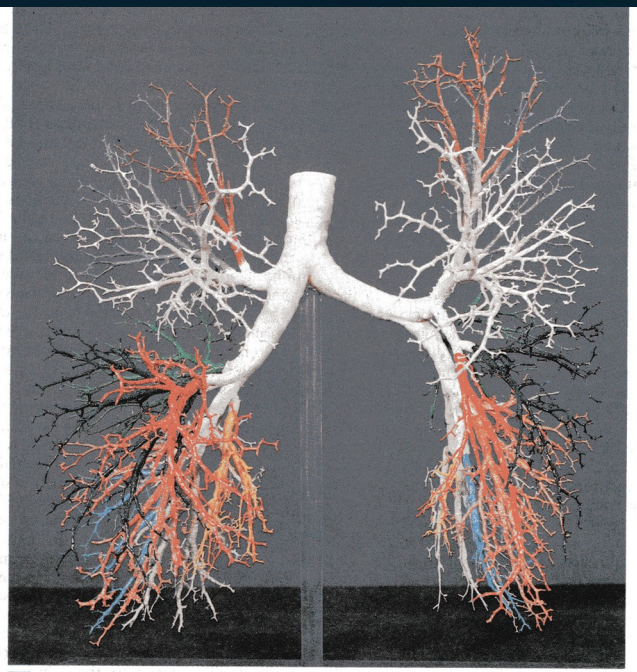
Bronchial Tree and Bronchopulmonary Segments

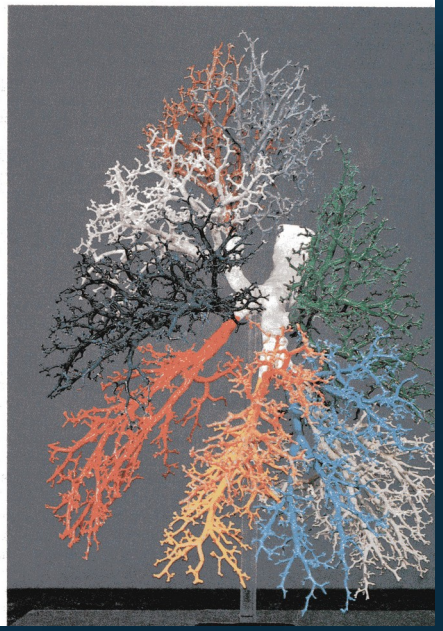
Overview

- Functional Significance
- Definitions
- Structure
- Bronchopulmonary Segments
- Lung Lobules
- Histology
- Blood and Nervous Supply



A





Functional Significance

- Individual segments of lung can be removed
- Surgery: single segment, multi-segment, lobectomy or complete pneumonectomy
- Bronchoscopy
- Physiotherapy for postural drainage of lung segments
- Superior (apical) segment of inferior lobe common site of abscess formation following aspiration

The Bronchial Tree

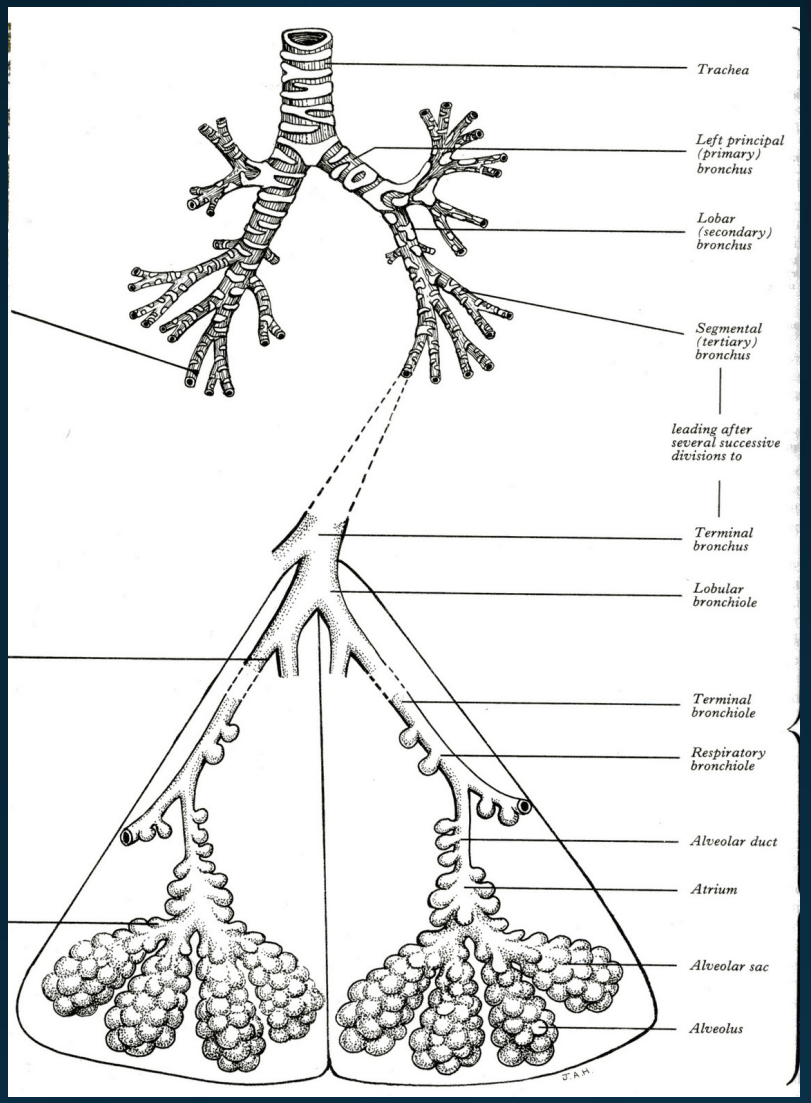


Respiratory passages: Definitions

- Primary bronchi-lung
- Secondary (lobar) bronchi-lung lobe
- Tertiary (segmental) bronchi-bronchopulmonary segment
- Bronchi <1mm are bronchioles
- Repeated branching
- Confusion amongst authors

Respiratory passages: Definitions

- Each segmental bronchus divides repeatedly x20-25
- Eventually end in a terminal bronchiole
- Terminal Bronchiole –> Respiratory Bronchioles
- Respiratory bronchiole –> x2-11 alveolar ducts
- Alveolar duct —> x5-6 alveoli sacs
- Alveolar sacs consist of several alveoli opening into a single chamber

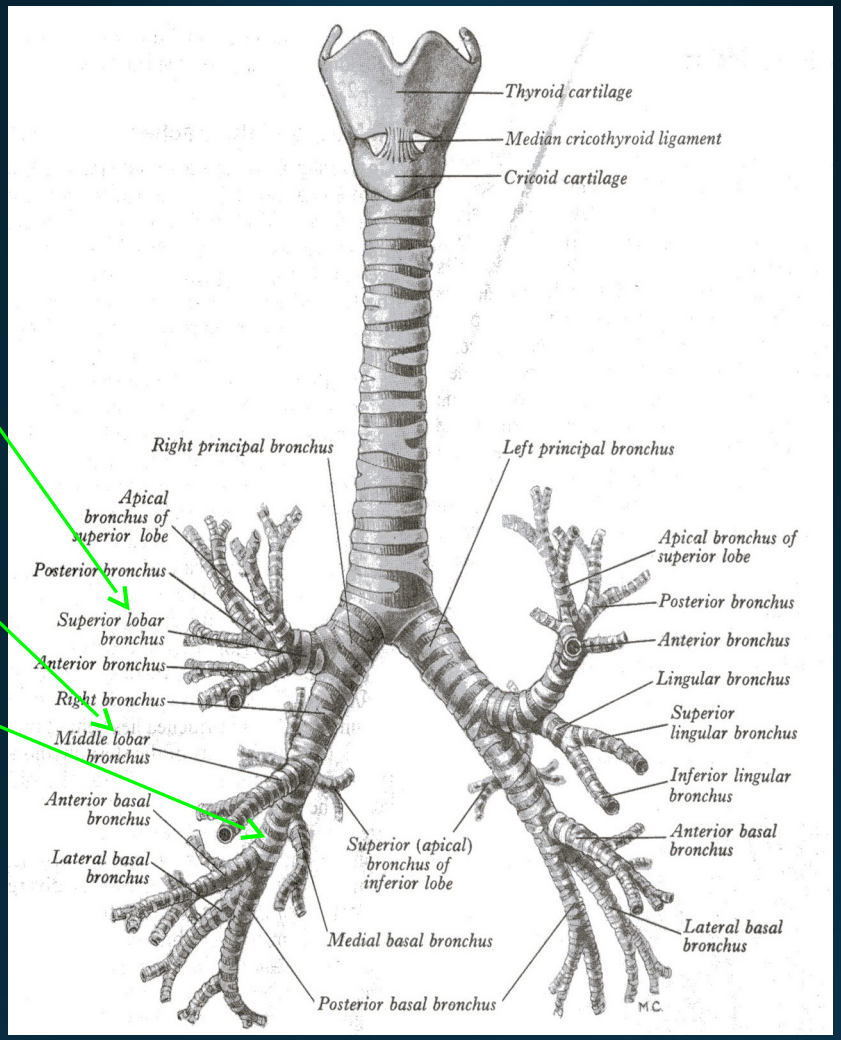


Structure

- Trachea
  - Cartilage, fibromuscular membrane, mucosa
  - 10-11cm long
  - 12mm in transverse diameter
- Trachea bifurcates at the sternal angle
- Right versus Left main bronchi
- Foreign bodies

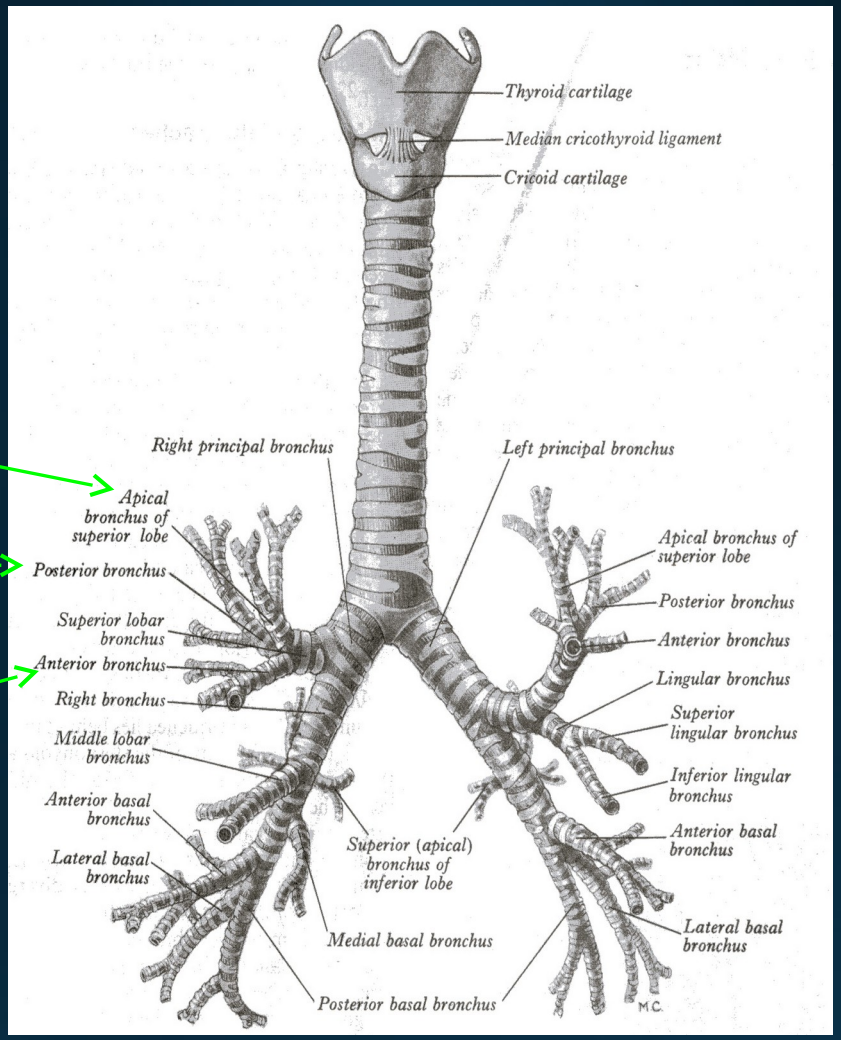
Right Main Bronchus

- Enters lung at level of 5th thoracic vertebrae
- Divides into:
  - Superior Lobar Bronchus
  - Middle Lobar Bronchus
  - Inferior Lobar Bronchus



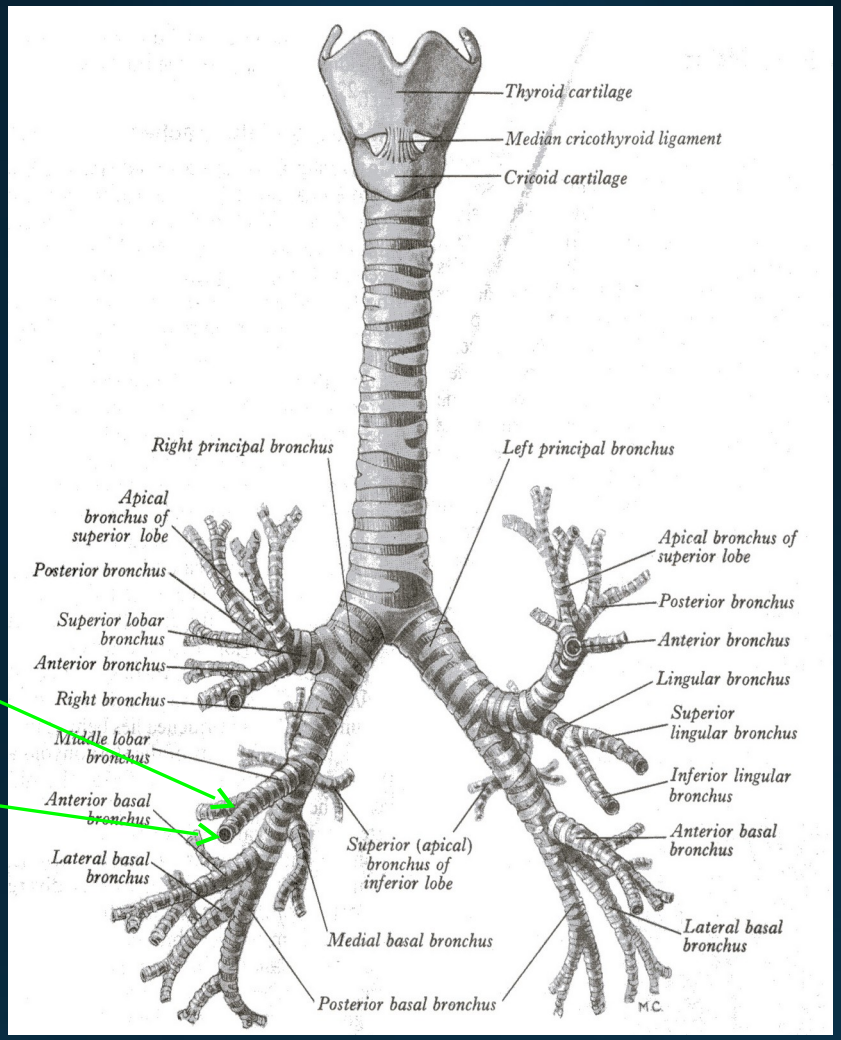
Right Main Bronchus-branches

- Superior Lobar Bronchus
  - Arises at the lateral aspect
  - Divides into
    - 1. Apical Segmental Bronchus
    - 2. Posterior Segmental Bronchus
    - 3. Anterior Segmental Bronchus



Right Main Bronchus-branches

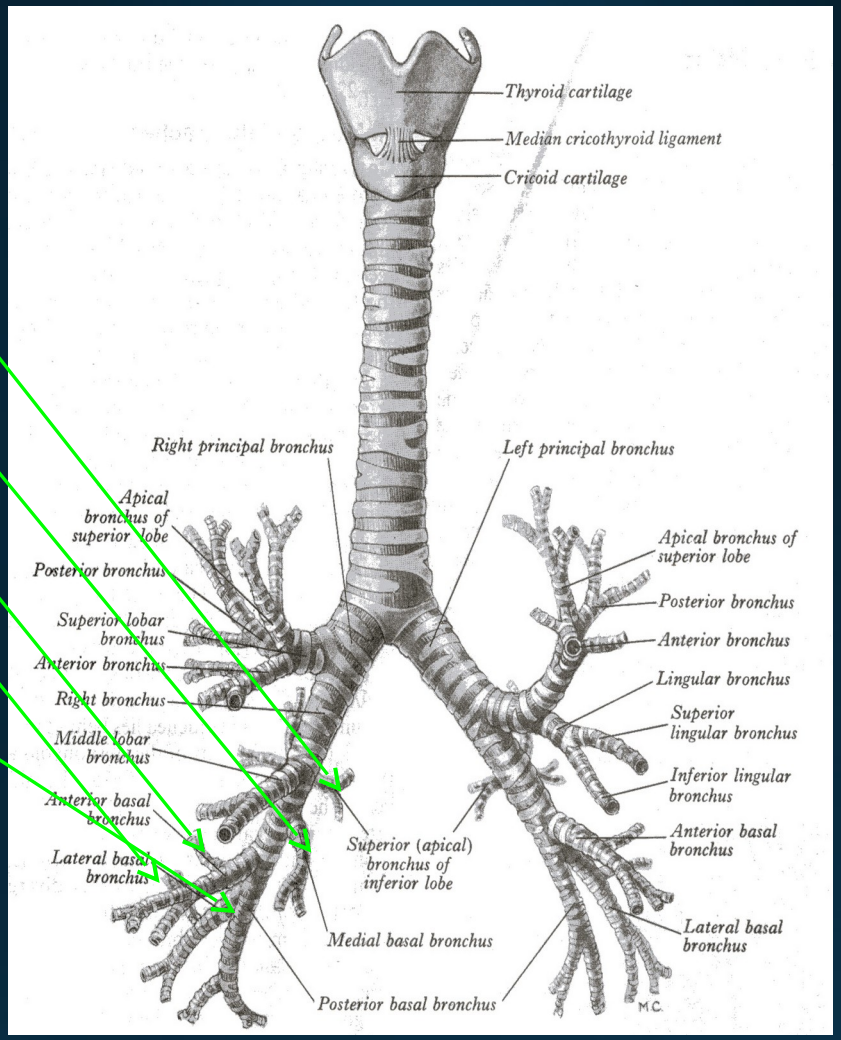
- The Middle Lobar Bronchus
  - Arises at the anterior aspect
  - 2cm below the origin of the superior
  - Divides into:
    - 4. Lateral segmental bronchus
    - 5. Medial segmental bronchus



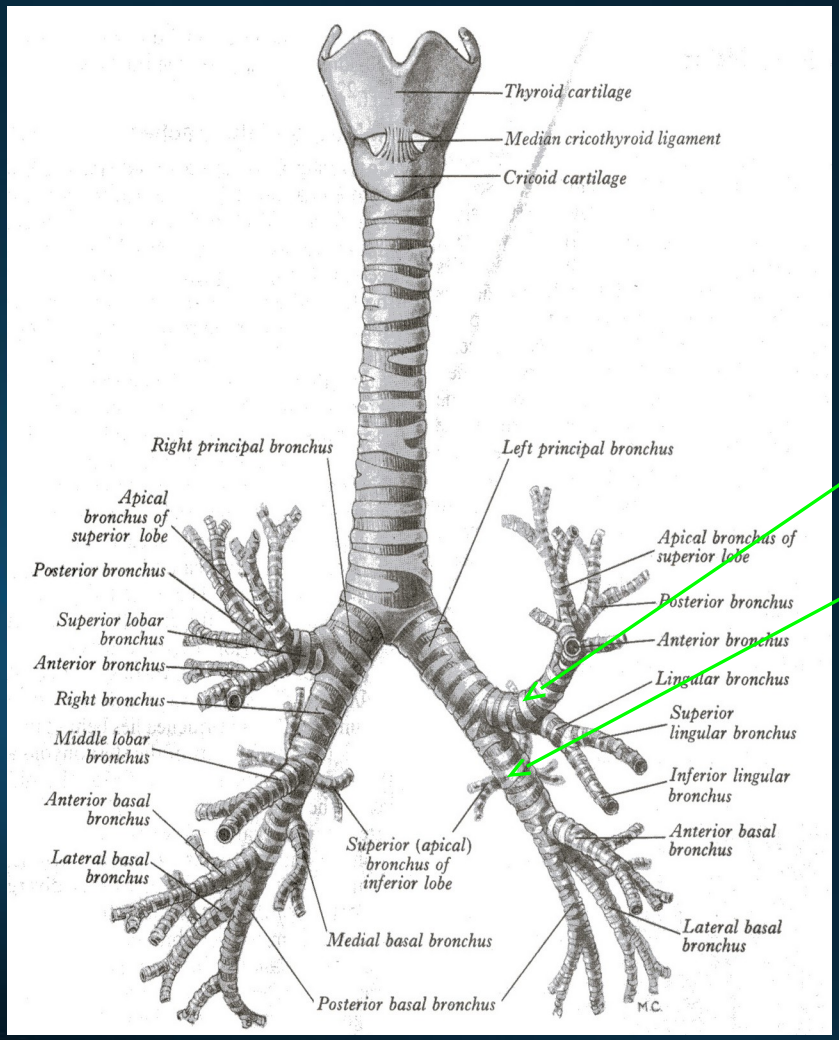
Right Main Bronchus-branches

- Inferior lobar bronchus
  - Continuation of the principle bronchus
  - It divides into:
    - 6. Superior (apical) segmental bronchus
    - 7. Medial Basal segmental Bronchus
    - 8. Anterior Basal segmental Bronchus
    - 9. Lateral Basal segmental bronchus
    - 10. Posterior Basal segmental bronchus

- In >50% of right lungs a subsuperior segmental bronchus

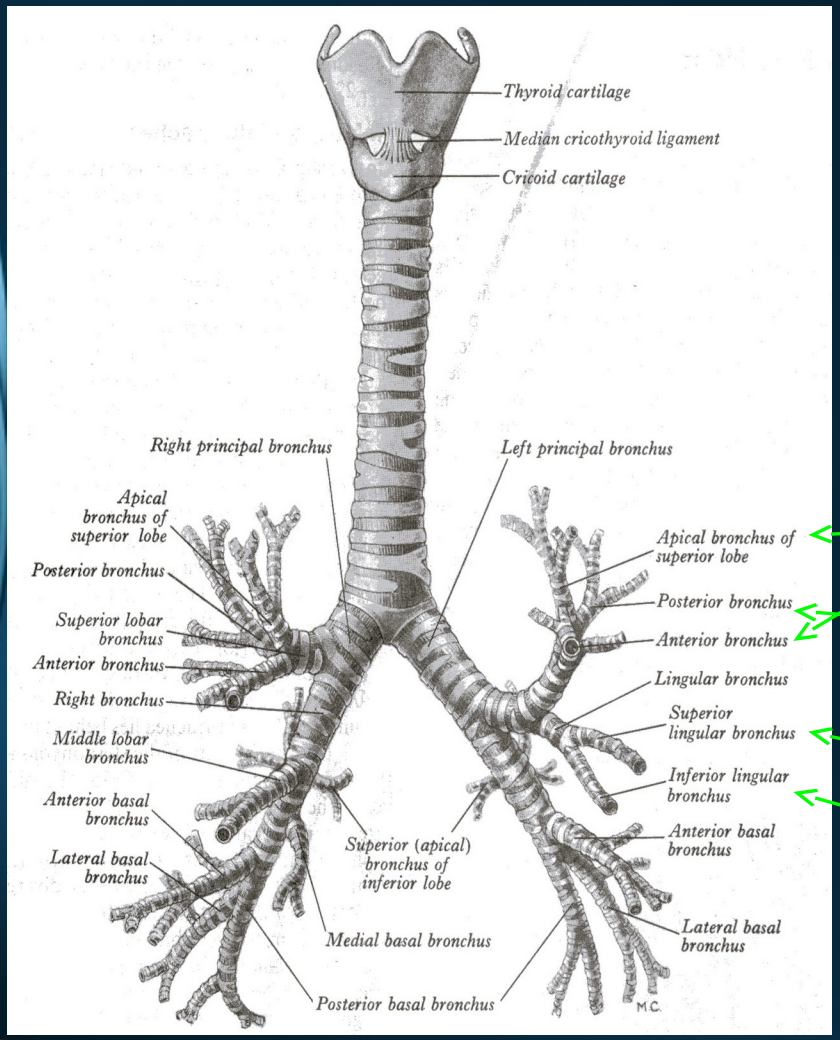


Left Main Bronchus



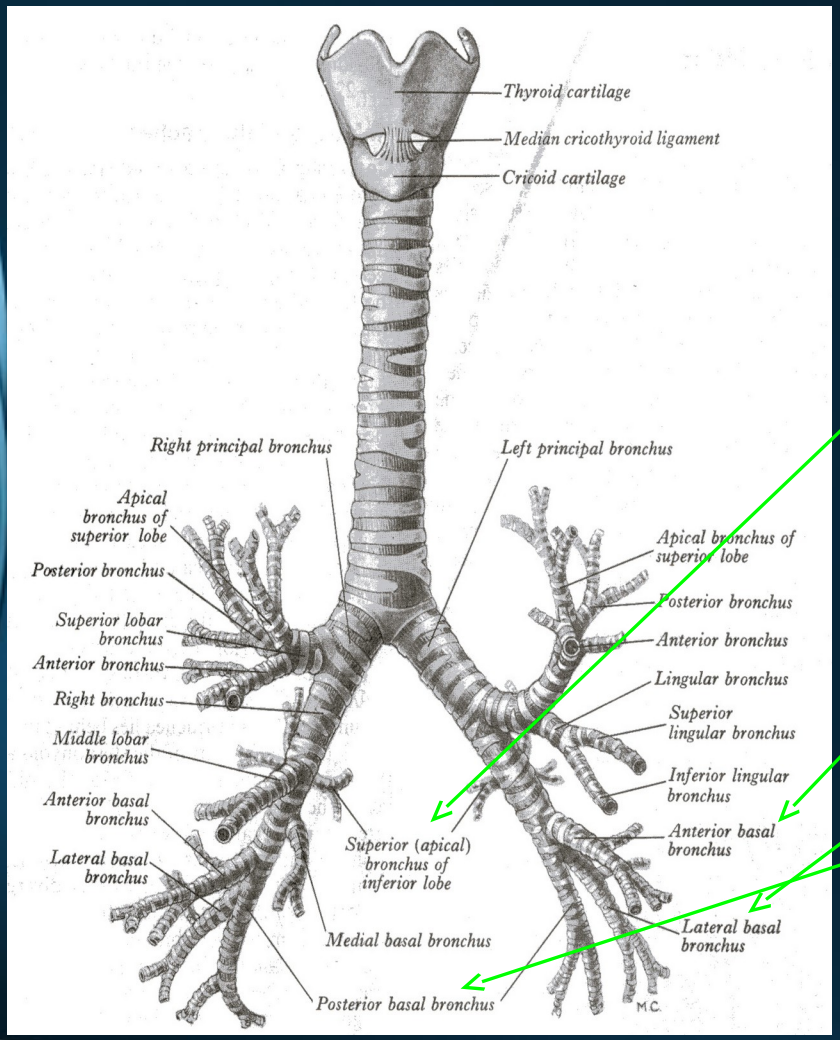
- Enters the lung level with the 6th thoracic vertebrae
- Divides into:
  - Superior Lobar Bronchus
  - Inferior Lobar Bronchus

Left Main Bronchus-branches



- Superior lobar bronchus
  - Arises from the anterolateral aspect
  - Divides into:
    - Superior Division:
      - 1. Anterior segmental bronchus
      - 2. Apical segmental bronchus
      - 3. Posterior segmental bronchus
    - Inferior Division
      - 4. Superior lingular segmental bronchus
      - 5. Inferior lingular segmental bronchus

Left Main Bronchus-branches



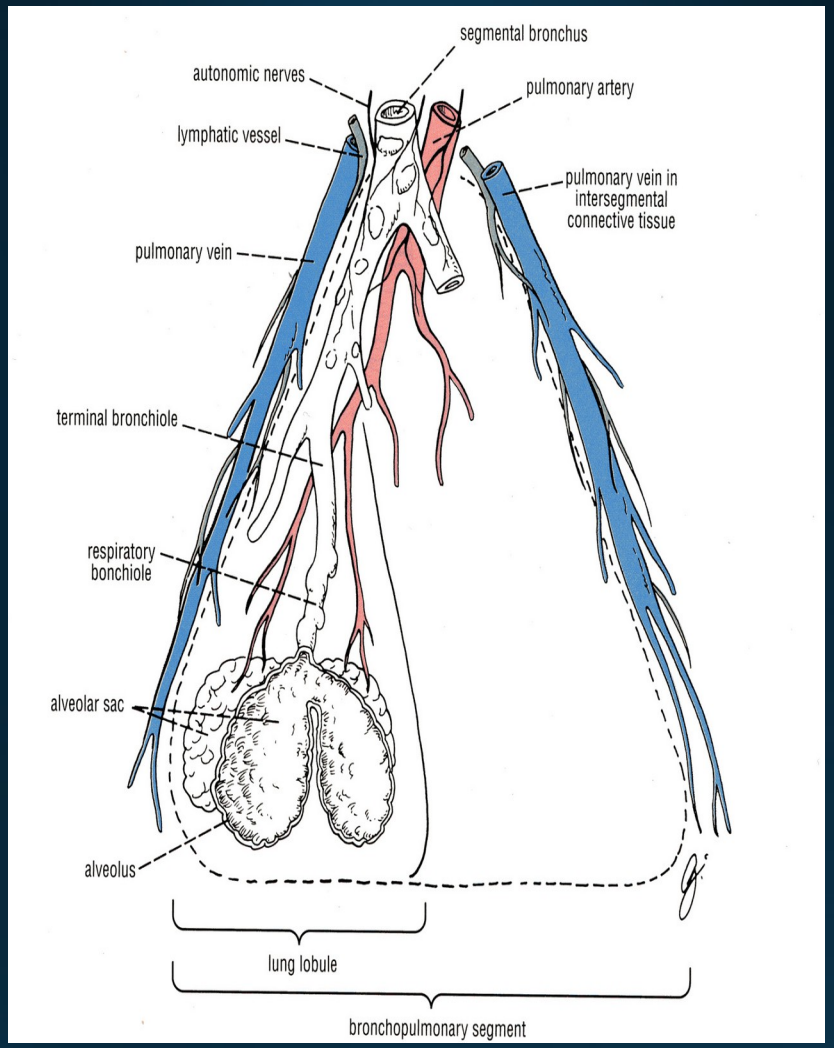
Left Inferior Lobar Bronchus

- Divides into
  - 6. Superior (apical) segmental bronchus
- Anteromedial Stem
  - 7. Medial Basal segmental bronchus (not shown)
  - 8. Anterior Basal segmental bronchus
- Posterolateral Stem
  - 9. Lateral Basal segmental bronchus
  - 10. Posterior Basal segmental bronchus

- 30% of left lungs have a subsuperior segmental bronchus

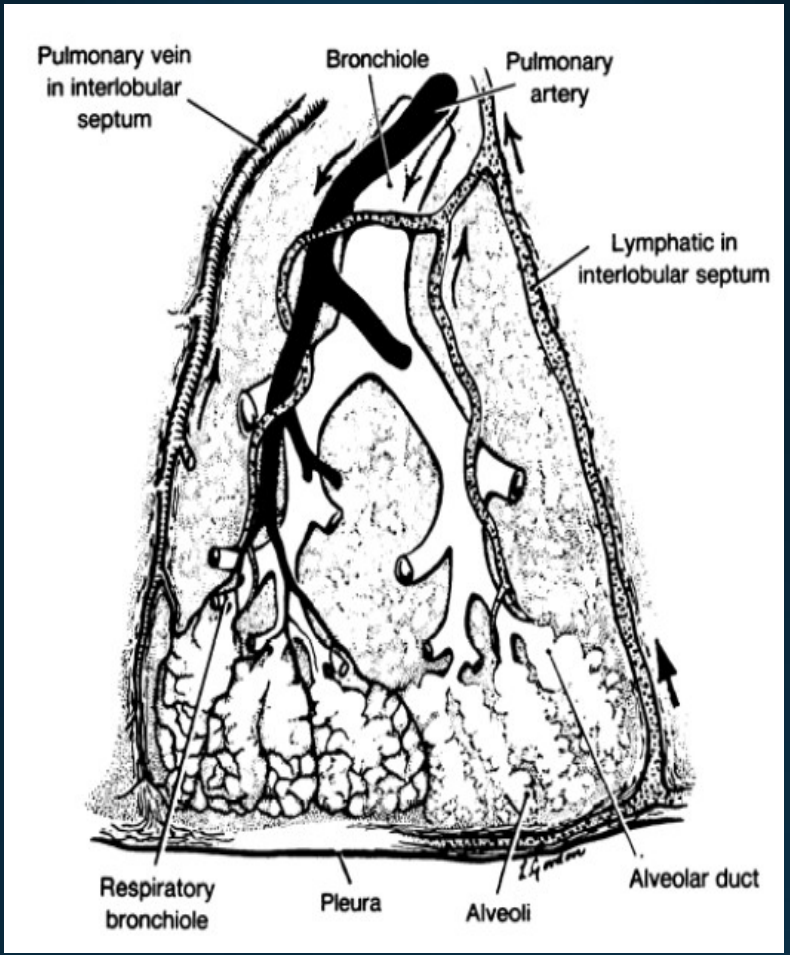
Bronchopulmonary Segments

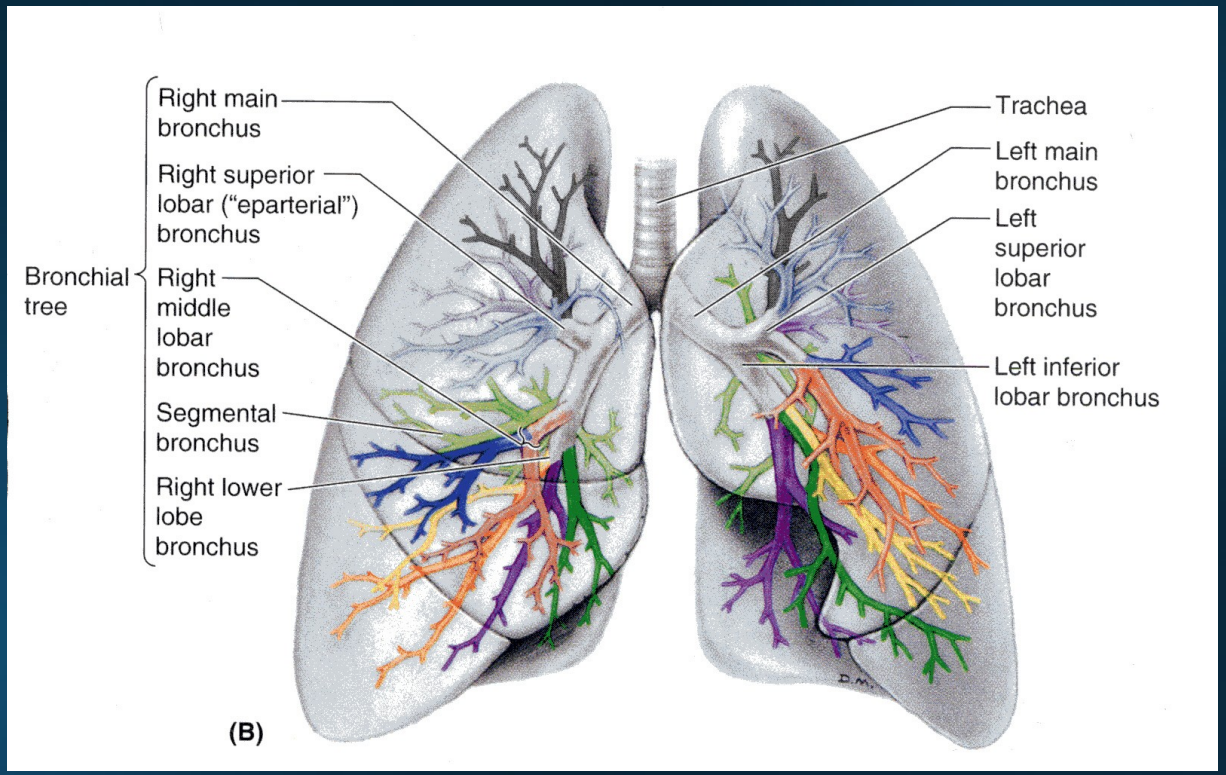
- It is a subdivision of a lung lobe
- It is pyramid shaped, with its apex towards the lung root
- It is surround by connective tissue
- It has its own segmental bronchus, segmental artery, lymph vessels and autonomic nerves
- The segmental vein lies in the connective tissue adjacent to the bronchopulmonary segments
- Lung Lobules



Lung Lobule

- Basic functional unit
- Each Terminal Bronchiole terminates in a Lobule
- Pyramid shaped
- Fibrous Septa

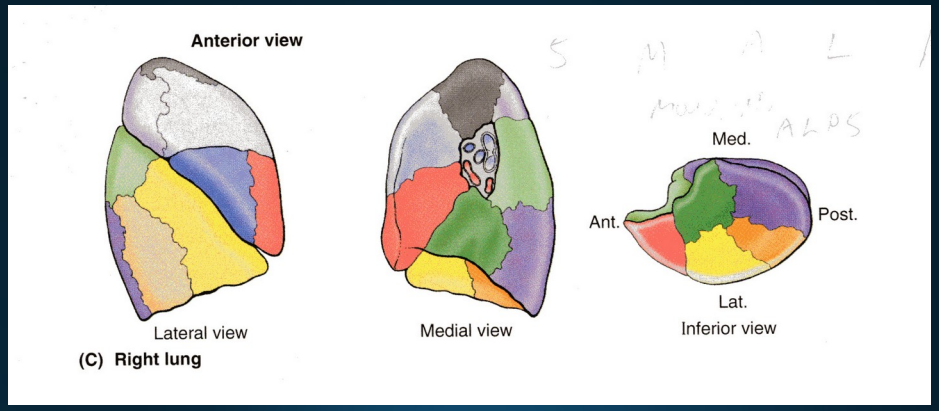


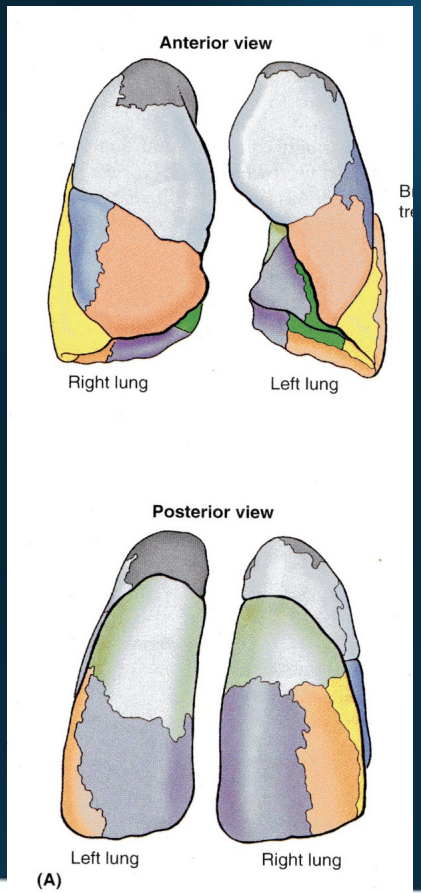

Bronchial tree
Right main bronchus
Right superior lobar ("eparterial") bronchus
Right middle lobar bronchus
Segmental bronchus
Right lower lobe bronchus
Trachea
Left main bronchus
Left superior lobar bronchus
Left inferior lobar bronchus
(B)

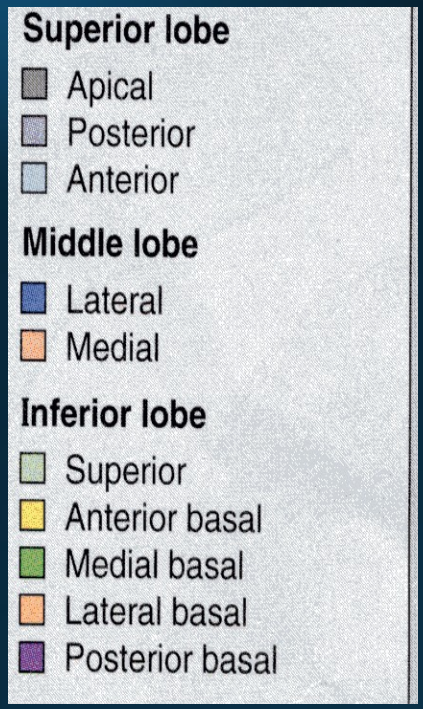
Right lung

- Upper lobe:
  - 1. **A**pical 2. **P**osterior 3. **A**nterior
- Middle lobe:
  - 4. **L**ateral 5. **M**edial
- Lower lobe:
  - 6. **S**uperior 7. **M**edial basal 8. **A**nterior basal 9. **L**ateral basal 10. **P**osterior basal

- **A PALM S**eed **M**akes **A**nother **L**ittle **P**alm

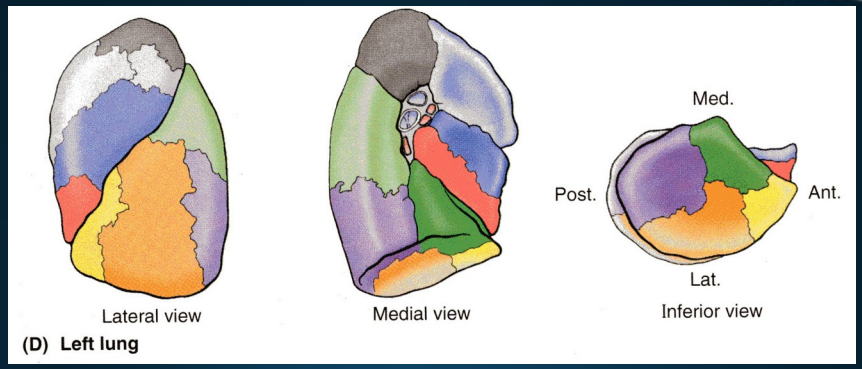


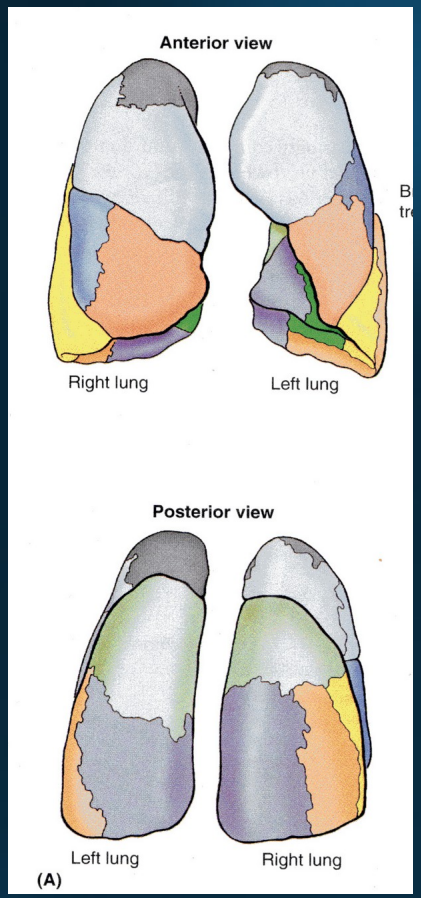


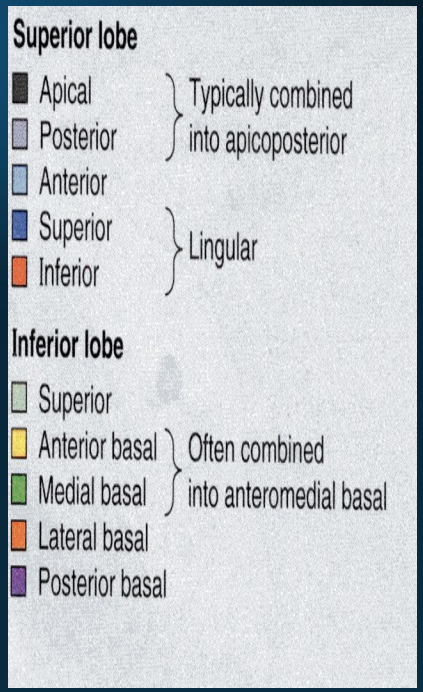


Left Lung

- Upper lobe
  - 1. **A**pical 2. **P**osterior 3. **A**nterior 4. **S**uperior lingular 5. **I**nferior lingular
- Lower Lobe
  - 6. **S**uperior 7. **M**edial Basal 8. **A**nterior basal 9. **L**ateral basal 10. **P**osterior basal







Histology

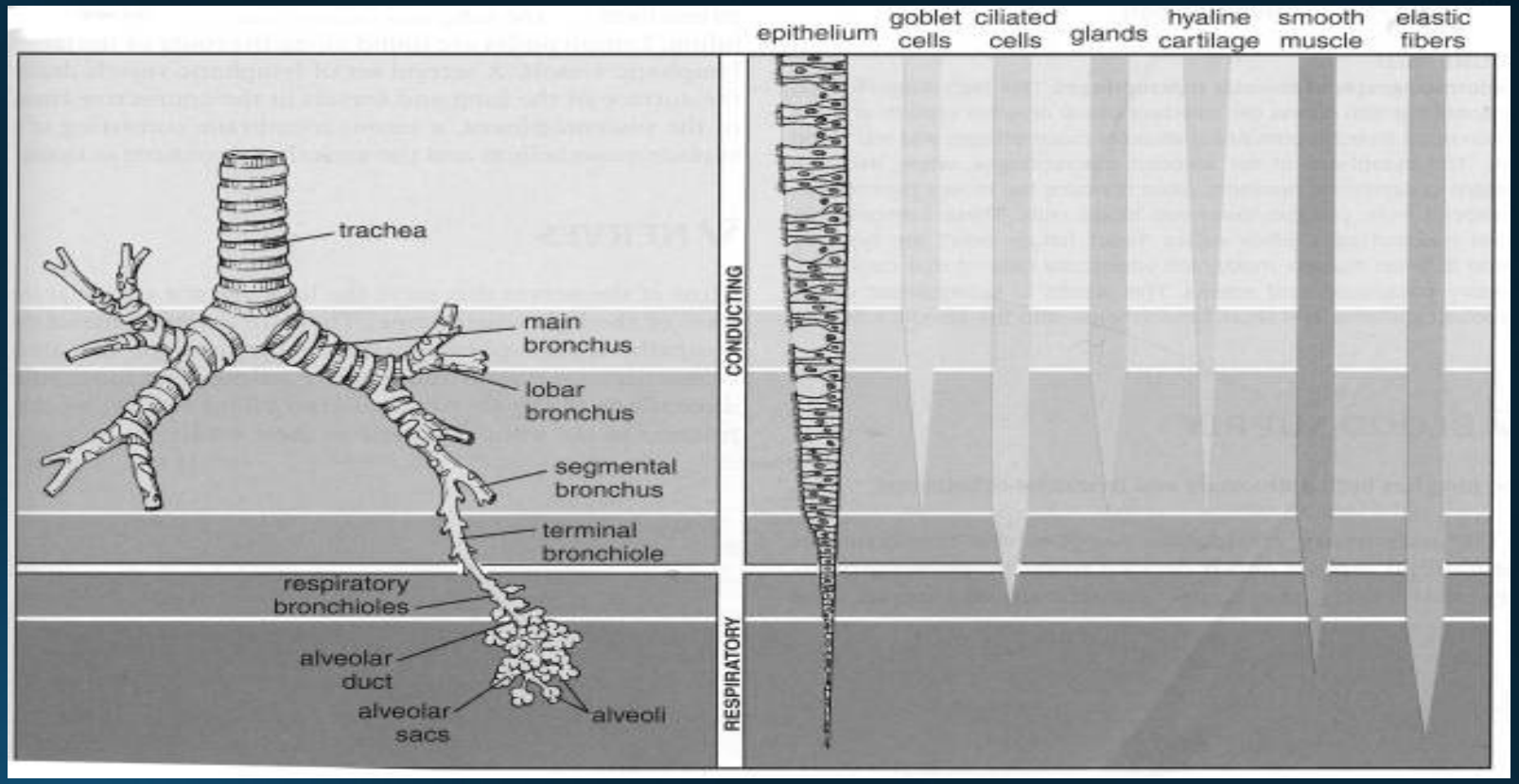
- The respiratory system has 3 parts
- Trachea, lobar and segmental bronchi-histology is almost identical
- Graded variations in the number of different cell types
- Layers
  - Tunica Mucosa
    - Consists of epithelium and lamina propria
    - Seromucous glands
  - Tunica Muscularis-
    - Helically orientated smooth muscle bundles
  - Tunica Fibrocartilaginea
  - Tunica Adventitia
    - Nerve fibres, lymphatic vessels, bronchial arteries and veins

Histology

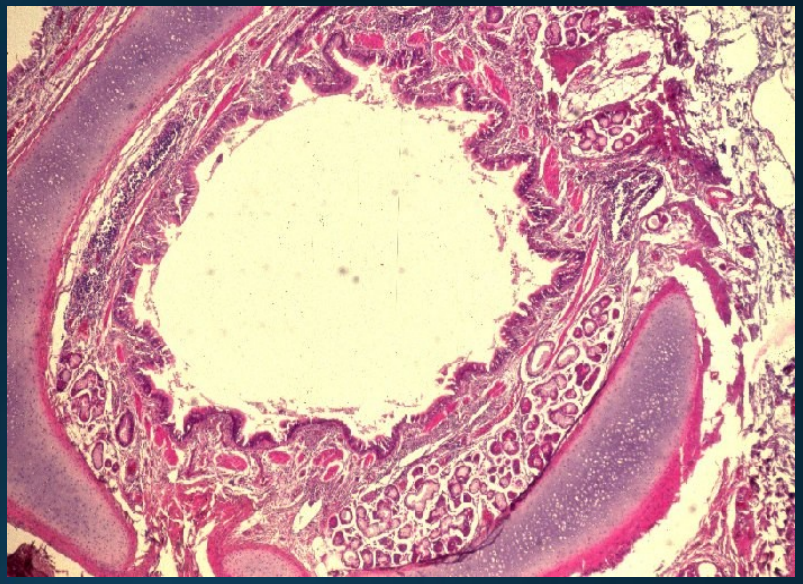
- Mucous Membrane
  - Larger intrapulmonary passages it is pseudostratified and largely ciliated
  - Terminal and respiratory bronchioles there are fewer cilia, and the cells are reduced in height to low columnar or cuboidal
  - Small bronchi and bronchioles is folded into conspicuous longitudinal ridges

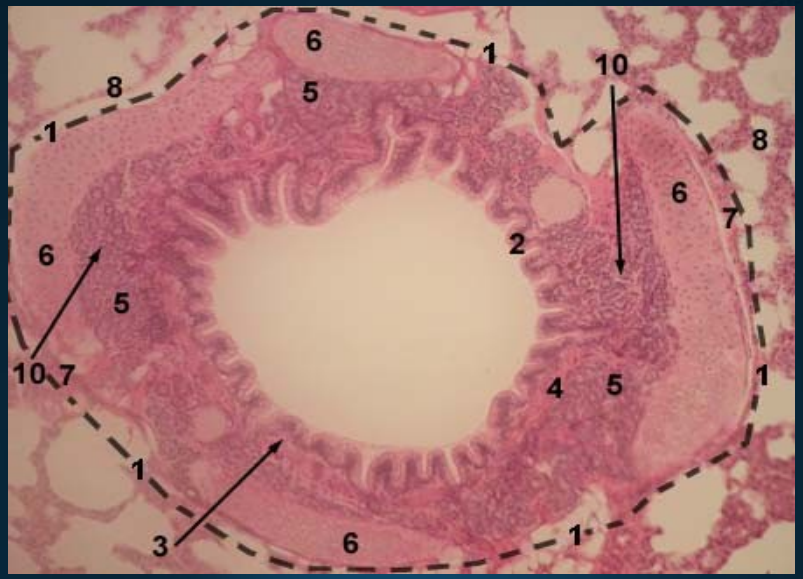
Histology

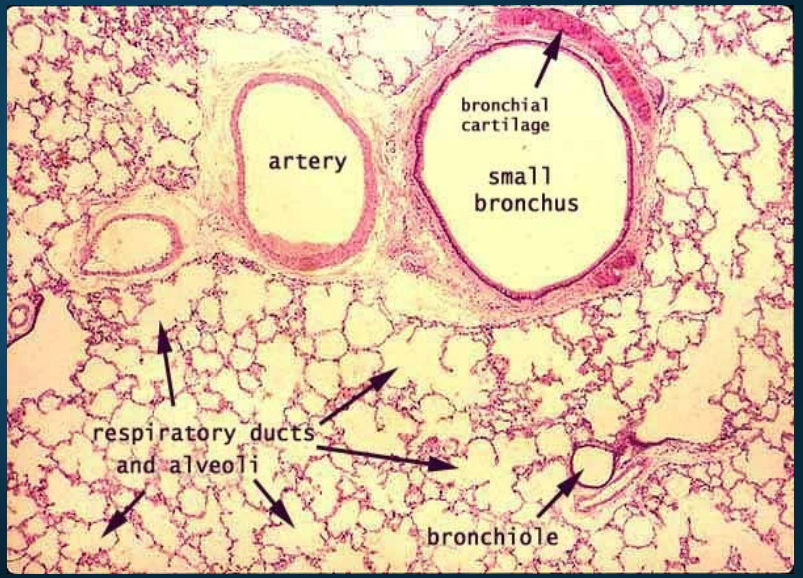
- Cartilage
  - Primary, lobar and segmental
  - Decreases in size with successive branching
  - Form cartilage plates
  - Bound together by fibroelastic connective tissue
  - Bronchioles-smooth muscle
- Exocrine glands and goblet cells



Histological component	Trachea	Bronchus	Bronchiole
Epithelium	Respiratory	Respiratory	Columnar
Elastic tissue	Present as lamina elastica	Longitudinal bands	Fibres only
Cartilage	C-shaped	Plates	None
Glands	Goblet and in submucosa	Goblet and between muscle and cartilage	None
Clara cells	Absent	Absent	Present



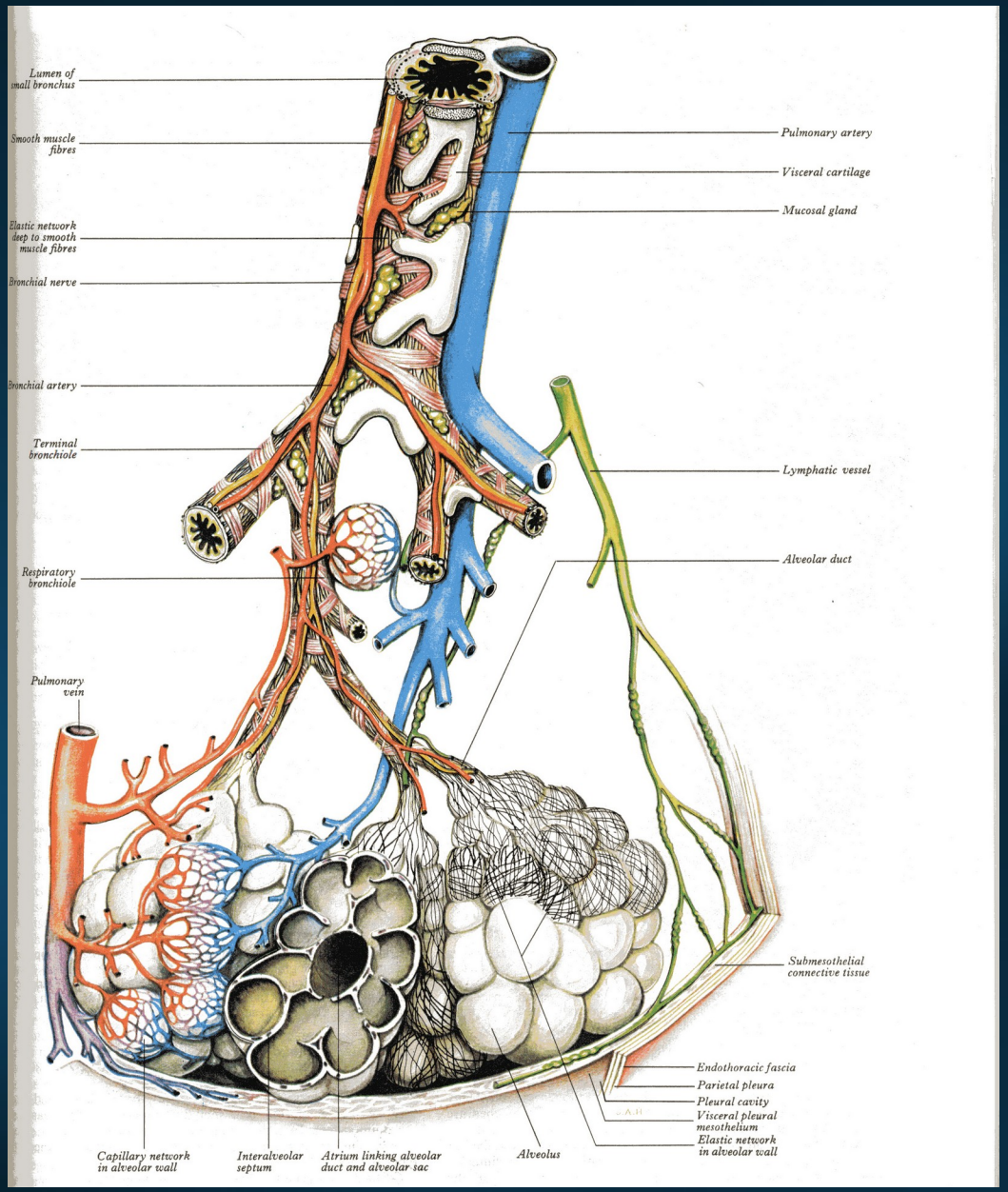

6
1
10
8
5
1
8
6
7
2
6
5
10
7
4
5
1
1
3
6
1


bronchial cartilage
artery
small bronchus
respiratory ducts and alveoli
bronchiole


Lung H&E
smooth muscle
bronchiole
connective tissue

Blood Supply

- Two functionally distinct circulations
- Pulmonary Vessels
- Bronchial Vessels
- Pulmonary arteries bifurcate with the bronchial tree
- End in dense capillary networks
- Pulmonary veins are independent
- A bronchopulmonary segment is NOT a complete vascular unit


Lumen of small bronchus
Smooth muscle fibres
Elastic network deep to smooth muscle fibres
Bronchial nerve
Bronchial artery
Terminal bronchiole
Respiratory bronchiole
Pulmonary vein
Pulmonary artery
Visceral cartilage
Mucosal gland
Lymphatic vessel
Alveolar duct
Submesothelial connective tissue
Endothoracic fascia
Parietal pleura
Pleural cavity
Visceral pleural mesothelium
Elastic network in alveolar wall
Capillary network in alveolar wall
Interalveolar septum
Atrium linking alveolar duct and alveolar sac
Alveolus

Blood Supply

- Right pulmonary artery
  - Divides into 2 branches
  - Superior branch
    - upper lobe
  - Inferior branch
    - recurrent branch-upper lobe
    - Middle lobe
    - Inferior lobe
- Left Pulmonary artery
  - Variable
  - 1st branch-anterior segment of upper lobe
  - Branch to superior segment of lower lobe
  - Lingular branches

Blood Supply

- Veins of the Right lung
  - Superior Right Pulmonary vein
    - Upper Lobe
    - Apical, anterior and posterior veins
    - Middle lobar vein
  - Inferior Right Pulmonary vein
    - Hilar, apical and common basal veins-lower lobe
- Veins of the Left lung
  - Superior Left Pulmonary vein
    - Apical, posterior, anterior, lingular veins-upper lobe
  - Inferior Left Pulmonary vain
    - Superior and common basal veins-lower lobe

Blood Supply

- Bronchiole arteries
  - Derived from descending thoracic aorta directly or indirectly
  - Right-branch of 3rd posterior intercostal artery
  - x2 Left- thoracic aorta
  - Supply bronchial glands and walls
  - Capillary plexus in the muscular tunica
  - Only go as far as respiratory bronchioles

Bronchial Veins

- Two distinct systems
- Deep Bronchial veins
  - Commence as Intrapulmonary bronchiolar plexuses
  - Communicate with pulmonary veins
  - End in main pulmonary vein or left atrium
- Superficial Bronchial veins
  - Drain extrapulmonary bronchi, visceral pleura, hilar lymph nodes
  - Communicate with pulmonary veins
  - End on the right in the azygos vein
  - End on the left in the left superior intercostal or the accessory hemiazygous veins

Nervous supply

- Anterior and posterior pulmonary plexuses
- Formed by sympathetic and vagal branches
- Rami accompany bronchi
- Bronchoconstrictors are supplied by the Vagus
- Sympathetic supply-relaxes
- Bronchodilation stimulus-pressure of inspired air