BASIC HISTOLOGY LAB

When it comes to organizing an organism, cells are the basic units of life which come together with matrix to form tissues. Tissues come together to form organs followed by organ systems and the entire organism. Many students get caught up early attempting to learn all tissues and the properties. I will use the model that determines structure and attempt to simplify histology to present it later in a more complex clinical histology. In essence, a tissue is a collection of cells held together by a matrix which can include almost anything. In tissues, cells work in concert to perform certain and specific functions. These functions are dependent on the structure of the tissue.

As matrix can be just about anything, it will suffice to say that it is the non-cellular aspect of tissue. There are four classes of tissues that are divided into more specific tissue types. The simplest way to look at the type of tissues is to look at how they are microscopically similar. We can begin with the relative amount of matrix within it.

Epithelial/ endothelial tissue usually lines organs. It is found inside the lumen of body tubes, lining body cavities, the outer layer of skin, and the alveoli. If we look at the tissue itself, we see many cells with the matrix being found predominantly in the basement membrane, or the floor holding the cells together. For the most part the major difference between epithelial and endothelial tissue is where in the body it is found. As the root endo means inside than the tissue lining blood vessels is endothelium. Epi means top so the tissue on top of your skin is epithelium. This tissue's characteristic is many cells with little matrix which is found on the bottom layer called the basement membrane.

The cells of epithelial tissue can be either simple (one cell layer thick) or stratified (many layers). Besides the layers, this tissue can have variations on cell shape. The three major types can be squamous or flat, cube-shaped (cuboidal) or Columnar.

1. What is a tissue?

2. What are the four classes of tissues and what makes each different?
    1. Many cells little matrix:
    2. A lot of matrix fewer cells
    3. Contract:
    4. Sends messages to neighboring cells a far distance away:

3. Define the difference between simple and stratified when it comes to epithelial tissues.

4. Draw a single layer of flat cells and label the tissue type, basement membrane and cells?

5. Draw a single layer of cubed cells and label the tissue type, basement membrane and cells?

6. Draw a single layer of columnar cells and label the tissue type, basement membrane and cells?

7. Draw a tissue with multilayered flat cells and label the tissue type, basement membrane and cells?

Connective tissues, the most numerous in the human body, are made up of more matrix than cells. This is seen in blood, tendons, ligaments, etc. These tissues connect the different organs of the body and allow the support needed to maintain life. There is one tissue that is an exception to this rule which is adipose, or fat, tissue.

Connective tissue proper can come in various forms. The first is a temporary tissue called Mesenchymal connective tissue which is composed of non-specialized cells which can become most other connective tissues. Other connective tissue proper fall under the arrangement of the fibers within them. They can be dense or loose, regular, or irregular. These tissues are made from fibroblast where fibro is fibers and blast mean maker.

Dense regular connective tissue is usually found either connecting bone to bone as ligaments or connecting muscle to bone as tendons. Fibroblast secretes the proteins of collagen and some elastic fibers. Dense regular connective tissue is mostly composed of cells within a matrix which lack a blood supply. This means that while the tissue is extremely durable, if it is damaged it may continue to cause problems though out life. After staining, the nucleus of the fibrocytes (fibroblast stuck in the tissue) becomes visible as a dark elongated structure within a collection of collagen fibers.

Another dense connective tissue that can sometimes be found in the ligaments of loose joints as well as around organs and in the dermis of skin is the dense irregular connective tissue. This connective tissue tends to maintain the round shape of the nuclei maintaining with an irregular arrangement of the collagen fibers. It is important to note that dense irregular connective tissue can also be found in the second layer of skin called the dermis, around bones as a membrane called the periosteum, and around cartilage called the perichondrium. As can be noticed Peri- will mean around.

The another type of connective tissue proper is loose irregular connective tissue, also known as areolar tissue. This tissue is usually found between different tissues and as the name suggests, it is composed of loose irregular fibers. One slides, you can see through most of it.

8. Copy an image of what is seen in Dense regular connective tissue at highest magnification, Label the cells that make this tissue. Draw in the collagen fibers.
9. Name two places where the above is found can be found.

10. What fibers make this tissue?

11. Look at a slide of dense irregular connective tissue and draw it next to the picture provided. Note the difference in appearance compared to the Dense Regular connective tissue then draw and label what you see in dense irregular connective tissue.

12. Draw what is seen in a slide of areolar tissue labeling the cells and fibers.

Within connective tissue proper group, there is one called Elastic tissue. Rather than having mainly collagen fibers, Elastic tissue is composed mainly of a protein called elastin. This protein allows for the tissue to recoil after it has become stretched. This tissue is found in the tunica adventitia of large arteries and is needed to recoil after the pressure that the heart produces with each beat.

13. Draw what is seen on a slide of elastic connective tissue.

14. What are the proteins found in elastic connective tissue?

Once we see the connective tissue proper, we can begin to look at the more specialized connective tissues. These tissues include three cartilages, two bone tissues, blood, reticular tissue, and adipose tissue. Cartilage has many different functions in the formation of, adult, and support of the skeletal system. There are three types of Cartilage, each has a particular the function.

Hyaline is the most abundant type of cartilage. It has a smooth look to it and is formed by a cell called a Chondroblast (chondro for cartilage and blast for maker.) When the tissue is complete a cell, called a chondrocyte, (cyte for bag or in this case a cell) occupying a cavity called a lacuna. This type of cartilage provides support, elasticity, and resistance. It is the cartilage that is the precursor for the long bones of the skeletal system.

Next, we have elastic Cartilage which is made of bent strands of collagen and elastin which is found in epiglottis and external ear. It gives flexibility as will be needed in these areas. The last type of cartilage found in the human body is Fibrocartilage. Fibrocartilage is found in joint spaces that are under weighted stress or in joints needing more strength due to stress such as holding the hip bones together. Looking at all cartilages, we see chondrocytes surrounded by matrix. This is because the Chondroblast in surrounding perichondrium starts secreting the cartilage matrix and becomes trapped inside.

15. Where is each cartilage found in an adult human?
    a. Hyaline cartilage
    b. Elastic cartilage
    c. Fibrocartilage
16. Draw what is seen on a slide of hyaline cartilage at highest magnification labeling the chondrocyte, matrix, and lacunae.

17. Draw what is seen on a slide of Elastic cartilage at highest magnification labeling the chondrocyte, matrix, and lacunae.

18. Draw what is seen on a slide of fibrocartilage at highest magnification labeling the chondrocyte, matrix, and lacunae.

19. Define chondro:

20. Define lacunae.

Before looking at osseous tissue, it helps to know how it was made. The process of bone making is called Osteogenesis and begins week eight post-conception. It is important to remember that all cartilage and bone cells form the mesoderm. Early during the third week when the primitive streak starts to form, some cells become a rod like structure called the notochord (making the embryo a chordate) this initiates neuroplate formation. Late in week three, an invagination of ectoderm occurs being called the neural tube. This will become the brain and spinal cord.

On about day twenty, some cells from the mesoderm begin to differentiate into what are called Somites. These will divide into three parts, the important one for bone development is the sclerotome (sclero means hard tome is layer) which migrates around the notochord and the neural tube. The sclerotome will become a mesenchyme membrane made up of a special connective tissue, called Mesenchymal connective tissue, and surrounds the brain and spine. The mesenchymal membrane will become the skull and vertebrae. In the

areas that will become long bones, this membrane is invaded by chondrocytes that will lay down hyaline cartilage to form the first skeleton of the embryo.

On week eight, Osteogenesis begins in two ways. Intramembranous Ossification bone forms membrane bone (bones of the skull and clavicles). Cells of the mesenchymal membrane become osteoblast (Osteo= bone blast=maker). The cells begin to secrete organic bone matrix (mostly collagen) and form a structure called an osteoid, trapping themselves within it. Osteoids formed around embryonic blood vessels leading to the formation of a woven structure. Together this leads to a structure called an Osteon composed of a central canal holding a blood vessel and nerve. This protein matrix is fixed with inorganic calcium phosphates salts, called hydroxyapatite, which mineralize the bone matrix under the influence of osteoblast.

21. Define the following:
    a. Osteo
    b. Cyte
    c. Blast
    d. Clast
    e. Intra
    f. Endo
    g. Peri
    h. Sclero
    i. Tome

Osseous tissue has two variants, compact and spongy depending on where the tissue is found. The two areas are noticeable when whole bone is cut. On the outside we find the cortex made up of compact bone and the inside area called the medulla is made up of spongy bone. Starting at the central canal, where blood vessels and nerves come in, we find concentric circles called concentric lamellae. Between the lamellae are holes called lacunae where osteocytes are found. Within the lamellae are small canals called canaliculi where portions of osteocytes cell membrane reach towards the nutrients. There are many osteons within compact bone so filling the areas between the concentric lamella are interstitial lamellae. Within the medulla of bone is the medullary bone composed of trabecula with osteocytes embedded within.

22. What cells form bone?
23. What cells break down bone?
24. Draw what is found in ground compact bone, label the central canal, Canaliculi, lacuna, and osteocyte.

25. Draw what a slide of spongy bone.

The following specialized connective tissues are Reticular, Blood, and adipose tissues. Reticular tissue is composed of transient cells (cells that may not always exist in the organ) and makes up most soft organs. These include the Spleen, tonsils, and red bone marrow. Reticular tissue (reticular means net-like) is composed of various structural proteins called reticular fibers. Blood tissue has three components which can only be seen if whole blood is spun. These are plasma, made up of proteins and fluid, and the formed elements which is the cellular portion of blood. Most cells found within blood do not have nuclei so once they leave the bone marrow they cannot reproduce. Adipose tissue is another important connective tissue composed mainly of adipocytes. The adipocyte (adipo- fat) is a modified cell with a large lipid droplet.

26. Define the following:
    a. Reticular
    b. Adipo
27. Look at a slide of reticular tissue and draw what you see. Label the reticular fiber.

28. Draw what is seen in a slide of blood smear.

29. Draw what is seen in a slide of adipose tissue.

The next two tissues are classified by their functions. Contractile tissue is found in the musculoskeletal system, myocardium, and on skin, blood vessels, and intestines. These three types are called; Striated skeletal muscle, striated cardiac muscle, and smooth muscle. Striated means striped and is seen in Striated muscle because of the thick and thin filaments within them. While smooth muscles have the same proteins, they are not arranged in alternating patterns, so they do not show up too well on slides.

Striated skeletal muscle is composed of non-branched multinucleated cells. This is due to embryology where the myoblast fuses to make long cylindrical fibers. Straited skeletal muscle is under voluntary control so requires nerves to send it the message. The Striated Cardiac muscle differs in that it may have 1, 2 or 3 nuclei and the myocardiocytes (myo, muscle, cardio heart, cyte cell) have branches. The cells contain dark lines between other cells called intercalated disks. Striated cardiac Muscle is involuntary but have nerves to either speed up or slow the contractions.

30. Define the following:
    a. Myo
    b. Cardio
    c. Striated
    d. Smooth
31. Draw what is seen in a slide of striated skeletal muscle and label the nuclei and the light and dark bands.

32. Draw a slide of Striated Cardiac Muscle tissue then label a myocardiocyte, intercalated disk, and a branching.

33. Draw a slide of smooth muscle tissue.

The last classification of tissues is Nervous tissue which is the tissue that sends messages. This tissue can be found everywhere as there is a constant amount of information entering and leaving the body. It is composed mainly of neurons, the functional unit. The neuron is made up of three main regions the dendrites

which receive messages, the soma (cell body) and a long projection called an axon. Dendrites are attached to soma which is where the nucleus is found. The soma is attached to the Axon which is a long projection usually covered in a lipophilic structure called a myelin sheath. This means that nervous tissue is hard to stain.

34. Draw a basic neuron.

35. Draw what is seen in a slide of the nervous system.