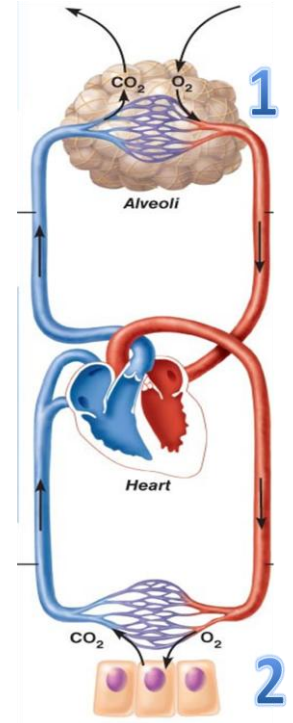


## Respiratory system :

**Respiration** : is a collective process of  $O_2$  intake from the environment ,oxidation of food materials in the cells with the release of water,  $CO_2$  , and energy and elimination of  $CO_2$  into the environment. It includes :

1. **External respiration** : the exchange of  $O_2$  and  $CO_2$  between the blood in the pulmonary capillaries and the air .
2. **Internal respiration** :the exchange of gases between tissue cells and the extracellular fluid .
  - **$O_2$  Used by mitochondria to generate ATP and produces  $CO_2$**
  - Average body consumption of  $O_2$  is 250 ml /min ,  $CO_2$  produced is 200 ml /min
  - **Respiratory exchange ratio (R):** ratio of  $CO_2$  produced to  $O_2$  used .normally R ratio is 0.8 .



## Anatomy of the respiratory tract

Respiratory tract is divided into :

1. Upper respiratory tract : nose ,nasal cavity , pharynx and larynx .
2. Lower respiratory tract: (airways and lungs )
  - a) conducting zone .
  - b) respiratory zone .

## Function of the upper respiratory tract

- I. Nose and Nasal cavity :
  1. Air **warming and humidification**: the nasal cavity is moist , ciliated and highly vascular. The large cross –sectional area of the nose has the capacity to modify temperature and water vapor of the inspired air .
  2. Removal of fine particles : large particles can be removed from the inspired air by the hair and cilia that are present in the nasal cavity.
  3. Modify speech sounds by the large hollow resonating chambers of the nose (Paranasal sinuses)

## II. Pharynx :

1. **Conducting pathway** for air and food .
2. Equalization of pressure between the middle ear and the pharynx through **Eustachian tube** .
3. Houses the tonsils (immunity role).

## III. Larynx :

1. Sound production (by the vocal cords).
2. Prevents entry of food into the trachea (**closure of glottis**): there is a reflex contraction of adductor muscle in the larynx →vocal cord approximation during swallowing and vomiting →stop food or liquid from entering the trachea and lungs .

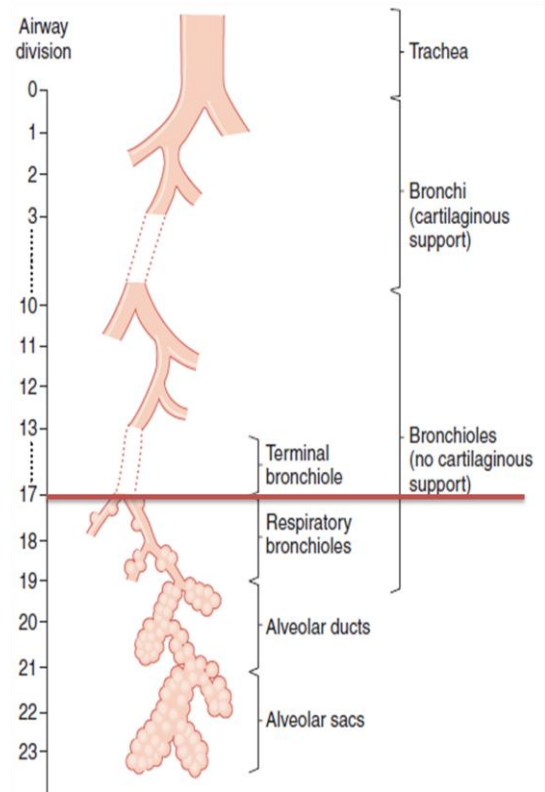
## Lower respiratory tract :

1. **Conducting zone** : includes the airways that do not participate in gas exchange .they transport gas from and to upper respiratory tract , they include: ( from 0-16 divisions)

- trachea
- bronchi
- bronchioles
- terminal bronchioles

### **Tracheobronchial tree** :

- Trachea is a hollow tubular placed anterior to the esophagus .it is kept permanently open by 15-20 incomplete **C- shaped cartilage** on its wall allow the trachea to **compressed slightly so that food can pass down the esophagus** that lies on its posterior side .



- Trachea divides into two main bronchi or **primary bronchi** . Each main bronchus divides into **secondary or lobar** which also subdivides into **tertiary or segmental bronchi** .
- Tertiary bronchi divides repeatedly to form bronchioles and terminal bronchioles .
- The conducting zone is lined with ciliated epithelium that contains mucous –secreting cells .Cilia can move particles up and out of the lungs (**mucoiliary escalator**).
- Smoking impairs respiratory cilia function (**ciliotoxins** ) .
- Cartilage are **absent** in bronchioles

2. **Respiratory zone** : gas exchange part .it includes:

- Respiratory bronchioles
- Alveolar ducts
- Alveolar sacs
- Alveoli (alveolus )

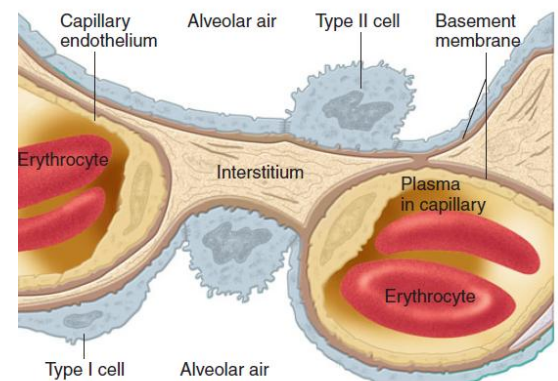
**Notes** : Cilia are absent from the **respiratory** bronchioles and downwards.

**Alveoli** :

- Alveoli are thin –walled sacs with internal diameter of 75-300 $\mu$ m interconnected by **pores of kohn** . The alveolar lining comprises two types of respiratory epithelium cells or **pneumocytes** :

a) **Type I pneumocyte** : are thin and flat , they make up the bulk of alveolar surface area (95 %).

b) **Type II pneumocyte** :5% of alveolar surface area They are more compact and therefore occupy less area .They are secretory cells secrete **surfactant** . type II cells are capable of rapid division which allow them to repair alveolar wall damage .They subsequently transform into type I cells which divide rarely .



c) **Other cells present in the alveoli:**

- Pulmonary alveolar macrophage
- Mast cells : contain histamine , proteases and leukotriene that participate in allergic reaction and produce bronchospasm.
- endocrine cells (**Amine precursor uptake and decarboxylation cells** )

**Non respiratory function of the lung**

1. Protective function : particles are expelled out by cough reflex and escalator action of cilia . epithelium cells in the conducting airway synthesize immunoglobulins like IgA , defensins , reactive oxygen
2. Acid –base balance :lungs play important role in maintaining the body PH by regulating the CO<sub>2</sub> content of blood .
3. Filtration of blood from clot : lungs contain a fibrinolytic system that lyses clot in the pulmonary vessels.
4. Regulation of blood pressure : **angiotensin converting enzyme(ACE)** that converts **angiotensin I** to **angiotensin II** ( a potent vasoconstrictor).  
Note : bradykinin is deactivated by the same enzyme
5. Regulation of blood volume : lungs act as a storage organ for blood since pulmonary circulation is a low- pressure system and the vessels are highly distensible.
6. Temperature regulation : heat is lost from the body during expiration .
7. Endocrine function : lungs synthesize prostaglandin , histamine and kallikrein with the help of APUD cells .
8. Remove substances from blood (partially) : ex: serotonin and norepinephrine .