Chapter 2.3

The Plasma Membrane

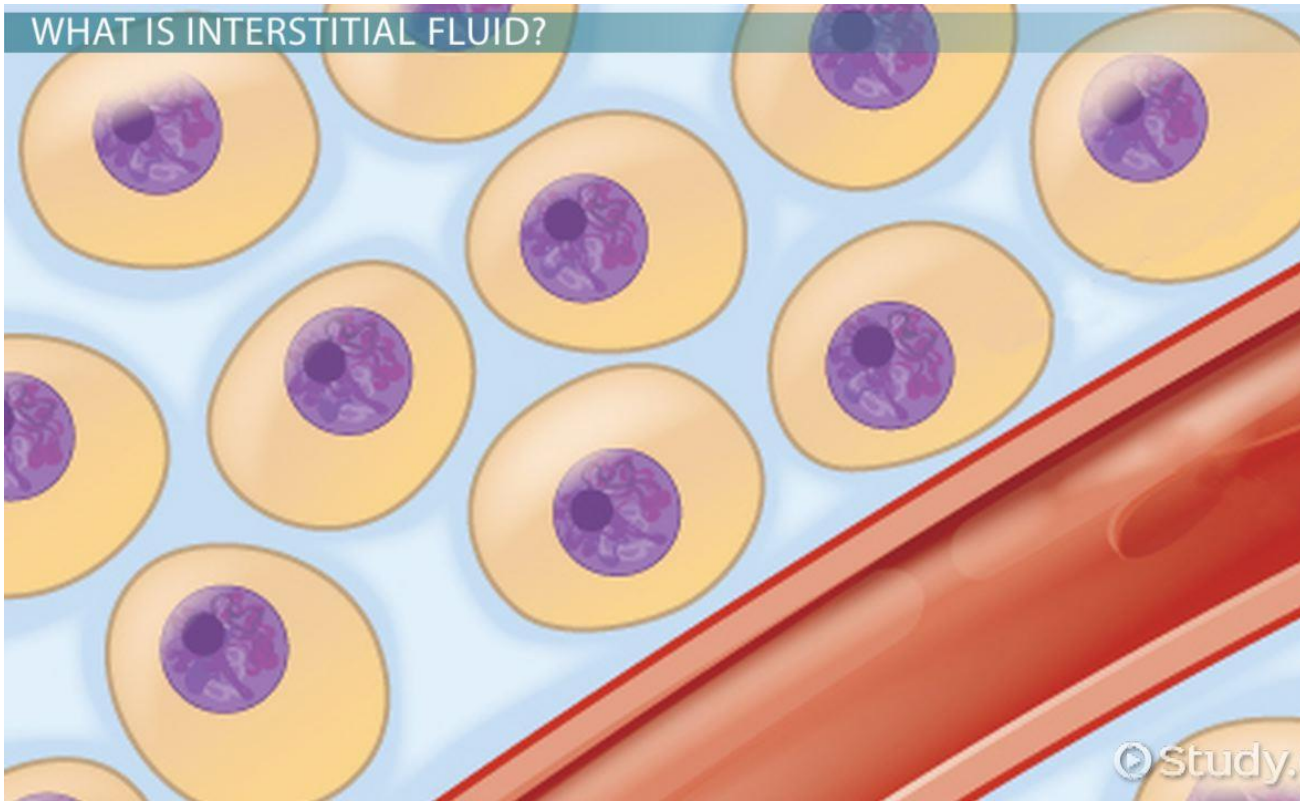
Extracellular fluid

Plasma membrane

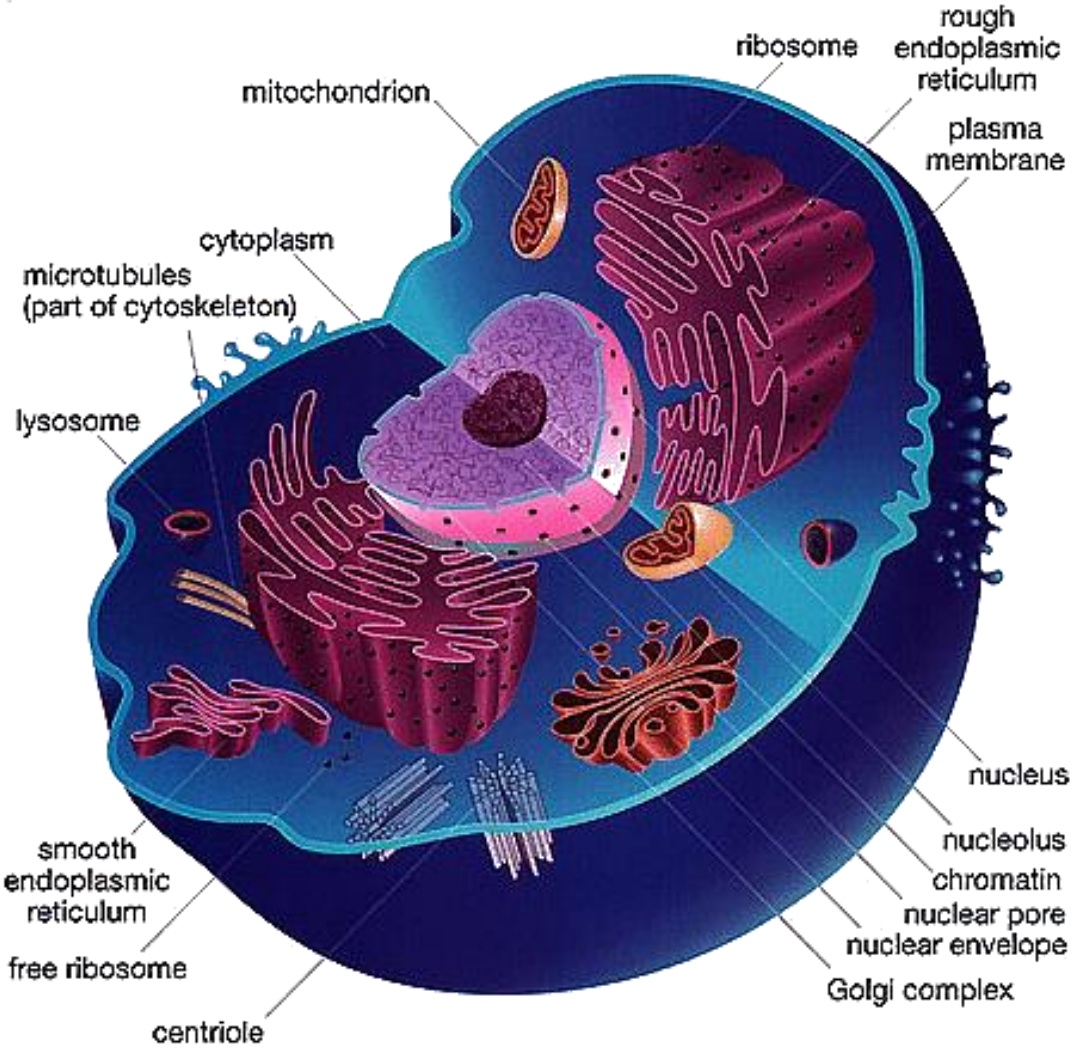
Nucleus

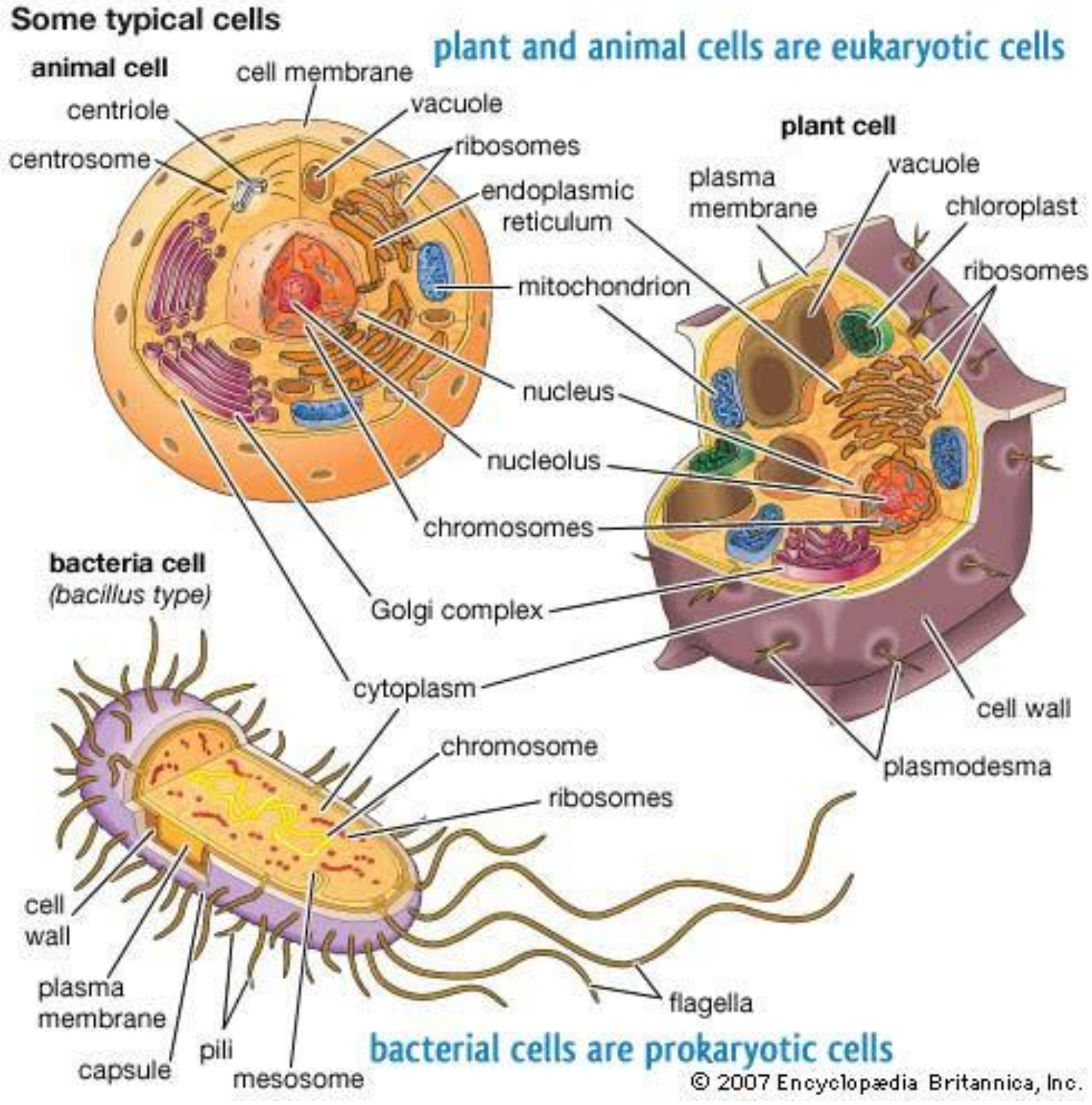
Intracellular fluid

Capillary



Generalised animal cell:





What is similar?

What is different?

Organelles in cells.

Table 2.1 Characteristics of cells in the five kingdoms.

	Monera	Protista	Fungi	Plantae	Animalia
Cell type	prokaryote	eukaryote	eukaryote	eukaryote	eukaryote
Plasma membrane	present	present	present	present	present
Nuclear membrane	absent	present	present	present	present
Chromosomes (DNA)	one, circular	more than one, linear	more than one, linear	more than one, linear	more than one, linear
Endoplasmic reticulum/ Golgi apparatus	absent	present	present	present	present
Chloroplasts	absent	present in many species	absent	present in some cells of all species	absent
Mitochondria	absent	usually present	present	present	present
Ribosomes	present	present	present	present	present
Centrioles	absent	present in some	absent in most	absent in most	present
Vacuoles	absent	present	present	usually large	small or absent
Cell wall	non-cellulose (e.g. murein)	various	non-cellulose (chitin)	cellulose	absent
Cilia/flagella	present in some species (3 fibres)	present in some species (9 + 2 tubules)	absent	present in some cells (9 + 2 tubules)	present in some cells (9 + 2 tubules)

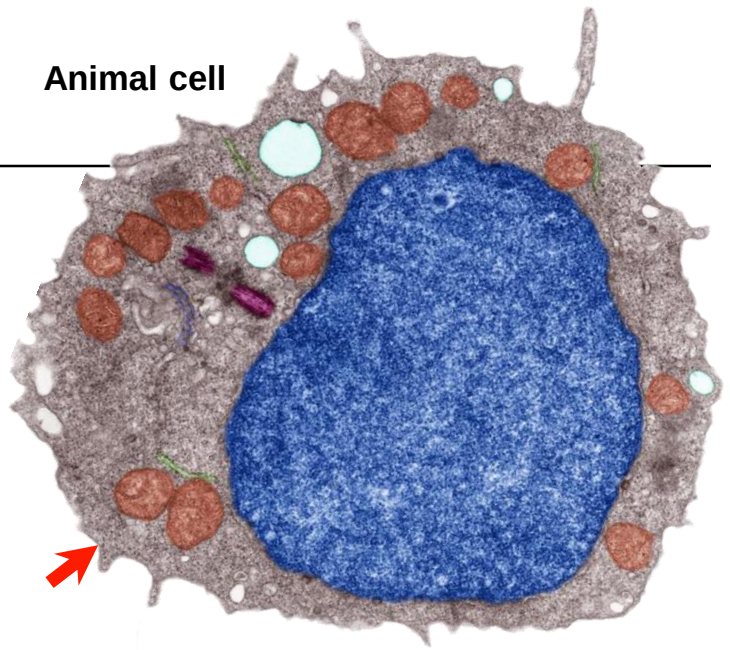
Introduction

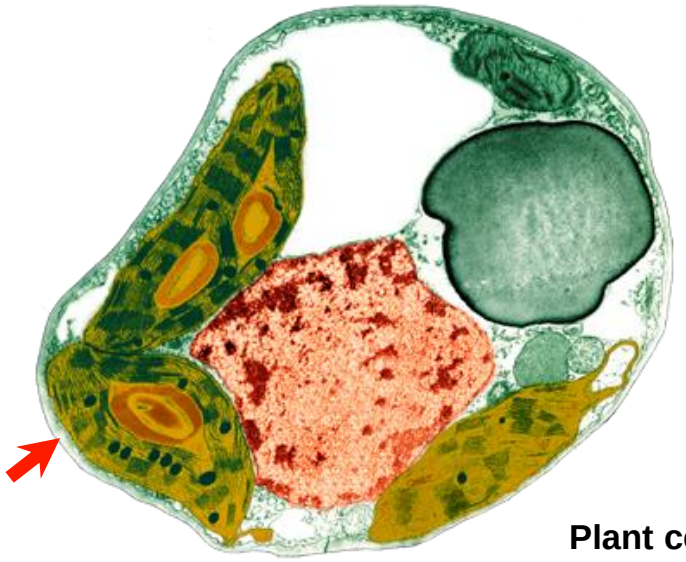
- Each living cell has an outer boundary called the plasma membrane.
- Within this there is a fluid called cytosol which consists of water and dissolved substances.
- Organelles are suspended in the cytosol with the assistance of protein filaments called the cytoskeleton.

Cells and Membranes

- Although the plasma membrane (arrowed) is only about 8 nm thick, it:
  - selectively controls the movement of materials into and out of the cell
  - is responsible for cell-cell recognition (e.g. when cells aggregate into tissues

Animal cell



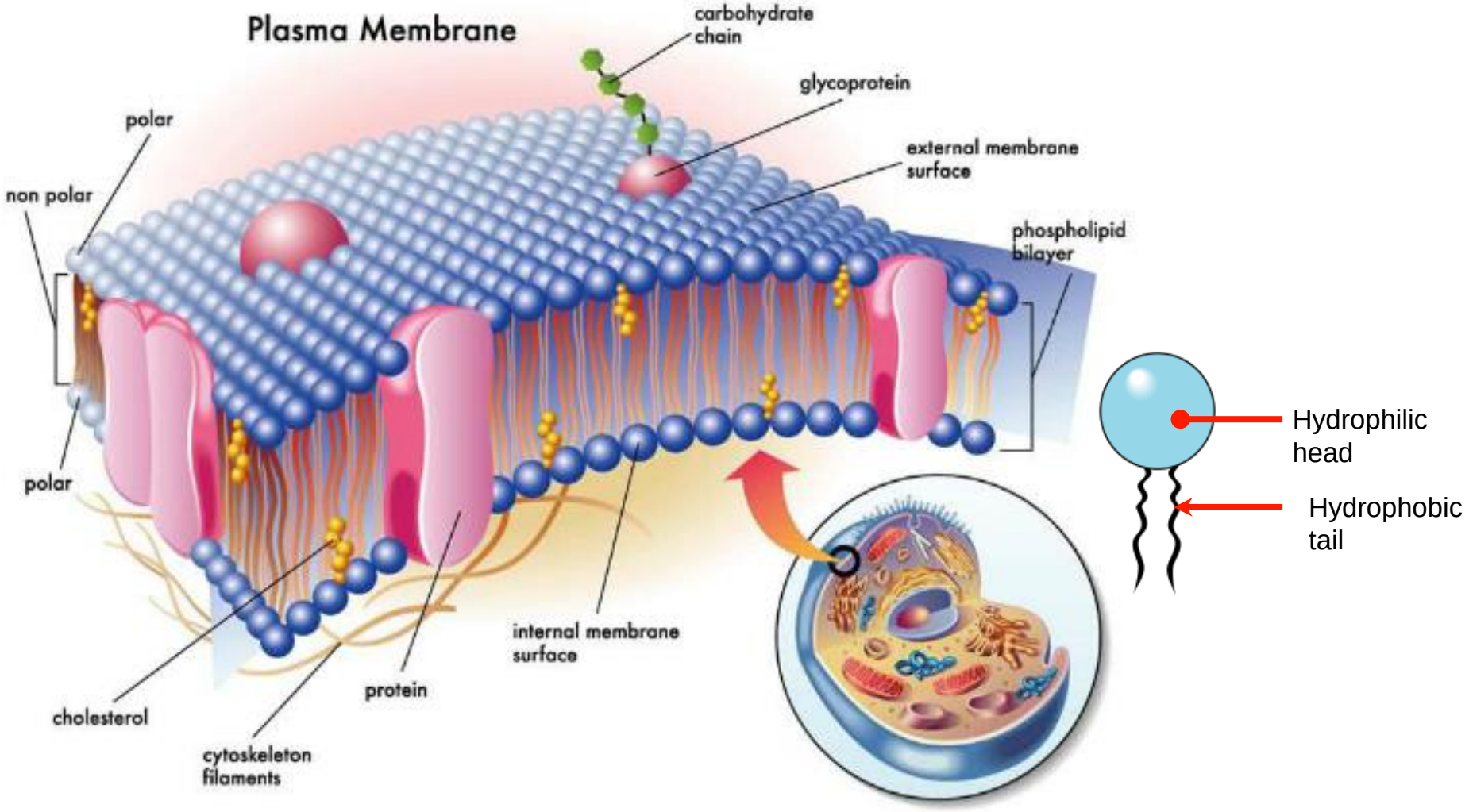


Plant cell

The fluid mosaic model…

- The lipid structure of the membrane gives it the unique property of being flexible and being able to repair itself if, for example, it is pierced; punctures that are not too extreme can be sealed.
- The fluidity allows the membrane to be permeable
- This property is made use of in biotechnological procedures when the inside of a cell has to be accessed .

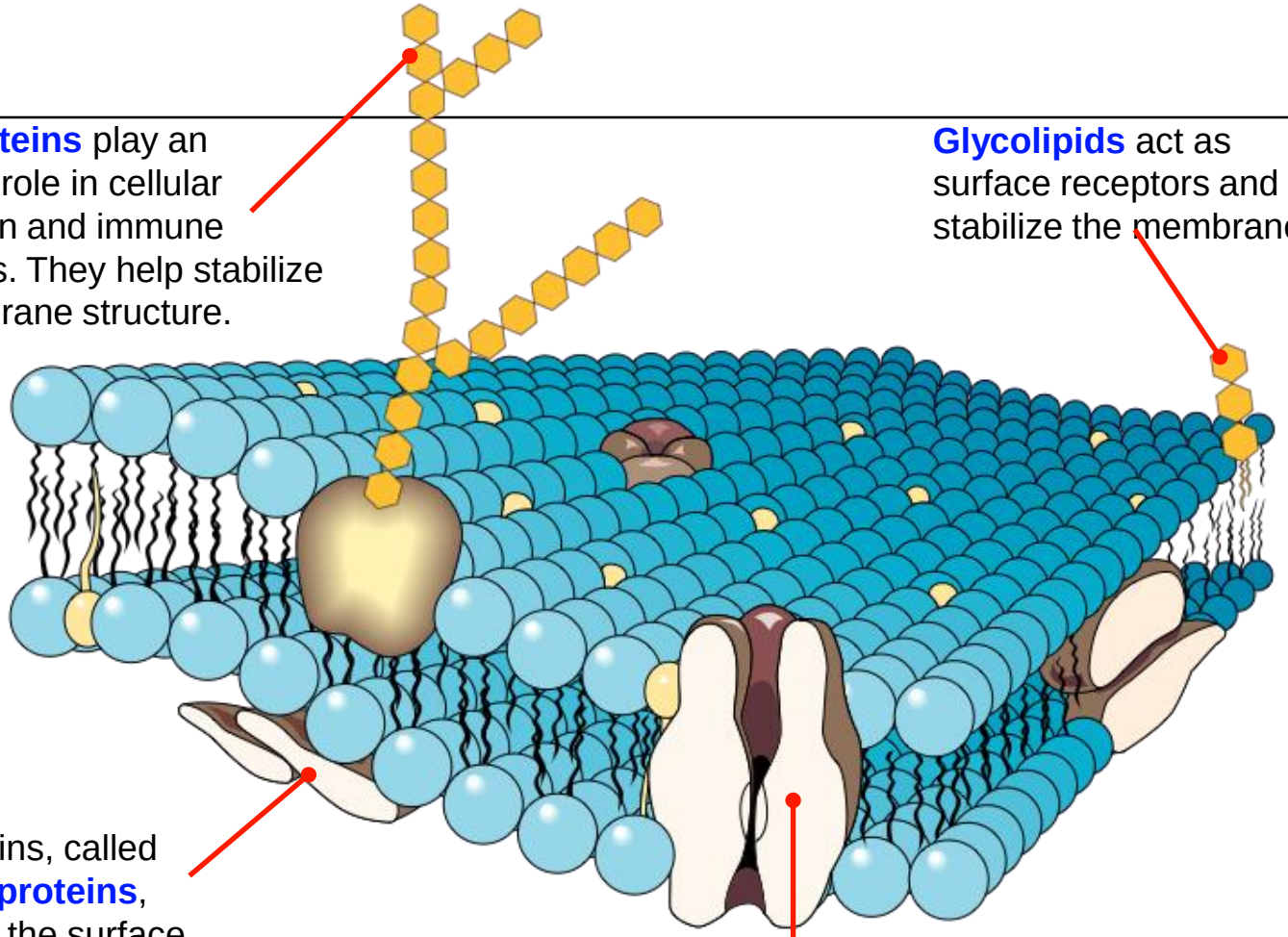
Fluid mosaic model
The Phospholipid Bilayer



Membrane Structure

Glycoproteins play an important role in cellular recognition and immune responses. They help stabilize the membrane structure.

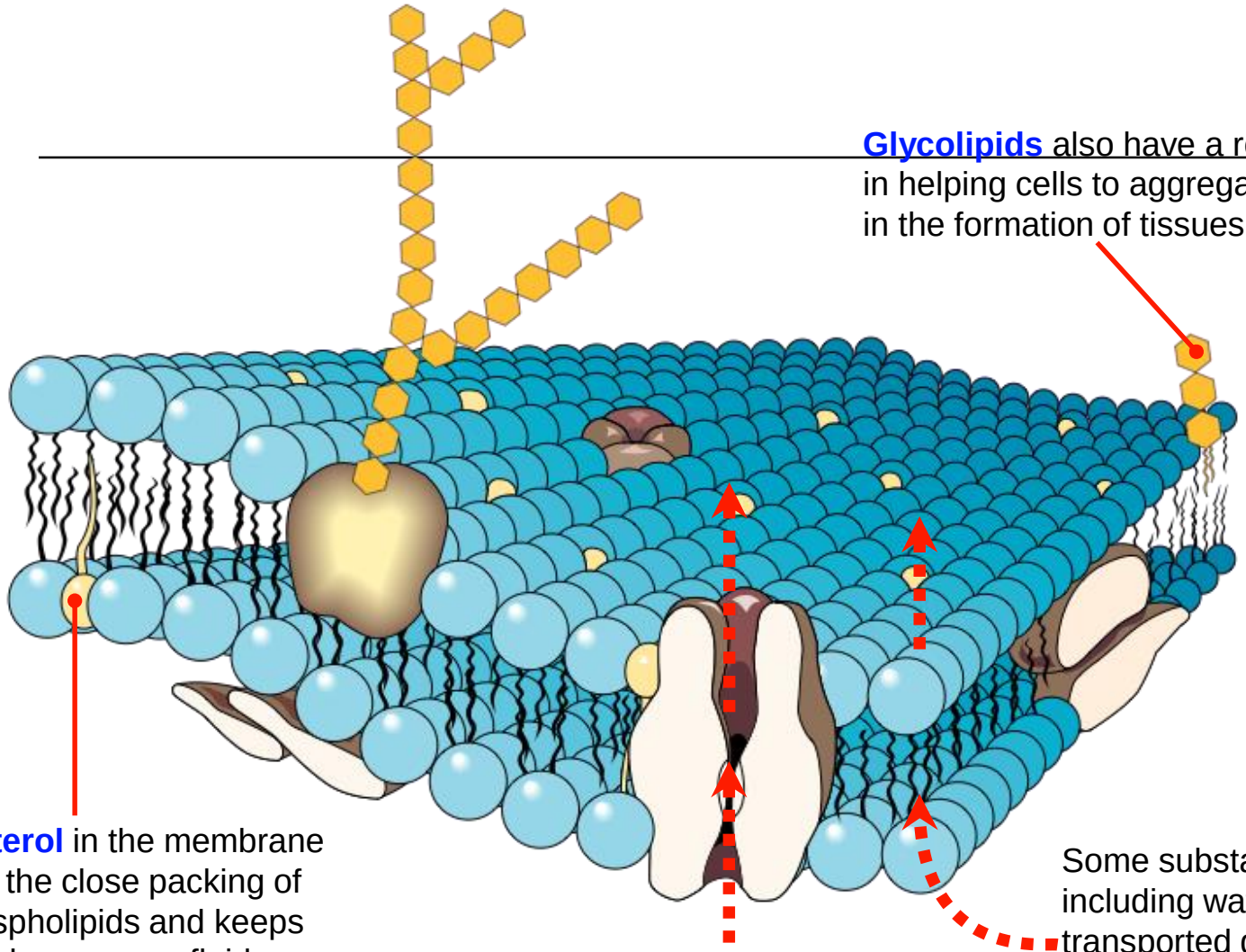
Glycolipids act as surface receptors and stabilize the membrane.



Some proteins, called **peripheral proteins**, are stuck to the surface of the membrane.

Some proteins completely penetrate the phospholipid layer. These proteins may control the movement of specific molecules into and out of the cell.

Membrane Structure



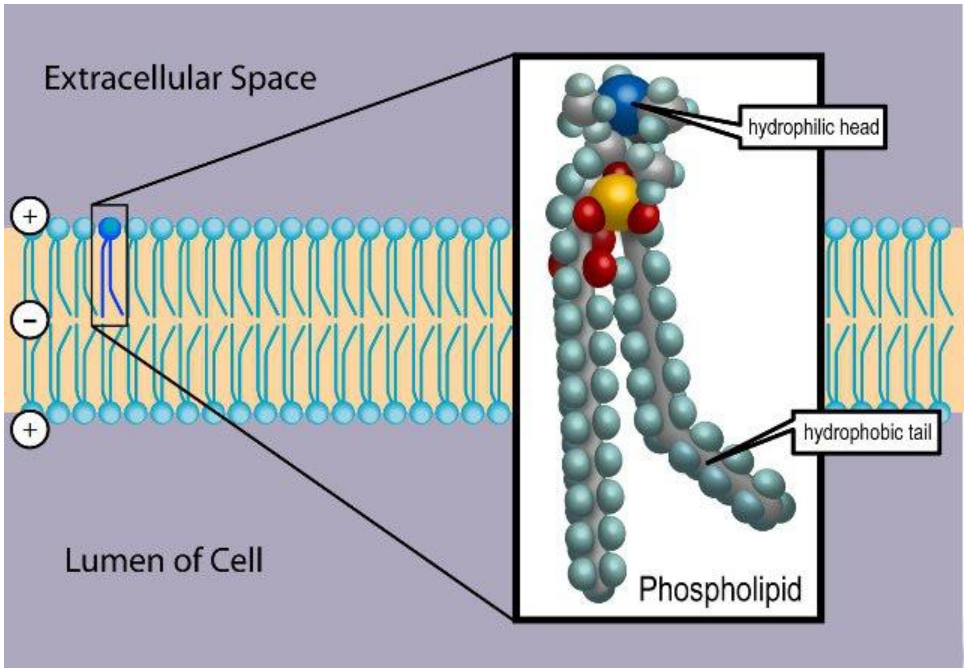
Glycolipids also have a role in helping cells to aggregate in the formation of tissues.

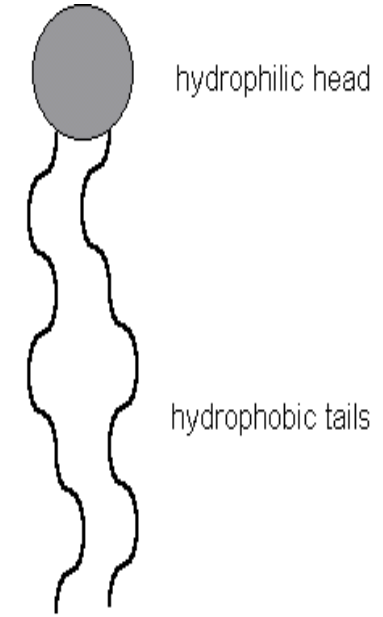
Cholesterol in the membrane disturbs the close packing of the phospholipids and keeps the membrane more fluid.

Some substances, particularly ions and carbohydrates, are transported across the membrane via the proteins.

Some substances, including water, are transported directly through the **phospholipid bilayer.**

- The plasma membrane is composed of two layers of phospholipids.
- Each phospholipid can be represented by a head and two tails.
  - The phosphate head is hydrophilic and
  - the fatty acid tails are hydrophobic. (or lipophilic)



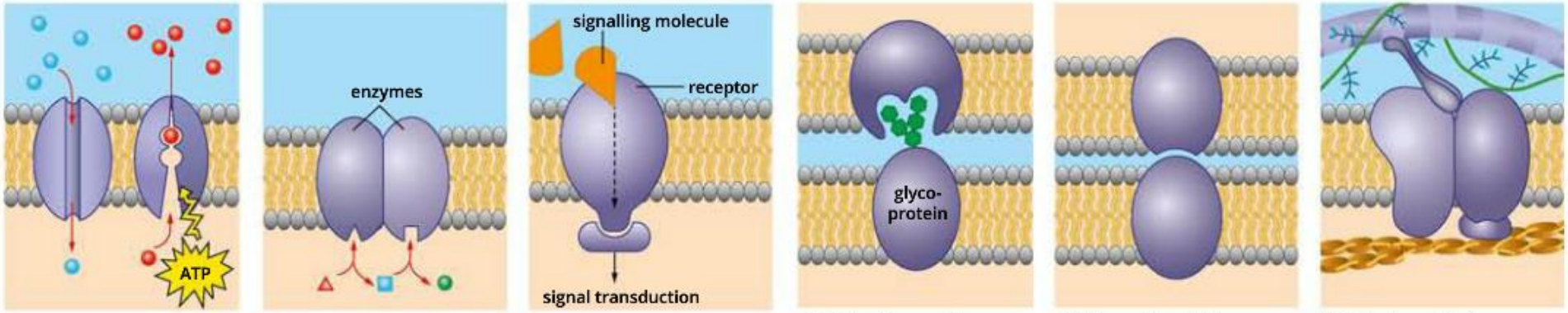


Phospholipid symbol

The fluid mosaic model…

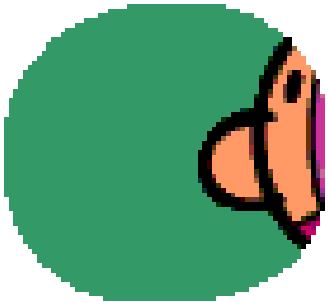
- The **head** tends to *dissolve* in water (like dissolves in like),
- whereas the **tails** are *repelled* and forced to face inwards away from the watery environment and towards each other.
- This forms the **phospholipid bilayer.**
- ***VIDEO*** *– The Plasma Membrane and fluid mosaic model*

The Proteins



(a) Transport (b) Enzymatic activity (c) Signal transduction (d) Cell-cell recognition (e) Intercellular joining (f) Attachment to the cytoskeleton and extracellular matrix (ECM)

FIGURE 2.3.6 Different functions of plasma membrane proteins.



Self or non-self?

- On the outer surface, a plasma membrane has substances called antigens that "label" or identify a cell as belonging to one particular organism.
- Antigens usually consist of proteins combined with carbohydrates – glycoproteins.

Self or non-self?

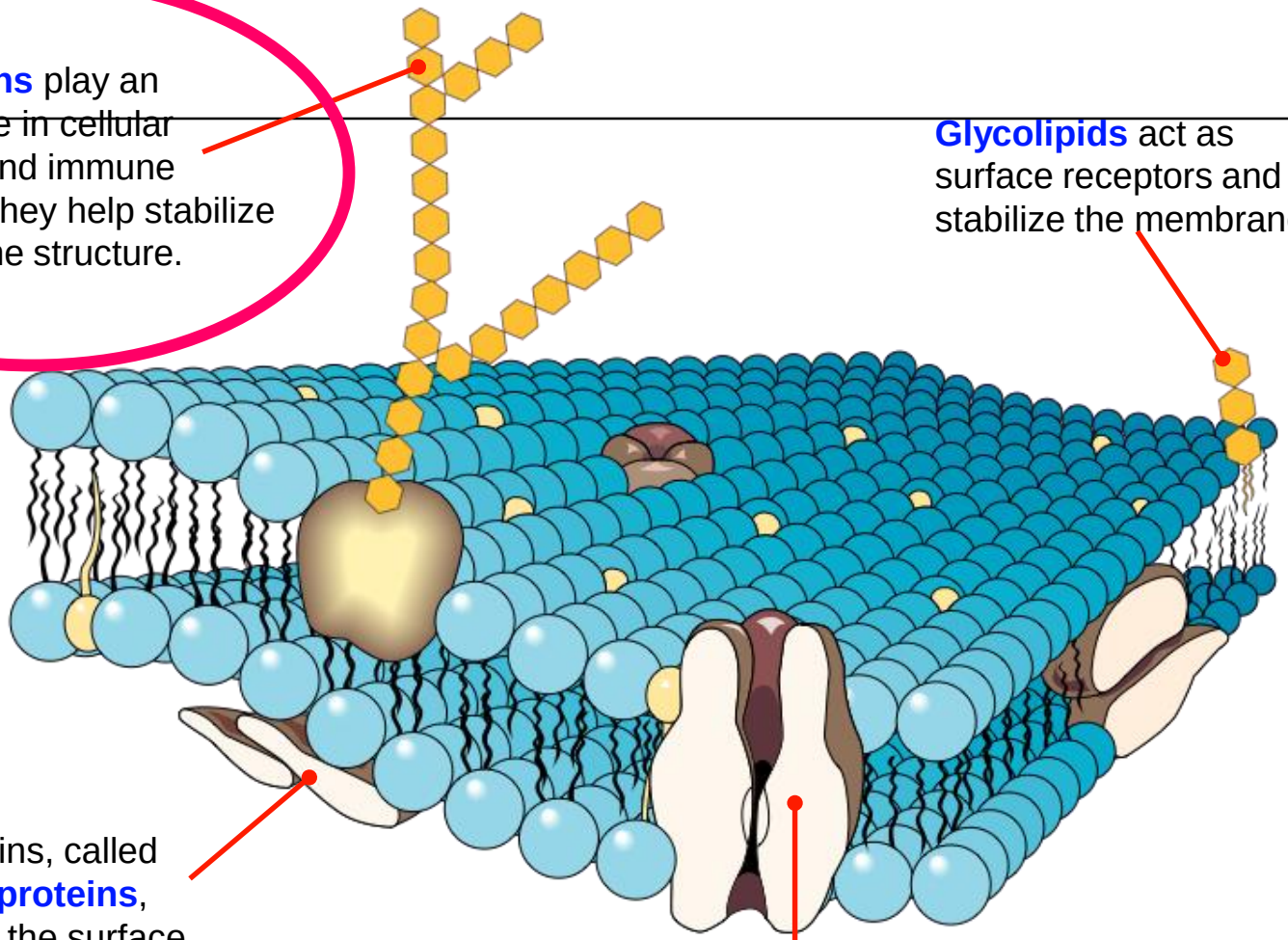
- These antigens differ between organisms.
- If cells from one organism were introduced into the body of another organism of the same species, the immune system recognizes these cells as foreign or non-self.
- The immune system responds with chemical and cellular attacks which kill the foreign/ non-self cell.

Organ transplant recipients will reject the donor organ if the antigen markers are recognised as “non-self”.

Membrane Structure

Glycoproteins play an important role in cellular recognition and immune responses. They help stabilize the membrane structure.

Glycolipids act as surface receptors and stabilize the membrane.

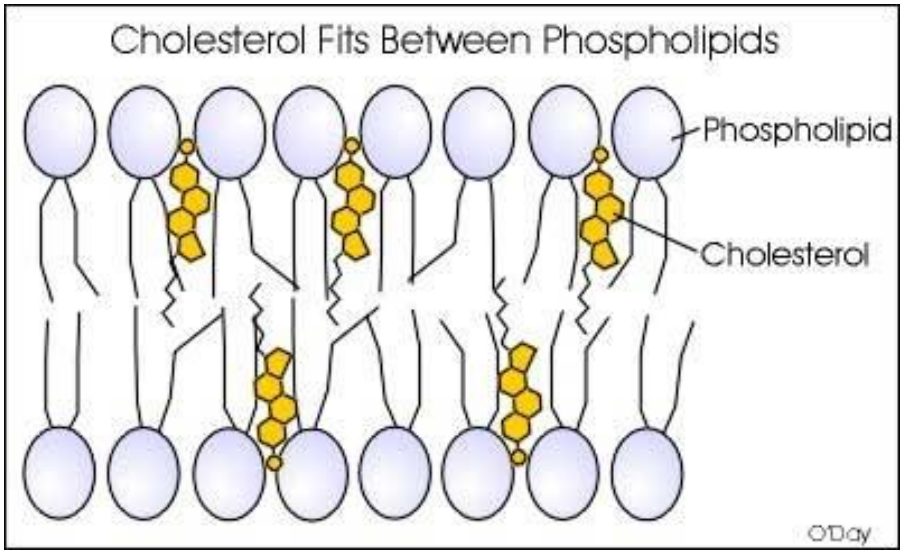


Some proteins, called **peripheral proteins**, are stuck to the surface of the membrane.

Some proteins completely penetrate the phospholipid layer. These proteins may control the movement of specific molecules into and out of the cell.

The role of cholesterol

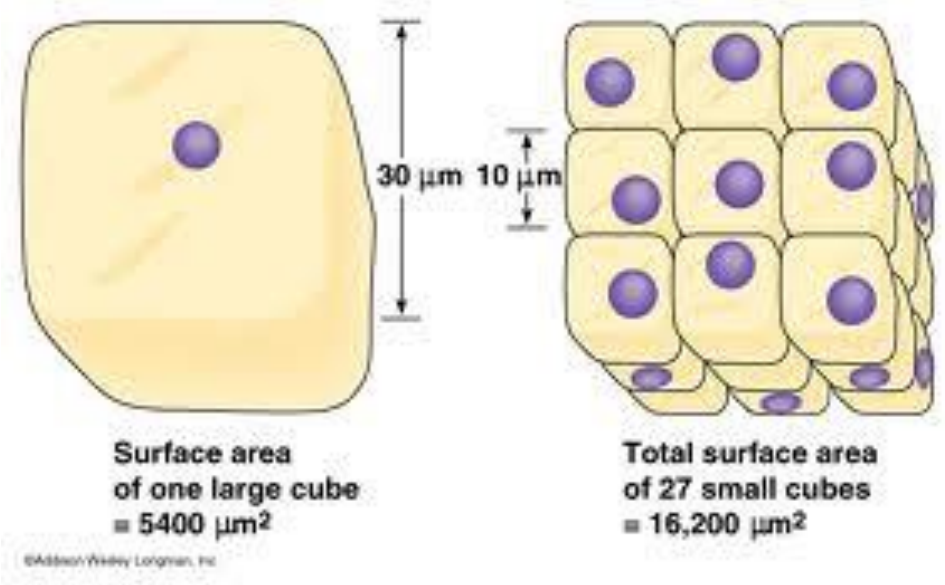
- At higher temperatures, cholesterol stops the plasma membrane from becoming too fluid by restricting the movement of phospholipids.
- At lower temperatures, cholesterol prevents the plasma membrane from solidifying by restricting the tight packing of phospholipids.



Surface Area to Volume

- Limits cell size in organisms
- Larger SA:V is best.
- Assists in delivering nutrients and reactants

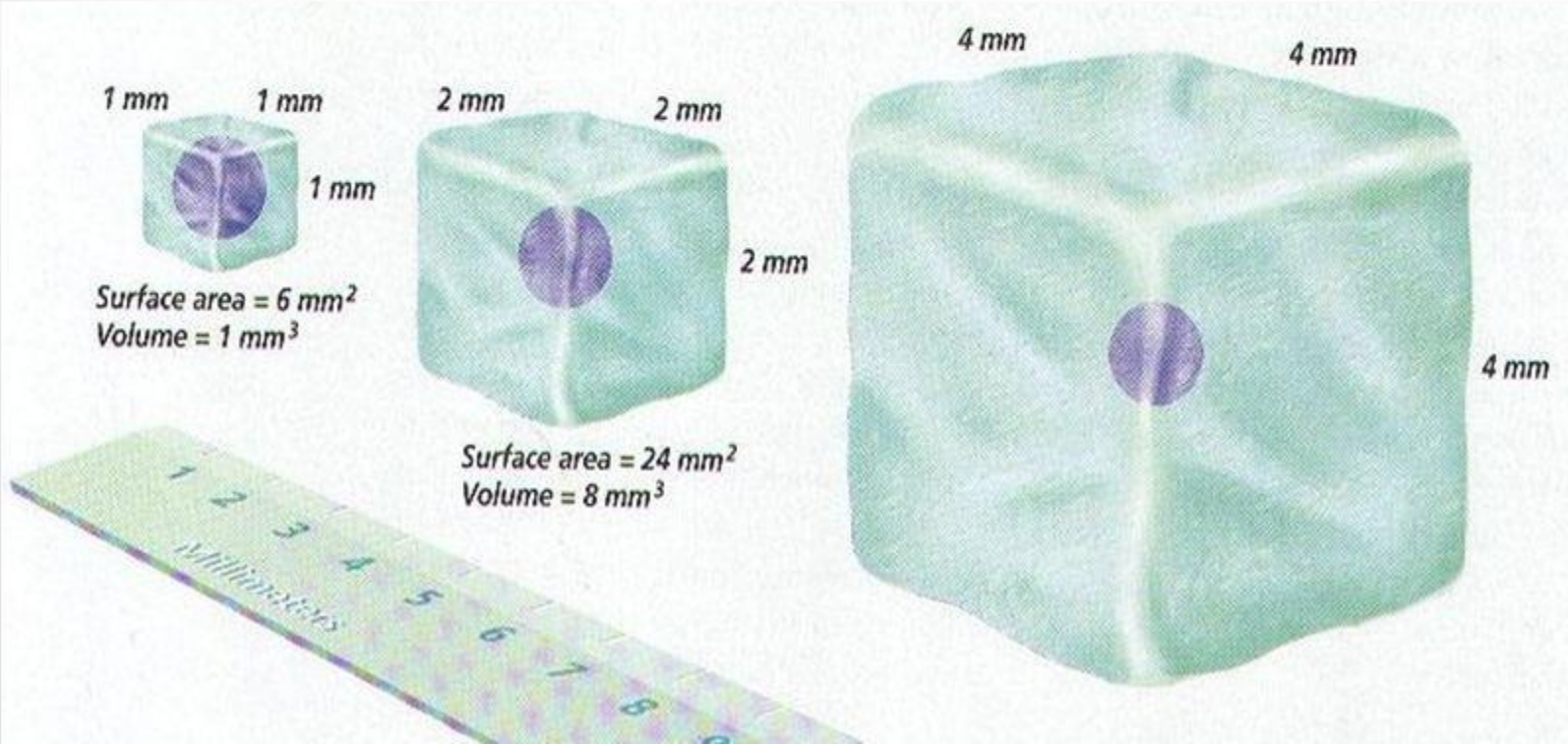
  AND
- removing wastes



Cell Size and Transport

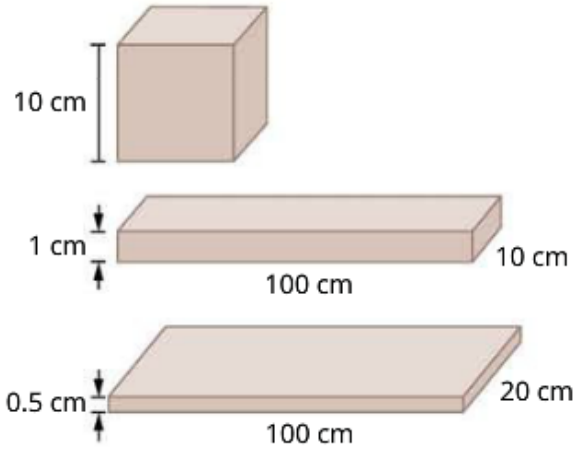
- For a cell to survive, its surface area must be large compared to its ***volume***.

- As a cell ***grows***, its volume increases faster than its surface area



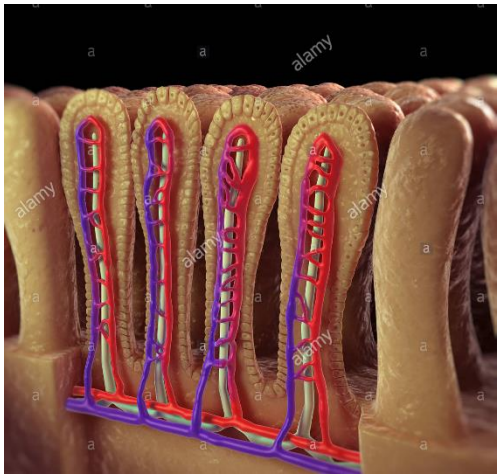
How to increase the SA:V ratio

1. Cell compartmentalisation
    1. Having organelles contained within their own membranes
2. Flattened shape



Surface area (SA)	Volume (V)	SA : V ratio
60 cm^2	1000 cm^3	0.06
2220 cm^2	1000 cm^3	2.22
4120 cm^2	1000 cm^3	4.12

3. Plasma membrane extensions



Activity

Edge of Cube s	Area of Face A = s x s	Surface Area of Cube SA = 6 x A	Volume V = s x s x s	Ratio of Surface to Volume SA : V
1 cm				
2 cm				
3 cm				
4 cm				
5 cm				
6 cm				
7 cm				
8 cm				

What now

- Complete page 99
- Key Questions 1,4,5,6

- Biozone pages