

The Muscular System

Reading Preview

Key Concepts

- What types of muscles are found in the body?
- Why do skeletal muscles work in pairs?

Key Terms

- involuntary muscle
- voluntary muscle
- skeletal muscle
- tendon
- striated muscle
- smooth muscle
- cardiac muscle

Target Reading Skill

Previewing Visuals When you preview, you look ahead at the material to be read. Preview Figure 15. Then, in a graphic organizer like the one below, write two questions that you have about the diagram. As you read, answer your questions.

Q. How does skeletal muscle help my body move?

A.

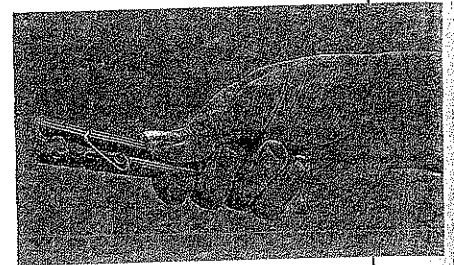
Q.

Lab
zone

Discover Activity

How Do Muscles Work?

1. Grip a spring-type clothespin with the thumb and index finger of your writing hand. Squeeze the clothespin open and shut as quickly as possible for two minutes. Count how many times you can squeeze the clothespin before your muscles tire.
2. Rest for one minute. Then, repeat Step 1.



Think It Over

Predicting What do you think would happen if you repeated Steps 1 and 2 with your other hand? Give a reason for your prediction. Then, test your prediction.

A rabbit becomes still when it senses danger. The rabbit sits so still that it doesn't seem to move a muscle. Could you sit without moving any muscles? Saliva builds up in your mouth. You swallow. You need to breathe. Your chest expands to let air in. All of these actions involve muscles. It is impossible to sit absolutely still without muscle movement.

There are about 600 muscles in your body. Muscles have many functions. For example, they keep your heart beating, pull your mouth into a smile, and move the bones of your skeleton. The girls kick boxing on the next page use many of their muscles for arm, leg, hand, feet, and head movement. Other muscles expand and contract the chest to breathe.

Types of Muscle

Some of your body's movements, such as smiling, are easy to control. Other movements, such as the beating of your heart, are impossible to control completely. That is because some muscles are not under your conscious control. Those muscles are called **involuntary muscles**. Involuntary muscles are responsible for activities such as breathing and digesting food.

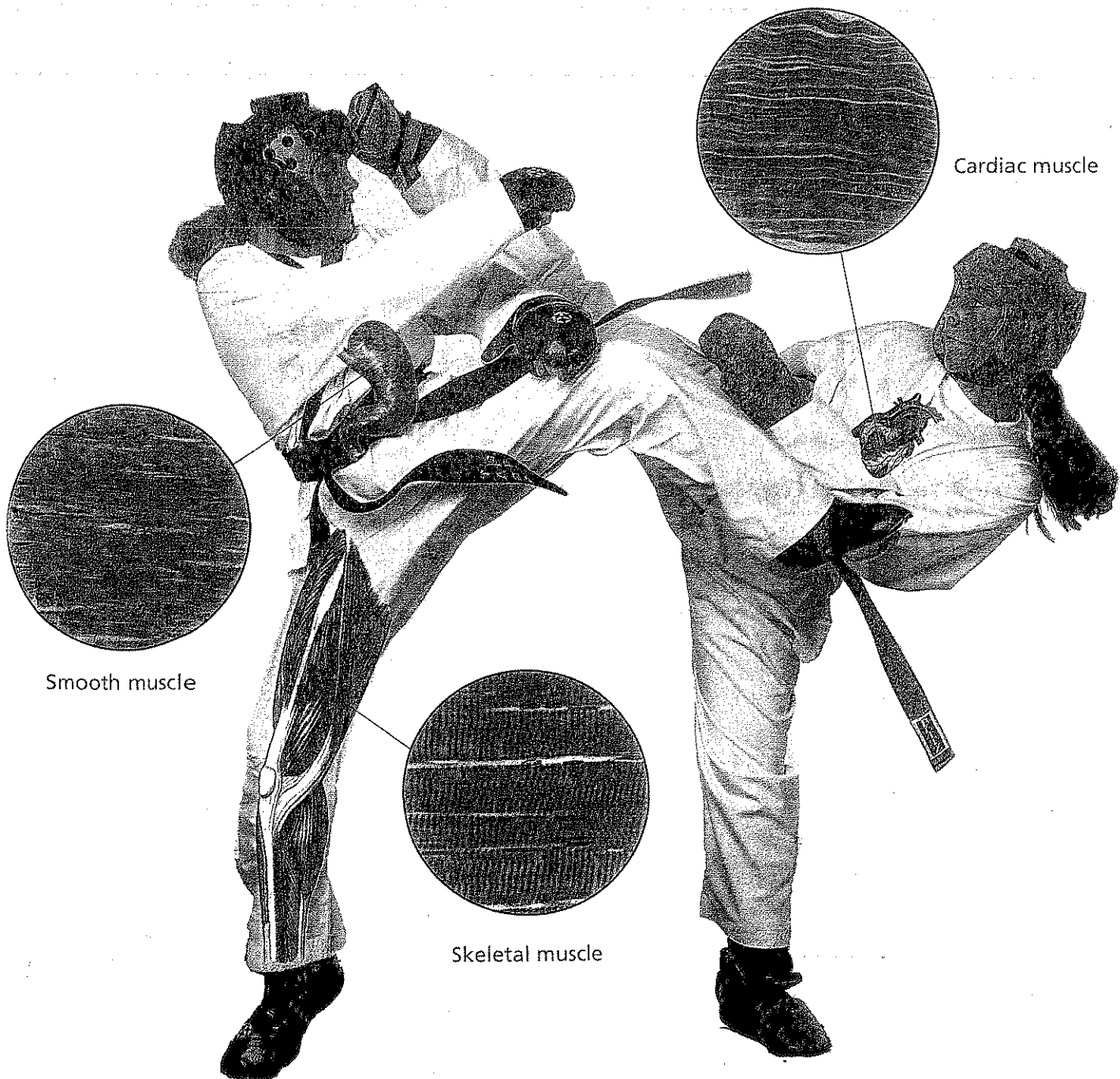
The muscles that are under your conscious control are called **voluntary muscles**. Smiling, turning a page in a book, and getting out of your chair when the bell rings are all actions controlled by voluntary muscles.

Your body has three types of muscle tissue—skeletal muscle, smooth muscle, and cardiac muscle. Some of these muscle tissues are involuntary, and some are voluntary. In Figure 15, you see a magnified view of each type of muscle in the body. Both skeletal and smooth muscles are found in many places in the body. Cardiac muscle is found only in the heart. Each muscle type performs specific functions in the body.

FIGURE 15

Types of Muscle

Your body has three types of muscle tissue: skeletal muscle, smooth muscle, and cardiac muscle. *Classifying Which type of muscle is found only in the heart?*



Skeletal Muscle Every time you type on a computer keyboard or walk across a room, you are using skeletal muscles. **Skeletal muscles** are attached to the bones of your skeleton and provide the force that moves your bones. At each end of a skeletal muscle is a **tendon**. A **tendon** is a strong connective tissue that attaches muscle to bone. Skeletal muscle cells appear banded, or striated. For this reason, skeletal muscle is sometimes called **striated** (STRY ay tid) **muscle**.

Because you have conscious control of skeletal muscles, they are classified as voluntary muscles. One characteristic of skeletal muscles is that they react very quickly. Think about what happens during a swim meet. Immediately after the starting gun sounds, a swimmer's leg muscles push the swimmer off the block into the pool. However, another characteristic of skeletal muscles is that they tire quickly. By the end of the race, the swimmer's muscles are tired and need a rest.

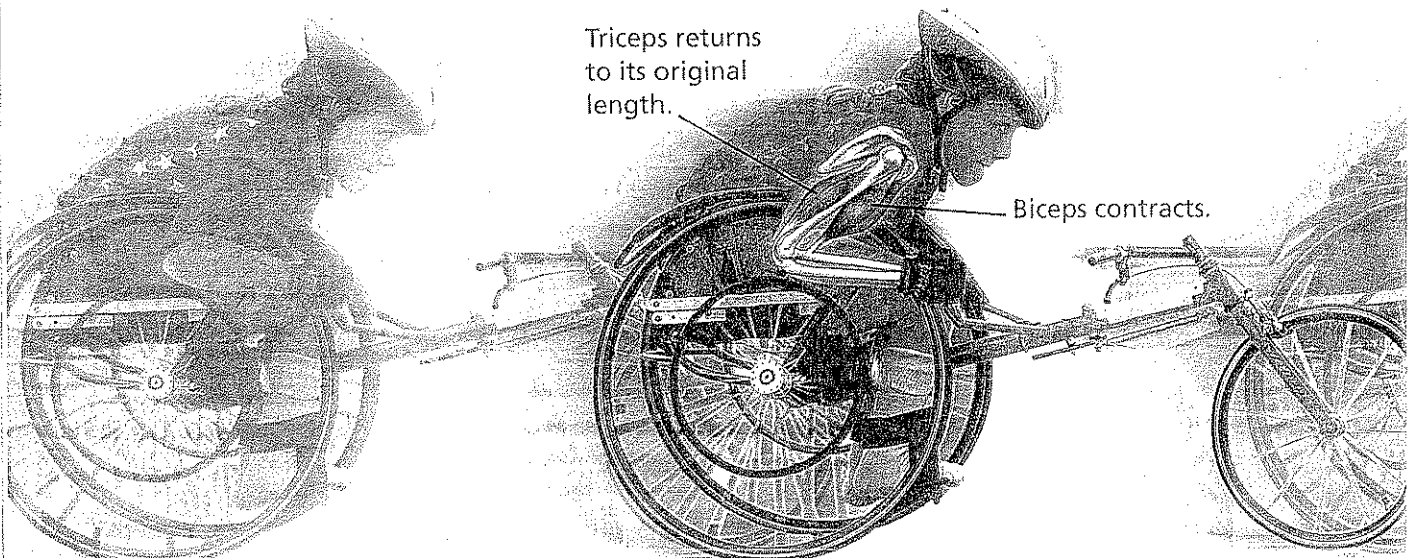
Smooth Muscle The inside of many internal organs of the body, such as the walls of the stomach and blood vessels, contain **smooth muscles**. Smooth muscles are involuntary muscles. They work automatically to control many types of movements inside your body, such as those involved in digestion. For example, as the smooth muscles of your stomach contract, they produce a churning action. The churning mixes the food with chemicals produced by your stomach. This action and these chemicals help to digest the food.

Unlike skeletal muscles, smooth muscle cells are not striated. Smooth muscles behave differently than skeletal muscles, too. Smooth muscles react more slowly and tire more slowly.

FIGURE 16

Muscle Pairs

Because muscles can only contract, or shorten, they must work in pairs. To bend the arm at the elbow, the biceps contracts while the triceps returns to its original length. *Interpreting Diagrams*
What happens to each muscle to straighten the arm?



Cardiac Muscle The tissue called **cardiac muscle** is found in your heart and has some characteristics in common with both smooth muscle and skeletal muscle. Like smooth muscle, cardiac muscle is involuntary. Like skeletal muscle, cardiac muscle cells are striated. However, unlike skeletal muscle, cardiac muscle does not get tired. It can contract repeatedly. You call those repeated contractions heartbeats.

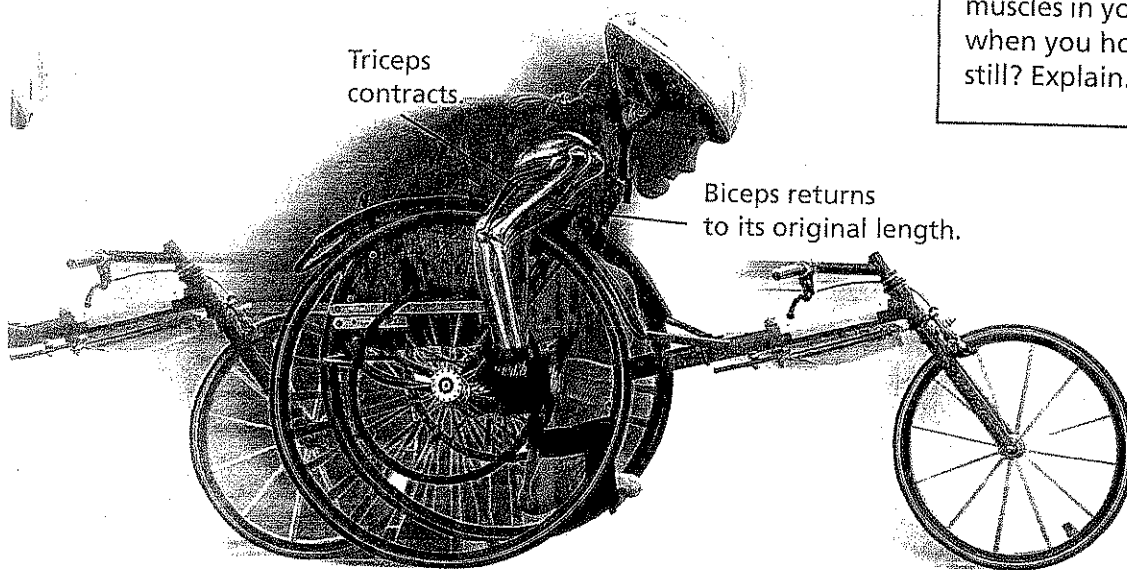


Where is smooth muscle found?

Muscles at Work

Has anyone ever asked you to “make a muscle”? If so, you probably tightened your fist, bent your arm at the elbow, and made the muscles in your upper arm bulge. Like other skeletal muscles, the muscles in your arm do their work by contracting, or becoming shorter and thicker. Muscle cells contract when they receive messages from the nervous system. **Because muscle cells can only contract, not extend, skeletal muscles must work in pairs. While one muscle contracts, the other muscle in the pair relaxes to its original length.**

Muscles Work in Pairs Figure 16 shows the muscle action involved in bending the arm at the elbow. First, the biceps muscle on the front of the upper arm contracts to bend the elbow, lifting the forearm and hand. As the biceps contracts, the triceps on the back of the upper arm relaxes and returns to its original length. Then, to straighten the elbow, the triceps muscle contracts. As the triceps contracts to extend the arm, the biceps relaxes and returns to its original length. Another example of muscles that work in pairs are those in your thigh that bend and straighten the knee joint.

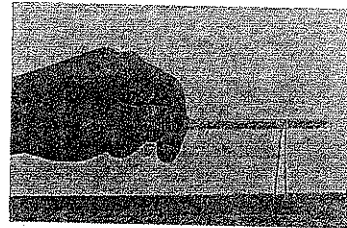


Lab zone Try This Activity

Get a Grip

Are skeletal muscles at work when you're not moving? Try this activity and see.

1. Hold a stirrer in front of you, parallel to a table top. Do not touch the table.
2. Have a partner place a hairpin on the stirrer.
3. Raise the stirrer until the “legs” of the hairpin just touch the table. The “head” of the hairpin should rest on the stirrer, as you see in the photo.
4. Hold the stirrer steady for 20 seconds. Observe what happens to the hairpin.
5. Grip the stirrer tighter and repeat Step 4. Observe what happens.



Inferring Based on your observations, are the skeletal muscles in your hand at work when you hold your hand still? Explain.



Muscular Strength and Flexibility

Exercise is important for maintaining both muscular strength and flexibility. Exercise makes individual muscle cells grow wider. As a result, the whole muscle becomes thicker. The thicker a muscle is, the stronger the muscle is. When you stretch and warm up thoroughly before exercise, your muscles become more flexible. Stretching helps prepare your muscles for exercise or play.



What are two ways to prepare the muscles for exercise?

FIGURE 17

Preventing Muscle Injuries

When you warm up before exercising, you increase the flexibility of your muscles.

Relating Cause and Effect How does exercise make muscles stronger?

Section 4 Assessment

Target Reading Skill Previewing Visuals Refer to your questions and answers about Figure 15 to help you answer Question 1 below.

Reviewing Key Concepts

1.
 - a. **Identifying** What are three types of muscle tissue?
 - b. **Comparing and Contrasting** How do voluntary and involuntary muscles differ? Give an example of each type of muscle.
 - c. **Predicting** The muscles that move your fingers are attached to the bones in your fingers by tendons. Suppose one of the tendons in a person's index finger were cut. How would it affect movement in the finger?
2.
 - a. **Identifying** Where might you find muscle pairs?
 - b. **Describing** Describe how the muscles in your upper arm work together to bend and straighten your arm.
 - c. **Inferring** Suppose your muscles did not work in pairs. How would that affect your ability to move?

Writing in Science

Comparing and Contrasting Write a paragraph to compare smooth muscle tissue and skeletal muscle tissue. Include whether these muscle tissues are voluntary or involuntary, where they are found, what their jobs are, and what you might expect to see if you looked at them under a microscope. *Hint:* Begin your paragraph with a topic sentence and include supporting details.