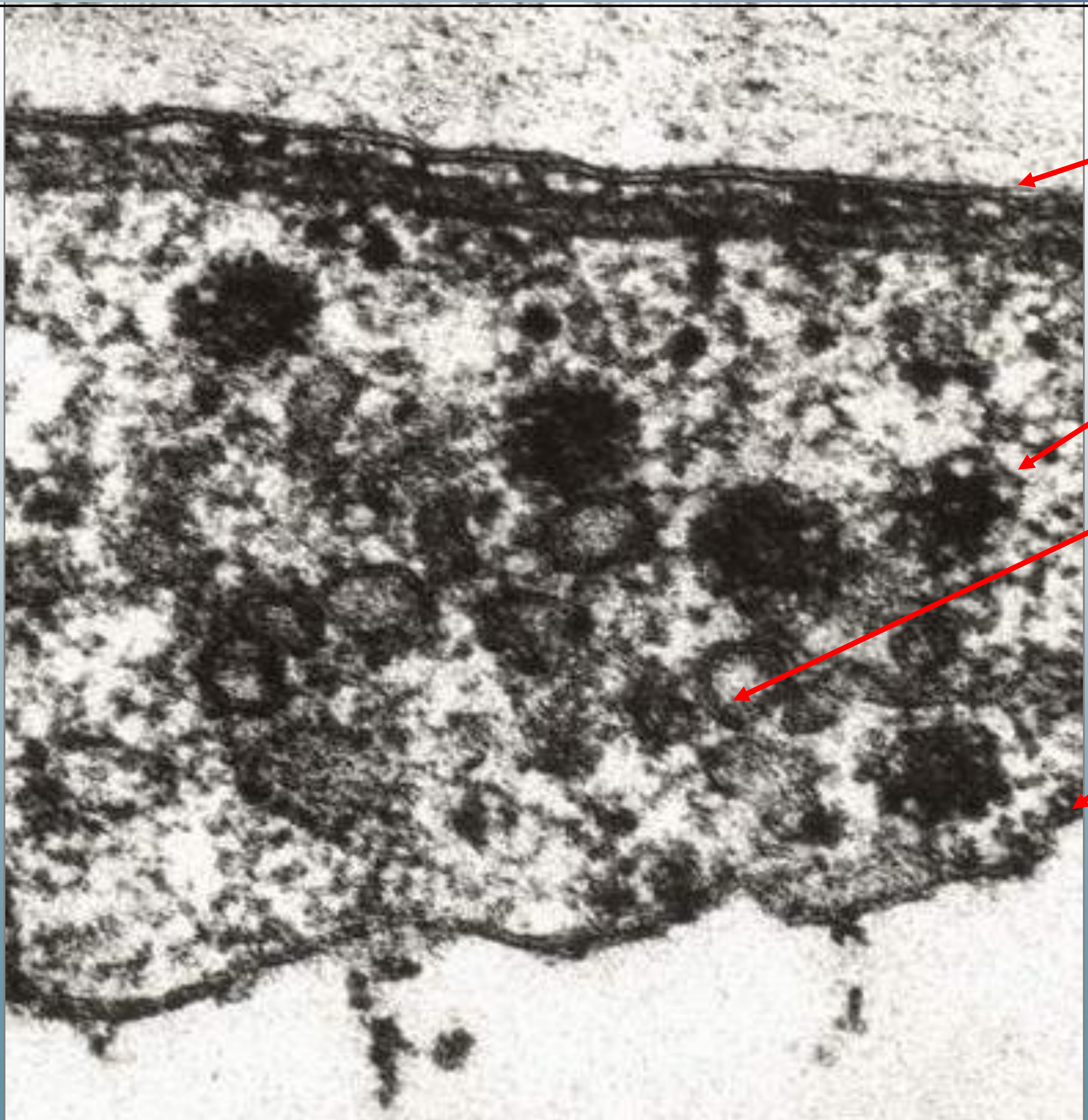
Plant Cell, Development & Ultrastructure

Plant Cell Biology Labs

Download at:
http://goo.gl/111Tha

IZMBonn
Institut für Zelluläre & Molekulare Botanik

Biomembranes



Plasma membrane

Microtubule

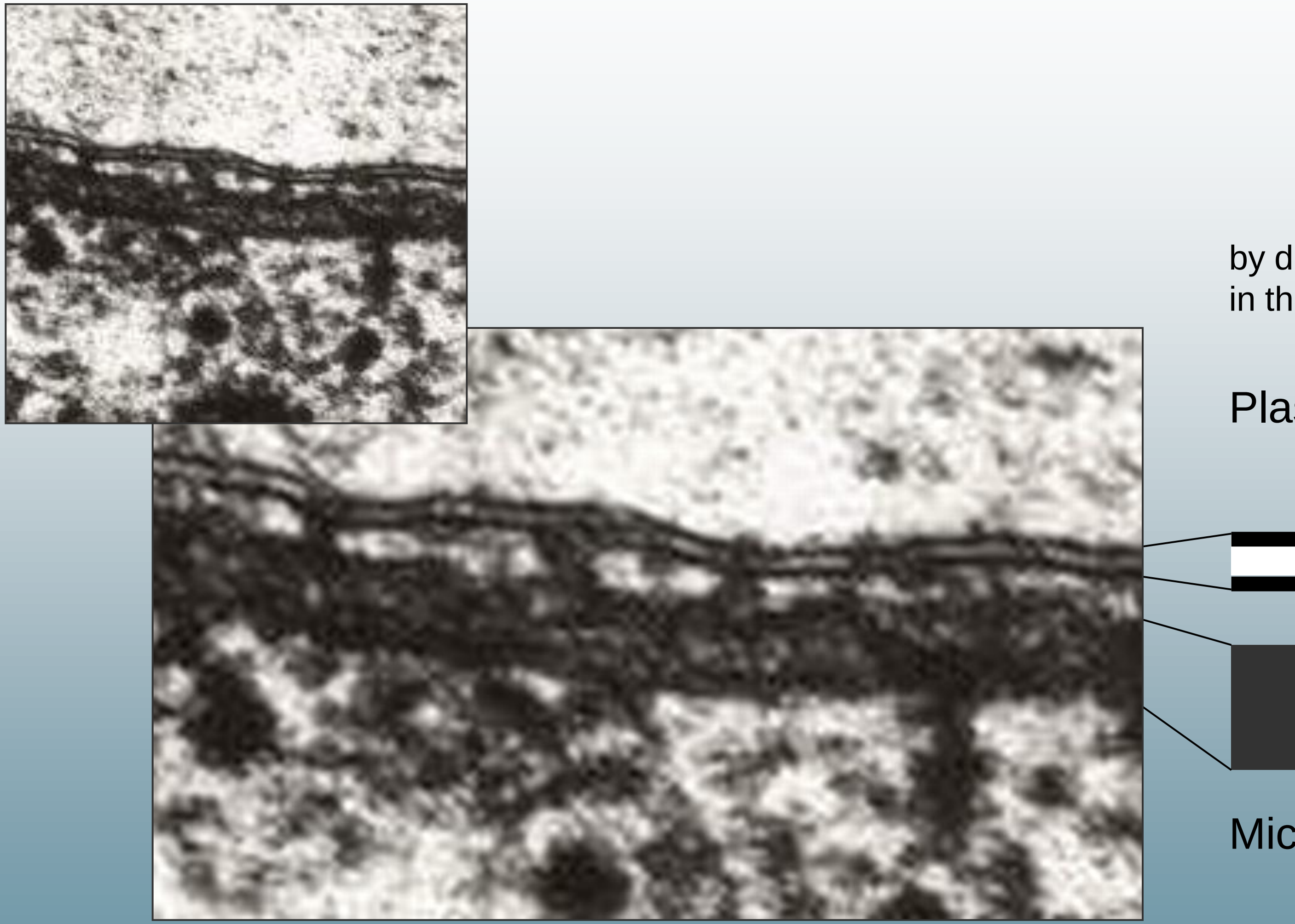
Coat of
coated vesicle

Bare vesicle
with vesicle membrane

Tonoplast (Vacuolar membrane)

Dimensions of Biological Membranes

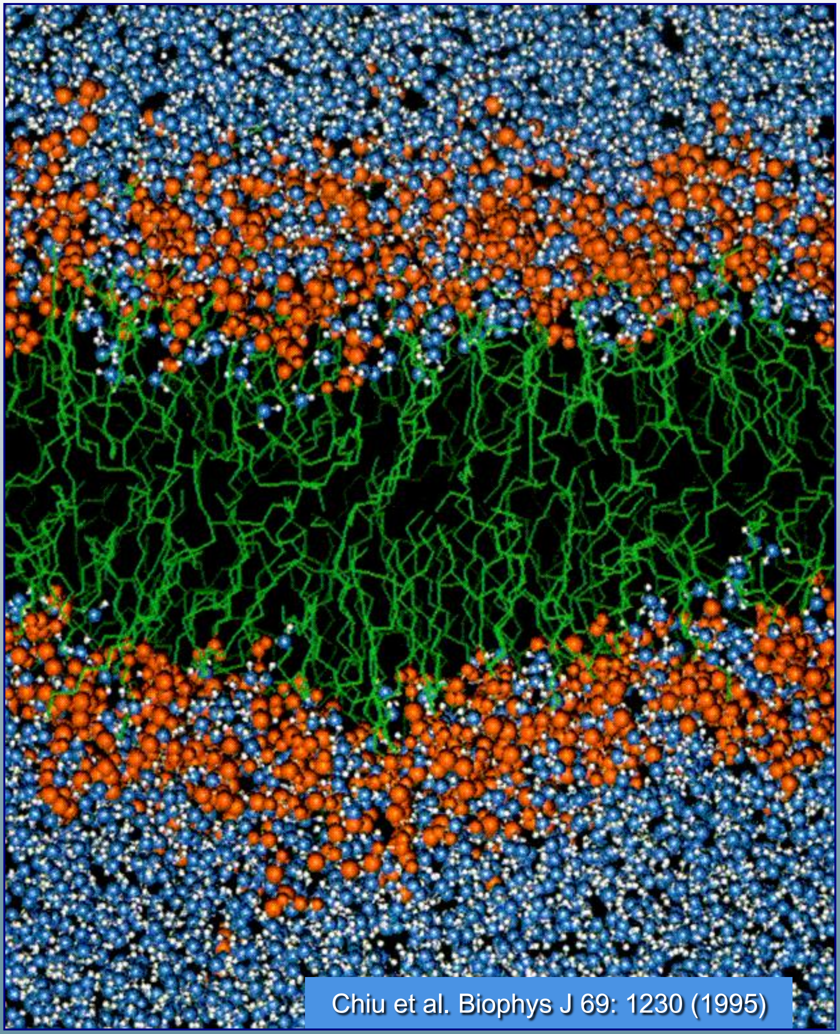
by direct measurement
in the electron microscope



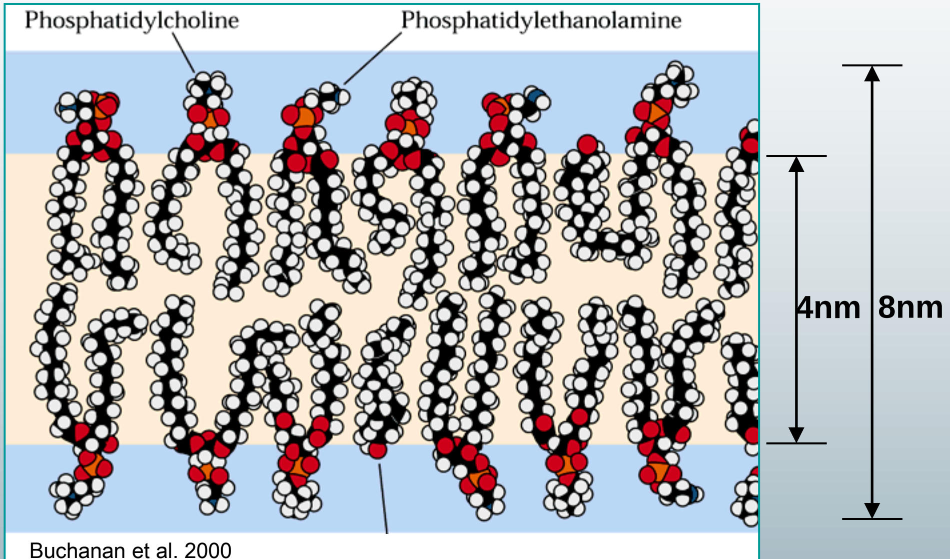
depending on the density of proteins within the membrane,
the diamter can be as much as 10nm

Phospholipid Bilayer

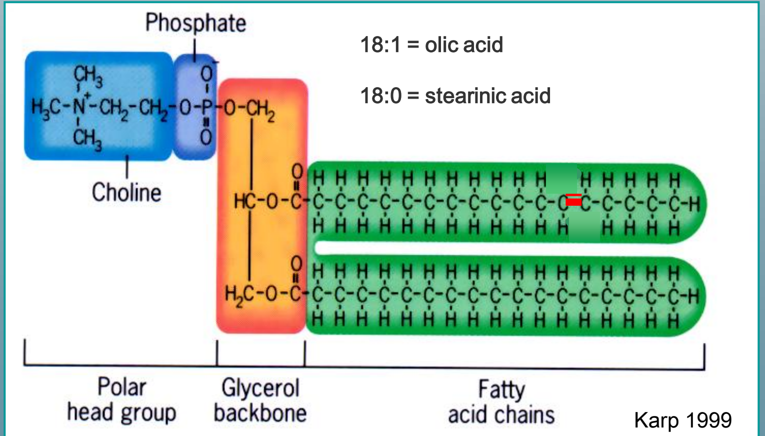
by calculation of atomic distances



Chiu et al. Biophys J 69: 1230 (1995)

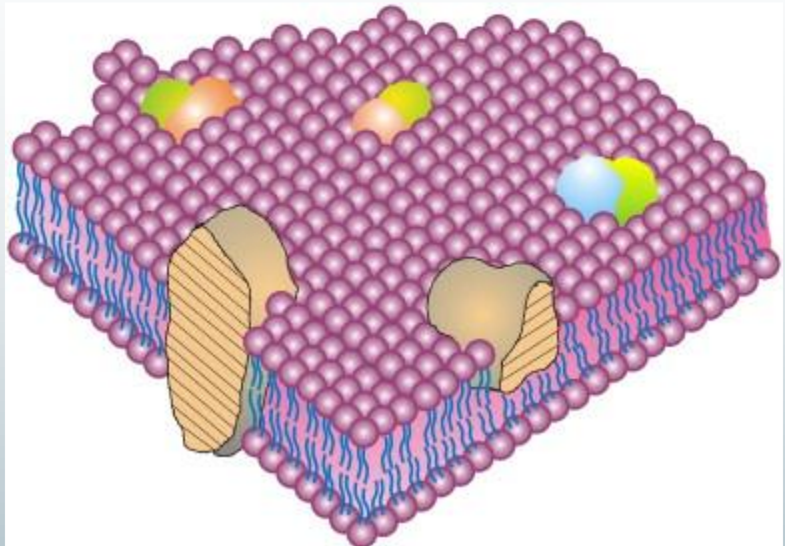


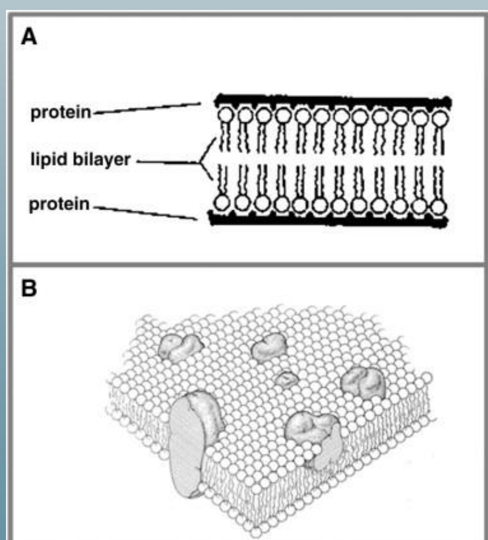
Buchanan et al. 2000

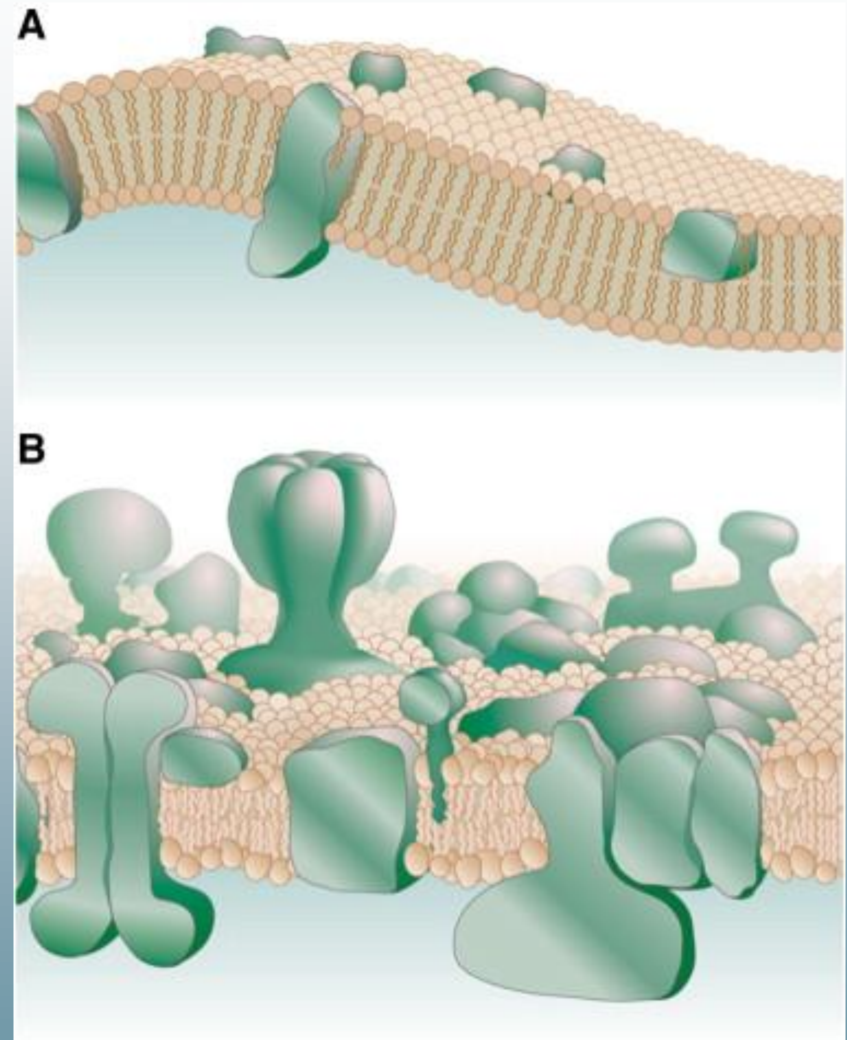


Karp 1999

Updated Singer-Nicolson Model







Updated Singer-Nicolson Model

BBA 1838: 1467-1476 (2014)

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Updated Singer-Nicolson Model

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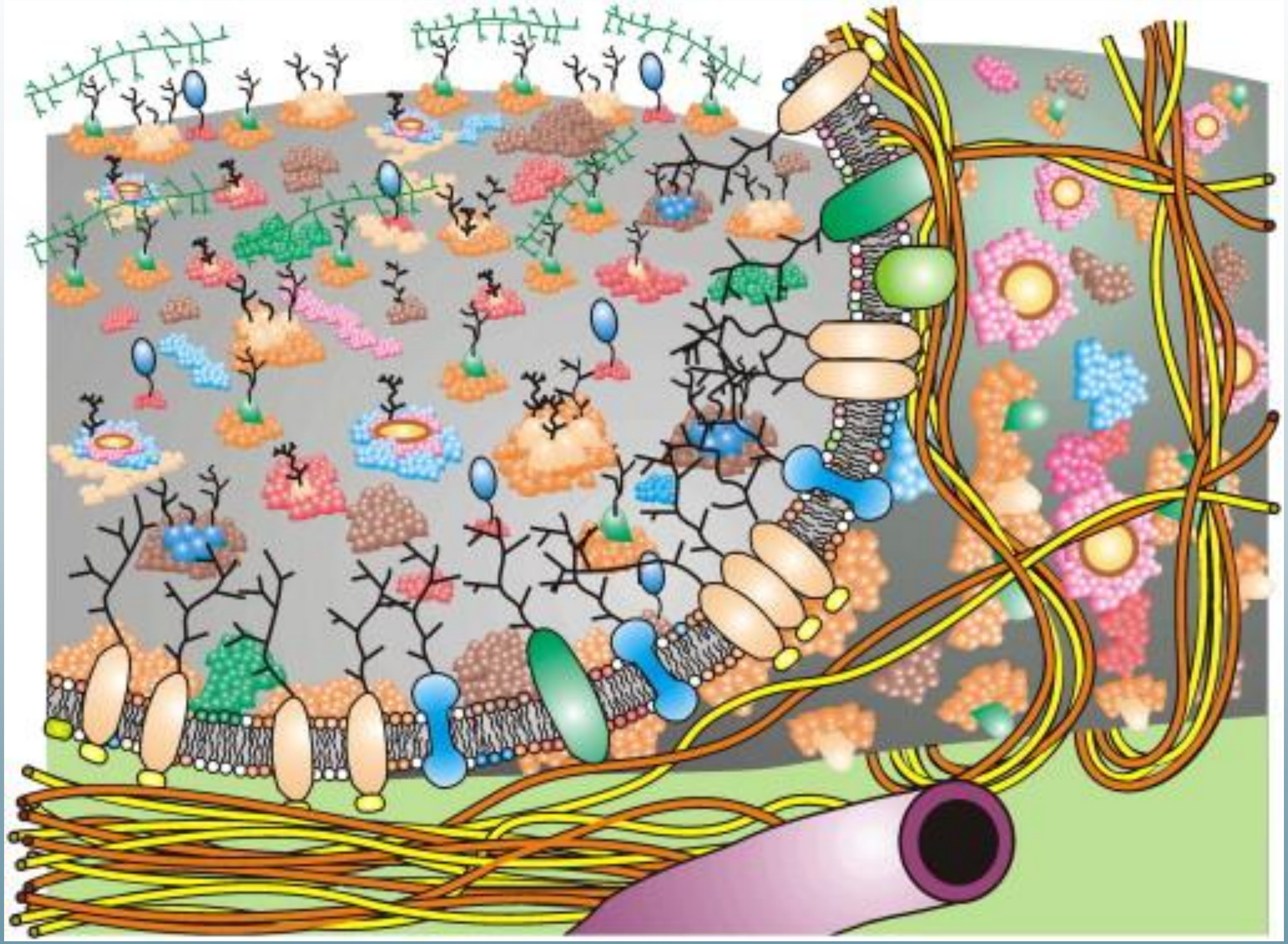


Associated Cytoskeletal and Extracellular Structures

BBA 1838: 1451-1466 (2014)

Phospholipids in Cellular Membranes

Composition of plant membranes (Heldt, 1999)

	Chloroplast Thylakoid membrane	Mitochondria inner membrane	Plasma membrane
Glycerolipide	% of total acyl-lipid content		
Monogalactosyldiglycerid	51	0	0
Digalactosyldiglycerid	26	0	0
Sulfochinovosyldiglycerid	7	0	0
Phosphatidylcholin	3	27	32
Phosphatidylserin	0	25	0
Phosphatidylethanolamin	0	29	46
Phosphatidylglycerol	9	0	0
Phosphatidylinositol	1	0	19
Cardiolipin	0	20	0

Aliphatic Lipids

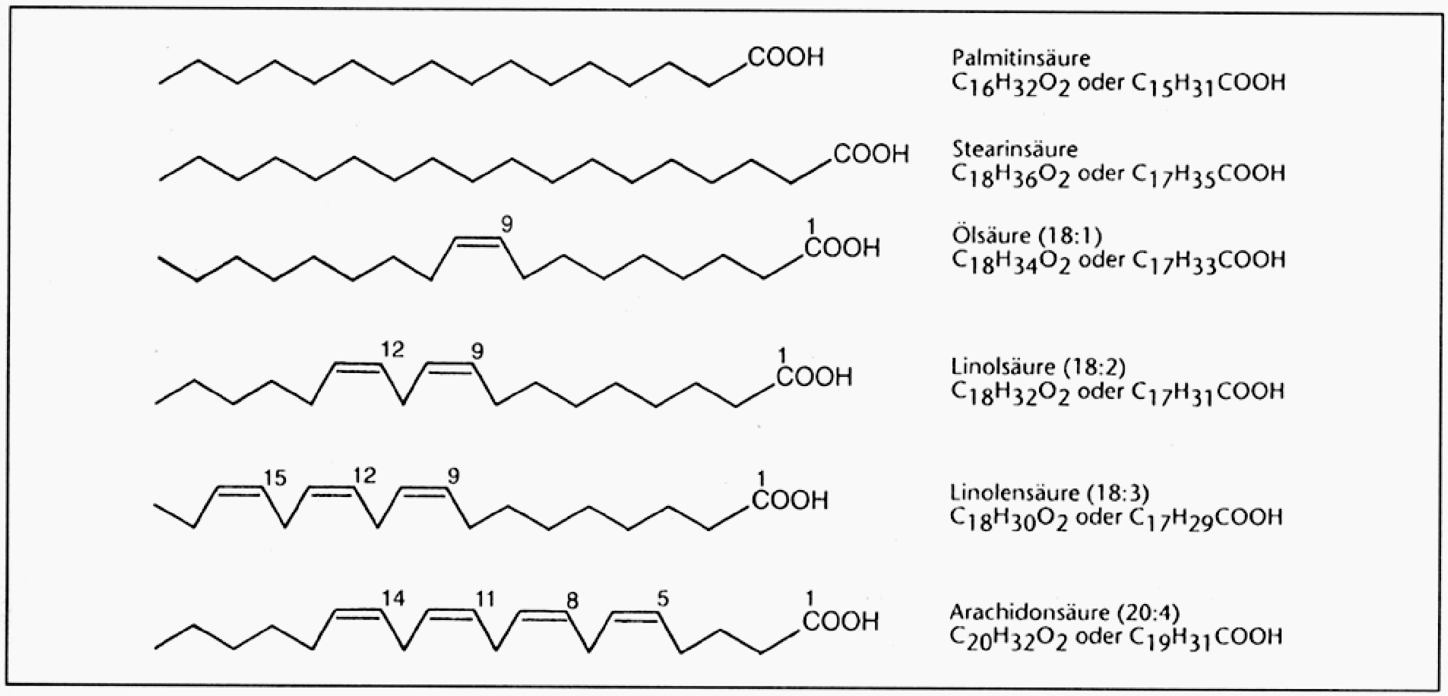
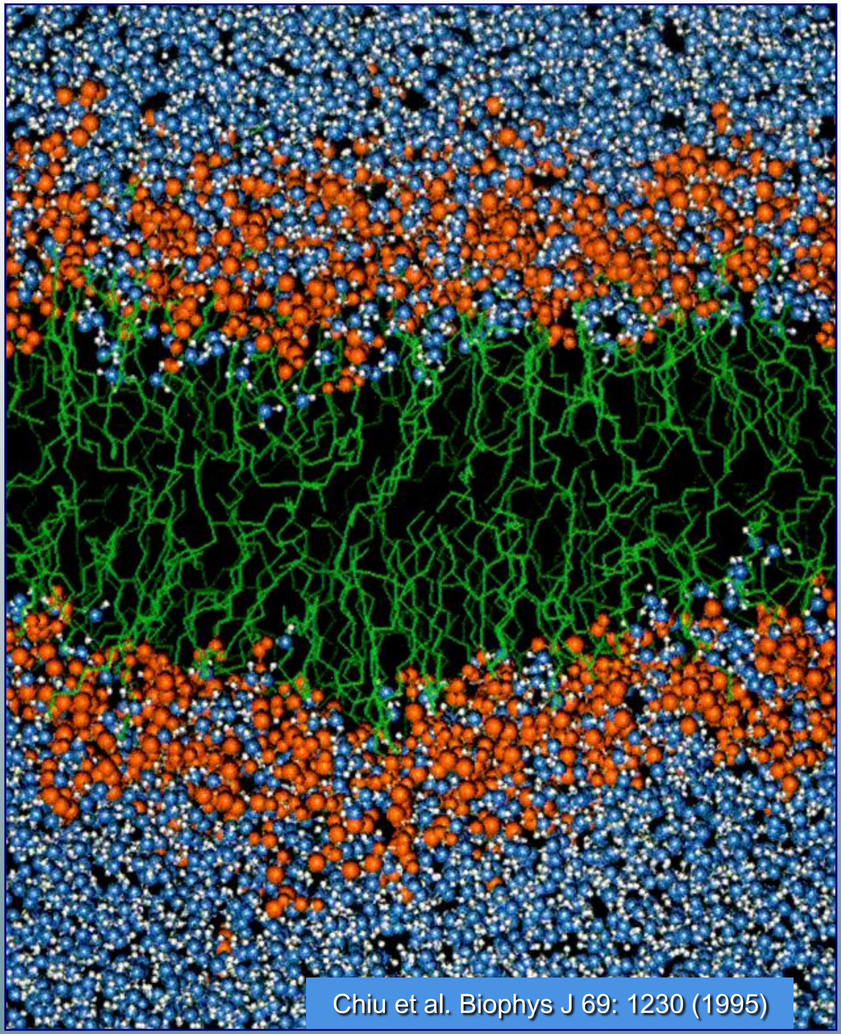
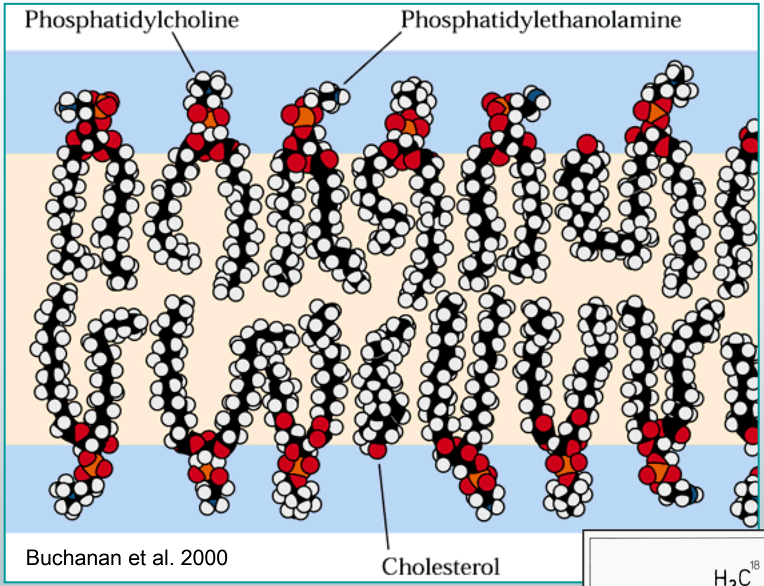
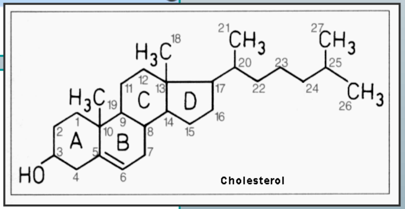


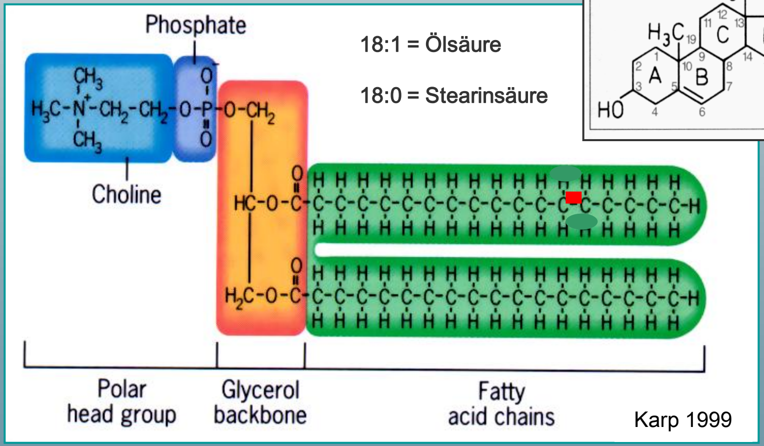
Abb. 2.3: In Pflanzen häufig vorkommende Fettsäuren.

Sterol Lipids in Animal Membranes









Phytosterole Lipids in Plants

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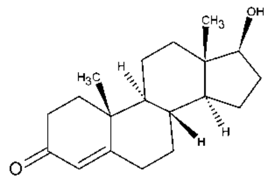
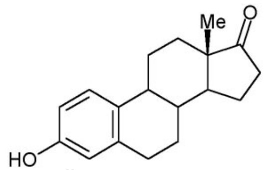


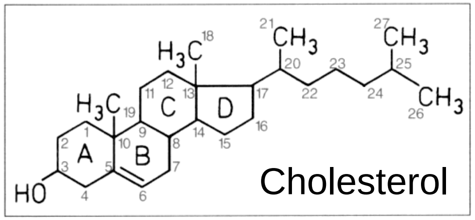
Testosteron



Östrogen

Sexual hormones

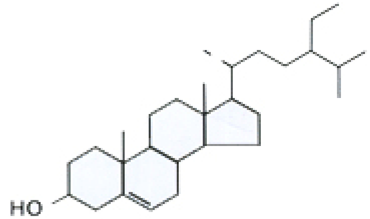
Animal



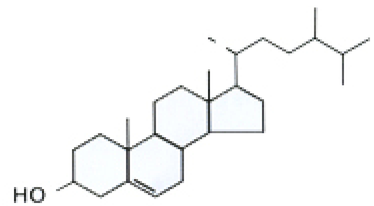
Cholesterol

Plant

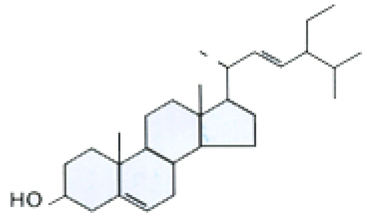
Isoprene	$= C_5$
Monoterpene	$= C_{10}$
Sesquiterpene	$= C_{15}$
Diterpene	$= C_{20}$
Triterpene	$= C_{30}$



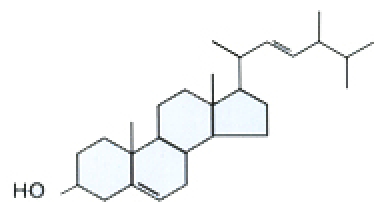
Beta-sitosterol



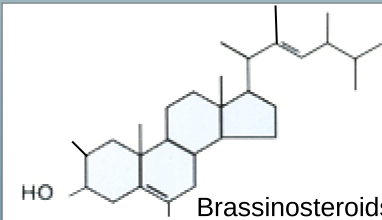
Campesterol



Stigma sterol



Brassicasterol



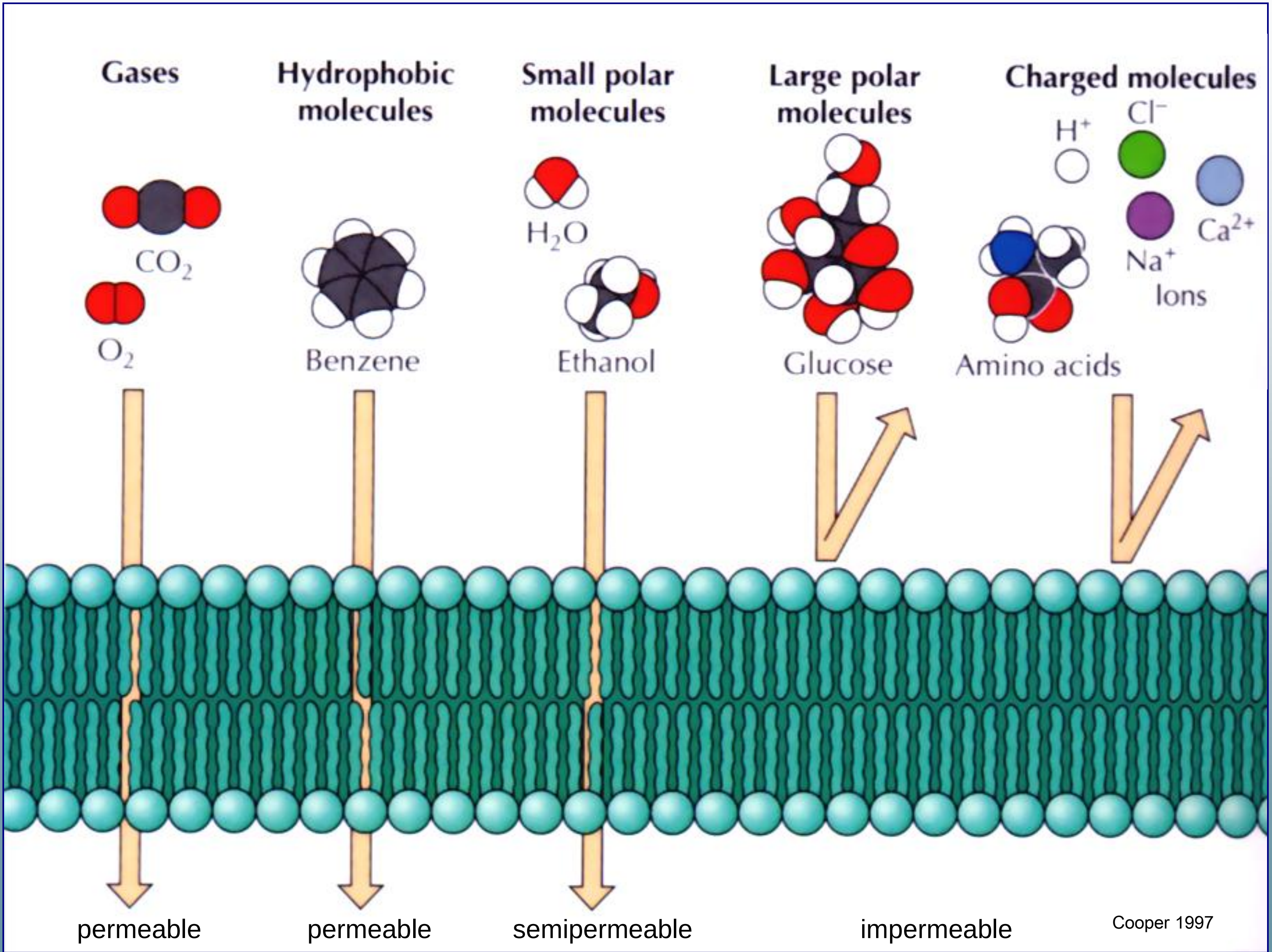
Brassinosteroids

Phytosterole Metabolites
Cyclic Triterpenes

Phytohormone growth & differentiation

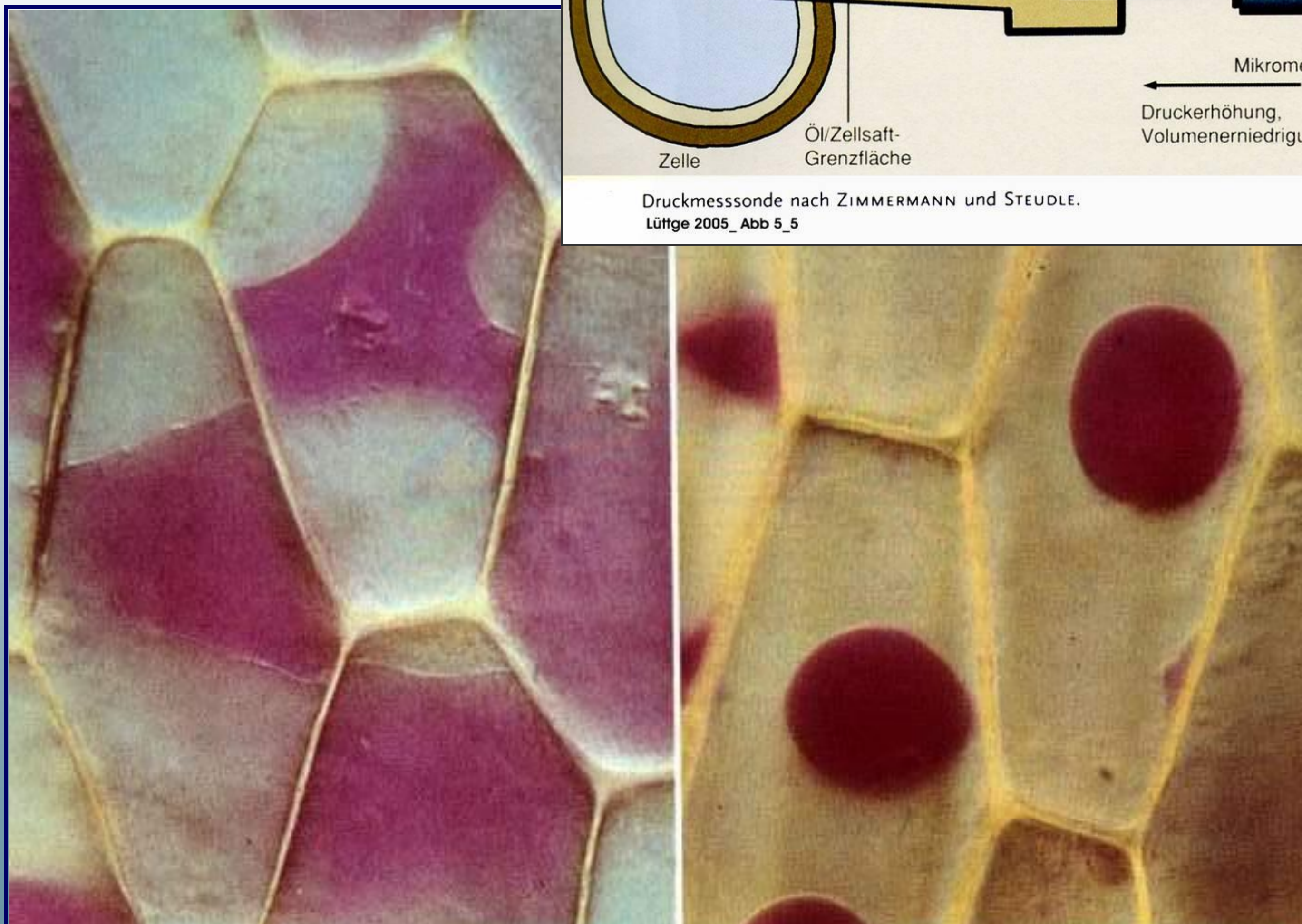
Phytohormones

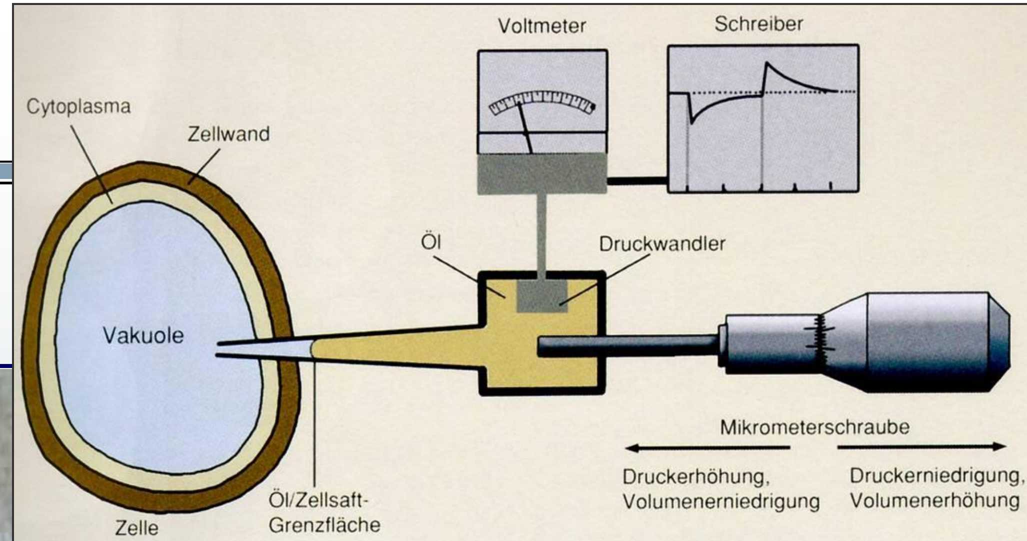
Biomembrane Acting as Barrier



Cooper 1997

Stages of Plasmolysis
in the lower epidermis of Rhoeo discolor
0.4-0.6M Sucrose

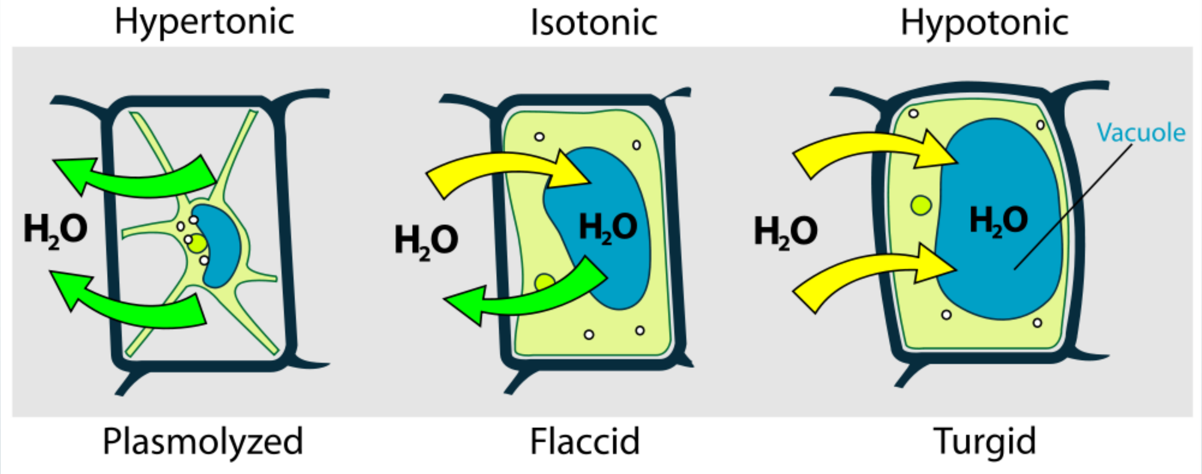




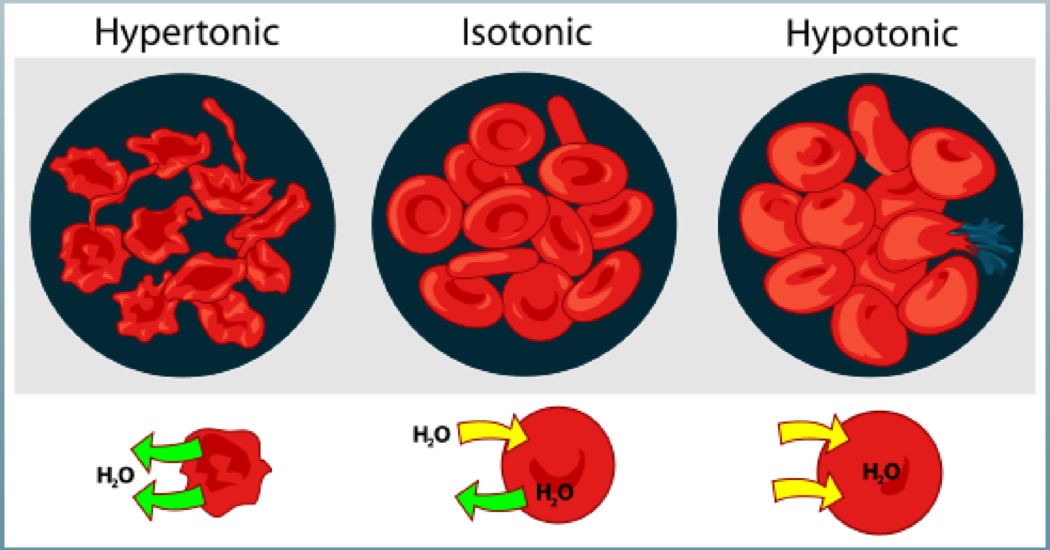
Druckmesssonde nach ZIMMERMANN und STEUDLE.
Lüttge 2005_ Abb 5_5

Turgor:
1-20 MPa
9,86-197,38atm

Cells as Osmotic Systems



Plant Cells



Red Blood Cells

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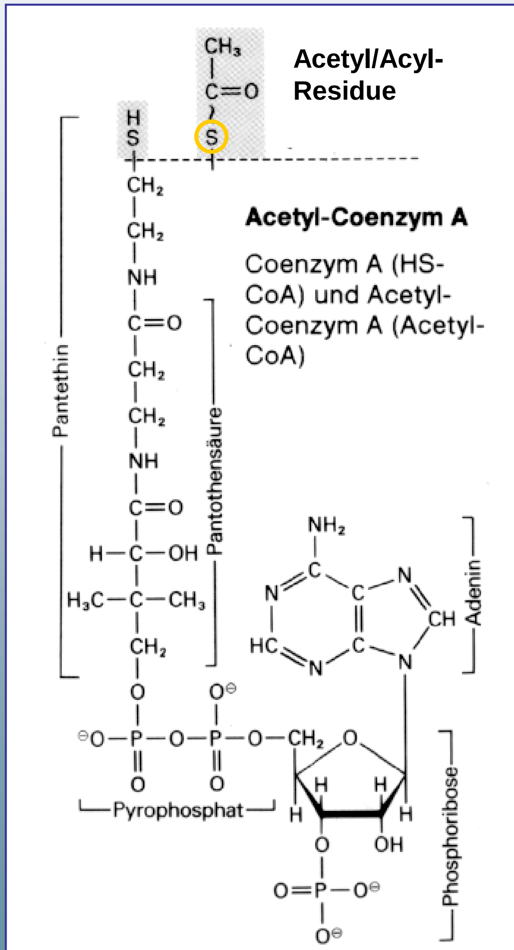
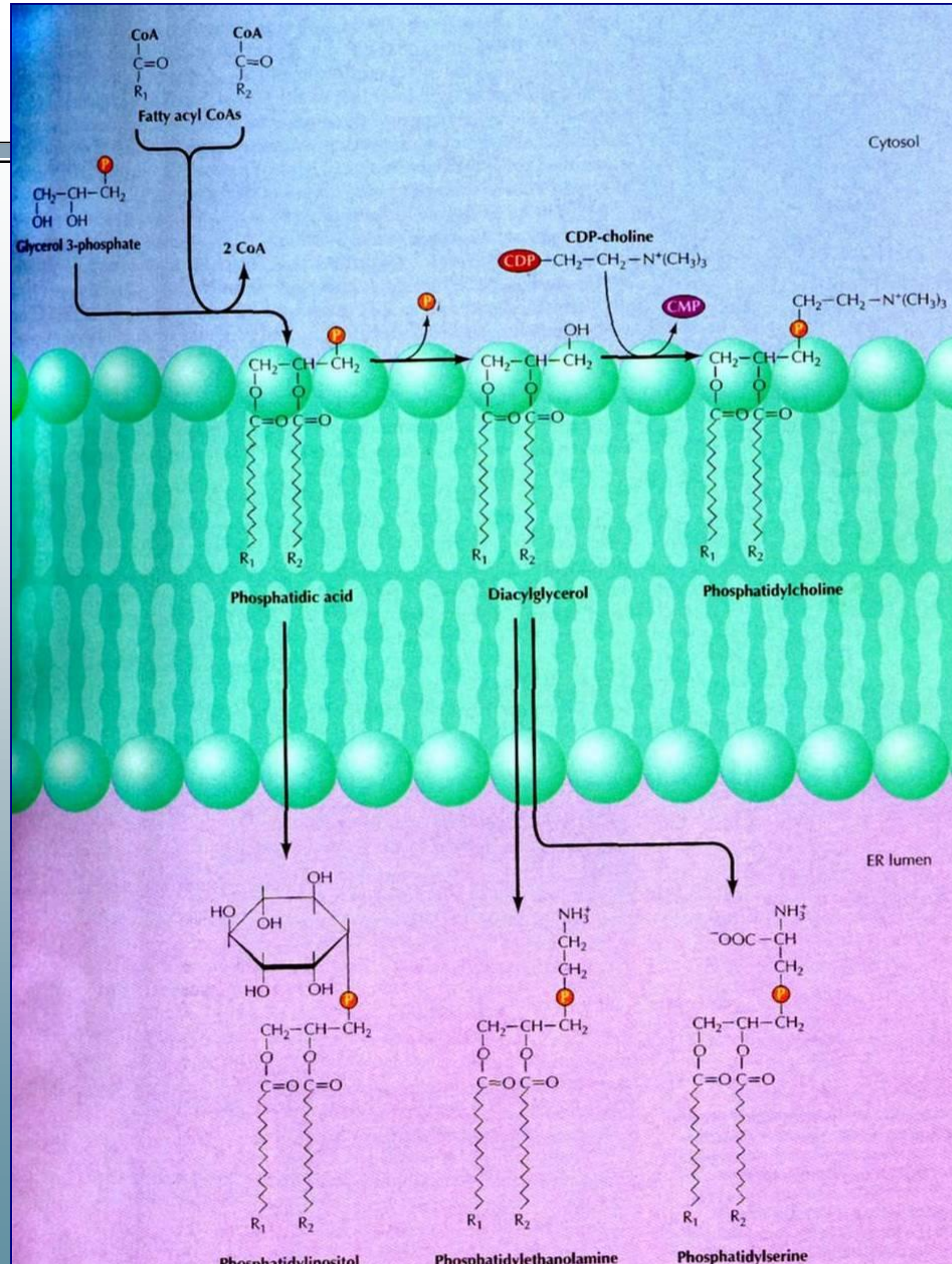
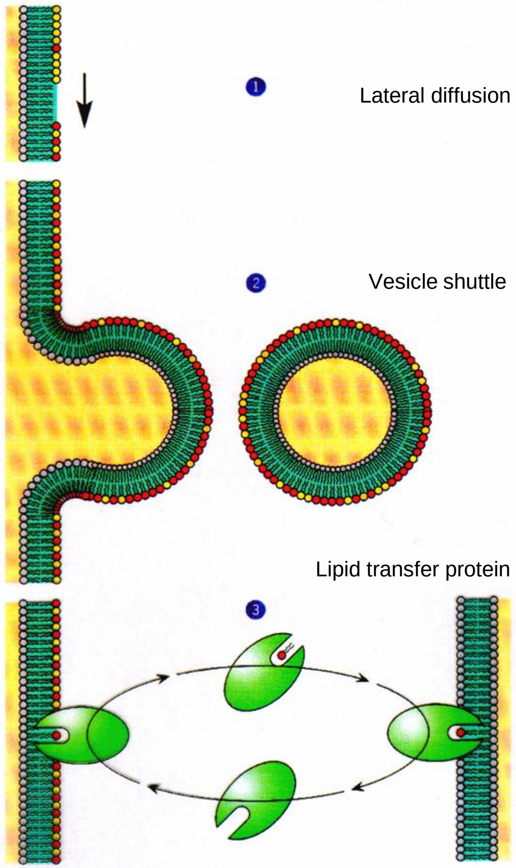
Synthesis of phospholipids in the ER-membrane



Lüttge, Kluge Bauer 2005

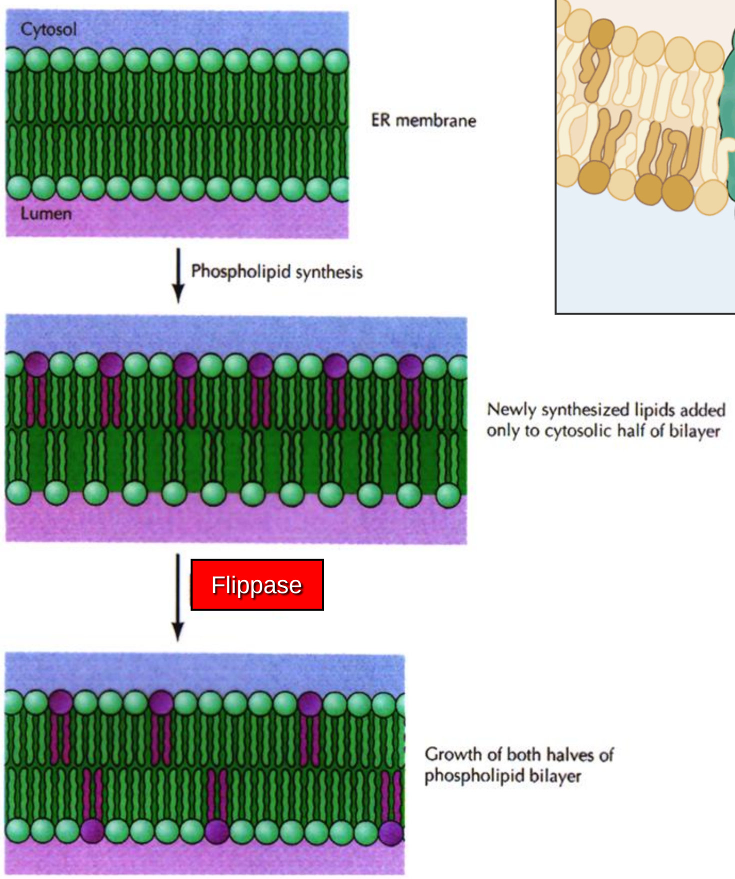


Lipid Transfer

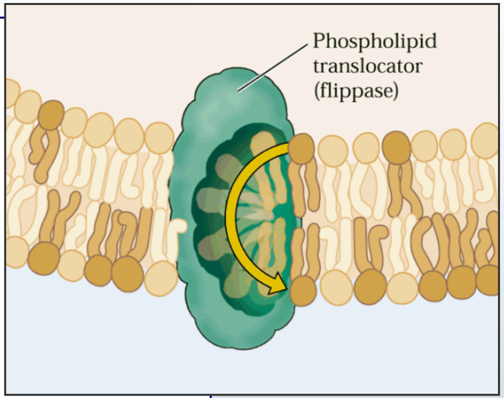


Transfer of Lipid between membranes

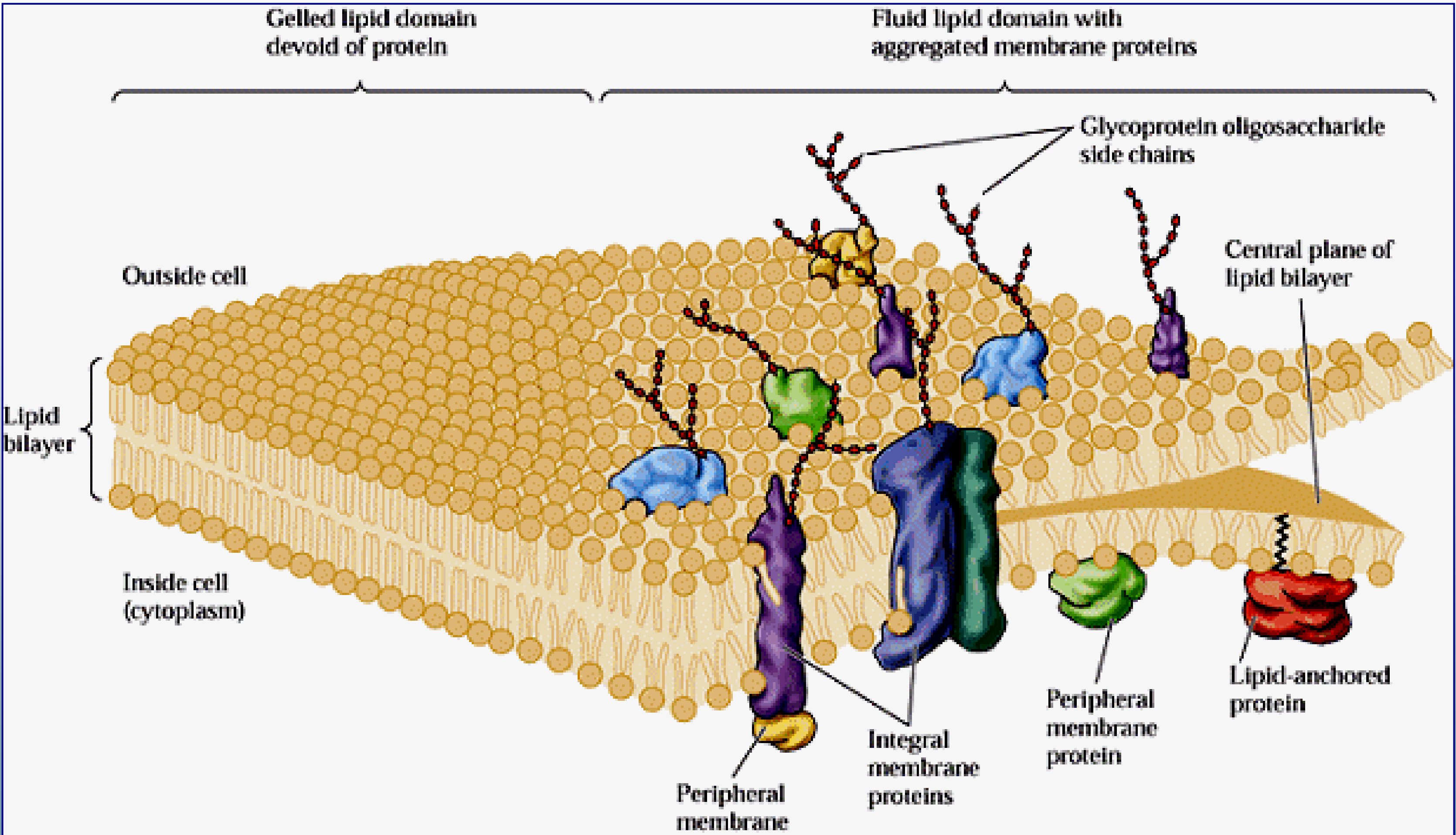
Fig. 8.14
Karp 1999



Cooper 1997
Fig. 9.17 Translocation of phospholipids across thr ER membrane

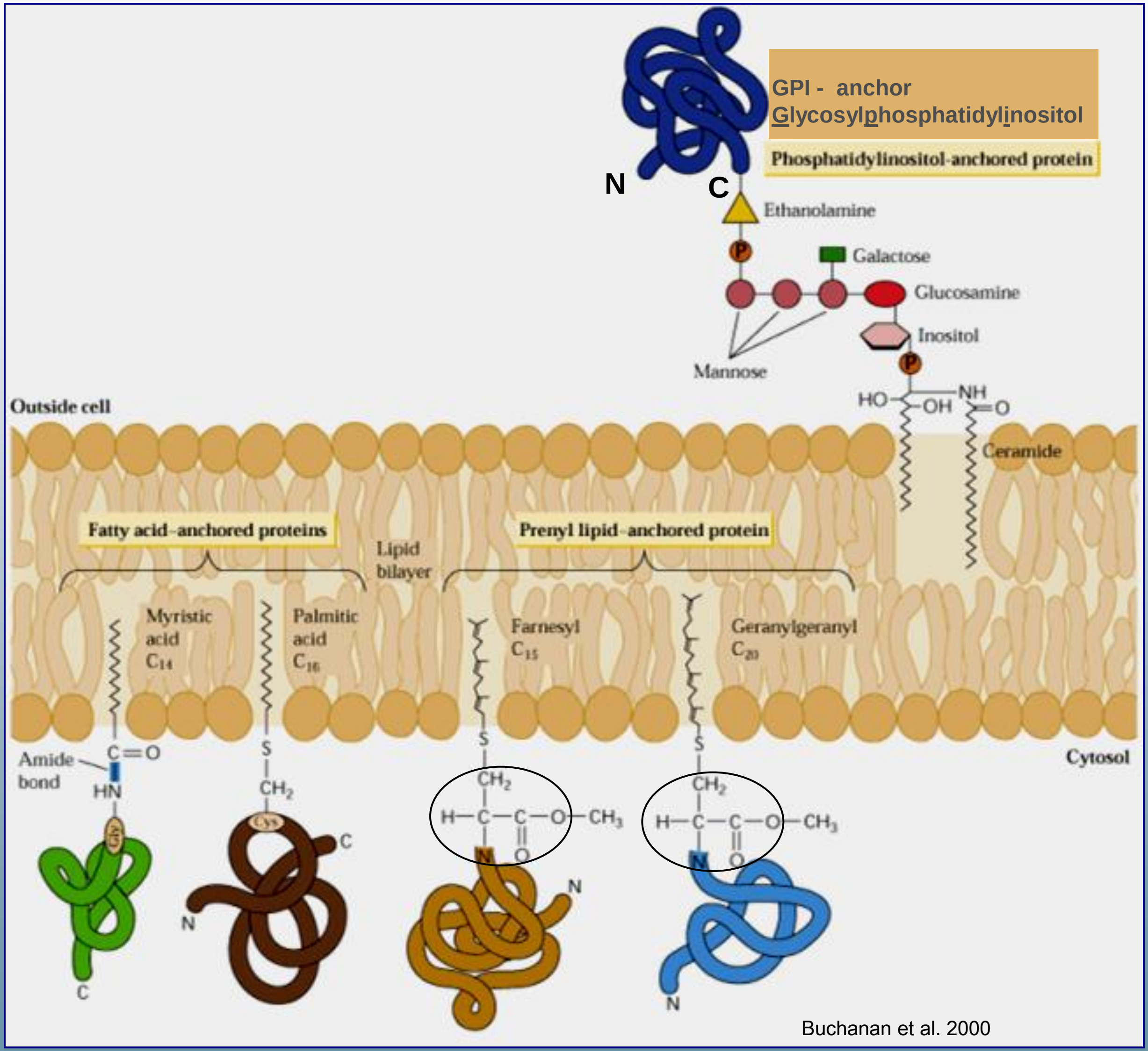


Membrane Proteins



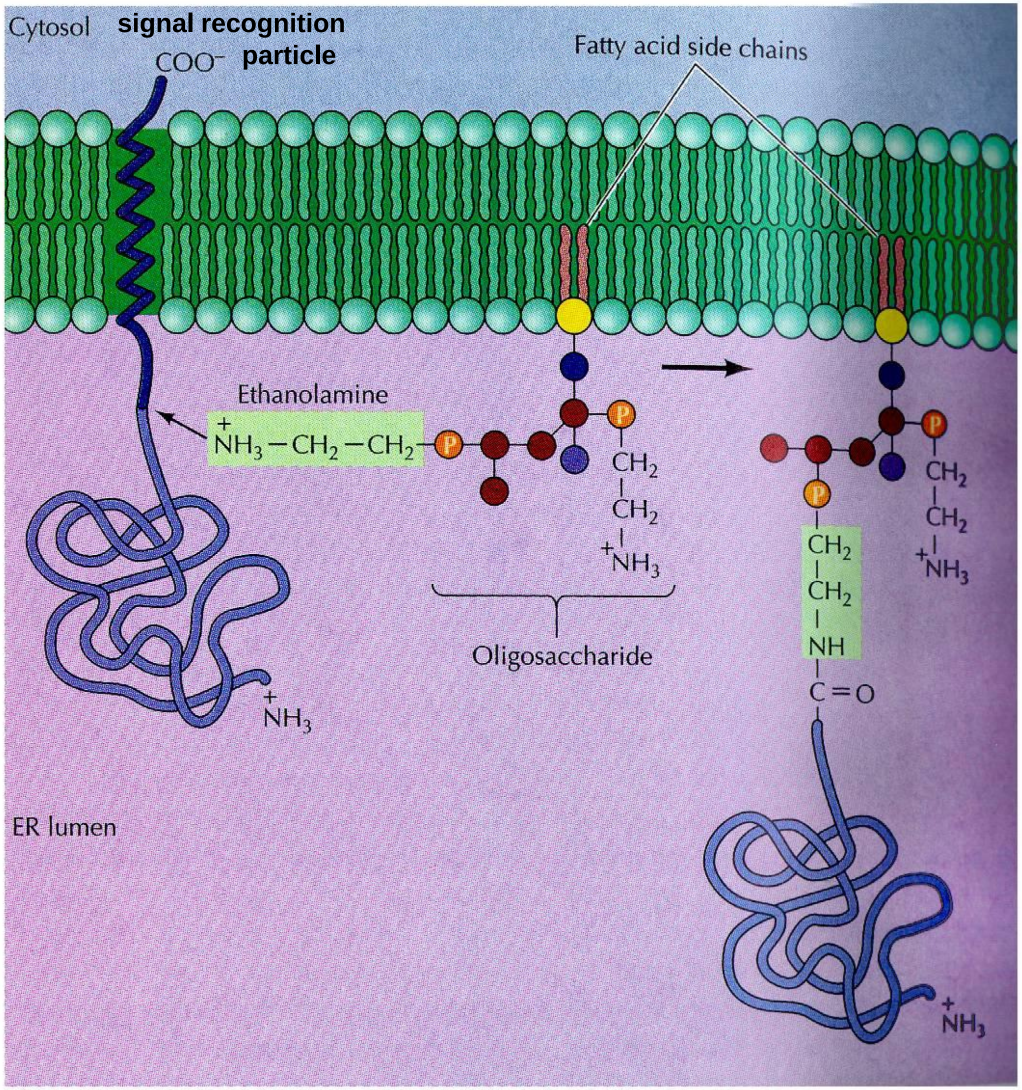
Buchanan et al. 2000

Lipid Anchors



Prenylation motif: **CAAX-Box** at C-Terminus recognized by the farnesyl transferase

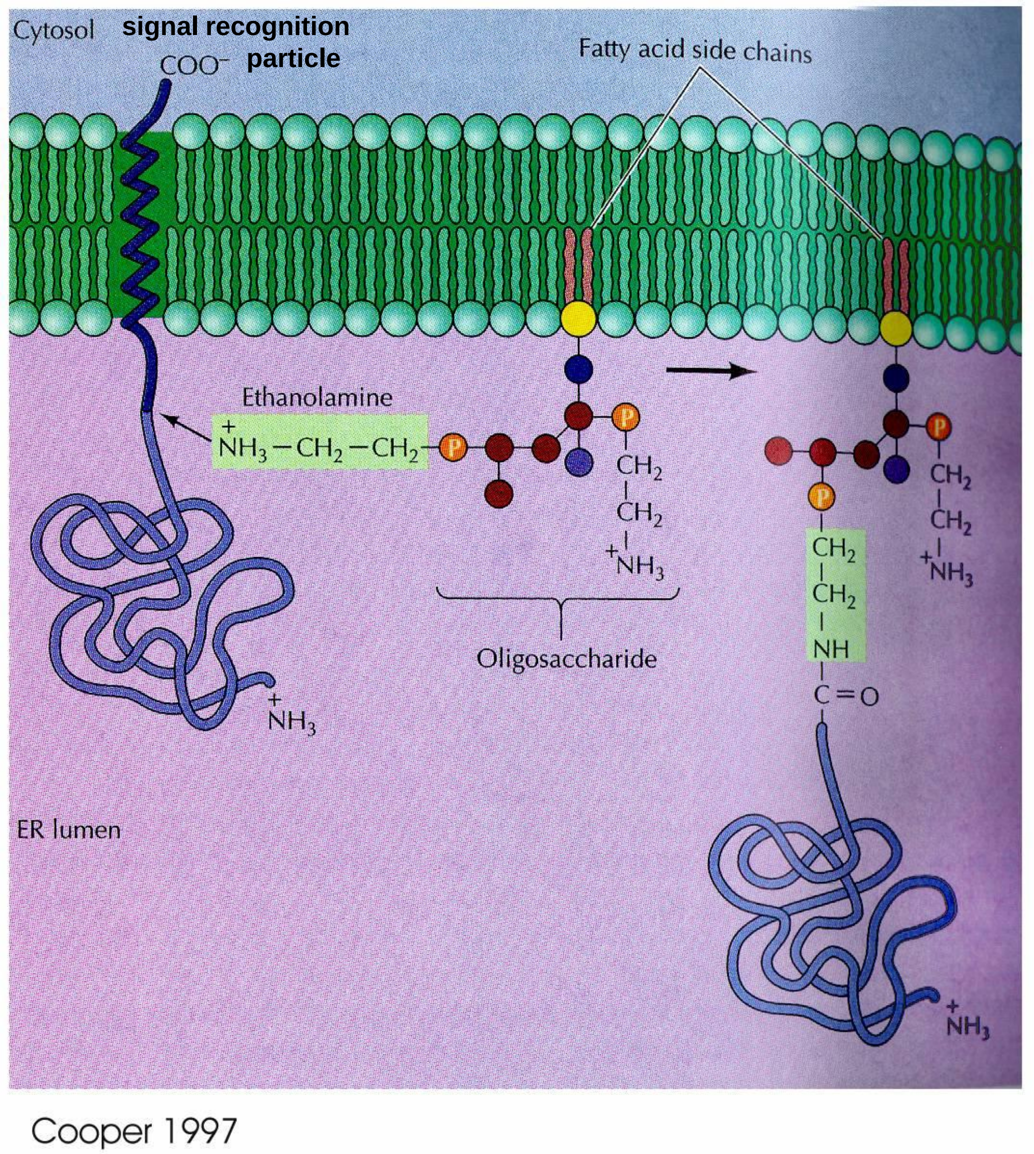
GPI-Anchored Proteins

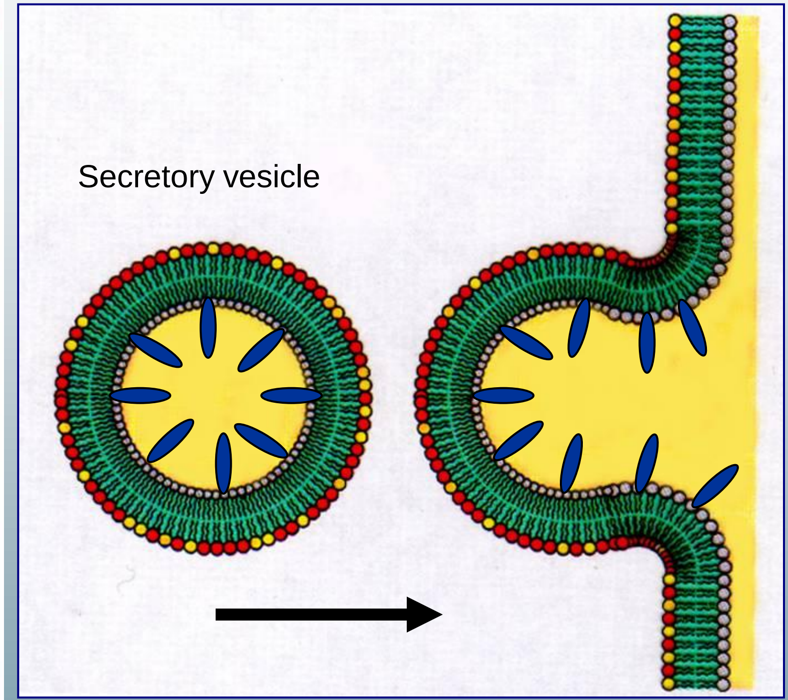


Cooper 1997

How are GPI-anchored proteins exported to the cell surface?

GPI-Anchored Proteins

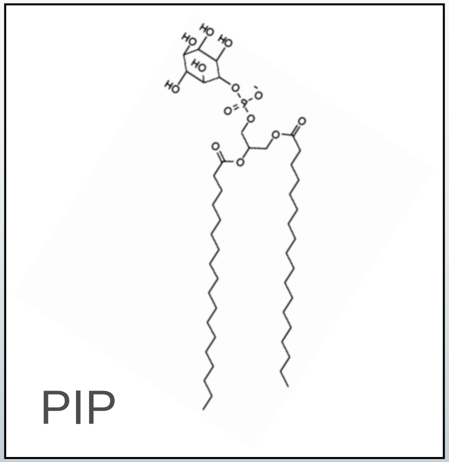




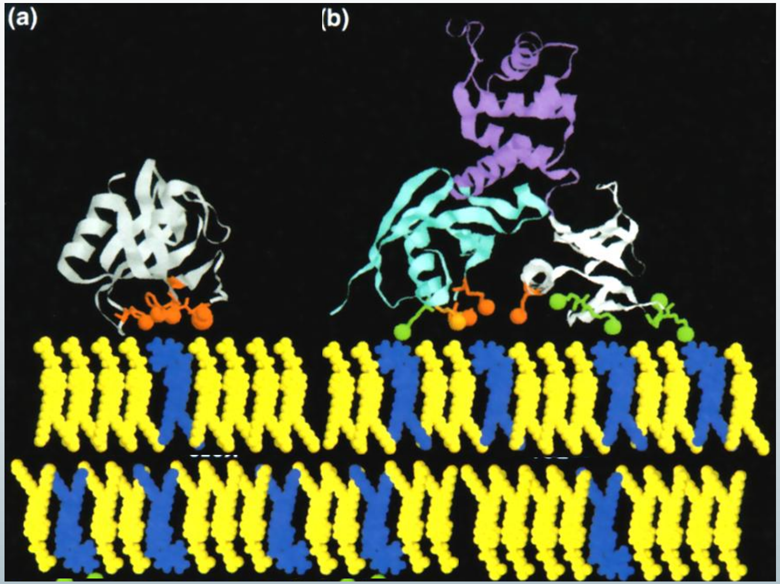
Export of GPI-anchored proteins
to the cell surface

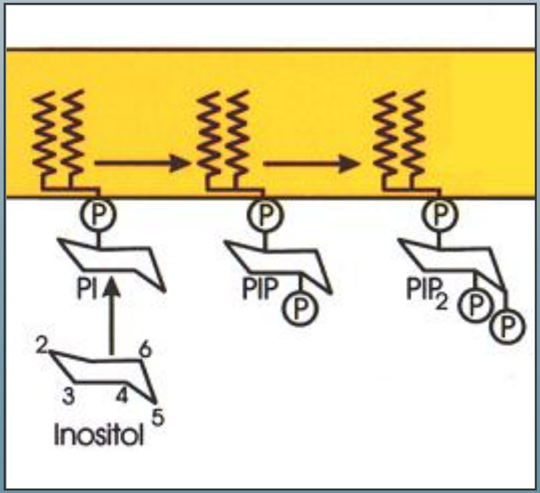
Lipid Rafts

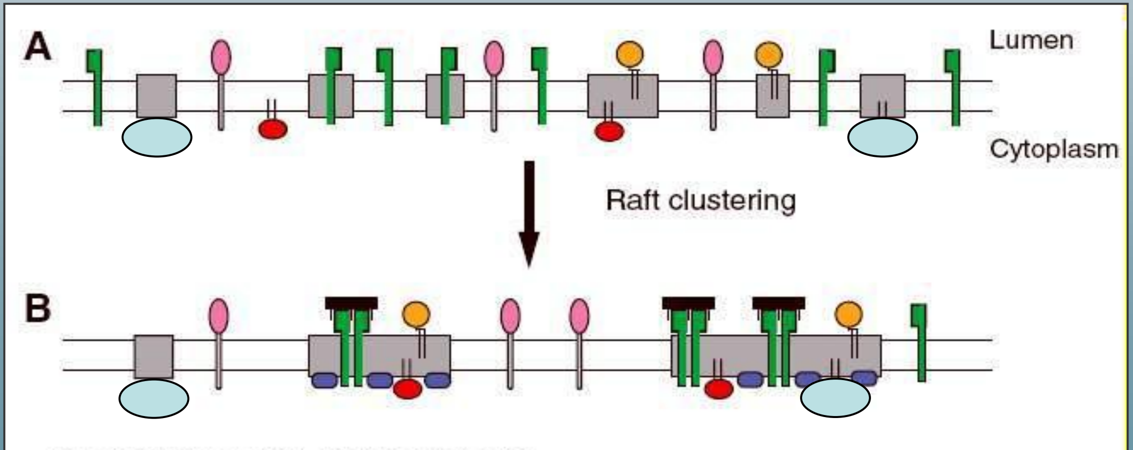
PIPs = phosphatidyl-inositol- phosphate esters



Peripheral membrane proteins bind PIPs



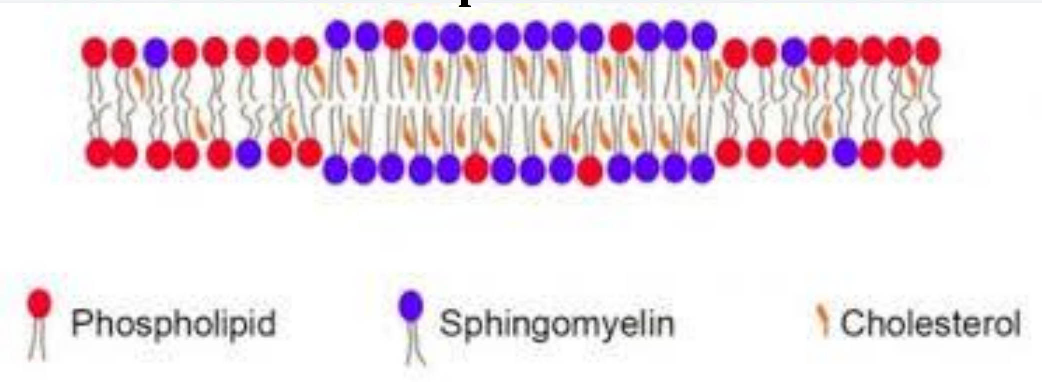


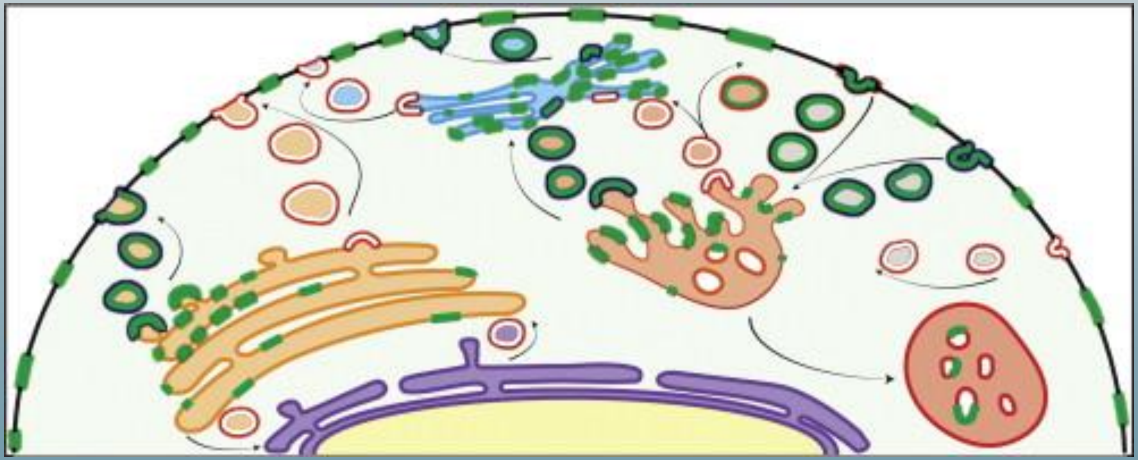


Schuck & Simon 2004, J Cell Sci 117: 5955

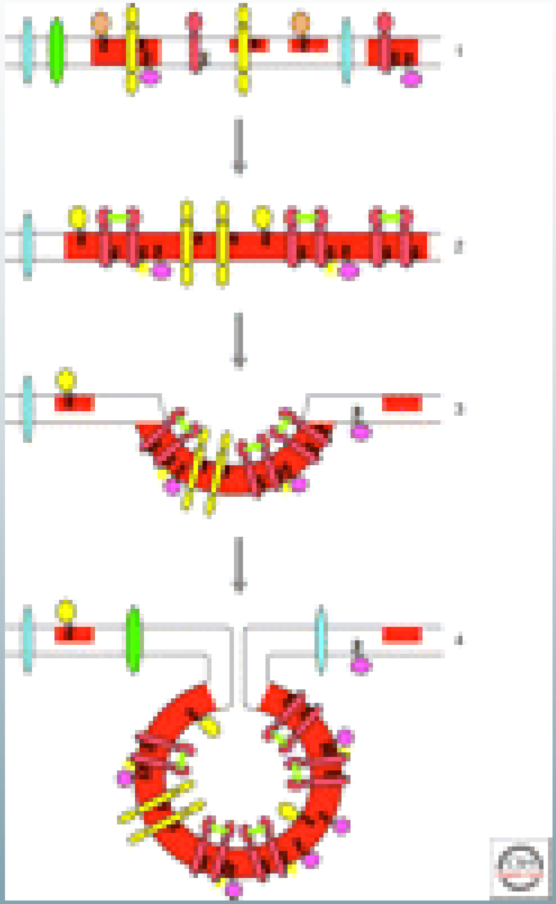
Lipid Rafts

Lipid Raft



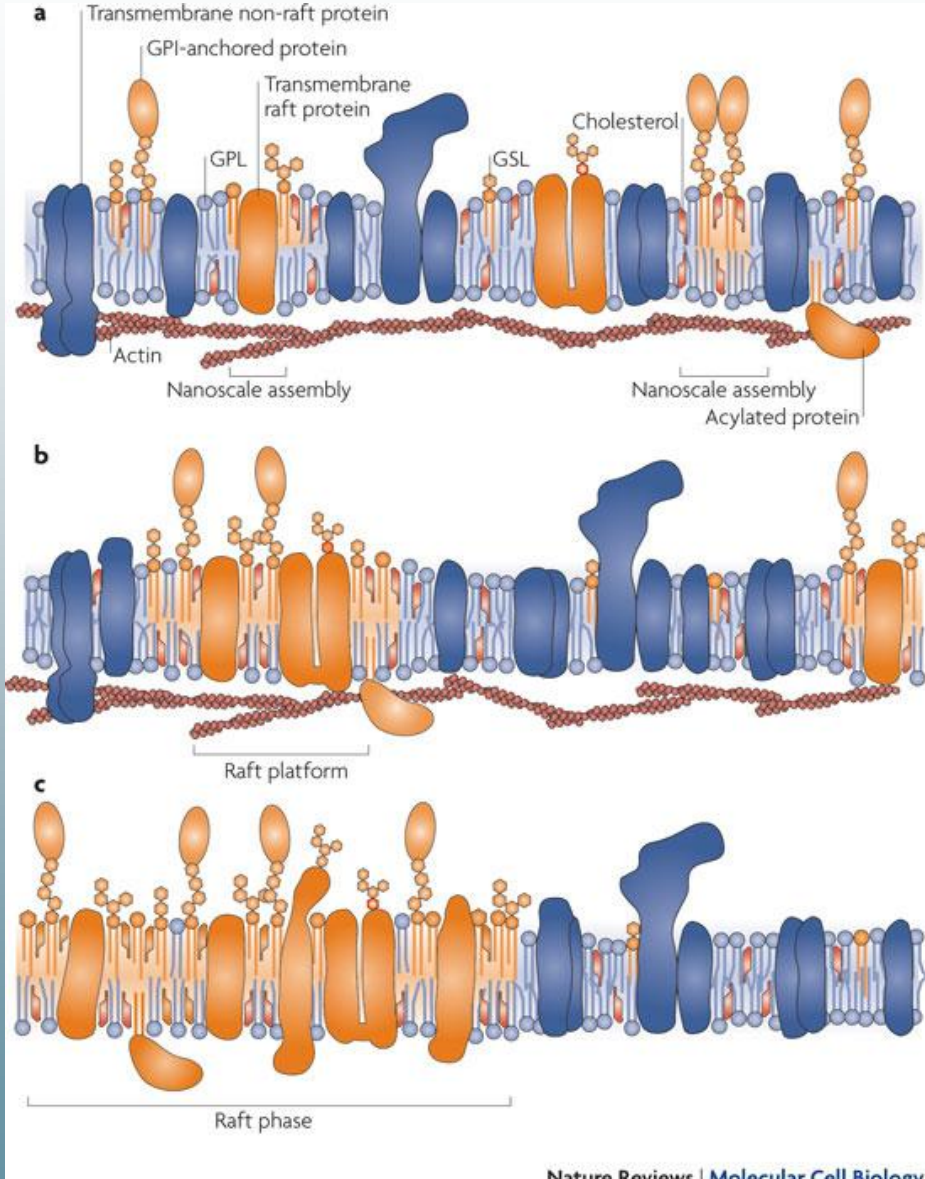


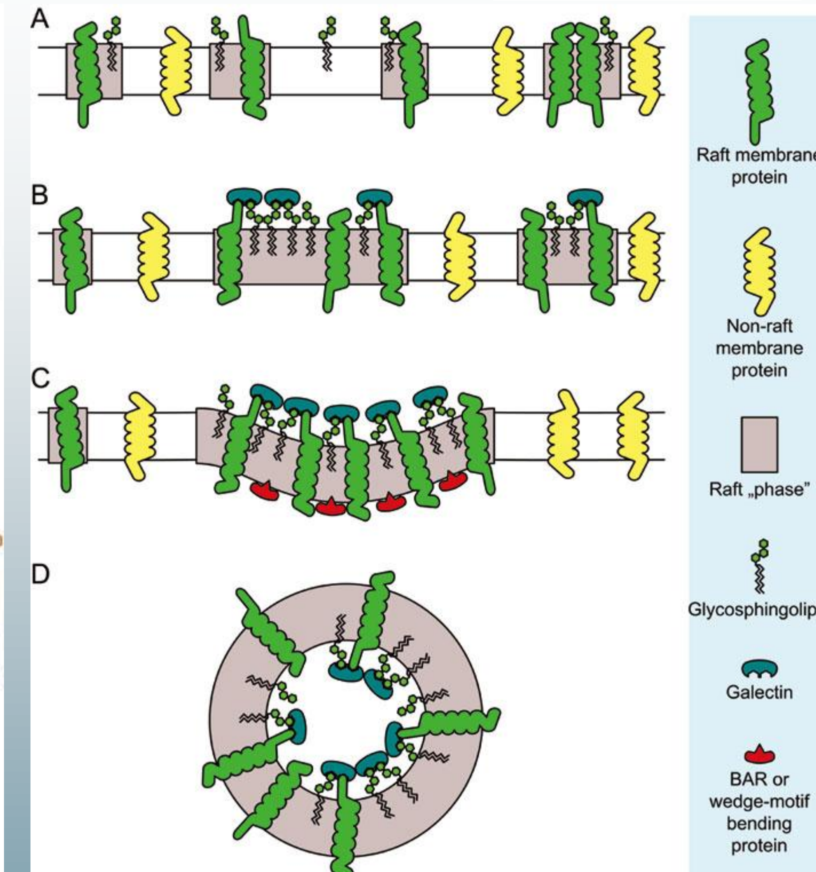
Recycling of Lipid Rafts



Lipid Rafts and Endocytosis

Lipid Rafts

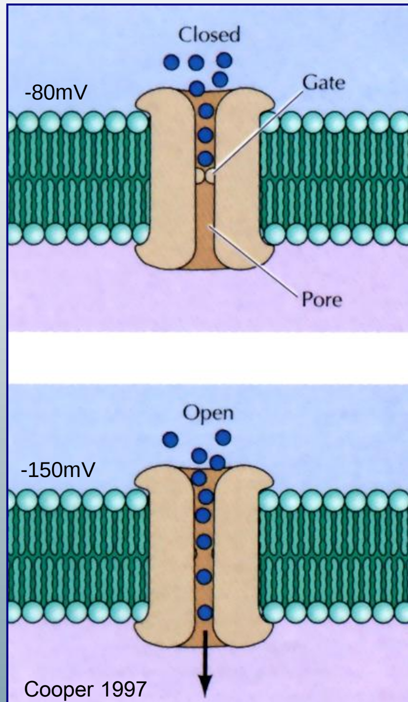




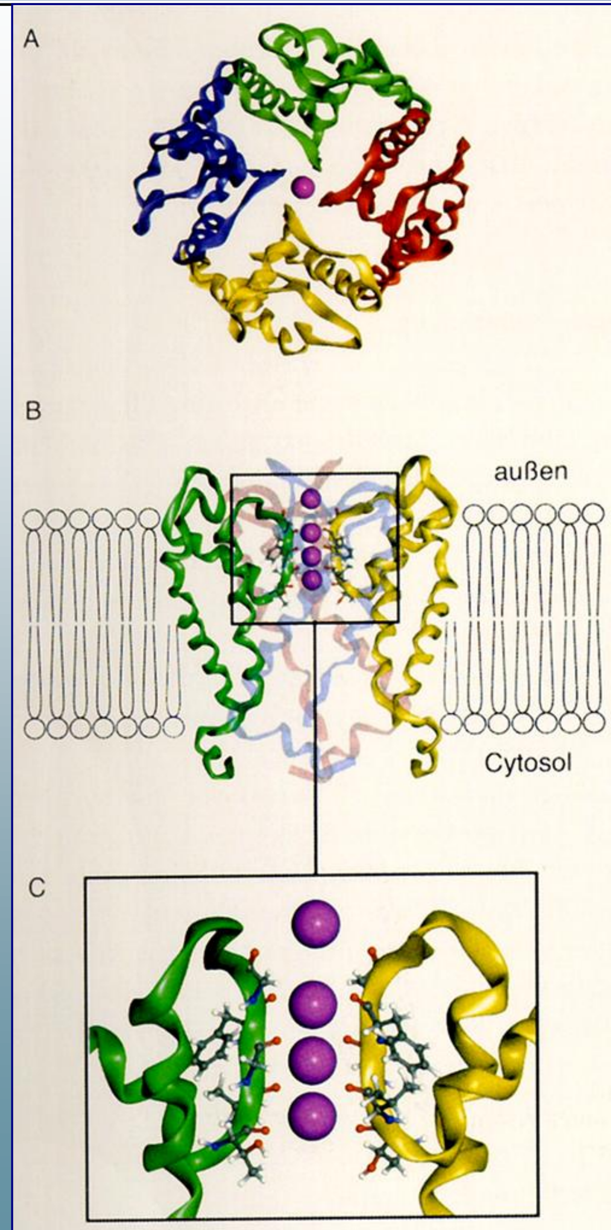
Lipid Rafts – Domain-Induced Vesicle Budding

Cell Res 22: 793-805 (2012)

Ion Channels



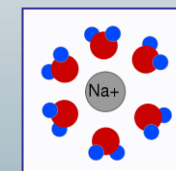
Cooper 1997



Lüttge, Kluge,Bauer 2005

K^+ Channel
Homotetramer

Hydrate sphere
Na^+ : 1.90Å
Ca^{2+} : 1.98Å
K^+ : 2.66Å
Cl^- : 3.62Å



Positively charged
Amino acids mediate
Voltage gating

Measuring Ion Channels

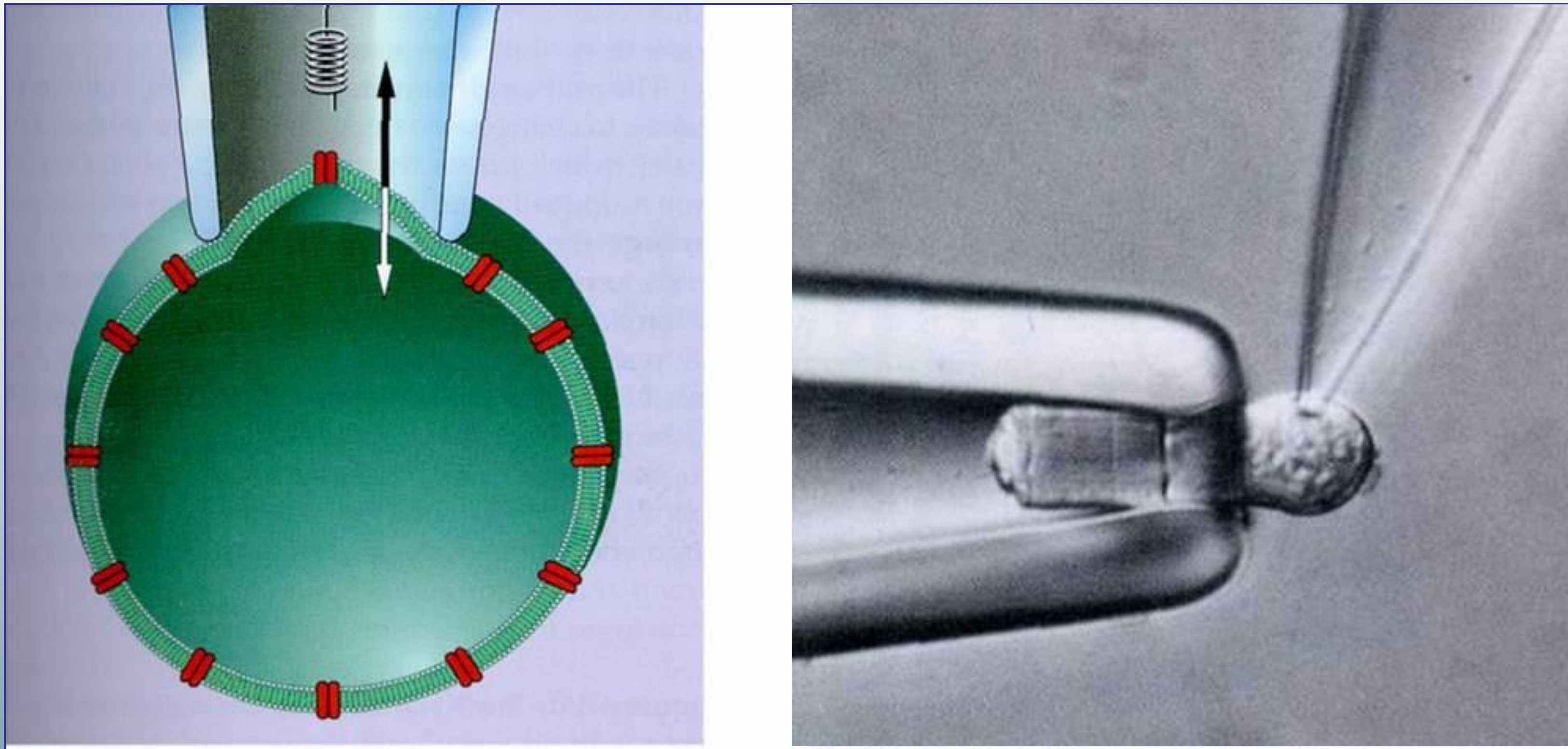


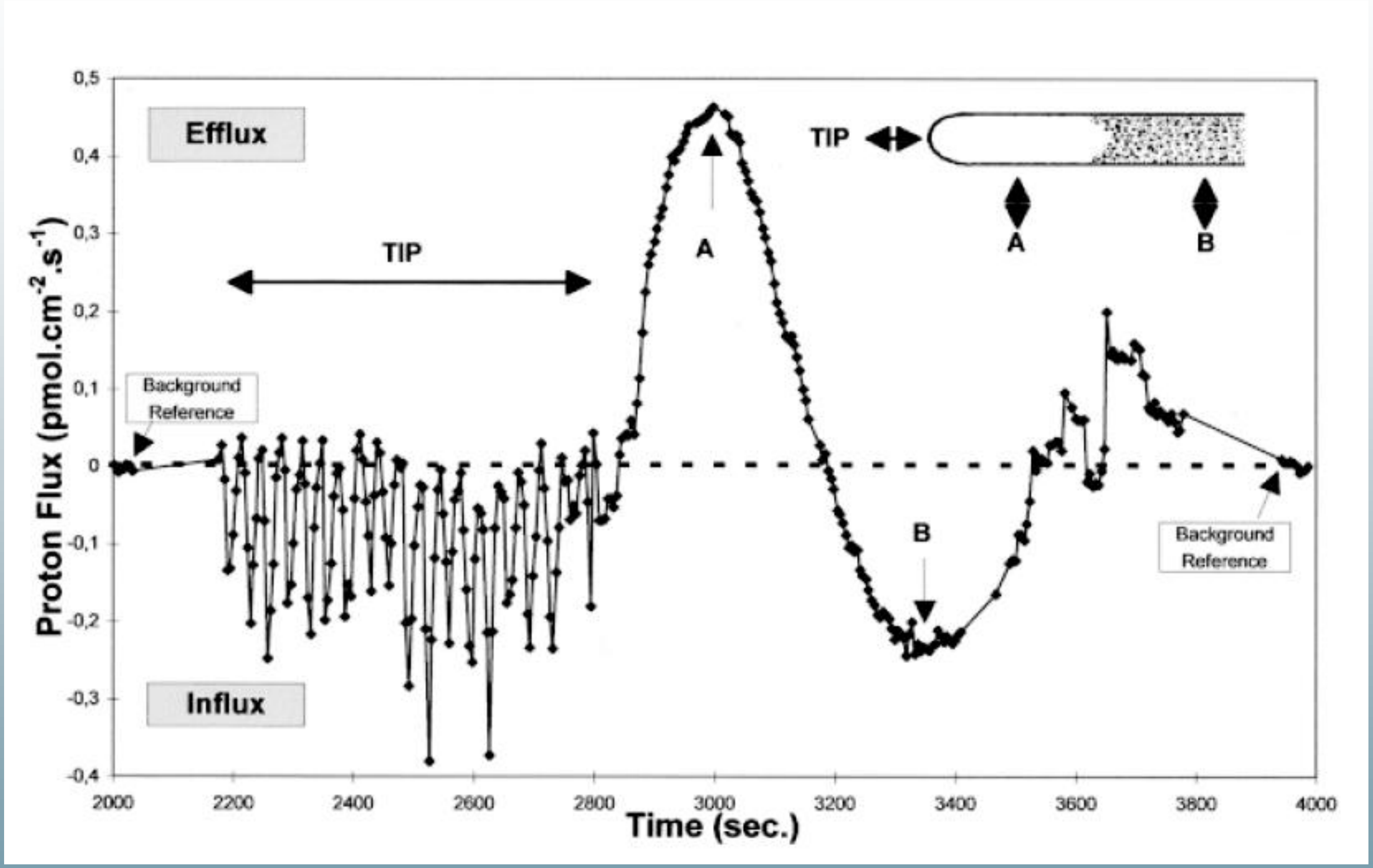
Fig. 4.35
Karp 1999

Patch - clamp technique

Erwin Neher and Bert Sakmann

Nobel Prize in Physiology or Medicine in 1991

Measuring Ion Fluxes Across Membranes



Proton fluxes at the pollen tube tip determined by a vibrating probe izmb.uni-bonn.de M.Sc. program **Plant Sciences**

Water Channels

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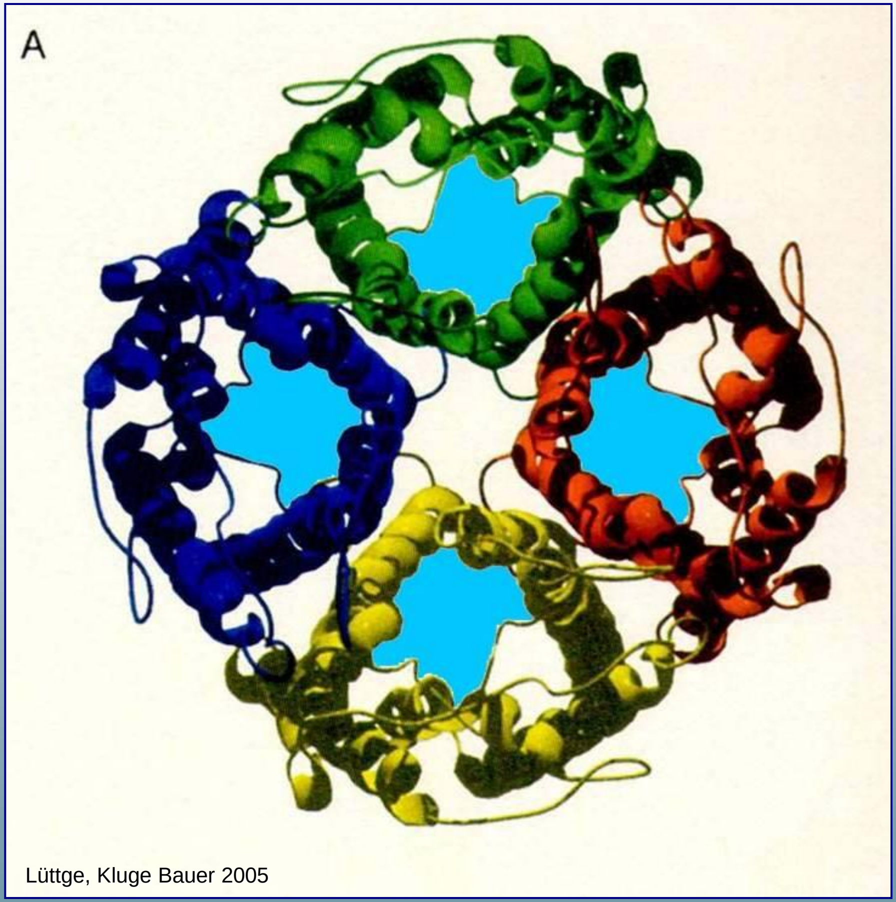
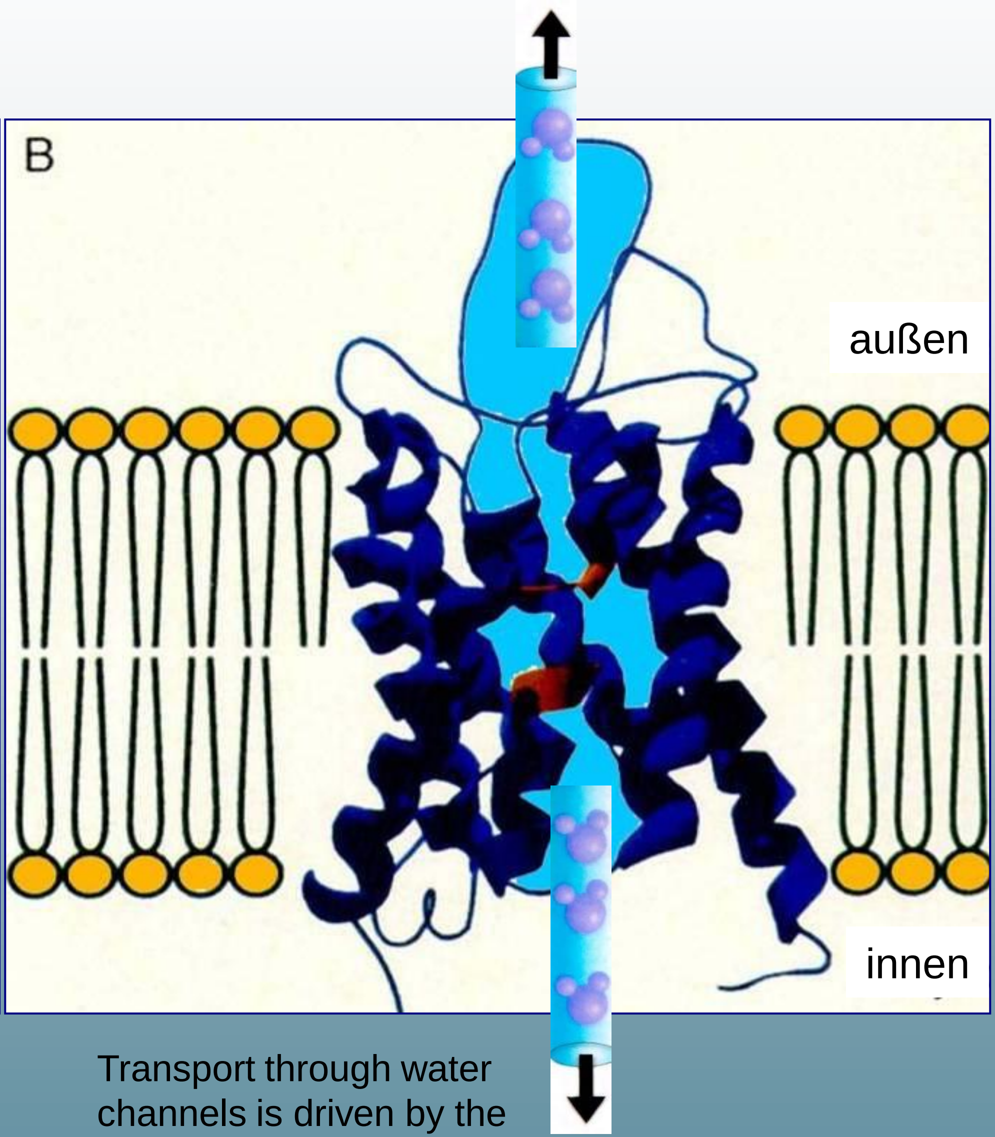
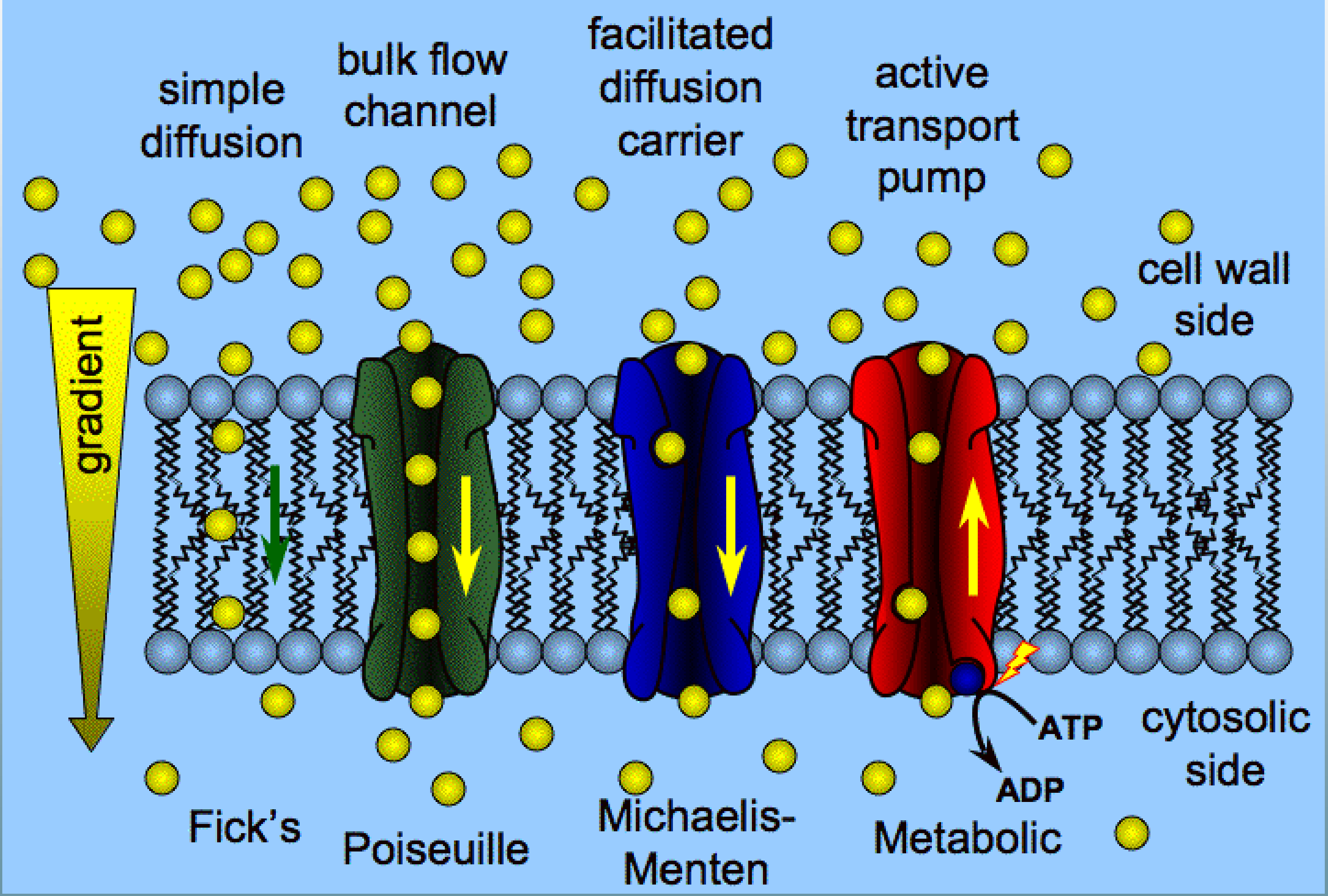




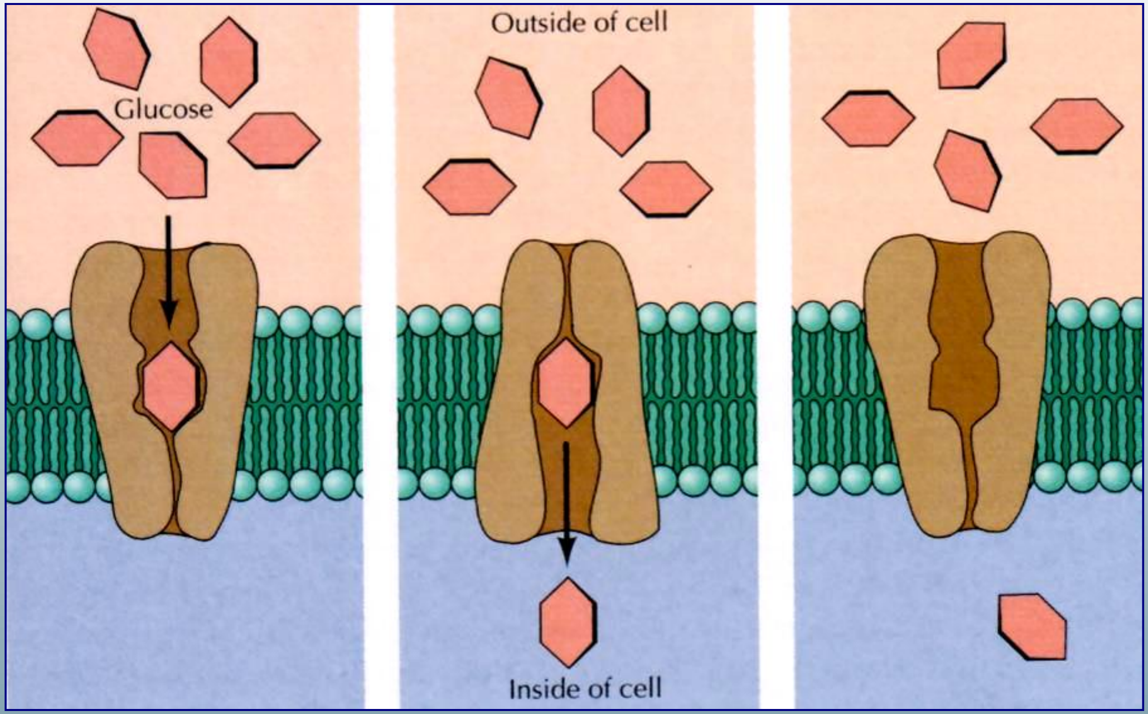
Aquaporin-Tetramer
monomer = 23-31kDa
4 classes ca. 60 genes

Transport through water channels is driven by the water potential gradient

Solute movement across a membrane

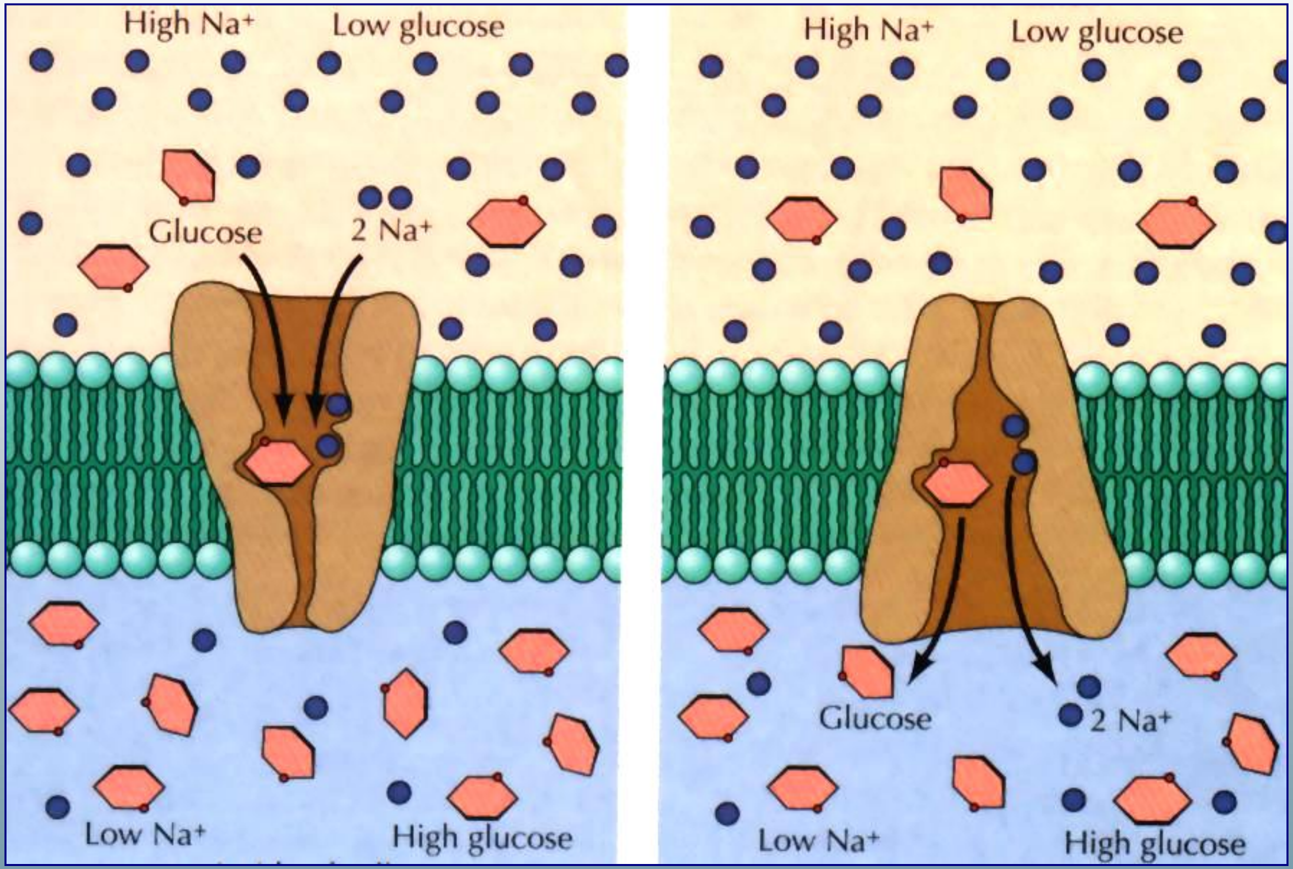


Carrier, Uniport



Transport through membrane carriers is driven by the concentration gradients

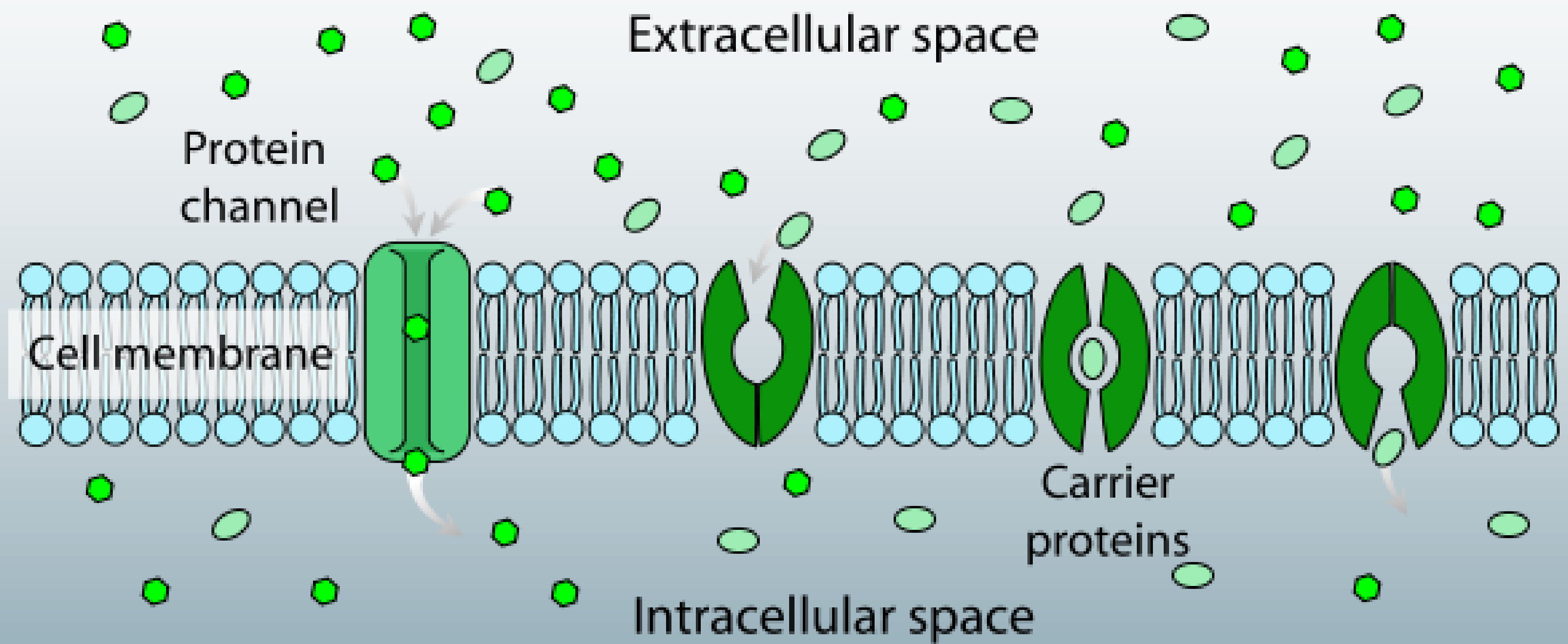
Carrier, Symport



Cooper 1997

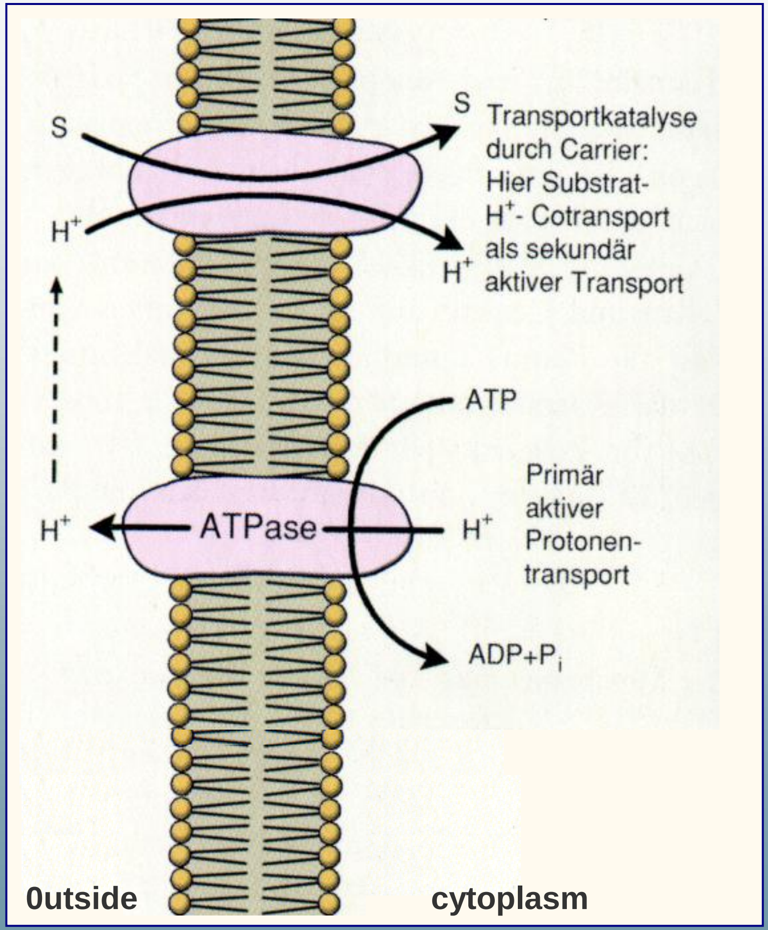
Transport through symports is driven by an electrochemical gradient

Carriers and Channels

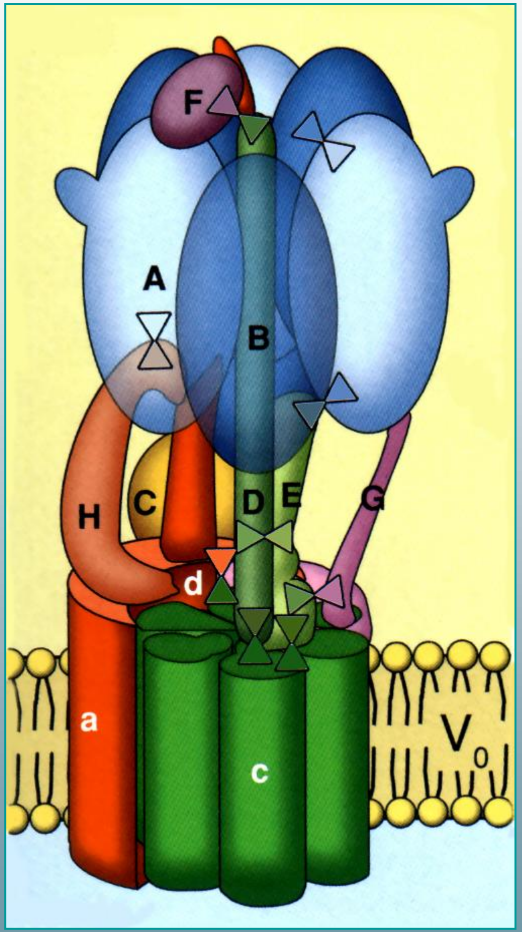


Transport through membrane carriers is driven by the concentration gradients

Proton-Sucrose Symporter



Proton sucrose symport driven by the electro chemical proton gradient



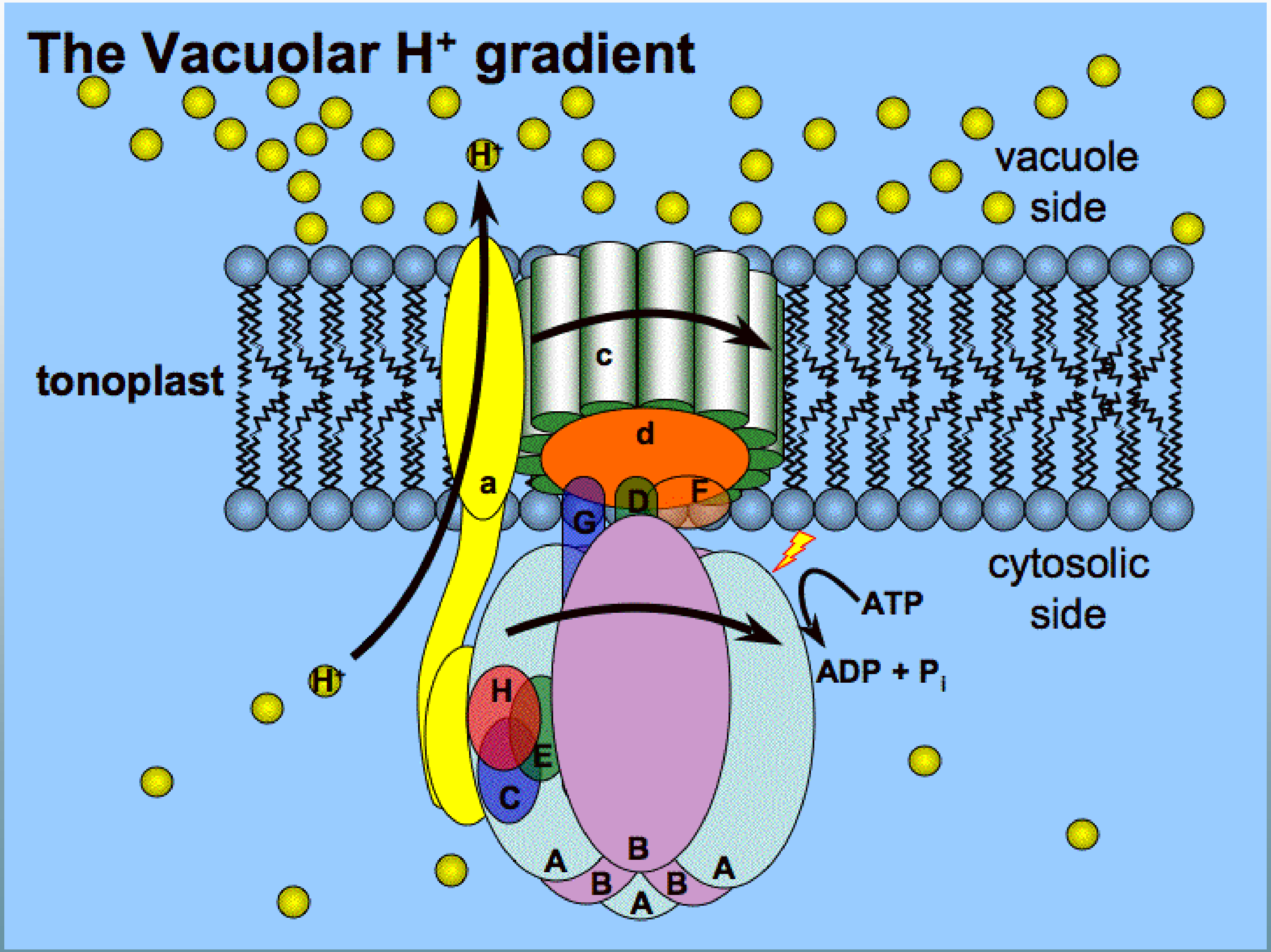
The Proton pump

ATP synthesis hexameric head

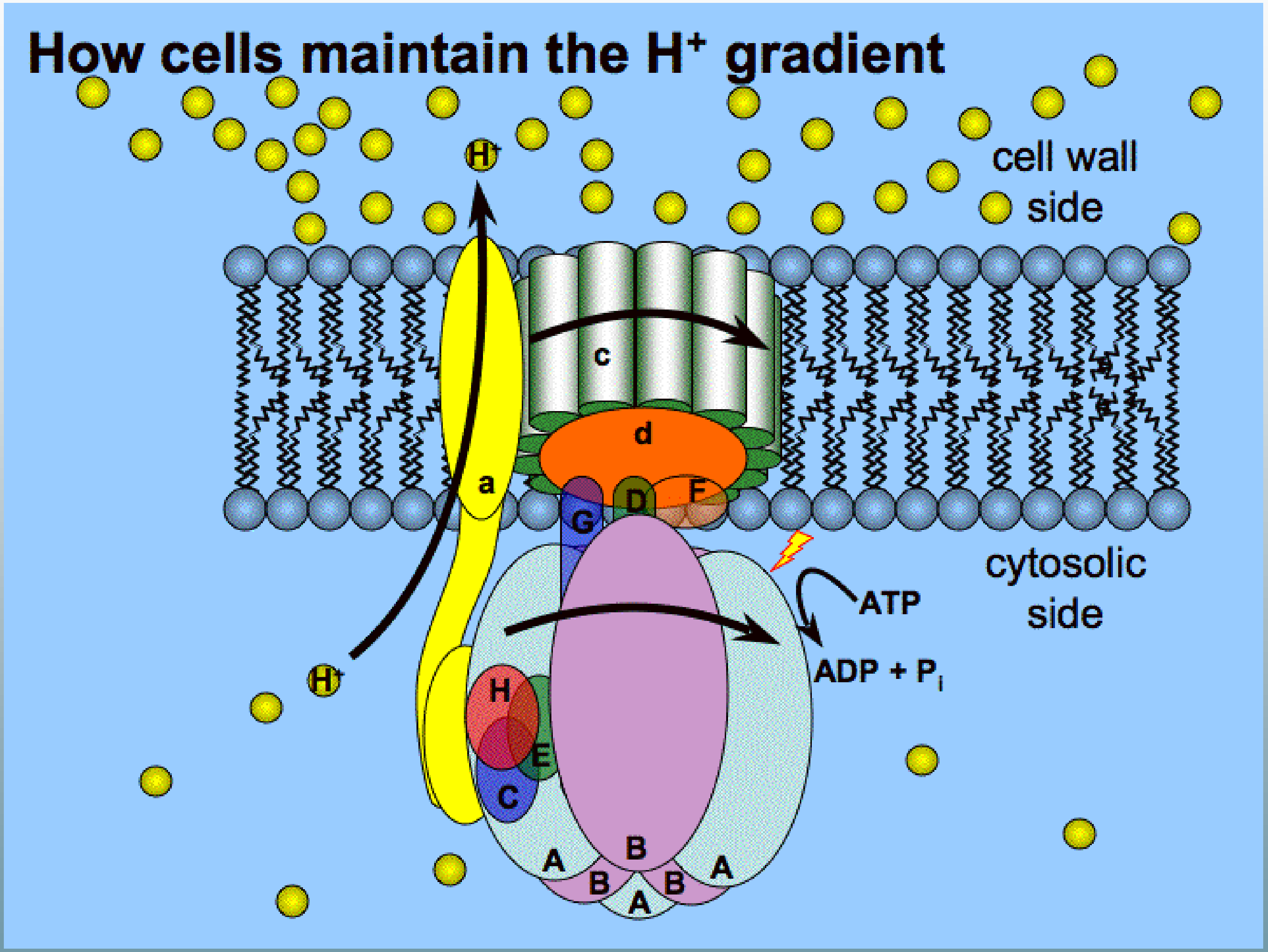
gamma subunit shaft (stator)

Proton translocation through rotor

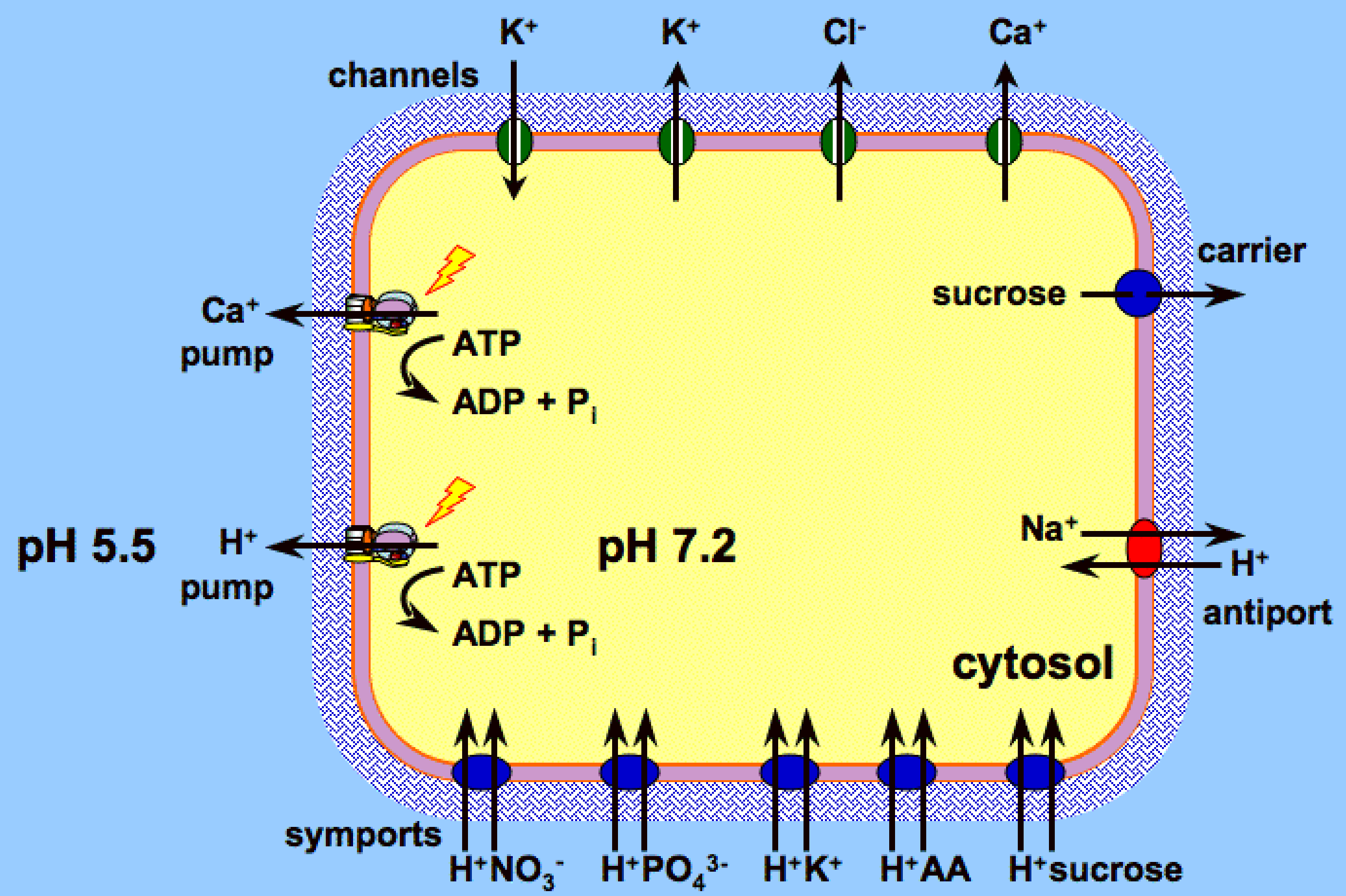
Vacuolar Proton Pump



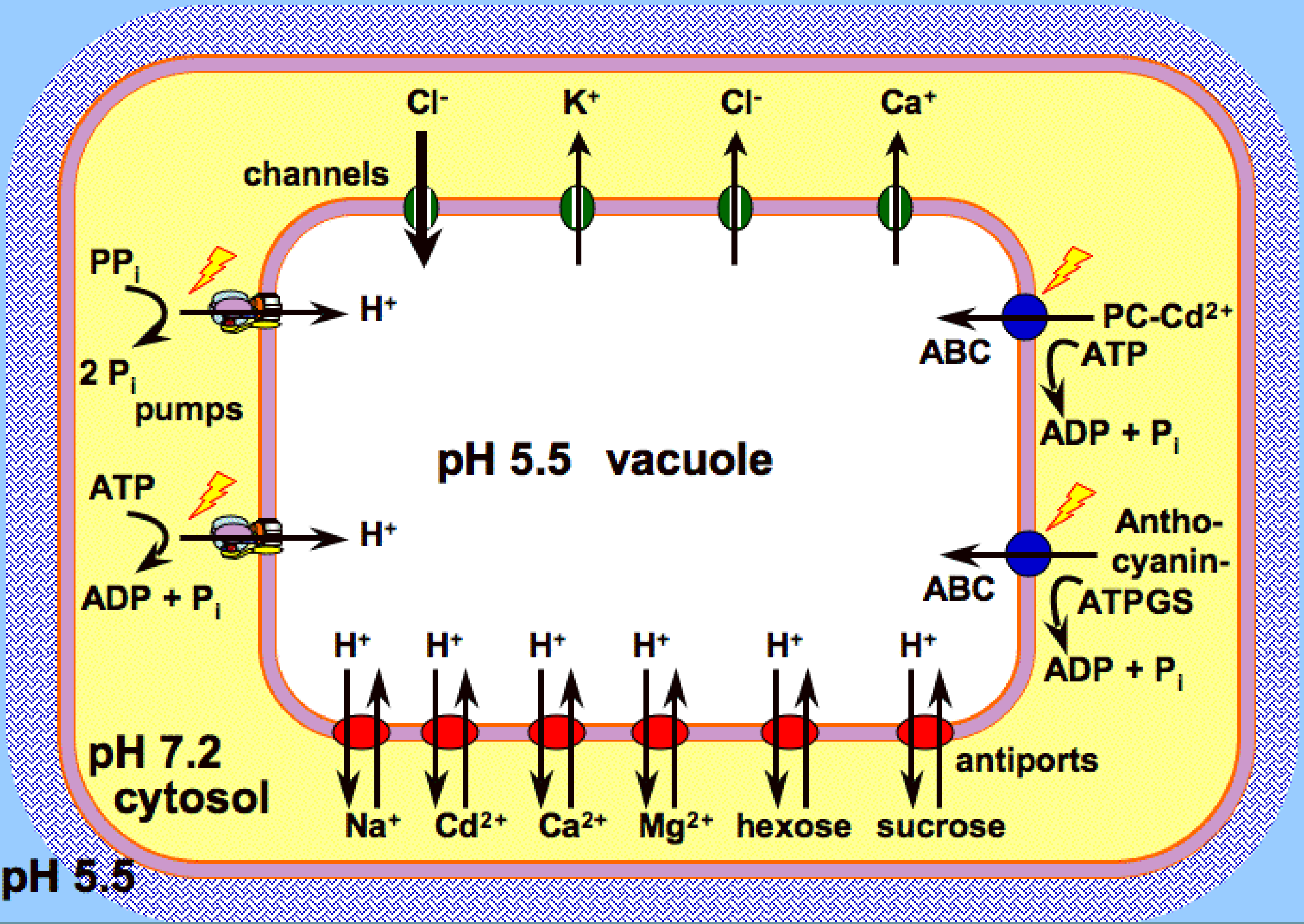
Plasma Memrbrane H^+ ATPase



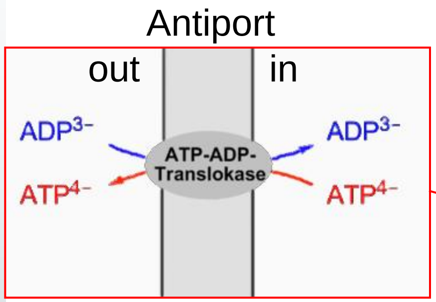
Cell Membrane Transport Proteins

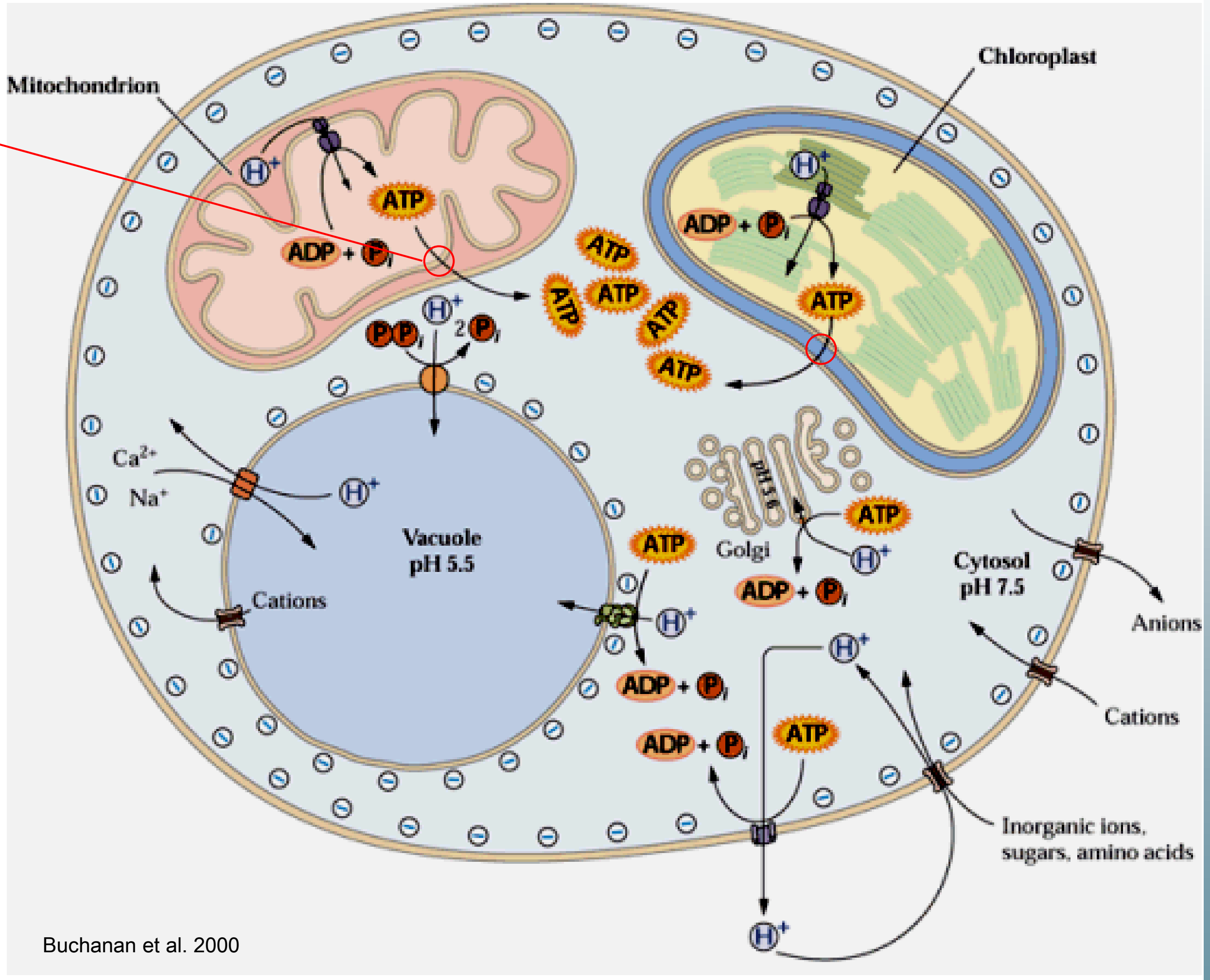


Vacuole Transport Proteins



Maintenance of Negative Membrane Potential

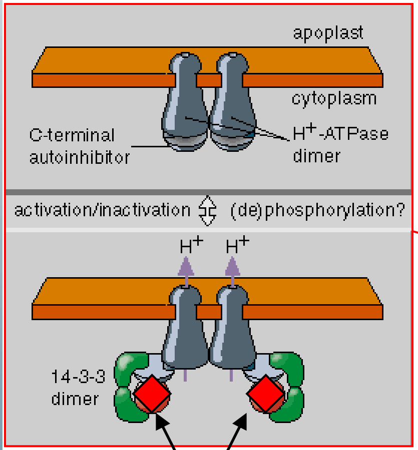




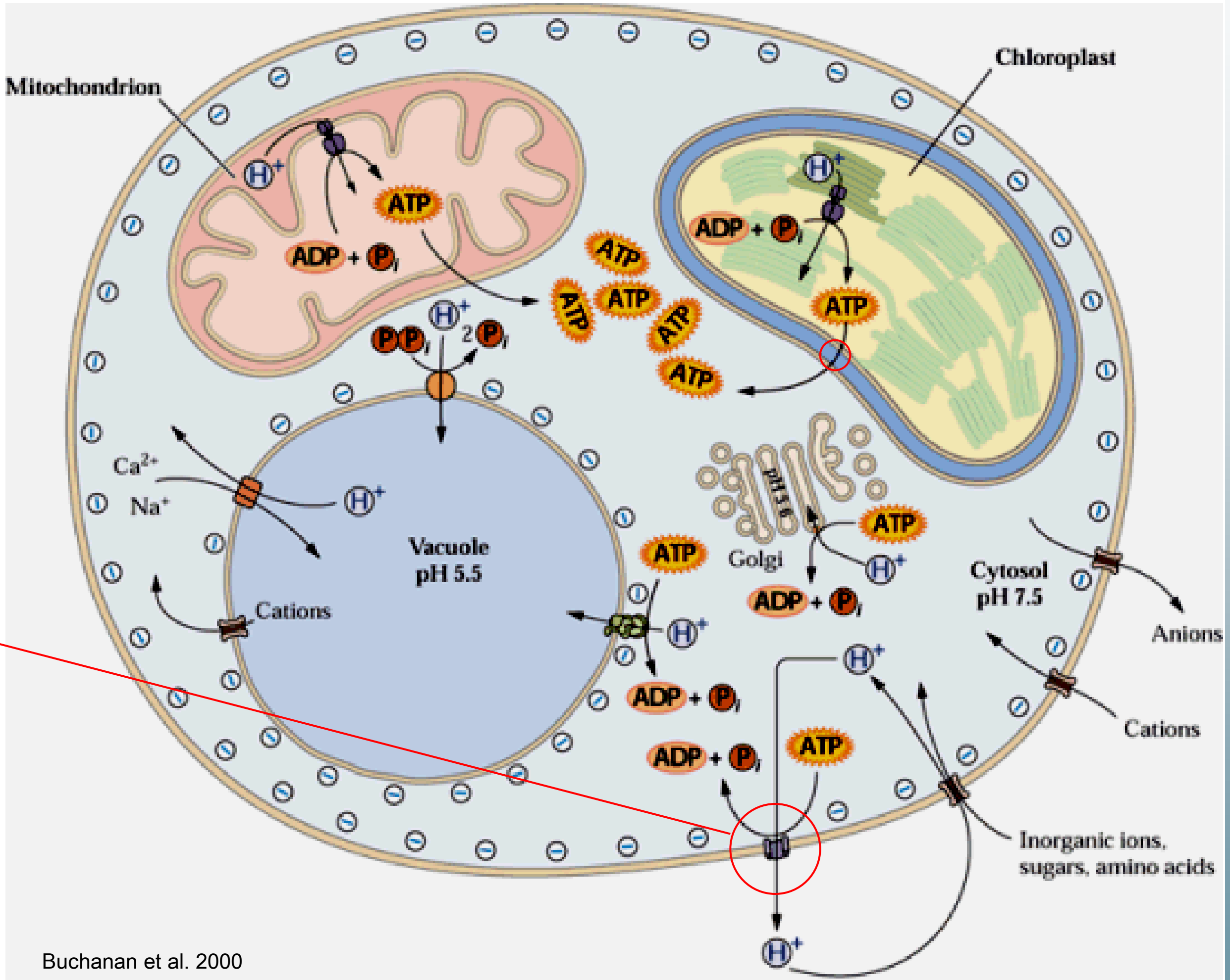
Negative membrane potential (-100 bis -300mV), basic pH in the cytoplasm

Maintenance of Negative Membrane Potential

Proton ATPase



Fusicoccin

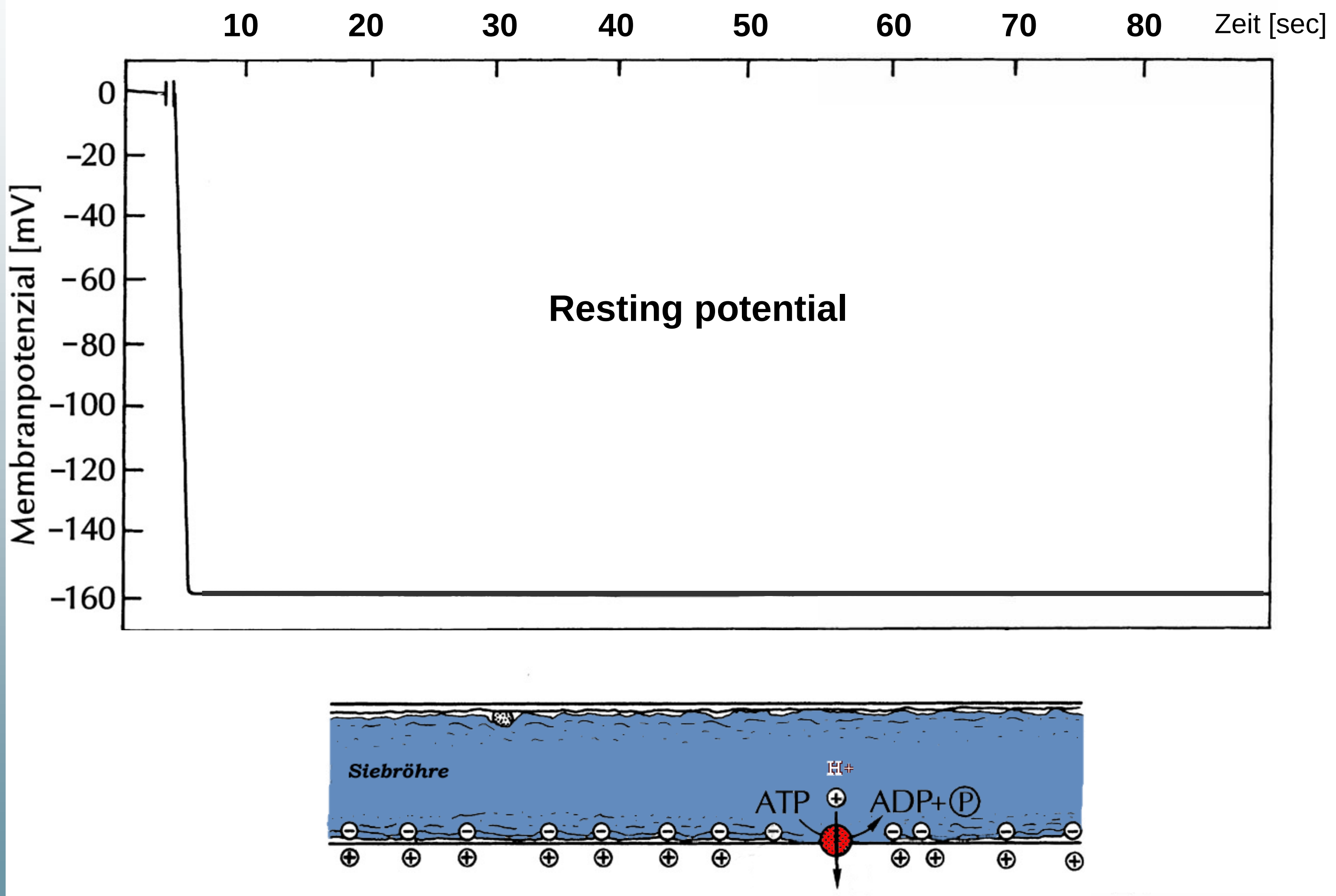


Buchanan et al. 2000

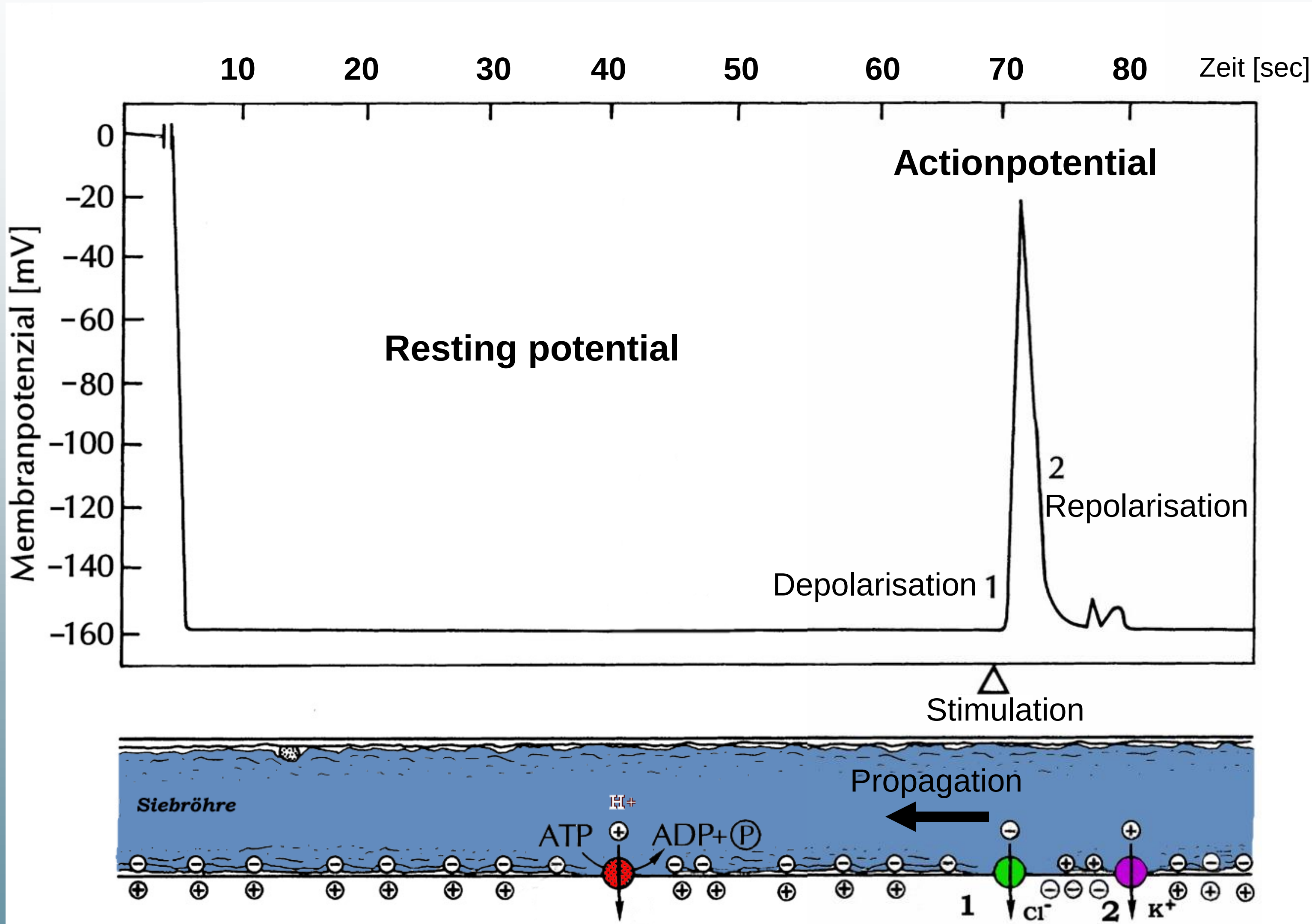
Fusicoccum amygdali causes wilting disease

Negative membrane potential (-100 bis -300mV), basic pH in the cytoplasm

Action Potential



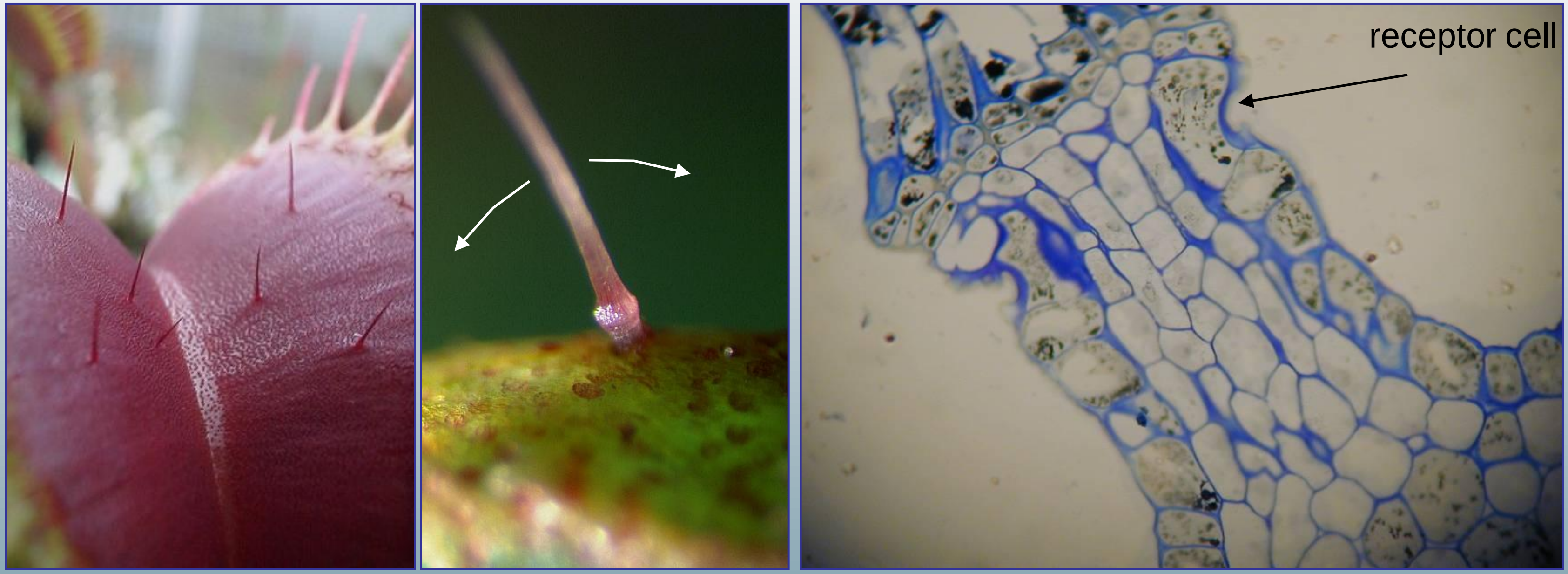
Action Potential



voltage gated ion -channels

Dionaea Trigger Hair

Insect trips over a trigger hair
trigger hair becomes bent,
thin walled receptor cells get squeezed,
mechanoreceptors recognize change in turgor pressur



Ion channels in the plasma membrane fire off action potential, which spreads over the leaf surface causing the turgor in the epidermis cells to break down.