

Microscopic Bone Anatomy

HASPI Medical Anatomy & Physiology 08c

Lab Activity - The following lab is adapted from "Microscopy of Bone and Step-by-Step Sample Preparation" by Ulf Griesmann.

Background

Bone Tissue Structure

Bone is made up of 65% inorganic minerals, primarily calcium and phosphorus, and 35% organic tissues. While bone is considered a connective tissue, it is actually composed of several different types of tissues. They include bone, nerves, blood, cartilage, and epithelial tissues. Because bone is made up of these different types of tissues, it is technically considered an organ. There are two types of bone structure in humans - the inner spongy bone and the outer compact bone.

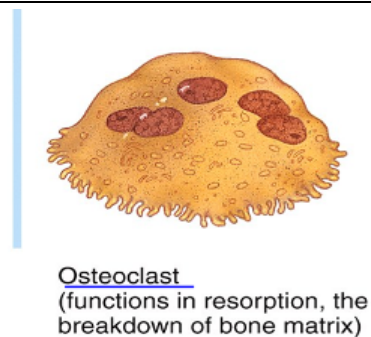
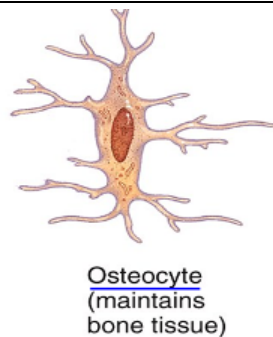
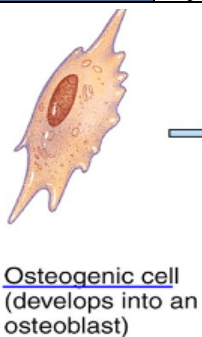
Spongy bone is made up of a dense spider web-like netting of bone called trabeculae. The spaces between the trabeculae webbing are filled with bone marrow. Bone marrow functions in hematopoiesis, and, in a healthy adult, produces more than 500 billion blood cells a day. Platelets, red blood cells, and white blood cells are all produced and stored within the red bone marrow. Yellow bone marrow is primarily made up of fat and found in the diaphysis (middle) of long bones. Bone marrow makes up 4% of the total body mass.

Externally, bones have a protective tissue layer called the periosteum. The periosteum contains cells that resist force and that also respond to external stress to initiate bone remodeling. Fibers called Sharpey's fibers connect the periosteum to the outer compact bone. The trabeculae of spongy bone also have a thin protective membrane called the endosteum.

The Cells of Bone

There are different types of cells present in bone tissue, and each function differently.

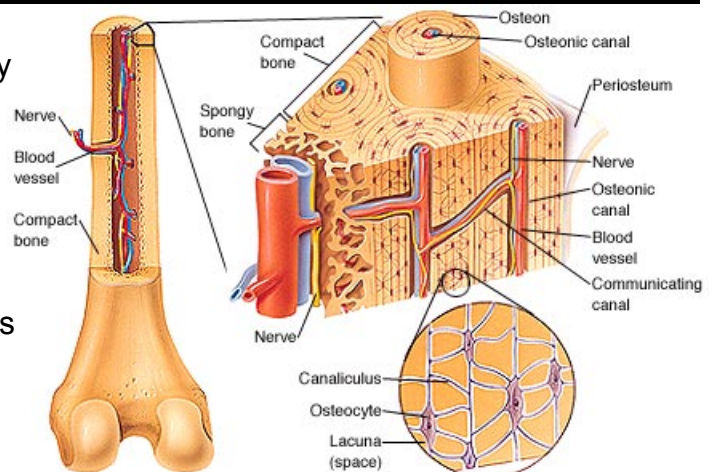
Bone Cell	Function
Osteogenic cells	Immature cells capable of differentiating (changing) into osteoblasts.
Osteoblasts	Cells capable of forming bone by secreting osteoid (proteins such as collagen) that form bone matrix, and eventually mineralized bone.
Osteocytes	Once an osteoblast is completely surrounded by bone matrix, it stops secreting osteoid and becomes an osteocyte. Osteocytes function in bone metabolism.
Osteoclasts	Cells that work opposite of osteoblasts and are capable of resorbing and breaking down bone structure. Osteoclasts use lysosomal enzymes and hydrochloric acid to break down bone.



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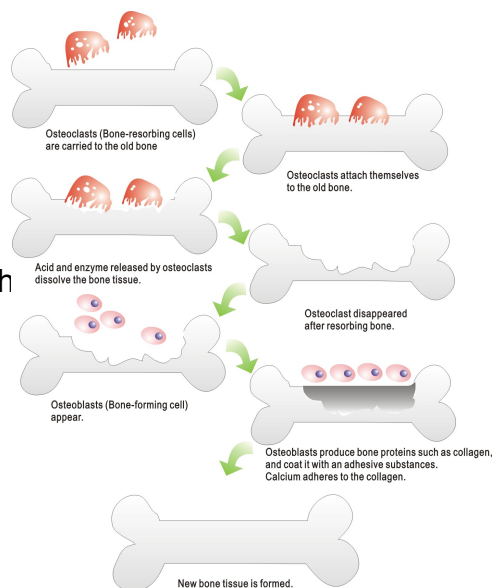
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http://www.mhhe.com/biosci/esp/2001_gbio/folder_structure/an/m5/s2/assets/images/anm5s2_1.jpg

Bone Remodeling

Bone remodeling occurs throughout the human lifetime and is the process by which minerals and tissues are constantly added/removed from bone. The formation of new bone is called ossification, and the removal of bone is called resorption. Bone remodeling is important in regular growth and development of skeletal structure, but it is also necessary following injuries such as fractures. Mechanical demand on bones can also increase or decrease the rate of bone remodeling on specific bones. When the remodeling procedure becomes imbalanced, bone diseases such as Paget's disease or osteoporosis can result.



Marieb, S. and Brady, P. 2011. *Bones, Bone Marrow, and Bone Tissue. Human Anatomy, 6th ed.*, Pearson Education.

Materials



Polishing paper	Glass glue	Bone chip
Sand paper	Microscope	Paper towel
Forceps	Plastic slide	

Procedure

Compact bone is opaque, and it is easy to visualize osteocytes and osteons when it is sectioned and sanded very thin. In this lab activity, you will use a section of a compact bone from a cow to create a slide of compact bone tissue for microscopic observation.

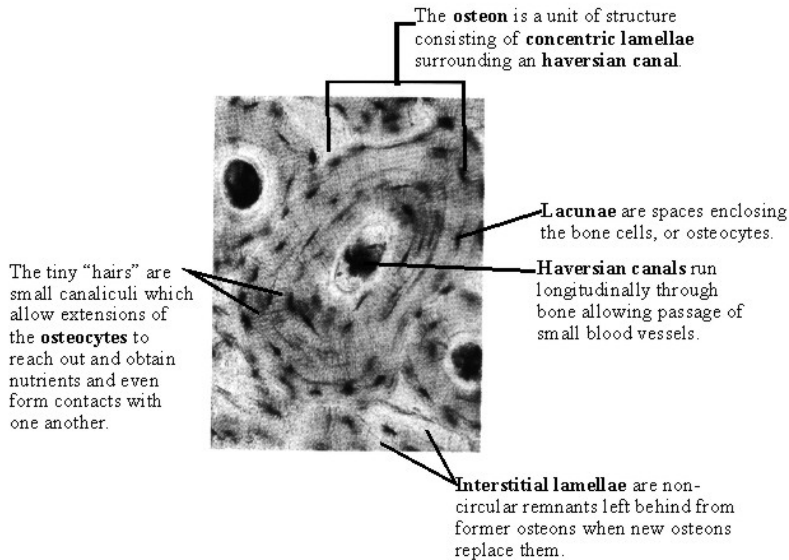
Directions

✓ when complete

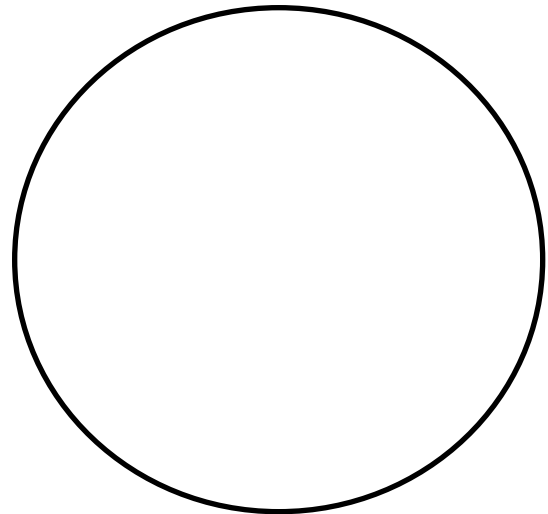
Step 1	Use the forceps to remove a bone chip from the container and place it in a paper towel. Thoroughly dry off the bone chip.	
Step 2	Place a drop of glue on the center of the plastic slide and place the bone chip on the drop of glue. Using forceps or your thumb and forefinger, squeeze the bone chip to the slide tightly and hold for 60 seconds.	
Step 3	Make sure the bone chip is securely glued to the slide before proceeding.	
Step 4	Starting with the sand paper, begin sanding the top surface of the bone chip.	
Step 5	The bone chip needs to be ground down thin enough that light from the microscope is able to pass through the sample, but not too thin or there will be nothing left to see. You would rather err on the side of the sample being too thick, since you will need to start over if you sand the sample too thin.	
Step 6	If you are not sure if the bone chip is too thick or thin, use the microscope to check to see whether light easily passes through the sample.	
Step 7	As the bone chip becomes thinner, use the polishing paper remove a finer amount of bone and obtain a mirror-like surface.	
Step 8	Figure A is an example of what you start with, and Figure B shows an example of what your slide should look like when it is finished.	
	<div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> <p>Figure A</p>  </div> <div style="text-align: center;"> <p>Figure B</p>  </div> </div>	
Step 9	Once the slide is finished, observe your slide under the light microscope. Draw and label what you see in the Analysis section.	

Analysis

Draw what you see on your slide under 400x power. An example has been provided on the left for reference. If the osteons are not visible on your slide, you may need to polish it further or you may have polished it too thin.



http://webanatomy.net/histology/bone/haversian_system.jpg



Draw your bone slide at 400x
In your drawing, label an **osteon**,
osteocyte, **lacunae**, and **Haversian canal**.

Griesmann, U. 2012. Microscopy of Bone and Step-by-Step Sample Preparation. Micsape, Microscopy-UK, www.microscopy-uk.org.uk.

Analysis Questions - on a separate sheet of paper complete the following

1. Why was it important to sand the bone chip thin?
2. What is the function of osteocytes? Explain how osteocytes are able to create osteons.
3. What is the importance of Haversian canals in compact bone?
4. Hypothesize how you think the compact bone might look different in a patient with osteoporosis (more bone minerals are removed than added).
5. **CONCLUSION:** In 1-2 paragraphs summarize the procedure and results of this lab.

Review Questions - on a separate sheet of paper complete the following

1. What percentage of bone is made up of inorganic minerals?
2. What types of tissues make up bone?
3. What is the difference between compact and spongy bone?
4. What is the function of bone marrow?
5. What is hematopoiesis?
6. What is the difference between periosteum and endosteum?
7. Explain how osteoblasts, osteocytes, and osteoclasts function in bone remodeling.
8. What is ossification?
9. What is bone resorption?
10. Explain why bone remodeling is an important process, especially when a bone is fractured.

