CARD
Center for Asbestos Related Disease
214 East 3rd Street Libby, Montana 59923 (406)293-9274 fax:(406)293-9280

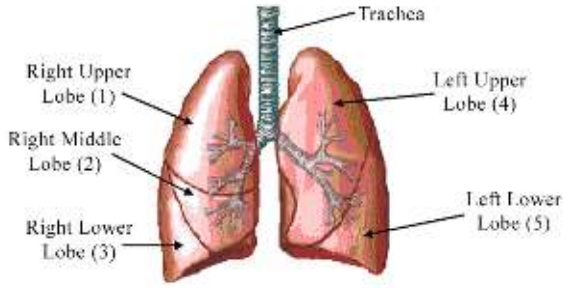
Anatomy and Physiology of the Lungs

The lungs consist of right and left sides.

The right lung has three lobes:
Upper lobe, Middle lobe, Lower lobe

The left lung has two lobes:
Upper lobe, Lower lobe

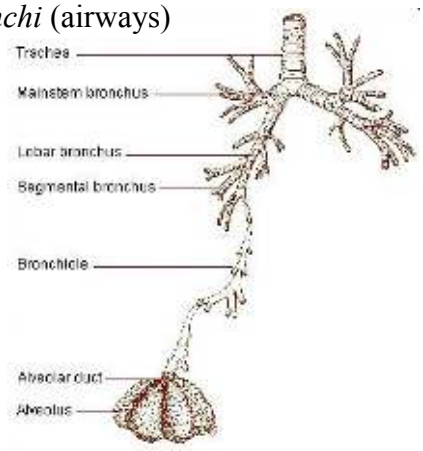
The heart sits in the mid chest extending into the left side



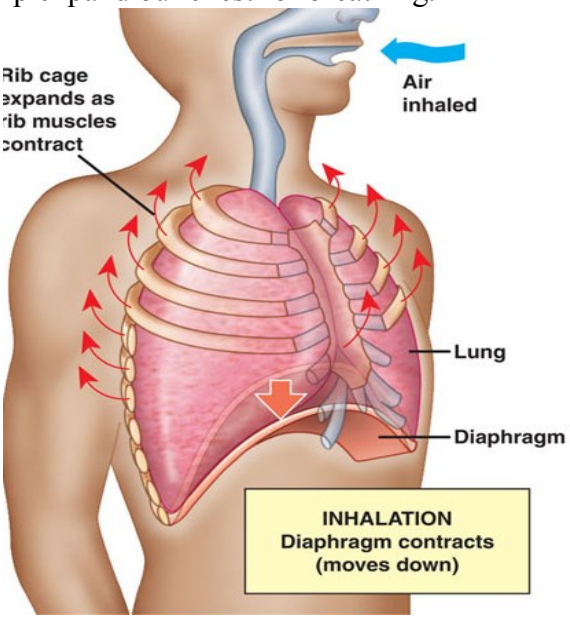
Starting from the *trachea* (windpipe), two large tubes known as *bronchi* (airways) separate and distribute air to the left and right sides of the lungs.

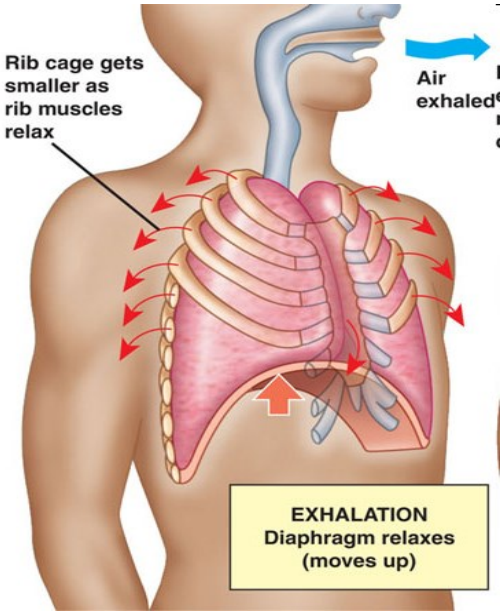
Bronchi gradually form more generations, like a tree branch, and become smaller and smaller.

As they spread to the ends of the lungs they eventually form a grape-like structure known as the alveoli.
(shown to the right).



The diaphragm is the large dome shaped muscle that contracts and relaxes during breathing. It also separates the chest and abdominal cavity. Muscles near our ribs also help expand our chest for breathing.





Oxygen is inhaled and released from the lungs to the blood.

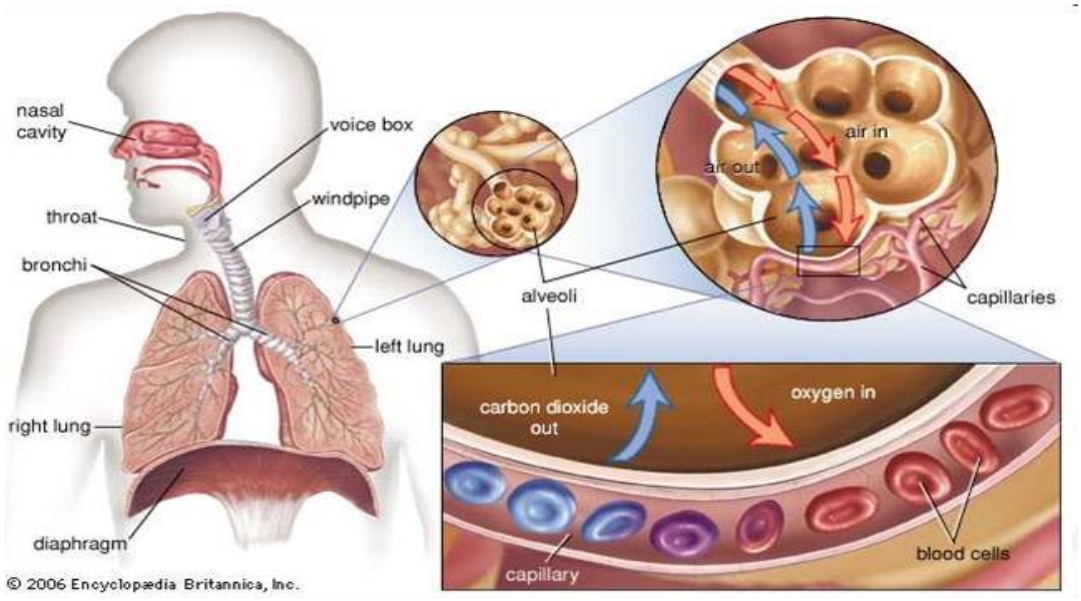
- Air reaches the alveoli (air sacs) where oxygen then moves from the air sacs into the capillaries through their thin walls.
- Capillaries are tiny blood vessels that carry oxygenated blood to the blood stream that supplies our body.

Carbon dioxide is released from the blood to the lungs and exhaled.

Carbon Dioxide moves FROM capillaries (tiny blood vessels) into the alveoli.

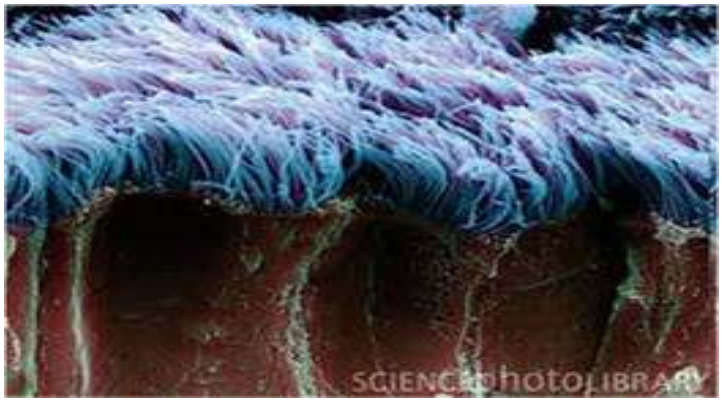
Too much carbon dioxide in the blood results from hypoventilation (too little breathing).

Too little carbon dioxide in the blood results from hyperventilation (too much/ or rapid breathing).



DLCO is your "Diffusion Rate" and is measured during pulmonary function testing. It measures how much oxygen is diffusing (moving) from your lungs into your blood. Normal diffusion rates are 80-120%.

Your DLCO _____



Tiny hairs, called cilia, line the bronchi. Cilia move back and forth in an ongoing motion– like a wave.

Mucus is carried on top of cilia.

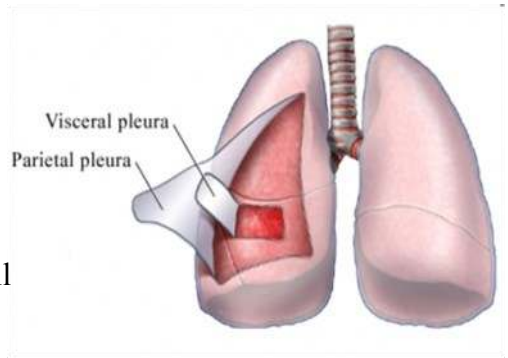
This is the first line of defense for infection by moving foreign objects, like bacteria or viruses, out of the lungs.

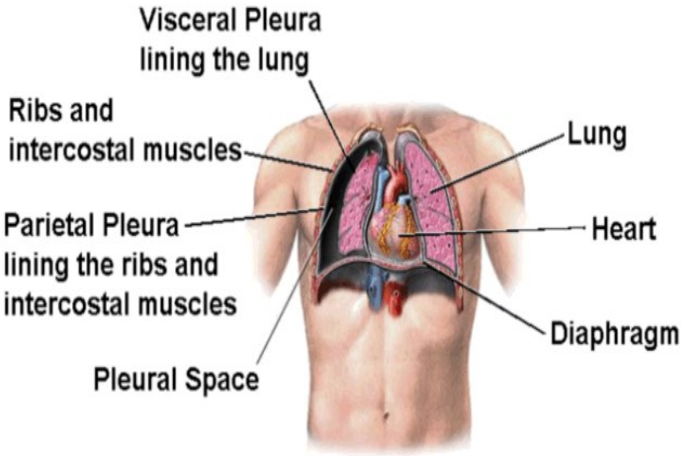
The *pleura* is a thin balloon like structure, like saran wrap, that surrounds the lungs and allows them to move smoothly as we breath in and out.

There are two types of pleura in our chest:

Visceral pleura– covers the lung

Parietal pleura– covers the chest wall





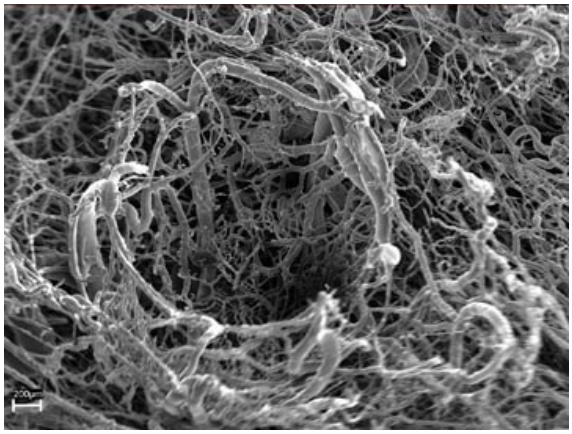
Between the visceral and parietal pleura exists the *pleural space* which contains a small amount of fluid.

This fluid is moved in and out of the lungs through the *lymphatic system* that exists between the lungs and the rest of the body.

The lymphatic system is a series of vessels, much like blood vessels, that move fluids through our bodies to help get rid of foreign objects, like bacteria, viruses or asbestos fibers.

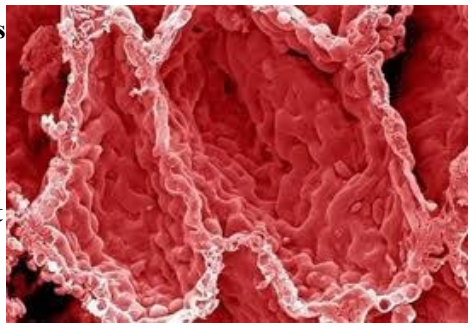
The *interstitium* refers to the tissue network that surrounds and supports the air sacs (alveoli).

It includes a web-like network of strong structural fibers that prevent the alveoli from being over stretched.



Collagen fibers
On left

Alveoli
On right



Parenchyma is the main part of an organ that contains the functioning cells. The word parenchyma can be used in reference to any organ.

The lung parenchyma is used to describe the respiratory bronchioles (smallest bronchi) and alveoli, where carbon dioxide and oxygen are exchanged.

Asbestos Related Pleural Disease

Asbestos fibers are so small that when inhaled they can reach the very ends of the lungs.

Because Libby amphibole asbestos is a long needlelike fiber, it becomes embedded in the lung tissue. Over time, some fibers move to the pleura, the thin lining around the lung.

The fluid in the pleural space may try to move the fiber out of the lung, which can then deposit the fiber throughout the body.

White blood cells (***macrophages***) recognize asbestos fibers as foreign objects and attempt to remove the fiber from our bodies.

However, amphibole asbestos fibers are so long that macrophages are killed by interaction with the fibers, and are unable to remove them.

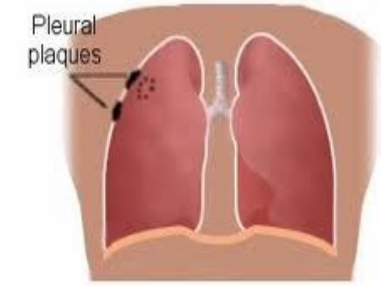
Left: Electron photo of macrophage unable to engulf fiber.

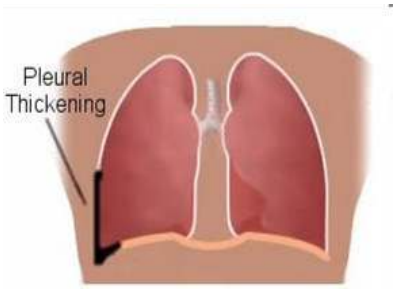
When macrophages die, harmful substances inside of them leak out and cause scarring. During this process the pleura becomes inflamed and creates ***fibrosis*** (scarring) which **hardens and thickens** the once saran wrap thin, stretchy pleura.

Pleural fibrosis (thickening/scarring)

The pleural lining can react in several ways to scarring from the asbestos fibers, the most common way is by developing pleural plaques.

Pleural plaques are elevated spots of scar tissue on the pleural lining, they can be non-calcified or calcified (with calcium in them).





Pleural thickening is when extended segments of the lining around the lung becomes thicker and less stretchy due to the formation of scar tissue. This can make it difficult for the lungs to expand during breathing and may cause the lungs to contract in size.

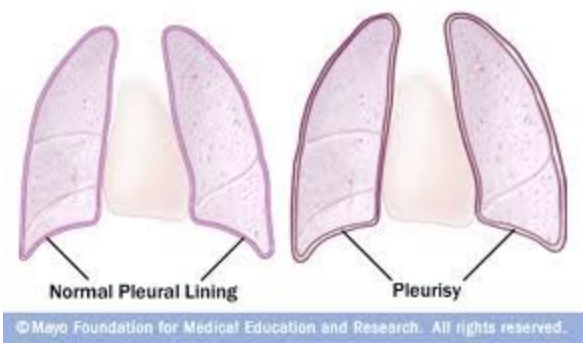
Pleuritis

Inflamed pleural layers ***(pleuritis)*** can rub against each-other when the lungs expand to breath air in.

This can cause severe sharp pain ***(pleurisy)*** with inhalation or certain body movements or positions.

Most pain sensors and nerve fibers are in the pleura (lining), not in the paryncheme (tissue).

Pain is caused by the inflammation that occurs in the pleural lining.



Scarring can extend from the pleura to the chest wall, sticking the two together.

In some cases of pleurisy, excess fluid builds up in the pleural space. This is called a ***pleural effusion***.

A large amount of extra fluid can push the pleura against your lung until the lung, or part of it, collapses.

You can develop a pleural effusion even if you don't have pleurisy.

Pleural Effusions require immediate medical attention!

Symptoms of Pleural Effusion

- Chest pain, usually a sharp pain that is worse with cough or deep breaths
- Cough
- Fever
- Hiccups
- Rapid Breathing
- Sudden onset of shortness of breath

Sometimes there are no symptoms.

Complications

- A lung that is surrounded by excess fluid for a long time may be damaged.
- Pleural fluid that becomes infected may need to be drained with a chest tube.

Treatment

Thoracentesis may be done if the fluid collection is large and causing symptoms.

Removing the fluid allows the lung to expand, making breathing easier.

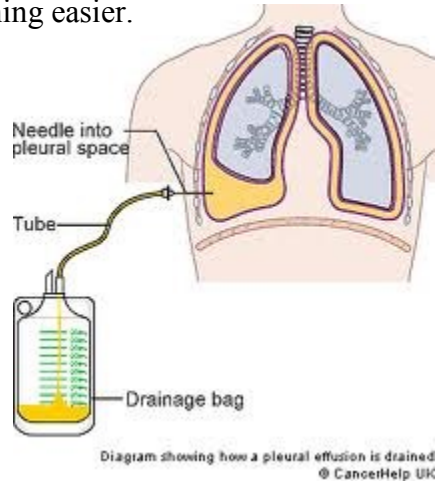
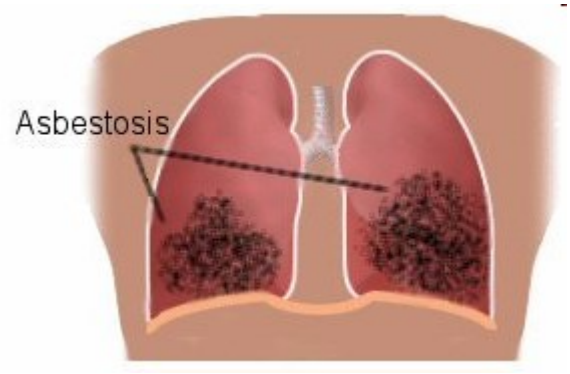


Diagram showing how a pleural effusion is drained
© CancerHelp UK

Interstitial Asbestos Related Disease (Asbestosis)

The term "***asbestosis***" has historically only been used in reference to scarring of the lung tissue, not the pleura (lining).

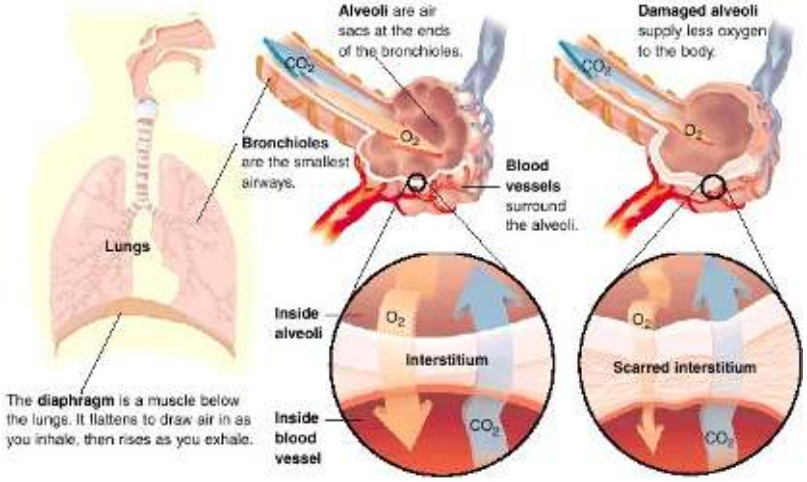
This is why people with pleural asbestos related disease (ARD) are not described as having "asbestosis".

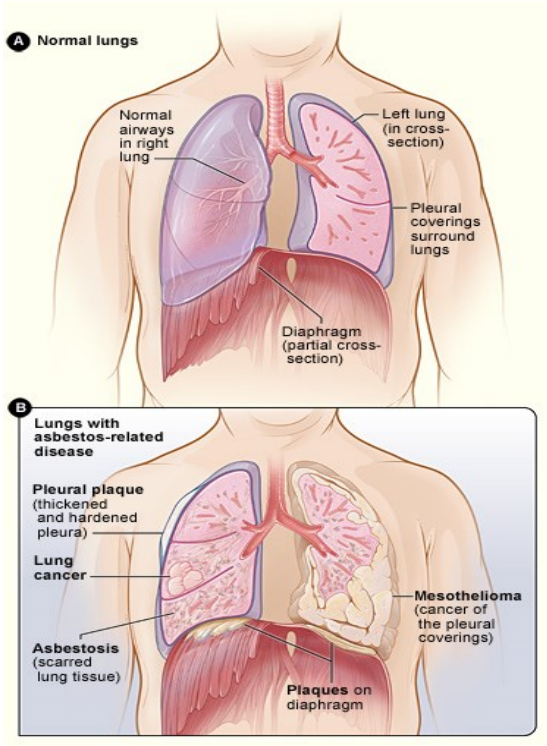


Asbestosis is caused when asbestos fibers cause inflammation in the lung tissue (*interstitum*).

This inflammation can lead to scarring in the intersitium, eventually making it difficult for the alveoli (air sacs) to supply oxygen to the body.

This scarring destroys the tiny blood vessels (capillaries) that exchange oxygen and carbon dioxide, decreasing the amount of oxygen that is able to diffuse (move) into our blood.





Mesothelioma is a cancer of the pleural lining of the chest or abdomen. *Most people with asbestos related diseases (ARD)* ***DO NOT*** *develop mesotehlioma.*

Lung Cancer occurs in the interstitum (lung tissue). Exposure to asbestos may increase your risk of lung cancers. Cigarette smoking greatly increases the likelihood of a person developing lung cancer as the result of asbestos exposure.