كلية الرشيد الجامعة / قسم الصيدلة
مختبر الفسلجة والامراض
المرحلة الثانية

Done By
Assis. Lecturer
Zeena Ayad Hussein

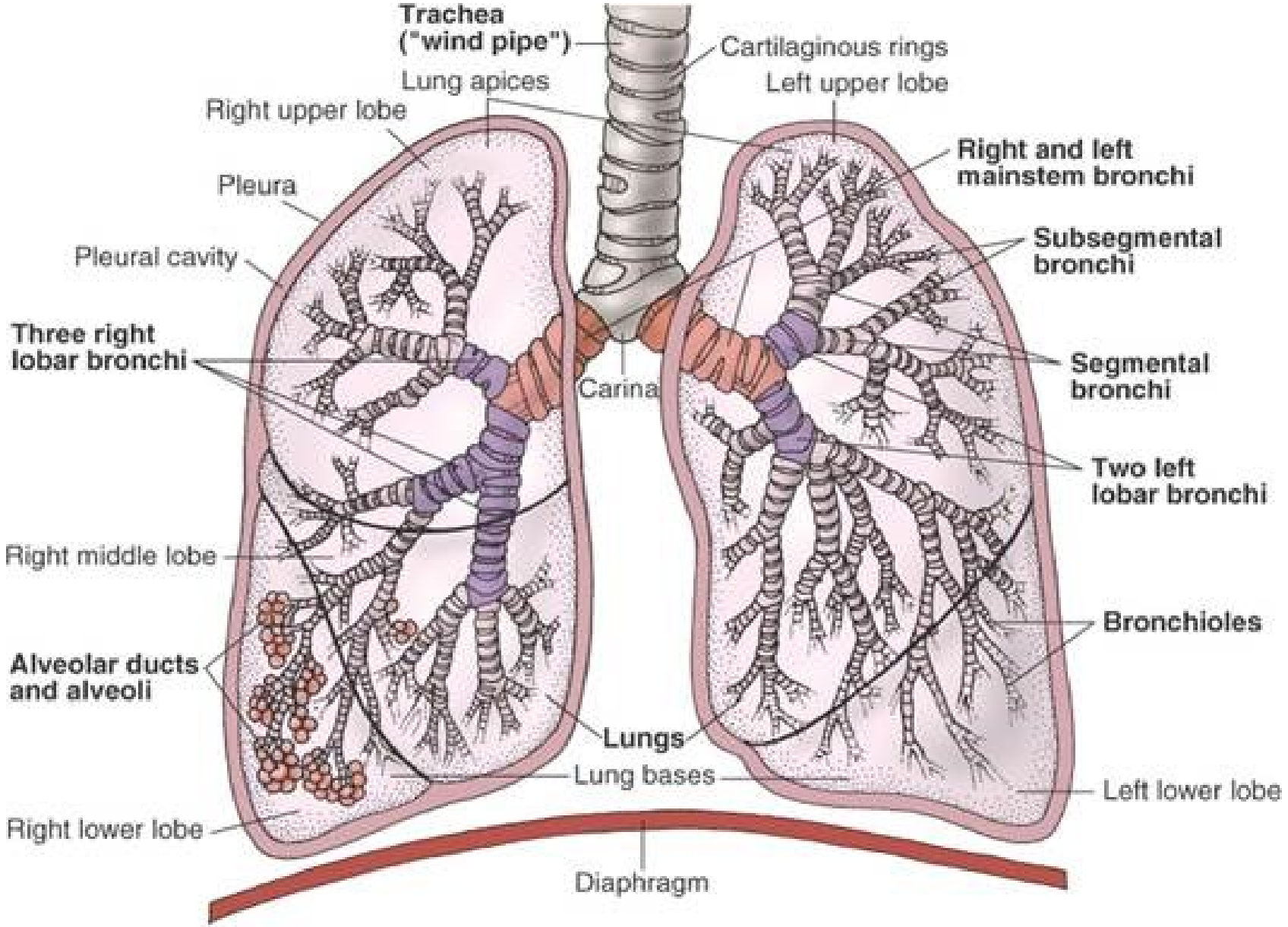
Ventilation

Physiology Lab.

Anatomy of Respiratory Tract:

- The lungs are ingeniously constructed to carry out their main function, the exchange of gases between inspired air and blood.

- The respiratory system consists of :
  - The trachea
  - Lung buds
  - Lobar bronchi
  - Bronchioles
  - Terminal bronchioles
  - Acinus
  - Alveoli (the alveolar duct & alveolar sac)



Definition:

- Is the process of moving air into and out of the lungs, there are two phases of ventilation:-

1. **Inspiration or called inhalation**: is the movement of air into the lungs (active process)
2. **Expiration or called exhalation**: is the movement of air out of the lungs (passive process)

Types of pressure involved:

- In the mechanism of respiration, three types of pressure are involved:-

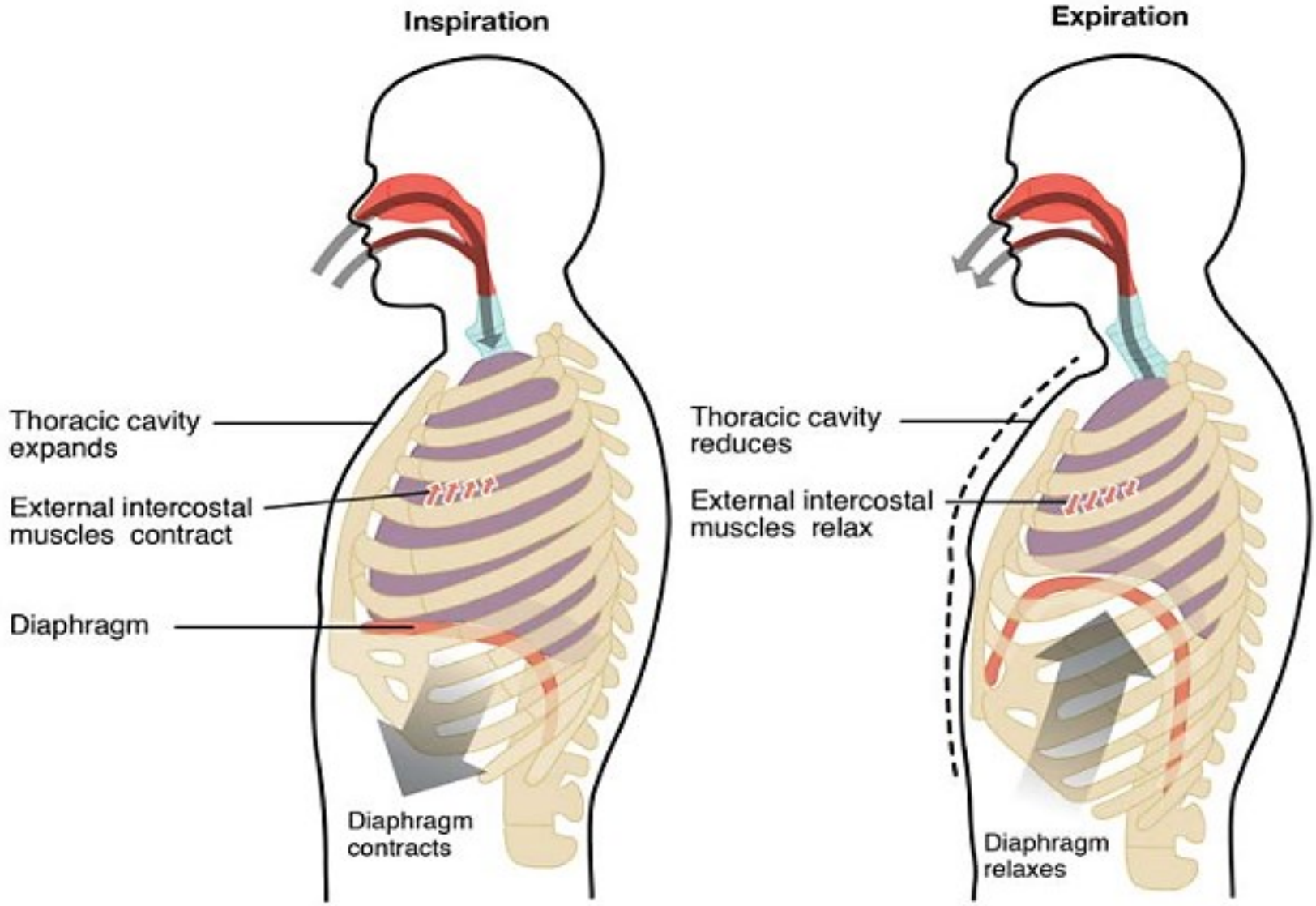
1. Atmospheric pressure: is the pressure that exerted by atmosphere at sea level
2. Intra-pulmonic pressure: is the pressure of air within the bronchi and bronchioles
3. Intra-pleural pressure (Intra-thoracic pressure): is the pressure of the pleural space

Inspiration:

- It is an active process involving muscular activity of diaphragm muscle and intercostal muscle contract
- When the atmospheric pressure increases, the intra-pulmonic pressure decreases and the intra-pleural pressure decreases then the air enters the lung until equilibrium reached
- In this case diaphragm muscles move downwards and the intercostal muscles move upwards and outwards.

Expiration:

- It is a passive process brought by relaxation of intercostal muscle and diaphragm
- the intra-pulmonic pressure increased slightly above atmospheric pressure and the air forced out of the lung.


Inspiration
Thoracic cavity expands
External intercostal muscles contract
Diaphragm
Diaphragm contracts
Expiration
Thoracic cavity reduces
External intercostal muscles relax
Diaphragm relaxes

Regulation of breathing:

- ***The respiratory center in the medulla oblongata of the brain*** controls the rate and depth of respiration according to the need of the body
- when the respiration center is stimulated; it sends impulse to the diaphragm then increases the rate of contraction.

Factors affecting the respiratory center:

- *Increase level of CO2*
- *Emotional excitement*
- *Exercise*

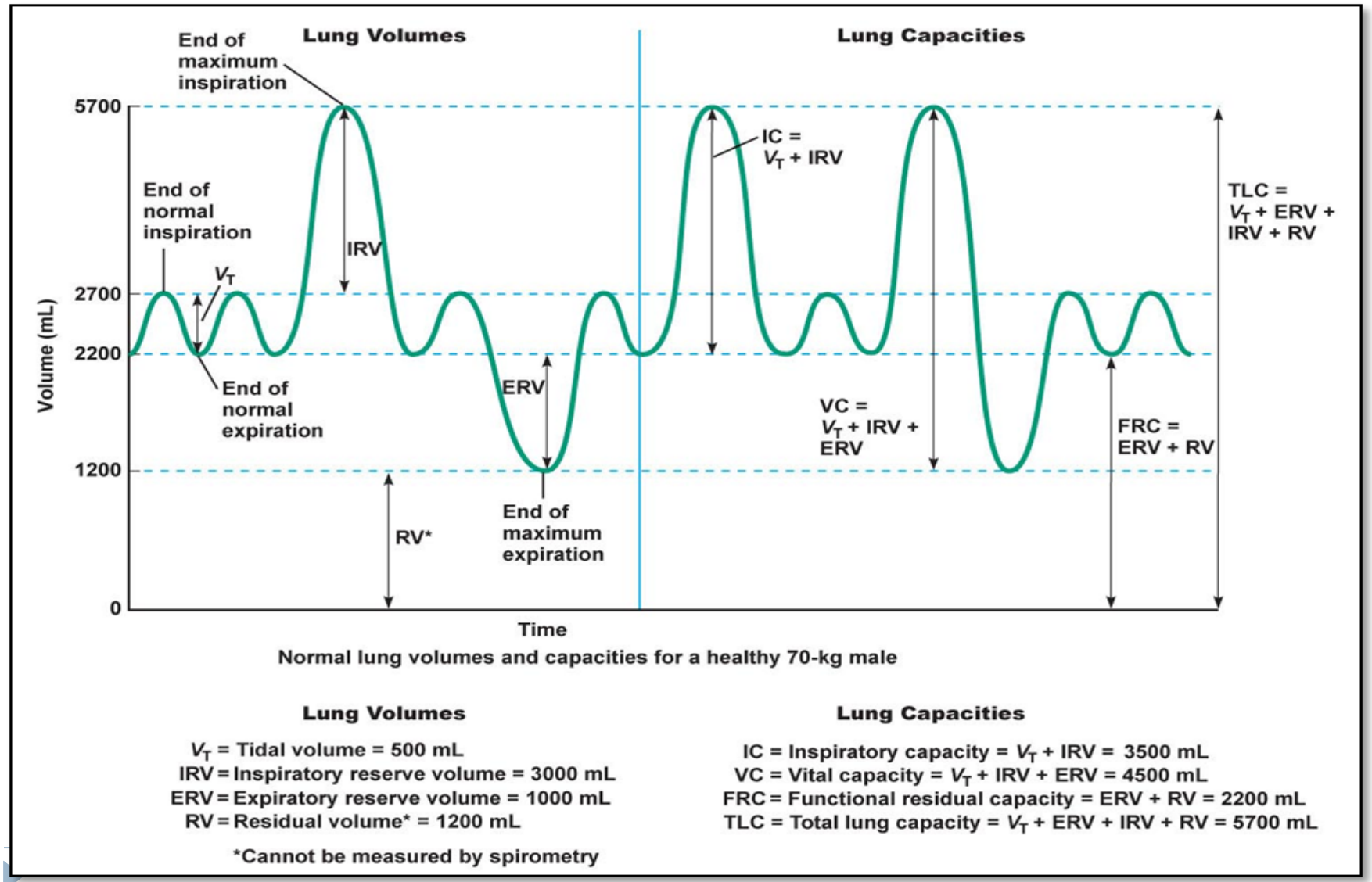
Lung Volumes:

- **Tidal volume (Vt):** the volume of air inspired or expired during normal quiet breathing (about 500 ml)
- **Inspiratory Reserve Volume (IRV):** the amount of air that can be inspired forcefully after inspiration of the normal tidal volume (about 3000 ml)
- **Expiratory Reserve Volume (ERV):** the amount of air that can be expired forcefully after expiration of the normal tidal volume (about 1000 ml)
- **Residual Volume (RV):** the volume of air that still remaining in the respiratory passages and lungs after a maximum expiration that keeps alveoli inflated between breaths and mixes with fresh air on next inspiration (about 1200 ml)

Lung Capacities:

- Lung capacities are the summation of two or more of lung volumes
- **Inspiratory Capacity:** is the tidal volume plus the inspiratory reserve volume; is the amount of air that a person can inspire maximally after a normal expiration (about 3800 ml)
- **Vital Capacity:** is the sum of the inspiratory reserve volume, tidal volume and the expiratory reserve volume; it is the maximum volume of air that a person can expel from his respiratory tract after a maximum inspiration (about 4800 ml)
- **Total Lung Capacity:** is the sum of the (IRV + ERV + VT + RV), about 6000 ml. the total lung capacity is also equal to the vital capacity plus the residual volume.

Chart of lung volumes and capacities:



Normal lung volumes and capacities for a healthy 70-kg male

Lung Volumes

V_T = Tidal volume = 500 mL
IRV = Inspiratory reserve volume = 3000 mL
ERV = Expiratory reserve volume = 1000 mL
RV = Residual volume* = 1200 mL

*Cannot be measured by spirometry

Lung Capacities

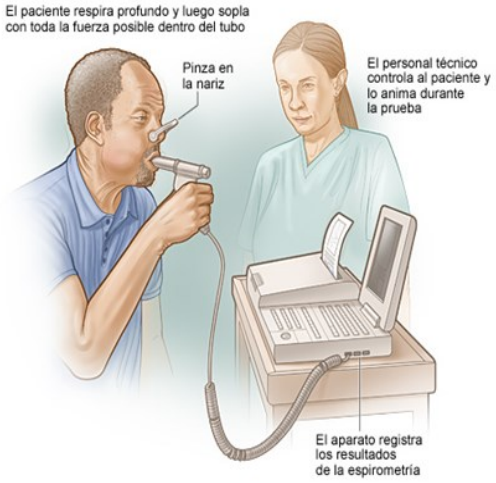
IC = Inspiratory capacity = V_T + IRV = 3500 mL
VC = Vital capacity = V_T + IRV + ERV = 4500 mL
FRC = Functional residual capacity = ERV + RV = 2200 mL
TLC = Total lung capacity = V_T + ERV + IRV + RV = 5700 mL

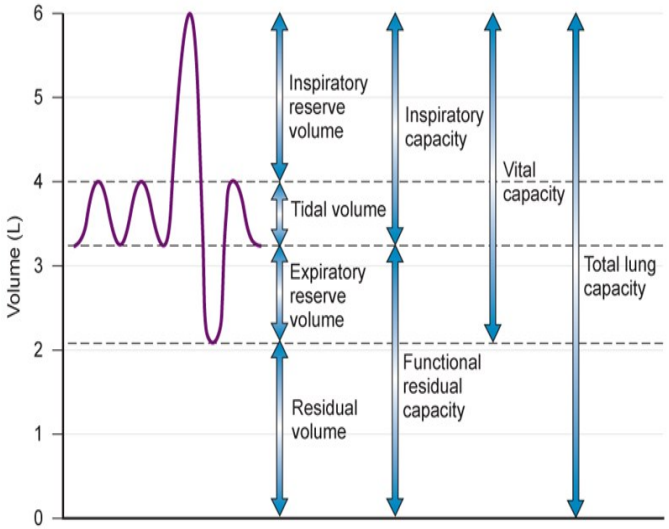
Mechanical & Digital Spirometer

All lung volumes can be measured by the spirometer <u>except</u> the residual volume (RV)

Spirometry:

- It is a physiological test that measures how an individual inhales or exhales volumes of air as a function of time.
- It is the most reliable test for measuring pulmonary function , which helps in diagnosis and differentiation of many respiratory disorders (obstructive and restrictive lung disorders).
- It measures the lung volumes and capacities





Pulmonary Function Test:

- They represent as an index of respiratory efficiency, they give some measure of:
  1. Lung compliance [elasticity].
  2. Airway resistance.
  3. Respiratory muscle strength.

- These three factors determine how much air can move into lungs per unit of time.

Respiratory Rate:

Is the number of breaths (inspiration + expiration) per minute which equals 12 - 15 breaths / minute (at rest), or 15 – 20 breaths / minute (at rest).

- **Respiratory Minute Volume (RMV):** It is the amount of air enters the air passages per minute and the work that done by respiratory muscles.

RMV = Vt (tidal volume) * RR (respiratory rate)

= 500 ml * 12 breath/min

= 6000 ml/min

- **Objective of Experiment:** To evaluate the effect of changing position and exercise on respiratory rate

Pare (1) of the experiment:

- Effect of **changing position** on the RR:
- Part one of the experiment will involve the measurement of the respiratory rate at sitting position and at standing position (at this part there should be no significant difference between the two readings)

#	Sitting	Standing	Difference (d)	(d^2)
1				
2				
3				
4				
5				
6				
7				

Part (2) of the experiment:

- Effect of **exercise** on RR:
- Part two of the experiment will involve the measurement of the respiratory rate at rest and after exercise (at this part there should be a significant difference between the two readings)

#	At rest	After exercise	Difference (d)	(d^2)
1				
2				
3				
4				
5				
6				
7				

Parameters used in the Experiment:

$$S.D. = \sqrt{\frac{\sum di^2 - \frac{(\sum di)^2}{n}}{n-1}}$$

$$S.E.M. = \frac{S.D.}{\sqrt{n}}$$

$$t = \frac{\bar{d}}{SEM}$$

SD = standard deviation
SEM= standard error of mean
di = difference between groups
n = number of participants
t = measurements of probability and significance
d = mean of difference

End of First Course !