Name _____ Date _____

TEACHER _____ Lab Day_____ Period_____

SKELETAL MUSCLES

STANDARDS 1 - 3 - 5 - 7

LAB 17

Every time you move part of your body, the action of muscles is required. Muscles are responsible for moving bones. It is this bone movement that results in your being able to walk, run, lift objects, or even nod your head yes and no. Muscle tissue is able to allow these movements because of its ability to shorten in length.

In this investigation, you will

(a) examine a slide of skeletal muscle under the microscope.
(b) compare diagrams of arm and leg muscles to determine how the shortening of muscles results in body movement.
(c) prepare a muscle model to demonstrate the way that muscle shortening results in body movement.

Materials

microscope
prepared slide of skeletal muscle
string (2 pieces, each 20 cm long)
poster board
paper punch
metal fastener
metric ruler
scissors

Procedure

Part A. Skeletal Muscle, Microscopic View

Skeletal muscle is attached to your skeleton. It makes up the bulk of your body weight.

- Examine a prepared slide of skeletal muscle under the microscope. Use low and high powers.
- Note the many nuclei (dark, round bodies) present. Also note that muscle tissue is made up of long strands or fibers. Each fiber shows a striped pattern resulting from alternating bands of light and dark protein fibers.
- Diagram skeletal muscle under high power in the space provided. Label *muscle fiber* and *nucleus*.

skeletal muscle

Part B. Muscle Contraction and Body Movement

Skeletal muscle does its job of moving bones or body parts by shortening its length. Biologists call this shortening contraction. As muscle contracts, it pulls bones or body parts into different positions. The muscles are attached to bones at two different places. During contraction, one end of the muscle and what it is attached to do not move. The other end of the muscle and what it is attached to move when the muscle contracts. When not contracting, muscle is said to be relaxing.

FIGURE 1

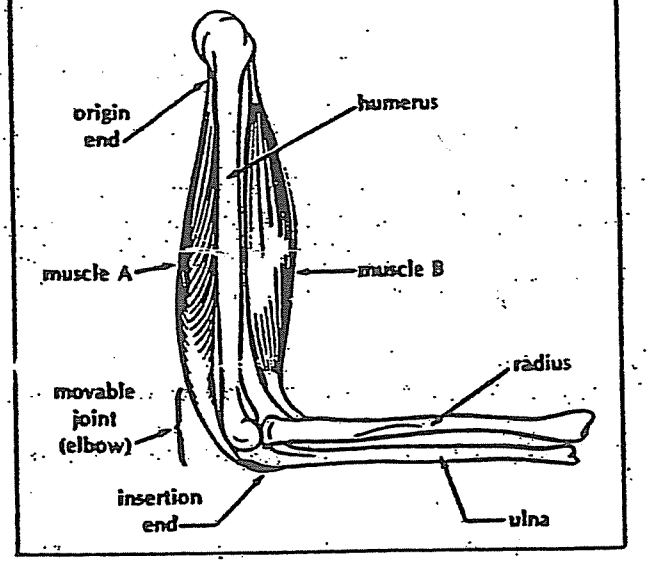
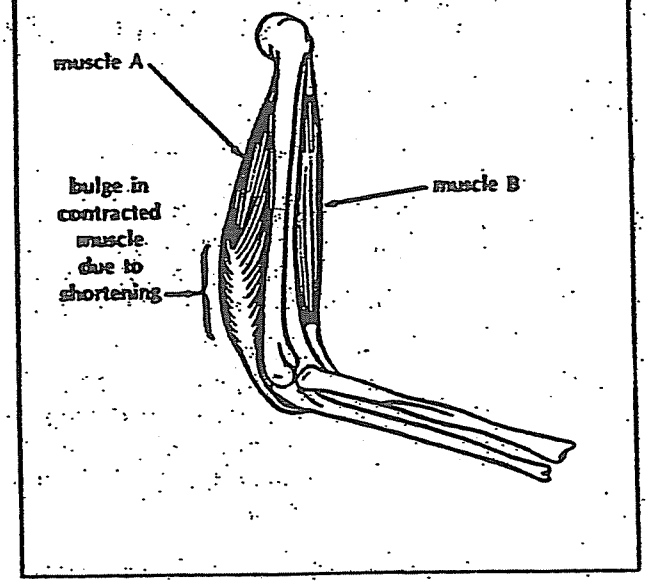


FIGURE 2



• Examine Figure 1. It shows how the muscles of your upper arm are attached to your lower arm. The top end of one muscle (marked A) is attached to the middle of a nonmovable portion of the upper arm bone (humerus). This muscle end is called the point of origin. The muscle stretches over the elbow and is attached to the end of the lower arm bone (ulna). This muscle end is called the point of insertion. As the muscle shortens or contracts, the ulna is pulled down.

Figure 2 shows how the arm looks as muscle A contracts. Note that as a skeletal muscle shortens, it tends to bulge out.

Figure 3 shows a second arm muscle marked B.

• Label its point of origin.

• Label its point of insertion.

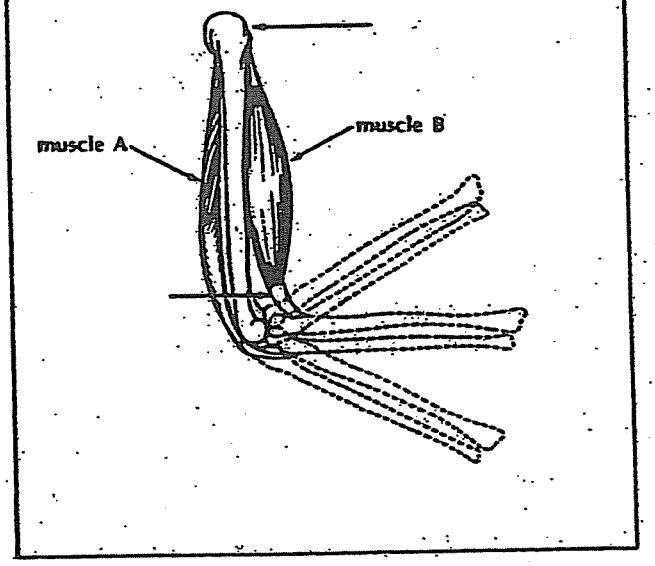
• Use Figure 3 to predict the location of the lower arm when muscle B contracts. Complete the diagram by drawing over the proper dashed lines to correctly show the new lower arm position.

1. How does muscle B change in shape as it contracts?_____

2. (a) Measure the length of muscle B in Figure 2. Record its length in millimeters here_____

(b) Measure the length of muscle B in Figure 3. Record its length in millimeters here_____

FIGURE 3



(c) How did the length of muscle B change as it contracted?_____

3. (a) Does muscle A move the lower arm up or down?_____

(b) Does muscle B move the lower arm up or down?_____

(c) How many different muscles are needed to move the lower arm up and down?_____

• Figure 4 shows one of the muscles needed to move your foot down. The muscle, however, is

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FIGURE -4

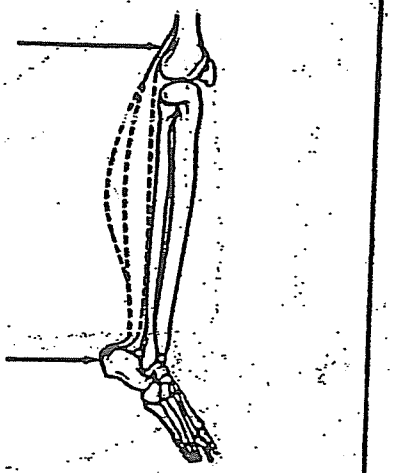
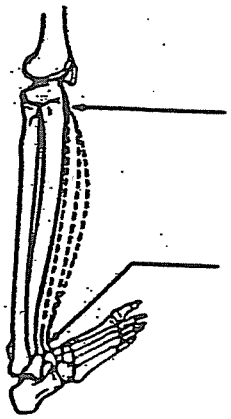


FIGURE -5



shown with only dashed lines. Label the *points of origin* and *insertion* of the muscle. Remember, the ankle is a movable joint.

- Complete Figure -4 by drawing over the correct muscle shape when the foot is pulled down.

- Figure -5 shows one of the muscles needed to move your foot up. The muscle again is shown with dashed lines. Complete Figure -5 by drawing over the correct muscle shape when the foot is pulled up. Label the *points of origin* and *insertion* of this muscle.

4. (a) In Figure 4, is movement of the foot down achieved when the muscle shown contracts or relaxes?_____
   (b) In Figure -5, is movement of the foot up achieved when the muscle shown contracts or relaxes?_____
5. (a) Can the same muscle move your foot both up and down?_____
   (b) How many different muscles does it appear to take to accomplish movement up and down?_____

Part C. Muscle Model

Scientists often use models to help illustrate a particular idea or concept. This part of the investigation will use a muscle-skeleton model to help illustrate the concepts from Part B.

- Trace Figure -6 onto a piece of paper.
- Cut out your traced figures and use them as a pattern for outlining the figures onto heavy paper (posterboard). CAUTION: *Always be careful with scissors.*
- Cut out the figures and connect both model pieces by using a metal fastener.
- Push the fastener through at the points marked with an X.
- Punch holes where indicated on both pieces.

FIGURE -6

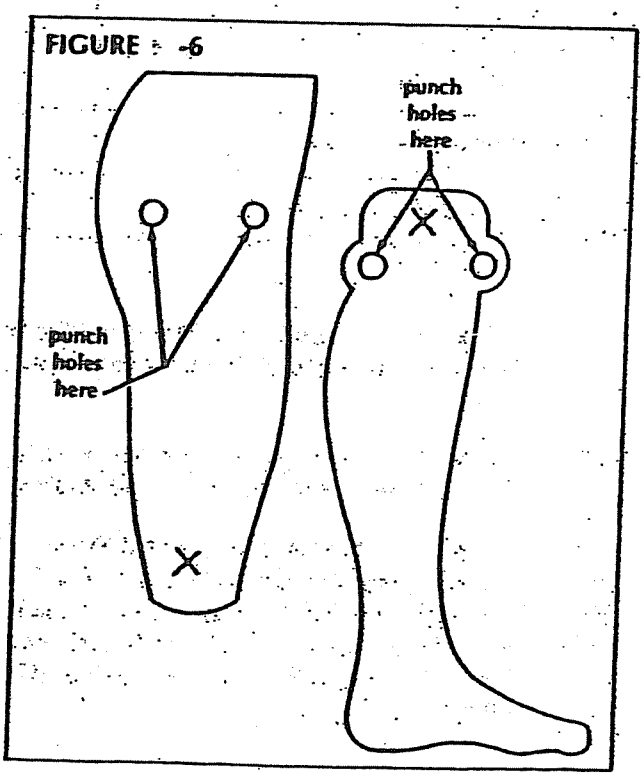


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FIGURE -4

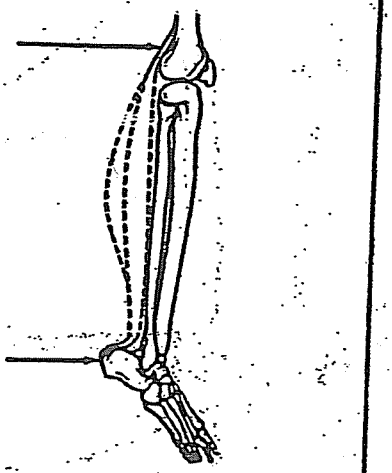

FIGURE -5

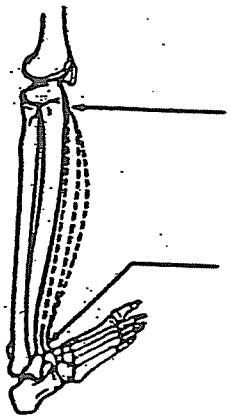

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FIGURE -6

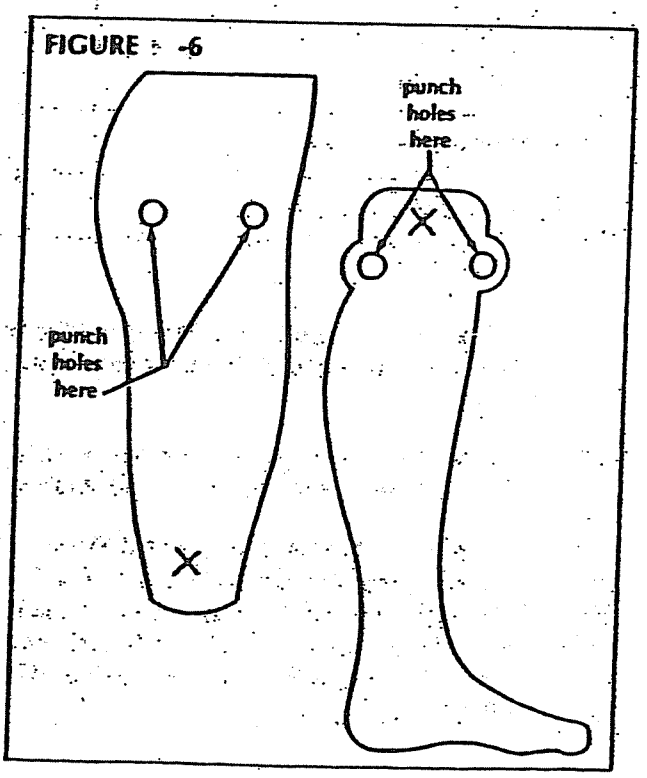

FIGURE -7

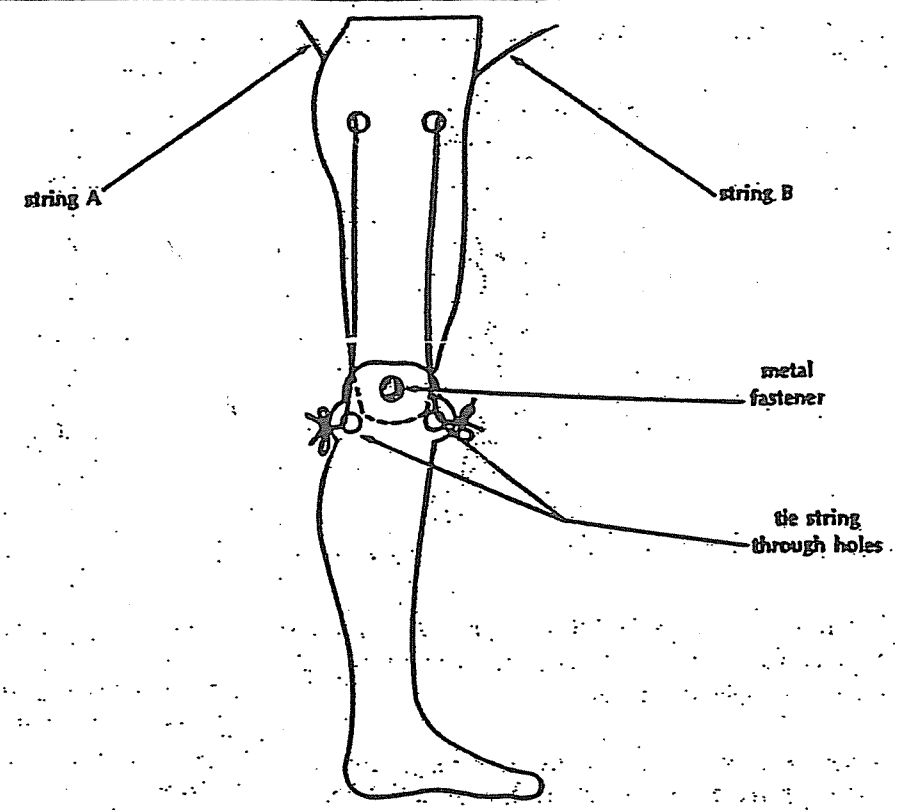

TABLE 67-1. MUSCLE MODEL SUMMARY

LEG POSITION	STRING TO BE PULLED?	LENGTH OF STRING IN MILLIMETERS		MUSCLE (STRING) RELAXED OR CONTRACTING?	
		A	B	A	B
Straight					
Pulled forward					
Pulled backward					

- Add string to your model as shown in Figure -7. The strings represent the muscles present in your thigh.

- Position your leg model so that the foot appears flat as if the leg were standing on a flat surface.

- Measure the length of each string in millimeters and record these numbers in Table 1. NOTE: Measure only from where the string is tied in place to where it enters the top hole. Refer to the string on the left side as string A and the one on the right side as string B.

- Determine which string must be pulled in order to move the leg forward. Remeasure the strings while the leg is forward and record their lengths in the proper row of Table 1.

- Determine which string must be pulled in order to move the leg backward. Remeasure the strings while the leg is pulled back and record their lengths in the proper row of Table 1.

- Complete the last two columns of Table 1.

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Analysis

1. Define the following terms:

(a) skeletal muscle _____

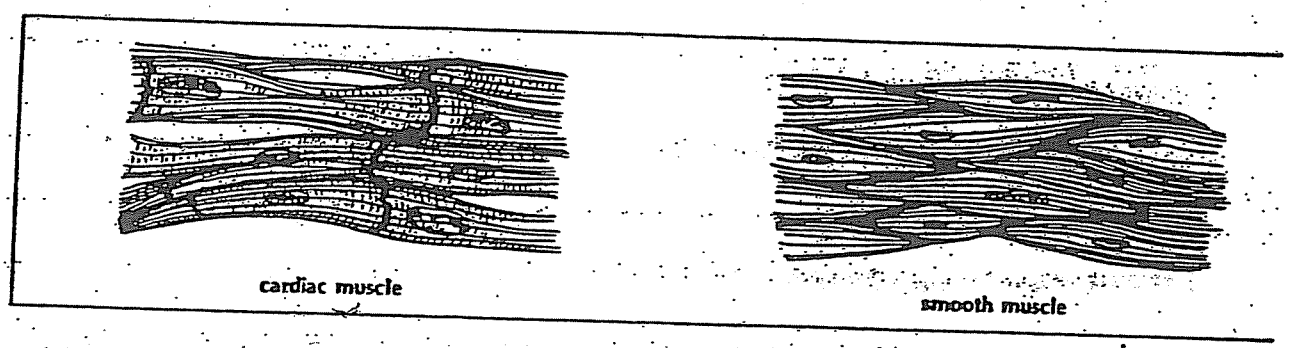
(b) contraction _____

(c) point of origin _____

(d) point of insertion _____

2. In Part A, you examined skeletal muscle. It is sometimes called striated muscle. Why is this name appropriate? _____

3. These two diagrams show two other muscle types present in your body. They are both drawn as they would appear under high power magnification.



(a) Use your text or other resources to determine where in your body cardiac and smooth muscle are found. _____

(b) Explain how cardiac muscle fibers differ from the fibers of skeletal muscle. _____

(c) Explain how smooth muscle differs from skeletal and cardiac muscle when comparing appearance of stripes. _____

4. Skeletal muscles are always found in pairs in your body. That is, one muscle moves a body part in one direction and a different muscle moves the same body part in an opposite direction. This pairing is referred to as antagonistic pairs.

(a) What is the meaning of the word antagonist? _____

(b) Were muscles A and B in Figures -1 and -3 antagonistic pairs? _____

Why? _____

(c) Were the two muscles in Figures -4 and -5 an antagonistic pair?_____

Why?_____

5. Using Figures -1 and 3 again, describe the condition (contracted or relaxed) for:

(a) muscle A in -1_____

muscle B in -1_____

(b) muscle A in -3_____

muscle B in -3_____

(c) Describe how antagonistic muscles behave when a body part is moved in one direction and then in the opposite direction._____

6. Using your model from Part C,

(a) explain what the two strings represent._____

(b) explain what the metal fastener represents._____

(c) explain the relationship between the two strings. (Were they antagonistic?)_____

(d) explain what pulling on each string actually represents._____

7. Using your model from Part C,

(a) describe where the points of origin of those muscles which move your leg are located._____

(b) describe where the points of insertion of those muscles which move your leg are located._____

8. (a) In designing a marionette (puppet), how many strings would be needed to allow it to nod its head "no"?_____

turn its body toward the left or right?_____

(b) Could these strings be thought of as antagonistic muscles?_____

Explain._____