FACULTAD DE CIENCIAS
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UNIVERSIDAD DE LA REPÚBLICA URUGUAY

Biología Celular
2020

Membrana plasmática

1. estructura
2. **función**

María José Arezo
Flavio Zolessi

Funciones de las membranas celulares

¿Cuáles es LA función PRINCIPAL de la membrana plasmática?

A – Impide (regula) el pasaje de iones.

B – Impide la pérdida de agua.

C – Impide la entrada de patógenos, como virus.

D – Comunica a la célula con el exterior.

Funciones de las membranas celulares

1. Barrera: control del pasaje de moléculas

2. Compartimentalización

3. Recepción y transducción de señales

4. Unión intercelular y con la matriz extracelular

5. Soporte para reacciones bioquímicas y conversión de energía

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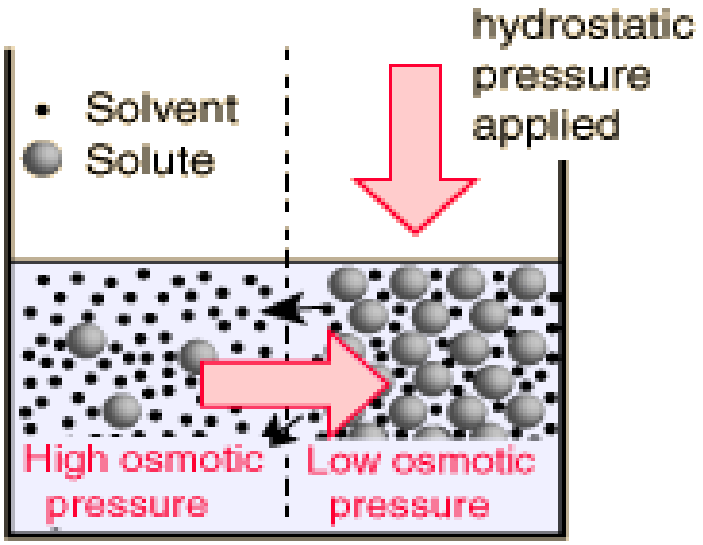
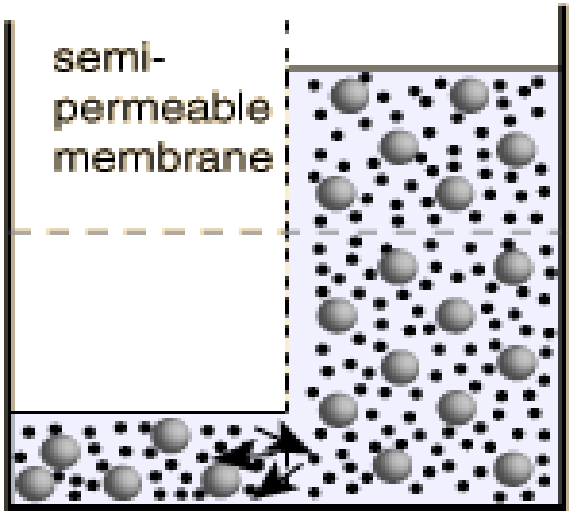
Membranas semipermeables y ósmosis





- ósmosis
- tonicidad (con respecto al interior cel, soluto no permeable)
  - medio hipotónico
  - medio isotónico
  - medio hipertónico
- osmolaridad
- soluciones hipo/iso/hiper osmóticas

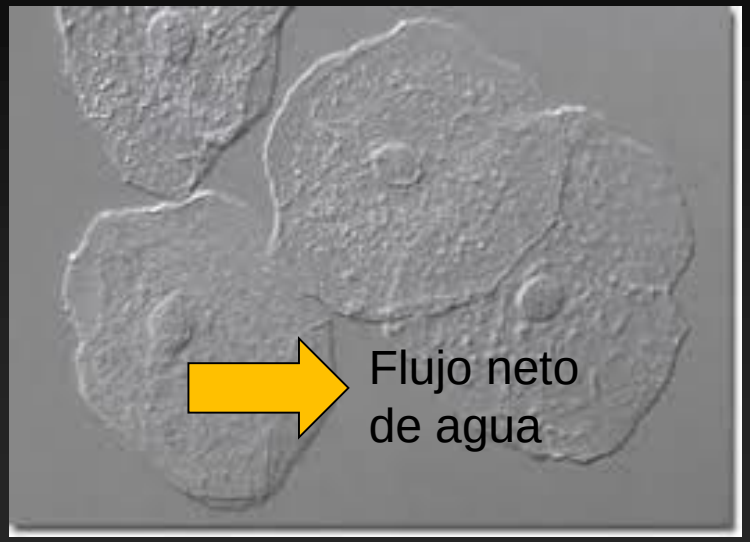
(con respecto al interior celular, independiente de permeabilidad del soluto)

- efecto osmótico

Osmolaridad interior celular = aprox. 0.3 osmolar

NaCl 1 M = 2 osmolar

(se disocia en solución)



Glucosa 1 M = 1 osmolar

(**no** se disocia en solución)

¿qué concentración debe tener una solución de NaCl para ser isotónica con respecto al interior celular?

0.15 M = 0.3 osm (M x nº partículas)

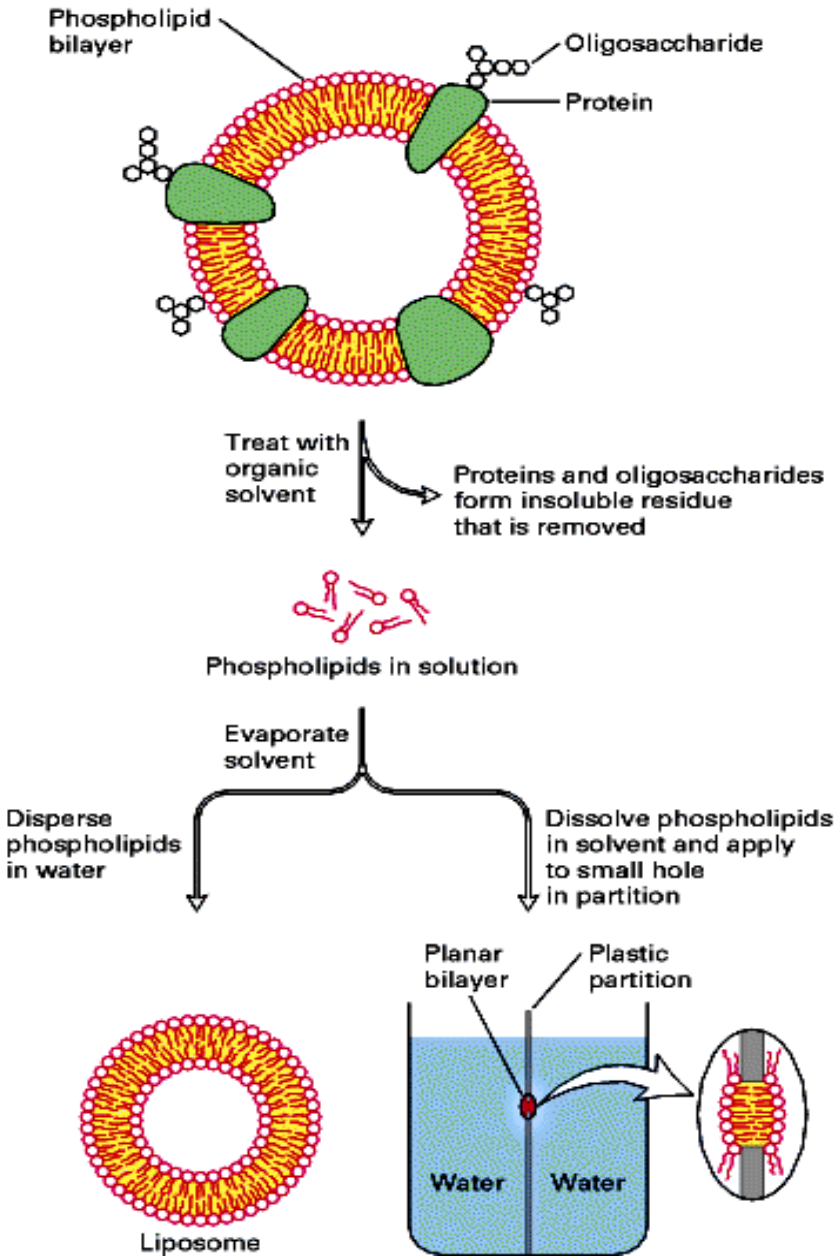
¿y una de glucosa?

0.3 M = 0.3 osm

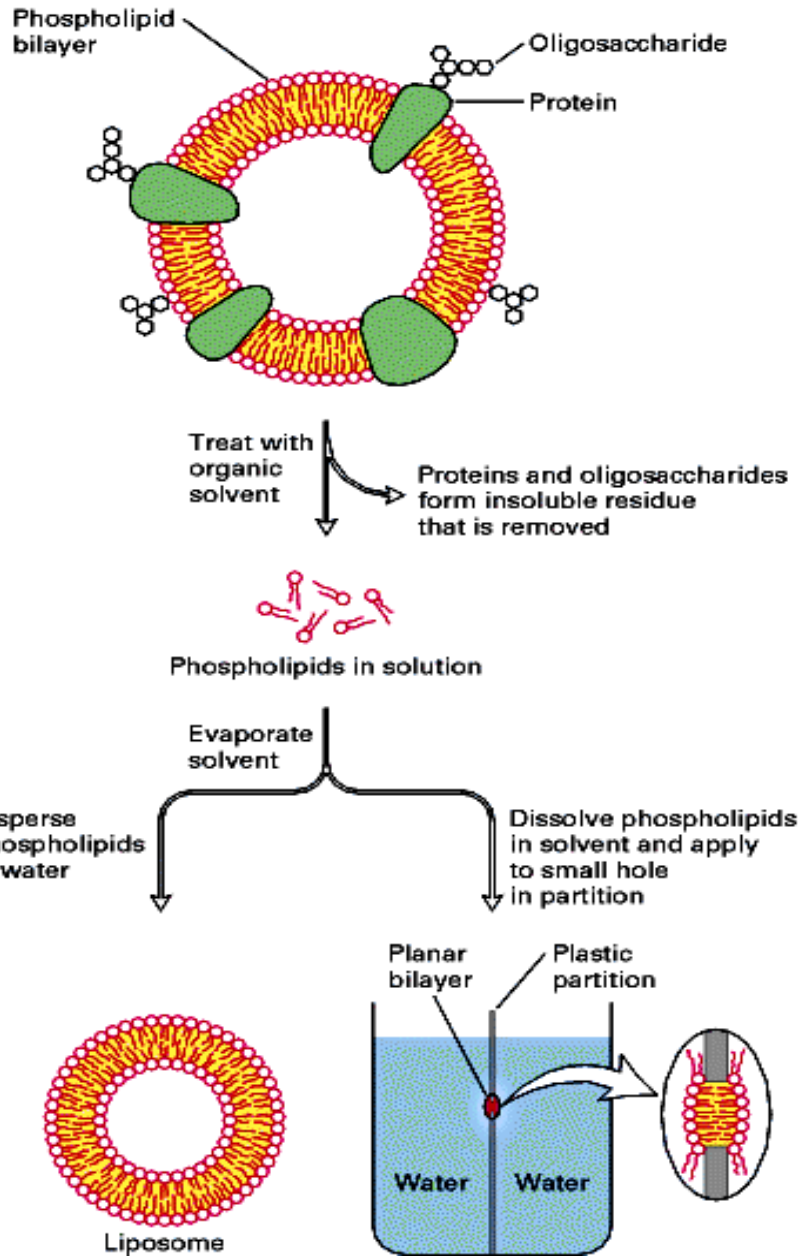
Concepto esencial en fisiología celular

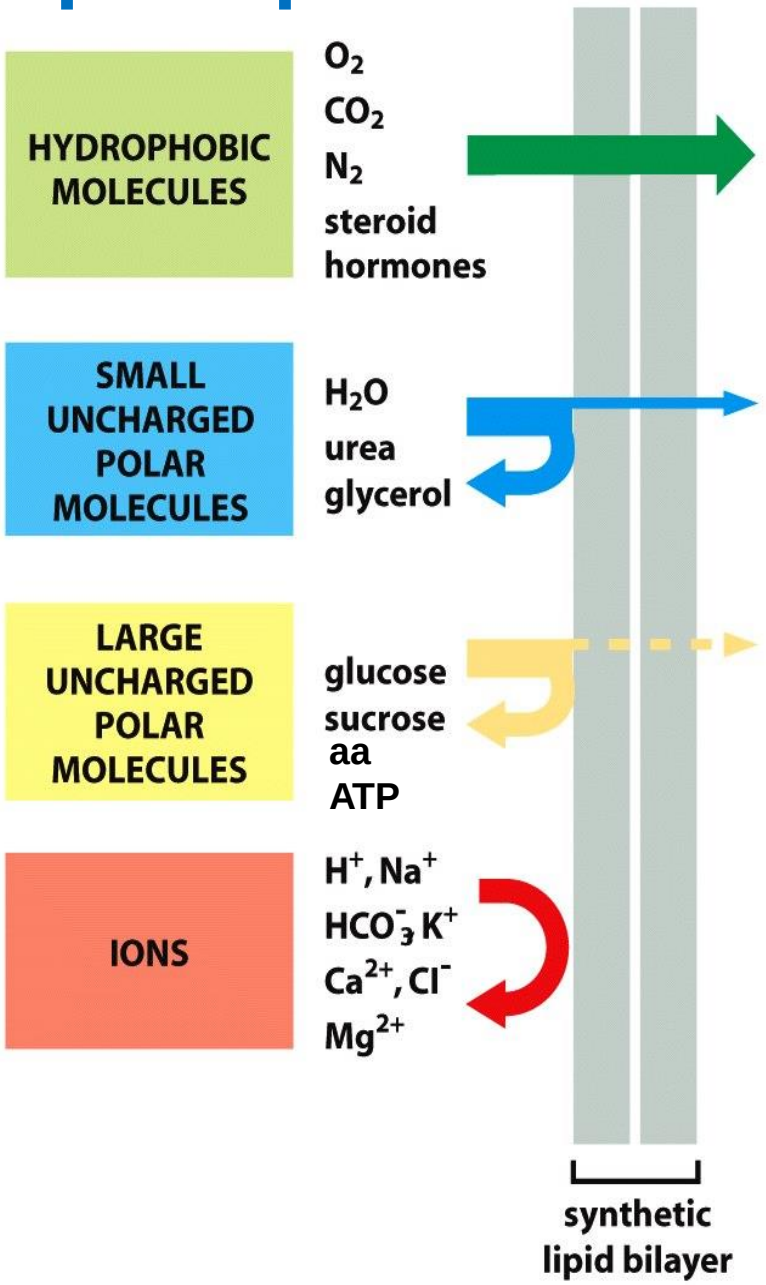
Efecto osmótico de una solución depende del número de partículas disueltas en la solución.

Permeabilidad en bicapas lipídicas

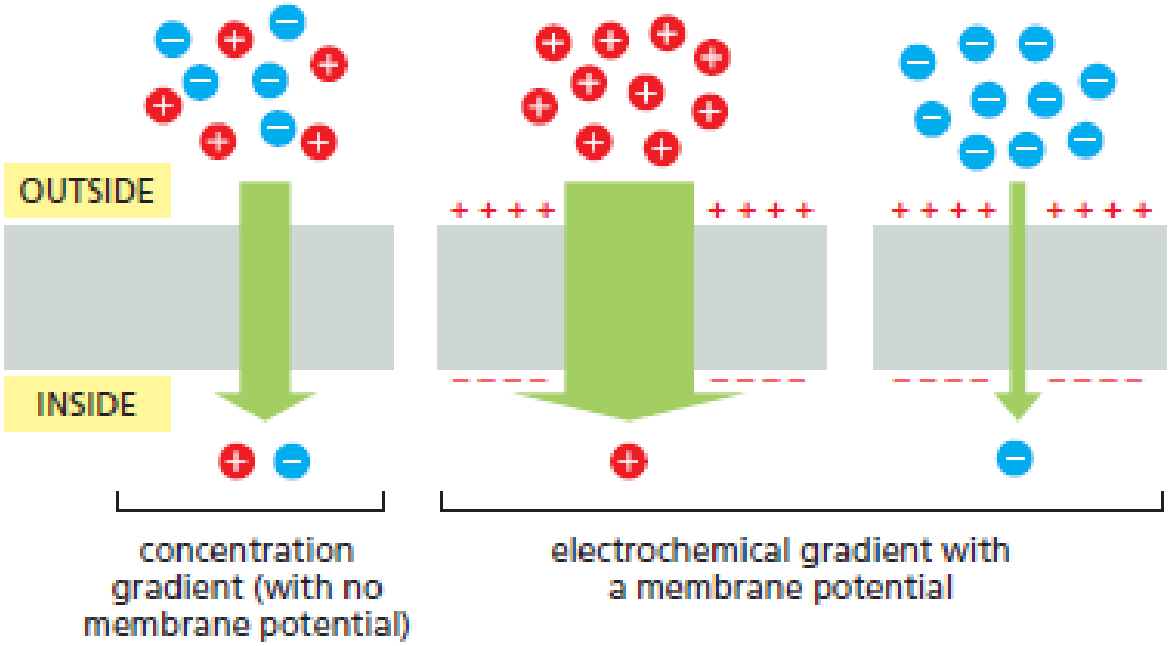


Permeabilidad en bicapas lipídicas



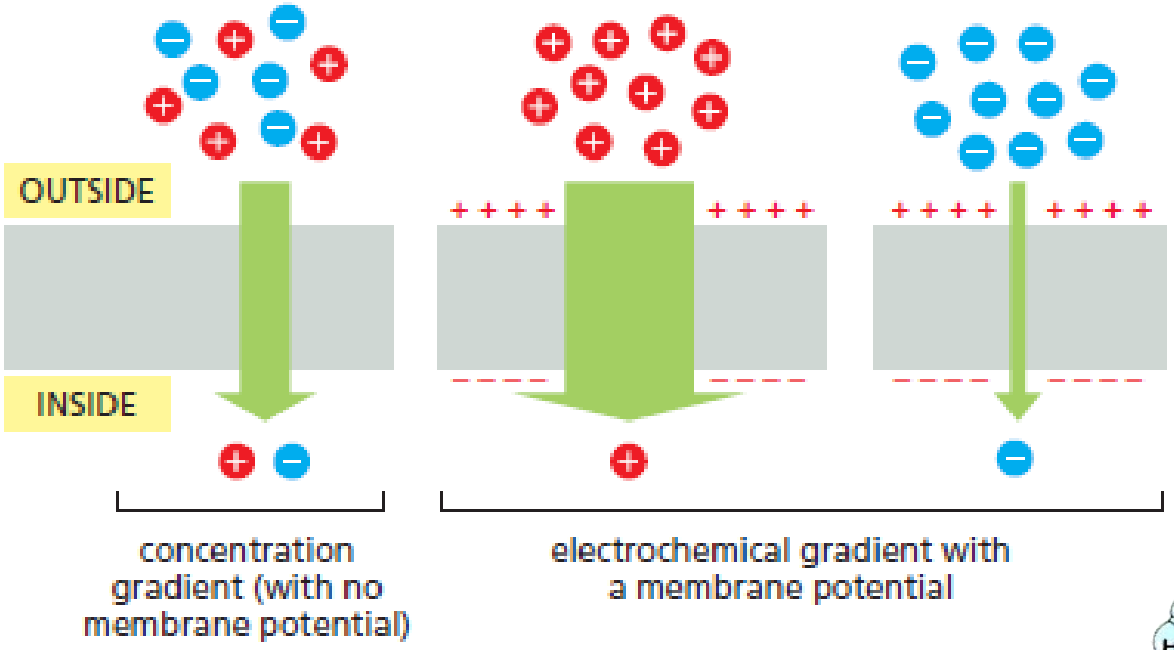


Gradientes de concentración iónica

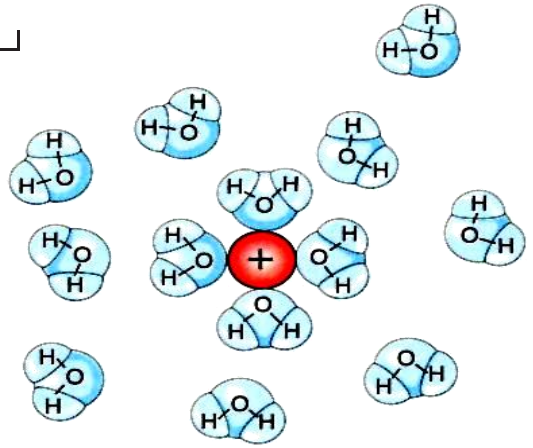


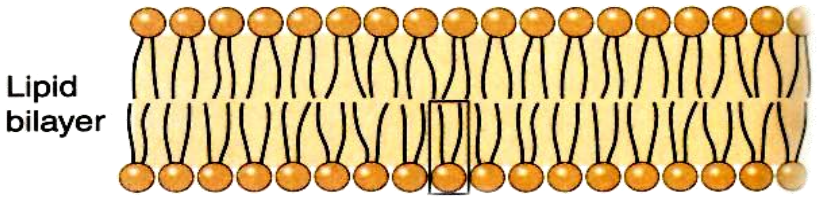
Gradiente electroquímico

Gradientes de concentración iónica



Gradiente electroquímico





Difusión y transporte a través de una membrana biológica

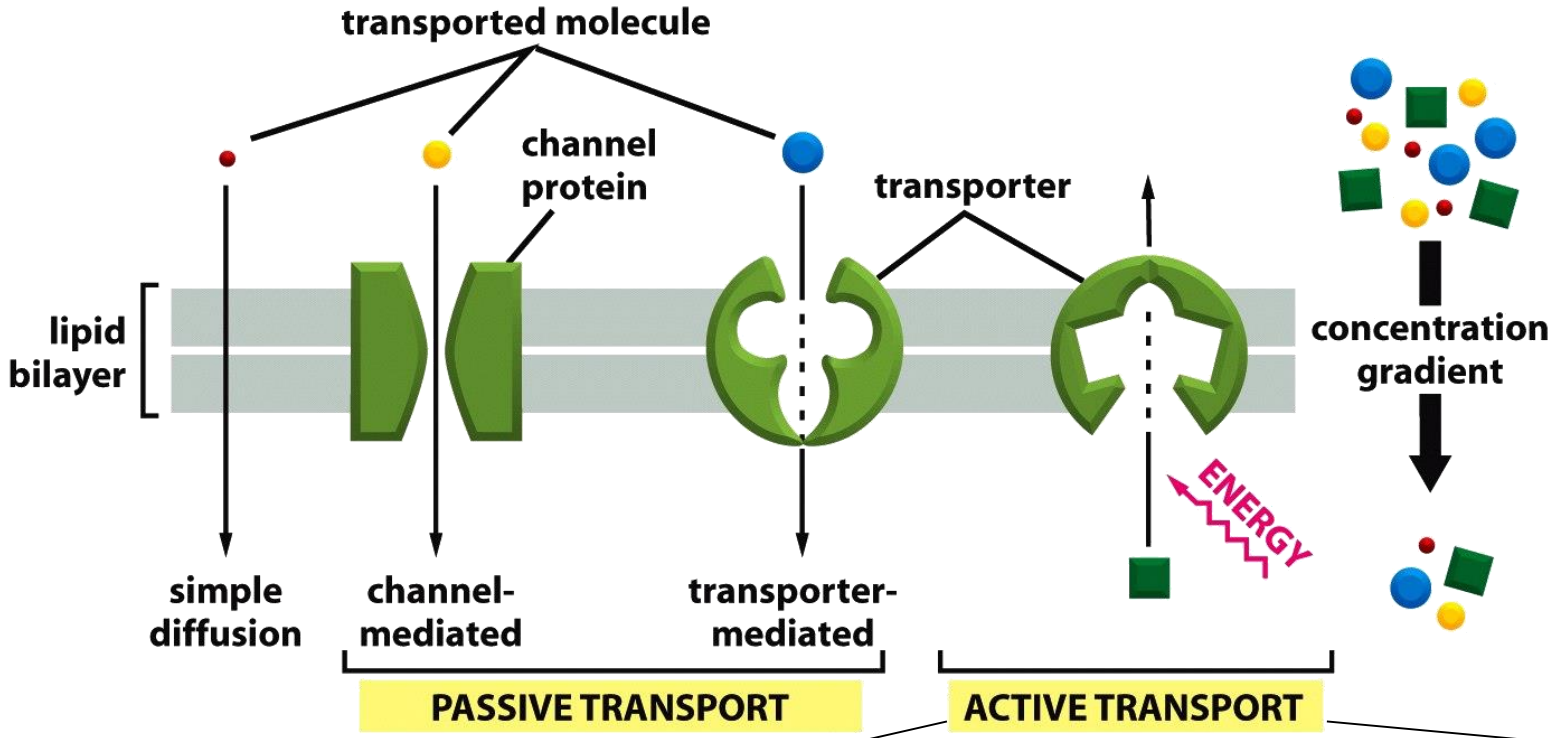


Figure 11-4a Molecular Biology of the Cell 5/e (© Garland Science 2008)

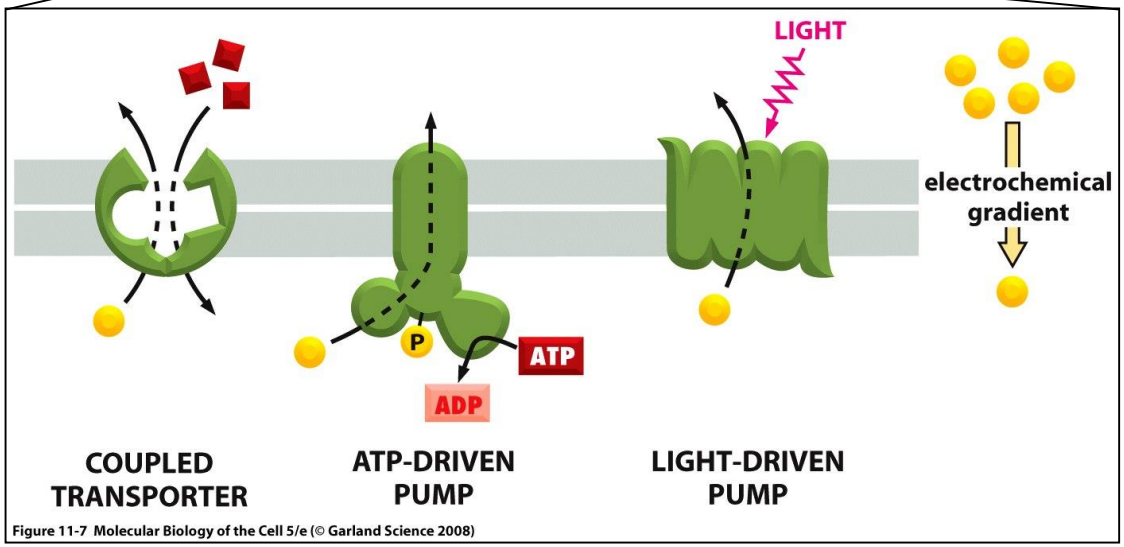
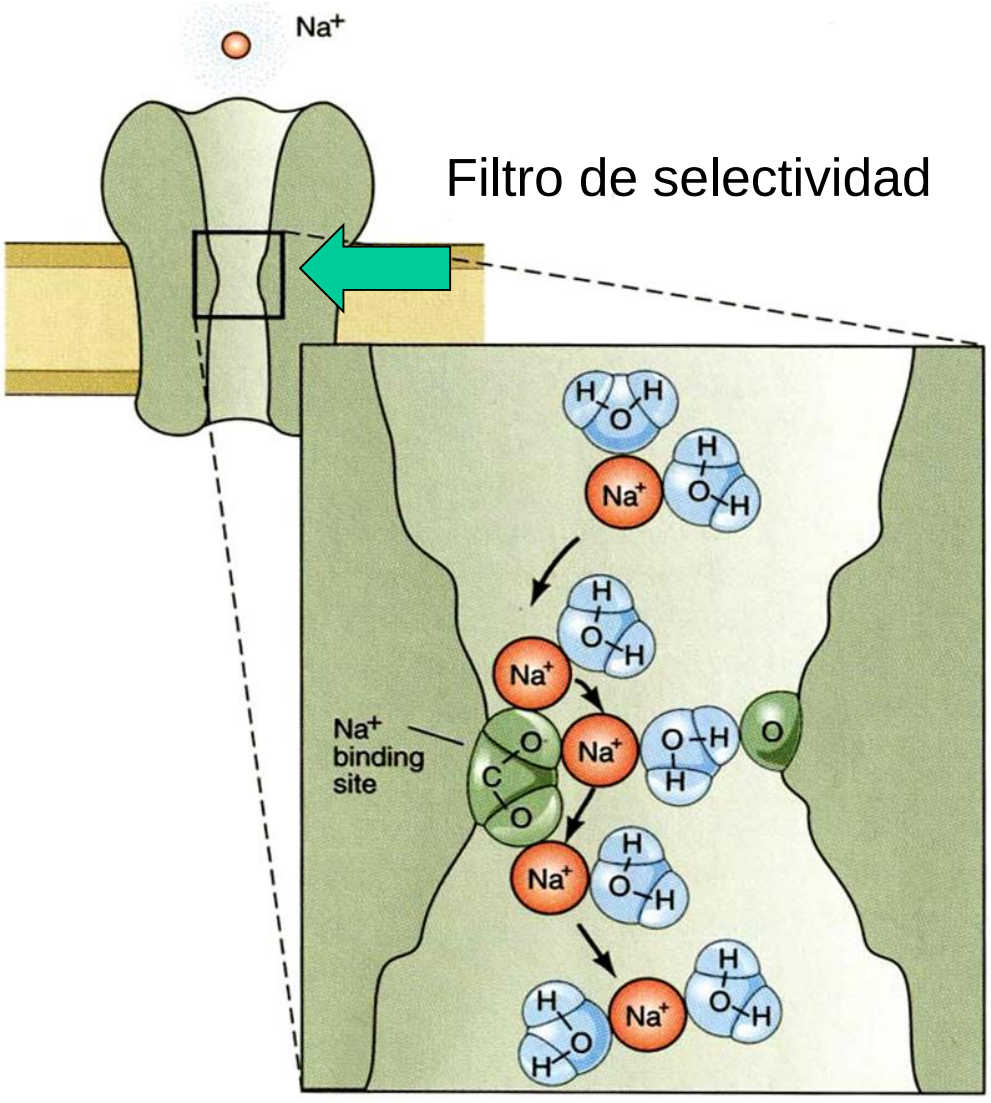
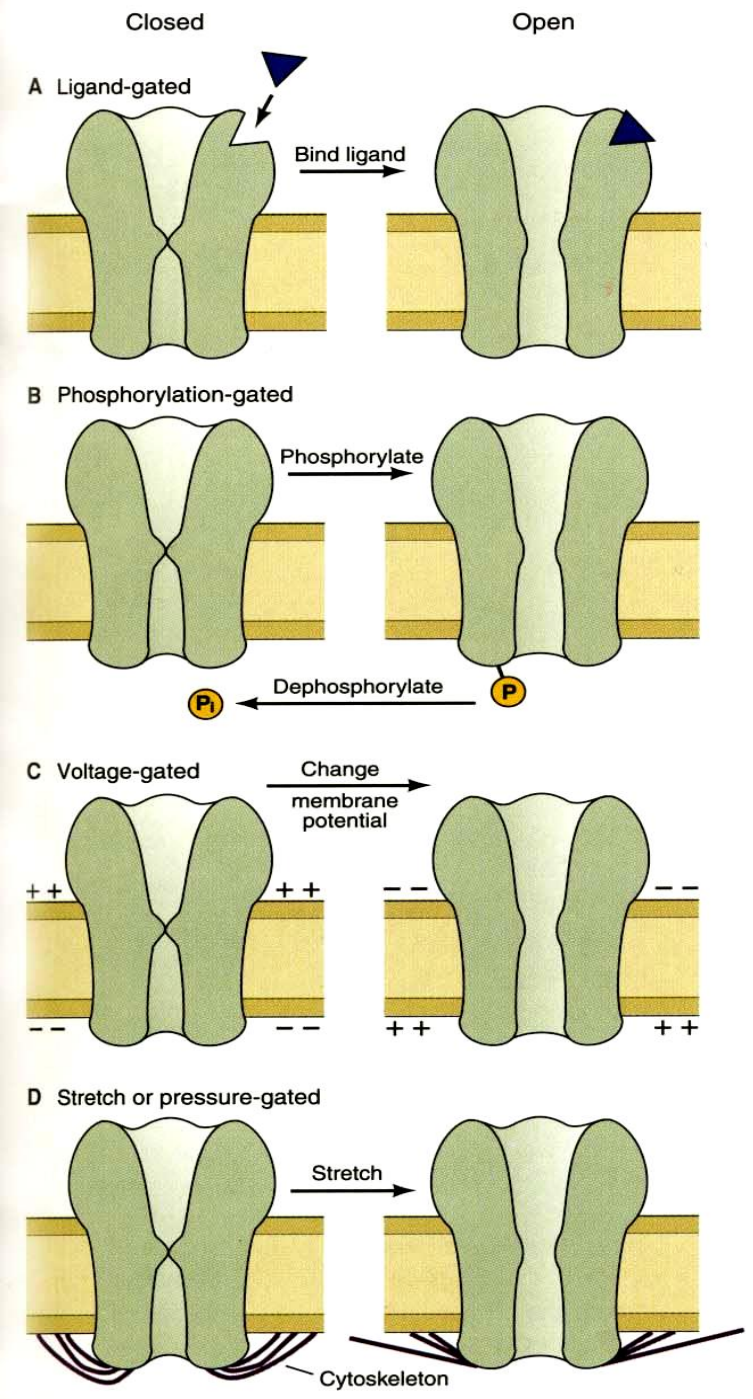


Figure 11-7 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Proteínas canal





Proteínas transportadoras

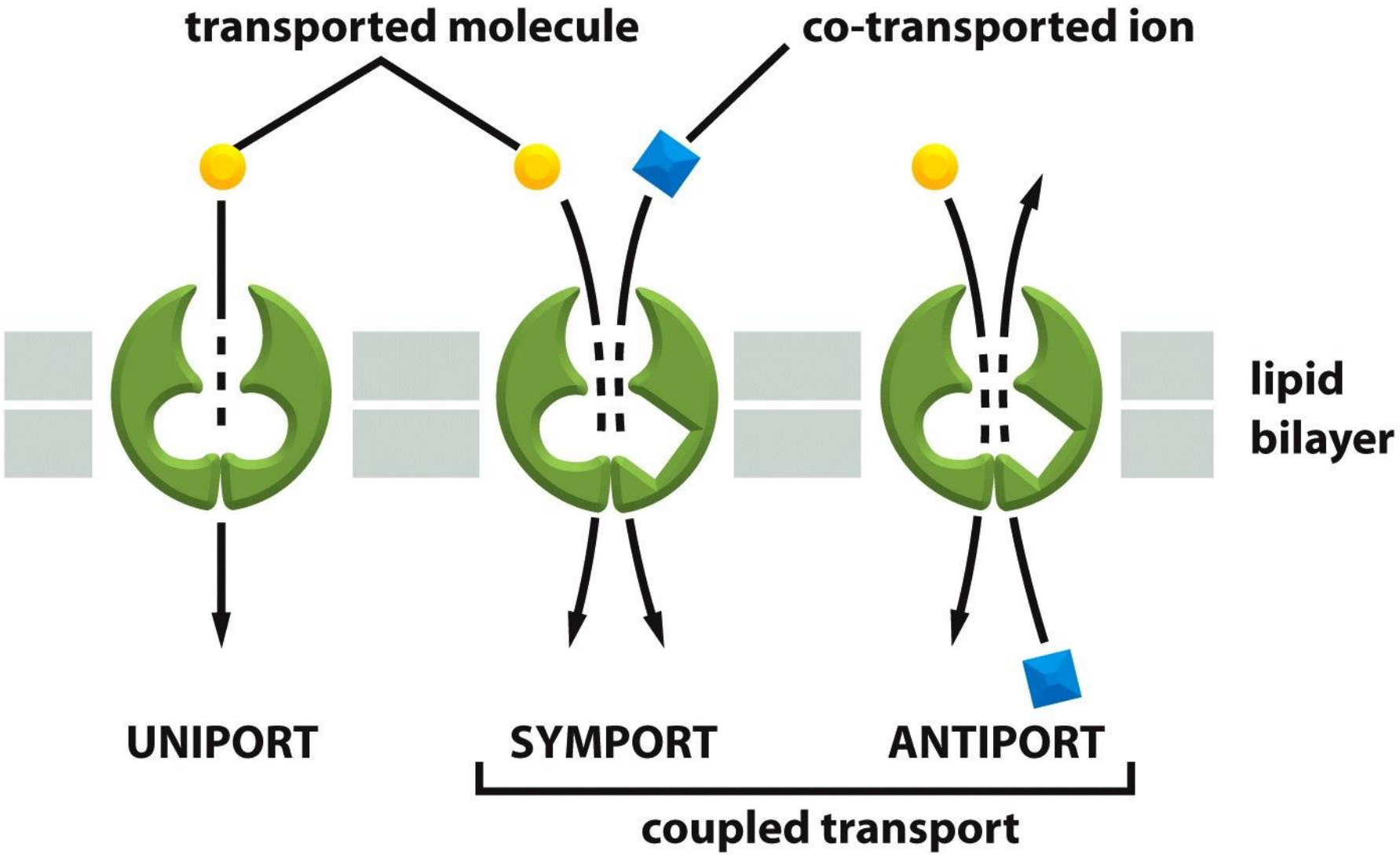


Figure 11-8 Molecular Biology of the Cell 5/e (© Garland Science 2008)

co-transportadores intercambiadores

Transporte acoplado a gradientes de concentración

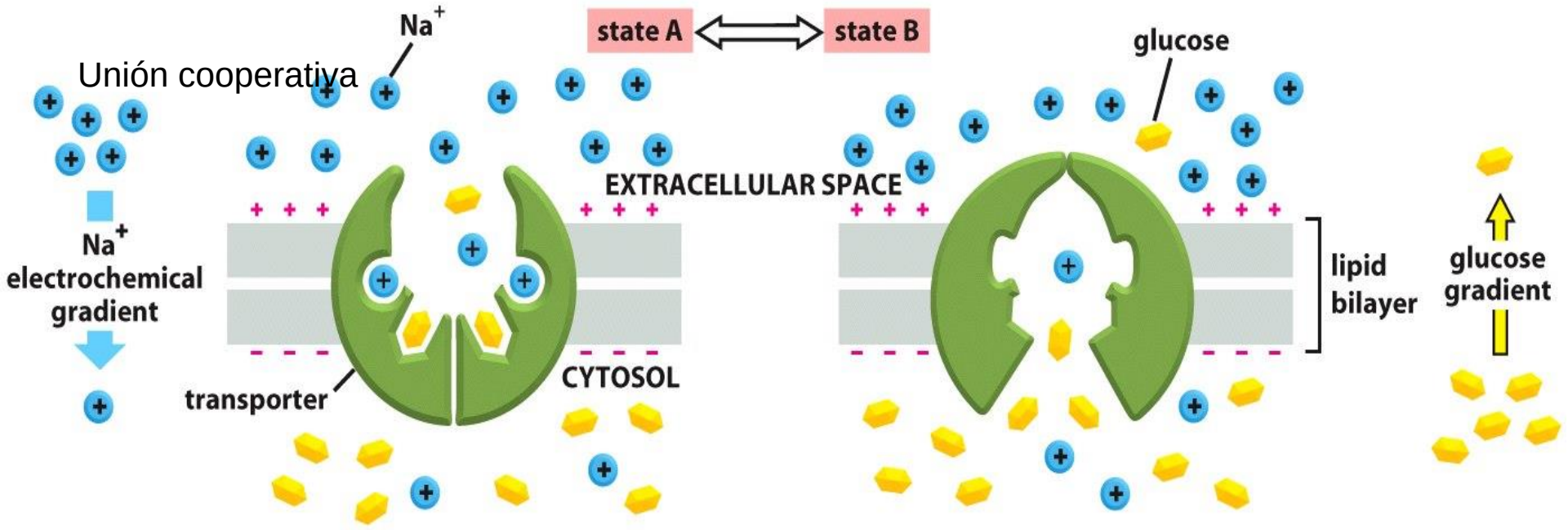
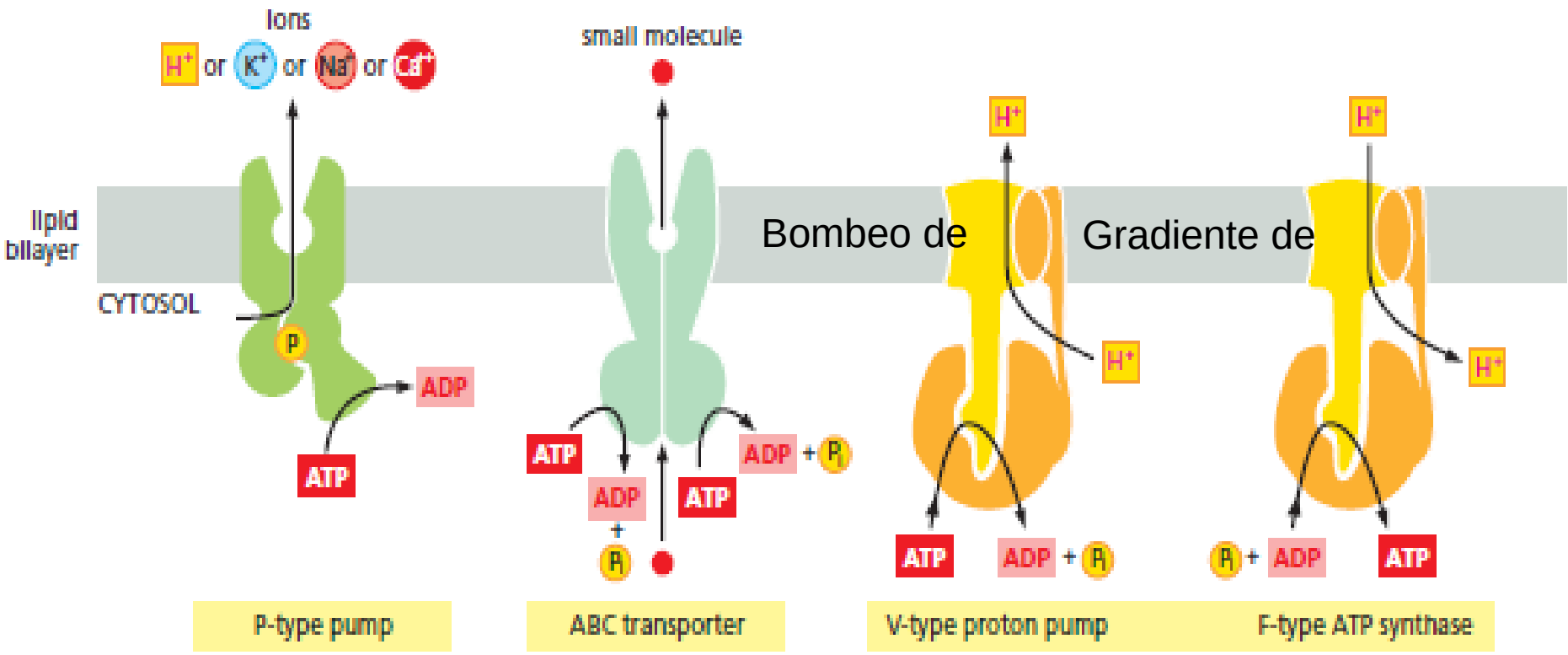


Figure 11-9 Molecular Biology of the Cell 5/e (© Garland Science 2008)

- membranas de células animales: Na^+
- levaduras, organelos membranosos: H^+

(transporte activo secundario)

Bombas



1 2 3

Na+, K+, Ca++ **pequeñas moléculas** **H+**

¿Qué carrera está cursando cada uno de ustedes?

A – Ciencias Biológicas (FCien)

B – Bioquímica (FCien)

C – Biología Humana (FCien)

D – Doctor en Medicina (FMed)

E – Otra

Transporte de glucosa a través del epitelio intestinal

Transporte de glucosa a través del epitelio intestinal

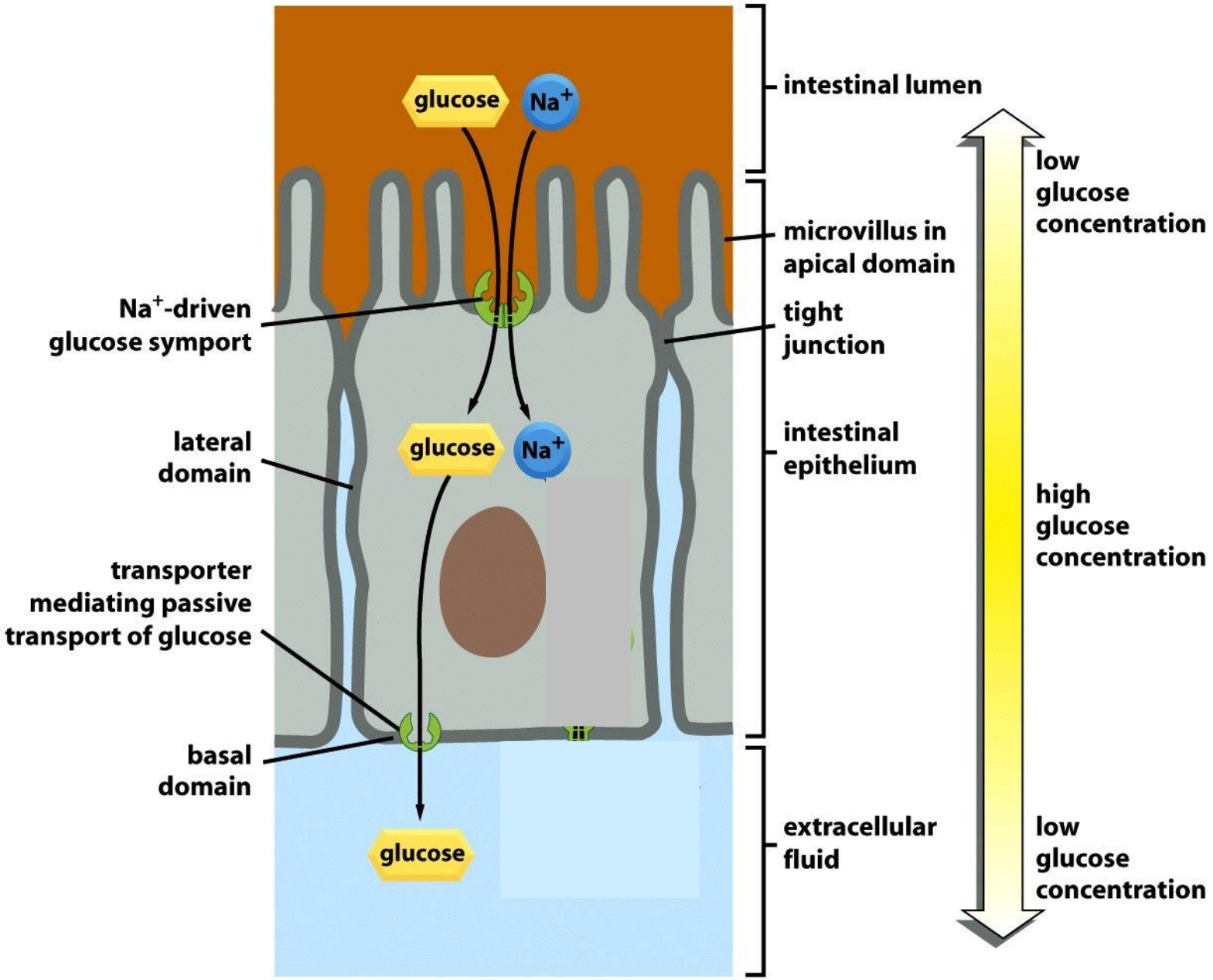


Figure 11-11 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Transporte de glucosa a través del epitelio intestinal

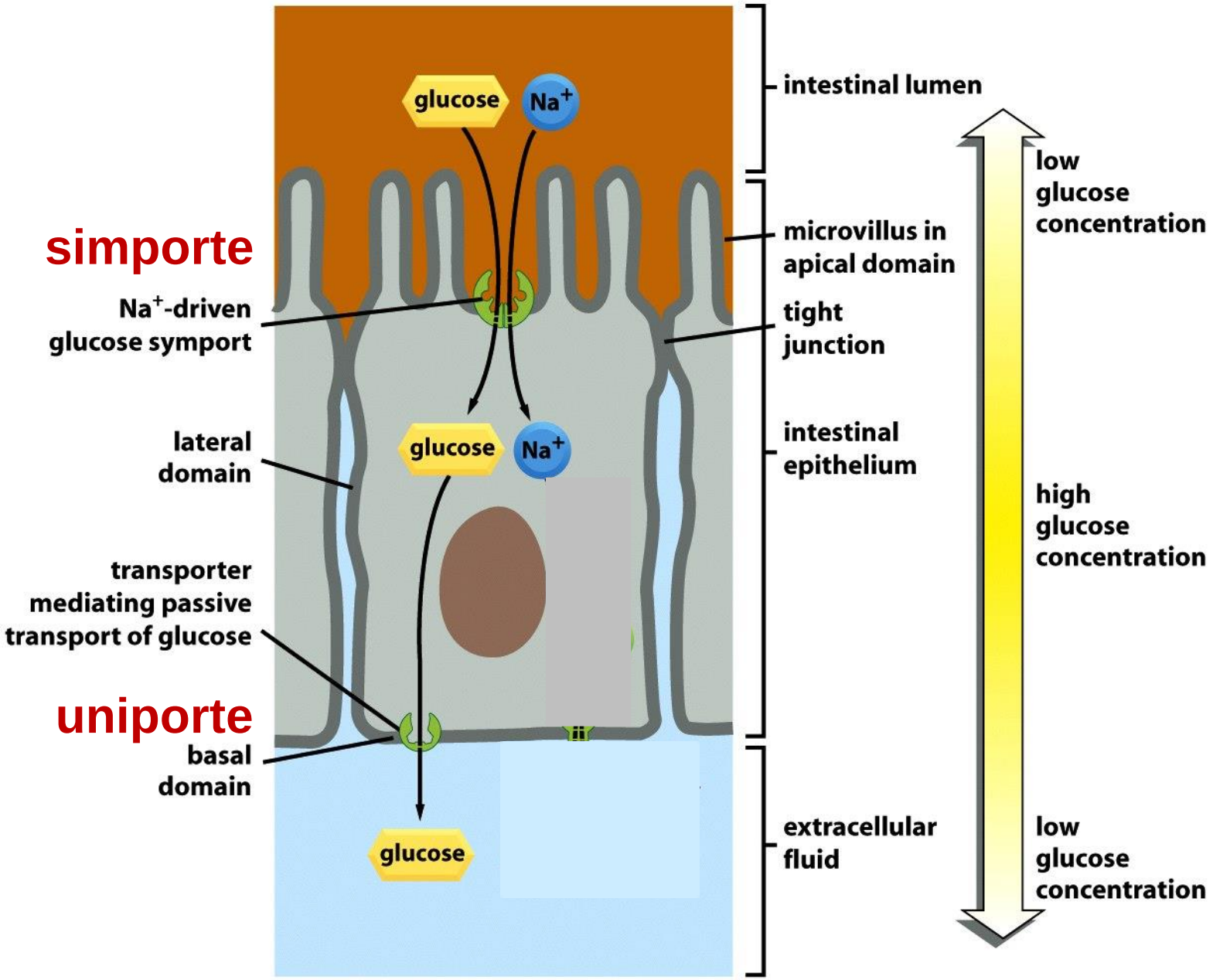


Figure 11-11 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Transporte de glucosa a través del epitelio intestinal

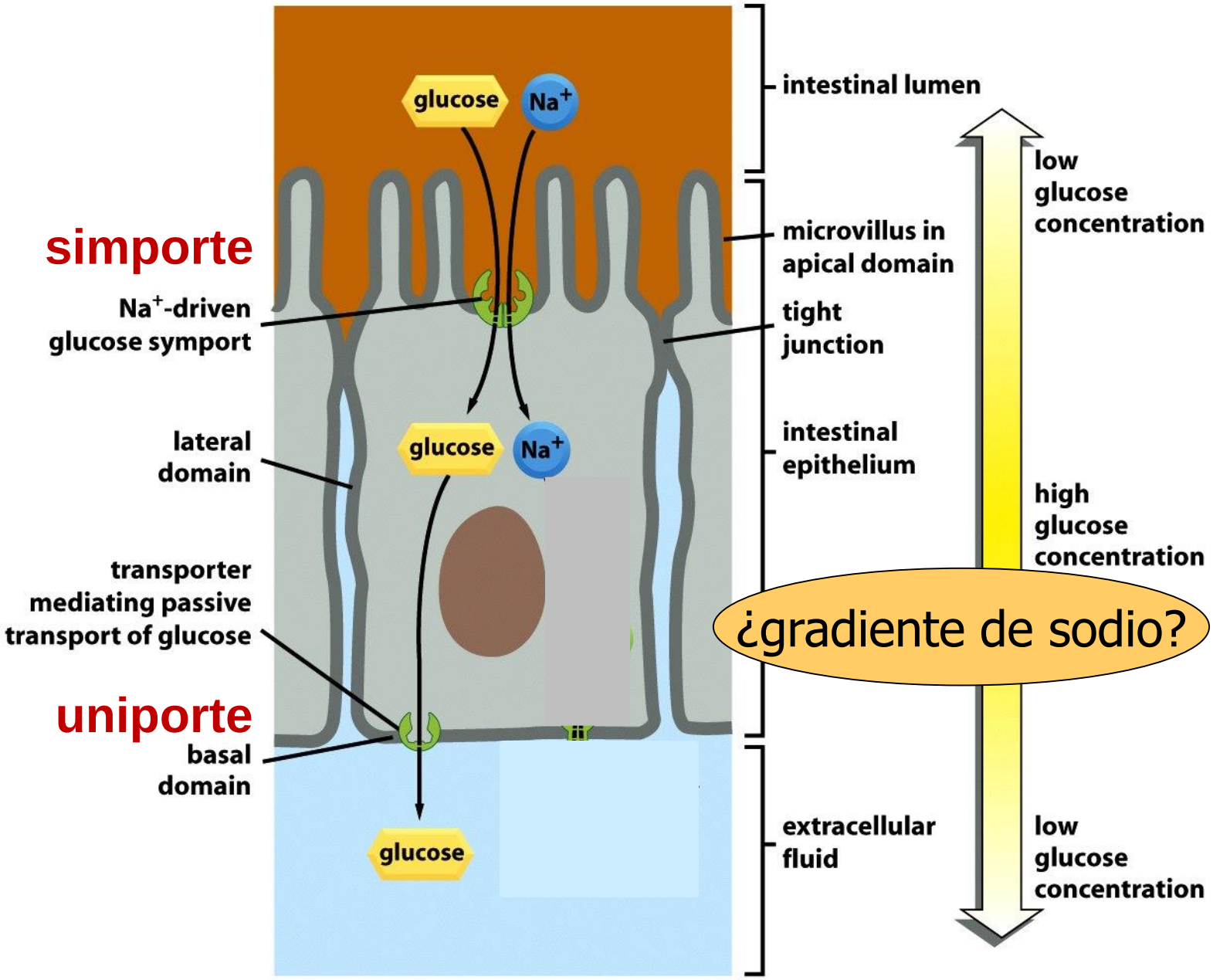


Figure 11-11 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Transporte de glucosa a través del epitelio intestinal

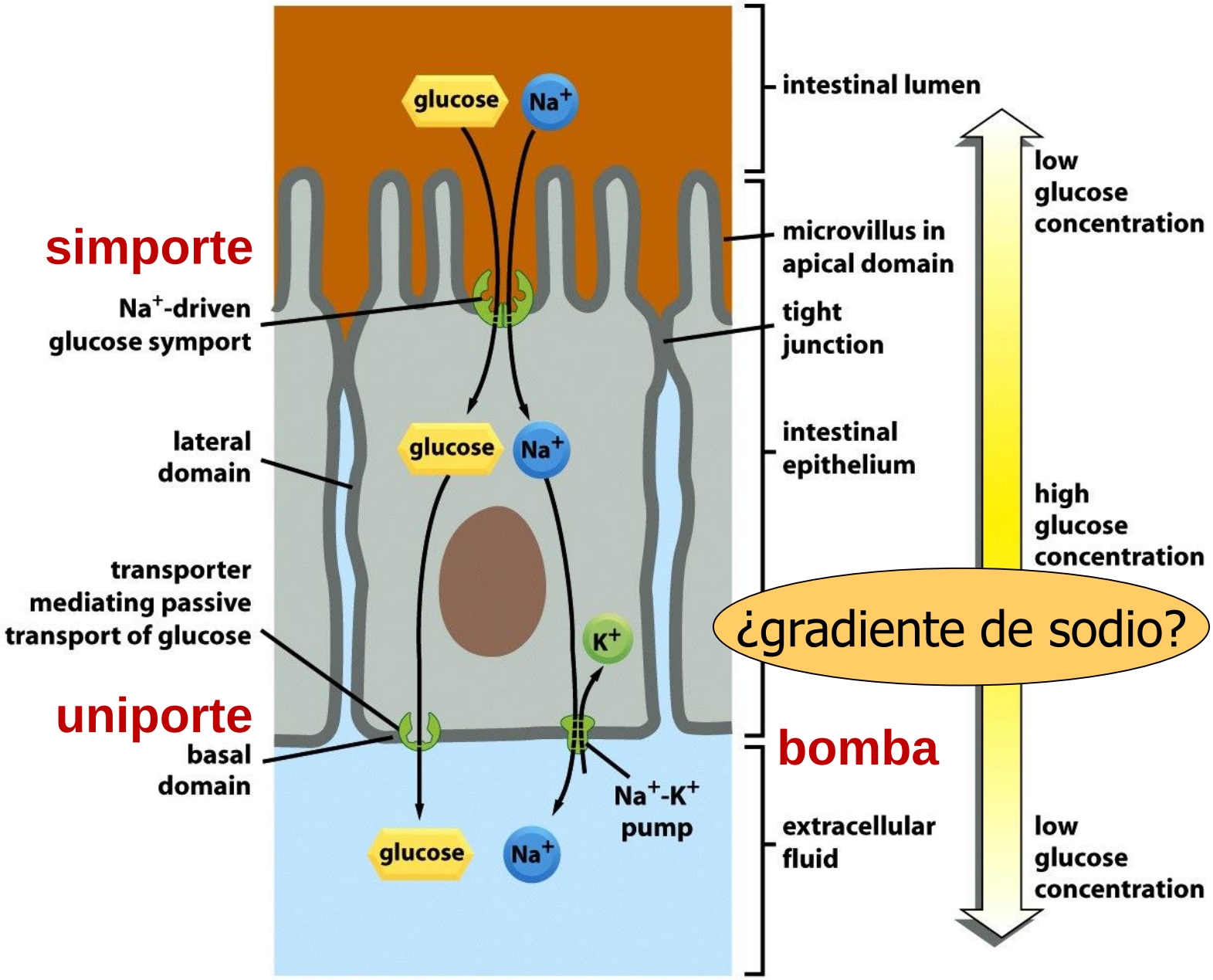


Figure 11-11 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Na^+K^+ATPasa

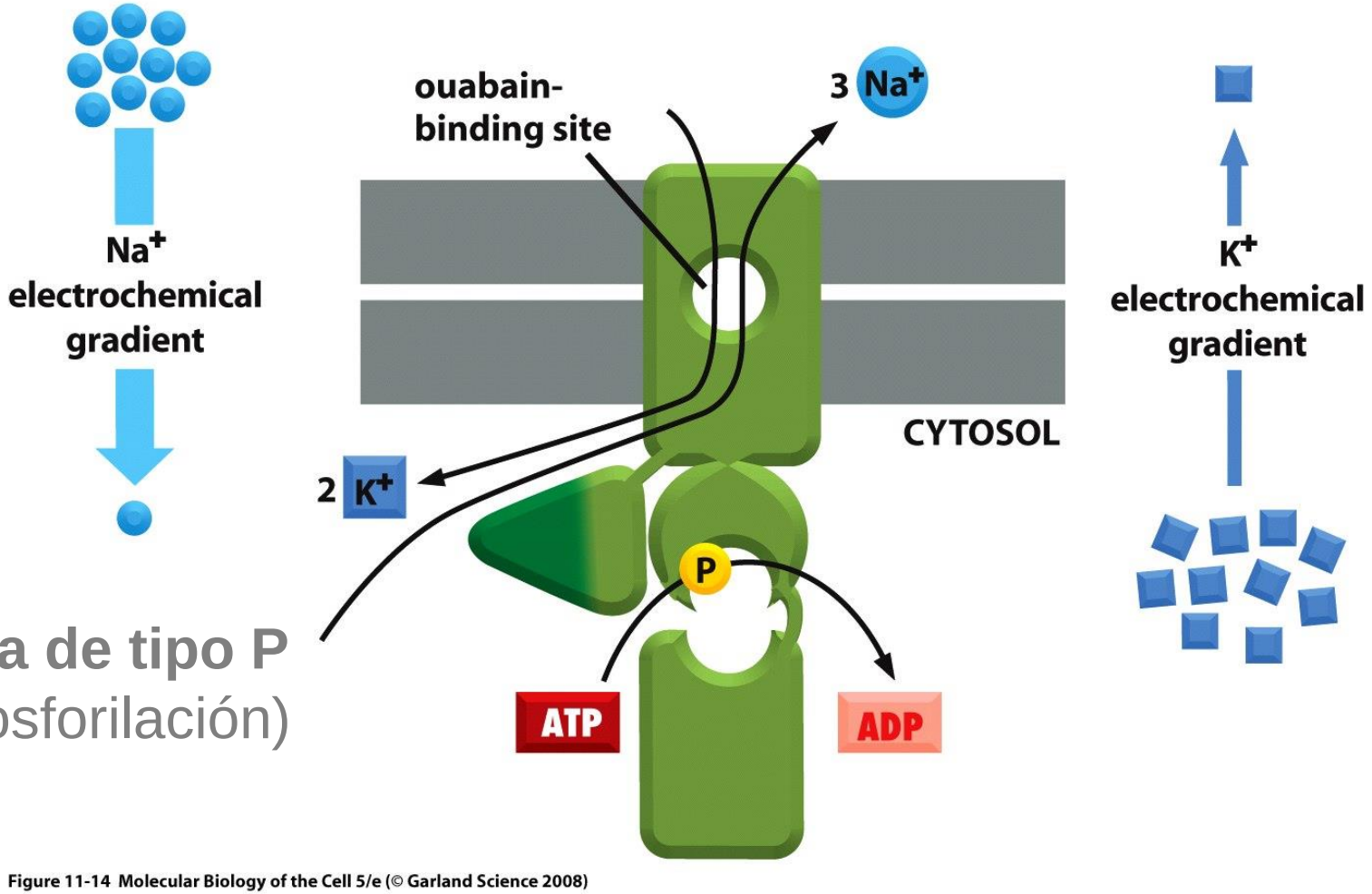
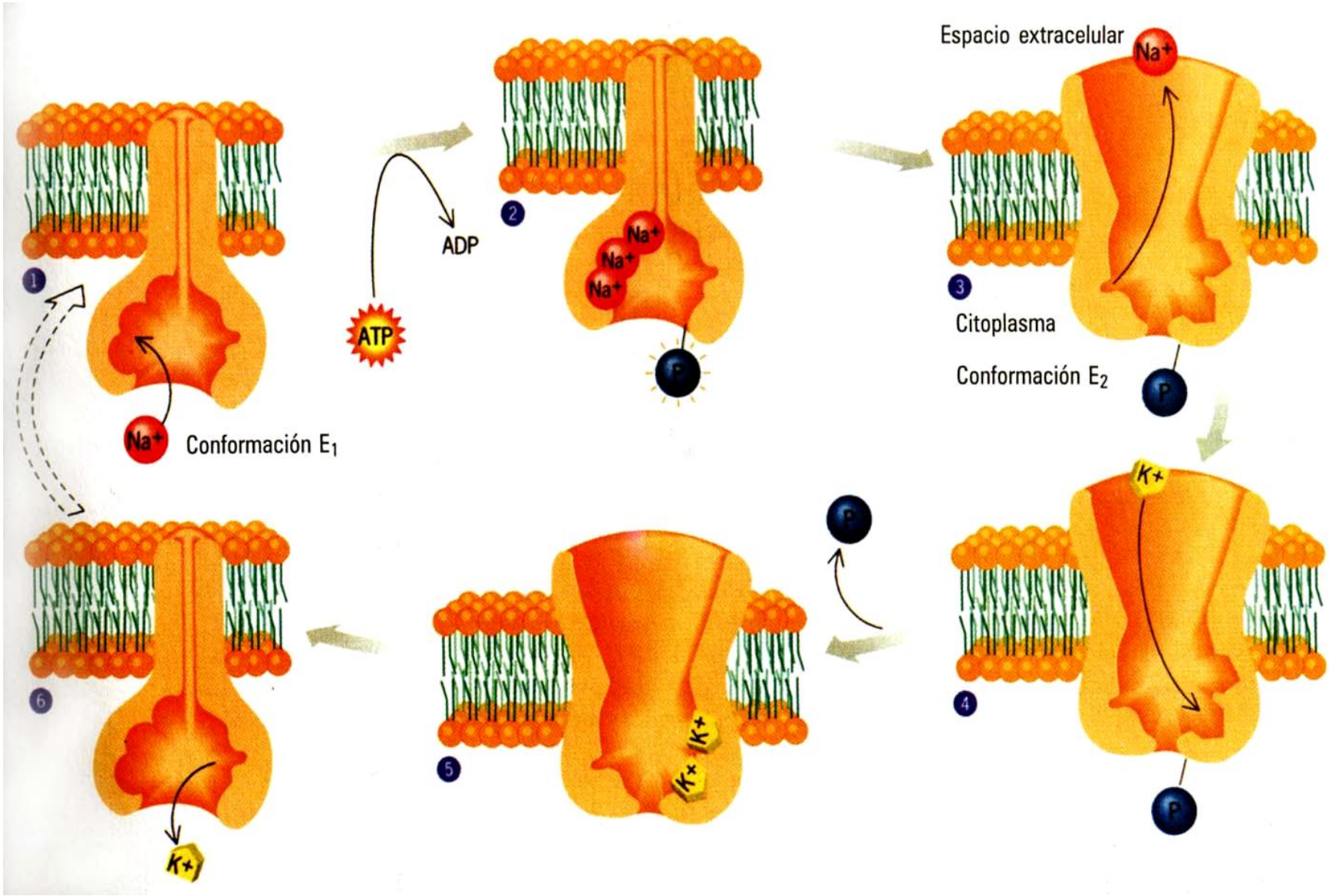


Figure 11-14 Molecular Biology of the Cell 5/e (© Garland Science 2008)

Bomba de tipo P
(autofosforilación)

- membrana plasmática de todas las células animales
- 1/3 requerimiento de energía de una célula animal (mayor en cél.nerviosas)

Mecanismo de la Na+K+ATPasa



¿Cómo atraviesan las moléculas de agua las membranas?

¿Cómo atraviesan las moléculas de agua las membranas?

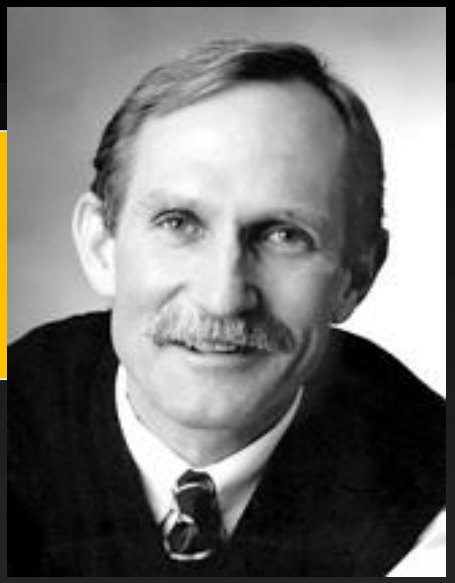
A – No pasa.

B – A través de la bicapa lipídica.

C – Hay proteínas canal específicas.

D – Transporte activo.

Premio Nobel en química 2003

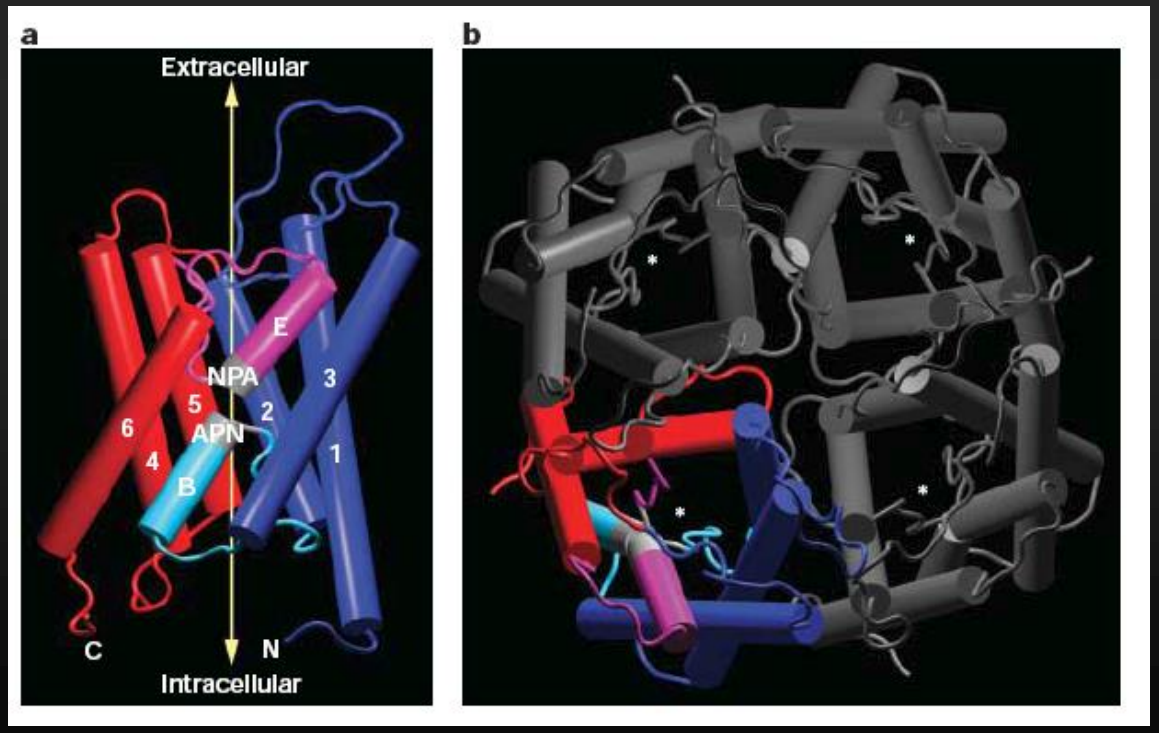


Peter Agre

acuaporinas

canales de agua

facilitan flujo osmótico



King y col. 2004

THE JOURNAL OF BIOLOGICAL CHEMISTRY

Vol. 263, No. 30, Issue of October 25, pp. 15634-15642, 1988
Printed in U.S.A.

Identification, Purification, and Partial Characterization of a Novel M_r 28,000 Integral Membrane Protein from Erythrocytes and Renal Tubules*

(Received for publication, April 19, 1988)

Bradley M. Denker, Barbara L. Smith, Francis P. Kuhajda, and Peter Agre‡

From the Departments of Medicine and Cell Biology/Anatomy, Johns Hopkins University School of Medicine, Baltimore, Maryland 21205

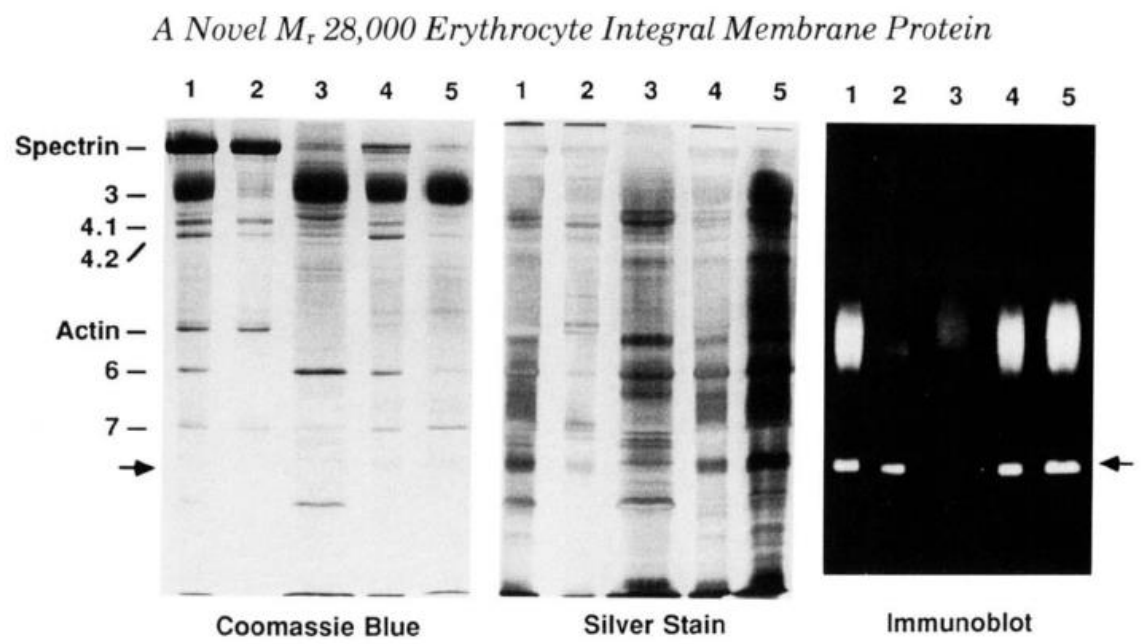
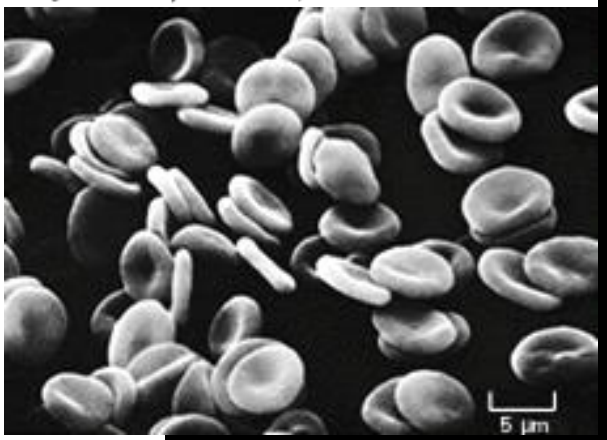


FIG. 2. **Membrane distribution of 28kDa.** Whole erythrocyte membranes (*lanes 1*), Triton X-100 insoluble membrane skeletons (*lanes 2*), Triton-soluble extract (*lanes 3*), spectrin-actin-depleted membrane vesicles (*lanes 4*), and KI-stripped membrane vesicles (*lanes 5*) were electrophoresed into 12% SDS-PAGE slabs which were then stained with Coomassie, or silver reagent, or immunoblotted with anti-28kDa as indicated. Each lane is equivalent to membranes prepared from 15–30 μl of erythrocytes.



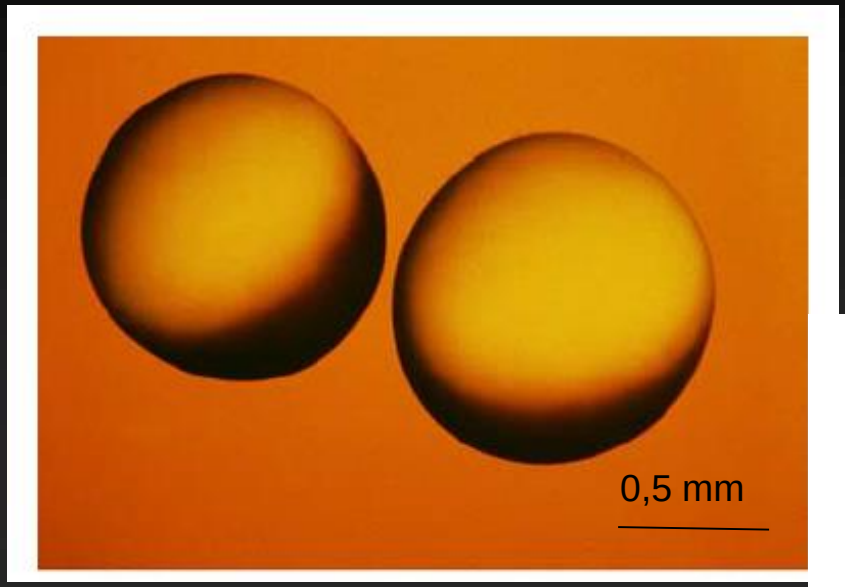
Hallazgo
"*por accidente*"…

- aislamiento
- purificación
- generación de Ac

…***también en riñón!!!***

Ovocito control
(inyectado con sol. tampón)

Ovocito problema
(inyectado con ARNm CHIP28)



Ovocitos de *Xenopus laevis*
muy impermeables al agua

SCIENCE • VOL. 256 • 17 APRIL 1992

15 November 1991; accepted 18 February 1992

Appearance of Water Channels in *Xenopus* Oocytes Expressing Red Cell CHIP28 Protein

Gregory M. Preston, Tiziana Piazza Carroll,
William B. Guggino, Peter Agre*

Water rapidly crosses the plasma membrane of red blood cells (RBCs) and renal tubules through specialized channels. Although selective for water, the molecular structure of these channels is unknown. The CHIP28 protein is an abundant integral membrane protein in mammalian RBCs and renal proximal tubules and belongs to a family of membrane proteins with unknown functions. Oocytes from *Xenopus laevis* microinjected with in vitro–transcribed CHIP28 RNA exhibited increased osmotic water permeability; this was reversibly inhibited by mercuric chloride, a known inhibitor of water channels. Therefore it is likely that CHIP28 is a functional unit of membrane water channels.

ARNm inyectado – se traduce –
proteína a membrane plasmática

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(inyectado con sol. tampón)

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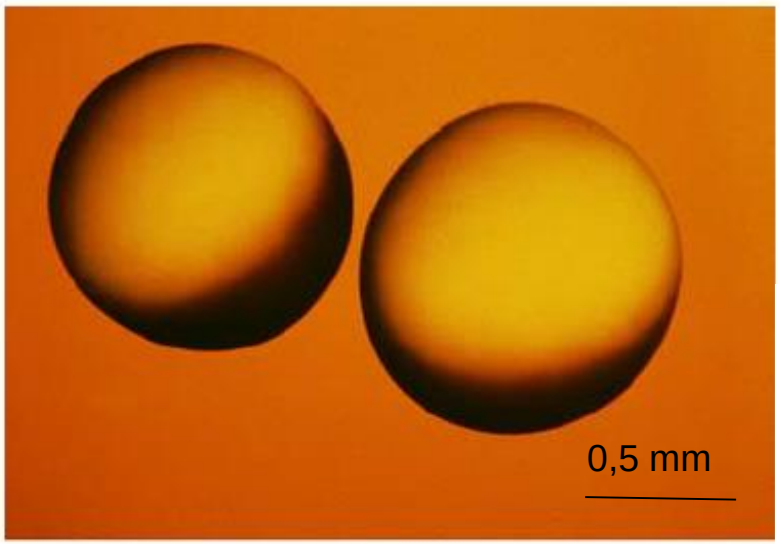

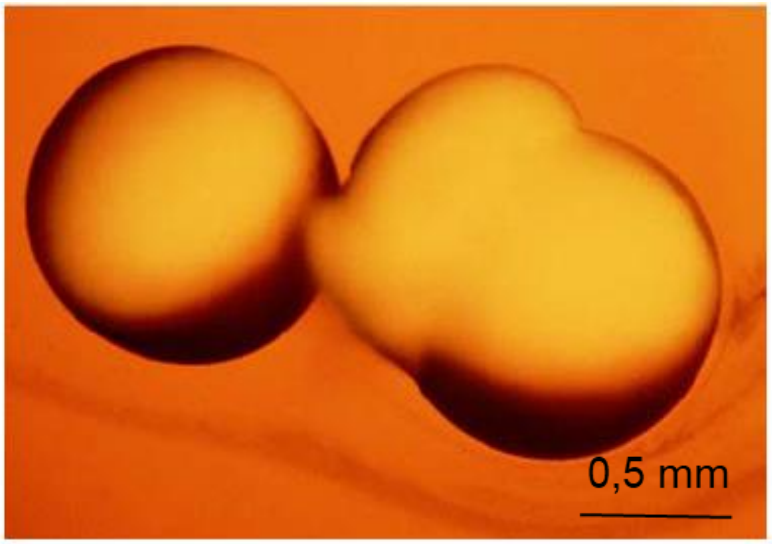

Cambio de medio: agua destilada

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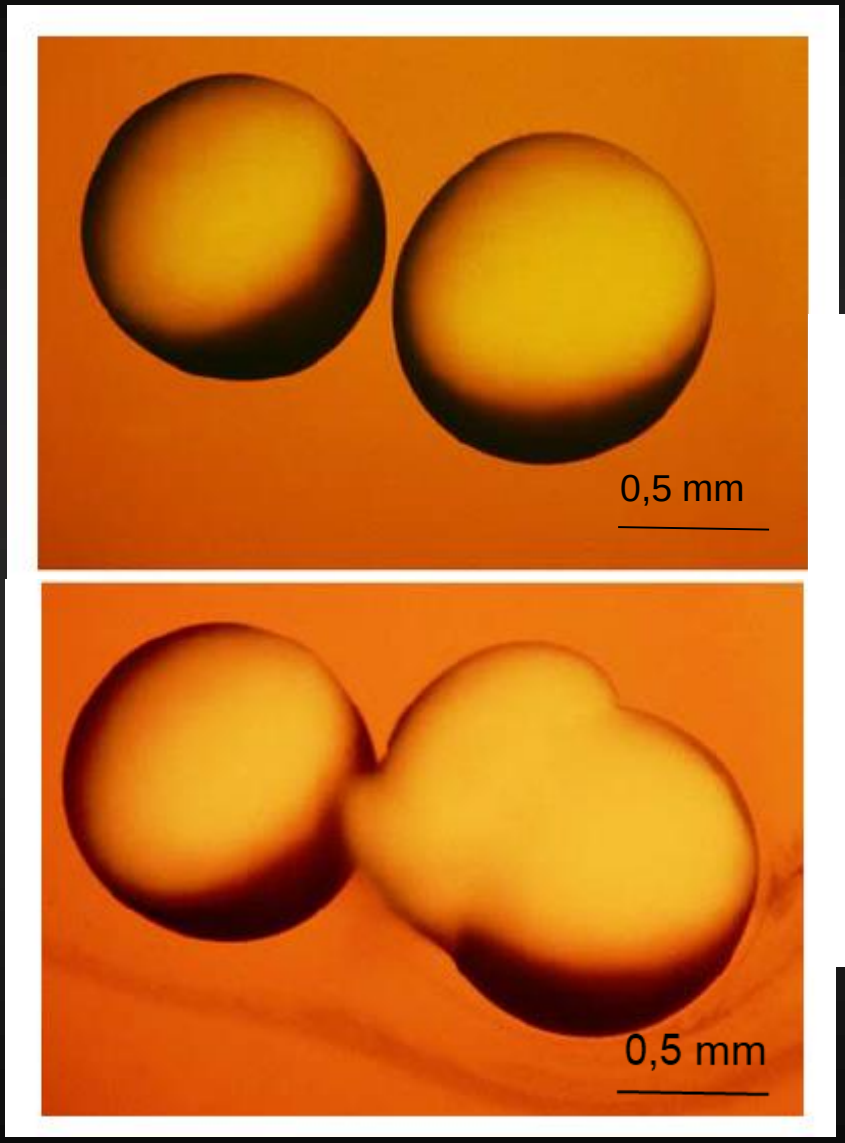

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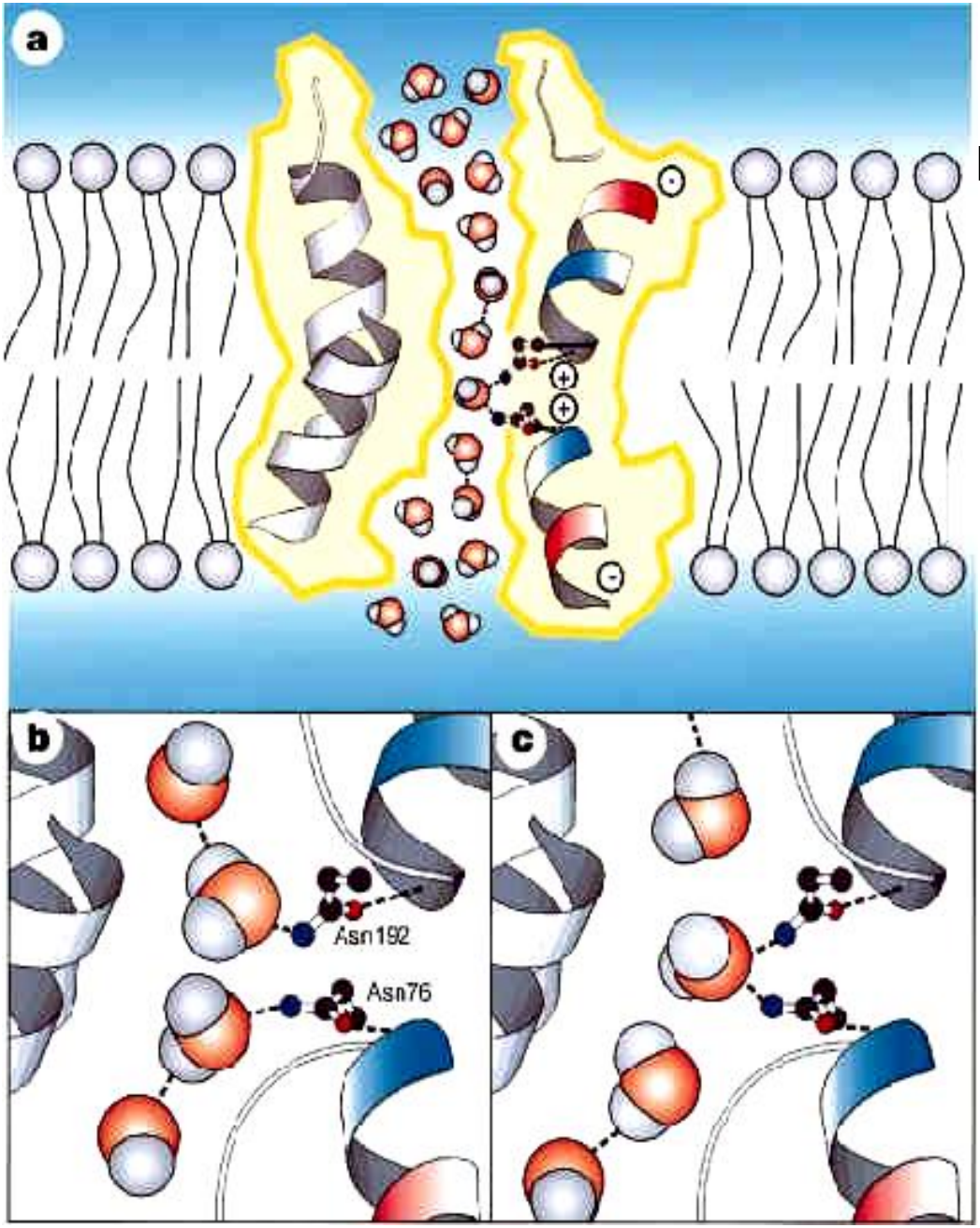
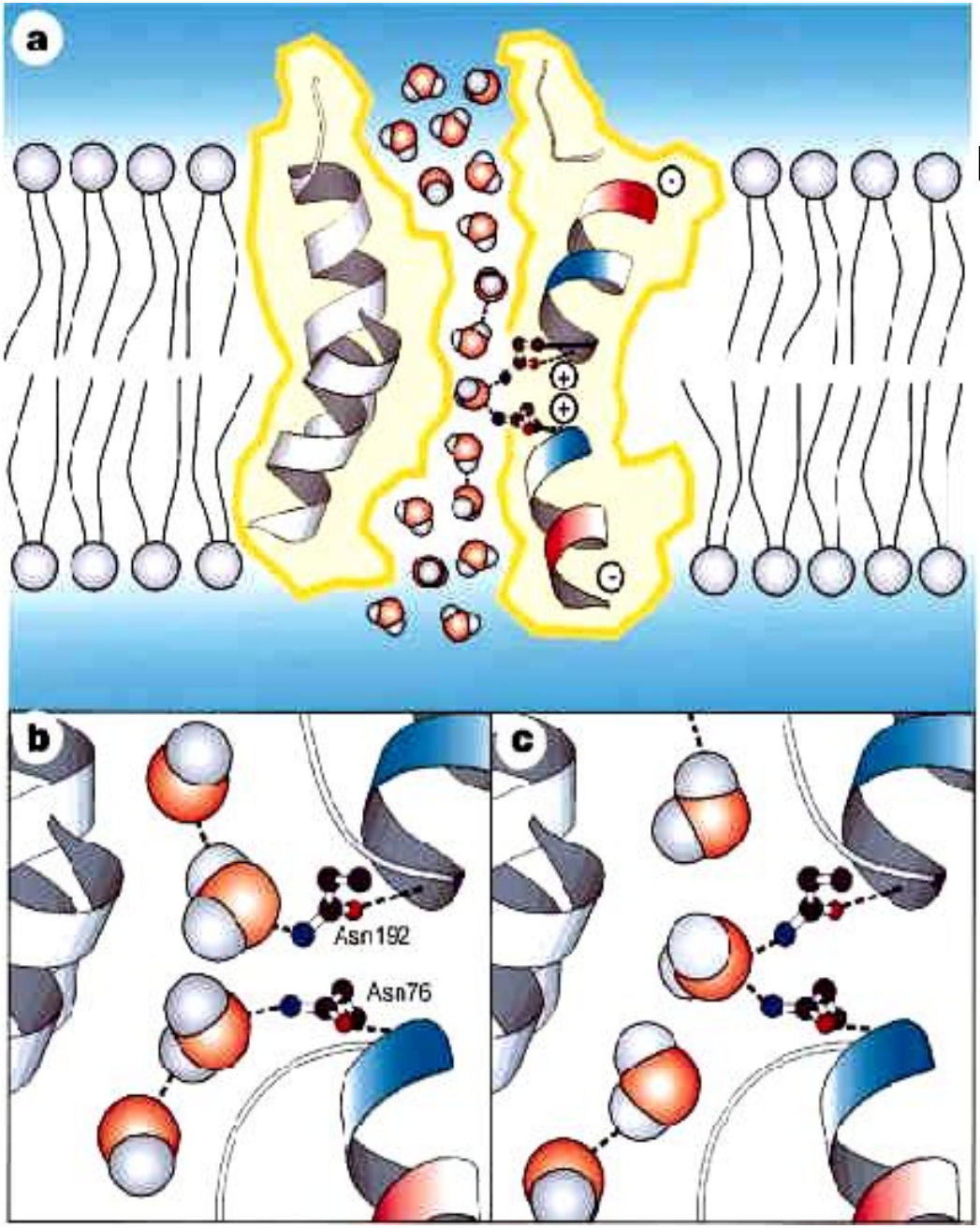
proteína a membrane plasmática

Cambio de medio: agua destilada

Gregory Preston

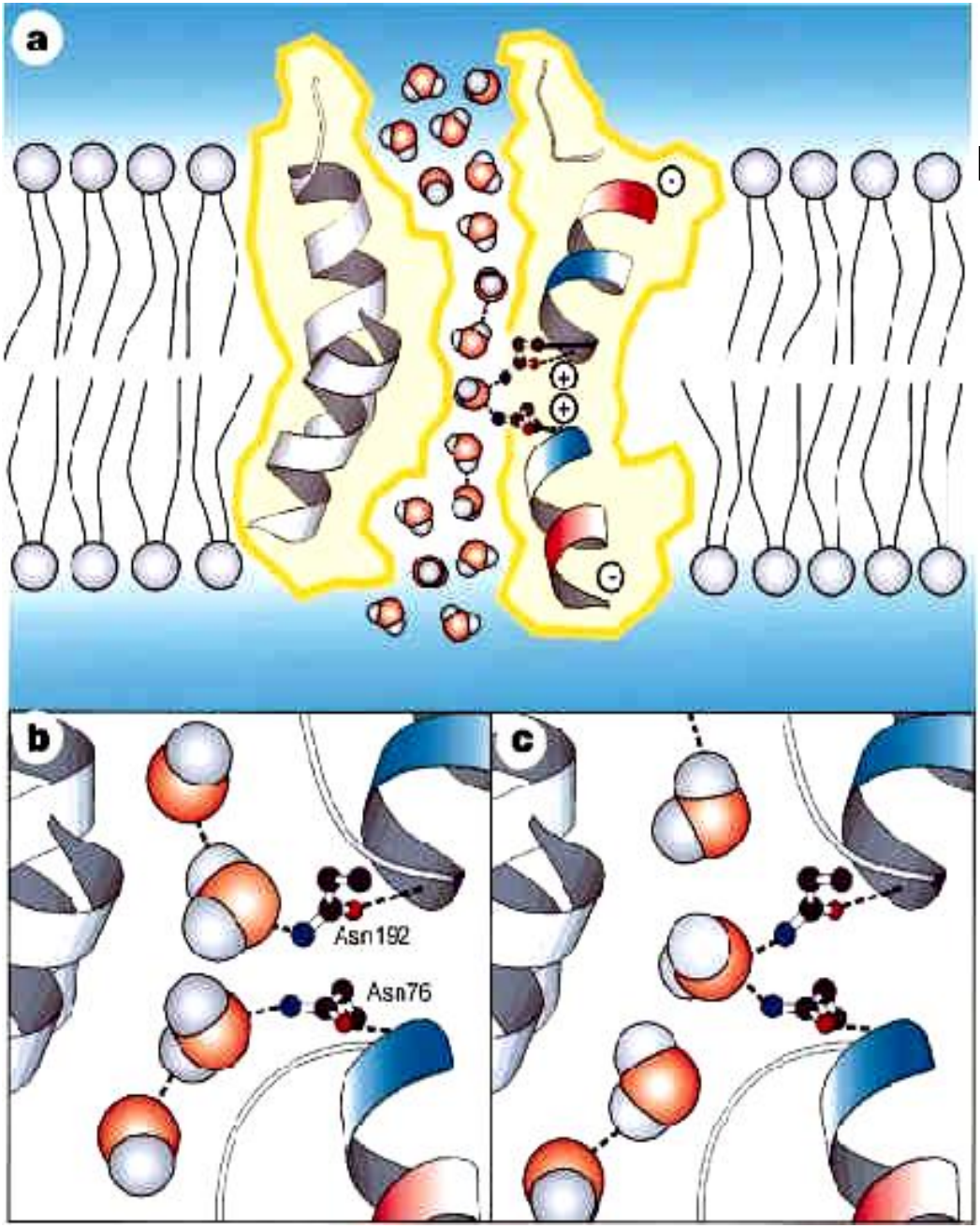


Diámetro canales: 2.8 Å



Diámetro canales: 2.8 Å

¿por qué no ingresan iones?



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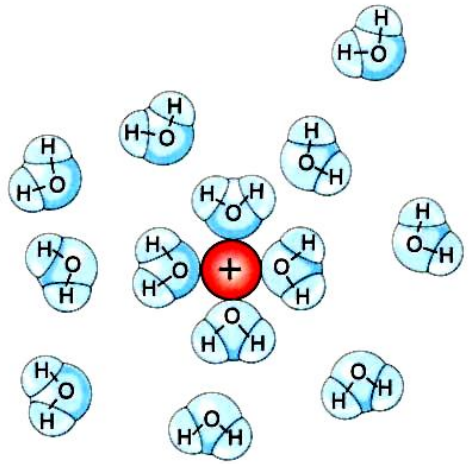
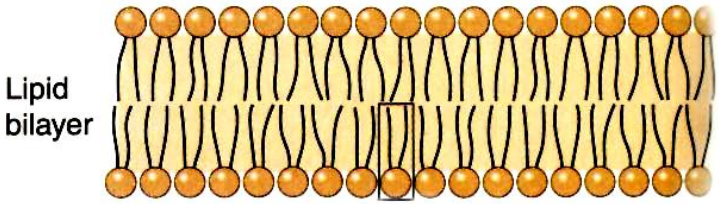
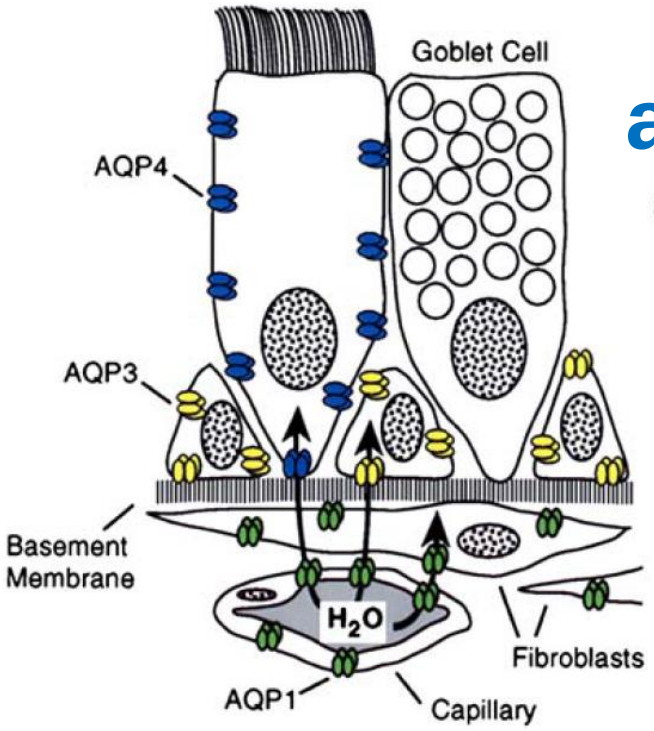
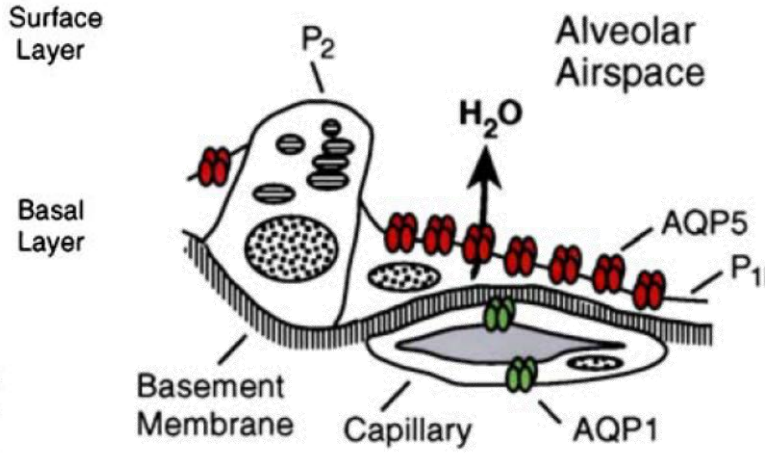




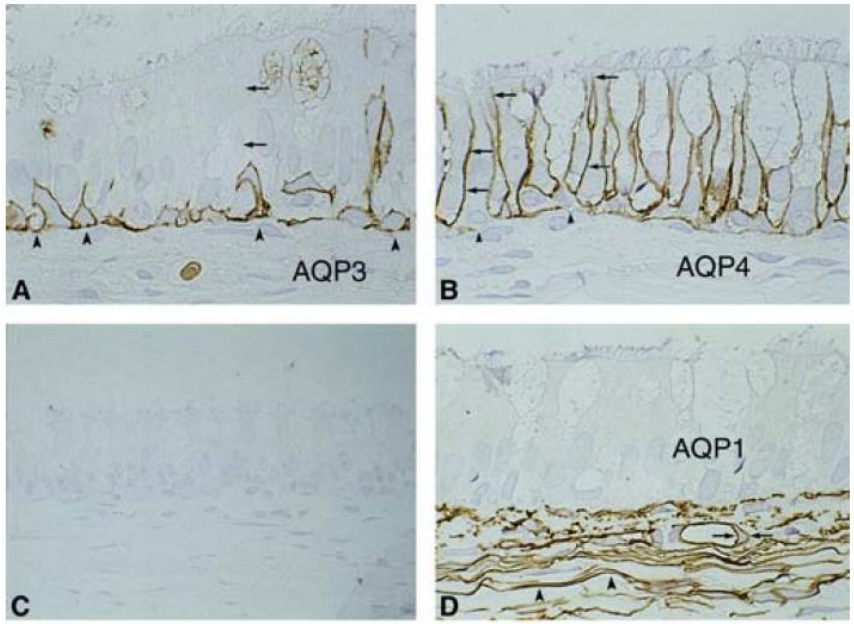
Distribución de acuaporinas en las células



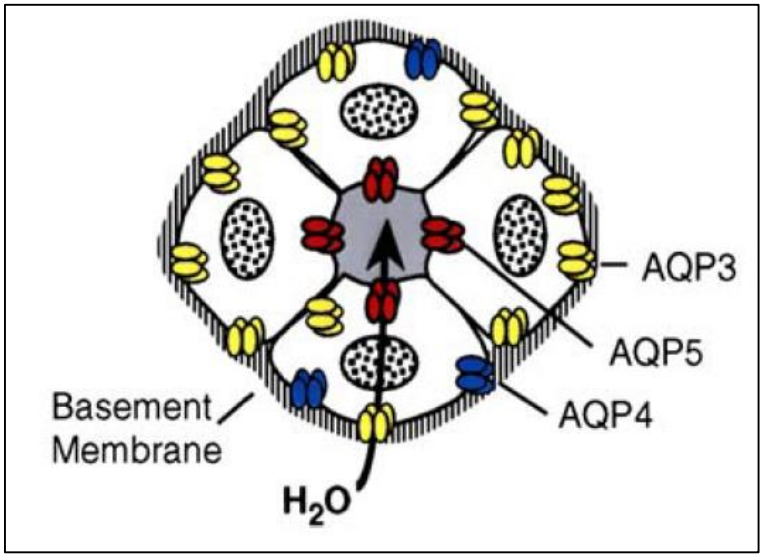


Agre, 2006

Epitelios respiratorios



Acino de glándula salival



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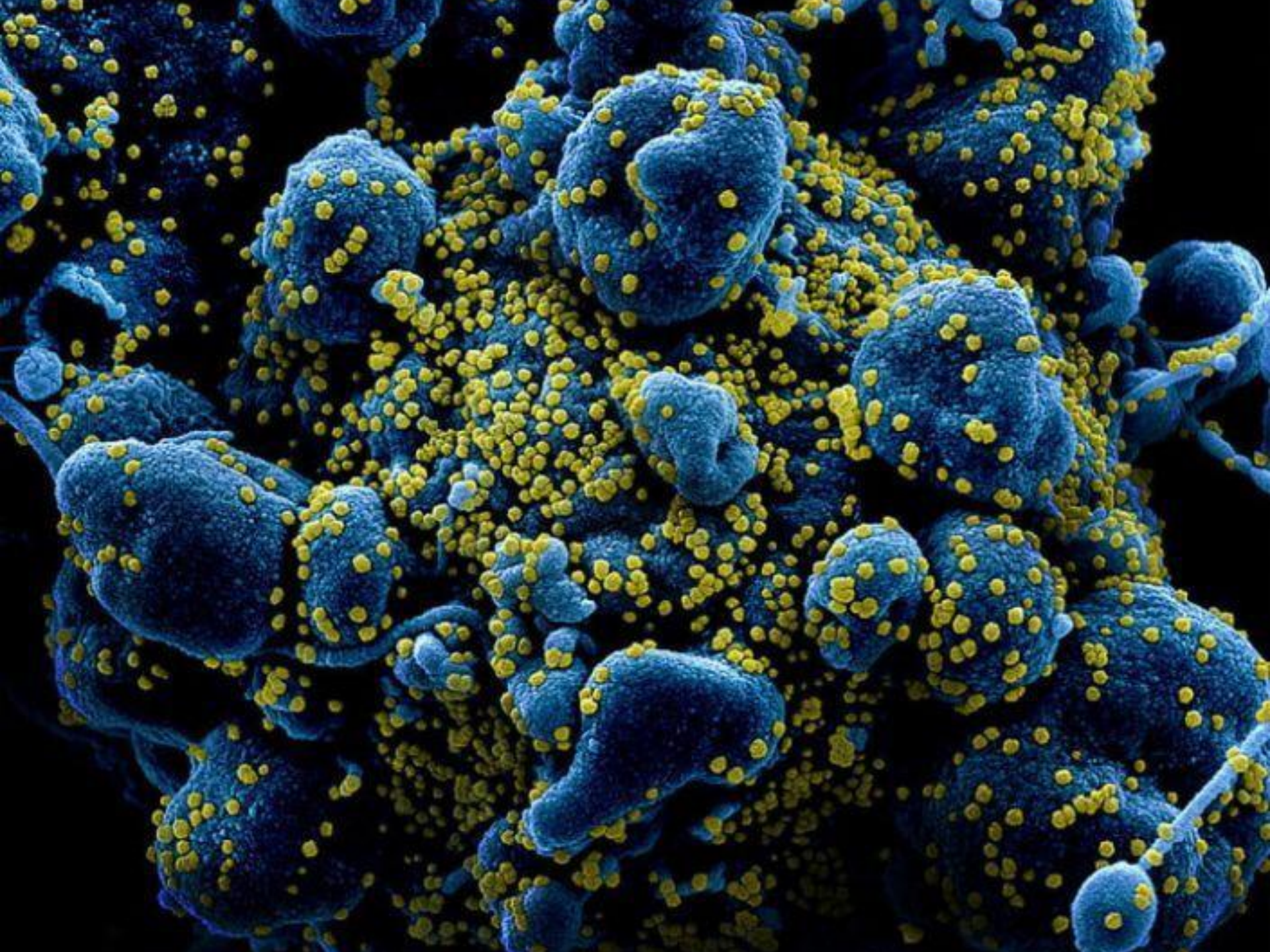
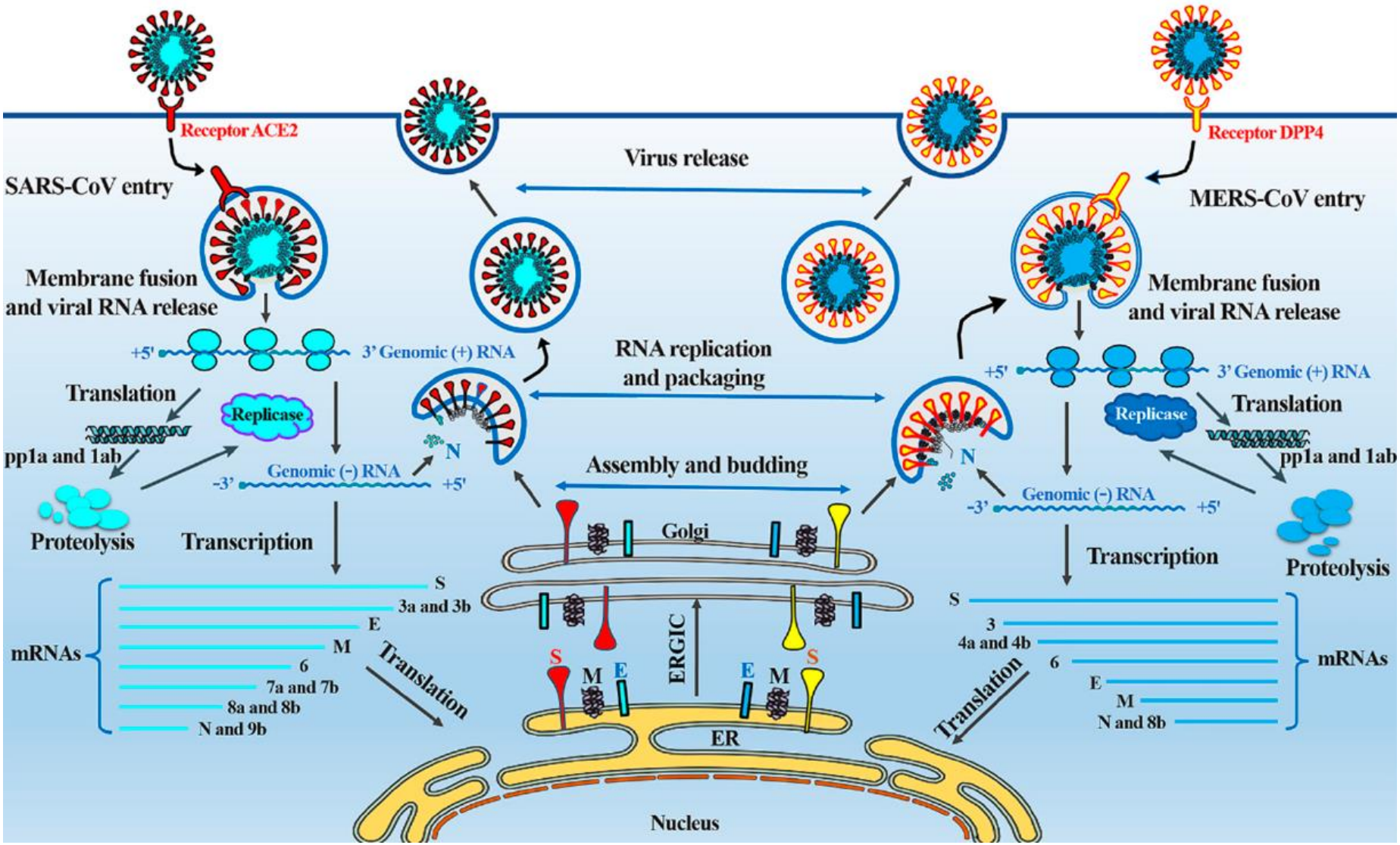


Entrada de virus a las células: Coronavirus



https://www.mdpi.com/1999-4915/11/1/59?type=check_update&version=1

Song et al., 2019

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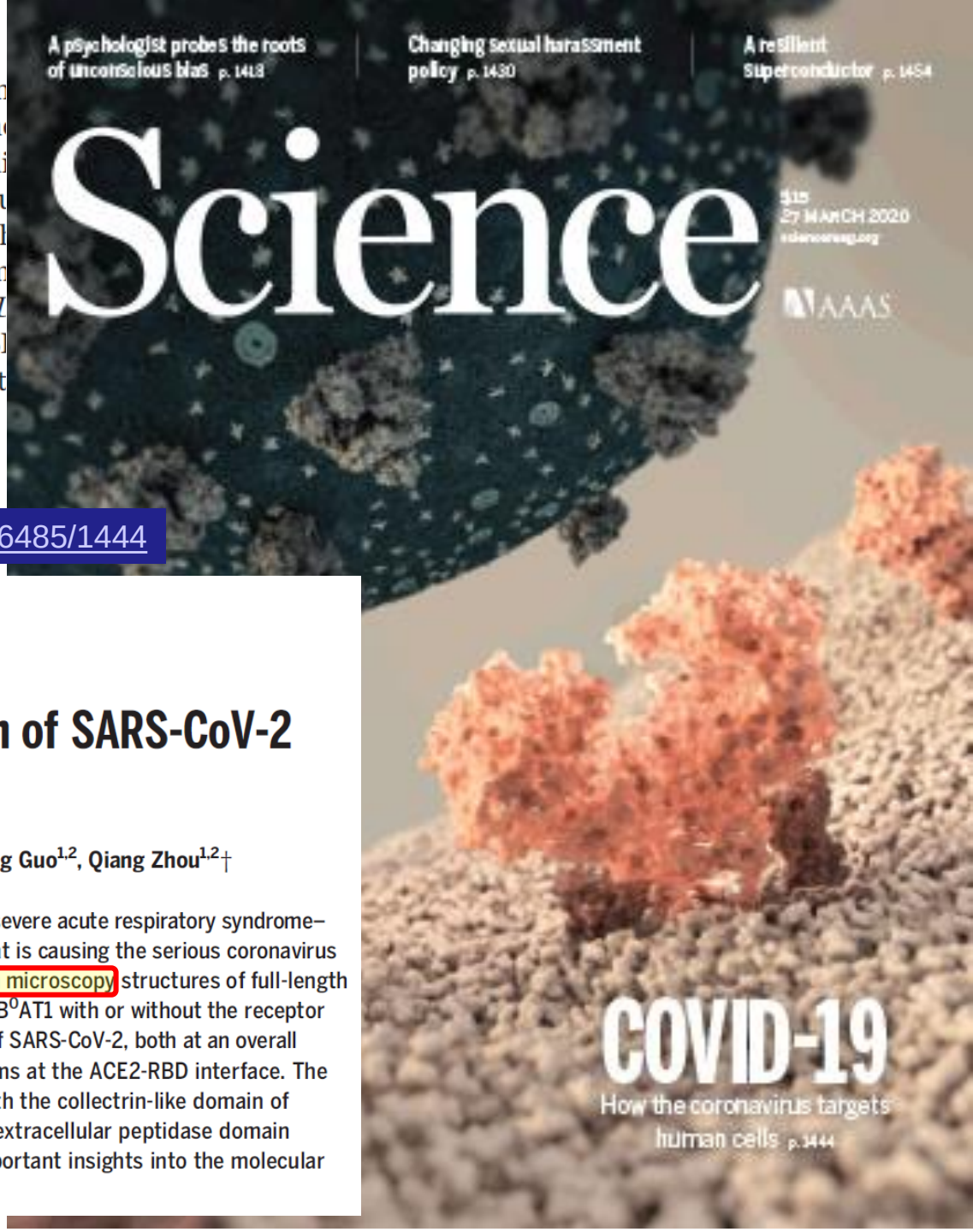
Yan *et al.*, *Science* **367**, 1444–1448 (2020) 27 March 2020

https://science.sciencemag.org/content/367/6485/1444



RESEARCH ARTICLE

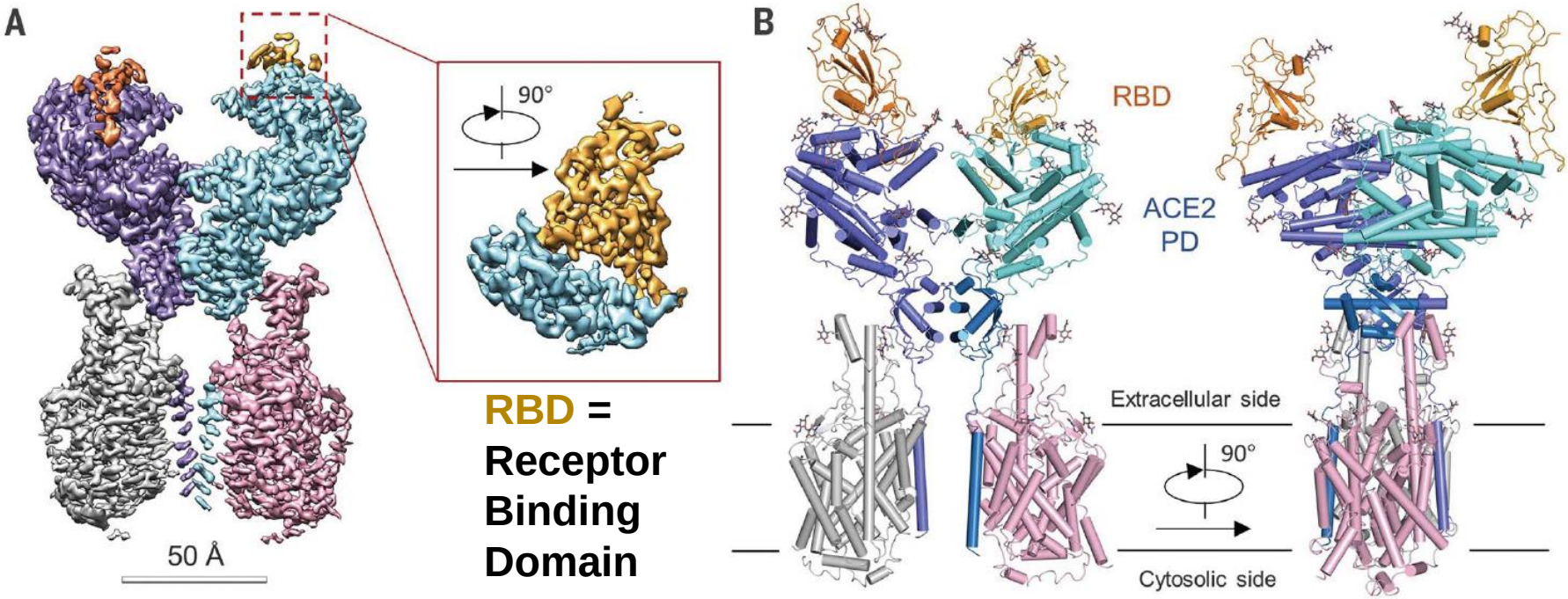
CORONAVIRUS

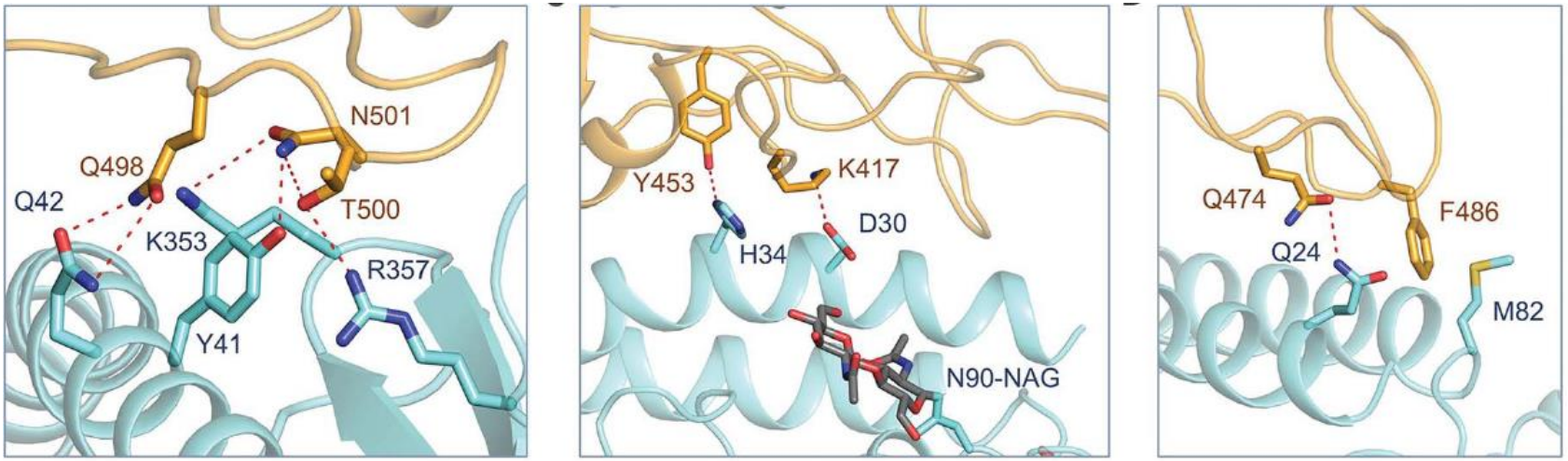
Structural basis for the recognition of SARS-CoV-2 by full-length human ACE2

Renhong Yan[1,2], Yuanyuan Zhang[1,2]*, Yaning Li[3]*, Lu Xia[1,2], Yingying Guo[1,2], Qiang Zhou[1,2]†

Angiotensin-converting enzyme 2 (ACE2) is the cellular receptor for severe acute respiratory syndrome–coronavirus (SARS-CoV) and the new coronavirus (SARS-CoV-2) that is causing the serious coronavirus disease 2019 (COVID-19) epidemic. Here, we present cryo–electron microscopy structures of full-length human ACE2 in the presence of the neutral amino acid transporter B^0AT1 with or without the receptor binding domain (RBD) of the surface spike glycoprotein (S protein) of SARS-CoV-2, both at an overall resolution of 2.9 angstroms, with a local resolution of 3.5 angstroms at the ACE2-RBD interface. The ACE2-B^0AT1 complex is assembled as a dimer of heterodimers, with the collectrin-like domain of ACE2 mediating homodimerization. The RBD is recognized by the extracellular peptidase domain of ACE2 mainly through polar residues. These findings provide important insights into the molecular basis for coronavirus recognition and infection.

Estructura del complejo de reconocimiento de SARS-Cov2





Yan *et al.*, *Science* **367**, 1444–1448 (2020) 27 March 2020

Journal of Cell Science
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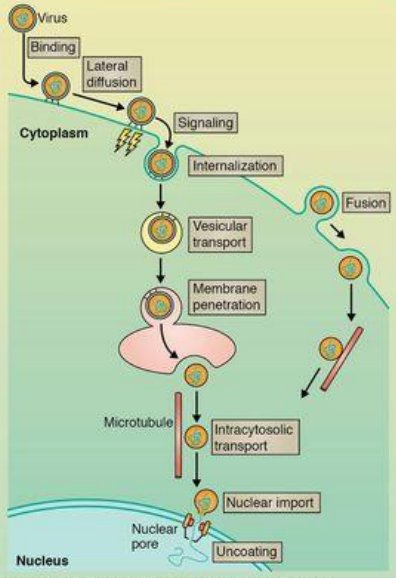
Virus Entry at a Glance

Yohei Yamauchi and Ari Helenius

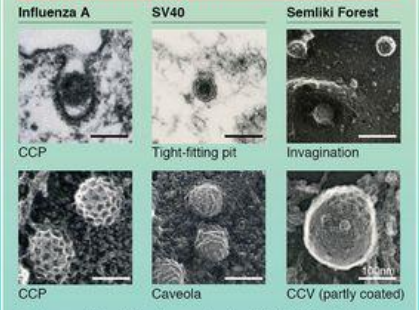
https://jcs.biologists.org/node/1547202.full

Steps of virus entry



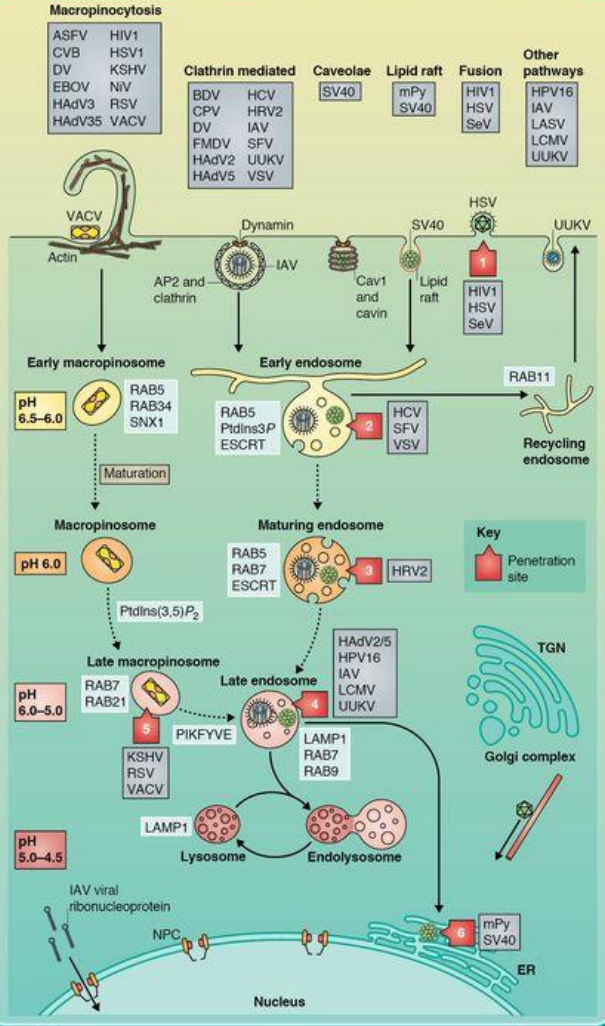
Panel adapted from Marsh and Helenius (2006). *Cell* **124**, 729-740

Virus uptake into vesicles

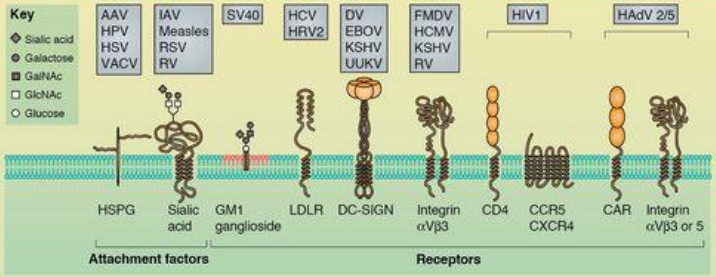


The image on the top left has been previously published by Matlin et al., (1981). *J. Cell Biol.* **91**, 601-613. The images in the bottom row were captured with the help of Jiro Usukura (Nagoya University, Japan).

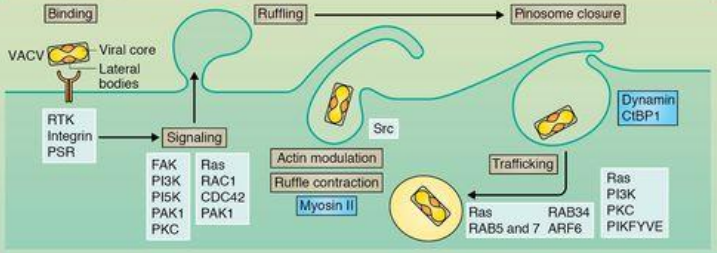
Mechanisms of virus entry and sites of virus penetration



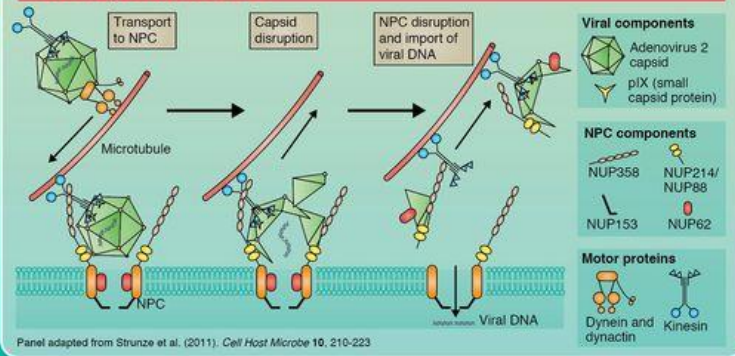
Attachment factors and receptors



Macropinocytosis



Uncoating of adenovirus 2



Panel adapted from Strunze et al. (2011). *Cell Host Microbe* **10**, 210-223

Abbreviations: AAV, Adeno-associated virus; ASFV, Africa Swine-fever virus; BDV, Borna disease virus; BTV, Bluetongue virus; CAR, Coxsackievirus and adenovirus receptor; CVB, Group B coxsackie virus; CCHFV, Crimean Congo hemorrhagic virus; CCP, clathrin-coated pit; CCR, chemokine receptor; CCV, clathrin-coated vesicle; CD, cluster of differentiation; CPV, canine parvovirus; CtBP1, C-terminal binding protein1; CXCR, chemokine receptor; DC-SIGN, dendritic cell-specific intercellular adhesion molecule-3-grabbing non-integrin; DV, Dengue virus; EBOV, Ebola virus; ECHOV, Echovirus; ER, endoplasmic reticulum; ESCRT, endosomal sorting complex required for transport; FAK, focal adhesion kinase; FMDV, Foot-and-mouth disease virus; GalNAC, N-acetylgalactosamine; GlcNAc, N-acetylglucosamine; GM1, monosialotetrahexosylganglioside; HAdV, Human adenovirus; HCMV, Human cytomegalovirus; HCV, Hepatitis C virus; HIV, Human immunodeficiency virus; HPV, Human papillomavirus; HRV, Human rhinovirus; HSPG, heparan sulphate proteoglycan; HSV, Herpes simplex virus; IAV, Influenza A virus; LASV, Lassa virus; LDLR, low-density lipoprotein receptor; JUNV, Junin virus; KSHV, Kaposi's sarcoma-associated herpesvirus; LCMV, lymphocytic choriomeningitis virus; mPy, mouse polyomavirus; NiV, Nipah virus; NPC, nuclear pore complex; NUP, nucleoporin; PICV, Pinchinde virus; PI3K, phosphatidylinositol 3-kinase; PI5K, phosphatidylinositol 5-kinase; PtdIns(3,5)P_2, phosphatidylinositol 3,5-bisphosphate; PIKFYVE, phosphoinositide kinase, FYVE finger containing; PKC, protein kinase C; PtdIns3P, Phosphatidylinositol 3-phosphate; PSR, phosphatidylserine receptor; RSV, respiratory syncytial virus; RTK, receptor tyrosine kinase; RV, Rotavirus; SFV, Semliki Forest virus; SNX, sorting nexin; SV40, Simian virus 40; TGN, trans-Golgi network; UUKV, Uukuniemi virus; VACV, Vaccinia virus; VSV, vesicular stomatitis virus.