

ANATOMY & PHYSIOLOGY – SPIROMETER LAB PROCEDURE

Introduction

Measurement of lung volumes provides a tool for understanding normal function of the lungs as well as disease states. The breathing cycle is initiated by expansion of the chest. Contraction of the diaphragm causes it to flatten downward. If chest muscles are used, the ribs expand outward. The resulting increase in chest volume creates a negative pressure that draws air in through the nose and mouth. Normal exhalation is passive, resulting from “recoil” of the chest wall, diaphragm, and lung tissue. In this experiment, you will measure lung volumes during normal breathing and with maximum effort. You will correlate lung volumes with a variety of clinical scenarios.

Objectives: In this experiment, you will

1. Obtain graphical representation of lung capacities and volumes.
2. Compare lung volumes between males and females.
3. Correlate lung volumes with clinical conditions.

Lab Set-Up

Each group will need the following materials:

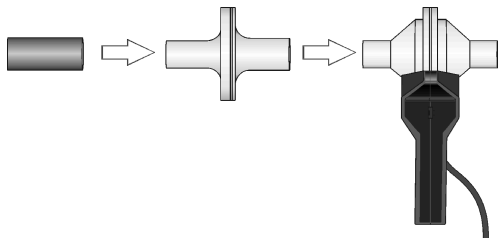
- Laptop
- Spirometer flowhead & Microguard filter
- 1 mouthpiece per person tested
- Vernier LabPro
- Power Cord for LabPro(black)
- USB cable (2 shapes on each side!)

How to set up the LabPro:

1. Plug the laptop into an outlet and log on, continue to follow the steps below while computer logs on.
2. Attach the power cord to the LabPro (on the left side of LabPro) and then plug large end into an outlet
3. Plug the USB cable into the right side of the LabPro and attach the other end to the right side of the computer (either slot will work for plugging it into the computer)
4. If you are confused, look at the computer that has already been set up for guidance! Then, if you are still confused, ask for help!

How to set up the Spirometer & Prepare to Collect Data:

1. Plug the black cord of the spirometer into one of the channel slots on the left side of the Vernier LabPro
2. Attach the bacterial filter to the side of the flow head marked “inlet” and attach the cardboard mouthpiece to the bacterial filter. See the picture below:



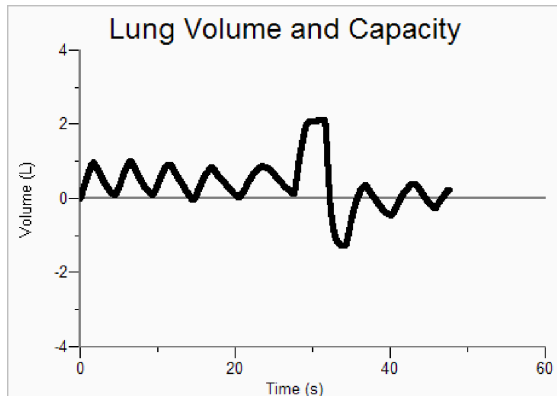
3. Open the program LoggerPro on your laptop (it should be on the desktop, the icon looks like graph paper)
4. The program will automatically open up to the spirometer lab, but you will need to go to the “pages” menu at the top of the screen and click on “next page” to get to the lung volumes graph. There is a “next page” icon you can click as well on the menu bar.
5. Once you are on the lung volumes graph, you are ready to collect data. You may want to practice a few times!
 - Use the nose clip to ensure that the person tested is only breathing through their mouth
 - Make sure person is standing vertically and still during use, and start data collection on the exhale
 - Sometimes it helps when the person doing the breathing is not watching the computer so they don't alter their depth of breathing in response to the computer graph.

Activity 1: Respiratory Rate

1. Subject counts the number of breaths they take while breathing normally. The other person will time the subject for a minute, instructing the subject when to start and stop counting their breaths. Record this on the data sheet.

Activity 2: Tidal Volume

1. Do NOT do this part of the lab if you have a cold or flu! Use your partner's data instead!
2. Have subject breath normally for a few breaths, and continue to breathe normally once the "collect" button is hit. Have the subject breath 3-4 normal breaths before clicking the "stop" button.
3. You may notice that your graph drifts upwards, to correct this, click the up arrow on the Baseline Adjustment to bring your bottom values closer to the zero line. See the figure below, notice that the graph does not "drift upwards."



4. Select a representative peak and valley in your graph. Place the cursor on the peak and click and drag down to the valley that follows it. Enter the Δy value displayed in the lower left corner of the graph to the nearest 0.1 L as *Tidal Volume* in the table.

Activity 3: Inspiratory and Expiratory Reserve Volume & Calculations

1. Do NOT do this part of the lab if you have a cold or flu! Use your partner's data instead!
2. Have the subject breath normally for a few breaths, hit the collect button. After the subject takes 1-2 more normal breaths, instruct them to breathe in as deeply as they can, and then out, as deeply as they can. In essences, they will be "sucking" in air as hard as they can, and "blowing" out as much air as they can. After they have done this, and have taken their next, normal breath, hit the "stop" button.
3. Again, if the graph drifts upwards, click on the up arrow on the *Baseline Adjustment* to correct this.
4. Move the cursor to the peak that represents the maximum inspiration. Click and drag down the side of the peak until you reach the zero line. Subtract your *Tidal Volume* value (recorded from Activity 1) from this Δy value. Round your answer to the nearest 0.1 L and record this value in your data table as your *Inspiratory Reserve Volume*.
5. Next, move the cursor to the valley that represents your maximum expiration. Click and drag up the side of the peak until you reach the zero line. Enter the Δy value displayed in the lower left corner of the graph to the nearest 0.1 L as *Expiratory Reserve Volume* in the table.
6. Calculate the *Vital Capacity* and enter the total to the nearest 0.1 L in the table: **$VC = TV + IRV + ERV$**
7. Calculate the *Total Lung Capacity* and enter the total to the nearest 0.1 L in Table 1. (Use the value of 1.5 L for the *Residual Volume*) **$TLC = VC + RV$**
8. Place your data on the board to share your data with your classmates and complete the Class Average columns in the table.

Once you are done with both activities, complete the questions on your student data sheet and turn this in when complete.

EXTENSION: Repeat the experiment with the chest or abdomen constricted (use a girdle or ace bandage).