20. EXERCISE AND BLOOD PRESSURE

How do blood pressure parameters change with exercise?

Objectives

- Determine the effects of exercise on different blood pressure parameters.
- Compare systolic, diastolic, and mean arterial pressures during rest and exercise.

Materials and Equipment

- Data collection system
- Blood pressure sensor with cuff

Safety

Follow these important safety precautions in addition to your regular classroom procedures:

- Do not perform this activity if vigorous exercise will cause discomfort. If you experience discomfort or pain, immediately stop exercise.
- Never pump the cuff above 180 mmHg.
- If student is experiencing pain or discomfort while wearing the blood pressure cuff, release pressure immediately by depressing the push-button release valve and remove the cuff.

Procedure

1. Select Sensor Data in SPARKvue.
2. Connect the blood pressure sensor.
3. Choose Monitoring Blood Pressure from the Quick Start Experiments menu.
4. Work in pairs. One student is in charge of collecting data and keeping track of time while the other student is the *subject*, or the person whose heart rate is being measured. Select a subject who can conduct vigorous exercise without discomfort.
5. The subject should sit comfortably in a chair with legs un-crossed, resting an arm palm-up on a table. The subject must either remove or push away constrictive clothing and jewelry so the arm is uncovered up to the shoulder as shown in Figure 1.
6. Position the blood pressure cuff on the subject's arm as follows:
   a. Find the side of the cuff that has no VELCRO®. Place that side against the skin.
   b. The bottom of the cuff should be about 2 cm above the inner bend of the elbow as shown in Figure 1.
   c. Tighten the cuff around the upper arm. The cuff should feel snug, but not too tight.
   d. Align the subject's brachial artery inside the marked cuff range as shown in Figure 1.

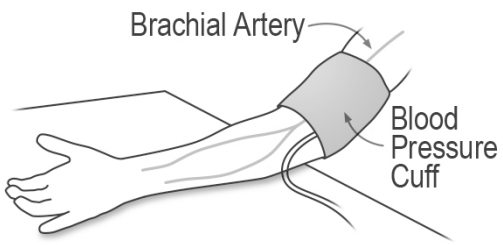

Figure 1: Align brachial artery in cuff range

7. Remind the subject to relax and quietly sit still with the arm in the proper position during data collection. The subject should not look at the data while it is collected.

8. Select Start to begin data collection. Use the graph to monitor pressure while you pump the cuff up to about 170 mmHg. Do not exceed 180 mmHg.

9. Wait up to one minute for data to populate the digit displays. Once systolic and diastolic data appear, stop data collection. Deflate the cuff by depressing the push-button pressure release valve near the bulb.

10. Record systolic pressure and diastolic pressure in Table 1. Systolic pressure is higher as this is the pressure created in your arteries when the ventricles contract. Diastolic pressure is lower as this is the pressure produced in your arteries when the ventricles relax.

Note: If you need to repeat blood pressure measurement, ensure that circulation in the arm and hand have returned to normal before repeating data collection.

11. Have the subject leave the cuff in place and hold the bulb and sensor in their hand, stand up, and find a suitable area to conduct vigorous exercise such as jogging in place or doing jumping jacks for 2 minutes.

12. Have the subject return to the seated position immediately after exercise. Remind the subject to relax and quietly sit still with the arm in the proper position during data collection. The subject should not look at the data while it is collected.

13. Start data collection immediately and pump the cuff up to 170 mmHg.

14. After the digit displays populate, stop collecting data and record systolic pressure and diastolic pressure in Table 1. Deflate the cuff but have the subject remain seated in position for 4 minutes. During this time, the subject should move their arm and hand to "feel normal" while leaving the cuff in place.

15. After 4 minutes, repeat Steps 13-14. Record the results in Table 1 in the 4+ Minutes row.

16. Wait 4 more minutes, repeat data collection, and record the results in Table 1 in the 8+ Minutes row.

17. Wait 4 more minutes, repeat data collection, and record the results in Table 1 in the 12+ Minutes row. The subject may remove the cuff after data collection ends.

18. The mean arterial pressure (MAP) indicates cardiac output and shows the pressure produced when blood consistently delivers oxygen and nutrients to body tissues. Use the following equation to calculate the estimated MAP for all activity levels. Round answers to the nearest whole number and record results in Table 1.

$$\text{MAP} = \frac{[(2 \times \text{diastolic pressure}) + \text{systolic pressure}]}{3}$$

19. The difference between the systolic and diastolic pressure is the pulse pressure, which can indicate artery flexibility. Use the following equation to calculate pulse pressure for all activity levels. Record results in Table 1.

    Pulse Pressure = Systolic Pressure - Diastolic Pressure

20. Share your results with the class. When all class data has been collected, calculate class averages for each activity level and record results in Table 2.

Data Collection

Table 1: Subject's blood pressure and heart rate data*

Activity Level	Systolic Pressure (mmHg)	Diastolic Pressure (mmHg)	Estimated MAP (mmHg)	Calculated Pulse Pressure (mmHg)
Resting				
Immediately After Exercise				
4+ Minutes After Exercise				
8+ Minutes After Exercise				
12+ Minutes After Exercise				

* The blood pressure sensor is meant for educational purposes and should not be used for medical or diagnostic purposes

Table 2: Average blood pressure and heart data among classmates*

Activity Level	Average Systolic Pressure (mmHg)	Average Diastolic Pressure (mmHg)	Average Estimated MAP (beats/min)	Average Calculated Pulse Pressure (mmHg)
Resting				
Immediately After Exercise				
4+ Minutes After Exercise				
8+ Minutes After Exercise				
12+ Minutes After Exercise				

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Questions and Analysis

1. Compare the subject's blood pressure reported as the systolic pressure/diastolic pressure (for example, 121/76 mmHg) and MAP while resting and after exercise. What changes do you observe? Are these changes consistent with the class average?

2. Compare pulse pressure during resting and after exercise. Use your data to explain which blood pressure parameter is responsible for the changes observed.

3. Describe blood pressure and pulse trends observed within class average data from Table 2.

4. Which measurement shows the greatest increase after exercise: systolic pressure, or diastolic pressure? Explain why this measurement must increase.

5. Compare your recovery time to that of your classmates. Support your answer with data and provide at least two reasons for the differences between the two data sets.

6. Describe at least one benefit of tracking blood pressure before, during, and after exercise.