

# **RESPIRATORY BLOCK**

**Physiology Team ~ 430**

## **1st Lecture** **Functional of the respiratory system**

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- **Respiration include :-**

- 1- Pulmonary ventilation.
- 2- Transfer of oxygen and CO<sub>2</sub> in the lungs.
- 3- Transport of O<sub>2</sub> from the lungs to the tissues and CO<sub>2</sub> from the tissues to the lungs.
- 4- Regulation of respiration

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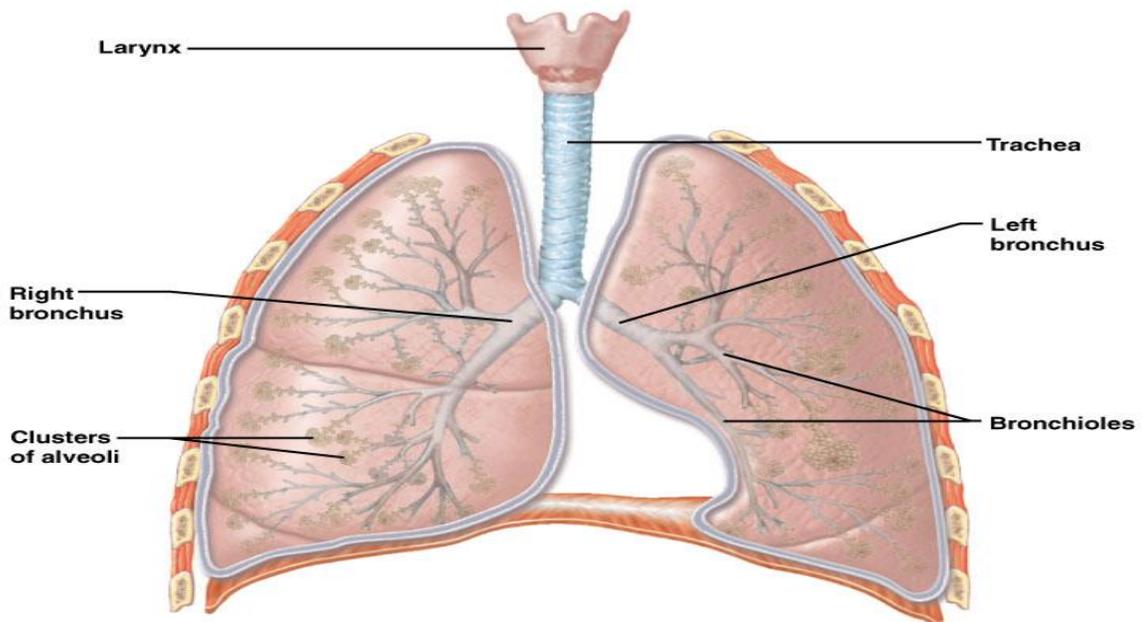
- **Four Respiration Processes :**

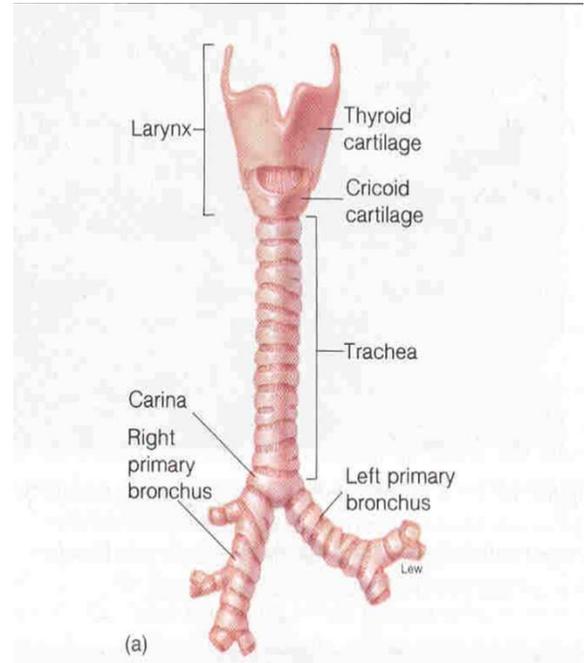
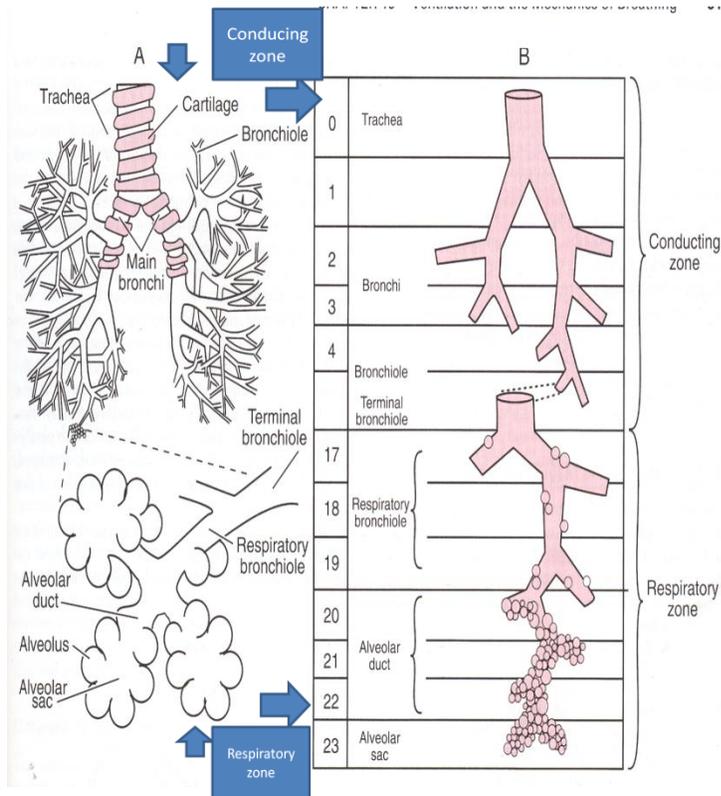
- **Breathing (ventilation):** air in to and out of lungs
- **External respiration:** gas exchange between air and blood (in the lung)
- **Internal respiration:** gas exchange between blood and Tissues (in cellular level)
- **Cellular respiration:** oxygen use to produce ATP, carbon dioxide(CO<sub>2</sub>) as waste

**Cellular level** means internal respiration but never mean cellular respiration

- **Components of the Lower Respiratory Tract:**

- 1- larynx
- 2- trachea
- 3- bronchi
- 4- alveoli
- 5- bronchioles





**Right primary bronchus** more likely to be has a foreign body because it's more straight than the left  
**Conducting zone** just transport the air  
**Respiratory zone** take place in exchange the air

Respiratory passageways have to be patent (open),

• the factor that keeps it open:

**1- The semi-circular cartilage in the trachea and the small bronchi prevent the airways from collapsing.**

دائما مرن ولو فرضنا ان القصبة الهوائية بدونها ممكن اي ضغط خارجي يسبب إقفال القصبة ولكن الله سبحانه وتعالى حماها بالعضروف وحينما يضغط أي مؤثر خارجي على القصبة فسترجع إلى وضعها الطبيعي بسبب وجود هذا العضروف وكما نلاحظ أن هذا العضروف يحيط بالجهة الأمامية من القصبة بشكل شبه دائرة والسبب ان خلفها هو المريء .

**2-Epinephrine and nor-epinephrine + sympathetic stimulation → dilatation of bronchial tree and decrease secretions.**

*(by  $\beta_2$  receptor (useful for asthma) , at the same time  $\beta_1$  active and will cause vasoconstriction )*

**parasympathetic → mild to moderate constriction of the bronchioles and increase secretions.**

*(bad for asthma because we need the bronchioles to be wider)*

• Local Factors:-

1- **Histamine** ( cause bronchoconstriction an increase mucus secretion)

2- **Slow Reacting substance of anaphylaxis.**

**Both** are released by **mast cells** due to allergic reactions → **Allergic asthma.**

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• Functions of the respiratory system :

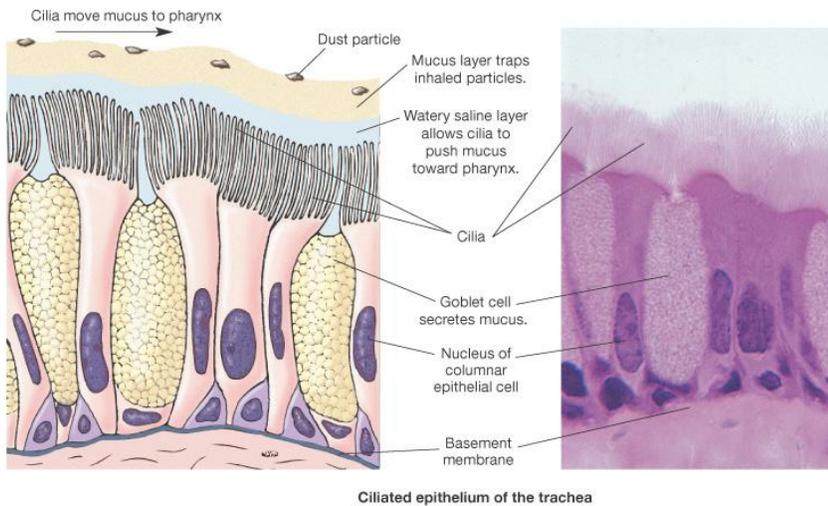
1- **Role in body defense:-**

1- **The nose:-** Presence of hair, Mucus, and cilia,

→ Filter, humidify, and warm the inspired air.

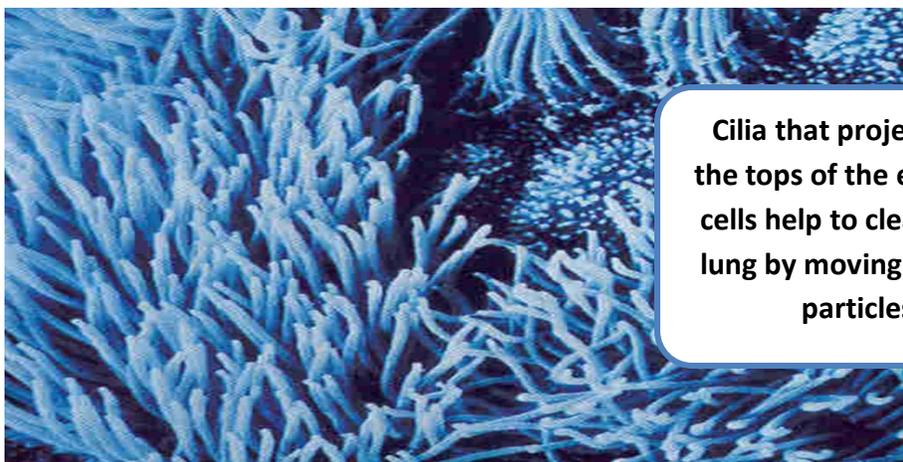
2- **The conductive zone:-** Presence of mucus and cilia → Filter and humidify the inspired air. **Cilia is inhibited by cigarette smoking .(very important )**

3- **The respiratory zone:-** Presence of alveolar macrophages → Destroy bacteria. **Also inhibited by cigarette smoking . (this point very important)**



**Cilia** move the foreign body to pharynx to cough it or to destroyed by stomach enzymes

Cilia التي في الأنف تنزل الأجسام الغريبة تحت للـpharynx أما cilia التي أسفل pharynx تطلعها فوق للـ pharynx وبعدها تطلع مع العطس



Cilia that project from the tops of the epithelial cells help to cleanse the lung by moving trapped particles

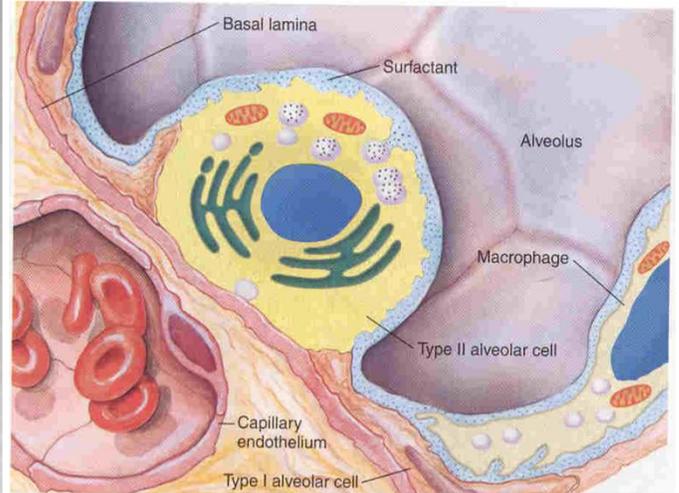
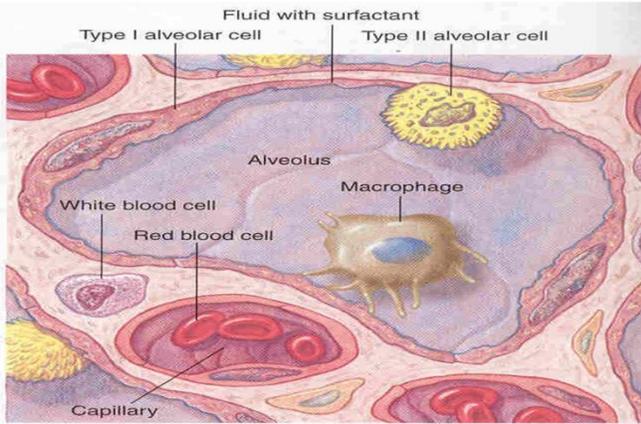


Figure 16.1 The relationship between lung alveoli and pulmonary capillaries. Notice that alveolar walls are quite narrow and lined with type I and type II alveolar cells. Pulmonary macrophages can phagocytose particles that enter the lungs.

Type 1 surround the alveoli  
Type 2 secrete surfactant

The production of pulmonary surfactant, produced by type 2 alveolar cells, surfactant appears to be composed of a derivative of lecithin combined with protein

- **Surfactant is a mixture of phospholipids, proteins and ions.**

It reduces the surface tension (توتر) of the water layer of the alveoli leading to easy expansion of the alveoli

In human, Surfactant appears at about week 34 (a full term pregnancy is 40 weeks).

Deficiency leads to Respiratory Distress Syndrome (RDS)

Type II alveolar cell produce surfactant and its function reduces the surface tension so :  
- The collapse will not occur

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- **Other Functions of the Respiratory System :**

2- Regulation of H<sup>+</sup> ions.

3- produce surfactant.

Deficiency of surfactant → Respiratory Distress Syndrome (RDS).

Rapid shallow breathing → ↓ Spread of surfactant → Atelectasis.

Atelectasis :The collapse of a part of or the whole lung caused by inner factors rather than a pneumothorax

هذا النوع يكون عند البالغين وسببه التنفس السطحي لأجل ذلك يقل توزيع surfactant

Advice patients after major chest or abdominal surgery to take deep breath from time to time to enhance spread of surfactant.

### 3- Produce the converting enzyme :

Angiotensin I → Angiotensin II

When blood volume is low, juxtaglomerular cells in the kidneys secrete renin. Renin stimulates the production of angiotensin I .

angiotensin I → angiotensin II ( by angiotensin-converting enzyme (ACE ) in lung )

. Angiotensin II stimulates the secretion of the hormone aldosterone from the adrenal cortex. Aldosterone causes the tubules of the kidneys to increase the reabsorption of sodium and water into the blood. This increases the volume of fluid in the body, which also increases blood pressure.

خلاصة الكلام :

production of converting enzyme that converts angiotensin I into angiotensin II which helps in regulating blood pressure

### 4- Vocalization (speech) :-

Phonation by the vocal cords.

Articulation by the lips , tongue , and soft palate.

Block of nasal sinuses → Change quality of voice.

5- inactivate bradykinin, serotonin, and prostagladins.

6- Act as blood reservoir → 500ml.(10%) of circulating blood is in pulmonary circulation

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### • Respiratory Distress Syndrome (RDS)

#### • Surfactant

- decreases the surface tension of the alveoli
- needed for alveoli to fill with air and expand (compliance)

- Infant respiratory distress syndrome (hyaline membrane disease)  
(Deficiency of surfactant)

- Adult respiratory distress syndrome (Rapid shallow breathing)

### Law of LaPlace: $P = 2T/r$

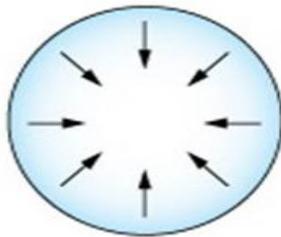
$P$  = pressure

$T$  = surface tension

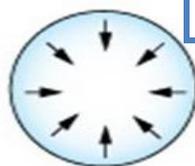
$r$  = radius

According to the law of LaPlace, if two bubbles have the same surface tension, the small bubble will have higher pressure.

(a) Pressure is greater in the smaller bubble.



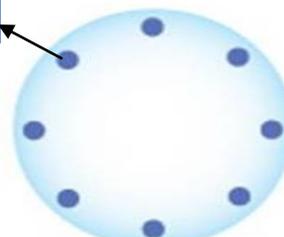
Larger bubble  
 $r = 2$   
 $T = 3$   
 $P = (2 \times 3)/2$   
 $P = 3$



Smaller bubble  
 $r = 1$   
 $T = 3$   
 $P = (2 \times 3)/1$   
 $P = 6$

surfactan

(b) Surfactant reduces surface tension ( $T$ ). Pressure is equalized in the large and small bubbles.



$r = 2$   
 $T = 2$   
 $P = (2 \times 2)/2$   
 $P = 2$

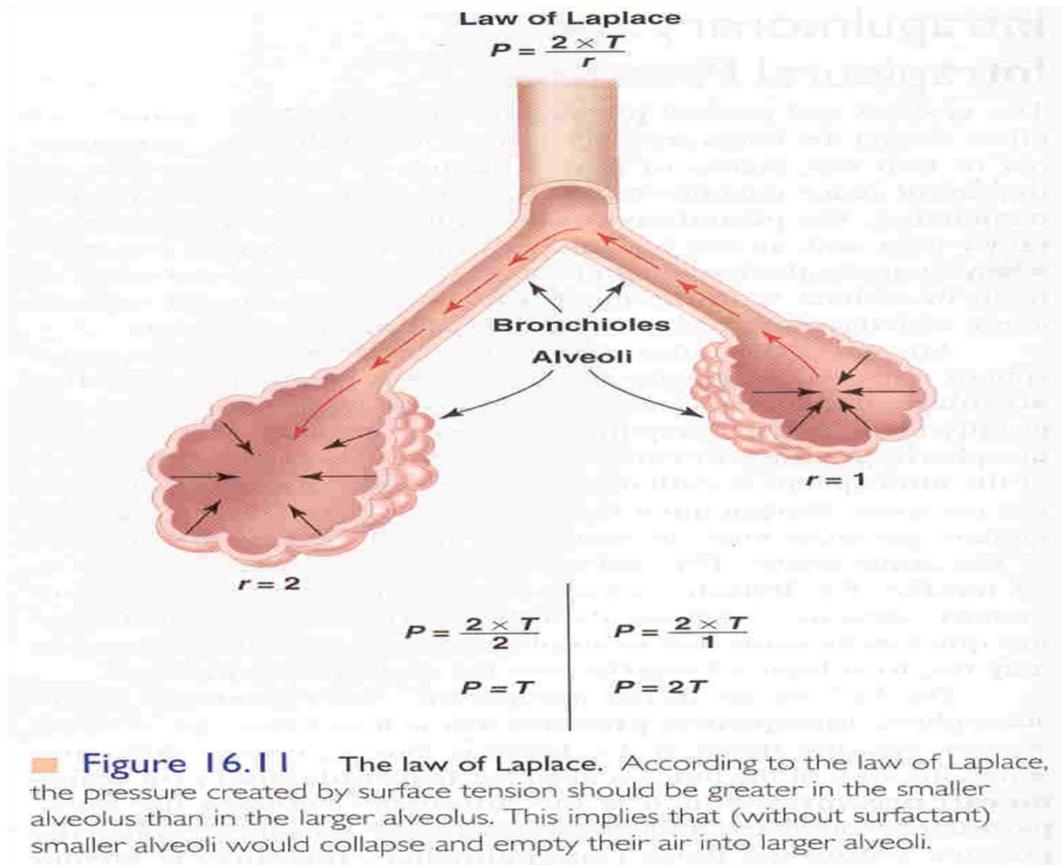


$r = 1$   
 $T = 1$   
 $P = (2 \times 1)/1$   
 $P = 2$

في حالة تساوي ( $T$ ) Surface tension  
في فقاعتين فإنه كلما قل القطر زاد الضغط

Small bubble collapse more than large bubble because it has more pressure

كلما قل surfactant زاد ( $T$ ) Surface tension  
وهنا تساوى الضغط مع أن القطرين مختلفين وذلك بسبب  
التغير في ( $T$ ) Surface tension



**Pressure in the smaller alveoli more than the other**

وكما قلنا يزداد الضغط عندما يقل القطر مع ثبات Surface tension (T)

**Good Luck**