The quantity of Golgi varies in different cells. Cells that are involved in secreting large quantities of materials have higher amounts of Golgi. For example, cells that make up the salivary glands secrete digestive enzymes into the mouth, which aids in digestion. Some cells of the immune system secrete antibodies into the blood, which helps protect us from foreign invaders.

In plant cells, the Golgi has an additional role in synthesizing polysaccharides. Some of these polysaccharides are incorporated into the cell wall and while others are used in different parts of the cell.

Lysosomes

Some of the proteins packaged by the Golgi include digestive enzymes. Some of those enzymes remain inside the cell to be used for breaking down certain materials. The enzyme-containing vesicles released by the Golgi may form new lysosomes or fuse with existing lysosomes. A **lysosome** is an organelle that contains enzymes that break down and digest unneeded cellular components, such as a damaged organelle. A lysosome is like a wrecking crew that takes down old and unsound buildings in a neighborhood. Lysosomes are also important for breaking down food materials or foreign materials that may be dangerous to the cell. For example, when certain immune defense cells take up bacteria, the bacterial cell is enclosed in a vesicle (Figure 4.24) that then fuses with a lysosome. The enzymes found in the lysosome then digest the bacteria. As one might imagine, these immune defense cells contain large numbers of lysosomes.

Under certain circumstances, lysosomes perform a more grand and dire function--in the case of damaged or unhealthy cells, lysosomes can be triggered to open and release their digestive enzymes into the cytoplasm of the cell, killing the cell. This "self-destruct" mechanism is called autolysis and makes the process of cell death controlled; a mechanism called "apoptosis."

It is important to note that lysosomes are not present in plant cells. Because lysosomes are considered part of the endomembrane system, they are being discussed in this section. In plant cells, the digestive processes take place in vacuoles and not lysosomes.

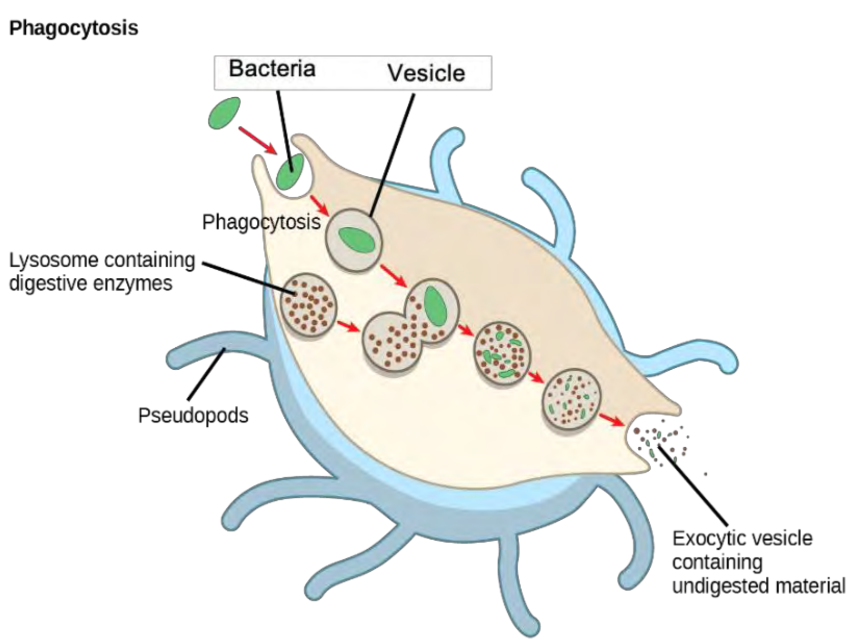


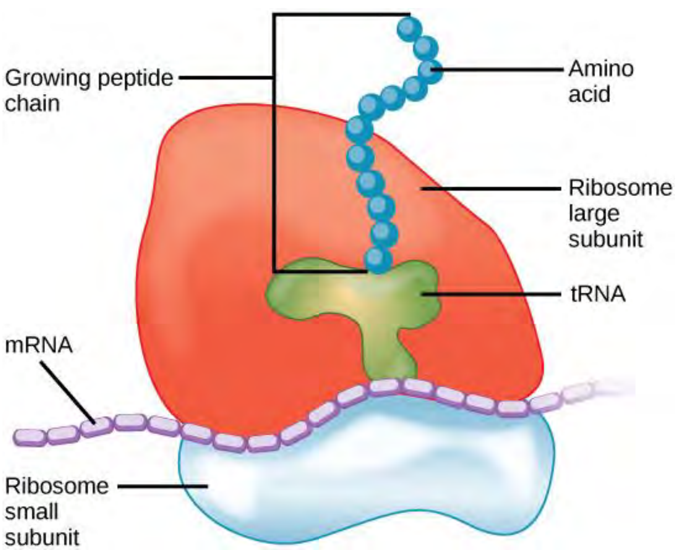
Figure 4.24 A macrophage has taken up a bacterium, which then fuses with a lysosome within the cell. Other organelles are present in the cell, but for simplicity, are not shown. (credit: Modified by Elizabeth O'Grady original work by Clark et al. / Biology 2E OpenStax)

Vesicles and Vacuoles

Vesicles (Figure 4.24) and **vacuoles** (Figure 4.18) are membrane-bound sacs that function in storage and transport. Other than the fact that vacuoles are somewhat larger than vesicles, there is a very subtle distinction between them. Vesicle membranes can fuse with either the plasma membrane or other membrane systems within the cell. Additionally, some enzymes within plant vacuoles break down macromolecules (Figure 4.18).

Ribosomes

Ribosomes are the cellular structures responsible for protein synthesis and are not part of the endomembrane system. They are the only organelle not enclosed in a plasma membrane. When viewed through an electron microscope, free ribosomes appear as either clusters or single tiny dots floating freely in the cytoplasm. Ribosomes may also attach to either the plasma membrane or the rough endoplasmic reticulum (red circles in Figure 4.22). Electron microscopy has shown that ribosomes consist of large and small subunits (Figure 4.25). Ribosomes are enzyme complexes that are responsible for protein synthesis.



Because protein synthesis is essential for all cells, ribosomes are found in practically every cell. In prokaryotic cells, ribosomes are smaller and differ slightly in their chemical makeup when compared to ribosomes found in eukaryotic cells.

Figure 4.25 A large subunit (top) and a small subunit (bottom) comprise ribosomes. (credit: Clark et al. / [Biology 2E OpenStax](#))

Check your knowledge

Which type of cell is most likely to have the greatest amount of smooth endoplasmic reticulum?

a. A cell that secretes enzymes
b. A cell that destroys pathogens
c. A cell that makes steroids
d. A cell that performs photosynthesis

Answer: c

Mitochondria

Mitochondria (singular = mitochondrion) are often called the "powerhouses" or "energy factories" of a cell because they are responsible for making adenosine triphosphate (ATP), the cell's primary energy molecule. The formation of ATP from the breakdown of glucose is known as cellular respiration. Mitochondria are oval-shaped, double-membrane organelles (Figure 4.26) that have their own ribosomes and DNA. Each membrane is a phospholipid bilayer embedded with proteins. The inner layer has folds called cristae, which increase the surface area of the inner membrane. The area surrounded by the folds is called the inner mitochondrial matrix (space). The space between the inner and outer membranes is the intermembrane space (outer mitochondrial matrix). The cristae and the matrix have different roles in cellular respiration, which will be discussed in chapter 6.

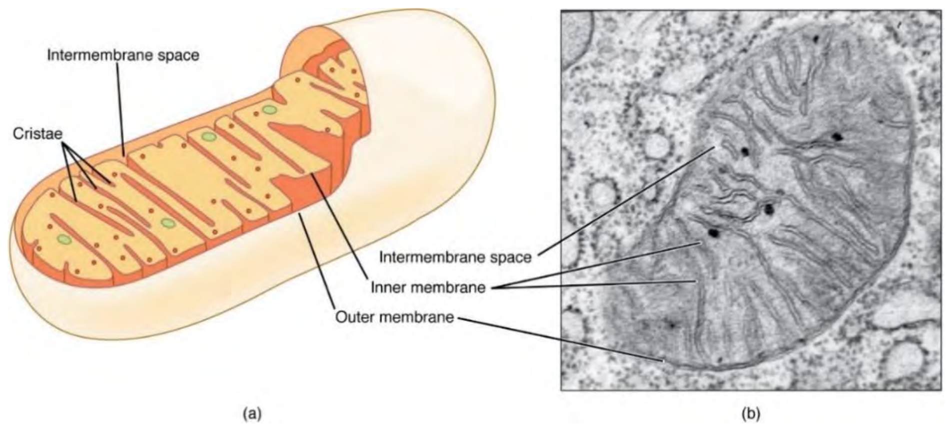


Figure 4.26 (a) A mitochondrion is composed of two separate lipid bilayer membranes. (b) An electron micrograph of mitochondria. EM × 236,000. (Micrograph provided by the Regents of University of Michigan Medical School © 2012 / Anatomy and Physiology OpenStax)

Peroxisomes

Peroxisomes are small, round organelles enclosed by single membranes (Figure 4.27). They carry out reactions that break down fatty acids and amino acids. They also detoxify many poisons that may enter the body. Peroxisomes detoxify alcohol in liver cells. A byproduct of these reactions is the highly reactive molecule hydrogen peroxide, H_2O_2. Hydrogen peroxide is contained within the peroxisomes to prevent it from causing damage to cellular components outside of the organelle. Hydrogen peroxide is safely broken down into water and oxygen with the help of the enzyme catalase. Catalase, in addition to many other enzymes, is located in the center of the peroxisome in a region called the crystalline core.

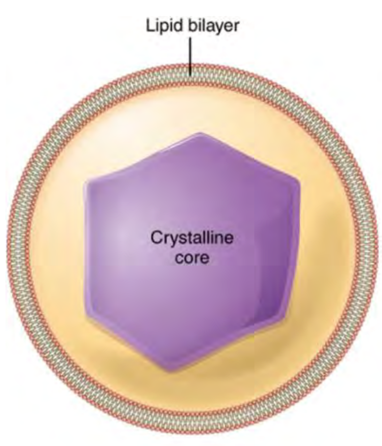


Figure 4.27 Peroxisome (credit: Betts et al. / Anatomy and Physiology OpenStax)