

# MUSCLE MATES

## BENCHMARKS AND TASKS

**SC.F.1.2.1** The student knows that the human body is made of systems with structures and functions that are related.

**SC.F.1.2.3** The student knows that living things are different but share similar structures.

- The student knows that processes needed for life are carried out by the cells and that complex animals have specialized organs to carry out life processes.
- The student uses a model to explain the functions of the major organ systems of the human body (e.g., digestive, respiratory, circulatory, skeletal, nervous, muscular, excretory).

## KEY QUESTION

How do the muscles in your body help your limbs to bend, reach, twist, lift, flip, leap, and even move the muscles in your hand so you can grasp a pencil to do your homework?

## BACKGROUND INFORMATION

Bones form your body's framework, but they can't move by themselves; they need extra help. Every time a bone moves, there is a muscle to move it. There are more than 600 muscles and more than 200 bones in the human body. Every moving bone has at least two muscles attached to it. Muscles work in teams because they can move in only one direction; they only pull (contract). One muscle contracts and pulls a bone to get you into a certain position. Then its partner must contract to pull the bone back and get you out of the position. A muscle can perform just one single motion. A muscle can make itself shorter by contracting. When it's not doing that, it relaxes. Tendons are the ties that bind muscles to your bones. The joints of the bones are connected by strong, fibrous **tissue** called ligaments.

A muscle receives an electric command from the brain through the nerves. The neurons (nerve cells) get their instructions from the brain on which muscle to move and then the electric stimulus to that muscle stimulates the muscle movement or "reflex" action.

There are three types of muscles. Skeletal muscles are the muscles that move your bones and other parts of your body, such as your eyes. They are voluntary muscles that operate on command from your brain. Smooth muscles work automatically. They are involuntary muscles, such as the muscles that control the movement of food in our stomach. They are found in the internal **organs** like the stomach, heart, and lungs. Cardiac muscle is muscle found only in the heart.

## MATERIALS

### Per class

1 meter stick

1 timer

1 roll of heavy string  
1 roll of masking tape

1 wide-mouth glass jar  
1 rubber band

### **Per group**

2 pieces of tagboard 16 cm x 5 cm  
scissors  
2 strips of elastic, each 15 cm long

1 brass fastener  
tape  
1 hole punch

### **ENGAGE**

1. Explain that there are some “rules” that our muscles must follow in order to function properly. They must only pull, they never push, and they always work in pairs. Set the scene by telling the class, *Look what happens when you bend your arm. To feel these muscles at work, straighten your right arm. Now put your left hand on your right upper arm and slowly bend your right arm. You will feel the biceps muscle contract, getting thicker as it does so.*
2. Tell the class: *Today you are going to take part in a Muscle Tug-o-War. You will play the roles of muscles and brain neurons. Do I have any volunteers?*

### **EXPLORE (Part 1)**

1. Cut a piece of string about 12 meters long.
2. Lay the string out on the floor and place the meter stick representing the bone directly in the center of the string in a vertical position.
3. Wrap about one meter of string around the top of the meter stick in one direction, and then wrap another one-meter length of string around the top of the meter stick going in the opposite direction. You should end up with the meter stick in the middle of the string with 5 meters of string hanging loose on both sides of the meter stick. (Note: If the string starts to pull loose, you may want to place a rubber band around the part of the string wrapped around the meter stick.)
4. Place the jar on the floor in the middle of the room or out in the hallway.
5. Ask for two student volunteers. Have one of the students line up approximately 5 meters from one side of the glass jar.
6. Have the other student line up the same distance on the opposite side of the jar so that he/she is facing the other student.
7. Tell each student to grasp an end of the yarn but caution them not to pull hard.
8. Choose another student to be the timer of this event.
9. Say to the students: *On the signal “go,” you will pull lightly on your yarn and see if you and your partner can guide the meter stick into the jar. You can do this only by pulling and working together. Try to complete this task in the least amount of time possible.*
10. Once students have completed the task and recorded their time on the board, let other student pairs play the role of muscles.

### **EXPLAIN (Part 1)**

1. After everyone has had a chance to participate in the activity, discuss:  
*In human body terms, what did the string represent? (tendons)*  
*What did the meter stick represent? (bone)*

What did the two students represent? (muscles)

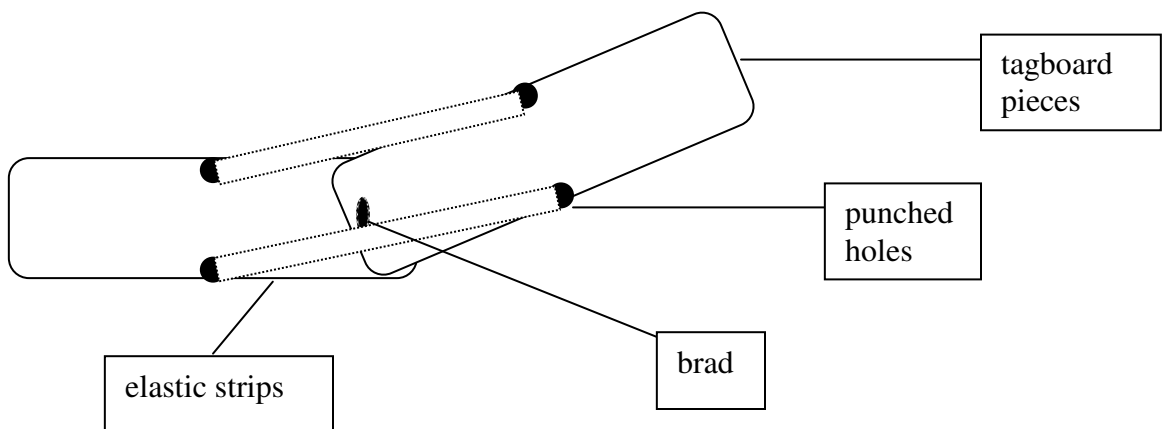
What did getting the stick into the jar represent? (doing work)

To perform this task successfully what did each muscle pair need to do? (Work in pairs and only pull, not push.)

2. Discuss with the class how all of these body parts - tendons, bones, and muscles - work together to allow the body to function as a smooth-running machine. (See Background Information.)

### **EXPLORE (Part 2)**

1. Have each student place his/her left hand over the biceps (the large muscle on the front of the upper arm) of the right arm while moving the right forearm up and down. Discuss how the biceps extends flat when the forearm is down. The same biceps seems to form a tight ball when the forearm is flexed upward toward the shoulder.
2. Ask: *If the biceps is the muscle that makes the forearm go upward, how does the forearm go downward?* Have students put the fingers of their right hand over the large triceps muscle at the back side of the upper arm. Now have them slowly move their forearms up and down with tension as if they were moving a heavy weight in their right hands. They should be able to feel some changes in the triceps muscle. It is needed to make the forearm go downward.
3. Have each group construct a model arm to help them understand how the bones and muscles work together. Begin by having students cut two pieces of tagboard, each about 16 cm x 5 cm. Round the corners.
4. Punch one hole in the center of the end of each tagboard piece and use a brass fastener to connect the two pieces, creating a *joint*.
5. Punch two holes in each piece of tagboard near the long edges about 8 cm from the ends.
6. Cut two strips of elastic each about 15 cm long. Push the elastic strips through the holes; each strip should go from a hole in one tagboard piece to the hole in the other tagboard piece.
7. Tie knots in the ends of the elastic strips or tape them to the tagboard to secure them.



8. The tagboard pieces represent the bones, and the elastic strips represent the muscles. The model arm has only two muscles while a real arm has many.
9. Watch what happens when you move the model arm. To pull the bones and make the arm bend, give a slight push. Then give a push in the opposite direction to make the arm straighten. For real muscles, the push is provided by the brain.

### **EXPLAIN (Part 2)**

*What do the tagboard pieces represent? (bones)*

*What do the elastic strips represent? (muscles)*

*Why does the model arm have at least two muscles? (Muscles work in teams, because they can move in only one direction; they only pull [contract]. One muscle contracts and pulls a bone to get you into a certain position. Then its partner must contract to pull the bone back and get you out of the position.)*

*What do muscles do for us? (move bones)*

### **EXTEND/APPLY**

1. Have a doctor/speaker from an orthopedic clinic make a presentation to the class. The speaker can share x-rays so students can get a closer look at bones/muscles.
2. Have students place one arm on the desk with the palm of the hand facing upward. Ask them to see how many times they can make a fist in 30 seconds, each time opening the hand completely and then forming a tight fist. Repeat the test several times. Ask: *Can you make the same number of fists each time? When does your arm begin to feel tired? (Your forearm muscles, which operate the fingers, are becoming fatigued. When a muscle becomes tired, fatigue occurs. The muscle may feel strained or it may not respond when you want it to.)*

### **ASSESSMENT**

Ask students to write in their science journals a short explanation of how muscles and bones work together and have them include drawings and terminology in their writing.