

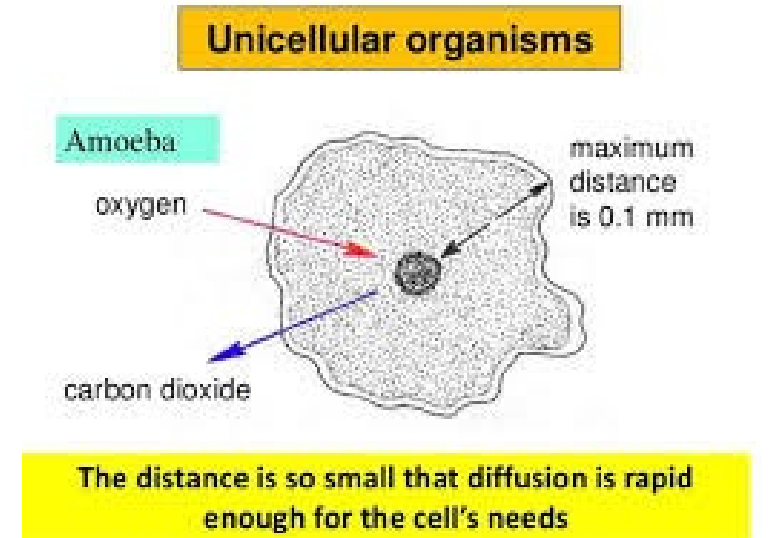


RESPIRATORY SYSTEM

Assoc. Prof. Dr. Yasemin SALGIRLI DEMİRBAŞ

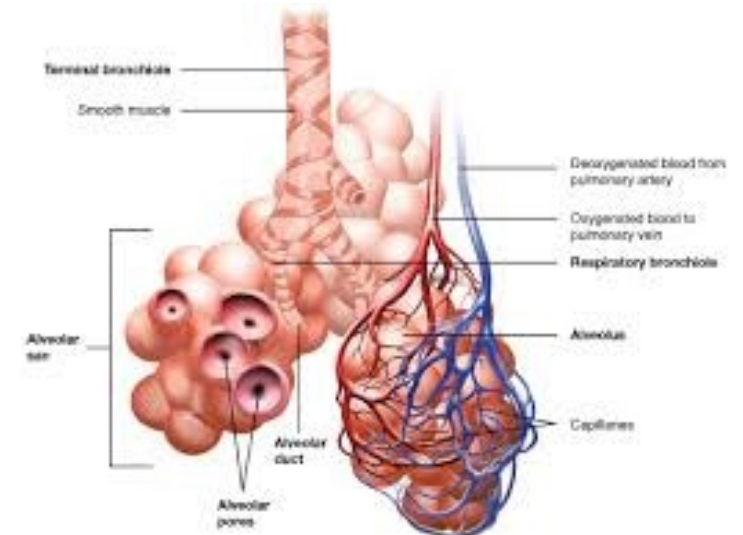
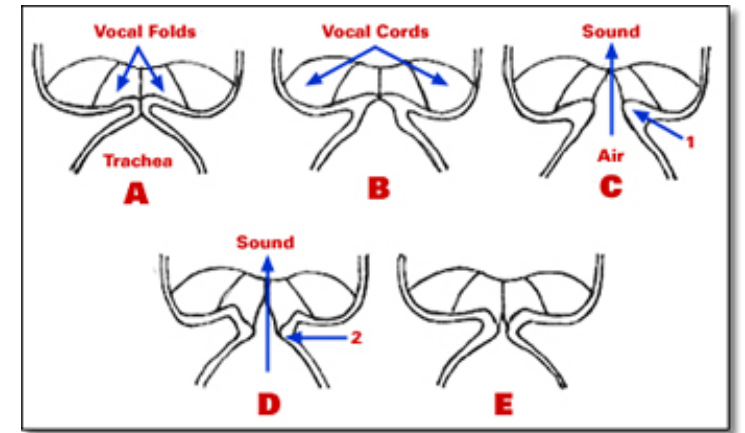
What is respiration?

- **(1)** utilization of oxygen in the metabolism of organic molecules by cell - **Cellular respiration**
- **(2)** the exchanges of oxygen and carbon dioxide between an organism and the external environment
- A unicellular organism can exchange oxygen and carbon dioxide directly with the external environment,
- The evolution of large animals required the development of specialized structures to exchange oxygen and carbon dioxide
- In mammals, the respiratory system includes **the lungs, the series of tubes leading to the lungs, and the chest structures** responsible for moving air into and out of the lungs during breathing.



Functions of the Respiratory System

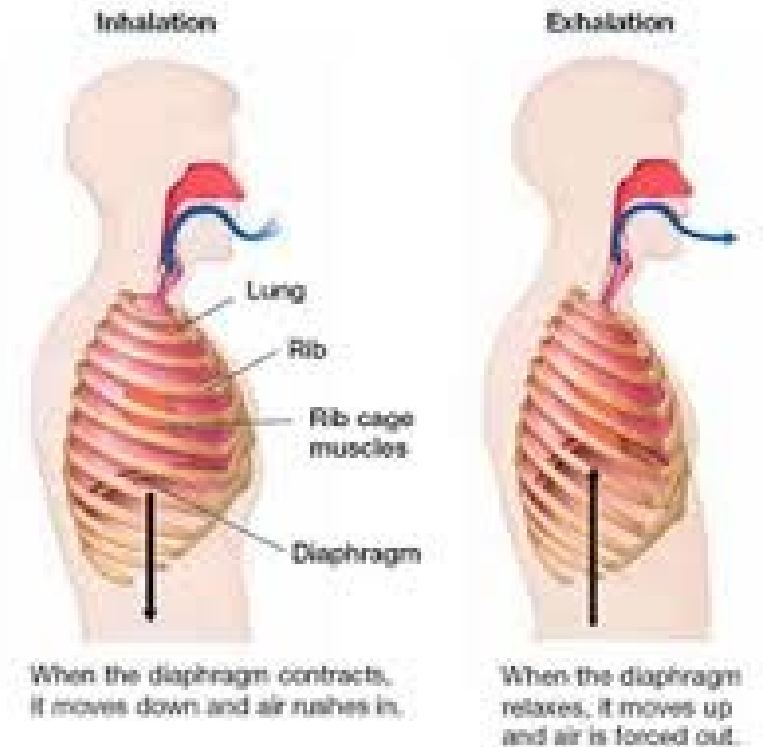
- 1. Provides oxygen.
- 2. Eliminates carbon dioxide.
- 3. Regulates the blood's hydrogen-ion concentration (pH).
- 4. Forms speech sounds (phonation).
- 5. Defends against microbes.
- 6. Influences arterial concentrations of chemical messengers by removing some from pulmonary capillary blood and producing and adding others to this blood.
- 7. Traps and dissolves blood clots.



Organization of the Respiratory System

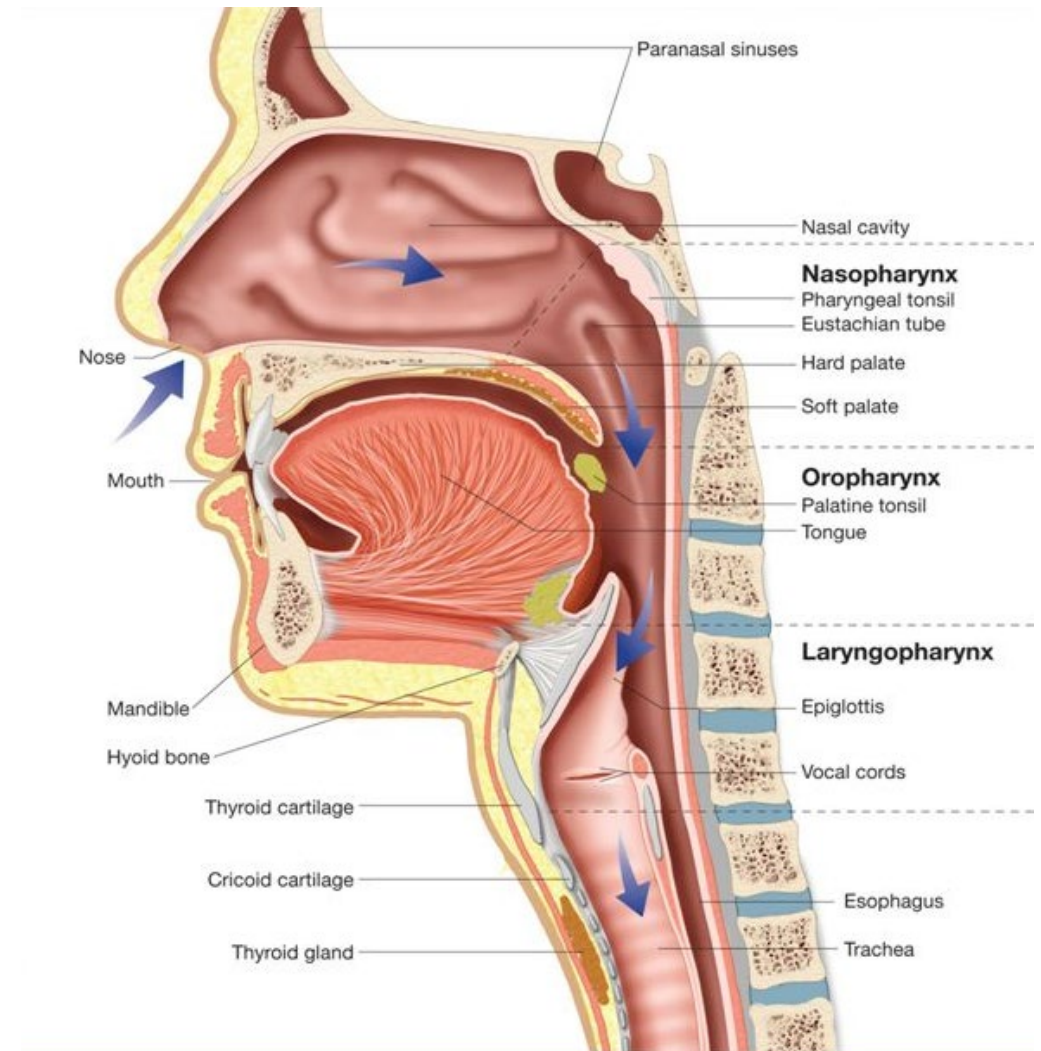
- There are two lungs, the right and left, each divided into several lobes.
- The lungs consist mainly of tiny air containing sacs called alveoli (singular, alveolus)
- **The airways** are all the tubes through which air flows between the external environment and the alveoli.
- **Inspiration (inhalation)** is the movement of air from the external environment through the airways into the alveoli during breathing.
- **Expiration (exhalation)** is movement in the opposite direction.
- An inspiration and an expiration constitute a **respiratory cycle**

Inhalation and Exhalation



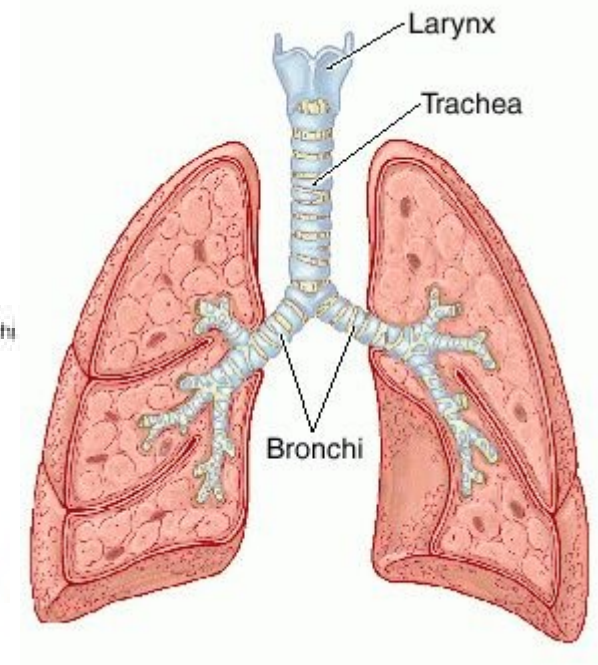
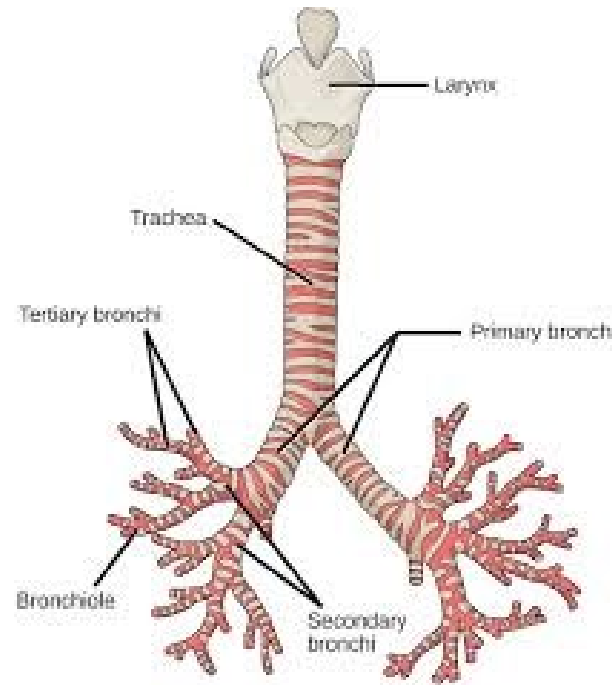
The Airways and Blood Vessels

- During inspiration air passes through either the nose (the most common site) or mouth into the pharynx (throat).
- The pharynx branches into two tubes, the esophagus and the larynx, which is part of the airways.
- The larynx houses the vocal cords, two folds of elastic tissue stretched horizontally across its lumen.
- The flow of air past the vocal cords causes them to vibrate, producing sounds.
- The nose, mouth, pharynx, and larynx are termed the **upper airways**.



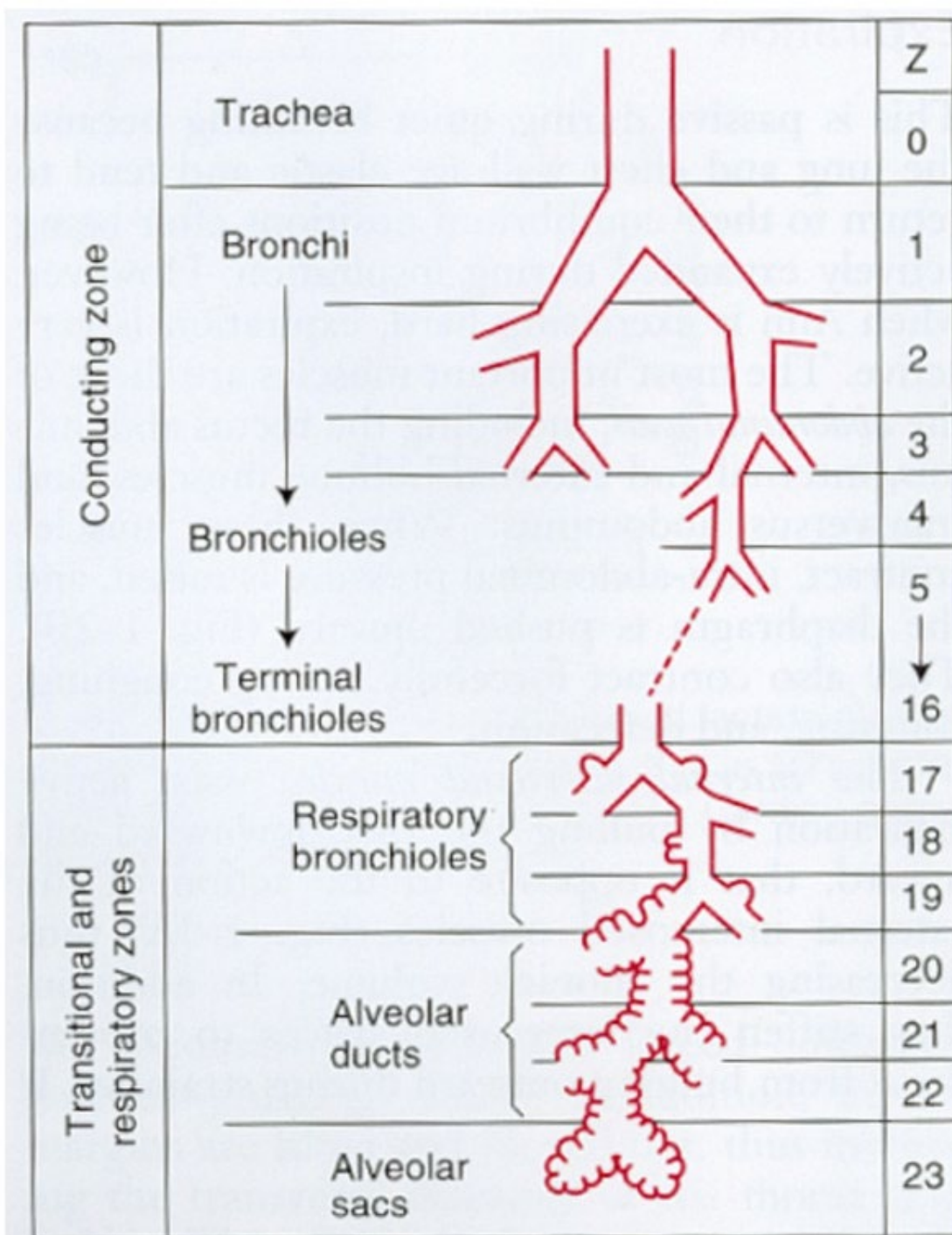
The Airways and Blood Vessels

- The larynx opens into a long tube, the trachea, which in turn branches into two bronchi (singular, bronchus), one of which enters each lung.
- Within the lungs, there are more than 20 generations of branchings, each resulting in narrower, shorter, and more numerous tubes.
- The walls of the trachea and bronchi contain cartilage, which gives them their cylindrical shape and supports them.
- The first airway branches that no longer contain cartilage are termed **bronchioles**

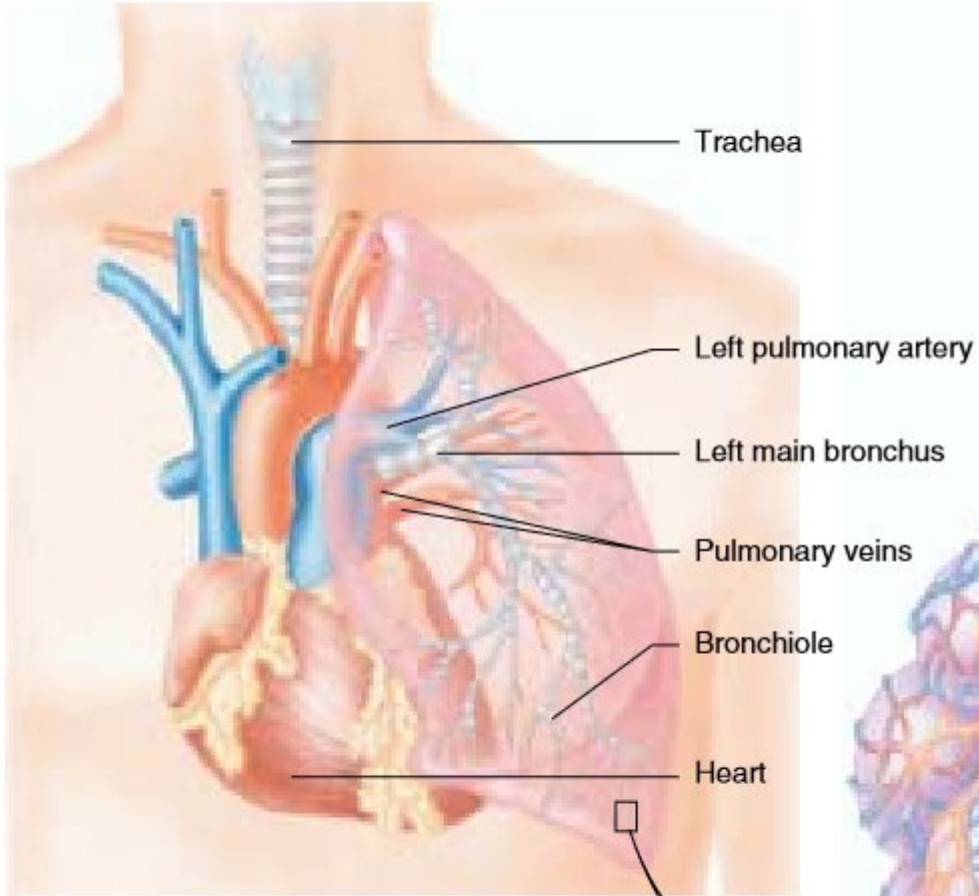


The Airways and Blood Vessels

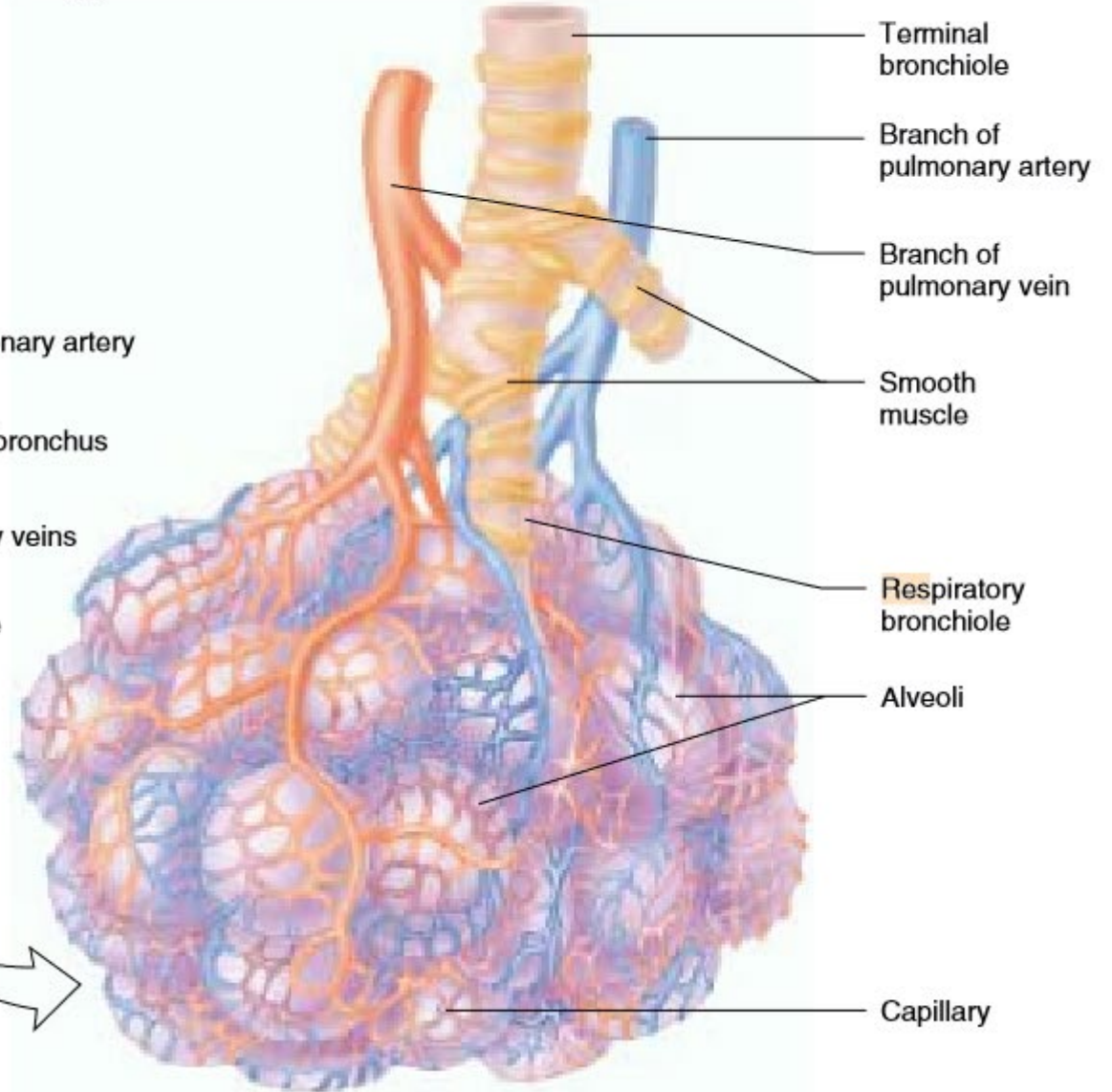
- Alveoli first begin to appear in respiratory bronchioles, attached to their walls.
- The airways then end in grapelike clusters consisting entirely of alveoli.
- The airways beyond the larynx can be divided into two zones:
 - ❖ (1) **The conducting zone** extends from the top of the trachea to the beginning of the respiratory bronchioles; it contains no alveoli and there is no gas exchange with the blood
 - ❖ (2) **The respiratory zone**, which extends from the respiratory bronchioles on down, contains alveoli and is the region where gases exchange with the blood.



(a)

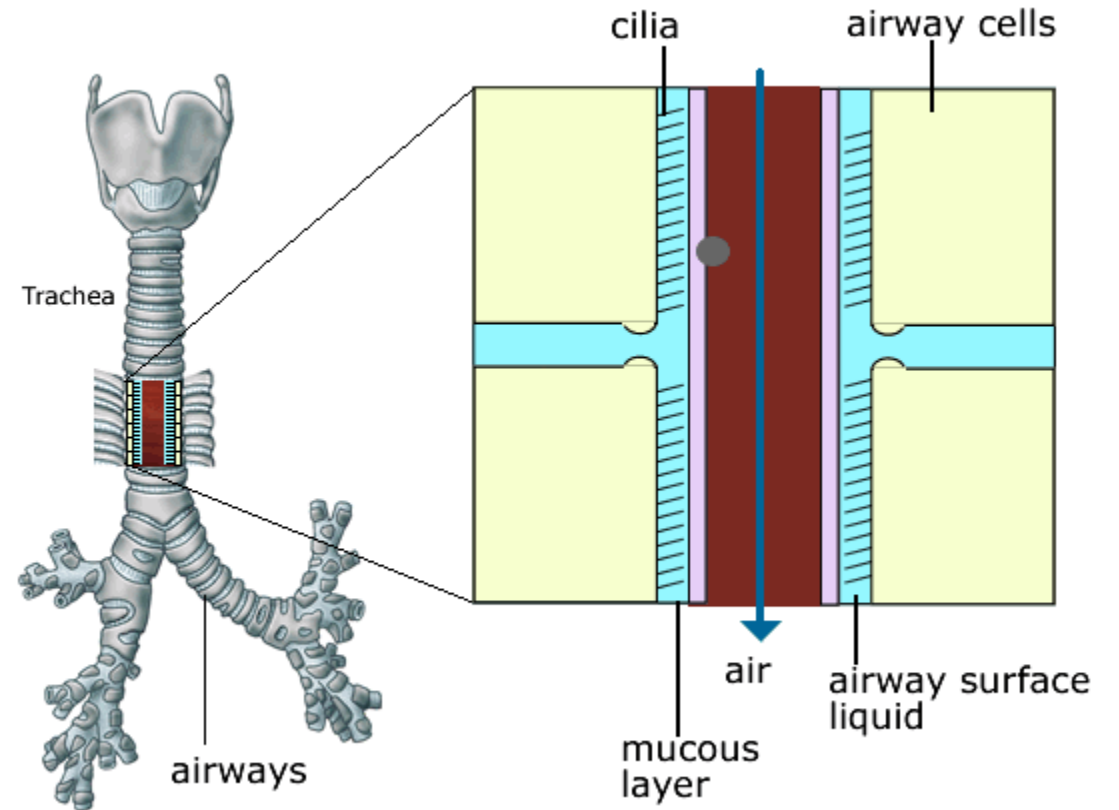


(b)



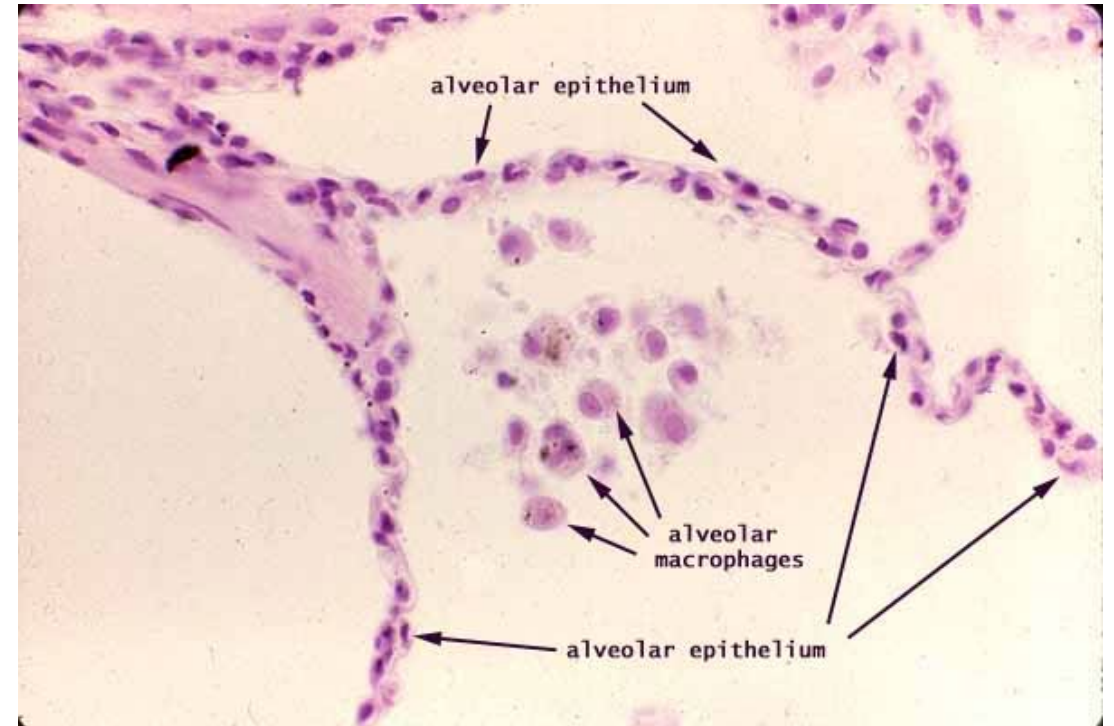
The Airways and Blood Vessels

- The epithelial surfaces of the airways, to the end of the respiratory bronchioles, contain **cilia** that constantly beat toward the pharynx.
- They also contain glands and individual epithelial cells that **secrete mucus**.
- Particulate matter (dust) in the inspired air, sticks to the mucus, which is continuously and slowly moved by the cilia to the pharynx and then swallowed.
- This mucus escalator is important in keeping the lungs clear of particulate matter and the many bacteria that enter the body on dust particles.
- Ciliary activity can be inhibited by many noxious agents. For example: smoking



The Airways and Blood Vessels

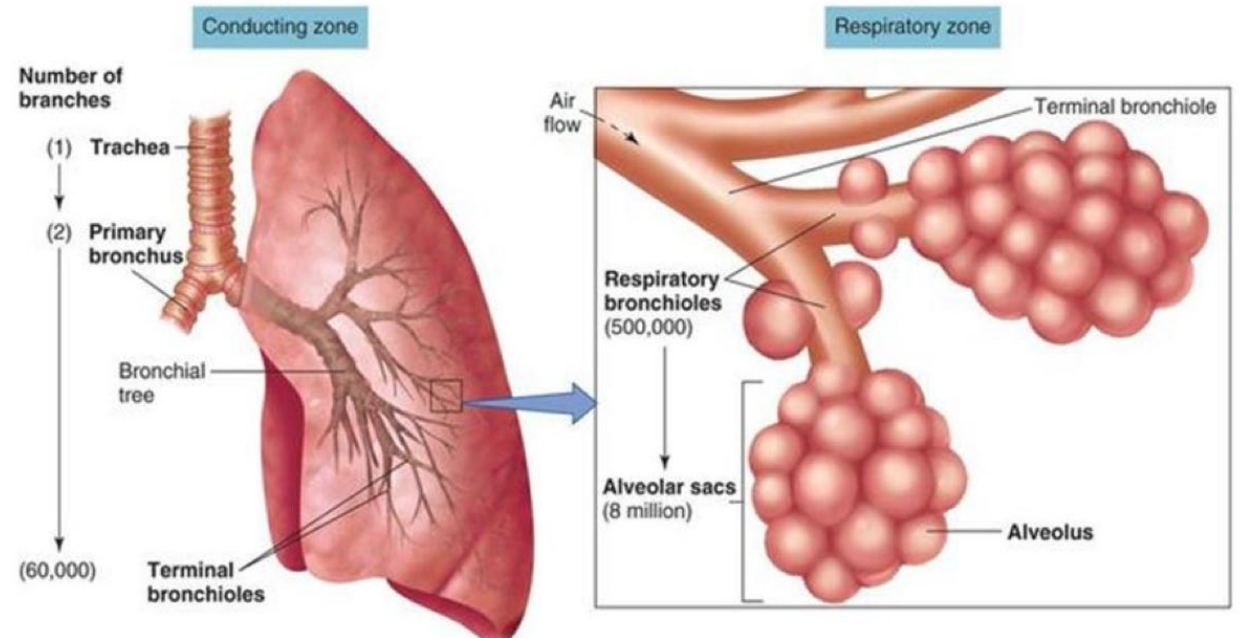
- The airway epithelium also secretes a watery fluid upon which the mucus can ride freely.
- A second protective mechanism against infection is provided by cells that are present in the airways and alveoli and are termed **macrophages**.
- These cells engulf inhaled particles and bacteria, rendering them harmless.
- Macrophages, like cilia, are injured by cigarette smoke and air pollutants.



Functions of the Conducting Zone of the Airways

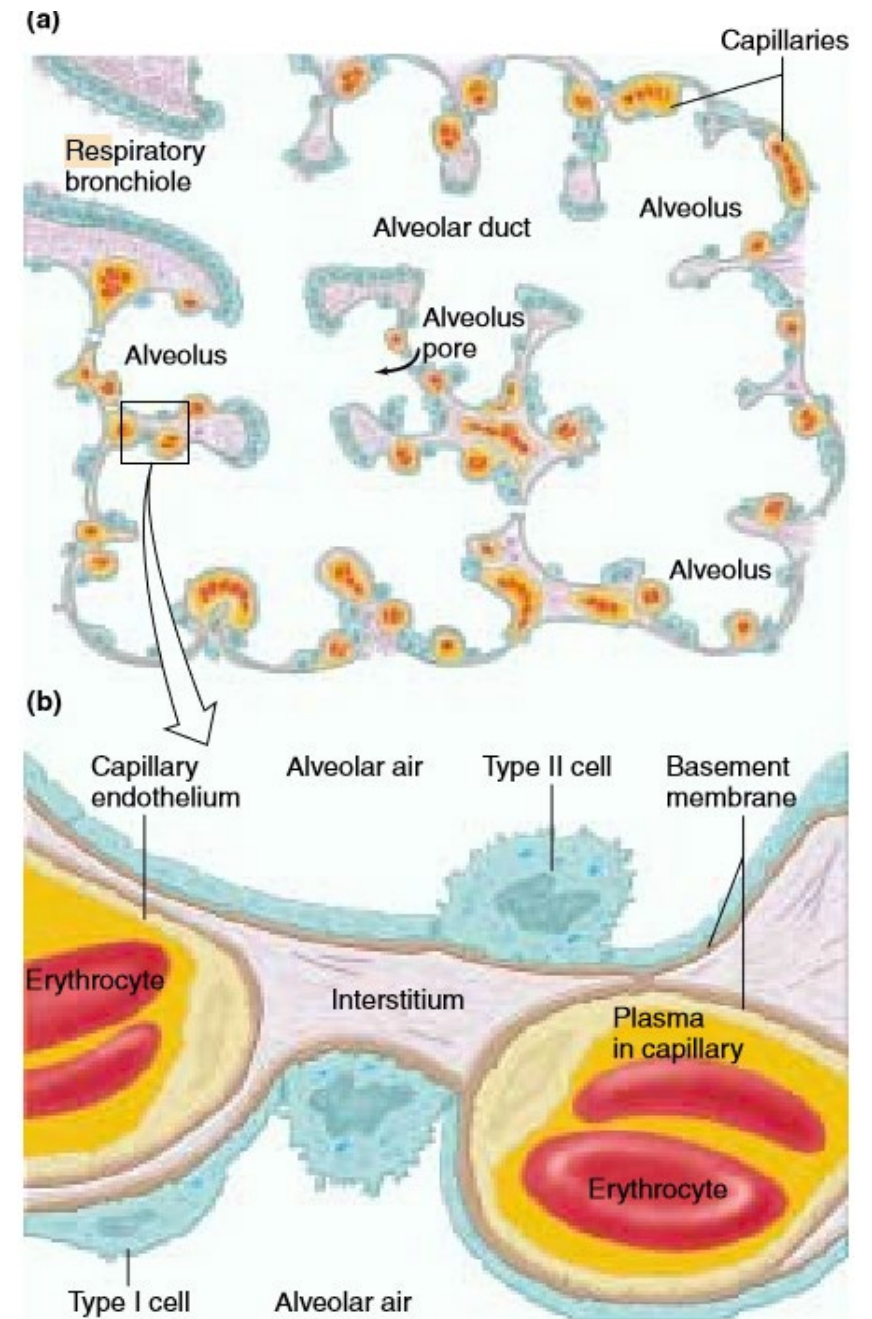
1. Provides a low-resistance pathway for air flow; resistance is physiologically regulated by changes in contraction of airway smooth muscle and by physical forces acting upon the airways.
2. Defends against microbes, toxic chemicals, and other foreign matter; cilia, mucus, and phagocytes perform this function.
3. Warms and moistens the air
4. Phonates (vocal cords).

Conducting and Respiratory Zones



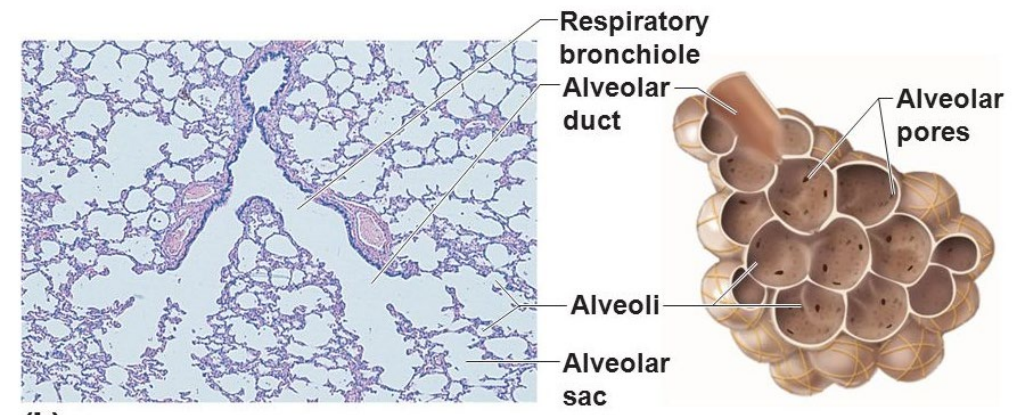
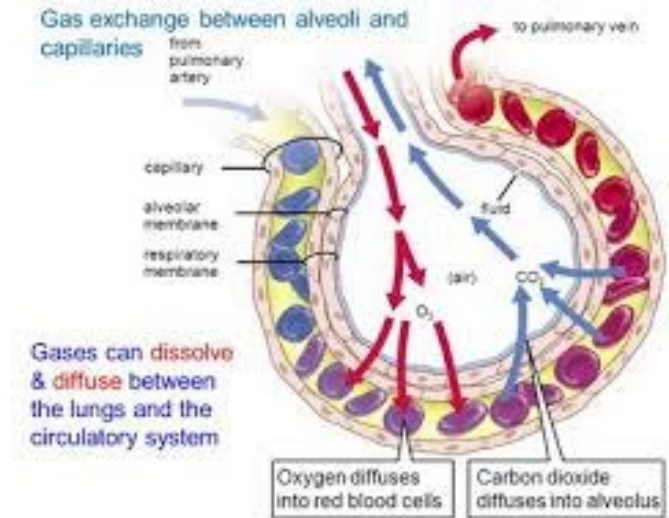
Site of Gas Exchange: The Alveoli

- The alveoli are tiny hollow sacs whose open ends are continuous with the lumens of the airways.
- Typically, the air in two adjacent alveoli is separated by a single alveolar wall.
- Most of the air-facing surface(s) of the wall are lined by a continuous layer, one cell thick, of flat epithelial cells termed **type I alveolar cells**.
- Interspersed between these cells are thicker specialized cells termed **type II alveolar cells** that produce a detergent-like substance, **surfactant**.



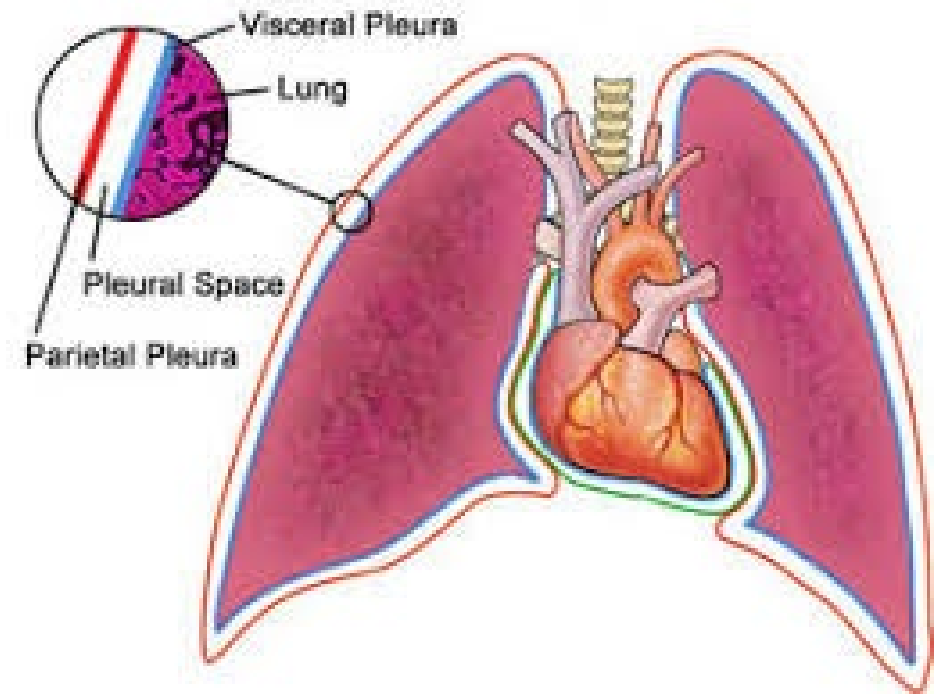
Site of Gas Exchange: The Alveoli

- The alveolar walls contain capillaries and a very small interstitial space, which consists of interstitial fluid and a loose meshwork of connective tissue.
- In many places the basement membranes of the alveolar-surface epithelium and the capillary-wall endothelium fuse.
- The blood within an alveolar-wall capillary is separated from the air within the alveolus by an extremely thin barrier
- The total surface area of alveoli in contact with capillaries is roughly the size of a tennis court.
- **This extensive area and the thinness of the barrier permit the rapid exchange of large quantities of oxygen and carbon dioxide by diffusion.**
- In some of the alveolar walls, there are pores that permit the flow of air between alveoli.



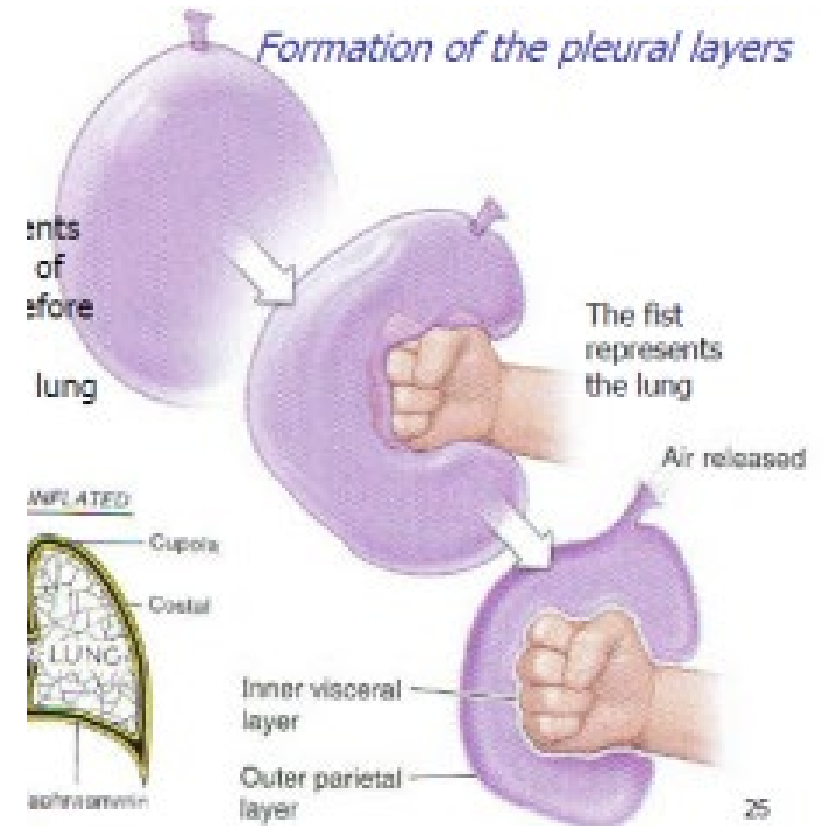
Relation of the Lungs to the Thoracic (Chest) Wall

- The lungs, like the heart, are situated in the thorax, the compartment of the body between the neck and abdomen.
- "Thorax" and "chest" are synonyms.
- Each lung is surrounded by a completely closed sac, the pleural sac, consisting of a thin sheet of cells **called pleura**.
- The two pleural sacs, one on each side of the midline, are completely separate from each other.



Relation of the Lungs to the Thoracic (Chest) Wall

- The relationship between a lung and its pleural sac:
- **what happens when you push a fist into a balloon :**
- The arm represents the major bronchus leading to the lung, the fist is the lung, and the balloon is the pleural sac.
- The fist becomes coated by one surface of the balloon.
- The balloon is pushed back upon itself so that its opposite surfaces lie close together.
- Unlike the hand and balloon, however, the pleural surface coating the lung (the visceral pleura) is firmly attached to the lung by connective tissue.
- Similarly, the outer layer (the parietal pleura) is attached to and lines the interior thoracic wall and diaphragm.
- The two layers of pleura in each sac are so close to each other that normally they are always in virtual contact, but they are not attached to each other.
- Rather, they are separated by an extremely thin layer of intrapleural fluid, the total volume of which is only a few milliliters.



SUMMARY

- What is respiration?
- Functions of the Respiratory System
- Organization of the Respiratory System
- The Airways
- The Alveoli

