

# Cardiovascular Fitness Lab

## OBJECTIVES

When you have completed this lab, you should be able to do the following:

- Measure heart rate and blood pressure in a human volunteer
- Describe the effect of changing body position on heart rate and blood pressure
- Explain how exercise changes heart rate
- Determine a human's fitness index
- Analyze pooled cardiovascular data
- Measure relative cardiac fitness based on blood pressure changes upon change in body position

## INTRODUCTION

The circulatory system functions to deliver oxygen and nutrients to tissues for growth and metabolism, and to remove metabolic wastes. The heart pumps blood through a loop that includes arteries, capillaries, and veins. One important loop is the pulmonary loop, where there is an exchange of gases within the lung. The right side of the human heart receives deoxygenated blood from body tissues and pumps it to the lungs. The left side of the heart receives oxygenated blood from the lungs and pumps it to the tissues. With increased exercise, several changes occur within the circulatory system, thus increasing the delivery of oxygen to actively respiring muscles cells. These changes include increased heart rate, increased blood flow to muscular tissue, decreased blood flow to non-muscular tissue, increased arterial pressure, increased body temperature and increased breathing rate.

### Procedure A: Standing Pulse Rate

1. The subject should stand **at ease** for 2 minutes.
  2. After the two minutes, determine your partner's pulse.
  3. Count the number of beats for 30 seconds and multiply by 2. The pulse rate is the number of beats per minute. **Repeat this procedure three times to get an average pulse rate.** Record this on the data sheet.
- Assign fitness points based on Table 10.2 and record them on the data sheet.

**Table 10.2: Fitness points assigned to various heart rates**

Average Pulse Rate (beats/min)	Fitness Points
60-70	3
71-80	3
81-90	2
91-100	1
101-110	1
111-120	0
121-130	0
131-140	-1

### Procedure B: Reclining Pulse Rate

1. The subject should lay flat for **5 minutes** on the laboratory bench.
2. After 5 minutes the other partner will determine the subject's resting pulse. **(Do not stand up)**
3. Count the number of beats for 30 seconds and multiply by 2. Record it on the Data sheet. Assign fitness points based on Table 10.3 and record them on the data sheet.

**Table 10.3: Reclining Pulse Rate**

Pulse Rate (beats/min)	Fitness Points
50-60	3
61-70	3
71-80	2
81-90	1
91-100	0
101-110	-1

### Procedure C: Baroreceptor Reflex (Pulse Rate Increase from Reclining to Standing)

1. **The reclining subject should now stand up.**
2. Immediately take the subject's pulse. Record this value below. The observed increase in pulse rate is initiated by baroreceptors (pressure receptors) in the carotid artery and in the aortic arch. When the baroreceptors detect a drop in blood pressure they signal the medulla of the brain to increase the heartbeat, and consequently the pulse rate. **Count beats for 30 seconds + multiply by 2.**
3. **Subtract the reclining pulse rate** (recorded in procedure **B**) from the pulse rate immediately upon **standing** (recorded in Procedure **C**) to determine the pulse rate increase upon standing. Assign fitness points based on Table 10.4 and record on the data sheet.

**Table 10.4: Pulse Increase from Reclining to Standing**

Reclining Pulse (beats/min)	Pulse Rate Increase on Standing (# beats)				
	0-10	11-18	19-26	27-34	35-43
	<b>Fitness Points</b>				
50-60	3	3	2	1	0
61-70	3	2	1	0	-1
71-80	3	2	0	-1	-2
81-90	2	1	-1	-2	-3
91-100	1	0	-2	-3	-3
101-110	0	-1	-3	-3	-3

## Procedure D: Heart Rate and Physical Fitness—Running in Place (Endurance)

During physical exertion, the heart rate (beats per minute) increases. This increase can be measured as an increase in pulse rate. Although the maximum heart rate is usually the same in people of the same age group, those who are physically fit have a higher **stroke volume** (milliliters per beat) than more sedentary individuals.

A person who is in poor physical condition, therefore, reaches their maximum heart rate at a lower work level than a person with of comparable age who is in better shape.

Maximum heart rates are listed in Table 10.5.

Individuals who are in good physical condition can deliver more oxygen to their muscles before reaching maximum heart rate than can those in poor condition.

Age (years)	Maximum Heart Rate (beats/min)
10-29	190
30-39	160
40-49	150
50-59	140
60 and above	130

### Procedure

1. Jog in place vigorously for 2 minutes, being sure to lift each foot off the ground **at least** 8-10 inches with each step.
2. Immediately after the completion of the exercise, measure the pulse for 120 seconds and record on the data chart. Tell your partner the number of beats you have counted at 15, 30, 60, 90, and 120 seconds. Record on your data sheet
3. Observe the time that it takes for the pulse rate to return to approximately the level as recorded in Test
  - A. Assign fitness points based on Table 10.6 and record them on the data sheet.

**Table 10.6: Time Required for Return of Pulse Rate to Standing Level after Exercise**

Time (seconds)	Fitness Points
0-30	4
31-60	3
61-90	2
91-120	1
121+	1
1-10 beats above standing pulse rate	0
11-30 beats above standing pulse rate	-1

4. Subtract your normal standing pulse rate (recorded in Test A) from your pulse rate immediately after exercise (the 0-to 15-second interval) to obtain pulse rate increase. Record this on the data sheet. Assign fitness points based on Table 10.7 and record them on the data sheet.

**Table 10.7: Pulse Rate Increase Immediately After Exercise**

Standing Pulse (beats/min)	Pulse Rate Increase Immediately after Exercise (#beats)				
	0-10	11-20	21-30	31-40	41+
	<b>Fitness Points</b>				
60-70	3	3	2	1	0
71-80	3	2	1	0	-1
81-90	3	2	1	-1	-2
91-100	2	1	0	-2	-3
101-110	1	0	-1	-3	-3
111-120	1	-1	-2	-3	-3
121-130	0	-2	-3	-3	-3
131-140	0	-3	-3	-3	-3

### **PROCEDURE E: Blood Pressure upon Positional Change**

A *sphygmomanometer* (blood pressure cuff) is used to measure blood pressure. The cuff, designed to fit around the upper arm, can be expanded by pumping a rubber bulb connected to the cuff. The pressure gauge, scaled in millimeters, indicates the pressure inside the cuff. We will use automated blood pressure cuffs of the brachial (upper arm).

#### **Procedure for automated blood pressure cuff measurement:**

1. Place the cuff in the appropriate location—upper arm for brachial measurement, wrist for radial measurement.
2. Follow the directions provided by the machine, reminding your subject to remain quiet and still the entire time. Any movement will disrupt data collection.
3. After the allotted time has passed, collect the data from the machine and clear it for use on another test subject. Record the data on the blood pressure data sheet.

The point scores on the following tests provide an evaluation of fitness based not only on cardiac muscular development but also on the ability of the cardiovascular system to respond to sudden changes in demand.

**Caution: Make sure that you do not attempt this exercise if strenuous activity will aggravate a health problem..**

#### **Procedure**

1. The subject should recline on a laboratory bench for **5 minutes**. At the end of this time, measure the systolic and diastolic pressure and record these values on the blood pressure data sheet.

2. Remain reclining for two minutes, then stand and IMMEDIATELY repeat measurements on the same subject (arms down). Record these values on the blood pressure data sheet.
3. Determine the change in systolic pressure from reclining to standing by subtracting the standard measurement from the reclining measurement. Assign fitness points based on Table 10.8 and record in the appropriate space on the data sheet.

**Table 10.8: Changes in Systolic Pressure from Reclining to Standing**

Change (mm Hg)	Fitness Points
rise of 8 or more	3
rise of 2-7	2
no rise	1
fall of 2-5	0
fall of 6 or more	-1

**Table 10.1: Normal Blood Pressure for Men and Women at Different Ages**

Age in Years	Systolic Pressure		Diastolic Pressure	
	Men	Women	Men	Women
10	103	103	69	70
11	104	104	70	71
12	106	106	71	72
13	108	108	72	73
14	110	110	73	74
15	112	112	75	76
16	118	116	73	72
17	121	116	74	72
18	120	116	74	72
19	122	115	75	71
20-24	123	116	76	72
25-29	125	117	78	74
30-34	126	120	79	75
35-39	127	124	80	78
40-44	129	127	81	80
45-49	130	131	82	82
50-54	135	137	83	84
55-59	138	139	84	84
60-64	142	144	85	85
65-69	143	154	83	85
70-74	145	159	82	85