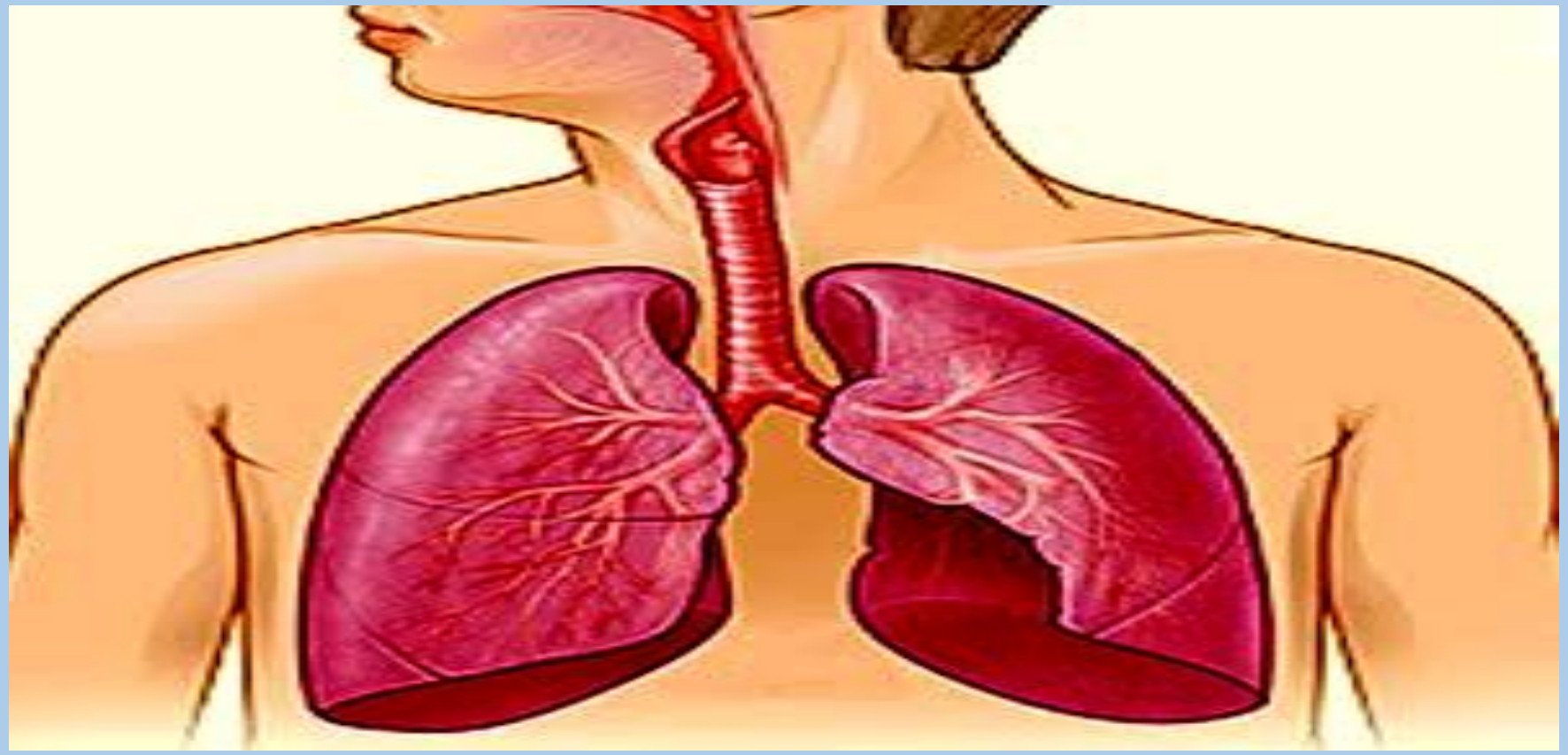
Overview of Respiration



Prof. Khaled Abdel-Sater

RESPIRATORY MUSCLES

I-Muscles of Inspiration: 1-Main Muscles:

A- Diaphragm:- (supplied by the phrenic nerve (origin from C3 to C5). 70% Contraction (= descent) of the diaphragm leads to enlargement of the thoracic cavity vertically.

B-External Intercostal Muscles: Contraction of them lead to **e**levation and **e**version of the ribs.

2-Accessory Muscles:-Act only in forced inspiration.

-They are **s**ternomastoid (elevates the sternum), **s**caleri (elevates the 1st rib), **s**eratus posterior superior and **s**eratus posterior inferior (elevate the remaining ribs).

II-Muscles of Expiration:

Expiratory muscles act only in forced expiration.

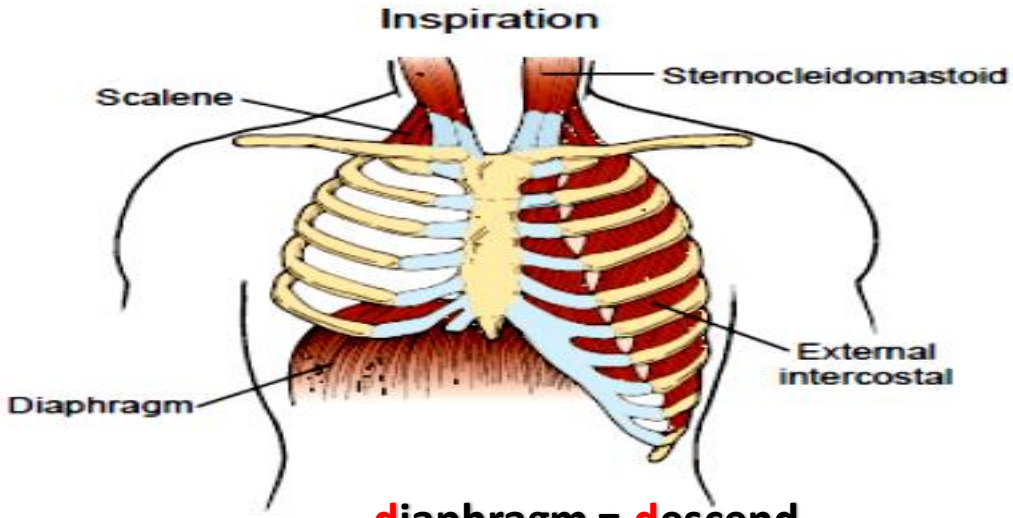
A-Abdominal Wall Muscles:

(i.e. abdominal recti, transverses abdominis, internal and external oblique muscles). Contraction leads to compression of abdominal contents which increases the intra-abdominal pressure and elevates the diaphragm upward.

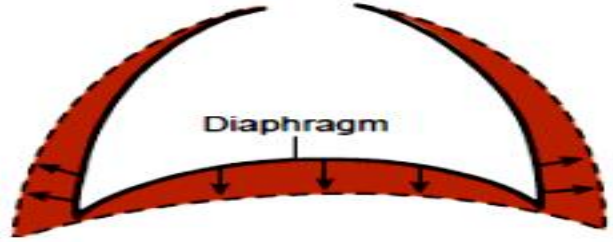
B-Internal Intercostal Muscles:

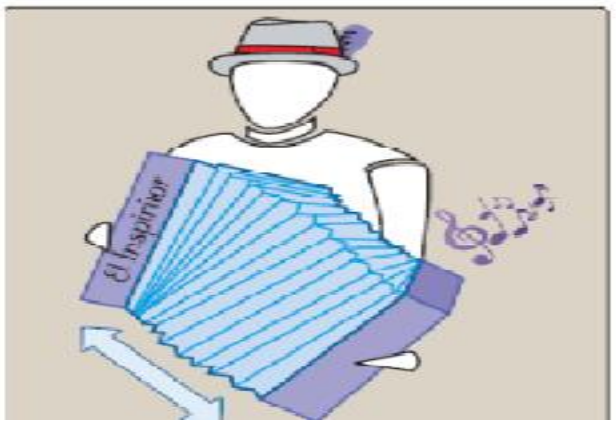
Contraction of the internal intercostal muscles leads to depression and inversion of the ribs.

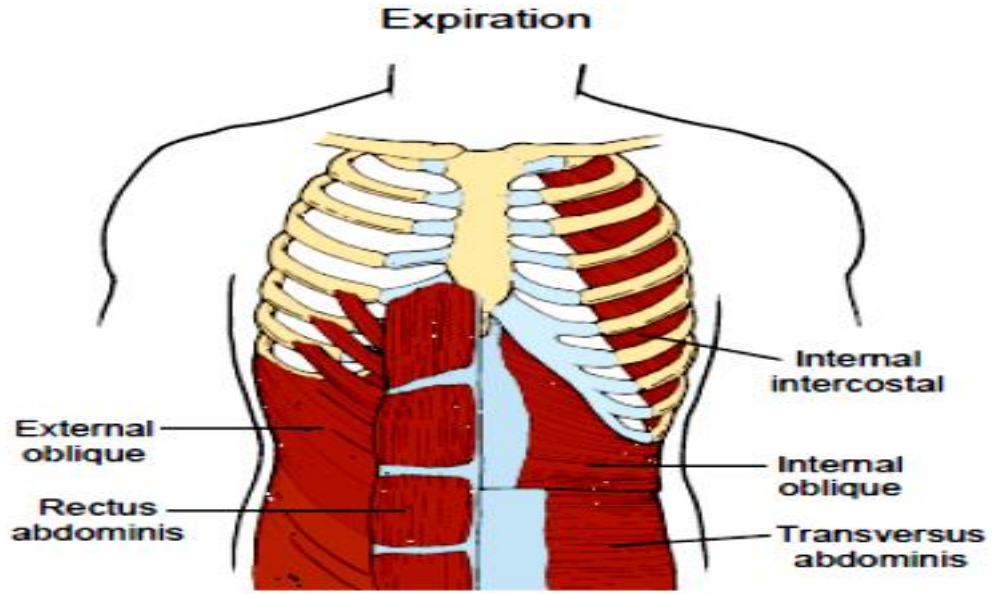
RESPIRATORY MUSCLES

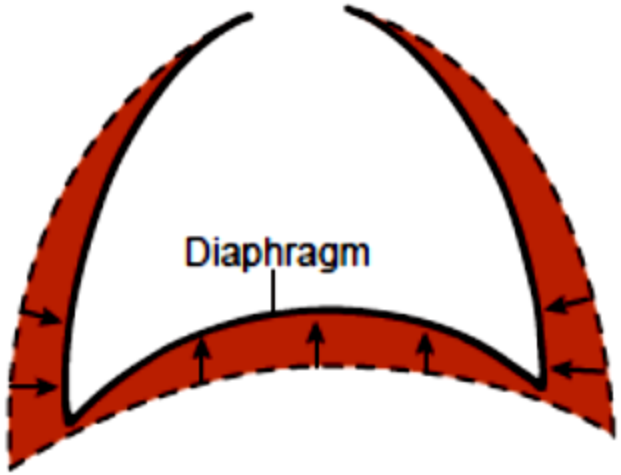


diaphragm = descend





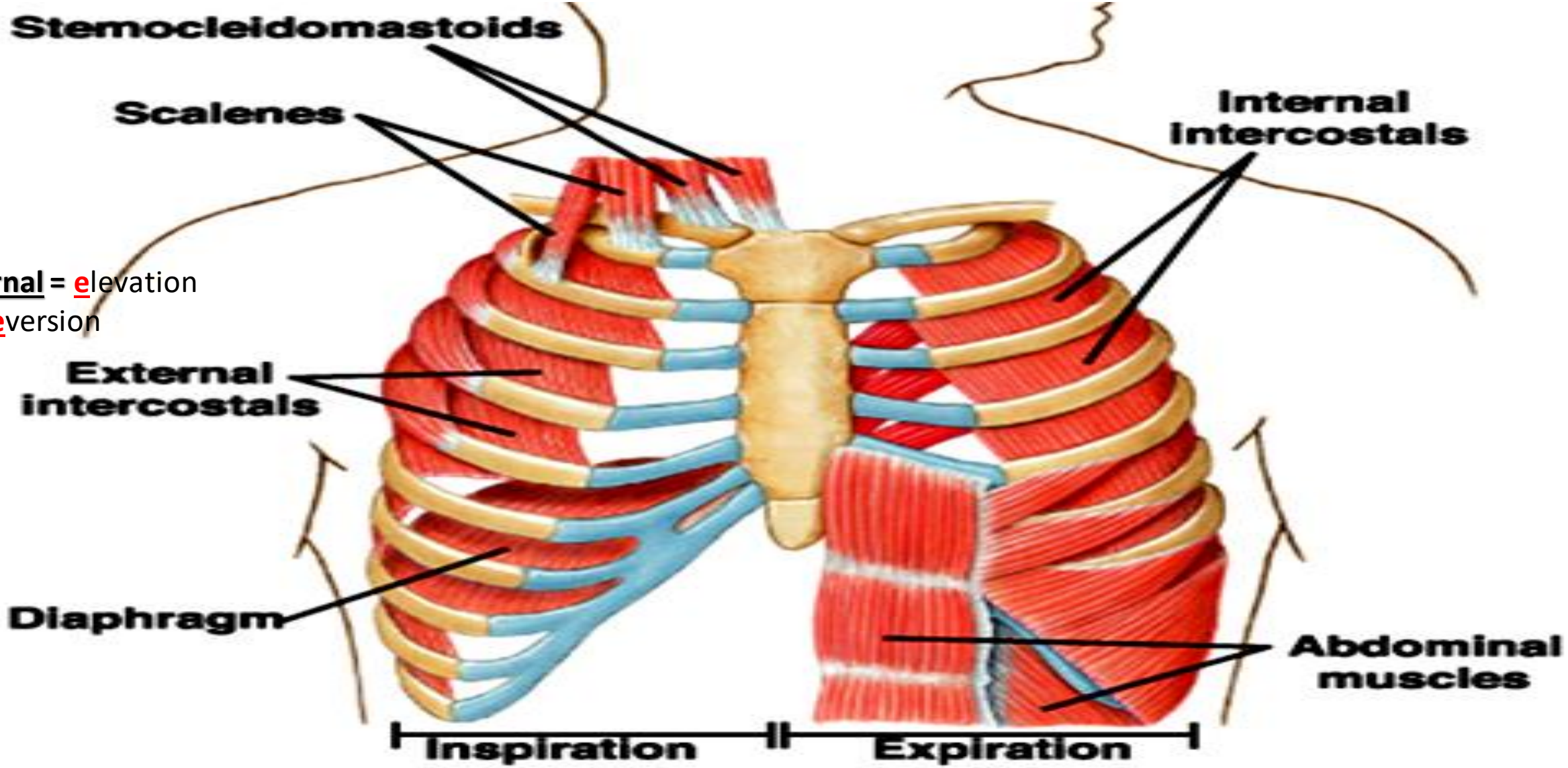




external = elevation and eversion

diaphragm = descend

RESPIRATORY MUSCLES



external = elevation and eversion

MECHANISM OF BREATHING

1-Inspiration:

A-In Normal Resting Inspiration:

Respiratory center → phrenic and external intercostal nerves→ contraction diaphragm and external intercostal muscles → expansion of the chest wall in all directions→ distention of the lung and decrease of intrapulmonary pressure to (–1 mm Hg) & rush the air into the lungs.

B- In Forced Inspiration:

The main and the accessory muscles contract strongly so, greater increase in the thoracic cavity and rush more volume to the lungs.

Dr Khaled Abdel-Sater

2-Expiration:

A-In Normal Resting Expiration:

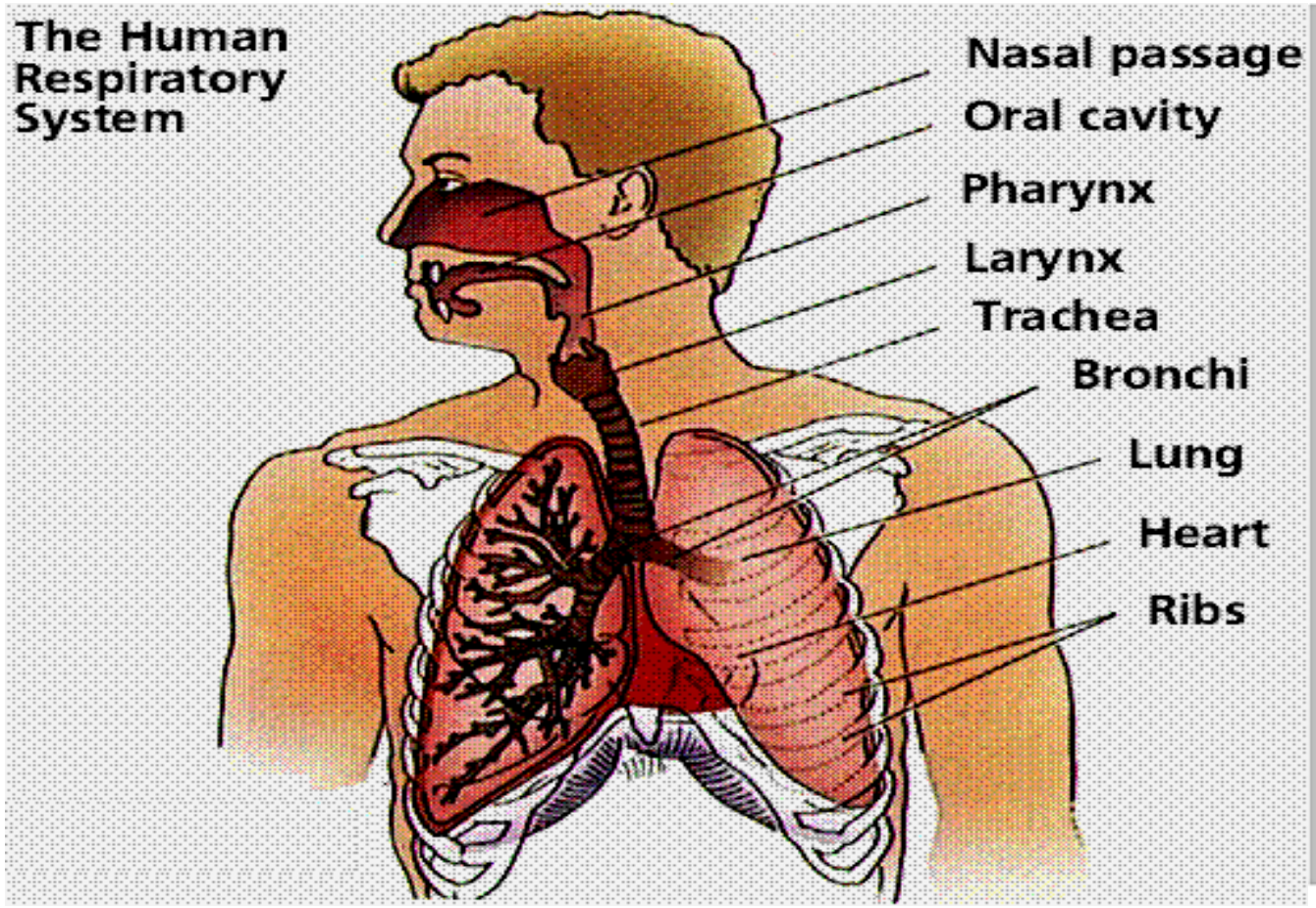
-Normal expiration is the passive process. It is produced by relaxation of inspiratory muscles. Drop of the thoracic cage and elevation of diaphragm increase of intrapulmonary pressure to (+1 mm Hg) & rush the air out the lungs.

B- In Forced Expiration:

The expiratory muscles contract strongly so, more depression and inversion of ribs more decrease in the thoracic cavity and rush more volume out of the lungs.

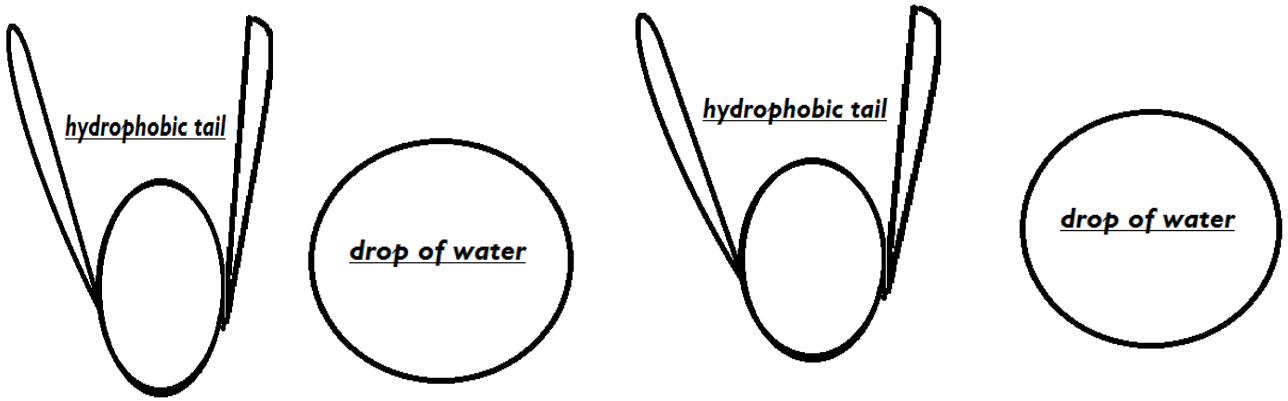
RESPIRATORY SYSTEM DEFINITIONS

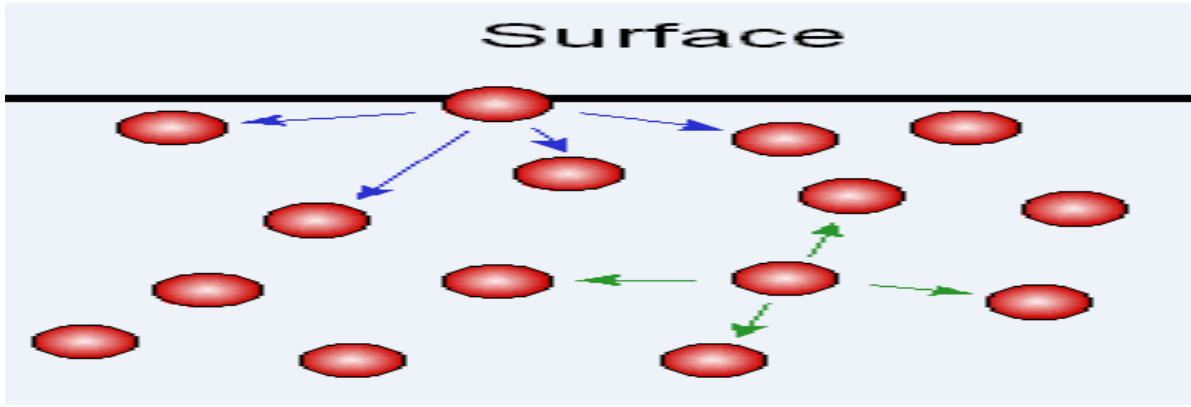
- **Dead space :** It is the volume of air which does not undergo gas exchange with blood in the lung (=150 ml).



	Generation		Diameter cm	Number
Conducting zone	trachea	0	1.80	1
	bronchi	1	1.22	2
		2	0.83	4
		3	0.56	8
	bronchioles	4	0.45	16
	terminal bronchioles	5 ↓ 16	0.35 ↓ 0.06	32 ↓ 6×10^4
Respiratory zones	respiratory bronchioles	17 18 19	↓ 0.05	↓ 5×10^5
	alveolar ducts	T_3 20 T_2 21 T_1 22	↓	↓
	alveolar sacs	T 23	0.04	8×10^6

- **Elastic Recoil of the Lungs:** When the lung is inflated, it tends to recoil (collapse).
- **Surfactant:** It is a surface active agent secreted by type II alveolar epithelial cell to decrease the surface tension of fluid lining alveoli and antagonist lung collapse.





-Normally the walls of alveoli are coated with a thin film of water.

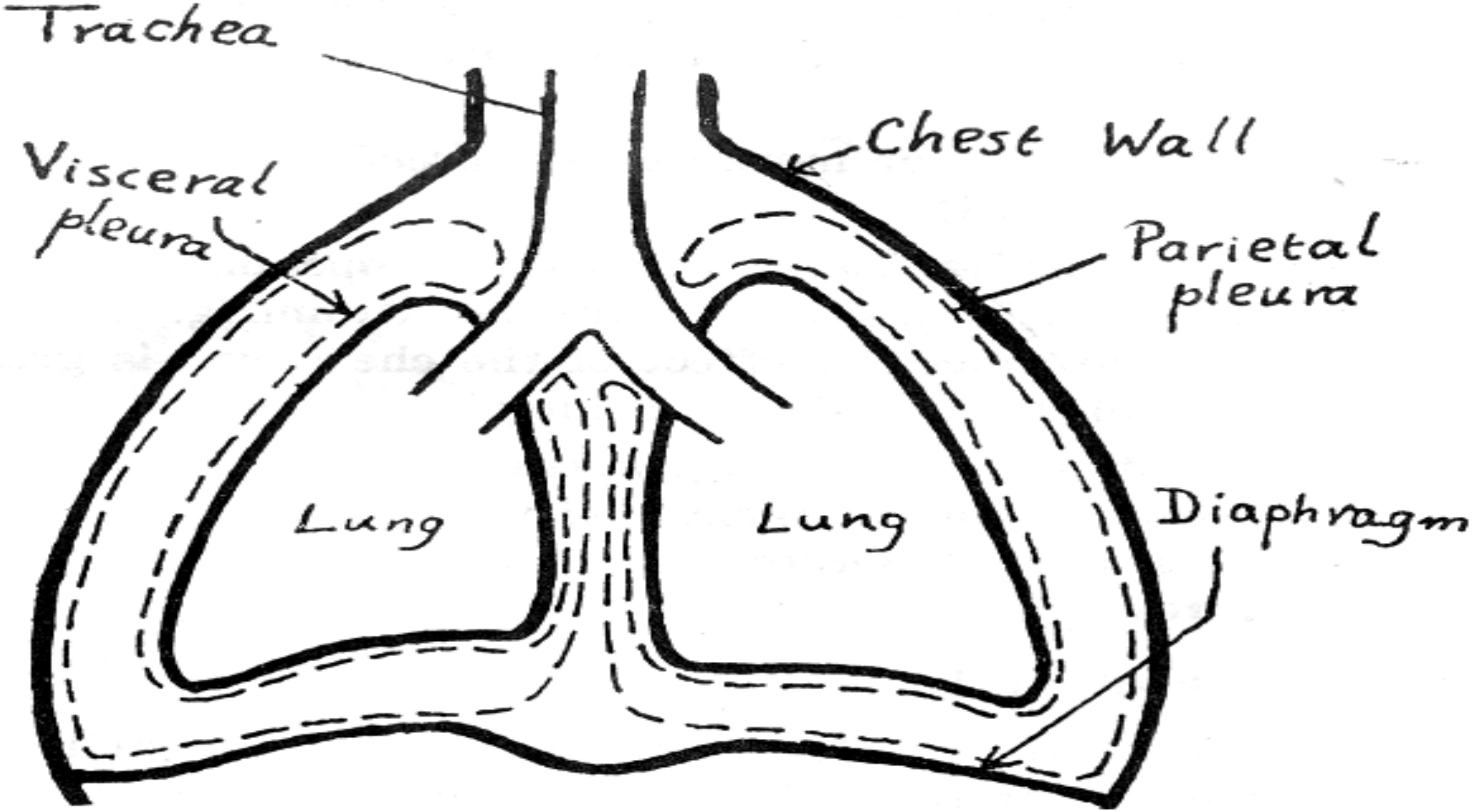
- **Compliance of the lungs:** A unit change in lung volume per the unit change in distending pressure.

- **Tidal volume:** It is the volume of air that can be inspired or expired during a single breath in resting person.
- **Pulmonary ventilation :** It is the volume of air respired in one minute (by normal respiration). Respiratory rate is normally from 12-16 beat/ minute. Pulmonary ventilation = tidal volume X respiratory rate. 500 X 12 = 6000 ml/minute (6 liters/min).
- **Alveolar Ventilation =Effective Pulmonary Ventilation:**

  = (tidal volume – dead space) X respiratory rate

  = 500-150 X12 = 4200 ml/minute.
- **Maximum Breathing Capacity (MBC):** It is the maximum volume of air respired in one minute by deepest and fastest respiration = 60 liters/min..

- **Intrapleural pressure:** It is the pressure of the fluid in the pleural cavity.
- **Pneumothorax:** It is the presence of the air in the pleural cavity.
- **Intrapulmonary pressure:** It is the pressure inside the alveoli.
- **Hypoxia :** It is the decreased of O2 supply or O2 utilization at the tissue.
- **Dyspnea :** It is awareness of difficulty in breathing.
- **Orthopnea :** This is the difficulty breathing in lying in bed but not in standing or sitting positions due to compression of the diaphragm by the viscera.
- **Apnea :** It is the temporary stoppage of respiration.


Trachea
Visceral pleura
Chest Wall
Parietal pleura
Lung
Lung
Diaphragm

Test your self

When the diaphragm contracts which of the following will happen in the lungs?

A. Air pressure will increase, volume will decrease and exhalation will occur.

B. Air pressure will decrease, volume will increase and exhalation will occur.

C. Air pressure will decrease, volume will increase and inhalation will occur.

D. Air pressure will increase, volume will increase and inhalation will occur.

Which of these muscles are involved in quiet inspiration:

A.external oblique muscles

B.external oblique muscles

C.Internal intercostals

D.External intercostals

The inspiratory muscles include the

A. diaphragm and internal intercostal muscles.
B. diaphragm and external intercostal muscles.
C. diaphragm and abdominal muscles.
D. internal and external intercostal muscles.
E. none of these answers.

How is the diaphragm innervated?

A. From the respiratory centre in concert with chemoreceptors that detect

blood oxygen level

B. By the spinal nerves arising from thoracic vertebrae at the same level

C. By the phrenic nerve arising from vertebrae C3 to C5

D. By the vagus nerve arising from the medulla oblongata

Which of the following does not occur during expiration when a person is breathing quietly?

A. the size of the thoracic cavity is reduced.
B. the intra-alveolar pressure becomes greater than atmospheric pressure.
C. air flows out of the lungs.
D. the expiratory muscles contract.
E. intrapleural pressure is less than intra-alveolar pressure.

The maximum volume of air respired in one minute by deepest and fastest respiration is called

A. Maximum breathing capacity
B. Pulmonary ventilation
C. Alveolar ventilation
D. None of the above

The pressure inside the alveoli is called:

A. Intra –thoracic pressure

B. Intra –abdominal pressure

C. Intra –pulmonary pressure

D. Intra –cardiac pressure

During inspiration,

A. intra-alveolar pressure falls below atmospheric pressure.
B. the diaphragm contracts.
C. the internal intercostal muscles contract.
D. both (a) and (b) above.
E. all of these answers.

Regarding respiratory muscles, which of the following statements is true:

A. diaphragm & internal inter-costal muscles are involved during forced inspiration.

B. external inter-costal muscles are involved during expiration.

C. abdominal muscles are involved during forced expiration.

D. All of the above are correct.

E. none of the above is correct.

A healthy, 25–year–old medical student participates in a 10–kilometer Mutah University Race. Which muscles does the student use (contract) during expiration?

A. Diaphragm and external intercostals

B. Diaphragm and internal intercostals

C. Sternocleidomastoid

D. Scaleni

E. Internal intercostals and abdominal recti

Difficulty breathing in lying in bed is called:

A. Pneumothorax.
B. Hypoxia.
C. Dspnea.
D. Orthopnea.
E. Apnea.

1. C
2. D
3. B
4. C
5. D
6. A
7. C
8. D
9. C
10. E
11. D