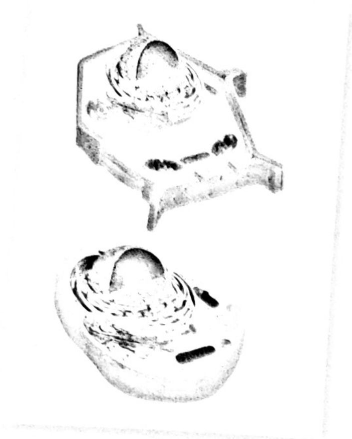


Organelles That Capture and Release Energy

What are the functions of chloroplasts and mitochondria?

All living things require a source of energy. Factories are hooked up to the local power company, but how do cells get energy? Most cells are powered by food molecules that are built using energy from the sun.

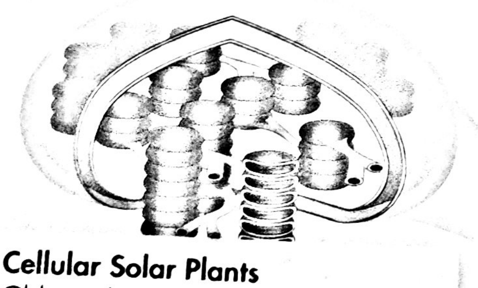
Chloroplasts Plants and some other organisms contain chloroplasts (KLAWR uh plasts). **Chloroplasts** are the biological equivalents of solar power plants. **Chloroplasts capture the energy from sunlight and convert it into food that contains chemical energy in a process called photosynthesis.** Two membranes surround chloroplasts. Inside the organelle are large stacks of other membranes, which contain the green pigment chlorophyll.

Mitochondria Nearly all eukaryotic cells, including plants, contain mitochondria (myt oh KAHN dree uh; singular: mitochondrion). **Mitochondria** are the power plants of the cell. **Mitochondria convert the chemical energy stored in food into compounds that are more convenient for the cell to use.** Like chloroplasts, two membranes—an outer membrane and an inner membrane—enclose mitochondria. The inner membrane is folded up inside the organelle, as shown in **Figure 7–12.**

One of the most interesting aspects of mitochondria is the way in which they are inherited. In humans, all or nearly all of our mitochondria come from the cytoplasm of the ovum, or egg cell. This means that when your relatives are discussing which side of the family should take credit for your best characteristics, you can tell them that you got your mitochondria from Mom!

Another interesting point: Chloroplasts and mitochondria contain their own genetic information in the form of small DNA molecules. This observation has led to the idea that they may be descended from independent microorganisms. This idea, called the endosymbiotic theory, is discussed in Chapter 19.

FIGURE 7–12 Cellular Powerhouses Chloroplasts and mitochondria are both involved in energy conversion processes within the cell. **Infer** ***What kind of cell—plant or animal—is shown in the micrograph? How do you know?***



Cellular Solar Plants
Chloroplasts, found in plants and some other organisms such as algae, convert energy from the sun into chemical energy that is stored as food.

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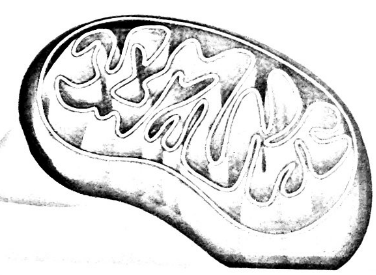


Cellular Power Plants
Mitochondria convert chemical energy stored in food into a form that can be used easily by the cell.

Quick Lab
OPEN-ENDED INQUIRY

Making a Model of a Cell

1. Your class is going to make a model of a plant cell using the whole classroom. Work with a partner or in a small group to decide what cell part or organelle you would like to model. (Use **Figure 7–14** on pages 206–207 as a starting point. It gives you an idea of the relative sizes of various cell parts and their possible positions.)

2. Using materials of your choice, make a three-dimensional model of the cell part or organelle you chose. Make the model as complete and as accurate as you can.

3. Label an index card with the name of your cell part or organelle, and list its main features and functions. Attach the card to your model.

4. Attach your model to an appropriate place in the room. If possible, attach your model to another related cell part or organelle.

Analyze and Conclude

1. Calculate Assume that a typical plant cell is 50 micrometers wide (50×10^{-6} m). Calculate the scale of your classroom cell model. (*Hint:* Divide the width of the classroom by the width of a cell, making sure to use the same units.) MATH

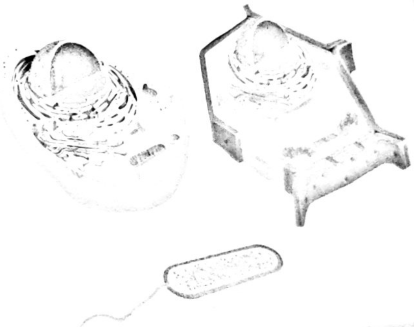
2. Compare and Contrast How is your model cell part or organelle similar to the real cell part or organelle? How is it different?

3. Evaluate Based on your work with this model, describe how you could make a better model. What new information would your improved model demonstrate?

Cellular Boundaries

What is the function of the cell membrane?

A working factory needs walls and a roof to protect it from the environment outside, and also to serve as a barrier that keeps its products safe and secure until they are ready to be shipped out. Cells have similar needs, and they meet them in a similar way. As you have learned, all cells are surrounded by a barrier known as the cell membrane. Many cells, including most prokaryotes, also produce a strong supporting layer around the membrane known as a **cell wall.**



Cell Walls Many organisms have cell walls in addition to cell membranes. The main function of the cell wall is to support, shape, and protect the cell. Most prokaryotes and many eukaryotes have cell walls. Animal cells do not have cell walls. Cell walls lie outside the cell membrane. Most cell walls are porous enough to allow water, oxygen, carbon dioxide, and certain other substances to pass through easily.

Cell walls provide much of the strength needed for plants to stand against the force of gravity. In trees and other large plants, nearly all of the tissue we call wood is made up of cell walls. The cellulose fiber used for paper as well as the lumber used for building comes from these walls. So if you are reading these words off a sheet of paper from a book resting on a wooden desk, you've got cell walls all around you.

BUILD Vocabulary

ACADEMIC WORDS The adjective **porous** means "allowing materials to pass through." A porous cell wall allows substances like water and oxygen to pass through it.

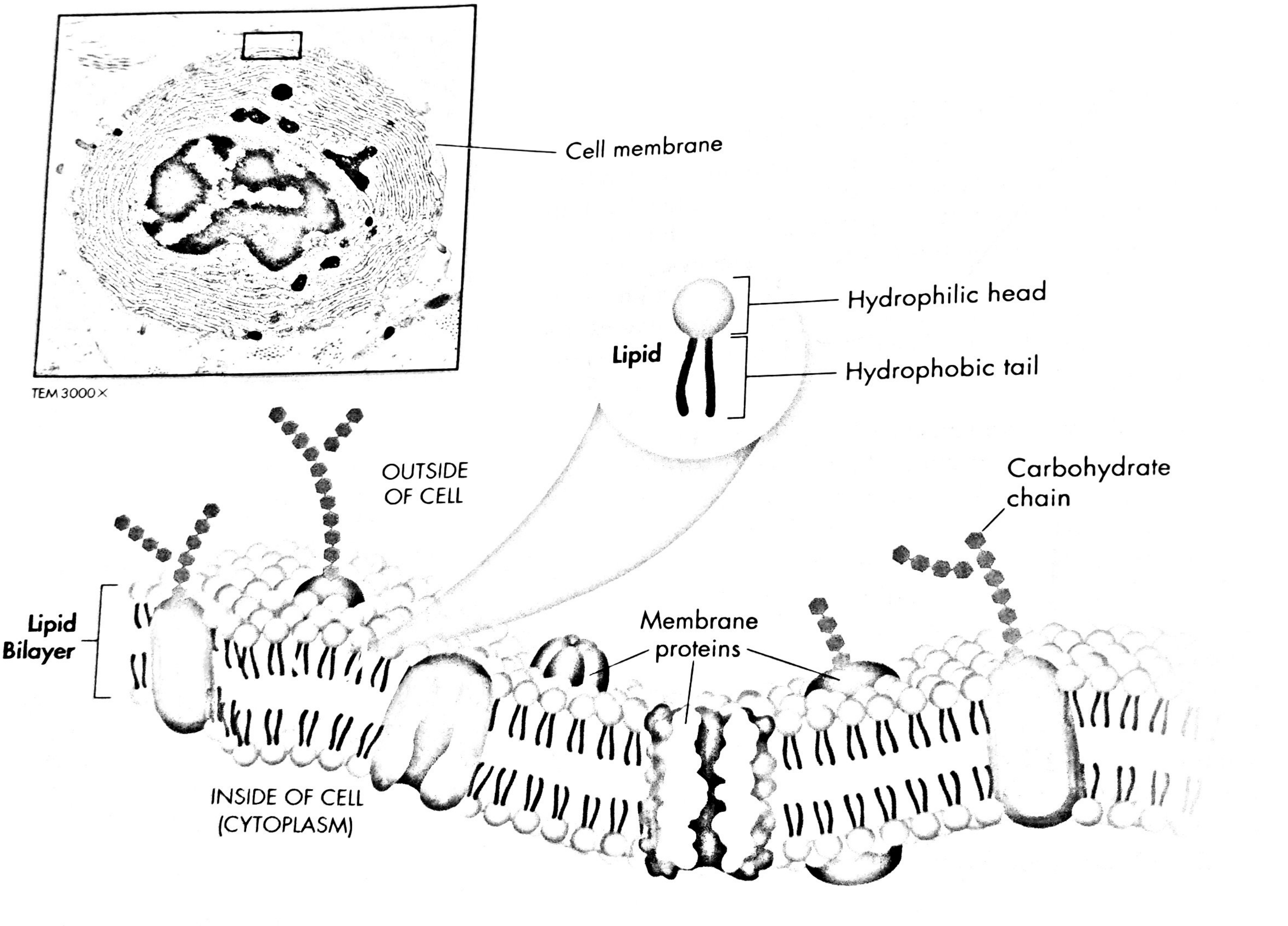
Cell Membranes All cells contain cell membranes, which almost always are made up of a double-layered sheet called a lipid bilayer, as shown in **Figure 7–13.** The **lipid bilayer** gives cell membranes a flexible structure that forms a strong barrier between the cell and its surroundings. **The cell membrane regulates what enters and leaves the cell and also protects and supports the cell.**

▶ ***The Properties of Lipids*** The layered structure of cell membranes reflects the chemical properties of the lipids that make them up. You may recall that many lipids have oily fatty acid chains attached to chemical groups that interact strongly with water. In the language of a chemist, the fatty acid portions of this kind of lipid are hydrophobic (hy druh FOH bik), or "water-hating," while the opposite end of the molecule is hydrophilic (hy druh FIL ik), or "water-loving." When these lipids, including the phospholipids that are common in animal cell membranes, are mixed with water, their hydrophobic fatty acid "tails" cluster together while their hydrophilic "heads" are attracted to water. A lipid bilayer is the result. As you can see in **Figure 7–13,** the head groups of lipids in a bilayer are exposed to the outside of the cell, while the fatty acid tails form an oily layer inside the membrane that keeps water out.

ZOOMING IN

THE CELL MEMBRANE

FIGURE 7–13 Every cell has a membrane that regulates the movement of materials. Nearly all cell membranes are made up of a lipid bilayer in which proteins and carbohydrates are embedded. **Apply Concepts** ***Explain why lipids "self-assemble" into a bilayer when exposed to water.***



The Fluid Mosaic Model Embedded in the lipid bilayer of most cell membranes are protein molecules. Carbohydrate molecules are attached to many of these proteins. Because the proteins embedded in the lipid bilayer can move around and "float" among the lipids, and because so many different kinds of molecules make up the cell membrane, scientists describe the cell membrane as a "fluid mosaic." A mosaic is a kind of art that involves bits and pieces of different colors or materials. What are all these different molecules doing? As you will see, some of the proteins form channels and pumps that help to move material across the cell membrane. Many of the carbohydrate molecules act like chemical identification cards, allowing individual cells to identify one another. Some proteins attach directly to the cytoskeleton, enabling cells to respond to their environment by using their membranes to help move or change shape.

As you know, some things are allowed to enter and leave a factory, and some are not. The same is true for living cells. Although many substances can cross biological membranes, some are too large or too strongly charged to cross the lipid bilayer. If a substance is able to cross a membrane, the membrane is said to be permeable to it. A membrane is impermeable to substances that cannot pass across it. Most biological membranes are **selectively permeable,** meaning that some substances can pass across them and others cannot. Selectively permeable membranes are also called semipermeable membranes.

7.2 Assessment

Review Key Concepts

1. a. **Review** What are the two major parts of the cell?
   b. **Use Analogies** How is the role of the nucleus in a cell similar to the role of the captain on a sports team?
2. a. **Review** What is the function of lysosomes?
   b. **Apply Concepts** How do contractile vacuoles help maintain water balance?
3. a. **Review** What is the difference between rough and smooth ER?
   b. **Sequence** Describe the steps involved in the synthesis, packaging, and export of a protein from a cell.
4. a. **Review** What is the function of mitochondria?
   b. **Infer** You examine an unknown cell under a microscope and discover that the cell contains chloroplasts. From what type of organism does the cell likely come?
5. a. **Review** Why is the cell membrane sometimes referred to as a fluid mosaic? What part of the cell membrane acts like a fluid? And what makes it like a mosaic?
   b. **Explain** How do the properties of lipids help explain the structure of a cell membrane?
   c. **Infer** Why do you think it's important that cell membranes are *selectively* permeable?

VISUAL THINKING

6. Using the cells on the next page as a guide, draw your own models of a prokaryotic cell, a plant cell, and an animal cell. Then use each of the vocabulary words from this lesson to label your cells.