

Physiology of the Respiratory System

Respiration

Respiration has 3 phases:

1. Pulmonary ventilation - movement of air into and out of the lungs
2. External respiration - exchange of gases b/n lungs and blood
3. Internal respiration - exchange of gases b/n blood and tissues

Pulmonary ventilation consists of

1. Inspiration - inhalation, movement of air into lungs
2. Expiration - exhalation, emptying air from lungs into atmosphere

Pulmonary Ventilation

[\[Section 22.3.2: Pulmonary Ventilation\]](#)

[\[Figure 22.17: Inspiration and Expiration\]](#)

For pulmonary ventilation to occur, the pressure in the thoracic cavity must be different from atmospheric pressure

- **Inspiration** is an *active process*, it requires the contraction of several muscles to change volumes and pressures
- **Expiration** is *passive*, muscles relax, thoracic wall and lungs recoil, air moves out

Lung Volumes and Capacities

[\[Section 22.3.3: Respiratory Volumes and Capacities\]](#)

[\[Figure 22.18: Respiratory Volumes and Capacities\]](#)

A **Spirometer** measures respiratory volumes

- **Tidal Volume*** is the amount of air inhaled or exhaled during normal resting breathing
- **Inspiratory Reserve Volume (IRV)** is the amount of air forcibly inspired above normal inhalation
- **Expiratory Reserve Volume (ERV)*** is the amount of air forcibly expired after a normal exhalation
- **Vital Capacity*** is the maximum amount of air exhaled from lungs after maximum inhalation

* *can be measured directly with spirometer*

IRV can be calculated from the VC, TV, and ERV:

$$VC = IRV + ERV + TV \rightarrow IRV = VC - ERV - TV$$

The respiratory system always contains some air

- The **Residual Volume** is the amount of air that cannot be forcefully exhaled from the lungs

- ***Total Lung Capacity*** is ~ 6,000 ml; $TLC = VC + RV$
- ***Minimal Volume*** is the amount of residual air that stays in the lungs even after collapse
- ***Respiratory Rate*** is the number of breaths taken per minute
- ***Minute Volume*** amount of air exchanged b/n lungs and environment in 1 minute:
 $MV = TV \times RR$