University of Karbala

College of Pharmacy

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: ***Johnks and Lnglis (eds.), Text Book of Human Biology, 3rd Ed.***

Lecturer: Dr . Hadi Rasool Hassan.

Objectives: Study the human body composition, 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 such as the Mendelian inheritance, division of chromosomes,

ت	التاريخ	عنوان المحاضره	عدد الساعات	
١		**Cellular Organization- Cell Structure and Introduction of human biology Function**	3 hours	
٢		**Type of Tissue 1-epithelial tissue 2- connective tissue 3- muscular tissue**	3hours	
٣		**Type of Tissue 4- nervous tissue,** Cells and Tissues of Immune System	hours 3	
٤		**Digestive system**(Mouth, Esophagus, Stomach &intestine)	3 hours	
٥		**Cardiovascular & Blood circulation – System**	3 hours	
٦		**respiratory system & Excretory system**	**3 hours**	
٧		Cell cycle & Human genetics	**3 hours**	
8		Reproductive System	3 hours	

(Lecture one)

(2014-2015)

Cellular Organization

_Cell Structure and Function

16/11/2014

cell:- it is essential unit in the human organs and it is
organized unit .

ell contains : The cell contain organelles that carry out
ic functions.

plasma membrane regulates the entrance and exit of
ules and ions into and out of the cell .

nucleus, a centrally located organelle, controls the metabolic
oning and structural characteristics of the cell.

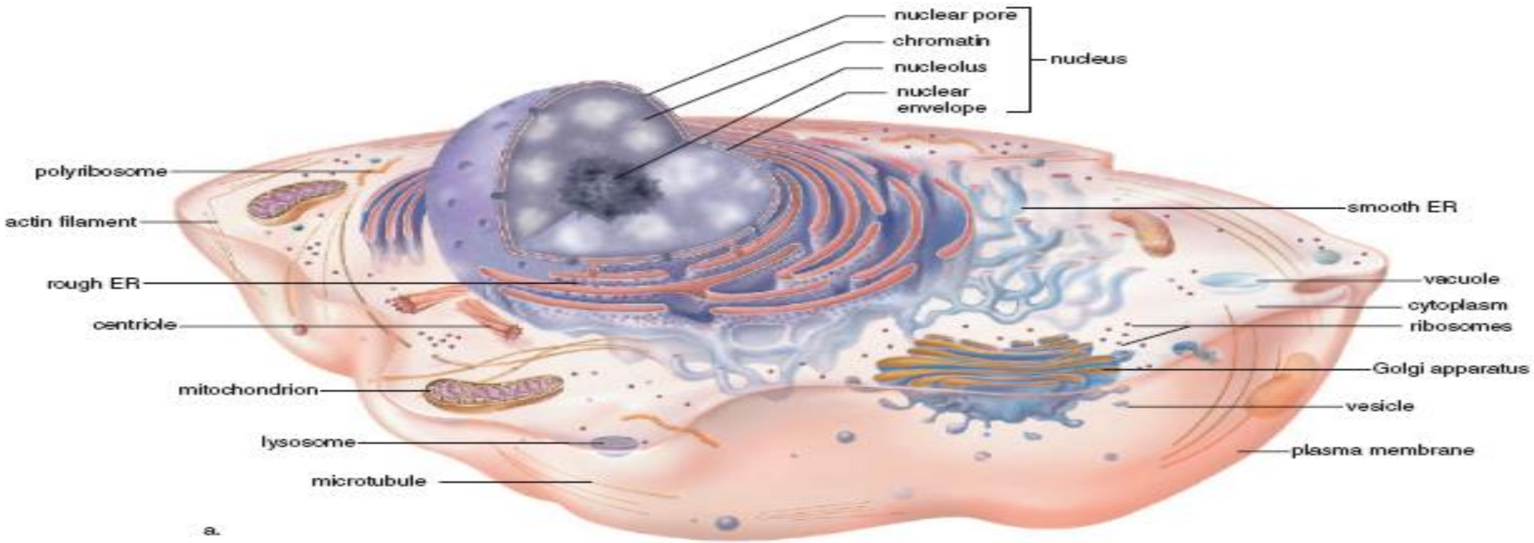
3• A system of membranous canals and vesicles works to produce, store, modify, transport, and digest macromolecules

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

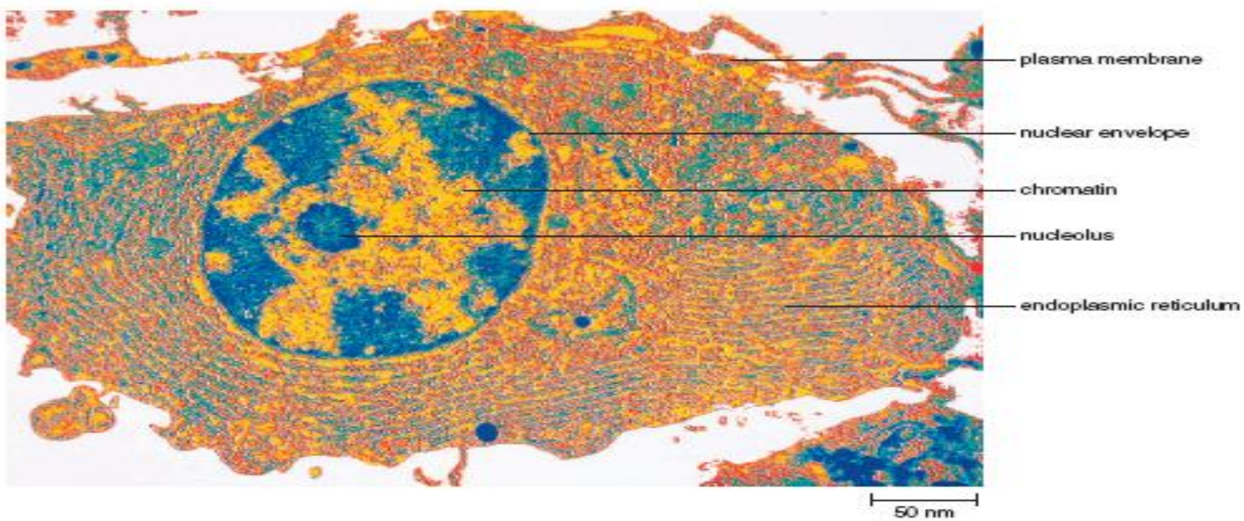
5. The cell has a cytoskeleton composed of microtubules and filaments; the cytoskeleton gives the cell a shape and allows it and its organelles to move.

Table 3.1 Structures in Animal Cells

Name	Composition	Function
Plasma membrane	Phospholipid bilayer with embedded proteins	Selective passage of molecules into and out of cell
Nucleus	Nuclear envelope surrounding nucleoplasm, chromatin, and nucleolus	Storage of genetic information
Nucleolus	Concentrated area of chromatin, RNA, and proteins	Ribosomal formation
Ribosome	Protein and RNA in two subunits	Protein synthesis
Endoplasmic reticulum (ER)	Membranous saccules and canals	Synthesis and/or modification of proteins and other substances, and transport by vesicle formation
Rough ER	Studded with ribosomes	Protein synthesis
Smooth ER	Having no ribosomes	Various; lipid synthesis in some cells
Golgi apparatus	Stack of membranous saccules	Processing, packaging, and distributing molecules
Vacuole and vesicle	Membranous sacs	Storage and transport of substances
Lysosome	Membranous vesicle containing digestive enzymes	Intracellular digestion
Mitochondrion	Inner membrane (cristae) within outer membrane	Cellular respiration
Cytoskeleton	Microtubules, actin filaments	Shape of cell and movement of its parts
Cilia and flagella	9 + 2 pattern of microtubules	Movement of cell
Centriole	9 + 0 pattern of microtubules	Formation of basal bodies



a.



b.

Figure 3.3 Animal cell.
a. Generalized drawing. b. Transmission electron micrograph. SeeTable 3.1 for a description of these structures, along with a listing of their functions.

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

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

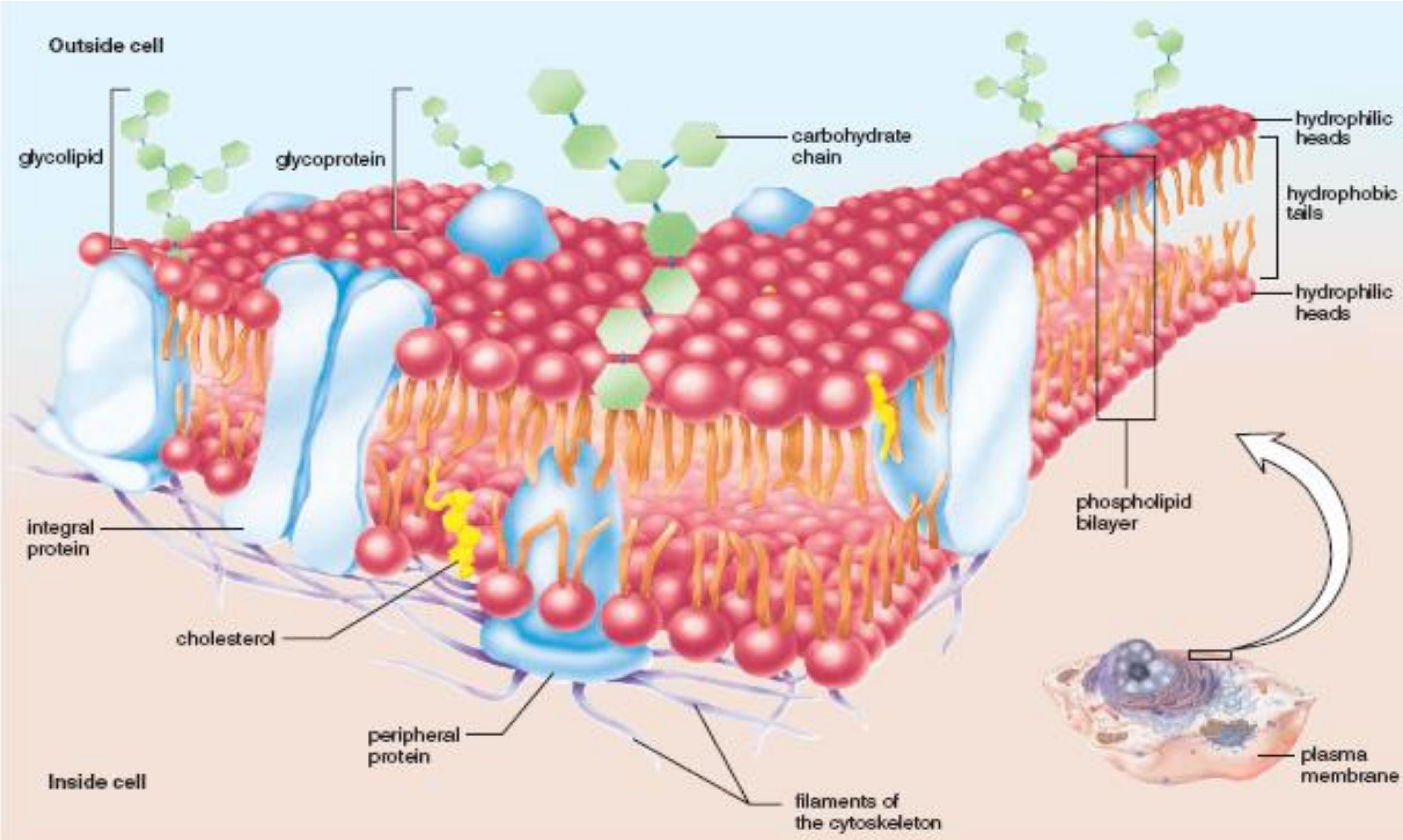


Figure 3.4 **Fluid-mosaic model of the plasma membrane.**
The membrane is composed of a phospholipid bilayer. The polar heads of the phospholipids are at the surfaces of the membrane; the nonpolar tails make up the interior of the membrane. Proteins are embedded in the membrane. Some of these function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

says that

the protein molecules have a changing pattern form a mosaic within the fluid phospholipids bilayer (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 glyco-lipids, respectively

It is believed

that these carbohydrate chains, specific to each cell, help mark it as belonging to a particular individual.

They account for why people have different blood types, for example

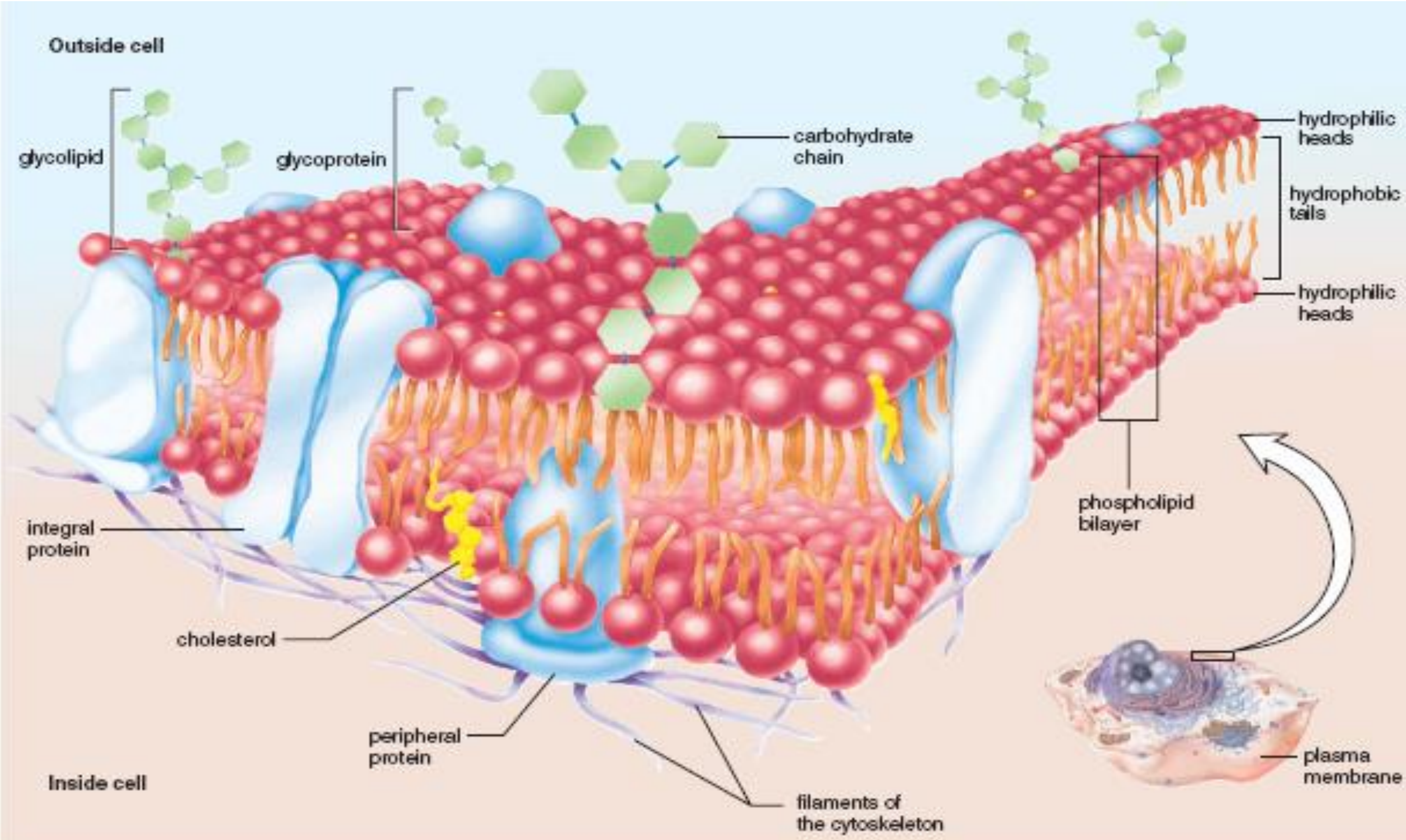


Figure 3.4 **Fluid-mosaic model of the plasma membrane.**

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.

The Plasma Membrane in animal cell is surrounded by an outer plasma membrane.

Plasma membrane marks the 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.

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	Sugars, amino acids, and ions
	Endocytosis	Toward inside	Vesicle formation	Macromolecules
	Exocytosis	Toward outside	Vesicle fuses with plasma membrane	Macromolecules

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.

Gases can also diffuse through the lipid bi layer; 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 (breathing in), the concentration of oxygen in the alveoli is higher than that in the blood; therefore, oxygen diffuses into the blood.

When molecules simply diffuse down their concentration. gradients across plasma membranes, no cellular energy is involved.

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.

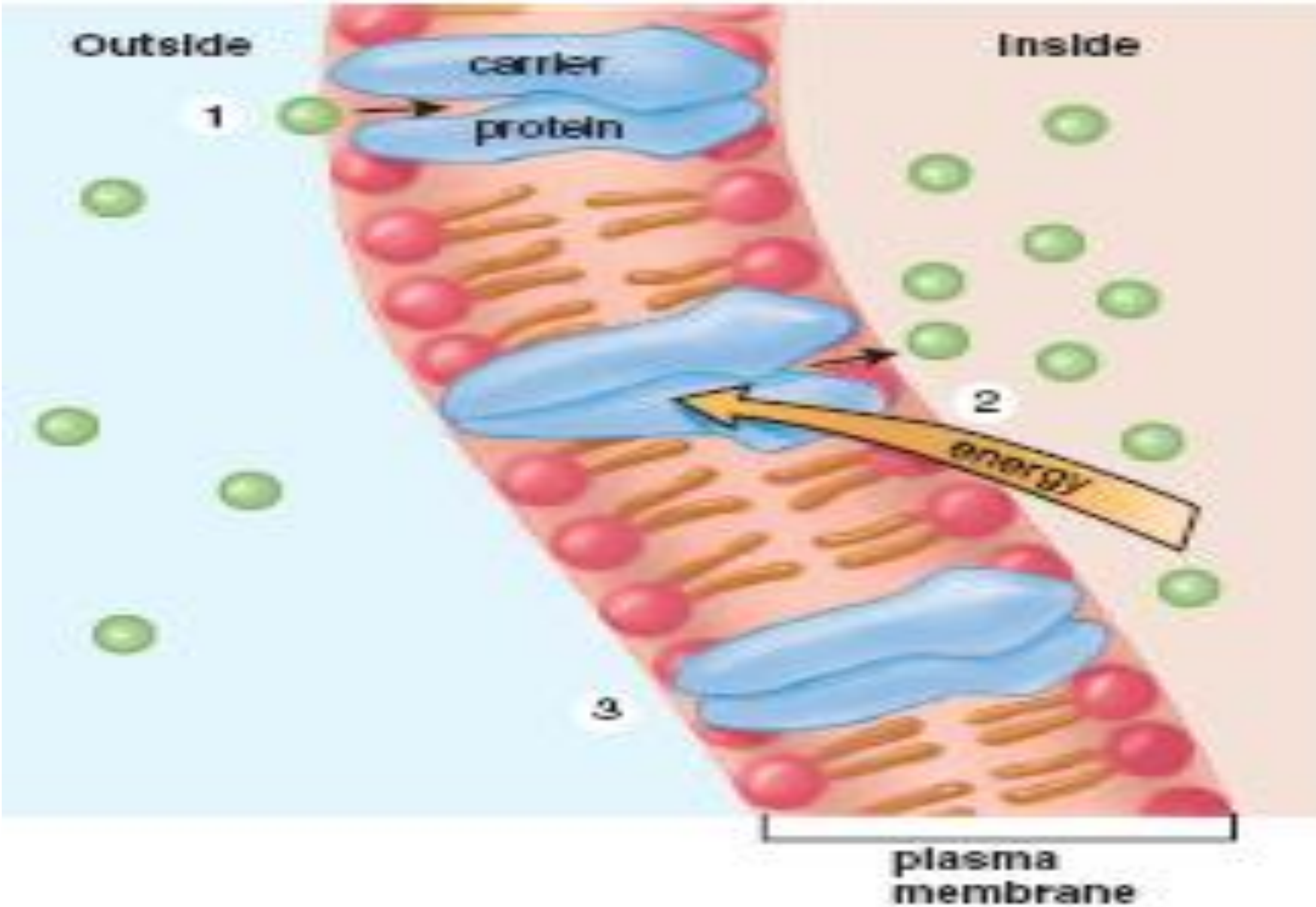
Solutions that cause cells to swell or even to burst due to an intake of water are said to be hypotonic solutions. If red blood cells are placed in a hypotonic solution, which has a higher concentration of water (lower concentration of solute) than do the cells, water enters the cells and they swell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

The term lyses is used to refer to disrupted cells; hemolysis, then, is disrupted red blood cells.
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.

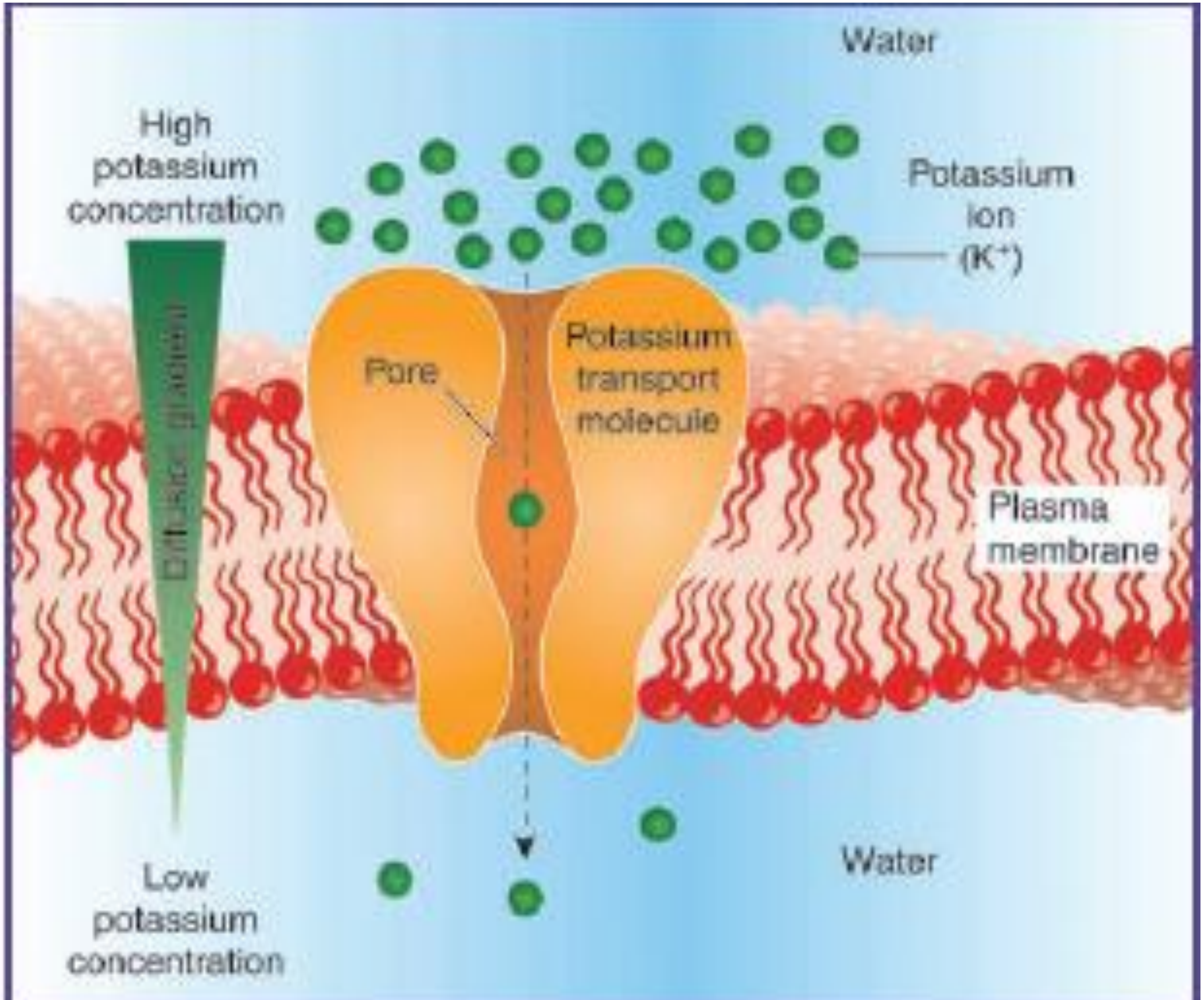

Outside
Inside
carrier
protein
1
2
energy
3
plasma
membrane

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 active transport..

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

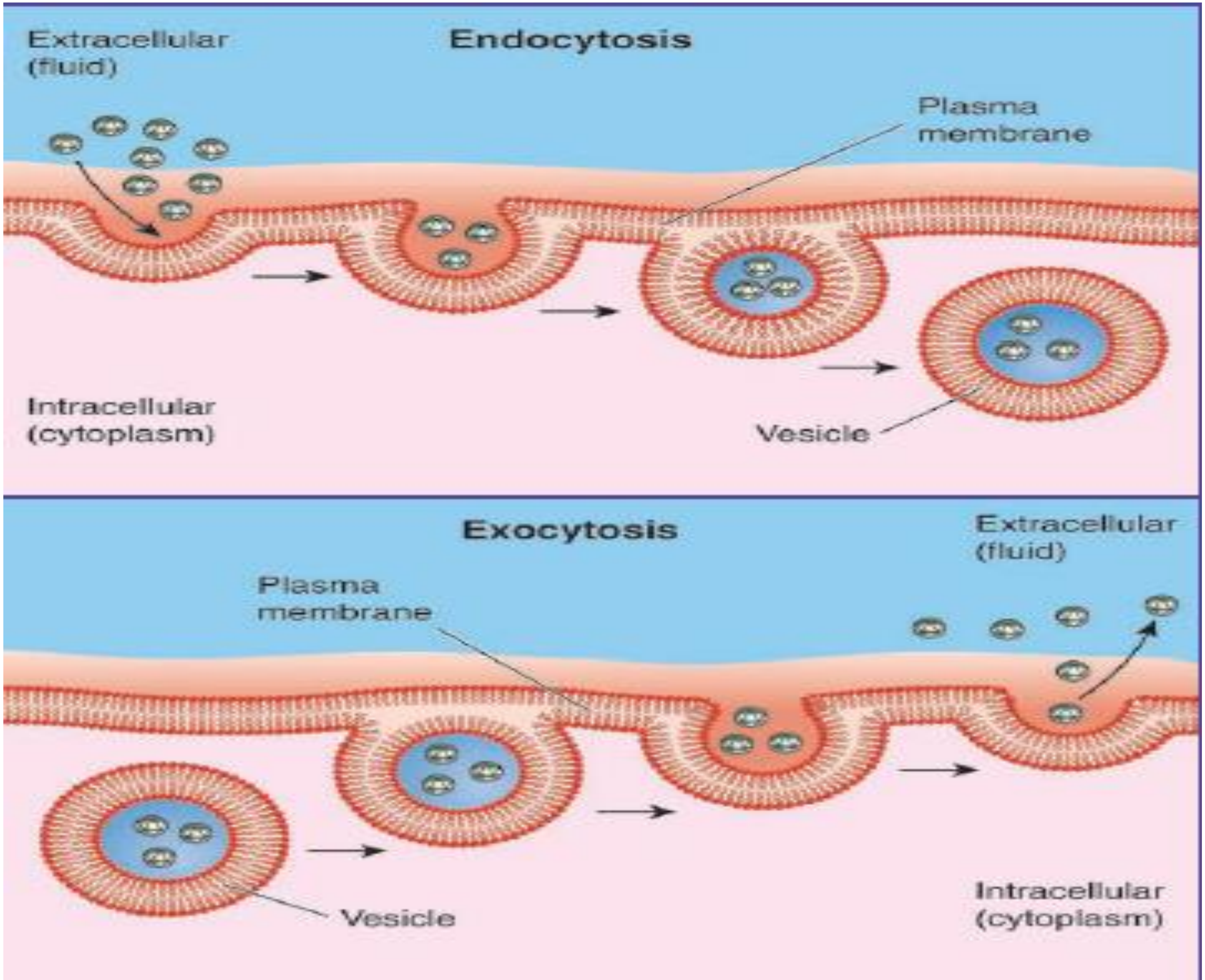
One type of pump that is active in all cells but is especially associated with nerve and muscle cells moves sodium ions (Na+) to the outside of the cell and potassium ions (K+) to the inside of the cell.

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


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 ipid bilayer (as shown here). However, small polar or charged particles (such as water and ons) 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 an ucleate 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

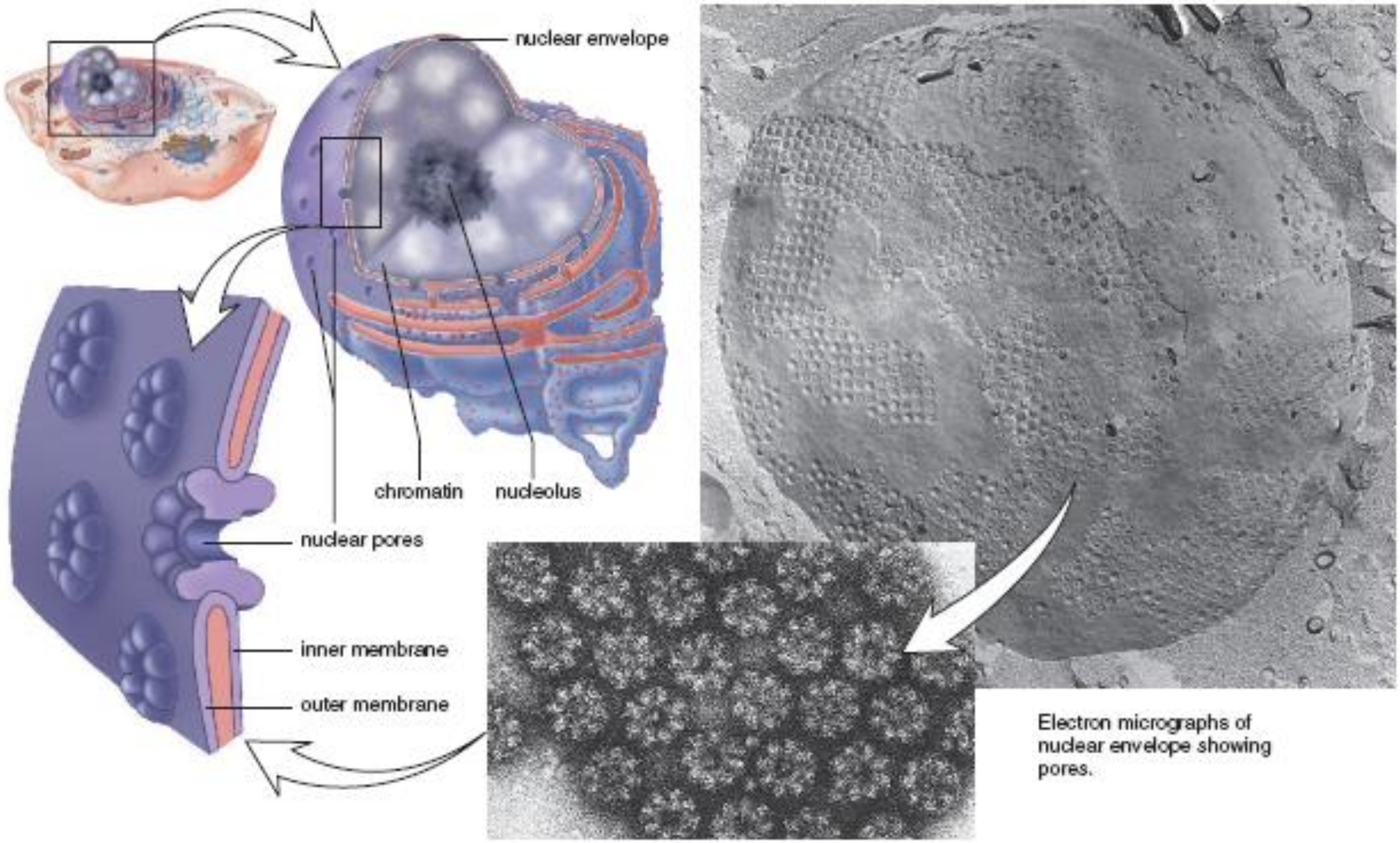
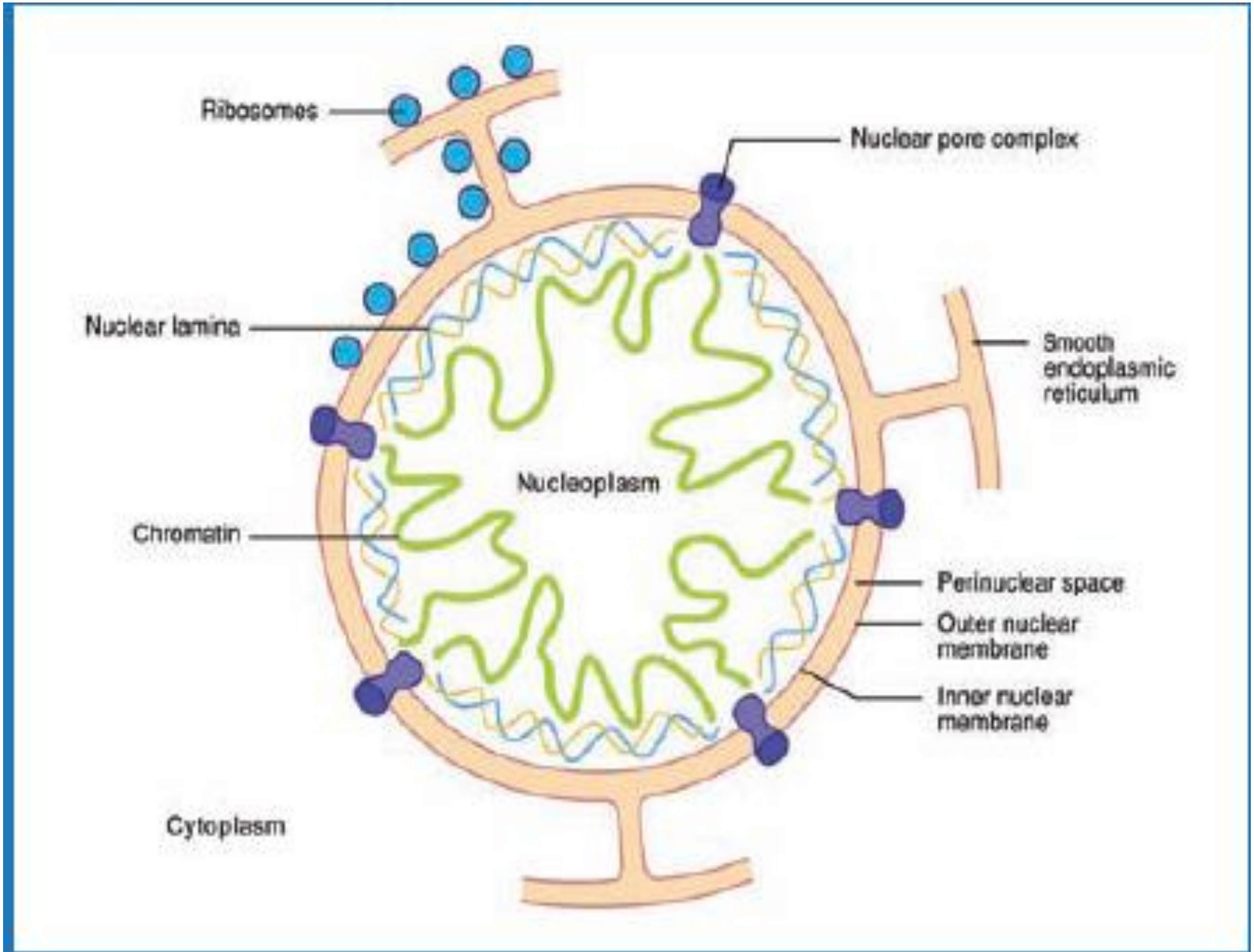


Figure 3.7 **The nucleus and the nuclear envelope.**
The nucleus contains chromatin. Chromatin has a special region called the nucleolus, which is where rRNA is produced and ribosomal subunits are assembled. The nuclear envelope contains pores, as shown in this micrograph of a freeze-fractured nuclear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

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 orotein, 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.

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.

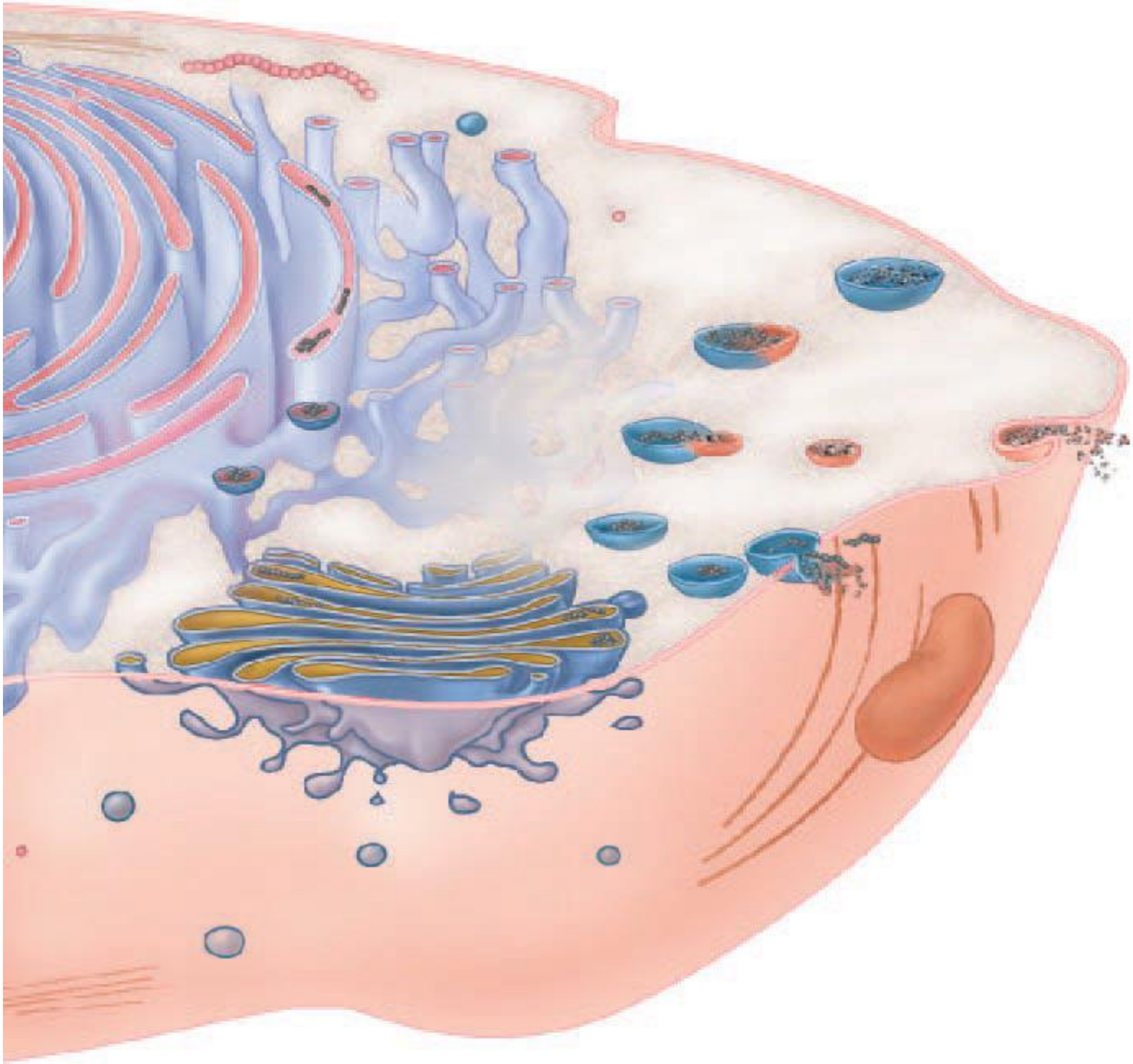
For example, sugar groups may be added, forming *glycoproteins*. In addition, proteins may fold into complex, three-dimensional shapes

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.



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

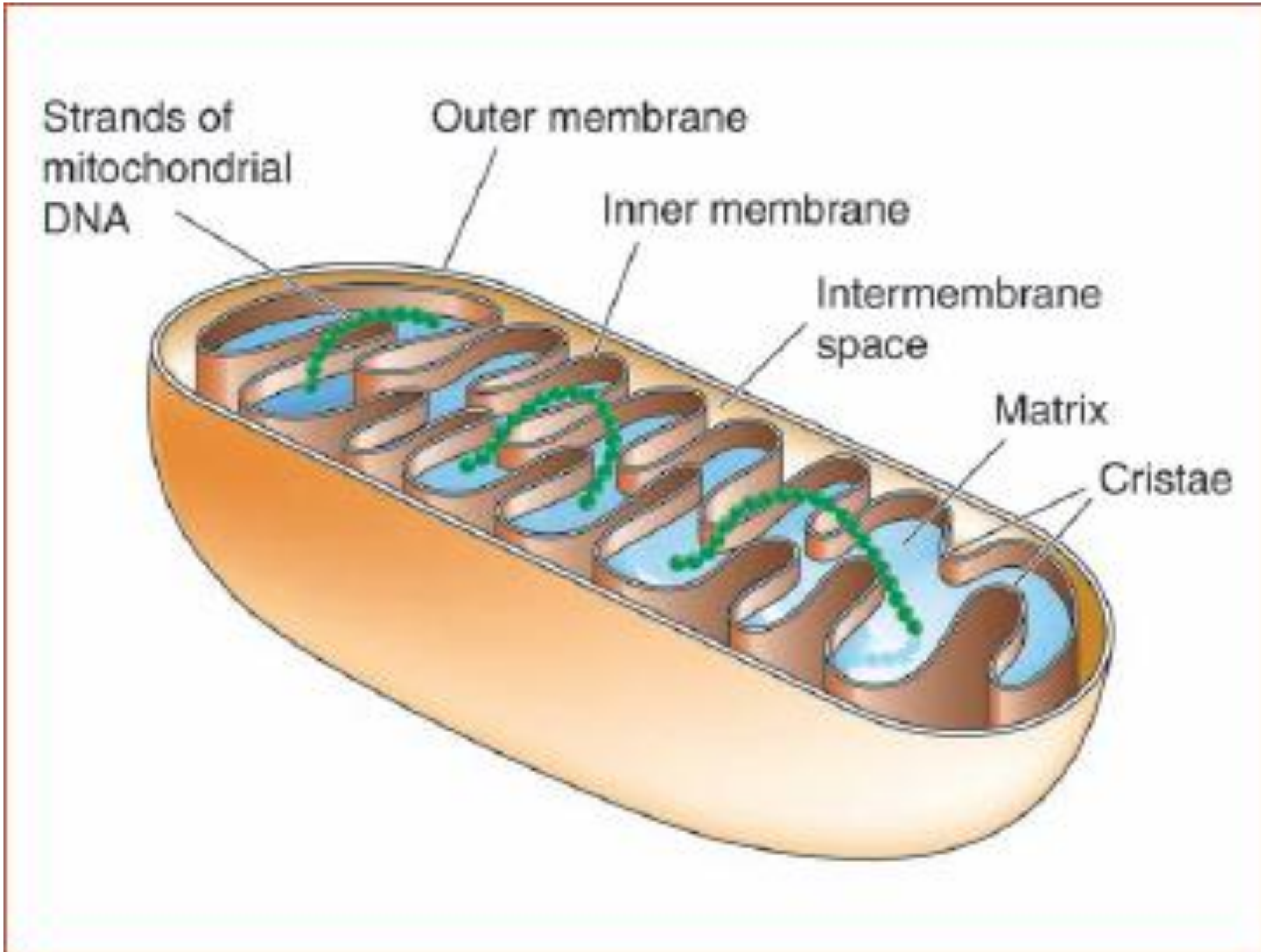

Strands of mitochondrial DNA
Outer membrane
Inner membrane
Intermembrane space
Matrix
Cristae

Figure 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

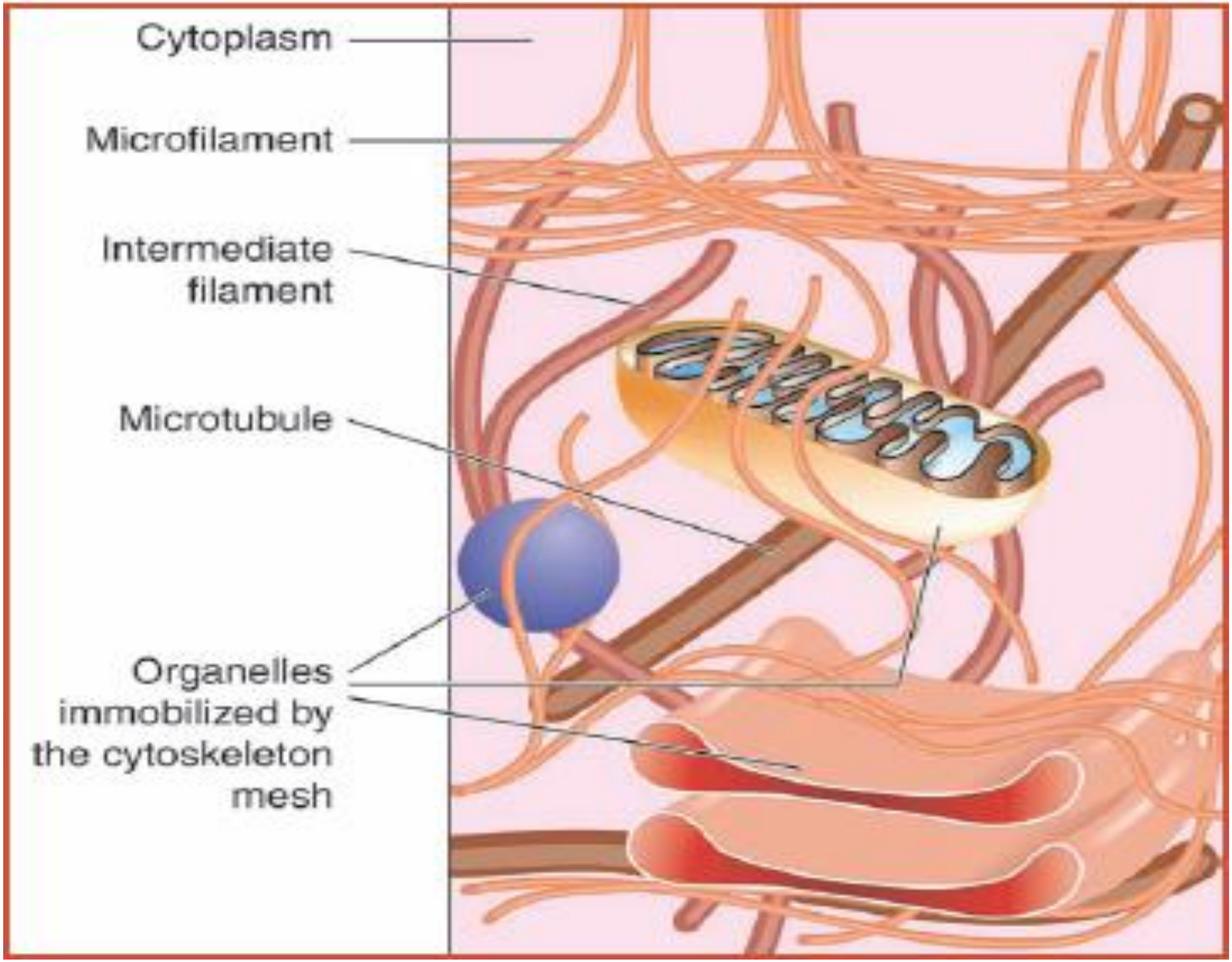
Cells contain an elaborate network of protein structures throughout the cytoplasm called the cytoskeleton

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

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