Physiology

Ref.: Textbook of Medical Physiology.

13th. Ed.

12th edition

Jordan Edition

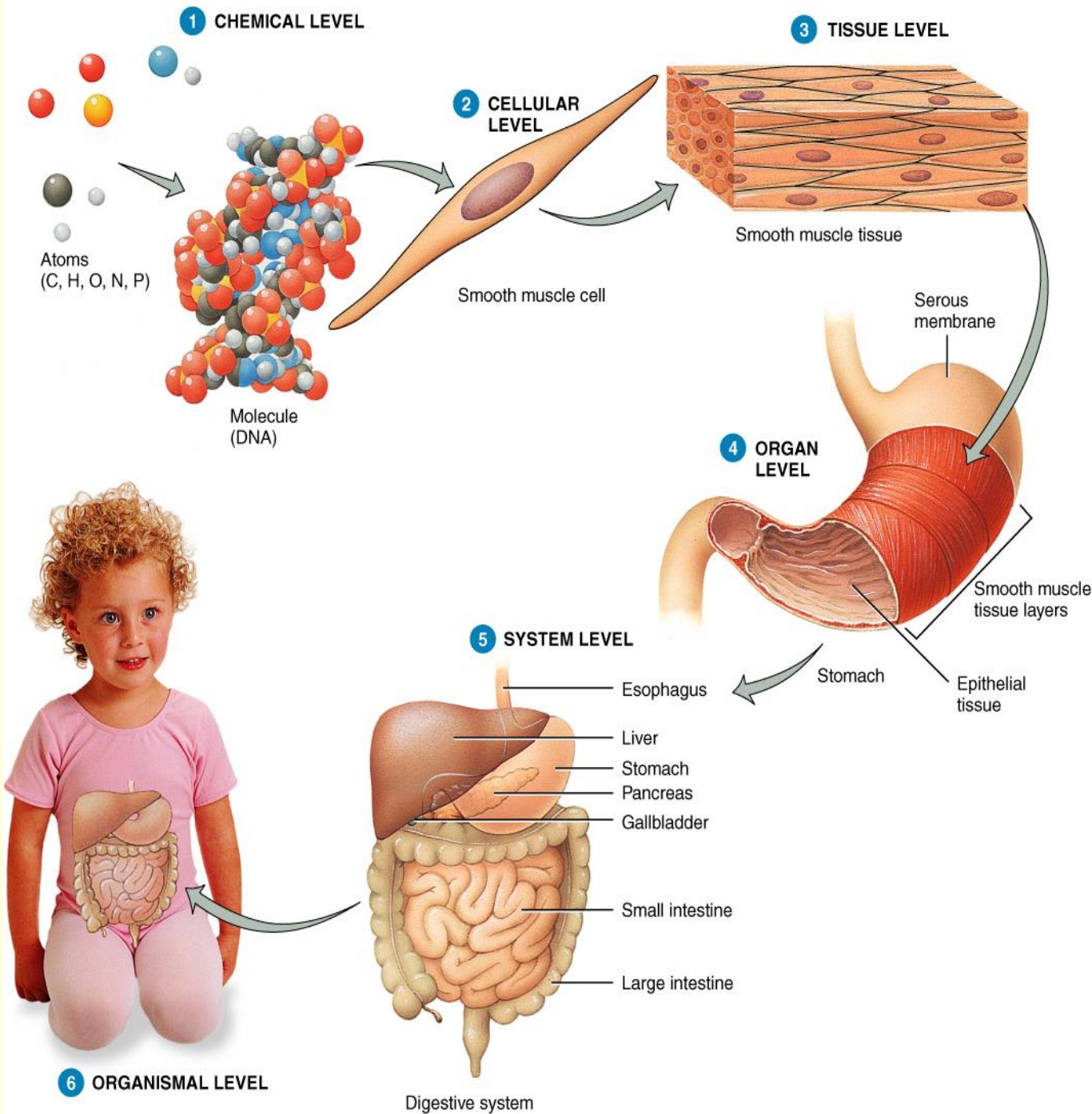
By, Guyton and Hall.

Subjects	Lect. No.	Pages in Guyton 14th	Pages in Guyton 13th
Introduction to Physiology: General outline of physiology. **Homeostasis**, control systems, negative & positive feedback mechanism	1	MK 3-10 MK	MK 3-10 MK
Cell and Organelles	2	MK 13-16	MK 11-14
Transport-I (Passive) A. Simple Diffusion B. Facilitated Diffusion C. Osmosis	3	MK 51-59	MK 47-54
Transport-II (Active) A. Primary Active. B. Secondary Active: Co-and Counter-Transport C. Vesicular transport	4	MK 59-62	MK 55-59
Excitable Membranes: Resting Membrane Potential: Origin And Determinants. Distribution Of Different Ions Across Cell Membranes	5	MK 63-76	MK 61-74
Electrochemical Equilibrium (Nernst Equation) As a Predictor For RMP	6	MK 63-76	MK 61-74

Physiology

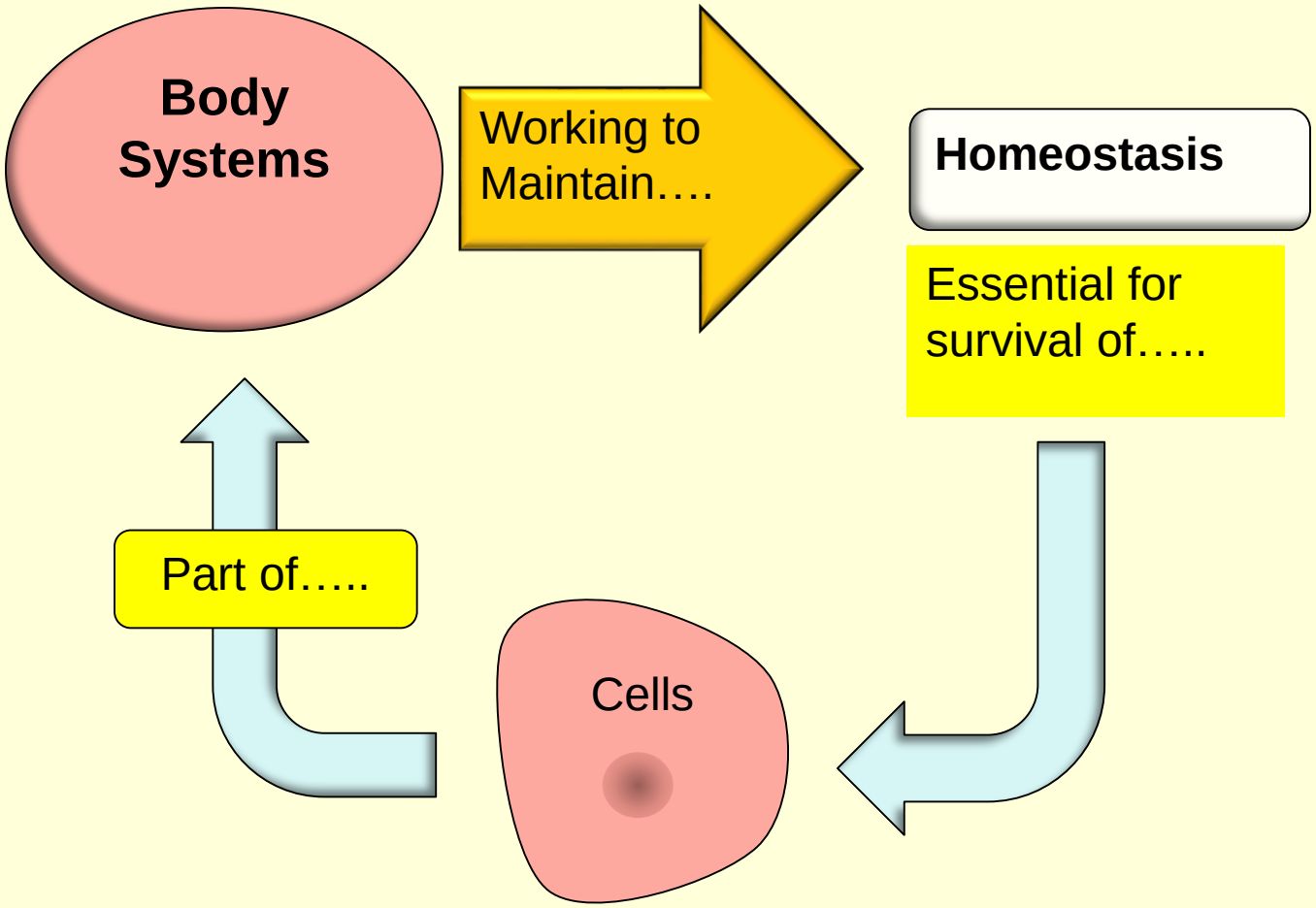
Introduction

Structural Levels In Human Body



Interdependence

Cells-Body systems-Homeostasis



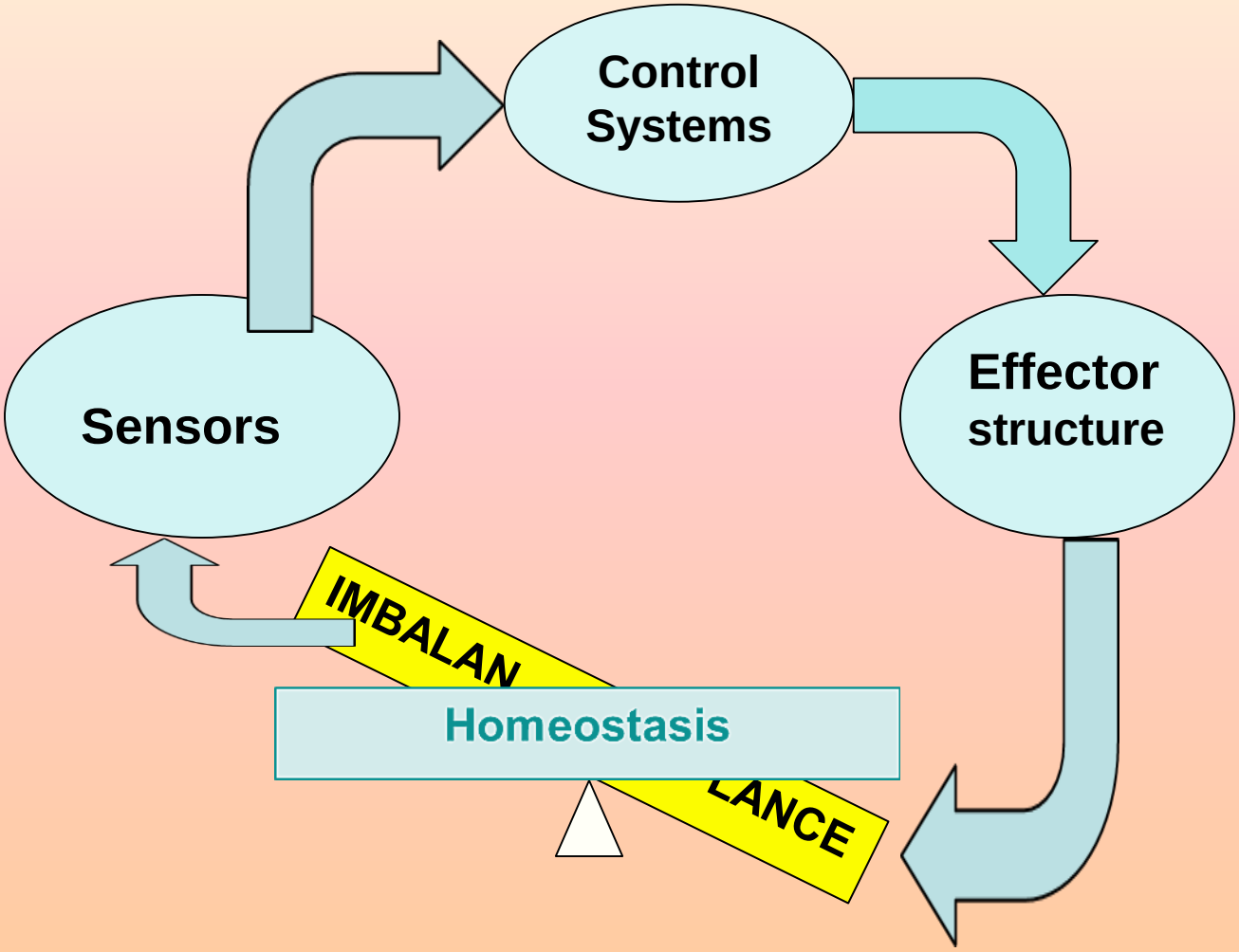
Systemic Functions

Systems are functioning to maintain an OPTIMAL condition in internal environment for the survival of cells.

Achieved by keeping **CONSTANCY** of internal environment:

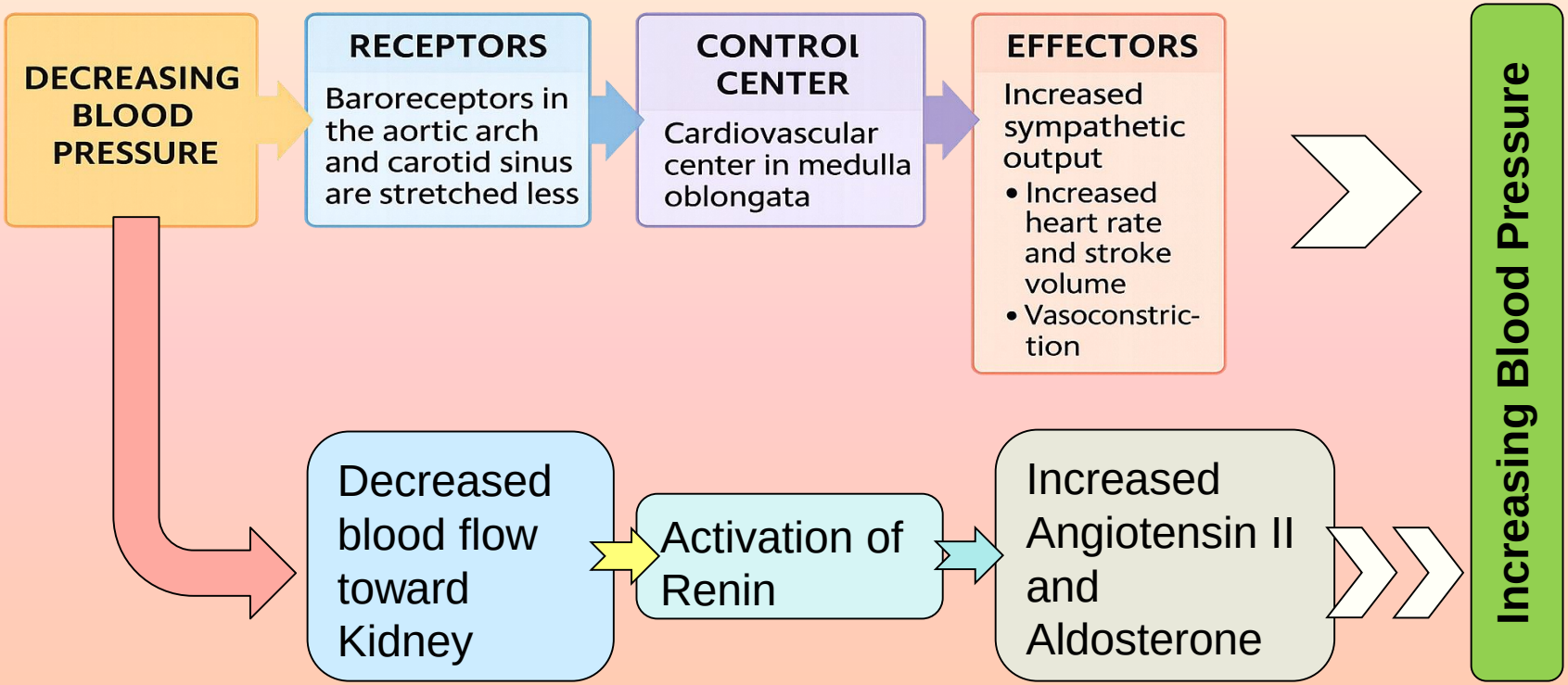
HOMEOSTSIS

Control of Homeostasis




Homeostasis
involves coordination between two systems
involves maintenance, within a narrow range, of a variety of
despite changes in internal and external
ENVIRONMENT
detected by
is an example of a
result in responses that can be
RECEPTORS
BEHAVIOURAL
PHYSIOLOGICAL
PUT ON CLOTHES
for example, when body temp. ↓
ENDOCRINE
made up of organs/tissues known as
GLANDS
involves release of
HORMONES
release chemical messengers called
TARGET CELL
travel via blood to a specific
responses are quicker but shorter compared to
NERVOUS
SENSORY
FACTORS
PANCREAS
releases chemical messengers
leads to release of glucagon by cells, an example of a response that is
GLUCAGON
basic unit is
includes motor, connecting and
NEURON
divided into PNS and
CNS
these include O_2, CO_2, pH and
detected by cells in
GLUCOSE
conc. in blood is ↑ by
conc. in blood is ↓ by
INSULIN
WATER
TEMPERATURE
detected by
detected by
released from thyroid gland to ↑ heat gain
examples of a hormone
stimulates uptake of glucose and conversion into glycogen by
LIVER/MUSCLE
HYPOTHALAMUS
blood vessels do this to ↓ heat loss
THYROXINE
CONTRACT
along with spinal cord makes up
BRAIN
located in the
stimulates this gland
PITUITARY
releases ADH to act on
KIDNEY
produce this sort of urine when ADH levels low
DILUTE
an example of an
EFFECTOR
in stimulus-response model it is the

Control Blood pressure



Involvement of Neural and Hormonal Control

Ca++ HOMEOSTASIS

Ca++ ECF

Parathyroid Glands

PTH

Vitamin D

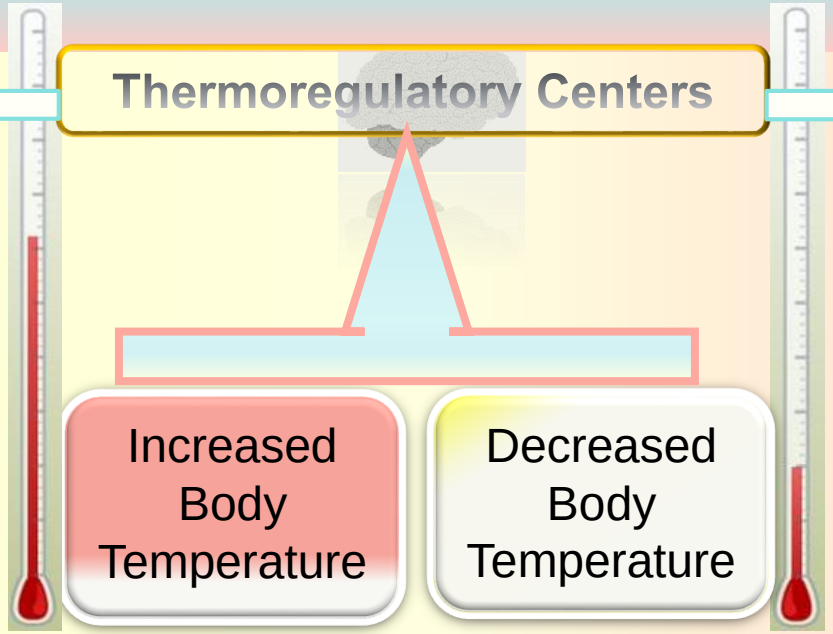
Ca++ Absorption

Ca++ Reabsorption
Phosphate Excretion

Bone Resorption

Ca++ ECF

Control of Body Temperature



- Vasodilation (Increasing heat loss)

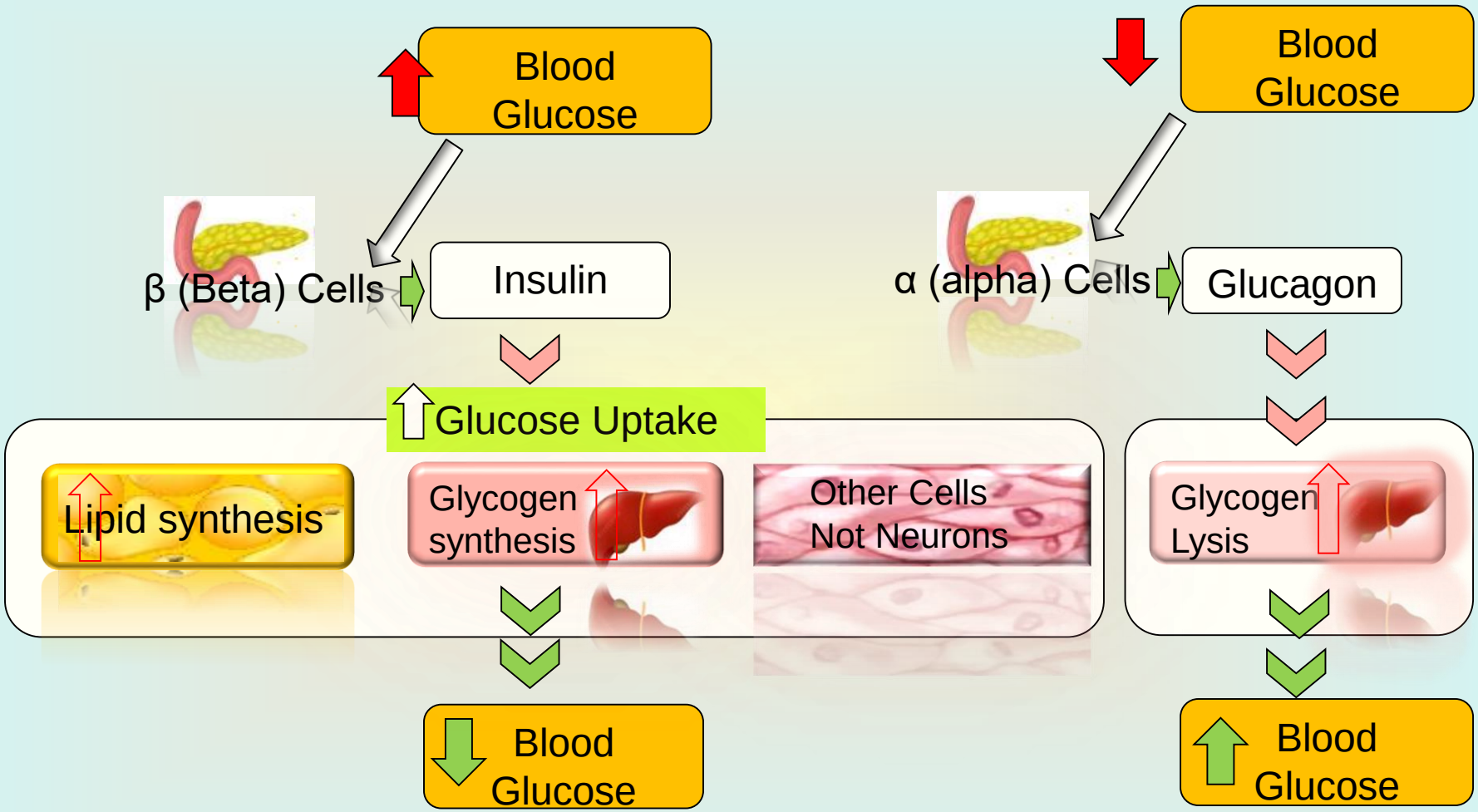
- Sweating and evaporation to increase heat loss from the body

Normal Body Temperature

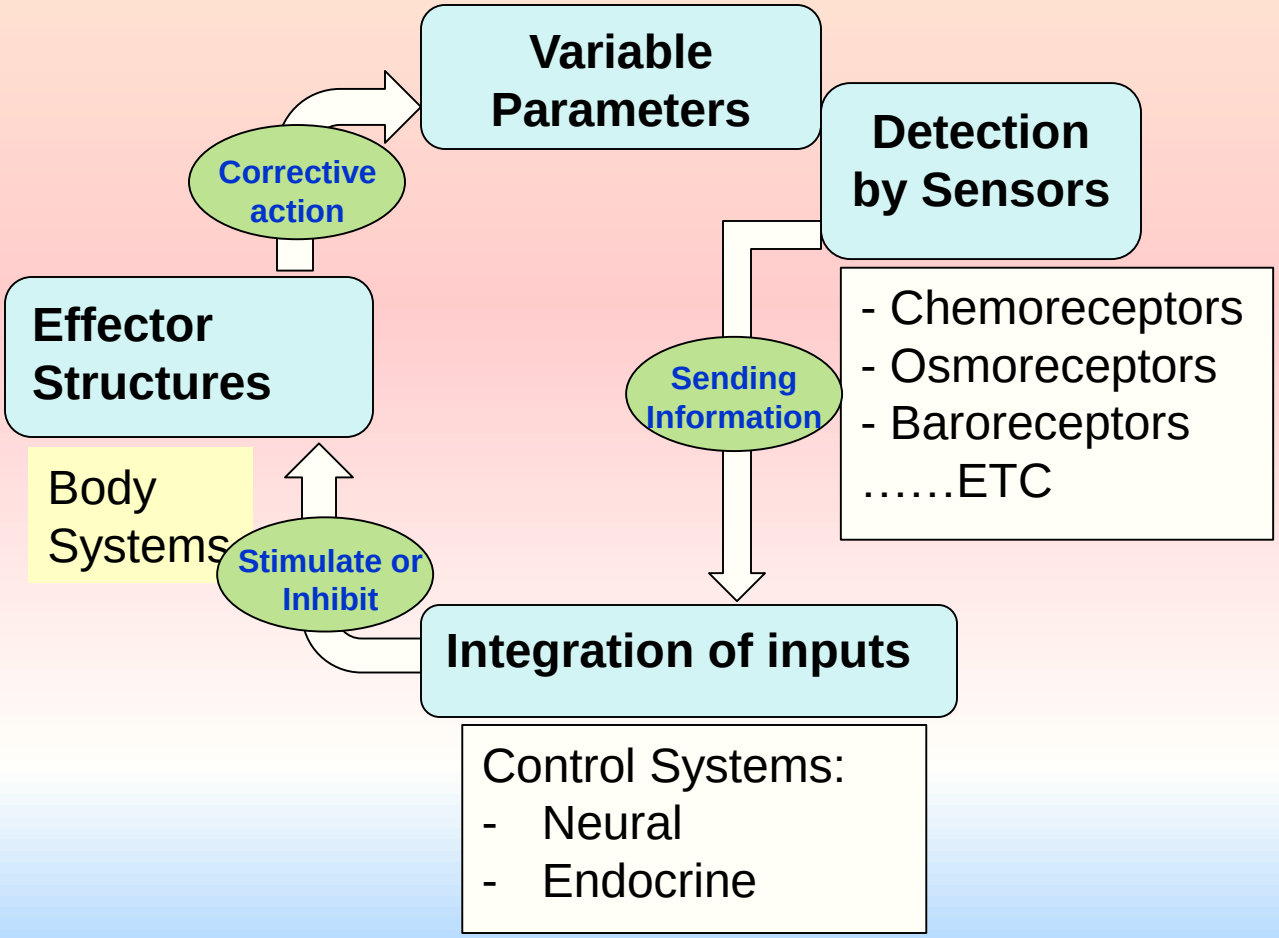
- Vasoconstriction (decreasing heat loss)

- Shivering (Involuntary muscle contractions) to produce more heat and warming the body

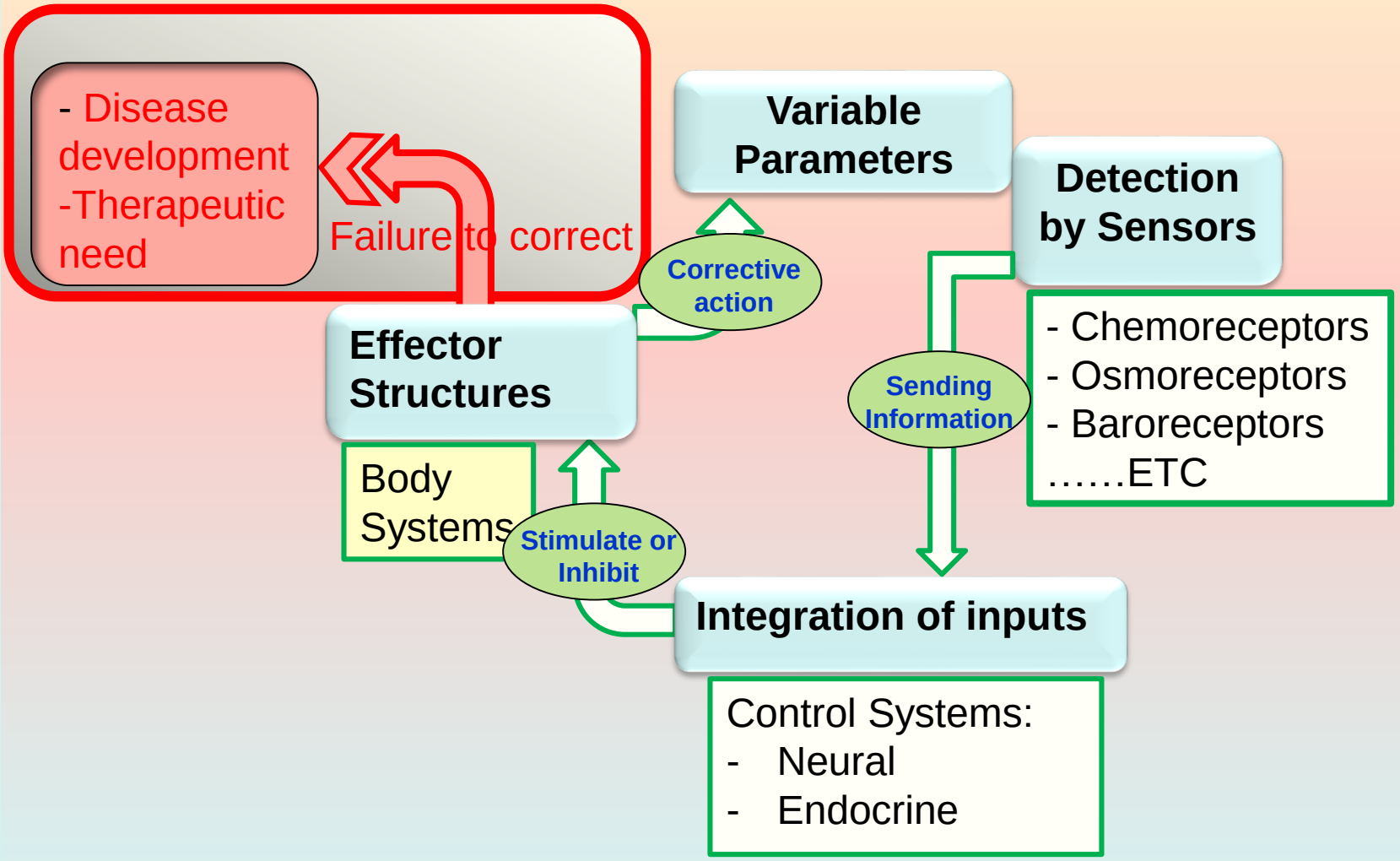
Negative Feedback

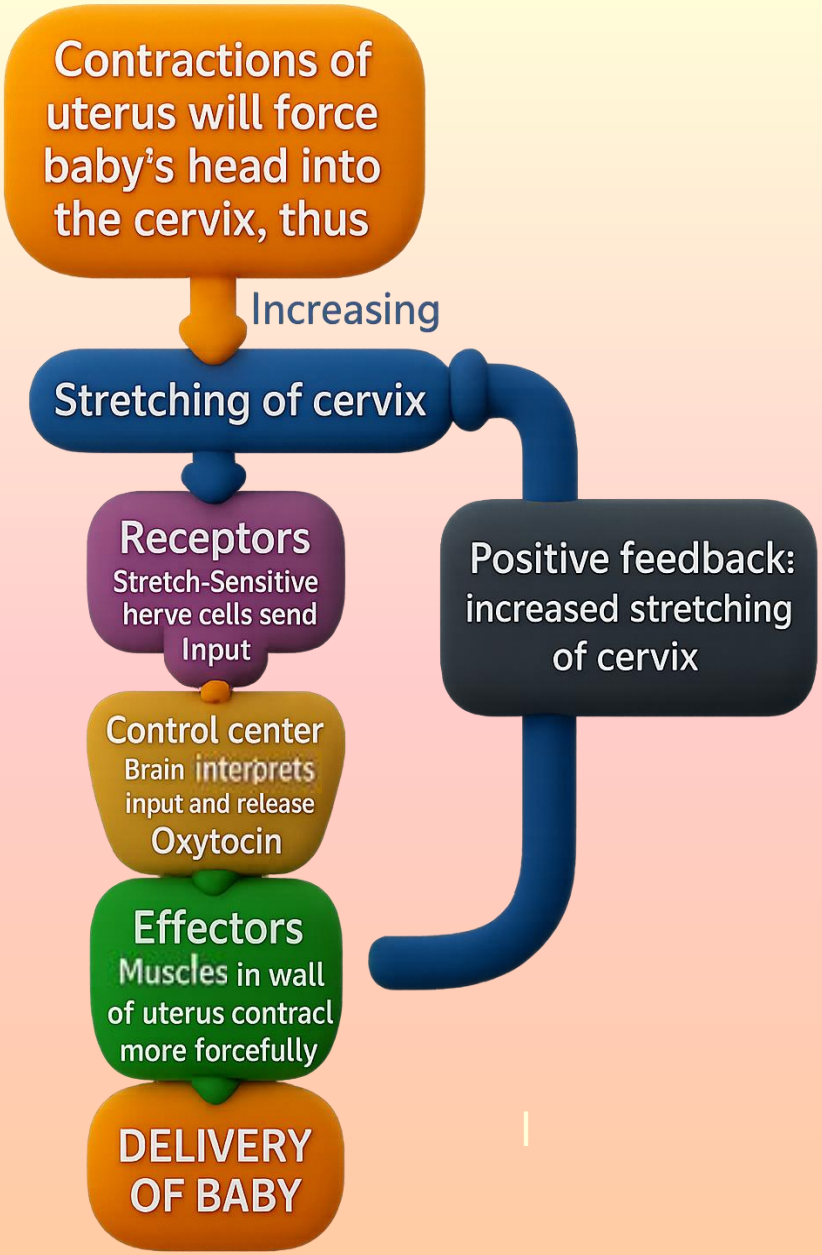


Summary of Homeostatic Control



Summary of Homeostatic Control





POSITIVE FEEDBACK

Mechanisms intensify responses to achieve specific outcomes.

It IS NOT INVOLVED IN CONTROLLING HOMEOSTASIS

Further Readings and Animation links

- https://www.phdnest.com/homeostasis-definition-types-and-examples/

- https://www.youtube.com/watch?v=Rgpj__C2jCc
- https://www.youtube.com/watch?v=LSgEJSlk6W4

Summary of Control systems

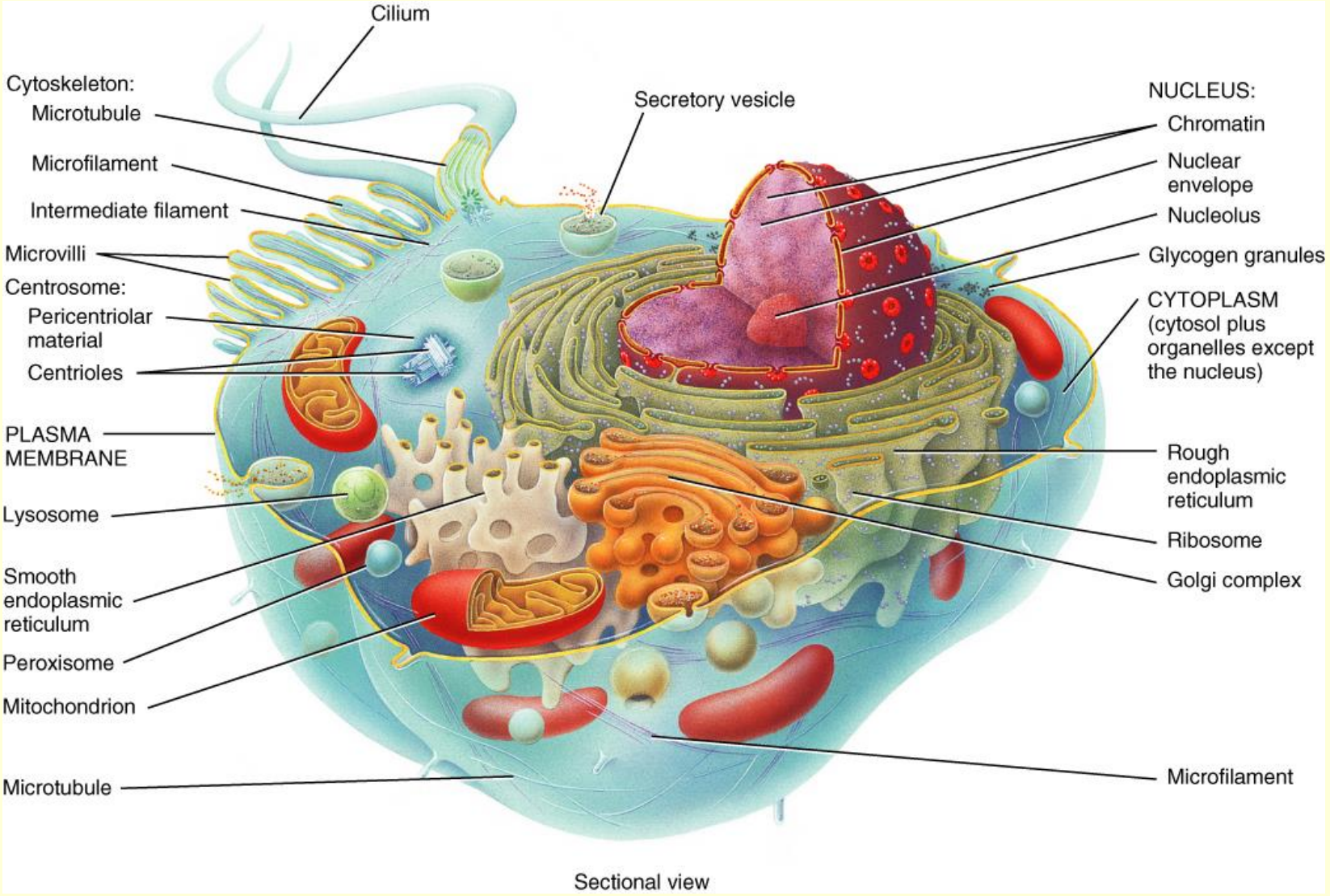
- **Negative feedback mechanisms maintain stability**, keeping physiological variables within healthy limits,
- **Positive feedback mechanisms intensify responses** to achieve specific outcomes.
- Both types of control systems are essential for coordinating bodily functions and sustaining life.

CELL STRUCTURES AND FUNCTIONS

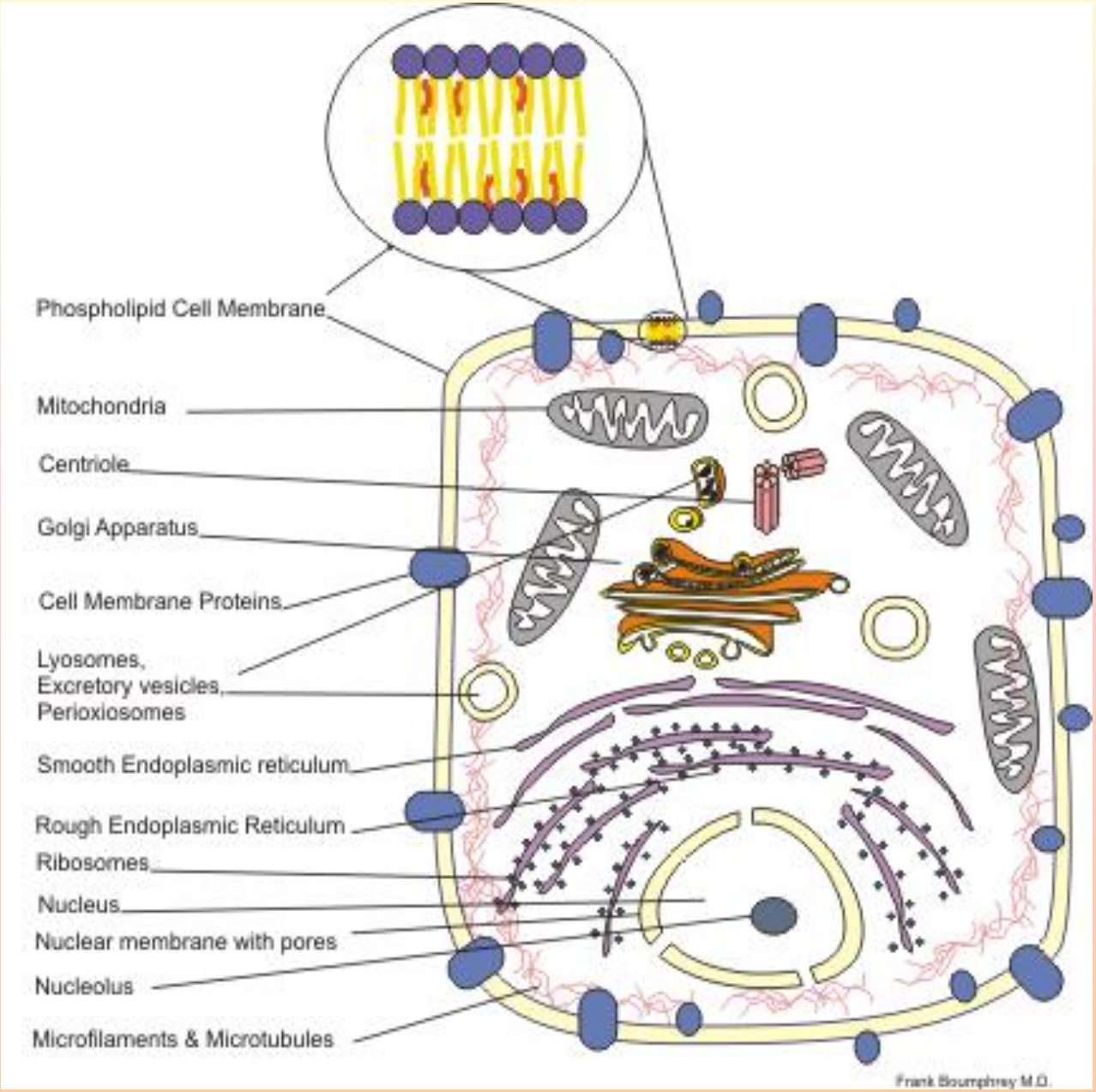
Many Types of Cells

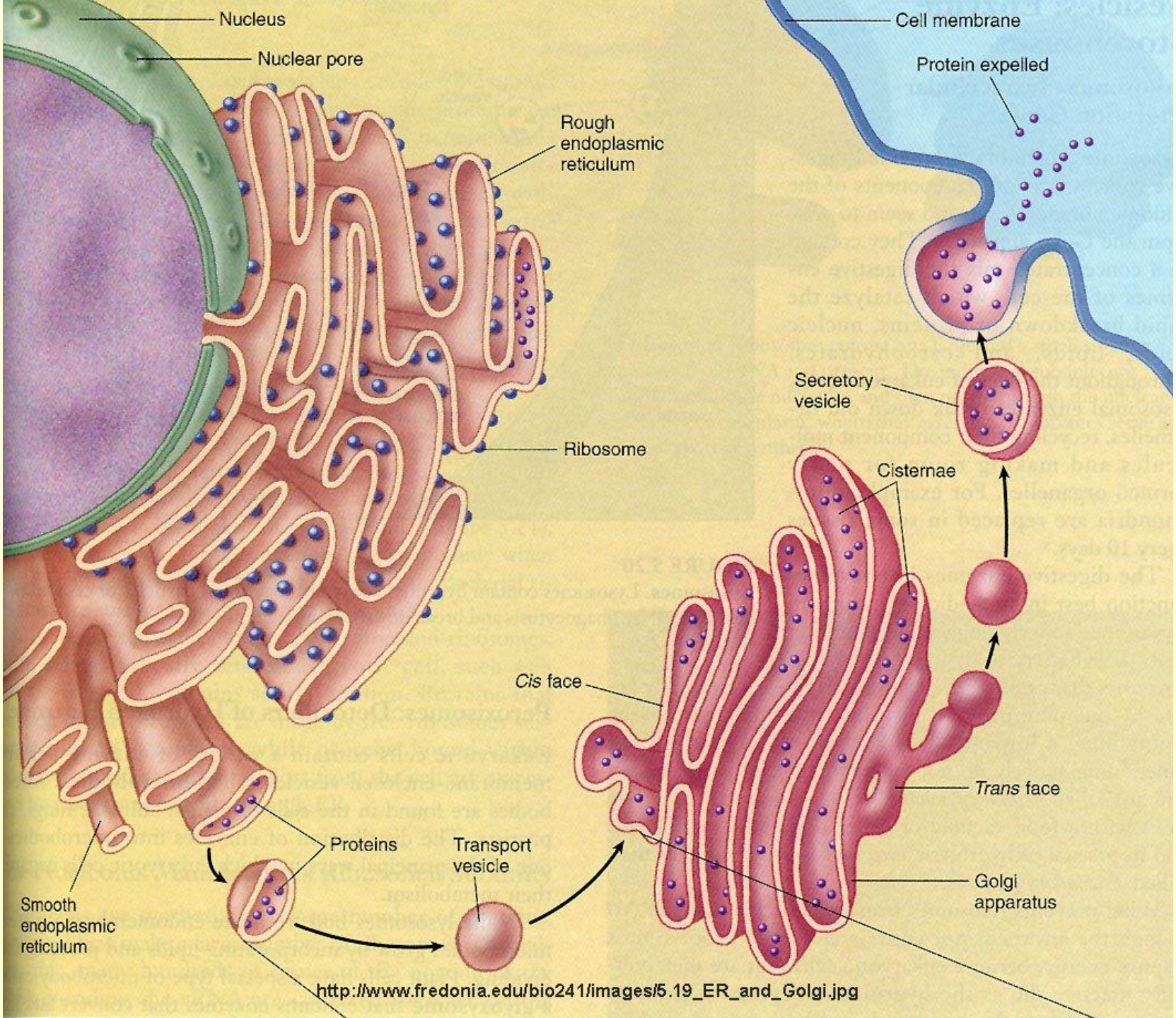
- Various Functions and structures
  - Contractile cells.
  - Secretory Cells.
  - Absorptive Cells.
  - Immune Cells.
  - ……..ECT

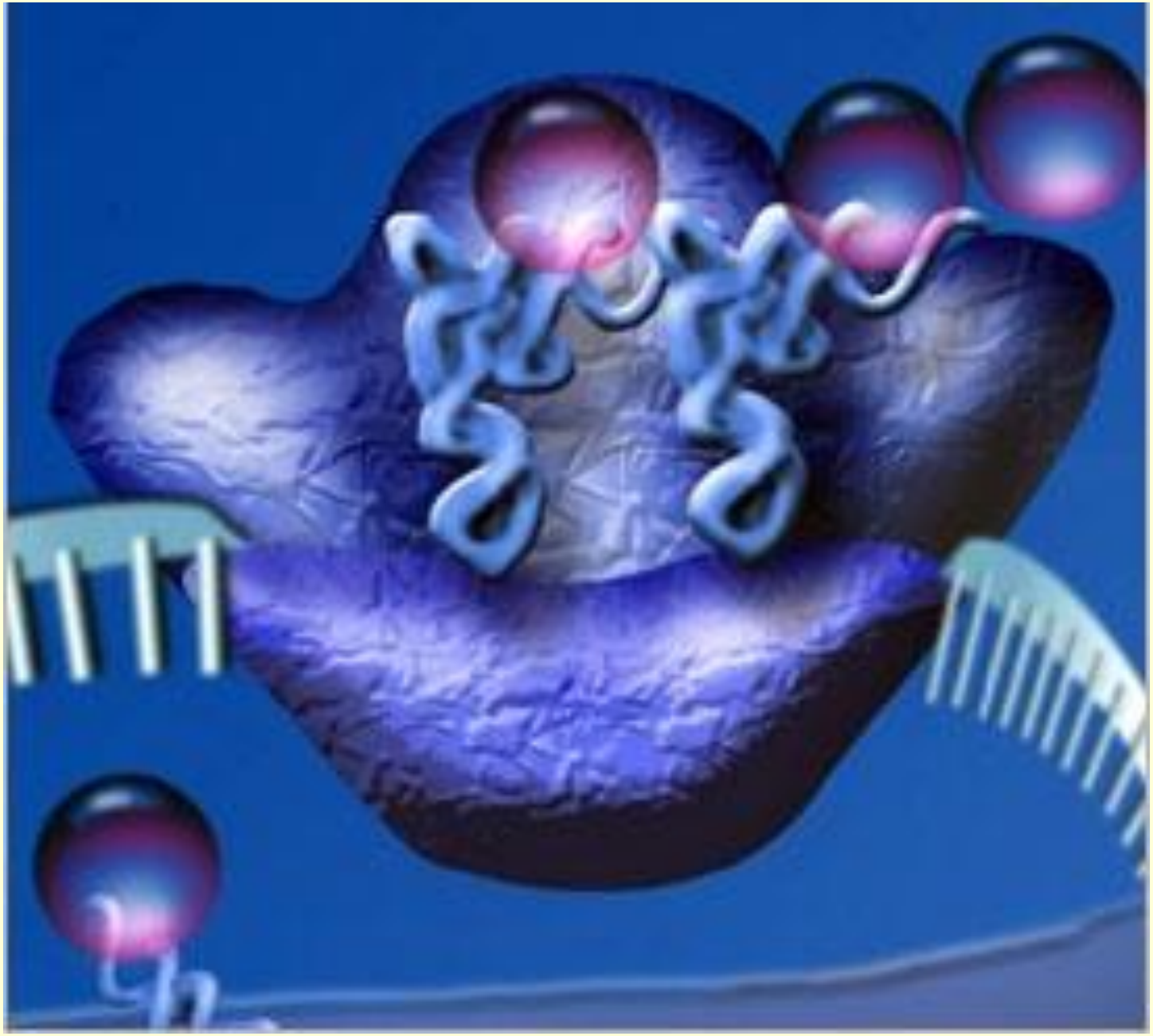
ORGANELLES


Cilium
Cytoskeleton:
Microtubule
Microfilament
Intermediate filament
Microvilli
Centrosome:
Pericentriolar material
Centrioles
PLASMA MEMBRANE
Lysosome
Smooth endoplasmic reticulum
Peroxisome
Mitochondrion
Microtubule
Secretory vesicle
NUCLEUS:
Chromatin
Nuclear envelope
Nucleolus
Glycogen granules
CYTOPLASM (cytosol plus organelles except the nucleus)
Rough endoplasmic reticulum
Ribosome
Golgi complex
Microfilament
Sectional view

Organelles

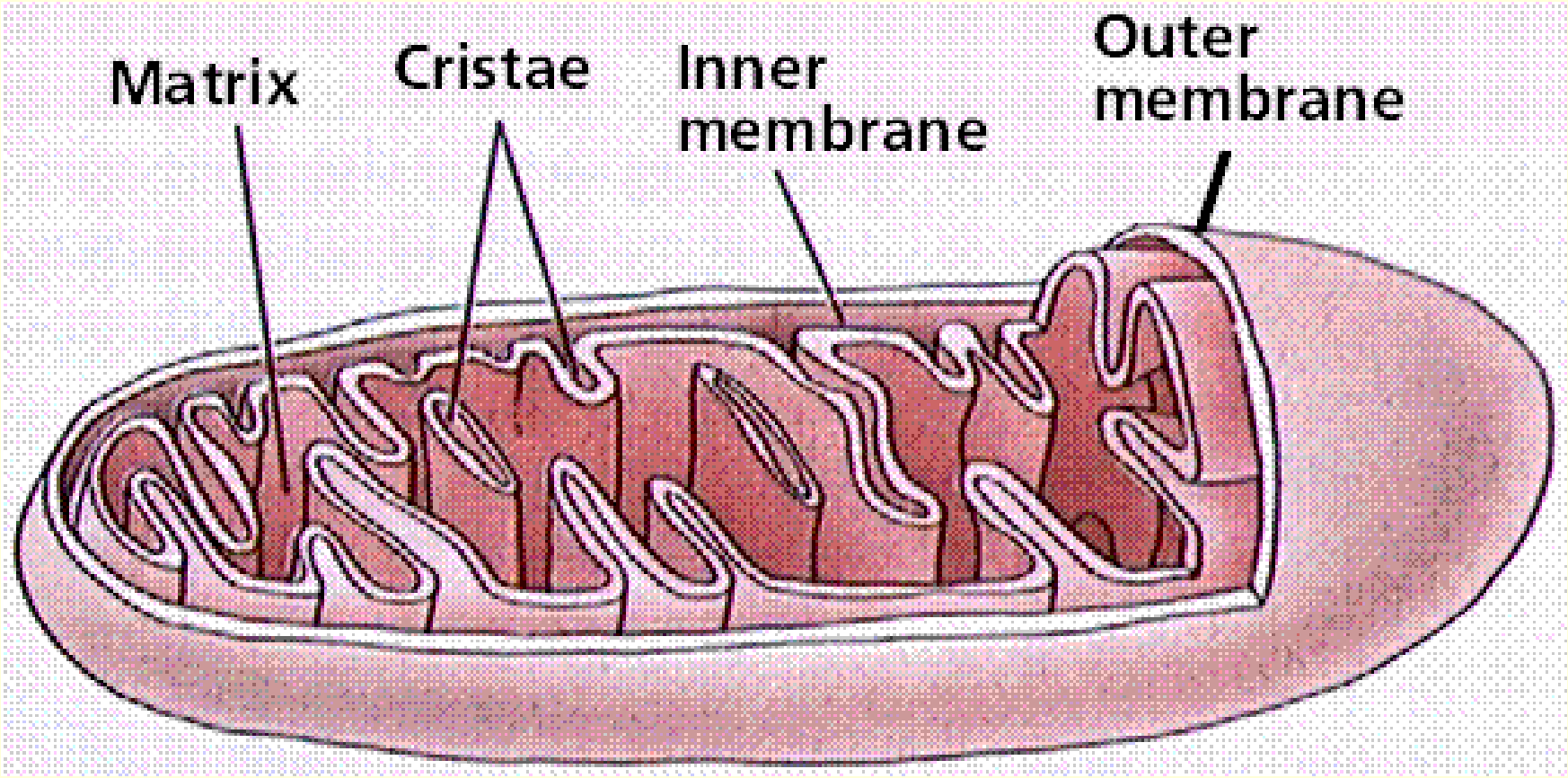

Phospholipid Cell Membrane
Mitochondria
Centriole
Golgi Apparatus
Cell Membrane Proteins
Lyosomes,
Excretory vesicles,
Perioxiosomes
Smooth Endoplasmic reticulum
Rough Endoplasmic Reticulum
Ribosomes
Nucleus
Nuclear membrane with pores
Nucleolus
Microfilaments & Microtubules
Frank Boumphrey M.D.

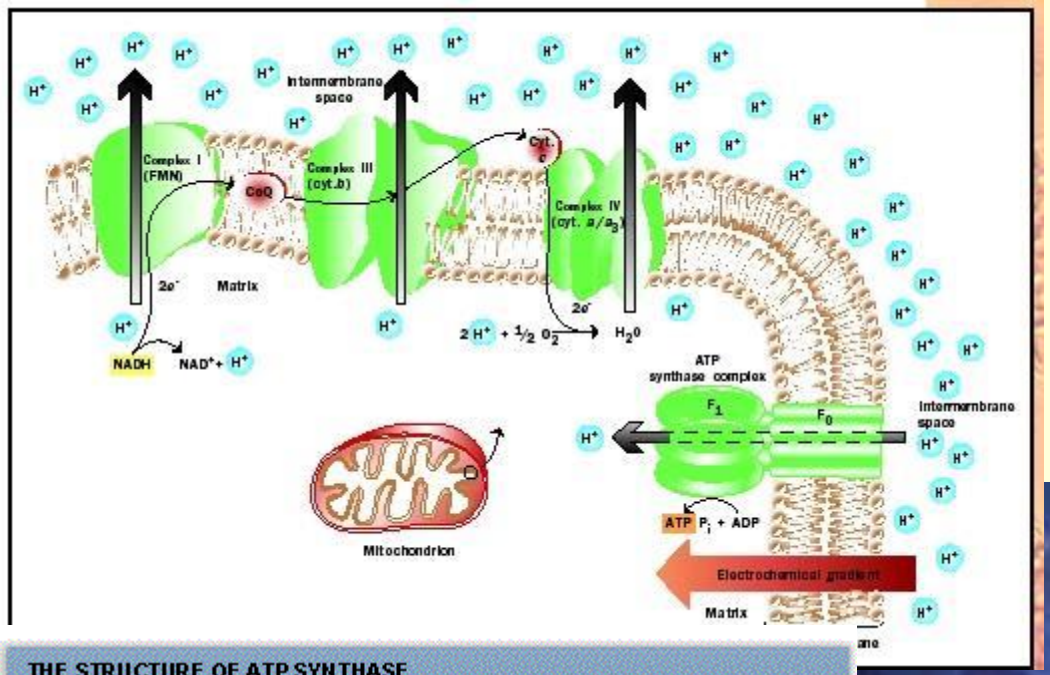

Nucleus
Nuclear pore
Rough endoplasmic reticulum
Ribosome
Cell membrane
Protein expelled
Secretory vesicle
Cisternae
Cis face
Trans face
Golgi apparatus
Proteins
Transport vesicle
Smooth endoplasmic reticulum
http://www.fredonia.edu/bio241/images/5.19_ER_and_Golgi.jpg

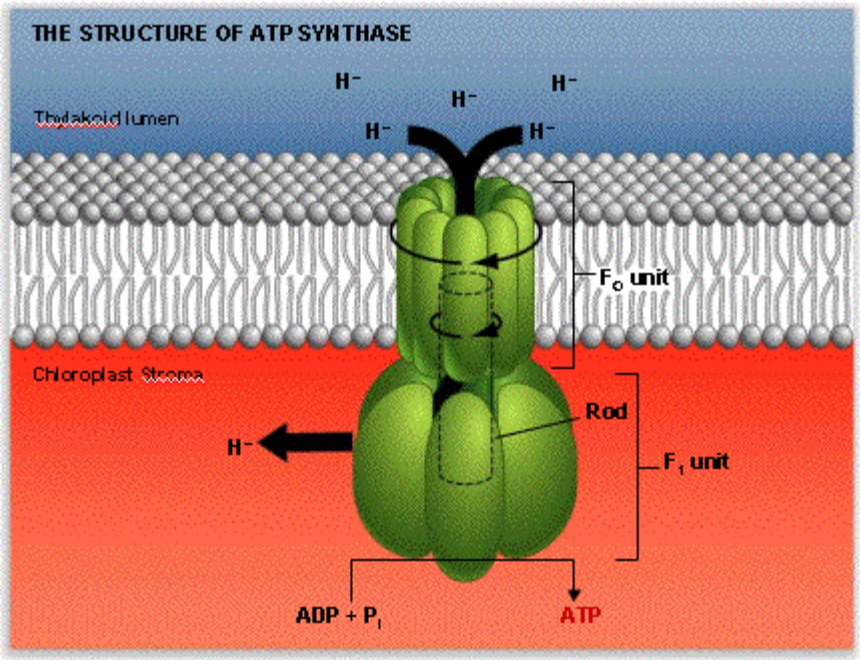


Lysosomes and peroxisomes

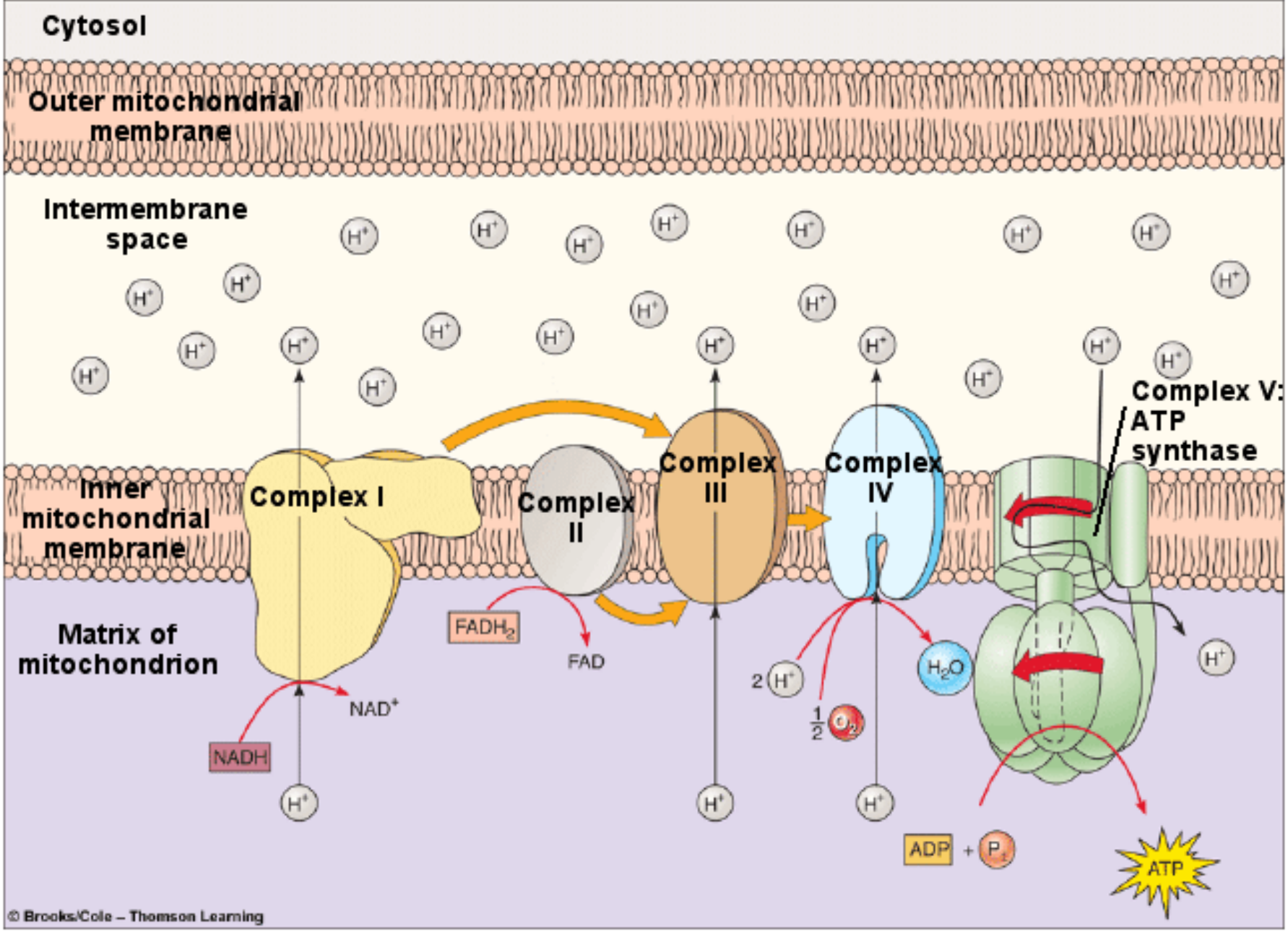
U.S. National Library of Medicine


Matrix
Cristae
Inner membrane
Outer membrane


Intermembrane space
Complex I (FMN)
CoQ
Complex III (cyt.b)
Cyt. c
Complex IV (cyt. a/a3)
2e⁻
Matrix
NADH
NAD⁺ + H⁺
2 H⁺ + ½ O2
H2O
ATP synthase complex
F1
F0
Intermembrane space
ATP Pi + ADP
Mitochondrion
Electrochemical gradient
Matrix


THE STRUCTURE OF ATP SYNTHASE
Thylakoid lumen
H⁻
Fo unit
Chloroplast Stroma
Rod
F1 unit
ADP + Pi
ATP

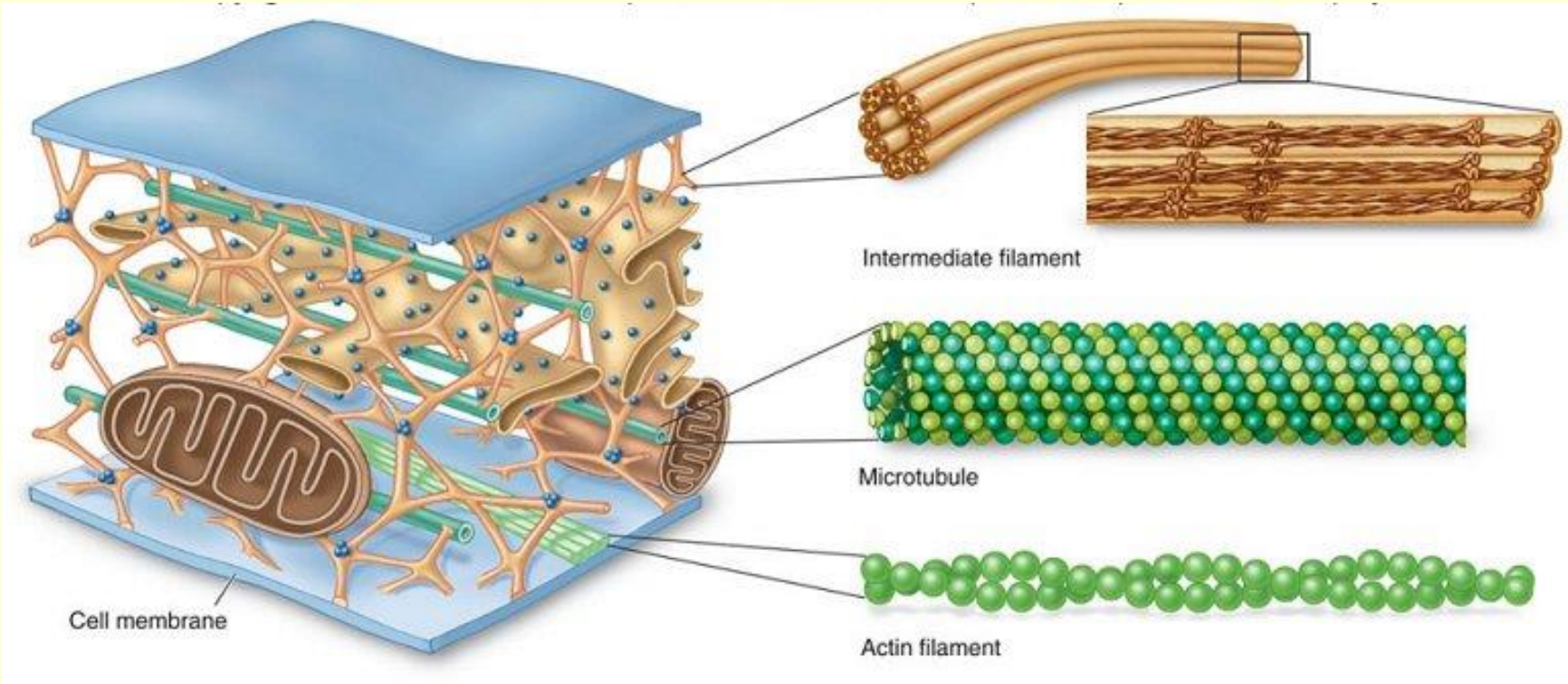

http://www.microscopy.fsu.edu/cells/animals/mitochondria.html
http://www.hybridmedicalanimation.com/pages/chloroplast.html



(a)

Fig. 7-10a(2)
Page 149

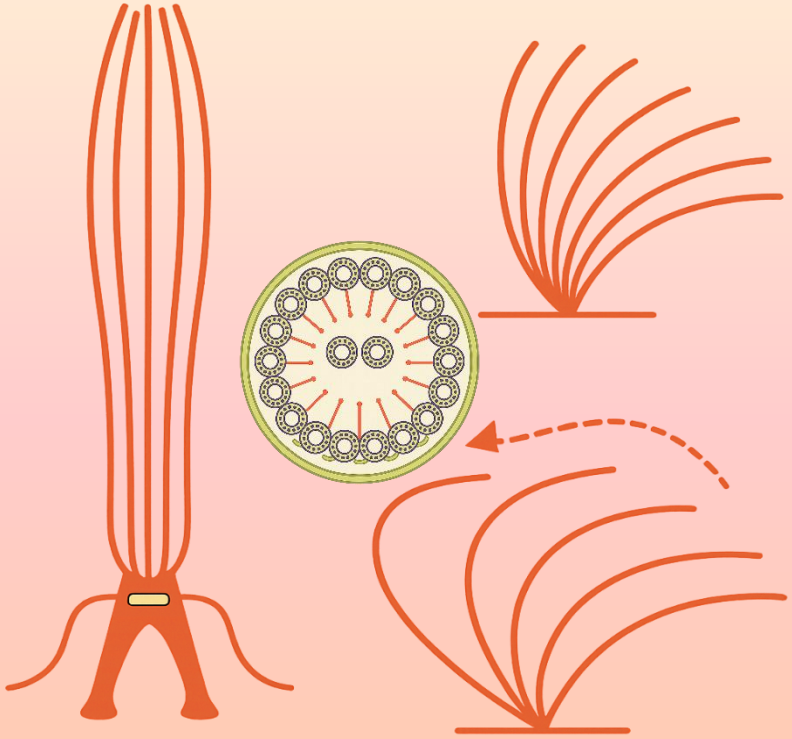
Cytoskeletal Structures


Intermediate filament
Microtubule
Actin filament
Cell membrane

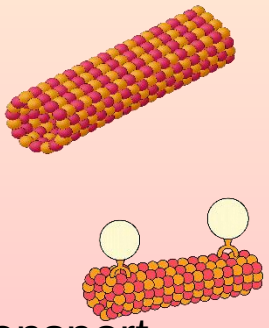
Cytoskeletal Structures

Microtubules

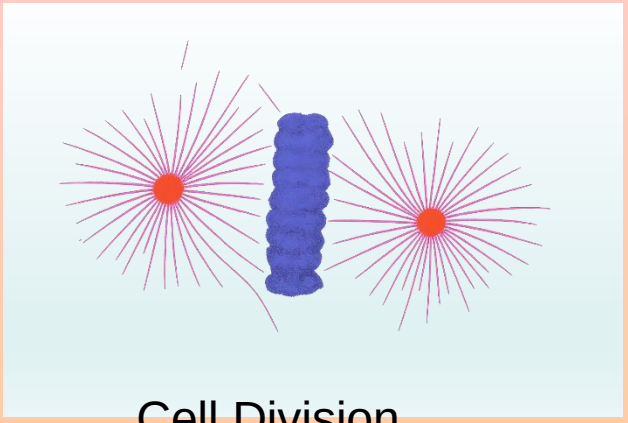
6.1. Microtubules



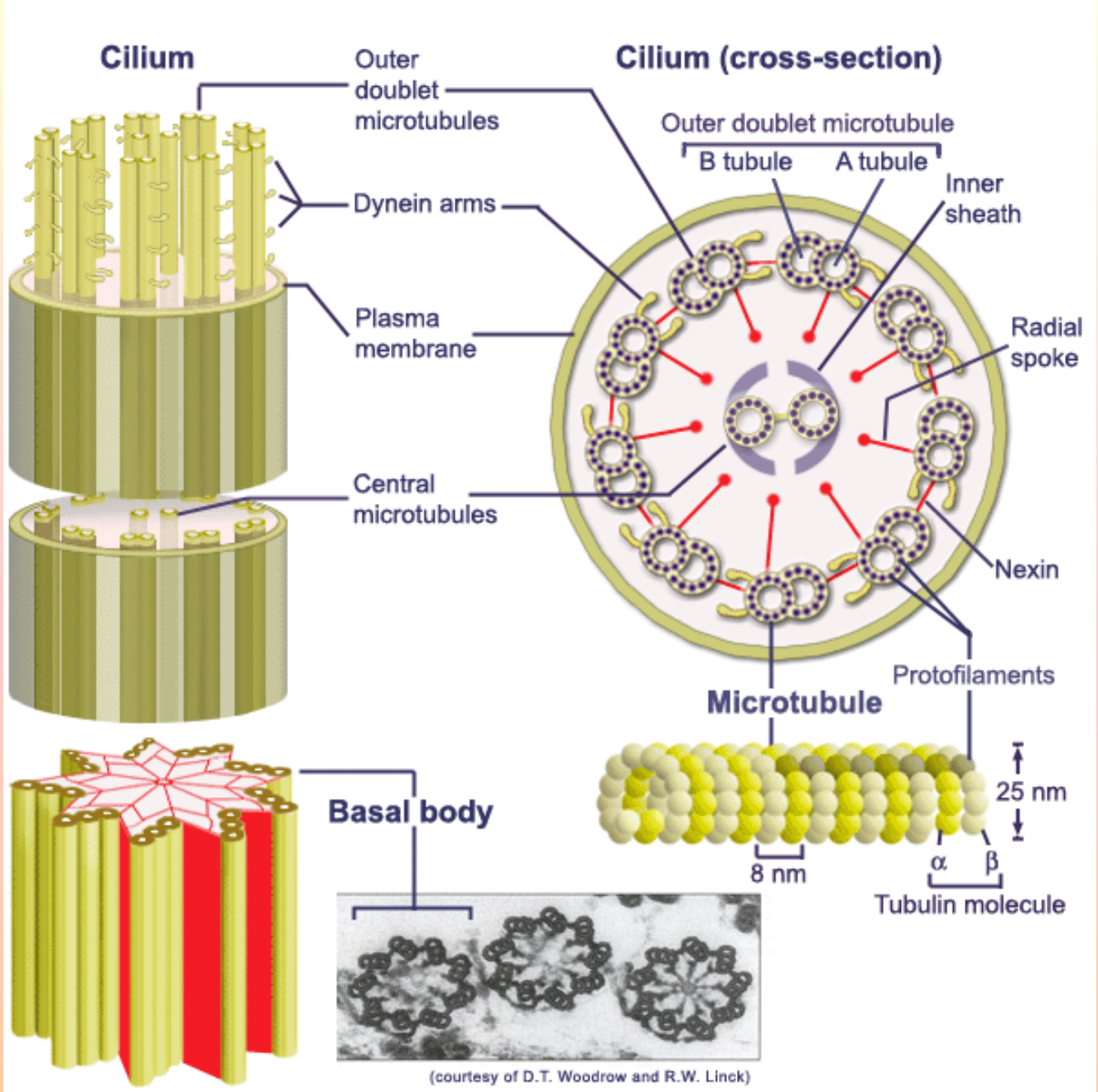
Formation of Cilia



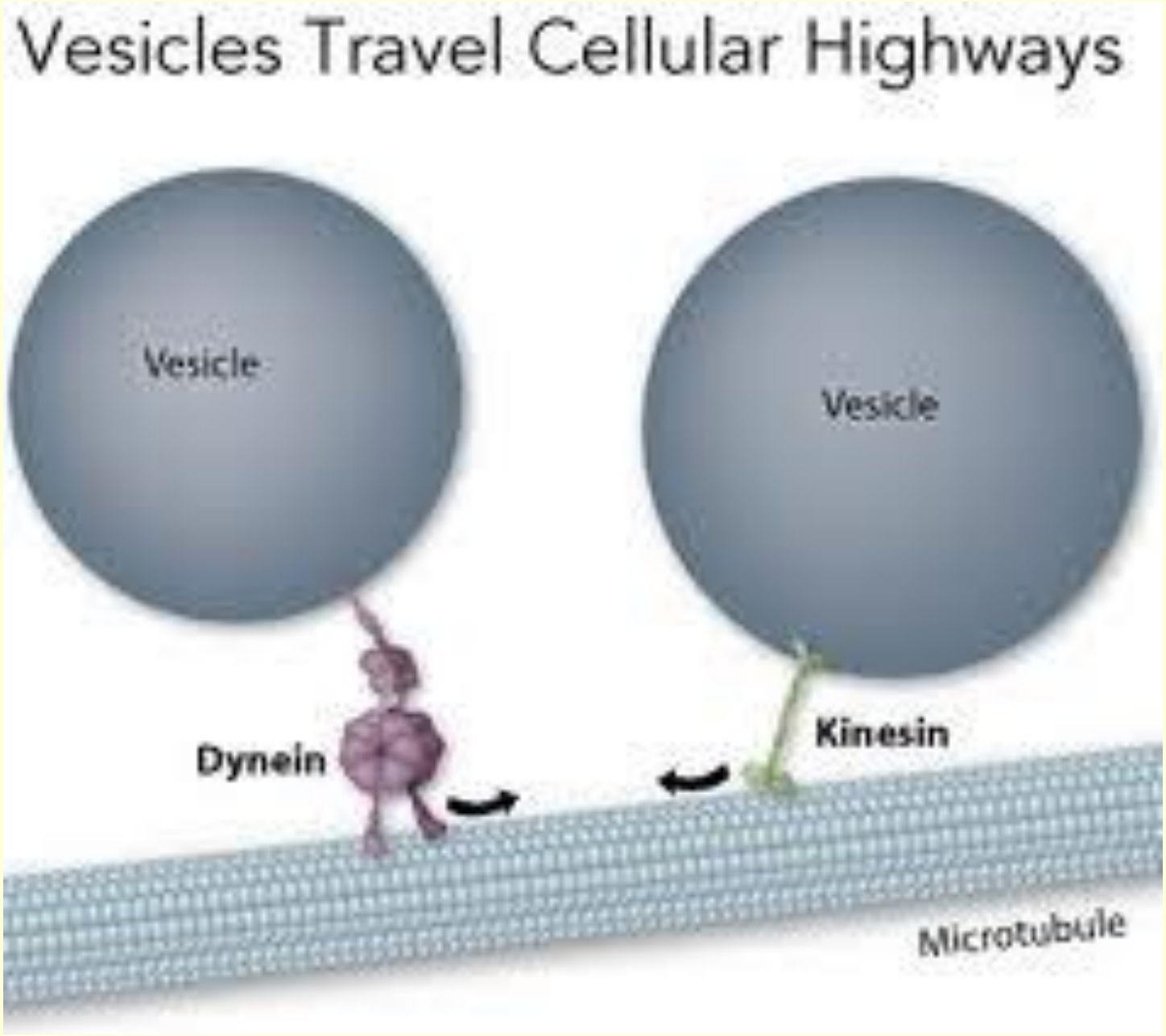
Vesicular Transport

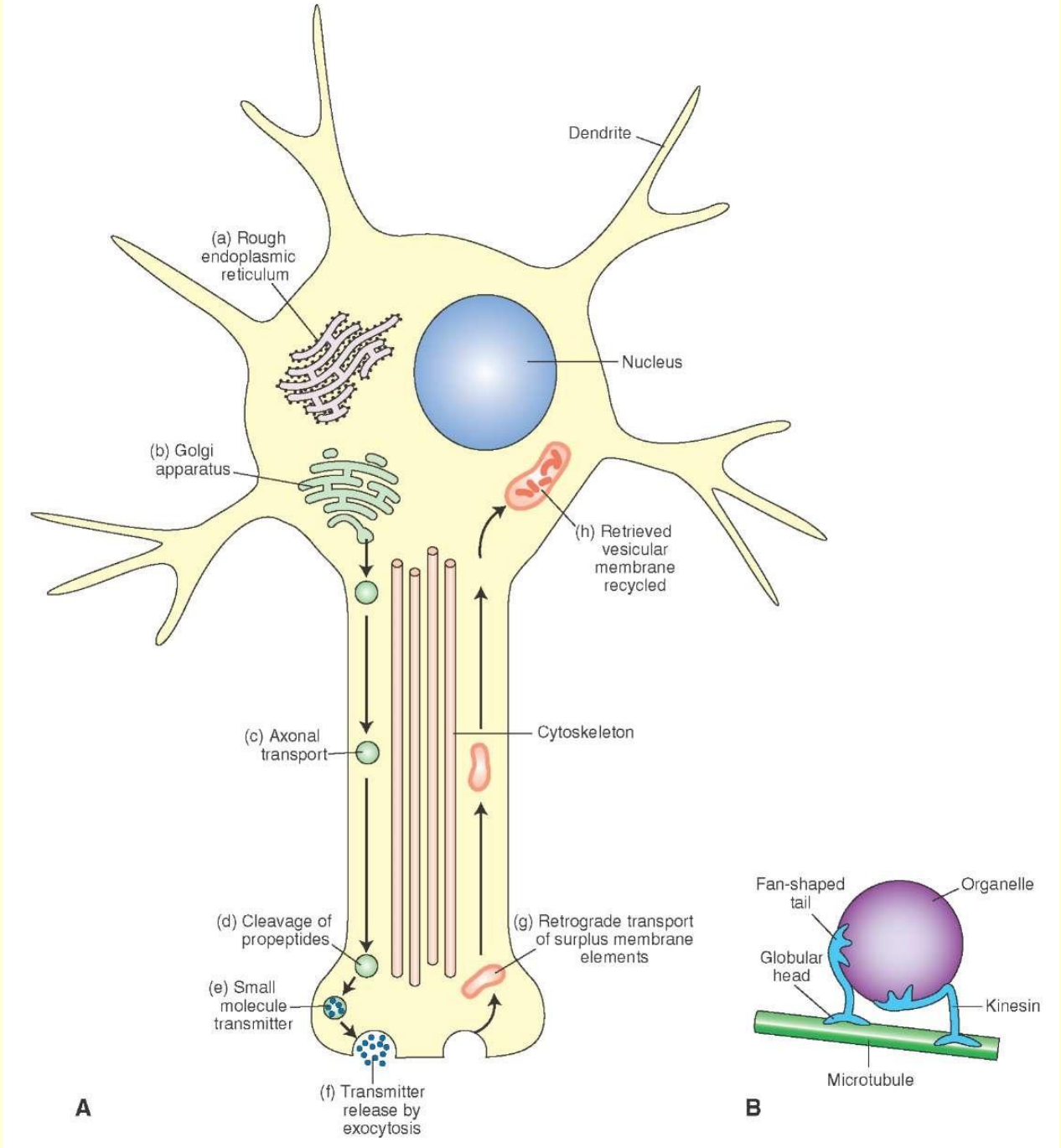


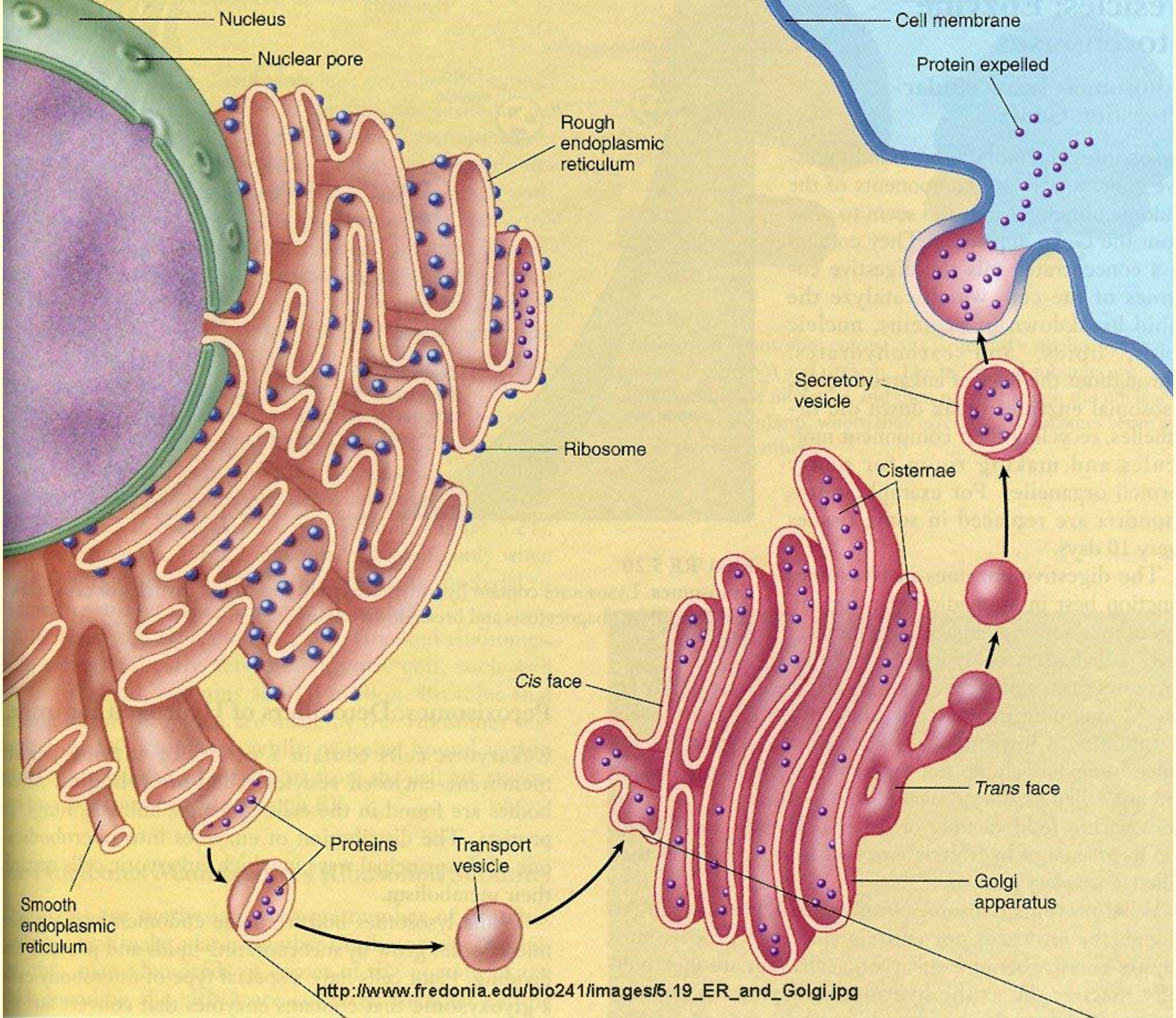
Cell Division


Cilium
Outer doublet microtubules
Dynein arms
Plasma membrane
Central microtubules
Cilium (cross-section)
Outer doublet microtubule
B tubule
A tubule
Inner sheath
Radial spoke
Nexin
Protofilaments
Microtubule
25 nm
8 nm
α
β
Tubulin molecule
Basal body
(courtesy of D.T. Woodrow and R.W. Linck)

Vesicles Travel Cellular Highways




Dendrite
(a) Rough endoplasmic reticulum
Nucleus
(b) Golgi apparatus
(h) Retrieved vesicular membrane recycled
(c) Axonal transport
Cytoskeleton
(d) Cleavage of propeptides
(g) Retrograde transport of surplus membrane elements
(e) Small molecule transmitter
(f) Transmitter release by exocytosis
A
Fan-shaped tail
Organelle
Globular head
Kinesin
Microtubule
B


Nucleus
Nuclear pore
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Ribosome
Cell membrane
Protein expelled
Secretory vesicle
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Cis face
Trans face
Golgi apparatus
Proteins
Transport vesicle
Smooth endoplasmic reticulum
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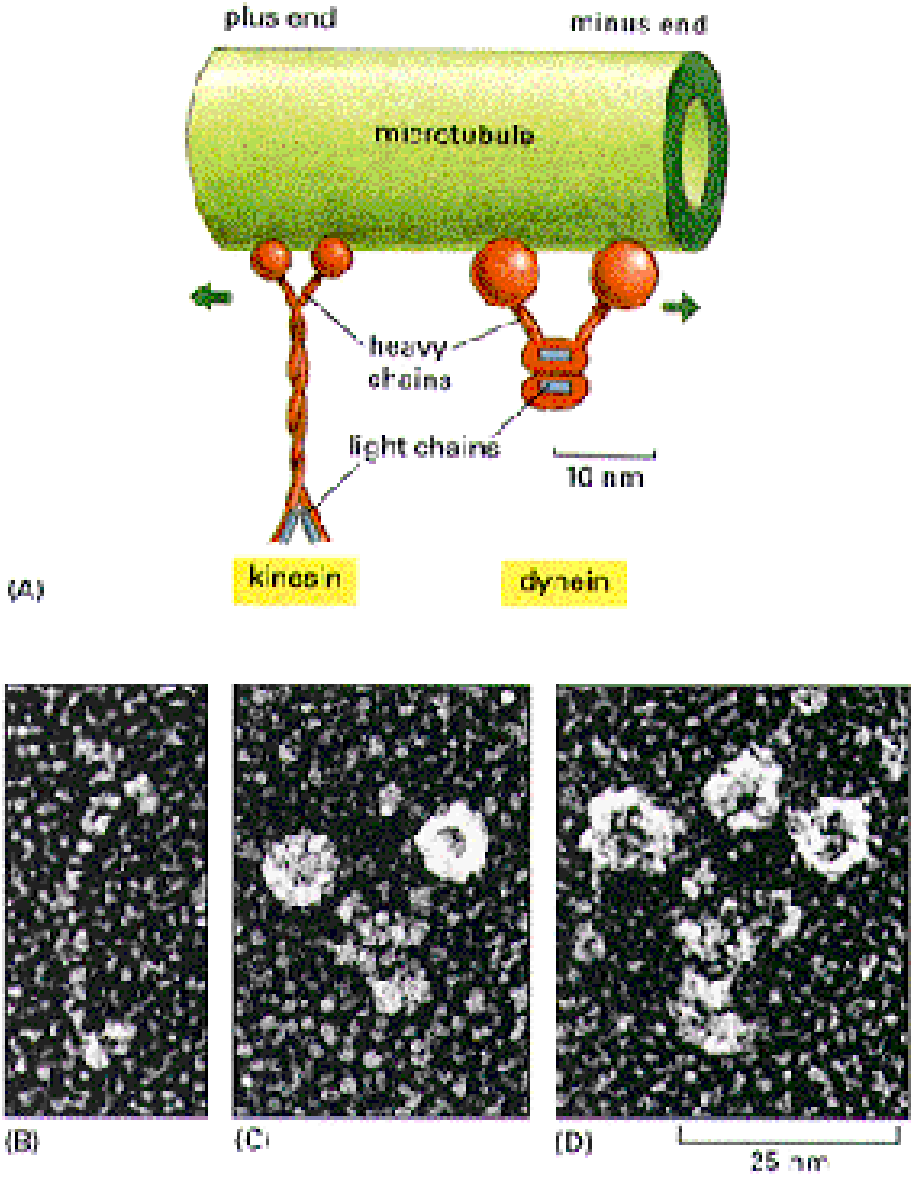
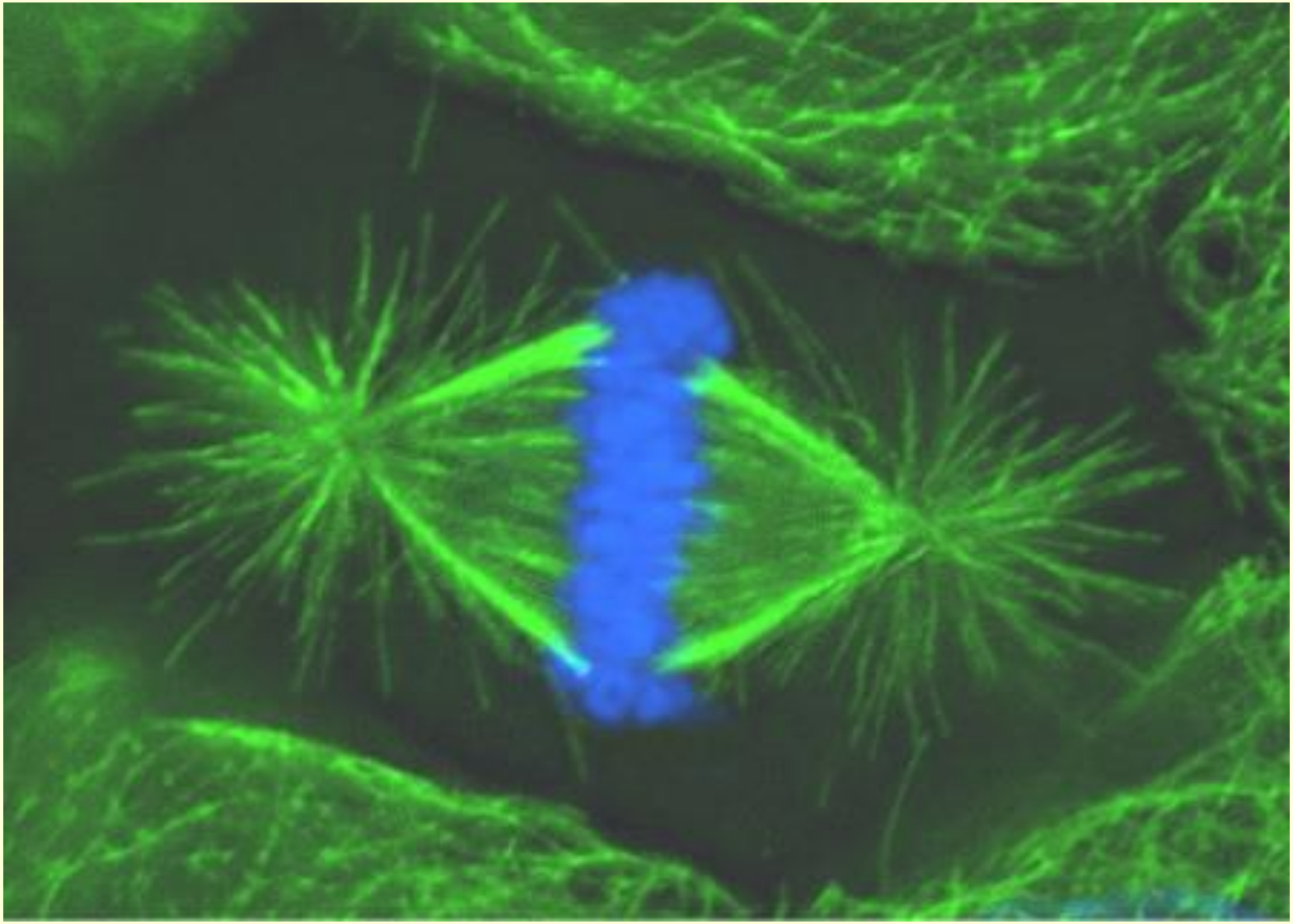
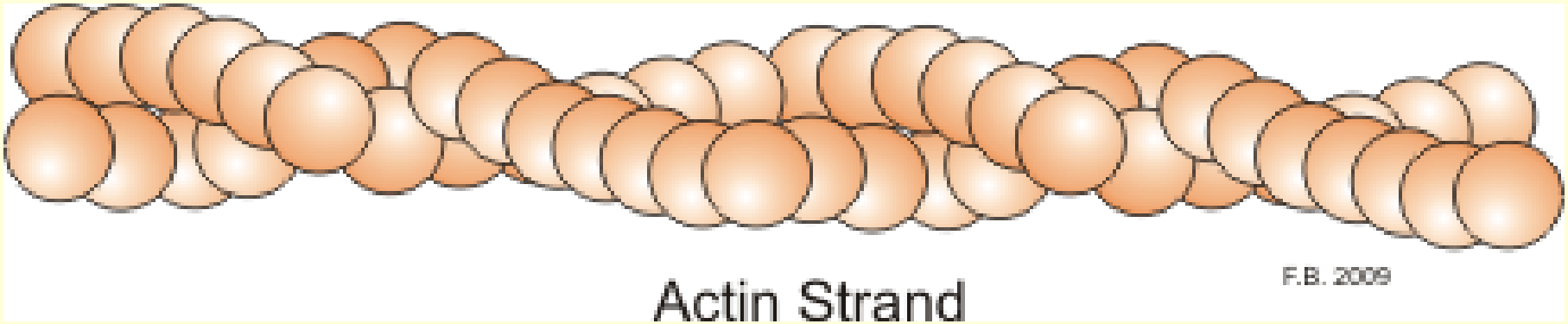

plus end
minus end
microtubule
heavy chains
light chains
10 nm
(A)
kinesin
dynein
(B)
(C)
(D)
25 nm

Mitotic spindle

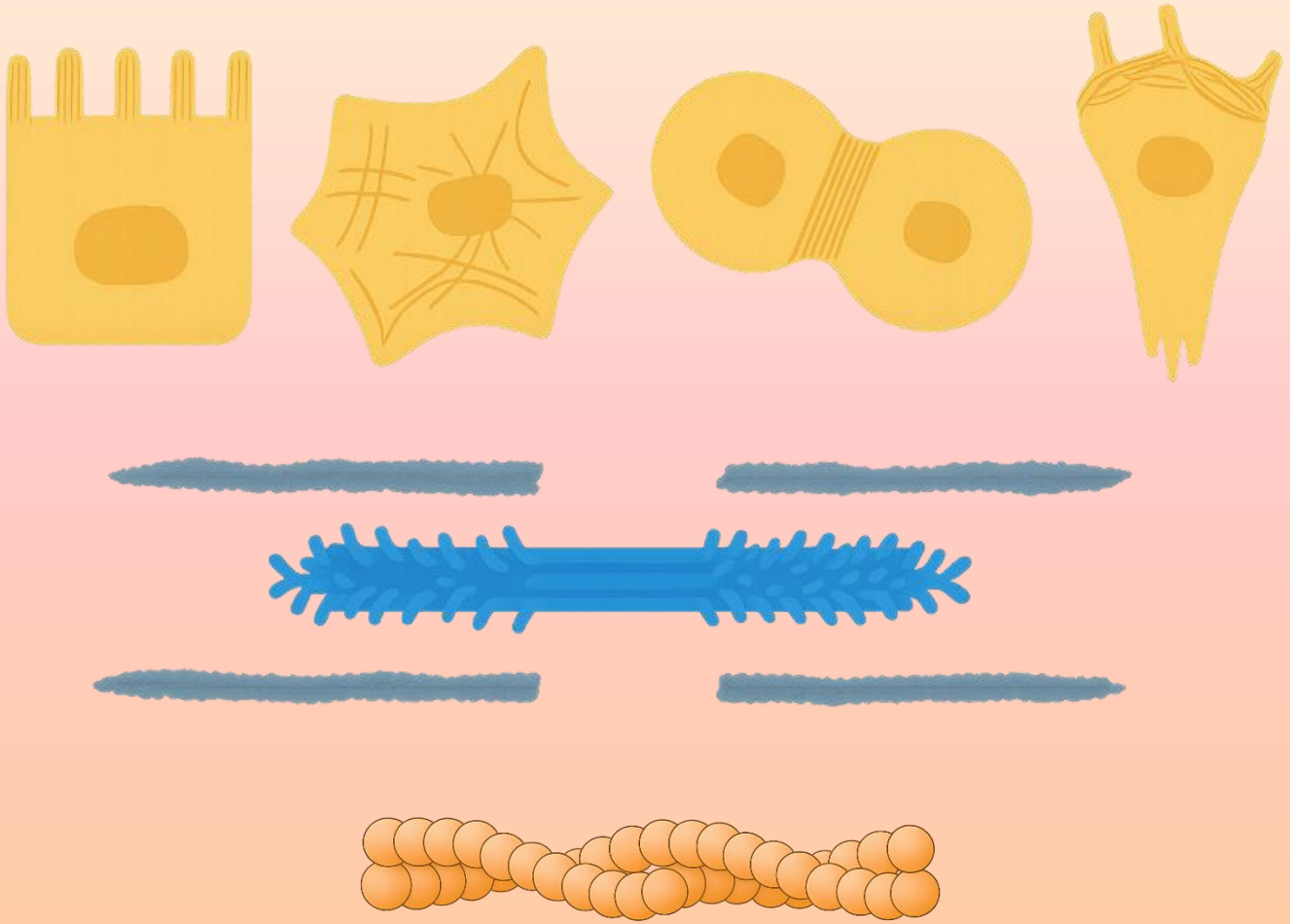


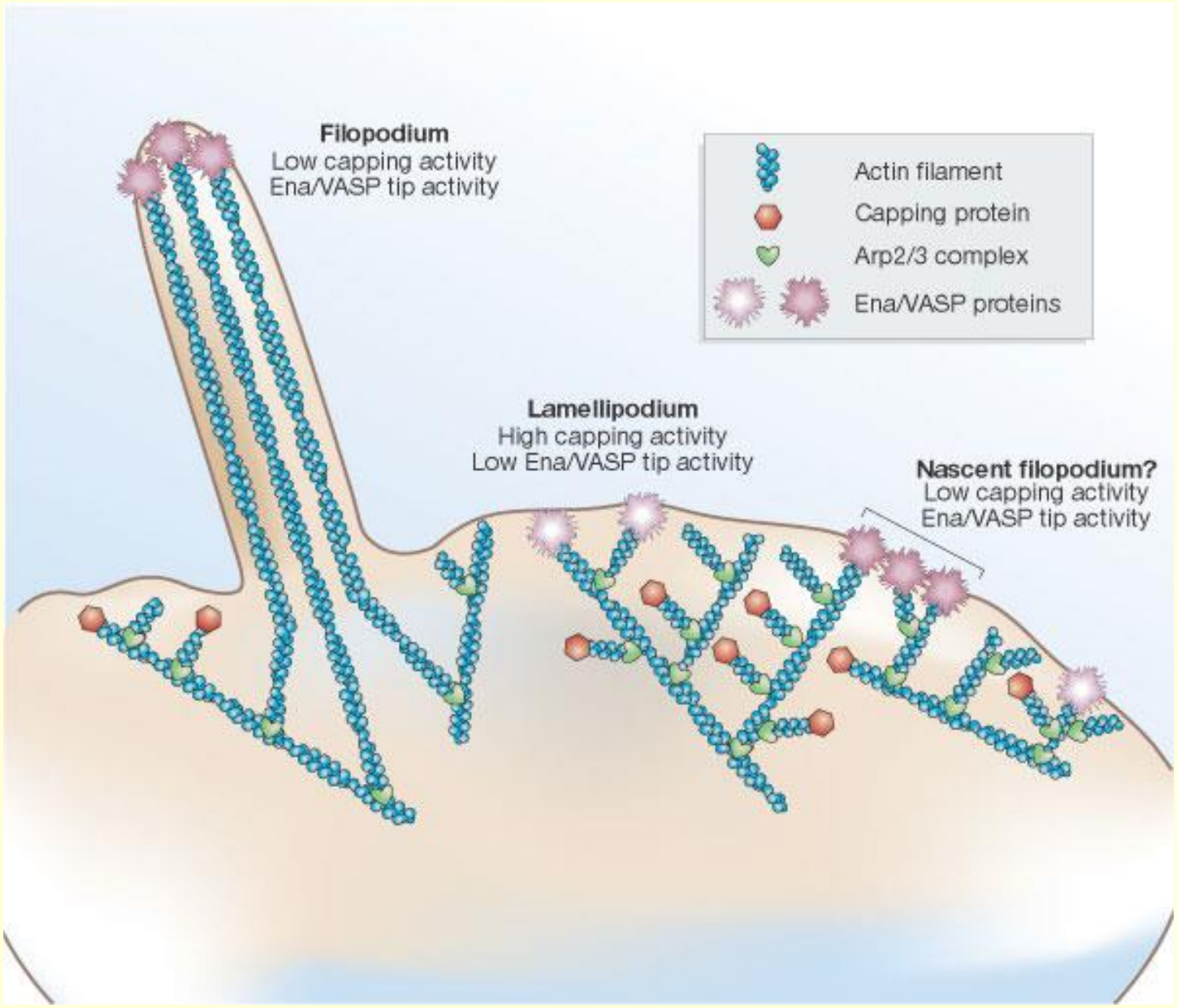
Cytoskeletal Structures



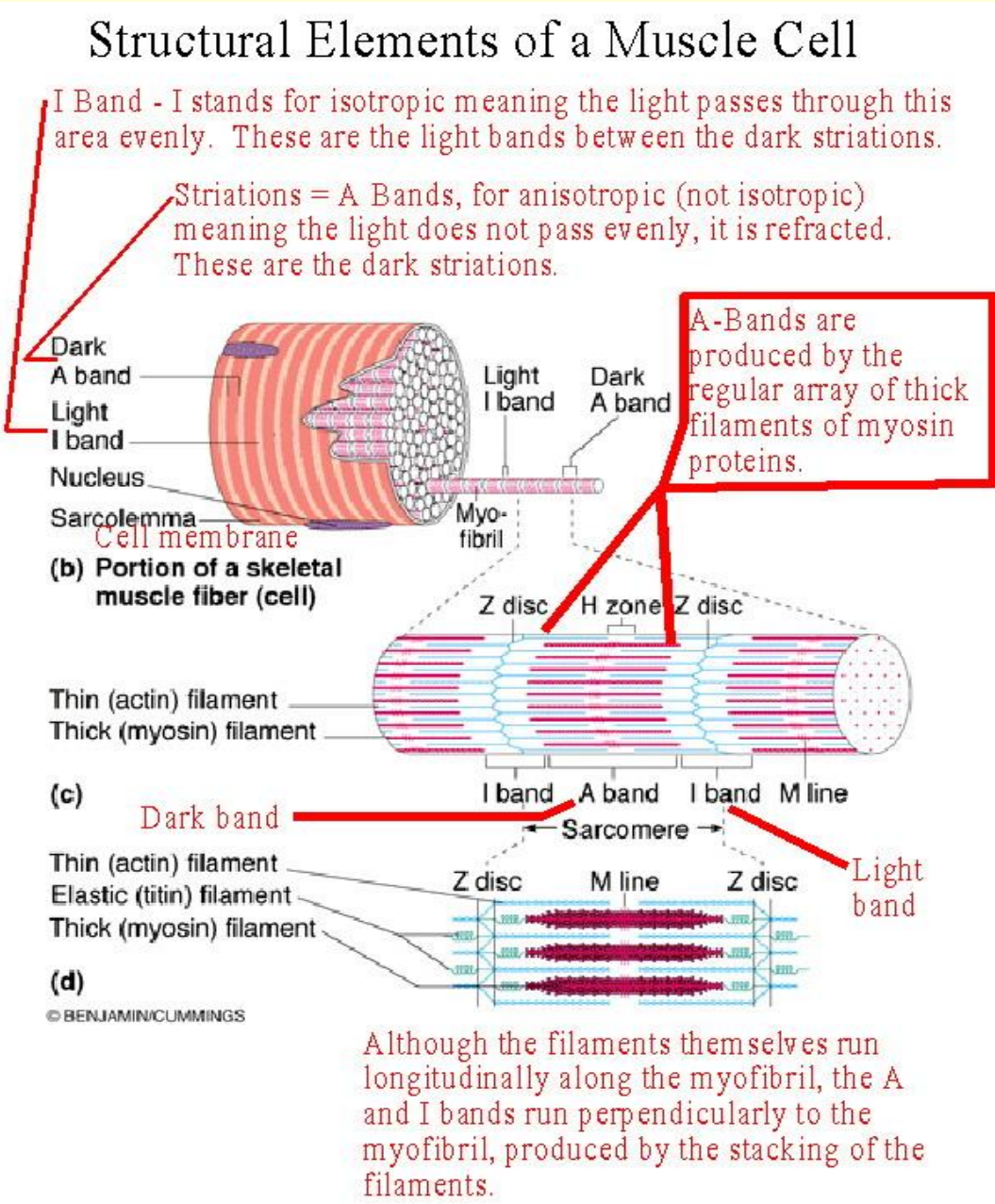
Actin filaments

6.2. Actin Filaments

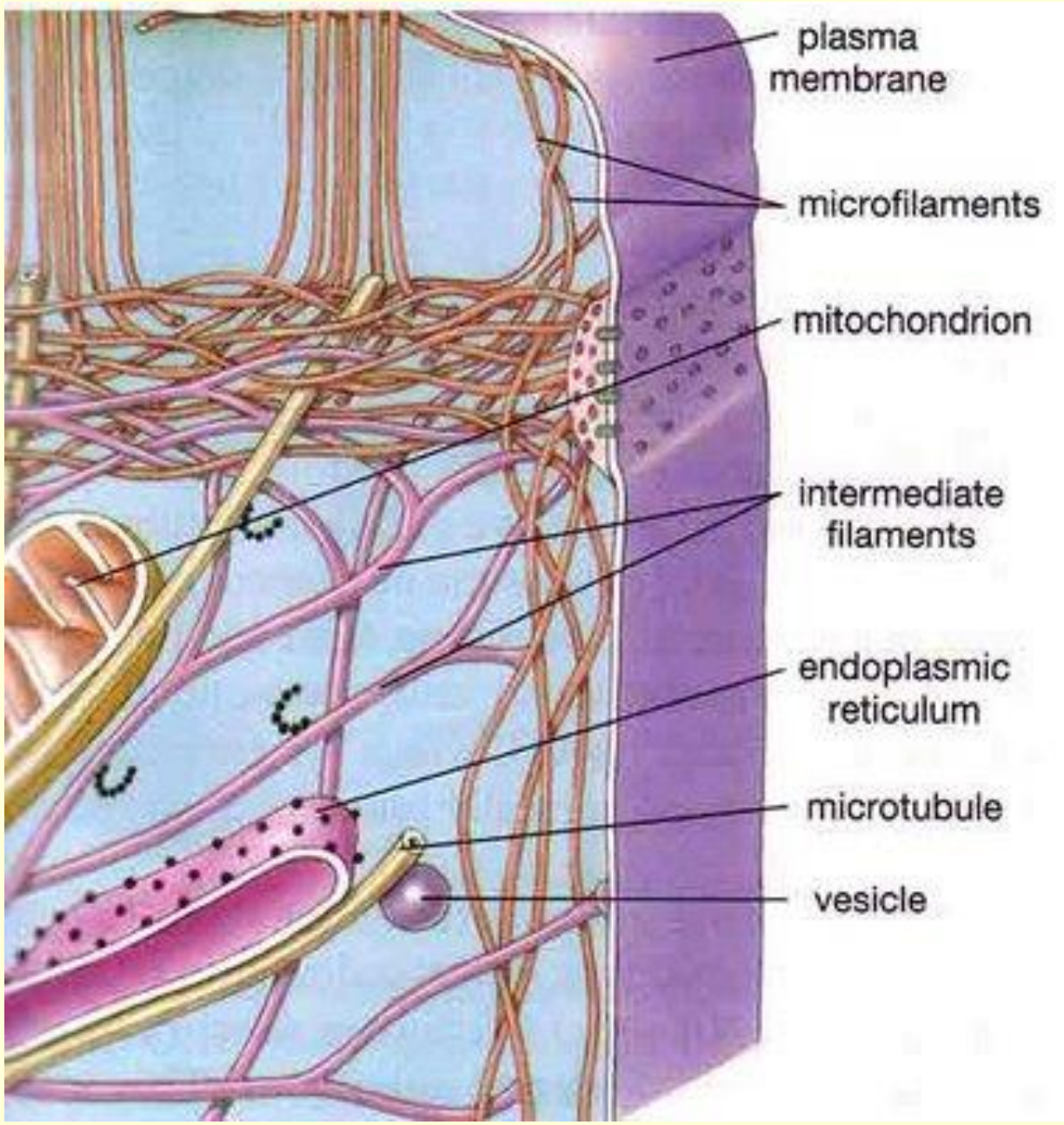


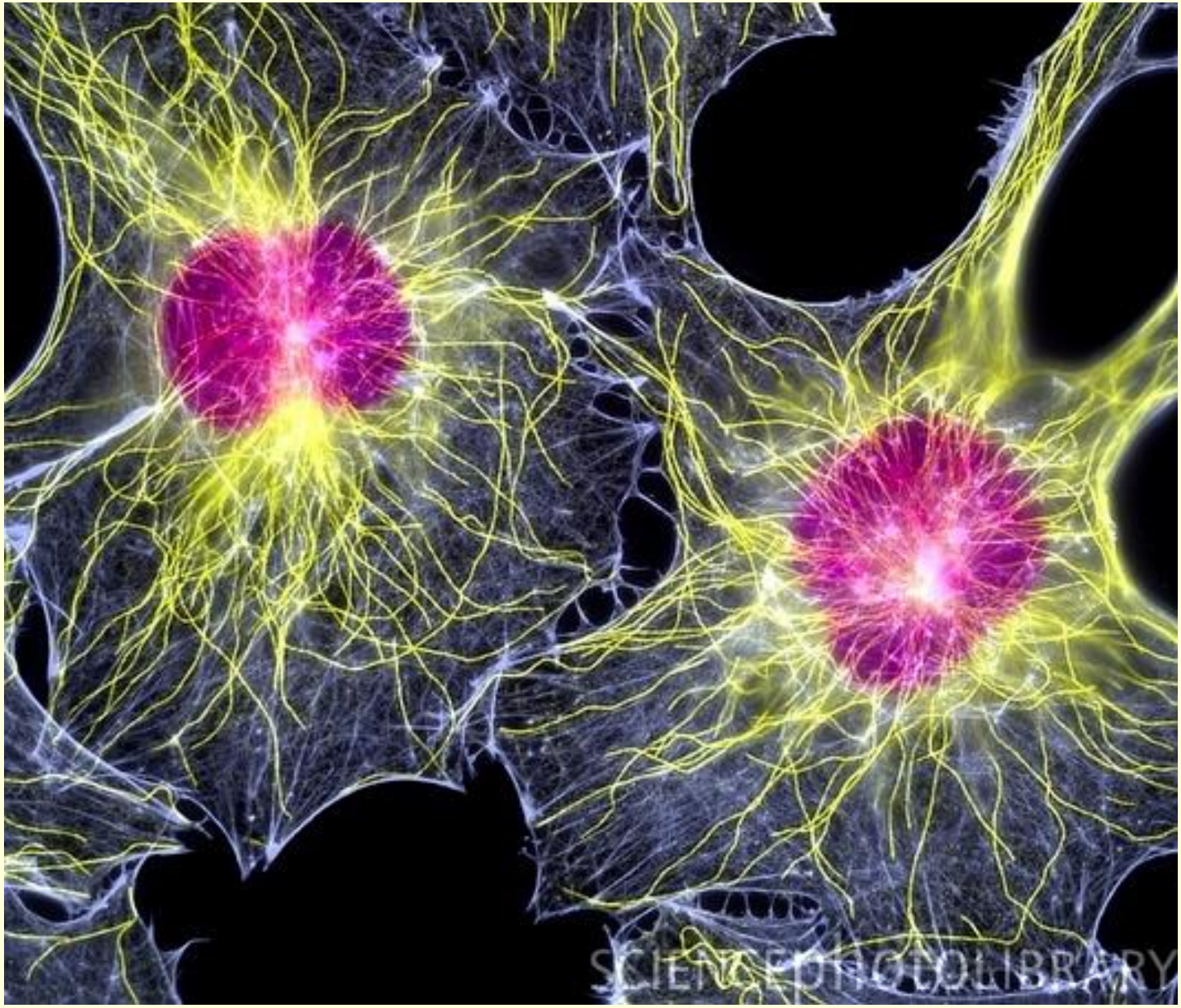

Filopodium
Low capping activity
Ena/VASP tip activity
Actin filament
Capping protein
Arp2/3 complex
Ena/VASP proteins
Lamellipodium
High capping activity
Low Ena/VASP tip activity
Nascent filopodium?
Low capping activity
Ena/VASP tip activity

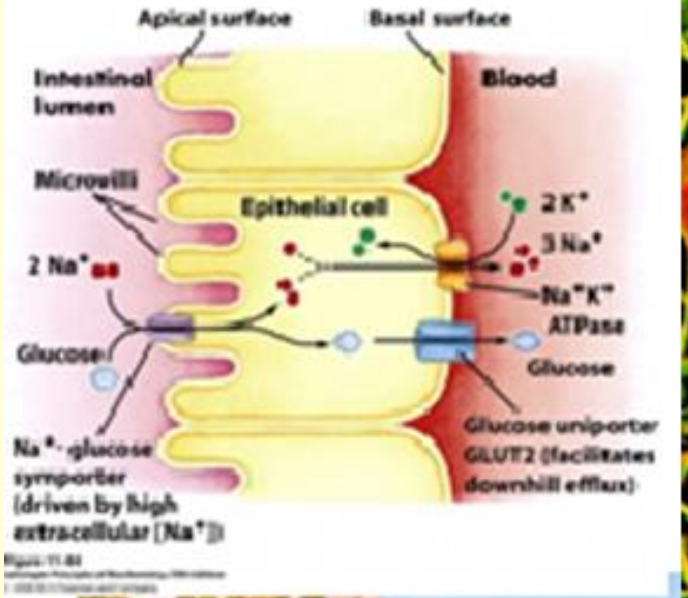
Contractile Filaments

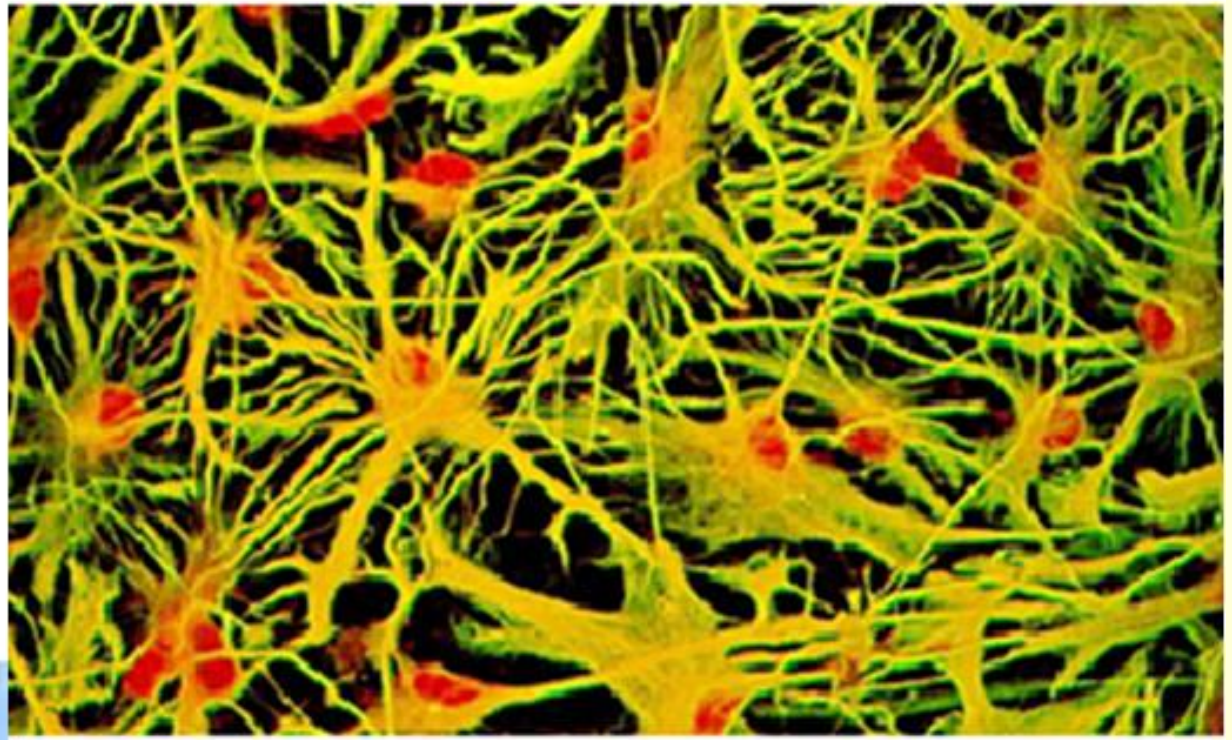


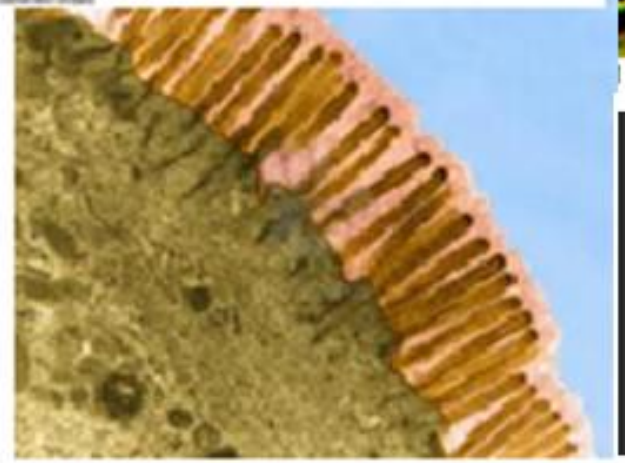
Anchored to structures in plasma membranes

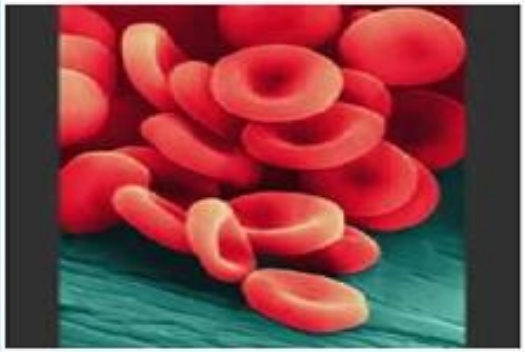


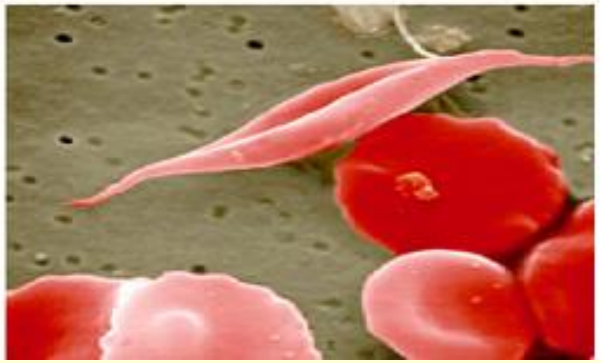

SCIENCE PHOTO LIBRARY


Apical surface
Basal surface
Intestinal lumen
Blood
Microvilli
Epithelial cell
2 K+
3 Na+
2 Na+
Na+K+ ATPase
Glucose
Glucose
Glucose uniporter GLUT2 (facilitates downhill efflux)
Na+-glucose symporter (driven by high extracellular [Na+])

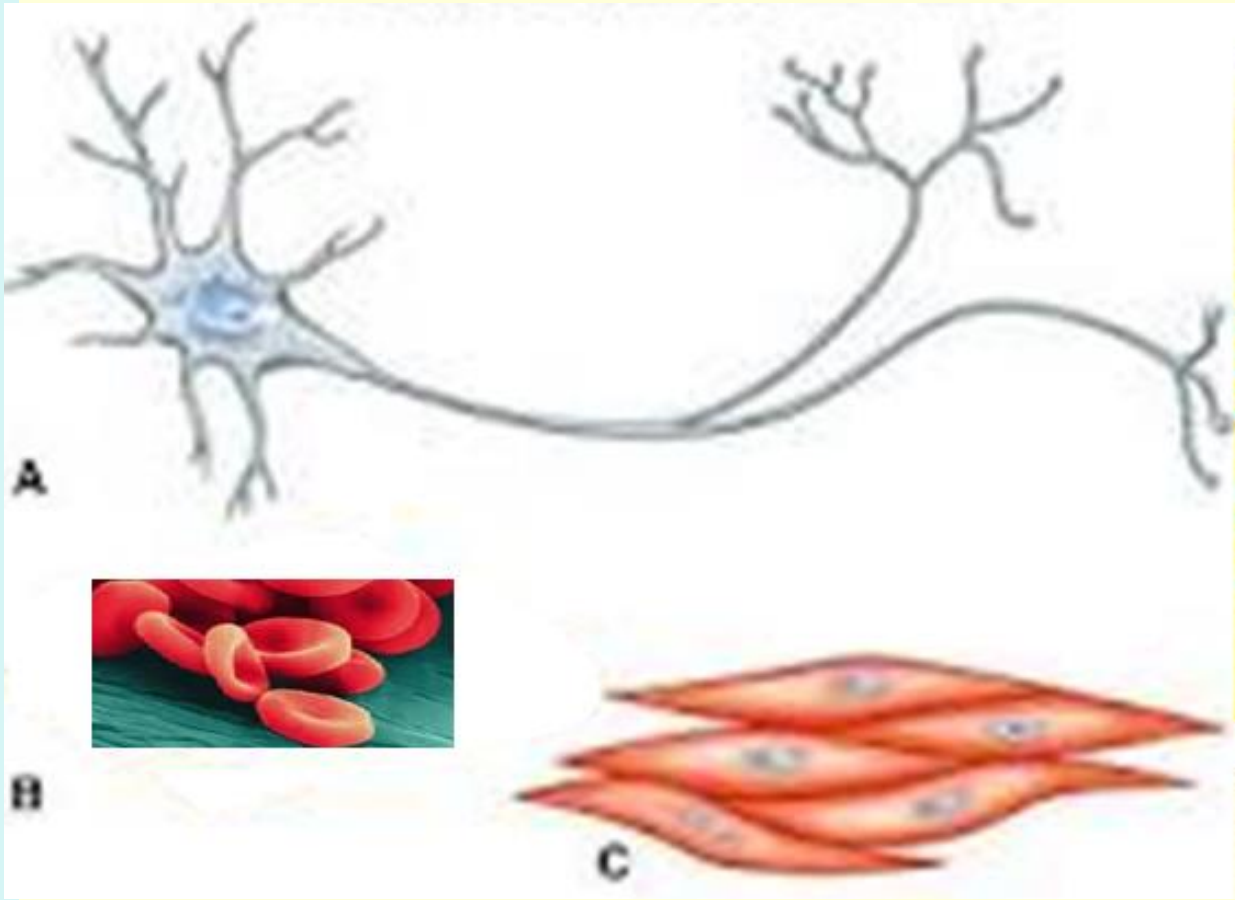




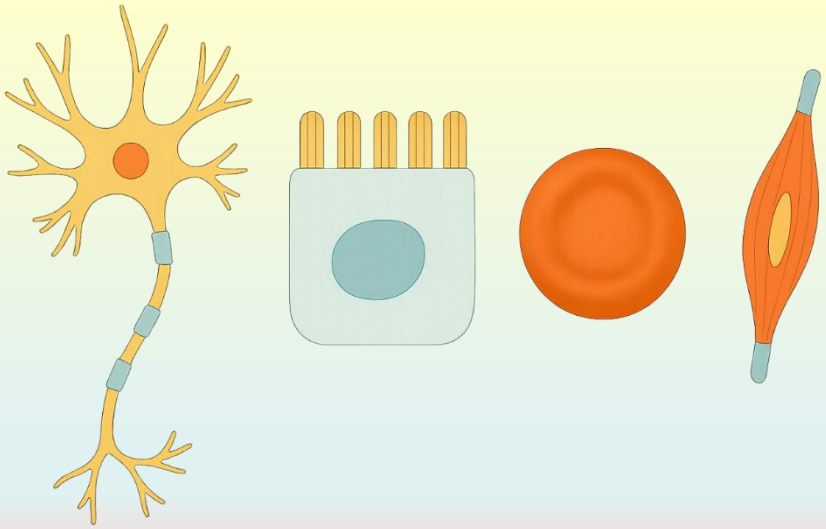




THE IMPORTANCE OF CELL SHAPE FOR FUNCTIONS



THE IMPORTANCE OF CELL SHAPE FOR FUNCTIONS



These diverse shapes are maintained by the cytoskeleton, which provides structural support and allows the cell to adapt its form as needed. Thus, cell shape is not merely structural—it is integral to the cell's functional identity and performance.

The elongated shape of nerve cells allows them to transmit signals over long distances.

While the flattened shape of epithelial cells enables them to form a protective layers.

Microvilli in the Absorptive cells increase surface area for absorption of nutrients.

Biconcave shape of Red blood cells maximizes surface area and reduce distance to O2 carrying molecules and enhancing oxygen delivery to tissues.

Elongates shape of muscle cells is ensuring mechanical effect by shortening.

Summary

- Collectively, organelles operate in a highly integrated manner, ensuring coordinated biochemical processes that sustain cellular viability and responsiveness.

- Cytoskeletal structures, provide structural support and give diverse shapes and allows the cell to adapt its form as needed. Thus, cell shape is not merely structural—it is integral to the cell's functional identity and performance. which provides structural support and allows the cell to adapt its form as needed.