Oak Meadow
YOUR TRUSTED PARTNER IN JOYFUL LEARNING

Human Anatomy and Physiology

Sample Lesson

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Lesson 1: Getting Started with Anatomy and Physiology

In these first two lessons we will start our study of the human body with a broad exploration of how our body systems work together to maintain life.

Look at the picture of the ice climber on page 797 of your textbook. Think about the careful concentration and coordination the climber has to use to be successful at this activity. What activities do you do that require a high degree of focus and coordination? Perhaps you dance, skateboard, play an instrument, or play tennis? Whatever you do, imagine what it would be like if you had to concentrate on every step you took or every hand movement, as this climber does. These are things your body does for you automatically. It maintains coordination between cells, tissues, and organ systems that goes well beyond your awareness. At first, when you do a new set of movements (learn a new piece on your cello, a new dance, a new skill set in your sport), your movements might feel clumsy and not in sync with each other. What is this thing we call "muscle memory?" How does it work? Similarly, how does your body just know what is a "foreign invader" to be fought off by your immune system, and what is friendly and helpful? What is it that sometimes causes these things to go awry?

It's time to dig in and explore!

Learning Objectives

At the end of this lesson you will be able to:

- Understand the meaning of anatomy and physiology and the relationship between structure and function.
- Refamiliarize yourself with cell biology concepts.
- Understand anatomical and directional terms.

Assignments

First, we will do some review of the biology concepts that are needed to proceed further with anatomy and physiology. If you have not read the beginning of the introduction in this coursebook, please do so now. In this course, there will be many, many new terms, and that might seem daunting. However, science and medical terminology is not always difficult if you have a sense of word roots and what they mean.

1. Watch the first of the Crash Course series, "Introduction to Anatomy & Physiology: Crash Course A&P #1," (*YouTube.com*). There is no written assignment for this. Enrolled students please let your teacher know you've done this.
2. Do an internet search for "word roots in medicine (or anatomy, or physiology)." Make a list of 10-15 words that you might have heard before, but you weren't sure of their meanings. Using the word roots, describe the meaning of each word.

   As you go forward, try to figure out what a new term means using the roots before you look it up. Consider making this a game for yourself. Come up with a little reward for

yourself every time you get one right, even if it's just a prefix or suffix. Keep a score, and work to constantly improve your score.

3. Assignment 3: Now you will take a self-quiz to see what you remember from biology. The results of this quiz will not count toward your grade for this lesson. This is a tool to help you decide how much review you should do this week before we really dive into anatomy and physiology. Do not look in the textbook or online for any of these answers! That will come later.

Self-quiz

1. What is a cell?
2. Can you describe a "system" that is in your body? How about one that is not in your body?
3. What is homeostasis? Give an example of homeostasis in your body.
4. What is the genetic material called that determines the characteristics of any organism?
5. Give two examples of medical imaging technology that can help "see" inside our bodies.
6. Your body is made of mostly _____.
7. Why are there so many chemical reactions that take place in the human body? Relate this to your answer to #3 above.
8. What is an enzyme?
9. Name at least three organelles that are found in your cells. Can you explain the function of each?
10. Why do cell membranes need to be "selectively permeable?"
11. What is the difference between active and passive transport?
12. What is osmosis?
13. What is the process called that occurs in all cells and provides energy in the form of ATP?
14. Do you know what "lactic acid fermentation" is? In what kind of situation would this process occur in your muscles?
15. Discuss a few reasons why it could be important to understand genetics when learning about anatomy and physiology.

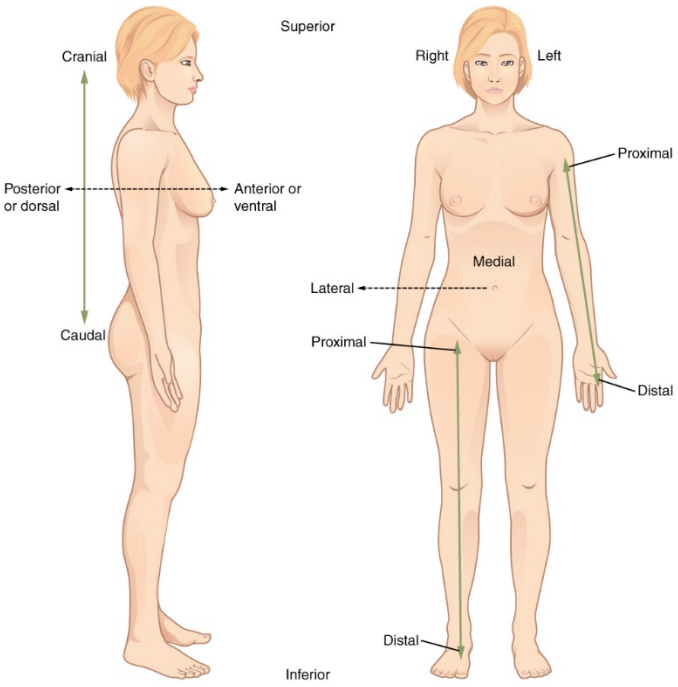
After you complete the quiz, review Chapters 1-4 in the textbook and correct any answers that need adjustment, using a different color font after your original answer. Pay special attention to the section headings and the "main ideas" that are in blue. Finish by adding a few statements on this experience. Were you pleased with your results? Do you feel like you have a lot to review? If you need review, remember that you have this textbook available to you; you can review these basic concepts at any time!

4. Review Chapters 5 and 6 in your textbook. Again, take note of the section headings and main ideas, and pay special attention to sections 5.5 and 6.6. These concepts are covered in the beginning of a biology course because they are broad concepts that are present in

all eukaryotic life forms. We will revisit some of these in more detail in this course. There is no written assignment here, although taking notes is always recommended. Enrolled students please make a note to your teacher that you have done this.

5. They say that the amount of new vocabulary learned in a high school biology course is similar to that learned in an introductory language course. Anatomy and physiology only ramps up that trend some more! As you go through this course, please keep a vocabulary list. This can be either handwritten in your notebook, or on a separate document that is organized by lesson or topic. The act of writing definitions down can help you learn the terms better than you would just by reading them. And of course, now you will have a go-to place to look up the terms that you forget as we go along.

   Enrolled students: Please share this ongoing list with your teacher when you submit your lessons.



Anatomical Position and Directional Terms

Look at the image above. Do you see the position the woman is standing in? This is called the *anatomical position*. When learning anatomy, this is the standard position used to explain body parts in reference to each other, regardless of the position the body happens to be in at the time. Notice particularly the position of the hands, with the palms forward and the thumbs to the side.

The following are the directional terms to become familiar with. They are commonly used by medical professionals. As you go through the course, you will see these terms (and more) often.

Superior (or cranial) = above, or toward the head end

Inferior (caudal) = below, or toward the lower end

Anterior (ventral) = in front of, or toward the front of the body

Posterior (dorsal) = behind, or toward the back of the body

Medial = toward the midline of the body

Lateral = away from the midline of the body

Proximal = closer to the point of attachment to the trunk

Distal = farther from the trunk

Superficial = closer to the body surface

Deep = farther from the body surface; more internal

Using these directional terms and the anatomical position, you can see that the head, for example, is superior to the heart even if the person is doing a handstand or lying on a bed.

You can see more images about this on the following website: https://www.visiblebody.com/blog/anatomy-and-physiology-anatomical-position-and-directional-terms

For Enrolled Students

You will submit your work at the end of the next lesson.

Lesson 7: The Skeletal System

In the next three lessons, we are going to cover some extremely important body systems: your skeletal system, muscular system, and integumentary system. Plan to spend one week on each of these body systems.

Have you ever watched a beetle that got turned upside down, helplessly wiggling its legs, with no hope of being righted unless somebody comes along to help it? Why do you think this is the case? Beetles have an exoskeleton, which, as you know, is quite rigid. There is no flexibility at all. There are no vertebrae that can allow the beetle to twist itself around. Think about the incredible flexibility that your endoskeleton and muscles provide for you. And just when you think you are flexible compared to the beetle, now think about how flexible your cat is! Cats' spines can bend 180°; this is partially because they have more vertebrae than other animals, and more elastic cushioning between each vertebra. Cats have other fascinating skeletal and muscular adaptations as well. If you're a cat lover you might be interested in doing some research about this.

We'll start with the bones that hold us together and give us support. This is an interactive lesson; you will be doing some exploration of your own body from different perspectives. Have fun!

Learning Objectives

At the end of this lesson you will be able to:

- Apply the concepts of structure and function when learning the components of the skeletal system.
- Understand the process of bone growth.
- Explore the joints of the body.
- Discover more about the skeletal system with a creative project.

Think about It

Our bodies can be viewed as a combination of simple machines we know as levers. Like any lever, the skeleton moves in ways that exerts force on objects. Every lever needs a fulcrum, or pivot point, and that would be a joint. As you go through your week, think about this when you move: when you walk, run, lift objects, chew your food, etc. Where is the fulcrum (joint) that acts as the pivot point for the movement? Where is the force being exerted? In the next lesson, we'll discuss that it is muscles that exert the force on the bones to allow movement.

Sometimes too much force is exerted too quickly, and then you might have an injury. Broken bones, torn ligaments, sprains, etc. *Biomedical engineers* are people who study the human body and its problems and design solutions - everything from prosthetic limbs to pacemakers to artificial knees, as well as computer systems and software. Getting back to the skeletal system, can you see how understanding the force that a bone or joint needs to be able to handle is essential for doing this kind of work? If you were to design a prosthetic limb, you would need to

know exactly how much force your new "bone" needs to be able to exert, and how much impact it can take.

Reading and Viewing

Read Section 33.1 of Chapter 33, "Protection, Support, and Movement" (935-941), in your textbook.

Read and explore the "Skeletal System" on the *Innerbody.com* website. Be sure to read the text section below the image of the skeleton.

Read and explore "The Skeleton and Bones" in the Anatomy and Physiology section of the *teachpe.com* website. http://www.teachpe.com/anatomy-physiology/the-skeleton-bones/

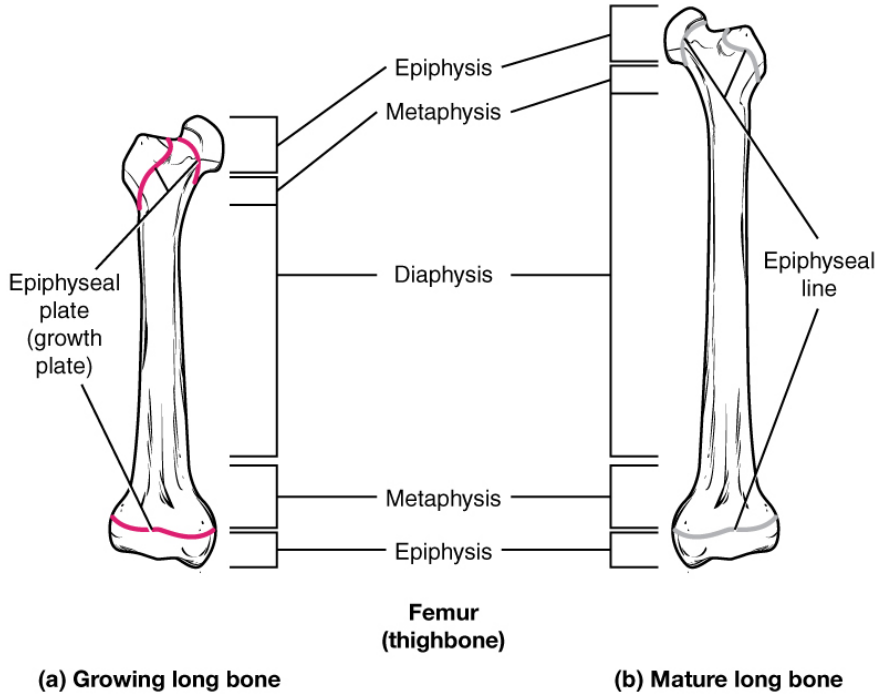
Other resources

Test your knowledge of the bones in the skeleton: https://www.wisc-online.com/learn/career-clusters/health-science/mea304/the-skeleton-bones-joints

More to Think About

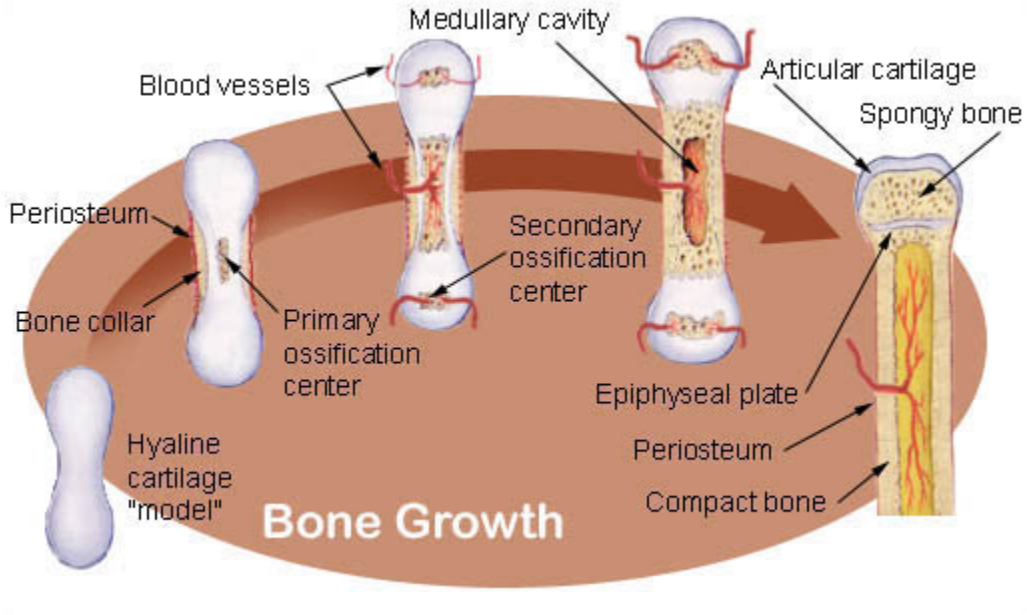
Your appendicular skeleton contains many *long bones.* Long bones aren't necessarily always long; they are called that simply because they are longer than they are wide. For example, your finger bones are long bones. At each end of every long bone in the body, there is a *growth plate*, which is also known as the *epiphyseal plate*. The growth plate is made of cartilage and is where all growth in the length of the bone takes place. It is what determines the shape and length of the mature bone. At this point in your life right now, you may or may not be done growing. In girls, the growth in bone length is usually complete by age 16, and in boys it can be several years later. Also, different bones stop growing at different times. When you are done growing (and that is determined by genetics), the growth plates "close" and become hardened bone. The epiphyseal plate is then called the epiphyseal line.

Have you ever broken a bone in your arm or leg? If you have, you might have heard your parents or doctor expressing concern about whether or not the growth plate was fractured. In fact, this is the most common bone injury in children, because the growth plate is the weakest part of a child's bone. A growth plate fracture can complicate proper healing and possibly compromise future growth of the bone if it doesn't heal properly. Special measures might have to be taken to assure that it heals properly.

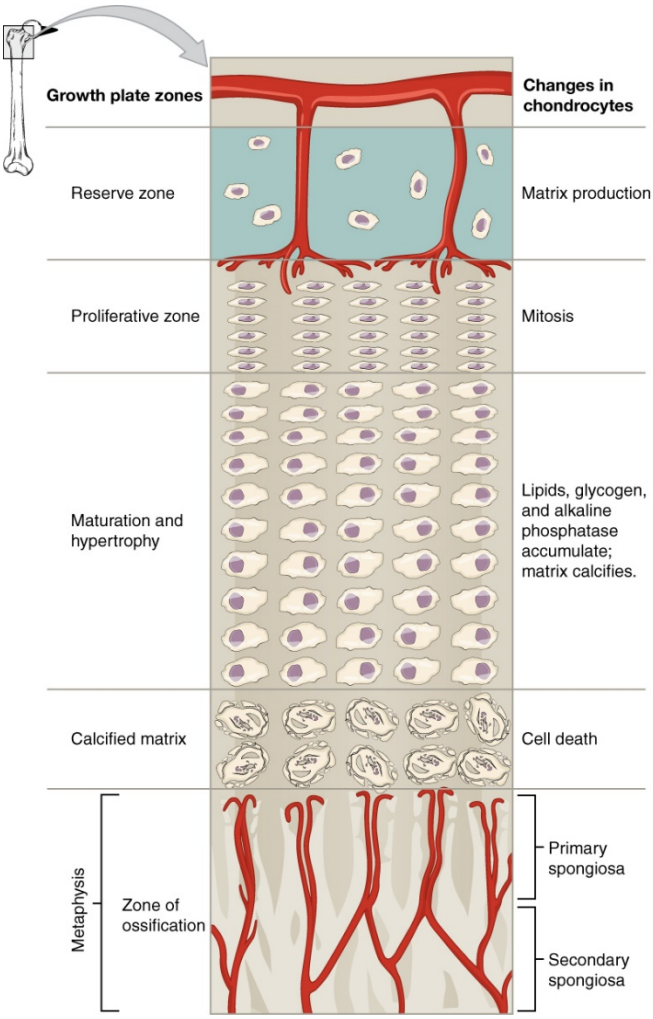


This shows the location of the epiphyseal plate and eventual epiphyseal line.

Here is a more detailed image of the stages of bone formation and lengthening:



This is a close-up of what is happening in the growth plates:



Comprehension

1. Ligaments, bone, and cartilage are all part of the skeletal system. Which of the four types of body tissue are they made of? Explain in terms of the functions of this type of tissue.
2. a. Considering the word roots of axial and appendicular (see text box), distinguish between the axial and appendicular skeleton.
   b. For each word root, can you come up with another commonly used word that also use that prefix?
3. Describe the two types of bone tissue.
4. Describe how bones elongate during childhood.

Critical Thinking

1. Think about the function of the vertebrae. Why do you think it is important that vertebrae have cartilaginous joints that limit movement instead of more flexible joints?
2. Now consider the functions of the ribs. Why is it important that the ribs are connected by cartilage?

Activity

Complete the following activities.

A. Categorize Joints

Learning and keeping track of all the types of joints can be challenging. There are three broad categories of joints, which are based on how much movement the joint allows. There are an additional five (or six, depending on where you look) types of joints within one of those broad categories. Using the information in your textbook as well as in the *teachpe.com* website, create a concept map illustrating the types of joints in the body. Include any relevant information that will help you understand the joint types.

B. Explore Your joints.

Referring to figure 1.3 (939) and the text on page 938, do the following movements and answer the questions:

1. Straighten your index finger as if to point. Slowly bend the finger until touches your palm. Moving only your finger, try to move the individual parts of the finger in other directions. What type of joint is in the fingers?
2. Move your arm in as many ways as possible.
   a. What movements can your shoulder make? What kind of joint is it?
   b. What movements can your elbow make? What kind of joint is it?

3. Use your left hand to grip your right arm just above the wrist. Without moving your forearm, move your hand in all possible directions. Identify the kind of joint in the wrist that allows this movement.

4. Identify which types of joints are used in walking.

5. For each type of synovial joint, come up with a common, non-living object that has a similar type of joint in its construction.

Project Choice

Complete one of the following project options. Alternatively, if you have an idea about a project you'd like to do, come up with your own project. (Enrolled students please share the idea with your teacher before you start.)

A. **Teach Bone Identification**

Come up with a fun way to teach the major bones to a middle school or younger child. Some options include the following:

- Create a board game
- Create a rhyming song, or a song and dance
- Create a puzzle of some sort

Alternatively, you might want to target an older audience, such as one of your peers. Perhaps your own skeleton rap song?

B. **Bone Healing Research**

Research bone healing and either write a written report or create an illustrated presentation that describes how bone heals after a fracture.

C. **Bones as Levers**

Review the "Think About It" textbox above. Let's expand on this concept.

1. Review the different types of levers (first, second, and third class) and the different parts of a lever (lever arm, fulcrum, effort, load). Draw each of the classes of levers so you are clear on the differences.
2. Before you research the limbs as levers, think deeply about the different movements that you can make with different parts of your body. Sketch some of them, labeling which type of lever that body movement is.
3. When you have done that with at least three different movements, do a little research about bones as levers. Does what you find agree with what you figured out for yourself? What are some other limbs that act as levers that you hadn't thought of?
4. Include all of the above steps of this project, along with a brief summary of your experience, when you submit your work for the lesson.

D. **Aging and Bones Challenge**

Here's the scenario: You find out one day that your elderly grandmother has fallen and is in the hospital with a fractured hip. After performing a DXA scan, it is found that her bone density (or BMD - bone mineral density) results show a T-score of -3.2.

1. Look up what a DXA (or DEXA) scan is and what the different results of a bone density test suggest.
2. What could be a likely diagnosis in this situation?
3. If you wanted to find out possible causes of her condition (which you should have identified by now), what type of background knowledge would you need to know? Is there a concern that other members of her family (like you) could develop this same

condition? Brainstorm at least three possible questions that you could answer with further investigation, suggesting where you might look for answers.

4. Watch the following two short videos to learn more:
   - "Diagnosing Osteoporosis (Osteoporosis #3)" https://www.youtube.com/watch?v=xxmkMMoJ_Mg
   - "Osteoporosis" https://www.youtube.com/watch?v=5uAXX5GvGrI This video is a great illustration of what is occurring in the bone with osteoporosis.
5. At this point, choose one of the three following options to continue this project:
   a. Continue with learning about the condition. Do some research on the causes, how common it is, if it seems to be hereditary, and what can be done to prevent it. Present your findings in a written report.
   b. Do the above research, but rather than write a report, create an informative brochure that illustrates what people can to do prevent the condition.
   c. Research how bone mineral density is measured using a DXA scan. What type(s) of imaging is being used? How does it differ from other body scans that see inside your body? Describe the science behind DXA. Are there any other imaging techniques being used or researched to measure bone density? Report on your findings.