

23. VOLUME OF BREATH

How will the amount of air moving in and out of your lungs change after exercise?

Objectives

- Use a pulmonary function test to investigate how the respiratory system responds to changes in physical activity.

Materials and Equipment

- Data collection system
- PASCO interface such as a Wireless Airlink
- Spirometer
- Spirometer mouthpiece
- Stopwatch or timer

Safety

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

- The spirometer mouthpiece can only be used by one student and cannot be re-used after this investigation.
- Do not perform this activity if vigorous exercise will cause discomfort. If you experience discomfort or pain, immediately stop exercise.
- If you feel faint at any point, immediately stop what you are doing and notify your instructor.

Procedure

1. Attach the Spirometer to the interface.
2. To open the experiment file in SPARKvue, select Open PASCOS Experiment > Quick Start Labs > Lung Volume > OK.
3. Use the Bluetooth icon to connect a wireless interface to your device.
4. Line up the pins on the mouthpiece (white) to the holes on the Spirometer handle (blue). Connect the mouthpiece to the handle as shown in Figure 1.
5. Start recording data. Watch for the red wait indicator on the sensor to stop flashing. Do not continue until the green ready indicator turns on.
6. This activity requires the *subject* or person whose lung volume is being measured to perform exercise such as jumping jacks for 3 minutes. Select a subject who can conduct vigorous exercise without discomfort. The subject whose pulmonary function is being measured will do the following to make sure all breath flows through the mouthpiece:
 - Place the tapered end of the mouthpiece between the front teeth with the lips creating a seal around the mouthpiece. Hold the nose closed once data collection begins.
 - Stand comfortably and breathe only through the mouth during the measurements. Have someone count breaths for you and do not look at the data while it is being recorded.

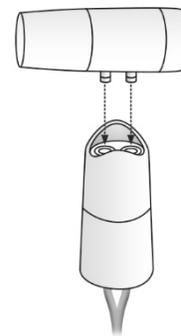


Figure 1:
Connect
mouthpiece to
handle

7. When the green ready indicator light on the sensor is lit, the subject will perform the following:

Note: The person who keeps track of breaths and operates SPARKvue should count aloud to guide the subject's breathing: "Take 4 normal breaths, 1... 2... 3... 4... inhale deeply... exhale deeply with maximum effort... and take 2 normal breaths, 1... 2..."

- a. Take 4 normal, quiet breaths.
 - b. Inhale deeply, followed immediately by exhaling deeply with maximum effort.
 - c. Take 2 normal, quiet breaths.
8. Stop recording data. Sketch your results in Graph 1. Include numbers, labels, and units on the x- and y-axes.

9. Use SPARKvue tools and refer to Figure 2 to measure the distance (time in seconds) that determines the tidal volume (TV), the forced expiratory volume in one second (FEV_{1.0}), and the vital capacity (VC). Record these "before exercise" measurements in Table 1 and label Graph 1 with these measurements.

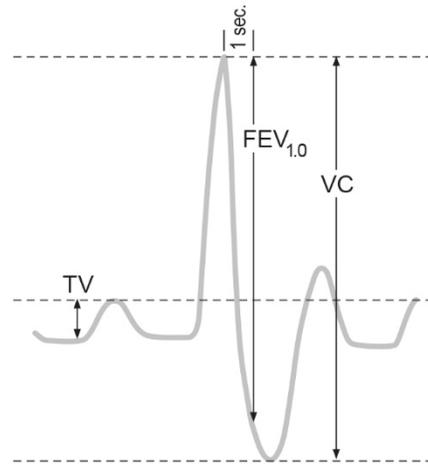


Figure 2: TV, FEV_{1.0}, and VC

10. The subject should find a suitable area to perform aerobic exercise (like running in place or doing jumping jacks) for 3 minutes.

11. Immediately after 3 minutes of exercise, the subject will stand comfortably and repeat the pulmonary test (Steps 5-8).

12. Repeat Step 9 and record "after exercise" values in Table 1. Sketch your results in Graph 2. Include numbers, labels, and units on the x- and y-axes and add labels for TV, FEV_{1.0}, and VC measurements.

13. Calculate the forced expiratory volume percentage (FEV_{1.0%}) before and after exercise according to the following equation and record the results in Table 1.

$$FEV_{1.0\%} = FEV_{1.0} \div VC \times 100$$

Data Collection

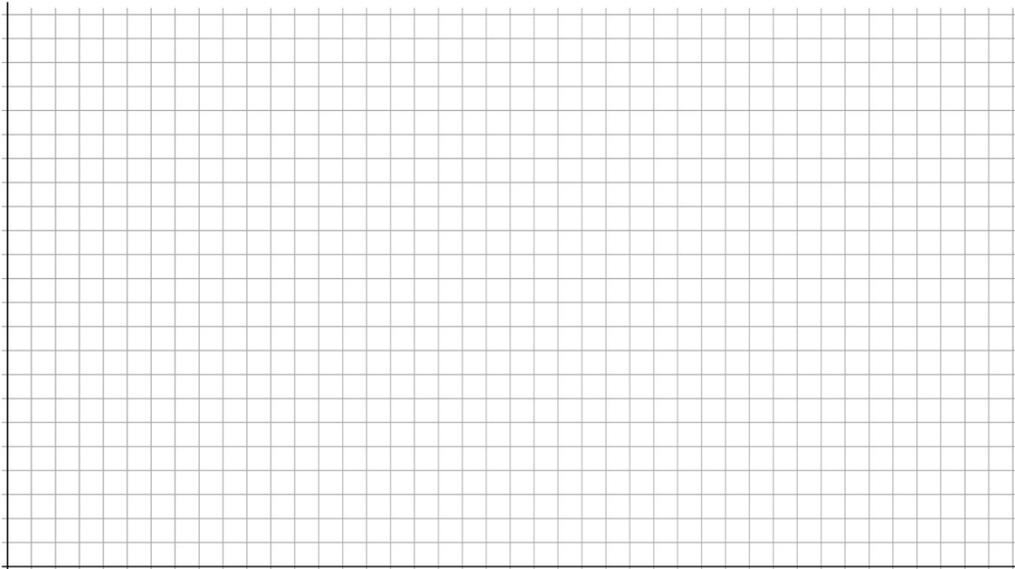
Table 1: Volume and vital capacity measurements from a pulmonary function test

Measurement	Value Before Exercise	Value After Exercise
Tidal volume (TV): volume of 1 breath		
Forced expiratory volume in one second (FEV _{1.0})		
Vital capacity (VC): maximum moveable air in the lungs		
Forced expiratory volume percentage (FEV _{1.0%})		

Graph 1: Lung volume before exercise



Graph 2: Lung volume after exercise



Questions and Analysis

1. Describe how tidal volume, $FEV_{1.0}$, and vital capacity changed after exercise. Propose an explanation for your results.

