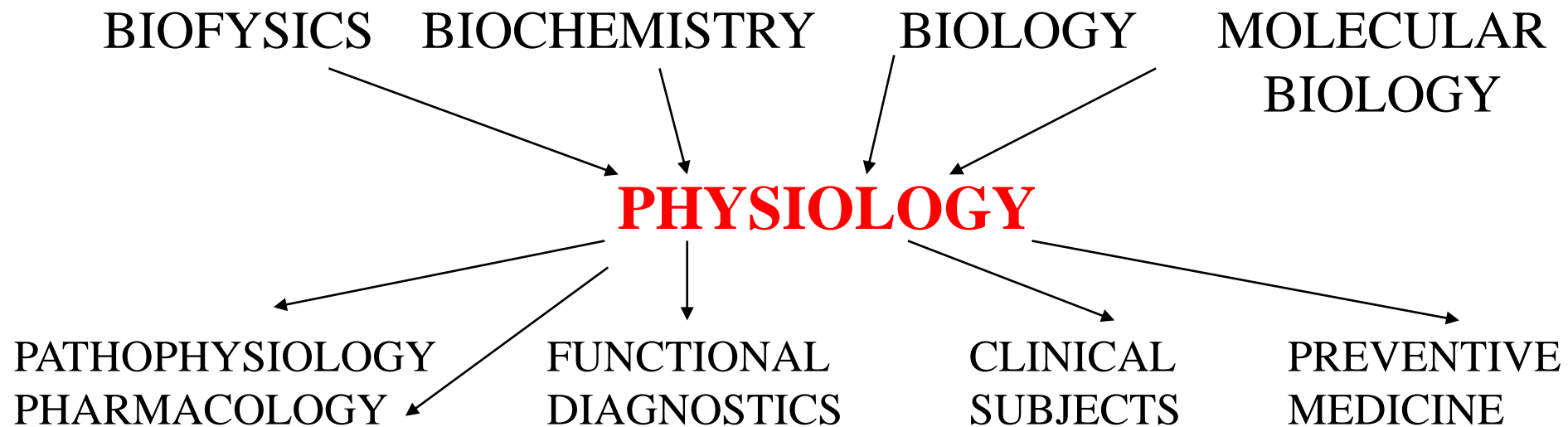




PHYSIOLOGY

- Science about living systems (Fernel, 1642)
- Experimental science (W. Harvey, 1643; C. Bernard, J.E. Purkyně)





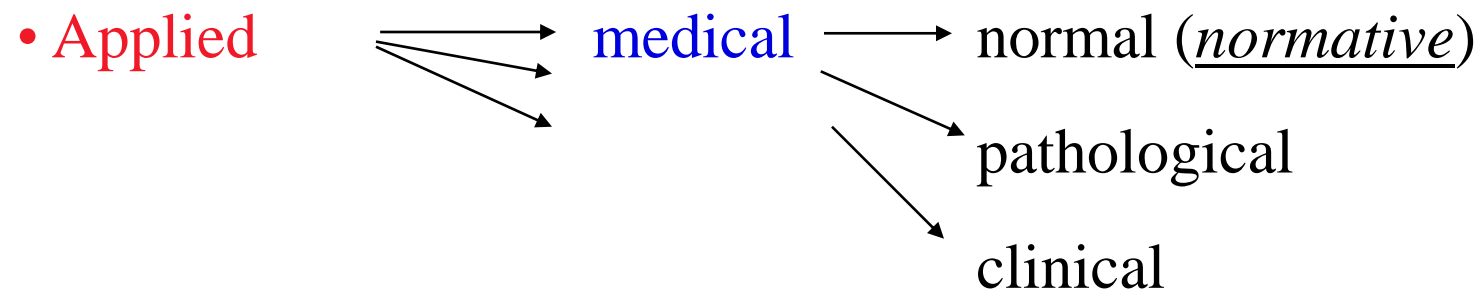
Aims of the course:

1. Learn the terms
2. Learn basic facts
3. Understand functional relations
4. Understand clinical consequences

Teaching forms – lecture, seminar, demonstration, practical (lab)

PHYSIOLOGY – science about functions (dynamics)

- General
- Special
- Comparative
- Evolutional
- Applied



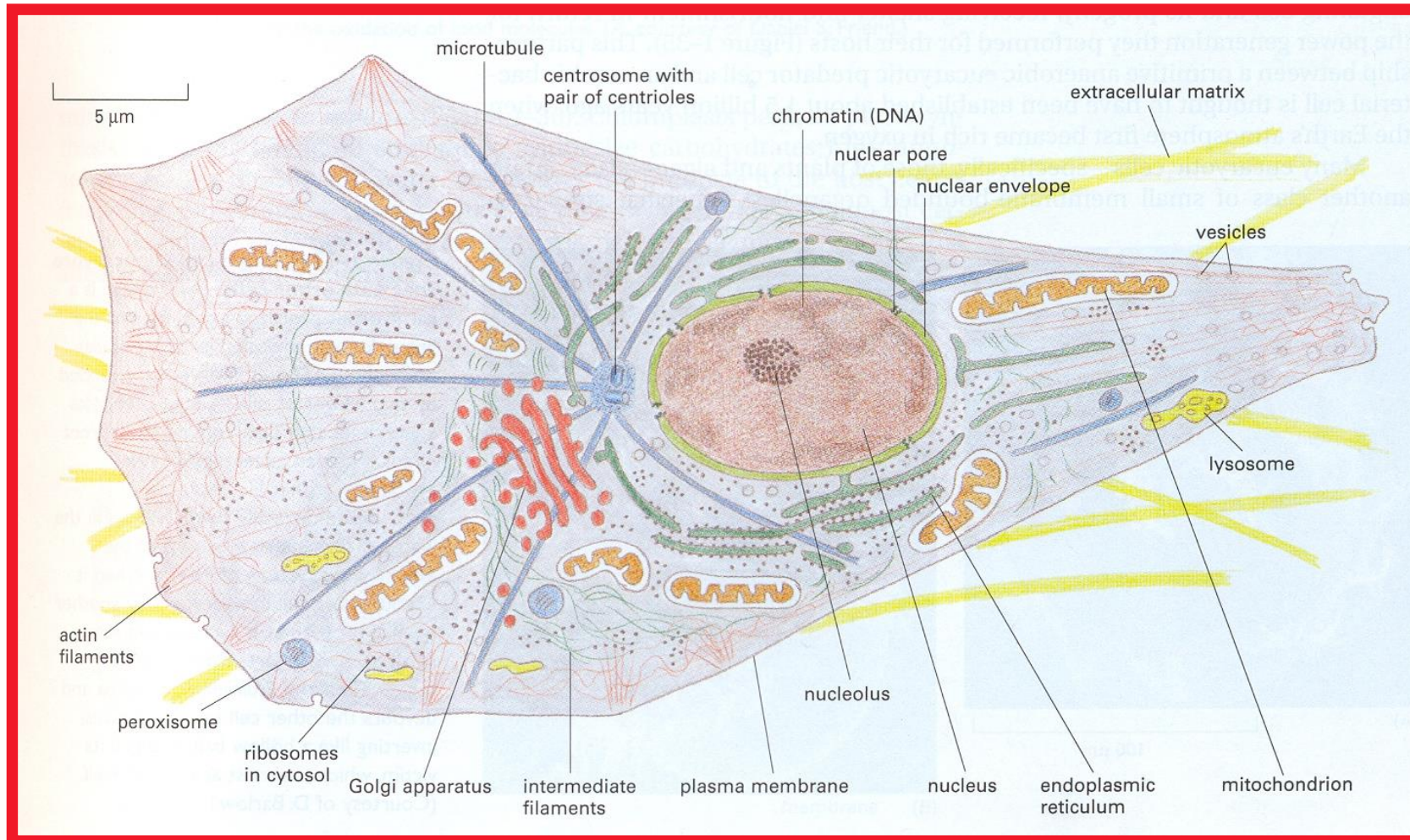
Functions are studied at 5 levels: molecular, cellular, tissue, organ, organism

Structural and functional organisation of the living systems.

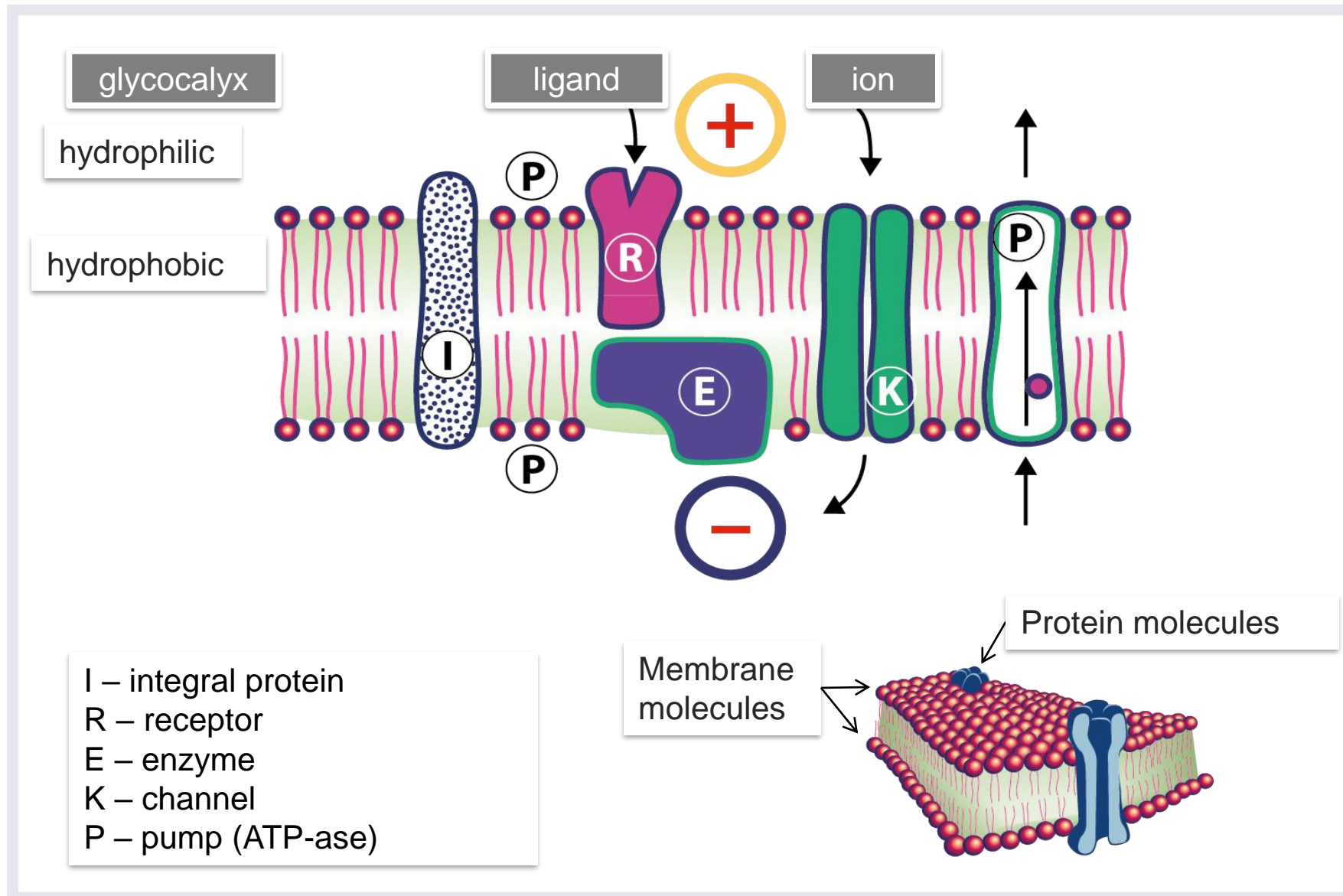
Homeostasis.

*Life is a dynamic system with focused behavior, with autoreproduction,
characterized by **flow of substrates, energies and information.***

STRUCTURE AND FUNCTIONS OF CELL ORGANELLES



PLASMATIC MEMBRANE



COMPARTMENTALISATION OF BODY FLUIDS

GIT, lungs, kidney, skin

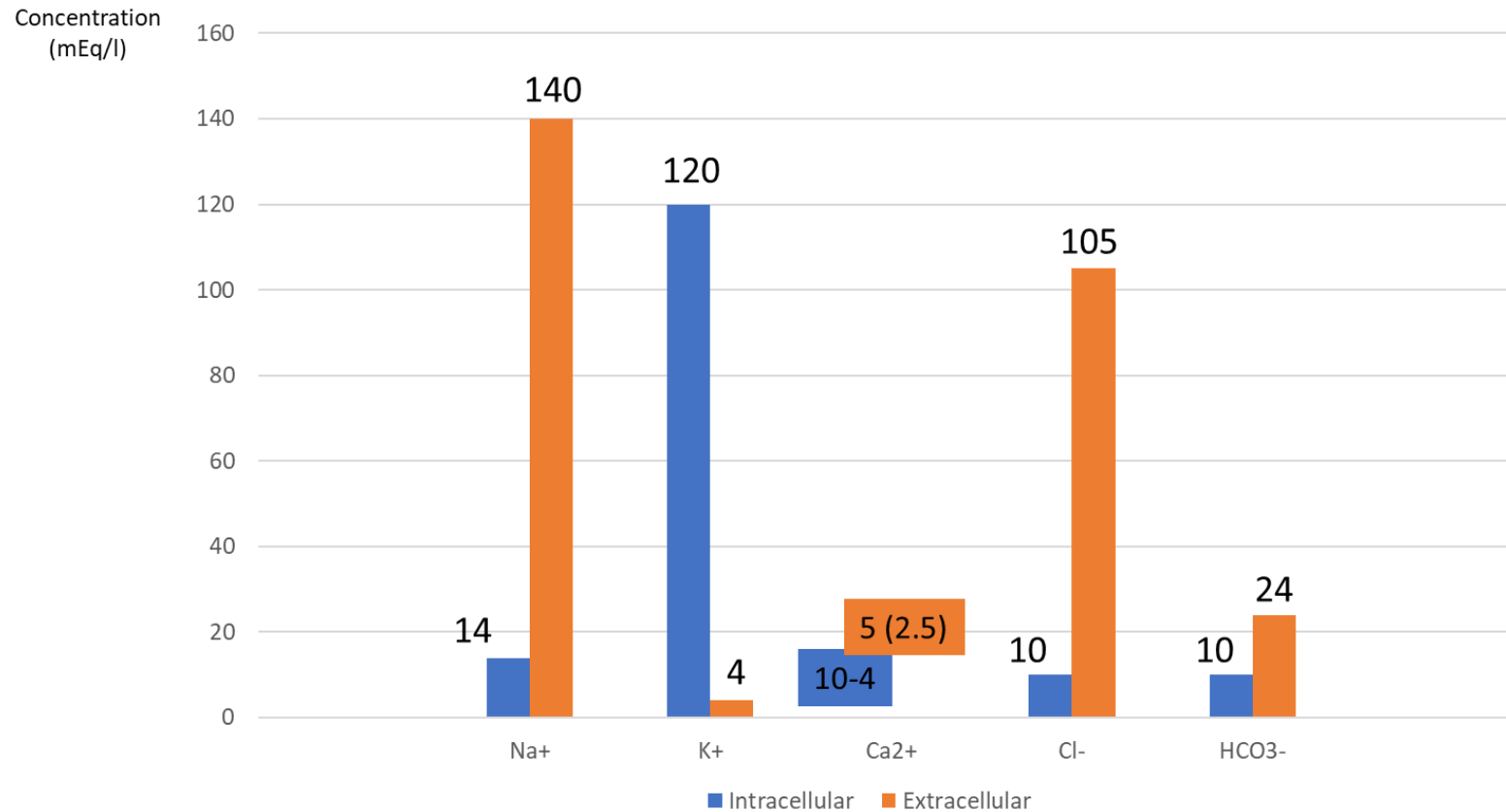
}	Plasma	5% - 3.5 litres	<i>Evans blue, ¹³¹J</i>
	Interstitial fluid	15% - 10.5 litres	<i>Inulin, manitol, sacharose</i> Extracellular fluid (incl. plasma)
	Intracellular fluid	40% - 28 litres	<i>Antipyrin, D₂O</i>
			Total volume of fluids

BODY FLUIDS

BODY COMPOSITION

Water	60% (80-50%) of body mass
Proteins	18%
Lipids	15%
Minerals	7%

Concentration of ions in body fluids



TRANSPORT MECHANISMS

PASSIVE

REGULATED

ACTIVE

DIFFUSION

FACILITATED DIFUSION

ATP-ases

OSMOSIS

COTRANSPORT

SYMPORT

FILTRATION

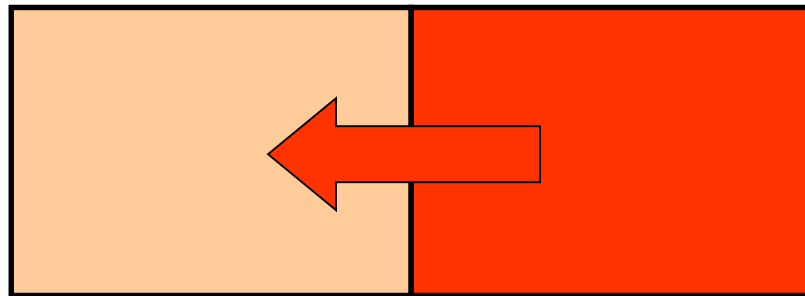
ANTIPOINT

PASSIVE TRANSPORT MECHANISMS

Differences in body fluids composition result from features of barriers and forces responsible for transport.

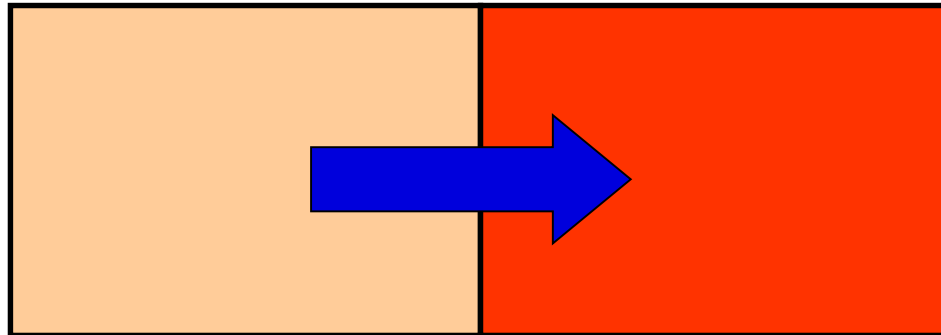
DIFUSION

Transport of gases, substrates, metabolites (up to m.w. 60 thous. in direction of concentration gradient of diluted substance. It depends on its solubility in water and lipids.



OSMOSIS

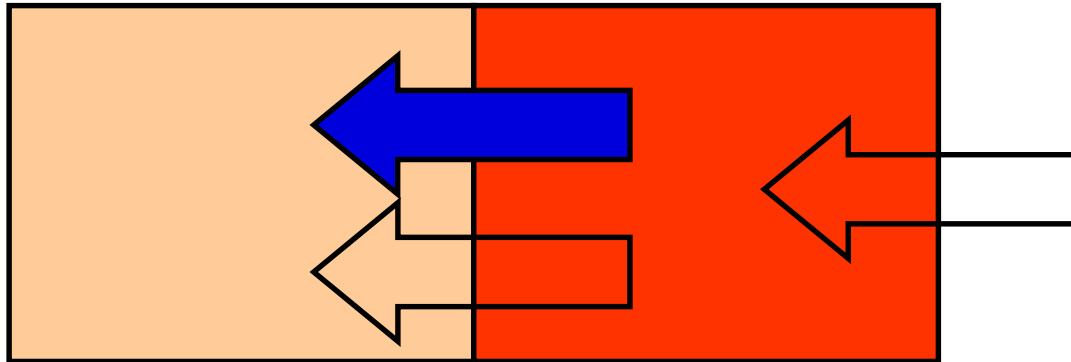
Transport of water across semipermeable membrane in direction to higher concentration of diluted substance (e.g. in direction to lower concentration of water). It depends on number of particles.



FILTRATION

Movement of solvent as a result of osmotic and hydrostatic pressure.

Production and resorption of interstitial fluid (**Starling forces**).



REGULATED TRANSPORTS

FACILITATED DIFUSION

selective carrier
limited capacity

amino acids
phosphate

COTRANSPORT

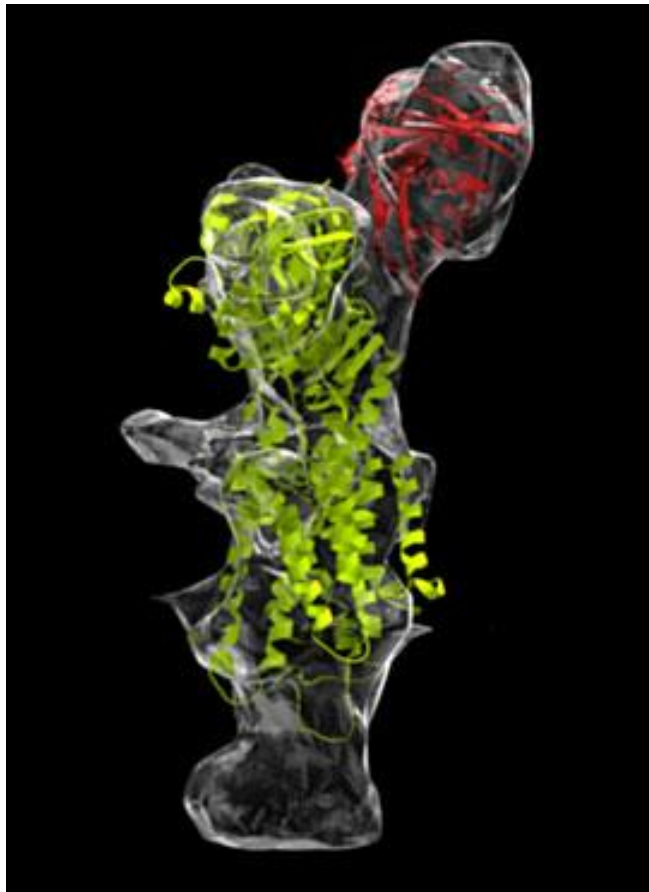
transported compound uses concentration
gradient of Na^+ as the driving force

SYMPORT in the same direction

glucose, AA

ANTIPOINT in opposite direction

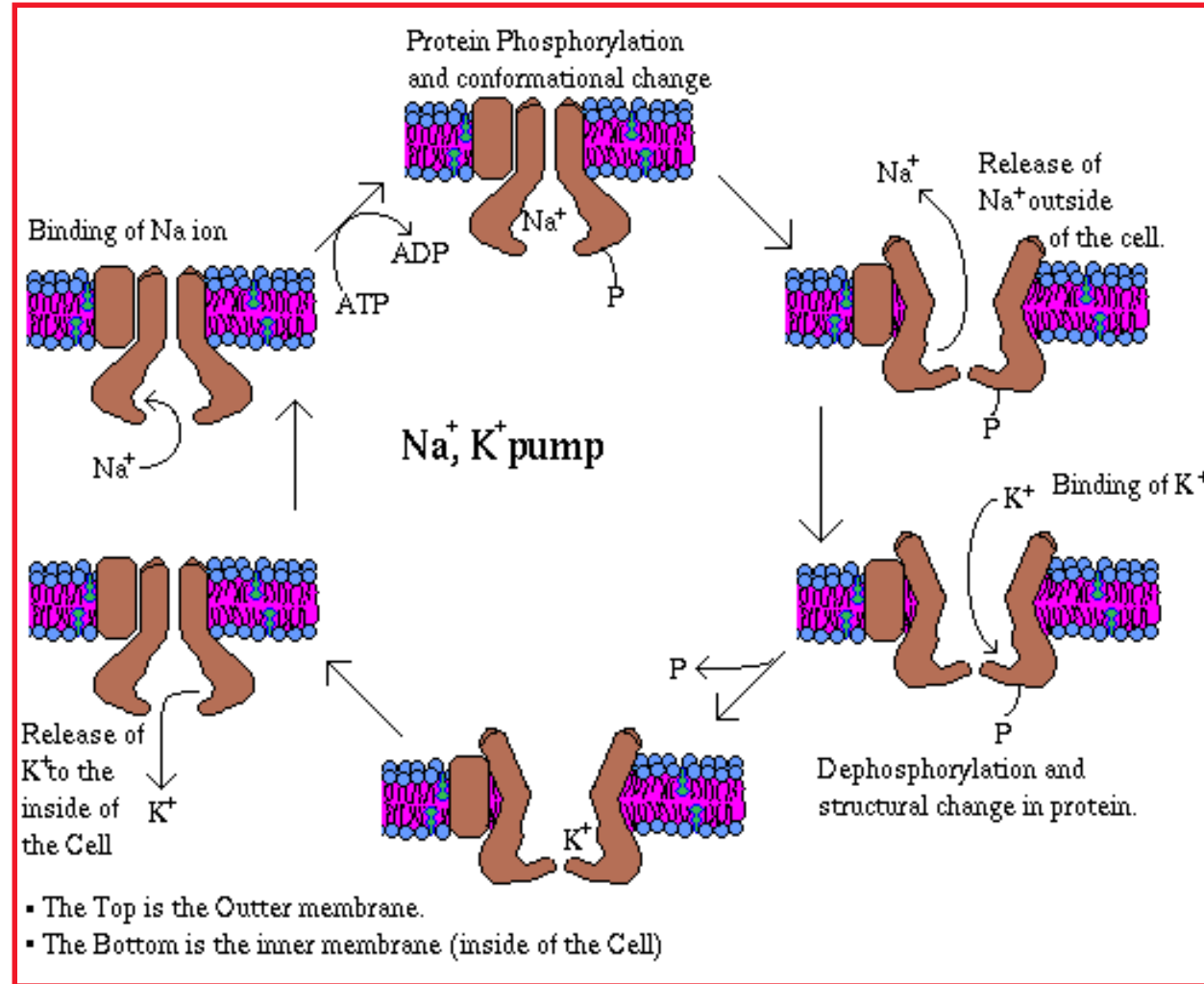
Ca^{2+} , H^+



ACTIVE TRANSPORTS

Na⁺/K⁺ ATP-ase (exchanger)

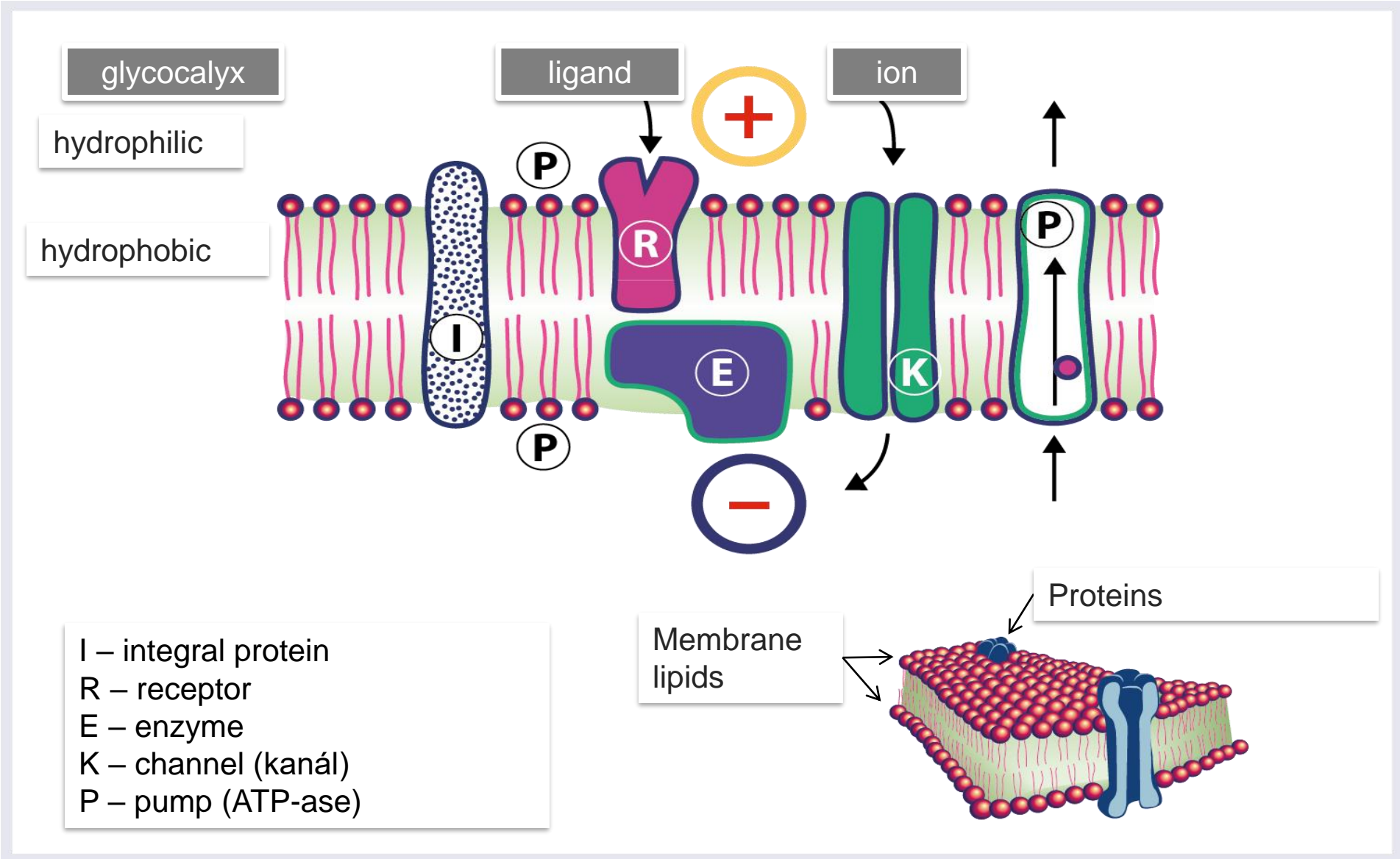
AGAINST concentration gradient



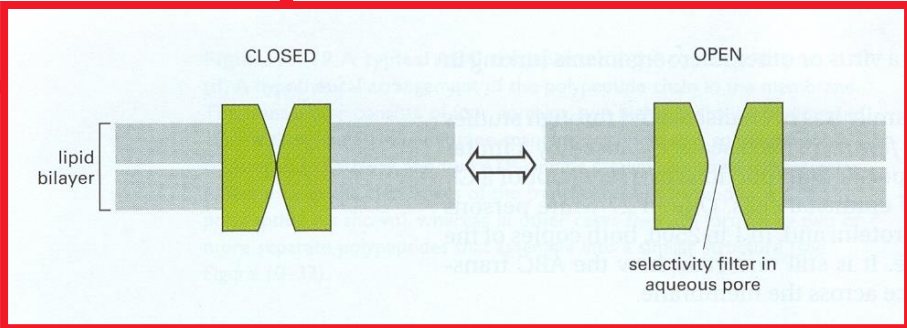
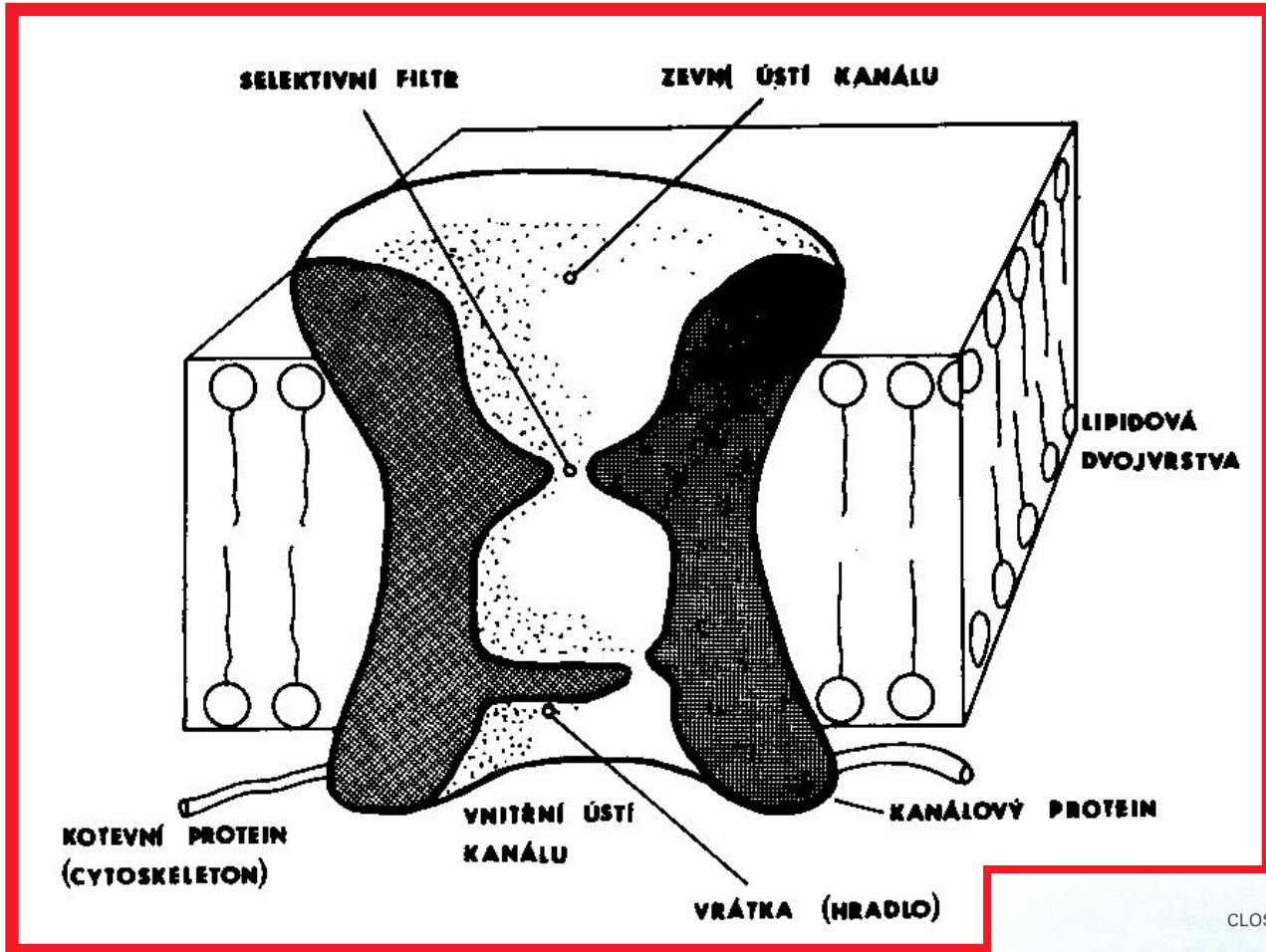
Similar transports:

- Ca²⁺/H⁺
- Na⁺/K⁺
- K⁺/H⁺
- Na⁺/H⁺

PLASMATIC MEMBRANE

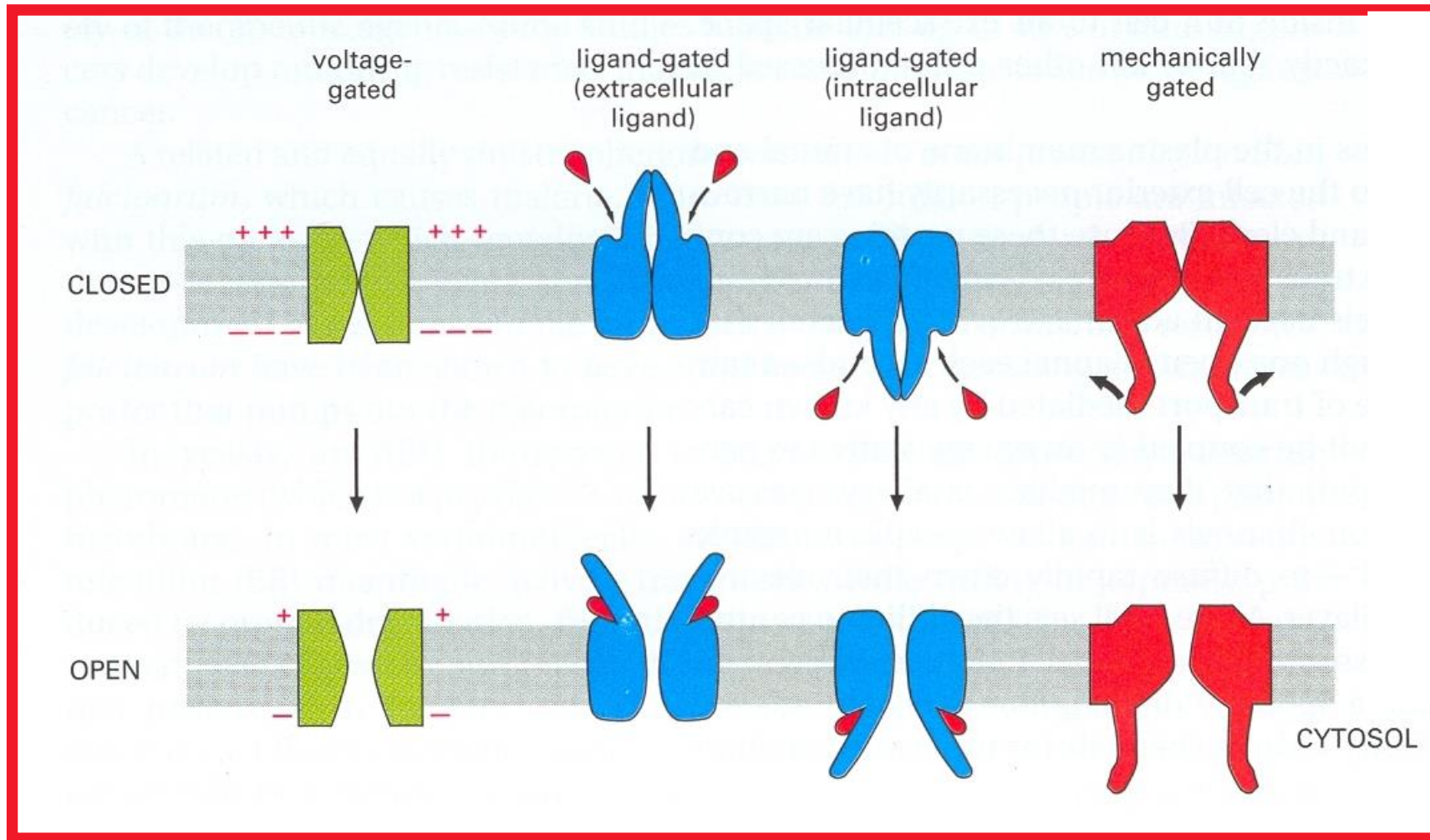


IONIC CHANNEL

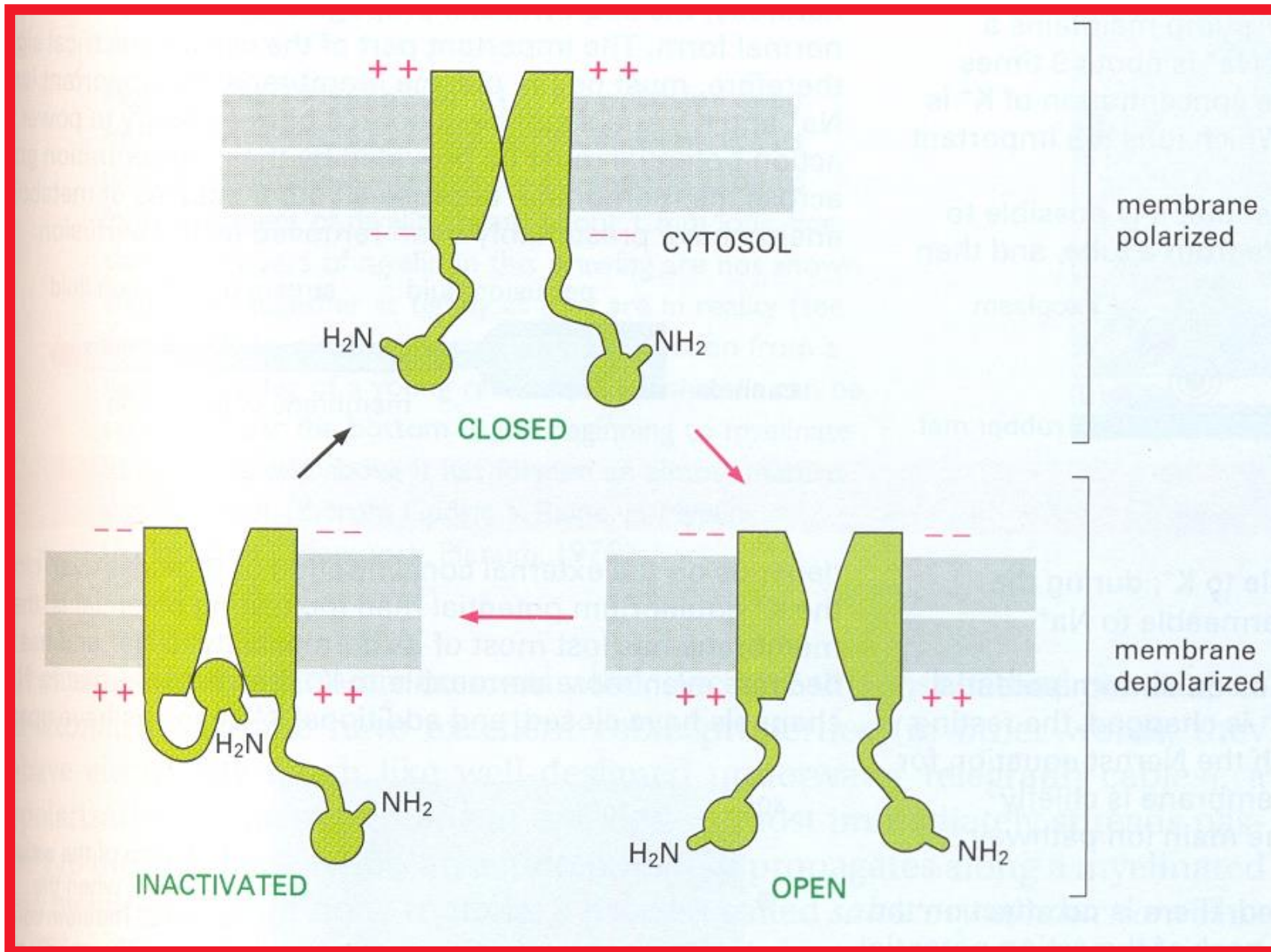


Membránová elektrofyziologie myokardu, P. Pučelík, Avicenum, 1990
Molecular biology of the cell. B. Alberts et al., Garland Science 2002

GATING



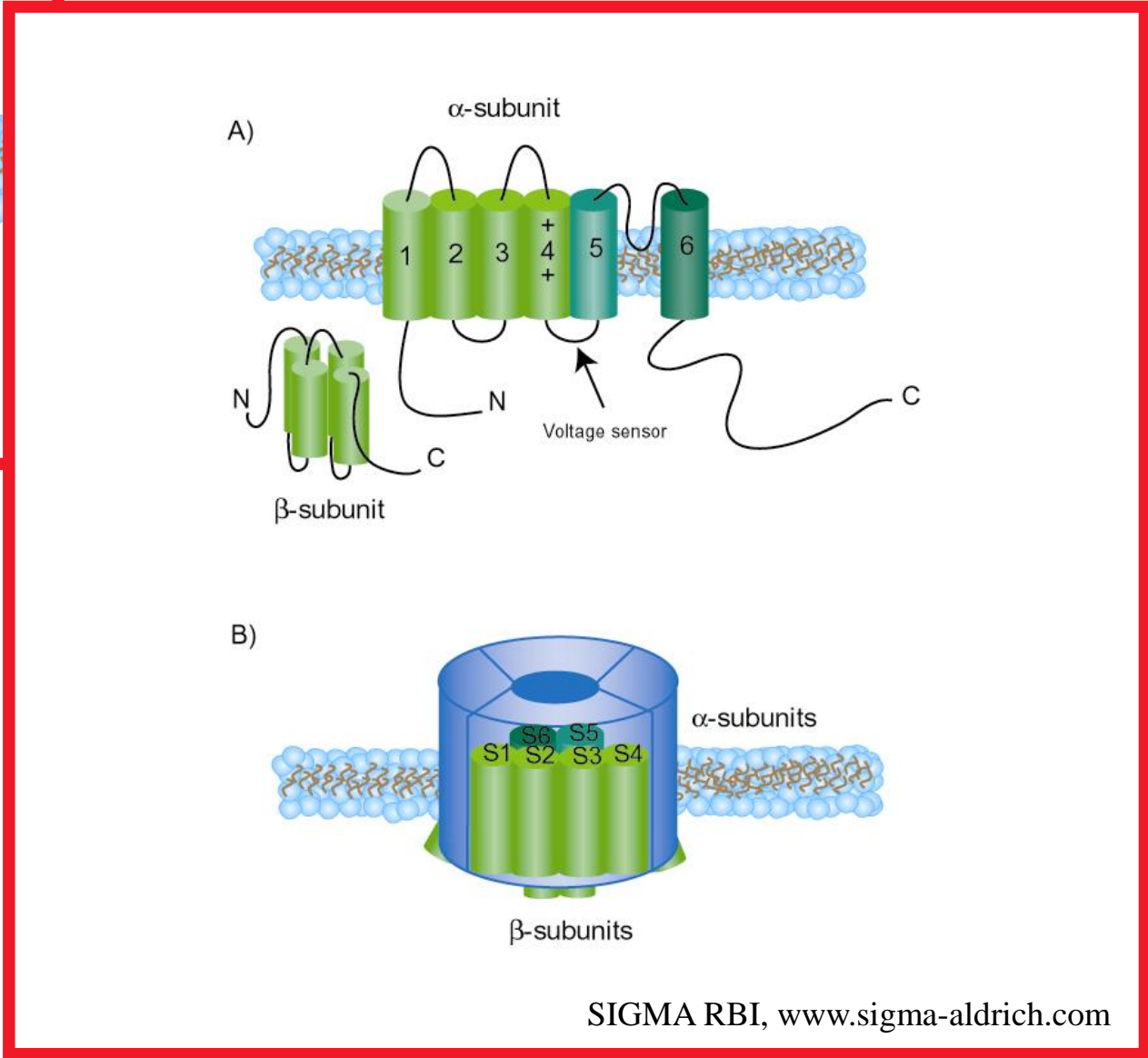
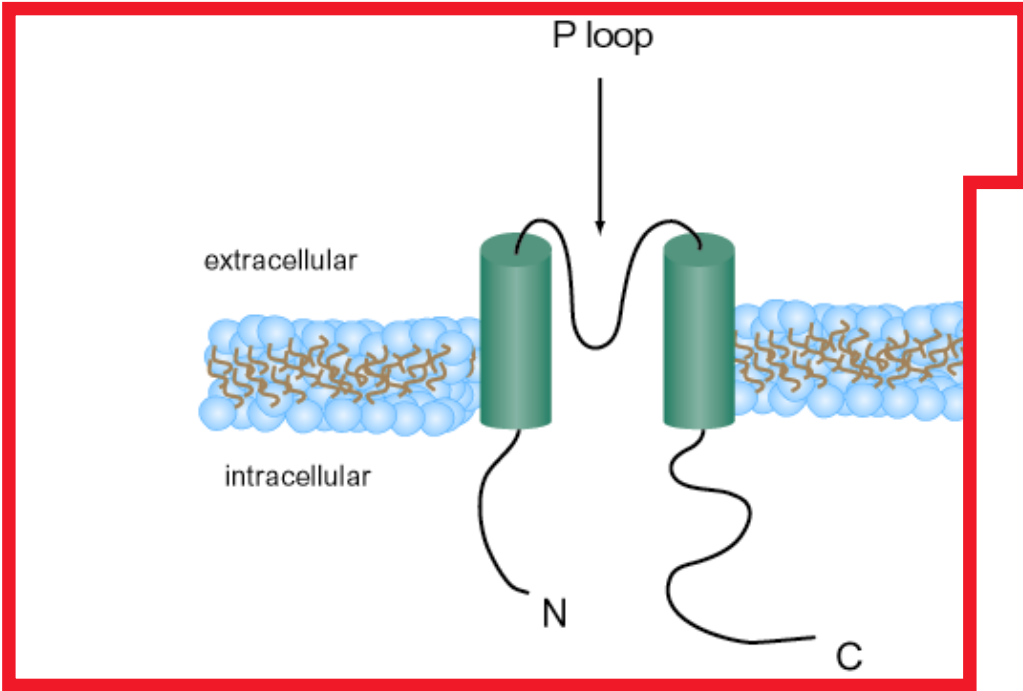
Molecular biology of the cell. B. Alberts et al., Garland Science 2002



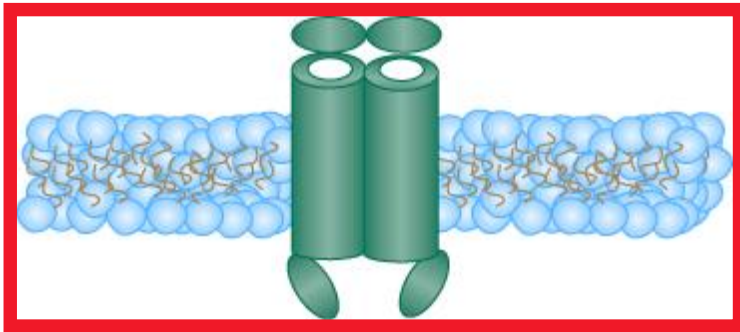
Molecular biology of the cell. B. Alberts et al., Garland Science 2002

K⁺

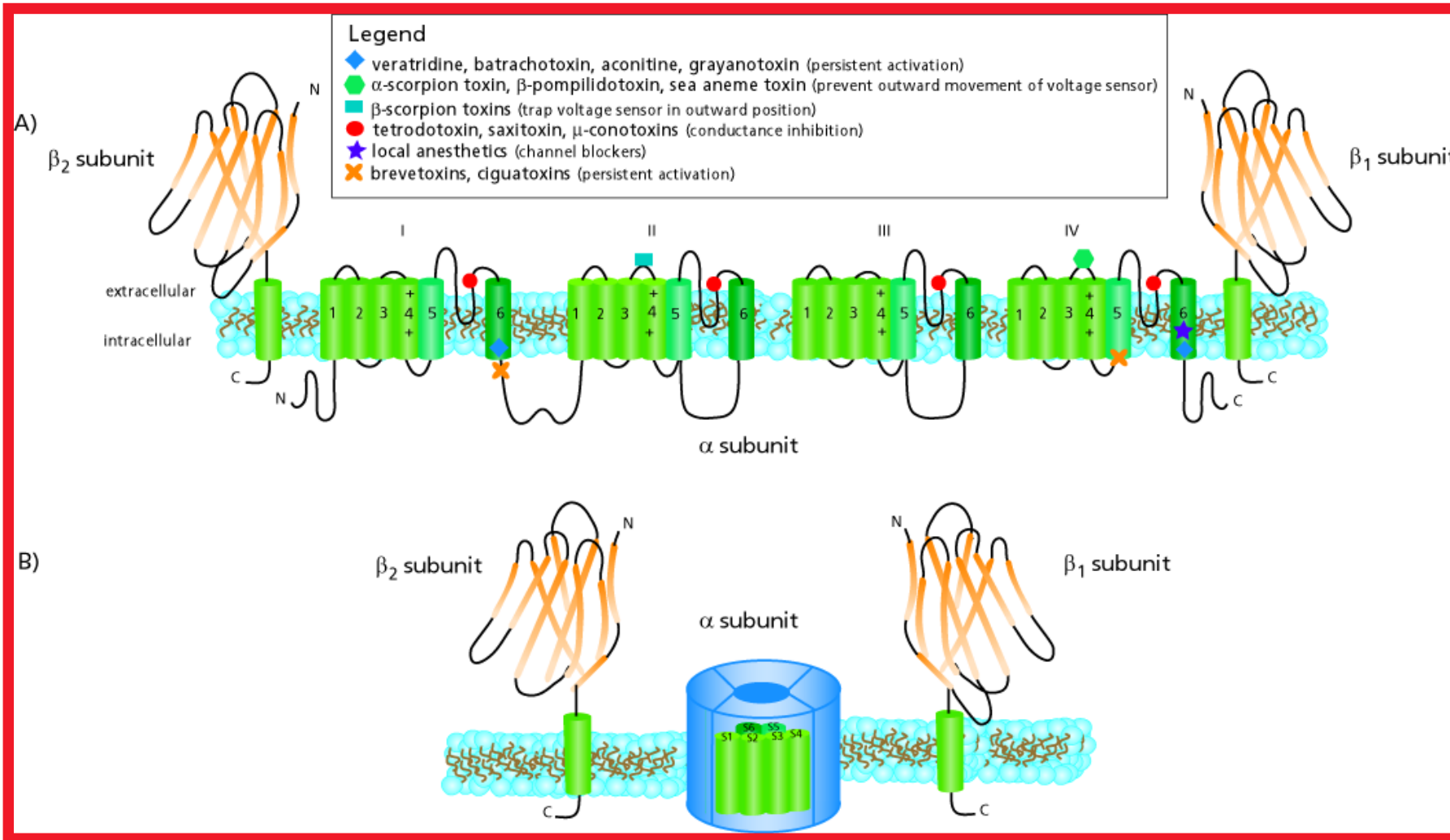
Repolarization reserve



Cl⁻



Na⁺

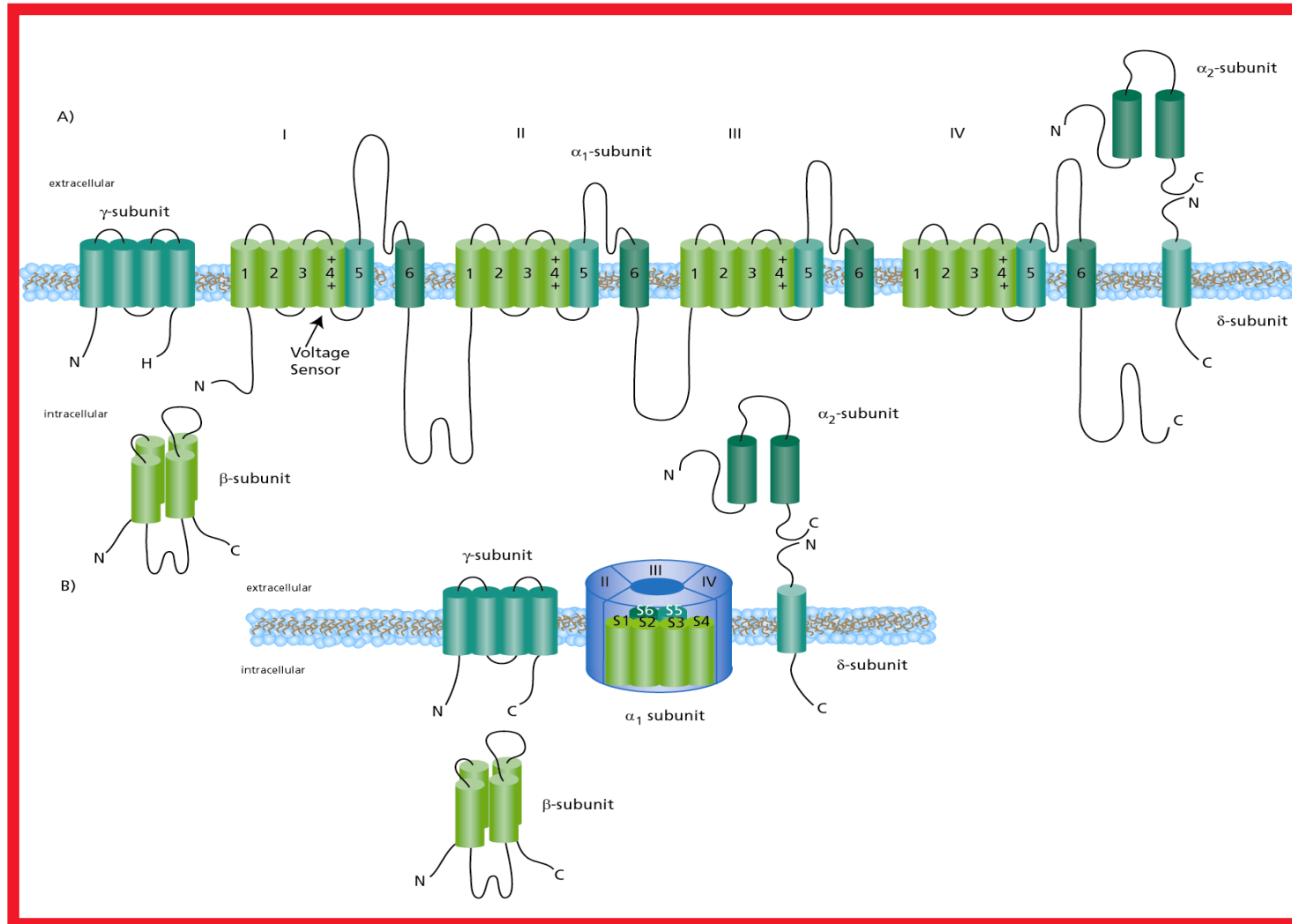


SIGMA RBI, www.sigma-aldrich.com

MUNI
MED

Ca⁺

L, T, N type



SIGMA RBI, www.sigma-aldrich.com

COMMUNICATION AMONG THE CELLS

MECHANICAL CONNECTION

- desmosomes (macula adherens; cell adhesion and mechanical stability of tissues) – epidermis, liver, myocardium

ELECTRICAL CONNECTION

- gap junction (nexus) (in intercalar disc; consists of connexons)

HUMORAL CONNECTIONS (REGULATION)

- autocrine
- paracrine
- endocrine
- juxtacrine
- neurocrine

Receptor, ligand, second messenger

NERVOUS CONNECTIONS (REGULATION)

INTEGRATION OF HUMORAL AND NERVOUS SYSTEMS

- synapse
- hypothalamus - pituitary gland
- adrenal medulla

HOMEOSTASIS - MAINTENANCE OF CONSTANT CONDITIONS IN THE INTERNAL ENVIRONMENT

IN A BROAD SENSE – in body fluids

IN A STRICT SENSE – in particular compartments

(blood.....organelles) or maintenance of certain parameter (blood pressure, muscular tension, etc.)

REGULATED PARAMETERS:

body temperature, volume of body fluids, osmotic pressure, pH, pO₂, pCO₂, concentration of ions, glycaemia, etc.

(isohydria, isovolemia, isoionia, isoosmia, ...)

DISTURBANCES IN HOMEOSTASIS

- **Communication with surroundings**

lungs, GIT, kidneys, skin

- **Internal sources of instability**

metabolism

Extracellular fluids represent transport systems

REGULATION

Control of living systems.

Living systems – open systems; their existence depends on flow of energy and substances between organism and environment in both directions.

Appears at all levels of system (cell – whole organism).

ASSOCIATION OF DIFFERENT LEVELS OF REGULATION

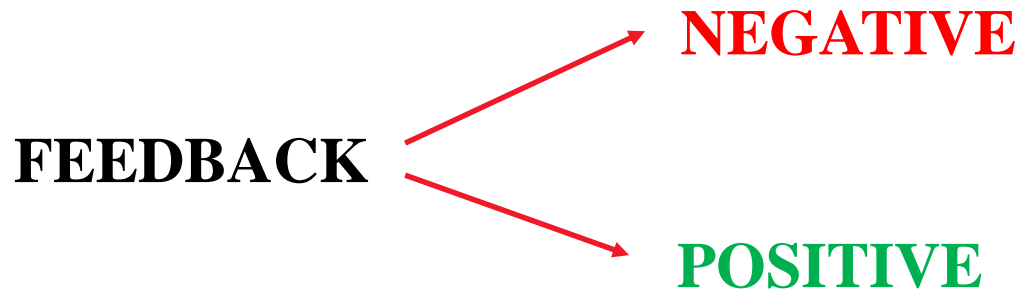
Systemic regulation – nervous and humoral

Local regulation (metabolic) – chemical – pO_2 , pCO_2 , pH, prostaglandins

Autoregulation

myogenic – constant blood flow during changing perfusion pressure

in the heart – homeometric and heterometric



Deviation from desired value **oscillates** or continuously **increases**.

