

The Respiratory System

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INTRODUCTION

“Respiration” is used several different ways:

- *Cellular respiration* is the aerobic breakdown of glucose in the mitochondria to make ATP.
- *Respiratory systems* are the organs in animals that exchange gases with the environment.
- “Respiration” is an everyday term that is often used to mean “breathing.”

Respiratory system function

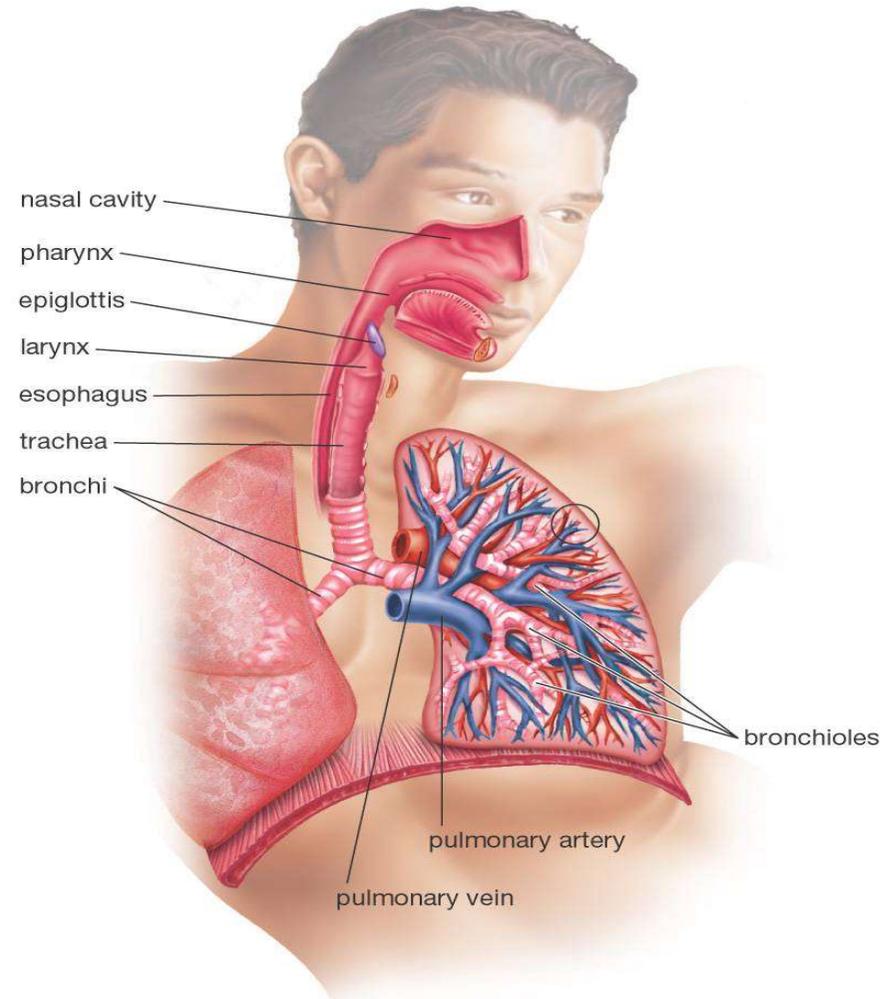
Respiratory systems allow animals to move oxygen (needed for cellular respiration) into body tissues and remove carbon dioxide (waste product of cellular respiration) from cells.

Human respiratory system

(a)

- Parts of the respiratory system include:

- Nose
- Trachea
- Bronchi
- Bronchioles
- Alveoli

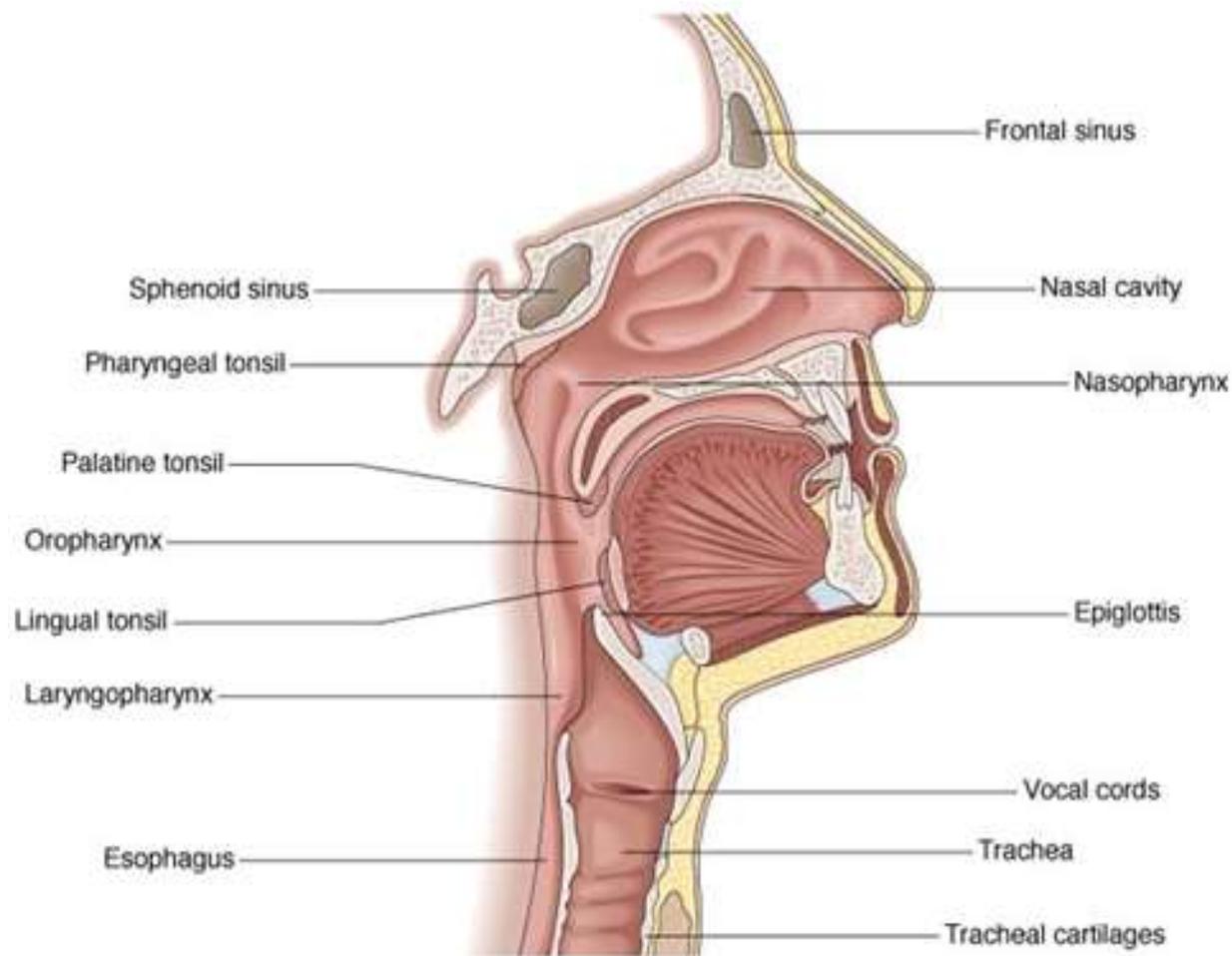


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Respiration:

- Exchange of O_2 / CO_2 between atmosphere, blood and cells
- Cardiovascular and respiratory systems work together to supply O_2 to and remove CO_2 from cells

The Anatomy and Functions of the Nose



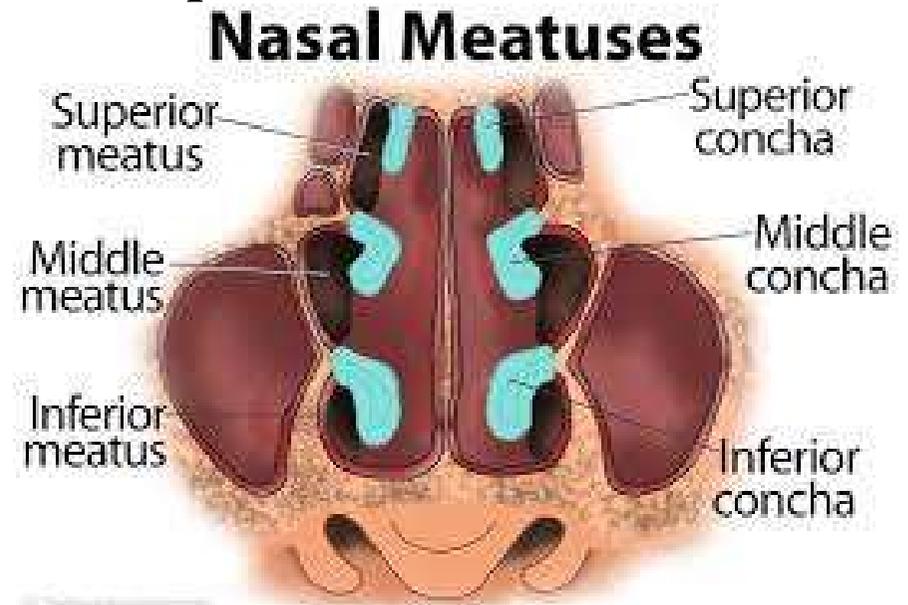
The Anatomy and Functions of the Nose

Parts of nose

- **External nares:** openings into the nose
- **Internal nares:** connect nose and pharynx
- Coarse hairs line the vestibules
 - Filter large dust particles

The Anatomy and Functions of the Nose

- **Three shelves:** formed by turbinate bones
 - Superior, middle and inferior meatus
- **Olfactory receptors:** located in the superior meatus
- **Functions of internal nose**
 - Warm and moisturize air, smell, speech tone



The Structure and Functions of the Pharynx

- **Functions**

- Passageway for food

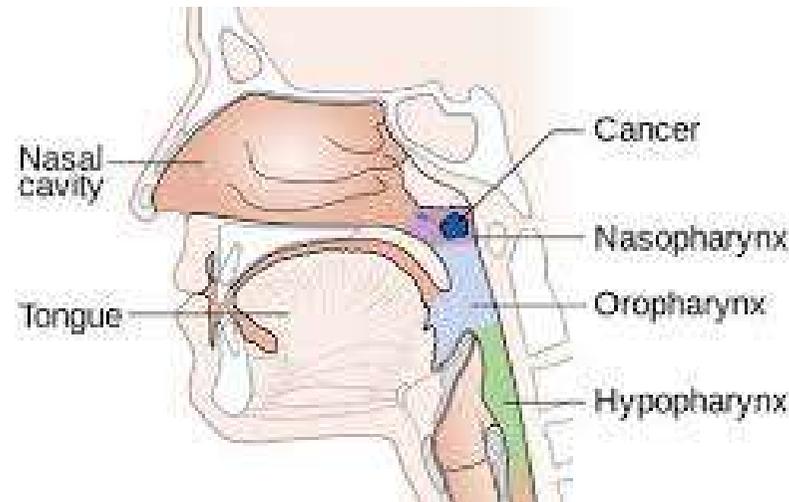
- Passageway for air

- Resonating chamber for speech

The Structure and Functions of the Pharynx

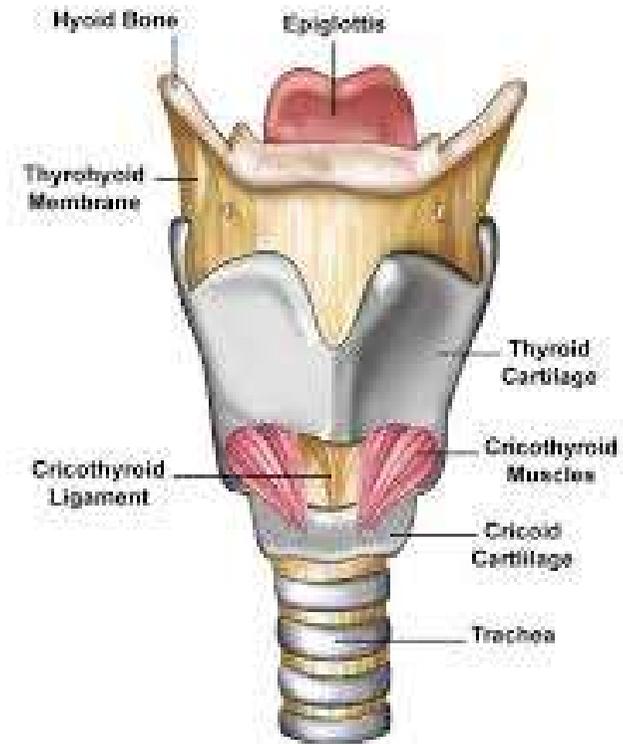
- **Divisions**

- **Nasopharynx:** internal nares and Eustachian tubes
- **Oropharynx:** connection to mouth
- **Laryngopharynx:** connects with esophagus and larynx



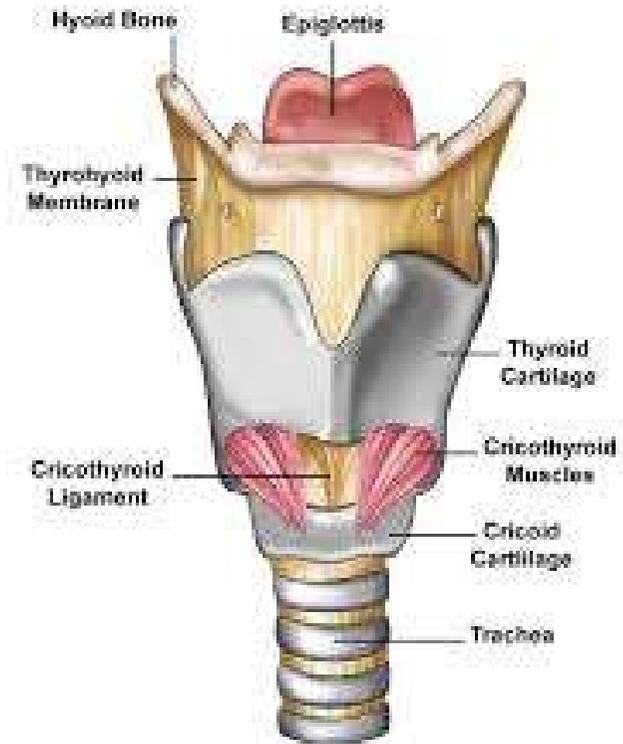
The Larynx or Voice Box

- Supporting cartilage
 - **Thyroid cartilage:** largest, Adam's apple
 - **Epiglottis:** prevents food and liquids from entering trachea
 - **Cricoid:** connects with first tracheal ring



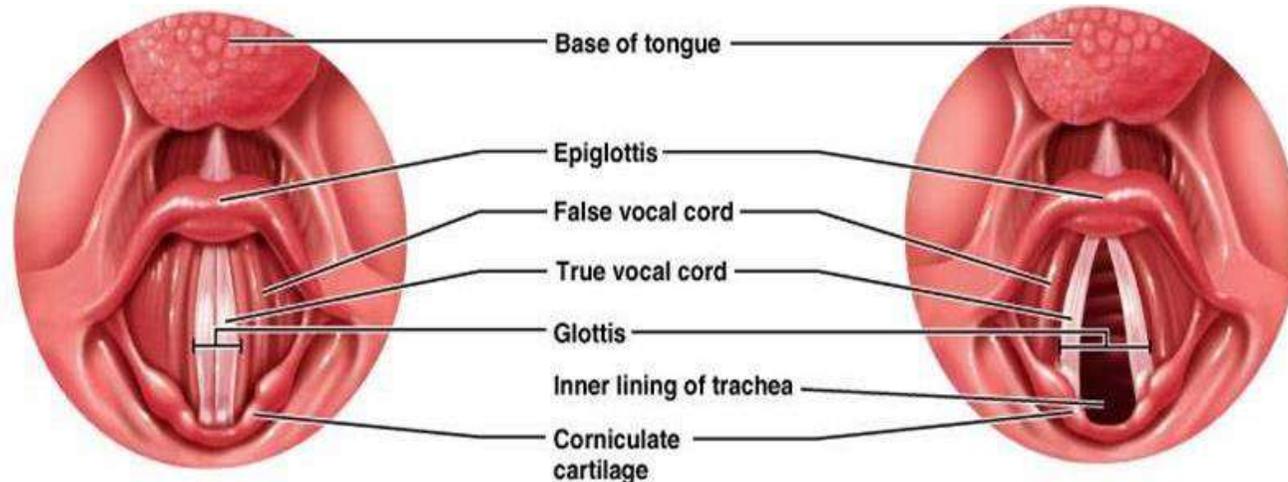
The Larynx or Voice Box

- Supporting cartilage
 - **Arytenoid:** attach to vocal cords and laryngeal muscles
 - **Corniculate and cuneiform:** connect epiglottis to arytenoid cartilage

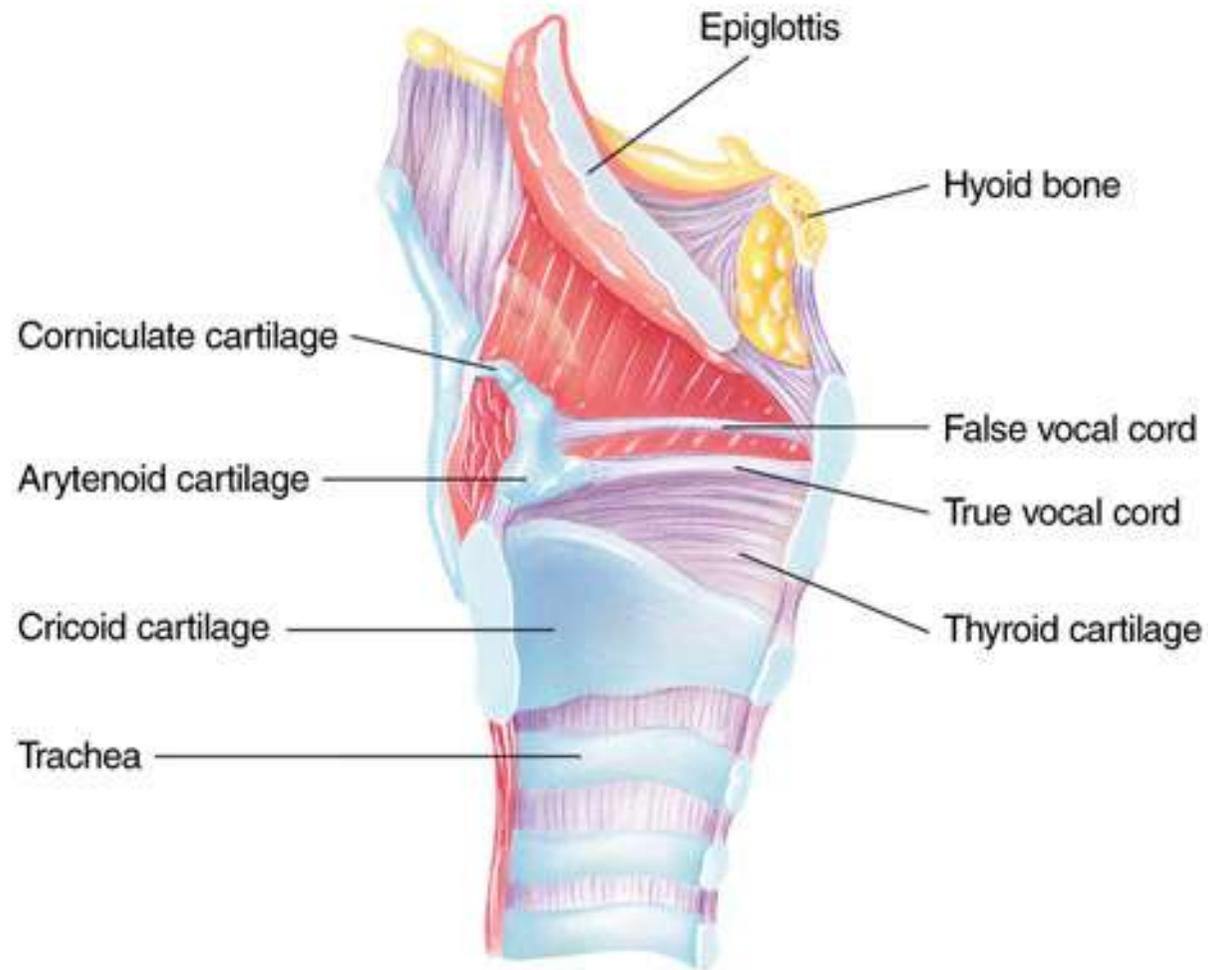


The Larynx or Voice Box

- Form and function
 - **Mucous membrane:** two pairs of folds
 - False vocal cords
 - True vocal cords
 - **Glottis:** opening over true vocal cords
 - Sound produced by air vibrating vocal cords

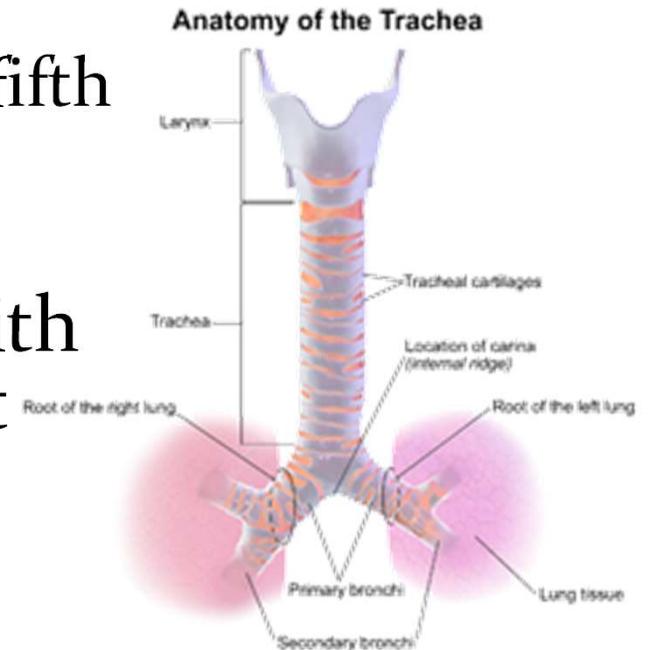


The Larynx or Voice Box



The Trachea or Windpipe

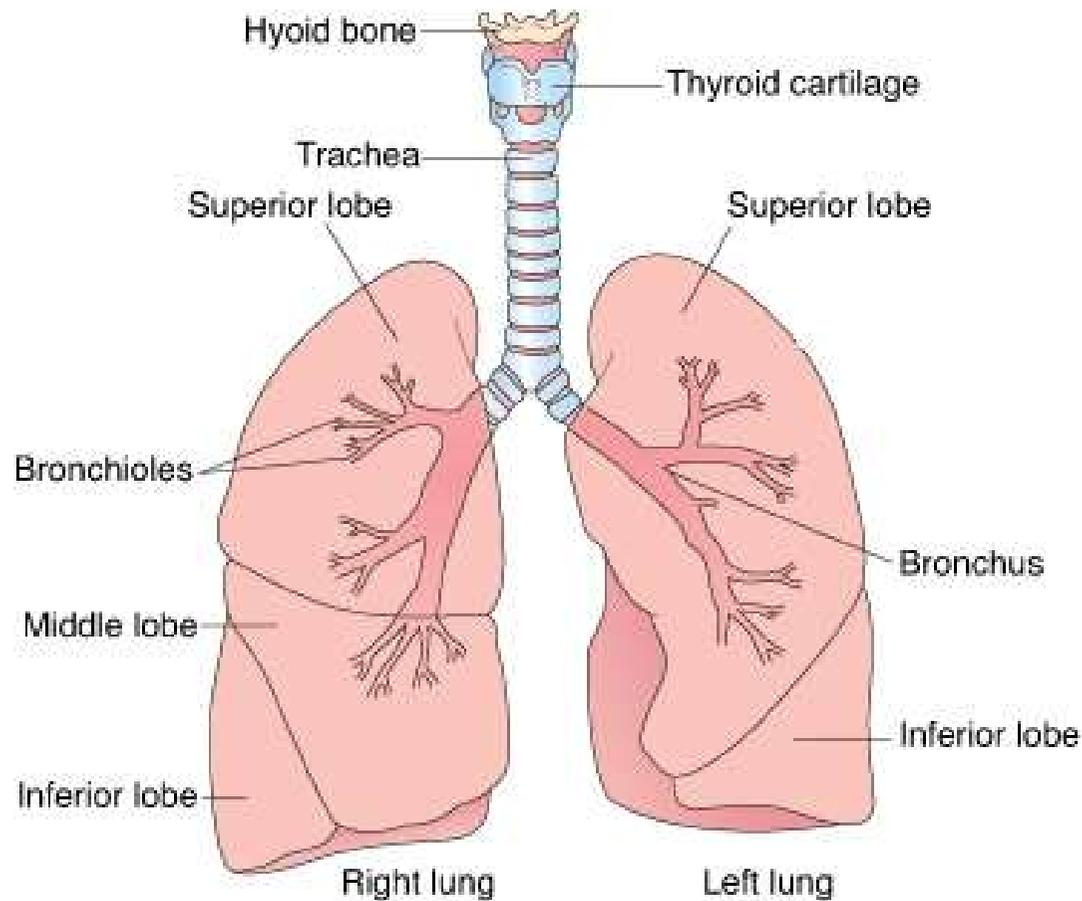
- It's a tubular passageway for air
 - Anterior to esophagus
 - Extends from cricoid cartilage to fifth thoracic vertebra
- Pseudo-stratified epithelium with cilia and goblet cells are present
- Smooth muscle and connective tissue are also associated



The Trachea or Windpipe

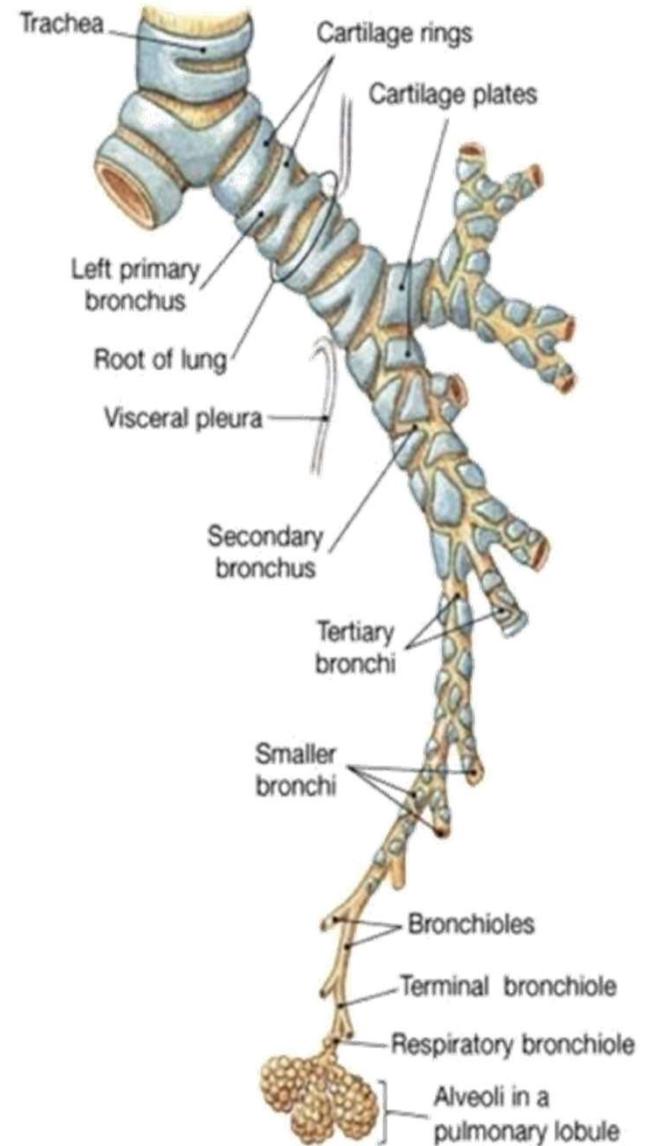
- Supporting cartilage: stack of Cs
- Cough reflex stimulated by foreign object
- Tracheostomy done if object cannot be expelled
 - Usually done between second and third tracheal cartilages
 - Can be closed when object removed

The Bronchi and the Bronchial Tree



The Bronchi and the Bronchial Tree

- Trachea branches into left and right primary bronchi
- Primary bronchi branch into secondary bronchi
- Secondary bronchi branch into tertiary bronchi
- Tertiary bronchi branch into bronchioles
- Bronchioles branch into terminal bronchioles
- Terminal bronchioles branch into respiratory bronchioles
- Respiratory bronchioles branch into alveoli



The Anatomy and Function of the Lungs

- Pleural membrane: encloses and protects lungs
 - Parietal pleura: outer
 - Visceral pleura: inner
 - Pleural cavity: between pleura, prevents friction
- **Pleurisy:** inflammation of parietal pleura

The Anatomy and Function of the Lungs

- Segments: supplied by each tertiary bronchi
- Lobules
 - Wrapped in elastic connective tissue
 - Each has: lymphatic, arteriole, venule, bronchioles
- Terminal bronchioles subdivide into respiratory bronchioles

The Anatomy and Function of the Lungs

- Respiratory bronchioles divide into alveolar ducts
- Alveoli surround the alveolar ducts
 - Grapelike outpouching
 - Surrounded by capillary network
- Respiratory gases pass through alveolar-capillary membrane
 - Coated with surfactant: reduces surface tension

The Respiration Process

- **Ventilation or breathing**
 - Inhalation
 - Diaphragm and intercostal muscles contract
 - Pressure decreases in lungs: air rushes in
 - Exhalation
 - Diaphragm and intercostal muscles relax
 - Pressure increases in lungs: air rushes out

The Respiration Process

- External respiration
 - Exchange of gases between lungs and blood
- Internal respiration
 - Exchange of gases between blood and body cells

The Respiration Process

- Partial pressure of gas
 - Amount of pressure gas contributes to total pressure
 - Directly proportional to concentration of gas
- Gas diffuses from high partial pressure to low partial pressure

The Respiration Process

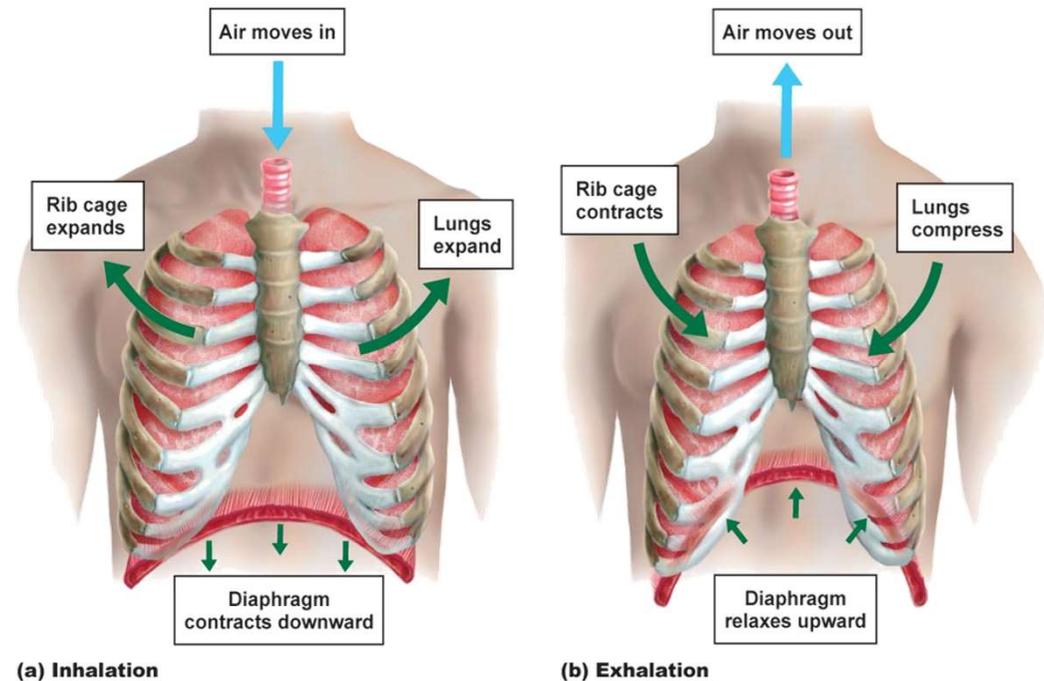
- Lung capacity
 - Functional residual capacity: volume of gas in lungs at the end of a normal tidal volume exhalation
 - Inspiratory capacity: maximum volume of gas that can be inhaled from end of resting exhalation

The Respiration Process

- Lung capacity
 - Total lung capacity: volume of gas in lungs at end of maximum inspiration
 - Vital capacity: maximum volume of air that can be expelled at normal rate of exhalation after a maximum inspiration

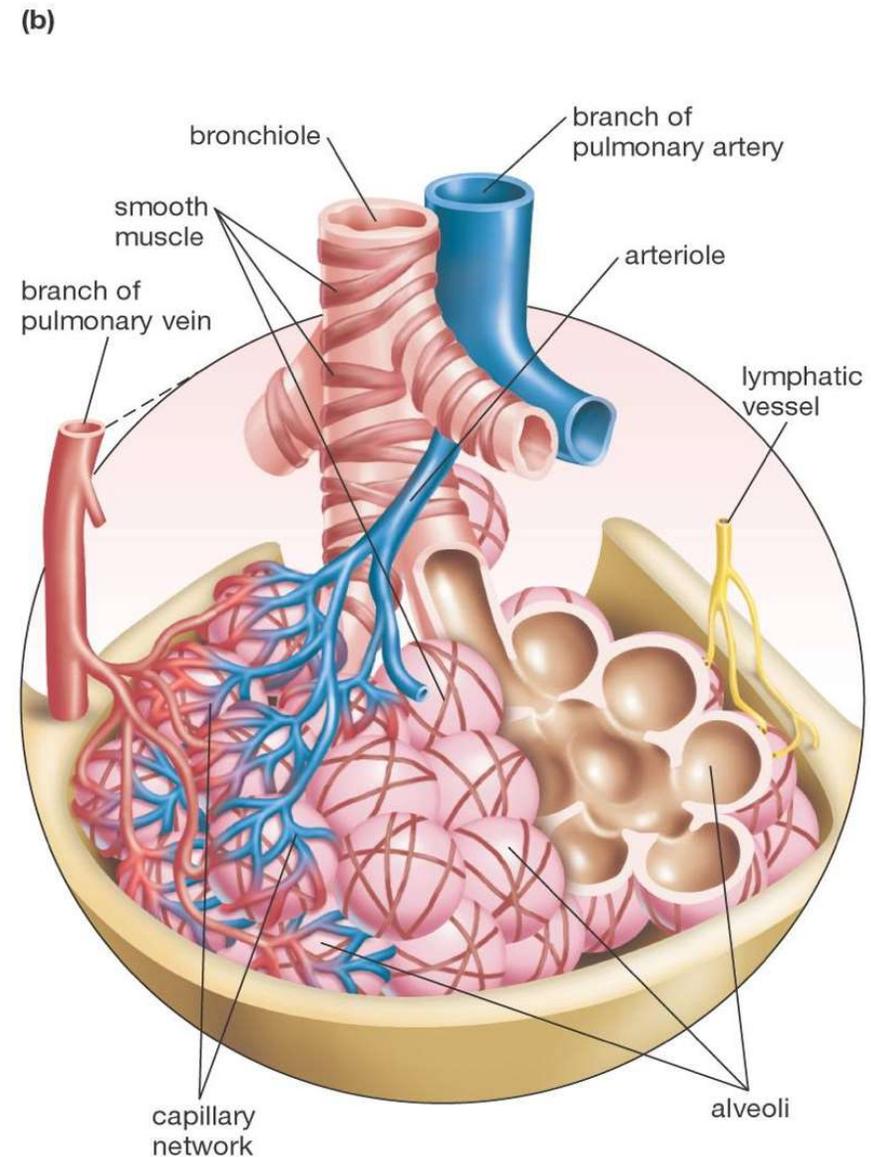
Moving air in and out

- During inspiration (inhalation), the diaphragm and intercostal muscles contract.
- During exhalation, these muscles relax. The diaphragm domes upwards.



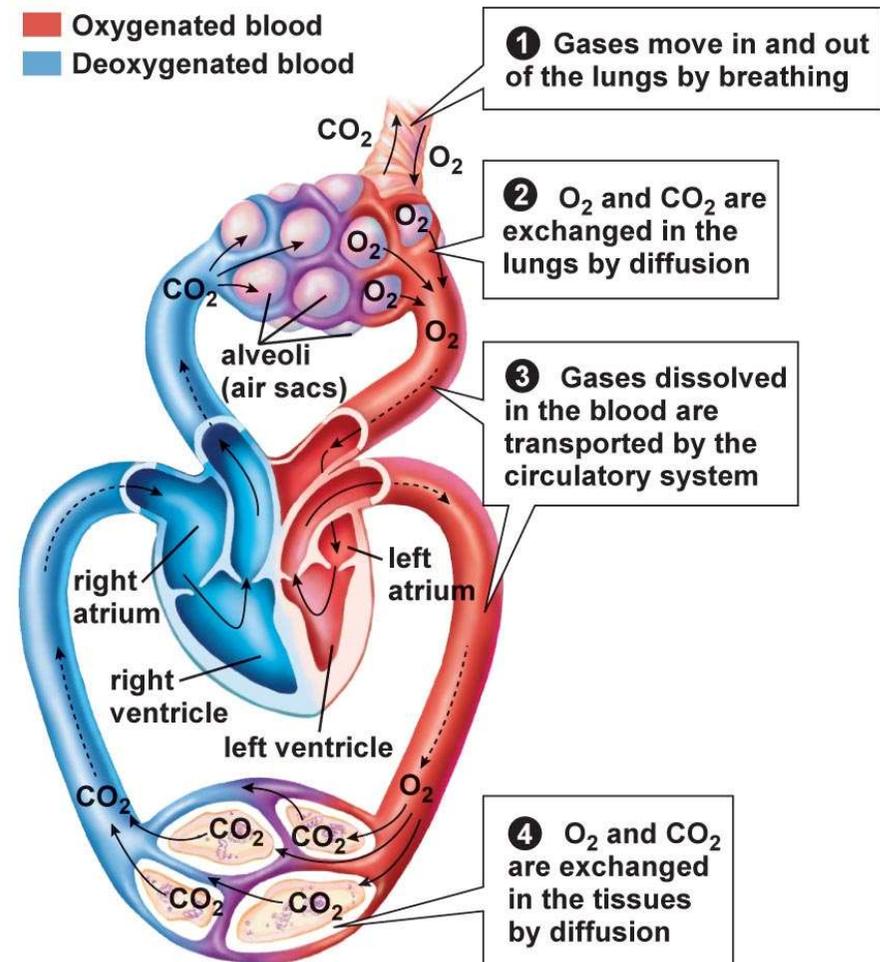
Alveoli

- The alveoli are moist, thin-walled pockets which are the site of gas exchange.
- A slightly oily surfactant prevents the alveolar walls from collapsing and sticking together.



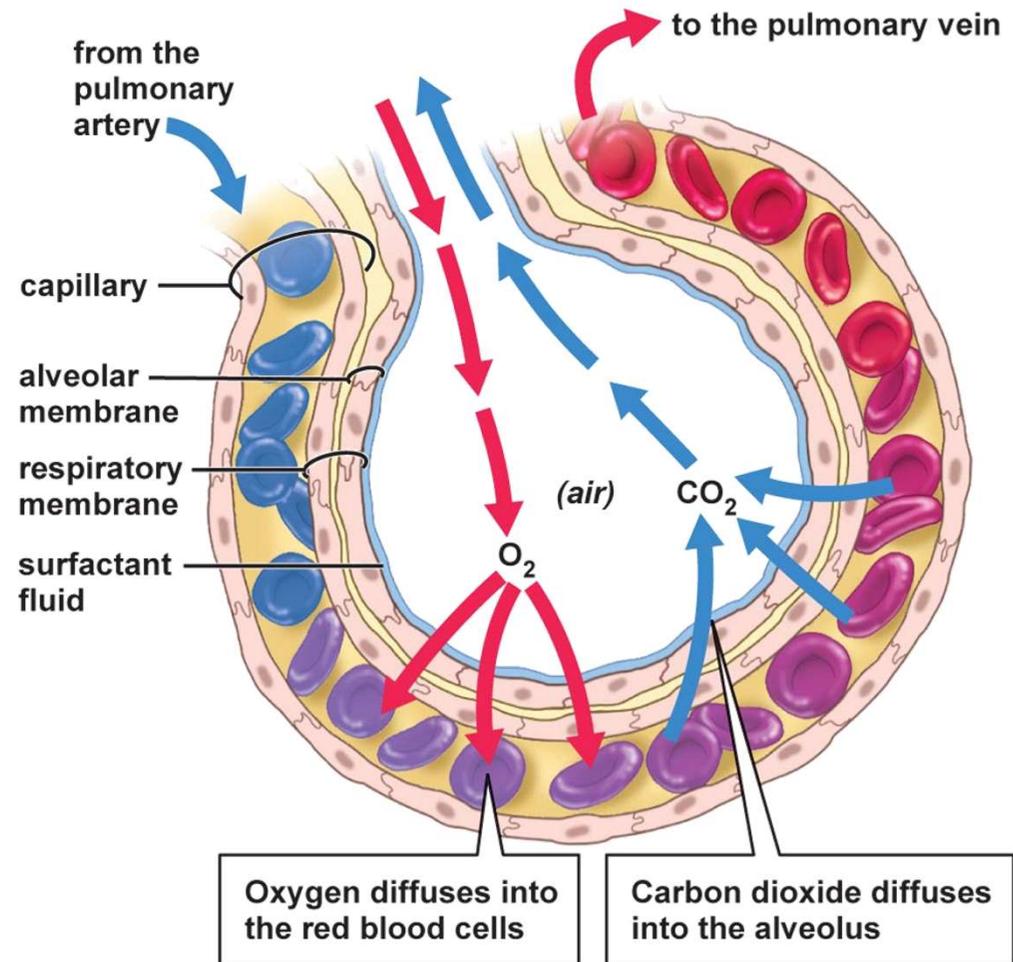
Circulation and Gas Exchange

- Recall the interconnection between circulation and the respiratory system.
- Gas exchange at the lungs and in the body cells moves oxygen into cells and carbon dioxide out.



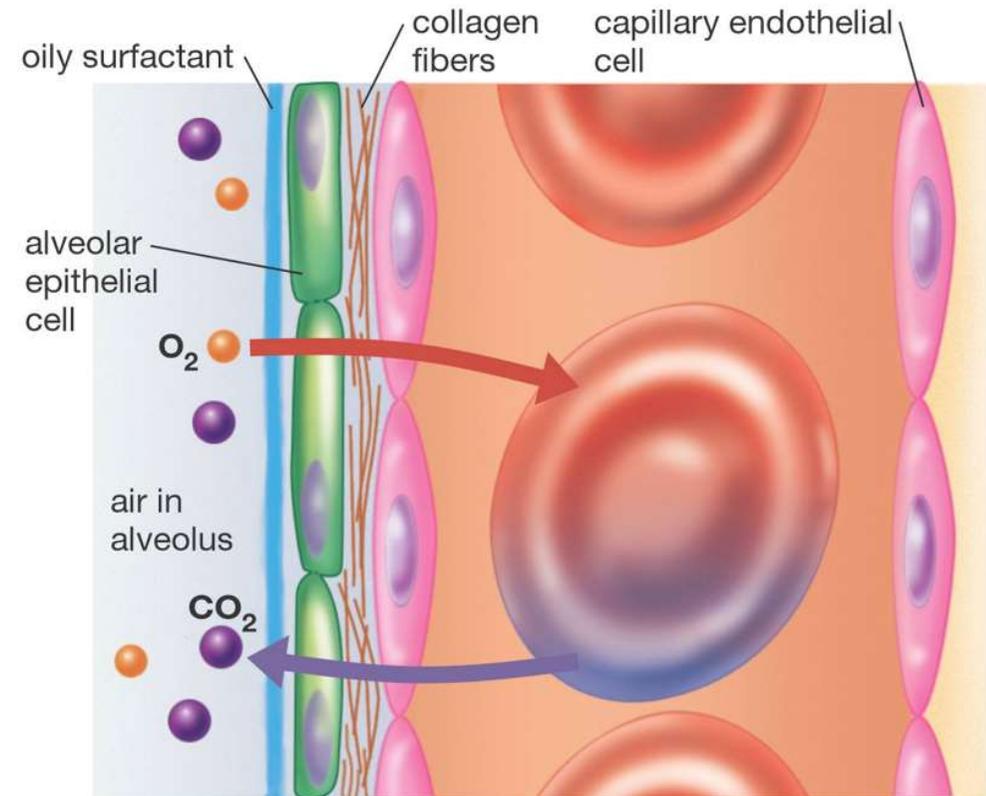
In the alveolus

- The respiratory surface is made up of the alveoli and capillary walls.
- The walls of the capillaries and the alveoli may share the same membrane.



Gas exchange

- Air entering the lungs contains more oxygen and less carbon dioxide than the blood that flows in the pulmonary capillaries.
- How do these differences in concentrations assist gas exchange?

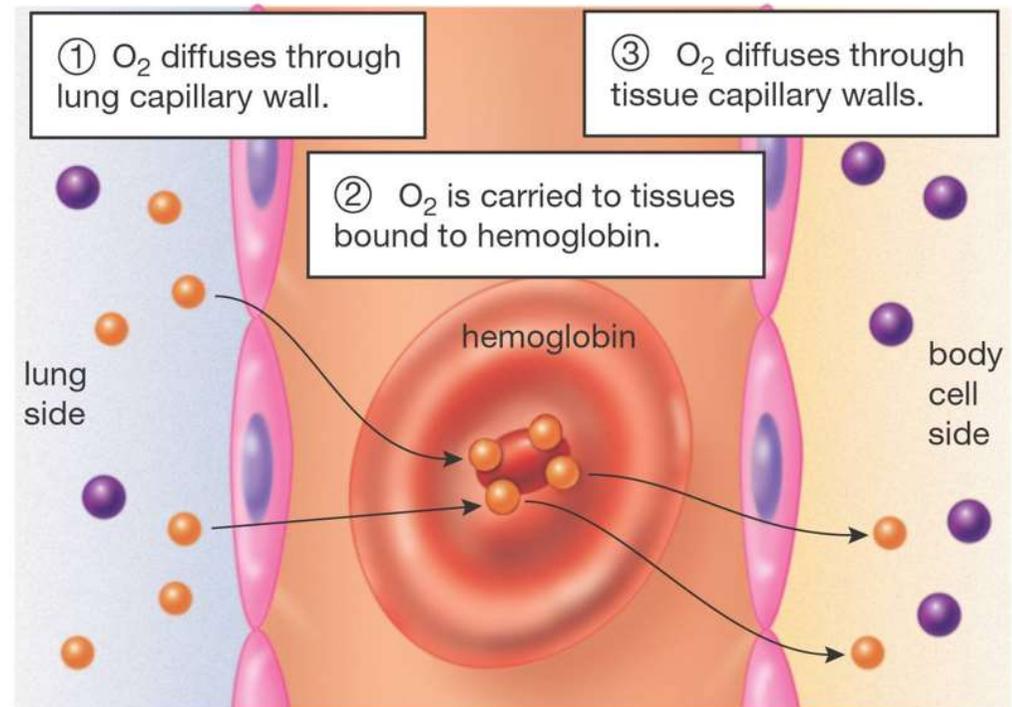


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Oxygen transport

- Hemoglobin binds to oxygen that diffuses into the blood stream.
- What are some advantages to using hemoglobin to transport oxygen?

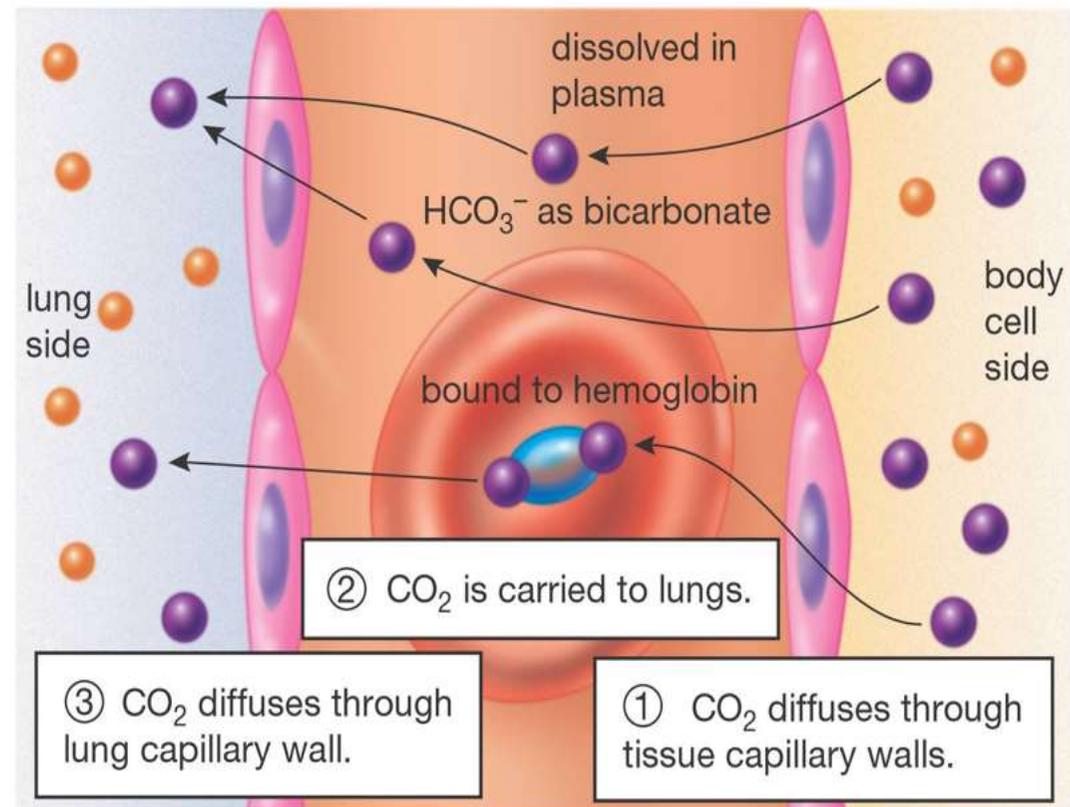
(a) Transport of oxygen (●)



Carbon dioxide transport

- Carbon dioxide can dissolve in plasma, and about 70% forms bicarbonate ions.
- Some carbon dioxide can bind to hemoglobin for transport.

(b) Transport of carbon dioxide (●)



Pulmonary Disorders

Dyspnea:

- Shortness of breath.
- Due to exercise, altitude, tight clothing, etc...

Asthma:

- Obstructive air flow through bronchioles.
- Caused by inflammation and mucus secretion.
- Inflammation contributes to increased airway responsiveness to agents that promote bronchial constriction.

Ex: IgE, exercise.

Emphysema:

- Alveolar tissue is destroyed.
- Chronic progressive condition that reduces surface area for gas exchange.
- Decreases ability of bronchioles to remain open during expiration.
- Cigarette smoking stimulates macrophages and leukocytes to secrete protein digesting enzymes that destroy tissue.

Pulmonary fibrosis:

- Normal structure of lungs disrupted by accumulation of fibrous connective tissue proteins.

Ex: Anthracosis.

Disorders Caused by High Partial Pressures of Gases

Nitrogen narcosis:

- At sea level nitrogen is physiologically inert.

Under hyperbaric conditions:

- Nitrogen dissolves slowly.
- Can have deleterious effects.
- Resembles alcohol intoxication.

Decompression sickness:

- Amount of nitrogen dissolved in blood as a diver ascends decreases due to a decrease in Partial pressure of Nitrogen.
- If occurs rapidly, bubbles of nitrogen gas can form in tissues and enter the blood.
- Block small blood vessels producing the “bends.”

Respiratory Acidosis

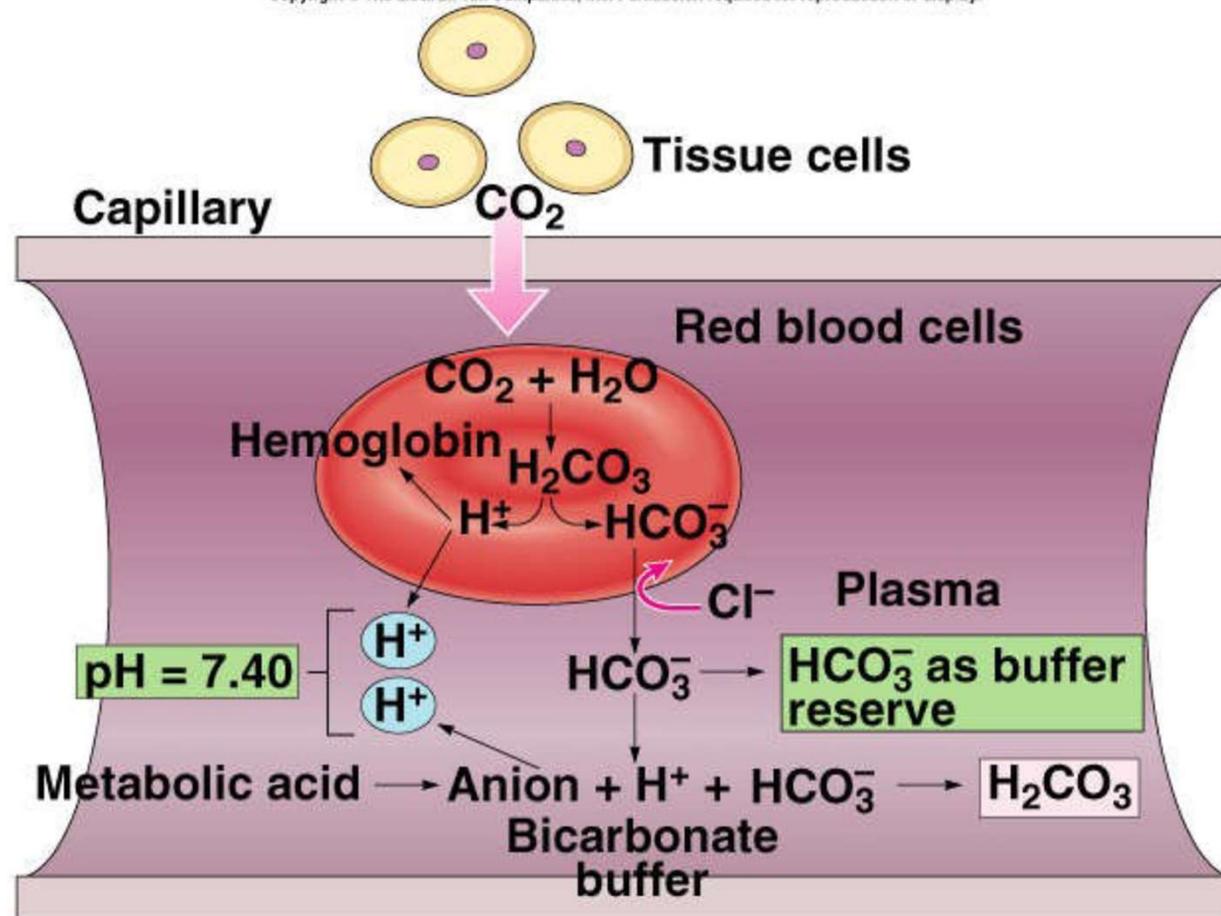
- Hypoventilation.
- Accumulation of CO₂ in the tissues.
- Partial pressure of CO₂ increases.
- pH decreases.
- Plasma HCO₃ (bicarbonate) increases.

Respiratory Alkalosis

- Hyperventilation.
- Excessive loss of CO₂.
- Partial pressure of CO₂ decreases.
- pH increases.
- Plasma HCO₃⁻ (bicarbonate) decreases.

Effect of Bicarbonate on Blood pH

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ARTIFICIAL RESPIRATION

- When the lung stop's functioning (or) sudden stoppage of breathing ..

CAUSES

- Drowning
- Electrocution
- Anesthesia
- CO₂ poisoning
- Poliomyelitis
- Myasthenia gravis
- Drugs

TYPES

- Manual

Mouth to mouth

Cardiopulmonary resuscitation (CPR)

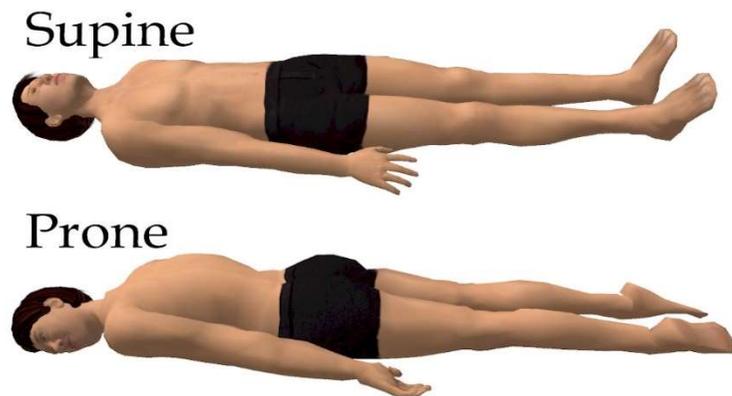
- Mechanical

Tank respirators (Iron lung machine)

Ventilators

MANUAL-MOUTH TO MOUTH

- Put the patient in supine position
- Clear airway
- Extend the neck
- Close the nostrils
- Apply your mouth to subject and exhale forcefully
- Look for chest expansion and abd distention
- Repeat at the rate of 10 – 15 /min





- Volume of air must be twice as normal tidal volume
- Expiration occurs passively
- Should be continued till patient starts breathing normally or shifted to hospital .

IMPORTANT

- Effective because of Co₂ of expired air Contains 16% of O₂
- Simple , effective , and useful in all age groups
- Only manual technique able to produce adequate ventilation

CARDIOPULMONARY RESUSCITATION (CPR)

- **CPR** is an emergency procedure that combines chest compressions often with artificial ventilation in an effort to manually preserve **intact brain function** until further measures are taken to restore spontaneous blood circulation and breathing in a person who is in cardiac arrest.

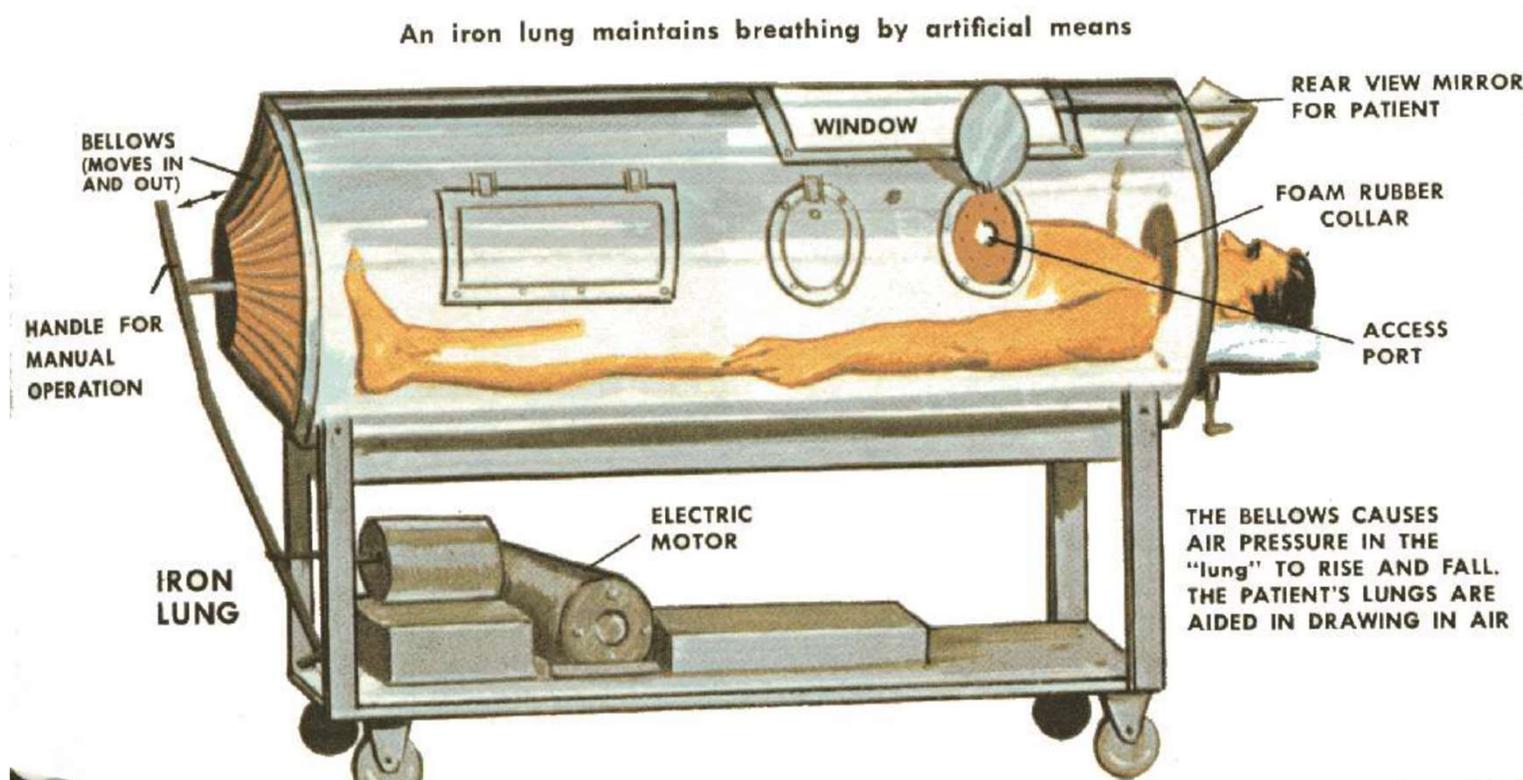


FIRST AID CPR

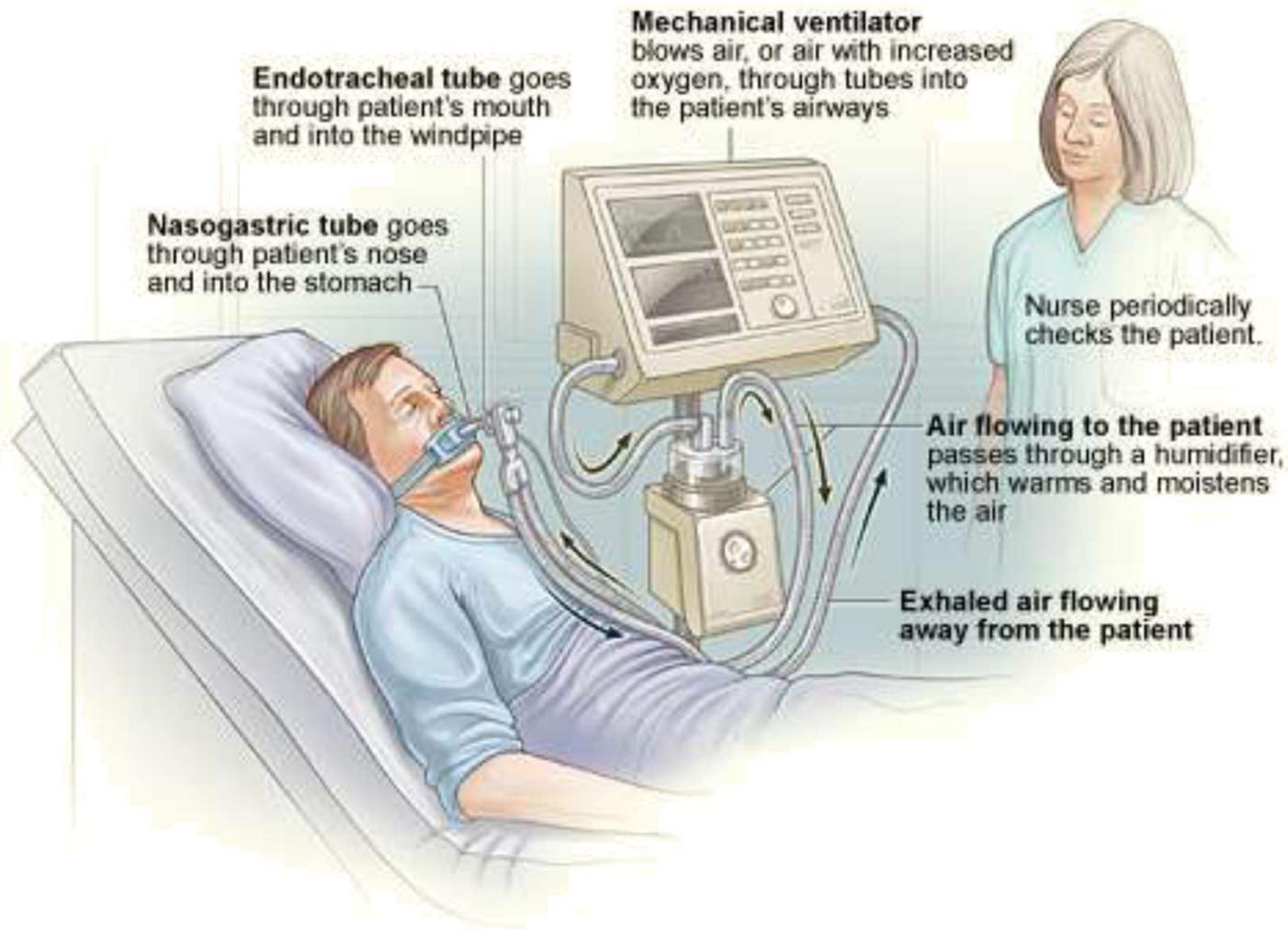


MECHANICAL RESPIRATION

IRON LUNG MACHINE



VENTILATORS



THANK YOU