Biological Frameworks for Engineers

ME 411 / ME 511

Biological Frameworks for Engineers

UNIVERSITY OF WASHINGTON

Class Organization

- Hw 4 due Friday
- Lab 3 – Muscle Lab
  - Next Friday (11/14)
  - MEB 127
  - 1:30, 2:30, 3:30 sign-up

Class Organization

- *Tiny Workhorse Projects*

Motor Protein	Grad Student
Helicase	Kevin & Ye
Actin-Myosin	Nathan & Kateri
Clathrin	Scott & Spencer & Kevin
B. Flagella	Brian & Wai
Kinesin-5	Jarrod & Mark
Dynein	Tadbhagya & Amit
?	Tzu-Lin & Jiayang

"Git along little doggies!"

Biological Frameworks for Engineers ME411/511

ME 411 / ME 511

Cell-Cell and Cell-Matrix Interactions

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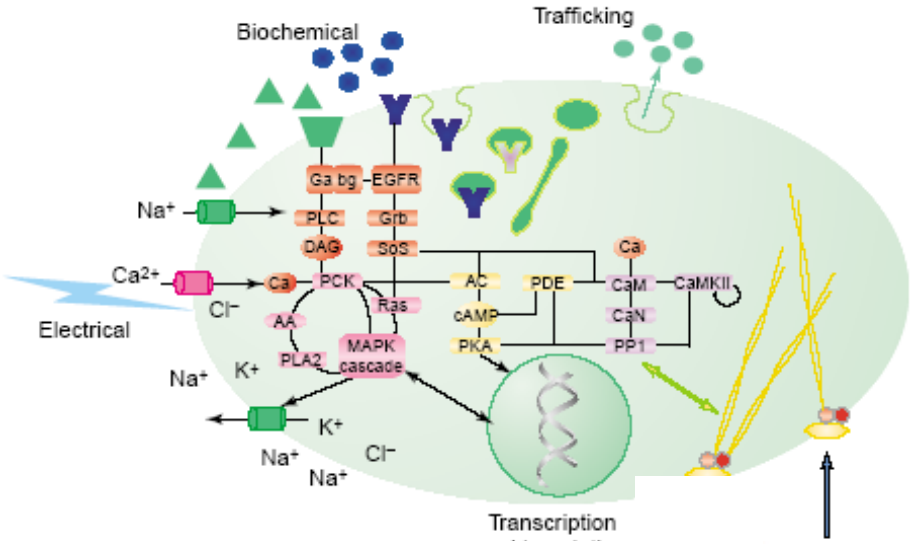
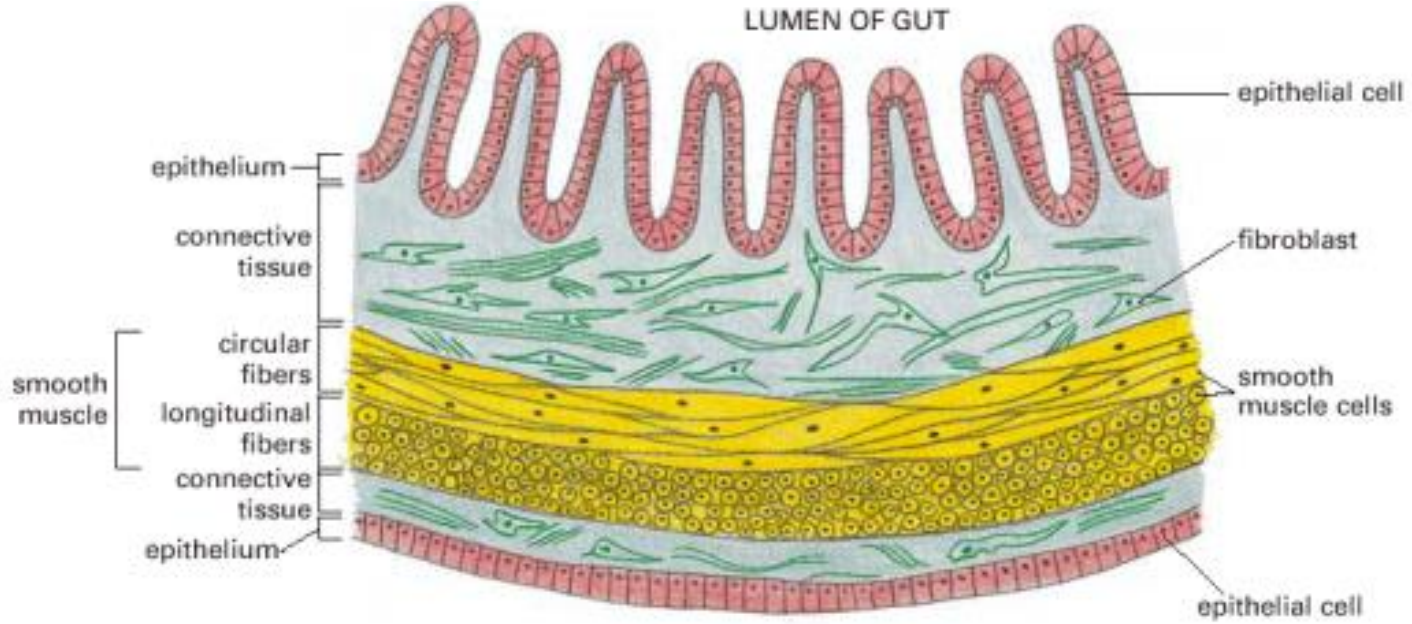
No Cell is an Island





Cell Interactions

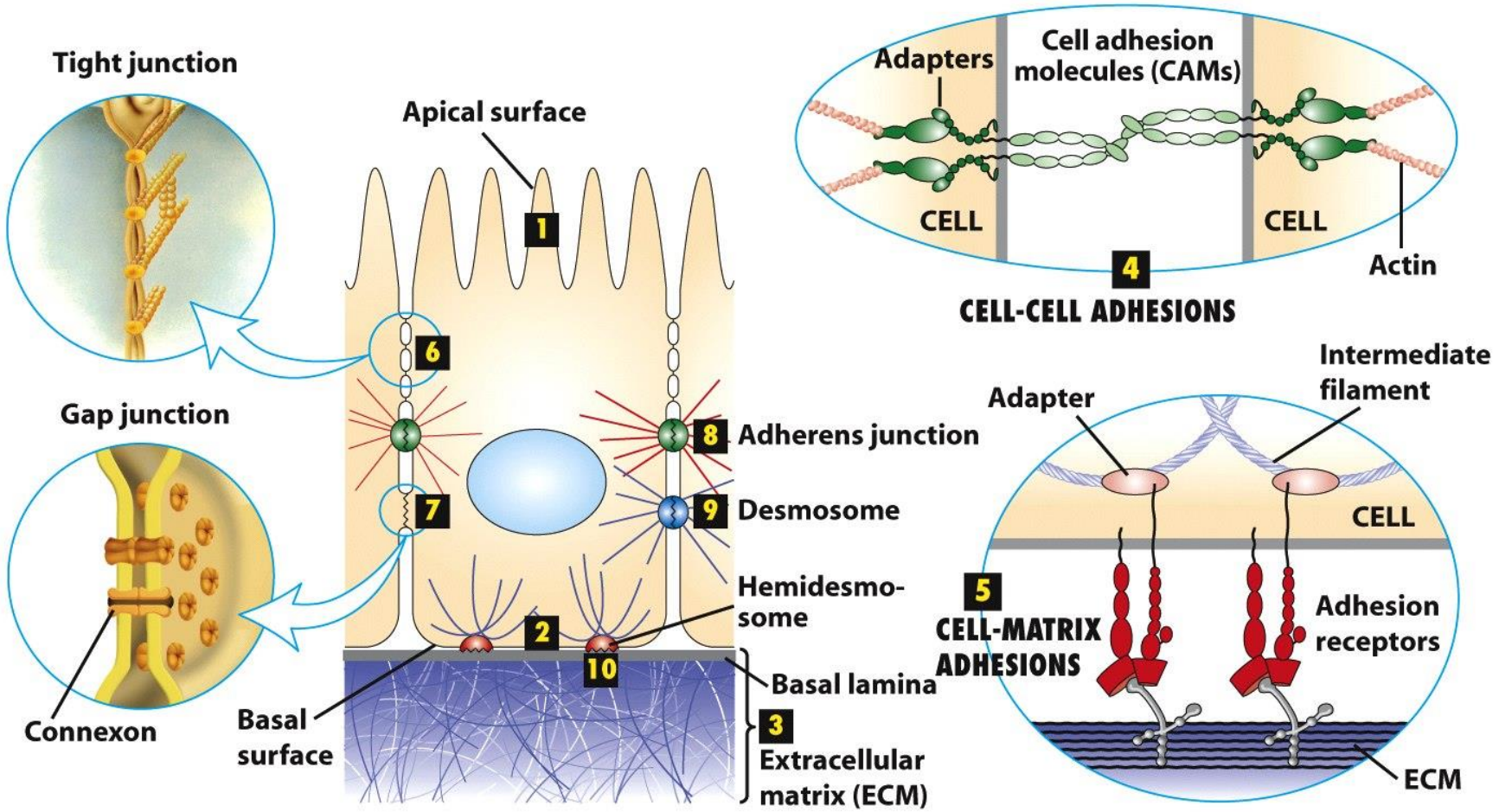
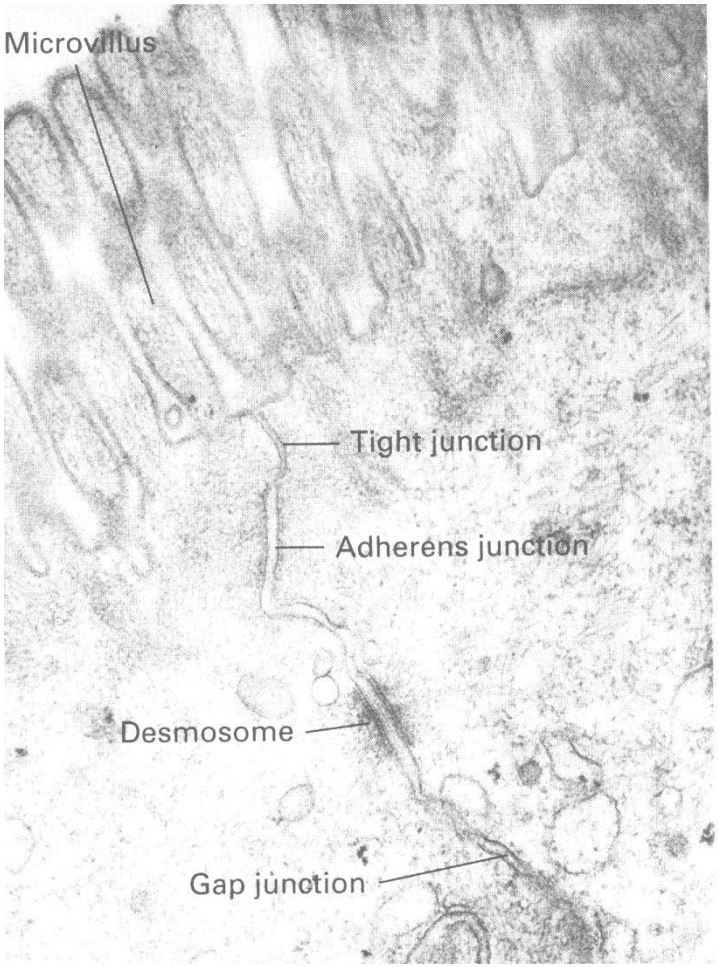
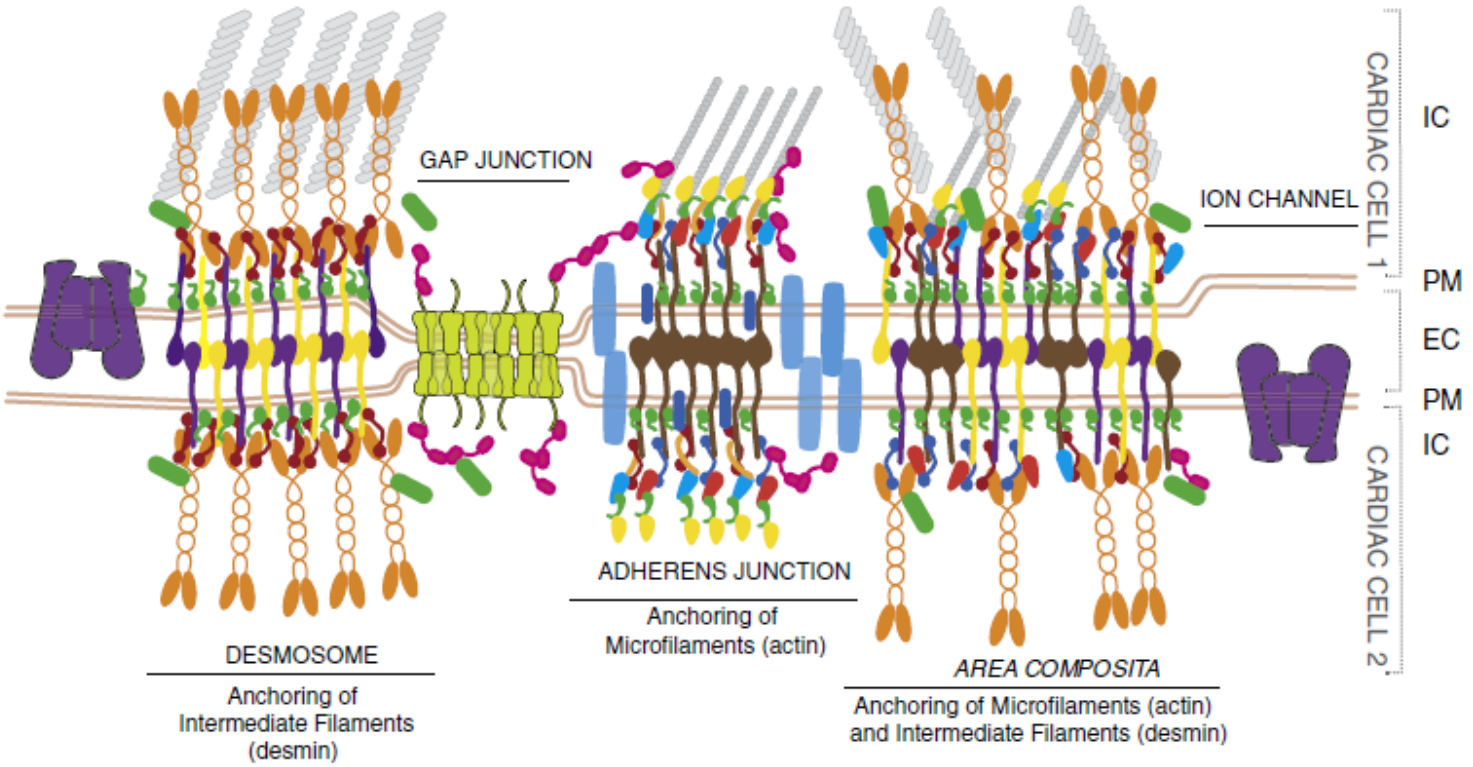


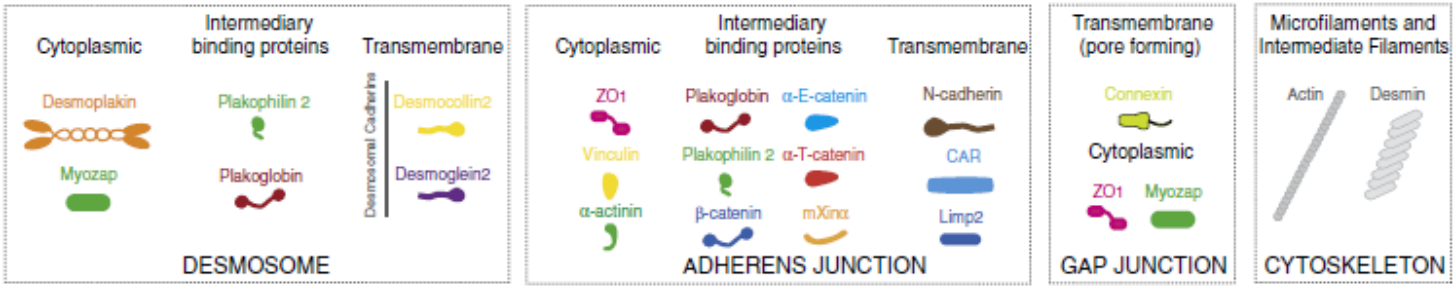
Figure 19-1
Molecular Cell Biology, Sixth Edition

Cell-to-Cell


Microvillus
Tight junction
Adherens junction
Desmosome
Gap junction

Cell-to-Cell


GAP JUNCTION
ION CHANNEL
CARDIAC CELL 1
IC
PM
EC
PM
IC
CARDIAC CELL 2
ADHERENS JUNCTION
Anchoring of Microfilaments (actin)
DESMOSOME
Anchoring of Intermediate Filaments (desmin)
AREA COMPOSITA
Anchoring of Microfilaments (actin) and Intermediate Filaments (desmin)


Cytoplasmic
Intermediary binding proteins
Transmembrane
Desmoplakin
Plakophilin 2
Desmocollin2
Desmosomal Cadherins
Myozap
Plakoglobin
Desmoglein2
DESMOSOME
Cytoplasmic
Intermediary binding proteins
Transmembrane
ZO1
Plakoglobin
α-E-catenin
N-cadherin
Vinculin
Plakophilin 2
α-T-catenin
CAR
α-actinin
β-catenin
mXinα
Limp2
ADHERENS JUNCTION
Transmembrane (pore forming)
Connexin
Cytoplasmic
ZO1
Myozap
GAP JUNCTION
Microfilaments and Intermediate Filaments
Actin
Desmin
CYTOSKELETON

Tight Junctions

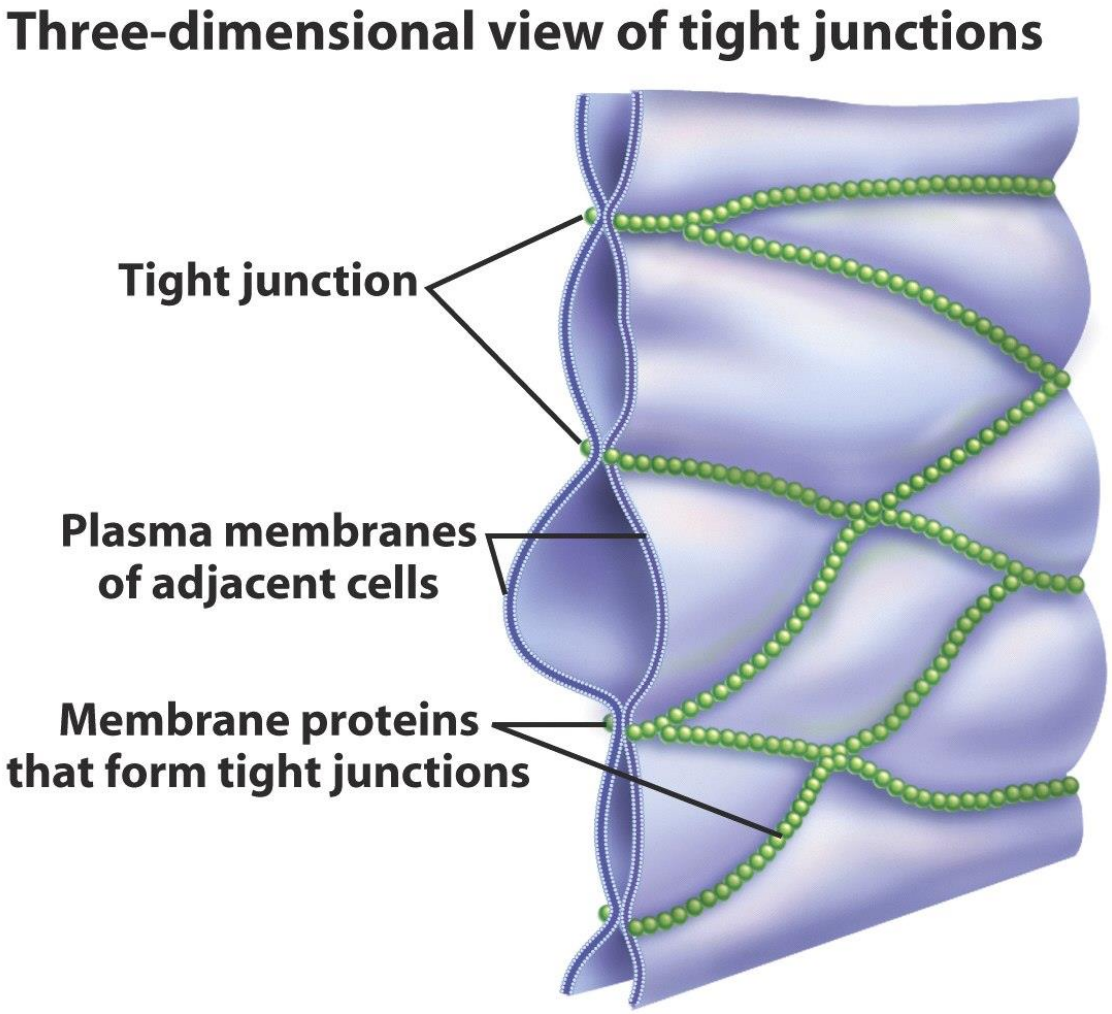
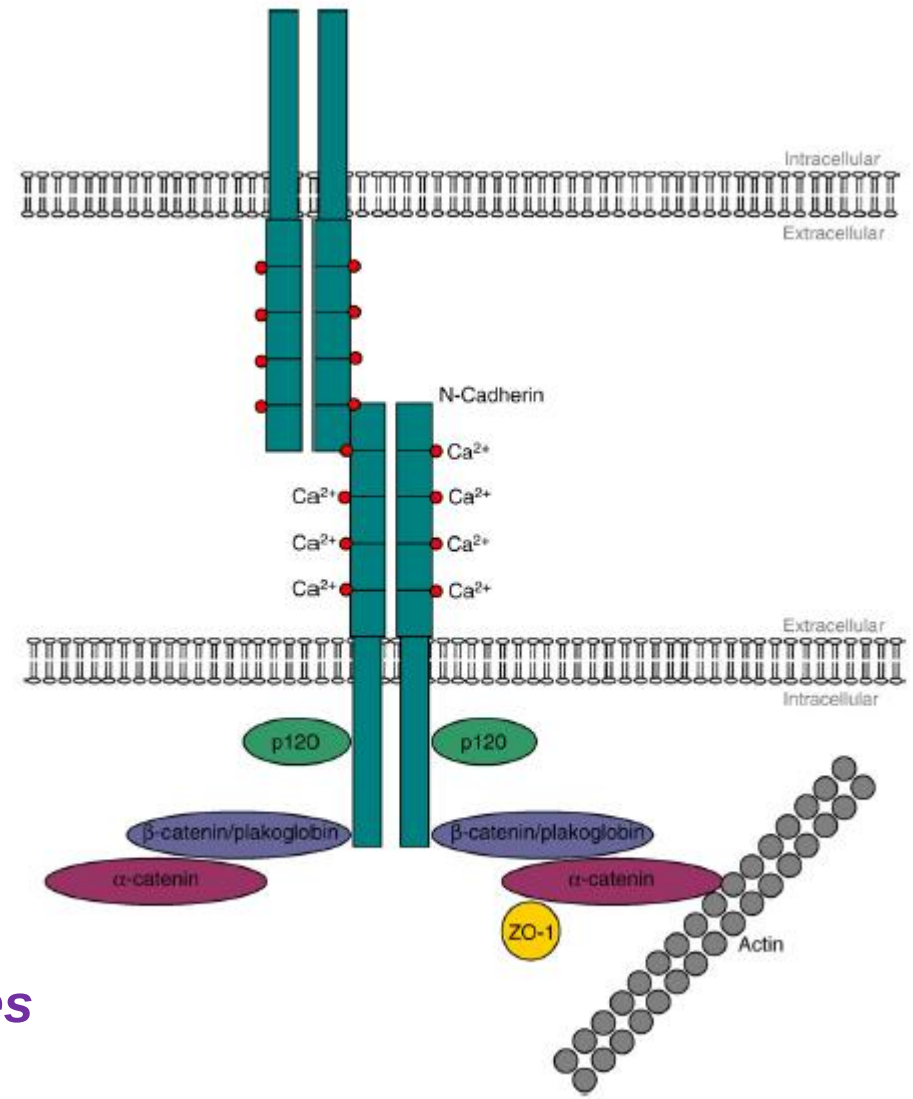


Figure 8-9b Biological Science, 2/e

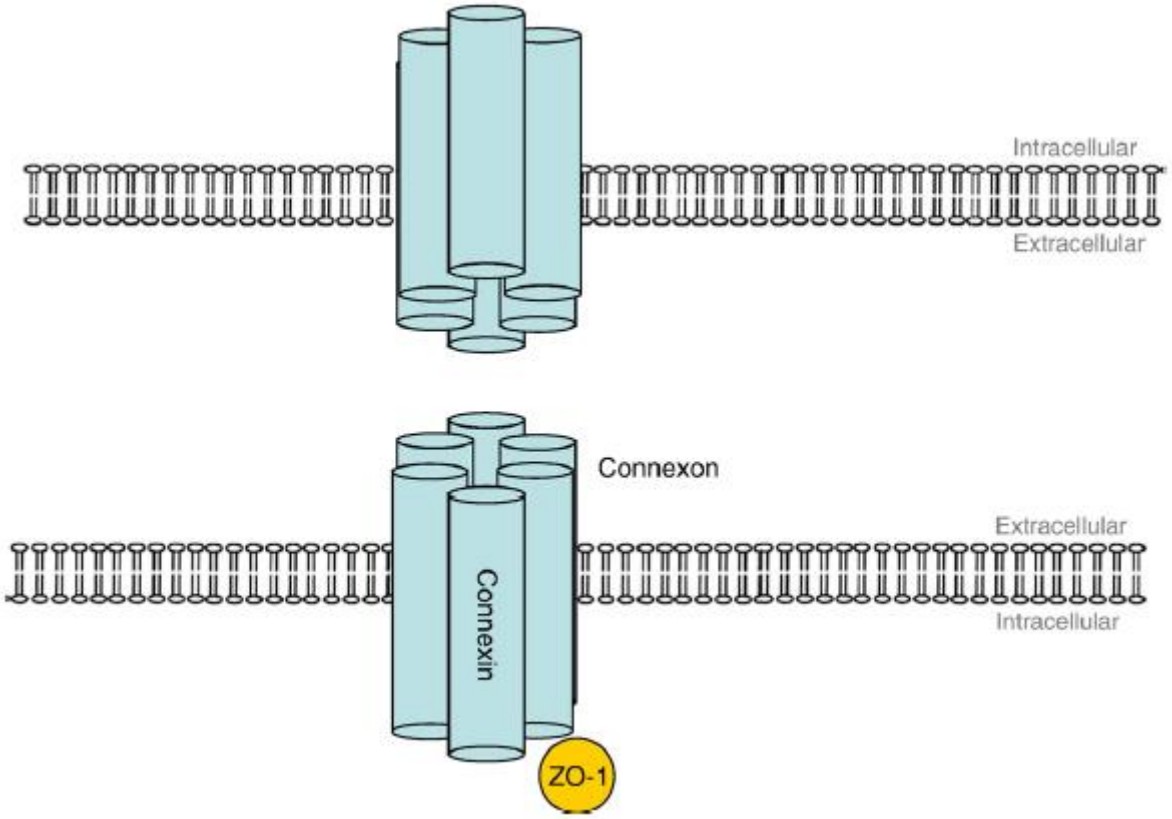
Prevent cell leakage

Adherens Junctions



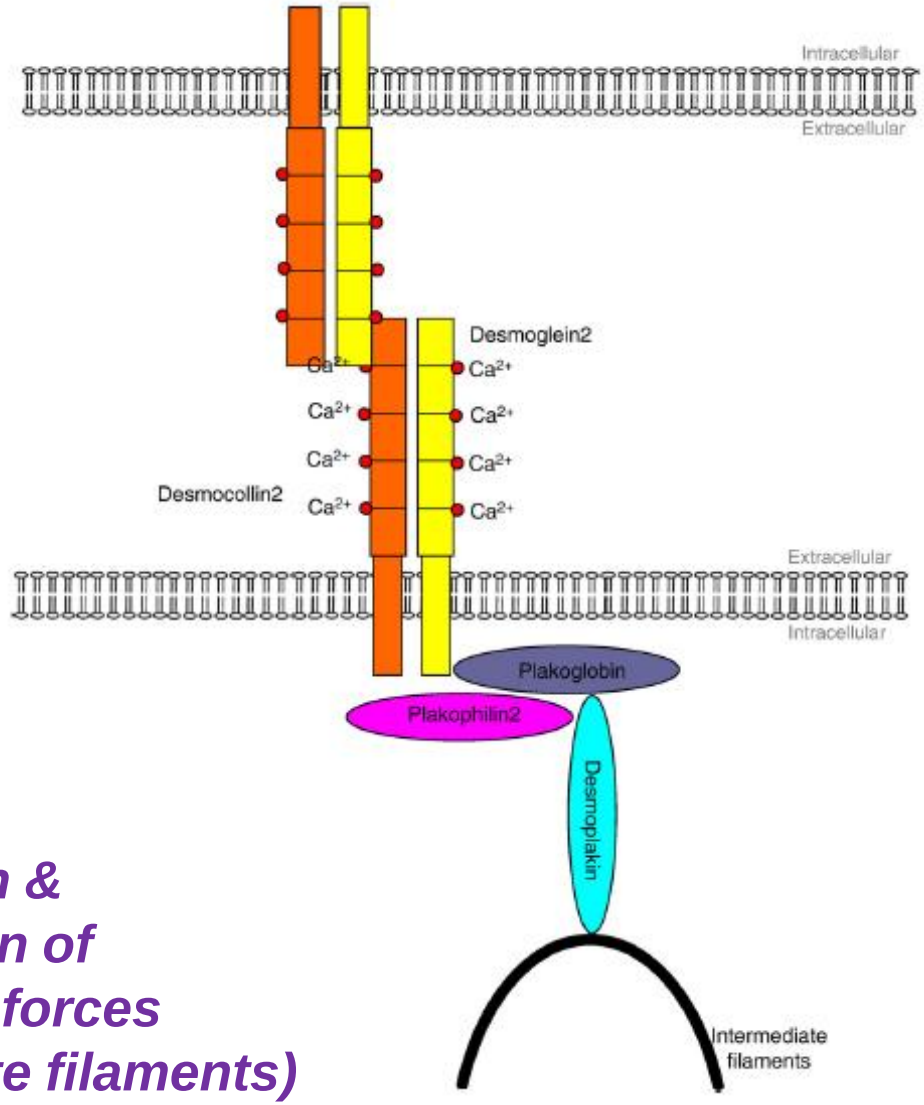
Stabilization & transmission of mechanical forces (actin)

Gap Junctions



Transmission of ions and molecules

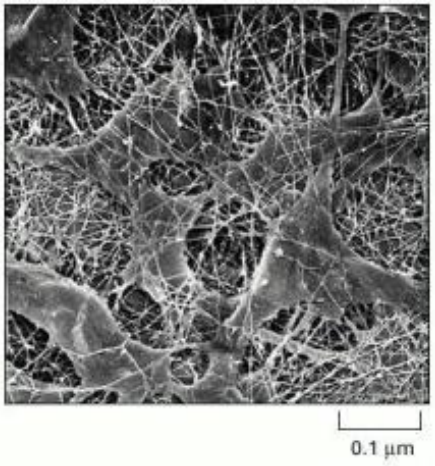
Desmosomes

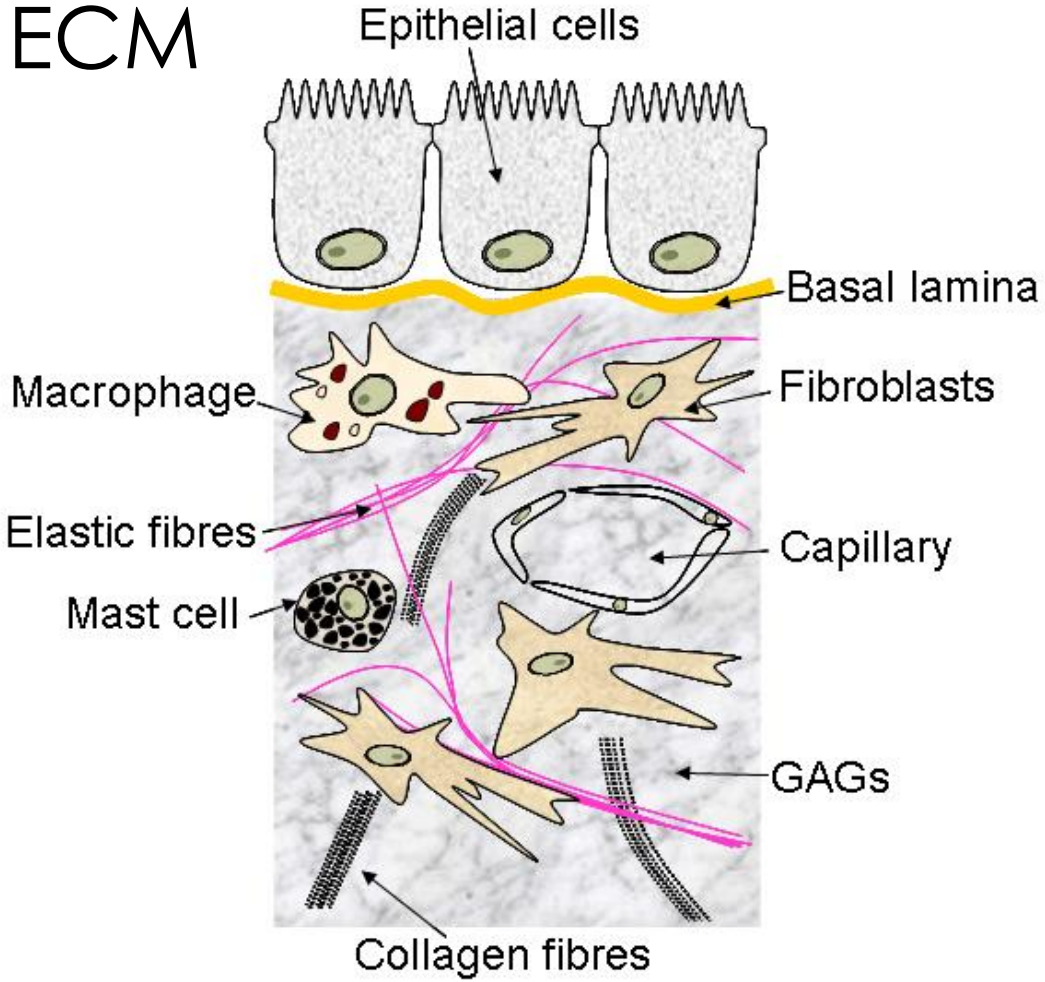


Stabilization & transmission of mechanical forces (intermediate filaments)

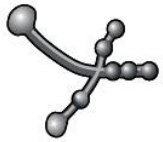
Cell-to-ECM

- Tissue = cells + ECM



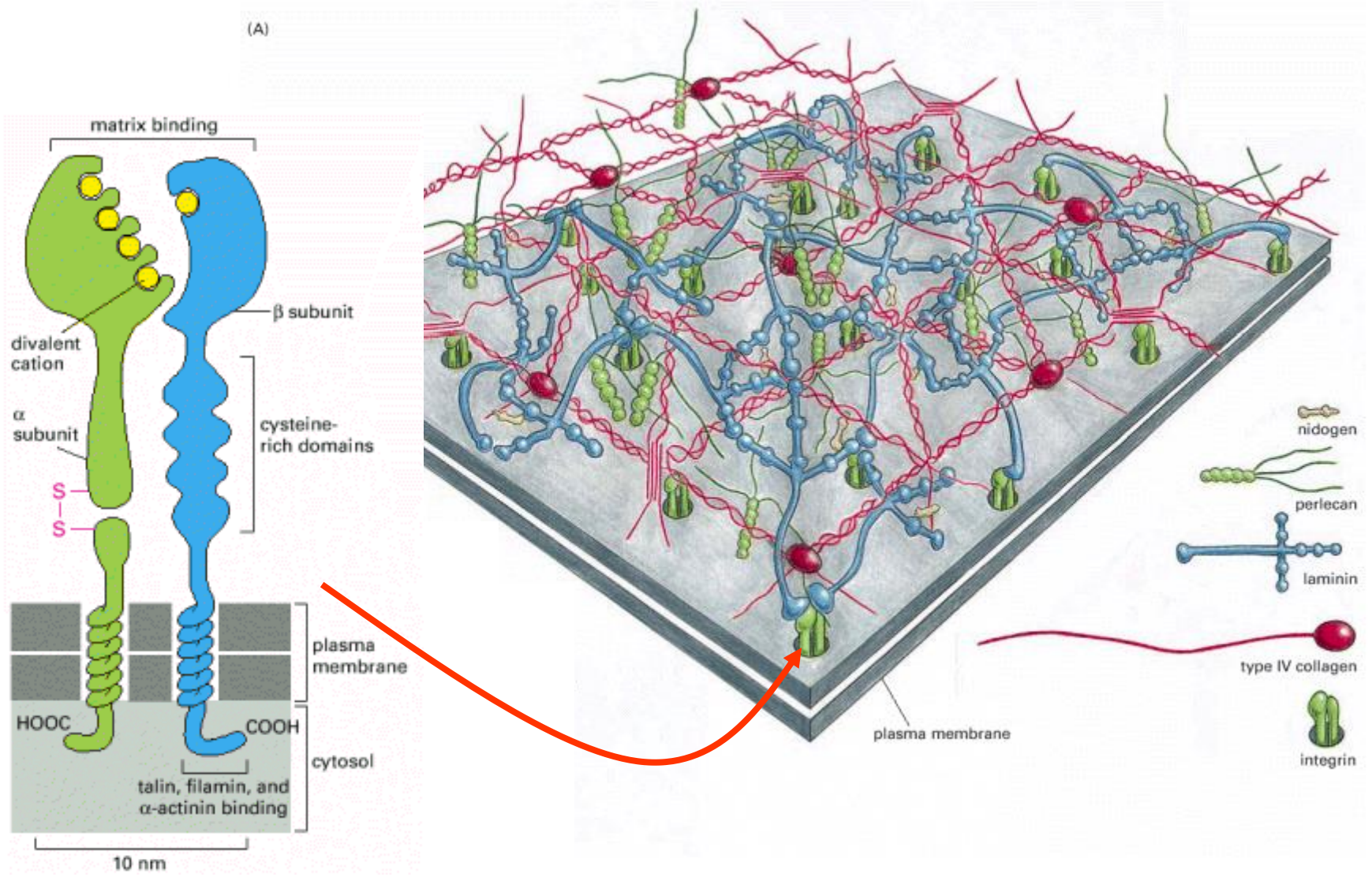


Extracellular Matrix

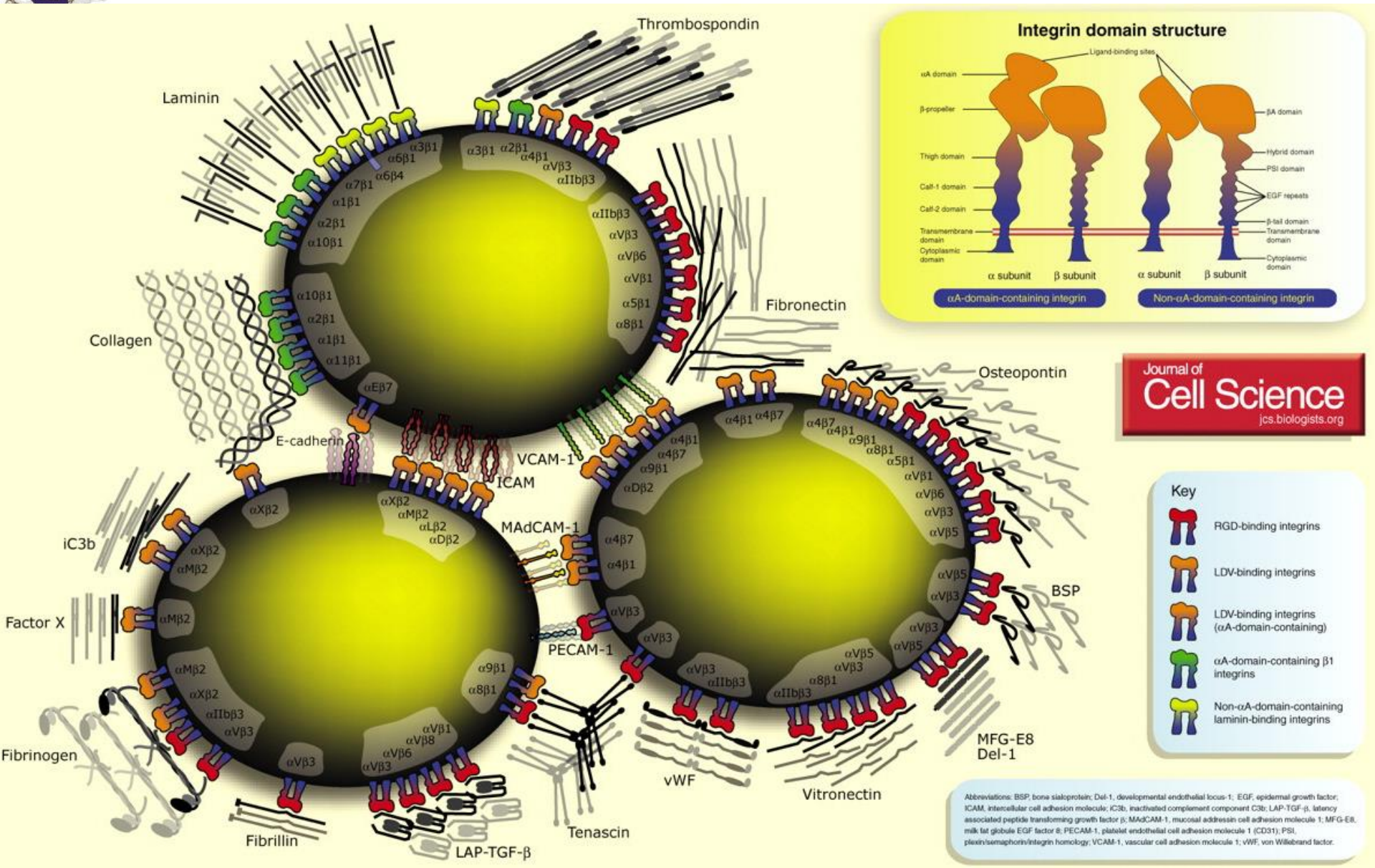
Collagens	**Sheet forming (e.g., type IV)**		
	Fibular collagens (e.g., types I, II, and III)		
Multiadhesive matrix proteins	**Laminin**	2D	
	Fibronectin	3D	

Collagen I bONE - main component of bone
Collagen II carTWOlage - main component of cartilage
Collagen III streTcHREE- flexible tissues (skin, lung, vascular)
Collagen IV FLOUR - forms the basement membrane

Integrins

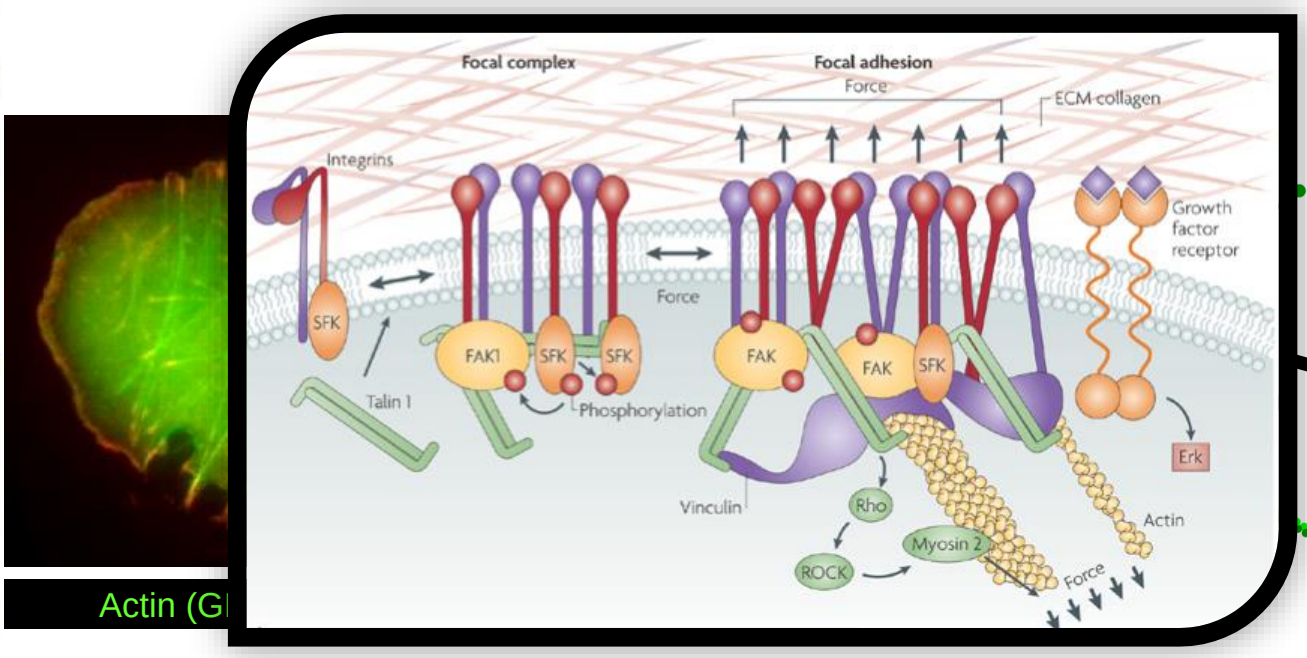

(A)
matrix binding
β subunit
divalent cation
α subunit
cysteine-rich domains
S
S
plasma membrane
HOOC
COOH
cytosol
talin, filamin, and α-actinin binding
10 nm
nidogen
perlecan
laminin
type IV collagen
integrin
plasma membrane

Integrin-ECM Binding



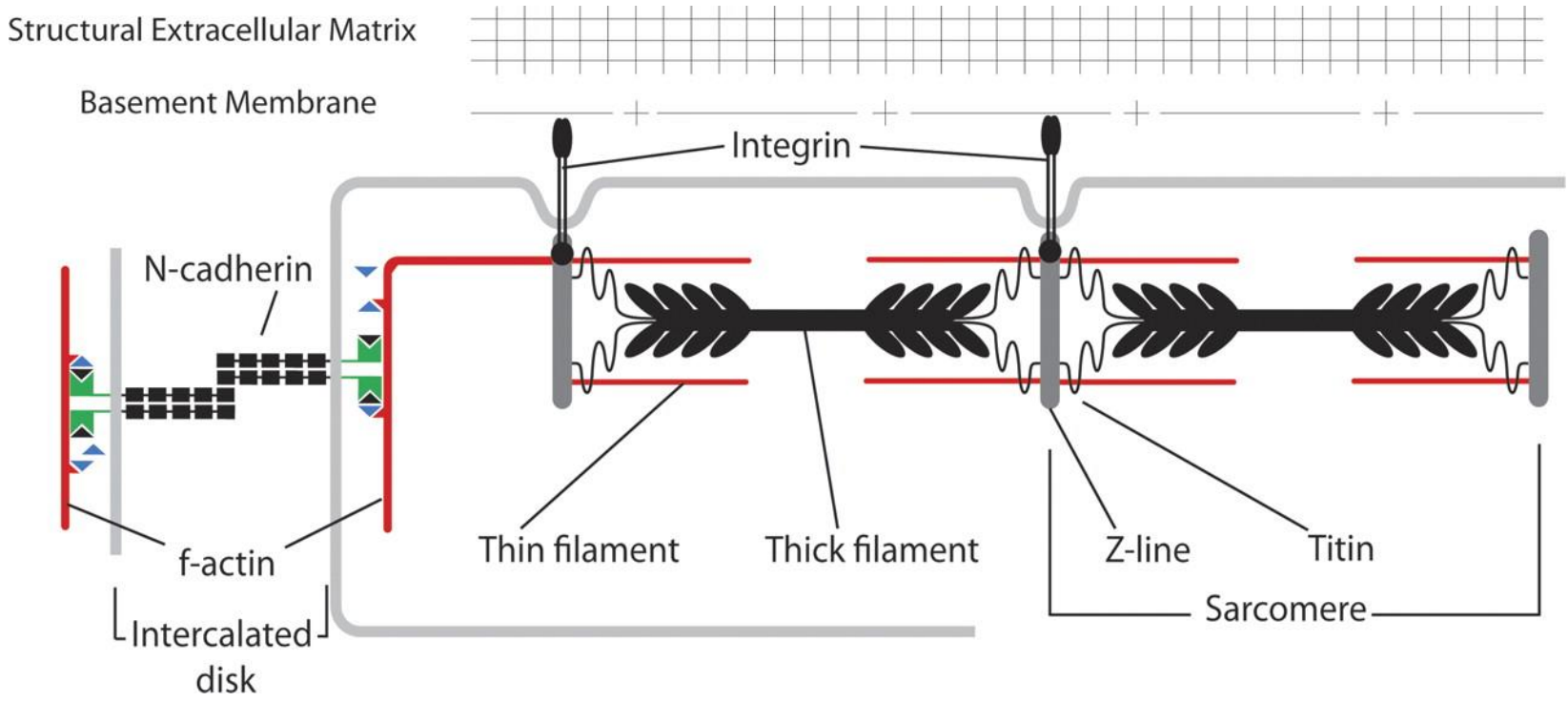
Focal Adhesions

- Mechanosensory protein complexes at the cell-ECM interface



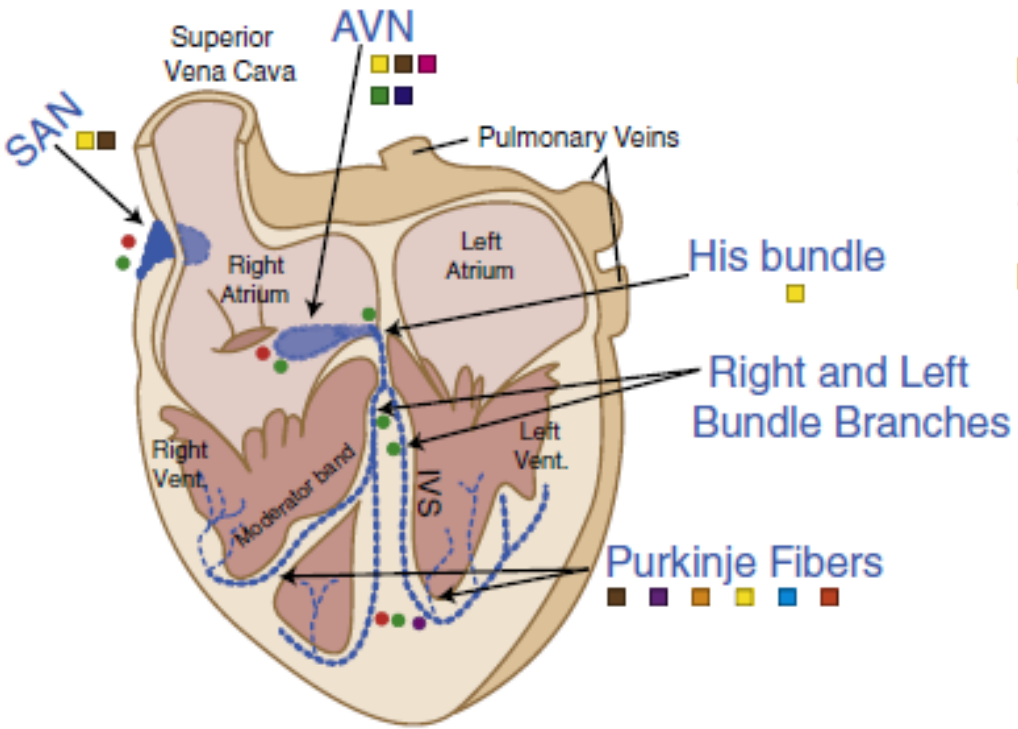
Cell-Cell & Cell-ECM

- Cell-cell and cell-ECM contacts are not independent of one another



Cell Contacts & Disease

- Faulty cell-cell or cell-ECM communication can result in disease



Intercellular Junction Structures

- Desmosomes (Shimada, T. *et al.*, Pieperhoff, S. *et al.*, 2010)
- Gap Junctions (Shimada, T. *et al.* 2004, Severs, NJ. *et al.*, 2008)
- *Area composita* (Pieperhoff, S. *et al.*, 2010)

Intercellular Junction Proteins

- Desmoplakin (Yoo, S *et al.* 2006, Pieperhoff, S. *et al.*, 2010, Dobrzynski, H *et al.* 2000)
- Plakophilin-2 (Pieperhoff, S.*et al.*, 2010)
- β-Catenin (Pieperhoff, S.*et al.*, 2010)
- Plakoglobin (Lim, BK. *et al.*, 2008)
- Desmoglein-2 (Pieperhoff, S.*et al.*, 2010)
- N-Cadherin (Pieperhoff, S.*et al.*, 2010)
- CAR (Lim, BK. *et al.*, 2008)
- ZO-1 (Lim, BK. *et al.*, 2008)
- Vinculin (Vohra, MS. *et al.*, 1998)

Questions?