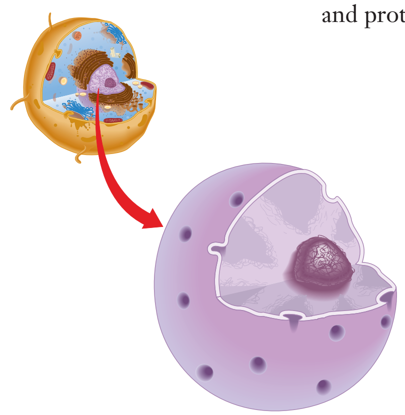
interNET CONNECTION To find out more about the works of Dr. Lewis Thomas, visit the Glencoe Science Web Site. **www.glencoe.com/sec/science**

Internet Address Book

interNET CONNECTION Note Internet addresses that you find useful in the space below for quick reference.

Chapter 7 Assessment

Summary

	Main Ideas	Vocabulary
Section 7.1 **The Discovery of Cells** 	■ Microscopes enabled biologists to see cells and develop the cell theory. ■ The cell theory states that the cell is the basic unit of organization, all organisms are made up of one or more cells, and all cells come from preexisting cells. ■ Using electron microscopes, scientists can study cell structure in detail. ■ Cells are classified as prokaryotic or eukaryotic based on whether or not they have membrane-bound organelles.	cell (p. 175) cell theory (p. 176) compound light microscope (p. 175) electron microscope (p. 176) eukaryote (p. 177) nucleus (p. 180) organelle (p. 177) prokaryote (p. 177)
Section 7.2 **The Plasma Membrane** 	■ Through selective permeability, the plasma membrane controls what enters and leaves a cell. ■ The fluid mosaic model describes the plasma membrane as a phospholipid bilayer with embedded proteins.	fluid mosaic model (p. 184) homeostasis (p. 181) phospholipid (p. 182) plasma membrane (p. 181) selective permeability (p. 181) transport proteins (p. 184)
Section 7.3 **Eukaryotic Cell Structure** 	■ Eukaryotic cells have a nucleus and organelles, are enclosed by a plasma membrane, and some have a cell wall that provides support and protection. ■ Cells make proteins on ribosomes that are often attached to the highly folded endoplasmic reticulum. Cells store materials in the Golgi apparatus and vacuoles. ■ Mitochondria break down food molecules to release energy. Chloroplasts convert light energy into chemical energy. ■ The cytoskeleton helps maintain cell shape, is involved in the movement of organelles and cells, and resists stress placed on cells.	cell wall (p. 185) chlorophyll (p. 190) chloroplast (p. 190) chromatin (p. 186) cilia (p. 193) cytoplasm (p. 187) cytoskeleton (p. 191) endoplasmic reticulum (p. 188) flagella (p. 193) Golgi apparatus (p. 188) lysosome (p. 189) microfilament (p. 191) microtubule (p. 191) mitochondria (p. 191) nucleolus (p. 187) plastid (p. 190) ribosome (p. 187) vacuole (p. 189)

Chapter 7 Assessment

Main Ideas

Summary statements can be used by students to review the major concepts of the chapter.

Using the Vocabulary

To reinforce chapter vocabulary, use the Content Mastery Booklet and the activities in the Interactive Tutor for Biology: The Dynamics of Life on the Glencoe Science Web Site: **www.glencoe.com/sec/science**

THE PRINCETON REVIEW ***All Chapter Assessment questions and answers have been validated for accuracy and suitability by The Princeton Review.***

GLENCOE TECHNOLOGY

VIDEOTAPE
MindJogger Videoquizzes
Chapter 7: *A View of the Cell*
Have students work in groups as they play the videoquiz game to review key chapter concepts.

Resource Manager

Chapter Assessment, pp. 37-42
MindJogger Videoquizzes
Computer Test Bank
BDOL Interactive CD-ROM, Chapter 7 quiz

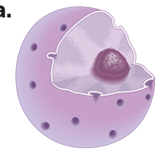
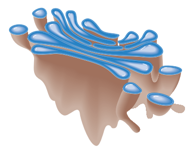
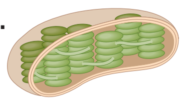
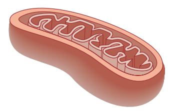
Understanding Main Ideas

1. c
2. b
3. c
4. d
5. b
6. a
7. c
8. b
9. d
10. d
11. vacuoles
12. protein synthesis
13. transmission electron microscope (TEM)
14. plasma membrane
15. cell walls, cellulose
16. ribosomes

Understanding Main Ideas

1. What type of cell would you examine to find a chloroplast?
a. prokaryote **c.** plant
b. animal **d.** fungus

2. Which of the following structures utilizes the sun's energy to make carbohydrates?

a.

c.

b.

d.


3. Which of the following pairs of terms is NOT related?
a. nucleus—DNA
b. chloroplasts—chlorophyll
c. flagella—chromatin
d. cell wall—cellulose

4. Magnifications greater than 10 000 times can be obtained when using _______.
a. light microscopes
b. metric rulers
c. hand lenses
d. electron microscopes

5. A bacterium is classified as a prokaryote because it _______.
a. has cilia
b. has no membrane-bound nucleus
c. is a single cell
d. has no DNA

THE PRINCETON REVIEW Test-Taking Tip

Maximize Your Score
Ask how your test will be scored. In order to do your best, you need to know if there is a penalty for guessing, and if so, how much of a penalty. If there is no random-guessing penalty at all, you should always fill in an answer.

6. Which of the following structures is NOT found in both plant and animal cells?
a. chloroplast **c.** ribosomes
b. cytoskeleton **d.** mitochondria

7. Which component is NOT stored in plastids?
a. lipids **c.** amino acids
b. pigments **d.** starches

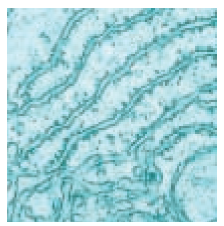
8. Which is a main idea of the cell theory?
a. All cells have a plasma membrane.
b. All cells come from preexisting cells.
c. All cells are microscopic.
d. All cells are made of atoms.

9. Electron microscopes can view only dead cells because _______.
a. only dead cells are dense enough to be seen
b. a magnetic field is needed to focus the electrons
c. the fluorescent screen in the microscope kills the cells
d. the specimen must be in a vacuum

10. Ribosomes _______.
a. do not have a cell wall
b. are not surrounded by a membrane
c. do not contain cytoplasm
d. all of the above

11. _______ are membrane-bound spaces that serve as temporary storage areas.

12. The small bumps shown in this photomicrograph are the site of _______.



13. The photomicrograph in question 12 was probably taken using a _______ microscope.

14. The _______ maintains a chemical balance within a cell by regulating the materials that enter and leave the cell.

15. Plants are able to grow tall because their cells have rigid _______ that contain a strong network of _______.

16. Smooth ER is different from rough ER in that smooth ER has no _______.

17. Although prokaryotes lack _______, they still contain DNA.

18. Microtubules and microfilaments, which make up the cell cytoskeleton, are composed of _______.

19. A plant cell has a green color due to the presence of _______, a pigment that is embedded in the _______ membranes of the _______.

20. Cilia and flagella are an arrangement of _______ and allow the cell to _______.

Applying Main Ideas

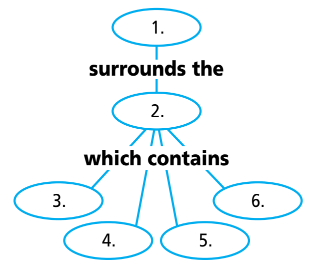
21. Explain why packets of proteins collected by the Golgi apparatus merge with lysosomes.

22. How does the structure of the plasma membrane allow materials to move across it in both directions?

Thinking Critically

23. Making Predictions Predict whether you would expect muscle or fat cells to contain more mitochondria and explain why.

24. Concept Mapping Complete the concept map using the following vocabulary terms: cytoplasm, mitochondria, Golgi apparatus, ribosomes, plasma membrane, nucleus.

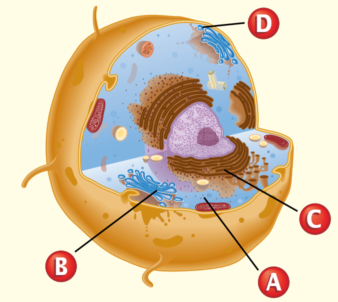


CD-ROM

For additional review, use the assessment options for this chapter found on the ***Biology: The Dynamics of Life Interactive CD-ROM*** and on the Glencoe Science Web Site.
www.glencoe.com/sec/science

Assessing Knowledge & Skills

The diagram below shows the parts of a cell.



Interpreting Scientific Illustrations Use the diagram to answer the following questions.

1. The structure labeled C represents the _______.
a. plasma membrane
b. nuclear membrane
c. endoplasmic reticulum
d. nucleolus

2. The function of the circular structures on membrane C is to _______.
a. synthesize cellulose
b. transform energy
c. synthesize proteins
d. capture the sun's energy

3. The structure labeled B represents the _______.
a. lysosome **c.** nucleus
b. Golgi apparatus **d.** vacuole

4. The type of cell shown is a _______ cell.
a. plant **c.** animal
b. fungal **d.** prokaryotic

5. Sequencing Structures A, B, C, and D are involved in making a product to be released to the outside of the cell. What is the sequence of the production of this product?

17. organelles
18. proteins
19. chlorophyll, thylakoid membranes, chloroplasts
20. microtubules, move

Applying Main Ideas

21. If a particular protein is not needed immediately, its building blocks can be recycled into other proteins.
22. Some protein transporters carry materials out of the cell and some carry materials into the cell. The lipid bilayer itself allows diffusion of small molecules in either direction.

Thinking Critically

23. Muscle cells are very active cells that use a lot of energy, whereas fat cells are used mainly for storage of fat. Mitochondria are the cell organelles that transform energy for the cell. Therefore, muscle cells will contain more mitochondria.
24. 1. Plasma membrane; 2. Cytoplasm; 3. Mitochondria; 4. Golgi apparatus; 5. Ribosomes; 6. Nucleus

Assessing Knowledge & Skills

Structure A: ribosomes
Structure B: Golgi apparatus
Structure C: endoplasmic reticulum
Structure D: vesicles

Interpreting Scientific Illustrations

1. c
2. c
3. b
4. c
5. The ribosomes (A) synthesize proteins, which are transported by the endoplasmic reticulum (C) to the Golgi apparatus (B), which packages the proteins into vesicles (D), which are then transported to cell membranes for release to the outside of the cell.