4.5 Diversity of cell organelles within the eukaryotes

Learning objectives

By the end of this section, you will be able to:

- *Describe the differences between eukaryotic plant and animal cells*
- *Summarize the Endosymbiotic theory*
- *Understand how cells communicate with one another*
- *Know the differences between plant cell and animal cell communication*
- *Describe the cell's extracellular matrix*
- *Be able to define and explain all bolded terms*

All eukaryotic cells have a membrane-bound nucleus and numerous membrane-bound organelles. They are all enclosed within a plasma membrane, have genetic material, and use ribosomes to synthesize proteins. Despite their fundamental similarities, there are some striking differences amongst the different groups of cells that make up the eukaryotes. Those groups being Plantae, Protista, Animalia, and Fungi. We will briefly introduce the groups Protista and Fungi, before focusing our attention on the kingdoms Plantae and Animalia.

Protist

There are over 100,000 described living species of protists. Because the name "protist" serves as a catchall term for eukaryotic organisms that are not animal, plant, or fungi, it is not surprising that very few characteristics are common to all protists. Most protists are microscopic, unicellular organisms that are abundant in soil, freshwater, brackish, and marine environments. They are also common in the digestive tracts of animals and the vascular tissues of plants. Some protists have huge, macroscopic cells, such as the plasmodia of myxomycete slime molds or the marine green alga *Caulerpa*. Some protists are multicellular, such as red, green, and brown seaweeds. Because of their diversity, protists have a wide variety of different membrane-bound organelles. In the lab, you will have the opportunity to look at several protists: *Amoeba, Paramecium*, and green algae. At that time, you will observe some of the organelles found in protists.

Fungi

The kingdom Fungi includes an enormous variety of living organisms collectively referred to as Eumycota, or true Fungi. While scientists have identified about 100,000 species of fungi, this is only a fraction of the 1.5 million species of fungus likely present on Earth. Edible mushrooms, yeasts, black mold, and the producer of the antibiotic penicillin, *Penicillium notatum*, are all members of the kingdom Fungi. Because of their diversity, fungi also have a wide variety of different membrane-bound organelles. Students will not be held accountable for learning the cell organelles of fungi.

We will now focus on the groups Animalia and Plantae and discuss key differences between these two groups.

Animal vs. Plant

Despite their fundamental similarities, there are some striking differences between cells found in the groups Animalia and Plantae (see Table 4.1). Plant cells have a cell wall, chloroplasts, and a large central vacuole. Plant cells also have plastids that are used for storage. For example, cells that make up the potato have amyloplasts, a type of plastid used for storing starch. These organelles are not found in animal cells. As you learned in previous sections, animal cells have centrosomes and lysosomes. Both animal cells and plant cells have intercellular junctions for communication; however, there are distinct differences in these junctions. We will now spend some time discussing the differences in detail.

Cell Wall

In Figure 4.29b, the diagram of a plant cell, you see a structure external to the plasma membrane called the cell wall. The **cell wall** is a rigid covering that protects the cell, provides structural support, and gives shape to the cell. While the chief component of prokaryotic cell walls is peptidoglycan, the major organic molecule in the plant cell wall is cellulose. Cellulose is a polysaccharide made up of long, straight chains of glucose units. Some organisms have the enzyme cellulase and can digest cellulose and use it as a source of energy.

Chloroplasts

Like mitochondria, chloroplasts have their own DNA and ribosomes. **Chloroplasts** are the location of photosynthesis and can be found in eukaryotic cells such as plants and algae. In photosynthesis, carbon dioxide, water, and light energy are used to make glucose and oxygen. One of the significant differences between plant and animal cells is that plants can make their own food and are referred to as **autotrophs.** Whereas animals, referred to as **heterotrophs,** must rely on other organisms for their organic compounds or food source.

Like mitochondria, chloroplasts have outer and inner membranes. Inside the inner membrane of the chloroplast is a fluid called stroma. In the stroma is a set of interconnected and stacked, fluid-filled membrane sacs called thylakoids (Figure 4.28). Each stack of thylakoids is called a granum (plural = grana). In chapter 7, you will learn about how different photosynthetic reactions take place in the stroma and thylakoid membranes.

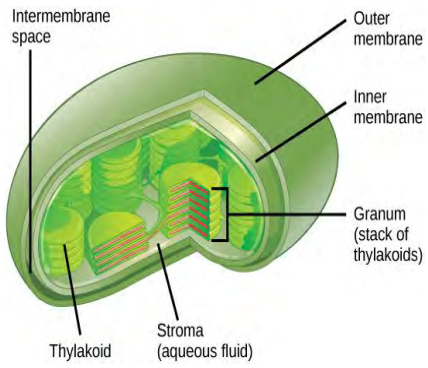

Figure 4.28 This simplified diagram of a chloroplast shows the outer membrane, inner membrane, thylakoids, grana, and stroma (credit: Fowler et al. / Concepts of Biology OpenStax).

The chloroplasts contain a green pigment called chlorophyll, which captures the energy of sunlight for photosynthesis. It is this pigment that gives leaves their green appearance. Like plant cells, photosynthetic protists also have chloroplasts. Some bacteria also perform photosynthesis, but they do not have chloroplasts. Their photosynthetic pigments are located in the thylakoid membrane within the cell itself.

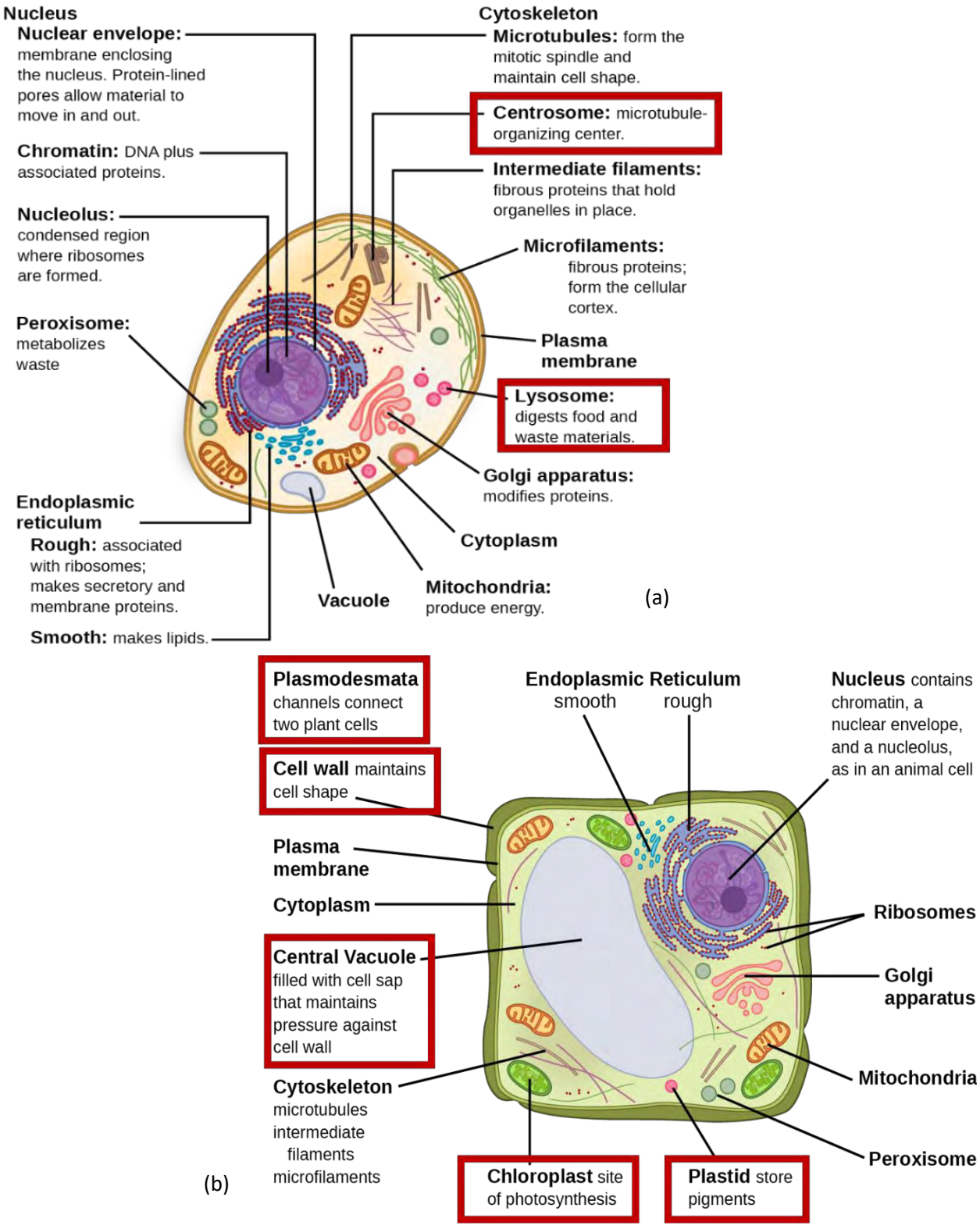

Figure 4.29 These figures show the major organelles and other cell components of (a) a typical animal cell and (b) a typical eukaryotic plant cell. (credit: Modified by Elizabeth O'Grady original work by Clark et al. / Biology 2E OpenStax)