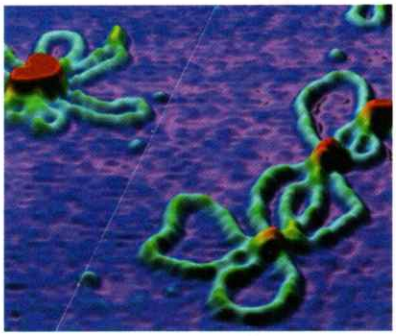
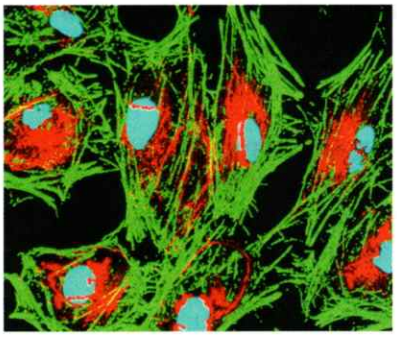
FIGURE 7–3 VARIETY OF MICROGRAPHS

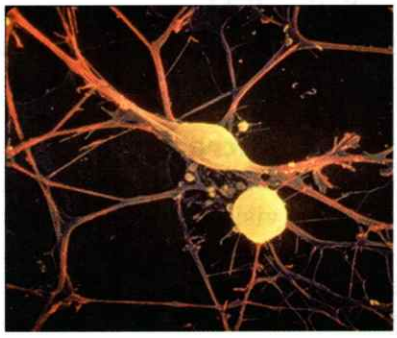
Different types of microscopes produce a variety of images of cells and cell parts.



Scanning Probe Micrograph
A scanning probe microscope scans a tiny probe just above the surface of a sample and produces an image by recording the position of the probe. These powerful instruments can even visualize single molecules, such as DNA, on carefully prepared surfaces. (magnification: 320,000X)



Confocal Light Micrograph
Confocal light microscopes construct images by scanning cells with a computer-controlled laser beam. In this fluorescent confocal light micrograph of HeLa cells, researchers attached fluorescent labels to the different molecules. By doing this, researchers can follow molecules as they move through a living cell. (magnification: 500X)



Scanning Electron Micrograph
Scanning electron microscopes produce three-dimensional images of the surfaces of cells, such as these neurons, and tissues. (magnification: 8900X)

Scanning Probe Microscopes In the 1990s, researchers perfected a new class of microscopes that produce images by tracing the surfaces of samples with a fine probe. These scanning probe microscopes have revolutionized the study of surfaces and made it possible to observe single atoms. Unlike electron microscopes, scanning probe microscopes can operate in ordinary air and can even show samples in solution. Researchers have already used scanning probe microscopes to image DNA and protein molecules as well as a number of important biological structures.

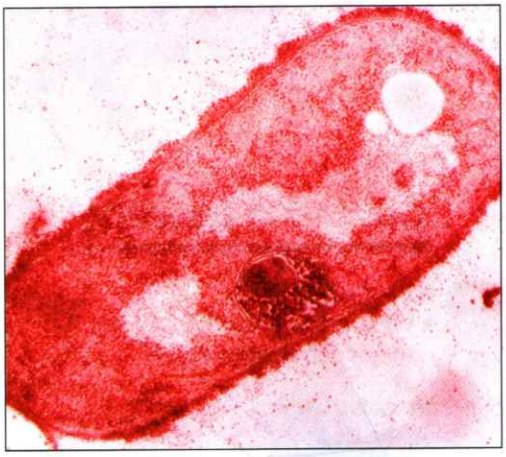
Prokaryotes and Eukaryotes

Cells come in a great variety of shapes and an amazing range of sizes. Although typical cells range from 5 to 50 micrometers in diameter, the tiniest mycoplasma bacteria are only 0.2 micrometers across, so small that they are difficult to see under even the best light microscopes. In contrast, the giant amoeba *Chaos chaos* may be 1000 micrometers in diameter, large enough to be seen with the unaided eye as a tiny speck in pond water. Despite their differences, all cells have two characteristics in common. They are surrounded by a barrier called a cell membrane; and, at some point in their lives, they contain the molecule that carries biological information—DNA.

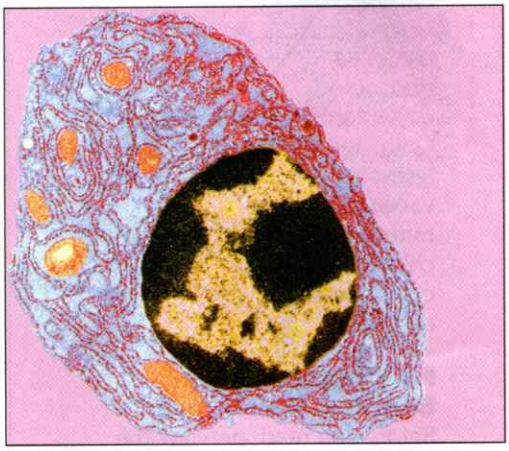
Cells fall into two broad categories, depending on whether they contain a nucleus. The **nucleus** (plural: nuclei) is a large membrane-enclosed structure that contains the cell's genetic material in the form of DNA. The nucleus controls many of the cell's activities. **Eukaryotes** (yoo-KAR-ee-ohts) are cells that contain nuclei. **Prokaryotes** (pro-KAR-ee-ohts) are cells that do not contain nuclei. Both words derive from the Greek words *karyon,* meaning "kernel," or nucleus, and *eu,* meaning "true," or *pro,* meaning "before." These words reflect the idea that prokaryotic cells evolved before nuclei developed.

Prokaryotes Prokaryotic cells are generally smaller and simpler than eukaryotic cells, although there are many exceptions to this rule. **Prokaryotic cells have genetic material that is not contained in a nucleus.** Some prokaryotes contain internal membranes, but prokaryotes are generally less complicated than eukaryotes. Despite their simplicity, prokaryotes carry out every activity associated with living things. They grow, reproduce, respond to the environment, and some can even move by gliding along surfaces or swimming through liquids. The organisms we call bacteria are prokaryotes.

Eukaryotes Eukaryotic cells are generally larger and more complex than prokaryotic cells. As you can see in **Figure 7–4,** eukaryotic cells generally contain dozens of structures and internal membranes, and many are highly specialized. **Eukaryotic cells contain a nucleus in which their genetic material is separated from the rest of the cell.** Eukaryotes display great variety. Some eukaryotes live solitary lives as unicellular organisms. Others form large, multicellular organisms. Plants, animals, fungi, and protists are eukaryotes.



(magnification: 18,300×)



(magnification: 350×)

Figure 7–4 The cells of eukaryotes have a nucleus, but the cells of prokaryotes do not. Notice how many more structures are located in the eukaryotic cell (bottom) as compared with the prokaryotic cell (top).

7–1 Section Assessment

1. **Key Concept** What three statements make up the cell theory?
2. **Key Concept** What are the differences between prokaryotic cells and eukaryotic cells?
3. Compare the processes used to produce a TEM and an SEM.
4. What structures do all cells have?
5. **Critical Thinking Inferring** How did the invention of the microscope help the development of the cell theory?

Thinking Visually

Constructing a Chart

Make a three-column chart comparing prokaryotes with eukaryotes. In the first column, list the traits found in all cells. In the second column, list the features of prokaryotes. In the third column, list the features of eukaryotes.