

Biology 347 General Physiology Lab

Advanced Pulmonary Functions: Respirometry and Factors that Effect Respiration

Objectives

- Students will measure a variety of factors that affect breathing parameter such as:
 - Coughing
 - Concentration

Introduction

The respiratory control center in the medulla is responsible for matching the amount of O₂ used by and CO₂ produced at the tissues, with the amount of O₂ taken up and CO₂ discharged at the lungs. Lung ventilation can be influenced by many factors, including emotion, speech, disease and the body's position relative to gravity. This latter factor was the focus of the last exercise. In this lab you will examine other factors that influence breathing, as well as the effect of breathing on cardiac function.

Procedure: Equipment Set-up

1. Open the LabScribe program.
2. Click on the **Settings** menu and select the **Breathing-OtherFactors-LS2** settings file.
3. After a short time, LabScribe will appear on the computer screen as configured by the **Breathing-OtherFactors** settings.
4. The spirometer will monitor breathing from a volunteer. It is important that the volunteer is healthy and has no history of respiratory or cardiovascular problems.
5. The outlets on the flow head should always be in the upright position to avoid problems with condensation developing in the airflow tubes.
6. Turbulence in the flow head will produce a noisy signal. To reduce turbulence, the subject should place his or her lips around the outside of the opening of the flowhead, or its mouthpiece.
7. Use a clip to prevent air from entering or leaving the nose as the subject is breathing. Air that passes through the nose is not included in the volume measurements and causes errors in these values.
8. The settings file, **Breathing-OtherFactors**, programmed LabScribe to display the **Airflow** of the spirometer and the **Volume**. The settings file activates an algorithm designed specifically to convert the airflow data of the iWorx SP-304 spirometer to volume data.
9. Click on the words **Spirometry (AirFlow)** that are next to the title of the **Volume** channel, to open the **computed function pull-down menu**. Select **Set-up** from this pull down menu to open the **Spirometer Calibration Dialogue window**. Enter the calibration voltage that is listed on the label of the spirometer unit, into the equation that sets the calibration voltage equal to one liter.
10. Make sure the reset time is set to 60 seconds and the first five seconds of the recording are used to zero the baseline of the **Volume** channel. Click OK.
11. Allow the SP-304 to warm up for 10 minutes before recording for the first time. Do not hold the spirometer amplifier in your hand; the heat of your hand will alter the volumes recorded.
12. Determine which opening of the flowhead should be used to make the deflection on the **Airflow** channel go up as the subject inhales. Inhalation is always displayed as an upward deflection.
13. Allow the SP-304 to warm up for 10 minutes before recording for the first time. Do not hold the spirometer amplifier in your hand; the heat of your hand will alter the volumes recorded.

Procedure: Breathing Parameters and Coughing

1. The subject should sit quietly and become accustomed to breathing through the spirometer. They should be breathing normally before any recordings are made. Remember to hold the flowhead so that the outlets are on top.
2. Have the subject remove the flowhead from their mouth. They should hold it at the same level as their mouth, but in a position that prevents their breath or any other airflow from moving through the flowhead.

*Note: The LabScribe software will zero the **Volume** channel during the first five seconds of recording. No air should be moving through the flow head during this time.*

3. Type “Cough” on the comment line. Press the **Enter** key on the keyboard as the subject coughs. Make sure to have five cycles.
4. The volunteer should return to normal breathing through the spirometer.
5. Click **Stop** to halt recording.

Procedure: Data Analysis Coughing

1. Place the cursors on the coughing data on the **Volume channel** to measure the following parameters using the **V2- V1**, **Max_dv/dt**, and **Min_dv/dt** functions. Measure the following:
 - **Maximum Inspiratory Flow Rate before Cough.** If the subject inhaled before coughing, determine the maximum flow rate by placing one cursor in the trough or on the baseline prior to the inhalation and the second cursor on the peak of that inhalation. The value for the **Max_dv/dt** function on the **Volume channel** is the maximum flow rate prior to the cough.
 - **Maximum Expiratory Flow Rate during Cough.** Since a cough is similar to an exhalation, place one cursor on the peak of the inhalation or the baseline before the cough and the second cursor on the trace at the end of the cough. The value for the **Min_dv/dt** function on the **Volume channel** is the maximum flow rate during the cough.
 - **Air Expelled during Cough,** by keeping the cursors in the same positions used for measuring the maximum exhalatory flow rate. The value for the **V2-V1** function on the **Volume channel** is the volume of air expelled during the cough.
2. Enter the values for the parameters measured in Table 3.

Table 1: Coughing

	Air Expelled (during cough)	Forced Inspiratory Flow Rate (before cough)	Forced Expiratory Flow Rate (during cough)
Coughing Cycle			

Procedure: Breathing Parameters and Concentration

1. As before, the volunteer should not be disturbed and should be relaxed and accustomed to breathing through the spirometer.
2. Have the subject remove the flowhead from their mouth. They should hold it at the same level as their mouth, but in a position that prevents their breath or any other airflow from moving through the flowhead.

*Note: The LabScribe software will zero the **Volume** channel during the first five seconds of recording. No air should be moving through the flow head during this time.*

3. Type “Concentration” on the comment line. After the five normal breathing cycles, ask the subject to try to thread the needle for five breathing cycles. Press the **Enter** key on the keyboard as the subject begins their attempt. .
4. Type “Through” and press the **Enter** key when the needle has been threaded.
5. Click **Stop** to halt recording.
6. Save the file.

Procedure: Data Analysis

1. Follow the data analysis steps from the coughing experiment and complete tables 4, 5 and 6. Also, use the **T2-T1** function from the list in the **Analysis** window to measure the Breath Duration for 4 adjacent cycles in each of the three experimental conditions.

Table 2: Concentration Breathing Parameters

	Tidal Volume (liters)	Period (secs/breath)	Maximum Inspiratory Flow	Maximum Expiratory Flow	Breath Rate (breaths/min)
Cycle 1					
Cycle 2					
Cycle 3					
Cycle 4					
Average					

Table 3: Completed Task (Through) Breathing Parameters

	Tidal Volume (liters)	Period (secs/breath)	Maximum Inspiratory Flow	Maximum Expiratory Flow	Breath Rate (breaths/min)
Cycle 1					
Cycle 2					
Cycle 3					
Cycle 4					
Average					