RESPIRATORY SYSTEM

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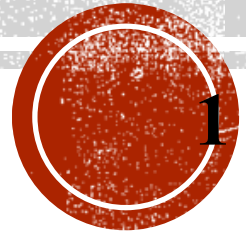


RESPIRATORY SYSTEM

- The respiratory system is composed of the upper and lower respiratory tracts. Together, the two tracts are responsible for **ventilation** (movement of air in and out of the airways).

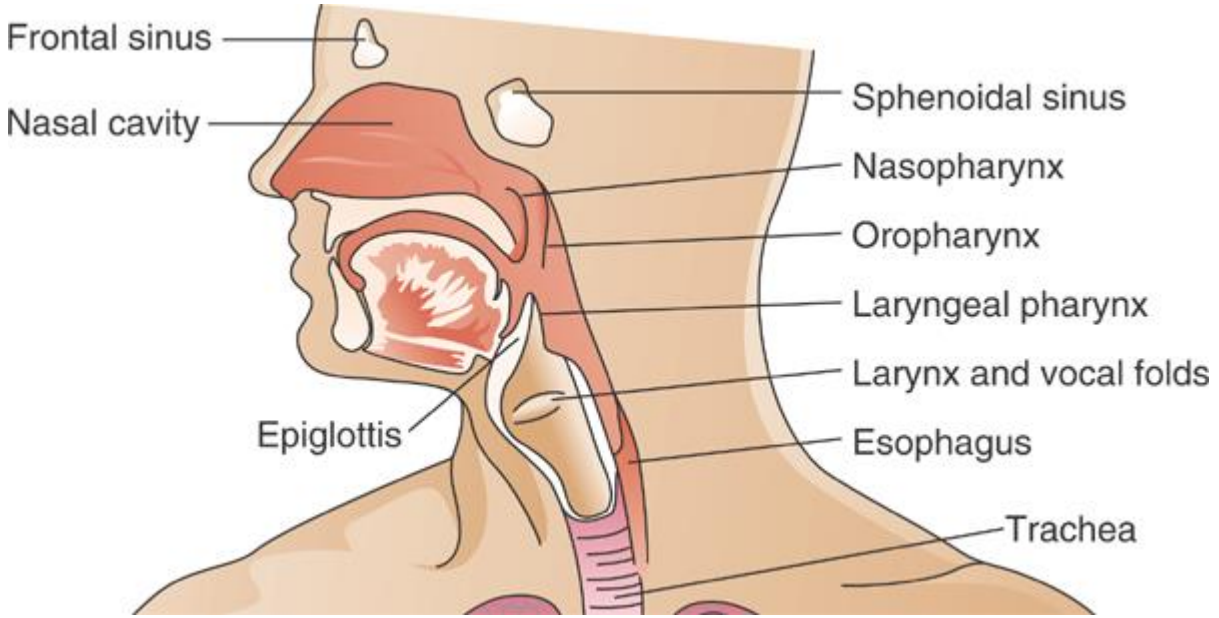
- The upper tract warms and filters inspired air so that the lower respiratory tract (the lungs) can accomplish gas exchange.

- Gas exchange involves delivering oxygen to the tissues through the bloodstream and expelling waste gases, such as carbon dioxide, during expiration.

STRUCTURES OF THE URT

- Nose
- Sinuses and nasal passages
- Pharynx: the conducting airways that connect nasal passages and mouth to the lower parts of the respiratory tract.
- Larynx: The passageway for air entering and leaving the trachea and containing the vocal cords, epiglottis, glottis and cartilages
- Trachea: Commonly known as the windpipe, this tube is composed of connective tissue mucosa and smooth muscle supported by C-shaped rings of cartilage.

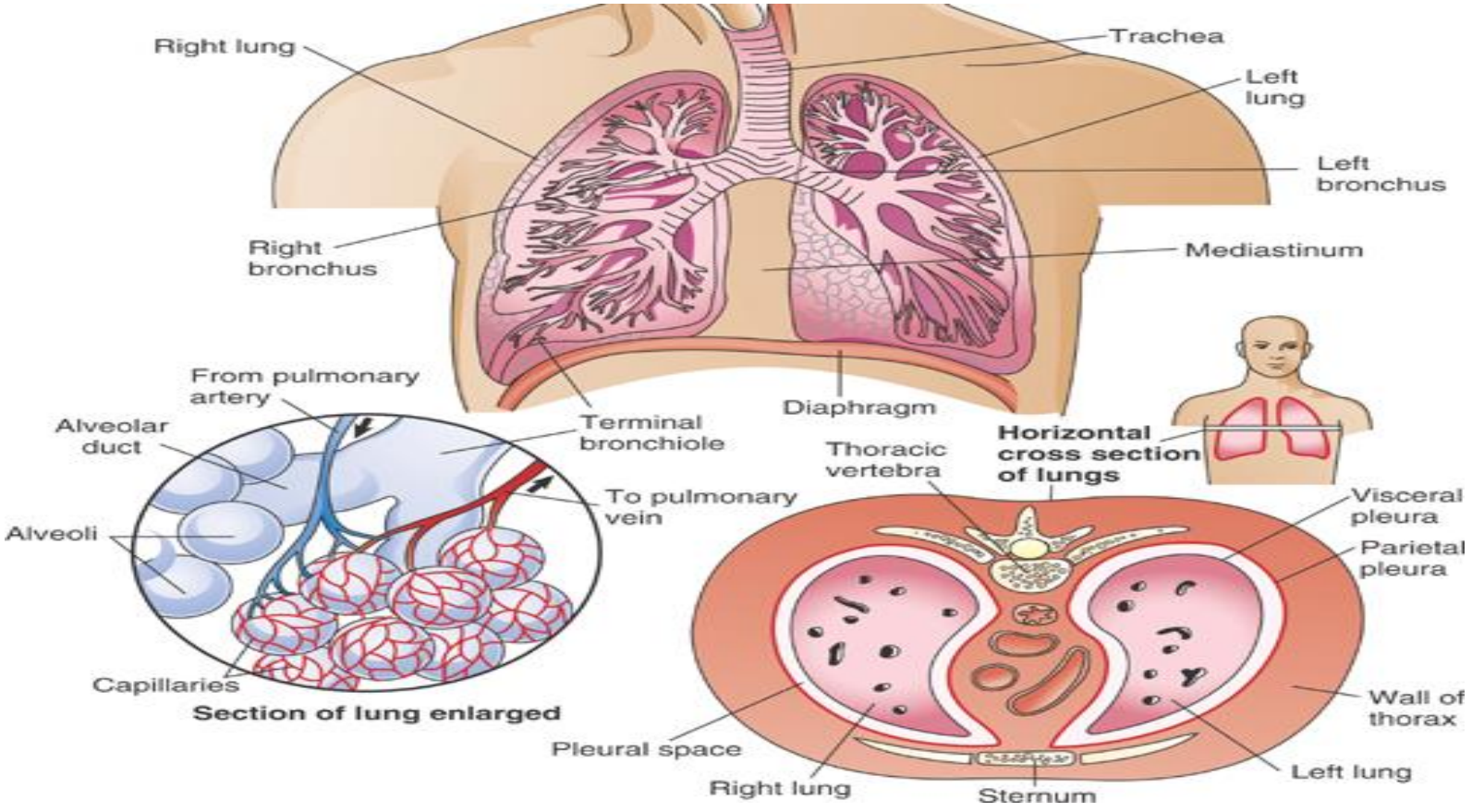
UPPER RESPIRATORY SYSTEM



STRUCTURES OF THE LOWER RT

- Lungs
- Pleura
- Mediastinum
- Lobes of the lungs:
  - Left: 2 Lobes: upper and lower
  - Right: 3 Lobes: upper, middle, and lower
- Bronchi: Two tubes, the right and left primary bronchi, that each pass into its respective lung.
- Bronchioles: Within the lungs, the bronchi branch off into increasingly smaller diameter tubes until they become the terminal bronchioles.
- Alveoli

LOWER RESPIRATORY SYSTEM



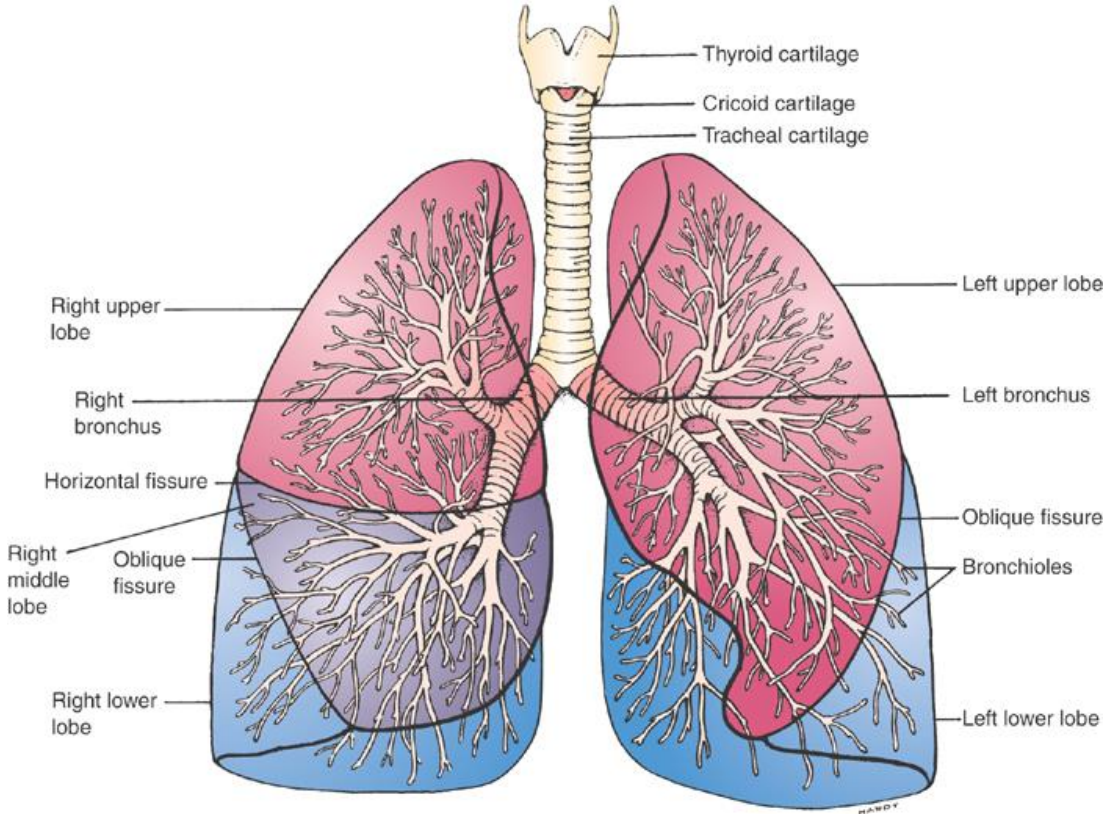
THORACIC CAVITY

- The inside of the chest cage is called the *thoracic cavity.*
- Contained within the thoracic cavity are the lungs, cone-shaped, spongy organs covered in the *pleura,* a thin, transparent double-layered serous membrane lining the thoracic cavity.
- The upper portion of the lungs is the *apex;* the lower portion is the *base*.

Conducting Airways

- The conducting airways are tubelike structures that provide a passageway for air as it travels to the lungs.
- The conducting airways include the nasal passages, mouth, pharynx, larynx, trachea, bronchi, and bronchioles.

THE LOBES OF THE LUNGS AND BRONCHIOLE TREE



FUNCTION OF THE RESPIRATORY SYSTEM

1- **Oxygen Transport: Oxygen** is supplied to, and **carbon dioxide** is removed from, cells by way of the circulating blood.

- Cells are in close contact with capillaries, whose thin walls permit easy passage or exchange of oxygen & carbon dioxide.
- Oxygen diffuses from the capillary through the capillary wall to the interstitial fluid. At this point, it diffuses through the membrane of tissue cells, where it is used by mitochondria for cellular respiration. The movement of CO_2 occurs by diffusion in the opposite direction—from cell to blood.

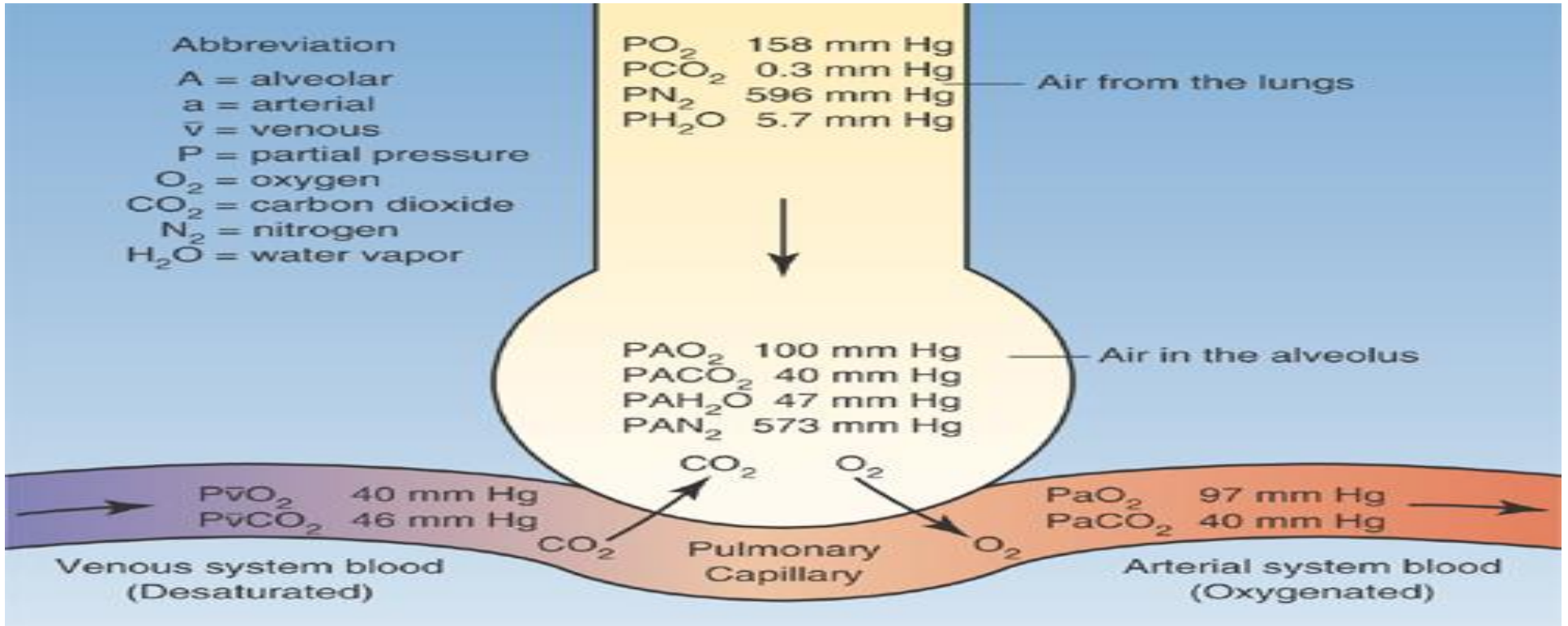
FUNCTION OF THE RESPIRATORY SYSTEM

2- Respiration: After these tissue capillary exchanges, blood enters the systemic veins (where it is called venous blood) and travels to the pulmonary circulation.

- The O2 concentration in blood within the capillaries of the lungs is lower than in the lungs' air sacs (alveoli). Because of this concentration gradient, oxygen diffuses from the alveoli to the blood.
- CO2, which has a higher concentration in the blood than in the alveoli, diffuses from the blood into the alveoli.
- Movement of air in and out of the airways (ventilation) continually replenishes the O2and removes the CO2 from the airways in the lung.
- This whole process of gas exchange between the atmospheric air and the blood and between the blood and cells of the body is called **respiration.**

RESPIRATION

- Two types of respiration: *external* and *internal.*
- External Respiration: The exchange of gases between the inhaled air and the blood in the pulmonary capillaries.
- Internal Respiration: the exchange of gases at the cellular level between tissue cells and blood in systemic capillaries.



FUNCTION OF THE RESPIRATORY SYSTEM

3- **Ventilation:** Physical factors that govern air flow in & out of the lungs are collectively referred to as the mechanics of ventilation & include air pressure variances, resistance to air flow, & lung compliance.

a. air pressure variances: During inspiration, movement of the diaphragm & other muscles of respiration enlarges the thoracic cavity & thereby lowers the pressure inside the thorax to a level below that of atmospheric pressure. As a result, air is drawn through the trachea & bronchi into the alveoli.

- During normal expiration, the diaphragm relaxes and the lungs recoil, resulting in a decrease in the size of the thoracic cavity. The alveolar pressure then exceeds atmospheric pressure, & air flows from the lungs into the atmosphere.

FUNCTION OF THE RESPIRATORY SYSTEM

b. airway resistance:

- resistance is determined by the size of the airway through which the air is flowing.
- Any process that changes the bronchial diameter or width affects airway resistance & alters the rate of air flow for a given pressure gradient during respiration.
- With increased resistance, greater-than-normal respiratory effort is required by the patient to achieve normal levels of ventilation.

CAUSES OF INCREASED AIRWAY RESISTANCE

- Contraction of bronchial smooth muscle—as in asthma
- Thickening of bronchial mucosa—as in chronic bronchitis
- Obstruction of the airway—by mucus, a tumor, or a foreign body
- Loss of lung elasticity—as in emphysema (swelling), which is characterized by connective tissue surrounding the airways, thereby keeping them open during both inspiration and expiration.

FUNCTION OF THE RESPIRATORY SYSTEM

c. compliance: A measure of the elasticity, expandability, & distensibility of the lungs and thoracic structures is called compliance.

- Compliance is determined by examining the volume–pressure relationship in the lungs and the thorax.
- In normal compliance (1.0 L/cm H2O), the lungs and thorax easily stretch and distend when pressure is applied.
- High or increased compliance occurs when the lungs have lost their elasticity and the thorax is over distended (i.e., in emphysema).
- When the lungs and thorax are "stiff," there is low or decreased compliance as lung fibrosis

FUNCTION OF THE RESPIRATORY SYSTEM

5- Diffusion and Perfusion:

- **Diffusion** is the process by which O2 and CO2 **are** exchanged at the air–blood interface. The alveolar–capillary membrane is ideal for diffusion because of its large surface area and thin membrane.
- **Pulmonary perfusion** is the actual blood flow through the pulmonary circulation.
- The blood is pumped into the lungs by the RV through the pulmonary artery. The pulmonary artery divides into the right and left branches to supply both lungs. These two branches divide further to supply all parts of each lung.
- Normally about 2% of the blood pumped by the RV does not perfuse the alveolar capillaries. This shunted blood drains into the left side of the heart without participating in alveolar gas exchange.

FUNCTION OF THE RESPIRATORY SYSTEM

6- Ventilation/Perfusion (V/Q Ratio):

- Ventilation is the movement of air in and out of the lungs.
- Air must reach the alveoli to be available for gas exchange.
- Perfusion is the filling of the pulmonary capillaries with blood.
- Adequate gas exchange depends upon an adequate V/Q ratio, a match of ventilation and perfusion.
- Shunting occurs when there is an imbalance of ventilation and perfusion. This results in hypoxia.
- **Normal Ratio**

  In the healthy lung, a given amount of blood passes to alveolus and is matched with an equal amount of gas . The ratio is 1:1 (ventilation matches perfusion).

VENTILATION/PERFUSION (V/Q MISMATCHING)

- **<u>High</u> Ventilation–Perfusion Ratio: Dead Space**

✓ When ventilation exceeds perfusion, dead space results . The alveoli do not have an adequate blood supply for gas exchange to occur.

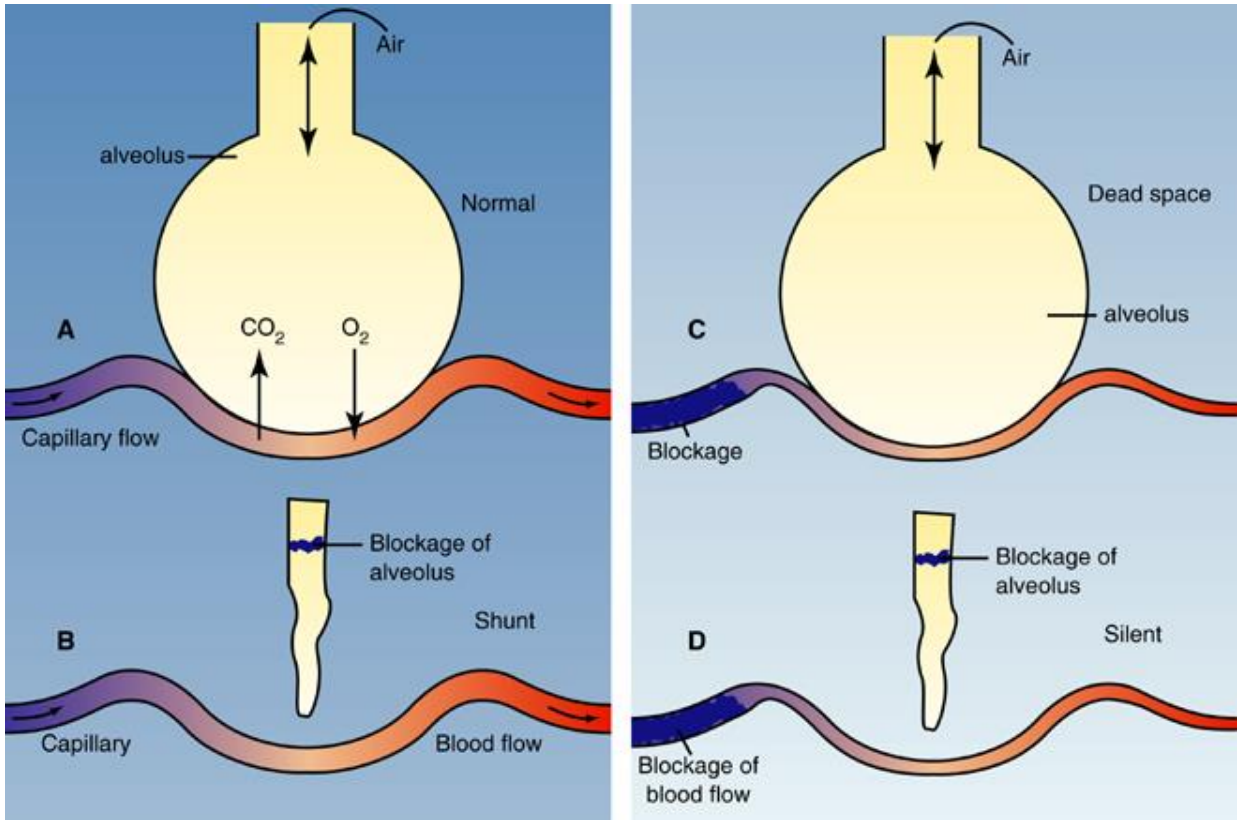
✓ This is characteristic of a variety of disorders, including pulmonary emboli, pulmonary infarction, and cardiogenic shock.

- **Silent Unit**

✓ a condition known as a silent unit occurs in the absence of ventilation and perfusion or with limited ventilation and perfusion,

✓ This is seen with pneumothorax and severe acute respiratory distress syndrome.

VENTILATION-PERFUSION RATIOS:
A- NORMAL RATIO
B- SHUNTS
C- DEAD SPACE
D- SILENT UNIT

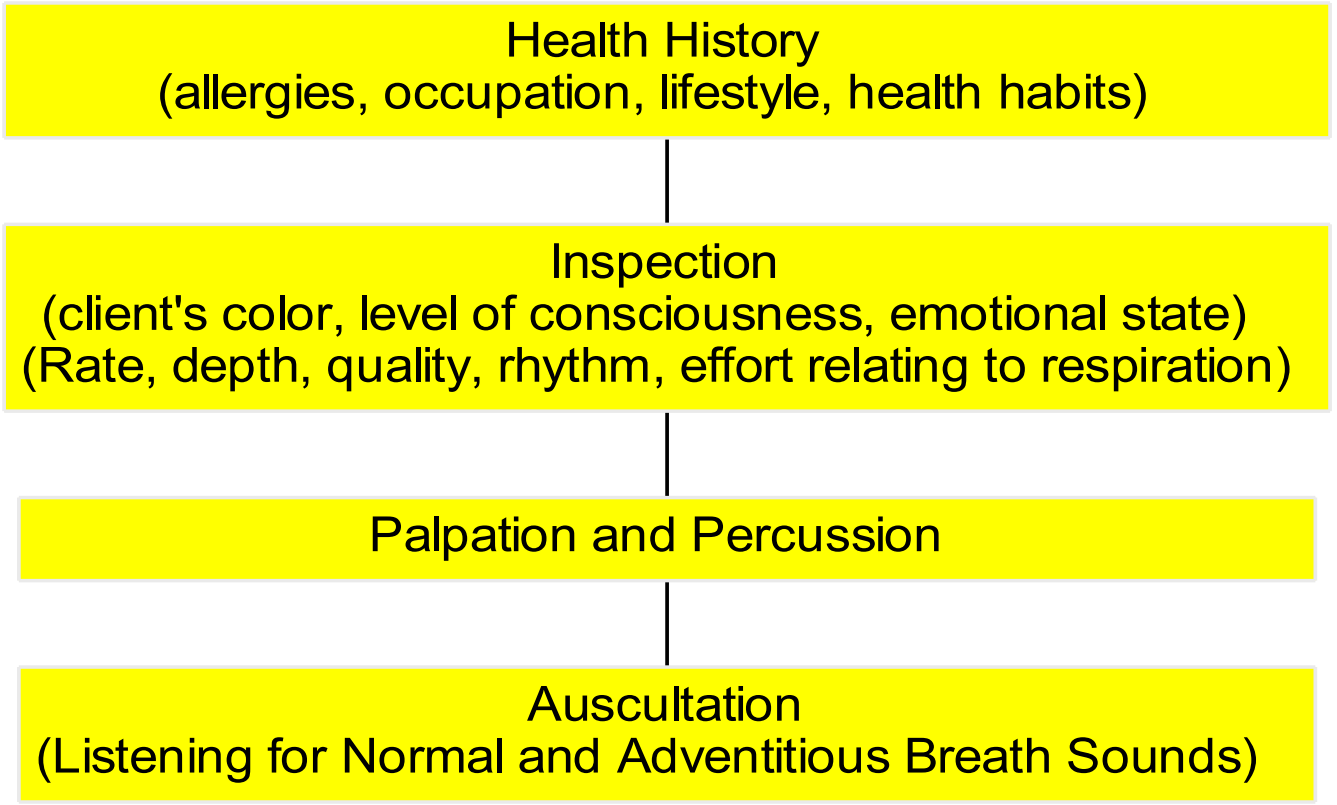


FUNCTION OF THE RESPIRATORY SYSTEM

7- **Gas Exchange:** The air we breathe is a gaseous mixture consisting mainly of nitrogen (78.62%) and oxygen (20.84%), with traces of CO2 (0.04%), water vapor (0.05%), helium, and argon.

- The atmospheric pressure at sea level is about 760 mm Hg.

ASSESSMENT


Health History
(allergies, occupation, lifestyle, health habits)
Inspection
(client's color, level of consciousness, emotional state)
(Rate, depth, quality, rhythm, effort relating to respiration)
Palpation and Percussion
Auscultation
(Listening for Normal and Adventitious Breath Sounds)

ADVENTITIOUS BREATH SOUNDS

Abnormal sounds and some conditions associated with them:

- Fine crackles (dry, high-pitched popping…COPD, CHF, pneumonia)
- Coarse crackles (moist, low-pitched gurgling …pneumonia, edema, bronchitis)
- Sonorous wheezes (low-pitched snoring

…asthma, bronchitis, tumor)

- Sibilant wheezes (high-pitched, musical

… asthma, bronchitis, emphysema, tumor)

- Pleural friction rub (creaking, grating

… pleurisy, tuberculosis, abscess, pneumonia)

- Stridor (crowing…croup, foreign body obstruction, large airway tumor).

Common diagnostic tests for respiratory disorders

- **Pulmonary function tests:** Such tests include measurements of lung volumes, ventilatory function, and the mechanics of breathing, diffusion, and gas exchange.
- PFTs generally are performed by a technician using a spirometer that has a volume-collecting device attached to a recorder that demonstrates volume and time simultaneously.

Common diagnostic tests for respiratory disorders

- **Arterial blood gas studies:** Measurements of blood pH and arterial O2 and CO2 tensions are obtained when managing patients with respiratory problems and in adjusting oxygen therapy as needed.
- The arterial oxygen tension (PaO2) indicates the degree of oxygenation of the blood, and the arterial CO2 tension (PaCO2) indicates the adequacy of alveolar ventilation.
- ABGs studies aid in :
- 1- assessing the ability of the lungs to provide adequate oxygen and remove CO2
- 2- and the ability of the kidneys to reabsorb or excrete bicarbonate ions to maintain normal body pH.

Common diagnostic tests for respiratory disorders

- **Pulse oximetry:** a noninvasive method of continuously

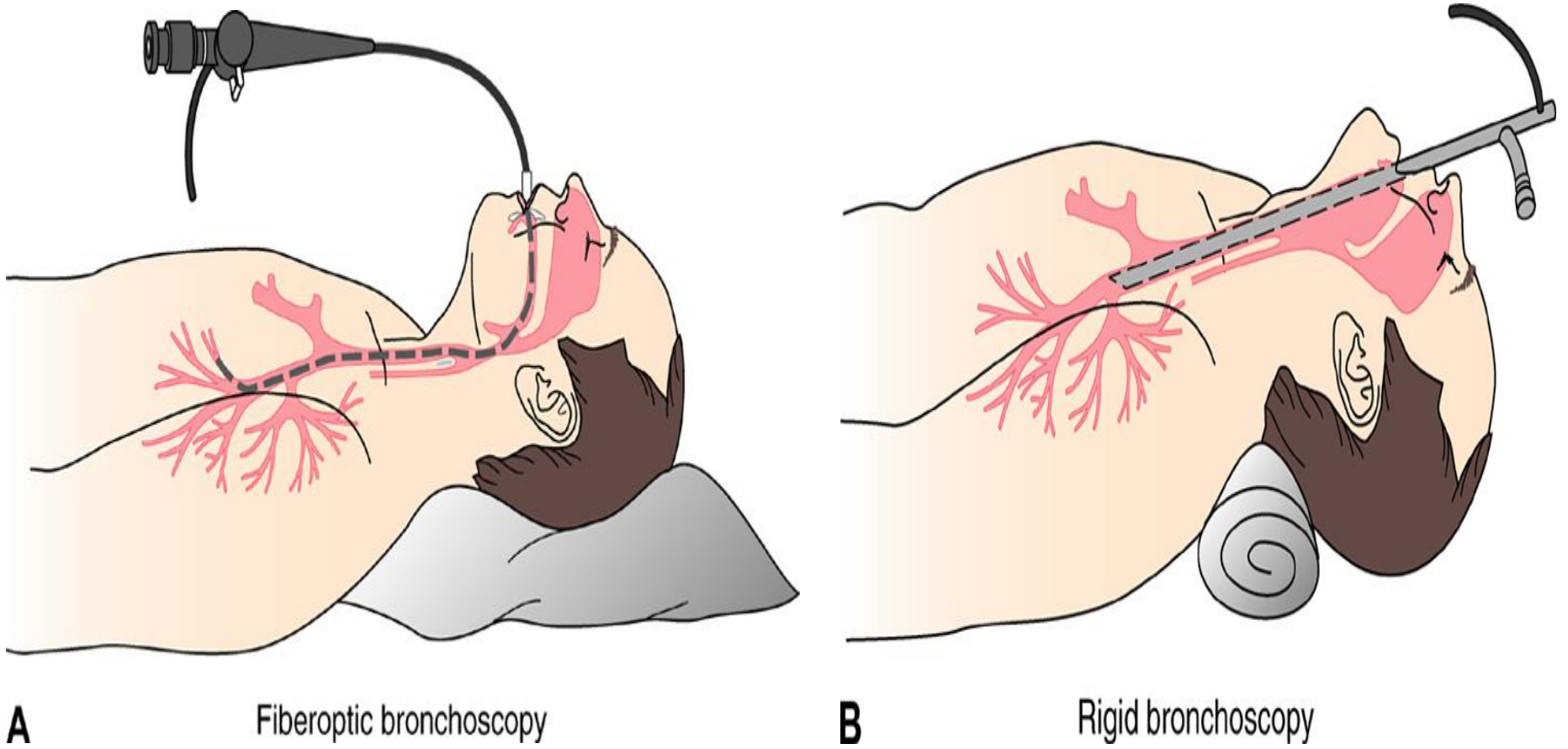
monitoring the oxygen saturation of hemoglobin (SpO2 or SaO2). Although pulse oximetry does not replace ABGs measurement, it is an effective tool to monitor for subtle or sudden changes in oxygen saturation.

- Normal SpO2 values are 95% to 100%. Values less than 85% indicate that the tissues are not receiving enough oxygen, & the patient needs further evaluation.
- SpO2 values obtained by pulse oximetry are unreliable in
- cardiac arrest & shock,
- when dyes (ie, methylene blue)
- or vasoconstrictor medications have been used,
- or severe anemia or a high carbon monoxide level.

COMMON DIAGNOSTIC TESTS FOR RESPIRATORY DISORDERS

- **Cultures:** Throat culture may also assist in identifying organisms responsible for infection of the lower respiratory tract. Nasal swabs also may be performed for the same purpose.
- **Imaging studies:** including x-rays, (CT) scans, (MRI), contrast studies, & radioisotope diagnostic scans may be part of any diagnostic workup, ranging from a determination of the extent of infection in sinusitis to tumor growth in cancer.
- **Sputum studies:** Sputum is obtained for analysis to identify pathogenic organisms & to determine whether malignant cells are present.
- **Fluoroscopic Studies, Pulmonary Angiography, Bronchoscopy, Biopsy.**

FIBEROPTIC BRONCHOSCOPY AND RIGID BRONCHOSCOPY



A Fiberoptic bronchoscopy

B Rigid bronchoscopy

COMMON DIAGNOSTIC TESTS FOR RESPIRATORY DISORDERS

▶**Thoracentesis** used for:

- Removal of fluid and air from the pleural cavity
- Aspiration of pleural fluid for analysis
- Pleural biopsy
- Instillation of medication into the pleural space

▶**Thoracoscopy** is a diagnostic procedure in which the pleural cavity is examined with an endoscope. Small incisions are made into the pleural cavity in an intercostal space; the location of the incision depends on the clinical and diagnostic findings.

POSITION OF A PATIENT FOR THORACENTESIS