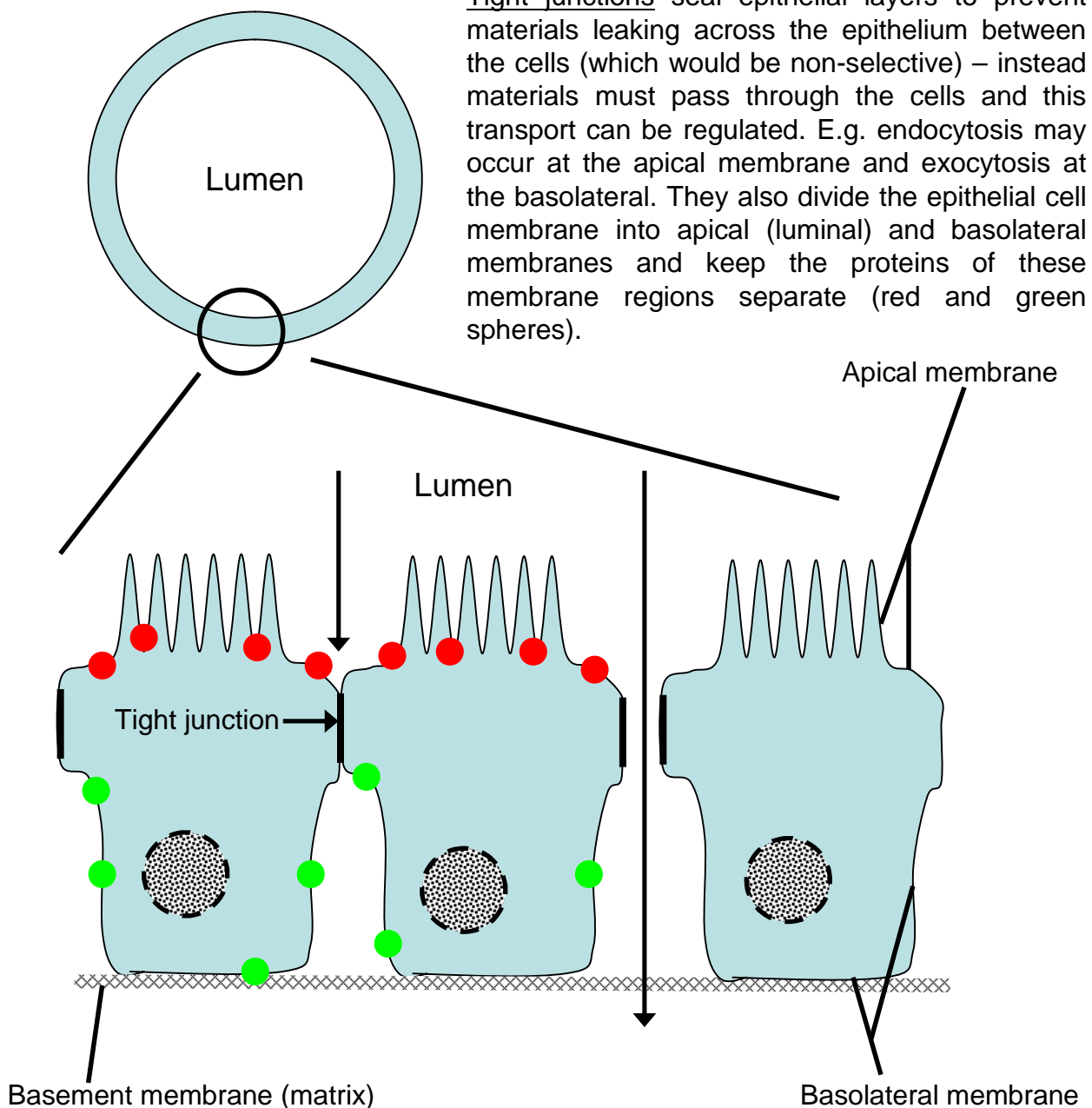


## Cell-cell junctions:

Tight junctions  
Adherens junctions  
Desmosomes  
Gap junctions

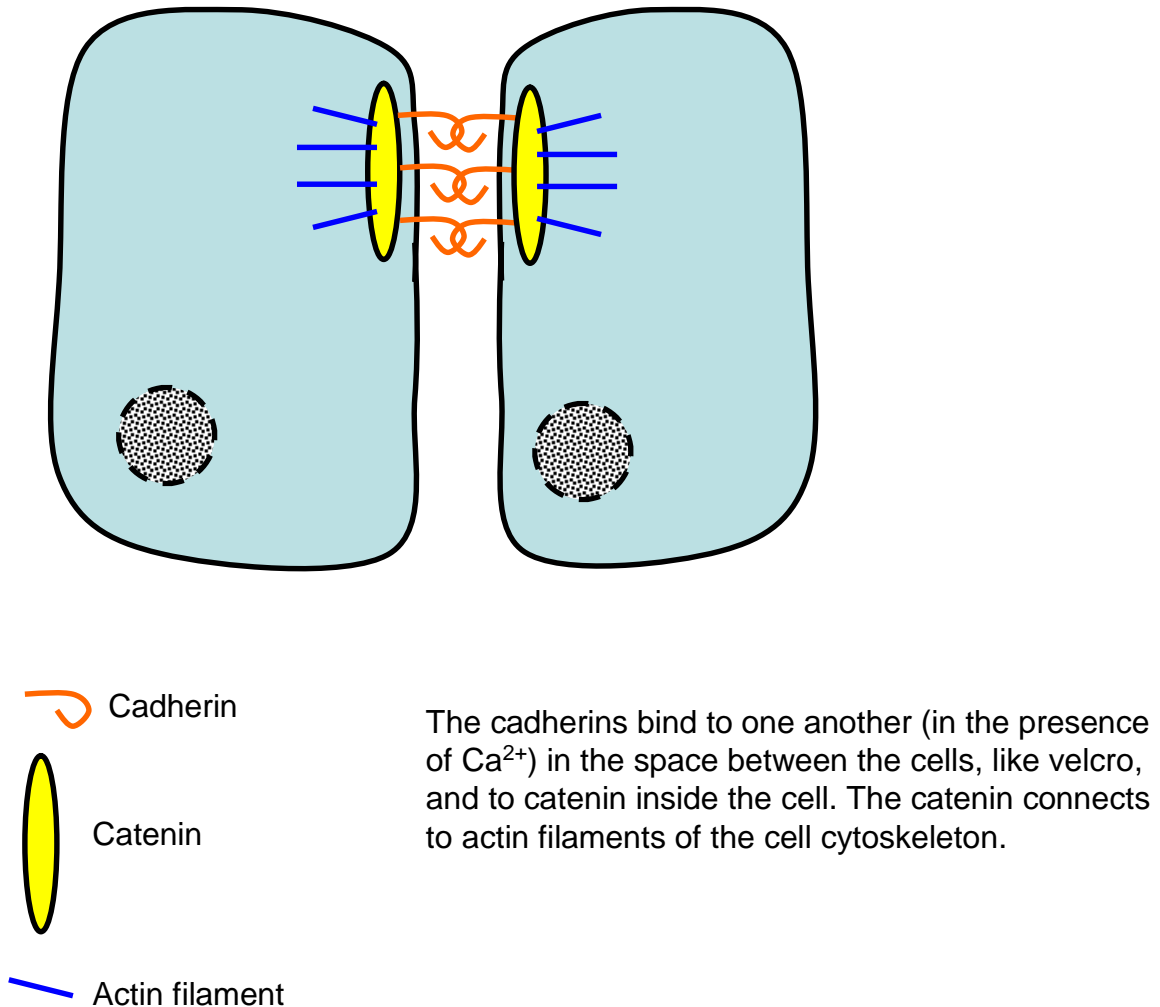
There are 4 principle types of junctions between animal cells. These junctions involve proteins that act as rivets or bolts to bind neighbouring cells together. these junctions may occur wherever neighbouring cells contact one another and these contact areas are often highly folded to form inter-digitating processes that interlock and help bind the cells more strongly.

A tubular organ, formed by an epithelium:



Tight junctions seal epithelial layers to prevent materials leaking across the epithelium between the cells (which would be non-selective) – instead materials must pass through the cells and this transport can be regulated. E.g. endocytosis may occur at the apical membrane and exocytosis at the basolateral. They also divide the epithelial cell membrane into apical (luminal) and basolateral membranes and keep the proteins of these membrane regions separate (red and green spheres).

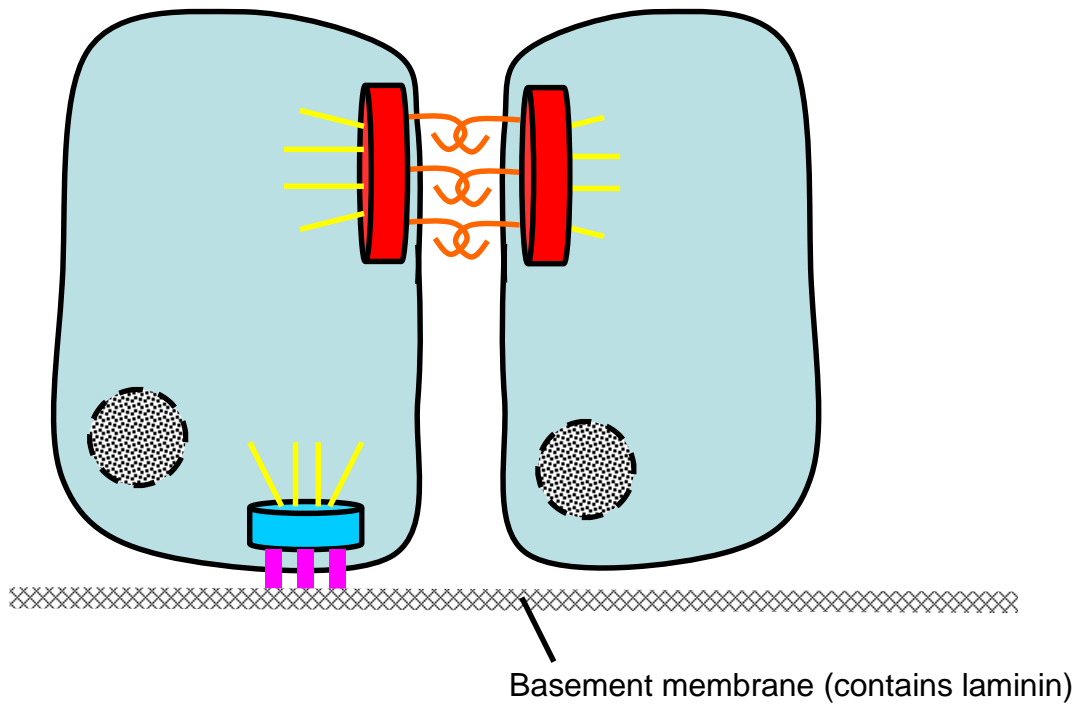
Adherens junctions bond cells together strongly, for example they bond cardiac muscle cells together, to stop the tissue tearing when the heart contracts:



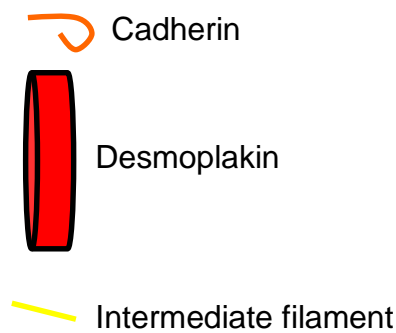
Adherens junctions also bind epithelial cells together, where they may form a band around the circumference of each cell, called zonula adherens (the adhesion zones). They may also bind cells together at discrete spots (focal adhesions). They may also bind cells to the extracellular matrix (ECM) at spots called adhesion plaques.

It is thought that adherens junctions are required for contact inhibition and mutations in these genes seem to be responsible for certain cancers.

Desmosomes are similar in some respects to focal adhesions of the adherens type and also contain cadherins, but they link in to the intermediate filaments of the cytoskeleton:



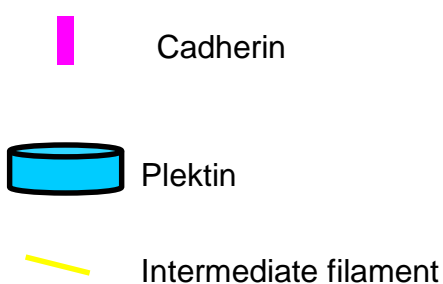
### Desmosomes



Desmosomes function like rivets. Pemphigus vulgaris is an autoimmune disorder in which antibodies are produced against desmoglein 3 (a type of cadherin). This results in blistering of the skin.

In the skin, the intermediate filaments are primarily **keratin** and the desmosomes hold the epithelial cells together and give the skin mechanical strength.

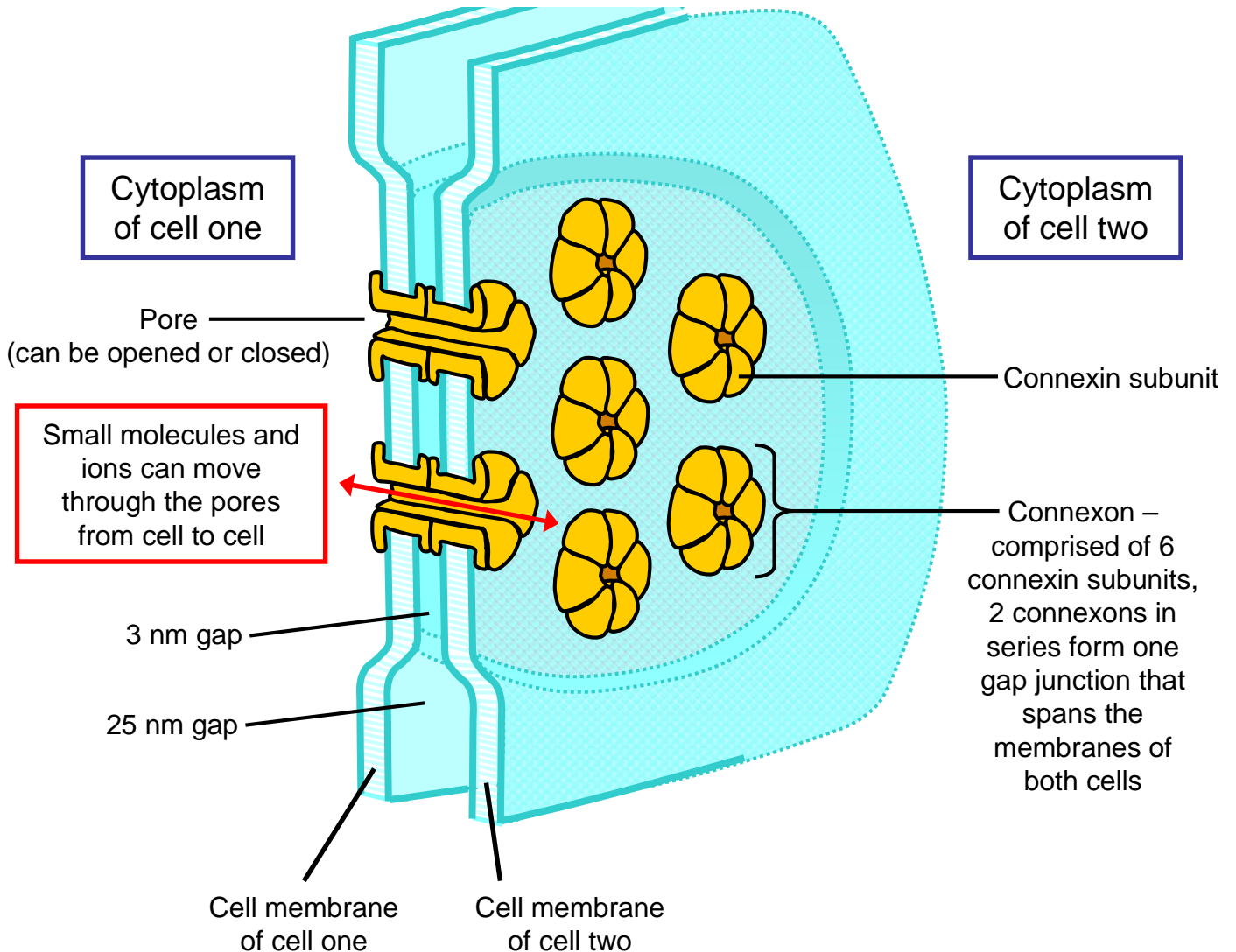
### Hemidesmosomes



Hemidesmosomes are rivet-like structures that connect the basal membranes of epithelial cells to the basement membrane (basal lamina) of the ECM. For example, in the skin, keratin intermediate filaments may connect to a plektin plaque which may connect to integrins which also bind to components of the basement membrane, such as **laminin**.

## Gap junctions

These are formed from proteins in the cell membranes that form hollow tubes through which small molecules and ions (with a molecular mass below 1000) electrochemical signals, such as  $\text{Ca}^{2+}$  (a second messenger) or  $\text{Na}^+$  can be delivered from one cell to its neighbours. If you touch a single cell in an epithelial sheet, then not only that cell will respond, but also its neighbours, as an electrical signal passes from the stimulated cell to the neighbouring cells via the [gap junctions](#).



Above: gap junctions connecting the cytoplasm of two neighbouring animal cells

Gap junctions are extremely important for coordinating cells in a tissue and tissues requiring precise coordination have lots of gap junctions, for example, cardiac muscle, which must beat in synchrony, or the smooth muscle of the uterus wall ready for child-birth. They also occur in certain locations in the nervous system as electrical synapses which are faster than chemical synapses, but are bidirectional rather than unidirectional. Gap junctions allow cells to communicate rapidly with their nearest neighbours. They are similar functionally to plasmodesmata in plants and certain junctions in some filamentous bacteria (such as the cyanobacterium *Oscillatorium*).