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School of Medical Sciences - Anatomy

## ANAT2241 Histology - Basic and Systematic Covering and Lining Epithelia

**COMMONWEALTH OF AUSTRALIA**


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## Covering and Lining Epithelia

### Lecture Objectives

1. Understand the function of epithelia
2. Understand the concept of covering and lining epithelia
3. Understand the classification of epithelia
4. Understand epithelial specialisations
5. Understand basement membrane and adhesion junctions

### Resources

- Wheater's Functional Histology
- II Basic Tissue Types - 5 Epithelial tissues pp82
- Practical Support Page
- [http://tiny.cc/ANAT2241\\_Epithelia](http://tiny.cc/ANAT2241_Epithelia)

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## Epithelia Function

- Barrier, protection
- Secretion
- Absorption
- Transport
- Sensory
- Development
  - epithelium and mesenchyma

### Resources

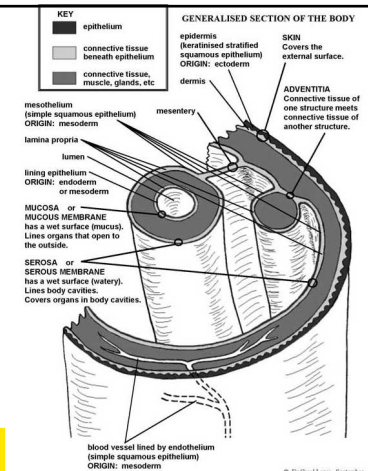
- Wheater's Functional Histology
- II Basic Tissue Types - 5 Epithelial tissues pp82

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## Location of Epithelia

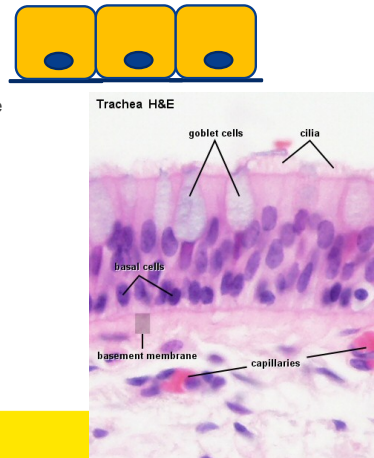
- **Covers** all free surfaces of the body
  - one side therefore free, and the other rests on basement membrane
- **Lines** the large internal body cavities
- **Mesothelium**
- Internal surfaces of blood and lymph vessels
  - **Endothelium**



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## Basement Membrane

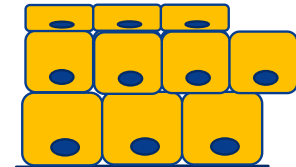
- Histological term for extracellular layer at base of an epithelium
  - ExtraCellular Matrix (ECM)
- Interface between epithelium and connective tissue
- Light microscope after staining
  - Not always visible
  - includes the **basal lamina**
    - Not visible by light microscope only EM



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## Classification of Epithelia

1. Number of cell layers
  1. Simple – one layer
  2. Pseudostratified – one layer
  3. Stratified – two or more layers

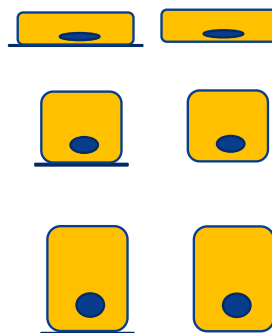


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## Classification of Epithelia

1. Shape of the cells in the **surface layer**
  - squamous cells
  - cuboidal cells
  - columnar cells
2. Shape of the cells in the **surface layer**
  1. squamous (scale- or plate-like)
  2. cuboidal
  3. columnar

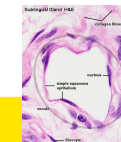
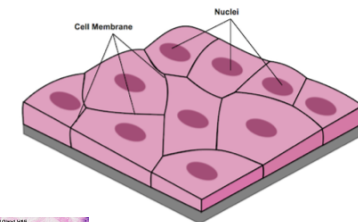


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## Simple Squamous Epithelium

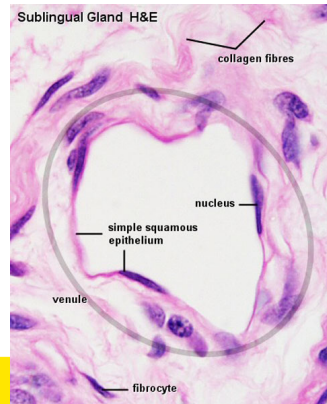
- Composed of a single layer of flattened, scale- or plate-like cells
- Common in the body
  - large body cavities, heart, blood vessels and lymph vessels
- Cell nuclei of the epithelial cells are often flattened or ovoid and located close to the centre of the cells



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## Simple Squamous Epithelium

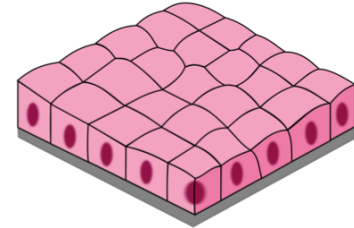


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## Simple Cuboidal Epithelium

- Cells appear cuboidal in sections perpendicular to the surface of the epithelium.
- Polygonal when viewed from the surface
- Locations
  - Glands - small excretory ducts
  - Thyroid gland - follicles
  - Kidney tubules
  - Ovary surface

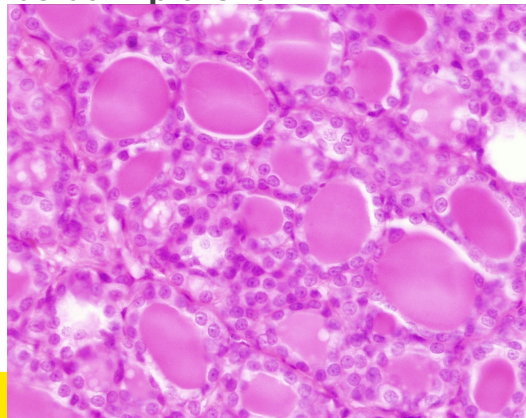


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## Simple Cuboidal Epithelium

Thyroid gland follicles  
(cat)  
Stain - H&E

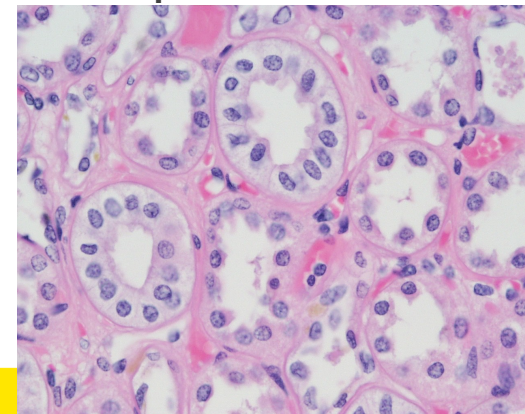


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## Simple Cuboidal Epithelium

Human Kidney  
Nephron collecting duct  
Distal tubule  
Stain - H&E

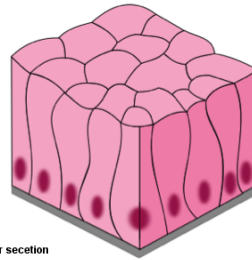
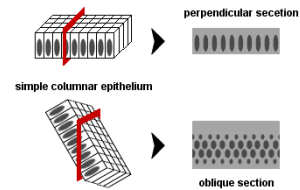


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## Simple Columnar Epithelium

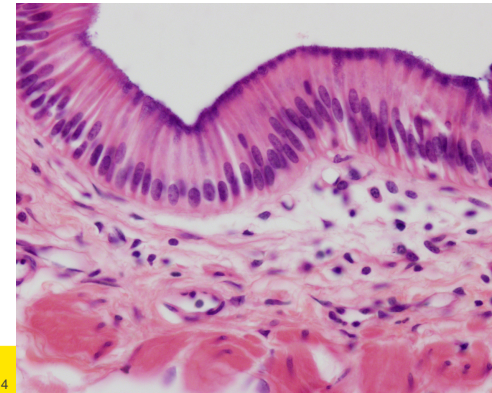
- Cells are taller than they are wide
- Cell nuclei usually located at the same height
- Cell nuclei often close to base of the cytoplasm
- Gastrointestinal tract - from cardia of the stomach to the rectum



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## Simple Columnar Epithelium – Bile Duct

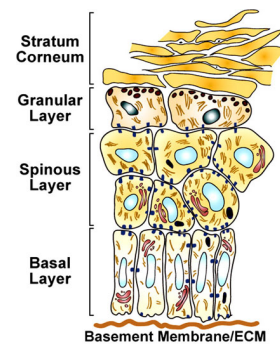


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## Stratified Squamous Epithelium

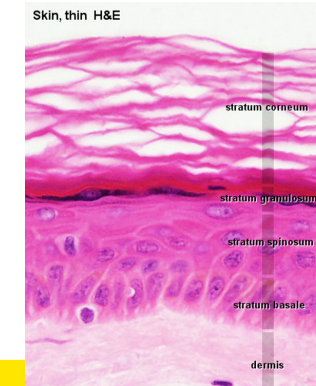
- Skin, oesophagus, tongue, vagina
- Epithelium may vary in thickness
  - depends on the number of cell layers present
- Cells in contact with the basement membrane, are cuboidal or columnar in shape.
  - Basal cell layer
  - Basal cells mitotically active
- Next layers are polyhedral shaped
- Surface layers flattened



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## Stratified Squamous Epithelium



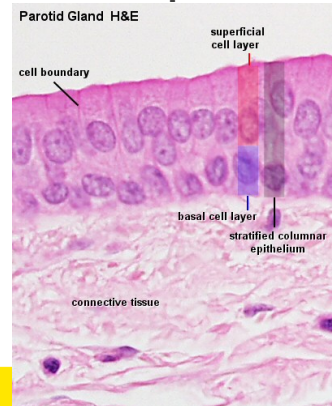
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## Stratified Cuboidal/Columnar Epithelium

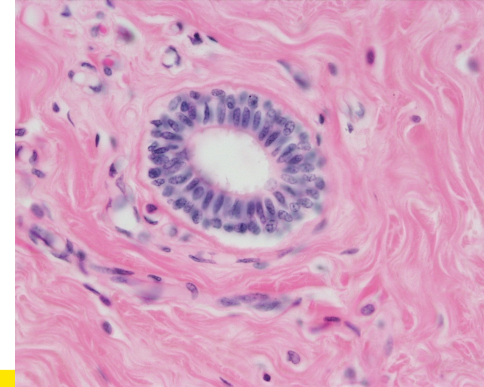
- An uncommon type of epithelia
- Two-layered cuboidal epithelium
  - Sweat gland ducts
- Stratified columnar epithelia
  - Mammary and large salivary gland excretory ducts



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## Stratified Columnar Epithelium - lactiferous duct



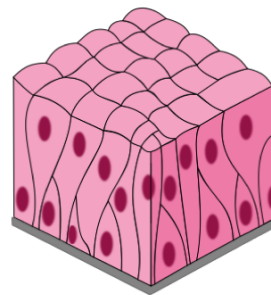
Stain - H&amp;E

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## Pseudostratified Columnar Epithelium

- All cells contact the basement membrane
- Not all reach the epithelium surface
- Cell nuclei located in widest part of cell
- Nuclei often located at different heights
  - gives the epithelium a stratified appearance "pseudostratified"
- Testis epididymis, excretory ducts of many glands



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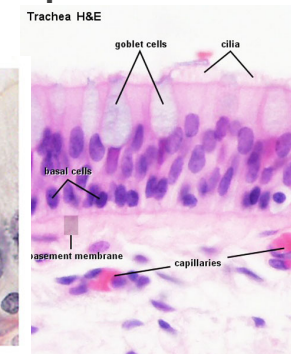
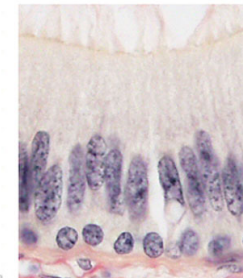


## Pseudostratified Columnar Epithelium

pseudostratified epithelium



Epididymis van Gieson



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## Pseudostratified Columnar Epithelium

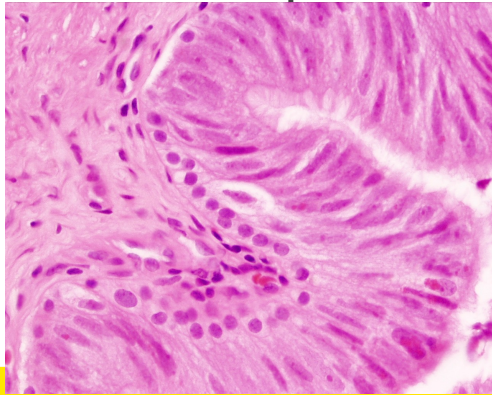
Human vas deferens

Pseudostratified columnar epithelium

Basal cells

Stereocilia

Stain - H&E

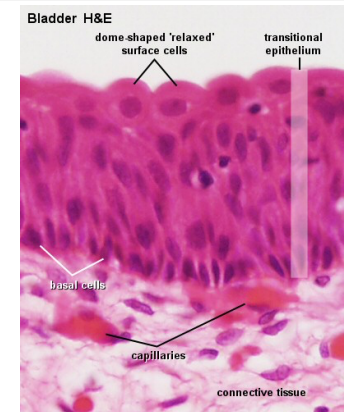


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## Transitional Epithelium

- Only in excretory urinary passages
  - renal calyces, pelvis, ureter, urinary bladder, and part of the urethra
- Surface cell shape varies depending upon tissue distension
  - "relaxed" appears as many cell layers
  - "distended" appears as only one or two layers

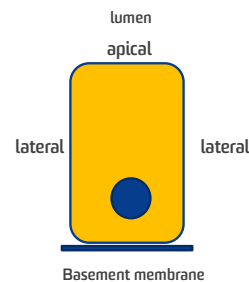


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## Apical Surface Specializations

- Epithelial cells can have a number of different apical specialisations
  - Microvilli
  - Cilia
  - Stereocilia

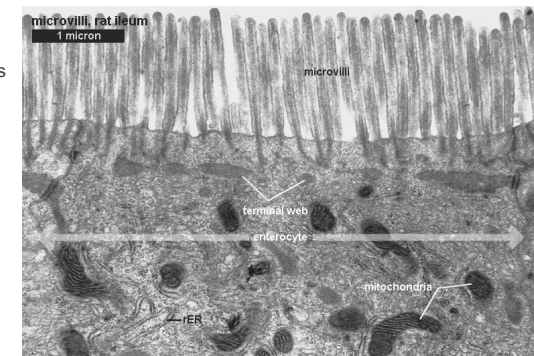


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## Microvilli Epithelium

- Microfilament filled
- Apical membrane extensions
- Increase surface area
- Absorption
- GIT - Small intestine

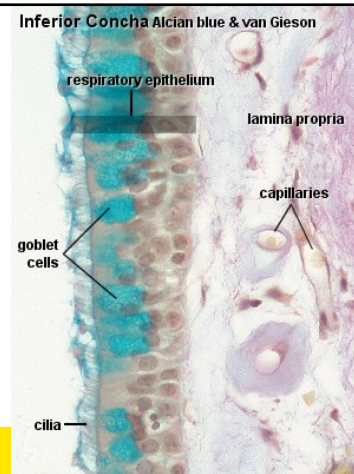


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## Ciliated Epithelium

- Microtubule filled
- Apical membrane extensions
- Motility
- Move lumen solutions
- Respiratory tract, uterine tube
  - Mucous movement



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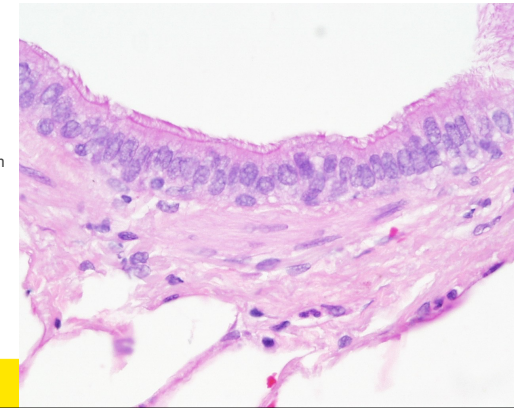
## Ciliated Epithelium

Human bronchiole

Simple columnar epithelium

Ciliated

Stain – H&amp;E

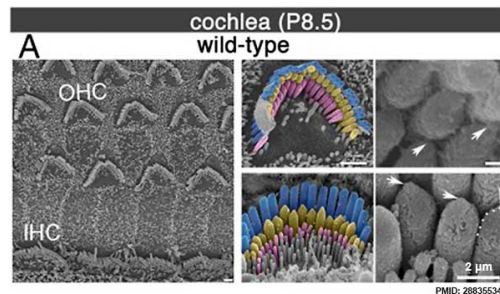


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## Stereocilia Epithelium

- Microfilament filled
- Apical membrane extensions
- Not motile
  - Careful not “cilia” MT
- Epididymis, ductus deferens
  - facilitate absorption
- Cochlea hair cells
  - Signal transduction
  - Hearing



PMID: 28835534

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Emptoz et al., (2017) PMID 28835534



## Pseudostratified Columnar Epithelium

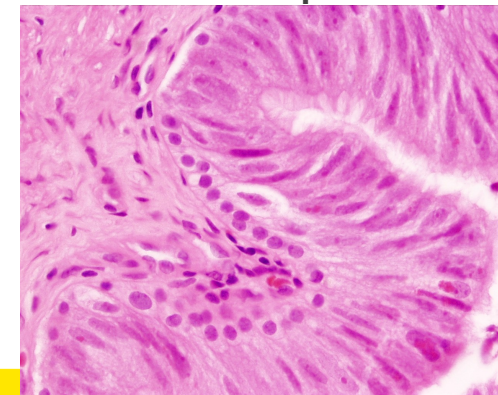
Human vas deferens

Pseudostratified columnar epithelium

Basal cells

Stereocilia

Stain - H&amp;E



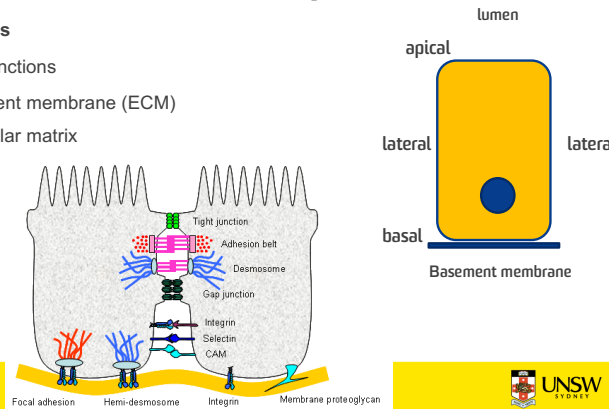
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## Lateral and Basal Surface Specializations

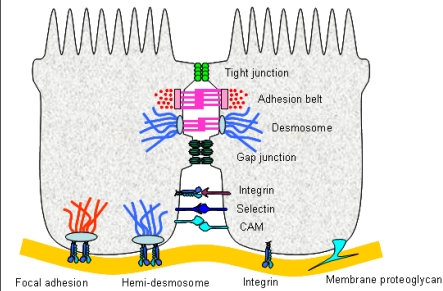
- Adhesion junctions
- Lateral – cell-cell junctions
- Basal – cell-basement membrane (ECM)
  - ECM - extracellular matrix



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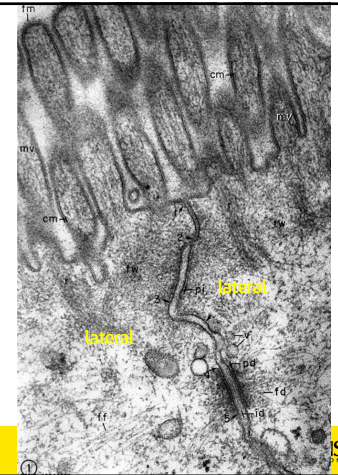


## Cell-Cell Junctions



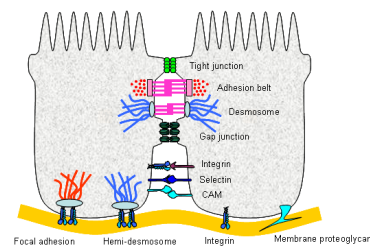
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Electron micrograph



## Lateral Surface Specializations

- Cell-Cell junctions
  - several different types in the one cell
- Tight Junction
- Adherens Junction
- Desmosome
- Gap Junction

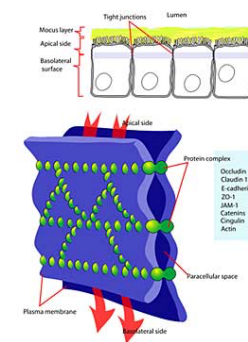


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## Tight Junction - zonula occludens

- Fusion of 2 plasma membranes
  - acts as a “seal”
- located on epithelia linings
  - digestive system gut, ducts, cavities of glands, liver, pancreas capillary walls urinary bladder
- central nervous system
- blood-brain barriers
  - brain capillaries and choroid plexus (modified cuboidal epithelium)

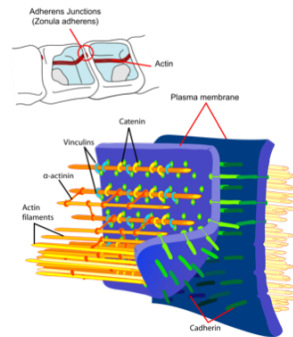


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## Adherens junctions - zonula adherens

- plasma membrane proteins linked to **microfilaments (MF)**
- anchor plaque occurs under membrane
- heart muscle, layers covering body organs, digestive tract

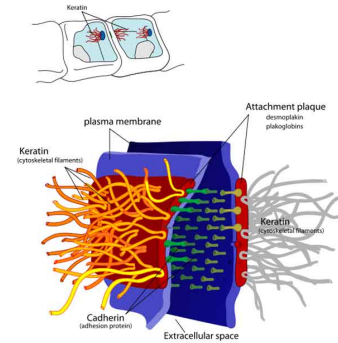


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## Desmosomes - macula adherens

- plasma membrane proteins linked to **intermediate filaments (IF)**
- dense plaque that occurs under the membrane
- *desmos* = bond
- skin, lining of internal body cavity surfaces
- disappear when cells are transformed

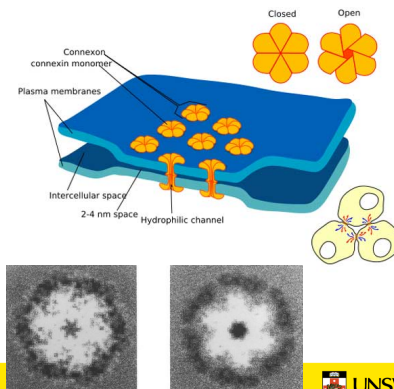


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## Gap Junctions

- Plasma membrane proteins linked to each other
- two hemi-channels
- form hollow 1.5 nm diameter cylinders
- Used for rapid communication
- Electrical and chemical integration
- Act as single functional unit
- Heart muscle, smooth muscle, embryo blastocyst cells



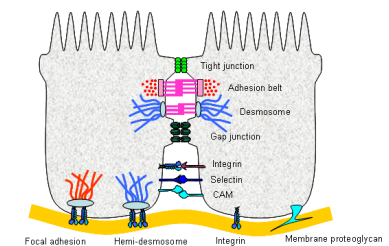
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Electron micrograph



## Basal Surface Specializations

- Cell-Basement Membrane junctions
- several different types in the one cell
- Hemi-Desmosome (IF linked)
  - "hemi" (= half)
- Focal Adhesion (MF linked)
  - Half an adherens junction



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