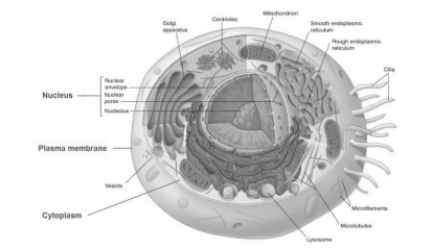
Generic Cell Structure



• Plasma membrane: The boundary of the cell
• Nucleus: The center of the cell
• Cytoplasm: A gel-like substance surrounding the nucleus and packed with various organelles and molecules, each of which serves a specific function

Plasma Membrane

The plasma membrane defines the boundary of the cell and regulates the passage of substances into and out of the cell.	Phosph-olipids form the bulk of the membrane.	Cholesterol molecules are scattered within the phosph-olipid molecules; they stiffen and strengthen the plasma membrane.	Proteins are embedded in various spots in the membrane

Plasma Membrane (cont)

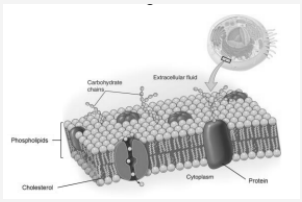
It consists of phosph-olipids, choles-terol, and protein.	They have a head and twin tails: The heads are “water loving” (hydro-philic) and the tails are “water fearing” (hydro-phobic).	Some pass through the membrane and act as channels.
	They are positioned in a double layer (bilayer): Some heads point toward the fluidf-illed cell interior and others point toward the fluid surrounding the cell’s exterior	Some attach to the surface and serve as receptors for specific chemicals or hormones

Plasma Membrane (cont)

The tails point toward each other, forming a “hydro-phobic” core.	Others have carbohydrates attached to their outer surface (forming glycoproteins, which act as markers to help the body distinguish its own cells from foreign invaders).

▪ Transparent barrier for cell contents
▪ Contains cell contents
▪ Separates cell contents from surrounding environment
▪ The membrane is selectively permeable: Some substances pass through easily, whereas
others do not.

Plasma Membrane



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Nucleus

The nucleus contains all of a cell's genetic information.

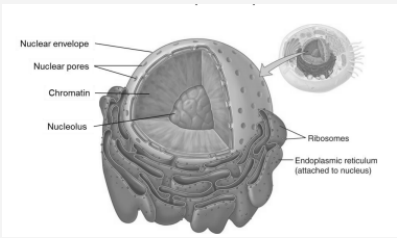
Most cells have only one nucleus, although a few (like liver and skeletal muscle cells) contain more than one; red blood cells have no nucleus.

The nuclear envelope surrounds the nucleus. Nuclear pores allow molecules (like materials needed for construction of RNA and DNA) to pass into and out of nucleus.

Extending throughout the nucleoplasm are strands composed of DNA and protein called chromatin.

The center of the nucleus is the nucleolus; it manufactures ribosomes (the cell's protein-producing structures)

Nucleus



- Control center of the cell
- Contains genetic material known as DNA
- DNA is needed for building proteins
- DNA is necessary for cell reproduction
- Three regions:

1. Nuclear envelope (membrane)
2. Nucleolus
3. Chromatin

The Nucleus: The Nucleus Envelope

Nuclear envelope (membrane)

- Consists of a double membrane that bounds the nucleus
- Contains nuclear pores that allow for exchange of material with the rest of the cell
- Encloses the jellylike fluid called the nucleoplasm
- Sites of ribosome assembly
- Ribosomes migrate into the cytoplasm through nuclear pores to serve as the site of protein synthesis

The Nucleus: Chromatin

Chromatin

- Composed of DNA wound around histones (proteins)
- Scattered throughout the nucleus and present when the cell is not dividing
- Condenses to form dense, rod-like bodies called chromosomes when the cell divides

Overview of the Cellular Basis of Life

Cell Theory	Major Elements in Cells
A cell is the basic structural and functional unit of living organisms	Carbon
The activity of an organism depends on the collective activities of its cells	Hydrogen

Overview of the Cellular Basis of Life (cont)

• According to the principle of complementarity, the biochemical activities of cells are dictated by their structure (anatomy) which determines their function (physiology)	Oxygen
	Nitrogen

- Cells are the structural units of all living things
- The human body has 50 to 100 trillion cells
- Continuity of life has a cellular basis
- Cells are about 60% water

Centrioles

Two centrioles lie perpendicular to each other just outside the nucleus

These bundles of microtubules play a role in cell division.

Peroxisomes

Membranous sacs of oxidase enzymes

Detoxify harmful substances such as alcohol and formaldehyde

Break down free radicals (highly reactive chemicals)

Free radicals are converted to hydrogen peroxide and then to water

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Golgi Apparatus

The Golgi apparatus receives proteins from the endoplasmic reticulum (ER), and prepares and packages them for export to other parts of the body

1. The ER delivers a protein molecule to the Golgi apparatus.
2. The protein passes through each of the sacs of the Golgi apparatus, undergoing modifications along the way.
3. The Golgi apparatus envelopes the protein and then pinches off the portion of itself containing the protein, creating a vesicle.
4. The vesicle migrates to the surface of the cell and pops open to secrete the protein inside. Some of the protein becomes part of the plasma membrane; some become secretory vesicles that store substanc

Packages protein secretions for export, packages enzymes into lysosomes for cellular use, and modifies proteins destined to become part of cellular membranes

Golgi Apparatus

Appears as a stack of flattened membranes associated with tiny vesicles	Produces different types of packages

Golgi Apparatus (cont)

Modifies and packages proteins arriving from the rough ER via transport vesicles	– Secretory vesicles
	– In-house proteins and lipids
	– Lysosomes

Smooth Endoplasmic Reticulum

- Lacks ribosomes
- Functions in lipid metabolism
- Detoxification of drugs and pesticides

Synthesizes lipids and steroid molecules. Also acts in fat metabolism, in drug detoxification, and as a calcium ion depot.

Endoplasmic Reticulum (ER)

Fluid-filled tunnels (or canals) that carry substances within the cell

Continuous with the nuclear membrane

Two types:
– Rough ER
– Smooth ER

Ribosomes

Made of protein and ribosomal RNA	Organelles fill the cytoplasm and perform specific tasks in metabolism.

Ribosomes (cont)

Sites of protein synthesis in the cell	Ribosomes, which manufacture proteins, dot the surface of some of the ER (called rough ER). Smooth ER has no ribosomes; smooth ER synthesizes certain lipids and carbohydrates

Found at two locations:
– Free in the cytoplasm
– As part of the rough endoplasmic reticulum

Lysosomes

Lysosomes are membranous vesicles that form from pinched off pieces of the Golgi apparatus

Inside, they contain enzymes that help break down protein the cell doesn't need

This allows the cell to reuse amino acids; it also cleans out the cell

Lysosomal enzymes can also destroy bacteria.

Lysosomes have the nickname "cellular garbage disposals."

House phagocytes that dispose of bacteria and cell debris

Degrade worn-out organelles and stressed or dead cells, and they release ionic calcium from bone

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Mitochondria

Mitochondria function as the cell's "powerhouses."	Mitochondria have two membranes: an outer membrane and an inner membrane. The inner membrane folds back and forth across its interior; these folds are called cristae
Spaces between the cristae contain enzymes that the organelle uses to convert organic compounds into ATP, which cells use for energy	Cells that do a lot of work (such as liver cells) contain more mitochondria than cells that do less work (such as sperm cells).

Sites of ATP formation. Internal enzymes carry out oxidative reactions of cellular respiration.

Cytoplasm

The cellular material outside the nucleus and inside the plasma membrane

Site of most cellular activities

▪ Three major component of the cytoplasm
1. Cytosol: Fluid that suspends other elements and contains nutrients and electrolytes
2. Inclusions: Chemical substances, such as stored nutrients or cell products, that float in the cytosol
3. Organelles: Metabolic machinery of the cell that perform functions for the cell
– Many are membrane-bound, allowing for compartmentalization of their functions

Cytoskeleton

Microvilli	Cilia	Flagella
Folds of the cell membrane that greatly increase the surface area of the cell; they are found in cells charged with absorbing nutrients (intestines).	Hair-like processes on the cell surface; they beat in waves to propel a substance forward.	Have a whip-like motion to move a cell; in the human body, flagella occur only in sperm
Tiny, fingerlike extensions of the plasma membrane	Move materials across the cell surface	
	Located in the respiratory system to move mucus	

▪ Framework of the cell
▪ Determines cell shape
▪ Strengthens cell
▪ Allows cell to move
▪ May have extensions: microvilli, cilia, or flagella

Movement Through the Cell Membrane

▪ Passive transport
• Requires no energy
• Includes diffusion, osmosis, filtration, and facilitated diffusion
▪ Active transport

Movement Through the Cell Membrane (cont)

• Requires energy
• Includes transport by pumps and vesicles

Cellular Transport

Passive Transport- The movement of substances across a cell membrane without the input of energy.

Diffusion- The spontaneous movement of molecules or ions from an area of higher concentration to an area of lower concentration.

Osmosis- The diffusion of a solvent through a selectively permeable membrane.

Facilitated Diffusion- The movement of substances across the membrane with the help of transport proteins.

Filtration- Fluid and solutes are separated by passing them through a filter or porous membrane.

Active Transport- Substances are moved across a cell membrane against their concentration gradient, requiring the input of energy.

Vesicular Transport- The movement of substances within a cell by the formation and fusion of vesicles.

Solute Pumping – The movement of molecules or ions across a cell membrane against their concentration gradient with the expenditure of energy.

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