

2.2 STRUCTURE & FUNCTIONS: PLASMA MEMBRANE & ORGANELLES

Learning outcomes

At the end of this lesson, students should be able to:

- I. Show the structures of typical plant and animal cells and state the organelles present.
- II. Identify the structures and state the functions of the following organelles: nucleus, rough endoplasmic reticulum, smooth endoplasmic reticulum, Golgi body, lysosome, ribosome, mitochondria, chloroplast and centriole.
- III. Show the structure of plasma membrane based on Fluid Mosaic Model.
- IV. Explain the structure of the plasma membrane and the functions of each of its components.

1. The Detailed Structures of Typical Plant & Animal Cells

Plant cell	Animal cell

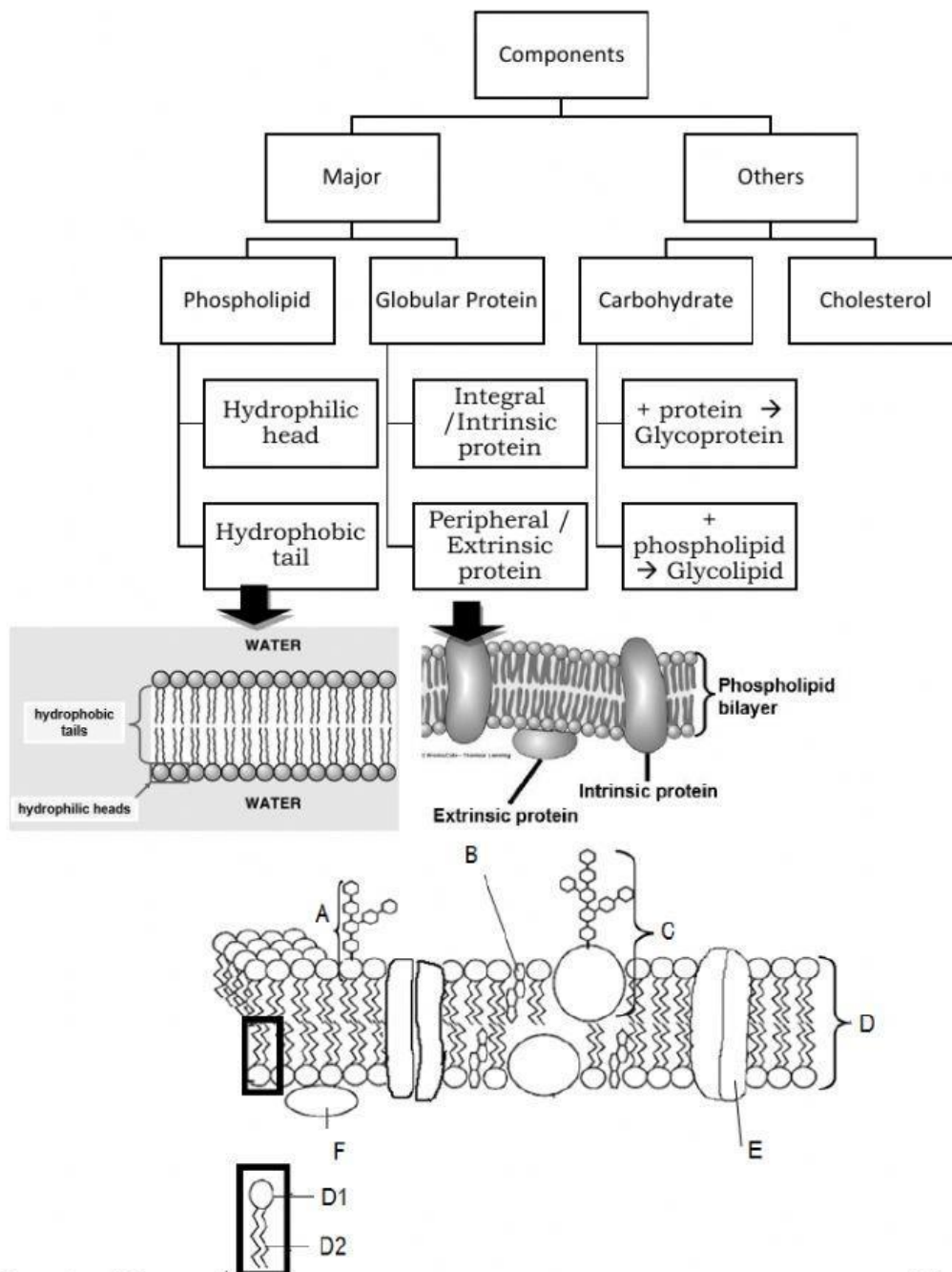
Similarities?

1. Both have _____
2. Both have _____
3. Both have _____ with organelles such as Golgi apparatus, ribosome, endoplasmic reticulum etc.

Differences?

	Plant cell	Animal cell
Cilia or flagella	Flagella only found in some specialize cell / lower plant male gametes	
Shape		Irregular shape
Chloroplast	Chloroplast present in photosynthetic cell	
Vacuole		Vacuoles usually small & temporary
Centrioles	Centrioles absent	
Cell wall		No cell wall
Plasmodesmata	Plasmodesmata present in cell wall	
Lysosomes		Have lysosomes

2. The Structure of Plasma Membrane and The Function of Its Component



Exercise 2.2

(a): Based on figure above, correctly use the **color code and identify** the name for each part of the cell membrane.

Letter	Name/Color	Letter	Name/Color
	Phospholipid bilayer (no color)		Peripheral protein (red)
	Integral protein (orange)		Cholesterol (blue)
	Hydrophobic tail		Glycoprotein (green)
	Hydrophilic head		Glycolipids (purple)

Structure of plasma membrane based on **Fluid Mosaic Model** is proposed by _____ (1972)

Exercise 2.2 (b): Use the terms given to fill in the blanks below.

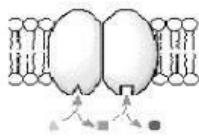
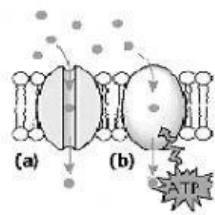
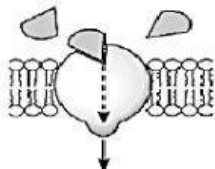
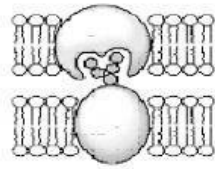
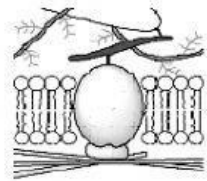
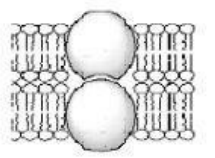
<i>Peripheral proteins</i>	<i>Outwards</i>	<i>Fluid</i>
<i>Mosaic</i>	<i>Integral proteins</i>	<i>glycoprotein</i>
<i>glycolipid</i>	<i>Phospholipids</i>	<i>Inwards</i>

Why the model is known as Fluid Mosaic Model?	“_____” refers to the phospholipid & some protein molecules that can move laterally along the phospholipid bilayer. “_____” refers to pattern arrangement of the protein molecules embedded within the phospholipid bilayer.
Components	
i. Phospholipid	- The plasma membrane consists of a phospholipid bilayer - The hydrophilic heads of phospholipids face _____ and attracted to aqueous surrounding. - The hydrophobic hydrocarbon tails face _____ and not attracted to aqueous surrounding.
ii. Globular protein	- There are two types of protein: i. _____ on the outer and inner surface of the membrane, ii. _____ partially or fully (transmembrane protein) embedded in the membrane.
iii. Carbohydrate	- Carbohydrate chain attach to protein is called _____ - Carbohydrate chain attach to phospholipid is called _____
iv. Cholesterol	Cholesterol _____ molecules are found between _____ molecules.

Exercise 2.2 (c): Match the cell membrane structure or its function with the correct letter from the cell membrane diagram in page 6.

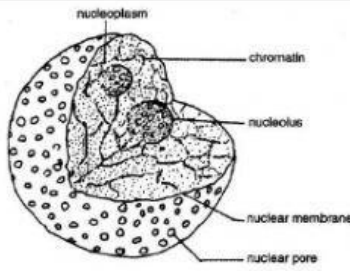
Letter	Structure/Function	Letter	Structure/Function
	Attracts water		Repels water
	Helps regulate flexibility of membrane		Make up the bilayer
	Act as recognition sites		Help transport certain materials across the cell membrane
	Affect the fluidity & permeability of the membrane		

Exercise 2.2 (d): Match the Roles of Cell Membrane Protein with the explanations and the correct diagram.

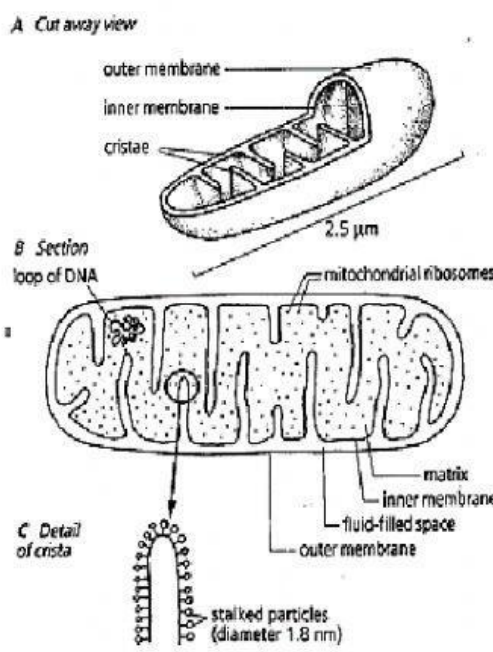
A. Act as Enzyme	_____ ● Transmembrane protein transport molecules across membrane ● Transport protein has hydrophilic channels that allow polar molecules to pass through ● Eg: channel protein, carrier protein	_____ 
B. Intercellular Joining	_____ ● Globular protein has active site which can bind to a specific substrate ● Catalyze specific chemical reaction	_____ 
C. Act as Transport Protein	_____ ● Has a binding site with a specific shape for chemical messenger ● Eg: hormone ● Send information into the cell	_____ 
D. Attachment site of cytoskeleton & extracellular matrix	_____ ● Membrane proteins of adjacent cell may join together ● Eg: gap junction	_____ 
E. Act as Receptor Protein	_____ ● Act as identification tag ● Specifically recognized by other cells ● Eg: antigen is recognized by human cells as foreign	_____ 
F. Cell- cell Recognition	_____ ● Outer surface ~ attach to extracellular matrix ● Inner surface ~ attach to cytoskeleton ● Maintain cell shape	_____ 

3. The Structure & Functions of Organelles:

a) Nucleus

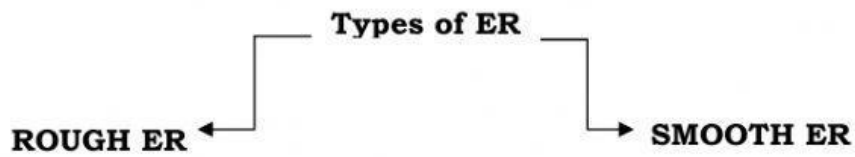
 Labels in diagram: nucleolus, chromatin, nuclear membrane, nuclear pore.	Structure: • Average diameter ~ 5 μm. • Spherical or oval in shape. • Enclosed by _____ nuclear membrane with nuclear pores $\rightarrow$ channels through which molecules can pass through between nucleus & cytoplasm such as RNA • Contains: (fill in the blanks with the correct structure) i. _____ – cytoplasm-like that fills the nucleus. ii. _____ – 1 or more dense small spherical bodies. iii. _____ – contain hereditary material. Function: i. Contain genetic materials of a cell (DNA) ii. Control cellular activities (eg: protein synthesis) iii. Involved in the production of ribosomes & RNA (nucleolus)
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b) Mitochondrion

Structure: • Vary in size and shape but often rod-like structure • Enclosed by _____ layers of membrane ○ Outer membrane ✓ Highly permeable to small solute ○ Inner membrane ✓ folded inward to form _____ (to increase the surface area for attachment of enzymes involved in cellular respiration) • Space between outer & inner membrane ~ _____ space • Inner membrane enclosed a fluid-filled space ~ matrix • Matrix contains DNA & ribosome to synthesize own protein & enzymes involved in Krebs cycle Function: • _____	 Labels in diagram: A Cut away view, outer membrane, inner membrane, cristae, 2.5 μm, B Section, loop of DNA, mitochondrial ribosomes, matrix, fluid-filled space, C Detail of crista, stalked particles (diameter 1.8 nm), outer membrane.
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c) Endoplasmic reticulum (ER)

- Extensive network of membranous tubules ~ cisternae (interconnected)
- Continuous with the outer nuclear membrane
- Enclosed by a _____ membrane
- Space within ER ~ cisternal space (lumen)



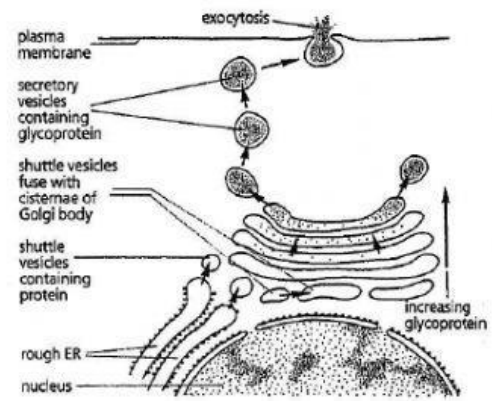
• Consist of _____ sacs • Has _____; attached on the outer surface ~ appear granular	• Consist of more _____ sacs • Lack of _____ on outer surface ~ appear smooth
FUNCTION: • _____	FUNCTION: • _____ • Detoxification of toxic waste (drugs & poison) • Storage of calcium ions in skeletal muscle cells

d) Golgi body

	• Enclosed by a _____ membrane • Consist of stacked flattened membranous sacs ~ cisternae • Each Golgi stack has _____ face & _____ face • <i>Cis</i> face is facing towards the ER / _____ • <i>Trans</i> face is facing towards the _____
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Transport of protein

- RER contain protein pinches off to form _____ vesicles
- Which move towards Golgi body
- It fuses with the cis face
- Golgi body _____ the substances as it moves from *cis*-face to the *trans*-face
- The tips of trans face cisternae pinch off to form _____ vesicles
- Secretory vesicles move towards plasma membrane & fuse with it to release substances by _____



Function:

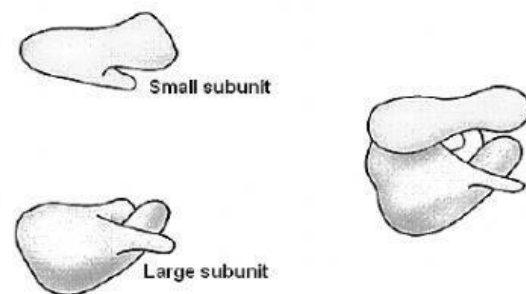
- _____
- Form lysosomes

e) Ribosome

- Small granule
- Spherical-shaped
- Non-membranous
- Made of _____ & _____
- Consist of 2 subunits (large & small)

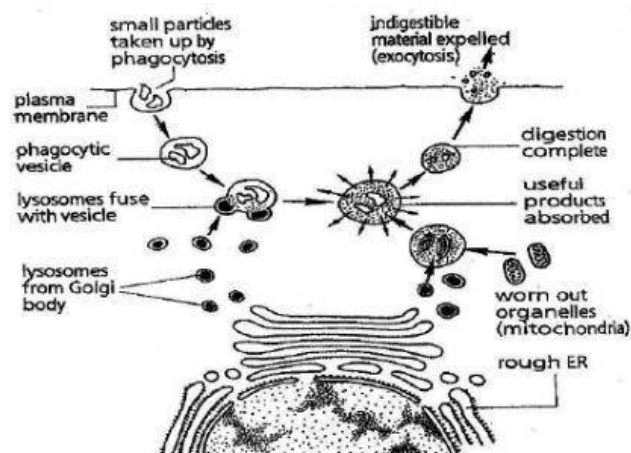
Function:

- _____
- Act as enzyme (ribozyme) to catalyze the formation of peptide bond



f) Lysosome

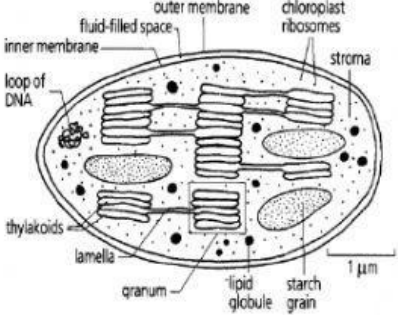
- Small, spherical-shaped
- Enclosed by a special _____ membrane
- Contain many _____ (digestive) enzymes



Function:

- i. **Intracellular digestion** → Digest macromolecules which enter the cell by _____ process
- Plasma membrane engulfs large molecules & pinches off to form food vacuole (phagosome) by phagocytosis process
 - Primary lysosome fuses with food vacuole → called as secondary lysosome
 - Hydrolytic enzymes digest large molecules
 - Useful substances are absorbed into cytosol
 - Eg: *Amoeba* & macrophage (engulf bacteria & digest them for defense or protection)
- ii. **Recycle cell's own organic material** → Digest old or damaged organelles to recycle organic material by _____ process
- Old or damaged organelle is enclosed by a single membrane to form autophagic vacuole (autophagosome)
 - Lysosome fuse with autophagic vacuole & digest the organelle with hydrolytic enzymes by autophagy process
- iii. **Programmed cell destruction** → Digest the whole cell by _____ process
- In old or damaged cell, lysosome membrane ruptures
 - Hydrolytic enzymes are released into the cytoplasm
 - Digest the whole cell by autolysis process
 - Eg : destroy old / damaged cell
: during metamorphosis & development

g) Chloroplast

	• Shape ~ oblong / biconvex • Enclosed by _____ layers of membrane • Space between outer & inner membrane ~ _____ space • Inner membrane enclosed a fluid-filled space ~ _____ • Stroma contains: - • DNA & ribosome to synthesize own protein & enzymes • Embedded within stroma, are membranous system called _____ • Thylakoids ~ discs like sac which are stacked to form grana • Grana are interconnected by _____ • Chlorophyll & photosynthetic pigments are embedded within thylakoid membrane.
Function: • _____ • Light dependent reaction occurs in grana / thylakoid	

- Light independent reaction occurs in stroma
- Store starch (in stroma)

h) Centriole

- Exist in _____, orientated at 90° angle to another
- Located in a region called _____ ~ near nucleus of animal cell
- Each centriole composed of 9 sets of _____ microtubules, arranged in a circle ("9x3")

Function:

- _____
- Form the bases of cilia & flagella

