

Blood Pressure as a Vital Sign

Blood pressure is a measure of the changing fluid pressure within the circulatory system. It varies from a peak pressure produced by contraction of the left ventricle, to a low pressure, which is maintained by closure of the aortic valve and elastic recoil of the arterial system. The peak pressure is called *systole*, and the pressure that is maintained even while the left ventricle is relaxing is called *diastole* (see Figure 1).

Mean arterial pressure (MAP) is not a simple average of the two pressures, because the duration of diastole is twice that of systole. MAP is used by emergency room and intensive care unit personnel as a measure of the adequacy of blood supplied to vital tissues (such as the brain, heart, and kidneys) when the blood pressure is dangerously low.

Blood pressure is traditionally reported with the *systolic* pressure stated first and the *diastolic* pressure stated second. In adults, 120/80 and below is considered normal blood pressure. High blood pressure is 140/90 or above. The seriousness of low blood pressure, as well as the health risks of high blood pressure (also called *hypertension*), have been elucidated over the past several decades. High blood pressure is a major risk factor for a number of health problems including strokes and congestive heart failure. Diet and exercise are beneficial, but many people require medication for optimal blood pressure control.

In this experiment, you will examine your blood pressure using the Vernier Blood Pressure Sensor. You will compare blood pressures taken before and after exposure to cold. The cold stimulus activates the sympathetic nervous system, resulting in hemodynamic changes that prepare the body for a “fight or flight” response (i.e., when fighting or running from danger).

The sensitivity of blood pressure to harmful external or internal injuries makes it useful as a *vital sign*, an indicator of health, disease, excitement, and stress.

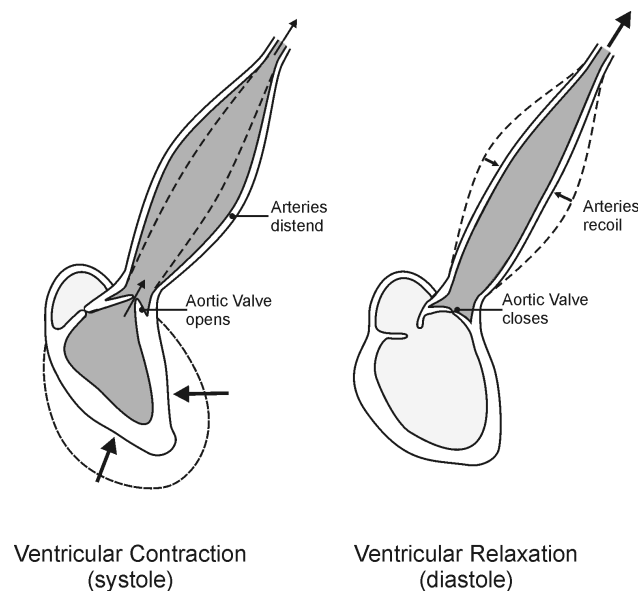


Figure 1

OBJECTIVES

In this experiment, you will

- Obtain graphical representation of blood pressure.
- Compare blood pressure before and after exposure to cold stimulus.
- Observe an example of sympathetic nervous system activation (“fight or flight” response).

MATERIALS

computer
Vernier computer interface
Logger Pro

Vernier Blood Pressure Sensor
ice water bath
towel (paper or cloth)

PROCEDURE

Select one or more persons from your lab group to be the subject(s).

Part I Baseline Blood Pressure

1. Connect the Blood Pressure Sensor to the Vernier computer interface. There are two rubber tubes connected to the pressure cuff. One tube has a black Luer-lock connector at the end and the other tube has a bulb pump attached. Connect the Luer-lock connector to the stem on the Blood Pressure Sensor with a gentle half turn.
2. Open the file “07 Blood Press Vital Sign” from the *Human Physiology with Vernier* folder.
3. Attach the Blood Pressure cuff firmly around the upper arm, approximately 2 cm above the elbow. The two rubber hoses from the cuff should be positioned over the biceps muscle (brachial artery) and not under the arm (see Figure 2).
4. Have the subject sit quietly in a chair with his or her forearm resting on a table surface. *The person having his or her blood pressure measured must remain still during data collection; there should be no movement of the arm or hand during measurements.*
5. Click to begin data collection. Immediately pump the bulb pump until the cuff pressure reaches at least 160 mm Hg. Stop pumping. The cuff will slowly deflate and the pressure will fall. During this time, the systolic, diastolic, mean arterial pressures, and pulse will be calculated by the software. These values will be displayed on the computer screen. When the cuff pressure drops below 50 mm Hg, the program will stop calculating blood pressure. At this point, you can terminate data collection by clicking . Release the pressure from the cuff, but do not remove it.
6. Enter the pulse and the systolic, diastolic, and mean arterial pressures in Table 1.
7. Store the data by choosing Store Latest Run from the Experiment menu.



Figure 2

Part II Blood Pressure Response to Cold

8. Prepare an ice water bath for use in the next step. The subject will be instructed to place his or her opposite hand (the one to which the Blood Pressure cuff is not attached) in the ice water bath for 15 s.
9. Collect data to examine the body's response to cold.
 - a. With the cuff still attached, have the subject from Part I put the hand of his or her non-cuffed arm in the ice water bath.
 - b. As soon as the subject's hand enters the ice water bath, click .
 - c. Pump the bulb until the cuff pressure reaches at least 160 mm Hg, then stop pumping.
 - d. When data have been collected for 15 s, have the subject remove his or her hand from the ice water bath.
 - e. The systolic, diastolic, and mean arterial pressures will be calculated by the software. These values will be displayed on the computer screen. When the blood pressure readings have stabilized (after the pressure drops to 50 mm Hg), the program will stop calculating blood pressure. At this point, you can terminate data collection by clicking . Release the pressure from the cuff, and remove the cuff from the subject's arm.
10. Enter the systolic, diastolic, and mean arterial pressures, and the pulse in Table 2.

DATA

Table 1–Baseline Blood Pressure			
Systolic pressure (mm Hg)	Diastolic pressure (mm Hg)	Mean arterial pressure (mm Hg)	Pulse (beats/minute)

Table 2–Blood Pressure Response to Cold			
Systolic pressure (mm Hg)	Diastolic pressure (mm Hg)	Mean arterial pressure (mm Hg)	Pulse (beats/minute)

DATA ANALYSIS

1. Describe the trends that occurred in the systolic pressure, diastolic pressure, mean arterial pressure, and pulse with cold stimulus. How might these be useful in a “fight or flight” response?

Experiment 7

- Vasovagal syncope* is a condition in which severe pain or fright activates the parasympathetic nervous system instead of the sympathetic nervous system, resulting in fainting. Keeping in mind that the parasympathetic system causes a response opposite to that of the sympathetic system, describe the hemodynamic changes that would explain this.
- As a vital sign, blood pressure is an indicator of general health. A high blood pressure (140/90 or higher) increases the risk of cardiovascular disease and strokes. Collect the systolic and diastolic pressures for the class and calculate the average for each. Rate the class average blood pressure using the following scale:

Blood Pressure	Category
140/90 or higher	High
120–139/80–89	Pre-hypertension
119/79 or below	Normal

EXTENSION

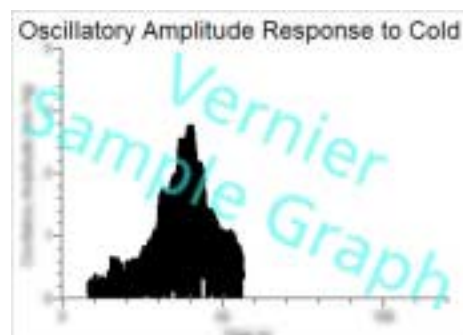
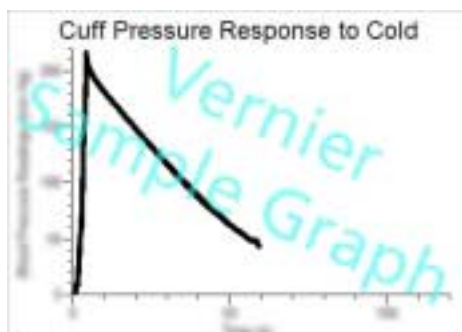
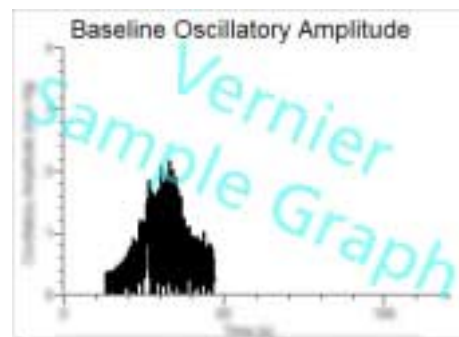
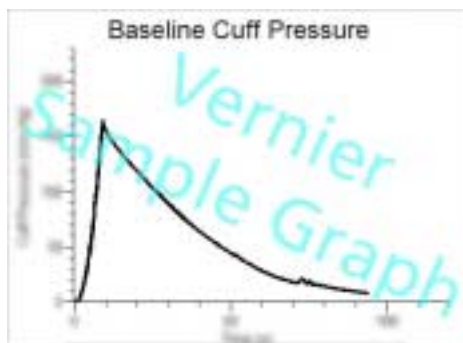
Blood pressure is traditionally obtained by using a stethoscope to listen to the brachial artery. The pumping of air into the blood pressure cuff acts to stop the blood flow through this artery. As the pressure is released, the blood again is allowed to flow. When the blood begins to flow, pulsations can be heard through the stethoscope. The pressure in the cuff at that time can be noted, and corresponds closely to the systolic blood pressure. As pressure continues to be released from the cuff, the pulsations of the artery become less audible. The pressure at which they disappear has been found to approximate the diastolic pressure. These sounds are known as *Korotkoff Sounds*.

With a stethoscope, obtain the blood pressure of a classmate by listening for the appearance and disappearance of pulsations as the pressure in the cuff is released. Compare this to the blood pressure you obtained with the Vernier Blood Pressure Sensor.

Blood Pressure as a Vital Sign

1. Blood pressure may vary from reading to reading for a variety of reasons. It is normal for blood pressure to vary with the time of day or to be elevated in times of stress. For this reason, single blood pressure readings are not adequate for a diagnosis of abnormal blood pressure. It is normal for health care professionals to repeat blood pressure measurements over a period of several weeks before diagnosing high blood pressure.
2. Alert the students to be sure to secure the cuff around the subjects' arms very snugly. A loosely secured cuff will return erratic data.
3. The duration of the experiment is set for 120 s in order to accommodate individual differences in the determination of blood pressure. When the blood pressure readings have stabilized (after the pressure drops to 50 mm Hg), data collection can be terminated and pressure released from the cuff.
4. If the pressure does not reach 50 mm Hg by the time data collection ends, adjust the exhaust rate of the pressure release valve according to the directions listed under "Adjusting the Pressure Release Valve" in the Blood Pressure Sensor booklet that accompanies the sensor. This sensor booklet is also available on the Vernier web site, www.vernier.com/probes.
5. Graphs of oscillatory amplitude are included to aid in assuring that the pressure sensor is sending enough data for *Logger Pro* to correctly calculate blood pressure.

SAMPLE DATA



Experiment 7

Baseline and response to cold data for cuff pressure and oscillatory amplitude

Table 1–Baseline Blood Pressure			
Systolic pressure (mm Hg)	Diastolic pressure (mm Hg)	Mean arterial pressure (mm Hg)	Pulse (beats/minute)
xxx	xxx	xxx	xxx

Table 2–Blood Pressure Response to Cold			
Systolic pressure (mm Hg)	Diastolic pressure (mm Hg)	Mean arterial pressure (mm Hg)	Pulse (beats/minute)
xxx	xxx	xxx	xxx

ANSWERS TO THE DATA ANALYSIS QUESTIONS

Answers have been removed from the online versions of Vernier curriculum material in order to prevent inappropriate student use. Graphs and data tables have also been obscured. Full answers and sample data are available in the print versions of these labs.