30: TISSUE TYPES and EPITHELIAL TISSUE (part 1)

Now that we've finished our study of cells, we are ready to see how cells cooperate to form tissues. Tissues will then combine together to form organs. Organs are connected in various ways to make our major body systems such as the respiratory system or the digestive system. Finally, the systems are all interconnected so that they all function together as a unit— a whole body.

All cells in the bod, except egg and sperm cells, can be classified into one of four categories. Just four! With all the many different types of cells, you'd think there would be more categories. Admittedly, it's a stretch for a few of the classifications, especially blood cells. However, this classification system works well enough that it probably won't change any time soon.

The four main tissue types are: ***epithelial, connective, muscle, and nervous***.

Epithelial tissue is used as a covering, both outside and inside. The top layer of skin, the ***epidermis***, is epithelial tissue, and so is the lining of the lungs and the digestive tract. Epithelial tissue is designed to be replaced often so it can take the wear and tear of touching and rubbing against things. It will also absorb things from the environment, both nutrients and toxins.

Connective tissue is used to bind and support body parts. By definition, connective tissue occurs in a ***matrix***. This means the cells are in some kind of solid, liquid, or gel. Connective tissue includes ligaments, tendons and cartilage, but it also includes bone, blood and fat cells. You might be able to guess that bone will be in a solid matrix and blood will be in a liquid matrix.

Muscle tissue is designed for movement. Protein cables called actin and myosin will work together to cause cell fibers to slide past each other. Muscles cells are very strange, forming long "megacells" with hundreds of nuclei. There are three types of muscles tissue: ***voluntary*** (the ones you can move), ***involuntary*** (the ones you have no control over, like in your intestines) and ***cardiac*** (in the heart).

Nervous tissue is made of cells called ***neurons***. This type of tissue is designed for communication and uses electricity to pass signals from cell to cell. Nervous tissue is found in the brain, the spinal cord and the peripheral nerves (nerves in the body).

Epithelial tissue is our exterior covering, both inside and out. ("Epi" means "on," and "thele" means "teat or nipple." So originally, back in the early 1700s, the word epithelial meant just the skin around the nipple area, which looks different from regular skin. Eventually, scientists realized that the two types of skin were basically the same and the word was adopted for all skin areas.) Epithelial cells come in three basic shapes: ***squamous*** (flat and wide), ***cuboidal*** (like a cube), and ***columnar*** (like a column). Each type of cell is very good in a certain application, as we will see in the newt lesson. A specialized type of columnar cells is the ***goblet cell*** that produces mucus.

All epithelial tissue is built on ***basement membrane***, which is a layer of protein cables of different types. The connections found in the basement membrane are very mechanical— great examples of protein gadgets. The epithelial cells themselves are held together by adhesion junctions that use ***desmosomes***. Desmosomes have ***attachment plaques*** on the inside of the plasma membrane so that the protein cables won't pop out of the membrane. The plaques help to spread out the pulling force over a larger surface area, thus reducing the pressure at any one point. (Remember, the consistency of the plasma membrane is similar to olive oil— soft and fluid.) The cables that go across between the plaques are actually half-cables coming out from each side. The half-cables meet in the middle, with a connection that might be thought of as biological Velcro®. (Cells can dissolve and rebuild desmosomes very quickly. We'll see this again in later lessons.) On the inside, the plaques are attached to the cytoskeleton that runs all over the inside. Thus, again, we see pulling and stretching forces being spread out over a large area to prevent tearing at any one point. NOTE: There might also be gap junctions present so that the cells can communicate.)

On the bottom, there are ***hemidesmosomes*** (half-desmosomes) that attach to the basement membrane. The basement membrane is not made of cells, but of protein cables. Mostly, these cables are made of a type of protein called ***collagen***. We will take a look at the molecular structure of collagen in lesson 32. There are different kinds of collagens and they are known by Roman numerals. Some sources say that there are 16 types of collagen, but others will say up to 28 have been discovered. Here we see collagens I, III, IV and VII. The top layer of basement membrane is called the ***basal lamina*** and it has two layers: a top layer consisting of protein hooks and a bottom layer made of fibers of collagen. (These hooks are made of proteins called ***laminins***.) Under the basal lamina there is a layer called the ***reticular lamina***. (Remember, "rete" is Latin for "net," so when you see a word starting with "reti-" expect to see some kind of network.) The reticular lamina is made of more collagen fibers, and looping fibers woven throughout it, connecting up to the laminin hooks. The basal lamina and the reticular lamina together make the basement membrane.

Beneath the basement membrane, you will often find another layer of connective tissue. In the skin, it will be the dermis layer. Remember that skin is made of two layers, the epidermis and the dermis, with the basement membrane in between. Only the epidermis is made of epithelial cells. The basement membrane in skin is often where a blister will form. Those protein cables get broken as your skin rubs back and forth against something (such as a rake handle). The epidermis separates from the dermis and a space opens up between the two. The immune system senses damage and immediately fills the space with fluid that has many immune cells in it. As the blister heals, new epithelial cells and new basement membrane will grow and will replace the old, damaged ones.