Lung Capacity

**Background information:** We need a constant supply of oxygen in order to stay alive. We use oxygen to break down food to release energy and produce carbon dioxide as a waste product. We need to continually take in oxygen from the air and expel carbon dioxide into the air. The respiratory system functions to filter, warm, and humidify the air that we breathe, and to supply the cells with oxygen while removing carbon dioxide.

Air moves into the lungs through the trachea and then back out again. When each breath is complete, the lung still has some air, called the residual volume. Each inhalation adds additional air. Each exhalation removes about the same volume as was inhaled.

The amount (volume/capacity) of air in the lungs can be measures several ways:

- **TOTAL LUNG CAPACITY** (TLC) - the amount of air in the lungs after a deep inhalation (the vital capacity plus the residual volume)
- **RESIDUAL VOLUME** (RV) - the amount of air left in the lungs after a deep exhalation
- **VITAL CAPACITY** (VC) - the amount of air exhaled in one breath; the maximum amount of air that can be forcibly exhaled after breathing in as much as possible.
- **TIDAL LUNG CAPACITY** - the amount of air your lungs hold during normal breathing; the amount of air moved in and out of the body in one breath

Lung volumes differ with age, sex, body frame and aerobic fitness. Measuring your lung capacity can help you determine how much stamina you may have available to go about your daily routine, including sports and other activities. Usually you need about 1/3 of your lung capacity to carry out routine tasks that do not require exertion. It is also possible to increase your lung capacity through regular exercise.

Your lung capacity may be affected by certain disorders such as asthma and emphysema. Such things as altitude, the position your body is in, air temperature, weather conditions, air pollution, and cigarette smoking may also contribute to a decrease in lung capacity.

Volume or capacity is measured in liters (l), milliliters (ml), and cubic centimeters (cm$^3$). One ml is equal to one cm$^3$. 
Materials:
String (70cm)    Meter Stick    Round Balloon    Calculator

Procedure:
1. Blow up the balloon several times to stretch before beginning to take measurements.
2. Take a deep breath, and blow up the balloon as much as you can with ONE BREATH. Hold the opening of the balloon closed with your fingers.
3. Use the string and ruler to measure the circumference (the distance around) the biggest part of the balloon. Record this number.
4. Repeat this 4 times, for a total of 5 trials.
5. Find the average circumference of the balloon by adding them up and dividing by 5.

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<th>Trial</th>
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<th>5</th>
<th>Sum</th>
<th>Average Circumference</th>
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6. Find the volume of the air in the balloon by completing the following calculations.
   Show your work.
   - Calculating the diameter of the balloon-
     Diameter = circumference ÷ π (3.14)

   - Calculate the radius of the balloon-
     Radius = diameter ÷ 2

   - Calculate the volume of the sphere-
     Volume = radius³ X π X ¾
The volume you have calculated is your **experimental lung capacity** - it is the amount of air your lungs actually held.

Your **vital capacity** is the amount of air you **should be able** to hold considering your height and age. To find your vital capacity:
- Find your height in centimeters: ____________
- Now use this formula and show your work:
  \[ \text{Vital capacity} = 0.041 \times \text{height in cm} - 0.018 \times \text{age} - 2.69 \]

Your **vital lung capacity** is ___________________
Data Analysis:
1. How does your experimental lung capacity compare to your vital lung capacity?
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________

2. What are three things that might account for any difference between your capacities?
   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________

3. Compare your vital lung capacity with the capacities of the students around you. Are they the same? ______ Explain your answer.
   __________________________________________________________________________
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4. Aerobic exercise can result in an increase of lung capacity. Suggest a reason for this increase.
   __________________________________________________________________________
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5. What type of athlete would you think would have the largest lung capacity? Explain your answer.
   __________________________________________________________________________
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