

The Skeletal System

Reading Preview

Key Concepts

- What are the functions of the skeleton?
- What role do joints play in the body?
- What are the characteristics of bone, and how can you keep your bones strong and healthy?

Key Terms

- skeleton • vertebrae • joint
- ligament • cartilage
- compact bone • spongy bone
- marrow • osteoporosis

Target Reading Skill

Asking Questions Before you read, preview the red headings. In a graphic organizer like the one below, ask a *what* or *how* question for each heading. As you read, answer your questions.

The Skeletal System

Question	Answer
What does the skeleton do?	The skeletal system provides shape . . .

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Discover Activity

Hard as a Rock?

1. Your teacher will give you a rock and a leg bone from a cooked turkey or chicken.
2. Use a hand lens to examine both the rock and the bone.
3. Gently tap both the rock and the bone on a hard surface.
4. Pick up each object to feel how heavy it is.
5. Wash your hands. Then make notes of your observations.



Think It Over

Observing Based on your observations, why do you think bones are sometimes compared to rocks? List some ways in which bones and rocks are similar and different.

A high rise construction site is a busy place. After workers have prepared the building's foundation, they begin to assemble thousands of steel pieces into a frame for the building. People watch as the steel pieces are joined to create a rigid frame that climbs toward the sky. By the time the building is finished, however, the building's framework will no longer be visible.

Like a building, you also have an inner framework, but it isn't made up of steel. Your framework, or **skeleton**, is made up of all the bones in your body. The number of bones in your skeleton, or skeletal system, depends on your age. A newborn has about 275 bones. An adult, however, has about 206 bones. As a baby grows, some of the bones in the body fuse together. For example, as you grew, some of the bones in your skull fused together.

What the Skeletal System Does

Just as a building could not stand without its frame, you would collapse without your skeleton. Your **skeleton** has five major functions. It provides shape and support, enables you to move, protects your organs, produces blood cells, and stores minerals and other materials until your body needs them.

Shape and Support Your skeleton determines the shape of your body, much as a steel frame determines the shape of a building. The backbone, or vertebral column, is the center of the skeleton. Locate the backbone in Figure 6. Notice that the bones in the skeleton are in some way connected to this column. If you move your fingers down the center of your back, you can feel the 26 small bones, or **vertebrae** (VUR tuh bray) (singular: *vertebra*), that make up your backbone. Bend forward at the waist and feel the bones adjust as you move. You can think of each individual vertebra as a bead on a string. Just as a beaded necklace is flexible and able to bend, so too is your vertebral column. If your backbone were just one bone, you would not be able to bend or twist.



Why is the vertebral column considered the center of the skeleton?

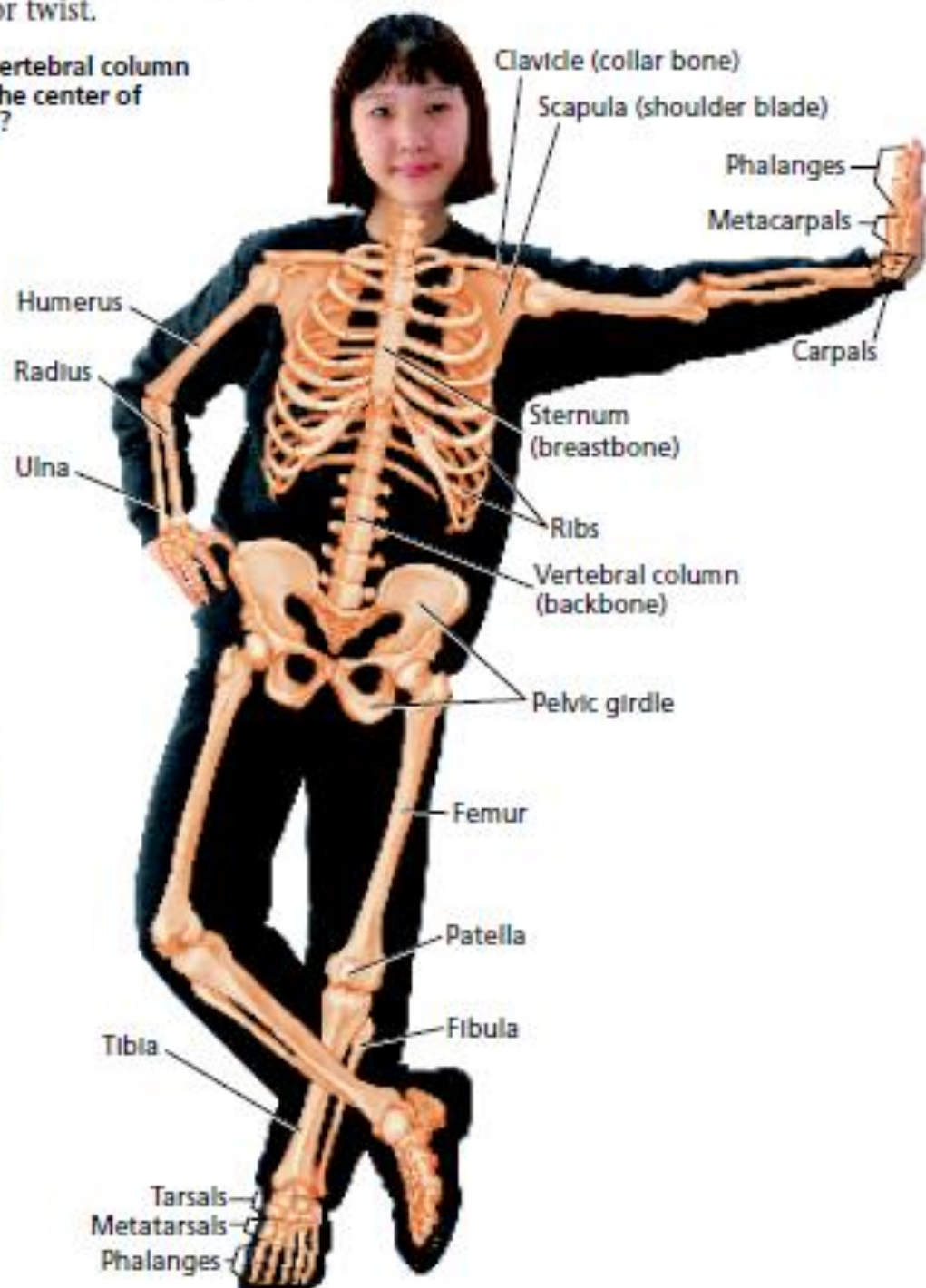
FIGURE 6

The Skeleton

The skeleton provides a framework that supports and protects many other body parts. **Comparing and Contrasting** In what ways is the skeleton like the steel framework of a building? In what ways is it different?



Skull



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For: Movable Joints activity
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FIGURE 7

Movable Joints

Without movable joints, your body would be as stiff as a board. The different kinds of joints allow your body to move in a variety of ways.

Comparing and Contrasting How is the movement of a hinge joint different from that of a ball-and-socket joint?

Movement and Protection Your skeleton allows you to move. Most of the body's bones are associated with muscles. The muscles pull on the bones to make the body move. Bones also protect many of the organs in your body. For example, your skull protects your brain, and your breastbone and ribs form a protective cage around your heart and lungs.

Production and Storage of Substances Some of your bones produce substances that your body needs. You can think of the long bones of your arms and legs as factories that make certain blood cells. Bones also store minerals such as calcium and phosphorus. When the body needs these minerals, the bones release small amounts of them into the blood.

Joints of the Skeleton

Suppose that a single long bone ran the length of your leg. How would you get out of bed or run for the school bus? Luckily, your body contains many small bones rather than fewer large ones. A **joint** is a place in the body where two bones come together. **Joints allow bones to move in different ways.** There are two kinds of joints—immovable joints and movable joints.



Hinge Joint

A hinge joint allows forward or backward motion. Your knee is a hinge joint that allows you to bend and straighten your leg. Your elbow is also a hinge joint.



Ball-and-Socket Joint

Ball-and-socket joints allow the greatest range of motion. The ball-and-socket joint in your shoulder allows you to swing your arm freely in a circle. Your hips also have ball-and-socket joints.



Classifying

Perform these activities.

- Move your arm in a circle.
- Push open a door.
- Lift a book from a desk.
- Kneel down.
- Wave your hand.
- Twist your head from side to side.

Determine which type of movable joint or joints is involved in performing each activity. Give a reason to support your classifications.

Immovable Joints Some joints in the body connect bones in a way that allows little or no movement. These joints are called immovable joints. The bones of the skull are held together by immovable joints.

Movable Joints Most of the joints in the body are movable joints. Movable joints allow the body to make a wide range of movements. Look at Figure 7 to see the variety of movements that these joints make possible.

The bones in movable joints are held together by strong connective tissues called **ligaments**. Most joints have a second type of connective tissue, called **cartilage** (KAHR tuh lij), which is more flexible than bone. Cartilage covers the ends of the bones and keeps them from rubbing against each other. For example, in the knee, cartilage acts as a cushion that keeps your femur (thighbone) from rubbing against the bones of your lower leg. In addition, a fluid lubricates the ends of the bones, allowing them to move smoothly over each other.



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How are movable joints held together?



Pivot Joint

A pivot joint allows one bone to rotate around another. The pivot joint in your neck allows you to turn your head from side to side.



Gliding Joint

A gliding joint allows one bone to slide over another. The gliding joint in your wrist or ankle enables you to bend and flex as well as make limited side-to-side motions.

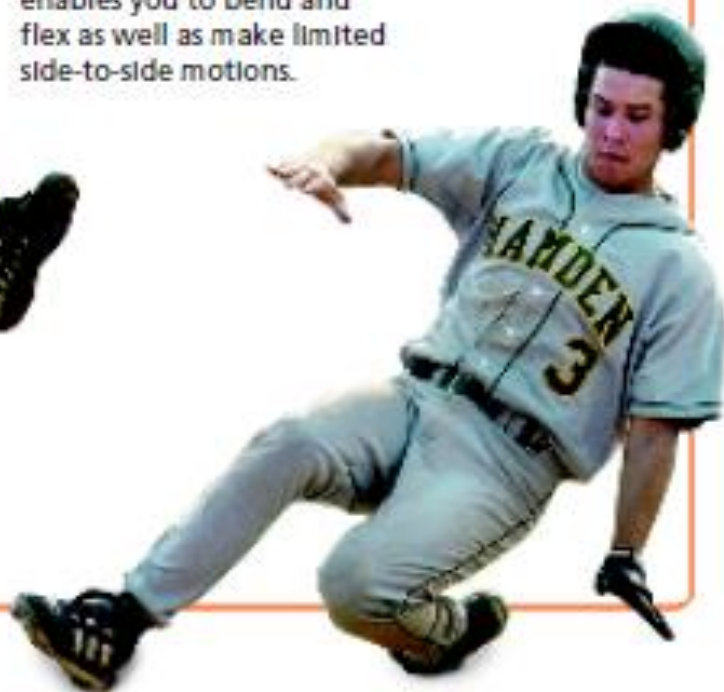


FIGURE 8

Bone Structure

The most obvious feature of a long bone, such as the femur, is its long shaft. Running through the compact bone tissue within the shaft is a system of canals. The canals bring materials to the living bone cells.

Interpreting Diagrams What different tissues make up the femur?

Femur



Bones—Strong and Living

When you think of a skeleton, you may think of the paper cut-outs that are used as decorations at Halloween. Many people connect skeletons with death. The ancient Greeks did, too. The word *skeleton* actually comes from a Greek word meaning “a dried body.” The bones of your skeleton, however, are not dead at all. **Bones are complex living structures that undergo growth and development.**

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Try This Activity

Soft Bones?

In this activity, you will explore the role that calcium plays in bones.

1. Put on protective gloves. Soak one clean chicken bone in a jar filled with water. Soak a second clean chicken bone in a jar filled with vinegar. (Vinegar causes calcium to dissolve out of bone.)
2. After one week, put on protective gloves and remove the bones from the jars.
3. Compare how the two bones look and feel. Note any differences between the two bones.

Drawing Conclusions Based on your results, explain why it is important to consume a diet that is high in calcium.

Bone Structure Figure 8 shows the structure of the femur, or thighbone. The femur, which is the body’s longest bone, connects the pelvic bones to the lower leg bones. Notice that a thin, tough membrane covers all of the bone except the ends. Blood vessels and nerves enter and leave the bone through the membrane. Beneath the bone’s outer membrane is a layer of **compact bone**, which is hard and dense, but not solid. As you can see in Figure 8, small canals run through the compact bone. These canals carry blood vessels and nerves from the bone’s surface to the living cells within the bone.

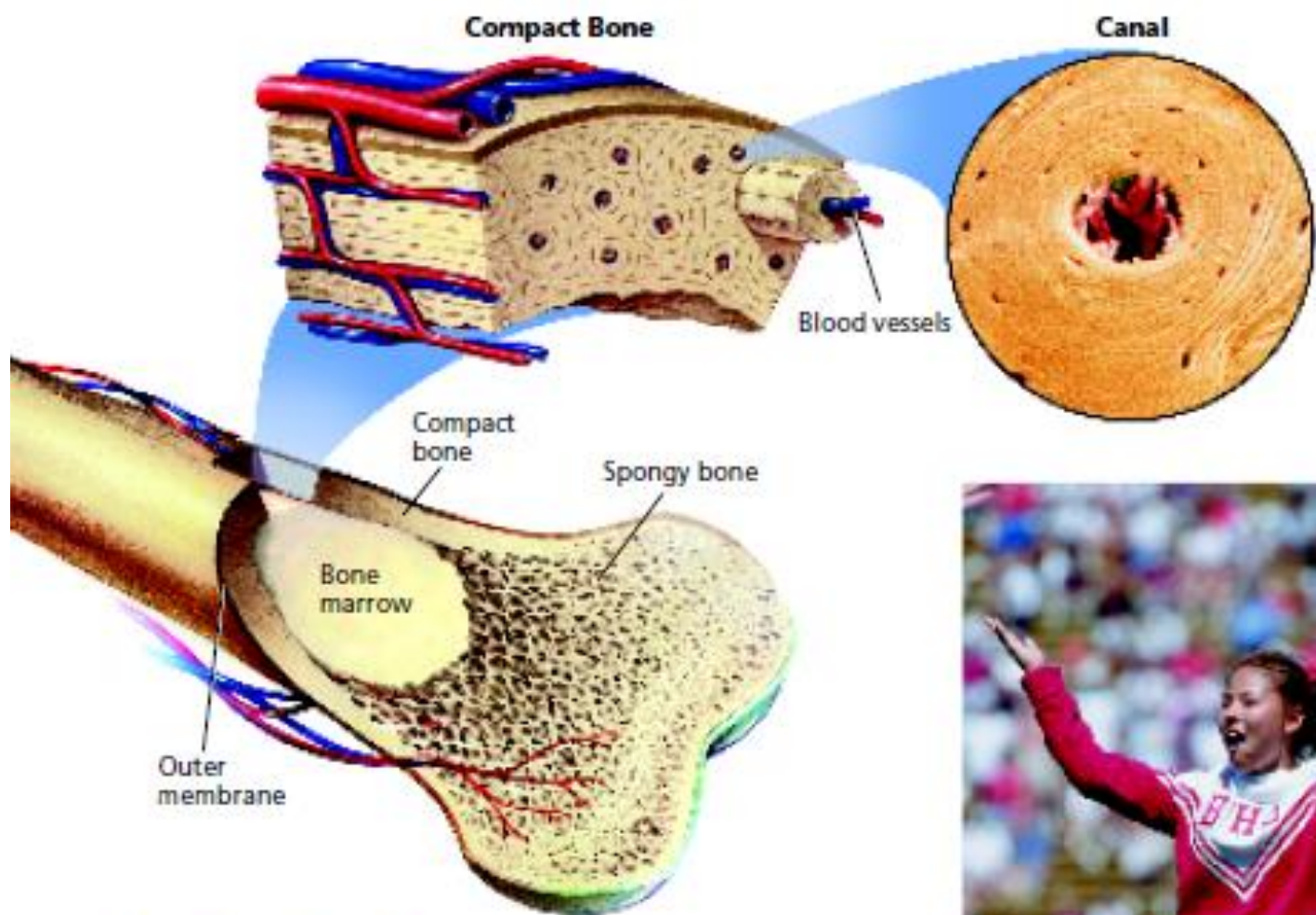
Just inside the femur’s compact bone is a layer of spongy bone. Like a sponge, **spongy bone** has many small spaces within it. This structure makes spongy bone tissue lightweight but strong. Spongy bone is also found at the ends of the bone.

The spaces in many bones contain a soft, connective tissue called **marrow**. There are two types of marrow—red and yellow. Red bone marrow produces some of the body’s blood cells. As a child, most of your bones contained red bone marrow. As a teenager, only the ends of your femurs, skull, hip bones, and sternum (breastbone) contain red marrow. Your other bones contain yellow marrow. This marrow stores fat that can serve as an energy reserve.



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What are the two types of bone marrow?



Bone Strength The structure of bone makes it both strong and lightweight. In fact, bones are so strong that they can absorb more force without breaking than can concrete or granite rock. Yet, bones are much lighter than these materials. In fact, only about 20 percent of an average adult's body weight is bone.

Have you ever heard the phrase "as hard as a rock"? Most rock is hard because it is made up of minerals that are packed tightly together. In a similar way, bones are hard because they contain minerals—primarily phosphorus and calcium.

Bone Growth Bones are alive—they contain cells and tissues, such as blood and nerves. Because they are alive, bones also form new bone tissue as you grow. Even after you are grown, however, bone tissue continues to form within your bones. For example, every time you play soccer or basketball, some of your bones absorb the force of your weight. They respond by making new bone tissue.

Sometimes, new bone tissue forms after an accident. If you break a bone, for example, new bone tissue forms to fill the gap between the broken ends of the bone. In fact, the healed region of new bone may be stronger than the original bone!



FIGURE 9

Bone Strength

You can jump up and down or turn cartwheels without breaking bones.

Bone Development Try this activity: Move the tip of your nose from side to side with your fingers. Notice that the tip of your nose is not stiff. That is because it contains cartilage. As an infant, much of your skeleton was cartilage. Over time, most of the cartilage was replaced with hard bone tissue.

The replacement of cartilage by bone tissue usually is complete by the time you stop growing. You've seen, however, that not all of your body's cartilage is replaced by bone. Even in adults, many joints contain cartilage that protects the ends of the bones.

Taking Care of Your Bones

Because your skeleton performs so many necessary functions, it is important to keep it healthy. **A combination of a balanced diet and regular exercise are important for a lifetime of healthy bones.**

Diet One way to help ensure healthy bones is to eat a well-balanced diet. A well-balanced diet includes enough calcium and phosphorus to keep your bones strong while they are growing. Meats, whole grains, and leafy green vegetables are all good sources of both calcium and phosphorus. Dairy products, including yogurt, are good sources of calcium.

Exercise Another way to build and maintain strong bones is to get plenty of exercise. During activities such as running, skating, or dancing, your bones support the weight of your entire body. These weight-bearing activities help your bones grow stronger and denser. To prevent injuries while exercising, be sure to wear appropriate safety equipment, such as a helmet and pads.



What are two ways to keep your bones healthy?



FIGURE 10

Caring for Your Bones
Exercising regularly and eating a balanced diet help to keep your bones strong and healthy.

Healthy Spine



Spine with Osteoporosis



FIGURE 11

Osteoporosis

Without enough calcium in the diet, a person's bones weaken. These photos show how the shape and structure of vertebrae in a healthy spine compare with those in a person with osteoporosis.

Relating Cause and Effect What can you do to prevent osteoporosis?

Osteoporosis As people become older, their bones begin to lose some of the minerals they contain. Mineral loss can lead to **osteoporosis** (ahs tee oh puh ROH sis), a condition in which the body's bones become weak and break easily. You can see the effect of osteoporosis in Figure 11. Osteoporosis is more common in women than in men. Evidence indicates that regular exercise throughout life can help prevent osteoporosis. A diet with enough calcium can also help prevent osteoporosis. If you eat enough calcium-rich foods now, during your teenage years, you may help prevent osteoporosis later in life.

Section 2 Assessment

Target Reading Skill Asking Questions Work with a partner to check the answers in your graphic organizer.

Reviewing Key Concepts

- Listing** What are five functions of the skeleton?
 - Explaining** How does the skeleton protect the body?
 - Predicting** How would your life be different if your backbone consisted of just one long bone?
- Naming** What are four types of movable joints?
 - Comparing and Contrasting** Compare immovable joints with movable joints.
 - Classifying** Which of your movable joints are ball-and-socket joints?
- Identifying** What are three types of tissue in bone?
 - Relating Cause and Effect** How does the structure of bones make them both strong and lightweight?
 - Applying Concepts** How do a well-balanced diet and weight-bearing exercise help keep bones strong?

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At-Home Activity

Model Joints Choose two examples of movable joints from Figure 7. Ask a family member to perform separate movements that involve one joint and then the other. Make drawings to represent the joints and bones involved in each movement. Use the drawings to explain to your family how the motions of the two joints differ.