Data Collection

Table 1: Lung Volume Measurements

Trial	Inspiratory Reserve Volume IRV (L)	Tidal Volume TV (L)	Expiratory Reserve Volume ERV (L)	Vital Capacity (L)
1	1.5	0.5	0.8	2.8
2	1.6	0.5	0.9	3.0
3	1.4	0.5	1.0	2.9
Average	1.5	0.5	0.9	2.9

Table 2: Tidal Volume and Breathing Rate of Rest and After Exercise

	Tidal Volume TV (L/breath)	Breathing Rate (bpm)
1. At Rest	0.5	19
2. After Exercise	1.1	15

Lung Volume Measurement Lab

Purpose

1. To measure one's lung volumes including tidal volume, vital capacity, inspiratory reserve volume and expiratory reserve volume.
2. To measure one's tidal volume and breathing rate at rest and after exercise and to compare the results.

Hypothesis

My hypothesis is that the breathing rate and tidal volume increases after exercise.

Materials

1. Spirometer or lung volume measurement bags
2. Stopwatch or clock
3. Disposable mouthpiece

Method

1. Read the method and prepare your observation tables ahead of time.
2. Make sure the black zero indicator is properly positioned on your spirometer's scale at zero.
3. Put your mouthpiece into the hose opening of the spirometer.
4. Inhale normally. Put the mouthpiece in your mouth and exhale normally. Measure the volume and record as your tidal volume. Repeat this step 2 more times. Calculate the average tidal volume and record.
5. Inhale as deeply as possible, put the mouthpiece in your mouth and exhale as much air as possible. Measure the volume and record as your vital capacity. Repeat this step 2 more times. Calculate your average vital capacity and record.
6. Exhale normally, place the mouthpiece in your mouth and then exhale as much as you can. Measure the volume and record as your expiratory reserve volume. Repeat another 2 times. Calculate your average expiratory reserve volume and record.
7. Inhale as deeply as possible, put the mouthpiece in your mouth and exhale normally. Measure the volume and subtract your tidal volume and record as your inspiratory reserve volume. Repeat another 2 times. Calculate your average inspiratory reserve volume and record.
8. Relax and breathe normally. Have your partner count the number of breaths you take in one minute at rest. Record.
9. Perform the step test on the stairs for 3 minutes at level 4 on the CD. Have your partner count the number of breathes you take in one minute after exercise. Record.
10. Perform the step test on the stairs for 3 minutes at level 4 on the CD. Return to the spirometer as fast as possible. Inhale normally. Put the mouthpiece in your mouthpiece and exhale normally. Measure the volume and record this as your tidal volume after exercise.
11. Record your tidal volume at rest from step 4 above

Conclusion

My lung volume is 3.9L, vital capacity is 2.9L, tidal volume is 0.5L, inspiratory reserve volume is 1.5L and expiratory reserve volume is 0.9L. The hypothesis that the breathing rate and tidal volume increases after exercise is correct. The average vital capacity of males is 5.0L, females is 3.4L. This difference lies in the physiology of both genders; males have broader shoulders compared with females, which gives rise to larger lungs and hence, bigger vital capacities. Several factors that decrease one's lung volume or vital capacity include respiratory illnesses like asthma, chronic bronchitis, emphysema and the common cold, as with the narrowed airways in the lung or inflammation of the lung airways, the lungs cannot take in as much air. A factor that increase's one's lung volume or vital capacity is exercise, as exercise strengthens and enlarges muscles, causing an increase in cardiac output by increasing the stoke volume rather than the heart rate, and ventilation is increased by increasing the tidal volume rather than increasing the breathing rate.

My tidal volume, bpm and pulmonary ventilation rate before exercise is 0.5L, 19 and 9.5L/min respectively. My tidal volume, bpm and pulmonary ventilation rate after exercise is 1.1L, 45 and 49.5L/min respectively. The change in pulmonary ventilation from rest to after exercise is 27.1L/min. The pulmonary ventilation rate increases during exercise as, when we exercise, we need more oxygen for the muscles in order to produce more energy; to provide more oxygen for aerobic respiration in the cells, we need to breathe faster, leading to an increase in pulmonary ventilation.

The tidal volume of an athlete is deeper and less frequent than that of a non-athlete. This is because an athlete has stronger intercostals and diaphragm muscles which can contract with more strength, thus producing deeper breath. The body increases tidal volume and bpm during exercise, as when the respiration rate in the muscles increases, the carbon dioxide level in the blood increases and consequently, the pH of the blood drops, that is the blood becomes more acidic. This decreased pH affects the chemo sensors located in the aorta and carotid arteries. These chemo sensors send messages to the respiratory centres in the brain stem, which in turn send messages to the breathing apparatus (the diaphragm and the intercostals muscles) to increase their activity. These muscles start to contract and relax faster, thus increasing the breathing rate involuntarily.

Evaluation

2 limitations of the lab procedure include: the number of trials done on each of the respiratory volumes was low at 3 times only, and the sample of males and females doing the experiment were not enough to infer an accurate result of the experiment.

A solution to the first limitation would be to increase the number of trials done on each of the respiratory volumes to at least 20 times, and the second solution would be to gather a larger cohort of students from both genders to carry out the experiment.