What Is This Module About?

In Part 1 of the module on the muscular system, you learned about the many functions of the muscles of the human body. The muscular system's primary task is to enable us to move both our external body parts and internal organs. These movements are made possible by the muscles' ability to contract. There are two major groups of muscles in the body, the voluntary skeletal muscles and the involuntary muscles of the heart and internal organs such as the stomach and intestines. You also learned about the role of the muscles in protecting the body and providing heat so that the organ systems can function properly. You discovered how important muscles are for survival.

But have you ever wondered how your muscles accomplish all these? What causes the muscles to contract and thereby move parts of the body?

This module shall tell you more about the muscular system. You will learn about the processes that are responsible for making them move. You will discover more about the different types of muscles and how they operate. You shall also find out some of the injuries and diseases that can harm the muscular system and how to best take care of it.

This module is made up of two lessons:

Lesson 1 – *The Muscle Tissue*

Lesson 2 – *Common Injuries and Diseases of the Muscular System*

What Will You Learn From This Module?

After studying this module, you should be able to:

- explain the two properties of muscle tissues;
- identify and describe the different types of muscles found in the human body;
- enumerate some injuries and diseases that can affect the human muscular system;
- demonstrate first-aid treatment for injuries to the muscular system; and
- cite ways to best take care of the muscular system.

Let's See What You Already Know

To find out what you already know about the topics to be discussed in this module, answer the questions below.

1. Enumerate the three major types of muscle tissues.

   a. _____

   b. _____

   c. _____

2. What is the basic contractible unit of muscles?

   _____

3. What makes cardiac muscles different from skeletal and smooth muscles?

   _____

4. State three injuries or diseases that can affect the muscular system.

   a. _____

   b. _____

   c. _____

5. Cite two ways to take good care of the muscles of your body.

   a. _____

   b. _____

Well, how was it? Do you think you fared well? Compare your answers with those in the *Answer Key* on page 28.

If all your answers are correct, very good! This shows that you already know much about the topic. You may still study the module to review what you already know. Who knows, you might learn a few more new things as well.

If you got a low score, don't feel bad. This means that this module is for you. It will help you understand important concepts that you can apply in your daily life. If you study this module carefully, you will learn the answers to all the items in the test and a lot more. Are you ready?

You may go now to the next page to begin Lesson 1.

LESSON 1

The Muscle Tissue

In the previous module, you learned about the structure and organization of the muscular system. You also learned about the differences between voluntary and involuntary muscles. To make you understand better what makes muscles function so well, this lesson shall introduce you to the characteristics and properties of muscle tissues. You shall study the more detailed structure of the different types of muscle tissues. You will learn what gives muscles their special ability to contract which enables you to stand erect, walk and perform functions vital for survival such as breathing and digesting food.

Think of this lesson as looking closer at the muscles of your body. Knowing how individual muscles work will give you an idea of how the entire muscular system functions. Are you ready to learn more?

Let's Try This

Do you know what a muscle looks like? If you haven't seen one yet, then do this simple activity. Go to the nearest wet market in your community. Observe the beef or pork being sold there. The flesh attached to the bone of the animal are muscles.

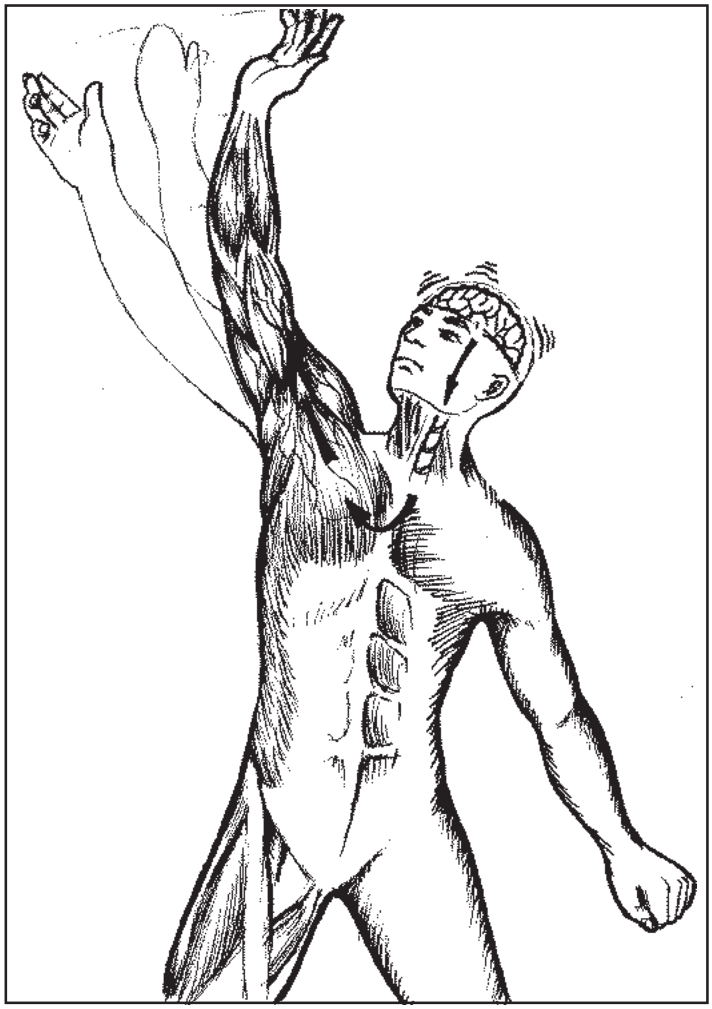
Draw what you saw in the box below.

Let's Learn

Did you know that your body has about 650 muscles? Your muscles make up about one-half of your body weight. Hence, if you weigh 50 kilograms, about 25 kilograms of you is pure muscle!

Muscles are made up of fibers that have two very special properties. The first is **excitability.** This refers to the muscles' ability to respond to electrical signals provided by the nerves of the nervous system. These electrical signals "excite" muscles. When a muscle group receives signals from the nervous system through **efferent nerves** (nerves which bring signals from the brain to the body), changes occur in the muscle group. This leads you to the second property of muscles which is **contraction.** This enables the body to make both internal and external movements. Contraction involves shortening of the muscle fibers. In skeletal muscles, this shortening of fibers brings bones together and allows actions to occur.

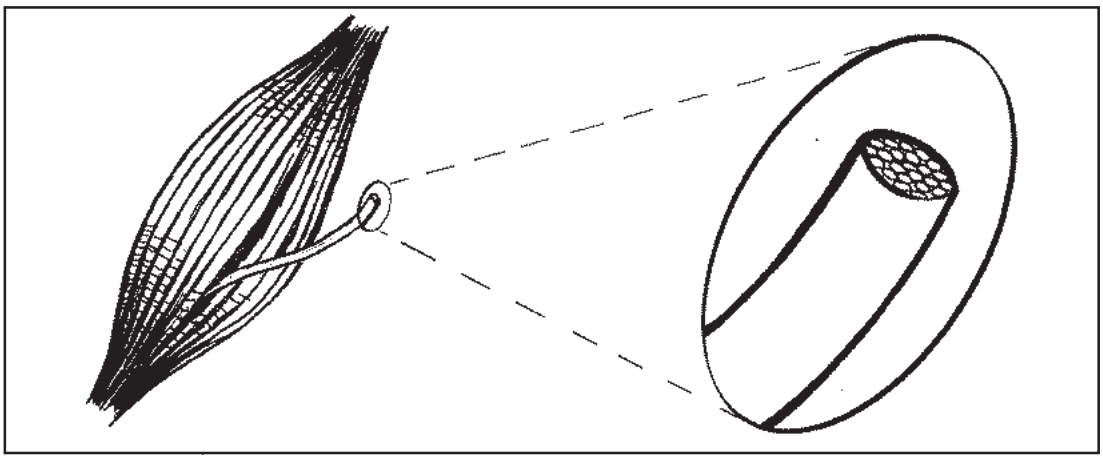
The drawing below shows you how a signal from the brain reaches the excitable muscle causing it to contract and move.



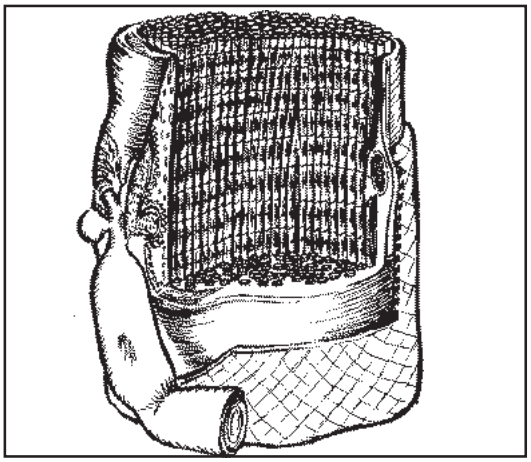
Muscles are generally divided into two types: voluntary and involuntary. **Voluntary muscles** are muscles that are under conscious control and produce voluntary movements by pulling against the bones of the skeleton to which they are attached by means of tendons. The **skeletal muscles,** or the muscles attached to bones, comprise this group. Voluntary skeletal muscles allow you to stand erect and engage in various activities. In terms of performance, they are like high-speed engines. They work fast and powerfully but easily get tired because of the high amounts of energy needed to make them move.

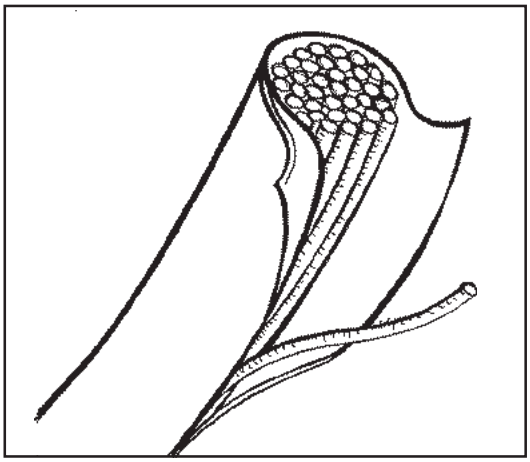
Skeletal muscles are also called ***striated*** *(striped)* ***muscles*** because if seen under a microscope, their individual fibers are visible.

Cross section of a striated muscle showing its individual fibers



Skeletal muscle cells are cylindrical in shape. They are also very long. Think of them as ropes made of abaca fibers. If you look closely at them, you will see that they are composed of individual fibers packed together.

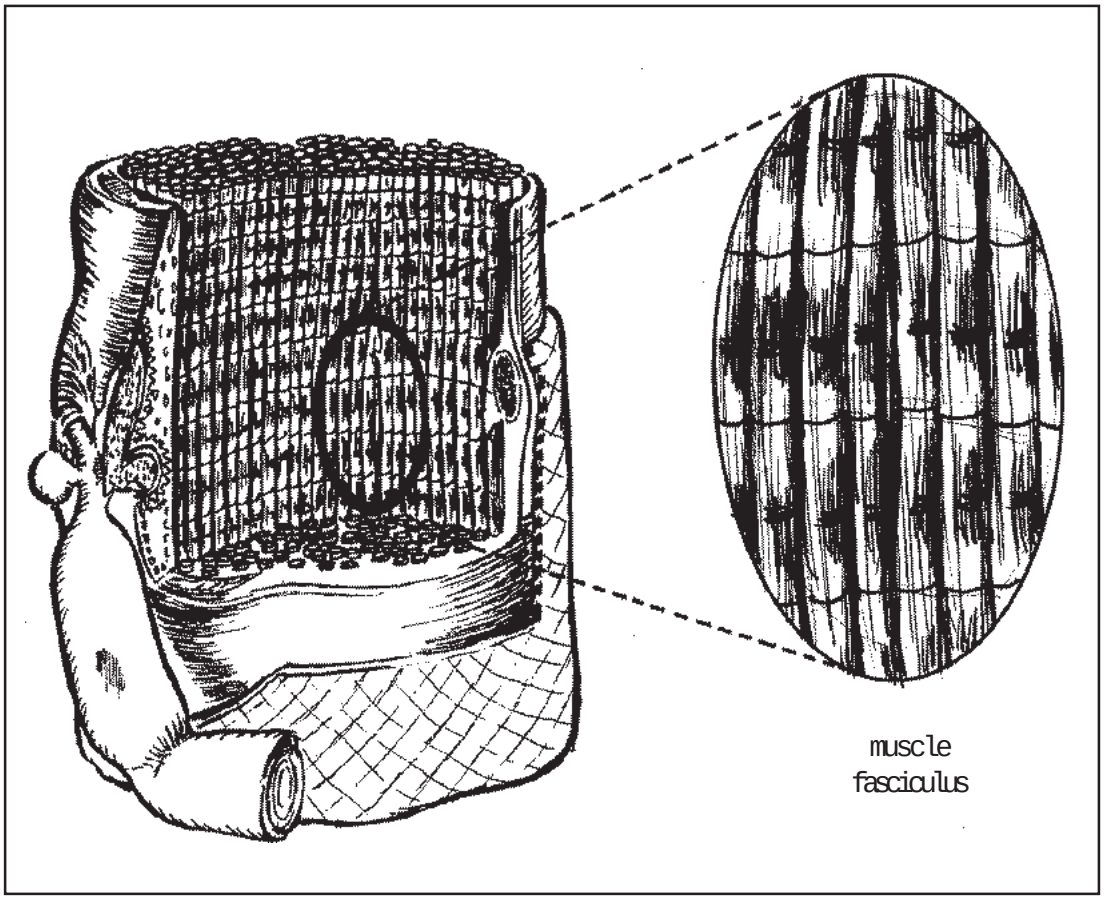




Each individual fiber in a bundle is called a **myofibril.** A group of myofibrils when enclosed in a membrane is called a **sarcolemma.** The word **sarco** means "flesh" in Latin.

If you look at a myofibril under a microscope, you will see alternating dark and light bands on it which are responsible for the characteristic appearance of the skeletal muscle. The dark bands are called **A bands** and the light bands are called **I bands.** The light bands have thin lines traveling through the center of a myofibril called **Z lines.** The area between two Z lines is called a **sarcomere,** the contractile unit of the myofibril.

Study the drawing of a section of a myofibril below. Note how sarcomeres are formed by the Z lines in each myofibril. Notice how myofibrils are packed together as a single unit inside the sarcolemma, called a **muscle fiber.** Also take note of how muscle fibers are packed together in bundles to form **muscle fasciculi** (plural of fasciculus). Groups of muscle fasciculi in turn compose a muscle.



To remember the arrangement of muscle components, follow the diagram below.

A bands (dark bands) and I bands (light bands)

↓

Sarcomere

↓

Myofibril

↓

Sarcolemma

↓

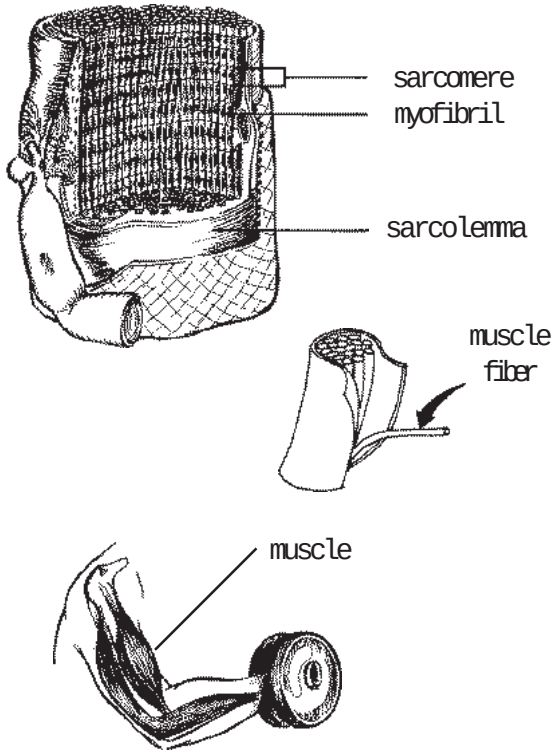
Muscle fiber

↓

Muscle fasciculus

↓

Muscle



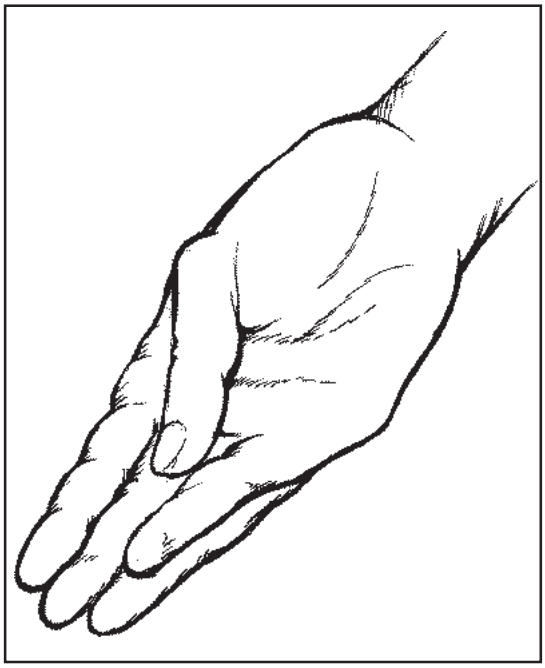
If you are confused at this point, don't worry. You may go back to the previous drawing to understand the organization of each muscle fiber. The basic pattern of muscle component movement is from the smallest to the biggest unit.

Movement is achieved through a complex series of protein interactions inside each **sarcomere,** the basic contractible unit of a muscle. When muscles get excited, the signals reach the sarcomeres whose structures glide past each other through a complex but very fast process. This gliding causes myofibrils and hence muscles to shorten in length and therefore contract.

This gliding, shortening and then elongating again all happen so fast without our knowledge. The process is automatic.

Let's Try This

Position your hands as shown in the following illustrations alternately. Move your fingers toward and away from each other. This process is of course very simple but this shows you how sarcomeres work. These small movements are added up to form the big movements that the skeletal muscles are capable of doing.



The skeletal muscles are highly vascular. This means they are rich in blood supply needed for the fast, powerful movements of the body.

Let's Review

Write the letter of the description in Column B that matches the word or phrase in Column A .

Column A	Column B
_____1. Voluntary muscle	a. basic contractible unit of the muscular system
_____2. Striated	b. rich in blood supply
_____3. Muscle fasciculus	c. muscle movement
_____4. I band	d. skeletal muscle cell
_____5. Contraction	e. dark band
_____6. Sarcolemma	f. muscle bundle

_____7. Sarcomere	g. comprised mostly of skeletal muscles
_____8. A band	h. light band
_____9. Vascular	i. striped in appearance
____10. Myofibril	j. covering membrane of myofibrils

Compare your answers with those in the *Answer Key* on page 29. If you got a score of 6 or higher, congratulations! You did great! You have learned a lot but you still need to review the parts you missed.

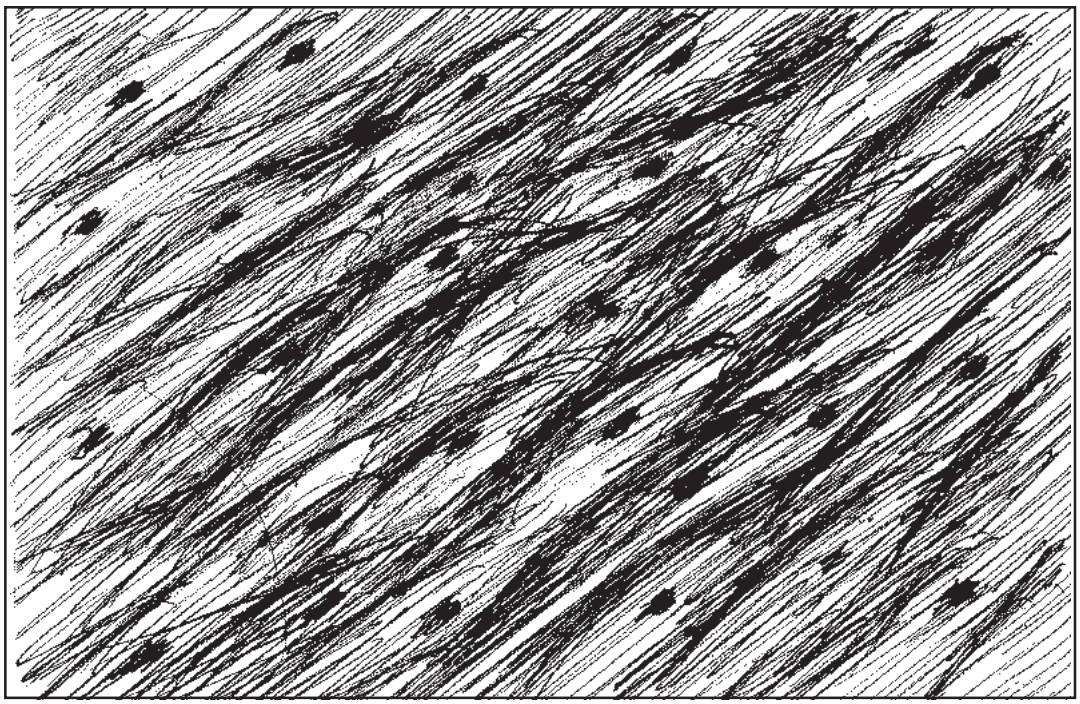
If you got a score of 5 or below, though, review the entire lesson. After doing so can you proceed to the next part.

Let's Learn

You have just learned about the voluntary muscles and how they make movement possible. This time, you will learn about the involuntary muscles.

Involuntary muscles are the muscles that are not under conscious control. They are also called **smooth muscles.**

The smooth muscles can be found in hollow **viscera** or internal organs such as the stomach, intestines, bladder, uterus, walls of the blood vessels, glands and even skin.



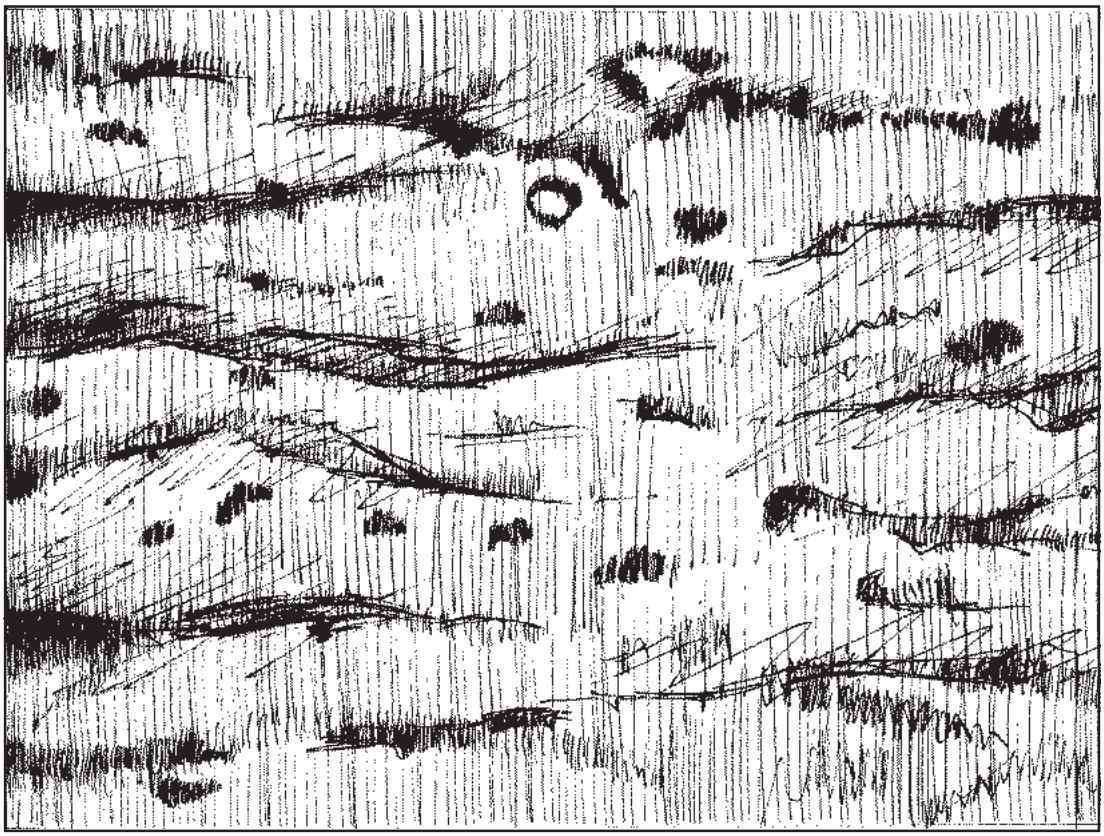
The smooth muscles are distinguished from the skeletal muscles because they do not appear striated when seen under a microscope. Internal organs need to create sustained, prolonged movements that are less powerful and thus have no need for striations except for the heart. These are required in **peristalsis,** a wavelike movement of muscles in the gastrointestinal tract.

The only muscle that is striated is the heart. The heart pumps blood throughout the body 24 hours a day, seven days a week without fail. Since it is an involuntary muscle it continues to work even without conscious control. It beats without your knowledge. There are times when your heart would beat continuously even faster than usual. But most of the time, it beats regularly.

Why do you think the heart is the only involuntary muscle that is striated? This is because it needs all the power it can get to pump blood throughout the body. The muscles of the heart are called **cardiac muscles.**

So what differentiates cardiac muscles from skeletal muscles? Instead of A bands, the dark stripes in cardiac muscle fibers are called **intercalated disks.** These disks mark the points of strong adhesion between the cells of the cardiac muscles which must withstand strong pressures during contraction.

The cardiac muscle showing the intercalated disks when viewed under a microscope



Let's Review

Write a three-sentence response to each of the questions below.

1. Why are cardiac muscles striated like skeletal muscles?

   _____

   _____

   _____

2. Why are the muscles of the internal organs such as the intestines called smooth muscles?

   _____

   _____

   _____

Compare your answers with those in the *Answer Key* on page 29. If you answered both questions correctly, good work! You learned a lot about the involuntary muscles of the human body. If you were able to answer only one or none of the questions, go back to the parts of the lesson you did not understand first before proceeding to the next part of the module.

Let's See What You Have Learned

Answer the following questions briefly.

1. What are the two general classifications of muscles? Differentiate one from the other.

   _____

   _____

   _____

   _____

2. Why are voluntary muscles striated? Explain your answer.

   _____

   _____

   _____

   _____

3. How are cardiac muscles similar to skeletal muscles? How are they different? Explain your answers.

_____
_____
_____
_____

4. Why are cardiac muscles, though involuntary, striated? Explain your answer.

_____
_____
_____
_____

Compare your answers with those in the *Answer Key* on page 29. Did you get a perfect score? If you did, that's very good. You can now proceed to the next lesson. If you didn't, don't worry. Just review the parts you missed before going to Lesson 2.

Let's Remember

- There are three kinds of muscle tissues: the skeletal, smooth and cardiac muscles.
  - **Skeletal muscles** are voluntary muscles. They appear striated when seen under a microscope because of the bands of alternating shades in their sarcomeres which allow fast, powerful movements to occur.
  - **Smooth muscles** are generally involuntary and lack the striated appearance when seen under a microscope except for the cardiac muscles. They allow prolonged, steady but less powerful movements to occur inside internal organs.
  - **Cardiac muscles** though involuntary appear striated to allow powerful movements needed to pump blood throughout the body.

Common Injuries and Diseases of the Muscular System

Have you ever sat in an uncomfortable position for a long time? What happened afterward? Did you feel a bit numbed? Was it difficult to move? If you felt this way before, then you have experienced **muscle cramps.** Cramps are caused by decreased blood supply to certain muscle groups which lead to accumulation of lactic acid inside them. When you have cramps, you experience numbness, pain and tingling sensations and become unable to move. Do you have cramps often? What should you do when you get muscle cramps?

In the previous module, you learned about the structure and functions of the different parts of the muscular system. You already have an idea of how important your muscular system is in making the parts of your body move and your internal organs function well. Although your muscles are generally tough and strong because of their fibrous nature, they are still prone to a lot of injuries and diseases.

This lesson shall let you know about some of them. It will also teach you how to take care of your muscular system so it will stay healthy and function well.

Let's Try This

Try your best not to move for about five minutes. Avoid any form of movement. Stay in one position for the entire duration. How did you feel afterward? Do you now realize how important movement is to you as a human being? What do you think would happen if your heart stopped, if your diaphragm became paralyzed or if your intestines stopped working? Would you still be able to live?

Let's Learn

The muscular system, tough as it is, is still prone to diseases. It needs to be taken care of too! The following are some of these injuries and diseases.

Muscle Strain

A **muscle strain** is a tear or stretch in the muscle fiber or the tendon that connects a muscle to a bone. It can range from a relatively mild injury, with some muscle fibers being torn, to a large muscle tear with swelling and bleeding.

Muscle strains are usually caused by:

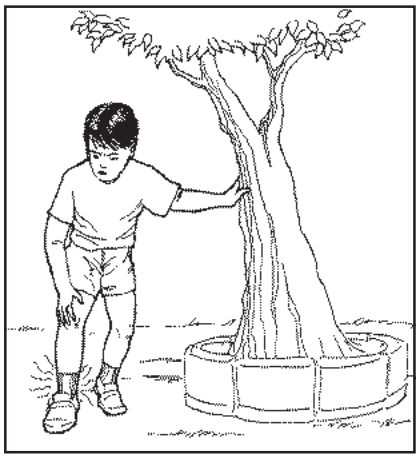
1. **Muscular imbalance** – This occurs when one side of the joint is stronger than the other or the opposite muscle does not relax while the other contracts. This can be traced in most cases to either a lack of conditioning or overtraining one muscle group versus an opposing muscle group, e.g., the front of the thighs (quadriceps) versus the back of the thighs (hamstrings).
2. **Muscle fatigue** – This occurs when additional stress is put on a muscle and its connective tissue.

The more active a person is, the greater his/her risk of injury. Poorly conditioned people are also at risk when they do strenuous activities without proper preconditioning.

The following are the signs/symptoms of muscle strain:

1. pain in a muscle group or joint;
2. swelling of a muscle group or joint; and
3. tenderness in a muscle group or joint.

You were running when suddenly you tripped on a rock.



You did not fall but you suddenly felt a very painful sensation near the side of your right ankle. What are you going to do?

Have you ever experienced having muscle strain? What did you do when this happened? The following are some first-aid tips when you experience muscle strain:

1. Reduce your activities. Avoid movements that place stress on the injured area.
2. Apply a cold compress or some ice on the injured area. Do this for 24 to 48 hours after the injury.
3. You may try applying a hot compress or an analgesic balm on the injured area on the third day or as soon as the swelling is gone.
4. Apply an elastic bandage to the injured area.
5. Elevate the injured area for 24 to 48 hours depending on the severity of the injury.
6. Taking in aspirin may also help reduce the pain and inflammation. Just be sure to use it as directed.
7. Try slow gentle stretches. Avoid stretching for a few days if the injury is severe; do movements that promote circulation instead, e.g., slow walking, gentle arm rotation exercises, etc.
8. Be sure to properly condition your body first before doing strenuous activities next time.
9. Strengthen major muscle groups with weight training.
10. Consult a doctor if:
    a. there is excessive swelling, bruising and/or tenderness in the injured area;
    b. the pain prevents you from moving.

Muscle Spasms or Cramps

After standing for a long time, Ana, a saleslady in a shoe store, felt her legs becoming numb and painful. She felt a pricking sensation like needles were being pinned on her legs. What's happening to Ana?

Muscle spasms or **cramps** are contractions of the muscles which are often painful. **Muscle twitching** is the result of minor local muscle contractions or the uncontrollable twitching of a single muscle group served by a single motor nerve fiber or filament.

Muscle spasms or cramps are commonly caused by:

1. muscle fatigue;
2. heavy exercise;
3. dehydration; and
4. pregnancy.

Muscle twitching can be caused by:

1. a **benign** (of a mild form), **nonpathologic** (not caused by disease or disorders) **fasciculation** which:
    a. often affects the eyelids, calf or thumb; and
    b. is normal or common and is often triggered by stress and anxiety;
2. a diet deficiency;
3. drug overdose; and
4. a side effect of taking in drugs such as **diuretics** (drugs that increase the volume of urine produced and excreted), **corticosteroids** (steroid hormones) and **estrogens** (steroid hormones, produced mainly by the ovaries, that control the growth and functioning of the female sex organs and the appearance of female secondary sexual characteristics).

Muscle cramps most often occur in the foot or calf muscles. Muscle twitches are minor and often go unnoticed. Some are common and normal while others indicate a neurologic disorder. The following are some first-aid treatments for muscle cramps:

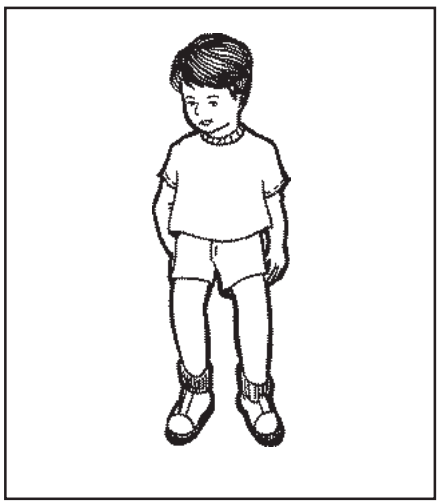
1. slow stretching exercises;
2. following prescribed therapy; and
3. taking in prescribed **analgesics** or pain relievers.

But you should consult your doctor if:

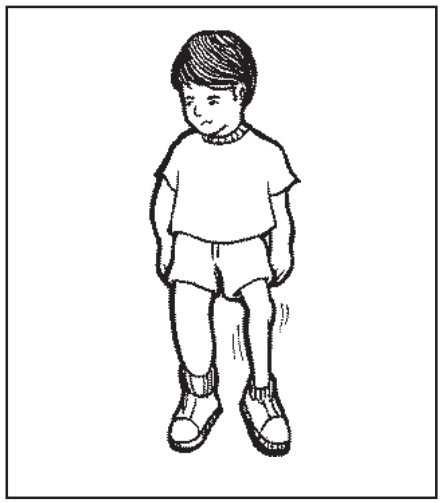
1. there are severe, prolonged or recurring muscle spasms or cramps that are unexplained or that aren't relieved by simple stretching exercises; and
2. there are prolonged or persistent muscle twitches that are unexplained.

Poliomyelitis

Poliomyelitis or what is commonly known as polio is a disorder caused by a viral infection (poliovirus) that affects the whole body including muscles and nerves. Severe cases may cause permanent paralysis or even death. It is usually manifested by loss of muscle tone and bulk. People with polio usually have unequally sized legs which cause impaired movement. Polio has a vaccine but is very hard to treat when already present in one's body.



A child without polio



A child with polio

Poliomyelitis is a communicable disease caused by infection with the poliovirus. Transmission of the virus occurs by direct person-to-person contact, by contact with infected secretions from the nose or mouth or by contact with infected feces. The virus enters through the mouth and nose, multiplies in the throat and intestinal tract and then is absorbed and spread through the blood and lymph system. Incubation ranges from five to 35 days (average of seven to 14 days).

There are three basic patterns of polio infection:

1. **Subclinical infections** – These are infections that may go unnoticed. These have no symptoms or if they do, the symptoms last for only 72 hours or less. These said symptoms include:

    a. slight fever;

    b. headache;

    c. **malaise** (general discomfort or uneasiness);

    d. sore throat; and

    e. vomiting.

2. **Nonparalytic poliomyelitis** – This may occur after recovery from a subclinical infection. Its symptoms may last for one to two weeks. These include:

    a. moderate fever;

    b. headache;

    c. stiff neck;

    d. vomiting;

    e. diarrhea;

    f. **fatigue** or excessive tiredness;

    g. irritability;

    h. pain or stiffness of the back, arms, legs and abdomen;

    i. muscle tenderness and spasm in any area of the body;

    j. neck pain;

    k. back pain;

    l. leg pain (especially in the calf muscles); and

    m. painful skin rash or lesion.

3. **Paralytic poliomyelitis** – This may occur after recovery from subclinical infections. Its symptoms include:

    a. fever, occurring five to seven days before the other symptoms;
    b. headache;
    c. stiff neck and back;
    d. muscle weakness characterized by rapid onset which can progress to paralysis depending on where it affects the spinal cord;
    e. abnormal sensations of an area;
    f. oversensitivity to touch;
    g. difficulty in urinating;
    h. constipation;
    i. bloated abdomen;
    j. difficulty in swallowing;
    k. muscle pain;
    l. muscle contractions or spasms particularly in the calf, neck or back;
    m. drooling;
    n. difficulty in breathing;
    o. irritability; and
    p. positive **Babinski's reflex** (a reflex where the great toe flexes toward the top of the foot and the other toes fan out when the sole of the foot is firmly stroked; normal in children but abnormal after about two years of age).

The occurrence of polio may be prevented by **polio immunization** (vaccine). But if it has already taken effect, treatment can still be undertaken. The goal of treatment is to control symptoms while the infection runs its course. Lifesaving measures, particularly assistance with breathing, may be necessary in severe cases. Symptoms are treated according to their presence and severity. Antibiotics may be used to treat urinary tract infections. Medications such as **bethanecol** (may reduce urinary retention), analgesics (may reduce headache, muscle pain and spasms) and narcotics which are not usually given because they increase the risk of breathing difficulty. Moist heat (heating pads, warm towels, etc.) may also reduce muscle pain and spasms. Physical therapy, braces or corrective shoes, orthopedic surgery or similar interventions may eventually be necessary though to maximize the recovery of muscle strength and function.

The following are some of the complications that may develop from polio:

1. spread of infection to other non-immune people;
2. permanent muscle paralysis, disability or deformity;
3. **pulmonary edema** (a condition characterized by fluid accumulation in the lungs caused by back pressure in the lung veins);
4. shock;
5. complications of immobility and respiratory involvement such as:
    a. **aspiration pneumonia** (an inflamation of the lungs caused by an infection which causes difficulty in breathing);
    b. **hypertension** (a condition in which the blood pressure is abnormally high);
    c. urinary tract infections;
    d. kidney stones; and
    e. **paralytic ileus** (loss of intestinal functioning);
6. **myocarditis** (inflammation of the **myocardium** or the muscular tissue of the heart); and
7. **cor pulmonae** (enlargement of the right ventricle that occurs because of pulmonary hypertension from lung disorders).

To avoid the diseases and the complications mentioned beforehand, be sure to consult your doctor if:

1. symptoms of poliomyelitis occur;
2. someone close to you has developed poliomyelitis and you are not immunized against the disorder; and
3. if your child's polio immunization vaccine is not up-to-date.

Let's Think About This

Think of some ways to maintain the health of your muscles and avoid diseases of the muscular system. List down as many as you can in the space provided below.

_____

_____

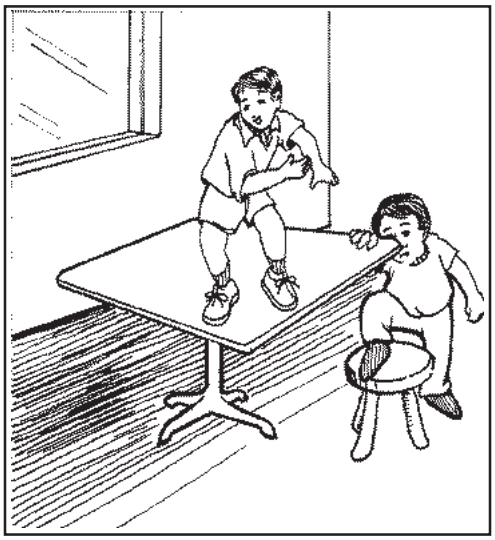
_____

_____

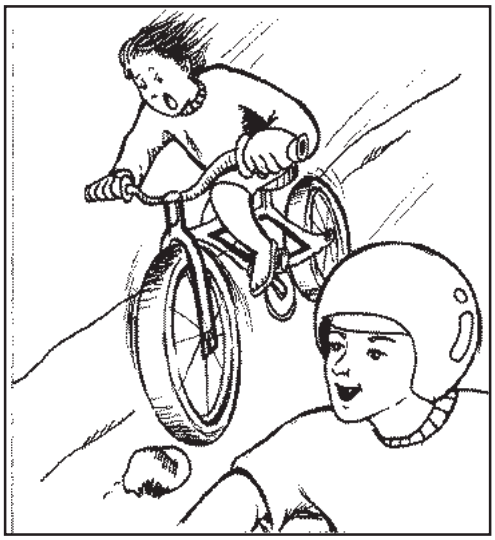
Afterward, go back to your list. Are you observing proper care of your muscular system?

Caring for Your Muscular System

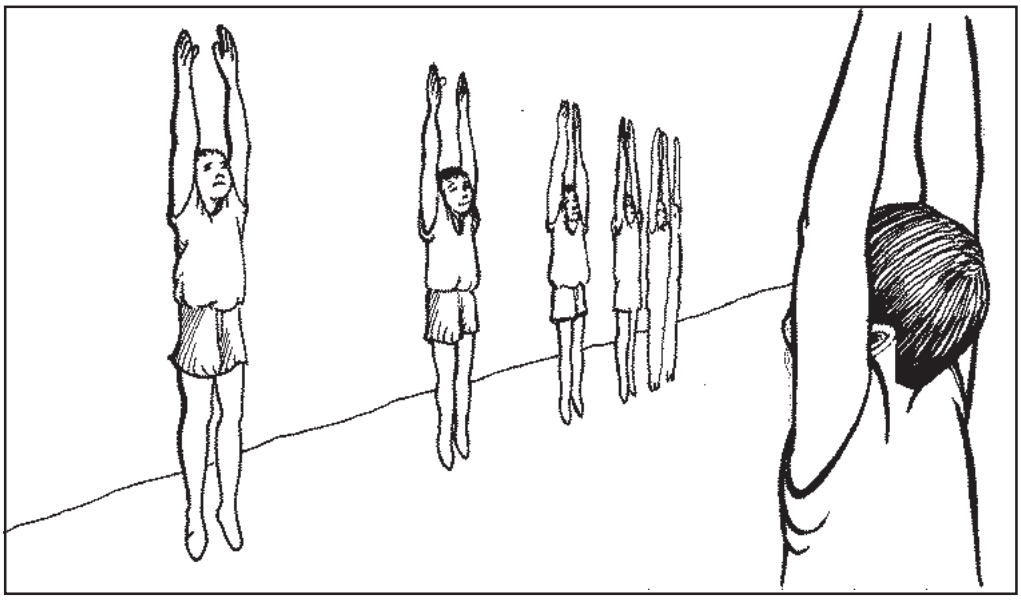
Eat a lot of protein-rich foods such as soya beans, vegetables, meat and fish. **Proteins** help build muscles and are needed for them to function properly.



Avoid activities that may cause injuries such as climbing on top of unstable furniture.

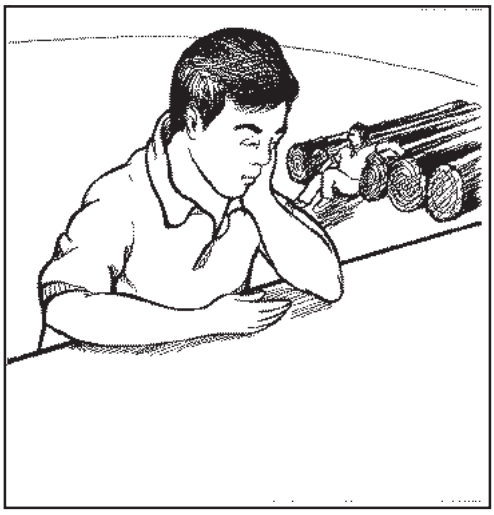


Always wear or use protective equipment when doing something that might be dangerous.

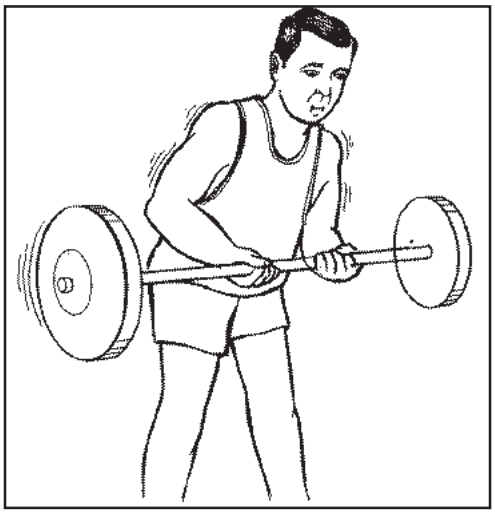


Exercise regularly to make your muscles strong. Regular stretching exercises also strengthen your tendons and give more flexibility to the muscular system.

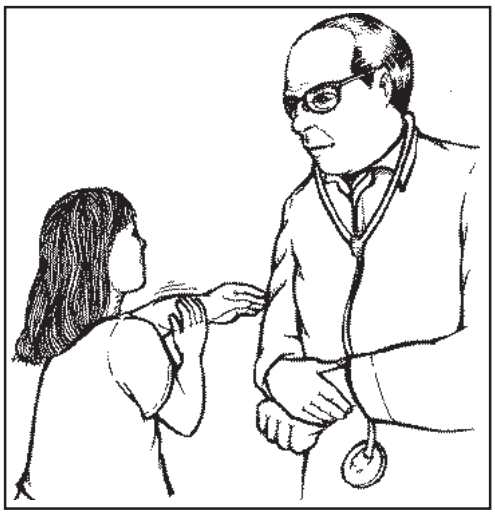
Keep things in order. Playthings left on the stairs or elsewhere may cause accidents.



Rest every now and then while working to allow your muscles to relax.



Lift weights properly. Avoid bending forward when carrying heavy loads.



Always seek medical advice when an injury to muscles or tendons occurs, just to be sure.

Maintain proper hygiene always.

You have just learned some of the ways of taking care of the muscular system. This module taught you about the structure and function of each part of the muscular system as well as the illnesses that can affect it. You learned that the muscular system is very important and that without it, life would not be possible.

Let's See What You Have Learned

Fill in the blanks with the correct answers.

_____ 1. A tear or stretch in the muscle fiber or the tendon that connects a muscle to a bone

_____ 2. Occurs when one side of the joint is stronger than the other or the opposite muscle does not relax while the other contracts

_____ 3. Occurs when additional stress is put on a muscle and its connective tissue

_____ 4. A contraction of a muscle which is often painful

_____ 5. The result of minor local muscle contractions or the uncontrollable twitching of a single muscle group served by a single motor nerve fiber or filament

_____ 6. Commonly known as polio

_____ 7. Infections that may go unnoticed

_____ 8. A reflex where the great toe flexes toward the top of the foot and the other toes fan out when the sole of the foot is firmly stroked

_____ 9. A condition in which the blood pressure is abnormally high

_____ 10. Help build muscles and are needed for them to function properly

Compare your answers with those in the *Answer Key* on page 30. Did you get a perfect score? If you did, that's very good. If you did not, review the parts you missed.

Let's Remember

- A **muscle strain** is a tear or stretch in the muscle fiber or the tendon that connects a muscle to a bone.
- A **muscular imbalance** occurs when one side of the joint is stronger than the other or the opposite muscle does not relax while the other contracts.
- **Muscle fatigue** occurs when additional stress is put on a muscle and its connective tissue.
- **Muscle spasms** or **cramps** are contractions of the muscles which are often painful.
- **Muscle twitching** is the result of minor local muscle contractions or the uncontrollable twitching of a single muscle group served by a single motor nerve fiber or filament.
- **Poliomyelitis** is a disorder caused by a viral infection that affects the whole body including muscles and nerves.
- **Subclinical infections** are infections that may go unnoticed.
- **Proteins** help build muscles and are needed for them to function properly.

Well, this is the end of the module! Congratulations for finishing it. Did you like it? Did you learn something useful from it? A summary of its main points is given below to help you remember them better.

Let's Sum Up

This module tells us that:

- The three kinds of muscle tissues are the skeletal, smooth and cardiac muscles.
  - **Skeletal muscles** are also called voluntary muscles. They appear striated when seen under a microscope becuse of the bands of alternating shades in their sarcomeres which allow fast, powerful movements to occur.
  - **Smooth muscles** are generally involuntary and lack the striated appearance when seen under a microscope except for the cardiac muscles. They allow prolonged, steady but less powerful movements to occur inside internal organs.

- **Cardiac muscles** though involuntary appear striated to allow powerful movements needed to pump blood throughout the body.

- A **muscle strain** is a tear or stretch in the muscle fiber on the tendon that connects a muscle to a bone.
- A **muscular imbalance** occurs when one side of the joint is stronger than the other or the opposite muscle does not relax while the other contracts.
- **Muscle fatigue** occurs when additional stress is put on a muscle and its connective tissue.
- **Muscle spasms** or **cramps** are contractions of the muscles which are often painful.
- **Muscle twitching** is the result of minor local muscle contractions or the uncontrollable twitching of a single muscle group served by a single motor nerve fiber or filament.
- **Poliomyelitis** is a disorder caused by a viral infection that affects the whole body including muscles and nerves.
- **Subclinical infections** are infections that may go unnoticed.
- **Proteins** help build muscles and are needed for them to function properly.

What Have You Learned?

A. Fill in the blanks with the correct answers.

_____ 1. Nerves which bring signals from the brain to the body

_____ 2. Enable the body to make both internal and external movements

_____ 3. Muscles that are under conscious control and produce voluntary movements by pulling against the bones of the skeleton to which they are attached by means of tendons

_____ 4. Muscles that are attached to bones

_____ 5. Another word for “striped”

_____ 6. Muscles that are not under conscious control and are generally smooth

_____ 7. The only striated involuntary muscle

_____ 8. A tear or stretch in the muscle fiber or the tendon that connects a muscle to a bone

_____ 9. Contractions of the muscles which are often painful

_____ 10. A disorder caused by a viral infection that affects the whole body including muscles and nerves

B. Answer the following questions briefly.

1. What are the two major types of muscles?

   a._____

   b._____

2. What are the three kinds of muscle tissues?

   a._____

   b._____

   c._____

3. What three muscular disorders were discussed in the module?

   a._____

   b._____

   c._____

4. List down five ways of taking care of your muscular system properly.

   a._____

   b._____

   c._____

   d._____

   e._____

Compare your answers with those in found in the *Answer Key* on pages 30 and 31.

Answer Key

A. Let's See What You Already Know *(page 2)*

1. a. skeletal muscle
   b. smooth muscle
   c. cardiac muscle
2. sarcomere
3. Cardiac muscles, although involuntary are striated to allow the heart to pump blood throughout the body.
4. a. muscle strain
   b. muscle spasms or cramps
   c. poliomyelitis
5. Choose any two of the following:
   a. Eat protein-rich foods.
   b. Keep things in order.
   c. Rest every now and then while working to allow your muscles to relax.
   d. Lift weights properly.
   e. Always seek medical advice when an injury to muscles or tendons occurs, just to be sure.
   f. Always maintain proper hygiene.
   g. Avoid activities that may cause injuries such as climbing on top of unstable furniture.
   h. Always wear or use protective equipment when doing something that might be dangerous.
   i. Exercise regularly to make your muscles strong.

B. Lesson 1

Let's Review (pages 8 – 9)

1. g
2. i
3. d
4. e
5. c
6. j
7. a
8. h
9. b
10. f

Let's Review (page 11)

1. Cardiac muscles are striated because of the presence of special structures called intercalated disks. These structures enable the heart to make powerful, continuous movements.
2. The muscles of internal organs such as the intestines are smooth because they are not striated unlike the skeletal and cardiac muscles. They have the special ability to make less powerful but sustained peristaltic movements.

Let's See What You Have Learned (page 12)

1. Muscles are generally classified as:
   a. **Voluntary** – made up of skeletal muscles or the muscles that are attached to the bones.
   b. **Involuntary** – generally made up of the smooth muscles except for the cardiac muscles.
2. Voluntary muscles are striated to allow them to make powerful movements that are responsible for most of our physical activities.
3. Cardiac muscles are similar to skeletal muscles in that they are also striated even if they are considered involuntary.
4. They are striated to allow the heart to make powerful movements that are responsible for pumping blood throughout the body.

C. Lesson 2

Let's See What You Have Learned (page 24)

1. muscle strain
2. muscular imbalance
3. fatigue
4. muscle spasm or cramp
5. muscle twitching
6. poliomyelitis
7. subclinical infections
8. Babinski's reflex
9. hypertension
10. proteins

D. What Have You Learned? *(pages 26 – 27)*

A. 1. efferent nerves
2. muscles
3. voluntary muscles
4. skeletal muscles
5. striated
6. involuntary muscles
7. heart/cardiac muscle
8 muscle strain
9. muscle spasms/cramps
10. poliomyelitis/polio

B. 1. a. voluntary muscles
b. involuntary muscles
2. a. striated muscles (skeletal muscles)
b. smooth muscles
c. cardiac muscles

3. a. muscle strain

   b. muscle spasms or cramps

   c. poliomyelitis

4. Choose any of the following:

   a. Eat protein-rich foods.

   b. Keep things in order.

   c. Rest every now and then while working to allow your muscles to relax.

   d. Lift weights properly.

   e. Always seek medical advice when an injury to muscles or tendons occur just to be sure.

   f. Always maintain proper hygiene.

   g. Avoid activities that may cause injuries such as climbing on top of unstable furniture.

   h. Always wear or use protective equipment when doing something that might be dangerous.

   i. Exercise regularly to make your muscles strong.

Glossary

A Bands The dark bands in skeletal muscles

Analgesic Pain relievers

Aspiration pneumonia An inflammation of the lungs caused by an infection which causes difficulty in breathing

Babinski's reflex A reflex where the great toe flexes toward the top of the foot and the other toes fan out when the sole of the foot is firmly stroked; normal in children but abnormal after two years of age

Benign Of a mild form

Bethanecol A drug that reduces urinary retention

Cardiac muscles Muscles of the heart

Contraction Enables the body to make both internal and external movements

Cor pulmonae Enlargement of the right ventricle that occurs because of pulmonary hypertension from lung disorders

Corticosteroids Steroid hormones

Diuretics Drugs that increase the volume of urine produced and excreted

Efferent nerves Nerves which bring signals from the brain to the body

Estrogens Steroid hormones produced mainly by the ovaries that control the growth and functioning of the female sex organs and the appearance of female secondary sexual characteristics

Excitability The ability of muscles to respond to electrical signals provided by the nerves of the nervous system

Fatigue Excessive tiredness

I bands The light bands in skeletal muscles

Involuntary muscles Muscles that are not under conscious control

Intercalated disks Disks that mark the points of strong adhesion between the cells of the cardiac muscles which must withstand strong pressures during contraction

Malaise General discomfort or uneasiness

Muscle fasciculus A bundle of muscle fibers

Muscle fatigue Occurs when additional stress is put on a muscle and its connective tissue

Muscle fiber The unit made up myofibrils packed together

Muscle spasms Also known as cramps; contractions of the muscle which are often painful

Muscle strain A tear or stretch in the muscle fiber or the tendon that connects a muscle to a bone

Muscle twitching The result of minor local muscle contractions or the uncontrollable twitching of a single muscle group served by a single motor nerve fiber or filament

Muscular imbalance Occurs when one side of the joint is stronger than the other or the opposite muscle does not relax while the other contracts

Myocarditis An inflammation of the myocardium

Myocardium The muscular tissue of the heart

Myofibril An individual fiber in a sarcolemma

Nonpathologic fasciculation Not caused by disease or disorders

Paralytic ileus Loss of intestinal functioning

Peristalsis A wavelike movement of muscle in the gastrointestinal tract

Poliomyelitis Commonly known as polio; a disorder caused by a viral infection (poliovirus) that affects the whole body including muscles and nerves

Proteins Help build muscles and are needed for them to function properly

Pulmonary edema A condition characterized by fluid accumulation in the lungs caused by back pressure in the lung veins

Sarco A word which means "flesh" in Latin

Sarcolemma A group of myofibrils enclosed in a membrane

Sarcomere The area between two Z lines

Striated muscles Muscles that are striped when seen under a microscope

Skeletal muscles Muscles attached to bones

Smooth muscles Muscles that do not appear striated when seen under a microscope

Subclinical infections Infections that may go unnoticed

Viscera Internal organs

Voluntary muscles Muscles that are under conscious control and produce voluntary movements by pulling against the bones of the skeleton to which they are attached by means of tendons

Z lines Thin lines traveling through the center of myofibrils

Reference

WebMD Corporation. (2000). *Lycos Health With WebMD.* http://webmd.lycos.com. January 22, 2001, date accessed.