

## 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

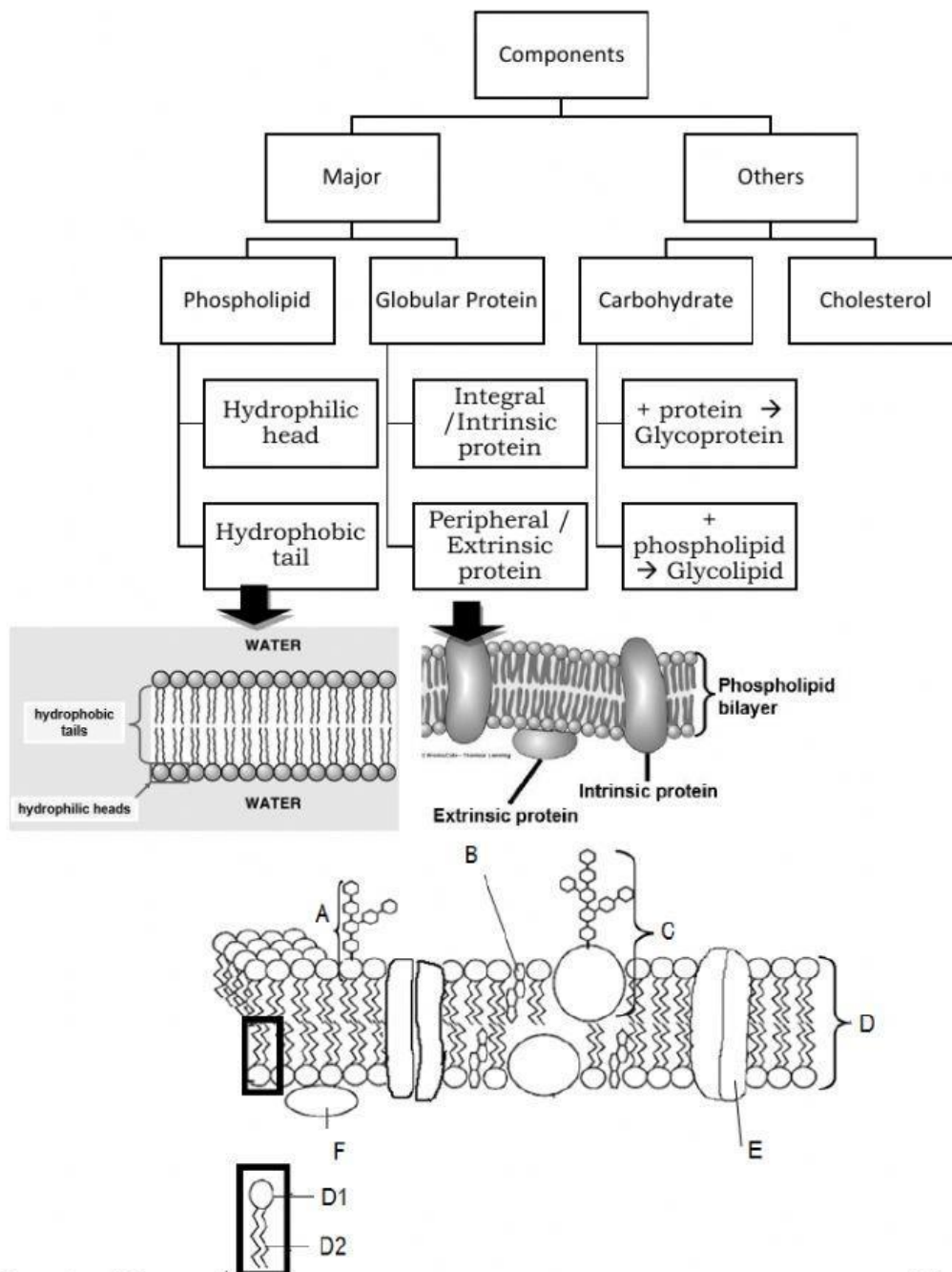
#### Similarities?

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>

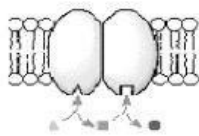
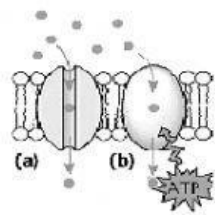
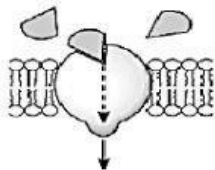
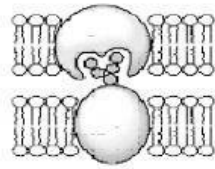
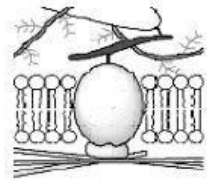
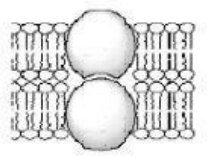
Why the model is known as Fluid Mosaic Model?	<p>“_____” refers to the phospholipid &amp; some protein molecules that can move laterally along the phospholipid bilayer.</p> <p>“_____” refers to pattern arrangement of the protein molecules embedded within the phospholipid bilayer.</p>
<b>Components</b>	
i. Phospholipid	<ul style="list-style-type: none"> <li>The plasma membrane consists of a phospholipid bilayer</li> <li>The hydrophilic heads of phospholipids face _____ and attracted to aqueous surrounding.</li> <li>The hydrophobic hydrocarbon tails face _____ and not attracted to aqueous surrounding.</li> </ul>
ii. Globular protein	<ul style="list-style-type: none"> <li>There are two types of protein: <ul style="list-style-type: none"> <li>i. _____ on the outer and inner surface of the membrane,</li> <li>ii. _____ partially or fully (transmembrane protein) embedded in the membrane.</li> </ul> </li> </ul>
iii. Carbohydrate	<ul style="list-style-type: none"> <li>Carbohydrate chain attach to protein is called _____</li> <li>Carbohydrate chain attach to phospholipid is called _____</li> </ul>
iv. Cholesterol	<ul style="list-style-type: none"> <li>Cholesterol _____ molecules are found between _____ molecules.</li> </ul>

**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		

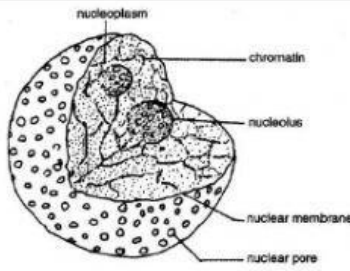


**Exercise 2.2 (d): Match the Roles of Cell Membrane Protein** with the explanations and the correct diagram.

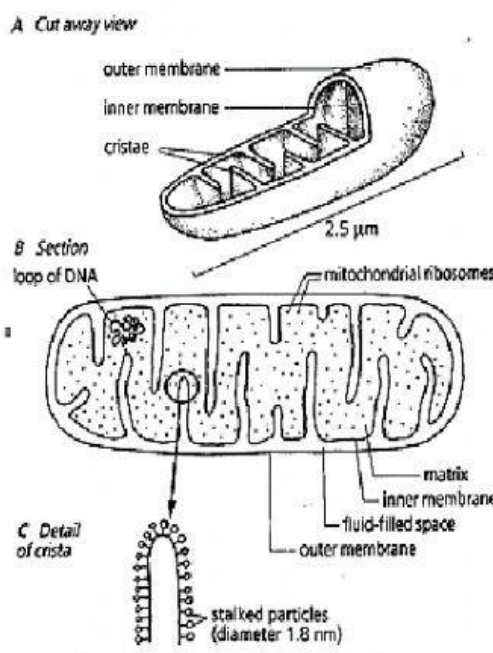
<p><b>A. Act as Enzyme</b></p>	<p>_____</p> <ul style="list-style-type: none"> <li>● Transmembrane protein transport molecules across membrane</li> <li>● Transport protein has hydrophilic channels that allow polar molecules to pass through</li> <li>● Eg: channel protein, carrier protein</li> </ul>	<p>_____</p> 
<p><b>B. Intercellular Joining</b></p>	<p>_____</p> <ul style="list-style-type: none"> <li>● Globular protein has active site which can bind to a specific substrate</li> <li>● Catalyze specific chemical reaction</li> </ul>	<p>_____</p> 
<p><b>C. Act as Transport Protein</b></p>	<p>_____</p> <ul style="list-style-type: none"> <li>● Has a binding site with a specific shape for chemical messenger</li> <li>● Eg: hormone</li> <li>● Send information into the cell</li> </ul>	<p>_____</p> 
<p><b>D. Attachment site of cytoskeleton &amp; extracellular matrix</b></p>	<p>_____</p> <ul style="list-style-type: none"> <li>● Membrane proteins of adjacent cell may join together</li> <li>● Eg: gap junction</li> </ul>	<p>_____</p> 
<p><b>E. Act as Receptor Protein</b></p>	<p>_____</p> <ul style="list-style-type: none"> <li>● Act as identification tag</li> <li>● Specifically recognized by other cells</li> <li>● Eg: antigen is recognized by human cells as foreign</li> </ul>	<p>_____</p> 
<p><b>F. Cell- cell Recognition</b></p>	<p>_____</p> <ul style="list-style-type: none"> <li>● Outer surface ~ attach to extracellular matrix</li> <li>● Inner surface ~ attach to cytoskeleton</li> <li>● Maintain cell shape</li> </ul>	<p>_____</p> 

### 3. The Structure & Functions of Organelles:

#### a) Nucleus

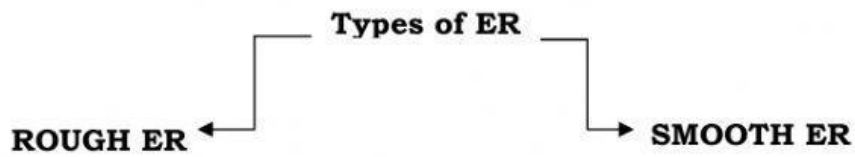
 <p>Labels in diagram: nucleolus, chromatin, nuclear membrane, nuclear pore.</p>	<p><b>Structure:</b></p> <ul style="list-style-type: none"> <li>• Average diameter ~ 5 <math>\mu\text{m}</math>.</li> <li>• Spherical or oval in shape.</li> <li>• Enclosed by _____ nuclear membrane with nuclear pores <math>\rightarrow</math> channels through which molecules can pass through between nucleus &amp; cytoplasm such as RNA</li> <li>• Contains: (fill in the blanks with the correct structure) <ul style="list-style-type: none"> <li>i. _____ – cytoplasm-like that fills the nucleus.</li> <li>ii. _____ – 1 or more dense small spherical bodies.</li> <li>iii. _____ – contain hereditary material.</li> </ul> </li> </ul> <p><b>Function:</b></p> <ul style="list-style-type: none"> <li>i. Contain genetic materials of a cell (DNA)</li> <li>ii. Control cellular activities (eg: protein synthesis)</li> <li>iii. Involved in the production of ribosomes &amp; RNA (nucleolus)</li> </ul>
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#### b) Mitochondrion

<p><b>Structure:</b></p> <ul style="list-style-type: none"> <li>• Vary in size and shape but often rod-like structure</li> <li>• Enclosed by _____ layers of membrane <ul style="list-style-type: none"> <li>○ Outer membrane</li> <li>✓ Highly permeable to small solute</li> <li>○ Inner membrane</li> <li>✓ folded inward to form _____ (to increase the surface area for attachment of enzymes involved in cellular respiration)</li> </ul> </li> <li>• Space between outer &amp; inner membrane ~ _____ space</li> <li>• Inner membrane enclosed a fluid-filled space ~ matrix</li> <li>• Matrix contains DNA &amp; ribosome to synthesize own protein &amp; enzymes involved in Krebs cycle</li> </ul> <p><b>Function:</b></p> <ul style="list-style-type: none"> <li>• _____</li> </ul>	 <p>Labels in diagram: A Cut away view, outer membrane, inner membrane, cristae, 2.5 <math>\mu\text{m}</math>, B Section, loop of DNA, mitochondrial ribosomes, matrix, fluid-filled space, C Detail of crista, stalked particles (diameter 1.8 nm), outer membrane.</p>
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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)



<ul style="list-style-type: none"> <li>• Consist of _____ sacs</li> <li>• Has _____; attached on the outer surface ~ appear granular</li> </ul>	<ul style="list-style-type: none"> <li>• Consist of more _____ sacs</li> <li>• Lack of _____ on outer surface ~ appear smooth</li> </ul>
<b>FUNCTION:</b> <ul style="list-style-type: none"> <li>• _____</li> </ul>	<b>FUNCTION:</b> <ul style="list-style-type: none"> <li>• _____</li> <li>• Detoxification of toxic waste (drugs &amp; poison)</li> <li>• Storage of calcium ions in skeletal muscle cells</li> </ul>

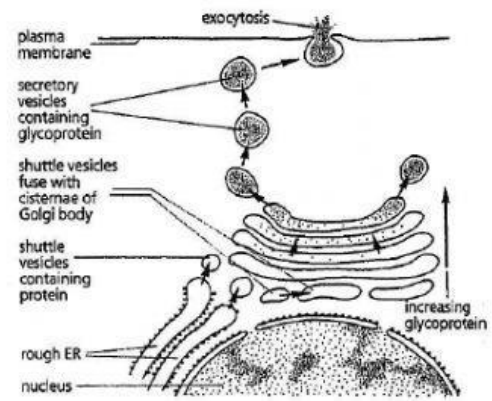
**d) Golgi body**

	<ul style="list-style-type: none"> <li>• Enclosed by a _____ membrane</li> <li>• Consist of stacked flattened membranous sacs ~ cisternae</li> <li>• Each Golgi stack has _____ face &amp; _____ face</li> <li>• <i>Cis</i> face is facing towards the ER / _____</li> <li>• <i>Trans</i> face is facing towards the _____</li> </ul>
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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:

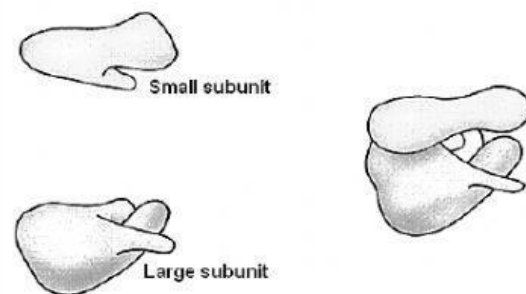
- \_\_\_\_\_
- Form lysosomes

### e) Ribosome

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

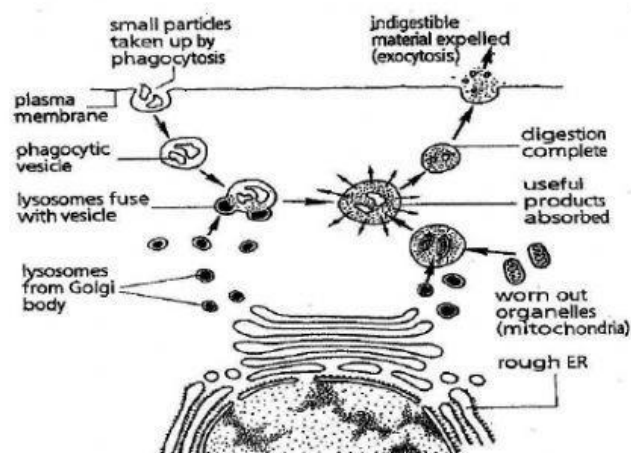
### Function:

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



### f) Lysosome

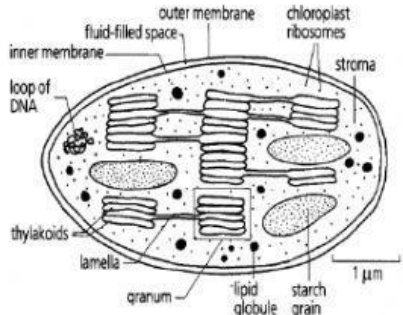
- Small, spherical-shaped
- Enclosed by a special \_\_\_\_\_ membrane
- Contain many \_\_\_\_\_ (digestive) enzymes



### Function:

i.	<b>Intracellular digestion</b> → Digest macromolecules which enter the cell by _____ process
	<ul style="list-style-type: none"> <li>• Plasma membrane engulfs large molecules &amp; pinches off to form food vacuole (phagosome) by phagocytosis process</li> <li>• Primary lysosome fuses with food vacuole → called as secondary lysosome</li> <li>• Hydrolytic enzymes digest large molecules</li> <li>• Useful substances are absorbed into cytosol</li> <li>• Eg: <i>Amoeba</i> &amp; macrophage (engulf bacteria &amp; digest them for defense or protection)</li> </ul>
ii.	<b>Recycle cell's own organic material</b> → Digest old or damaged organelles to recycle organic material by _____ process
	<ul style="list-style-type: none"> <li>• Old or damaged organelle is enclosed by a single membrane to form autophagic vacuole (autophagosome)</li> <li>• Lysosome fuse with autophagic vacuole &amp; digest the organelle with hydrolytic enzymes by autophagy process</li> </ul>
iii.	<b>Programmed cell destruction</b> → Digest the whole cell by _____ process
	<ul style="list-style-type: none"> <li>• In old or damaged cell, lysosome membrane ruptures</li> <li>• Hydrolytic enzymes are released into the cytoplasm</li> <li>• Digest the <u>whole cell</u> by autolysis process</li> <li>• Eg : destroy old / damaged cell : during metamorphosis &amp; development</li> </ul>

### g) Chloroplast

	<ul style="list-style-type: none"> <li>• Shape ~ oblong / biconvex</li> <li>• Enclosed by _____ layers of membrane</li> <li>• Space between outer &amp; inner membrane ~ _____ space</li> <li>• Inner membrane enclosed a fluid-filled space ~ _____</li> <li>• Stroma contains: -</li> <li>• DNA &amp; ribosome to synthesize own protein &amp; enzymes</li> <li>• Embedded within stroma, are membranous system called _____</li> <li>• Thylakoids ~ discs like sac which are stacked to form grana</li> <li>• Grana are interconnected by _____</li> <li>• Chlorophyll &amp; photosynthetic pigments are embedded within thylakoid membrane.</li> </ul>
<b>Function:</b> <ul style="list-style-type: none"> <li>• _____</li> <li>• Light dependent reaction occurs in grana / thylakoid</li> </ul>	



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

## h) Centriole

- Exist in \_\_\_\_\_, orientated at  $90^\circ$  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

