



Al- mustaqbal University College  
Anesthesia Techniques Department  
First stage /medical physics  
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**Lecture 4:**

***Physics of the lung and Breathing***

We breath 6 liters of air per minute (this is also about the Volume of blood the heart pumps each minute). Men breathe 12 times per minute at rest while women and infants breathe 20 times, 60 times per minute respectively.

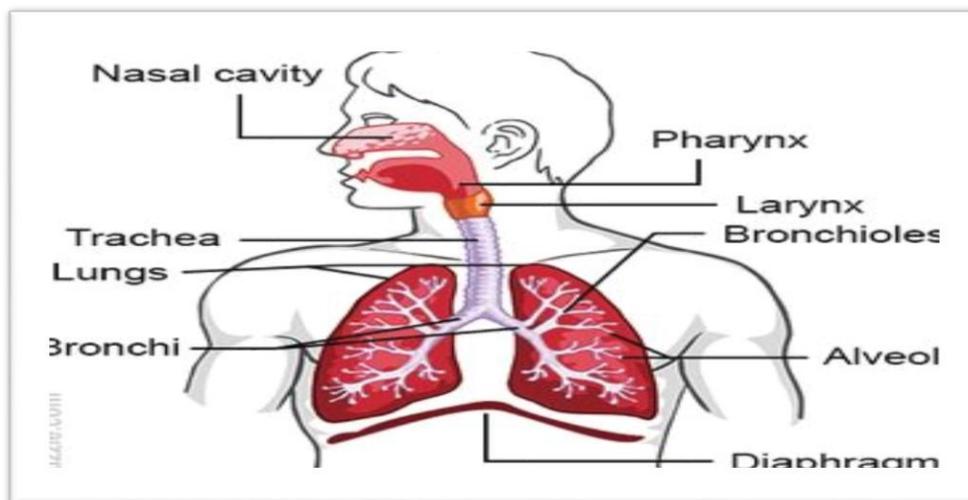
The lungs have large convoluted shape with surface area about  $80\text{m}^2$ .

## ***Function of Lungs & Breathing***

- 1- Exchange of O<sub>2</sub> & Co<sub>2</sub> between the blood and air.
- 2- Keeping PH (acidity) of the blood constant.
- 3- Heat exchange between the body and atmosphere.
- 4- Fluid balance of the body by warming and moistening the air we breath.
- 5- Voice production.
- 6- Removing the dust particles stuck to the moist lining of various air ways.

### ***-The Air Ways***

- 1- The nose: The first way the air passes, it works to purify the air and remove dust from it.
- 2- The trachea: A windpipe that the air passes through goes to a lung.
- 3- The bronchi: Two divisions from the trachea .Each bronchus go to a lung.
- 4- Bronchioles: Each bronchus divides 15 times into smaller branches call bronchioles.
- 5- Alveoli: it's like millions of small interconnected bubbles and it is an important part of the respiratory system, with a spherical shape in which all gas exchange processes take place in the lungs between the outside atmosphere and the blood.



## *Physics of the Alveoli*

There are overall processes involved in your breathing:

Moving air in and out of your lungs (ventilation) oxygen-carbon dioxide exchange (diffusion) pumping blood through your lungs (perfusion).

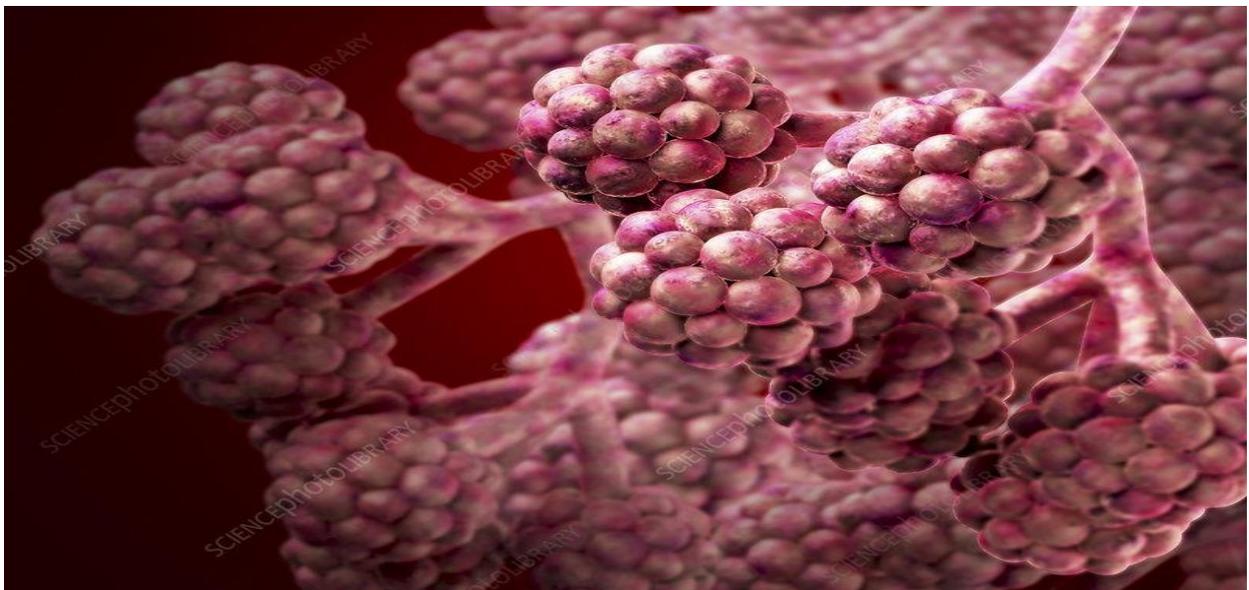
Although tiny, the alveoli are the center of your respiratory system's gas exchange, as showed in figure below.

The alveoli pick up the incoming energy (oxygen) you breathe in and release the outgoing waste product (carbon dioxide) you exhale.

As it moves through blood vessels (capillaries) in the alveoli walls, your blood takes the oxygen from the alveoli and gives off carbon dioxide to the alveoli.

These tiny alveoli structures taken all together form a very large surface area to do the work of your breathing, both when you're at rest and when you are exercising.

To push the air in and out, your diaphragm and other muscles help create pressure inside your chest. When you breathe in, your muscles create a pressure less than the atmospheric pressure that helps suck air in. When you breathe out, the lungs recoil and return to their normal size.



## ***-Physics of Common Lung Diseases***

### ***1- Emphysema***

Emphysema is a lung condition that causes shortness of breath. In people with emphysema, the air sacs in the lungs (alveoli) are damaged. Over time, the inner walls of the air sacs weaken and rupture, creating larger air spaces instead of many small ones. This reduces the surface area of the lungs and, in turn, the amount of oxygen that reaches your bloodstream.

### ***-Emphysema Produces two changes***

- 1- The lungs become flabby and expands
- 2 -The tissues do not pull very hard on the airways permitting the narrowed airways to collapse easily during expiration.

### ***2- asthma***

In Asthma is caused by swelling (inflammation) of the breathing tubes that carry air in and out of the lungs. This makes the tubes highly sensitive. Due to increasing airway resistance.

### ***3-Fibrosis***

Fibrosis of lungs, the membranes between alveoli thicken. This has two effects:

- 1- The compliance of the lungs decreases
- 2- The diffusion of O<sub>2</sub> into capillary decreases