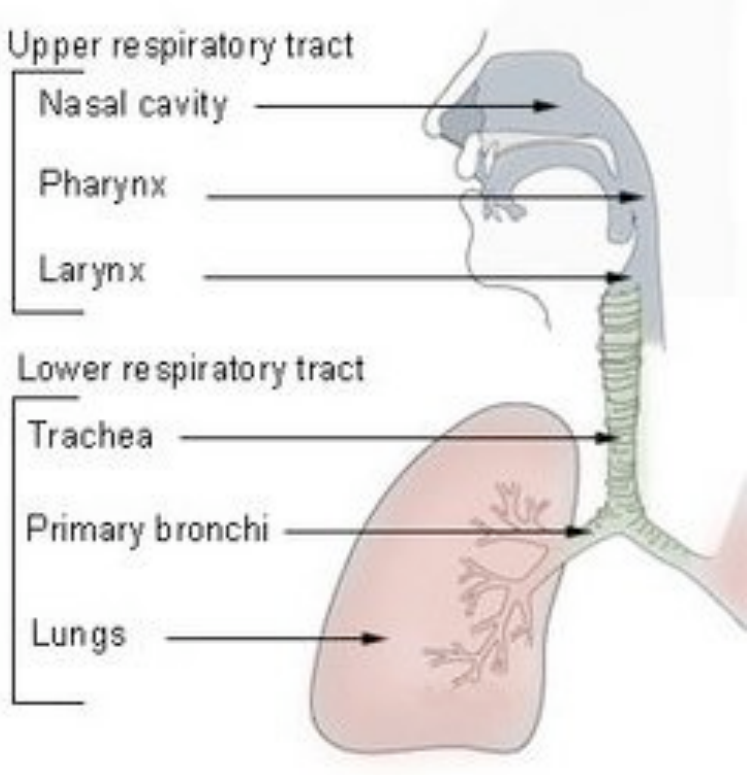
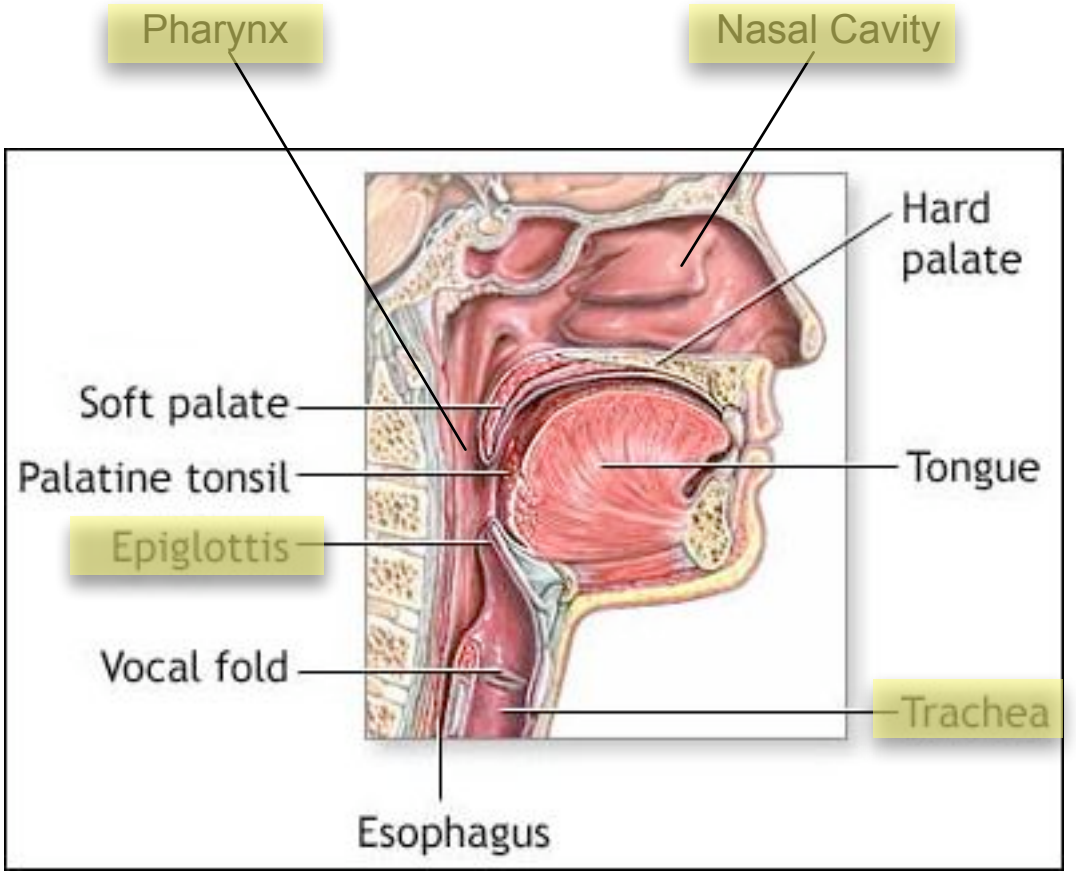
The Respiratory System



Virtually all life forms need to exchange gases with their environment. The use of food as a source of energy (cellular respiration) results in the waste product CO_2. Although not all organisms need oxygen to use food for energy, certainly, all multicellular complex organisms do.Therefore each species must have a respiratory surface where gases can be exchanged with their surroundings. In humans this respiratory surface can be found in the lungs.
Simple organisms like the protozoans (ameba, paramecium) have cell membranes that are in direct contact with the environment so gas exchange occurs across the cell membrane.

There are a variety of structures needed to perform gas exchange in humans - let's take a look where this process begins on the next page

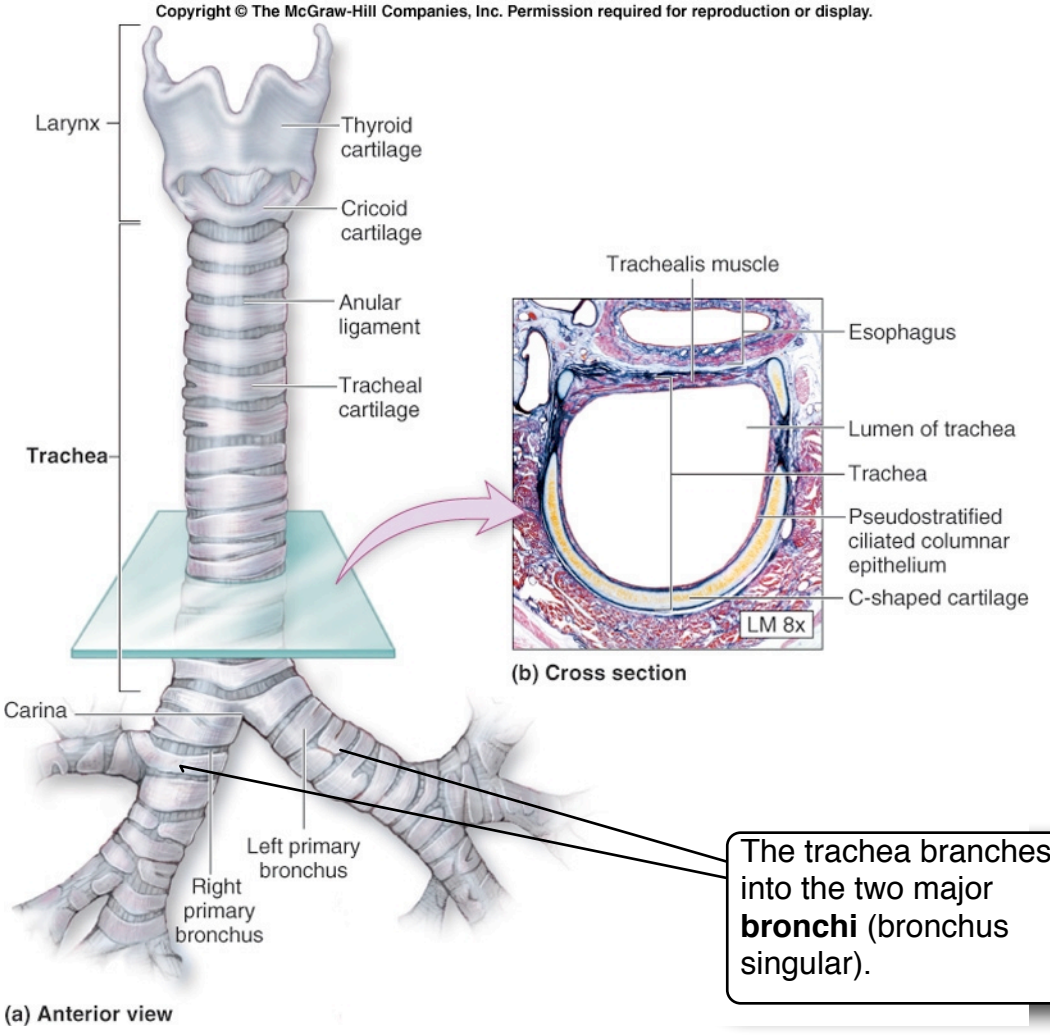


The **Nasal Cavity** is where air typicaly enters the body.
The air is *moistened*, *warmed*, and *filtered* by little hairs on the lining of the cavity.

Just below this is the **Pharynx** (the space behind the tongue).

The **Epiglottis** is a flap that covers the trachea when swallowing. If food clogs the opening to the trachea a person will choke and die if the obstruction is not removed. Be careful while eating with your mouth open breathing in through the mouth increases your risk of choking.

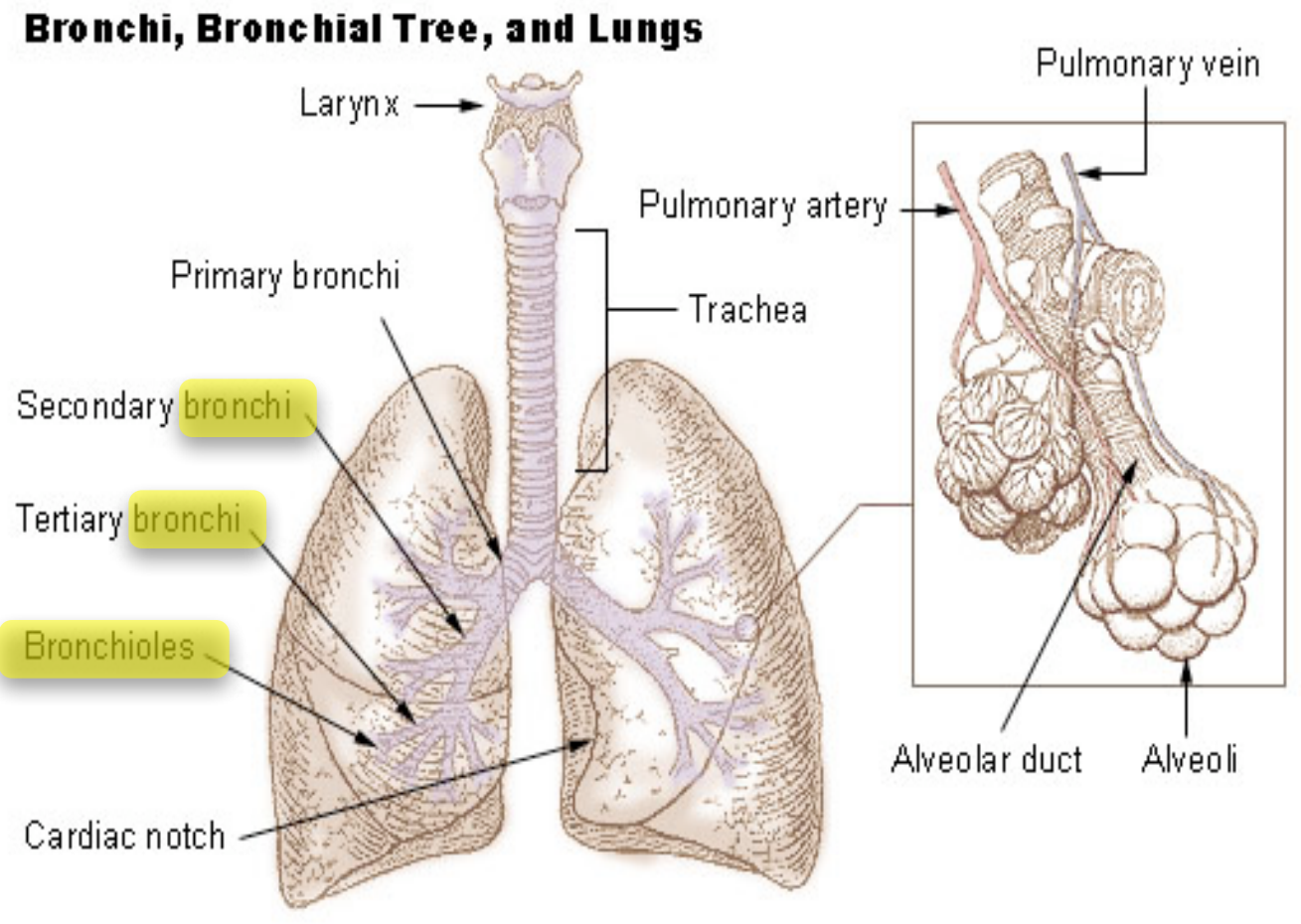
The Trachea



Wow! This looks complicated. But actually it's a fancy straw that brings air from the *pharynx* to towards the lungs. Notice the rings of cartilage around the **trachea** - this helps prevent the **trachea** from collapsing.

The trachea branches into the two major **bronchi** (bronchus singular).

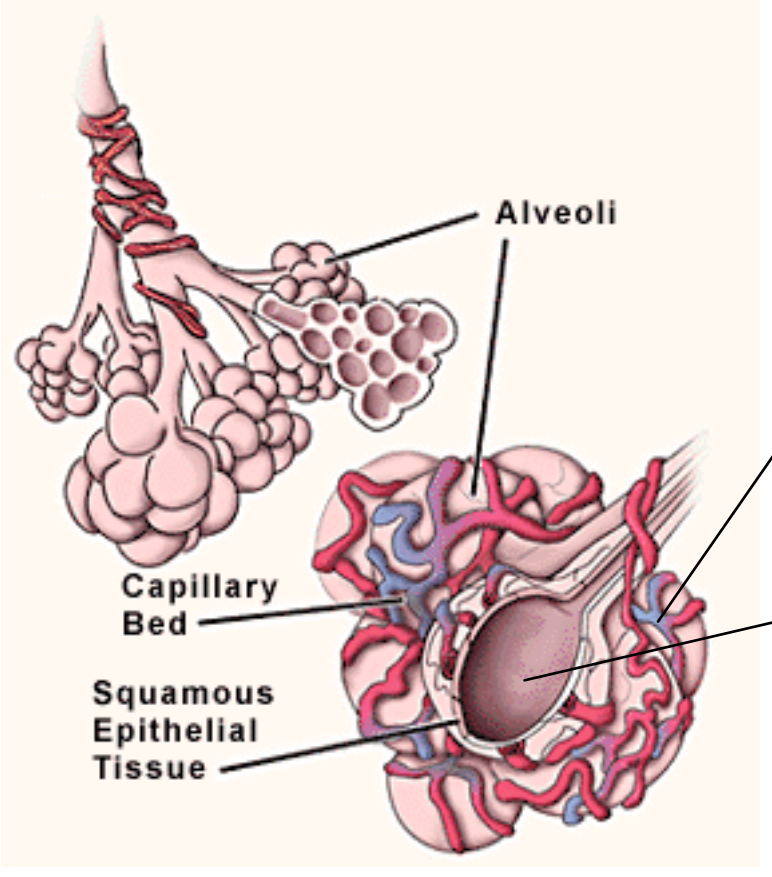
Bronchi & Bronchioles



Bronchi divide and become smaller until eventually we call them **bronchioles** (little Bronchi). The last tube before the **Alveoli** are called Alveolar ducts or terminal bronchioles, but we do not need to know these terms.

Alveoli

The **Alveoli** are the actual place where **gases** are **exchanged** between the **body** and **environment**. **Capillaries** surround the alveoli and bring blood high in CO_2 and low in O_2. These **gases diffuse** *across* the *membranes* allowing the CO_2 to leave the body and the new oxygen to be gathered by the passing **red blood cells**.



Capillaries

Inside the alveolus

What are the requirements of a respiratory surface?

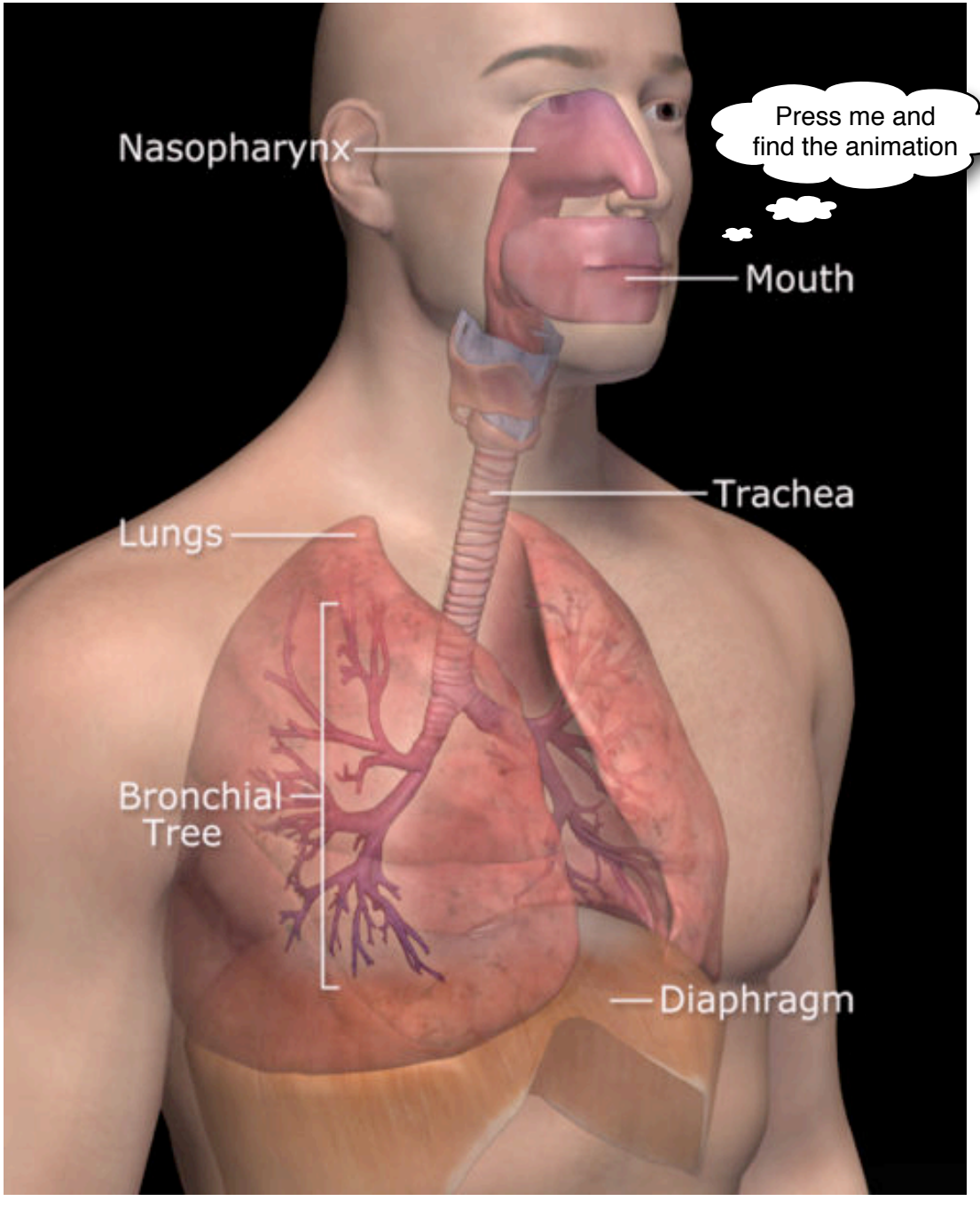
Qualities of a Respiratory Surface

1. Must be **thin** so that gases can *diffuse* across the membrane.

2. It must be in **contact** with the **environment**.

3. It must be in **contact** with the **circulatory system** in complex organisms.

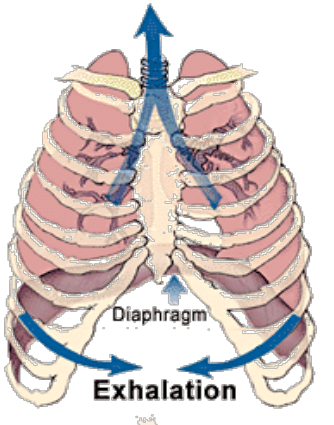
4. It must be **moist -** gases will not attach to the membranes if the membranes are not moist.

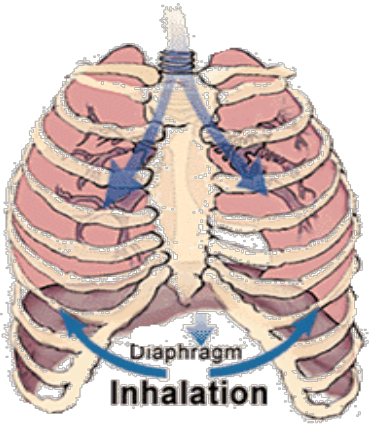


Breathing results from changes in the size of the chest cavity which causes pressures changes in the lungs. Of course lungs are not active - they are like balloons. Balloons do not inflate themselves.

During **inhalation**, the muscles between the ribs cause the **rib cage** to **expand**, and the **diaphragm muscle <u>lowers</u>** causing pressure changes that allow air to enter.

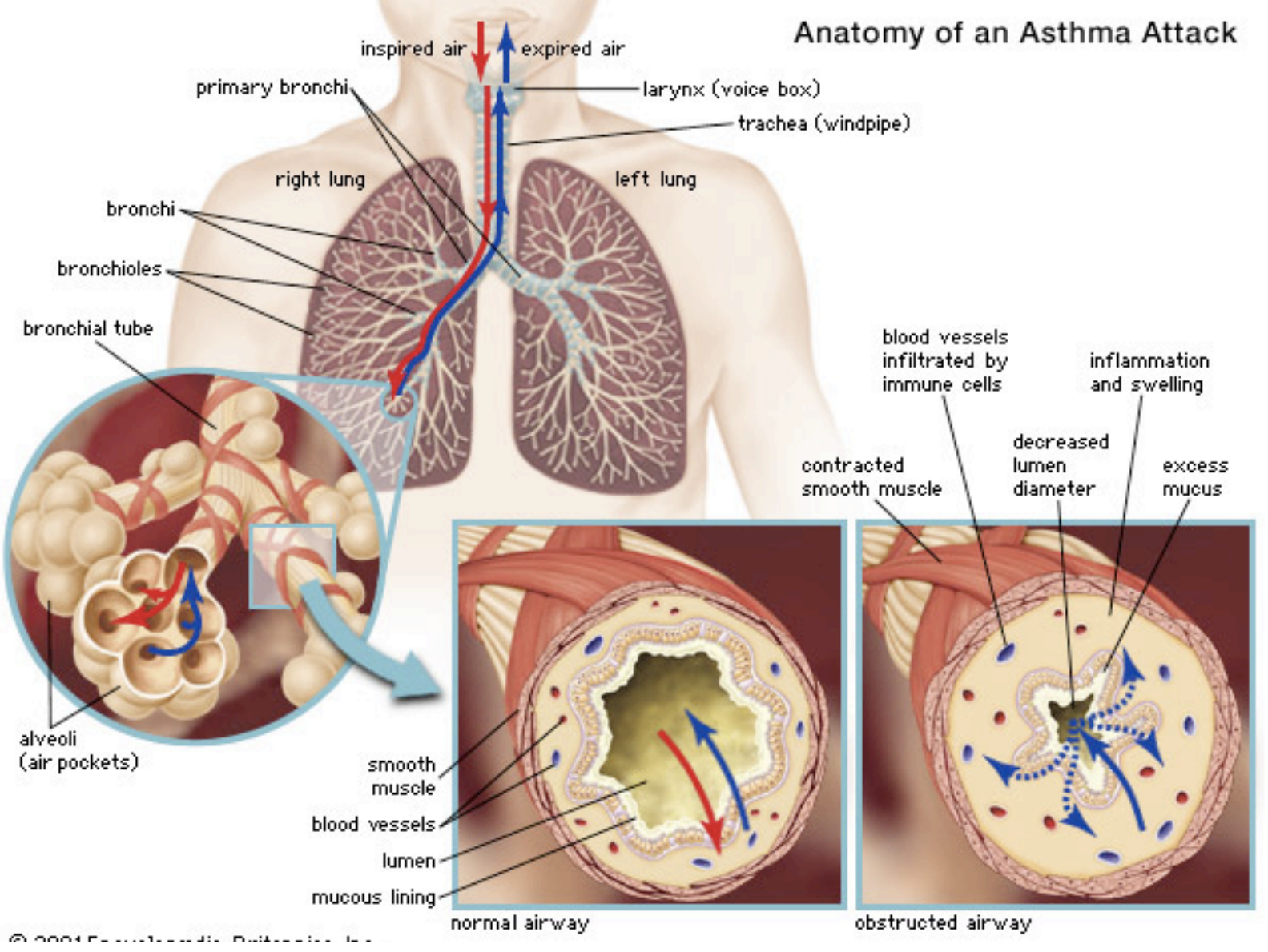
The opposite is true during exhalation.





Diseases of the Respiratory System

1. Asthma - an inflammation and swelling of the bronchioles. This makes it difficult to breath. It can be fatal if the person is not treated.



2. **Emphysema** is a chronic (long-term) lung disease that can get worse over time. It's usually caused by smoking. Having emphysema means some of the air sacs in your lungs are damaged, making it hard to breathe.

3. **Tuberculosis** (TB) is a bacterial infectious disease that can affect your lungs and other parts of your body. With proper treatment, people with TB can be cured of the infection.

4. Lung cancer is cancer that starts in the lungs. Cancer is a disease where cancerous cells grow out of control, taking over normal cells and organs in the body.

Figure 3: Female mortality from lung cancer by age and year of death, England & Wales 1921-90