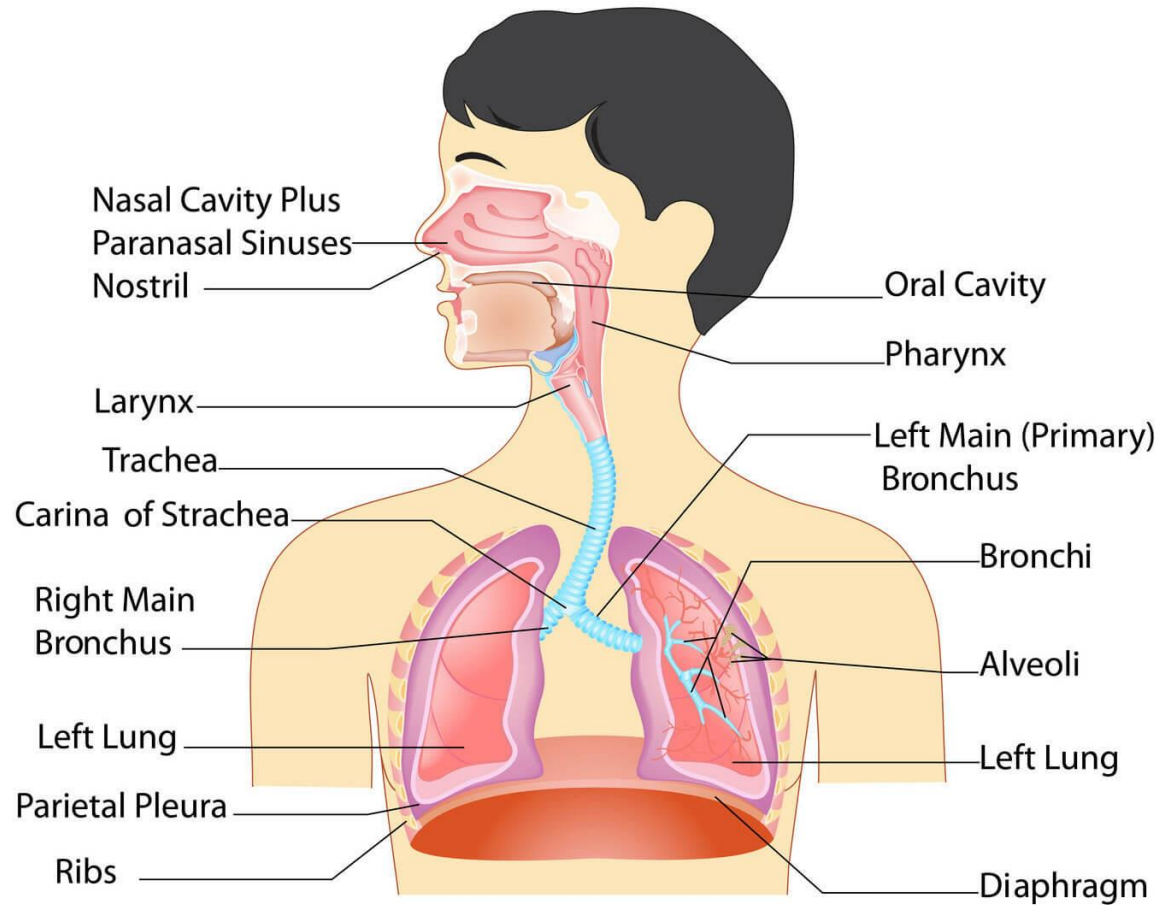




Respiratory system

L- 1 (Respiratory System)

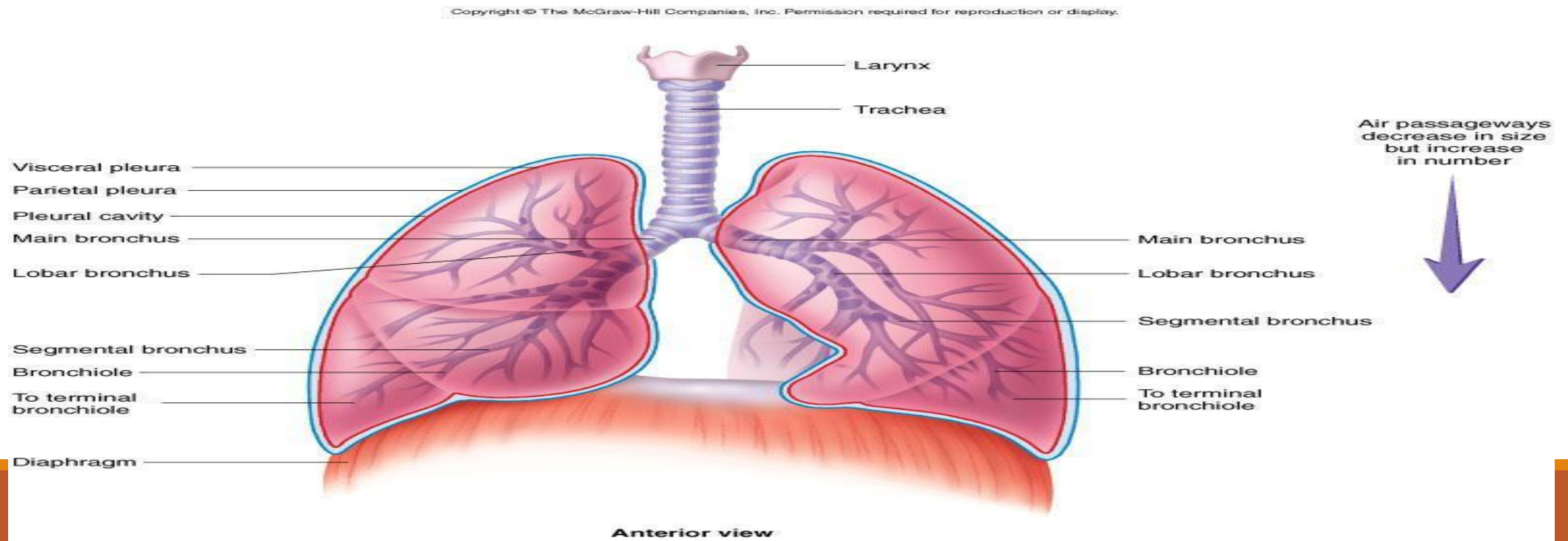
By Lecturer. Rasha Naseer Mohammed
Pharmacology and Toxicology Department
College of pharmacy
University of Basrah

Respiratory system: is the system responsible for equipment of air to the body tissues .

Respiration :is a complex processes by which the living organism meets requirements of O₂ and eliminates CO₂

External respiration

Internal respiration



In man respiration comprises the following processes :

- 1-Exchange of air between the external environment and pulmonary alveoli (external respiration)
- 2-Exchange of gases between the alveolar air and the blood flowing along the pulmonary capillaries .
- 3-Transport of gases by the blood .
- 4-Exchange of gases between the tissues cells and blood in the tissues capillaries.
- 5-consumption of O₂ by the cells and production of CO₂.

Functions of Respiratory System:

In addition to the main function (obtaining O₂ and getting rid of CO₂) there are other important functions **Non respiratory functions of lungs**

1-Pulmonary defense mechanisms.

Defense against pathogens and foreign particles in airways:

- Remove foreign particles (mucus and cilia)
- Neutrophils, lymphocytes and macrophages in alveoli
- Immunoglobulin (IgA)

2-Metabolic functions of the lungs.

Lungs synthesize hormones like PG, serotonin, histamine etc

3-Acid –Base Balance

4-anti coagulation function:

5-Temperature regulation

6- blood pressure regulation

Respiratory Airways

R airways are divided into upper and lower parts .

Upper respiratory airways

Upper R airways include many parts and the most important are :

- 1-Nose (nasal cavity): (air conditioning ,defense mechanism warming and humidification of inspired air).
- 2-Paranasal sinuses: (modify speech sound)
- 3- Eustachian tube ,
- 4- the pharynx (nasopharynxes, oropharynx, laryngopharynx)
- 5- larynx (voice box) .

Upper respiratory airways have several physiological functions in addition to air conductions such as: swallowing, conditioning of air before its passage to the trachea .

The lower respiratory airways :

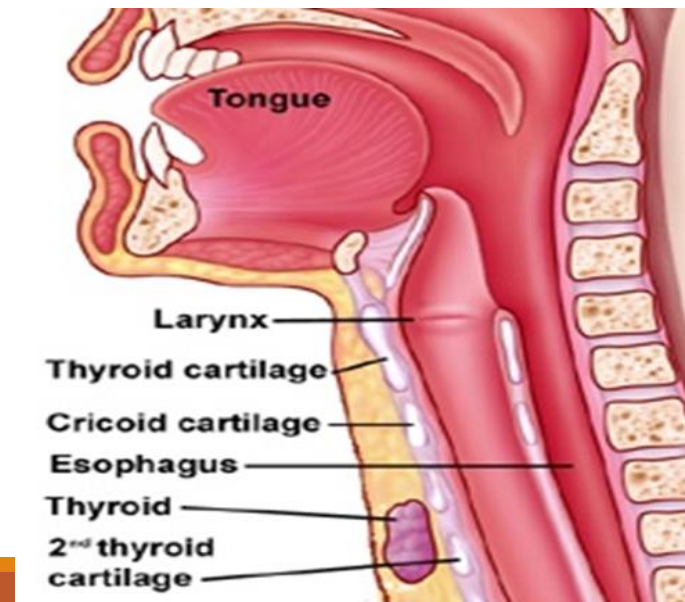
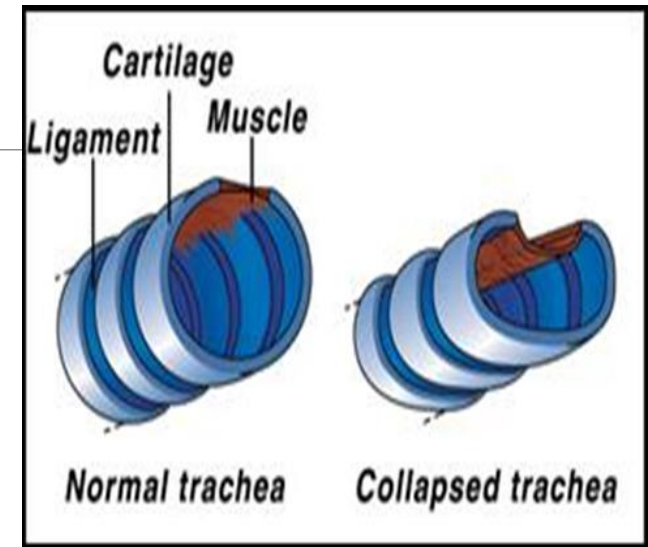
Trachea :

- ❖ Extend from the larynx to the bifurcation in the mediastinum.
- ❖ Inner diameter 1.5 cm
- ❖ lined by respiratory epithelium
- ❖ called (first generation respiratory passageway)
- ❖ 15-20 incomplete C-shaped cartilage

The **trachea** is a tube leading to the lungs.

It is lined with '**C' shaped rings of cartilage**, which prevent the collapse of the tube when the air pressure is reduced during inspiration (otherwise breathing would be impossible).

- The esophagus lies posteriorly to the trachea.
- The cartilaginous rings are incomplete to allow the trachea to collapse slightly so that food can pass down the esophagus



The trachealis muscle:

The trachealis muscle contracts during coughing → ↓ lumen of the trachea → ↑ rate of air flow

- contracts to reduce the size of the trachea, e.g. during coughing or during an asthma attack
- relaxes during swallowing (food passing down the oesophagus projects into the trachea) and also to expand the trachea during exercise (so air breathed in faster).

The inner surface of the trachea (and bronchi + bronchioles) is lined with **mucus secreting goblet cells**

(the mucus traps foreign particles, e.g. dust and parasites) and **ciliated cells** carrying the mucus to the nose.

Trachea :

divided into :right and left primary (main) bronchi.

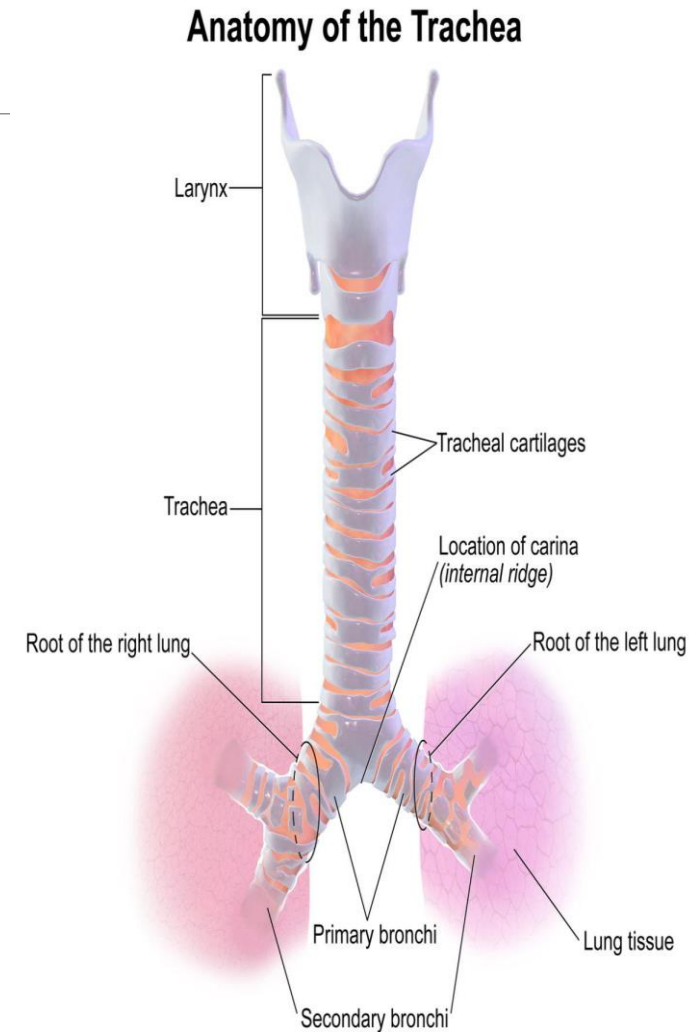
Trachea → Bronchi → 1-r.Bronchi
2-l.Bronchi

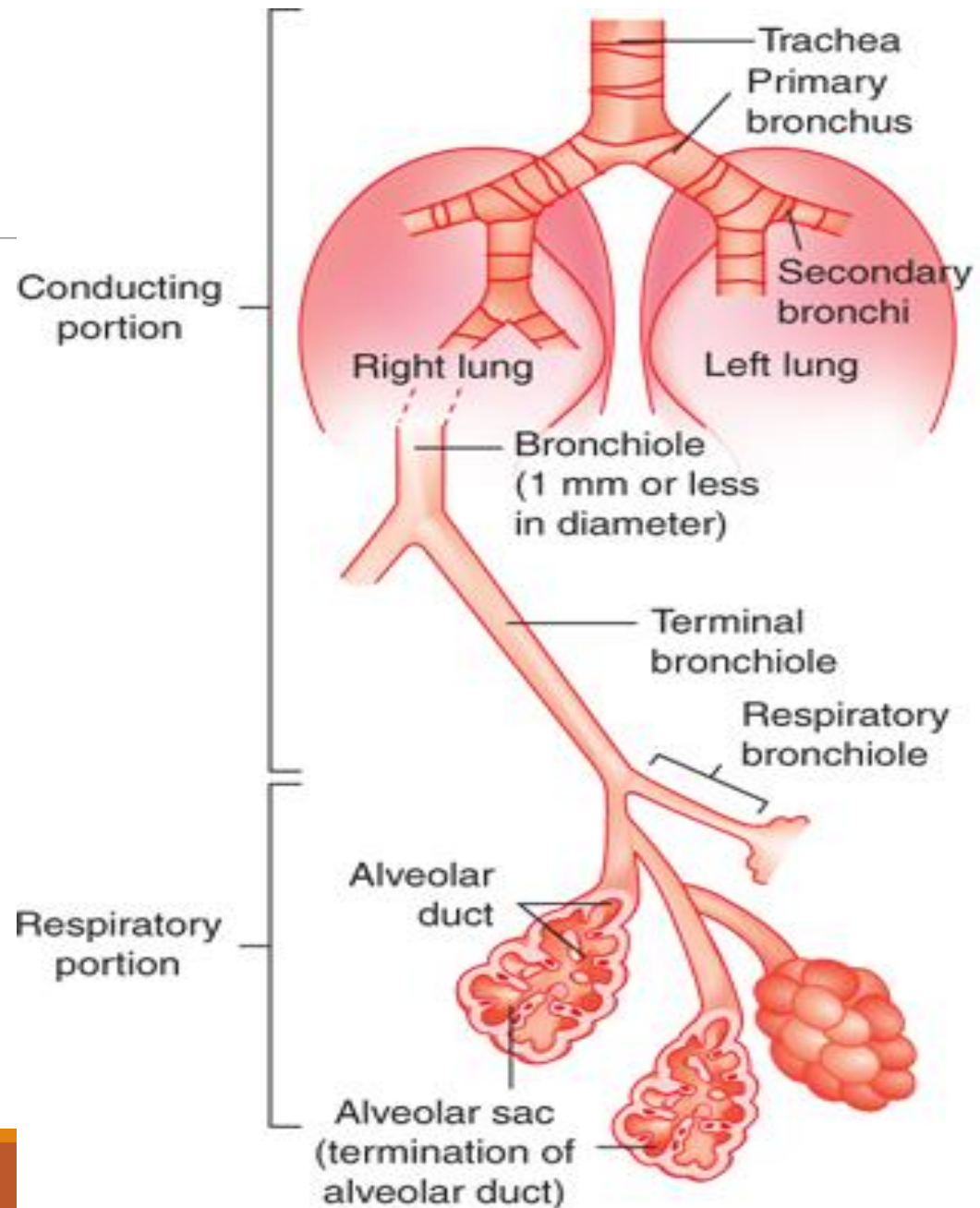
Bronchi (second generation of respiratory passageway).

The bronchi are < 1 mm in diameter

and have cartilaginous rings that protect them from collapsing during expiration.

They are not embedded in the lung parenchyma, so their diameter is not dependent on lung volume





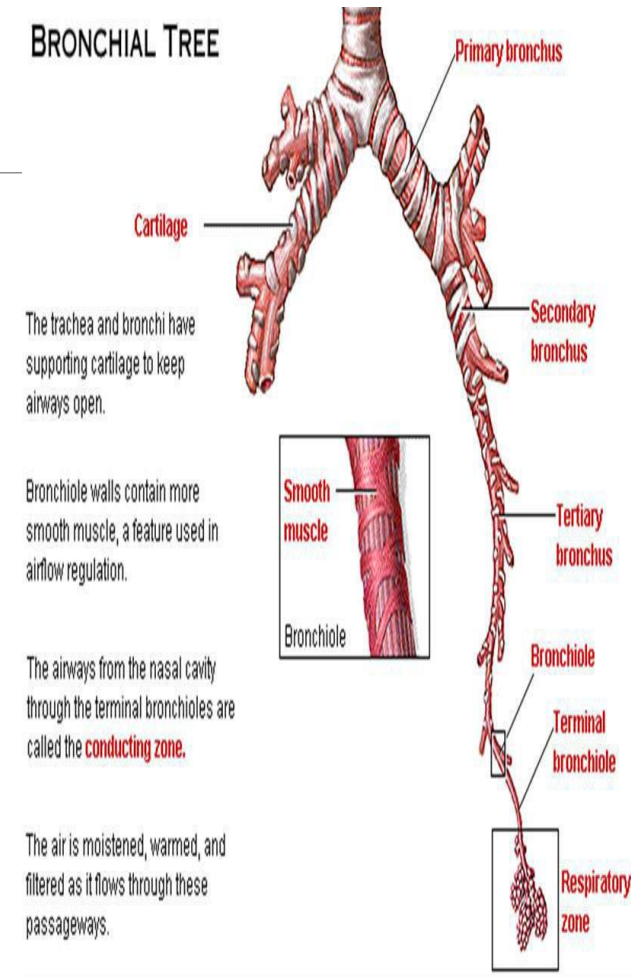
Bronchus in turn is divided to form small branches (bronchioles)

- That are smaller in diameter and have no supporting cartilage.
- They are embedded within lung parenchyma, and their diameter expands and contracts with lung volume.

Bronchioles are divided to form smaller branches (**the terminal bronchioles**)

Terminal bronchioles are further divided into very small bronchioles (**respiratory bronchioles**).

There are 20-25 generations before reaching finally to the **alveolar duct and alveoli**.



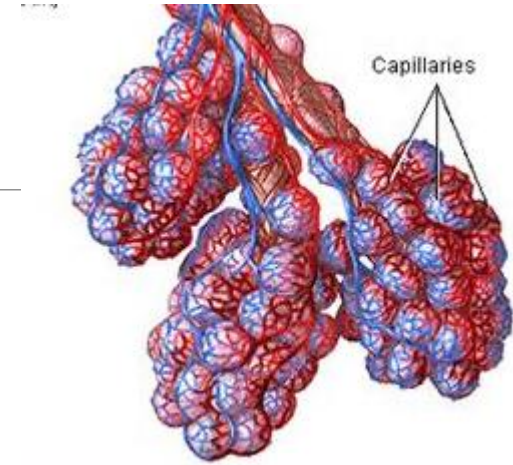
Alveoli

- there is 300 million alveoli in both lungs
- 70m² surface area.

The **lungs** are subdivided into **3 right (superior, middle, inferior lobes)** and **2 left lobes (superior& inferior)**

Each served by a bronchiole ending in a mass of 300m tiny air sacs = **alveoli**.

Each alveolus having an average diameter of about 0.2 mm. The alveolar walls are extremely thin 5-10 micrometer).



The wall of an alveolus consists of single layer of flattened squamous epithelial cells, through which the gases will diffuse.

The wall consists of a layer of flattened epithelium comprising 2 types of cells:

Type 1 pneumocystis (flat cell) → gas exchange

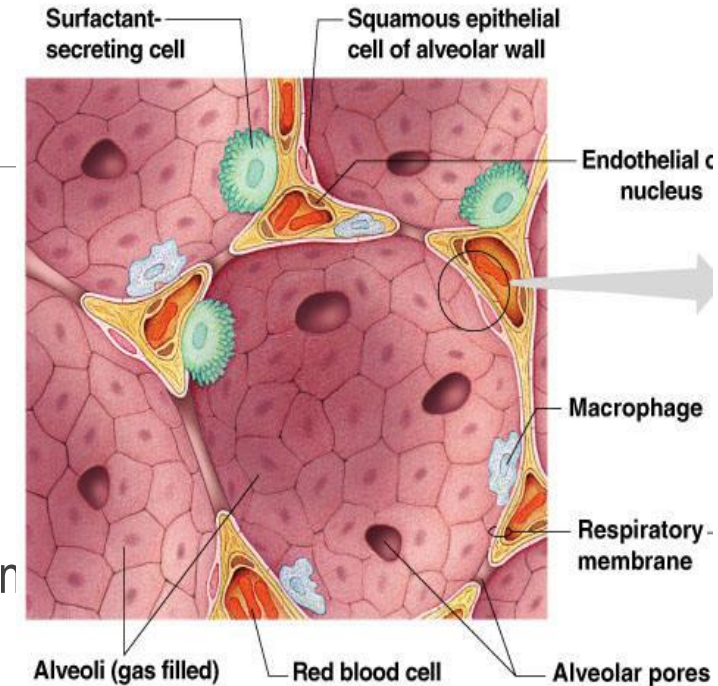
Type II pneumonocytis (granular cell) → secrete surfactant

Other cells (pulmonary alveolar macrophages & mast cells)

Surfactant

Is a surface tension lowering agent present in the alveolus between the alveolar fluid and air. It maintains alveolar stability (prevents over distension or collapse of alveoli) by greatly reducing the surface tension.

- ↑Diameter of the alveolus (inspiration) → ↓ surfactant concentration → ↑ surface tension → prevents over distension
- ↓Diameter of alveoli (expiration) → ↑ surfactant concentration → ↓ surface tension → prevents collapse



Within the alveolar walls there is an almost solid network of interconnecting capillaries.

Because of the extensiveness capillaries plexus, the flow of blood in the alveolar wall has been described as (sheet)

so the alveolar gases are in close proximity to the blood of capillaries ,that is why gaseous exchange between the alveolar gas and blood in pulmonary capillaries occurs through the membrane of all terminal portions of the lung

and these membranes are called :respiratory membrane or pulmonary membrane.

Anatomy

The respiratory system is composed of the conducting airways and the respiratory airways.

Conducting and Respiratory Airways

The conducting airways include the nose, mouth, pharynx, larynx, trachea, bronchi, bronchioles, and terminal bronchioles. As their name suggests, these airways merely conduct air to the respiratory airways; they do not participate in gas exchange.

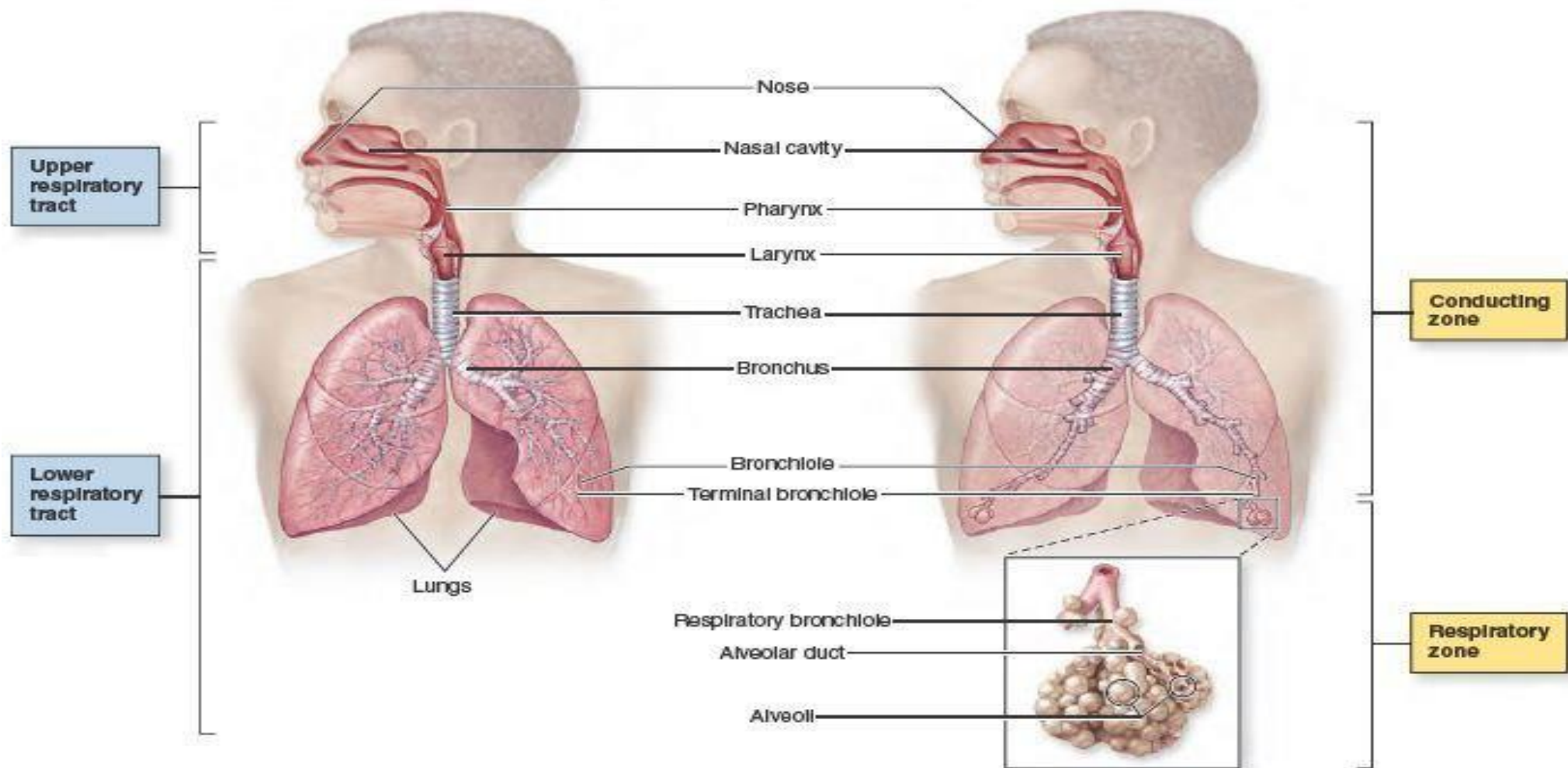
Conducting airways :anatomically incapable of gas exchange with venous blood
(anatomical dead space)

The respiratory airways include the respiratory bronchioles, alveolar ducts, alveolar sac and alveoli. In which gas exchange occurs.

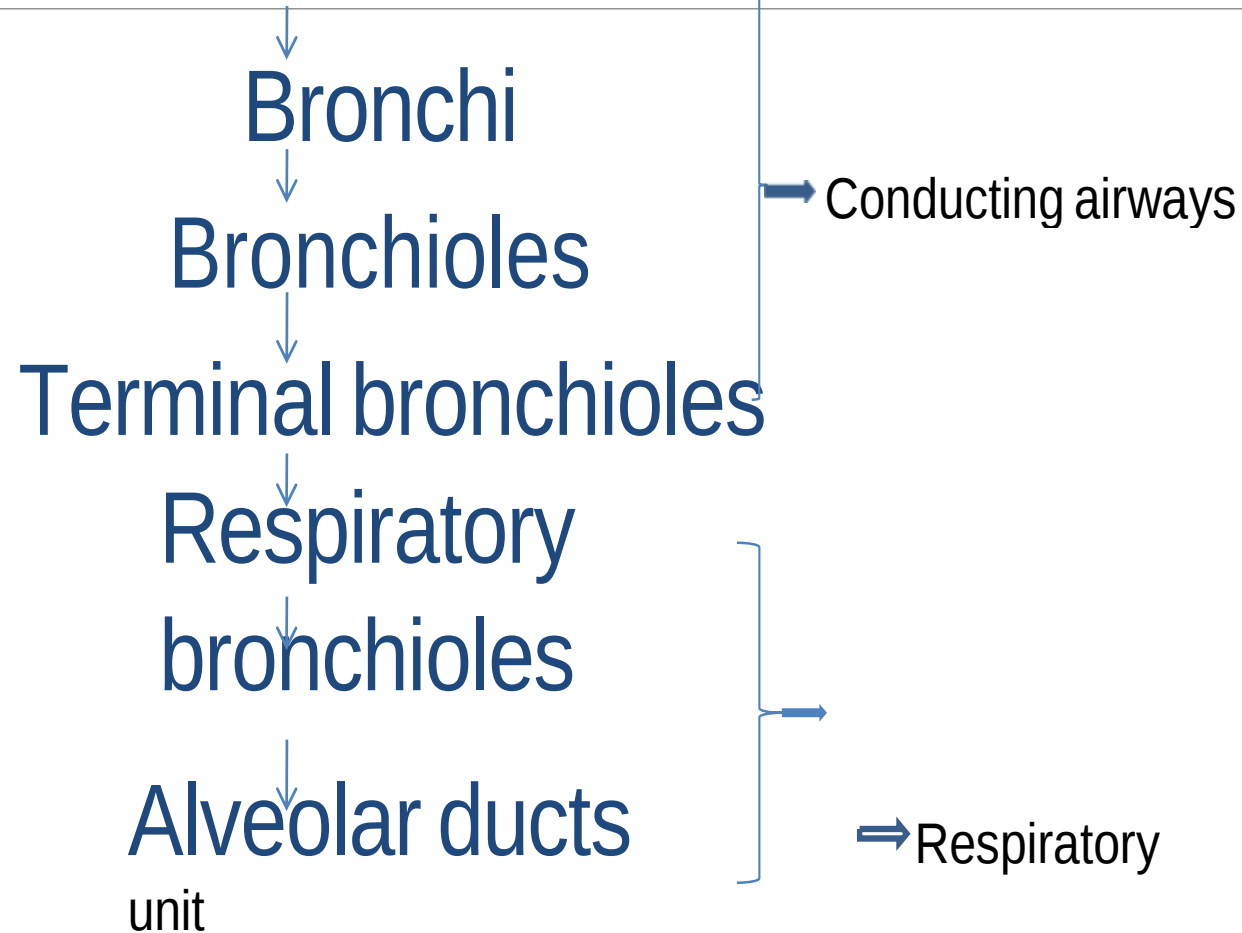
Respiratory unit(R.ZONE) :area in which gas exchange occurs.

Structural organization

Functional organization

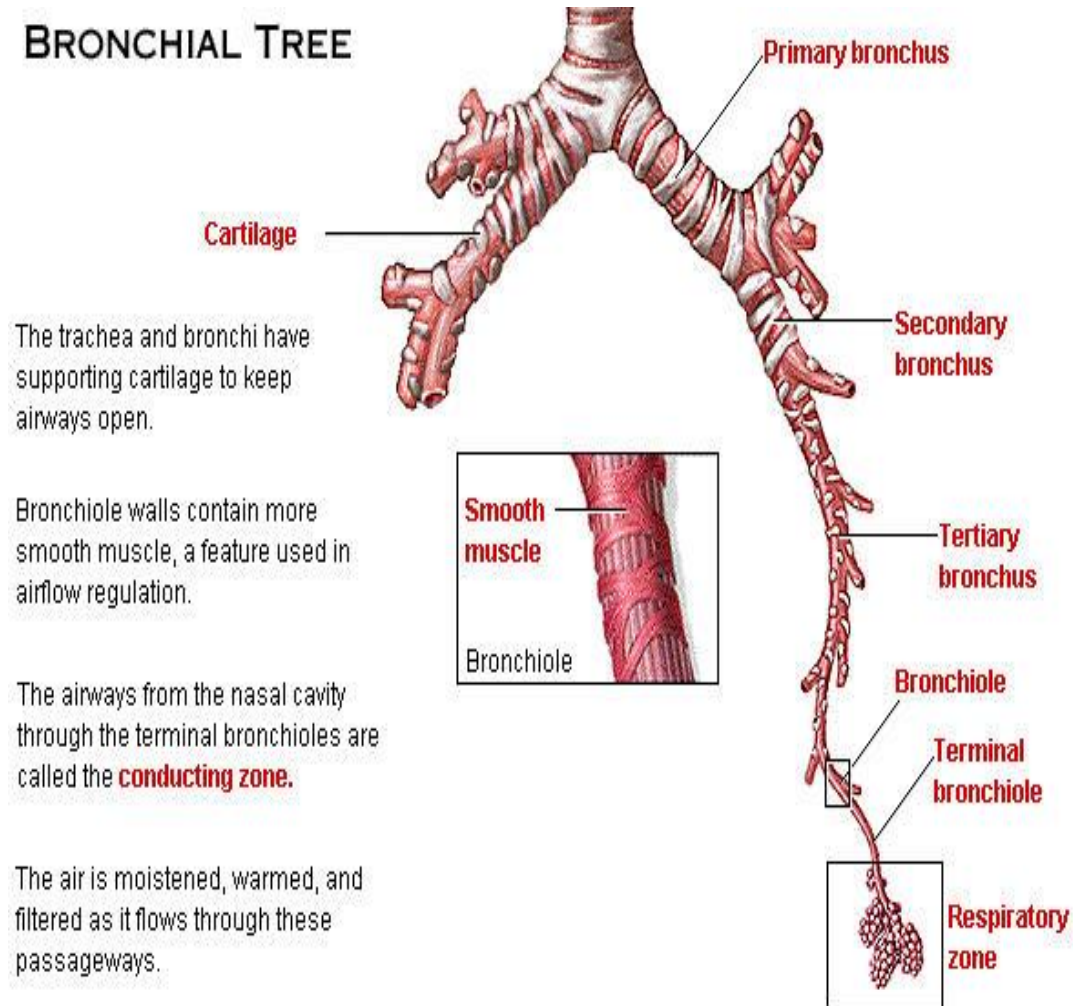


Nose(mouth) $\Rightarrow$ pharynx, larynx (upper
airways) Trachea (first generation)



alveoli

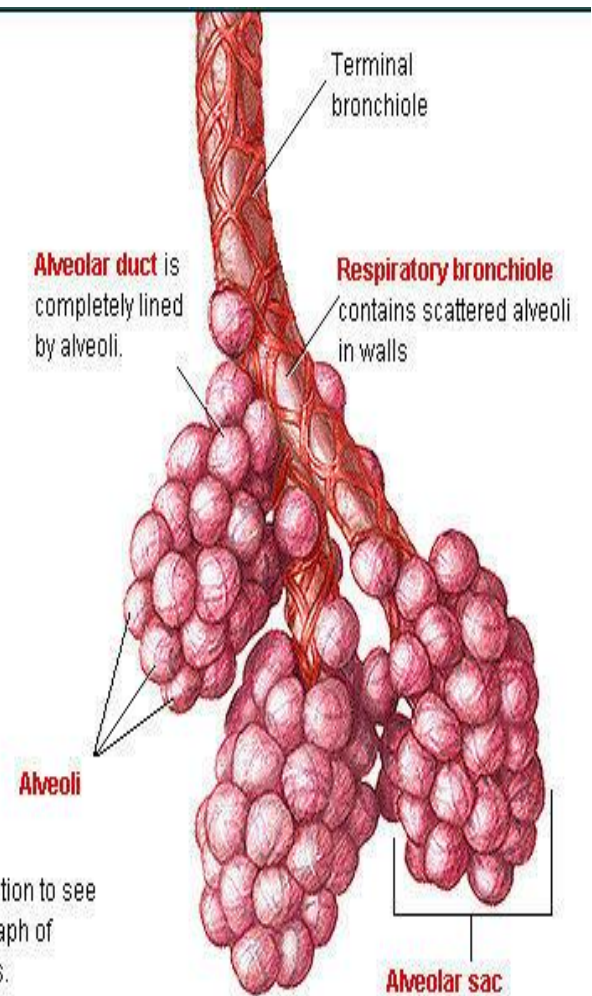
BRONCHIAL TREE



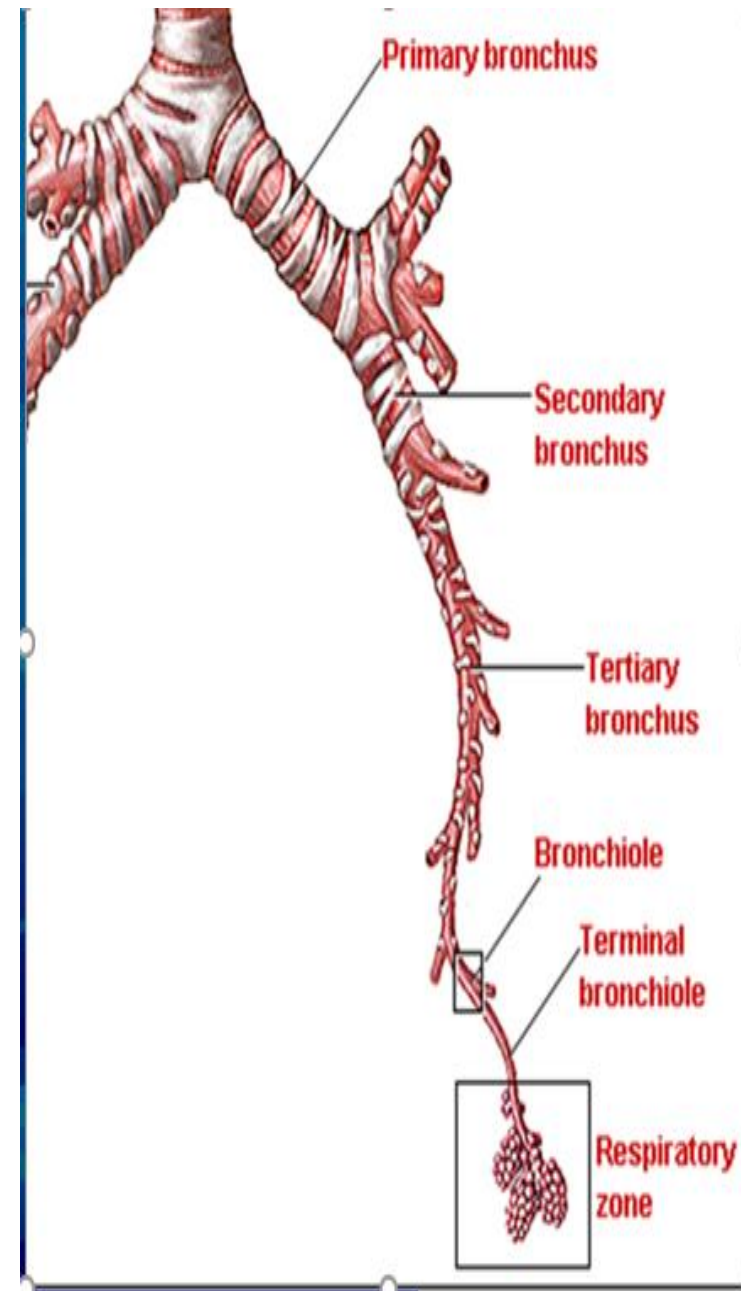
RESPIRATORY ZONE

The **respiratory zone** contains alveoli, tiny thin-walled sacs where gas exchange occurs.

Alveolar ducts end in clusters of alveoli called alveolar sacs.

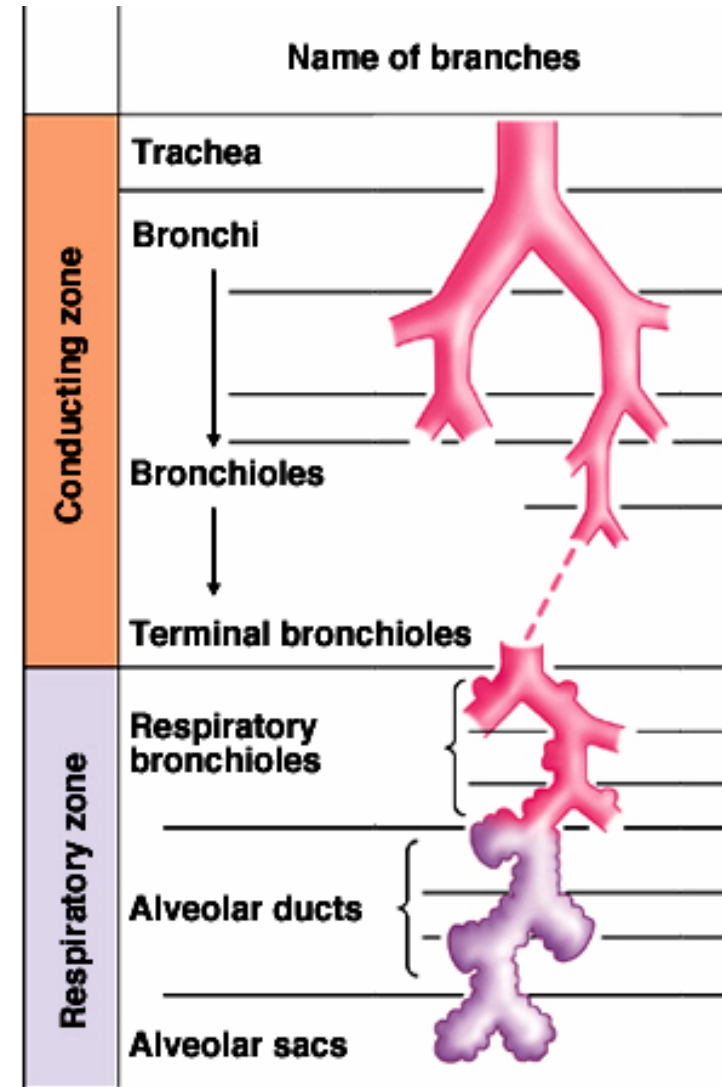


Structure	Cartilage	Glands	Cilia	Smooth muscle
Trachea	Ring	+	+	+
1° Bronchi	Ring	+	+	+
2° Bronchi	Plate	+	+	+
3° Bronchi	Plate	+	+	+
Bronchiole	No	-	+	++
Terminal	No	-	+	+++
Respiratory	No	-	±	++
Alveolar duct	No	-	-	±
Alveolar sac	No	-	-	-



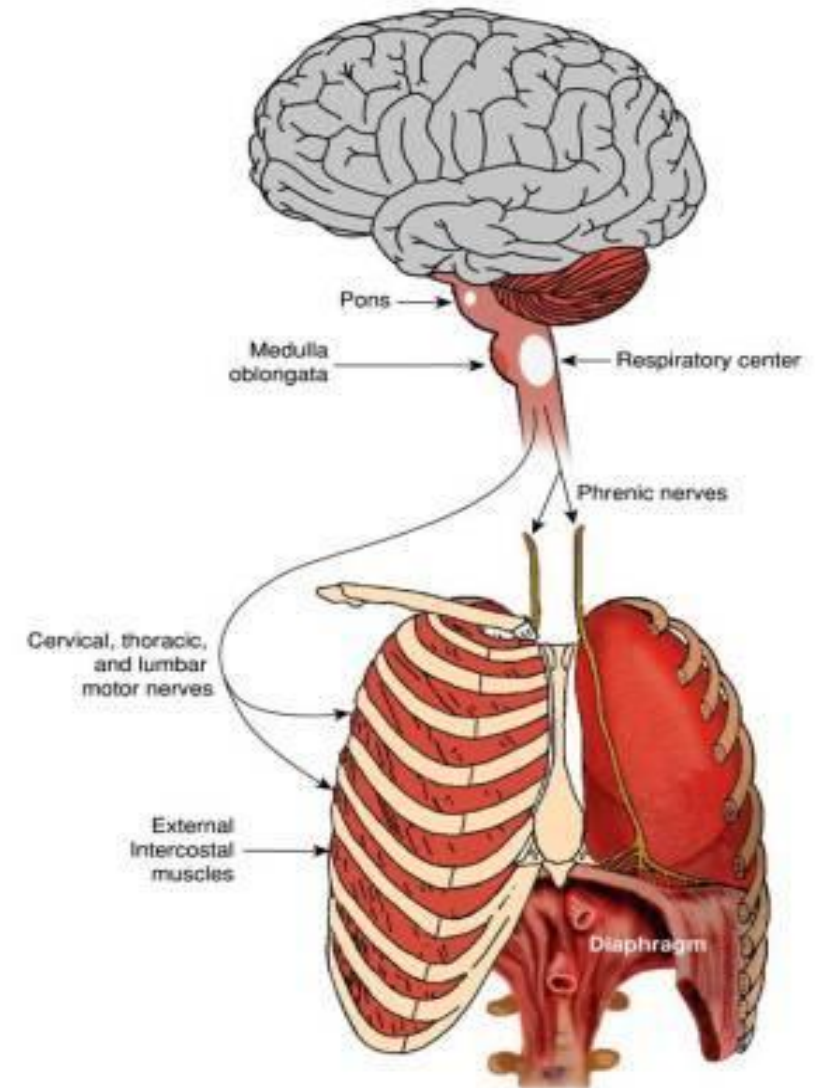
Trachea → alveoli (23 divisions)

Conducting zone (dead space)	Respiratory zone
1st 16 divisions	Last 7 divisions
End by terminal bronchiole	Begin by respiratory bronchiole
No alveoli	There is alveoli
- Function - Distribute air to respiratory zone - Air conditioning function (warm, humidify and filtering of inspired air)	- Function - Gas exchange (type 1) - Surfactant (type 2) - Defensive (alveolar macrophages)
Blood supply Systemic circulation (bronchial)	Blood supply Pulmonary circulation



Functional anatomy of the Respiratory System:

1. Lungs (gas exchange organs)
2. Chest walls
3. respiratory muscles, which consist of muscles of respiration such as diaphragm ,external intercostal muscles ,abdominal muscles and rib cage
4. Part of CNS concerned with the control of respiratory muscles



Pleura

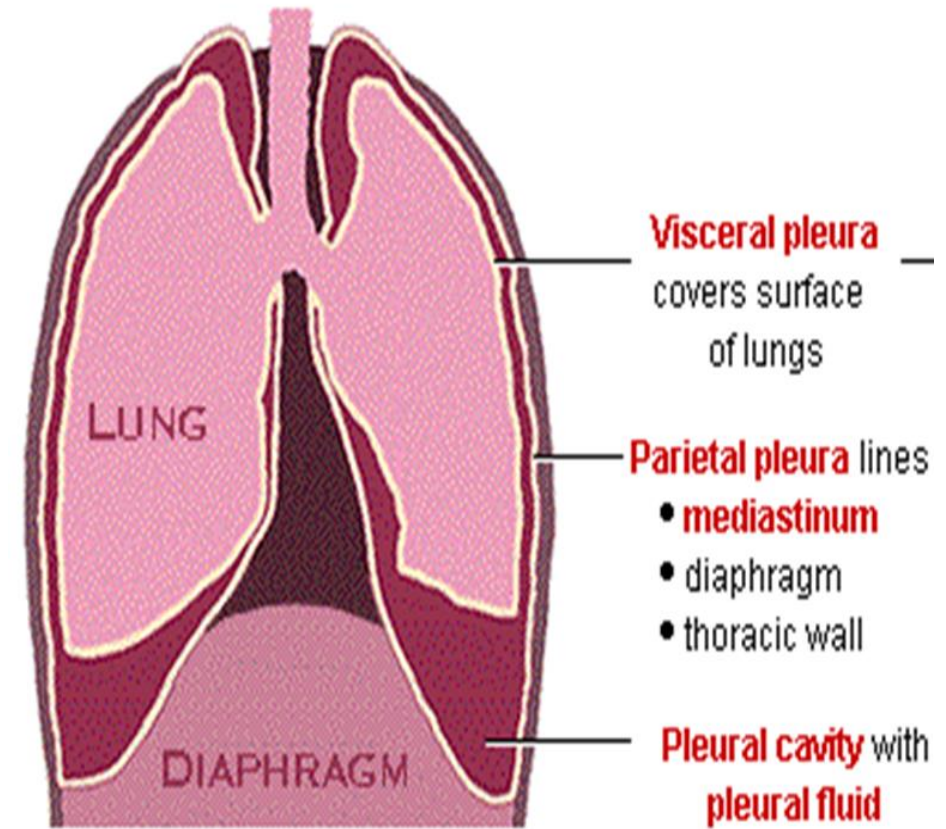
✱ Visceral pleura

✱ Parietal pleura:

✱ Pleural cavity contains pleural fluid (few milliliters)

✱ **Functions of pleural fluid**

- 1) Keeps the two pleural layers together
- 2) Acts as a lubricant and helps in the sliding movements between the two layers



Bronchial tone

1) Nervous control: bronchi & bronchioles innervated by

- ✱ Autonomic nervous system:

- ☛ Parasympathetic (Ach) → M receptors → bronchoconstriction

- ☛ Sympathetic (noradrenaline) → β_2 → bronchodilation

- ✱ Substance P (some nerve ending) → bronchoconstriction

2) Humoral control:

- ✱ Histamine and slow reacting substance of anaphylaxis (from mast cells) → ↑ bronchiolar tone.

- ✱ Leukotrienes → bronchoconstriction (Leukotrienes receptors blocker useful in bronchial asthma)

3) Circadian rhythm:

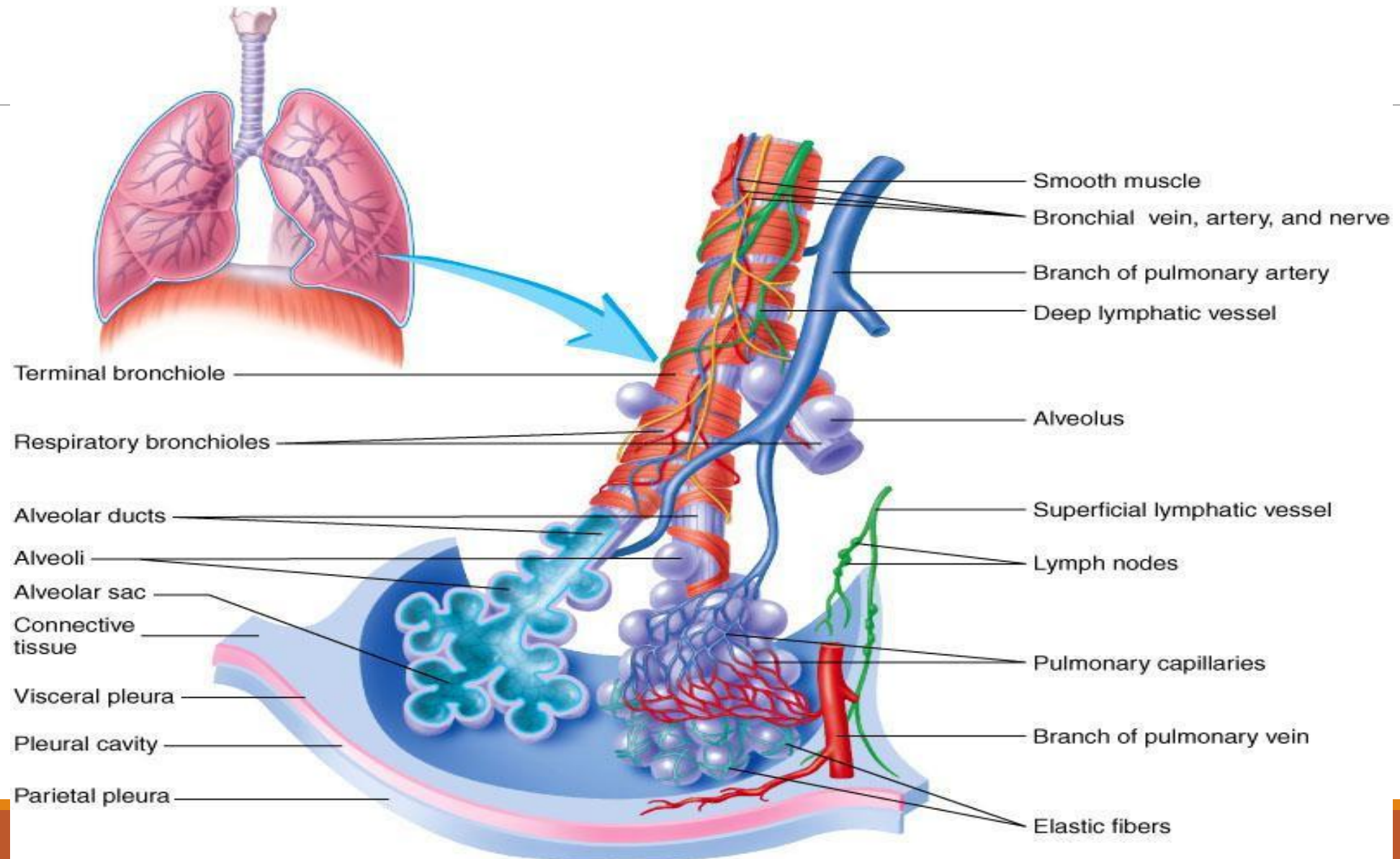
- ✿ Maximum constriction at about 6:00AM and maximum dilation at about 6:00PM.

4) Irritants and chemicals

- ✿ e.g. sulfur dioxide produces reflex bronchoconstriction

5) Cool air

- ✿ Causes bronchoconstriction, exercise also causes bronchoconstriction (increased respiration cools the airways).



Thanks

