Lecture 10-cell processes-cell surface structures

- Cell surface extensions play a role in: movement of cells, movement of extracellular material along cells, detect movement in extracellular material, enlarge surface area of cell and thus support function, assist in cell to cell contact strengthening.
- Cell surface structures are associated with the cytoskeleton.
- **Cilia and flagella:**
- Flagellum is the tail on a sperm cell- help them move.
- **Cilium**- found on epithelial cells. Some of these cells look like they have a lawn of grass on them but is actually cilia.
- Both cilia and flagella are associated with microtubules.
- Capable of movement- need ATP for energy.
- Cillia are many hair like structures where flagella are one longer tail
- Cilia create movement in extracellular material in fluid that are outside the cell.
- Flagella create movement of the whole cell e.g. sperm.
- In C and F, microtubules are arranged in a **9+2 array.** In middle, have 2 microtubule surrounded by 9 mtubules doublets. The whole thing is then surrounded by a plasma membrane.
- The doublets have dinein molecules in them.
- Microtubules are supported by additional proteins. Dynein arms are most important protein here. They make contact with neighbouring doublet and create movement using ATP.

Figure 1-left is flagella, right is cilia.

- Mtubules grow from basal body. They have a covering around them and this become C or F.
- **How do C and F move?** The action of dynein and ATP causes mtubules to slide. The dynein heads periodically contact an adjacent doublet and move along it.
- Proteins link and connect the external doublets with the central mtubules. This holds the structure together and converts the sliding dynein action into bending. THINK OF TWO PLANKS OF WOOD SPERATED BY A ROPE. WHEN ONE PLANK SLIDES UP, THE OTHER ONE HAS TO FOLLOW SINCE IT IS ATTACHED. THIS OCCURS AND THE MOVEMENT IS CONVERTED INTO A BENDING MOTION.

Figure 2-this is a transverse view of a cilia or flagella

- What happens if dynein is missing? If a mutation occurs that stops dynein production, the cilia can't move! **This can cause infertility- the sperm cannot move!**
- **Epithelial cells**- in nose, the cilia help to move pathogens and dust to the outside of the body- make mucus which traps all the stuff in it. If no cilia function, we can't get rid of pathogens and dust in respiratory tract- get pneumonia and respiratory disease.
- **Cilia:** can only just see using a light microscope. They extend from the free surface of the cell and there are several hundred cilia per cell.

- **Work together in a coordinated fashion-** they pump and create a **wave** that sweeps across the epithelium that moves mucus from body to the outside.
- They have a fast forward stroke which is followed by a flexible slower recovery stroke.
- In respiratory tract-move mucous in a wave.
- Reproductive tract- propel sperm and eggs.
- Also found in central canal of spinal cord and ventricle of the brain
- **Flagella:** are just one long cilium. They perform rapid successive waves of bending in the direction of the attached end to the free end.
- **Microvilli**: much more passive, can be blob like projections and also closely packed uniform projections.
- Relatively small.
- They increase surface area to increase absorption.
- Cannot see with a light microscope.
- Supported by 20-30 parallel actin filaments (microfilaments).
- Actin filaments anchor to the plasma membrane via myosin at the tip and sides of the microvilli.
- May be found on apical surface of epithelia.
- Found in small intestine for increased nutrient absorption. The intestine has folds in it-microvilli live in there.
- Can't see individual microvilli using a light microscope.
- **Stereocilia:** long and rigid microvilli-narrow at base and wide at tip.
- Aggregate into a bundle
- They can identify if there is movement in extracelluar material.
- They are at sensory surfaces e.g. taste buds, cochlear in the ear-detect movement for balance.
- **Filopodia and lamellipodia:** made from actin. Are an irregular cell protrusion that allow crawling of cells e.g. WBC migrating, axons growing in nerve cells.
- Actin filaments actively grow and shorten and push the cell surface forward in sheetlike (lamellipodia) or thin like microvilli (filliopodia) protrusion.
- These protrusions stick to favourable surfaces via **integrins**- sticky molecules. They make contact with a surface and then cell pushed out Lamellipodium. Cell shortens the L and then pulls itself along.
- **Integrin deficiency:** Leukocyte adhesion deficiency. When there is an infection, the WBC can't move! Animal has constant bacterial infections.
- **Lateral and basal cell surface folds:** lateral surface of epithelial cells-seen in cells where fluid rushed past cells at very high speed. These folds create a better boundary for the cells. FINISH.

Figure 3- lamellipodia are a blob like cell extension.

Lecture 11 cell-cell connections

- Many cell-cell connections found in epithelial cells.
- Epithelial sheets play a similar role in multi cell organisms as does the plasma membrane in a single cells.

- This creates a selectively permeable barrier
- Have to be receptive to info from the outside.
- Create compartments in our body
- Come in different shapes- have apical and basal surface. Basal layer sits on basal lamina.
- Because they are a selective barrier and control what comes into cell, they need to work together and need ways to communicate between each other.
- They have cell junctions-ways of connecting the cells.
- Some withstand mechanical stress so cells don't lose contact with each other when have pressure on them.
- Other ones allow for effective communication between cells.
- **Tight junctions: zonula occludens.** Only found in epithelial cells. Are a continuous belt of transmembrane proteins of neighbouring cells. They are strands of tight junction proteins. They help link the outer edges of adjacent membranes to stop "leakage".
- They have a sealing function. This is important because means we can have control as to what leaves and enters cells.
- Tight junctions require transmembrane transport and transcytosis (have vesicles that take up material and take it past the junctions)- this is how stuff gets through them!
- Tight junctions assist in maintaining cell polarity. Means they can help certain proteins stay on certain sides of the junction where they are needed.
- **Cytoskeleton linked junctions:** main role is to help cells withstand mechanical stress. Help cells not to lose contact and rip apart. Have three types:
- **Cell to cell contact-**adherins junction, desmosomes.
- **Cell to basal lamina:**
- **Adherens:** are a belt like structure below the tight junction in epithelial cells. They allow the cytoskeletons of different cells to attach to each other.
- Actin network can be contractile- important during embryonic development as epithelial sheets can bend to form tubes and vesicles.
- **Desmosome: macula adherens.** Circular areas of contact between cells. Can't be seen with light microscope.
- Cells are held together with transmembrane linker proteins (cadherins) which are linked to intracellular attachment proteins which are attached to intracellular intermediate filaments e.g. keratins.
- Help withstand mechanical stress.
- They link cytoskeleton of neighbouring cells to maintain integrity of tissue and resist mechanical stress.
- **Hemidesmosome:** connect cells to basal lamina. Circular shape.