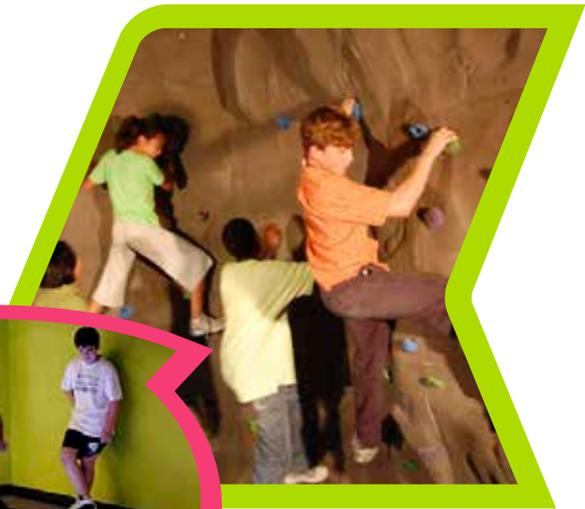
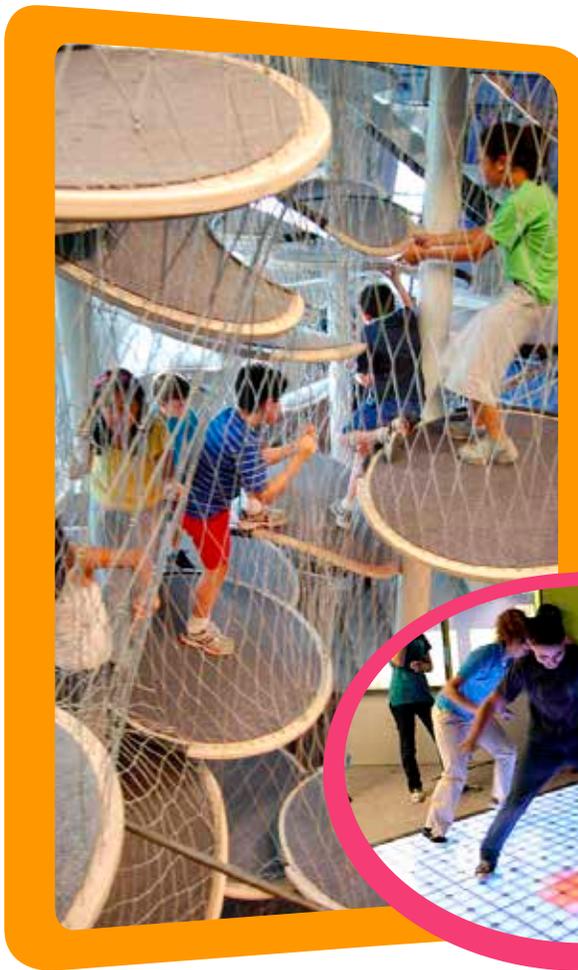


PowerPlay

TEACHER'S GUIDE



Nancy P. Moreno, PhD, Barbara Z. Tharp, MS, and Sonia Rahmati Clayton, PhD

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SAFETY

Follow all school district and school safety procedures. It always is a good idea for students to wash their hands before and after any activity.

Teacher Tips

Follow these guidelines when your students visit the PowerPlay exhibit at the Children’s Museum of Houston (CMH).

- Students must wear tennis shoes.
 - The CMH’s PowerPlay exhibit is on three levels, connected by the Power Tower. Level 2 of the Power Tower is on the main entry level of the Museum. It is suggested that teachers have a chaperone on each level of the Power Tower or have a chaperone accompany each group.
 - An elevator for handicapped children is available (CMH guide will have key). It is suggested that you inform CMH officials about any special needs your students may have before you arrive at the museum.
 - Before your visit, help students understand the difference between heart rate while resting and after exertion, (see “Activity 3. Heart Rate and Exercise”).
 - Also before your visit, explain to students that they will rate (on a 1–10 scale) the amount of effort they expend during some of the activities in the exhibit. This is known as “perceived exertion rate.”
 - Ask the CMH guide for a “Kid Card” (Power Tracker) for each student. To set up a card, each student will need the information below before visiting the Museum (see “Kid Card” video). Please make sure your students are ready to enter the following information (or have a chaperone assist).
 - Username (numbers and letters only)
 - Password
 - Male or female
 - Birthday (numerical date)
 - E-mail (optional)
- As a final step, have students measure their baseline heart rates.

IDEAS FOR TEACHERS WITHOUT ACCESS TO THE CHILDREN’S MUSEUM OF HOUSTON

- Incorporate any of the lessons into your regular curriculum.
- Plan a special “field day” at your school. Prior to the event, conduct the Pre-visit lessons. After the event, use the Post-visit lessons.
- Create a classroom fitness plan that provides one month of activities. Help students plan a calendar with different fitness activities for each day.
- Participate in the President’s Challenge for fitness (www.presidentschallenge.org).

Exhibit Key

	Cardiovascular	Strength	Flexibility	Balance
Power Tower: Climb, leap and jump in a 3-story climbing structure that takes you to other parts of PowerPlay.				
Dance Mania: Listen to music and follow along with different dance moves. Record your heart rate after you play.				
Match My Moves: Capture images of your own body in action and follow the poses you've set through a sequence of quick movements, testing your endurance and raising your heart rate.				
Light Chase: Race around an interactive game board, while increasing your speed and raising your heart rate.				
Jump It Up: Get your heart pumping as you jump over a glowing, virtual rope, which gets faster and faster the more you jump!				
Blast Off: Crank hand pedals as fast as you can to race flying superheroes across the exhibit.				
Adventure Course: Run through a course of climbing and crawling activities along padded, sloping surfaces! Slap each hand whacker along the way and record the level you achieve.				
Mt. Boulder: Face three challenges on a climbing wall and measure how far you've climbed, your grip strength, reach, flexibility and coordination.				
Grip It: Measure your grip strength and record this measurement using your Kid Card.				
Power Course: Grab a scoot and use your upper body strength to push or pull yourself along this wheelchair accessible course.				

PowerPlay

PRE-VISIT

Activity and Exercise

Students practice jumping rope for a week and measure any improvements in their performance. They also predict their levels of “perceived exertion” during physical exercise.

TIME

- 50 minutes the first day
- 10 minutes on each of the next three days
- 50 minutes on the final day

M A T E R I A L S

PER GROUP OF STUDENTS

- Chart paper
- Markers
- Stopwatch

PER STUDENT

- One jump rope for each student (or have students share ropes and work in groups)
- Student notebook to record data

Regular exercise and physical fitness are vital for health and wellbeing, and for building and maintaining healthy bones and muscle. Lack of exercise, especially when combined with poor eating habits, can lead to obesity—a factor known

to increase the likelihood of developing type 2 diabetes—as well as elevated cholesterol levels, high blood pressure, heart disease, asthma, arthritis, and overall poor health. Studies from the United States Centers for Disease Control and Prevention (CDC) indicate that almost half of all Americans between the ages 12 and 21 do not engage in vigorous exercise. Additional reports note that one out of every three American children is overweight or obese,

and that the prevalence of obesity in children aged 6-11 more than doubled in the past 20 years (from 6.5% to 17%). In addition to these physical concerns, obesity can contribute to low self-esteem and negative body image.

Many students know that exercise is “good for you,” but it can be difficult for them to understand how or why. One strategy is to help students realize that exercise can be fun, and that improvement can be measured.

The Children’s Museum of Houston’s PowerPlay exhibit is designed to help young people discover new ways to be physically active, and also to reinforce healthy behaviors. As students progress through the exhibit and participate in various PowerPlay activities, they will be able to measure strength, examine performance levels and track heart rate. In addition, children will be able to track their improvement over time.

During their visit, students will engage in an activity called Jump It Up, using a virtual jump rope. To prepare for their visit to the Children’s Museum, they will examine, in class, different ways to jump rope and chart their performance over the course of a week. Students should complete this activity before the visit.

ENGAGE

1. Begin class by jumping rope or having a volunteer student jump rope in the front of the class. Ask, *Do you think jumping rope could be a form of exercise? Do professional athletes jump rope for training? Why or why not?*
2. Discuss how jumping rope involves muscle movement, coordination and balance. Ask students if practice could improve their performance. Discuss the role of practice.

When a movement is repeated frequently over time, a long-term

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS) OBJECTIVES

SCIENCE

3.2.A; 4.2.A; 5.2.A

Student uses scientific inquiry methods during laboratory and outdoor investigations.

3.4.A; 4.4.A; 5.4.A

Students know how to use a variety of tools, materials, equipment, and models to conduct science inquiry.

HEALTH

3.1.A; 4.1.F; 5.1.E

Students will recognize and explain ways to enhance and maintain health and recognize and perform behaviors that reduce health risks throughout their lifespan.

→ muscle or “motor” memory for the movement is created in the brain. This motor memory allows the movement to be carried out without conscious effort, and increases efficiency. Many kinds of activities are improved with practice. Examples include riding a bicycle, typing on a keyboard, or learning to play a musical instrument. Practice of physical activities also contributes to improved physical fitness and strength.

3. There are many different types of jumps, such as the basic double bounce, basic single bounce, alternate footstep, side straddle, heel exchange, etc. You can find a variety of ideas at the following websites: Children’s Heart Center (childrensheartcenter.com/pdfs/JumpRope.pdf) and the American Heart Association (heart.org/HEARTORG/Educator/FortheGym2/JumpRopeSkills/Jump-Rope-Skills_UCM_001270_Article.jsp).
4. Have students investigate and list as many types of jumps as they can find. Create a class list.

EXPLORE

1. Divide students into groups of 4. Clear a space in the classroom or find an area in the school or playground that has enough room for at least one student to jump rope safely.
2. Instruct each group to lay one jump rope flat on the floor in a straight line.
3. Have students take turns jumping forward and backward across the rope. Next, have each student stand with his/her side to the rope and jump from side to side across the rope.
4. Ask students to practice hopping back and forth across the rope to a drumbeat (or clap). Begin with a slow tempo and speed up gradually.
5. Direct all student groups to practice jumping rope. After they have warmed up, clap your hands and have students jump in time to the rhythm you provide.
6. Instruct students to predict the number of successful jumps they will be able to perform in 15 seconds, and to write down their predictions.
7. Ask students to predict how strenuous (level of exertion) the activity will be, using a scale of 1 (“little or no effort”) to 10 (“extreme effort”) and record their response in their notebook.
8. Have students count the number of jumps they can do in 15 seconds. If a student misses, tell him or her to keep going for the full 15 seconds.

9. Ask the class, *Was the activity easier or harder than you predicted?*
10. Finally, have students jump as many times as they can without missing, and then record the number of jumps in their notebooks. Also have students rate how much effort they expended during the activity, using a scale of “1” (little or no effort) to “10” (extremely high effort). Ask, *Do you think that practice can increase the number of jumps you can make without a miss?* Have students record their daily predictions and actual results.
11. Have students practice the jump rope exercises in steps 9 and 10 each day for the next three days.

EXPLAIN

1. Tell students that they soon will visit the Children’s Museum of Houston. Explain that the Museum has an exhibit, called PowerPlay, which provides a fun way for students to measure their strength, speed and endurance. During their visit to the Museum, students will try a number of activities, including Jump It Up.
2. Have student groups visit the PowerPlay section of the Museum’s website, or show the site to the entire class (www.cmhouston.org/powerplay).
3. Explain that the Children’s Museum has a number of activity stations, where students can monitor their performance on different exercises. Before beginning some activities, students will be asked to predict how difficult or easy they think the activities will be (perceived level of difficulty).
4. At the educator’s request, each student will receive an electronic card with which to track his or her performance at various stations. While at the Museum, each student also may create a username and password that will allow him or her to view his/her record later, from any computer.
5. After their visit, students may access the PowerPlay website to view their results and keep track of other activities they do outside the museum experience.

ELABORATE

1. Explain to students that different physical activities can benefit the body in different ways. Go to the Children’s Museum’s PowerPlay website (www.cmhouston.org/powerplay) and show students the symbols for a) Cardiovascular, b) Lower Body Strength, c) Flexibility, d) Upper Body Strength, and e) Balance (see illustrations, page 3).



- ➔ 2. Ask students why cardiovascular fitness, strength, balance and flexibility are important to their health.
- 3. Have students suggest other physical activities that would be appropriate to exercise the body parts represented by each symbol. Create a class list.

EVALUATE

1. On the final day of the activity, have students repeat the jump rope challenge that they began during the Explore phase of this lesson. Once again, have students take turns jumping rope, and have them count the number of jumps they can do in 15 seconds. If a student misses, tell him or her to keep going for the full 15 seconds.
2. Ask the class, *Was the activity easier or harder this time than before?*
3. Finally, have students jump as many times as they can without missing, and then record the number of jumps in their notebooks. Also have students rate how much effort they expended during the activity, using a scale of "1" (little or no effort) to "10" (extremely high effort).
4. Ask the class, *Were you able to beat the number of jumps you performed on the first day of this activity?* Discuss students' responses as a class. Hopefully, most students will have improved with practice. Ask students if jumping rope got easier or harder over time. Discuss the importance of practice.
5. Have student groups create their own "jump-rope rhymes" or demonstrate some of the different types of jumps they discovered on the first day of the activity. Then, allow groups to demonstrate their rhymes or sample jumps for the rest of the class.

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Look for these symbols to see how the challenges benefit your body.



< Cardiovascular

Lower Body Strength >



< Flexibility

Upper Body Strength >



< Balance

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PowerPlay

PRE-VISIT Body Strength

Students discover that muscles need to work to stay strong.

TIME

- 50 minutes on Day 1
- 5 minutes every other day for two weeks
- 50 minutes on the final day to conduct the activity

M A T E R I A L S

PER CLASS

- Clock with a second hand or timer

PER STUDENT

- Notebook
- Spring-hinged clothespin
- Student sheet

The Children's Museum of Houston's PowerPlay exhibit is designed to help young people discover new ways to be physically active and reinforce healthy behaviors. Students will have opportunities to track their heart rates, measure strength, and examine performance levels.

Students should complete this activity before visiting the Museum. It will help them to focus on ways to 1) measure their performance on different physical activities, and 2) chart their improvement over time.

Exercise includes any activity that requires physical effort, such as walking, running, riding a bike or jumping rope. Our bodies need regular physical activity to be healthy.

Exercise can improve muscle strength and/or stamina (the length of time one can

perform an activity without becoming tired). Low-intensity, long-duration activities, such as running and swimming, increase muscle stamina. High intensity, short-duration exercises, like weight lifting, increase muscle strength.

E N G A G E

Write the word "strength" on the board. Ask students to create an acrostic for "strength" in their notebooks, using words related to fitness and exercise (see "Acrostics," below). Have students share their acrostics during a class discussion.

Acrostics

An acrostic is a paragraph, poem or other text in which the first letter, syllable or word of each line spells out a word or message. For example, an acrostic for the directions of the compass is given to the right.

Never
Eat
Sour
Watermelons

E X P L O R E

1. Explain to students that they will learn about one way to improve hand strength. Mention that even in the hands and arms, there are small muscles responsible for movement.
2. Tell students that they will test the strength and stamina of their hand muscles by squeezing a clothespin with their non-dominant hand (left or right) for one minute.
3. Have students predict the number of times they can squeeze the clothespin in one minute.

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TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS) OBJECTIVES

SCIENCE

3.2.A-F; 4.2.A-F; 5.2.A-F

Student uses scientific inquiry methods during laboratory and outdoor investigations.

3.4.A-B; 4.4.A-B; 5.4.A-B

Students know how to use a variety of tools, materials, equipment, and models to conduct science inquiry.

HEALTH

3.1.A; 4.1.F; 5.1.E

Students will recognize and explain ways to enhance and maintain health and recognize and perform behaviors that reduce health risks throughout their lifespan.

DATE	TRIAL 1		TRIAL 2		TRIAL 3	
	Prediction	Actual	Prediction	Actual	Prediction	Actual

- Instruct students to create a table on which to record their predictions and actual results (see example, page 2).
- Time students for one minute as they squeeze and count silently. They should count only the times they are able to squeeze the clothespin completely (so that the ends are touching). Have them record the results.
- Tell students to rest for a few minutes and then repeat the clothespin "squeeze." Repeat the test at least two more times, and have students record each count on their data tables.
- Instruct students to examine their data. Ask, *How did your hand feel after all three trials? What happened after each trial? How did the number of squeezes change over the three trials?*
- For the next two weeks, have students repeat the exercise at least every other day. During this "conditioning period," students' hand muscles should strengthen, enabling students to squeeze the clothespin more times during each trial. Students should record their results each day.

EXPLAIN

- Ask students if the number of squeezes per minute changed during the two-week period. Ask, *Why do you think this happened?*
- Discuss how exercise increases muscle strength and performance over time.

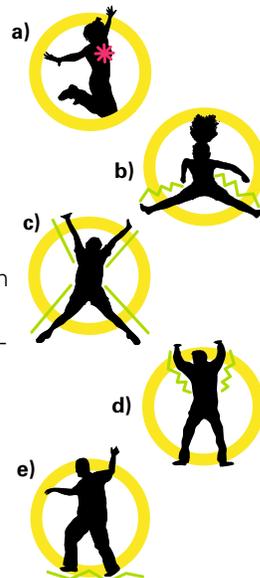
ELABORATE

- To promote deeper understanding of how their strength and endurance increased, have students graph and analyze their results. Have students graph their results to produce a visual representation of changes that occurred in the trials over the course of two weeks.

- They should create separate graphs for each one-minute period and record how the number of clothespin clicks changed over time. This will help students understand how their strength and endurance increased.

EVALUATE

- Explain to students that different physical activities can benefit the body in different ways. Go to the Children's Museum of Houston's PowerPlay website (www.cmhouston.org/powerplay) and show students the symbols on the site for a) Cardiovascular, b) Lower Body Strength, c) Flexibility, d) Upper Body Strength, and e) Balance (see symbols, right).
- Divide students into groups, and have each group create a daily exercise plan focusing on one of the four areas high-lighted on the PowerPlay site. For example, a group might choose to focus on improving upper body strength. That group should be sure to mention the part of the body they are working to improve and how often/ how long a person should exercise to achieve the desired improvement.
- Have each group explain its plan to the class. Then, lead all students in a class effort to develop an exercise plan that benefits the entire body.
- Finally, have each student create a new acrostic for the word, "strength," using the same criteria as before. Have students compare their "before" and "after" acrostics, and discuss whether students incorporated more information about fitness and exercise into their "after" acrostics.



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PowerPlay

PRE-VISIT Heart Rate and Exercise

Students measure their heart rates after a variety of physical activities, and then compare their post-exercise heart rates to their resting rates. They also compare their heart rates to those of the other students in their groups.

TIME

Two class periods of 45 – 60 minutes: one to collect data and a second to process, present and interpret measurements

M A T E R I A L S

PER CLASS OR GROUP OF STUDENTS

- Stopwatch with second hand, watches with second hand, or classroom clock
- CD player or other music player

- One music selection without words that has a strong, up-tempo beat
- One music selection without words that is slow and relaxing

PER STUDENT

- Access to a clock or watch with a second hand (or one stopwatch per team)
- Copies of “Your Pulse Rate” and “Heart Rate Observations” student sheets
- Optional: Lab notebook

Every day, it seems we hear or read about the importance of exercise for heart health. Why? What is the relationship among the heart, circulation, and exercise? The Children’s Museum of Houston’s PowerPlay exhibit is designed to teach young people

about heart health and reinforce healthy behaviors, as students discover new ways to be physically active. While they progress through the exhibit, students will be able to track heart rate, measure strength, and examine performance levels. This activity will enable students to learn how their hearts respond to physical activity. It should be completed before they visit the Museum.

Even when you are sleeping, reading, or watching TV, your body uses oxygen and nutrients, and produces carbon dioxide and other wastes. When you get up and start moving around, your body demands more oxygen and produces more carbon dioxide as waste. These demands increase even further if you start running or doing another strenuous activity. The circulatory system responds by raising the heart rate (how often the pump contracts) and stroke volume (the amount of blood pumped with each contraction) to increase the cardiac output (the volume of blood pumped from the left ventricle per minute). During exercise, heart rate can rise dramatically, from a resting rate of 60–80 beats per minute to a maximum rate of about 200 for a young adult.

A pumping heart makes the sound we call the “heartbeat.” The “lub-dub” of a heartbeat is actually the sound of blood being pushed against the closed, one-way valves of the heart. One set of valves (tricuspid and bicuspid) closes as the ventricles contract. This generates the “lub” of our heartbeat. A second set of valves (pulmonary and aortic) closes when pressure in the ventricles is lower than the pressure in the aorta and pulmonary artery. This produces the “dub” of our heartbeat.

As the heart beats, it forces blood from the ventricles into the muscular, elastic walls of the arteries, causing them to expand. Each artery wall then contracts to “push” the blood onward, further through the body. You can feel those “pulses” of blood, moving

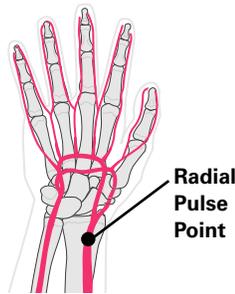
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→ through the arteries in rhythm with your heartbeat. The number of pulses per minute, usually referred to as pulse rate, is measured in beats per minute (BPM). The average pulse rate for a child ranges from 60 to 120 BPM.

ENGAGE

1. Ask students if they know how to measure their heart rate. Distribute copies of “Your Pulse Rate” student sheets.
2. Show students how to measure heart rate (beats per minute) by feeling for the surge of blood surge through an artery. Have each student find his or her pulse by placing slight pressure on the wrist with the middle and ring fingers. Tell students not to use the thumb, because it has a pulse of its own (see illustration, right).
3. Allow students to practice taking their pulse rates several times while you count off 15-second intervals. Instruct students to multiply the 15-second pulse count by four to determine how many times their hearts beat in one minute.



The safest and most common site to check pulse is on the thumb-side of the wrist (radial pulse). Use the middle finger and ring finger together to apply slight pressure at the location shown above.¹

EXPLORE

1. Ask students if they think heart rate can vary, or if it always is the same. Ask, *What kinds of situations might cause heart rate to change?* [exercise, rest, standing, walking up stairs, nervousness, excitement, etc.]
2. Distribute the “Heart Rate Observations” sheets.
3. Review the activity sheet with students, stopping periodically to ask questions and make sure they understand the content.
4. Ask students to complete the prediction section for the first activity listed (i.e., students should check whether they expect their heart rates to increase, decrease or stay the same when they “Listen to soft, slow music”).

¹Pulse site recommended for the general public by the National Heart, Lung, and Blood Institute, National Institutes of Health.

Illustration © Williams & Wilkins. All rights reserved.

Explain that predictions should be made in order, and for only one activity at a time. (The outcome of each activity may influence students’ predictions for the next.)

5. Have students sit quietly for one minute. Then, instruct them to count their pulses while you time them for 15 seconds. To establish their resting, or beginning, pulse rates, students should multiply by four the number of pulses they counted in 15 seconds. Have them record their beginning pulse rate numbers on the appropriate lines of their “Heart Rate Observations” sheets.
6. Have the class sit quietly and listen to soft music for one minute. Then, have all students measure and record their pulse rates once again. Continue to lead students, as a class, through the first three activities on the sheet. During the deep breathing exercise, make a point of telling students when to inhale and exhale, to ensure that they maintain a very slow pulse rate. Instruct students to continue this pattern of slow breathing as they take their pulses.
7. Have students complete the remaining activities listed on the sheet, in order. Each student may work with a partner, if desired. Remind students to record their pulse rate predictions before each step. Students should apply anything they learned from previous experiences when making each new prediction.
8. Be sure students have sufficient time to regain their resting pulse rates before beginning each new activity. You may wish to have them record how long it takes to return to their resting heart rates. (Pulse rates will recover more quickly if students are seated.) Some students’ heart rates may fall below their resting rates before returning to normal. This is common.
9. Be sensitive to students who may feel uncomfortable doing jumping jacks or sit-ups in front of the class.
10. Instruct students to complete the written questions below the table on the activity sheet.

EXPLAIN

1. Have students form groups of four. Each group should combine its data, create a presentation of its collective results (graph, table, pictures, etc.), and present its findings to the class.
2. Ask, *What have you learned about heart rate?* Students should have observed that heart rate increases during more strenuous physical activities.



- ➔ 3. Ask, *What happened to your breathing during activities that increased your heart rate?* Students should have noticed that breathing rate and volume of air taken in increased when the physical activity became more demanding.
- 4. Help students to understand the relationship between the body's need for more oxygen during exercise and the heart's effort to deliver that oxygen (by pumping blood more quickly).

ELABORATE

1. Ask students, *Why would an athlete have a slower resting heart rate than a non-athlete?* Discuss the normal resting heart rate for an average adult (72 BPM), compared to the following average resting heart rates in beats per minute.

a. Weightlifter	65 BPM
b. Football Player	55 BPM
c. Swimmer	40 BPM
d. Marathon Runner	40 BPM
2. Ask, *Why would a slower heartbeat during rest indicate a healthier heart?* Explain that regular exercise strengthens the heart, and that a well-conditioned heart can pump the same amount of blood with fewer beats. Cardiovascular exercise (such as swimming and running) also increases the size of cardiac muscle cells and the heart chambers, which actually causes the heart to grow larger. Therefore,

even with a lower number of beats per minute, a healthy, fit heart pumps more blood than a heart that is not accustomed to exercise.

3. To achieve the best health, we must make exercise a lifestyle, not a temporary fitness "kick." Studies have found that non-activity for as little as three weeks can reduce heart muscle size and stroke volume (amount of blood pumped from the left ventricle in each contraction).

EVALUATE

To conclude the activity, have students write a journal entry describing what they learned about the connections between activity intensity and heart rate. Students should complete the following statements, and may want to draw pictures to accompany their words.

- I discovered...
- I learned...
- I never knew...
- I was surprised...
- I enjoyed...

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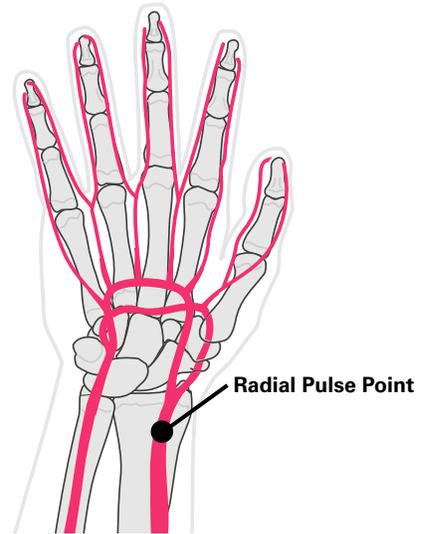


YOUR PULSE RATE

You can measure your heart rate by taking your pulse. Each pulse you feel in your wrist represents one heartbeat.

To feel your pulse, lightly press your ring and middle fingers against the inside of your wrist (see illustration, right). Do not use your thumb, because it has a pulse of its own. What do you think happens to your heart rate after different kinds of physical activity? You're about to find out, as you observe the response of your pulse rate to a variety of activities.

1. Sit quietly for one minute. Then, measure your resting heart rate by counting your pulse for 15 seconds.
2. Multiply the number of pulse beats by four to calculate the number of beats per minute.



_____ beats in 15 seconds x 4 = _____ (Beats Per Minute)



HEART RATE OBSERVATIONS

Before starting each activity listed in the table below, predict how that activity will affect your pulse rate by checking the appropriate box. Then, carry out each activity for one minute. Stop and immediately take your pulse for 15 seconds (multiply by four to obtain the number of beats per minute). Be sure to do the activities in order, and to make only one prediction at a time.

Before starting each new activity, sit quietly until your heart rate is close to your resting rate. Calculate the difference between your resting pulse rate and your heart rate after each activity. Record the difference in the appropriate column.

TYPE OF ACTIVITY (Conducted for 1 Minute)	PREDICTED EFFECT OF ACTIVITY ON PULSE RATE (CHECK ONE BOX)			PULSE RATE IMMEDIATELY AFTER ACTIVITY (Beats Per Minute)	DIFFERENCE BETWEEN RESTING PULSE RATE AND RATE AFTER ACTIVITY (BEATS PER MINUTE)		
	Increase	Decrease	Same		Increase	Decrease	Same
1. Listen to soft, slow music							
2. Listen to fast music							
3. Breath deeply							
4. Walk briskly around the room							
5. Do jumping jacks							
6. Do sit-ups							
7.*							

*Record activity of your choice.

- How do the different activities affect your heart rate?
- How do your predictions compare to your actual data?
- What did you discover? Were there any surprises? How will you present your findings to the class?

PowerPlay

PRE-VISIT

Gravity and Muscles

4

Students learn about the body's center of gravity, and how the body adjusts to the force of gravity to remain balanced.

TIME

10 minutes for set-up; 60 minutes to conduct activity

M A T E R I A L S

PER GROUP OF STUDENTS

- Light-weight chair or stool
- Copy of the "Balancing You" student sheet

Gravity places a heavy load on the human body. But good direction from the nervous system and coordination among muscles in the back, legs, ankles and feet enable us to counteract the downward pull of gravity and remain balanced and upright.

To balance itself, the body makes continual tiny corrections to maintain its center of gravity over the feet, an imaginary point within the body at which there is balance and from

where the weight on all sides is equal. Fortunately, the muscle adjustments necessary to maintain balance and posture are directed automatically by the nervous system.

The Children's Museum of Houston's PowerPlay exhibit is designed to reinforce healthy behaviors and help young people discover new ways to become more physically active. This activity will help students to begin understanding how one's "sense of balance" affects his/her ability to do physical

activities. It should be completed before students visit the Museum.

ENGAGE

1. Ask students, *Do you usually fall over when you're walking, riding a bicycle or standing on a bus? Why or why not?* Encourage students to think about how the body coordinates balance. Ask, *Do you need muscles to keep your balance? Would your skeletal system alone be able to keep you upright?*
2. Explain that students will investigate balance and stability while learning how living things use muscles and body position to maintain balance

EXPLORE

1. Ask students what our "center of gravity" is, and if it ever changes. Ask, *How do you keep yourself from falling when you trip? How do you maintain your balance when you're standing in a moving train or bus?* Tell students that they will be exploring their own centers of gravity in two different ways.
2. First, have students in each group take turns standing up from a seated position in their chairs, and then record the results on their data sheets. Ask, *How easy was it to stand up?* (very easy)
3. Have students try again to stand up from a seated position in a chair. This time, however, have them do so without leaning forward. Once again, students should record their results.
4. Next, instruct one student to stand with feet shoulder-width apart. Have a second student place a lightweight

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS) OBJECTIVES

SCIENCE

3.2.A-F; 4.2.A-F; 5.2.A-F

Student uses scientific inquiry methods during laboratory and outdoor investigations.

3.4.A-B; 4.4.A-B; 5.4.A-B

Students know how to use a variety of tools, materials, equipment, and models to conduct science inquiry.

3.4.A-B; 4.4.A-B; 5.4.A-B

Students investigate the effects of gravity

HEALTH

3.1.A; 4.1.F; 5.1.E

Students will recognize and explain ways to enhance and maintain health and recognize and perform behaviors that reduce health risks throughout their lifespan.

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→ chair 15 cm in front of the first student. Instruct the first student to try to pick up the chair and then record his/her results. Then have students switch roles and repeat the process.

5. Tell students to move to the periphery of the room and place their heels, hips, back and shoulders against the wall, and keep their feet flat on the floor. Have students take turns attempting to pick up the chair. They should record their results.



EXPLAIN

EXPLAIN

1. Discuss students' results, and ask the class to identify the differences between the two trials of each experiment. Ask, *Why do you think it was not possible to stand up when you didn't move your shoulders? Why was it impossible to pick up the chair while you were standing against the wall?* Help students understand that in both cases, needed changes in balance could not be made because their body movements were limited.
2. Discuss gravity again. Ask, *Does gravity affect people? Do people have a center of gravity? Have you ever observed changes in a person's center of gravity?*
3. Have students think about where their centers of gravity are when they are sitting in chairs, and how things change when they begin to stand up. As their weight shifts from their seats to their feet, their centers of gravity must change also.
4. Have students consider where their centers of gravity are when they lift a chair. The chair adds weight to the body, which must then compensate for that weight by moving the center of gravity.
5. The body changes the center of gravity and achieves balance by moving the hips backward. This is why students were unable to pick up a chair when their backs were against a wall.

6. Have students repeat these two experiments, this time paying close attention to their partners' body movements.



ELABORATE

1. The body and muscles constantly adjust to compensate for the pull of gravity. Some of the adjustments are large, like those made when we pick up a chair, but many are very subtle, almost unnoticeable.
2. Have students work in pairs. Each student should observe the movements of his or her partner as he/she performs certain tasks, such as moving from a two-footed stance to standing on one foot, walking heel-to-toe, squatting, or standing on tip-toes.



EVALUATE

1. Tell students to imagine a person standing in the aisle of a subway or bus, with nothing to hold on to.
2. Have student groups discuss and describe what would happen to the passenger when the vehicle begins to move, comes to a stop, or turns a right-hand corner. Without finding something to hold on to, how could the person keep from falling down?
3. Students should realize that the passenger could spread his/her feet out to keep from falling over. Ask, *What does this movement accomplish?* (It widens the person's "base" and adjusts his/her center of gravity.)

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BALANCING YOU

Experiment 1: From a sitting position

1. Sit in a chair and try to rise to a standing position. Switch places so your partner also can try. Record your results in the box next to Question "A," right.
2. Again, sit in a chair and try to rise to a standing position, but this time, do not let your shoulders move forward. Switch places with your partner so he or she can try. Record your results in the box next to Question "B," above.

EXPERIMENT 1	RESULTS
A. Stand up from a seated position.	
B. Stand up from a seated position (without leaning forward).	

Experiment 2: From a standing position

3. Stand up straight and have your partner place a chair 15 cm in front of you. Try to pick up the chair. Switch places so your partner can try, and then record your results in the box next to Question "C," right.
4. Repeat Step 3, but this time, stand with your heels, hips, back and shoulders flat against a wall. Then let your partner try it. Record your results in the box next to Question "D," above.

EXPERIMENT 2	RESULTS
C. While standing, pick up a chair.	
D. While standing with heels, hips, back and shoulders flat against the wall, pick up a chair.	

5. What happened during parts B and D?
6. Did you expect this result? Why or why not?

PowerPlay

PRE-VISIT
**Walk
the
Talk**

5

Students learn that physical and mental activities can be improved with practice by repeatedly walking while reciting a poem.

TIME

One 30-minute
class period

M A T E R I A L S

PER STUDENT

- Science notebook

The Children’s Museum of Houston’s PowerPlay exhibit is designed to reinforce healthy behaviors and help young people discover new ways to become more physically active. By introducing students to new activities that require practice to master, this investigation will help students experience the differences between well-learned movements that seem almost automatic and new movements, which require

more concentration to do well. The activity should be completed before your class visits the Museum.

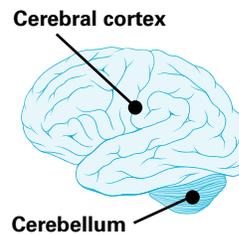
Many of the body’s movements happen without our having to think about them. Some of these automatic movements, such as breathing, beating of the heart, and movement of food through the digestive system, help to keep our body functioning properly. Other actions, such as reaching down to pick up a pencil or walking across the room, require us to make a conscious decision. Movements like these are called

voluntary, because we—or more specifically, the cerebral cortex, or “thinking” part of the brain—must make a decision to carry them out. The cerebral cortex chooses how to

proceed and then sends a signal out along a motor neuron (nerve cell that delivers signals from the brain and spinal cord to the muscles).

These decisions and communications take time. As you become skilled at a given movement, you gradually are able to perform it more

rapidly and smoothly than you could at first. Well-learned movements are guided by another part of the brain, called the cerebellum. Eventually, with practice, you can carry out some repetitive, rhythmic voluntary movements without much concentration at all; they become almost automatic. Examples might include walking, running, bicycling, jogging, skating or dancing. The cerebellum coordinates many of these movements, leaving the cerebral cortex free to carry out other jobs. Practice also improves performance in other kinds of tasks that require memory, such as playing a musical instrument or learning a list of names.



ENGAGE

1. Conduct this activity in an area free of obstacles. Have students select and walk quietly with a partner, making a large circle around the perimeter of the space.
2. After a few moments, ask students if it was difficult to walk in the circle. Did they have to practice before they were able to do this?

EXPLORE

1. Ask each set of partners to walk again



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TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS) OBJECTIVES

SCIENCE

3.2.A-F; 4.2.A-F; 5.2.A-F

Student uses scientific inquiry methods during laboratory and outdoor investigations.

3.4.A-B; 4.4.A-B; 5.4.A-B

Students know how to use a variety of tools, materials, equipment, and models to conduct science inquiry.

HEALTH

3.1.A; 4.1.D,F; 5.1.E

Students will recognize and explain ways to enhance and maintain health and recognize and perform behaviors that reduce health risk throughout their lifespan.

3.11.F; 4.11.B; 5.9.D-E

The student recognizes critical-thinking, decision-making, goal-setting, and problem solving skills for making health-promoting decisions.

- ➔ in the circle. But this time, have one student in each pair tell a story or recite a poem (e.g., “Mary Had a Little Lamb” or “Twinkle, Twinkle Little Star”) as they walk together (2–3 minutes). Ask, *Was it difficult to walk and talk?*
- 2. Have students switch roles and repeat step 1, using the same story or poem.
- 3. Next, change the walk for one partner in each pair. Have this person walk two steps forward (so that the heel of one foot is in contact with the toe of the other foot) and one step backward in a straight line, while reciting the same story or poem used before.
- 4. Again, have students switch roles and repeat the previous step.
- 5. Ask, *What was the difference between the two walking patterns? What role did balance have in the walk? Talking? Thinking about the steps?*
- 5. Have students record their impressions of the investigation in their notebooks and draw conclusions about the results. For instance, they should explain which walk was easier, which was most difficult, and why this might be.

EXPLAIN

1. Lead a class discussion about students’ experiences with the two walking activities. Ask students to identify which elements of the assigned movements were most difficult, and why they think this is so. Emphasize that the act of simple walking has been “programmed” into students, so it seems almost like an automatic function. Thus, it was easy to tell a story or poem during “normal”

walking. However, it became harder to recite something when the “thinking” part of the brain was occupied with carrying out the new way of walking.

2. Ask students if they ever have watched a toddler learn to walk. Some students may even have seen video of their own first attempts to walk.
3. Ask students how they could improve their performance on this activity. Encourage them to consider if/how practicing might help.

ELABORATE

Over a period of several days, have students practice walking in a straight line while reciting the alphabet backwards. By the end of the experiment, students should observe an increase in speed and accuracy.

EVALUATE

Ask, *What situations can you think of in which it would be very important to be able to walk, run, ride a bicycle, etc., without having to pay attention to those movements?* Have each student write a short paragraph describing one such scenario.

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PowerPlay

POST-VISIT

Human Body Ratios

6

Students practice estimating and measuring in metric units, and investigate the concepts of ratio and proportion as they relate to features of the human body.

TIME

One or two 45-minute class periods

M A T E R I A L S

PER STUDENT

- Student worksheets
- Metric tape measure
- Small mirror

Measuring, an essential skill for all students, is the focus of this Children's Museum of Houston's PowerPlay station (www.cmhouston.org/powerplay), which allows individuals to measure their height and weight. In addition to completing the station, students are encouraged to track changes in their height and weight over time by logging into their own private, web-based PowerPlay accounts (www.powerplay-houston.org).

Have you ever heard the sayings, "Once around the waist, twice around the neck," or "Once around the neck, twice

around the wrist?" In this activity, students will investigate simple proportional relationships among the measurements of various body parts. For example, consider the following correlations for an average adult (may vary somewhat for children).

- Total height is equivalent to 7 to 7.5 heads tall
- Nose length is equivalent to first two digits of index/pointer finger

- Head is approximately four to five eyes wide
- Length of face is equal to length of hand
- Eyes are separated by one eye's width
- Bottom of nose to outside corner of eye is equal to length of ear
- Length of foot is equal to length of forearm
- Waist to neck ratio is 1 to 2 (waist is twice the circumference of the neck)
- Neck to wrist ratio is 1 to 2 (neck is twice the circumference of the wrist)

ENGAGE

1. Ask students, *How long is your foot? Did you know there is a way to estimate this length without even looking at your foot? Does anyone know the secret?*
2. Call a volunteer student to the front of the room. Measure the length of that student's forearm. Then instruct each student measure his/her own forearm in the same way.
3. Have students compare their forearm measurements to the heel-to-toe length of one of their feet. The two measurements should be very close.
4. Ask students if they think other body parts might have similar sizes, or if there might be other predictable ratios between the sizes of different body parts. Mention that students will investigate a number of body measurements and determine some possible relationships among them.

EXPLORE

1. Before beginning, review with the class how to use a tape measure.
2. Distribute the "Estimates and Measures" student sheet. Have each



TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS) OBJECTIVES

SCIENCE

3.2.A-F; 4.2.A-F; 5.2.A-F

Student uses scientific inquiry methods during laboratory and outdoor investigations.

3.4.A-B; 4.4.A-B; 5.4.A-B

Students know how to use a variety of tools, materials, equipment, and models to conduct science inquiry.

3.2.B; 4.2.B; 5.2.B

Students collect data by observing and measuring using the metric system and recognize differences between observed and measured data.



student estimate his or her height in centimeters and record that number on the first line in the "Estimate" column. Next, instruct students use a tape measure to measure their height accurately and record that number on the appropriate line in the "Actual" column.

3. Have students estimate, then measure the next body dimension (arm span) listed on the student data sheet. Students should continue in this manner until all measurements are completed.
4. Direct students to look for patterns and relationships among their measurements. For instance, ask, *How does the length of your nose compare with the width of the first two digits of your pointer finger?*



E X P L A I N

EXPLAIN

1. Ask, *Did the estimates you recorded for the size of each body part become more accurate as you continued making measurements? Why might this be the case?*
2. Ask students if any of their measurements are equal, half, double, or 1.5 times the length of any of the other measurements. (For example, the length of most people's foot is equal to the length of their forearm.) *If so, what are they?*
3. Have the class form student groups of 4. Have each group calculate and record the average measurement of each body part for their group in the "Group Average" column and then compare the team average to individual



E L A B O R A T E

ELABORATE

1. Distribute the "Human Body Ratios" student sheet. Have students use information from the "Actual" column in the "Estimates and Measures" student sheet to complete column one.
2. Ask students if they notice measurement patterns and



E V A L U A T E

EVALUATE

1. At 2.72 meters (8 ft, 11 in.) in height, Robert Pershing Wadlow was the tallest man in recorded history. Ask students, *Based on the relationship of one body part to another on your completed "Human Body Ratios" sheet, what would his estimated arm span and head size be?*
2. Ask students if they ever have heard the old saying, "Once around the waist, twice around the neck; once around the neck, twice around the wrist." Have them ~~determine if this statement is true for themselves and~~ other members of their groups.

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ESTIMATES AND MEASURES

Name: _____

Individual Estimates and Measures (in centimeters)

1. Estimate the measurements of different parts of your body and record them in the "Estimate" column below.
2. Use a tape measure to determine the actual measurements of the same body parts. Record the numbers in the "Actual" column.

ITEM	ESTIMATE (in cm)	ACTUAL (in cm)	GROUP AVERAGE (in cm)
Total height			
Arm span			
Length of head (from crown to base)			
Length of nose			
Length of first two digits of pointer finger			
Width of eye			
Width of head			
Distance between eyes			
Distance from bottom of nose to outside corner of eye			
Length of ear			
Length of foot			
Length of face (from hairline to chin)			
Length of hand			
Waist circumference (distance around)			
Neck circumference			
Wrist circumference			

Group Averages (in centimeters)

Calculate the average measurement of each body part for your entire group. Record your results in the "Group Average" column. Do you see any common measurement patterns or relationships?

MEASURING BODY PARTS

Total height: Have a partner measure from the bottom of the foot to the top of the head.

Arm span: With arms spread out, measure the distance between the fingertips.

Height of head: Measure from the bottom of the chin to the top of the head.

Length of top two digits index/pointer finger: Measure from the fingertip to the second line (joint).

Eye width: Measure from corner to corner.

Head width: Measure across from ear to ear (not the distance around the head).

Distance between eyes: Measure from the inside corner of both eyes.

Length of hand: Measure from the top of the wrist to the fingertips.

Circumference: Measure the distance around a circular object, such as a person's waist, neck or wrist.



HUMAN BODY RATIOS

Name: _____

- Use the actual measurements from your “Estimates and Measures” page to complete the list below. The value for each item listed in the left column below is equal to “1.” The answer given for the first item is “2,” because the circumference of the neck is twice the circumference of the wrist (or a ratio of 1 to 2).

Neck circumference = 2 **Wrist circumference**

Total height = _____ Length of head (from crown to base)

Total height = _____ Arm span

Length of nose = _____ Length of first two digits of pointer finger

Width of head = _____ Width of eye

Length of face = _____ Length of hand

Width of eye = _____ Distance between eyes

Length of ear = _____ Distance from bottom of nose to outside corner of an eye

Length of foot = _____ Length of face (from hairline to chin)

Waist circumference = _____ Neck circumference

- Do you notice any patterns or relationships between each pair of measurements?

PowerPlay

POST-VISIT

Body Mass Index (BMI)

Students investigate how Body Mass Index (BMI) values are calculated and how the information can be used in research.

TIME

Two 45-minute class periods

M A T E R I A L S

PER STUDENT

- CDC's Child and Teen BMI Calculator (<http://apps.nccd.cdc.gov/dnpabmi>) and CDC's Children's BMI Tool for Schools (http://www.cdc.gov/healthyweight/assessing/bmi/childrens_bmi/tool_for_schools.html)

Note: If you do not have Internet access, see "Explore," item 4 on page 2.

- Computer with Internet access
- Student worksheets

During their visit to the PowerPlay exhibit, students were asked to measure their body weight and height. But accurate measurements are just one part of an investigation. The ability to interpret and make sense of the information gathered is at least as important. This skill requires careful examination and analysis of data, and a capacity to draw solid conclusions based on the evidence available. In this activity, students will calculate body mass index (BMI),

using measurements of height and weight for six different fictitious individuals. Although BMI is not a direct measure of body fatness, it is a fairly reliable indicator of a person's fat levels, and an elevated BMI can be a sign of future health risks. BMI can be measured in children (aged 2–19), but is interpreted differently for girls and boys of different ages. In addition to calculating their own BMI, students will use data from the Centers for Disease Control and Prevention (CDC) to draw conclusions regarding obesity in the United States.

Results from the 2007–08 National Health and Nutrition Examination Survey, using measured heights and weights, indicate that approximately 17% of US children and adolescents aged 2–19 years are obese. Obese children have an increased risk of heart disease caused by high cholesterol and high blood pressure, Type 2 diabetes, asthma, sleep apnea, and social discrimination.

For additional information, see the following pages on the CDC website: "Overweight and Obesity" (cdc.gov/obesity) and "Make a Difference at Your School" (cdc.gov/healthy-outh/keystrategies/index.htm).

According to the World Health Organization, health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS) OBJECTIVES

SCIENCE

2. B; 4. 2. A-F; 5. 2. A

Collect and record data by observing and measuring, using the metric system, and using descriptive words and numerals. Measure, compare, and contrast physical properties of matter, including size.

3. 4. A; 4. 4. A; 5. 4. A

Students know how to use a variety of tools, materials, equipment, and models to conduct science inquiry by collecting, recording and analyzing information using tools while using appropriate safety equipment.

HEALTH

3. 1. A; 4. 1. D,F; 5. 1. E

Students will recognize and explain ways to enhance and maintain health and recognize and perform behaviors that reduce health risk throughout their lifespan.

3. 11. F; 4. 11. B; 5. 9. D-E

The student recognizes critical-thinking, decision-making, goal-setting, and problem solving skills for making health-promoting decisions.

ENGAGE

1. Ask students to define the word, "healthy." Follow by asking, *What determines if a person is healthy? Can our weight influence our health?*

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- 2. Divide the class into groups of four and have each group compile a list of reasons for being overweight. Every student should provide at least one reason. Record group lists on the board.

EXPLORE

1. Healthcare providers and scientists use a measure, called the Body Mass Index (BMI), to help determine if a person is underweight, normal weight, overweight or obese.
2. Explain that BMI is a fairly reliable indicator of body fatness for most people.
3. Tell students that they will need the following information to determine BMI: weight (pounds or kilograms), height (inches or centimeters), gender (male or female), and age. Students will load these data into the CDC's Child and Teen BMI Calculator (<http://apps.nccd.cdc.gov/dnpabmi>) to determine the BMI for the six individuals listed on the student sheet.
4. If you do not have Internet access, or wish to have students calculate BMI values themselves, use one of the formulas below.

- **English Units (pounds and inches):**
BMI = [weight / (height x height)] x 703
- **Metric Units (kilograms and meters):**
BMI = [weight / (height x height)]

5. Have students calculate the BMI values as a group project or a full class activity. Be sure that students record the BMI value and the Weight Status (underweight, normal, overweight or obese) for each child.

BMI	WEIGHT STATUS
Below 18.5	Underweight
18.5 – 24.9	Normal
25.0 – 29.0	Overweight
30.0 and above	Obese

EXPLAIN

1. It is possible for one person to be more or less healthy than another person of the same height, weight and BMI. For example, have students discuss how the following factors might influence a person's health.
 - Smoking
 - Eating foods high in fats
 - Exercise
 - Disease
 - Age
3. Ask students, *How were BMI values similar for the three boys and three girls listed on the student sheet? How were they different? What conclusions can you draw about the possible health of the six students, based on their BMI values?*
4. Lead a class discussion about the affects of different factors (e. g. , age, gender, genetics, level of physical activity, access to fresh and healthy foods, etc.) on a person's health.
5. Instruct students to create a T-chart with factors that can lead a person to become overweight on one side and factors that promote a healthier weight on the other side.

ELABORATE

Have students examine charts 1 and 2 on the student sheets and answer the questions below each. Discuss their answers as a class.

EVALUATE

Calculate the average height and weight for students in the class, and ask students, either individually or working in groups, to calculate the average BMI for the class. Conduct a discussion about the results. Have students come up with list of changes that people can make in their activities or diet to help improve a BMI that falls within the range of overweight or obese.

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CALCULATING BMI LEVELS

BOYS

Boy 1

Height: 4 feet 8 inches
Weight: 90 pounds
Birth date: January 1989

BMI _____

Weight Status _____

Boy 2

Height: 3 feet 2 inches
Weight: 60 pounds
Birth date: March 1995

BMI _____

Weight Status _____

Boy 3

Height: 4 feet 0 inches
Weight: 90 pounds
Birth date: January 1989

BMI _____

Weight Status _____

GIRLS

Girl 1

Height: 4 feet 0 inches
Weight: 75 pounds
Birth date: January 1989

BMI _____

Weight Status _____

Girl 2

Height: 4 feet 2 inches
Weight: 60 pounds
Birth date: March 1995

BMI _____

Weight Status _____

Girl 3

Height: 4 feet 0 inches
Weight: 90 pounds
Birth date: January 1989

BMI _____

Weight Status _____

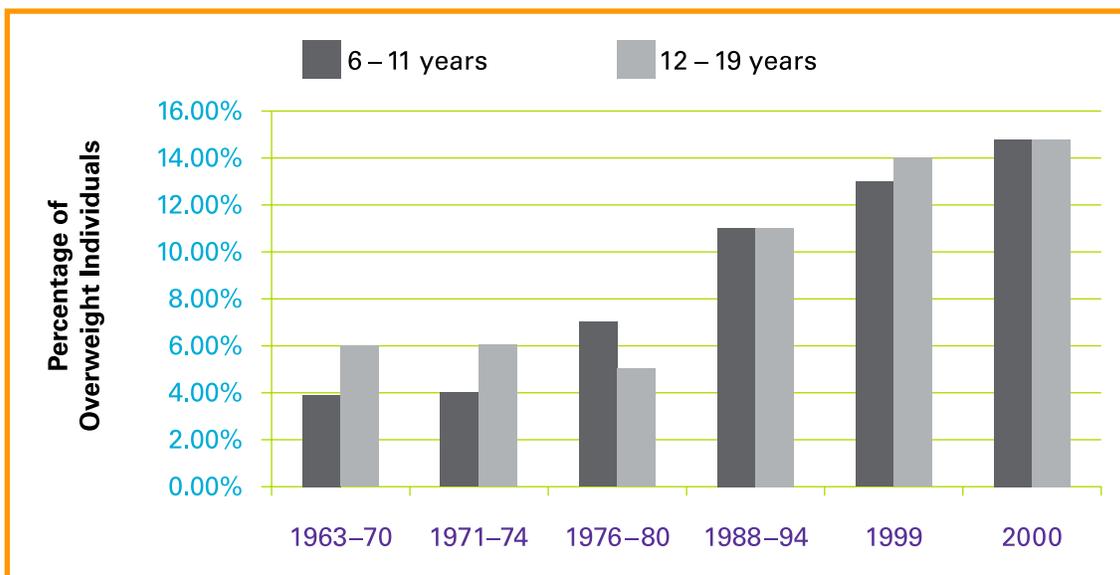
Question for discussion

How did the different BMI values compare?



CHART 1: BY AGE GROUP

Overweight Children in the United States by Age Group
(6 – 11 years of age and 12 – 19 years of age)



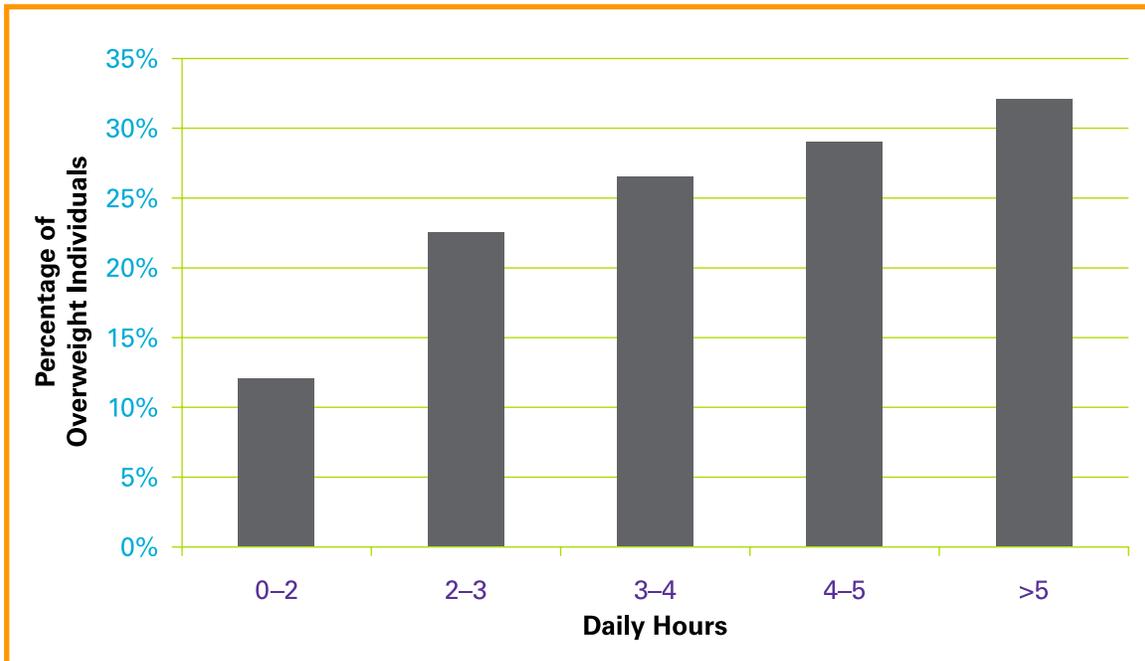
Prevalence of Overweight Among Children and Adolescents: United States, 1999-2000. National Center for Health Statistics, Centers for Disease Control and Prevention (www.cdc.gov).

1. Which age range is represented by the dark gray bars? The lighter bars?
2. How many years are covered by the data in this table?
3. What was the percentage of overweight children, aged 6–11, during 1963–70?
4. How do the percentages change for both groups of students between 1963 and 2000?
5. What do you think the chart would look like if it included data from 2009? Why?



CHART 2: EFFECTS OF TV

Hours of TV Watched and Percentage of Children Who are Overweight
(10 – 15 years of age)



Gortmaker SL, Must A, Sobol AM, et al. (1996). Television Viewing as a Cause of Increasing Obesity Among Children in the United States, 1986-1990. *Arch Pediatr Adolesc Med.* 150 (4):356-62.

1. Based on the information in the chart, who is more likely to be overweight: someone who watches two hours of television per day or someone who watches five hours of television per day?
2. Why might watching television make someone be overweight?
3. How can you reduce the amount of time your family watches television?

PowerPlay

POST-VISIT Water in Your Body

8

Students learn how much water our bodies need each day.

TIME

One 45-minute
class period

M A T E R I A L S

PER CLASS

- Box of food coloring

PER GROUP OF STUDENTS AND DEMONSTRATION

- 3 one-liter containers
- Dishpan or other similar container with a capacity of at least 3 liters

The Children's Museum of Houston's PowerPlay exhibit is designed to help young people discover new ways to be physically active, and also to reinforce healthy behaviors. Water—a unique substance upon which all life depends—is important to both of these objectives. To practice healthy habits, students must be aware of their own needs for water and the importance of water to all life on Earth.

Water is essential, both inside and outside the body's cells. It transports nutrients and other materials, and is

necessary for the removal of waste. Animals lose water through evaporation from lung surfaces and the skin, elimination in feces, and excretion in urine. The water lost must be replaced.

An average human doing light work in a temperate climate loses nearly six pints (three liters) of water daily. Healthy human beings begin to show the effects of water deprivation

(dehydration) after about three days. Death is likely when water loss reaches about 20% of the total volume of water in the body. On the other hand, as long as water is available, it is possible to survive for up to two months without food.

ENGAGE

1. Ask students, *How much water did you drink in the last 24 hours?*
2. Have students record in their notebooks all sources from which their drinking water comes, along with the approximate amount of water consumed each day.
3. Discuss water consumption as a class. Remind students that most foods contain water. For instance, a glass of milk is about 90% water. Tea and Kool-Aid are mostly water, too, as are the cells and tissues that make up living organisms. A tomato is about 90% water, a tree is about 70% water, and an earthworm is about 80% water.

EXPLORE

1. Explain that the body of each student in the class consists of approximately two-thirds water. Water transports food to every cell in the body, helps carry substances in and out of cells, and carries waste out of the body.
2. Have student groups use beakers to measure 3,000 ml of water into a large container. Ask, *What do you think this amount of water represents?* (It is approximately how much water enters a person's body each day.)
3. Conversely, the average adult removes or loses about three liters of water each day.
4. Ask students to list ways in which water is eliminated from the body. Discuss the list. Most students will list urine, but beyond that, few realize



TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS) OBJECTIVES

SCIENCE

3. 2. A-F; 4. 2. A-F; 5. 2. A-F

Collect and record data by observing and measuring, using the metric system, and using descriptive words and numerals.

3. 4. A; 4. 4. A; 5. 4. A

Students know how to use a variety of tools, materials, equipment, and models to conduct science inquiry by collecting, recording and analyzing information using tools while using appropriate safety equipment.

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- ➔ that water also is lost through breathing, perspiration and excretion of solid waste.
- Have students estimate how much of the 3,000 ml of water we lose each day is lost through each process.
 - Direct student groups to fill each of the three, one-liter containers with the amount of water they think is lost each day through breathing, sweating, urination, or excretion of feces. Tell students that they have only three bottles because more than 1,000 ml are lost through one of the four processes listed above. They should estimate how much we lose through that final process and leave that amount in their large dishpan or container.
 - Have students record the amounts they predict are eliminated by each process.

EXPLAIN

- After students have recorded their estimates, conduct a demonstration. Fill each demonstration container with the amount of water listed below. You may use food coloring to tint the water, if desired.
 - 150 ml (eliminated by the intestines)
 - 1,500 ml (lost in urine)
 - 600 ml (lost through evaporation from breathing)
 - 750 ml (lost through perspiration)
- Tell students that your containers represent the actual amount of water lost daily from the body through sweating, urination, breathing, and excretion of feces. Hold up one container at a time and ask, *What water elimination process might be represented by the water in this container?* After students have discussed possible answers, confirm the correct response, and pour the water into a clear tub.

- Explain that during a typical day, we consume 1,200 ml of water in our foods and another 1,500 ml in our drinks. We gain another 300 ml of water as a by-product of the chemical breakdown of food.

ELABORATE

- Explain that an average adult human can live up to two months without food, but only about three days without water. Ask, *Why do you think our bodies can live so much longer without food than they can without water?*
- Have students investigate unique characteristics and strategies that help desert-dwelling organisms to conserve water.
- Have students investigate water sources used by desert-dwelling people.

EVALUATE

- Instruct groups to create a strategy to replace the 3,000 ml of water lost by the body each day. Note that about half of the water we need each day can come from food, and that about 300 ml of water per day is produced inside the body, as energy is released from food. Have groups share their ideas with the rest of the class.
- Ask, *If you went on a trip through the desert and had to survive only on what you could carry, what would you bring, and in what amounts?* Have students explain their answers.

Funded by a Science Education Partnership Award (SEPA) R25RR022697, from the National Center for Research Resources, a component of the National Institutes of Health.

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PowerPlay

POST-VISIT

Food: What Is a Calorie?



All animals, including humans, are consumers, which means they obtain food by eating other organisms. Students learn that people derive their energy from the food that they eat; that this energy is measured in a unit, called a calorie; and that different foods provide different amounts of energy.

TIME

15 minutes
for setup; 45
minutes for
activity

M A T E R I A L S

TEACHER

- Single-hole punch
- Masking tape
- Pair of scissors

PER GROUP OF STUDENTS

- Prepared soft drink can (bottom half of a soda can with two holes punched out at the top, aligned directly across from one another; cover sharp edge with masking tape; see illustration above)
- Pencil (to be used as a holder for the can)
- Graduated cylinder or beaker (100-ml)
- 6-in thermometer (°C)
- 2 pieces of round, unsweetened oat cereal (Cheerios®)
- 1/2 pecan (no shell)
- Large paper clip
- 2-cm piece of clay
- Matches or lighter
- Safety goggles for each student
- Water
- Copy of student sheet
- Two different food labels
- Nonflammable, flat surface



TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS) OBJECTIVES

SCIENCE

2.9, 3.9, 4.9, 5.9

Organisms and environments. The student knows that plants and animals have basic needs and depend on the living and nonliving things around them for survival.

Living things that cannot harness solar energy through photosynthesis must eat other organisms, or the products of other organisms, as food. The amount of energy stored in food usually is measured in calories, with one calorie defined as the

amount of energy required to raise the temperature of one gram (or one ml of water) of pure water one degree Celsius. The calories shown on most food labels are written with an uppercase "C," which represents one kilocalorie or 1,000 calories.

The Children's Museum of Houston's PowerPlay exhibit is designed to help young people discover new ways to be physically active, and also to reinforce healthy behaviors. Students must be aware of the energy needed for the physical activities they do. They also must understand that different foods provide differing amounts of energy. Carbohydrates, fats and proteins are the main sources of energy in our food. Sugars, starches (such as those in bread, pasta and potatoes), and fiber (in many vegetables, whole fruits and whole grains) are the main forms of carbohydrates. Foods rich in fats include animal and vegetable oils, lard, butter and cream. Proteins, the building blocks of muscles and molecules within cells, are present in meats, eggs, and animal products, as well as in plant materials, like nuts and beans.

Each food group provides different amounts of energy. Fats and oils provide about nine Calories (Cal) per gram. Carbohydrates and proteins each provide four Cal per gram. Excess energy from food is stored in the body as fat.

ENGAGE

1. Ask students to discuss the basic needs of most living things. Make sure students understand that all living things need energy to live. Some organisms (mainly plants) use sunlight to make their own food, but many (including humans) rely on other living things for energy.
2. Have students pair off, and give each pair two different food labels. Instruct students to examine the nutritional information and read the calorie and

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- ➔ nutritional information on each label. Ask, *Do all types of food provide the same amount of energy?*

EXPLORE

1. Challenge students to predict which provides more energy: a carbohydrate-rich food or an oil-rich food.
2. Have one student from each pair collect all materials for his/her team from a central area in the classroom.
3. Direct students follow the instructions on their activity sheets to complete the investigation. They will begin by pouring 50 mL of water into the prepared soft drink can and measuring the temperature of the water.
4. Next, students will create a food holder from the paper clip and clay (see illustration, right). They will hang two pieces of oat cereal on the paper clip and light them from below. They should hold the can by the pencil support, with the bottom of the can about one inch above the flame. If necessary, students should re-light the cereal pieces until they will no longer burn. When the flame has gone out, they should record the final water temperature.
5. Have students repeat the investigation using a piece of pecan that is approximately the same size as the two pieces of cereal together (place on top of the paperclip "holder").
6. Have students follow the instructions on the student page to calculate the approximate number of calories released by the similar volumes of each food.



EXPLAIN

1. Discuss results with the class. Ask, *Which food released more heat when burned? Which food had more calories?*
2. Help students understand that, due to the nature of the chemicals involved, fats and oils are more energy-rich than carbohydrates.
3. Fats are rich sources of energy. Certain fats and oils are

healthier than others. Fats that are solid at room temperature, such as shortening, margarine and lard, should be avoided. In general, these fats are called "saturated" fats. Healthier choices are olive, flaxseed, nut, and fatty fish or canola oils ("unsaturated" fats). "Trans" fats are created by adding hydrogen to vegetable oil (hydrogenation). They are used in many commercially produced foods because they are less likely to spoil and have a longer shelf life. Trans fats are less healthy than many other forms of fat.

ELABORATE

1. The first version of this activity had students compare similar "portion sizes" of cereal and pecan. Have students conduct the investigation again, using similar masses of cereal and pecan.
2. Have students weigh the pieces in advance and adjust the amount of each "fuel" tested to ensure that similar masses of cereal and pecan are compared.

EVALUATE

1. Give each student team two new food labels and ask them to determine the calories provided by each food group described on the labels.
2. Have students record the amounts of saturated fat, trans fat and sugar found in a serving of the food listed on the label.

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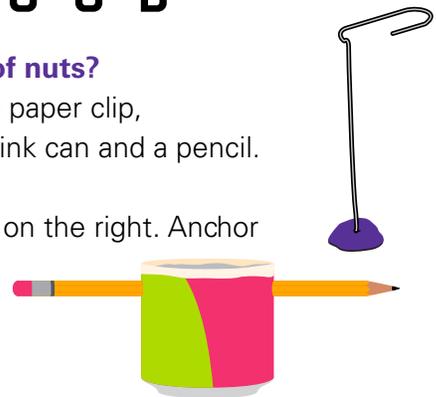


CALORIES IN FOOD

What has more calories, breakfast cereal or a similar-sized portion of nuts?

To find out, you will need a pecan half, two pieces of cereal, clay, a large paper clip, a thermometer, 100 mL of water, matches or a birthday candle, a soft drink can and a pencil.

1. Straighten the sections of a paper clip so that it looks like the image on the right. Anchor the base in the clay, with the curved part of the paper clip in the air.
2. You also will need a soft drink can with the top removed. Slide a pencil through the holes in the sides of the can to make a handle.



Cereal

3. Add 50 mL of water to the can. Measure the starting temperature of the water and record your result in the box to the right.
4. Hook the cereal pieces on the paper clip. Carefully light the cereal from below using a match or candle.
5. Hold the can of water by the pencil, about one inch above the top of the flame. If the cereal stops burning, light it again until it won't burn any more. Measure the temperature of the water again and record the result.
6. How many degrees did the temperature of the water change? Record your answer.

CEREAL	
Starting water temperature:	°C
Final water temperature:	°C
Change in temperature:	°C

Pecan

7. Repeat steps 3–6 using the pecan piece. Place the pecan on top of the paper clip. After the pecan is completely burned, record the water temperature in the box to the right.

PECAN	
Starting water temperature:	°C
Final water temperature:	°C
Change in temperature:	°C

How many calories?

A calorie is the amount of energy needed to raise the temperature of one mL of water by one degree Celsius. To find out how many calories were given off by each food, multiply the change in temperature in degrees by 50. Record your answers below.

Total calories: Cereal _____ Pecan _____

PowerPlay

POST-VISIT Serving Sizes

10

Students estimate serving sizes of different foods and compare their estimates to serving size information provided on food package nutrition labels.

TIME

15 minutes
for set-up; 45
minutes to
conduct the
activity

M A T E R I A L S

TEACHER

- 3 large containers of dry sample foods
- 2-liter bottle of regular soft drink
- 2 identical packages of each of the following: frozen peas, dry breakfast cereal, popped popcorn

Note: Remove the Nutrition Facts labels from all the food items. Create a “Nutrition Facts Labels” page by pasting all of the labels onto a sheet of paper (eliminate duplicate labels).

TEXAS ESSENTIAL KNOWLEDGE AND SKILLS (TEKS) OBJECTIVES

SCIENCE

3.2.A-F; 4.2.A-F; 5.2.A-F

Student uses scientific inquiry methods during laboratory and outdoor investigations by collecting data, constructing charts and graphs, analyzing and interpreting patterns in data, repeating investigations for more reliability and communicating conclusions.

3.4.A; 4.4.A; 5.4.A

Students know how to use a variety of tools, materials, equipment, and models to conduct science inquiry.

HEALTH

3.1.A; 4.1.F; 5.1.E

Students will recognize and explain ways to enhance and maintain health and recognize and perform behaviors that reduce health risk throughout their lifespan.

PER GROUP OF FOUR STUDENTS

- 6 paper plates (for dry foods)
- 2 large cups or containers (for liquids)
- 2 measuring cups (one for solids, one for liquids)
- Permanent marker
- Prepared copy of “Nutrition Facts Labels” (see “Note” above)
- Copy of “What is a Serving Size?” sheet
- 4 copies of “Estimates and Labels”

The Children’s Museum of Houston’s PowerPlay exhibit is designed to help young people discover new ways to be physically

active, and also to reinforce healthy behaviors. Healthy food choices are important to both objectives. Food labels and other guides often use “serving size” to describe a recommended single portion of a food. However, serving sizes vary among different kinds of foods (liquid versus solid food, and cooked versus raw food).

Frequently, the serving size listed on a food Nutrition Facts label—and the portion size actually eaten—are larger than the serving sizes suggested by other guides to healthy eating, such as the USDA Food Pyramid. Serving sizes provided on food labels are designed to make it easier for consumers to compare the calorie, carbohydrate and fat content of similar products, and to identify the nutrients present in a food. Used appropriately, food labels can help us to make better food choices.

ENGAGE

1. Ask students, *What is a serving size?* Use their answers to guide the class into a discussion of food portions.
2. Explain that food portions usually are measured in terms of “cups,” pieces or other units. Show students the measuring cups they will use to measure dry and liquid foods. Point out that each unit commonly used in cooking can be translated into standard international (metric) units, such as liters or grams.

EXPLORE

1. After discussing food portions and serving sizes, challenge students to predict the serving sizes for the liquid and solid foods that you provide.
2. Have one student from each group pick up the materials for his or her group. Give each group a copy of the

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- ➔ “What is a Serving Size?” sheet. Have students follow the instructions on their activity sheets to label their plates and cups, and then predict appropriate portion sizes for each of the four foods.
- After students have recorded their estimates, allow each group to measure out and place the corresponding amount of each food into the cup or onto a plate labeled “Estimate.”
 - Give each group a copy of the “Nutrition Facts Labels” page.
 - Help students find the manufacturer’s suggested serving size on each food label. Then, have students measure out and place one serving of each food (as indicated on the label) into the cup or onto a plate marked “Food Label.” Have students observe and compare the amounts they estimated to be one serving size with the amounts actually listed on the food labels.

EXPLAIN

- Allow each group to share its findings with the rest of the class.
- Distribute a copy of the “Estimates and Labels” sheet to each student.
- Help students find other relevant information on the Nutrition Facts labels, such as details for diets with different caloric needs, and amounts of important nutrients in the food.
- Point out the “Quick Hand Measures” of portion sizes shown on the sheet. Ask, *Do you think food labels can help you make better decisions about what and how much to eat?*

ELABORATE

To learn about “hidden sugar” in different foods and drinks, have students compare the amounts of sugar listed on the

nutritional labels of fruit juices, soft drinks, cookies, cereal, baked goods and other foods (4g of sugar = 1 tsp).

EVALUATE

- Ask students to bring in all types of food labels over the next week.
- Provide an assortment of labels to each group. Using the labels provided, have each group identify the food that fits each of the following categories.
 - Most fat per serving
 - Least fat per serving
 - Most calories per serving
 - Least calories per serving
 - Most protein per serving
 - Least protein per serving
 - Most carbohydrates per serving
 - Least carbohydrates per serving
 - Most sugar per serving
 - Least sugar per serving
- Discuss the results as a class.

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WHAT IS A SERVING SIZE?

Have you ever wondered what the appropriate serving sizes are for different foods? In this activity, you will investigate the serving sizes for the foods displayed in your classroom. To get started, you will need six plates and two cups. Label three of the plates and one cup as "Estimate." Mark the remaining three plates and one cup as "Food Label."

Serving Sizes: Estimates

1. Write the name of each food under the "Food Name" column on Table 1.
2. For each food, estimate how many cups (or fractions of cups) make up one serving. Record your estimates on the table.
3. Take the plates and cup labeled "Estimate" to the station where the foods are displayed. Also bring this sheet with your serving size estimates. Measure out what you estimated as one serving size of each food onto a plate or into the cup.

Table 1. Estimates

Food Name	Estimate one serving of this food. Use cups as a measure.

Serving Sizes: Nutrition Fact Labels

1. Look at your copy of the food Nutrition Facts labels. Write the name of each food under the Food Name column on Table 2.
2. Find the serving size recommendations on each Nutrition Facts label. Write that serving size for each food in the appropriate space on Table 2.

Table 2. Nutrition Facts Label Recommended Serving Size

Food Name	Nutrition Facts label serving size. Use cups as a measure.

Serving Sizes: Measurements

1. Take the plates and cup marked "Food Label" to the food station. Measure out the appropriate amount of each food, based on its Nutrition Facts label. Put each portion on a plate or in the cup.
2. Compare the amount of food in your initial serving size estimates to the serving sizes recommended by the Nutrition Facts labels. Describe any differences on the back of this sheet.
3. Based on the information you collected in this investigation, why do you think it might be important to look at the serving sizes listed on food labels? Record your answer on the back of this sheet.



ESTIMATES AND LABELS

Serving sizes often are smaller than the portions we actually eat.

Look for low levels of saturated, hydrogenated and trans fats. These are unhealthy.

Cholesterol is found in foods of animal origin.

Look for foods that have more carbohydrates as fiber and fewer as sugar. Only foods from plants provide fiber.

Protein is important for muscles and growth. It is found in animal and plant foods.

Vitamins and minerals are essential for health. Calcium is important for bones and teeth.

Use this section as a guide for daily planning. The amount of calories needed by each person depends on many factors, including exercise. Foods with high amounts of saturated fats or sugars may not be the best choices.

Refried Beans Fat Free

Nutrition Facts

Serving Size 1/2 cup (125g)
Serving Per Container 3.5

Amount Per Serving	
Calories 130	Calories from Fat 0
% Daily Value*	
Total Fat 0g	0%
Saturated Fat 0g	
Trans Fat 0g	0%
Cholesterol 0mg	0%
Sodium 490mg	20%
Total Carbohydrate 24g	8%
Dietary Fiber 7g	28%
Sugars 0g	0%
Protein 9g	16%
Vitamin A	0%
Vitamin C	0%
Calcium	6%
Iron	15%

* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories: 2,000	2,500
Total Fat	Less than 65g	80g
Sat Fat	Less than 20g	25g
Cholesterol	Less than 300mg	300mg
Sodium	Less than 2,400mg	2,400mg
Total Carbohydrate	300g	375g
Dietary Fiber	25g	30g

Quick Hand Measures

Use the Quick Hand Measures to estimate the size of one serving of different foods.



A closed fist

=

Piece of fruit or cup of raw vegetables



Two fingers

=

Ounce of cheese



A cupped hand

=

Cup of dry cereal



An open palm

=

Single serving of meat



Tip of thumb

=

Teaspoon of butter

