Chapter 22: Respiratory System

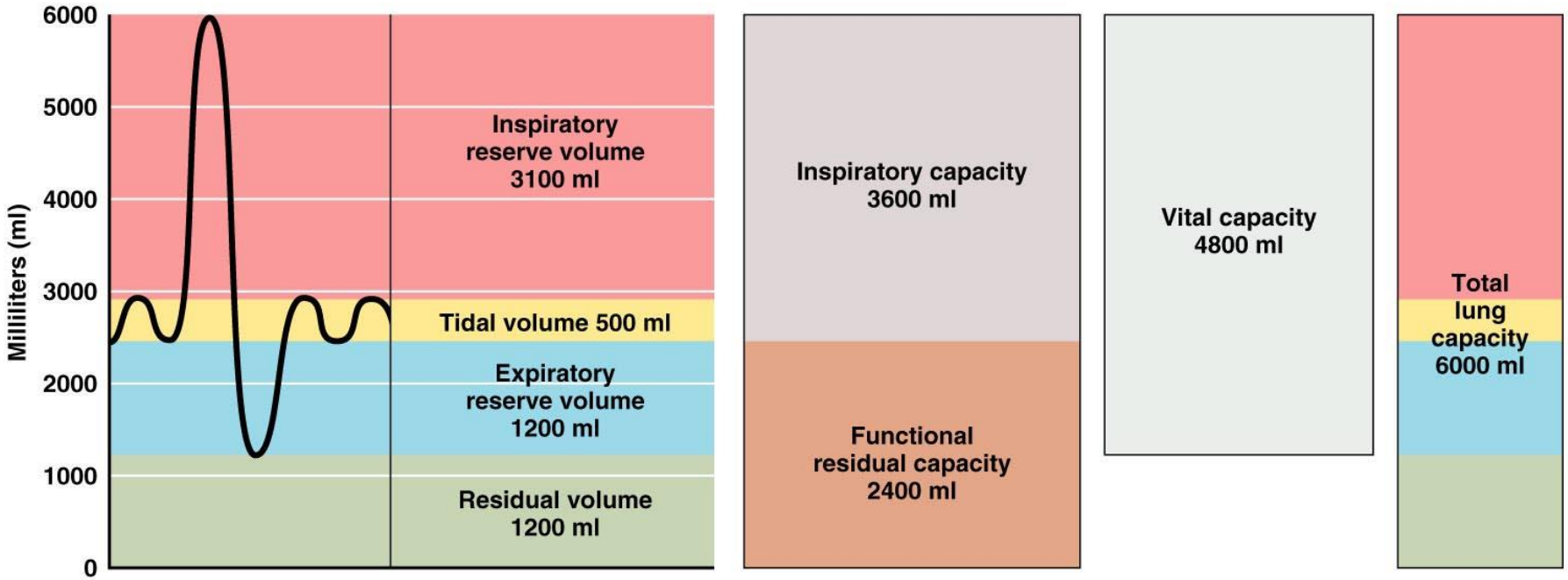
Respiratory Volumes

Respiratory Volumes and Capacities

- **Respiratory volumes** → The amount of air that is flushed in and out of the lungs
- **Respiratory capacities** → Specific sums of the respiratory volumes
- **Spirometer** → measures respiratory volumes

Respiratory Volumes

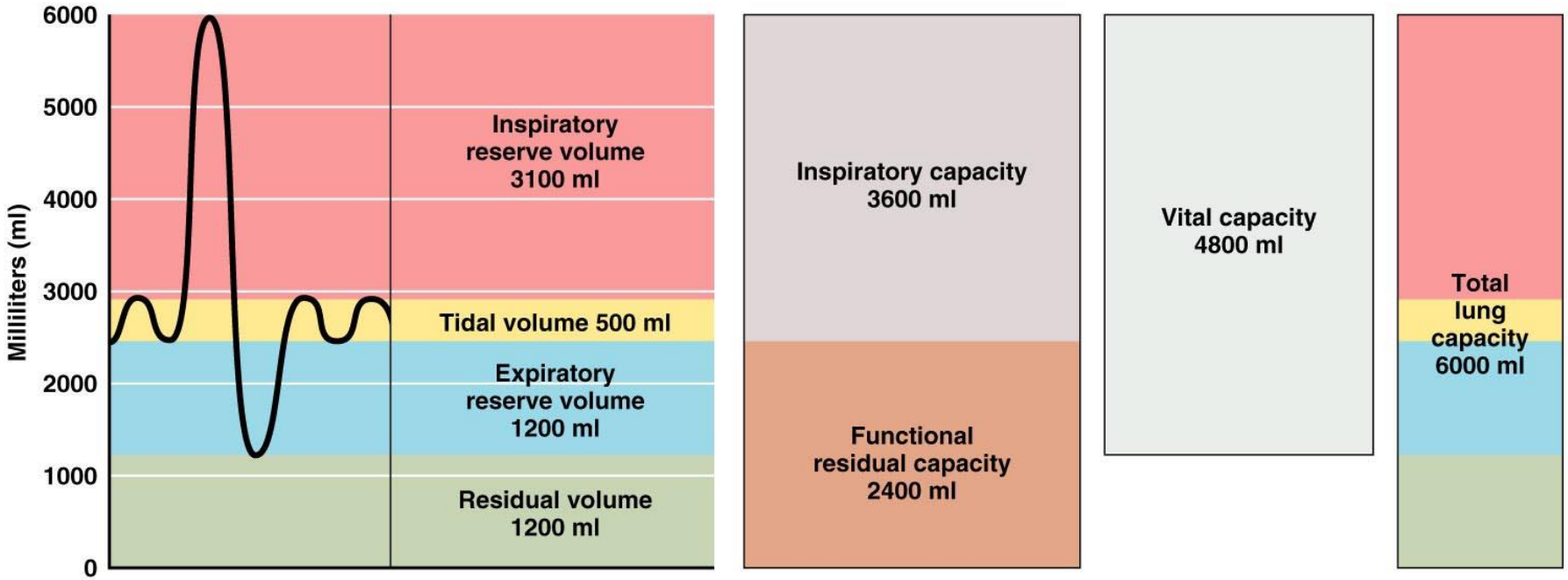
- **Tidal volume (TV)–** during normal quiet breathing the amount of air that moves into and out of lungs
  - 20 yrs 155 lbs → 500 ml



(a) Spirographic record for a male

Respiratory Volumes

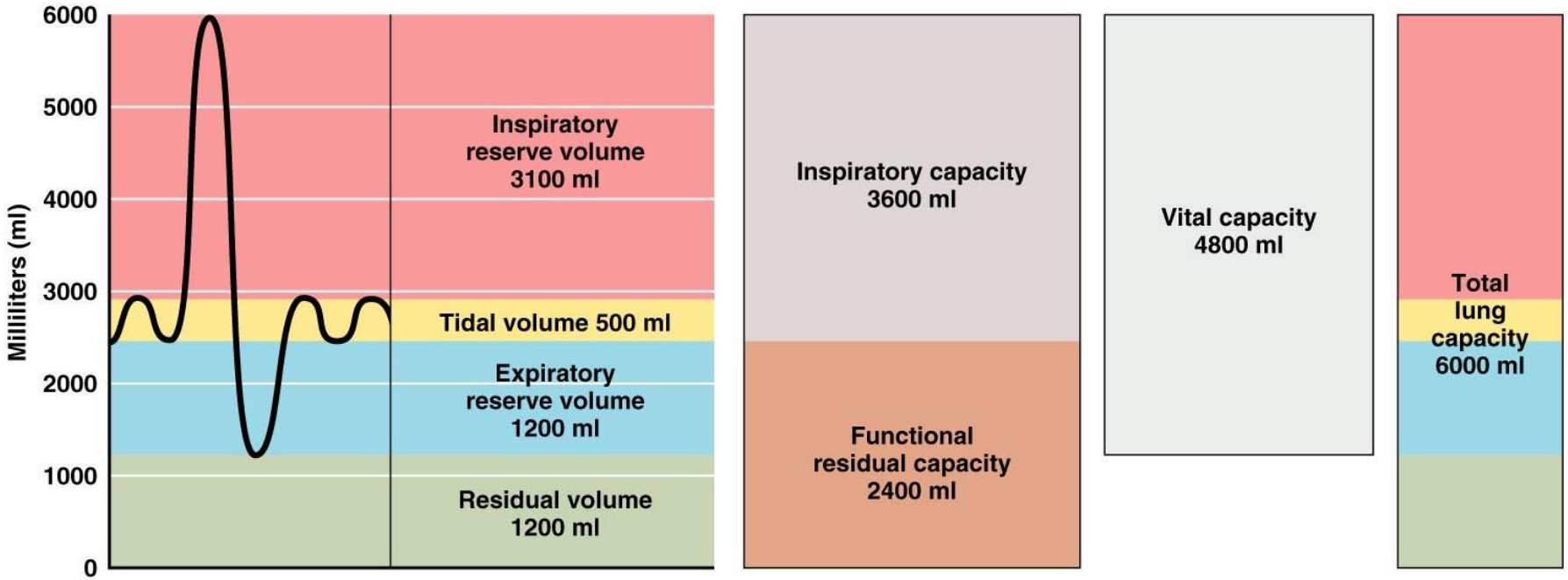
- **Inspiratory reserve(IRV)** – the amount of air that can be inspired forcibly beyond the normal inhalation (2100 – 3200 ml)



(a) Spirographic record for a male

Respiratory Volumes

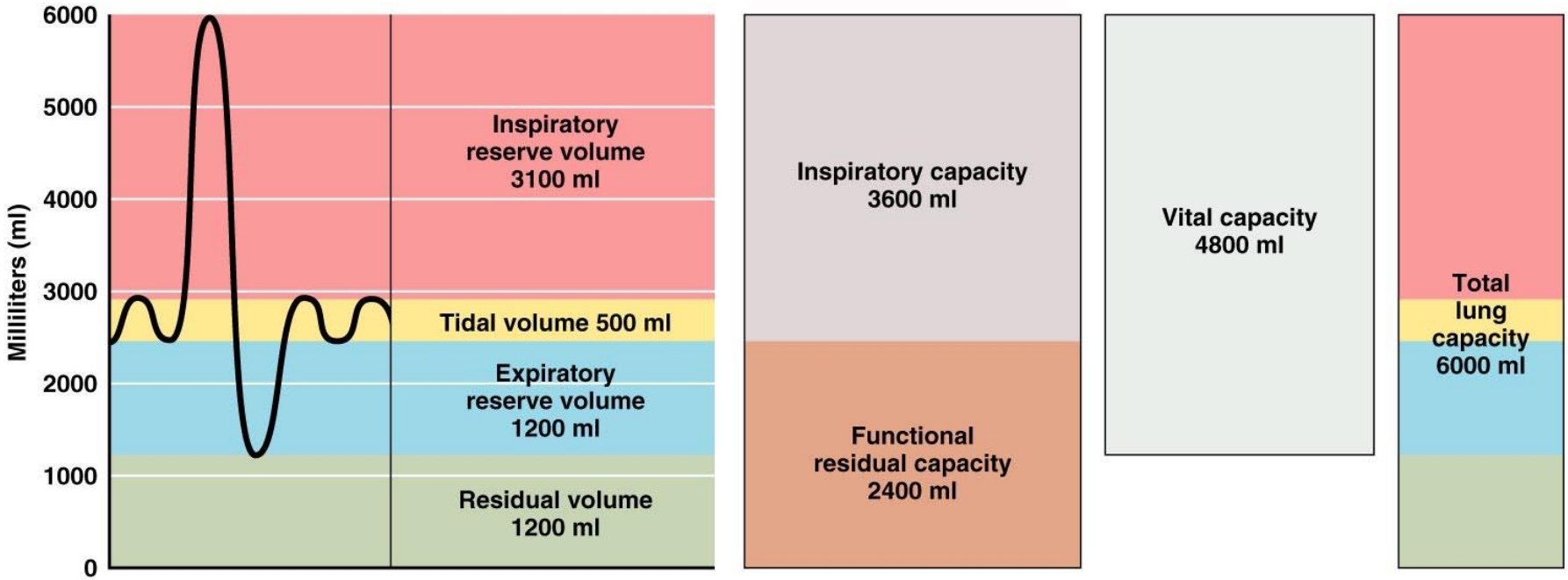
- **Expiratory reserve (ERV)–** the amount of air that can be evacuated from the lungs after normal exhalation (1000 – 1200 ml)



(a) Spirographic record for a male

Respiratory Volumes

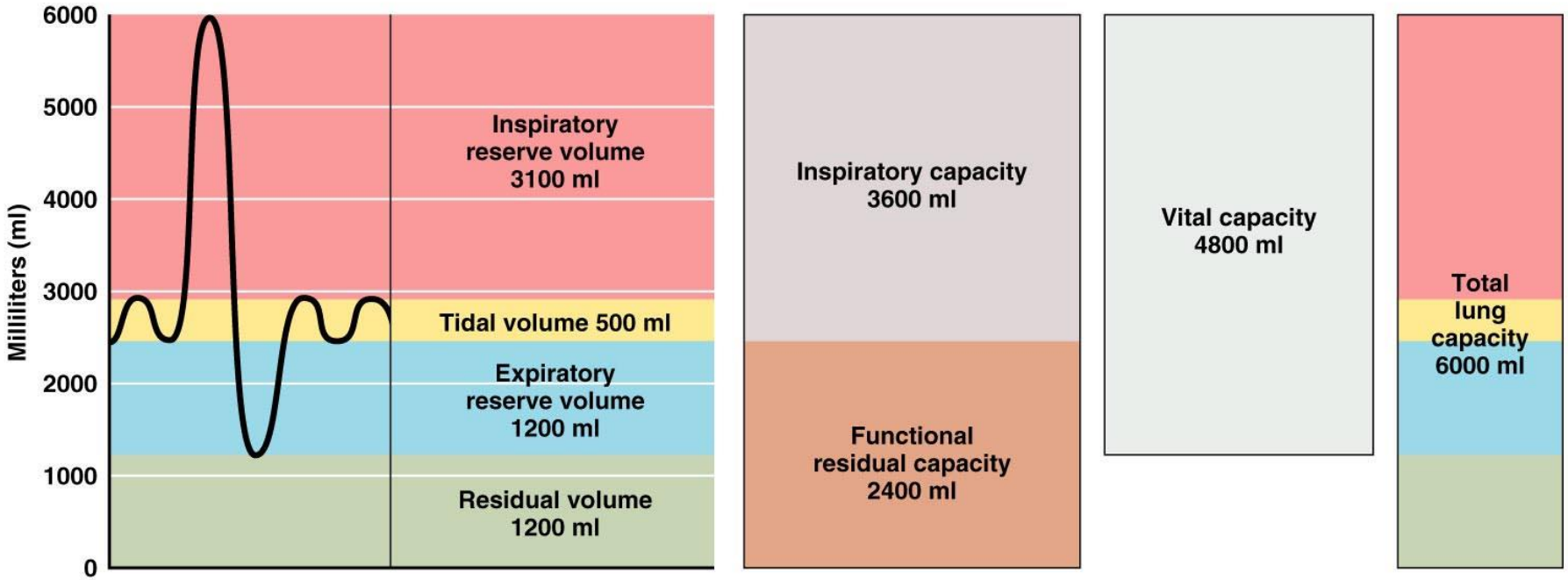
- **Residual volume (RV)** – the amount of air left in the lungs after the most strenuous expiration (1200 ml)
  - Helps to keep the alveoli open and prevent lung collapse



(a) Spirographic record for a male

Respiratory Capacities

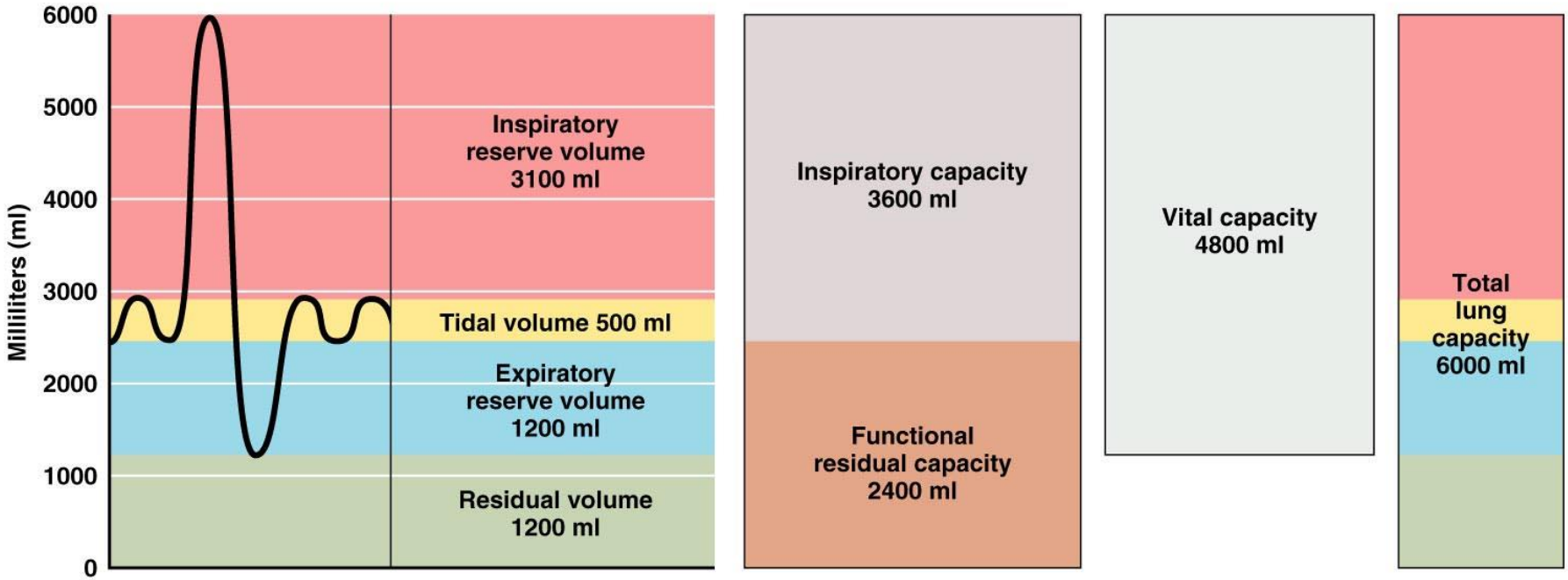
- **Inspiratory Capacity (IC)**
  - Total amount of air that can be inspired after a tidal expiration
  - IC = TV + IRV



(a) Spirographic record for a male

Respiratory Capacities

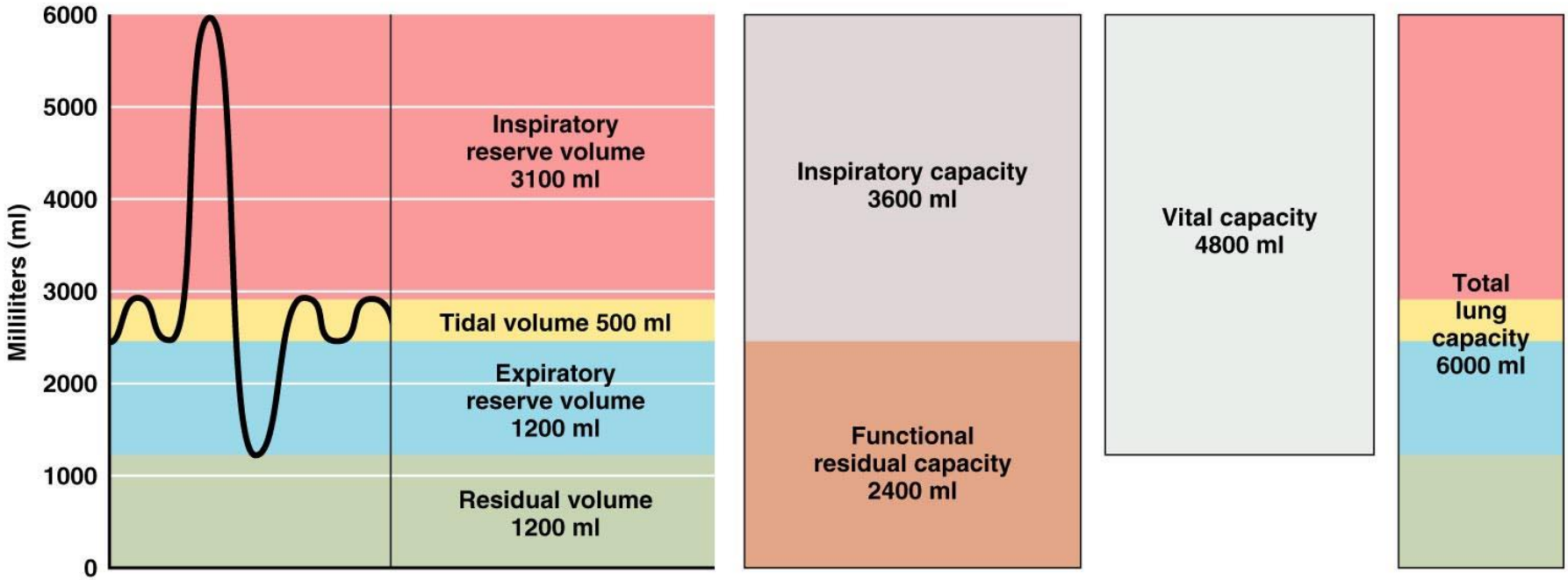
- **Functional residual capacity (FRC)**
  - Volume of air remaining in the lungs after a normal tidal expiration
  - FRC = ERV + RV



(a) Spirographic record for a male

Respiratory Capacities

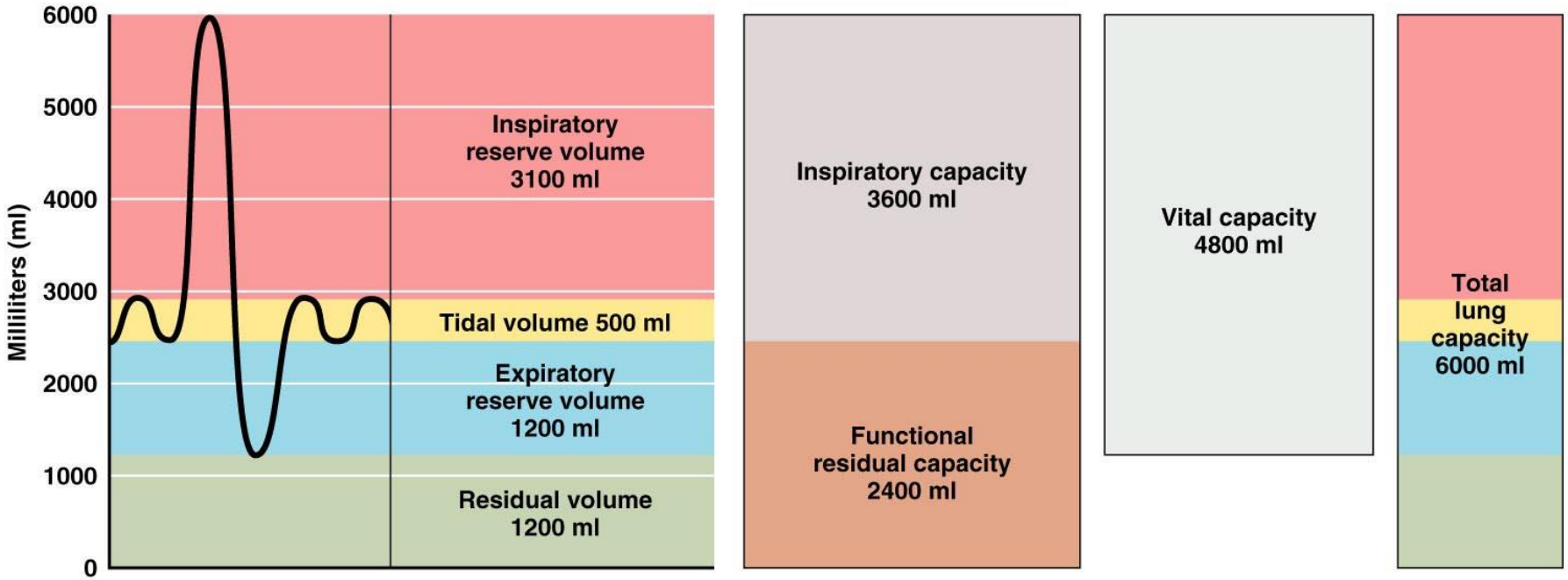
- **Vital capacity (VC)**
  - Maximum amount of air that can be expired after a maximum inspiratory effort
  - VC = TV + IRV + ERV
  - Should be 80% of TLC



(a) Spirographic record for a male

Respiratory Capacities

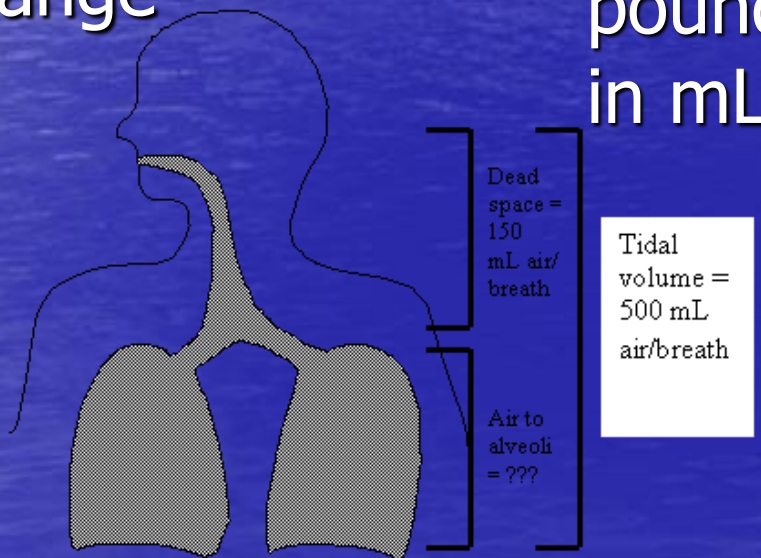
- **Total lung capacity (TLC)**
  - Maximum amount of air contained in lungs after maximum inspiratory effort (sum of all volumes)
  - TLC = TV + IRV + ERV + RV



(a) Spirographic record for a male

Anatomic Dead Space

- Inspired air that fills the conducting passageways, but doesn't contribute to gas exchange
- About 150 mL
- Easy way to determine → your ideal weight in pounds is dead space in mL

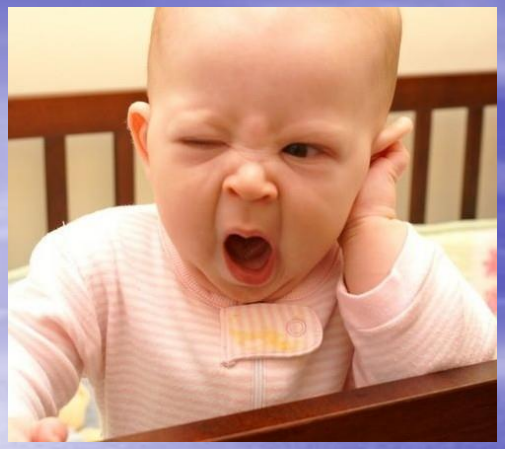


Coughing

- A long-drawn and deep inhalation followed by complete closure of glottis, which results in a strong exhalation that suddenly pushes the glottis open and sends a blast of air through the upper respiratory passages. Stimulus may be a foreign body lodged in larynx, trachea, or epiglottis

Sneezing

- Spasmodic contraction of muscles of exhalation that forcefully expels air through the nose and mouth. Stimulus may be an irriatation of the nasal mucosa



Yawning

- A deep inhalation through the widely opened mouth producing an exaggerated depression of the mandible. It may be stimulated by drowsiness, fatigue, or someone else's yawning. Precise cause is unknown

Hiccupping

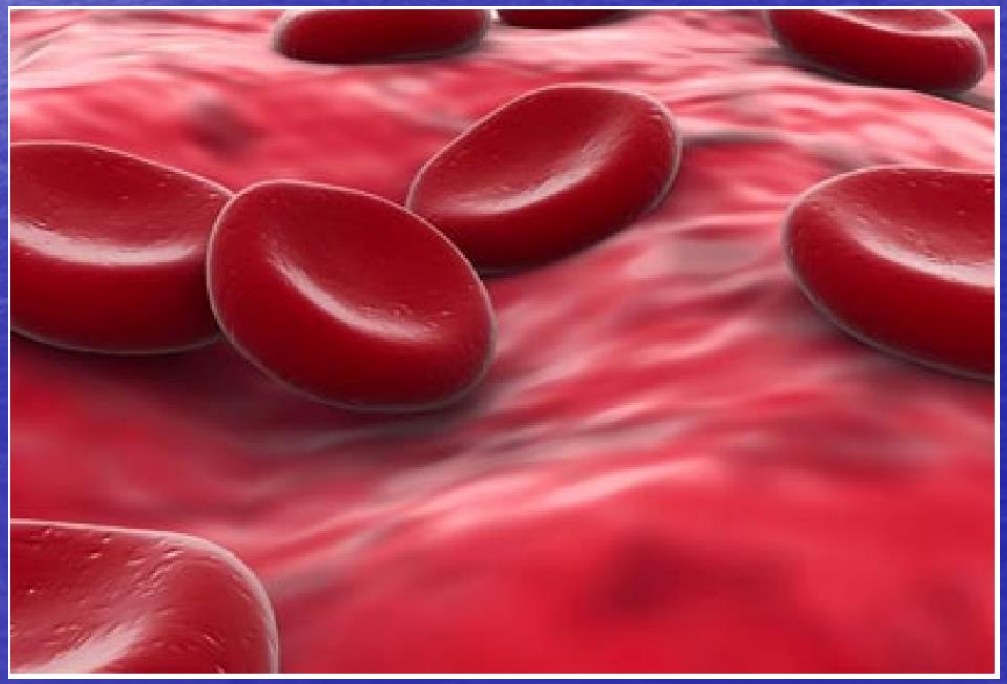
- Spasmodic contraction of the diaphragm followed by a spasmodic closure of the glottis, which produces a sharp sound on inhalation. Stimulation is usually irritation of the sensory nerve endings of the GI tract

Chapter 22: Respiratory System

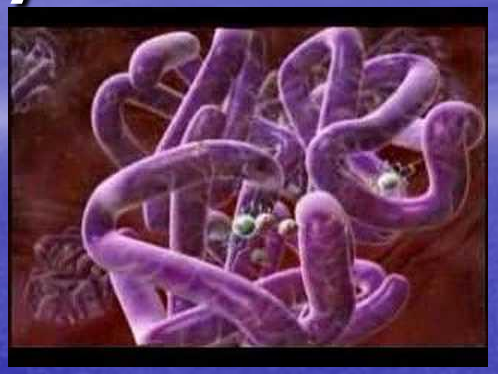
Transport of Respiratory Gases

Transport of Respiratory Gases

- Oxygen Transport
  - Dissolved in the plasma – 1.5 %
    - O_2 is poorly soluble in water



Transport of Respiratory Gases



- Oxygen Transport
  - Bound to hemoglobin – 98.5%
    - Hemoglobin (Hb) is composed of 4 polypeptide chains, each bound to an iron-containing heme group.
    - The iron binds the oxygen. Each hemoglobin can take 4 oxygen molecules.
    - After first oxygen binds, the Hb molecules changes shape → each oxygen afterwards binds quicker than the last

Transport of Respiratory Gases

- Carbon dioxide Transport
  - Dissolved in plasma – 7 - 10%
  - Bound to hemoglobin – ~20%
    - Binds directly to the *globin*
    - Doesn't compete with oxygen transport
  - Bicarbonate ion (HCO_3^-) in plasma – ~70%
    - $CO_2 + H_2O \leftrightarrow H_2CO_3 \leftrightarrow H^+ + HCO_3^-$
    - CO_2 enters RBC and reaction takes place very quickly → HCO_3^- moves from RBC into the plasma.
    - Reaction also takes place but at a much slower rate!

Respiration

- External respiration → Pulmonary gas exchange → gas exchange between lungs and the blood
- Internal respiration → systemic gas exchange → gas exchange between blood and the tissue
- Cellular respiration → blood to cells, cells use O_2 to break down food for useable energy (ATP)