Measuring Lung Capacity Lab

Human lung capacity can be measured in several ways. One way, is by using a piece of laboratory equipment called a spirometer. We can also measure lung capacity using a balloon. The data you obtain may not be as accurate as that obtained using a spirometer, but will give you an idea of how much volume your lungs hold.

Several different lung volume measurements can be made. The largest possible amount of air that can be exhaled after drawing a deep breath is the **vital capacity**. The amount of air that remains in the lungs after exhaling normally but which can be expelled is the **expiratory reserve**. The amount of air taken in or expelled during normal breathing is called the **tidal volume**. A certain amount of air in the lungs cannot be expelled. This is the **residual volume**.

Purpose: To determine different capacities in your lungs.

Procedure:
Part A: Vital Capacity
1. Stretch balloon several times.
2. Take as deep a breath as possible. Then exhale all the air you can into the balloon and pinch the balloon closed to prevent air from escaping.
3. Measure the diameter of the balloon in centimeters and record in column A of the Data Table. Do this by using two metric rulers as shown in the diagram below.

Record measurement where the height of the balloon meets the side ruler (with the balloon on its side). This is the balloon's diameter.

Diameter of Balloon
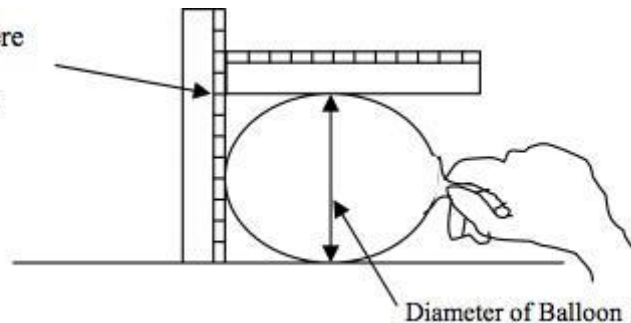
4. Deflate balloon and do two more trials. Record the diameter of the balloon in column A.

Part B: Expiratory Reserve Volume
1. Exhale normally.
2. *Without* inhaling as you normally would, put the balloon in your mouth and exhale all the air still left in your lungs.
3. Measure the diameter of the balloon in centimeters and record in column B of the Data Table.
4. Do two more trials. Record the diameter of the balloon in column B.

Part C: Tidal Volume
1. Take in a normal breath. Exhale into the balloon only as much air as you would normally **exhale**. DO NOT force your breathing.
2. Record the diameter of the balloon in centimeters in column C of Data Table.
3. Do two more trials. Record the diameter of the balloon in column C.

Part D: Convert Diameters to Volume Using Graph

Lung volume is expressed in cubic centimeters (cm^3).

1. To convert from balloon diameter to volume, locate the balloon diameter on the x-axis on the graph in Figure 1. Follow this number up to the curve, and then read across to locate the corresponding volume.
   Example: if balloon diameter is 14.5 cm, then the corresponding lung volume is 1500 cm^3.
2. Convert each diameter in your Data Table to its corresponding volume and record each volume onto the Data Table in columns D, E, and F.
3. Calculate and record your average lung volume for each of the three measurements.
4. Calculate the Inhaling Reserve Volume (the amount of air that can still be inhaled following a normal inhalation) using the following formula, using your average calculated values and the formula below:

$$\text{Inhaling Reserve} = \text{Vital Capacity} - (\text{Tidal Volume} + \text{Exhaling Reserve})$$

5. Determine the total lung capacity, assuming the residual volume to be 1000 mL.

Results:
Table 1: Lung Volumes Data

| Trial	Balloon Diameter (cm)			Lung Volume (cm^3)		
	Column A Vital Capacity	Column B Expiratory Reserve Volume	Column C Tidal Volume	Column D Vital Capacity	Column E Expiratory Reserve Volume	Column F Tidal Volume
1						
2						
3						
TOTAL						
AVERAGE						

Note: 1 cm^3 = 1 mL

Inspiratory Reserve Volume = _____

Total Lung Capacity = _____

Analysis: Compare your results to normal (average) lung volumes for males and females.

"Average" Lung Volumes Measured with a Spirometer

	Male (cm^3 or mL)	Female (cm^3 or mL)
Vital capacity	5000	4000
Total Lung Capacity	6000	5000
Experiatory Reserve Volume	1200	1000
Tidal Volume	525	475

Figure 1: Relationship Between Balloon Diameter (cm) and Lung Volume (cm^3)

Balloon Diameter in Centimeters (cm)
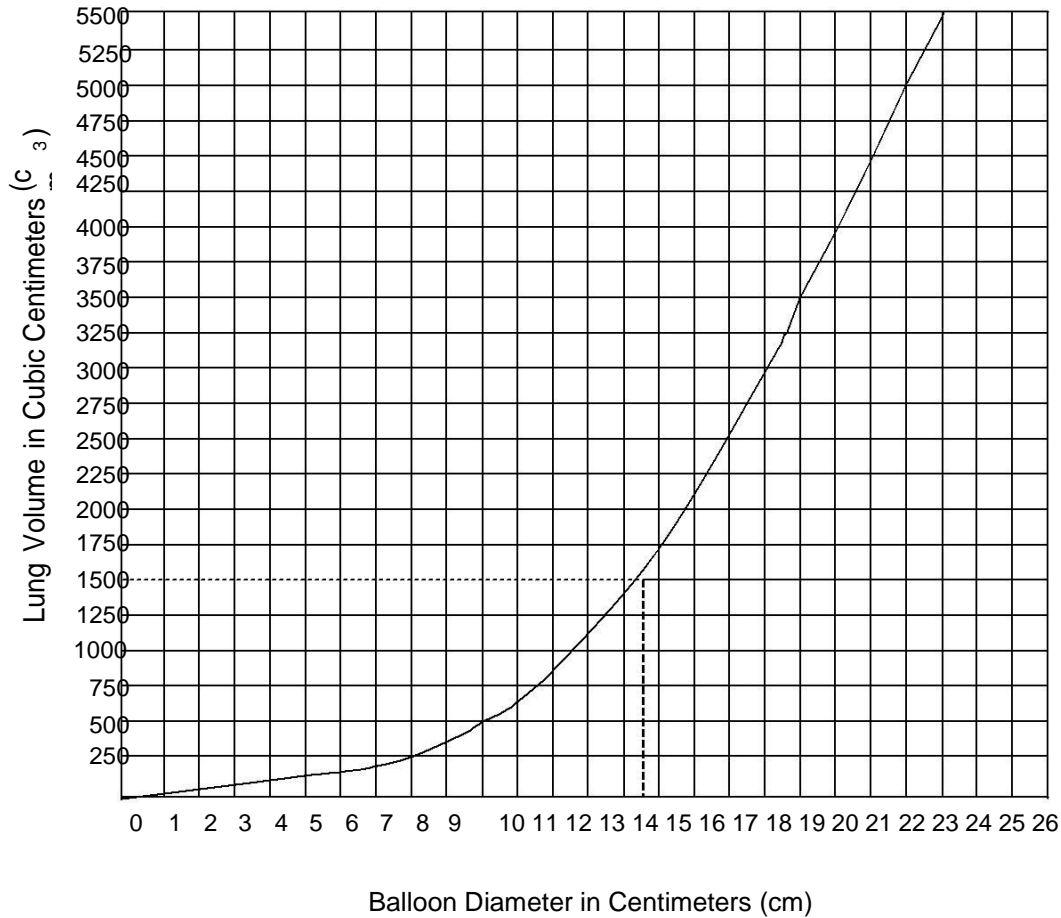
Discussion Questions: Answer the following **using complete sentences**.

1. Compare/contrast your results with the average values.

2. Which person would be more physically fit - an individual with a normal expiratory reserve volume and extremely high vital capacity, or an individual with an extremely high expiratory reserve volume and a rather normal vital capacity? Explain the reasoning behind your choice.

3. Identify 2 sources of error in this investigation.

4. Suggest at least two changes for improving the accuracy of your results in this investigation. (How can you reduce sources of error?)

5. Not everyone has the same lung capacity. Besides the male/female difference, explain two reasons why lung capacities might be different between individuals (consider their environment, activities, health, etc.)