CF Intro

RESPIRATORY SYSTEM

Guided Notes (Handout)

“The day I was born, the median life expectancy of someone living with CF was 31. I was shielded from this knowledge until about age 12, when I secretly read my mother’s diary. The words “inevitable” and “death” still stick in my memory.

What is CF?

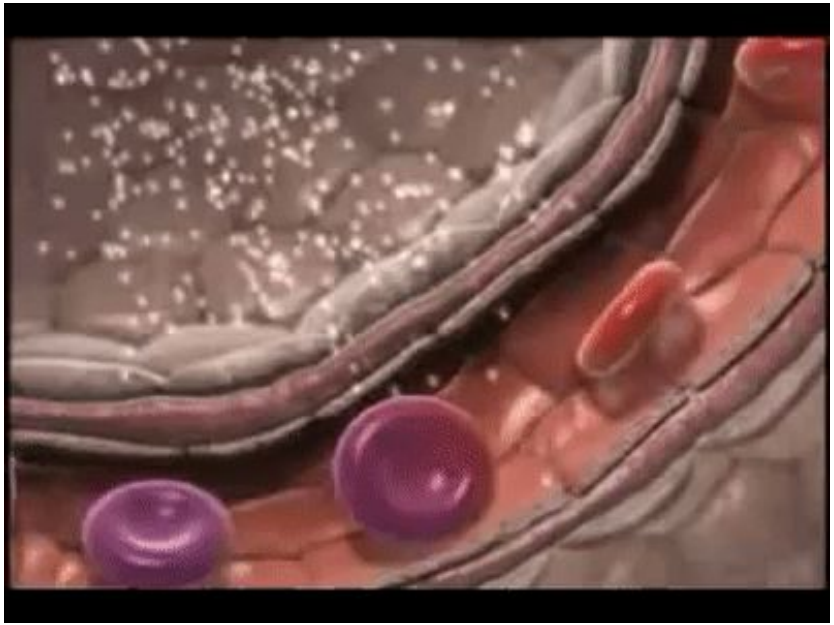
When did we first learn about CF?

Gabriella Balasa
Cystic Fibrosis Foundation

Life Cycle of CF

PRIMARY FUNCTIONS

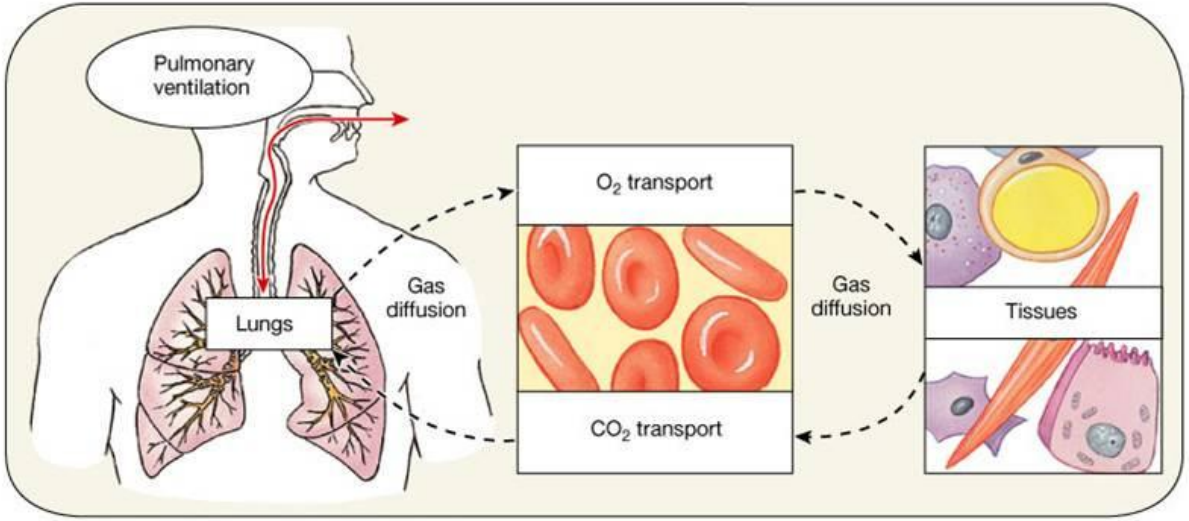
1. Exchange gases (oxygen and CO_2)
2. Produce vocal sounds
3. Sense of smell
4. Regulate blood pH

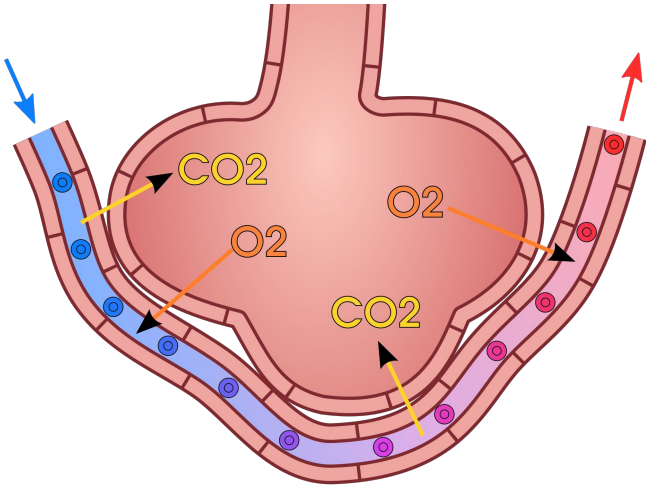


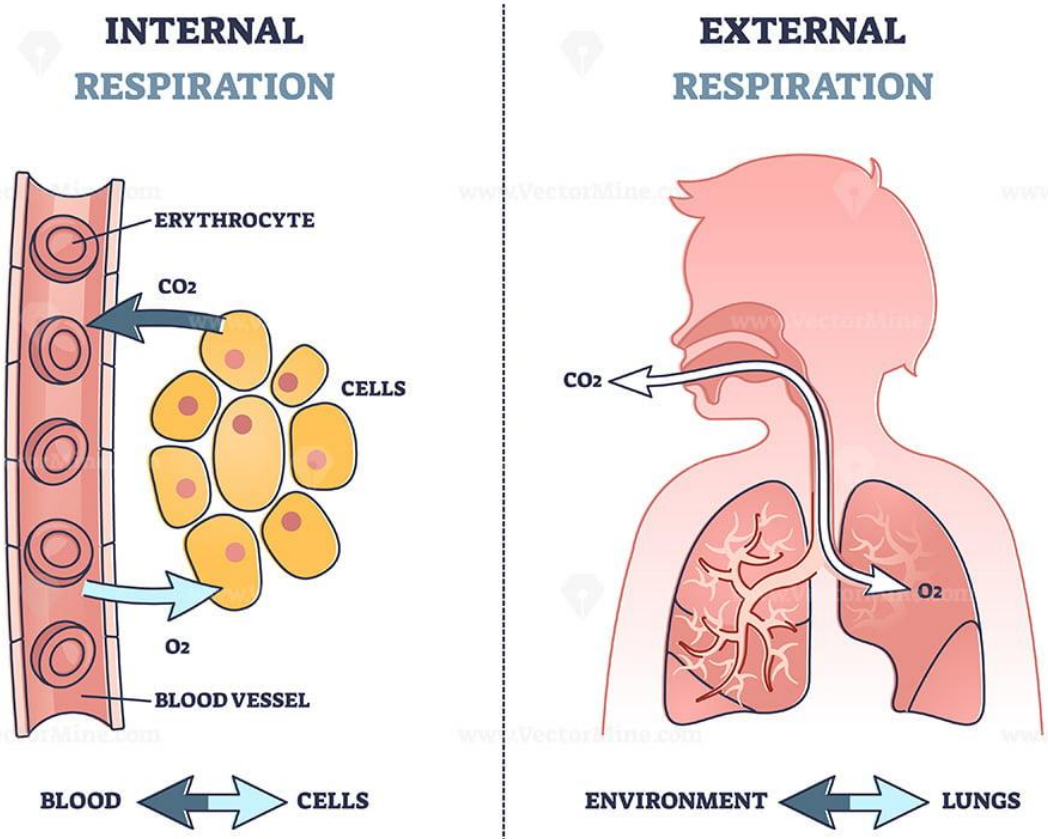
What is causing the blood cells to turn bright red?

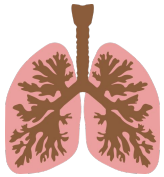
Respiration = process of gas exchange

External respiration = air enters the lungs, (air → blood)
Internal respiration = blood travels to body parts and exchanges gas with those tissues (blood → tissues)









Today, I'm 28. CF is a genetic, progressive disease that causes thick, sticky mucus to build up primarily in the lungs, but also in the digestive tract and sinuses.

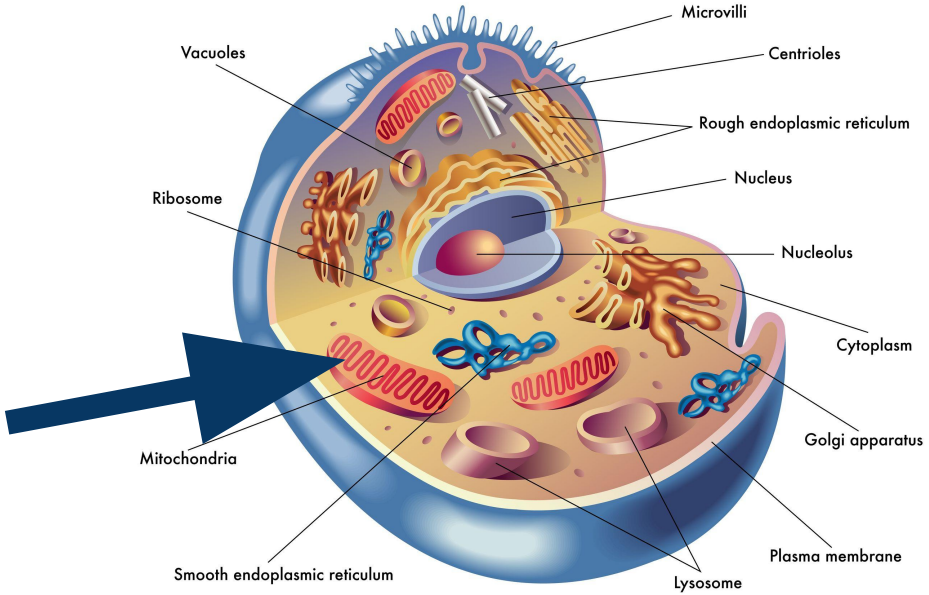
This mucus reduces my lung function and makes it difficult to breath.

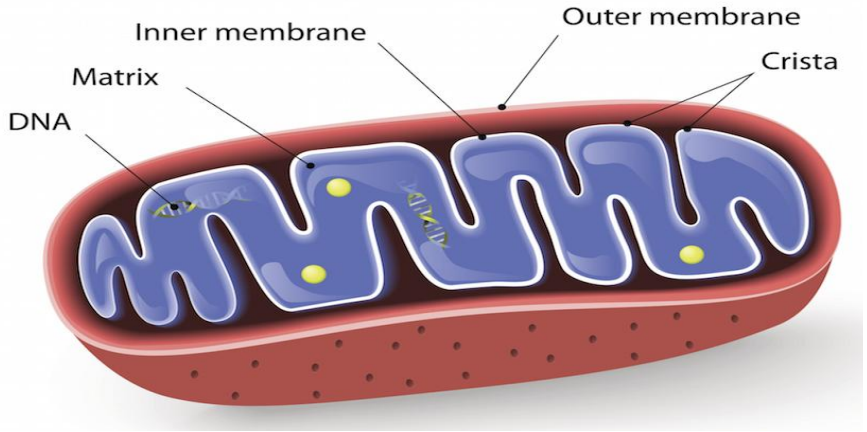
Does CF cause a problem with internal or external respiration?

Why do we need oxygen?

Cellular respiration = cells use oxygen and sugars to create energy in the form of ATP

*ATP is then used to power cellular processes

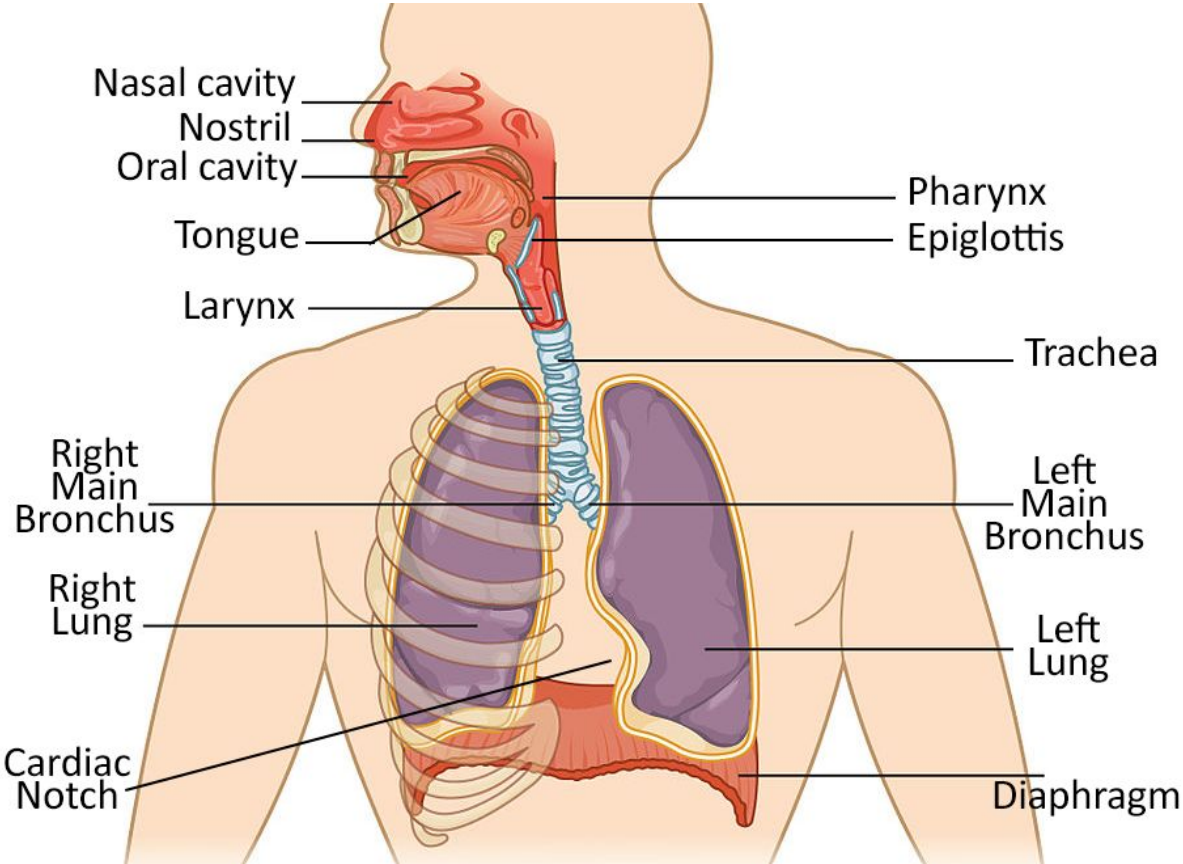




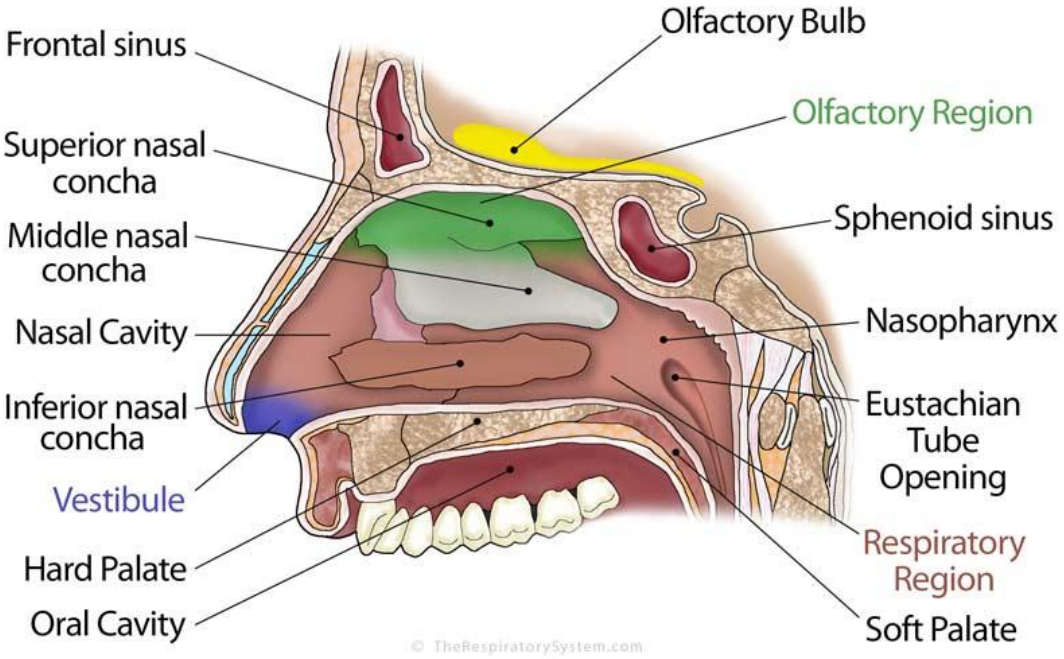
MITOCHONDRION

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

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



Nasal <u>concha</u> – bones that divide the nasal cavity, support the mucus membrane and increase surface area (superior, middle, inferior)



Mucus Membrane - warms and moistens air, also traps <u>dust</u> and other particles

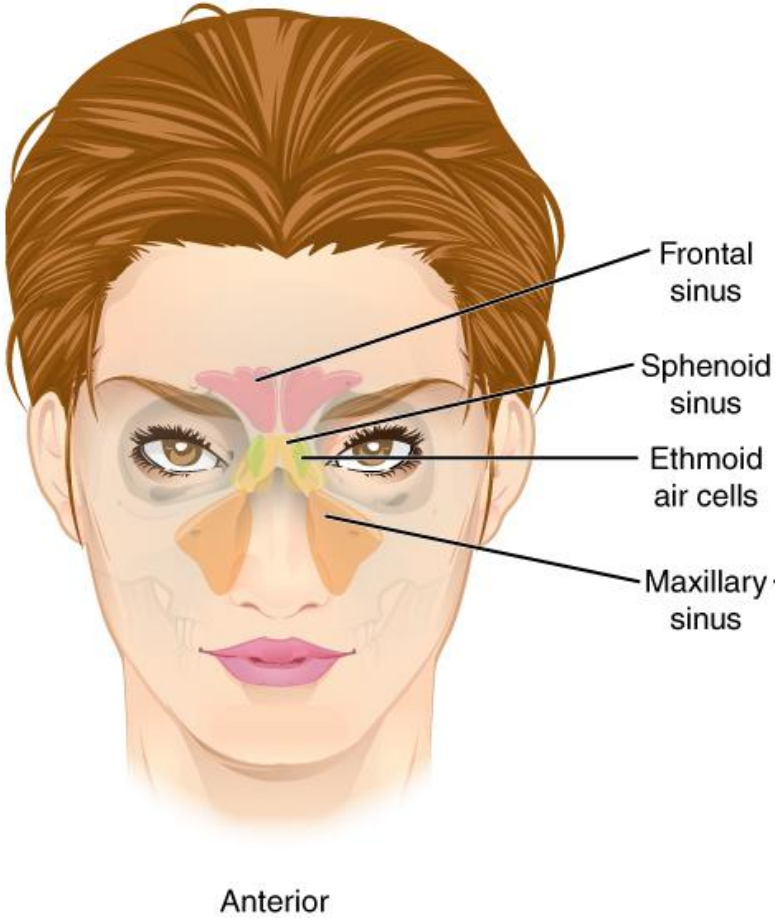
*particles go to stomach

Paranasal Sinuses - spaces within the bones

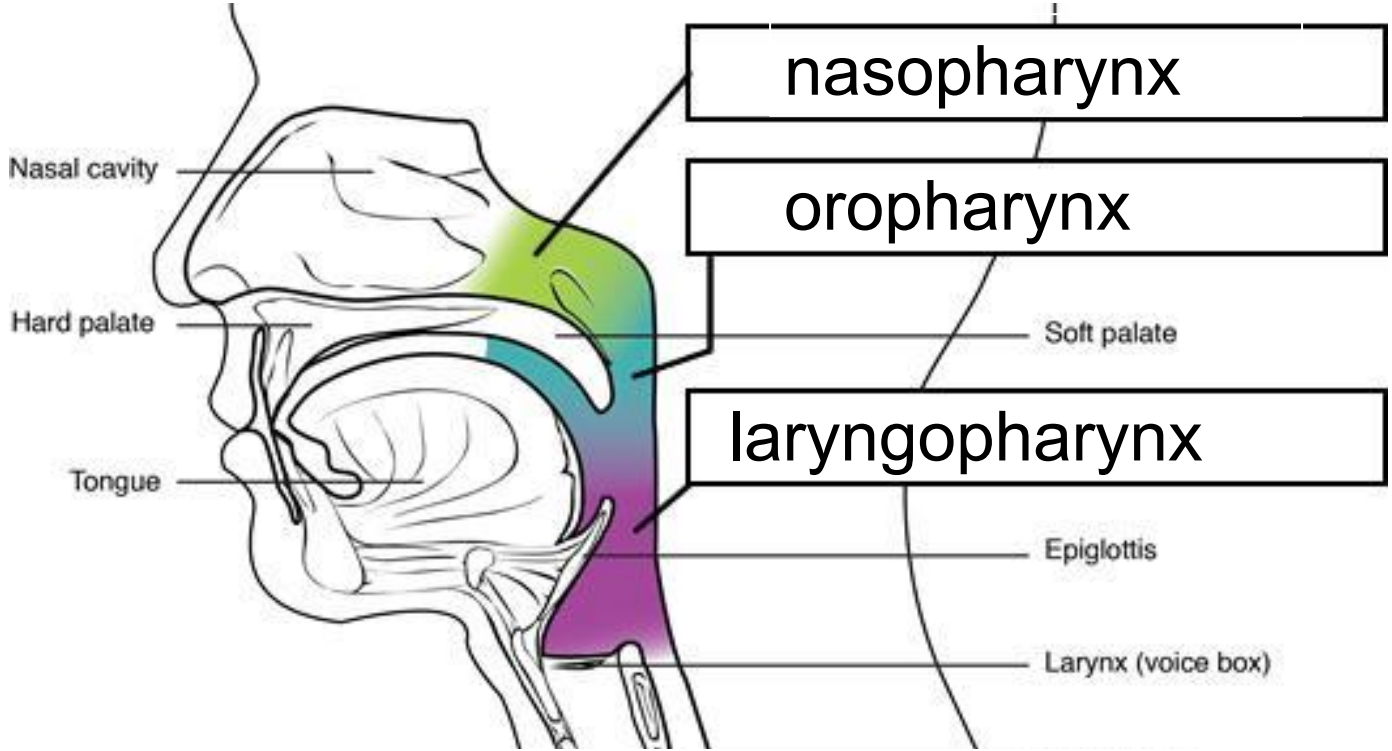
They are named after the bones:

- maxillary
- frontal
- ethmoid
- sphenoid

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

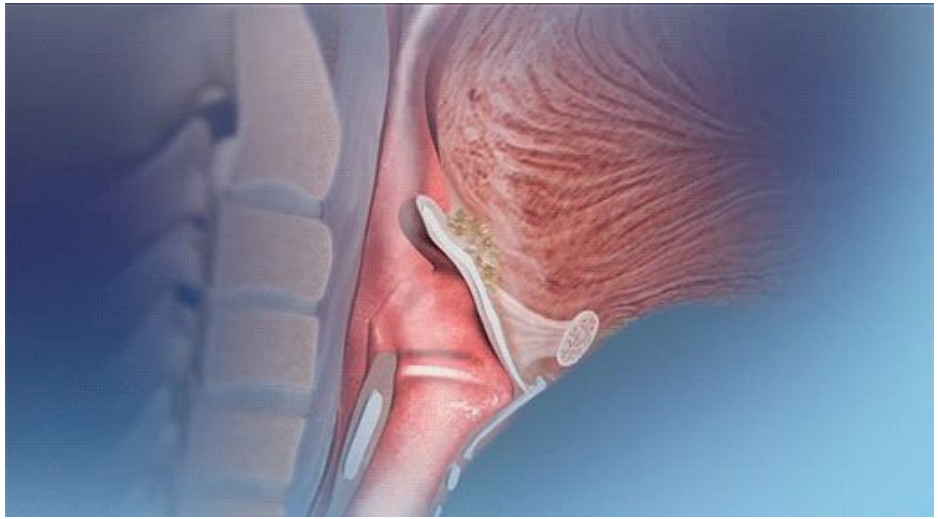


Pharynx – behind the oral cavity, between the nasal cavity and larynx (space, not a structure)



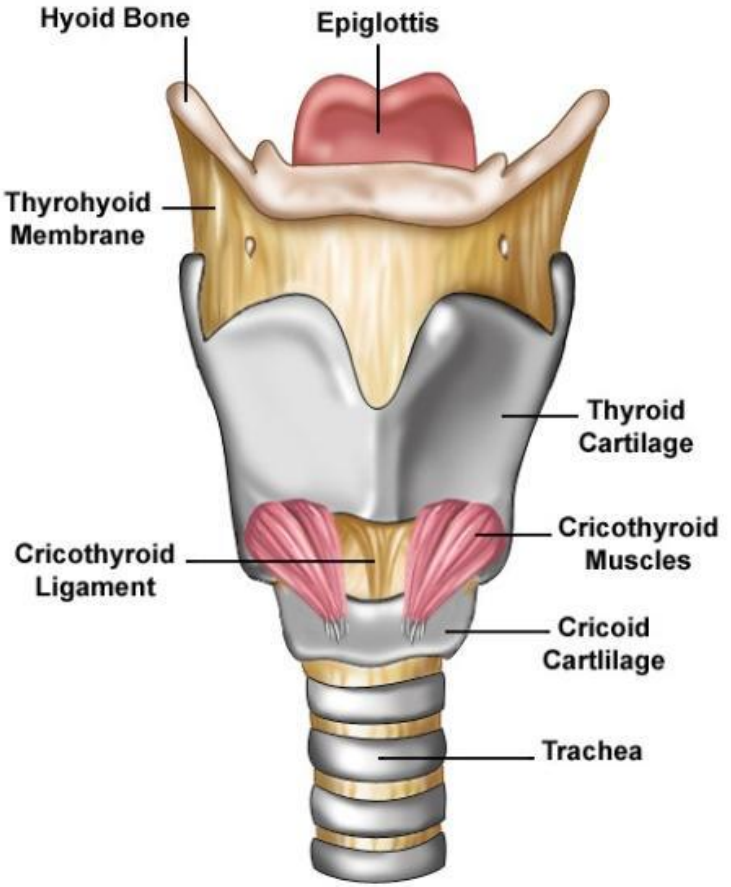
Epiglottis - this flap closes when you swallow, preventing food from going into the airway.

Heimlich maneuver - used to save someone who is choking.



Larynx – enlargement at the top of the trachea, houses vocal cords

composed of muscles and <u>cartilage</u>

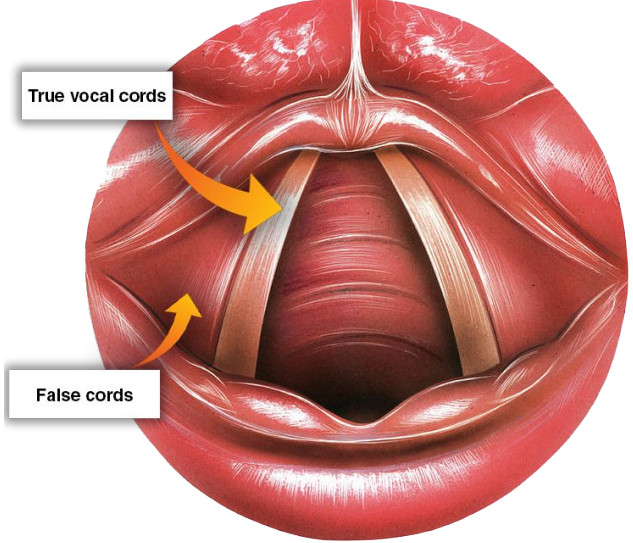


GLOTTIS: part of the larynx consisting of the vocal cords

- false vocal folds – close airway during swallowing

- true vocal folds - produce sound

Video of Vocalization



LARYNGITIS

Inflammation of the larynx that makes the voice hoarse

Caused by illness, allergies, smoking, some medications.

If you have chronic laryngitis, you might want to see an…

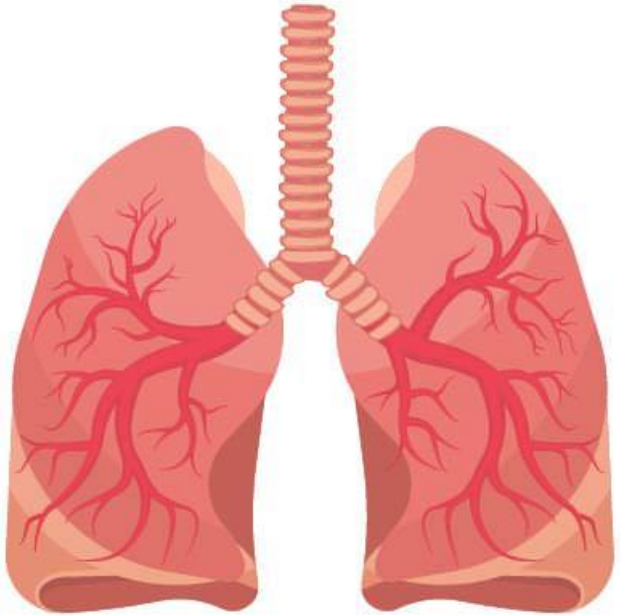
OTOLARYNGOLOGIST

Ear, nose, and throat doctor

Laryngoscope

Trachea (windpipe)

- cylinder with stiff cartilage to keep it from collapsing
- Trachea leads to the <u>BRONCHIAL TREE</u>



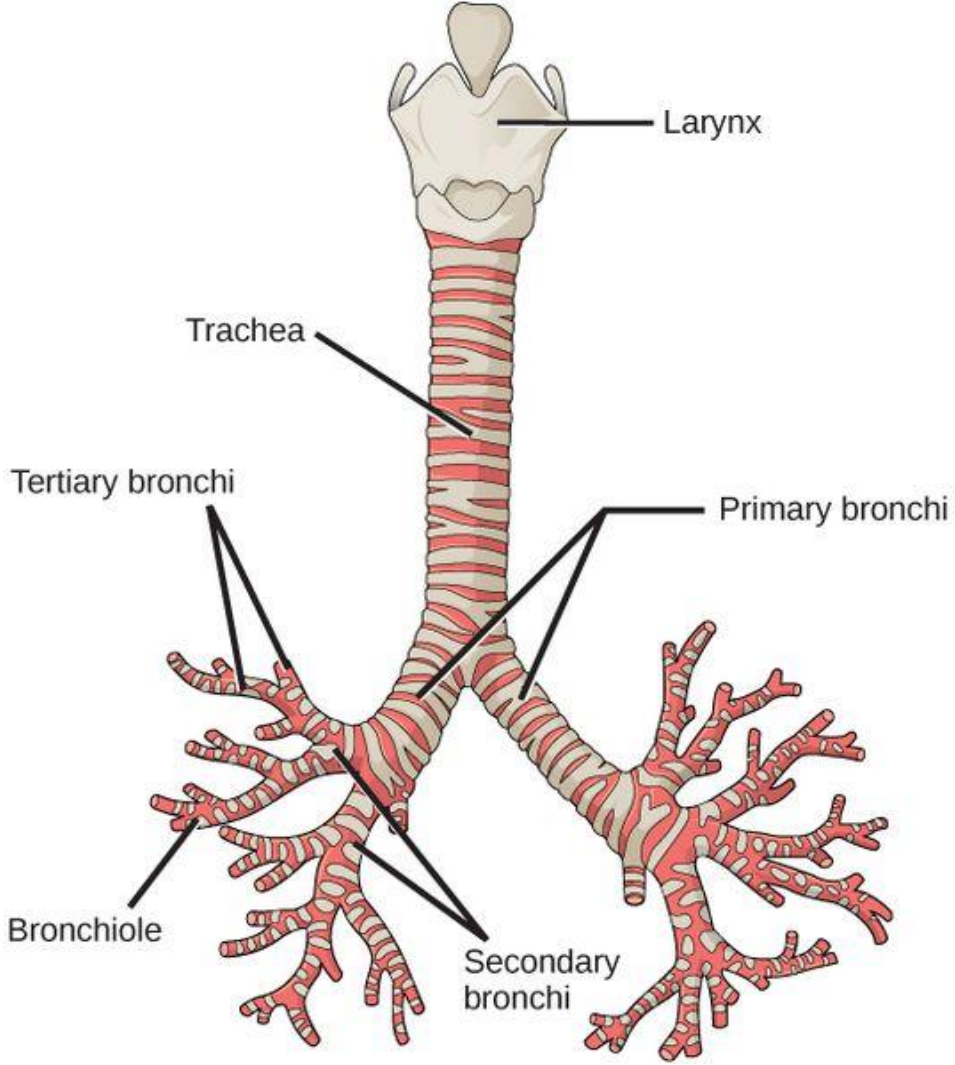
1) Trachea

2) Primary Bronchi

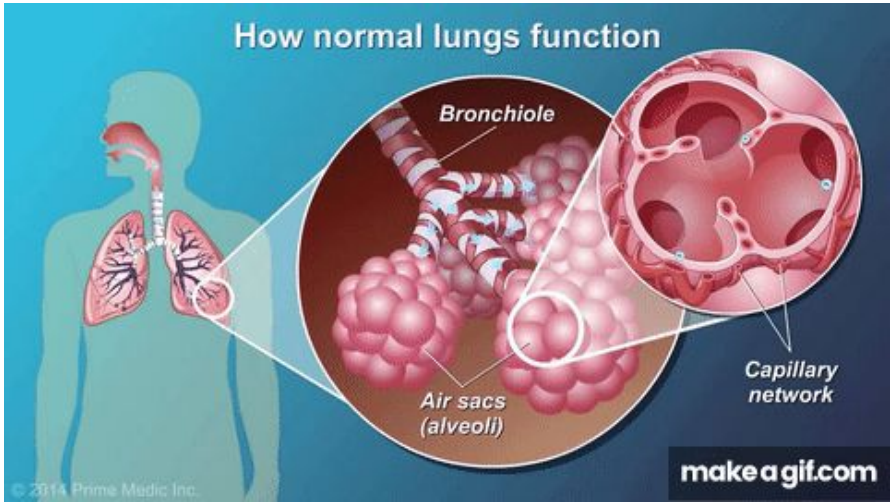
3) Secondary Bronchi

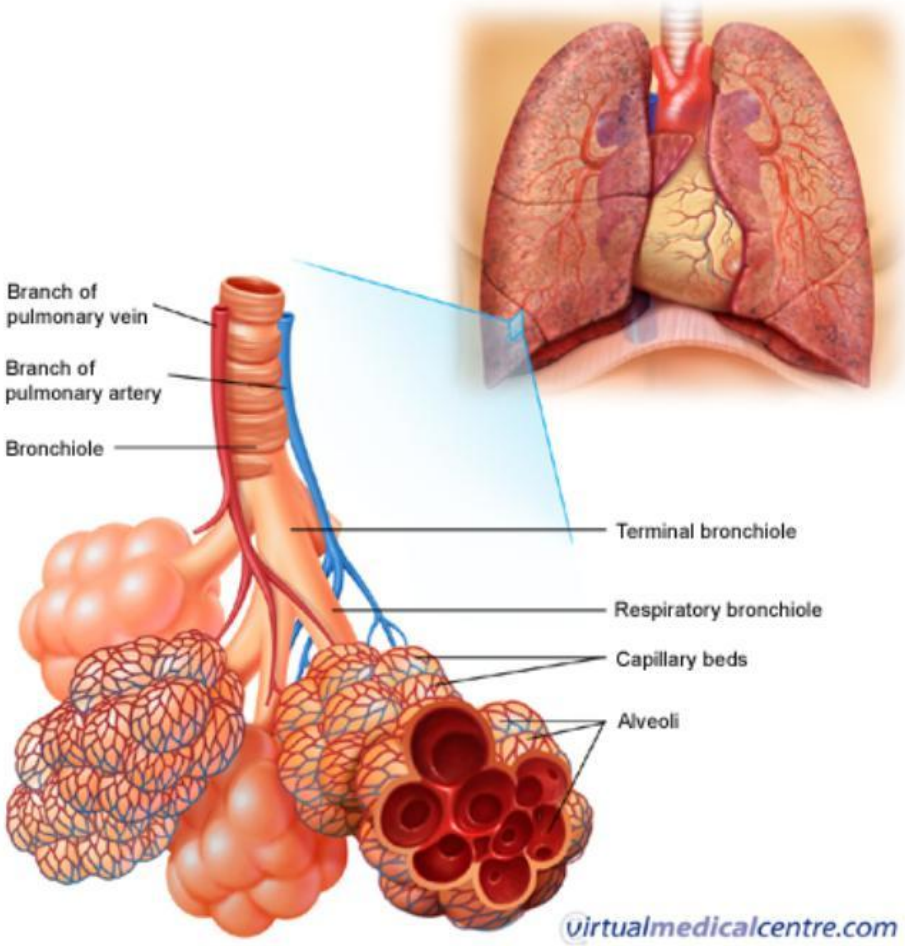
4) Tertiary Bronchi

5) Bronchiole



Bronchioles have air sacs called alveoli which are connected to the circulatory system via capillaries

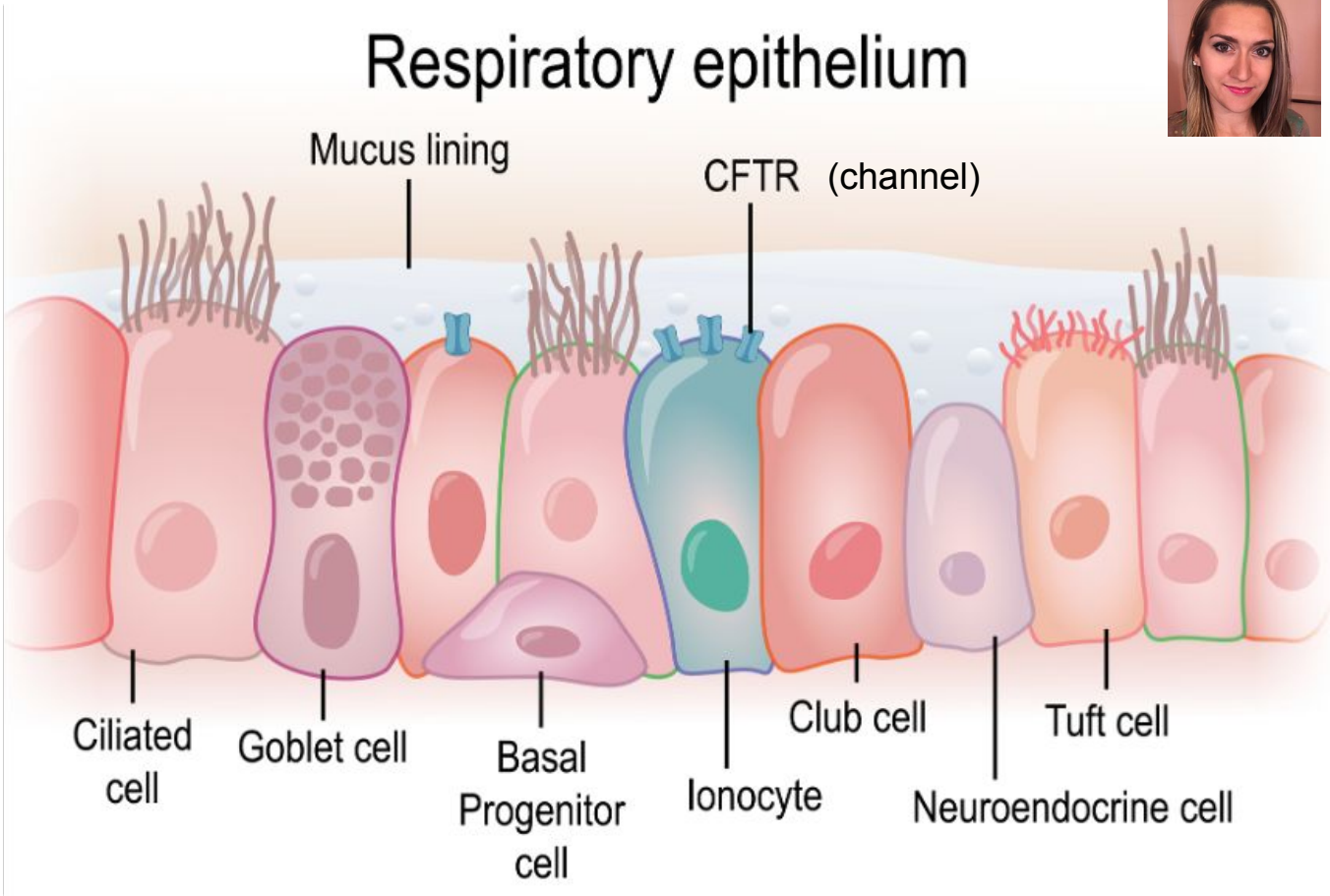


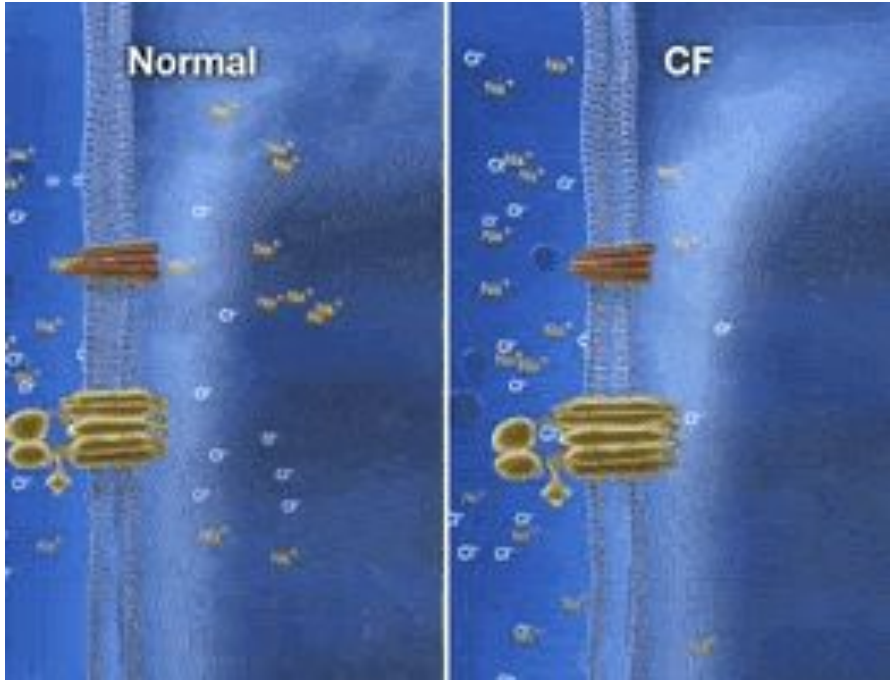


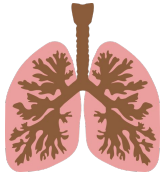
Channels in the epithelium move chlorine ions out of the cell.

If those channels are “broken”, chlorine builds up which attracts water (osmosis!).

This water causes a thick mucus to build up extracellular space, restricting air flow.







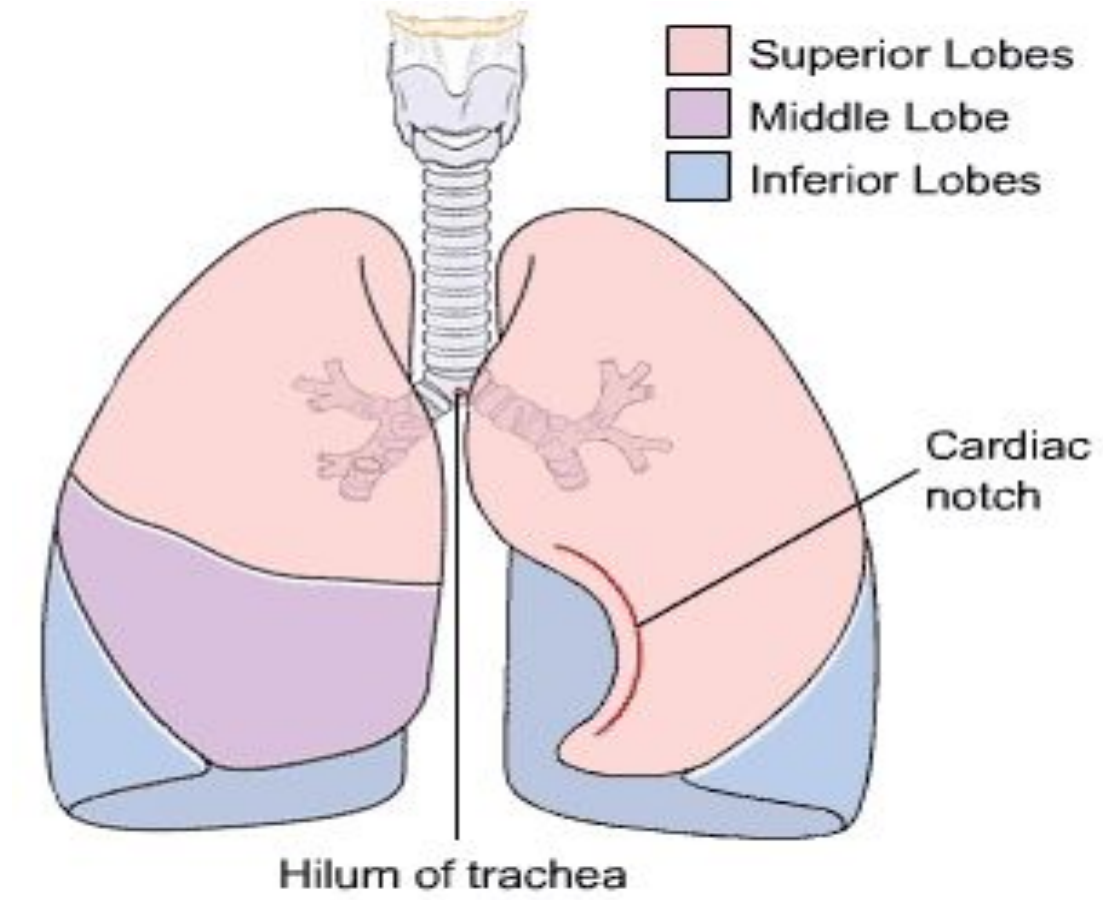
“Over time, this mucus breeds infections from bacteria, which I then inhale into my lungs; the cycle of infections and inflammation leads to lung damage, then eventually respiratory failure, and death. “

LUNGS - spongy tissue that sit within the pleural cavity

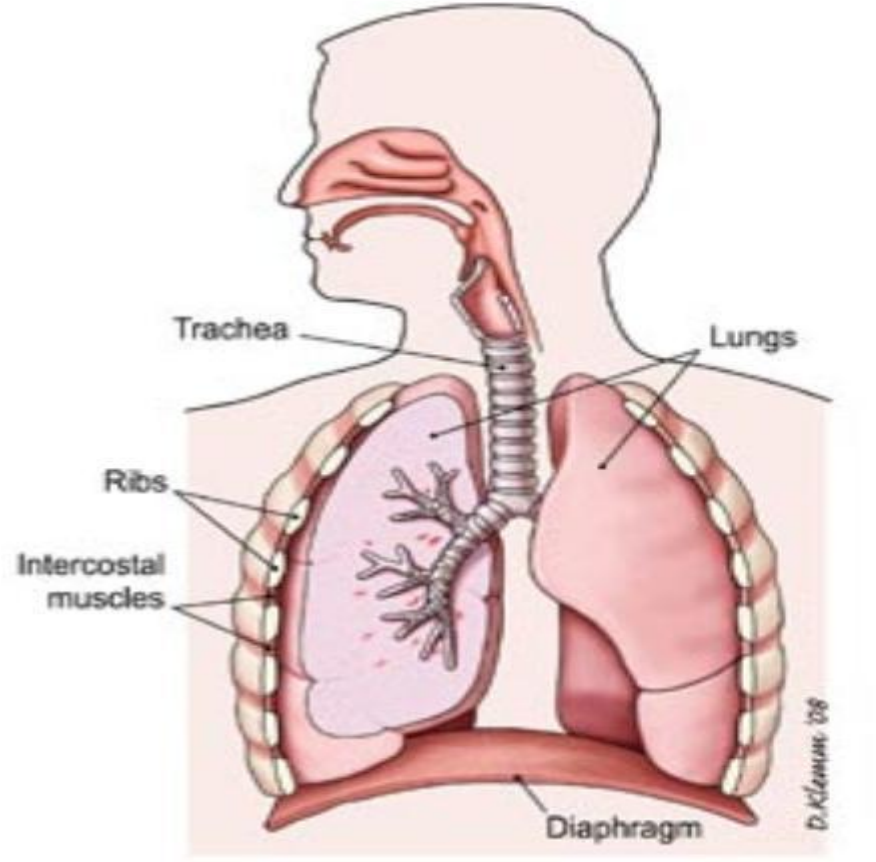
Right Lung
= 3 lobes
Left Lung
= 2 lobes

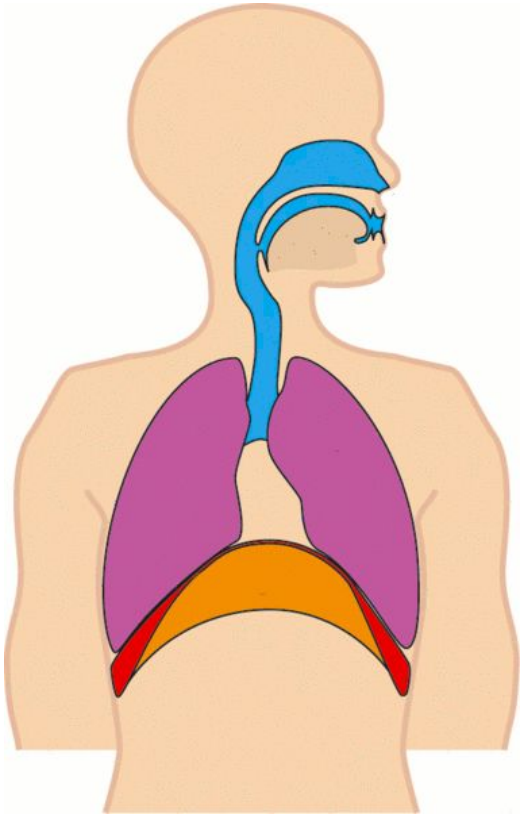
Cardiac notch - space for heart

Serous fluid lubricates lungs during breathing



BREATHING MECHANISM





1. Diaphragm moves down, forcing air into airways
2. Intercostals contract, enlarging cavity even more
3. Surface tension in alveoli and surfactant keep them from collapsing
4. Other muscles can force a deeper breath
5. Relaxing the diaphragm causes elastic recoil(exhalation)

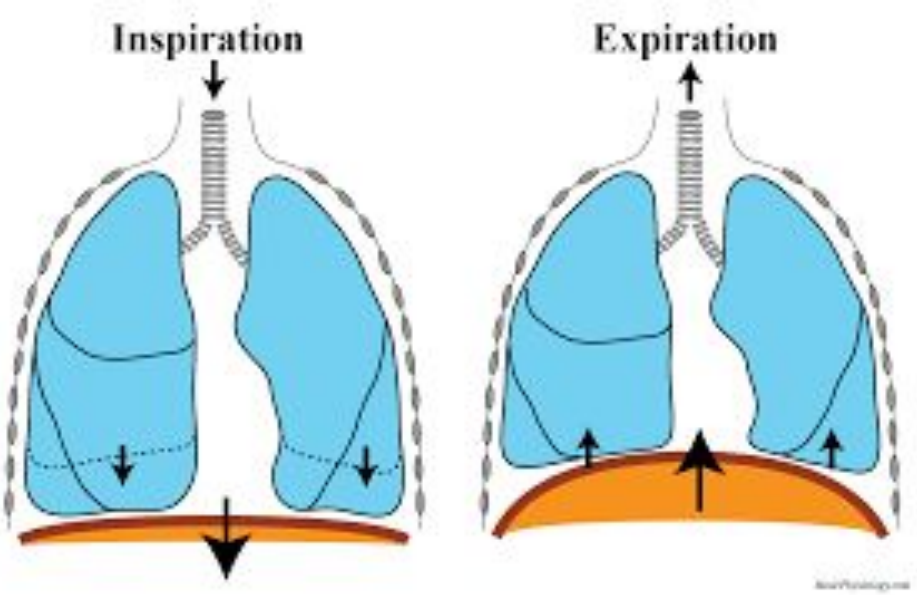
*The first breath in newborns is the hardest due to lack of surfactant

Respiratory Cycle

Respiratory Cycle = one sequence of inhalation and exhalation

Inspiration - air enters the lungs (inhale)
Expiration - air leaves the lungs (exhale)

Inspiration occurs when muscles of the **diaphragm** change the pressure in the pleural cavity, causing air from the outside to enter the lungs.



Respiratory rate for for adults is 12-18 breaths per minute

Modeling Lung Function

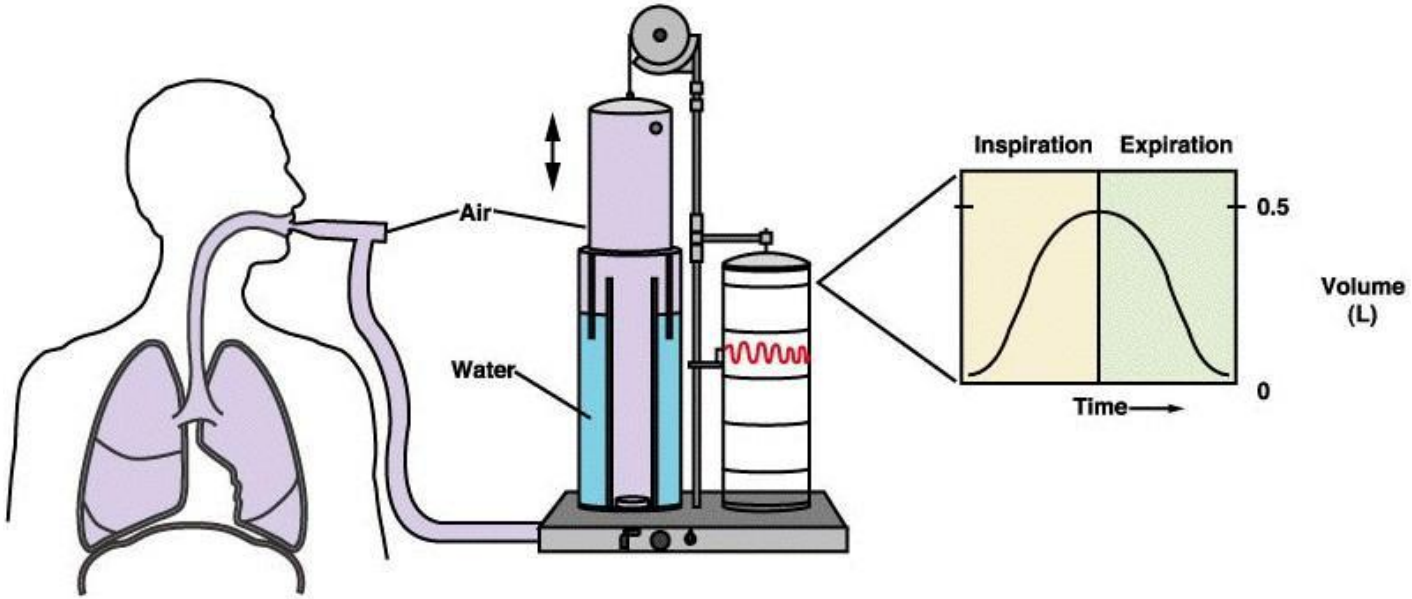
Materials to Collect

- Clear plastic drink bottle
- Balloon
- Rubber band
- Tape Scissors

Create your own model!

Respiratory Air Volumes

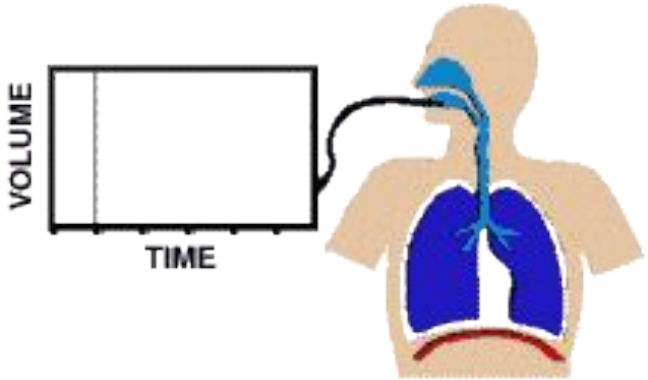
Spirometry - measures the amount (volume) of air moving in and out of the lungs



Spirometry Virtual Lab

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

*take a normal breath

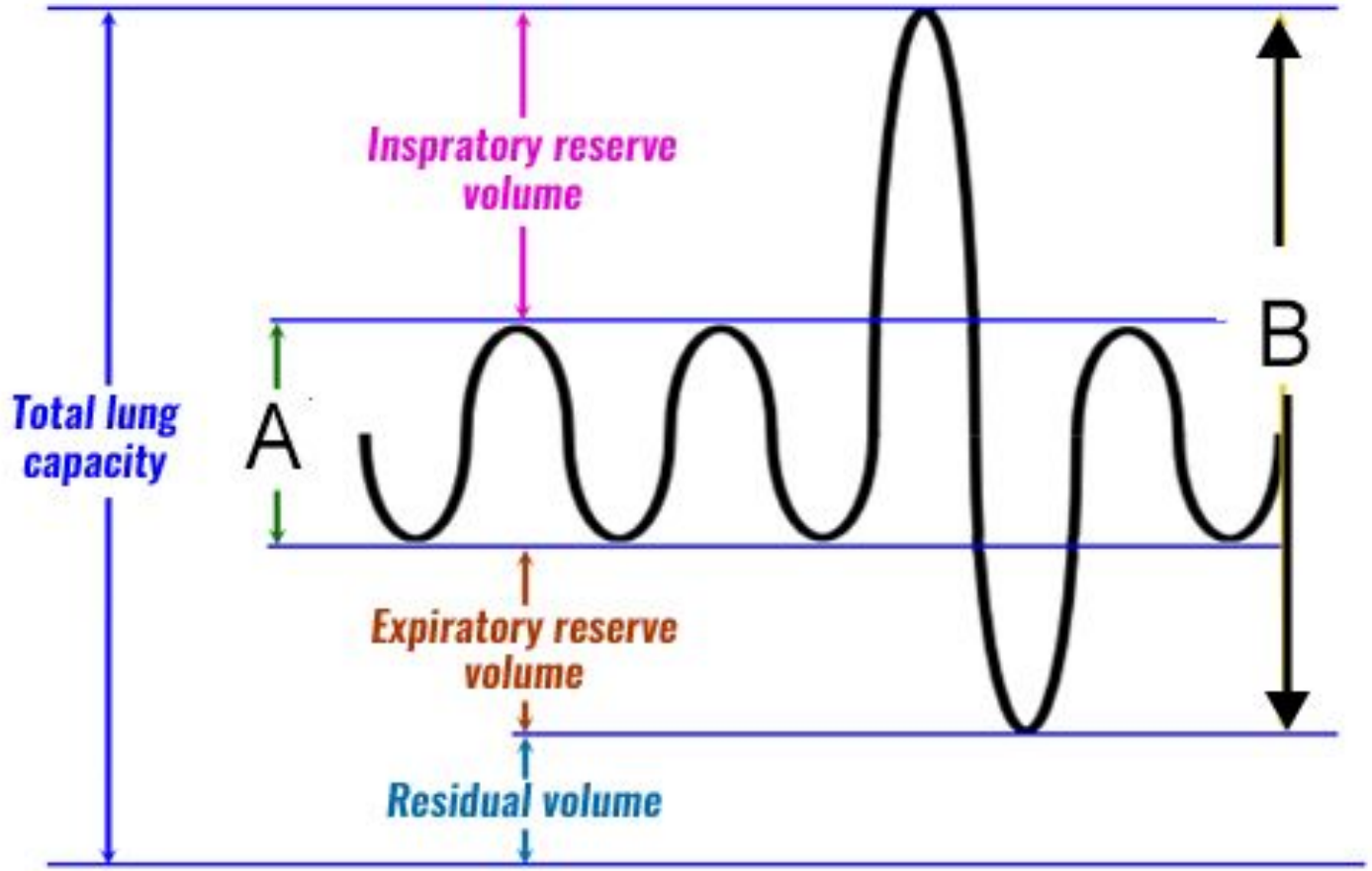


Vital Capacity (lung capacity) the amount of air that can be forced in or out by taking a deep breath.

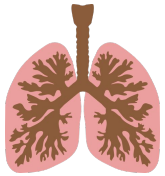
In this lab, we will use balloons and spirometers to measure vital capacity.

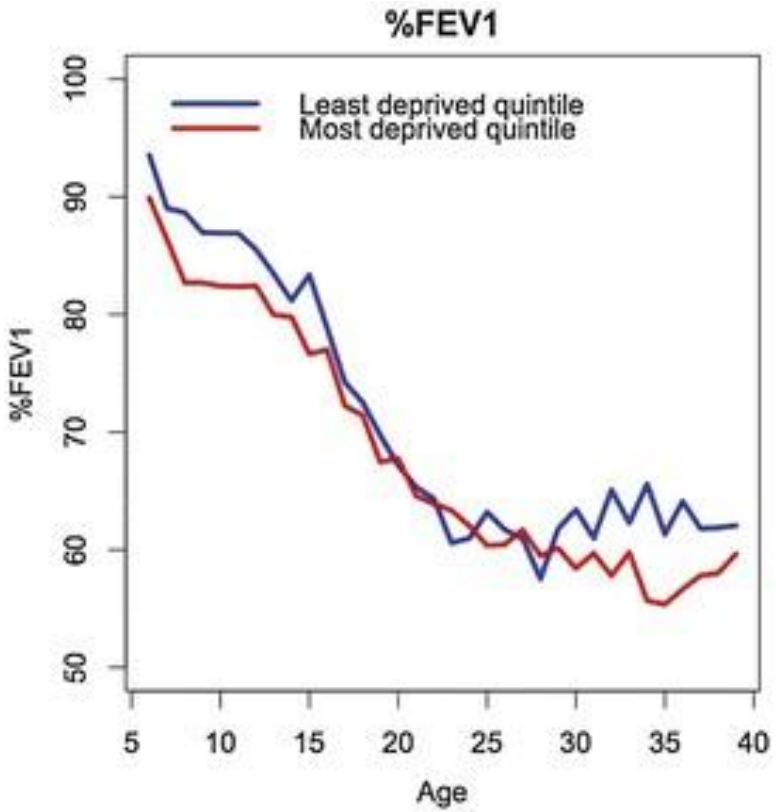
A = tidal volume

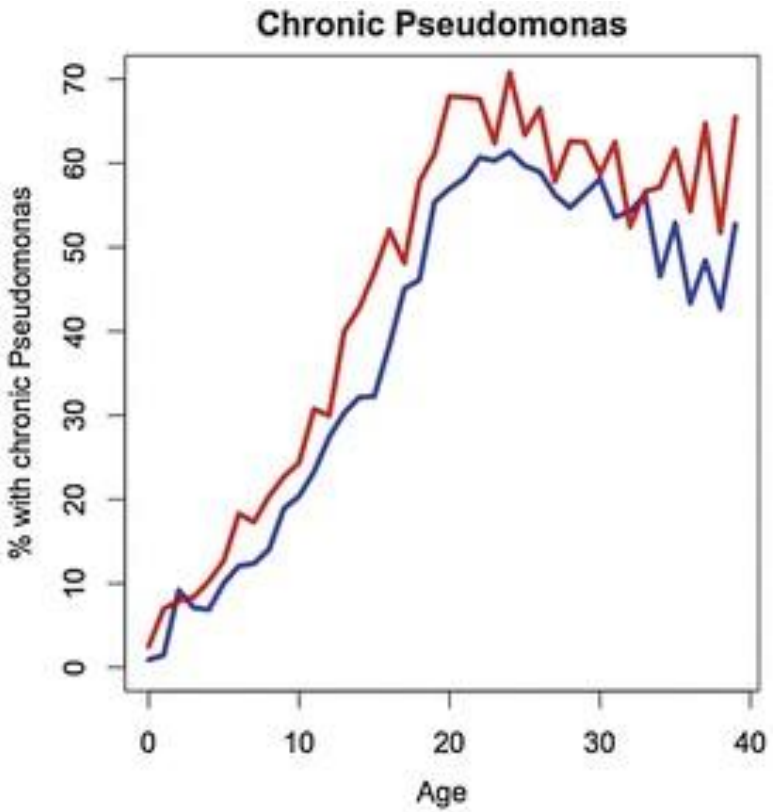
B = vital capacity



FEV1 = Forced expiratory volume in 1 second is an established marker of cystic fibrosis (CF) disease progression

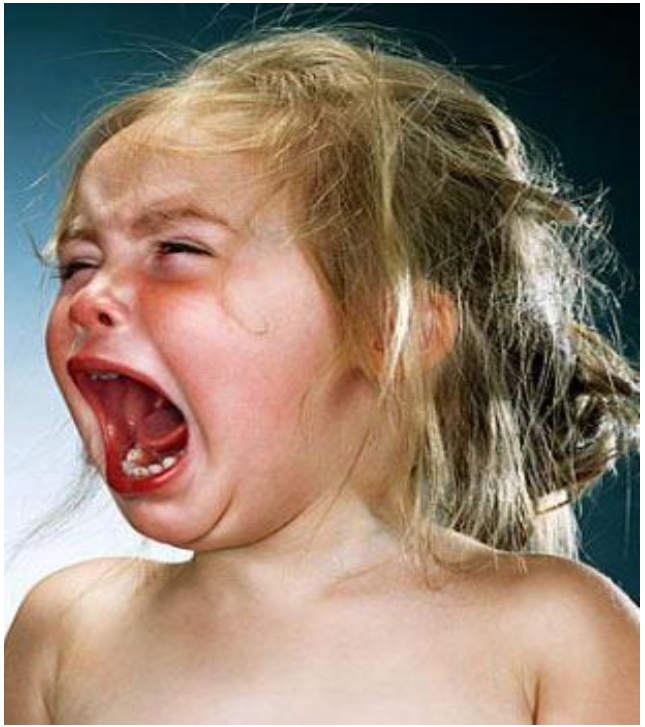






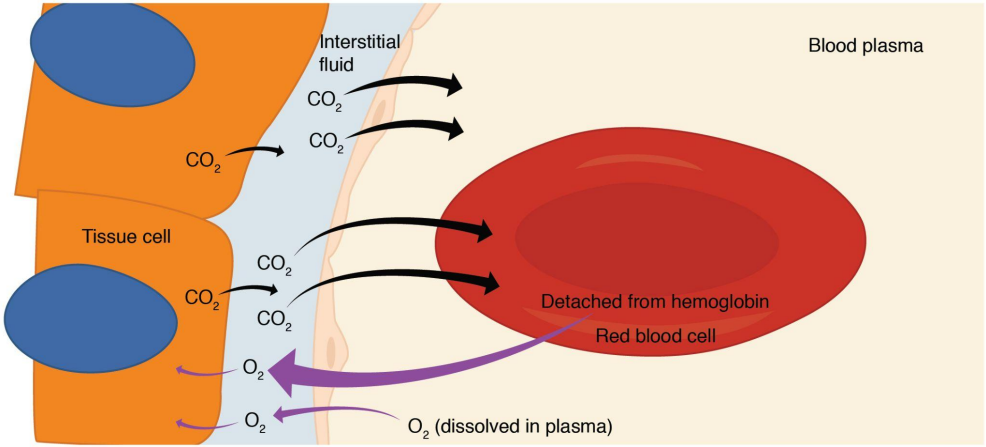
Factors that can Affect Breathing

1. Rise in CO_2
2. Emotional upset, fear and pain
3. <u>Low blood oxygen</u>



Hyperventilation - increased breathing, lower CO_2 concentration

Respiratory Membrane



Alcohol can be detected in breath

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

Oxygen DIFFUSES into the bloodstream

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).

Blue skin is an indication of hypoxia, also called cyanosis.

Asphyxia deficient supply of oxygen that arises from being unable to breathe normally.

*An example of asphyxia is choking.

Career: Respiratory Therapist

2021 Median Pay
$61,830 per year
$29.73 per hour

Typical Entry-Level Education
Associate's degree

Number of Jobs, 2021
135.800

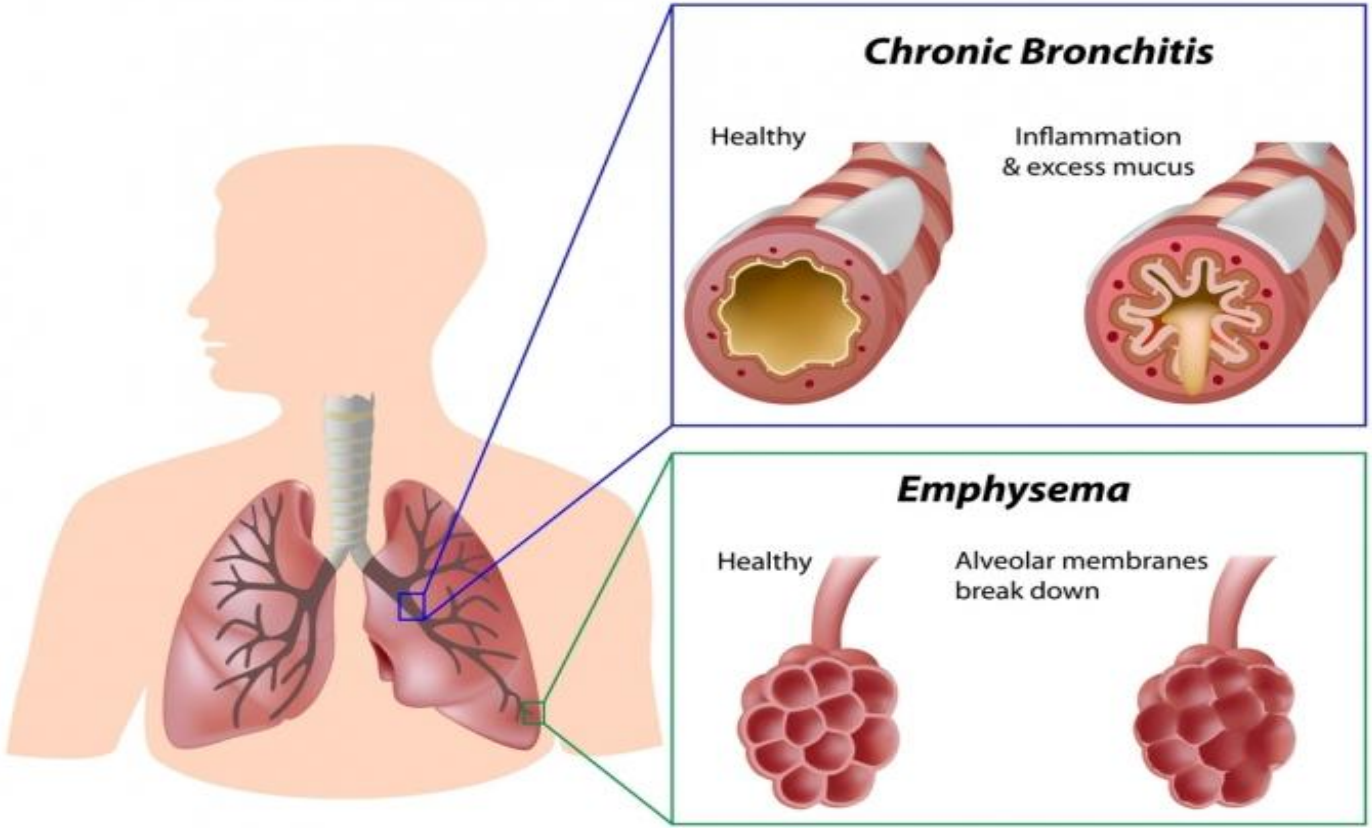
Job Outlook, 2021-31
14% (Faster than average)

Program at SWIC

St. Louis College of Health Careers

ILLNESSES RELATED TO THE RESPIRATORY SYSTEM

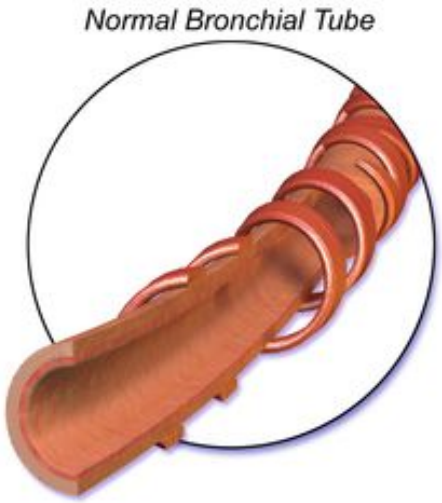
COPD = Chronic obstructive pulmonary disease

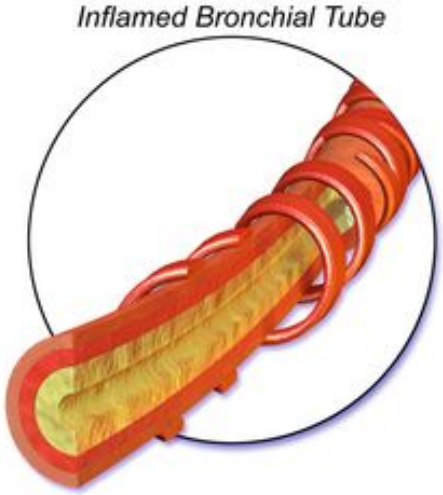


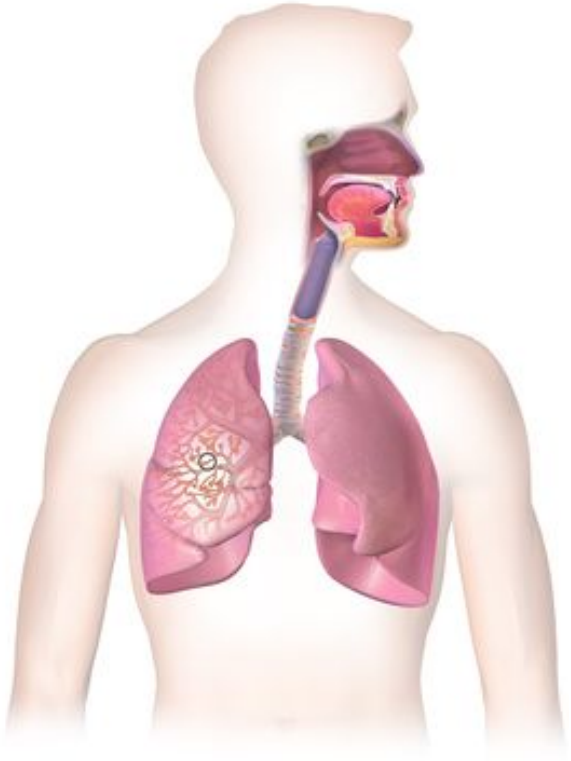
Most commonly caused by smoking

Bronchitis =
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.



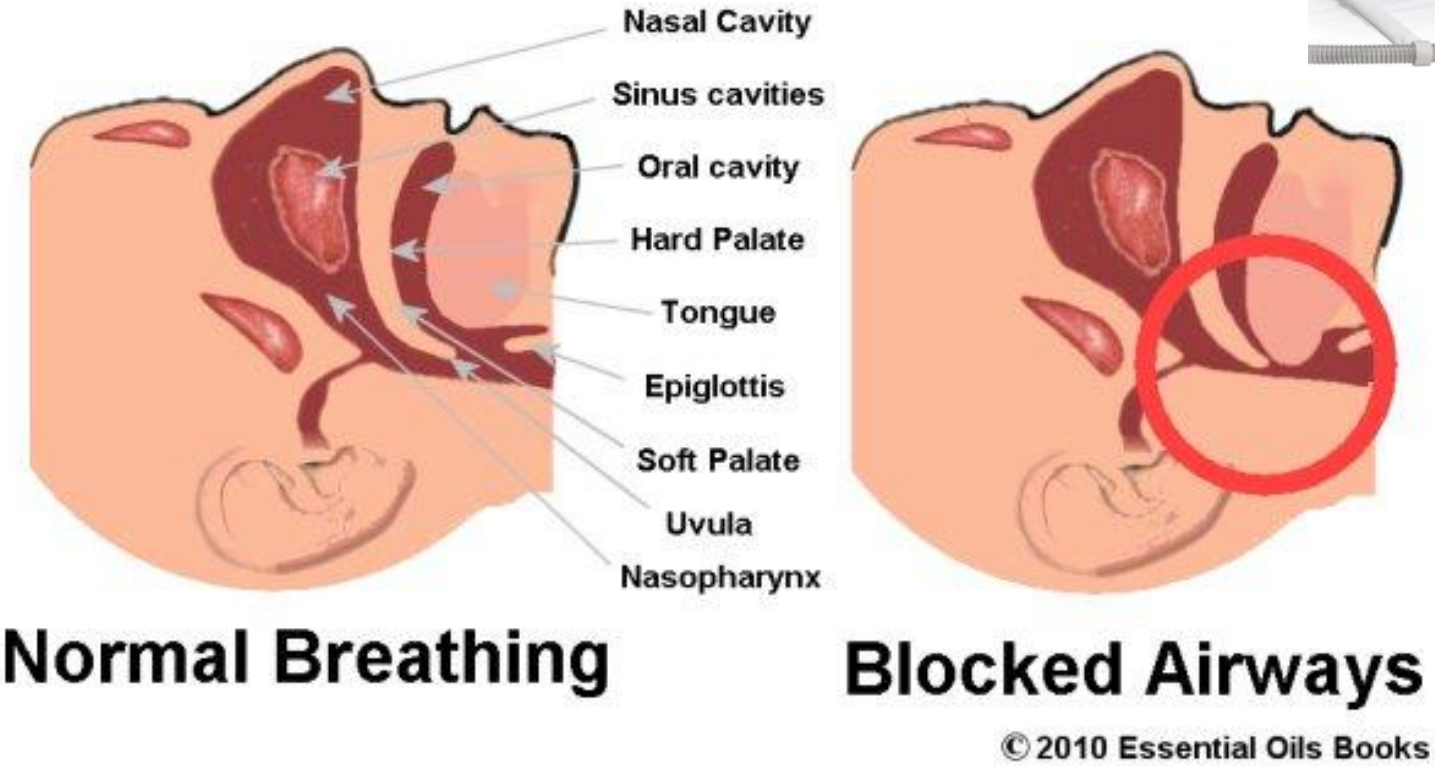




Bronchitis

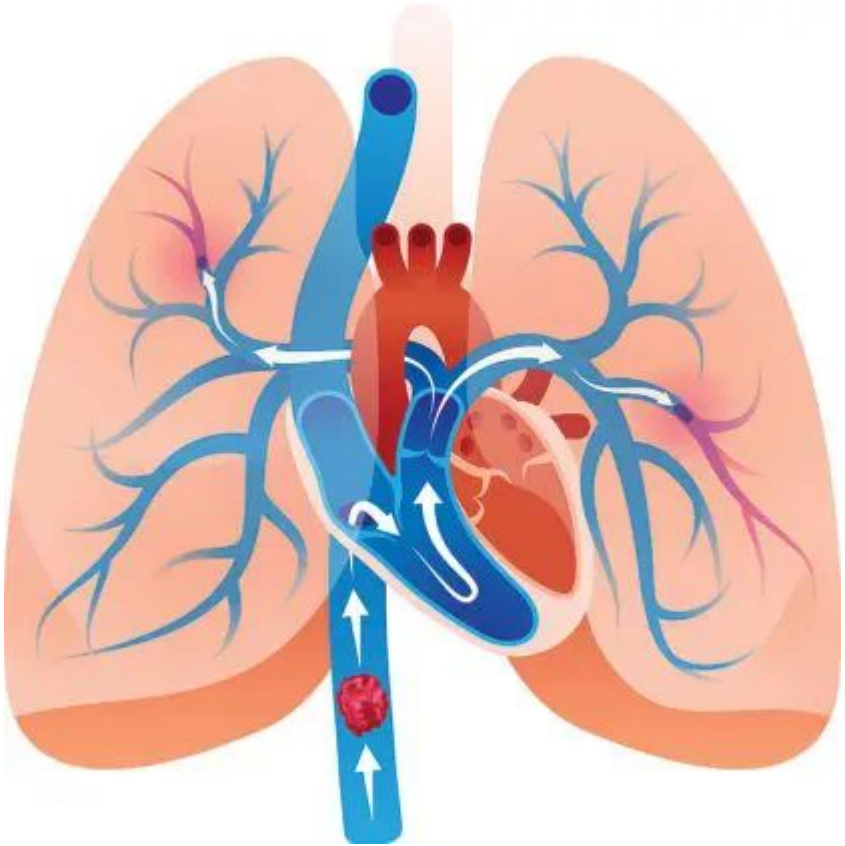
What is sleep apnea?

Pause or slowing of breathing during sleep



Pulmonary Embolism

- a blood clot that moves to the lungs
- this can cause shortness of breath, rapid heartbeat
- hypoxia

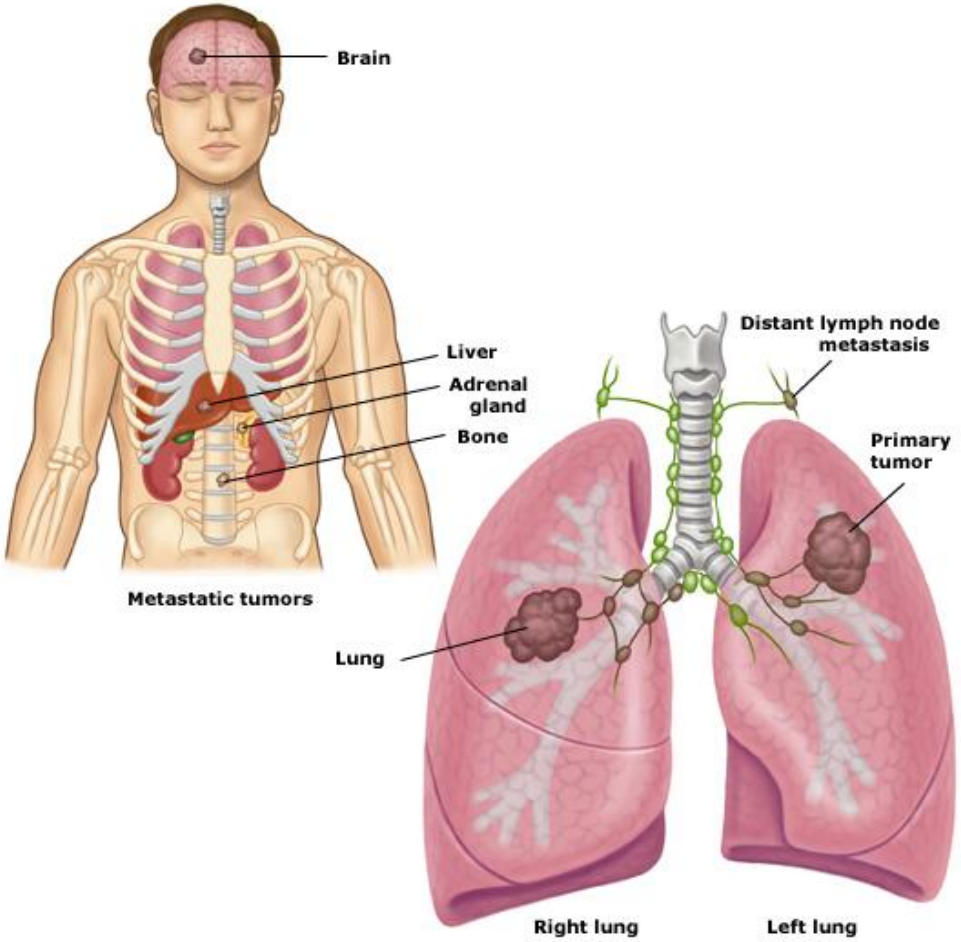


Lung Cancer

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.



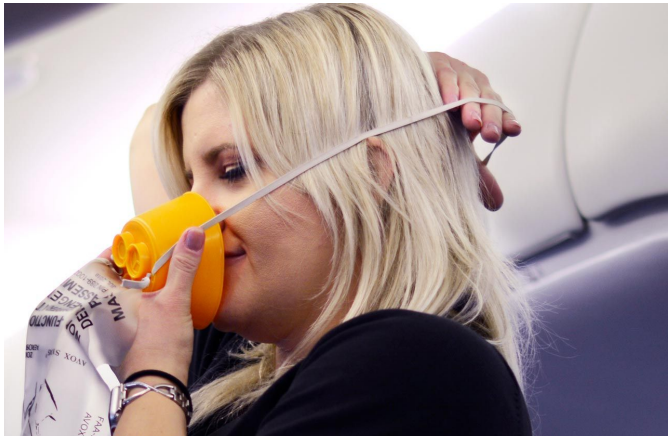
Altitude Sickness

Atmospheric Pressure is necessary for breathing

Lack of pressure on mountains can be dangerous. Hundreds of bodies are lying on Mount Everest

Video: Climbing Mt Everest

[Video of Mt Everest Bodies](#) (cartoon version) | More [Photos](#)



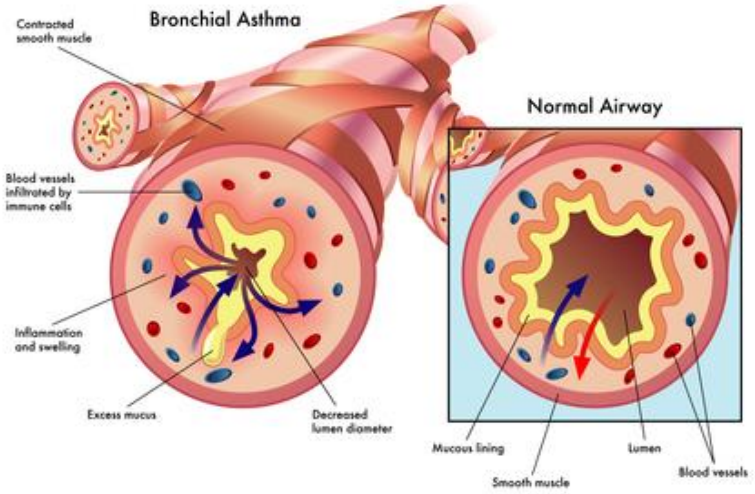
Oxygen supplied on airplanes in case there is a drop in cabin pressure.

Case Study - How Do Tibetans Survive at High Altitude?

In this case study, explore how changes in the body and changes in the genetics of people help them survive at high altitudes.

Asthma

inflammation of the bronchial tubes with increased production of sticky secretions



Common asthma symptoms include:

- Coughing, wheezing
- Shortness of breath
- Chest tightness, pain, or pressure

<u>Bronchodilators</u> are used to open airways.

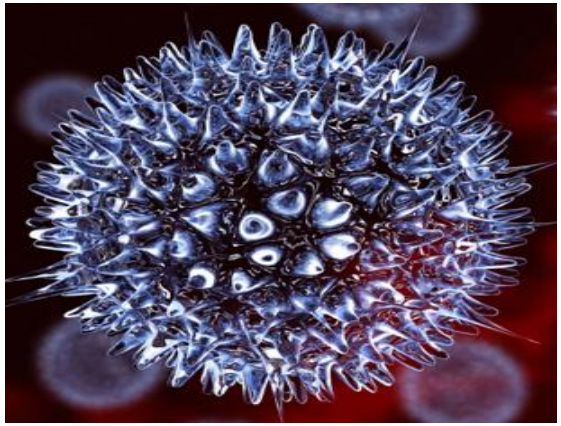
Bacteria / Viral Infections

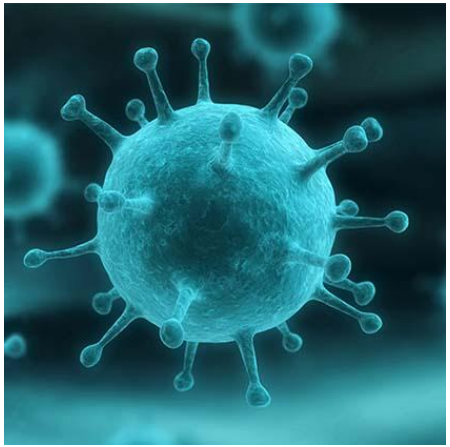
Pneumonia

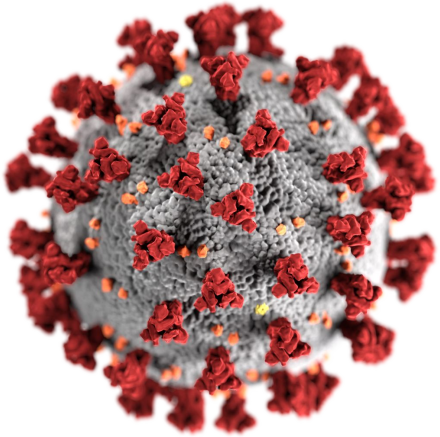
Influenza

Rhinovirus

Covid-19

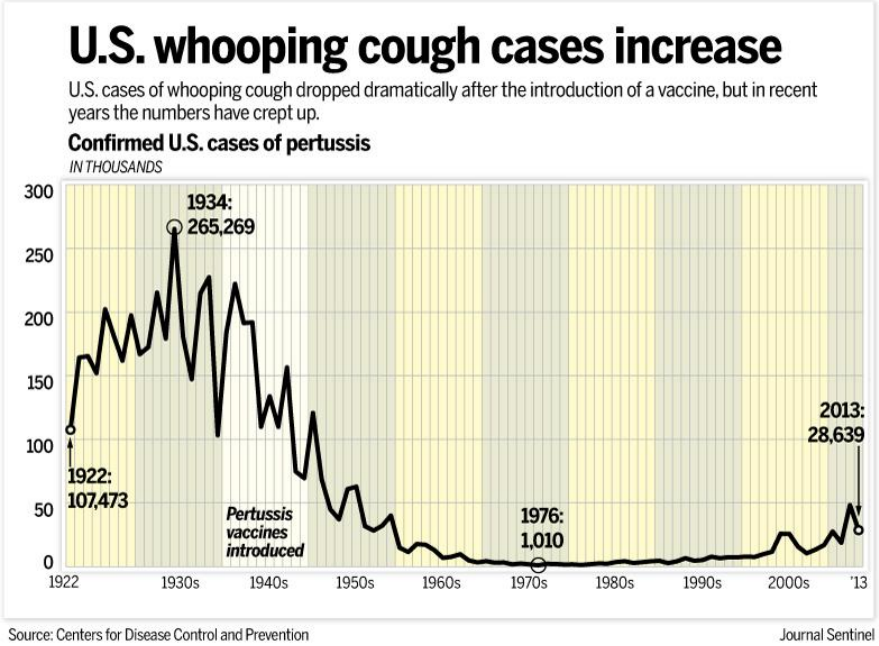






Whooping Cough (Pertussis)

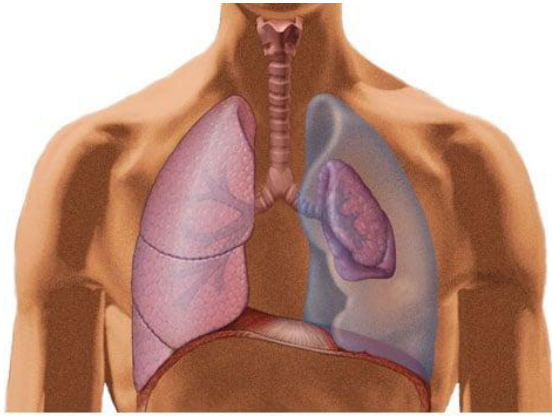
Causes serious coughing and gasping for breath, dangerous for infants.

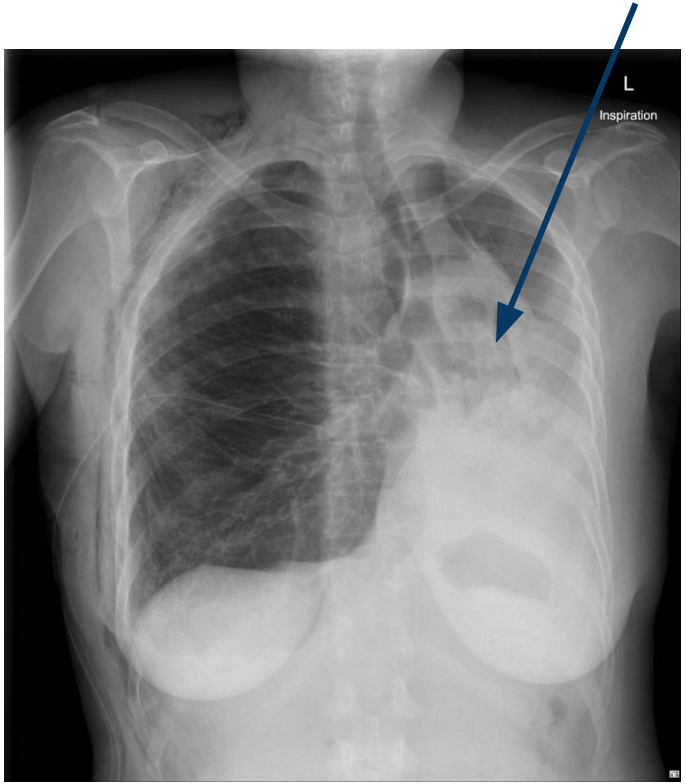


Pneumothorax - Collapsed Lung

- pressure from fluid in the pleural cavity deflates lung
- causes breathing difficulties
- treatment includes draining fluid from the cavity

Watch video showing a chest tube insertion.



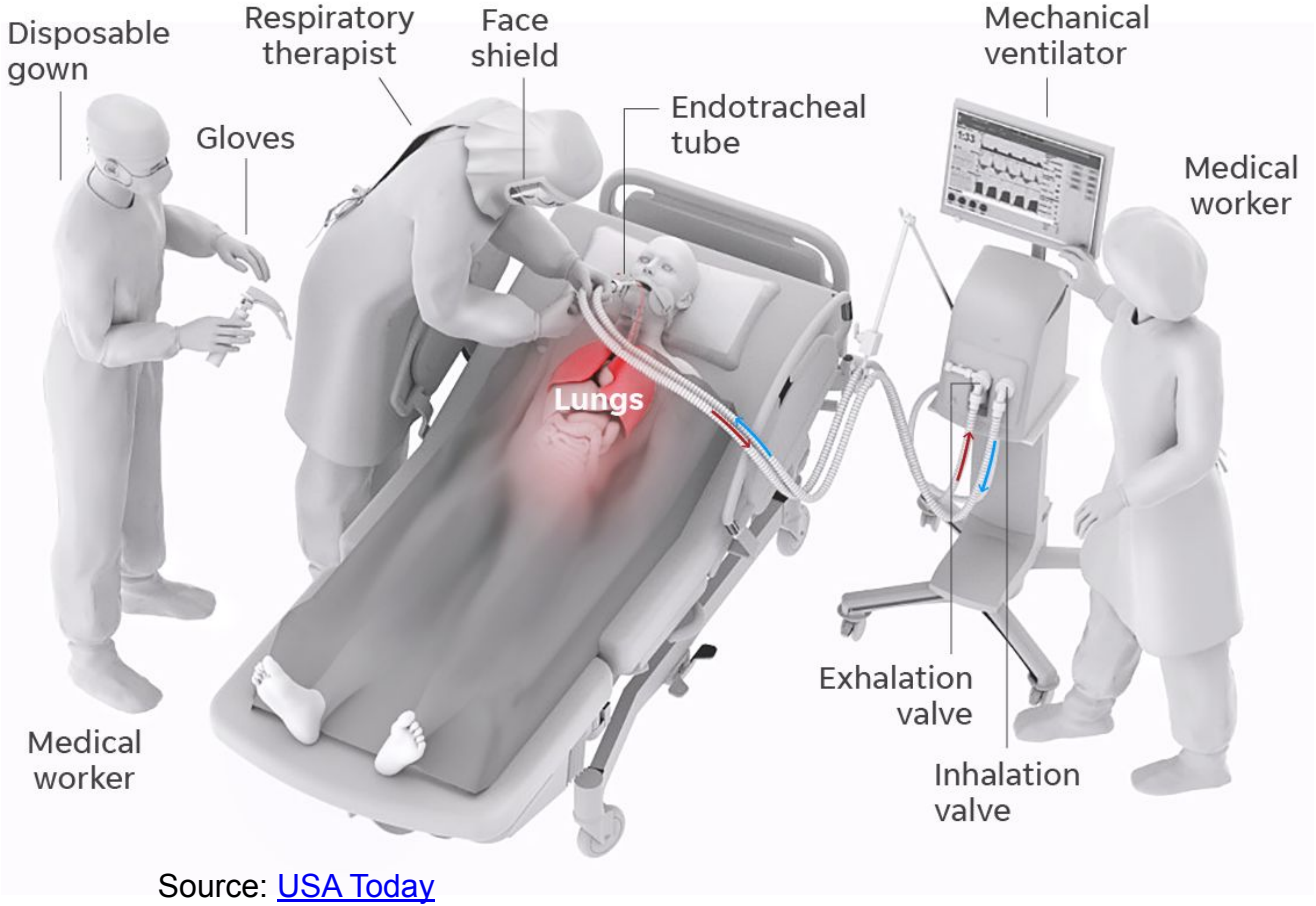


Covid-19

- primarily affects lungs

- some patients are INTUBATED and placed on a VENTILATOR

- There is a vaccine!

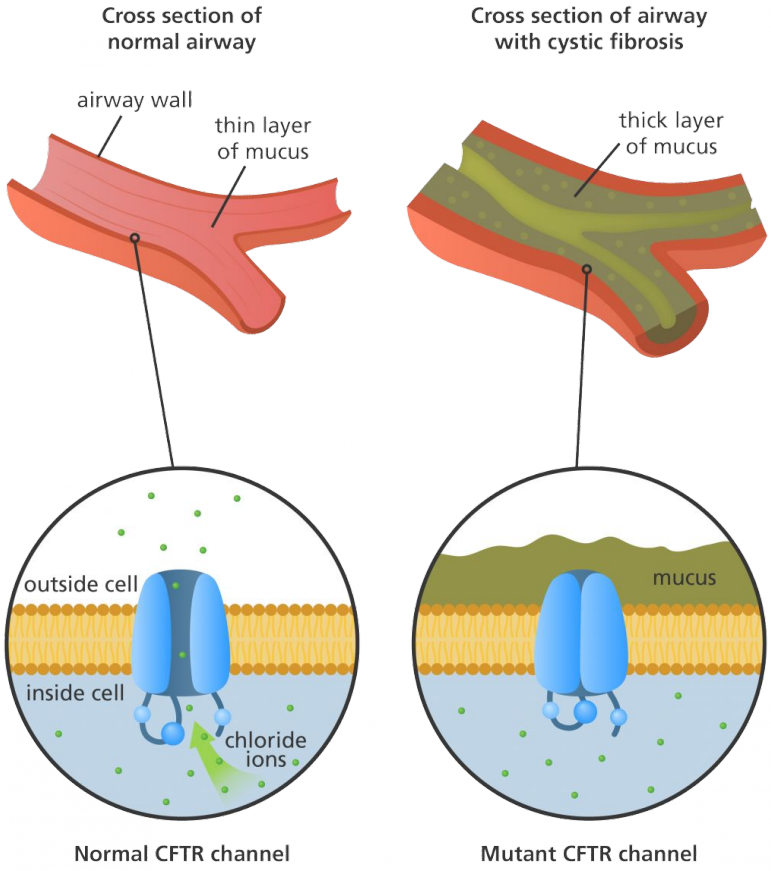


Source: [USA Today]

Cystic Fibrosis - hereditary disease, mucus clogs the lungs, making it difficult to breathe and causing infections

If both parents are carriers, what is the chance they will have a child with the disease?

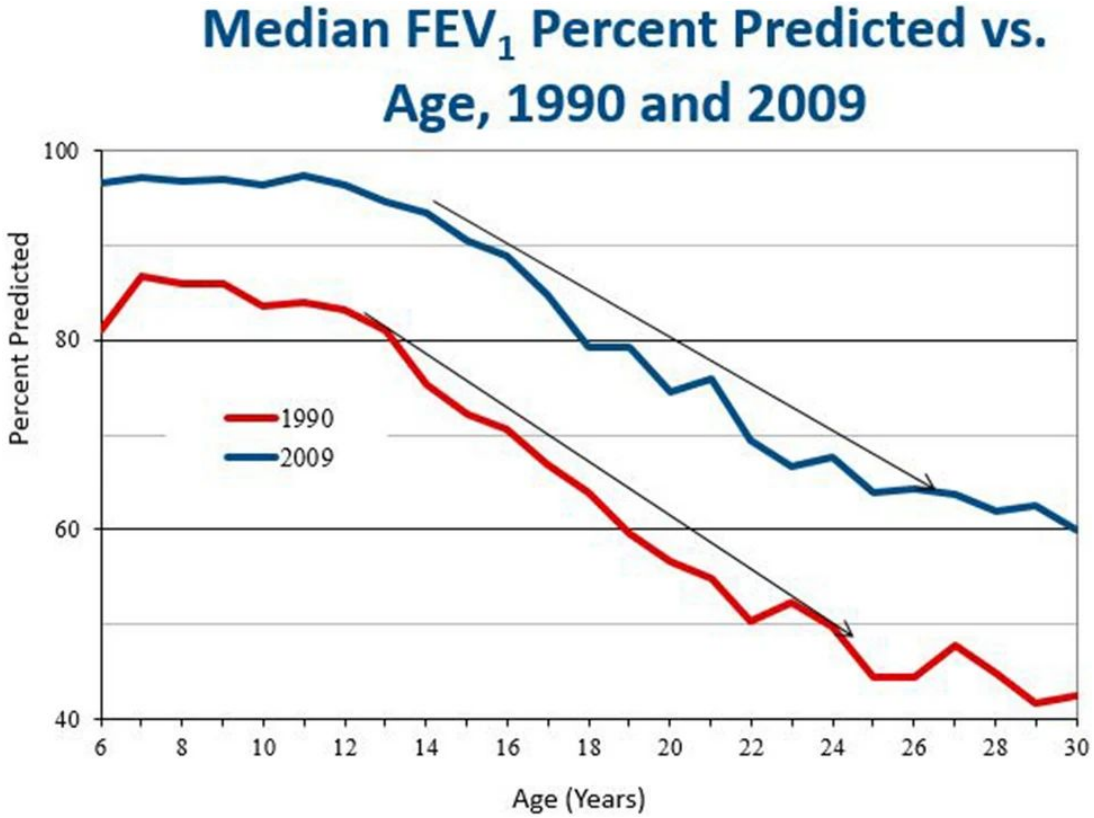
Dd x Dd



Treatment of Patients with Cystic Fibrosis

- Antibiotics
- Medicines to reduce mucus
- Medicines to widen airways
- Medicines to absorb food better (GI tube)
- Medicines to increase movement of Cl+ across membranes
- Lung transplant

*Average lifespan is 44 years



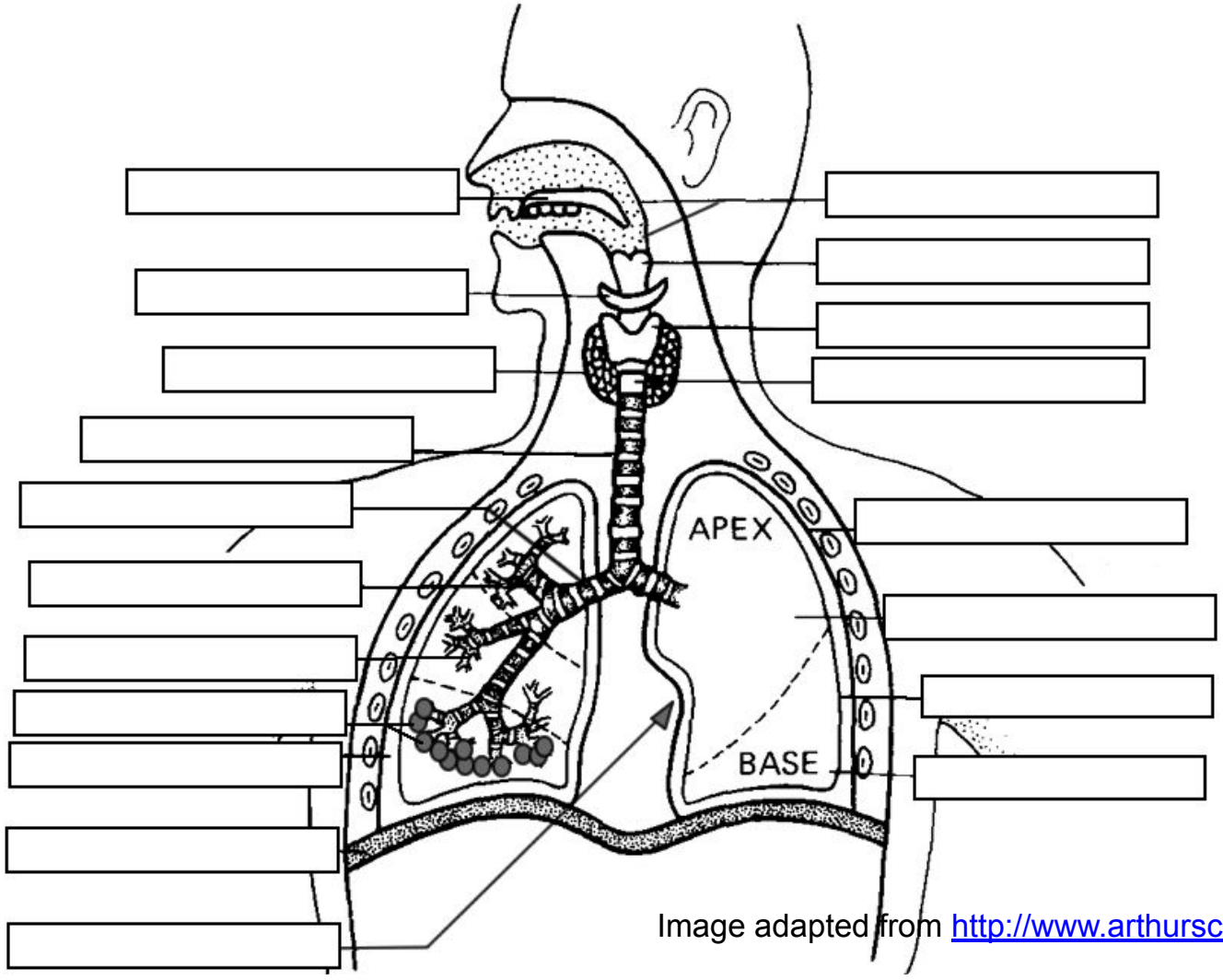
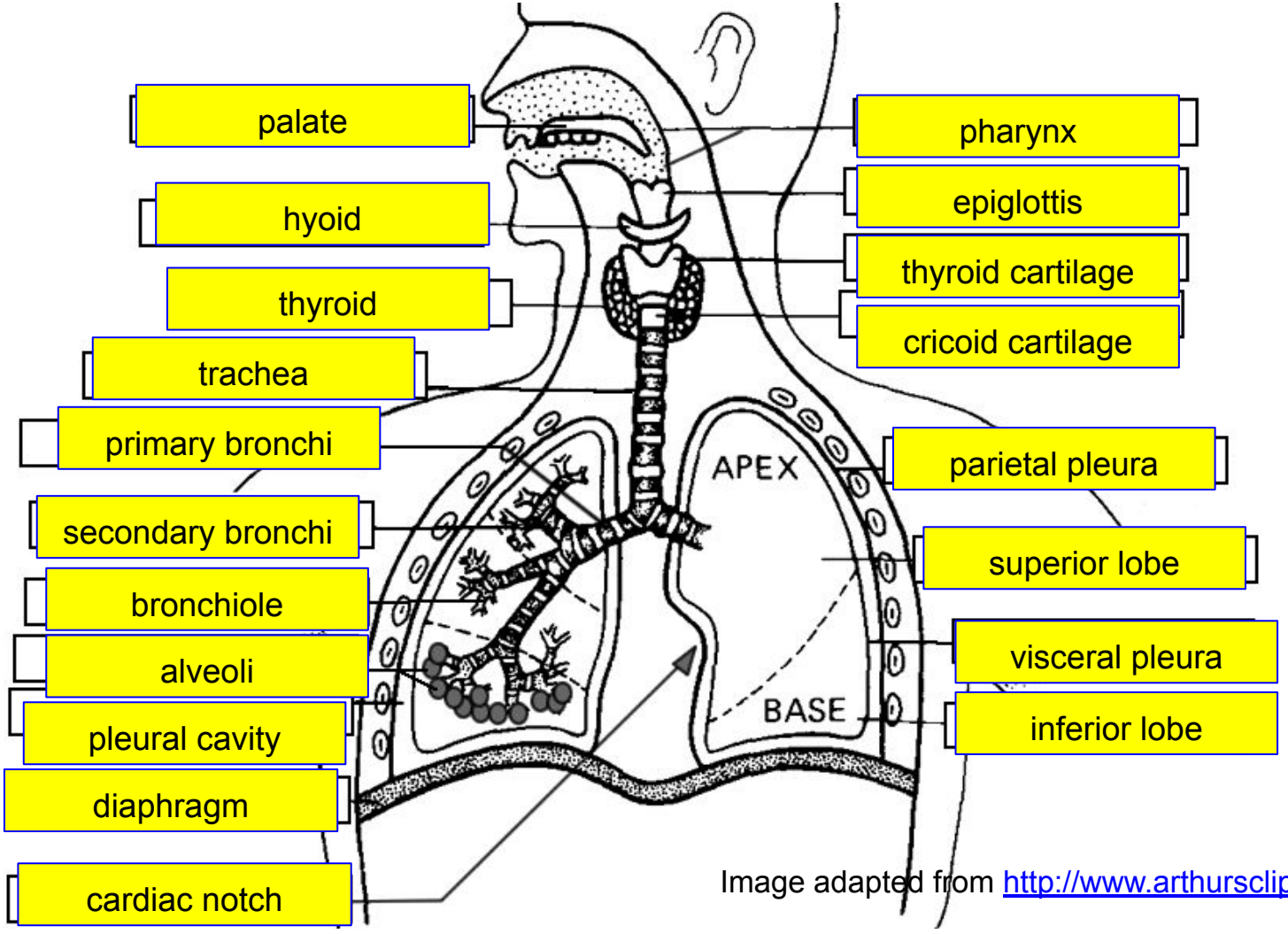


Image adapted from http://www.arthursclipart.org/



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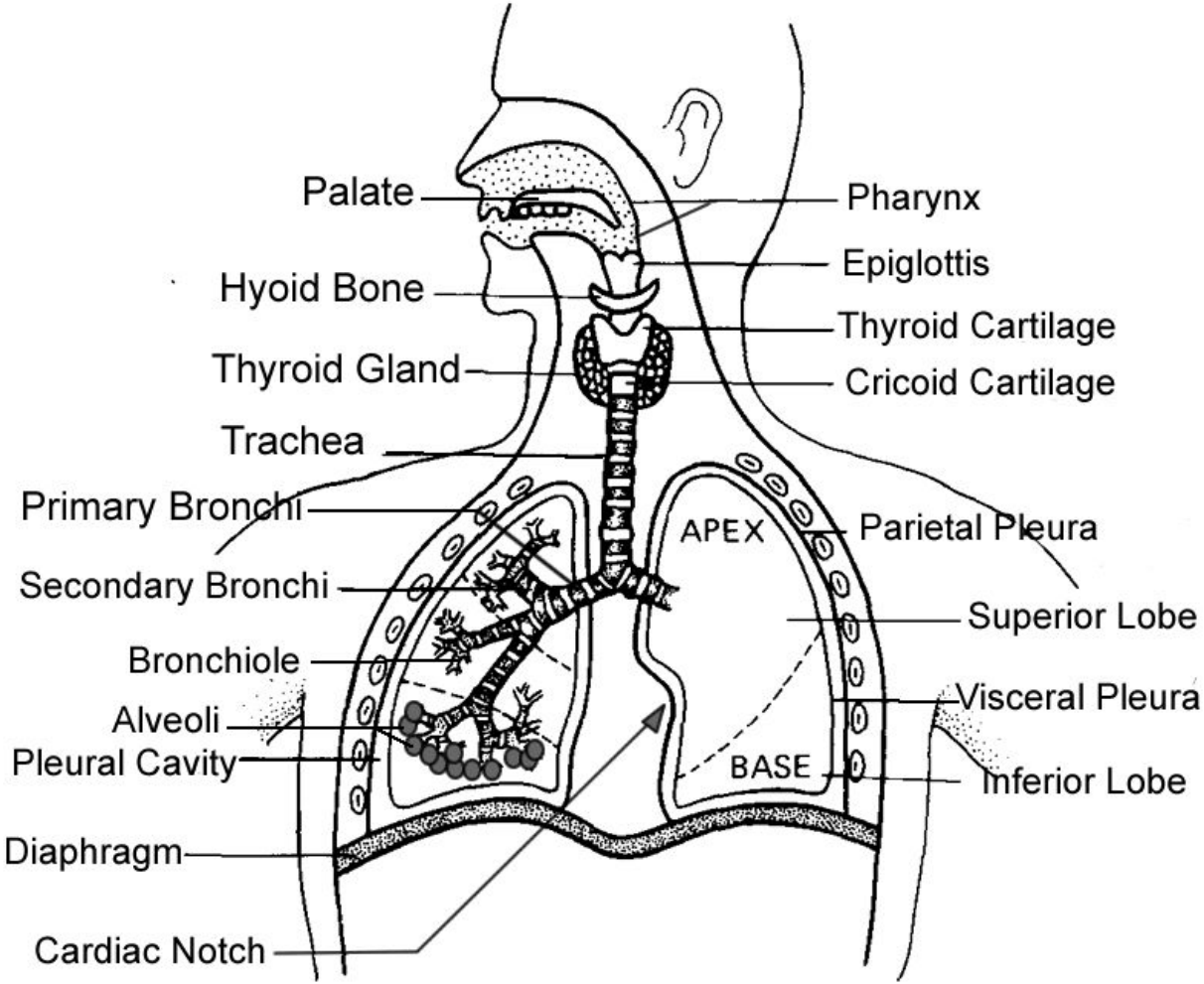
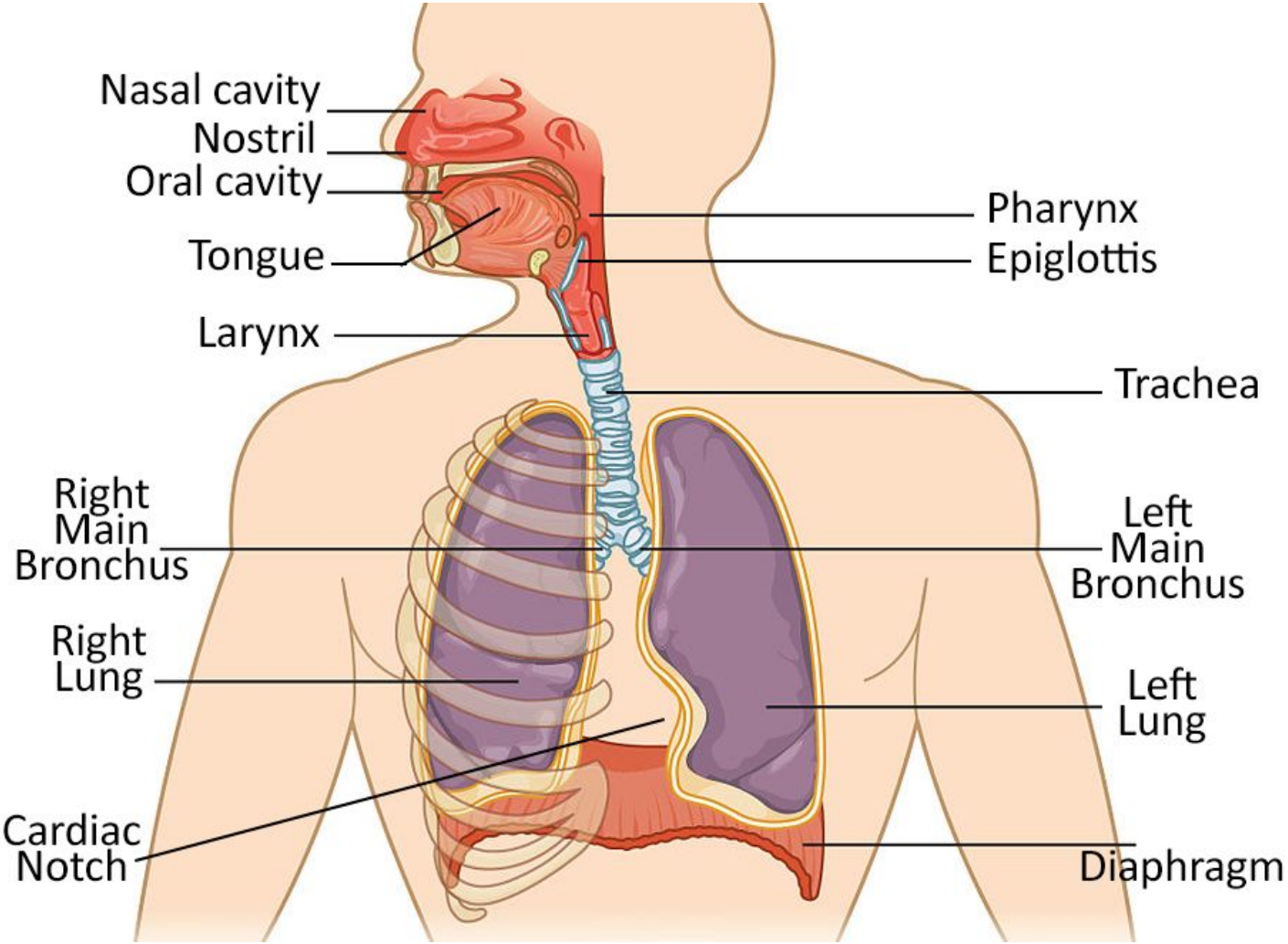

Palate
Pharynx
Epiglottis
Hyoid Bone
Thyroid Cartilage
Thyroid Gland
Cricoid Cartilage
Trachea
Primary Bronchi
APEX
Parietal Pleura
Secondary Bronchi
Superior Lobe
Bronchiole
Visceral Pleura
Alveoli
Pleural Cavity
BASE
Inferior Lobe
Diaphragm
Cardiac Notch


Nasal cavity
Nostril
Oral cavity
Tongue
Larynx
Pharynx
Epiglottis
Trachea
Right Main Bronchus
Left Main Bronchus
Right Lung
Left Lung
Cardiac Notch
Diaphragm