**Sweaty Science: How Does Heart Rate Change with Exercise?**

A physical pursuit from Science Buddies

* By [Science Buddies](https://www.scientificamerican.com/author/science-buddies/) on January 2, 2014

**Key concepts**
The heart
Heart rate
Health
Exercise

**Introduction**
Have you ever wondered how many times your heart beats in a day, a month, a year—or will beat in total throughout your life? Over an average lifetime, the human heart beats more than 2.5 *billion* times. For a person to keep their heart healthy, they should eat right, not smoke and get regular exercise. In this science activity, you'll measure your heart rate during different types of physical activities to find out which gives your heart the best workout to help keep it fit.

**Background**
A 150-pound adult has about 5.5 liters of blood on average, which the heart circulates about three times every minute. A person's heart is continuously beating to keep the blood circulating. Heart health experts say that the best ways to keep our hearts healthy is through a balanced diet, avoiding smoking and regular exercise.

Exercise that is good for your heart should elevate your heart rate. But by how much, for how long and how often should your heart rate be elevated? This has to do with how fit you are and your maximum heart rate, which, for adults, is about 220 beats per minute (bpm) minus your age. For example, if you are 30 years old, your maximum heart rate would be 190 bpm. The American Heart Association (AHA) recommends doing exercise that increases a person's heart rate to between 50 to 85 percent of their maximum heart rate. This range is called the target heart rate zone. The AHA recommends a person gets at least 30 minutes of moderate to vigorous exercise—exercise that elevates their heart rate to the target heart rate zone—on most days of the week, or a total of about 150 minutes a week.

**Materials**
• Scrap piece of paper
• Pen or pencil
• Clock or timer that shows seconds or a helper with a watch
• Comfortable exercise clothes (optional)
• Simple and fun exercise equipment, such as a jump rope, bicycle, hula-hoop, two-pound weight, etc. Alternatively you can do exercises that do not require equipment, such as walking, doing jumping jacks, jogging in place, etc. You will want to do at least two different types of exercises, both of which you can sustain for 15 minutes. (Remember to always stop an exercise if you feel faint.)
• Calculator

**Preparation**
• Practice finding your pulse. Use the first two fingers of one hand to feel your radial pulse on the opposite wrist. You should find your radial pulse on the "thumb side" of your wrist, just below the base of your hand. Practice finding your pulse until you can do it quickly. (You can alternatively take your carotid pulse to do this activity, but be sure you know how to safely take it and press on your neck only very lightly with your fingers.)
• Measure your resting heart rate, which is your heart rate when you are awake but relaxed, such as when you have been lying still for several minutes. To do this, take your pulse when you have been resting and multiply the number of beats you count in 10 seconds by six. This will give you your resting heart rate in beats per minute (bpm). *What is your resting heart rate?* Write it on a scrap piece of paper.
• You will be measuring your heart rate during different types of physical exercises over a period of 15 minutes. Choose at least two different exercises. Some examples include jumping rope, lifting a two-pound weight, riding a bike, hula-hooping, walking, etc. Gather any needed materials. (If you want to make a homemade hula-hoop, steps for doing this are given in [the activity Swiveling Science: Applying Physics to Hula-Hooping](https://www.scientificamerican.com/article.cfm?id=bring-science-home-hula-hoop-physics) .) *Do you think the activities will affect your heart rate differently? How do you think doing each activity will affect your heart rate?*

**Procedure**
• Choose which exercise you want to do first. Before starting it, make sure you have been resting for a few minutes so that your heart is at its resting heart rate.
• Perform the first exercise for 15 minutes. While you do this, write down the number of beats you count in 10 seconds after one, two, five, 10 and 15 minutes of activity. (You want to quickly check your pulse because it can start to slow within 15 seconds of stopping exercising.) *How do the number of beats you count change over time? How did you feel by the end of the exercise?*
• Calculate your heart rate after one, two, five, 10 and 15 minutes of exercise by multiplying the number of beats you counted (in 10 seconds) by six. *How did your heart rate (in bpm) change over time?*
• Repeat this process for at least one other exercise. Leave enough time between the exercises so that your heart rate returns to around its normal resting level (this should only take a few minutes). *How did you feel by the end of the second exercise? How did your heart rate change over time for this exercise?*
• Take a look at the results you wrote down for this activity. *Which exercise increased your heart rate the most? Which exercise increased your heart rate the fastest? Which exercise(s) elevated your heart rate to the target heart rate zone (50 to 85 percent of your maximum heart rate, where your maximum heart rate is 220 bpm minus your age)? Do you notice any consistent patterns in your results?*
• **Extra:** Try this activity again but test different physical exercises. *How does your heart rate change when you do other exercises? How are the changes similar and how are they different?*
• **Extra:** Measure your heart rate while lying down, while sitting down, and while standing. *How does your heart rate change with body position?*
• **Extra:** Repeat this activity with other healthy volunteers. *How does their heart rate compare to yours? How does their change in heart rate while exercising compare to how yours changed?*
• **Extra:** Try this activity again but vary the intensity of your exercise. *What intensity level elevates your heart rate to 50 percent of its maximum heart rate? What about nearly 85 percent of its maximum?* Be sure not to exceed your recommended target heart rate zone while exercising!

**Observations and results**
After just a minute of exercise, did you see your heart rate reach its target heart rate zone? Did it initially jump higher for a more strenuous exercise, like hula-hooping, compared to a more moderately intense exercise, such as walking?

If you did a moderately intense exercise, such as walking, you may have seen an initial jump in your heart rate (where your heart rate falls within the lower end of your target heart rate zone within about one minute of exercise), but then your heart rate only slowly increased after that. After 15 minutes, you may have reached the middle of your target heart rate zone. To reach the upper end, people usually need to do a moderately intense exercise for a longer amount of time (such as for 30 minutes). If you did a more strenuous exercise—hula-hooping, for example—you may have seen a higher initial bump in your heart rate (such as reaching the middle of your target heart rate zone after just one minute of exercise), and then your heart rate stayed about the same for the remaining 14 minutes of exercise. Overall doing a more strenuous exercise generally raises a person's heart rate faster compared to doing an exercise that is only moderately intense.

**More to explore**
[Target Heart Rates](http://www.heart.org/HEARTORG/GettingHealthy/PhysicalActivity/Target-Heart-Rates_UCM_434341_Article.jsp), from the American Heart Association
[Cut to the Heart](http://www.heart.org/HEARTORG/GettingHealthy/PhysicalActivity/Target-Heart-Rates_UCM_434341_Article.jsp), from NOVA and PBS
[Life's Simple 7—Get Active](http://www.heart.org/HEARTORG/Conditions/More/MyHeartandStrokeNews/Lifes-Simple-7-Get-Active_UCM_450765_Article.jsp), from the American Heart Association
[Heart Health: How Does Heart Rate Change with Exercise?](http://www.sciencebuddies.org/science-fair-projects/project_ideas/Sports_p006.shtml), from Science Buddies

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