

Blood Pressure and Heart Rate

Each time the ventricles contract, about 70 mL of blood is forced into the arteries. Every time this happens, the pressure is raised throughout the arterial system. This arterial pressure, however, falls as the blood is pushed through the capillaries. Then a new ventricular contraction repressurizes the system. This rhythmic change in arterial pressure is called the pulse and can be felt almost anywhere an artery can be pressed by a finger.

If you exercise vigorously, the rate of your heartbeat, that is, your pulse rate, increases. The amount that it increases depends on how fit you are. A strong heart can pump blood more efficiently than a weak one, therefore, the pulse rate of a physically fit person will not increase as much with exercise as will that of a physically unfit person. One measure of fitness is the Heart Performance Score (HPS).

Blood pressure and heart rate can be affected by the activity the body is performing. In this activity, you will investigate the effect of posture and exercise on heart rate and blood pressure.

Procedure

For all steps, record all data in a table format. Also, collect data for each step for each partner.

Part A - Pulse

Note: For all pulse rate measurements, take the radial pulse for 20 s; then multiply by 3 to get the pulse rate in beats per minute. Resting heart rate can be used as an indicator of cardiovascular fitness. The best time to take resting heart rate is while sitting quietly after a period of inactivity.

1. Make sure you can find the radial pulse in both wrists and in those of your partner.
2. Have your partner use one hand to find the radial pulse and, at the same time, use the other hand to find the carotid pulse. Concentrate carefully, do they occur at the same time?
3. Using a stethoscope, determine whether the carotid pulse corresponds to the first or second heart sound.

Part B - Blood Pressure and Heart rate

4. Measure your blood pressure while sitting quietly.
5. To improve the accuracy of our data, the exercise you should do is running on the spot for the prescribed time. To see any meaningful results, it is very important that you measure heart rate exactly when you are supposed to. Make sure that you and your partner are organized so that you can get the results quickly. Measure and record your heart rate for each of the following conditions:
(i) lying (ii) standing (iii) after 60 s of exercise (iv) after 60 s of rest after exercise
6. Add your data to the class pool so that averages for the class can be calculated.

Part C - Heart Performance Score

7. Calculate your HPS by adding together the 4 pulse rates (lying down, standing, after 60 s of exercise, after 60 s of rest after exercise) plus the difference between your sitting and standing heart rate.
8. Check the chart to see your general fitness level.

Part D - Breathing Rate

9. Sit very still. Count only the number of times you inhale for one minute. Pool your data with the class. Find the average.
10. Run on the spot for 60 s and then count the number of inhalations for one minute. Pool the data with the class and calculate the average.

| HPS | General Fitness Level |
|---------|-----------------------|
| 200-250 | endurance athlete |
| 250-300 | athletic |
| 300-325 | very good |
| 325-350 | good |
| 350-375 | fairly good |
| 375-400 | fair |
| 400-450 | poor |
| 450-500 | very poor |

Part E - Air Inhalation Time

When you inhale, air rushes into the lungs to fill an expanding chest volume. Determine your inhalation time by trying this short investigation.

11. Exhale until you can force no more air out of your lungs.
12. Have your partner measure the time taken for a full inhalation through just your nose. This is not a race so don't try to force the air - just breathe normally.
13. Repeat the previous two steps, this time inhaling by mouth only.

Questions

1. a) Which occurs first, the radial or carotid pulse?
b) Explain why the carotid and radial pulses are not in time with each other?
2. Did the pulse correspond to the first or second heart sound?
3. What is the average breathing rate before and after the exercise? Explain any difference. Account for any difference between your results and the class average.
4. a) Account for the difference between mouth and nose inhalation times.
b) What advantages does mouth breathing have?
c) What advantages does nose breathing have?
5. a) What are the immediate and long term effects of exercise on the heart?
b) Explain what causes the heart to react in this way.
c) How does the body benefit from the change in heart rate during exercise?
d) Describe the effect of resting after exercise on the heart rate.
6. a) Each ventricle pumps out 70 mL of blood with every beat. How many beats are necessary to pump 4.2 L of blood through the heart?
b) How long would this take at your resting heartbeat rate?
c) How long would this take when your body is hard at exercise?
7. a) Research the topic of bradycardia as it relates to the diving response in mammals.
b) What are the advantages in reducing the heart rate while under water?
c) Bradycardia is a medical condition in humans. What are the dangers?

If time permits, you can try the following fitness test:

Step up on to a standard gym bench once every two seconds for five minutes (150 steps)

Have someone to help you keep to the required pace

One minute after finishing the test take your pulse rate (bpm)- Pulse 1

Two minutes after finishing the test take your pulse rate (bpm) - Pulse 2

Three minutes after finishing the test take your pulse rate (bpm) - Pulse 3

Use the calculator below to determine your level of fitness

Excellent: Anything less than 97 beats per minute

Good: 97-127 beats per minute

Fair: 128-142 beats per minute

Poor: 143-171 beats per minute

Very Poor: anything above 172 beats per minute