

Activity 5.2.1: Looking Inside Bone

Introduction

Bones are a remarkable example of engineering, combining lightness, flexibility and incredible strength. Bone provides a tough, flexible frame for the human machine. Pound for pound, bone is actually stronger than concrete. But remember, bone is living tissue. Cells and protein fibers are wrapped inside layers of hard mineral salts. These cells are hard at work, constantly remodeling and replacing old or damaged bone. Blood vessels and nerves bring needed nutrients and signals to the cells in this hard matrix. All of these structural components allow bone to withstand tremendous amounts of stress and protects the internal organs from damage and injury.

To understand how bone is able to protect our body, we must look at the anatomy of this calcified tissue. How does the structure of bone relate to its ability to withstand stress? In this activity, you will dissect a long bone and observe the key structures that contribute to bone’s unique architecture. You will then look deeper into the chemical structure of this tissue as you view prepared slides of both compact and spongy bone.

Equipment

* Computer with Internet access
* Discovery Channel *Human Body: Pushing the Limits* DVD or Internet clip
* Laboratory journal
* Longitudinal section of long bone (cow)
* Dissecting tray and tools
* Microscope
* Prepared slides of compact and spongy bone
* Safety goggles
* Colored pencils or markers
* Gloves (optional)
* Reference textbook (optional)

Procedure

1. With your partner, research the four main types of bone – long, short, flat and irregular. Describe the structure of each type in your laboratory journal. Use your graphic organizer or your Maniken® to find an example of each type of bone in the human skeleton. Write these examples next to your descriptions.
2. Research a long bone and draw a bone section and label the following in your lab journal:

* Epiphysis
* Diaphysis
* Cartilage
* Periosteum
* Compact (cortical) bone
* Spongy (cancellous) bone
* Medullary cavity
* Red bone marrow
* Yellow bone marrow

1. Explore the internal anatomy of your long bone by visiting the website below.

* Human Anatomy Online – Cross Section of a Bone <http://www.innerbody.com/image_skel09/skel01.html>

1. With a partner, visit the Discovery Channel – Human Body: Pushing the Limits website at <http://dsc.discovery.com/tv/human-body/explorer/explorer.html>. Your teacher may choose to show this clip to the entire class on DVD. If so, skip to Step 5.
2. Click on the word *Strength*.
3. Choose video number “2” on the right side of the screen and watch the clip about bone strength and flexibility.
4. Answer conclusion questions 1 and 2.
5. In groups of three or four, obtain a section of cow long bone and a set of dissecting tools from your teacher. Place the bone in a dissecting tray or on a covered lab bench. Cow and human long bones have a similar general structure.
6. Use the forceps to remove a piece of the periosteum from the outer surface of the bone. You may find fragments of tendon, ligament or muscle adhering to the periosteum. In your laboratory journal, describe the composition of this membrane as well as its function.
7. Use the dissecting probe to compare the texture of compact and spongy bone. Poke into each tissue and feel the composition of each type of bone. Describe the difference in your laboratory journal.
8. Note the location of spongy and compact bone in the epiphysis and the diaphysis. Indicate these locations on your drawing.
9. Research the composition of both compact and spongy bone and describe your findings in your laboratory journal. Note the minerals and proteins that make up this tissue.
10. Examine the epiphysis and find the articular cartilage. In your laboratory journal, describe the role of this slippery tissue.
11. Carefully scoop out the fat from the medullary cavity. Describe the composition of this marrow as you remove it from the bone. Make sure to note the presence of any blood vessels or nerves. Also note in your laboratory journal the function of this yellow bone marrow.
12. Identify where red bone marrow would be located in your cow bone. In your laboratory journal, note the function of this type of marrow.
13. Make sure all internal and external structures are labeled on your bone drawing.
14. Follow your teacher’s instruction to dispose of the bone and to clean up your station.
15. Answer conclusion questions 3-5.
16. Get a closer look at compact and spongy bone structures by viewing each type of tissue under the microscope. Compact bone may appear rock solid, but it actually contains many holes for cells, nerves and blood vessels.
17. Use the Internet to help you identify structures you see in the slides. Examine how cells are organized in bone tissue and compare the overall structure of the two types of bone.
18. Observe a cross-section of calcified compact bone. Use colored pencils to draw and label the following structures as they appear using the 40X objective.

* Haversian canal
* Osteocyte (mature bone cell) in lacuna
* Canaliculi

1. Observe a cross-section of spongy bone. Draw and label the following structures as they appear using the 10X objective

* Bone marrow
* Bony trabeculae

1. Relate what you see on the slides to what you have researched about the chemical structure of compact and spongy bone. Make sure to describe the function of each feature you have labeled on your slides in your laboratory journal.
2. Answer the remaining conclusion questions.

Conclusion

1. What properties of bone prevented Matt from breaks and damage to internal organs?
2. What role did Matt being knocked unconscious play in his body’s ability to resist damage?
3. What type of fibers or minerals do you find in the extracellular matrix of bone? How does this composition relate to the properties of bone?
4. What aspects of bone’s structure make it stronger than concrete? Think about the engineering design of bone. Use the terms *tensile strength* and *compressional strength* in your answer.
5. How do red bone marrow and yellow bone marrow differ in function?
6. Explain how the structure of spongy bone helps reduce the overall weight of bone.
7. Describe at least two ways bone functions in protection of the human body.