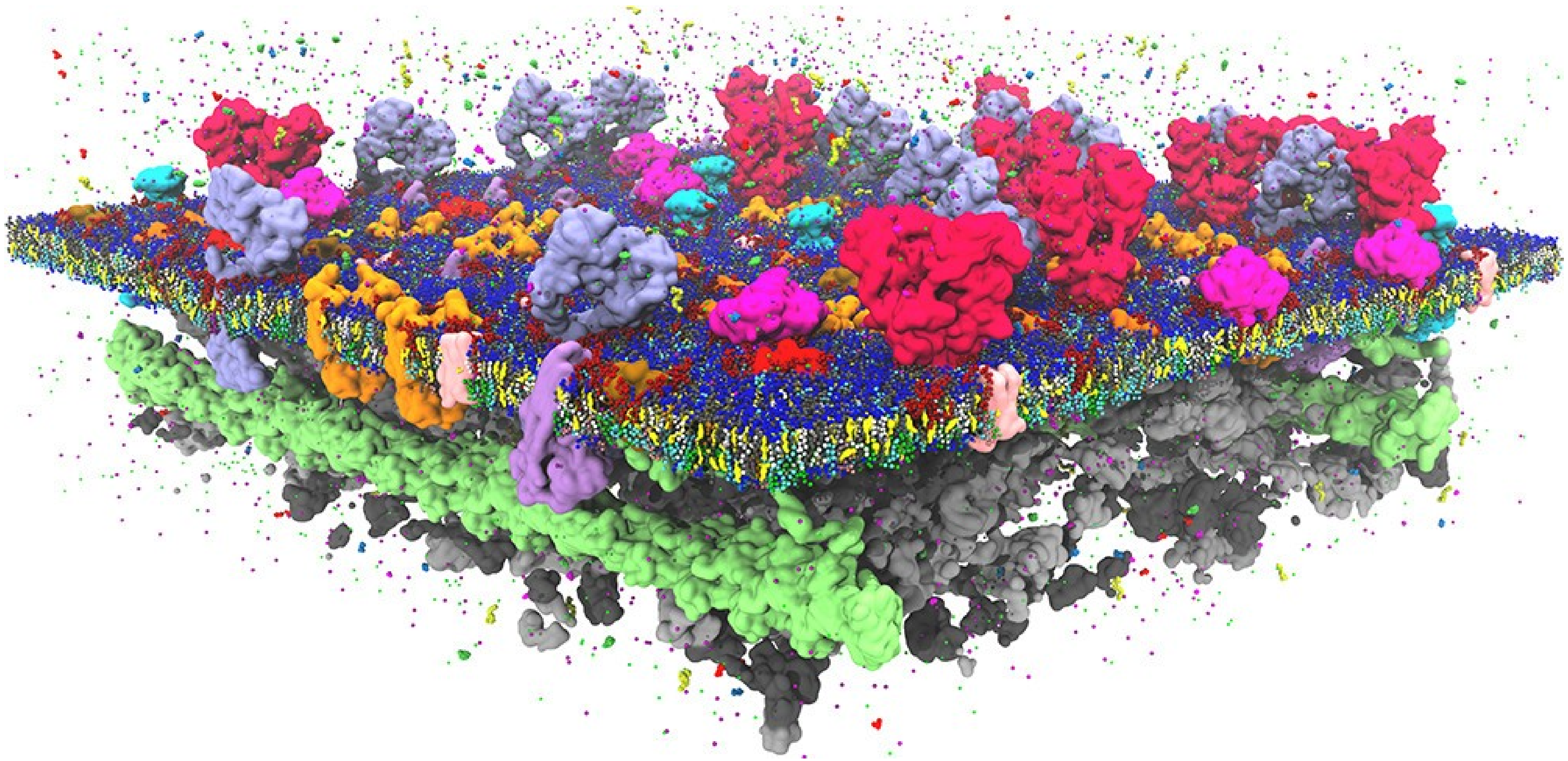
BC 03 :
Membranes et échanges membranaires



DOC 1 : Structure des principaux lipides membranaires

Introduction

- Lipides amphiphiles
- Liaisons de Van der Waals
- Différents rôles

FIGURE 1.5 *Organization of amphipathic lipid molecules in a bilayer.*

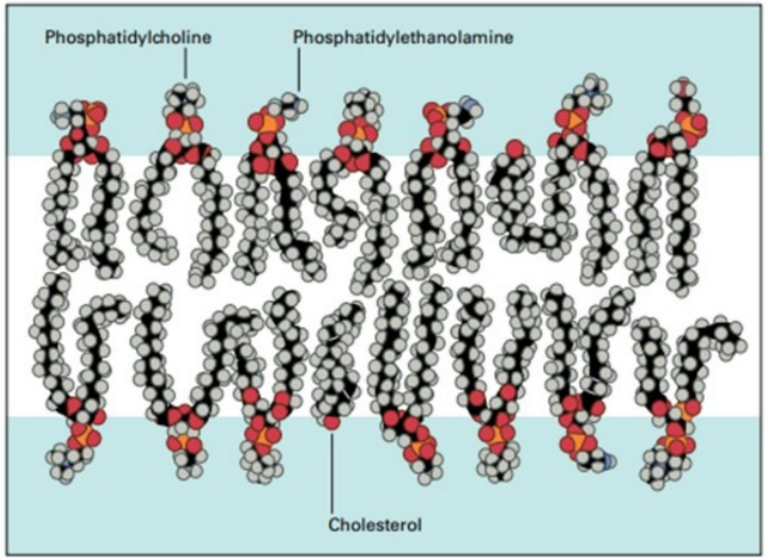
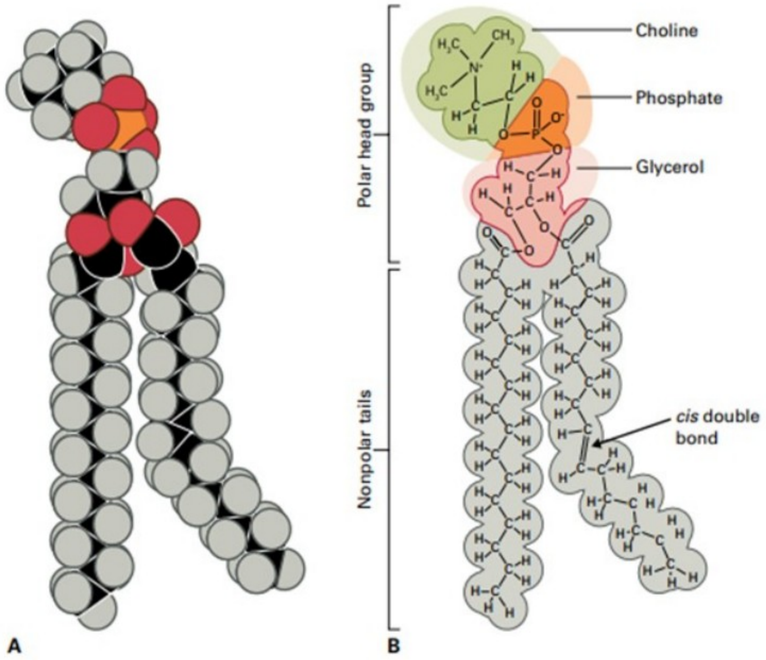
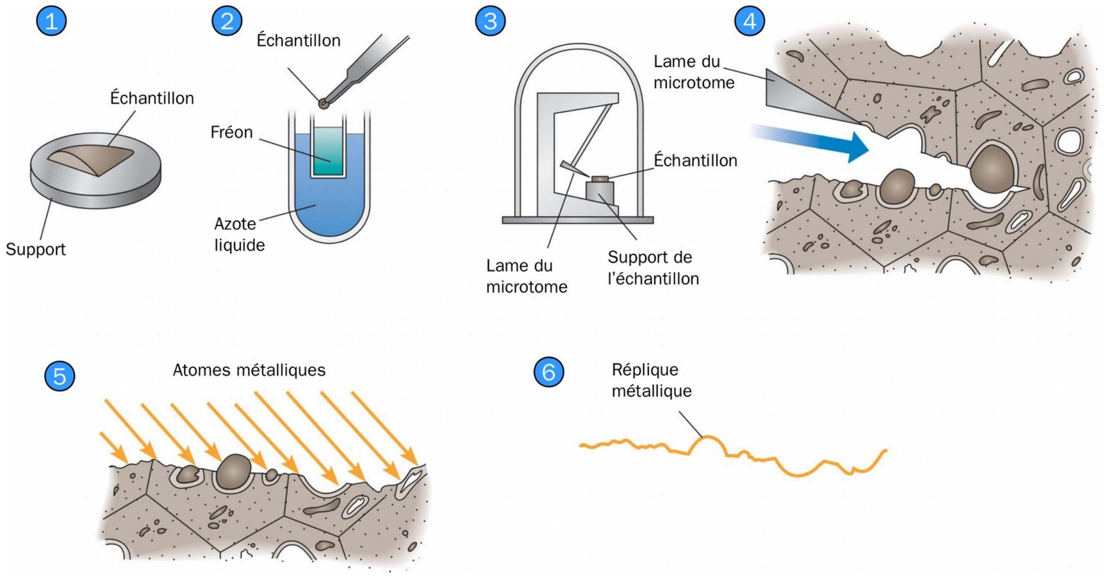


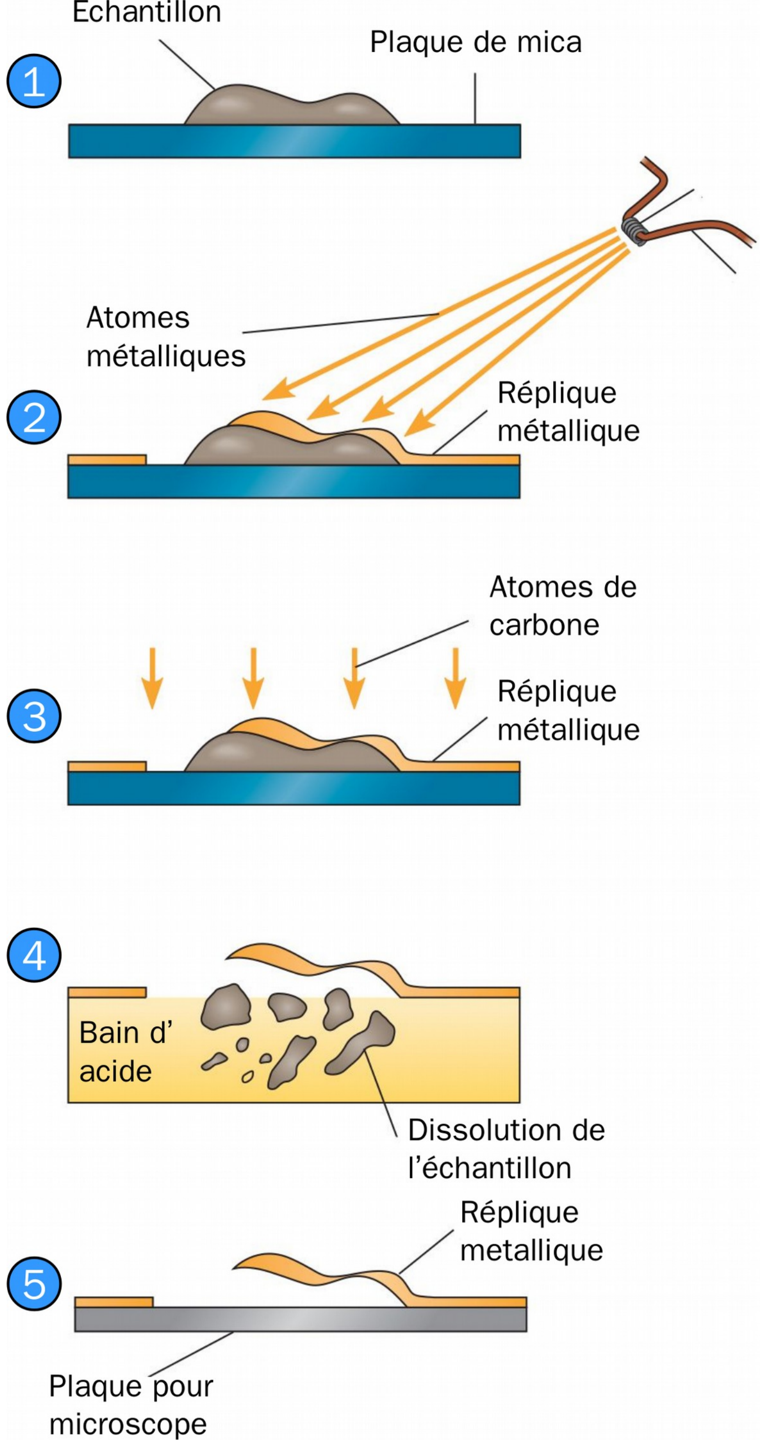
FIGURE 1.6 *(A) Space-filling model of a phosphatidylcholine molecule. (B) Diagram defining the functional groups of a phosphatidylcholine molecule.*



Singer et Nicholson

- Cryofracture
- Cryodécapage
- Ombrage métallique





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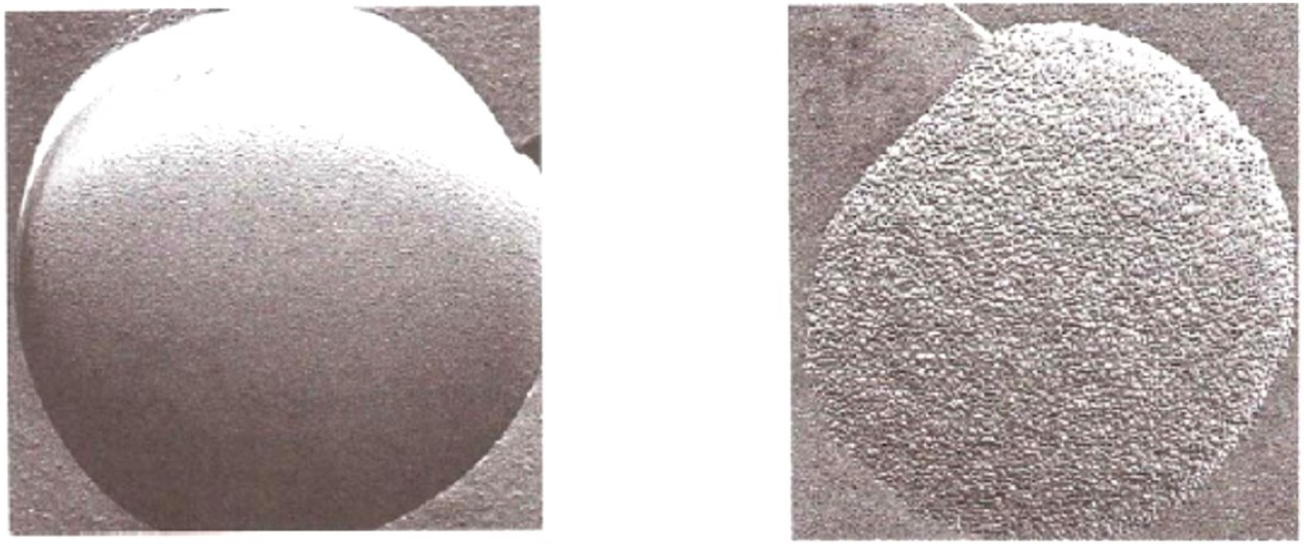
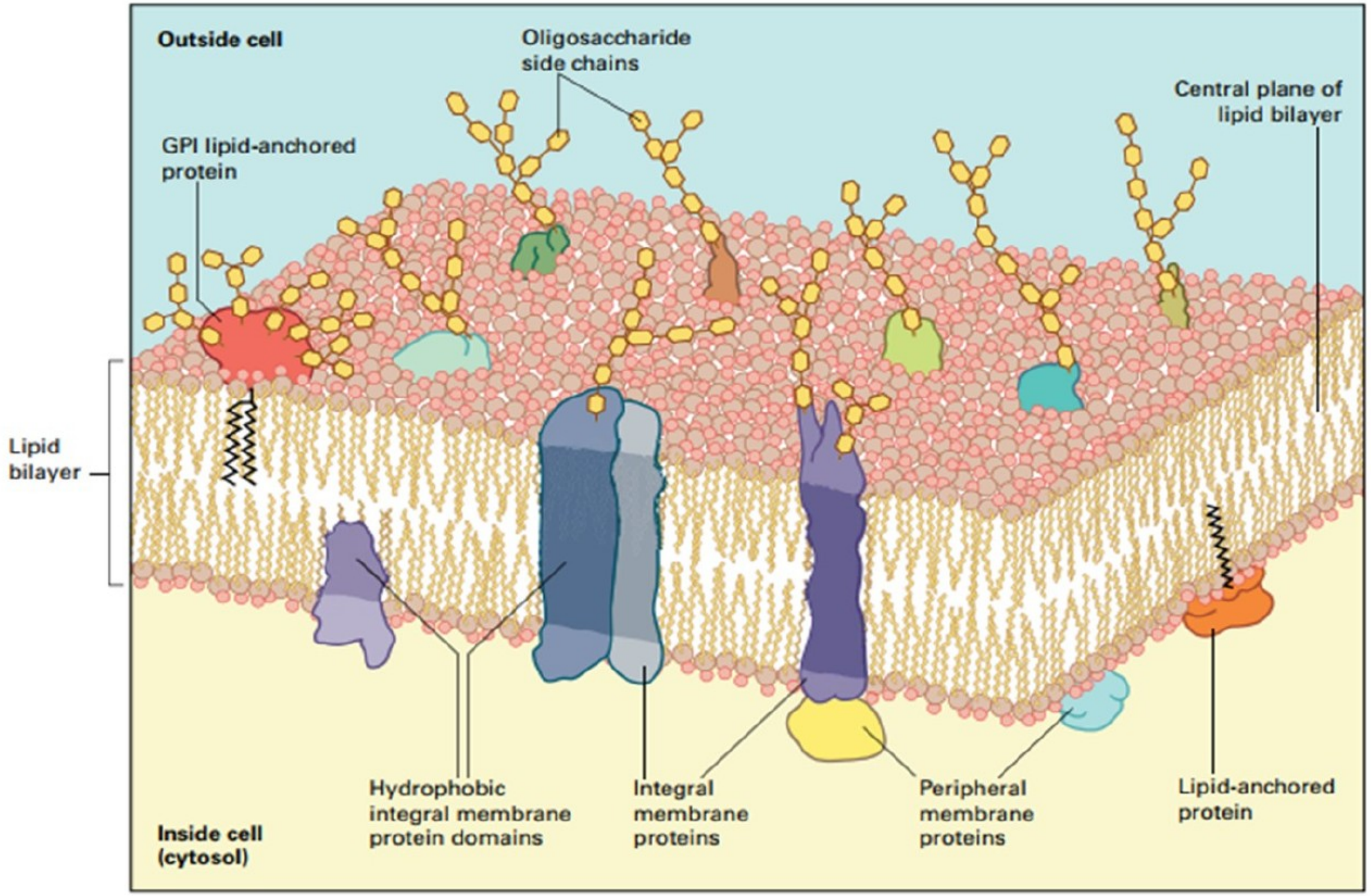


Document 1 : Clichés de cryofracture au microscopie électronique d'un liposome et d'une membrane. A gauche, cryofracture de liposomes (agrandissement : 80000). A droite, cryofracture d'une membrane cytoplasmique d'E. coli (agrandissement : 50000) ; Les irrégularités visibles sur le cliché de droite disparaissent après un traitement aux protéases.
D'après Biochimie et biophysique des membranes, Shechter E., 1997, Masson, 2e édition.

DOC 3 : Résultats d'expériences de cryofracture sur liposome ou sur membrane

Singer et Nicholson

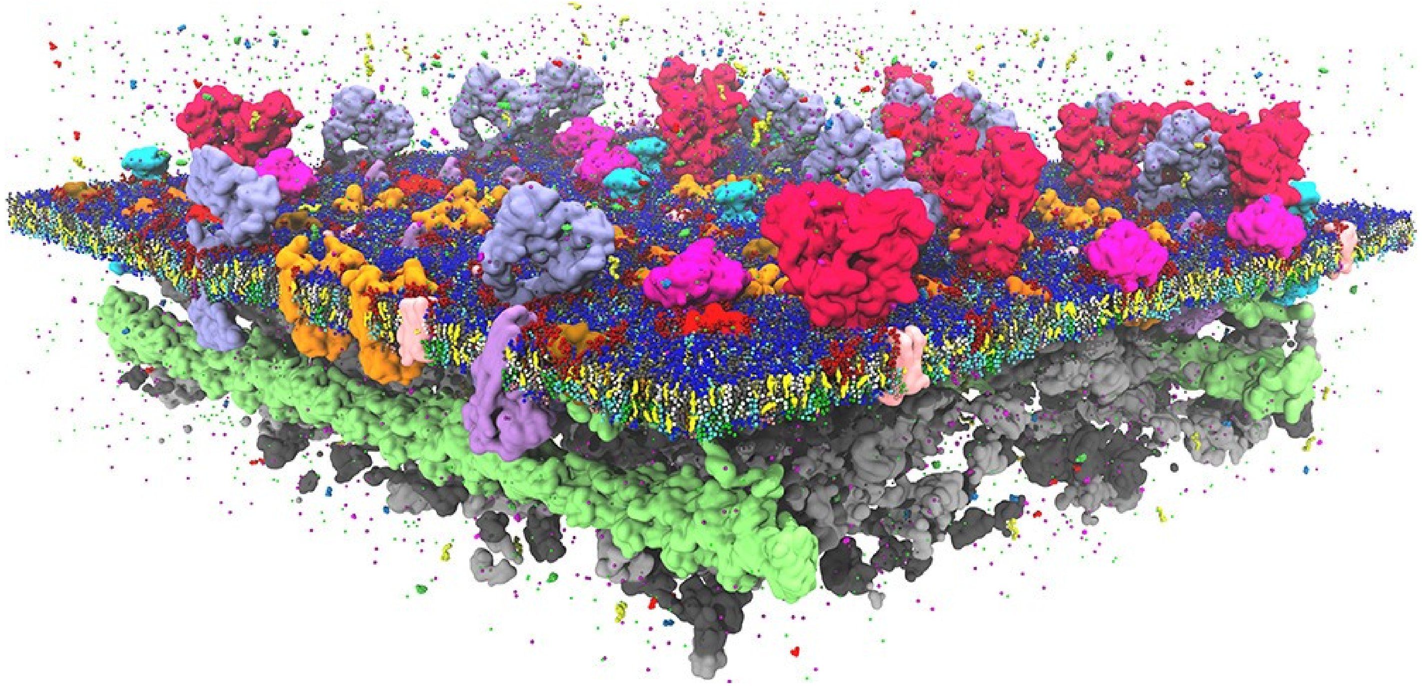
- Modèle final valant un prix Nobel



DOC 2 : Modèle de membrane plasmique (Singer et Nicholson)

Protéines membranaires

- Intrinsèques/intégrales
- Extrinsèques
- Rôle des protéines
  - AdhérenceS
  - Marqueurs
  - Récepteurs
  - Canaux
  - Pompes (coûte de l'énergie sous forme d'ATP)
  - Transporteurs
- 60 % des médicaments ciblent des protéines membranaires



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Computational Modeling of Realistic Cell Membranes

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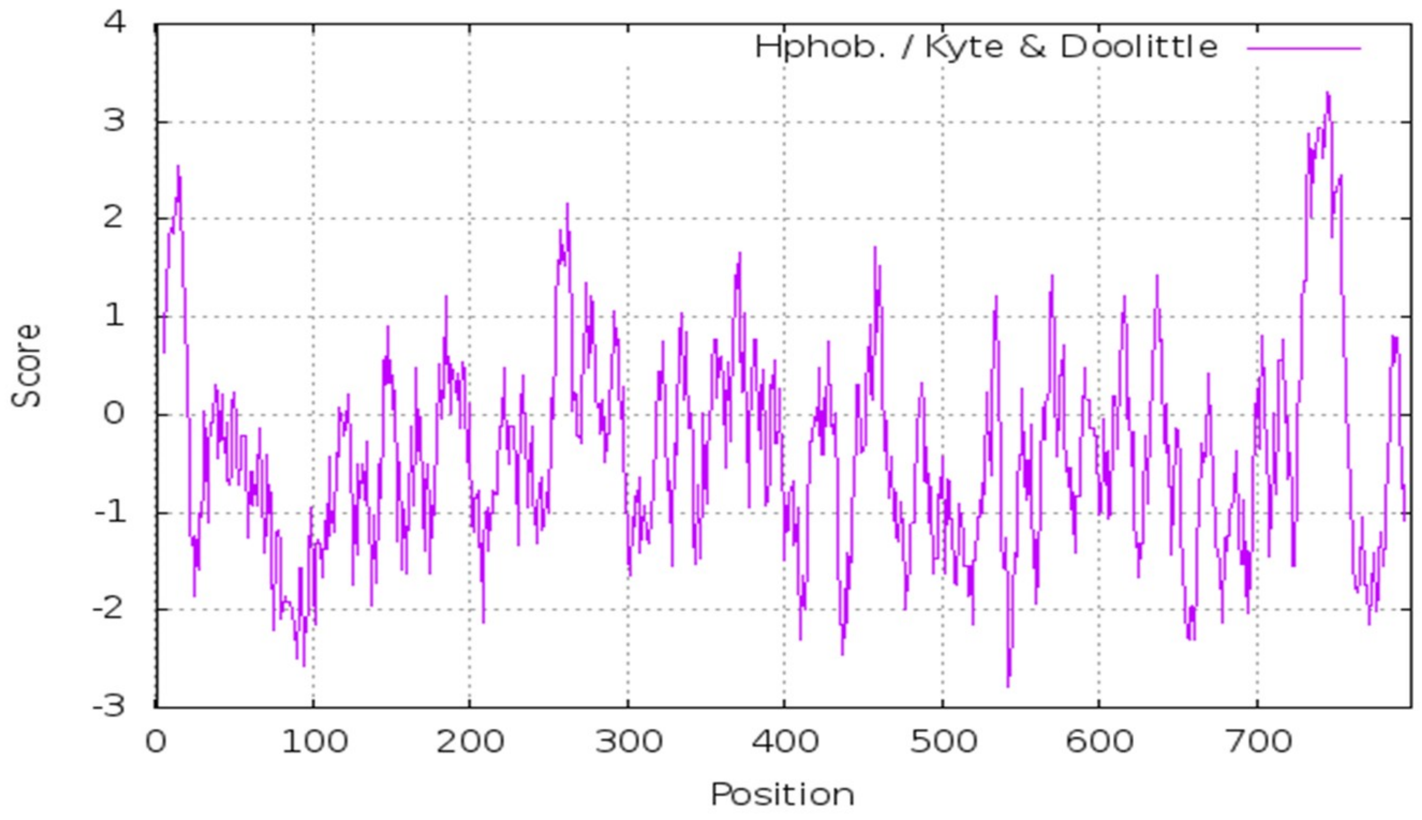
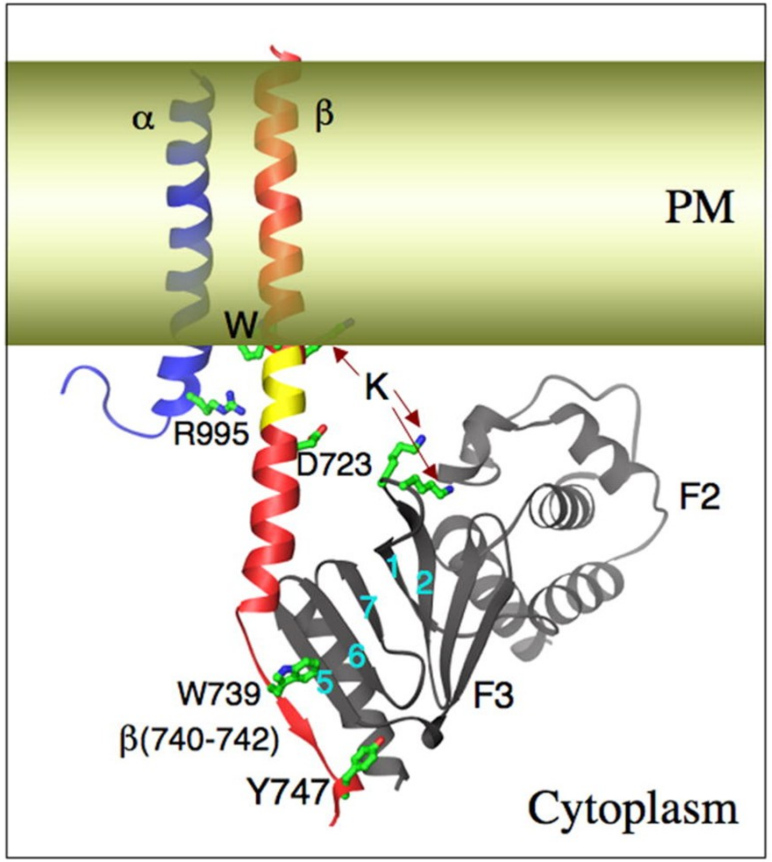
Mise en évidence d’une protéine intrinsèque

- Profil d’hydropathie
- Ici exemple d’une protéine appelée « intégrine beta »



Mise en évidence d'une protéine intrinsèque

- Une longue portion transmembranaire constituée d'acides aminés hydrophobes



Asymétrie des membranes

- Un glycocalyx (revêtement glucidique) à l'extérieur
- Ici sur la membrane d'une hématie

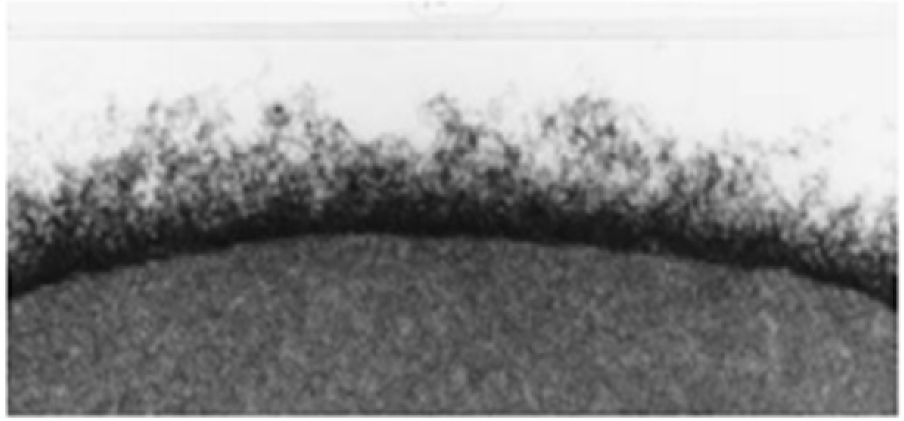
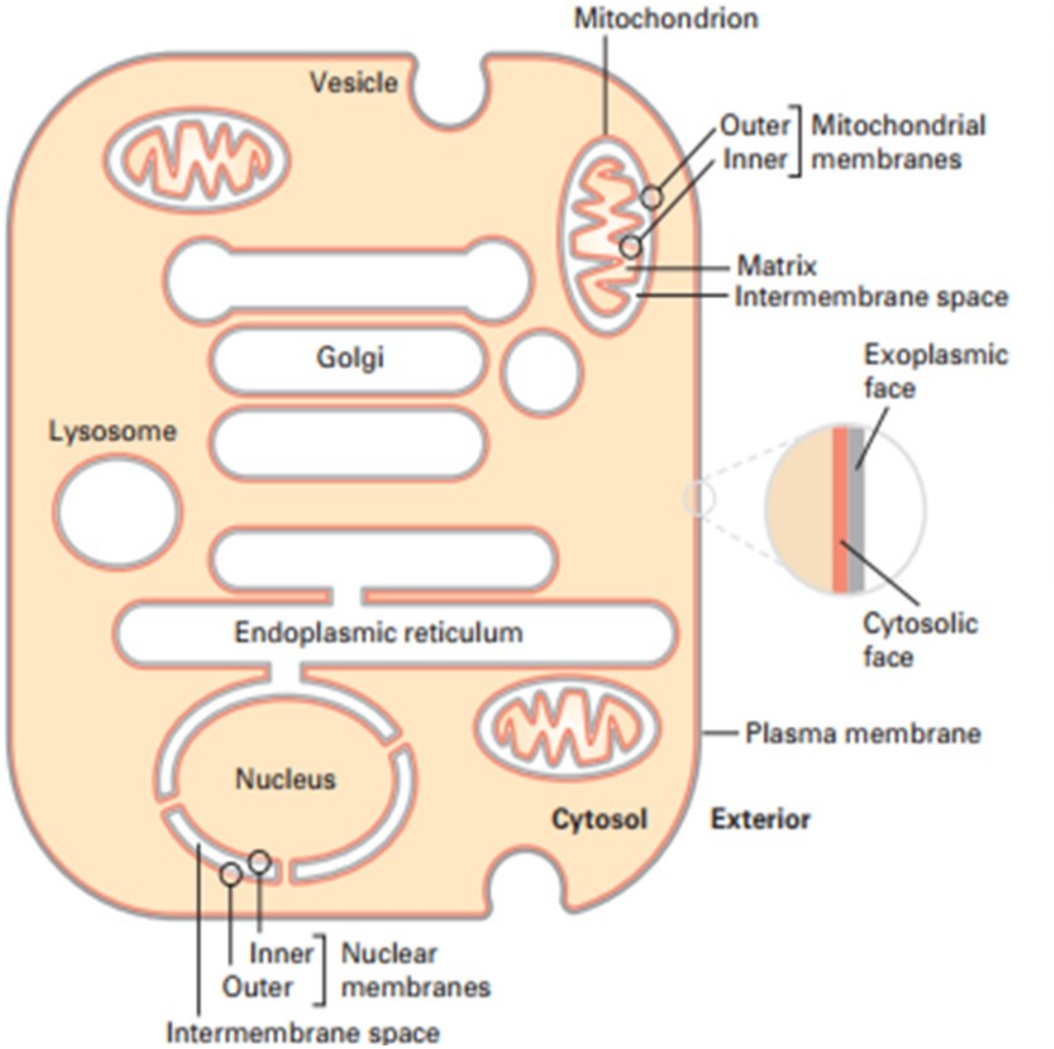


Figure 12-40 **The erythrocyte glycocalyx as revealed by electron microscopy using special staining techniques.** It is up to 1400 Å thick and composed of closely packed, 12- to 25-Å-diameter oligosaccharide filaments linked to plasma membrane–associated proteins and lipids. [Courtesy of Harrison Latta, UCLA.]

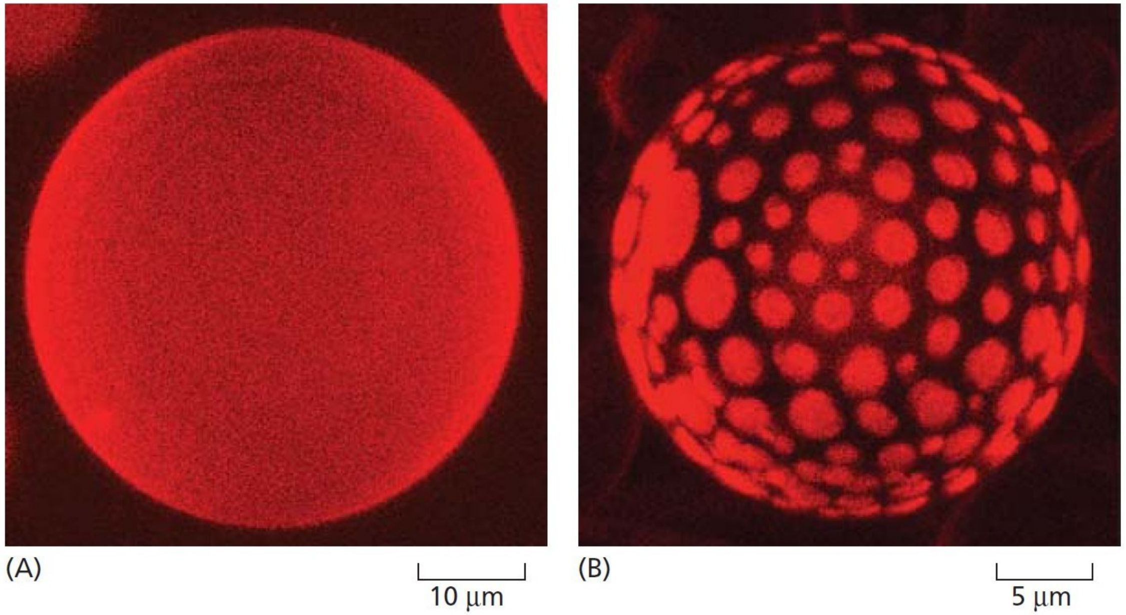
Asymétrie des membranes

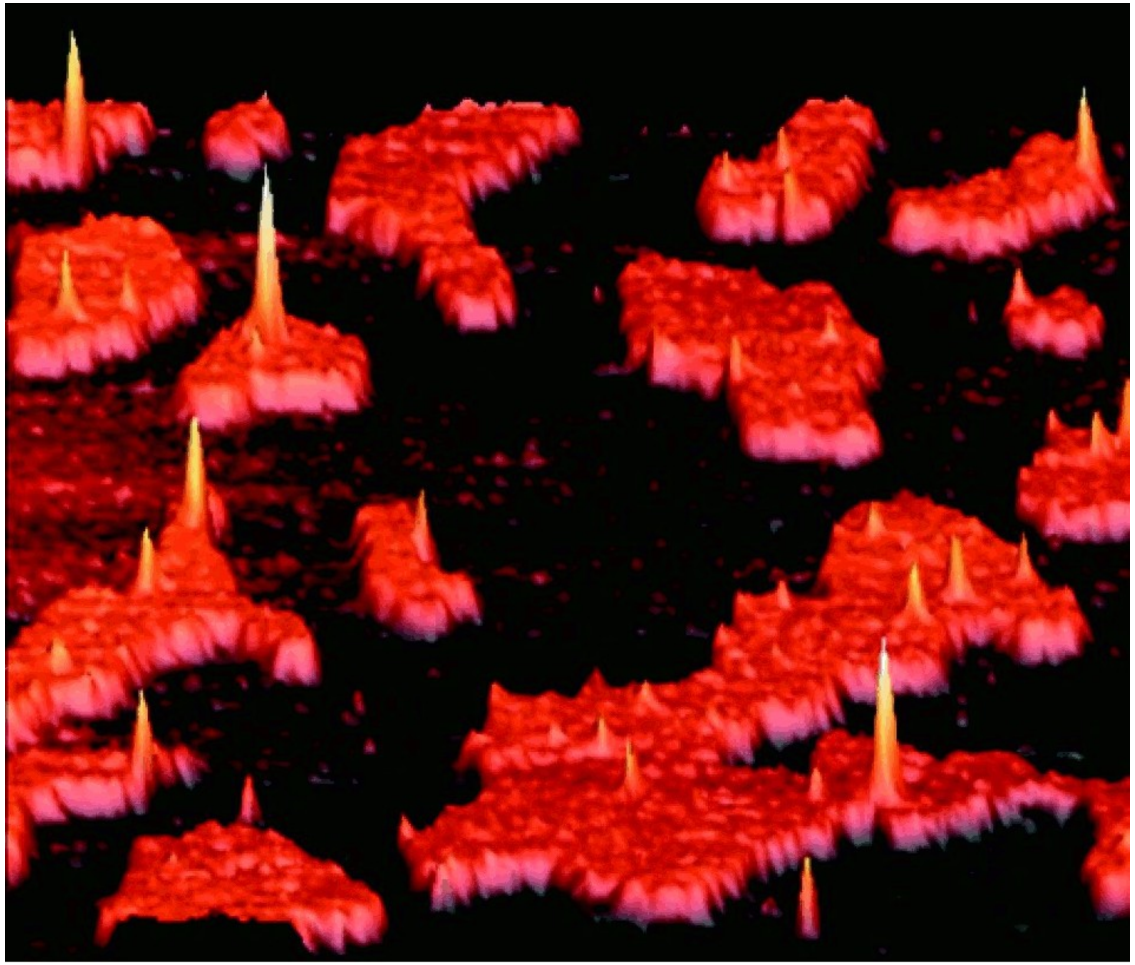
- Deux hémimembranes différentes



Radeaux lipidiques

- Zone moins fluide
- Sphingolipide + Cholestérol
- Caveolin





Radeaux lipidiques

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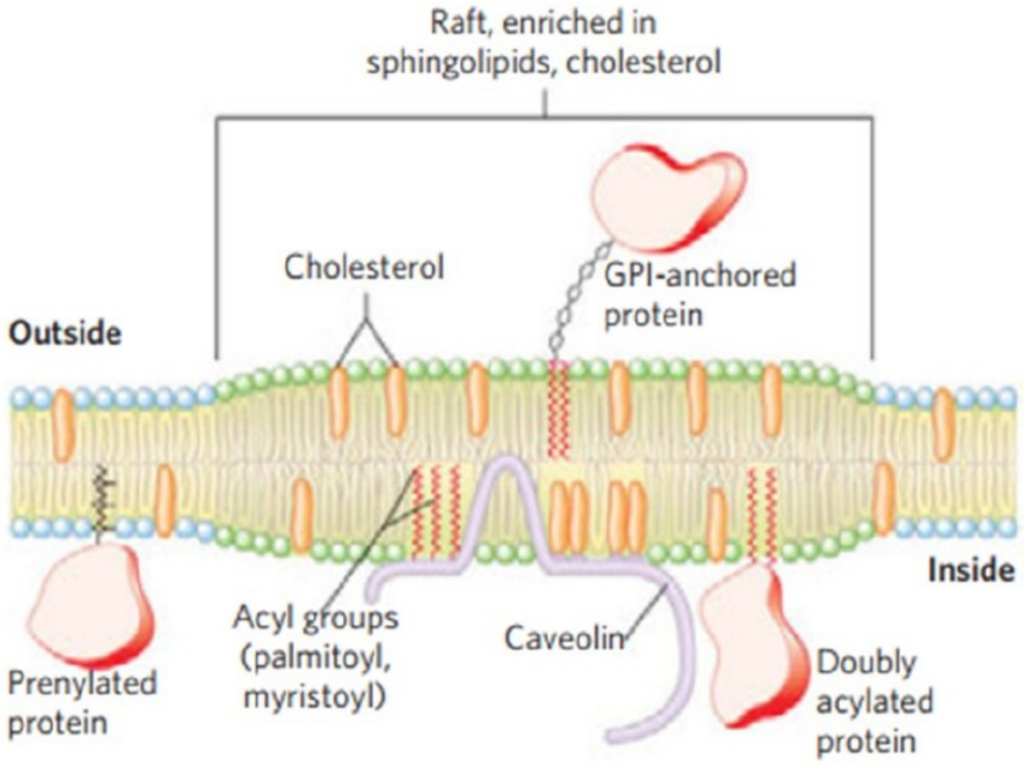
- Sphingolipide + Cholestérol
- Caveolin

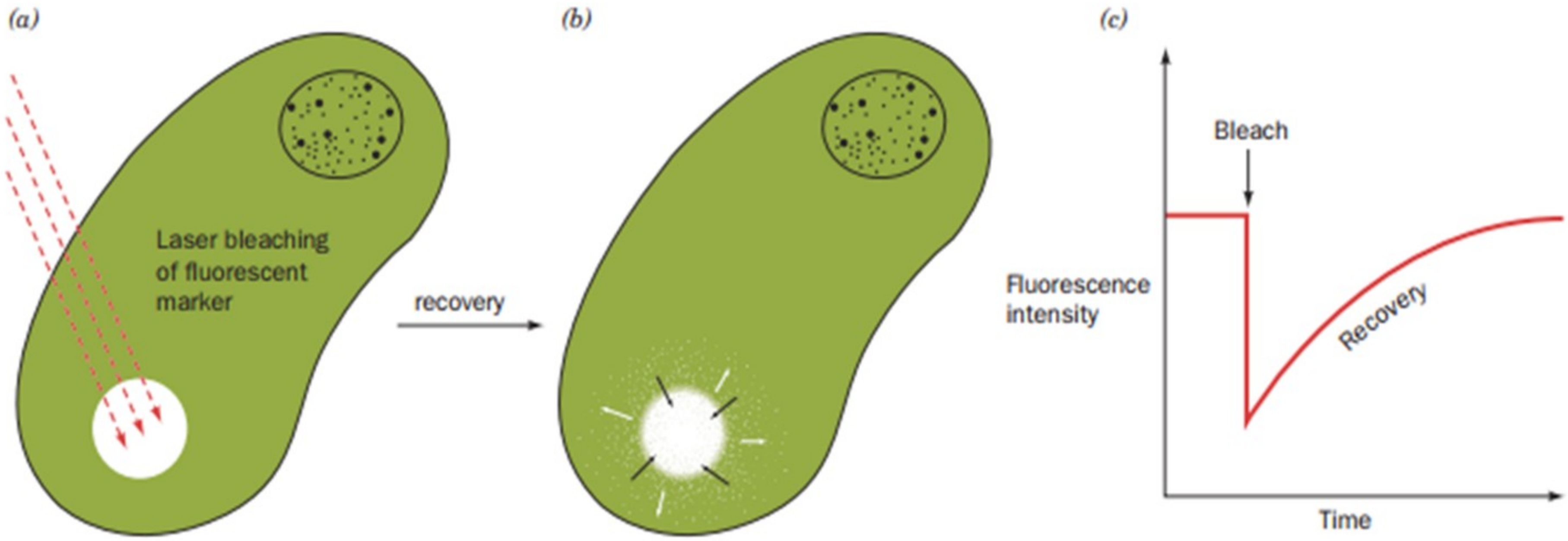
In molecular biology, **caveolins** are a family of integral membrane proteins that are the principal components of caveolae membranes and involved in receptor-independent endocytosis.[1][2][3] Caveolins may act as scaffolding proteins within caveolar membranes by compartmentalizing and concentrating signaling molecules. They also induce positive (inward) membrane curvature by way of oligomerization, and hairpin insertion. Various classes of signaling molecules, including G-protein subunits, receptor and non-receptor tyrosine kinases, endothelial nitric oxide synthase (eNOS), and small GTPases, bind Cav-1 through its 'caveolin-scaffolding domain'.

DOC 7 : Organisation d'un radeau lipidique



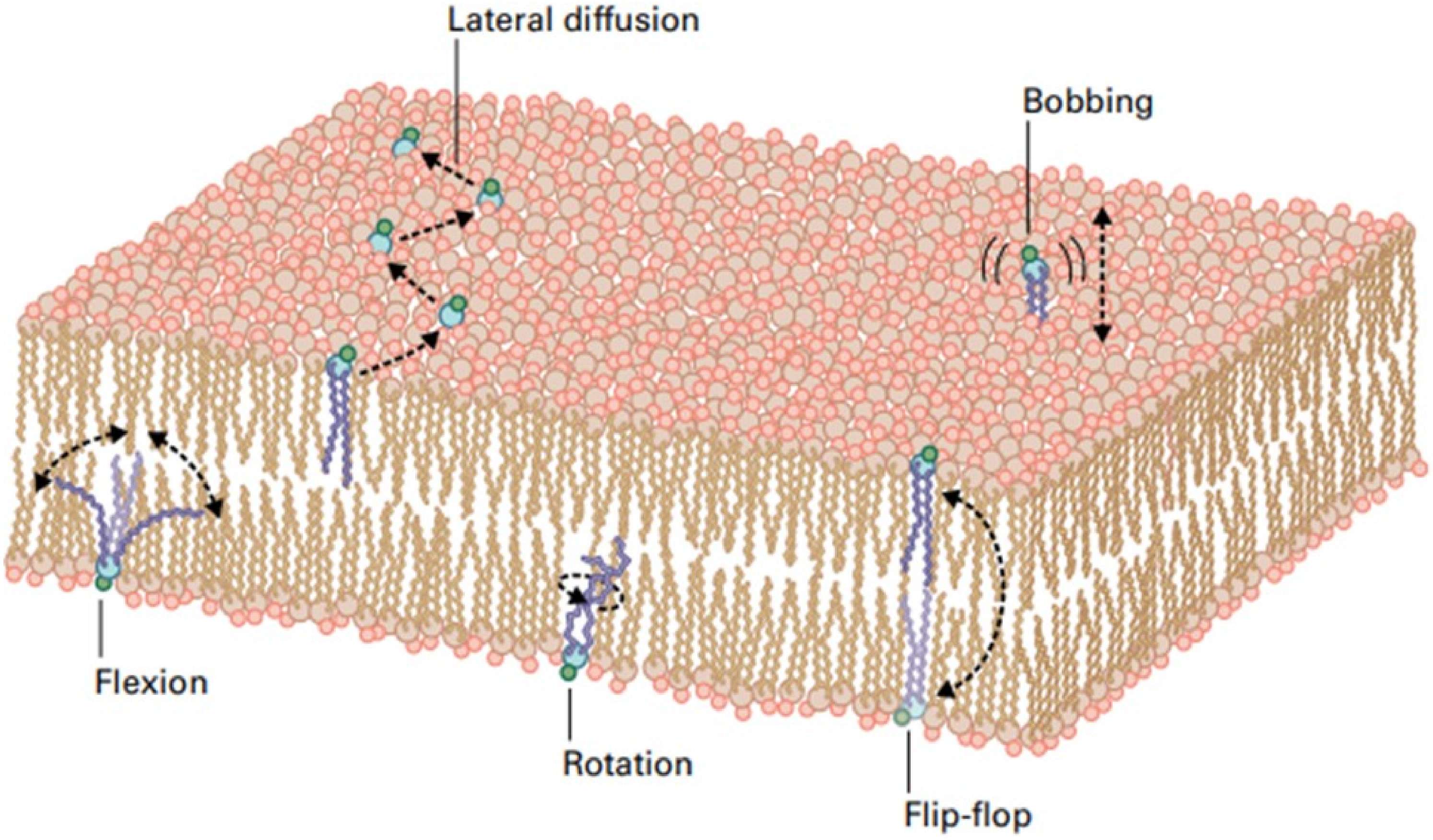
Mouvements au sein de la membrane

- Mise en évidence de la fluidité latérale par la technique de FRAP



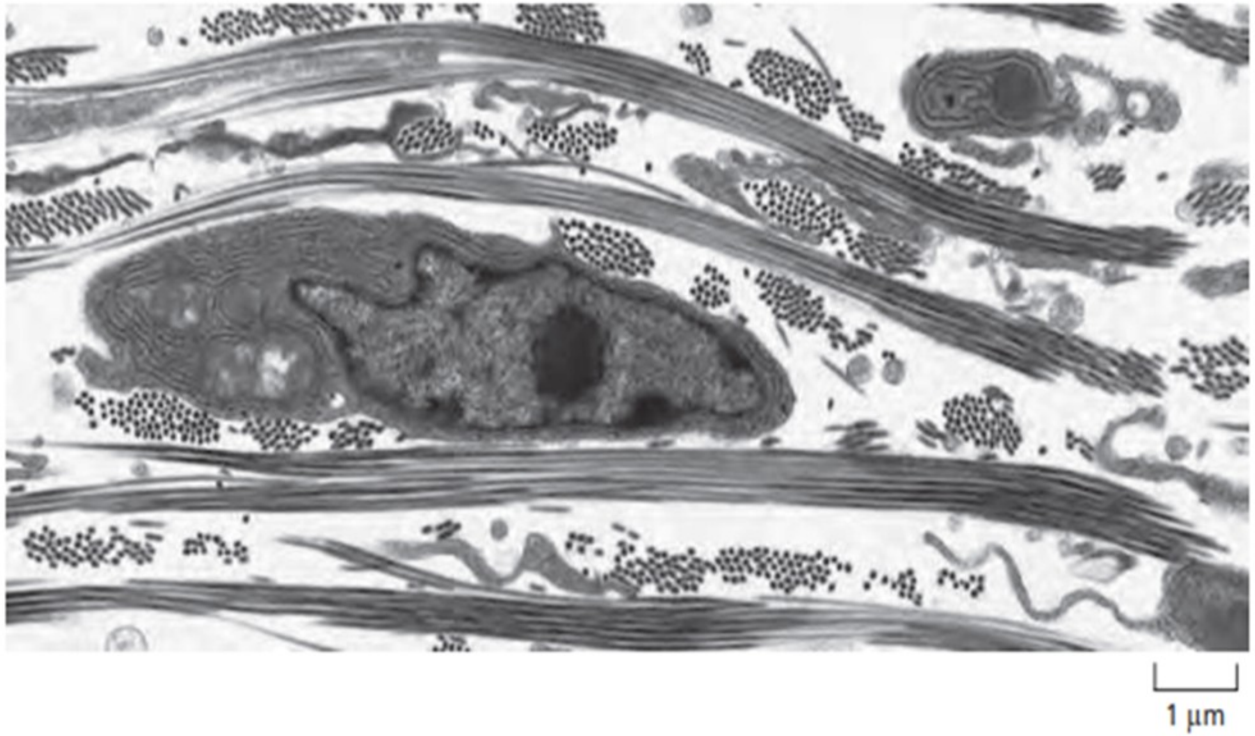
Mouvements au sein de la membrane

- Diffusion latérale
- Flip-flop
- Rotation



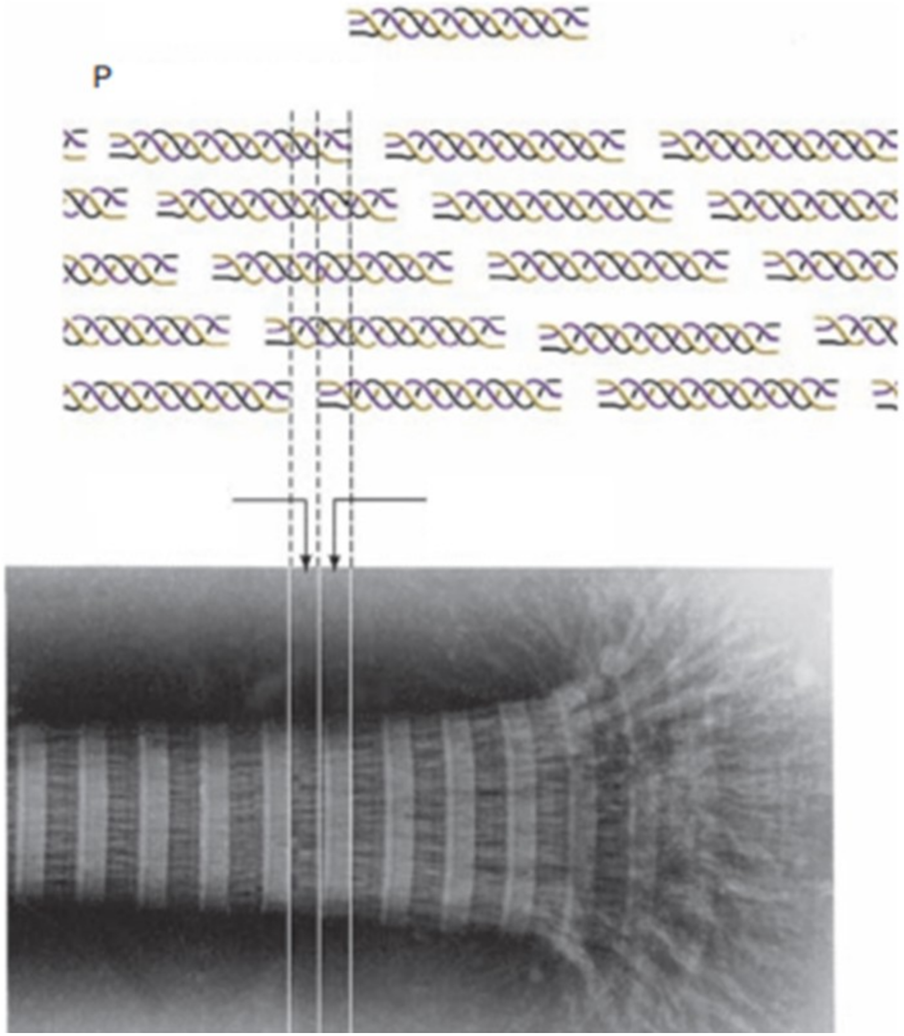
Une cellule entourée de MEC

- Exemple d’un fibroblaste entouré de fibres de collagène



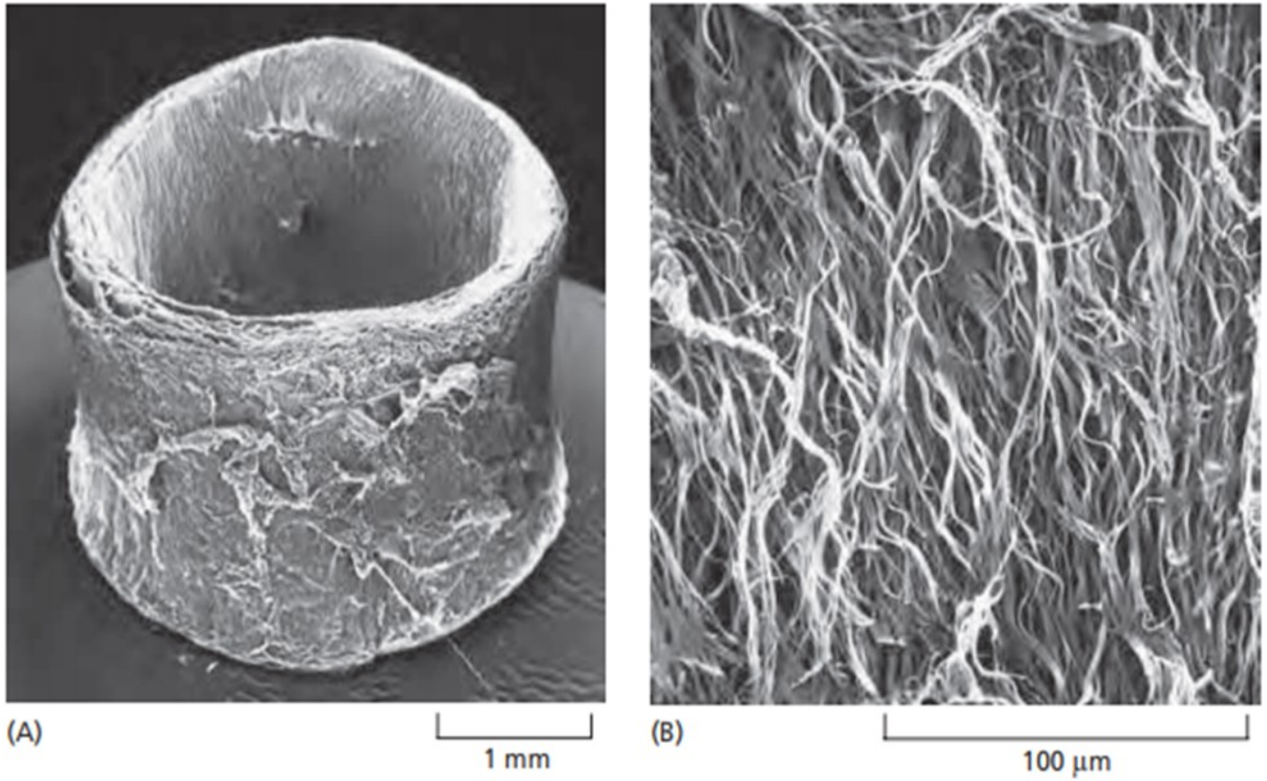
Organisation du collagène

- Stries apparaissant au MET



MEC et élastine

- Ici observées au MEB
- Abondante dans les parois des artères



MEC et protéoglycanes

- Grandes molécules qui retiennent l'eau dans la MEC

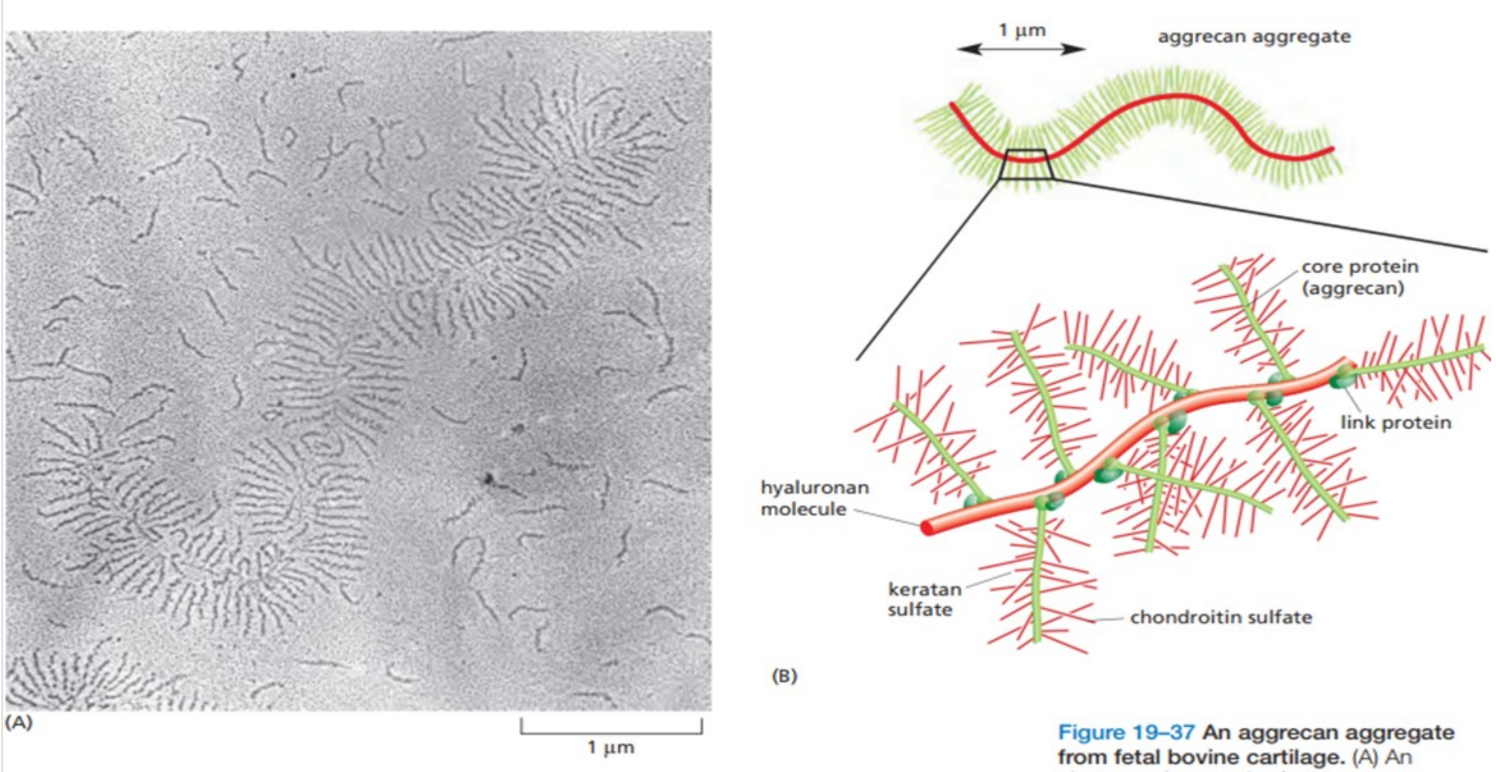


Figure 19–37 An aggrecan aggregate from fetal bovine cartilage. (A) An electron micrograph of an aggrecan aggregate shadowed with platinum. Many free aggrecan molecules are also visible. (B) A drawing of the giant aggrecan aggregate shown in (A). It consists of about 100 aggrecan monomers (each like the one shown in Figure 19–36) noncovalently bound through the N-terminal domain of the core protein to a single hyaluronan chain. A link protein binds both to the core protein of the proteoglycan and to the hyaluronan chain, thereby stabilizing the aggregate. The link proteins are members of a family of hyaluronan-binding proteins, some of which are cell-surface proteins. The molecular mass of such a complex can be 10^8 daltons or more, and it occupies a volume equivalent to that of a bacterium, which is about 2×10^{-12} cm^3. (A, courtesy of Lawrence Rosenberg.)

MEC et GAG

- Les GAG retiennent l'eau en raison de leurs groupements chargés qui diminuent le potentiel osmotique de la MEC

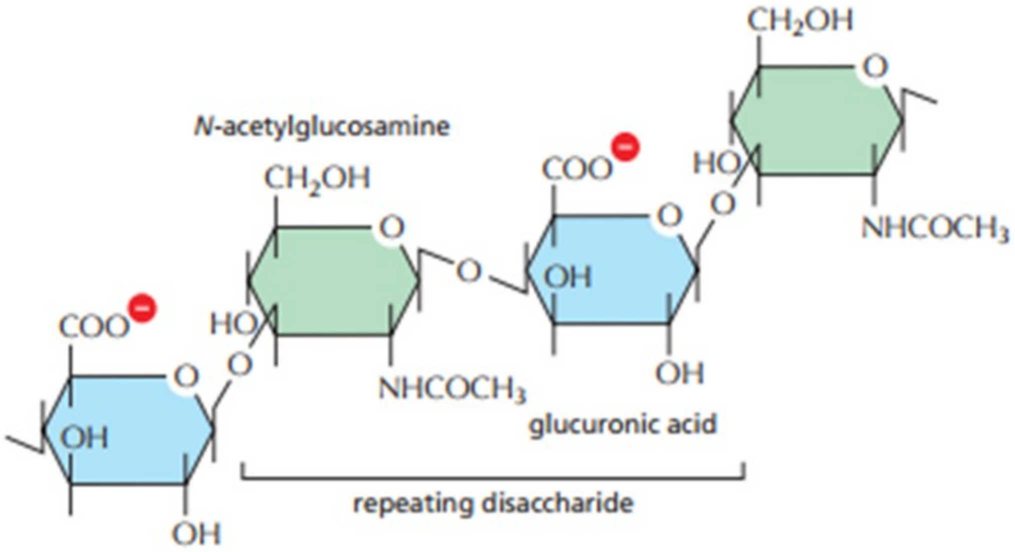
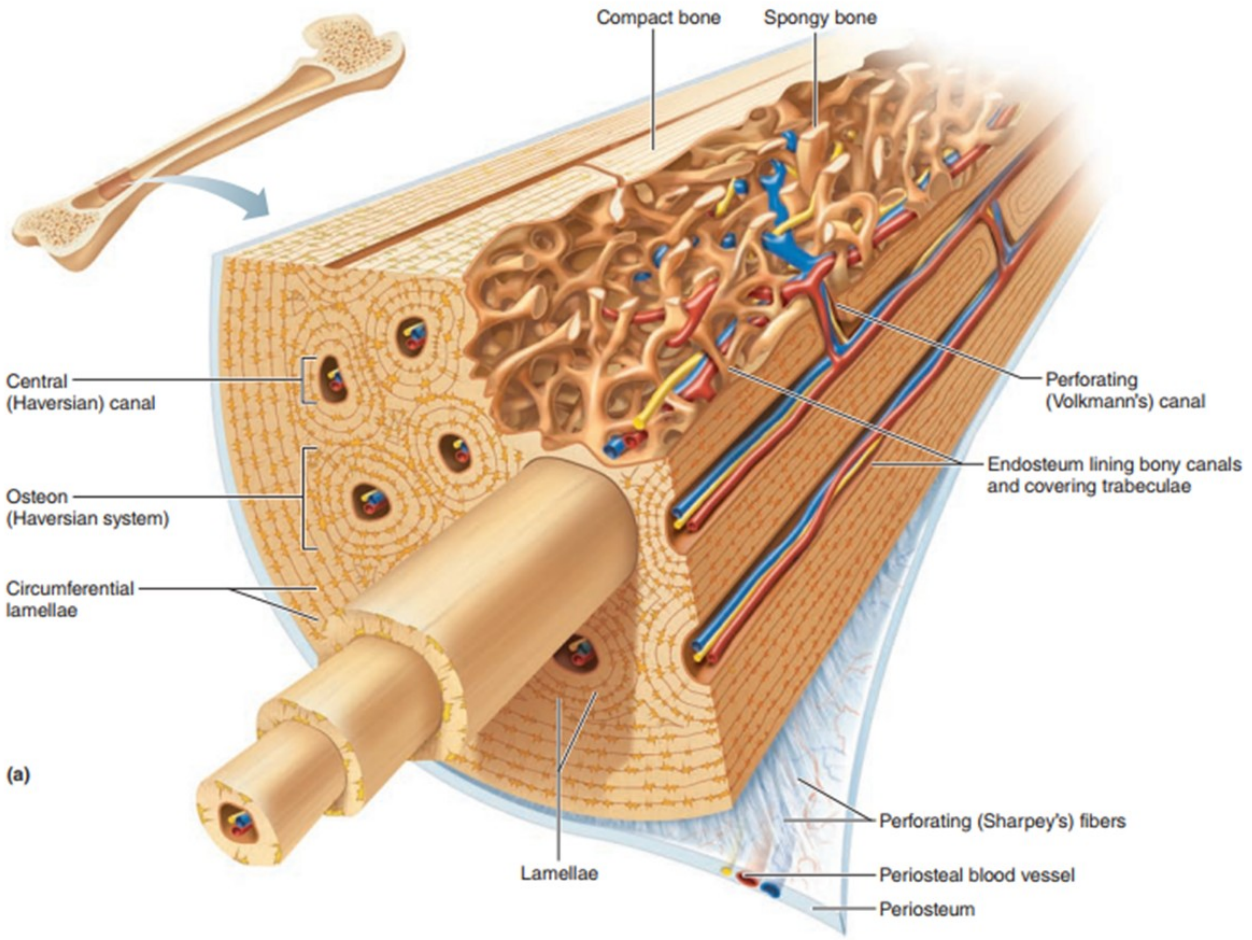


Figure 19–34 The repeating disaccharide sequence in hyaluronan, a relatively simple GAG. This ubiquitous molecule in vertebrates consists of a single long chain of up to 25,000 sugar monomers. Note the absence of sulfate groups.

Une MEC minéralisée, l'os

- Os constitué de cellules entourées d'une MEC minéralisée
- Cristaux d'hydroxyapatite (phosphate de calcium)
- Os = tissu riche en vaisseaux sanguins et nerfs



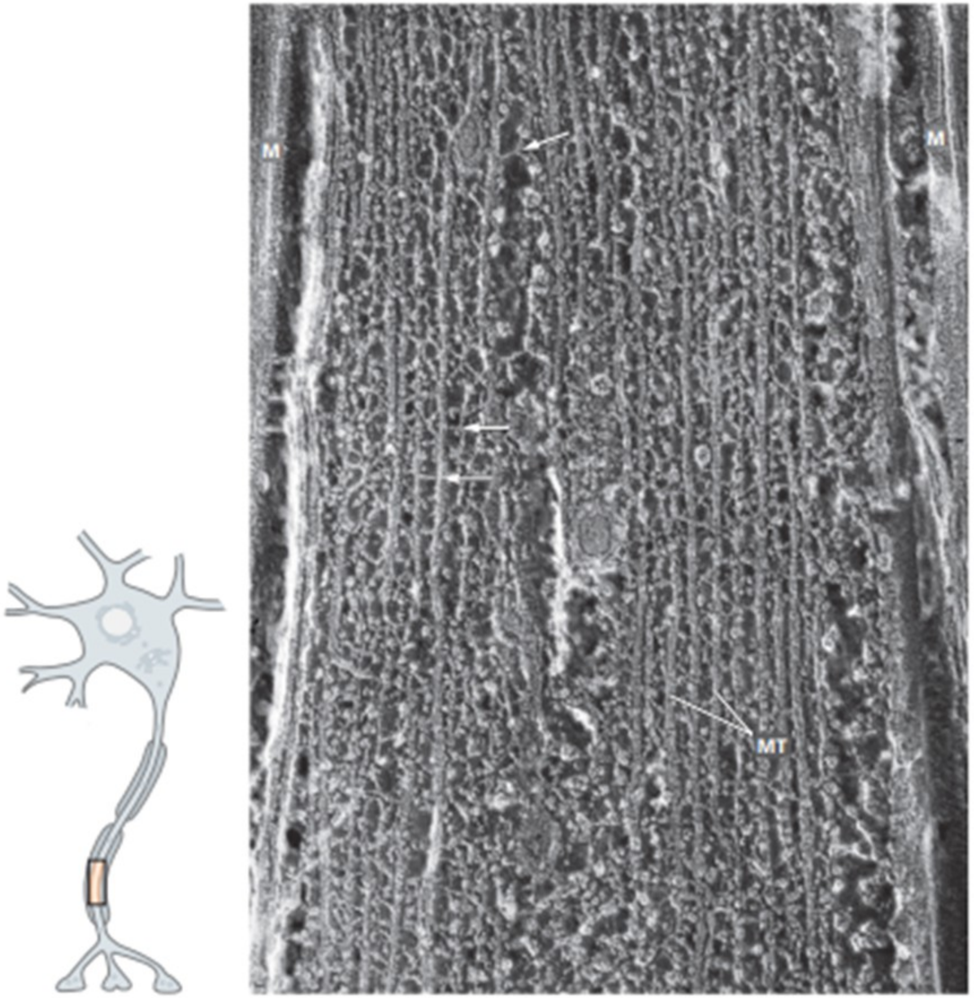
Cytosquelette

- Cellule après action d'un détergent qui solubilise les membranes
- Le cytosol contient un réseau de filaments

FIGURE 5.2 *Electron micrograph of cytoskeletal meshwork, showing detergent-resistant fibrous elements from a suspension-cultured carrot (*Daucas carota*) cell.*
Source: Xu et al. (1992). Plant Cell 4:941–951.

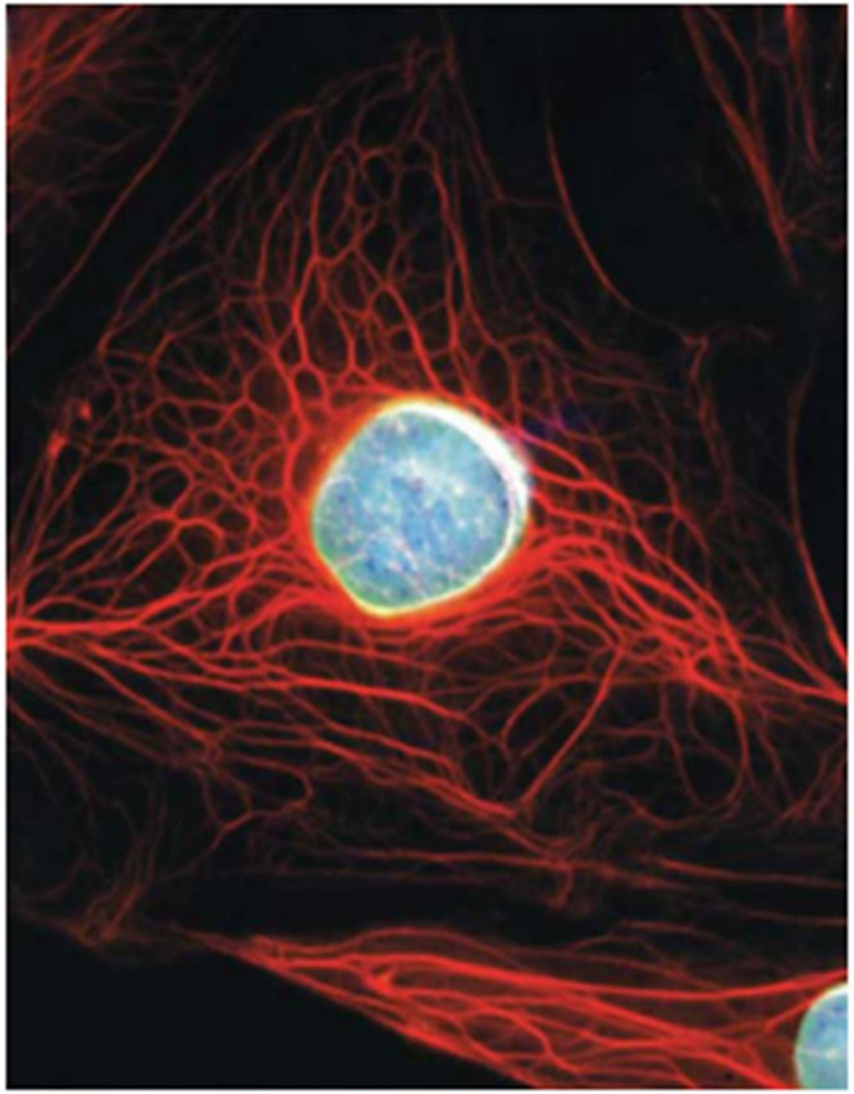
Cytosquelette : microtubules

- Axone en microscopie électronique
- Nombreux microtubules visibles



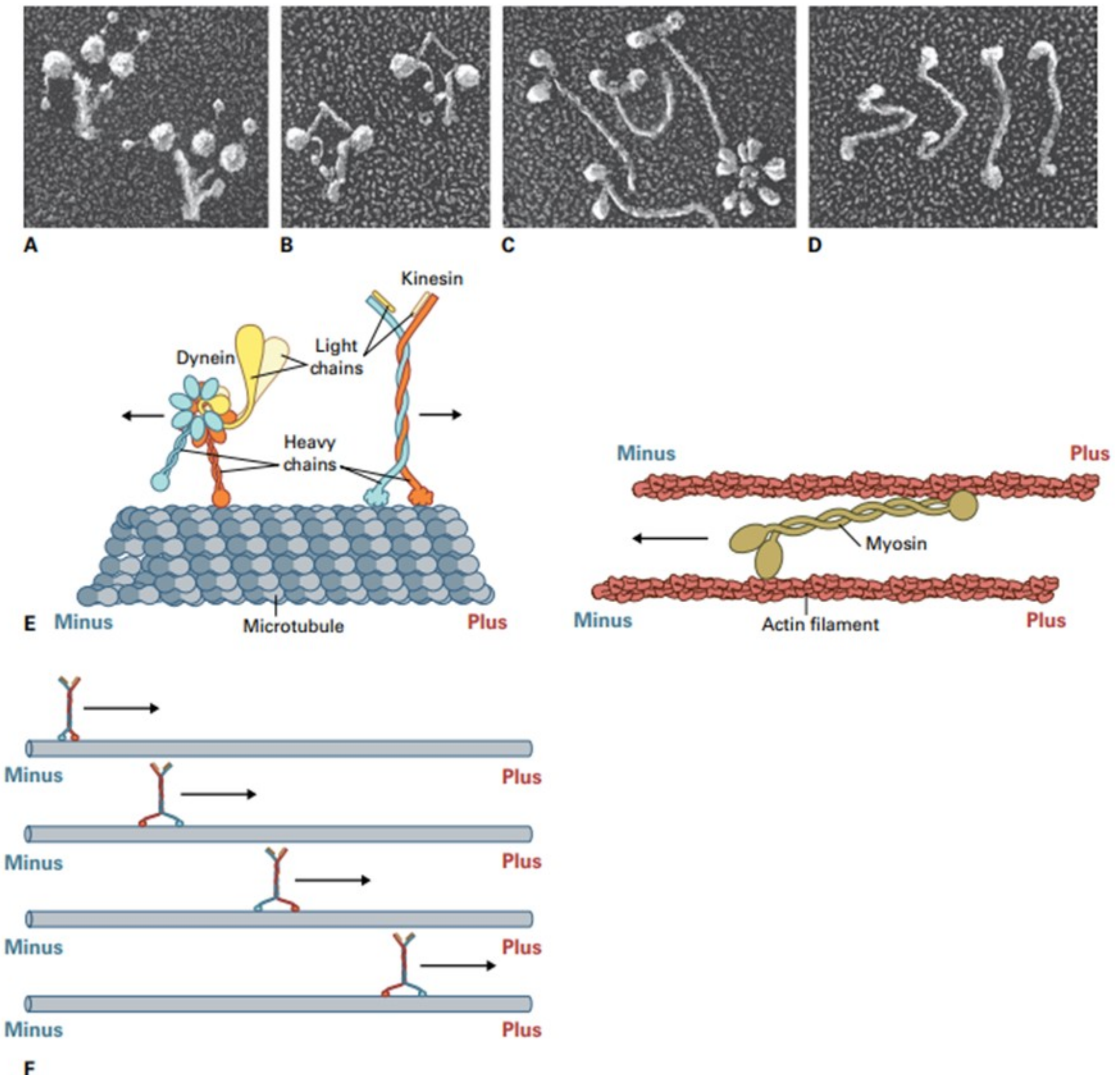
Cytosquelette : filaments intermédiaires

- Microscopie à fluorescence
- Kératine (en rouge)
- Lamines (en bleu)



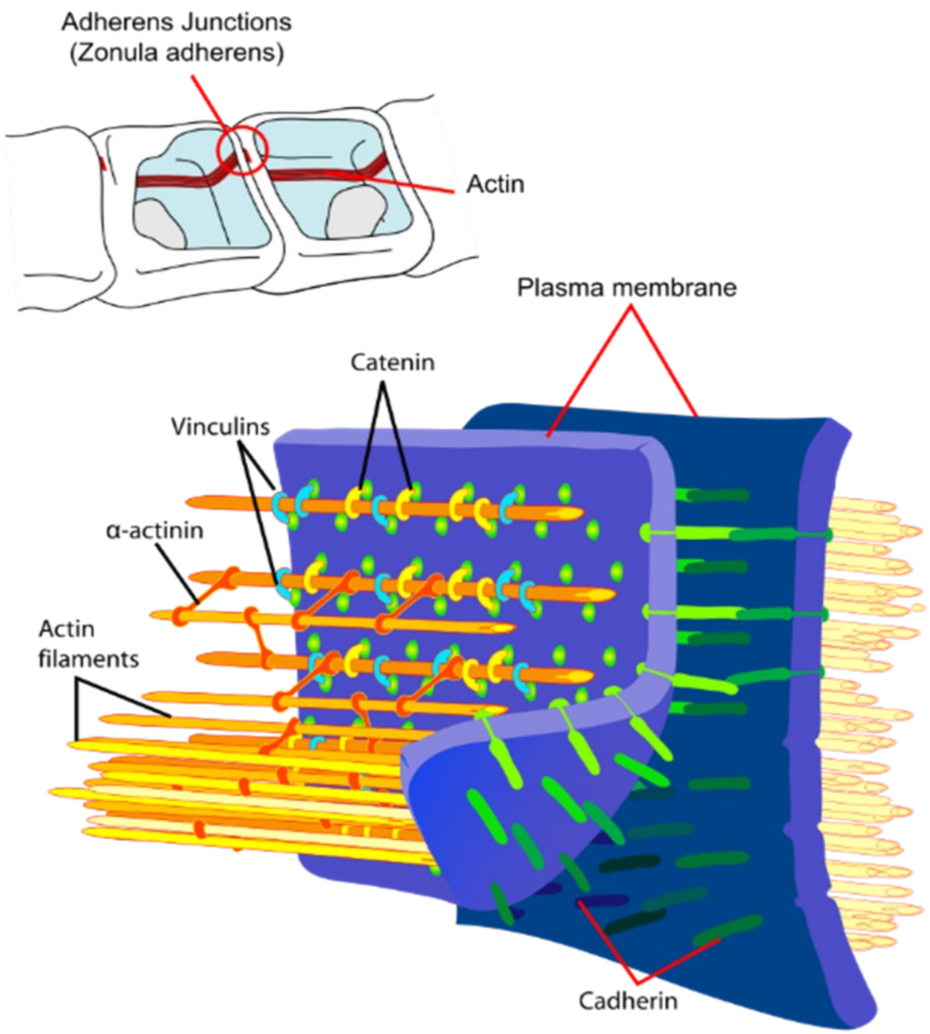
Cytosquelette : moteurs moléculaires

- Myosines et actine
- Kinésine/dynéine et microtubules
- Déplacements des organites et des protéines sur les filaments du cytosquelette



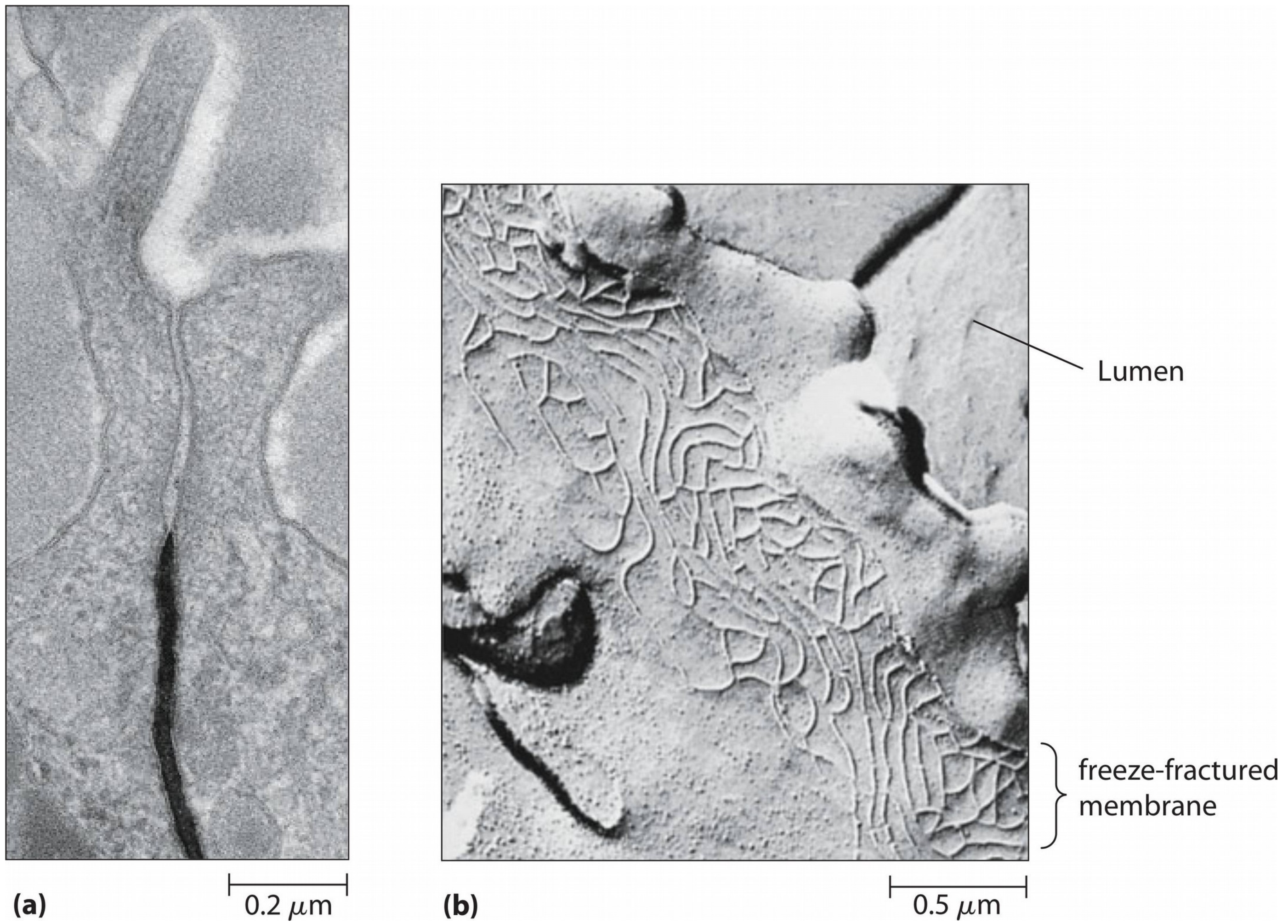
Jonctions : ceinture d’adhérence

- Pôle apical
- Dans les cellules épithéliales
- Cadhérines, actine, protéines adaptatrices



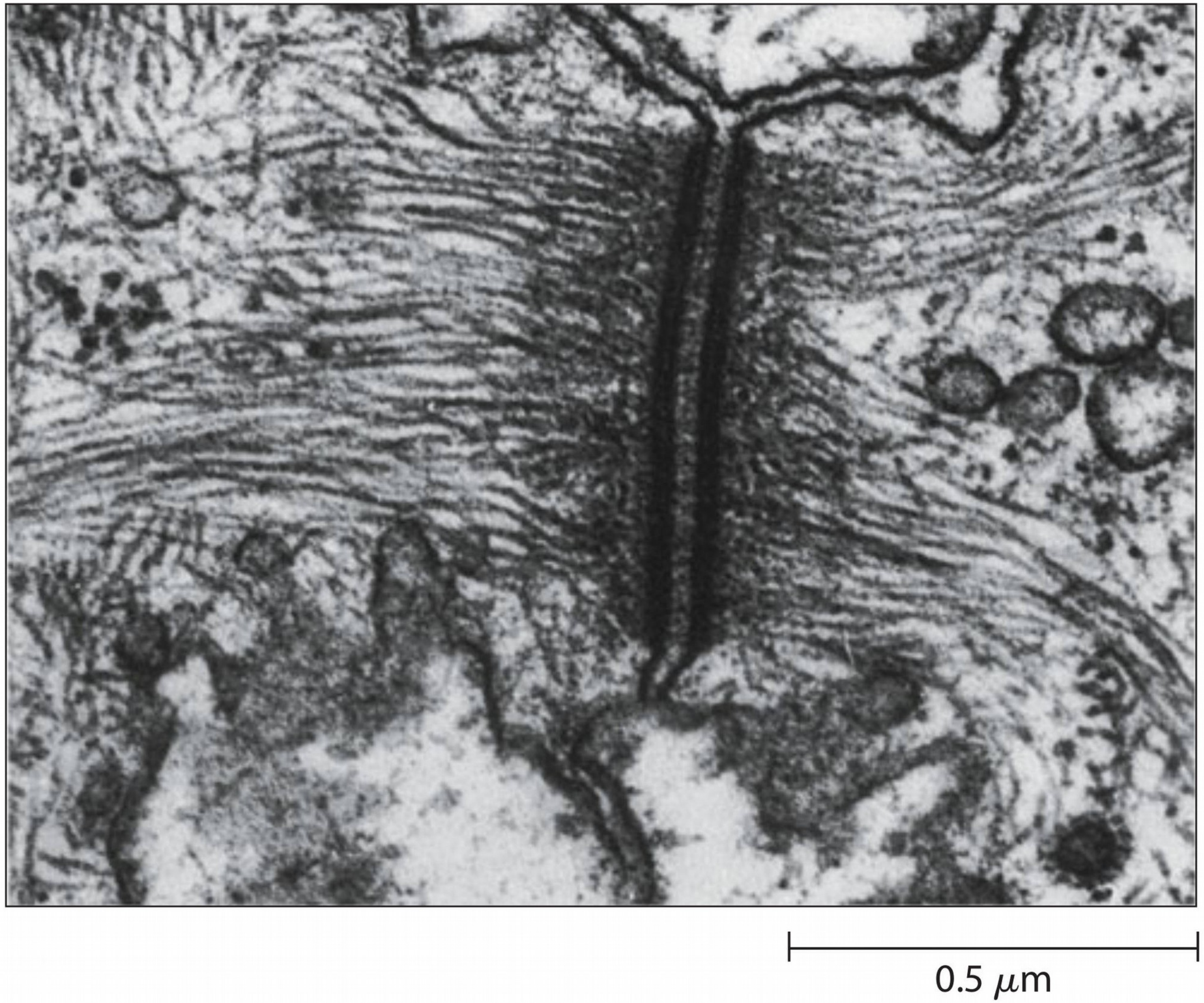
Jonctions : ceinture d'étanchéité

- Pôle apical
- Dans les cellules épithéliales
- Occludines, claudines



Jonctions : desmosomes

- Patchs
- Cadhérine, protéines adaptatrices, kératine

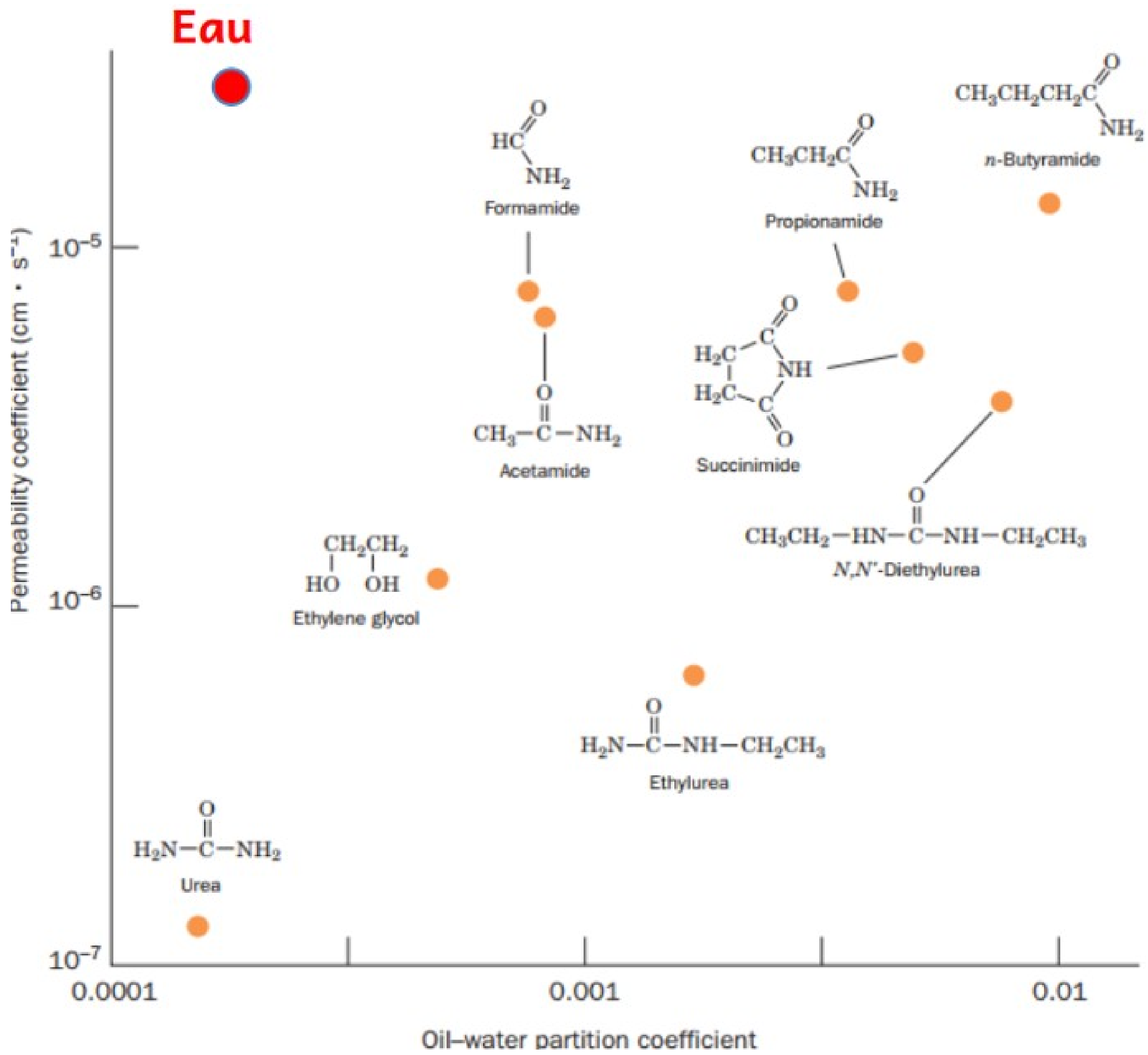


Transports membranaires

- Potentiel électrochimique
- Potentiel chimique
- Potentiel électrique
- Sens de passage
- Exergonique VS endergonique

Transports membranaires

- Coefficient de partition
- Hydrophobe → diffusion simple facilitée



Transports membranaires : cas de l’eau

- Transport par des aquaporines

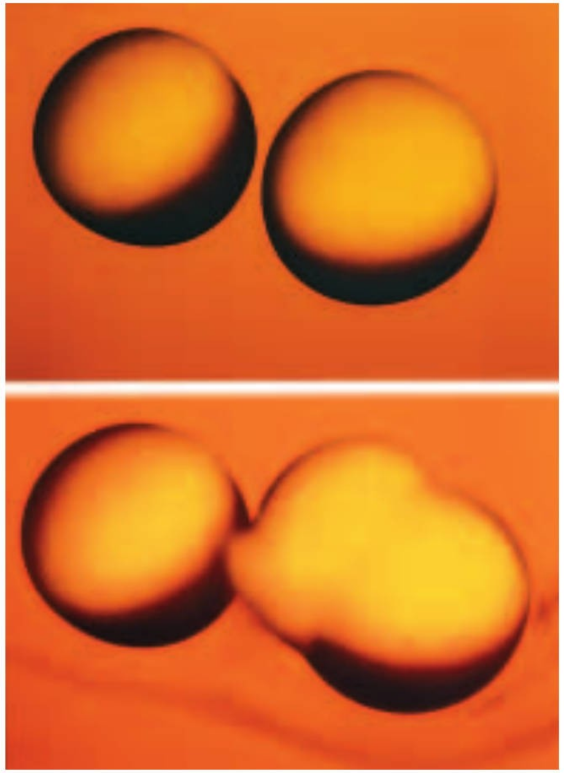
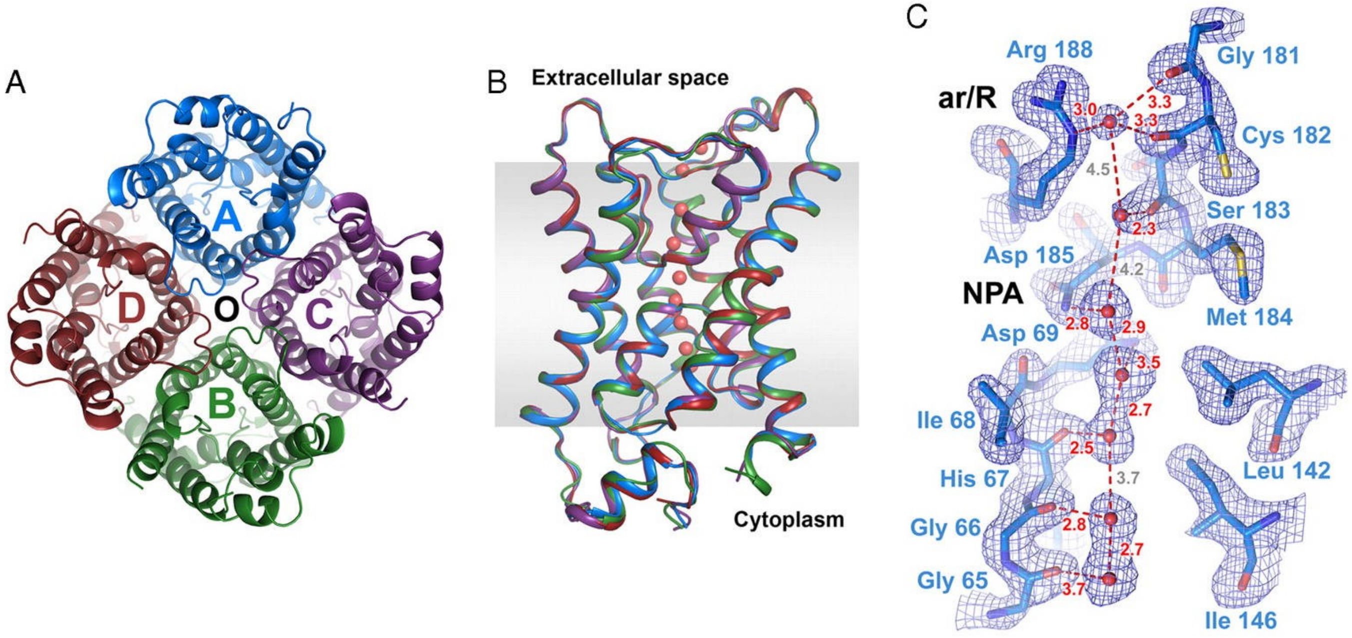
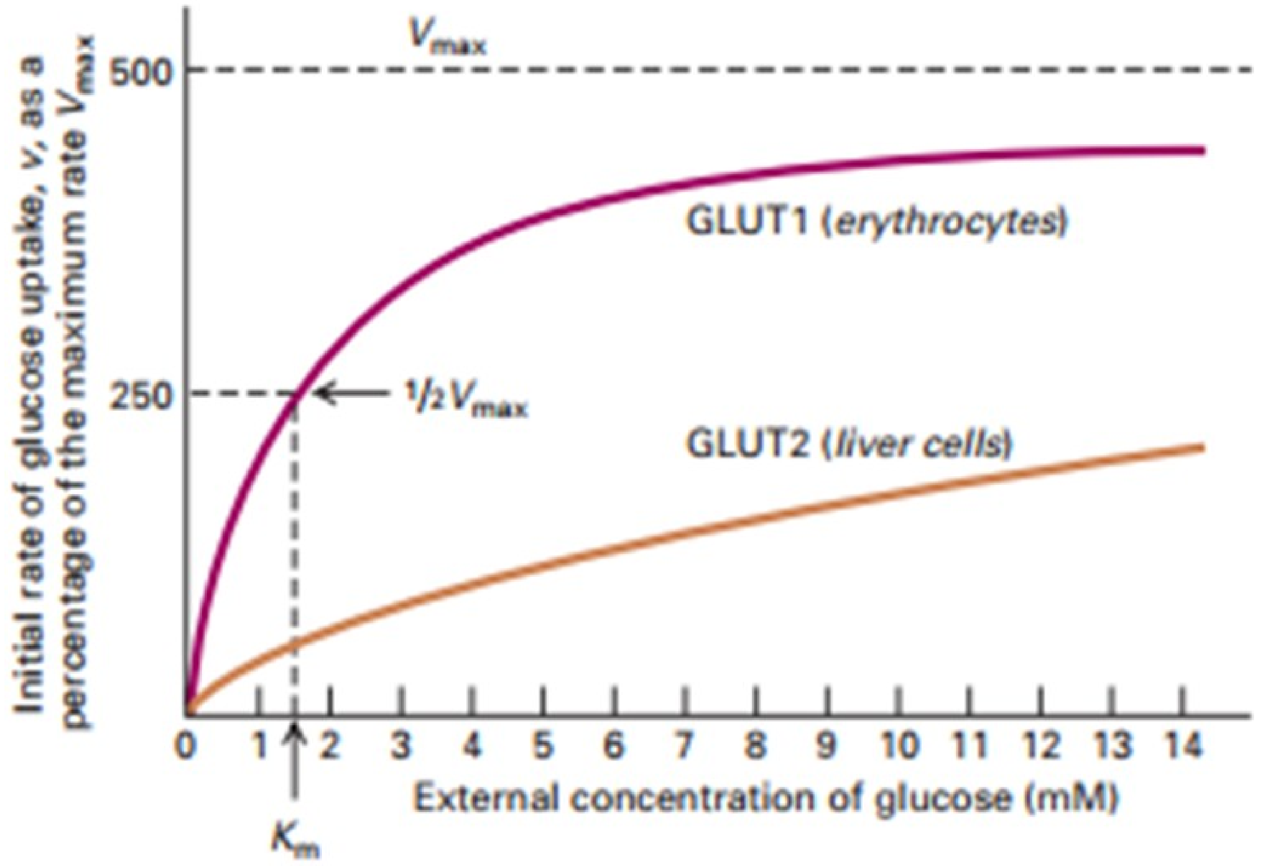


Figure 2. Functional expression of AQP1 water channels in *Xenopus laevis* oocytes. Control oocyte (left) was injected with water; AQP1 oocyte (right) was injected with cRNA. The oocytes were transferred to hypotonic buffer. After 30 seconds (top) the AQP1 oocyte has begun to swell; after 3 minutes (bottom), the AQP1 oocyte has exploded. Modified and reprinted from Science with permission (Preston *et al.*, 1992).



Transports membranaires : cas du glucose

- Transport par des transporteurs spécialisés (GLUT)
- Famille de transporteurs aux cinétiques variables



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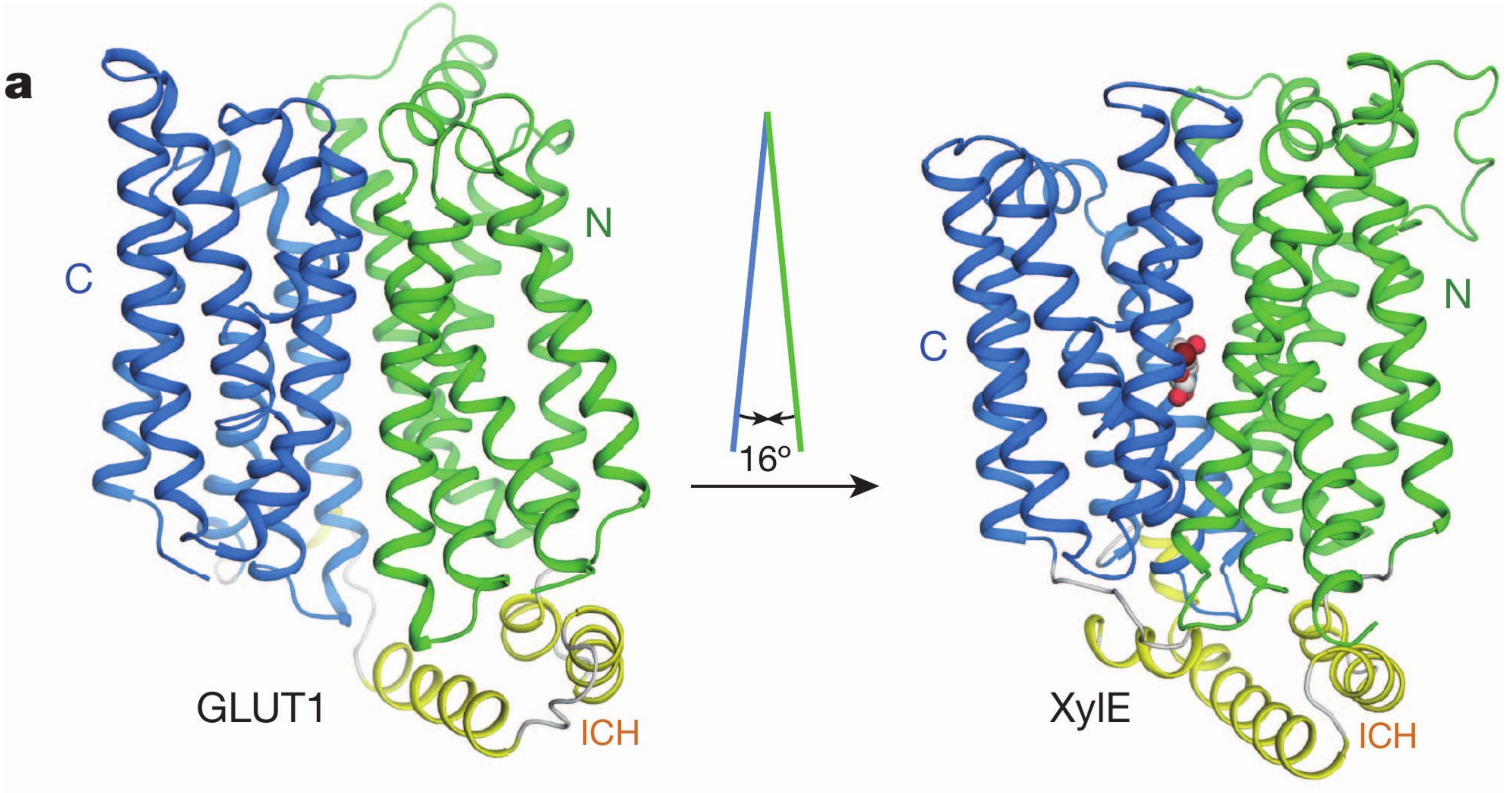
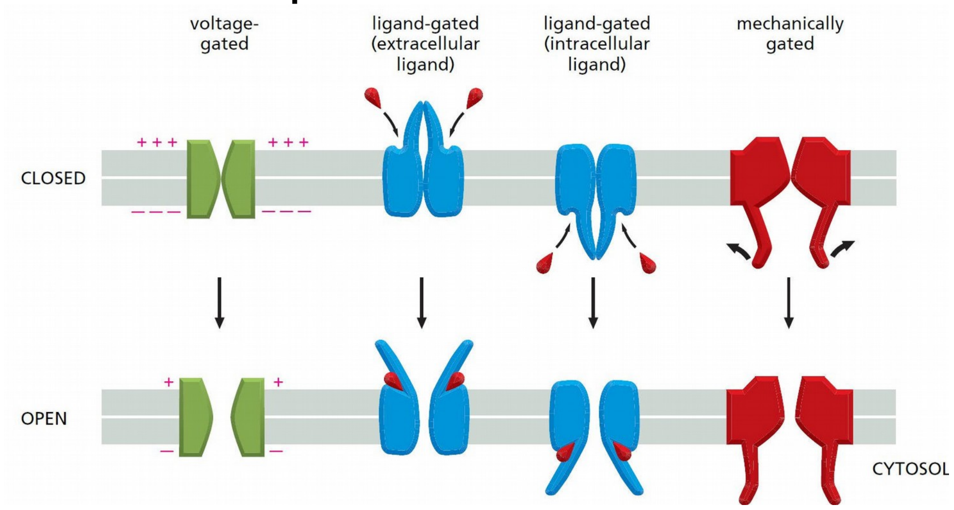
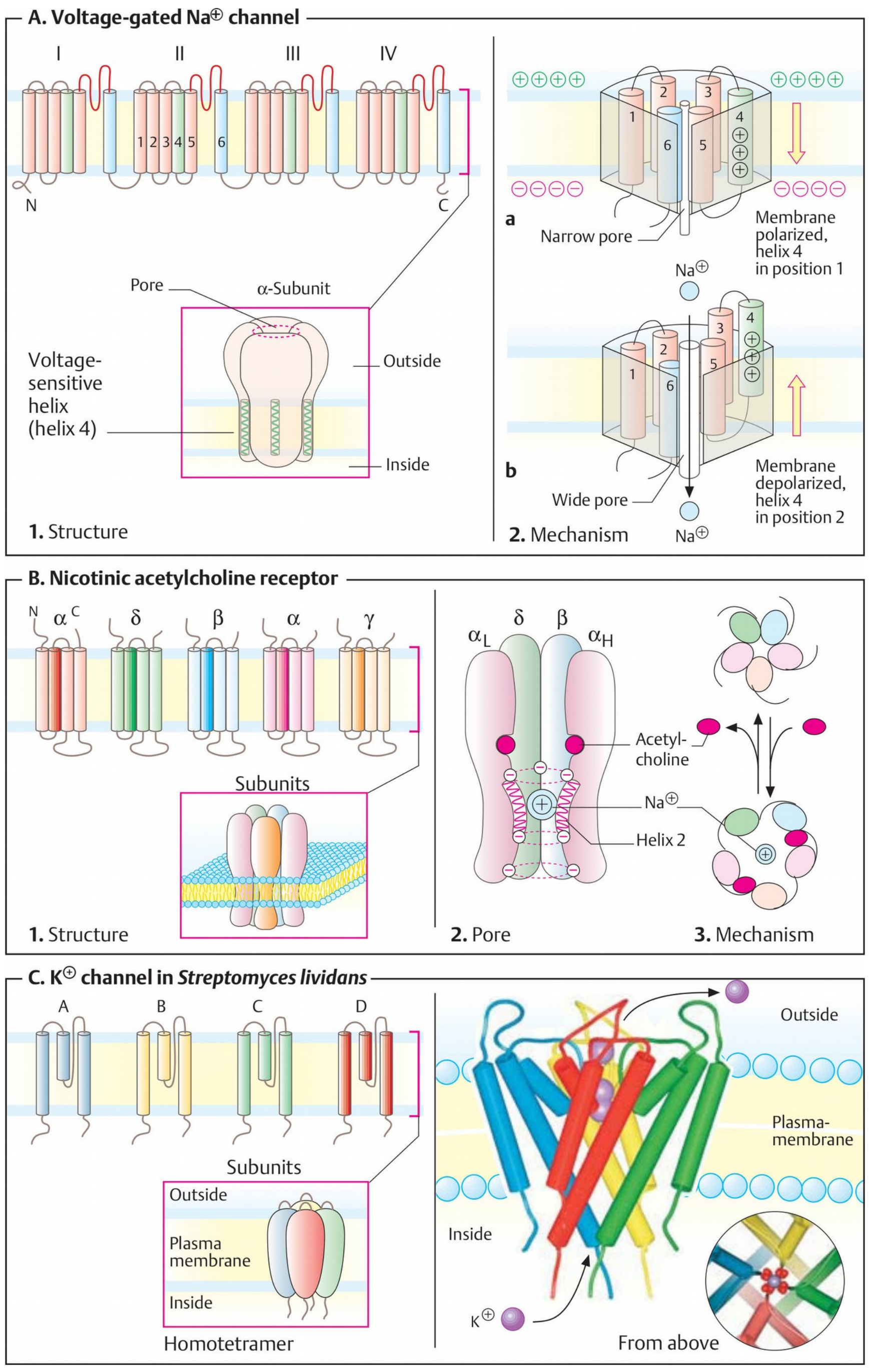


Transports membranaires : cas des ions

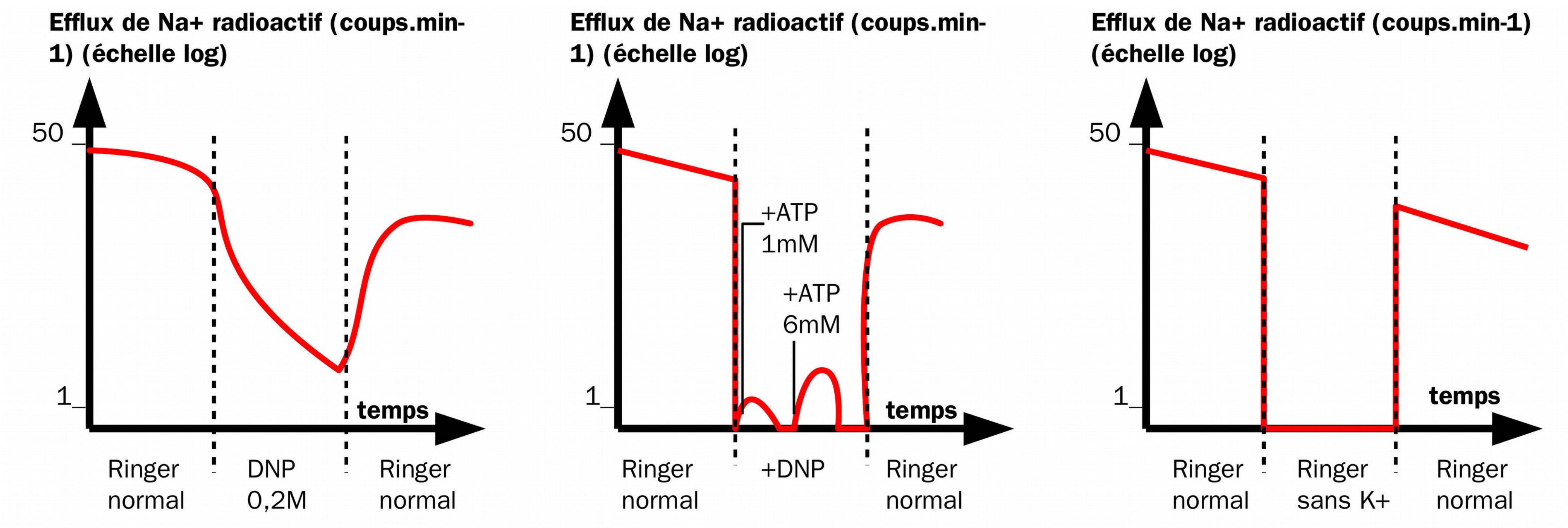
- Canaux ioniques
  - De fuite
  - Voltage-dépendants
  - Chimio-dépendants
  - Mécano-dépendants





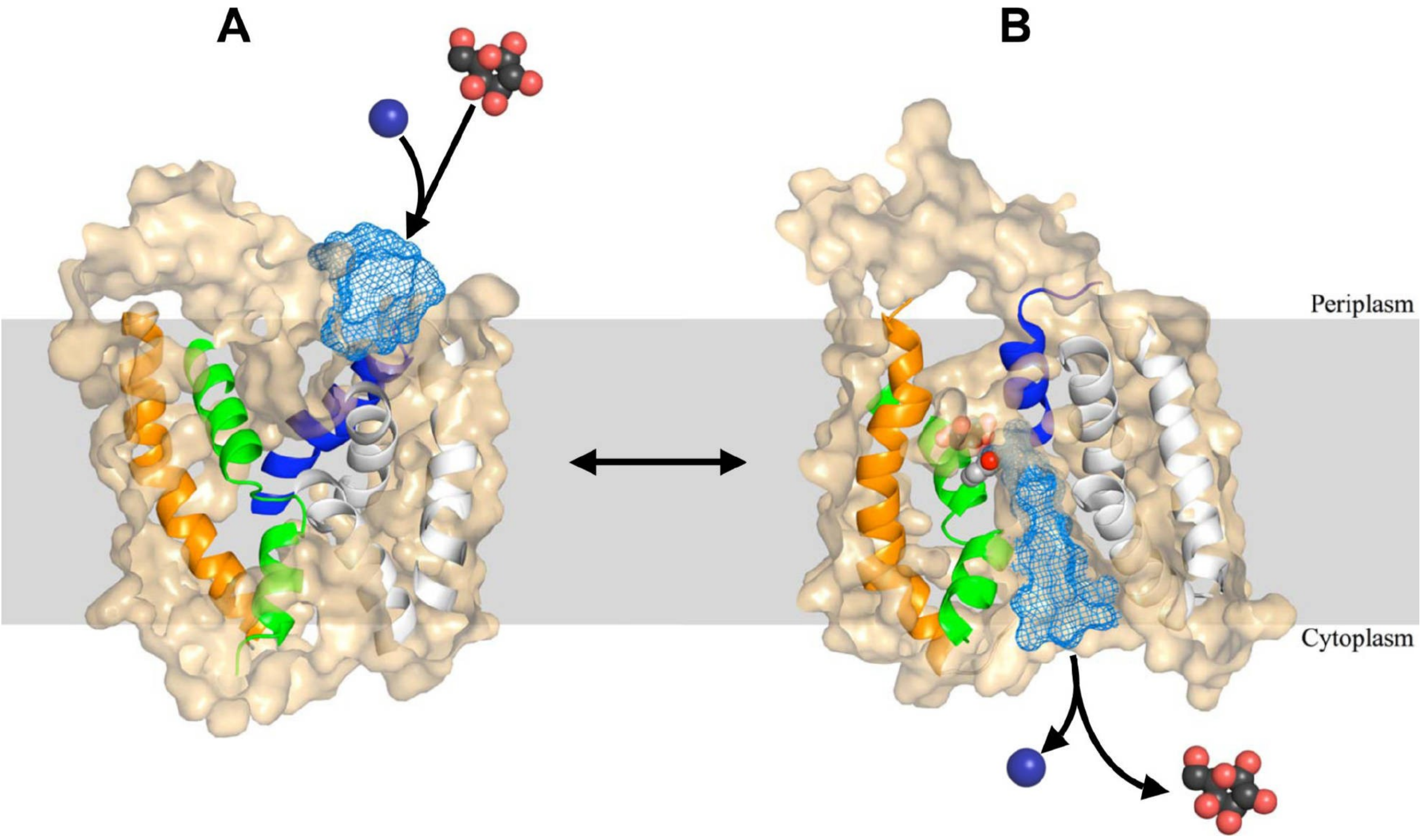
Transports membranaires : découverte des transports actifs

- Sur axone de Calmar
- Nobel 1963



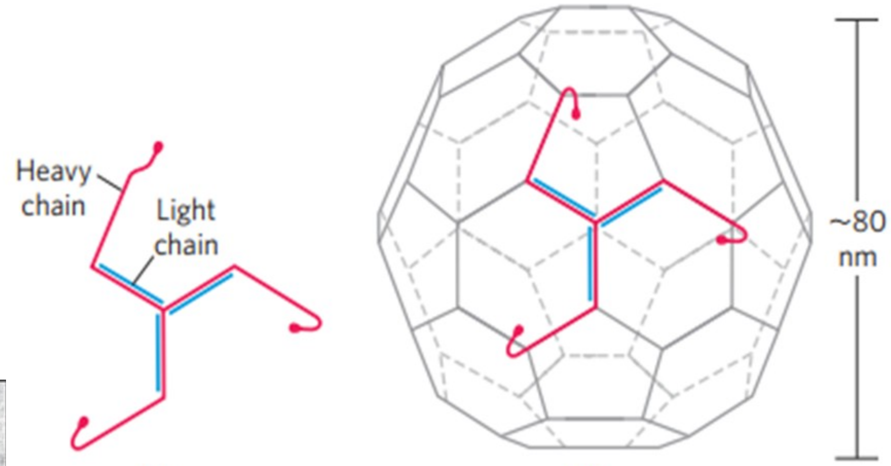
Transports membranaires : transports actifs secondaires

- SGLT

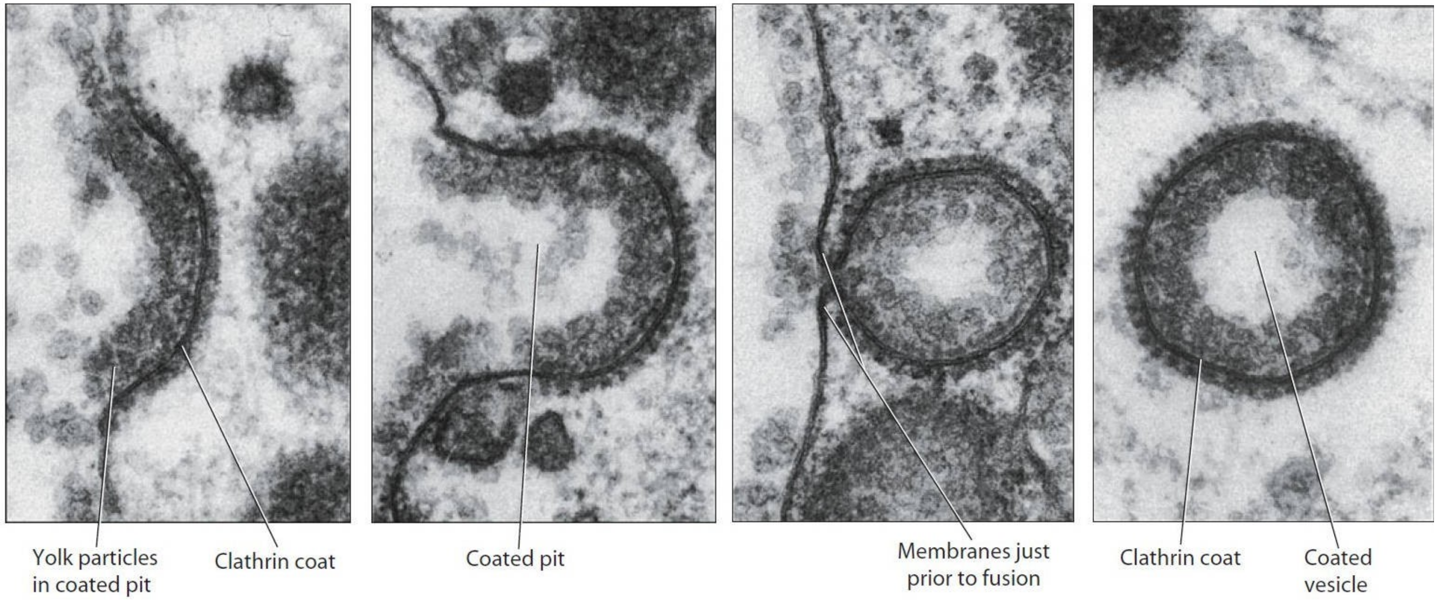


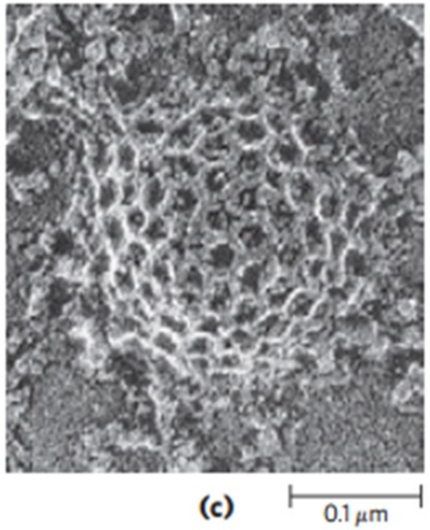
Transports membranaires : endocytose

- Molécules de clathrine



(a) (b)





(c)

Transports membranaires : endocytose

- Modèle d'endocytose
- Intervention de la dynamine