

## **Grade 4: Muscles and Skin**

**Lesson 1: Muscular System: Types of Muscles and Movement**

**Lesson 2: Muscular System: Posture & Support**

**Lesson 3: Muscular System: Heat Generation**

**Lesson 4: Skin**

### **Objectives:**

1. Students will define the **Muscular System**.
2. Students will identify three **functions** of the Muscular System; **movement**, **posture** and **support**, and heat generation.
3. Students will identify the two kinds of muscle action--**voluntary** and **involuntary**--and give an example of each.
4. Students will identify the main **functions** of the **skin**.
5. Students will identify the two **layers** of the **skin**.

### **Materials:**

- Skeleton Chart (Kit - optional)
- Muscle Chart (Kit - optional)
- Skin Chart (Kit - optional)
- Feathers, soft fabric, smooth rock, rough pebbles, ice cubes, lamp, paper clip, water in a bowl, tree bark
- Plain paper for journal
- 2 x 18 section of cardboard for each child
- Pliable clay, drawing pencils, string, yarn, wire, noodles, small beads
- Egg, mud, bowl of water
- Types of Muscles Handout (**See Figure 1**)
- Types of Muscles Evaluation (**See Figure 2**)
- Muscle Child Graphic Diagram (**See Figure 3**)
- Skin Diagram (**See Figure 4**)

### **Activity Summary:**

In this lesson students will acquire a basic understanding of the skin (Dermal System) and the Muscular System, including their functions and importance to health. Students will use this foundation to develop their understanding of muscle and skin health in their own body.

### **Background Information for the Teacher: 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.

The muscles in your face are attached to the skin. These are the **facial muscles** that put a smile on your face when you are laughing, or wrinkle your brow when you are puzzled.

**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.

For example, the desire (or thought) to scratch our nose initiates a series of motor nerve impulses. These nervous system messages direct the action of the arm, the hand and the finger to scratch the nose at just the right place with just the right amount of pressure. Then a recovery message is sent directing the arm to move to another position and another activity. If the nervous system and the excitability quality of muscle tissue were not so highly developed we might end up slapping our face instead of scratching our nose!

## THE SKIN

**The skin is the largest organ of the body. It grows faster than any other organ, and renews itself throughout life.** The surface cells of the skin, the epidermis, are repeatedly shed and replaced throughout your lifetime. It is estimated that a 70-year-old has replaced her skin more than 850 times. Skin is amazingly adaptable, **able to change shape, size, thickness, and sensitivity depending on our body's needs.** Skin is thinnest on the eyelids and thickest on the soles of the feet and palms of the hands.

The skin is a very busy place. Skin contains an astounding array of:

- **Cells**
- **Glands (sweat and oil)**
- **Receptors (heat, cold, pressure, pain, touch)**
- **Blood and lymph vessels**
- **Hair follicles**

**Skin also acts a storehouse for fat and glycogen (glucose).** The thickest skin on our bodies (on our hands and feet) develops wrinkles and ridges even before we're born! The prints of these An amazing thing to know is that an area of skin the size of a quarter contains about three million cells, one hundred sweat glands, fifty nerve endings, three feet of blood vessels, and almost as many lymph vessels. The thickest skin on our bodies, our hands and feet, develop wrinkles and ridges even before birth. The prints of these swirls are unique to every person.

**Skin has two layers: the epidermis on the surface and the dermis underneath:**

- **Epidermis** – This is the layer that is shed and replaced regularly throughout life. **Melanin** is in the epidermis. This is a pigment that is responsible for skin color and freckles. Sunlight promotes the growth of melanin and skin exposed to sunlight will darken. **Skin also makes Vitamin D when exposed to sunlight.**
- **Dermis** – The layer beneath the epidermis. Most of the glands, nerve endings, pressure and touch receptors are located here.

**Skin has five key functions that are very important to our health:**

- 1. Protection against infection** - Skin serves as a necessary barrier to prevent pathogen, bacteria and toxins entering our body and making us ill.
- 2. Protection against dehydration** – Maintaining adequate water in our bodies is essential to life.
- 3. Regulation of body temperature** – Prevention of the loss of too much body heat and protection from cold maintains the body's core temperature

**4. Communication of Sensory Information** – Temperature, touch, pressure and pain all send important signals to the brain and spinal cord. These signals help us process and integrate our sensory experiences.

**5. Metabolism of Vitamin D**– Sunlight makes vitamin D in the skin. And vitamin D is essential to the body for absorbing calcium needed for bone growth.

**Vocabulary:**

**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.

**Epidermis** – The surface layer of the skin.

**Dermis** – The skin layer under the epidermis.

**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 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.

**Lymph Vessels** – A system of tubes (like the veins but smaller) that collect and carry lymph in the body.

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

**Engage:** (5 minutes)

1. Invite a lunch worker to the classroom. Ask them to bring with them a 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?

**Explore:**

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."

**Explain:**

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 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

<b>Types</b>	<b>Example</b>	<b>Action</b>	<b>Benefit</b>
Smooth	Intestines Stomach Lungs	<b>Involuntary</b>	Allows you to digest your lunch while at school, and breathe while you're asleep.
Cardiac	Heart	<b>Involuntary</b>	Keeps heart beating when you're asleep.
Skeletal muscle	Muscles of the upper arm, back and leg	<b>Voluntary</b>	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 last 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 that students learned about in **Grade 3: The Skeletal System**.
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.



### Evaluate: Continuous Observation

Have students fill in a chart like the one above. (See Figure 2) They must name the three kinds of muscles, give examples of each, and determine whether it is voluntary or involuntary.

### Optional 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.

## Lesson 2: Posture and Support

### Engage: (10 minutes)

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?

### **Explore:**

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, 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)
  - Legs (two for each side)
  - Hips (one)
  - Spine (one)
  - Ribs (three or four for each side)
  - 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.)

**Explain:**

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 (optional--from Kit, or if available) 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.

**Extend:**

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?”***)

#### **Evaluate:**

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). Use the Muscle Child graphic diagram. **(See Figure 3)**

**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

#### Engage:

- 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?”**

#### Explore:

- 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.
- 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.)

### **Explain**

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.

### **Extend:**

Write a short story about being a muscle. 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.)

**Evaluate:** Use the Extend section as an assessment.

## **Lesson 4: Skin--The Largest Organ in the Body (30 minutes)**

### **Engage:**

Bring an egg (hardboiled or raw) to class, a glass of water, and mud. This activity will demonstrate some of the functions of the skin. Ask: **“What does the shell do for the egg inside?”** (The shell protects the egg.)

Wearing gloves, drop the clean egg into the mud. Ask: **“Is anything getting inside the egg? Take it out and wash it off in the clean water. Is the egg still the same? What if we put the egg in the trashcan? A lot of trash and garbage cans contain harmful bacteria. When we take the egg out and clean the dirt off, is it still safe to eat what's inside?”**

Ask: **“The shell of the egg is like what part of our bodies?”** (The skin.) **“How is it the same?”** (It protects the inside from bacteria, infection and any foreign material that might harm it.)

Ask: **“If we left the egg in the water overnight would any of the water get inside? If we left the egg in the sun would the egg dry out?”** (The protective “skin” of the egg, the shell, would keep water from getting inside the egg, and would also help regulate the “temperature” of the egg for quite a while, although

certainly over time the inside of the egg would be affected by the sun's heat. This is very much like what the skin does for our body.)

Ask: **“So why do we have skin? What does our skin do for us?”** (It protects us from bacteria/infection, keeps water and other material from getting inside our body and regulates the temperature of the body, protecting our tissues and organs from drying out—dehydration.)

**Explore:** (15 - 20 minutes)

1. Ask: **“What other jobs does your skin do?”** (Allows us to sense pain, itching, touch and temperature.) **“How does your skin know how to do what it does and how does it gather information to regulate temperature, pressure, sensation and pain?”** (Nerve receptors in your dermis—located one layer below the epidermis, which is the outer layer—tell you how things feel whenever you touch something. Working with your nervous system, these receptors tell your brain about what you're touching.)
2. Have students gather data about the different receptors in the skin. Have them divide a piece of paper into four columns labeled: 1) ITEM; 2) SENSATION; 3) MEASUREMENT; and 4) SENSORY RECEPTOR.
3. Prepare five different items for students to use. Suggestions are:
  - **Temperature:** ice cubes; a lamp with regular light bulb (or heat bulb) in it.
  - **Pressure:** large, heavy, smooth rocks that can be held in the palm of your hand;
  - **Sensation and pain:** soft fabric, a feather, flower petals, rough pebbles, tree bark, a bowl of water, and a straightened paper clip (so that a pain sensation would be felt when the sharp edge of the paper clip end is touched with some pressure.)
4. Have items organized on a table and have students come up in small groups to touch and hold each item, feeling the sensations of pain, pleasure, pressure and temperature. Have them record information on their paper under the correct column. In the “Sensation” column they would describe how each item felt. In the “Measurement” column they would record any data about how long they were able to hold their hand under the heat lamp or hold the ice before it became too uncomfortable; how many smooth rocks they could hold in one hand (students could weigh the rocks beforehand, mark each rock with that weight and then record the total weight on their paper.) Have students brainstorm other ways to create a measurement for each item they will be touching.



When the students finish going to all the stations and recording their results, have them write which sensory receptor they think was activated in their skin with each item. This should be recorded in the “Sensory Receptor” column.

5. Ask students to share their experience and their conclusions about the sensory receptors. Draw and label the same four columns on the board as the students used on their papers. As students are sharing write the information on the board.

**Explain :**

1. Emphasize that skin is very smart and knows how to **protect us from:**
  - **Infection.** (Skin serves as a necessary barrier to prevent pathogens, bacteria and toxins from entering our body and making us ill.)
  - **Dehydration.** (Maintaining adequate water in our bodies is essential to life. Also helps maintain a balance of electrolytes, a necessary element in the bloodstream.)
  - **Becoming too hot or too cold.** (Skin regulates our body temperature, and the fat under the dermis provides insulation.)
  - **Harmful pain, pressure, and temperature that touches our body.** (The pressure and temperature receptors and nerve endings in the dermis give the brain information about what is touching the body.)
2. Ask Introductory Questions to get the students thinking: **“How deep is your skin?”** (*Make predictions.*) Explain that skin is really MUCH more than “skin deep.”
3. Skin actually has two layers: **the epidermis on the surface and the dermis underneath.** Use the Skin Chart (optional – in kit or if available) to show the two layers of the skin and tell some information about the skin.
4. Ask: **“What is an organ?”** Have the students give examples of organs. (Check for understanding.) Explain that **the skin is the largest organ of the body.** It grows faster than any other organ, and continually renews itself throughout a person’s life.
5. Introduce the concept of the the skin’s **layers:**

**Layer #1: The Epidermis – The surface layer of skin cells.** These cells are shed and replaced throughout life. It takes about four weeks to replace all the epidermis cells (the skin’s surface layer) on a person’s body. The body gets a “new” skin about 12 times a year.



Ask: **“How many times has your surface skin been replaced since you were born?”** Have students calculate this for themselves by multiplying their age times 12.

**Layer #2: The Dermis** – The layer which lies immediately beneath the epidermis. Most of the glands, nerve endings, hair follicles, pressure and touch receptors are located here. Use the Skin Chart (from kit if available) to show these parts of the dermis. As you discuss each of the following components with the students and ask questions for each one to have the students draw conclusions about the function of the following structures and what they each do for our health:

- **Nerve endings:** Ask: **“What do nerve endings do?”** (*Carry messages to the brain.*) **“How is that important for our health?”** (*Nerve endings send information about pain, temperature, and other sensations so our body can respond and/or protect itself.*)

Quick activity: Have five volunteers line up. The first person is the skin, the middle three are nerves, and the last person is the brain. Tell the first person you are a bee and you’ve just stung him. Have the first person *whisper* “ouch” to the second person. Have the students play “telephone” with the second, third and fourth students each saying “ouch” just a little bit louder. The fifth person, who is the brain, gets to say a loud “ouch.”

That is how a nerve works in your skin. The skin has receptors that receive information which is passed along a nerves “chain” until it reaches the brain.

- **Oil glands:** Ask: **“What do oil glands do?”** (*Make oils to protect the skin from drying out.*) **“How is that important for our health?”** (*The skin’s natural oil, sebum, keeps your skin lubricated and protected, and makes it WATERPROOF, so it doesn’t absorb too much moisture and become waterlogged and soggy.*)
- **Blood vessels:** Ask: **“What do the blood vessels do?”** (*Carry oxygen to the skin cells and carry away carbon dioxide.*) **“How is that important for our health?”** (*This keeps your skin cells healthy by giving them oxygen and nutrients and carrying away waste.*)
- **Sweat glands:** Ask: **“What do sweat glands do?”** (*Sweat helps cool the body. It’s your body’s air conditioner.*) **“How is that important for our health?”** (*Besides regulating your body temperature, sweat mixes with sebum to form a protective*

*substance that is slightly sticky, making your fingers more dexterous.)*

- **Hair follicles:** Ask: **“What do hair follicles do?”** (They are the root of hair.) **“How are hair follicles important for our health?”** (Hair follicles contribute to the sweating process, which helps cool the body. Every follicle—which begins in the subcutaneous layer and extends up through the dermis—has its own sebaceous gland, which releases oils onto the hair. This not only makes the hair shiny and slightly waterproof, but when these oils reach the surface of the skin they evaporate, cooling the skin.)
- **Nerve Receptors:** Ask: **“What do nerve receptors do?”** (Gather information about pain, temperature, and pressure.) **“How is that important for our health?”** (Because sometimes what you touch—or what touches you—can be dangerous, your nerve endings keep you from getting hurt.)

**Layer #3: Subcutaneous Fat:** Ask: **“What does this fat layer do?”** (It insulates the body.) **“How is that important for our health?”** (It helps your body stay warm and absorb shocks, as well as holding your skin to the tissues beneath it.)

Hold a quarter up in front of the class and ask the students to tell what it is. Gather the students around you and place the quarter on your lower arm. With this demonstration, tell the students that an area of skin only about the size of a quarter contains about **three million cells, 100 sweat glands, 50 nerve endings, three feet of blood vessels,** and almost as many **lymph vessels.**

**Extend:**

Divide students into groups of three or four. (You may also have students do this individually if want to use this as an assessment.) Give each group/individual a large piece of tag board. Set out yarn, noodles, construction paper, string, wire, small beads or buttons, markers, crayons, and a variety of other art construction materials.

Give the groups the task of creating a three-dimensional model of the two layers of skin, the nerve receptors, hair follicles, blood vessels, fat, oil and sweat glands. They can use any of the construction materials and art materials to create their model.

They must create a **KEY** in the corner of the chart, showing how each skin feature is represented. Display the charts after the activity. To ensure all students participate tell them at the end of the activity they will be grading the

other group members on completeness and accuracy of the skin model. This activity can be as detailed or as easy as the teacher desires.

**Optional Enrichment Information:**

Ask: ***“If I told you that our skin is thicker in some places and thinner in other places, where do you think the skin would be the thickest? Why? Where would skin be the thinnest? Why?”***

Ask: ***“Compare the skin on your palms, eyelids, elbows, and back: what is different or the same about the texture, toughness, and appearance of the skin on these different parts of your body?”***

Emphasize the following points:

- **Skin** is amazingly **adaptable**. It is **able to change shape, size, thickness, or sensitivity, depending on your body’s needs.**
- Skin is **thinnest on the eyelids** and **thickest on the soles of the feet and palms of the hands.**
- The thickest skin on our bodies, on our hands and feet, develop wrinkles and ridges **even before birth.**
- The prints of these swirls are **unique** to every person, including identical twins.

Ask: ***“What determines skin color?”*** (Skin color varies throughout the world, ranging from a very dark brown to a near yellowish pink, and is created by the presence or lack of a pigment called MELANIN. Located in the epidermis, melanin provides protection from ultraviolet radiation.)

Ask: ***“What makes skin darken when we’ve been out in the sun?”*** (Sunlight causes the pigment (melanin) to increase, which makes the skin color darken.)

Ask: ***“What causes freckles?”*** (Some people with light skin and eyes are more likely to have freckles because they have less melanin. Instead of tanning, they freckle. For some people, freckles fade or disappear altogether in the winter. People who gets freckles are more likely to get sunburns.)

Discuss with students how being out in the sun affects our health. A certain amount of sunlight directly on the skin is beneficial (recent students indicate we should have at least 15-20 minutes of exposure each day) because it helps the skin make Vitamin D. An important vitamin for growing strong, healthy bones, Vitamin D helps the body absorb calcium that is essential for good bone growth. Of course, we still need to use sunscreen most of the time we are in the sun to prevent sunburn.

**Evaluate:**

1. Use the Extend activity as an assessment if done individually.
2. Give each student a copy of the Skin Diagram (**See Figure 4**) and have them color and label each of the features on the diagram.

**Additional Sources:**

[www.kidshealth.org](http://www.kidshealth.org)

[www.sciencenetlinks.com](http://www.sciencenetlinks.com)

**Correlation to Standards:****Grade Level Expectations:****Science:****Strand 7: Scientific Inquiry**

1. Science understanding is developed through the use of science process skills, scientific knowledge, investigation, reasoning, and critical thinking.
  - A. Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigation methods in order to obtain evidence relevant to the explanation.
    - a. Pose a question about objects, materials, organisms, and events in the environment.
    - b. Plan and conduct a fair test to answer a question.
  - B. Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations.
    - a. Make qualitative observations using the five senses.
  - C. Evidence is used to formulate explanations.
    - a. Use qualitative and quantitative data as support for reasonable explanations.
  - D. Scientific Inquiry includes evaluation of explanations in light of scientific principles
    - a. Evaluate the reasonableness of an explanation
  - E. The nature of science relies upon communication of results and justification of explanations
    - a. Communicate simple procedures and results of investigations and explanations through: oral presentations, drawings and maps, data tables, graphs, writings.

**Strand 8: Impact of Science, Technology and Human Activity**

3. Science and technology affect, and are affected by, society.

- A. People, alone or in groups, are always making discoveries about nature and inventing new ways to solve problems and get work done.
- b. Work with a group to solve a problem, giving due credit to the ideas and contributions of each group member (assess locally)

**Frameworks:**

**Health and Physical Education**

Functions and interrelations of systems

I. Body Systems

What all students should know:

- 5. The Muscular System provides humans with the ability to move and perform a variety of physical tasks. Specialized muscles help humans breathe, digest food, eliminate waste, and circulate blood.

What all students should be able to do:

- a. Identify and describe the basic structure and functions of the Muscular System.
- a. Design and conduct introductory laboratory investigations regarding body system functions.
- a. Plan effective oral and written communications regarding the body systems, their structures, and functions for parents and other students.

III. Risk Assessment and Reduction

What all students should know:

- 1. The body has ways to defend itself against disease

What all students should be able to do:

- a. Identify the body's basic lines of defense – including skin

IV. Efficiency of Human Movement and Performance

What all students should know:

- 1. The musculature involved in correct posture must be balanced to hold the bones and joints properly in place.

**Figure 1:**

Heart	Small Intestines
Large Intestines	Arm Muscles
Back Muscles	Leg Muscles
Lung Passages	Hand Muscles
Stomach	Blood Vessels

**Figure 2:**

Kinds	Example	Action	Benefit

Kinds	Example	Action	Benefit



Figure 3

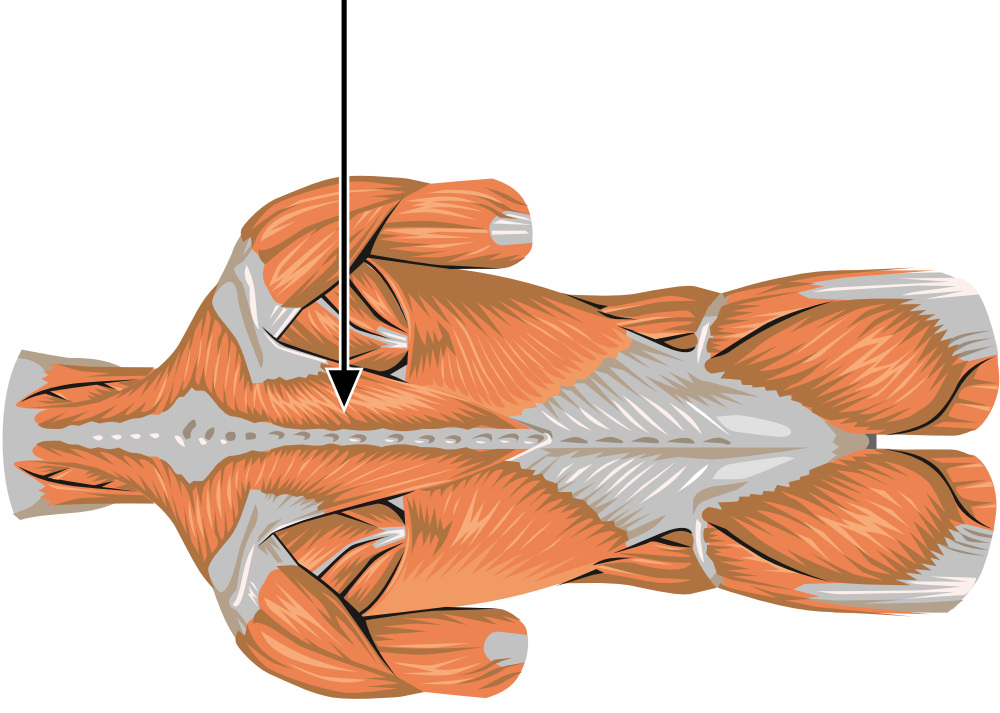
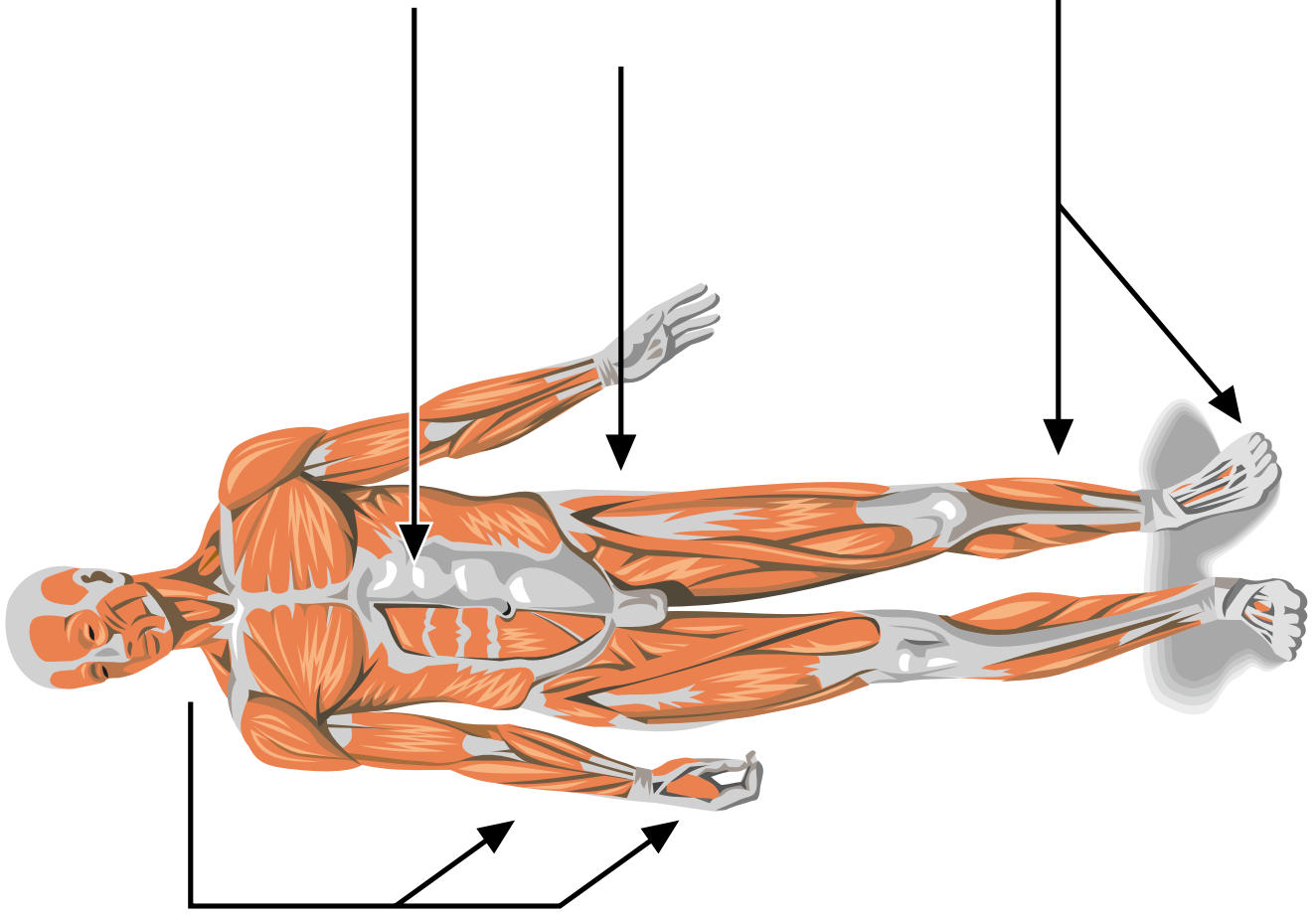


Figure 4

