

082-6250 (60-250) Student Wet Spirometer

Introduction: Lungs are remarkable organs. They are responsible for infusing oxygen into the blood of an animal, and expelling carbon dioxide. They surround the heart, and at any given moment half of the blood being pumped is cycled through the lungs. This allows gases to exchange, which is essential for life. All birds, mammals, reptiles, amphibians, and even some fish have them. Bird lungs are the most highly developed, which helps them cope with the stresses of flight. Lung capacity varies greatly in animals; in general, larger animals require larger lungs. This kit focuses on human lungs.

Although human lungs are small, they have enormous surface area. Inside, they are filled with hundreds of millions of tiny air sacs called *alveoli*. This gives lungs a large surface to dissipate gasses; as much as 70m² in some individuals. That's half the size of a tennis court! Average human lung volume is 4-6L. Shorter people, smokers, and those with pulmonary diseases will tend to have lower lung capacities. Heavy smokers will have much lower lung volume than non-smokers. Human lungs contain far more 'space' than they need, to cope with the effects of very strenuous exercise. This is why the elderly and heavy smokers may be fine at rest but quickly become winded after modest exertion. The lungs only need about 25% of their total capacity to keep a person alive; the rest is held in reserve.

There are three major measurements of lung capacity. *Tidal volume* is the amount of air exhaled during normal breathing. *Vital Capacity* is the total amount of air than can be forced from the lungs. Usually, 1-1.5 liters of air will be left in the lungs after this procedure. *Total lung capacity* is self explanatory. This instrument is capable of measuring all three.

Your spirometer is of the *water bell* variety; that is, it works based on the displacement of water. Adding air to the system causes a float to rise, which indicates a value on a scale.

Operation: To use your wet spirometer, you will first need to add water. You will notice that there is a green shell with a yellow inner core. You will want to fill the space between the two with water. It is best to fill to about 1-2 inches below the rim of the green shell. This will allow for maximal volume readings. As you breathe into the unit, air will become trapped under the yellow core, causing it to float. This in turn turns the scale.

In the middle of the scale on the right hand side is a small tick mark, next to a screw. You will need to line up the zero mark and the arrow on the scale with this mark. The roll pin on the scale must be placed above the arrow. When the scale turns, the arrow will push on this pin, marking the maximum



location. The scale measures from zero to nine liters. It is essentially impossible that any student can exceed this amount. That would imply a total lung capacity in excess of 10 liters, which is unheard of.

Measuring Vital Capacity:

- Have your student inhale the maximum possible amount of air. They should inhale until they physically cannot take another breath.
- Have the student exhale the most air possible. Ideally, the exhalation should last for at least six seconds.
- The arrow will indicate the maximum amount. This will likely be in the 3-5 liter range. Particularly tall or athletic students may have a considerable higher amount; smokers may have significantly less.
- Record this amount for each student in the class, and obtain an average.
- Total lung capacity is usually this number plus 0.9 liters for females, and 1.2 liters for males.

Measuring Tidal Volume:

- This is the volume of air present in one normal breath.
- Have the student inhale normally.
- They should then exhale normally into the mouthpiece.
- Values of 0.5 to 1L are normal.

A good activity is to have students measure lung capacities of the entire class, and then screen for different factors. For example, lung capacity versus height, sex, or age can be plotted on a graph. Your students can then determine how strong a correlation between the two exists.

Another activity requires more time and thus makes a good group project. Divide your students into groups of six to eight people. Instruct half of each group to perform strenuous cardiovascular exercise (if they are physically able) 3 days a week for two to three weeks. Your students will find that this slightly increases vital capacity. Note: actual lung capacity does not increase, because the size of the lungs is fixed. However, exercise makes the lungs more effective.

Warranty and Parts:

We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.