Tissues

Tissues are groups of cells that have a common function. There are four basic kinds of tissues in the body:
- Epithelial
- Connective
- Nervous
- Muscle

Epithelial Tissue

Epithelial tissue (epithelium) has two basic functions. (p 108) It is the covering or lining of organs and cavities and it functions in glands to secrete chemical substances. The outer layer of skin is an epithelial tissue as is the lining of the intestine, vagina, blood vessels, etc. It has many functions. In the kidneys, it is important in filtration and excretion; as skin, it provides protection; in the intestine it is important in absorption. In glands (sweat, stomach), secretions are its function.

All epithelia have certain common characteristics. (p109) Every epithelium has an apical and a basal surface. The apical surface may be the outside of the organ or it may be the surface closest to the lumen of our hollow organs. The basal surface is attached to the underlying connective tissue and rests on the basal lamina, a non-cellular material. The basal lamina rests on another lamina secreted by the connective tissue and together they form the basement membrane. Epithelial tissue cells fit tightly together and form continuous sheets. It also is always avascular, meaning there are no blood vessels in epithelial tissue. For that reason, epithelium is always very thin – it can never be too far away from blood which supplies nutrients and O_2 to all cells. Lastly, epithelial cells have a high rate of mitosis. Because they line organs, they easily erode and must be regenerated.

Epithelium is classified according to its shape and according to the number of cell layers. (pp 109 - 114) It may be simple epithelium which means it is only one cell layer thick, or stratified which means it is at least two or more layers. As to shape, it may be squamous (flat), cuboidal (like a square box) or columnar (elongated). This gives us six types:
- simple squamous. Examples: lining of blood vessels, lung alveoli, kidney glomeruli
- stratified squamous. Examples: outer layer of skin, lining of the esophagus and vagina
- simple cuboidal. Examples: kidney tubules, secretory parts of small glands.
- stratified cuboidal. Example: ducts of certain glands
- simple columnar. Examples: inner lining of uterus and fallopian tubes, lining of stomach and intestine
- stratified columnar. This is rare in the body and you need not know specific examples.

In addition to these, there are two other types. Pseudostratified epithelium in which there is one layer of differing heights. All rest on the basement membrane but some may not reach the apical surface. (Example: lining of trachea) Transitional epithelium is composed of both stratified squamous and stratified cuboidal (or columnar). We find this type in certain organs that stretch, such as the urinary bladder.

Glands contain epithelial tissue that secrete certain products (secretions). (pp 114 -115) They may be unicellular such as goblet cells that secrete mucus to moisten and lubricate the linings of the trachea and intestines, but are usually multicellular. These latter glands may be exocrine glands which secrete their products on to surfaces by way of ducts. Sebaceous glands in our skin and the bile-producing liver are exocrine glands. Other glands are ductless, secreting their products directly into the bloodstream. These are referred to as endocrine glands such as the adrenal glands and the pituitary. Some glands have both an exocrine and an endocrine function such as the pancreas. Exocrine glands may be further classified as simple, having an unbranched duct (stomach glands) or compound, having a branched duct (salivary glands).

Connective Tissue

Connective tissues vary widely in their function and appearance but all have common elements (pp 117 – 120) – cells and extracellular matrix. The latter is made up of ground substance and fibers. Ground substance is found between cells and contains non-cellular material such as interstitial fluid, proteins and other substances and may be gel-like, liquid or even hardened materials. The extracellular matrix also includes the fibers found in the ground substance and of which there are three kinds: (p119)

- collagen fibers made of the tough protein collagen and gives the tissue the ability to resist stress.
- elastic fibers which allow structures to stretch and then resume their original shape.
- reticular fibers which form networks to support soft tissues.

Connective tissues also arise from the same embryonic tissue called mesenchyme.

The following are all types of connective tissue. (pp 121 – 127)

1. Areolar connective tissue. This has a loose arrangement of all three types of fibers and a number of different cells including fibroblasts (fiber producing cells), white blood cells and mast cells (both important in our immune system) and a few fat cells that store the nutrient fat. It contains a lot of water and ions. It is the packing material around organs often binding different tissues together.

2. Adipose tissue. The cells (Adipocytes) contain large amounts of fat – so much that the nucleus is often pushed to just inside the cell membrane. Adipocytes store the nutrient fat, protect certain organs by providing a cusion around them (kidneys) and provide insulation to conserve body heat (subcutaneous fat).

3. Reticular connective tissue. This contains only reticular fibers and loosely connected cells that support certain soft organs such as the spleen and lymph nodes.

4. Dense connective tissue. This may be of two kinds – dense regular and dense irregular depending on the degree to which their fibers are parallel to one another. It is composed of mostly collagen and a few elastic fibers. It is poorly vascularized. Tendons, ligaments, and the fibrous capsules around joints are composed of dense connective tissue. It is also found in the dermis of the skin.

5. Cartilage. Cartilage is very firm despite its being composed of mostly water. It is firmer than dense connective tissue but not as firm as bone. It is avascular and the cells (chondrocytes) lie in spaces within the extensive matrix. Three kinds of cartilage are recognized. Hyaline cartilage is very firm, glass-like in appearance and found in ribs, nose and trachea. Fibrocartilage can resist compression and is found in the discs between the bone of the spinal column and the discs of the knee. Elastic cartilage has more elastic fibers than the other two and is found in the outer ear and the epiglottis.

6. Osseous (bone) tissue. Bone receives its hardness due to calcium compounds in the extracellular matrix. A certain amount of flexibility is attained by large amounts of collagen. Bone is well vascularized. The cells (osteocytes) also occur within lacunae. It functions chiefly to support and protect.

7. Blood. The cells are red blood cells (erythrocytes) and white blood cells (leucocytes). The extracellular matrix is the very watery plasma. Fiber-like proteins are present in clots.

Nervous Tissue

Nervous tissue (p 129) is composed of neurons which transmit electrical impulses, the main communicating system of the body. They are found in the brain, spinal cord and nerves. Nerve cells contain a cell body in which the nucleus is found, and cytoplasmic extensions called dendrites (which transmit impulses toward the cell body) and axons (which transmit impulses away from the cell body). Other kinds of smaller cells which play various types of supporting roles in the nervous system are known collectively as neuroglia. These do not play a role in transmission.

Muscle tissue

Muscle tissue (pp 130 – 131) is capable of contraction and functions to produce various types of movement within the body. There are three kinds:

1. Skeletal muscle (Voluntary muscle). These muscles are usually attached to bone and produce voluntary movement and locomotion. The cells are striated (striped) and multinucleate.

2. Smooth muscle. These muscles are involuntary, not striated and uninucleate. They occur in the digestive, reproductive, and urinary systems and in blood vessels to move substances through the body.

3. Cardiac muscle. This is found only in the heart. The cells are branched, striated and usually uninucleate. The desmosomes between the cells appear as thickened structures called intercalated discs.

Membranes

Membranes are continuous multicellular sheets that line or cover body structures and are made of both epithelial tissue and connective tissue bound to one another by the basement membrane. There are four types: (pp 132 – 133)

1. The cutaneous membrane or skin. The cutaneous membrane is made of stratified squamous epithelium overlying dense connective tissue. It is, of course, exposed to the air and, unlike other membranes, is dry.

2. The mucous membrane. This membrane lines the hollow organs of the body – alimentary canal, trachea, urinary tract, reproductive tract. It rests on loose connective tissue and is a wet membrane because of secretion such as mucus. Mucus is not produced in the urinary tract but is kept moist by urine. We often use the term “mucosa”, e.g. the intestinal mucosa.

3. Serous membrane. This type of membrane is composed of simple squamous epithelium overlying areolar connective tissue. Two serous membranes, parietal lining the cavity and visceral wrapping the organ, are separated by a lubricating fluid. Special names are often assigned to the membranes according to their location. Examples: pleura in the thoracic cavity, peritoneum in the abdominal cavity.

4. Synovial membranes. Synovial membranes are the exception in that they are composed entirely of connective tissue. They line joint cavities and they will be discussed later in the semester.