

INVESTIGATION 40

Muscular Activity

MATERIALS

Investigation ■ prepared slides of smooth muscle, ■ microscope
cardiac muscle, and skeletal muscle ■ clock or watch with a second hand

OBJECTIVES

- To understand that skeletal muscles work in pairs
- To identify smooth, cardiac, and skeletal muscle tissues
- To measure some changes that take place during muscular activity

Problem

Are there different kinds of muscle tissue? What happens during muscular activity?

Muscular tissue has the ability to contract and to produce movement. The three kinds of muscle tissue are: smooth, cardiac, and skeletal. Skeletal muscle tissue is made up of long, tapered cells with striations or dark bands. Skeletal muscles are the voluntary muscles, which can be controlled at will. Cardiac muscles are also striated, but they differ from skeletal muscles by their branching network of cells. Cardiac muscle is the involuntary muscle found in the heart. Smooth muscles are made of spindlelike cells with nuclei (one per cell) near the center. They are not striated. Smooth muscles are found in the internal organs of the stomach and intestines.

During muscular activity, muscle cells contract. The energy for muscular contraction comes from ATP, activated by nerve impulses. Skeletal muscles work in pairs — as one contracts, the other relaxes.

Procedure

Part I. Analysis

Make some basic observations about muscle activity by testing yourself. While sitting quietly rest your right arm on your desk with the palm of your hand up. Place your left hand lightly around your right arm as shown in the drawing at the right. Your thumb should be placed on the underside of your arm.

Make a fist and tightly bend (flex) your right arm. Make a note of the changes you feel by answering question 1.



(1) Explain the changes you feel in your right arm as you make a fist and flex your arm.

Now fully straighten (extend) your right arm. Record any changes and observations by answering questions 2 and 3.

(2) Describe the changes you feel as you straighten (extend) your arm.

(3) What observations show that skeletal muscles work in pairs?

With the aid of your text, identify the *flexor muscle* and the *extensor muscle* you used in this activity. Note where these muscles are attached and the pivotal joint where movement takes place. Then answer questions 4–9.

(4) What is the name of the *flexor muscle* involved in this activity?

(5) Name the *extensor muscle*.

(6) Where are these muscles attached?

(7) At what joint does movement take place?

(8) What must occur in the cells of the biceps when the arm is flexed?

(9) What must occur in the cells of the triceps when the arm is flexed?

It is important to remember that all body cells require energy to do their work. ATP is the energy of these active muscle cells. Recall what happens to the ATP molecule as energy is used (see Investigation 6). Answer question 10.

(10) What chemical molecule supplies the energy for muscle activity?

Investigation

(A) Carefully examine the three kinds of muscle cells — smooth, cardiac, and skeletal — with a microscope. Use the low power objective to find differences among the three muscle tissue samples. Sketch each tissue. Label the nuclei, cytoplasm, and cell membrane in the smooth tissue; nuclei, cytoplasm, and striations in the cardiac and skeletal tissues. Then complete questions 11–16.

(11) How does cardiac muscle tissue differ from skeletal muscle tissue?

(12) Name one similarity in cardiac and skeletal muscle tissues.

(13) In what way is smooth muscle tissue distinctive?

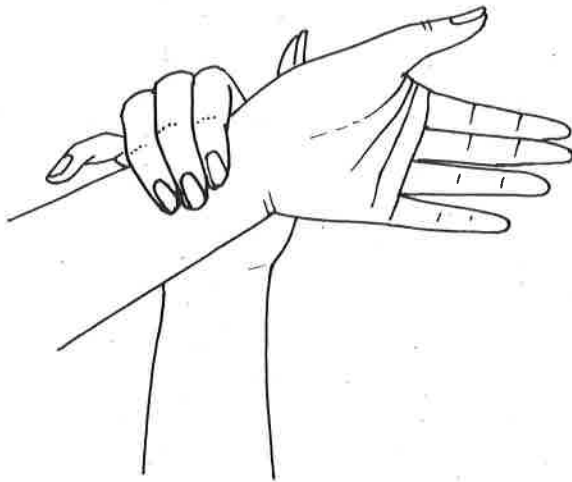
(14) Name places in the body where you would find cardiac muscle, smooth muscle, and skeletal muscle.

(15) Which type of muscle tissue is involved in bodily movements?

(16) Which kinds of muscle tissues are important in involuntary activities?

(B) The speed at which nutrients reach the muscles is indicated by the rate of the heart-beat. You can easily measure this by taking your pulse. Hold the fingers of one hand on the wrist of the other as in the drawing below. Count your pulse for 30 seconds. Double the number to find your pulse rate per minute. Another way to find your pulse rate is to *gently* place your right index finger and your middle finger on the side of your neck. Once again, count the “throbs” for 30 seconds and double your number. See the drawing at the top of page 167.

The rate of breathing is another measurement that indicates the oxygen requirements of muscles. Have your laboratory partner measure your respiration rate for one minute. (This is done by counting the rise and fall of the chest.) Record the “sitting position” respiration rate in a table like the one on page 167.



		Immediately	2 min.	4 min.	6 min.	8 min.
SITTING POSITION	pulse rate					
	respiration rate					
WALKING	pulse rate					
	respiration rate					
RUNNING	pulse rate					
	respiration rate					

Now stand up and walk in place for one minute. In your Table record your respiration rate and your pulse rate immediately. Wait two minutes and record these measurements again. If necessary, repeat the measurements until the rates are back to your "sitting position" rate.

Stand up again and run in place vigorously for exactly one minute. Sit down and immediately make the pulse and respiration rate measurements. Repeat these measurements every two minutes until the "sitting position" rates are reached. Record your results in the Table and complete questions 17-23.

- (17) What is your pulse rate per minute?
- (18) What other system (besides circulatory) is involved in the heartbeat rate?
- (19) What is your respiration rate?
- (20) When taking your pulse after running in place, did you observe anything about its *strength*? Explain.
- (21) How long did it take to "recover" from walking in place?

- (22) How long did it take to “recover” from running in place?
- (23) Explain why your answers to (21) and (22) are different.

Investigations On Your Own

- (1) Many physical fitness tests include measurements like those you have made in this Investigation. Locate two or three such tests from your physical education teacher or the library. Compare these tests and explain how the measurements they require indicate “fitness.”
- (2) Explain how regular exercise over a period of time might change the results obtained in the Investigation. Can you devise an experiment that might prove your hypothesis?

Summary

- (1) Explain the statement: “Skeletal muscles that move joints work in opposite pairs.”
- (2) Why was it necessary to take the “sitting position” measurements first?
- (3) How does this study of muscular activity indicate the coordination of several systems in your body?