ANPH 252: Anatomy and Pathology 2

Anatomy of the Respiratory System

MRT Program

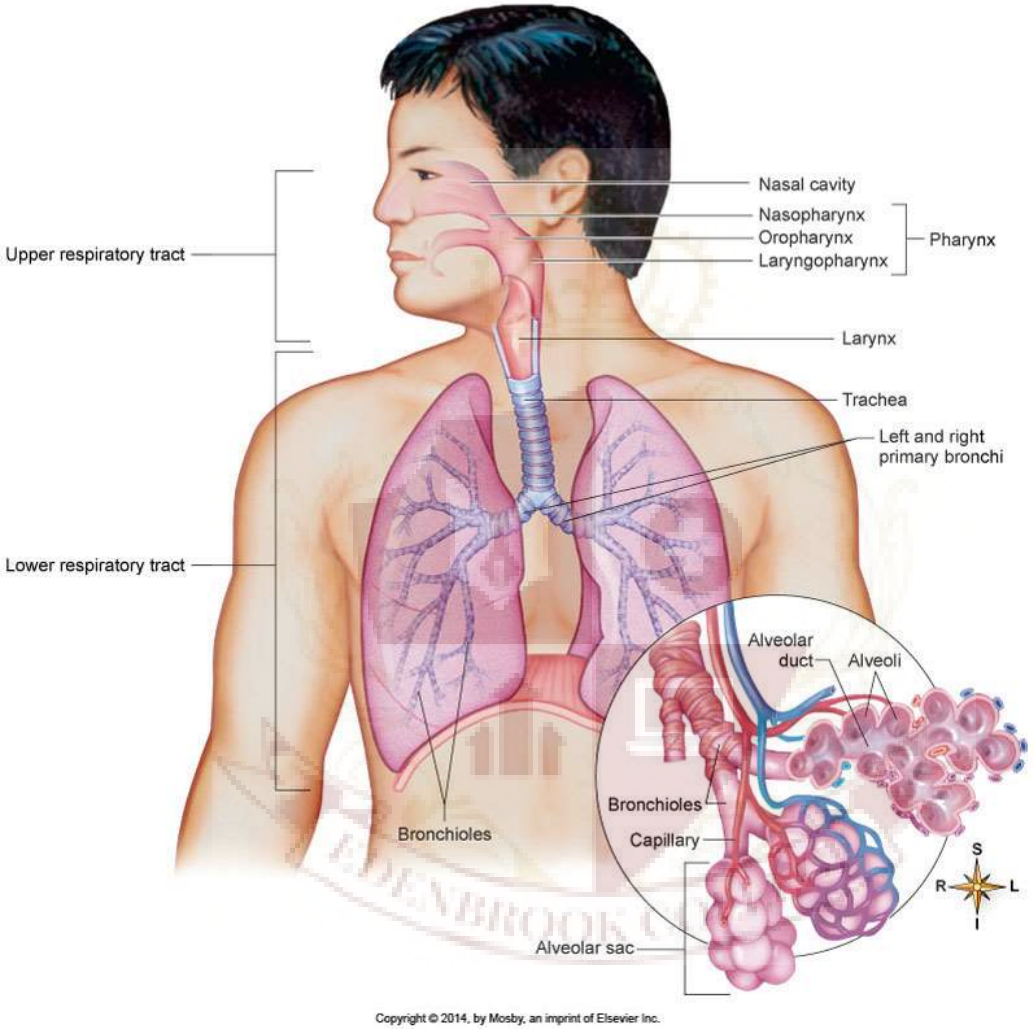
The Respiratory System

- Supplies body tissues with O_2
- Disposes of CO_2
- Filters, warms and humidifies air as we breathe
- Makes it possible to speak and smell

Respiratory System: Functional Anatomy

➢Major organs

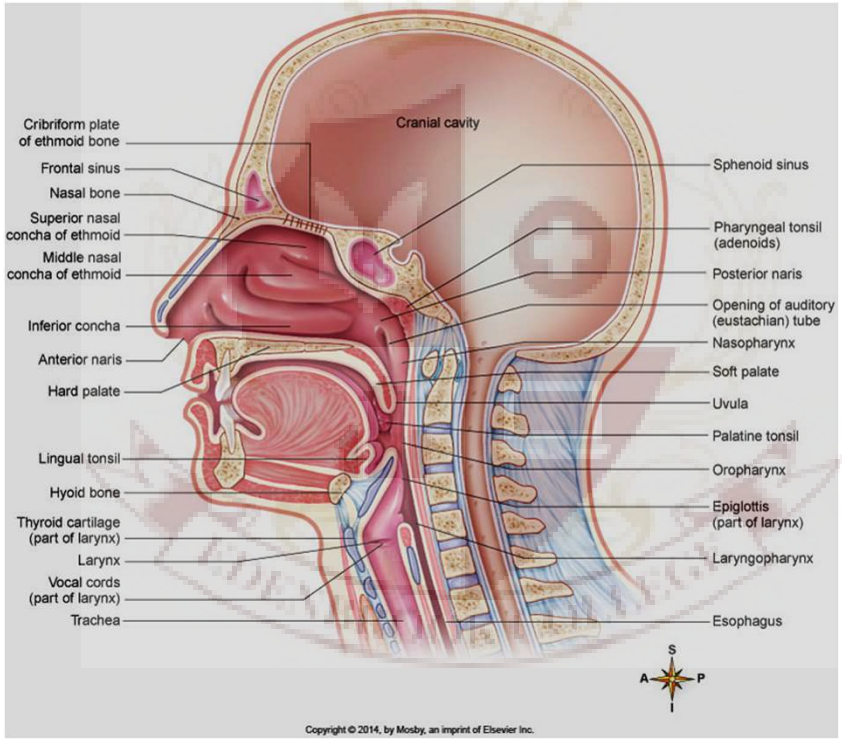
- Nose, nasal cavity, and paranasal sinuses
- Pharynx
- Larynx
- Trachea
- Bronchi and their branches
- Lungs and alveoli



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Upper respiratory tract organs are outside of the chest cavity and include nose, pharynx, and larynx



Patton and Thibodeau 17-4

The Nose

- Moistens, warms, and cleans air we breathe
- Serves as resonating chamber for speech
- Houses olfactory receptors
- **Nostrils** are called external nares

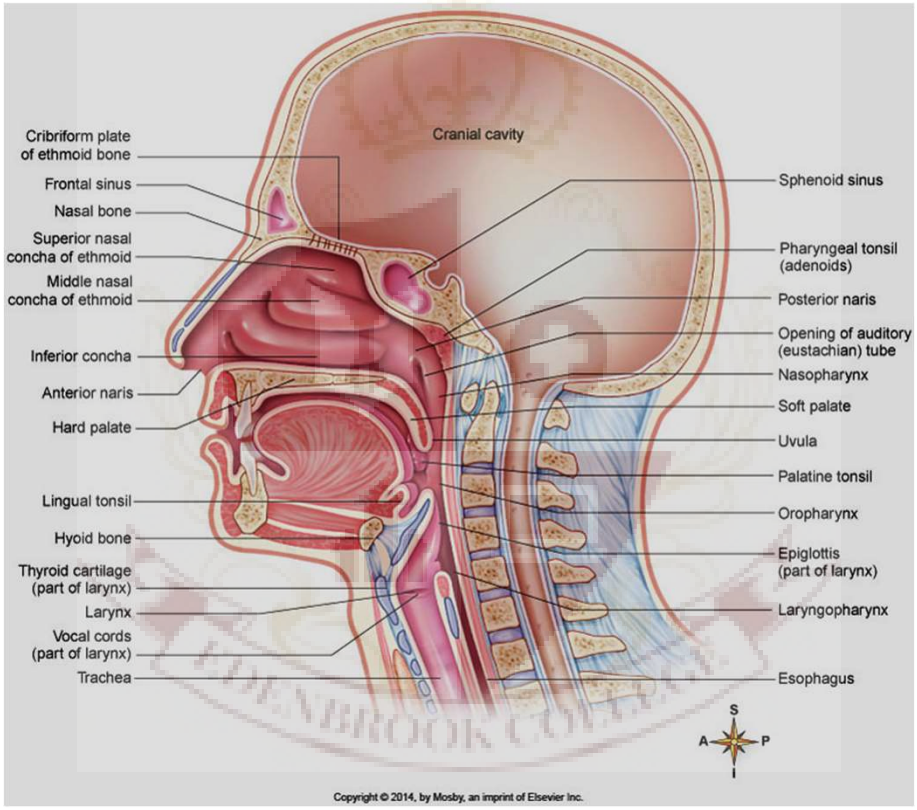
The Nose

- The nasal cavity lies within and posterior to the external nose:
  - It is divided by a midline nasal septum
  - It has two posterior nasal apertures that open into the nasopharynx known as internal nares
  - It has a floor that is half made up of hard palate (bone) and half of soft palate (muscle)
  - It is lined with mucous membranes that filter coarse particles out of air

Nasal Cavity

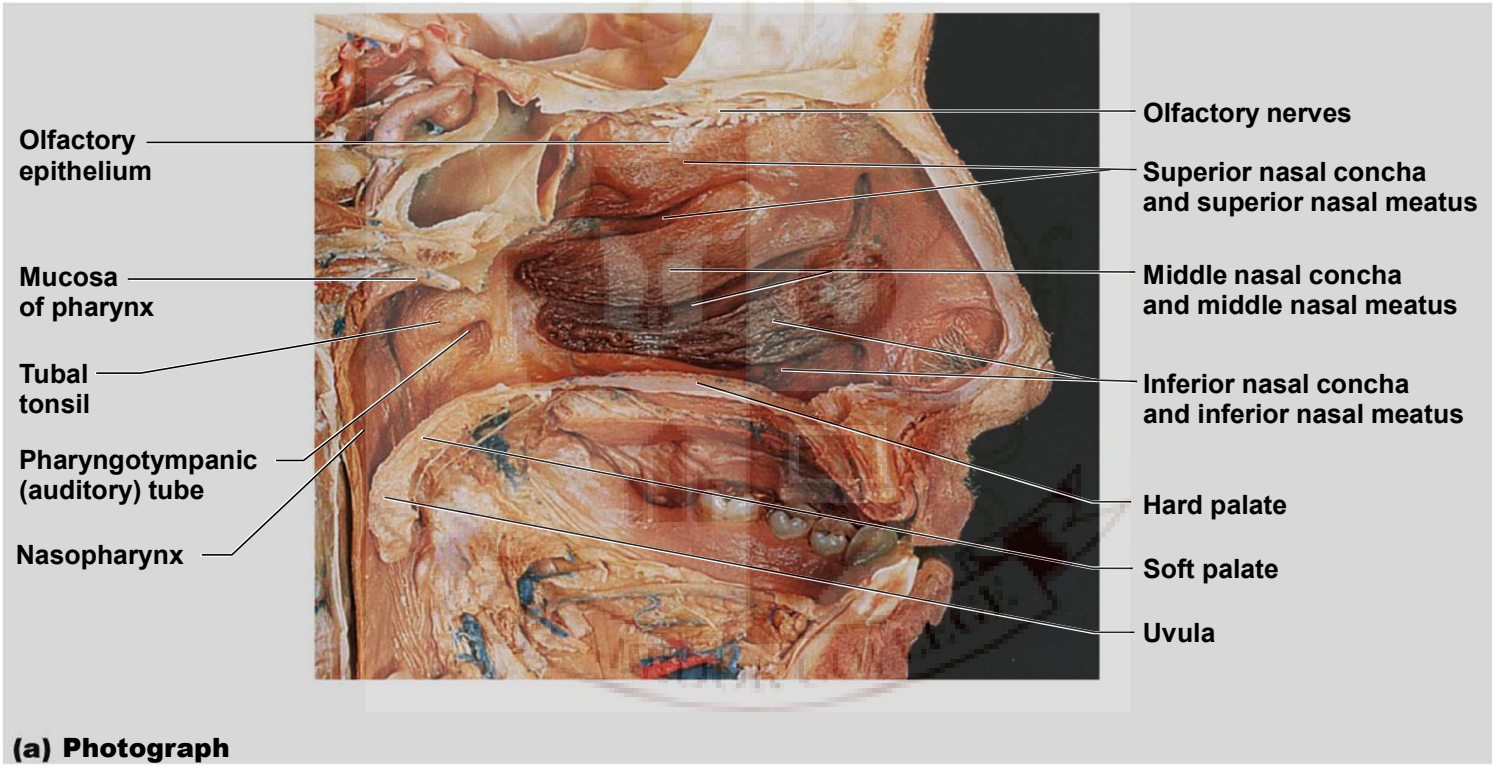
- **Nasal conchae** - superior, middle, and inferior:
  - Increase mucosal area
  - Enhance air turbulence
  - During inhalation, conchae and nasal mucosa, filter, heat, and moisten air
  - During exhalation these structures reclaim heat and moisture

Relational anatomy of the upper respiratory structures



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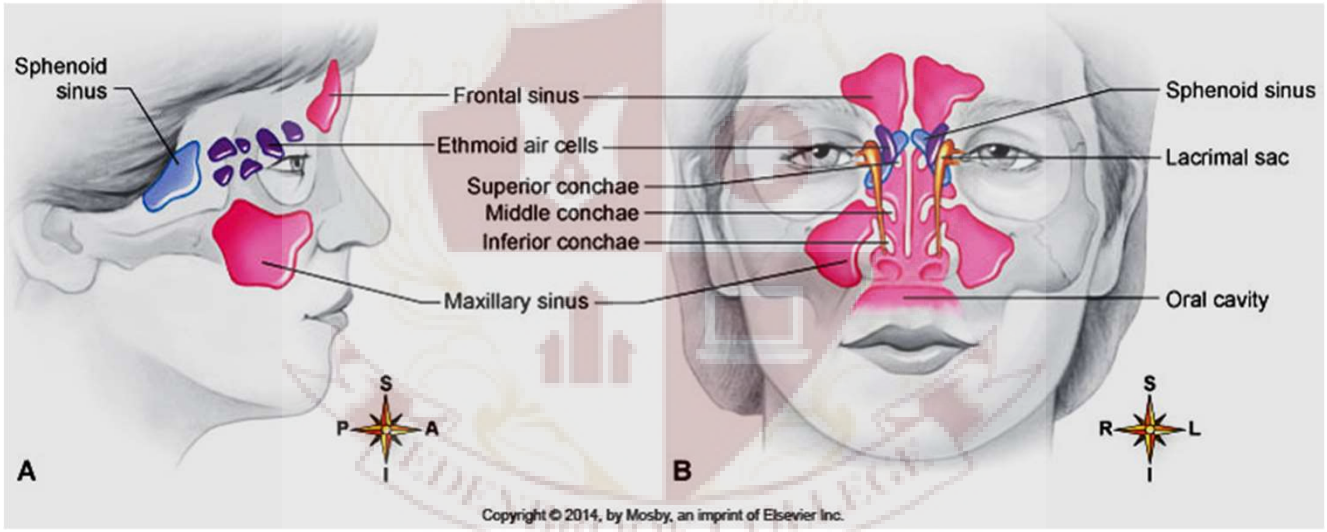
Figure 22.3a The upper respiratory tract.



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Paranasal Sinuses

- Lighten skull; secrete mucus; help to warm and moisten air

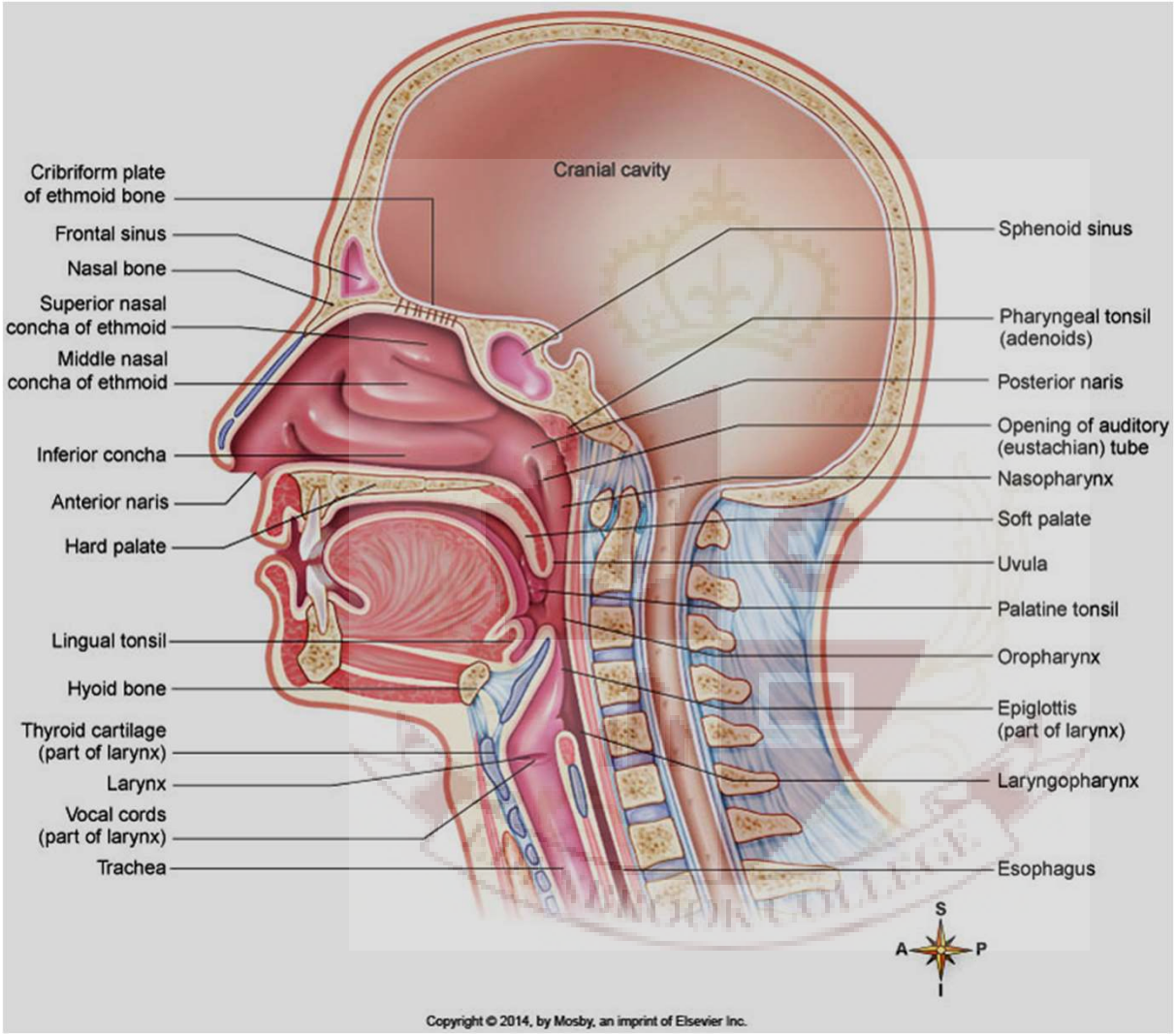


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Pharynx

- Is a muscular tube that extends from the base of skull to C_6 (also called the throat)
  - It connects nasal and oral cavities to the larynx and esophagus
  - It is a passageway for food and air
  - It is composed of skeletal muscle

- It has three regions:
  - Nasopharynx
  - Oropharynx
  - Laryngopharynx



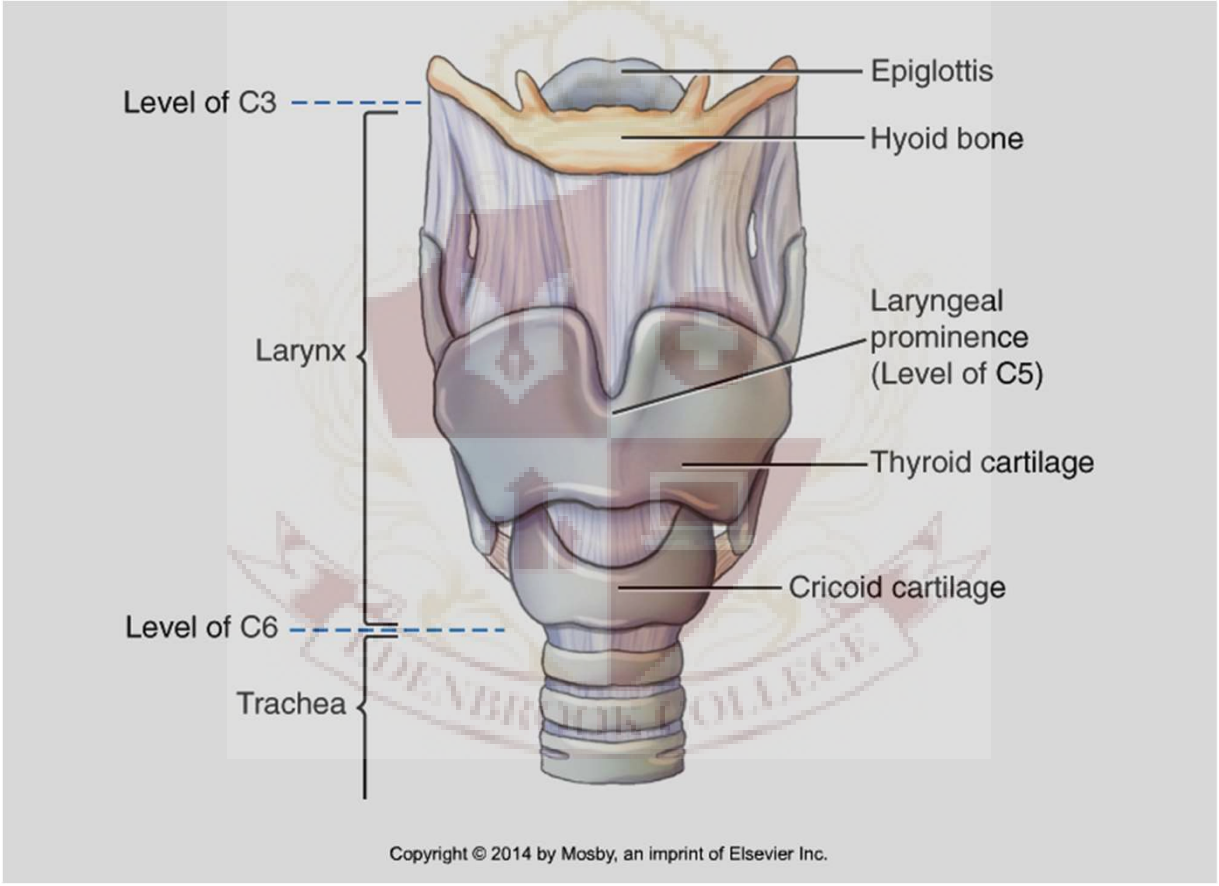
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Larynx

- Attaches to hyoid bone; opens into laryngopharynx; continuous with trachea
- Functions
  - Provides patent airway
  - Directs air and food into proper channels
  - Allows for voice production

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Bontrager 9th ed. Fig. 2.5



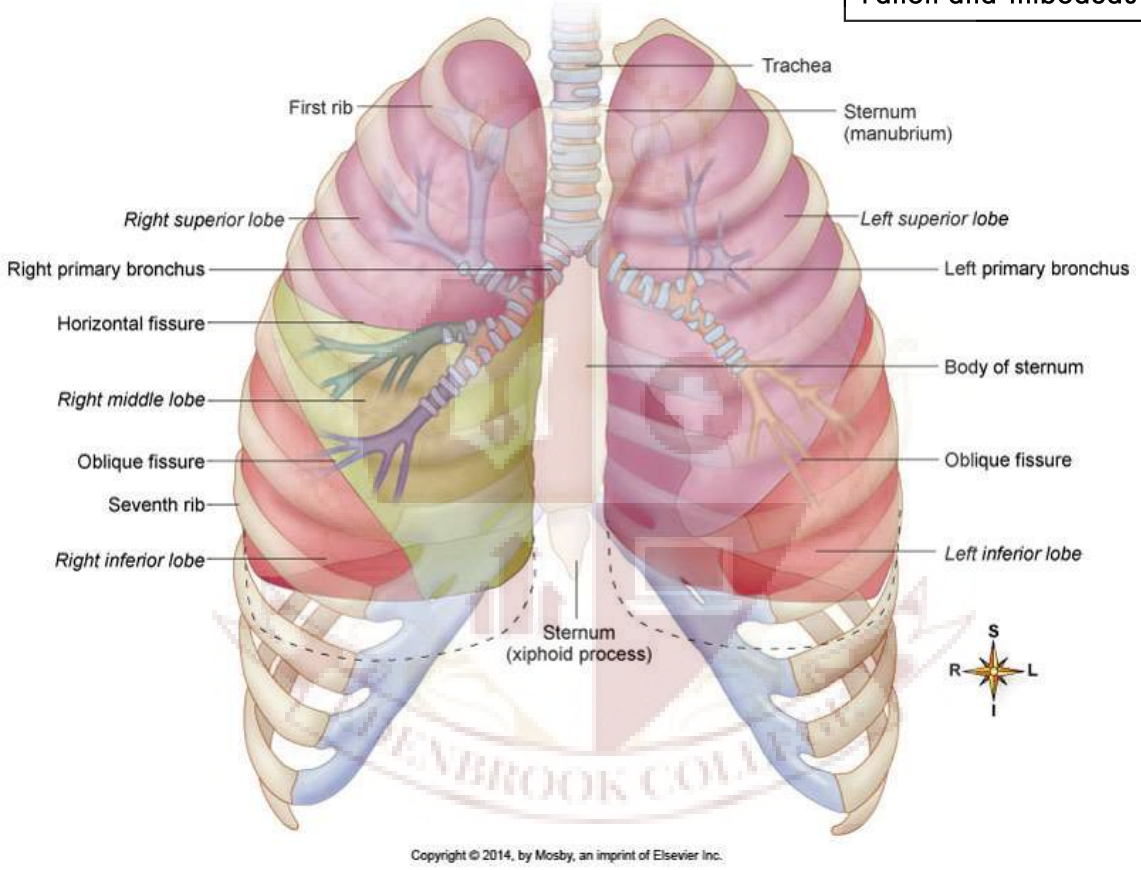
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Trachea (Windpipe)

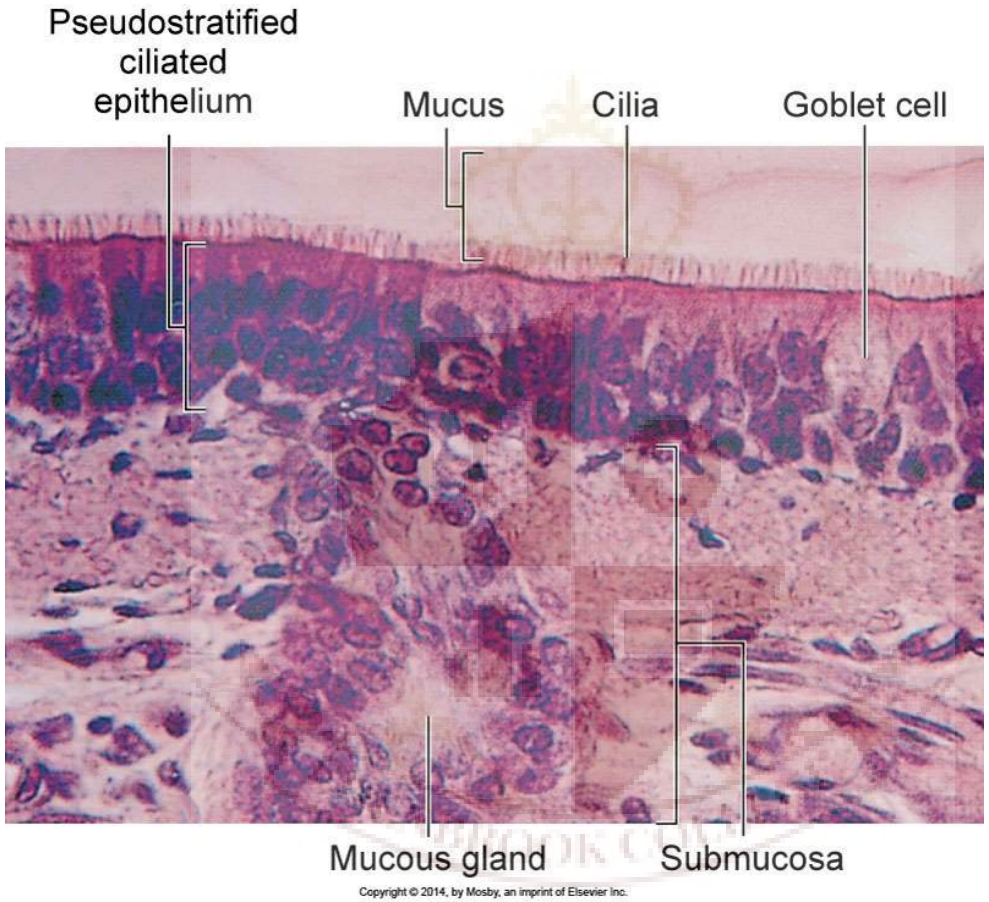
- Extends from larynx into the bronchi in the mediastinum

- The expanded tracheal cartilage is called the carina. It is the point where the trachea branches into two **main bronchi, right primary bronchus and left primary bronchus**

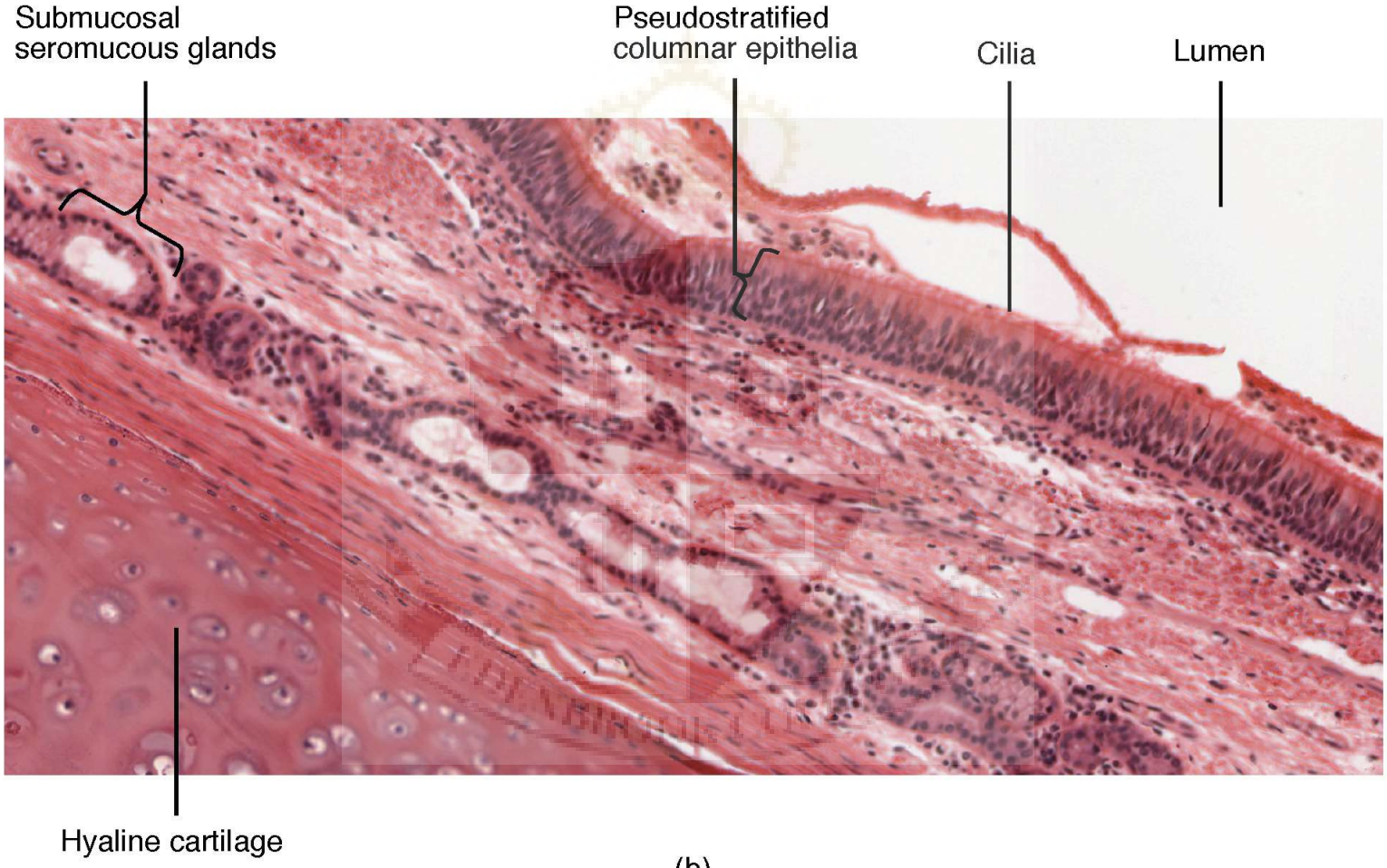
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Submucosal
seromucous glands
Pseudostratified
columnar epithelia
Cilia
Lumen
Hyaline cartilage

(b)

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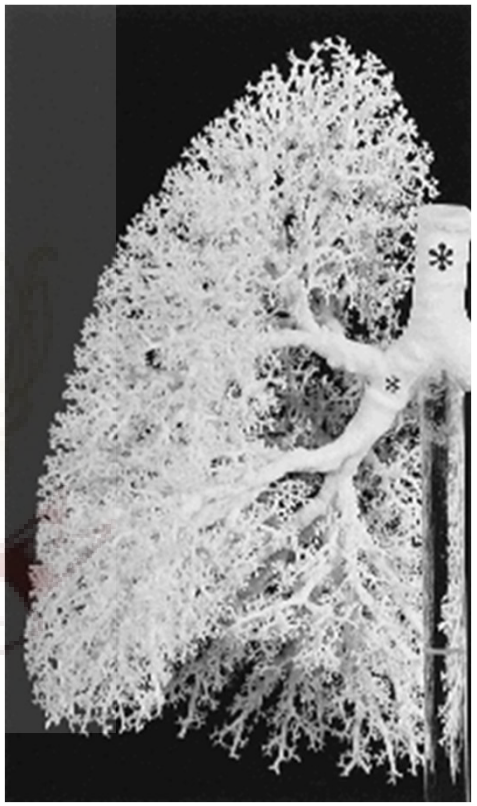


Scanning electron micrograph of cilia and goblet cells in the lining of the lung

Bronchi and Subdivisions

- Air passages undergo 23 orders of branching → **bronchial tree**

www.ehponline.org/.../1997/105-2/brownfig2.GIF



Bronchial Tree

Right and Left (Primary) Bronchi

↓

Lobar (Secondary) Bronchi

↓

Tertiary (segmental bronchi)

↓

Bronchioles (little bronchi < 1mm)

↓

Terminal bronchioles (<0.5 mm)

↓

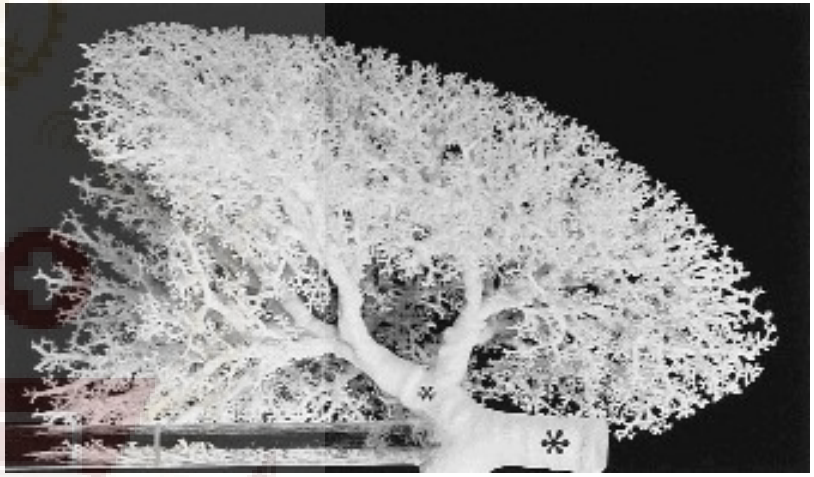
Respiratory bronchioles

↓

Alveolar ducts

↓

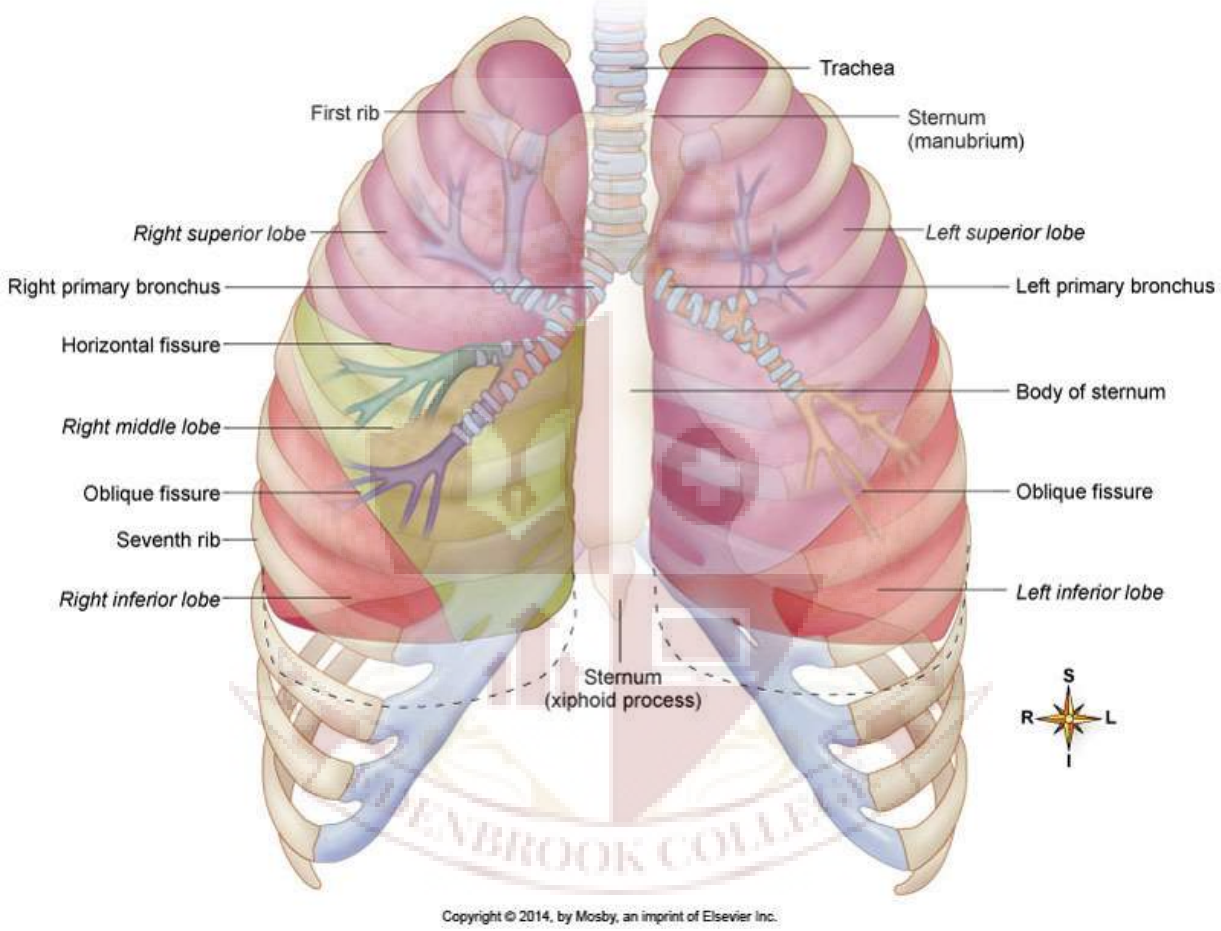
Alveolar sacs (bunch of grapes) with Alveoli (the grapes)



www.ehponline.org/.../1997/105-2/brownfig2.GIF

Conducting Zone Structures

- Each main bronchus enters hilum of one lung
- Right main bronchus wider, shorter, more vertical than left



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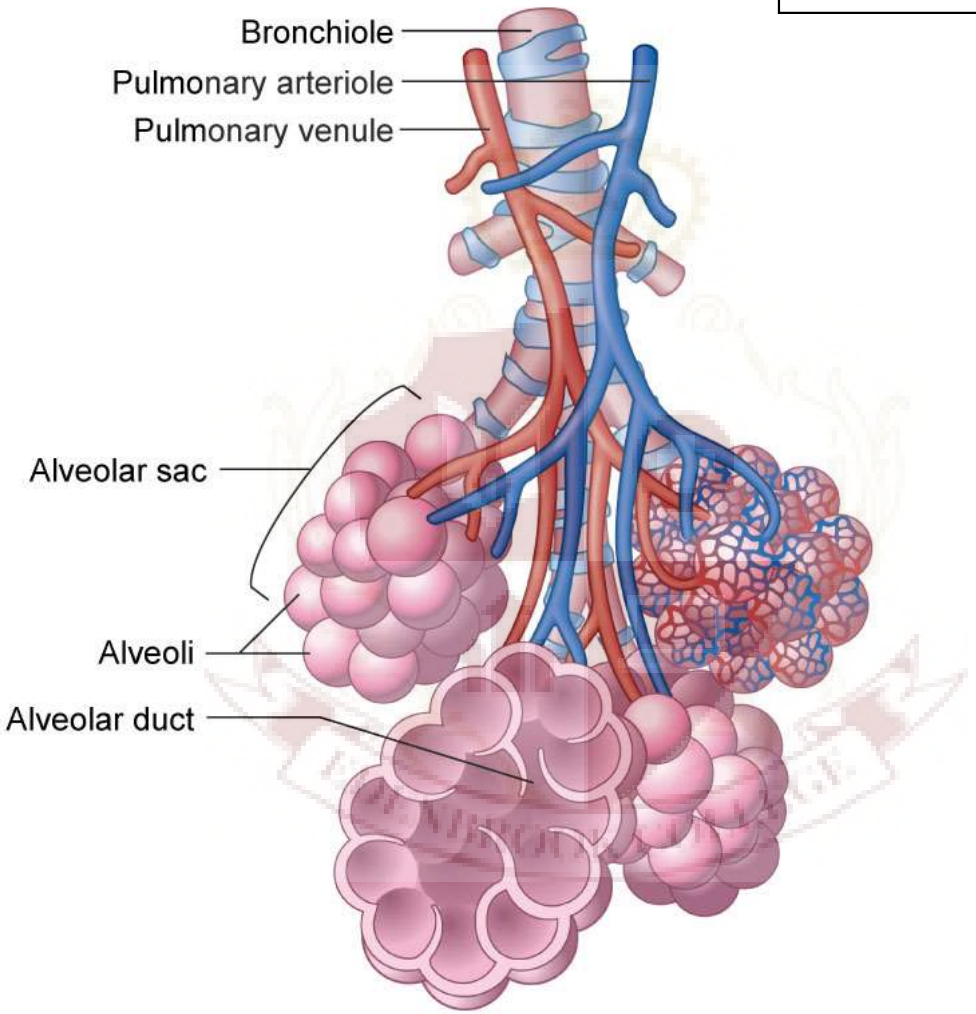
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Respiratory Zone

Alveolar sacs contain clusters of **alveoli**:

- ~300 million alveoli make up most of lung volume
- Sites of gas exchange

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Respiratory Membrane

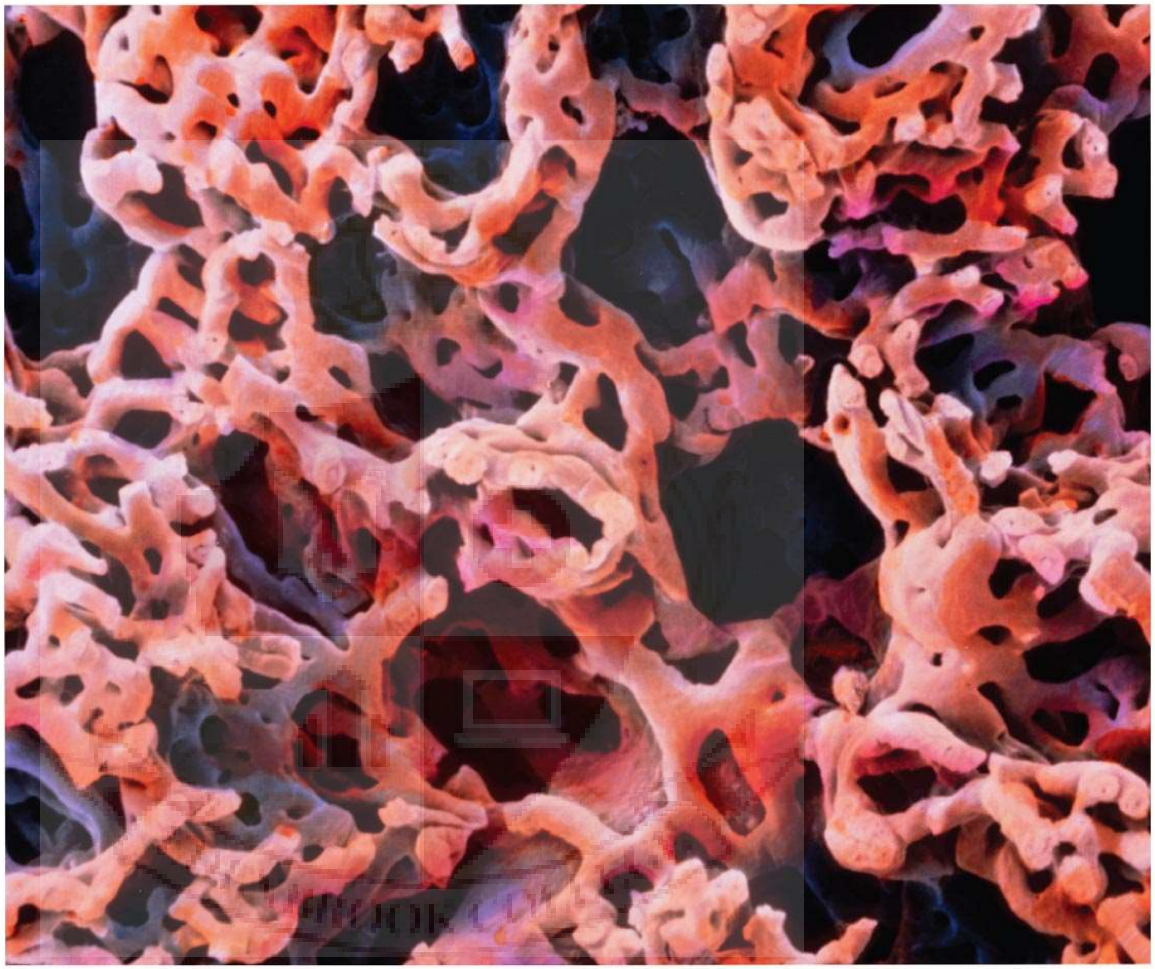
- Alveolar walls:

➢ are very thin to allow gas exchange to occur by simple diffusion

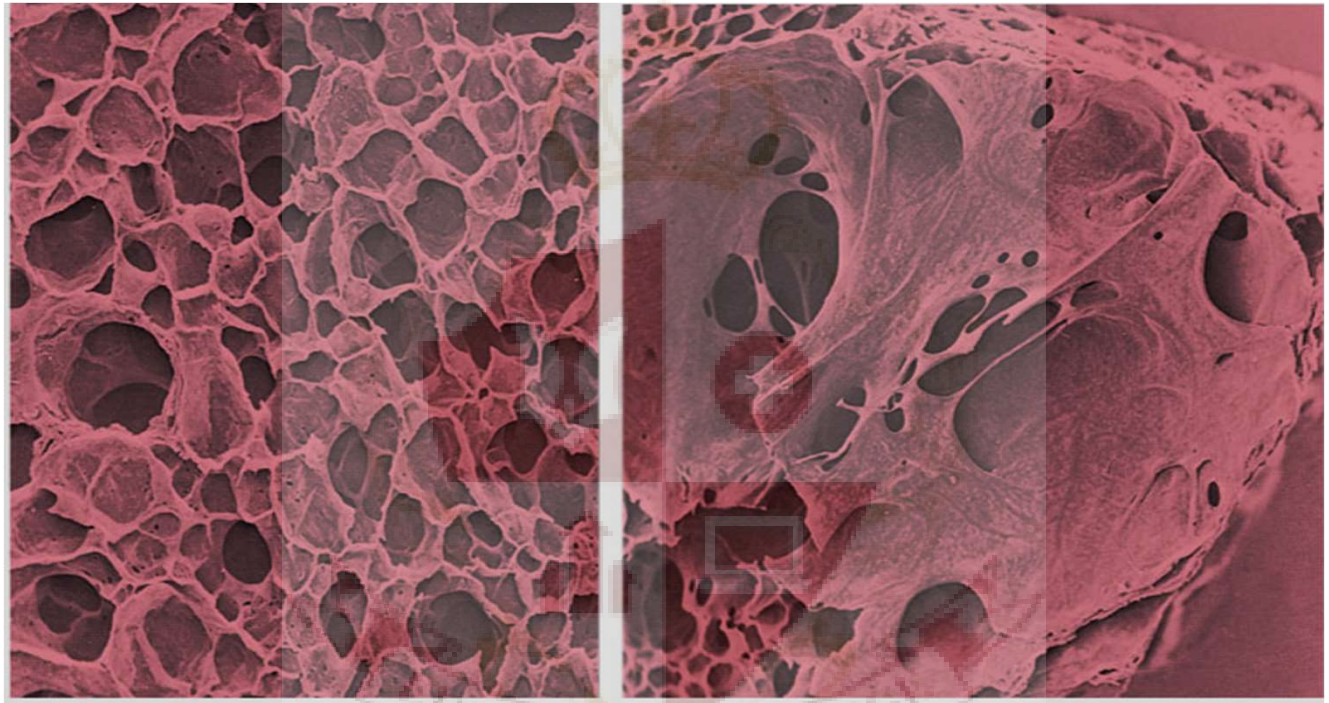
➢ CO_2 and O_2 exchanged

- The inner lining of the alveolus consists of a thin layer of **surfactant**
- Surfactant decreases the surface tension of water in the alveoli
- **Alveolar macrophages** remove microorganism and particles such as dust from the alveoli

Figure 22.9b Alveoli and the respiratory membrane.



(b) **Scanning electron micrograph of pulmonary capillary casts (70x)**



Courtesy Andrew P. Evan, Indiana University School of Medicine.

Lungs

- Occupy all thoracic cavity except mediastinum
- Composed primarily of alveoli

Lungs

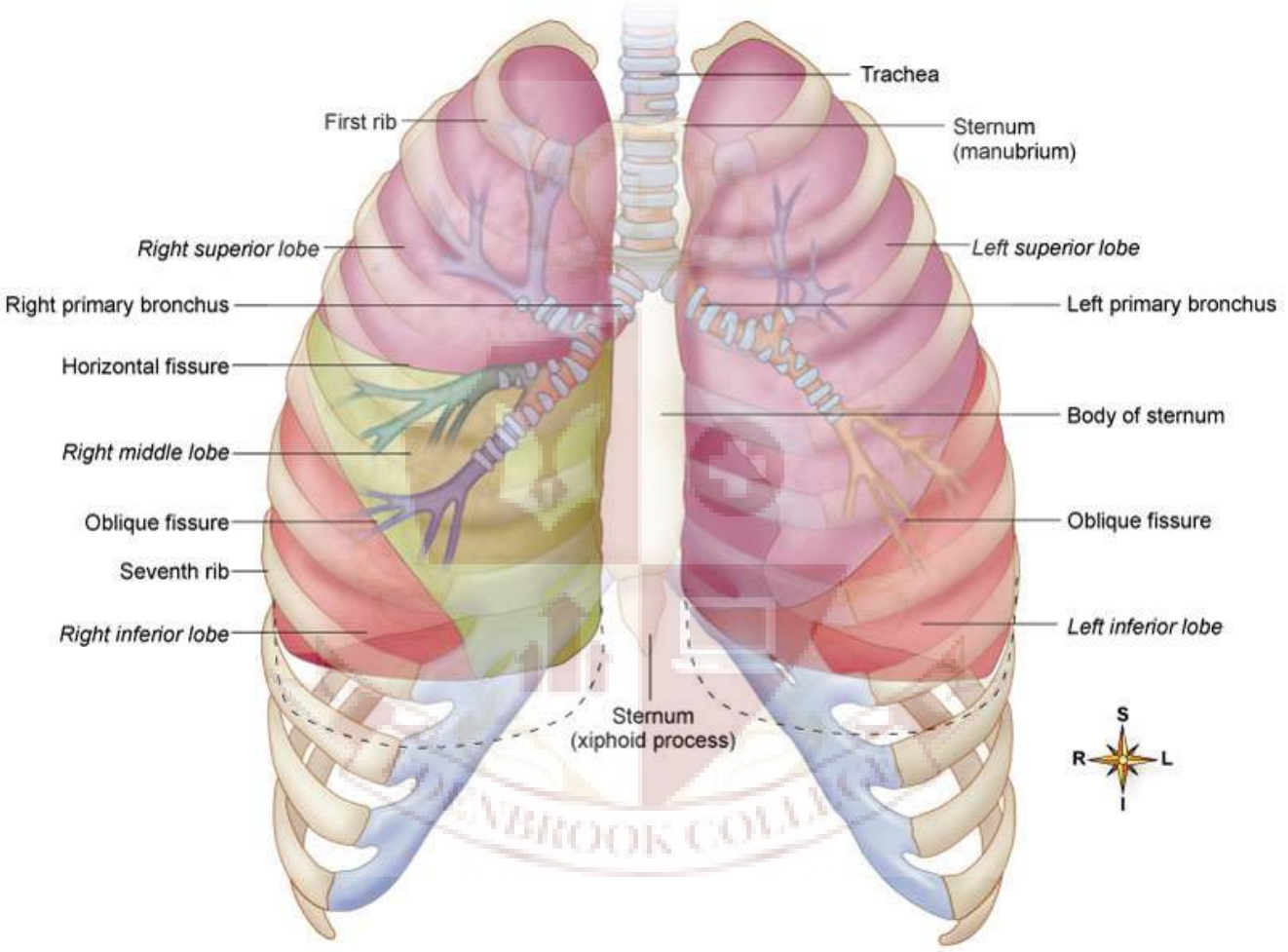
- **Apex** - superior tip; deep to clavicle
- **Base** - inferior surface; rests on diaphragm
- **Hilum** - on mediastinal surface; site for entry/exit of blood vessels, bronchi, lymphatic vessels, and nerves

Lungs

- Left lung smaller than right
  - **Cardiac notch**-concavity for heart
  - Separated into *superior* and *inferior* **lobes** by *oblique fissure*

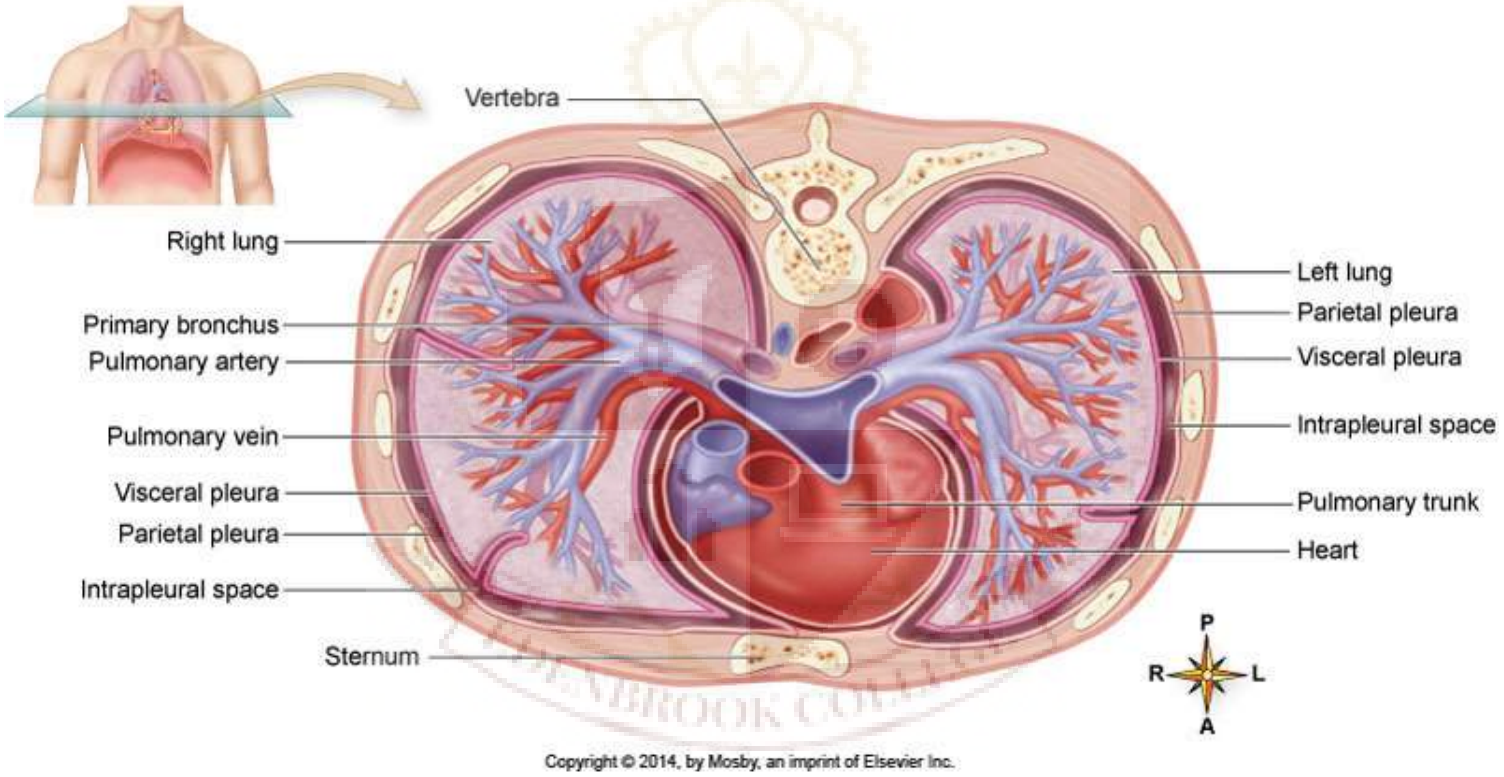
- Right lung
  - *Superior, middle, inferior* lobes separated by *oblique* and *horizontal fissures*

- Lobules - smallest subdivisions visible to naked eye; served by bronchioles and their branches



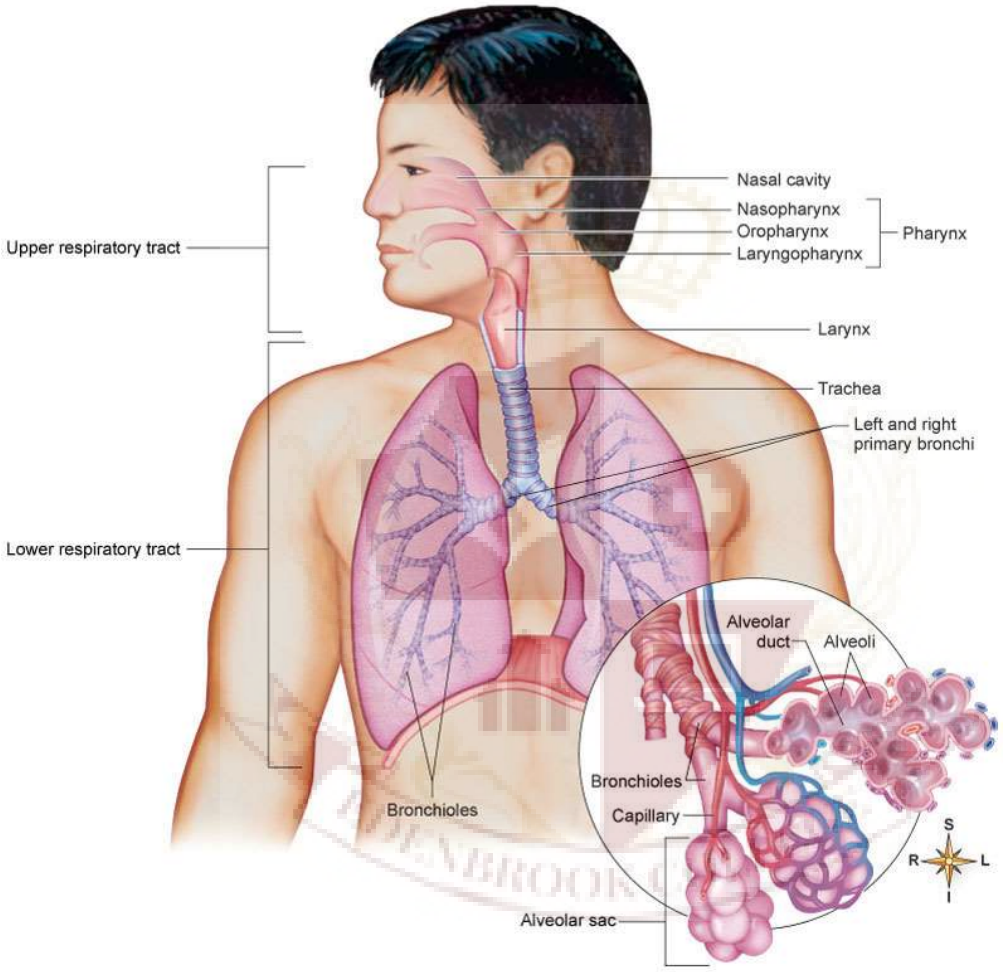
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Cross-section of respiratory structures.



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Blood Supply

- **Pulmonary arteries** deliver deoxygenated blood to lungs for oxygenation
- **Pulmonary veins** carry oxygenated blood from lungs back to the heart
- **Bronchial arteries** arising from the aorta, enter the lungs at the hilum

Mechanics of Breathing

- Pulmonary ventilation consists of two phases:
  - **Inspiration**-gases flow into lungs
  - **Expiration**-gases exit lungs

Inspiration

- Is an active process
  - Inspiratory muscles (diaphragm and external intercostals) contract
  - Thoracic volume increases
  - Lungs are stretched and intrapulmonary volume increases
  - Air flows into lungs

Forced Inspiration

- With vigorous exercise or chronic obstructive lung diseases, accessory muscles in the neck and chest wall help to expand the rib cage for increased respiration.

Expiration

- Quiet expiration is normally a passive process
  - Inspiratory muscles relax
  - Thoracic cavity volume decreases
  - Elastic lungs recoil and intrapulmonary volume decreases
  - Air flows out of lungs
- Note: *forced expiration is an* active process that uses abdominal muscles and internal intercostal muscles

Respiratory system summary:

https://www.youtube.com/watch?v=MrDbiKQOtlU

https://www.khanacademy.org/science/biology/crash-course-bio-ecology/crash-course-biology-science/v/crash-course-biology-126