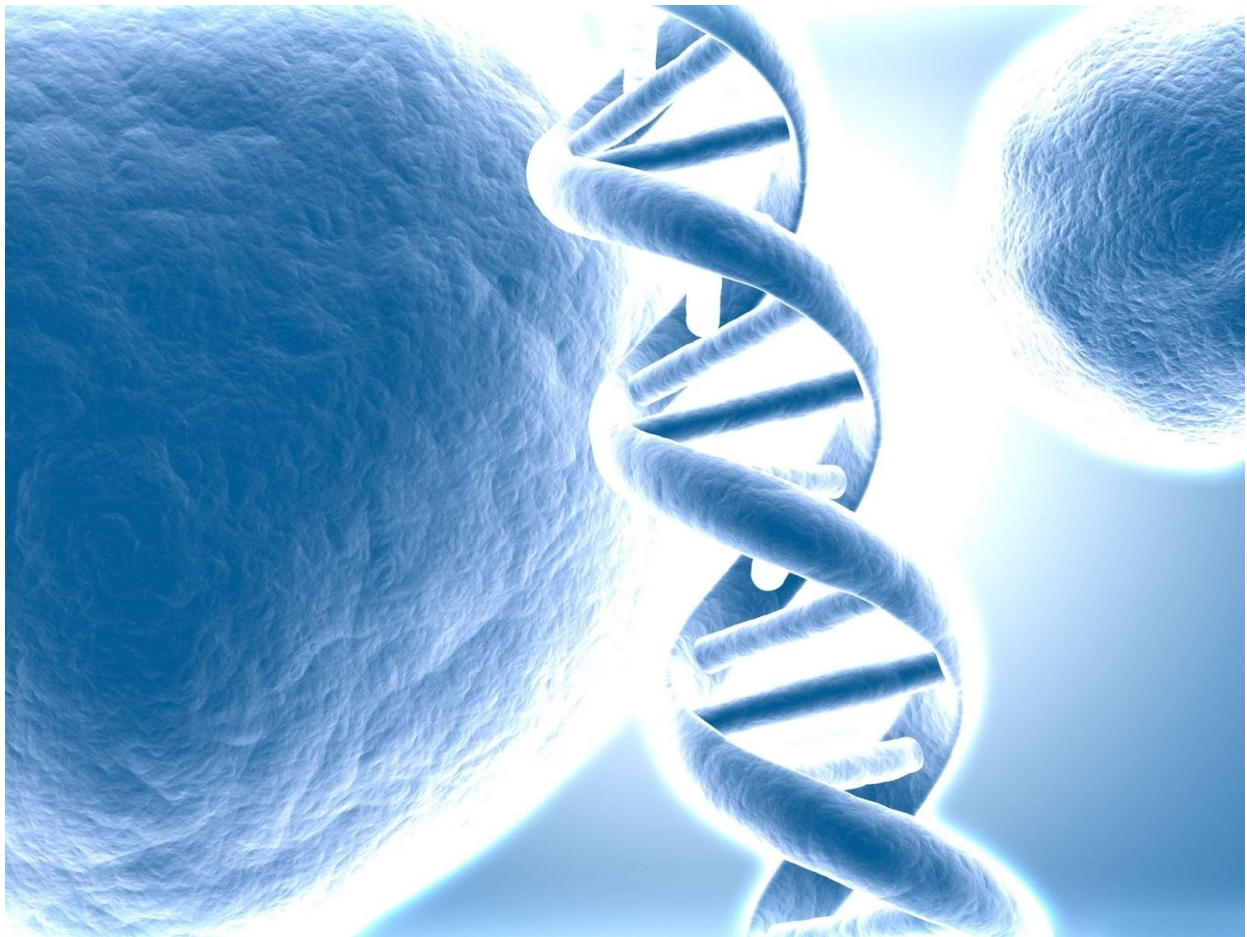


Chapter (2) Cell: structure and function

Lesson (1) Cell theory



Cell: *The building unit of living organisms which can carry out all vital processes.*

Diversity of cells

Cells have different shapes which are suitable for their functions, for example:-

Nerve cells (neurons):-

Neurons are long to be able to send messages from the spinal cord (in the vertebral column) to all body parts.

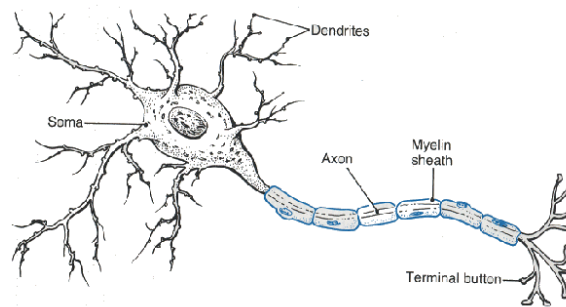


Fig. (1) Neuron

Muscle cells:-

They are long cells with cylinder shape which form muscle tissues. They have the ability to contract and relax to be able to move.

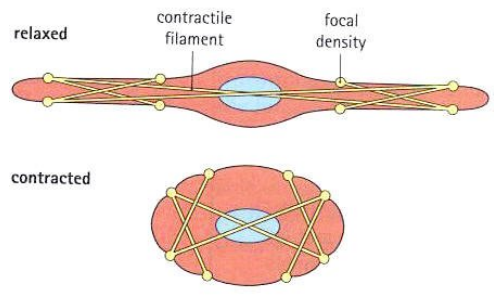


Fig. (2) Muscle cell

Cell theory

Scientists who took part in cell discovery:-

Robert Hooke

*An English scientist who discovered cell. He invented a simple microscope in 1665 and examined a piece of cork using it. He concluded that it consists of a number of tiny vacuoles. He named these vacuoles "**Cells**"*

→ The word "Cell" is derived from the Latin word "Cellula" which means "Vacuole or small chamber"

Antonie Van Leeuwenhoek

A Dutch scientist who worked as an employee in the government. He was fascinated about lenses. In 1674, he used these lenses to make a simple microscope of magnification power 200x.

This microscope was used to examine blood, lakes water and other things. Therefore, Leeuwenhoek was the first to see the world of living cells and microorganisms.

Mathias Shleiden

A German scientist who discovered in 1838 that all plants consist of cells.

Theodor Schwann

A German scientist who discovered in 1839 that all animals consist of cells.

Rudolf Virchow

A German physician who stated in 1855 that:-

- Cell is not only the building unit of living organisms, but only the functional unit of them.
- Cells are produced only from cells that existed before them.

The efforts of those scientists formed the so-called "**Cell theory**" which is one of the most important theories in modern life science.

Cell theory has three laws, which are:-

- 1- All living organisms are composed of one or more cells. (See Shleiden and Schwann)
- 2- The cell is the basic unit of structure, function, and organization in all organisms. (See Rudolf Virchow)
- 3- All cells come from pre-existing living cells (See Rudolf Virchow)

Evolution of microscopes

Light microscope

It was the only method available for scientists till 1950.

Properties of light microscope

- 1- It depends on light (sunlight, artificial light)*
- 2- It can magnify things by cutting them to thin slices which allow light to penetrate them.*
- 3- It can magnify things up to 1500 times according to the magnification power of the eyepiece and objective lenses in it. They cannot magnify more than 1500 times because this makes the photo unclear.*

*The magnification power of light microscope = Magnification power of eyepiece
x magnification power of objective lense*

Scientists discovered better ways to observe samples clearly by increasing the differentiation between the parts of the sample

These are two of the methods of increasing the differentiation between parts of samples:-

***1- Dyeing certain parts of the sample to become clearer** as what happens when examining white blood cells.*

Disadvantages of method: Dyes kill living samples.

2- Changing the level of lighting



Fig. (3) Light microscope

Electronic microscope

Scientist began using electronic microscopes in 1950.

How does an electronic microscope work

A beam of electrons with great speed is used instead of light. These electrons are controlled by electromagnetic lenses. This microscope has a magnification power of 1,000,000x (one million).

Importance

It helped scientist discover unknown cellular organelles and more accurate details about unknown structures.

→ *Electronic microscope is better than light microscope because:-*

- it gives clearer magnified photos with high differentiation due to the short wave length of electronic beams.*
- It receives the magnified photos of bodies on fluorescent screen or very sensitive photo screen.*



Fig. (4) Electronic microscope

Kinds of electronic microscopes

1- Scanning electronic microscope: *Used to study the cell surface*

2- Transmission electronic microscope: *Used to study the internal structure of cell.*

Definitions of lesson (1)

Cell: The building unit of living organisms which can carries out all vital processes inside living organisms.

Cell theory: A theory which states that all living organisms consist of one or more cells, cell is the basic functional and structural unit of living organisms, and that cells are produced for pre-existing ones.

Light microscope: A microscope which works by artificial light and sunlight with magnification power of 1500x.

Electronic microscope: A microscope which works by beams of electrons controlled by electromagnetic lenses instead of light, it has magnification power of 1,000,000x.

Show the importance of

Light microscope: It can magnify things up to 1500 times according to the magnification power of the eyepiece and objective lenses in it.

Electronic microscope: This microscope can magnify thing up to one million 1,000,000 times.

Scanning electronic microscope: Used to study the cell surface

Transmission electronic microscope: Used to study the internal structure of cell.

Give reasons for

1- Robert Hooke contributed in the discovery of cell.

Because he examined a piece of cork using a simple microscope and discovered that it consists of vacuoles called cells.

2- Antoine Van Leeuwenhoek is called the father of microscopy.

Because he invented a microscope in 1674 which could magnify samples up to

3- The theories of scientists Schleiden and Schwann are the basis of cell theory.

Because Schleiden stated that all plants consist of cells in 1838, and Schwann proved the same to animals in 1839.

4- Physician Rudolf Virchow was among those who formulated cell theory.

Because he proved that is the building and functional unit of living organisms, and that cells are produced from pre-existing ones.

5- The importance of light microscope.

Because it has the ability to magnify things up to 1500 times, which helped scientists examine cells

6- The importance of electronic microscope.

Because it has the ability to magnify things up to 1,000,000 times clearly, and give magnified photos of bodies on fluorescent screen.

Questions

1- Choose the correct answer

1- Scientist gave the name cells to cork vacuoles

A- Robert Brown B- Rudolf Virchow C- Robert Hooke D- Leeuwenhoek

2- Scientist invented a microscope that has magnification power of 200x

A- Leeuwenhoek B- Mathias Schleiden C- Theodor Schwann D- Virchow

3- Scientist stated that cells are produced from pre-existing ones.

A- Schleiden B- Virchow C- Robert Brown D- Charles Darwin

4- microscope has magnification power of 1500x

A- Electronic B- Light C- Stereo D- Digital

5- microscope works by sunlight and artificial light.

A- Electronic B- Light C- Stereo D- Digital

2- Complete

1- Scientist coined the term cell, while scientist..... stated that all animals consist of cells.

2- Light microscope is composed of two lenses which are and

3- Light microscope has a magnification power of x, while electric microscope has a magnification power ofx

4- Scientist stated that cell is the functional unit of living organisms, while scientist Stated that all plants are composed of cells.

5- Scientist Invented a microscope in 1674 of magnification power ofx

3- Write the scientific term

1- The building unit of living organisms.

2- A microscope which depends on light and has a magnification power of 1500x

3- A microscope which gives clear magnified photos of samples with high differentiation.

4- Show the importance of

1- Light microscope

2- Electronic microscope

3- Scanning electronic microscope

4- Transmission electronic microscope

5- Give reasons for

1- Robert Hooke contributed in the discovery of cell.

2- Antoine Van Leeuwenhoek is called the father of microscopy.

3- The theories of scientists Schleiden and Schwann are the basis of cell theory.

4- Physician Rudolf Virchow was among those who formulated cell theory.

5- The importance of light microscope.

6- The importance of electronic microscope.

6- Calculate the magnification power of a compound microscope in which:-

- The magnification power of its eyepiece equals 60x

- The magnification power of its objective lens equal 14x

Lesson (3) Cell ultra structure



Cell is the functional and structural unit of living organisms, it can reproduce, respond to environment, and even respire!!

Cell is like a factory

If you visit a factory of food industries, you will find it surrounded by a wall, and has :-

- Manager's office*
- Ovens*
- Belts*
- Food preparation systems*
- Store*

The components forming a factory are exactly like those forming a cell, in the following table we'll compare cell to a factory.

| <i>The factory</i> | <i>The cell</i> | <i>Function</i> |
|---------------------------------|------------------------------|--|
| <i>Factory wall</i> | <i>Plasma membrane</i> | <i>Allowing substances to enter and get out.</i> |
| <i>Manager's office</i> | <i>Nucleus</i> | <i>The centre of control</i> |
| <i>Oven</i> | <i>Mitochondria</i> | <i>Generating energy</i> |
| <i>Belts</i> | <i>Endoplasmic reticulum</i> | <i>Transporting substances to cells</i> |
| <i>Food preparation systems</i> | <i>Ribosomes</i> | <i>Making food</i> |
| <i>Stores</i> | <i>Saps</i> | <i>Storage</i> |

Cell parts

*Cell is composed of a protoplasmic substance surrounded by cell membrane. Protoplasm consists of **cytoplasm** and **nucleus**.*

Cells are divided into:-

- 1- Animal cells*
- 2- Plant cells*

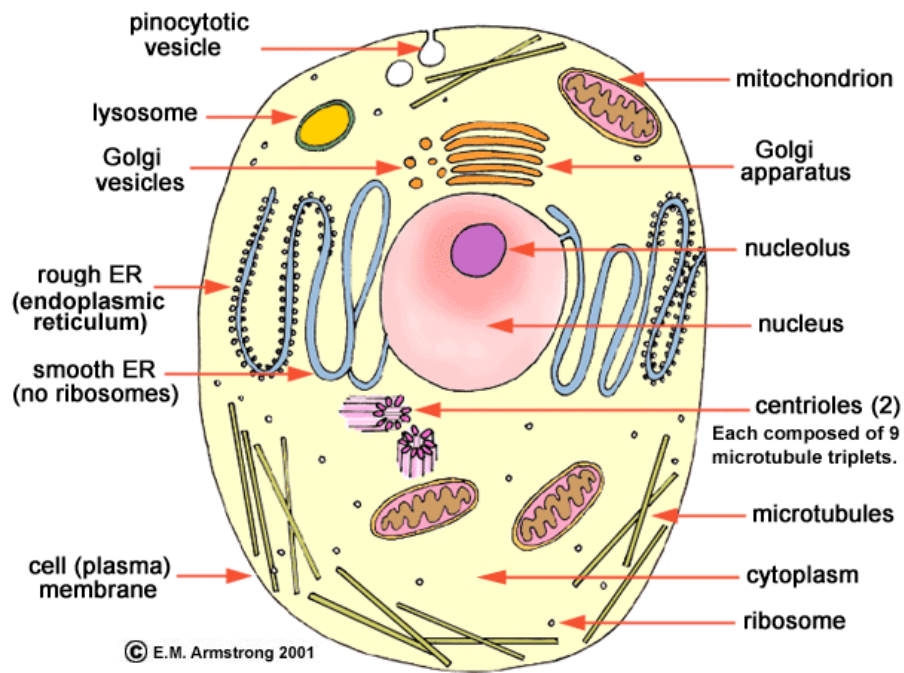


Fig. (5) Structure of animal cell

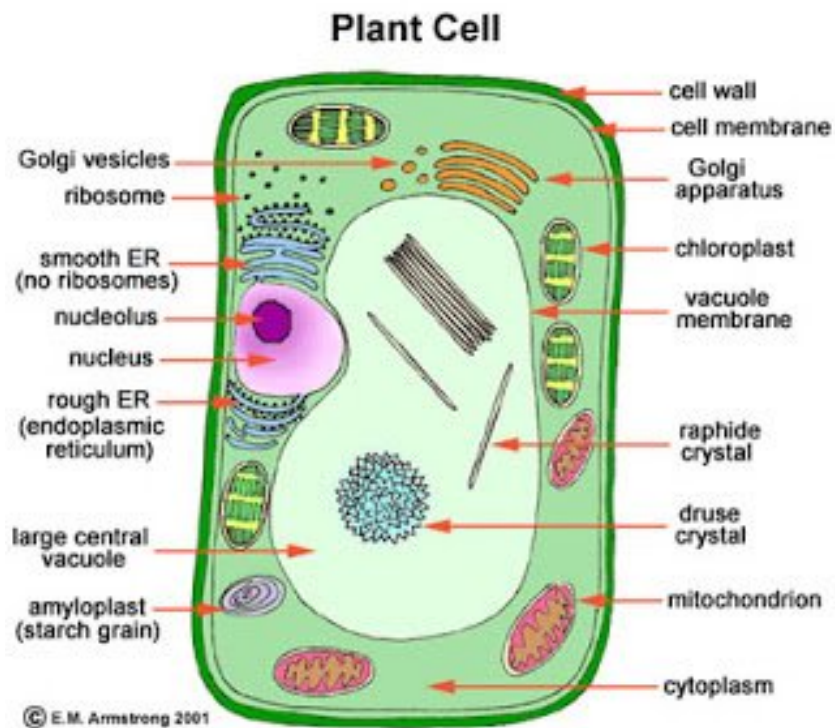


Fig. (6) Structure of plant cell

First: Cell wall

The cells of some bacteria, fungi, plants and algae are surrounded by a wall of Cell wall.

→ Cell walls have holes and made up of cellulose fibres, which makes substances and water pass through them easily.

Function of cell walls:-

They support and protect plant cells, and give them their definite shapes.

Second: Plasma membrane

Definition: *A thin membrane which surrounds the cell, it separates between the cell components and its external medium.*

Function:-

- 1- It organizes the passage of substances to and from the cell.*
- 2- It prevents the spread of cytoplasm outside the cell.*

Structure:-

Cell membrane is composed of phospholipid bi- layer. The hydrophilic heads (heads which can dissolve in water) of these molecules face the aqueous medium outside cell, while the hydrophobic tails (tails which cannot dissolve in water) exist inside.

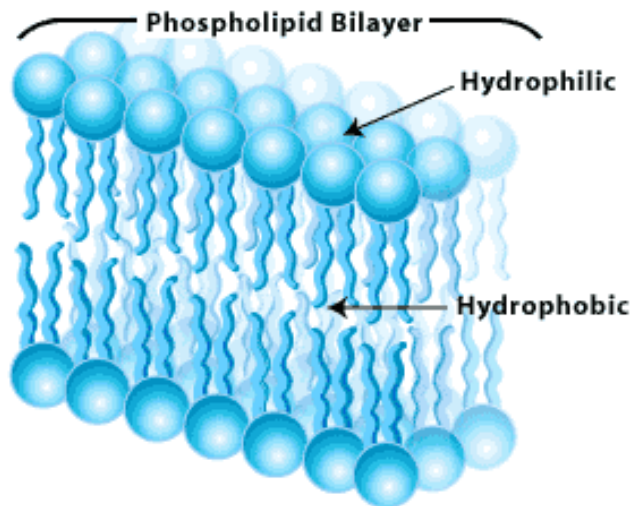


Fig. (7) Phospholipid bilayer in cells

There are some protein molecules between the two layer of phospholipids which work as:-

- Passages of the substances that enter and get out of the cell.
- Regions to identify the substances entering cells (such as hormones and nutrients)

→ Cell membrane is liquid (resembles oil in water) because the phospholipids forming it are in liquid state.

→ There are some cholesterol molecules bound to phospholipids in cell membrane to keep the membrane cohesive.

Third: Nucleus

Definition: The largest and most obvious organelle in cell, it has a spherical or ellipsoidal shape.

Nucleus consists of:-

1- Nuclear membrane

A double layer which separates between the components of the nucleus and cytoplasm. It has **nuclear pores** through which substances pass between the nucleus and cytoplasm

2- Nucleoplasm

A jelly-like transparent fluid which contains some filaments coiled around each other called **chromatins**

3- Nucleolus

There might be more than one nucleolus in cells (especially those which are responsible for secreting proteins like enzymes and hormones)

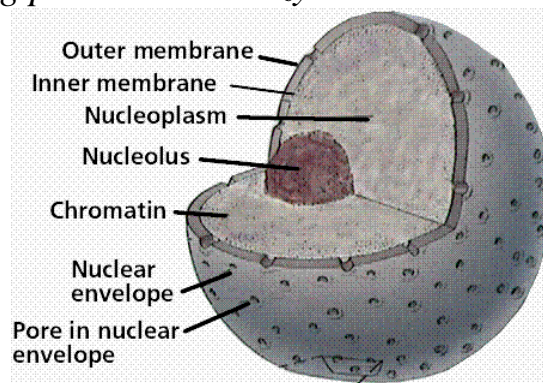


Fig. (8) Structure of nucleus

Structure of chromosomes:-

During cell division process, chromatins condense forming chromosomes. Chromosomes appear at Metaphase stage during cell division process in the form of two threads (two chromatids) attached together at a point called centromere

Structure of chromatids

Chromatids are composed of DNA coiled around Histones proteins.

DNA carries the hereditary traits of living organisms, which are being inherited across generations by reproduction process

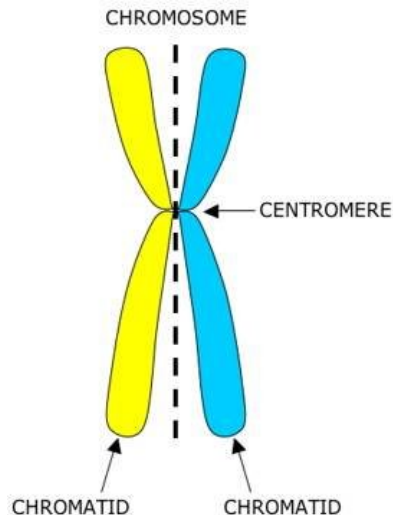


Fig. (9) Structure of chromosome

N.B: *Chromosome (Word derived from Latin which means colour body) is called by this name because it is stained by basic dyes which makes it more obvious during cell division.*

The importance of nucleus

- 1- It controls cell division process.*
- 2- It contains the nucleolus which is responsible for forming ribosomes (which synthesize proteins).*

Fourth: Cytoplasm

Definition: *A semi-fluid substance filling the space between the nucleus and cell membrane. It's composed of water and other organic and inorganic substances.*

Cytoplasm contains group of microtubes and filaments called cytoskeleton, which:-

- 1- Supports the cell.*
- 2- Works as passages for the transport of substances within cell*

Cytoplasm also contains cell organelles, they are divided into:-

Membranous organelles: *Organelles surrounded by membranes*

Examples: Golgi bodies – endoplasmic reticulum – plastids - mitochondria – Vacuoles.

Non-membranous organelles: Organelles which are not surrounded by membranes

Examples: ribosomes and centrosomes.

1- Ribosomes

They are non-membranous round organelles inside the cell which synthesize proteins, they exist in two regions of the cell:-

1- In Cytoplasm: They synthesize protein and send it immediately to the cytoplasm to be used in growth and renewal processes.

2- Attached to the external surface of endoplasmic reticulum: They are more than those in cytoplasm, they synthesize proteins which are send outside the cell through the inner endoplasmic reticulum after modifying them.

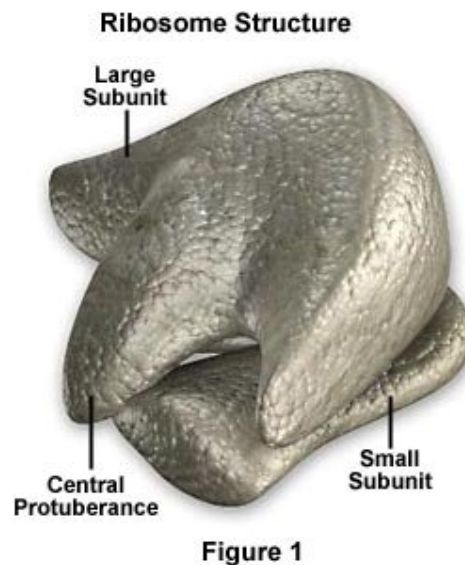


Figure 1
Fig. (10) Structure of ribosome

2- Centrosome

A structure which exists in animal cells (except nerve cell). It is composed of two particles called centrioles

There aren't any centrosomes in plant, algae and most fungi cells, but instead, there are parts of cytoplasm that carry out the functions of centrosomes.

Function:-

1- It plays an important role in cell division process because spindle fibres between the two centrioles extend between the poles of cell, which helps the cell split into two cells.

2- It forms cilia and flagella.

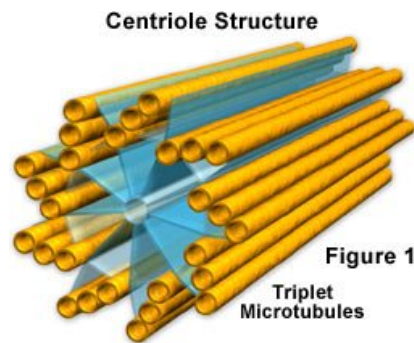


Fig. (11) the structure of centriole

3- Endoplasmic reticulum

A group of membranous microtubules which permeate all parts of cytoplasm, it is connected with both plasma and nuclear membranes.

Function: It transports substances across all parts of cell and from nucleus to cytoplasm.

Types of endoplasmic reticulum:-**Smooth Endoplasmic reticulum**

It doesn't have any ribosomes, it works on:-

- 1- Synthesizing lipids in cells.
- 2- Changing carbohydrates into glycogen.
- 3- Changing the nature of some toxins to become less poisonous

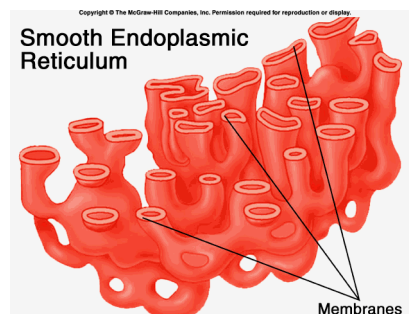


Fig. (12) Smooth endoplasmic reticulum

Rough Endoplasmic reticulum

It has a great no. of ribosomes, its works on

- 1- Synthesizing proteins in cells.*
- 2- Modifying proteins produced by ribosomes*
- 3- Producing new membranes for cells.*

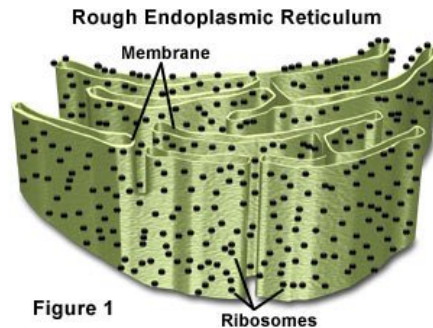


Fig. (13) Rough endoplasmic reticulum

4- Golgi body

A group of flat membranous sacs with spherical ends.

Function:-

It receives the substances produced by endoplasmic reticulum through transport vesicles. Then, it classifies these substances, modify them, and send them to:-

- Parts of cells which may use them.*
- Secretory vesicles which expel them from cell in the form of secretions.*

(N.B: The no. of Golgi bodies inside cell differs according to the secretory activity of cell, The cells of glands have great no. Golgi bodies)

Golgi bodies were named after scientist "Camillo Golgi" who was the first to describe them in 1898.

Golgi bodies in plants and algae are called "Dictyosomes"

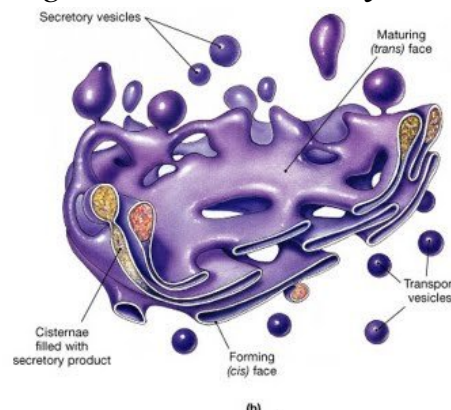


Fig. (14) Structure of Golgi body

5- Lysosomes

They are small spherical membranous vesicles formed by Golgi bodies, they contain digestive enzymes within them.

Function:-

1- Getting rid of useless old and destroyed cells or organelles.

2- Digestion of nutrients being swallowed by cells and breaking them to simple substances.

→ White blood cells use Lysosomes in killing microbes.

→ Cell is not affected by the enzymes of Lysosomes because their enzymes are separated from the other components of cell by a membrane.

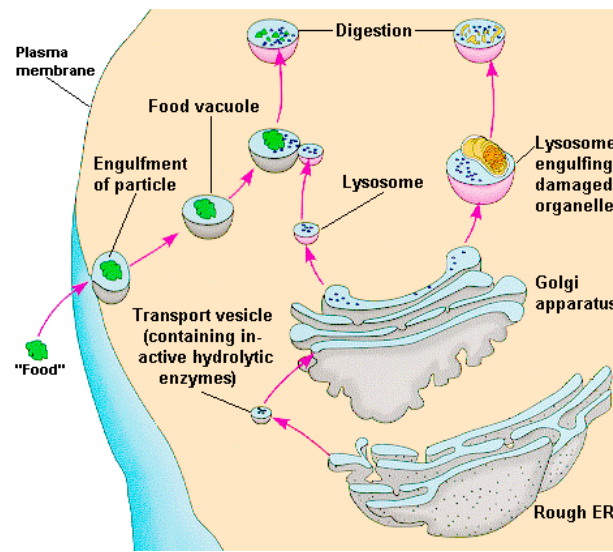


Fig. (15) Lysosomes function

6- Mitochondria

A sac-like membranous structure that exists in all cells, it is composed of:-

1- Inner membrane

It includes folds in it called Cristae

2- Cristae

They are folds occurring in the inner membrane, they increase the surface area of the medium of chemical reactions occurring inside mitochondria to speed them up

3- Outer membrane

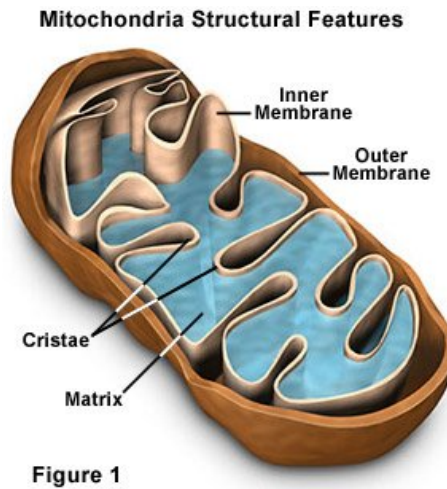


Fig. (16) Structure of mitochondria

Function of mitochondria

- 1- It stores respiratory enzymes in the cell*
- 2- It stores substances which are formed as a result of oxidation of nutrients such as glucose.*
- 3- It stores the energy resulted from respiration process in the form of a compound called Adenosine Triphosphate (ATP) from which the cell can release energy again.*

7- Vacuoles

They are small membranous sacs which exist in cells, they exist with great no. in animal cells, they can accumulate in one or more bigger vacuoles in plant cells.

Function: *They store water, wastes and food till the cell use or get rid of them.*

8- Plastids

They are membranous organelles which have different shapes and exist in plant cells, there are three kinds of plastids which are classified according to the kind of pigments in them, they are:-

Leucoplasts (White plastids)

They are colourless plastids which don't contain any pigments.

Function: *They store starch.*

They exist in cells of:-

- 1- Inner cauliflower leaves*
- 2- Potato roots*

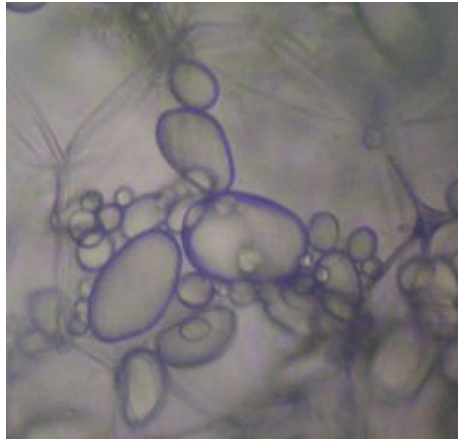


Fig. (17) Leucoplasts under microscope

2- Chromoplasts (Coloured plastids)

They contain pigments called "carotenoids", their colours may be red, orange or yellow.

They exist in cells of:-

- 1- Petals of flowers and fruits.*
- 2- Roots of some plants such as radish*

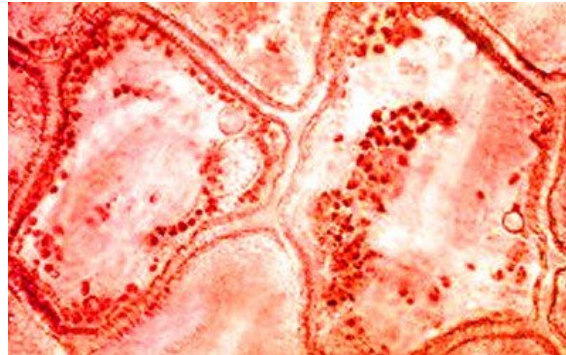


Fig. (17) Chromoplasts under microscope

3- Chloroplasts (Green plastids)

They contain chlorophyll pigment which change the light energy of sun to chemical energy stored in glucose chemical bonds

They exist in the cells of:-

Green leaves and stems of plants.

Structure:-

A chloroplast consists of :-

- 1- Inner membrane*
- 2- Outer membrane*
- 3- Stroma: An inner filling surrounded by the bi-layer membrane*
- 4- Granum: Stacks of inner membranes in the form of disks.*

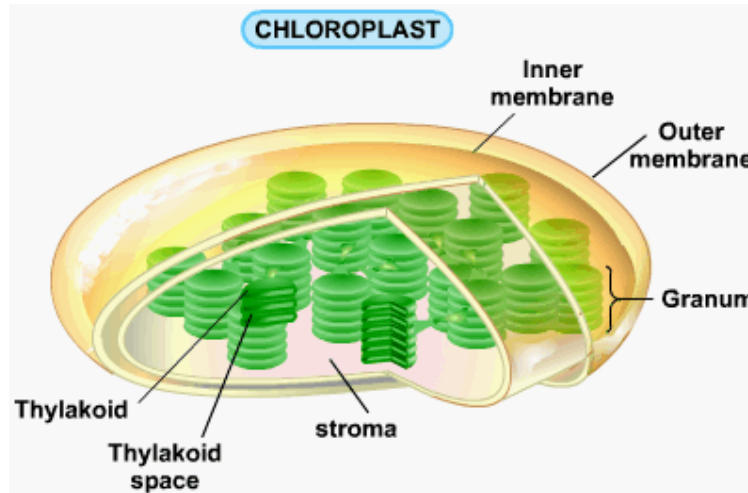


Fig. (18) Structure of a chloroplast

Prokaryotic and eukaryotic cells

Living organisms are classified according to their cells structure into:-

Prokaryotic cells: *Such as bacteria*

Eukaryotic cells: *Such as Monera, protista, fungi, plants and animals*

Common properties between prokaryotic and eukaryotic cells

- 1- They are surrounded by cell membranes which separate between their internal structures and their external mediums.*
- 2- They both have cell organelles that allow cell carry out its vital processes.*
- 3- They have cytoplasm in which cell organelles are suspended, it has substances which are essential for cell such as water, salts and enzymes.*
- 4- They have the hereditary material essential for their reproduction which control all the processes within cells.*

Prokaryotic cells

- 1- They are much smaller than eukaryotic cells
- 2- Their structures are less complex
- 3- They don't have any nuclei, as their hereditary material exist in cytoplasm directly
- 4- They don't have many organelles as eukaryotic cells. However, they can perform all cellular activities (nutrition, respiration, movement, reproduction, responding to environment...etc)

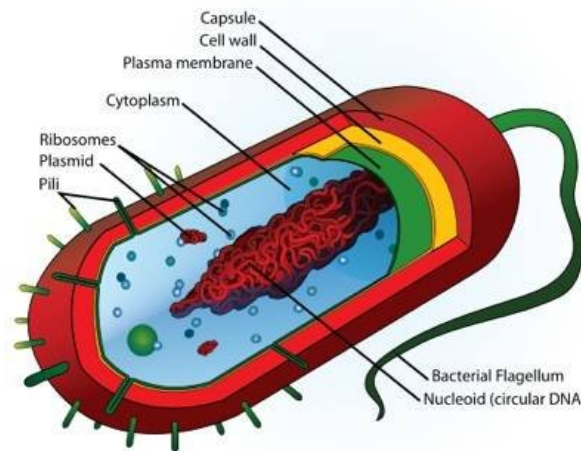


Fig. (19) Prokaryotic cell

Eukaryotic cells

- 1- They are bigger than prokaryotic cells
- 2- They have complex internal structure
- 3- Their hereditary material are surrounded by nuclear membrane (they have nuclei)
- 4- They have many organelles

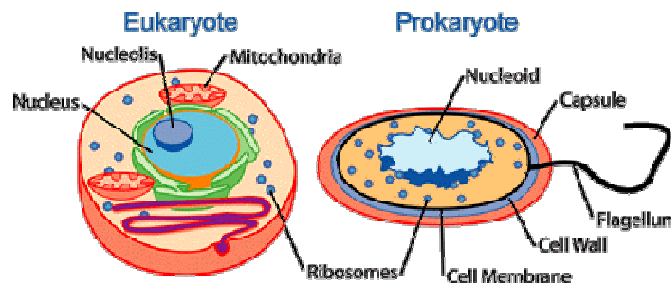


Fig. (20) Comparison between eukaryotic and prokaryotic cells

Definitions of lesson (2)

Cell wall: A wall made of cellulose which surrounds the cell membranes of plant cells and gives them definite shapes.

Cell membrane: A thin membrane which surrounds all cells, it consists of phospholipid bi-layer and allows the passage of substances to and from the cell.

Nucleus: The largest and most obvious organelle in eukaryotic cells which carries chromosomes which are responsible for transferring hereditary traits to the offspring.

Cytoplasm: A jelly-like fluid filling the space between the nucleus and cell membrane which consists of water, inorganic and organic compounds.

Ribosomes: Spherical organelles which occur in cytoplasm or endoplasmic reticulum of cells, they play an important role in protein synthesis process.

Centrosome: An organelle in animal cells which consists of two centrioles, it plays an important role in cell division process.

Endoplasmic reticulum: A group of membranous tubes which spread across the cell and connected with both cell and nuclear membranes, it plays an important role in transporting substances around the cell.

Golgi body: A flat membranous sac-like organelle which receives the substances transported by endoplasmic reticulum and distribute them across cell parts.

Lysosome: A small spherical membranous organelle which plays an important role in digesting nutrients and getting rid of wastes.

Mitochondria: An organelle inside living cells which plays an important role in generating energy.

Vacuoles: Membranous sacs inside cells which store water, nutrients and wastes

Plastids: Membranous organelles which occur in plant cells.

Leucoplasts: They are colourless plastids which don't contain any pigments.

Chromoplasts: They are coloured plastids which contain coloured pigments called carotenoids.

Chloroplasts: They are green plastids which contain green pigment called chlorophyll, they play an important role in photosynthesis process.

Prokaryote: A Cell whose hereditary material is not surrounded by a nuclear membrane and don't have many cell organelles such (ex. Bacteria)

Eukaryote: A Cell whose hereditary material is surrounded by a nuclear membrane and has many cell organelles.

Show the importance of

Cell wall: It supports plant cells and allows the passage of substances from and to them.

Cell membrane:-

- 1- It identifies the substances entering the cell
- 2- It allows the passage of substances from and to cells

Nucleus:-

- 1- It controls all processes occurring in cell
- 2- It contains chromosomes which contain genes (hereditary material)
- 3- It controls cell division process
- 4- It contains the nucleolus which is responsible for the formation of ribosomes which synthesize proteins.

Cytoplasm:-

- 1- It supports the shape of cell.
- 2- It has microtubules and filaments through which substances are transported across the cell.

Ribosomes: They synthesize proteins in the cell

Centrosome: It plays an important role in cell division process in animal cells, as its centrioles migrate towards the two poles of cell forming spindle fibres.

Endoplasmic reticulum: They transport substances across all cell parts and from nucleus to cytoplasm

Smooth endoplasmic reticulum:-

- 1- It synthesizes lipids
- 2- It changes carbohydrates to glycogen
- 3- It modifies some toxins to make them less poisonous.

Rough endoplasmic reticulum:-

- 1- It contains ribosomes which synthesize proteins.
- 2- It modifies the proteins produced by ribosomes
- 3- It produces new membranes for the cell.

Golgi body: It receives the substances secreted by endoplasmic reticulum, modifies them and sends them to parts of cell which use them or outside it in the form of secretions.

Lysosomes:-

- 1- Getting rid of useless old or destroyed cells or organelles.*
- 2- Digestion of nutrients being swallowed by cells and breaking them to simple substances.*

Mitochondria:-

- 1- It stores respiratory enzymes in the cell*
- 2- It stores substances which are formed as a result of oxidation of nutrients such as glucose.*
- 3- It stores the energy resulted from respiration process in the form of a compound called Adenosine Triphosphate (ATP) from which the cell can release energy again.*

Vacuoles: *They store water, nutrients and wastes in cell*

Leucoplasts: *They store starch inside cells*

Chloroplasts: *They contain chlorophyll which plays an important role in photosynthesis process*

Chlorophyll: *it changes the light energy of sun into chemical energy and stores it in chemical bonds in glucose.*

Give reasons for

1- Plant cells have definite shapes

Because they are surrounded by cell walls made of cellulose which give plant cells their definite shapes

2- Cell membrane is in liquid state

Because the phospholipids forming it are in liquid state

3- Cell membrane is cohesive

Because there are cholesterol molecules bound to phospholipid ones, which makes the membrane cohesive

4- The importance of nuclear membrane in nucleus

Because it separates between the nucleus components and cytoplasm

5- Plasma membrane plays an important role in cell

Because it identifies the substances entering cells and allow their passage from and to them.

6- Nucleus is the most important organelle in cell

Because:-

- 1- It controls all processes occurring in cell*
- 2- It contains chromosomes which contain genes (hereditary material)*
- 3- It controls cell division process*
- 4- It contains the nucleolus responsible for the formation of ribosomes which synthesize proteins.*

7- Ribosome plays an important role in cell

Because it synthesizes proteins in cell

8- The importance of ribosomes which exist in cytoplasm

Because they synthesize proteins and send them to all cell parts to be used in vital processes like growth.

9- The importance of ribosomes which exist in endoplasmic reticulum

Because they synthesize proteins which the inner endoplasmic reticulum send out of the cell in the form of secretions

10- Centrosome plays an important role in animal cells.

Because it plays an important role in cell division process, as its centrioles migrate towards the two poles of cell forming spindle fibres. It also forms cilia and flagella which helps the cell move.

11- The importance of the smooth endoplasmic reticulum

Because it synthesizes lipids, changes carbohydrates into glycogen, and make some toxics less poisonous

12- The importance of rough endoplasmic reticulum

Because it contains a great number of ribosomes to synthesize proteins and modifies them, too.

13- Chromosome are called by this name

Because they contain basic dyes that colour them , as the word chromosomes is derived from Latin language and means "colour body"

14- Golgi bodies are called by this name

To honour scientist "Camillo Golgi" who discovered them in 1898.

15- Golgi bodies play an important role in cells

Because they receive substances produced by ER and transport them across the cell or expel them out of it in the form of secretions.

16- The importance of Lysosomes in cells.

Because they get rid of old and destroyed organelles or cells, and contain digestive enzyme that digest nutrient inside cells.

17- The importance of Lysosomes in white blood cells

Because they destroy microbes

18- Cell is not affected by the digestive enzymes of Lysosomes

Because Lysosomes are surrounded by membranes.

19- Mitochondria have folds in their inner membranes called Cristae

In order to increase the surface area on which chemical reactions occur to speed them up

20- The biological importance of Mitochondria inside living cells

Because they store respiratory enzymes, substances which contain stored energy, and the energy resulted from respiration in the form of a compound called Adenosine Triphosphate (ATP)

21- Most cells have vacuoles

To store water ,nutrients and wastes

21- Plant cells can perform photosynthesis process, while animal cells cannot

Because plant cells have chloroplasts containing chlorophyll, which change light energy of sun into chemical energy and store it in glucose chemical bonds, while animal cells do not have these chloroplasts.

22- Bacteria are prokaryotes

Because their hereditary materials are not surrounded by nuclear membranes but exist in cytoplasm, and they do not have many cellular organelles

23- Human cells are eukaryotic cells

Because their hereditary material are surrounded by nuclear membranes, and they contain many cellular organisms.

24- There are many Golgi bodies in glandular cells

Because Golgi bodies in these cells are responsible for secreting hormones.

What happens if

1-plant cells were not surrounded by cell walls.

They would not have definite shapes

2- Cell walls didn't have any pores (holes)

Water and dissolved substances would not be able to enter plant cells.

3- Nuclei of eukaryotes did not have any nuclear membranes surrounding them.

The components of nucleus would mix with cytoplasm

4- Cells didn't have ribosomes

Cells wouldn't be able to synthesize proteins

5- Animal cells didn't have centrosome

They wouldn't be able to divide into two cells, as the two centrioles of centrosome form spindle fibres across the cell during cell division process (which help the cell divide into two cells)

6- Cells lack endoplasmic reticulum

Substances won't be transported across and outside the cell.

7- Cells didn't have smooth endoplasmic reticulum

They wouldn't be able to synthesize lipids or form new membranes for cellular organelles.

8- Cells didn't have Golgi bodies

Substances wouldn't be transported from the endoplasmic reticulum to other parts of cell.

9- White blood cells didn't have Lysosomes

They wouldn't be able to destroy microbes

10- Living cells didn't have Lysosomes

They wouldn't be able to digest nutrients or get rid of wastes.

11- Lysosomes of cells are not surrounded by membranes

The digestive enzymes inside the cell would spread in cytoplasm which may harm it.

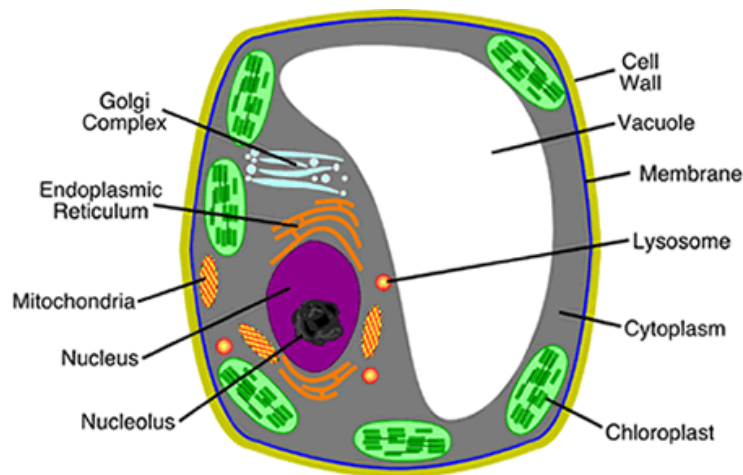
12- Cells didn't have mitochondria

They will not be able to store energy or respiration enzymes.

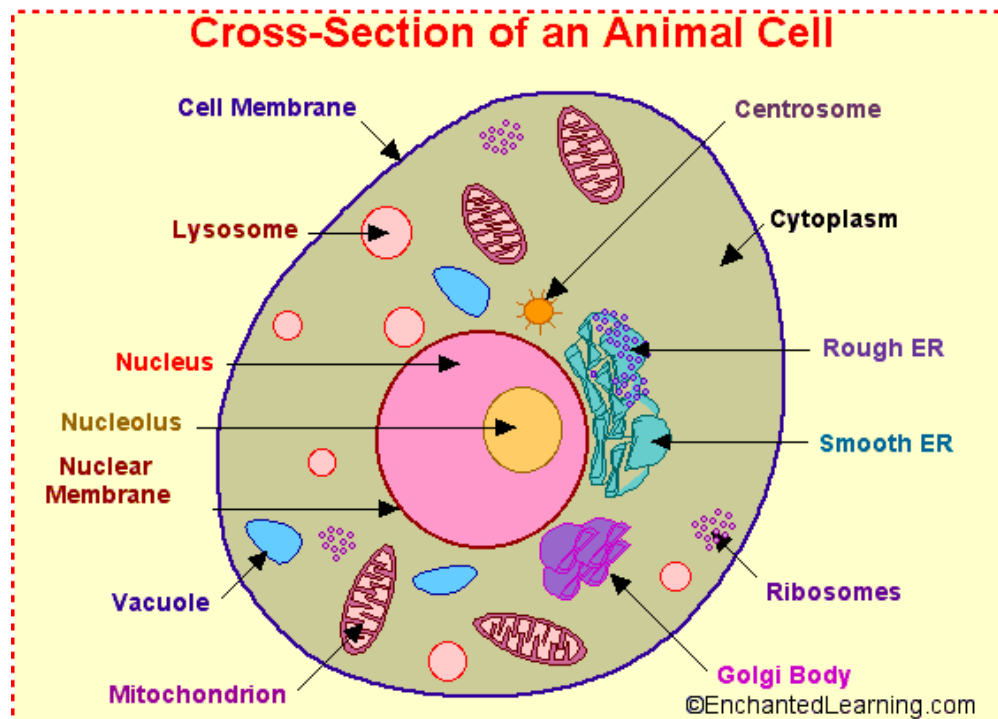
13- Plant cells didn't have chloroplasts

They will not be able to perform photosynthesis process

The structure of plant cell



The structure of animal cell



Questions

1- Choose the correct answer

1- Cell wall is formed from organic compound

A- Lipids B- Glucose C- Phosphoproteins D- Cellulose

2- Cell membrane is composed of

A- Phospholipids bi-layer
B- Cellulose layer
C- Chitin bi-layer
D- Glycoprotein bi-layer

3- are responsible for protein synthesis process in living cells.

A- Mitochondria B- Lysosomes C- Cytoskeleton D- Ribosomes

4- Centrosome exists in all animal cell except for.....

A- Nerve cells B- Sperm cells C- Liver cells D- Muscle cells

5- Chromosomes are formed in Stage of cell division

A- Anaphase B- Metaphase C- Telophase D- Prophase

6- form cilia and flagella in animal cells

A- Centrosome B- Mitochondria C- Lysosome D- Ribosome

7- is responsible for generating energy in cell

A- Centrosome B- Mitochondria C- Lysosome D- Ribosome

8- is responsible for digesting nutrients in cell.

A- Centrosome B- Mitochondria C- Lysosomes D- Ribosomes

9-..... are plastids which are devoid of pigments

A- Leucoplasts B- Chromoplasts C- Chloroplasts D- Chromatin

10- All the following organelles exist in animal cells except

A- Cell wall B- Cell membrane C- Mitochondria D- Lysosomes

11 cells do not have true nuclei.

A- Bacteria B- Monera C- Plants D- Animals

2- Complete

- 1- Cell walls are made up of an organic compound called, while cell membrane is made up to bi-layer
- 2- Nucleus contain a jelly-like fluid called, and filaments coiled around each other called
- 3- The point of connection of two chromatids of a chromosome is known as
- 4- A chromatid is composed ofand
- 5- Ribosomes synthesize, while smooth endoplasmic reticulum synthesizes
- 6- There are folds in the inner membrane of mitochondria called
- 7- Mitochondria store energy in the form of a compound called
- 8- Leucoplasts are used to store and exist in the cells of
- 9- Chromoplasts contain pigment, while chloroplasts contain..... pigment
- 10- help plant cells perform photosynthesis process because they contain

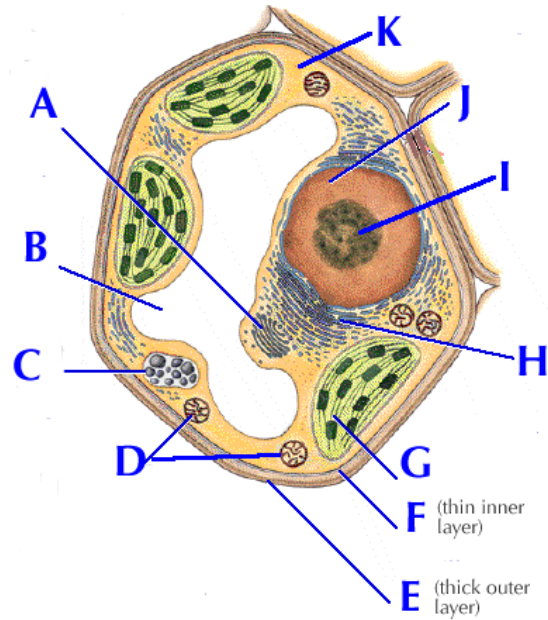
3- Write the scientific term

- 1- A cell that doesn't have a true nucleus and most cellular organelles
- 2- A cell which has a true nucleus and many cellular organelles.
- 3- A structure which is responsible for synthesizing proteins.
- 4- A structure which is responsible for synthesizing lipids.
- 5- A structure responsible for digesting nutrients
- 6- Pigments which exist in chromoplasts
- 7- A pigment which exist in chloroplasts
- 8- Thin filaments coiled around each other which turn into chromosomes during cell division process.

4- Compare between

- 1- Animal and plant cell
- 2- Prokaryote and eukaryote

5- This is the diagram of a typical plant cell, answer the following question

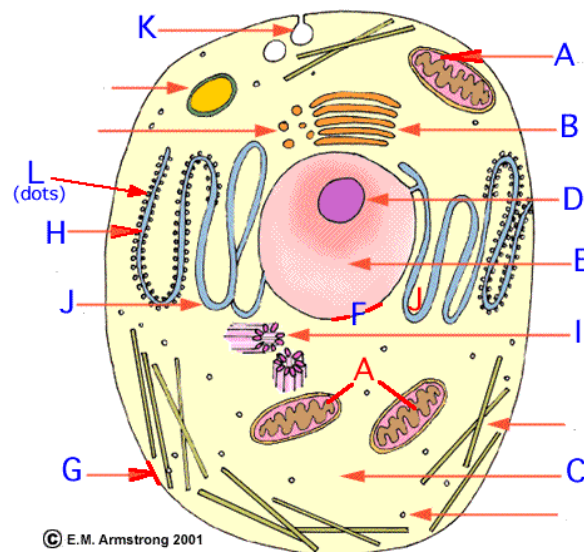


1- Label the previous cell

2- Mention the function of (A), (D) and (G)

3- Which organelle is responsible for synthesizing proteins?

6- This is the diagram of a typical animal cell, answer the following questions

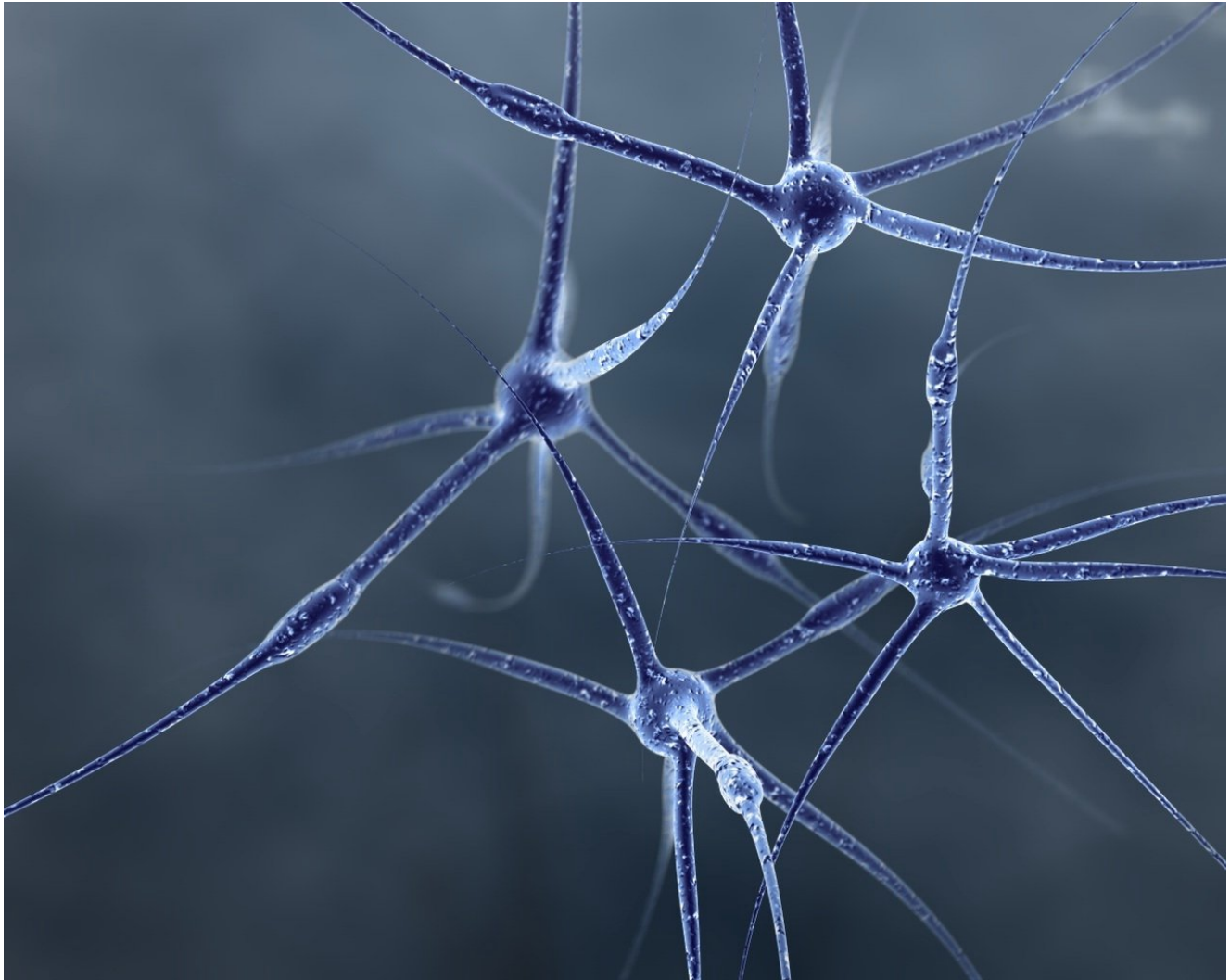


1- Label the previous cell

2- Mention the function of (A), (I), (J)

3- Which organelle is responsible for synthesizing lipids in cell?

Lesson (3) Differentiation of cells and diversity of plant and animal tissues



Organization of living organisms

*There are many types of cells, every kind of cells has a particular function, cells unite together forming **tissues** .*

There are two types of tissues, which are:-

Simple tissues: *They are tissues formed from identical cells.*

Complex tissues: *They are tissues formed from different types of cells.*

Tissues unite together forming organs (ex. Heart), organs unite together forming systems (ex. Circulatory system). These systems form living organisms' bodies

Plant tissues

1- Simple tissues

2- Parenchyma tissue

Definition: *A living tissue with thin and flexible walls whose cells have spherical or ellipsoidal shapes. These cells may be coloured, green or colourless.*

→ *There are spaces for aeration between the cells of Parenchyma tissue.*

Parenchyma cell contains one or more vacuoles filled with water and mineral salts.

Function of Parenchyma tissue:-

- 1- Performing photosynthesis process
- 2- Storing nutrients such as starch
- 3- Responsible for aeration.

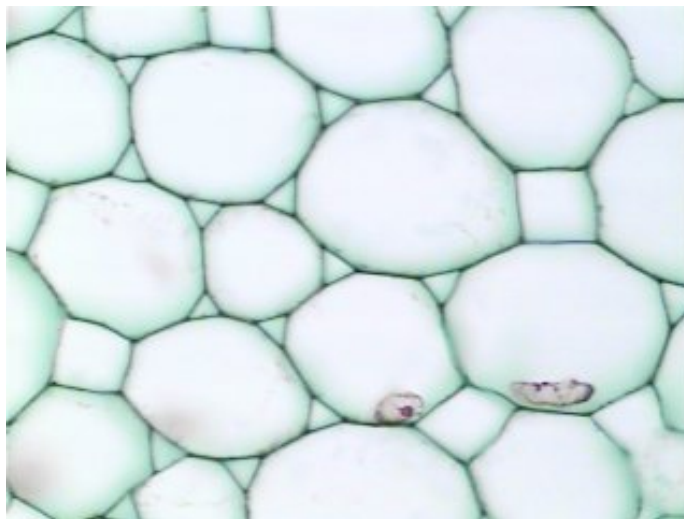


Fig. (21) Parenchyma tissue

2- Collenchyma tissue (flexible tissue)

Definition: A living tissue whose cells are semi-rectangular, its walls are irregularly thickened with cellulose.

Function: Supporting the plant by providing it with suitable flexibility.

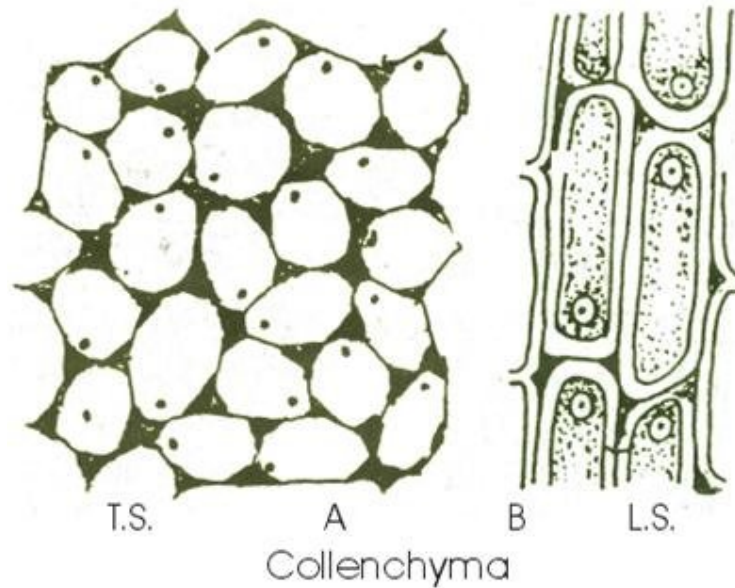


Fig. (22) Collenchyma tissue

3- Sclerenchyma tissue (solid tissue)

Definition: A non-living tissue, the walls of its cells are thickened by a substance called Lignin.

Function of Sclerenchyma tissue: It supports the plant and gives it flexibility and solidity.

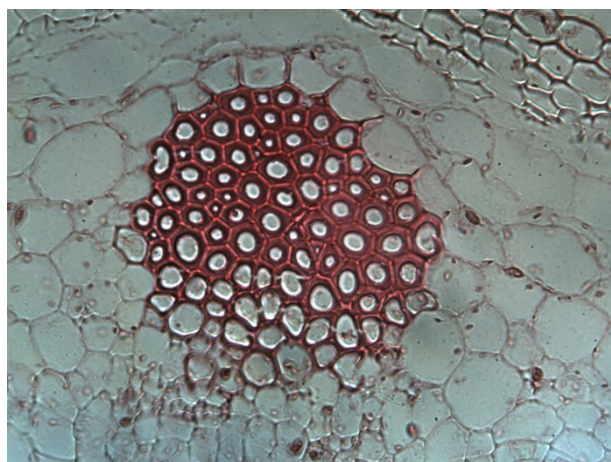


Fig. (23) Sclerenchyma tissue

2- Complex tissue

They are divided into:-

1- Xylem (wood tissue)

They are composed of :-

- **Xylem vessel elements:** They are tubes which consist of a vertical row of cells which lost protoplasm and their horizontal walls. Then, Lignin precipitated inside those cells changing them to long wide vessels through which water and mineral salts can be transported.

- **Xylem tracheids:** Each tracheid is composed of one cell which lost protoplasm and its cell wall is thickened with Lignin.

- **Parenchyma cells**

Function of xylem:-

1- It transports salts and water from roots to leaves

2- It supports the plant

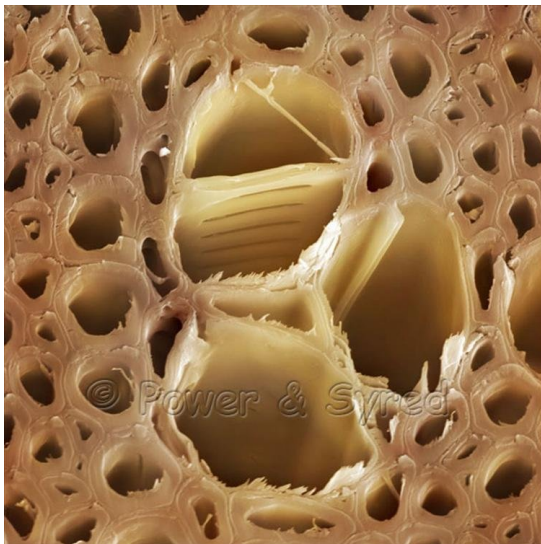


Fig. (24) Xylem tissue

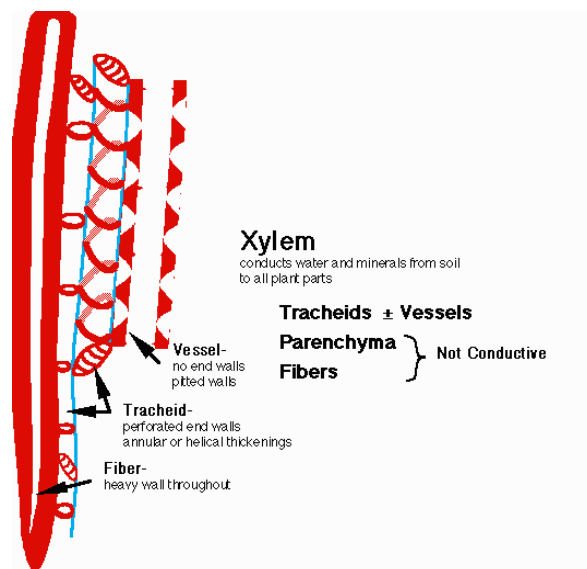


Fig. (25) Structure of xylem

2- Phloem

Sieve cells are formed from vertically-arranged cells which lost their nuclei and their walls separating between them became holed which are known as Sieve plates. Cytoplasm permeates these sieve plates in the form of cytoplasmic filaments.

→ There are some living cells near sieve tubes known as companion cells, these cells provide sieve tube with energy.

The function of Phloem:-

It transports the substances resulted from photosynthesis process from leaves to all parts of plant.

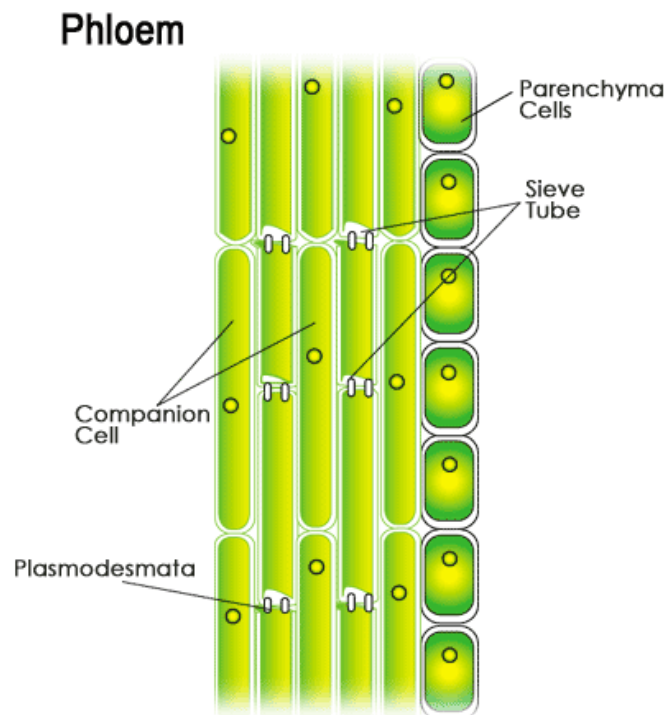


Fig. (26) Phloem structure

Animal tissues

1- Epithelial tissues

They are cells which cover the surface of body or line its cavity, it consists of a great number of attached cells with little intracellular substances between them

There are two types of epithelial tissues, which are:-

1- Simple epithelial tissues

Their cells are ordered in one layer, for example:-

1- Simple squamous epithelial tissue: It is composed of one layer of flat cells

Examples: Capillary linings – The walls of air alveoli in lungs

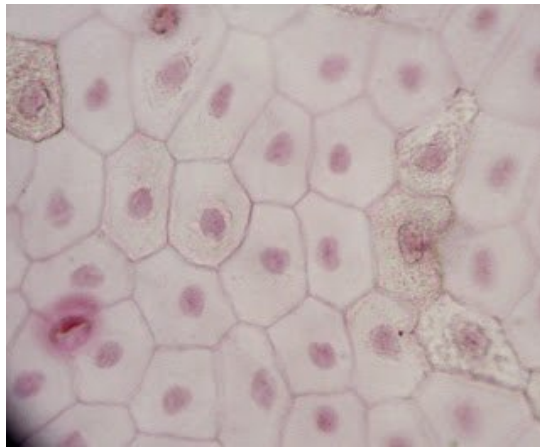


Fig. (27) Simple squamous epithelial tissue

2- Simple cuboidal epithelial tissue: It is composed of one layer of cuboidal cells.
Examples: The lining of kidney tubules.



Fig. (28) Simple cuboidal epithelial tissue

3- Simple columnar epithelial tissue: Composed of one layer of columnar cells.
Examples: The lining of stomach and intestine



Fig. (29) Simple columnar epithelial tissue

2- Complex (stratified) epithelial tissue

Its cells are arranged in many layers

Stratified squamous epithelial tissue: *It is composed of many layers or arranged cells above each other, the upper layer is squamous.*

Example: *Skin*

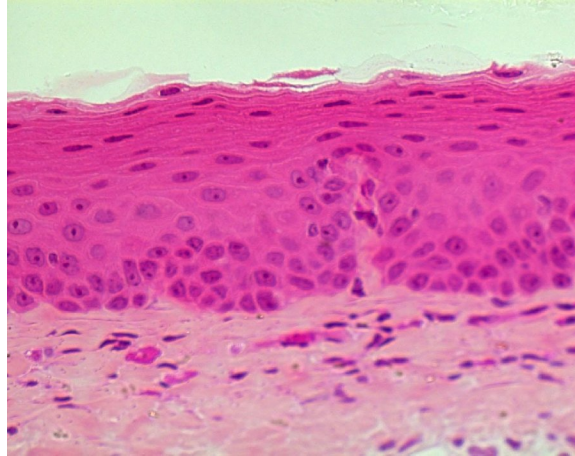


Fig. (30) Stratified squamous epithelial tissue

The functions of epithelial tissues:-

They perform different functions according to their locations, such as:-

- Absorbing water and digested food as in the lining of small intestine.*
- Protecting the cells they cover from dryness and harms as in skin*
- Secreting mucus to keep the cavity soft and moist as in air trachea and digestive canal*

2- Connective tissues

They are composed of relatively distant cells, the intracellular spaces between them are filled by liquid, semi-solid, or solid substances..

Connective tissues are classified according to the type of intracellular material into:-

1- Proper connective tissues: *The most common type, it has a medium degree of solidity and high flexibility .*

Function: *Connecting tissues and different organs with each other.*

Example: *Under skin – Peritoneum (in small intestine)*

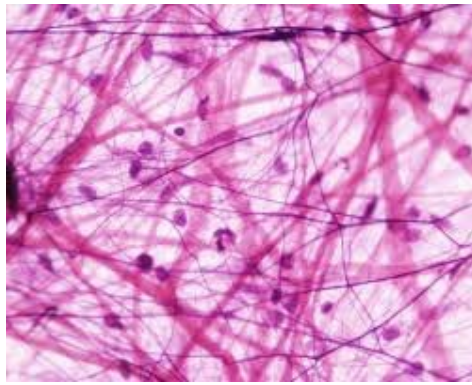


Fig. (31) Proper connective tissue

2- Skeletal connective tissue: It has solid intracellular substance (in bones, calcium is precipitated in it)

Examples: Bones – Cartilages

Function: Supporting the body

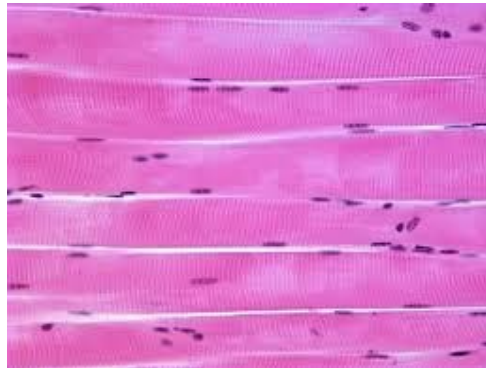


Fig. (32) Skeletal connective tissue

3- Vascular connective tissue: It has liquid intracellular substance.

Function: Transporting digested food, gases and excretions.

Examples: Blood – Lymph

3- Muscular tissues

They have the ability to contract and relax, which enable living organisms to move.

There are three kinds of muscular tissues, which are:-

1- Smooth muscles: They are composed of involuntary non-striated muscles fibres.

Examples: They exist in the wall of digestive canal, urinary system and blood vessels

2- Skeletal muscles: They are composed of striated voluntary muscles, they are usually found attached to the skeleton.

Example: The muscles of hands, legs and stem

3- Cardiac muscles: They are composed of striated involuntary muscles, they are found in the walls of heart only. Cardiac muscles contain intercalated disks which are attached to muscle fibers, they make heart pump blood regularly.

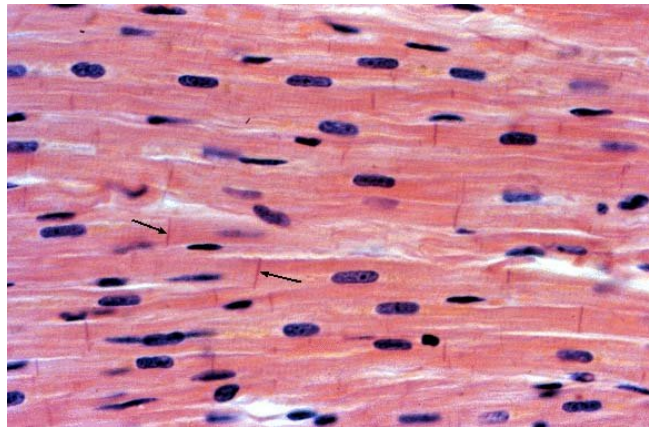


Fig. (33) Cardiac muscles

4- Nervous tissues

They are responsible for regulating the different functions of body organs because:-

They receive sensory stimuli inside or outside the body and send them to the brain and spinal cord. Then, it sends movement orders to responding organs.

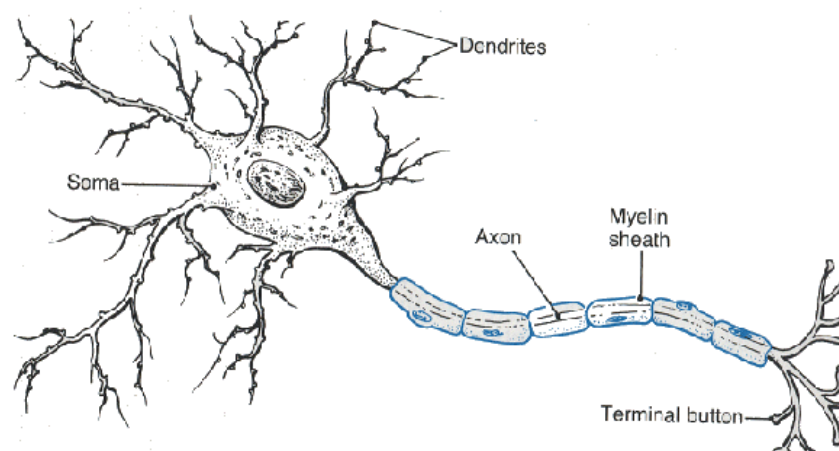


Fig. (34) Nerve cell

Definitions of lesson (3)

Parenchyma tissue: A living tissue composed of irregular cells with thin walls and intracellular distances between them. It is responsible for aeration, photosynthesis process and storing nutrients like starch.

Collenchyma tissue: A living tissue composed of rectangular cells, its wall are not thickened with Lignin but with cellulose

Sclerenchyma tissue: A tissue which supports the plant and protects its inner tissues.

Epithelial tissue: A tissue which covers the outer surface of body to protect it from outer stimuli (Temperature, Dryness, Microbes,) or line the body from inside.

Connective tissue: A tissue whose cells are relatively distant and it has a solid, liquid or semi-solid intracellular material.

Muscular tissue: A tissue which is known as muscular cells or fibres, it has the ability to contract and relax (which doesn't exist in all body cells)

Smooth muscles: Muscles which are composed of involuntary non-striated muscles fibres.

Skeletal muscles: They are composed of striated voluntary muscles, they are usually found attached to the skeleton.

Cardiac muscles: They are composed of striated involuntary muscles, they are found in the walls of heart only

Nervous tissue: A tissue whose cells receive sensory stimuli and transporting movements orders.

Show the importance of

1- Parenchyma tissue:-

It performs many functions such as:-

- 1- Performing photosynthesis process
- 2- Storing nutrients such as starch
- 3- Responsible for aeration process

2- Collenchyma tissue:-

It supports the plant by providing it with suitable flexibility.

3- Sclerenchyma tissue:-

It supports the plant and makes it flexible

4- Xylem:-

1- It supports the plant

2- It transports water and salts from the plant's roots to its leaves

5- Phloem:-

It transports the nutrients produced by photosynthesis process from leaves to all plant's parts

6- Epithelial tissue:-

It performs functions that differ according to its place, for example:-

1- It absorbs water and digested food in the lining of small intestine

2- It protects the cell it covers from dryness, microbes and damage as in skin

3- It secretes mucus in cavities to keep them moist and soft as in digestive canal and air trachea

7- Proper connective tissues

They connect different tissues and organs with each other

8- Skeletal connective tissues:-

They support the body

9- Vascular connective tissues:-

They transport water, digested food and wastes.

10- Nervous tissues:-

1- They regulate different organs functions

2- They receive sensory stimuli and send them to the brain and spinal cord in order to send movement orders to responding organs.

Give reasons for

1- Parenchyma tissues play an important role in plants

Because they are responsible for aeration and photosynthesis processes and storage of nutrients such as starch in plants

2- Collenchyma tissues are very important in plants

Because it supports the plant by making it flexible

3- The biological importance of Sclerenchyma tissues

Because they support the plant by making it flexible and solid

4- Xylem is from the most important tissues in plants and trees

Because it transports water and salts from their roots to their leaves

5- Phloem is from the most important tissues in plant and trees

Because it transports nutrients produced by photosynthesis process from plants' leaves to all their parts

6- In phloem tissues, there are living cells attached to these tissues sieve tubes

In order to provide them with energy

7- Epithelial tissues cover the outer surface of living organisms

In order to protect the cells under these surfaces from microbes, damage and dryness

8- Epithelial tissues line the small intestines of living organisms

To absorb water and digested food

9- Epithelial tissues exist in cavities such as digestive canal and air trachea

In order to keep them moist and soft by secreting mucus

10- Proper connective tissues are from the most important tissues in living organisms

Because they connect different tissues and organs with each other

11- The biological importance of vascular connective tissues

Because they transport water, nutrients and wastes around the bodies of living organisms

12- Skeletal muscles are so-called (called by this name)

Because skeletal muscles are found attached to skeleton (such as the muscles of hands and legs)

13- Cardiac muscles are found attached to intercalated disks.

To allow heart work and pump blood regularly

14- Muscle tissues have so many mitochondria

To provide muscles with the energy required for them to perform their functions perfectly.

What happens if

1- Plants and trees didn't have Parenchyma tissue

Plants wouldn't be able to perform photosynthesis process and store nutrients.

2- Plants and trees didn't have Collenchyma (or Sclerenchyma) tissues

The plant wouldn't be flexible

3- Xylem tissues didn't exist in trees and plants

The roots of plants wouldn't be able to transport salts and water to their leaves, and the plant won't be supported

4- Phloem tissues didn't exist in trees and plants

The nutrients produced during photosynthesis process wouldn't be transported from the plants' leaves to all its parts.

5- The outer surfaces of organisms weren't covered with epithelial tissues.

Their cells would be damaged

6- Epithelial tissues in small intestine disappears.

It won't be able to absorb food and water

7- Epithelial tissues in cavities like air trachea are absent

Mucus won't be secreted in these cavities and they won't be moist and soft.

8- Muscle tissues cells don't have many mitochondria

They will work improperly due to the lack of energy.

Questions

1- Choose the correct answer

1- The tissue which is responsible for storing nutrients in plants

A- Parenchyma B- Sclerenchyma C- Collenchyma D- Phloem

2- Cell walls of Collenchyma tissues cells are thickened with

A- Lignin B- Cellulose C- Chitin D- Glucose

3- The solid tissue is known as

A- Sclerenchyma B- Collenchyma C- Epithelium D- Parenchyma

4- The cell walls of Sclerenchyma tissues cells are thickened with.....

A- Lignin B- Cellulose C- Chitin D- Glucose

5- The tissue which is responsible for transporting water and salts from roots to leaves.

A- Xylem B- Phloem C- Sclerenchyma D- Parenchyma

6- The plant tissue which transport nutrients from leaves to all plant parts.

A- Collenchyma B- Sclerenchyma C- Xylem D- Phloem

7- An epithelial tissue which forms the lining of capillaries

A- Simple columnar epithelial tissue

B- Simple vascular epithelial tissue

C- Simple squamous epithelial tissue

D- Stratified squamous epithelial tissue

8- A tissue formed from one layer of flat cells.

A- Simple columnar epithelial tissue

B- Simple vascular epithelial tissue

C- Simple squamous epithelial tissue

D- Stratified squamous epithelial tissue

9- A tissue forming kidney tubules.

A- Simple columnar epithelial tissue

B- Simple vascular epithelial tissue

C- Simple squamous epithelial tissue

D- Stratified squamous epithelial tissue

10- Tissues which support body.

- A- Skeletal connective tissues
- B- Vascular connective tissues
- C- Simple squamous epithelial tissue
- D- Stratified squamous epithelial tissue

11- are formed from non-striated involuntary muscle fibers

- A- Smooth muscles
- B- Skeletal muscles
- C- Cardiac muscles
- D- Skeletal connective tissues

12- are formed from striated voluntary muscle fibers

- A- Smooth muscles
- B- Skeletal muscles
- C- Cardiac muscles
- D- Skeletal connective tissues

2- Write the scientific term

1- A living tissue composed of irregular cells with thin walls and intracellular distances between them for aeration

2- A living tissue composed of rectangular cells, its wall are not thickened with Lignin but with cellulose

3- A tissue which supports the plant and protect the inner tissues.

4- A tissue which covers the outer surface of body to protect it from outer stimuli (Temperature, Dryness, Microbes,) or line the body from inside.

5- A tissue whose cells are relatively distant and it has a solid, liquid or semi-solid intracellular material.

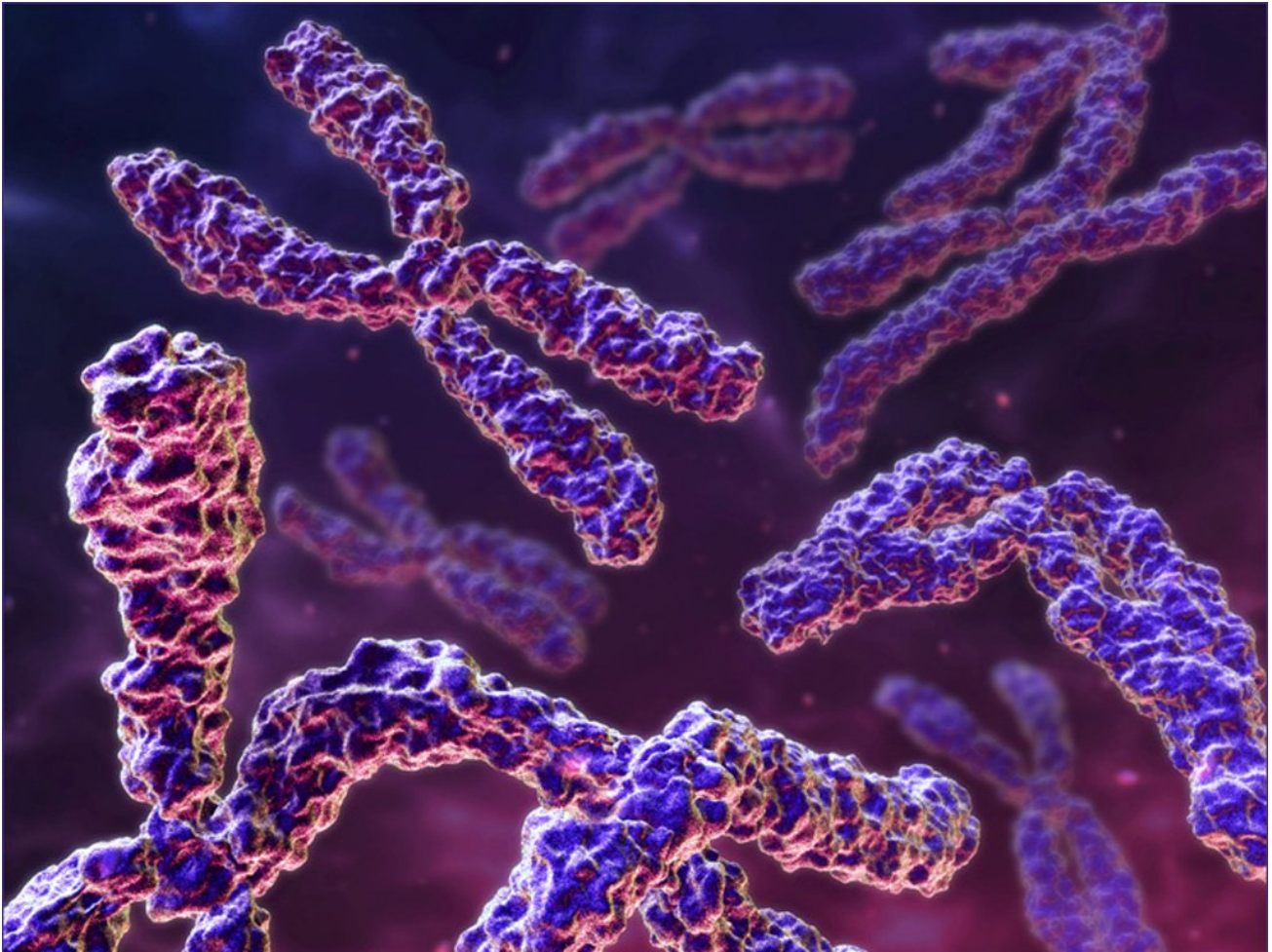
6- A tissue which is known as muscular cells or fibres, it has the ability to contract and relax (which doesn't exist in all body cells)

7- Muscles which are composed of involuntary non-striated muscles fibres.

8- They are composed of striated voluntary muscles, they are usually found attached to the skeleton.

9- They are composed of striated involuntary muscles, they are found in the walls of heart only

Lesson (4) Cell processes



Cells perform many vital processes such as respiration, movement, nutrition, reproduction...etc. In this lesson, we'll study some of these cellular processes

Cellular Transport

Cells get substances from the surrounding medium, and get rid of wastes by expelling them to the surrounding medium.

Cell membrane has a property called selective permeability. This means that some substances (such as water, oxygen, carbon dioxide) can pass through it, while other substances (such as big molecules and salts) cannot do so. This depends on many factors such as:-

- 1- Size of particles
- 2- Charge of particles
- 3- The difference of concentration between the two sides of cell membrane

Substances are transported to and from cells by the following methods:-

1- Passive transport

Passive transport: The movement of substances through cell membrane where cell doesn't consume any energy.

Passive transport has the following methods:-

1- Diffusion

Diffusion: The movement of molecules through membrane from a region of high concentration to a region of low concentration, which makes the concentration of molecules on both sides equal.

Example:-

The exchange of carbon dioxide and oxygen gases between the inner and outer mediums of the cell during respiration process.

If the concentration of molecules in cell is greater than that of the external medium, molecules move from the cell to the external medium to balance the concentration of both sides

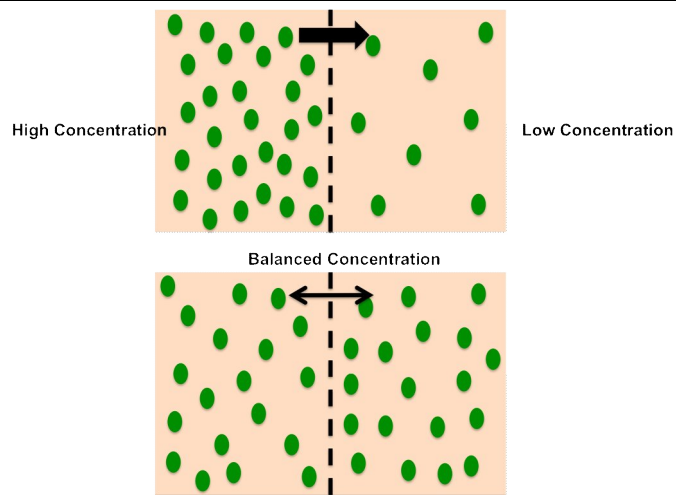


Fig. (35) How diffusion process occurs.

2- Osmosis

Osmosis: The movement of pure water molecules through a membrane from a region of low concentration to a region of high one, which makes the concentration of both sides equal.

Water transports from and to cell due to the difference between the concentration of cytoplasm (fluid inside the cell) and the external medium.

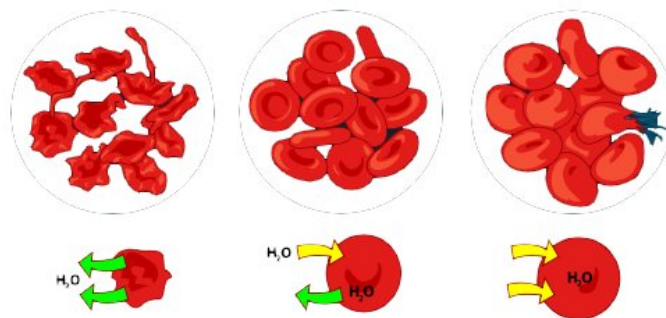


Fig. (36) Red blood cells and osmotic pressure

1- When we put cells in a solution of low concentration, water transports from the external medium (low concentration) into the cell (high concentration), which tears up cells.

2- When we put cells in a solution of equal concentration, water transports equally between the two mediums, and cells sizes don't change

3- When we put cells in a solution of higher concentration, water transports from the cell (low concentration) to the external medium (high concentration), which makes cells shrink.

3- Facilitated transport

Facilitated transport: The transport of molecules through a membrane by means of carrier protein (which carries molecules), where the cell doesn't consume any energy.

Example:-

Glucose is being transported to cells carried by carrier proteins.

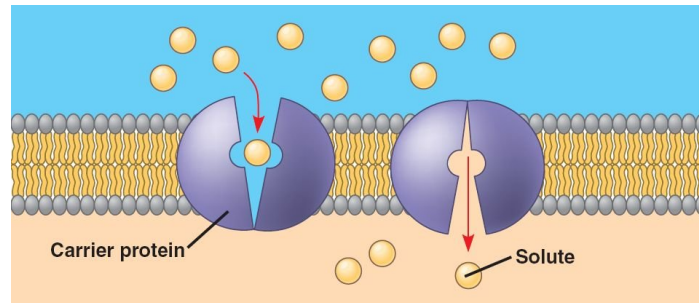


Fig. (37) How facilitated transport occurs.

2- Active transport

Active transport: The transport of big molecules and ions through cell membrane against their concentration gradient (from low to high concentration) using energy

Active transport balance the concentration of ions inside cells

Active transport and nerve cells

Active transport allows nerve cells control the concentration of sodium and potassium ions in them, which allows sending nerve impulses to muscle cells.

Active transport and plant cells

It allows root cells absorb the ions of soil salts (though the concentration of ions in these cells is lower than that of soil)

3- Bulk movement

Bulk movement: Transporting relatively big molecules (such as wastes and protein particles) through cell membranes.

There are two kinds of bulk movements, which are:-

1- Exocytosis

Exocytosis: *Transporting substances out of the cell through plasma membrane*

How do Exocytosis take place:-

- 1- Golgi bodies store wastes in its vacuoles (Golgi vacuoles)*
- 2- They move through cytoplasm to plasma membrane to fuse with it*
- 3- They empty these wastes outside the cell.*

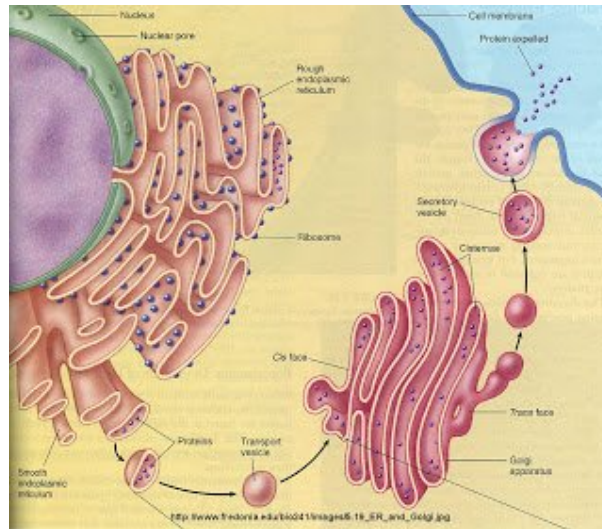


Fig. (38) Golgi body and Exocytosis

2- Endocytosis

Endocytosis: *Transporting substances to the cell through plasma membrane*

How does Endocytosis take place

- 1- A part of plasma membrane bends to surround the particle forming a sac.*
- 2- The sac containing the particle moves to cytoplasm.*

*→ If the solid substances enter the cell by means of endocytosis process, we call it **phagocytosis process***

*→ If liquid substances enter the cell by means of Endocytosis process, we call it **pinocytosis process**.*

Photosynthesis process

Photosynthesis process: A process by which green plant cells get energy required for the plant to perform its vital processes

Photosynthesis process takes place inside the chloroplasts of plant cells, where they change light energy to chemical energy. Photosynthesis process occur in two stages:-

1- First stage

- 1- Granum inside chloroplasts catch energy from sunlight by chlorophyll pigment
- 2- The plant use a part of energy to split water molecules to hydrogen and oxygen gases.
- 3- The leaves of plants release oxygen gas
- 4- Stroma in chloroplasts store hydrogen gas
- 5- The rest of the energy is stored in the form of ATP compound

2- Second stage

It occurs in Stroma, where the energy stored in ATP is used to bind carbon dioxide gas and hydrogen gas together forming glucose sugar.

The equation of photosynthesis process:-

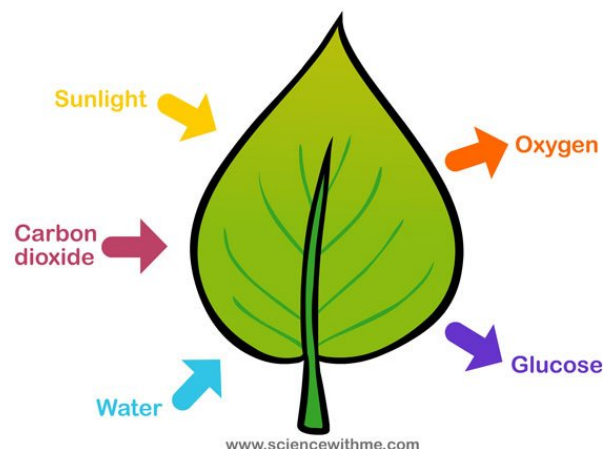
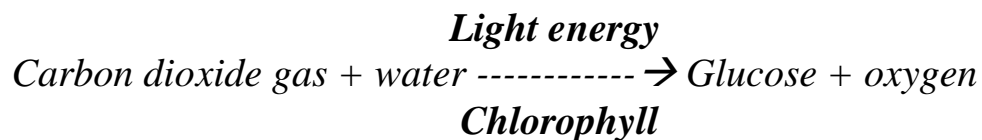


Fig. (39) Photosynthesis process

We can summarize photosynthesis process in the following points:-

- 1- Plants use light energy of sun to perform photosynthesis process*
- 2- Chloroplasts of plant cells absorb light energy*
- 3- A part of energy is used to split water molecules into hydrogen and oxygen gases*
- 4- Oxygen gas gets released from leaves, while hydrogen stays inside chloroplasts*
- 5- The rest of energy is used to bind carbon dioxide gas with hydrogen forming glucose sugar.*

Respiration and energy release

We studied in chapter (1) that energy is stored in glucose sugar. In order to release energy from it, cells break it into simpler molecules by oxidizing it.

Cell respiration: *Group of chemical reactions which occur inside cells to glucose in order to release the energy stored in it.*

Cell respiration occurs in two stages:-

First stage: *it occurs in cytoplasm releasing a small amount of energy.*

Second stage: *It occurs in mitochondria releasing a great amount of energy*

How cell respiration occurs:-

- 1- Glucose molecules break into carbon dioxide and water molecules*
- 2- Energy is stored in mitochondria in the form of ATP compound.*

(N.B: *Cell respiration is a catabolic process - involves catabolism- because glucose molecules are broken into simpler ones to release energy)*

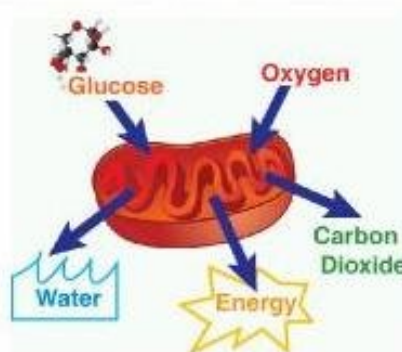


Fig. (40) Cell respiration (in mitochondria)

1- Stem cells

Stem cells: They are cells which have the ability to form any kind of specialized cells (muscle cells, liver cells, nerve cells...etc) according to certain conditions in laboratories.

Scientists discovered that these cells are formed during the early stages of fetus.

Importance of stem cells:-

They can be used to treat dangerous diseases, for example :-

- 1- Stem cells can be used to produce dopamine, which treats many diseases
- 2- They can be transplanted in the heart to form cardiac muscles instead of damaged ones.
- 3- They can form pancreas cells which secrete insulin to treat diabetes.



Fig. (41) Stem cells in the fetus

2- Cell fractionation

Cell fractionation: One of the new techniques which is used to study each kind of cells forming tissues, the structure, properties and locations of different cell organelles.

Importance of cell fractionation technique:-

- 1- Studying the kinds of cells forming different tissues
- 2- Studying the structure, properties and locations of different cell organelles.
- 3- Studying the vital processes occurring inside cells.

Cell fractionation technique depends on devices called **ultracentrifuges**.

Ultracentrifuge: It is a device used in cell fragmentation process, it is operated at different speeds to separate between the components of cells. It depends on the difference between the densities of cell components.



Fig. (42) Ultracentrifuge

Definitions of lesson (4)

Passive transport: The movement of substances through cell membrane where cell doesn't consume any energy.

Diffusion: The movement of molecules through membrane from a region of high concentration to a region of low concentration, which makes the concentration of molecules on both sides equal.

Osmosis: The movement of pure water molecules through a membrane from a region of low concentration to a region of high one, which makes the concentration of both sides equal.

Facilitated transport: The transport of molecules through a membrane by means of carrier protein (which carries molecules), where the cell doesn't consume any energy.

Bulk movement: Transporting relatively big molecules (such as wastes and protein particles) through cell membranes

Exocytosis: Transporting substances out of the cell through plasma membrane

Endocytosis: Transporting substances to the cell through plasma membrane

Phagocytosis: Transporting solid substances to the cell through plasma membrane

Pinocytosis: Transporting liquid substances to the cell through plasma membrane

Photosynthesis process: A process by which green plant cells get energy required for the plant to perform its vital processes

Cell respiration: Group of chemical reactions which occur inside cells to glucose in order to release the energy stored in it

Stem cells: They are cells which have the ability to form any kind of specialized cells (muscle cells, liver cells, nerve cells...etc) according to certain environmental conditions in laboratories.

Cell fractionation: One of the new techniques which is used to study each kind of cells forming different tissue, the structure, properties and locations of different cell organelles

Ultracentrifuge: It is a device used in cell fragmentation process, it is operated at different speeds to separate between the components of cells. It depends on the difference between the densities of cell components.

Give reasons for

1- When putting red blood cells in a solution with low concentration, they tear up and expand.

Because water molecules transport from the solution (low concentration) to red blood cells (high concentration) by osmosis process.

2- When putting red blood cell in a solution with high concentration, they shrink.

Because water molecules transport from red blood cells (low concentration) to the solution (high concentration) by osmosis process.

3- Active transport plays an important role in nerve cells

Because it allows the entrance of sodium and potassium ions to nerve cells which allow the transfer of nerve impulses to other body parts.

4- Active transport plays an important role in plant cells

Because it allows the root cells of plants absorb salts ions.

5- The biological importance of photosynthesis process to plants

Because plants use water, carbon dioxide gas and chlorophyll to form glucose in which energy is stored

6- The biological importance of cell respiration

Because cells break up glucose ions to carbon dioxide gas, water and energy (which is stored in the form of ATP compound in mitochondria)

7- Stem cells can be used in the treatment of various diseases

Because they can be used to form pancreatic cells which secrete insulin for diabetes patients, form cardiac tissues instead of damaged one to treat heart diseases, and produce dopamine substance which is used in the treatment of several diseases.

8- Cell fractionation is from the most important techniques in modern science.

Because it studies the cells of different tissues, the vital processes occurring inside living organisms, the structure, properties and locations of different cell organelles.

General test on chapter (2)

Answer four questions only

Question (1)

A- Choose the correct answer

- 1- Scientist stated that cells are produced from pre-existing ones.
A- Schleiden B- Virchow C- Robert Brown D- Charles Darwin
- 2-..... are plastids which are devoid of pigments
A- Leucoplasts B- Chromoplasts C- Chloroplasts D- Chromatin
- 3- The tissue which is responsible for transporting water and salts from roots to leaves.
A- Xylem B- Phloem C- Sclerenchyma D- Parenchyma
- 4- The cell walls of Sclerenchyma tissues cells are thickened with.....
A- Lignin B- Cellulose C- Chitin D- Glucose
- 5- microscope works by sunlight and artificial light.
A- Electronic B- Light C- Stereo D- Digital

B- Give reasons for:-

- 1- Active transport plays an important role in plant cells.
- 2- The importance of electronic microscope
- 3- Nucleus is the most important organelle in cell
- 4- Epithelial tissues line the small intestines of living organisms

Question (2)

A- Write the scientific term

- 1- The movement of pure water molecules through a membrane from a region of low concentration to a region of high one.
- 2- A living tissue composed of rectangular cells, its wall are not thickened with Lignin but with cellulose.
- 3- Coloured pigments which exist in chromoplasts
- 4- They synthesize proteins in the cell.

B- What happens if

- 1- Cells didn't have smooth endoplasmic reticulum
- 2- Putting red blood cells in a solution with low concentration
- 3- Muscle cells didn't have many mitochondria
- 4- Removing the nucleus from the cell.

Question (3)**A- Match**

| Group (A) | Group (B) |
|---|--------------------|
| 1- A thin membrane surrounding cytoplasm and controls the passage of substance to and from the cell | A- Golgi body |
| 2- A kind of plant tissue which transports nutrients and water from roots to leaves | B- Plasma membrane |
| 3- Thread- like structure which are composed of DNA combined with proteins | C- Green plastids |
| 4- A group of flat membranous sacs with spherical ends which exists in great no. in glandular cells | D- Xylem |
| 5- Cell organelles which exist only in plant cell and responsible for photosynthesis process | E- Chromosome |
| | F- Cell wall |

B- Write short notes about

- 1- Prokaryotic cells
- 2- Stem cells
- 3- Cell respiration
- 4- Cell theory

Question (4)**A- Correct the underlined words**

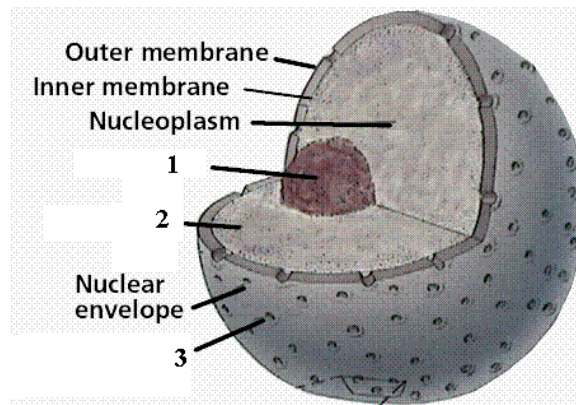
- 1- The part of cell which is responsible for synthesizing lipids is Lysosomes
- 2- Scientist Rudolf Virchow stated that all plants are composed of cells.
- 3- Collenchyma tissue is responsible for storing nutrients in cells
- 4- Mitochondria controls cell division process.

B- Compare between

- 1- Mitochondria and Lysosomes*
- 2- Parenchyma and Collenchyma tissues*
- 3- Epithelial and connective tissues*
- 4- Electronic and light microscope*

Question (5)

A- Study the following figure, and answer the questions



- 1- What is the name of this organ, what is its importance.*
- 2- Label the previous diagram*
- 3- What happens to structure (2) during cell division process?*

B- Calculate the magnification power of a compound microscope, the magnification power of its objective lens equal 40x and that of its eyepiece equals 15x

The Answers of lesson (2)

1- Choose

1- Robert Hooke 2- Leeuwenhoek 3- Virchow 4- Light microscope
5- Light microscope

2- Complete

1- Robert Hooke, Theodor Schwann
2- Eyepiece, objective lens
3- 1500x, 1,000,000x
4- Virchow, Schleiden
5- Leeuwenhoek, 200x

3- Write the scientific term

1- Cell 2- Light microscope 3- Electronic microscope

6-

The magnification power of light microscope = Magnification power of eyepiece
 \times magnification power of objective lens = $60 \times 14 = 840x$

The answers of lesson (2)

1- Choose

1- Cellulose 2- Phospholipid bilayer 3- Ribosomes 4- Nerve cells
5- Metaphase 6- Centrosome 7- Mitochondria 8- Lysosomes 9- Leucoplasts
10- Cell wall 11- Bacteria

B- Complete

| | |
|----------------------------------|-------------------------------------|
| 1- Cellulose, phospholipid | 2- Nucleoplasm, chromatic reticulum |
| 3- Centromere 4- DNA, proteins | 5- Proteins, lipids 6- Cristae |
| 7- Adenosine Triphosphate (ATP) | 8- Starch, roots of potato |
| 9- Carotenoids, chlorophyll | 10- Chloroplast, chlorophyll. |

C- Write the scientific term

1- Prokaryote 2- Eukaryote 3- Ribosomes 4- smooth endoplasmic reticulum
5- Lysosomes 6- Carotenoids 7- Chlorophyll

4- Compare between

1- Animal and plant cells

| <i>Animal cell</i> | <i>Plant cell</i> |
|--|---|
| <i>- It has a centrosome whose two centrioles form spindle fibers in cell division process</i> | <i>- It doesn't have centrosome, but has a part of cytoplasm which form spindle fibres in cell division process</i> |
| <i>- It is surrounded by plasma membrane</i> | <i>- Cell wall made of cellulose surrounds the plasma membrane</i> |

2- Prokaryote and eukaryote cells

| <i>Prokaryotic cells</i> | <i>Eukaryotic cells</i> |
|--|---|
| <i>- They are less complex cells</i> | <i>- They are more complex cells</i> |
| <i>- Their hereditary materials are not surrounded by nuclear membranes.</i> | <i>- Their hereditary materials are not surrounded by nuclear membranes</i> |
| <i>- They lack many cellular organelles. (ex. Bacteria)</i> | <i>- They contain many cellular organelles (ex. Animals)</i> |

5- Plant cell

1- Label

*A- Golgi body B- Vacuole C- Mitochondria D- Ribosomes E- Cell wall
F- Cell membrane G- Chloroplast H- Rough endoplasmic reticulum
I- Nucleolus J- Nucleus K- Cytoplasm*

2- Function

(A) Golgi bodies: It modifies and transports the substances sent to them from the ER across the cell or outside it.

(D) Ribosomes: They synthesize proteins.

(G) Chloroplast: Perform photosynthesis process.

3- (D) ribosomes

6- Animal cell

1- Label

*A- Mitochondria B- Golgi body C- Cytoplasm D- Nucleolus E- Nucleus
F- Nucleus G- Plasma membrane H- Rough endoplasmic reticulum
I- Centriole J- Smooth endoplasmic reticulum K- Vacuole L- Ribosome*

2- Function

(A) Mitochondria: Stores and generates energy.

(I) Centiole: forms spindle fibres across the cell during cell division process.

(J) Smooth ER: Changes carbohydrates to glycogen – synthesize lipids

3- Smooth endoplasmic reticulum

The answers of lesson (3)

1- Choose

*1- Parenchyma 2- Cellulose 3- Sclerenchyma 4- Lignin 5- Xylem
6- Phloem 7- Simple squamous epithelial tissue 8- Simple squamous epithelial
tissue 9- Simple cuboidal epithelial tissue 10- Skeletal connective tissue
11- Smooth muscle 12- Skeletal*

2- Complete

*1- Parenchyma 2- Collenchyma 3- Sclerenchyma 4- Epithelial tissue
5- Connective tissue 6- Muscular tissue 7- Smooth muscle 8- Skeletal
muscles 9- Cardiac muscles*

General test of chapter (2)

Question (1)

A- Choose the correct answer

1- Virchow 2- Leucoplasts 3- Xylem 4- Lignin 5- Light

B- Give reasons for

1- Because it allows the cells of roots absorb the ions of salt, although the concentration of ions in the soil is greater than that of cells

2- Because it has a magnification power of one million x, as it uses beams of electrons instead of light; which gives clearer photos with higher differentiation

3- Because it controls all the biological processes in the cell (including cell division process), its nucleolus produces ribosomes which synthesize proteins, and it has the hereditary material of the cell in the form of chromatin reticulum.

4- In order to allow the small intestine absorb digested food and water

Question (2)

A- Write the scientific term

1- Osmosis 2- Collenchyma 3- Carotenoids 4- Ribosomes

B- What happens if:-

1- The cell wouldn't be able to synthesize lipids, change carbohydrates into glycogen, or decrease the toxicity of poisonous substances.

2- Water molecules would transport from the solution (low concentration) to red blood cells (high concentration), which makes them expand and tear up.

3- Muscle cells would work improperly because they lack energy.

Question (3)

A- Match

1-B 2-D 3- E 4- A 5- C

B- Write short notes about:-

1- Prokaryotic cells:-

They are primitive cells which are less complex than eukaryotic (developed) cells, they don't have many cellular organelles (such as plastids, mitochondria, Golgi bodies...etc). The hereditary material of those prokaryotes are not surrounded by nuclear membranes as eukaryotes are. Bacteria are example on prokaryotes

2- Stem cells :-

They are cells which can form different types of specialized cells (cardiac cells, nerve cells, skin cells...etc). These cells are formed in the early stages of fetus. Scientists seek to use them in the treatment of diseases, as stem cells can be used to produce dopamine substance (which cure many diseases), they can form pancreatic cells that secrete insulin to treat diabetes patients and heart tissues instead of damaged one to treat heart diseases.

3- Cell respiration

A group of chemical reactions that occur inside mitochondria to release energy from glucose molecules. Glucose molecules are broken into carbon dioxide, water and energy (which is stored in the form of ATP compound)

4- Cell theory

Cell theory is one of the most important theories in modern science, it states that all organisms are composed of one or more cells, cells are produced from pre-existing ones and cell is the structural and functional unit of living organisms.

Question (3)

A- Correct the underlined words

1- Ribosomes 2- Schleiden 3- Parenchyma tissue 4- Nucleus

B- Compare between

| <i>Mitochondria</i> | <i>Lysosomes</i> |
|---|---|
| <ul style="list-style-type: none">- They store respiration enzymes in cell- They store substances which contain energy.- They store energy in the form of ATP | <ul style="list-style-type: none">- They contain digestive enzymes which help in digesting nutrients and getting ride of wasters. |

| <i>Parenchyma tissue</i> | <i>Collenchyma tissue</i> |
|---|---|
| <ul style="list-style-type: none">- living tissue which is composed of spherical or ellipsoidal cells with thin and flexible walls.- It stores nutrients, perform photosynthesis and aeration processes. | <ul style="list-style-type: none">- Living tissue which is composed of semi-rectangular cells whose wall are thickened with cellulose- They support the plant and protect its inner tissues. |

| <i>Epithelial tissues</i> | <i>Connective tissues</i> |
|---|---|
| <ul style="list-style-type: none">- They are tissues which cover the outer surface of the body and line its cavity- They consist of a great number of attached cells with little intracellular substances between them | <ul style="list-style-type: none">- they are tissues which connect between the tissues and organs of body, transport liquids inside it , or support the body- They are composed of relatively distant cells, the intracellular spaces between them are filled by liquid, semi-solid, or solid substances |

| <i>Electronic microscope</i> | <i>Light microscope</i> |
|---|---|
| <ul style="list-style-type: none">- It has a magnification power of one million x (1000000)- It depends on beams of electrons controlled by electromagnetic lenses | <ul style="list-style-type: none">- It has a magnification power of 1500 times- It depends in its works on sunlight or artificial light. |

Question (5)

A- The diagram

1- Label

Name: Nucleus

Importance: Control vital processes inside the cell (including cell division process) – contains the hereditary material of cell – contains nucleolus which forms ribosomes which synthesize proteins.

2- Label the diagram

1- Nucleolus

2- Chromatin reticulum

3- Nuclear pore

3- It condenses forming thread-like structure called chromosomes, which are two chromatids attaching to each other at a point called centromere, chromosomes appear at Metaphase stage of cell division.

2- The problem

The magnification power = magnification power of eyepiece x that of objective lens = 15 x 40 = 600x