

CELLS

Cytology

The Basic Unit of Life

By

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Cells

Simple organisms such as bacteria, are single cell.

Plants and animals are made up of many cells.

Each kind of cell has a particular function.



Cells: Size & Shape

Size and Shape depend upon its function.

Red blood cells are small and disc shaped to fit through the smallest blood vessel.

Muscle cells are long and thin. When they contract they produce movement.

Nerve cells which carry signals to the brain are very long.

Functions of Cells

Cell Function

Cells work together to perform basic life processes that keep organisms alive.

Getting rid of body wastes.

Making new cells for growth and repair.

Releasing energy from food.

Tissues, Organs, & Systems

Cells that work together to perform a specific function form a tissue.

Just as cells that work together form a tissue, tissues that work together form an organ.

Organs that work together to perform a function form a system. Example: circulatory system.

Plant cells also form tissues, such as the bark of a tree. And plant cells work together, forming organs, such as roots and leaves.

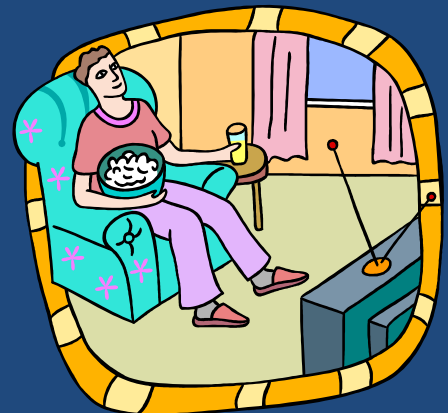
The Digestive System

Digestion begins as you chew food.

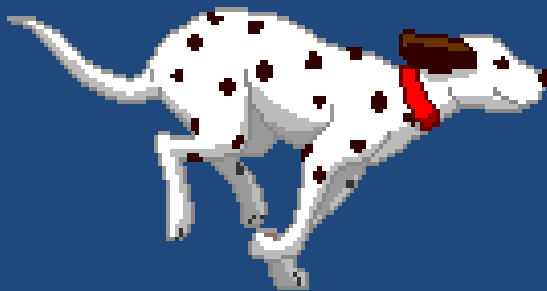
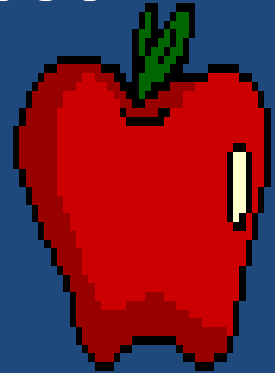
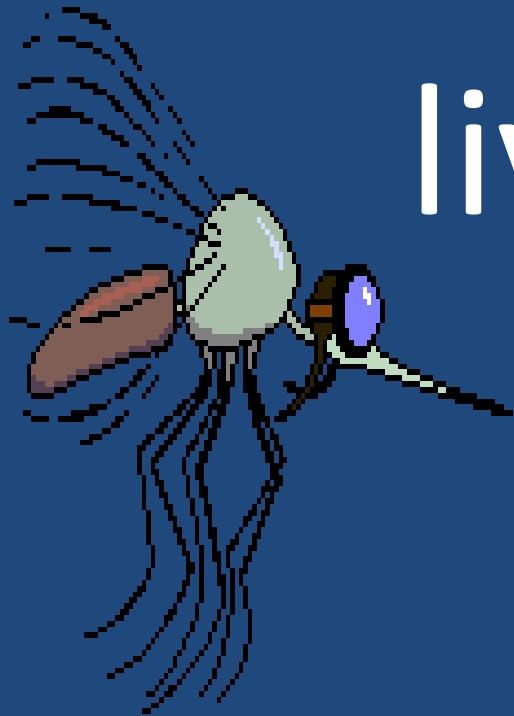
Glands in your mouth produce saliva to moisten food. •

The food passes through the esophagus to the stomach and moves to the small intestine. •

Nutrients diffuse through the villi, tiny projections from the intestine, into the blood.



Cells make up all
living things.

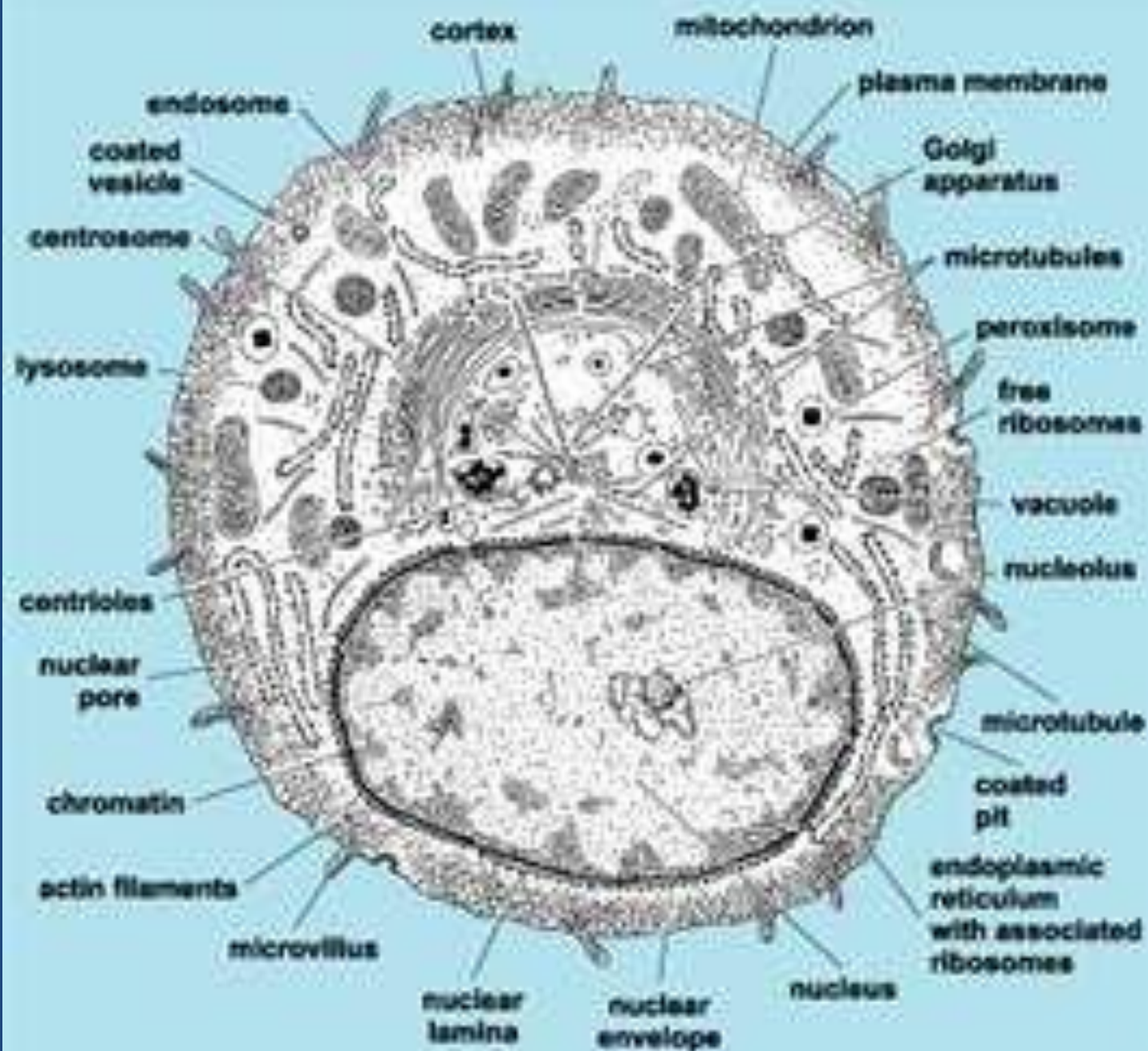


Cell Theory

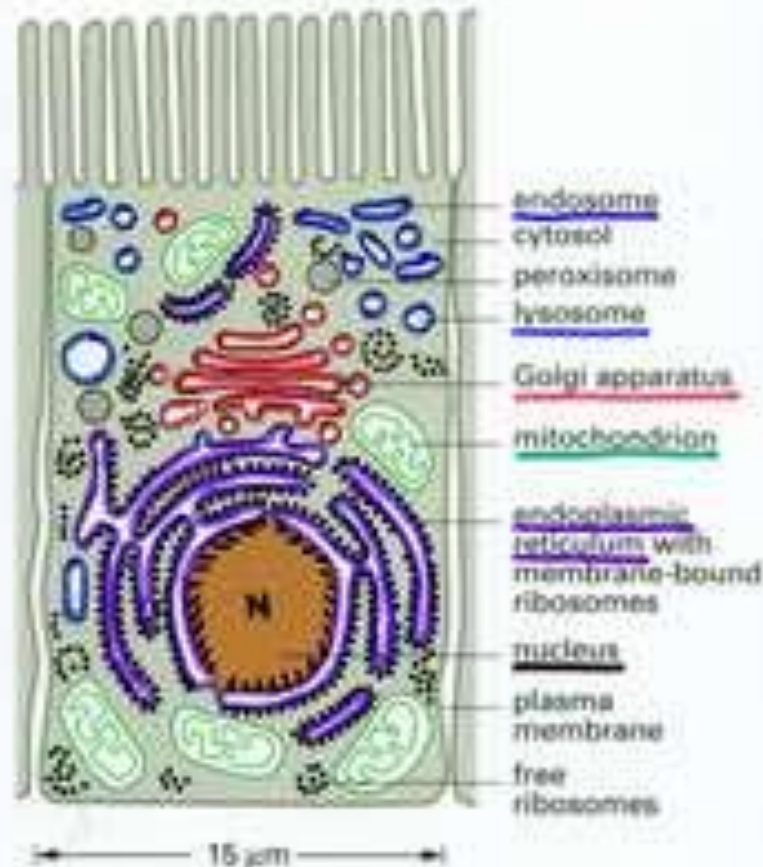
The cell is the basic unit of structure.

The cell is the basic unit of function.

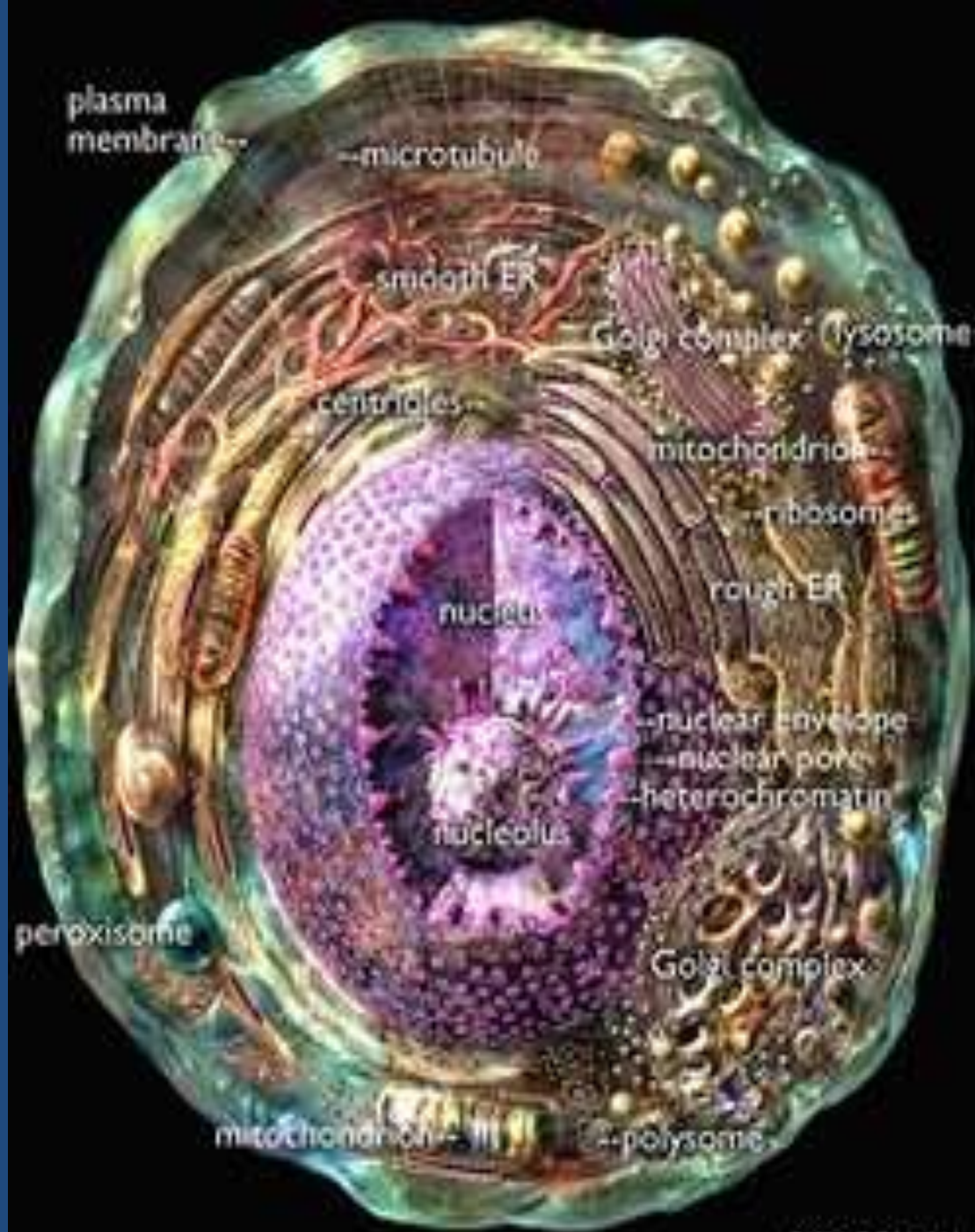
All cells arise from pre-existing cells.

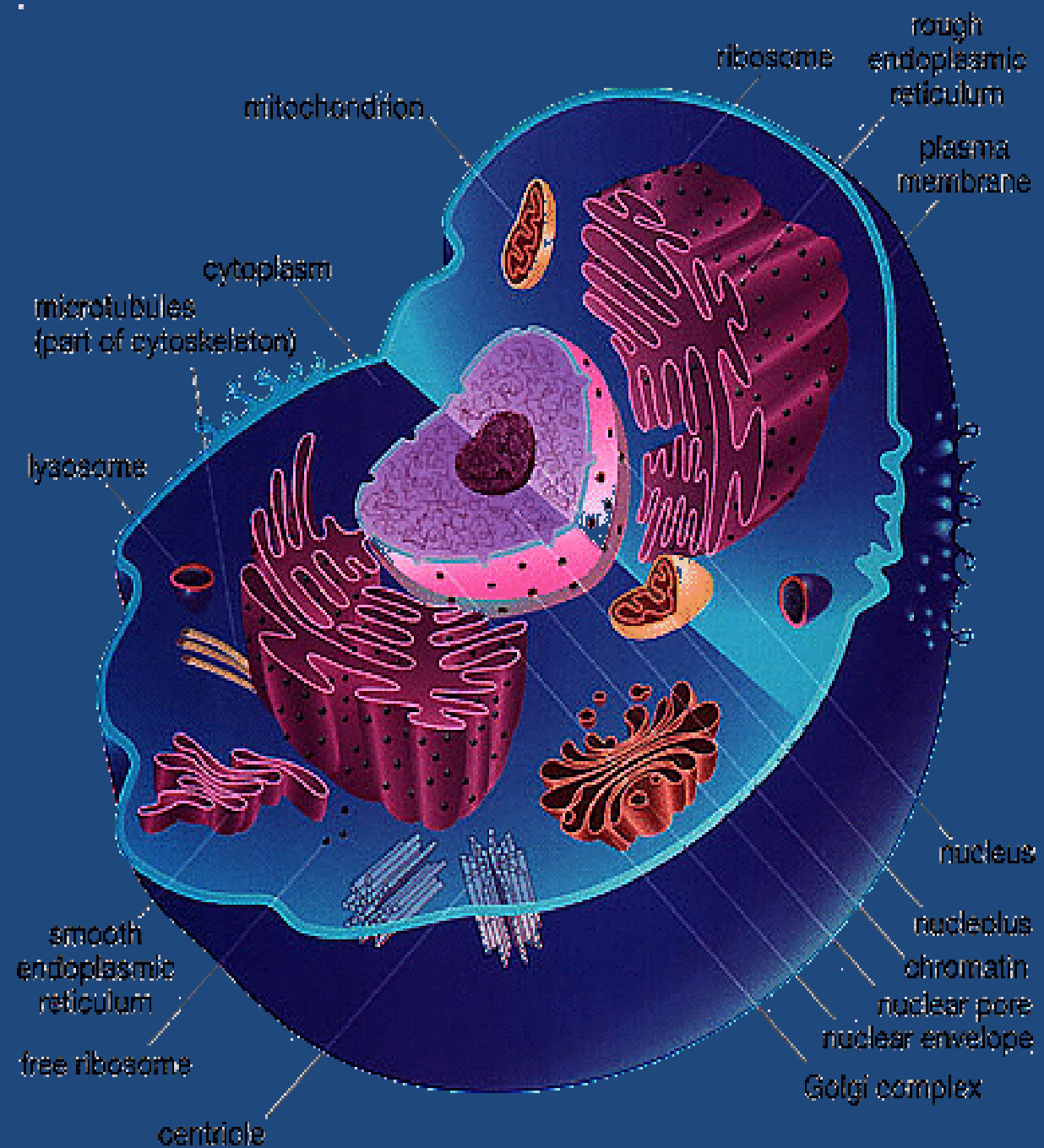


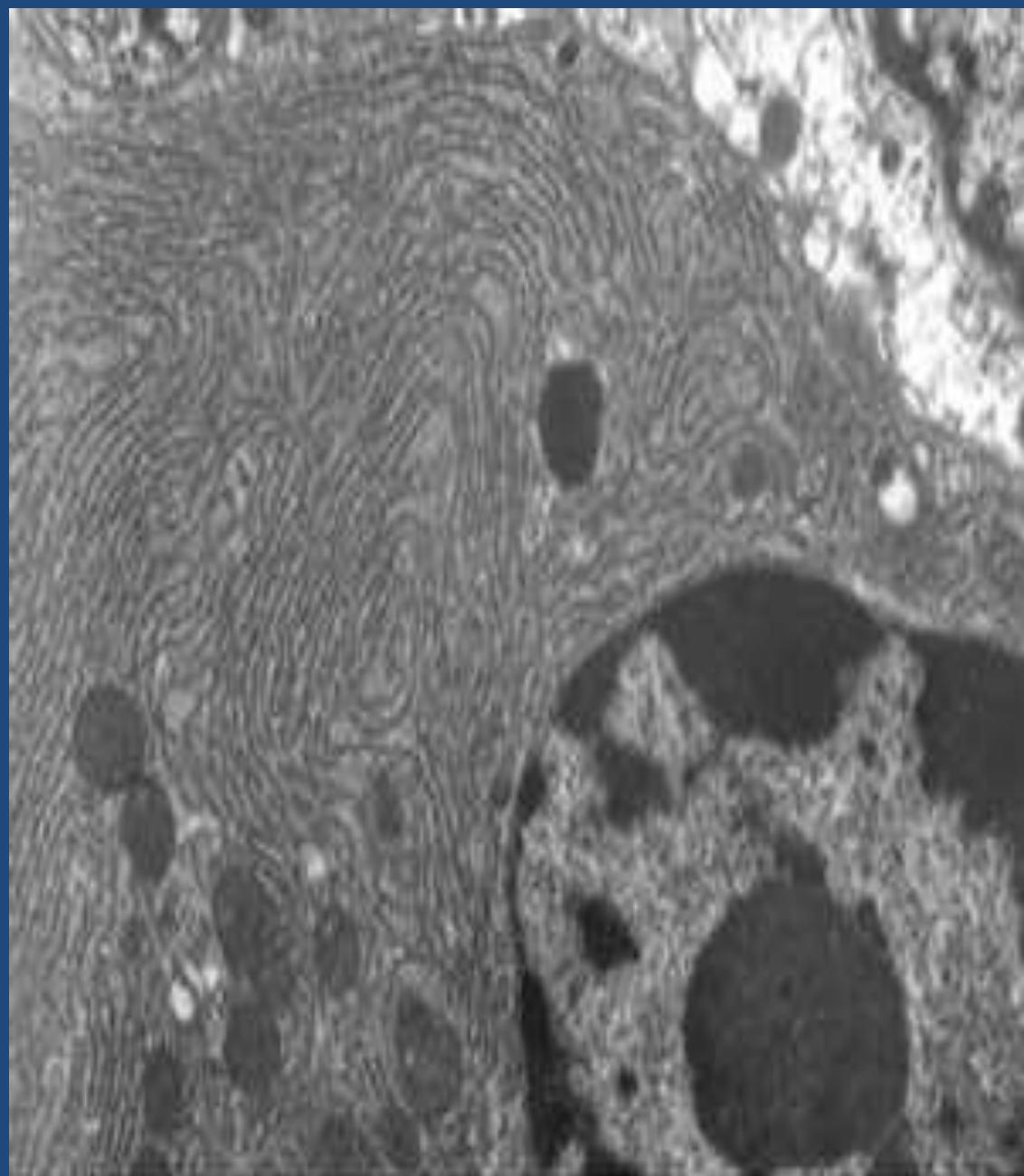
Major membrane-bounded organelles of an animal cell (epithelial cell)



Alberts et al. Fig. 15.2



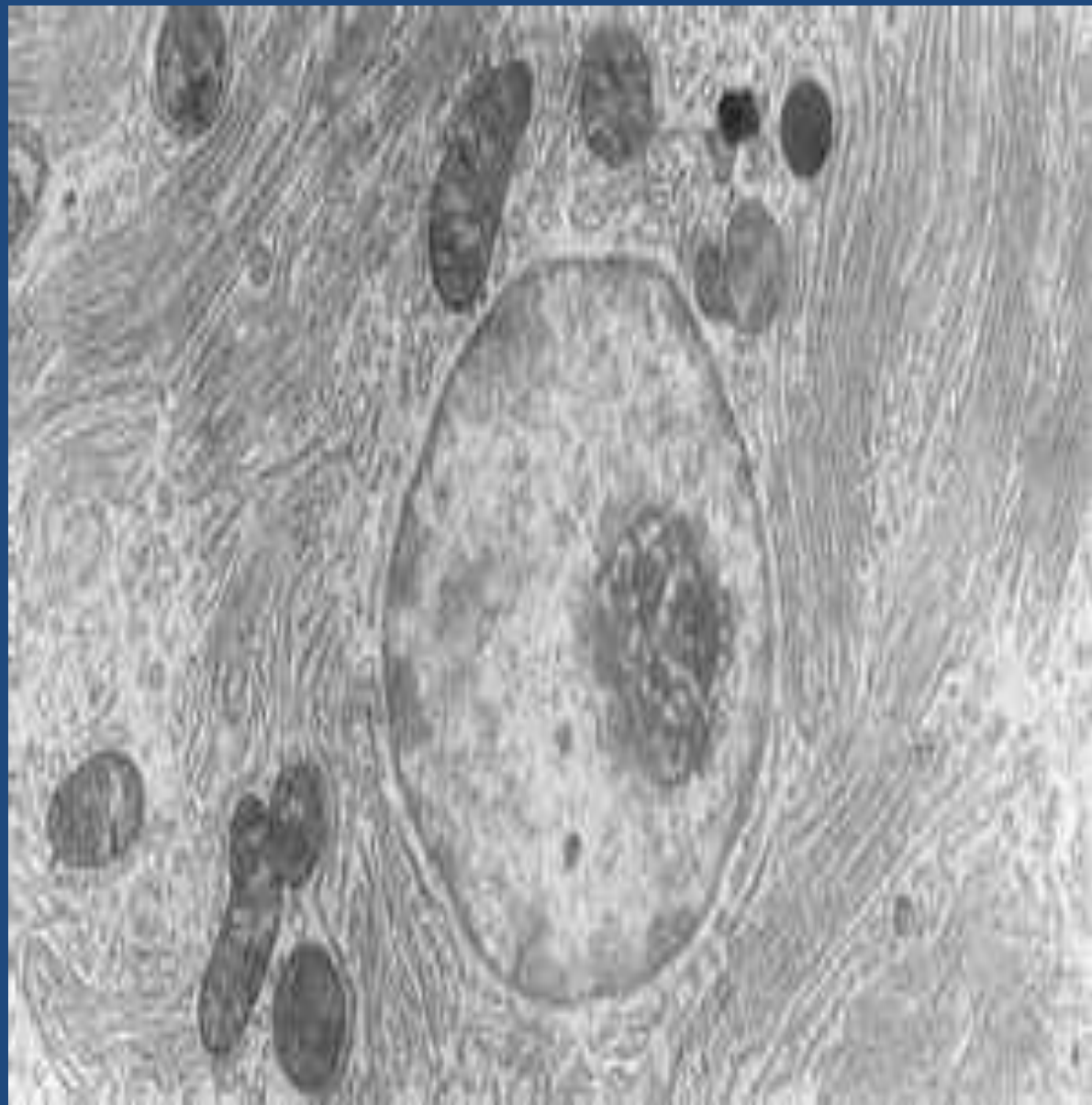




500 nm

INLungTEM

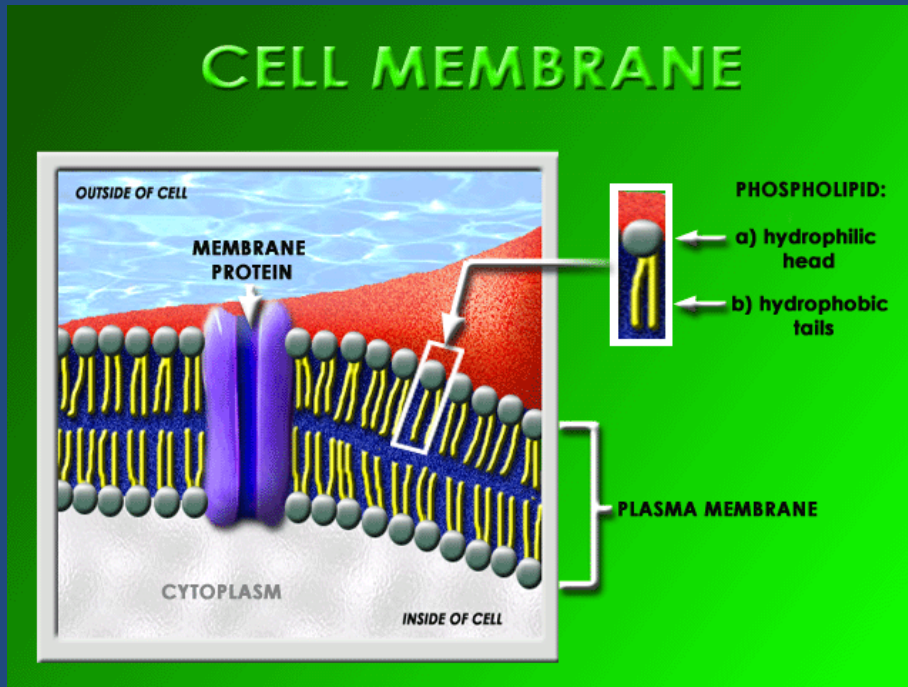
1/7/0 RIMP



Onion stained with Iodine



Cell Membrane

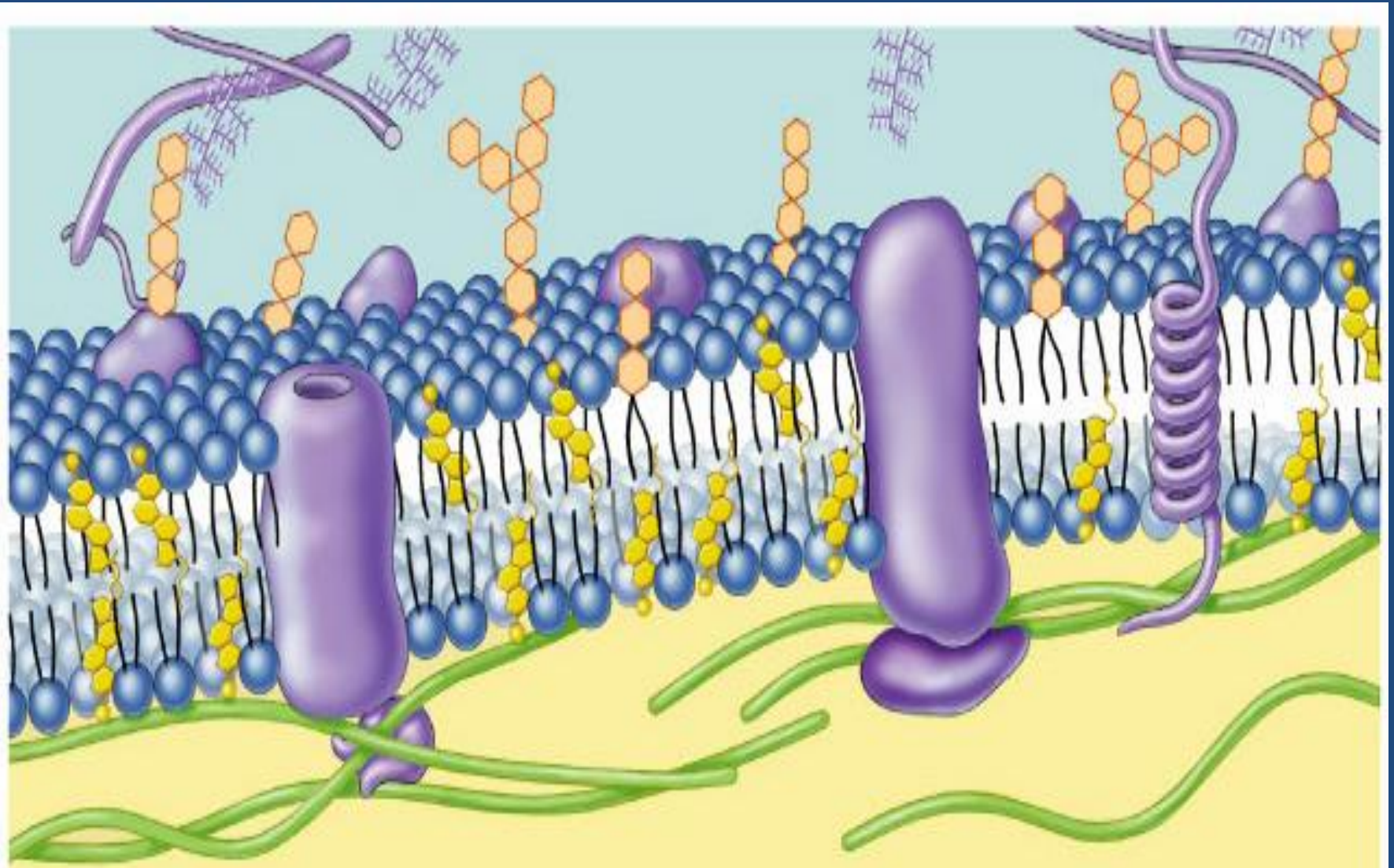


Outer boundary of cell

Protects the cell

Controls what enters and leaves the cell

The Cell Membrane



Overview

Cell membrane separates living cell from nonliving surroundings

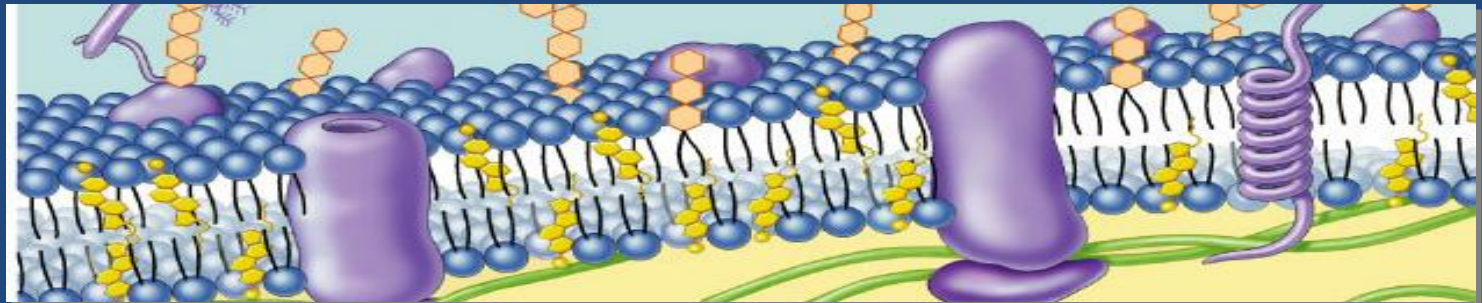
thin barrier = 8nm thick –

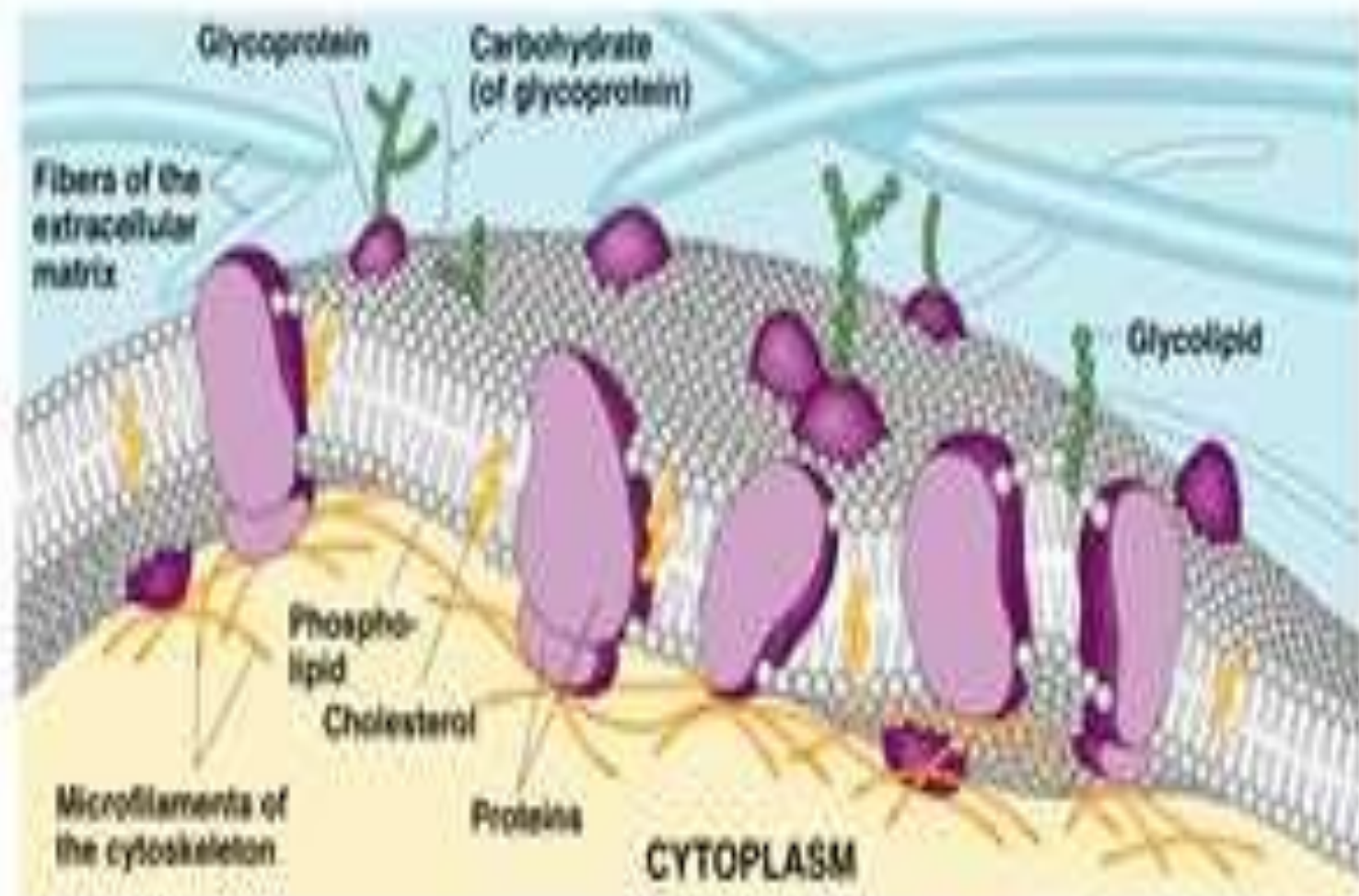
Controls traffic in & out of the cell

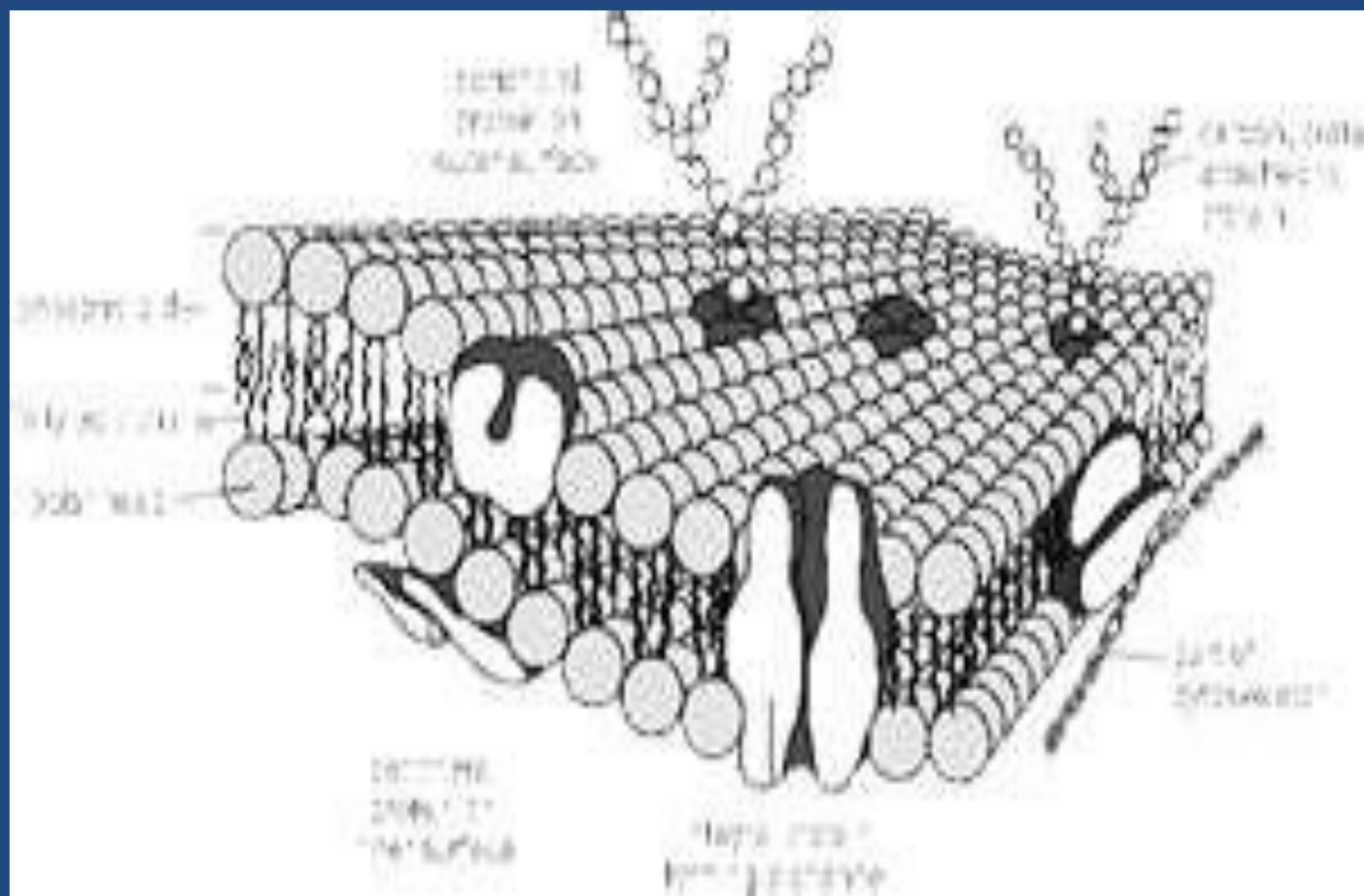
selectively permeable allows some substances to cross more easily than others

hydrophobic vs hydrophilic

Made of phospholipids, proteins & other macromolecules





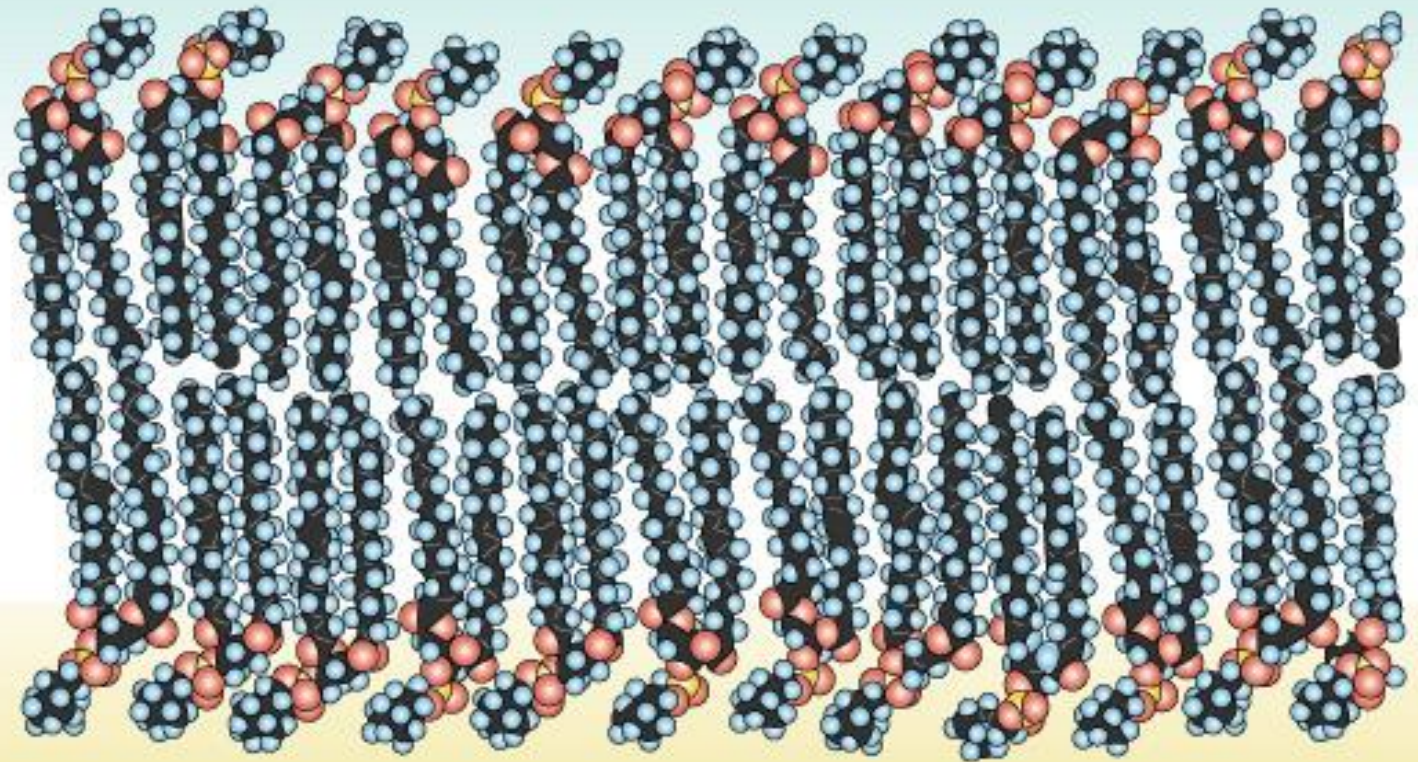


Phospholipid bilayer

polar
hydrophilic
heads

nonpolar
hydrophobic
tails

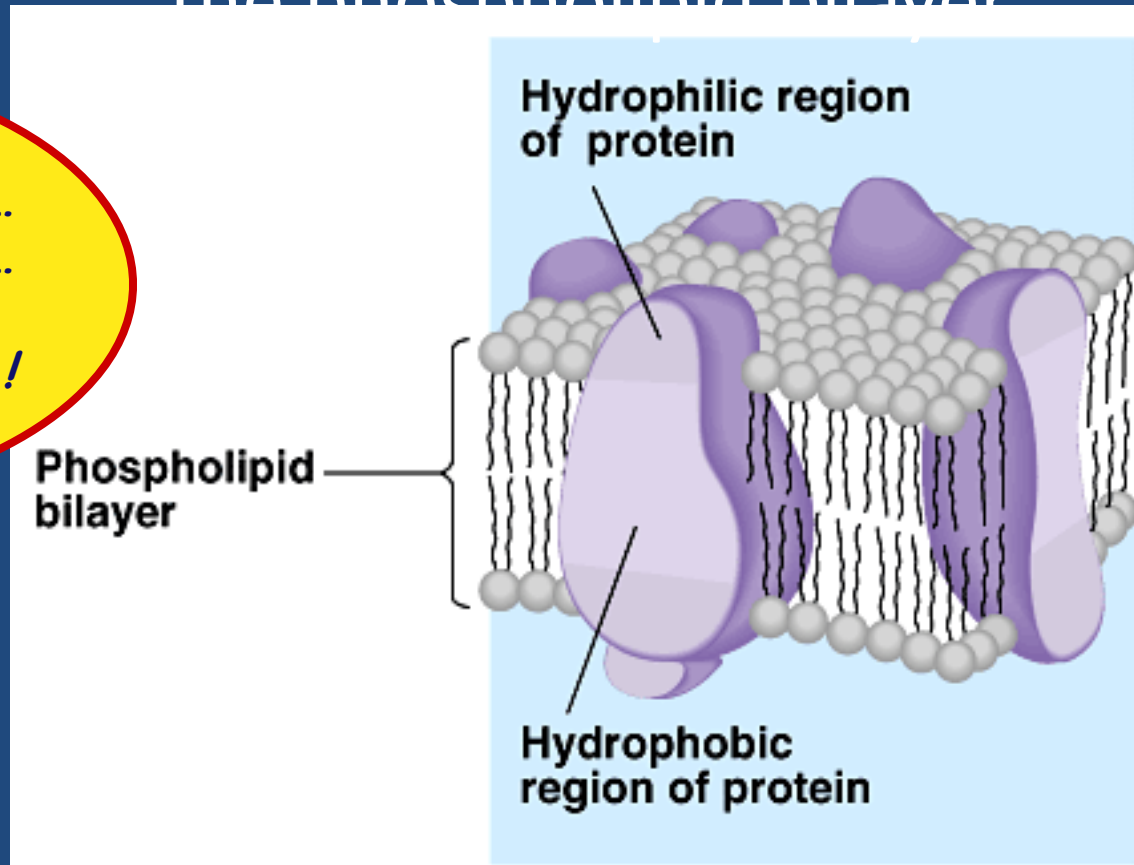
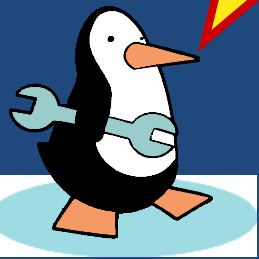
polar
hydrophilic
heads



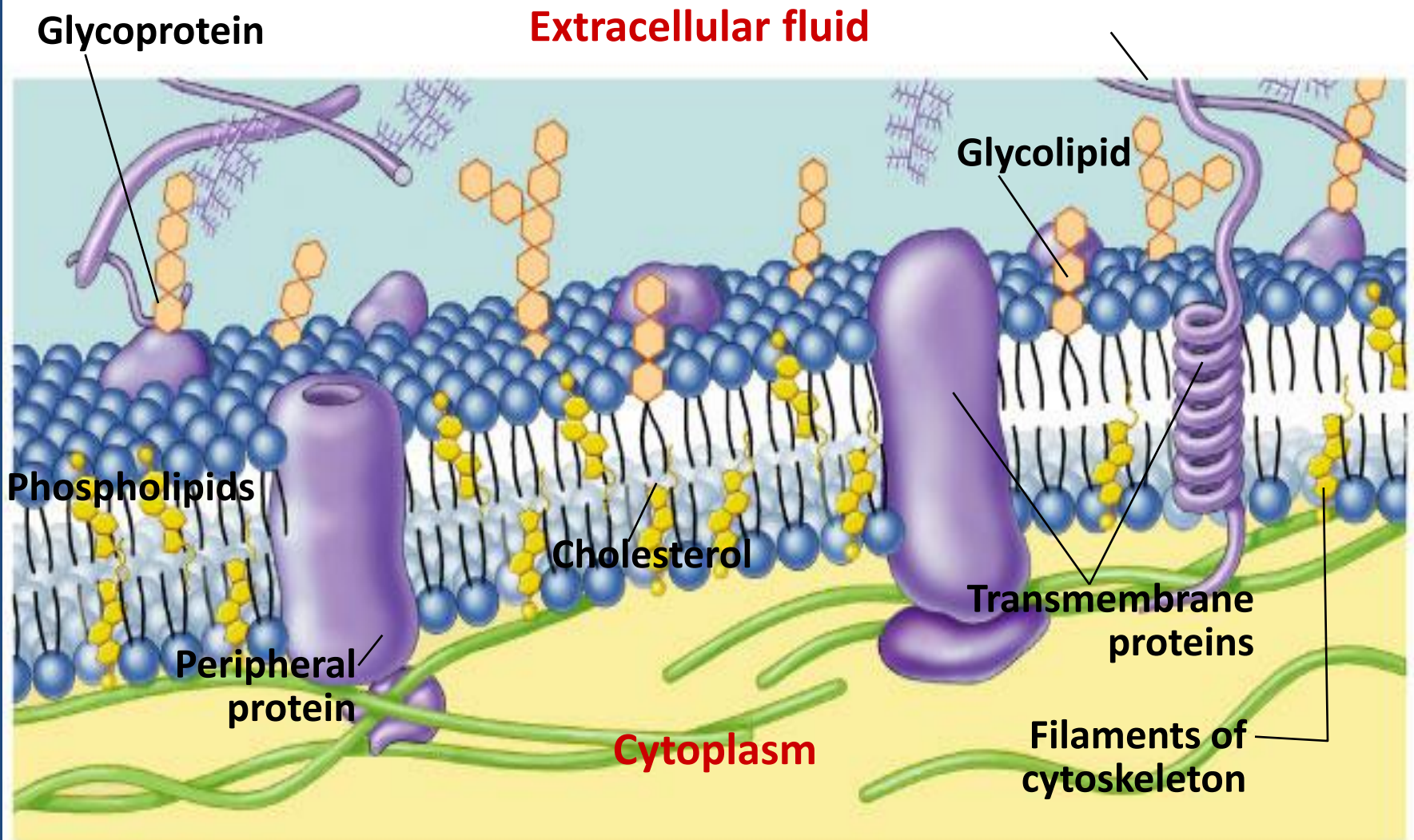
More than lipids...

In 1972, S.J. Singer & G. Nicolson proposed •
that membrane proteins are inserted into
the phospholipid bilayer

It's like a fluid...
It's like a mosaic...
It's the
Fluid Mosaic Model!



Membrane is a collage of proteins & other molecules embedded in the fluid matrix of the lipid bilayer



Membrane Proteins

Proteins determine membrane's specific functions
cell membrane & organelle membranes each have unique —
collections of proteins

Membrane proteins:

peripheral proteins —

loosely bound to surface of membrane
cell surface identity marker (antigens)

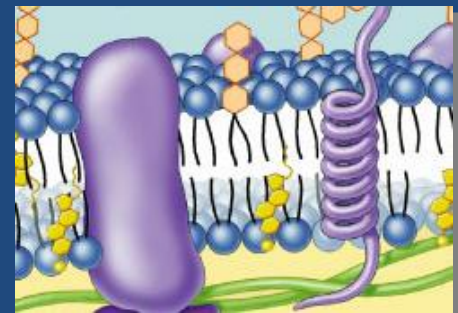
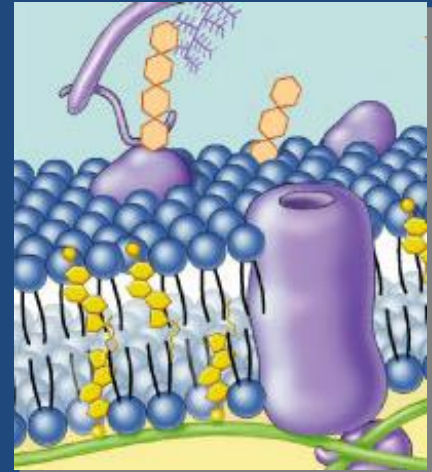
integral proteins —

penetrate lipid bilayer, usually across whole membrane

transmembrane protein

transport proteins

channels, permeases (pumps) —



Proteins domains anchor molecule

Within membrane

nonpolar amino acids

hydrophobic

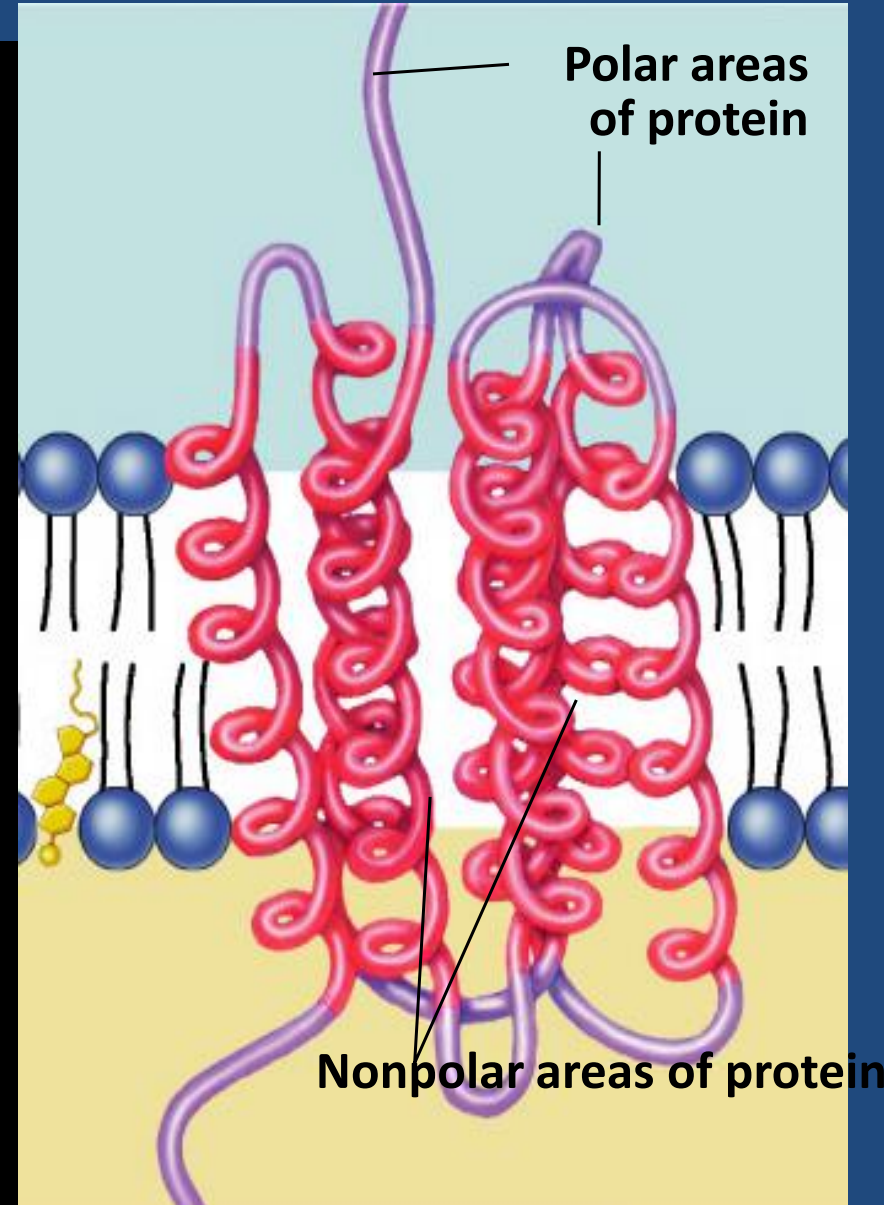
anchors protein
into membrane

On outer surfaces of
membrane

polar amino acids —

hydrophilic

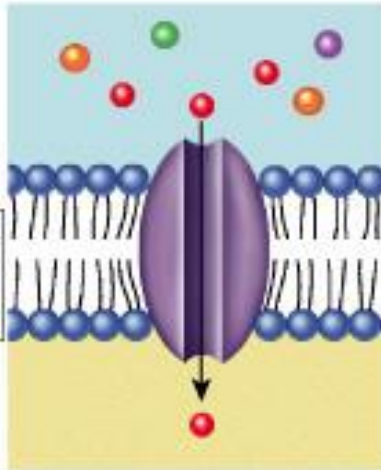
extend into extracellular
fluid & into cytosol



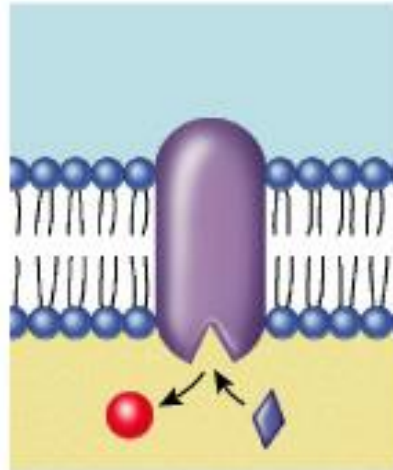
Outside

Plasma
membrane

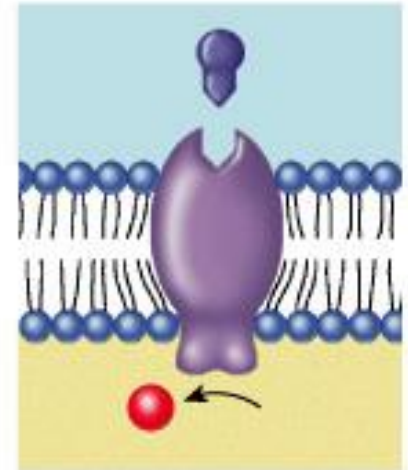
Inside



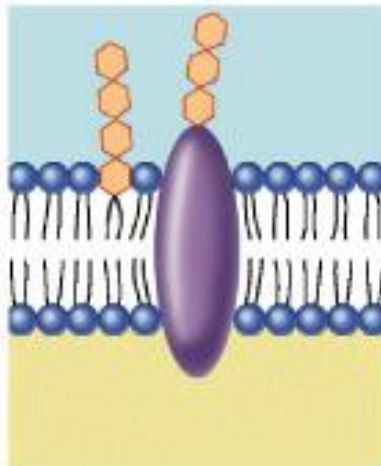
Transporter



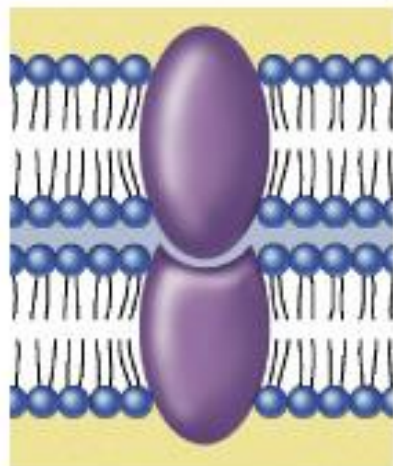
**Enzyme
activity**



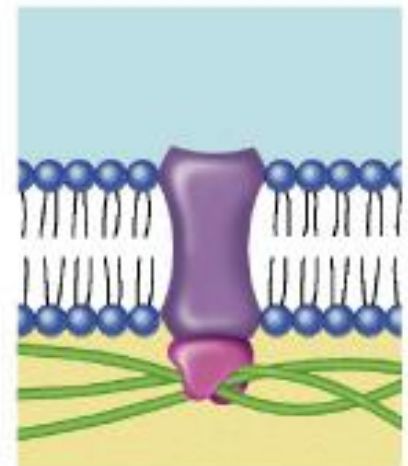
**Cell surface
receptor**



**Cell surface
identity marker**



Cell adhesion



**Attachment to the
cytoskeleton**

Membrane carbohydrates

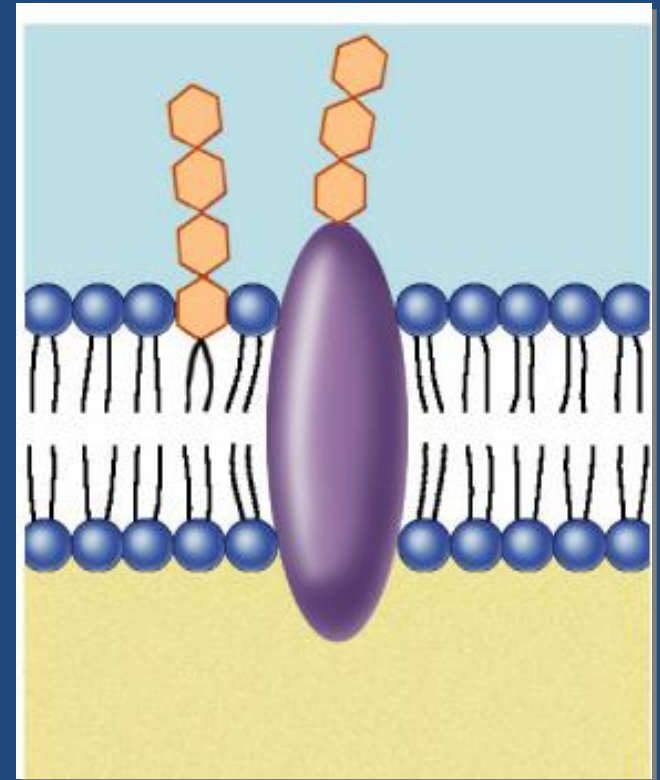
Play a key role in cell-cell recognition

ability of a cell to distinguish one cell from –
another

important in organ &
tissue development

basis for rejection of
foreign cells by

immune system



Diffusion across cell membrane

Cell membrane is the boundary between inside & outside...

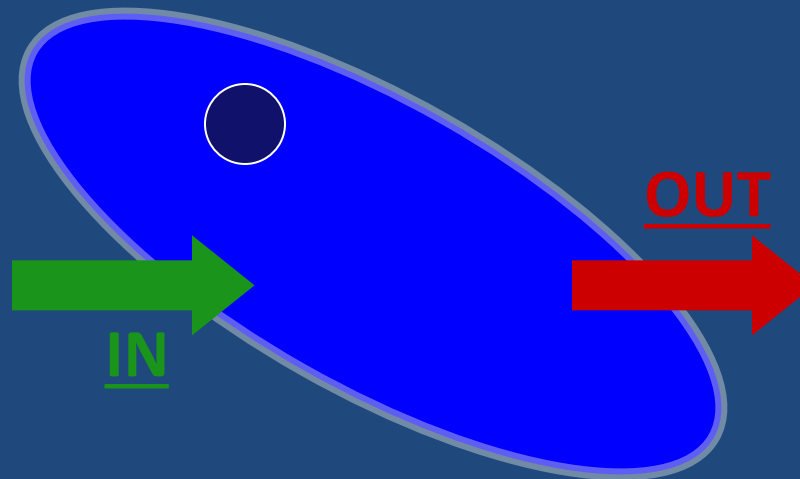
separates cell from its environment —

Can it be an impenetrable boundary?

NO!

IN
food

carbohydrates
sugars, proteins
amino acids
lipids
salts, O₂, H₂O



OUT
waste

ammonia
salts
CO₂
H₂O
products

cell needs materials in & products or waste out

Getting through cell membrane

Passive Transport

Simple diffusion —

diffusion of nonpolar, hydrophobic molecules
lipids —
high → low concentration gradient —

Facilitated transport —

diffusion of polar, hydrophilic molecules
through a protein channel
high → low concentration gradient —

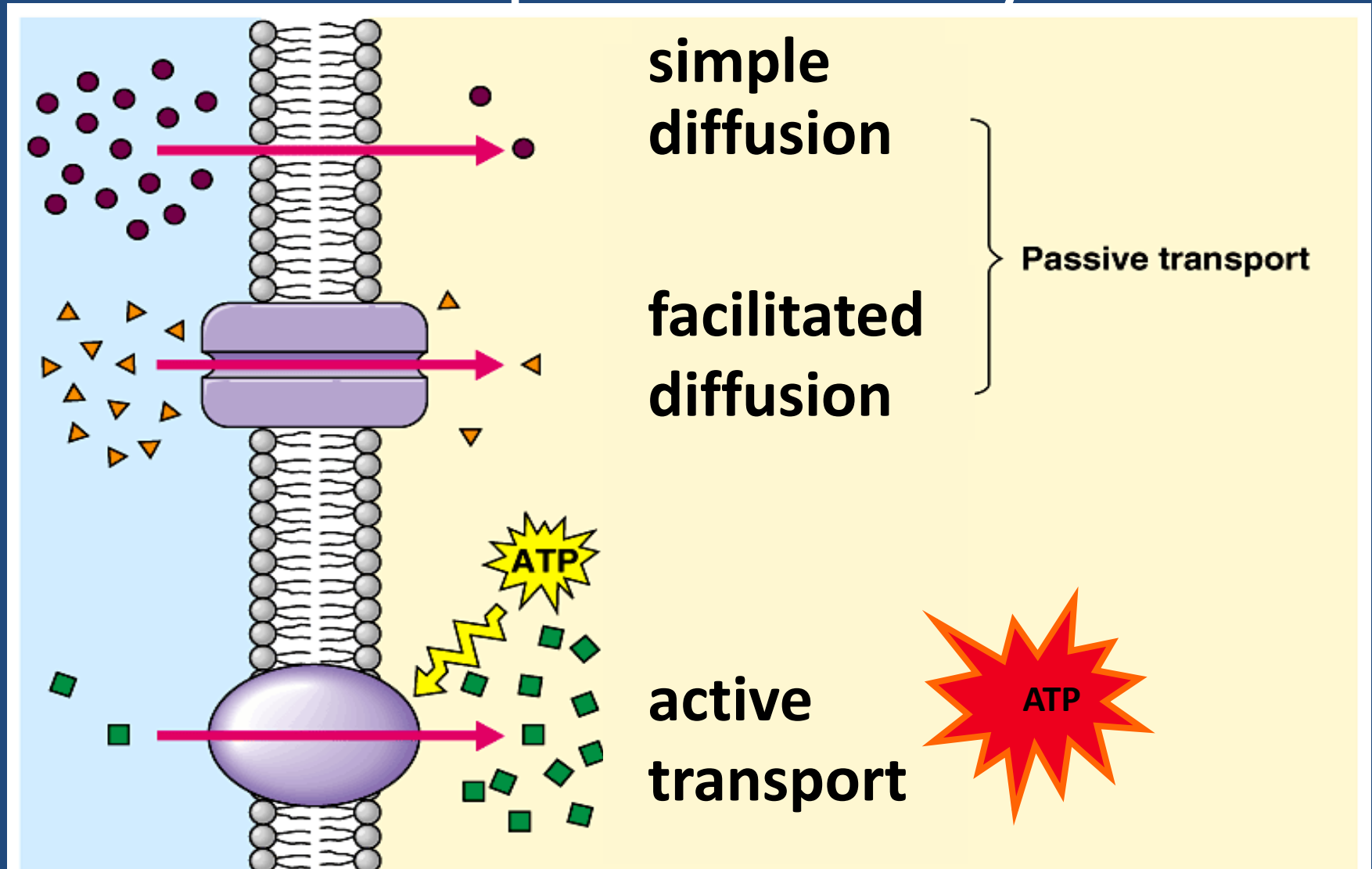
Active transport

diffusion *against* concentration gradient —
low → high



uses a protein pump •
requires ATP

Transport summary



How about large molecules?

Moving large molecules into & out of cell
through vesicles & vacuoles –

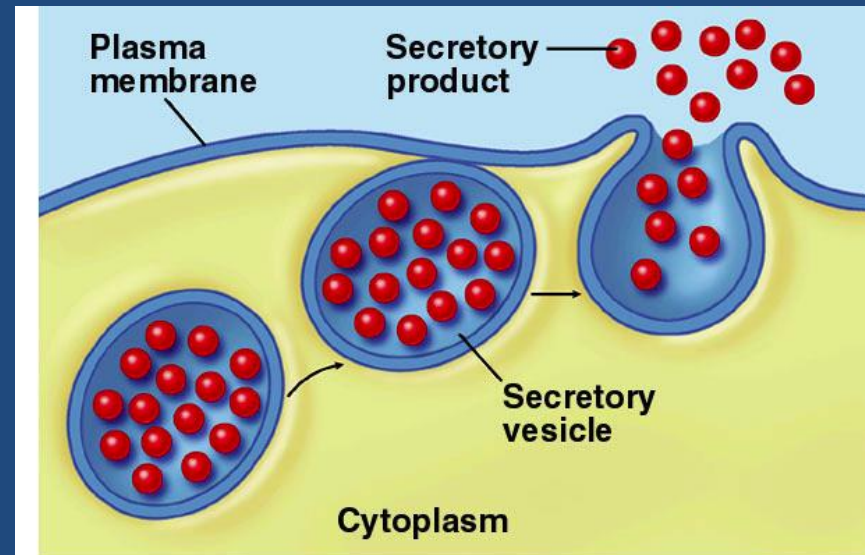
endocytosis –

phagocytosis = “cellular eating”

pinocytosis = “cellular drinking” •

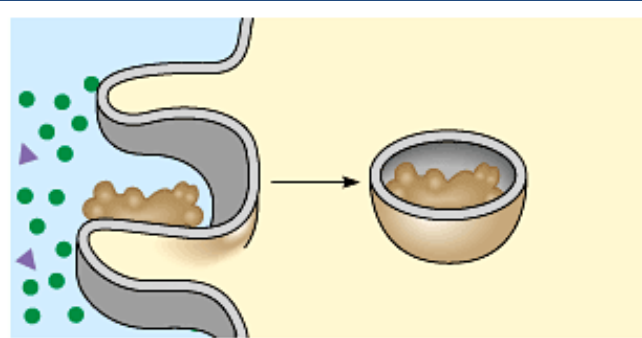
exocytosis –

exocytosis



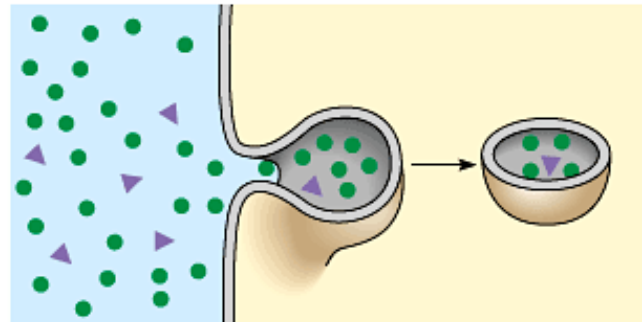
Endocytosis

phagocytosis



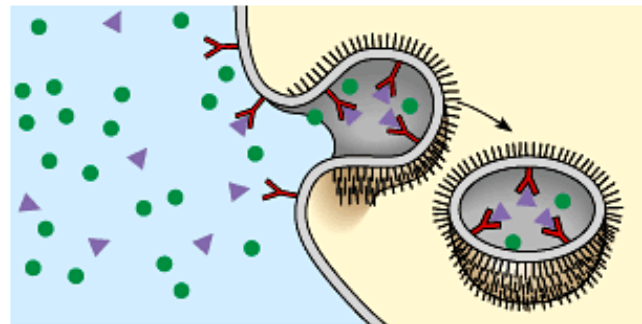
fuse with lysosome
for digestion

pinocytosis



non-specific
process

receptor-mediated
endocytosis



triggered by
molecular signal

Thank you