Respiration Rate and Volumes

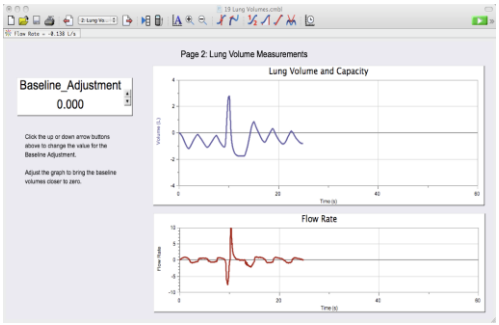
The physiologic basis of spirometry

Spirometry is the most useful and commonly available tests of pulmonary function. It is a physiological test that measures individual inhalation and exhalation volumes of air as a function of time. Pulmonologists and general-practice physicians commonly use spirometry in their offices in the assessment and management of lung disease.

Lung Volume and Function Tests with Spirometry

In lung volume testing, the values differ between healthy individuals based on levels of physical fitness as well as age, sex, and size, so keep in mind the numbers you see in the figure are averages.

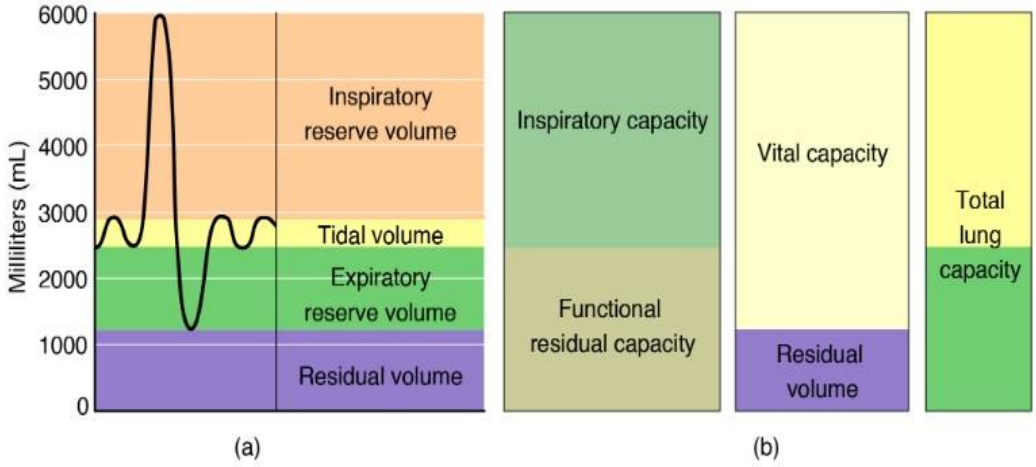
The spirometer—a device that measures movement of air—will provide us with a recording of a range of lung volumes (Taking Three normal breaths, followed by A maximal inspiration, followed by A maximal, forceful, fast expiration, followed by Three normal breaths).



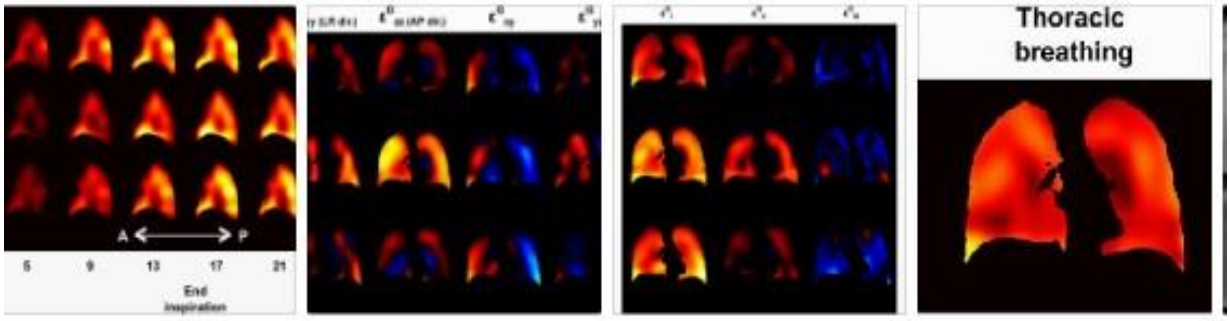
To test for obstructive lung disorders such as asthma, the rate of air movement out of the lungs is measured to determine the level of resistance in the airways. If an air passage has increased resistance, the amount of air a person can exhale in one second (FEV1) will be less than for someone without a respiratory disorder. Table below shows pulmonary (lung) function test measures.

Pulmonary function measure	Definition
Forced vital capacity (FVC)	Volume of air forcefully exhaled after maximum inhalation
Forced expiratory volume 1 (FEV1)	Volume of air forcefully exhaled, in the first second, after maximum inhalation.
Total lung capacity (TLC)	Volume of air contained in lungs after maximum inhalation.
Peak expiratory flow (PEF)	Maximum speed of forceful exhalation after a maximum inhalation
Residual volume (RV)	Volume of air in lungs after maximum exhalation
Tidal volume (TV)	Volume of air moved in or out of the lungs during relaxed, subconscious breathing
Inspiratory reserve volume (IRV)	Volume of air that can be inhaled beyond tidal inhalation
Expiratory reserve volume (ERV)	Volume of air that can be exhaled beyond tidal exhalation
Residual volume (RV)	Volume of air remaining lungs after maximum exhalation

Respiratory Volume and Capacities



3D Magnetic Resonance Spirometry



From a physiological standpoint, the lung volumes are either dynamic or static. Both subclasses are measured at different degrees of inspiration or expiration; however, dynamic lung volumes are characteristically dependent on the rate of air flow. The static lung volumes/capacities are further subdivided into four standard volumes (tidal, inspiratory reserve, expiratory reserve, and residual volumes) and four standard capacities (inspiratory, functional residual, vital and total lung capacities). The dynamic lung volumes are mostly derived from vital capacity. While dynamic lung volumes are essential for diagnosis and follow up of obstructive lung diseases, static lung volumes are equally important for evaluation of obstructive as well as restrictive ventilatory defects.

Abnormally Low Tidal Volume

A low Vt can be caused by hypoventilation (respiratory depression). In the early stages of hypoventilation, you may not experience any symptoms. As hypoventilation progresses, symptoms may include:

Difficulty breathing (dyspnea) at rest, Excessive daytime/nighttime sleepiness, Anxiety, Delirium

Abnormally High Tidal Volume

Hyperventilation (over-breathing) can cause a high Vt. Symptoms are often more distressing than over-breathing.

Symptoms may include: Agitation, Sense of terror, Chest pain, Lightheaded.