Chapter 7 Cell structure and function.

The cell

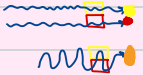
- It is the basic unit
- The simplest collection of matter that is alive
- The cells are too small to be seen by hacked eye

Microscopes

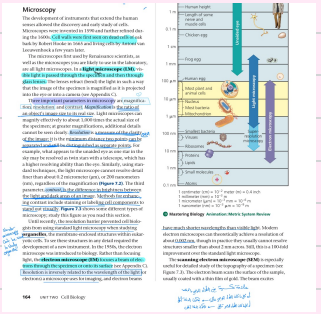
The parameters of microscopes.

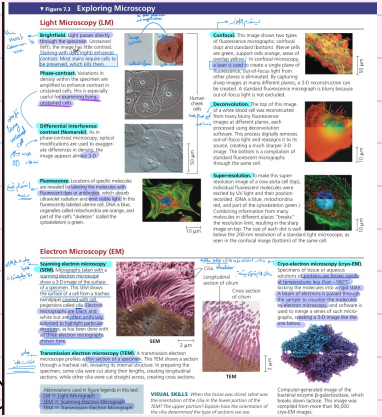
① **Magnification**
The ratio of object's size to it's real size
You can change it with lenses

② **Resolution**
(Clarity) minimum distance between two points to be distinguished.
Depends on of waves



③ **Contrast** (تباين)
The difference
The visible differences in brightness between parts of the sample





The types of microscopes

- Light microscopes
  - Bright field
  - flourescent
  - confocal
  - deconvolution
  - Super-resolution
- Electron microscopes ↑ resolution / study organelles
  - Scanning EM (SEM) → it shows only the surface of cells
  - Transmission EM (TEM) → It shows the internal structure cells

visible light passed through the specimen and then through glass lenses.

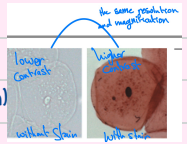
first microscope

يتم إلقاء الضوء من الأعلى
ثم يتم إسقاط جزء منه إلى الأعلى

light microscope (LM)

A visible light is passed through the specimen and then through glass lenses
The lenses refract the light in such a way that the image of the specimen is magnifiedas it is projected into the eye or into camera

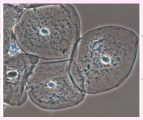
Bright-field



- light passes directly through the specimen
- the stains أصباغ require cell to be preserved (kill them)

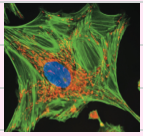
Phase- contrast

Variations in density within the specimen to enhance contrast in unstained cells;
this is useful for examining living, unstained cells.



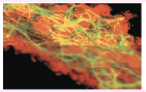
fluorescence

locations of specific molecules are revealed by labeling the molecules with fluorescent dyes or antibodies
Which absorb the emit visible light



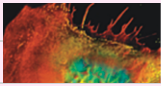
confocal

- The laser used in this microscope →to create a single plane of fluorescence
- A 3-D reconstruction can be created by capturing sharp images at many different planes,
- A standard fluorescence micrograph is blurry because out-of-focus light is not excluded.



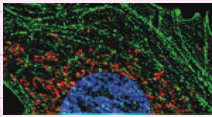
Deconvolution

- It takes many blurry fluorescent images at different planes ,each one processed using deconvolution software
- This process removes out of focus light and creating a much sharper 3-D image



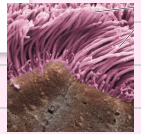
Super -resolution

- individual fluorescent molecules were excited by UV light and their position recorded
- Combining information from many molecules in different places "breaks" the resolution limit, resulting in the sharp image .



Electron microscope (EM)

- focuses a beam of elec- trons through the specimen or onto its surface
- Resolution is inversely related to the wavelength of the light (or electrons) a microscope uses for imaging, and electron beams have much shorter wavelengths than visible light.

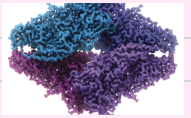


Scanning electron microscopy (SEM).

- 3-D emages
- This SEM shows the surface of cells
- Electron micrographs are black and white but are often artificially colorized to highlight particular structures

Transmission electron microscopy (TEM).

- needs a thin section of specimen
- it reveals the internal structure
-

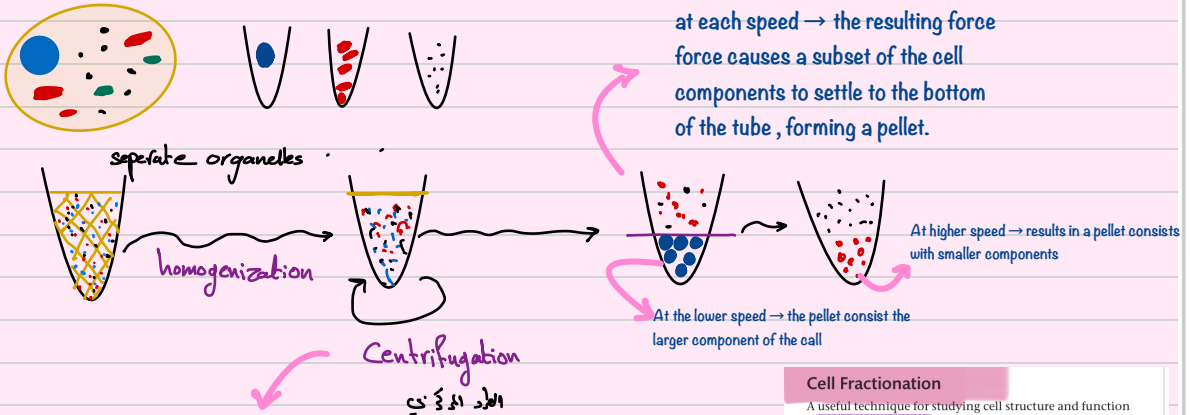


Cryo-electron microscopy (cryo-EM)

- The specimen is frozen rapidly at temperatures less than -160C ~locking the molecules into rigid state
- A beam of electrons is passed through the sample to visualize the molecules by electron microscopy, and software is used to merge a series of such micro- graphs, creating a 3-D image like the one below.

cell Fractionation

It is useful technique for studying cell structure

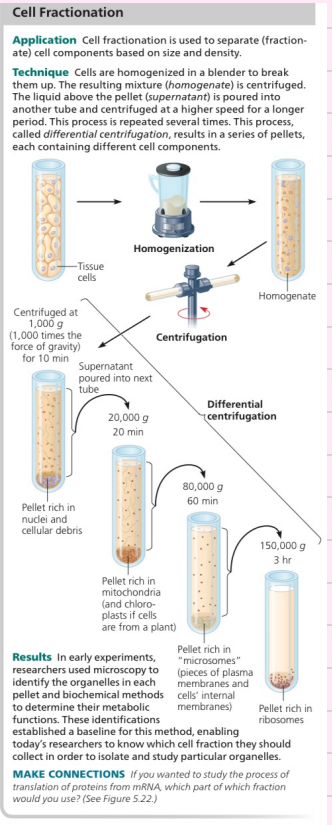


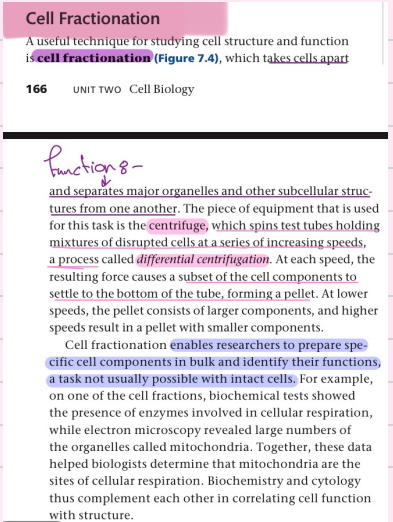
The centrifuge:-

A price of equipment that is used to spin test tubes holding mixtures called (differential centrifugation)

importance:-

The cell fractionation enables the researchers to prepare specific cell components in bulk and identify their functions





Cell Fractionation

A useful technique for studying cell structure and function is **cell fractionation** (Figure 7.4), which takes cells apart

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functions -

and separates major organelles and other subcellular structures from one another. The piece of equipment that is used for this task is the centrifuge, which spins test tubes holding mixtures of disrupted cells at a series of increasing speeds, a process called *differential centrifugation*. At each speed, the resulting force causes a subset of the cell components to settle to the bottom of the tube, forming a pellet. At lower speeds, the pellet consists of larger components, and higher speeds result in a pellet with smaller components.

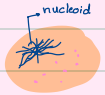
Cell fractionation enables researchers to prepare specific cell components in bulk and identify their functions, a task not usually possible with intact cells. For example, on one of the cell fractions, biochemical tests showed the presence of enzymes involved in cellular respiration, while electron microscopy revealed large numbers of the organelles called mitochondria. Together, these data helped biologists determine that mitochondria are the sites of cellular respiration. Biochemistry and cytology thus complement each other in correlating cell function with structure.

Cells

Eukaryotic cells are much larger than Prokaryotic cells

Pro karyotes

- No nucleus
  The DNA is unbounded region called nucleoid



- No membrane- bound organelles
  But its cytoplasm isn't a formless soup → there are some regions of prokaryotes are surrounded by proteins → where specific reactions take place.

examples :
Bacteria Archea

Eukaryotic cells "True nucleus"

- There is nucleus
  The DND is bounded by two layer membrane

- It has a membrane-banded organelles

Examples
Protist Fungi Plants Animals

what is the mayor difference between prokaryotic and eukaryotic calls?

↳ the Location of DNA

The major similarities between all cells :-

- Plasma membrane (selictive barior) Selective Permeability
- Cytosol (semifluid or jellylike substance)
- Chromosomes (which carry genes).
- Ribosomes (tiny complexes that make proteins).

the smallest cell is bacteria which called micro plazmas.

Comparing Prokaryotic and Eukaryotic Cells

All cells share certain basic features: They are all bounded by a selective barrier, called the *plasma membrane* (or the cell membrane). Inside all cells is a semifluid, jellylike substance called **cytosol**, in which subcellular components are suspended. All cells contain *chromosomes*, which carry genes in the form of DNA. And all cells have *ribosomes*, tiny complexes that make proteins according to instructions from the genes.

A major difference between prokaryotic and eukaryotic cells is the location of their DNA. In a **eukaryotic cell**, most of the DNA is in an organelle called the *nucleus*, which is bounded by a double membrane (see Figure 7.8). In a **prokaryotic cell**, the DNA is concentrated in a region that is not membrane-enclosed, called the **nucleoid** (Figure 7.5).

...her membrane-enclosed organelles

The plasma membrane and the surface

The plasma membrane → functions as selective membrane allowes passages of enough oxygen, nutrients and wastes to serviette entire cell

the ratio of surface area is critical

Because each square micrometer of membrane only can pass a limited amount of part isles per second.

the metabolic requirements of the cell set upper limits on size

The eukaryotic cells use typically (10 - 100) micrometer

If we increase the size → the volume will be highly increase as well as the cell's requirements

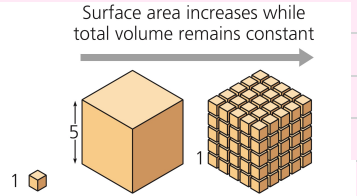
→ BUT the surface won't be enough to provide all cell's requirements

↑ Size → ↑↑↑ Volume → ↓ the surface
↑↑↑ requirements

Note
the lower limit of the cell's size present on bacteria called mycoplasmas

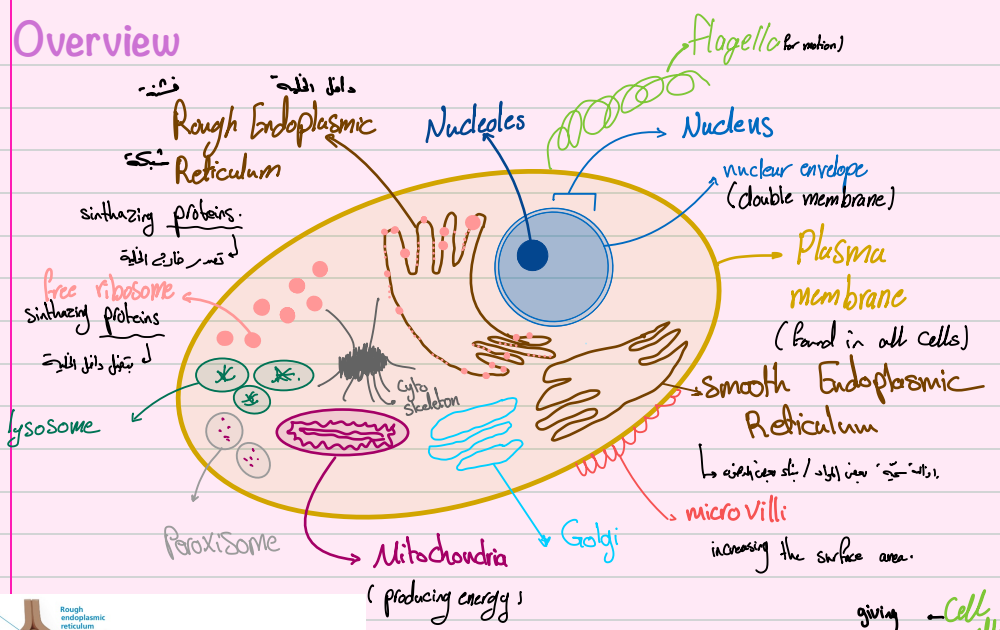
→ The smallest cell
Have diameters between 0.1 and 1.0 micrometer
But it have enough DNA to program metabolism and enough enzymes and enough other cellular equipment to carry out the necessary activities

the typical bacteria are 1-5 micrometer in diameter
Which about ten times the size of mycoplasmas



Total surface area [(height × width of 1 side) × 6 sides × number of cells]	6 units^2	150 units^2	750 units^2
Total volume [(height × width × length of 1 cell) × number of cells]	1 unit^3	125 units^3	125 units^3
Surface area-to-volume ratio [surface area ÷ volume]	6	1.2	6

Overview


Flagello (for motion)
Rough Endoplasmic Reticulum
Nucleoles
Nucleus
nuclear envelope (double membrane)
Sinthazing proteins.
Plasma membrane (found in all cells)
free ribosome
Sinthazing proteins
Smooth Endoplasmic Reticulum
lysosome
Cyto skeleton
microVilli
increasing the surface area.
Peroxisome
Golgi
Mitochondria
(producing energy)

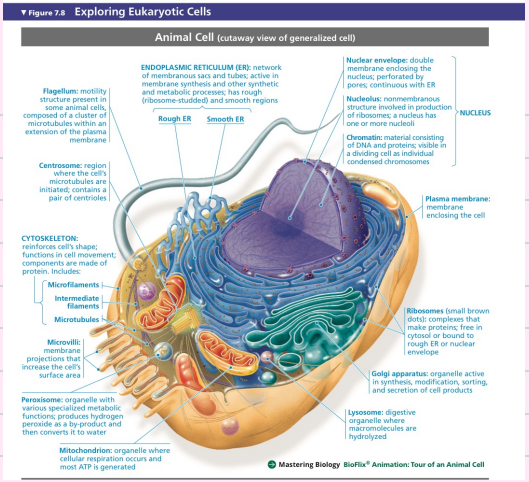
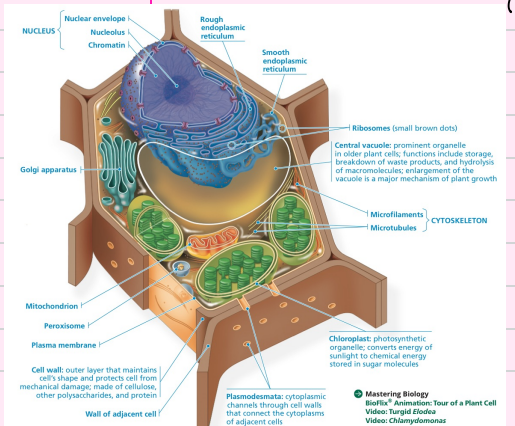
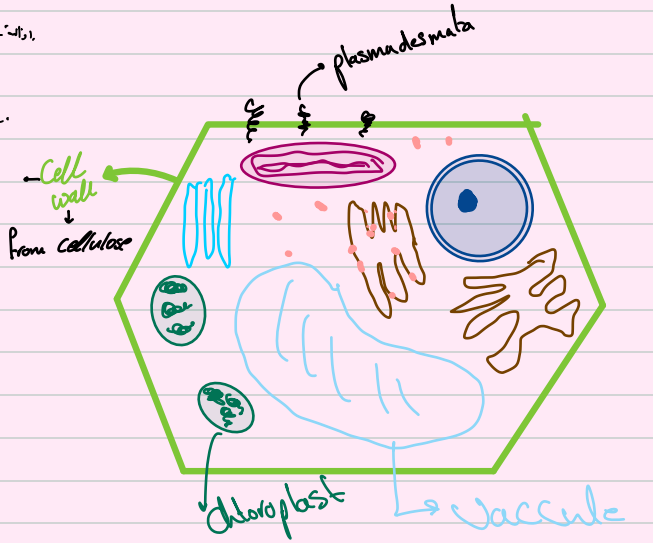


Figure 7.8 Exploring Eukaryotic Cells
Animal Cell (cutaway view of generalized cell)
ENDOPLASMIC RETICULUM (ER): network of membranous sacs and tubes; active in membrane synthesis and other synthetic and metabolic processes; has rough (ribosome-studded) and smooth regions
Rough ER
Smooth ER
Flagellum: motility structure present in some animal cells, composed of a cluster of microtubules within an extension of the plasma membrane
Centrosome: region where the cell's microtubules are initiated; contains a pair of centrioles
CYTOSKELETON: reinforces cell's shape; functions in cell movement; components are made of protein. Includes:
Microfilaments
Intermediate filaments
Microtubules
Microvilli: membrane projections that increase the cell's surface area
Peroxisome: organelle with various specialized metabolic functions; produces hydrogen peroxide as a by-product and then converts it to water
Mitochondrion: organelle where cellular respiration occurs and most ATP is generated
Nuclear envelope: double membrane enclosing the nucleus; perforated by pores; continuous with ER
Nucleolus: nonmembranous structure involved in production of ribosomes; a nucleus has one or more nucleoli
Chromatin: material consisting of DNA and proteins; visible in a dividing cell as individual condensed chromosomes
NUCLEUS
Plasma membrane: membrane enclosing the cell
Ribosomes (small brown dots): complexes that make proteins; free in cytosol or bound to rough ER or nuclear envelope
Golgi apparatus: organelle active in synthesis, modification, sorting, and secretion of cell products
Lysosome: digestive organelle where macromolecules are hydrolyzed
Mastering Biology BioFlix® Animation: Tour of an Animal Cell

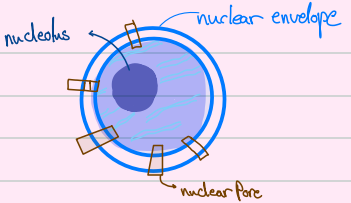

NUCLEUS
Nuclear envelope
Nucleolus
Chromatin
Rough endoplasmic reticulum
Smooth endoplasmic reticulum
Ribosomes (small brown dots)
Golgi apparatus
Central vacuole: prominent organelle in older plant cells; functions include storage, breakdown of waste products, and hydrolysis of macromolecules; enlargement of the vacuole is a major mechanism of plant growth
Microfilaments
Microtubules
CYTOSKELETON
Mitochondrion
Peroxisome
Plasma membrane
Chloroplast: photosynthetic organelle; converts energy of sunlight to chemical energy stored in sugar molecules
Cell wall: outer layer that maintains cell's shape and protects cell from mechanical damage; made of cellulose, other polysaccharides, and protein
Plasmodesmata: cytoplasmic channels through cell walls that connect the cytoplasms of adjacent cells
Wall of adjacent cell
Mastering Biology
BioFlix® Animation: Tour of a Plant Cell
Video: Turgid Elodea
Video: Chlamydomonas


plasmadesmata
giving strength
Cell wall
from Cellulose
Chloroplast
Vacuole

Cell Structure

1

Nucleus



It contain most of genes in the eukaryotic cell

The DNA is organised into discrete units Which called chromosomes

Structure that curry the genetic information

The complex of (protein +DNA) = chromatin

Each one carry one long DNA associated with proteins (histone)

It is a small basic proteins

Helps the DNA to coil and reducing length un make it fil in the nucleus

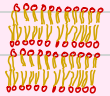
Nuclear envelope

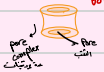
- .It is a membrane which enclose the nucleus and separate it component from the cytoplasm .
- . Double membrane each one is Biplayer
- The outer side of envelope is in direct contact with rough ER

Note

The space between nuclear membrane is continuous with the Er lumen because ER membrane and nuclear envelope are continuous

Nuclear pores





- It a complete proteins that allow a selective passages of molecules
- At the lip of the pore → the inner and outer membranes of the nuclear envelope are continuous.
- They play un important role in the cell by regulations the entry and the exit of proteins and RNAs

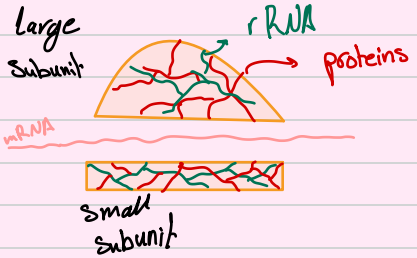
Nuclear Lamina

- It is a composed of proteins that line the nuclear side of the envelope which maintains the shape of the nucleus.
- the nuclear lamina with the nuclear matrix help organize the genetic material so it functions efficiently

Nucleolus

- It is important structure inside the nucleus and located in a specific part of the nucleus .
- Can be seen using an electron microscope
- Appears as a mass of dented granules und fibers adjoining part of chromatin
- The main function→to produce ribosomes→ because it contains genes from the DNA that codes for ribosomal RNA → forms ribosomal subunit
- It contained a proteins that imported from the cytoplasm that assembled with rRNA into large and small subunits of ribosomes
- It play a role in cell division and the life spain of the cell
- Some cells has more one nucleolus

2 Ribosomes → Protein factory.



- Ribosomes are complexes made of ribosomal RNAs and proteins
- It an the cellular components that carry out the protein synthesis
- Ribosomes aren't considered organelles → because they are not membrane bounded organelles

the major function:- proteins synthesis

Ribosomes carry out protein synthesis in two locations:-

1- In the cytosol (free ribosomes)

2-On the outside of the endoplasmic reticulum or n

The types of ribosomes:-

Free ribosomes

- It suspended in the cytosol
- Most of proteins that made on free ribosomes function in the cytosol

Ex → enzymes that catalyze the first step of sugar breakdown

Band ribosomes

- It bounded to the outer surface of rough endoplasmic reticulum or nuclear envelope
- Most of protein that made on bounded ribosomes generally are destined for insertion into membranes for packaging or for export from the cell (secretion)

Ex → the cells of pancreas that secrete digestive enzymes,

Endomembrane system

Includes

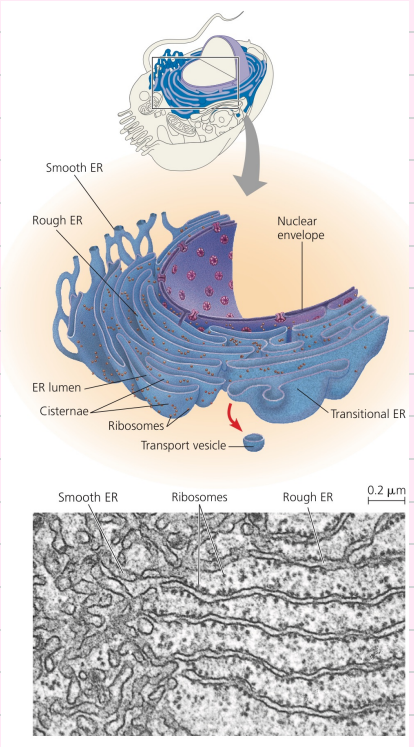
- The nuclear envelope
- The endoplasmic reticulum
- The Golgi apparatus
- Lysosomes
- Various kinds of vesicles
- The plasma membrane

the System Tasks

Transport of proteins out of the cell

Metabolism and movement of lipids

Detoxification of poisons



3 endoplasmic reticulum

- It is an extensive network of membranes that it accounts more than 50% of the total membranes
- Continue with the nuclear envelope
- If formed of a network of branching tubules and flattened sacs called cisternea
- It devided into two types according to the attachment of ribosomes
  - → rough endoplasmic reticulum
  - → smooth endoplasmic reticulum
- ER lumen (cavity)(cisternal space)→ is the ER membrane separates the internal compartment of the ER from the cytosol cavity

Smooth ER

It doesn't have ribosomes on its surface

Specialised in metabolic processes →

1- synthesising lipids such as

(oil/steroids "sex hormones " /new membrane phospholipids)

2- Carbohydrate metabolism

3- Detoxification of drugs and potions (in liver cells)

4- Storing and regulating of calcium ions (in muscles cells)

Note :-

Various steroid hormones are secreted by adrenal glands and sex hormones are secreted by the ovary and testes
And these cells are rich with smooth ER

Note .

By adding hydroxyl groups to the drug molecules and making them more water soluble and easier to flush from the body.

Note .

The SRE membrane pumps calcium ions from the cytosol into the ER lumen
When it stimulated by a nerve impulse, calcium ions rash back to the cytosol to trigger contraction of the muscle cell
On other types of cell → the release of calcium ions from the SRE triggers different responses → such as secretion of vesicles carrying newly synthesised proteins.

Rough ER

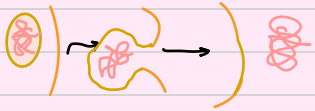
It has a ribosomes attached to its outer surface

Functions →

1- Specialised in synthasing proteins for
~secretion outside the cell
~insertion into membranes

2- membrane factory

The cell membrane growsby adding membrane proteins and phospholipids



The pores is formed by a protein complex

Protein process :-

Firstly → The ribosomes that attached to the RER manufacture a new polypeptide chain

Secondly → The proteins are threaded into the ER lumen (inner space) through a pore

Thirdly → The new polypeptide folds folds into its functional shape while it enters the ER lumen

fourth → the protein could be modified by enzymes built into the ER membrane

fifth→ it depart from the ER wrapped in the membranes of vesicles that bud like bubbles from a speciallized region called transitional ER

Transport vesicles → vesicles in transit form one part of the cell to another

Example → glycoproteins proteins with carbohydrates which covalently bonded to them

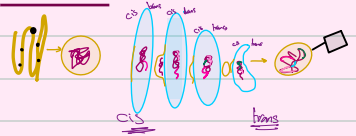
4 The Golgi apparatus

- Golgi apparatus consists of a group of associated flat tend membranous sacs → called cisterna
- It is a membranous organelle
- The cell could have hundreds of stacks
- There are vesicles that concentrate in the vicinity (near)of Golgi apparatus s engaged in transporting materials between parts of Golgi and other structures

It has two distinct faces→

→ **cis face** → closest to the ER- receives transport budding vehicles from ER between the cis and trans faces (Products are modified)

→ **trans face** → directs vesicles to various destinations



The function → receiving,sorting,shipping,manufacturing molecules for: 1- secretion / 2-use it in other parts of cell

1- Modifying products of the ER (proteins and lipids) and then storing them and then sent to other destinations

2- Manufacture certain macromolecules by itself→ (polysaccharides like pectins in the plant cells)

3- Sort and package materials into transport vesicles

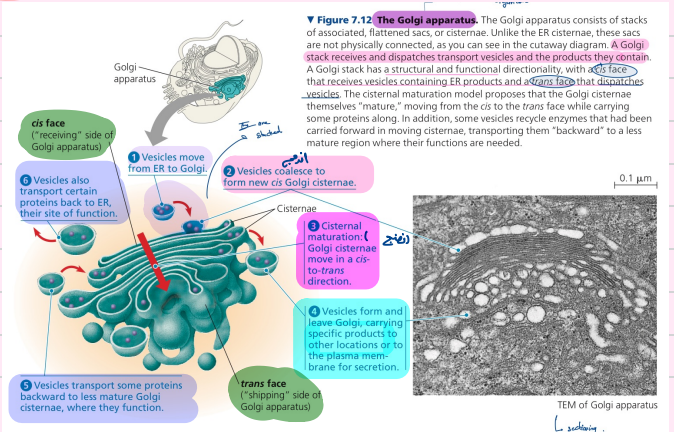
And then it will incorporated with cellulose into the cell wall

example →

1- glycoproteins formed in the ER and have their first modified Carbohydrates by the ER itself →then as it passes through Golgi apparatus, the Golgi removes sugar monomers and subtitles others

2- producing a large variety amount of carbohydrates

3- phospholipids may also be altered in the Golgi



5 Lysosomes: digestive compartment

It is a membranous sac of hydrolytic enzymes that is used to digest (hydrolyse) macromolecules in eukaryotic cells

Lysosomal enzymes work best in acidic environment (وسط حمضي) pH ↓

The membrane and enzymes of the lysosome →
are made in rough ER and → then transferred to the Golgi purchase for further processing .:
(تصنع في ER ثم تعدل في Golgi)

The 3 dimensional shape of the lysosomes →
protect the proteins of lysosomal membrane from enzymatic attack also protect the digestive enzymes from digesting themselves

Lysosomes carry out intercellular digestion in a variety of circumstances :-

Phagocytosis— is a process where cells engulf (اجتاح) smaller organisms or food particles
the food vacuole fuses (تندمج) with a lysosome then the lysosomal enzymes can digest the food

macrophages → are an example of human cells that use phagocytosis to protect the body
→ a type of white blood cells thatnvadershelps defendthe body by engulfing and destroying Bacteria and other foreign matter
(الخلايا آكلة البكتيريا)

Lysosomal storage diseases(inherited)→
The hydrolytic enzymes can't function normally→ the lysosomes become engorged (fulled)with indigestible material →this will interfere with other cellular activities
Example: TAY-SACHS disease (the lipid-digesting enzyme is missing)which leads to brain impairment

Note :-
If a lysosome breaks open or leaks its contents → the released enzymes are not very active
Because the cylosol has anear- neutral pH. (pH 7 يعتدل)
BUT;
The self -digestion→ excessive leakage from a large number of lysosomes which destroy the cell.
Autophagy →when the lysosomes use their hydrolytic enzymes to recycle the cell's own organic material

The process of autophagy →
1- the damage organelles surrounded by double membrane
2- a lysosome fuses with the outer membrane of this vesicle
3- the lysosome enzymes dismantle(تفكيك) the inner membrane and the enclosed
4- the result a small organic compounds are released to the cytosol for reuse.

So, the cell continually renews itself by the help of lysosomes
The liver recycles half of its macro molecules each week

the digestion products include:
-simple sugar
-amino acids
-other monomers
→ These products pass into the cytosol as (nutrients عناصر غذائية) for the cell

6 Vacuoles Diverse maintenance compartments

- Vaculaos are large vesicles derived from the endoplasmic reticulum and Golgi apparatus
- It is an essential part of a cells endoplasmic system

- The vacuolar membrane → is selective in transporting solutes→
  The result → →→ the solution inside a vacuole differs in composition from the cytosol

- Vacuoles perform a variety of functions in different kinds of cells
  1- Food vacuoles → formed by phagocytosis.
  2- Contractile vacuoles →like protists(الطلائعيات) that living in fresh water → pump axcess water out of cells →why → to maintaining a suitable concentration of ions and molecules inside.

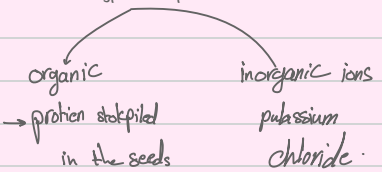
  3- Central vacuoles →found in mature cells plant → → holds organic compounds , water and inorganic ions like (potassium / chloride)
  → plays major role in the growth of plant cell which enlarge cell by absorbing water with new investment of cytoplasm
  → Developed by joining of smaller vacuoles
  → The solution inside the central vacuole called cell sap

not the central vacuoles

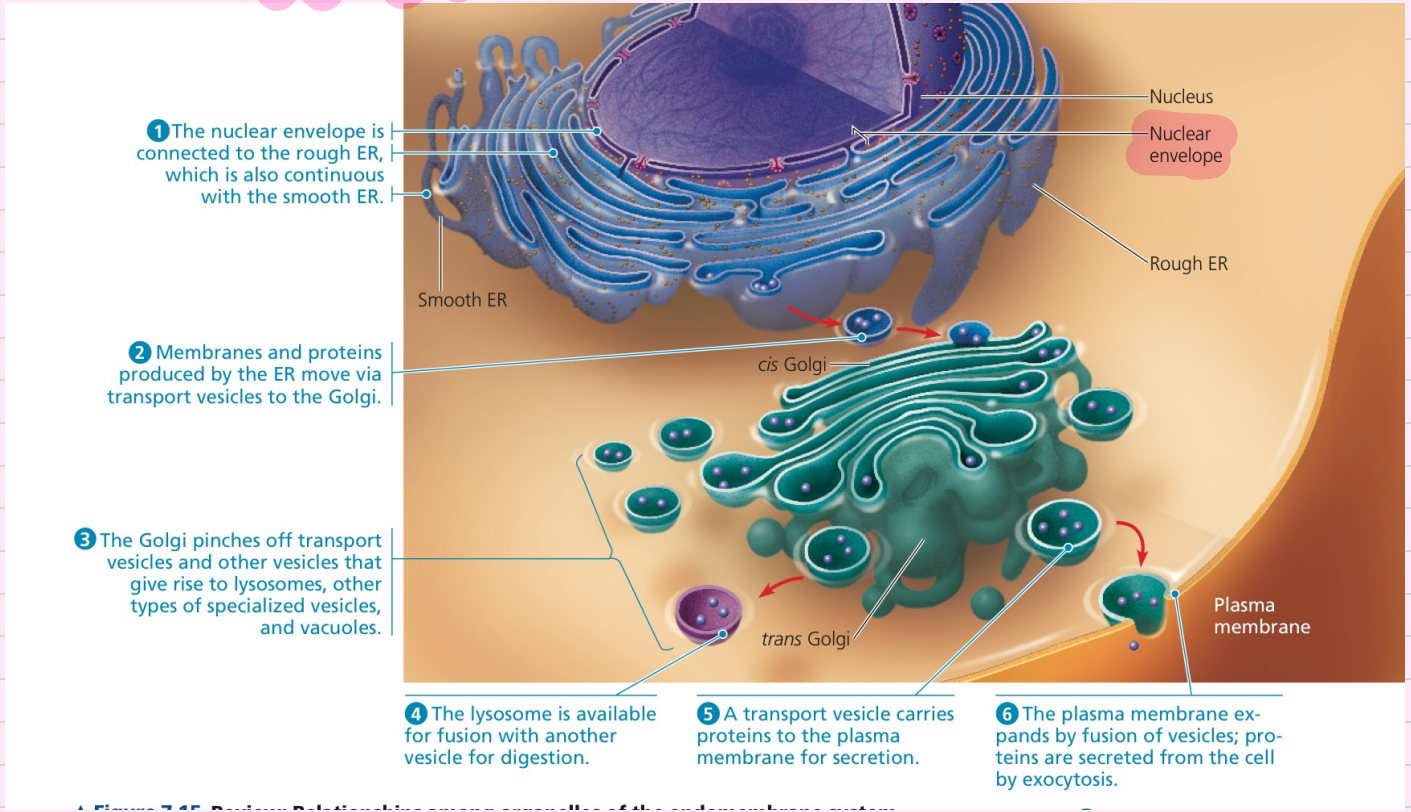
The function of certain vacuoles in plants and fungi :-
1- They carry out enzymatic hydrolysis
2- the small vacuoles in plants can hold reserves of important organic compounds like (proteins in the storage cells in seeds)
3- this vacuoles help to protect the plants against herbivores .
4- some plant vacuoles contain pigments صبغة (like red and blue pigments)of petals that help attract pollinating insects حشرات ملقحة to flowers

Note
Plants don't have lysosomes but have these certain vacuoles which act like lysosomes

Note -the vacuoles in plants storage two types of compounds



The trip of proteins and lipid in the endoplasmic system:



7 Mitochondria and Chlorlplasts.

Organisms transform the energy they acquire from their surroundings.

Mitochondria are the sites of

O_2 → ATP
Glu

→ cellular respiration

→ metabolic process that use oxygen to generate ATP by extracting energy from sugars,fats and other fuels

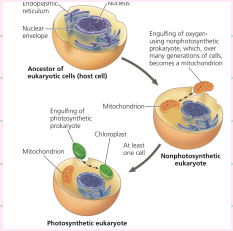
Chloroplasts found in plants and algae

ATP → O_2
Glu

Are the site of → photosynthesis

The process of converting solar energy to chemical energy by absorbing sunlight and using it to drive the synthesis of organic compounds such as sugars* → from Carbon dioxide und water

Endosymbiosis theory



The theory suggests that an early ancestor(اصل) of eukaryotes engulfed اندمج an oxygen-using nonphotosynthetic prokaryotic cell.....then the engulfed cell formed a relationship with the host cell to become "endosymbiosis" .....over the evolution , they become one single organism

The endosymbionts evolved into mitochondria

As least one of these cells may have then taken up a photosynthetic prokaryote .....which evolved into a chloroplasts

This theory explains the similarities between mitochondria and chloroplasts

Pay attention →
The prokaryote of mitochondria is →an oxygen-using non photosynthetic prokaryote
The prokaryote of chloroplast is →photosynthetic prokaryote

The similarities between mitochonaria and chloroplasts

1- enveloped by a double membrane unlike other organelles that have one membrane
2- they contain free ribosomes as well as circular (circle) DNA molecules
3- Organelles that grow and reproduce independently within the cell.

Note : 1
This is evidence that the ancestral engulfed prokaryotics had two outer membranes which become the double membranes of mitochondria and chloroplasts

Note 2:
the DNA of mitochondria and chloroplasts are the same with bacterial chromosomes-associated with their inner membranes
This DNA is programmed to synthesise organelle proteins on the ribosomes that have been made there aw well

Mitochondria

Animal
Plants
Fungi
most protists

- Mitochondria are found in nearly all eukaryotic cells
- Some cells have a single large mitochondrion ,BUT usually cells have hundreds or even thousands of mitochondria
  - The number related to the cell's level of metabolic activity

The length →1-10 macro m. &. They are dynamic structures

- The membranes of mitochondria →

Each one of the two membranes is a phospholipid belayer with unique collection of embedded proteins

→ the outer membrane is smooth

→ the inner membrane is convoluted مطوي ,with infolding called **cristae**

The enzymes that make ATP are built into it

- The inner membrane divides the mitochondria into two compartments :-

1- Inter membrane space 2- Mitochondrial matrix

The narrow region between the inner and outer membranes

Is enclosed by inner membrane
It contains →
Different Enzymes
Mitochondrial DNA
Ribosomes

- Some metabolic steps of cellular respiration are catalyzed in the mitochondrial matrix by enzymes
- Cristae present a large surface area for enzymes that synthesize ATP because it's high folding

Chloroplasts

The chloroplast is one of a group of plant organelles,called plastids

Chloroplasts contain the green pigment (chlorophyll)
It also contains enzymes and other molecules that function in photosynthesis

Leaves of Plants
green organs
Algae.

It(lens-shaped) organelles length about 3-6 micro m

The structure of chloroplasts :-

It enclosed with an envelope → Consist of two smooth membranes

The narrow space between the two membranes called inter membrane space

Inside the chloroplast → there are **grandma**

which is a flatten interconnected sacs

Each sac called a **thylakoids**

The fluid outside the thylakoids is the **storma**

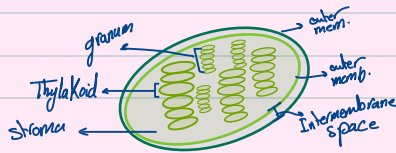
→which contains the chloroplast DNA and ribosomes and enzymes .

The chloroplast's membranes divide the chloroplast to three compartments
(1- the inter membrane space/ 2- storma / 3- thylakoid space)
→which enables the chloroplast to covert light energy to chemical energy

Types of chloroplast:-

,the amyloplast → is a colorless organelle that stores starch (amylose), particularly in roots and tubers

the chromoplast → which has pigments that give fruits and flowers their orange and yellow hues.

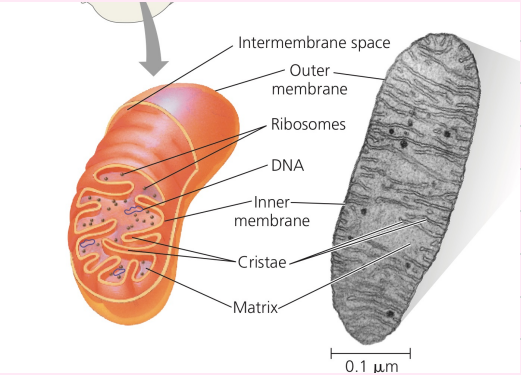


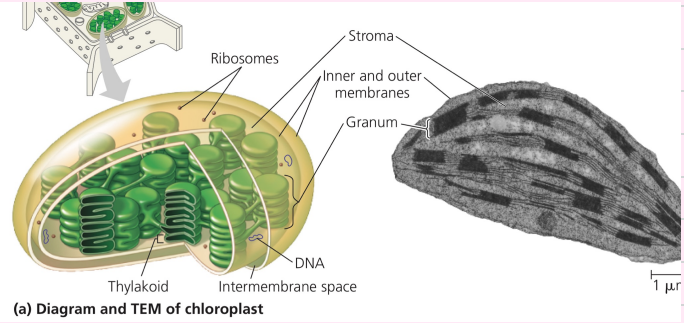
Mitochondria are dynamic structures which change their shapes and fuse, or divide into separate fragments unlike static structure scene in most diagrams. In skeletal muscles, this network has been referred to by researcher as a "power grid".

Time-lapse films → of living cells reveal mitochondria moving around/ changing its shape/ fusing اندماج /diving into separate fragments

The electron micrographs → show only the static structures

Chloroplasts are dynamic as well pinging into reproducing and moving alongside mitochondria and other organelles along the side of skeleton





(a) Diagram and TEM of chloroplast

Peroxisones

The peroxisome is a specialized metabolic compartment bounded by a single membrane
Very small organelle

Peroxisomes contain enzymes that remove hydrogen atoms
from various substrates and transfer them to oxygen (O2)
→ which results in producing hydrogen peroxide (H2O2)

H2O2 is very toxic itself
,BUT the peroxisome can deal with it →
because it also contains an enzyme that converts
H2O2 to water

The function of peroxisome reactions:-

1- use oxygen to break fatty acids down
into smaller molecules that are
transported to mitochondria and used as
fuel for cellular respiration.

2- Peroxisomes in the liver detoxify alcohol and other harmful compounds by
transferring hydrogen from the poisonous compounds to oxygen

Example about the above →
The enzymes that produce H2O2 and those that dispose of this toxic compound are sequestered away from other cellular components that could be damaged.

3- Specialized peroxisomes called glyoxysomes-
.are found in the fat-storing tissues of seeds
,They contain enzymes that initiate (start) the conversion of fatty acids to sugar
which is used as a source of energy and carbon until it can produce its own sugar by
.photosynthesis

Peroxisomes grow larger by joining proteins that made in the cytosol and ER,
as well as lipids made in the ER and within the peroxisome itself.

8 Cytoskeleton

cytoskeleton → a network of fibers extending throughout the cytoplasm

Note:
Bacterial cells also have fibers that form a type of cytoskeleton, constructed of proteins similar to eukaryotic ones

The function

1- Giving mechanical support to the cell and maintain its shape

2- It organizes the cell's structures and activities.

3- Providing anchorage for many organelles and even cytosolic enzyme molecules.

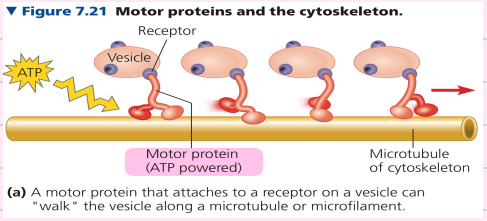
4- Cell motility →by the cytoskeleton the cell can change it's location and movements of cell parts

the cell motility requires interaction of cytoskeleton with motor proteins

EX:-

1- Cytoskeletal elements and motor proteins work together with the plasma membrane molecules → to allow whole cells to mole along fibers outside the cell.

2- Inside the cell → vesicles and other organelles often use motor protein to "walk" to their destinations along a track provided by the cytoskeleton



▼ Figure 7.21 Motor proteins and the cytoskeleton.

(a) A motor protein that attaches to a receptor on a vesicle can "walk" the vesicle along a microtubule or microfilament.

General informations about the structure:-

+ The remarkable strength and resilience (مرونه) are based on its architecture بنيته

+ It looks like a dome tent

+ cytoskeleton is stabilized by a balance between opposing forces exerted by its elements.

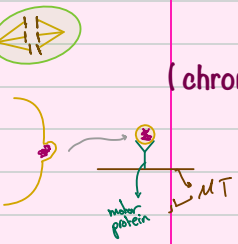
+ The cytoskeleton is more dynamic skeleton → It can be quickly dismantled يتفكك in one part of the cell and reassembled in a new location → changing the shape of the cell.

Note
In this concept ,Only the table is needed

The components of the cytoskeleton

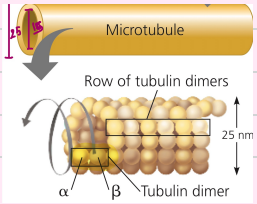
all of them working on maintaining the shape of the cell

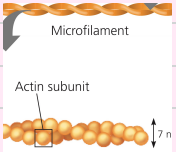
Microtubules (tubulin polymers)	Microfilaments (Actin filaments)	Intermediate filaments
structure Hollow tubes	structure Two intertwined strands of actin	Structure Fibrous proteins could into cables
Diameter 25 nm with 15 lumen	diameter 7 nm	Diameter 8-12 nm
protein subunits Tubulin Consist ∝-tubulin / β-tublin	protein subunits Actin	protein subunits Several proteins (Including keratins)
Function Cell motility (chromosomes and organelles movement)	Function Muscle contraction Cytoplasmic streaming (plant cell) Cell motility (animal cell)	function Anchorage of nucleus and other organelles Formation of nuclear lamina

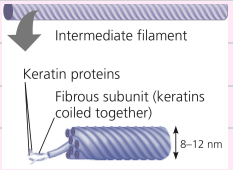


↳ during division

↳ Cillia & Flagella







Extra
Out of syllabus

Microtubules

present in all eukaryotic cells.

microtubules are a hollow rods (طرق مجوفة) constructed from globular proteins called tubulins

each tubulin protein is dimer → A molecule made up of two components

→ A tubulin dimer consists of two slightly different polypeptides (tubulin and tubulin)

The thickest type of the three components of the cytoskeleton

All eukaryotic cells have microtubules

The two ends of microtubule are slightly different → because of the orientation of tubulin dimer

One of the two ends called " plus end " → because the rate of accumulating or releasing tubulin diners is much higher than the other end.

Microtubules grow in length → by adding tubulin dimers

Function →

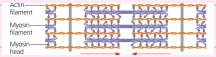
1- Microtubules shape and support the cell

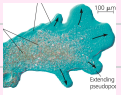
2- serve as tracks along which organelles equipped with motor proteins can move

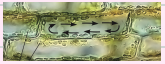
Example:-

#microtubules guide vesicles from the ER to the Golgi apparatus and from the Golgi to the plasma membrane.

#Microtubules are also involved in the separation of chromosomes during cell division.







Micro filament

the are thin rods

present in all eukaryotic cells.

They are called actin filaments because they are built from actin

A microfilament is a twisted double chain of actin subunits

function ! : bearing tension

microfilaments can form structural networks → when certain proteins bind along the side of such filament and allow a new filament to extend as a branch.

→ the networkof microfilaments is just to the inside plasma membrane → function 2 → helps support the cell's shape.

the cortex _→ the outer layercykoplasmic layer of a cell

→ the semisolid consistency of a gel,

function 3

Microfilaments are well known for their role in cell motility

Microfilaments that function in cellular motility contain the protein myosin in addition to actin

EX:-

- In the unicellular protist Amoeba and some of our white blood cells → Cells crawl along a surface by extending pseudopodia (cellular extensions) and moving toward them
- Myosin interact to cause contraction of muscle cells
- In plant cells, actin-protein interactions contribute to cytoplasmic streaming, a circular flow of cytoplasm within cells

Intermediate Filaments

Extra
Out of syllabus

it is Cytoskeletal component

intermediate filaments are only found in the cells of some animals, including vertebrates.
While microtubules and microfilaments are found in all eukaryotic cells.

Size: Intermediate filaments are about 8-12 nanometers in diameter, making them thicker than microfilaments ,but thinner than microtubules.

Composition: Unlike microfilaments and microtubules, intermediate filaments are made up of fibrous proteins
Diversity: There are several types of intermediate filaments, each constructed from a particular molecular subunit. Examples include:
- Keratin filaments in epithelial cells
- Vimentin filaments in many cells of mesenchymal origin

• Consistency :Intermediate filaments are remarkably consistent in diameter and molecular composition across various cell types.

• Function:They play a crucial role in maintaining cell shape and providing mechanical strength for instance:
- Keratin filaments strengthen protective epithelial sheets
- Nuclear lamins support the nuclear envelope

•Importance: Intermediate filaments are particularly important in cells and tissues that withstand mechanical stress, such as hair cells and skin cells.

Extra information → out of the syllabus

cilia and Flagella

- They found in (unicellular protist طلائعيات) / sperm of animals(الحيوان المنوي)/ algea (طحالب) / some plants
- they are acellular extensions of plasma membrane that contain Microtubules with a specialized arrangement of the microtubules (9+2) .

(9+2) means (Nine doublets of microtubules are arranged in a ring with two single microtubules in its center)

The basal body is a structure found at the base of cilia and flagellaand it modified centrioles

- cilia and flagella are struturally similar but differ in :-

1- length

2- Number per cell (Motile cilia usually occur in large numbers on the cell surface. Flagella are usually limited to just one per cell)

3- beat pattern (A flagellum has an undulating motion (حركة متموجة). /, cilia have alternating power and recovery strokes (قوة متضاربة وحركات انتعاش)).

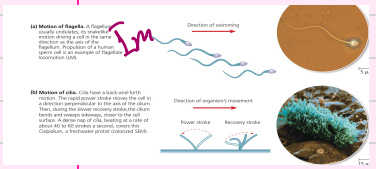
- the cilia might act as signals receiving

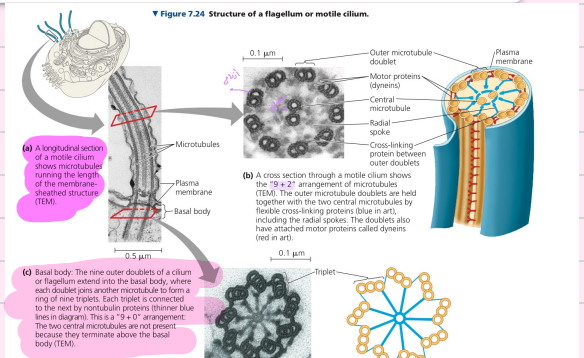
Example ;

-The cilia lining the trachea (windpipe قصبة هوائية) sweeps mucus containing trapped deters out of lungs

-In women's reproductive tract, the cilia lining the oviducts to help move an egg toward the uterus

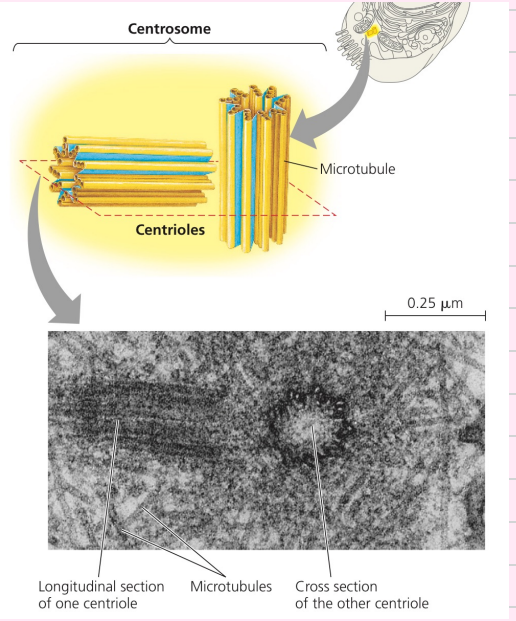
Extra
Out of syllabus





Centrosomes and Centrioles

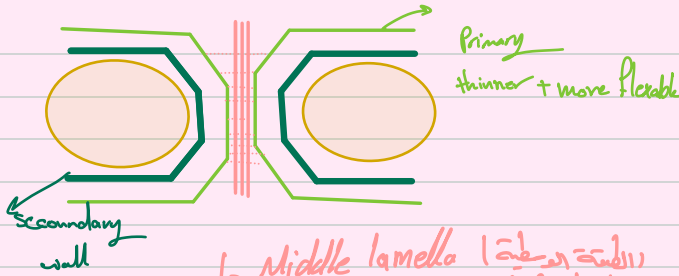
- Microtubules grow out from the centrosome → Which is located near the nucleus .
- These microtubules function as compression-resisting girders of the cytoskeleton.
- Within the centrosome a pair of centrioles → each one composed of 8 sets of three(triplet)(ثلاثية) Microtubules arranged in a ring
- It found in animal cells but some eukaryotes it's centrosomes lack centrioles



Call wall

The call wall is an extracellular structure of plant calls

The cell wall can be found in plants , prokaryotes and some protists and fungi)



Function

1- protection the cell
2- maintaining the shape of the call
3- preventing excessive uptake of water
4- holding the plant up against the gravity

The cell wall is made from →

microfibrils made of polysaccharide **cellulose** →

Plant cell wall more thicker than the plasma membrane →
the thickness ranging from 0.1 micro meter to several micrometers.

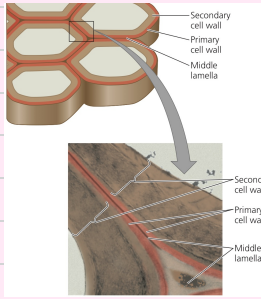
Which synthesized by enzyme called cellulose synthase also it secreted to the extra cellular space where they become embedded in matrix of other polysaccharides and proteins
This combination of materials (cellulose + proteins + polysaccharides)
→ is a strong fibers in a "ground substance "

The layers of cell wall

Primary cell wall → when a young plant cell secretes a relatively thin and flexible wall

##middle lamella → a thin layer rich in sticky polysaccharides called **pectins** and this lamella glues adjacent cells together / location ;Between primary walls of adjacent cells

Note
Pectin is used in cooking
as a thickening agent in jams and jellies



Secondary cell wall → When the cell matures and stops growing, it strengthens it's wall by two ways
→ some plant cells secrete hardening substances into the primary wall
→ other cells add a secondary wall betweenthe plasmamembrane and the primary wall which often deposited in several laminated layers which hush strongand durable matrix

The Extracellular Matrix (ECM) of Animal Cells

Animal cells have an elaborate extracellular matrix

the main ingredients of the ECM are **Glycoproteins** and other **Carbohydrate- containing molecules** which secreted by cell

Recall:

The glycoproteins are a proteins with covalently bonded carbohydrates.

Such as → protoglycan – fibronectin – collagen

collagen →

The most abundant glycoprotein in the ECM

- which forms strong eibers outside the cells
- the collagen accounts about 40% of total protein in human body
- The collagen fibers are embedded in a network woven out منسوجة من of proteoglycans secreted by the cell

Proteoglycan→

- A proteoglycan molecule consists of a small core protein with many carbohydrate chains.
- Protein +carbohydrates → covalently attached
- so that it may be up to 95% carbohydrate.
- the proteoglycans are attached to ((polysaccharide molecule))
- (proteoglycans +one polysaccharide) = proteoglycan complex

Fibronectin

- it's function communicating with the cell through integrins which leads to (the ECM can regulate a cell's behaviour)
- it is a CEM glycoprotein which attached to the cell
- This ECM proteins bind to cell-surface receptor proteins called

Glyco proteins بروتين سكري

Proteoglycan سكر بروتين

integrins

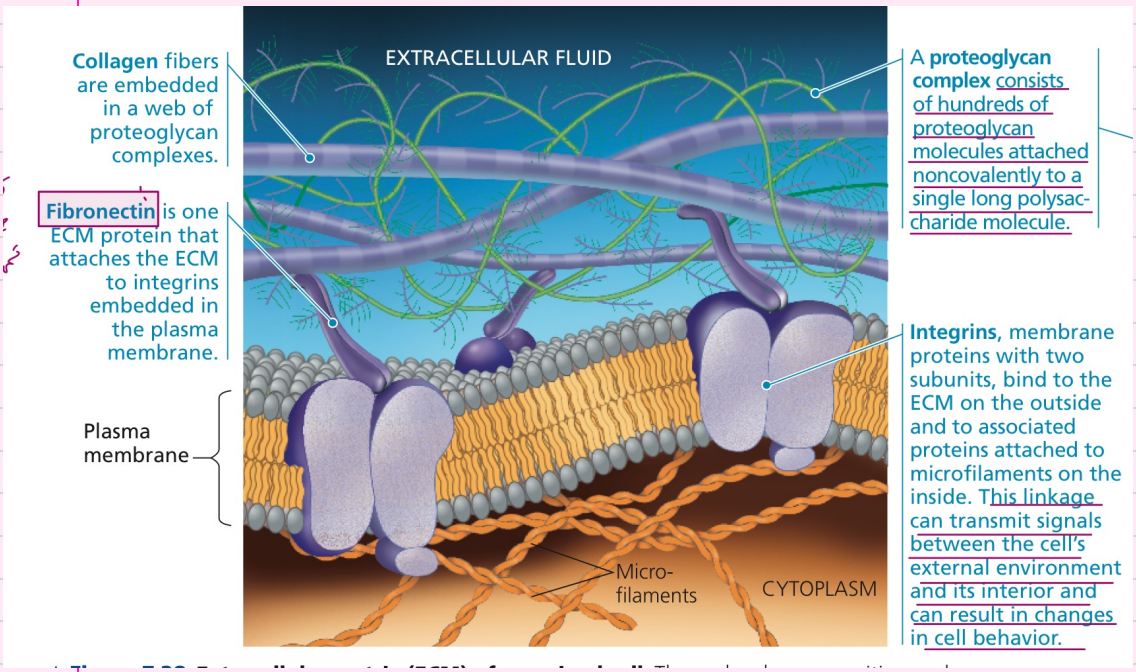
A membrane protein act like receptor protein (with two subunit) →built into the plasma membrane

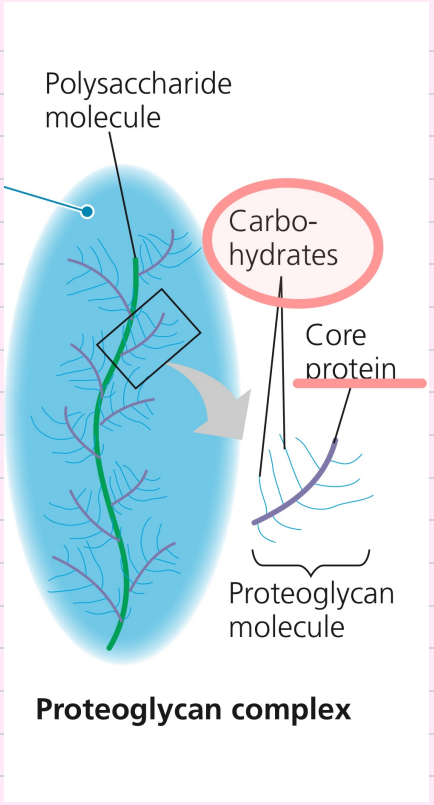
We have two sides →

1- the inner side:- (cytoplasmic side)the integrins are associated proteins attached to microfilaments of the cytoskeleton

2- outer side - bird to the ECM

- Integrins are in a position to transmit signals between the ECM and the cytoskeleton and thus to integrate changes occurring outside and inside the cell.





Note
Fibronectin outside in ECM
Micro filaments inside in cytoplasm

Note :-
Large proteoglycan complexes can form when hundreds of proteoglycan molecules become noncovalently attached to a single long polysaccharide molecule,

Cell junctions

Cells are organized into tissues, organ systems

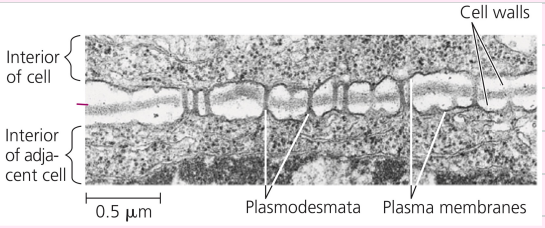
Neighboring cells often adhere, interact, and communicate via sites of direct physical contact.

Plant cells

Plasmodesmata

are channels that connect plant cell walls

- Through plasmodesmata, water and small solutes (and sometimes proteins and RNA) can pass from cell to cell
- the plasma membranes of adjacent cells line the channel of each plasmodesma and thus are continuous
- the cells share the same internal chemical environment - because the channels are filled with the cytosol
-



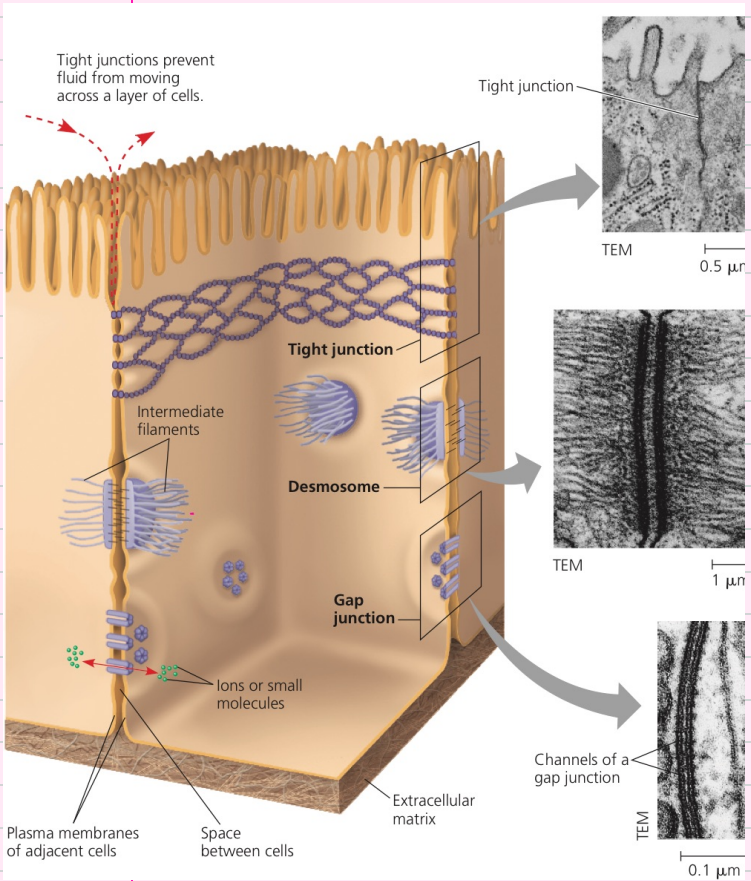
animal cells

Tight Junction

Desmosomes

Gap Junctions

All three types of cell junctions are especially common in epithelial tissue, which lines the external and internal surfaces of the body



Tight Junctions

- the plasma membranes of nighboring cells are very rightly pressed against each other
- bound together by specific proteins
- forming continuous seals around the cells
- it establish a barrier that prevents leakage of extra cellular fluid across a layer of epithelial cells →
- ex: -Tight junctions between skin cells make us watertight

Desmosomes

- Function like rivets مسامير
- Fixing cells together into strong sheets
- The intermediate filaments made of keratin proteins

→ This intermediate filaments anchor تثبت desmosomes in the cytoplasm

Ex :- Desmosomes attach muscle cells to each other in a muscle

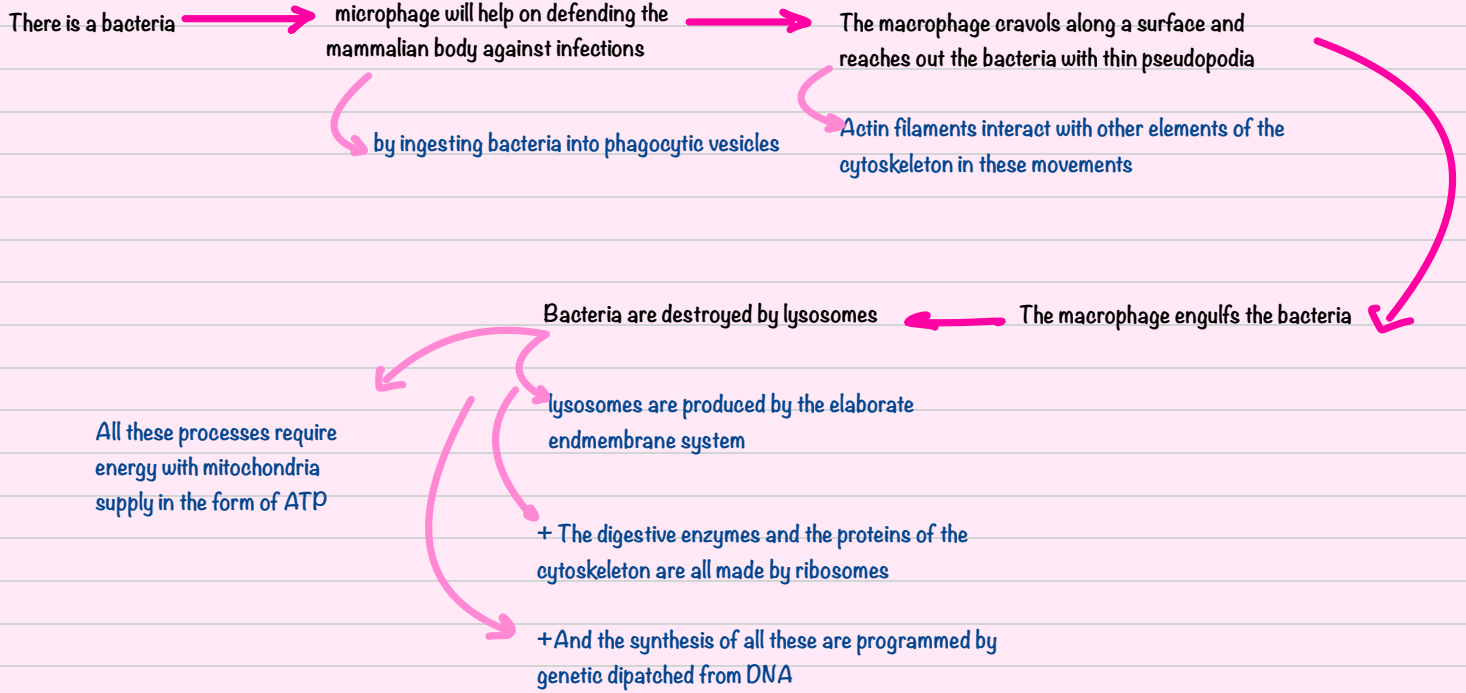
Gap junctions

- provide cytoplasmic channels from one

cell to an adjacent cell and

- they are similar in their function to the plasmodesmata in plants.
- Gap junctions consist of membrane proteins extending from the membranes of the two cells.
- → These proteins create pores through which ions, sugars, amino acids, and other small molecules may pass.
- Gap junctions are necessary for communication between cells in many types of tissues
- Ex:- heart muscle, and in animal embryos.

Remember that none of a cell's components work alone.



the end

By Tala Alali

دعوة حلوة من الناس الحلوة