University of Karbala

College of Applied medical science

Department of Clinical Laboratory Sciences

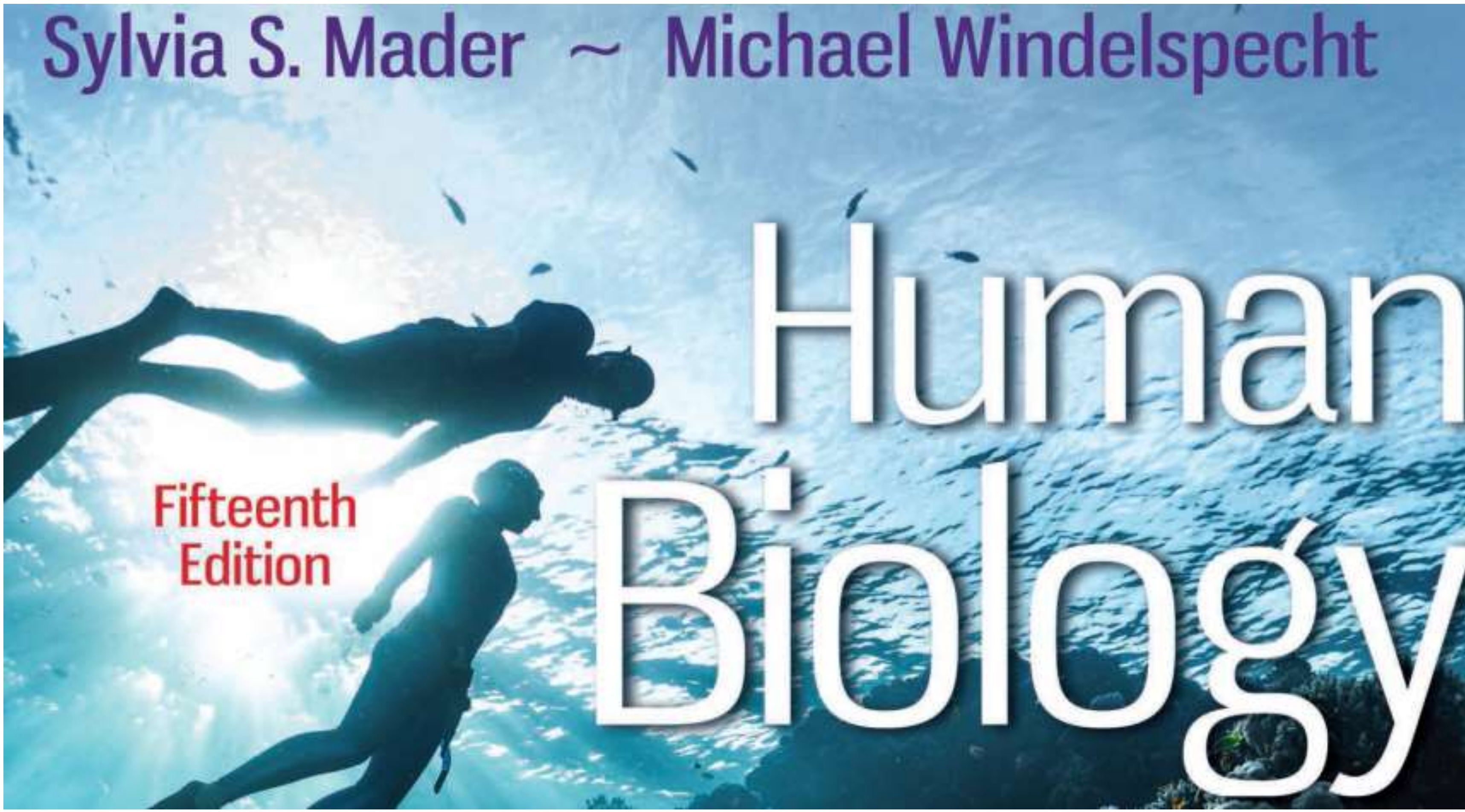
Title of the course: ***Human Biology***

Level: 1st Class, 1st Semester

Credit hours: **Theory 3 hours   Laboratory   1**

Reference text: ***Human Biology*** **sylvia S. Mader & Michael windelspecht,** ***Text Book of Human Biology*** **, Fifteen edition.**

Lecturer: Dr . Hadi Rasool Hassan.


Sylvia S. Mader ~ Michael Windelspecht
Human Biology
Fifteenth Edition

ت	التاريخ	عنوان المحاضره	عدد الساعات	
١		**Introduction of human biology Function** Exploring Life and Science . **1.1** The Characteristics of Life & Science as a Process . Chemistry of Life **2.1** From Atoms to Molecules **2.2** Water and Life **2.3** Molecules of Life **2.4** Carbohydrates . **2.5** Lipids 31 **2.6** Proteins 35 **2.7** Nucleic Acids 37	3 hours	
		Cell Structure and Function **3.1** What Is a Cell? **3.2** How Cells Are Organized **3.3** The Plasma Membrane and How Substances Cross It **3.4** The Nucleus and Endomembrane System **3.5** The Cytoskeleton, Cell Movement, and Cell junctions . **3.6** Metabolism and the Energy Reactions	3hours	
٣		Organization and Regulation of Body Systems .	3hours	

Objectives: Study the human body composition, definition of cell,types of cell structures, types of tissues, bone, skeleton, joints and muscle as well as the nutrition.

Human biology also explains in details the different body systems and human genetics.

At the end of the course. the student should be able to describe the human body composition, body systems structure and function, and human genetics, division of cell & chromosomes replication ,

(Lecture one)

(2017-2018)

Cellular Organization _Cell Structure and Function

12/11/2017

The cell:- **it is essential unit of life,** A single-celled organis exhibits the basi
aracteristics of life and that is able to reproduce and grow, such as the bacteria, a
single-celled, other organisms, including
humans and plants, are multicellular. In multicellular.

life did not generate spontaneously, *must be the new cells arise only* ***from preexisting ce***

uman the zygote is the first cell of a new multicellular organism. And after that somatic cells
replicate   by mitotic division .

The cell consider is a highly specialized and organized unit in the human body
nd the similar cells are often organized as tissues, **and organs and all organs consist th**
human body.

The cell contains : The cell contain organelles that carry out specific functions.
1• The plasma membrane : surrounded the cell contents and keep the cell intake & regulates the entrance and exit of molecules and ions into and out of the cell .

2• The nucleus, a centrally located organelle, controls the metabolic functioning and structural characteristics of the cell.
3• A system of membranous canals and vesicles works to produce, modify, store, transport, and digest macromolecules

4• Mitochondria are organelles concern with the conversion of glucose energy into ATP molecules.

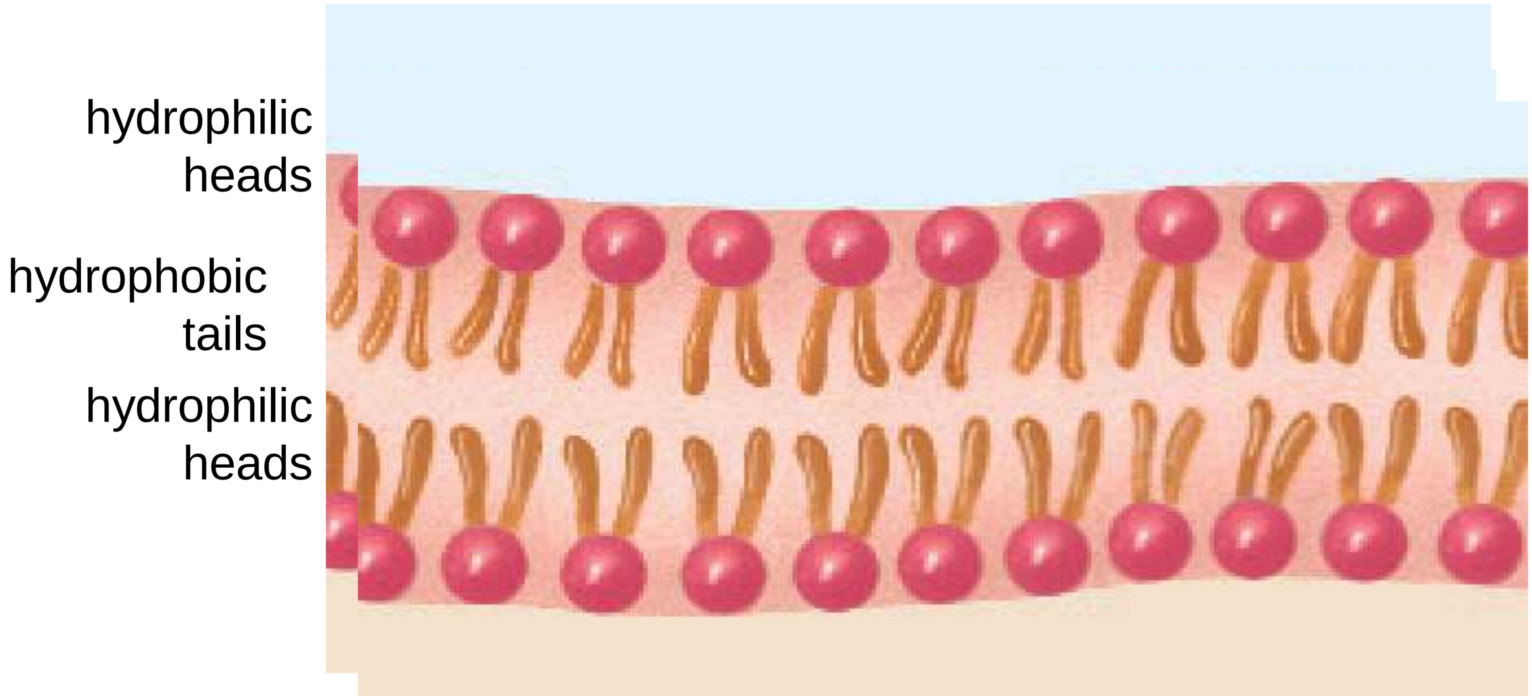
5. The cell has a cytoskeleton composed of microtubules and filaments; the cytoskeleton gives the cell a shape and allows it and its organelles to move.

The plasma membrane is a phospholipids bi layer with attached or embedded proteins.
The structure of a phospholipids is such that the molecule has a polar head and non polar tail (Fig. 1)
The polar heads, being charged, are hydrophilic (water loving) and face outward, toward the cytoplasm on one side and the tissue fluid on the other side.

The nonpolar tails are hydrophobic (not attracted to water) and face inward toward each other, where there is no water. The nonpolar tails are hydrophobic (not attracted to water) and face inward toward each other, where there is no water.

At body temperature, the phospholipids bilayer is a liquid; it has the consistency of olive oil, and the proteins are able to change their position by moving laterally.

The fluid-mosaic model, a working description of membrane structure



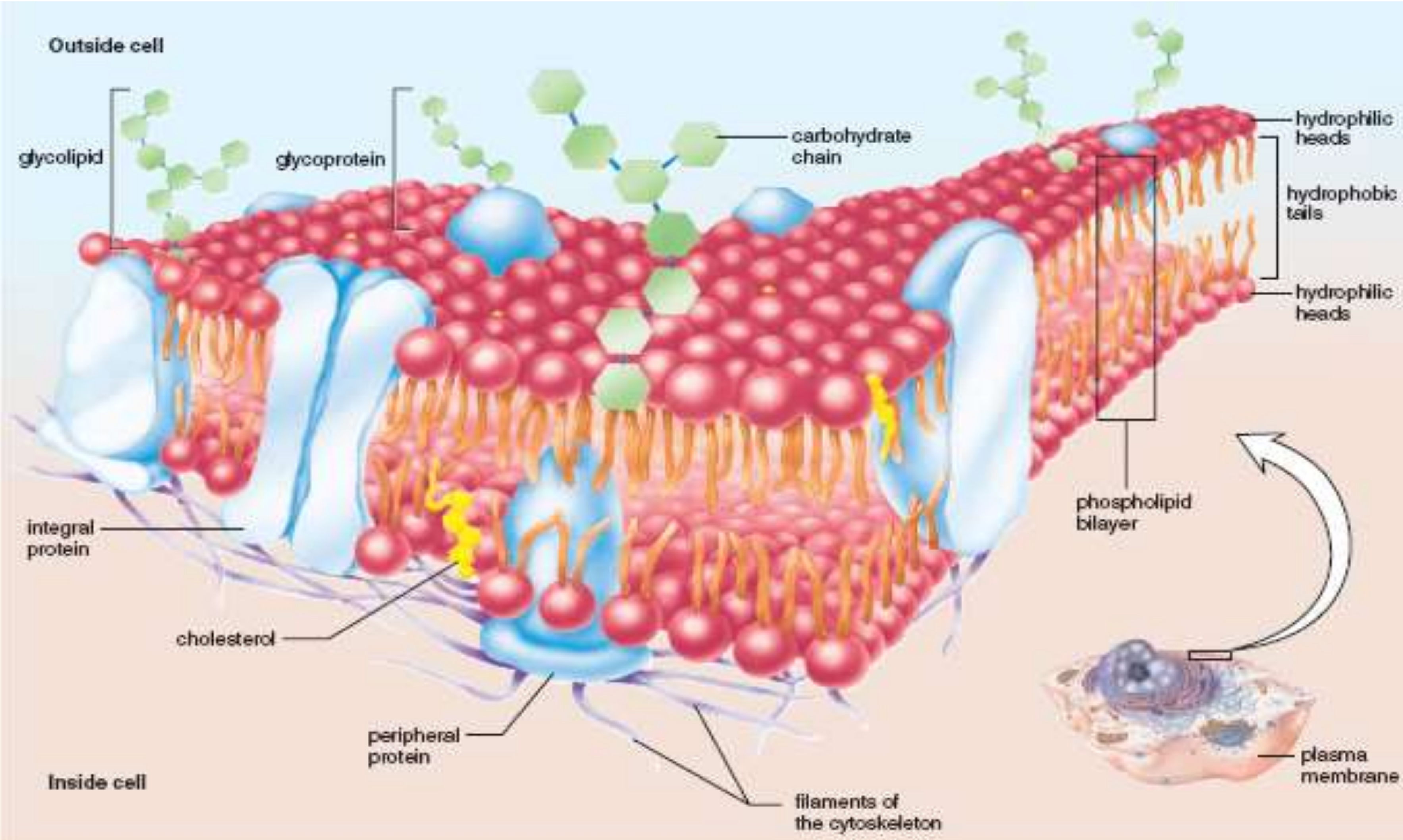


Figure 3.4 **Fluid-mosaic model of the plasma membrane.**
The membrane is composed of a phospholipid bilayer. The polar heads of the phospholipids are at the surfaces of the membrane; the nonpolar tails make up the interior of the membrane. Proteins are embedded in the membrane. Some of these function as receptors for chemical messengers, as conductors of molecules through the membrane, and as enzymes in metabolic reactions.

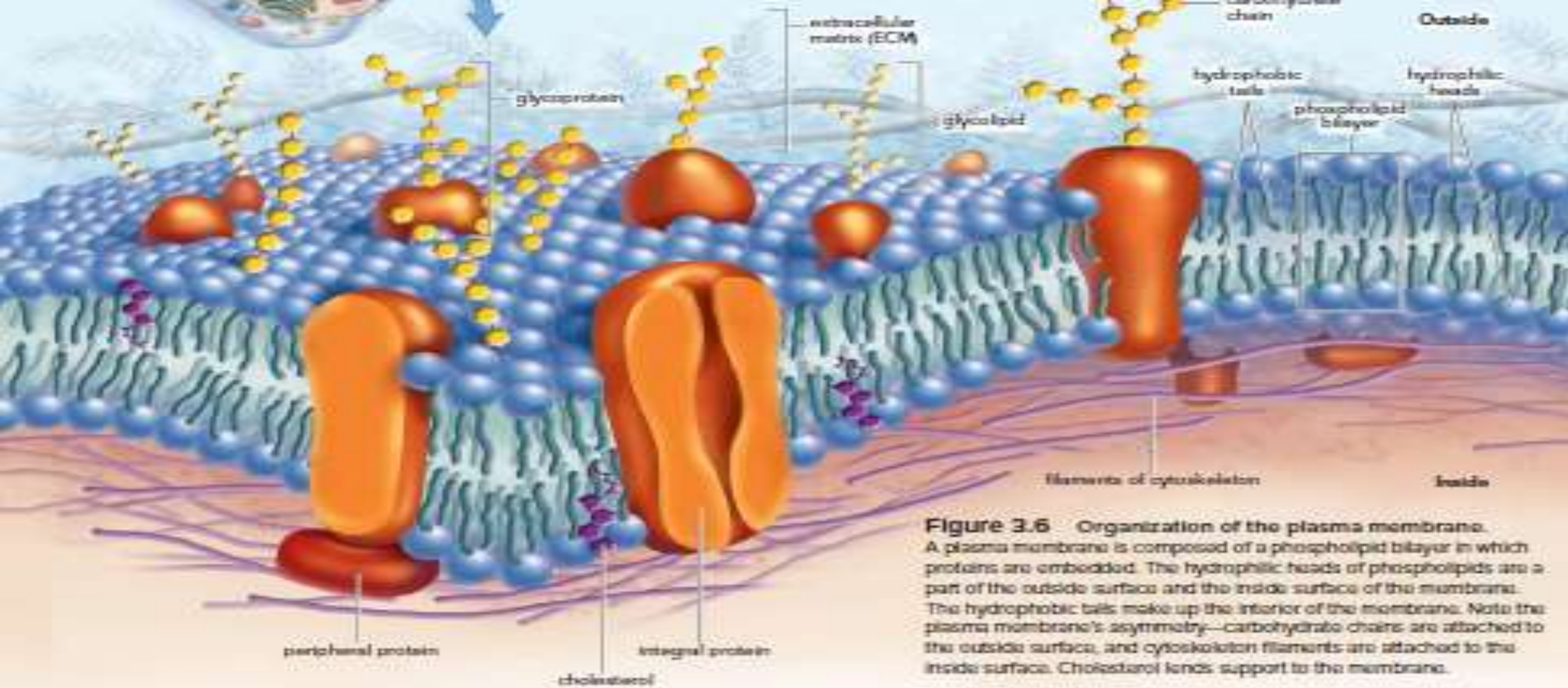


Figure 3.6 **Organization of the plasma membrane.** A plasma membrane is composed of a phospholipid bilayer in which proteins are embedded. The hydrophilic heads of phospholipids are a part of the outside surface and the inside surface of the membrane. The hydrophobic tails make up the interior of the membrane. Note the plasma membrane's asymmetry—carbohydrate chains are attached to the outside surface, and cytoskeleton filaments are attached to the inside surface. Cholesterol lends support to the membrane.

water enters the cells. They swell to bursting (Fig. 3.9*b*). *Lysis* is used to refer to the process of bursting cells. Bursting of red blood cells is termed *hemolysis*.

Solutions that cause cells to shrink or shrivel due to loss of water are said to be *hypertonic*. A hypertonic solution has a higher concentration of solute and a lower concentration of water than do the cells. If red blood cells are placed in a hypertonic solution, water leaves the cells; they shrink (Fig. 3.9*c*). The term *crenation* refers to red blood cells in this condition. These changes have occurred due to osmotic pressure. **Osmotic pressure** controls water movement in our bodies. For example, in the small

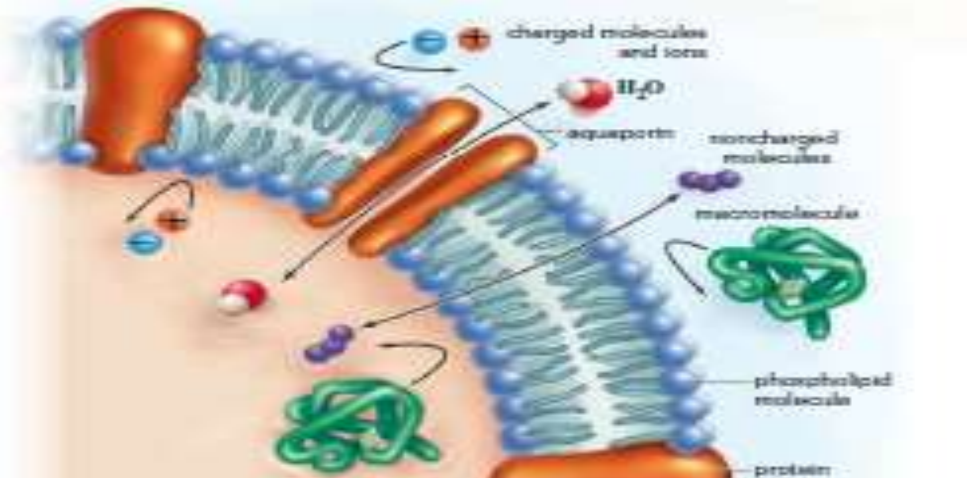


Figure 3.7 **Selective permeability of the plasma membrane.** Small, uncharged molecules are able to cross the membrane, whereas large or charged molecules cannot. Water travels freely across membranes through aquaporins.

says that

the protein molecules have a changing pattern form a mosaic within the fluid phospholipids bi layer (Fig. 1).

Cholesterol lends support to the membrane.

Short chains of sugars are attached to the outer surface of some protein and lipid molecules (called glycoprotein and glycolipids) respectively.
The Plasma Membrane in animal cell is: surrounded cell contents and boundary between the outside of the cell and the inside of the cell.
Plasma membrane integrity and function are necessary to the life of the cell.

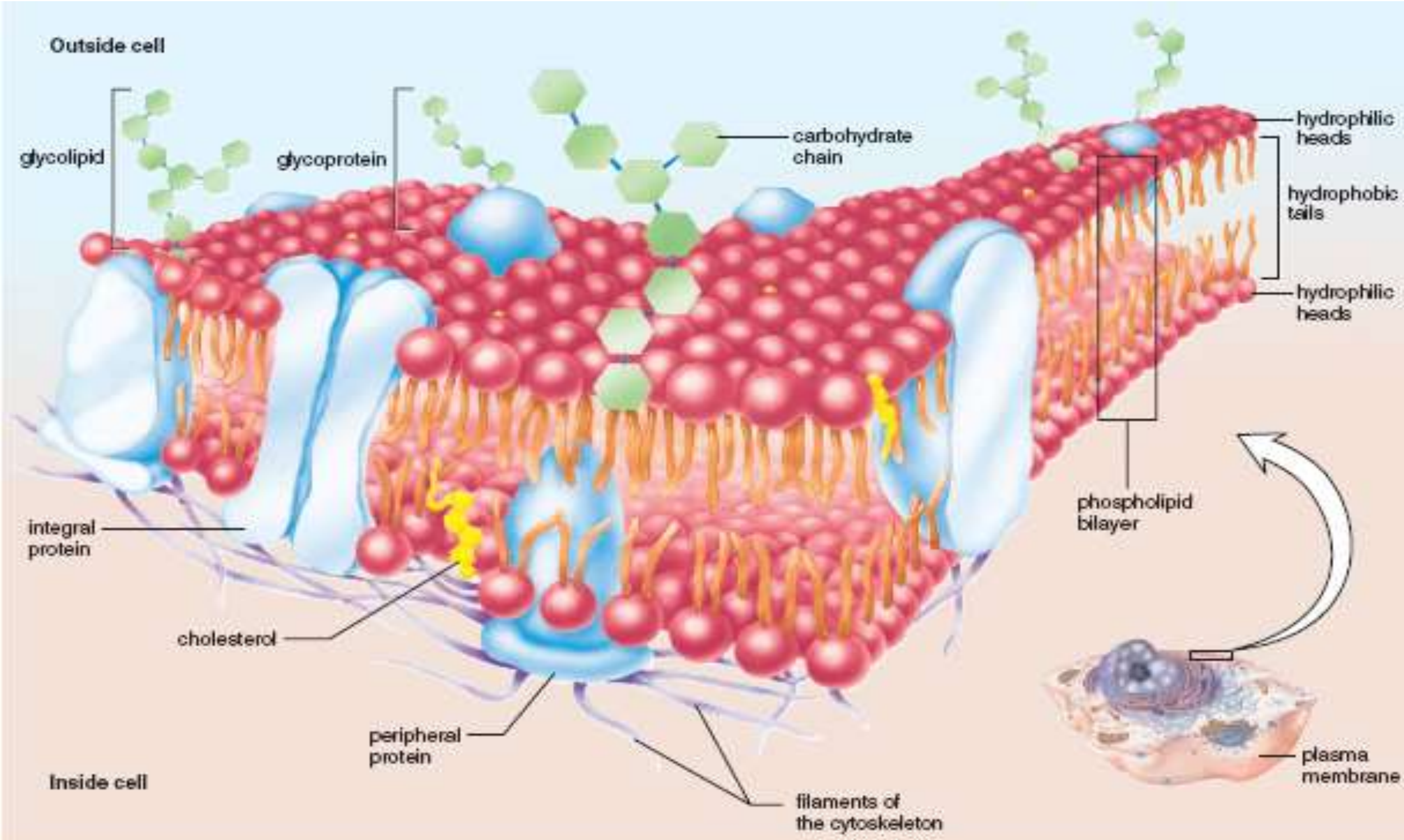


Figure 3.4 **Fluid-mosaic model of the plasma membrane.**
The membrane is composed of a phospholipid bilayer. The polar heads of the phospholipids are at the surfaces of the membrane; the nonpolar tails make up the interior of the membrane. Proteins are embedded in the membrane. Some of these function as receptors for chemical messengers, as conductors of molecules through the membrane, and as enzymes in metabolic reactions.

Plasma Membrane Functions

The plasma membrane keeps a cell intact. It allows only certain molecules and ions to enter and exit the cytoplasm freely; therefore, the plasma membrane is said to be selectively permeable.

Small molecules that are lipid soluble, such as oxygen and carbon dioxide, can pass through the membrane easily.

Certain other small molecules, like water, are not lipid soluble, but they still freely cross the membrane. Still other molecules and ions require the use of a carrier to enter a cell.

Table 3.2 Passage of Molecules into and out of Cells

	Name	Direction	Requirement	Examples
PASSIVE TRANSPORT	Diffusion	Toward lower concentration	Concentration gradient	Lipid-soluble molecules, water, and gases
	Facilitated Transport	Toward lower concentration	Carrier and concentration gradient	Sugars and amino acids
ACTIVE TRANSPORT	Active Transport	Toward greater concentration	Carrier plus energy ions	Sugars, amino acids, and
	Endocytosis	Toward inside	Vesicle formation	Macromolecules
	Exocytosis	Toward outside	Vesicle fuses with plasma membrane	Macromolecules

this is the mechanism by which oxygen enters cells and carbon dioxide exits cells.

As an example, consider the movement of oxygen from the alveoli (air sacs) of the lungs to blood in the lung capillaries. After inhalation the concentration of oxygen in the alveoli is higher than that in the blood;

When molecules simply diffuse down their concentration . gradients across plasma membranes, no cellular energy is involved . Gases can also diffuse through the lipid bi layer;

Osmosis

***is the diffusion of water across a plasma membrane*. It occurs whenever there is an unequal concentration of water on either side of a selectively permeable membrane. Normally, body fluids are isotonic to cells**

(there is an equal concentration of substances (solutes) and water (solvent) on both sides of the plasma membrane, and cells maintain their usual size and shape.

Intravenous solutions medically administered usually

have this tonicity

Tonicity is the degree to which a solution's concentration of solute versus water causes water to move into or out of cells.

Solutions that cause cells to swell or even to burst due to an intake of water are said to be hypotonic solutions. If red blood cells are placed in a hypotonic solution, which has a higher concentration of water (lower concentration of solute) than do the cells, water enters the cells and they swell to bursting. The term lyses is used to refer to disrupted cells; hemolysis, then, is disrupted red blood cells.

in Solutions that cause cells to shrink or loss of water are said to be hypertonic solutions. If red blood cells are placed in a hypertonic solution, which has a lower concentration of water (higher concentration of solute) than do the cells, water leaves the cells and they shrink. The term crenation refers to red blood cells in this condition

These changes have occurred due to osmoti pressure.

Osmotic pressure is the force exerted on a selectively permeable membrane because water has moved from the area of higher to lower concentration of water (higher concentration of solute).

Figure (4) Active transport through a membrane.
Active transport plasma allows a solute to cross the membrane from lower concentration to higher solute concentration.
① Molecule enters carrier
②Chemical energy of ATP is needed to transport the molecule which exits inside of cell, ③
Carrier returns to its inactive state.

Diffusion

It is the random movement of molecules from the area of higher concentration to the area of lower concentration until they are equally distributed.

The chemical and physical properties of the plasma membrane allow only a few types of molecules to enter and exit a cell simply by diffusion.

Lipid-soluble molecules such as alcohols and can diffuse through the membrane because lipids are the membrane's main structural components.

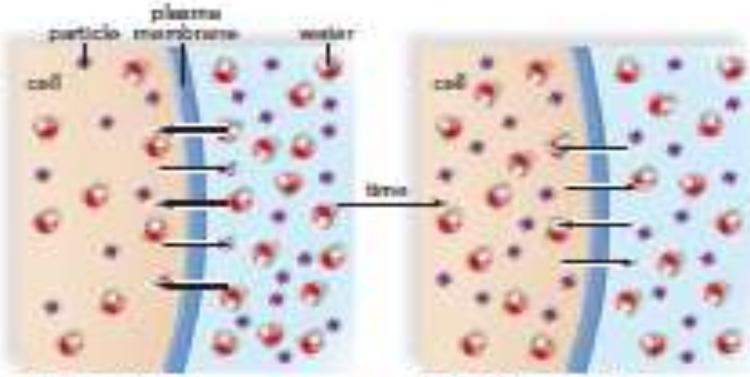


Figure 3.8 Diffusion across the plasma membrane.
a. When a substance can diffuse across the plasma membrane, it will move back and forth across the membrane, but the net movement will be toward the region of lower concentration. **b.** At equilibrium, equal numbers of particles and water have crossed in both directions, and there is no net movement.

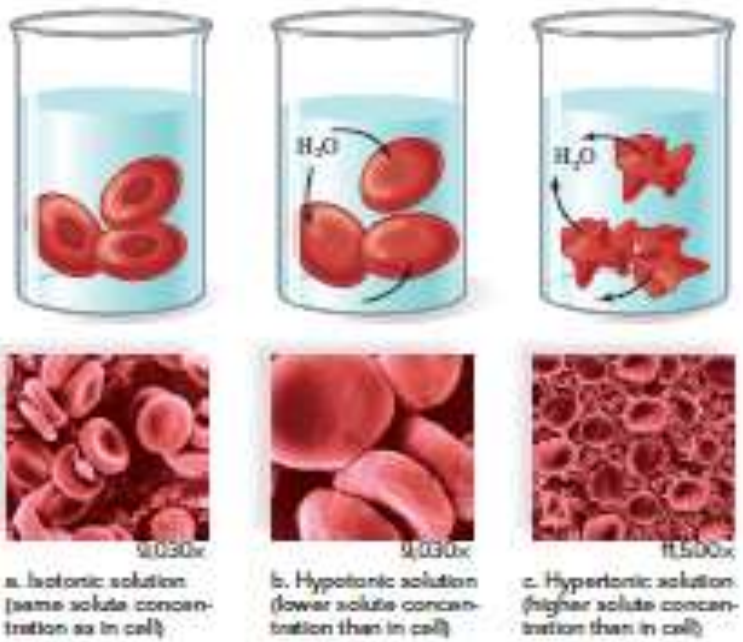


Figure 3.9 Effects of changes in tonicity on red blood cells.
a. In an isotonic solution, cells remain the same. **b.** In a hypotonic solution, cells gain water and may burst (lysis). **c.** In a hypertonic

SCIENCE IN YOUR LIFE

Can you drink seawater?

Seawater is hypertonic to our cells. Seawater contains approximately 3.5% salt, whereas our cells contain 0.9%. Once salt has entered the blood, your cells would shrivel up and die as they lost water trying to dilute the excess salt. Your kidneys can only produce urine that is slightly less salty than seawater, so you would dehydrate providing the amount of water necessary to rid your body of the salt. In addition, salt water contains high levels of magnesium ions, which cause diarrhea and further dehydration.

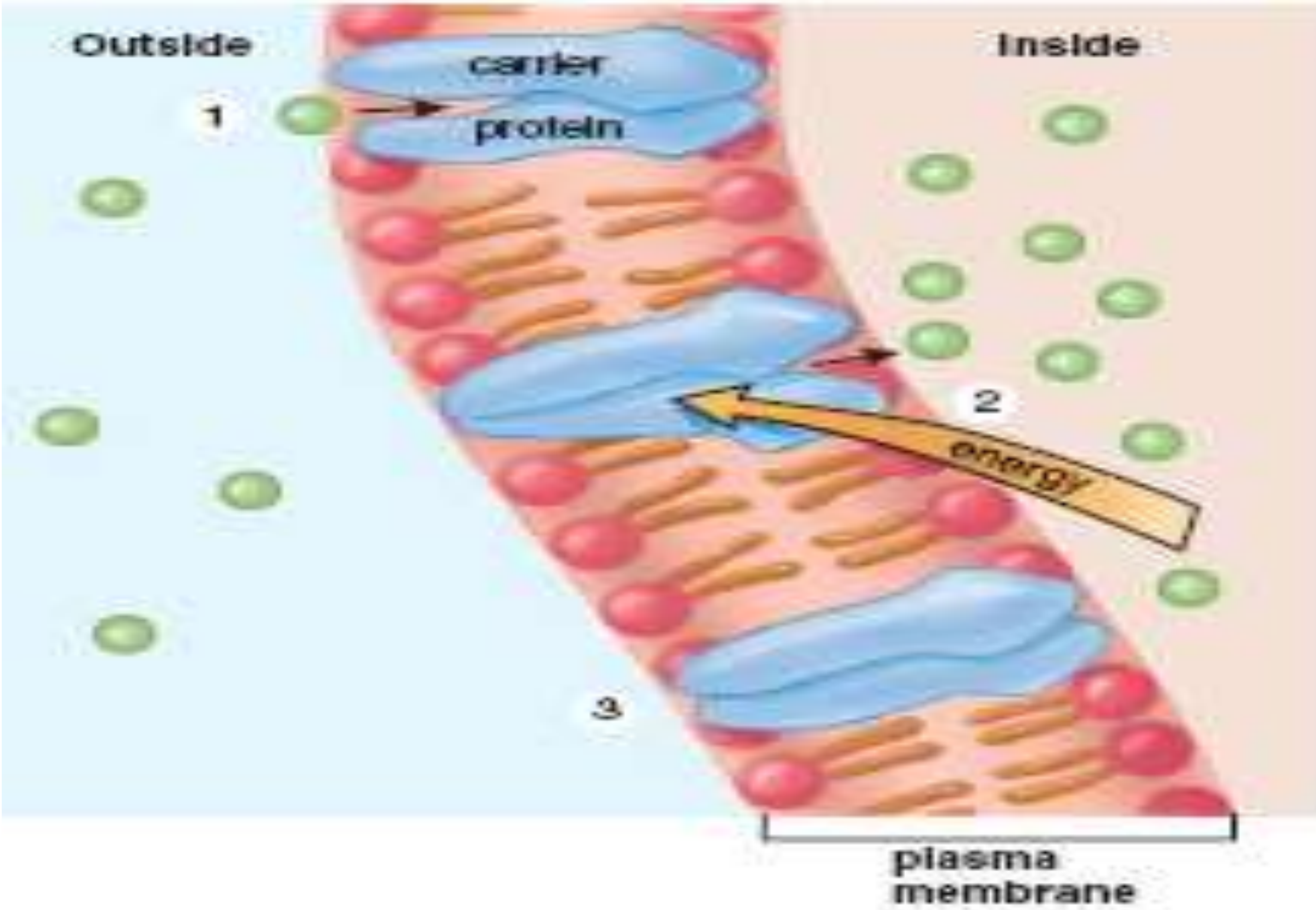
membrane. During **facilitated transport,** a molecule is transported across the plasma membrane from the side of higher concentration to the side of lower concentration (Fig. 3.10). This is a passive means of transport, because the cell does not need to expend energy to move a substance down its concentration gradient. Each protein carrier, sometimes called a *transporter,* binds only to a particular molecule, such as glucose. Type 2 diabetes results when cells lack a sufficient number of glucose transporters.

SCIENCE IN YOUR LIFE

What causes cystic fibrosis?

In 1989 scientists determined that defects in a gene on chromosome 7 are the cause of cystic fibrosis (CF). This gene, called *CFTR* (cystic fibrosis conductance transmembrane regulator), codes for a protein that is responsible for the movement of chloride ions across the membranes of cells that produce mucus, sweat, and saliva. Defects in this gene cause an improper water-salt balance in the excretions of these cells, which in turn leads to the symptoms of CF. To date there are over 1,800 known mutations in the CF gene. This tremendous amount of variation in this gene accounts for the differences in the severity of the disease in CF patients.

Figure 3.10 Facilitated transport across a plasma membrane.
This is a passive form of transport in which substances


Outside
Inside
carrier
protein
1
2
energy
3
plasma
membrane

Active transport requires a protein carrier and the use of cellular energy obtained from the breakdown of ATP. When ATP is broken down, energy is released, and in this case the energy is used by a carrier to carry out

Therefore, it is not surprising that cells involved in active transport, such as kidney cells, have a large number of mitochondria near the membrane at which active transport is occurring active transport..

One type of pump that is active in all cells but is especially associated with nerve and muscle cells moves sodium ions (Na^+) to the outside of the cell and potassium ions (K^+) to the inside of the cell.

First, sodium ions are pumped across a membrane; then, chloride ions simply diffuse through channels that allow their passage.

Active Transport

During **active transport,** a molecule is moving from an area of *lower* to an area of *higher* concentration. One example is the concentration of iodine ions in the cells of the thyroid gland. In the digestive tract, sugar is completely absorbed from the gut by cells that line the intestines. In another example, water homeostasis is maintained by the kidneys by the active transport of sodium ions (Na^+) by cells lining kidney tubules.

Active transport requires a protein carrier and the use of cellular energy obtained from the breakdown of ATP. When ATP is broken down, energy is released. In this case, the energy is used to carry out active transport. Proteins involved in active transport often are called *pumps.* Just as a water pump uses energy to move water against the force of gravity, energy is used to move substances against their concentration gradients. One type of pump active in all cells moves sodium ions (Na^+) to the outside and potassium ions (K^+) to the inside of the cell (Fig. 3.11). This type of pump is associated especially with nerve and muscle cells.

The passage of salt (NaCl) across a plasma membrane is of primary importance in cells. First sodium ions are pumped across a membrane. Then chloride ions diffuse through channels that allow their passage. In cystic fibrosis, a mutation in these chloride ion channels causes them to malfunction. This leads to the symptoms of this inherited (genetic) disorder.

Bulk Transport

Cells use bulk transport to move large molecules, such as polysaccharides or polypeptides, across the membrane. These processes use vesicles rather than channel or transport proteins. During *endocytosis,* a portion of the plasma membrane invaginates, or forms a pouch, to envelop a substance and fluid. Then the membrane pinches off to form an endocytic vesicle inside the cell (Fig. 3.12*a*). Some white blood cells are able to take up pathogens (disease-causing agents) by endocytosis. This process is given a special name: **phagocytosis.** Usually cells take up small molecules and fluid, and then the process is called *pinocytosis* (Fig. 3.12*b*).

During *exocytosis,* a vesicle fuses with the plasma membrane as secretion occurs. Later in this chapter we will see that a steady stream of vesicles moves between certain organelles, before finally

Figure 3.11 Active transport and the sodium-potassium pump. This is a form of transport in which a molecule moves from low concentration to high concentration. It requires a protein carrier and energy. Na^+ exits and K^+ enters the cell by active transport, so Na^+ will be concentrated outside and K^+ will be concentrated inside

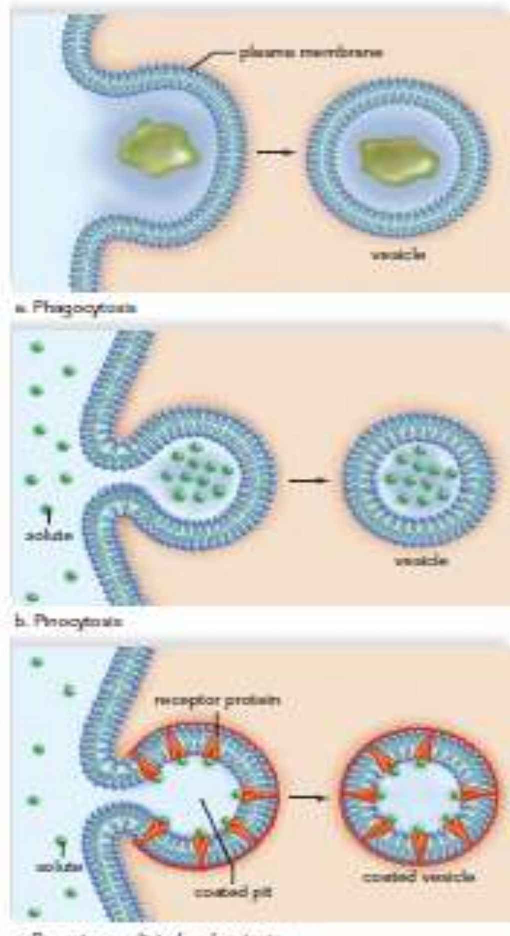
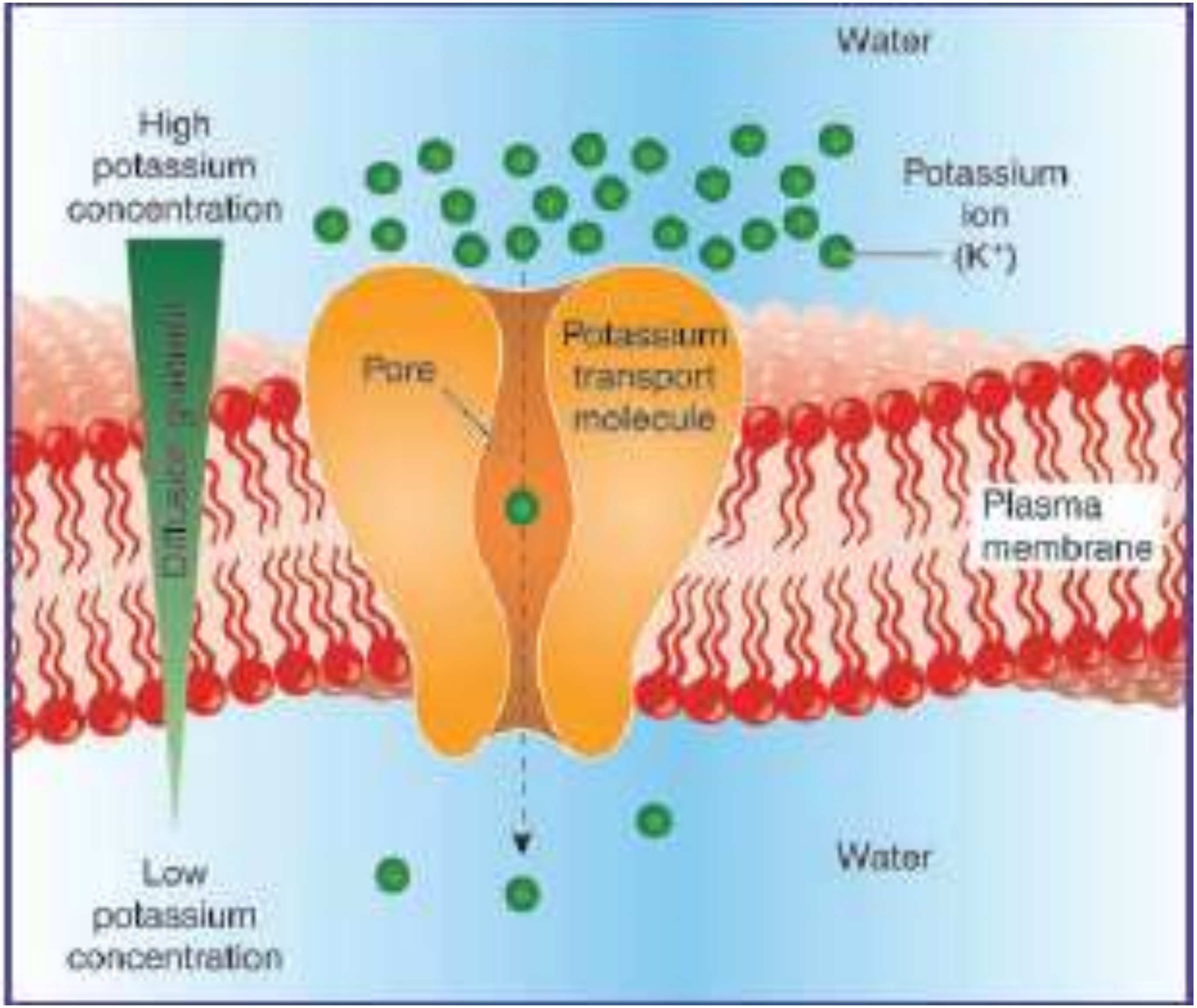
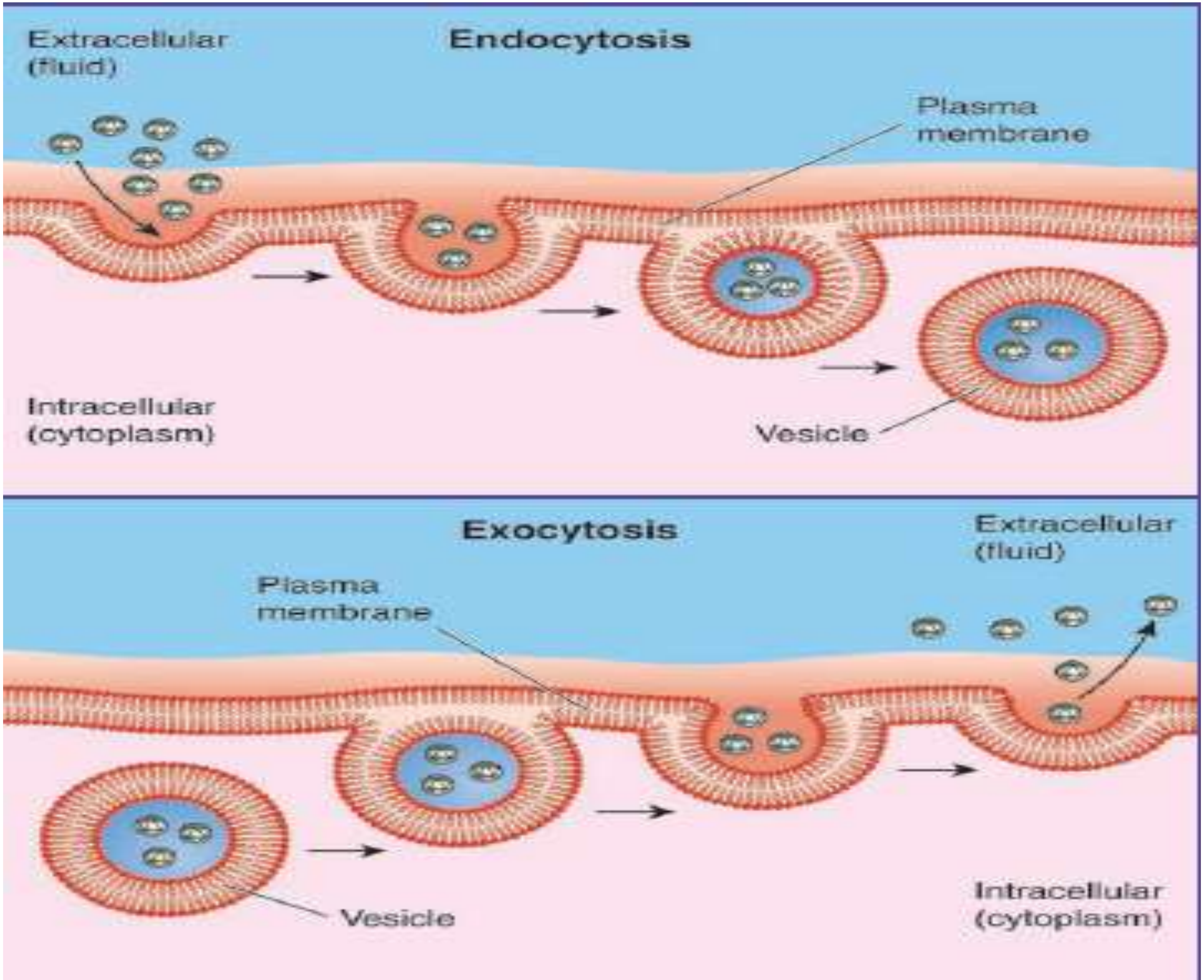


Figure 3.12 Examples of bulk transport.


Water
High
potassium
concentration
Potassium
ion
(K⁺)
Pore
Potassium
transport
molecule
Plasma
membrane
Water
Low
potassium
concentration

in the figure above Most water-soluble substances are unable to diffuse through a lipid bi layer (as shown here). However, small polar or charged particles (such as water and ions) can cross a cell membrane by diffusing through protein structures called *channels*, which form water-filled pores that traverse the width of a membrane.

This figure illustrates potassium ions diffusing through a potassium-permeable channel. Lipid-insoluble substances that are too large to permeate channel proteins (e.g., glucose and amino acids) may cross a cell membrane using protein *carrier* molecules in a process known as facilitated diffusion


Endocytosis
Extracellular
(fluid)
Plasma
membrane
Intracellular
(cytoplasm)
Vesicle
Exocytosis
Extracellular
(fluid)
Plasma
membrane
Vesicle
Intracellular
(cytoplasm)

THANK YOU

Will MEET IN NEW LECTURE

The Nucleus

The nucleus, which has a diameter of about 5μm, is a prominent structure in the eukaryotic cell.

The nucleus is primary importance because it stores genetic information that determines the characteristics of the body’s cells and their metabolic functioning.

he Nucleus:

Command Center for Cells

D YOU KNOW?

very cell type in the body contains a ucleus, with one notable exception. ature red blood cells lose their ucleus before entering the blood ream from bone marrow. As a onsequence, these anucleate cells annot synthesize proteins.

Therefore, circulating red blood cells do not have the ability to replace enzymes or structural parts that break down.
For this reason, they have a limited life span, approximately 3 to 4 months.
In contrast, some cells contain many nuclei, such as those in skeletal muscle and the liver. The presence of multiple nuclei usually indicates a relatively large mass of cytoplasm that must be regulated.

NUCLEAR ENVELOPE

Similar to mitochondria, nuclei are bound by a double membrane
barrier called the nuclear envelope (or *nuclear membrane*).
It consists of two lipid bilayer membranes in which numerous protein molecules are embedded. This envelope encloses the nucleo-plasm, the fluid portion of the nucleus. Like the cytoplasm, nucleo-plasm contains dissolved salts and nutrients.

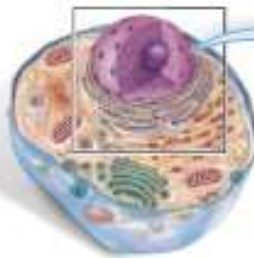
The outer layer of the nuclear envelope is continuous with rough ER and also is studded with numerous ribosome's.
The inner surface has attachment sites for protein filaments that maintain the shape of the nucleus and also anchor DNA molecules, helping to keep them organized. As with all cell membranes, the nuclear envelope keeps water-soluble substances from moving freely into and out of the nucleus. However, at various points, the two layers of membrane fuse together

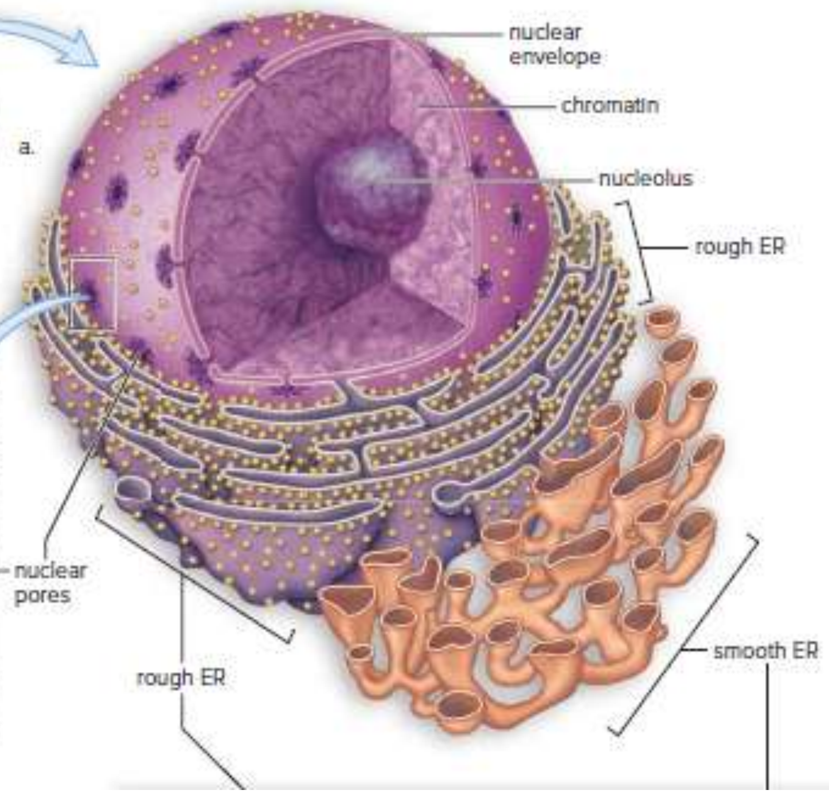
Nuclear pores, composed of clusters of proteins, are found at such regions and span the entire width of both layers.

These pores allow transport of ions and small, water-soluble substances, as well as regulate entry and exit of large particles, such as ribosomal subunits .

The nuclear envelope has nuclear pores of sufficient size (100 nm) to permit the passage of proteins into the nucleus and ribosomal

subunits out of the ribosomes





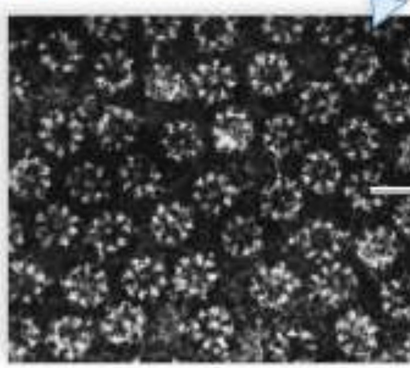


Figure 3.13 The nucleus and endoplasmic reticulum. **a.** The nucleus contains chromatin. Chromatin has a region called the nucleolus, where rRNA is produced and ribosome subunits are assembled. **b.** The nuclear envelope contains pores that allow substances to enter and exit the nucleus to and from the cytoplasm. **c.** The nuclear envelope is attached to the endoplasmic reticulum, which often has attached ribosomes, where protein synthesis occurs.

(b): © Don W. Fawcett/Science Source; (c): © Martin M. Rotker/Science Source

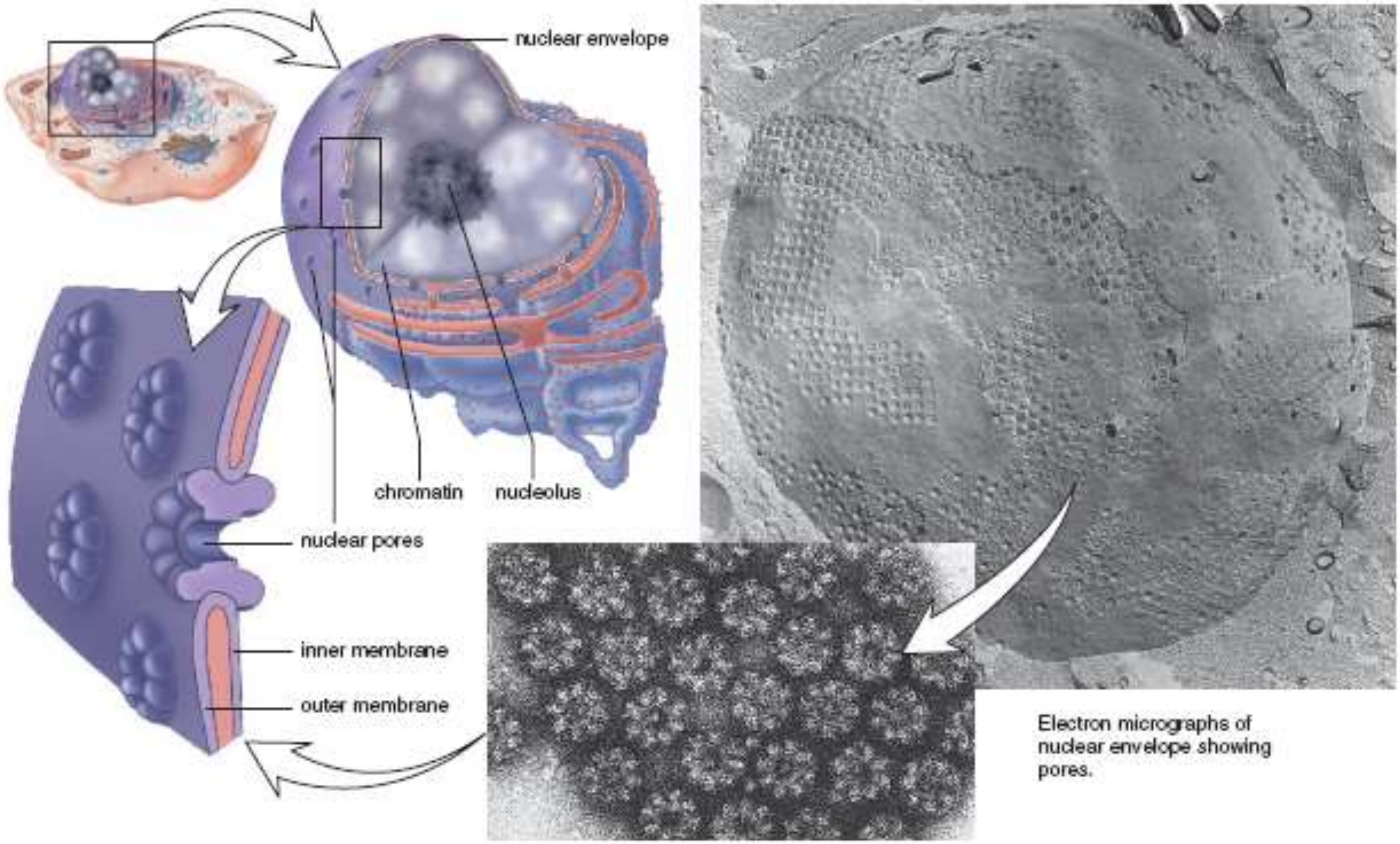
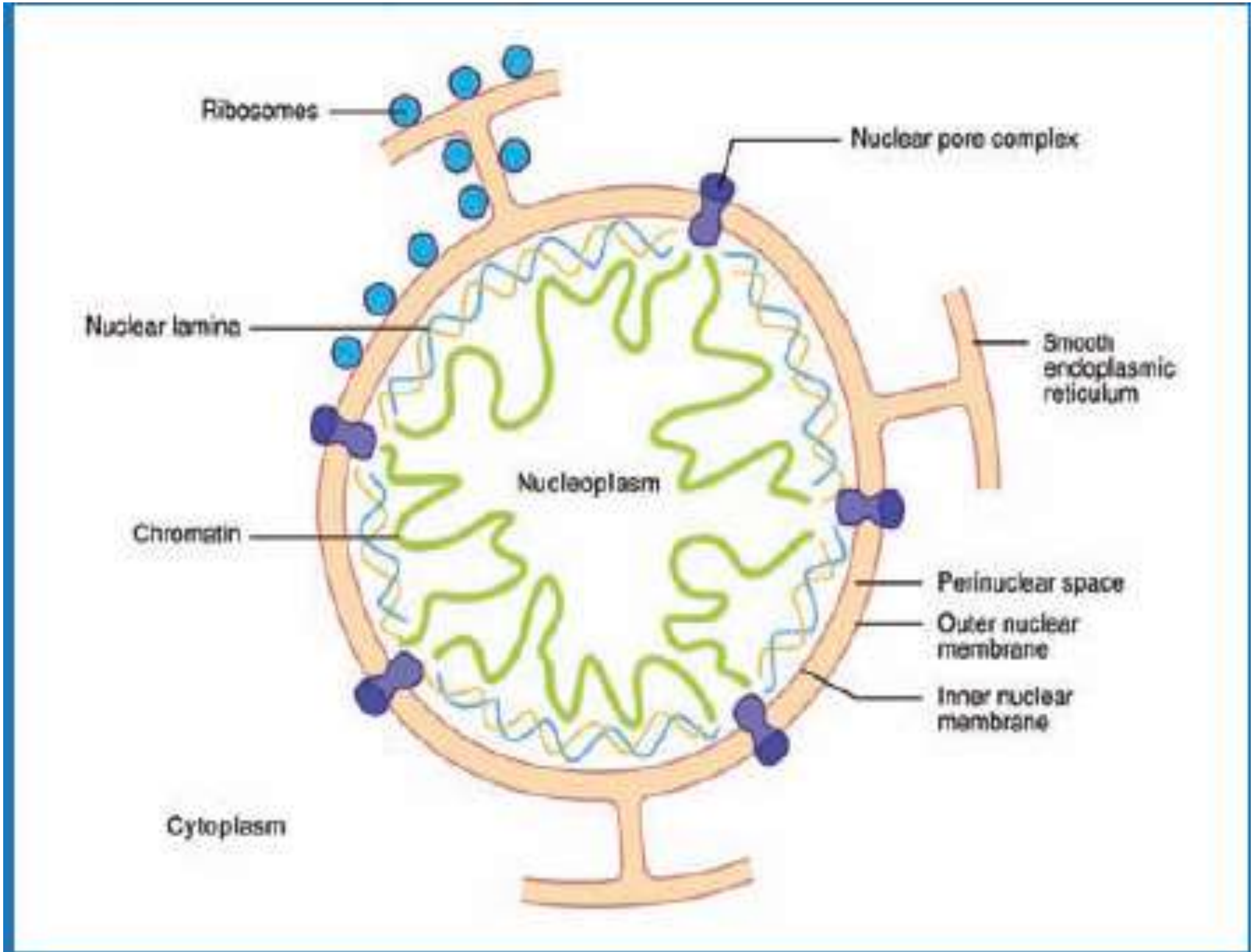


Figure 3.7 The nucleus and the nuclear envelope.
The nucleus contains chromatin. Chromatin has a special region called the nucleolus, which is where rRNA is produced and ribosomal subunits are assembled. The nuclear envelope contains pores, as shown in this micrograph of a freeze-fractured nuclear envelope. Each pore is lined by a complex of eight proteins.


Ribosomes
Nuclear pore complex
Nuclear lamina
Smooth endoplasmic reticulum
Nucleoplasm
Chromatin
Perinuclear space
Outer nuclear membrane
Inner nuclear membrane
Cytoplasm

NUCLEOLI

Each nucleus contains one or more nucleoli ("little nuclei"), small, non-membranous, dense bodies composed largely of RNA and protein. Nucleoli are the sites where ribosomal subunits are assembled. Accordingly, they are associated with specific regions of *chromatin* that contains DNA for synthesizing ribosomal RNA. Once ribosomal subunits are formed, they migrate to the cytoplasm through nuclear pores.

Every cell contains a complex copy of genetic information, but each cell type has certain genes, or segments of DNA, turned on, and others turned off

الى هنا

Activated DNA, with RNA acting as an intermediary, specifies the sequence of amino acids during protein synthesis. The proteins of a cell determine its structure and the functions it can perform.

When you look at the nucleus, even in an electron micrograph, you cannot see DNA molecules but you can see chromatin

Chromatin looks grainy, but actually it is a hreadlike material that undergoes coiling into ro ike structures called chromosomes just before t cell divides.

Chemical analysis shows that chromatin, and herefore chromosomes, contains DNA and muc protein, as well as some RNA.

Chromatin is immersed in a semi fluid medium called the nucleo-plasm.

A difference in pH between the nucleoplasm and the cytoplasm suggests that the nucleoplasm has a different composition. Most likely, too, when you look at an electron micrograph of a nucleus, you will see one or more regions that look darker than the rest of the chromatin

These are nucleoli (sing., nucleolus) where another type of RNA, called ribosomal RNA (rRNA), is produced and where rRNA joins with proteins to form the subunits of ribosomes.
(Ribosomes are small bodies in the cytoplasm that contain rRNA and proteins).The nucleus is separated from the cytoplasm by a double membrane known as the nuclear envelope, which is continuous with the endoplasmic reticulum .

Ribosomes

are composed of two subunits, one large and one small. Each subunit has its own mix of proteins and rRNA. Protein synthesis occurs at the ribosome's.

Ribosomes are found free within the cytoplasm either singly or in groups called polyribosomes

Ribosome's are often attached to the endoplasmic reticulum, a membranous system of saccules and channels discussed in the next section. Proteins synthesized by cyto-plasmic ribosome's are used inside the cell for various purposes.

Those produced by ribosome's attached to endoplasmic reticulum may eventually be secreted from the cell transport to anather cell like hormones.

3• A system of membranous canals and vesicles works to produce, store, modify, transport, and digest macromolecules

4• Mitochondria are organelles concern with the conversion of glucose energy into ATP molecules.

5. The cell has a cytoskeleton composed of microtubules and filaments; the cytoskeleton gives the cell a shape and allows it and its organelles to move.

Endoplasmic Reticulum

The cytomembrane system refers to a series of organelles (*endoplasmic reticulum*, *Golgi apparatus*, and *vesicles*)

That synthesize lipids and also modify new polypeptide chains into complete functional proteins. This system also sorts and ships its products to different locations within the cell

The cytomembrane system begins with the endoplasmic reticulum (ER), a complex organelle composed of membrane bound, flattened sacs and elongated canals that twist through the cytoplasm.
In fact, the ER accounts for about half of the total membrane of a cell

The ER is continuous with the membrane that surrounds the nucleus, and also interconnects and communicates with other organelles.
In this capacity, it serves as a micro "circulatory system" for the cell by providing a network of channels that carry substances from one region to another.
There are two distinct types of ER: rough ER and smooth ER. The rough ER has many ribosomes attached to its outer surface

This gives it a studded appearance when viewed with an electron microscope. In contrast, smooth ER lacks ribosome's. Rough ER has several functions

Its ribosome's synthesize all the proteins secreted from cells. Consequently, rough ER is especially abundant in cells that export proteins, such as white blood cells, which make antibodies, and pancreatic cells that produce digestive enzymes.

The newly synthesized polypeptides move directly from ribosomes into ER tubules, where they are further processed and modified.

For example, sugar groups may be added, forming *glycoproteins*. In addition, proteins may fold into complex, three-dimensional shapes

The rough ER then encloses newly synthesized proteins into vesicles, which pinch off and travel to the *Golgi apparatus*. The rough ER is also responsible for forming the constituents of cell membranes, such as integral proteins and phospholipids. Smooth ER is continuous with rough ER; however, it does not synthesize proteins. Instead, it manufactures certain lipid molecules, such as *steroid hormones* (i.e., testosterone and estrogen).

Golgi Apparatus

The Golgi apparatus appears as stacks of flattened membranous sacs Whereas the ER is the “factory” that produces products,

the Golgi is a “processing and transportation center.” Its enzymes put the finishing touches on newly synthesized proteins and lipids arriving from the rough ER. For example, sugar groups may be added or removed.

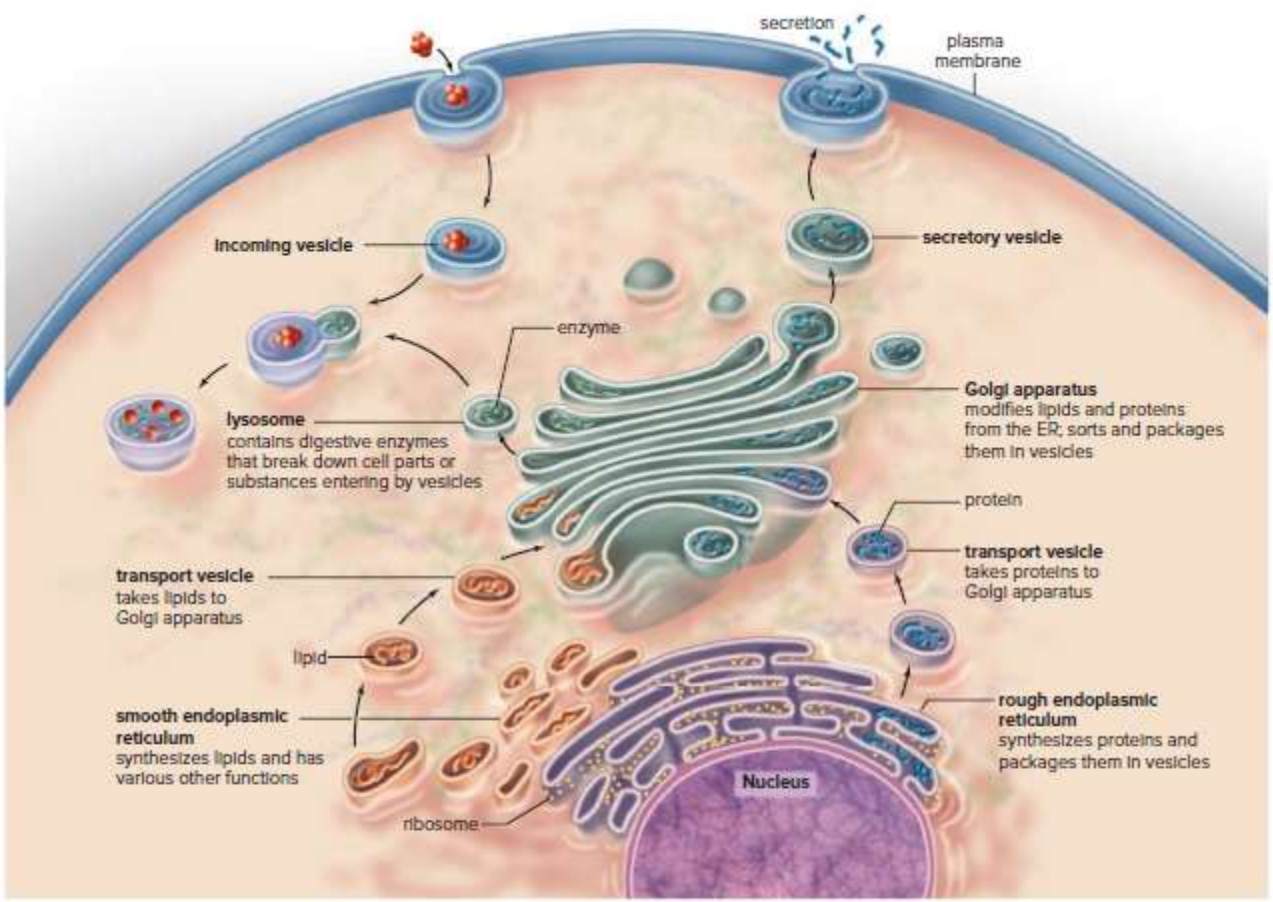


Figure 3.14 The endomembrane system.

The organelles in the endomembrane system work together to produce, modify, and secrete products for the cell. Some of these may be loaded into vesicles to produce lysosomes to digest incoming materials.

Phosphate groups also may be attached.

The Golgi apparatus then sorts out various products and packages them in vesicles for shipment to specific locations. Thus, like an assembly line, vesicles from the ER fuse with

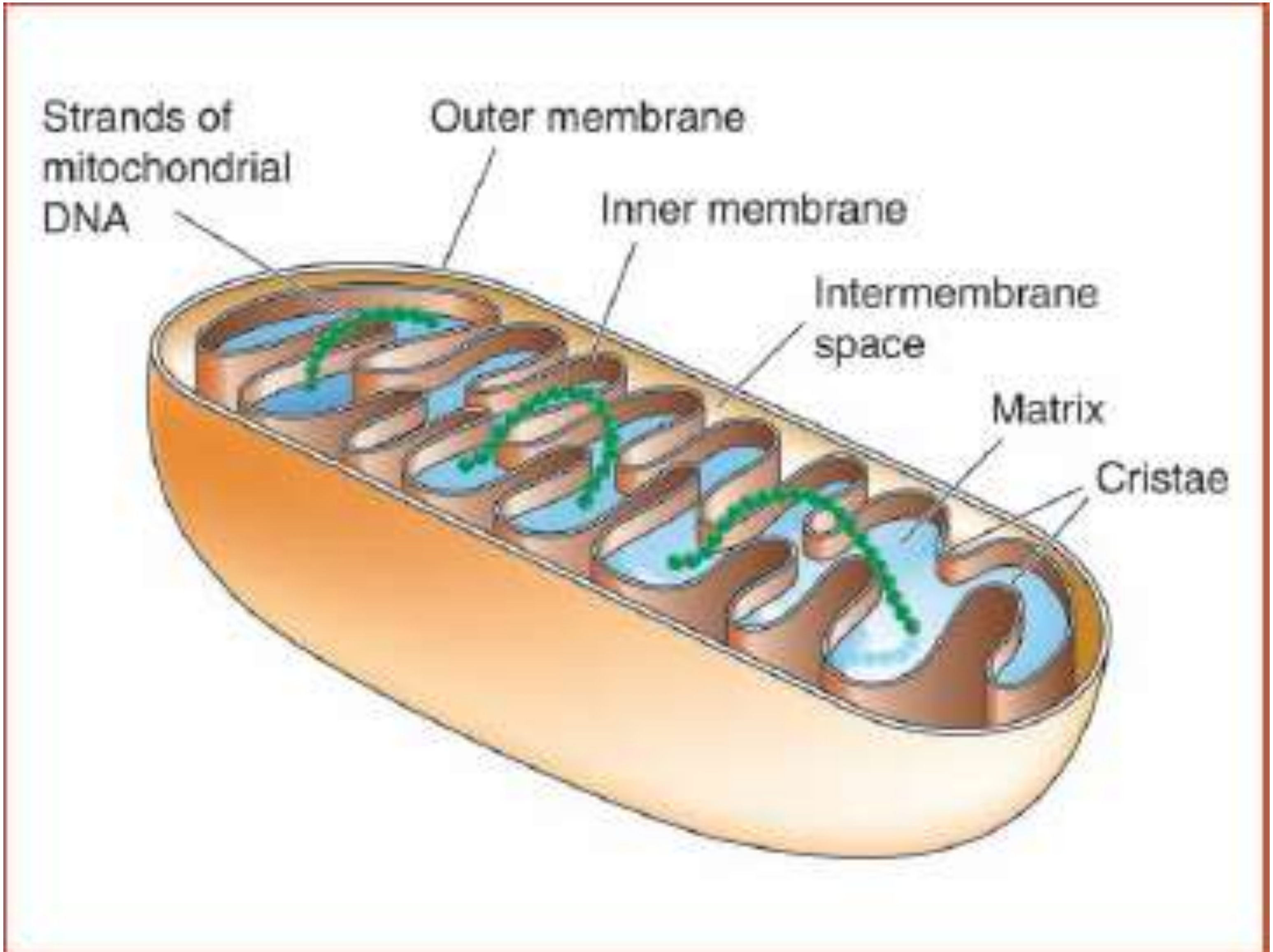
The Golgi apparatus on one side, and newly formed transport vesicles containing the finished product bud off the opposite side.

Some of these vesicles may fuse with the plasma membrane for subsequent exocytose of product. Alternatively, they may fuse with various organelles in the cytoplasm.

Mitochondria

appear as elongated, fluid-filled, sausage like sacs that vary in size and shape. Their wall consists of two separate cell membranes: a smooth outer membrane and an inner membrane that has a number of large folds called *cristae*, which increases its surface area. Some of the enzymes necessary to make ATP are physically part of the cristae (integral and peripheral membrane proteins).

Other enzymes are dissolved in the fluid within the *matrix* (the region enclosed by the inner membrane).
Cyanide gasis highly toxic because it blocks the production of ATP in mitochondri


Strands of mitochondrial DNA
Outer membrane
Inner membrane
Intermembrane space
Matrix
Cristae

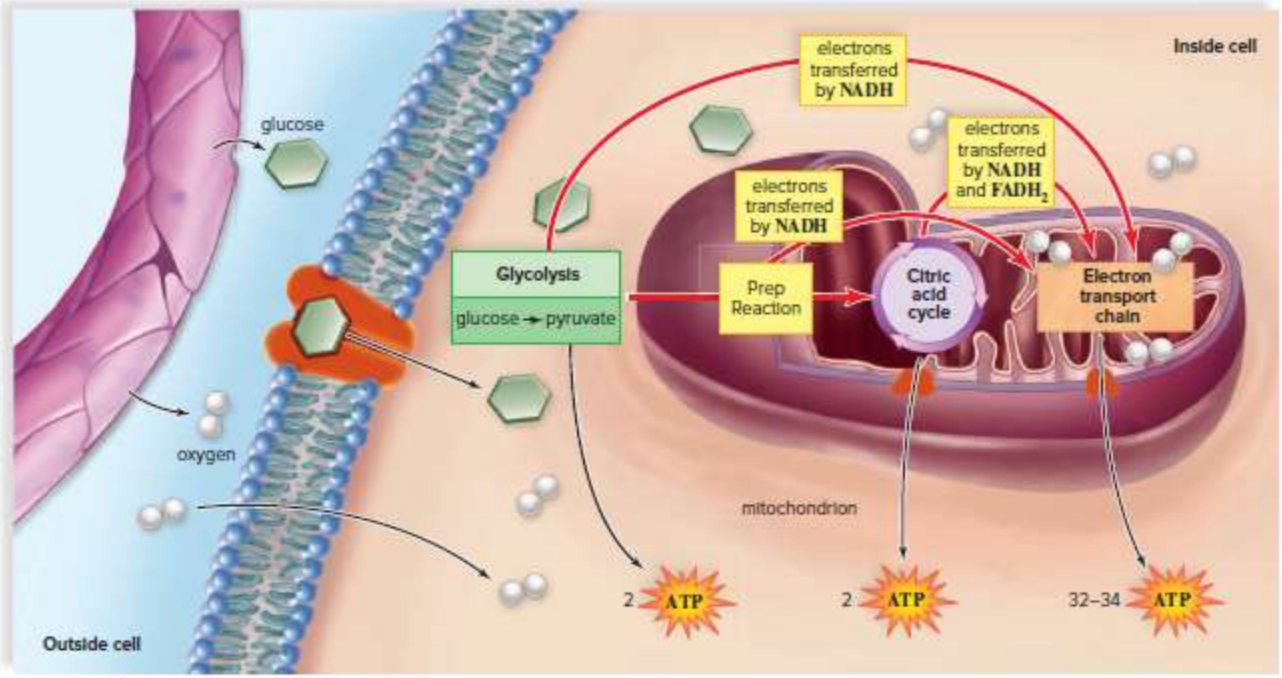
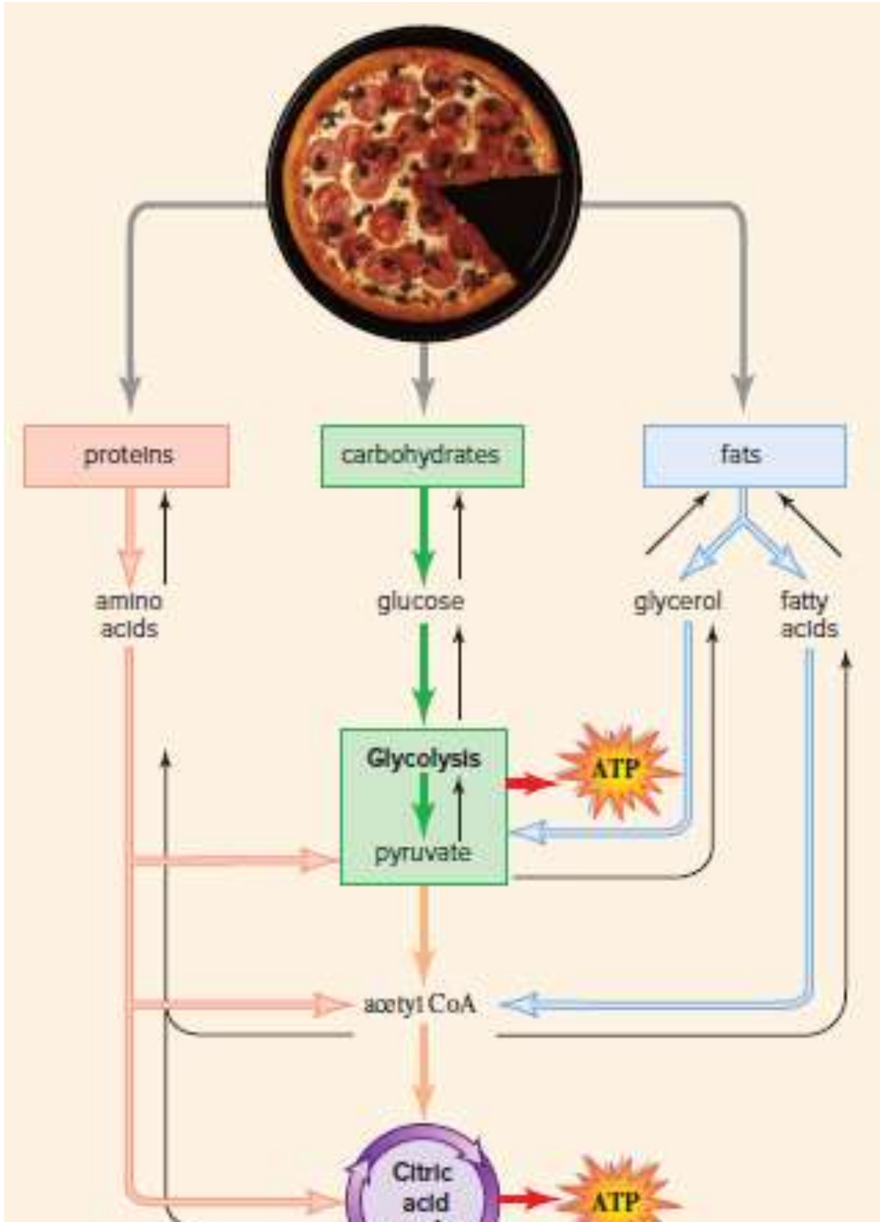


Figure 3.22 Production of ATP.

Glucose enters a cell from the bloodstream by facilitated transport. The three main pathways of cellular respiration (glycolysis, citric acid cycle, and electron transport chain) all produce ATP, but most is produced by the electron transport chain. NADH carries electrons to the electron transport chain from glycolysis and the citric acid cycle. ATP exits a mitochondrion by facilitated transport.



proteins
carbohydrates
fats
amino acids
glucose
glycerol
fatty acids
Glycolysis
pyruvate
ATP
acetyl CoA
Citric acid
ATP

Figure 4.2 The mitochondria are the cell’s energy-producing facilities. They supply the cell with the ATP needed to perform its functions. Mitochondria consist of two separate membranes. The inner membrane has many folds, called cristae, which increase the surface area and thus increase the amount of space where ATP can be produced. The matrix, the inner most portion of the mitochondria, is filled with an enzyme-rich fluid

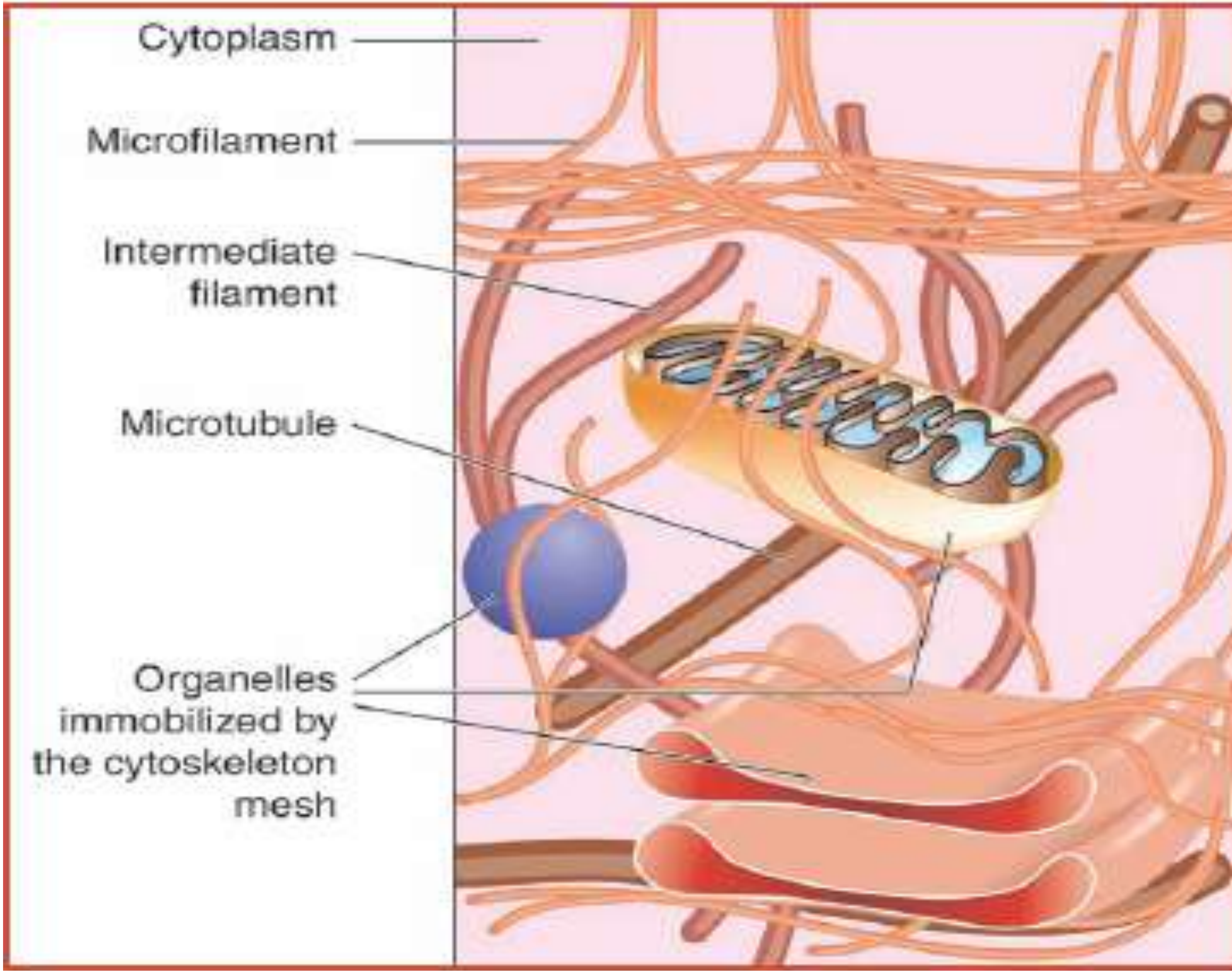
Cytoskeleton

Cells contain an elaborate network of protein structures throughout the cytoplasm called the cytoskeleton

These structures can be thought of as both the “bones” and “muscles” of cells, because they provide a physical framework that determines cell shape, reinforce the plasma membrane and nuclear envelope, and act as scaffolds for membrane and cytoplasmic proteins

They also are used for intracellular transport and for various types of cell movements. Many of these elements are permanent. However, some only appear at certain times in a cell cycle. For example, before cell division occurs, *spindle fibers* form, which are used to separate chromosomes and distribute them to each of the newly formed daughter cells.

They are primarily composed of the protein *actin*. Microfilaments
are involved with cell motility and in producing changes in cell shape.
The most stable of the cytoskeletal elements are the rope-like intermediate filaments that mechanically strengthen and help maintain the shape cells and their parts. In some cases, they can be thought of as internal “wires” that resist pulling forces.

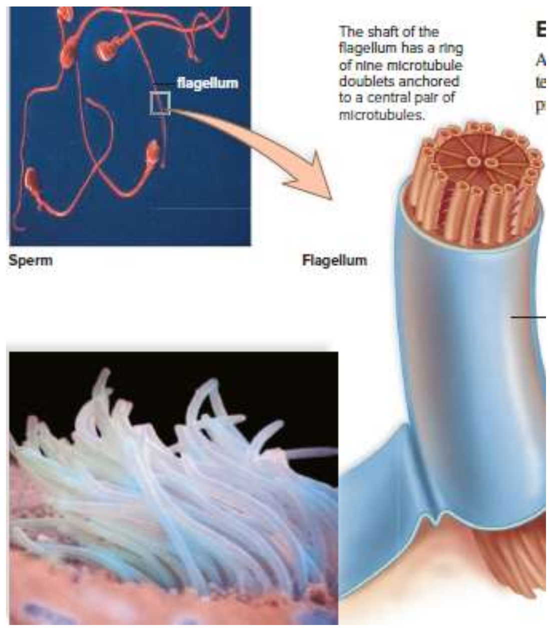

Cytoplasm
Microfilament
Intermediate filament
Microtubule
Organelles immobilized by the cytoskeleton mesh

the figure is a diagrammatic view of cytoskeletal elements. Microfilaments are strands composed of the protein actin and are involved with cell motility and changes in cell shape. Intermediate filaments are tough protein fibers, constructed like woven ropes, and act as internal wires to resist pulling forces on the cell. Microtubules are hollow tubes made of the protein tubulin. They help determine overall cell shape and the distribution of cellular organelles.

Centrioles, Cilia, and Flagella

They are primarily made of microtubules. Centrioles are important in cell reproduction by working with spindle fibers to distribute chromosomes.

In some cells, centrioles also may give rise to extensions called cilia and flagella. Cilia occur in precise patterns and rows on a cell surface, displaying coordinated



Sperm

Flagellum

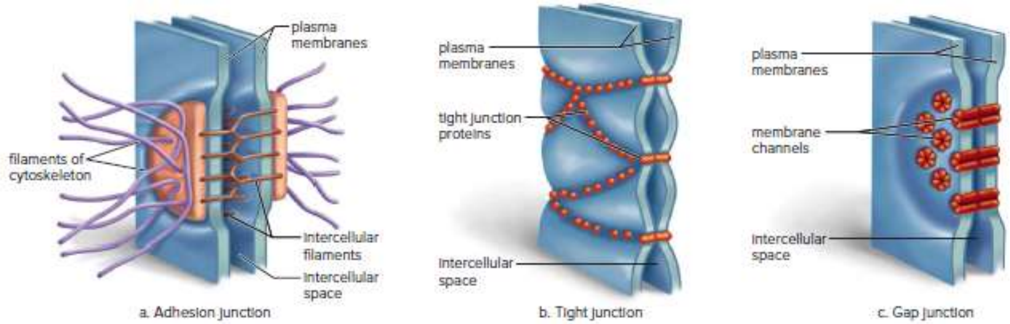


Figure 3.17 **Junctions between cells.**
a. Adhesion junctions mechanically connect cells. **b.** Tight junctions form barriers with the external environment. **c.** Gap junctions allow for communication between cells.

HOME WORKE

1. Describe the structure and biochemical makeup of a plasma membrane. 46

2. What are three mechanisms by which substances enter and exit cells? Define isotonic, hypertonic, and hypotonic solutions. 47

3. Describe the nucleus and its contents, including the terms DNAand RNA in your description. 49

4. Describe the structure and function of endoplasmic reticulum. Include the terms rough and smooth ER and ribosomes in your description. 50

5. Describe the structure and function of the Golgi apparatus and its relationship to vesicles and lysosomes. 50–51

6. Describe the structure of mitochondria, and relate this structure to the pathways of cellular respiration. 52–53

- 7. Describe the composition of the cytoskeleton. 53
- 8. Describe the structure and function of centrioles, cilia, and flagella. 53–54
- 9. Discuss and draw a diagram for a metabolic pathway.
- 10-Discuss and give a reaction to describe the specificity theory of enzymatic action.
- 11-Define coenzyme that make up cellular respiration e
- .12- Why is fermentation necessary but potentially harmful to the human ?

THANK YOU

Will MEET IN NEW LECTURE