

## Muscular System Grades 3-5

### BACKGROUND

#### The Muscular System

Muscle makes up most of everything underneath the skin. This is the tissue that makes up the heart, body organs, and skeletal muscles. Muscle accounts for about half of the body's weight.

As humans, **our sense of well-being and ease in our bodies is determined in large measure by our "sense" of our muscles.** For instance, we may say we feel "stiff", "achy", or "tense" in our shoulders or back when we play or work those muscles too much. We think of our muscles as being "in shape" or "out of shape." When our muscles are soft and pliable we feel relaxed and at ease throughout our whole body. Our muscle tone and pliability has a lot to do with our overall outlook on life.

There are **three kinds** of muscle:

- 1. Smooth** – Found in the hollow walls of the body organs (colon, small intestine, rectum, etc.), the blood vessels, and the respiratory passageways.
- 2. Cardiac** - These are the muscles of the heart.
- 3. Skeletal** - These are the muscles that attach to bones and produce movement at the joints. Skeletal muscles attach on the rough places, protrusions, and hollows on the bones that students learned about in Grade 3: The Skeletal System.

There are about **600 skeletal muscles in the body.** Skeletal muscles alone make up about 40% of body weight. Muscles usually act in pairs or groups to accomplish movement.

**Muscles come in many shapes, sizes, and thicknesses.** The smallest muscles are in the middle ear. The largest muscle is the gluteus maximus that forms the buttock. Another unusual muscle is the diaphragm. This muscle is attached along the edge and inside of the ribcage. The diaphragm is the primary muscle for breathing.

**Muscular action** is categorized as **voluntary** (operates under *conscious* control) or **involuntary** (operates automatically, *without* conscious decision or direction.)

- **Smooth muscle and cardiac muscle are INVOLUNTARY.** These are the muscles, operating automatically, without conscious effort, that control the internal systems of the body—the digestive, circulatory, urinary, and reproductive systems. These muscles work "automatically" to keep us healthy even when we are asleep.
- **Skeletal muscle is VOLUNTARY,** because it operates under conscious control.

The **skeletal muscles have three main functions:**

- 1. Movement of the skeleton:** Muscles are attached to two bones that make up a joint. When the muscles contract, the joint moves. Muscles act in pairs or groups. (For example, when the biceps muscle on the front of the upper arm contracts, the elbow bends.) This movement is called "flexion." When the triceps muscle on the back of the upper arm contracts, the lower arm straightens. This movement is known as "extension." This is an example of how muscles work in pairs or groups to make a movement happen.
- 2. Maintenance of posture and support:** Muscles maintain the body upright in varying positions. Muscle tone, a consistent, slight contraction of muscle, maintains posture and position. The back, neck, and abdominal muscles are some of the muscles involved in maintaining posture.
- 3. Generation of heat:** This is an important job. Heat is a natural byproduct of muscle cell metabolism resulting from muscle movement. Muscles create most of the heat necessary to keep the body at 98.6 F.

**All muscle tissue (smooth, cardiac, and skeletal) features these four features characteristics:**

- 1. Contraction:** Muscles have the ability to contract or shorten, which allows movement to happen. A muscle can be shortened up to one third of its resting length. When muscles contract, they become thicker and feel harder or denser. For example, when the elbow is bent we can feel bulge of the biceps muscle on the upper arm. Muscles use energy in shortening and lengthening. Protein, glucose, calcium and oxygen all play a part in the energy cycle of muscle activity. That is why good nutrition and exercise are very important for good muscle health.
- 2. Extensibility** – Muscles can stretch beyond their normal resting length. This allows flexibility to the body and helps minimize injury and tears.
- 3. Elasticity-** This feature allows muscle to return to their normal length after being stretched or contracted.
- 4. Excitability** – Muscles are responsive to nerve stimulation. This is how muscle contraction is initiated and relaxed. This is a complex activity that is fine-tuned according to the command.

## BASIC LESSON

### Objective(s)

*Students will be able to...*

- define the **Muscular System**.
- identify three **functions** of the Muscular System; **movement, posture and support**, and heat generation.
- identify the two kinds of muscle action--**voluntary** and **involuntary**--and give an example of each.

### State Science Content Standard(s)

- 1.1: Develop abilities necessary to safely conduct scientific inquiry, including asking questions about objects, events, and organisms in the environment.
- Make observation using the five senses
  - Record observations by drawing or orally explaining
- 3.1: Identify that plants and animals have structures and systems that serve functions for growth, survival, and reproduction.
- List characteristics of living organisms (body systems

### Materials

### Safety

#### From the Kit

#### Provided by Teacher

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• Figure 1 – List of Muscle, organs and heart – Binder</li> <li>• Figure 2 – Types of Muscle Chart – Binder</li> <li>• Muscular System Chart</li> </ul> | <ul style="list-style-type: none"> <li>• Large Piece of Red Meat or Chicken wrapped in plastic</li> <li>• Craft Sticks (Dollar Tree)</li> <li>• Rubber Bands</li> <li>• Rubber Cement</li> <li>• Glue sticks</li> <li>• Tape</li> <li>• Clay</li> </ul> |
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- Wash hands after handling meat products.

### Key Vocabulary

### Mastery Questions

**Muscular System** - The body tissue that makes up the heart, body organs, and skeletal muscles.

**Contraction** – The shortening of skeletal muscle that allows movement to happen.

**Elasticity** – The quality that allows muscle to return to its normal length after being stretched or contracted.

**Flexion** - A muscle movement that brings two bones closer together. **Skeletal Muscle** - The type of muscle that is attached to bone. Skeletal muscle makes our bodies move.

**Smooth Muscle** – The type of muscle that makes up the hollow organs of the

- See Lessons

body such as the stomach, intestines, etc.

**Cardiac Muscle** –The type of muscle found in the heart.

**Nerves** – Special tissue that carries sensory and motor information throughout the body.

### Detailed Plan

#### Lesson 1: What is the Muscular System? What Does It Do? What Types of Muscle are in the Body?

##### Introduction

1. Show the students a large piece of chicken and/or red meat.
2. Ask: **“What is this?”** (Meat.)
3. Ask: **“Besides meat, what is this in the body?”** (Is it bone, fat...?) Write down predictions on scratch paper.
4. Once everyone has an answer, share responses.
5. Ask: **“Can we see the bone?”** (No.)  
Ask: **“How do we know this isn’t bone?”** (Color, hardness.) Ask: **“What do we think this is?”** (Muscle.)  
Ask: **“What do muscles do for our body?”** Why do we need it?

##### Exploration

- Give students a list of muscles, body organs, and the heart. **(See Figure 1)** Have the students cut out each word/body part and then group things that are alike together. Come together and share how they grouped things together.
- Now explain to the students that each part listed is a muscle. Some of these muscles move all the time without us telling them to. Other muscles we can control. We can tell those muscles when to move.
- Have the students group the muscles, organs, and heart again, this time according to muscles we control and muscles that we can’t control. Have the students share which muscles and organs they put in the “Voluntary” group and which ones they classified as “Involuntary.”

##### Explanation

An important function of muscle is movement. Muscle movement can be **voluntary or involuntary**.

**Voluntary** muscles operate under conscious control.

**Involuntary** muscles operate automatically without conscious decision or direction. These are the muscles that control the internal systems of the body—the digestive, circulatory (heart and blood vessels), and reproductive systems. These muscles work “automatically” to keep us healthy, even when we are asleep.

##### Expand

Ask: **“Why are some muscles voluntary and some involuntary? How are voluntary muscles helpful? How are involuntary muscles beneficial to us?”**

As you record student answers, it might be useful to organize the information on the board in a chart format such as the one below. Fill in the information in **bold black** print for the students, included in the “Action” column. Have them provide you with “Examples” of the involuntary and voluntary muscles, filling in the chart like the one below. Finally, have students list possible benefits. The red print are where student examples would be placed.

Types	Example	Action	Benefit
Smooth	Intestines Stomach Lungs	Involuntary	Allows you to digest your lunch while at school,

			and breathe while you're asleep.
Cardiac	Heart	Involuntary	Keeps heart beating when you're asleep.
Skeletal muscle	Muscles of the upper arm, back and leg	Voluntary	Helps you throw a baseball in the direction you want, bend over and touch your toes, or kick a soccer ball and score a goal.

Ask the students if they can name the **types** of muscles that are voluntary and involuntary. (There are three.) This most likely will be a new concept for the students. Try to get them to come up with the first category in the chart (types.)

- 1. Skeletal** – Ask students to think about where these muscles attach to bones, and to consider that when all the bones are put together we are looking at the skeleton (skeletal muscles.) These are the muscles that attach to bones and produce movement at the joints. Skeletal muscles attach on the rough places, protrusions, and hollows on the bones.
- 2. Cardiac** – Ask students what kind of muscle makes up the heart muscle. Explain that another word associated with the heart is cardiac, so cardiac muscles are the muscles of the heart.
- 3. Smooth** – Use the charts from the Kit (optional) for the Cardiovascular, Digestive, and Urinary Systems. Ask the students to examine the pictures of the stomach, intestines, and urinary tract and to explain what they think the surface of the muscle is like. Try to get them to come up with the word *smooth*. These smooth muscles are found in the hollow walls of the body organs (colon, small intestine, rectum, etc.), the blood vessels, and the respiratory passageways.

**Wrap up:** We've discovered that an important function of muscle is movement. There are two types of muscle: Voluntary and Involuntary muscles. We can move some muscles on our own, while others move all the time without our conscious intent. We also discovered that there are three types of muscles: Skeletal, Cardiac, and Smooth.

**📄 Interesting information about muscles to share with the students:**

- Muscle makes up the vast majority of everything underneath the skin.
- Muscles account for about **half** of a person's total body weight. Connect to math – have students weigh themselves and determine what that half amounts to for each of them.
- There are about **600 skeletal muscles in the body.**
- **Muscles come in many shapes, sizes, and thicknesses.**
- The **smallest** muscles are in the **middle ear.**
- The **largest** is the **gluteus maximus** muscle that forms the buttock.
- There is a very interesting muscle called the **diaphragm**. This muscle is attached along the edge and inside of the ribcage. The diaphragm is the **primary muscle for breathing.**
- While most muscles attach to bones, the muscles in your face are attached to the skin. Facial muscles are the muscles that put a smile on your face when you are laughing, or wrinkle your brow when you are puzzled.

**Assessment**

Have students fill in a chart like the one above. **(See Figure 2 – makes two charts)** They must name the three kinds of

muscles, give examples of each, and determine whether it is voluntary or involuntary.

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## Lesson 2: Posture and Support

### Introduction

Have the students analyze an experience with posture and support in their own bodies. Have each student take a piece of paper and draw a line across the top of the paper. Divide the paper into four columns, with the line dividing the second and third columns being darker. Label the first and third columns "Description," and second and fourth columns "Observation."

1. Ask the students to notice their posture exactly as they are sitting right now. *Without moving*, have them *describe* their posture. Ask: **"How are you sitting? Are you leaning? Are you slouched down in your chair/desk? OBSERVE: How does your back feel? Your shoulders? Your neck? What muscles are you feeling the most right now? Observe how the muscles feel. How are you breathing? Notice if you feel tense, achy, or at ease. Where are you feeling that in your body?"** Have students write their description and observations in the first and second columns.
2. Ask the students to move themselves to a position that gives their body more support. You can give the students the following **cues** to guide them in changing their posture:
  - Place both feet on the floor.
  - Straighten your spine.
  - Arrange your shoulders so they feel as if they are over your hips and **not** leaning forward, backward, or to the side.
  - Drop your chin just a little.
  - Take a breath, letting your shoulders drop.
  - Lift the top of your head towards the ceiling, taking an easy, soft and full breath IN, followed by a slow breath OUT.
3. Ask the students to notice how they are feeling now. Say: **"Observe: How do your back, shoulders, and neck feel? What muscles are you feeling the most right now? Observe how the muscles feel. How are you breathing? Notice if you feel tense or achy. Where are you feeling at ease in your body?"** Have students write their description and observations in the third and fourth columns.
4. Ask the students to say why they think they felt differently in the two postures. What was happening with their muscles and their skeleton between the first posture and the second posture?

### Exploration

A second important function of the Skeletal Muscles is maintaining **POSTURE** and **SUPPORT**. Try this experiment:

1. Have students build a skeleton. Dividing into smaller groups, give each group a pail with sticks or tongue depressors. Tell the students they need to build a skeleton that is able to stand erect. Ask: **"What do you think the sticks represent?" (Bones.)**
2. Let the students begin building. Right away the students will notice a problem: There is no way to get their skeleton to stand up. When they ask to use glue or tape, tell them they can **only** use the sticks. When they recognize that it's not possible to build a skeleton this way, have one group share why that is impossible and what they need to make it possible.
3. Ask: **"What do our bones need so we can maintain posture and support?" (Muscles.)** Now give each group one kind of connecting material such as tape, rubber cement, glue stick, and rubber bands (which the group can cut). Each group should be given only **one** type of connecting material and each group should have a **different** kind of connecting material from that of the other groups.
4. Tell students the connecting materials represent muscles. Have each group construct a skeleton with the sticks

and connecting material. Clarify for the students the number of sticks they should use for their skeleton:

- Feet (two – one broken in two)
- Legs (two for each side)
- Hips (one)
- Spine (one)
- Ribs (no ribs)
- Shoulders (two)
- Arms (two for each side)
- Head (one)

5. After each group has completed their skeleton, have them present it to the class. Ask each group to demonstrate their skeleton bending over *and* bending the leg or arm. Many will discover that they can't do this or the skeleton will break. Discuss the reasons for this. Save the rubber band group for last. That group should be able to bend the skeleton over and back. What does this illustrate? (Muscles are elastic; they move the body and they maintain posture.)

### Explanation

Show how the posture is maintained. As you bend the whole body over it stays connected; it doesn't fall apart. Explain that **muscles hold the body together** as you move. Next, consider what would happen if you *didn't* have muscles. When you bent over or bent a joint, the skeleton would not move and would probably fall apart. Ask: **"From this, what can we conclude?"** (*That muscles help us move and maintain posture/support.*) Reinforce the notion that **the muscles of the back, shoulder, chest, neck and abdomen are some of the muscles involved in posture.**

Use the Muscle Chart to show the muscles of back, neck and abdomen. Use a skeleton model (optional--from Kit, or if available) to show students the bony structure under the muscles. In particular, point out the vertebrae of the spine, which includes very small muscles that extend from one vertebra to the next. These tiny muscles allow the spine to bend and turn to the left or right. Note: since these muscles are located under the large muscles of the back, they are difficult to touch.

Have students experience *in their own bodies* the support of the back muscles as well as the mobility of the spine:

1. Ask students to stand up.
2. Have students place their feet about soccer ball-width apart.
3. Direct the students to slowly begin bending over by letting their head fall forward while their arms hang at their sides.
4. Have students slowly continue moving the head towards the floor, letting the arms hang loose.
5. The purpose of this bending motion is **not** to touch the floor. The purpose is to go as far **towards the floor** as is comfortable for the student.
6. Ask the students to notice that they are still standing while bent over. They have not fallen because the muscles of the back and the legs are working to support the body.
7. Now ask the students to slowly rise up. Ask them to imagine that they are **slowly re-stacking their vertebrae**, like building blocks, one at a time from the bottom (at the hips), through the lower back and upper back, the shoulders and the neck, finally balancing the head on top of the spine.
8. As they slowly return to a standing position, direct the students to focus all their attention on the muscles in their back and *feel* how those muscles work to bring them from the bent-over position back to the standing position.
9. Ask students to **describe how their muscles felt**. Briefly demonstrate, using the Muscle Chart and Skeleton to emphasize the vertebrae and the muscles the students used for support and posture in this experience.

**(NOTE: It may be beneficial to have the students think back to just the bones of the skeleton. Ask: "If the skeleton were in pieces and we put it back together, could it stand and move on its own? If we wanted the skeleton to**

***bend over, what would happen? What does the skeleton need to move? What does the skeleton need for posture and support?”)***

### **Assessment**

Have students identify muscle groups on the body that are used mostly for **support and posture** (muscles of the back, neck and hip) and muscles used mostly for **movement** (muscles of the arms, legs, hands and feet) using the Muscle Child graphic diagram. (See Figure 3) On the diagram have them identify those muscles used for movement and those used for support using the words **movement** and **support**.

**Writing Activity:** Have students write a short paragraph on one or both of the following topics...

- “If I didn’t have leg muscles . . .”
- “If I didn’t have back muscles . . .”

**Optional Enrichment Activity: Today I Feel . . . Journal** 1. Ask students to create a journal page in their notebook.

2. Divide the page into three columns:
3. Begin entries with the **Date**, then: “**Today I feel . . .**” and “**My muscles feel . . .**”
4. Ask the students to spend **five minutes a day** doing this exercise. If possible, they should remain quiet and by themselves. Have students close their eyes, then ask: “**Today, I feel . . .**” and write their response in the second column. Finally have them ask: “**My muscles feel . . .**” and write their responses in the third column.
5. **Class Discussion:** Ask students to share what they have learned from keeping this journal for a week. Use their answers to discuss how we feel when our muscles feel good and how we feel when our muscles feel bad.
6. Have students suggest **actions** they could take **to help their muscles feel better**. (Possible answers: drink more water, take a walk, stretch, use better posture, get more sleep, eat a piece of fruit instead of junk food.) Next, have students suggest actions they could take to feel better *emotionally*. (Possible answers: write in their journal, talk to a good friend, draw a picture.)

## **Lesson 3: Muscle Movement Generates Heat**

### **Introduction**

- As a practical experience of muscle movement generating heat, have students stand and do big arm circles (like a windmill) at a very fast pace. (Be sure there is enough space between each student for the arms to move without hitting anyone.) In order to compare and contrast results, have some students **do a few arm circles slowly**, while others do **many circles very quickly**.
- Or, have students form a big circle and slowly begin walking around the room two or three times. As you complete the final slow circle, ask the students to notice their body and any sensation of warmth they feel. Then have the students walk very quickly around the room for three-four minutes. During the final fast circle ask the students to check their body’s sensations of warmth again. Have them compare the sensation of warmth they feel now with the one they felt following the slow circle walk.
- At the end have the students share their experience. Ask: “**What happened? How do you feel?**”

### **Exploration**

- Start by showing students how muscles are striated. Draw a muscle on the board and discuss how muscles are made up of many small fibers. These fibers band together into larger and larger groups of fibers to create a complete muscle. Use muscular system chart to further demonstrate this.
- Arrange students in pairs. Explain that each pair will *become* a muscle together by stacking their hands on top of each other’s. This is an example of a muscle (their hands are like the bands of fibers that make up the whole muscle.)

Now have students rub their hands together for about 30 seconds. Ask: **“What happened?”** (Hands became hot.) **“Why? If muscles are layered the same way, what happens to muscles when we move?”** (The muscles are moving/rubbing back and forth.) **“What does that do?”** (It creates heat.) **“So what can we say our muscles do for us?”** (They create heat.)

### **Explanation**

Ask: **“How does your body feel after you play soccer or basketball for a while? Tired? Out of breath? What else?”** (Try to draw out the response that the body will feel WARM.) **“What causes this?”**

Help students understand the following concepts:

- Heat is a natural by-product of muscle movement.
- Muscles use energy during the process of shortening and lengthening.
- Protein, glucose, calcium and oxygen all play a part in the energy cycle of muscle activity. All are necessary to keep our muscles healthy.
- Good nutrition and exercise are very important for good muscle health.
- Muscles create most of the heat necessary to maintain body temperature at 98.6 F.

### **Activity**

Write a short story about being a muscle. Assign students different muscles. Pretend you are a muscle. What is around you? How often do you work? What happens when you move a lot? What happens when you don't move very often? (You may have students do this individually or you may choose to do this activity as a large group.)

### **Assessment**

Use the Extend section as an assessment.

## **Assessment**

See Lessons

## **Resources**

- ❖ Healer Within <http://www.healerwithin.org>

## **EXPLORE MORE**

### **Enrichment Activity: Cardboard and Clay Muscle Chart**

Have students work in teams of three or four to “build” a cardboard and pliable clay muscle chart.

1. Use a piece 12” x 18” cardboard for each student.
2. Have the students draw the two outlines of themselves (front and back) on the same side of the cardboard. Tell the students they are going to make a three-dimensional muscle chart.
3. Have them look at the Muscle Chart (from the kit) and decide which muscles they are going to include on their chart. (Remind students that on the front of the body the “other” muscles (the heart, intestines) could be shown.
4. Have them use clay to make three-dimensional models of the muscles and assemble them on the cardboard outline.
5. By each muscle the students should write:
  - a) the name of muscle
  - b) a movement that the muscle performs
6. Have the students do research about their muscles to see if they can find out one interesting piece of

information about each muscle on the chart. (This could be about the shape of the muscle, how it got its name, etc.) They can find information in the school or city library's anatomy books, classroom resource material, encyclopedias, the Internet, etc.

7. Have each group present their muscle chart to the class.