Chapter 2-1: The Animal Cell

The basic unit of all living systems is the cell. In this plate, we will describe some of the features of animal cells. We will study the plant cell in the next plate.

This plate consists of a diagram of a section of an animal cell. Under a light microscope, the animal cell appears relatively simple, but the electron microscope reveals a wealth of structures that contribute to its activities. As you read about the structures in the following paragraphs, color them in the plate. Light colors are recommended, because the structures are small.

It is impossible to locate a typical animal cell in nature because none exists; here we present a composite cell. The cell is enclosed by a cell (plasma) membrane [A], which is composed of phospholipids and proteins. Various biochemical mechanisms permit small nutrients to pass through the membrane to the cell's interior, and will be discussed in a future plate.

Within the cell membrane is the cytoplasm, which is also known as the cytosol [B]. This fluid matrix of the cell suspends organelles, and enzymes and other proteins are produced within the cytosol.

The cytosol contains an internal protein framework called the cytoskeleton [C]. Tracing the fibers with a dark color will help highlight their presence. Microtubules within the cytoskeleton provide the mechanism for contraction in muscle cells, and other cytoskeleton fibers called microfilaments participate in cell reproduction.

Extending out from the cell membrane are projections called microvilli [D]. These fine thread-like projections are found in cells of the digestive tract, where absorption takes place. Long hair-like extensions called cilia [E] are found on cells of the respiratory tract, where they trap dust particles in mucus in order to prevent them from entering the lungs.

We now move to some of the submicroscopic structures within the cell, and relate them to cell functions. Continue your coloring as above. Light colors are recommended to keep you from obscuring the details in the plate.

The first internal cell structure we will study is the centrosome [F]. The centrosome contains two bodies called centrioles [F1]. As the plate indicates, centrioles are situated at right angles to one another and are composed of microtubules; they are involved in mitosis.

- Ribosomes [G] are found at numerous locations within the cell. These ultramicroscopic bodies are the "workbenches" of the cells; they are the sites of protein synthesis from amino acid subunits. Ribosomes are especially numerous in cells that synthesize proteins, such as pancreatic cells, muscle cells, and epithelial cells.

An important organelle of the cytoplasm is the mitochondrion [H]. The mitochondrion is a double-membrane enclosed organelle that produces ATP, which is the energy currency of the cell. Cells that require a large amount of energy, such as muscle cells and sperm cells, contain many mitochondria, while fewer exist in less active cells.

The center of genetic activity in the cell is the nucleus [I]. With the exception of red blood cells and gametes (sex cells), all human cells have forty-six chromosomes in their nucleus. A body of DNA, called the nucleolus [J], is suspended in the fluid-like nucleoplasm [K] in the nucleus. The genes within the nucleus are specific nucleotide sequences of DNA that contain the biochemical instructions for the synthesis of particular proteins.

We complete the plate by examining the last few cellular structures important to the activity of the cells. Some of these structures can be involved in protein synthesis. Continue using light colors, since these structures are relatively small.

The endoplasmic reticulum [L], also called the ER, is a system of interconnected membrane channels in the cytosol. These membranes may or may not have ribosomes associated with them. If ribosomes are associated with the ER, it is referred to as rough ER [L1]. Rough ER predominates in cells that are actively synthesizing protein for export. Where the endoplasmic reticulum has few or no ribosomes, it is known as smooth ER [L2]. After proteins have been manufactured, they are generally stored in a series of flattened membranes called the Golgi body [K]. The Golgi body sorts and packages proteins for secretion from the cell.

The cell stores digestive enzymes in organelles known as lysosomes [K]. Enzymes in lysosomes help break down organic materials into components that are useful to the cell in protein synthesis and energy metabolism. Enzymes are also stored in peroxisomes [M]. This is the site in which toxic compounds are neutralized. For this reason, peroxisomes are abundant in liver cells where they participate in the breakdown of alcohol, among other toxins.

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Chapter 2-3: The Plant Cell

The tissues of all organisms are composed of cells, and it is within cells that the metabolic functions of living things take place. Most cells are microscopic, but some, such as the flagellar cells, can be seen with the naked eye.

Looking over the plate, notice that we are observing a cross section of a typical plant cell. Just for our study, we have combined the features of most plant cells in this hypothetical one. As you read about the parts of the cell, color them in the plate.

The cell wall (A). This structure protects and supports the plant cell and renders it somewhat rigid. The polysaccharide cellulose is the main component of the plant cell wall.

Inside the cell wall is the flexible cell membrane (B), also known as the plasma membrane. The cell membrane regulates the movement of materials into and out of the cell, and allows for communication between cells. Phospholipids and proteins make up this membrane.

The main component of the interior of the cell is the cytoplasm (C), or cytosol. You should use a light color for this liquid mass, which is the site of many metabolic activities. Three types of protein fibers compose a cytoskeleton (D) within the cytoplasm, which provides a framework for many cellular activities.

Located within the cytoplasm are ultrastructure organelles called ribosomes (E), which should be indicated with spots of black. These are the "workbenches" of the cell, they are the sites of protein synthesis.

Ribosomes are commonly located along inclusions of the cell membrane called the ER, or endoplasmic reticulum (F), which forms an internal network within the cytoplasm. Membrane components and lipids are synthesized at the ER. When ribosomes are located along the ER, it is referred to as rough ER (F), and if there are no associated ribosomes, it is smooth ER (F). The arrows that point to the two types should be colored dark colors.

Now that we have discussed the major components of the cytoplasm, we will focus on another prominent structure, the nucleus.

The nuclear membrane (G), which surrounds a nucleus, is characterized by shallow depressions called nuclear pores (H). RNA passes out of the nucleus through these pores and travels to ribosomes for translation. Proteins and nucleotides also pass into the nucleus through these pores. The fluid substance inside the nucleus is called nucleoplasm (I). The final structure we will look at is the nucleolus (J). This is a body of RNA, and is also the area in which RNA is synthesized.