

## Chapter 2-9: Structures of Photosynthesis

Photosynthesis is the biochemical process through which plants convert the sun's energy into a usable chemical form. During photosynthesis, a plant produces carbohydrates that provide energy for the plant and are modified in numerous ways to serve as important cellular components.

Photosynthesis is also essential to animals, including humans, who obtain all their food either directly or indirectly from plants. In addition, photosynthesis replenishes the atmospheric oxygen used in animal metabolism.

The reactions of photosynthesis take place within the chloroplasts of plant cells and in the cytoplasm of cyanobacteria. This plate focuses on chloroplasts and describes their structure and function in photosynthesis.

In this plate, we present a series of diagrams starting with the leaf and progressing to the submicroscopic structures involved in photosynthesis.

We will begin with a survey of the main photosynthetic structure of the plant, the leaf (A). Although the leaf is considered the center of photosynthesis, this process also occurs in cells of the plant stem.

In diagram 2, we show a cross section of the leaf. The surface of the leaf is covered by a thin waxy layer called the cuticle (B), under which lie the cells of the epidermis (C). Beneath the epidermis are several layers of cells called mesophyll cells (D). Some of these cells are tall and stacked against each other; these make up the palisade layer of mesophyll cells, while others are more cubical and loosely packed; these comprise the spongy layer of the mesophyll. Mesophyll cells contain the main structures that carry on photosynthesis. At the lower portion of diagram 2 are stomates, where carbon dioxide necessary for photosynthesis enters the leaf.

We have begun our survey of photosynthetic structures by focusing on the leaf and some of its details. We will now take a single cell of the leaf and display its photosynthetic structures. Continue your reading as you color the plate.

Take a look at the single plant cell in diagram 3. This cell is rectangular compared to an animal cell, because plant cells have cell walls that maintain their box-like rigidity.

In diagram 3, we show a single mesophyll cell (D) and some of its major features. For example, the nucleus (E) is situated along the edge of the cell because the large central vacuole has pushed it to the side, and within the cytoplasm are a number of chloroplasts (F). These bodies can be seen with a light microscope, but the smaller structures we will mention in this plate can only be seen with an electron microscope. The mesophyll cell contains numerous chloroplasts, which are where the photosynthetic structures are found.

The next view is of a single chloroplast (F) in diagram 4. The fluid-filled space within the chloroplast is known as stroma (G), which is a matrix that holds the functional components of photosynthesis. We now move to diagram 5, in which the chloroplast has been further magnified. You can see stacks of membranous, sac-like vesicles called thylakoids (I). Thylakoids are disc-shaped, and a stack of them composes what is called a granum (H).

We complete the plate with a study of view 6, in which a granum (H) is enclosed by a bracket. The region between the thylakoid membranes is the thylakoid space (J), and this space is also sometimes called the lumen. The space around the thylakoids is the stroma of the chloroplast.

In the thylakoid membranes themselves we see a number of photosynthetic pigments (K) embedded in the thylakoid membrane. These pigments, which include chlorophyll, are the biochemical substances involved in photosynthesis. Also embedded in the membrane is a chemical complex called ATP synthetase (L), at which energy from the sun is converted to the energy of ATP molecules. We will explain how this takes place in the next plate.

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