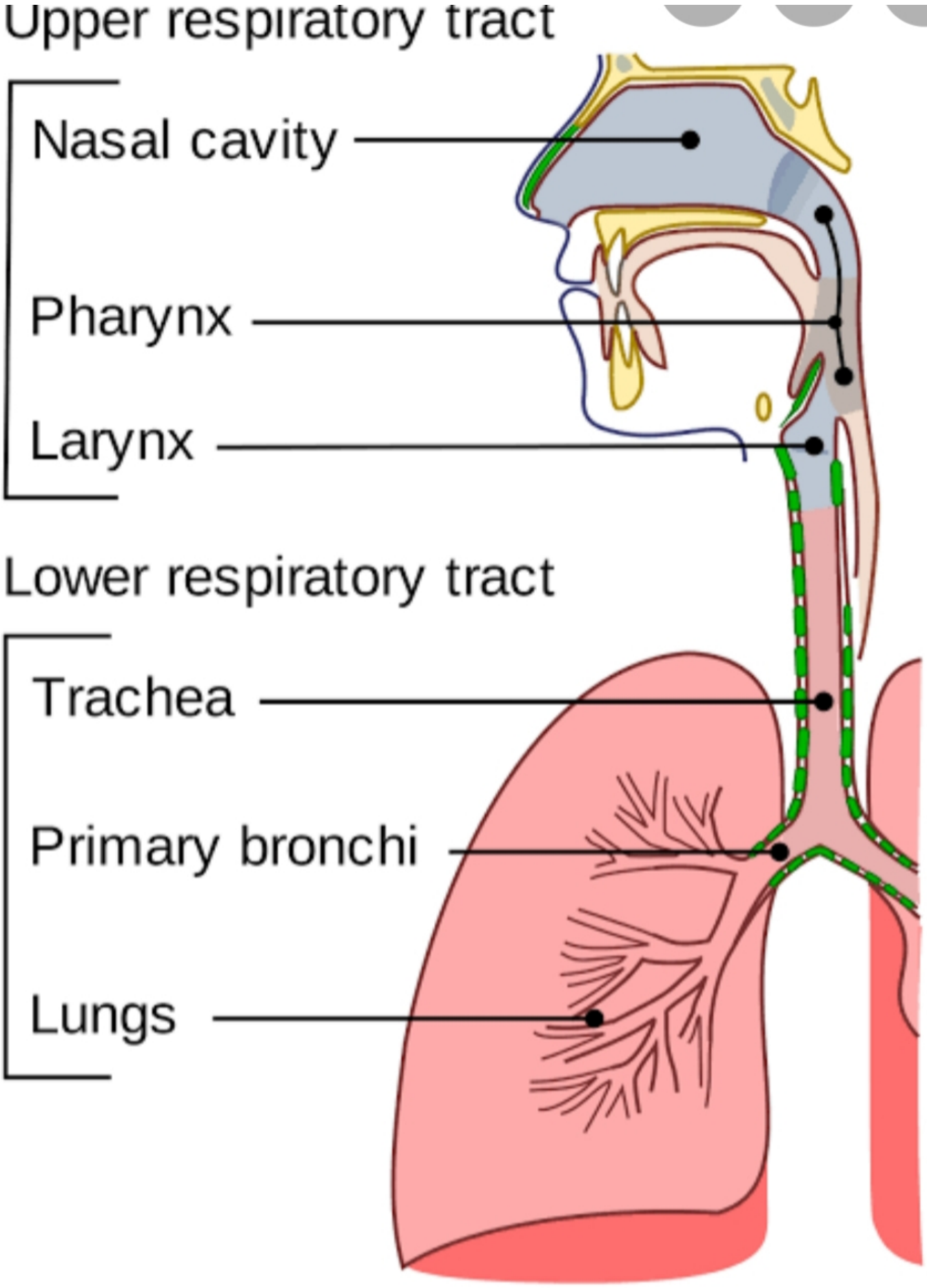
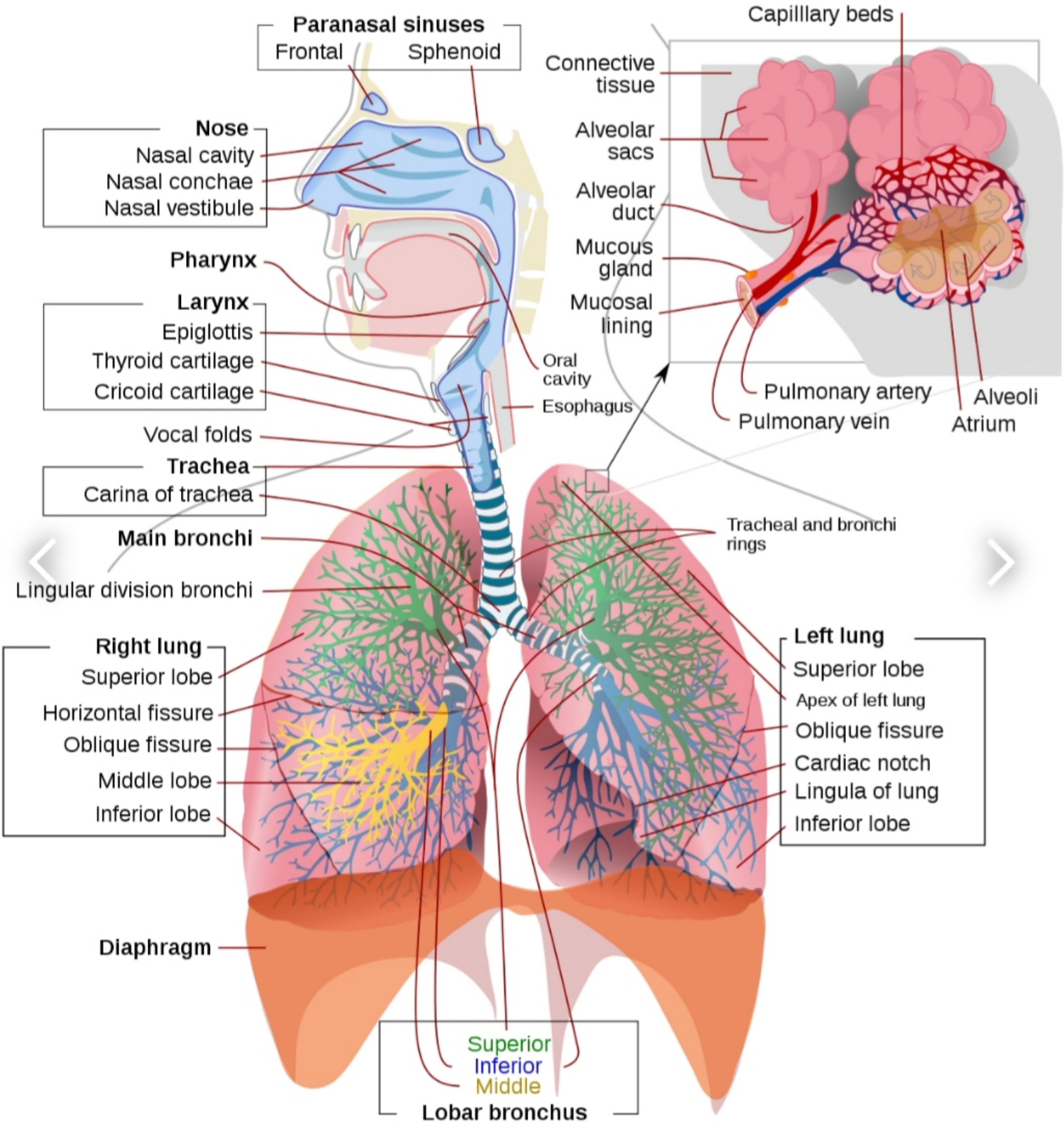
In physiology, **respiration** is the movement of oxygen from the outside environment to the cells within tissues, and the transport of carbon dioxide in the opposite direction.

Anatomy and histology of the **respiratory tract**. The **respiratory tract** can be divided into upper and lower compartments. The upper **airway** extends from the sino-nasal area to the larinx. The lower **tract** extends from trachea to the lungs and is the major focus of **respiratory** cytology.


Upper respiratory tract
Nasal cavity
Pharynx
Larynx
Lower respiratory tract
Trachea
Primary bronchi
Lungs



complete respiratory system

When you can't breathe, nothing else matters.

Slogan of the American Lung Association

INTRODUCTION

The lung has three major functions: gas exchange, host defense, and metabolism. The primary function of the lung is gas exchange, which consists of the movement of oxygen into the body and the removal of carbon dioxide. In addition to gas exchange, the lung also functions as a barrier between the world outside and the inside of the body. And finally, the lung is a metabolic organ that synthesizes and metabolizes different compounds.

Breathing is automatic and under the control of the central nervous system. Gas exchange, or the process of respiration, begins with the act of inspiration, which is initiated by the contraction of the diaphragm, the major muscle of respiration. Upon contraction, the diaphragm protrudes into the abdominal cavity moving the abdomen outward. The descent of the diaphragm creates a negative pressure inside the chest. The upper airway (glottis) opens, creating a portal that connects the outside world to the respiratory system. Because gases flow from higher to lower pressure, air moves into the lungs from the outside, much like the way a vacuum cleaner sucks air into the canister. Lung volume increases, oxygen (O_2) is taken up, and carbon dioxide (CO_2) is eliminated at the level of the alveolus. During exhalation, the diaphragm (and other respiratory muscles) relaxes, the pressure inside the chest increases, and gas flows passively out of the lungs.

The important respiratory components of gas exchange are the gas(es) being inhaled, the characteristics of the conducting airways, the gas-exchanging unit (alveolar capillary network), the pulmonary circulation that regulates blood flow through the gas-exchanging unit, and the muscles that move the gas in and out of the lung. In addition to the respiratory system, a systemic circulatory system brings oxygen to the tissues and cells throughout the body and removes CO_2 from these sites. Thus, both the respiratory system and the systemic circulatory system are essential for health and well-being.

The lungs are a remarkable feat of engineering. They receive the entire right ventricular cardiac output and they are called upon at birth to function without cessation. The lungs are contained in a space with a volume of approximately 4 L, but they have a surface area for gas exchange that is the size of a tennis court (~85 m^2). This large surface area is comprised of myriads of independently functioning respiratory units. Unlike the heart, but similar to the kidneys, the lungs demonstrate functional unity; that is, each unit is structurally identical and functions just like every other unit. Because the divisions of the lung and the sites of disease are designated by their anatomic locations (right upper lobe, left lower lobe, etc.), students must fully understand pulmonary anatomy in order to clinically relate respiratory physiology and pathophysiology.

GROSS ANATOMY

The respiratory tract (or system) begins at the nose and ends in the most distal alveolus. Thus, the nasal cavity, the posterior pharynx, the glottis and vocal cords, the trachea, and all the divisions of the tracheobronchial tree are included in the respiratory system. The **upper airway** consists of all structures from the nose to the vocal cords, including sinuses and the larynx, whereas the **lower airway** consists of the trachea, airways, and alveoli.

UPPER AIRWAYS

The major function of the upper airways is to "condition" inspired air, so that by the time it reaches the trachea, it is at body temperature and fully humidified. The nose also functions to filter, entrap, and clear particles greater than 10 µm in size. Finally, the nose provides the sense of smell. Neuronal endings in the roof of the nose above the superior turbinate carry impulses through the cribriform plate to the olfactory bulb. The volume of the nose in an adult is approximately

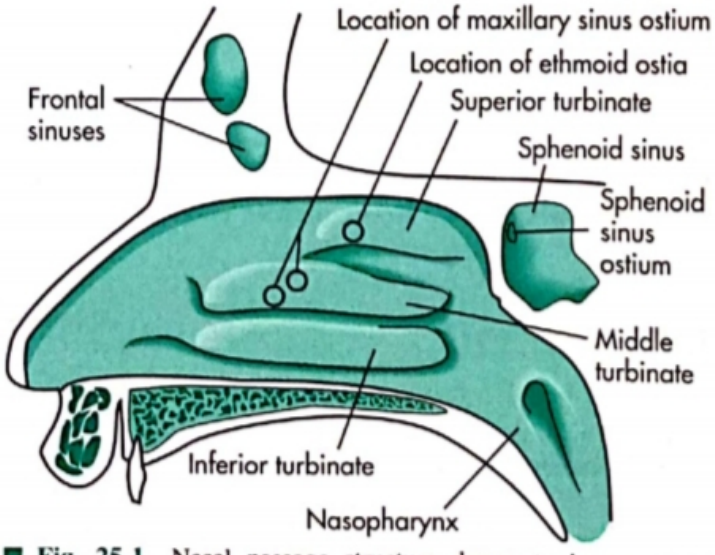
20 ml, but the cross-sectional area is greatly increased by the nasal turbinates, which are a series of three continuous ribbons of tissue that protrude into the nasal cavity (Fig. 25-1). In humans, the volume of air entering the nares each day is in the order of 10,000 to 15,000 L.

Resistance to air flow in the nose during quiet breathing accounts for ~50% of the total respiratory system resistance, which is ~8 cm H_2O/L/sec. Nasal resistance increases with viral infections and with increased airflow, such as during exercise. When nasal resistance becomes too high, mouth breathing begins.

The interior of the nose is lined by the respiratory epithelium, which is interspersed with surface secretory cells. The flow of mucus clears the main nasal passages approximately every 15 minutes. Nasal secretions contain important immunoglobulins, inflammatory cells, and interferons, which are the first step in host defense.

The paranasal sinuses are lined by ciliated epithelium, and they nearly surround the nasal passages. The fluid covering their surface is continually being propelled into the nose along the principal line of inspiratory flow. In some sinuses (e.g., the maxillary sinus) the opening (ostium) of the sinus is at the upper edge of the sinus, which makes them particularly susceptible to mucus retention (Fig. 25-1). The ostia are readily obstructed in the presence of nasal edema, resulting in retention of secretions and secondary infection (sinusitis). The sinuses have two major functions—they lighten the skull, which makes upright posture easier, and they offer resonance to the voice. They may also protect the brain during frontal trauma.

The major structures of the larynx include the epiglottis, arytenoids, and vocal cords. With some infections, these structures can become edematous (swollen) and can contribute significantly to airflow resistance. The epiglottis and arytenoids "hood" or cover the vocal cords during swallowing. Thus, under normal circumstances, they function to inhibit aspiration into the lower respiratory tract. The act of swallowing food after mastication (chewing) usually occurs within 2 seconds, and it is synchronized closely with muscle reflexes that coordinate the opening and closing of the airway. Hence, air is allowed to enter and food and liquids are kept out. Patients with neuromuscular diseases have altered muscle reflexes and they can lose this coordinated swallowing mechanism. Thus, they may become susceptible to aspiration of food and liquid, with the risk of pneumonia.



■ **Fig. 25-1** Nasal passage structure demonstrating superior, middle, and inferior turbinates. Approximate locations of some sinus ostia are shown.

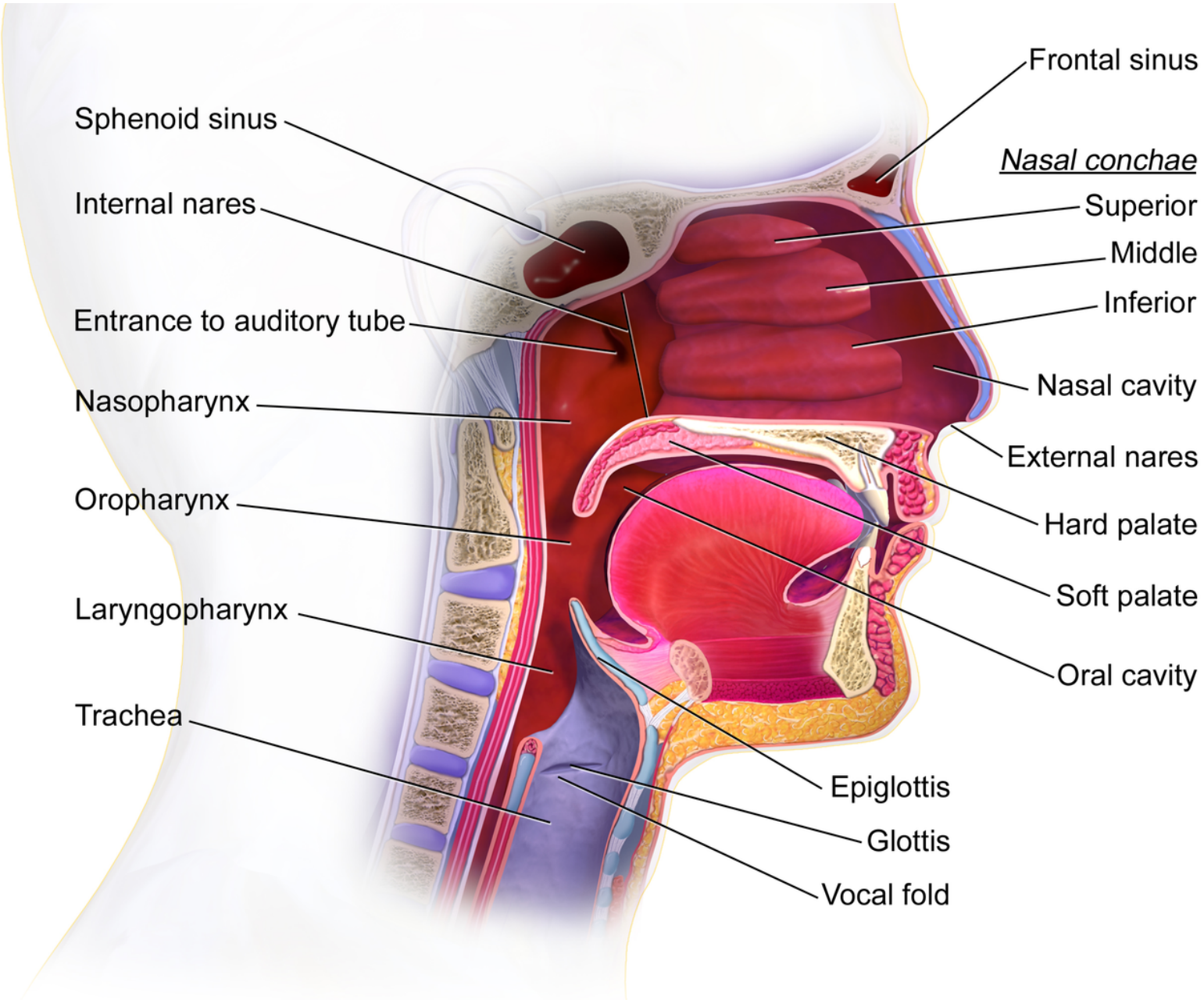
LOWER AIRWAYS

The trachea bifurcates (branches) into two mainstem bronchi, which enter the lungs, which are subdivided by fissures that form incomplete divisions (Fig. 25-2). The right lung, located in the right hemithorax, has three lobes (the right upper lobe, the right middle lobe, and the right lower lobe). The left lung is divided into the left upper lobe, which includes the lingula, the homologous lobe of the right middle lobe, and the left lower lobe. Both the right and left lung are covered by the visceral pleura and are encased by the parietal pleura over p5 of the last version. The interface of these two pleuras allows for the smooth gliding of the lung as it expands in the chest and produces a potential space. Air can enter between the visceral and parietal pleuras either because of trauma, surgery, or rupture of a group of alveoli creating a pneumothorax. Because the right and left lungs and their pleuras are separate, a pneumothorax will involve only the right or left hemithorax.

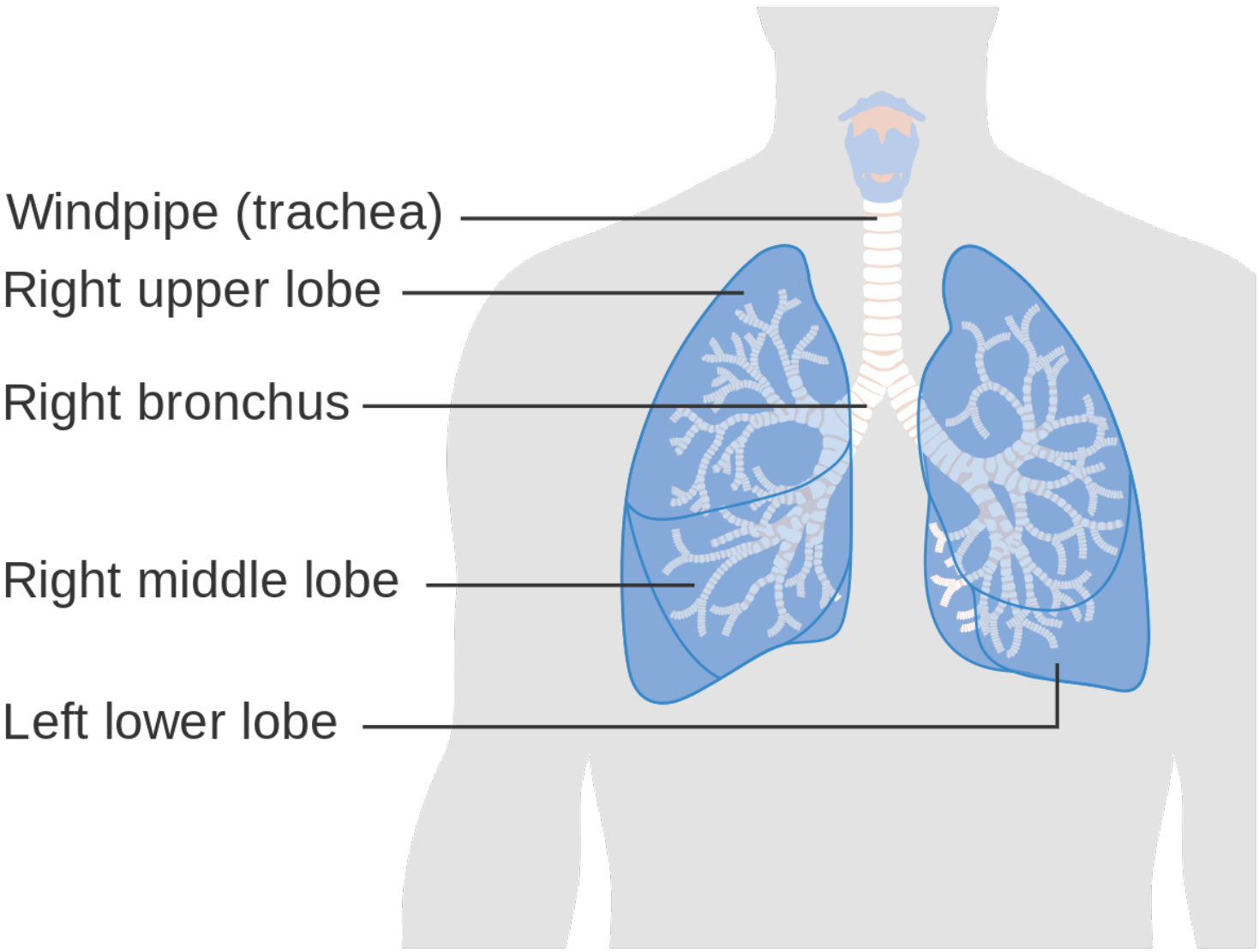
The tracheobronchial system (also called the tracheobronchial "tree") consists of all of the airways, beginning with the trachea. Air flows into the lung through the trachea and airways. As the airways divide and penetrate deeper into the lung, they become narrower, shorter, and more numerous (using a tree analogy, the branches become smaller as they approach the leaves). The trachea divides at the carina (named because it has the appearance of the "keel" of a boat) into the right and left mainstem bronchi, which in turn divide into the lobar bronchi and then the segmental bronchi (Fig. 25-3). The airways continue to divide in what is called a dichotomous or asymmetric branching pattern, until they form terminal bronchioles that are distinguished by being the smallest airways without alveoli.

The bronchopulmonary segment, the region of the lung supplied by a segmental bronchus, is the **functional anatomical unit** of the lung. Disease usually involves a segment at a time and surgical resection follows along segments. The airways can be further divided into two types: cartilaginous airways, or bronchi, and noncartilaginous airways, or bronchioles (Table 25-1).

Bronchi are the conductors of air between the external environment and the distal sites of gas exchange (i.e., the alveoli). The amount of cartilage decreases as the airways become smaller and smaller, and the cartilage disappears completely in airways that are approximately 1 mm in diameter. Airways from the trachea to the terminal bronchioles contain no alveoli, and thus they do not participate in gas exchange. These airways form the anatomic dead space.



The Upper Respiratory System


Windpipe (trachea)
Right upper lobe
Right bronchus
Right middle lobe
Left lower lobe

Parts of the lower respiratory tract.

1. Trachea
2. Mainstem bronchus
3. Lobar bronchus
4. Segmental bronchus
5. Bronchiole
6. Alveolar duct
7. Alveolus

The lower respiratory tract is also called the **respiratory tree** or **tracheobronchial tree**, to describe the branching structure of airways supplying air to the lungs, and includes the trachea, bronchi and bronchioles.[7]

- trachea
  - main bronchus (diameter approximately 1 – 1.4 cm in adults)[8]
    - lobar bronchus (diameter approximately 1 cm)
      - segmental bronchus (diameter 4.5 to 13 mm)[8]
        - subsegmental bronchus (diameter 1 to 6 mm)[8]
          - conducting bronchiole
            - terminal bronchiole
              - respiratory bronchiole
                - alveolar duct
                - alveolar sac
                - alveolus

Introduction

* Breathing occurs in two stages i.e., inspiration and expiration
* During inspiration air enters the lungs from atmosphere and during expiration air leaves the lungs.
* Breathing is a physical process and it is the first step of respiration
* Respiration is a biochemical process by which organic compounds are oxidised to liberate chemical energy from the food and the energy is stored as ATP molecules.

Respiratory Organs in Animals :-

Animal Group	Respiratory Structure
① Protozoans (amoeba, paramecium)	Plasma Membrane
② Sponges	Plasma Membrane
③ Cnidaria	Body Surface

④	Platyhelminthies	Body Surface
⑤	Earthworm	Skin
⑥	Prawn	Gills
⑦	Insects	Trachea
⑧	Scorpions, Spider	Book lungs
⑨	King crab	Book lungs
⑩	Star fish	Tube feet
⑪	Mammals	lungs

Human Respiratory System:-

* Human Respiratory System is located in the thoraic cavity & it consists of lungs and no of small tubes

* The human respiratory system is divided into two major components
  - ⓐ Respiratory tract
  - ⓑ Respiratory organ

Respiratory tract:-

* It serves as a passage for the respiratory gases

*

* The respiratory tract consists of nostrills, nasal cavity, pharynx, larynx, trachea, bronchi and alveoli

* Nostrils are the holes of nose through which air enters and it opens into the nasal cavity

* The nasal cavity has special ciliated epithilum by which air is filtered before it enters the lungs

* Pharynx consist of nasopharynx at the posterior part and air has to pass through this to enter the larynx.

* Larynx is also known as sound box which is made up of cartilage and is present at the opening of the trachea

* Larynx opens into pharynx by a slit like opening called Glottis. Glottis consists of a leaf like cartilage called epiglottis which closes during swallowing

* Trachea runs through the neck in front of the oesophagus and extends into the thoracic cavity

* It connects lungs to the pharynx and it consists of a C-shaped ring of Hyaline Cartilage, that prevents the collapse of trachea during inspiration

* Trachea divided into right and ~~length~~ left primary bronchi. Each bronchus undergoes repeated division to form secondary and tertiary bronchi and bronchioles.

* Each bronchioles give rise to small vascular bag like structure called alveoli

* RESPIRATORY ORGANS

* The network of bronchi, bronchioles and alveoli comprises the lungs.

Each lungs consist of a double membrane covering called plura

The plura consists of a cavity called pleural cavity that secrets a fluid, which reduces the friction of lungs during inspiration and expiration