

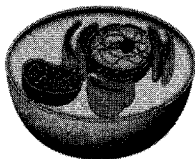
# 3. Cells

The smallest part of you

VISUAL LEARNING GLOSSARY: Key Terms in the order you see them in the text.

### **CELL (p. 82)**

The smallest unit of life that can function independently; a three-dimensional structure, surrounded by a membrane and, in the case of prokaryotes and most plants, a cell wall, in which many of the essential chemical reactions of the life of an organism take place.



[Lat., cella, room]

### **CELL**

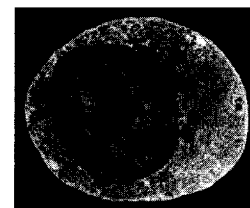
#### **THEORY (p. 84)**

A unifying and universally accepted theory in biology that holds that all living organisms are made up of one or more cells, and that all cells arise from other, preexisting cells.

### **EUKARYOTIC**

#### **CELL (p. 84)**

A cell with a membrane-surrounded nucleus containing DNA, membrane-surrounded organelles, and internal structures organized into compartments.



### **EUKARYOTE (p. 84)**

An organism composed of eukaryotic cells. [Gk., eu, good + karyon, nut, kernel]

### **PROKARYOTIC CELL (p. 84)**

A cell bound by a plasma membrane enclosing the cell contents (cytoplasm, DNA, and ribosomes); there is no nucleus or other organelles.

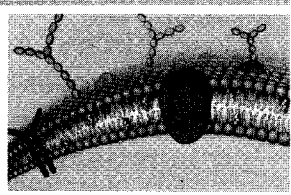


### **PROKARYOTE (p. 84)**

An organism consisting of a prokaryotic cell (all prokaryotes are one-celled organisms). [Gk., pro, before + karyon, nut, kernel]

### **PLASMA MEMBRANE (p. 84)**

A complex, thin, two-layered membrane that encloses the cytoplasm of the cell, holding the contents in place and regulating what enters and leaves the cell; also called the cell membrane. [Gk., plasma, anything molded]



### **CYTOPLASM (p. 84)**

The jelly-like fluid that fills the inside of the cell; in eukaryotes, the cytoplasm contains the organelles. [Gk., kytos, container + plasma, anything molded]

### **RIBOSOMES (p. 84)**

Granular bodies in the cytoplasm, released from their initial positions on the rough endoplasmic reticulum, that copy the information in segments of DNA to provide instruction for the construction of proteins.

### **CELL WALL (p. 85)**

A rigid structure, outside the cell membrane, that protects and gives shape to the cell; found in many prokaryotes and plants.



**FLAGELLUM (p. 85)**

Long, thin, whip-like projection from the cell body of a prokaryote that aids in cell movement through the medium in which the organism lives; in animals, the only cell with a flagellum is the sperm cell. [Lat., flagellum, whip]

**PILUS (p. 85)**

A thin, hair-like projection that helps a prokaryote attach to surfaces. [Lat., pilus, a single hair]

**NUCLEUS (p. 86)**

A membrane-enclosed structure in eukaryotic cells that contains the organism's genetic information as linear strands of DNA in the form of chromosomes. [Lat., nucleus, dim. of nux, nut]



**ORGANELLES (p. 86)**

Specialized structures in the cytoplasm of eukaryotic cells with specific functions, such as the rough and smooth endoplasmic reticulum, Golgi apparatus, and mitochondria. [Gk., organon, tool]

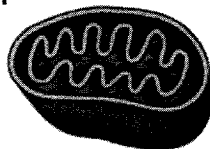
**CHLOROPLAST (p. 88)**

The organelle in plant cells in which photosynthesis occurs. [Gk., chloros, pale green + plastos, formed]



**MITOCHONDRION (p. 88)**

The organelle in eukaryotic cells that converts the energy stored in food in the chemical bonds of carbohydrate, fat, and protein molecules into a form usable by the cell for all its functions and activities. [Gk., mitos, thread + chondros, cartilage]



**ENDOSYMBIOSIS THEORY (p. 86)**

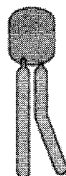
Theory of the origin of eukaryotes that holds that, in the past, two different types of prokaryotes engaged in a close partnership and eventually one, capable of performing photosynthesis, was subsumed into the other, a larger prokaryote. The smaller prokaryote made some of its photosynthetic energy available to the host and, over time, the two became symbiotic and eventually became a single more complex organism in which the smaller prokaryote had evolved into the chloroplast of the new organism. A similar scenario can be developed for the evolution of mitochondria. [Gk., endon, within + symbios, living together]

**INVAGINATION (p. 88)**

The folding in of a membrane or layer of tissue so that an outer surface becomes an inner surface. [Lat., in, in + vagina, sheath]

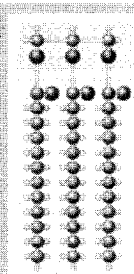
**PHOSPHOLIPIDS (p. 89)**

A lipid that is the major component of the plasma membrane; phospholipids are structurally similar to fats, but contain a phosphorus atom and have two, not three, fatty acid chains.



**GLYCEROL (p. 89)**

A small molecule that forms the head region of a triglyceride fat molecule. [Gk., glykys, sweet + -ol, chemical suffix for an alcohol]



**POLAR (p. 89)**

Having an electrical charge.

**NONPOLAR (p. 89)**

Electrically uncharged.

**HYDROPHOBIC (p. 89)**

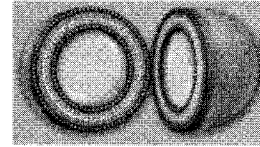
Repelled by water, as, for example, nonpolar molecules that tend to minimize contact with water. [Lat., hydro-, pertaining to water, Gk., phobos, fearing]

**HYDROPHILIC (p. 89)**

Attracted to water, as, for example, polar molecules that readily form hydrogen bonds with water. [Lat., hydro-, pertaining to water; Gk., philios, loving]

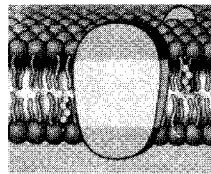
**PHOSPHOLIPID BILAYER (p. 90)**

The structure of the plasma membrane; two layers of phospholipids, arranged tail to tail (the tails are hydrophobic and so avoid contact with water), with the hydrophilic head regions facing the watery extracellular fluid and intracellular fluid.



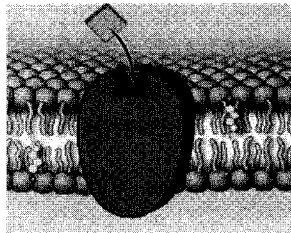
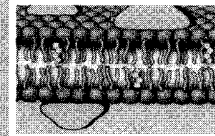
**TRANSMEMBRANE PROTEIN (p. 91)**

A protein that can penetrate the phospholipid bilayer of a cell's plasma membrane.

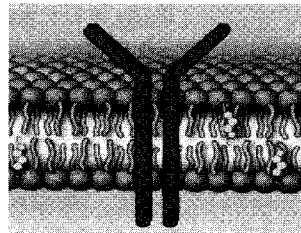


**SURFACE PROTEIN (p. 91)**

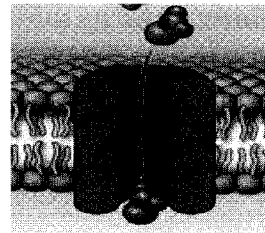
A protein that resides primarily on the inner or outer surface of the phospholipid bilayer that constitutes the plasma membrane of the cell.



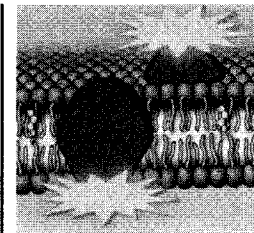
**RECEPTOR PROTEIN (p. 91)**  
A protein in the plasma membrane that binds to specific chemicals in the cell's external environment to regulate processes within the cell; for example, cells in the heart have receptor proteins that bind to adrenaline.



**RECOGNITION PROTEIN (p. 92)**  
A protein in the plasma membrane that provides a "fingerprint" on the outside-facing surface of the cell, making it recognizable to other cells. Recognition proteins make it possible for the immune system to distinguish the body's own cells from invaders that may produce infection, and also help cells bind to other cells or molecules.



**TRANSPORT PROTEIN (p. 92)**  
A transmembrane protein that provides a channel or passageway through which large or strongly charged molecules can pass. Transport proteins are of a number of shapes and sizes, making possible the transport of a wide variety of molecules.



**ENZYMATIC PROTEIN (ENZYME) (p. 92)**  
A protein that initiates and accelerates a chemical reaction in a living organism; enzymatic proteins take part in chemical reactions on the inside and outside surfaces of the plasma membrane. [Gk., en, in + zyme, leaven]

**CHOLESTEROL (p. 92)**

One of the sterols, a group of lipids important in regulating growth and development; an important component of most cell membranes, helping the membrane maintain its flexibility. [Gk., chole, bile + stereos, solid + -ol, chemical suffix for an alcohol]

**FLUID MOSAIC (p. 92)**

A term that describes the structure of the plasma membrane, which is made up of several different types of molecules, many of which are not fixed in place but float, held in proper orientation by hydrophilic and hydrophobic forces.

**PASSIVE TRANSPORT (p. 97)**

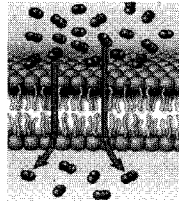
Molecular movement that occurs spontaneously, without the input of energy; the two types of passive transport are diffusion and osmosis.

**SOLUTE (p. 97)**

A substance that is dissolved in a gas or liquid; in a solution of water and sugar, sugar is the solute. [Lat., solvere, to loosen]

**SIMPLE****DIFFUSION (p. 97)**

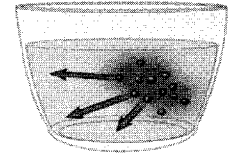
Diffusion of molecules directly through the phospholipid bilayer of the plasma membrane that takes place without the assistance of other molecules; oxygen and carbon dioxide, because they are small and carry no charge that would cause them to be repelled by the middle layer of the membrane, can pass through the membrane in this way.

**OSMOSIS (p. 99)**

A type of passive transport in which water molecules move across a membrane, such as the plasma membrane of a cell; the direction of osmosis is determined by the relative concentrations of all solutes on either side of the membrane. [Gk., osmos, thrust]

**DIFFUSION (p. 97)**

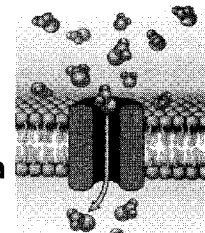
Passive transport in which a particle (the solute) is dissolved in a gas or liquid (the solvent) and moves from an area of higher solute concentration to an area of lower solute concentration. [Lat., diffundere, to pour in different directions]

**SOLVENT (p. 97)**

The gas or liquid in which a substance is dissolved; in a solution of water and sugar, water is the solvent. [Lat., solvere, to loosen]

**FACILITATED****DIFFUSION (p. 98)**

Diffusion of molecules through the phospholipid bilayer of the plasma membrane that takes place through a transport protein (a "carrier molecule") embedded in the membrane. Molecules that require the assistance of a carrier molecule are those that are too big to cross the membrane directly or are electrically charged and would be repelled by the middle layer of the membrane.

**TONICITY (p. 99)**

For a cell in solution, a measure of the concentration of solutes outside the cell relative to that inside the cell. [Gk., tonos, tension]



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**ISOTONIC (p. 99)** Refers to solutions with equal concentrations of solutes. [Gk., isos, equal to + tonos, tension]

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**HYPOTONIC (p. 99)** Of two solutions, that with a lower concentration of solutes. [Gk., hypo, under + tonos, tension]

>

**HYPERTONIC (p. 99)** Of two solutions, that with a higher concentration of solutes. [Gk., hyper, above + tonos, tension]

**ACTIVE TRANSPORT (p. 101)**

Molecular movement that depends on the input of energy, which is necessary when the molecules to be moved are large or are being moved against their concentration gradient.

**PRIMARY**

**ACTIVE TRANSPORT (p. 101)**

Active transport using energy released directly from ATP.

**ATP**

**SECONDARY ACTIVE TRANSPORT (p. 101)**

Active transport in which there is no direct involvement of ATP (adenosine triphosphate); the transport protein simultaneously moves one molecule against its concentration gradient while letting another flow down its concentration gradient.

**ENDOCYTOSIS (p. 102)**

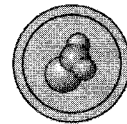
A cellular process in which large particles, solid or dissolved, outside the cell are surrounded by a fold of the plasma membrane, which pinches off, forming a vesicle, and the enclosed particle now moves into the cell. The three types of endocytosis are phagocytosis, pinocytosis, and receptor-mediated endocytosis. [Gk., endon, within + kytos, container]

**EXOCYTOSIS (p. 102)**

A cellular process in which particles within the cell, solid or dissolved, are enclosed in a vesicle and transported to the plasma membrane, where the membrane of the vesicle merges with the plasma membrane and the material in the vesicle is expelled to the extracellular fluid for use throughout the body. [Gk., ex, out of + kytos, container]

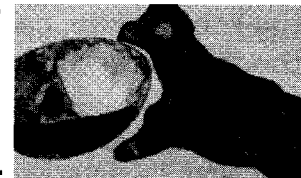
**VESICLE (p. 102)**

A small, membrane-enclosed sac within a cell. [Lat., vesicula, dim. of vesica, bladder]



**PHAGOCYTOSIS (p. 102)**

One of the three types of endocytosis, in which relatively large solid particles are engulfed by the plasma membrane, a vesicle is formed, and the particle is moved into the cell.

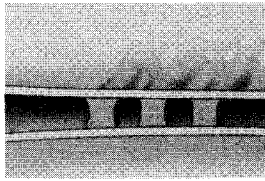


**PINOCYTOSIS (p. 102)**

One of the three types of endocytosis, in which dissolved particles and liquids are engulfed by the plasma membrane, a vesicle is formed, and the material is moved into the cell. The vesicles formed in pinocytosis are generally much smaller than those formed in phagocytosis. [Gk., pinein, to drink + kytos, container]

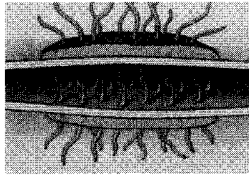
**RECEPTOR-MEDIATED ENDOCYTOSIS (p. 102)**

One of the three types of endocytosis, in which receptors on the surface of a cell bind to specific molecules; the plasma membrane then engulfs both molecule and receptor and draws them into the cell.



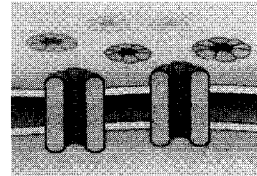
**TIGHT  
JUNCTION (p. 105)**

A continuous, water-tight connection between adjacent animal cells. Tight junctions are particularly important in the small intestine, where digestion occurs, to ensure that nutrients do not leak between cells into the body cavity and so become lost as a source of energy.



**DESMOSOMES (p. 105)**

Irregularly spaced connections between adjacent animal cells that, in the manner of Velcro, hold cells together by attachments but are not water-tight. They provide mechanical strength and are found in muscle tissue and in much of the tissue that lines the cavities of animal bodies. [Gk., desmos, bond + soma, body]



**GAP  
JUNCTION (p. 105)**

A junction between adjacent animal cells in the form of a pore in each of the plasma membranes surrounded by a protein that links the two cells and acts like a channel between them, allowing materials to pass between the cells.

**NUCLEAR  
MEMBRANE (p. 107)**

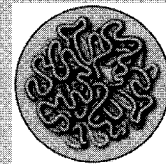
A membrane that surrounds the nucleus of a cell, separating it from the cytoplasm, consisting of two bilayers and perforated by pores enclosed in embedded proteins that allow the passage of large molecules from nucleus to cytoplasm and from cytoplasm to nucleus; also called the nuclear envelope.

**NUCLEOLUS (p. 108)**

An area near the center of the nucleus where subunits of the ribosomes are assembled. [Lat., nucleolus, dim. of nucleus, kernel, small nut]

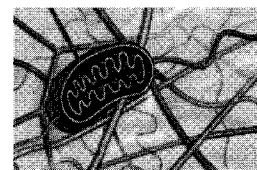
**CHROMATIN (p. 108)**

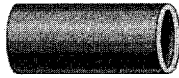
A mass of long, thin fibers consisting of DNA and proteins in the nucleus of the cell. [Gk., chroma, color]



**CYTOSKELETON (p. 109)**

A network of protein structures in the cytoplasm of eukaryotes (and, to a lesser extent, prokaryotes) that serves as scaffolding, adding support and, in some cases, giving animal cells of different types their characteristic shapes. The cytoskeleton serves as tracks guiding the intercellular traffic flow and, because it is flexible and can generate force, gives cells some ability to control their movement.





**MICROTUBULES**  
(p. 109)

One of three types of protein fibers (the others are intermediate filaments and microfilaments) that make up the eukaryotic cytoskeleton, providing it with structure and shape. These are the thickest elements in the cytoskeleton; they resemble rigid, hollow tubes, functioning as tracks to which molecules and organelles within the cell may attach and be moved along; also help pull chromosomes apart during cell division.



**INTERMEDIATE FILAMENTS** (p. 109)

One of three types of protein fibers (the others are microtubules and microfilaments) that make up the eukaryotic cytoskeleton, providing it with structure and shape; a durable, rope-like system of numerous different overlapping proteins.

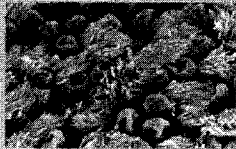


**MICROFILAMENTS** (p. 109)

One of three types of protein fibers (the others are intermediate filaments and microtubules) that make up the eukaryotic cytoskeleton, providing it with structure and shape. These are the thinnest elements in the cytoskeleton; long, solid, rod-like fibers that help generate forces, including those important in cell contraction and cell division.

**CILIA** (p. 110)

Short projections from the cell surface, often occurring in large numbers on a single cell, that beat against the intercellular fluid to move the fluid past the cell. [Lat., cilium, eyelid]



**INTERMEMBRANE SPACE** (p. 112)

In a mitochondrion, the region between the inner and outer membranes. [Lat., inter, between + membrana, a thin skin]

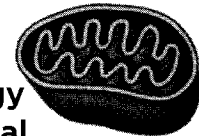
**LYSOSOME** (p. 112)

A round, membrane-enclosed, enzyme- and acid-filled vesicle in the cell that digests and recycles cellular waste products and consumed material. [Gk., lysis, releasing + soma, body]



**MITOCHONDRION** (p. 110)

The organelle in eukaryotic cells that converts the energy stored in food in the chemical bonds of carbohydrate, fat, and protein molecules into a form usable by the cell for all its functions and activities. [Gk., mitos, thread + chondros, cartilage]



**MATRIX (MITOCHONDRIAL)** (p. 112)

The space within the inner membrane, where the carriers NADH and FADH<sub>2</sub> begin the electron transport chain by carrying high-energy electrons to molecules embedded in the inner membrane.

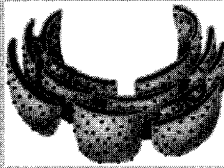


**ENDOMEMBRANE SYSTEM** (p. 114)

A system of organelles (the rough endoplasmic reticulum, the smooth endoplasmic reticulum, and the Golgi apparatus) that surrounds the nucleus; it produces and modifies necessary molecules, breaks down toxic chemicals and cellular by-products, and is thus responsible for many of the fundamental functions of the cell. [Gk., endon, within + Lat., membrana, a thin skin]

**ROUGH ENDOPLASMIC RETICULUM (p. 114)**

An organelle, part of the endomembrane system, structurally like a series of interconnected, flattened sacs connected to the nuclear envelope; called "rough" because its surface is studded with ribosomes. [Gk., endon, within + plasma, anything molded; Lat., reticulum, dim. of rete, net]



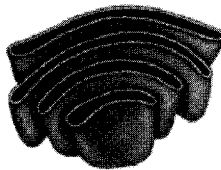
**SMOOTH ENDOPLASMIC RETICULUM (p. 114)**

An organelle, part of the endomembrane system, structurally like a series of branched tubes; called "smooth" because its surface has no ribosomes. Smooth endoplasmic reticulum synthesizes lipids such as fatty acids, phospholipids, and steroids. [Gk., endon, within + plasma, anything molded; Lat., reticulum, dim. of rete, net]



**GOLGI APPARATUS (p. 116)**

(pron. GOHL-jee) An organelle, part of the endomembrane system, structurally like a flattened stack of unconnected membranes, each known as a Golgi body. The Golgi apparatus processes molecules synthesized in the cell and packages those molecules that are destined for use elsewhere in the body. [From the name of the discoverer, Camillo Golgi, 1843-1926]



**PLASMODESMATA (p. 119)**

In plants, microscopic tubelike channels connecting the cells and enabling communication and transport between them. [Gk., plassein, to mold + desmos, bond]

**TURGOR PRESSURE (p. 120)**

In plants, the pressure of the contents of the cell against the cell wall, which is maintained by osmosis as water rushes into the cell when it contains high concentrations of dissolved substances. Turgor pressure allows non-woody plants to stand upright, and its loss causes wilting. [Lat., turgere, to swell]

**VACUOLE (CENTRAL) (p. 119)**

A membrane-enclosed, fluid-filled, multipurpose organelle prominent in most plant cells (but also present in some protists, fungi, and animals); functions vary but can include storing nutrients, retaining and degrading waste products, accumulating poisonous materials, containing pigments, and providing physical support. [Lat., vacuus, empty]



**THYLAKOIDS (p. 120)**

Interconnected membranous structures in the stroma of a chloroplast, where light energy is collected and the conversion of light energy to chemical energy in photosynthesis takes place. [Gk., thylakis, dim. of thylakos, bag]



**STROMA (p. 120)**

In the leaf of a green plant, the fluid in the inner compartment of a chloroplast, which contains DNA and protein-making machinery. [Gk., stroma, bed]