

Section 2.1: Cell Structure and Function

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1. The main difference between eukaryotic cells and prokaryotic cells is that eukaryotic cells have membrane-bound organelles, while prokaryotic cells do not. Membrane-bound organelles can maintain their own structure and function while simultaneously being able to integrate their function with other organelles within the cell.
2. (a) The endoplasmic reticulum is an extension of the outer membrane of the nuclear envelope.
(b) The centriole is the structure where microtubules are assembled.
(c) The subunits of ribosomes are assembled in the nucleolus.
(d) Many plastids like chloroplasts and chromoplasts contain pigments.
3. The nuclear envelope is a double-layered membrane that contains pores and many other specialized proteins—some are receptors and others are transporters. These membrane proteins work with the lipid bilayer to transport molecules across the membrane. Other membrane proteins sit on the inner surface and help to anchor and organize DNA molecules. The outer layer of the nuclear envelope is continuous with the membranes of the endoplasmic reticulum.
4. (a) The endomembrane system is a series of organelles located in the cytosol that interact with each other.
(b) The endomembrane system varies among different types of cells. It commonly includes the endoplasmic reticulum, vesicles (including transport vesicles, peroxisomes, vacuoles, and lysosomes), and Golgi bodies.
(c) The endoplasmic reticulum makes proteins (rough) or lipids (smooth). Vesicles transport proteins and other substances. Peroxisomes inactivate toxins. Vacuoles are used for storage. Lysosomes carry out digestion. Golgi bodies package proteins.
5. The smooth endoplasmic reticulum and rough endoplasmic reticulum are composed of delicate membranes and are found next to the nuclear membrane and in the cytosol. They form a network of sacs and tubes throughout the cell. The rough ER has ribosomes attached to the outer surface of its membrane while the smooth ER does not. The rough ER is involved in the folding and storage of proteins made in the ribosomes. The smooth ER is also involved in lipid synthesis.
6. Lysosomes carry out intracellular digestion while peroxisomes inactivate toxins like hydrogen peroxide.
7. (a) They are observing a Golgi body.
(b) The Golgi body's function is to modify new polypeptide chains and to sort and transport proteins and lipids.
8. Both are hollow compartments used for storage. Vesicles can digest substances within a cell and transport substances from one organelle to another. Vacuoles can aid in cellular metabolism and water balance.
9. (a) Mitochondria are organelles that specialize in making ATP.
(b) Mitochondria are between 1 and 4 μm in length, have two lipid membranes: one highly folded in the other, creating two compartments. They have their own DNA, can divide independently of the cell, and have their own ribosomes.

(c) Mitochondria are sometimes referred to as “power plants” of the cell because they are the site of most ATP synthesis during aerobic cellular respiration. All work that is done by the cell relies on ATP for energy.

10. Plastids are used to make food in the form of sugars (chloroplasts), to store food (amyloplasts), and to make and store pigments (chromoplasts). Green plastids perform photosynthesis. Colourful chromoplasts provide colour for fruits and colourless amyloplasts are used for storage of starches.

11. They both have an increased internal surface area. In chloroplasts it allows for maximum light absorption (thylakoids) and in mitochondria it allows for maximum electron transport chain activity (cristae).

12. Microtubules and microfilaments play an important role in cell structure and cell movement. Microtubules form a dynamic scaffolding in cells, which is important in cell division to separate duplicated chromosomes. Microtubules also stabilize cilia and flagella used in cell transport. Microfilaments are responsible for muscle contraction and the formation of pseudopods.

13. (a) Acrosomes help in egg cell recognition—they are found in sperm cells.

(b) Eyespots sense light. They are found in many protists.

(c) Proteasomes break down unwanted and damaged protein. They are found in most or all eukaryotic cells.

14. (a) There are about 280 million molecules of hemoglobin in a typical red blood cell.

(b) No, red blood cells in humans and other mammals lack a nucleus but the red blood cells of most vertebrates that are not in the class mammals have a nucleus.

(c) The benefit that red blood cells have by not possessing a nucleus is more space for packaging hemoglobin, which in turn allows them to carry more oxygen.