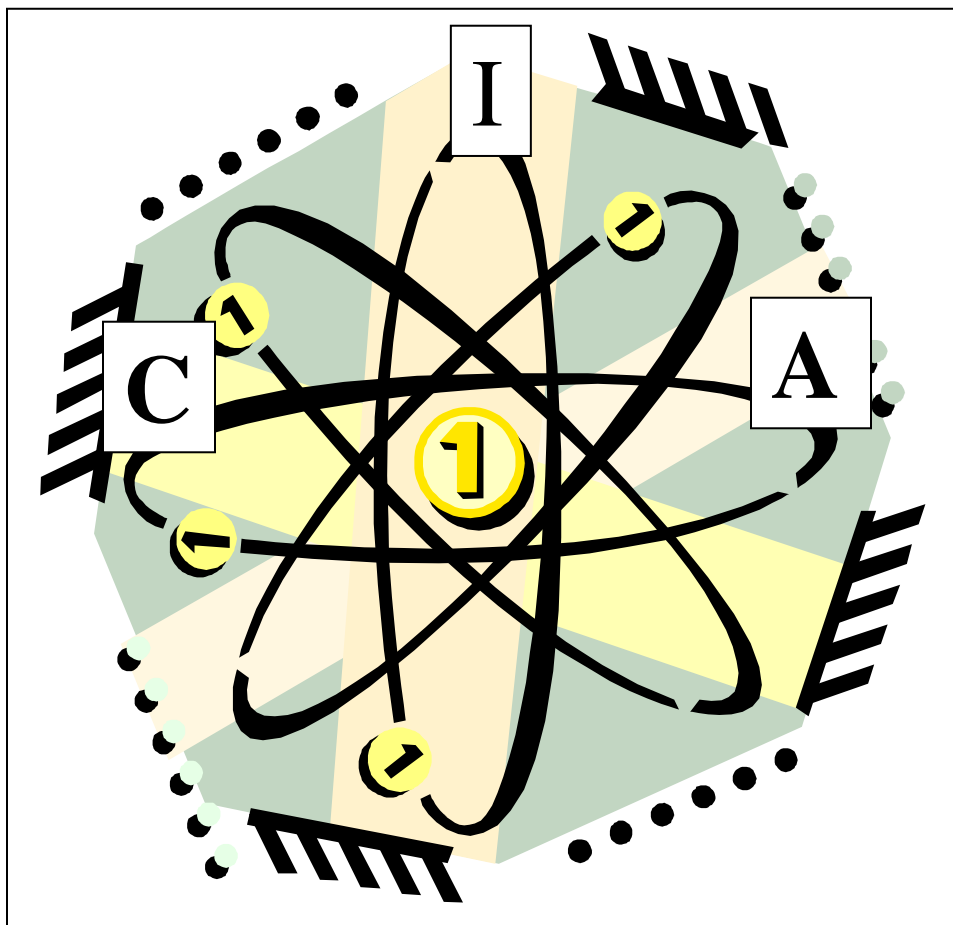


Curriculum, Instruction, Assessment (CIA) Alignment

Science, Grade 5 Unit 4: The Human Body

Task Analysis and Hands-on Investigations



Ronald Blocker, Superintendent
Orange County Public Schools
Orlando, Florida
2003-2004



Subject Area: Science
Strand F: Processes of Life
Grade: 5

Benchmarks

SC.A.2.2.1: The student knows that materials may be made of parts too small to be seen without magnification.
SC.F.1.2.1: The student knows that the human body is made of systems with structures and functions that are related.
SC.F.1.2.3: The student knows that living things are different but share similar structures.
SC.F.1.2.4: The student knows that similar cells form different kinds of structures.

TASK ANALYSIS	
The student...	THE HUMAN BODY
	<ul style="list-style-type: none"> observes and studies minute details of objects using a variety of tools (hand lens, microscope).
	<ul style="list-style-type: none"> uses a microscope to see that living things are made mostly of cells.
	<ul style="list-style-type: none"> identifies the main parts of plant and animal cells.
	<ul style="list-style-type: none"> explains that all organisms are composed of cells – the fundamental unit of life. Specialized cells perform specialized functions in multi-cellular organisms. Important levels of organization for structure and function include cells, tissues, organs, organ systems, whole organisms, and ecosystems.
	<ul style="list-style-type: none"> knows that processes needed for life are carried out by the cells and that complex animals have specialized organs to carry out life processes.
	<ul style="list-style-type: none"> uses a model to explain the functions of the major organ systems of the human body (e.g., digestive, respiratory, circulatory, skeletal, nervous, muscular, excretory).
	<ul style="list-style-type: none"> collects personal health-related data (e.g., temperature, heart rate) with simple devices such as a watch, a thermometer, and a stethoscope, to get a sense of how such information varies.

MESSING AROUND WITH MICROSCOPES



BENCHMARKS AND TASKS

SC.A.2.2.1 The student knows that materials may be made of parts too small to be seen without magnification.

SC.F.1.2.4 The student knows that similar cells form different kinds of structures.

- The student observes and studies minute details of objects using a variety of tools (hand lens, microscope).
- The student uses a microscope to see that living things are made mostly of cells.
- The student identifies the main parts of plant and animal cells.
- The student explains that all organisms are composed of cells - the fundamental unit of life. Specialized cells perform specialized functions in multi-cellular organisms. Important levels of organization for structure and function include cells, tissues, organs, organ systems, whole organisms, and ecosystems.

KEY QUESTION

What do magnified onion cells look like?

BACKGROUND INFORMATION

A simple microscope uses a single convex lens that provides a magnified view of an object. A hand lens is an example of a simple microscope. The magnifying power of a single lens is defined by the number of times an object viewed through the lens is magnified. If the lens is 3X, then the object viewed will appear to be three times larger than the actual object.

A compound microscope, like the Magiscope, uses two magnifying lenses – an objective lens placed near the object being viewed and an eyepiece lens placed near the eye of the viewer. The magnifying power of a compound microscope is found by multiplying the power of the objective lens times the power of the eyepiece lens. For example, if the objective lens is a 4X lens and the eyepiece lens is a 5X lens, then the magnification will be 20X. The object viewed will appear to be 20 times larger than the actual object.

Magnification not only makes objects look larger, but also reveals details that were invisible with the unaided eye. Color comic strips provide an excellent example of how perception changes, depending upon viewpoint. A magnifier reveals that some comic-strip colors are actually dots of other colors, printed side-by-side.

All living things are made up of smaller units called cells. Although cells vary in shape and size, most of them have a similar cellular structure. All cells have cell membranes, and plant cells also

have cell walls. The cell wall is a strong, rigid structure that protects the cell and gives structural support. Inside the cell wall is the cell membrane. It is so thin that it is difficult to observe. The cell membrane allows dissolved material to enter and leave the cell. Cytoplasm is the jelly-like substance that fills each cell. **Chemical changes** take place in that part of the cell. There is a darker, sac-like structure inside some cells. This nucleus, a dark, round structure, is the control center of the cell and controls all the processes that occur within the cell. Cells are organized into **tissues** and **organs**.

Most animal cells resemble plant cells in many ways. For example, both have a nucleus and a cell membrane. There are also important differences. Most plant cells have thick cell walls, while animal cells do not; animal cells do not contain chlorophyll, so they cannot make food by **photosynthesis** as plants do.

MATERIALS

Per pair or group

1 microscope
1 blank slide
1 white onion slice
1 cover slip
paper towels
2 toothpicks
1 pair of tweezers
water
1 dropper
small amount of diluted Methylene Blue solution
in a dropper bottle
color comic strip with many different colors

Per student

1 hand lens
science journal
paper/pencil
1 metric ruler

Per class

collection of living and nonliving objects
collection of other colored print materials

TEACHING TIPS

1. Blot onions on a paper towel to reduce possible eye irritation.
2. Cut the onion so that each group can have one slice.
3. Cut the color comic strips apart so that you have several for each group.
4. Set up groups depending on the number of microscopes that are available. Ideally, students should work in pairs.
5. Wash materials and hands carefully after the activity!
6. Make a solution using half Methylene Blue and half water and pour a small amount into a drop bottle for each group.

ENGAGE

Ask students to draw a rectangle on their paper about 0.5 cm x 2 cm in size. Then have them try to write a secret message inside the rectangle that is so small that it cannot be read without a magnifier. Later students can exchange papers with a partner and try to read the secret message.

EXPLORE AND EXPLAIN (Part 1)

Introduce students to the microscope that they will be using. Talk about the various parts of the instrument and explain how the microscope is used to magnify objects. Reinforce the concept that lenses magnify. (See Background Information.) Show students how to correctly focus the microscope. Allow students to explore freely by viewing various objects.

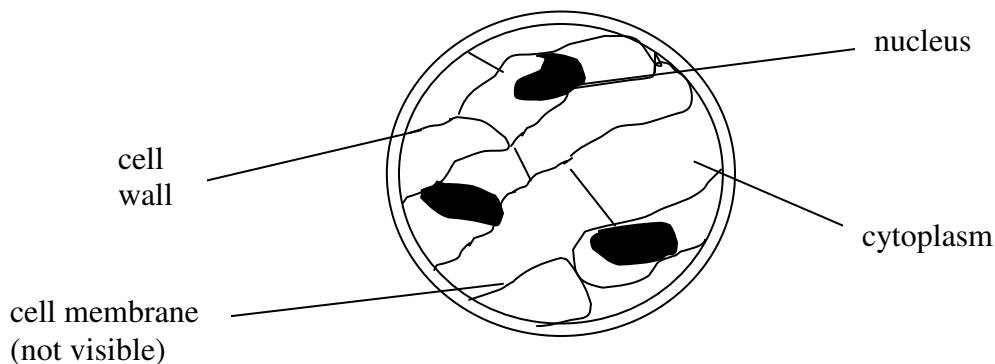
EXPLORE and EXPLAIN (Part 2)

1. Distribute some color comic strips to each pair.
2. Have students study the color comic strip using only the unaided eye. Encourage students to focus on the colors. Ask: *What colors do you see?* Have students record their observations in their science journals.
3. Next, have students study the same color comic strip with a magnifier. Have students record their observations in their science journals.
4. Students should then use the microscope to explore the color comic strip.
5. Ask: *Can you see any details that you couldn't see with the unaided eye or the hand lens? Do any colors look very different with the magnifier than without? What color dots and background dots did the printer use to make part of the comic appear pink? Purple? Orange? Green? Brown?* (Some colors in comic strips are made by printing other colors upon or near each other. Colors, such as pink and light blue, are often dots of red or blue printed on a white background. Orange is usually made of red and yellow; but because yellow is such a light color, it is often printed as a solid background with red dots on top of it. Because the yellow background makes the red dots more orange, students may say that the dots are red or orange. Very dark greens may look like solid colors because they are made of solid blue printed on top of solid yellow. Have students look for medium or lighter greens that appear to be made of green dots on a yellow background. Browns appear to be made of green and red or green and orange dots on a yellow background.)
6. Allow students to explore the class collection of other colored print materials (e.g., colored flyers, magazines, newspaper ads).
7. Emphasize that many things may be made of parts too small to be seen without magnification and that they will continue to explore this idea by using the microscope to study the parts of cells.

EXPLORE (Part 3)

1. Distribute materials.
2. Direct students to break the onion slice in two. Demonstrate how to use tweezers to carefully peel off a tiny piece of very thin skin found on the inside of the onion ring. This layer should be as thin as tissue paper.
3. Students should lay the onion skin flat in the center of the slide. Show students how to use a toothpick to smooth out the onion skin on the slide.
4. Ask students to observe the onion skin with the unaided eye and then with a hand lens.
5. Ask: *What do you see?* Have students record their observations by drawing and writing.
6. Have students place a small drop of water on the onion skin and then place a cover slip over it. They should press the cover slip down firmly with a paper towel to remove any air bubbles.

7. Demonstrate how to place the slide under the microscope. Have students place the slide under the microscope, adjust the microscope, and observe carefully.
8. Ask: *What do you see now? Can you see any details that were not visible before?* Have students record their observations by drawing and writing.
9. Have students lift the cover slip and stain the slide by using a toothpick to place one drop of Methylene Blue solution on the onion skin. (Note: If there is too much water and blue stain, lay a paper towel over the cover slip, gently press, and the towel will absorb the excess moisture.)
10. Ask students to predict what they think the stained onion skin will look like under the microscope.
11. Allow time for students to observe the stained onion skin and to record their observations by drawing and writing. (Remind students that they might need to readjust the microscope to see different aspects of the cell structure.)
12. Ask: *Do you see any cells?* (Explain that a cell is a division, the building block of all tissues.) *How many parts of a cell can you see through the microscope?* Draw a picture of a cell on the board and label the parts: cell wall, nucleus, cytoplasm, and cell membrane. Have students draw a plant cell in their journals and label it. Discuss the function of the various parts. (See Background Information.)



Parts of an Onion Cell

EXPLAIN (Part 3)

What was the shape of the onion cells? (rectangular)

How many sides does an onion cell seem to have? (four)

Why do you think the cells were all close together? (for strength and protection)

Is the onion skin composed of one cell or many cells? (many cells)

Why was it easier to see the cells after they were stained? (The stain created contrast between the light and dark structures.)

All plant cells have cell walls. What do you think the purpose of the cell wall is? (to provide strength and protection)

What is the control center of the cell called? (the nucleus)

Why do scientists use microscopes? (Many objects may be made of parts too small to be seen without magnification.)

EXTEND/APPLY

1. Have students exchange papers and use a magnifier to try to read the secret message they wrote earlier.
2. Place some objects, both living and nonliving (e.g., thin pieces of hair, thread, leaves, grass), on a table in the classroom. Invite students to use the microscope to study these living and nonliving things. They may not be that easy to distinguish; but in general, the cell structure of living things forms a more complex pattern under the microscope than that of nonliving things. Students should keep a record of their observations, listing the object viewed, whether it is living or nonliving, and noting such observations as whether or not it appears to be made of smaller units. (Note: Some objects were made by living things but are not themselves living [e.g., hair, fingernails]. Other things, such as sawdust and paper, were once living but have been processed so that the cell structure is no longer visible.)

EXTENSIONS

1. Have students make their fingerprints by making pencil smudges on a piece of paper, pressing each finger in the smudge, and then pressing the finger on a clean sheet of paper. Students can then use the hand lenses and microscopes to observe and classify their fingerprints.
2. Read about the scientist, Robert Hooke. He looked at a sliver of cork under his microscope and saw rows of “little empty boxes” that reminded him of rows of prison or monastery cells. He was the first to describe these structures, which he called “cells.”

LUNG POWER

BENCHMARKS AND TASKS

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

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

- The student knows that processes needed for life are carried out by the cells and that complex animals have specialized organs to carry out life processes.
- The student uses a model to explain the functions of the major organ systems of the human body (e.g., digestive, respiratory, circulatory, skeletal, nervous, muscular, excretory).
- The student collects personal health-related data (e.g., temperature, heart rate) with simple devices such as a watch, a thermometer, and a stethoscope, to get a sense of how such information varies.

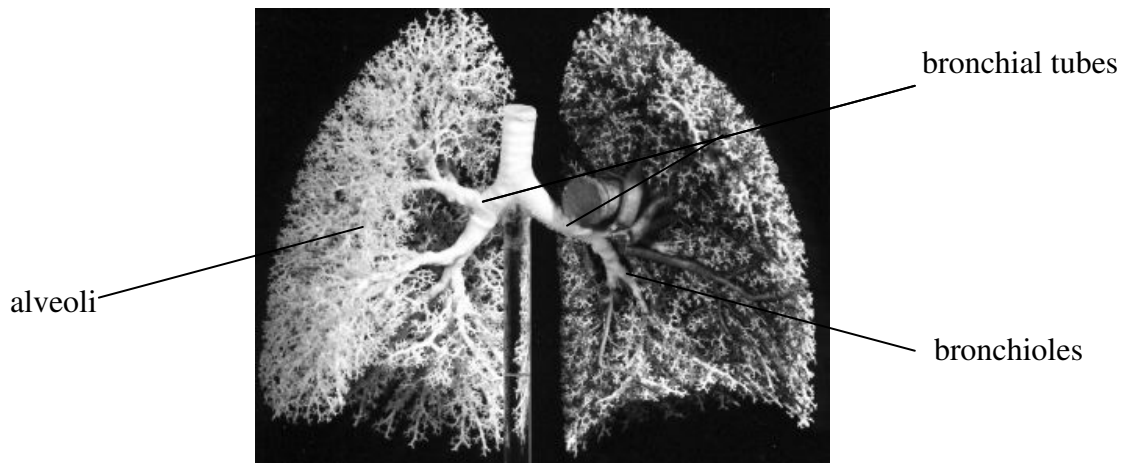
KEY QUESTION

What is your vital lung capacity?

BACKGROUND INFORMATION

All animals need oxygen to live. Land animals get oxygen when their lungs pump in air. When air is inhaled, the diaphragm contracts and drops down to enlarge the chest cavity. At the same time, rib muscles contract and lift the ribs upward and outward. Air rushes in to fill the space. When air is exhaled, the diaphragm relaxes back into its up position, and the ribs settle down. The space shrinks and air is squeezed out of the lungs. Different people have different lung capacities and different breathing rates; what's natural for one person may not be for another. (Note regarding this activity: A person cannot exhale all the air that is in the lungs. The amount that can be exhaled is the vital capacity, although sometimes it is incorrectly called the lung volume. The lung volume is actually all of the air that can be held inside the lungs.)

The lungs are about the size of a pair of footballs, and they fill the chest from neck to ribs. Air passes in through the windpipe, which divides into two branches, called the bronchial tubes. These divide into smaller tubes called bronchioles. These open into little air sacs called alveoli. You have about 600 million of these spongy sacs. Our breathing **system** allows us to take in air, remove oxygen from it, and exhale a body waste product called carbon dioxide. One's rate of breathing is controlled automatically in the brain.



MATERIALS

Per group

1 plastic tub or basin
 1 plastic, gallon jug
 water
 1 measuring cup or graduated cylinder
 1 permanent marker
 paper towels
 1 bag for used straws
 newspaper
 several metric measuring tapes

Per student

several flexible straws
 science journal
The Human Lungs worksheet
 1 index card

TEACHING TIPS

1. Be sure that each student uses a clean straw!
2. Be sensitive to individual student data. The purpose of the investigation is to show that there are differences in lung capacity due to many factors.
3. Note that there may be some students who can push all of the water out of the gallon jug!
4. This activity is easier to manage if student groups work near a sink area. You may choose to give each group a set of materials, or you may choose to set up only one station near a sink area where each group can take a turn.
5. Before the lesson, have students work with partners to determine their height in centimeters.

ENGAGE

1. Ask students to sit still and count the number of times they breathe out in one minute.
2. Have students compare their breaths per minute to other students' rates. (Note: A line plot would be useful here.)
3. Ask: *Is everyone's breathing rate the same? Why do you think they're different?*
4. Tell students to bend and touch their toes 50 times and then count their breaths for one minute.
5. Ask: *How does exercise affect your breathing rate?*

EXPLORE

1. Instruct groups to cover their table with newspaper. Distribute the other materials to each group.
2. Have each group fill a large basin half full (approximately 6 inches) of water.
3. Students should tape a bag to the table for the disposal of used straws.
4. Show students how to calibrate the jug:
 - Have students use a measuring cup or graduated cylinder to add 400 mL of water at a time to the jug. Using a permanent marker, students should mark the water level along the side of the jug after each addition.
 - Students should continue adding water and marking until the jug is completely filled. (The last addition of water will probably be just a portion of the 400 mL.)
 - Write the calibrations on the jug, starting at the top, with the jug turned upside down.
 - Have students completely fill the jug with water (if it was emptied to write on) and screw on the lid.
5. Students will need to put two straws together by inserting one part of the way into the other to make them long enough.
6. Tell students to tip the jug upside down in the basin so the bottleneck is underwater. Remove the lid.
7. The first student should put one end of the lengthened, flexible straw inside the bottleneck. The student should take a deep breath and exhale as slowly and completely as possible into the straw. Tell students not to exhale too quickly or some of the air will bubble out the sides instead of going up inside the jug.
8. Quickly put the lid back on the jug.
9. Observe the level of the water to determine how much water has been pushed out of the jug by the air that was breathed into it. Record.
10. Students should continue the process until each person has had a chance to determine his/her vital lung capacity. Remember to refill the jug with water each time.

EXPLAIN

1. Discuss:
 - What pushed water out of the jug?* (air that was exhaled into the jug)
 - What would be equal to the amount of air you breathed into the jug?* (The volume of air in the jug is approximately the same as the volume of air that was exhaled.)
2. Have students write their height in centimeters on one side of an index card and their vital lung capacity in milliliters on the other side of the card.
 - Have students stand up and order themselves according to their vital lung capacity.
 - Use the class data to discuss these questions:
 - What is the class range of vital lung capacities?*
 - What is the most frequent vital lung capacity measurement (the mode)?*
 - What is the median?*
 - What is the average vital lung capacity of the class (the mean)?*
 - Next, have students stand up and order themselves according to their height.
 - Discuss: *Are we in the same order for height as we were for vital lung capacity? Does the tallest person also have the greatest vital lung capacity?*

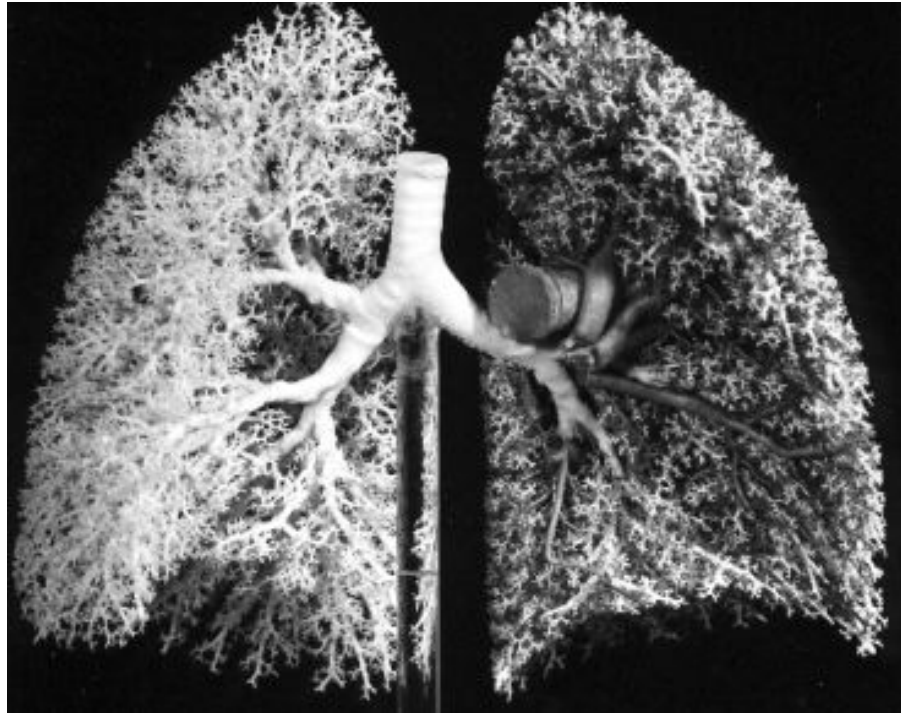
EXTEND/APPLY

Discuss the flow of air through the lungs as students label the picture on the student worksheet.

EXTENSIONS

1. It is a fact that continuous exposure to polluted air or cigarette smoke over a long period of time damages the lungs. One result of this damage is that the lungs slowly lose their ability to absorb oxygen from the air and eliminate carbon dioxide. Contact the American Lung Association for educational materials or request speakers on this topic.
2. Students can investigate exercise and age as factors that influence lung capacity (e.g., How can people keep maximum lung capacity as they age?).

THE HUMAN LUNGS



THE BEAT GOES ON

BENCHMARKS AND TASKS

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

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

- The student knows that processes needed for life are carried out by the cells and that complex animals have specialized organs to carry out life processes.
- The student uses a model to explain the functions of the major organ systems of the human body (e.g., digestive, respiratory, circulatory, skeletal, nervous, muscular, excretory).
- The student collects personal health-related data (e.g., temperature, heart rate) with simple devices such as a watch, a thermometer, and a stethoscope, to get a sense of how such information varies.

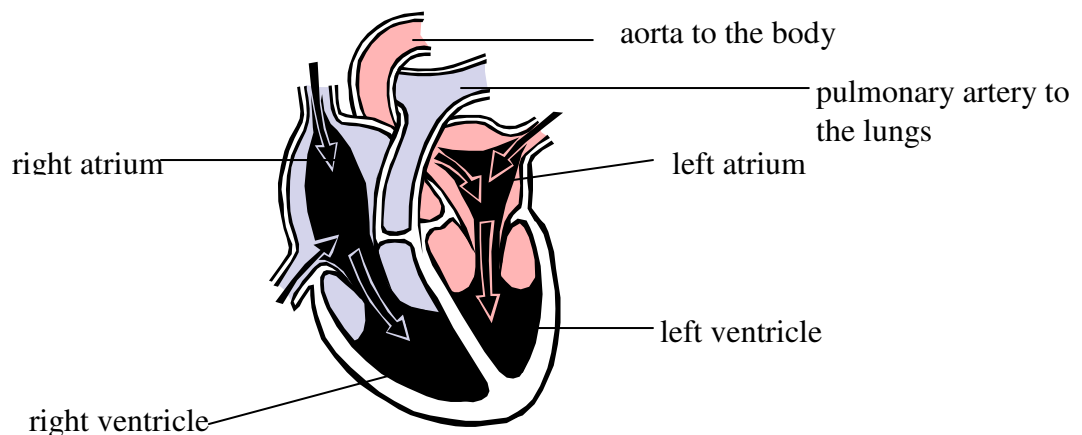
KEY QUESTION

What causes a change in pulse rate?

BACKGROUND INFORMATION

During an average lifetime, your heart, an **organ** the size of your fist, will beat almost 3 billion times. The heart is the strongest muscle in the human body. The heart is located in the center of the chest between the lungs and just under the breastbone.

The heart has four chambers through which blood passes. Both sides of the heart are divided into two chambers. The upper chamber is called the atrium, and the lower chamber is called the ventricle. Blood passes through the right atrium and the right ventricle and then to the lungs, where it picks up oxygen. This oxygen-rich blood is then pumped through the left atrium and the left ventricle and out to the body through the aorta.



When the heart contracts (pumps), it forces blood out into the arteries (tubes that carry blood from the heart to all parts of the body) and the walls of the arteries stretch. As the heart relaxes, the artery walls contract elastically to push the blood along. Each time the heart beats, the artery walls expand and contract once to produce one beat.

You can listen to a heartbeat, but you can feel your pulse. The pulse is caused by blood stopping and starting as it rushes through the arteries. By counting these pulse beats, you can tell how fast your heart beats. A general guide for the pulse rate is: 50-100 beats per minute resting, 90-150 beats per minute after walking, and 160-220 beats per minutes after running. Children's heartbeats are normally faster than adults' heartbeats. A person's resting pulse rate decreases with age.

MATERIALS

Per student

modeling clay
1 wooden match or toothpick
1 calculator
The Human Heart worksheet

Per class

clock/watch with a second hand
model of the human heart

Per group

1 tennis ball

TEACHING TIPS

Show students how to use their fingers to locate their pulse:

1. Begin by putting the tips of the index and middle fingers together side by side on the right hand.
2. Turn the left hand facing you with the palm up.
3. With the two right hand fingertips, trace a path on the left hand beginning at the left thumb all the way up to a point approximately 3.5 cm up the arm from where the wrist begins.
4. Keep the fingertips in an arched position for increased sensitivity. You should now be able to feel a pulse.
5. Do NOT use your thumb to take a pulse as thumbs have their own pulse!

ENGAGE

Have students take turns squeezing a tennis ball to simulate the force needed to squeeze blood out of the heart. If they squeeze 60 times a minute, they will have a good idea of how hard the heart works. The normal resting pulse rate is 50-100 times per minute.

EXPLORE

1. Tell students we can feel our own pulse beat by placing our fingers on a spot where there is an artery close to the surface of the skin. Explain that some arteries are too deep in the body to feel a good pulse beat. Another place to find a pulse is on the side of your throat, just under your chin. This artery is called the carotid artery. Ask students if they can find a pulse any place else on their bodies - face, armpit, elbow, wrist, abdomen, hip joint, knee, or ankle.

2. While students are seated, ask them to count the number of pulse beats in 15 seconds. Have students multiply this number by four to get their resting pulse rate per minute. Have students record this measurement.
3. Have students take a pulse rate again to see if they get the same results.
4. Ask students to walk briskly for one minute and then find their pulse rate again immediately afterwards. Be sure they record the results on their data sheets.
5. Have students run in place for one minute and repeat the procedure.
6. Have students relax and let their pulse rates return to the resting rate. Have them note how long this takes on the data sheet.

EXPLAIN

1. Discuss:
Did all students have the same resting pulse rate? Why?
Did all students have the same pulse rate after exercising? Why?
What was the class range of pulse rates for each activity?
What was the difference in your pulse rates after one minute of brisk walking?
What was the difference in your pulse rates after one minute of running in place?
How long did it take for your pulse to return to its resting rate?
2. Average the students' individual rates to get the average pulse rate for the class - a great calculator activity. Ask: *What was the average resting pulse rate for the class?*

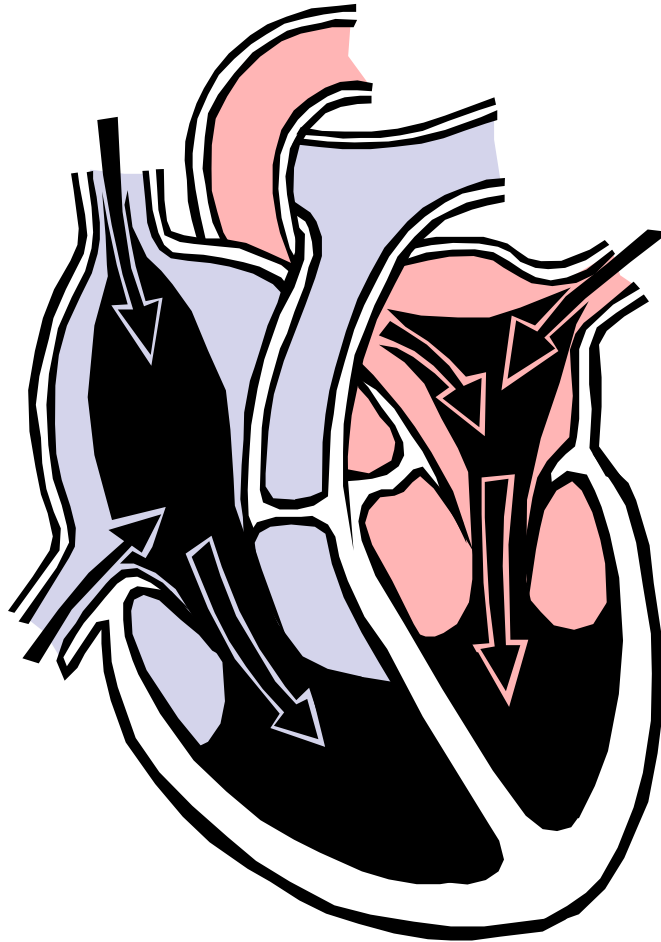
EXTENDAPPLY

1. One way for students to visualize a heart beat is to make a pulse meter.
 - Form a small ball of clay about the size of a dime.
 - Stick a toothpick or wooden matchstick in the clay so that it is facing upwards like a pointer.
 - You may want to color the tip a dark color with a marker so you will be able to see the movement of the pointer better.
 - Place this pulse meter on the pulse spot on your wrist. You may have to move it around to find the best spot. Try the inside of your left wrist on the thumb side.
 - You should now be able to see the pulse meter moving in time with your pulse rate.
2. Use a model of the human heart to help students label the heart on the student worksheet and explain the flow of blood.

EXTENSION

Obtain a stethoscope and have students listen to someone's heart beat.

THE HUMAN HEART



THE BODY'S FILTERING SYSTEM

BENCHMARKS AND TASKS

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

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

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

KEY QUESTION

How are waste products removed from the blood in the kidneys?

BACKGROUND INFORMATION

The job of the excretory **system** is to remove wastes produced by the activities of cells. Many of these wastes are eliminated as liquid urine. Urine is formed by the urinary system, which is made up of the kidneys, the ureters, the urinary bladder, and the urethra.

Kidneys are filters that are located near your spine in the middle of your back. The kidneys perform two jobs. They retain non-waste materials (e.g., proteins, sugar) to be reabsorbed into the blood stream through the circulatory system, and they rid the body of wastes. These waste products are eliminated from the body in the form of urine. This separation is accomplished through a process called filtration. Each kidney is a mass of more than a million filter tubes, called nephrons, where blood is filtered in and then out again. In one minute, more than one quart of blood will make its way through the kidneys. The blood enters the kidney through a large artery and flows into ever-smaller blood vessels. Waste products are collected in these tubes and drain from each kidney to the bladder in the form of urine through tubes called ureters. The bladder is a muscular bag located in the middle of your lower abdomen. The urine enters and is stored in the bladder and exits the body through a single tube called the urethra.

The roles of the excretory system and the digestive system are different in eliminating wastes from the body. Feces are the unusable remains of food you eat. Urine is cellular waste that has been filtered from your bloodstream.

MATERIALS

Teacher

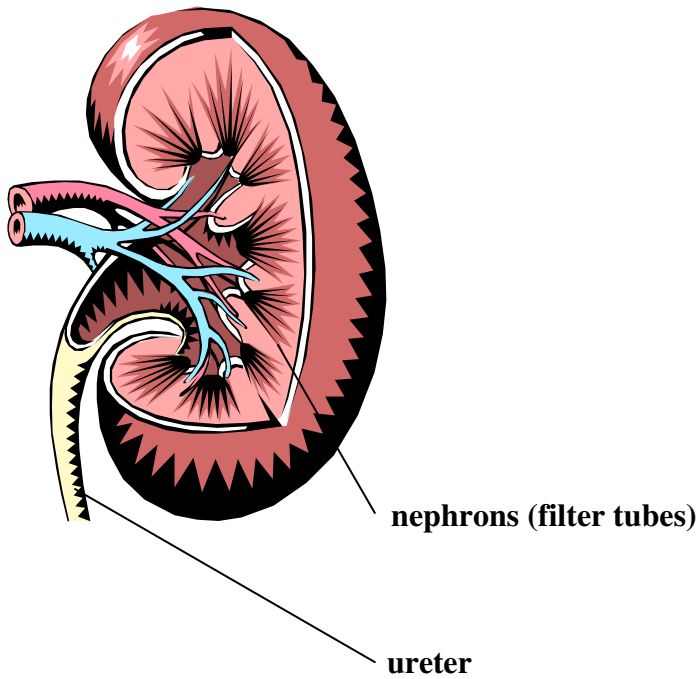
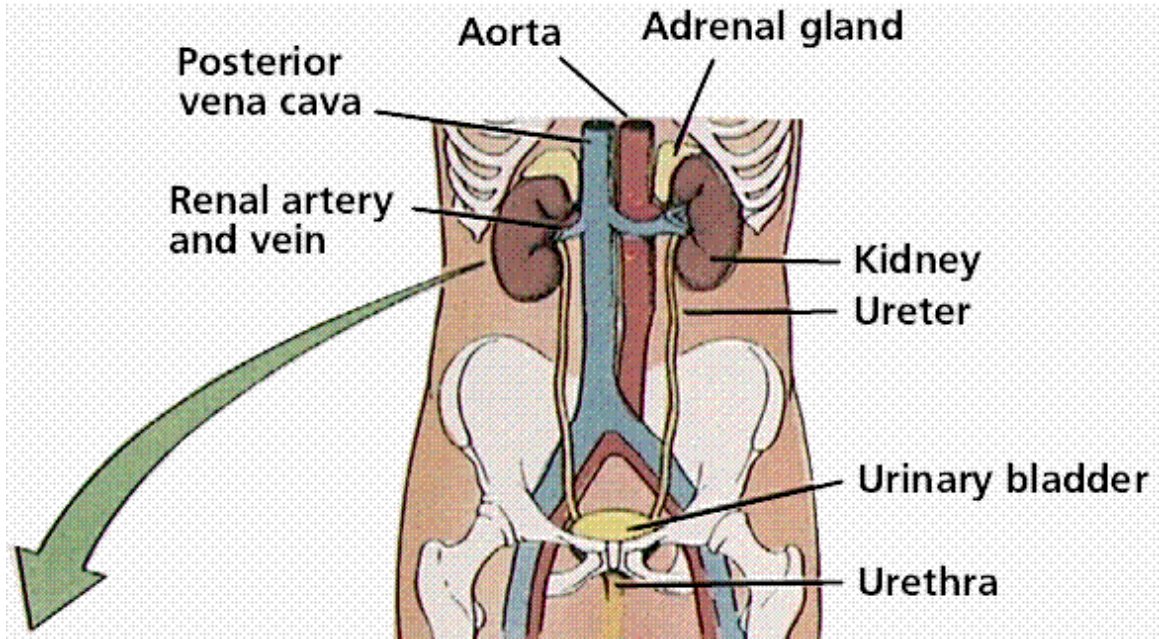
coffee pot and filter (optional)

Per class

model of the human body

Per group

2 plastic cups
food coloring
1 coffee filter
1 piece of chalk
water
1 small spoon
paper towels
1 rubber band



KIDNEY

ENGAGE

Discuss how the body must separate waste products from useful products. Relate to things students have seen filtered in daily life (e.g., coffee, water). Display a coffee filter and coffee pot. Discuss why the coffee filter is necessary because it separates the waste – the used coffee grounds – from the coffee.

EXPLORE

Part 1

1. Use the model of the human body to point out the main parts of the urinary system.
2. Have students draw and label a diagram of the kidneys and bladder. Discuss the function of each part. Clarify and discuss the following terms: kidney, bladder, urethra, ureter.

Part 2

Tell students that they will be demonstrating how the kidneys work as a filtration system for the body. Provide the following directions for each group, along with 2 plastic cups, water, food coloring, coffee filter, spoon, paper towel, and chalk.

1. Pour enough water to fill one cup half full.
2. Add a few drops of food coloring.
3. Crush the chalk on a paper towel.
4. Add ½ spoonful of crushed chalk to the colored water.
5. Place the coffee filter over the top of the second cup and secure with a rubber band, if needed.
6. Slowly pour the colored water mixture onto the filter.
7. Observe the contents of the coffee filter and the cup.

EXPLAIN

What happened in this investigation that is similar to what happens to blood in the kidneys? (The filter separated the waste products from non-waste products.)

Where is the waste product and where is the non-waste product? (The waste product, urine, is in the filter. The non-waste is in the bottom container.)

If the colored water in the bottom container represents the non-waste product found in the urinary system, what will happen to it in the body? (It will be reabsorbed into the body through the circulatory system.)

If what remains in the coffee filter represents the waste product known as urine, what will happen to it in the body? (The urine will pass from the kidneys into the bladder through the ureters. The urine will be stored in the bladder until it is released, and it will then exit the body through the urethra.)

EXTEND/APPLY

Discuss ways to keep the kidneys in good working order. (e.g., Stress the importance of drinking water every day to flush out the body's excretory system.)

ASSESSMENT

Have students answer the key question: How are waste products removed from the blood in the kidneys?

MUSCLE MATES

BENCHMARKS AND TASKS

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

KEY QUESTION

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

BACKGROUND INFORMATION

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

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

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

MATERIALS

Per class

1 meter stick

1 timer

1 roll of heavy string
1 roll of masking tape

1 wide-mouth glass jar
1 rubber band

Per group

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

1 brass fastener
tape
1 hole punch

ENGAGE

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

EXPLORE (Part 1)

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

EXPLAIN (Part 1)

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

What did the two students represent? (muscles)

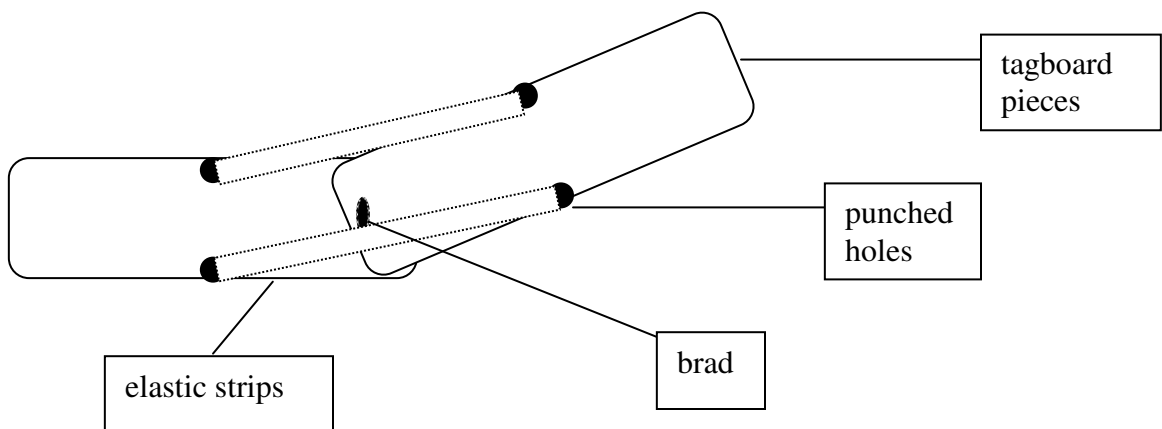
What did getting the stick into the jar represent? (doing work)

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

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

EXPLORE (Part 2)

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



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

EXPLAIN (Part 2)

What do the tagboard pieces represent? (bones)

What do the elastic strips represent? (muscles)

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

What do muscles do for us? (move bones)

EXTEND/APPLY

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

ASSESSMENT

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

DISCOVERIES ABOUT DIGESTION

BENCHMARKS AND TASKS

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

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

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

KEY QUESTION

What path does food follow through the digestive tract?

BACKGROUND INFORMATION

The digestive tract is the body's passageway through which food moves and digests. The digestive tract includes the mouth, esophagus, stomach, small intestine, large intestine, and the anus. Other **organs** that support digestion are the salivary glands, pancreas, liver, and gall bladder.

The digestive **system** physically and chemically breaks down food to supply the body with its **energy** and nutrient needs for growth and repair. The teeth physically break the food into smaller pieces. The tongue moves the food particles into a ball that is swallowed. The food moves down the throat into the esophagus, the food tube that is lined with muscles that help to mix the food and push it down toward the stomach. The stomach, which can hold two to four liters of food, kneads the food, breaking it down more. The stomach also adds chemicals to the food, turning it into a soupy liquid. The food then passes into the small intestine, a narrow tube and the longest part of the digestive tract. The food is then broken down into particles small enough to be absorbed into the bloodstream.

The liver produces bile, which is stored by the gallbladder and then released into the small intestine where it helps to break down the fats. The liver stores the fats and carbohydrates we use for energy along with iron and other vitamins. It also regulates the blood sugar levels in the body. The pancreas produces chemicals that help in the digestion of carbohydrates, fats, and proteins. It also helps to neutralize the stomach acids. The digestive tract is a continuous muscular tube that runs from the mouth to the anus. An adult's digestive tract is approximately nine meters (30 ft.) in length – about five times the adult's height.

MATERIALS

Per student or per group (See Teaching Tips)

1 body cutout from craft paper	construction paper
cash register tape or crepe paper	scissors

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glue

calculator

TEACHING TIPS

1. Give students a piece of craft paper or butcher paper and ask them to have someone at home trace around their body. They should cut this out and bring it to school on the designated day.
2. As an alternative, one student per group could volunteer to create the body outline. Then students could work as a group to create one digestive tract model per group. This would require less space in the classroom.

ENGAGE

1. Ask students to predict how long their digestive tract is from their mouth to their anus. They should cut a piece of cash register tape this length and write their name on it.
2. Next, have students use calculators to determine the actual length of their digestive tracts, using the following measurements:

Mouth to esophagus	10 cm
Esophagus	25 cm
Stomach	15 cm
Small intestine	student's height x 3
Large intestine to anus	student's height + 15 cm
3. Add these amounts to find the total length of the digestive tract.

EXPLORE

1. Have students trace around their bodies on craft paper or have them bring these cutouts from home – as assigned earlier.
2. Have students cut cash register tapes or crepe paper strips about 5-8 cm wide to the lengths listed in the Engage section.
3. The strips can be rolled to form an actual tube. (For the large intestine, two strips can be glued along the edges to form a larger tube.)
4. Students should position the paper strips representing the digestive tract on their body cutouts. Once the strips are in place, students will glue them to the body outline.
5. Have students draw the remaining main organs (stomach, liver, pancreas, and gall bladder) on construction paper and cut them out.
6. They should position the organs on the model, glue them in place, and then label them. Students should label the mouth, esophagus, stomach, liver, pancreas, gall bladder, small intestine, large intestine, and anus.
7. Each group should research the various organs included in the digestive system and be prepared to use the model to trace the path of food through the digestive tract.

EXPLAIN

What is the function of the digestive system? (the physical and chemical breakdown of food to supply the body with energy and nutrients needed for growth and repair)

Where does digestion begin? (the mouth)

Where does digestion end? (Waste products pass from the large intestine through the anus and are expelled from the body.)

What is the role of each organ in digestion? (See Background Information.)

What is the longest organ of the digestive tract? (the small intestine)

Why do you think the small intestine is so long? (There the food is broken down into particles small enough to be absorbed into the bloodstream.)

Approximately how long is the digestive tract in an adult? (about five times the adult's height)

EXTEND/APPLY

Have students determine the average ratio of their heights to the length of their digestive tracts.

ASSESSMENT

Have students answer the key question: What path does food follow through the digestive tract?

BRAIN DRAIN OLYMPICS

BENCHMARKS AND TASKS

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

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

- The student knows that processes needed for life are carried out by the cells and that complex animals have specialized organs to carry out life processes.
- The student collects personal health-related data (e.g., temperature, heart rate) with simple devices, such as a watch, a thermometer, and a stethoscope, to get a sense of how such information varies.

KEY QUESTION

How does hypertension affect the brain and the central nervous system?

BACKGROUND INFORMATION

The nervous **system** is made up of the brain (the major command center), the spinal cord (the nerve highway), and the neurons (nerve cells). The basic job of the nervous system is to assist the body as it reacts to changes in the **environment** and adjust to any necessary changes. It does this by split-second reactions that transfer electrical impulses via neurons along the spinal cord and then transfer this **energy** to the muscles and internal **organs**. When the nervous system is working properly, it coordinates the normal work of your trillions of cells. It monitors your internal operations as well as what goes on in the world outside your body. It senses changes in the environment and makes the necessary adjustments. It keeps things running smoothly and on course. There are, however, times when things can go wrong with the nervous system.

Hypertension, or high blood pressure, is a serious problem that can damage many organs of the body, particularly the brain and the heart. Hypertension can cause the heart to enlarge and become weak. It can cause arteries to become scarred and less elastic. This can lead to the formation of blood clots that can cause heart attacks or possible strokes to the brain. The occurrence of cerebral hemorrhage or stroke reflects the severe stress that is imposed upon the large arteries. The blood that seeps out accumulates, presses upon the delicate brain tissue, and causes damage to brain cells. This damage can cause paralysis, disturbances in speech, sight, and other complex activities.

MATERIALS

Per station

Stations 1-6:

masking tape

stopwatch or clock with second hand

Station 1:

1 man's shirt with buttons

Station 2:

1 large jar of peanut butter

1 plastic knife

loaf of bread

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Per student

Brain Drain Olympics worksheet

Per class

1 bolt with a screw-on nut

paper plates

Station 3:

1 pad of writing paper

1 copy of a poem

Station 4:

scissors

several sheets of paper imprinted with a simple pattern to cut

Station 5:

1 box of paper clips

Station 6:

1 man's shoe with laces and pencil

TEACHING TIP

Set up six stations with the following six task cards:

Station #1: Put on a man's shirt and button all the buttons.

Station #2: Make a peanut butter sandwich.

Station #3: Copy the poem that is provided.

Station #4: Cut out the pattern that is provided.

Station #5: Pour out the box of paper clips onto the desk, pick them up, and put them back in the box.

Station #6: Untie one shoe and put it on. Tie the laces. Untie the laces and remove the shoe.

ENGAGE

Ask for a student volunteer to come to the front of the class. Ask the student if he thinks he could complete a simple task in a very short period of time. Tell the student that you want him to completely screw on a nut to a bolt and then unscrew the nut from the bolt. He must complete this in less than 10 seconds, but the catch is...he cannot use either of his thumbs. He must use only his fingers. Begin timing the student. Once frustration has taken over, discuss why this task was so difficult. Tell students that they are simulating a "nerve" roadblock to completing the task, and they will be investigating several more nerve roadblocks.

EXPLORE

1. Divide the class into groups of four. They will be taking turns at each station as recorders, timers, investigators, and observers.
2. Instruct students to perform the tasks at each station (see Teaching Tips) and time how long it takes to perform these tasks. Record this data on the *Brain Drain Olympics* worksheet.
3. Instruct students to perform the tasks a second time, but this time the student who is performing the task should have his thumb taped securely to his hand so that he cannot use his thumb. (The student who did the task the first time should be the one who repeats it in order to make a comparison.)
4. The students will time how long it takes to perform each activity and record the information on the worksheet.

EXPLAIN

Which task took the longest to perform? (Tasks that required gripping took the longest to perform.)

What problems did you encounter when you performed the tasks with your thumb taped?

Why were the tasks where you couldn't use your thumbs difficult to perform? (We have been programmed since birth to grasp with our thumbs and fingers. Anything that opposes this seems alien.)

EXTEND/APPLY

1. Humans are the only animals that have opposable thumbs. This has enabled the human race to advance and perform to a high degree of efficiency. Have students research monkeys, focusing on their thumbs.
2. Have students research other effects of strokes and share with the class.

BRAIN DRAIN OLYMPICS

TASK	PERFORMANCE TIME (USING THUMBS)	PERFORMANCE TIME (WITHOUT USING THUMBS)
<p style="text-align: center;"><u>STATION 1</u> Put on a man's shirt and button all the buttons.</p>		
<p style="text-align: center;"><u>STATION 2</u> Make a peanut butter sandwich.</p>		
<p style="text-align: center;"><u>STATION 3</u> Copy the poem that is provided.</p>		
<p style="text-align: center;"><u>STATION 4</u> Cut out the pattern that is provided.</p>		
<p style="text-align: center;"><u>STATION 5</u> Pour out the paper clips onto the desk, pick them up, and put them back in the box.</p>		
<p style="text-align: center;"><u>STATION 6</u> Untie one shoe and put it on. Tie the laces. Untie the laces and remove the shoe.</p>		