Chapter 2-4: The Cell Membrane

The cell membrane is also known as the plasma membrane, and we use the terms interchangeably in this book. The cell membrane is responsible for bringing essential materials into the cell and excreting metabolic waste products. In this plate, we will examine some of the components of the membrane. You should keep in mind that other membranes such as the endoplasmic reticulum and the nuclear membrane are similar to the cell membrane. These organelles were discussed in a previous plate.

This plate presents an enlarged view of the cell membrane. We will identify the various structures that make up the membrane and mention their activities. Begin your reading below.

The cell membrane is made up of proteins and carbohydrates as well as a phospholipid bilayer. It is an extremely thin structure that measures about 5 to 10 nanometers (nm) in thickness, and it can only be seen clearly through an electron microscope. The currently accepted hypothesis of membrane structure is referred to as the fluid mosaic model, and was proposed by Singer and Nicholson in 1976.

The most prominent element of the cell membrane is a fluid bilayer of lipids, in which a number of proteins are embedded. In the plate, the bracket outlines the **lipid bilayer (A)**, in which you can see individual **phospholipids (B)**. As the detailed diagram at the bottom of the plate indicates, a phospholipid consists of a somewhat circular phosphate group head, and two long, fatty acid chain tails. The head region is said to be **hydrophilic and polar (C)** because it is water-soluble, while the tail portions are **hydrophobic and nonpolar (D)** because they are not water-soluble. Notice that the hydrophilic heads of the lipid bilayer point toward the cell's exterior and interior, while the hydrophobic tails point inward. The brackets pointing out the hydrophilic heads and hydrophobic tails should be colored in bold colors, but the phospholipid (B) itself should be a single pale color.

Another type of lipid that is found within the lipid bilayer is the **cholesterol molecule (E)**. Cholesterol helps to maintain the fluid condition of the bilayer by breaking up the closely associated phospholipids. The detailed view shows several cholesterol molecules, which are types of steroid lipids.

We have discussed the basic structure of the cell membrane, and now we will focus on the proteins and carbohydrates associated with it.

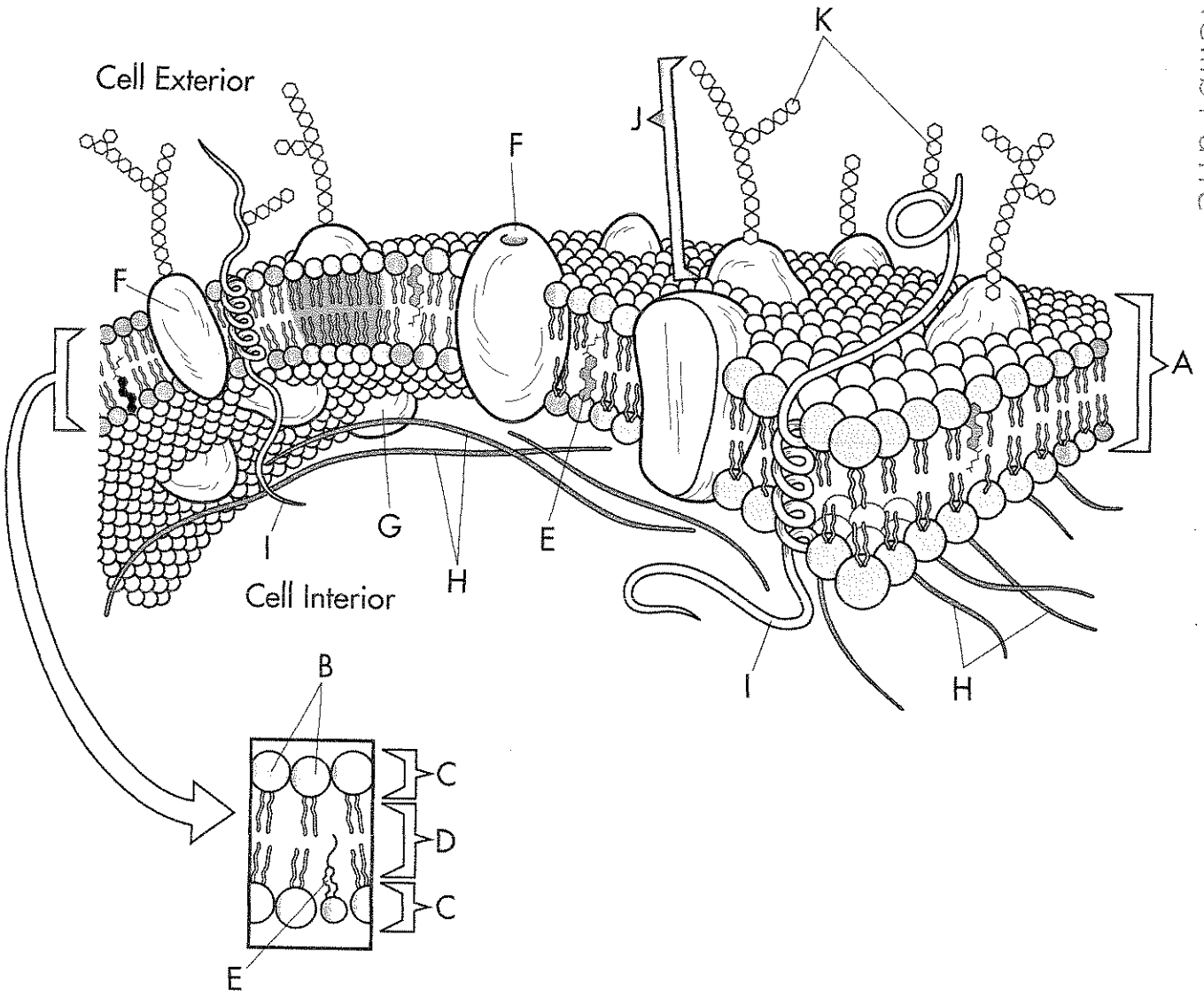
Proteins that are embedded in the cell membrane carry out various cellular functions such as nutrient and energy transport and message transmission. One type of embedded protein is the **integral protein (F)**, which spans the entire width of the lipid bilayer and protrudes at both sides. These proteins function as channels through which ions and molecules can travel into and out of the cell.

Other membrane proteins include **peripheral proteins (G)**, which are not embedded in the lipid bilayer, but sit on the outside and are bound to exposed regions of integral proteins. Peripheral proteins are often connected to **cytoskeleton filaments (H)** on the cell's interior. Several filaments are shown in the plate.

Another type of protein found in the membrane is the **alpha helix protein (I)**, which is wound like a coil. It extends through the membrane, as the plate indicates, and acts as a channel for nutrients entering the cytoplasm.

Having mentioned the lipids and proteins involved in the cell membrane, we will now focus on carbohydrates. Continue your reading below and complete the coloring of the plate.

Glycoproteins (J) consist of a protein with an attached **carbohydrate (K)**. In the diagram, we show a string of hexagonal molecules that represent the glucose molecules in a polysaccharide. The carbohydrate molecules are involved in cell recognition as receptors, and they also aid in the cell's adhesion to other cells. For example, hormones attach to the carbohydrates on the membranes of target molecules. Research on these membrane carbohydrates is ongoing.



The Cell Membrane

- ○ Lipid Bilayer .....A
- ○ Phospholipids.....B
- ○ Hydrophilic Polar Head C
- ○ Hydrophobic Nonpolar Tail .....D
- ○ Cholesterol Molecule ..E
- ○ Integral Protein .....F
- ○ Peripheral Protein ....G
- ○ Cytoskeleton Filaments.....H
- ○ Alpha Helix Protein ..I
- ○ Glycoprotein .....J
- ○ Carbohydrate .....K

Chapter 2-2: Cell Types and Tissues

There are hundreds of different types of cells in plants, animals, and microscopic organisms, and each type of cell has a specific function. In multicellular organisms, cells usually function in organized groups called tissues. In this plate, we will examine the various types of cells and tissues found in the human body.

This plate shows some of the numerous types of cells and tissues that exist in the human body. Start your work by looking over the plate, and then continue your reading below.

There are four major types of tissues in the human body. The first type that we'll discuss is **epithelial tissue (A)**, seen here enclosed by a box that you should color. Epithelial tissue is located at the body's surface and where the body meets with agents of the external environment, such as lining of the digestive tract.

The epithelial tissue found on the body's surface is made up of flat cells called **squamous cells (A_1)**, seen here lying on what's called the basement membrane. These cells provide the body with protection from dehydration and some mechanical injury. Squamous cells also make up the blood vessels and the air sacs in the lungs. The center drawing depicts **columnar cells (A_2)**, which line the digestive tract, absorbing nutrients from food. Cilia on the surface of these cells provide them with massive surface areas relative to their size, which increases the rate of absorption of nutrients. The third type of epithelial cell is the **cuboidal cell (A_3)**. These cube-shaped cells make up the epithelia of kidney tubules and many glands.

We now move to the next two types of tissue: muscle and nerve tissue. Continue your reading as you color the appropriate portions of the diagram.

A second type of tissue in the human body is **muscle tissue (B)**, which is outlined by a box in the art. This type of tissue consists of long, fibrous **muscle cells (B_1)**, in which you can see dark nuclei. The muscle shown is skeletal muscle; skeletal muscle can be found, for instance, in the arms and legs. Muscle tissue permits movement of the appendages and lines the hollow structures of the body such as blood vessels.

A third type of tissue is **nerve tissue (C)**. The **nerve cells (C_1)** that make up this tissue are long and have numerous extensions through which nerve impulses travel on their route throughout the body. Nerve cells are often called neurons. An accumulation of neurons and supporting tissue exists in the brain.

We conclude the plate by examining the final type of tissue, connective tissue. We will mention six types of connective tissue.

Connective tissue (D) supports and binds the other tissues of the body. The first type of connective tissue we'll mention is **cartilage (D_2)**. Cartilage is made up of **chondroblasts (D_1)** embedded in a rubbery substance known as chondrin. It maintains the shape of organs such as the outer ear.

On the opposite side of the plate is a second type of connective tissue, **bone (D_4)**. Bone tissue contains cells called **osteoblasts (D_3)**, shown as dark dashes within the rings. You should use spots of color for them. Bone material exists in concentric rings; the osteoblasts are confined to spaces called lacunae and secrete the calcium phosphate and collagen that make bone hard. Bones provide support for the body.

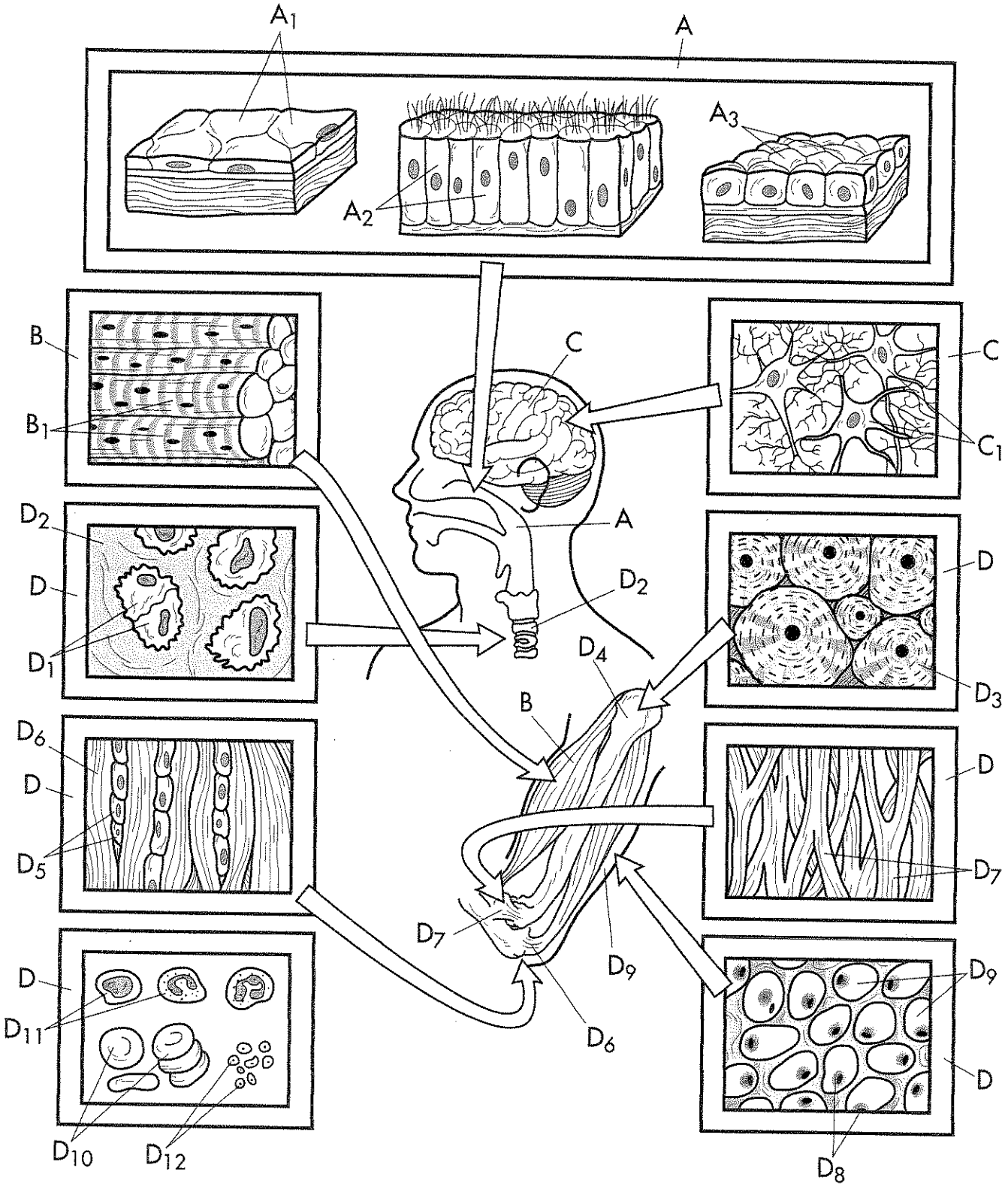
Two other kinds of connective tissue are **tendons (D_6)** and **ligaments (D_7)**. Tendons are made up of fibrous connective tissue, which in turn is made up of strands of protein produced by **tendon-forming cells (D_5)**. Tendons connect muscle to bone, as you can see in the diagram. **Ligaments (D_7)** are similar to tendons, but they connect bone to bone.

At the bottom right of the plate, we see another type of connective tissue called fat (adipose). **Fat (D_9)** is the organic substance that takes up most of the internal space of **fat (adipose) cells (D_8)**. The nuclei of the fat cells can be seen as spots along the perimeters of the cells, but the main portion of the cell is composed of fat droplets. Fat provides insulation for the body and stores fuel for metabolic activity.

The final connective tissue we will examine is blood. Blood contains **red blood cells (D_{10})**, which are shaped like discs and are sometimes stacked. Red blood cells carry oxygen to cells and pick up carbon dioxide from them for expulsion from the body. Blood also contains **white blood cells (D_{11})**, which act as the body's defense system, phagocytosizing bacteria and other harmful organisms and producing substances used in the immune system. The final type of blood cell is the **platelet (D_{12})**. Platelets are cell fragments involved in blood clotting. A future plate will discuss blood cells in more detail.

Cell Types and Tissues

- ○ Epithelial Tissue.....A
  - ○ Squamous Cells ....A_1
  - ○ Columnar Cells ....A_2
  - ○ Cuboidal Cells ....A_3
- ○ Muscle Tissue .....B
  - ○ Muscle Cells .....B_1
- ○ Nerve Tissue C
  - ○ Nerve Cells.....C_1
- ○ Connective Tissue.....D
  - ○ Chondroblasts.....D_1



- Cartilage.....D_2
- Osteoblasts.....D_3
- Bone .....D_4
- Tendon-Forming Cells.....D_5
- Tendons.....D_6
- Ligament .....D_7
- Fat (Adipose) Cells.....D_8
- Fat (Adipose) ....D_9
- Red Blood Cells ..D_{10}
- White Blood Cells .....D_{11}
- Platelets .....D_{12}