The fundamental structural unit on cells biology essay

Science, Biology

The fundamental structural unit of all living organisms. Some cells are complete organisms, such as the unicellular bacteria and protozoa; others, such as nerve, liver, and muscle cells, are specialized components of multicellular organisms. Cells range in size from the smallest bacteria, called mycoplasmas, which are 0. 1 micrometer (0. 000004 in) in diameter, to the egg yolks of ostriches, which are about 8 cm (about 3 in) in diameter. Although they may differ widely in appearance and function, all cells have a surrounding membrane and an internal, water-rich substance called the cytoplasm, the composition of which differs significantly from the external environment of the cell. Within the cell is genetic material, deoxyribonucleic acid (DNA), containing coded instructions for the behavior and reproduction of the cell and also the chemical machinery for the translation of these instructions into the manufacture of proteins (see Genetics). Viruses are not considered cells because they lack this translation machinery; they must parasitize cells in order to translate their own genetic code and reproduce themselves. Cells are of two distinctly different types, prokaryotes and eukaryotes (sometimes spelled procaryotes and eucaryotes); thus, the living world is divided into two broad categories (see Classification). The DNA of procaryotes is a single molecule in direct contact with the cell cytoplasm, whereas the DNA of eucaryotes is much greater in amount and diversity and is contained within a nucleus separated from the cell cytoplasm by a membranous nuclear envelope. Many eucaryotic cells are further divided into compartments by internal membranes in addition to the nuclear envelope, whereas procaryotic cells never contain completely internal membranes. The procaryotes include the bacteria and archaebacteria. The eucaryotes comprise all plant and animal cells. In general, plant cells differ from animal cells in that they have a rigid cell wall exterior to the plasma membrane; a large vacuole, or fluid-filled pouch; and chloroplasts that convert light energy to chemical energy for the synthesis of glucose. STRUCTURE AND FUNCTIONCells are composed primarily of oxygen, hydrogen, carbon, and nitrogen, the elements that make up the majority of organic compounds. The most important organic compounds in a cell are proteins, nucleic acids, lipids, and polysaccharides (carbohydrates). The " solid" structures of the cell are complex combinations of these large molecules. Water makes up 60 to 65 percent of the cell, because water is a favorable environment for biochemical reactions. All cells are dynamic at some stage of their life cycle, in the sense that they use energy to perform a variety of cell functions: movement, growth, maintenance and repair of cell structure, reproduction of the cell, and manufacture of specialized cell products such as enzymes and hormones. These functions are also the result of interactions of organic molecules. Plasma MembraneThe plasma membrane (PM), a continuous double layer of phospholipid molecules 75 to 100 angstroms thick, constitutes the boundary between the cell and its external environment. In addition to lipids, the PM has protein components (polypeptides) that are associated with either the outer or inner surfaces of its layers or are buried within them. The structure as a whole is selectively permeable, or semipermeable; that is, it permits the exchange of water and selected atoms and molecules between the cell exterior and interior. This is vital to the cell because while the PM helps maintain high local concentrations of organic molecules within the cell, it also allows interaction between the cell and its external environment. The PM mediates such interactions in various ways. The exchange of mineral ions and small nutrient molecules is controlled by PM proteins that act as pumps, carriers, and channels. The PM also participates in the exchange of larger molecules through phagocytosis, the engulfing of large food particles; endocytosis, the intake of fluids and membrane components; and exocytosis, the expulsion of cell products or cell waste. (The PM of some cells, such as those of the human intestine, is convoluted to enhance the surface area for these exchanges.) In addition, the PM contains receptors that selectively receive nerve and hormone signals and transmit them to the interior of the cell. Finally, direct cell-to-cell interactions can occur through specialized regions of the PM known as junctions. Organs such as the skin and the small intestine consist of cells held together by tight junctions and local thickenings, or desmosomes, which constitute another type of junction. Cells can communicate electrically through a third type of junction, called a gap junction, that consists of tiny protein " tunnels" between two cells, through which tiny " message" molecules and ions may be passed. When the PMs of two cells are continuous, an actual bridge of cytoplasm forms between them; in plants these bridges are called plasmodesmata. Cell WallsExterior to the PM of most plant cells and bacteria is a cell wall, a cell product made largely of complex polysaccharides. In higher plants the polysaccharide is cellulose. The presence of a cell wall makes these cells rigid and sturdy, but it poses special problems for the transport of substances into and out of the cell. CytoplasmThe cytoplasm is the water-rich matrix within a cell that contains and surrounds the other cellular contents. It has both gel-like and liquid properties, and it contains contractile proteins, similar to those found in muscle, that are responsible for cellular movement. This movement can be in the form of amoeboid movement or, as in rigid plant cells and a variety of algal cells, it can involve an internal streaming of the cytoplasm. Through an electron microscope the cytoplasmic gel appears as a three-dimensional lattice of slender, protein-rich strands in a continuous water-rich phase. The latticework is reminiscent of the internal structure of spongy bone, which is composed of many strutlike fibers. CytoskeletonThe so-called cytoskeleton influences the shape of the cell in much the same way tent poles determine the shape of a tent. Without the cytoskeleton a cell tends to become spherical. The cytoskeleton probably gives direction to the movement of components within the cytoplasm as well and participates in movement of the cell itself. The cytoskeleton is composed of three main filament types: the microtubules, microfilaments, and intermediate-size filaments that are supported and distributed within the cytoplasmic gel. Microtubules are long, rigid cylinders that act as the bones of the cell. They also may act as tracks along which intracellular components are transported. The walls of the cylinders are composed of two proteins, alpha- and beta-tubulin. Microfilaments are rodlike structures composed of actin, a major protein of muscle. They often occur in long bundles called stress fibers and may act as the muscles of the cell. The intermediate-size filaments are a heterogeneous class of proteins whose functions include anchoring the nucleus within the cell and strengthening the cellular infrastructure. They are rodlike in structure and are more stable than microtubules and microfilaments, both of which constantly assemble and disassemble. NucleusThe membranebounded structures contained within the cytoplasm of eucaryotes are referred to as organelles. The nucleus is the most easily recognizable of these. DNA, combined with protein, is organized inside the nucleus into structural units called chromosomes, which usually occur in identical pairs. The DNA in each chromosome is a single, very long, highly coiled molecule subdivided into functional subunits called genes. Genes contain the coded instructions for the assembly of polypeptides and larger proteins. Together the chromosomes contain all the information needed to build an identical functioning copy of the cell. The nucleus is surrounded by an envelope of two concentric membranes. Interaction between the nuclear contents and the surrounding cytoplasm is permitted through holes, called nuclear pores, in this envelope. The nucleus also contains a specialized region, the nucleolus, where nucleoprotein particles are assembled. These particles migrate through the nuclear pores into the cytoplasm, where they are modified to become ribosomes. RibosomesRibosomes are the " factories" where the instructions encoded in the DNA of the nucleus are translated in order to produce proteins. The instructions are carried from the DNA to the ribosomes by means of long nucleic-acid molecules, which are called messenger ribonucleic acids (RNAs). Endoplasmic Reticulum (ER)Among the other membranous structures within the eucaryotic cell are extensive membrane systems that make up the smooth and the rough endoplasmic reticulum (SER and RER). The SER often takes the form of branching tubes. (In skeletal muscle it acts as a reservoir for calcium ions and is called the sacroplasmic reticulum.) The RER is made up of sheetlike flattened sacs, which often are stacked one on top of the other; the term rough refers to the numerous ribosomes that dot the cytoplasmic surfaces of the sacs. The RER is one of the sites of protein synthesis in the cytoplasm. Proteins are synthesized on the cytoplasmic surface and pass through the membrane to become sequestered within the sacs. These packaged proteins are destined for secretion to the outside of the cell. Other proteins, synthesized on ribosomes that are not attached to membranes, are not secreted and remain as structural proteins or metabolic enzymes.