

In a Heartbeat

Skills: Math, Science, Health, Language Arts, Music

Objective: Students will measure their heart rates at rest and after physical activity.

Background

The heart is a muscle about the size of your fist. It is a pump that delivers oxygen, through the blood, to the tissues. It beats, without stopping, for an entire lifetime. In an adult, each heartbeat pumps about 55-80 milliliters (ml) (1/3 cup) of blood. The average child's heart pumps around 25-85 ml per beat. The average adult heart pumps about 6,000-7,500 liters (1,500-2,000 gallons) of blood each day, although that amounts to only about 5 quarts continuously circulated.

During each heartbeat, the muscles of the heart contract, causing a wave of pressure which forces blood through the arteries. This wave of pressure is known as a pulse. There is one pulsation for each heartbeat. The pulse can be felt at various points on the body where the arteries are just under the skin—the temples, neck, crook of the elbow, wrist, groin, back of the knee, and the inside back of the ankle. The normal pulse rate varies with age.

The best place to feel your blood pulse is at the carotid artery and the radial artery. To find the carotid artery, place your index and middle finger just below the angle of the jaw. To find the radial artery, place your finger on your thumb, slide it up, just above your wrist and gently press.

When you are at rest, about 5 liters of blood per minute flow through your heart. When you exercise, your body needs more oxygen, causing about 20 liters of blood per minute flow through the heart. The heart can beat up to 200 times per minute with extreme exercise. The brain sends nerve signals to the heart to control the rate. The body also produces chemical hormones, such as adrenaline, which can change the heart rate. When we are excited, scared, or anxious, our heart gets a signal to beat faster. During a fever, the heart beats faster to bring more blood to the surface of the body to release heat and cool the body. The heart rate increases during and after a meal to send more blood to the digestive system.

A trained athlete's heart can pump more blood with each beat so his or her heart rate is slower. Likewise, an athlete's recovery time is shorter.

There are two ways the heart can meet the body's need for oxygen during exercise. It can beat faster or it can beat harder, moving more blood per pump. But it can only beat harder if it has been strengthened through regular exercise.

Doctors use an instrument called a "stethoscope" to listen more closely to

P.A.S.S.

GRADE 3

Health—I.11; 6.4

Physical Activity—4.2,3

Math Process—1.1,2,3;
4.4; 5.1

Math Concept—3.1,2a;
4.4; 5.1a

Science Process—3.2,3,
4.3

Physical Science—1.3

Music—1.1b; 3.3,4

GRADE 4

Health—I.11; 6.4

Physical Activity—4.5

Math Process—1.1,2,3;
4.4; 5.1

Math Concept—3.1,4c

Science Process—3.1,2,3;
4.1

Music—1.4b, 3.3,4

GRADE 5

Health—I.8,11; 3.10; 6.1

Physical Activity—3.4; 4.2

Math Process—1.1,2,3;
4.4; 5.1

Science Process—3.1,2,3;
4.1

Music—3.7

Materials

1 cardboard tube from a paper towel roll per every 2 students

1- stopwatch per every two students.

your heart. The stethoscope was invented in 1816 when a young French physician named Rene Theophile Hyacinthe Laennec was examining a young female patient. Laennec was embarrassed to place his ear to her chest, which was a method used by physicians at that time. He remembered a trick he learned as a child, that sound travels through solids, so he rolled up 24 sheets of paper, placed one end to his ear and the other end to the woman's chest. He was delighted to discover that the sounds were not only conveyed through the paper, but they were also louder and clearer.

Laennec preferred to have his instrument simply called "Le Cylindre," as he thought naming such a fundamental instrument was unnecessary. He disliked all the names it was being given by his colleagues and decided that if it should be called anything, it should be "stethoscope," from the Greek words for "I see" (scope) and "the chest" (steth).

Laennec then took his idea further. He set up a small shop in his home, with a wood-turning lathe and many different materials. He created a stethoscope from a turned piece of wood that was hollow in the center. It was made of two pieces. One end had a hole to place against the ear, and the other was hollowed out into a cone. There was a third piece that fit into this cone which had a hollow brass cylinder placed inside it. This piece was placed in the stethoscope to listen to the heart, and removed to examine the lungs.

Language Arts

1. Read and discuss background.
2. Brainstorm all the ways we use the word "heart" (heart-throb, heart-break, heartless, heart-to-heart, heartsick, heart-rending, take to heart, know by heart, hearty, heartfelt). Discuss the meanings of all these expressions.

Health

1. Help students locate their pulse points on their wrists and their necks, using the information found in the background.
2. Hand out the cardboard tubes, and have students pair up and listen for their partners' heartbeats.
 - Place the tube over the partner's heart.
 - Count the number of beats per 30 seconds.
 - Double this number to find out how many times each minute the person's heart beats.
 - Have one partner run in place for one minute, then listen again.
 - Students will write down what they hear and calculate the new beats per minute.
 - Subtract the first number from the second number to determine how many more beats per minute the heart beats after exercise.
 - Have the partners switch and repeat the process.
 - Have students try a variety of activities—walking all the way around the playground or around the school, walking or running different dis-

- tances, cleaning the blackboard, etc.—and then count heartbeats again.
- The amount of time the heart takes to return to a normal at-rest rate after exercise is called recovery time. This is a measure of the body's general fitness. The shorter the recovery time, the higher the level of fitness. Determine recovery rate by first measuring and recording the pulse rate at rest. Next, run in place for two minutes. Now measure the pulse rate every minute until the at-rest rate is reached. How long did it take the heart to return to the normal rate?
 - Have students keep a record of their heart rates for one week by taking their own pulse a few times a day, at rest (watching TV or playing video games) and after a variety of activities.
 - Brainstorm some normal activities students can do to increase their heart rate, e.g., cleaning their rooms, sweeping, helping with yard work, etc.
 - Have students compare their heart rates while watching Note time of day and activity at the time.

Science/Math

- To get the most accurate count, you should take your pulse for a full 60 seconds. However, the pulse can be taken for time intervals which are factors of sixty—30, 15, 12, 10, 6 seconds, etc. Have students find their pulse points and count the number of beats for different factors of 60.
 - Select a factor of 60.
 - Count the number of beats in that time period,
 - Multiply the number of beats counted by the corresponding factor to obtain the approximate number of times the heart beats in a minute, e.g., count the number of beats in 15 seconds; multiply the number by four. ($15 \times 4 = 60$, there are 60 seconds in one minute). This is how many times the heart beats in one minute.
- Chart the heart rates of students in the class. Are the heart rates the same or different?
- Find the average heart rate of all the students? (Add up all the heart rates listed and divide this number by the total number of students.)
- Have students collect pulse rates from various adults and list them on a graph. Calculate the average heart rate for adults. How does this compare with the students' average heart rate?
- Try using cardboard stethoscopes to listen for other sounds—through walls, etc.

Social Studies

- Have students research the evolution of the stethoscope and other medical inventions.

Music

Vocabulary

adrenaline—a hormone of the adrenal gland acting especially on smooth muscle, causing narrowing of blood vessels, and raising blood pressure -- called also “epineph-rine.”

artery— one of the tube-shaped branching muscular-walled and elastic-walled vessels that carry blood from the heart to all parts of the body.

carotid artery—one of the pair of arteries that pass up each side of the neck and supply the head.

contract—to make or become smaller.

heart—a hollow muscular organ of vertebrates that expands and contracts to move blood through the arteries, veins, and capillaries

hormone—a product of living cells that circulates in body fluids (as blood) or sap and produces a specific and often stimulating effect on cells usually at a distance from the place where it is made.

muscle—an organ that is a mass of muscle tissue attached at either end to a fixed point (as to bones) and that by contracting moves or stops the movement of a body part.

(Continued on next page.)

1. Have students find their pulses at the carotid or radial artery and tap their heartbeats in 2/4, 3/4, 4/4 and dotted rhythm (quarter note equals one pulse).
2. Have students sing simple songs (“Twinkle, Twinkle, Little Star,” “Mary Had a Little Lamb”) to the pulse of their own hearts.

Online Resource

“Habits of the Heart,” Science Museum of Minnesota,
<http://www.smm.org/heart/>

Vocabulary (Cont.)

oxygen—a colorless tasteless odorless gaseous element that constitutes 21 percent of the atmosphere and is found in water, in

most rocks and minerals, and in numerous organic compounds, and that is essential for animal and plant respiration.

pulse—a regular throbbing caused in the arteries by the contractions of the heart.

radial—relating to, placed like, or moving along a bodily radius (as the bone of the forearm)

stethoscope—a medical instrument used for listening to sounds produced in the body and especially those of the heart and lungs.