UNIT 4 - SKELETAL SYSTEM

ACTIVITY – LAB: An Overview of the Skeletal System and Long Bones

***Pre-lab Discussion*:** The skeleton is not just a framework of bones. It serves an attachment for muscles, as support for the body, and as protection for vital organs. Bones also store certain minerals and contain special cells that form red and white blood cells. The human body contains 206 bones.

The bones of the human skeleton are grouped into two divisions: the *axial skeleton* which includes the skull, vertebrae and rib cage and the *appendicular skeleton* which includes the rest of the skeleton: the arms, legs, shoulder girdle and the pelvic girdle.

In addition to bone, human skeletons also contain *cartilage*. In fact, the human skeleton is initially formed from cartilage, which is gradually replaced by bone. Cartilage is found in adult humans between the vertebrae of the spinal column, at the tips of ribs and other bones, and in the nose, ears and larynx. Some lower vertebrates, such as the shark and the lamprey, have skeletons composed entirely of cartilage. Of the three types of cartilage found in the human body – *hyaline, fibrous and elastic – hyaline cartilage* is the most common. It is pearly white and glassy or translucent in appearance. Hyaline cartilage is found at the ends of bones or in movable joints.

In this lab, you will observe closely the structure of bone and cartilage. You will also observe closely the structure of long bones and become familiar with bone marrow.

***Materials*:**

Prepared slide of hyaline cartilage
Prepared slide of bone
Prepared slide of bone marrow
Microscope for viewing microscope slides
Stereomicroscope
Knife
Long bone from chicken leg
Dissecting tray
Colored pencils

I. Observing the Structure of a Long Bone

1. Obtain a long bone of a chicken leg and place it in a dissecting tray. Observe the outside covering and features of the bone. Note the smooth covering at both ends of the bone. Also notice the presence of small holes along the surface of the bone. Describe the surface of the chicken leg bone.

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2. With a knife, cut one end of the bone to expose the fine structure of the spongy bone and some bone marrow. *Be careful when handling the knife. Be sure to cut in a direction away from your hands and body. If you are having trouble cutting, see your instructor for help*.

3. Using your book or your diagram of the long bone as a guide, continue to observe the chicken bone. For better observation of structures, you will want to use a dissecting microscope at this point. Observe the *periosteum*, which covers and protects bone. Beneath the periosteum is a hard dense layer called *compact bone*. Notice the softer *spongy bone* is near the ends of the bone. Spongy bone contains many small spaces. In long bones the spongy bone also contains *red marrow*, which produces red and white blood cells. Note the internal cavity of the bone, which may contain some fat-storing *yellow marrow*. On the outer edge of the end of the bone, find the plate of *articular cartilage*. Remember that this cartilage helps in bone movement. Each of the wide ends of a long bone is called the *epiphysis*, whereas the long shaft of the bone is called the *diaphysis*.

4. Sketch the internal structure of the chicken leg bone. Label the *periosteum, compact bone, spongy bone, red marrow, yellow marrow, articular cartilage, epiphysis, diaphysis*.

5. Answer the following questions about the chicken leg bone.

a. Why is it necessary that the ends of the bones be smooth?

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b. What is the function of the small holes in the bone surface?

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c. What is the importance of compact and spongy bone?

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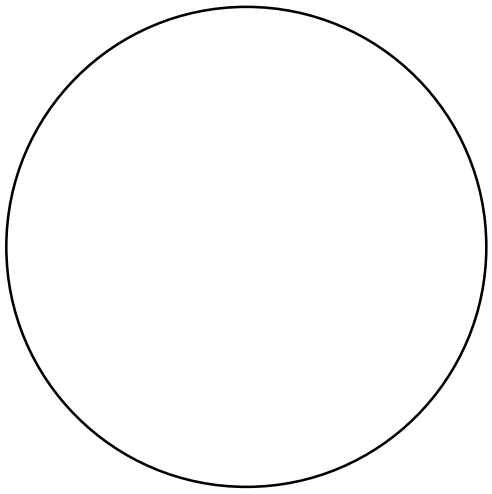
II. Observing Cartilage, Bone and Bone Marrow

1. Cartilage is more flexible than bone, thus it can take a great deal of stress. Live cartilage cells, called *chondrocytes*, are found in cavities called *lacunae*. Cartilage contains no blood vessels. Materials enter and exit the chondrocytes by diffusion to and from the blood vessels in adjacent layers of tissue. *Hyaline cartilage* is composed of close collagen fibers, making it tough and slightly flexible. Hyaline cartilage is found on the articular surfaces of bones. It also connects the ribs to the sternum and is the chief component of the embryonic skeleton.

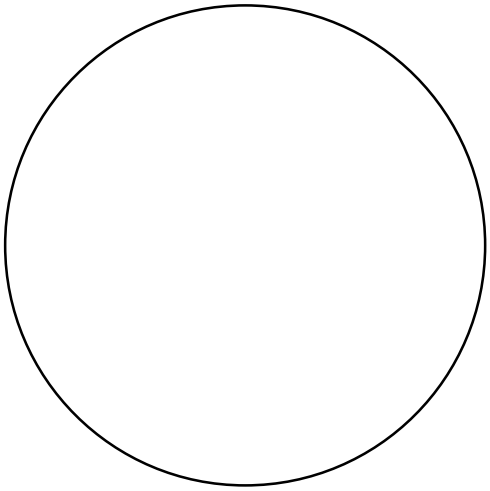
2. Obtain a slide of *hyaline cartilage*. Note the *chondrocytes* within the *lacunae*. The collagen fibers are too fine to be seen using ordinary staining procedures and ordinary microscopes. Look around the slide and assure yourself that the cartilage is indeed avascular.

3. Draw the hyaline cartilage. Be sure and label the *chondrocyte* and the *lacunae*.

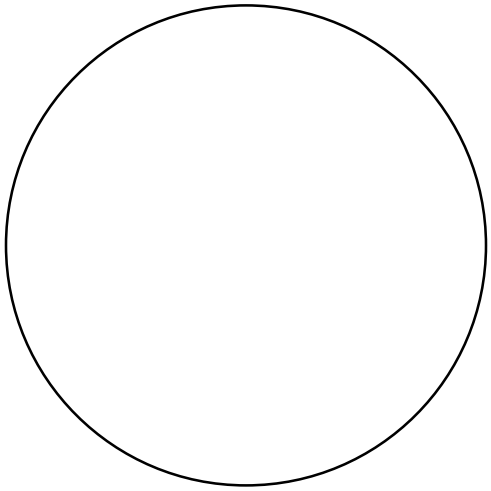


4. Bone is the hard tissue chemically identified by crystals of *calcium phosphate* or *calcium carbonate*. The calcium salts are quite strong but are brittle. The main component of the rest of bone is *collagen*. Collagen fibers are long, straight, unbranched three-ply protein chains that are highly flexible. Since the calcium salts are organized around the collagen fibers, the combined portions of the osseous tissue exhibit the best of both worlds. The result is a strong, flexible and relatively shatter-resistant structure. Remember back to the histology unit when we studied about bones. We learned about the *Haversian systems* which are responsible for supplying the bone with nutrients and removing wastes. Making up the bone are many thin, concentric circles known as *lamella*. The black spaces within the lamella are the *lacunae*, wherein reside the *osteocyte or bone cell*. The *canaliculi* are the canals running between the lacunae. In addition to housing the cytoplasmic streamers of the osteocytes, the canaliculi serve as the passageway for the osteocytic nutrients and waste products. Within the *central canal* or the *Haversian canal*, are the blood vessels of the bone. The Haversian vessels and canals are longitudinal. The bone also contains transverse vessels found in the transverse *perforating canals* (or Volkman's canals or communicating canals).

5. Obtain a prepared slide of ground bone tissue. (The term *"ground"* means the tissue proper. In other words, the bone is complete with a matrix and assorted landmarks.) Sketch what you see. Label the *lamella, lacuna, canaliculi*, and the *Haversian canal*.



BONE



BONE MARROW

6. Bone marrow is the region in which blood cells are made. Even though we have not studied hemopoiesis in detail, try to identify some of the tissues and cells that you see. Refer to the chapter on blood and see how much you can actually identify. Draw, in the circle above, and label what you see.

7. Answer the following questions about the microslides.

a. Why is red bone marrow important?

b. How is cartilage similar to bone?

c. How do cartilage and bone differ?

d. The skeleton of an unborn baby consists of a large amount of cartilage, which will later change to bone. Of what advantage to the unborn child is a skeleton made of cartilage?

e. Based on your knowledge of cartilage and bone, are the fontanels of the fetal skull cartilage or bone and why?

f. Describe how a chondrocyte is able to obtain nutrients.

g. Describe how an osteocyte receives nutrients from a blood vessel that is penetrating through the periosteum. Please be specific with the bone structures through which nutrients must pass. You should end up at the osteocyte.

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8. The overview of the lab taught you the difference between the axial and appendicular portions of the skeleton. Color the appendicular skeleton blue and the axial skeleton red. Practice your knowledge of the basic skeleton. Write numbers of the bones next to the corresponding name.

Carpals _____

Scapula _____

Fibula _____

Clavicle _____

Radius _____

Tibia _____

Ribs _____

Metacarpals _____

Cranium _____

Tarsals _____

Phalanges _____

Ulna _____

Humerus _____

Sternum _____

Femur _____

Pelvis _____

Metatarsals _____

Vertebral column _____

Patella _____