

## 16.2

## KEY CONCEPT

## The skeletal system provides support and protection.

## Sunshine State STANDARDS

SC.F.1.3.2: The student knows that the structural basis of most organisms is the cell and most organisms are single cells, while some, including humans, are multicellular.

## VOCABULARY

skeletal system p. 576

compact bone p. 577

spongy bone p. 577

axial skeleton p. 578

appendicular

skeleton p. 578

## BEFORE, you learned

- The body is made of cells, tissues, organs, and systems
- Cells, tissues, organs, and organ systems work together
- Systems in the body interact

## NOW, you will learn

- About different types of bone tissue
- How the human skeleton is organized
- How joints allow movement

## EXPLORE Levers

## How can a bone act as a lever?

## PROCEDURE

- 1 A lever is a stiff rod that pivots about a fixed point. Hold the bag in your hand and keep your arm straight, like a lever. Move the bag up and down.
- 2 Move the handles of the bag over your elbow. Again hold your arm straight and move the bag up and down.
- 3 Now move the bag to the top of your arm and repeat the procedure.

## MATERIALS

sports bag



## WHAT DO YOU THINK?

- At which position is it easiest to move the bag?
- At which position does the bag move the farthest?
- How does the position of a load affect the action of a lever?

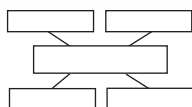
## Bones are living tissue.

Every movement of the human body is possible because of the interaction of muscles with the **skeletal system**. Made up of a strong connective tissue called bone, the skeletal system serves as the anchor for all of the body's movement, provides support, and protects soft organs inside the body. Bones can be classified as long bones, short bones, irregular bones, and flat bones. Long bones are found in the arms and legs. Short bones are found in the feet and hands. Irregular bones are found in the spine. Flat bones are found in the ribs and skull.

You might think that bones are completely solid and made up of dead tissue. They actually are made of both hard and soft materials.

## MAIN IDEA WEB

Make a web of the important terms and details about the main idea: *Bones are living tissue.*



Like your heart or skin, bones are living tissue. Bones are not completely solid, either; they have spaces inside. The spaces allow blood carrying nutrients to travel throughout the bones. Because bones have spaces, they weigh much less than they would if they were solid.



Explore the skeletal system.

## Two Types of Bone Tissue

Every bone is made of two types of bone tissue: compact bone and spongy bone. The hard compact bone surrounds the soft spongy bone. Each individual bone cell lies within a bony web. This web is made up mostly of minerals containing calcium.

**Compact Bone** Surrounding the spongy, inner layer of the bone is a hard layer called **compact bone**. Compact bone functions as the basic supportive tissue of the body, the part of the body you call the skeleton. The outer layer of compact bone is very hard and tough. It covers the outside of most bones.

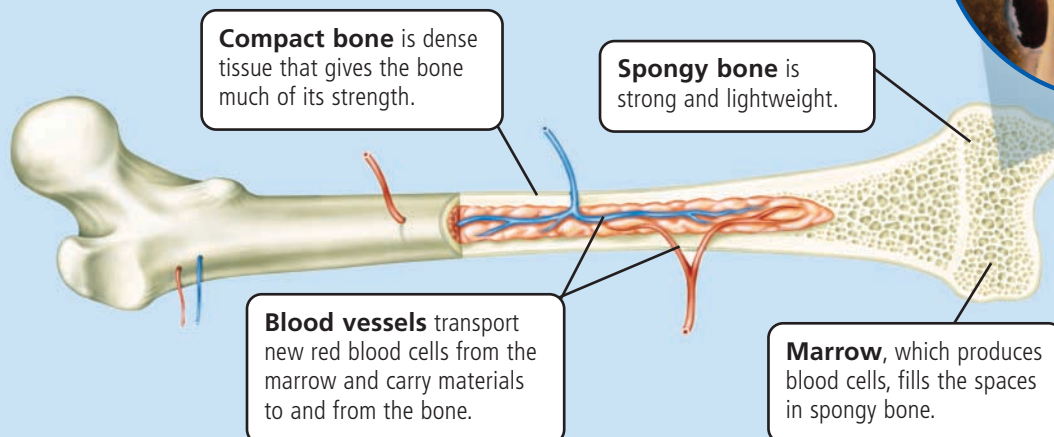
**Spongy Bone** Inside the bone, the calcium network is less dense. This tissue is called **spongy bone**. Spongy bone is strong but lightweight. It makes up most of the short, flat, and irregular bones found in your body. It also makes up the ends of long bones.

## Marrow and Blood Cells

Within the spongy bone tissue is marrow, the part of the bone that produces blood cells. The new blood cells travel from the marrow into the blood vessels that run throughout the bone. The blood brings nutrients to the bone cells and carries waste materials away.

### A Close Look at Bone

All bone, like the long bone shown here, is made up of compact bone tissue and spongy bone tissue.

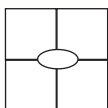


## The skeleton is the body's framework.

Like the frame of a building, the skeleton provides the body's shape. The skeleton also works with other systems to allow movement. Scientists have identified two main divisions in the skeleton. These are the axial (AK-see-uhl) skeleton, which is the central part of the skeleton, and the appendicular (AP-uhn-DIHK-yuh-luhr) skeleton. Bones in the appendicular skeleton are attached to the axial skeleton. The diagram on page 579 labels some of the important bones in your skeleton.

### VOCABULARY

Remember to add four squares for *axial skeleton* and *appendicular skeleton* to your notebook.



## The Axial Skeleton

Imagine a line straight down your back. You can think of that line as an axis. Sitting, standing, and twisting are some of the motions that turn around the axis. The **axial skeleton** is the part of the skeleton that forms the axis. It provides support and protection. In the diagram, parts of the axial skeleton are colored in red.

The axial skeleton includes the skull, or the cranium (KRAY-nee-uhm). The major function of the cranium is protection of the brain. Most of the bones in the cranium do not move. The skull connects to the spinal column in a way that allows the head to move up and down as well as right and left.

Your spinal column makes up the main portion of the axial skeleton. The spinal column is made up of many bones called vertebrae. The many bones allow flexibility. If you run your finger along your back you will feel the vertebrae. Another set of bones belonging to the axial skeleton are the rib bones. The ribs function to protect the soft internal organs, such as the heart and lungs.

## The Appendicular Skeleton

The diagram shows the bones in the appendicular skeleton in yellow. Bones in the **appendicular skeleton** function mainly to allow movement. The shoulder belongs to the upper part of the appendicular skeleton. The upper arm bone that connects to the shoulder is the longest bone in the upper body. It connects with the two bones of the lower arm. The wristbone is the end of one of these bones in the lower arm.

The lower part of the body includes the legs and the hip bones. This part of the body bears all of the body's weight when you are standing. The leg bones are the strongest of all the bones in the skeleton. Just as the lower arm includes two bones, the lower leg has two bones. The larger of these two bones carries most of the weight of the body.



### CHECK YOUR READING

How are the axial and appendicular skeletons alike?  
How are they different?

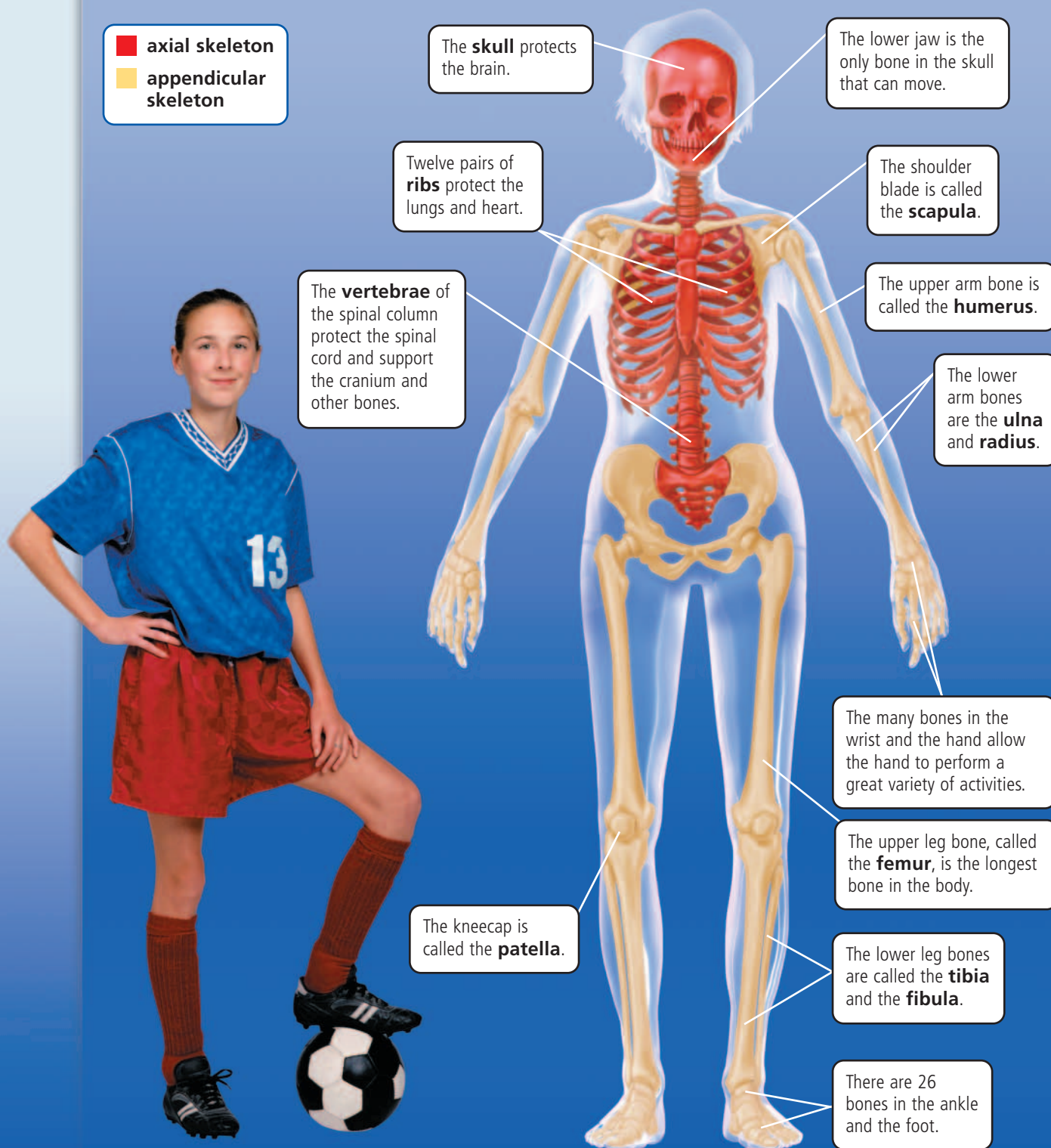


Assemble a skeleton.

## The Skeletal System

The skeletal system interacts with other body systems to allow this soccer player to stand, run, and kick.

**axial skeleton**  
**appendicular skeleton**

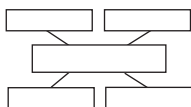


### READING VISUALS

The word *appendicular* has the same root as the word *append*, which means to attach. How do you think this word applies to the appendicular skeleton?

## The skeleton changes as the body develops and ages.

**MAIN IDEA WEB** Make a web of the important terms and details about the main idea: *The skeleton changes as the body develops and ages.*



### REMINDER

Density is the ratio of mass over volume. Bone density is a measure of the mass of a bone divided by the bone's volume.

You will remember that bones are living tissue. During infancy and childhood, bones grow as the rest of the body grows. Bones become harder as they stop growing. In adulthood, bones continue to change.

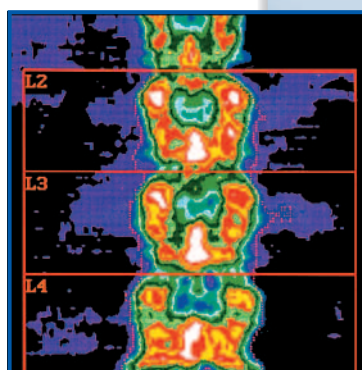
**Infancy** The skull of a newborn is made up of several bones that have spaces between them. As the brain grows, the skull also grows. During the growth of the skull, the spaces between the bones close.

**Childhood** Bone growth occurs at areas called growth plates. These growth plates are made of cartilage, a firm, flexible connective tissue. The length and shape of bones is determined by growth plates. Long bones grow at the ends of the bone surrounding growth plates.

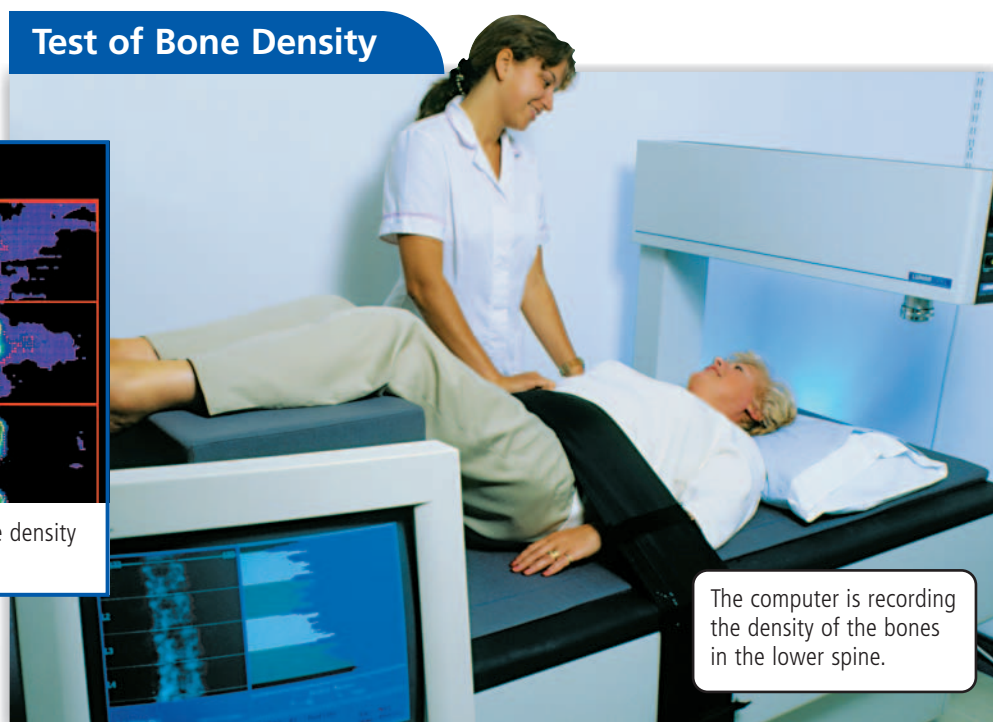
**Adolescence** At the end of adolescence (AD-uhl-EHS-uhns) bones stop growing. The growth plate is the last portion of the bone to become hard. Once growth plates become hard, arms and legs stop growing and the skull plates fuse.

**Adulthood** Even after bones stop growing, they go through cycles in which old bone is broken down and new bone is formed. As people age, more bone is broken down than is formed. This can lead to a decrease in bone mass, which causes a decrease in bone density. The strength of bones depends upon their density. As people age, their bone density may decrease. Bones that are less dense may break more easily. Many doctors recommend that adults over a certain age get regular bone density tests.

### Test of Bone Density



A bone scan shows bone density using color.



The computer is recording the density of the bones in the lower spine.

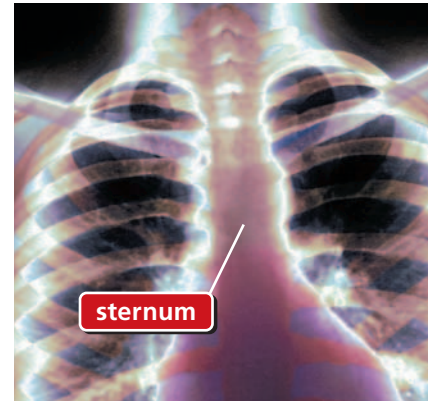
## Joints connect parts of the skeletal system.

A joint is a place at which two parts of the skeletal system meet. There are three types of joints: immovable, slightly movable, and freely movable.

**Immovable and Slightly Movable Joints** An immovable joint locks bones together like puzzle pieces. The bones of your skull are connected by immovable joints. Slightly movable joints are able to flex slightly. Your ribs are connected to your sternum by slightly movable joints.

**Freely Movable Joints** Freely movable joints allow your body to bend and to move. Tissues called ligaments hold the bones together at movable joints. Other structures inside the joint cushion the bones and keep them from rubbing together. The entire joint also is surrounded by connective tissue.

Movable joints can be classified by the type of movement they produce. Think about the movement of your arm when you eat an apple. Your arm moves up, then down, changing the angle between your upper and lower arms. This is angular movement. The joint that produces this movement is called a hinge joint.



The sternum is an example of a slightly movable joint.

## INVESTIGATE Movable Joints

### How can you move at joints?

#### PROCEDURE

- 1 Perform several activities that involve your joints. Twist at the waist. Bend from your waist to one side. Reach into the air with one arm. Open and close your mouth. Push a book across your desk. Lift the book.
- 2 Record each activity and write a note describing the motion that you feel at each joint.
- 3 Try to see how many different ways you can move at joints.

#### WHAT DO YOU THINK?

- How was the motion you felt similar for each activity? How was it different?
- Based on your observations, identify two or more ways that joints move.

**CHALLENGE** Draw a diagram showing how you think each joint moves. How might you classify different types of joints based upon the way they move?

**SKILL FOCUS**  
Observing

**MATERIALS**  
book

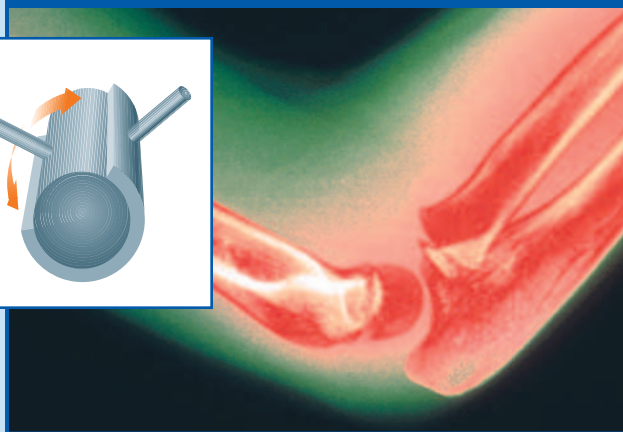
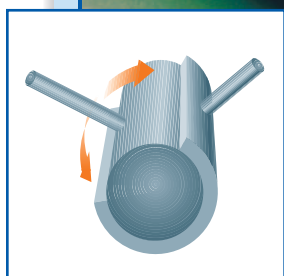
**TIME**  
20 minutes



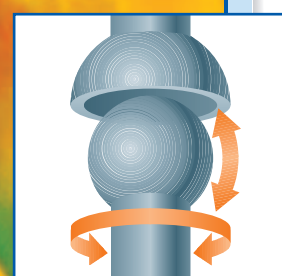
## Movable Joints

The joints in the elbow and hip allow different types of movement.

### Angular movement (elbow)



### Rotational movement (hip)



#### READING VISUALS

**INFER** How do the structure and shape of each joint allow bones to move?

Your arm can also rotate from side to side, as it does when you turn a doorknob. Rotational movement like this is produced by a pivot joint in the elbow. You can also rotate your arm in a circle, like the motion of a softball pitcher winding up and releasing a ball. The joint in the shoulder that produces this type of rotational movement is called a ball-and-socket joint.

Joints also produce gliding movement. All joints glide, that is, one bone slides back and forth across another. In some cases, as with the joints in your backbone, a small gliding movement is the only movement the joint produces.

## 16.2 Review

### KEY CONCEPTS

1. What are the functions of the two types of bone tissue?
2. What are the main divisions of the human skeleton?
3. Name three types of movement produced by movable joints and give an example of each.

### CRITICAL THINKING

4. **Infer** What function do immovable joints in the skull perform? Think about the different stages of development in the human body.
5. **Analyze** Which type of movable joint allows the most movement? How does the joint's shape and structure contribute to this?

### CHALLENGE

6. **Classify** The joints in your hand and wrist produce three different types of movement. Using your own wrist, classify the joint movement of the fingers, palm, and wrist. Support your answer.