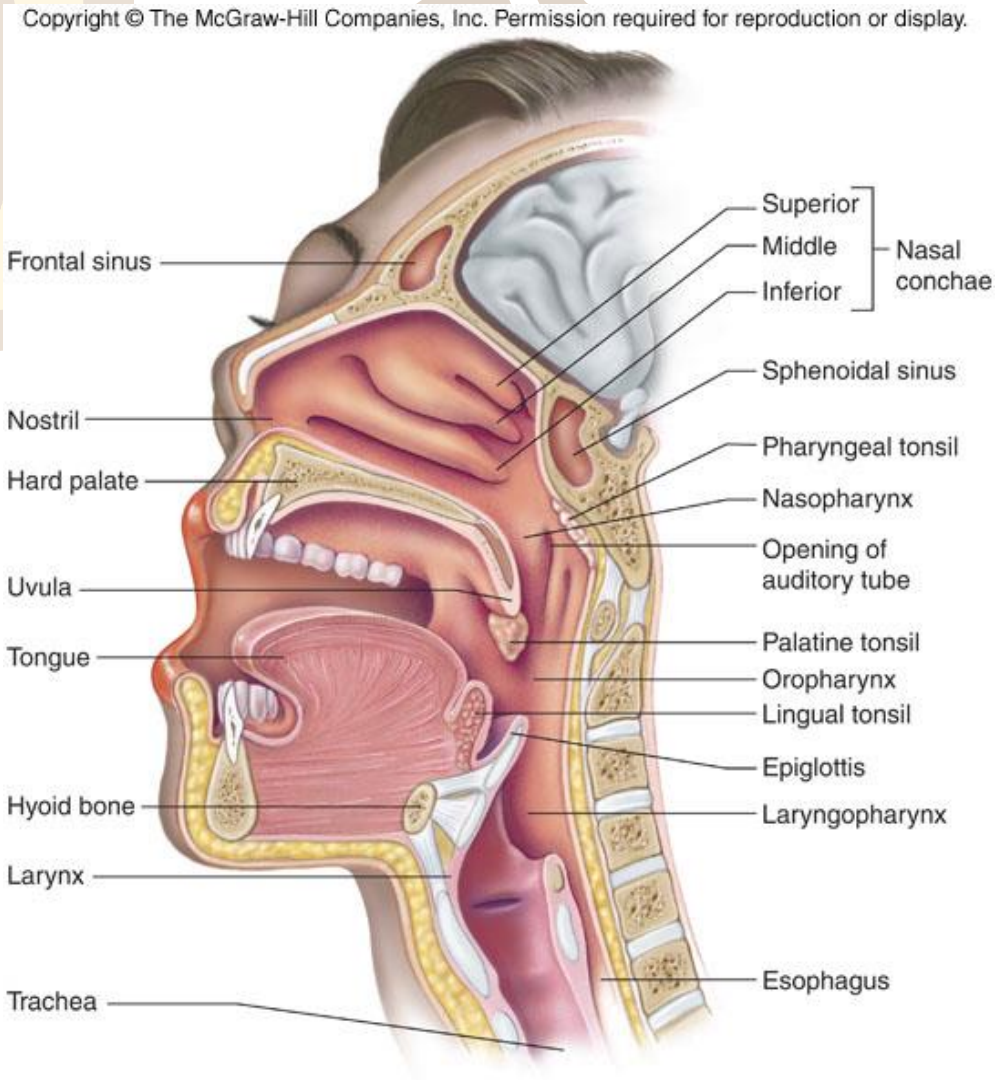
Functions of the Respiratory System

- Air Distributor
- Gas exchanger
- Filters, warms, and humidifies air
- Influences speech
- Allows for sense of smell

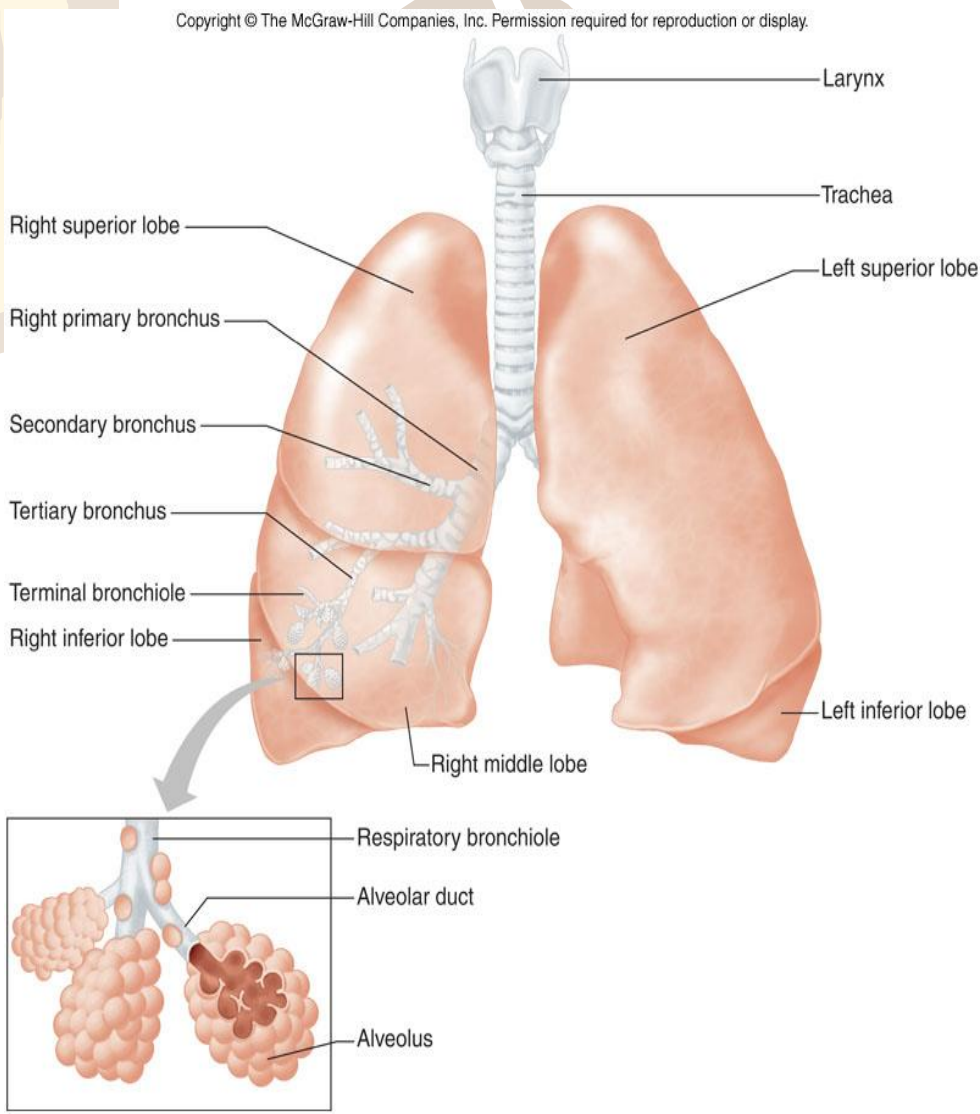
Divisions of the Respiratory System

- Upper respiratory tract (outside thorax)
  - Nose
  - Nasal Cavity
  - Sinuses
  - Pharynx
  - Larynx



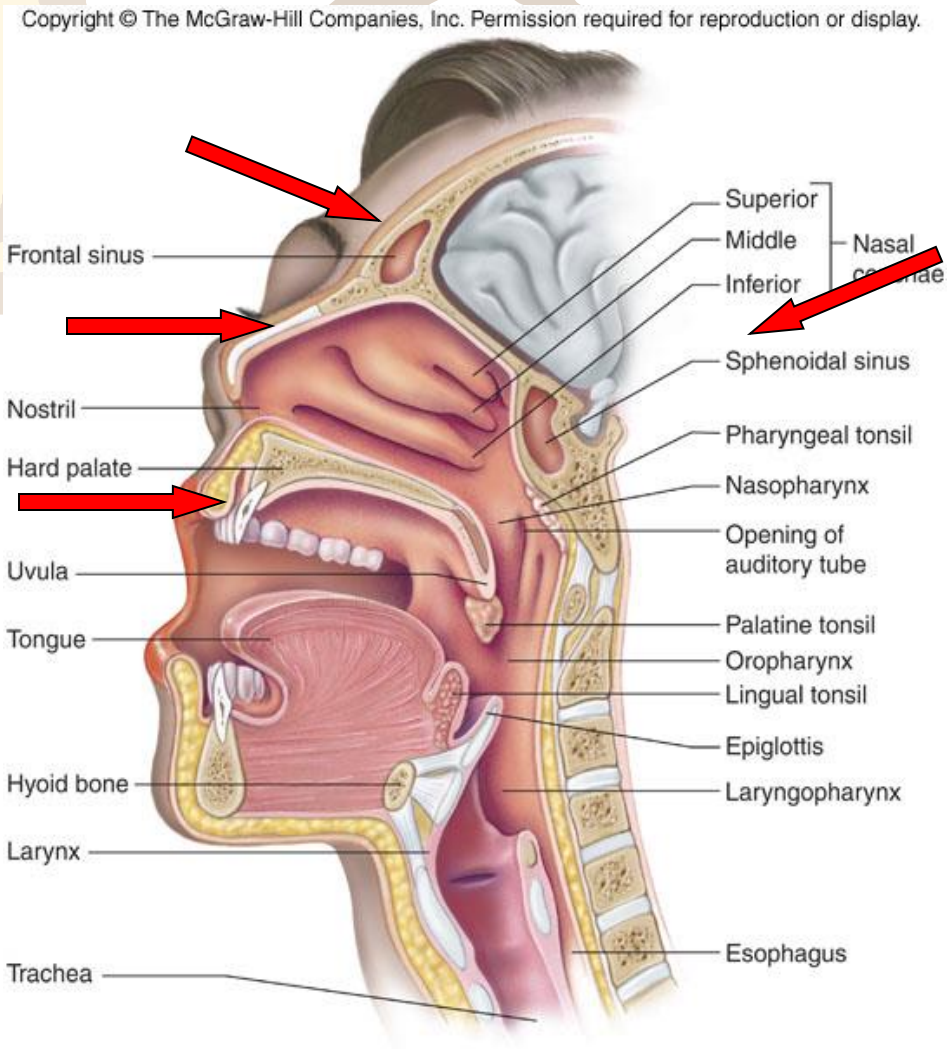
Divisions of the Respiratory System

- Lower respiratory tract (within thorax)
  - Trachea
  - Bronchial Tree
  - Lungs



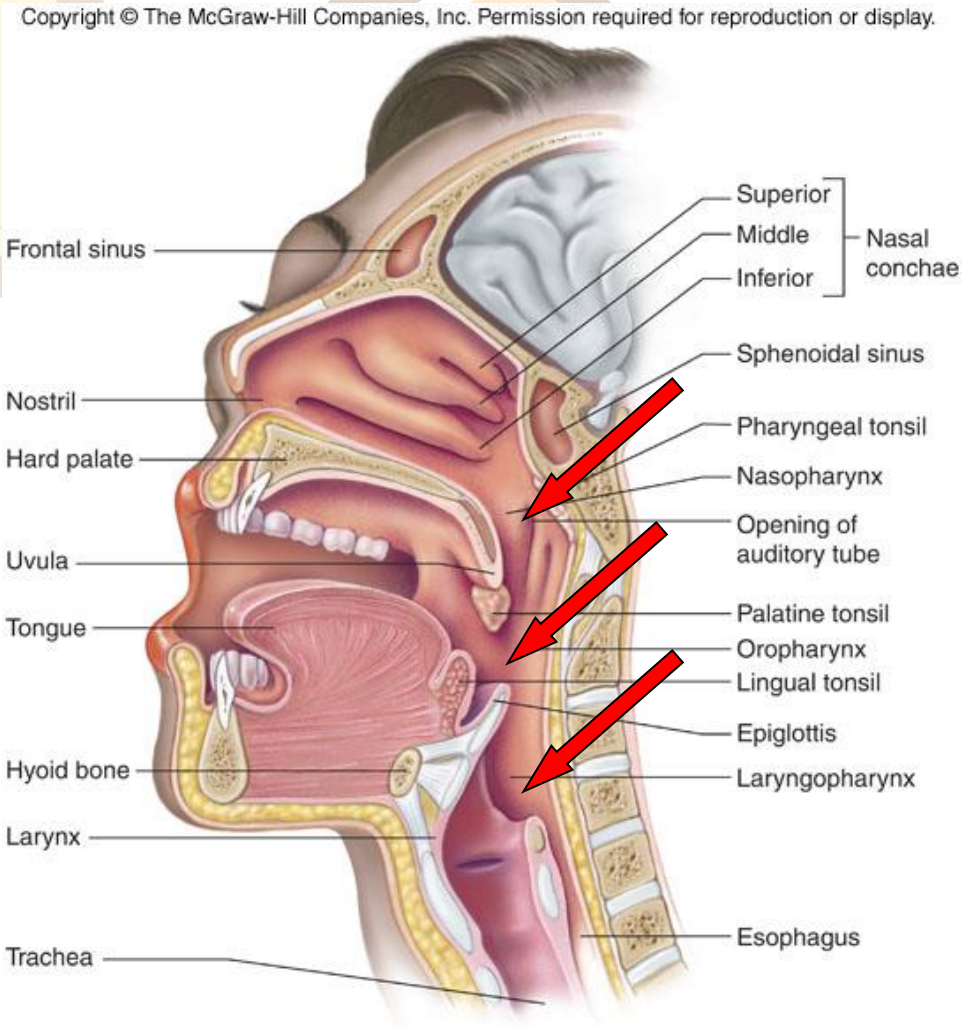
Structures of the Upper Respiratory Tract

- **Nose** - warms and moistens air
  - **Palantine bone** separates nasal cavity from mouth.
    - **Cleft palate** - Palantine bone does not form correctly, difficulty in swallowing and speaking.
  - **Septum** - separates right and left nostrils
    - rich blood supply = nose bleeds.
  - **Sinuses** - 4 air containing spaces – open or drain into nose - (lowers weight of skull).



Structures of the Upper Respiratory Tract

- **Pharynx** - (throat)
- Base of skull to esophagus
- **3 divisions**
  - **Nasopharynx** - behind nose to soft palate.
    - Adenoids swell and block.
  - **Oropharynx** - behind mouth, soft palate to hyoid bone.
    - tonsils
  - **Laryngopharynx** - hyoid bone to esophagus.

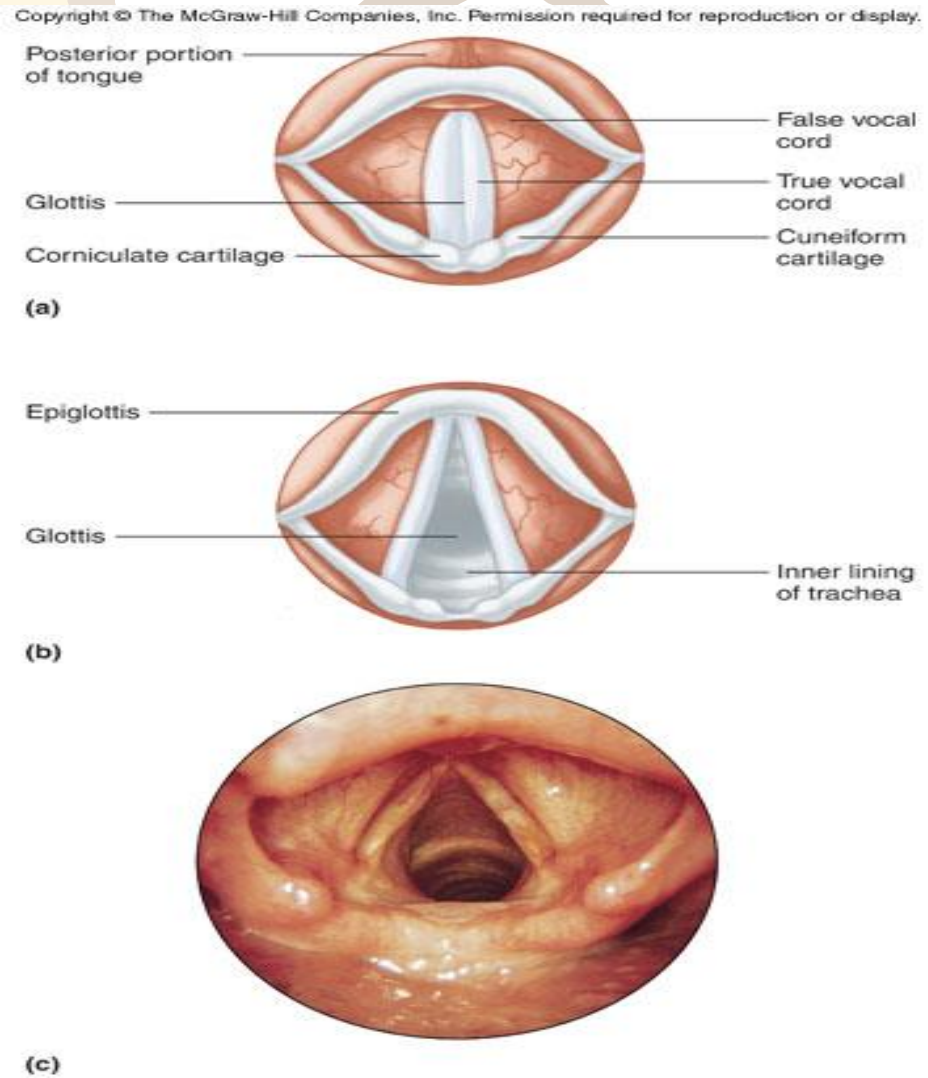


Structures of the Upper Respiratory Tract Pharynx Continued

- Changes shape to allow for vowel sounds = phonation.

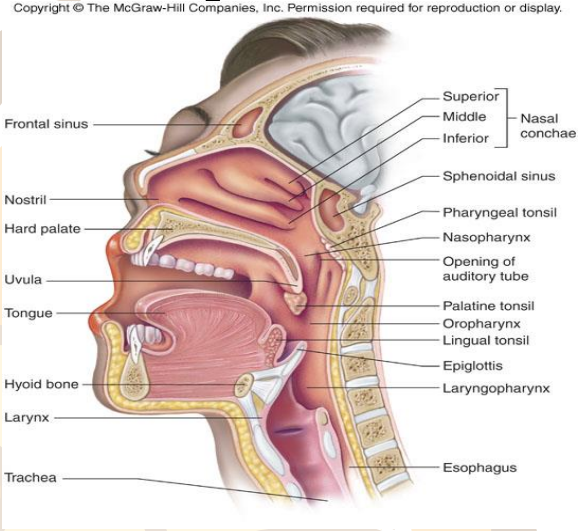
Structures of the Lower Respiratory Tract

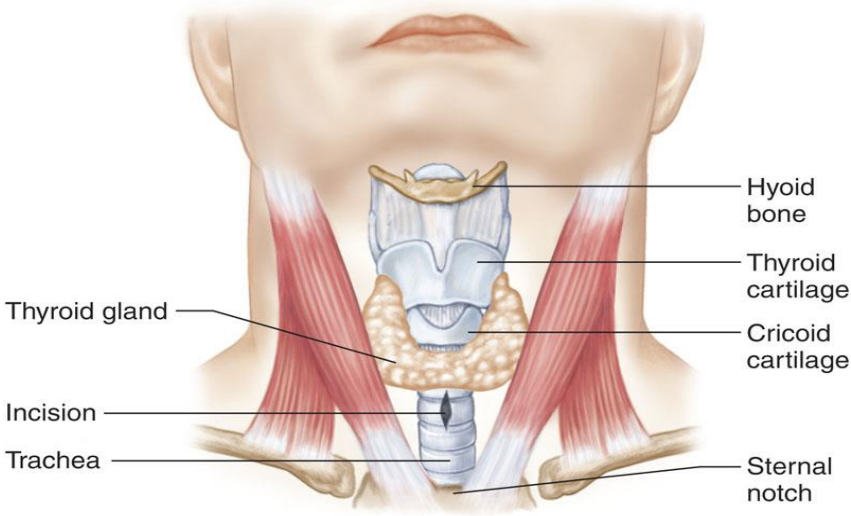
- **Larynx** - voice box
  - Root of tongue to upper end of trachea.
  - Made of cartilage
  - 2 pairs of folds
    - Vestibular - false vocal cords
    - True vocal cords



Structures of the Lower Respiratory Tract larynx cont…

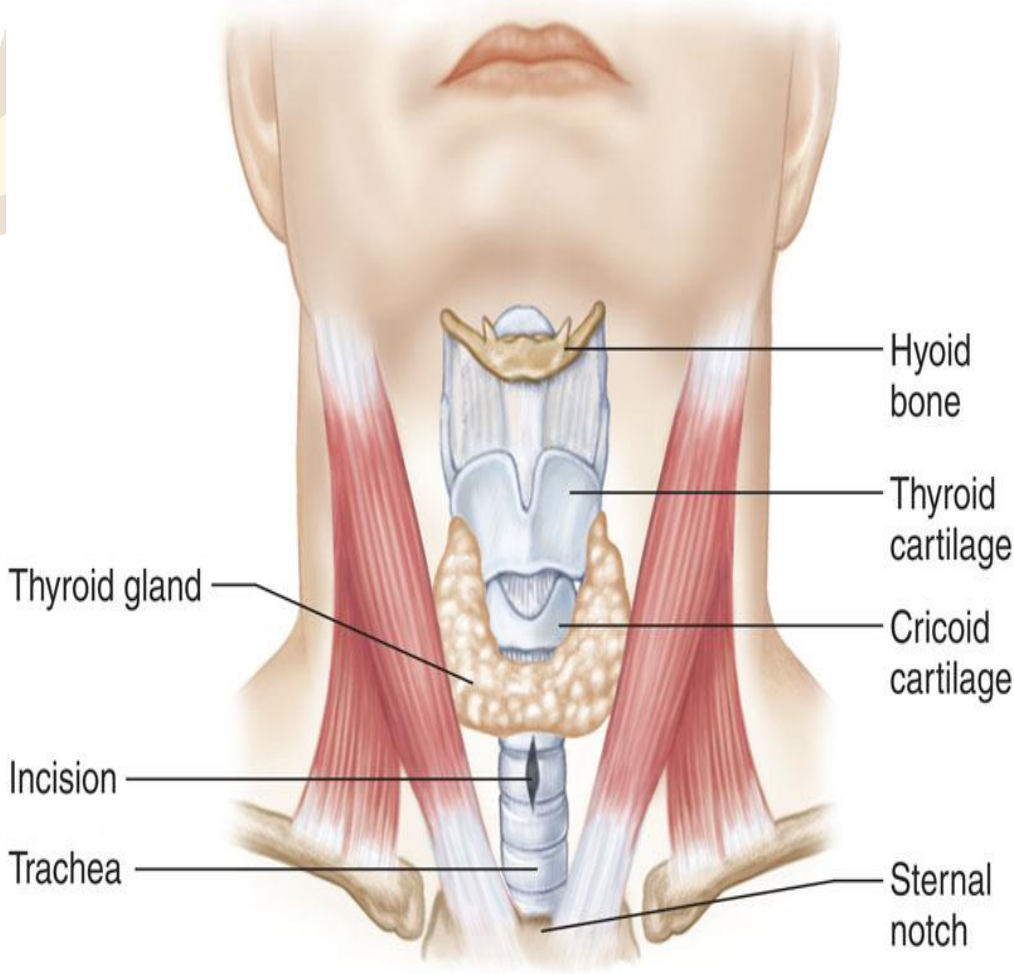
- **Thyroid cartilage** - adam's apple - larger in males due to testosterone.
- **Epiglottis** - flap of skin (hatch) on trachea, moves when swallowing and speaking.
  - closes off trachea when swallowing food





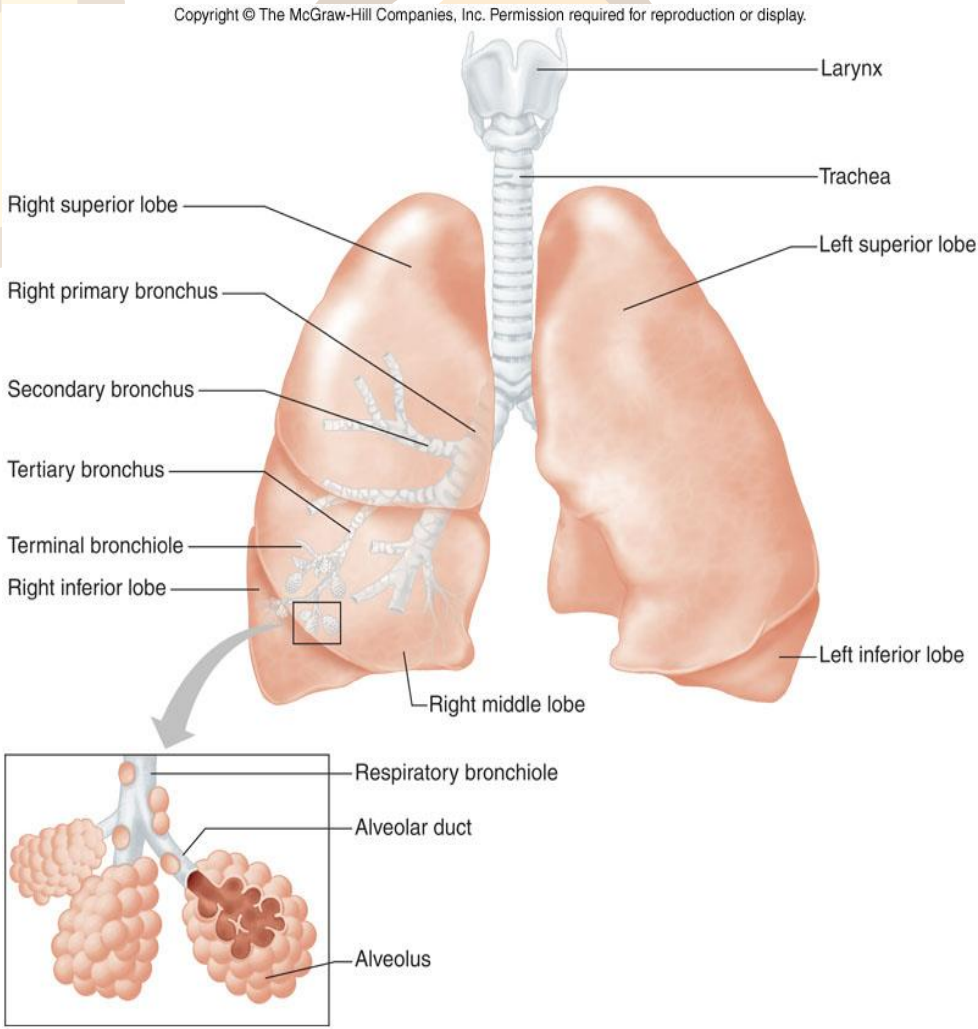
Structures of the Lower Respiratory Tract

- **Trachea (windpipe)**
  - Larynx to bronchi
  - Consists of smooth cartilage and C shaped rings of cartilage.
  - **Tracheostomy** - cutting of an opening in trachea to allow breathing.

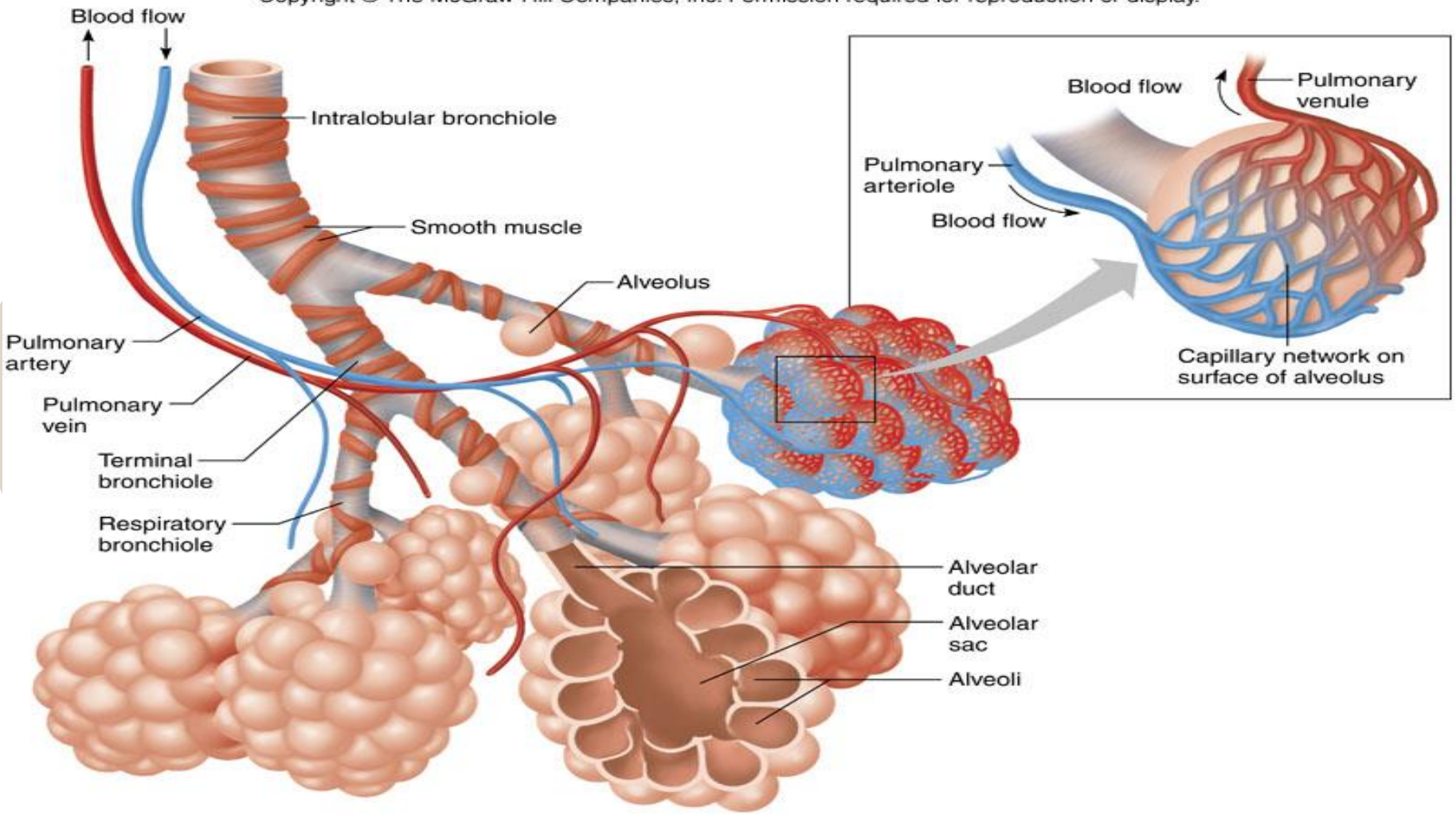


Structures of the Lower Respiratory Tract

- **Bronchi**
  - Tubes that branch off trachea and enter into lungs
  - Ciliated
  - Branches: Primary bronchi—secondary bronchi—tertiary bronchi—bronchioles
  - Bronchioles branch into microscopic alveolar ducts. Terminate into alveolar sacs
  - Gas exchange with blood occurs in sacs.

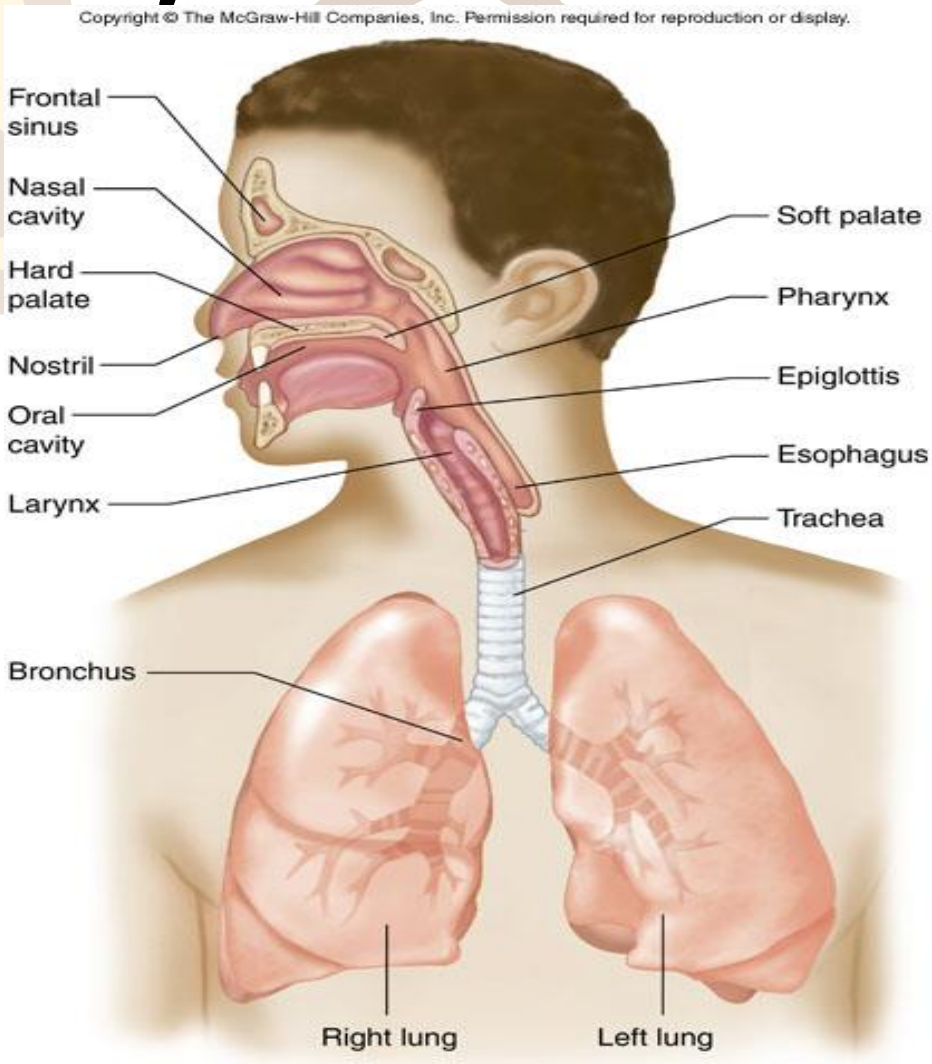


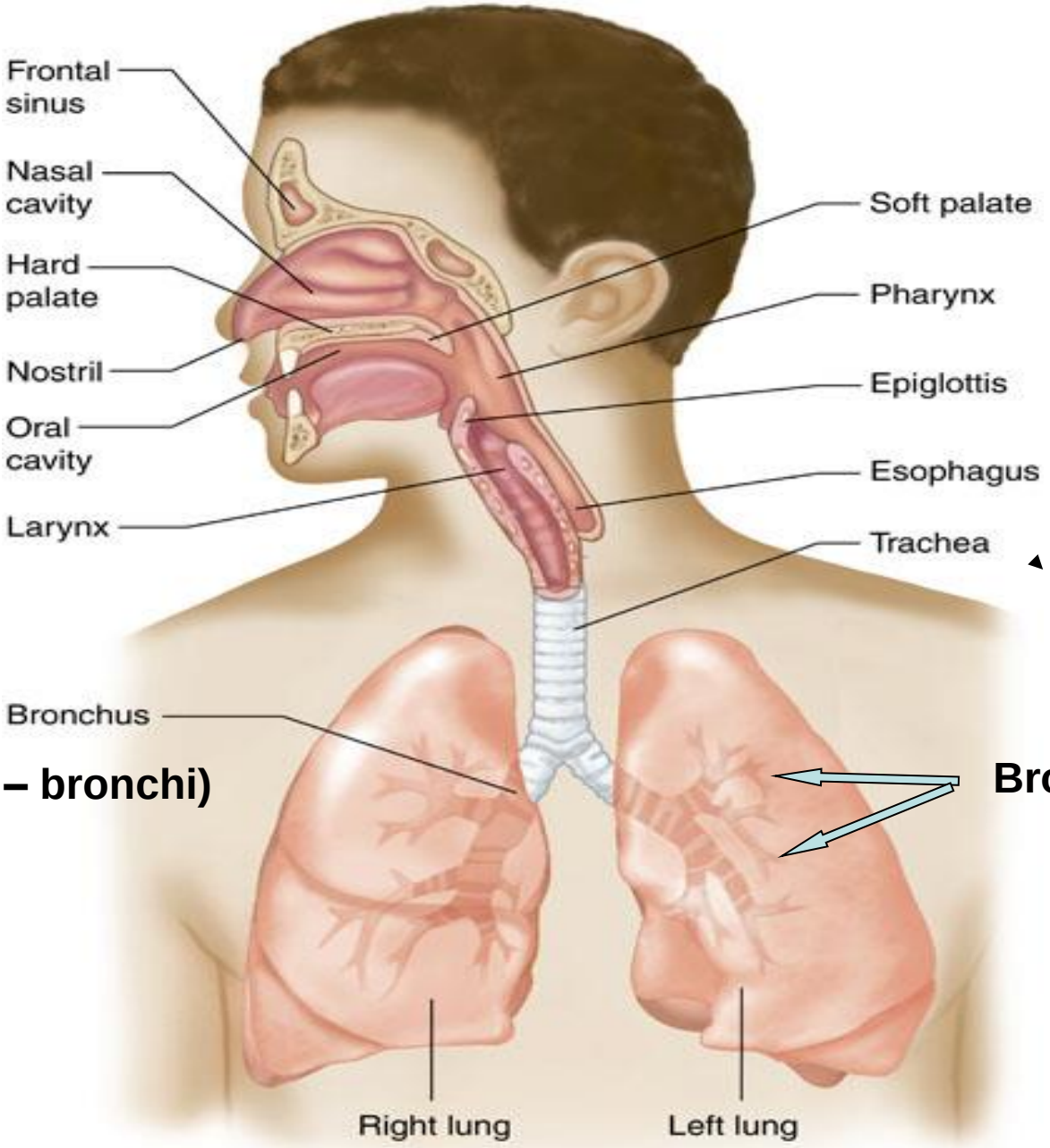
Structures of the Lower Respiratory Tract



Structures of the Lower Respiratory Tract

- **Lungs**
  - Extend from diaphragm to clavicles
  - Divided into lobes by fissures.
  - Visceral pleura adheres to the lungs.
    - **Pleurisy** = inflammation of the pleural lining



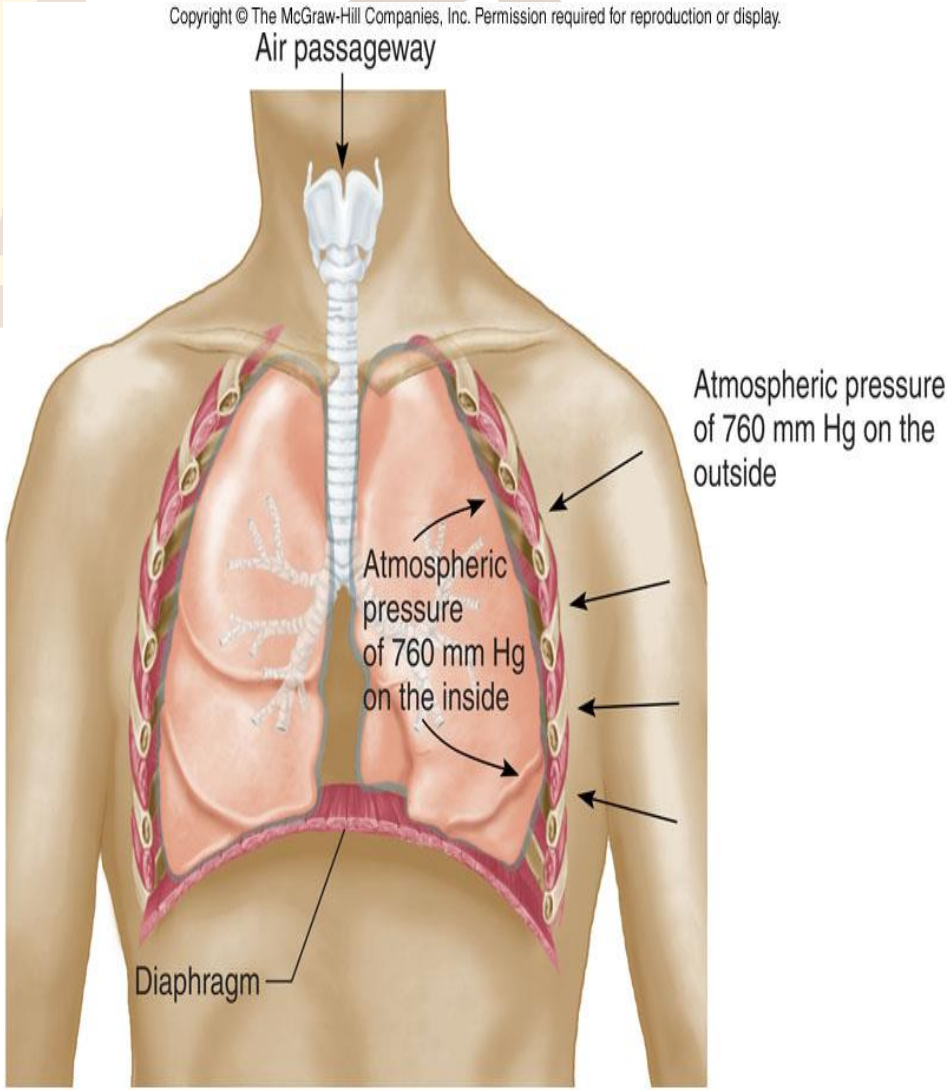


(Plural – bronchi)

Bronchioles

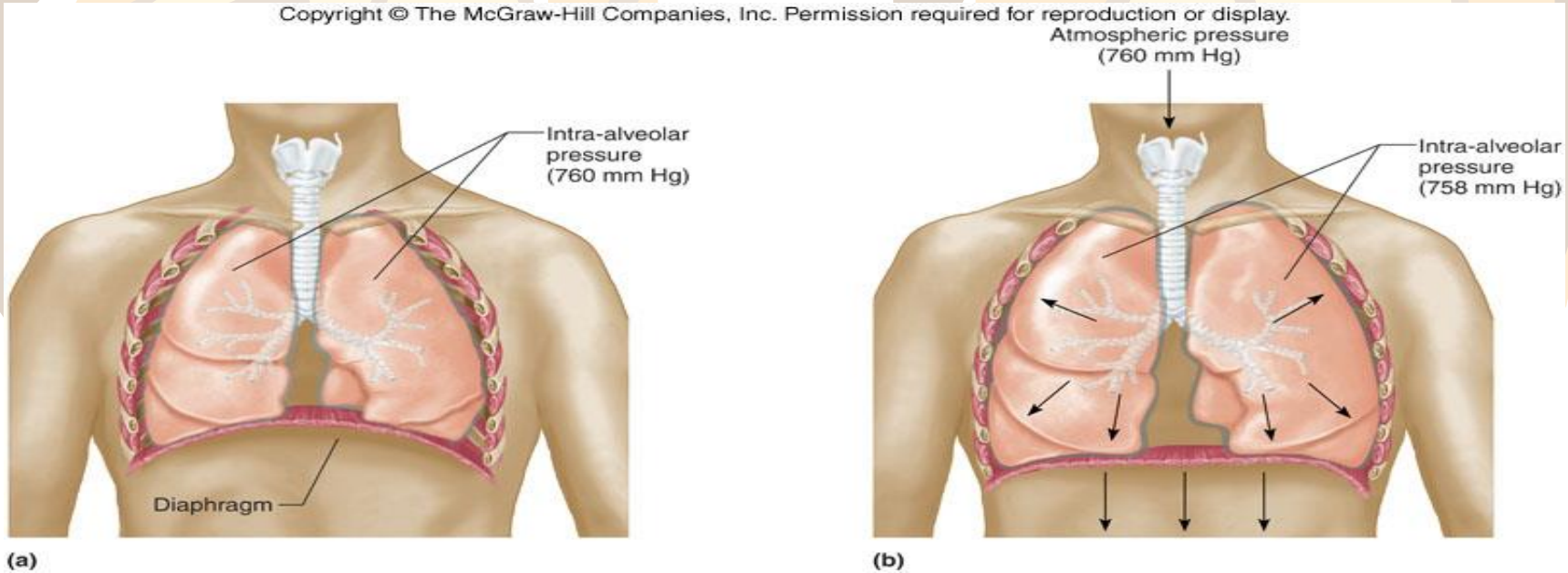
Respiratory Physiology

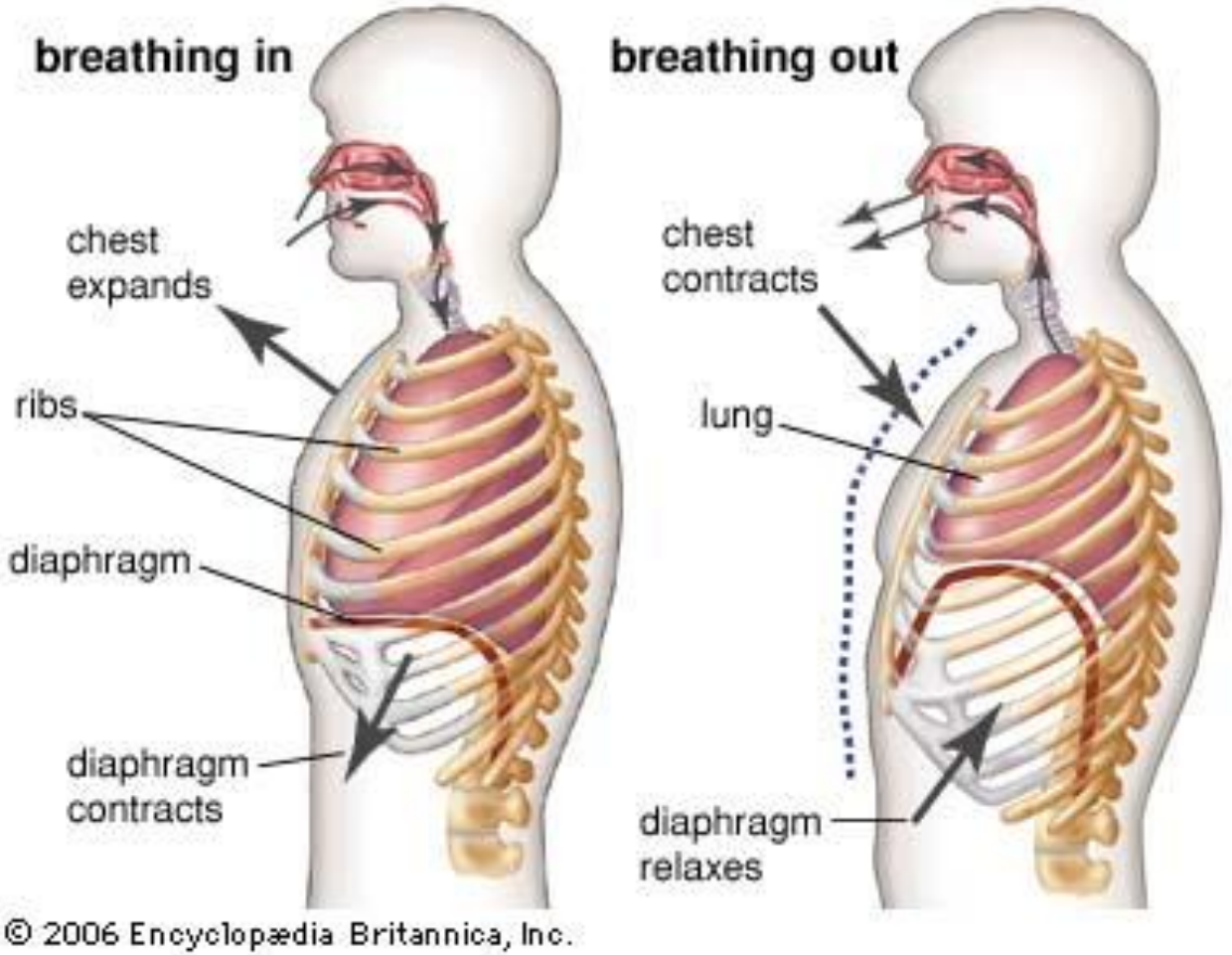
- **Pulmonary Ventilation** = breathing
  - **Mechanism**
    - Movement of gases through a pressure gradient - hi to low.
    - When atmospheric pressure (760 mmHg) is greater than lung pressure ---- air flows in = **inspiration**.
    - When lung pressure is greater than atmospheric pressure ---- air flows out = **expiration**.



Respiratory Physiology

- **Pressure gradients are established by changes in thoracic cavity.**
  - increase size in thorax = a decrease in pressure --- air moves in.
  - Decrease size in thorax = increase in pressure --- air moves out.

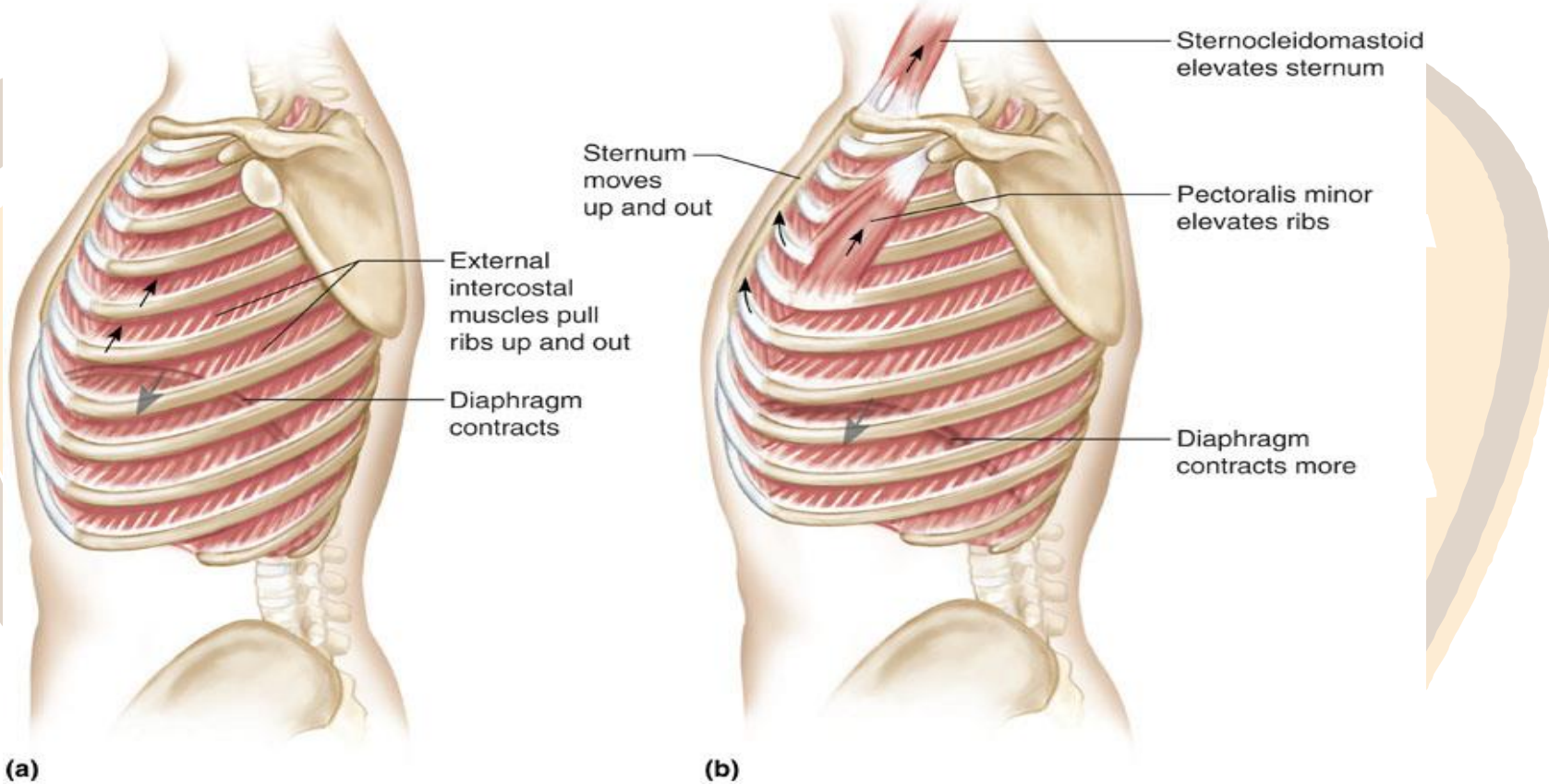




http://people.eku.edu/ritchisong/301notes6.htm

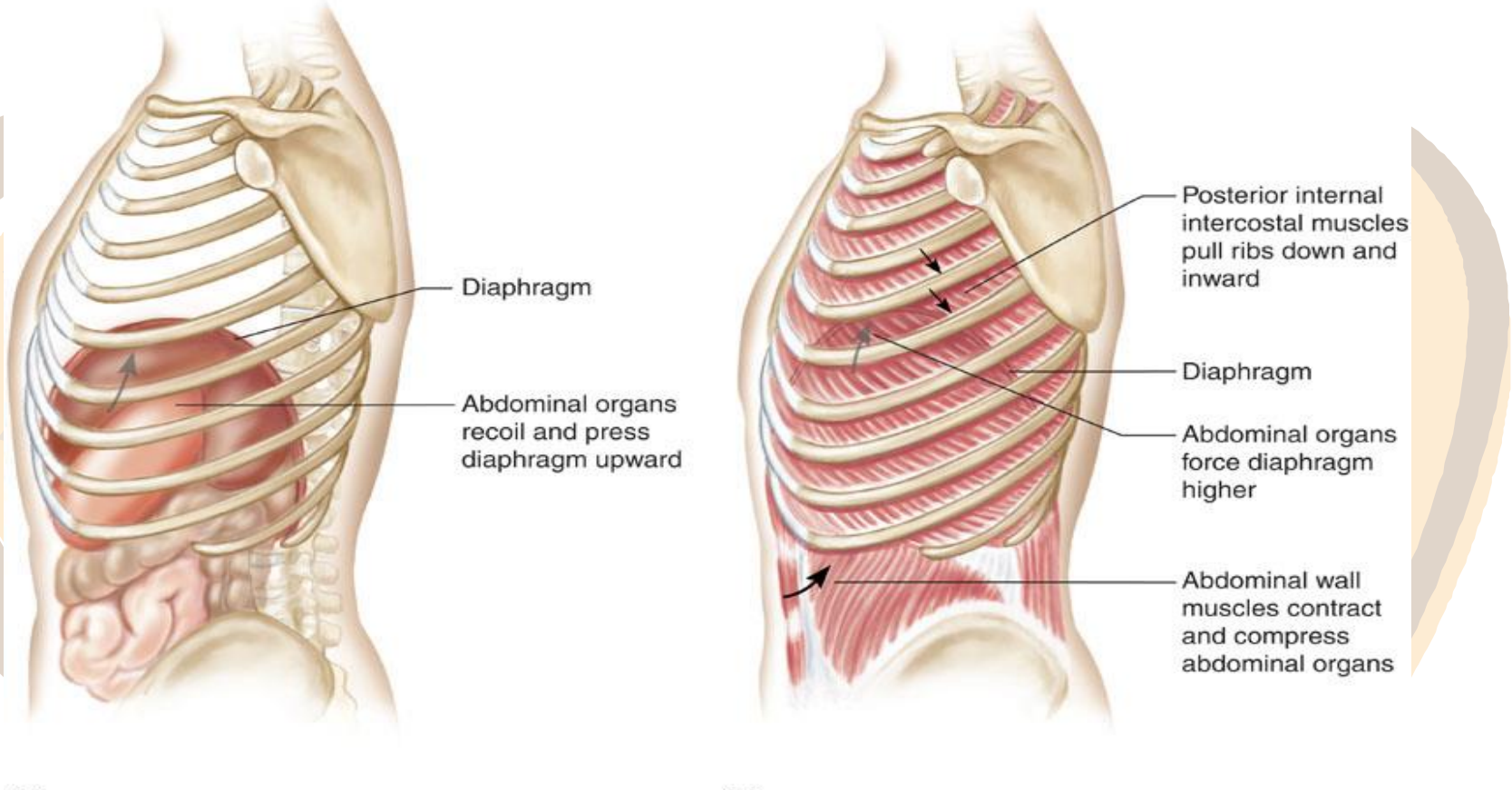
Inspiration

-contraction of diaphragm and intercostal muscles



Expiration

- relaxation of diaphragm and intercostal muscles



Volumes of Air Exchange

- ***Tidal volume*** - amount of air exhaled normally after a typical inspiration. Normal - about 500 ml
- ***Expiratory Reserve volume*** - additional amount of air forcibly expired after tidal expiration (1000 - 1200 ml).
- ***Inspiratory Reserve volume*** - (deep breath) amount of air that can be forcibly inhaled over and above normal.
- ***Residual volume*** - amount of air that stays trapped in the alveoli (about 1.2 liters).

Volumes of Air Exchange

- ***Vital capacity*** - the largest volume of air an individual can move in and out of the lungs.
- Vital capacity = sum of IRV+TV+ERV
- Depends of many factors
  - size of thoracic cavity
  - posture
  - volume of blood in lungs → congestive heart failure, emphysema, disease, etc…

Volumes of Air Exchange

- **Eupnea** - normal quiet breathing, 12-17 breaths per minute.
- **Hyperpnea** - increase in breathing to meet an increased demand by body for oxygen.
- **Hyperventilation** - increase in pulmonary ventilation in excess of the need for oxygen.
  - Someone hysterical
  - exertion

  Breathe into paper bag.
- **Hypoventilation** - decrease in pulmonary ventilation.
- **Apnea** - temporary cessation of breathing at the end of normal expiration.

Heimlich Maneuver

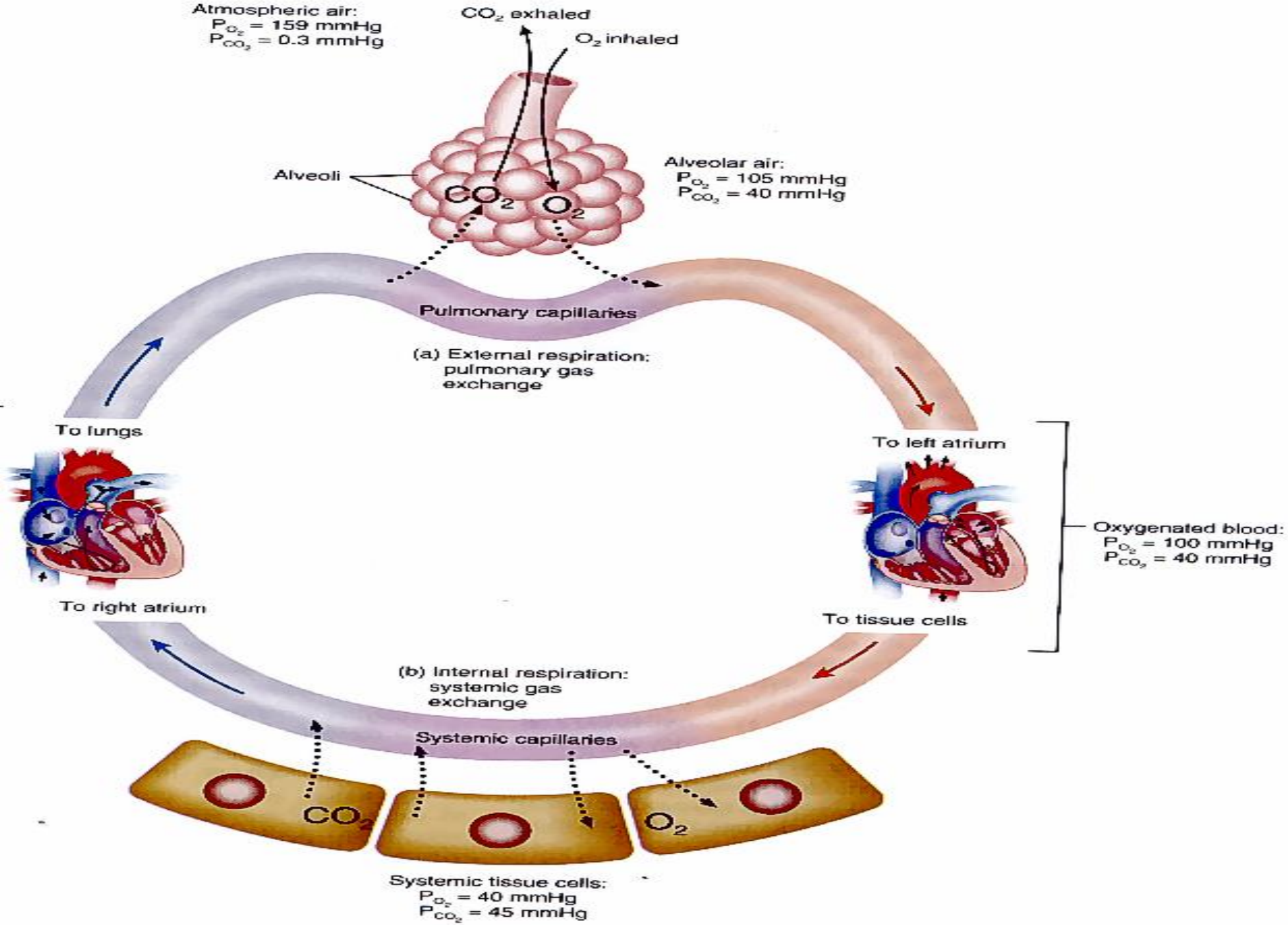
- Lifesaving technique that is used to open a windpipe that is suddenly obstructed.
- Air already in lungs used to expel object.

Heimlich Maneuver

- **Technique - Conscious victim**
  - Ask the victim if he/she can talk
  - Stand behind victim and wrap your arms around their waist.
  - Make a fist with one hand and grasp it with the other hand.
  - Place thumb side of fist below xiphoid process and above navel.
  - Thrust your fist in and upward - about 4 times.
- DO NOT press on ribs or sternum

Heimlich Maneuver

- **Technique - Unconscious victim**
  - Catch victim if they begin to fall - place on floor face up.
  - Straddle hips
  - Place one hand on top of other on the victims abdomen - above navel and below xiphoid process.
  - Forceful upward thrusts with heel of hand - several times if necessary.


Atmospheric air:
P_{O_2} = 159 mmHg
P_{CO_2} = 0.3 mmHg
CO_2 exhaled
O_2 inhaled
Alveoli
CO_2
O_2
Alveolar air:
P_{O_2} = 105 mmHg
P_{CO_2} = 40 mmHg
Pulmonary capillaries
(a) External respiration: pulmonary gas exchange
To lungs
To left atrium
Oxygenated blood:
P_{O_2} = 100 mmHg
P_{CO_2} = 40 mmHg
To right atrium
To tissue cells
(b) Internal respiration: systemic gas exchange
Systemic capillaries
CO_2
O_2
Systemic tissue cells:
P_{O_2} = 40 mmHg
P_{CO_2} = 45 mmHg

Molecular mechanism of movement of o2 and co2 through lungs

- The exchange of gases at the cellular level in lungs & tissues is described as internal respiration.
- Two gases, namely o2 & co2 are transported b/n lungs and tissues through blood
- These exchange mechanism work on the principle of biophysics that gases try to equalize the pressure on either side by the process of diffusion, if there is pressure gradient

Exchange of gases in alveoli

- The inspired air has Po2 in blood as 158.2 mmHg. where as Pco2 as 0.3mmHg.the blood coming from right ventricle of heart (I,e,,through pulmonary arteries) have Po2 as 40mmHg & Pco2 as 46.0 mmHg. Thus in the alveoli because of the difference in partial pressure there is quick diffusion of o2 from inspired air to the blood & of co2 from blood to the air in the lungs

- As result the air to be expired has po2 as 116.0mmHg & pco2 as 26.8 mmHg, where as, the blood going out from lungs to heart will have high ammount of o2(po2 100mmHg) & low ammount of co2 (pco2 40.0 mmHg)

Transport mechanisms for oxygen

- Transport of o2 from the lungs to the tissues & vice-versa is done by haemoglobin
- Haemoglobin combines with o2 to form oxygenated haemoglobin or oxyhaemoglobin
- When haemoglobin looses its 02 it is known as reduced haemoglobin

- Formation of oxyhemoglobin & reduced haemoglobin or the loading & unloading of o2 from the tissues depend on
- a)po2
- b)pco2
- C) Body temp

- Graph shows that when the blood becomes slightly acidic , with the pHdecreasing from the normal value of 7.4 t0 7.2 , the oxygen haemoglobin dissociation curve shifts, on average, about 15% to the right . Conversly, an increase in pH from the normal 7.4 to 7.6 shifts the curve a similar amount to the left

- Shift of the oxygen haemoglobin dissociation curve to the right by increases in
- 1) hydrogen ion
- 2)CO2
- 3)Temp or 2-3 DPG(diphospho glycerate)

- The oxygenated dissociation curve is shifted to left if pco2 or temp is decreased. Since decreases in pco2 is associated with decreases in H+ OR Increases in pH. Oxygen dissociated curve is shifted to left . This effect is refferred to as the Bohrs effect

Transport of co2

- Venous blood carries about 52cc% of co2 where as, arterial blood carries about 48cc% of co2 thus about 4cc% co2 is released in lungs by deoxygenated blood and from the tissues 4cc% co2 by the oxygenated blood
- Under normal conditions of temp & pressure only 2.7 ml of co2 is carried in physiological soln I,e,,as H_2CO_3. majority of co2 is carried by blood as bicarbonate

- When co2 enters the blood chloride ion from plasma enters the red cells. While base Na+ is left behind
- When co2 escapes from blood, chloride ions leaves the cells,enters the plasm & combines again with Na+
- This phenomenon is known as chloride shift. It is the major transport mechanism for co2 transport