

Physiology

Cell & Homeostasis

(figures in this ppt are from google images, Guyton, Ganong, Tortora)

SLO's

- Define homeostasis.
- Describe factors controlling homeostasis.
- Describe effect of disturbed homeostasis.
- Describe mechanism of feedback control.
- Applied physiology

cell

- **In unicellular organism all vital process occur in a single cell**

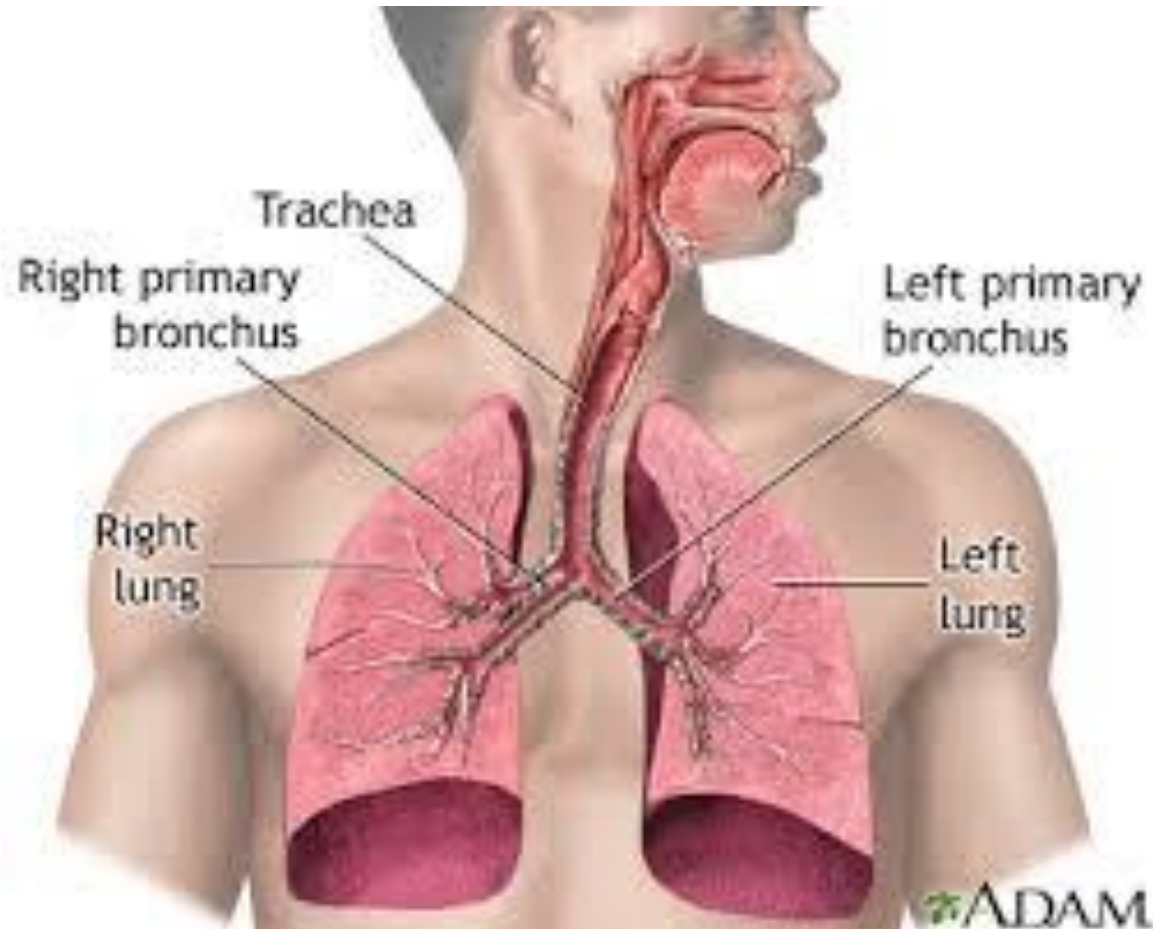


- **As the evolution of multicellular organism progressed, various cell groups have taken particular(separate) functions**

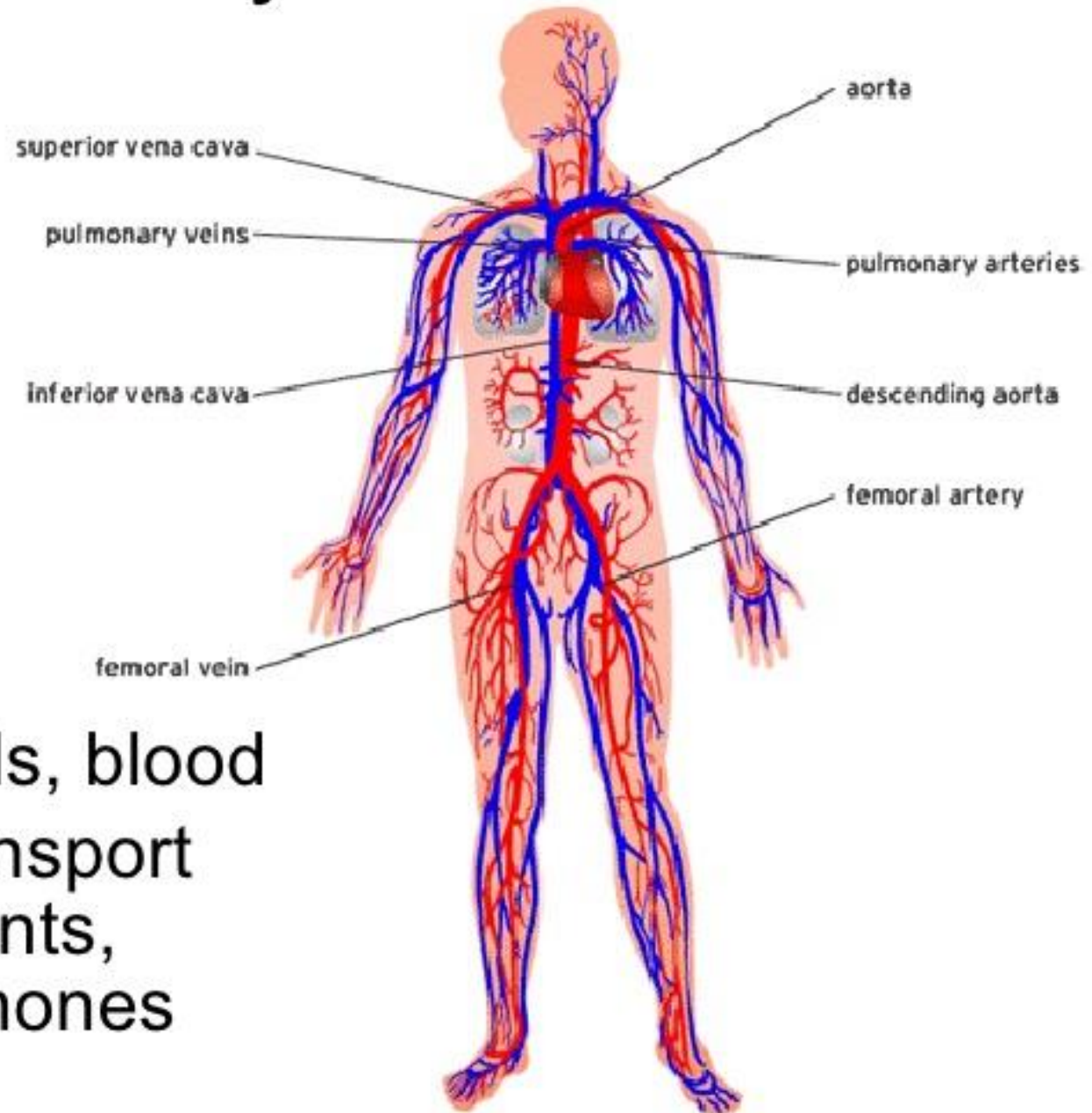
Gastrointestinal system:-Digest & absorb food



Respiratory system:-take up O₂ & eliminate CO₂



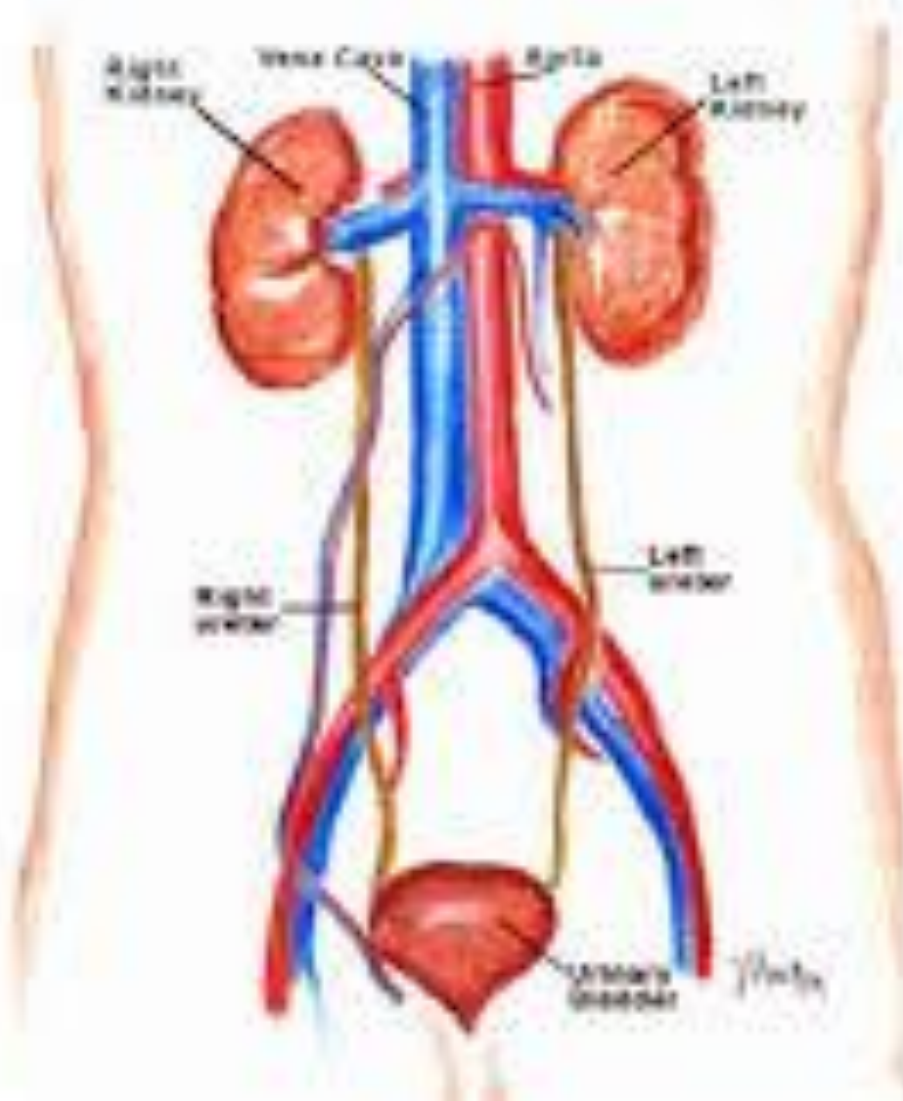
Cardiovascular System



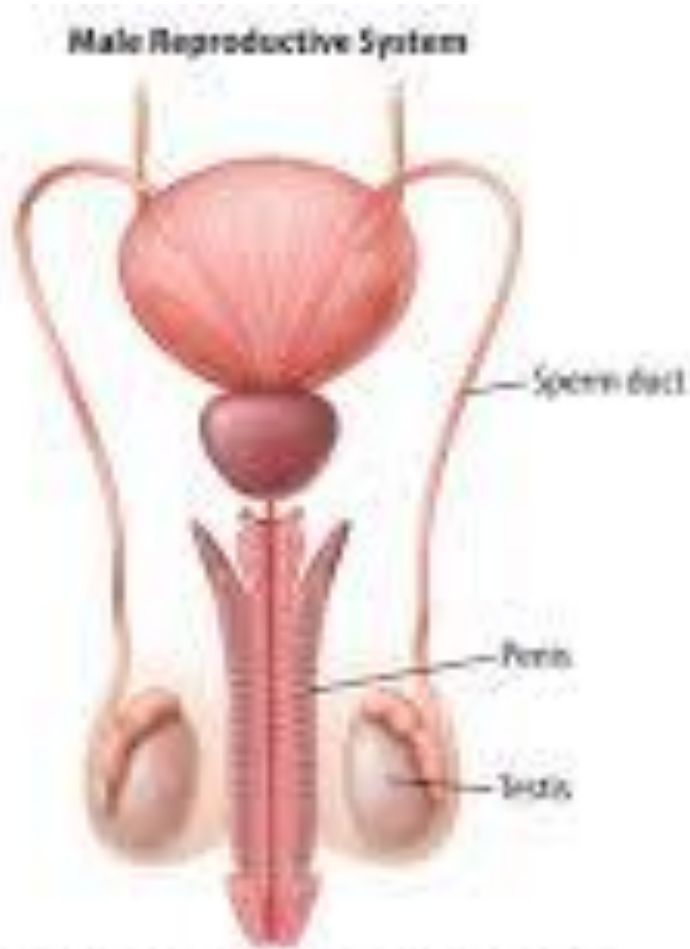
- Heart, vessels, blood
- Function: transport gases, nutrients, wastes, hormones

Excretory System

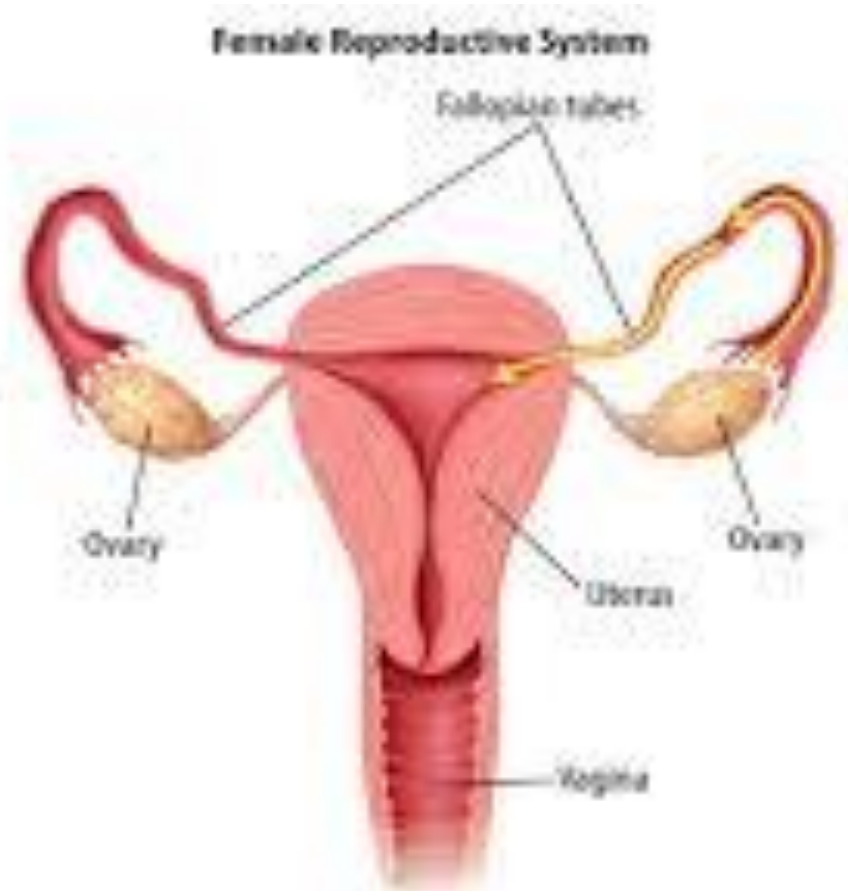
- Removal of waste from the body



Reproductive system:-Perpetuate species

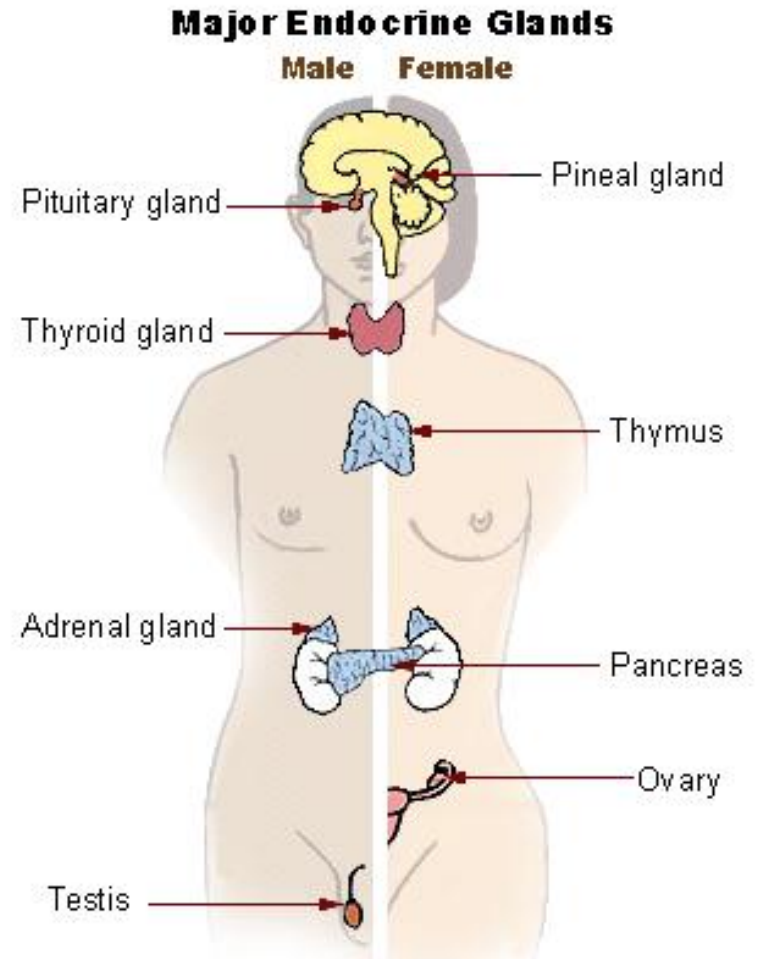
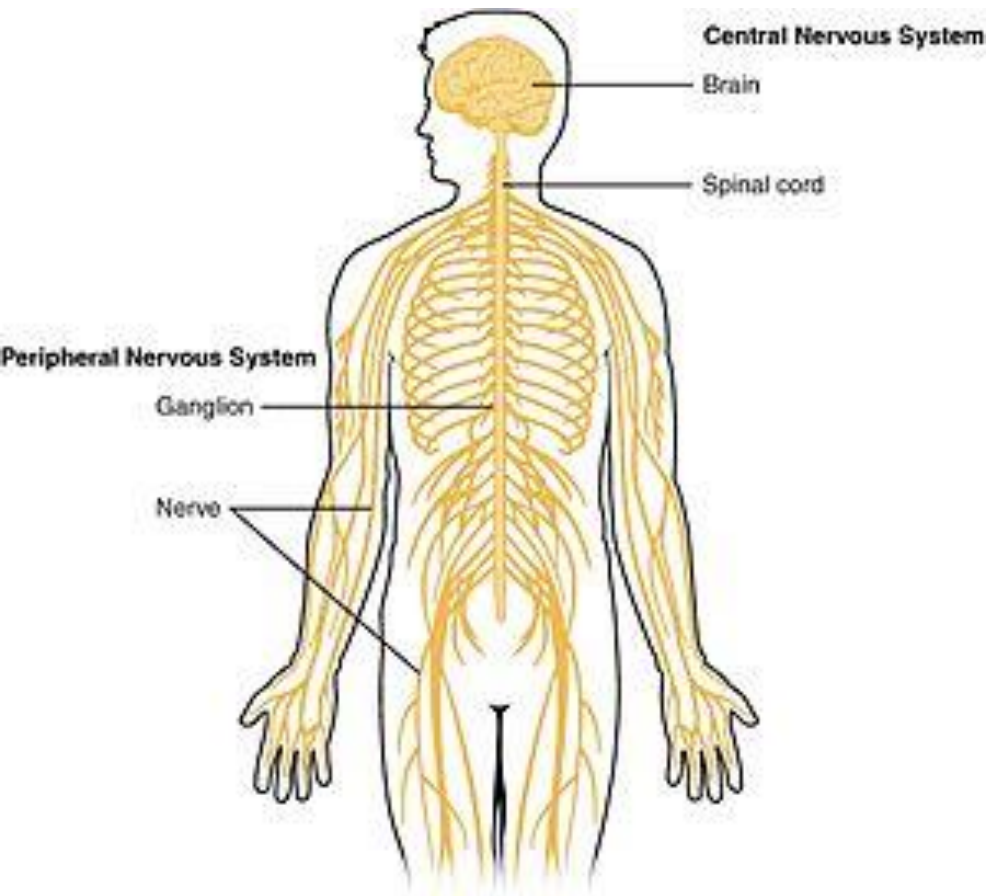


The organs of the male reproductive system produce sperm and deliver it to the female reproductive system.



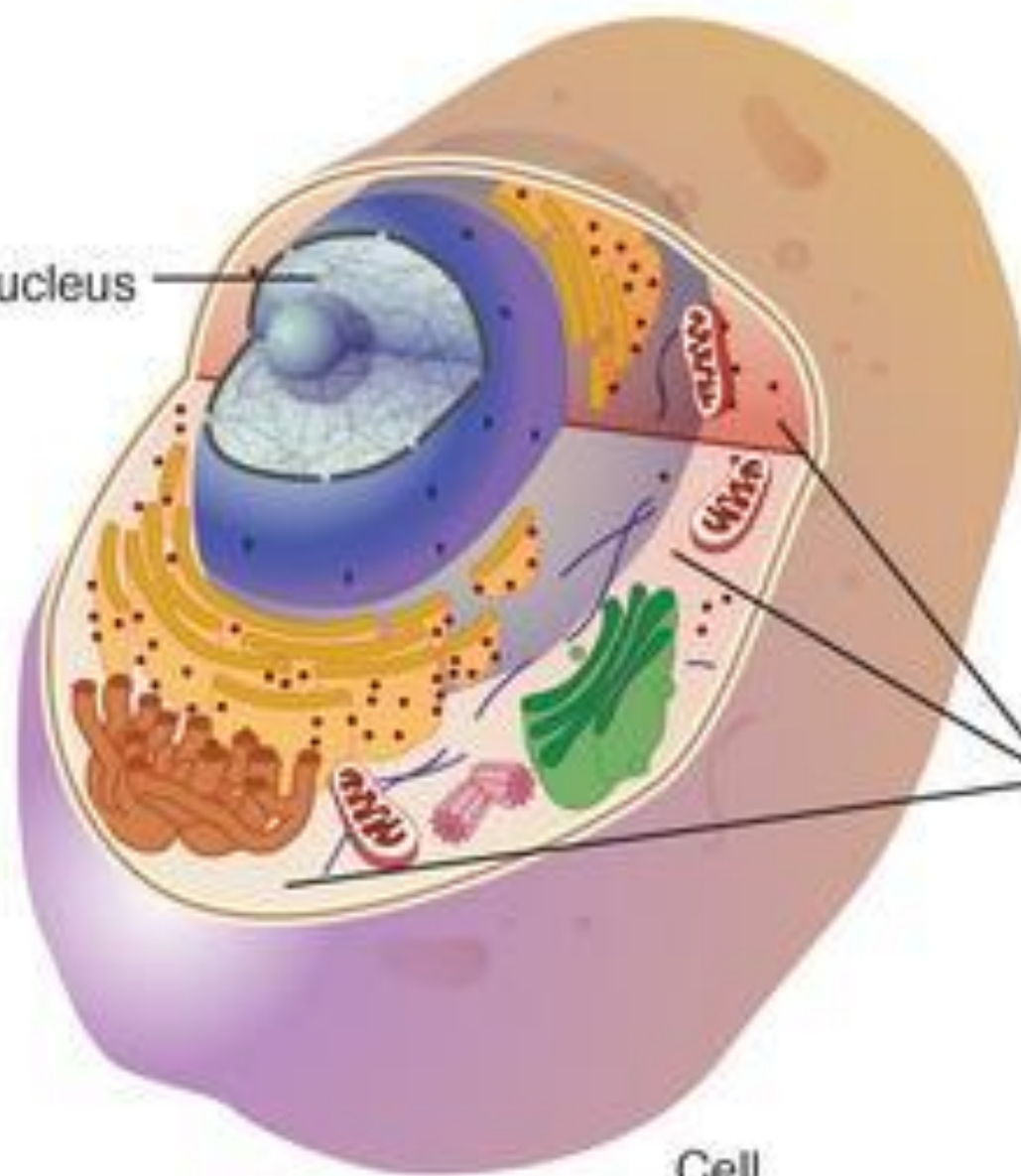
The female reproductive system produces eggs and provides a place for a new human to grow and develop before birth.

Nervous System and Endocrine System :- Coordination & integration



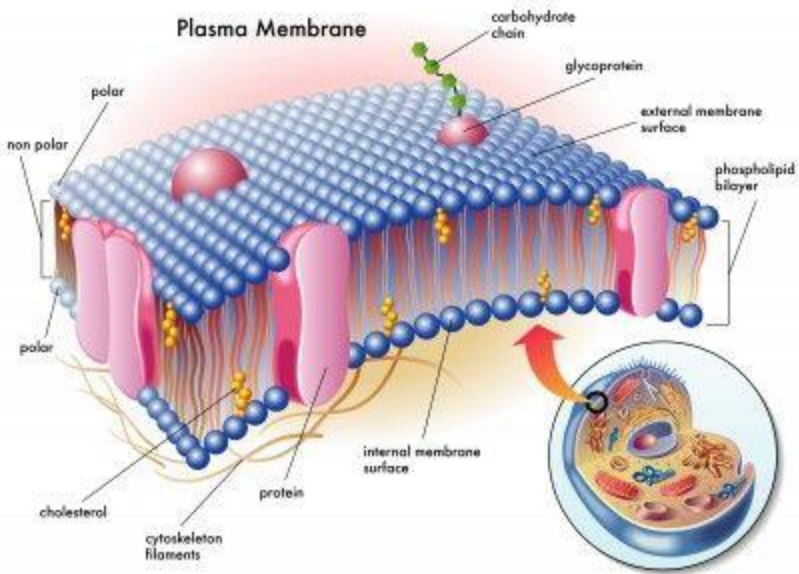
- **To understand the function of organs and other structures of the body it is essential that we first understand the basic organization of the cell & the function of its component parts**

Nucleus

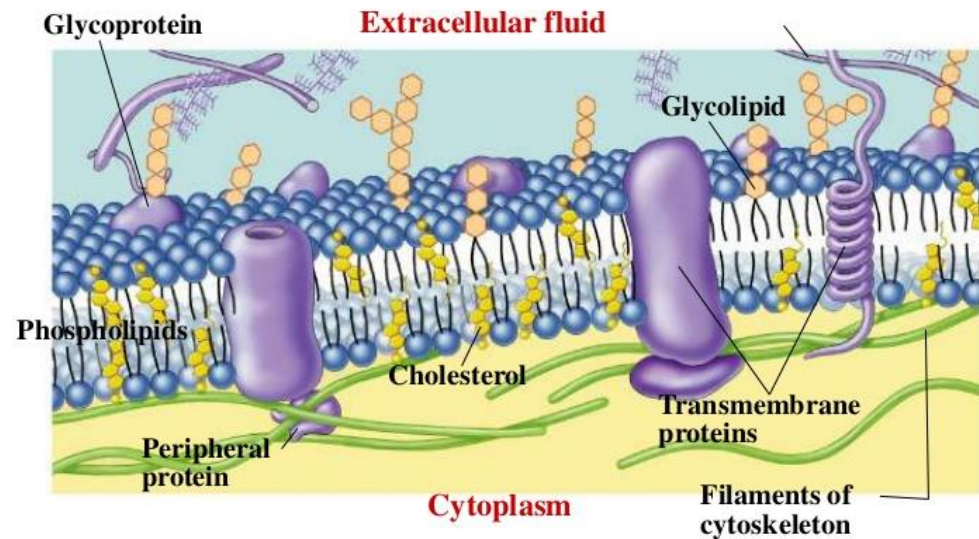


Cytoplasm

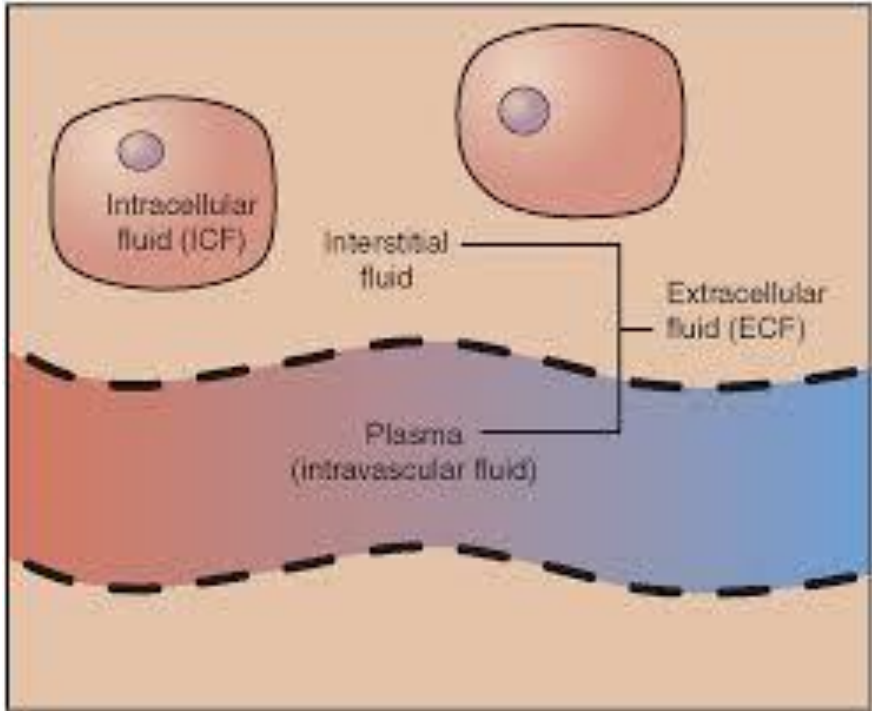
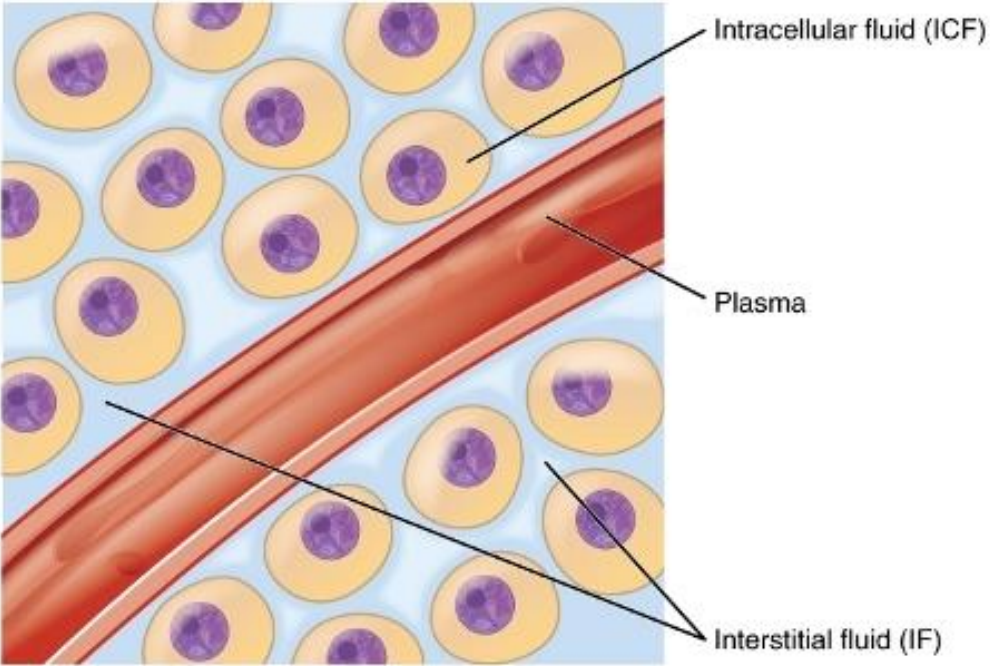
Cell

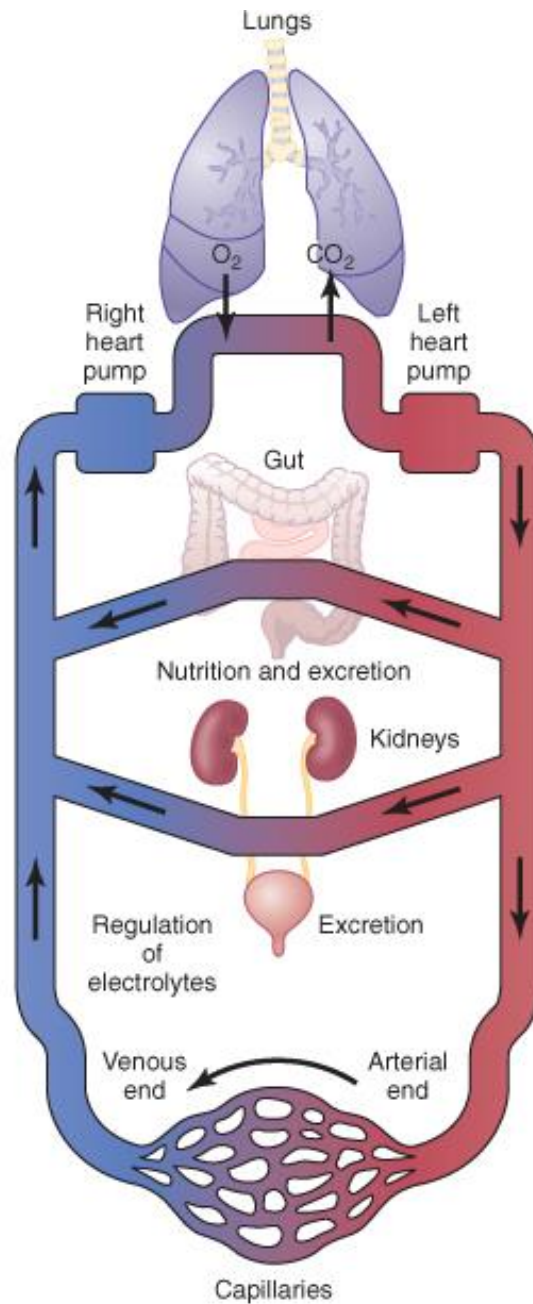


Membrane is a collage of proteins & other molecules embedded in the fluid matrix of the lipid bilayer

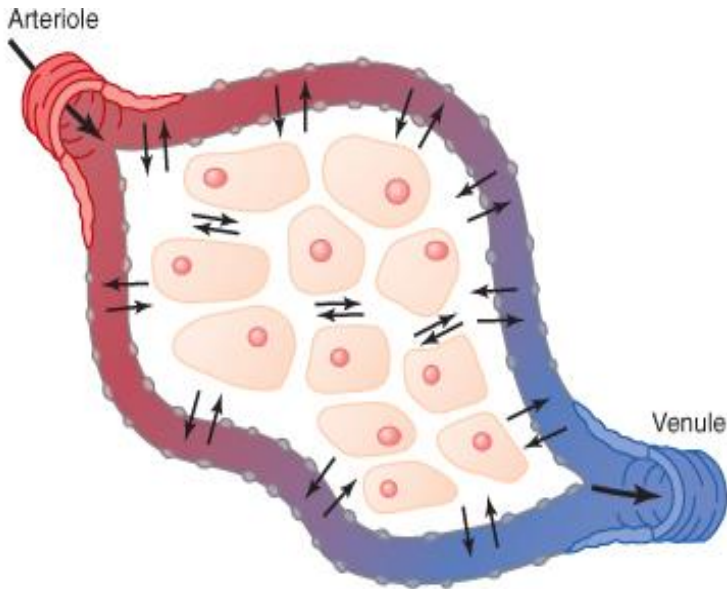


Extracellular fluid & Intracellular fluid





Starling's forces



er. Guyton & Hall: Textbook of Medical Physiology 11e - www.studentconsult.com

- Colloid osmotic pressure(in capillary)
- Hydrostatic pressure (in capillary)
- Colloid osmotic pressure(in extracellular space)
- Hydrostatic pressure(in EC space)

homeostasis

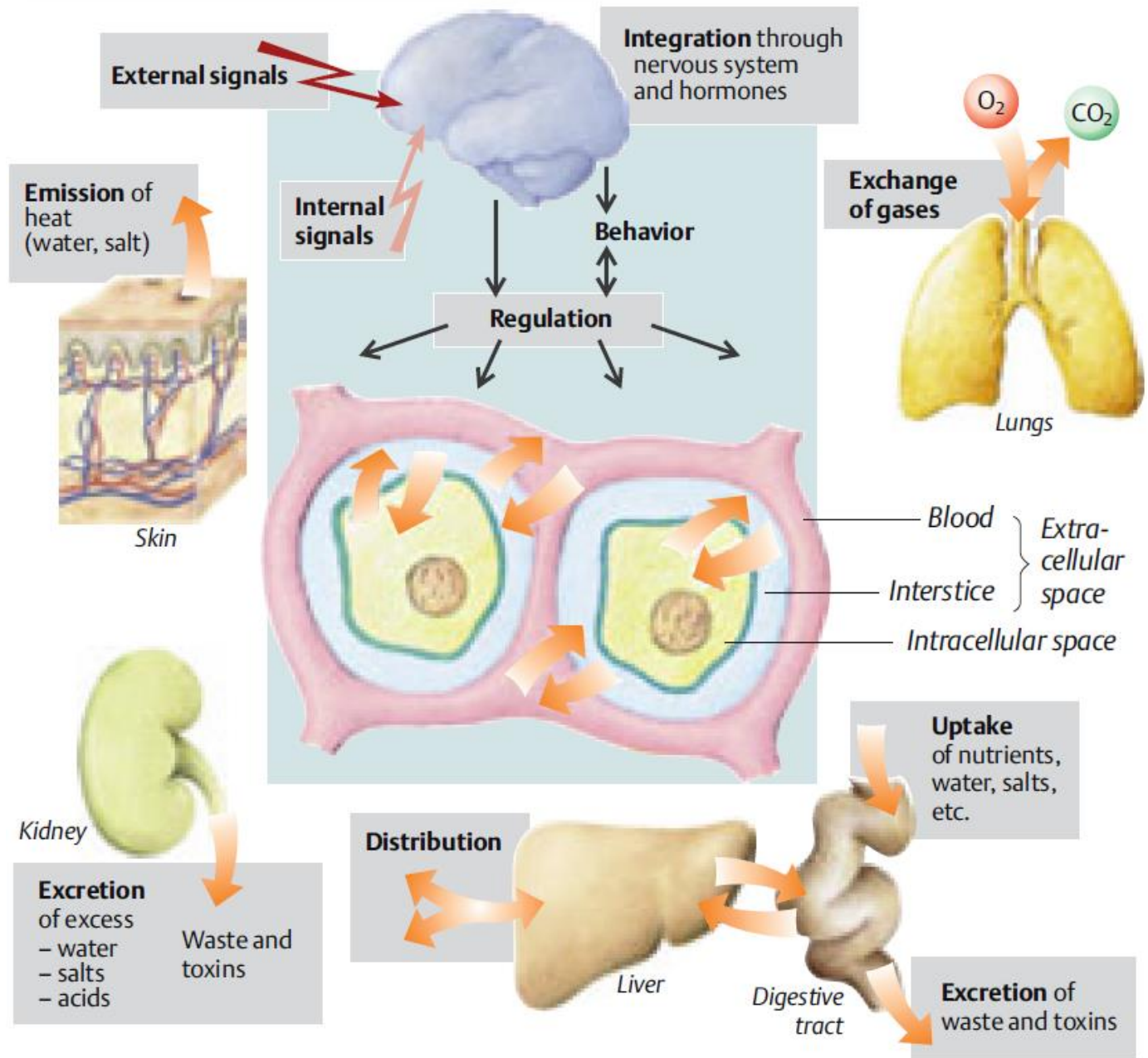
- Maintenance of static or **constant conditions in the internal environment**
- All the organs & tissues perform functions that help to maintain homeostasis
- Negative feedback
- Positive feedback(vicious cycle)

Adaptive control system

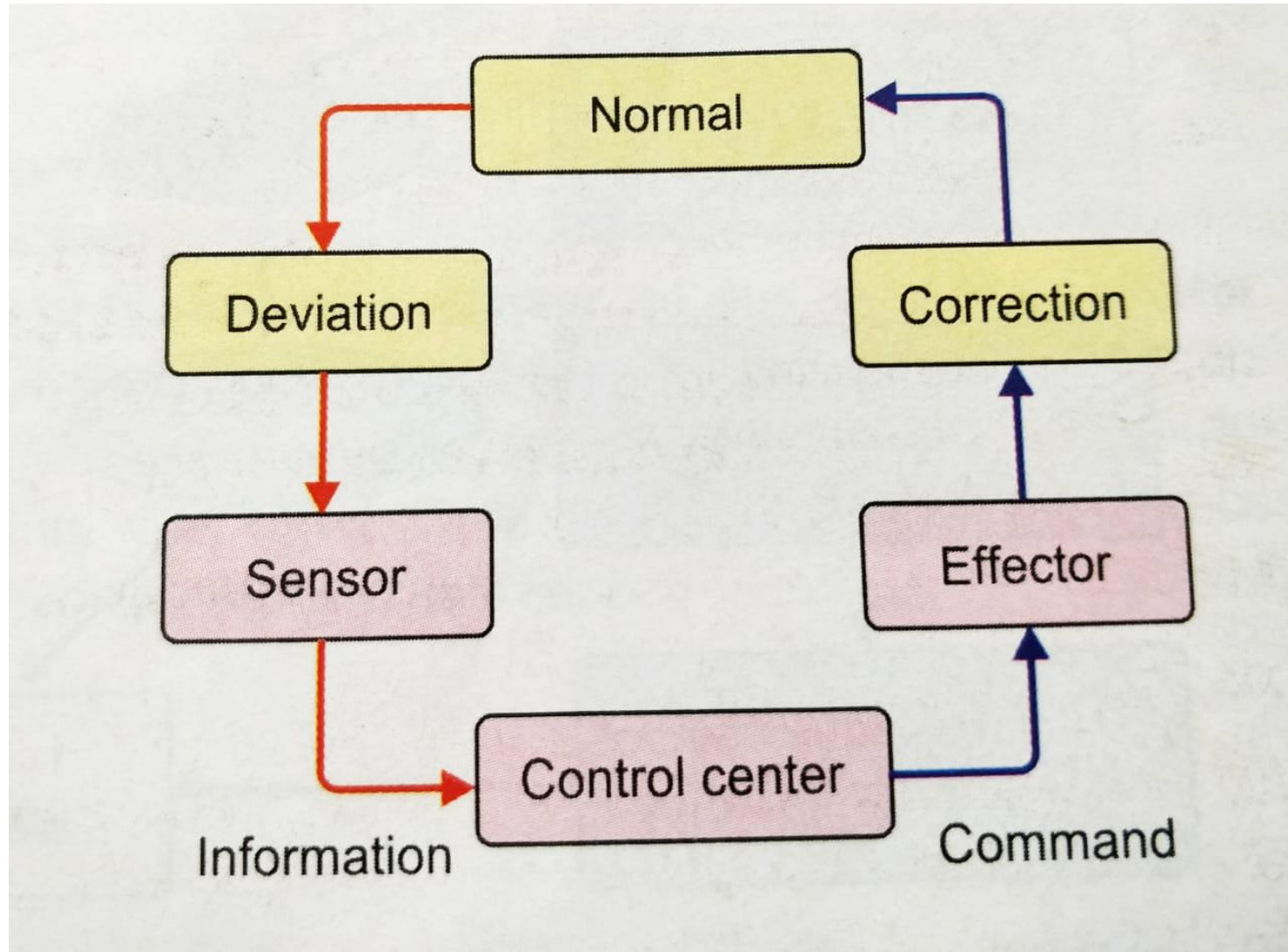
- Correction made by successive retrospective feedback mechanism is called adaptive control**
- Delayed type of negative feedback mechanism**
- Seen in nervous system**
- Feed forward control used by brain to control muscle contraction(if fast movement)**

Automaticity of the body

- Cell benefits from homeostasis & in turn each cell contributes its share towards the maintenance of homeostasis
- This reciprocal interplay provides continuous **automaticity** until one or more functional systems lose their ability to contribute their share of function and then all the cells of body suffer
- **Moderate dysfunction lead to sickness & extreme dysfunction leads to death**



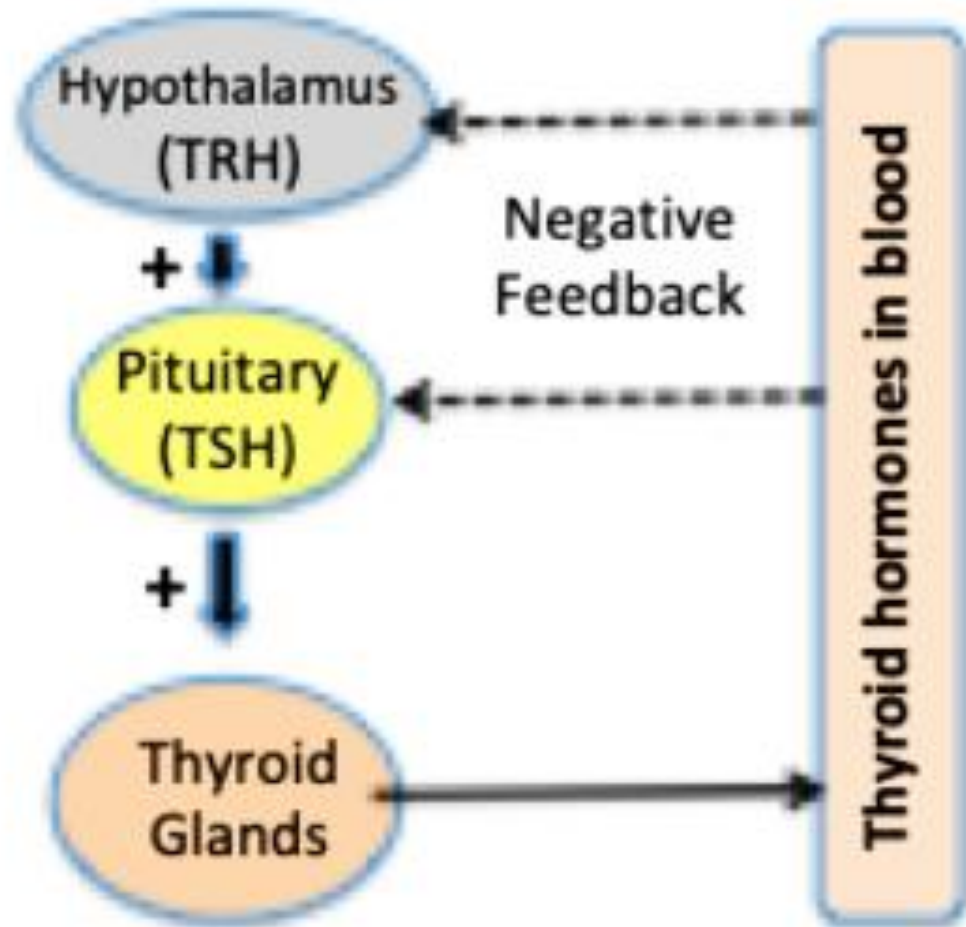
2) Mechanism of homeostasis (control systems of the body)-



2) Mechanism of homeostasis (control systems of the body)-

(a) Negative feedback mechanism-

Response inhibits stimulus & reverse direction of change



decrease body Water



Increases plasma osmolarity



Osmoreceptores at area AV3V near anterior Hypothalamus get stimulated



Lateral nucleus get stimulated



Increase thirst



Supraoptic nucleus get stimulated



Increase ADH release which cause water retention



Plasma osmolarity decreases & Body water becomes normal

(impulses from GIT also regulate thirst)

Exposure to heat



**warm receptors
in skin & deep
tissues get stimulated**



**Ante. preoptic nucle.
In Hypothalamus
get stimulated**



**Increase heat loss
(sweating &
vasodilatation)
decrease
heat production**

Exposure to cold



**cold receptors
in skin & deep
tissues get stimulated**



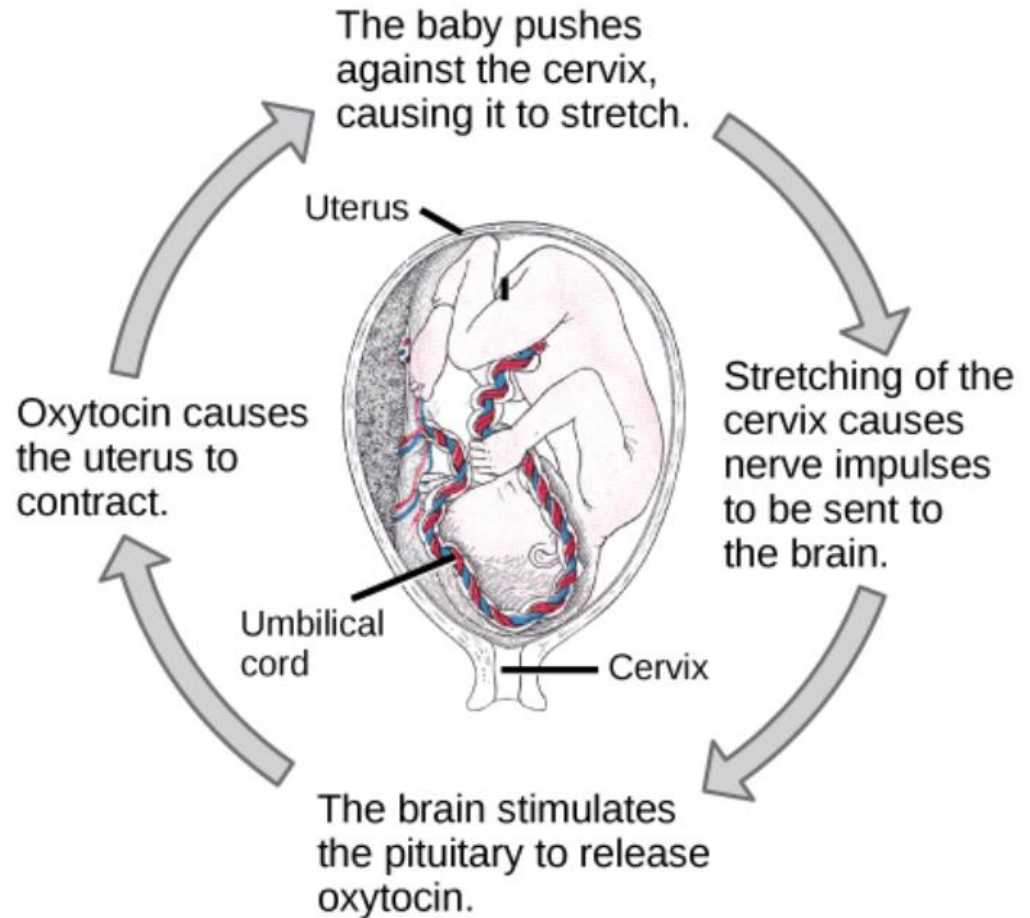
**posterior nucleus
In Hypothalamus
get stimulated**

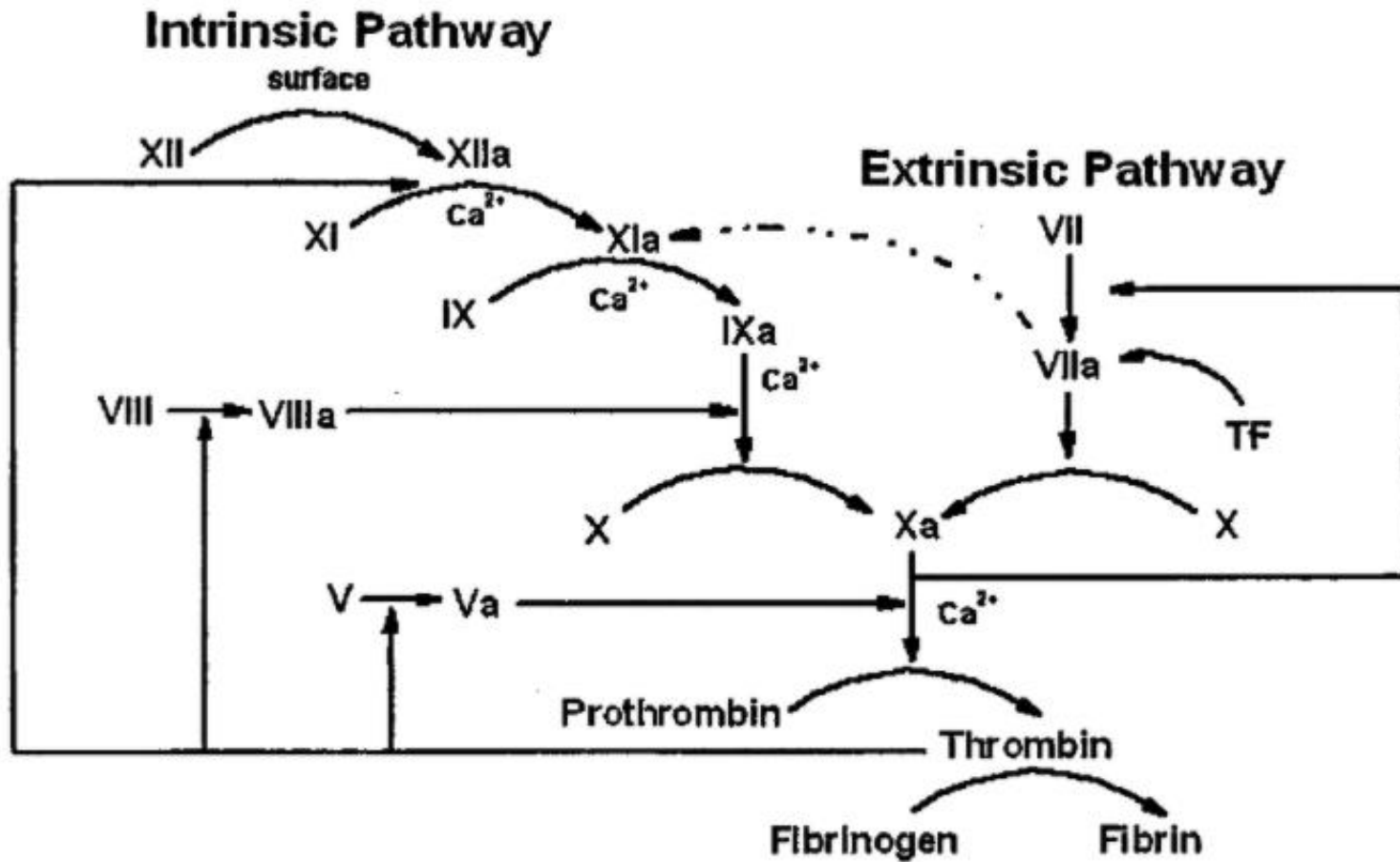


**decrease heat loss
(vasoconstriction)
increase heat production
(shivering)**

2) Mechanism of homeostasis (control systems of the body)-

Response stimulates stimulus & ↑ intensity of change in same direction

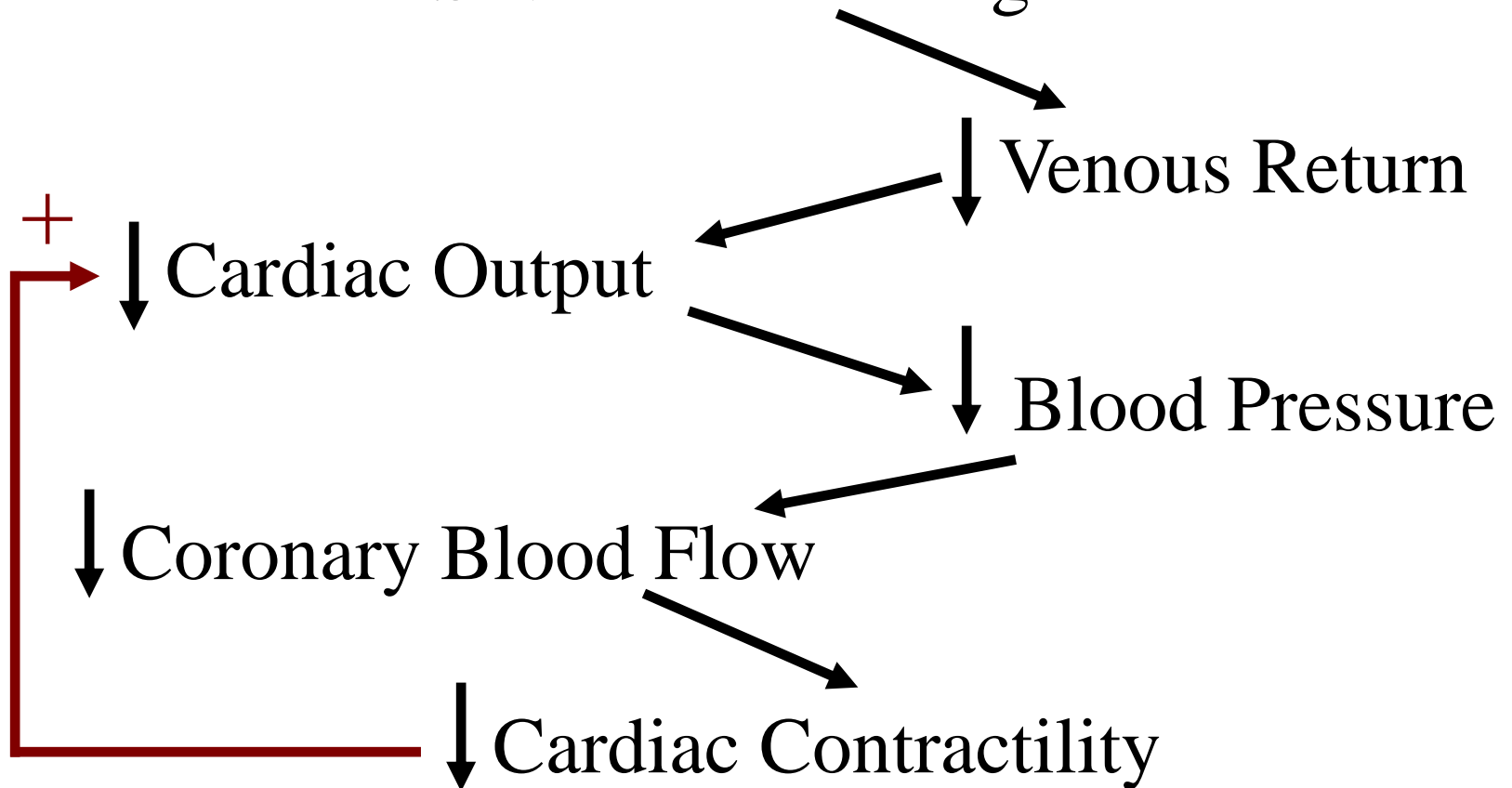




Blood coagulation - role of thrombin

Hemorrhagic Shock: Positive Feedback

Severe Hemorrhage



- Disturbance of homeostasis many lead –
Diseases

& if not corrected on time OR

- Very severe Disturbance of homeostasis
many lead - Death

Applied Physiology

- **Apoptosis**

- **Necrosis**

- **Atrophy**

- **Hypertrophy**

- **Hyperplasia**

- **Metaplasia**

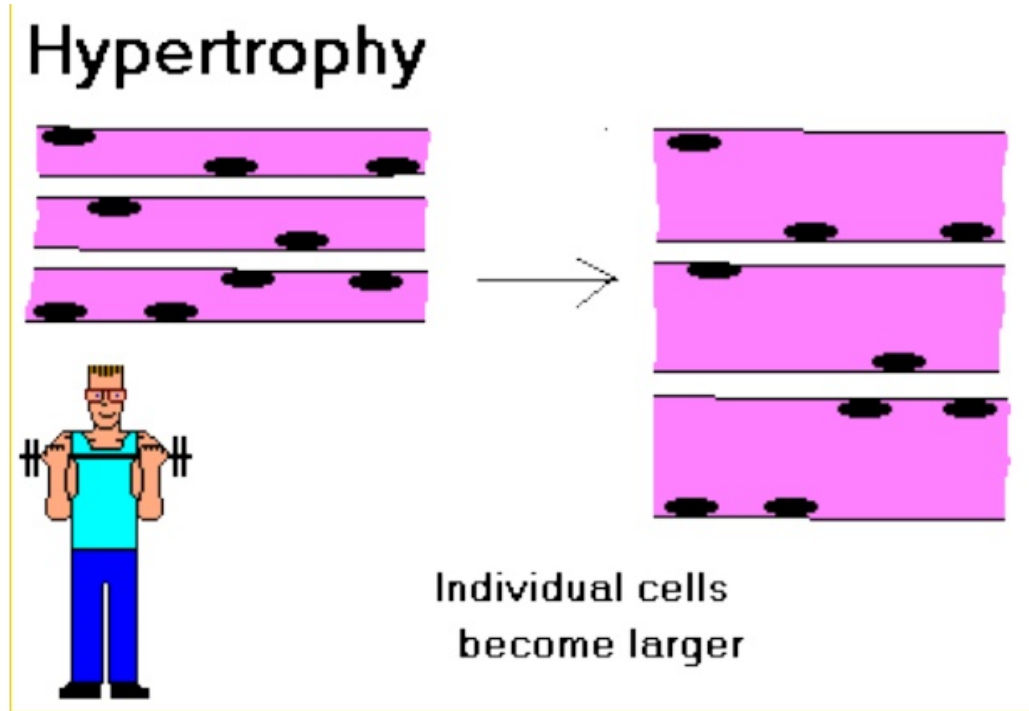
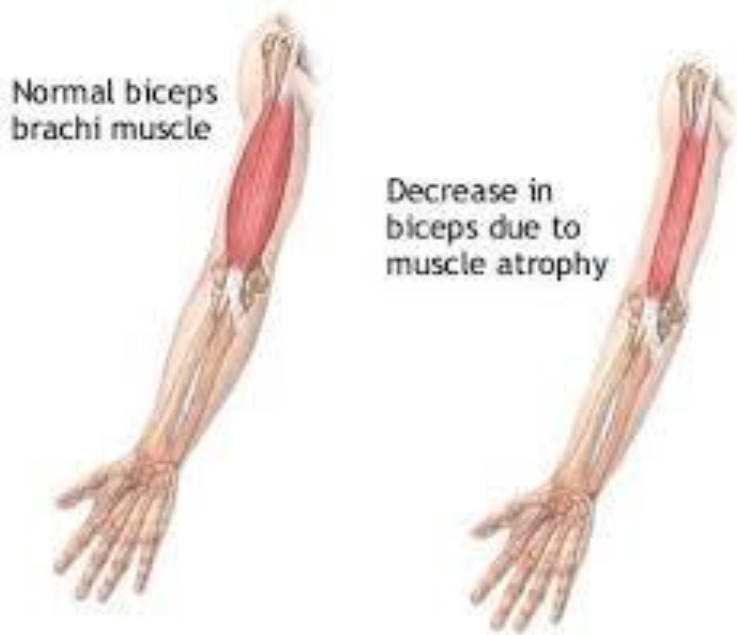
- **Cancer**

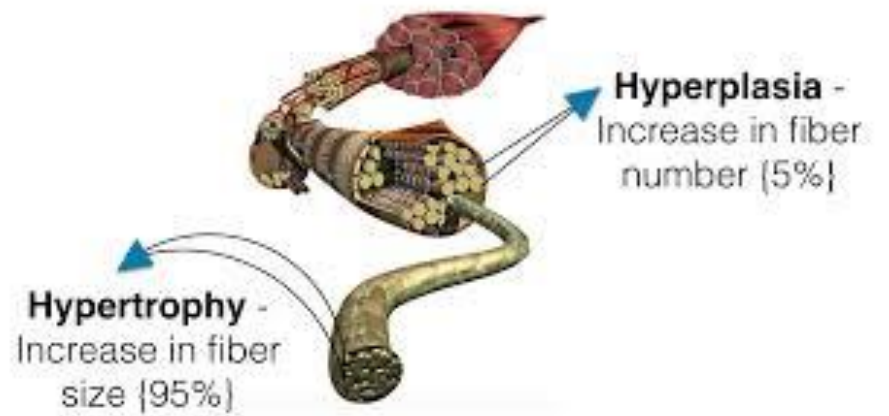
Cell Degeneration

Cell aging

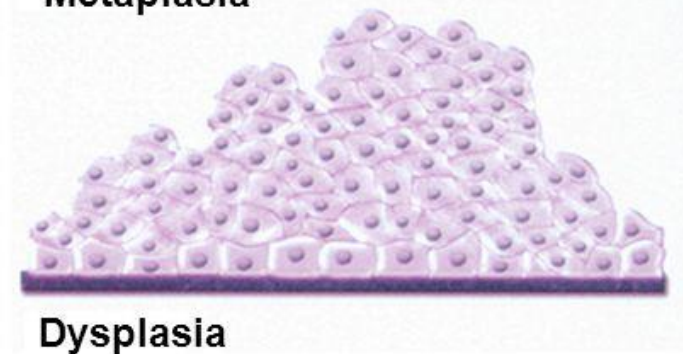
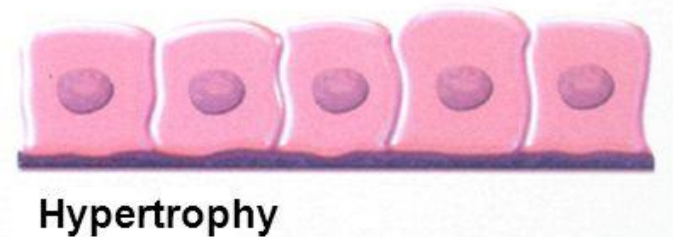
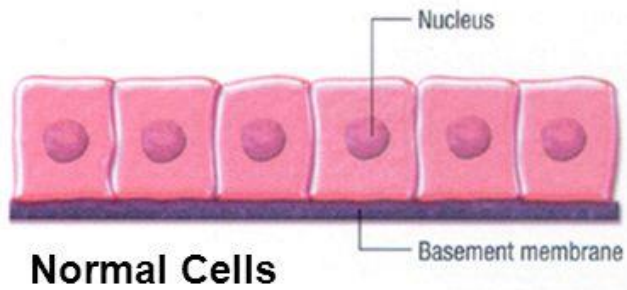
Dysplasia

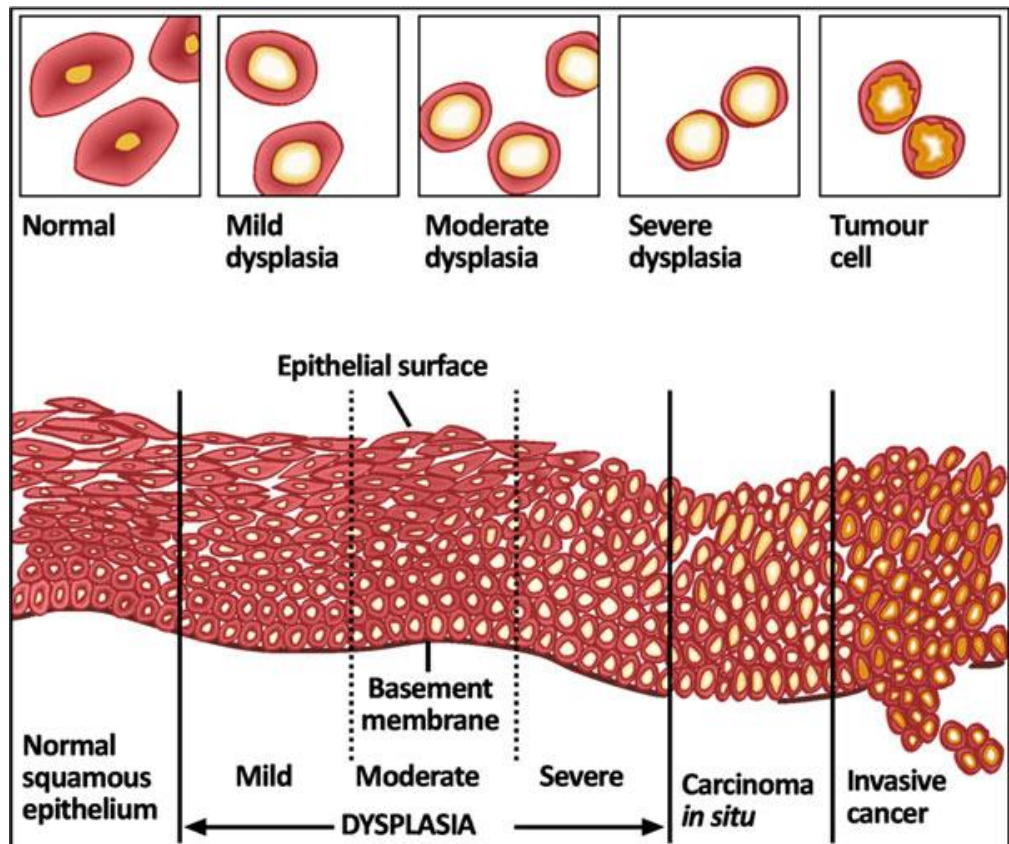
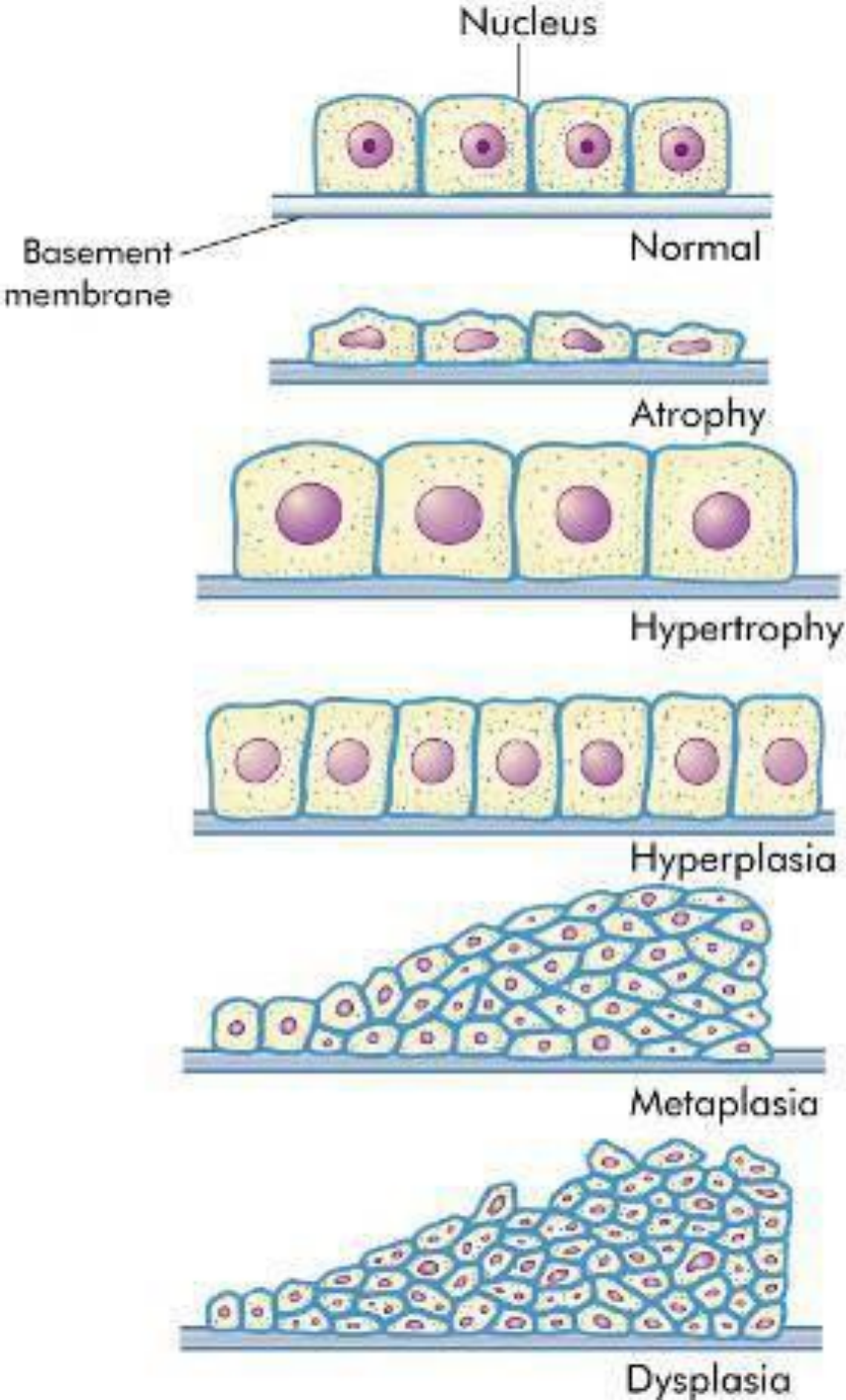
Atrophy & hypertrophy





Response to Stress

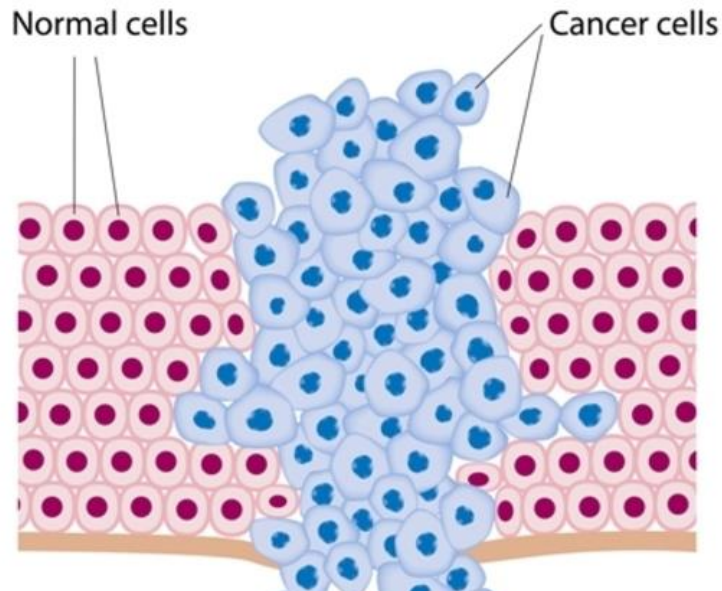




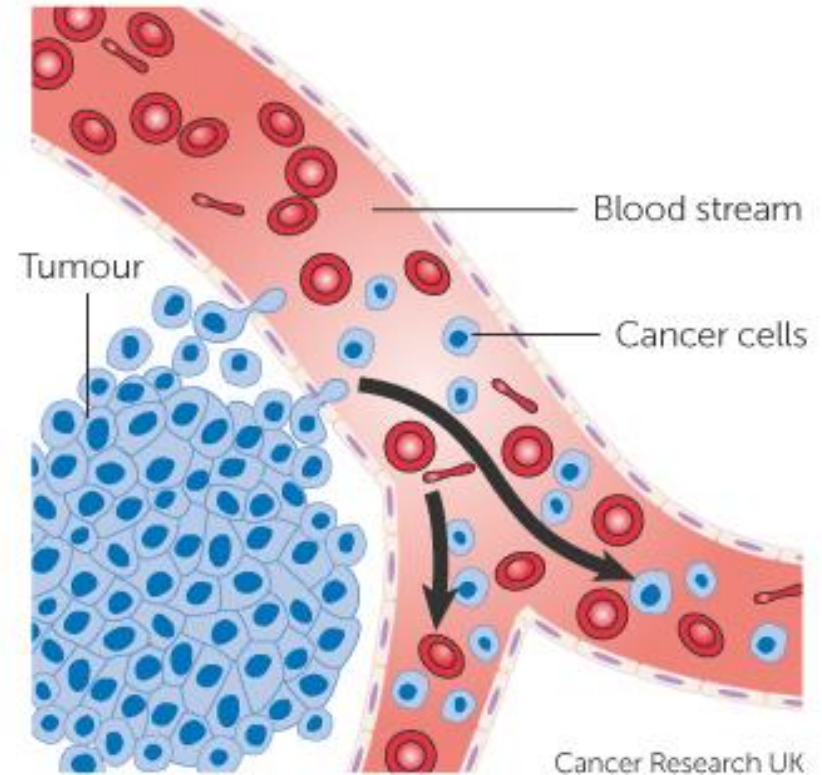
Don't follow usual
cellular growth
limits

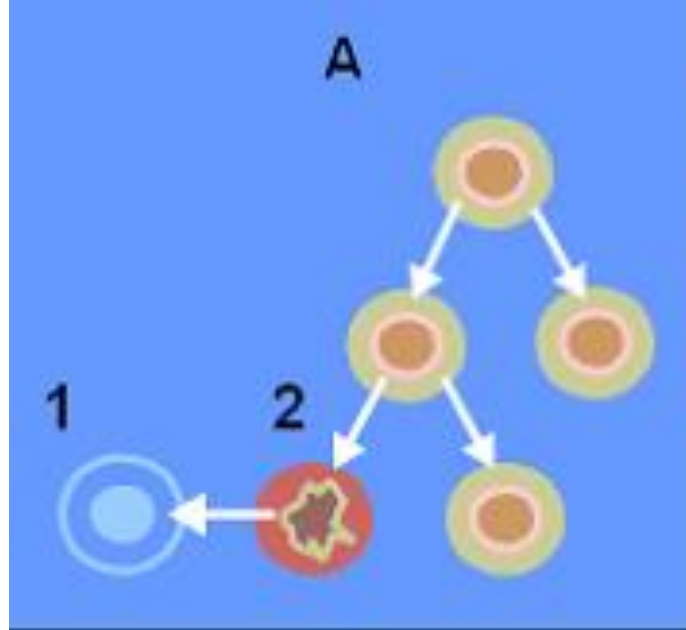
Less adhesive

Produce angiogenic
factors

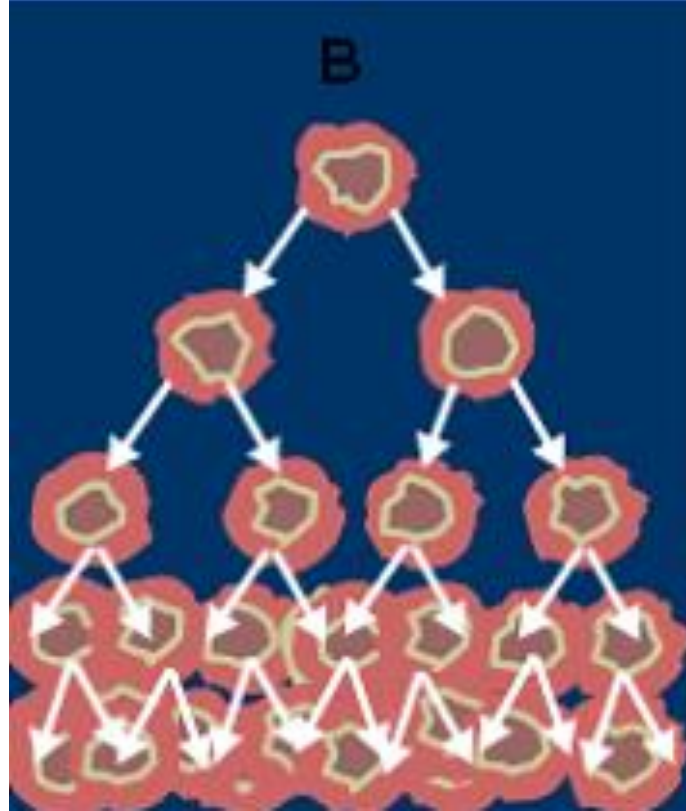


**Cancer cells &
metastasis**
Through blood &
lymph





In normal cells, cell division is tightly regulated. Old cells undergo apoptosis as new cells are produced.



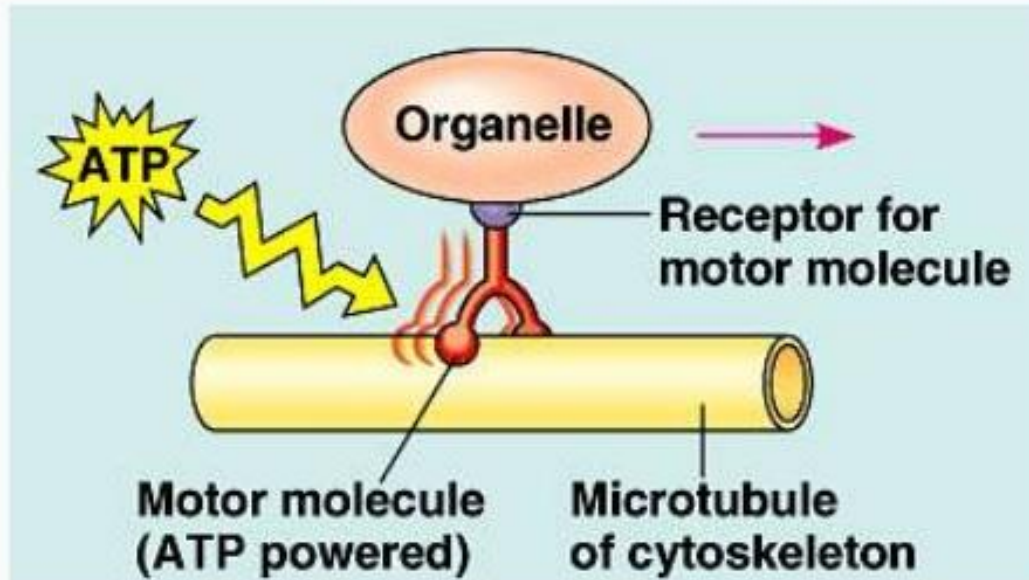
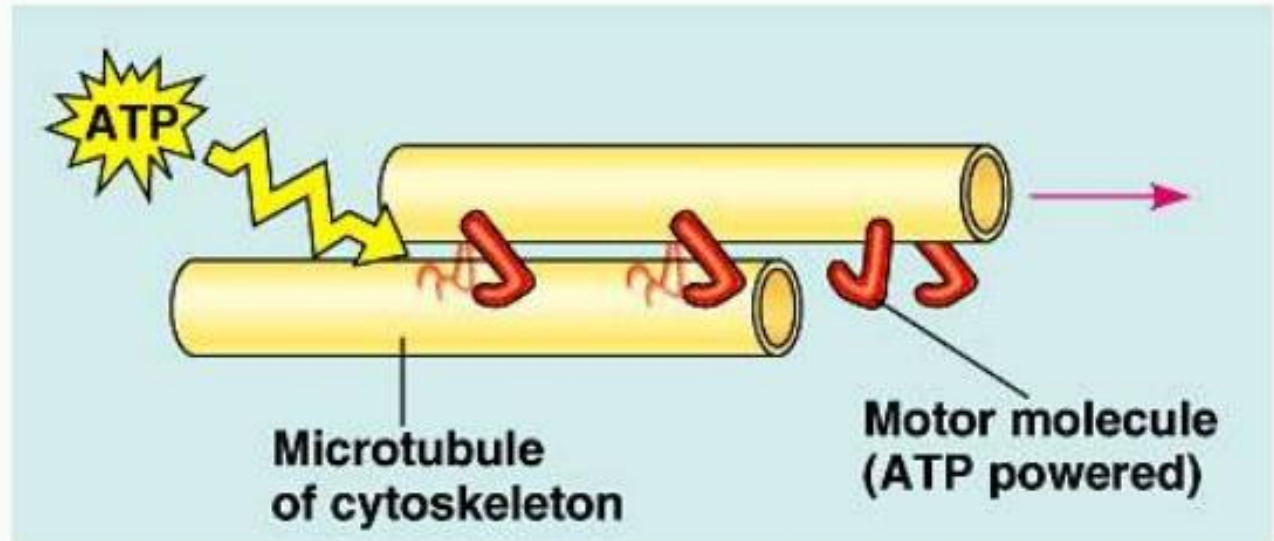
A cancerous tumor forms when cell division gets out of control and cells do not undergo normal apoptosis

Summary

- Homeostasis-its definition, feedback & applied
- Starling's forces to control filtration of fluids

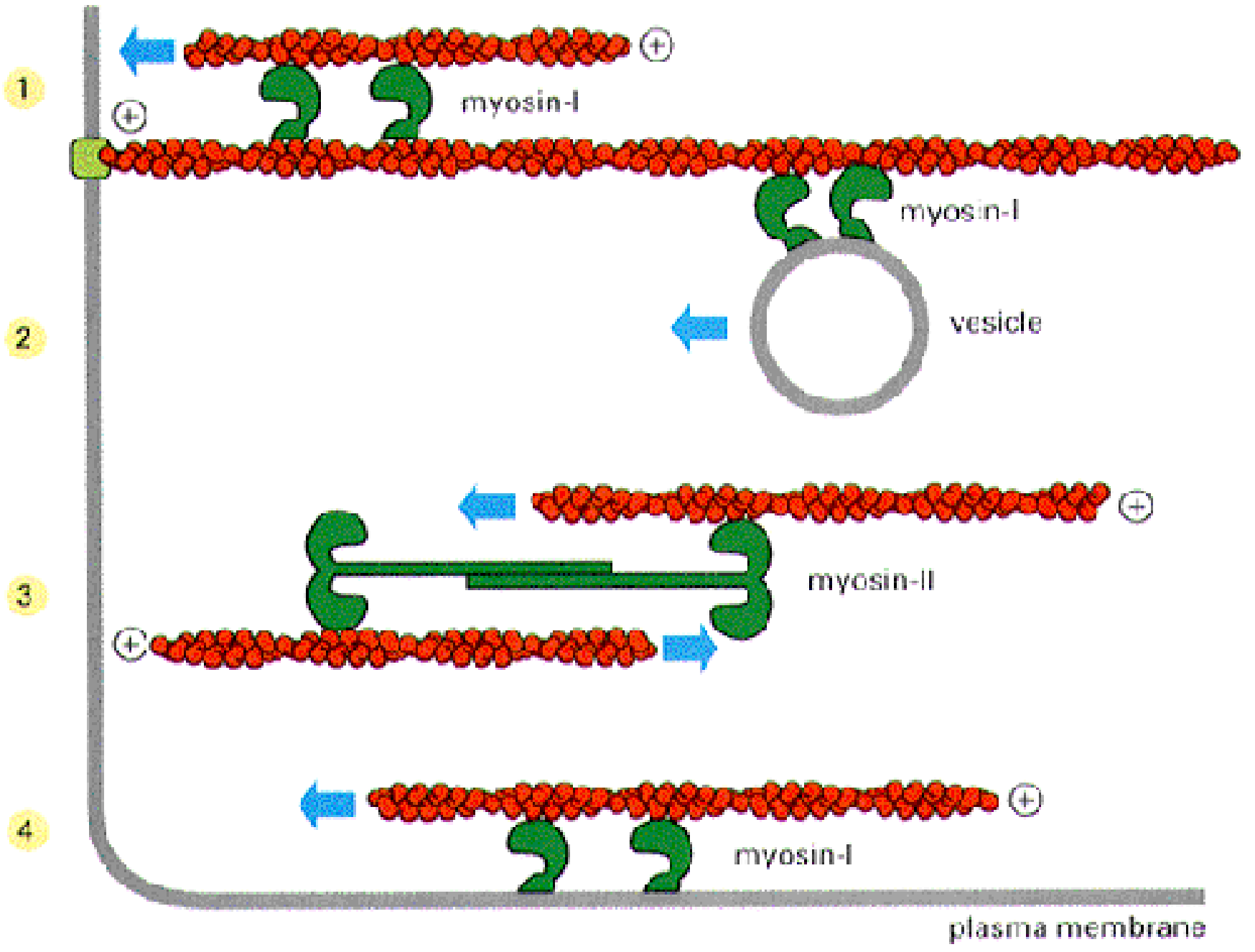
Molecular motors:-kinesin, Dynein, Myosin

Motor proteins pull components of the cytoskeleton past each other.



Motor molecules also carry vesicles or organelles to various destinations along "monorails" provided by the cytoskeleton.

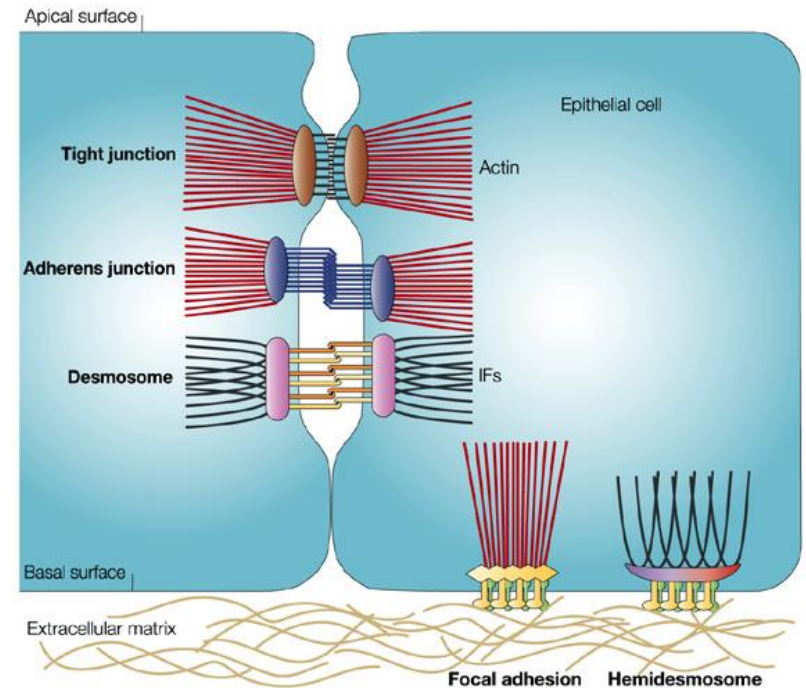
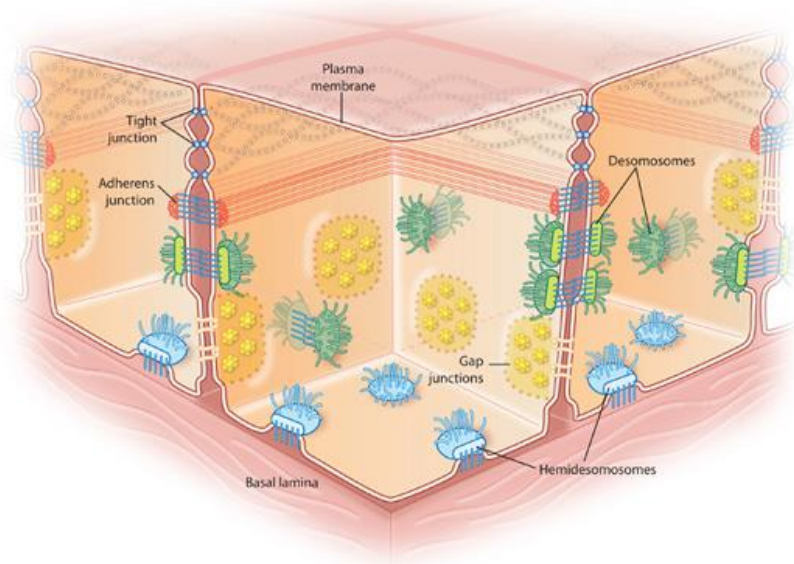
MOTOR	FUNCTIONS
MICROTUBULE BASED	
Kinesin	
conventional	Moves particles & membranes towards “plus” end of microtubules
other kinesins	Meiosis & mitosis
Dynein	
Cytoplasmic	Moves particles & membranes towards “minus” end of microtubules
Axonemal	Causes sliding of one flagellar microtubule on another
ACTIN BASED	
Myosin –I	Moves membranes on actin filaments, moves one actin filament on another
Myosin-II	Causes muscle contraction, cell polarity, cytokinesis, capping of surface molecules, cortical tension
Other myosins	



Intercellular connections

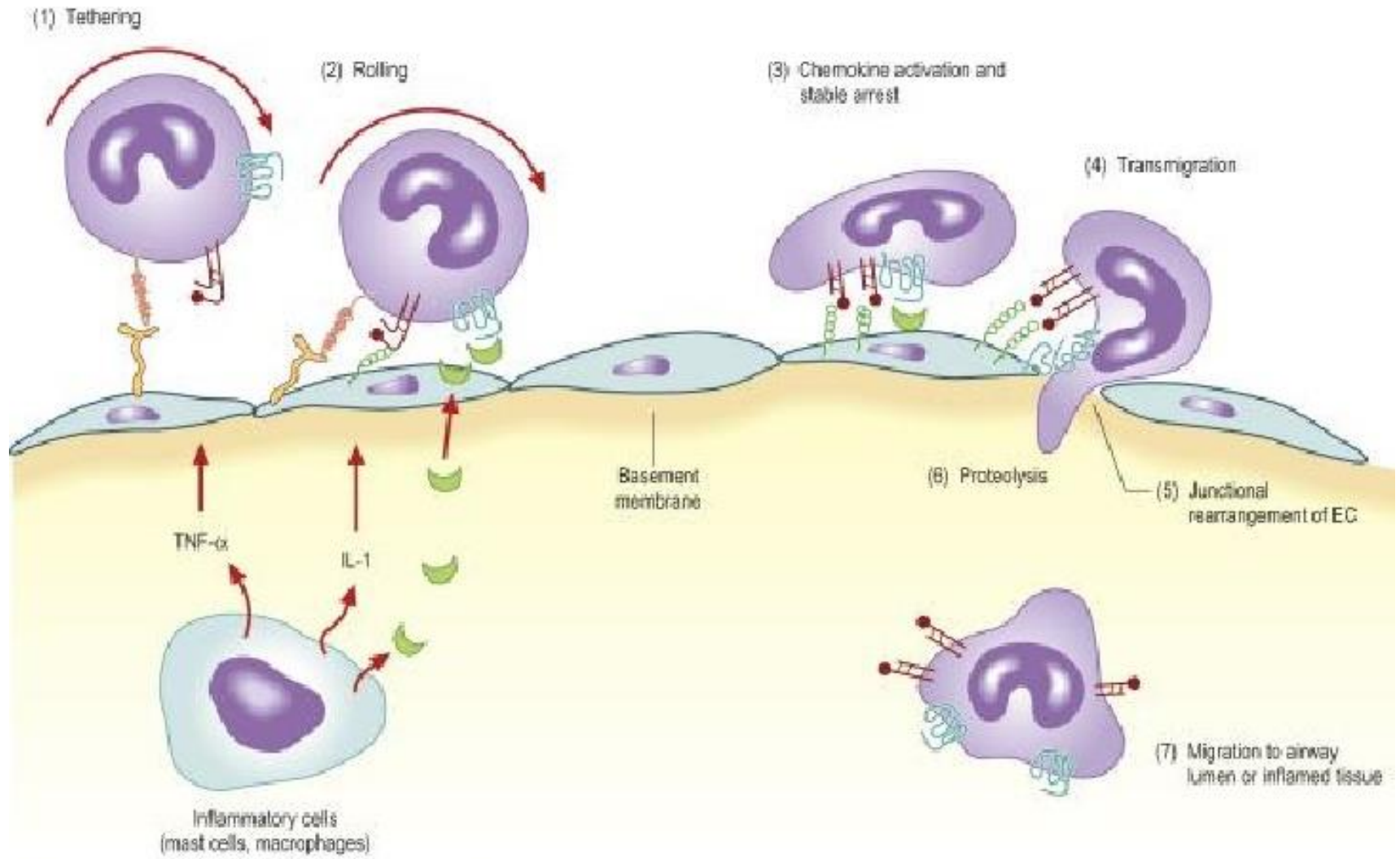
Tight Junctions (zonula occludens),








Desmosomes & hemidesmosomes



CAM's Cell adhesion molecules

- **Integrins**
- **Selectins**
- **Cadherins**
- **IgG superfamily**
- **Cell adhesion molecules (CAMs)** are proteins located on the **cell** surface involved in binding with other **cells** or with the extracellular matrix (ECM) in the process called **cell adhesion**. In essence, **cell adhesion molecules** help **cells** stick to each other and to their surroundings



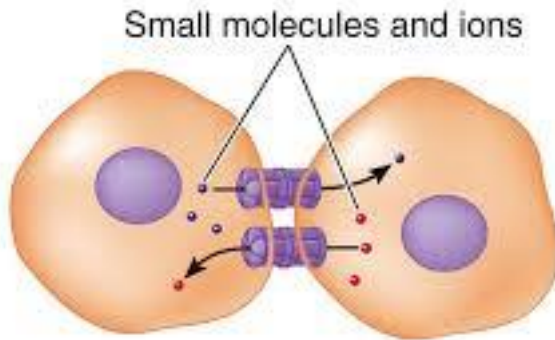
-  E- or L-selectin
-  L-selectin
-  Resting integrin
-  Activated integrins
-  ICAM or VCAM
-  GPCR
-  Inflammatory stimulus

Intercellular communication

Neural, Endocrine, Paracrine

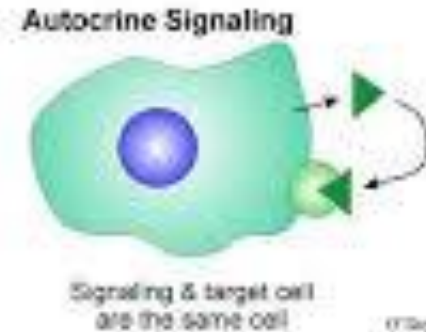
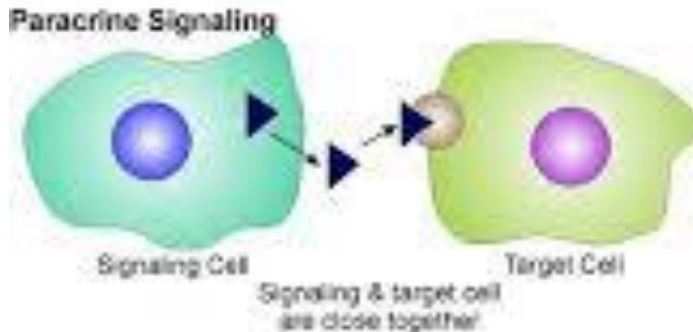
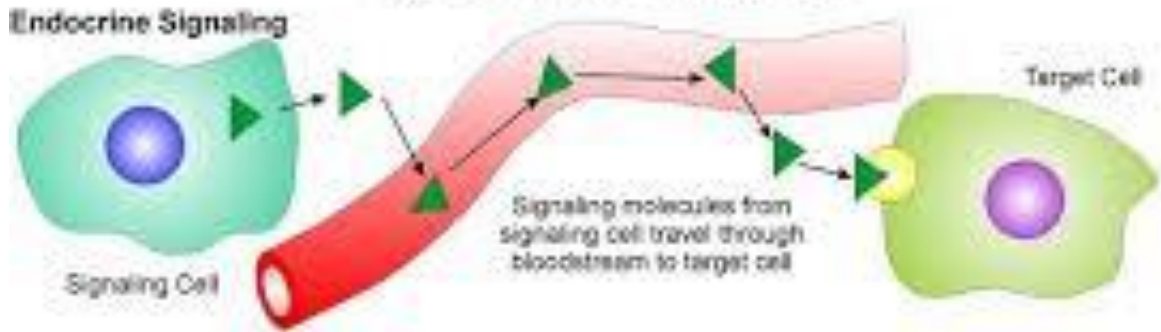
Direct communication

Direct intercellular communication



(a) Gap junctions

Types of Intercellular Signaling



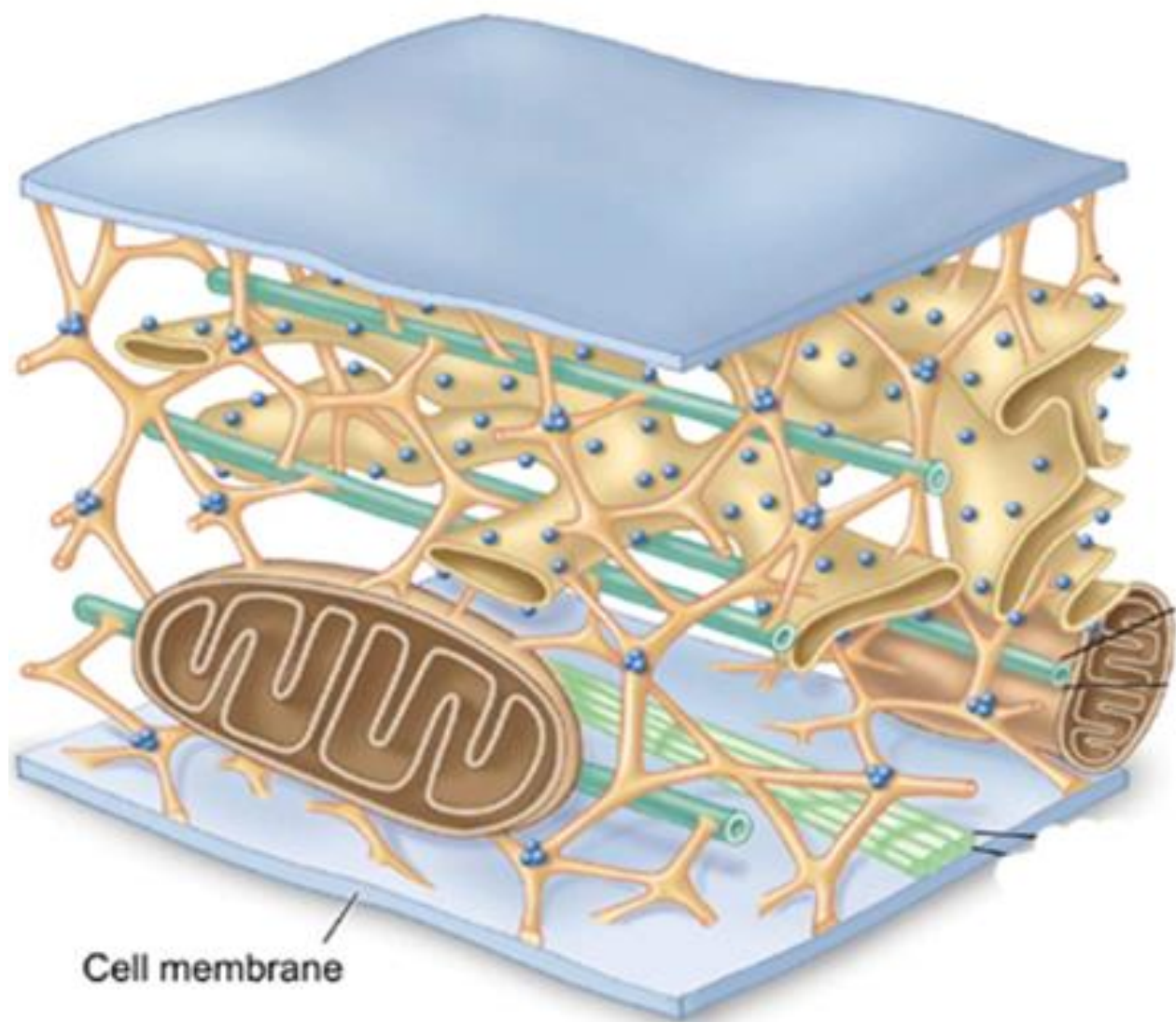
Stem Cells

- Embryonic stem cells
- Adult stem cells

Pleuripotent stem cell (hemopoietic)

Cytoskeleton

- a) Microfilaments:-made of protein **actin**
 - b) Microtubules:-made of protein **tubulin**
 - c) Intermediate filaments
 - d) Other protein structures that anchor them ,
bind them & move along with them
- Cellular elements that give shape & form to the cell
 - Help cell to change its shape
 - Movement of entire cell



Cell membrane

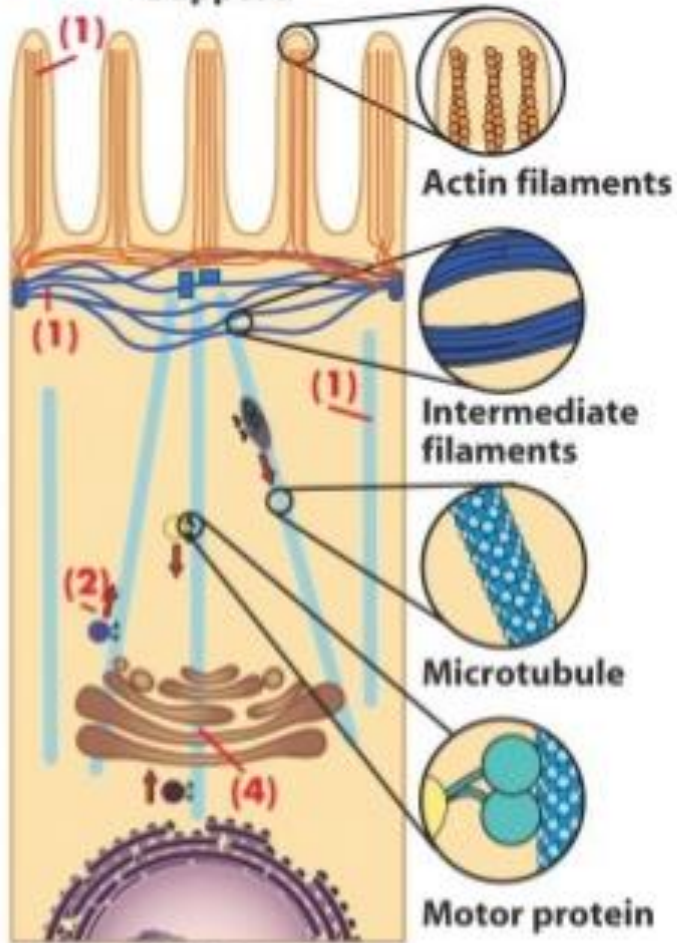
Key to Cytoskeletal Functions

(1) Structure and Support

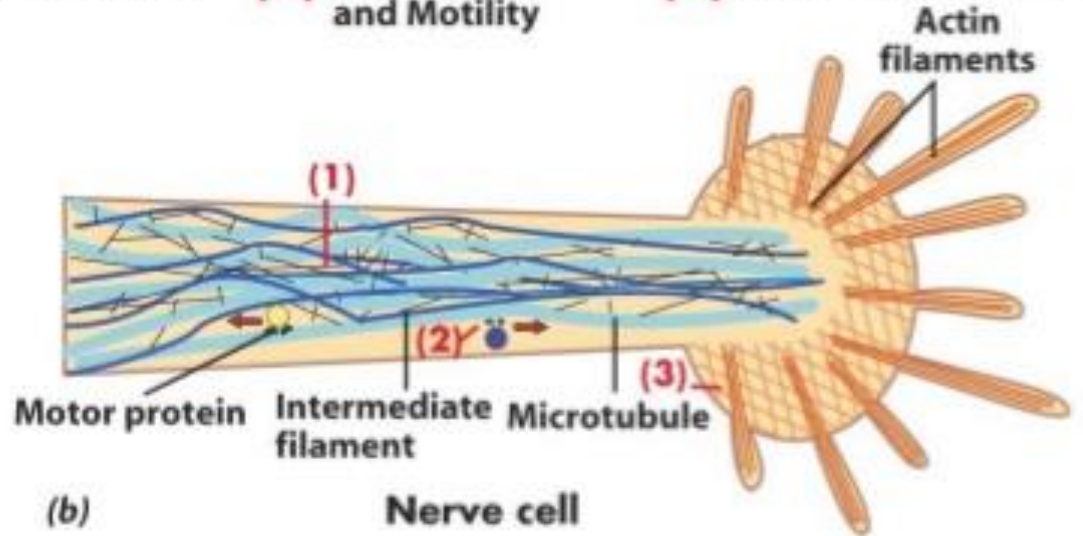
(2) Intracellular Transport

(3) Contractility and Motility

(4) Spatial Organization

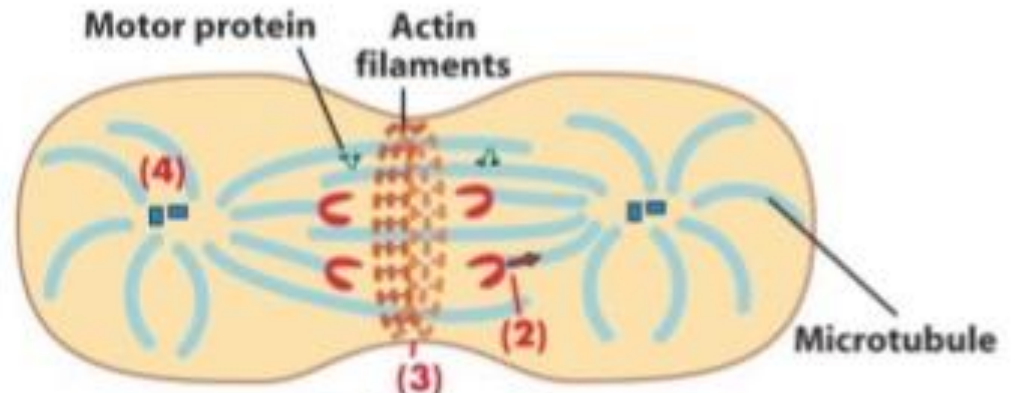


(a) Epithelial cell



(b)

Nerve cell



(c)

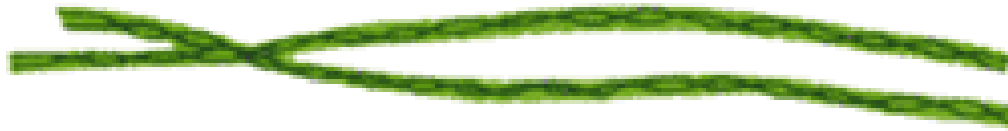
Dividing cell

microtubules



**25-nm
diameter**

actin filaments

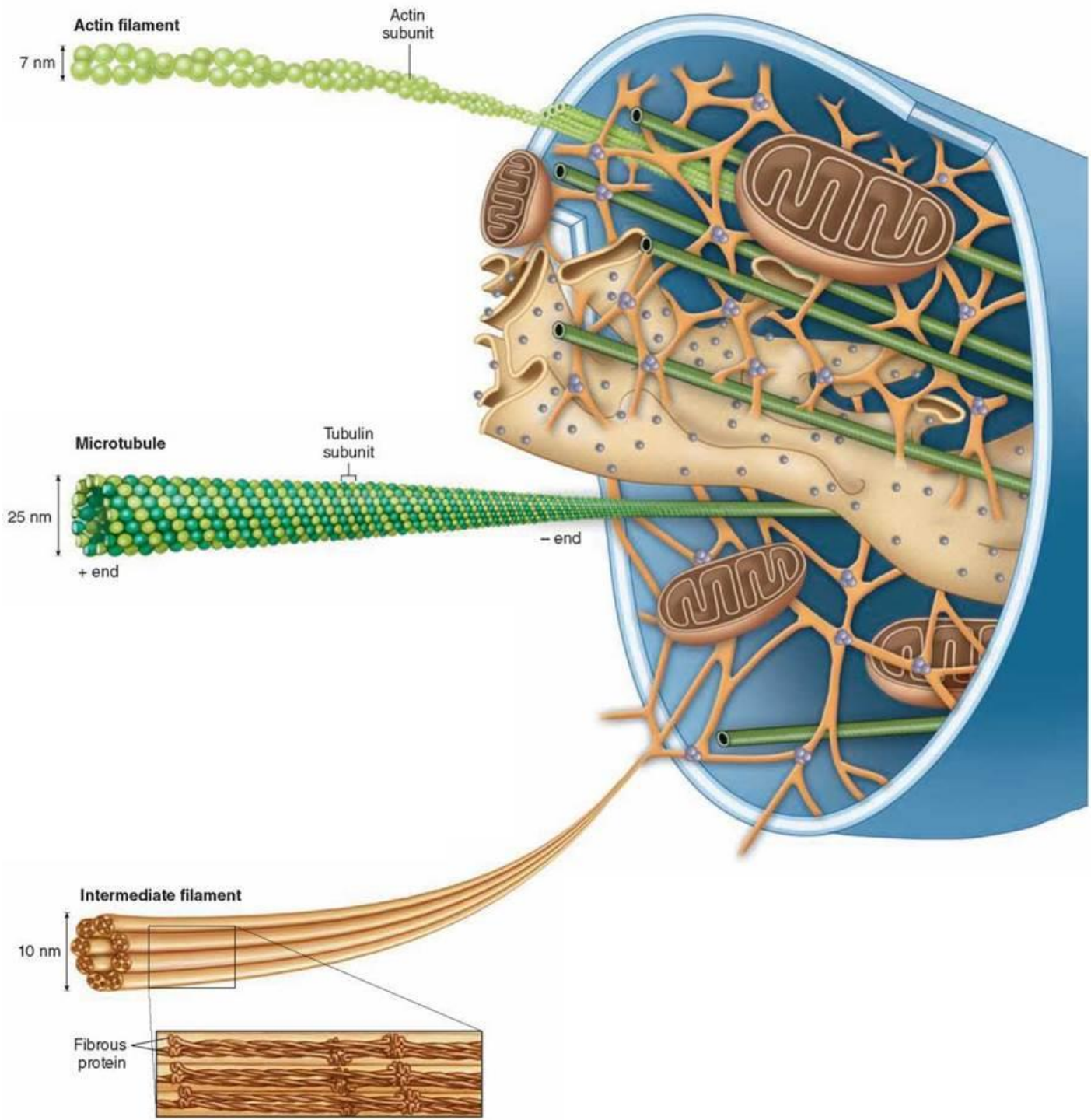


**7-nm
diameter**

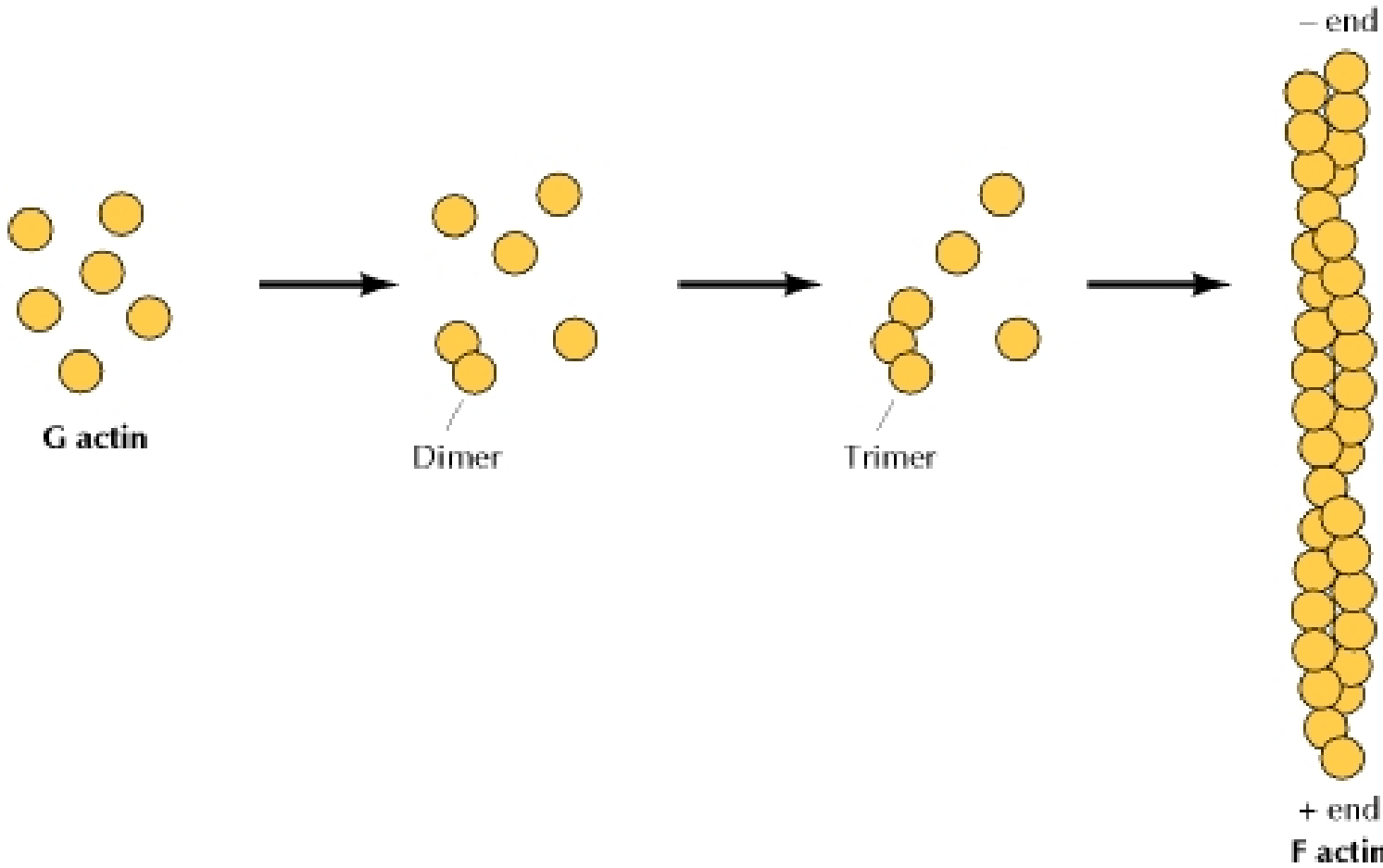
intermediate filaments



**10-nm
diameter**



Globular & filamentous actin

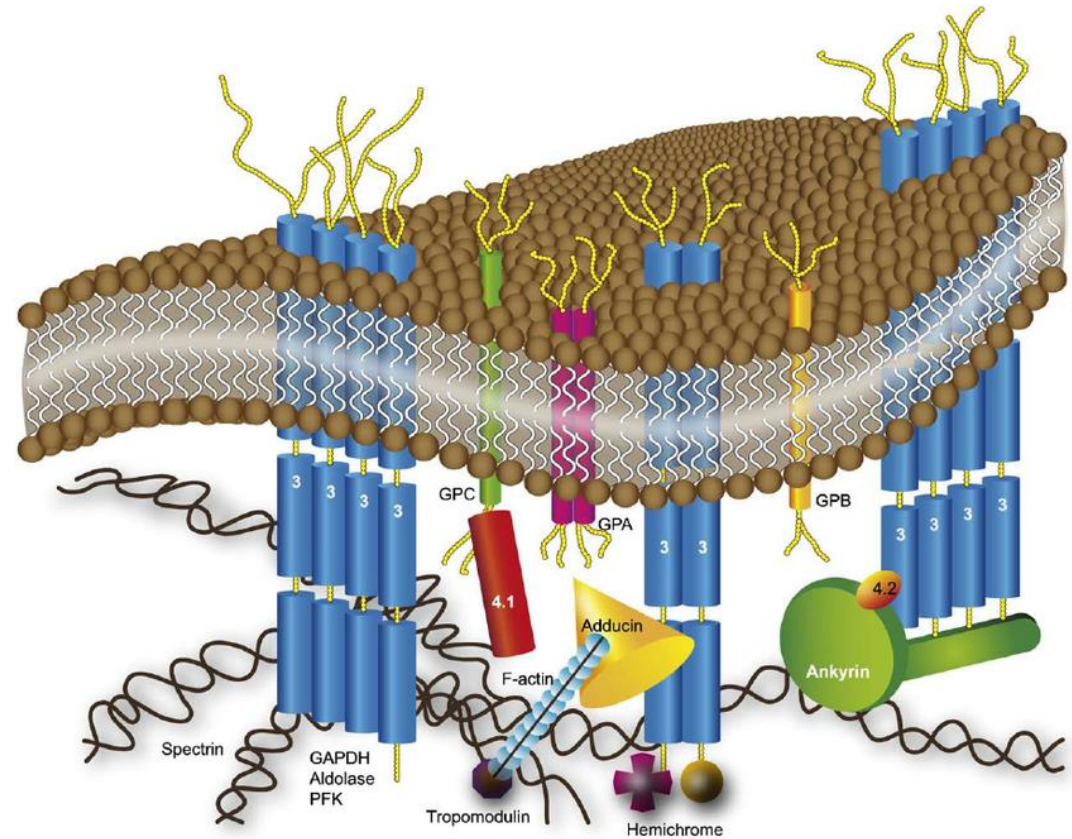


EC matrix

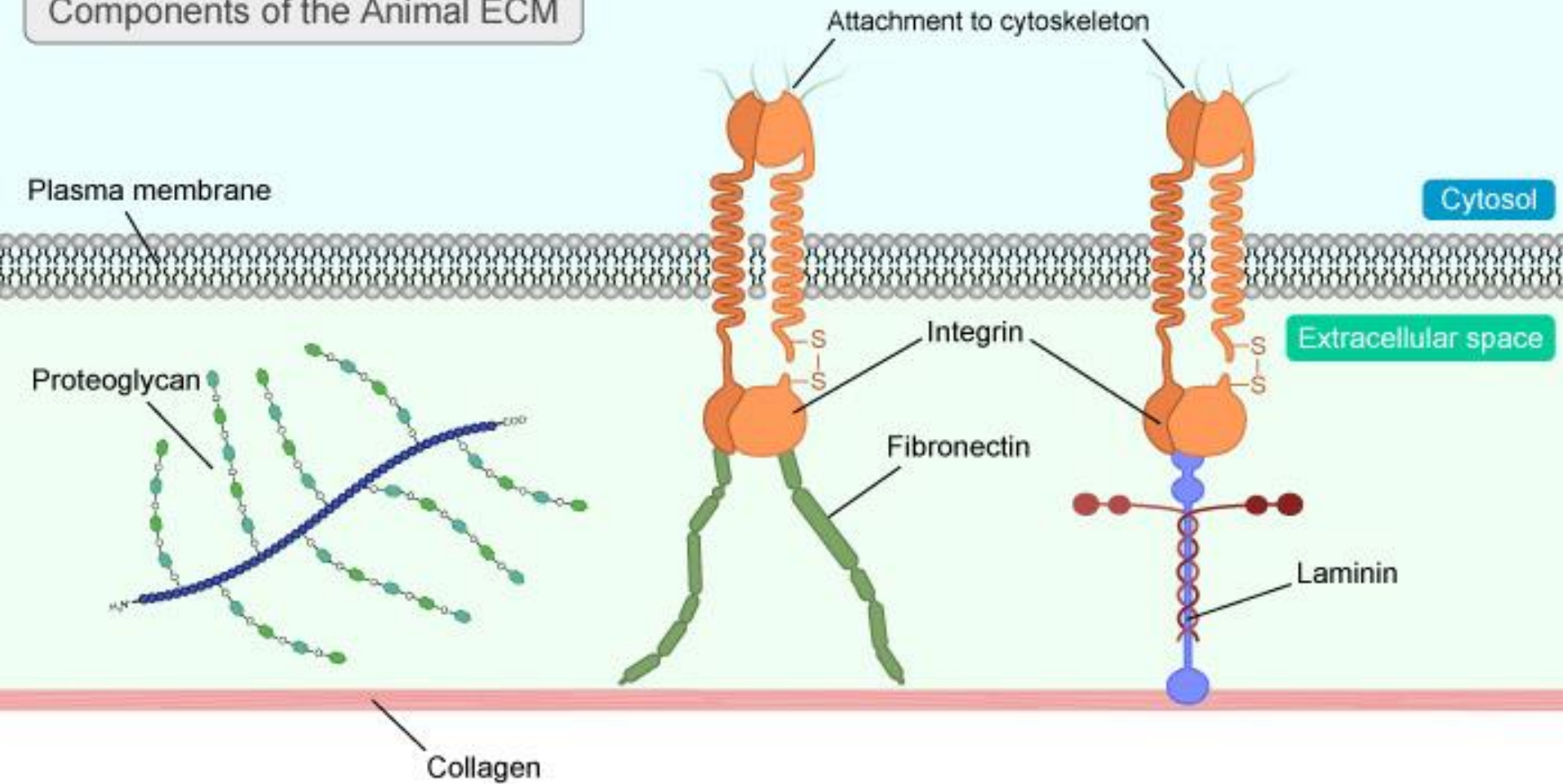
Laminins

Fibronectin

Proteoglycans



Components of the Animal ECM



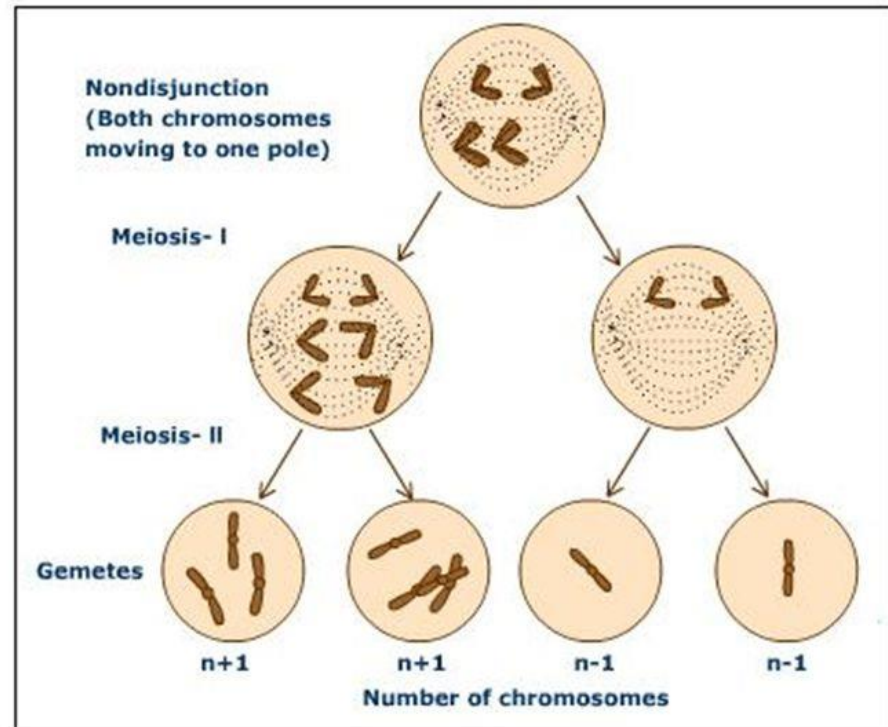
Cell division

- Mitosis
- Meiosis(reduction division)
- Mutation

Genetic material

Aneuploidy (abnormal chromosome number)

- Euploidy
- Haploid
- Diploid
- Aneuploidy



Apoptosis

- Cells not only divide & grow under genetic control ,**They can die & get absorbed under genetic control**
- **It is common during development & adulthood**