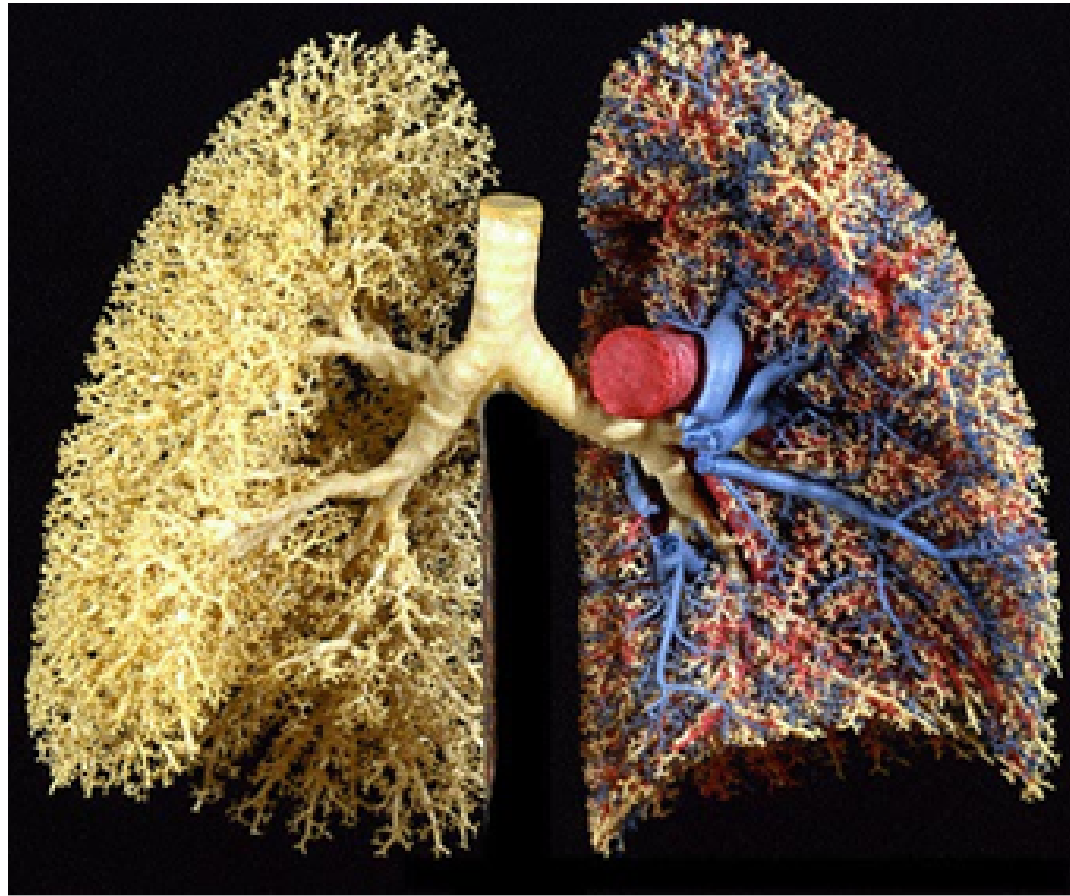


The Respiratory System

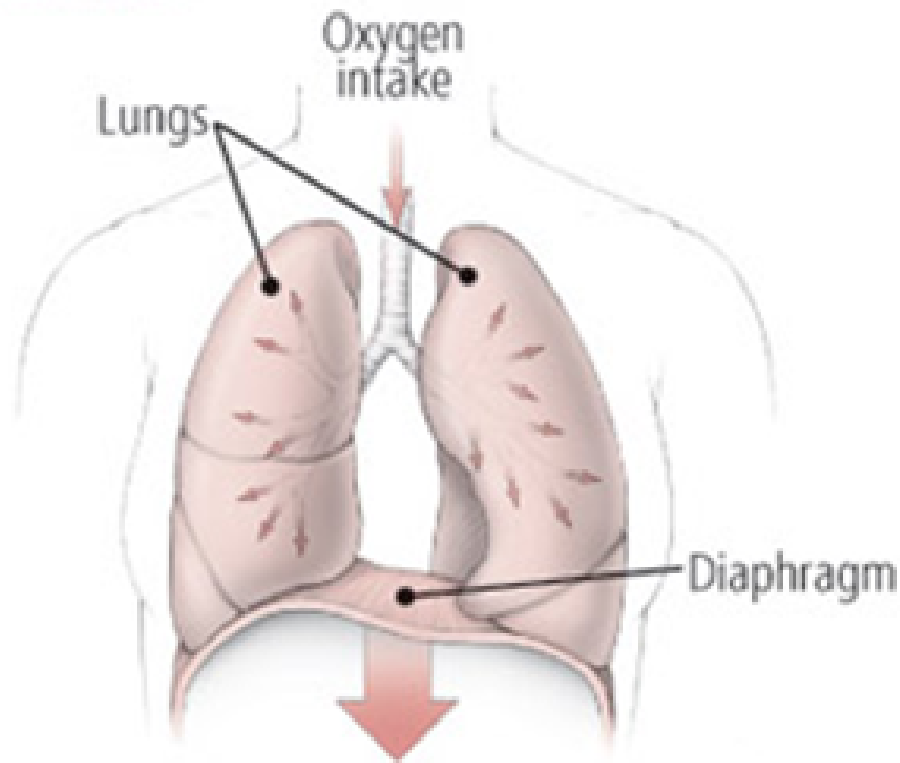


The primary function of the respiratory system is gas exchange.

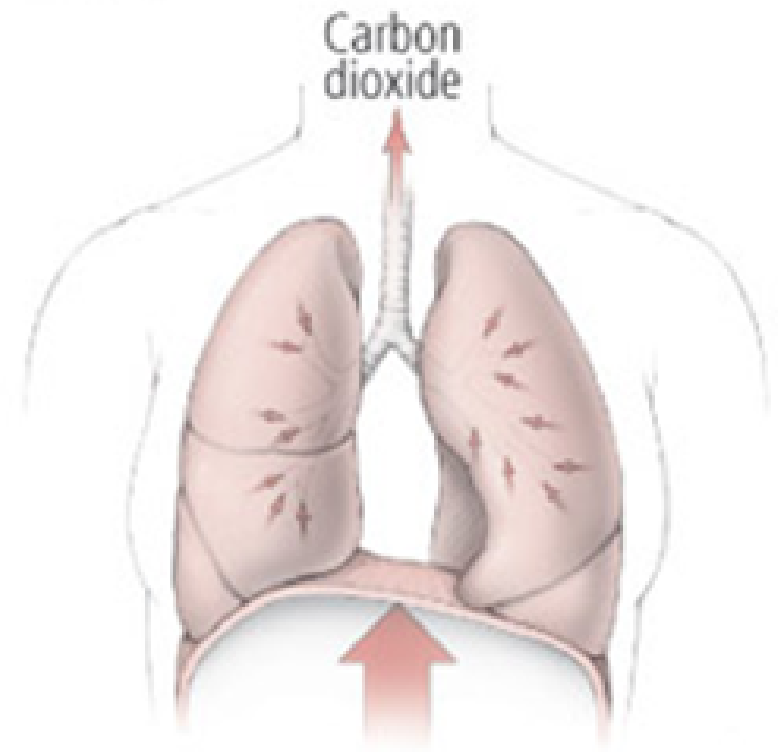
Oxygen from the air enters the blood and carbon dioxide from the blood exit into the air.

Inspiration = Inhaling

Inhalation



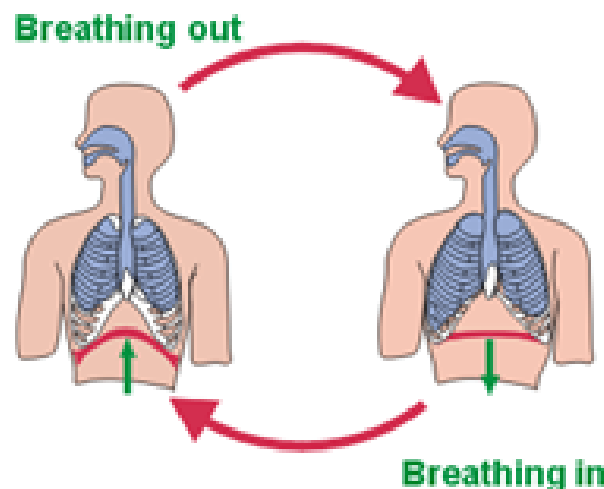
Exhalation



Expiration = Exhalation

The respiratory system works with the cardiovascular system to accomplish:

1. Pulmonary Ventilation (breathing); the entrance and exit of air into and out of the lungs



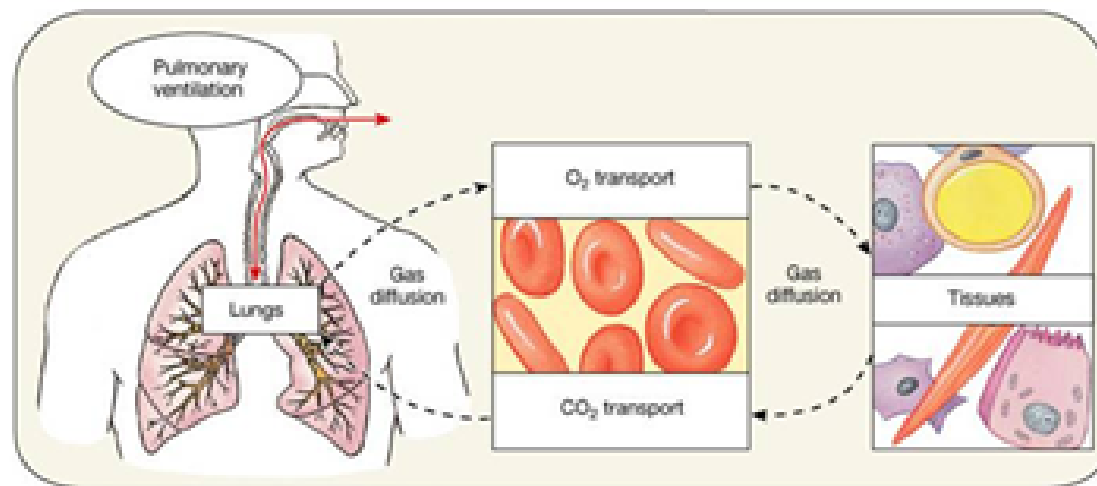
The respiratory system works with the cardiovascular system to accomplish:

2. External Respiration: The exchange of gases



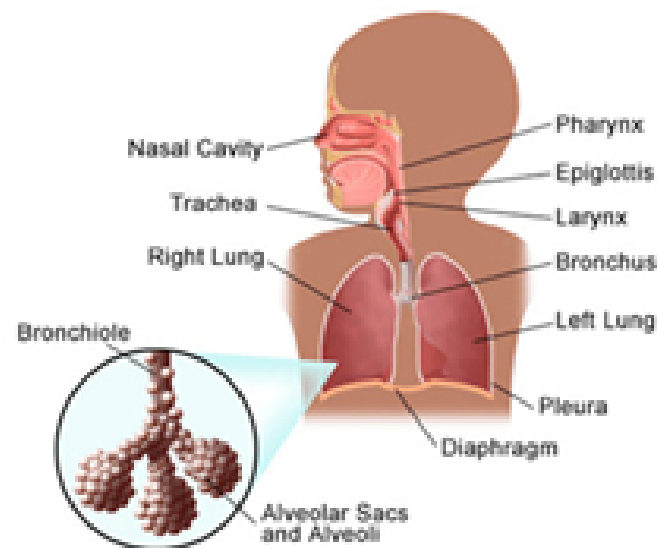
The respiratory system works with the cardiovascular system to accomplish:

3. Internal Respiration: The exchange of gases between blood and tissue

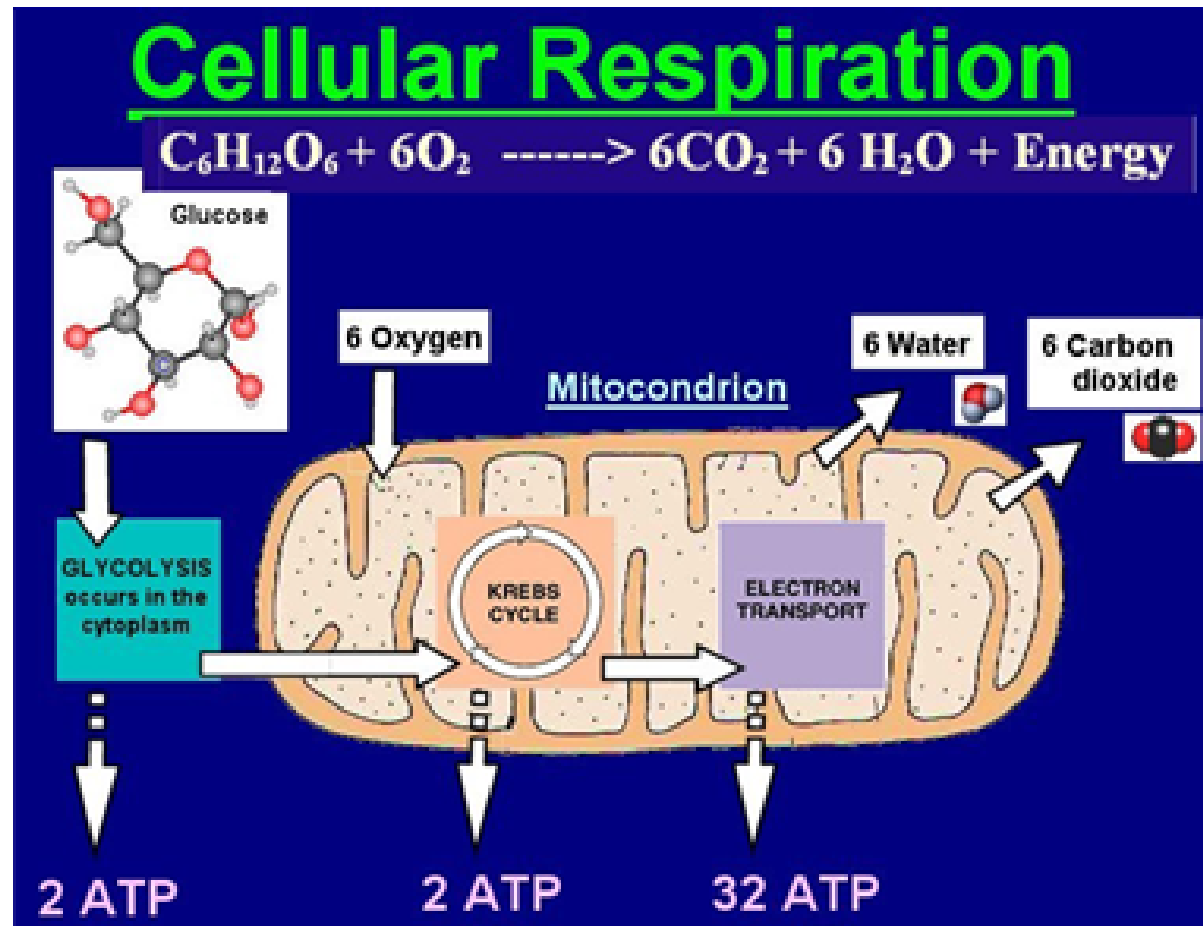


The respiratory system works with the cardiovascular system to accomplish:

4. Transport of gases to and from the lungs and tissues.

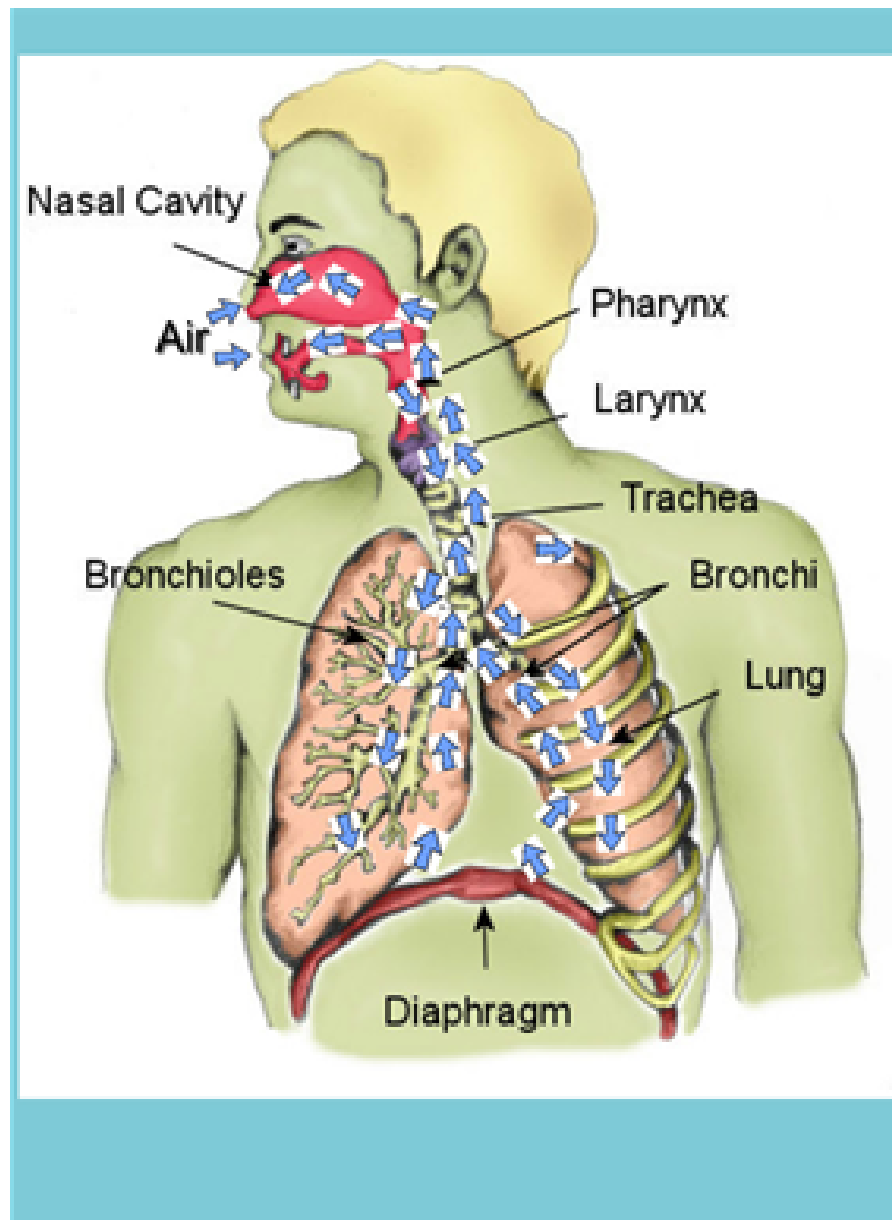


Cellular respiration (creation of ATP) uses the oxygen and produces carbon dioxide as a byproduct. The cells need a continuous supply of ATP (hence also need a continuous supply of oxygen).





The respiratory tract extends from the nasal cavities to the lungs.



As air moves along the airways it is:



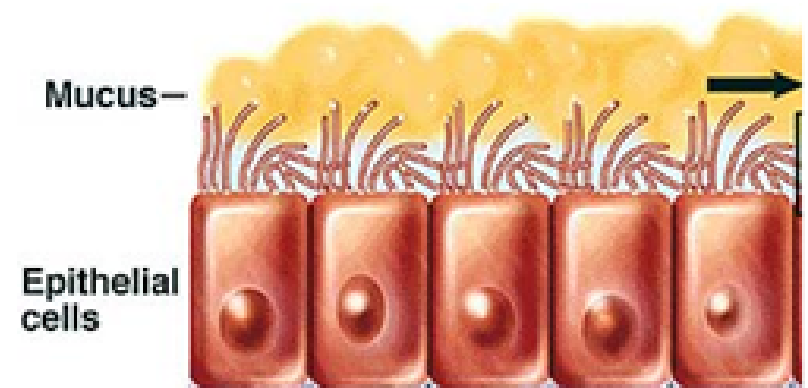
1. Cleansed

- coarse hairs just inside the nostrils and catch dust, dirt, pollen, fungal spores etc.

- cilia inside the nasal cavity beat backwards sweeping the mucous sheet into the throat where it can be swallowed and killed by stomach acid

- lysozyme in the mucus help kill bacteria

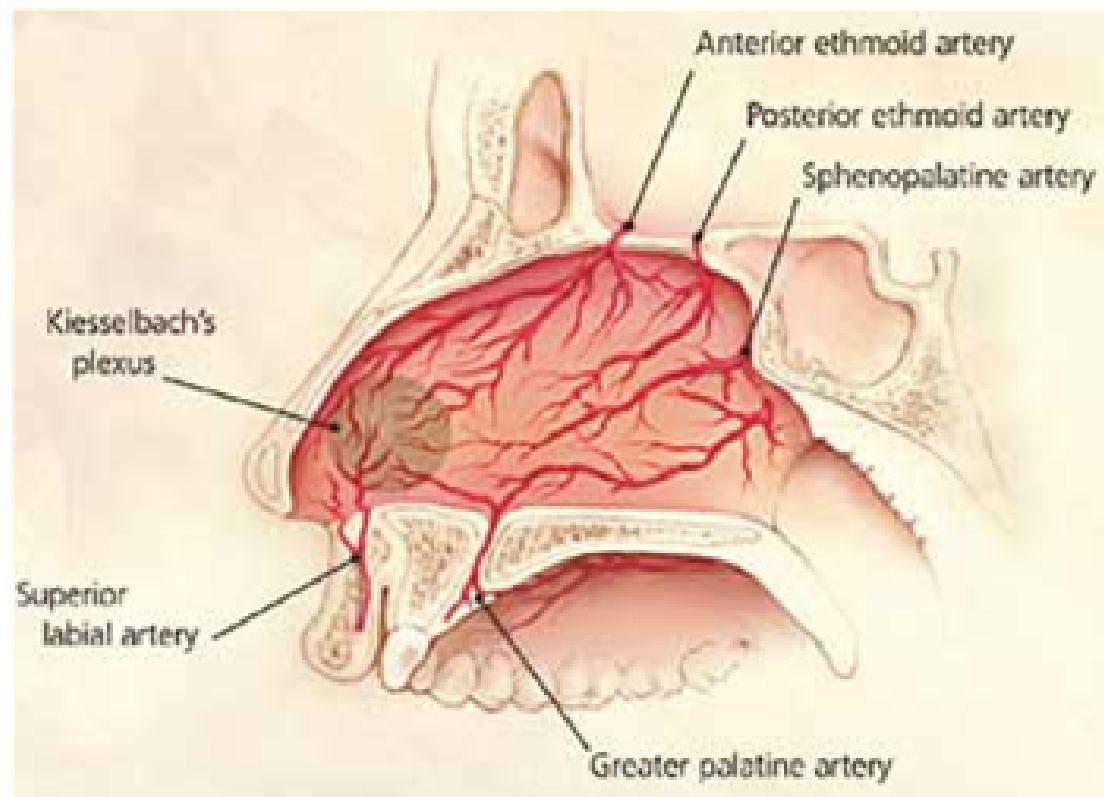
- cilia in the trachea beat upward, carrying mucus, dust and other trapped contaminants into the pharynx (this is called the mucociliary escalator)



As air moves along the airways it is:

2. Warmed

-by heat given off by blood vessels lying close to the surface of the lining of the airways.

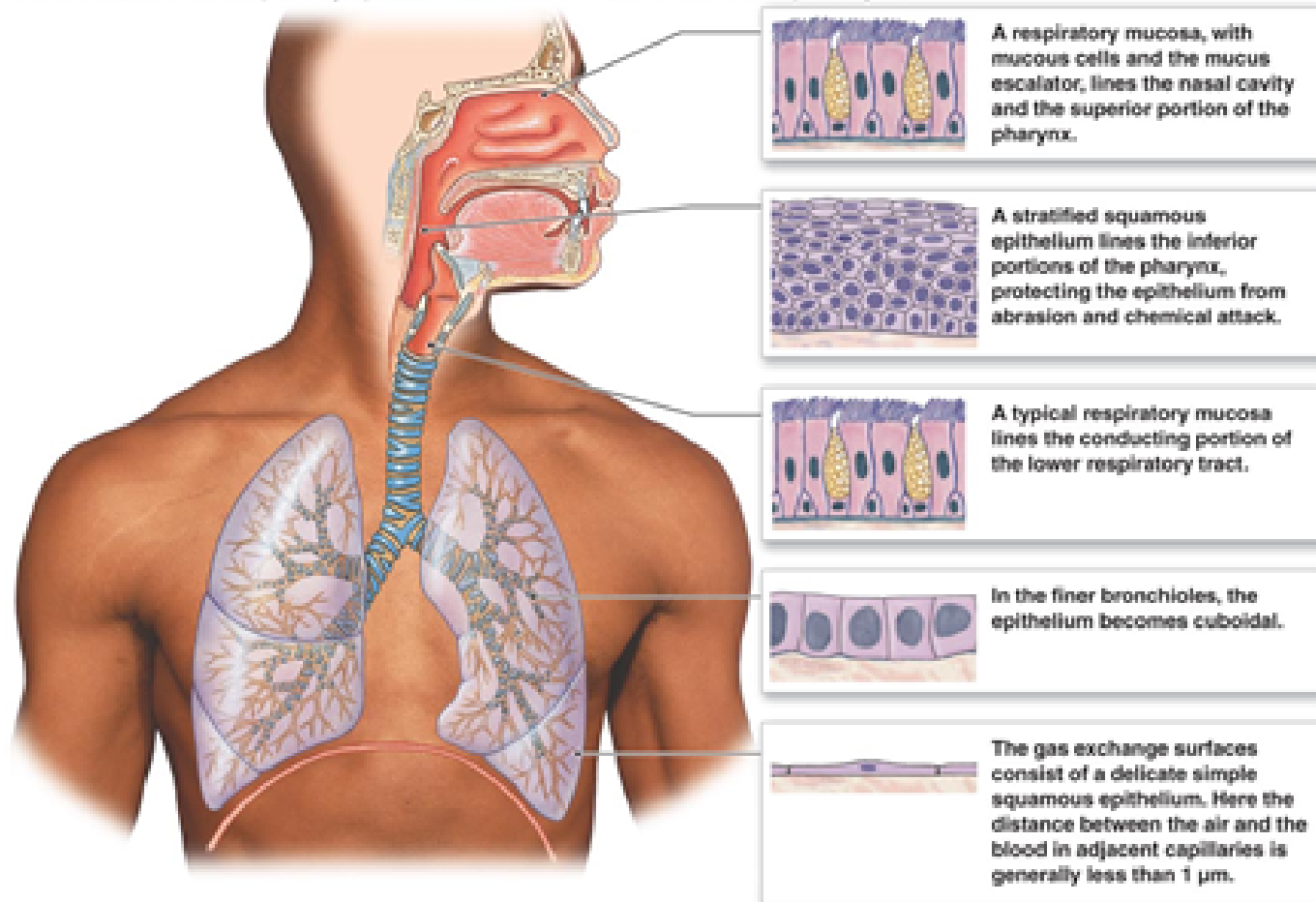


As air moves along the airways it is:

3. Moistened

-by the wet surface of the mucous membrane

The structure of the respiratory epithelium at different sites within the respiratory tract



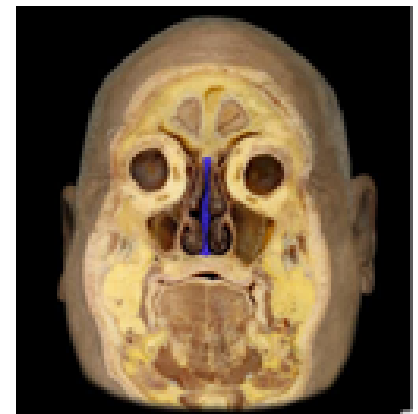
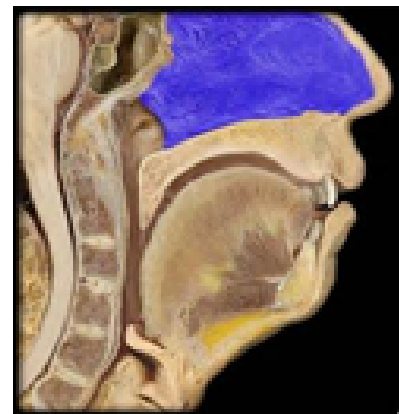
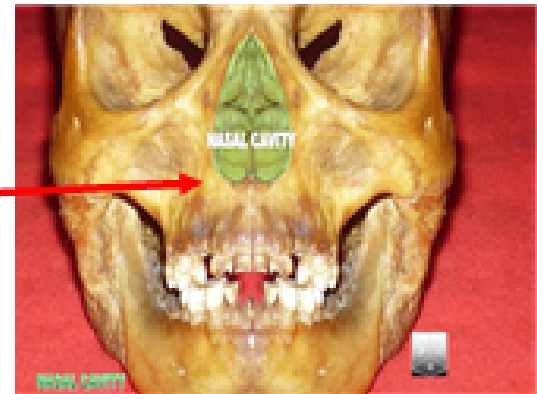
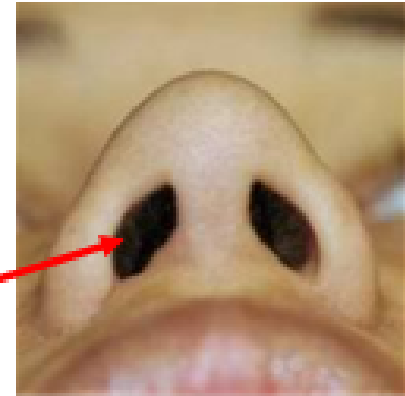
As air moves out during expiration it;

Cools and loses its moisture. The moisture is deposited on the lining of the trachea and the nose. However, enough moisture remains in the air that on a cold day, our breath condenses and forms a small cloud.



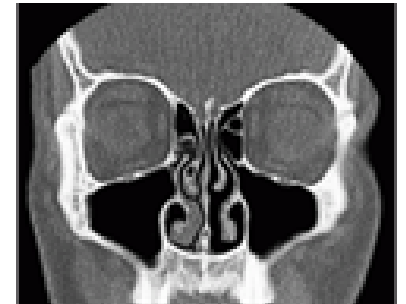
Nose

- The only external part of the respiratory system
- Air enters through external openings called nostrils
- Contains two mucous lined nasal cavities which are narrow canals separated from one another by a septum composed of bone and cartilage



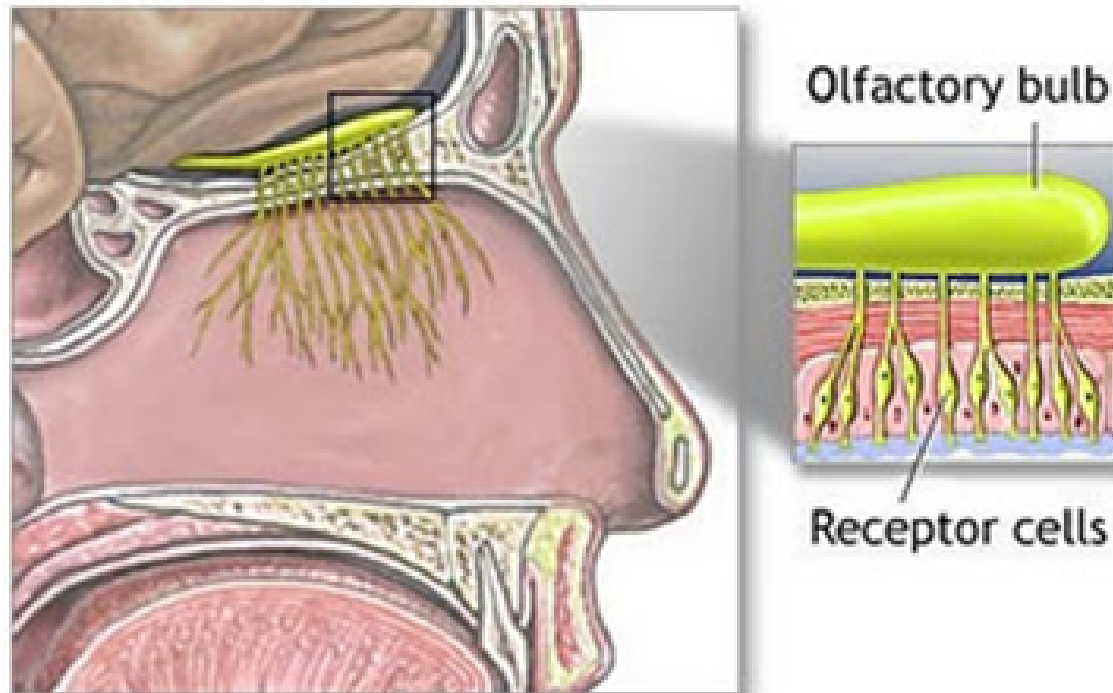
Nose cont.

- Nasal conchae - bony ridges that project literally into the nasal cavity; their purpose is to increase the surface area for moistening and warming air during inhalation and for trapping droplets in exhalation



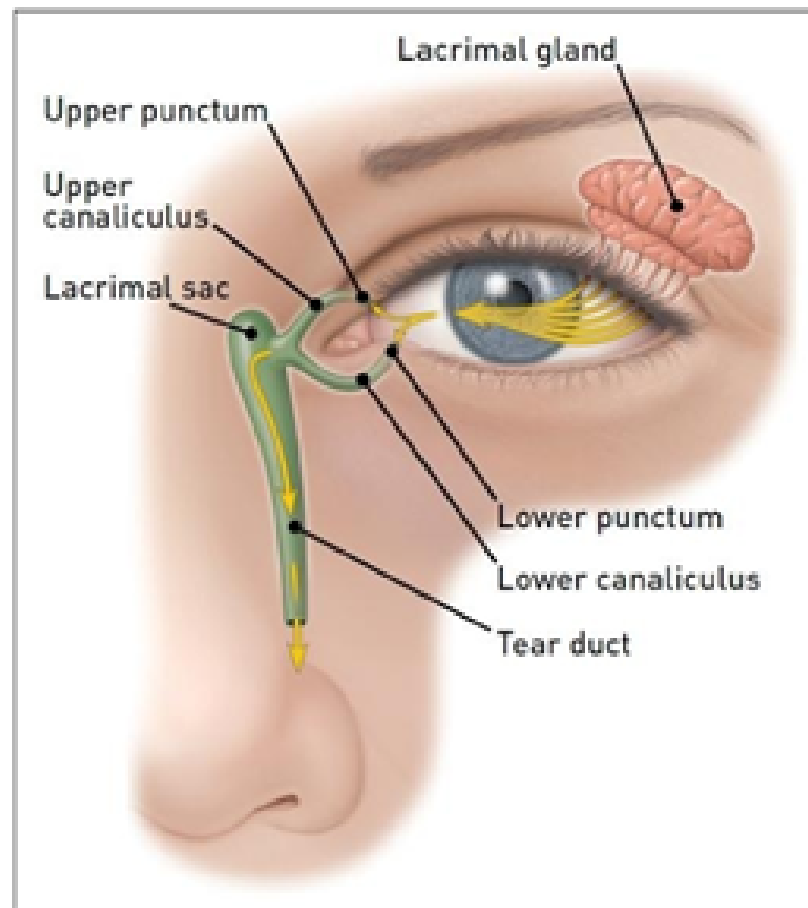
Nose cont.

- Cilia located in the highest parts of the nasal cavity contain odor receptors



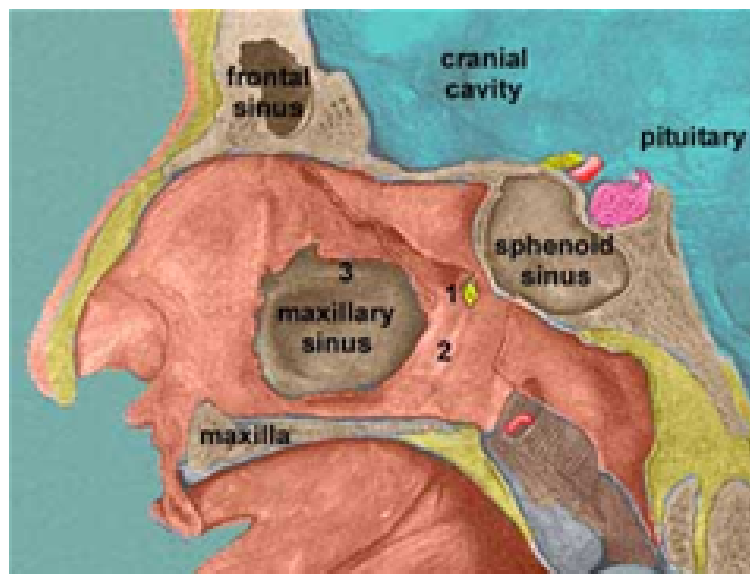
Nose cont.

- The lacrimal (tear) gland drains into the nasal cavity by way of tear ducts (because of this, crying may equal a runny nose)



Nose cont.

- Nasal cavities communicate with the paranasal sinuses (remember sinuses are airfilled spaces that lighten the weight of the skull) and act for resonation of the voice (these cavities can also become inflamed and accumulate fluid causing a sinus headache)



Sinus Headaches

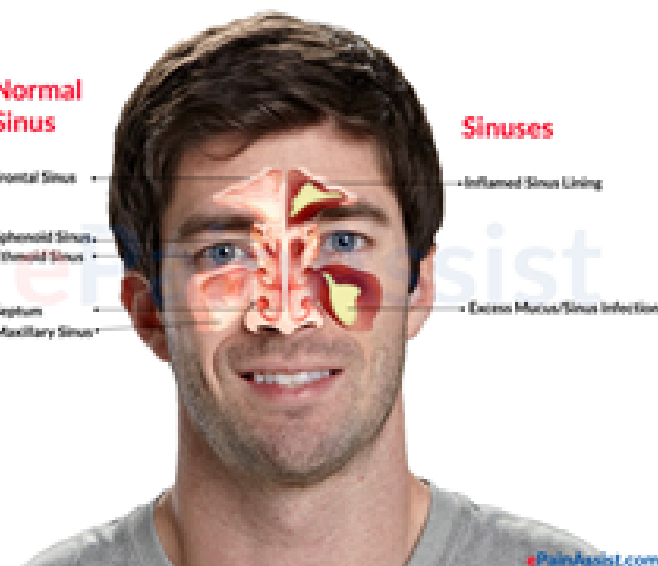
Normal Sinus

Frontal Sinus
Sphenoid Sinus
Ethmoid Sinus
Septum
Maxillary Sinus

Sinuses

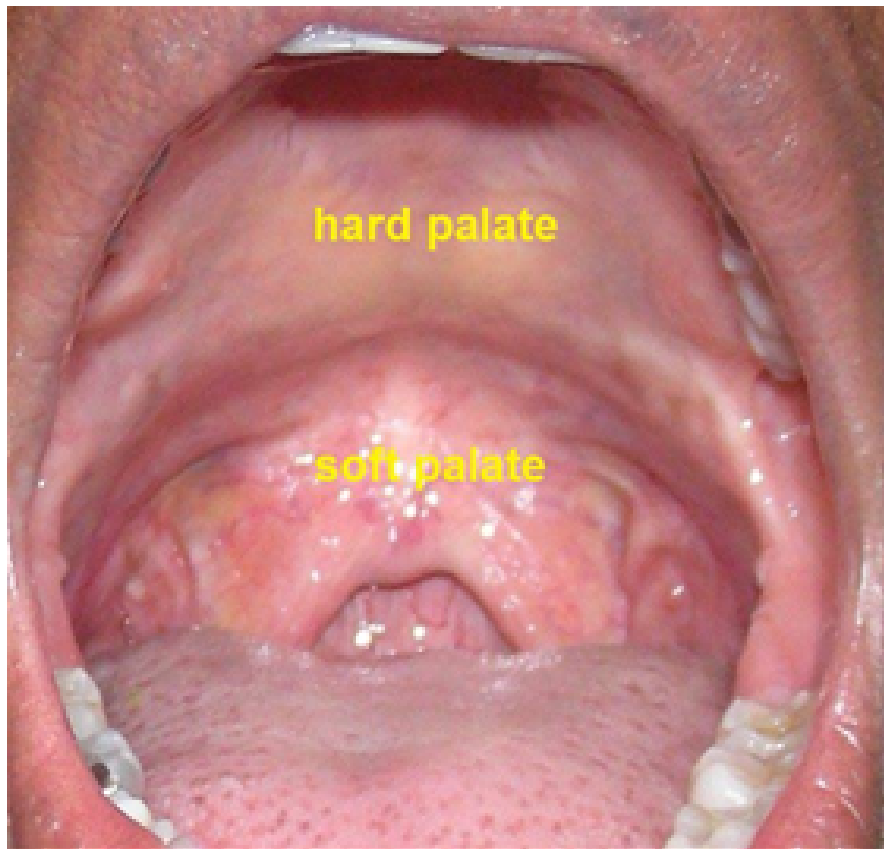
Inflamed Sinus Lining

Excess Mucus/Sinus Infection



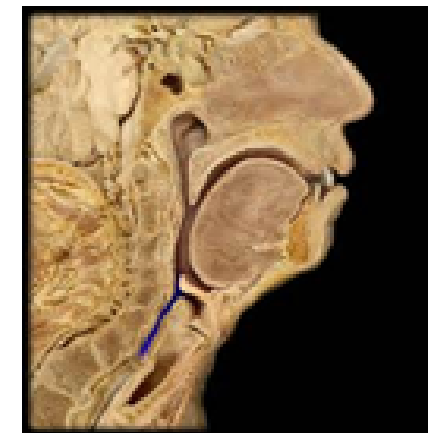
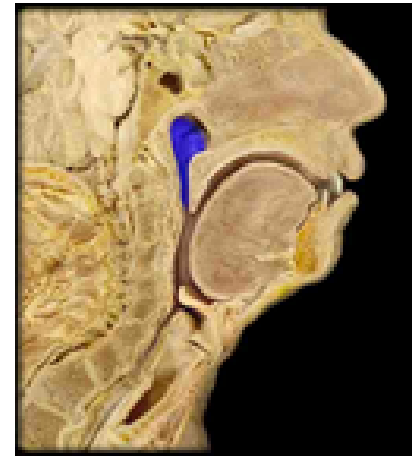
Nose cont.

- The nasal cavities are separated from the oral cavity by the hard and soft palate



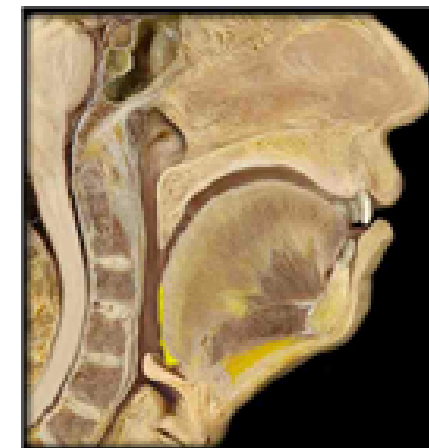
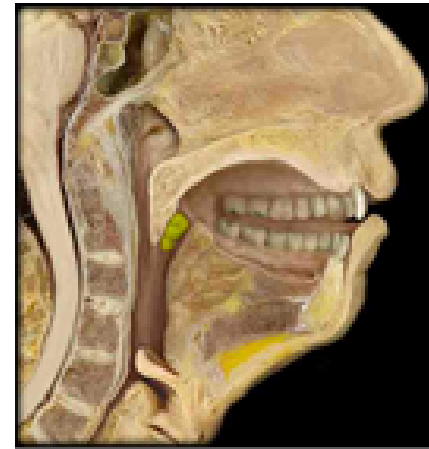
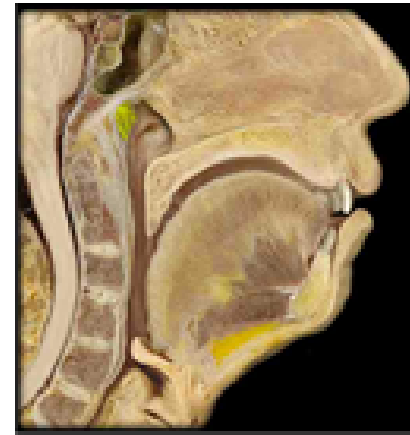
Pharynx

- a funnel-shaped passageway that connects the nasal and oral cavities to the larynx
 - has three parts;
 1. nasopharynx - where the nasal cavities open to the soft palate
 2. oropharynx - where the oral cavities joins the pharynx
 3. laryngopharynx - opens to the larynx (talked about soon)



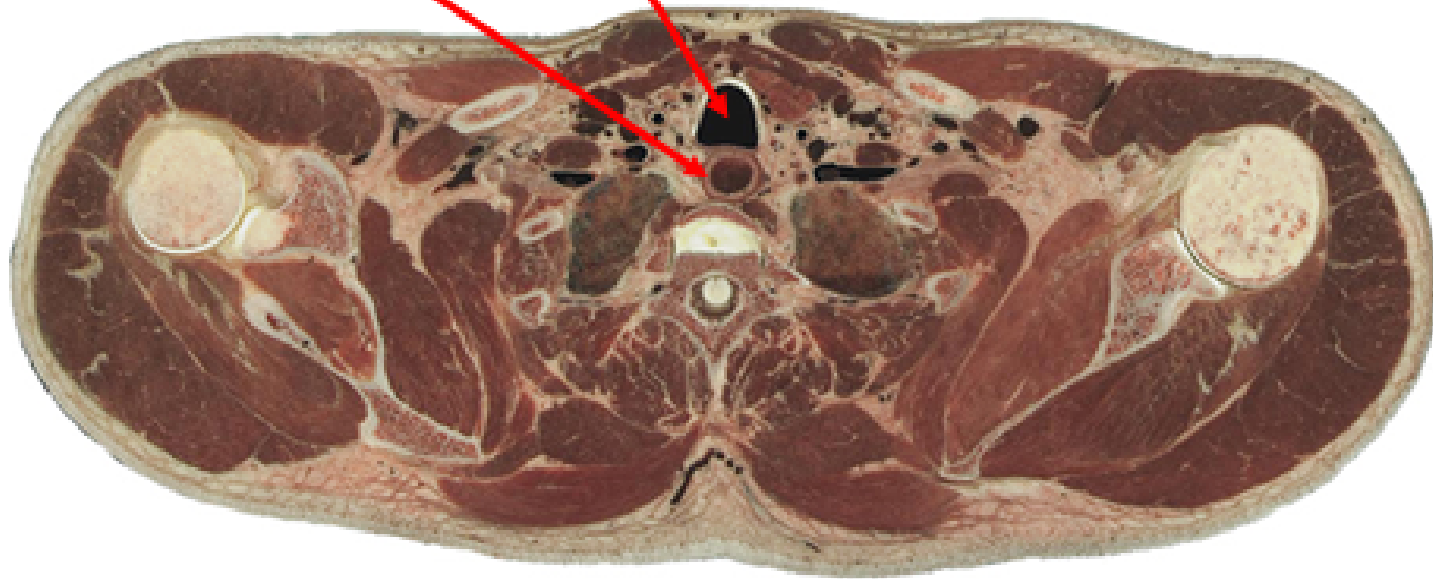
Pharynx cont.

- There is a single pharyngeal tonsil (also called adenoids) in the posterior nasal cavity to help defend against infection
- There is a pair of palatine tonsils at the rear of the oropharynx
- There is a pair of lingual tonsils at the base of the tongue
- Tonsils contain lymphocytes that protect against invasion of inhaled pathogens



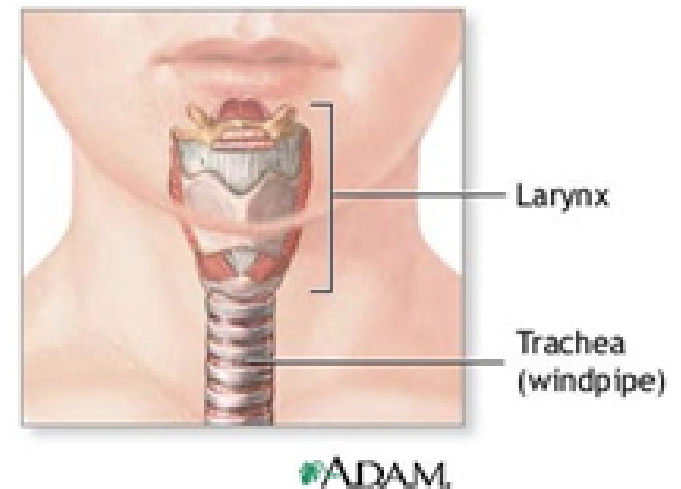
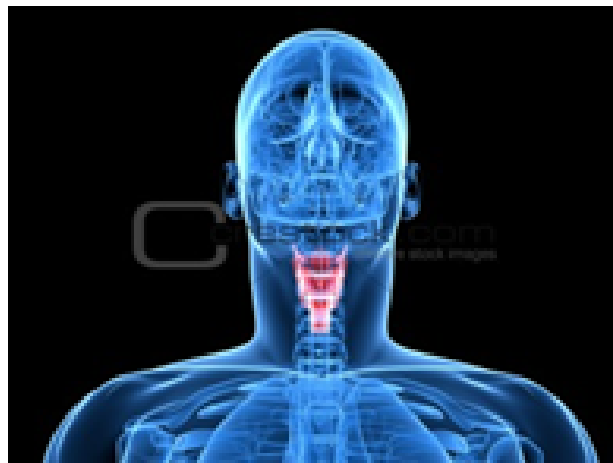
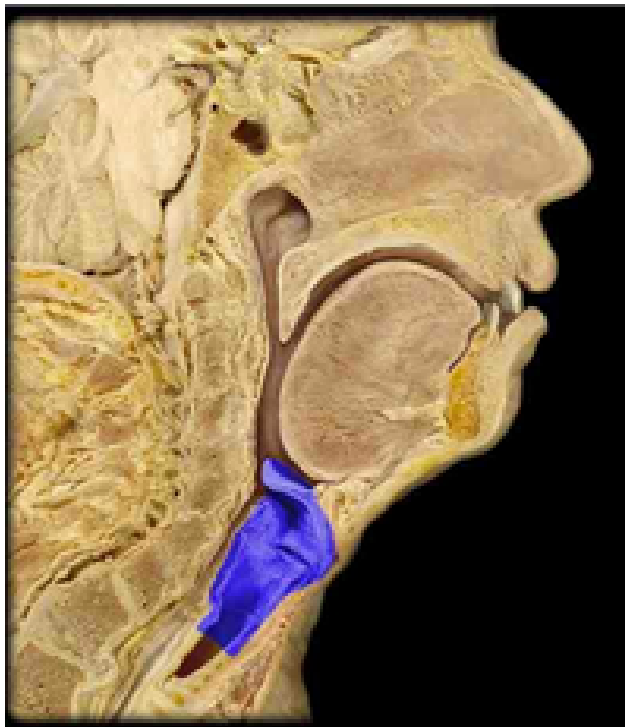
Pharynx cont.

- In the pharynx, the air passage and the food passage cross because the larynx (talked about next), which receives air is anterior to the esophagus which receives food.
- The larynx and trachea are normally open, allowing air to pass, but the esophagus is normally collapsed and opens only when a person swallows



Larynx

- a cartilaginous structure that serves as a passageway for air between the pharynx and the trachea



Larynx cont.

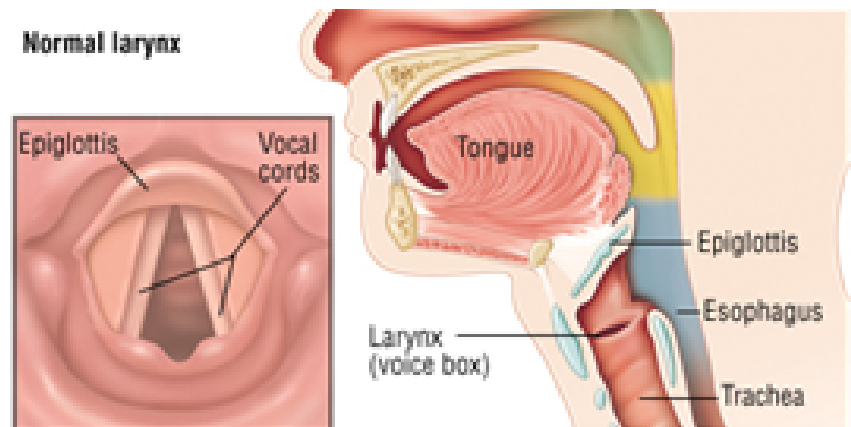
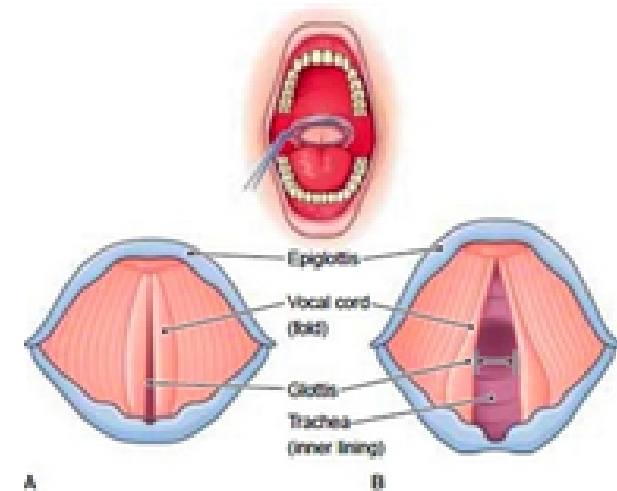
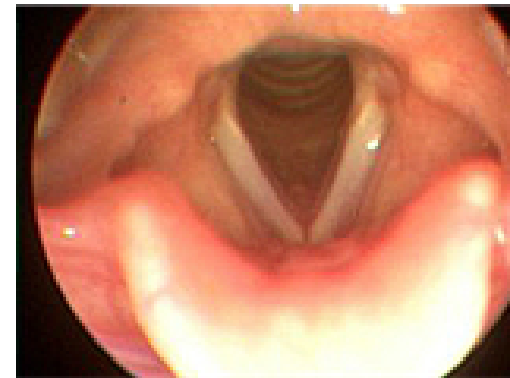
- Can be pictured as a triangular box whose apex, the Laryngeal Prominance (aka Adam's apple), is located at the anterior of the neck.



- both sexes have one, but an increase in testosterone results in an increase in size of male's Adam's Apple during puberty

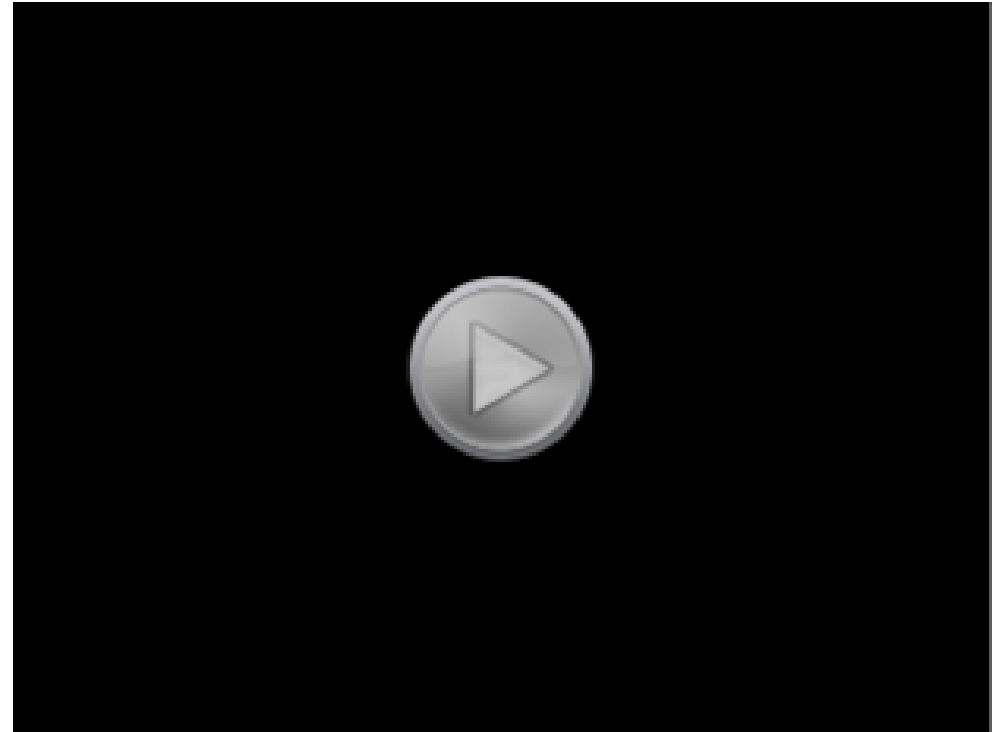
Larynx cont.

- often called the voice box because it houses the vocal cords
- Vocal cords are supported by elastic ligaments
- The slit between the vocal cords is an opening called the glottis



Larynx cont.

- When air goes past the vocal cords through the glottis the vocal cords vibrate producing sound
- Pitch is determined by the tensions on the vocal cords (the tighter the tension the higher the voice)



<https://www.youtube.com/watch?v=v9Wdf-RwLcs>

Larynx cont.

- when food is swallowed the larynx moves upward against the epiglottis, preventing food from getting into the larynx



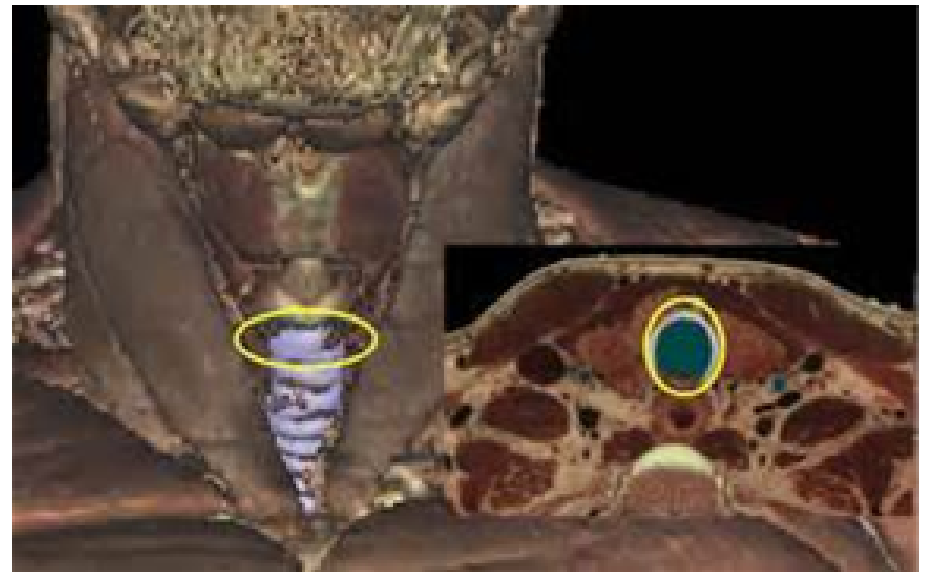
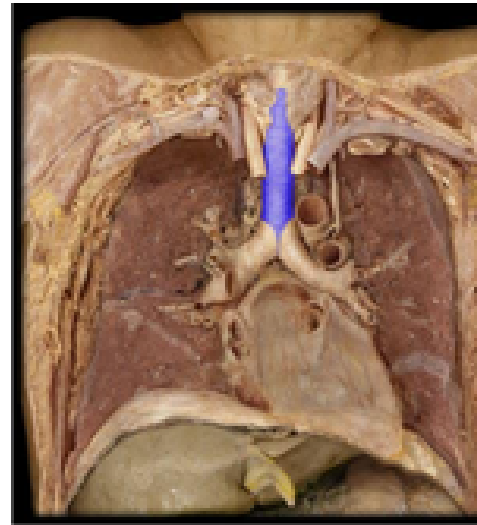
<https://www.youtube.com/watch?v=Ri8bBhw9msQ>

SECTION



Trachea

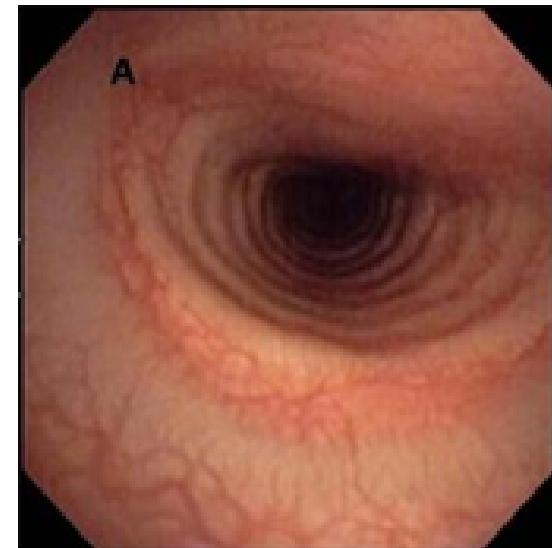
- commonly known as the 'windpipe'
- connects the larynx to the primary bronchi
- lies ventral to the esophagus
 - held open by cartilaginous rings



Trachea cont.

Horse Trachea

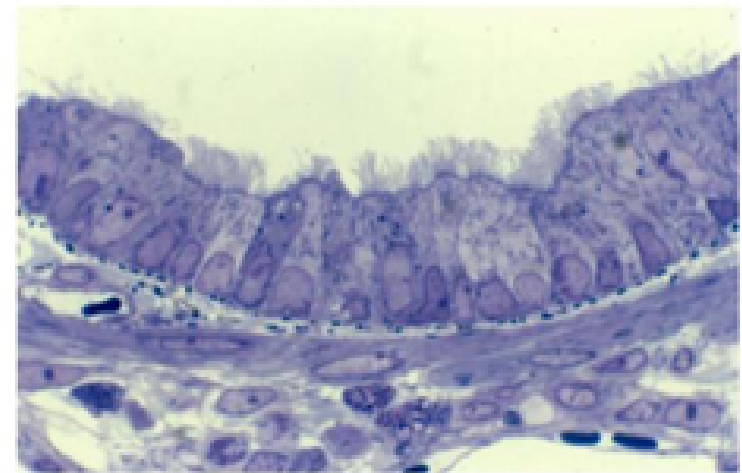
- held open by cartilaginous rings
- the rings are C-shaped to allow the esophagus to expand when swallowing



Trachea cont.

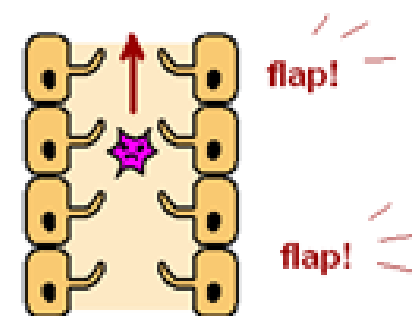
- Mucosa lines the trachea and has a layer of pseudostratified ciliated columnar epithelium to help keep the lungs clean by sweeping mucus, produced by goblet cells, and debris toward the pharynx (mucociliary escalator)

Normal Respiratory Epithelium



(c) 2005, Angelina Warner, D.V.M., D.Sc.

The MUCOCILIARY ESCALATOR!

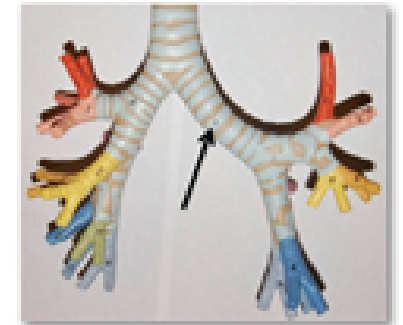
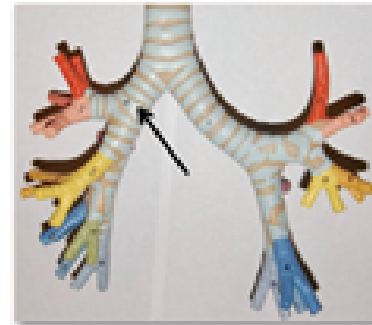


Bronchial Tree

- The trachea divides into the right and left primary bronchi

Right Lung

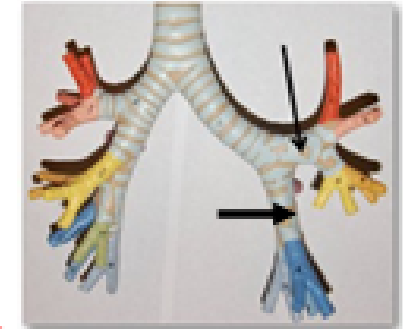
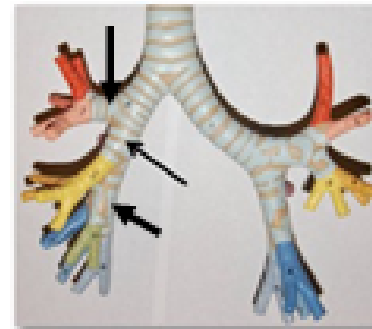
Left Lung



- Primary bronchi branch into secondary bronchi (one for each lobe of the lung)



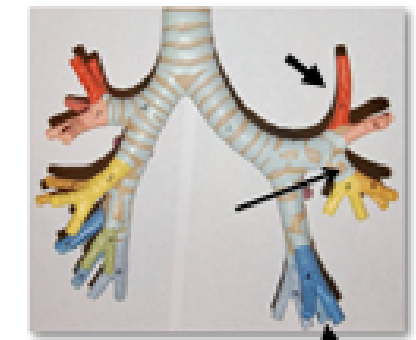
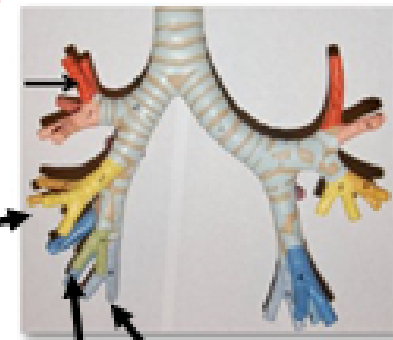
- Because there are three lobes on the right lung, there are three secondary bronchi for the right lung



- The left lung only has 2 lobes (to allow room for the heart) so there are only two secondary bronchi

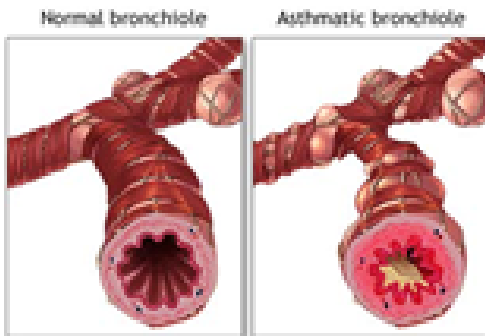


- Each secondary bronchus then divides into the smaller tertiary bronchi



Bronchial Tree cont.

- Bronchioles are the smallest conducting airways
- Bronchioles lack cartilage support but possess a ciliated apithelium and a well developed smooth muscle layer

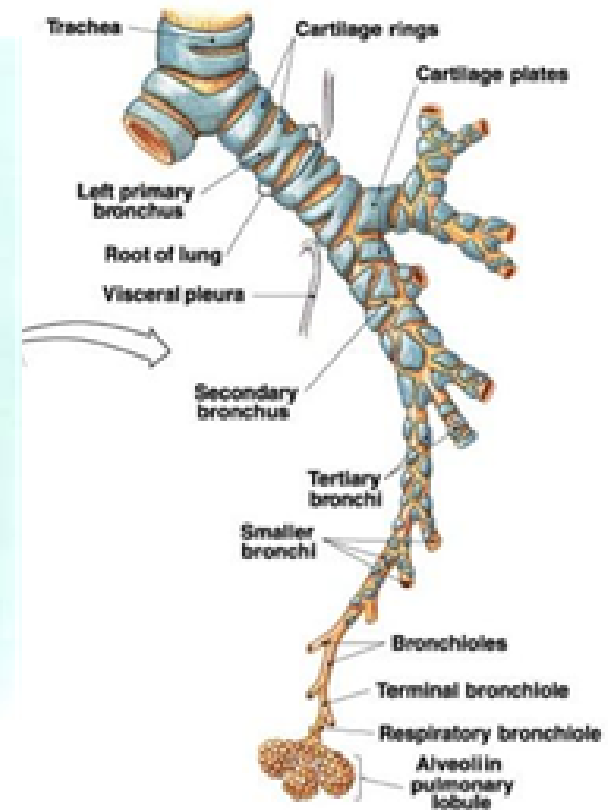


- With asthma, the smooth muscle contracts restricting airflow

ADAM

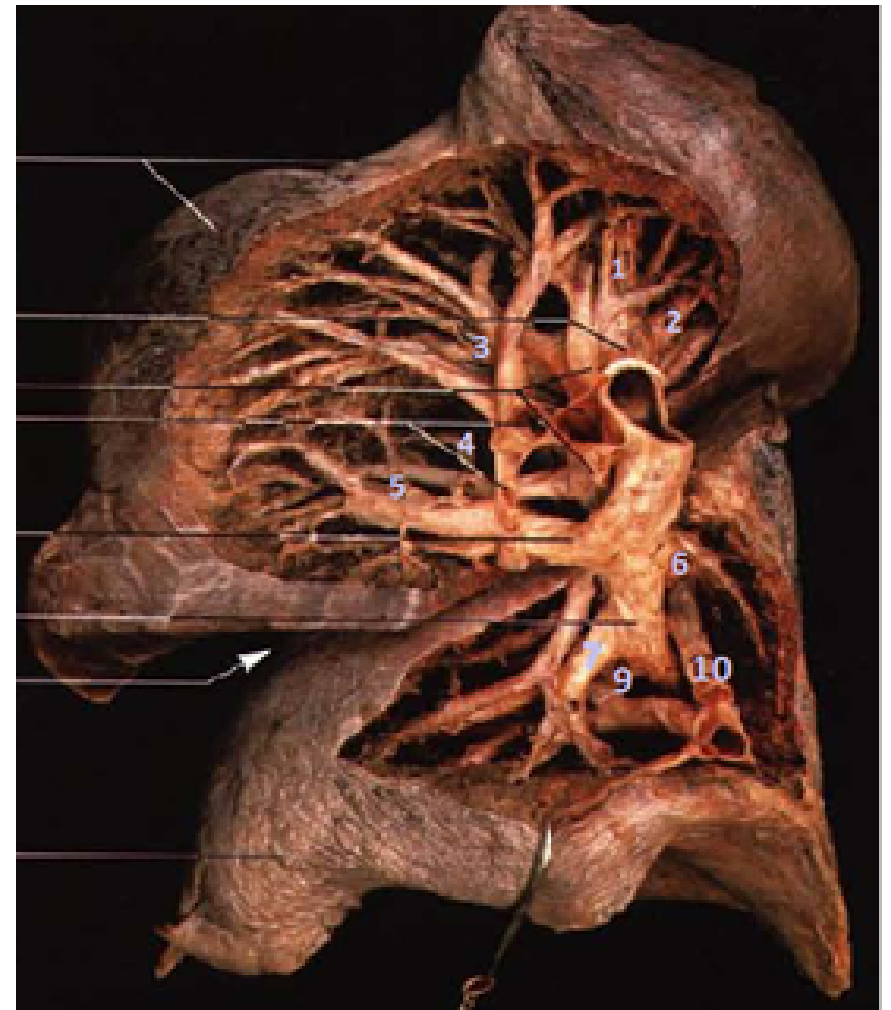


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Biggest to Smallest

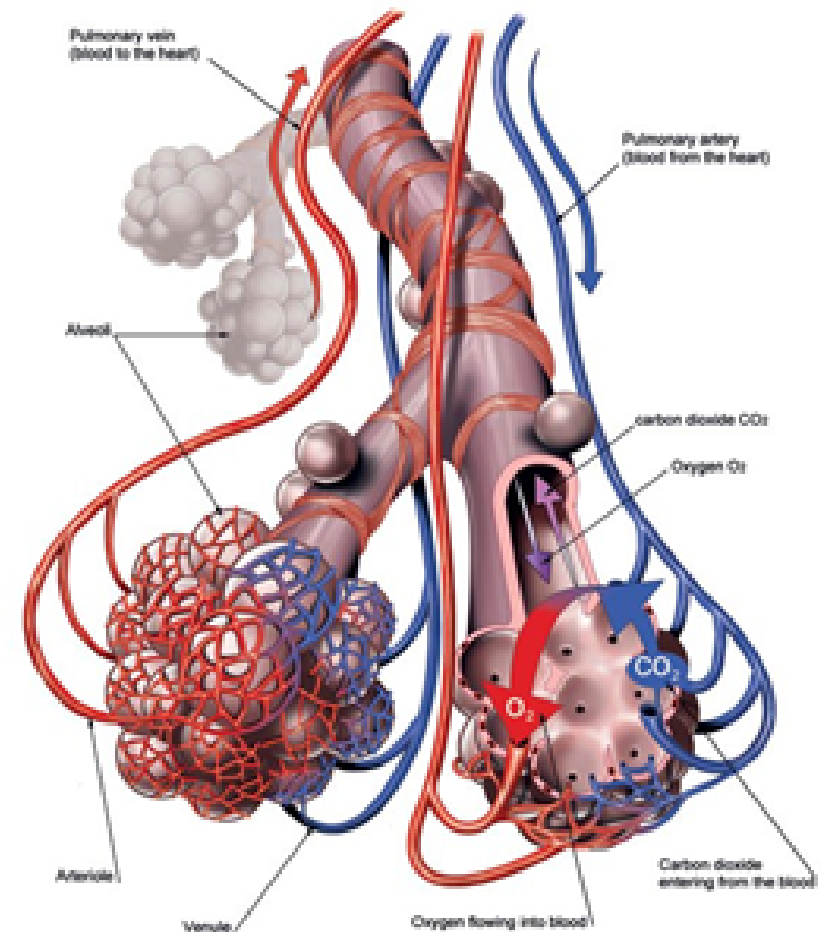
- Trachea
- Primary Bronchi
- Secondary Bronchi
- Tertiary Bronchi
- Bronchiolus





Lungs

- each bronchiole leads to an elongated space enclosed by multiple pockets, or sacs called alveoli (the main component of lungs - along with capillaries)
- with each inhalation, air passes by way of the bronchial tree to the alveoli
- Gas exchange occurs between the air in the alveoli and the blood capillaries; oxygen diffuses across the alveolar and capillary walls to enter the bloodstream and carbon dioxide diffuses across these walls to enter the alveoli



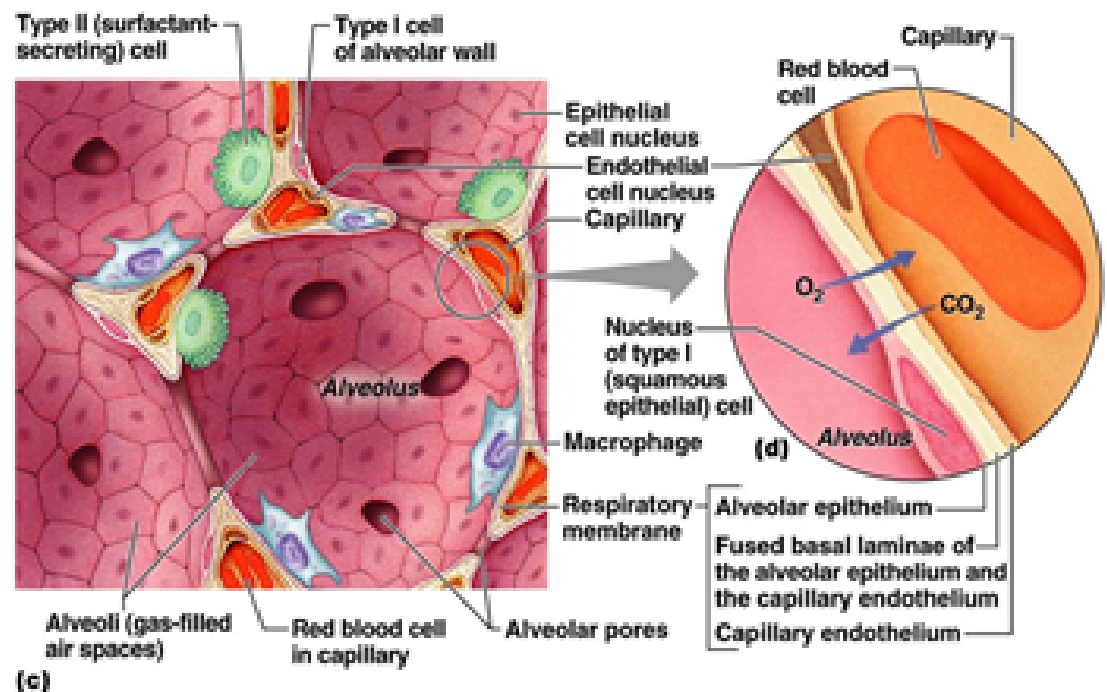
Lungs

- Gas exchange occurs very rapidly because of the characteristics of the membrane separating the alveoli and the capillaries

- This membrane is called the respiratory membrane

- In the membrane, capillaries are extremely thin forcing red blood cells pressed against the walls with little plasma speeding up oxygen release from the red blood cells

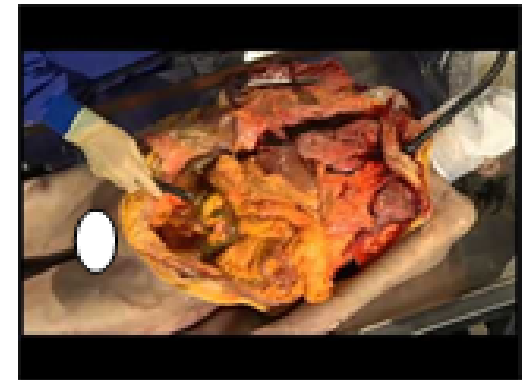
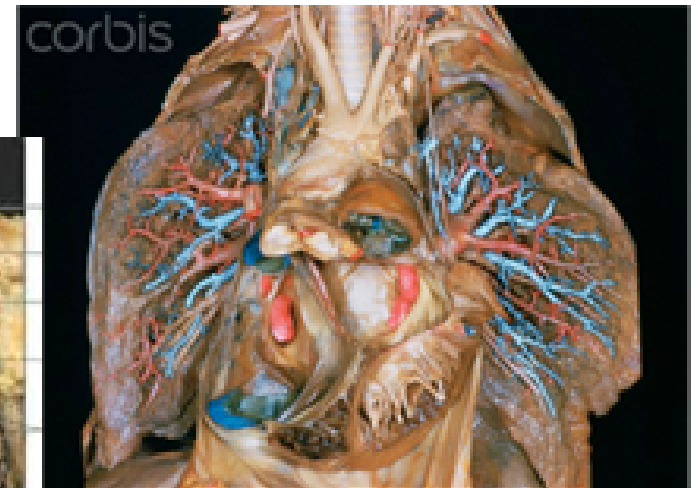
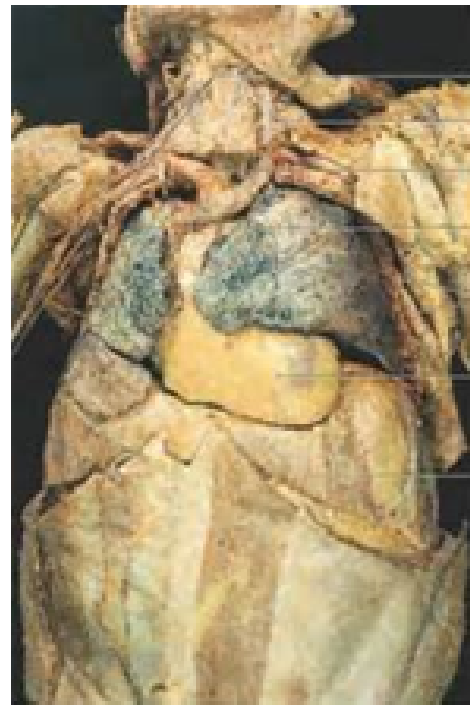
- Surfactant is a lubricant released by special cells in the alveoli to help make the alveoli elastic and recoil after expansion but never collapse





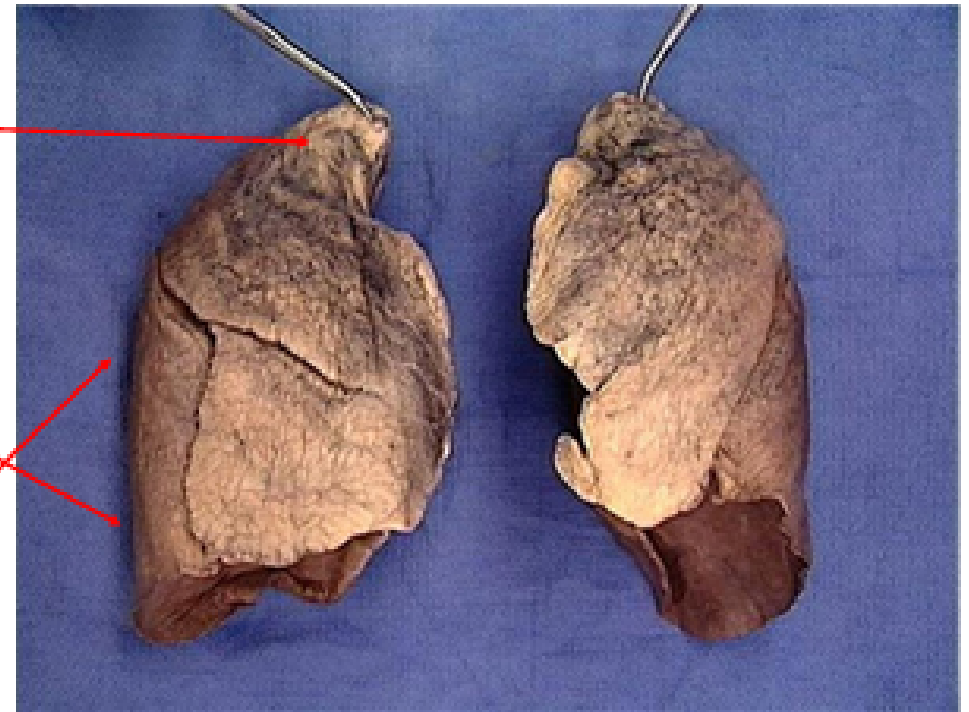
Lungs

- 2 of them
- cone-shaped organs
- Fills its own pleural cavity inside the thoracic cavity separated by the mediastinum



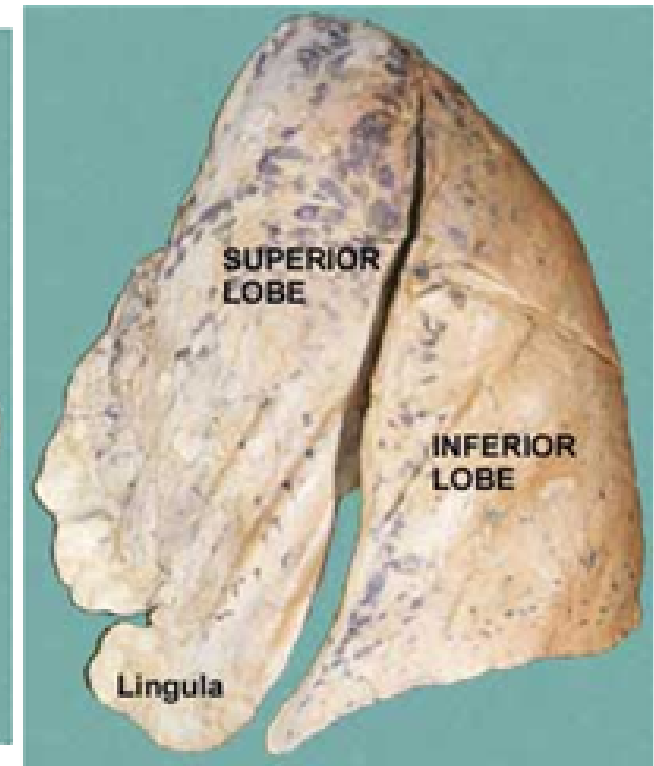
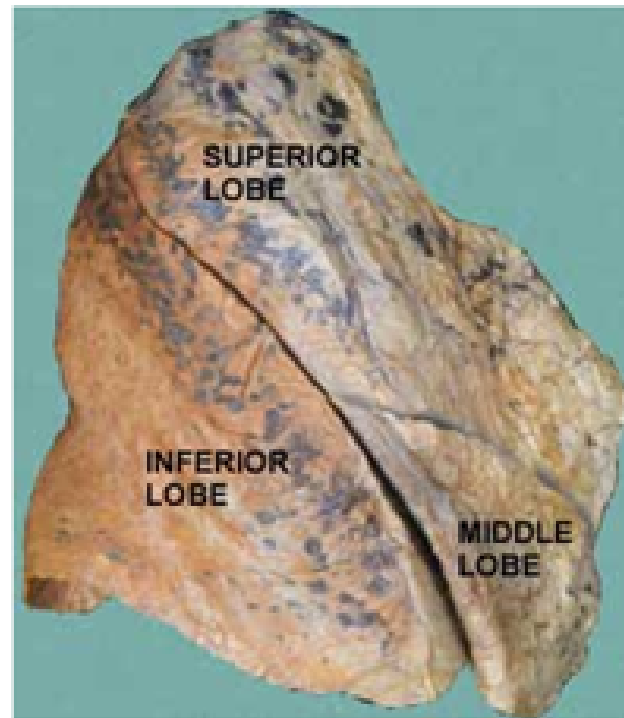
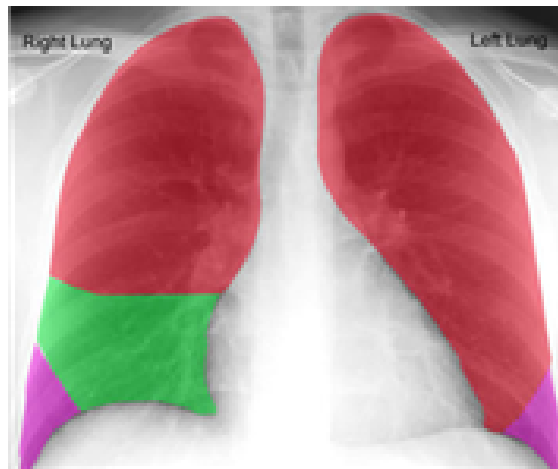
Lungs cont.

- The apex of the lung is the superior narrow portion of a lung
- The base of the lung is the inferior broad portion that curves to fit the dome-shaped diaphragm
- The lateral portion of the lungs curves to follow the contours of the ribs in the thoracic cavity



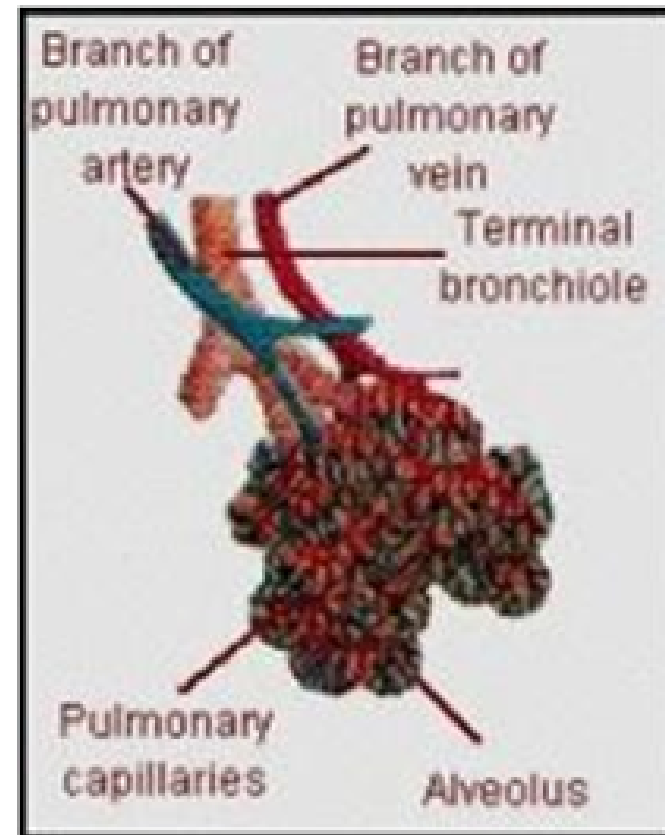
Lungs cont.

- Each lung has lobes
- The right lung has three lobes
- The left lung has 2 lobes (to leave space for the heart)



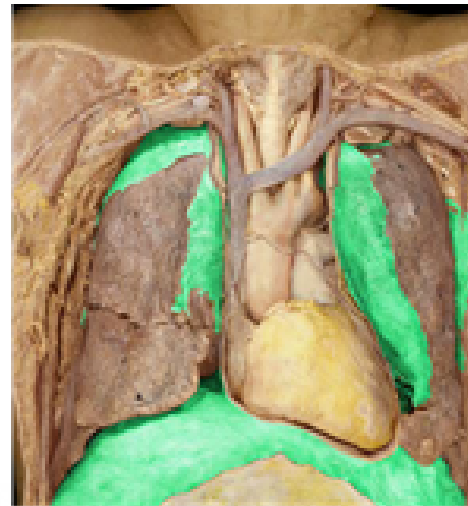
Lungs cont.

- Each lobe is further divided into lobules
- Each lobule has a bronchiole supplying many alveoli with oxygen
- Pulmonary arteries travel alongside the bronchi and pulmonary arterioles parallel the bronchioles
- Each pulmonary arteriole branches to form pulmonary capillaries

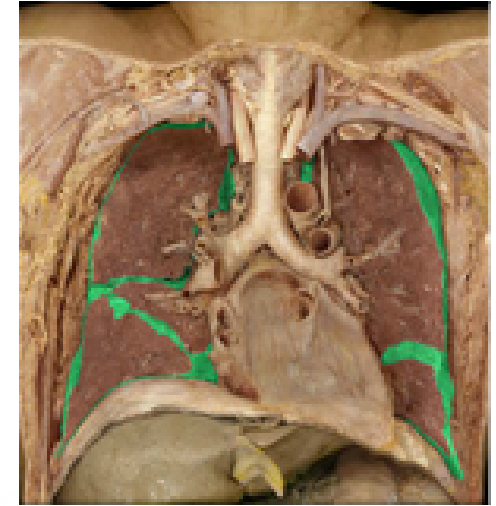


Lungs cont.

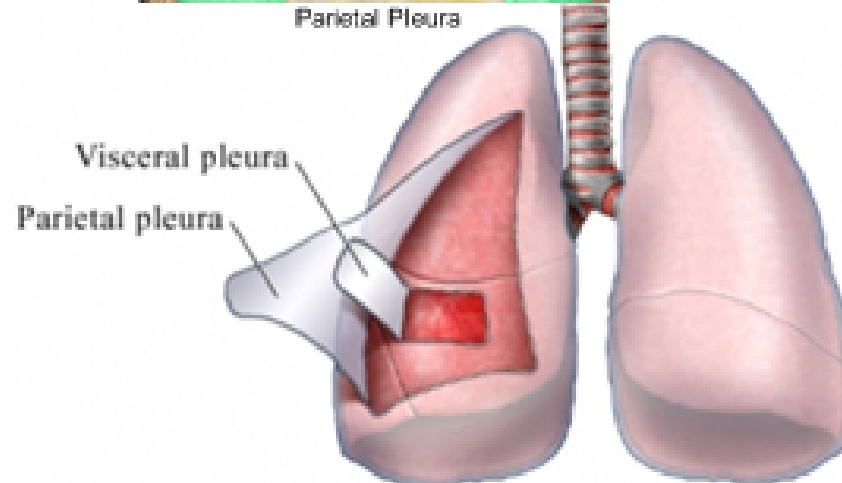
- Each lung is enclosed by a double layer of serous membrane called pleurae
- Visceral pleura adheres to the surface of the lung
- Parietal pleura lines the inside of the thoracic cavity
- Pleurae produces a lubricating serous fluid that reduces friction



Parietal Pleura



Visceral Pleura





Respiratory
Membrane