Semester II
CC- IV : Animal Physiology
Unit 3 : Respiratory system

E-class : 01
Topic : Respiratory volumes & capacities

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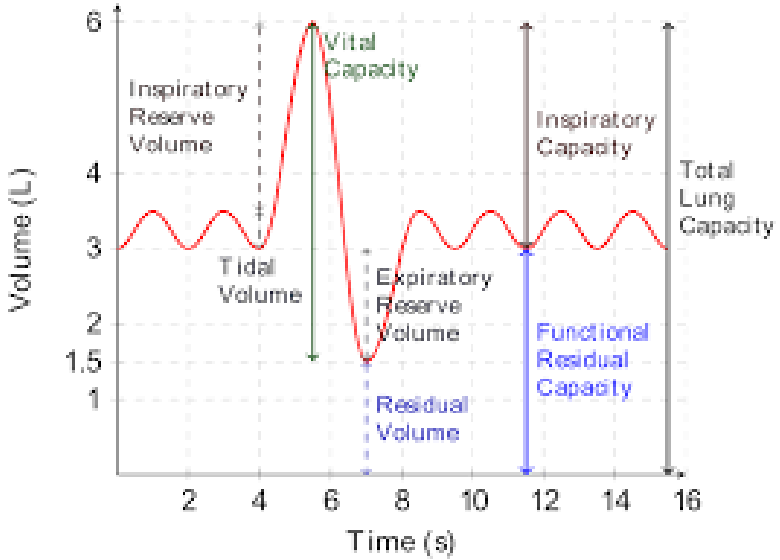
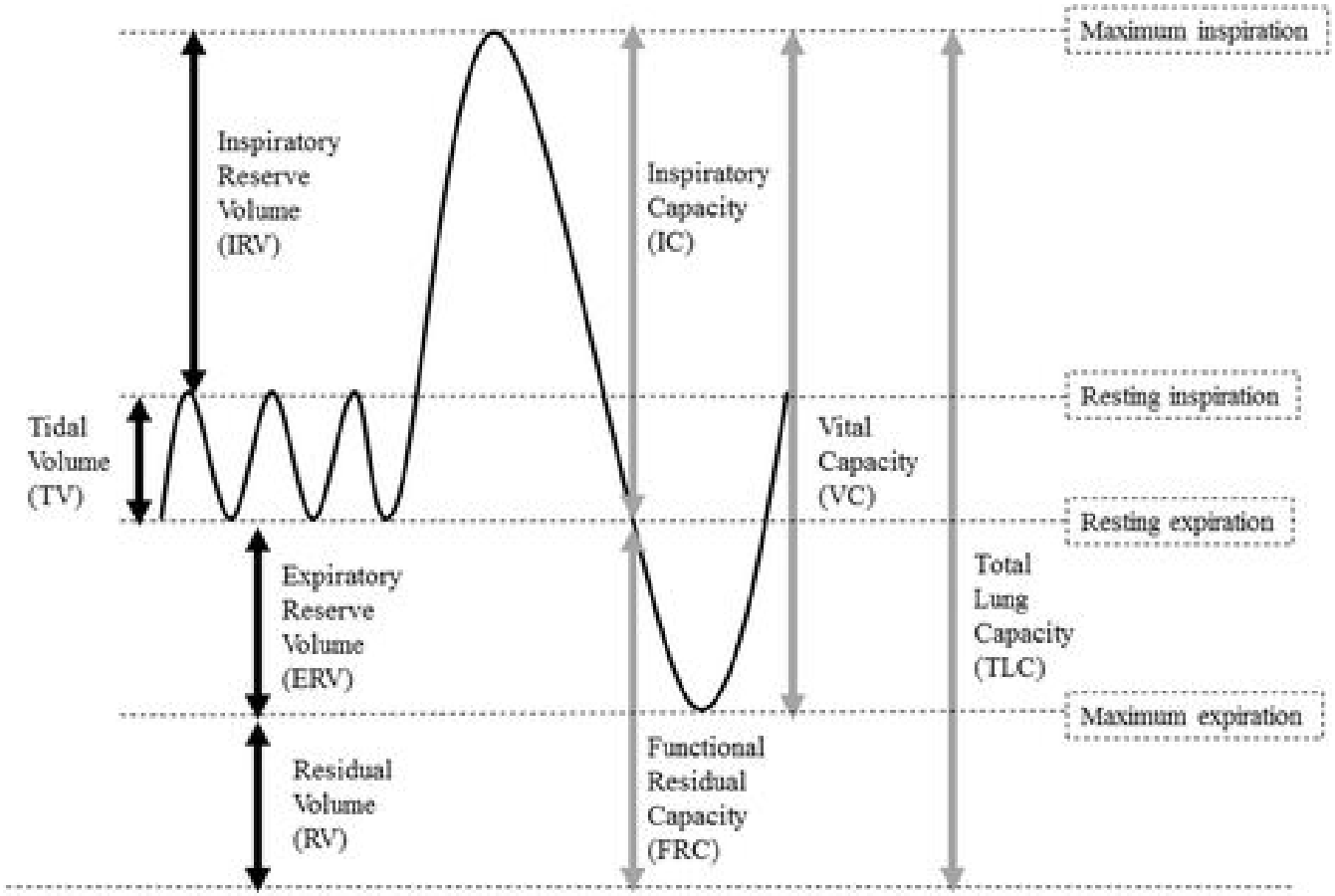
Respiratory volumes & Capacities



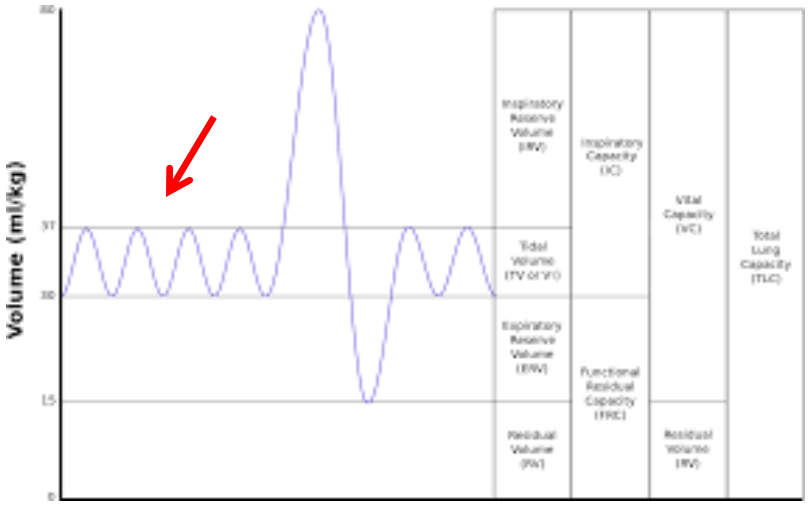


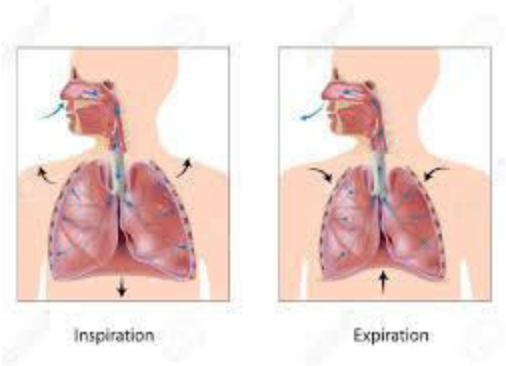
TV IRV ERV RV IC = TV + IRV FRC = ERV + RV VC = TV + IRV + ERV

TLC = TV + IRV + ERV + RV or TLC = VC + RV

Tidal Volume (TV or V_T)

Volume of air moves into and out of the lungs during normal inspiration and expiration respectively.





TV = 500 ml (approx.) / inspiration or expiration
Or
TV = 7 ml / kg body wt.

Low TV causes the lungs to collapse resulting in shunt and hypoxia

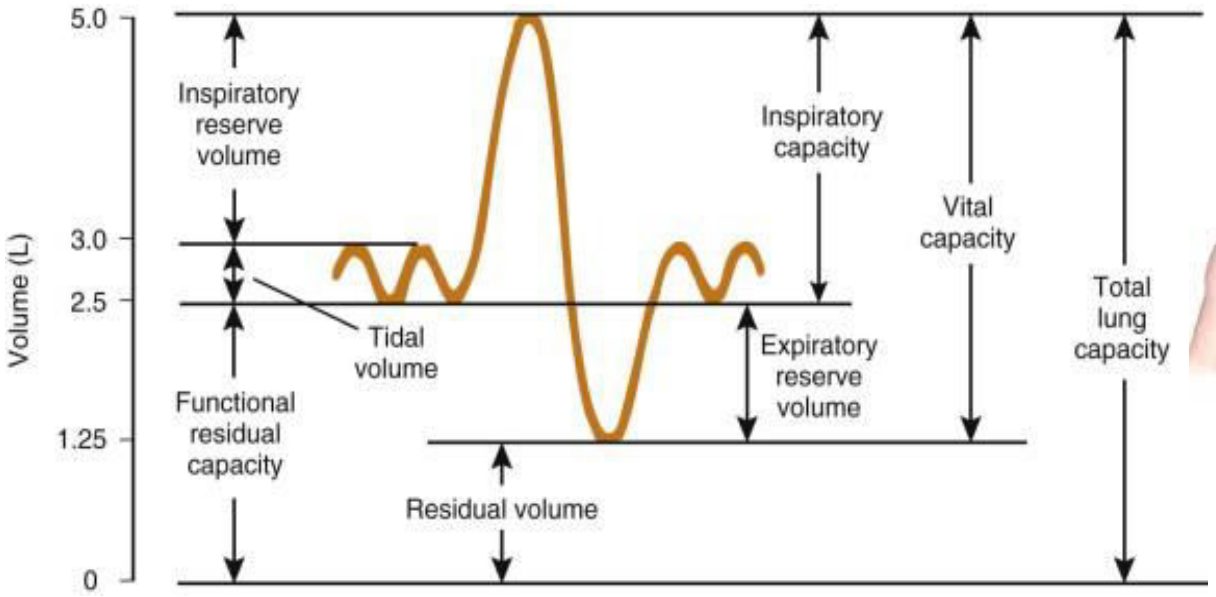
TV α Exercise

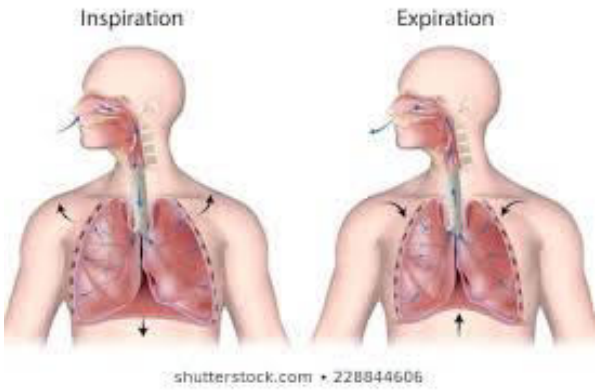
TV α $\frac{1}{Hypoxia}$

TV α $\frac{1}{Shunt}$

Inspiratory Reserve Volume (IRV)

Maximum forced inhalation after normal inspiration





Male : 3.3 L
Female : 1.9 L

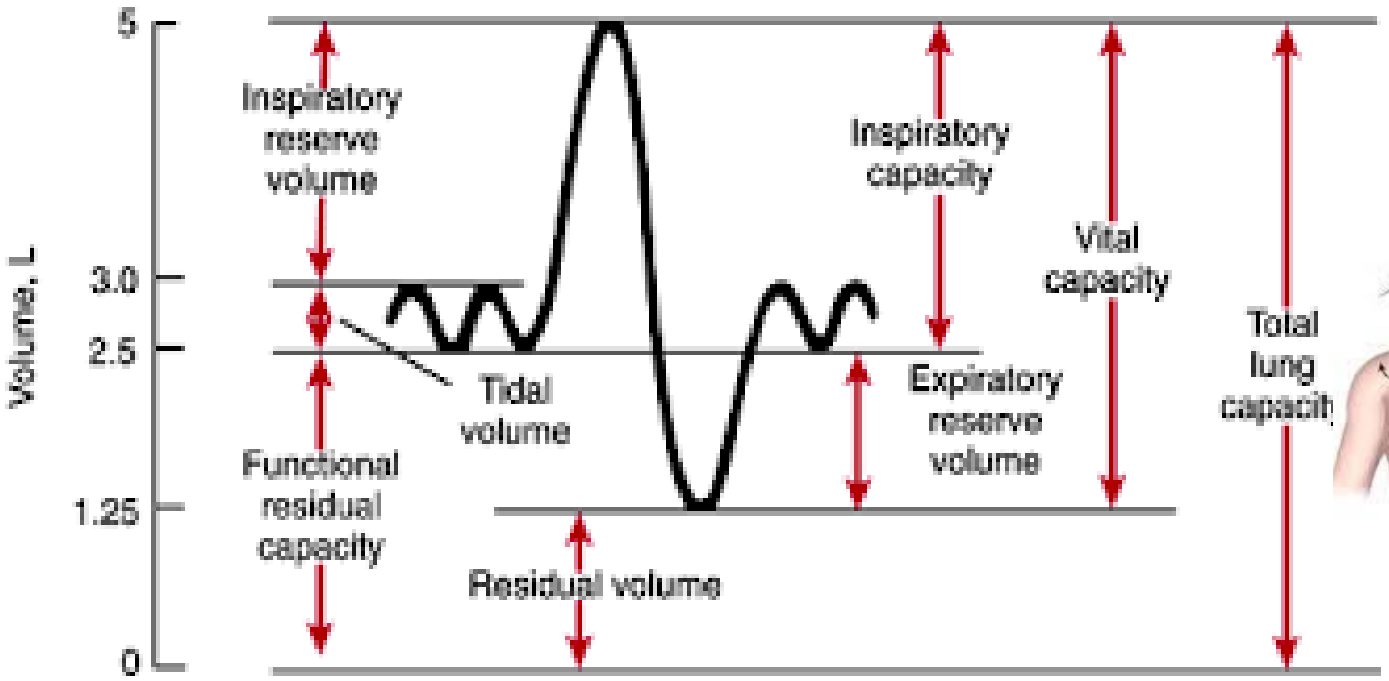
Lungs do not collapse after greatest expiration

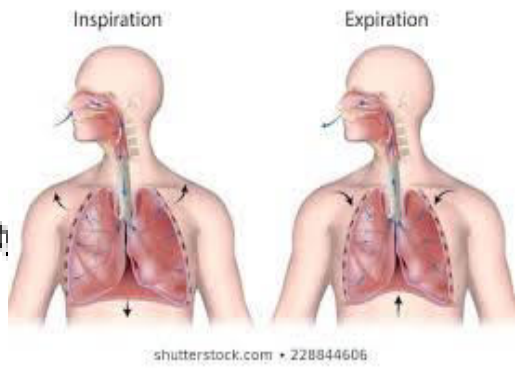
IRV remains constant during exercise

Spirometer

Expiratory Reserve Volume (ERV)

Maximum forced exhalation after normal expiration





Male : 1.1 L

Female : 0.7 L

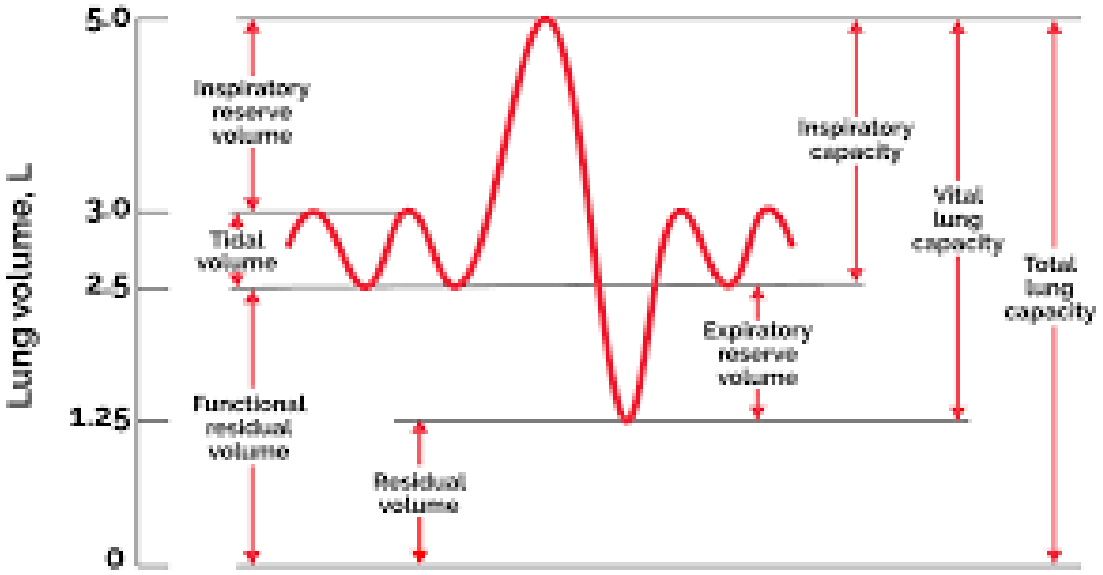
ERV resists lungs to collapse

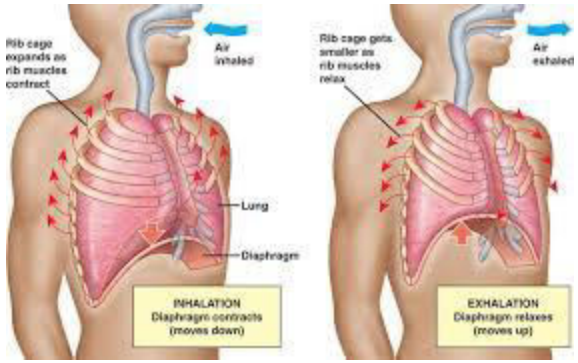
It assists in gaseous exchange

ERV reduces in obesity and abdominal swelling

Residual Volume (RV)

Amount of air remains in lungs after fully exhalation





Male : 1.2 L
Female : 1.1 L
RV : 20 – 25 ml/kg

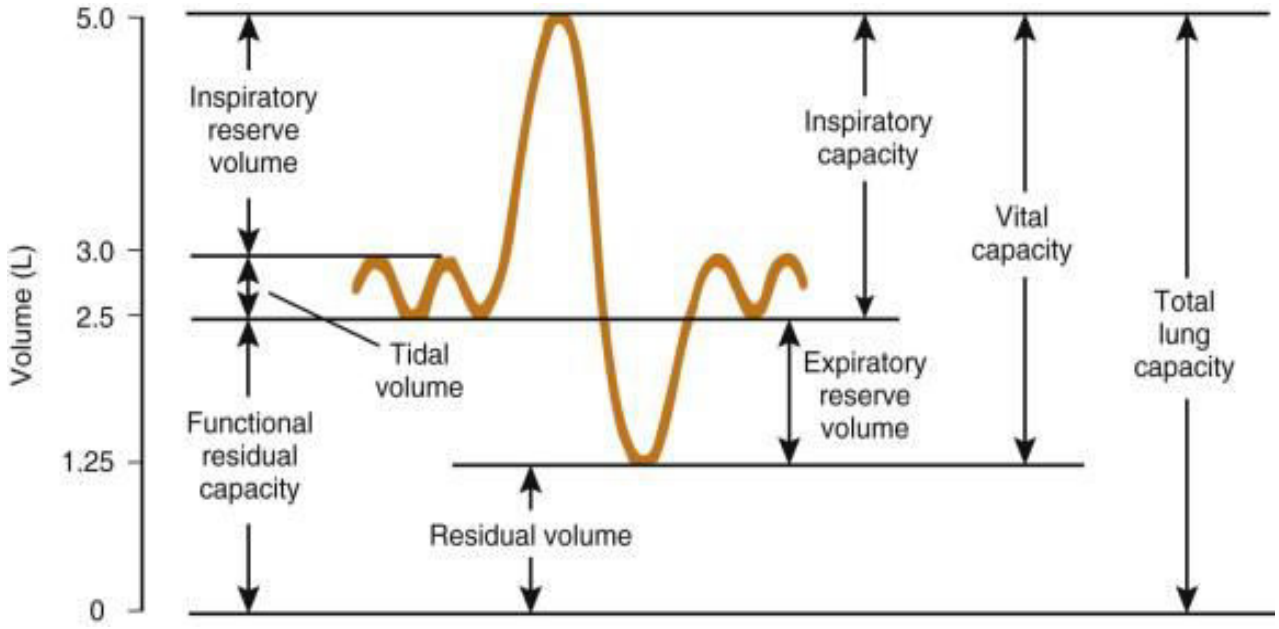
It prevents the lungs from collapsing and allows continual gas exchange

RV is not decreased in wall muscle weakness

RV is not measured directly by Spirometer

Inspiratory Capacity (IC)

Volume of air inhaled during maximum inspiration following a normal expiration



IC = TV + IRV

Male : 3.8 L
Female : 2.4 L

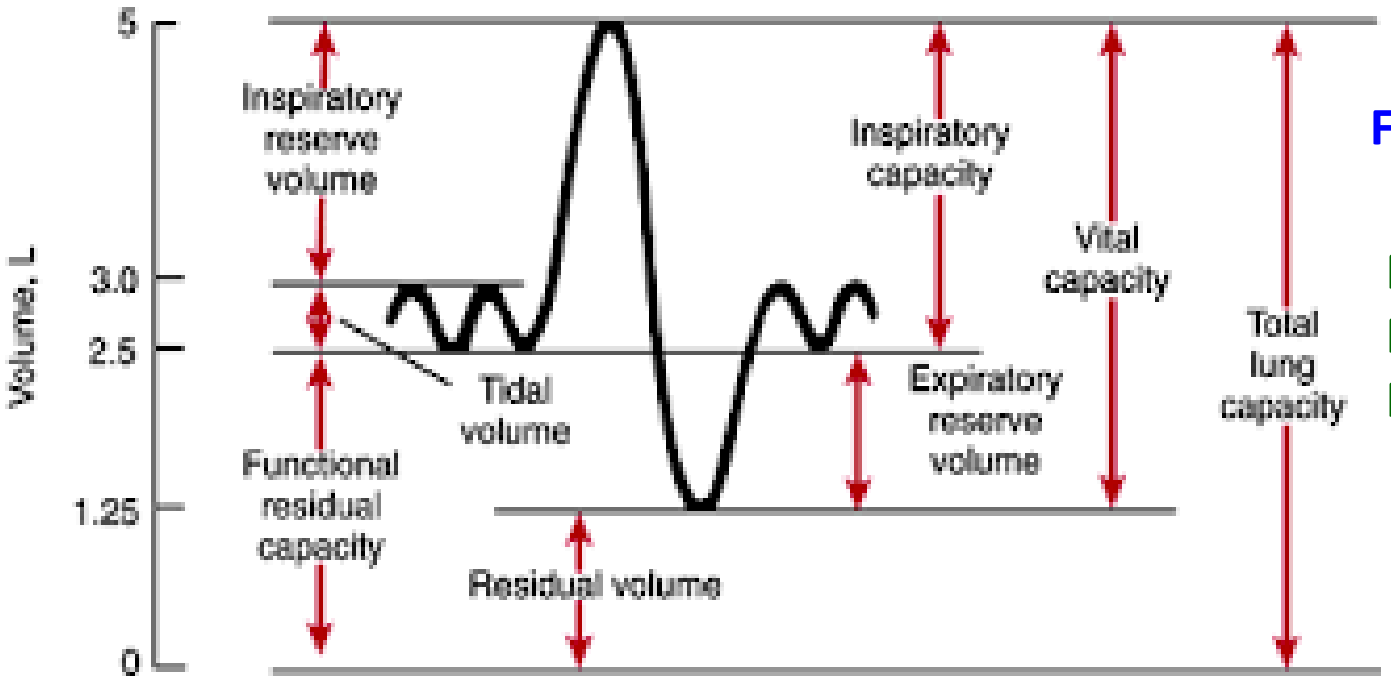
Prevents lungs from collapsing

Gaseous exchange

IC increases during exercise
IC reduces in COPD

Functional Residual Capacity (FRC)

Volume of air in lungs after normal expiration



FRC = ERV + RV

Male : 2.4 L
Female : 1.8 L
FRC : 30 ml/kg

FRC can't be spirometry

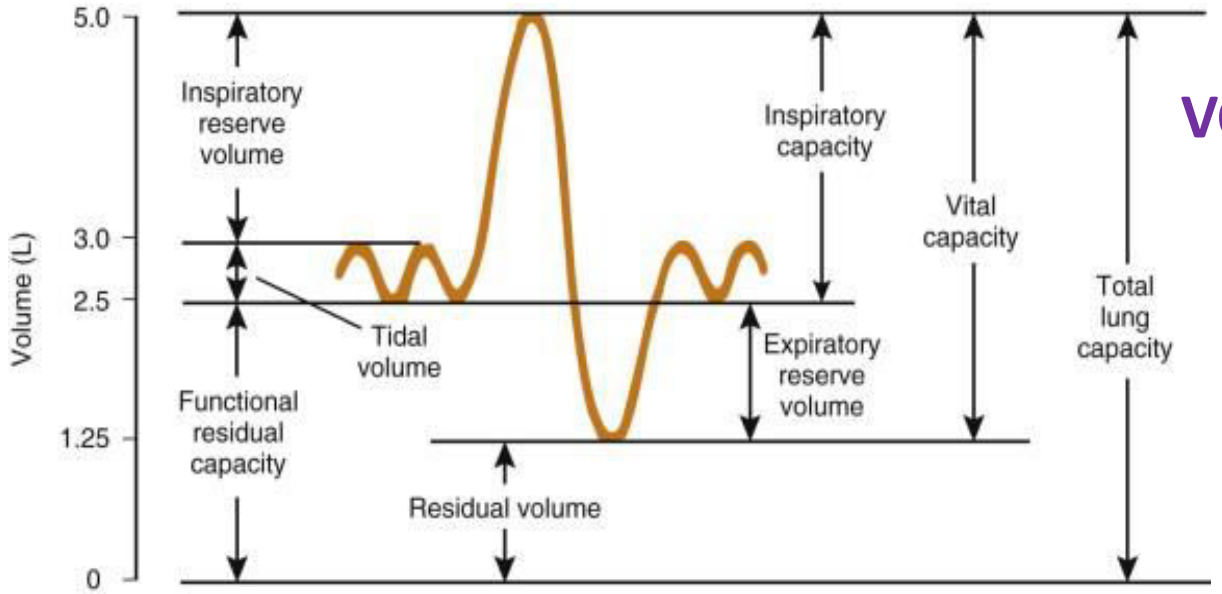
FRC opposes elastic recoil forces of lungs and chest wall and Prevents lungs from collapsing

Participate in gaseous exchange

FRC α h, posture and α obesity^{-1}
FRV (↕) indicates respiratory disease

Vital Capacity (VC)

Maximum amount of air expelled after a maximum inhalation



VC = IRV + TV + ERV

Male : 4.9 L
Female: 3.1 L

VC : 60 -70 ml/kg

Measured in Spirometer

VC provides O_2+ air and expels O_2- air and thus promotes gaseous exchange in lungs

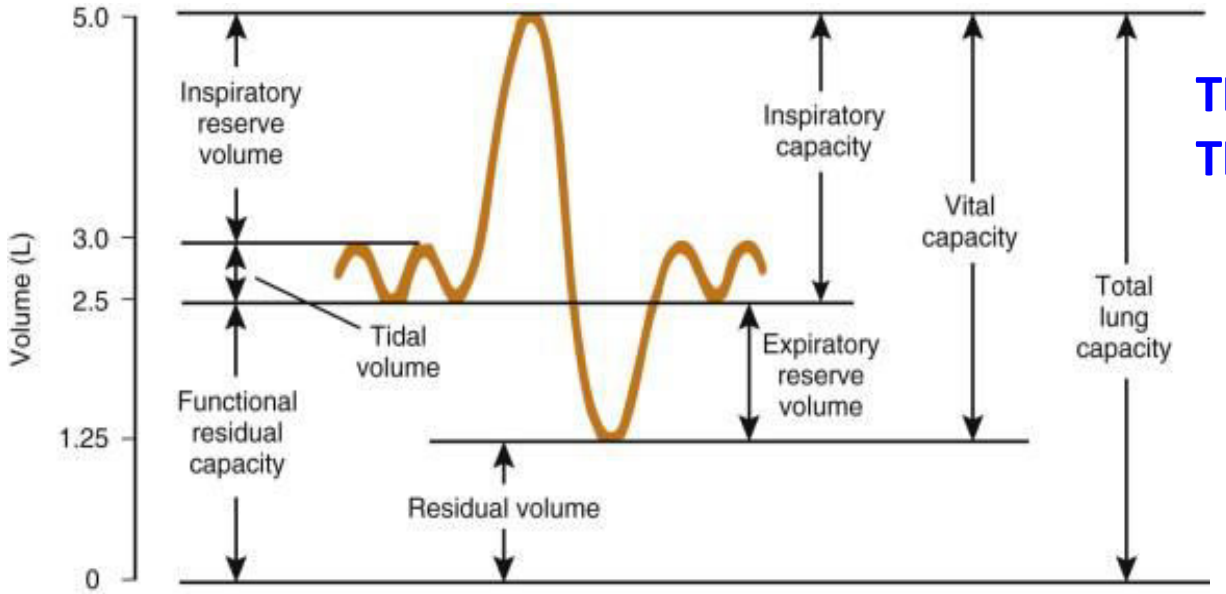
Low VC indicates restrictive lungs disease

Sportsman & Mountaineer have higher VC

VC α h, exercise & constant in pregnancy

Total Lung Capacity (TLC)

Volume of air in lungs after maximum inspiration



TLC = IRV + TV + ERV + RV
TLC = VC + RV

Male : 6.0 L
Female : 4.2 L
TLC : 75-80 ml/kg

TLC α h, exercise, obesity^{-1}, respiratory disease $^{-1}$, chest wall deformity^{-1}

Promotes gaseous exchange

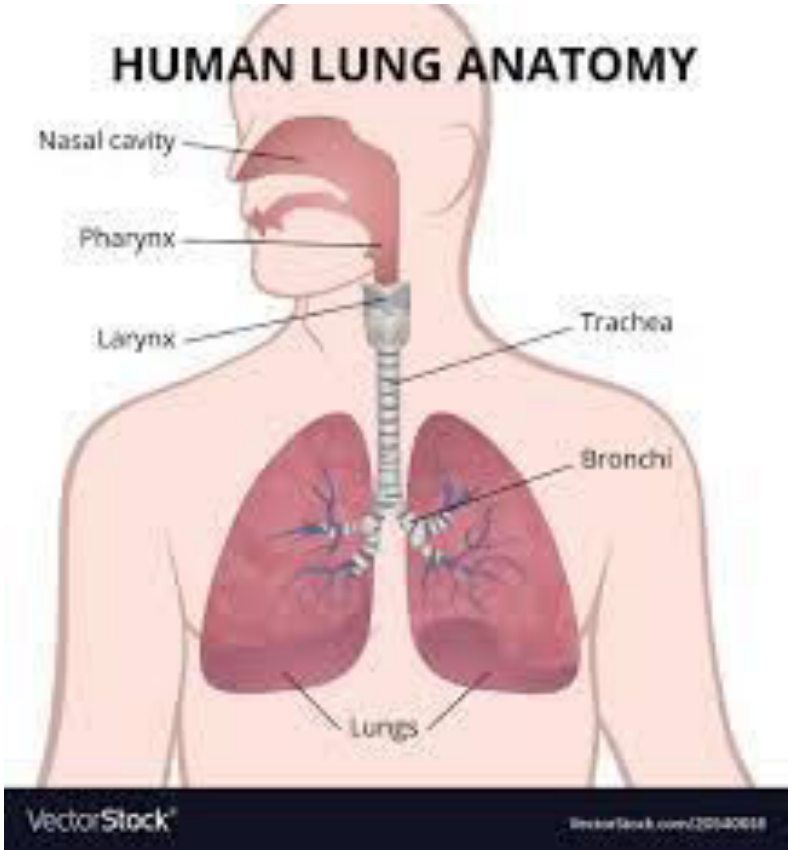
Prevents lungs from collapsing

Measured in Plethysmography

Anatomical Dead Space Volume (VD_{ana})

Volume of air in respiratory tract (nose, pharynx, trachea, bronchi, bronchioles, alveolar duct & alveolar sac) does not participate in gaseous exchange.

VD_{ana} conducts air to bronchioles and alveoli

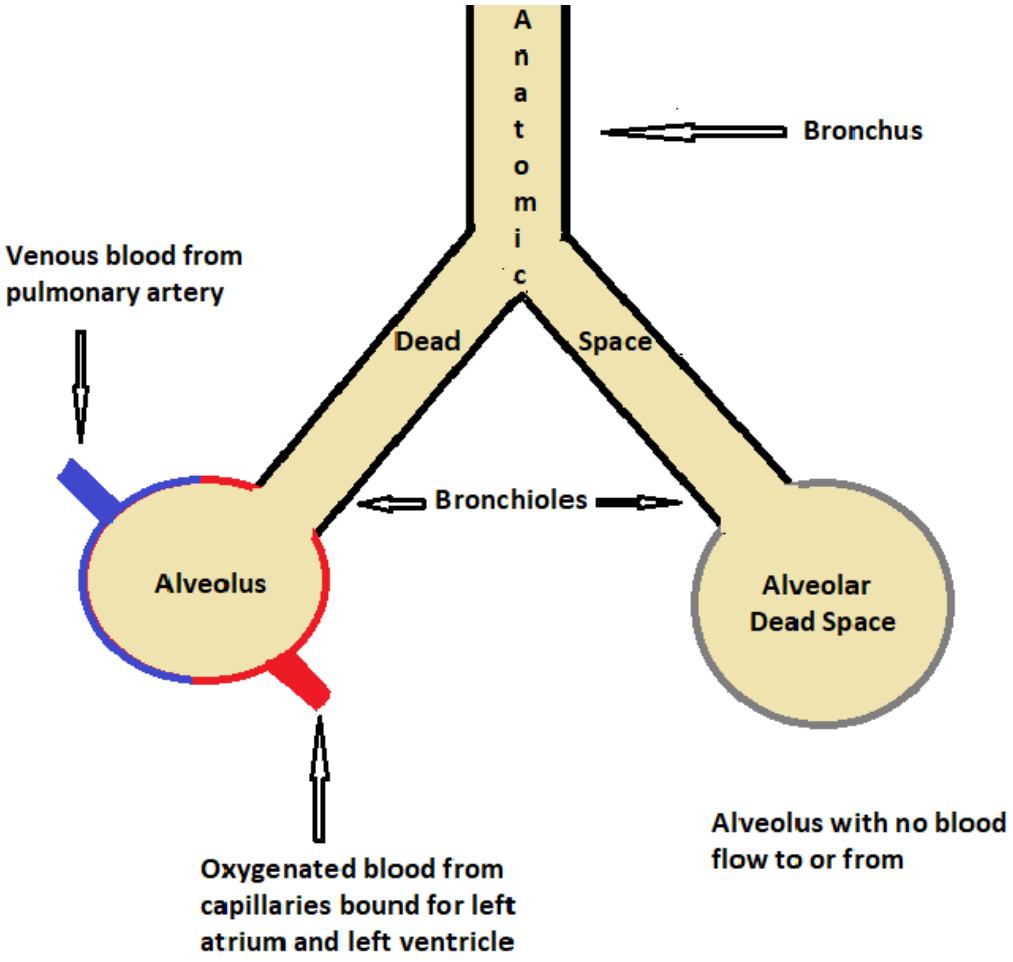


VD_{ana} : ~ 150 ml or 2.2 ml/kg

No blood capillary in VD and no part in gaseous exchange

Alveolar Dead Space Volume (VD_{alv})

Volume of air in alveoli does not take part in gaseous exchange

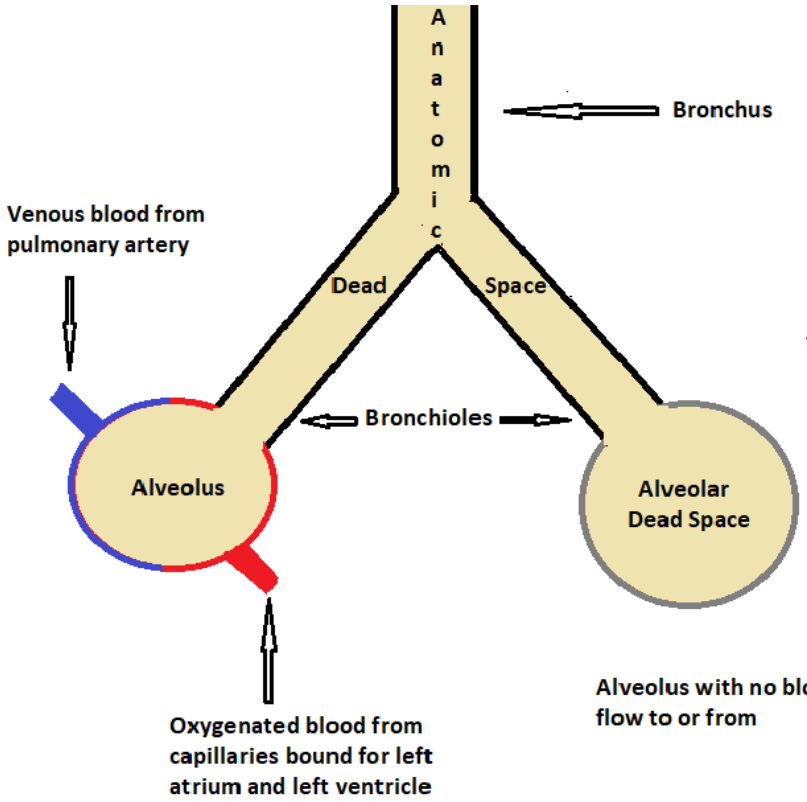


Negligible in healthy adult human

Physiological Dead Space Volume (VD_{phy})

Volume of air in respiratory tract (nose, pharynx, trachea, bronchi, bronchiololes, alveolar duct, alveolar sac and alveoli) does not take part in gaseous exchange

No capillary in the track



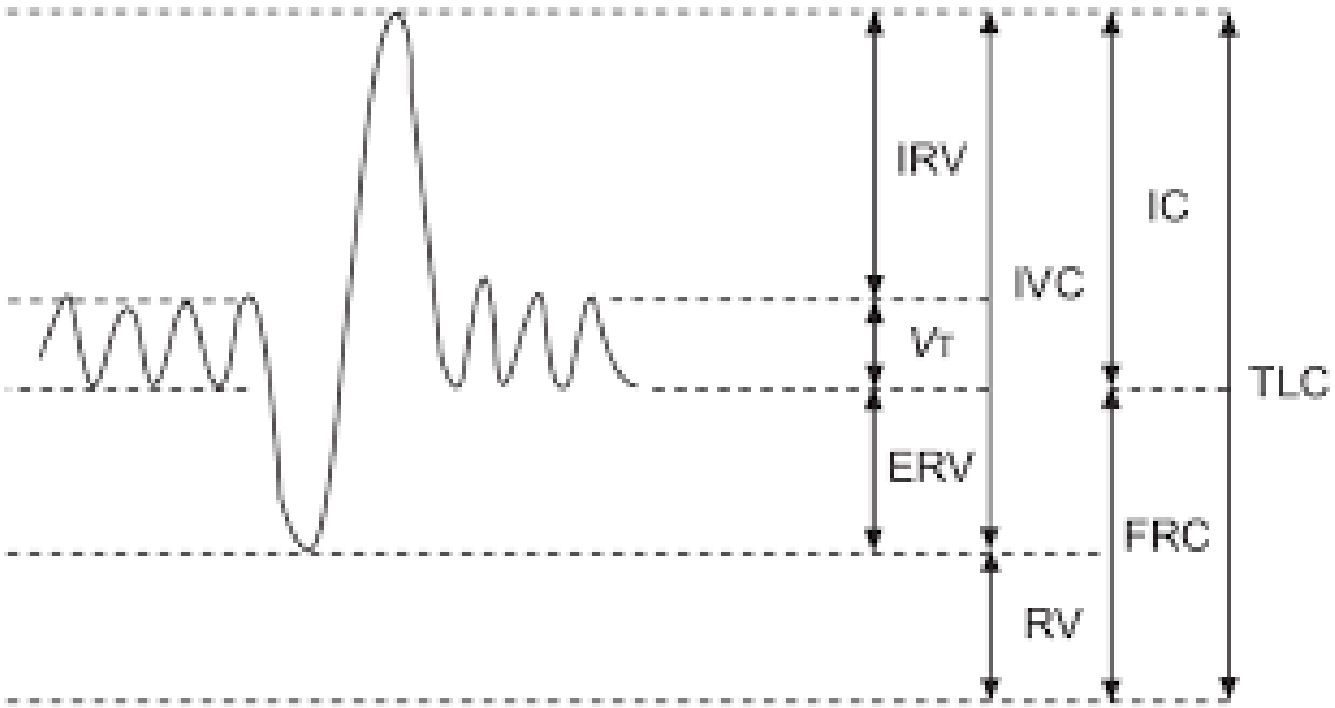
$VD_{phy} = VD_{ana} + VD_{alv}$

$VD_{phy} = 150\ ml + 0 = 150\ ml$

Conduction of air to alveoli

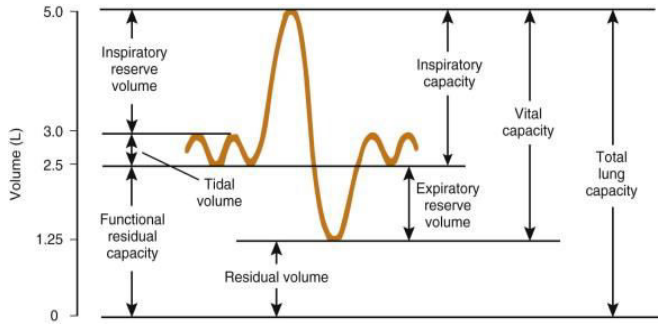
VD_{phy} increases in lung disease

Recapitulation



Model Questions

1. What is tidal volume ? Cite the volume ? Mention the role exercise to influence TV.
2. What do you understand by Inspiratory reserve volume ? Write its importance.
3. Define expiratory reserve volume. Write the role of obesity to reduce ERV.
4. Write the significance of TV? Why is RV non-spirometric?
5. Cite two importance of FRC. Mention two influencing factors. Write the measuring method of FRC.
6. Why does IC increase during exercise?
7. What is VC ? Write its importance. Why have sportsman & mountaineer higher VC?
8. Define TLC ? Enlist some influencing factors. Mention the volume in adult health female.
9. What do you mean by anatomical dead space volume, alveolar dead space volume & physiological dead space volume ?
10. Calculate TV, IRV, ERV, FRV, RV, IC, VC, TLC, VD_{ana}, VD_{alv} & VD_{phy} from the following graph.



11. A 70 kg man exhales maximum air @ 60ml /kg after maximum inspiration. Calculate his VC.