

## **Grade 3: The Skeletal System**

**Lesson 1: Bone Identification**

**Lesson 2: How Do Bones Feel and Look?**

**Lesson 3: Why Are Bones Hard?**

**Lesson 4: Joints**

*(Note to teachers: This unit is long, but can easily be broken down into separate segments according to the lesson number.)*

### **Objectives:**

1. Students will identify at least **three functions** of the Skeletal System.
2. Students will know the technical names of the **major bones** in the Skeletal System.
3. Students will explore the **shapes and physical characteristics of bones**, naming the four major shapes of bone.
4. Students will discover that **calcium** supports strong, healthy bones and that **bones are alive**, growing and changing throughout life.
5. Students will name the **three types of joints**, demonstrate how joints allow us to move, and identify that different joints perform different functions.

### **Materials:**

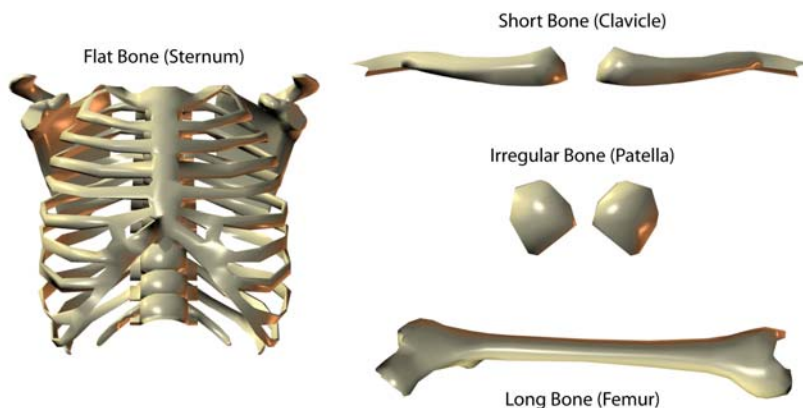
- Skeleton Model (optional)
- Crayons or colored pencils
- Butcher paper
- Masking tape
- Marking pens
- Chicken bones
- Vinegar
- Plastic containers
- Small plastic toy animals
- Bones (skeleton model, if available)
- Peanut M&M's
- Books (from the book list or others that seem appropriate)
- Kitchen utensils (egg beater, can opener)
- Overhead projector
- Overhead projector film/markers
- Bone/Technical Name/Purpose handout (**See Figure 1**)
- Cards with Bone Names (**See Figure 2**)
- Pictures of each part of the skeleton drawn on separate pieces of paper ("Be a Bone" Exercise) (**See Figure 3**)
- Student Skeleton Puzzle (**See Figure 4**)
- Skeleton Information Chart (**See Figure 5**)
- School House Rock – Science Rock (**See Figure 6**)
- Detailed Skeleton Picture (**See Figure 7**)

- “Drink Milk” advertisement (**See Figure 8**)
- Parent Letter (**See Figure 9**)
- Parent Letter – Reminder (**See Figure 10**)
- Large Skeleton Puzzle (**See Figure 11**)
- Joint Information Chart (**See Figure 12**)

**Activity Summary:** Students will acquire a basic understanding of the Skeletal System, bones, and joints, and relate this information to their own bodies.

### Background Information for the Teacher:

- The **Skeletal System** is made up of the **bones** of the body and the **joints** between the bones, as well as certain **connective tissue** (**cartilage** and **ligaments**.) This lesson will focus on the **bones** and **joints**. **The skeleton is the internal framework of the body.** Bones are probably best known for the hard structural role they play in the human body, but in fact **bones are living tissue**. Because bone is live tissue it receives nutrients and oxygen from the blood vessels that supply the bone. In addition, **bones have nerves**. That is why when you hit your “funny” bone in your elbow it doesn’t feel very funny.
- Bones come in **four** basic **shapes**: **LONG, FLAT, SHORT** and **IRREGULAR**.
- Bones also vary in **texture**: they may be either **rough** or **smooth**, with projections and hollows. Places on the bones that have irregular shapes and textures are the **attachment sites** for the muscles.



The **SKELETON** has many important functions in the body. It provides:

- **SUPPORT** for the body – The hardness of the bones provides a strong framework that helps us stand upright, and anchors muscles and organs.
- **PROTECTION** of the internal body organs – The ribs protect the heart, lungs, kidneys, and liver; the vertebral column surrounds the spinal cord. The hip bones give support and some protection to the bladder and the female reproductive organs. The skull encases the brain.
- **MOVEMENT** of the body – All muscles in the body attach to bones and all muscles cross joints. Muscles connect one bone with another bone. When the muscles move (contract) the joint moves and the bones that make up the joint move closer together.
- **STORAGE** of minerals and fat – Calcium, magnesium, phosphorus and sodium are stored in the bones.
- **RED BLOOD CELL FORMATION** – The red marrow found in the internal cavity of some bones is responsible for producing red blood cells.

The **SKELETON** has **206 bones**. The major skeletal regions are:

- **SKULL**: Made up of more than 20 different bones of the cranium, face and ear. The smallest bones in the body, the auditory ossicles, are located in the ear.
- **SPINE**: Consists of a column of 26 bones, 24 of which are called vertebrae: **cervical** (7); **thoracic** (12); and **lumbar** (5). The **sacrum** and the **coccyx** are made up of four or five vertebrae fused together.
- **RIBS & STERNUM** (BREASTBONE): 25 bones (12 pairs of ribs, plus the sternum)
- **PELVIS** (HIP BONES), **LEGS**, and **FEET**: 62 bones.  
The longest bone in the body is the FEMUR (thigh bone)

### **BONE FORMATION & GROWTH**

**Bones grow, change and regenerate** throughout life. This is a dynamic (not static) process that starts before birth and continues throughout a person's life. Bone begins as cartilage before birth, as the fetus begins the process of turning cartilage into bone (ossification.) **Calcium** is collected in the bony material along with other minerals and this facilitates the ossification process. By the time a baby is born, most of the cartilage has formed into bone.

During childhood, the long bones (such as the thighbone, shin bone, and long bones of the arm) lengthen and harden. This occurs through a process called **bone remodeling**. As a child's body grows, bone remodeling transports bone material throughout the body in order to maintain vital calcium levels in the blood, in addition to the calcium needed for bone growth. Calcium is so important to the body that if there is not enough of it in the blood, hormones will break down calcium from bony tissue and re-distribute it to other sites in the body. **Children have a greater need for calcium in order to develop the larger, denser, longer and stronger bones they need to grow into adolescence and adulthood.**

## **JOINTS**

A **joint** is where **two bones meet**. Bones are hard and can't bend, twist or turn, but joints can do all those things. **Muscles always cross joints**. Most muscles cross only one joint, but a few muscles cross two joints.

**There are three kinds of joints:**

1. **Nearly immovable** – such as the joints, or sutures, of the skull bones;
2. **Slightly moveable** – such as joints of the hip bones; and
3. **Freely moveable** – such as the knees, shoulders, wrists and toes. These are the most common joints in the body.

**There are also three kinds of joint *movement*:**

1. **Pivot** – One bone joint rotates around another bone. (Example: the movement of the head when a person is looking from side to side.)
2. **Ball and socket** – The end of one bone has a ball shape to it. It fits into the end of another bone that has a round hollow in it that looks like a cup. (Examples: the shoulder joint and the hip joint are both ball and socket joints. This joint allows omni-directional movement.)
3. **Hinge** – The rounded end of one bone is rounded and fits into a depression in the other bone. The movement of this joint is like a door hinge, thus the name. (Examples: In the elbow and knee joints the hinge joint movement is in one direction and moves the bones closer together (flexion) and farther apart (extension.)

## VOCABULARY:

- **Skeletal System** – made up of the bones in the body, the joints between the bones, and connective tissue (such as cartilage and ligaments)
- **Skeleton** – the internal framework of the body
- **Bone** –living tissue made up of bone cells and minerals, including calcium. Bones have many shapes and sizes and are the individual components of the skeleton
- **Joint** –where two bones come together

## LESSON 1: Bone Identification

**Engage** (5 minutes): Have the students take out a piece of paper and write their names on the top, numbering to two.

1. Ask: **“How many bones do you have in your body?”** (Have the students write down an estimate.)
2. After everyone has written a number down, show the students a jar in which you’ve put **206 Peanut M&M’s**. Say: **“The number of Peanut M&M’s in this jar is THE SAME as the number of bones in your body. Estimate how many bones you think there are in your body and how many peanut M&M’s are in the jar.”** (Let the students share their estimates, then share the correct answer—206.)
3. Say: **“Where are our bones? Are we able to see our bones?”** (No. *Bones are INSIDE your body.*)
4. Say: **“Bones are the internal FRAMEWORK of the body, which is the SKELETON. Think of a bed. If we took all the padding and fabric away what would the ‘internal frame’ consist of?”** (Wires, boards, etc...) **“Just like the body, if we take all the outside ‘stuff’ away, the inside frame is the bones.”**

**Explore** (15 minutes):

1. Divide the students into groups of three or four and assign roles: **Recorder, Reporter, and Supply Manager.**
2. Give each group a sheet of paper with a graphic organizer or have them copy it from the board. **(See Figure 1)**

Bone	Technical Name	Purpose
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3. Give each group an index card with the scientific/technical name of a bone written on it. **(See Figure 2)** Each card should have a couple of different **scientific** names of bones on it, from the following: CRANIUM, MANDIBLE, CLAVICLE, STERNUM, SCAPULA, HUMERUS, RIB, VERTEBRAE, PELVIS, RADIUS, ULNA, CARPALS, METACARPALS, PHALANGES, FEMUR, PATELLA, TIBIA, FIBULA, CALCANEUS, TARSALS, METATARSALS. (Suggested groupings: patella and femur; tarsal, carpals, and phalanges; spine and vertebra; tibia and fibula; ribs and sternum; pelvis and skull; scapula and humerus; radius and ulna.)
4. Give each group an encyclopedia and a sheet of overhead projector film. On the overhead projector paper have students create a graphic organizer like the one above. Next have them write the **scientific** names on their card, then what each bone is **commonly** called (ex. arm bone, thigh/leg bone, fingers, etc...), and finally the **purpose** of that bone in the body.

### **Explain: (10 min.)**

Have students come back together as a large group, then have each group share their information. As each group is sharing, students from the other groups should fill in the new information on their graphic organizers individually. (At the end everyone should have the same information recorded.)

Using the **Skeleton Information Chart (Figure 5)** at end of this lesson) as reference information, be sure to go over any information regarding the purposes/functions of the skeletal system that was previously overlooked.

### **Extend: (15 min.) BE A BONE (See Figure 3)**

1. Each technical bone name is written on a separate piece of paper, making sure that bones for each side of the body are included (example: humerus will need to be written twice.) To be sure there are enough bones so all students can participate, the spine can be divided into segments: for lower (lumbar), middle (thoracic) and neck (cervical). (Teachers may need to assist if the spine is separated into different segments).
2. Have students choose a name of a bone.
3. Students **become** the bone they have chosen by lying on the

floor and assembling themselves together in the correct order as a human skeleton.

4. Once everyone is on the floor and the skeleton is together, ask: “**What is the skull for? Why do we need the femur? etc...**” to check for understanding of the purpose of each bone.

### **Evaluation for Lesson 1: Bone Identification – Skeleton Puzzle**

Print off the outline of the Skeleton Puzzle (**See Figure 4**) on card stock if possible, or laminate the pages so the puzzle pieces will be more durable. Tell the students they will be making a puzzle. First they will need to name the bones. As you say the name of a bone, have students write (with colored pencil) that name in the appropriate place on the skeleton. (Names to check for understanding: patella, femur, tarsal, phalanges, pelvis, spine, vertebra, tibia, fibula, ribs, sternum, carpals, phalanges, skull, scapula, humerus, radius, ulna.) Save this for later. Do not have the students cut the puzzle out. Collect the puzzles for assessment and save for Lesson 4 (Joints).

#### **Other Assessment Techniques:**

- Observe group work and presentations.
  - Collect graphic organizers.
  - Observe “**Be a Bone**” activity.
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- ***Note to Teachers: Reinforcement/Additional Support: If the students need more reinforcement, try the following additional activity.***

#### **Skeleton and Bone Identification (20 minutes):**

Begin by explaining general information about the skeleton:

1. Major skeletal regions (skull; spine; ribs and sternum; shoulders, arm, and hands; hip bones, legs, and feet).

**Review the names of the bones** by having the students say the name when you point to the bone. Have the students point to or touch that bone on their own body while they say the name of the bone.

Bones of the Foot: Ankles ( <b>tarsals</b> ) Instep ( <b>metatarsals</b> ) Toes ( <b>phalanges</b> )	The 26 bones of the foot help enable us to stand, walk, run and kick.
Bones in the Legs: Shin bones (lower leg: <b>tibia &amp; fibula</b> )	The <b>femur</b> is the longest bone in the body. The bones in our legs enable

Knee cap ( <b>patella</b> ) Thigh bone (upper leg: <b>femur</b> )	us to stand up tall, walk up stairs, and climb.
Bones of the Hip: The <b>pelvis</b>	The <b>pelvis</b> provides support for the spine and some body organs, and is a very stable part of the body.
The backbone ( <b>spine</b> ) or <b>vertebral column</b>	Comprised of 26 separate <b>vertebrae</b> , the <b>spine</b> forms a flexible central column that enables us to stand up straight and protects the <b>spinal cord</b> .
The <b>Ribs</b> The Breastbone ( <b>sternum</b> )	There are 24 <b>ribs</b> in 12 pairs (seven “true” ribs are attached to the <b>sternum</b> , three “false” ribs are attached to a “true” rib, and two ribs are “floating.”) They protect the heart and the lungs.
The Shoulders: shoulder blade ( <b>scapula</b> ) and collar bone ( <b>clavicle</b> ) Upper arm ( <b>humerus</b> ) Lower arm ( <b>ulna &amp; radius</b> )	The arms are linked to the body by the shoulder blades and collar bones (the pectoral girdle.) A very mobile part of the body, the shoulders and arms enable us to give a hug!
Bones of the Hands: Wrists ( <b>carpals</b> ) Palms ( <b>metacarpals</b> ) Fingers and Thumbs ( <b>phalanges</b> )	The bones in our hands enable us to throw a ball, write, and work on the computer.
The Bones of the Skull & Face: Skull ( <b>cranium</b> ) Upper Jaw ( <b>maxilla</b> ) Lower Jaw ( <b>mandible</b> ) Ear Bones ( <b>ossicles</b> )	There are more bones in the skull, face and ear (29) than there are in the spine (26).

**Review the Function of the Bones:** Remind students that when they learned about the skeleton they also learned about some things that bones help us do. Ask if they can tell you what those things are, then use their responses to create a chart on the board of the major skeletal functions, along with a brief description, and some bones that are key to that function. **NOTE:** Use the Skeleton Information Chart at the end of this lesson outline as reference information. (See Figure 5)

## **Lesson 2: How Do Bones Feel and Look?**

### **Engage: (5 min.)**

Depending on the resources available in your classroom, begin with either: *School House Rock – Science Rock – Them Not-So-Dry Bones* (See Figure 6) or another book that is appropriate for this lesson.

### Explore: (10 min.)

- Break students into groups of three or four again. (You may want to have students keep the same groups throughout the entire skeleton lesson.)
- Give each group a copy of the skeleton. **(See Figure 7)** If available, you may also want to use actual human bones or a skeleton for the students to explore. Allow time for the groups to closely examine the bones and/or skeleton.
- Have each group **list** all the things they notice about bones as they touch them and look closely at them. Encourage them to use describing words (adjectives).

### Explain: (10 min.)

- Come back together as a large group. Create three columns on the board. Cover up the title of each column with a piece of paper. (Be sure the students cannot see the titles.)
- Tell the students that as you go around to each group the **reporter** from each group will share just **one** thing from their list at a time. As you continue going to each reporter, remind students to only share descriptive words (adjectives) that are not already on the board.
- Explain that you are going to list things that are **alike** in each column, but you have a **secret** and want to see who can figure out that secret. Your secret is that you have a **title** for each column. You want them to figure out what each item in the first column has in common so you can give a title to that column. In other words, you want them to “name” each column.
- Tell the students that when they have figured out what similarities there are among everything in a column and have come up with a name for that column, they should raise their hand and share their idea with the group. At this point you will tell them whether or not they have figured out the “secret.”
- The title for Column #1 will be: **“The Shape of Bones”**, Column #2: **“The Textures of Bones”** (or **“How Bones Feel”**), and Column #3: **“Other”**.

**SHAPES OF BONES****HOW BONES FEEL****OTHER**

Long	Rough	Any observations that don't fit in other categories
Short	Smooth	
Irregular	Sharp	
Flat		

Ask: ***“Why do bones have different shapes?”*** (Bones have different functions and purposes.) Ask: ***“Why do bones have bumps?”*** (Muscles attach to the bones at some of these sites.)

**Extend: (10-15 min.)**

Have students write a short story from one of the following topics:

“If my spine were a long bone...”

“If my femur were a flat bone...”

“If my humerus were a short bone...”

“If my skull were an irregular bone...”

**Evaluate:**

- Use the short stories for evaluation of understanding the different types of bones and the purpose of different types of bones.
- Observation during group activity.
- Have the students list the four types of bones, giving an example of each, and three adjectives that describe how bones feel.
- ***Note to Teachers: Reinforcement/Additional Support- If the students need more reinforcement here is an additional activity to try:***
  - *Create four categories on the board, then write the names of the bones on an index card (from the previous lesson.) If available, hold up the corresponding bone when the student reads their card. Have the student tell which category the bone belongs under. Tape the index card above the appropriate category, creating a graph. After all the cards are on the board, ask: What do we have the **most** of on the board? What do we have the **least** of? How many more Long Bones do we have than Flat Bones? Etc...*

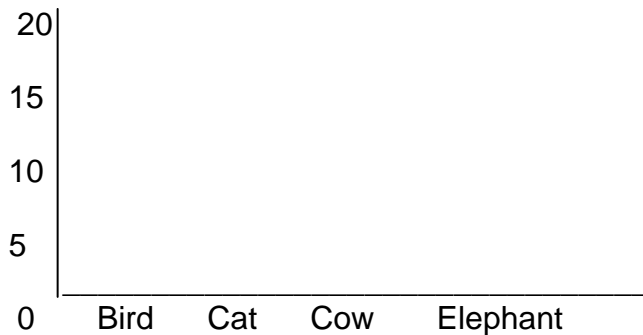
LONG (femur, tibia, fibula)  
FLAT (pelvis, skull bones)

SHORT (carpals, phalanges, tarsals)  
IRREGULAR (scapula)

### Lesson 3: Why Are Bones Hard?

#### **Engage: (5 min.)**

- Ask: ***“How strong are bones?”*** Allow students the opportunity to make guesses, then show them a two-inch square to provide them with a visual of how big two inches of bone is.)
- Using play animals, line them up on a desk in front of the classroom. (You’ll want to use all sizes of animals, but be sure to include an elephant.)
- Tell the students to think about how much weight a two-inch piece of bone can hold up.
- Tell the students that the weight of a two-inch piece of bone can hold up one of the animals represented by the toys in front of the room. Let them think about it, then vote. (You may want the students to close their eyes when they vote.)
- Ask: ***“Who thinks a two-inch piece of bone can only hold the weight of a bird?”*** Continue with each animal.
- Create a graph on the board with names of animals on the bottom and the number of students on the left.



***As the students vote, write the total under each animal name. When all students have voted, graph the information as a group. Have student volunteers come up and graph the information. Discuss findings.***

- Finally, reveal the answer to the students: ***“A two-inch piece of bone can hold the weight of an ELEPHANT.”*** Ask: ***“What does this tell us?”*** (Bones are really strong!)

**Explore: (This part will require about 20 minutes the first day. After that, students will need only about five minutes each day to record their observations.)**

1. Write the word “Question” on the board, then under that, write:  
***“What makes bones hard?”***
2. Bring in a milk carton or advertisement from a magazine that says something about calcium making bones hard and strong. (Check the back of the students’ milk cartons at lunch) **(See Figure 8)**
3. Show the carton to students, then have a student read the information to the class.
4. Ask: ***“Based on what we just read, what could we say is true about calcium and bones?”***
5. Say: ***“We are going to write a hypothesis. This means we are going to write a statement about something we believe is true.”***
6. Ask for a volunteer to come up with a hypothesis. Guide the students as needed. The hypothesis should look something like the following:

***“Calcium makes bones hard. Bones become soft and weak when the calcium is removed.”***

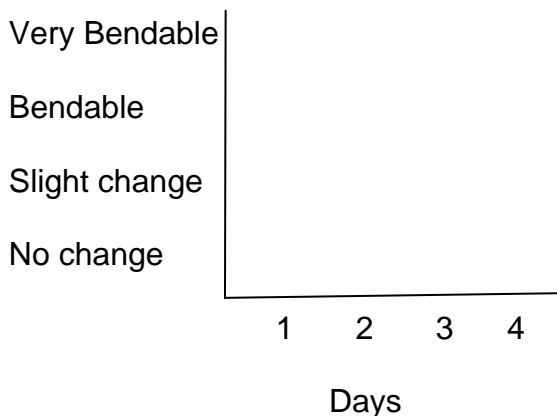
7. To illustrate, have students participate in the following experiment:
  - Tell the students that vinegar removes calcium.
  - Say: ***“If bones are STRONG because of CALCIUM and VINEGAR REMOVES CALCIUM, PREDICT what will happen to the bone when we immerse it in vinegar.”***
  - Allow time for students to make predictions, then ask: ***“If calcium makes our bones hard and vinegar REMOVES calcium, what can we predict will happen to the bone?”***  
(The bone will become bendable and soft.)
  - Have students record this info in a science journal.
  - Put students into groups of three or four. Give each group a chicken bone, a container with a lid, and vinegar. Have the students follow these instructions:

- 1) Write all the group members' names on the lid of the container.
- 2) Put the bone in the container.
- 3) Pour enough vinegar in the container so the bone is covered.
- 4) Seal the container.
- 5) Each day record data. Have the students take the bone out and record any changes they observe. Be sure to write down how the bone feels **before** the experiment begins. (It will take approximately four days, depending on the size of the bone, for it to become pliable--replace vinegar if necessary.)
- 6) Tell the students you will put one bone on the counter without anything. Each day they will also need to record how the bone that is not in any solution feels and if there are any changes.

**Explain: (10-15 min.)**

Draw conclusions after about day four. If the bones have not changed, continue the experiment. They will eventually all become soft and bendable.

Graph findings:



***On the graph, use a blue crayon/marker to record the bone with “No vinegar” and a red crayon/marker for the bone with “vinegar.” Plot points and draw a line. Draw conclusions from data. (Begin by having the students get in their group and draw conclusions. All students will need to write down their conclusions. Next have the reporter share with the class. Guide the students as needed.)***

### Conclusions:

1. From the graph we can see that the bone that was NOT in vinegar stayed the same.
2. From the graph we see that the bone that was IN vinegar gradually changed and became bendable and soft.
3. Vinegar removes calcium and when a bone that is hard is put in vinegar it becomes bendable. From this observation we can conclude that calcium is what makes bones hard.
4. Compare the hypothesis with the information observed.
5. Ask: ***“Are bones ALWAYS hard? When do bones become hard? Are bones alive? Are bones solid all the way through, or is there something inside them?”***
6. Explain that bones are soft when we are babies and become harder as we grow up. Bones may not look like they are alive, but **bone is living tissue** and is supplied with nutrients and oxygen from blood vessels. **Bone has nerve tissue**, just like the brain and the heart. Sometimes when we hit our bones against something harder it hurts. That is because of the nerves in the bone, and explains why your shin bone in your lower leg or “funny bone” at the elbow can hurt so much if it hits something.
7. Bone is living and continues to grow until we reach our late teens or twenties. Calcium is collected in the bones and in the blood. Ask: Ask: ***“Where do we get calcium?”*** (From milk, cheese, yogurt, etc.)
8. Say: ***“The body is very smart and will send calcium to wherever it is needed most in the body. Bones become longer, thicker and larger by a special process called BONE REMODELING, which moves bone material and calcium to wherever it is needed in the body.”***
9. Add: ***“It is important to help our bones grow by eating foods with lots of calcium, magnesium, and vitamin D. These are essential nutrients for bone growth. Physical activity and exercise are also important for growth and for strengthening bones.”***

### Extend: (10 min.) Growth Chart

*NOTE: You may want to utilize this as a homework activity, since individual charts could take up considerable space in the classroom. If you decide to do this as a home activity, ask parents to post the Growth Chart in the student's room. Students could bring in their chart at the end of the year and share it with the*

*class. Be sure to send a note home to the parents explaining what to do. (For Figure 9). Send a reminder slip to parents each month so they will remember to measure their child. (See Figure 10)*

1. Organize students into small groups to make growth charts for each other.
2. Give each group a length of butcher paper or newsprint and show students how to cut the paper so that it is 12 inches longer than each child's height. Tape each piece of paper to a section of wall and have one child stand with his/her back up against the paper, while another child uses the marking pencil to mark the child's current height. Then have each child write their name across the top. Have the child mark foot and inch segments on the paper to indicate their height.
3. Height is re-measured each month through the remainder of the school year. Indicate the date on each measurement. The growth between the markings is measured and labeled each time.

**Evaluation:**

Collect Science Journals.

## **Lesson 4: Joints**

**Engage: (5 min.)**

- Have all the students stand beside their desk with their arms bent. Next, have them touch their hand to the front of their shoulder. Now have them bend it in the **opposite** direction and touch the back of their hand to the back of their shoulder. (Obviously this is impossible!)
- Ask: ***“Why can’t you bend your arm backwards?”*** Show the students the skeleton and demonstrate the possible range of motion in the arm, saying: **“The radius and humerus are TWO SEPARATE bones.”**
- Ask: ***“Why can’t they bend in EVERY direction?”***

**Explore: (10 min.) Joints: How does my skeleton move?**

1. Copy a skeleton onto overhead film and project onto the board.
2. Have volunteers come up and circle space between bones.
3. Ask: ***“What is the place called where two bones meet on your body?”*** (Have students guess or predict. Write all answers on the board, but don’t tell students if they’re right or wrong.)
4. Put students into groups of three or four. Give each group an index card with two bone names on them (see examples below):
  - **SKULL** and **SPINE**

- **FEMUR** and **HIP/PELVIS**
- **SHOULDER/SCAPULA** and **HUMERUS**
- **RADIUS** and **HUMERUS**
- **FEMUR** and **TIBIA/FIBULA**
- **PHALANGES** and **CARPALS**

5. Give each group Popsicle sticks, glue, rubber bands, ribbon, yarn, etc... (give the group with the skull a disk)
6. From the picture of the skeleton in previous lessons have the students find the two bones listed on the card (this is a good review of the names of the bones) and think about how the bones move. Write the name of one bone on one stick and the other bone on the other stick. Using the supplies, connect the two “bones.”

#### **Explain: (15 min)**

1. Explain that a joint is where two bones meet. Although bone is living tissue, it is hard, and can’t bend, twist, or turn.
2. Write the three kinds of joints on the board:
  - PIVOT**
  - BALL** and **SOCKET**
  - HINGE**
3. Explain the three kinds of joints to the students, one at a time. Demonstrate with an object.
  - Hinge Joint (door hinge)
  - Ball and Socket Joint (egg beater or can opener)
  - Pivot (screwdriver)
4. Have each group present and “act” out how each particular joint works.
5. After each presentation, have the students move those body parts on themselves to test that joint.
6. After each presentation, ask if anyone knows what kind of joint that would be and why. Collect the index cards that were originally given to the students and tape them under the appropriate categories.
7. Review at the end.

#### **Extend: (15 min) Skeleton Puzzle (See Figure 11)**

- Pre-assemble the Skeleton Puzzle on the floor. Have the students look at the completed skeleton, then have each student take one piece of the skeleton puzzle. Ask the students to identify the name of the bone for their puzzle piece.
- Have the students work together to re-assemble the skeleton puzzle on the floor. Ask the students if they can name and find the three kinds of joints in the skeleton, and joints illustrating the three kinds of joint movement. Also, ask if students can name **and** find the **four** different bone **shapes**.

**Evaluate:**

Hand back the skeleton puzzle, **with corrections** so the students can make changes if they didn't name the bones correctly. On the side of the skeleton puzzle have three strips of paper (small rectangles) that can also be cut out. Have students write a different kind of joint on each rectangle, then cut out the puzzle and have students assemble it by themselves, placing the joint pieces over the proper places. Have the students leave these on their desks and determine whether they have all three joints written down and in their proper places.

- ***Note to Teachers: Reinforcement/Additional Support – The following activity provides additional reinforcement if necessary.***

**Bone and Joint Learning Table:** *Using table format in the Joint and Movement Chart at the end of the lesson (See Figure 12), have students complete the information in the table, then draw the table outline on the board with the major headings. Ask students to say what the kinds of joints are, give examples, and describe each of them.*

1. For each kind of joint ask the students to tell you **which** bones form the joint. Examples:
  - Pivot (movement of head from side to side) - Skull and spine bones (vertebrae)
  - Ball and socket (movement of arm in a circle or back and forth) – Shoulder (scapula) and arm bones (humerus, radius, ulna)
  - Hinge (movement of bending the knee and bringing the foot close to the hip) - Thigh bone (femur) and shin bone (tibia)
2. Ask: ***“What does this movement help you do?”*** Have students think of as many kinds of movements and activities as they can.  
Examples: Ball and socket: Throwing a softball  
Hinge: Walking up stairs, running on the soccer field  
Pivot - Looking over your shoulder
3. Pick four or five examples students have suggested and ask them to say what bones help create that movement. They can use their own bodies to help figure out the answers.

**Optional Enrichment Activity: Research Project**

Organize students in teams of three or four to do research on the information in this unit. Prepare a list of topics that students can choose from in order to learn more about. Have them research the topic, and creating models, drawings, posters or demonstrations. and prepare a short presentation to the class.

Suggested research topics are:

- Learning More About the Skeleton
- What Makes a Bone
- Understanding the Joints
- The Importance of the Skeleton
- How the Skeleton Has Changed from the First Humans to Modern Humans

Have the students look for additional information sources in the school or city library. You may provide a short list of books/internet sites to get the students started in the right direction.

Encourage students to formulate a research question to aid their investigation, such as ***“What does the inside of a bone look like/how does the spinal column protect the spinal cord/how does a hinge (or ball and socket) joint work, etc.”*** Students should go beyond the information presented in the class and try to learn something more about the skeleton, bones, and joints.

As a group, the students should brainstorm what resources to use to learn about their topics, deciding who will acquire information, and what kinds of drawings, posters, or models they want to create for their presentations.

One component of the projects could be for each student to show how their information relates to their own body and discuss how they could use that information to make healthy lifestyle choices. For example, research into what is inside a bone could lead students to explore what to do (exercise and diet) to help their own bones grow stronger. Learning more about the spine could lead a student to know why it is important to have good posture and how to develop good posture.

**Additional web resources:**

[www.cdc.gov/powerfulbones](http://www.cdc.gov/powerfulbones) - Site features games, quizzes, and excellent information, particularly for young women.

[www.bonehealth.com](http://www.bonehealth.com) – Includes a Bone Facts quiz.

**Correlation to standards:**

**Grade Level Expectations:**

**Science:**

**Strand 7: Scientific Inquiry**

1. Science understanding is developed through the use of science process skills, scientific knowledge, investigation, reasoning, and critical thinking.
  - A. Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate

investigation methods in order to obtain evidence relevant to the explanation.

- a. Pose a question about objects, materials, organisms, and events in the environment.
- b. Plan and conduct a fair test to answer a question.
- B. Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations.
  - a. Make qualitative observations using the five senses.
- C. Evidence is used to formulate explanations.
  - a. Use qualitative and quantitative data as support for reasonable explanations.
- D. Scientific Inquiry includes evaluation of explanations in light of scientific principles.
  - a. Evaluate the reasonableness of an explanation
- E. The nature of science relies upon communication of results and justification of explanations.
  - a. Communicate simple procedures and results of investigations and explanations through: oral presentations, drawings and maps, data tables, graphs, writings.

#### Strand 8: Impact of Science, Technology and Human Activity

- 3. Science and technology affect, and are affected by, society.
  - A. People, alone or in groups, are always making discoveries about nature and inventing new ways to solve problems and get work done.
  - b. Work with a group to solve a problem, giving due credit to the ideas and contributions of each group member (assess locally).

#### **Frameworks:**

##### **Health and Physical Education**

- 1. Functions and interrelations of systems

##### A. Body Systems

What all students should know:

- 3. The Skeletal System has basic structures and functions that enable humans to live and perform a variety of tasks.

What all students should be able to do:

- a. Identify and describe the basic structure and functions of the Skeletal System.

What all students should know:

- 4. The Skeletal System provides a framework for the body. It protects internal organs, aids in movement and plays a role in blood cell formation.

What all students should be able to do:

- a. Plan effective oral and written communications regarding the Body Systems, their structure, and functions for parents and other students.

IV. Efficiency of Human Movement and Performance:

What all students should be able to do:

- b. Discover and evaluate the major types of joints found in the human body and the actions they perform.

**Books/Children's Literature:**

*You Can't See Your Bones with Binoculars* by Harriet Ziefert

*Bones: Our Skeletal System* by Seymour Simon.

*Bones* by Anna Sandeman.

*The Visual Dictionary of the Skeleton* by Richard Walker

*The Head Bone's Connected to the Neck Bone: The Weird, Wacky, and*

*Wonderful X-Ray* by Carla Killough

## Figure 1

Bone	Technical Name	Purpose

Patella Femur	Tarsal Carpal Phalange
Spine Vertebra	Tibia Fibula
Ribs Sternum	Pelvis Skull
Scapula Humerus	Radius Ulna

Femur

Humerus

Femur

Humerus

Tarsal

Tibia

Tarsal

Tibia

Carpal

Fibula

Carpal

Fibula

Phalanges

Radius

Phalanges

Radius

Spine/Vertebra

Ulna

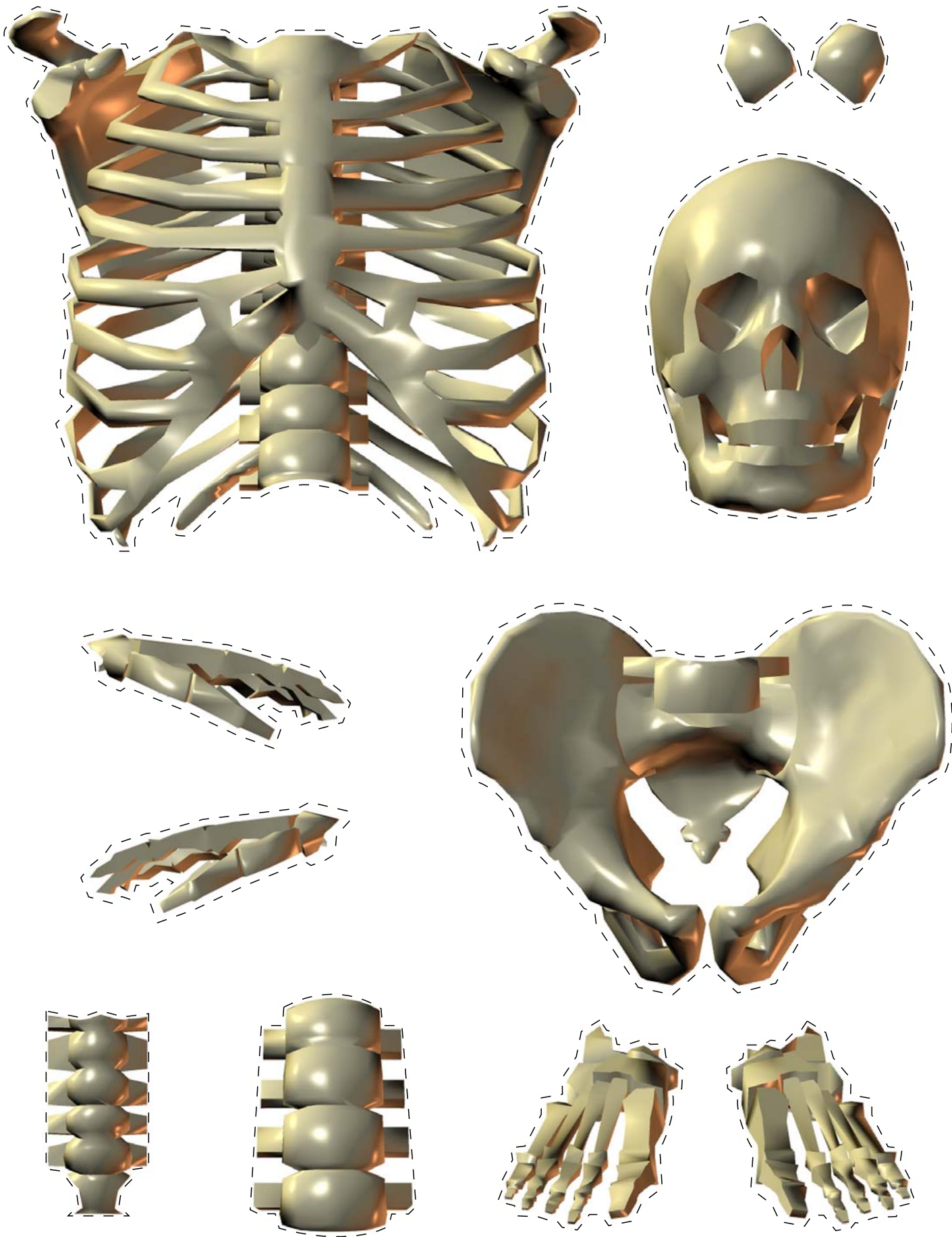
Scapula

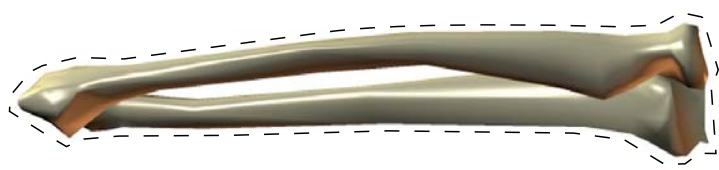
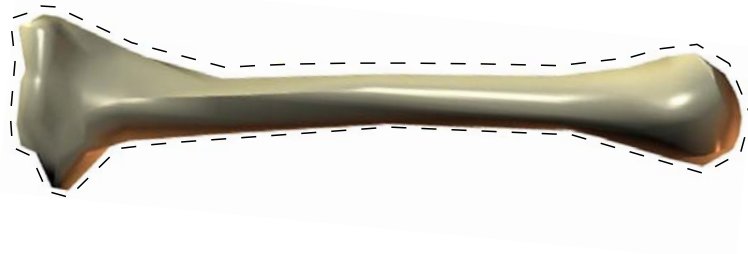
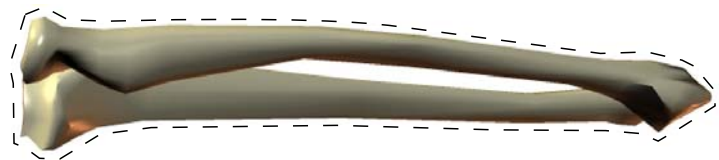
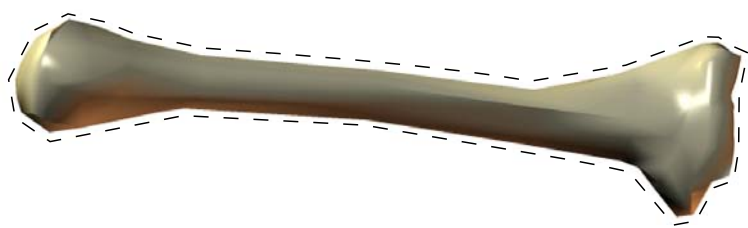
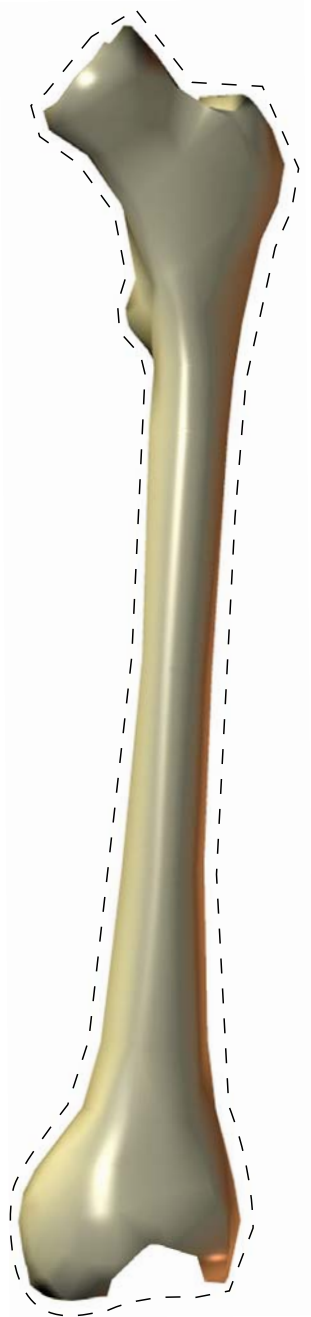
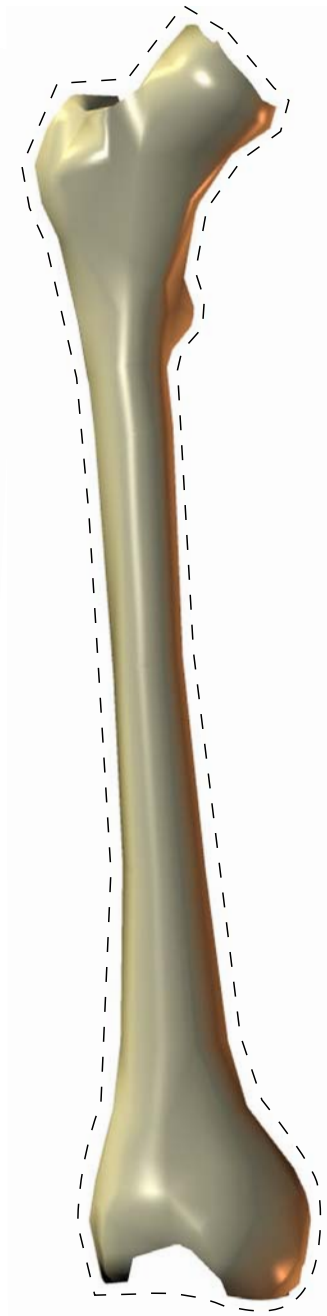
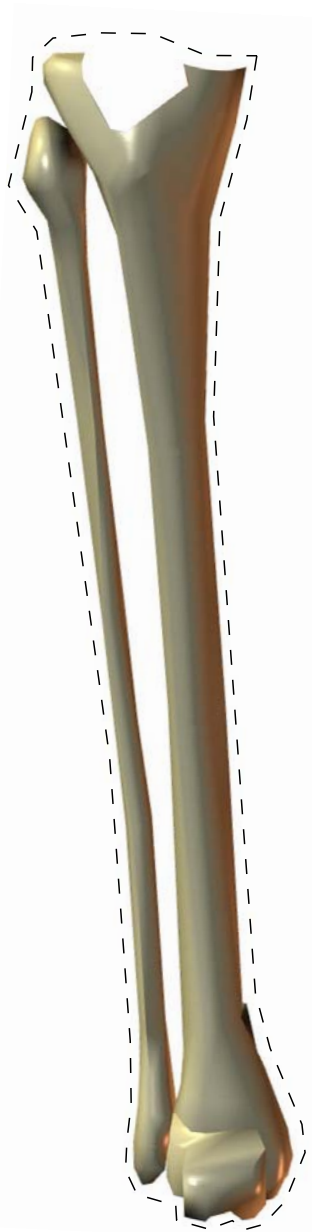
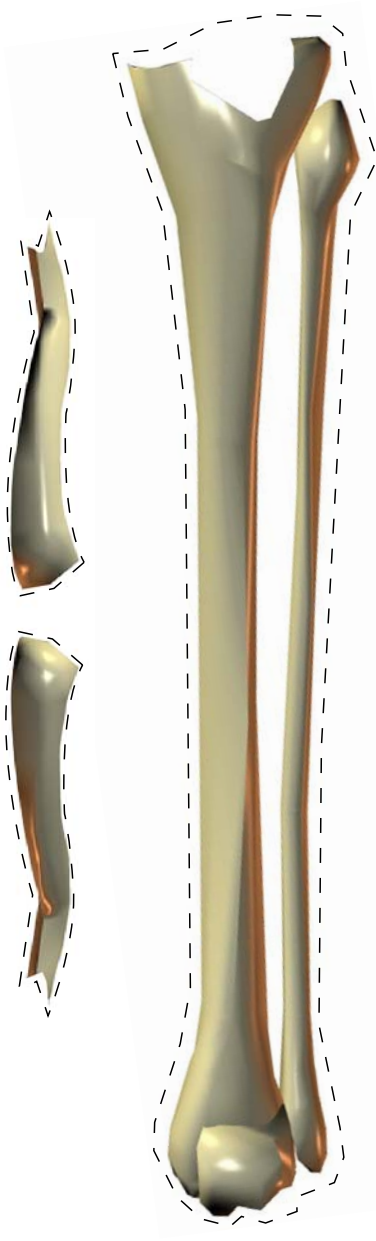
Ulna

Scapula

Sternum/Ribs

Figure 4





**Figure 5: Skeleton Information Chart**

<b>Functions of the Skeleton:</b>	<b>Description:</b>	<b>What Bones are Involved:</b>
Support for the body	A strong framework enables the body to stand erect and anchors muscles and organs.	Spine, hip bones
Protects the body's internal organs	Bone hardness helps protect organs from injury.	Ribs: heart, lungs, kidneys and liver Spine: spinal cord Hip bones: bladder Skull: brain
Movement of the body	Muscles cross over joints and attach to bones. When the muscles contract, the joints move.	Most bones in the body move, if only slightly. Example: The muscles that attach to the thigh bone and shin bone helps the knee move and that allows us to walk and run.
Storage of minerals and fat	Calcium, magnesium, phosphorous and sodium are stored in the bones.	All bones
Red blood cell formation	The red marrow found in the internal cavity of some bones is responsible for making red blood cells.	Primarily, though not exclusively, located in the long bones, such as the arm bones, thigh and shin bones.

**Figure 6: Words to School House Rock: Science Rock “Them Not-So-Dry-Bones”** Music & Lyrics: George Newall Sung by: Jack Sheldon Animation: Kim & Gifford Productions

Them bones, them bones, them dry bones  
Now they're the working of the Lord.

Bones are heard of, but seldom seen  
'Cept each year 'round Hallowe'en  
But I've got a shock-a-roo  
Right now there's a skeleton locked up inside of you! (Ha-ha-ha)

Minus bones you're... just a blob!  
Being framework's their main job.  
All your organs, muscles too,  
They need your bones to hold them safe and sound inside for you.

Your heart and lungs are tucked away  
And they're behind your ribs.  
Those bones have been protecting them  
Since we were little kids.

Look out! Here comes a bone-head play!  
Birdin' his brain! (Tweet, tweet, tweet) What a day!

Don't take much to overwhelm it,  
But luckily those bones up there work like a built-in helmet!

Shin bone connected to the knee bone...  
(That means the tibia connects to the patella)

Knee bone connected to the thigh bone...  
That means the patella connects to the femur.  
And here's how they really fit together!

Ligaments are what link... bone to bone.  
Cartilage that cushions... in between.  
Muscles hook on... by the tendons.  
So here's what's happenin' in your knees most ev'ry time you bend 'em.

Now there's a lot of skeleton  
We never get to see,  
But it holds other little parts  
That show quite obviously.  
I'm talkin' 'bout those thirty-two  
That we all call our teeth  
We gotta feed 'em right and keep 'em clean,  
Or they can come to grief. (OUCH! Ow!)

So please remember,  
You've got to do it while you're young!  
Feed your bones some good ol' calciuim.  
Drinking milk—a glass or two--  
Will help your bones to stay in shape and do their job for you.

Your skeleton  
It's a framework (yes, yes) holding you together.  
Shielding organs,yeah, that's its job, too!

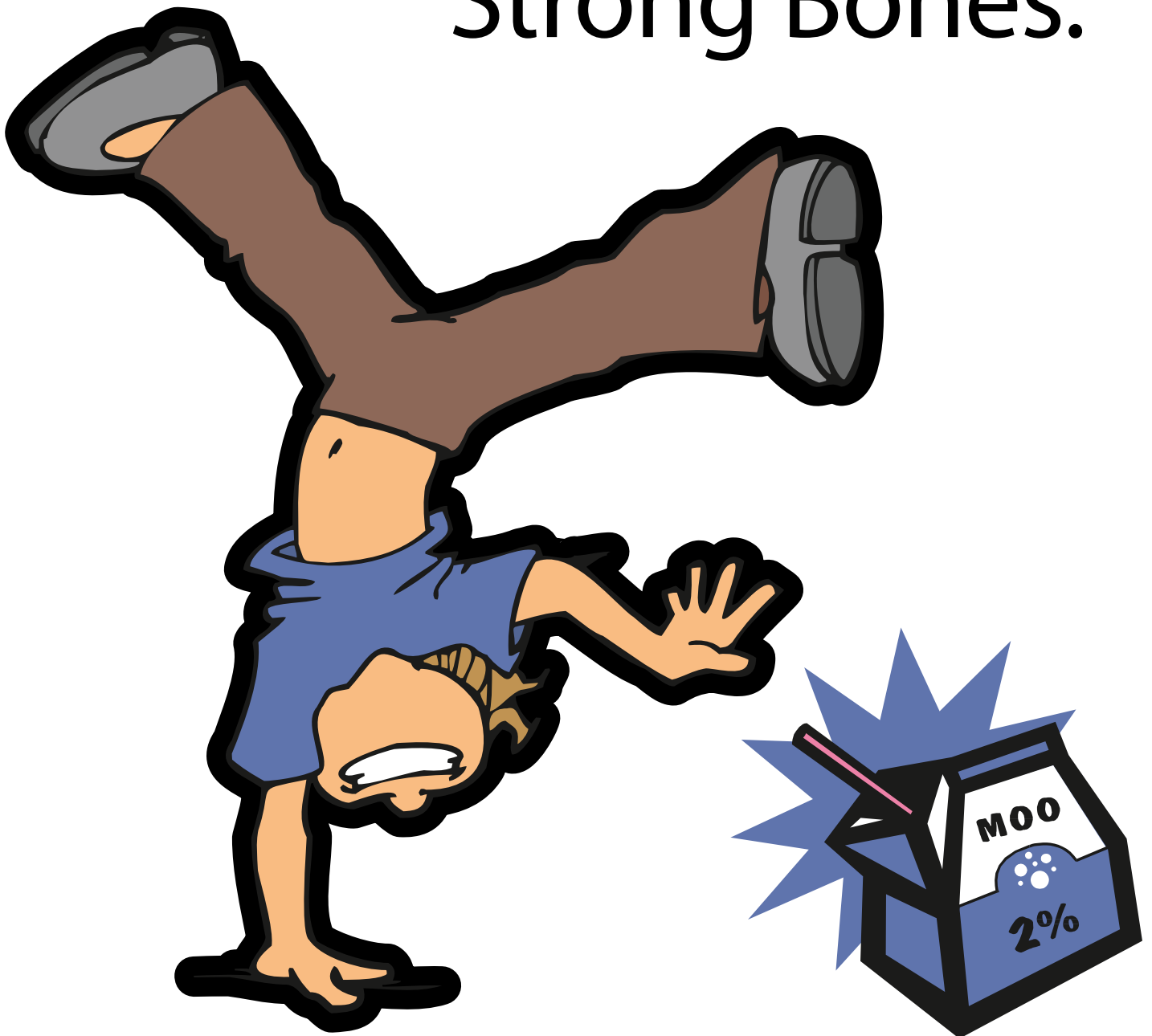
**Figure 7**



Figure 8

# Drink Milk!

## Calcium Builds Strong Bones.



## Figure 9:

Dear Parent/Guardian:

**Our BONES grow, change and regenerate throughout life**, a process that starts before birth and continues until the end of life. Calcium is so important to the body that if there is not enough in the blood, hormones will breakdown calcium from bony tissue and re-distribute it to other sites in the body. **Children have an increased need for calcium in order to develop the larger, denser, longer and stronger bones they need to grow into adolescence and adulthood.**

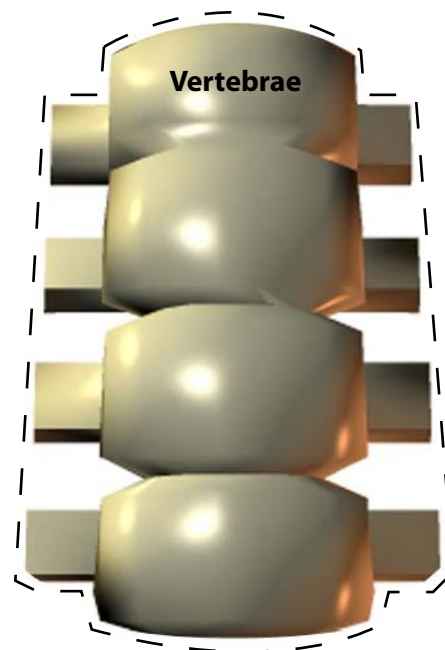
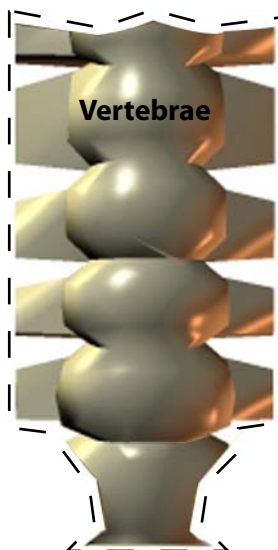
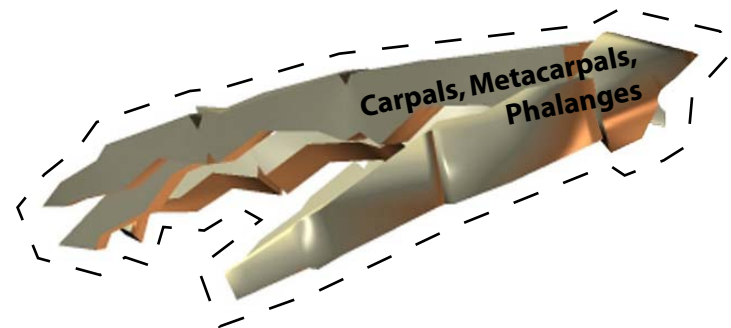
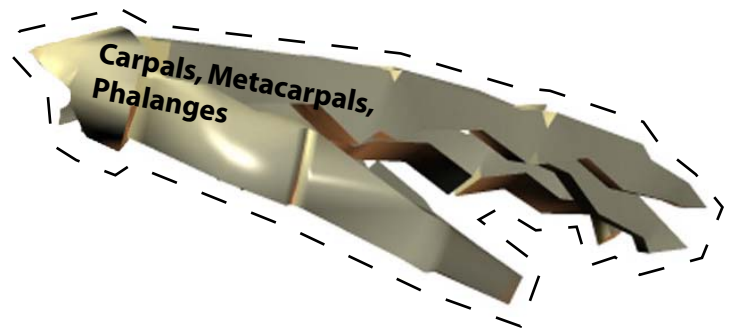
In order to increase our students' awareness of the importance of calcium in their diet, we are providing each child with their own growth chart, which your child received today. Please assist your child by **displaying** this chart in the child's room (or some other area in your home) and recording your child's growth **each month**.

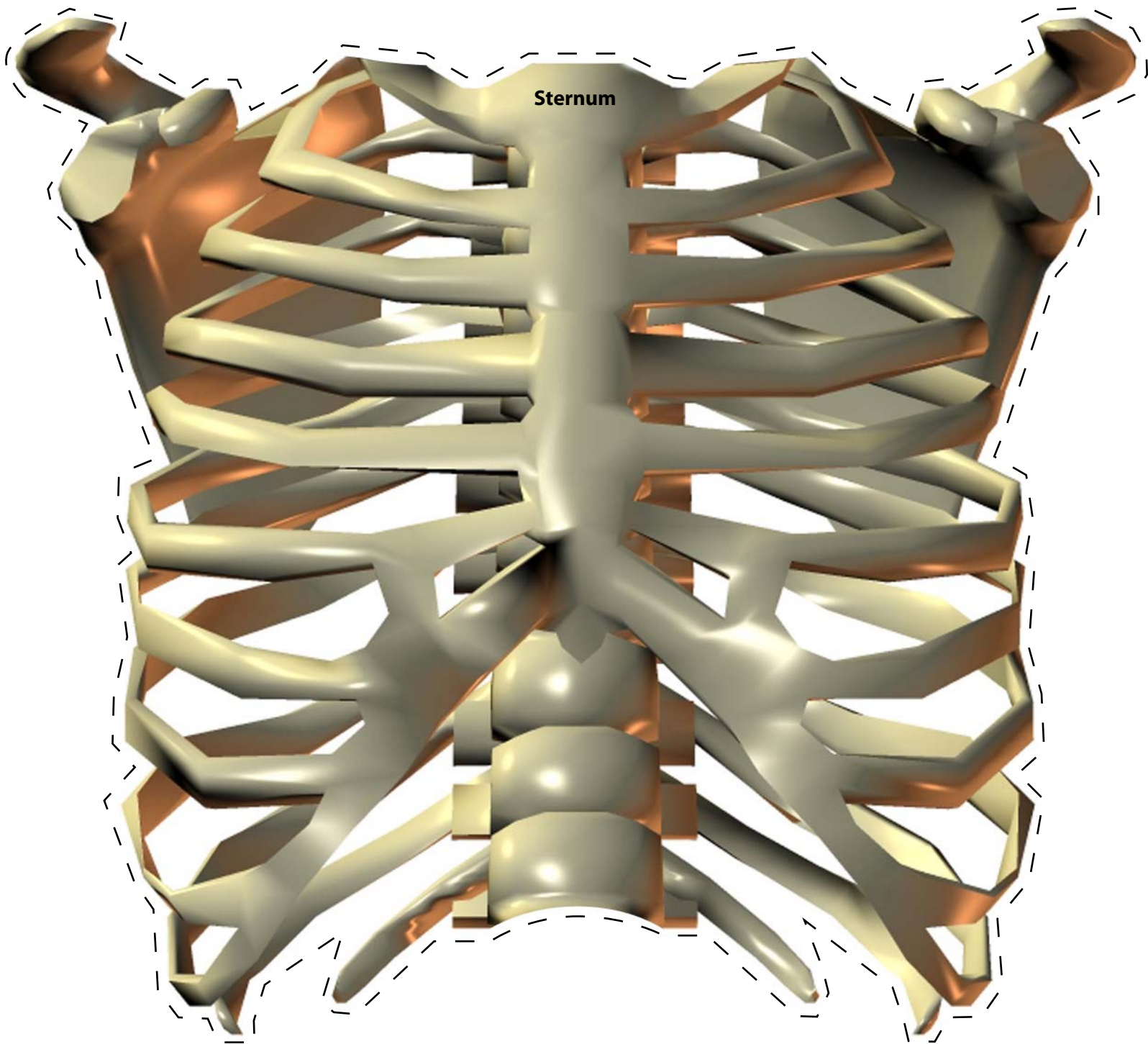
I will send home a reminder each month when it is time to measure your child. Please measure and mark the date on the growth chart and help encourage your child to eat healthy foods and drink plenty of milk in order to get the nutrients needed for growing strong bones. We will compile the data from these charts at the end of the school year.

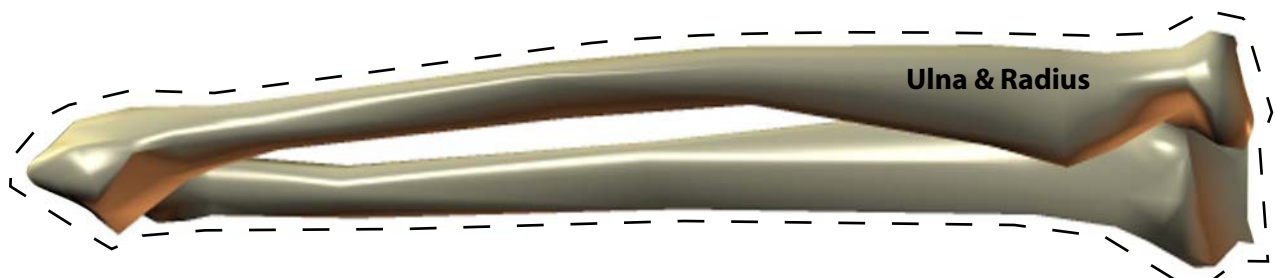
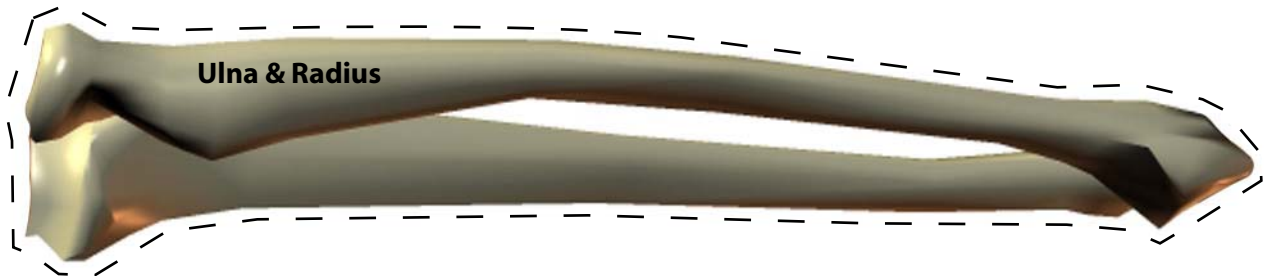
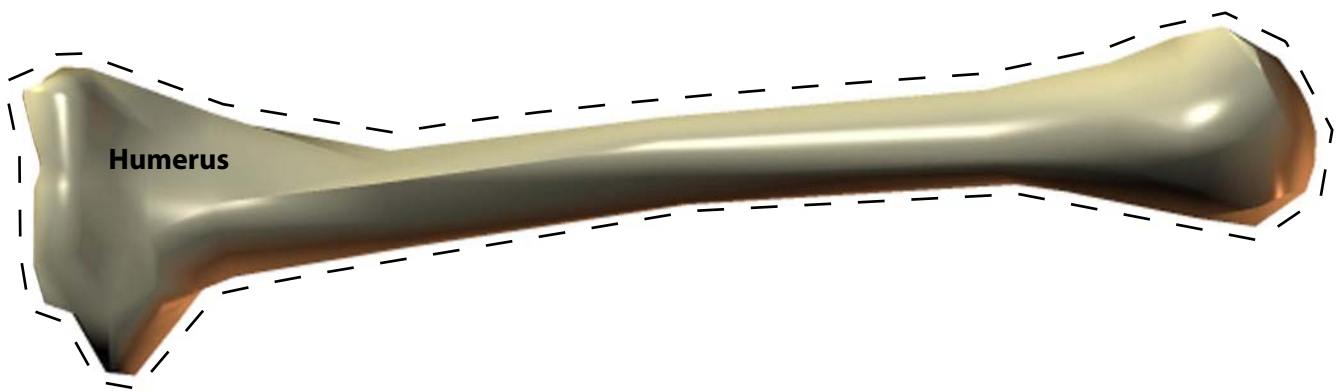
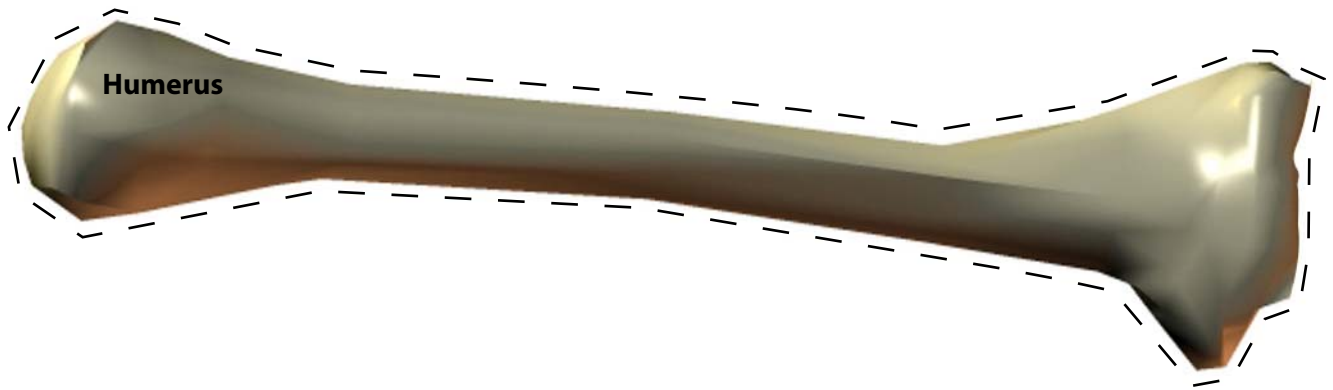
Enjoy watching the growth of your child and thanks for your help!

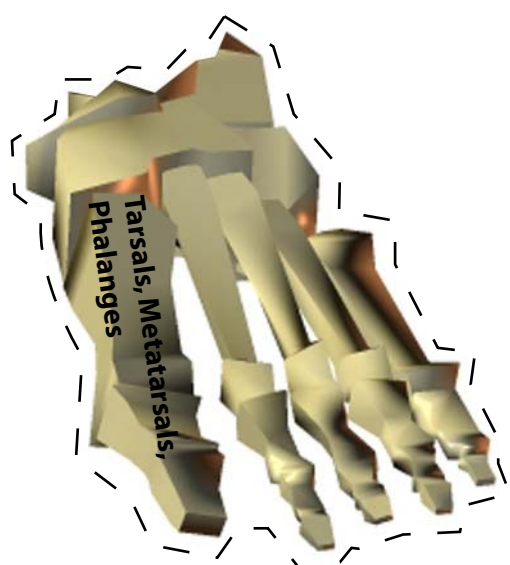
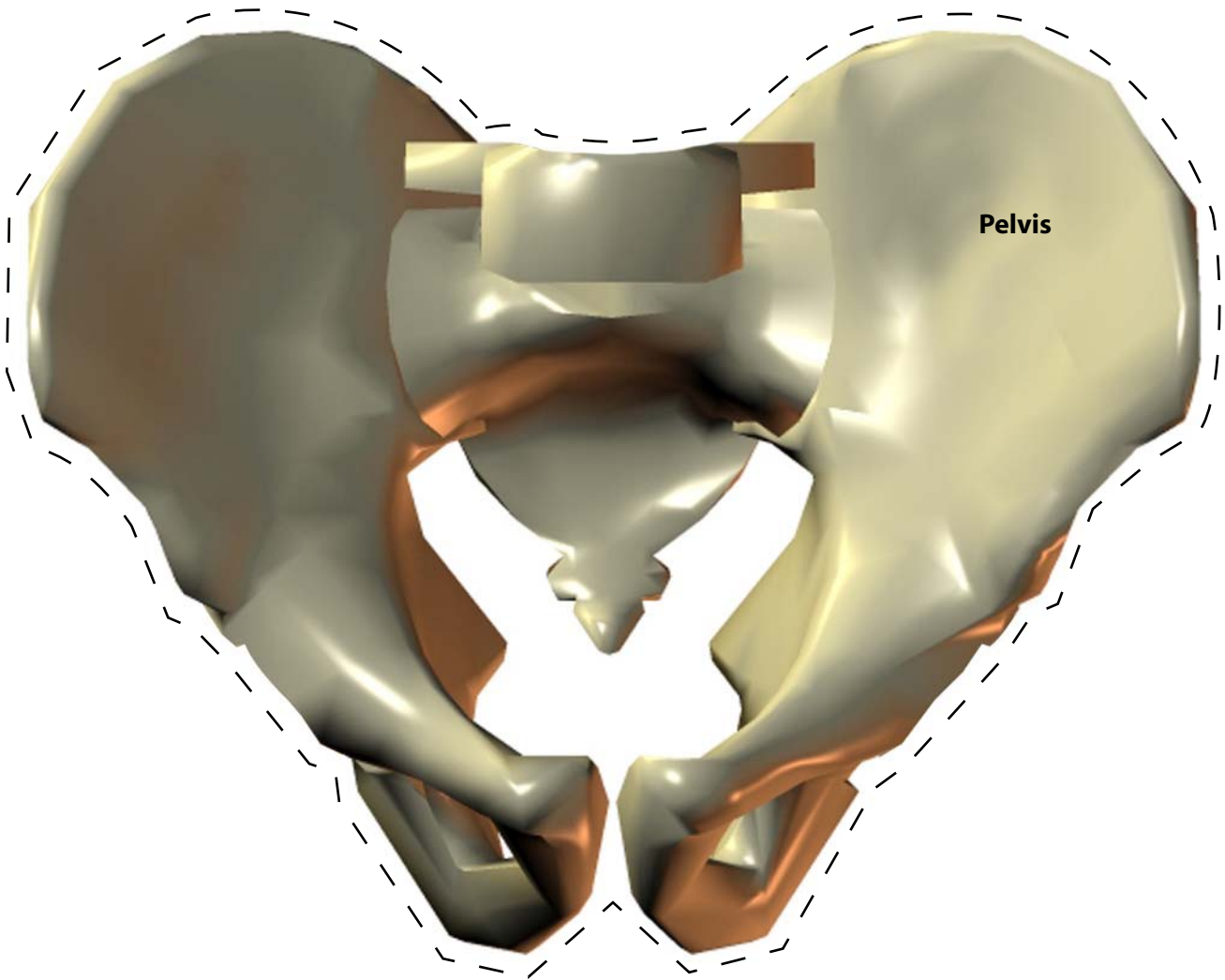
### **Figure 10:**

Parent Reminder: It is again time to measure your child. Please measure your child and write the date next to the measurement on their growth chart. Thanks!

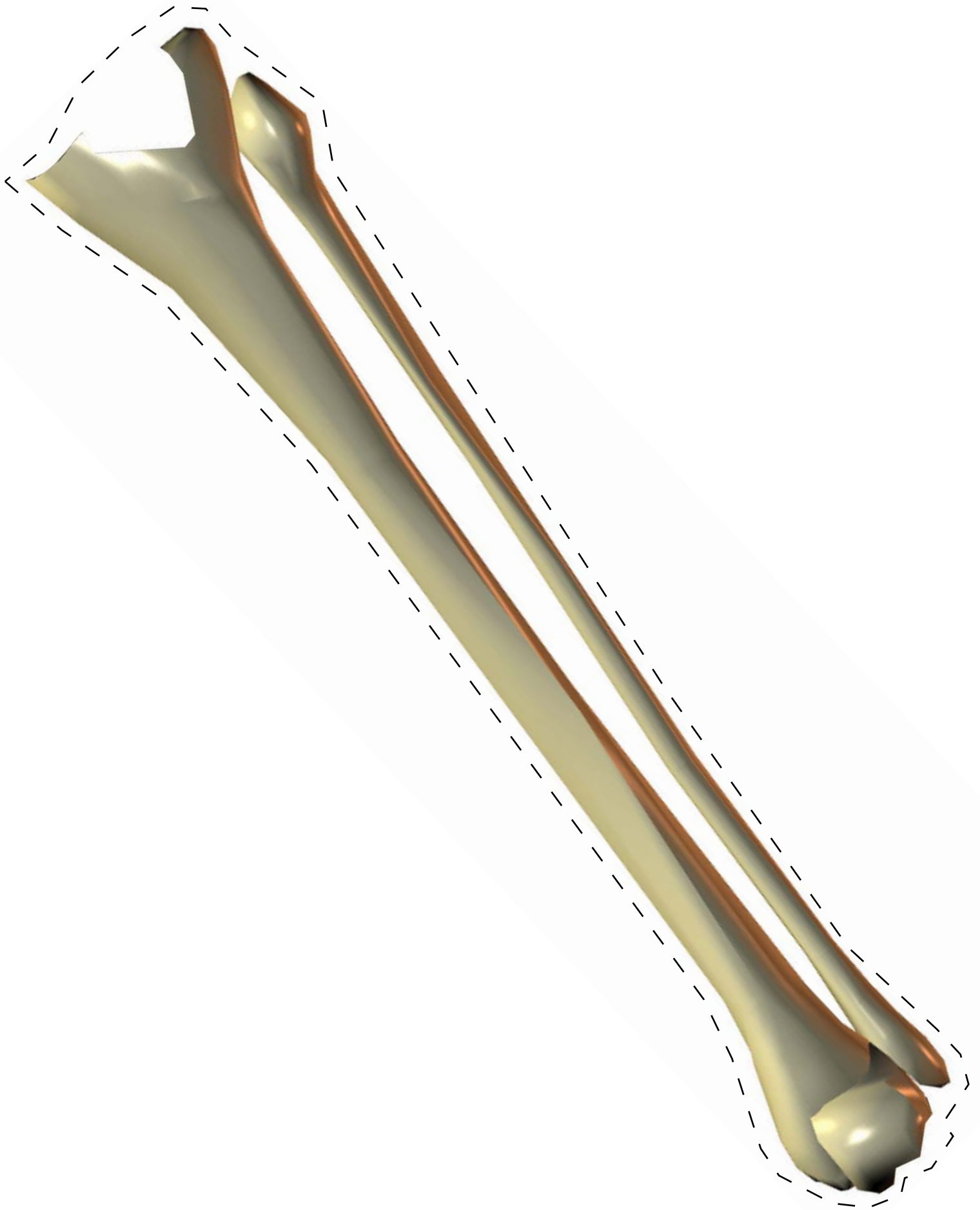






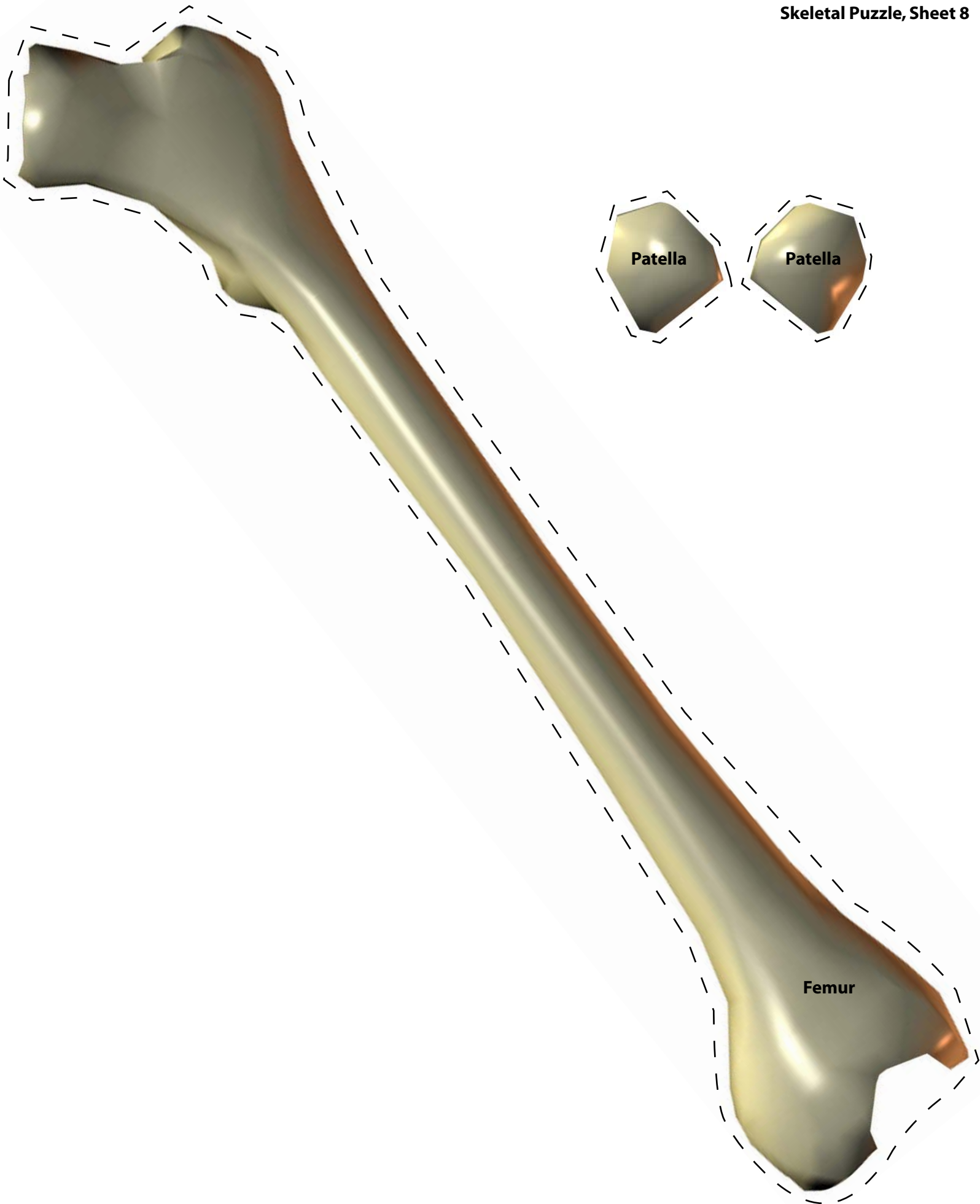


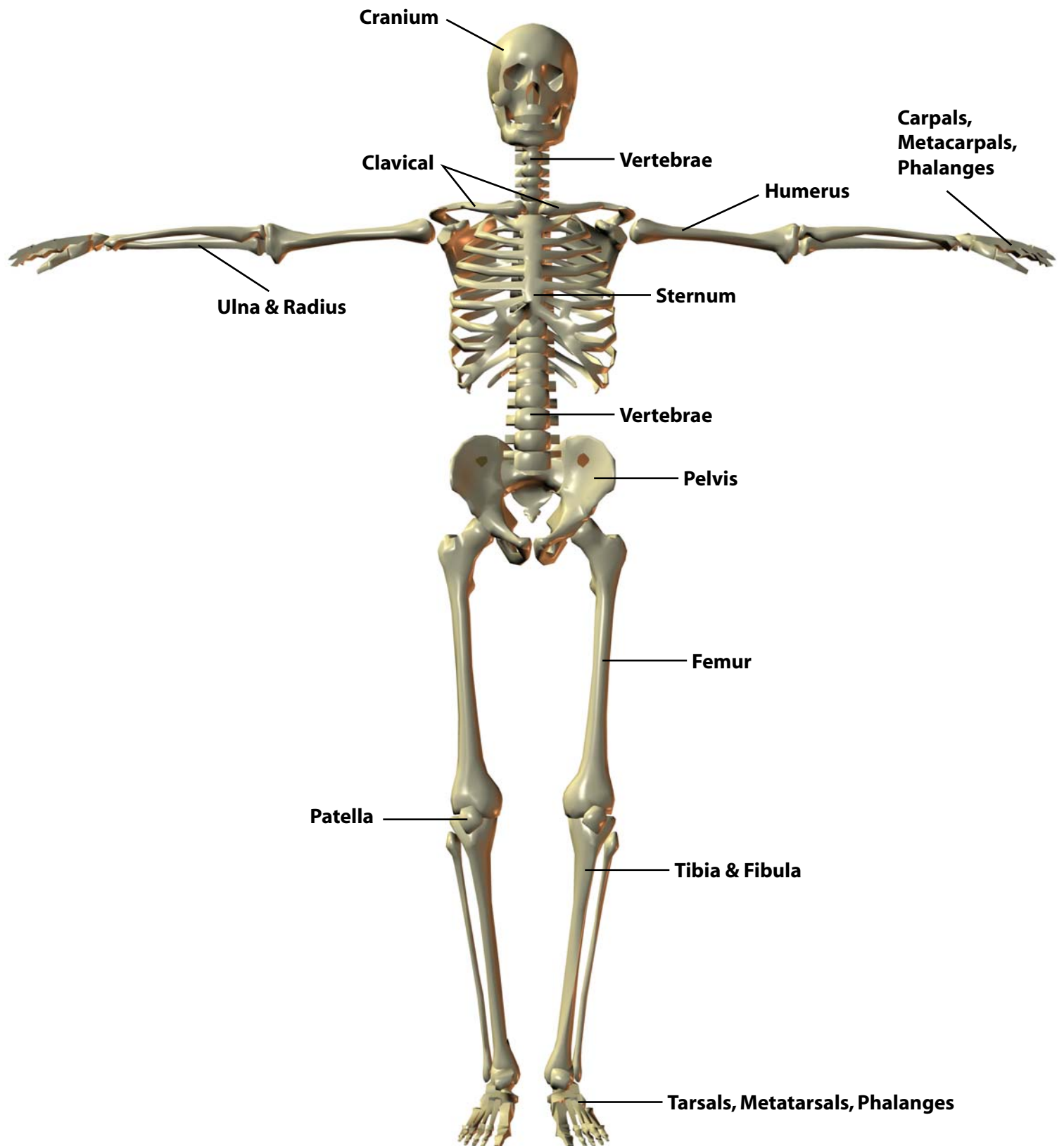






Femur





## Joints and Movement Chart

Kind of Movement	Description	Example
1. Pivot	1. One bone joint rotates around another bone.	1. Movement of the head looking side to side.
2. Ball and Socket	2. End of one bone has a ball shape to it and fits into another bone that has a rounded hollow in it that looks like a cup.	2. Omni-directional movement. Swinging the arm in a full circle.
3. Hinge	3. The end of one bone is rounded and fits into a depression in the other bone. Joint movement is like a door hinge.	3. Movement is in one direction. The bones move closer together (closing the door) and farther apart (opening the door.)