Just Breathe
By: Joyce Green

Lung Capacity

When we breathe, we are taking in oxygen and releasing carbon dioxide into the air. We need oxygen to help breakdown the food that we eat, to build muscles, and to help us remain active. While our cells are performing these tasks, they are using up the oxygen we breathe in and producing carbon dioxide and water which we exhale.

The main job of the Respiratory System is to bring oxygen to all parts of our body. Air comes in through the nose and mouth and travels down the trachea. The trachea then branches off into two bronchi, which lead towards our right and left lungs. The lungs are made up of tiny sacs called alveoli. The alveoli help the blood exchange gases, like oxygen and carbon dioxide.

When we exhale, air flows back through the bronchi, up the trachea and back out into the air. When each breath is completed, the lung still has some air, called the residual volume.

The amount of air in the lungs can be measured in several different ways:

Tidal Volume is the volume of air that you normally inhale and exhale.

Vital Capacity is the maximum volume of air that you can inhale and exhale.

Residual Volume is the air that remains in your lungs after you exhale the maximum amount of air in your lungs.

Total Lung Capacity is the total volume your lungs can hold; vital capacity plus residual volume.

Different factors such as age, activity level, height, and gender, can affect lung capacity. You can increase your lung capacity through regular exercise.

Today we are going to look at Vital Capacity by measuring the amount of air that can be exhaled into a balloon. Then we will compare that volume to an Expected Vital Capacity which takes into account a person’s age and height to calculate lung volume.
Activity: 1-2-3 Blow!

**MATERIALS NEEDED**
- Large balloon
- String
- Measuring tape or meter stick
- Student Worksheet

**Students should be able to:**
Calculate their total lung capacity, vital capacity and residual volume.

**What to do:**

1. With a partner to complete the activity. One person will record the measurements (data collector) and the other will blow up the balloon (test subject). If you have asthma or any other lung condition, have your partner blow up the balloon.

2. **Test subject** - Stretch the balloon and blow it up several times before you begin taking measurements.

3. **Test subject** - Take a deep breath and exhale as much air as you can into the balloon in **ONE BREATH**. Pinch the opening shut with your fingers.

4. **Data collector** - Take the string and wrap it around the widest part of the balloon. Place the string on the meter stick and record the length of the string in centimeters. This will give us the circumference of the balloon. Record this value under Trial 1 in **Table 1** on your worksheet.

5. Repeat this 4 times for a total of **5 trials**.

6. Calculate the average circumference of your 5 trials and record this value in **Table 2**.

7. Calculate the diameter of the balloon using the following formula then record your result in **Table 2**.
   \[
   \text{Diameter} = \frac{\text{circumference}}{\pi}
   \]
   \[\pi = 3.14\]

8. Calculate the radius of the balloon using the following formula then record your result in **Table 2**.
   \[
   \text{Radius} = \frac{\text{diameter}}{2}
   \]

9. Calculate the volume of air in the balloon using the following formula then record your result in **Table 2**.
   \[
   \text{Volume} = \pi r^2 \times \frac{3}{4}
   \]

10. Convert the volume of air (mL) to volume of air (L) or Experimental vital capacity using the following formula then record your results in **Table 2**.
   \[
   \text{Volume (L)} = \frac{\text{Volume (mL)}}{1000}
   \]
   The volume of air you calculated is your Experimental Lung Capacity, or the amount of air your lungs actually held.

   We can also calculate your Vital Capacity, or the amount of air your lungs should hold when based on your height and age.

11. Calculate your height in cm using the following formula then record your results in **Table 3**.
   \[
   \text{Height in cm} = \text{height in inches} \times 2.54
   \]

12. Calculate your expected vital capacity using the following formula then record your result in **Table 3**.
   \[
   \text{Vital Capacity} = 0.041 \times \text{height (in cm)} - 0.018 \times \text{your age} - 2.69
   \]
Activity: 1-2-3 Blow! Student Worksheet

Name: _______________________________   Date: ________________
Name: _______________________________

Table 1: Circumference of the Balloon

<table>
<thead>
<tr>
<th>Trial 1</th>
<th>Trial 2</th>
<th>Trial 3</th>
<th>Trial 4</th>
<th>Trial 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Table 2: Calculated Values

<table>
<thead>
<tr>
<th>Average Circumference</th>
<th>Diameter of the Balloon</th>
<th>Radius of the Balloon</th>
<th>Volume of Air in ML</th>
<th>Volume of Air in L</th>
</tr>
</thead>
<tbody>
<tr>
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</table>

Table 3: Expected Vital Capacity

<table>
<thead>
<tr>
<th>Age in Years</th>
<th>Height in Inches</th>
<th>Height in CM</th>
<th>Expected Vital Capacity in L</th>
<th>Experimental Vital Capacity (from Table 2)</th>
</tr>
</thead>
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Questions

1. How does your expected vital capacity compare to your calculated vital capacity?
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

2. Why might the experimental vital capacity be different than the calculated vital capacity?
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________

3. Compare your experimental vital capacity with other students in your class. Are they the same or different? Explain your answer.
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________
______________________________________________________________________