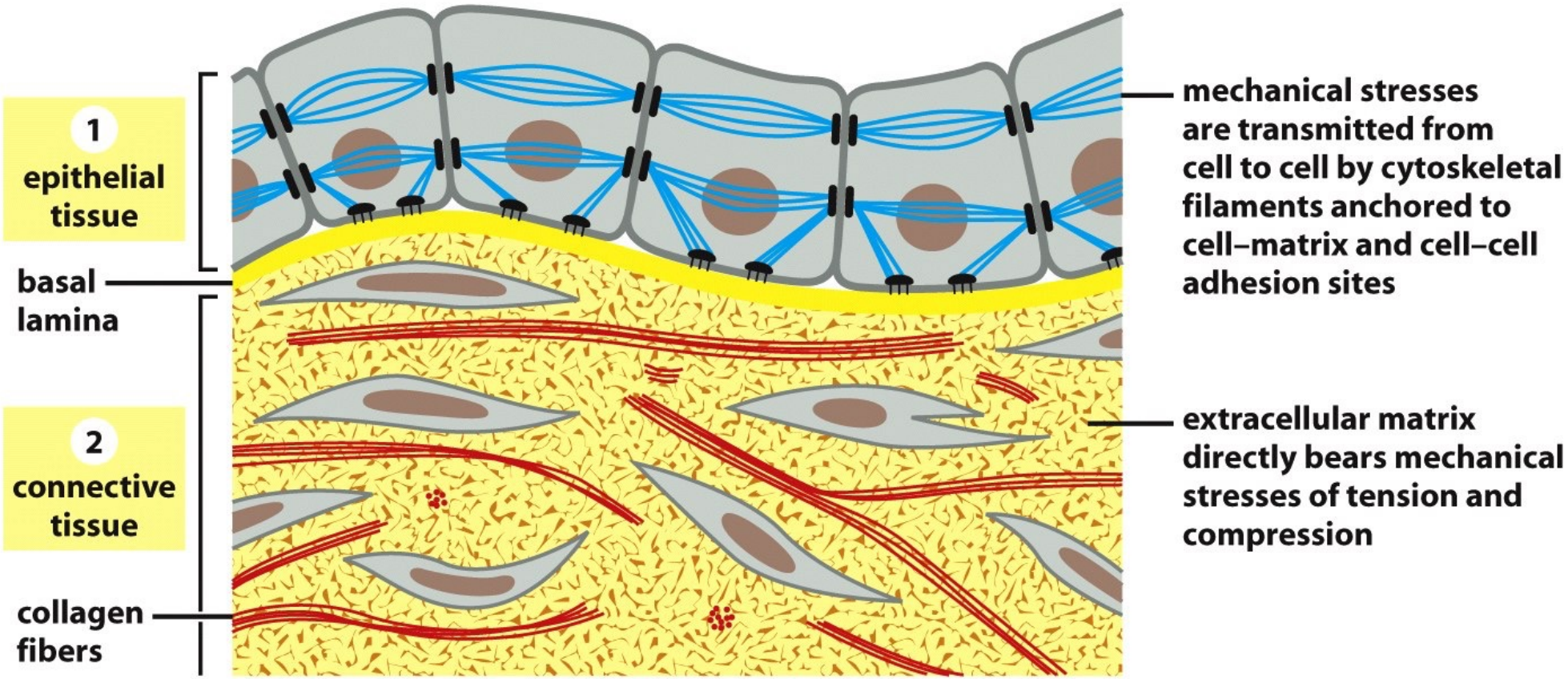
# Matriz extracelular y uniones celulares

**Dr. Alejandro Roth**

**(Clase basada en la clase del Dr. Christian Gonzalez-Billault)**

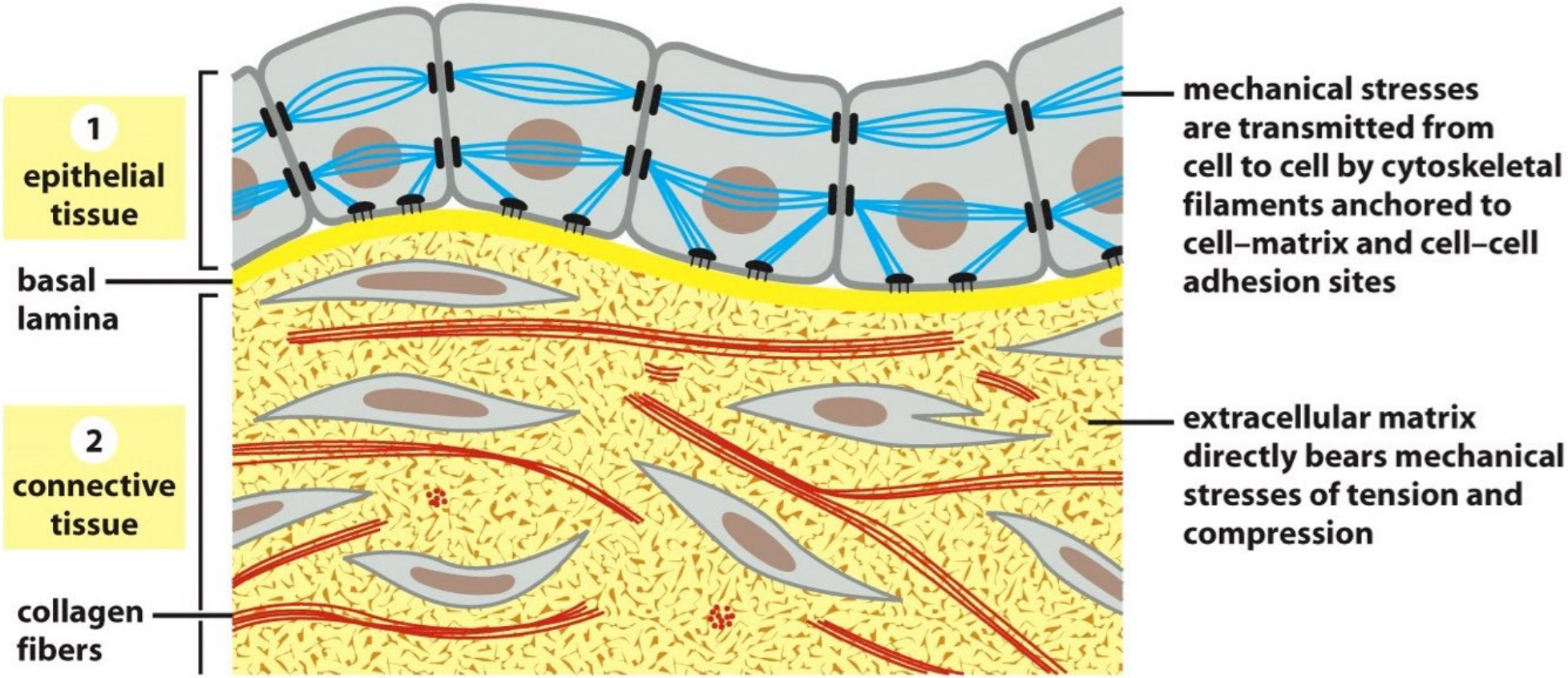
**Barreras!**




**Organos!**

Figure 19-1 *Molecular Biology of the Cell* (© Garland Science 2008)

# UNIONES CELULARES




El modelo más utilizado son las células epiteliales debido a que presentan polaridad, sin embargo, hay múltiples casos de gran importancia. Por ejemplo, las células musculares deben poder anclarse a su medio con mucha fuerza.

Figure 19-2 *Molecular Biology of the Cell* (© Garland Science 2008)

Lo que vamos a ver....

1.- Matrix extracelular animal y vegetal

2.- Uniones celulares

3.- Resúmen

Lo que vamos a ver....

1.- Matrix extracelular animal y vegetal

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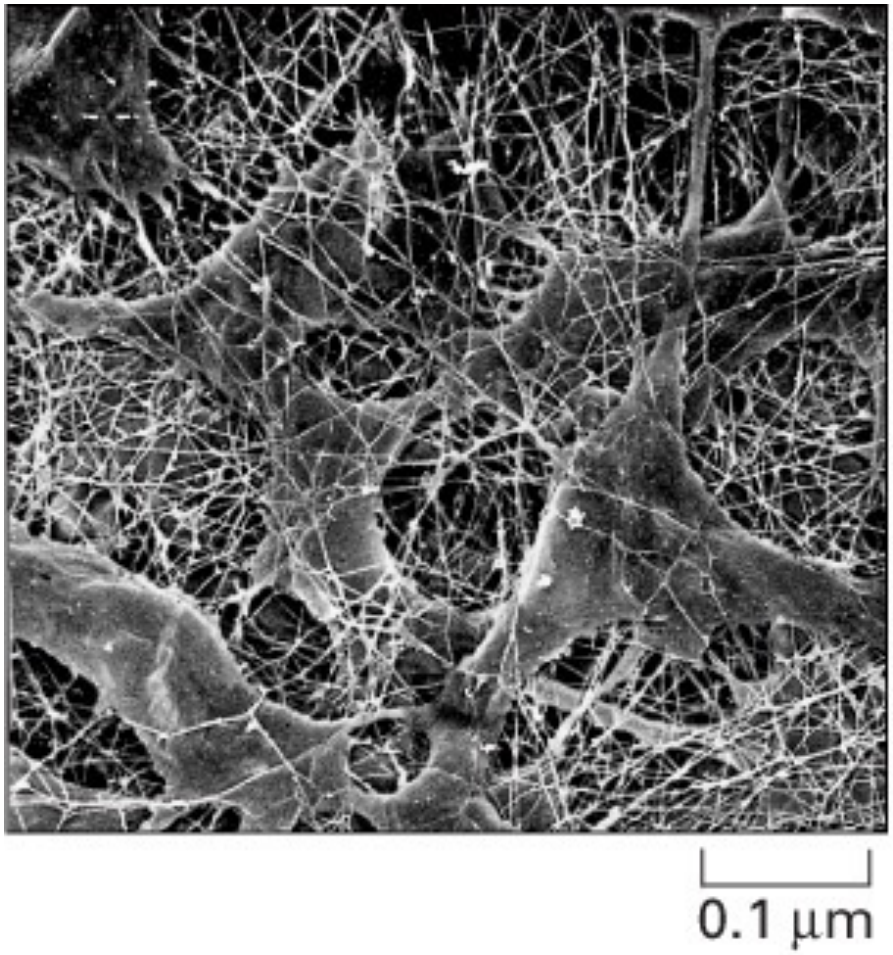
**Matrix extracelular?**

Cualquier material producido y secretado por las células hacia el medio que las rodea, usualmente se refiere a la porcion no celular de los tejidos




-Celulas secretoras de MEC son los fibroblastos (tejido conectivo)

-En el caso de tejidos conectivos más especializados como cartilago (condroblastos) y hueso (osteoblastos)

- Esta compuesta de 1) elementos fibrosos (colágeno), 2) proteínas de unión (fibronectina y laminina) y 3) moléculas complejas que rellenan el espacio extracelular (proteoglicanos)

**Matrix extracelular?**

Cualquier material producido y secretado por las células hacia el medio que las rodea, usualmente se refiere a la porcion no celular de los tejidos

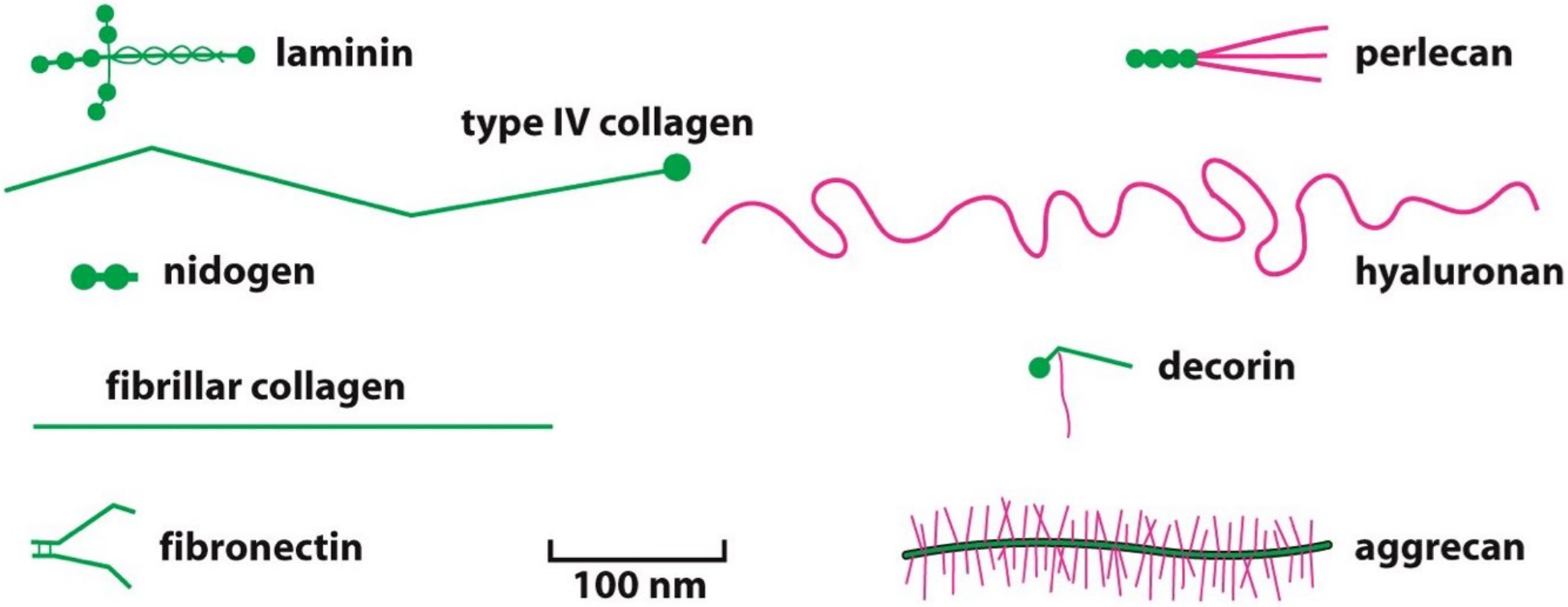
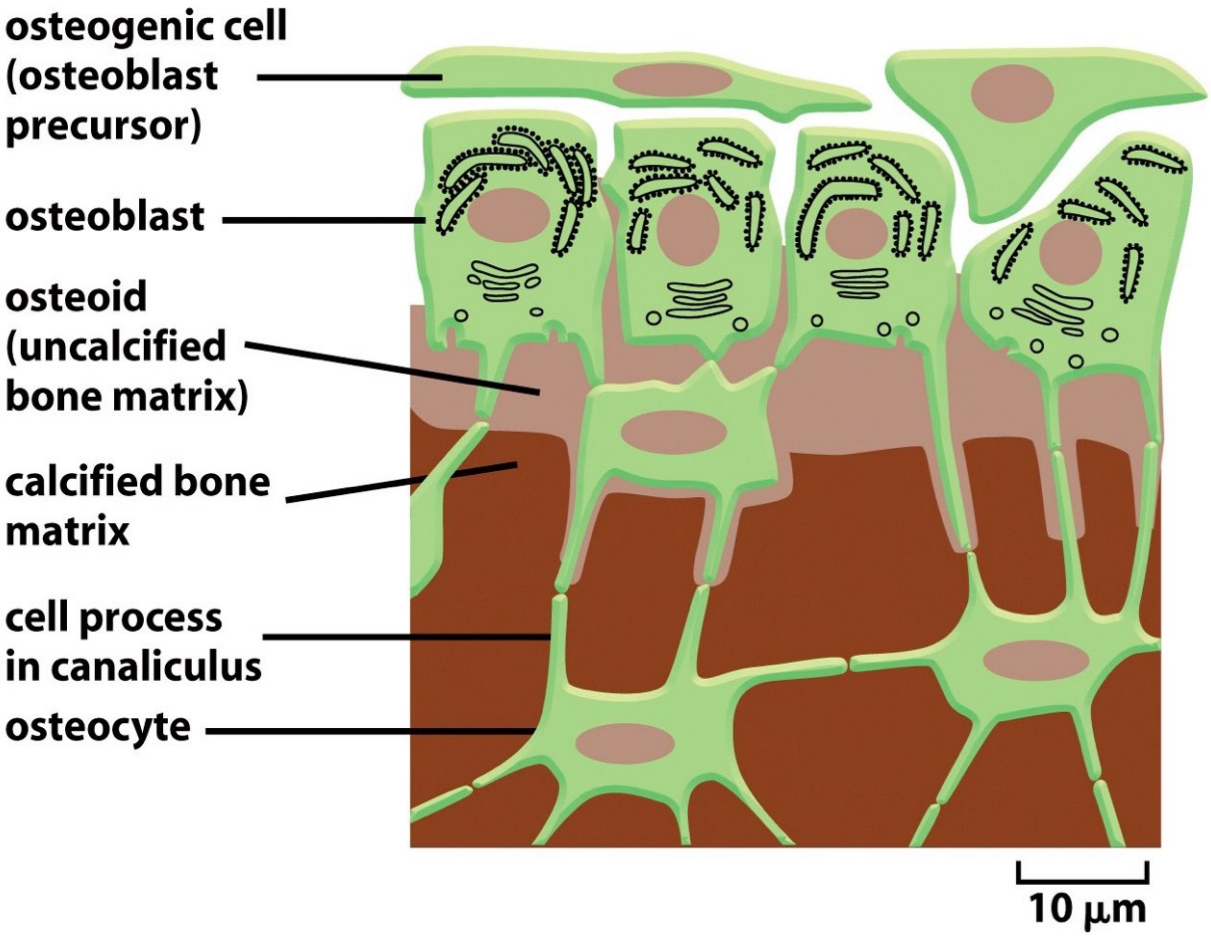



Figure 19-41 Molecular Biology of the Cell 5/e (© Garland Science 2008)

- Esta compuesta de 1) elementos fibrosos (colágeno), 2) proteínas de unión (fibronectina y laminina) y 3) moléculas complejas que rellenan el espacio extracelular (proteoglicanos)



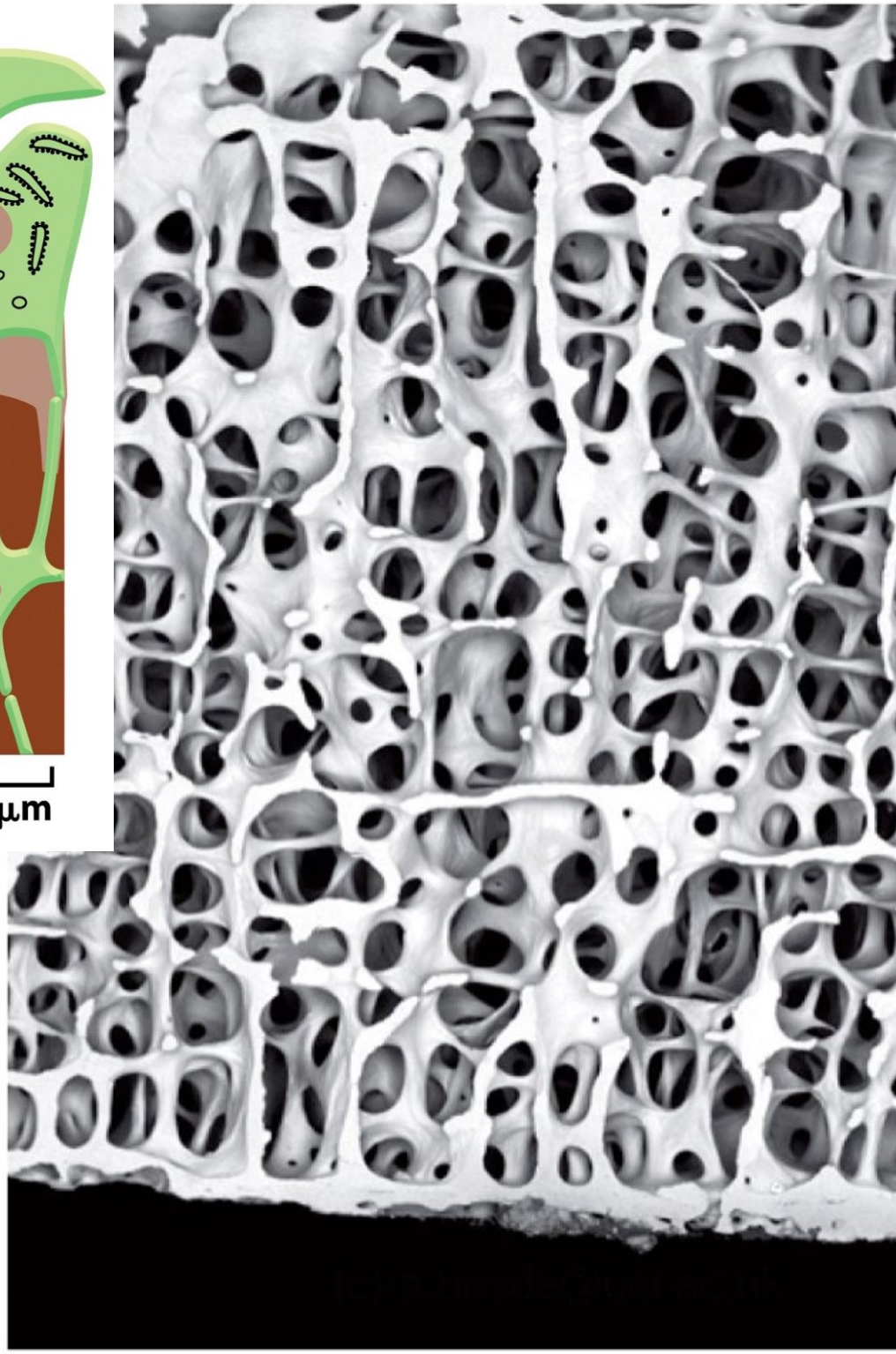



Figure 23-55 *Molecular Biology of the Cell* (© Garland Science 2008)

Figure 23-56a *Molecular Biology of the Cell* (© Garland Science 2008)

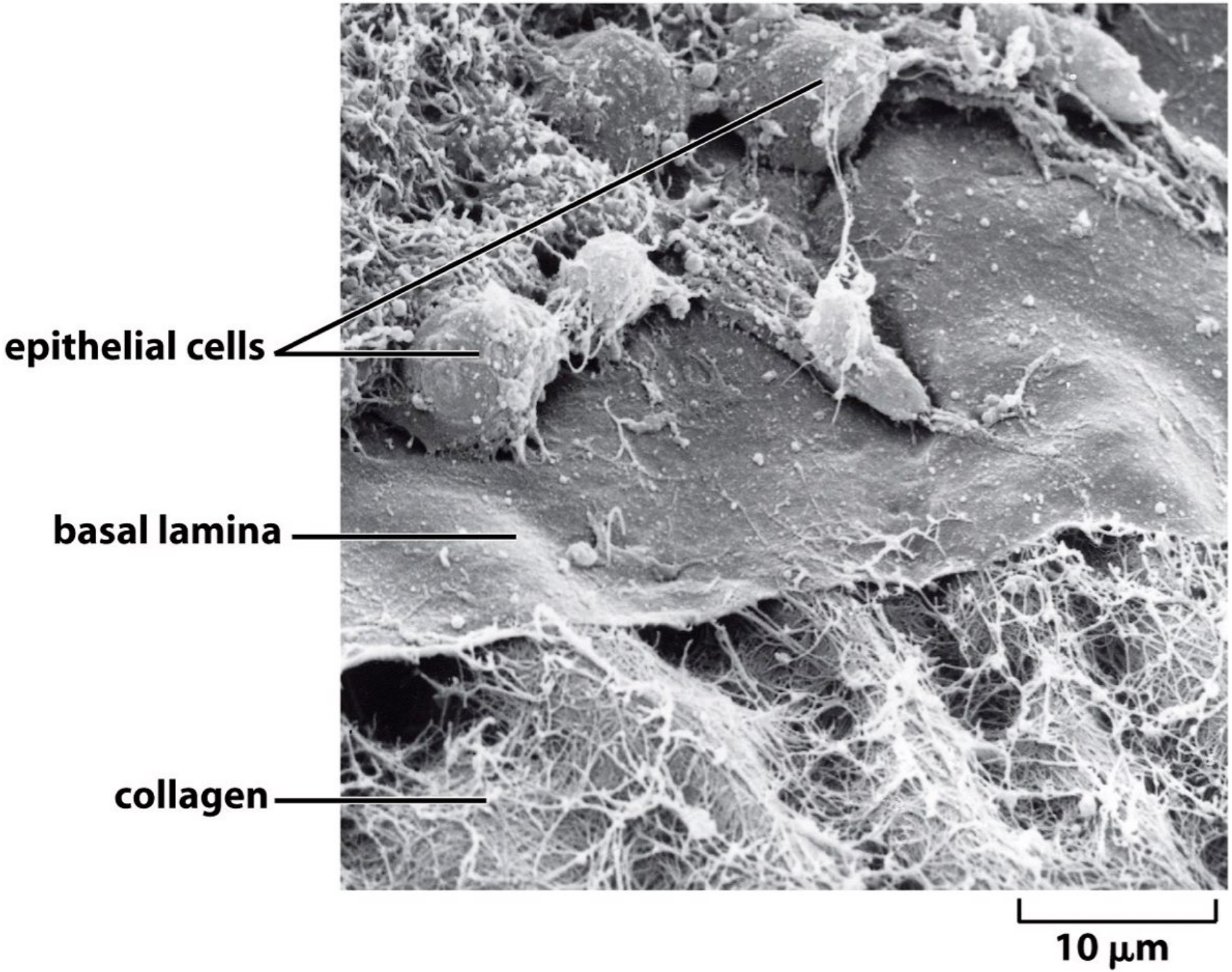



Figure 19-40 Molecular Biology of the Cell 5/e (© Garland Science 2008)

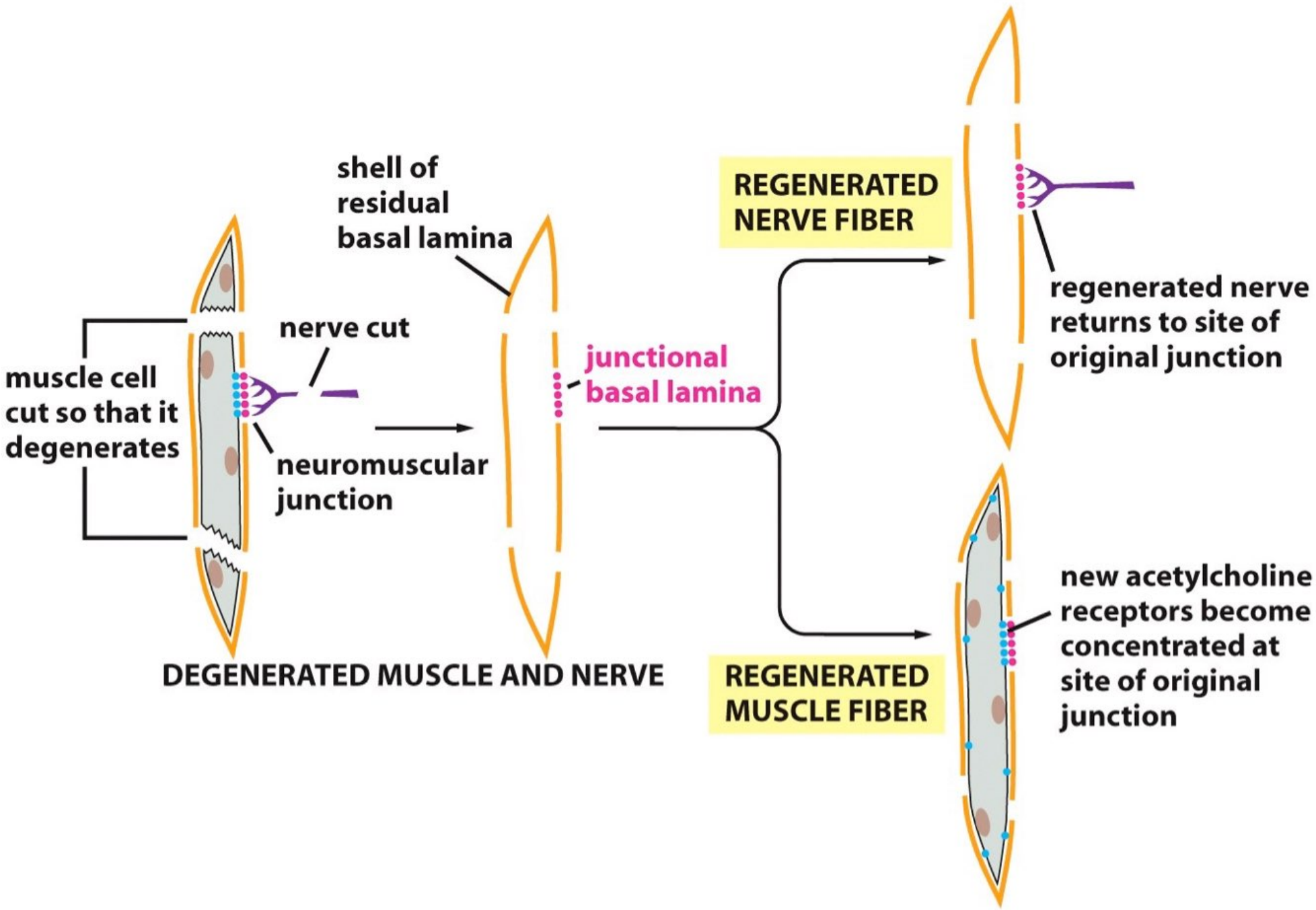
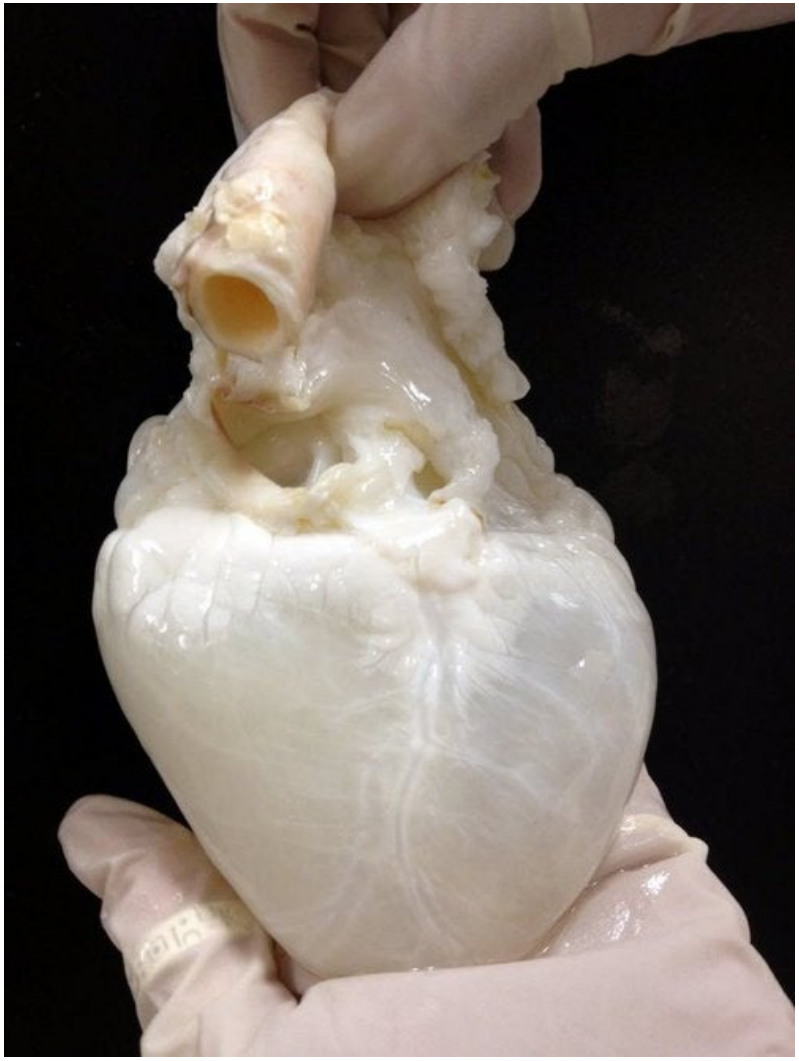



Figure 19-44 Molecular Biology of the Cell 5/e (© Garland Science 2008)



https://i.imgur.com/yb7BH0A.jpg

# Corazón “Fantasma”

Corazón humano de-celularizado. Solo queda la matriz extracelular que será repoblada con células troncales del receptor. Estas se diferenciarían a músculo cardiaco o células vasculares.

Se disminuye la posibilidad de rechazo del tejido, por lo que aumentan los órganos disponibles.


Tissue Engineering: How to Build a Heart
With thousands of people in need of heart transplants, researchers are trying to grow new organs
By Brendan Maher, Nature magazine on July 8, 2013

Decellularized matrices in regenerative medicine
Doris A.Taylor, Luiz C.Sampaio, Zannatul Ferdous, Andrea S.Gobin, Lakeshia J.Taitea
https://doi.org/10.1016/j.actbio.2018.04.044

# 1.- Elementos fibrosos (colageno)

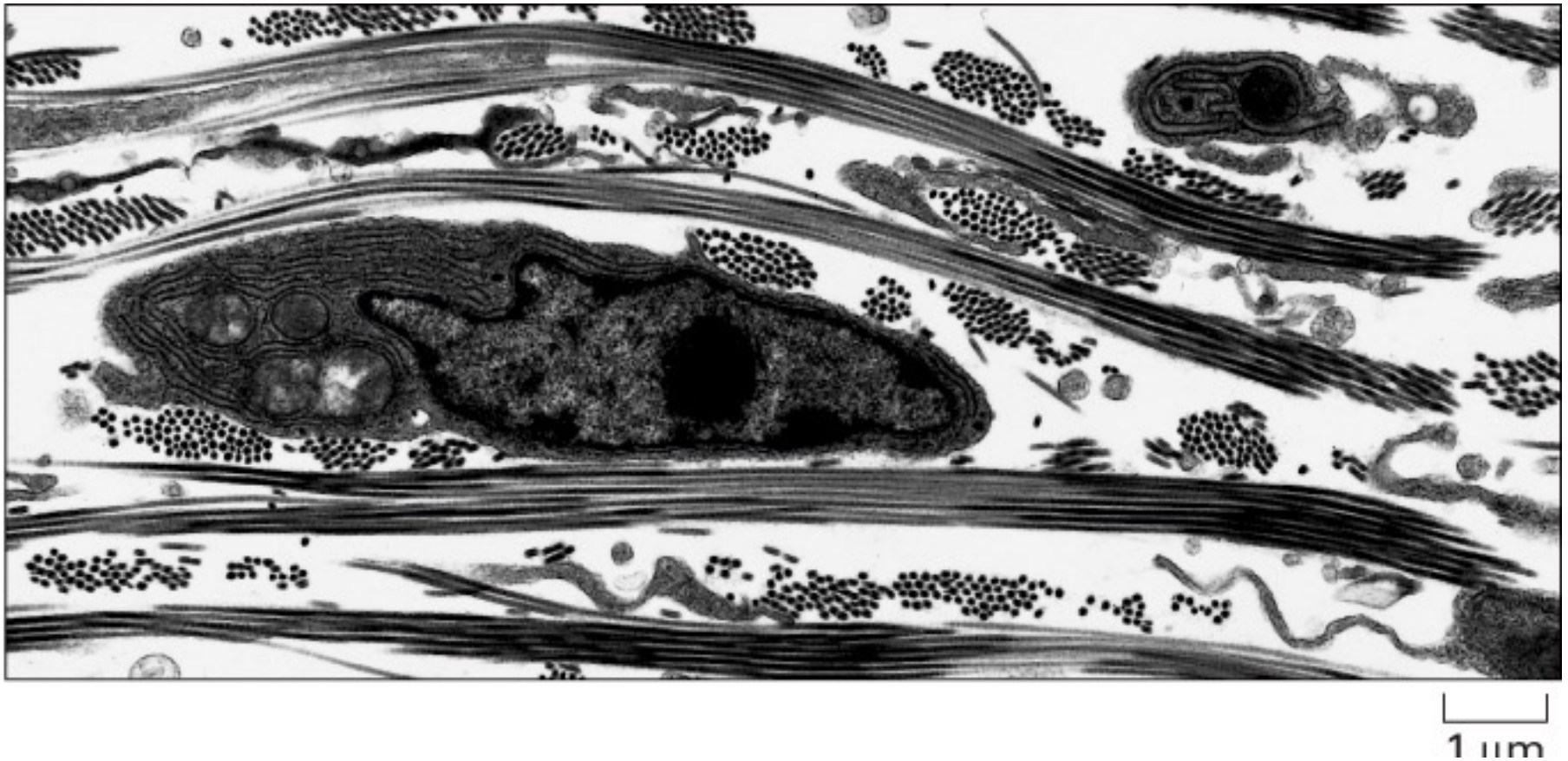
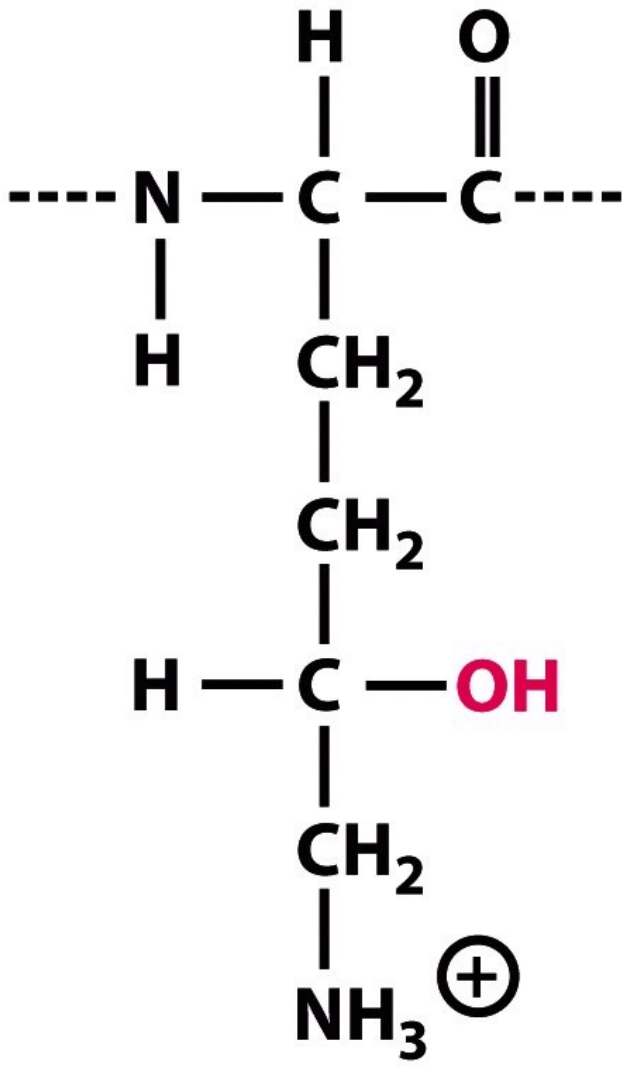


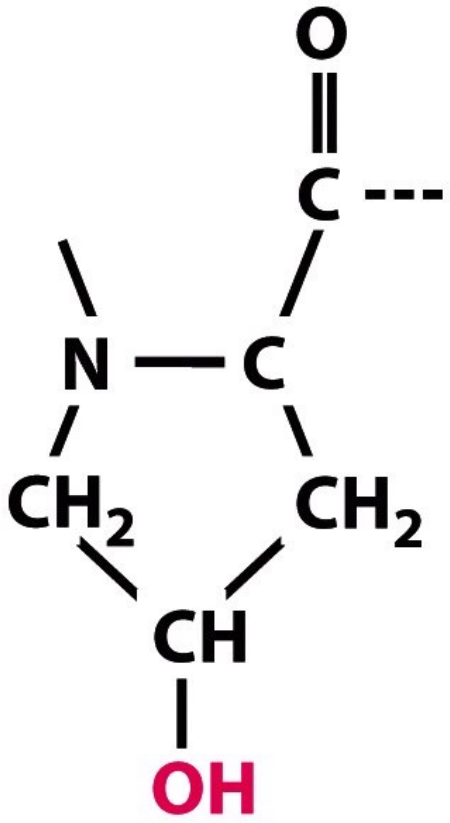
**Table 19–7 Some Types of Collagen and Their Properties**

| | TYPE | POLYMERIZED FORM | TISSUE DISTRIBUTION | MUTANT PHENOTYPE |
|---|---|---|---|---|
| Fibril-forming (fibrillar) | I | fibril | bone, skin, tendons, ligaments, cornea, internal organs (accounts for 90% of body collagen) | severe bone defects, fractures |
| | II | fibril | cartilage, invertebral disc, notochord, | cartilage deficiency, dwarfism vitreous humor of the eye |
| | III | fibril | skin, blood vessels, internal organs | fragile skin, loose joints, blood vessels prone to rupture |
| | V | fibril (with type I) | as for type I | fragile skin, loose joints, blood vessels prone to rupture |
| | XI | fibril (with type II) | as for type II | myopia, blindness |
| Fibril-associated | IX | lateral association | cartilage with type II fibrils | osteoarthritis |
| Network-forming | IV | sheetlike network | basal lamina | kidney disease (glomerulonephritis), deafness |
| | VII | anchoring fibrils | beneath stratified squamous epithelia | skin blistering |
| Transmembrane | XVII | non-fibrillar | hemidesmosomes | skin blistering |
| Proteoglycan core protein | XVIII | non-fibrillar | basal lamina | myopia, detached retina, hydrocephalus |

Note that types I, IV, V, IX, and XI are each composed of two or three types of α chains (distinct, nonoverlapping sets in each case), whereas types II, III, VII, XII, XVII, and XVIII are composed of only one type of α chain each. Only 10 types of collagen are shown, but about 27 types of collagen and 42 types of α chains have been identified in humans.




**hydroxylysine**
**in protein**




**hydroxyproline**
**in protein**

Figure 19-64 *Molecular Biology of the Cell* (© Garland Science 2008)

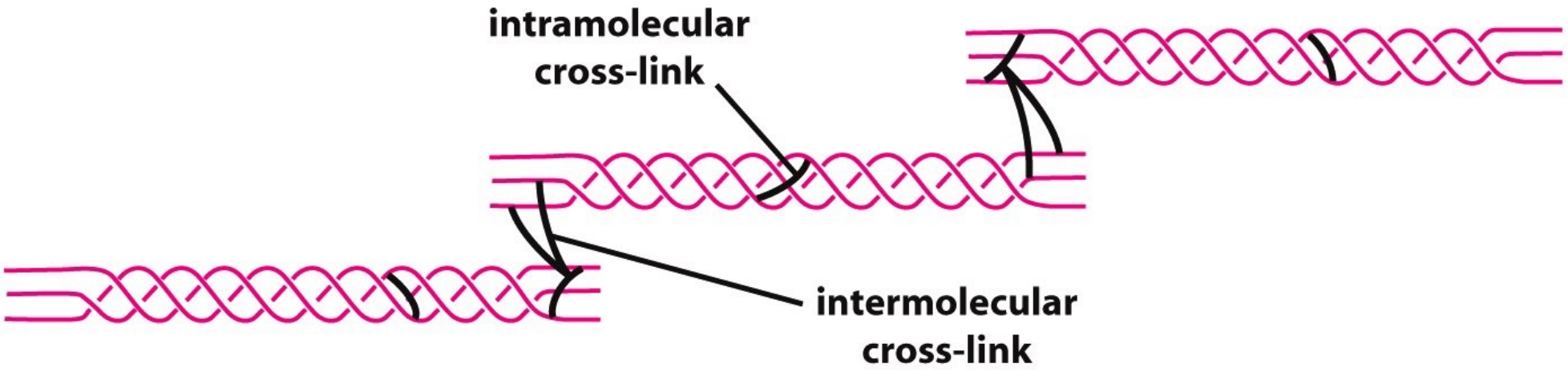



Figure 19-65 *Molecular Biology of the Cell* (© Garland Science 2008)

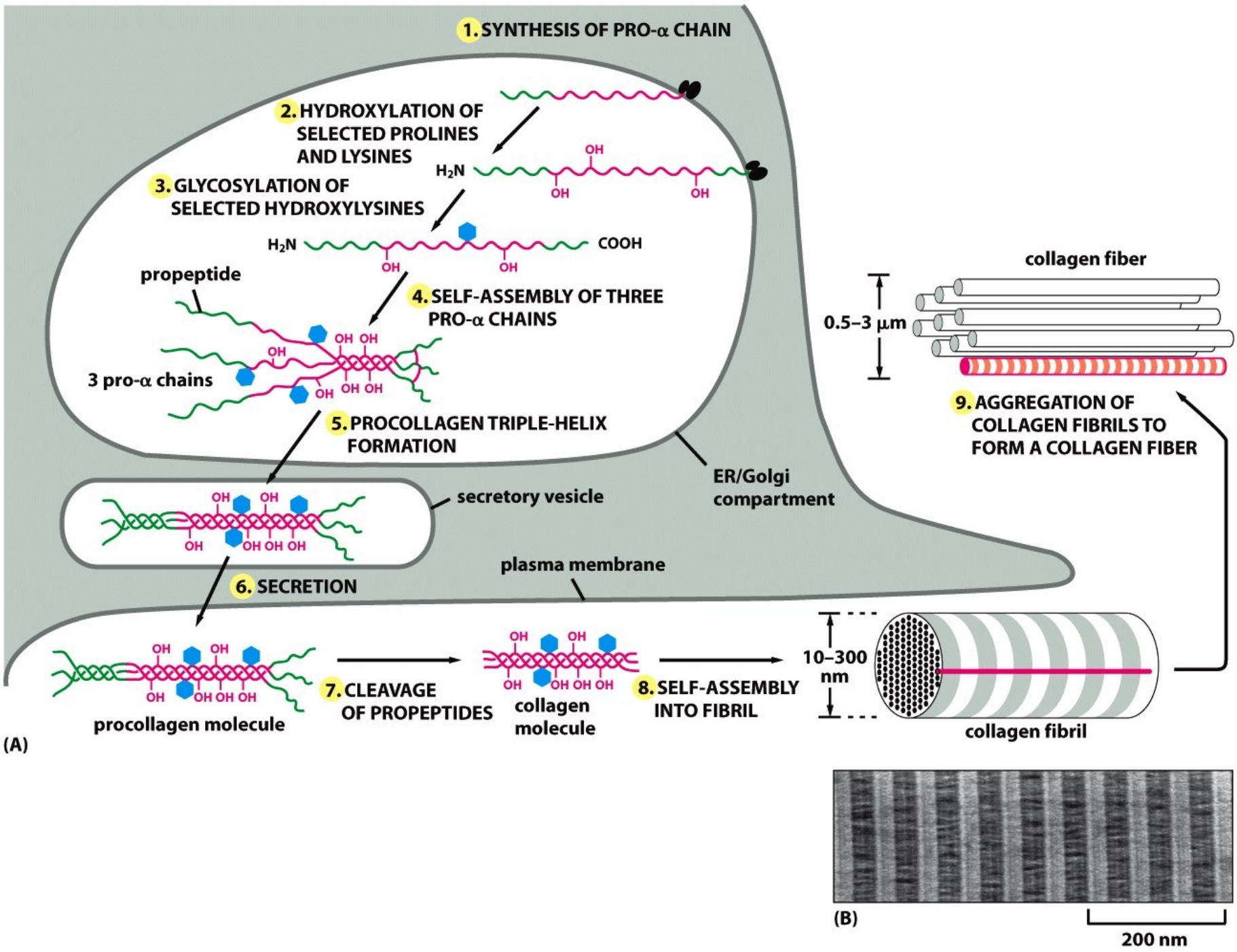



Figure 19-66 *Molecular Biology of the Cell* (© Garland Science 2008)

James Morris (1890)

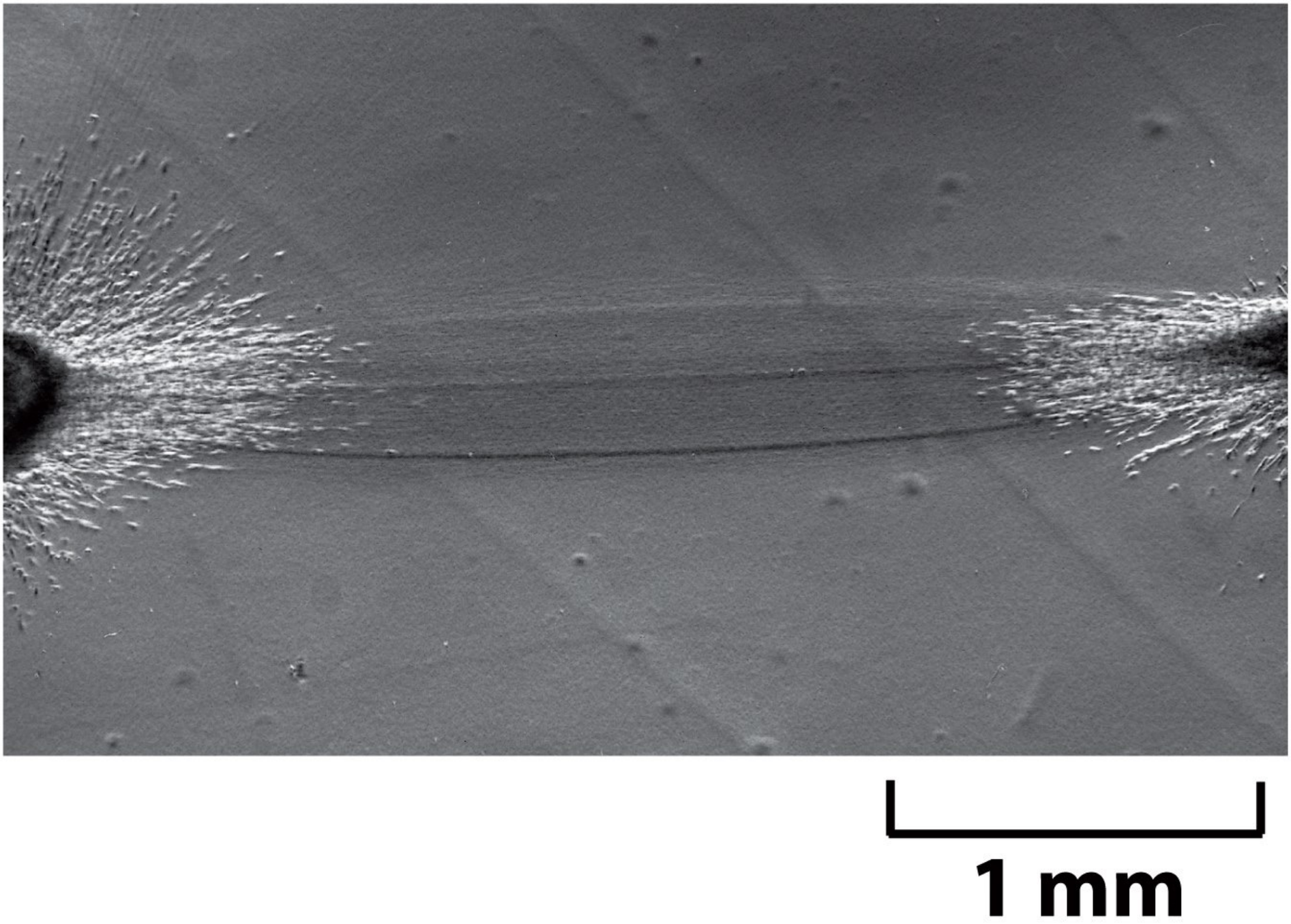



Figure 19-69 *Molecular Biology of the Cell* (© Garland Science 2008)

2) proteínas de unión (fibronectina y laminina)

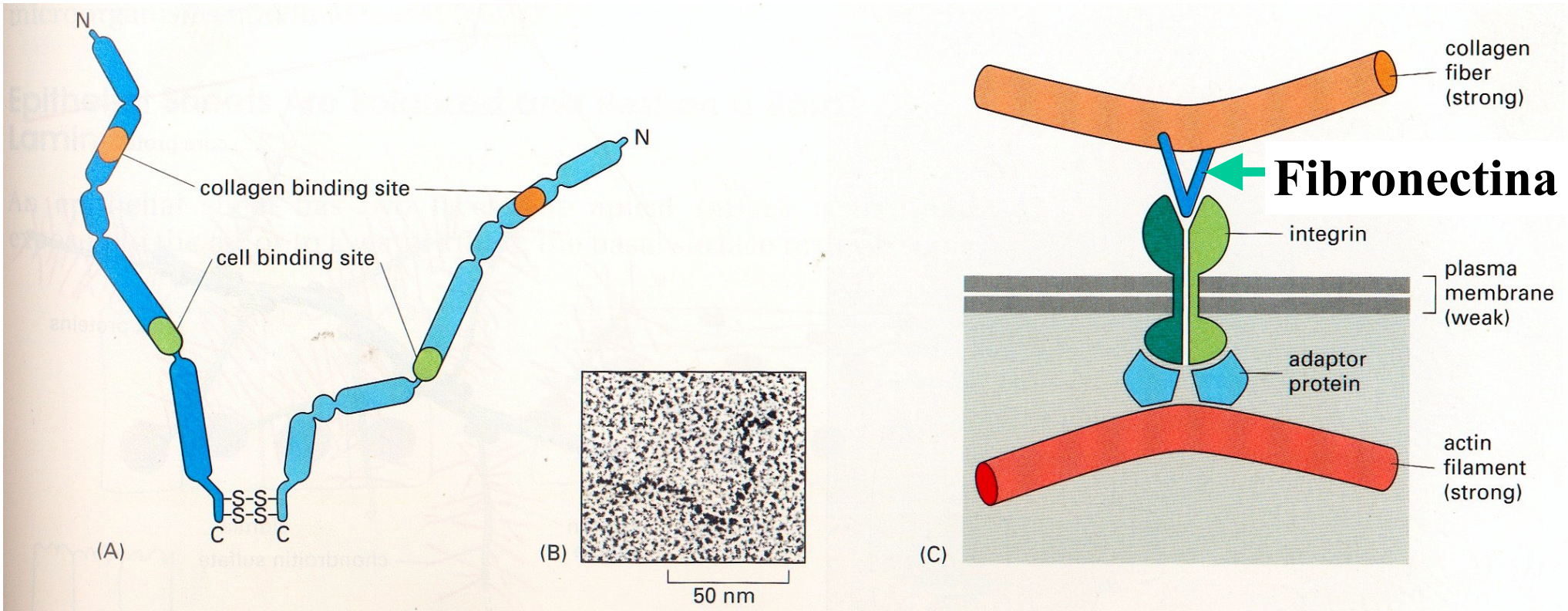



**Figure 21–14 Integrins link the extracellular matrix to the cytoskeleton in an animal cell.** (A) Diagram and (B) electron micrograph of a fibronectin molecule. (C) The transmembrane linkage mediated by an integrin molecule. The integrin molecule transmits tension across the plasma membrane: it is anchored inside the cell to the cytoskeleton and externally via fibronectin to the extracellular matrix. The plasma membrane itself does not have to be strong. The integrin shown links fibronectin to an actin filament inside the cell, but other integrins connect different extracellular proteins to the cytoskeleton (usually to actin filaments, but sometimes to intermediate filaments). (B, from J. Engel et al., *J. Mol. Biol.* 150:97–120, 1981. © Academic Press.)

# Laminina

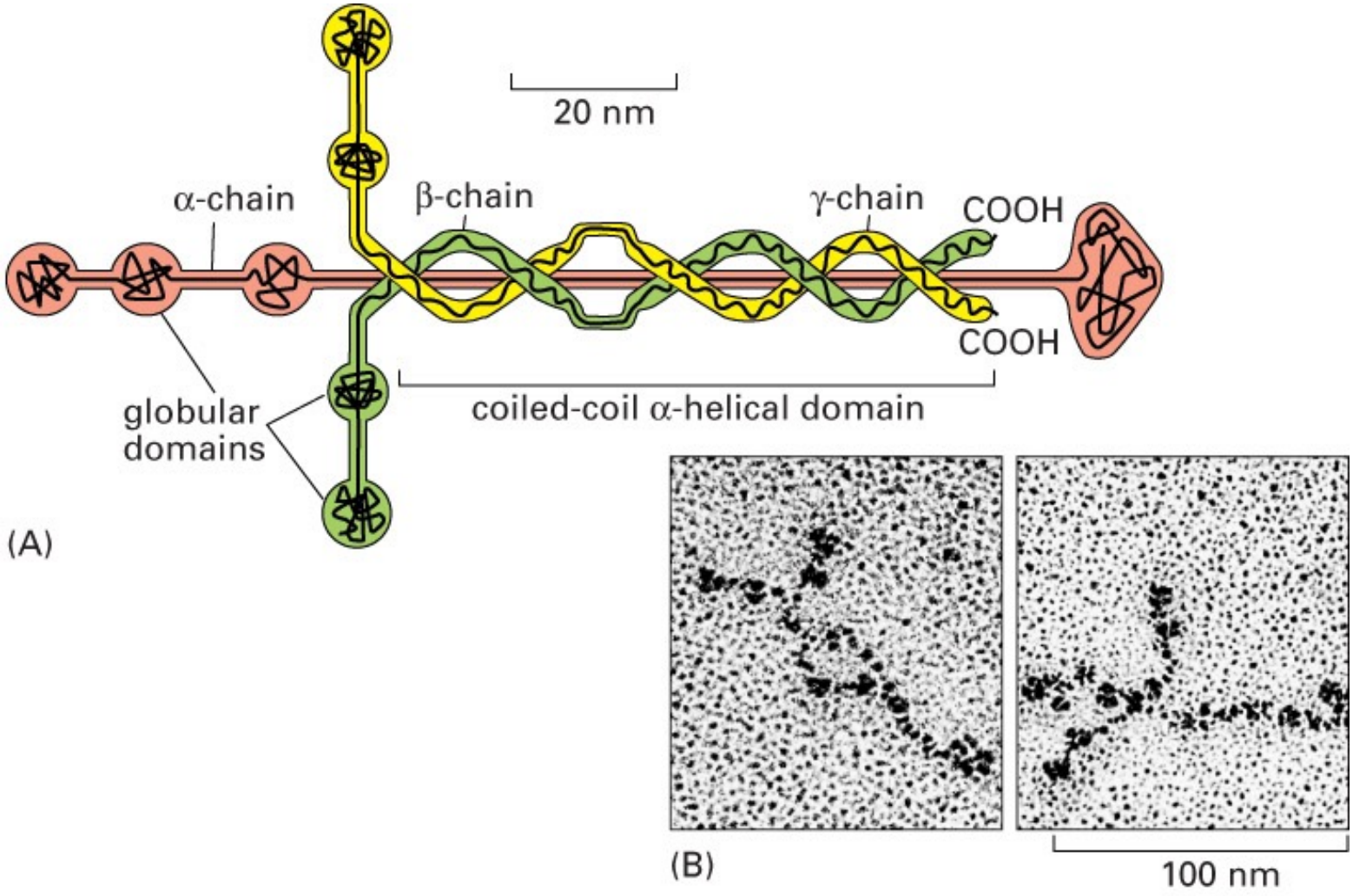



Figure 19–57. Molecular Biology of the Cell, 4th Edition.

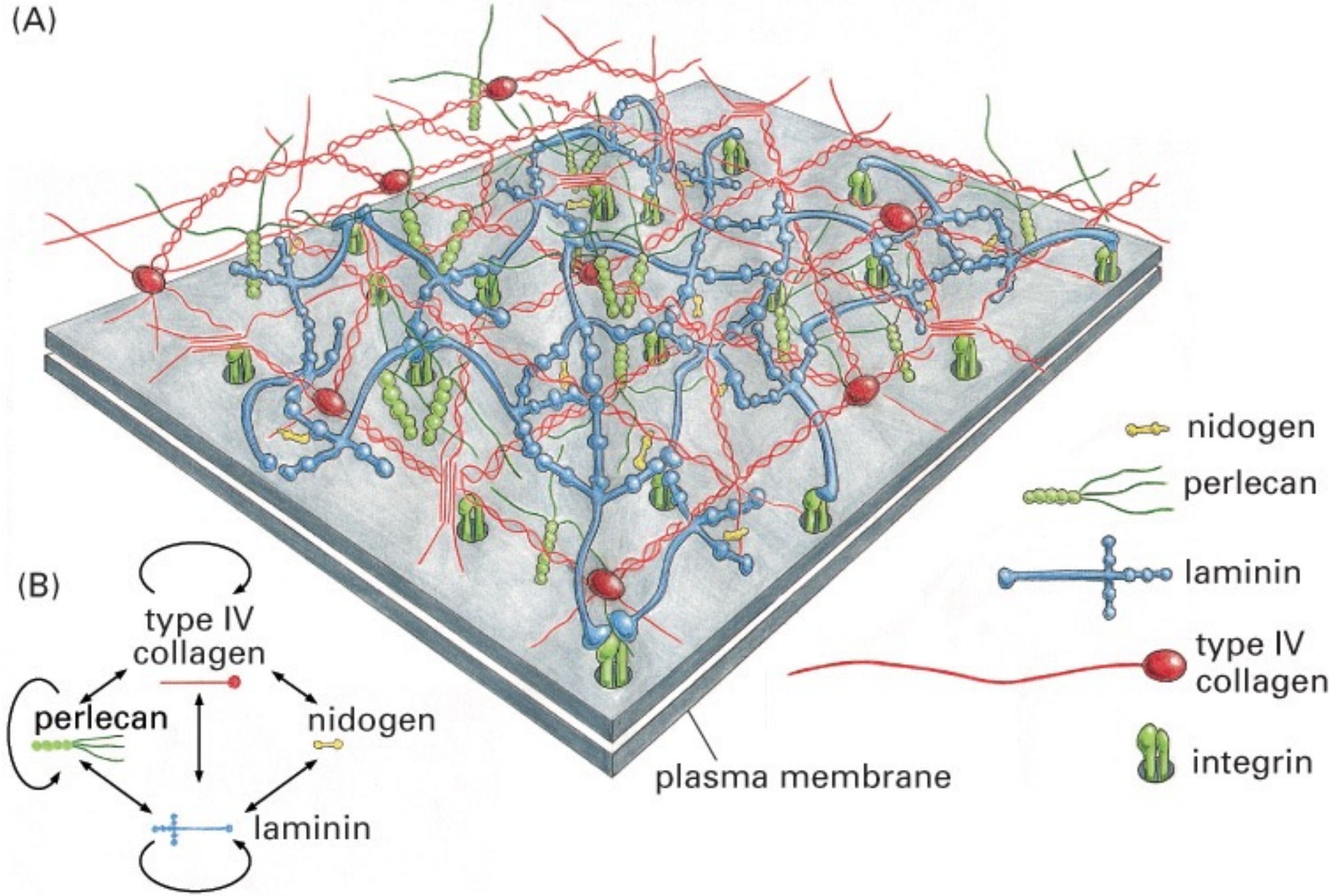



Figure 19–58. Molecular Biology of the Cell, 4th Edition.

# 3) moléculas complejas que rellenan el espacio extracelular

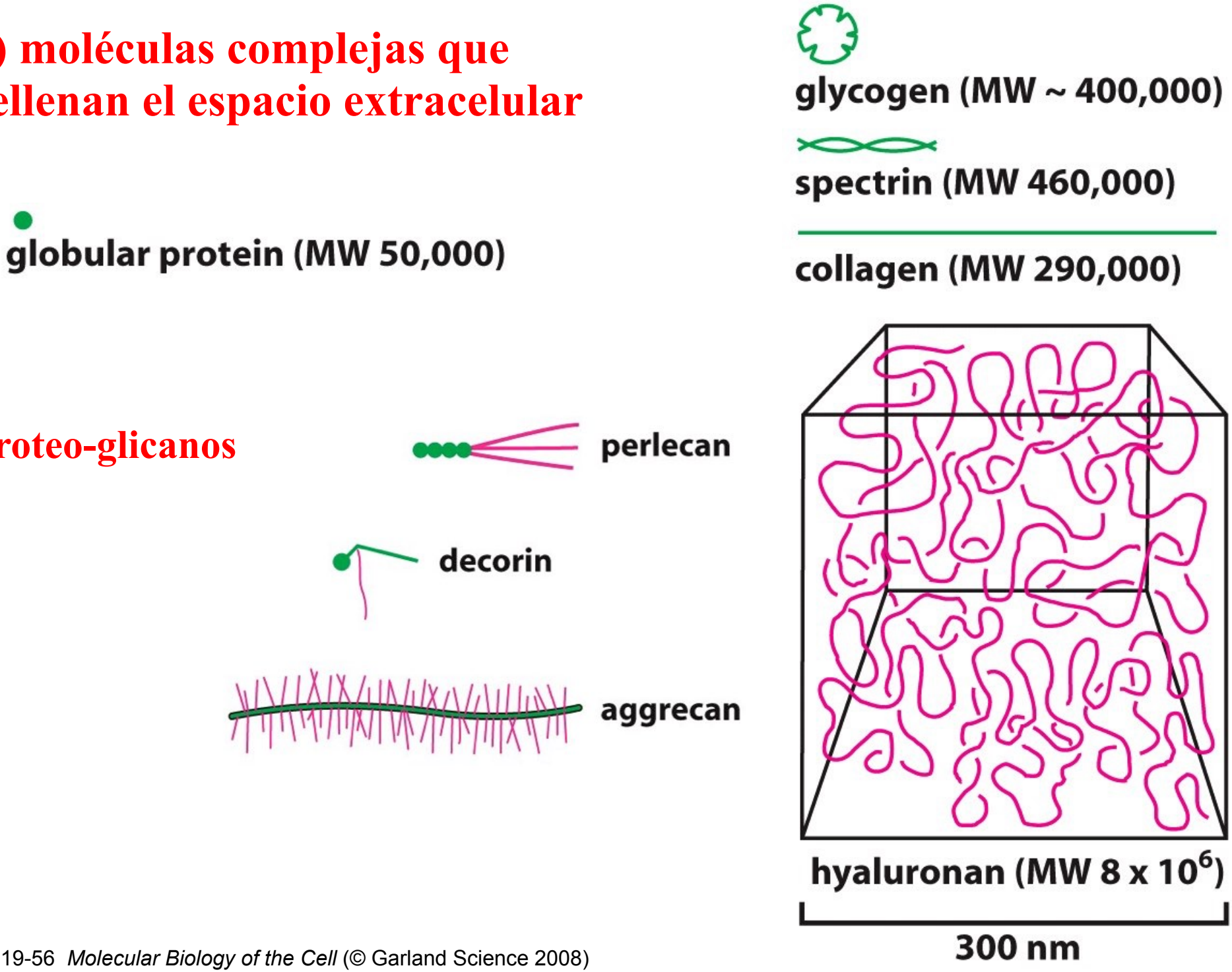
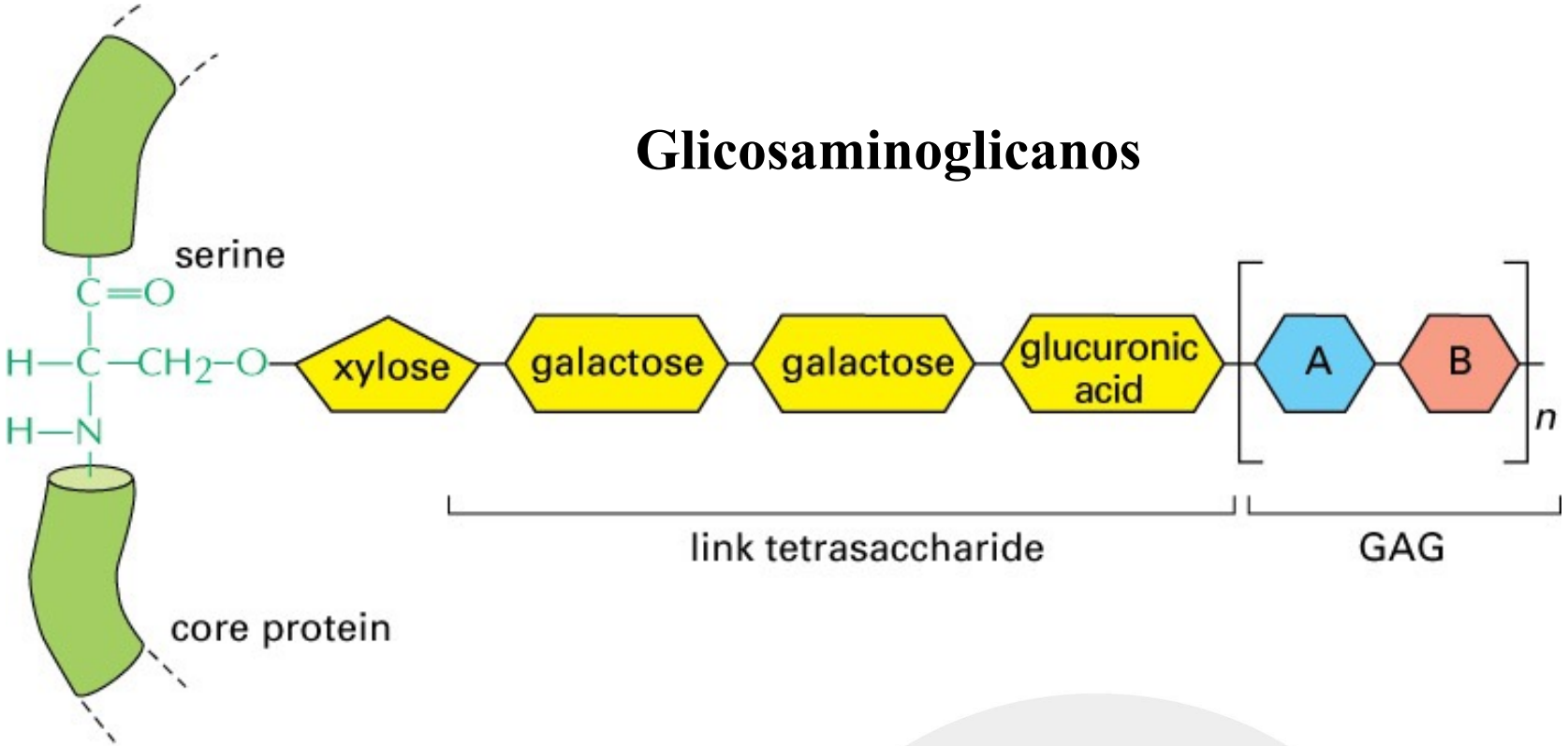
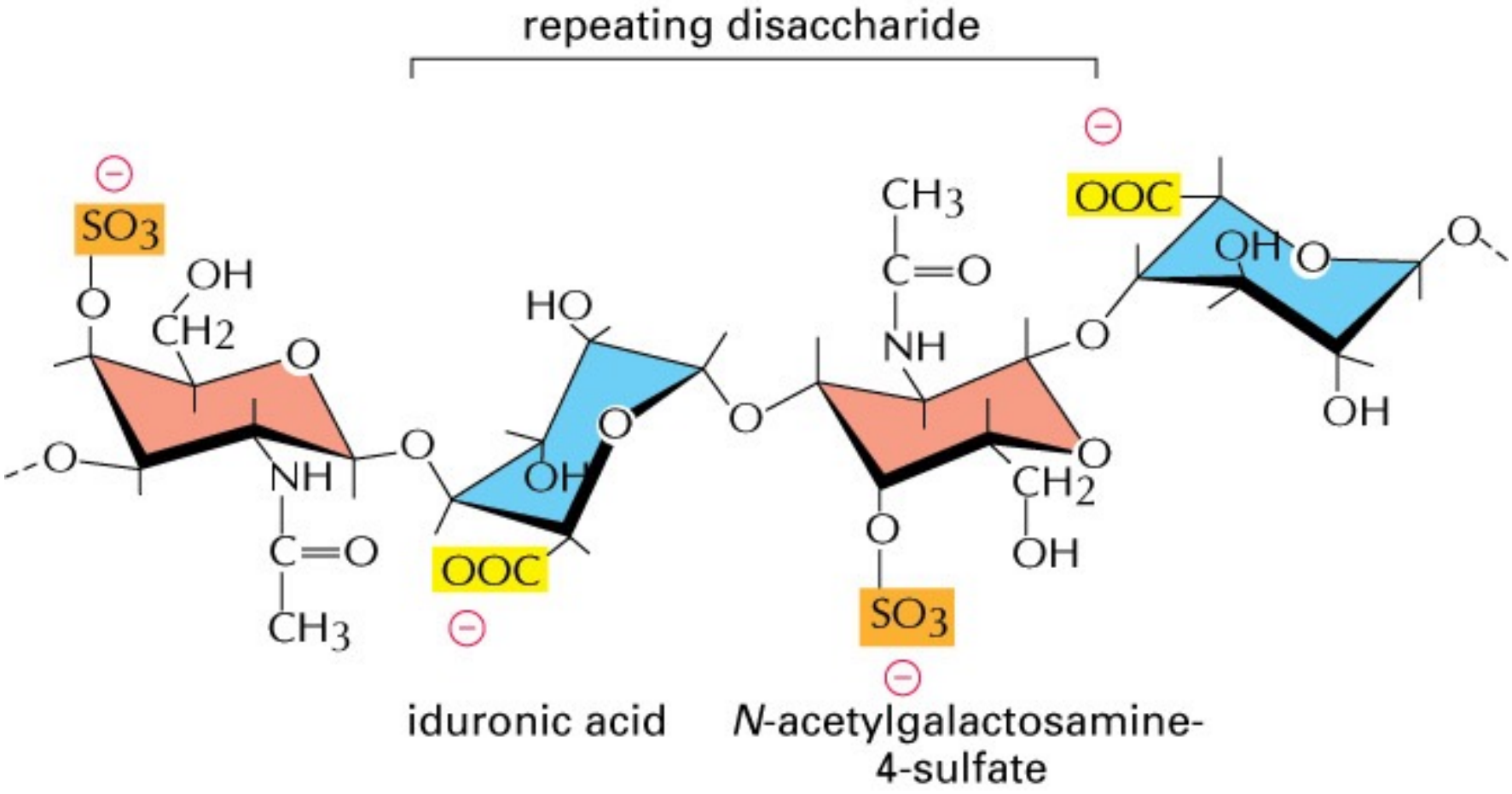



Figure 19-56 *Molecular Biology of the Cell* (© Garland Science 2008)

# 3) moléculas complejas que rellenan el espacio extracelular

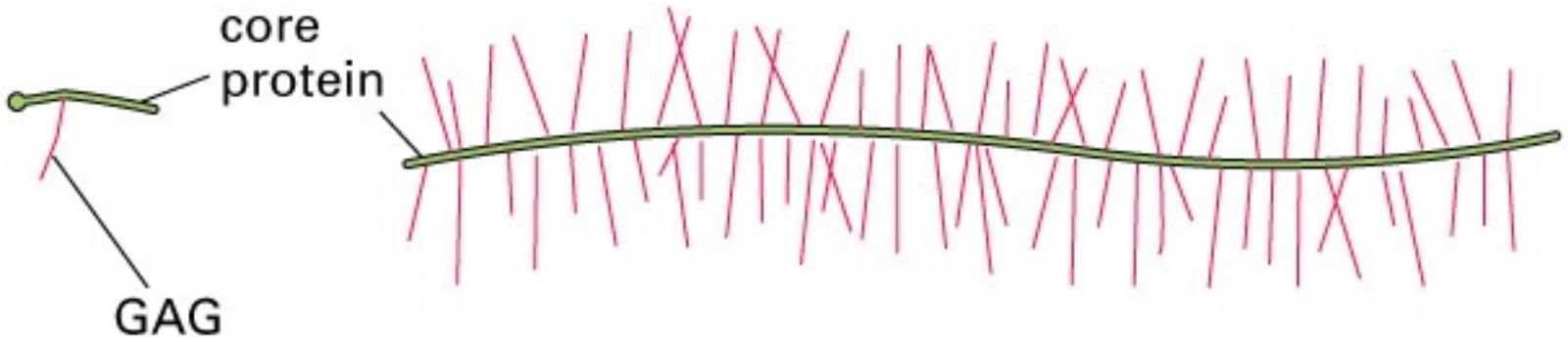
## Glicosaminoglicanos





repeating disaccharide
SO3
OH
CH2
O
NH
C=O
CH3
HO
OH
OOC
CH3
C=O
NH
OOC
OH
O
OH
CH2
OH
SO3
iduronic acid
N-acetylgalactosamine-
4-sulfate

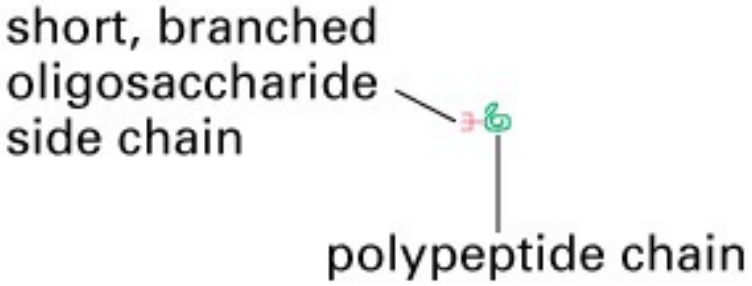
DECORIN
(MW ~ 40,000)

AGGRECAN
(MW ~ $3 \times 10^6$)

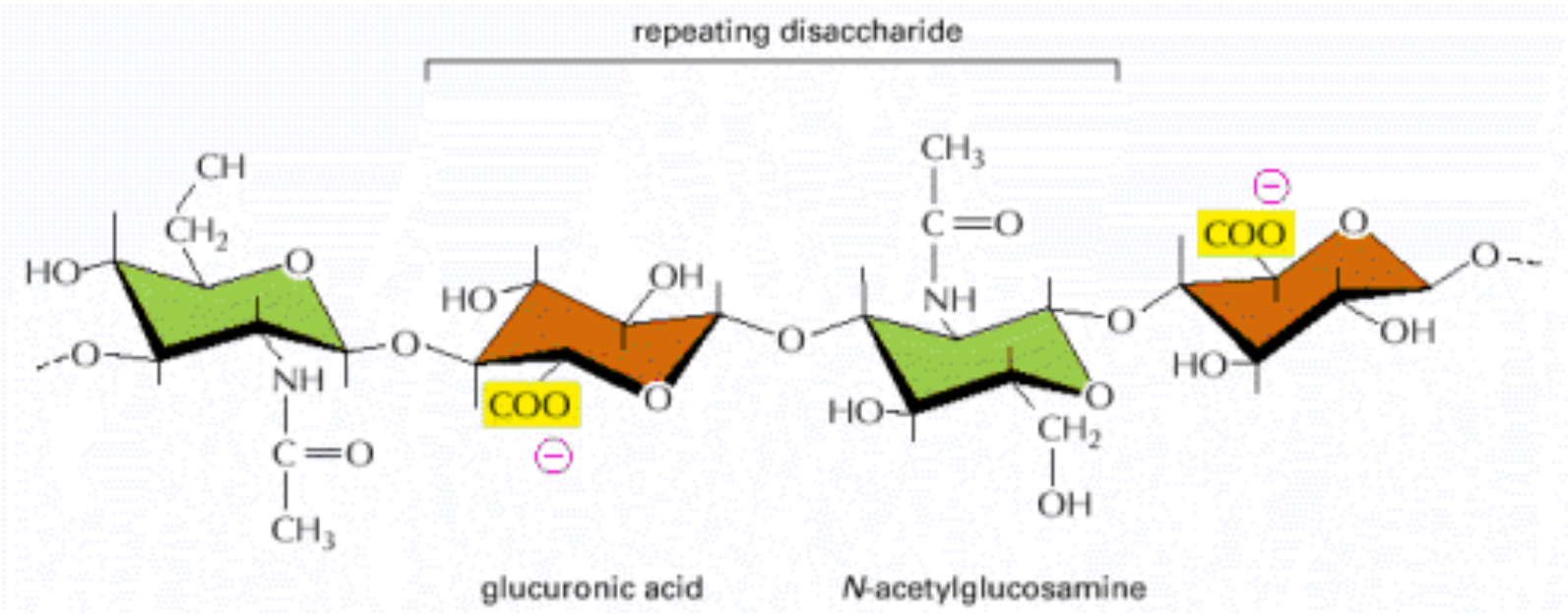



RIBONUCLEASE
(MW ~ 15,000)

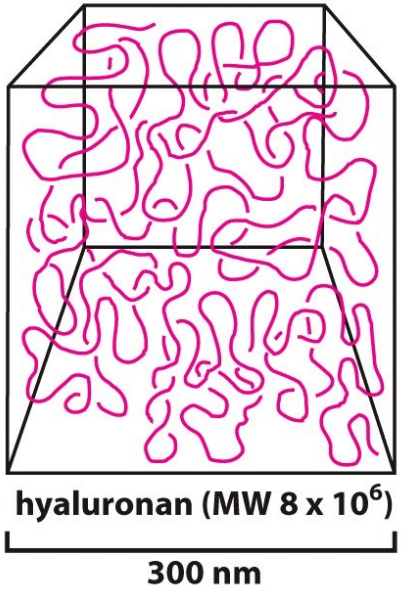
100 nm



# Hialorunano (Ac. Hialouronico)




-Mas simple
-No sulfato
-No unido a proteínas





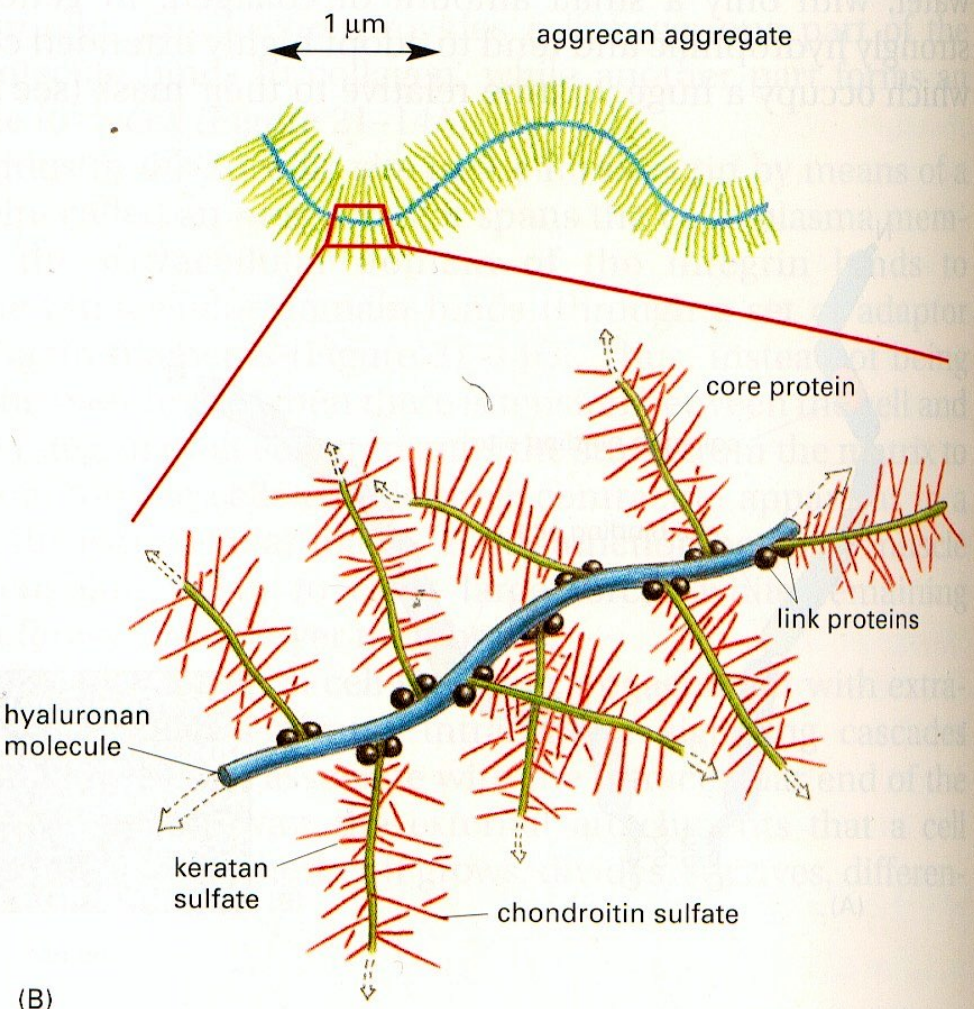
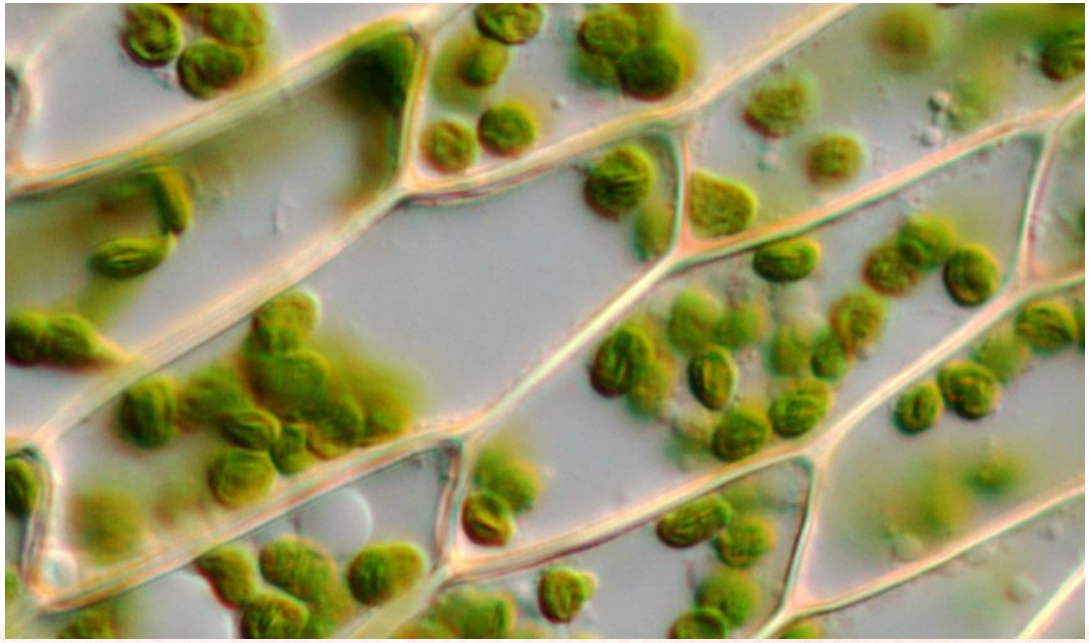



**Figure 21–16 Proteoglycans and GAGs can form large aggregates.** (A) Electron micrograph of an aggregate from cartilage spread out on a flat surface. Many free subunits—themselves large proteoglycan molecules—are also seen. (B) Schematic drawing of the giant aggregate illustrated in (A), showing how it is built up from GAGs and proteins. The molecular weight 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 $2 \times 10^{-12}$ $cm^3$. (A, courtesy of Lawrence Rosenberg.)

# Matrix extracelular vegetal



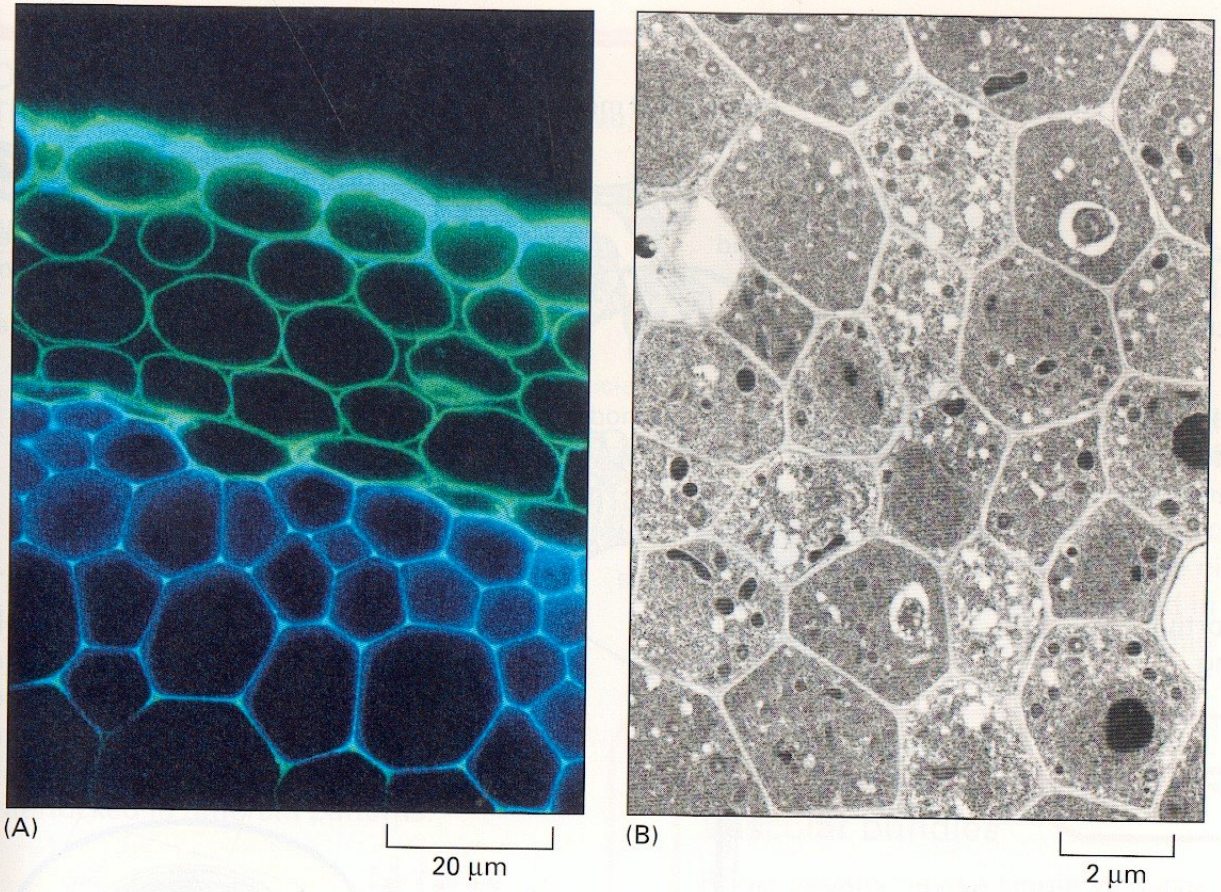


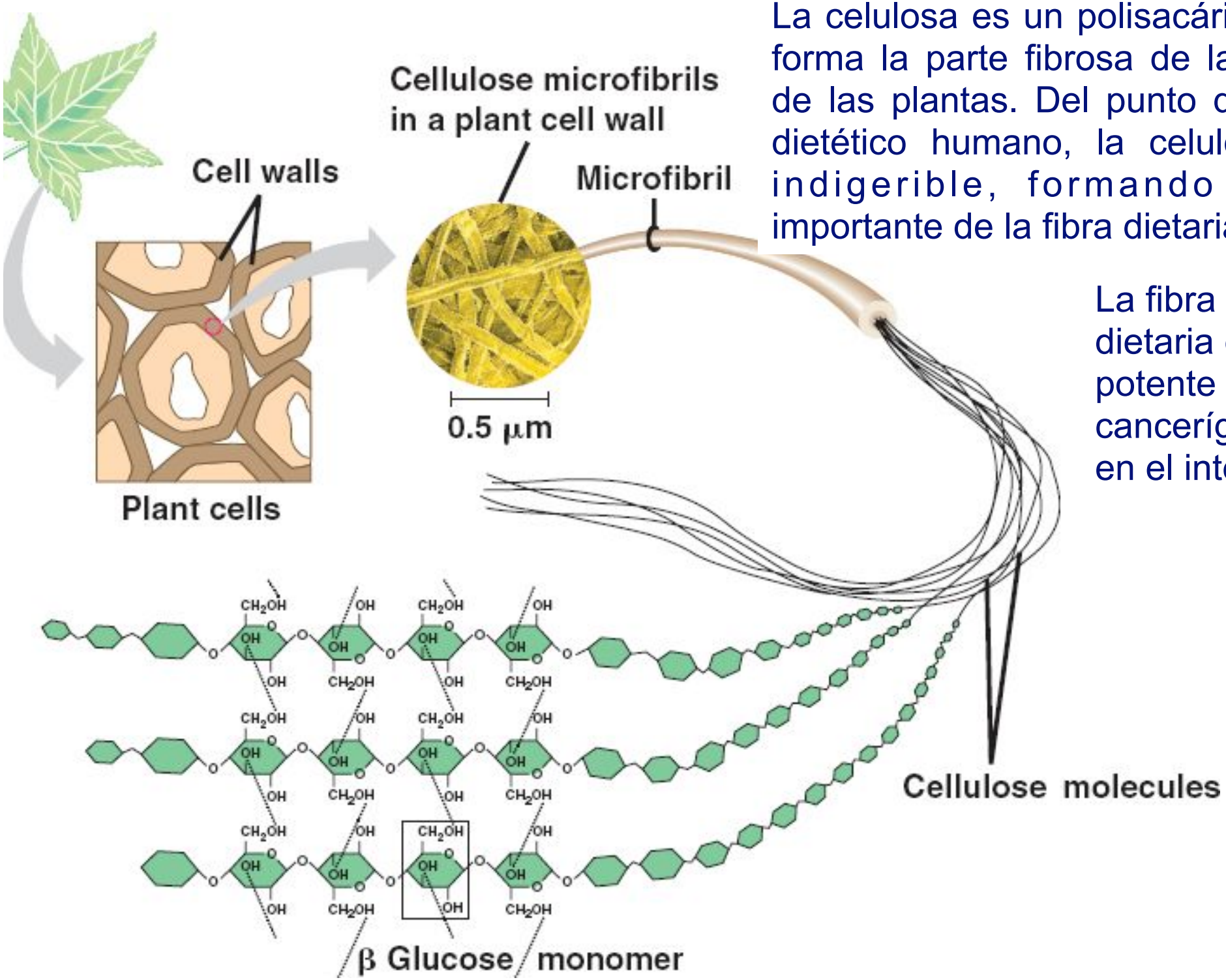

**Figure 21–3 Plant tissues are strengthened by the plant cell wall.** (A) A cross section of part of the stem of the flowering plant *Arabidopsis* is shown, stained with fluorescent dyes that label two different cell wall components—cellulose in *blue,* and another polysaccharide (pectin) in *green.* The cells themselves are unstained and invisible in this preparation. Regions rich in both cellulose and pectin appear white. Pectin predominates in the outer layers of cells, which have only primary cell walls (deposited while the cell is still growing). Cellulose is more plentiful in the inner layers, which have thicker, more rigid secondary cell walls (deposited after cell growth has ceased). (B) The cells and their walls are clearly seen in this electron micrograph of young cells in the root of the same plant. (Courtesy of Paul Linstead.)

# POLISACÁRIDOS SIMPLES

CELULOSA

La celulosa es un polisacárido que forma la parte fibrosa de la pared de las plantas. Del punto de vista dietético humano, la celulosa es indigerible, formando parte importante de la fibra dietaria.

La fibra dietaria es un potente anti-cancerígeno en el intestino.



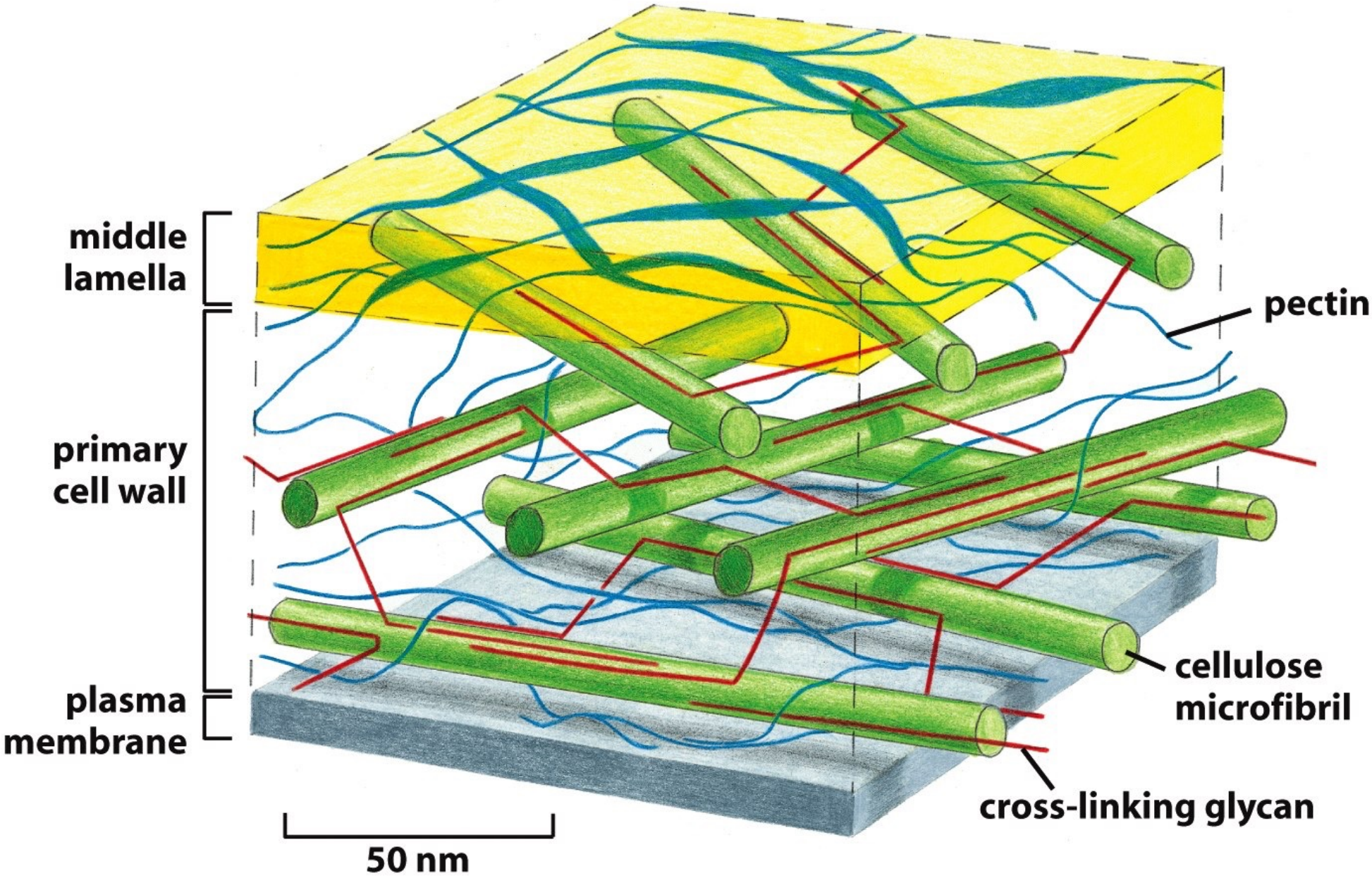



Figure 19-79 *Molecular Biology of the Cell* (© Garland Science 2008)

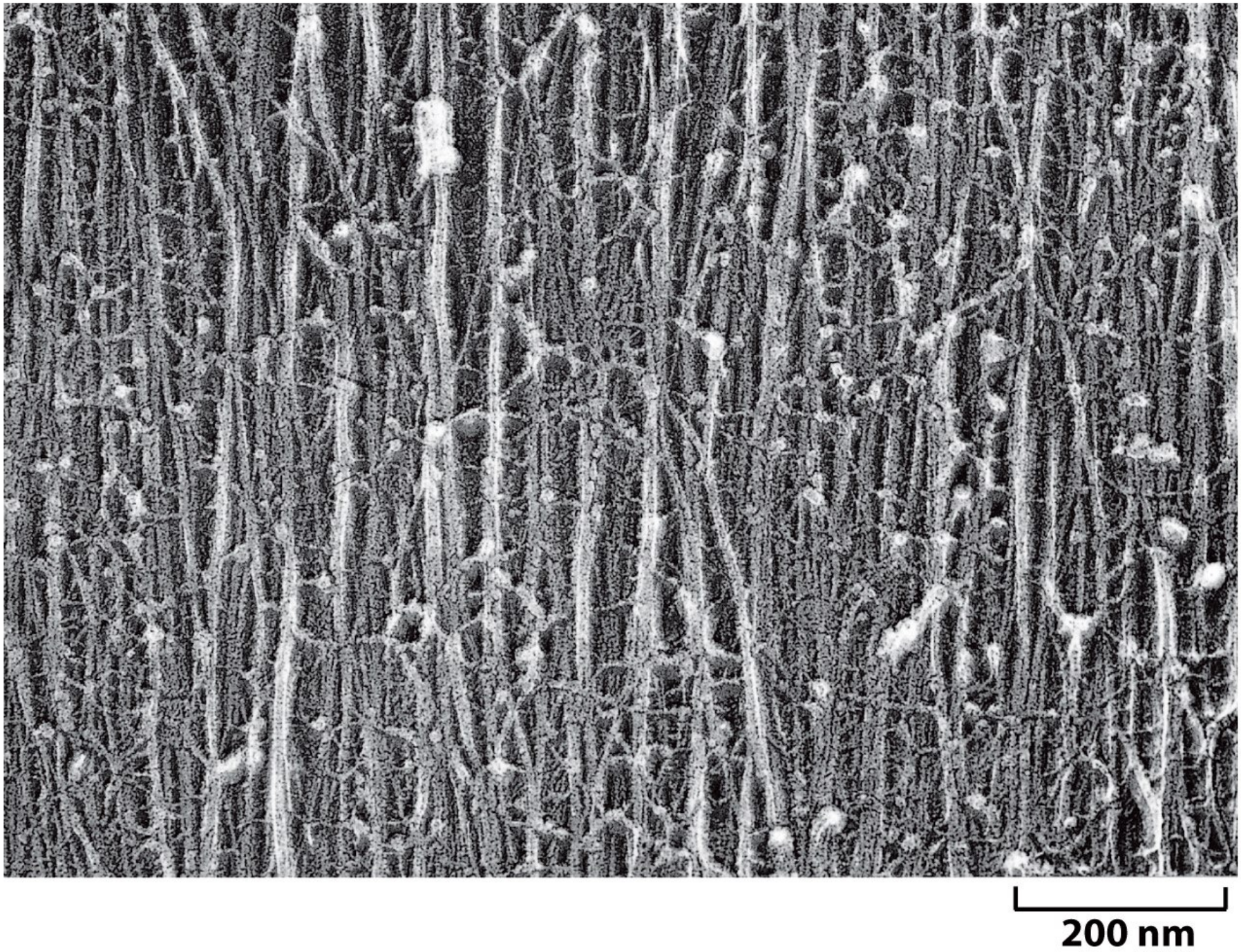



Figure 19-80a *Molecular Biology of the Cell* (© Garland Science 2008)

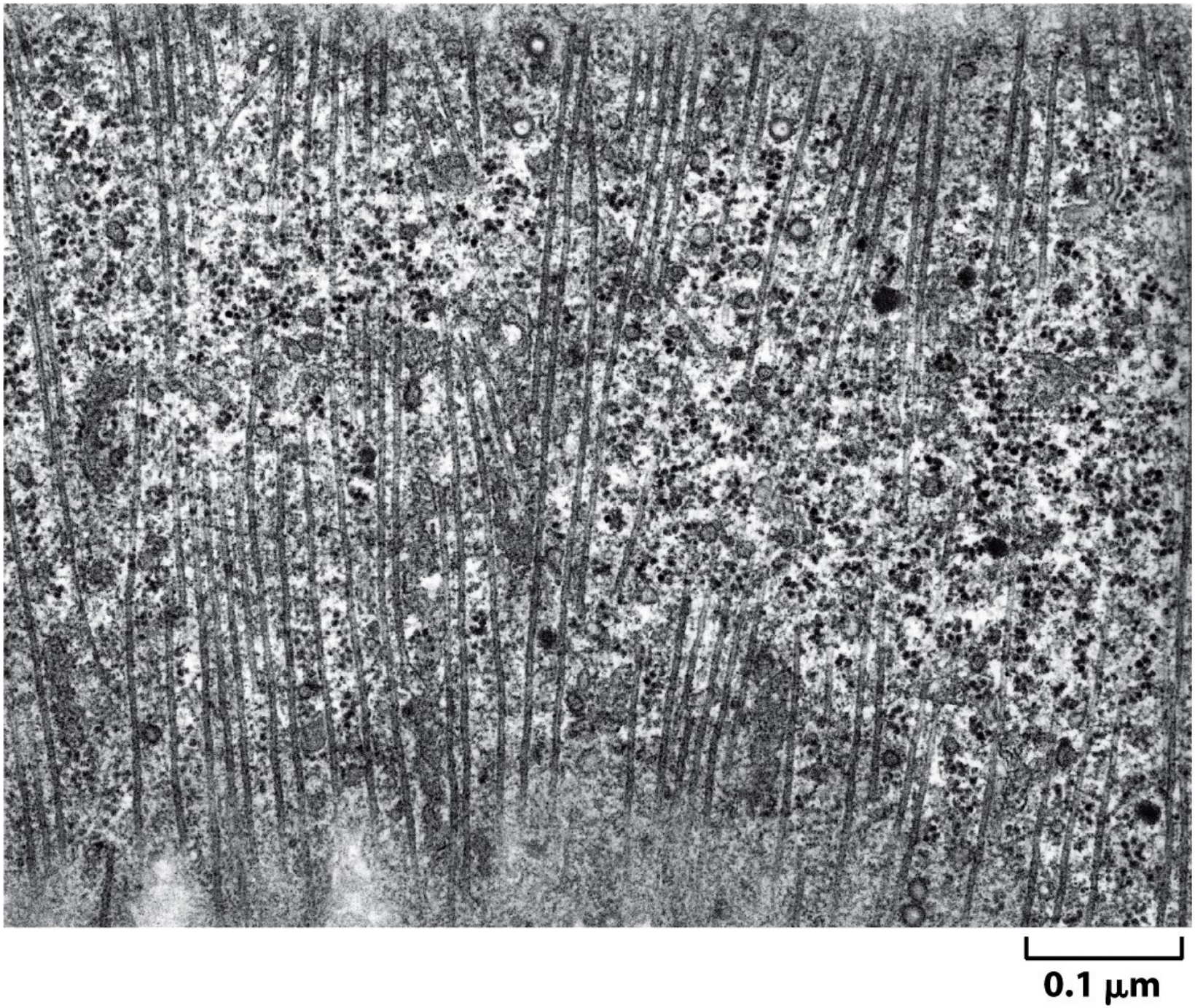



Figure 19-81a *Molecular Biology of the Cell* (© Garland Science 2008)

TIP:
Sintesis es extracelular

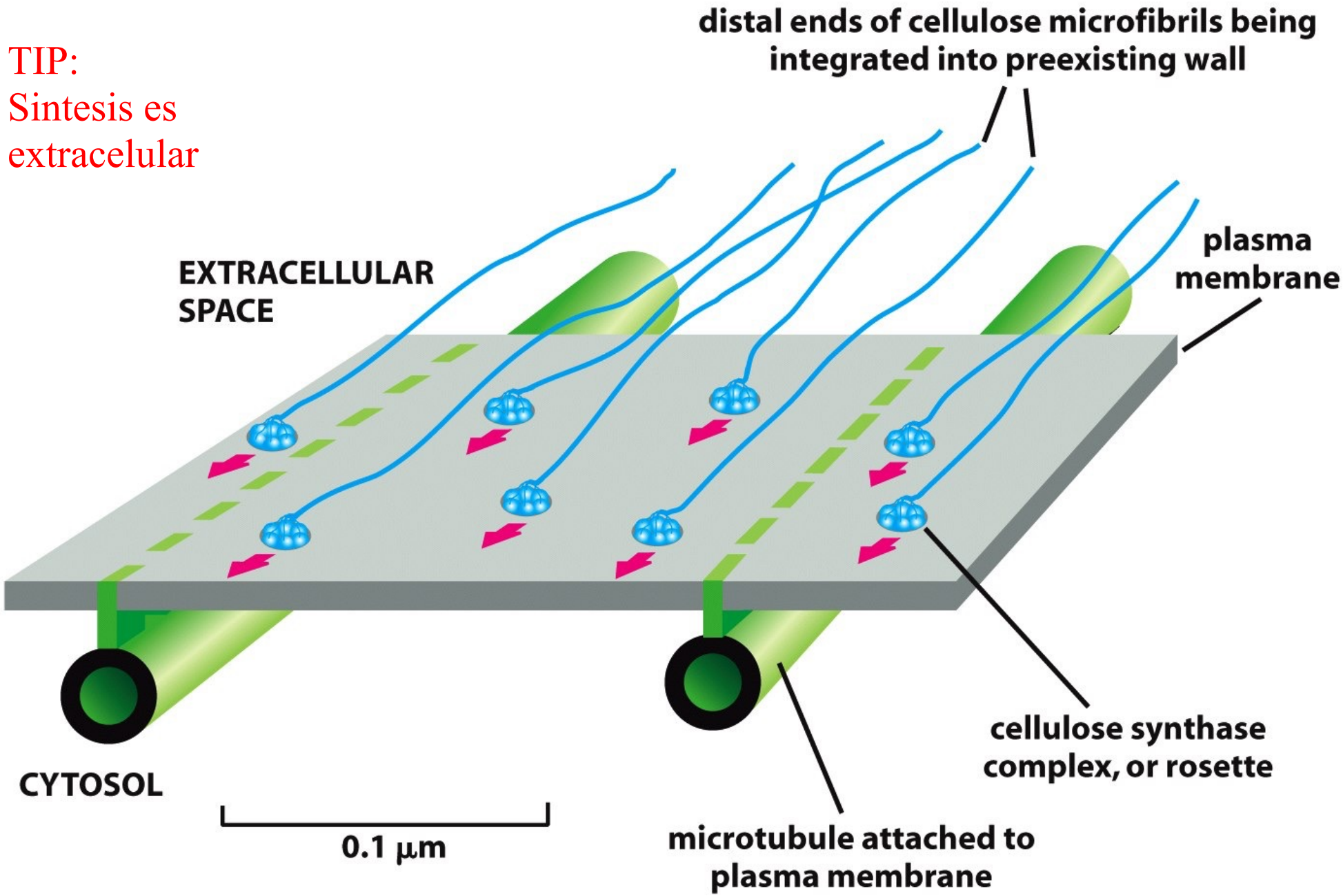



Figure 19-82a *Molecular Biology of the Cell* (© Garland Science 2008)

Lo que vamos a ver....

1.- Matrix extracelular animal y vegetal

2.- Uniones celulares

3.- Resúmen

# Tipos de Uniones

- Uniones Ocludentes:
  - -Uniones Estrechas (Tight Junctions)
  - -Uniones Septadas (solo en insectos)
- Uniones de Anclaje:
  - -Uniones Adherentes (uniones celula-celula)
  - -Desmosomas (uniones celula-celula)
  - -Hemidesmosomas (uniones celula-MEC)
  - -Contactos Focales (uniones celula-MEC)
- Uniones Comunicantes:
  - -Uniones en Hendidura (Gap Junctions)
  - - Sinápsis químicas
  - -Plasmodesmos (solo en plantas)

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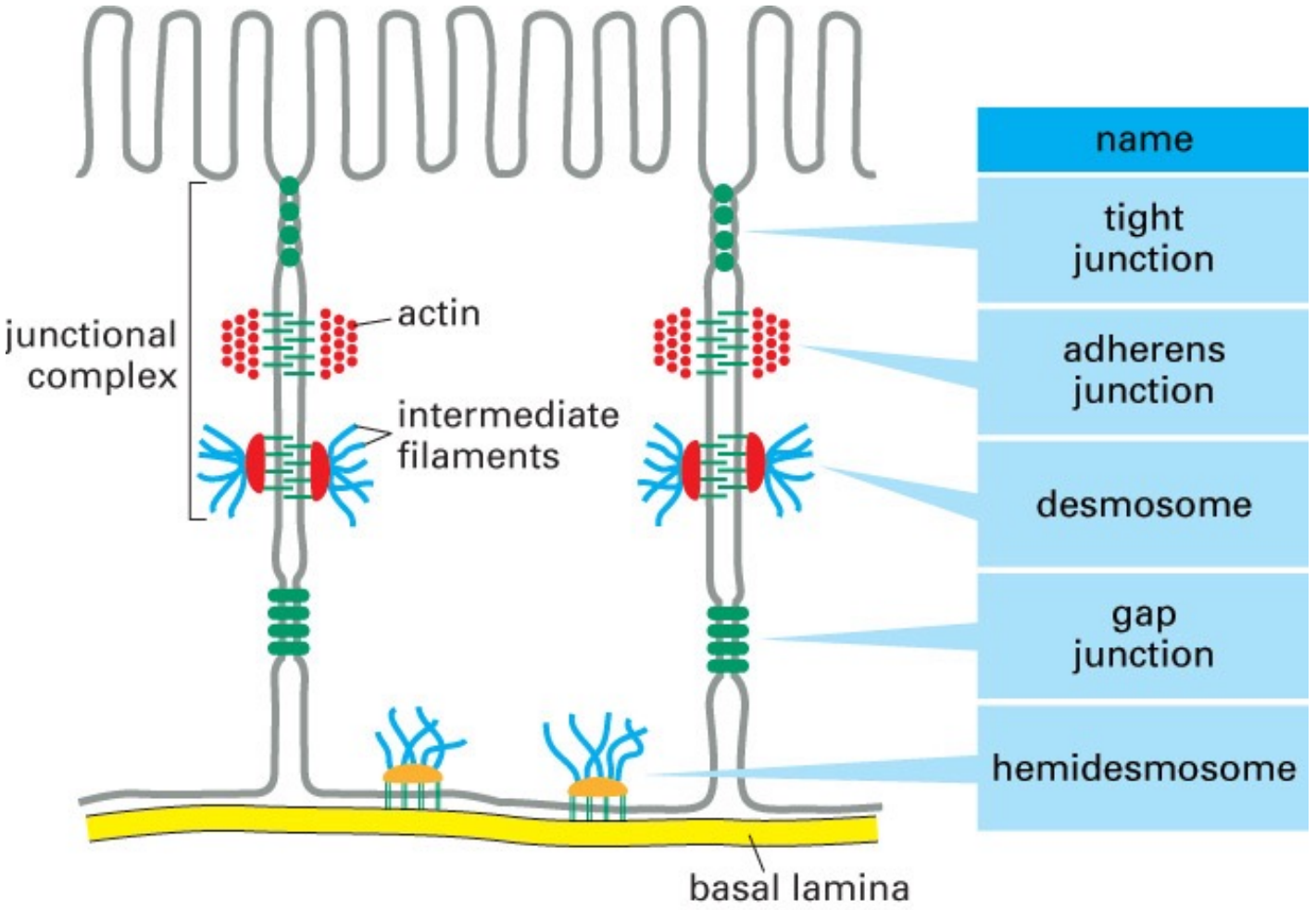
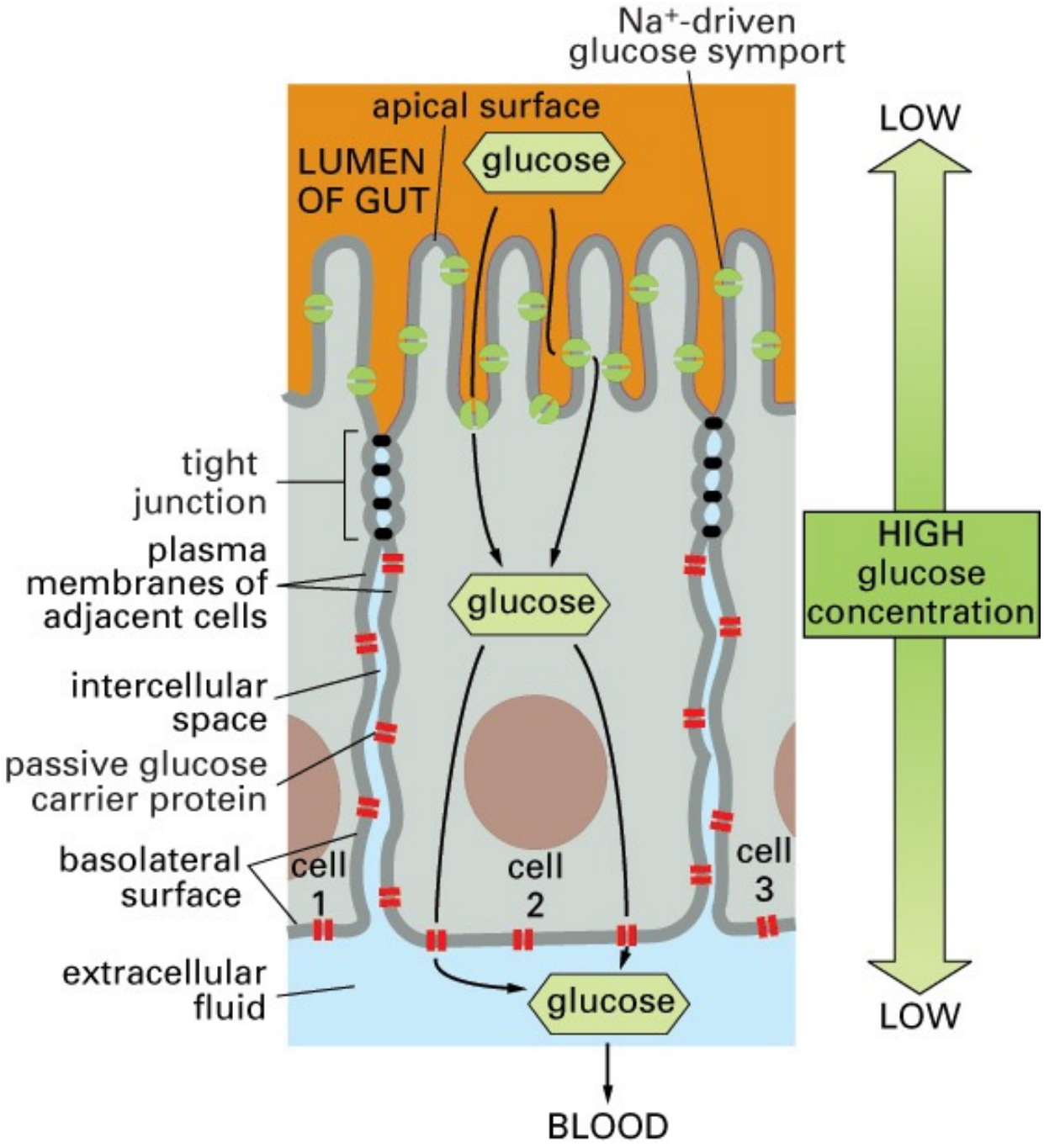
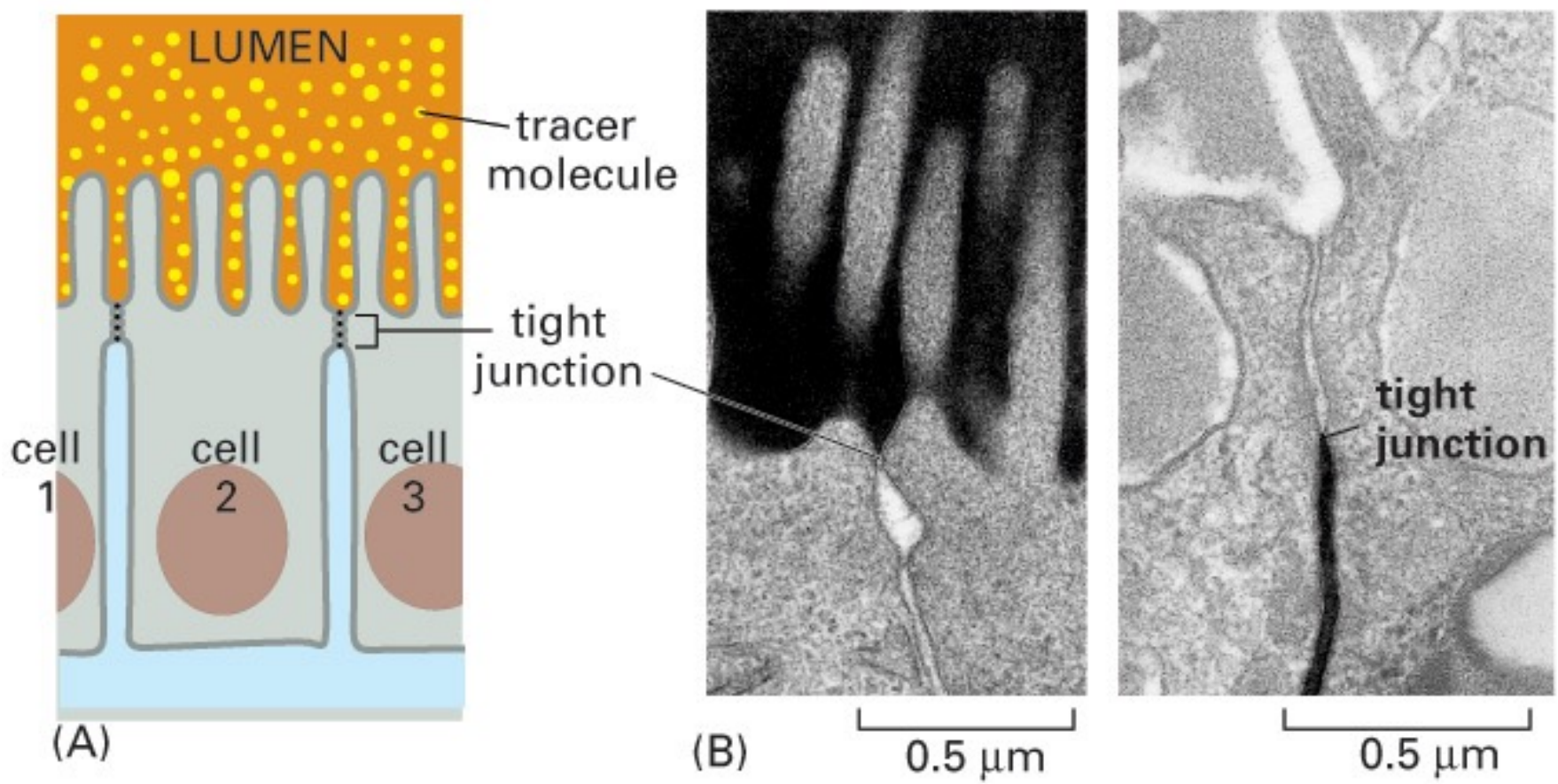
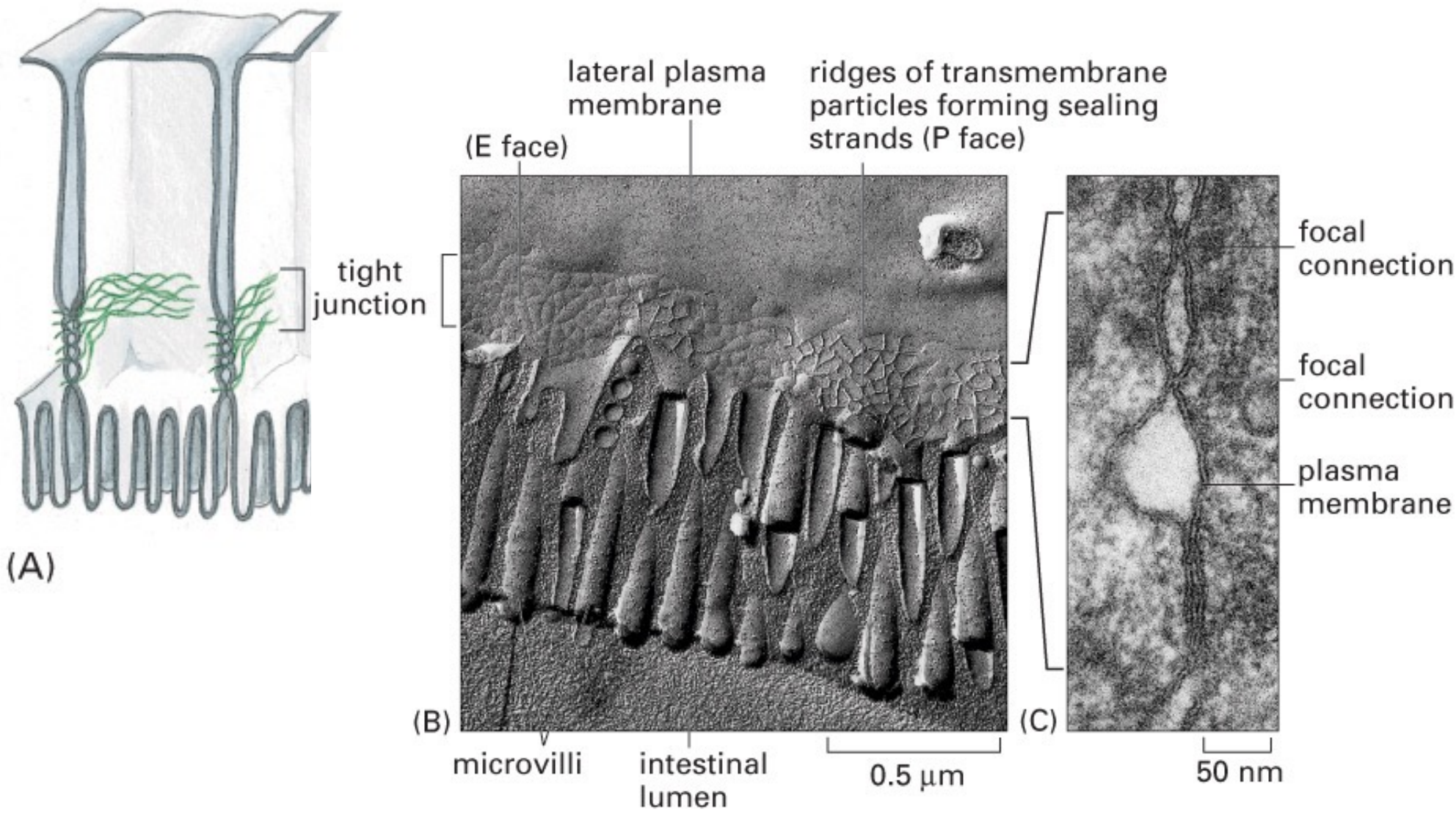
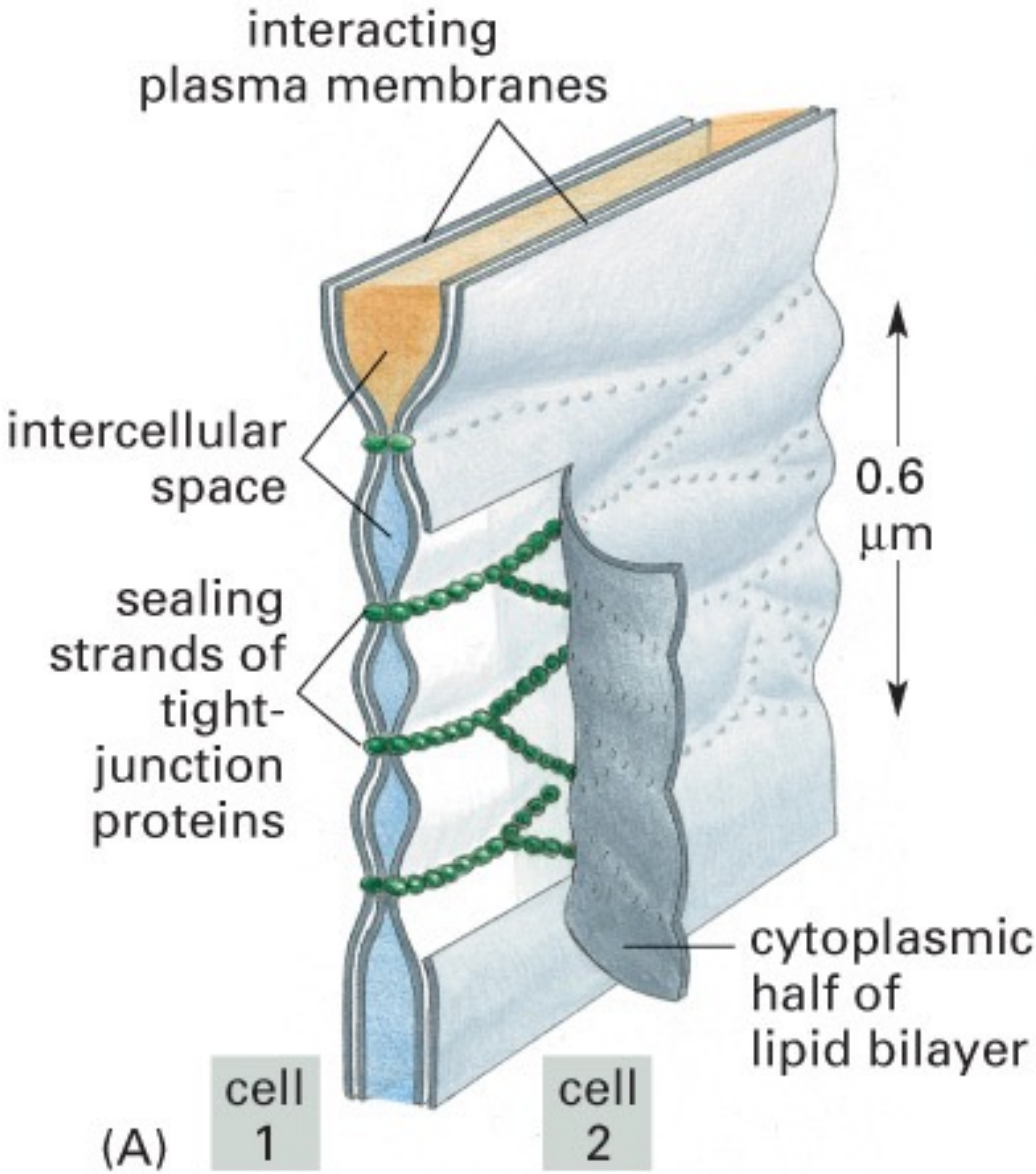
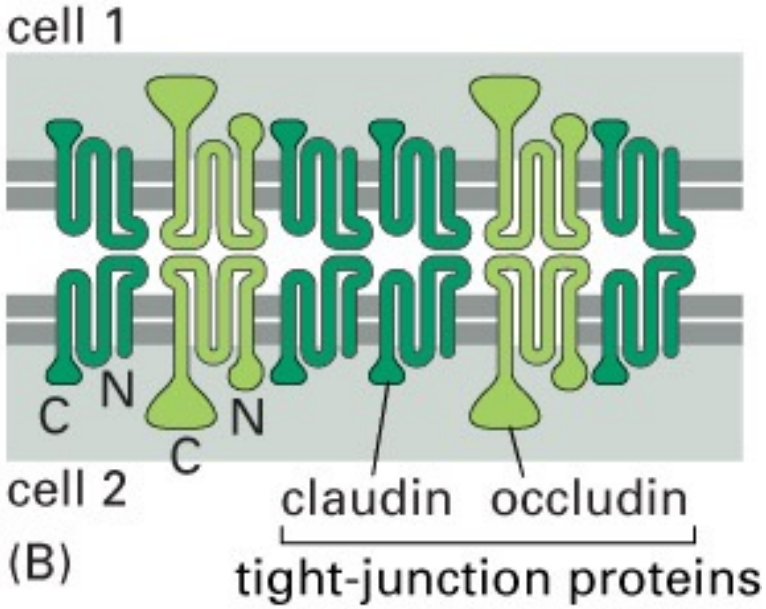

junctional complex
actin
intermediate filaments
basal lamina
name
tight junction
adherens junction
desmosome
gap junction
hemidesmosome


Na+-driven
glucose symport
apical surface
LUMEN
OF GUT
glucose
LOW
tight
junction
plasma
membranes of
adjacent cells
glucose
HIGH
glucose
concentration
intercellular
space
passive glucose
carrier protein
basolateral
surface
cell
1
cell
2
cell
3
extracellular
fluid
glucose
LOW
BLOOD


LUMEN
tracer molecule
tight junction
cell 1
cell 2
cell 3
(A)
(B)
0.5 μm
tight junction
0.5 μm


tight
junction
(A)
lateral plasma
membrane
(E face)
ridges of transmembrane
particles forming sealing
strands (P face)
(B)
microvilli
intestinal
lumen
0.5 μm
(C)
focal
connection
focal
connection
plasma
membrane
50 nm



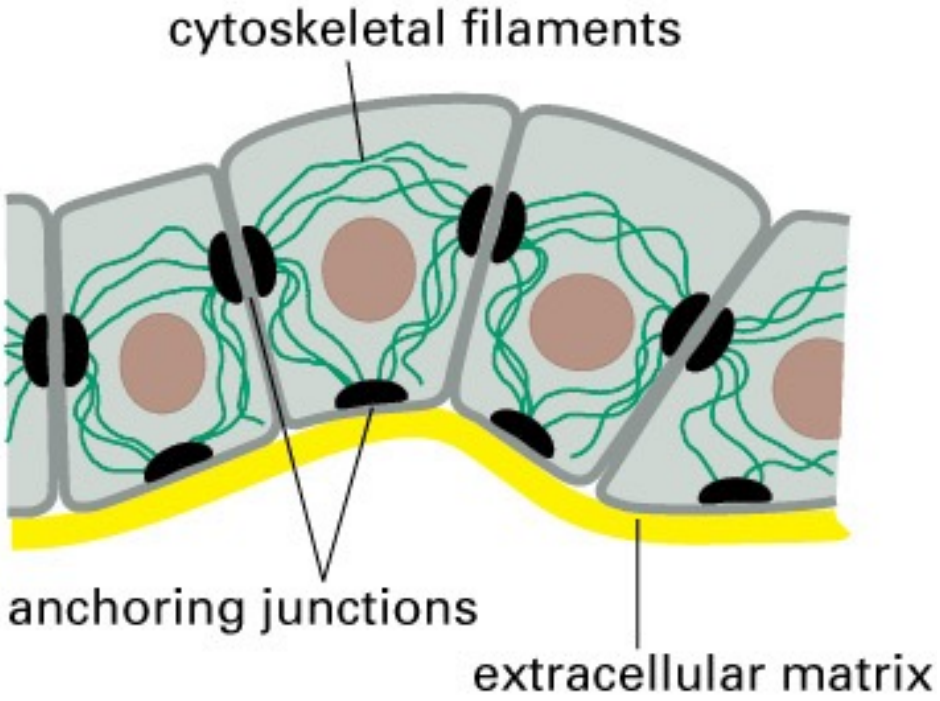



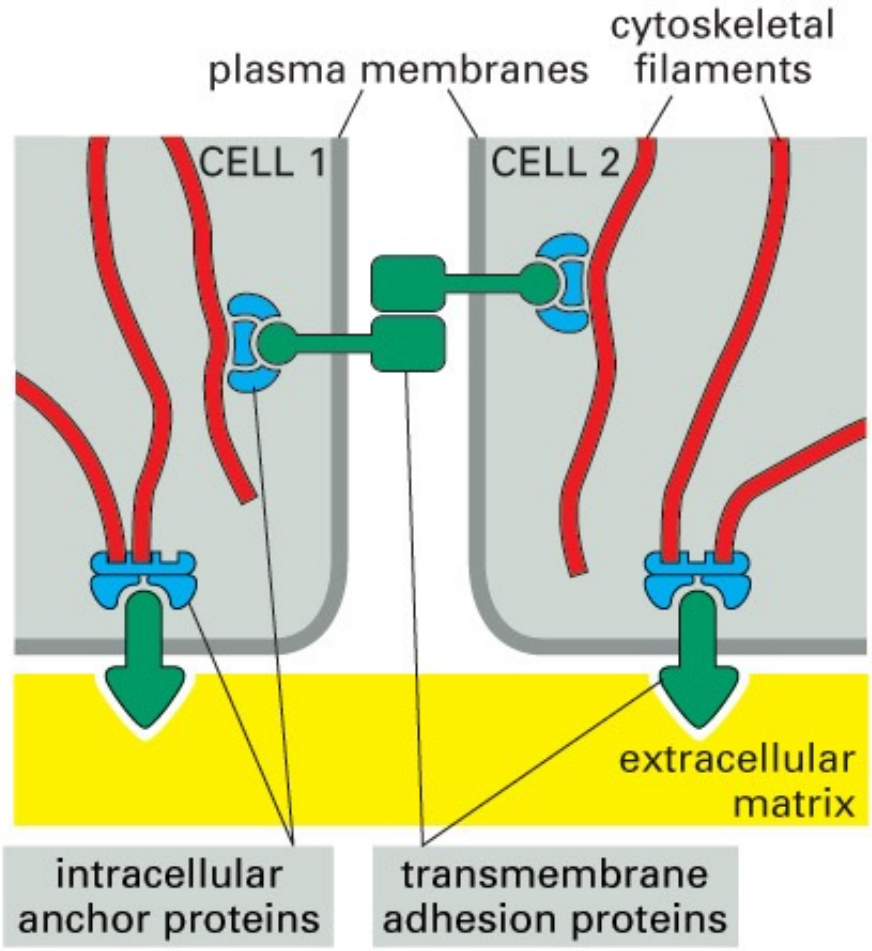

TIP: Proteínas ZO (*zonula occludens*)
Invertebrados
uniones estrecha:uniones septadas=
proteínas ZO:*Disc-large*

# Tipos de Uniones

- Uniones Ocludentes:
  - -Uniones Estrechas (Tight Junctions)
  - -Uniones Septadas (solo en insectos)
- Uniones de Anclaje:
  - -Uniones Adherentes (uniones celula-celula)
  - -Desmosomas (uniones celula-celula)
  - -Hemidesmosomas (uniones celula-MEC)
  - -Contactos Focales (uniones celula-MEC)
- Uniones Comunicantes:
  - -Uniones en Hendidura (Gap Junctions)
  - - Sinápsis químicas
  - -Plasmodesmos (solo en plantas)

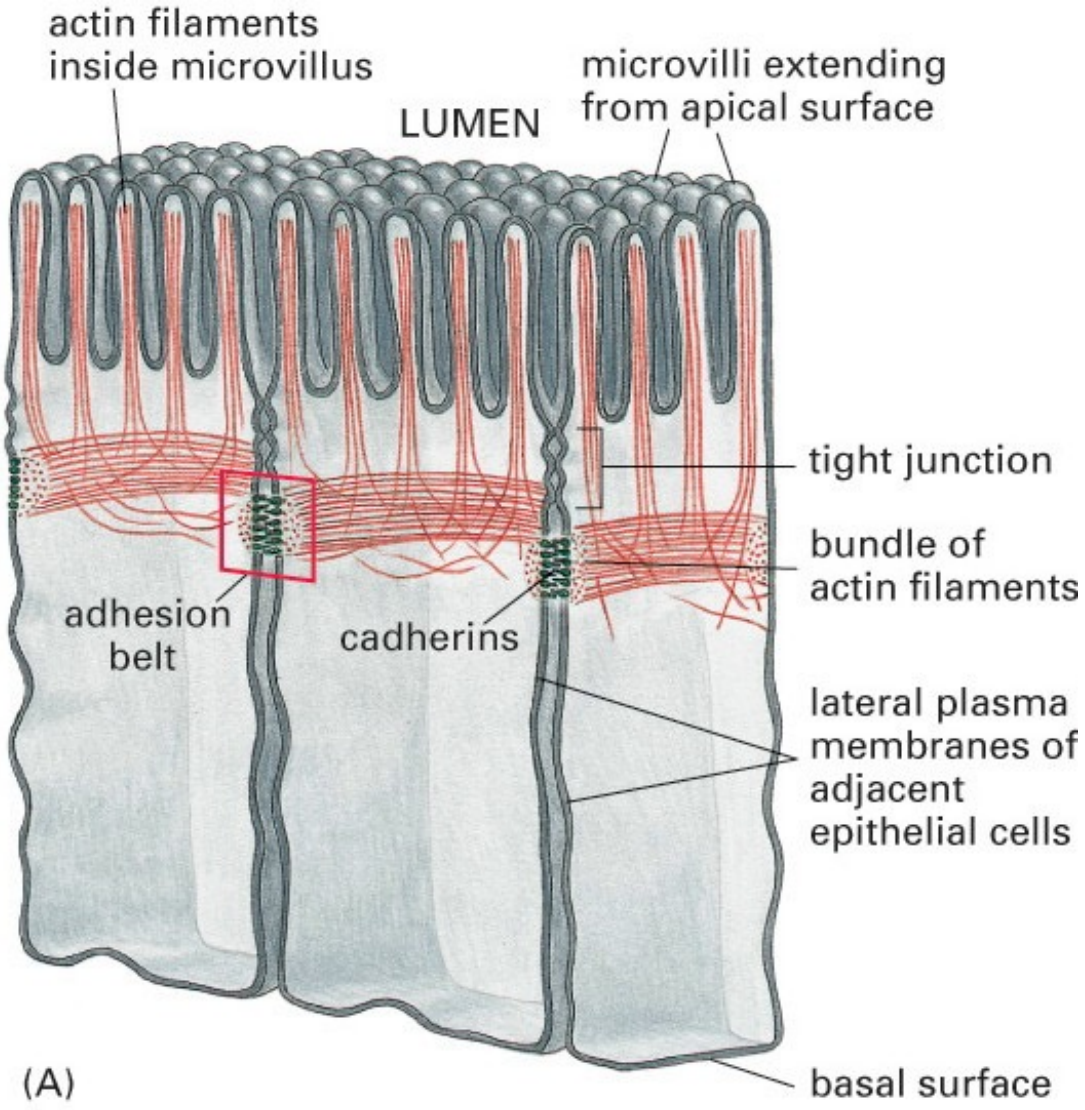
# Uniones de Anclaje

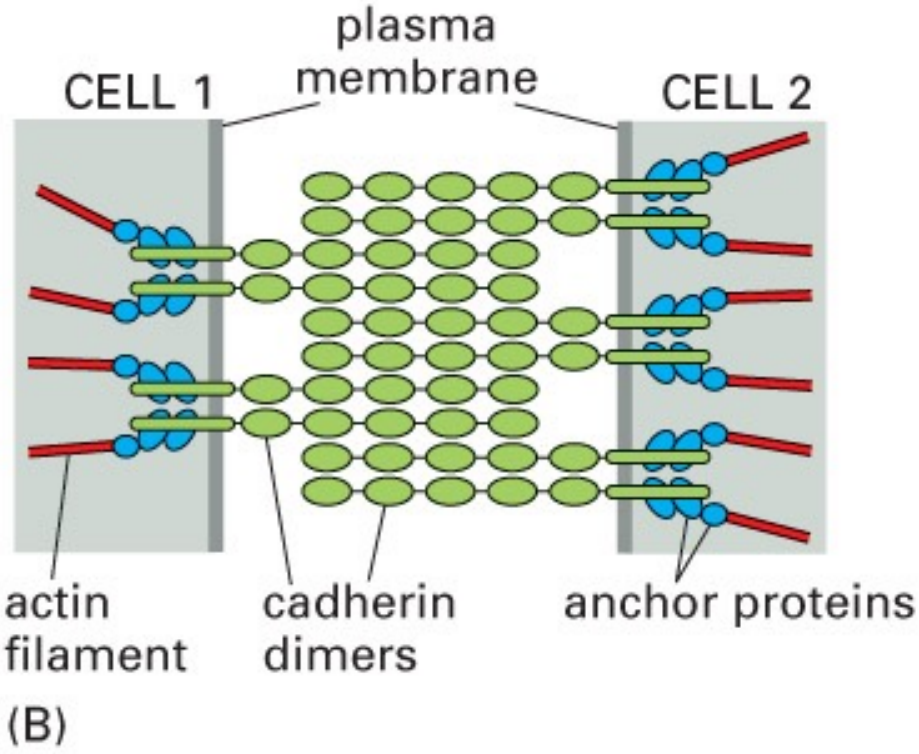


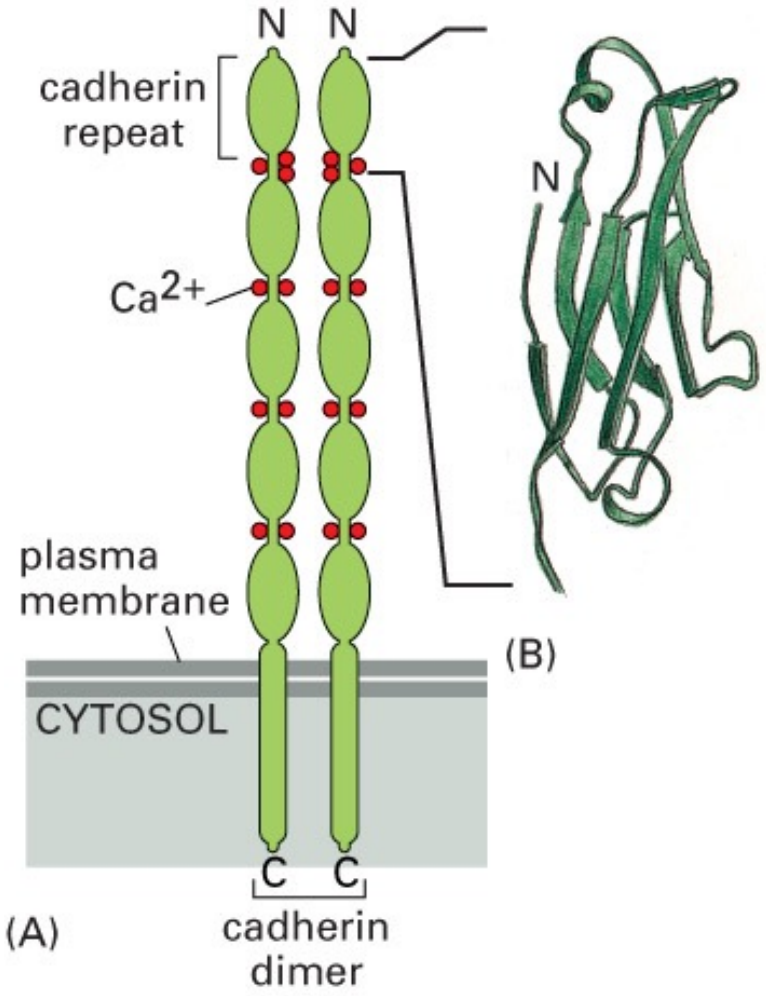
# Uniones Adherentes

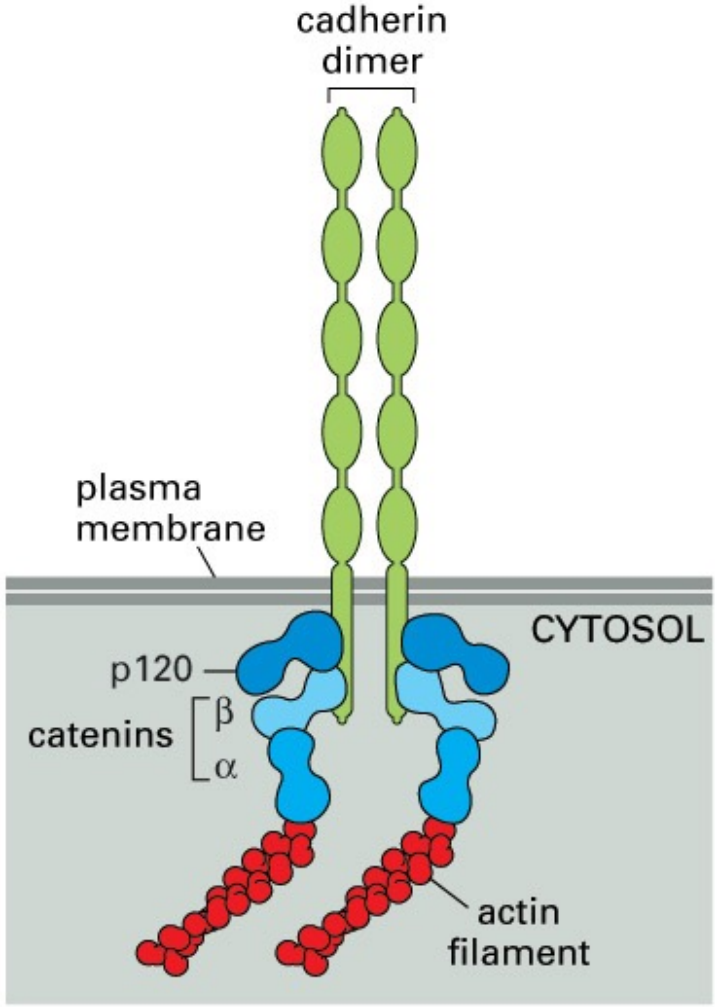
TIP: cinturon de adhesión o *zonula adherens*

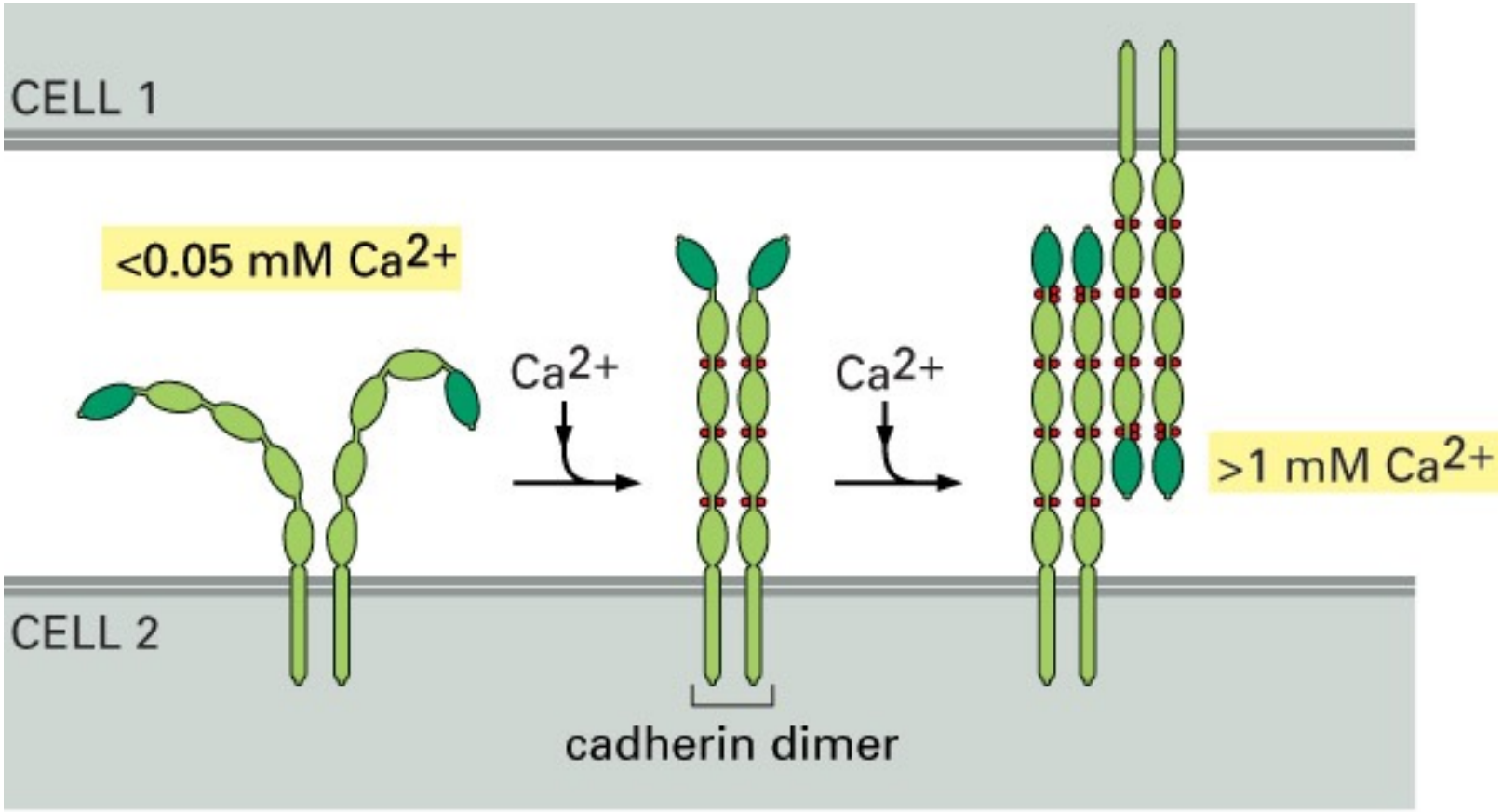


# Cadherinas

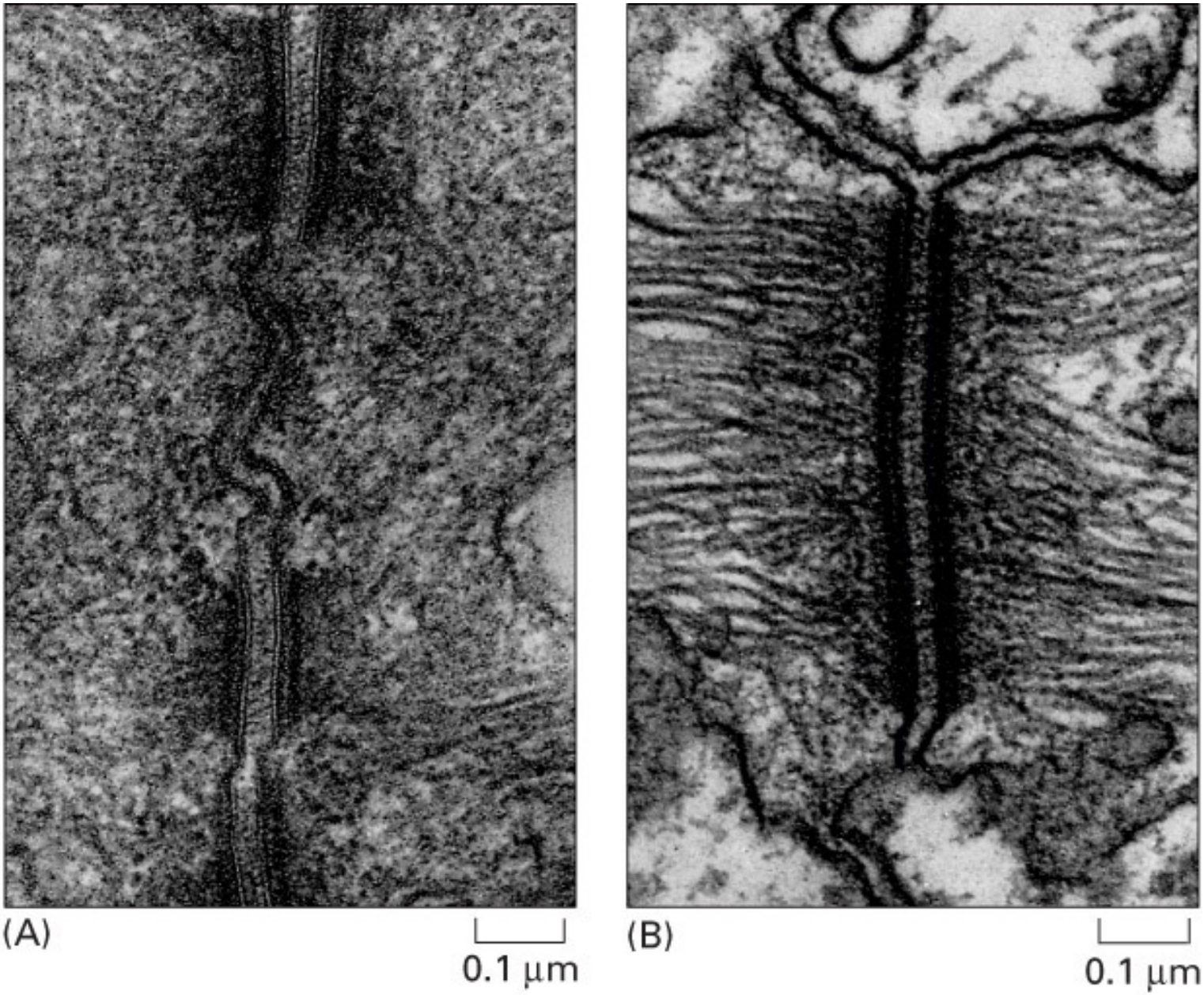

N
N
cadherin
repeat
Ca2+
plasma
membrane
CYTOSOL
C
C
(A)
cadherin
dimer
N
(B)


cadherin
dimer
plasma
membrane
CYTOSOL
p120
catenins
β
α
actin
filament

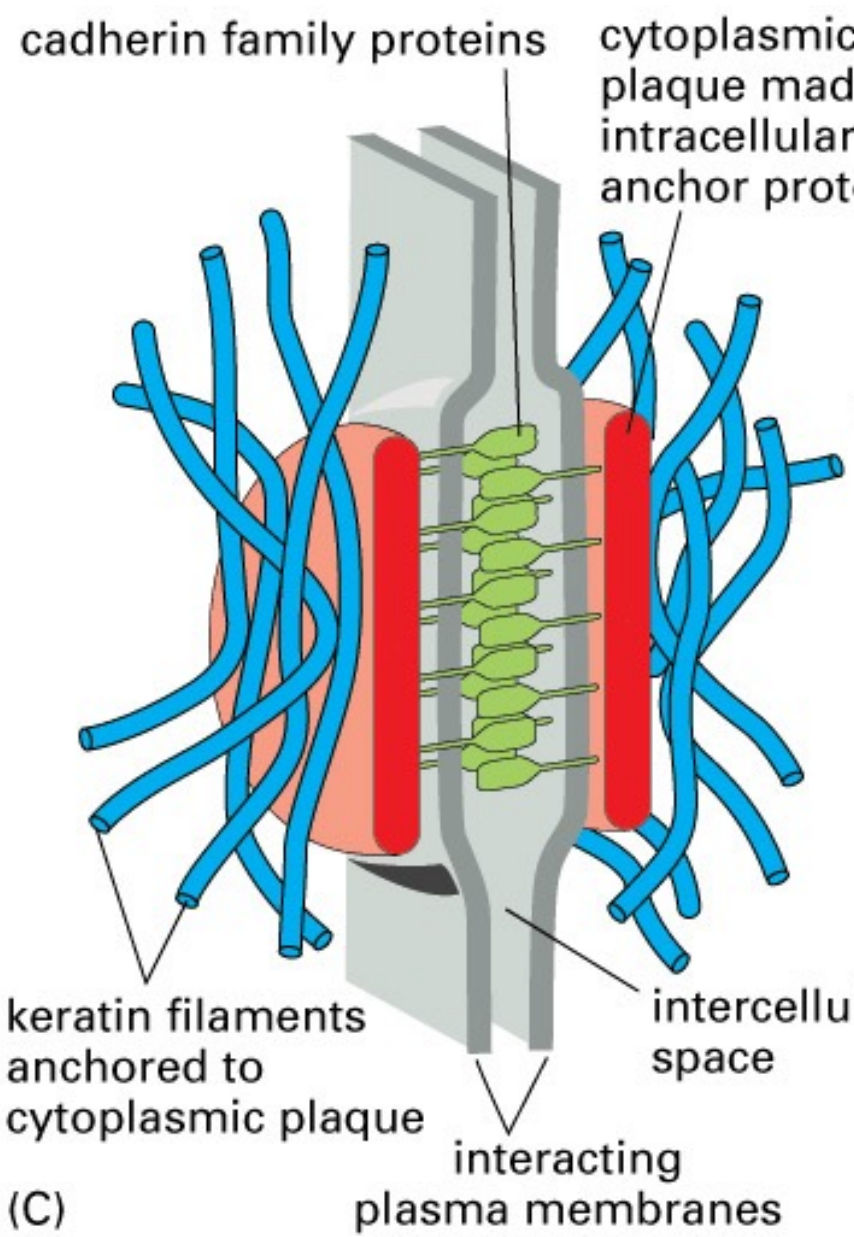


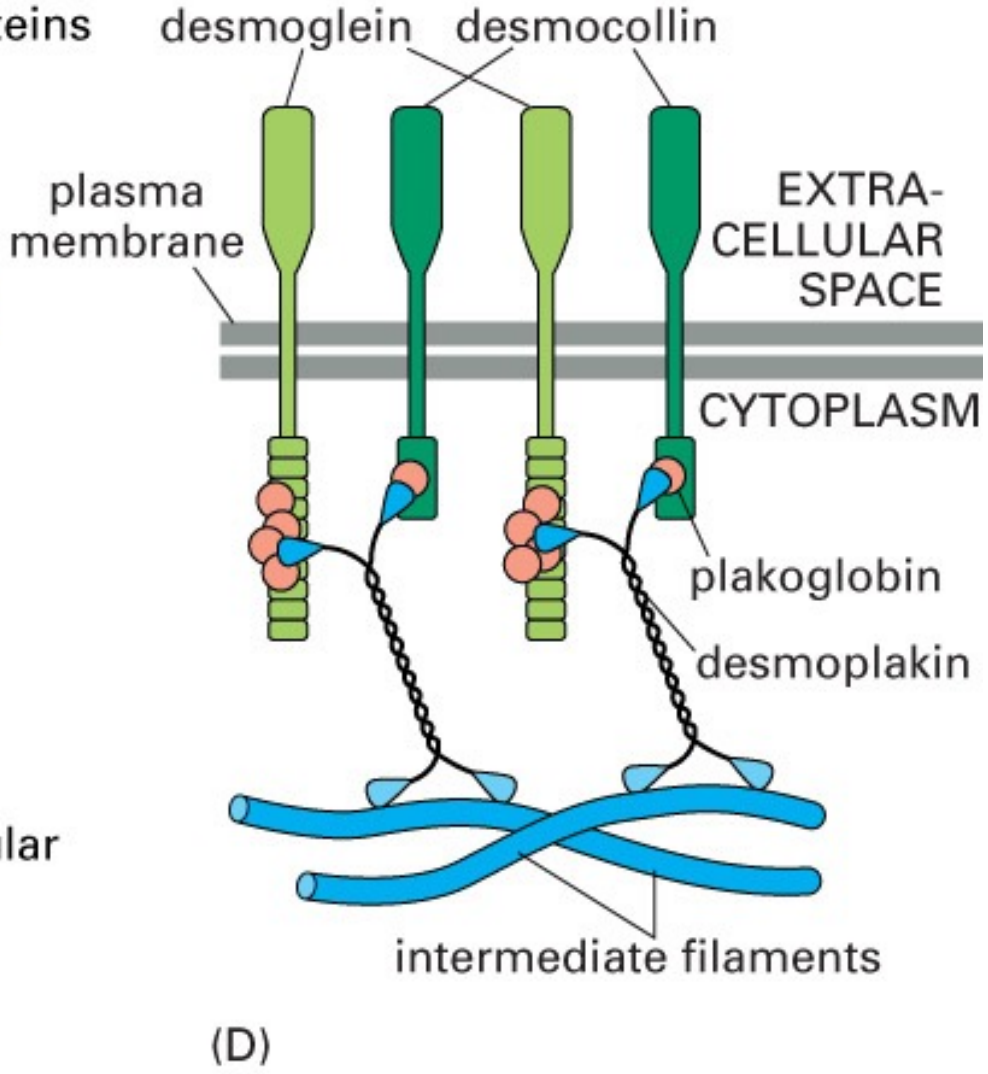

(C)

# Desmosomas

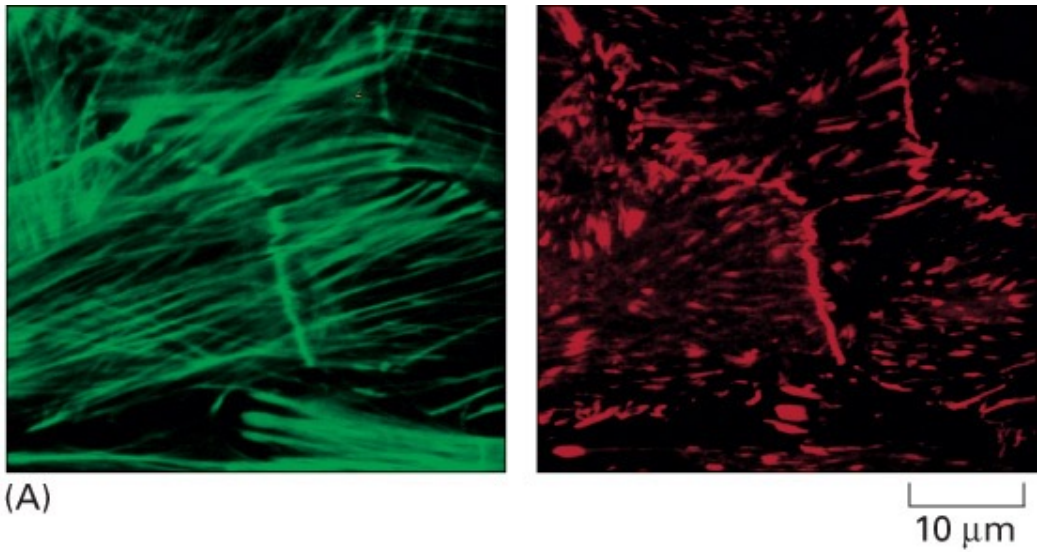


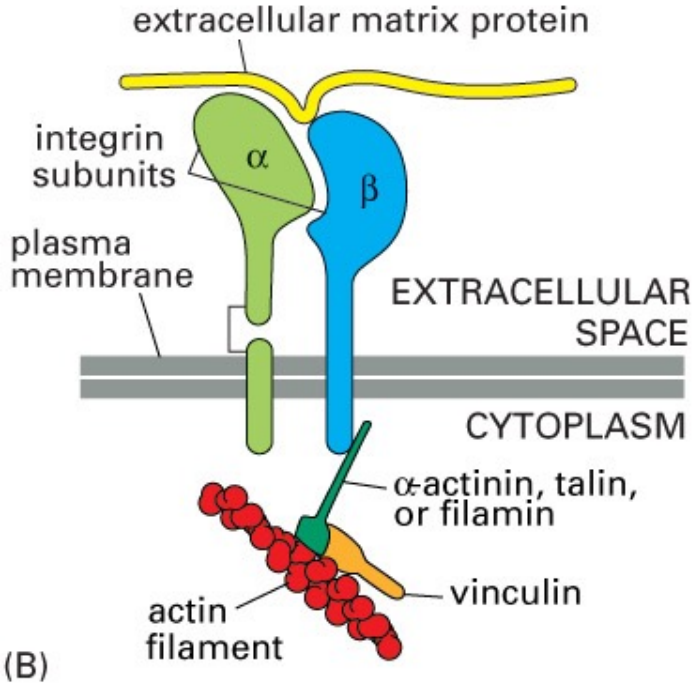
TIP: **desmina (FI)** musculo cardiaco



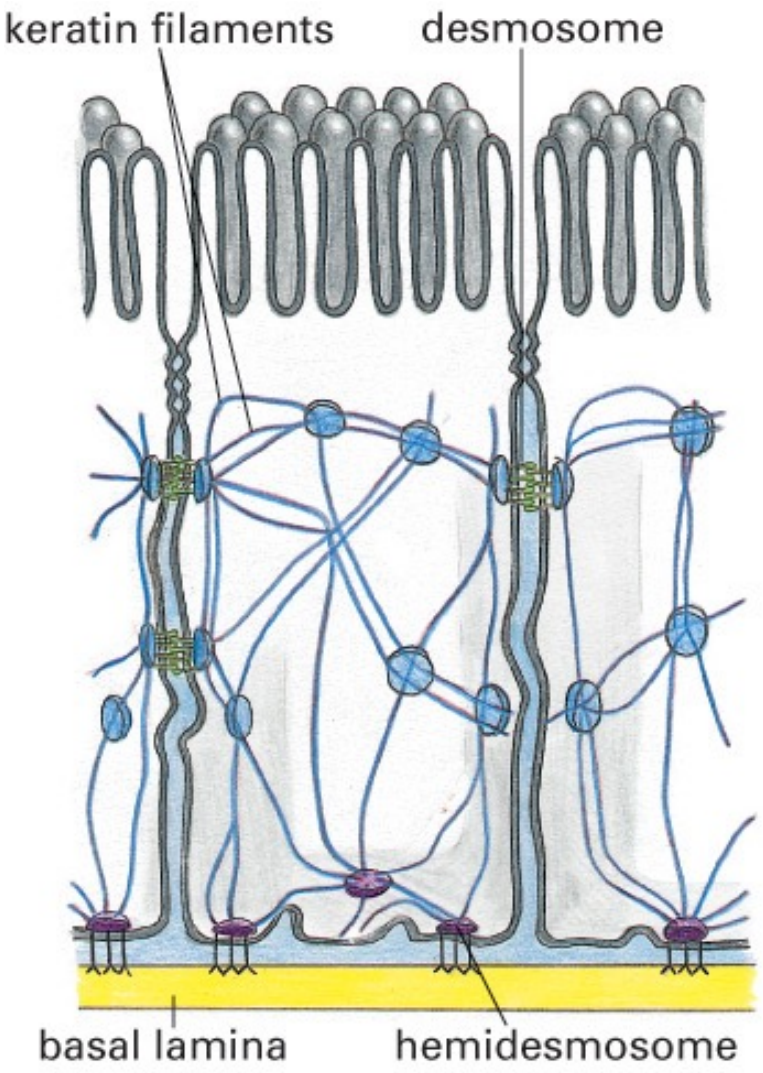



# Contactos Focales



## Hemidesmosomas




**TIP: Desmosomas (Desmocolina, desmogleinas: Placoglobinas,Desmoplaquinas: Filamentos Intermedios). Hemidesmosomas (Laminina:Integrinas: Plectinas:Filamentos intermedios)**

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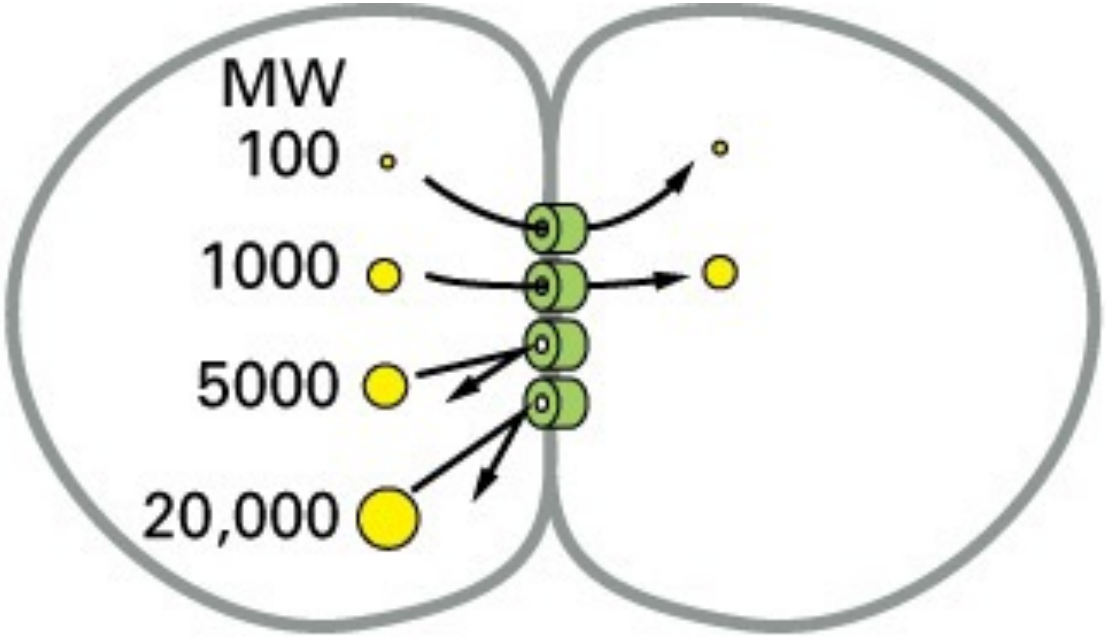
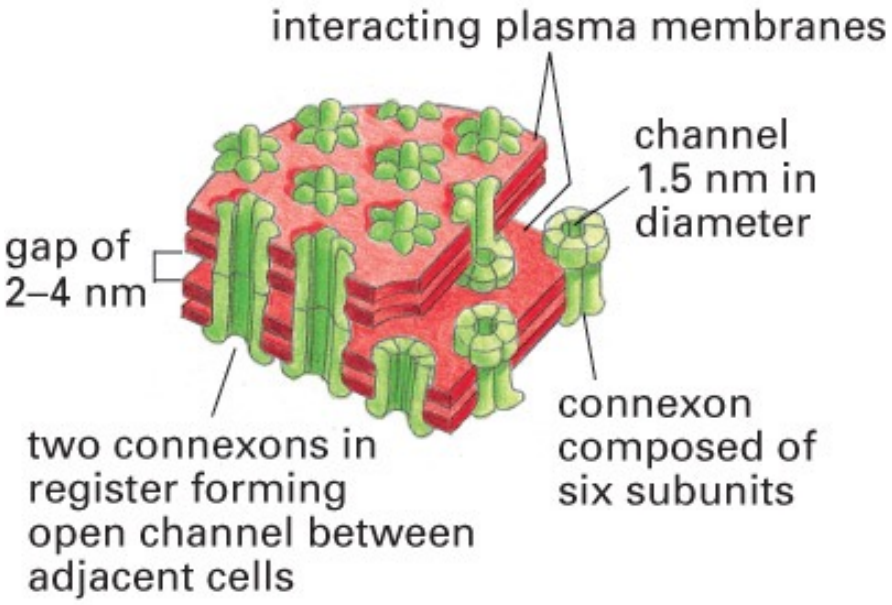
  - -Plasmodesmos (solo en plantas)

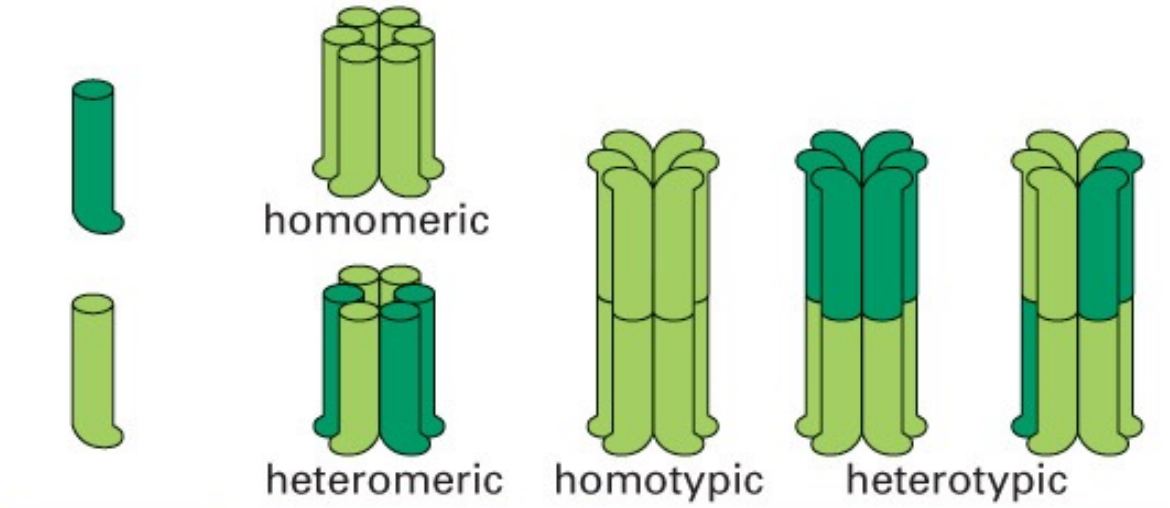
## Uniones en Hendidura



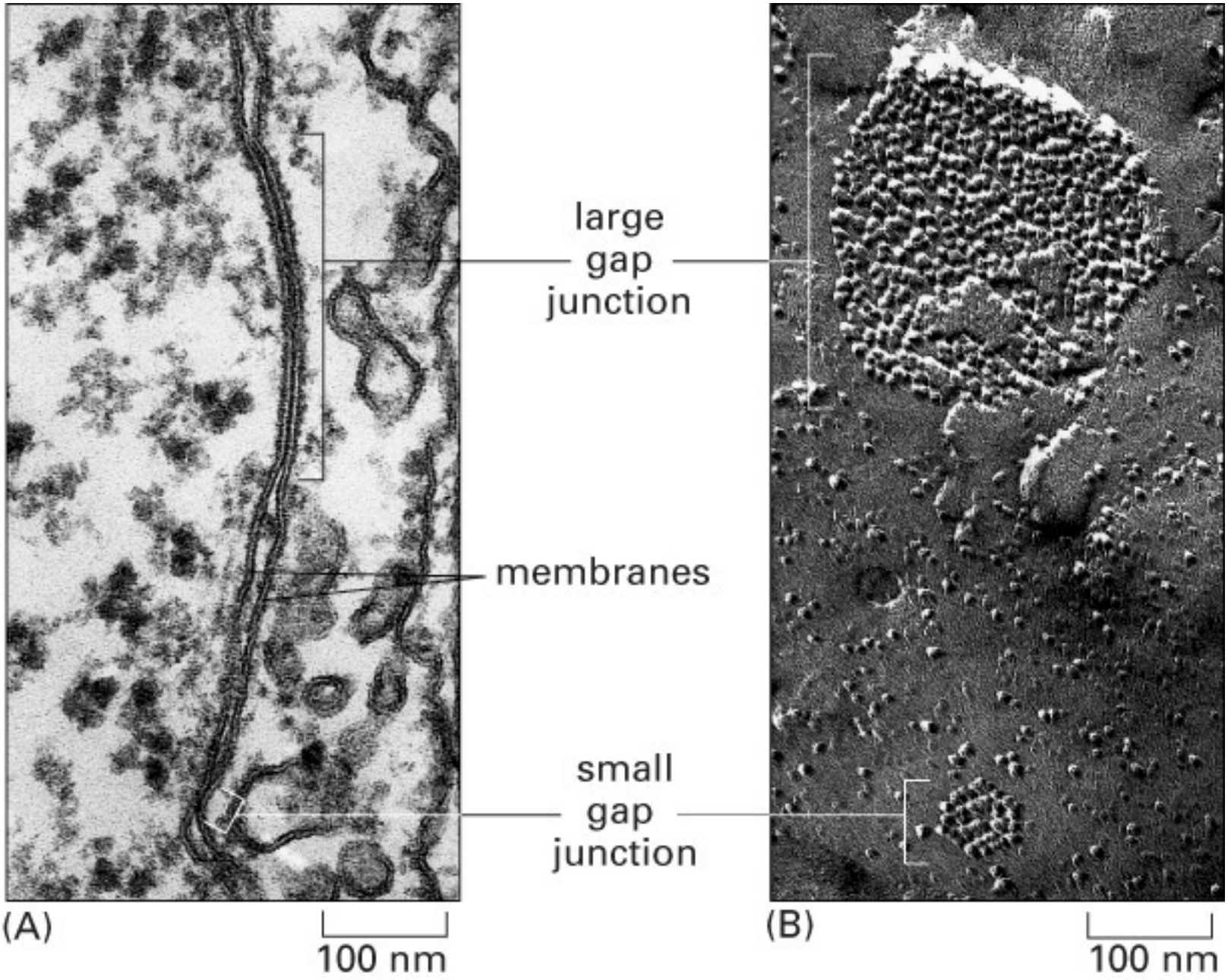

TIP: iones, azucares, aminoacidos, nucleotidos, cAMP e IP3)

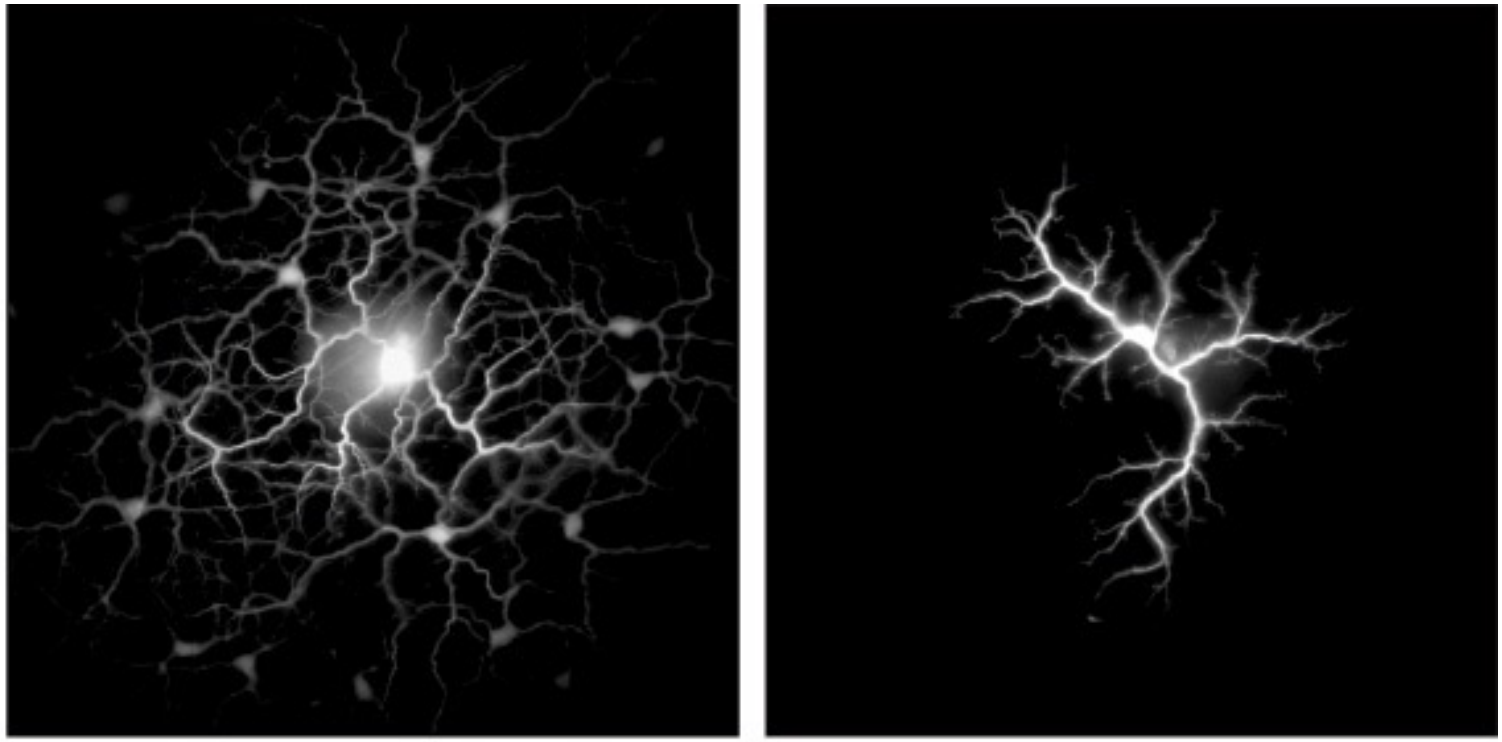

interacting plasma membranes
channel
1.5 nm in
diameter
gap of
2–4 nm
two connexons in
register forming
open channel between
adjacent cells
connexon
composed of
six subunits

(A)


homomeric
heteromeric
homotypic
heterotypic
connexins
connexons
intercellular channels

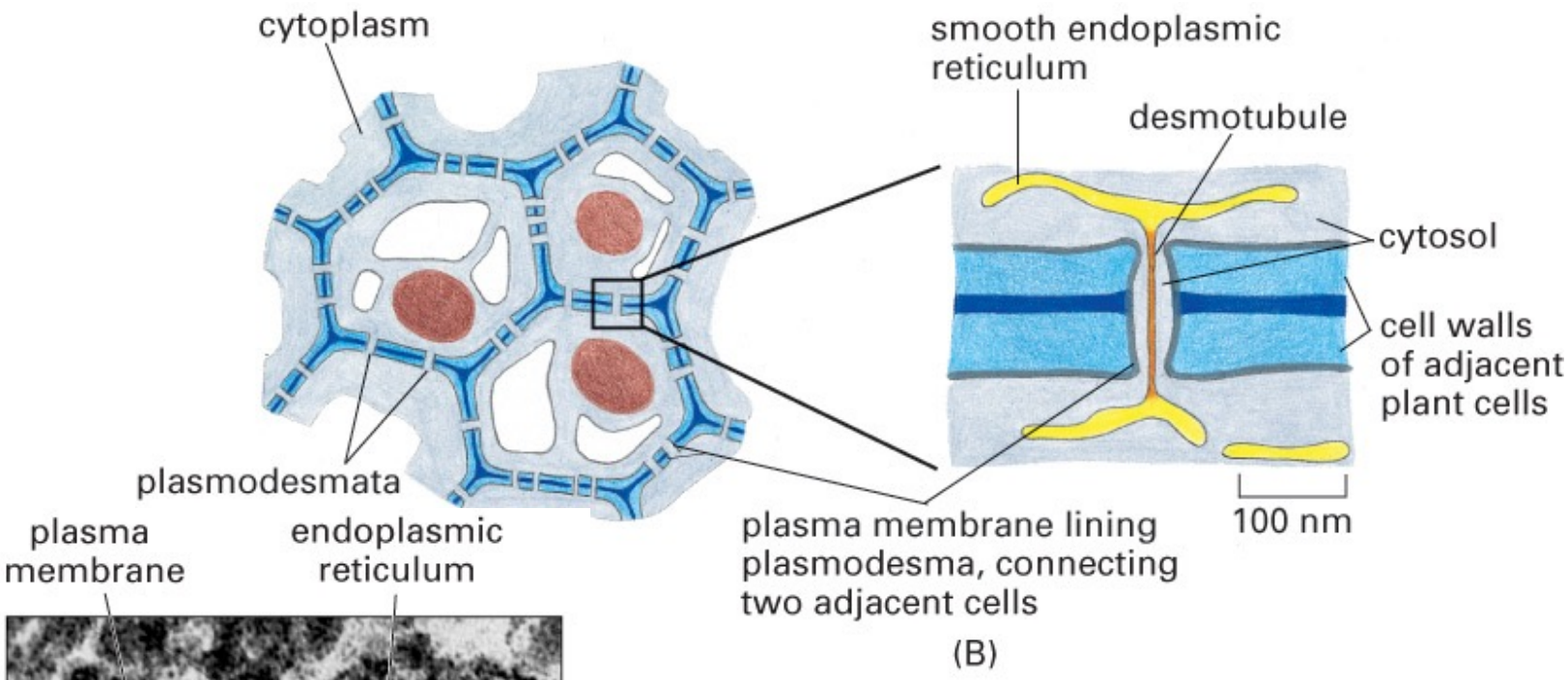
(B)

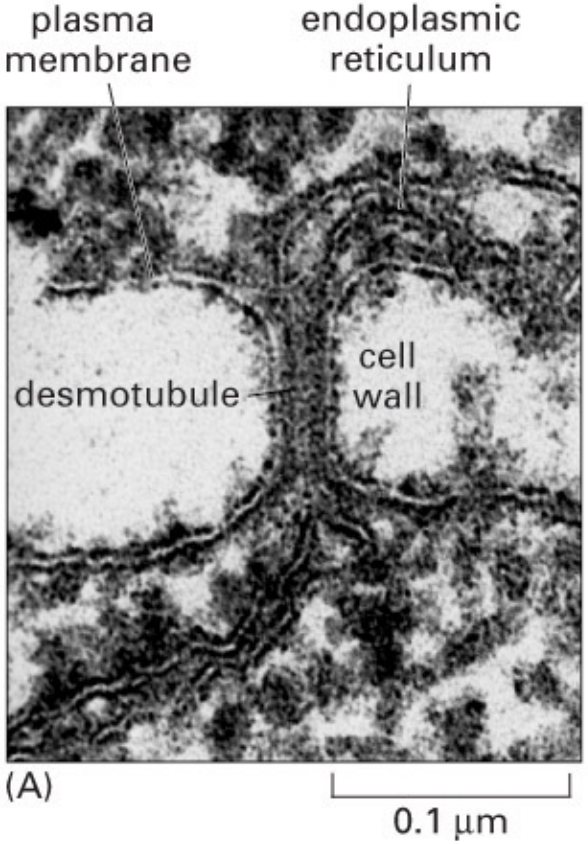

large
gap
junction
membranes
small
gap
junction
(A)
100 nm
(B)
100 nm



(A) (B)

# Plasmodesmos



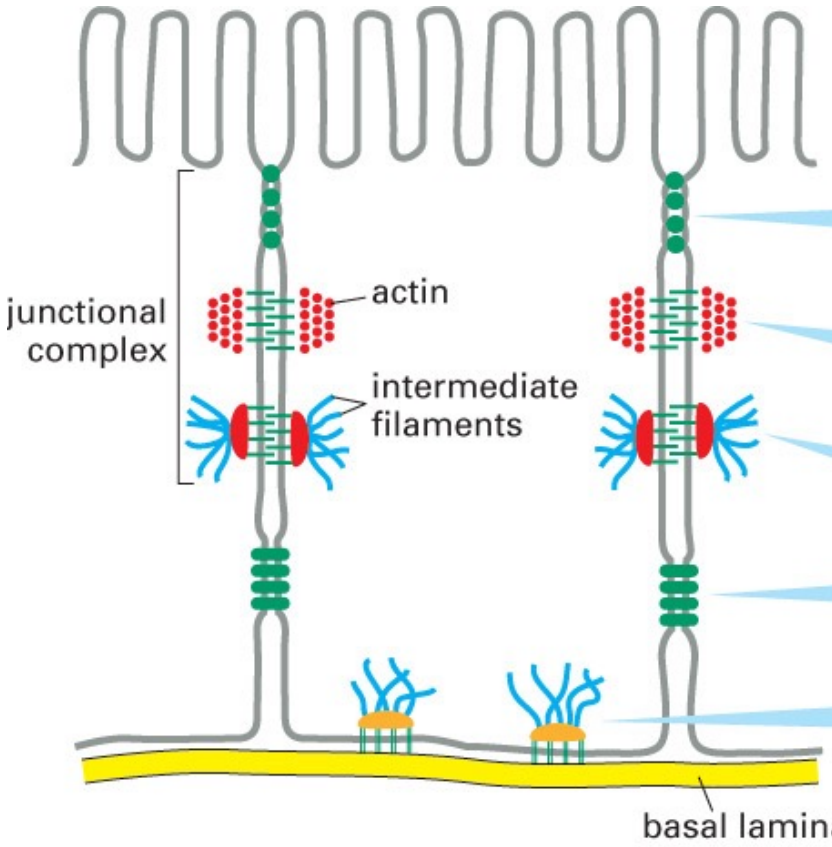



Lo que vamos a ver....

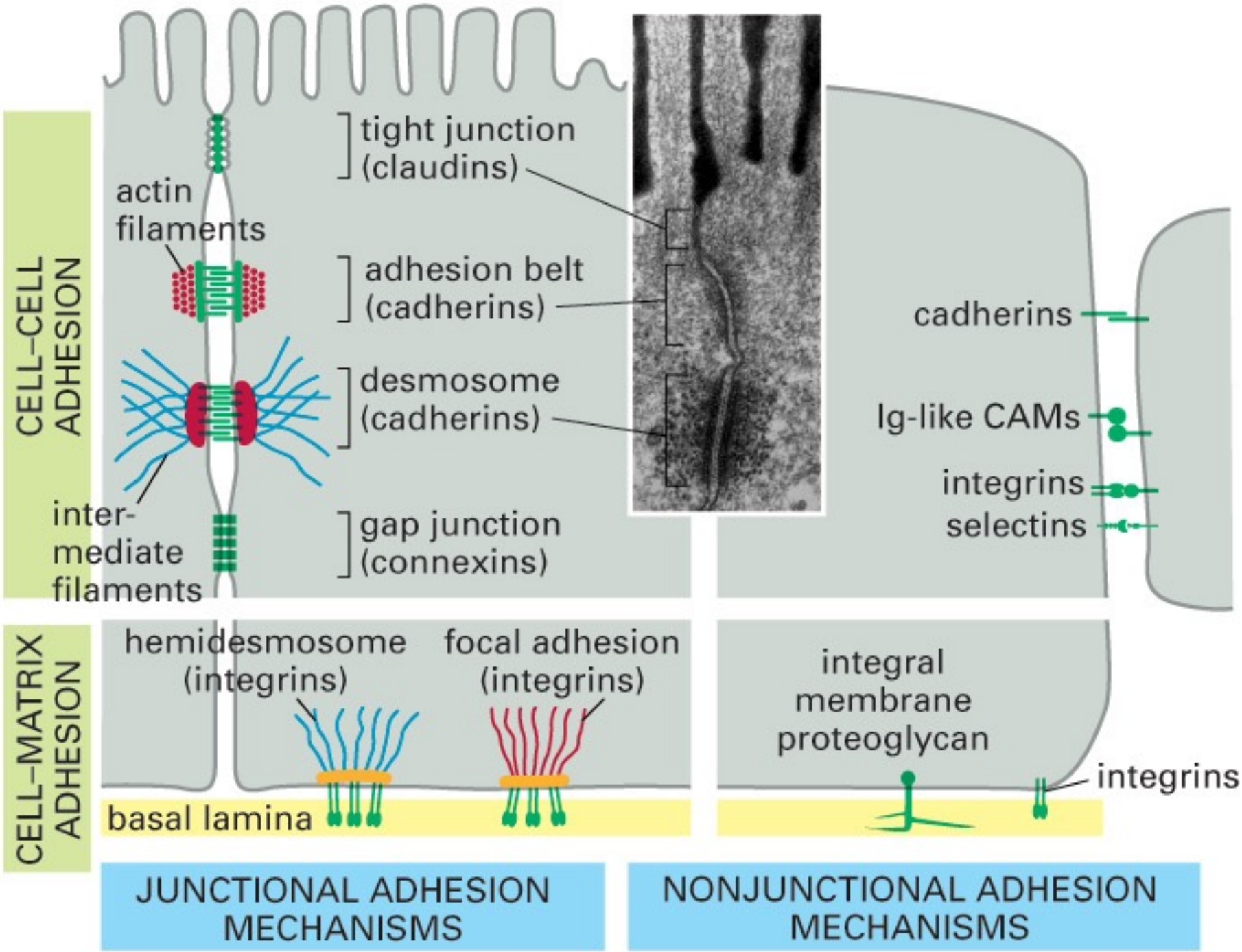
1.- Matrix extracelular animal y vegetal

2.- Uniones celulares

3.- Resúmen




| name | function |
|---|---|
| tight junction | seals neighboring cells together in an epithelial sheet to prevent leakage of molecules between them |
| adherens junction | joins an actin bundle in one cell to a similar bundle in a neighboring cell |
| desmosome | joins the intermediate filaments in one cell to those in a neighbor |
| gap junction | allows the passage of small water-soluble ions and molecules |
| hemidesmosome | anchors intermediate filaments in a cell to the basal lamina |


CELL–CELL ADHESION
actin filaments
tight junction (claudins)
adhesion belt (cadherins)
desmosome (cadherins)
inter-mediate filaments
gap junction (connexins)
cadherins
Ig-like CAMs
integrins
selectins
CELL–MATRIX ADHESION
hemidesmosome (integrins)
focal adhesion (integrins)
basal lamina
integral membrane proteoglycan
integrins
JUNCTIONAL ADHESION MECHANISMS
NONJUNCTIONAL ADHESION MECHANISMS

**Bibliografía Clase**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**- Essential Cell Biology (Bruce Alberts), 3nd Edition (2010)**