Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2019 Volume III: Human Centered Design of Biotechnology

How Your Skeleton Helps You

Curriculum Unit 19.03.11
by Carol Boynton

Introduction

As a primary-level teacher, I am responsible for creating a classroom that operates as a community, with everyone's voice included in the day-to-day environment and provides opportunities for students to learn through science, technology, engineering, art and mathematics. Key components of our school theme include problem solving and design development to improve human health. This unit will present the perspective that engineering design ideas and products created in purposeful way, with the diverse needs of people across the globe, can help solve problems in human health.

Teaching in a self-contained classroom at Edgewood Magnet School in New Haven, I find the neighborhood/magnet setting a rewarding environment, with students coming to school each day from a variety of home circumstances and with differences in academic levels. As a result of these variables, the children have differing levels of background knowledge and life experiences. The classroom is a mixture of varied ethnicities, economic strata and social and emotional strengths and weaknesses. The use of inquiry allows students at all levels to learn in an inherently differentiated environment, learning new concepts and experiencing laboratory and demonstrations as they move through this curriculum unit on understanding how our *skeleton helps us*.

Throughout the school year, the Kindergarten curriculum touches on the topic of health and nutrition. Our school staff is currently mandated to develop rich curriculum that supports our new S.T.E.A.M. focus, with particular emphasis on units that provide a variety of opportunities for the students to learn about engineering design. The idea that engineered solutions are necessary but can be of help only if they are affordable, accessible, and appropriate seems a primary aspect of understanding the goal of any design. This unit is in direct alignment with my responsibility to design curriculum and to correlate with the approach we use to help our students learn through science instruction, inquiry and investigation.

Young students seem fascinated by how their bodies work and this will be a great introduction to understanding human biology. The picture book, *The Skeleton Inside You* by Philip Balestrino, serves as a foundation for this unit. This text explains to young students how your skeleton helps you, focusing on the activities and actions of children – how you can leap, somersault, and touch your toes— and without it, you would be as floppy as a beanbag. The text and illustrations help children learn that there are over 200 bones *living and growing* inside you that make up your skeleton along with ligaments and joints that hold your bones together, and cartilage in your bendable parts like your ears and your nose. But what if one or more of the parts isn't working and needs help? What can we do to fix those parts? These are some beginning questions the students will to start thinking about at the launch of the unit.

Background Information

The skeletal system is the body system composed of bones, cartilage, ligaments and other tissues that perform essential functions for the human body. Bone tissue is a hard, dense connective tissue that forms most of the adult skeleton, the internal support structure of our body. In the areas of the skeleton where whole bones move against each other (for example, joints like the shoulder or between the bones of the spine), cartilage, a semi-rigid form of connective tissue, provide flexibility and smooth surfaces for movement. Ligaments are composed of dense connective tissue surround these joints, tying skeletal elements together, connecting bones to other bones.[1] Together, they perform the several functions of the skeletal system.

Many people think of bones as being dead, dry, and brittle. These adjectives correctly describe the bones of a preserved skeleton, but the bones in a living human being are very much alive. The basic structure of bones is bone matrix, which forms the underlying rigid framework of bones, formed of both compact and spongy bone. The bone matrix consists of tough protein fibers—mainly collagen—that become hard and rigid due to mineralization with calcium crystals. Bone matrix is crisscrossed by blood vessels and nerves and contains specialized bone cells that are actively involved in metabolic processes.[2]

Bone Cells

There are three types of specialized cells in human bones: osteoblasts, osteocytes, and osteoclasts. These cells are responsible for bone growth and mineral homeostasis. Osteoblasts make new bone cells and secrete collagen that mineralizes to become bone matrix. They are responsible for bone growth and the uptake of minerals from the blood. Osteocytes regulate mineral homeostasis. They direct the uptake of minerals from the blood and the release of minerals back into the blood as needed. Osteoclasts dissolve minerals in bone matrix and release them back into the blood.

Bones are far from static, or unchanging. Instead, they are dynamic, living tissues that are constantly being reshaped. Under the direction of osteocytes, osteoblasts continuously build up bone, while osteoclasts continuously break it down.

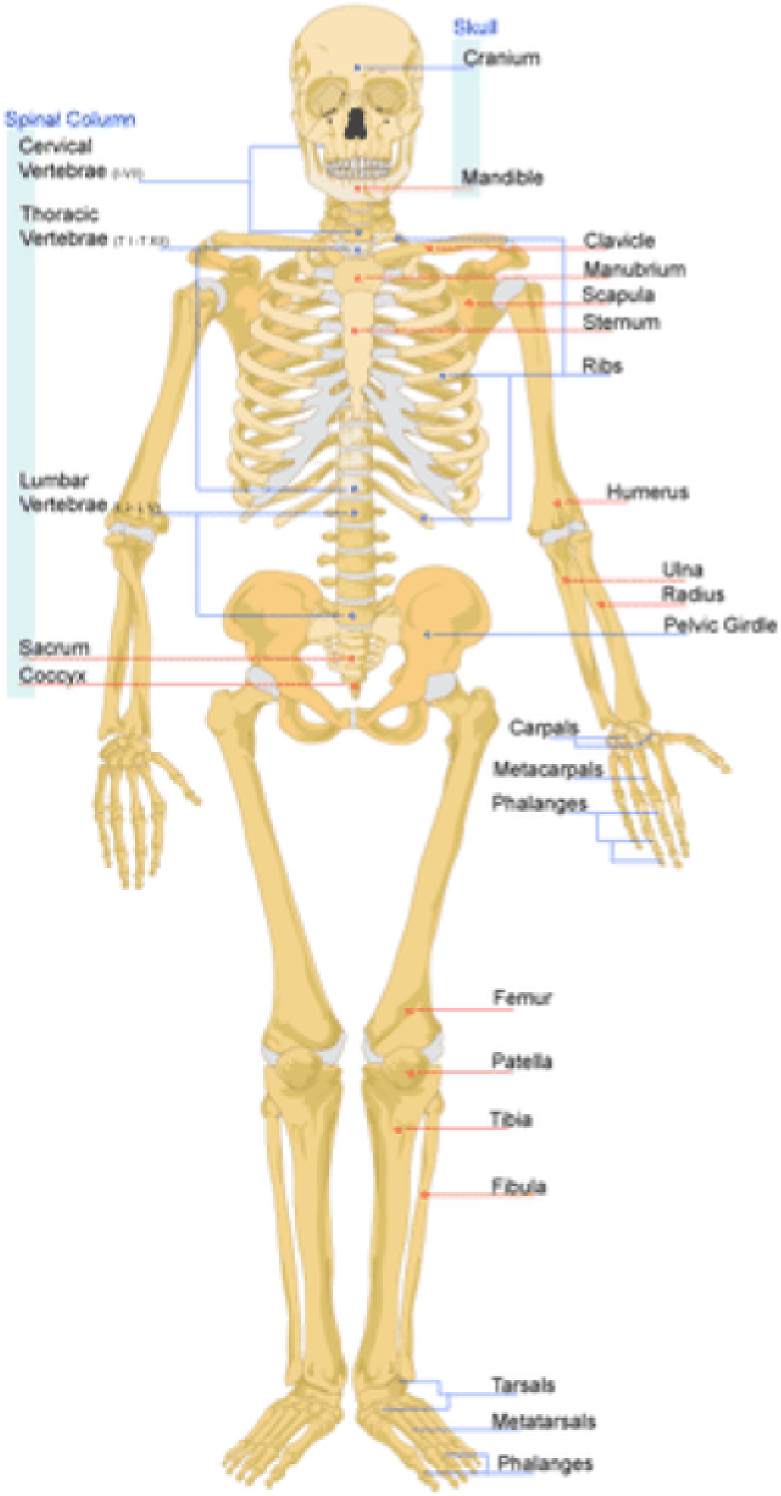


Diagram of human skeletal system

Bone Tissues

Bones consist of different types of tissue, including compact bone, spongy bone, bone marrow, and periosteum. Compact bone makes up the dense outer layer of bone. It is very hard and strong. Spongy bone is found inside bones and is lighter and less dense than compact bone. This is because spongy bone is porous. Bone marrow is a soft connective tissue that produces blood cells. It is found inside the pores of spongy bone. Periosteum is a tough, fibrous membrane that covers and protects the outer surfaces of bone.[3]

Growth and Development of Bones

Early in the development of a human fetus, the skeleton is made entirely of cartilage. The relatively soft cartilage gradually turns into hard bone through ossification. This is a process in which mineral deposits replace cartilage. Ossification of long bones, which are found in the arms and legs, begins at the center of the bones and continues toward the ends. By birth, several areas of cartilage remain in the skeleton, including the ends of the long bones. This cartilage grows as the long bones grow, so the bones can keep increasing in length during childhood.

It will be worth relating this aspect of one growth to the young students. Given that the children participating and learning from this unit of study will have larger growth plates (the growing cartilaginous bone at each end of the long bone), it is important to focus on this aspect.

In the late teens or early twenties, a person reaches skeletal maturity. By then, the cartilage has been replaced by bone, so no further growth in bone length is possible. However, bones can still increase in thickness. This may occur in response to increased load placed on the bone itself due to attached muscle activity, such as weight training.[4]

Movable Joints

Movable joints are also known as synovial joints. This is because the space between the bones is filled with a thick fluid, called synovial fluid, that cushions and lubricates the joint. The synovial fluid itself serves to reduce the friction between joint articulations.

There are a variety of types of movable joints, classified by how they move. For example, a ball-and-socket joint, such as the shoulder, has the greatest range of motion (degrees of freedom), allowing movement in several directions. Other movable joints, including hinge joints such as the knee, allow only one degree of freedom, considerably less than the ball-and-socket joint.

Skeletal System Problems

Despite their hardness and strength, bones can suffer from injury and disease. Bone problems include fractures, osteoarthritis, and rickets. Fractures are breaks in bone, usually caused by excessive stress on bone. Fractures heal when osteoclasts form new bone. Osteoarthritis is a condition in which cartilage breaks down in joints due to wear and tear, causing joint stiffness and pain. Rickets is softening of the bones in children that occurs because bones do not have enough calcium. Rickets can lead to fractures and bowing of the leg bones.[5]

Support, Movement, and Protection

Some functions of the skeletal system are more readily observable than others. When we move we can feel how your bones support us, enable our movement, and protect the soft organs of our bodies. In the same way that steel beams of a building provide a framework to support its weight, the bones and cartilages of our skeletal system make up the framework that supports the rest of our bodies. Without the skeletal system, we would be a limp pile of organs, muscle, and skin. Bones facilitate our movements by serving as points of attachment for our muscles. Bones also protect internal organs from injury by covering or surrounding them. For example, our ribs protect our lungs and heart, the bones of our vertebral column (spine) protect our spinal cord, and the bones of your cranium (skull) protect our brain.[6]

Mineral and Fat Storage, Blood Cell Formation

On a metabolic level, bone tissue performs several critical functions. The bone tissue acts as a collecting location for a number of minerals important to the functioning of the body, specifically calcium and phosphorus. These minerals can be released back into the bloodstream to keep levels needed to support healthy processes. Calcium ions, for example, are essential for muscle contractions and are involved in the transmission of nerve impulses. Bones also serve as a site for fat storage and blood cell production. As noted above, the connective tissue that fills the interior of most bones is called bone marrow. There are two types of bone marrow: yellow bone marrow and red bone marrow. Yellow bone marrow which serves as a source of energy for other tissues of the body. Red bone marrow is where the production of blood cells takes place. Red blood cells, white blood cells, and platelets are all produced in the red bone marrow.[7]

Problems with Bones

An orthopedist is a doctor who specializes in diagnosing and treating disorders and injuries related to the musculoskeletal system. Some orthopedic problems can be treated with medications, exercises, braces, and other devices, but others may be best treated with surgery. While the origin of the word “orthopedics” (ortho- = “straight”; paed- = “child”), literally means “straightening of the child,” orthopedists can have patients who range from pediatric to geriatric. Orthopedists commonly treat bone and joint injuries but they also treat other bone conditions including curvature of the spine. Mostly, they are readily treated by orthopedists. As people age, accumulated spinal column injuries and diseases like osteoporosis can also lead to curvatures of the spine, hence the stooping you sometimes see in the elderly.

One interesting element of bone is that it requires load (force being applied by weight) for it to grow. Therefore, in people who are sedentary, people in anti-gravity conditions, ie. Space flight, osteoporosis becomes a large concern. It may be something to touch on with this age group because it encourages movement for loading bone and continuous growth. Some orthopedists sub-specialize in sports medicine, which addresses both simple injuries, such as a sprained ankle, and complex injuries, such as a torn rotator cuff in the shoulder. Treatment can range from exercise to surgery.[8]

Prosthetic Limbs

People can lose all or part of an arm or leg for many reasons. Common reasons for amputation include circulation problems from atherosclerosis or diabetes; traumatic injuries, including from traffic accidents and military combat; cancer; and birth defects. An artificial limb can sometimes replace it. The device, which is called a prosthesis, can help a patient perform daily activities such as walking, eating, or dressing. Some artificial limbs let people function nearly as well as before.

Newer materials, such as advanced plastics and carbon-fiber composites can make a prosthetic limb light, strong and realistic. Electronic technologies make today's advanced prosthetics more controllable, even capable of automatically adapting their function during certain tasks, such as gripping or walking. While new materials and technologies have certainly modernized prosthetics over the past century, the basic components of prosthetic limbs remain the same.

The pylon is the internal frame or skeleton of the prosthetic limb. The pylon must provide structural support and has traditionally been formed of metal rods. In more recent times, lighter carbon-fiber composites have been used to form the pylons. The pylons are sometimes enclosed by a cover, typically made from a foam-like material. The cover can be shaped and colored to match the recipient's skin tone to give the prosthetic limb a more lifelike appearance.

The socket is the portion of the prosthetic device that interfaces with the patient's limb stump or residual limb. The socket transmits forces from the prosthetic limb to the patient's body so it must be precisely fitted to the residual limb so that it doesn't cause irritation or damage to the skin. A soft liner is generally placed within the interior of the socket, and the patient might also wear a layer of one or more prosthetic socks for a snug fit.

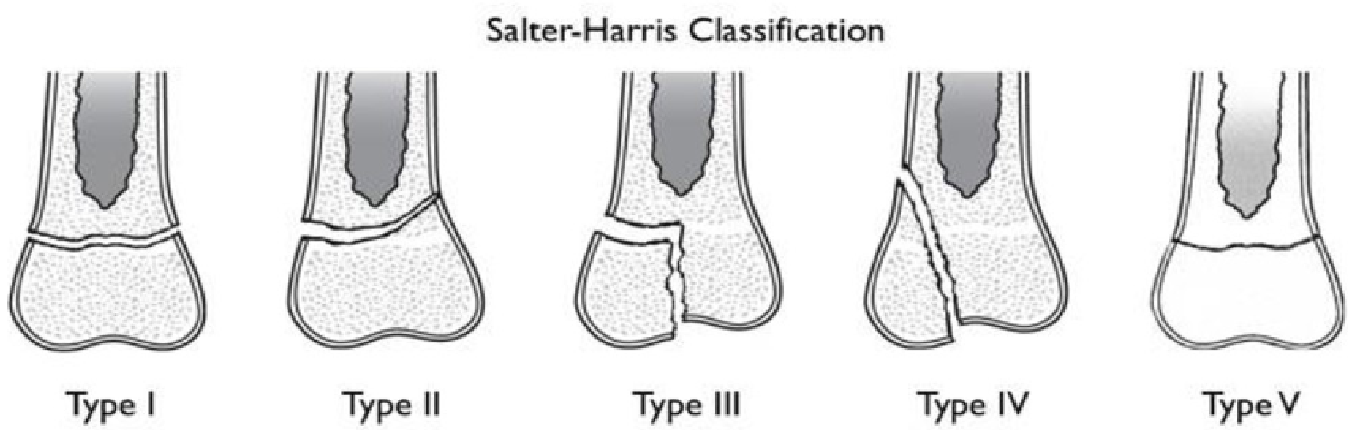
The suspension system is what keeps the prosthetic limb attached to the body. The suspension mechanism can come in several different forms. For example, in the case of a harness system, straps, belts or sleeves are used to attach the prosthetic device. For some types of amputations, the prosthetic stays attached just by fitting around the shape of the residual limb. One of the most common types of suspension mechanisms relies on suction. The prosthetic limb fits snugly onto the residual limb, and an airtight seal keeps it in place.

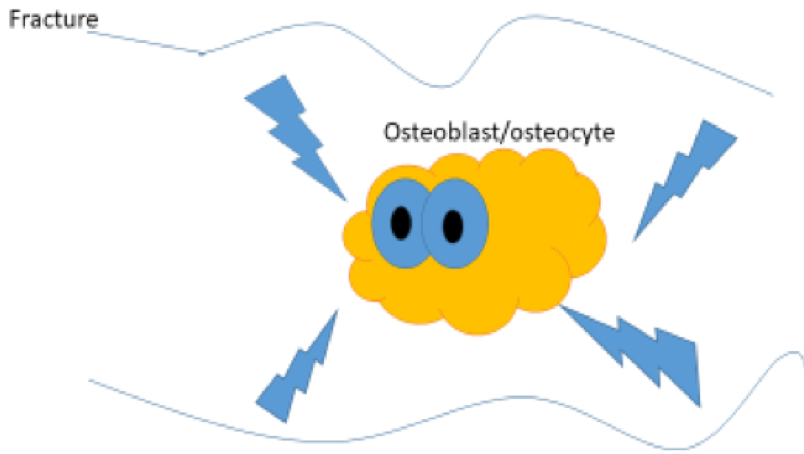
Though most prosthetic limbs have these basic components in some form, each device is unique and designed for a specific type and level of amputation. Whether an amputation is above or below major joints, like the elbow or knee, makes a big difference in what type of prosthetic limb is required. For example, an amputation above the knee requires a prosthetic device with an artificial knee, while an amputation below the knee allows the patient to retain the use of his or her own knee.[9]

Growth Plates

If growth plates become an area of focus (or really any type of fracture/injury) is introduced, have students consider the perspective of a bone cell (osteoblast) in the injury.

The image below describes fracture of the growth plate. If the growth plate is fractured there are bone cells that are at the fracture sites. Students can question what an individual cell may be experiencing (empathizing) at the fracture site, consider what may be missing that causes this cell to not produce bone (ideate) and develop methods to solve the issue (protoype.) This could potentially be done for any condition…or even from the perspective of a child experiencing a fracture. Think about what they are unable to do or participate in (empathize), what the source of that issue is and how it may be remedied (ideating), and actions/tools that could be helpful in facilitating bone repair (protoype).





Empathizing: What might this cell be missing when an injury happens?
  More cells, weight/load, food (nutrients)...
Ideating: What might this cell need to grow new tissue?
  Weight from the bone, calcium...
Prototyping: Are any of these things we can provide?
  Weigh from jumping (design an exercise that isn't too impact heavy, but increases weigh
  Calcium (design a milk-based snack that tastes good and provides calcium)
  More cells (design something (attractant) to draw more osteocytes to the site)

Teaching Strategies

Experiential Learning: The major strategy for this unit is to engage the students in hands-on learning. I want them to be actively participating as inquisitive scientists and engineers. The skeleton building activities and engineering projects are designed to be exploratory for the students, so that they are engaged in the enjoyment of the inquiry and design as well as the process.

Differentiated Instruction: The students will use a variety of approaches, working sometimes individually and sometimes in small groups, determined by the complexity of the activity. Because these are young children with variance in levels and background, guidance and pacing are adjusted to ensure that all students are engaged and active throughout the learning experiences. Students will have opportunities work with a variety of peers as they explore design ideas using a variety of materials.

Cooperative Learning: The students will be given opportunities to work as cooperative groups to complete assignments and activities. This strategy will allow students to work collaboratively taking on various roles necessary to complete the experiments and journal work, with a focus on success for all.

Classroom Activities

Provide a small educational human skeleton for students to observe throughout the teaching of the unit.

Activity One: Introduce the unit with mentor texts

Part One

Materials: *The Skeleton Inside You*, t-chart on chart paper with question, chart to track content from text (examples below), student science journals

To introduce the unit on the understanding of our skeletal system, students will learn about the need for a healthy skeleton to support and protect our bodies' various systems. Students will listen to *The Skeleton Inside You* by Philip Balestrino and begin to collect some facts. This text highlights the way that water is affected and needs to be treated.

Begin by asking some questions to activate background knowledge: Have you ever seen a skeleton? What kinds of things did you notice? What kinds of problems do people have with their bones? Have you ever seen ways that people are helped with their bones?

Ask students the question posted on the chart, "How does our skeleton help us?" Record any answers and ideas on the left side titled "What We Know." Read aloud *The Skeleton Inside Us*.

Prepare T-Chart

How does our skeleton help us?	
What We Know	What We Have Learned

Prepare text content chart

The Skeleton Inside You		
Bones we have	What bones do	Ways to help our bones

On the 2nd chart, track the learning that occurs during the reading in the first two columns with the third column for recording any thoughts and ideas the students might generate as they think about the text.

Return to the t-chart of responses and on the right-side section titled "What We Have Learned." In their science journals, students should transfer the information from each completed chart.

Part Two

A second introductory resource is the picture book, *Bones* by Stephen Krensky. This book will help students learn the structure of our skeleton and help them recognize that bones, in fact, can have problems.

Questions to ask before reading:

Why do we need our skeleton?

What would happen if your skeleton didn't work in some way?

Questions to ask after reading:

How do you think the bones are helpful?

What happens if part of the skeleton isn't working?

How do you think we can fix any problems with our bodies?

What do you think we can do to fix parts inside our bodies?

Compare your size with your parents' size? What are the differences?

Does our skeleton need you to help it every day? How?

What could we do as engineers to help people with skeletal problems?

What sorts of devices have you noticed that help people move around?

At the end of the book, use the skeleton model to reinforce the learning. Students will refer to the model for a number of activities throughout the unit so returning to it and making it available for inquiry will enhance the students' understanding.

From these two resources, my students will develop fundamental vocabulary and conceptual understanding to begin the hands-on work that will come later in the unit.

Activity Two: Skeletal & Engineering Terms

Students will be using a new set of vocabulary to discuss the concepts within this unit and it is important to have this available through anchor charts. Prepare two charts (or word walls) to ensure the students will have access to these Tier 3 words they discover throughout the unit. This will be an ongoing, interactive process.

Engineering, design process, observation, problem, solution, improve, data, materials, create, form, shape, model, analysis, investigate, control, diagram, patterns, predict, reflect, evidence,

Bones, skeleton, skull, ribs, pelvis, vertebrae, tibia, fibula, femur, radius, ulna, …

Activity Three: Creating a Skeleton

Students will mold, paint & display a human skeleton

Die cast supplies: casting material, paints, tray, glue, crayons & paint brush

Smithsonian Museum Craft Kits (purchased) will be used in small groups to create the human skeleton. The kit comes with directions that each group will follow, with adult support. After completing the project, students will record the experience through drawing and labeling their model.

Activity Four: Viewing X-rays

Light table, variety of x-rays

Students will have an opportunity to use the light table to explore and discover what images of our bones look like. Students, in small groups, will identify bones and place them on the light table to make a person. Some images show bones that have fractures and students will learn to identify the location of the fractures.

Activity Five: Creating a Skeletal X-ray

Several varieties of pasta, black construction paper, glue

Students will create a “skeleton” with pasta as a fun example of a human skeleton. Use this activity to support students’ skill of following directions. Each bone is represented by a corresponding pasta shape.

Activity Six: Visit Peabody Museum

We are fortunate to have the Peabody Museum of Natural History available to our students for field trips. We will take a field trip to look at and draw skeletons (of dinosaurs) in the Great Hall. Students will make connections to the understanding they have of the human skeleton and share their experience through their journals and through “sharing” with their peers in the classroom.

Additional Activities: Enrichment level options

Bone Puzzle

Though it’s much easier to remember the names of bones when looking at a skeleton, students should be able to identify bones in isolation by their shapes as well. In order to help young children understand how the skeleton works, not just as a system but as the sum of individual parts, ask them to build a person out of bones. After the students learn the proper names of the major bones, blow up a picture of a skeleton until it is approximately life-size. Carefully cut out each individual bone so you have a pile of paper bones. Divide the pile and your students into groups and ask the students to work together to tape the bones together in their appropriate places to build a skeleton.

Bones from the Inside Out

One of the most important lessons a child can learn about the skeleton is how a bone is made. Using sponges and paper towel tubes, explain to students that bones have marrow at their core, a substance that is spongy and lighter than the outer material of the bone, which is represented by the paper towel tube. Fit the sponge inside the paper towel tube to show how marrow makes a bone strong by comparing it to the empty paper towel tube. Compare human bones to bird bones, which have no marrow. A bird’s light, hollow bones let them fly, but make their bodies much more fragile than a human being’s bones. Identifying the difference between human and bird bones through weight and strength helps students understand the importance of marrow in the skeletal system.

Calcium in the Skeletal System

During the reading and conceptual understanding that takes place during this unit, the students learn that milk is good for their bones. This activity helps demonstrate how calcium makes a bone strong. Before class, boil and dry chicken bones. Have the students to describe how they feel -- they should mention that the bone feels strong. As a class, put half of the chicken bones in a jar of vinegar, explaining that vinegar dissolves calcium. At the end of the week, compare the group of bones that were in the jar of vinegar to the bones that were not. The vinegar bones will feel stretchy as the calcium that made the bone tissue strong has disappeared.

Fun Bone Song

Begin by writing the lyrics below (sung to the tune of “When You´re Happy and You Know It, Clap Your Hands”) on a large sheet of chart paper and display so that all the children in your class can see it. Then as children sing, have them point to each body part mentioned in the song.

"I'm Full of Bones"

From my fingers to my toes, I´m full of bones.From my fingers to my toes, I´m full of bones.If you count them all as one, they make a skeleton.From my fingers to my toes, I´m full of bones.

My smallest bone is found inside my ear.My smallest bone is found inside my ear.The stirrup helps me hear many sounds both far and near.My smallest bone is found inside my ear.

My longest bone is found inside my leg.My longest bone is found inside my leg.My femur´s really great ´cause it helps me stand up straight.My longest bone is found inside my leg.

My joints help my bones to move around.My joints help my bones to move around.My hips, elbows, and knees: Oh, it´s all so plain to seethat my joints help my bones to move around.

—Original song lyrics by Jennifer Prescott

Build A Bone

To help children understand what the inside of a bone looks like, have them each to make these simple bone models. Have students shape a 2" square of corrugated paper into a tube and tape the ends together. This tube represents compact bone, the hard outer layer that contains blood vessels and nerves. They then roll a 2" square of rubber shelf liner into a scroll and insert it into the bone tube. This represents spongy bone, a bone's lightweight inner layer. Finally, students fill the center of their models with red and yellow pompoms. Explain that the red marrow produces essential red and white blood cells for the body and that yellow marrow stores fat.

Long and Strong

Our arms and legs are each made up of three long bones: one in the upper part of each limb and two in the lower part. Invite pairs of students to measure and record the length of these bones to the nearest inch. First, have them measure the humerus from the shoulder to the elbow, the ulna from the elbow to the wrist, and the radius from the inside of the elbow to the thumb side of the wrist. Then ask children to measure the femur from the hip to the knee, the tibia from the knee to the inside ankle, and the fibula from the knee to the outside ankle. Which bone is the longest? (It is the femur.) This bone is also the strongest bone in the body. Can children explain why? Ask students to explain why the other bones in their legs and arms also need to be strong.

Bendable Backbone

The backbone is actually made up of many bones, called vertebrae, that link together and form sliding joints. To show how this construction allows for flexible movements such as twisting and bending, give children a fat plastic straw to cut in half. Have them cut snips along the length of one of the halves, being sure to leave the straw in one piece. When finished, ask students to bend and twist each straw half. Which straw half can be bent and twisted with more ease and flexibility?

Endnotes

---

1 https://www.healthline.com/human-body-maps/skeletal-system.

2 Ibid.

3 HowStuffWorks Science

4 Ibid.

5 Skeletal System: Anatomy and Function, Diagram, Diseases, and More.

6 HowStuffWorks Science

7 Skeletal System: Anatomy and Function, Diagram, Diseases, and More.

8 Ibid.

9 Isaac Perry Clements. "How Prosthetic Limbs Work."

Reading List

"All Posts from Orthotics & Prosthetics Category." UNYQ Orthotics Prosthetics Category. Accessed July 30, 2019. ttp://unyq.com/category/orthotics-prosthetics/.

Clements, Isaac Perry. "How Prosthetic Limbs Work." HowStuffWorks Science. June 28, 2018. Accessed June 12, 2019. https://science.howstuffworks.com/prosthetic-limb2.htm.

Dunning, A. G., and J. L. Herder. "A Review of Assistive Devices for Arm Balancing." *2013 IEEE 13th International Conference on Rehabilitation Robotics (ICORR)*, 2013. doi:10.1109/icorr.2013.6650485.

Johnson, Steven. *Where Good Ideas Come from the Seven Patterns of Innovation*. London: Penguin, 2011. This book provides a broad look at how innovation has occurred over time and identifies strategies useful to think about new technologies and developments.

Kate, Jelle Ten, Gerwin Smit, and Paul Breedveld. "3D-printed Upper Limb Prostheses: A Review." *Disability and Rehabilitation: Assistive Technology* 12, no. 3 (2017): 300-14. doi:10.1080/17483107.2016.1253117.

Poonsiri, Jutamanee, Rienk Dekker, Pieter U. Dijkstra, Juha M. Hijmans, and Jan H. B. Geertzen. "Bicycling Participation in People with a Lower Limb Amputation: A Scoping Review." *BMC Musculoskeletal Disorders* 19, no. 1 (2018). doi:10.1186/s12891-018-2313-2.

"Skeletal System: Anatomy and Function, Diagram, Diseases, and More." Healthline. Accessed June 12, 2019. https://www.healthline.com/human-body-maps/skeletal-system. A general overview of the human body systems presented in an accessible manner.

Strawbridge, Kirsty, and Peta Bell. "Wellcome." Step-by-step: Prosthetic Legs through the Ages (gallery). Accessed June 14, 2019. https://mosaicscience.com/story/step-step-prosthetic-legs-through-ages-gallery.

Zuniga, Jorge, Dimitrios Katsavelis, Jean Peck, John Stollberg, Marc Petrykowski, Adam Carson, and Cristina Fernandez. "Cyborg Beast: A Low-cost 3d-printed Prosthetic Hand for Children with Upper-limb Differences." *BMC Research Notes* 8, no. 1 (2015): 10. doi:10.1186/s13104-015-0971-9.

Appendix – Implementing District Standards

Next Generation Science Standards for K-2:

K-LS1-1 Earth and Human Activity: Use observations of what plants and animals (including humans) need to survive.

During this unit on the understanding of our skeletal system, students will learn about the need for a healthy skeleton to support and protect our bodies' various systems.

K-2-ETS1-1 Engineering Design: Ask questions, make observations, and gather information about a situation people want to change to define a simple problem that can be solved through the development of a new or improved object or tool.

Students will experience, through development and design, that bones can become fractured or amputated and that, with design and innovation, we can work to repair the affected areas.

K-2-ETS1-2 Engineering Design: Develop a simple sketch, drawing, or physical model to illustrate how the shape of an object helps it function as needed to solve a given problem.

Students will create a die-cast model of a human skeleton to understand that the shapes of our bones are connected to their function in our bodies and are those specific shapes are for efficient and effective use. When those shapes are affected by damage, we can design models to help preserve the function.

K-2-ETS1-3 Engineering Design: Analyze data from tests of two objects designed to solve the same problem to compare the strengths and weaknesses of how each performs.

As the students learn from the text Bones, students will analyze the ways that we can help our bones, through technology and innovation.

New Haven District Inquiry Standards:

A INQ.1 Make observations and ask questions about objects, organisms and the environment.

During the introduction of this unit and throughout, the students will generate a series of questions to investigate as they participate in the series of activities designed to explore and discover information about the skeletal system.

A INQ.2 Use senses and simple measuring tools to collect data.

Students will use measuring tools to compare the length and diameter of the major bones of the human body.

A INQ.3 Make predictions based on observed patterns.

Students will participate in testing models of bones they create. They will make predictions on the actions of their models and adjust designs based on the results.

A INQ.4 Read, write, listen and speak about observations of the natural world.

Students will document their findings throughout the unit