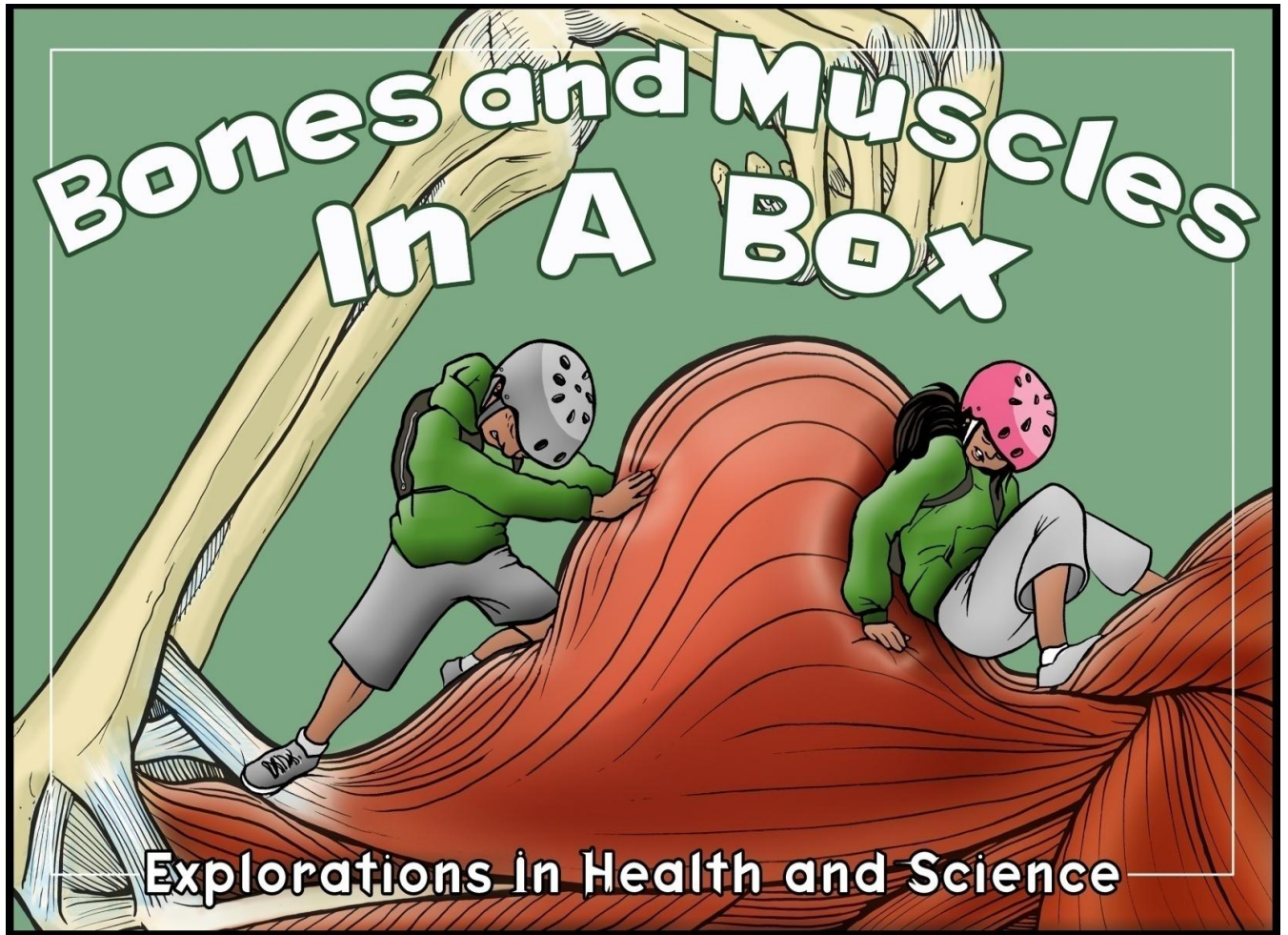


# Teacher Handbook



## Bones and Muscles In A Box

Explorations in Health and Science

<b>Contents</b>	<b>Page</b>
• Welcome	2
○ Funding sources – HHMI, AHEC, OHSU	
○ Contact information (central and regional AHEC offices)	
• How to use the box	3
○ The goals for this box	
○ Lesson structure and extensions	4
○ Set up	5
○ Station content and objectives	6
○ Grade level options	8
○ Assessment options	9
○ Restocking and ordering	9
• Box contents	9
○ <i>Bones and Muscles In-A-Box</i> (OHSU) DVD	
○ Five station activity envelopes	
○ Teacher & Student surveys- pre and post	
○ Bill Nye <i>Bones and Muscles</i> DVD and curriculum	
○ <i>Emmanuel's Gift</i> DVD	
○ NIH Curriculum-	
○ Muscles and Bones- From Outer Space to Inner Space curriculum	
○ <i>Country Doctors</i> DVD	
○ Box Artifacts-	
• Resources	10
○ Web resources	
○ Family involvement ideas	11
• Glossary of terms	12



Welcome to the AHEC “In-A-Box” curricula, created by scientists and educators at Oregon Health & Science University to support Oregon teachers and students! Currently, there are Ear In-A-Box, Eye In-A-Box, Guts In-A-Box, Expedition Northwest In-A-Box, and Brain In-A-Box.

We look forward to your feedback as we launch In-A-Box so that it can be improved from year to year.

Funding for In-A-Box curricula was made possible by the Howard Hughes Medical Institute grant, Oregon Area Health Education Centers (AHEC), and OHSU. It is critical to the funding of this program that teachers return the feedback form and student surveys...*Please help us by completing these.*

## **Oregon Area Health Education Centers (AHEC) Program office**

**Shera Hunn Felde- Education Director**

Oregon Health & Science University

64295 Schibel Rd., Bend, OR 97701 (503) 307-2361

[feldes@ohsu.edu](mailto:feldes@ohsu.edu)

The goals for this box are: to introduce the anatomy of muscles and bones; the injuries and disorders to bones and muscles that individuals encounter; use of our muscles and bones for health and activity; and to introduce some of the professionals who treat muscle and bone disorders.

## **Background for the Teacher:**

**Muscle types and movement:** To understand muscle contraction, it's important to know a little anatomy and physiology. There are three types of muscle in your body: skeletal (voluntary, like the muscles that move your limbs), smooth (involuntary, like around organs), and cardiac (the heart).

- **Skeletal muscle** is contractile tissue made up of thousands of parallel, cylindrical fibers that run the length of the muscle (you could have 100,000 fibers in your biceps alone!). Skeletal muscle was so named because it attaches to the bones in your skeleton. In fact, we're really just a bag of bones strung together by muscles! Most of the skeletal muscle in our body crosses a joint and attaches to a bone, and when muscles contract, or shorten, they pull on a bone and we move. For example, your biceps muscle crosses your elbow joint (a hinge joint), and when it contracts, your elbow flexes. When you do biceps curls, your biceps pulls on the bone in your forearm, your elbow bends, and you lift the weight (biceps actually cross the shoulder joint, too). The biceps couldn't bend your arm if your elbow wasn't a movable joint.
- **Cardiac muscle:** A type of muscle with unique features only found in the heart. The cardiac muscle is the muscle of the heart and medically is called the myocardium
- **Smooth muscle:** Generally forms the supporting tissue of blood vessels and hollow internal organs such as the stomach, intestine, and bladder. So named because of the absence of microscopic lines called "cross-striations" which are seen in the other two types of muscle.

**Bone structure:** Bone forms the skeleton of the body. It is composed chiefly of calcium phosphate and calcium carbonate. It also serves as a storage area for calcium, playing large role in calcium balance in the blood.

The 206 bones in the body serve several other purposes. They support and protect internal organs (for example, the skull protects the brain and the ribs protect the lungs). Muscles pull against bones to make the body move. Bone marrow, the soft, spongy tissue in the center of many bones, makes and stores blood cells.

**Bone density:** Bone density is the amount of bone tissue in a certain volume of bone. It can be measured using a special x-ray called a quantitative computed tomogram.

**Osteoporosis:** Thinning of the bones with reduction in bone mass due to depletion of calcium and bone protein. Osteoporosis can be detected by using tests that

measure bone density. Students will look at a photograph of osteoporosis as well as a model.

While we don't go into tendons and ligaments very much in this box, it is helpful to know what each does since the game show activity in station 2 mentions them.

**Tendon:** The tissue by which a muscle attaches to bone. A tendon is somewhat flexible, but fibrous and tough. When a tendon becomes inflamed, the condition is referred to as tendinitis or tendonitis. Inflamed tendons are at risk for rupture.

Tendons are like ligaments in being tough, flexible cords. But tendons differ from ligaments in that tendons extend from muscle to bone whereas **ligaments** go from bone to bone as at a joint. Despite their tough fibrous nature, tendons and ligaments are both considered "soft tissue," that is soft as compared to cartilage or bone.

### Lesson Structure:

Time as listed below = 1 ½ hours-alternative schedule structures can include: showing the film days prior to the activities and guest speaker or having the guest speaker and film prior to lesson activities.

Activity	Time	Materials
OHSU <i>Bones and Muscles In-A-Box</i> film of interviews with a massage therapist and a sports medicine doctor at OHSU	20 minutes	DVD player
Guest health professional speaker – if arranged	15 minutes	
Student pre-survey	5 minutes	Surveys in box
Five station activities- 10-15 min. each	50-70 minutes	Five clear envelopes
Student and teacher post surveys	5 minutes	Surveys in box
<b>Lesson extensions</b>		
NIH Curriculum 7 lesson plans about movement, bones, muscles, skin, and health.	Various times for each activity	Binder includes reproducibles, Oregon Content standards, resources & options
Muscles and Bones- From Outer Space to Inner Space. Ten complete lessons with activity sheets created by the National Space Biomedical Research Institute	Each lesson is about 45 minutes	
Bill Nye <i>Bones and Muscles</i> video Curriculum is included	25 minutes	DVD player
Country Doctors video	60 minutes	DVD player
Research projects about movement, bone and		Web resources for

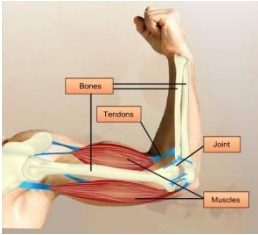

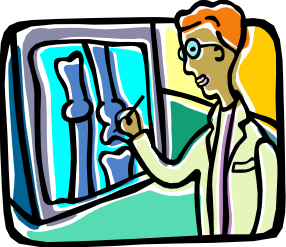

muscle anatomy, health/disease		students
Emmanuel's Gift video	80 minutes	DVD player
The inflatable clever catch ball! This can be played in a small group circle or as a whole class activity. Students throw the ball to someone across from them in the circle, and where ever their hand lands, they answer the question.	Any time	
The x-ray set – This 18 piece set can be assembled by a small group or large group. Activities are listed on the accompanying sheet at the back of the teacher guide.		Floor space

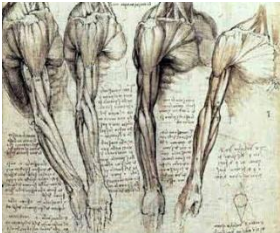
### Set up:

A DVD player is needed.

1. Set up the stations around the room.
2. Group the students ahead of time so they are evenly divided for the 5 stations.
3. Show the OHSU interview video- (Portland middle school students interviewing professionals at OHSU about their careers working with bones and muscles).
4. If arranged, your guest ambassador arrives with knowledge of the lesson structure and his/her role. The ambassador tells her story of pursuing health science; who her team is; and how she uses science & technology to help people. Students can ask questions about the professional's career or journey to the field.
5. Have students fill out short pre survey.
6. Assign students at a station to start the rotation. Give each student a station notes sheet. They will use this at each station. The activities are self explanatory using the material provided.
7. Have students fill out short post survey.
8. Return box contents, surveys and a teacher feedback sheet to the AHEC education coordinator as arranged. Use check sheet to ensure all non consumable supplies are in the box. **These two steps are very important. The In-A-Box curriculum depends on feedback surveys and cooperation from users.**

## Station Content and Objectives

Stations 1-5	Activity	Resources	Lesson Objective
<p><b>Bone &amp; Muscle Anatomy</b></p> 	<p>Students examine the posters and draw their versions of muscle types and bone content</p>	<p>Blueprint Posters Blank paper Colored pencils Bone diagram Muscle diagram</p>	<p>To learn there are three types of muscles in the body (cardiac, smooth, and skeletal) and that bones are made up of marrow, spongy, and compact bone.</p>
<p><b>Strong Bones Healthy Bones</b></p> 	<p>Weight bearing activity</p> <p>Analyze activities which build bone density</p>	<p>Bone density x-rays Weights Sports study description &amp; data sheet Gravity machine handout</p>	<p>Increased bone-mineral content is associated with stronger bones.</p> <p>Different sports produce weight loading on different bones leading to changes in bone mineral density.</p>
<p><b>Ouch! Sports Injuries</b></p> 	<p>Play the sports injury game show!</p>	<p>Question cards Noise maker Score cards</p>	<p>To learn how sports activities can lead to injuries to muscles and bones (as well as tendons and ligaments).</p>
<p><b>Bone/Muscle Disorder</b></p> 	<p>Memory game-matching disorder description to treatment card and professional card</p>	<p>Memory cards Osteoporosis model Orthosis brace</p>	<p>To better understand what some people experience and what happens in the body with the disorder.</p>

<p><b>Muscle Geography</b></p> 	<p>Observe and demonstrate the contracting and relaxing of muscles</p> <p>Map muscles on a partner and on a template</p>	<p>Muscle &amp; Exercise Guide poster</p> <p>Muscle templates</p> <p>Sticky notes</p>	<p>Muscles produce movement by contracting and relaxing (working in pairs)</p>
--	--	---	--

**Station 1 – Bone and Muscle Anatomy**

The goal for students is to learn the three types of muscles as well as the three parts to bone.

Teacher Notes: Each student will need a blank piece of paper to draw on.

**Station 2 – Growing bones/Strong bones**

Teacher Notes: This activity is part of the NIH curriculum Lesson 5.2 and can be extended with the rest of Lesson 5. After students rank the activities on the “description of sports study” sheet, they can view the real results in the envelope. Each group will use one ranking sheet and the data sheet in the envelope should be repacked before group rotation. The student who reads the anti-gravity/ space article may need some help from adults.

**Station 3 – Ouch!**

One student is the game host and reads the questions in order of their numbering. The game contestants use the noise maker if they have an answer to the question. There is a penalty for wrong answers so they should think carefully. The game host keeps score, and there is a score card for each group.

Teacher Notes:

The game questions include mention of tendons and ligaments so it may be helpful to point these out either before all activities begin (using the elbow model), or as each group begins this station.

**Station 4 – Bone and Muscle Disorders**

Students first examine the osteoporosis model and diagram, orthosis, and prosthesis picture. Then the cards are placed face down and the game (much like Memory) begins. There are three matches to try to make on each turn, disorder, treatment, and professional. If a student doesn’t make the match, they turn the cards back face down. When a student makes the match (color coding shows correct matches), they take the set. The one with the most sets at the end either has the best memory or the most experience with bone and muscle disorders!

Teacher Notes: The orthosis brace is commonly used for treatment of disorders that affect muscle function such as stroke, spinal cord injury, muscular dystrophy,

cerebral palsy, polio and multiple sclerosis. They control motion and position of the ankle, compensate for weakness, or correct deformities.

### **Station 5 – Muscle Geography**

Students demonstrate moving muscles in their arms and legs to learn about contracting and relaxing muscle motion.

*Teacher Notes: In the NIH curriculum Lesson 3, there is a more in depth opportunity to study these principles. You may choose to use the NIH lesson for a longer, whole class, activity to extend understanding of the muscle attachment to bone, contraction and release, and muscle names.*

### **Options for different grade levels**

- Research projects can take shape from the biological questions about bones and muscles or the many career choices. Use web links (under Resource section)
- Show *Emmanuel's Gift* which is a longer film but can lead to lesson extensions about geography, character, physical disabilities and much more.
- Follow up station activities with NIH curriculum and Inner Space Outer Space for older students.
- For younger students, demonstrate principles of muscle contraction and read enclosed books to the class prior to station activities.

## **Oregon Content Standards**

Specific content standards for the NIH binder of lesson extensions are inside the binder front cover.

Station activity content standards are on the master In-A-Box standards check sheet.

## Assessment Options

Station notes can be collected to assess student learning at the station activities or the following questions can be used for before and after or following activities.

1. Name one *type* of muscle
2. Name one thing you find inside human bone
3. Name one thing that helps your bones increase in density
4. Name one sports injury
5. What is *osteoporosis*?

## Restocking and Ordering

The Bones and Muscles Box needs to be returned to the AHEC education coordinator for restocking, but we encourage you to share this resource with your fellow teachers. Pass along your AHEC education coordinator's phone or e-mail for ordering. In-A-Box from AHEC also offers Brain-In-A-Box, Guts In-A-Box, Eye In-A-Box, Expedition Northwest In-A-Box, and Ear In-A-Box for grades 4-8.

**Loan periods-** You may keep your box for up to three weeks if you would like to explore use of the video *Country Doctors*, utilize the extension lessons, follow the web links (under Resources) for student activities, etc.

## Box Contents

Please use your Contents Check Sheet as you repack the box for return. Some items are replenishable, and AHEC will do this. Please be sure all other materials are checked off and in the box.

Five station envelopes:

Station 1: Colored pencils, 2 diagrams, skeleton facts, (6) flashcards

Station 2: Bone density x-rays, sports study description & data sheets, gravity machine handout, and ranking sheet

Station 3: Question cards, noise maker, answer sheet, and score cards

Station 4: Memory cards, prosthesis picture, and osteoporosis diagram

Station 5: 30 muscle templates, 2 pads of sticky notes

Pre and post student surveys help us to evaluate the effects of In-A-Box curriculum and are to be placed in the box at completion or mailed to our Portland office if an envelope is included.

Teacher feedback form- Please fill this out at the conclusion of your use with In-A-Box. Your feedback is vital to our funding and box improvements.

## **Artifacts:**

**Bones and Muscles In-A-Box**- poster is yours to keep for the classroom.

**Bones and Muscles In-A-Box** DVD- This is a 20 minute video of interviews with a sports medicine doctor and a massage therapist who work at Oregon Health & Science University.

**Bill Nye *Bones and Muscles*** DVD and curriculum

***Emmanuel's Gift*** DVD- the true account of an African athlete who continued his amazing involvement in sports with a prosthetic leg while inspiring all of those who watched him.

**Foot model** – This is for use before, during, or after station activities

**Clever Catch inflatable ball** – see extensions on page 3

**Orthosis brace** - This is for use before, during, or after station activities

**Muscle elbow model** – Use this to present the difference between nerves (the yellow), tendons and ligaments (clear), muscle (red), and bone (white). The legend is on the bottom of the model.

**Osteoporosis model** – For use with station 4

**Exercise and muscle poster**- Poster is used for station 5.

**X-ray set**- Students can identify bones on the x-rays after learning some of the names in the station activities. Activity ideas are included at the end of the teacher guide. This makes a fun extension activity.

**Blueprint for Health Muscles chart** – These posters are used for station 1  
**Blueprint for Health Bones chart**

***Country Doctors* video**- This one hour long PBS video was made in rural Oregon about the need for local health care providers.

**3 lb Weight** – For use with station 2

## Books:

- **Bones**
- **Muscles**
- **Understanding your Bones and Muscles**
- **Molly the Pony**

**NIH Curriculum-** *Looking Good, Feeling Good, from the Inside Out-* This seven lesson curriculum created by the National Institute of Health offers many extensions for lessons about bone health, muscle use, dietary needs, as well as lessons about skin health and anatomy.

**Muscles and Bones – From Inner Space to Outer space** - curriculum

## Resources

For Adults or older students:

- Fun Facts about Sports Injuries from the National Institute of Arthritis and Musculoskeletal and Skin Diseases (NIAMS)  
[http://www.niams.nih.gov/Health\\_Info/Sports\\_Injuries/sports\\_injuries\\_ff.asp](http://www.niams.nih.gov/Health_Info/Sports_Injuries/sports_injuries_ff.asp)  
PDF version available to print
- NASA site with information about bone loss for astronauts and research related to prevention <http://www.sti.nasa.gov/tto/spinoff1996/24.html>
- NASA- research on bone and muscle physiology  
[http://www.nasa.gov/mission\\_pages/station/science/experiments/Human\\_Research.html](http://www.nasa.gov/mission_pages/station/science/experiments/Human_Research.html)
- A glossary for bones, joints and muscles  
<http://www.health.uab.edu/14023/>
- National Institute of Health's National Library of Medicine on bones, joints and muscles. All conditions with links for research  
<http://www.nlm.nih.gov/medlineplus/bonesjointsandmuscles.html>
- Health Central- article on the effect of exercise on bones and muscles  
[http://www.healthcentral.com/diabetes/exercise-000029\\_5-145.html](http://www.healthcentral.com/diabetes/exercise-000029_5-145.html)
- Detailed article on the types of muscles we have  
<http://www1.american.edu/adonahue/k14muscles.htm>
- Body Quest for student exploration of the human anatomy  
<http://library.thinkquest.org/10348/>
- The Community Learning Network - Many links to further information about the muscles and skeletal system  
[http://www.cln.org/subject\\_index.html](http://www.cln.org/subject_index.html) - muscles  
[http://www.cln.org/subject\\_index.html](http://www.cln.org/subject_index.html) - skeletal system
- National Institutes of Health site on osteoporosis and other bones disorders.  
[www.osteoporosis.nih.gov/](http://www.osteoporosis.nih.gov/)

- National Institute on Aging article entitled, “Osteoporosis: The Bone Thief.”  
<http://www.nia.nih.gov/HealthInformation/Publications/osteoporosis.htm>
- New York Times article on stretching before exercising/participating in sports.  
<http://www.nytimes.com/2008/11/02/sports/playmagazine/112pewarm.html>

For student information:

- Kids Health- Student article about bones, muscles, and joints along with research for all health topics  
[http://kidshealth.org/parent/general/body\\_basics/bones\\_muscles\\_joints.html](http://kidshealth.org/parent/general/body_basics/bones_muscles_joints.html)
- How Stuff Works – The muscle and skeletal system with many interesting pictures <http://health.howstuffworks.com/body-systems-channel.htm>
- CDC website about bone health for girls. <http://www.girlshealth.gov/bones/>
- National Institute on Drug Abuse site on effect of anabolic steroid use.  
[http://teens.drugabuse.gov/mom/mom\\_ster2.php](http://teens.drugabuse.gov/mom/mom_ster2.php)

In the Box:

- Link to the National Space Biomedical Research institute *Muscles and Bones* curriculum, which is included with the Box.  
<http://www.bioedonline.org/resources/nsbri.cfm>
- Link to the NIH curriculum, *Looking Good, Feeling Good: From the Inside Out*, this is included in the Box.  
<http://science.education.nih.gov/customers.nsf/MSBone.htm>

### **Family Involvement Ideas**

- Invite families to view “Country Doctors” video to learn about rural health care needs.
- Ask students to invite any relatives to class who have prosthetics, bone screws, or pictures of bone/muscle surgeries so that they can tell their story to the class.
- Ask students to invite any relatives to class who work with bone or muscle safety risks (athletes, farmers, physical or massage therapists, laborers...) routinely to share how they protect their bones and muscles.

## Glossary

**A more extensive glossary can be found in the NIH curriculum**

**Actin:** A contractile protein found in muscle cells. Together with myosin, actin provides the mechanism for muscle contraction.

**Bone marrow:** A soft tissue found in the center of large bones. Bone marrow produces blood cells.

**Calcium:** A chemical element that plays a vital role in the biochemistry of a cell. Calcium is an important part of a healthy diet. It is stored in the skeleton and released into the bloodstream as needed.

**Cartilage:** An elastic connective tissue. Unlike bone, cartilage does not contain blood vessels and lacks the ability to regenerate.

**Diaphysis:** The shaft of a long bone.

**Epiphyses:** The end portions of long bones where growth occurs.

**Fuorapatite:** A fluorine-containing mineral that contributes strength to bone.

**Hydroxyapatite :** A mineral containing calcium and phosphorous that contributes strength to bone.

**Joint:** A location where bones meet and allow movement about that location.

**Ligament:** Connective tissue that connects bone to bone.

**Myosin:** A contractile protein found in muscle cells. Together with actin, myosin provides the mechanism for muscle contraction.

**Osteoblast:** A cell that contributes to the formation of bone.

**Osteoclast:** A cell that contributes to the breakdown and resorption of bone.

**Osteocyte:** A branched cell found in the bone matrix. Osteocytes are derived from osteoblasts. They communicate with other cells and help the bone respond to its environment.

**Sarcomere:** The structural and functional unit of muscle contraction.

**Tendon:** A band of connective tissue that attaches muscle to bone.

**Tissue:** A population of similar cells that act together to perform one or more specific functions in the body.

**Vitamin D:** A fat-soluble vitamin needed for normal growth of bone. Vitamin D is produced when sterols in the body are irradiated by ultraviolet light.