

Cells to Tissues

What we'll talk about...

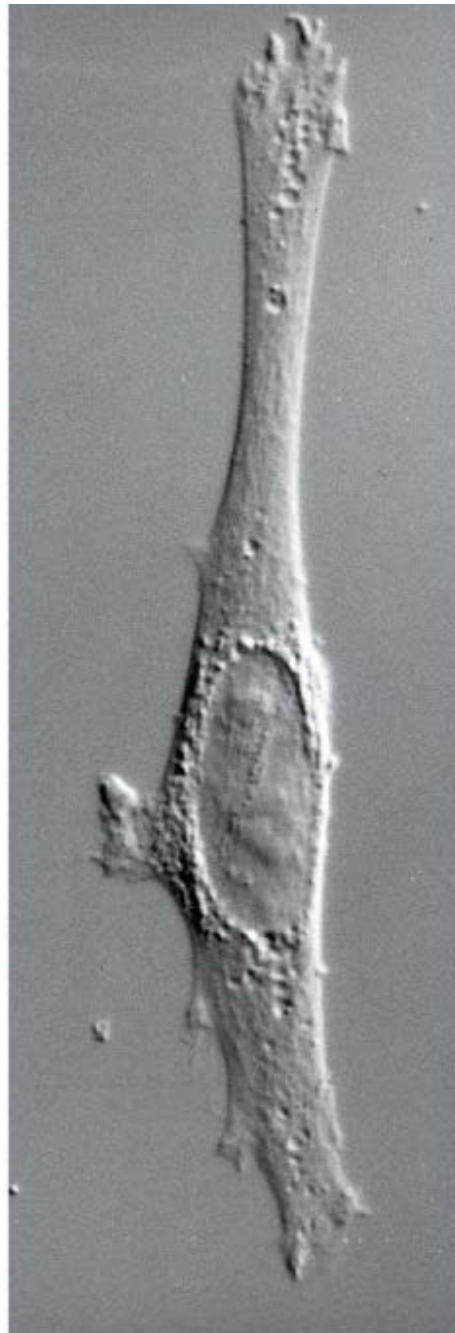
- Types and properties of tissues
- Cell to cell adhesion
- Cell to ECM adhesion
- Communication

Organs are composed of four major tissue types.

- Epithelia
- Muscle
- Nervous
- Connective

From one cell to ensembles of cells.

Single cell



Multiple cells

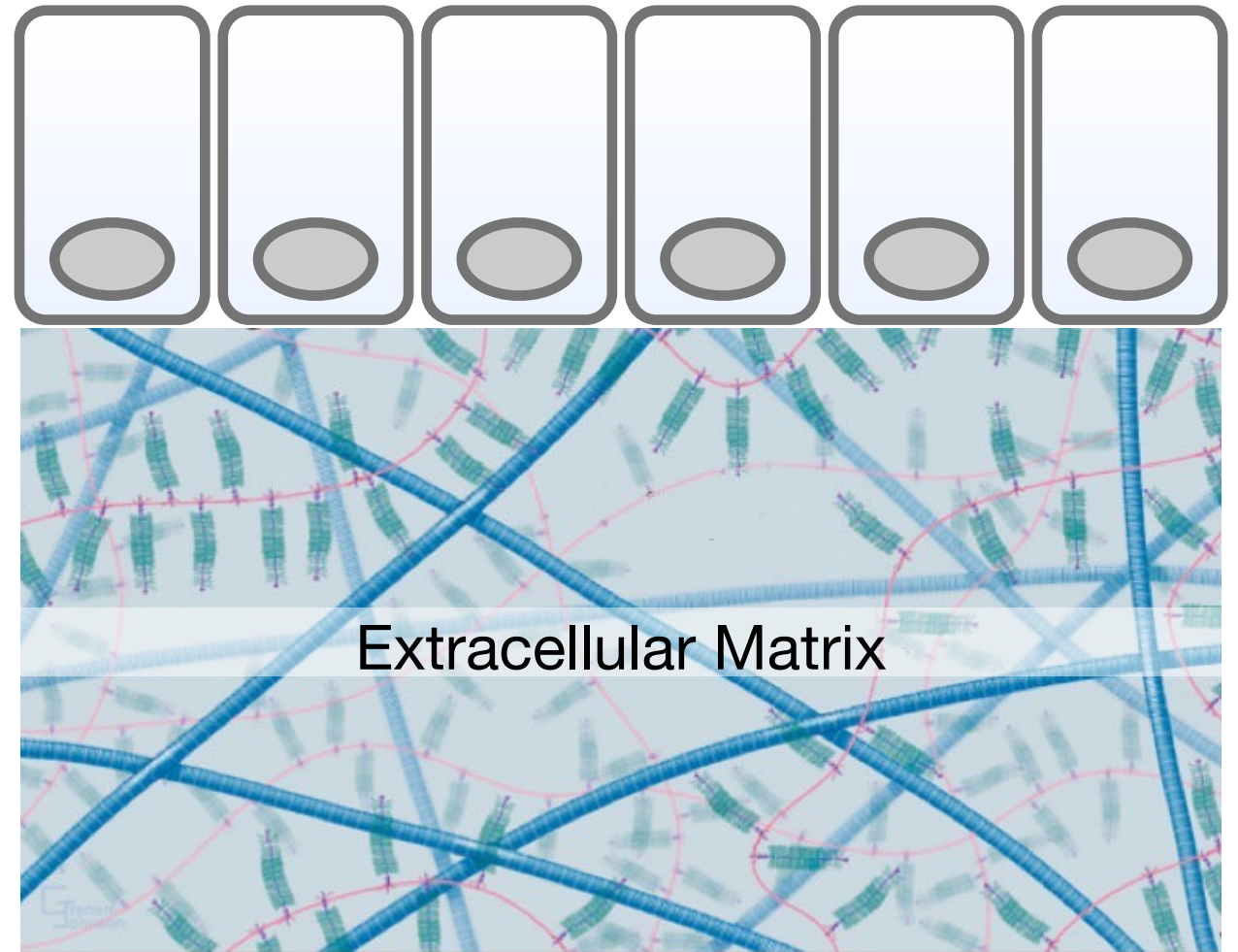
How do they stay together?

How do they work together?



Tissues have four essential properties.

- Adhesion
- Communication
- Identity
- Renewal

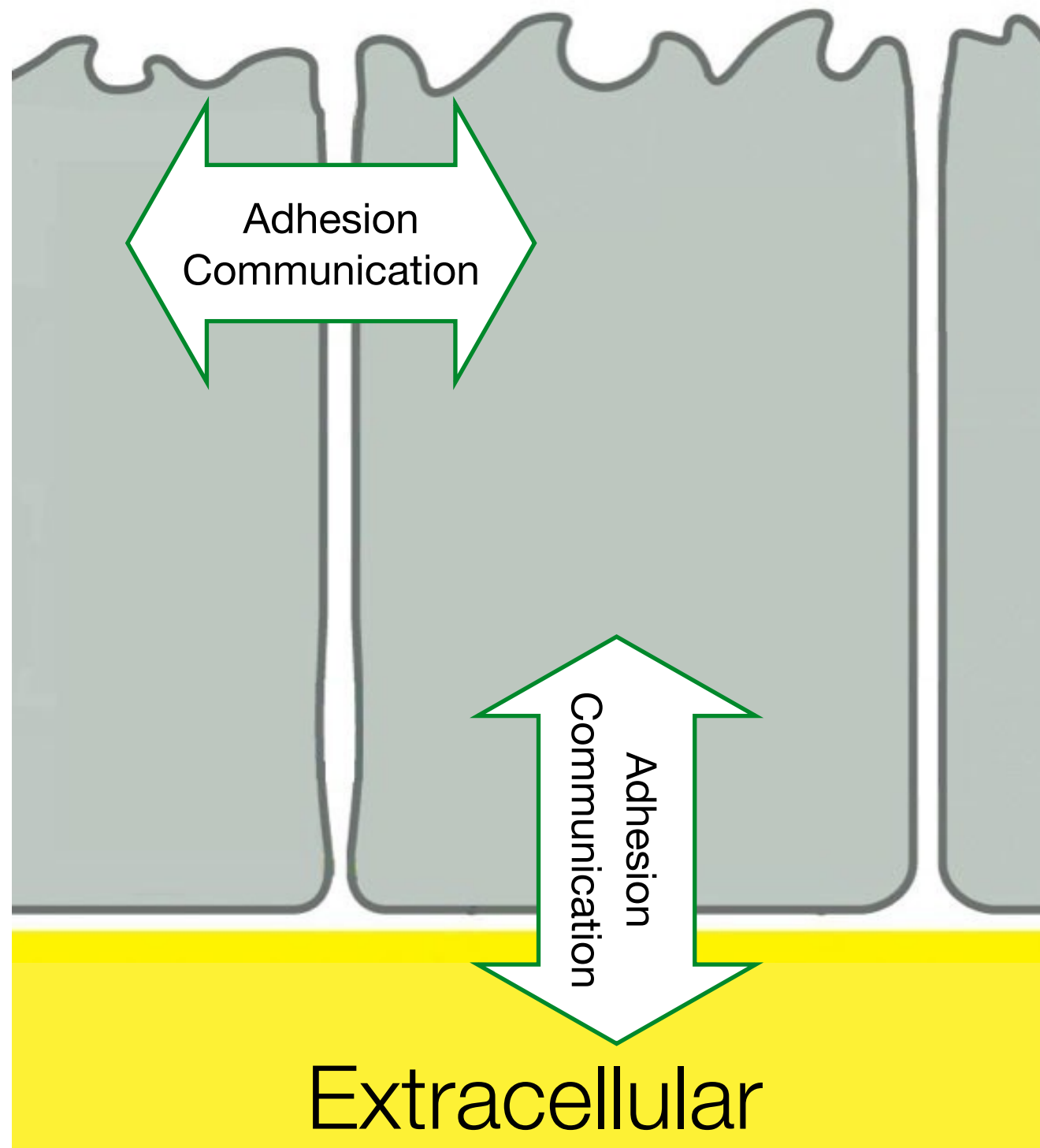


Tissues have four essential properties.

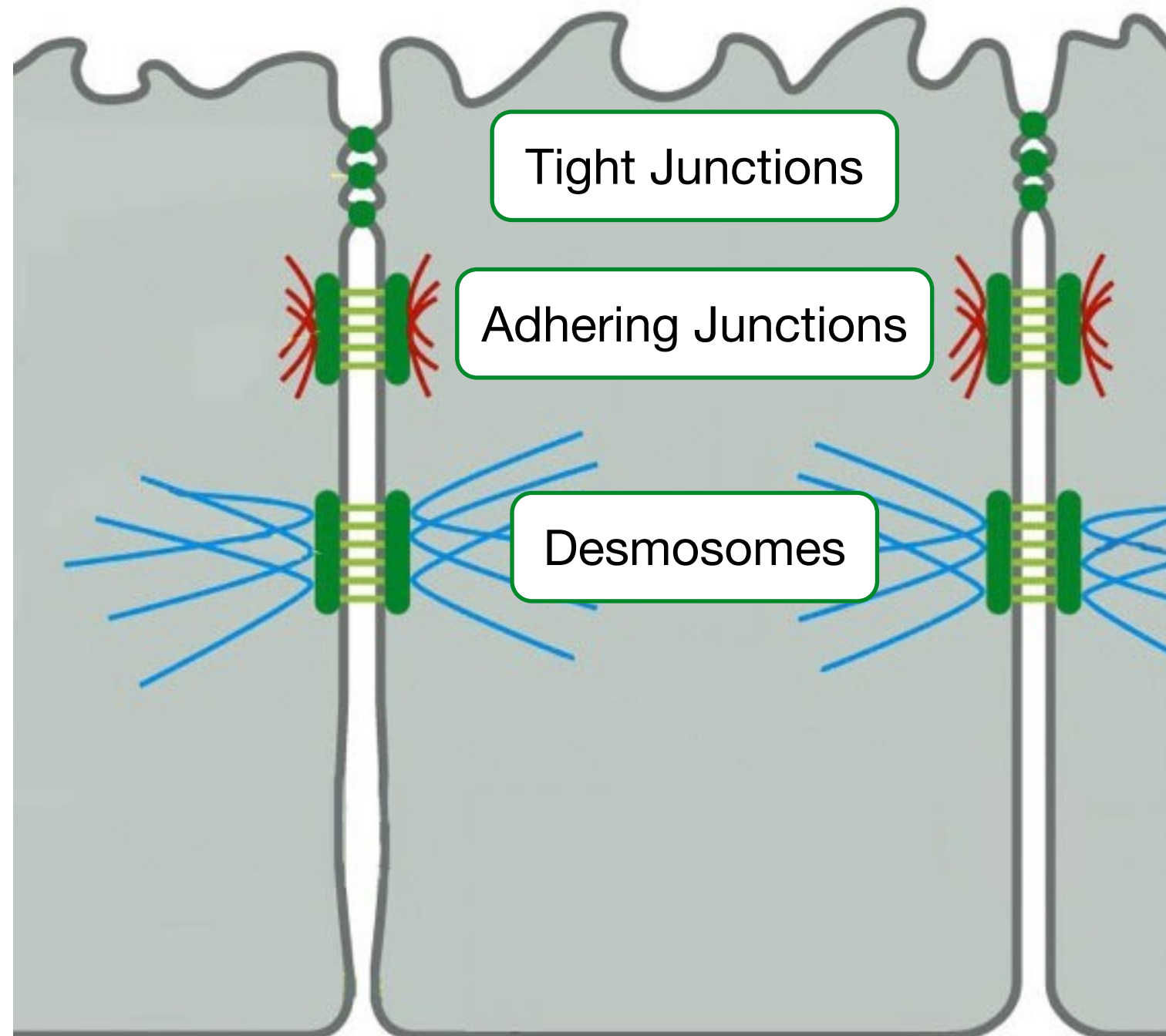
- Adhesion
- Communication
- Identity
- Renewal

Adhesion in Tissues

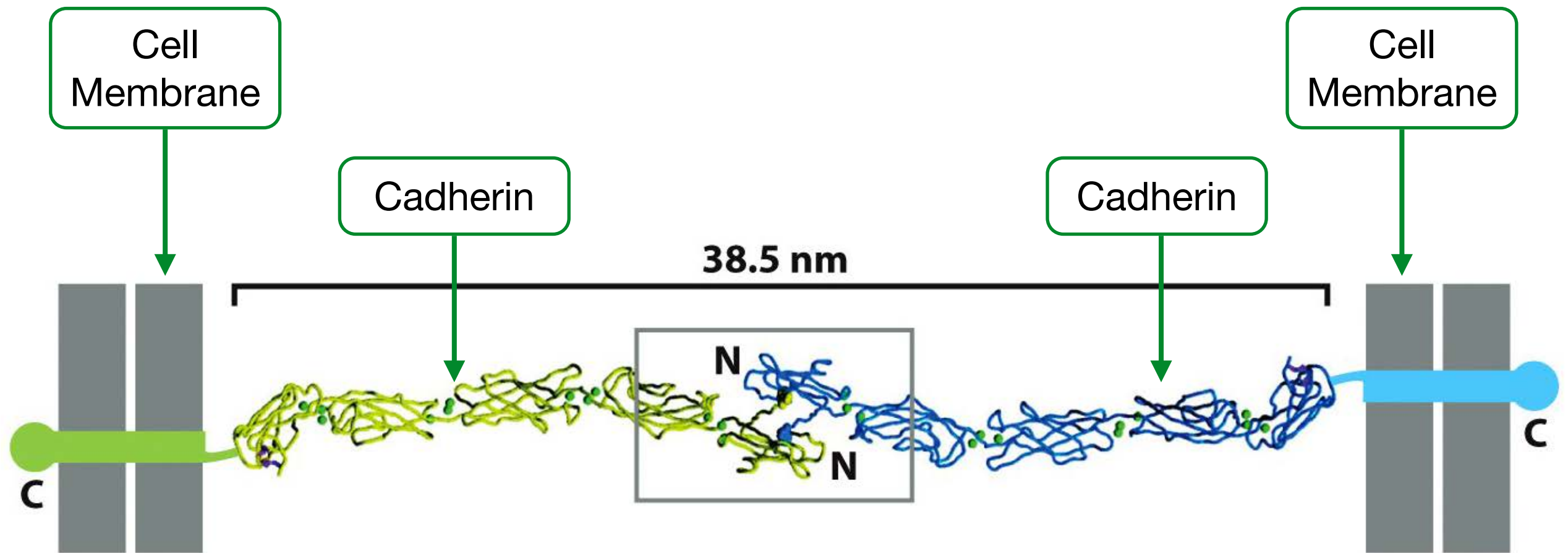
Adhesion and communication are critical for the integrity and function of tissues.



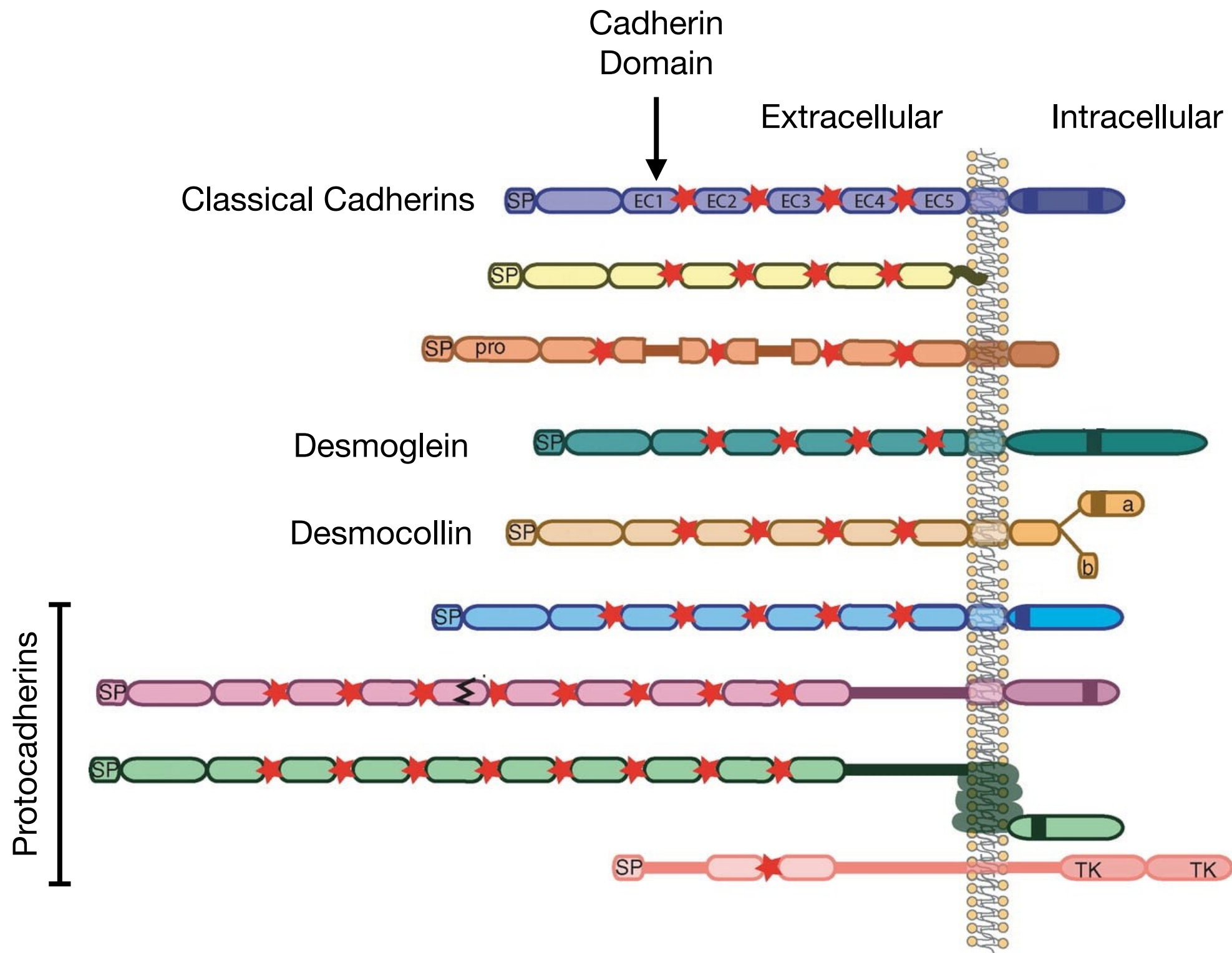
Three complexes generate intercellular adhesion



Cadherins in adjacent cells interact via their N-terminal domains.



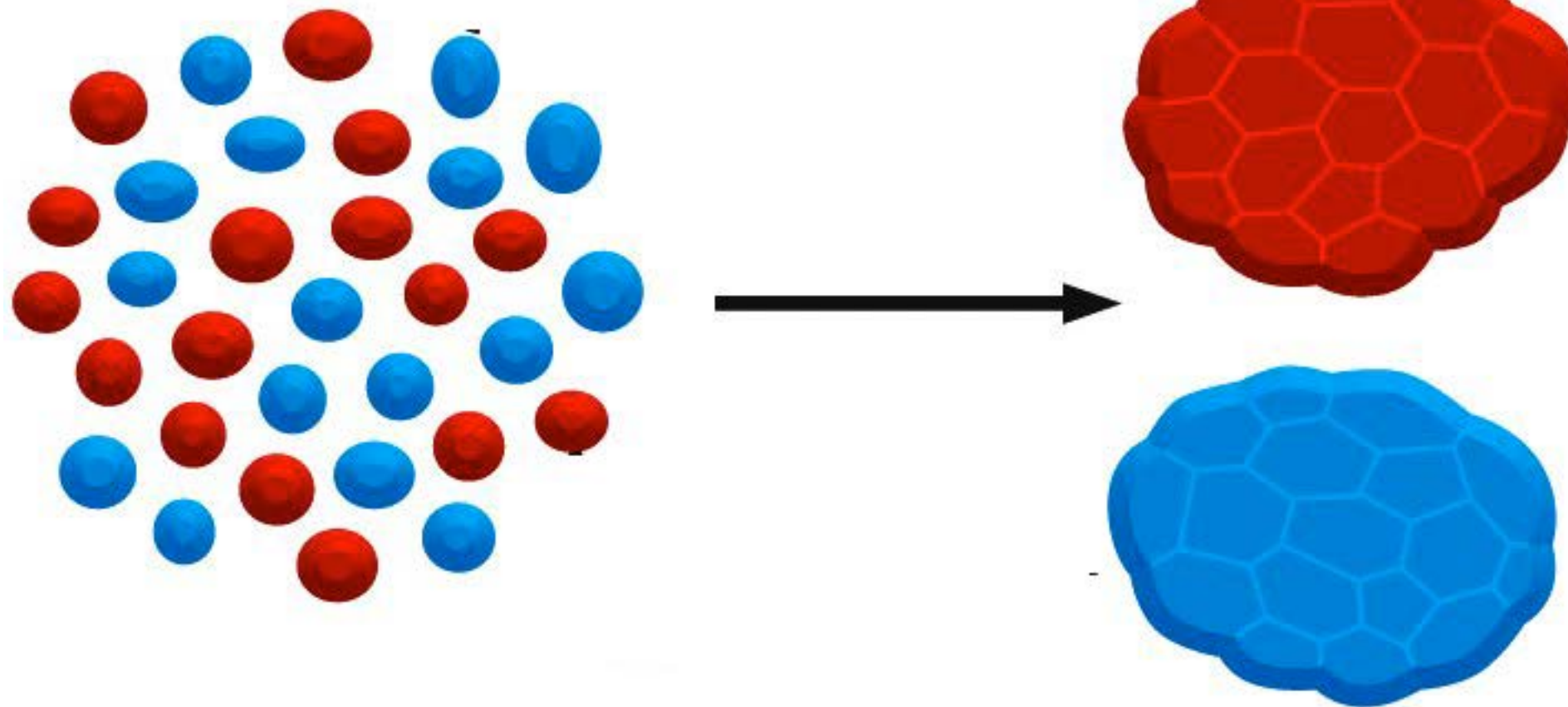
Cadherins comprise a large family of proteins.



Cells can be sorted by the types of cadherins.

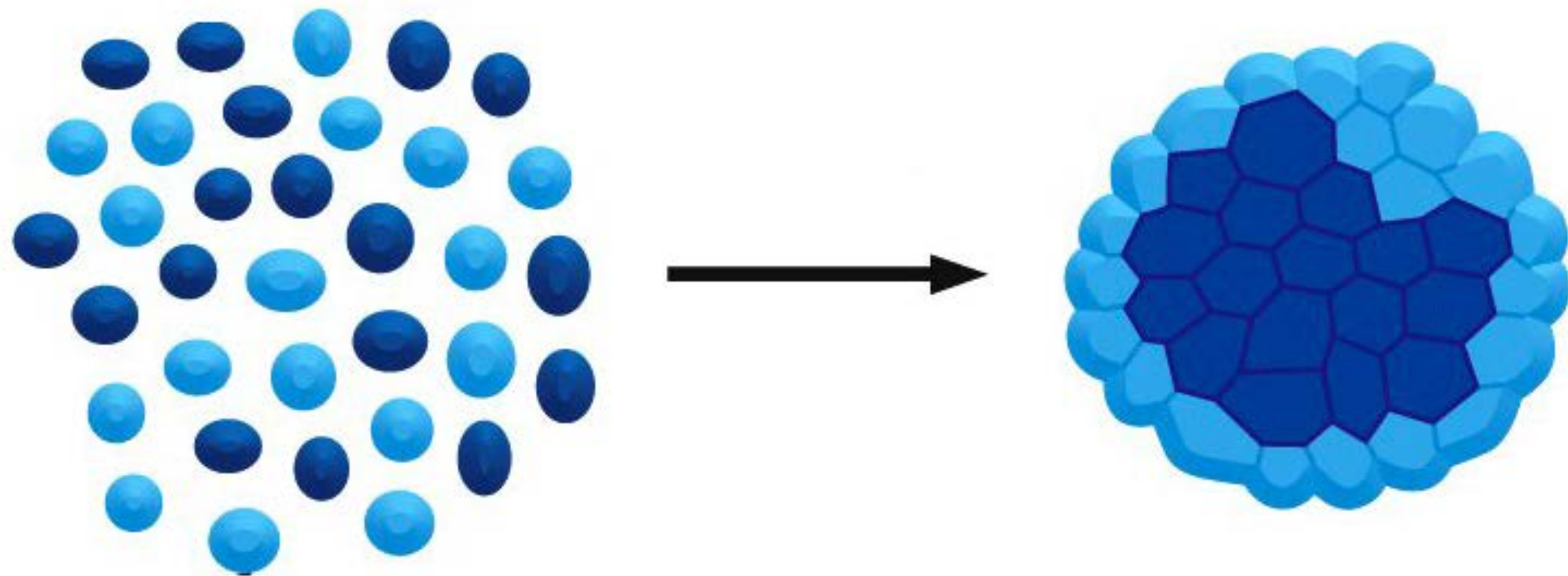
N-cadherin

E-cadherin

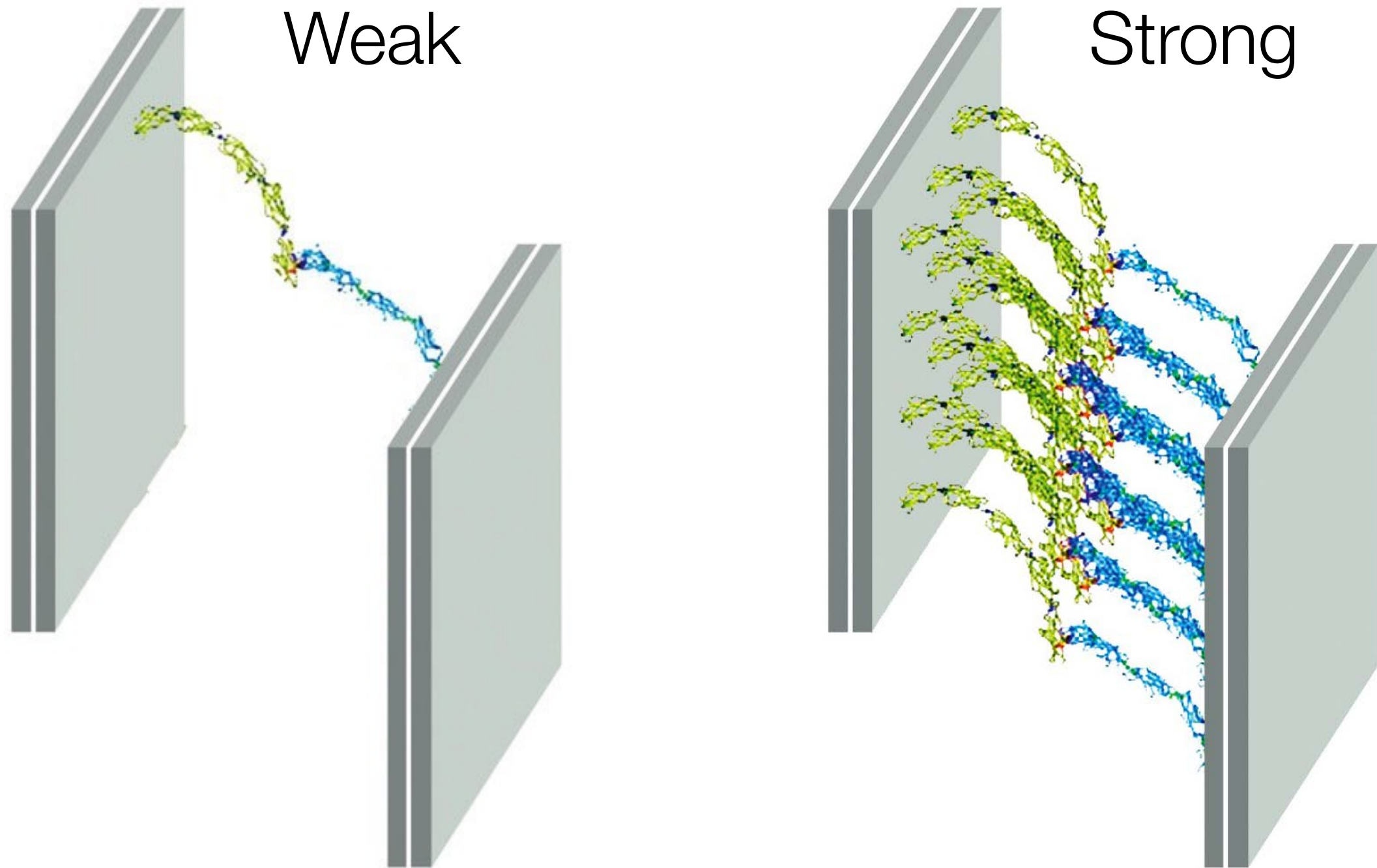


Cells can be sorted by the expression level of cadherins.

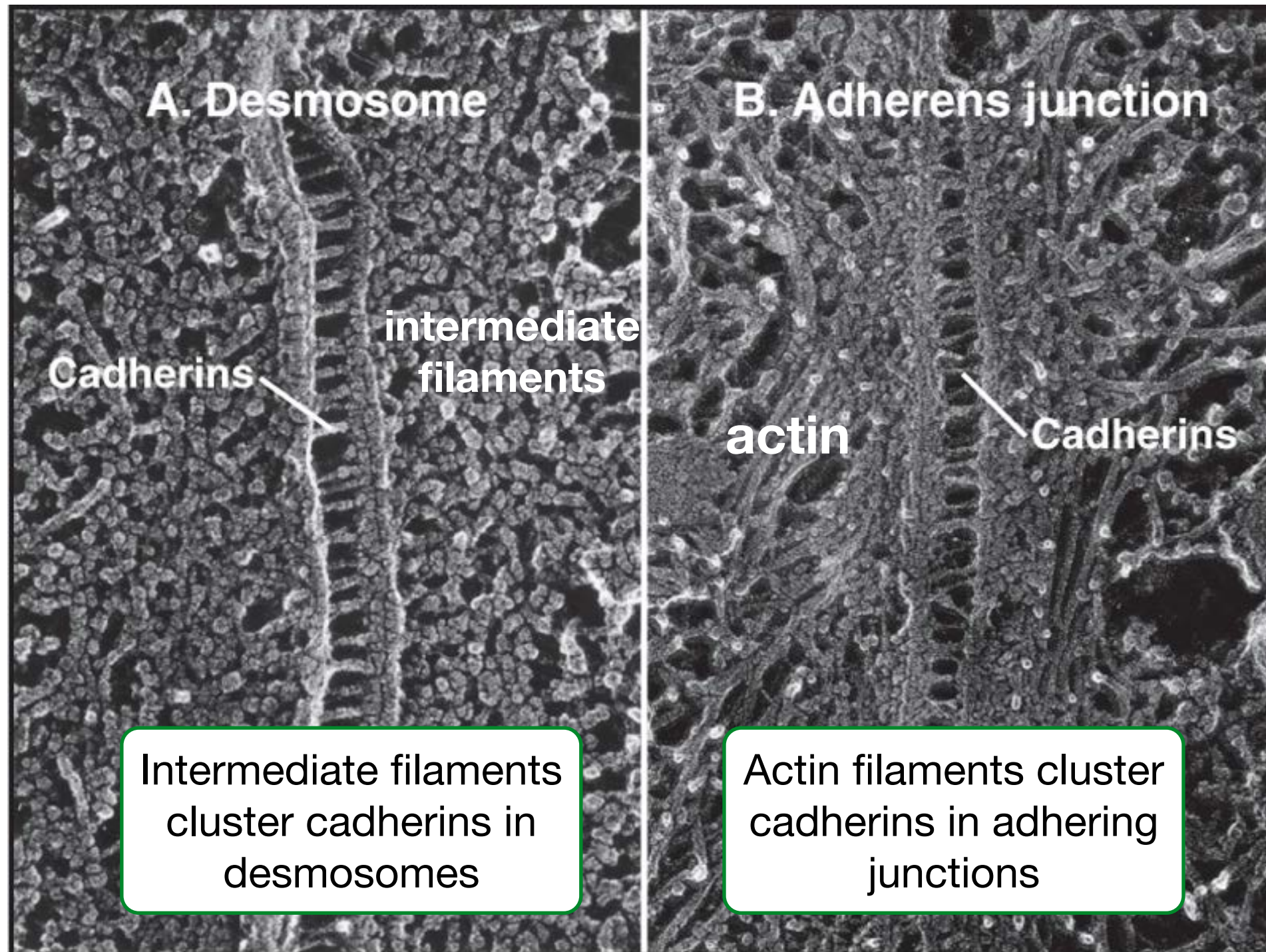
Low expression
High expression



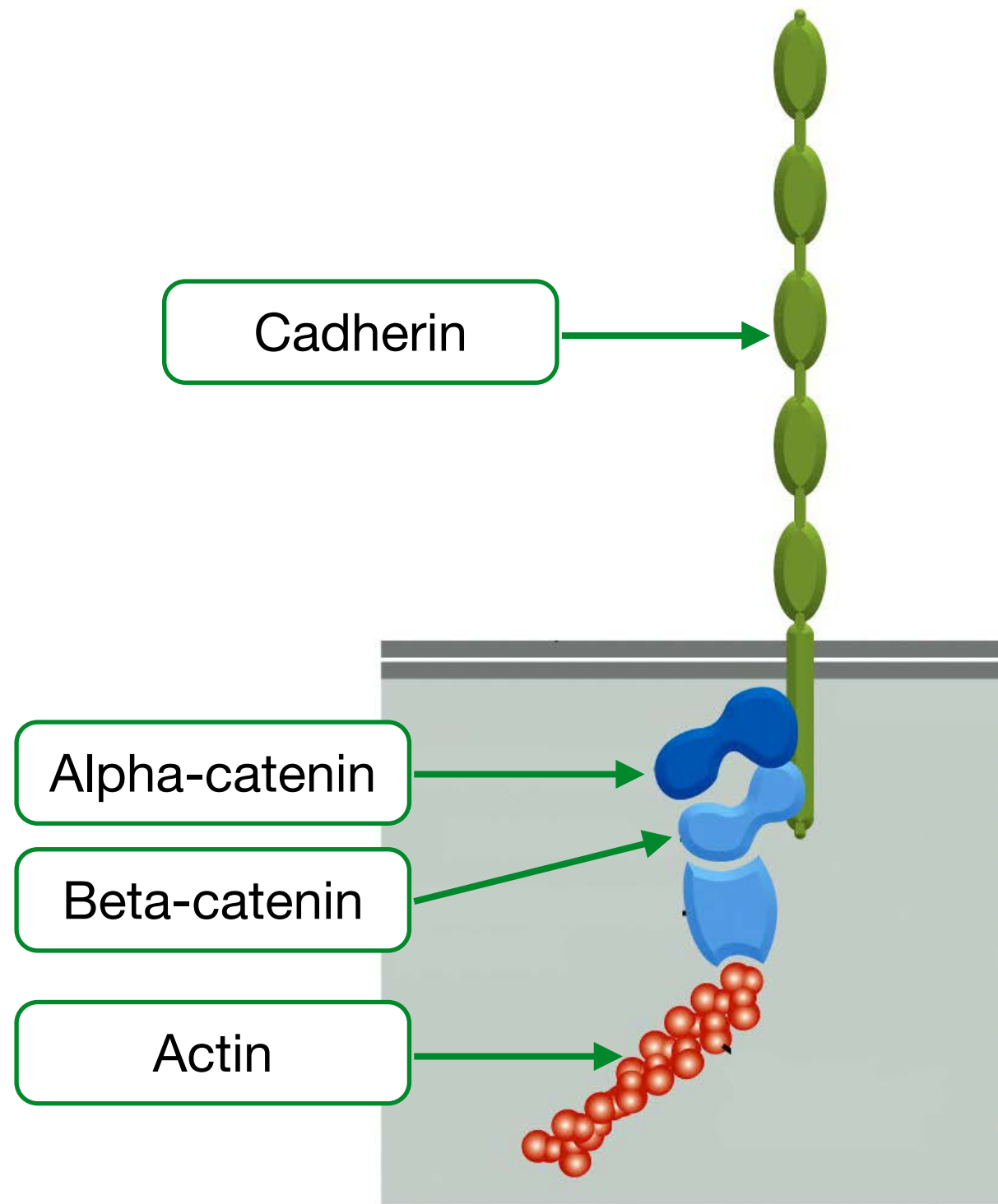
Clustering of cadherins increases strength of interactions between cells.



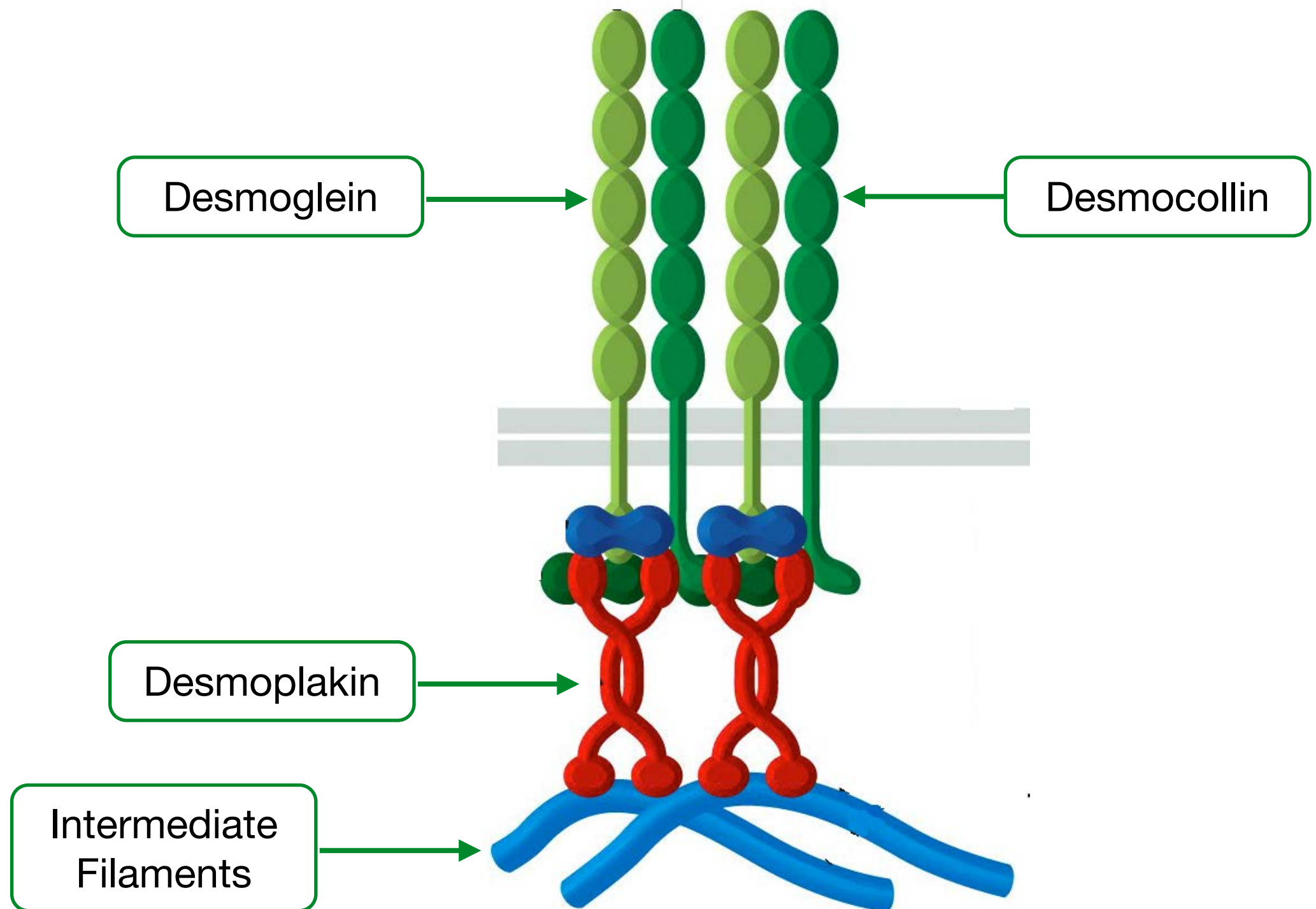
Links to cytoskeleton cluster cadherins in desmosomes and adhering junctions.



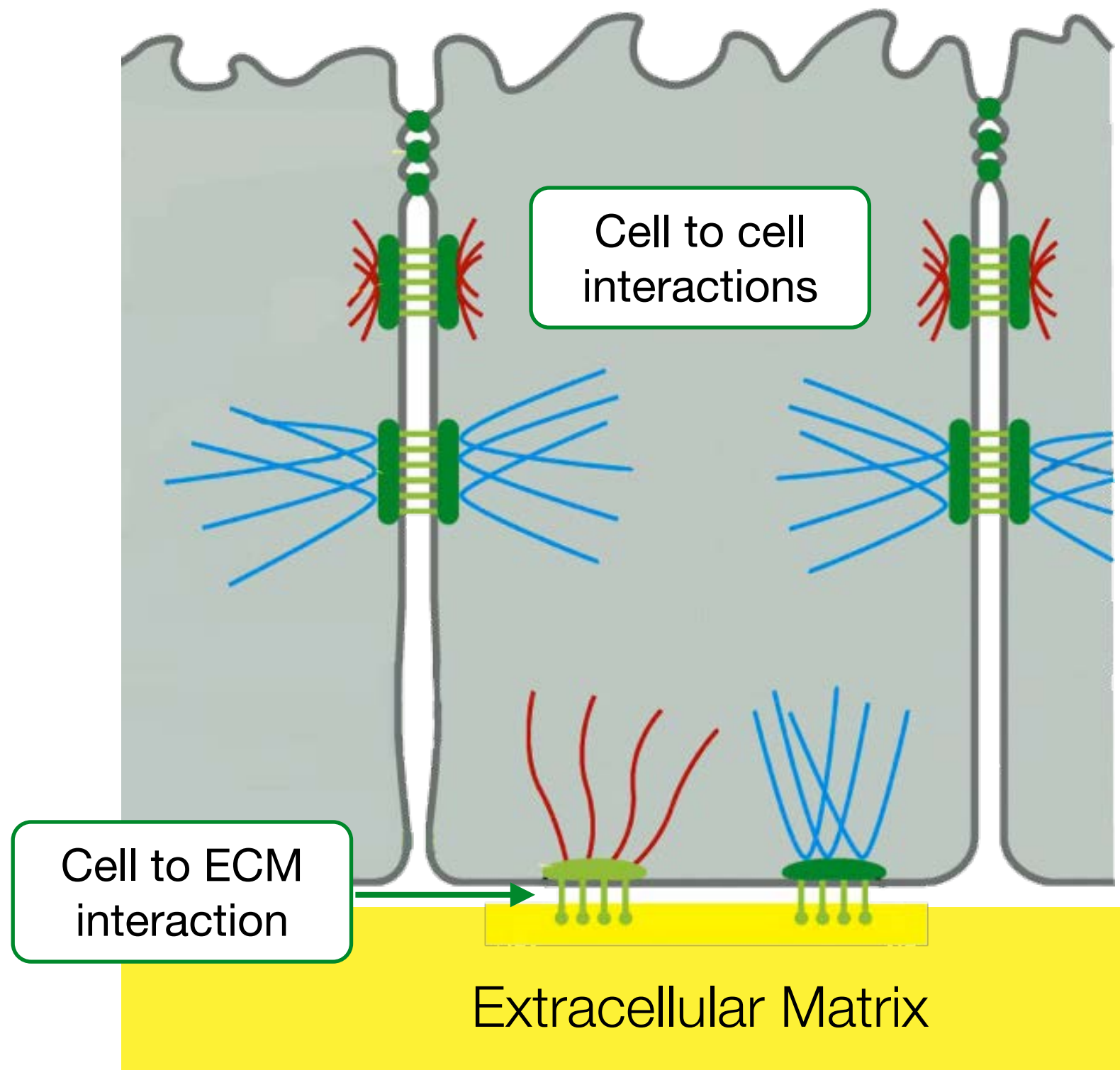
Catenins link cadherins to actin filaments in adhering junctions.



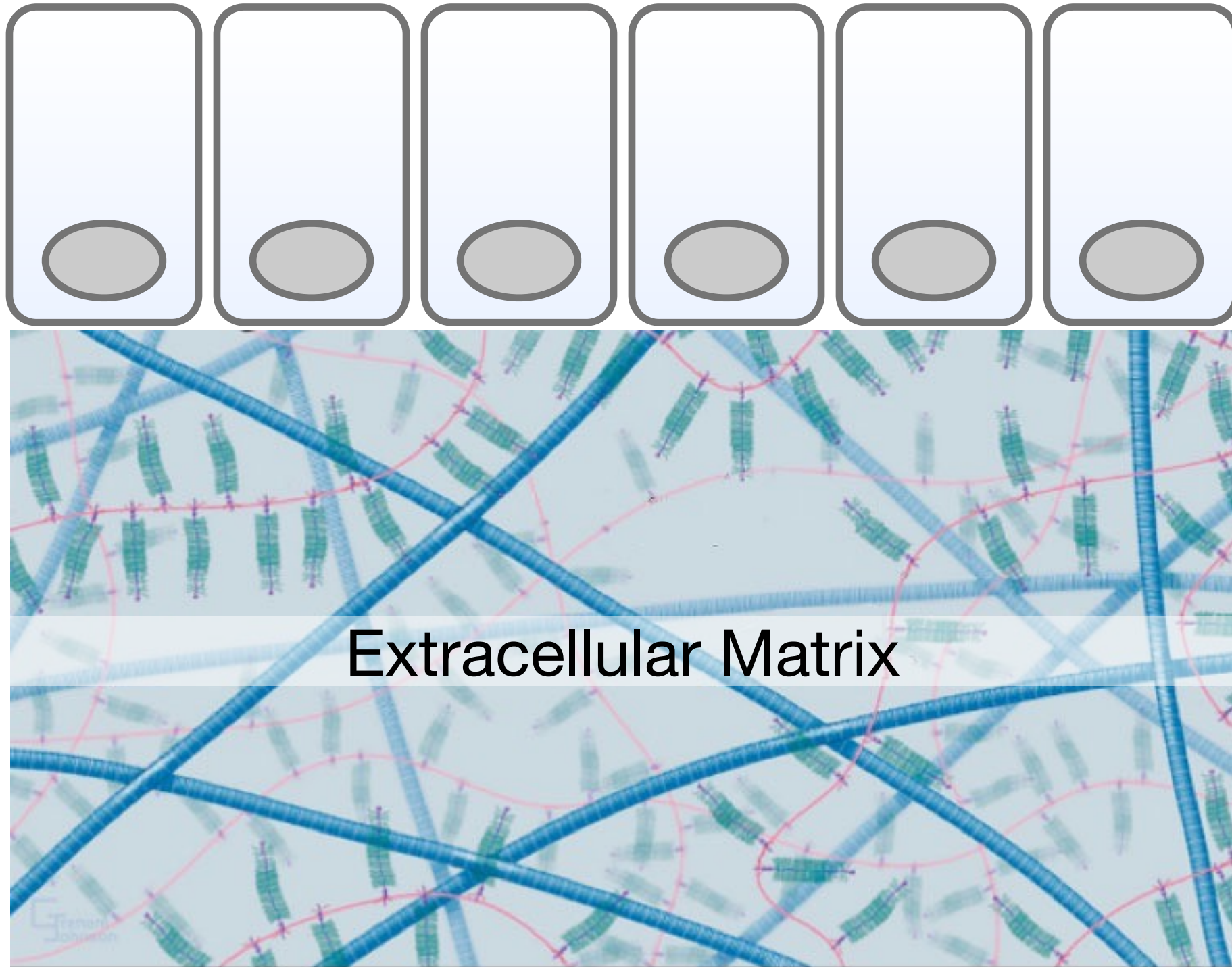
In desmosomes, cadherins are linked to intermediate filaments.



Interactions between neighboring cells and between cells and ECM hold tissues together.

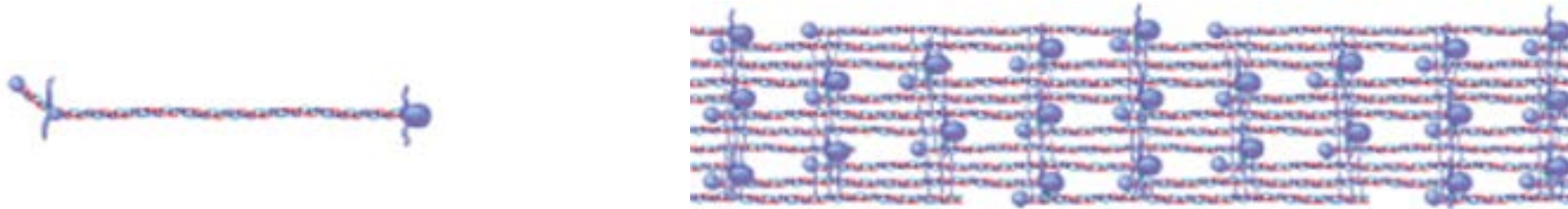


Extracellular matrix provides a common framework to support a group of cells.

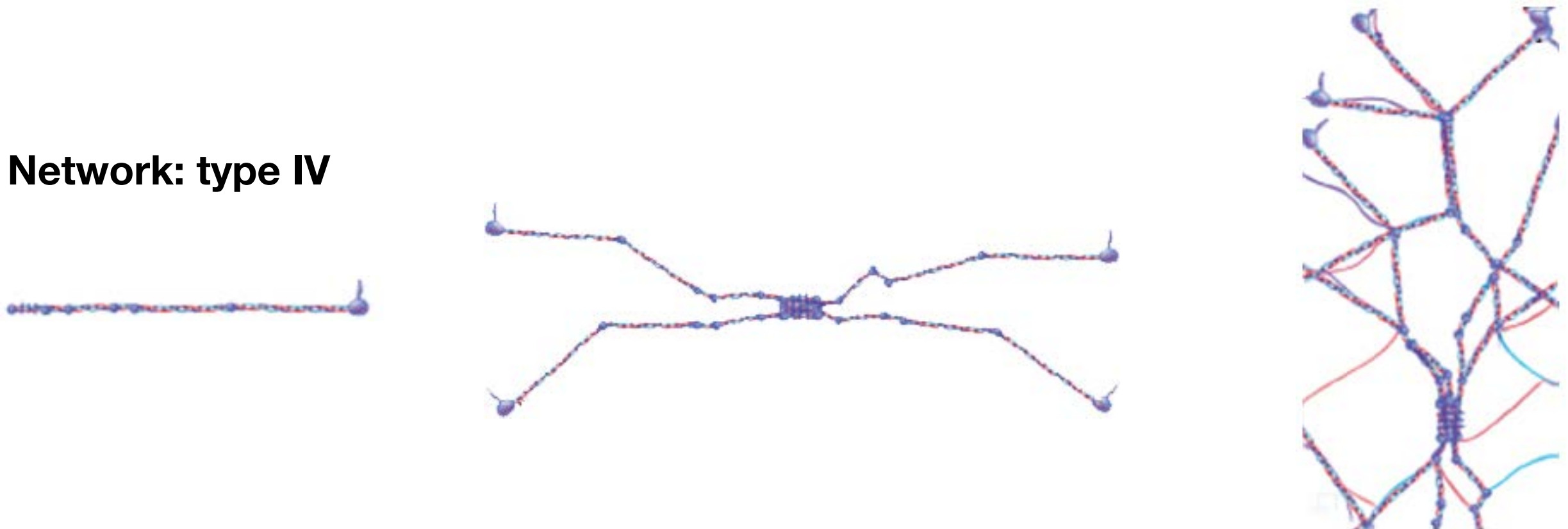


Collagens are a large family of proteins that form fibers or networks.

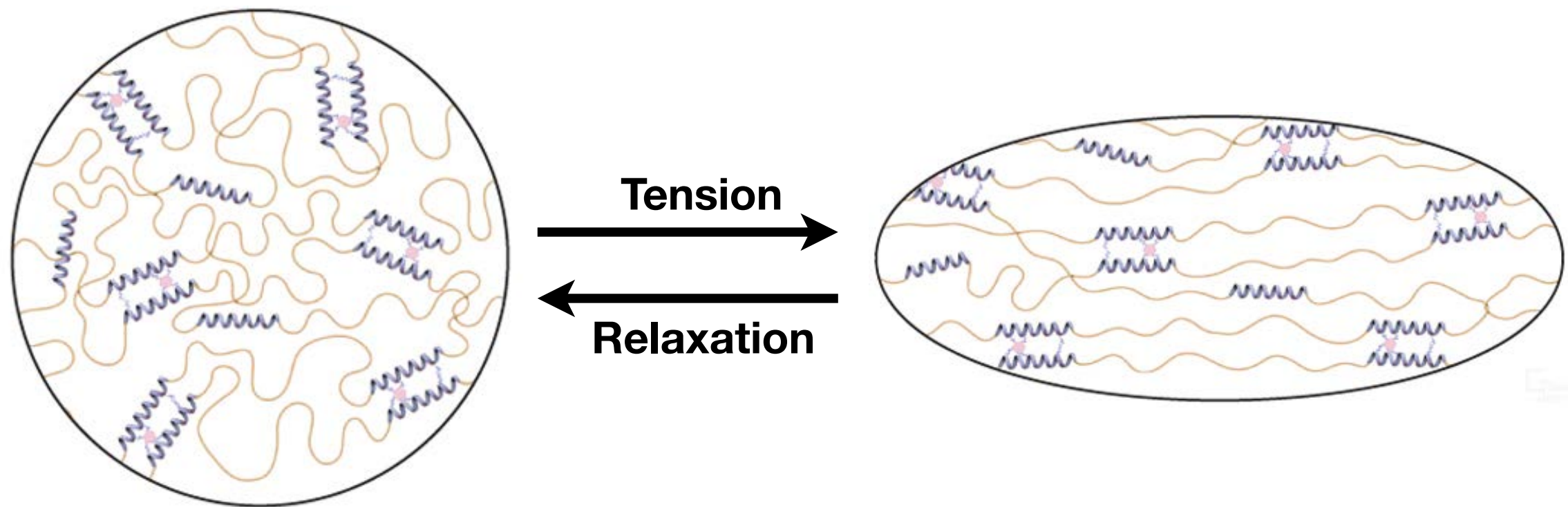
Fibrillar: type I, type II, type III



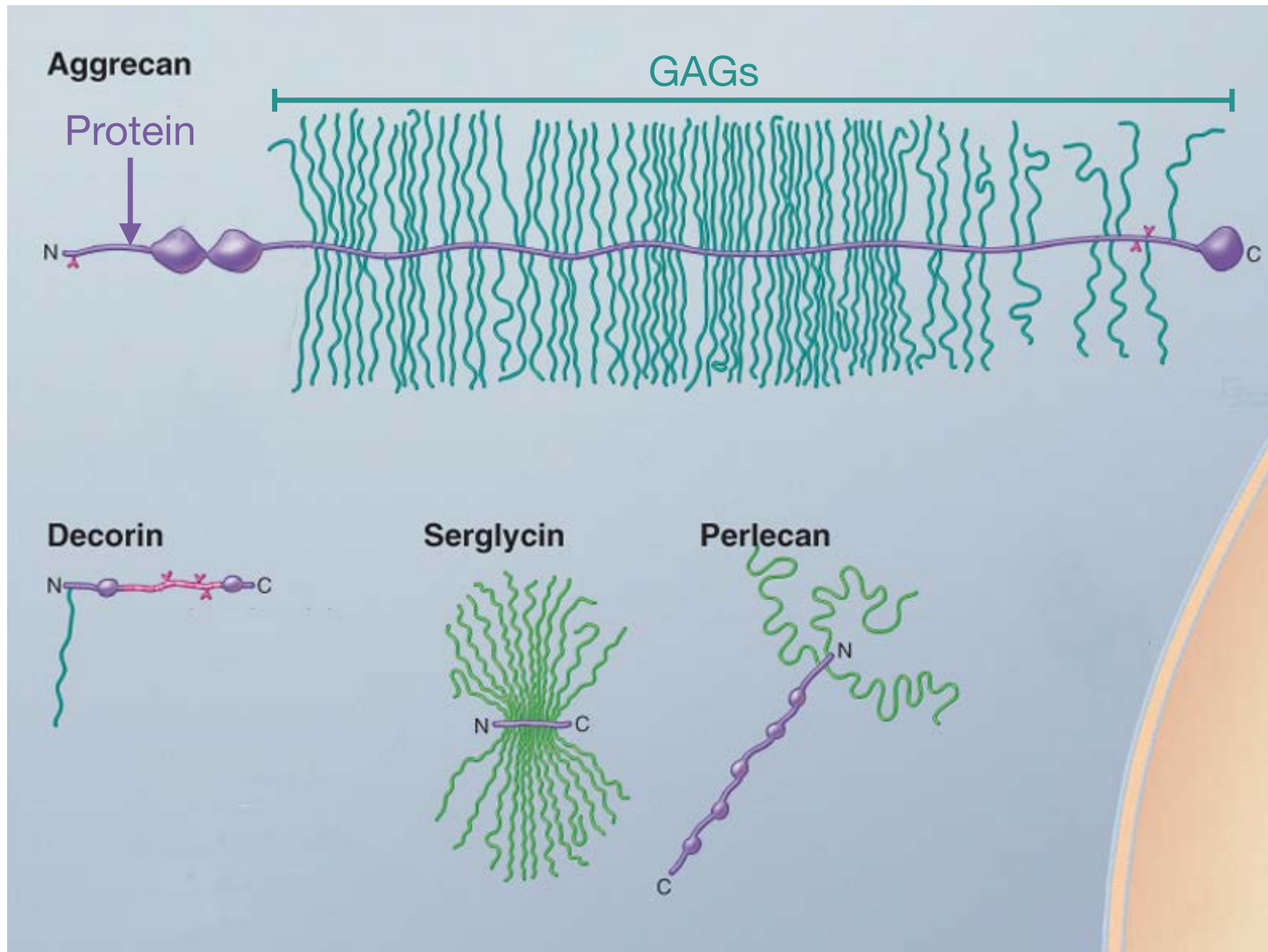
Network: type IV



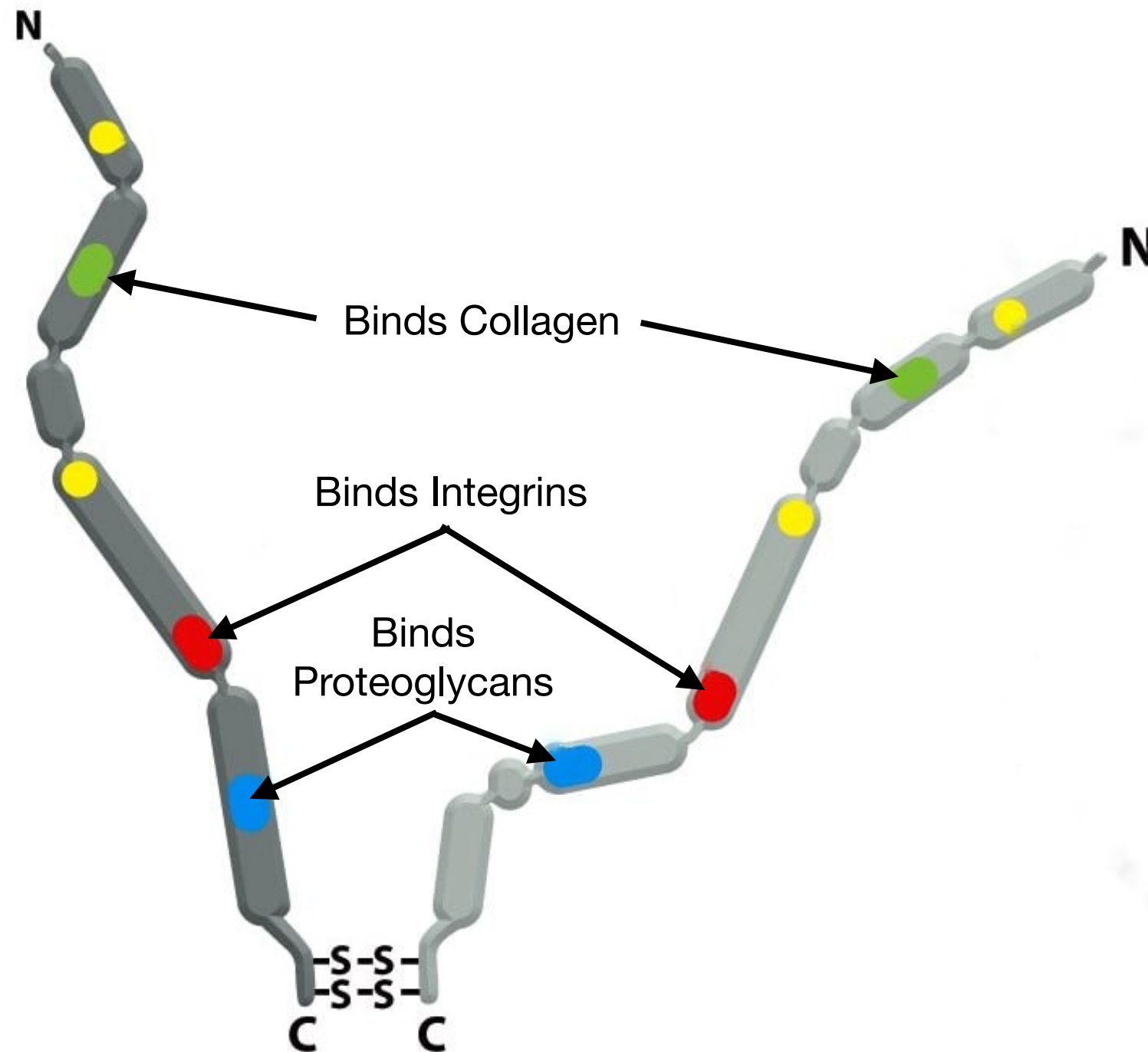
Tension generates order in elastin networks that provides energy for recoil.



Proteoglycans are single polypeptide with several attached glycosaminoglycans.

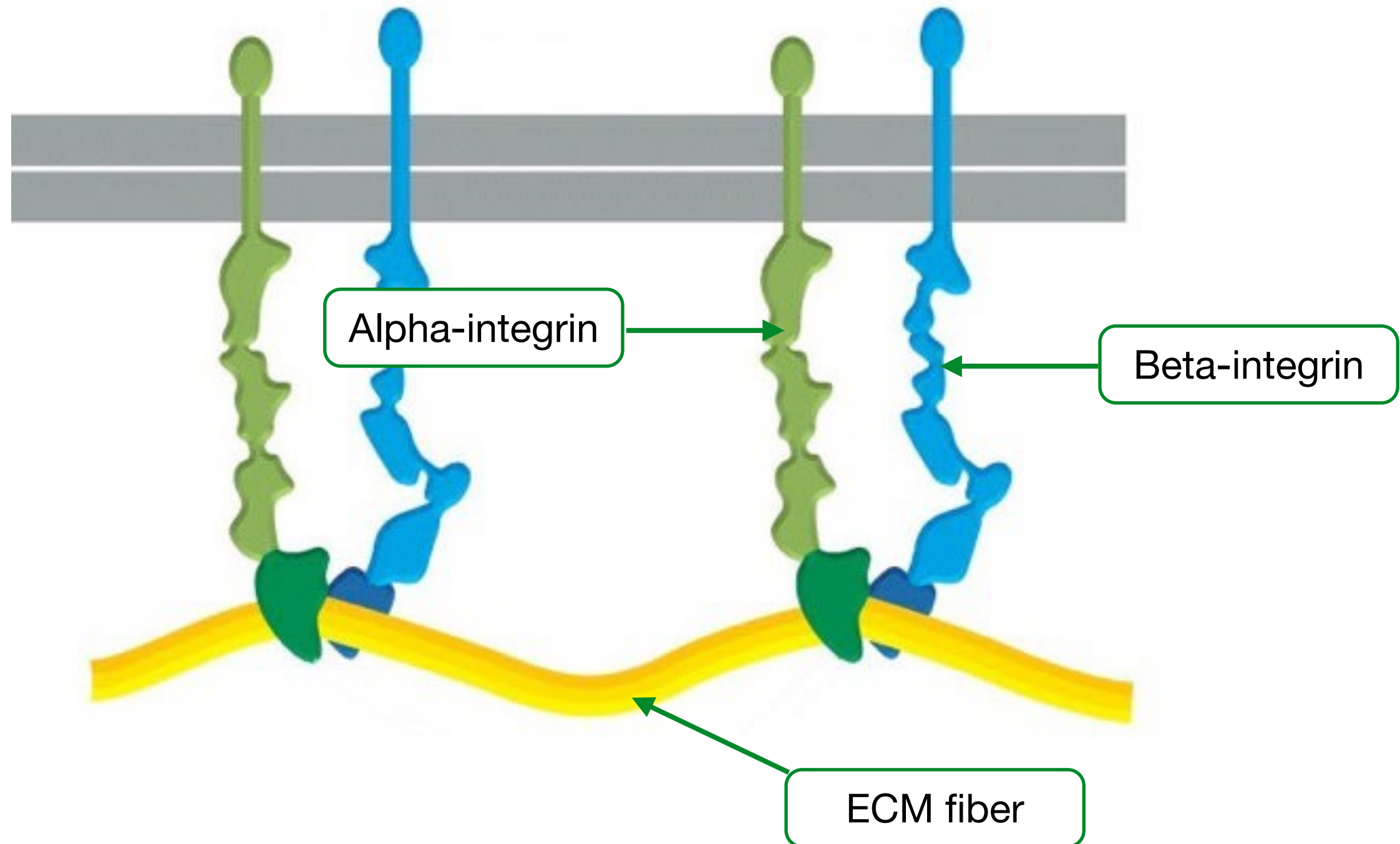


Fibronectin is a glycoprotein in the ECM that functions as molecular glue.

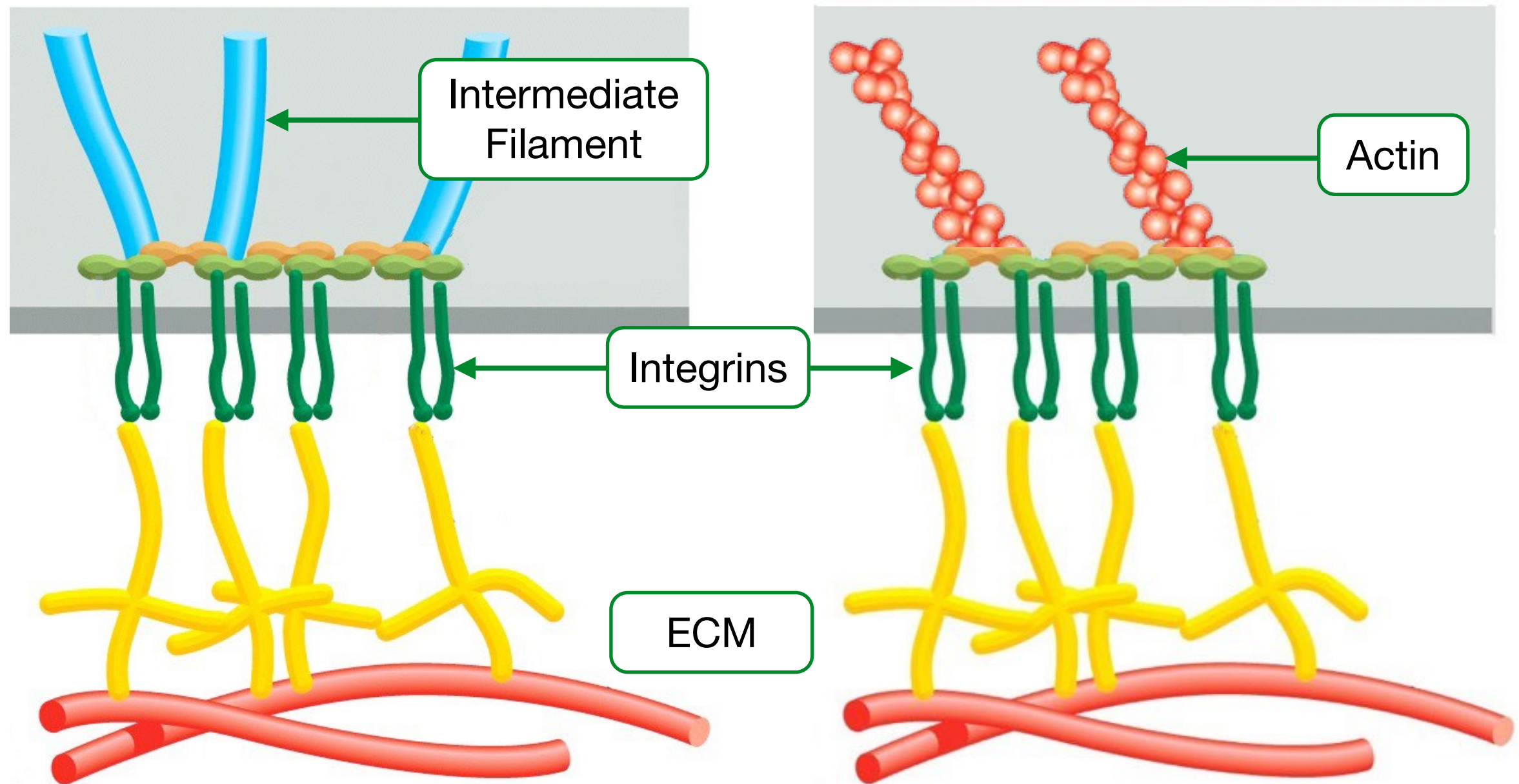


Attachment to the extracellular matrix

Integrins are cell surface receptors that link fibers of the extracellular matrix to the cytoskeleton.

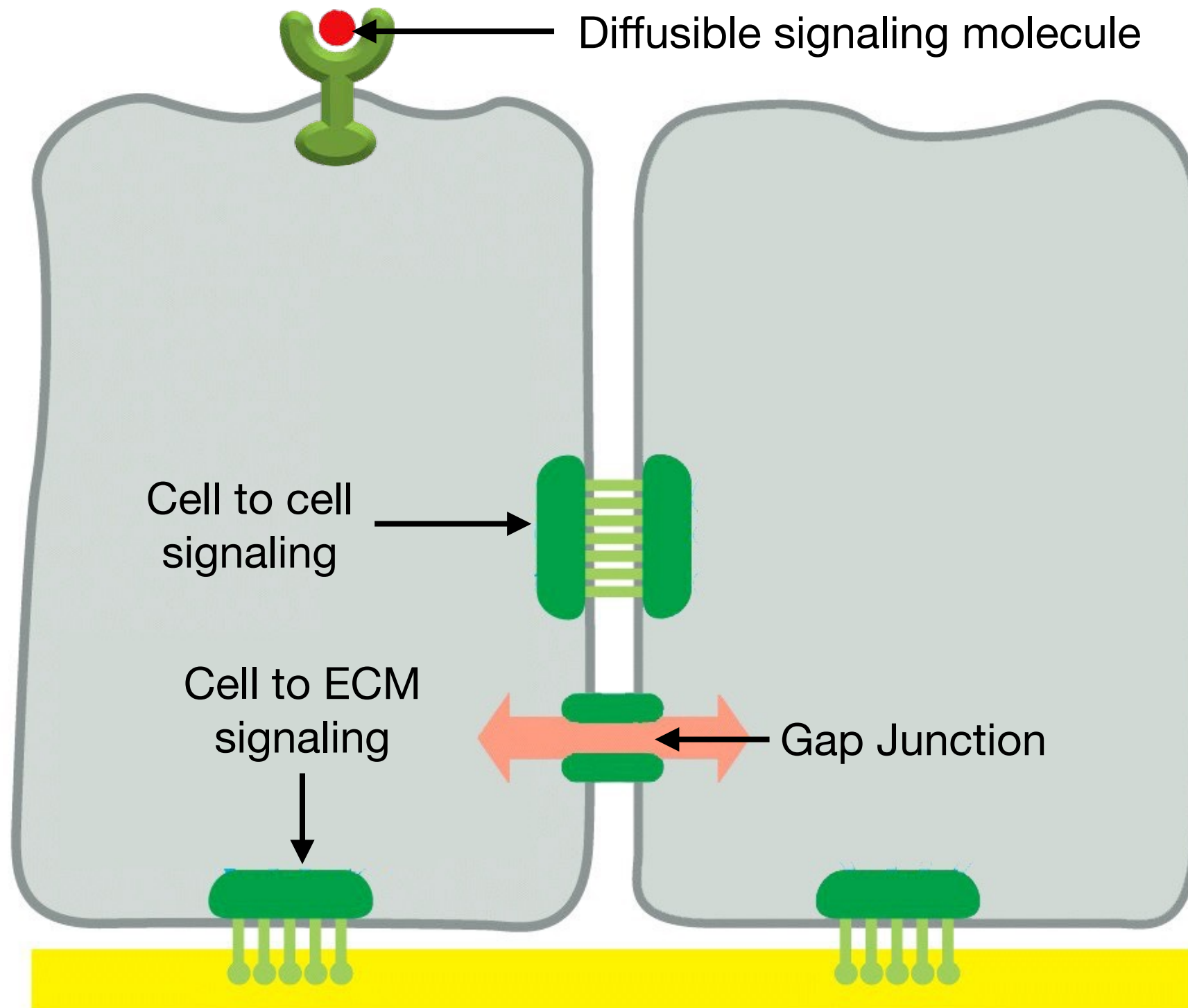


Integrins in cells under mechanical stress link ECM to intermediate filaments.

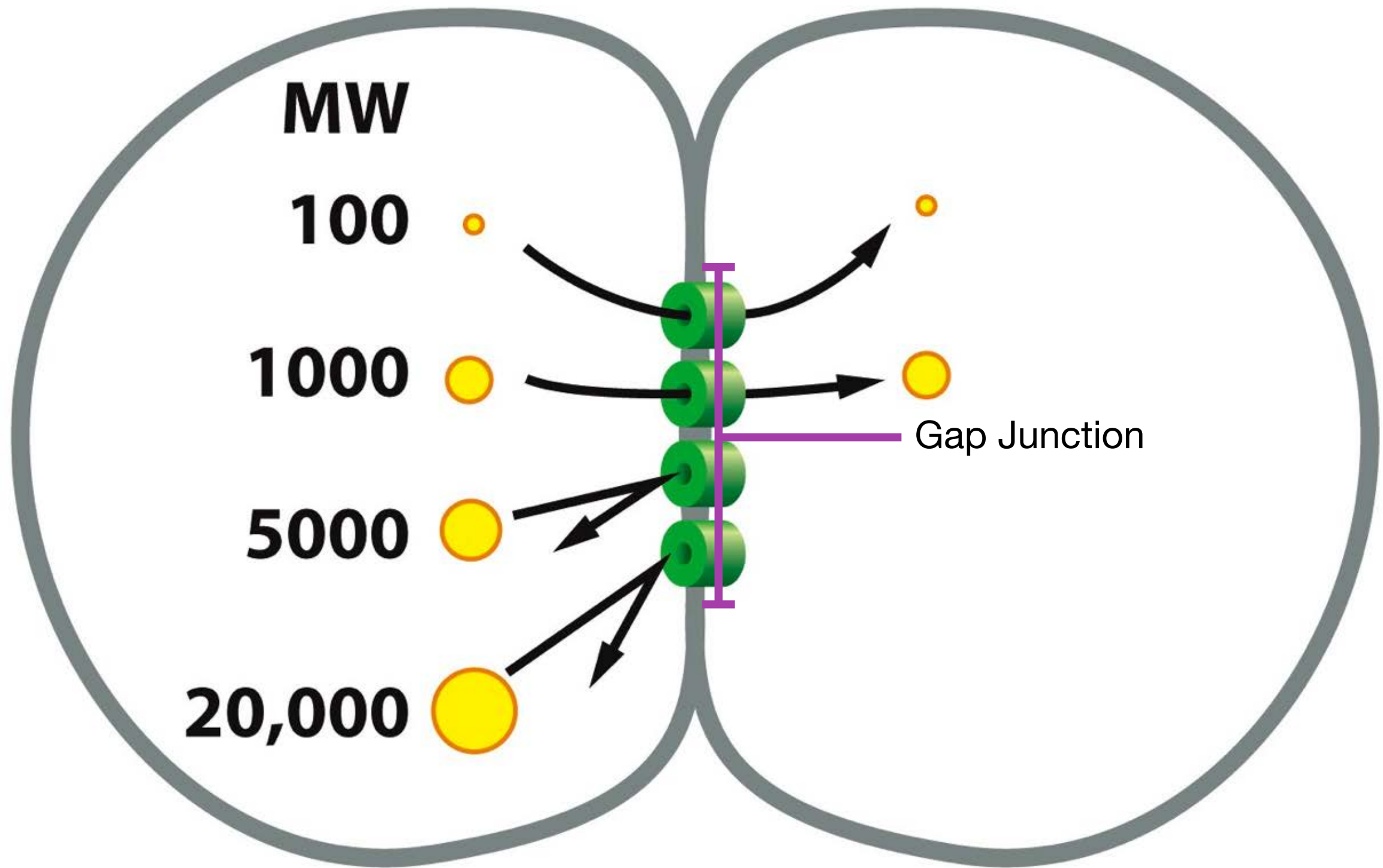


Communication in Tissues

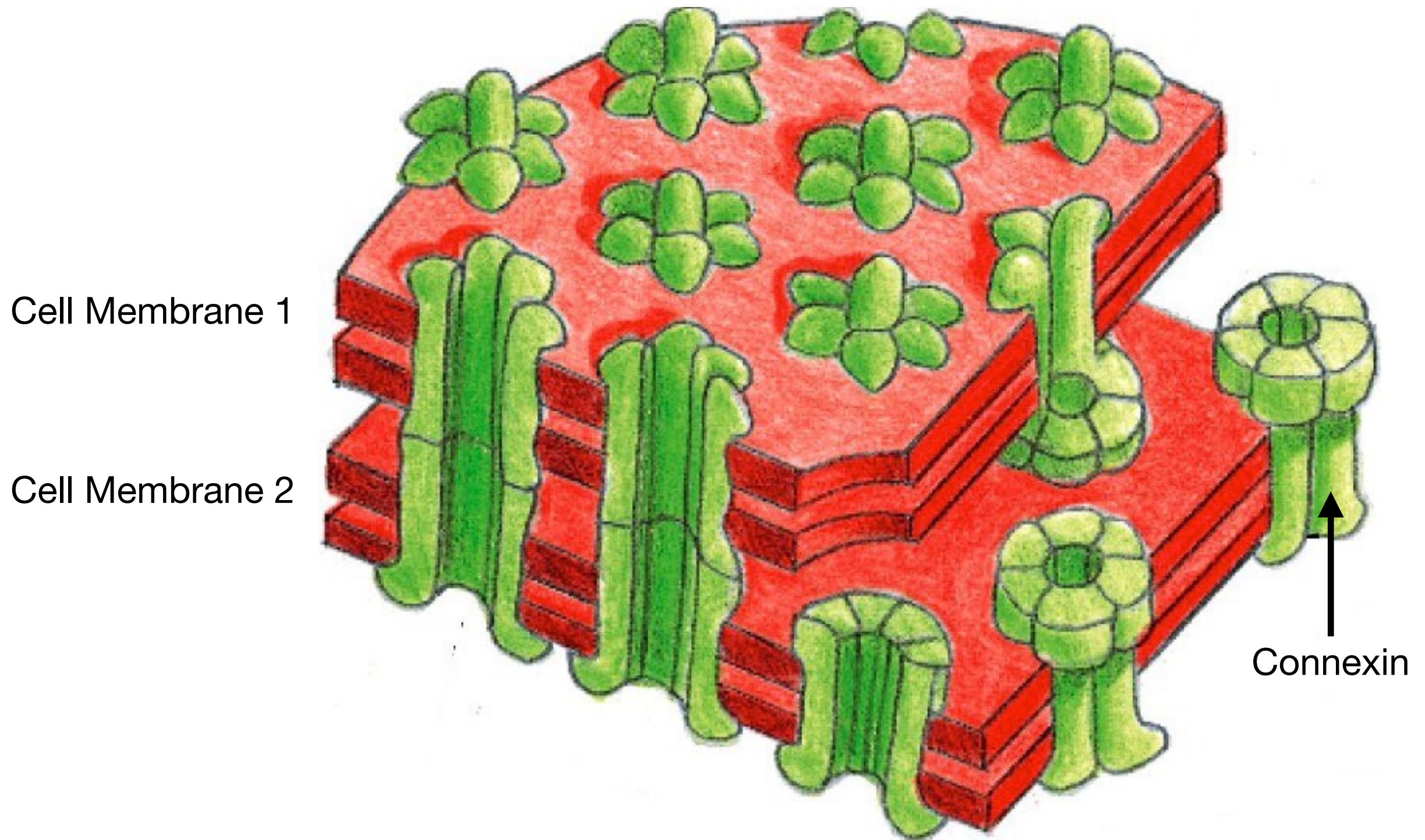
Cell communication regulates cell division and coordinate activities between cells.



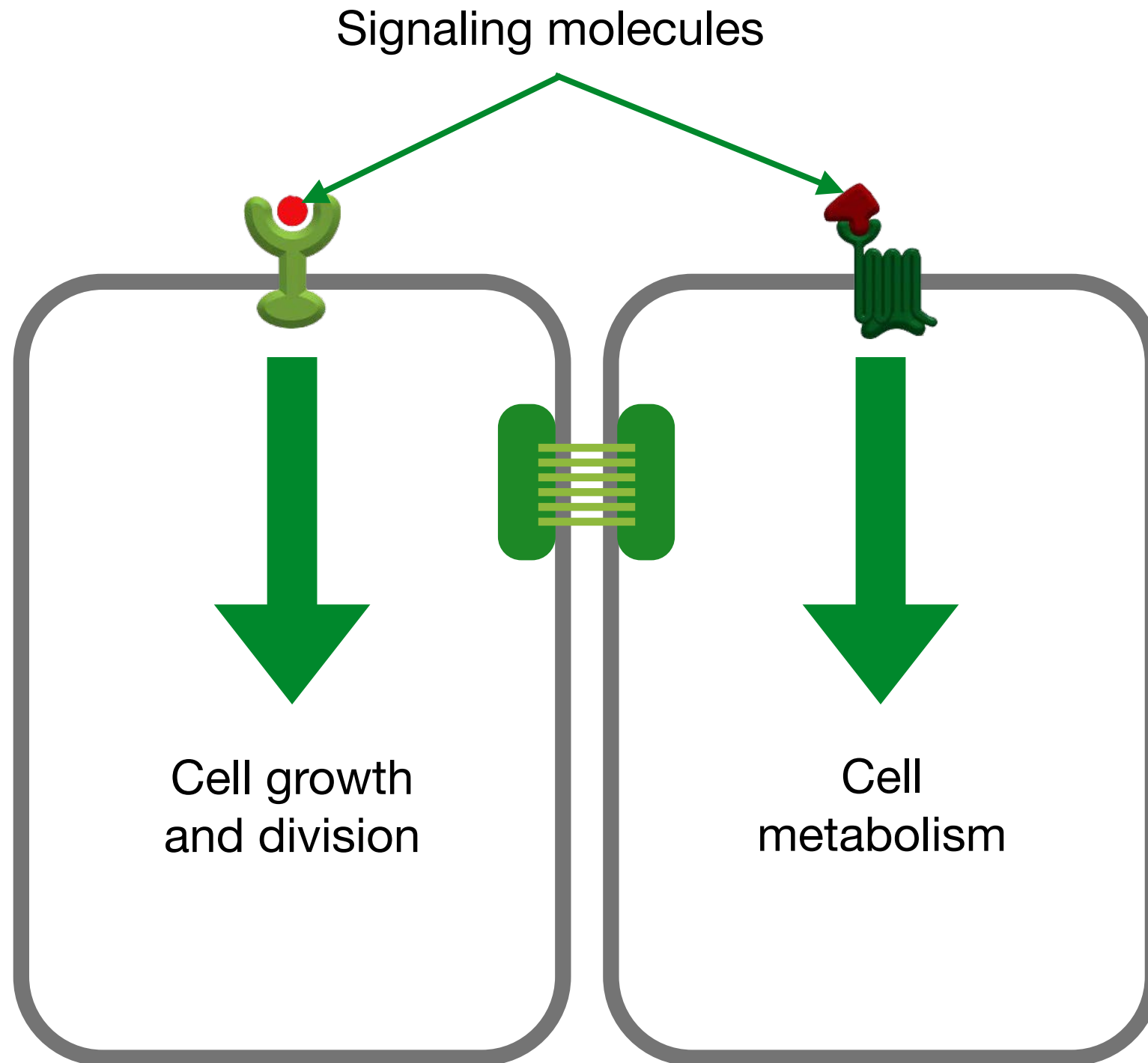
Gap junctions allow diffusion of small molecules between neighboring cells.



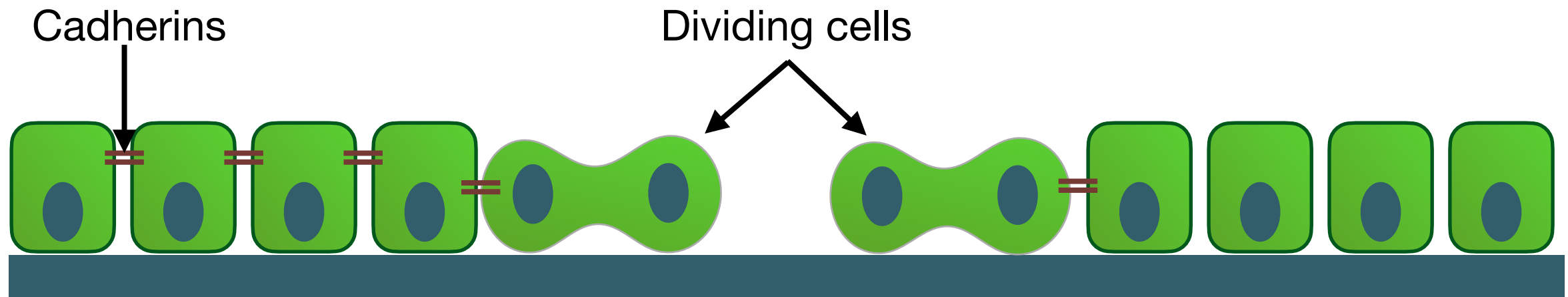
Connexins are transmembrane proteins that form ~1.5 nm pores between cells.



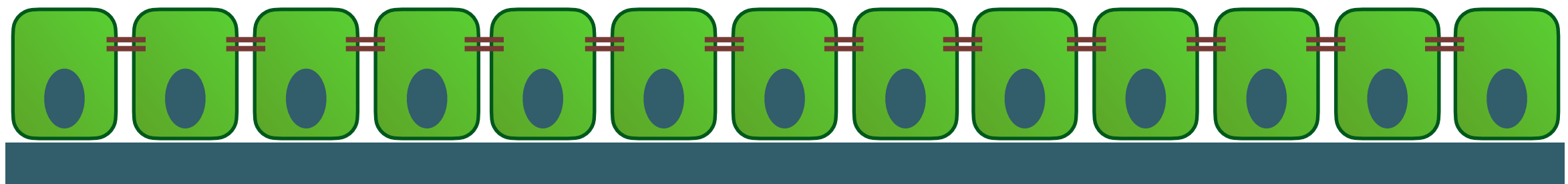
Signaling molecules in the ECM regulate cell behavior and activity.



Cadherins regulate cell division.

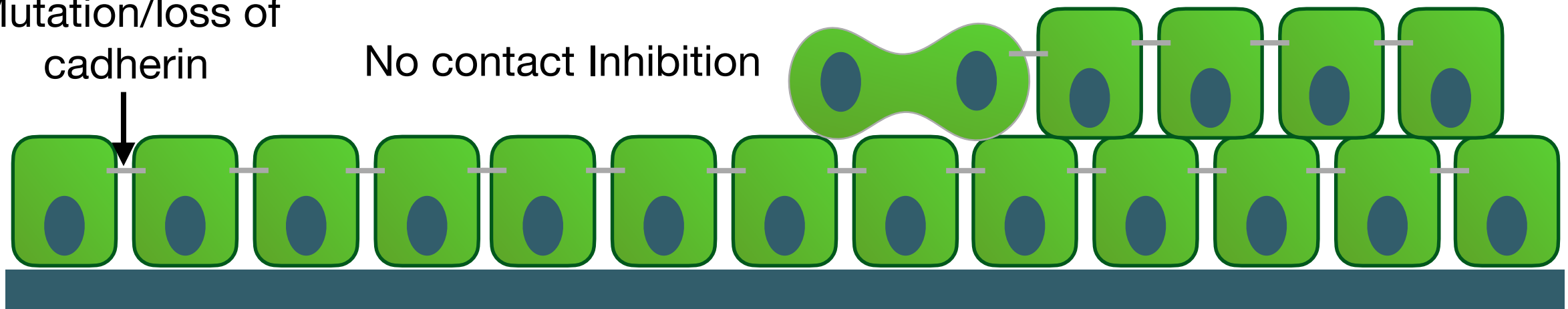


Contact Inhibition



Mutation/loss of cadherin

No contact Inhibition



Extracellular matrix regulates cell behavior.



ECM stiffness

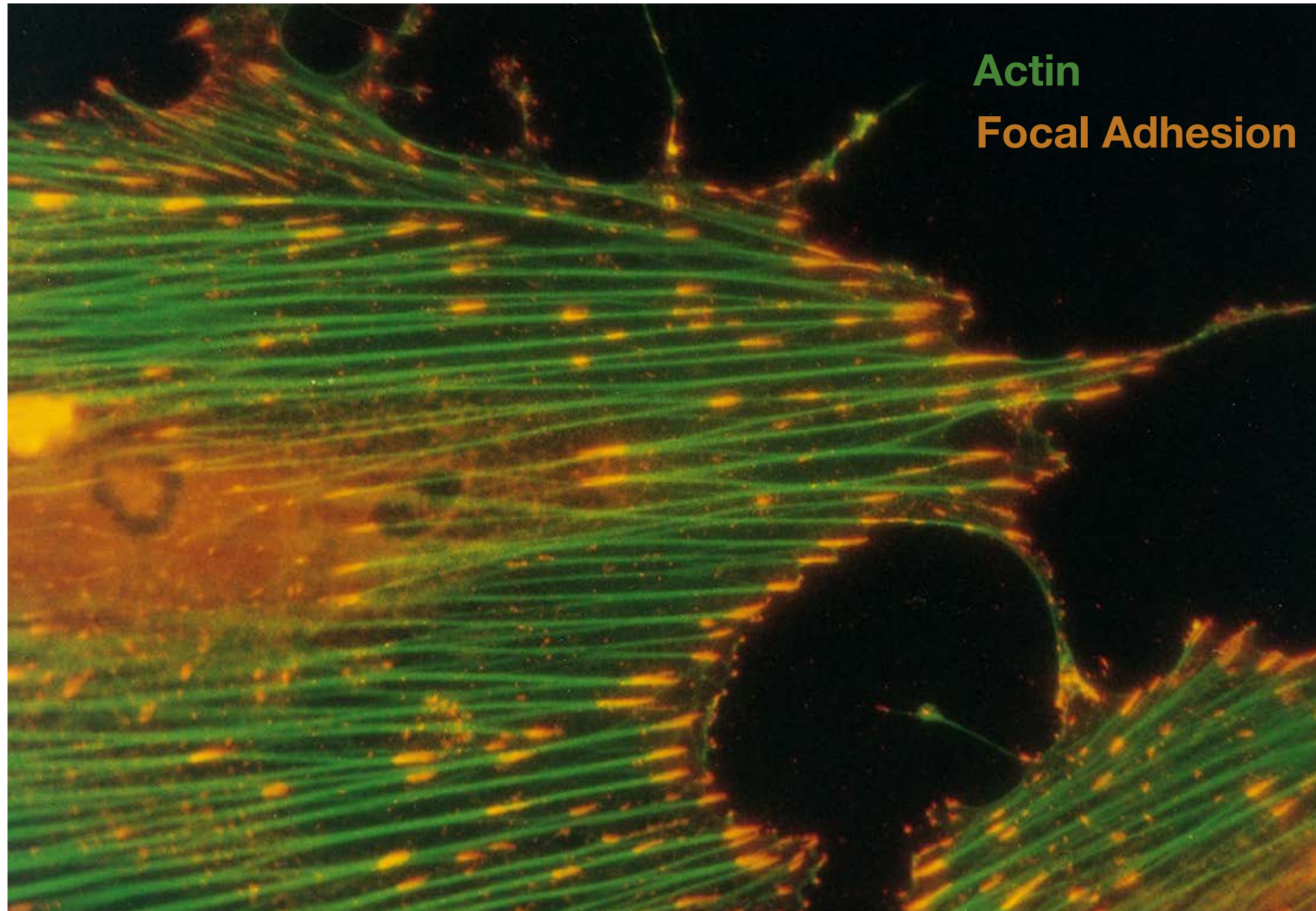


Morphology

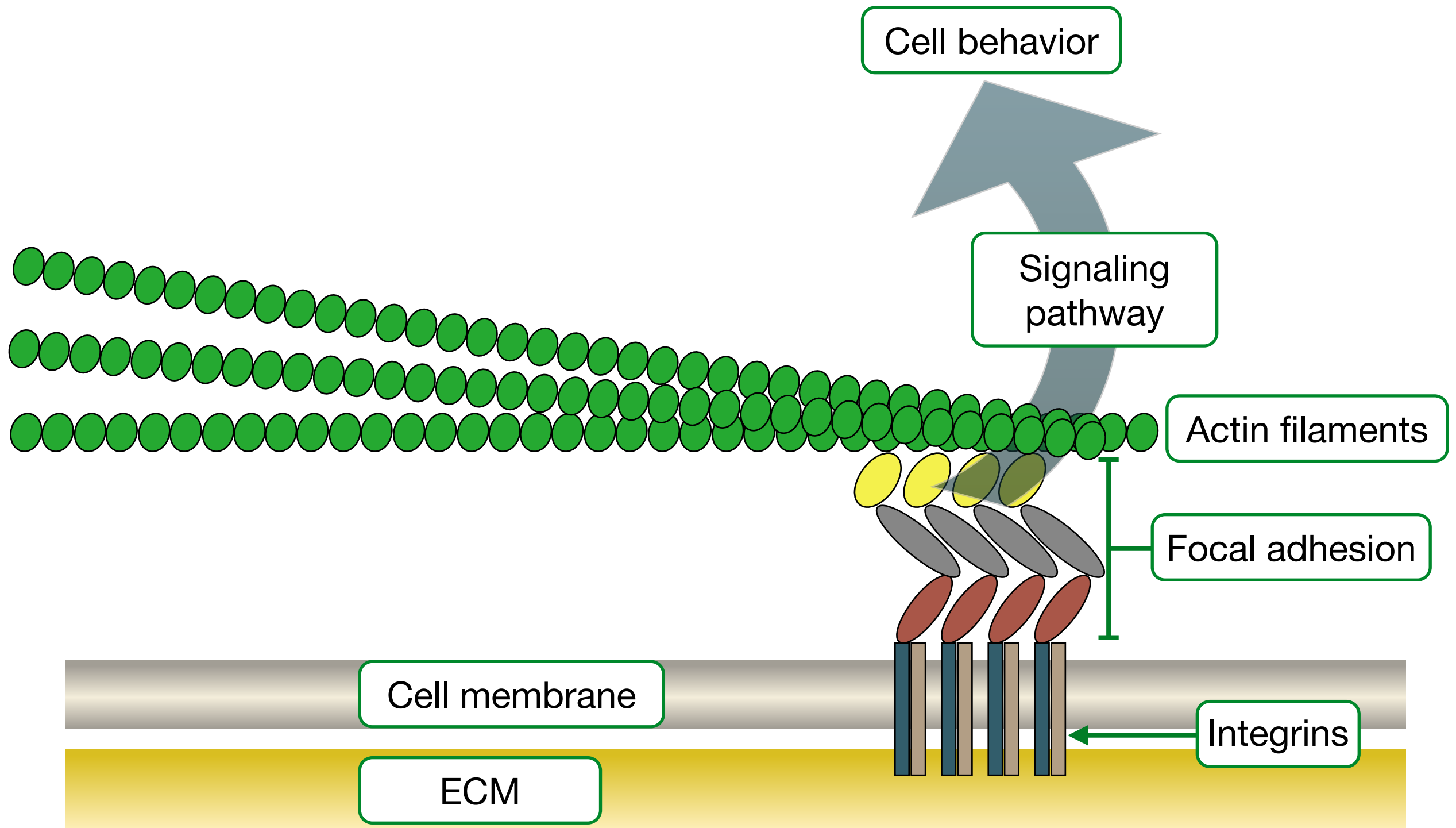


Gene expression

Cells connect to extracellular matrix at sites called focal adhesions.



Integrin attachment to ECM helps determine and maintain cell identity.



Take home messages...

- Adhesion in tissues maintains tissue integrity and regulates cell behavior.
- Cadherins mediate interactions between cells through adhering junctions and desmosomes.
- Integrins mediate interaction between cells and the extracellular matrix
- Cells in tissues communicate through gap junctions, intercellular connections, attachments to the ECM and diffusible signaling molecules