

# RESPIRATORY SYSTEM



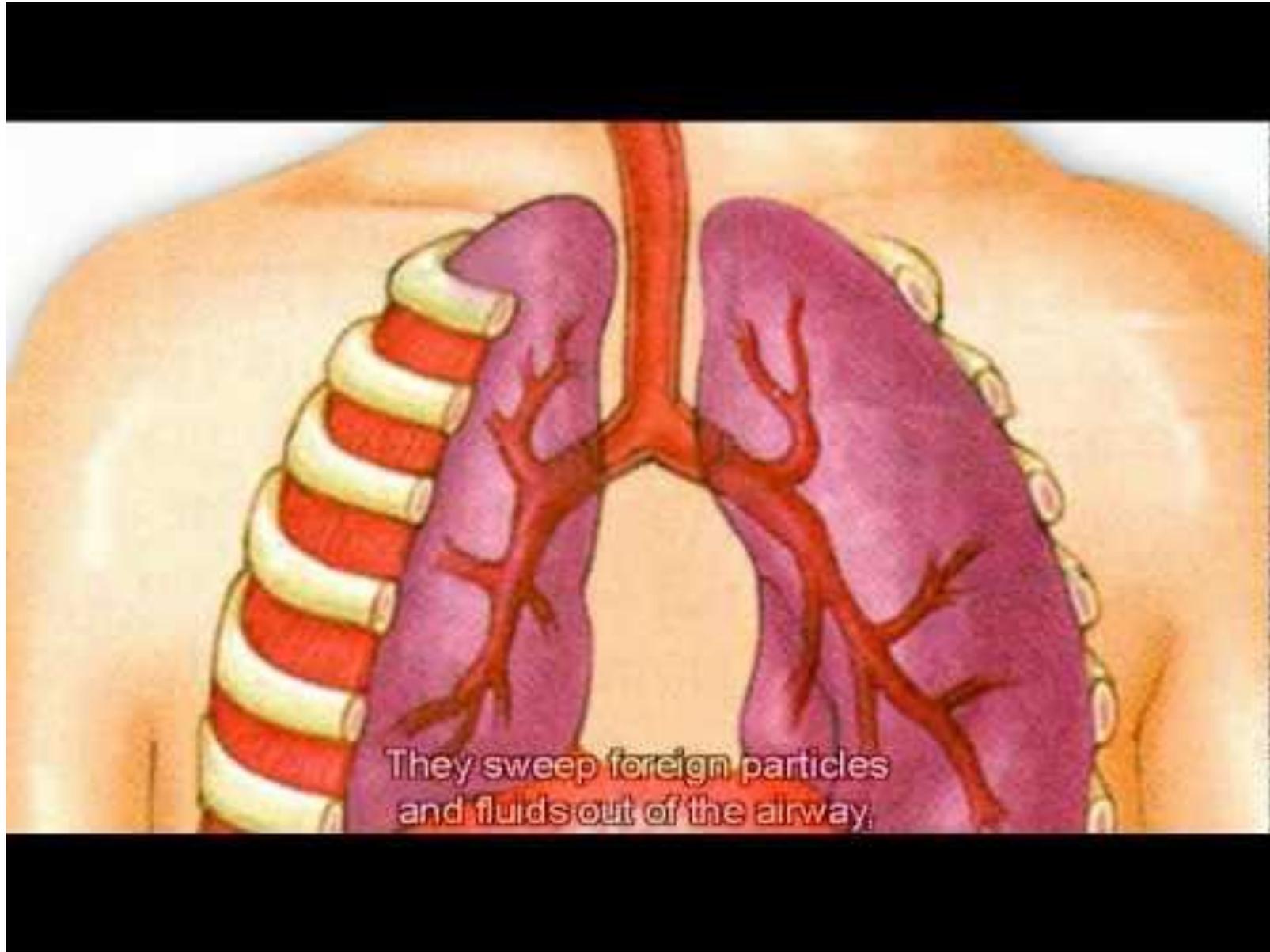
# PRIMARY FUNCTIONS

- Exchange gases (oxygen and CO<sub>2</sub>)
- Produce vocal sounds
- Sense of smell
- Regulation of blood pH

# Respiration - process of gas exchange

1. Movement of air into lungs
2. Gas exchange between blood and air  
(external respiration)
3. Gas transport in blood
4. Gas exchange between blood and body cells  
(internal respiration)

\*Cellular Respiration - oxygen use and CO<sub>2</sub> production at a cellular level



They sweep foreign particles and fluids out of the airway.

# Organs of the Respiratory System

## Conducting Passages

Main organs  
of the upper  
and lower  
respiratory  
system

Upper respiratory tract

Nasal cavity

Pharynx

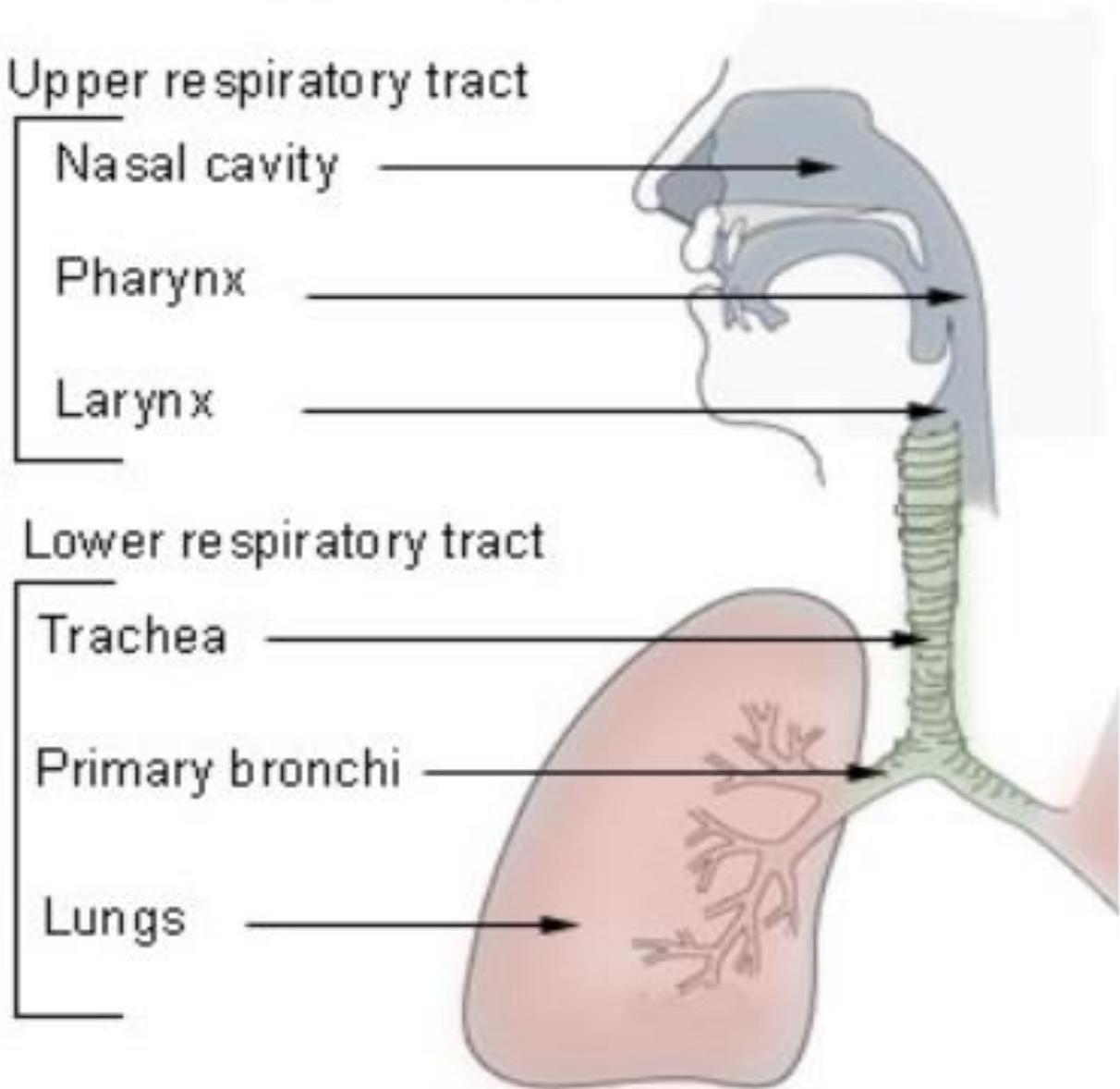
Larynx

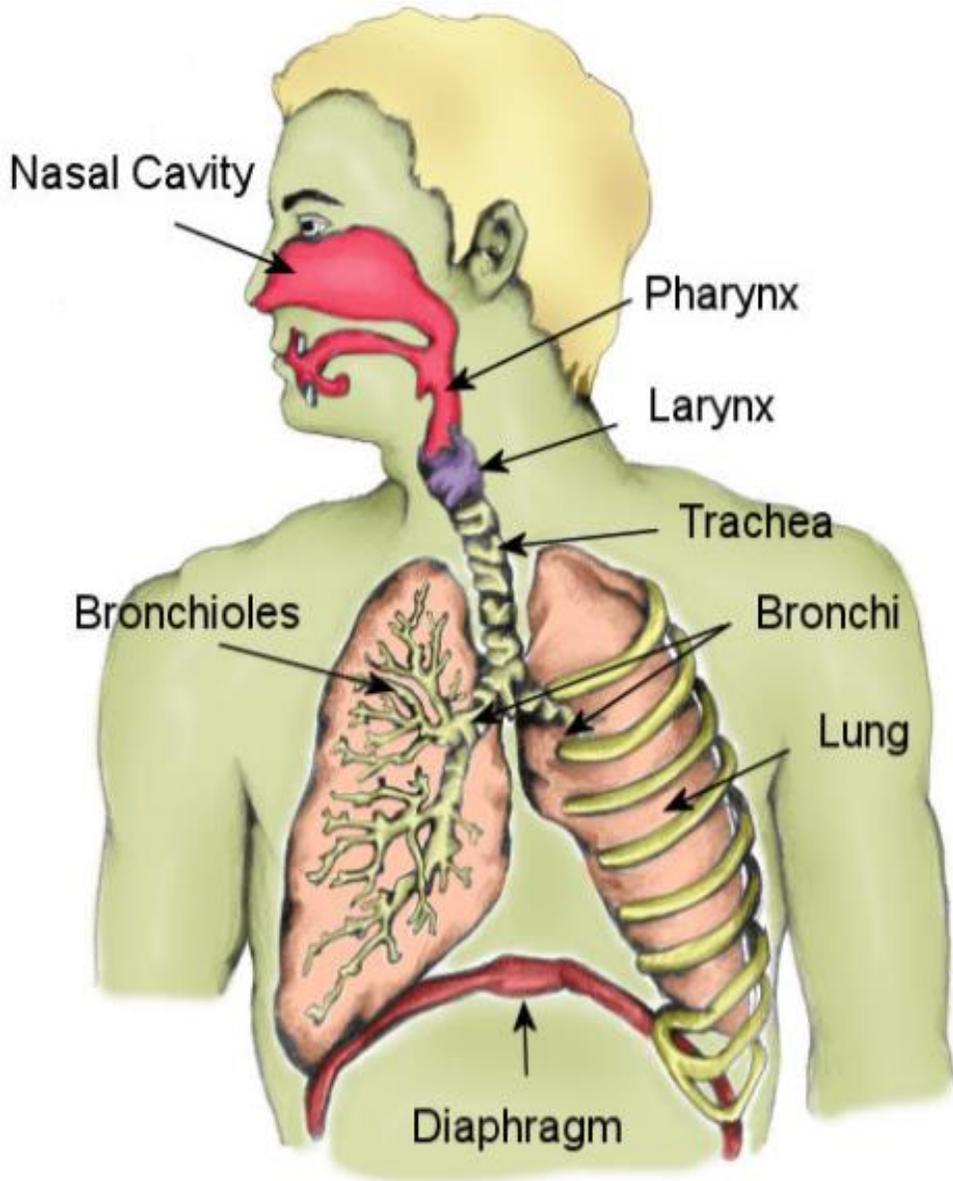
Lower respiratory tract

Trachea

Primary bronchi

Lungs





Upper Respiratory Tract – nose, nasal cavity, paranasal sinuses, pharynx

Lower Respiratory Tract – larynx, trachea, bronchial tree, lungs

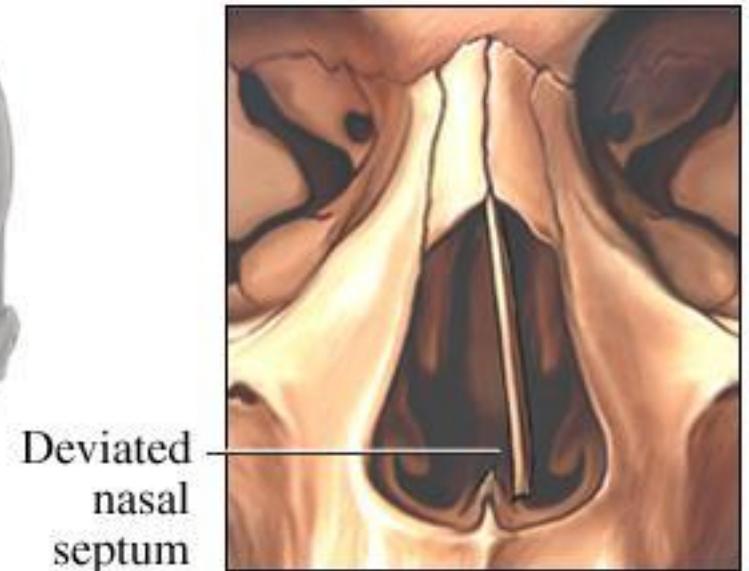
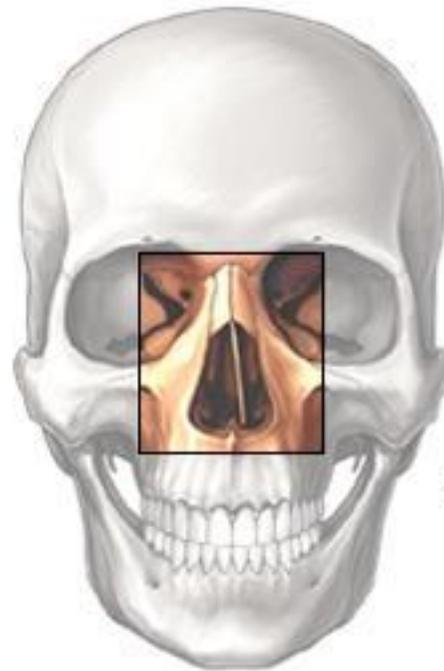
The NOSE bones and cartilage support nose, two openings (nostrils), hair filters large particles

Nasal Cavity – hollow space behind the nose

Nasal septum – divides the nose (bone)

Nasal conchae – bones that divide the nasal cavity, support the mucus membrane and increase surface area (superior, middle, inferior)

\* deviated septum – when the septum bends to one side

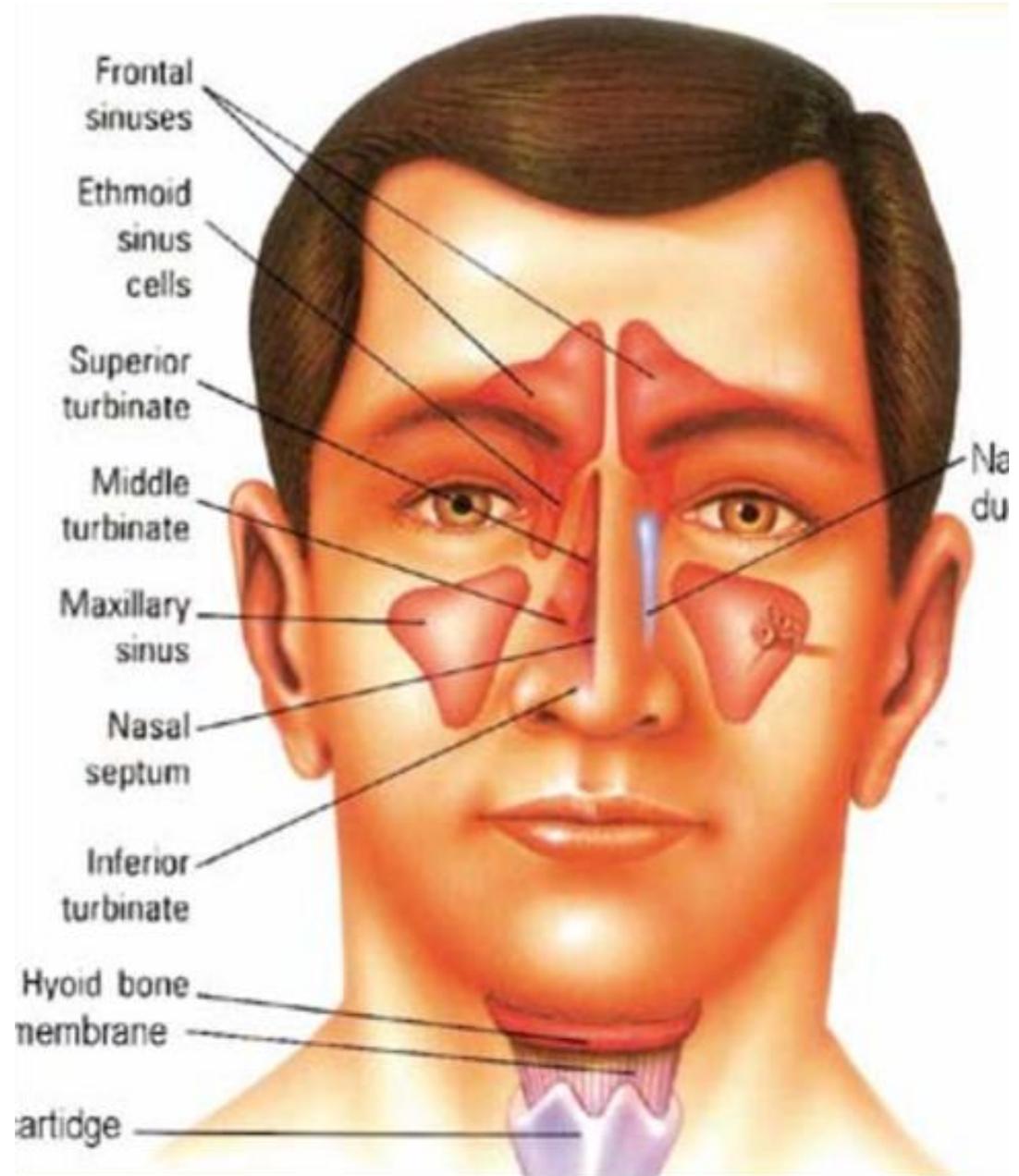


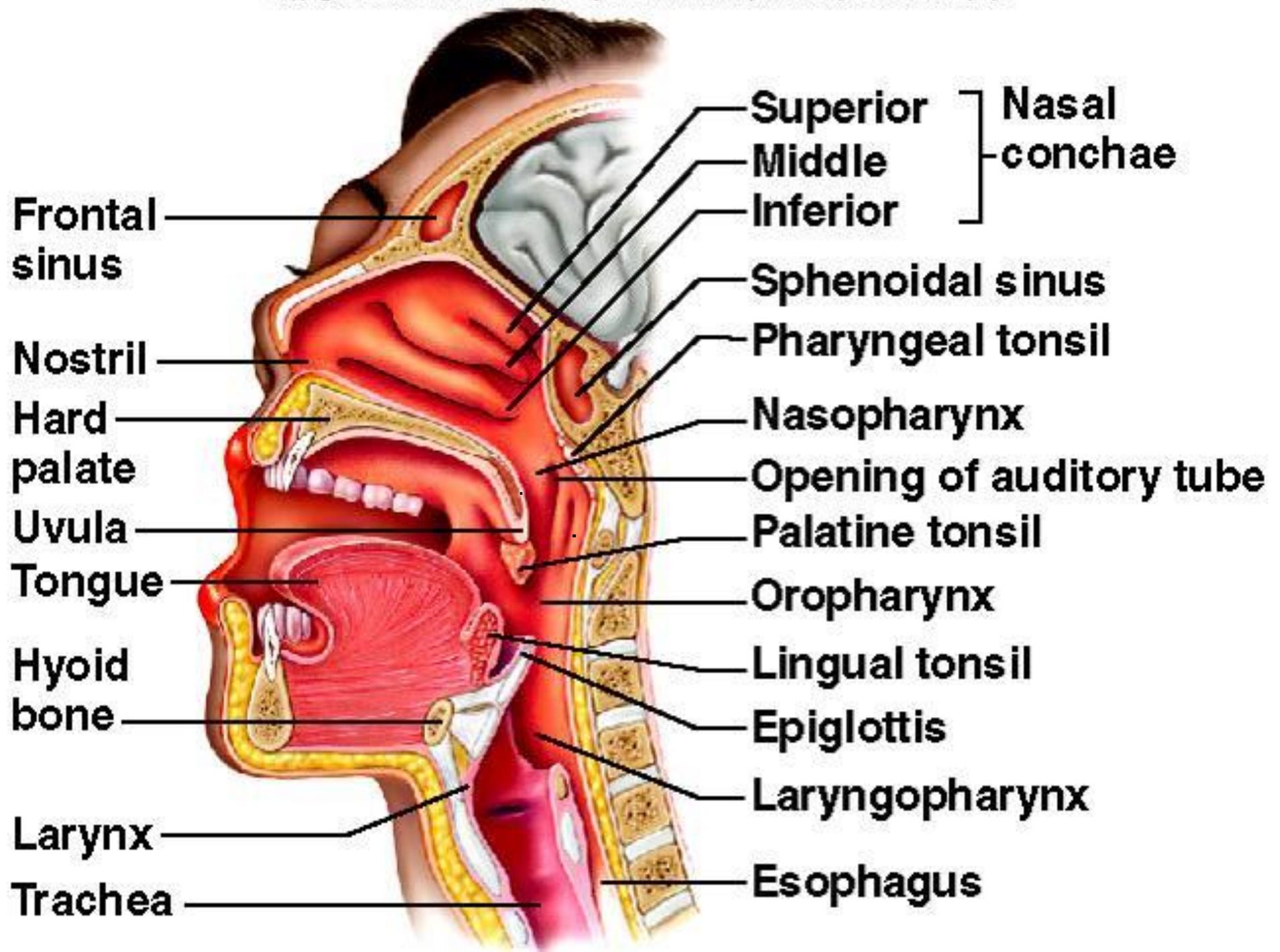
# Paranasal Sinuses -

– spaces within  
the bones

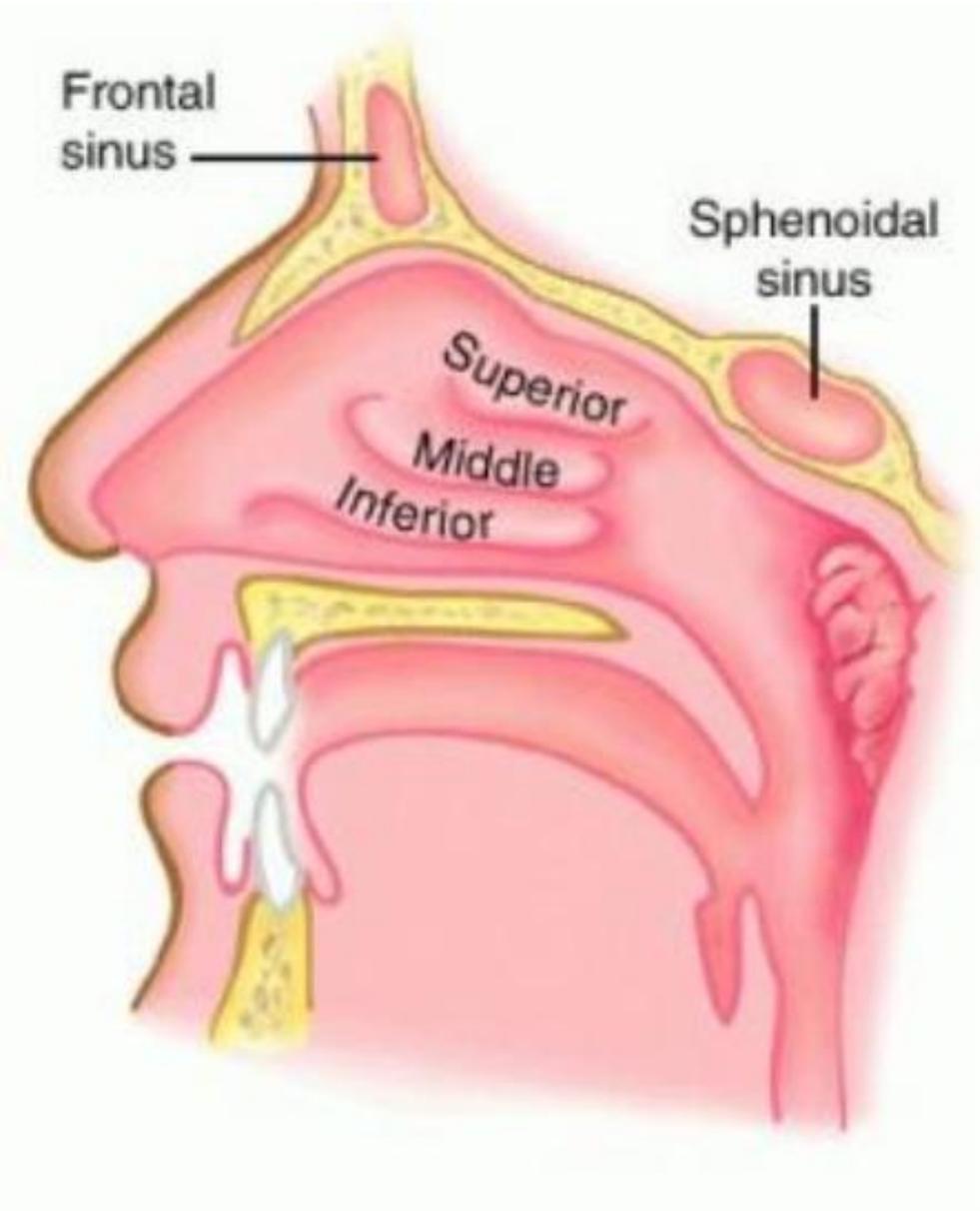
- maxillary
- frontal
- ethmoid
- sphenoid

reduce the weight of  
skull and are resonant  
chambers for voice.





## Nasal Conchae

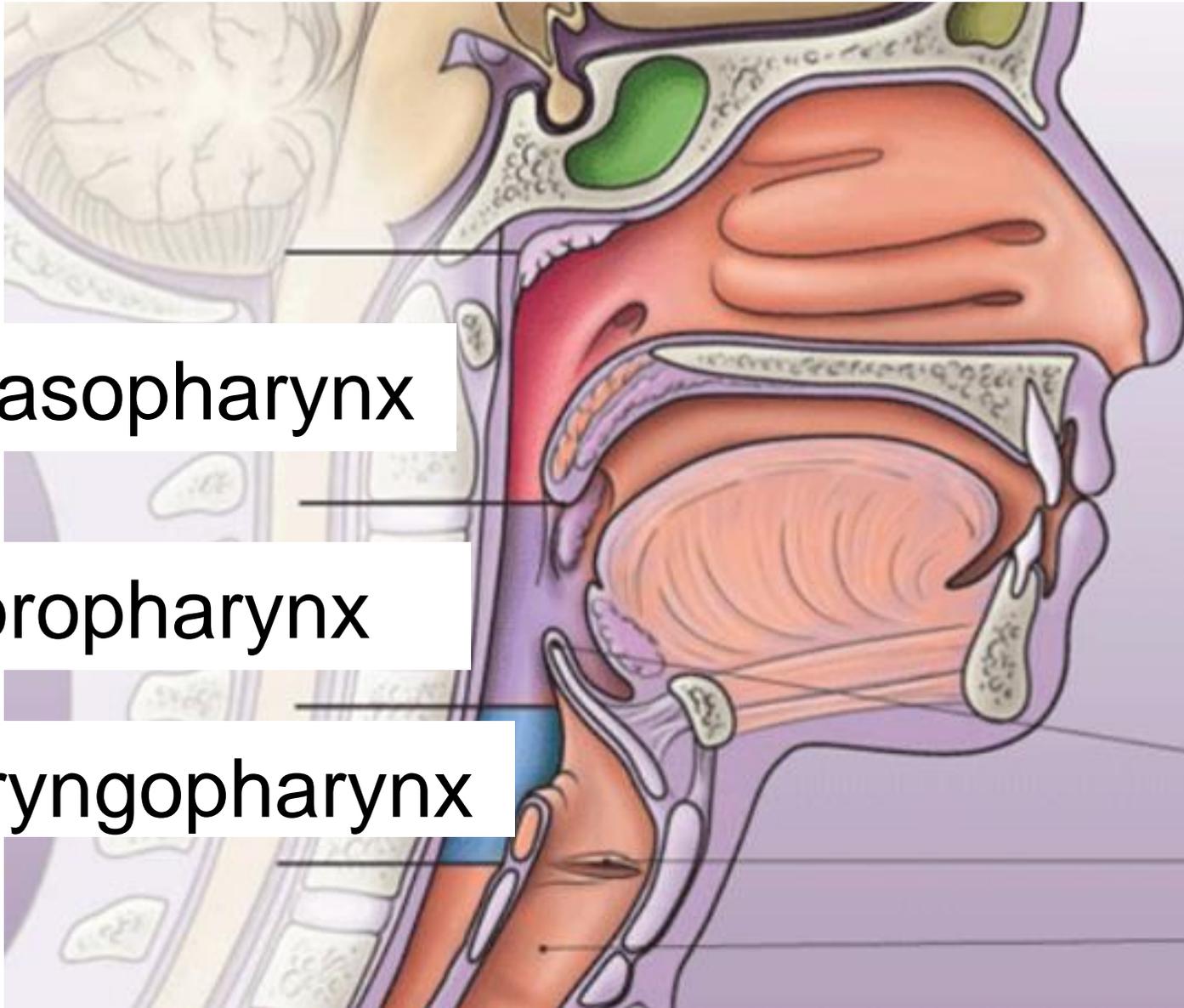


Function of the conchae - increase surface area

Mucus Membrane - warms and moistens air, also traps particles (dust)

\*particles go to stomach

Pharynx – behind the oral cavity, between the nasal cavity and larynx (space, not a structure)



nasopharynx

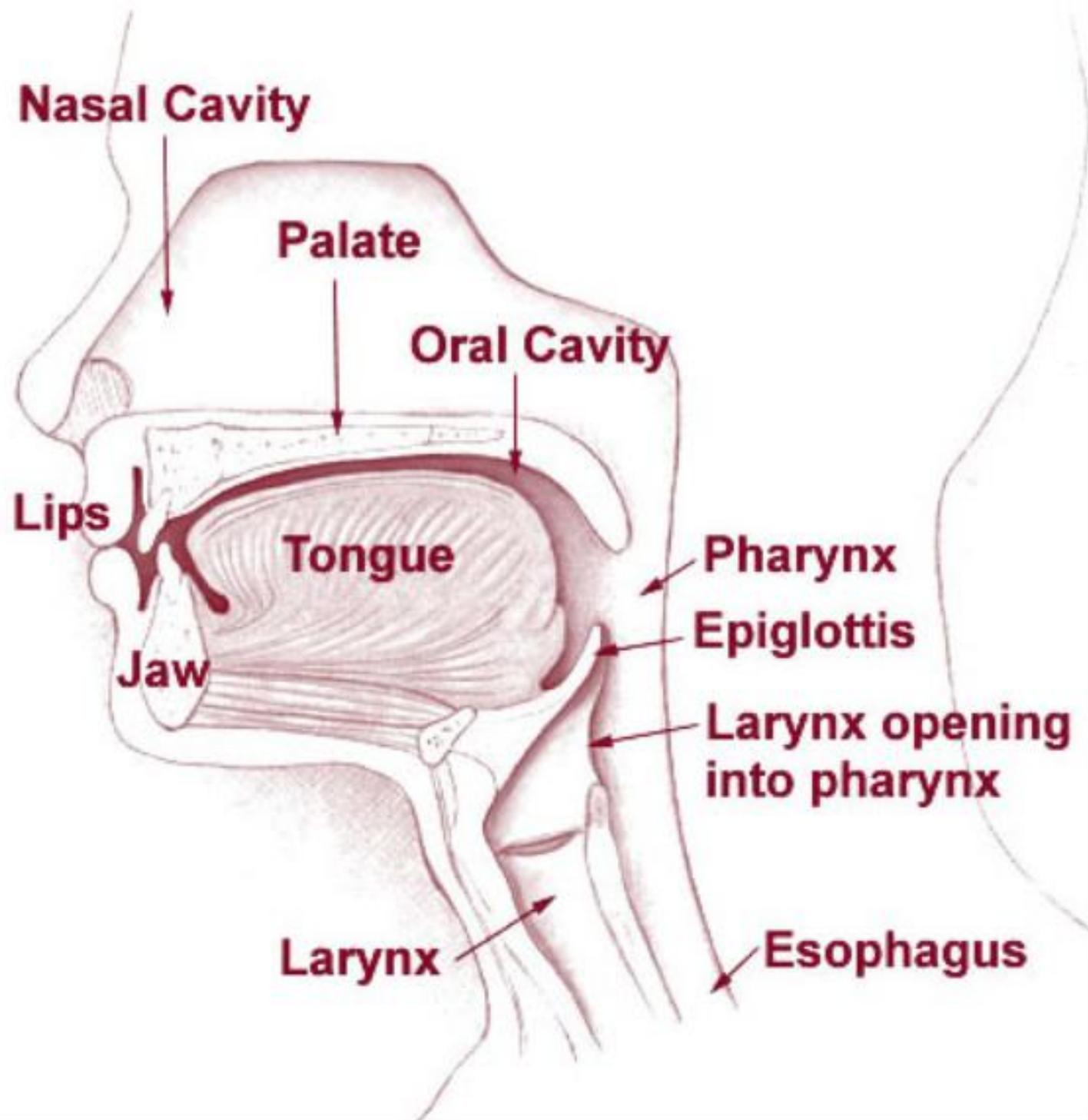
oropharynx

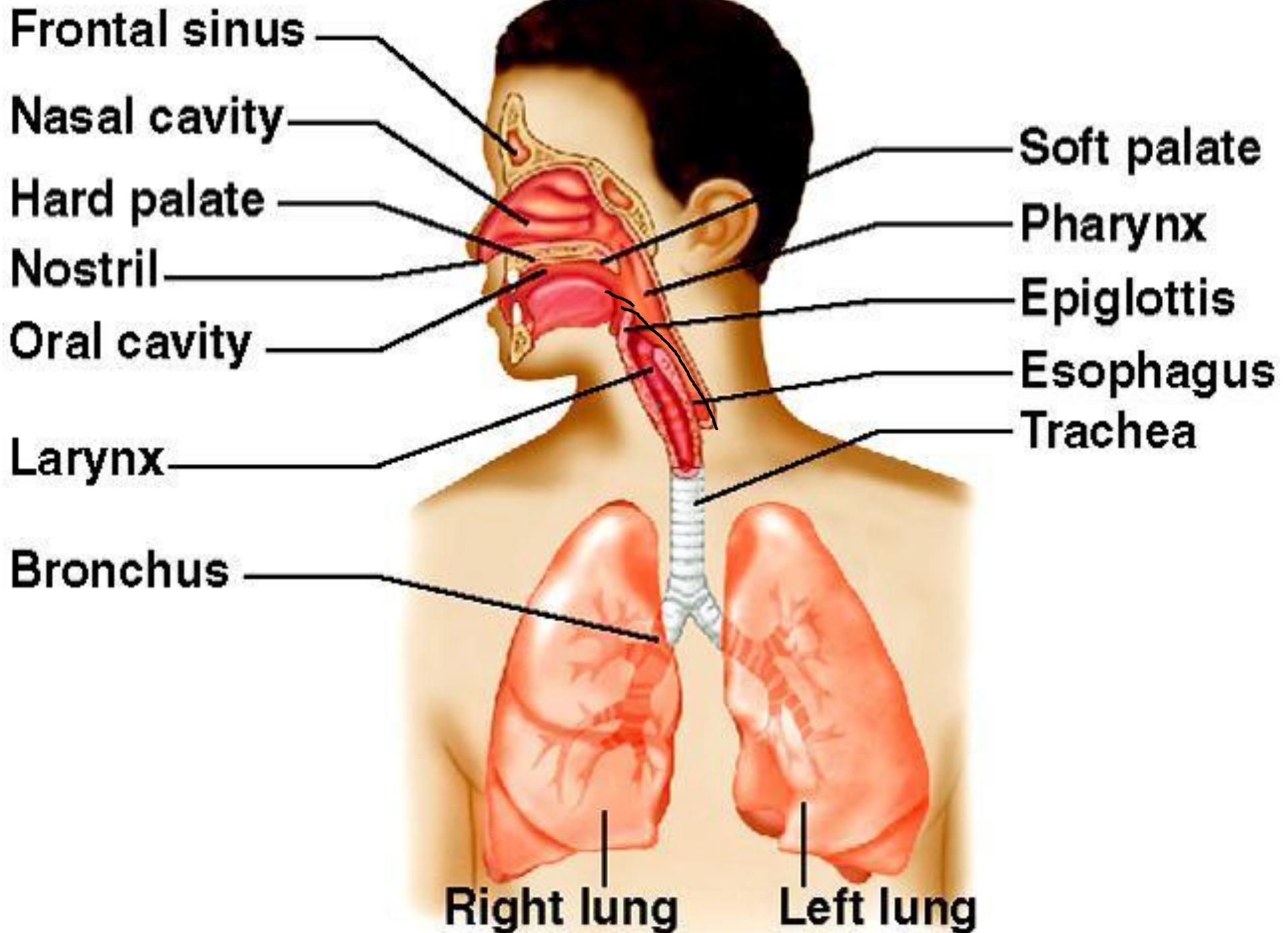
laryngopharynx

Epiglottis

Vocal folds

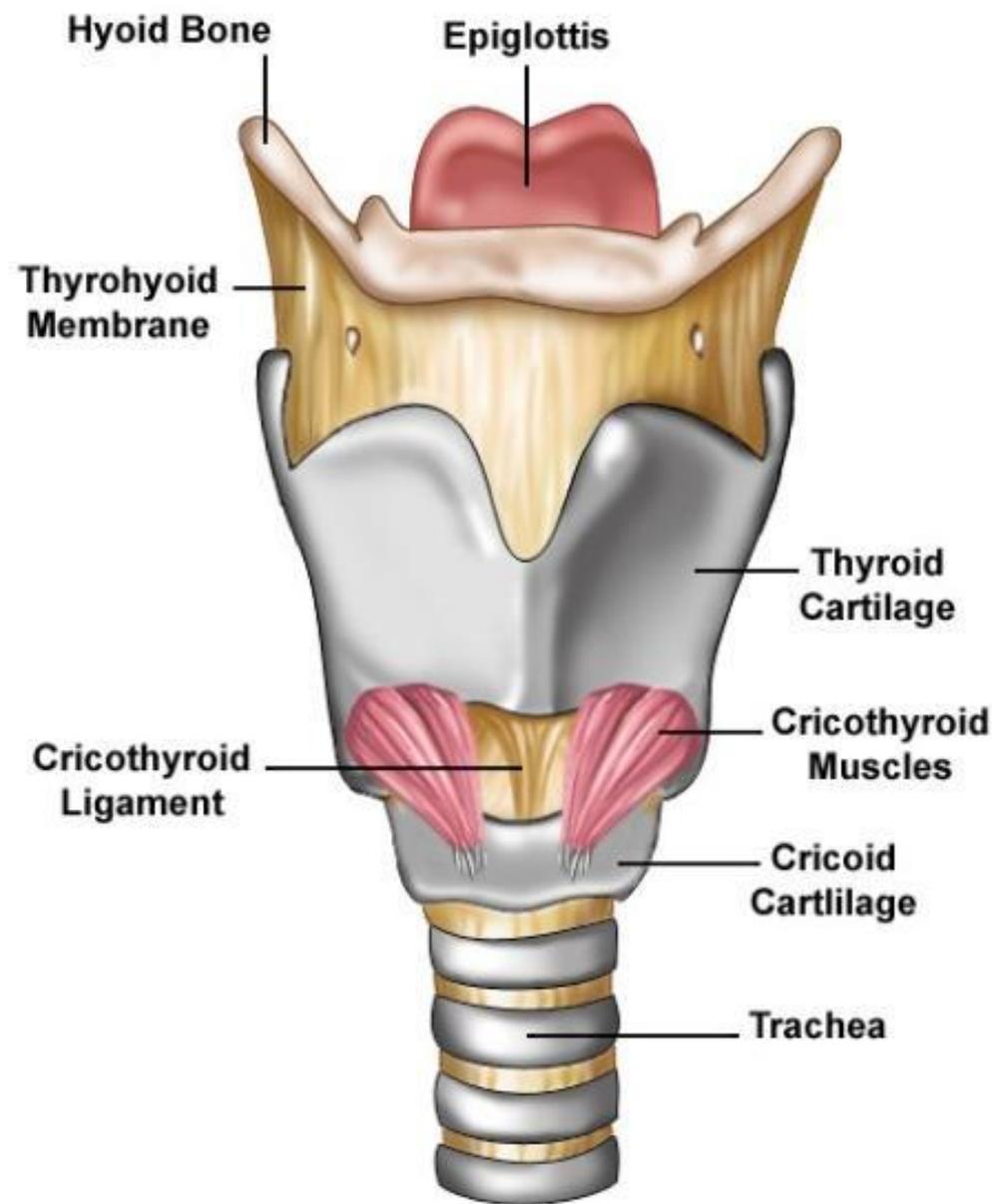
Trachea





Larynx – enlargement at the top of the trachea and below pharynx, conducts air in and out of trachea, houses vocal cords

- composed of muscles and cartilages (thyroid (Adam's apple), cricoids, epiglottic cartilages)



- false vocal folds (do not produce sound) – help close airway during swallowing

- true vocal folds (produce sound) – changing shape of the pharynx, and oral cavity changes sounds into words

- contracting and relaxing muscles changes pitch (increased tension = higher pitch)

Glottis

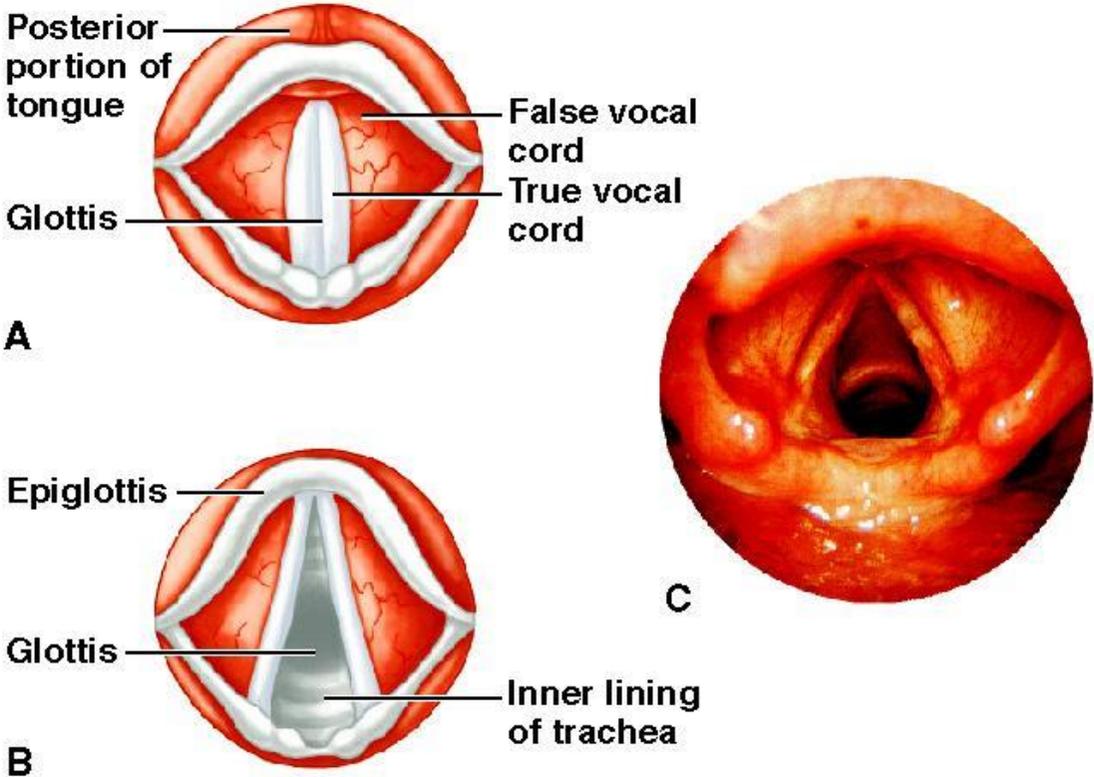




Glottis – triangular slit that opens during breathing/talking, and closes during swallowing

Epiglottis – flaplike structure that stands upright, allows air to enter larynx, during swallowing it presses downward and prevents food from entering air passages

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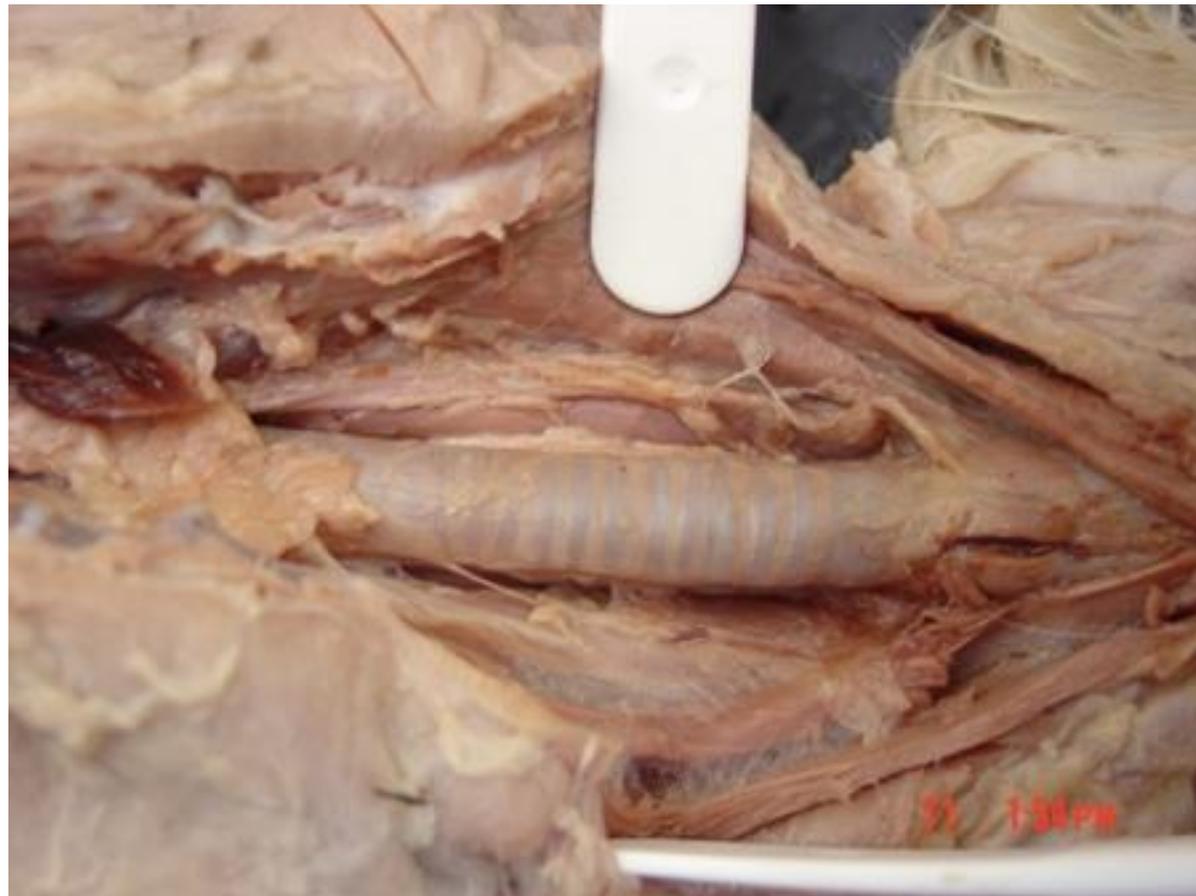


# LARYNGITIS

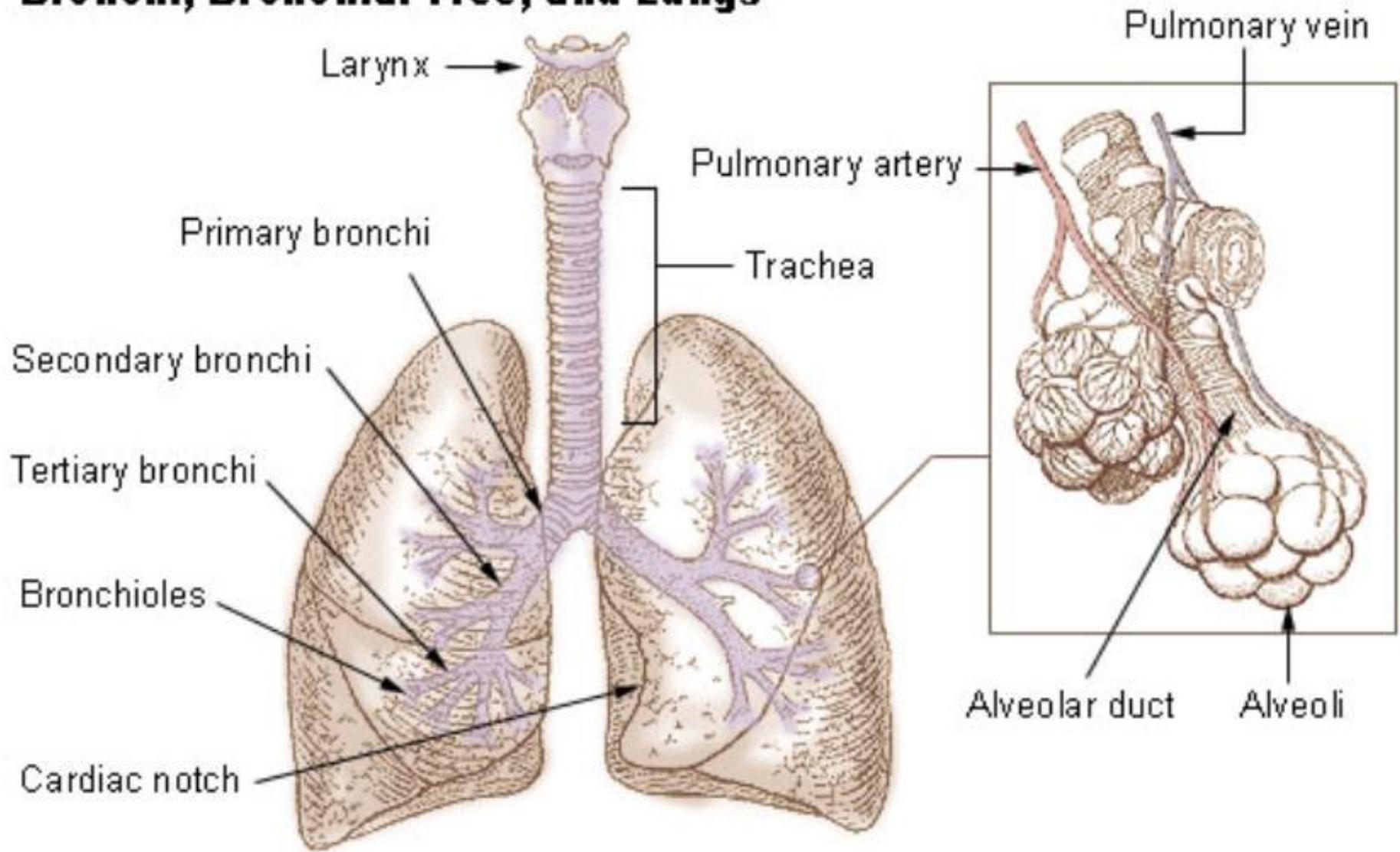
When the mucus membrane becomes swollen and prevents the vocal cords from vibrating freely.

Trachea (windpipe), flexible cylinder with cartilage to give it stiffness and keep it from collapsing

Trachea leads to the **BRONCHIAL TREE**

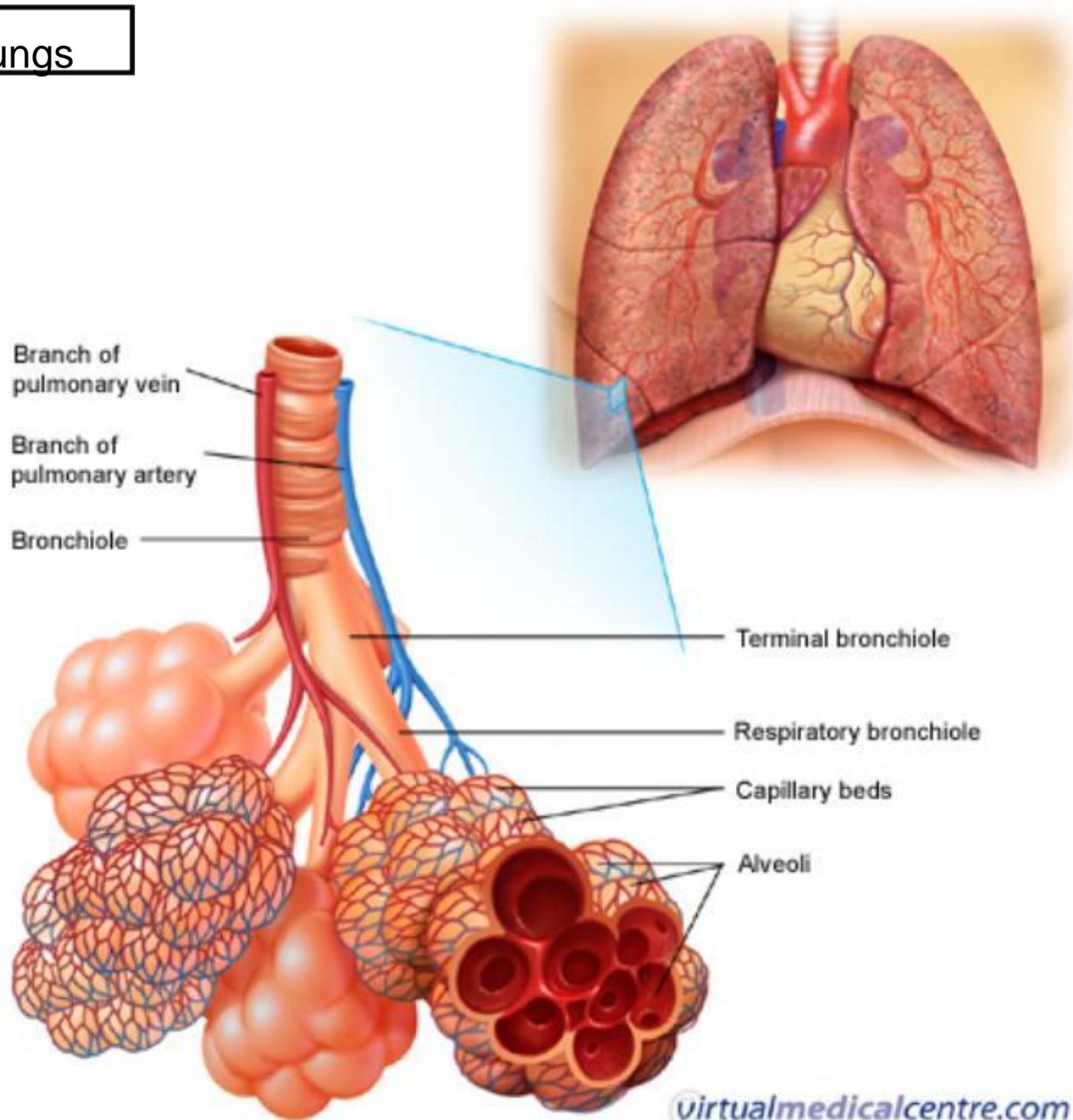


# Bronchi, Bronchial Tree, and Lungs

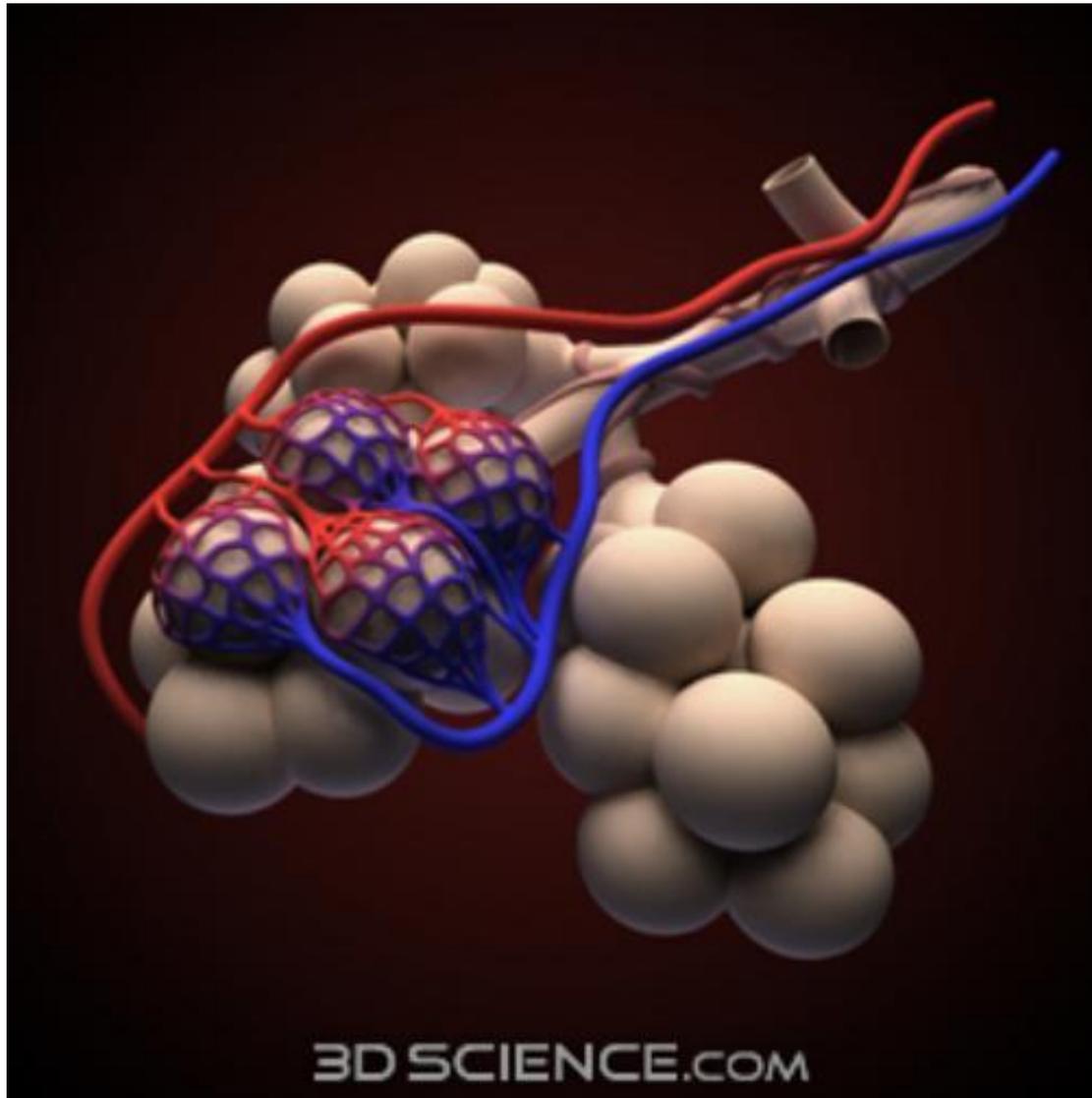


Primary bronchi --> bronchioles --> alveolar ducts --> sacs  
--> **alveoli**  
\*gas exchange

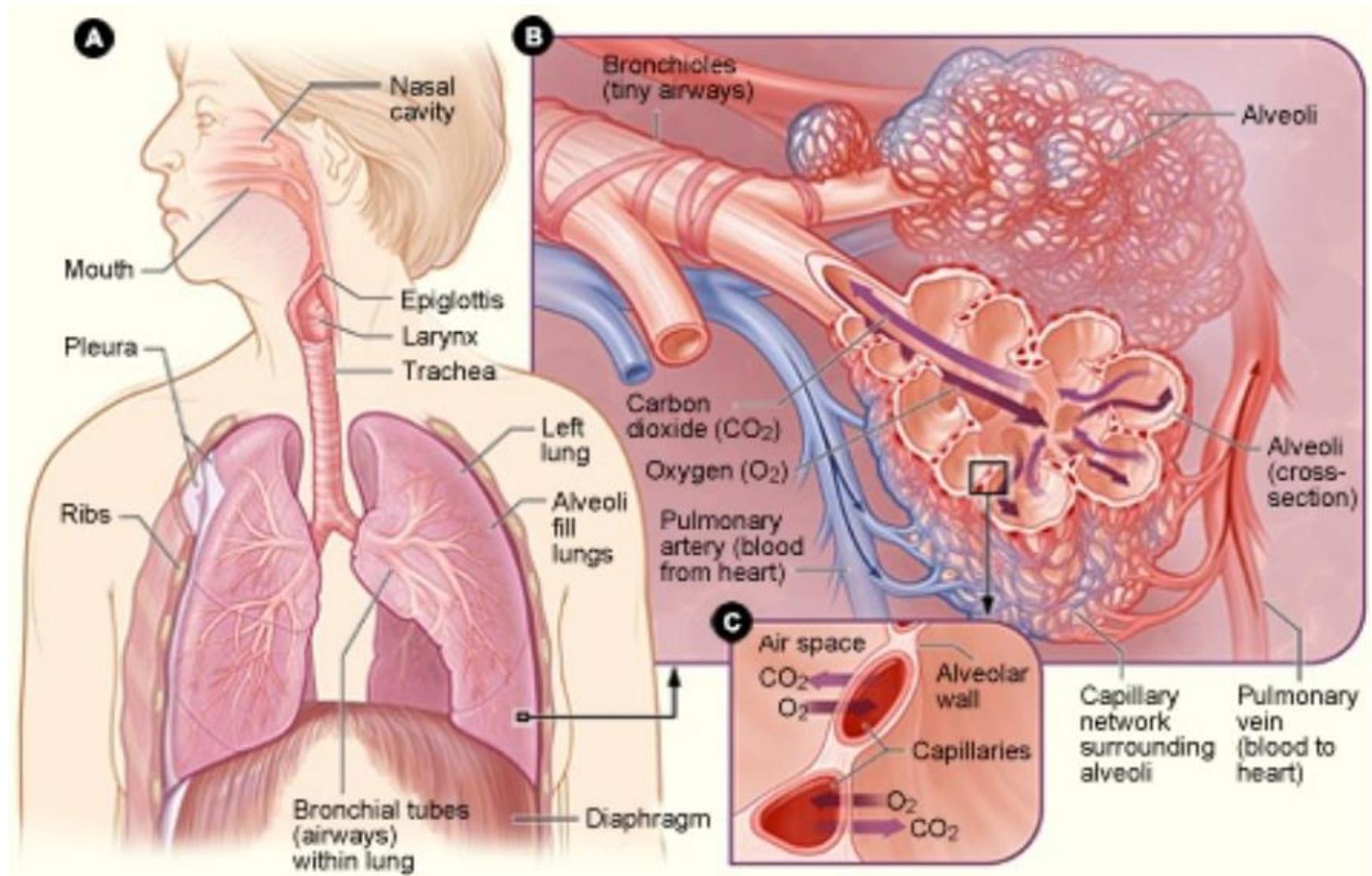
# Alveoli & Lungs



# ALVEOLI



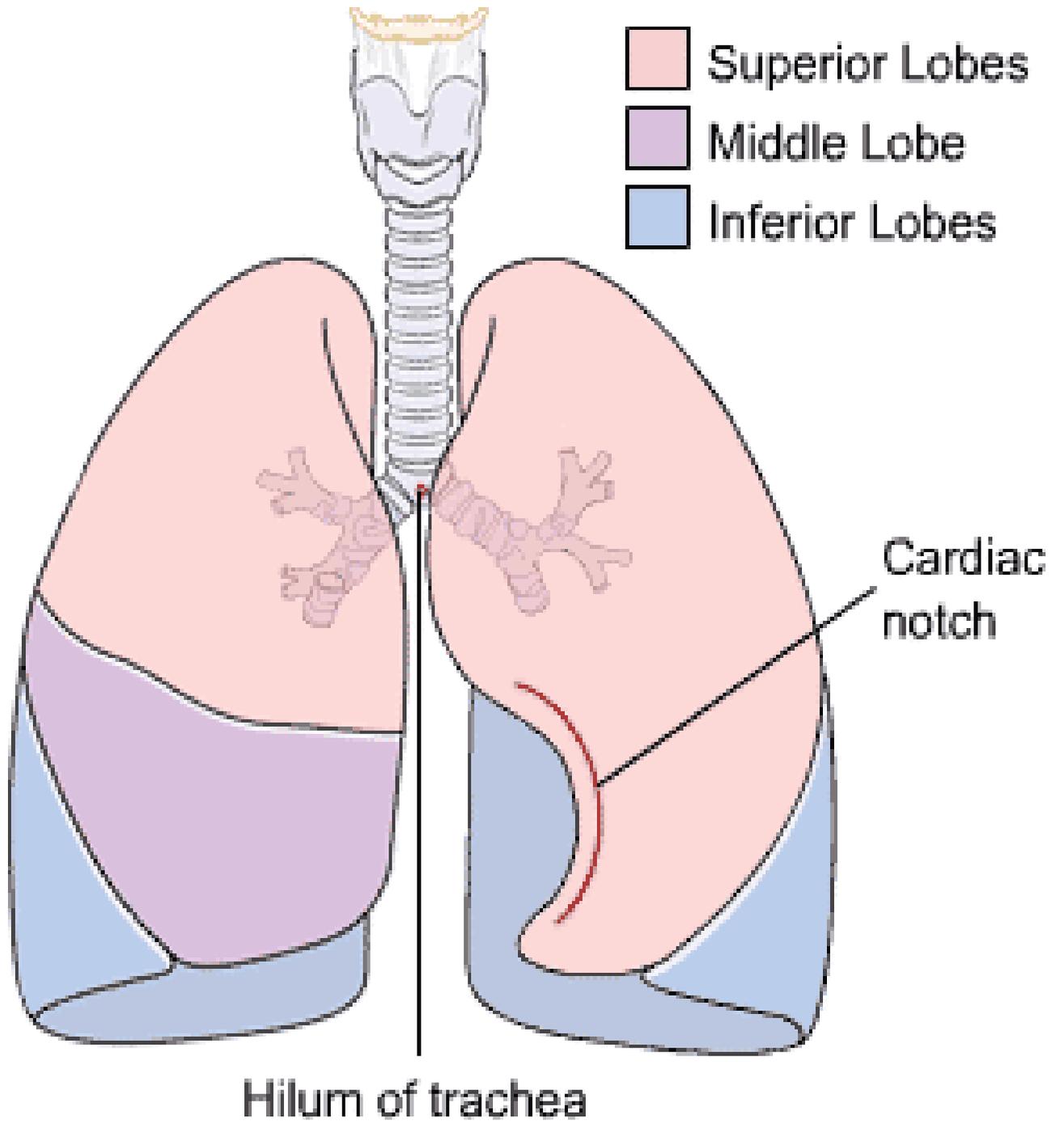
# LUNGS - spongy tissue that sit within the pleural cavity



Right Lung  
= 3 lobes

Left Lung  
= 2 lobes

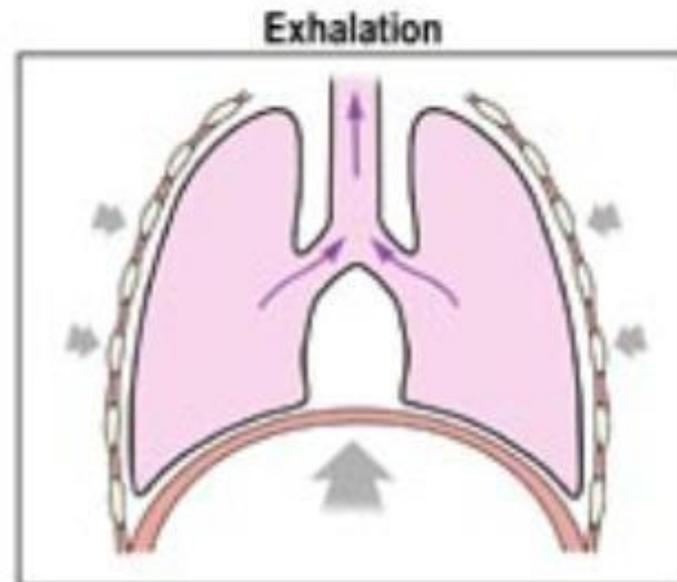
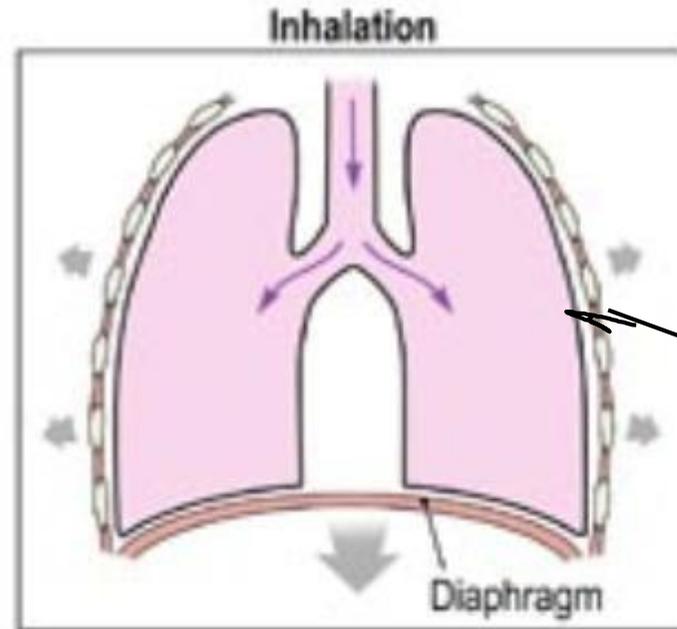
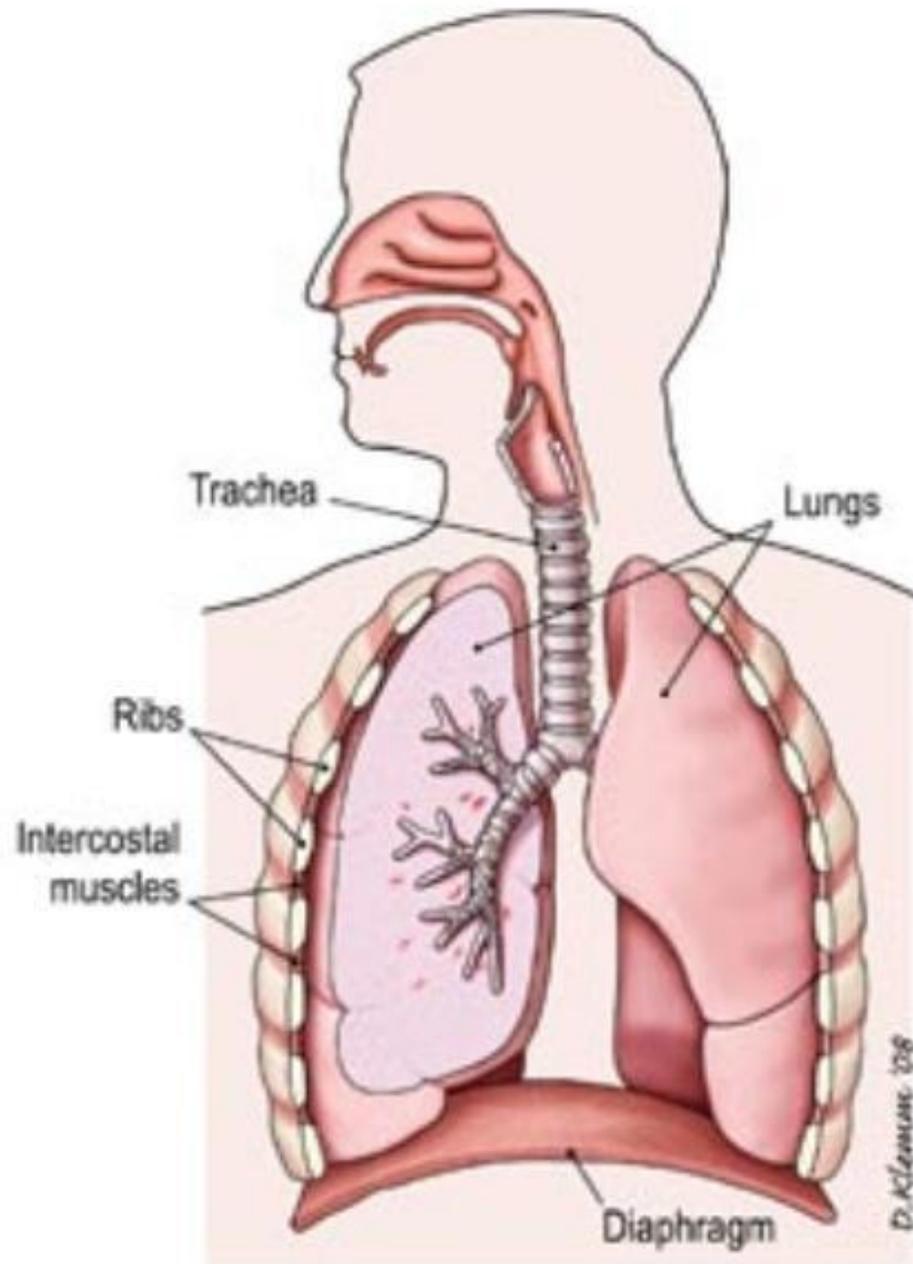
Serous fluid  
lubricates lungs  
during breathing



# Quick Quiz

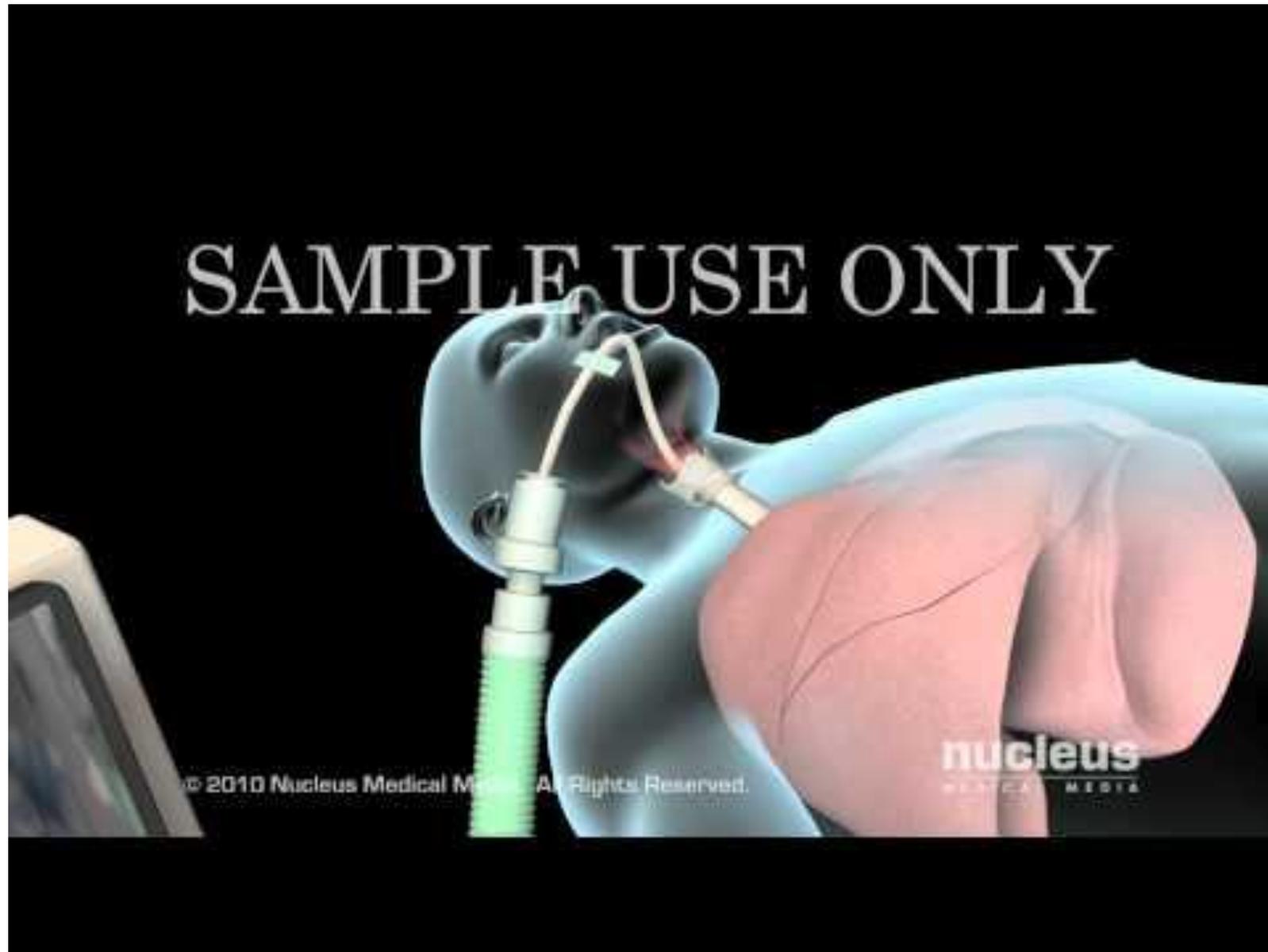
1. What do you call the bones found within the nasal cavity?
2. What specific bone divides the nasal cavity into two sides?
3. The space at the back of the mouth is the\_\_\_\_\_.
4. The spaces within the bones of the skull are called the \_\_\_\_\_
5. What structure is known as the windpipe? \_\_\_\_\_
6. What is the triangular slit that opens during breathing and talking?
7. In what structures does gas exchange occur?
8. During swallowing, this flap closes to prevent food from entering the airway: \_\_\_\_\_

# BREATHING MECHANISM





# Gas Exchange and Intubation



1. Diaphragm moves down, forcing air into airways
2. Intercostals contract, enlarging cavity even more
3. Membranes move with the contractions
4. Surface tension in alveoli and **surfactant** keep them from collapsing
5. Other muscles (pectoralis minor and sternocleidomastoid) can force a deeper breath
6. The first breath in newborns is the hardest due to lack of surfactant

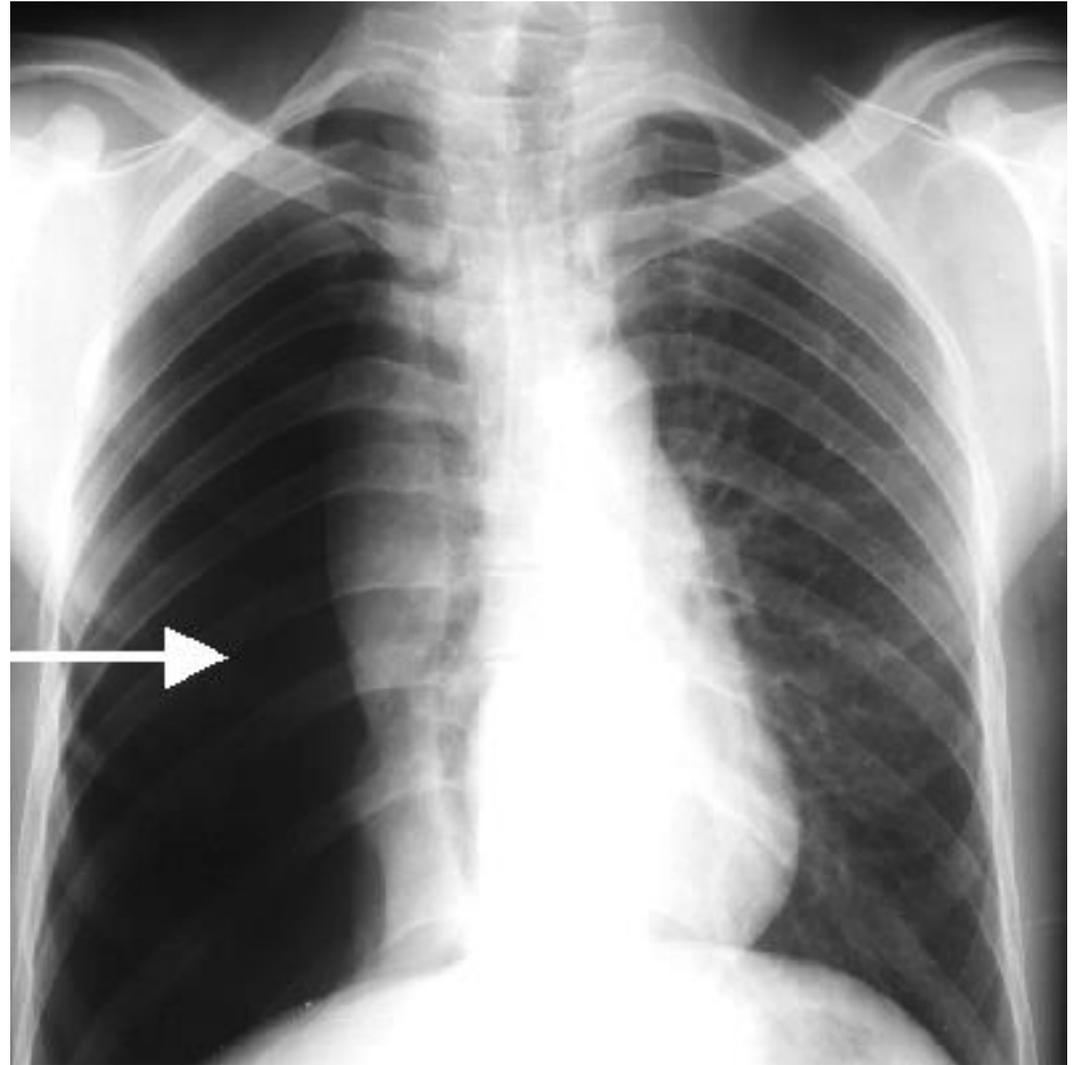


# ATMOSPHERIC PRESSURE = 760 Hg

**Pressure** is necessary for breathing, which is why it is difficult to breathe in high altitudes and also why a punctured lung can be dangerous.

A hole in the pleural cavity can cause the lung to collapse or deflate

Pneumothorax  
= collapsed lung

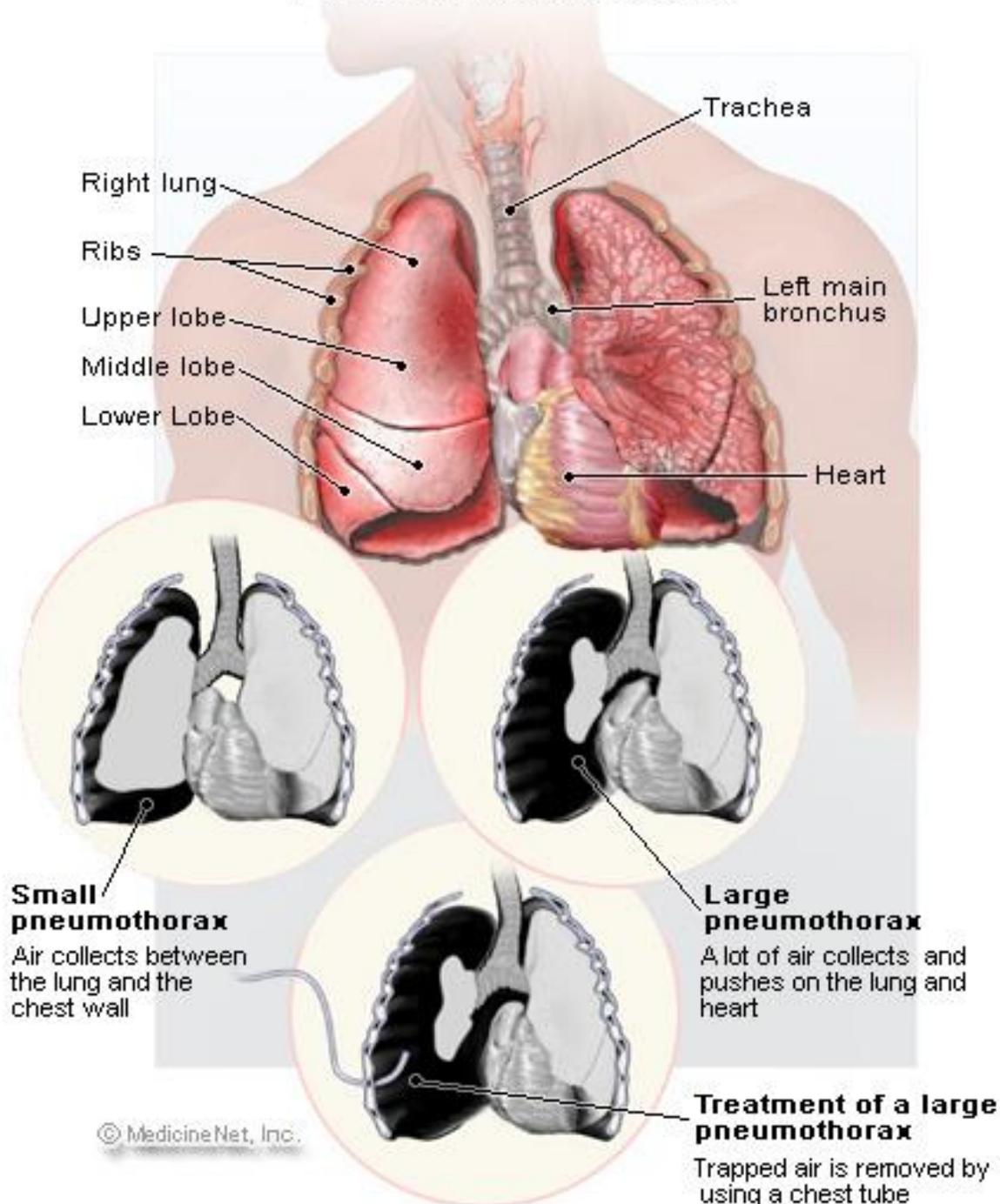


# Pneumothorax



Also check out this [procedure](#) where fluid is drained from the lungs - not for those with a weak stomach!

# Pneumothorax

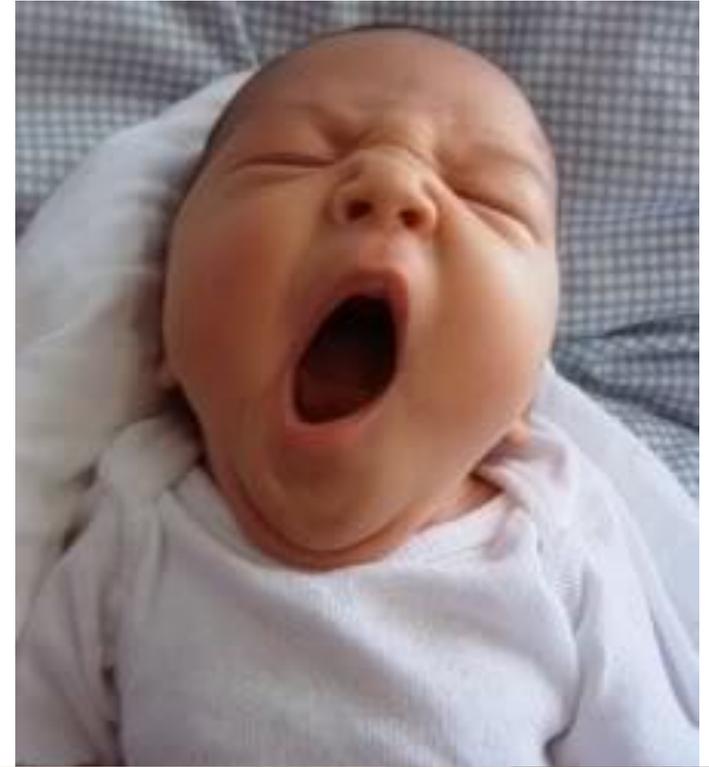


# NON RESPIRATORY MOVEMENTS

Coughing, sneezing,  
laughing, crying

Hiccup - spasm of the  
diaphragm

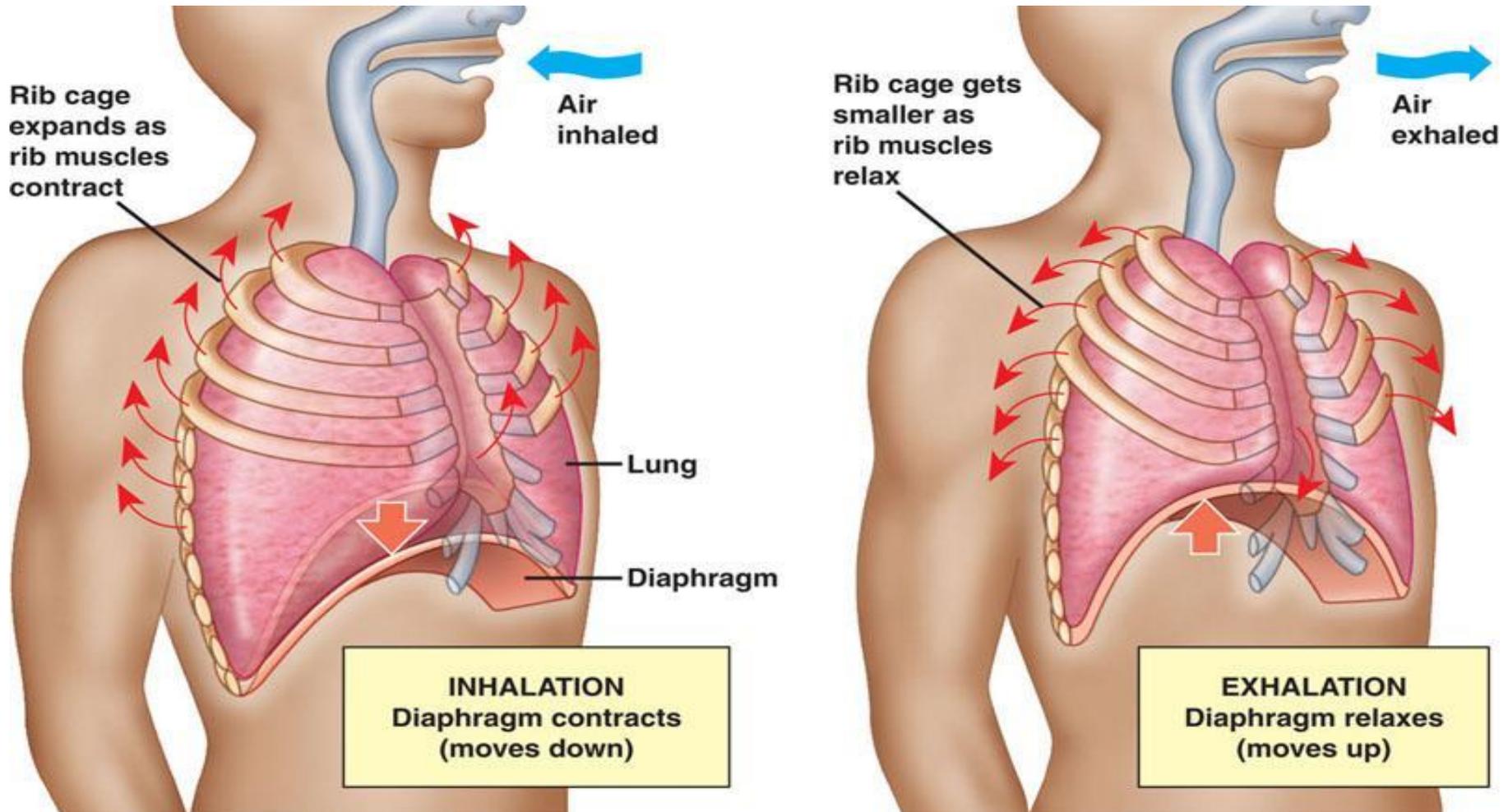
Yawn - possibly causes by  
low oxygen levels



# EXHALATION

As the diaphragm and other muscles relax, ELASTIC RECOIL from surface tension forces air out.

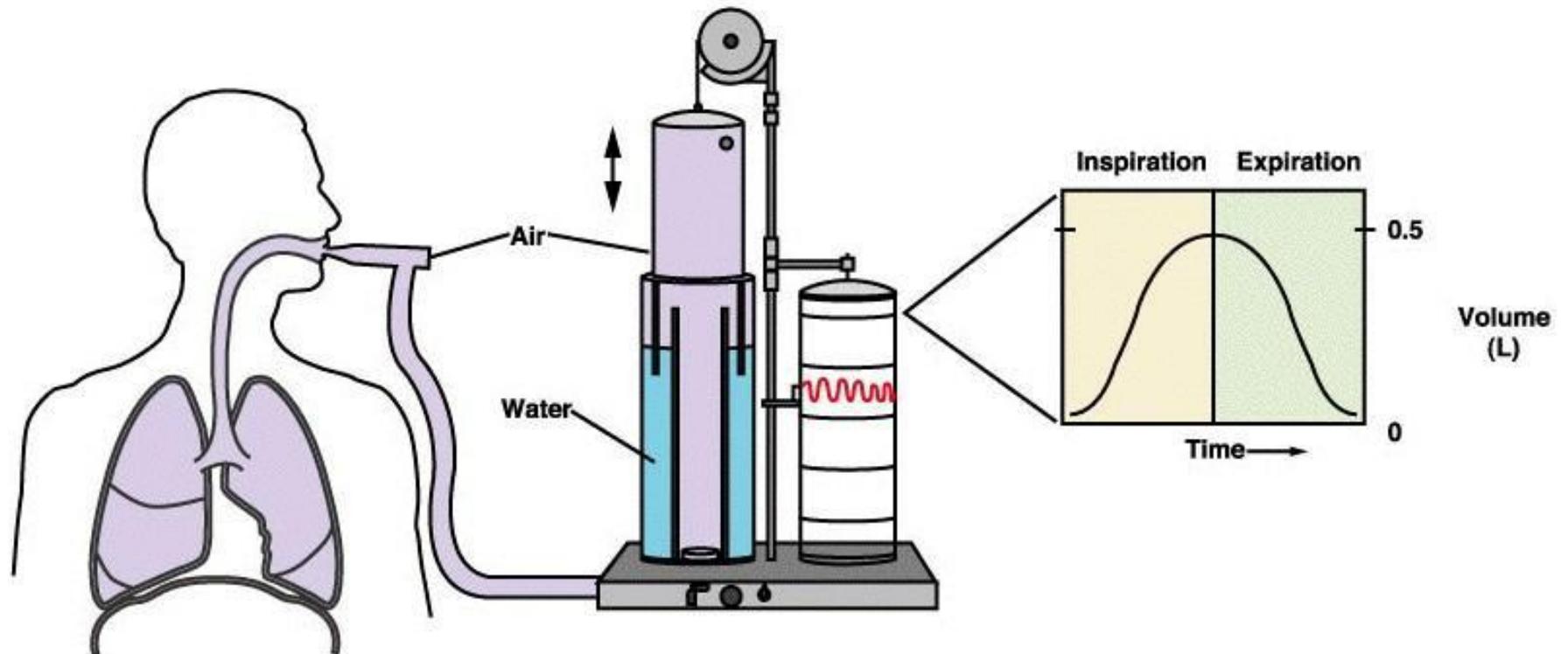
Muscles can force extra air out or in



# Respiratory Air Volumes

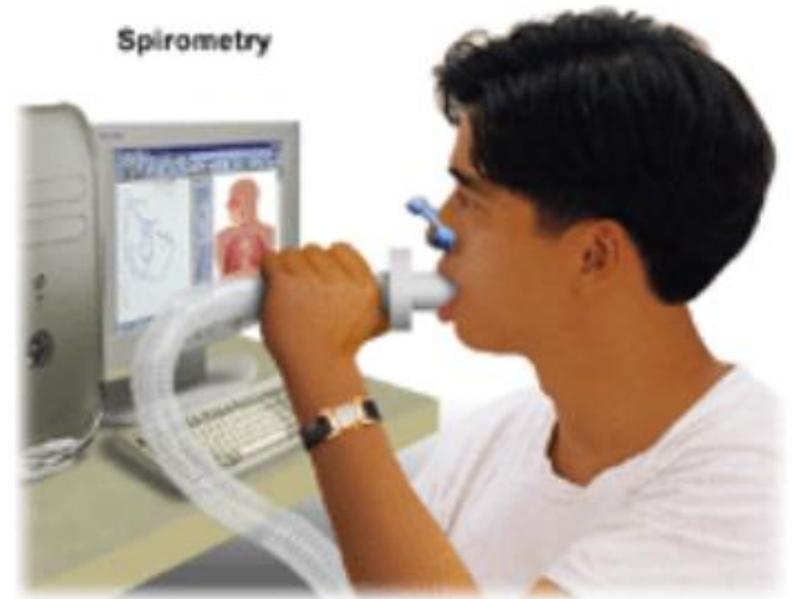
**Spirometry** - measures the amount (volume) of air moving in and out of the lungs

Respiratory Cycle - 1 inspiration and 1 expiration



Resting Tidal Volume -  
amount of air that enters  
the lungs during one cycle

\*take a normal breath



Reserve volumes - air that can be  
forced out or in

\*inhale normally, pause, and try to  
inhale more - that is your reserve  
inspiratory volume

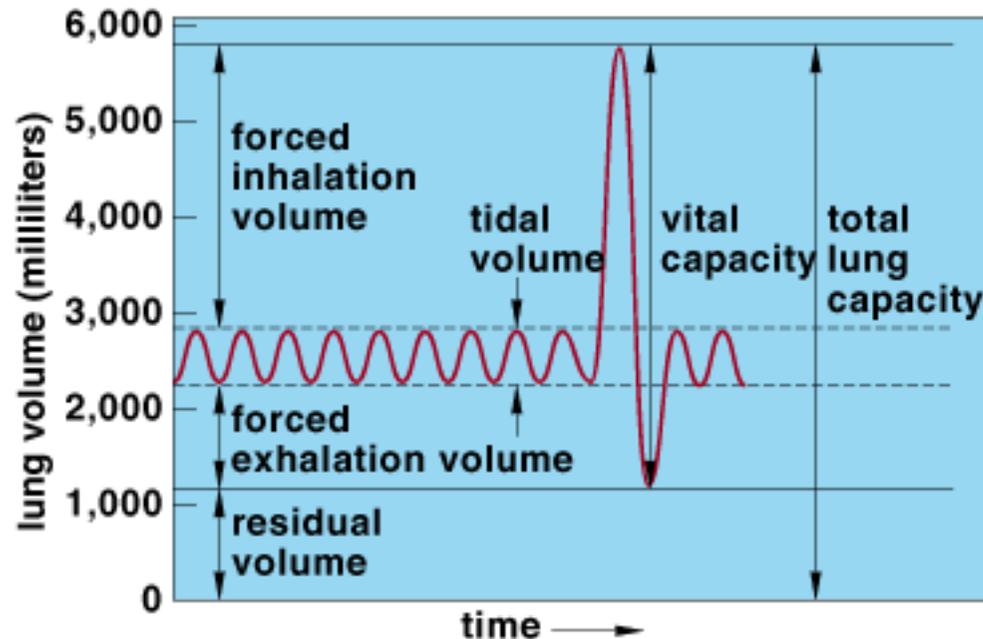
This respirometer has a tub filled with water. When you blow into the tube, the device raises and measures the lung capacity by how much the middle compartment rises.

**VITAL CAPACITY = Insp reserve + Exp reserve + Tidal Volume**

**INSPIRATORY CAPACITY = Tidal Volume + Insp Reserve Volume**

**FUNCTIONAL RESIDUAL CAPACITY** is the volume of air that remains in the lungs at rest

**TOTAL LUNG CAPACITY** varies by sex, age, body size, athletics



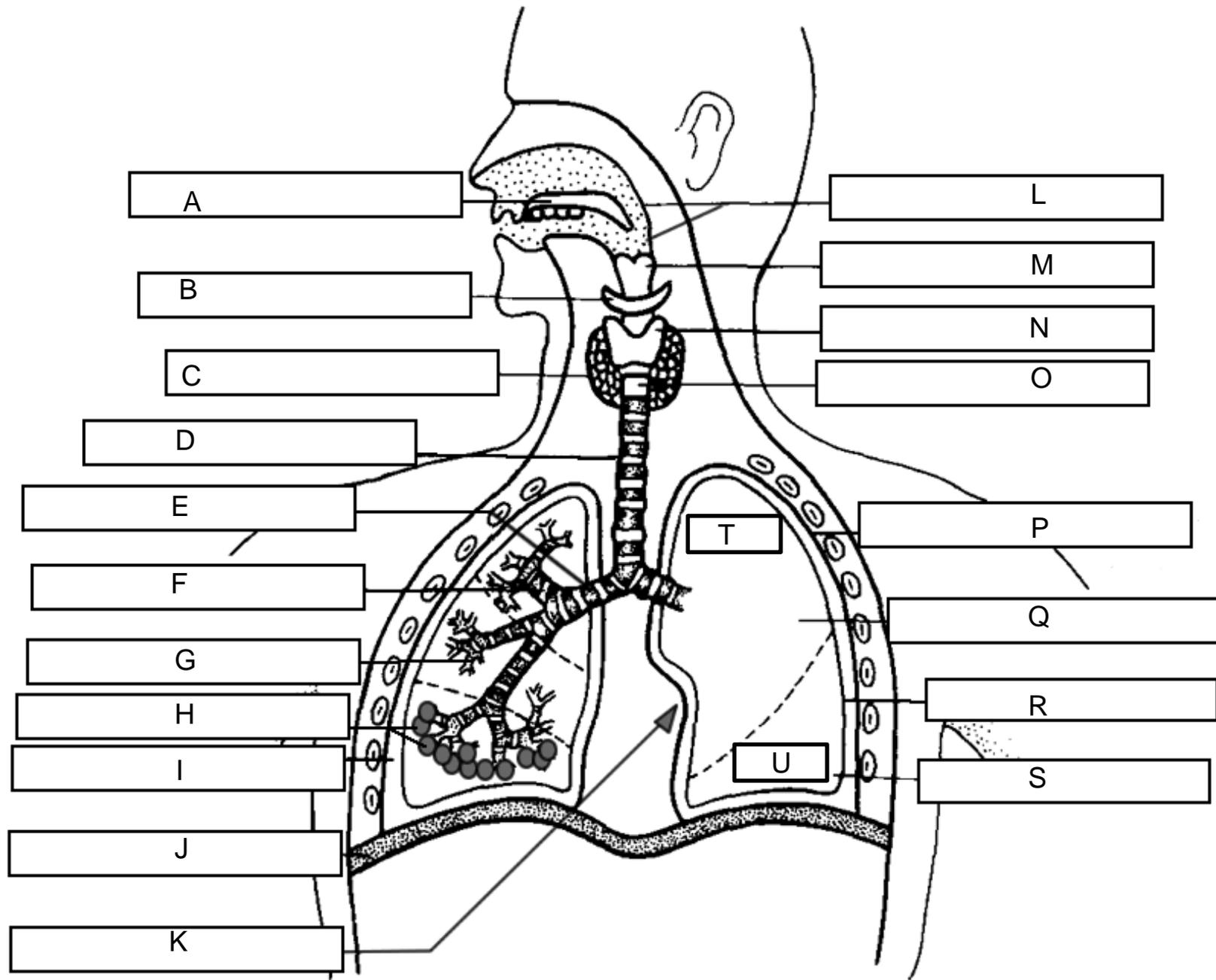
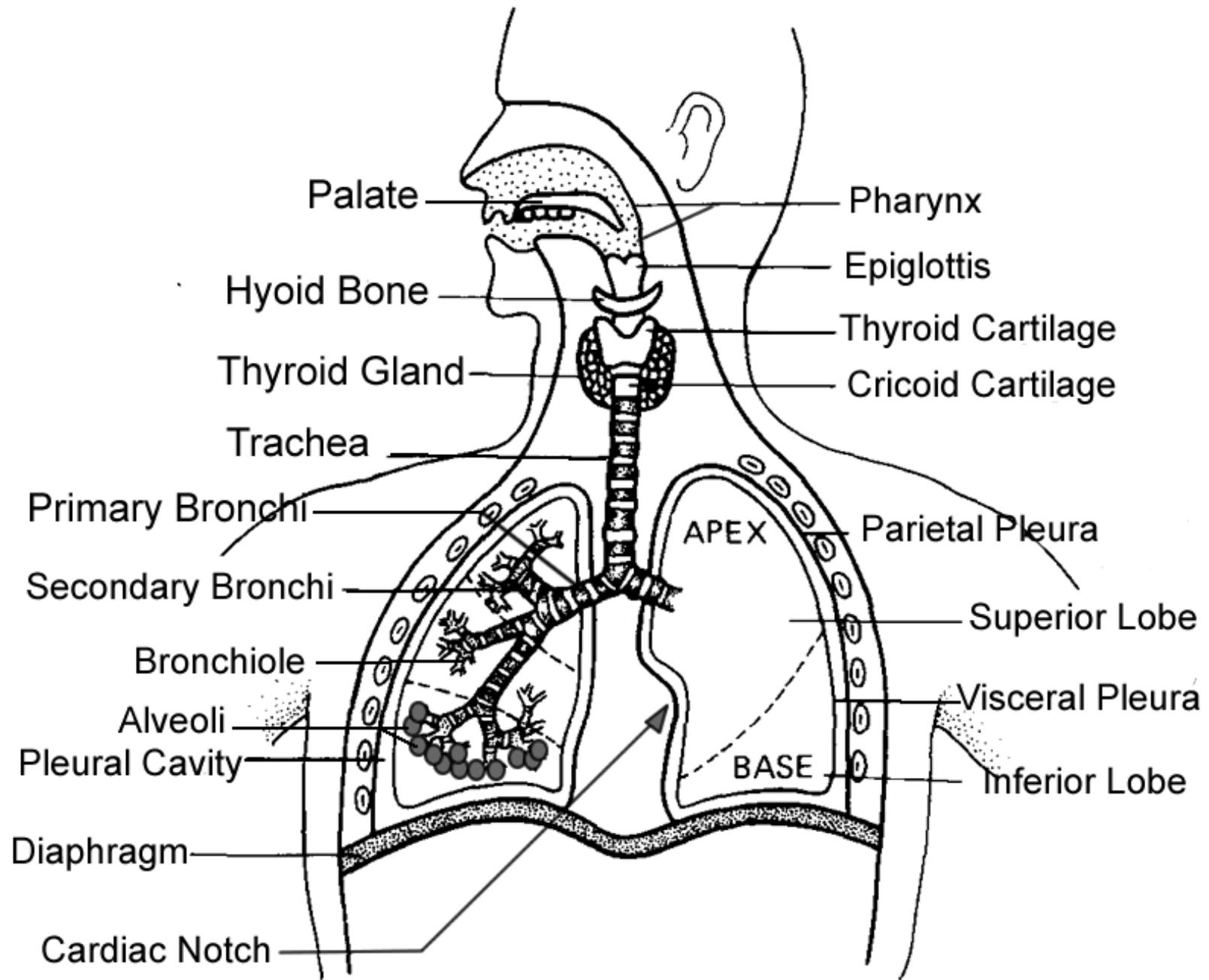


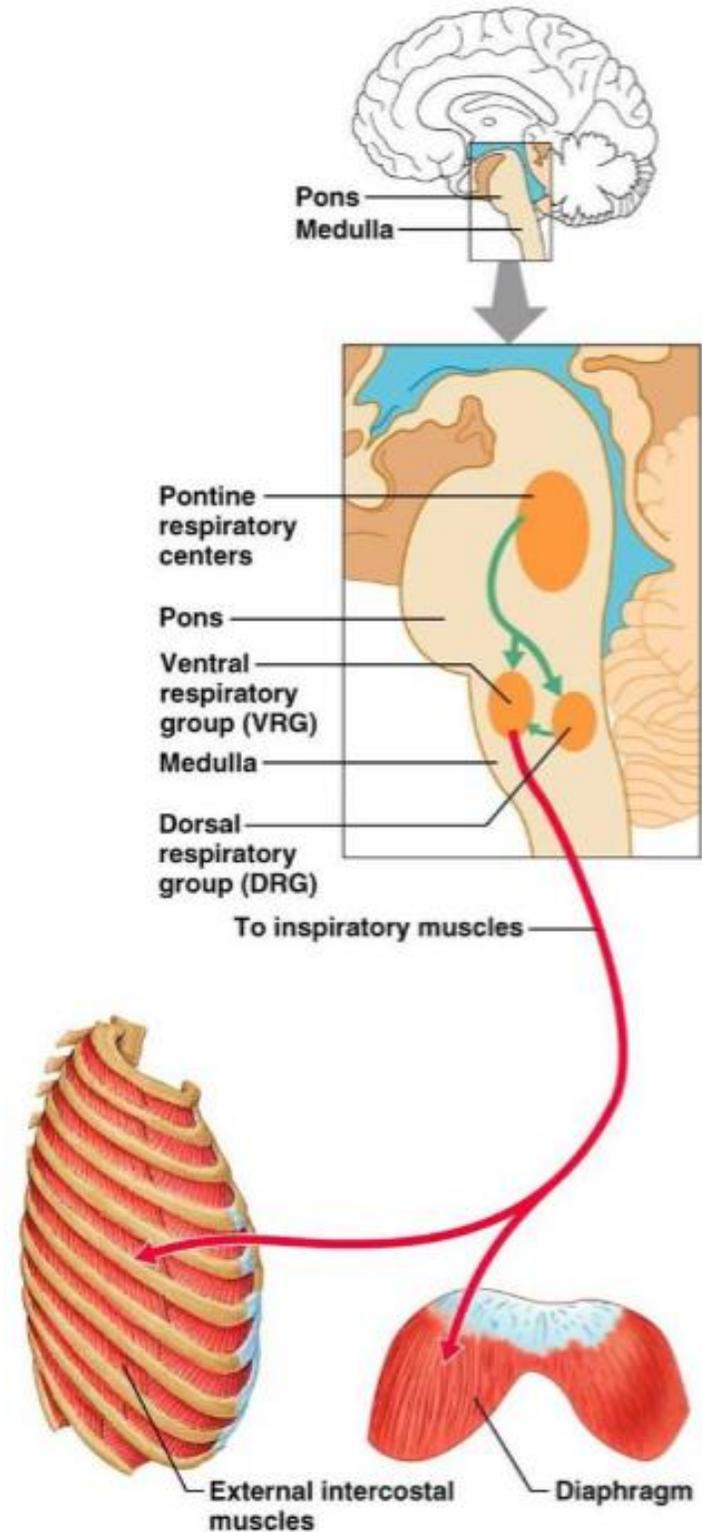
Image adapted from <http://www.arthursclipart.org/>



Breathing is involuntary, but muscles are under voluntary control

Respiratory Center – groups of neurons in the brain that control inspiration and expiration

(based in the medulla and the pons)



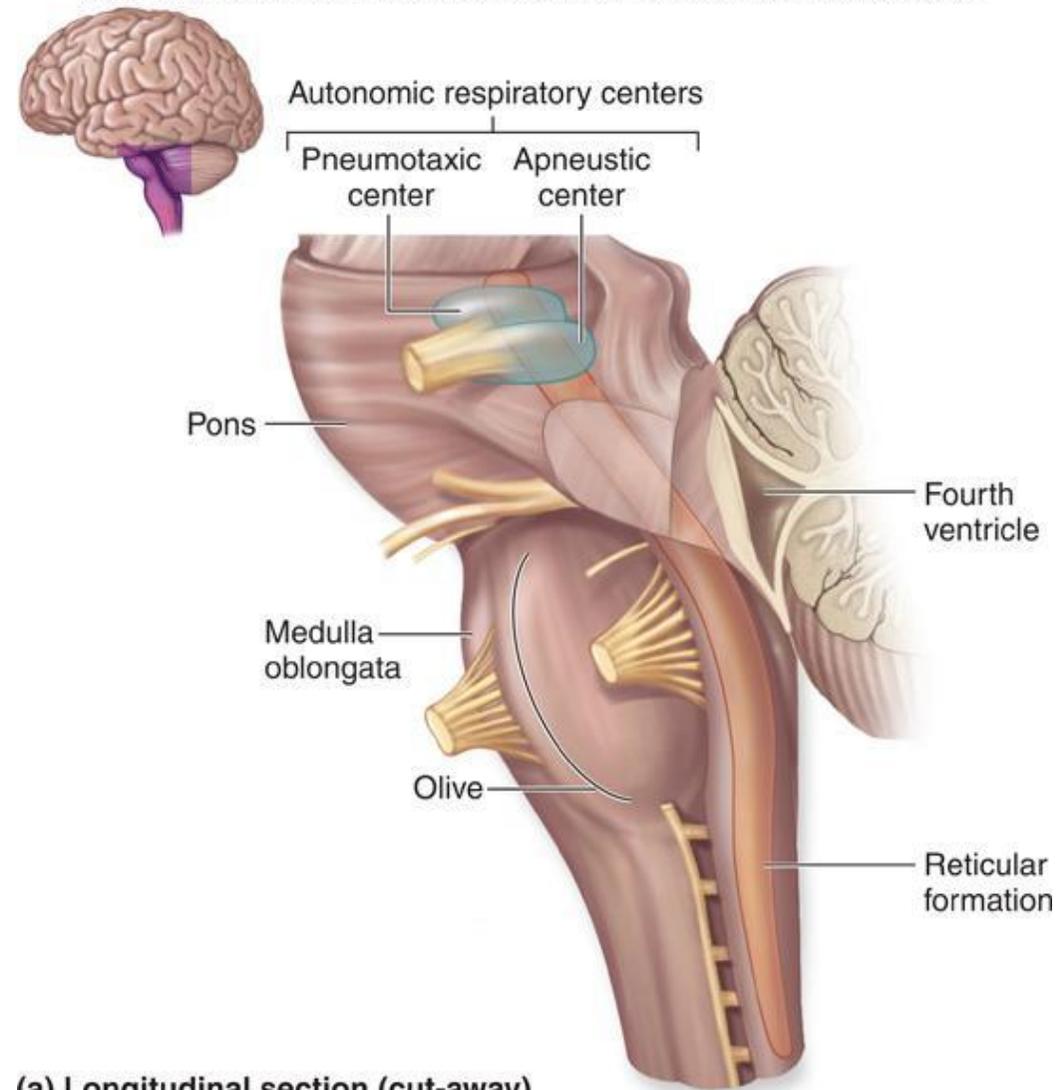
# Medulla Rhythmicity Area

Dorsal Respiratory Group  
(rhythm)

Ventral Respiratory Group  
(forced)

Pneumotaxic Area  
(pons) - inhibit

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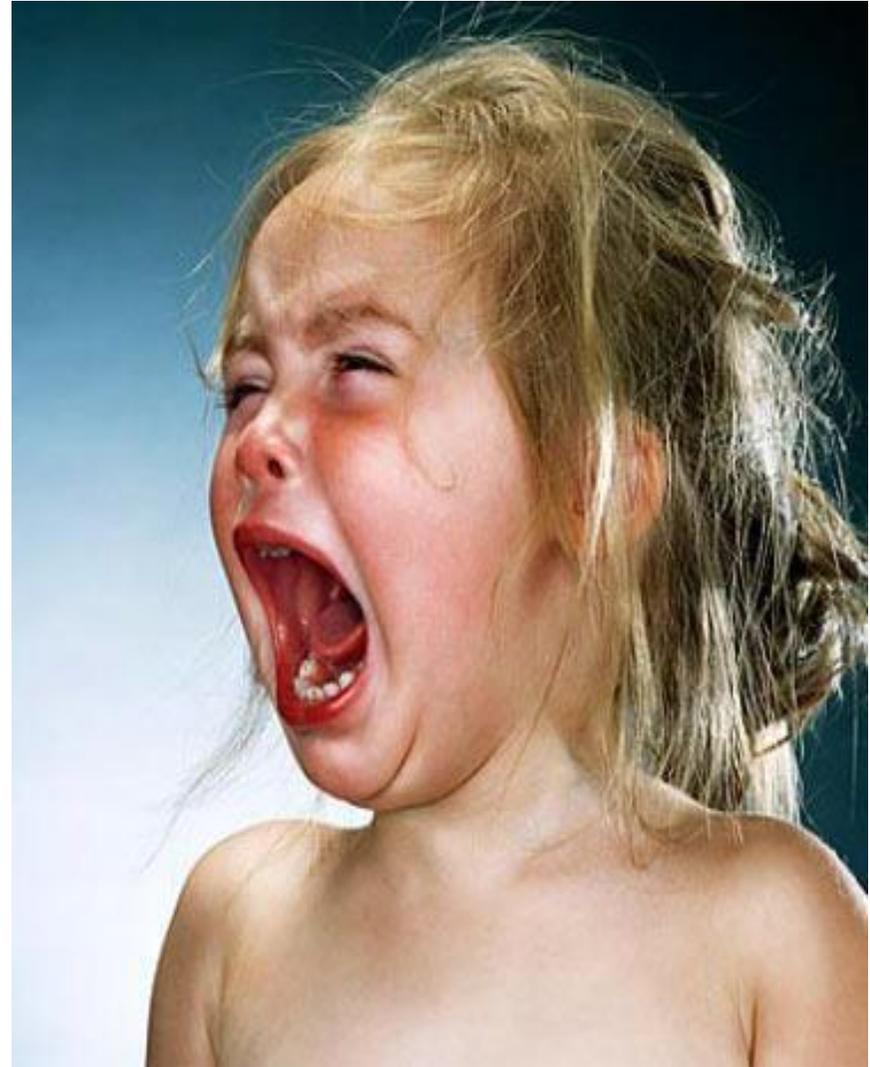


(a) Longitudinal section (cut-away)

# Factors Affecting Breathing

\*Chemosensitive areas – detect concentrations of chemicals like carbon dioxide and hydrogen

1. Rise in CO<sub>2</sub>
2. Low blood oxygen (peripheral chemoreceptors, carotid and aortic bodies, sense changes)
3. Inflation reflex – regulates the depth of breathing, prevents overinflation of the lungs
4. Emotional upset, fear and pain

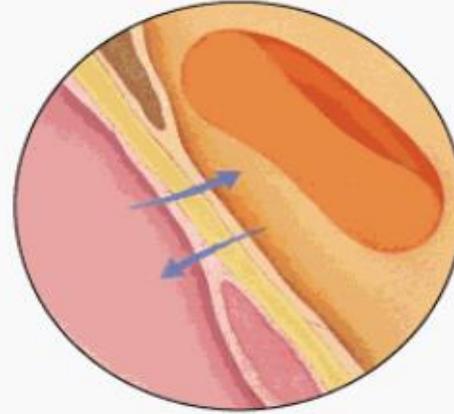
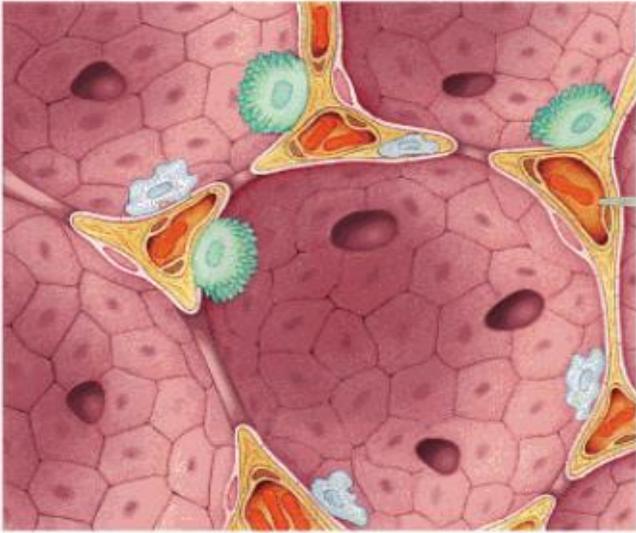


# Hyperventilation - increase breathing, lower CO<sub>2</sub> concentration

Breathing into a bag  
can restore CO<sub>2</sub>  
concentrations



# Respiratory Membrane – alveoli and blood exchange gasses



Gas exchange occurs across a membrane - a layer of simple squamous cells

Oxygen DIFFUSES into the bloodstream

Other substances (like alcohol can diffuse too)



**Hypoxia** is a disease in which there is an overall lack of oxygen content within the body's tissue and vital human organs (specifically the brain).

*Hypoxia has several potential causes, including: cardiac arrest, severe head trauma, carbon monoxide poisoning, suffocation, strangulation, and choking, as well as any instance in which oxygen supply is deprived from the body.*

**Asphyxia** is a condition of severely deficient supply of oxygen to the body that arises from being unable to breathe normally.

An example of asphyxia is choking. Asphyxia causes generalized hypoxia, which primarily affects the tissues and organs.



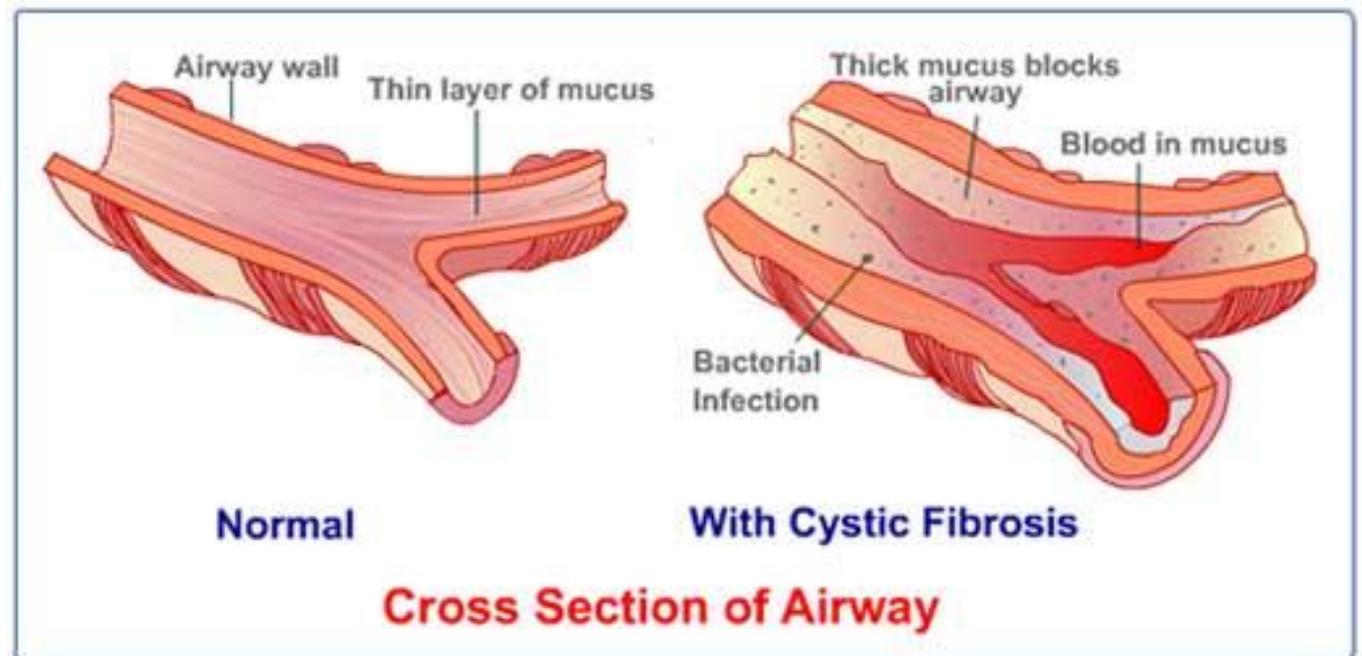
# ILLNESSES RELATED TO THE RESPIRATORY SYSTEM

1. Cystic Fibrosis (genetic)
2. Asthma
3. Bronchitis
4. Apnea
5. Emphysema
6. Lung Cancer
7. Altitude Sickness
8. Chronic Obstructive Pulmonary Disease (COPD)
9. Sinusitis
10. Bacterial or Viral Infections (cold, flu, pneumonia)



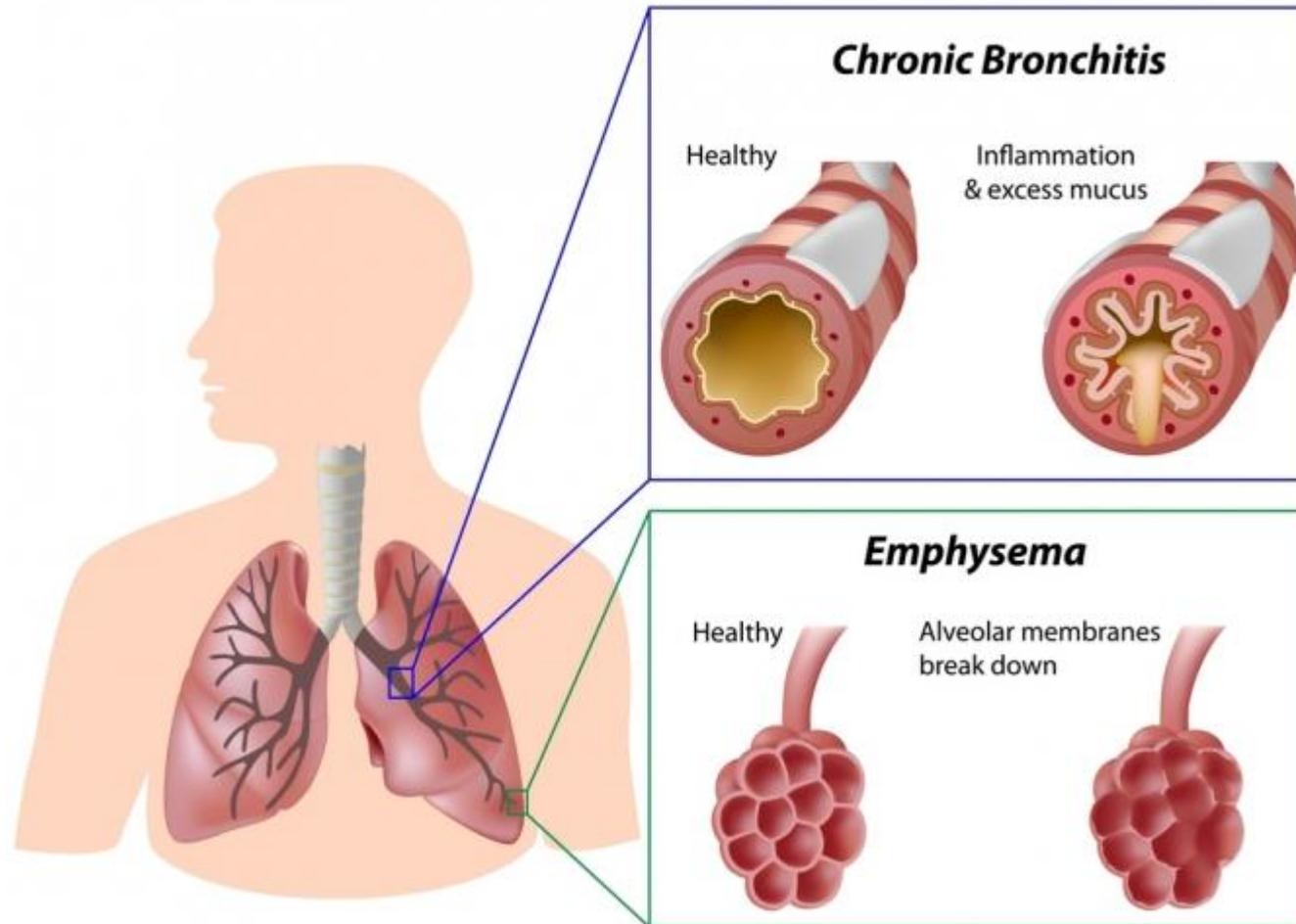
# Cystic Fibrosis - hereditary disease, mucus clogs the lungs.

Two parents can be carriers:  $Ff \times Ff$   
and produce a child with the disease:  $ff$

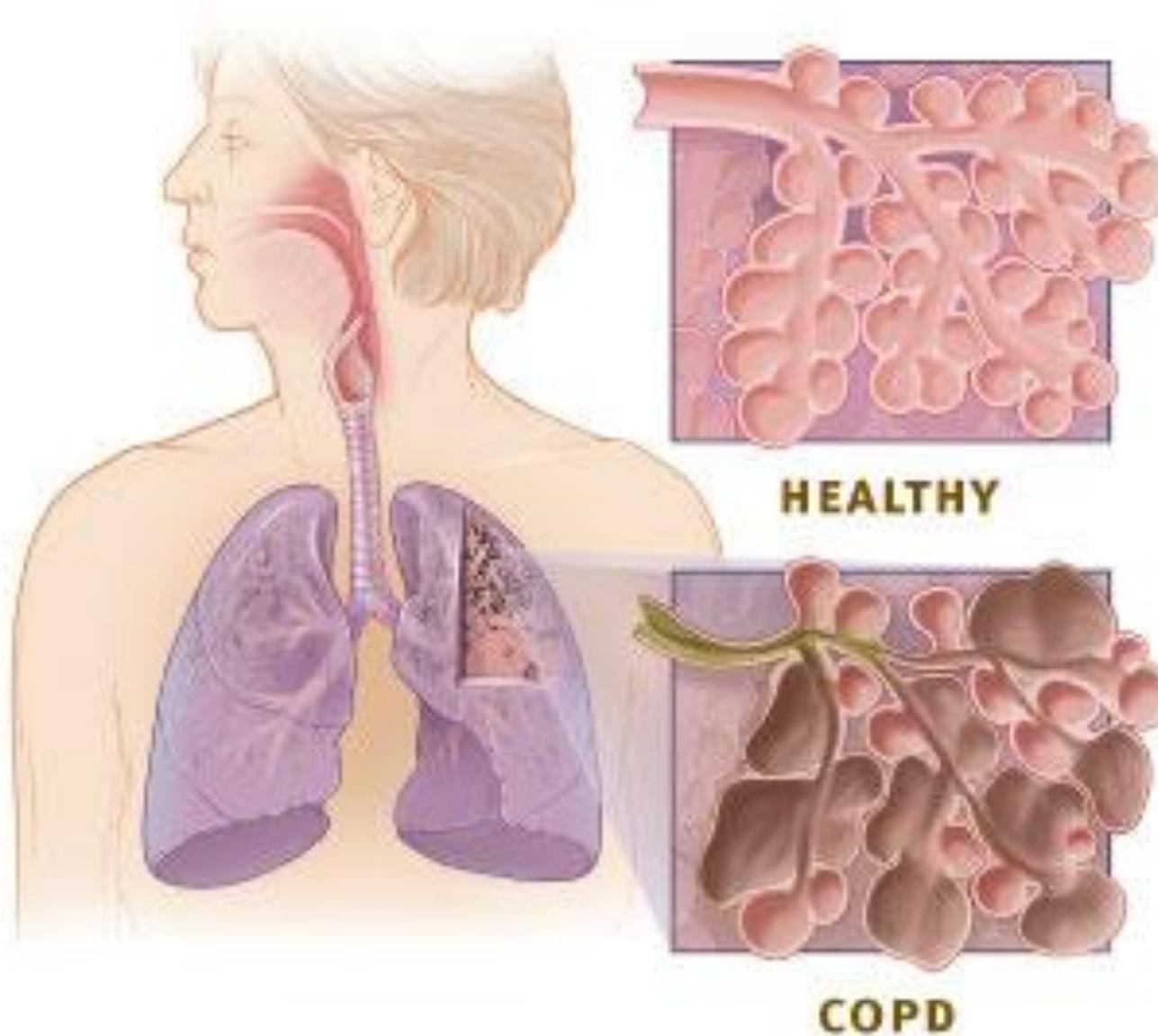


Chronic obstructive pulmonary disease, or COPD, is an obstruction of the airways that occurs with chronic bronchitis, emphysema, or both.

### Chronic Obstructive Pulmonary Disease (COPD)



# SMOKING IS THE MOST COMMON CAUSE OF COPD & EMPHYSEMA





Normal bronchi



Bronchitis



ADAM.

Bronchitis is inflammation of the main air passages to the lungs. Bronchitis may be short-lived (acute) or chronic, meaning that it lasts a long time and often recurs.



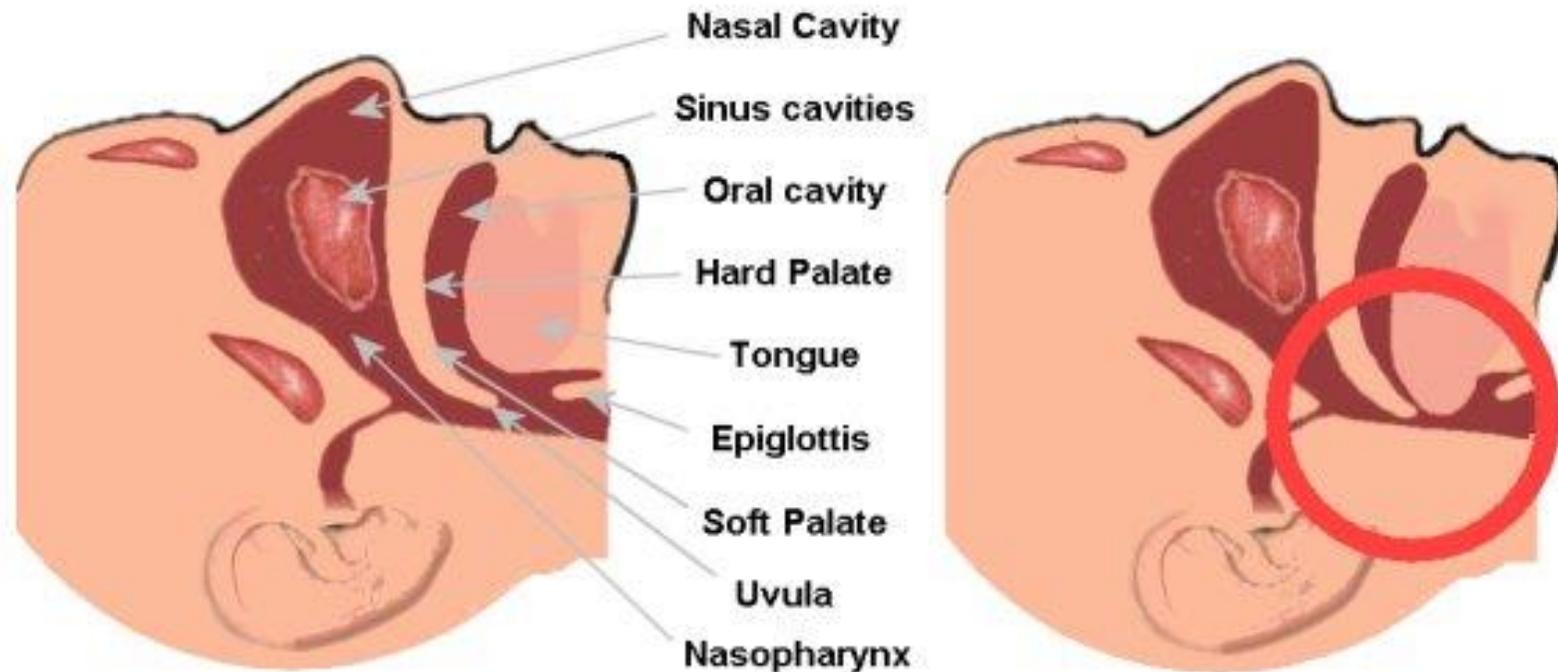
Use ADVAIR only twice a day, every day.

# What is sleep apnea?

Pause or slowing of breathing during sleep

[Video on Sleep Apnea](#)

## Sleep Apnea



**Normal Breathing**

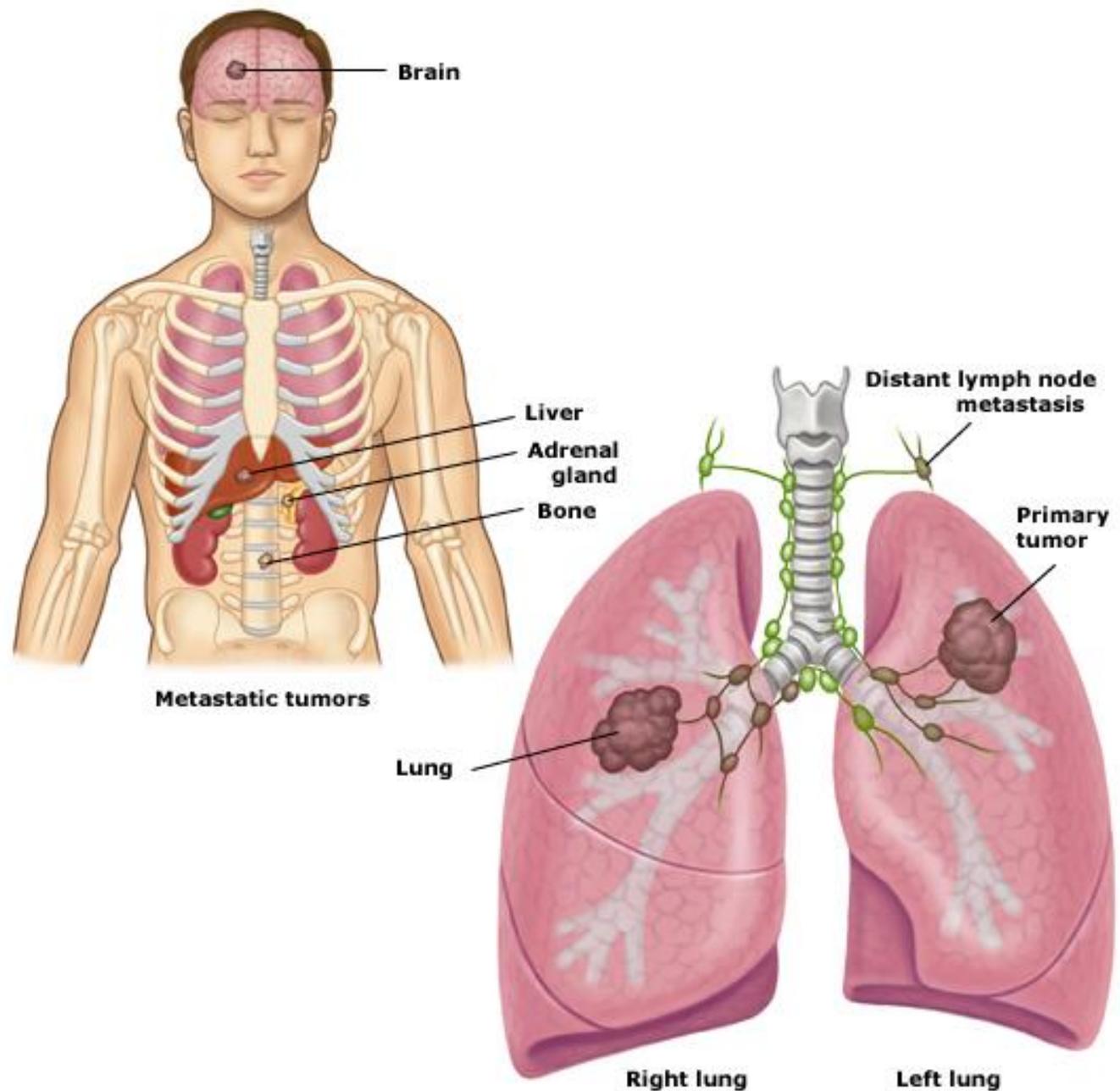
**Blocked Airways**

# Lung Cancer

Lung cancer starts when abnormal cells grow out of control in the lungs.

There usually are no signs or early symptoms of lung cancer.

As lung cancer stages advance, lung cancer symptoms may include coughing, wheezing, shortness of breath, and bloody mucus.



# ALTITUDE SICKNESS

Acute mountain sickness is brought on by reduced air pressure and lower oxygen concentrations.

Symptoms can range from mild to life-threatening, and can affect the nervous system, lungs, muscles, and heart.



Pulmonary edema is an abnormal buildup of fluid in the air sacs of the lungs, which leads to shortness of breath

# Bacteria / Viral Infection

Pneumonia

Tuberculosis

# Asthma