

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 stop watch 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

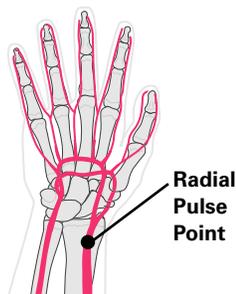
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→ through the arteries in rhythm with your heartbeat. The number of pulses per minute, usually referred to as pulse rate, is measured in beats per minute (BPM). The average pulse rate for a child ranges from 60 to 120 BPM.

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.

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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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The activities described herein are intended for school-age children under direct supervision of adults. The authors, Baylor College of Medicine, the Children's Museum of Houston and funders cannot be responsible for any accidents or injuries that may result from conduct of the activities, from not specifically following directions, or from ignoring cautions contained in the text.

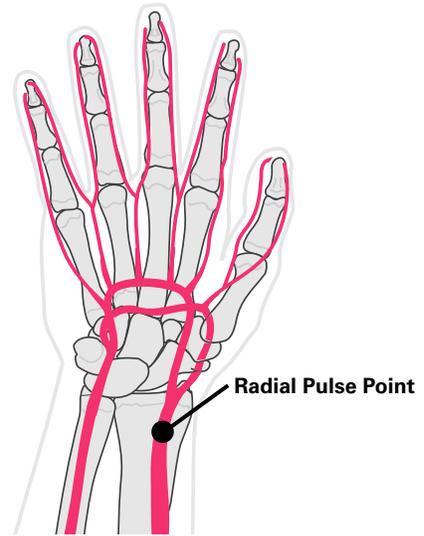


YOUR PULSE RATE

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.

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

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.				

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