Laboratory Investigation C16L1
Chapter 16 Lesson 1: The Respiratory System

Human Anatomy & Physiology: Respiratory System

You may refer to pages 427-434 in your textbook for a general discussion of the muscular system.

Time required: 120 minutes

Background Material

total lung capacity of an adult: approx. 6 l. or 5800 cc or 240 cubic inches
some air will always remain in the lungs no matter how forcefully you exhale
under normal inspiration and expiration about 1/2 l of air enters and leaves the lungs

Vital capacity - the maximum volume of air that can be exhaled after one takes the deepest breath possible (spirometer - an instrument which measures volume) (all the air a person can breath in and out in a forced inspiration)

vital capacity is a combination of:

1. tidal volume - the amount of air that enters the lung during normal inspiration or leaves the lung during a normal expiration (the amount of air of normal relaxed breathing)
2. inspiratory reserve volume - (or complemental air) the air that enters your lungs in addition to the tidal volume (all a person can breath in beyond a relaxed inspiration)
3. expiratory reserve volume - (or supplemental air) forcing out as much breath as you can (all a person can breath out beyond a relaxed inspiration)

Residual volume - the air that remains in your lungs afer forced expiration (air a person cannot breath out)
Total lung capacity - the sum of all lung volume (vital capacity + residual volume) (all the air in the lungs)

Materials Part 1

lung volume bag, rubber band, mouthpiece, paper towels

Part 1: Measuring Air Volume

A spirometer is a device used to measure the volume of air a person exhales. However, a long plastic bag calibrated in liters may be used instead of the relatively expensive spirometer to measure a person’s lung volume. The lung volume bag is not as accurate, but for the purposes of this exercise it will serve well.

How to Use a Lung Volume Bag

Prepare the lung volume bags.

- Insert the mouthpiece partway into the open end of the lung volume bag and secure it with a rubber band. (See Diagram 20A-l.)
- Have your partner sit down.
- Slide the bag slowly across your partner’s knee while he presses the bag with a paper towel. This will remove all air from the lung volume bag. (See diagram.)

Part 1: Measuring Lung Volume

1. Measure tidal volume.
   - Have the person being tested breathe in a normal breath, pinch his nose, put the lung volume bag mouthpiece in his mouth, and breathe out a normal breath.
   - You should then take the bag and hold it closed while sliding it across his knee and pressing it with a paper towel in order to force all the air to the bottom.
- Record the data on the lung volume chart.
- Empty the lung volume bag, using the procedure described earlier.
- Have your partner perform this experiment two more times. Record each volume in the proper space of the Lung Volume chart.

II. **Measure expiratory reserve volume.**
- Have your partner breathe in a normal breath, then breathe out a normal breath, pinch his nose, put the lung volume bag mouthpiece in his mouth, and breathe out as much as possible.
- Using the procedure described in the instructions for measuring tidal volume, measure the air and record the reading for each person in the proper spaces.
- Have your partner perform this experiment two more times. Record each volume in the proper space of the Lung Volume chart.

III. **Measure vital capacity.**
- Have your partner breathe in as much as he possibly can, then pinch his nose, put the lung volume bag mouthpiece in his mouth, and breathe out as much as possible.
- Using the procedure described in the instructions for measuring tidal volume, force the air to the bottom of the bag and record the reading in the proper space.
- Have your partner repeat this experiment two more times. Record each volume in the proper space of the Lung Volume chart.
- Now switch places and repeat all steps.

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<tr>
<th>Lung Volume Chart</th>
<th>Tidal Volume</th>
<th>Average</th>
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<tbody>
<tr>
<td>Your Partner</td>
<td>You</td>
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<td>2. _____________</td>
<td>2. _____________</td>
<td>or _____________ ml</td>
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<td>3. _____________</td>
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<table>
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<tr>
<th>Expiratory Reserve Volume</th>
<th>Average</th>
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<td>Your Partner</td>
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<table>
<thead>
<tr>
<th>Vital Capacity</th>
<th>Average</th>
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<td>Your Partner</td>
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Part 1: Computing Average Lung Capacities

I. Take all your data and determine averages for the following volumes. (Be careful to use the correct units.)
   - Tidal volume: ____________ ml
   - Expiratory reserve volume: ____________ ml
   - Vital capacity: ____________ ml

II. Using these averages, compute the inspiratory reserve volume. ____________ ml

III. Assuming a residual volume of 1,000 ml, what would be the average total lung capacity of you and your partner? ____________ ml

Structures of the Respiratory System

Label Diagram 20A-2 of the respiratory system.
Part 2 – Listening to Your Lungs

Materials - Part 2

stethoscope; alcohol; tissues

Background Material – Part 2

Air rushing into and out of healthy respiratory structures makes various sounds. Many respiratory problems cause various abnormal sounds which a physician can hear using a stethoscope. Hopefully you will not hear abnormal respiratory sounds when listening to your lab partner’s breathing. It can be interesting, however, to listen to normal sounds of the respiratory system.

Procedures – Part 2

I. Listen to the lungs by following these instructions:
   - Using a tissue and alcohol, clean the ear plugs of a stethoscope.
   - Place the stethoscope in your ears, allowing the tubes to hang freely and being careful not to hit the diaphragm on hard objects. (The noise can be very loud.)
   - Place the diaphragm of the stethoscope on your lab partner’s back and press lightly while he breathes normally.
   - Listen to a normal breath or two in areas A-F as labeled on Diagram 20A-3.

   Describe the sounds you hear.

   ___________________________________________________
   ___________________________________________________
   ___________________________________________________
   ___________________________________________________
   ___________________________________________________
   ___________________________________________________
   ___________________________________________________

   Are the sounds you hear different in different areas?

   ___________________________________________________
   ___________________________________________________
   ___________________________________________________
   ___________________________________________________
• Listen to a deep breath in the same areas. Do you hear a difference? __________
If so, describe the difference and tell what may account for it. ____________________________
____________________________________
____________________________________
____________________________________

• Listen to areas A and E while the person coughs. Describe what you hear.
____________________________________
____________________________________
____________________________________

• Listen to areas A and E while the person talks. Describe what you hear.
____________________________________
____________________________________
____________________________________

II. Using a stethoscope, listen to a person’s throat.
• Listen to your lab partner’s breathing in area G.
• Listen to your lab partner’s voice in the same area.
• Describe what you heard. ____________________________________________________________
____________________________________
____________________________________

Breathing Diagram

In each diagram below, draw an arrow to indicate the movement of air during inhaling and exhaling. Label each drawing as inhalation or exhalation.

1. 

2. 

Summing Up

1. What is respiration?

____________________________________________________________________________________

____________________________________________________________________________________

2. What happens to the carbon dioxide produced during respiration?

____________________________________________________________________________________

____________________________________________________________________________________

3. When you inhale, your ______________ flattens and moves downward. At the same time your rib muscles ______________ and lift your ribs up and out.

4. When you exhale, your diaphragm and ______________ muscles ______________, making your chest cavity smaller.

5. What is the function of small hairs in your nose and of cilia and mucus in your trachea?

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________