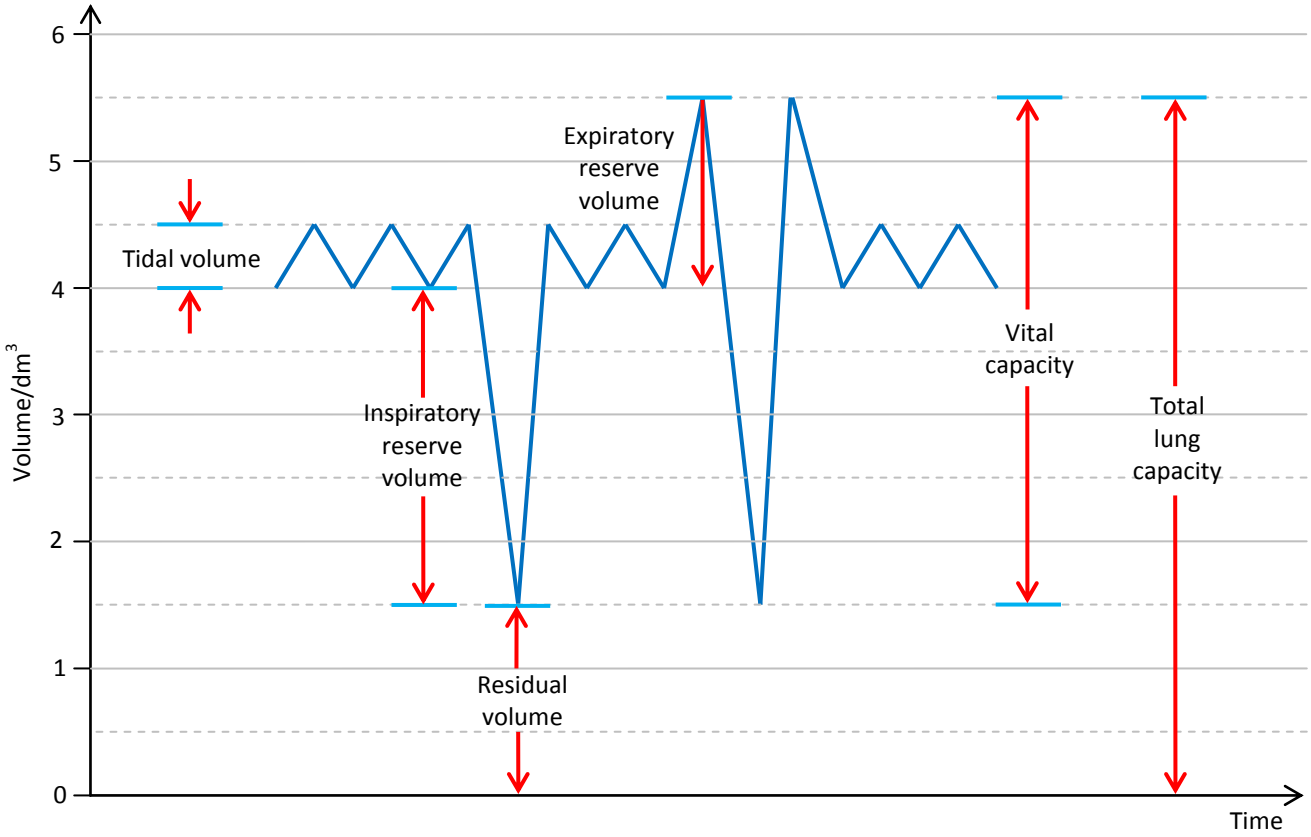
2.3 Measuring Lung Capacity

The different elements of lung volume involved in respiration

When you rest, air moves in and out of your lungs about twelve times a minute. Each breath refreshes some of the air in your lung and removes some of the carbon dioxide generated by your body. When you exercise, or are frightened, you breathe more deeply, and more oxygen-rich air enters the blood and more carbon dioxide is removed with each breath.

A **spirometer** consists of a chamber filled with oxygen that floats on a tank of water. A person breathes from a disposable mouthpiece attached to a tube connected to the chamber of oxygen. Breathing in takes oxygen away from the chamber, which then sinks down. Breathing out then pushes air into the chamber causing it to float.

Elements of Lung Volume



Tidal volume is the volume of air moved in and out of the lungs with each breath at rest. It is usually around 0.5dm^3 and provides the body with enough oxygen for resting needs and removes enough carbon dioxide to maintain safe levels

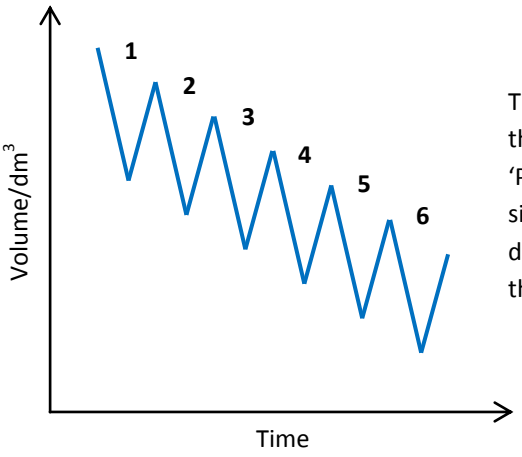
Vital capacity is the largest volume of air that can be moved into and out of the lungs in any one breath. It is usually around 5dm^3 but varies depending on gender, age, size, height and exercise habits

Residual volume is the volume of air that always remains in the lungs, even after the biggest possible exhalation. It is usually around 1.5dm^3

Inspiratory reserve volume is how much more air can be breathed in (inspired) over and above the normal tidal volume when you take a big breath. This reserve is called upon when you exercise

Expiratory reserve volume is how much more air can be breathed out (expired) above the tidal volume. This is smaller than the Inspiratory reserve volume

Dead space is the amount of air in the bronchioles, bronchi and trachea. There is no gas exchange between this air and the blood



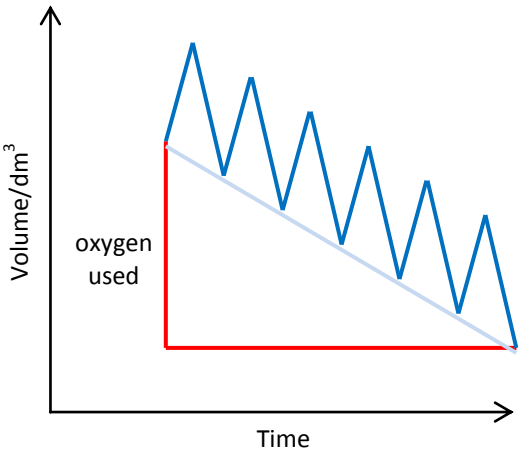
BREATHING RATE

This is easy to calculate using a **spirometer trace**, like the one here or on the pervious page. The trace will consist of a series of peaks and troughs. 'Peak-to-peak' or 'trough-to-trough' is one breath, so all you need to do is simply count the number of breaths per minute (or per 30 seconds and double the answer). You can also calculate **pulmonary ventilation**. This is the total air breathed per minute:

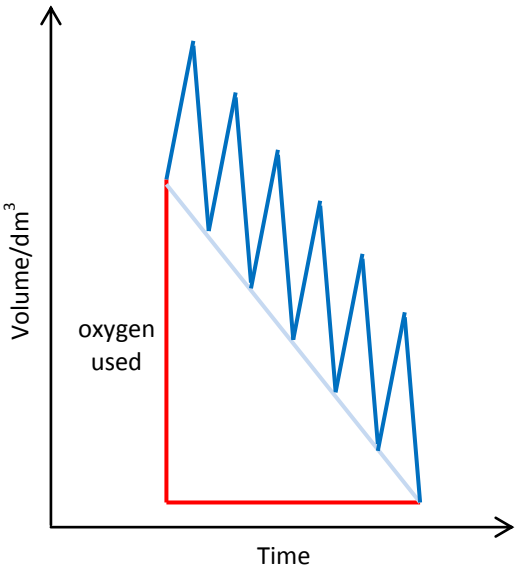
pulmonary ventilation = tidal volume x breathing rate

The air breathed into a spirometer has carbon dioxide removed from it. This is because there is soda lime present to absorb the carbon dioxide, as if someone was to breathe into the spirometer for a long time without having the carbon dioxide removed, the levels of carbon dioxide which built up would be dangerous. Because of this, the volume of gas decreases. The decrease is equivalent to oxygen consumption. We calculate the gradient on a spirometer trace to obtain the oxygen consumption rate.

at rest



during exercise



Note that the gradient of oxygen usage for the person during exercise is a lot steeper than at rest.