THE HEART AND LUNGS

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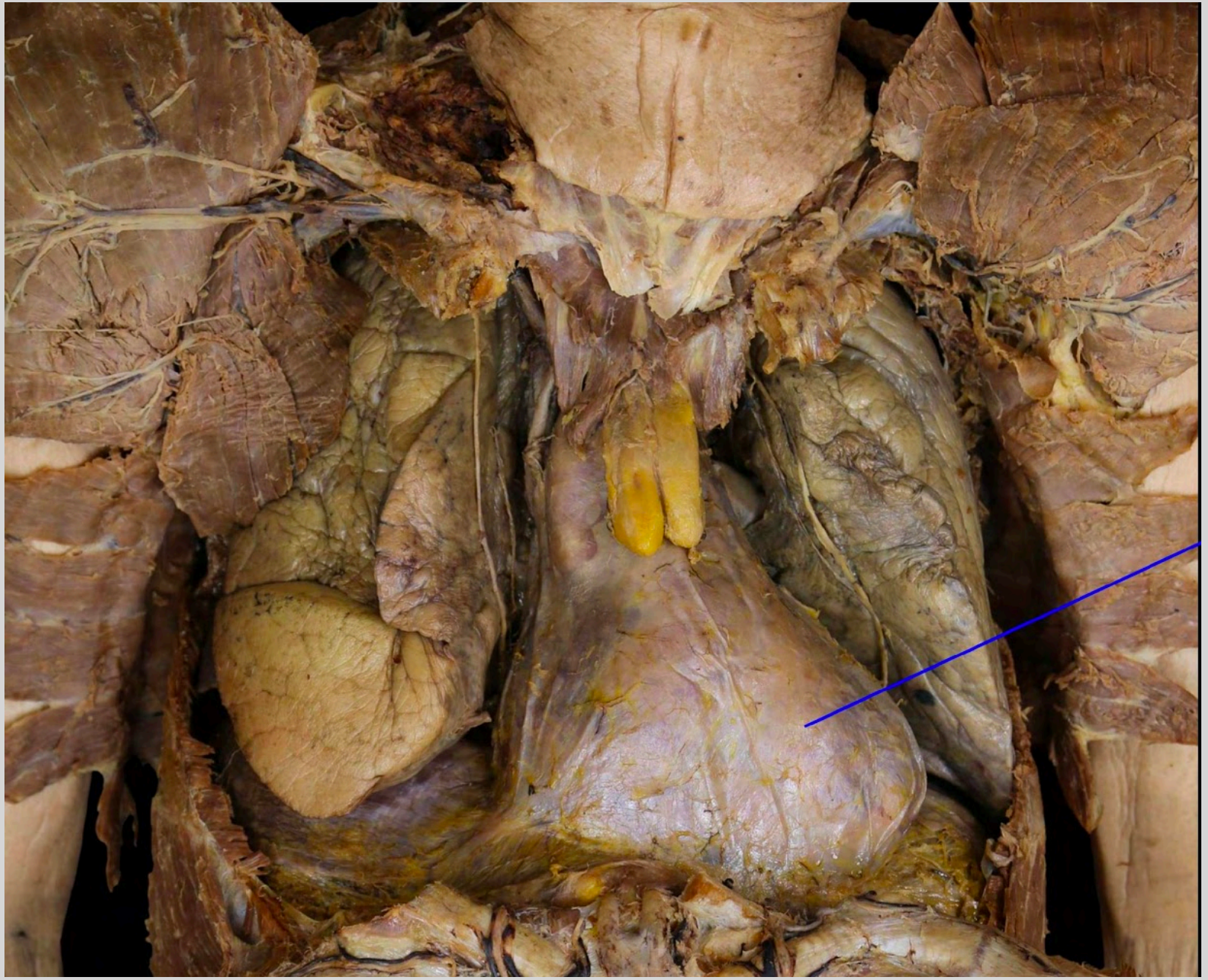


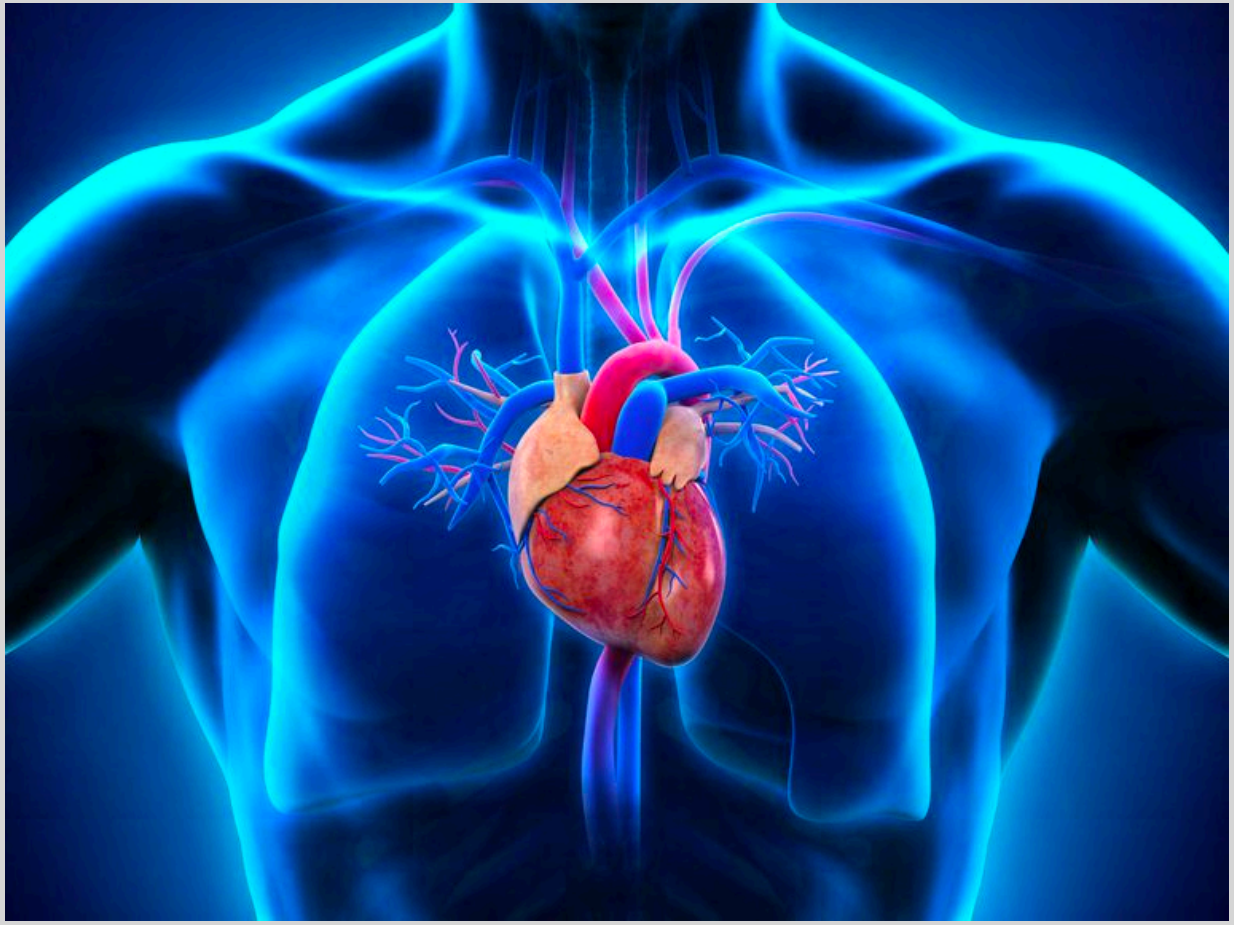
OBJECTIVES

- Provide an introduction to cardiothoracic anatomy and physiology
- Provide an insight into common surgical diseases

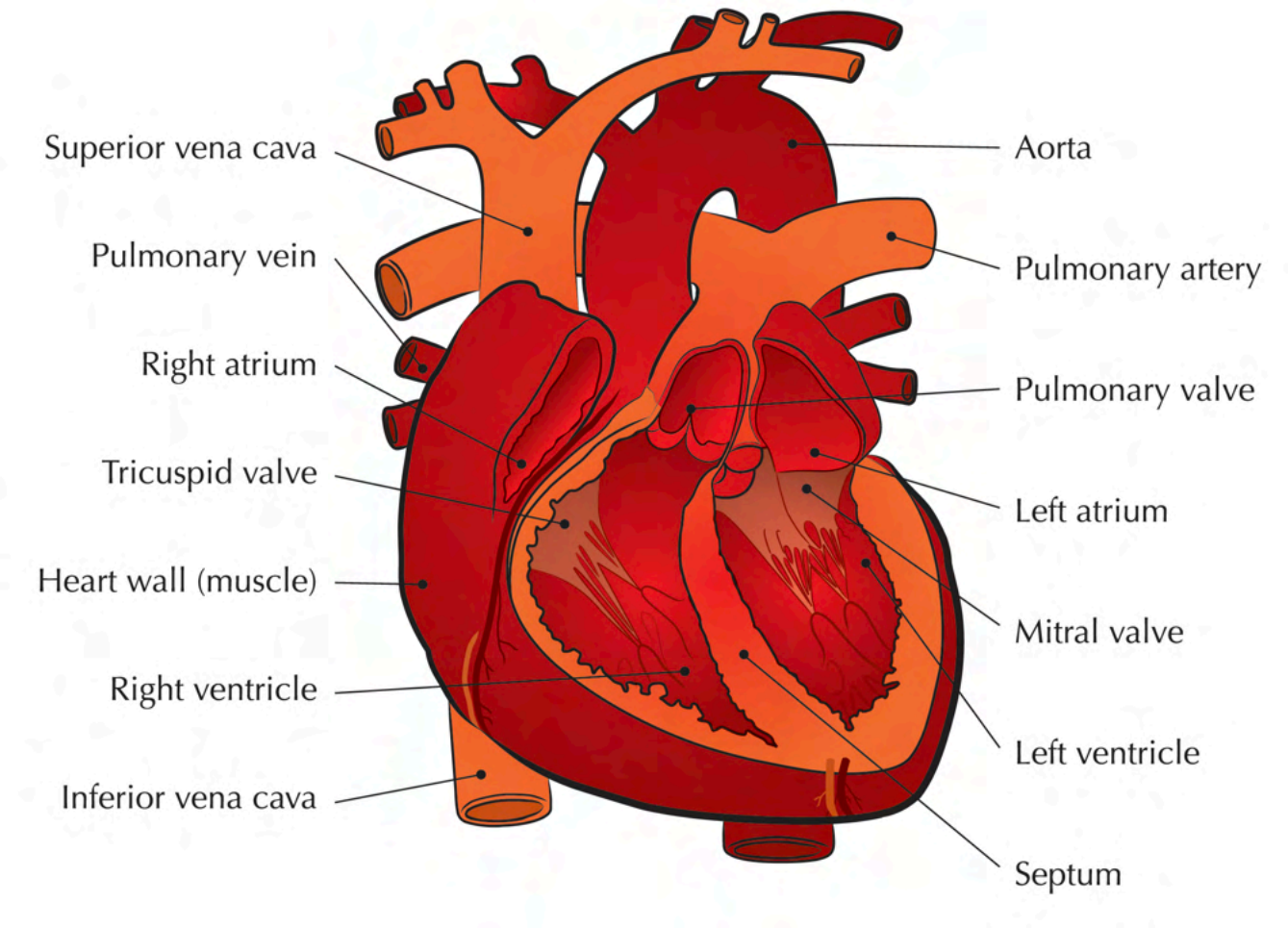
THE HEART

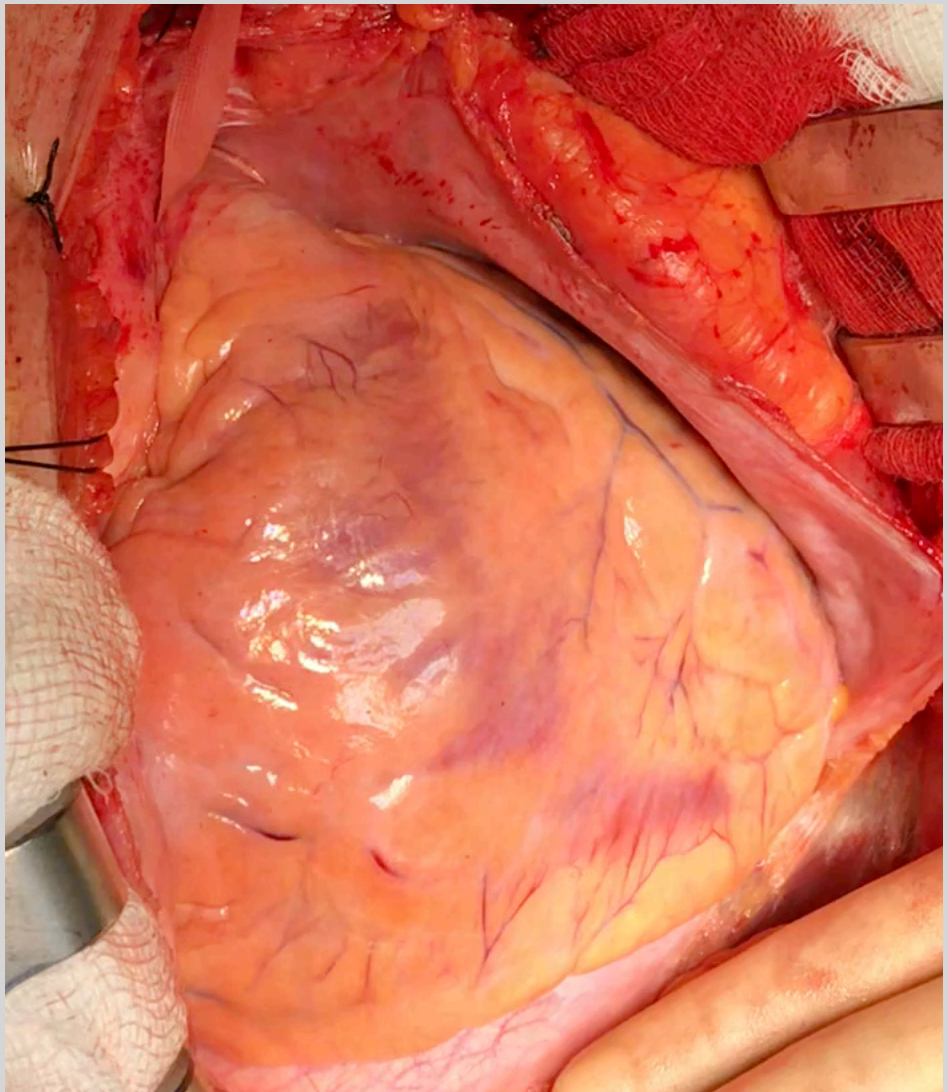
FUNCTION OF THE HEART

- Right heart → pumps blood to the lungs
- Left heart → pumps blood to the body
- Functions of the blood
  - Deliver oxygen and nutrients to the cells
  - Remove metabolic wastes and carbon dioxide
  - Immune system
  - Endocrine system
  - Coagulation system

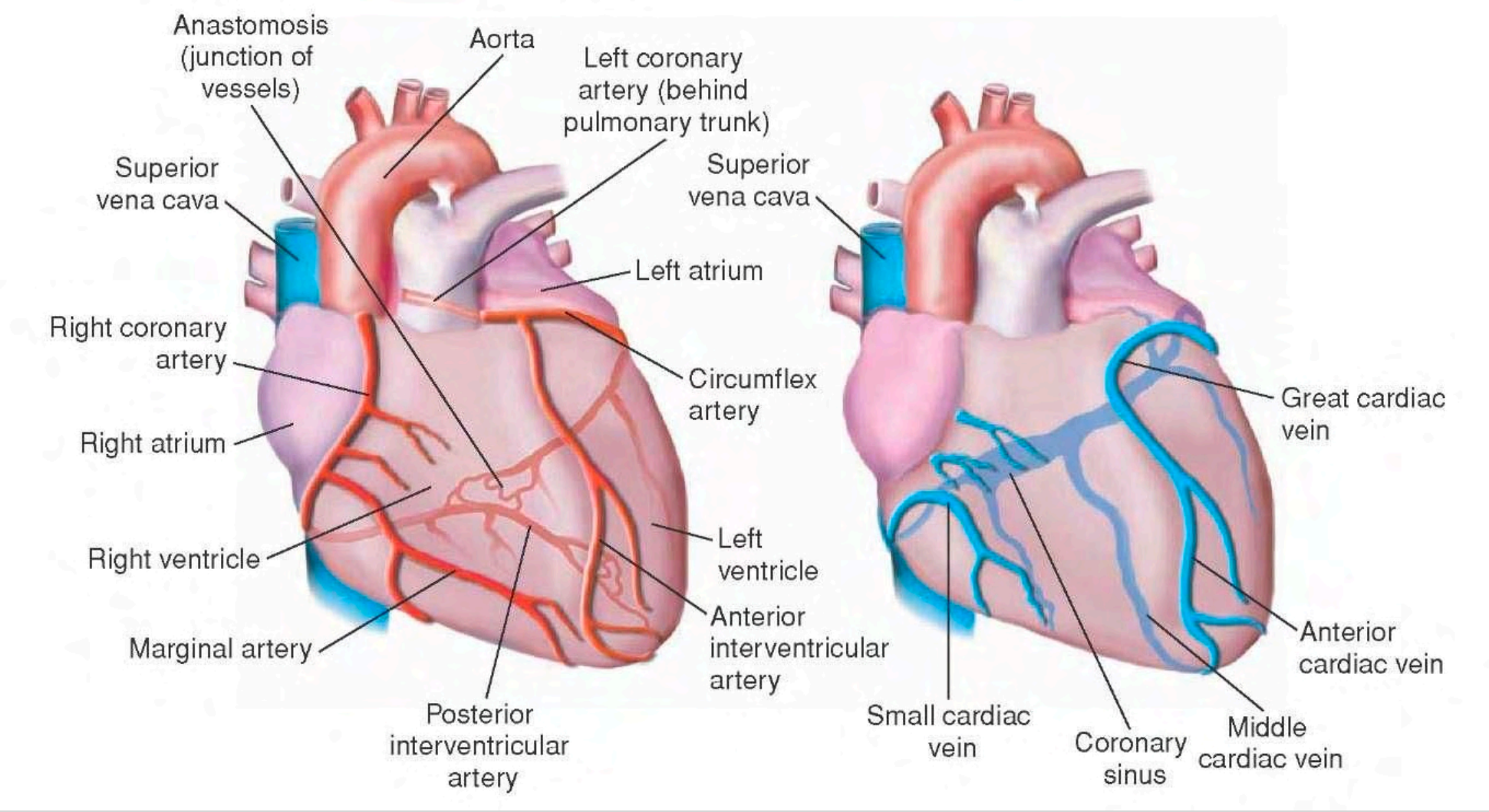


HEART STRUCTURE



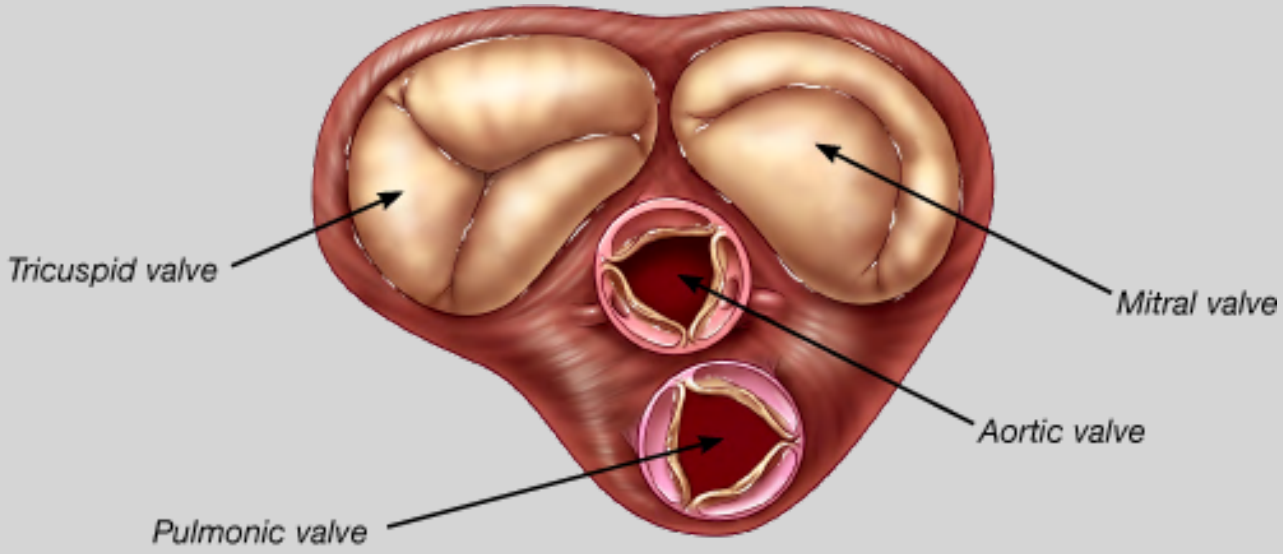


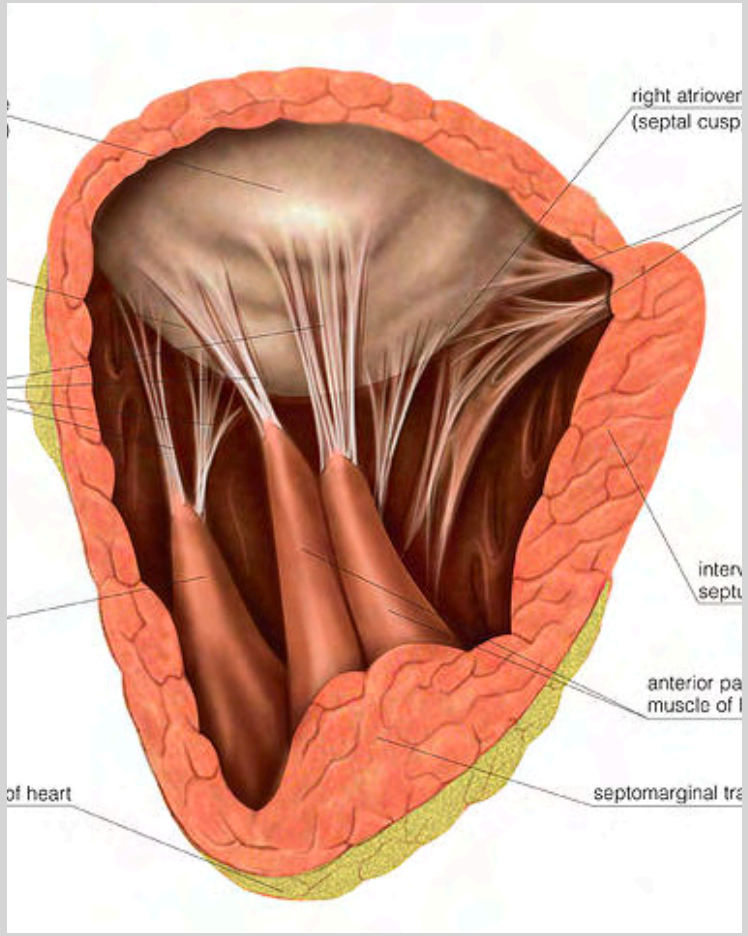
CORONARY CIRCULATION



HEART VALVES

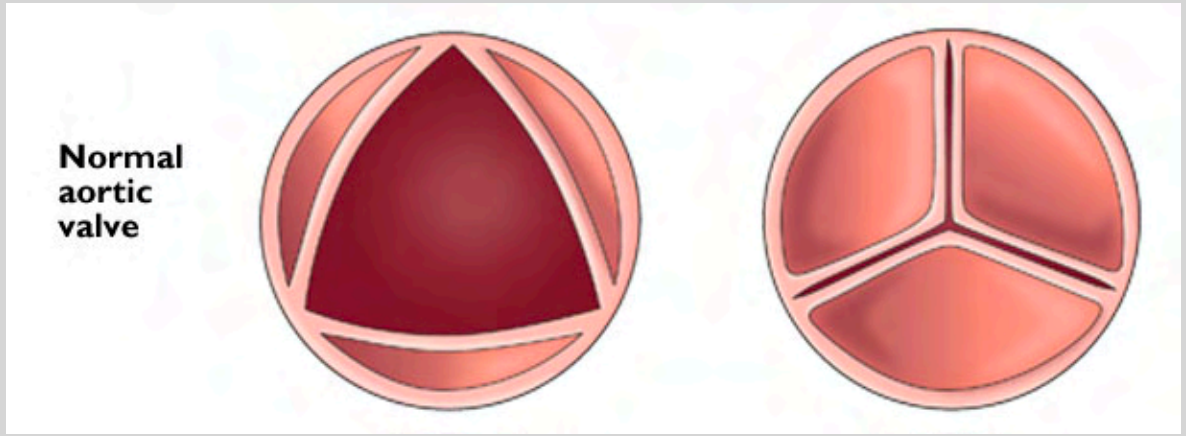
- Atrioventricular valves – Mitral and Tricuspid
  - Papillary muscles and chordae tendinae prevent leaflet prolapse

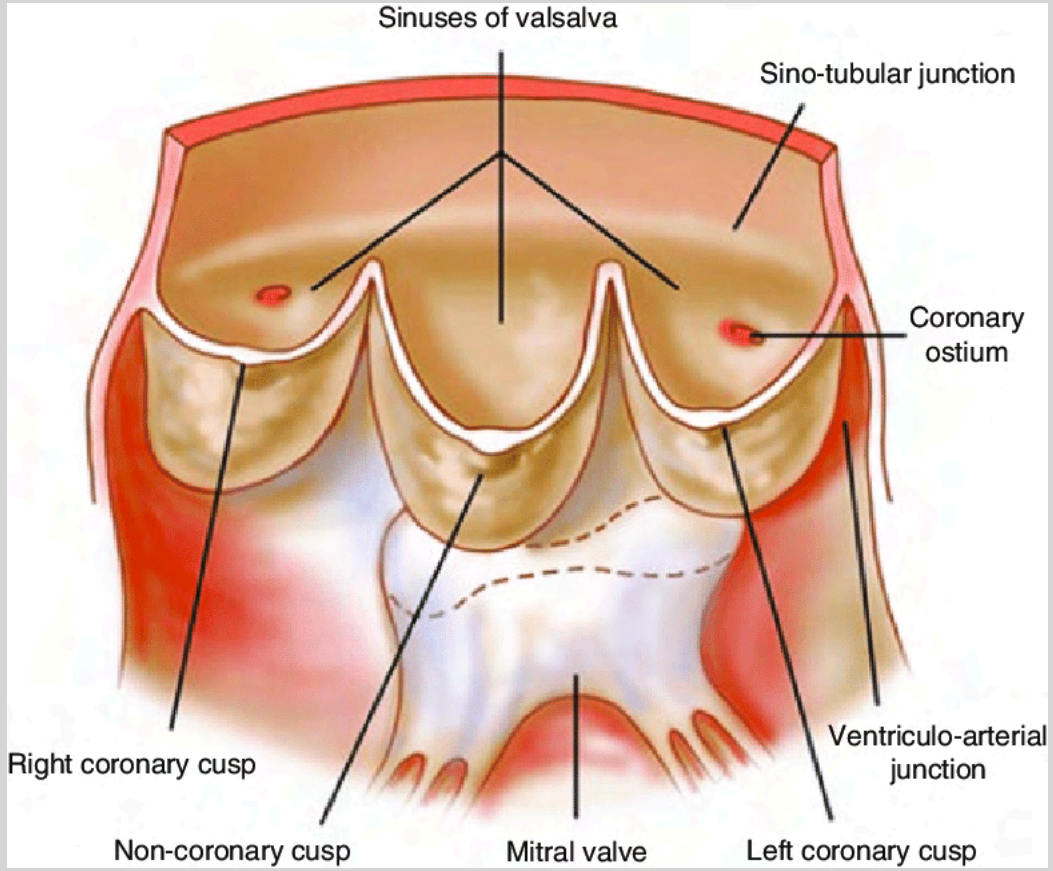




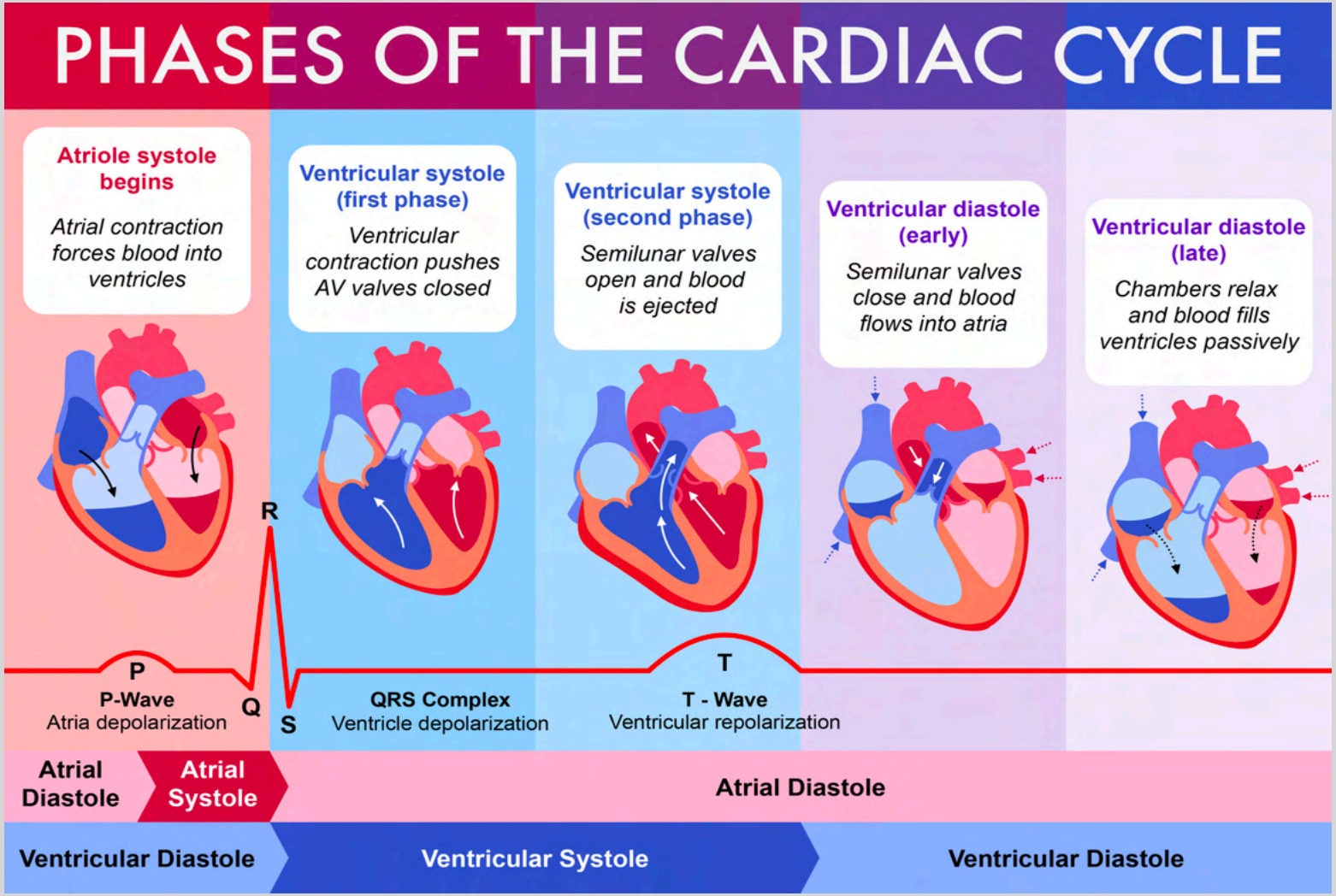
HEART VALVES

- Pulmonary artery and aortic valves are semilunar
  - Embedded in the artery wall
  - Significant pressure differences

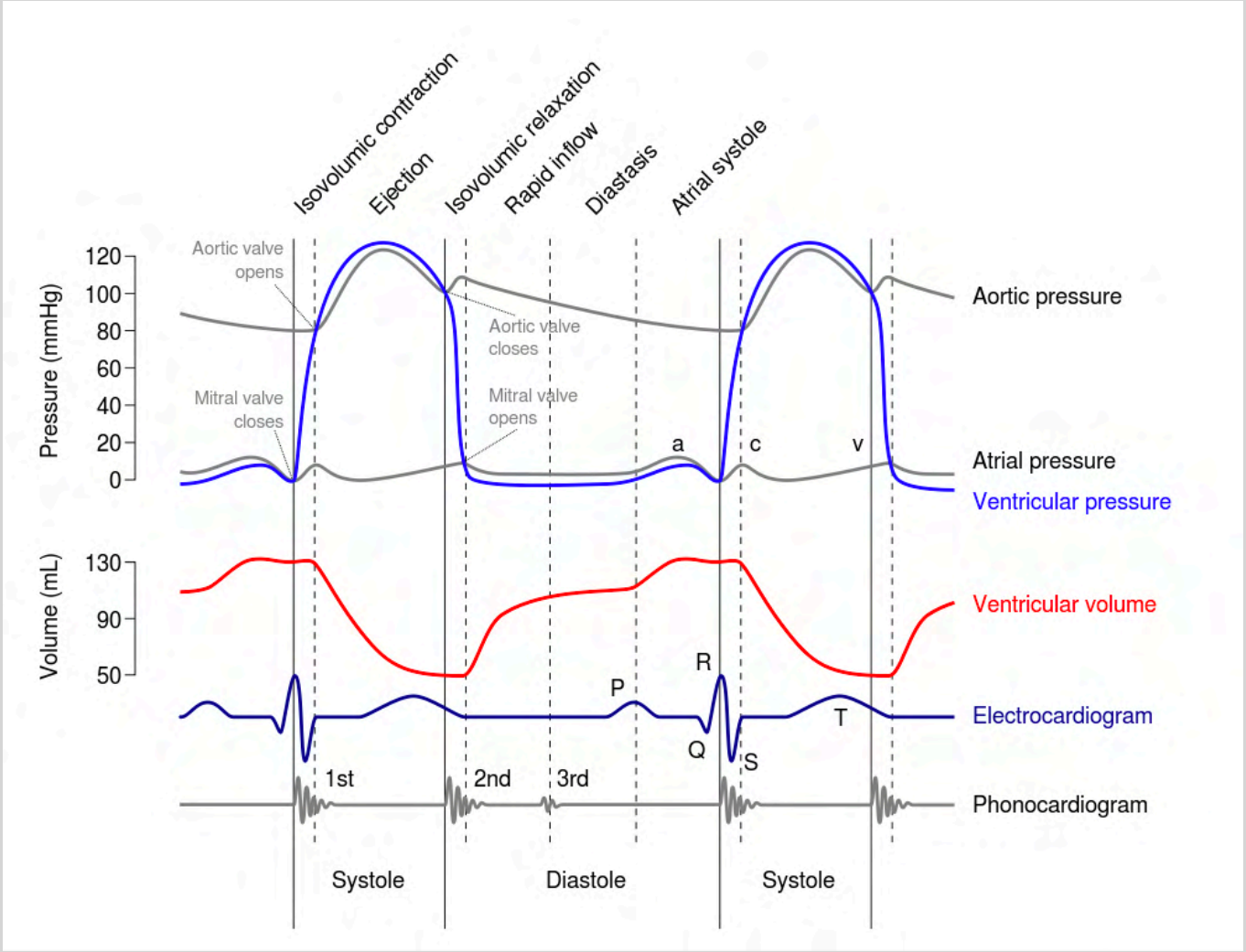




CARDIAC CYCLE

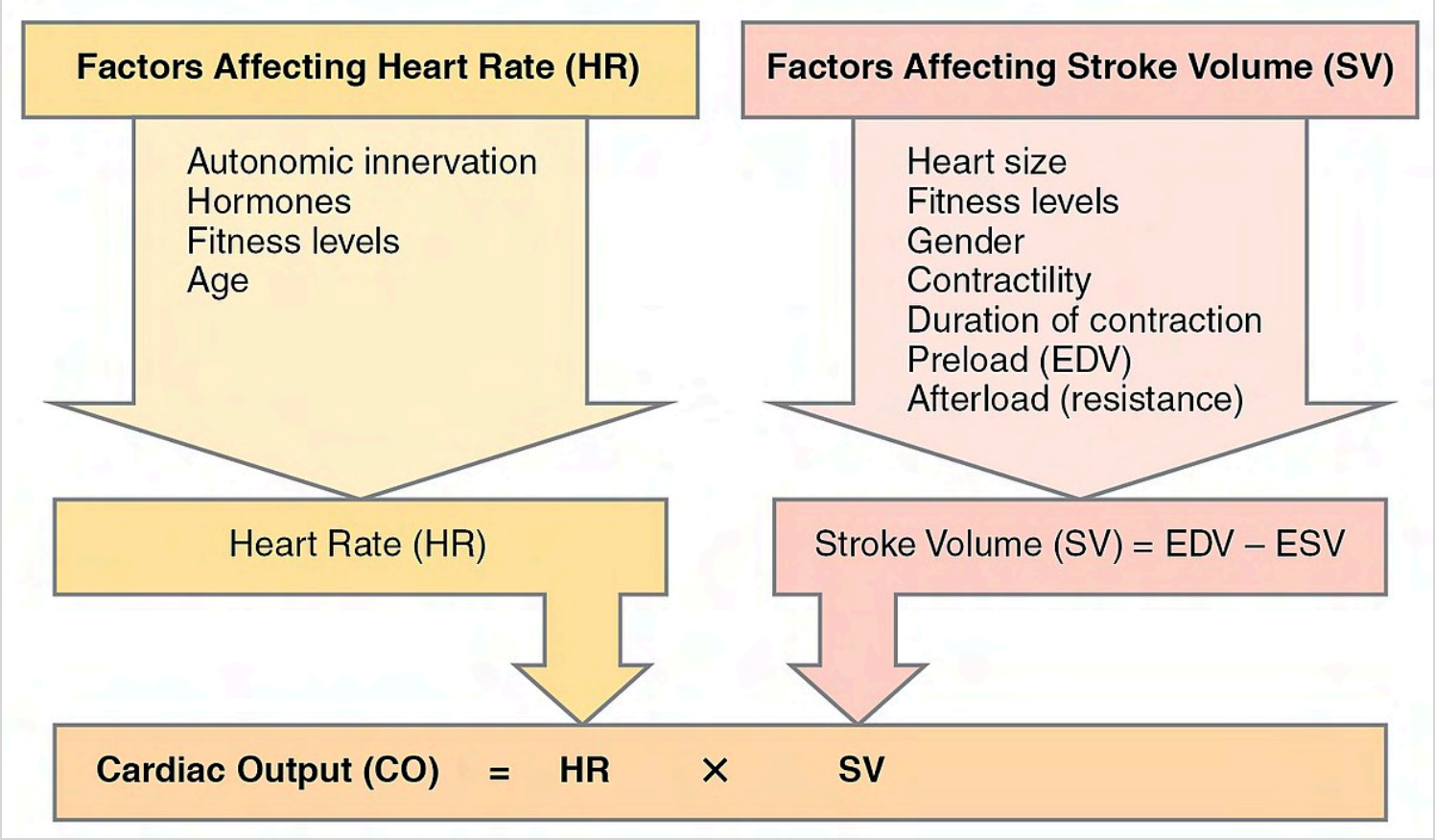


CARDIAC CYCLE



CARDIAC OUTPUT

- Cardiac output = the amount of blood pumped by the ventricle per minute = Heart rate x Stroke volume



HEART RATE

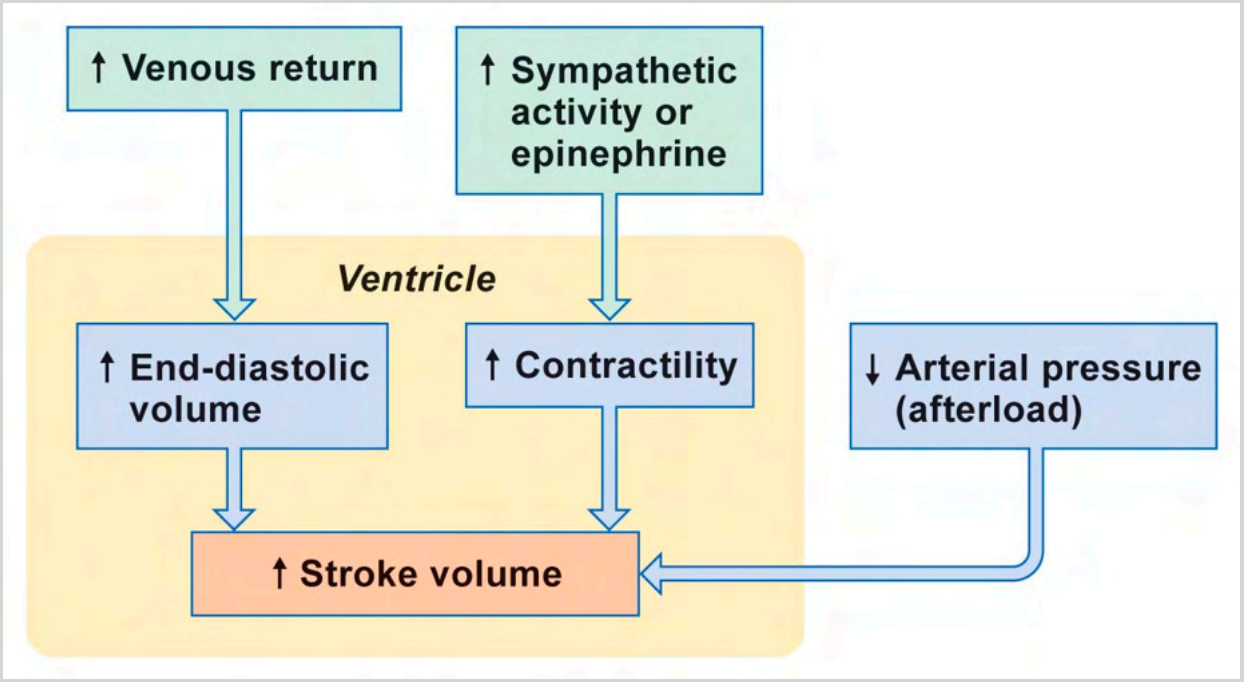
- Autonomic innervation
  - Sympathetic system → increases heart rate
  - Parasympathetic system → decreases heart rate

- Chemoreceptors → CO_2 elevation leads to increased heart rate
- Hormones → Thyroid hormone increases heart rate

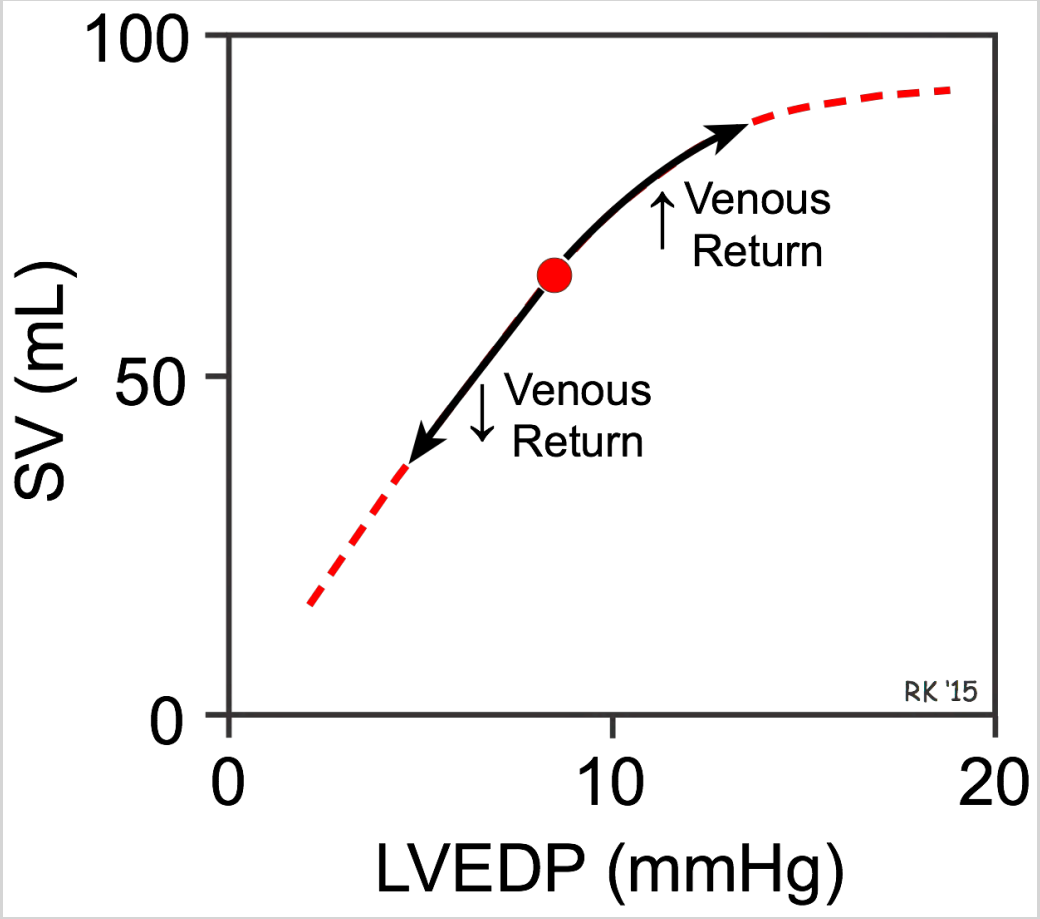
STROKE VOLUME

- Stroke volume = End diastolic volume – End systolic volume

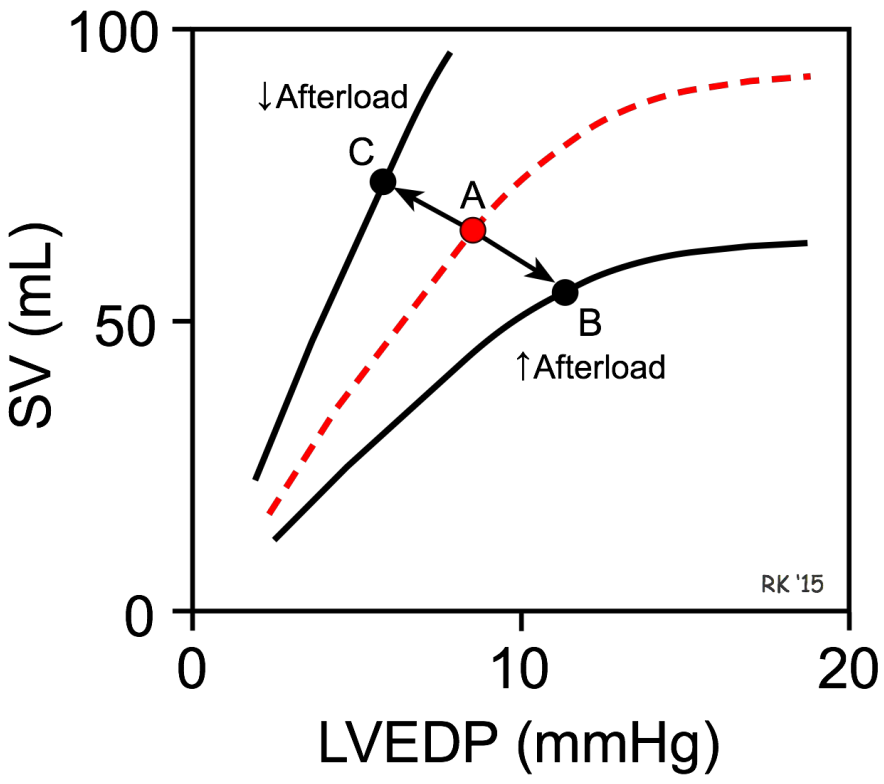
- Dependent on three variables:
  - **Preload** – how much blood is returning to the heart
  - **Myocardial contractility** – strength of myocardial contraction
  - **Afterload** – resistance against which the heart needs to pump

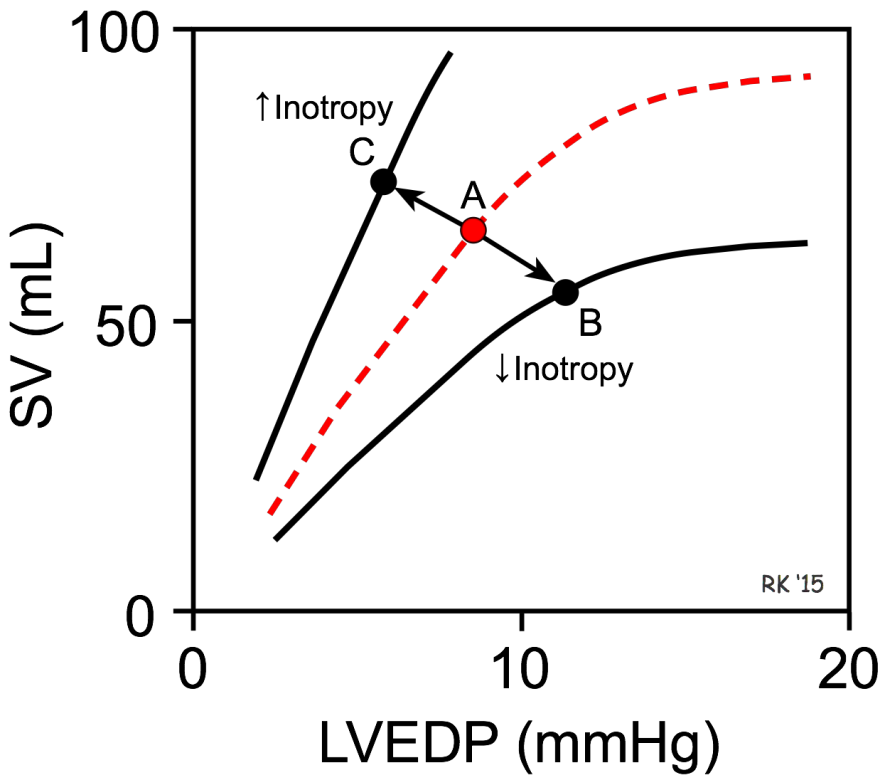


PRELOAD: STARLING LAW



AFTERLOAD AND CONTRACTILITY



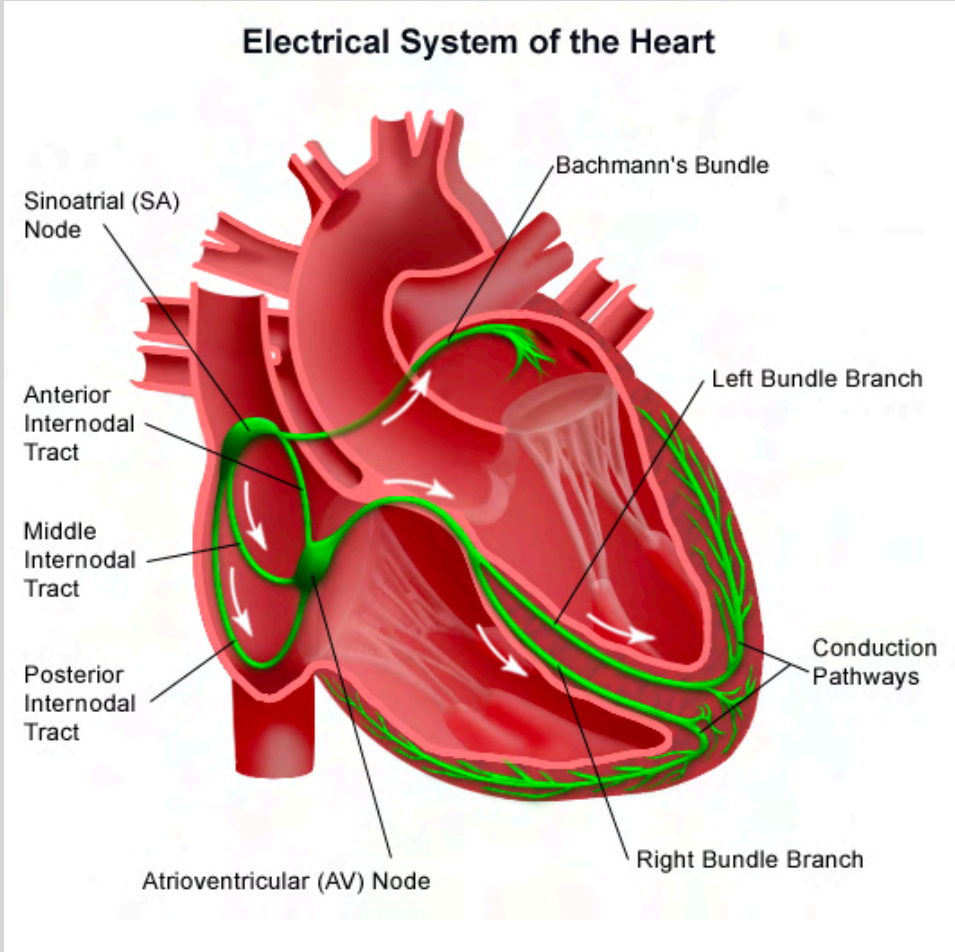


CONDUCTION SYSTEM

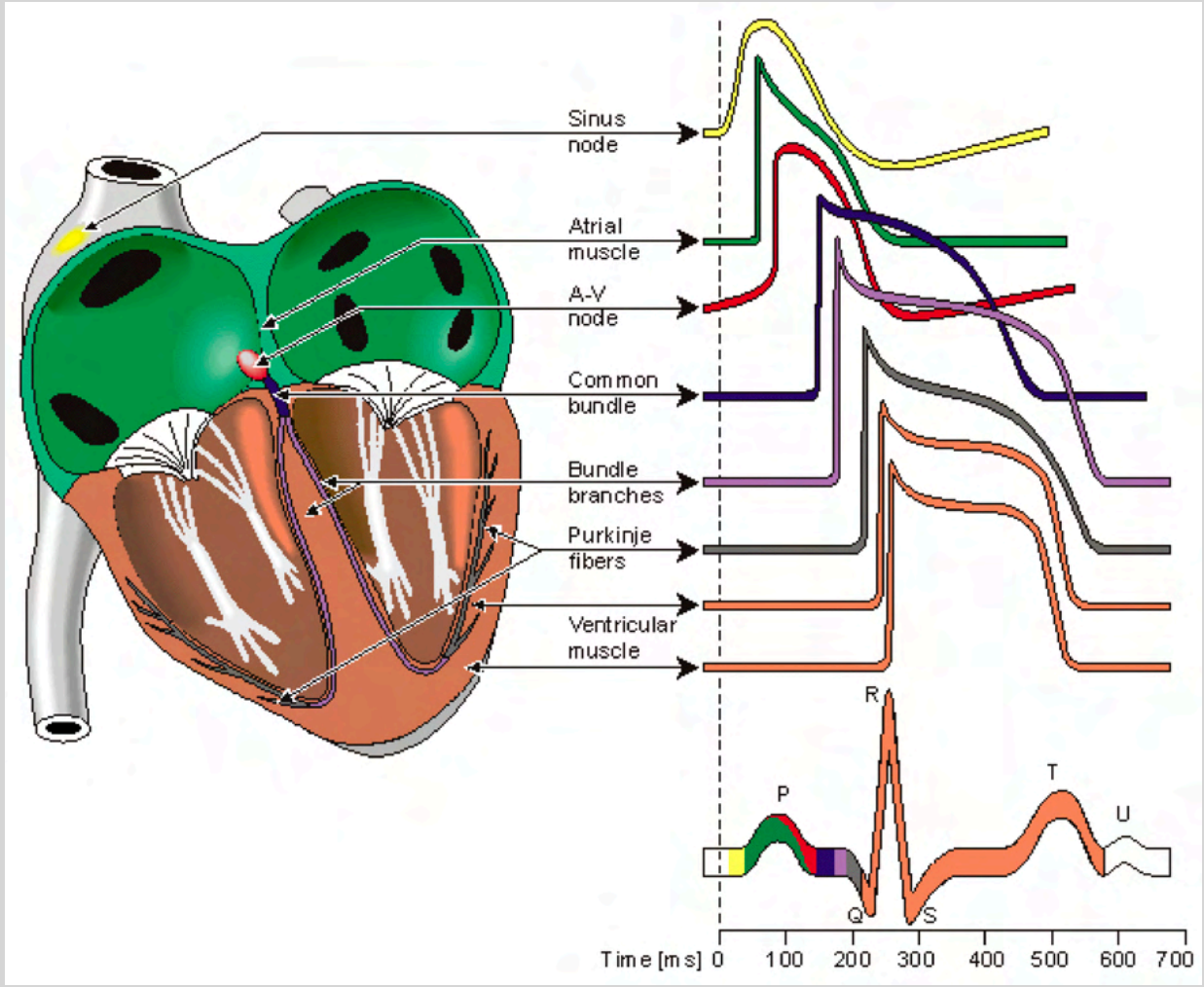
- Conducting tissue can generate action potentials independently

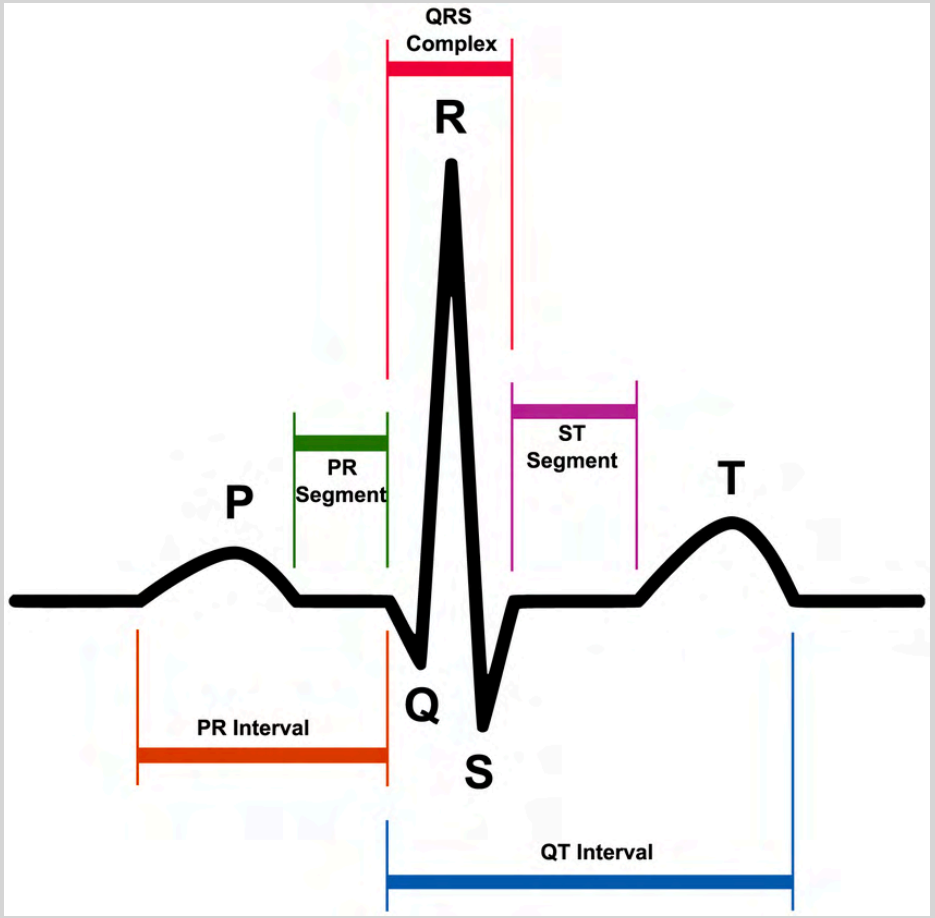
- **Sinoatrial node** – natural pacemaker
- **Atrioventricular node**
- **Bundle of His**
- **Purkinje fibres**

- A fibrous skeleton insulates atria from the ventricles



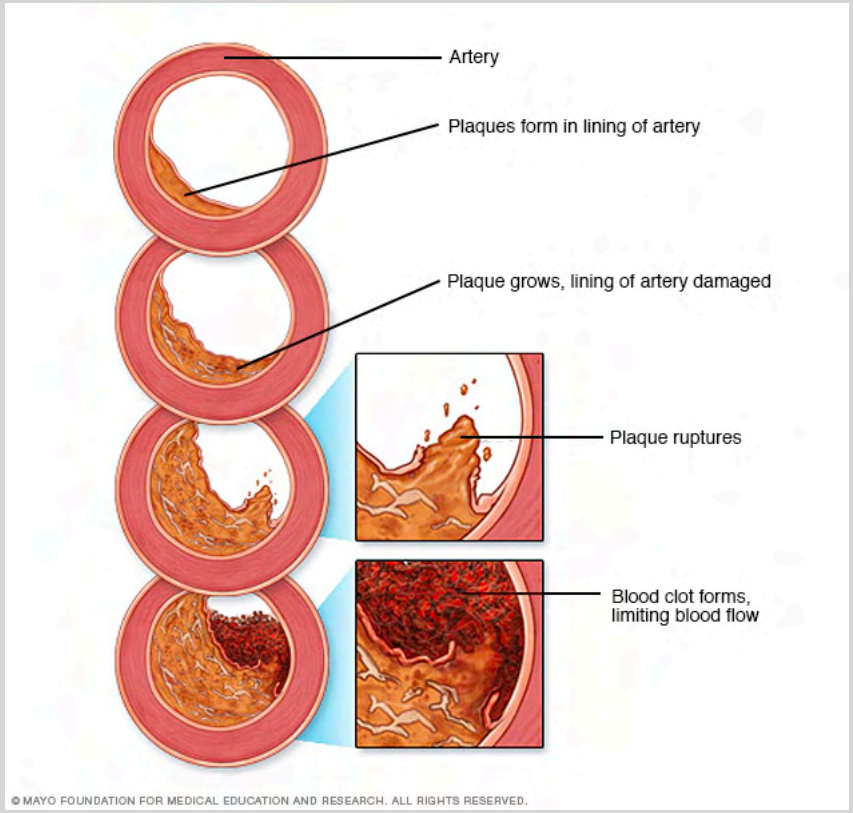
ELECTROCARDIOGRAM

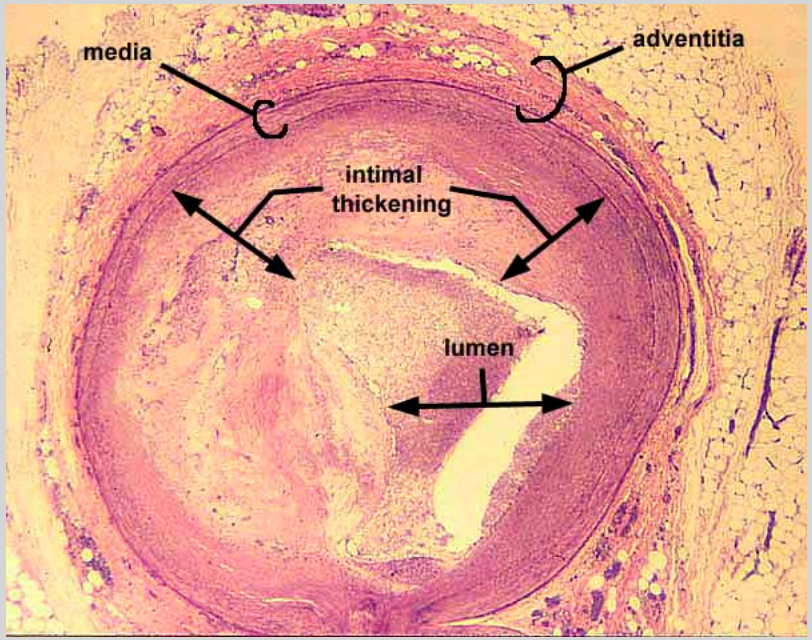


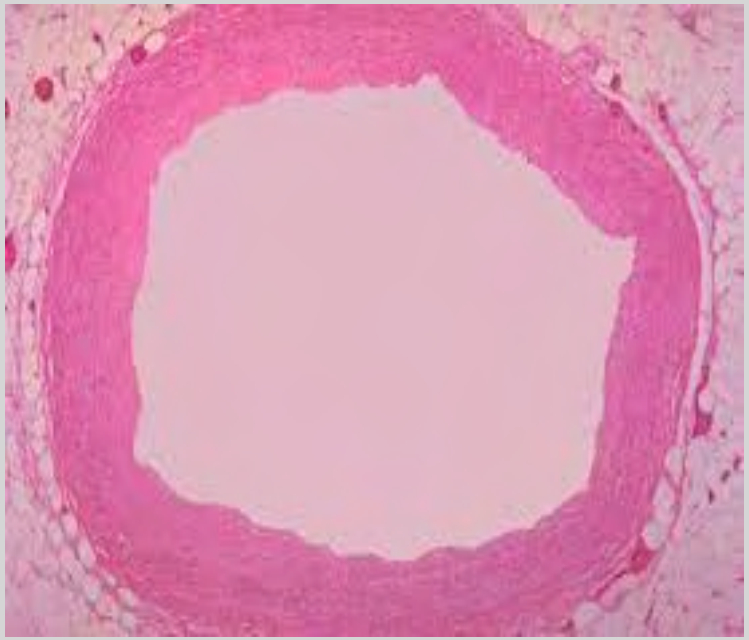


SURGICAL CARDIAC DISEASE

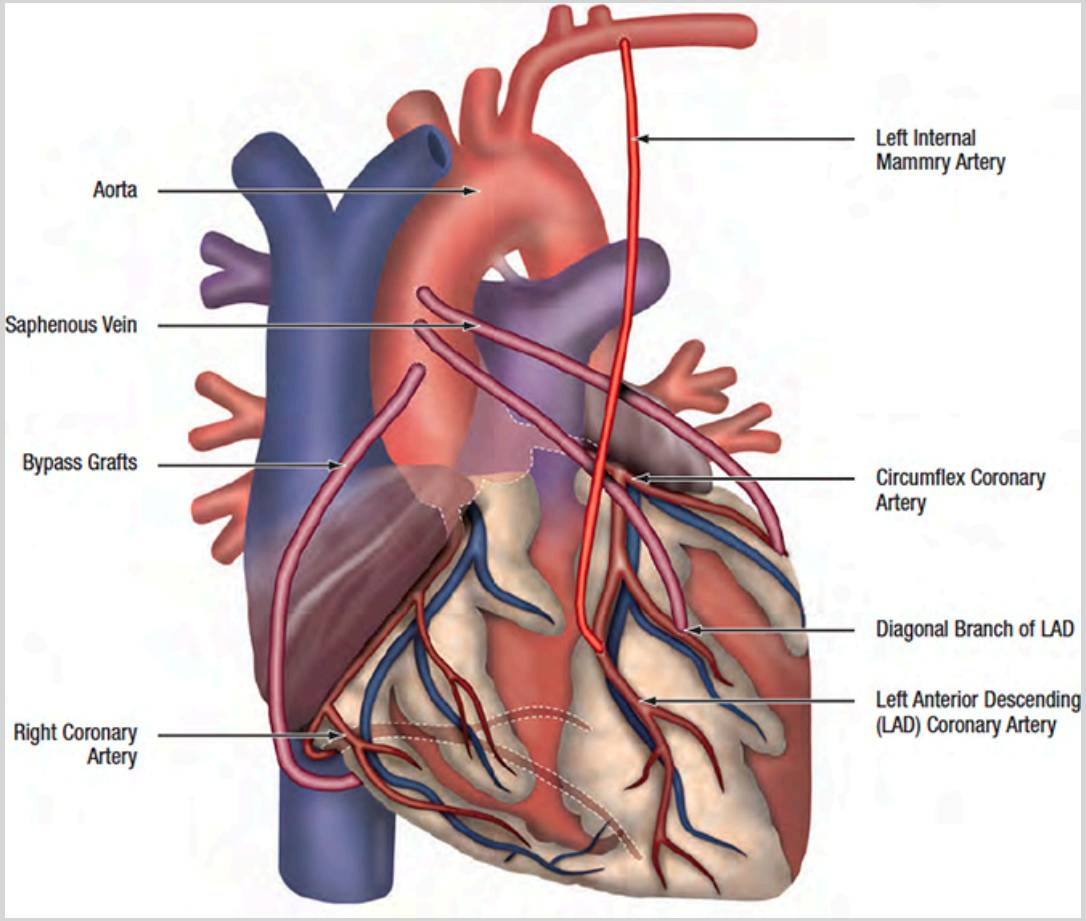
Coronary artery disease: atherosclerosis

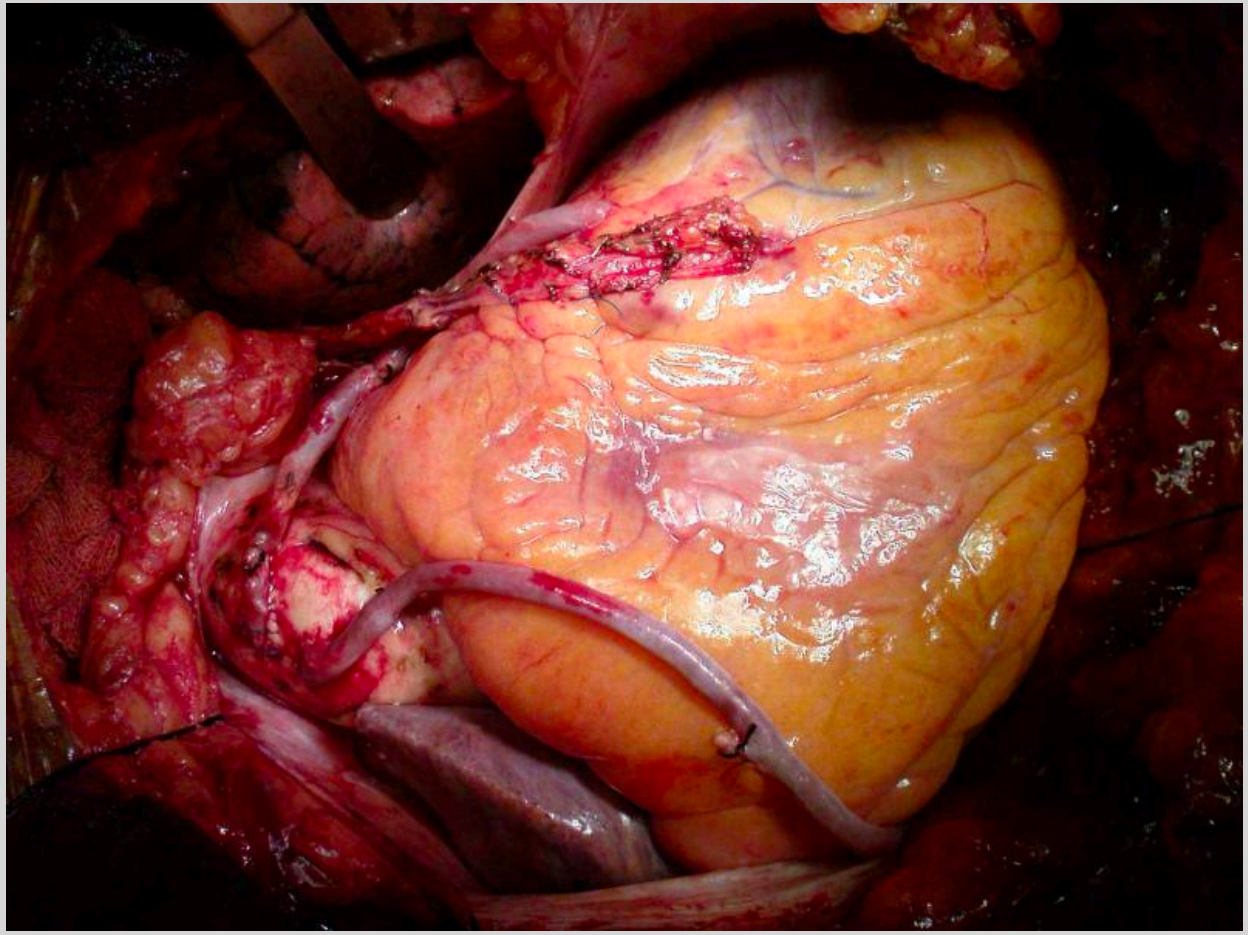




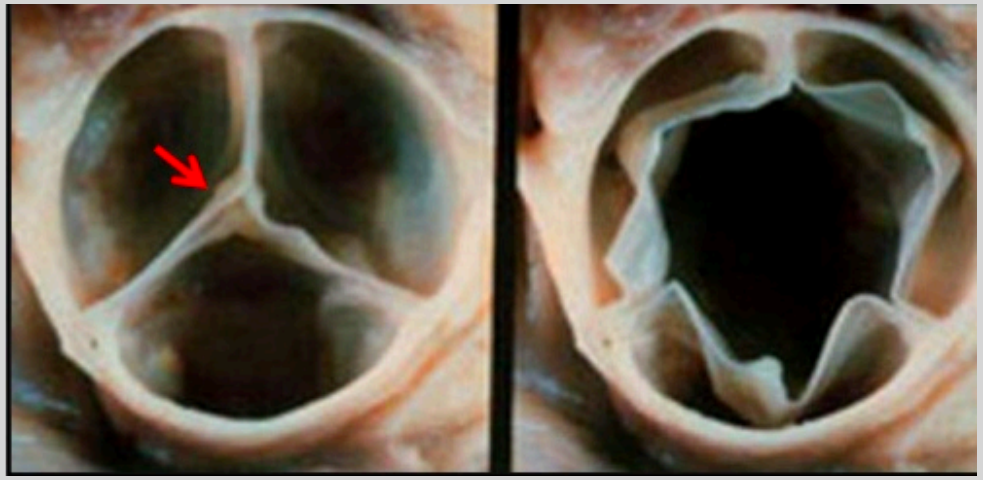


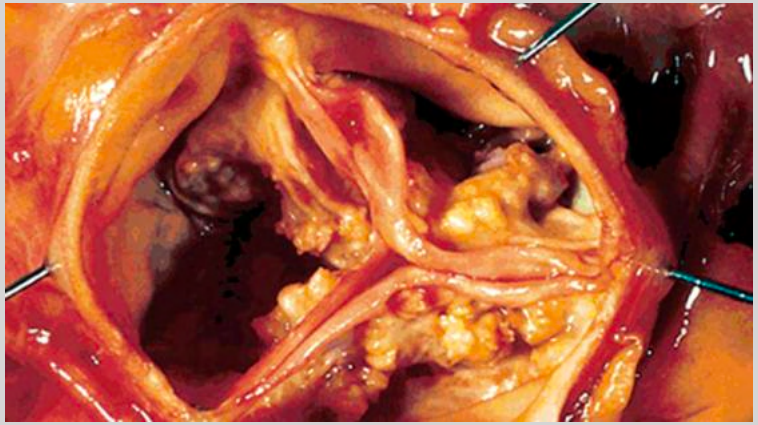
CORONARY ARTERY BYPASS GRAFTING

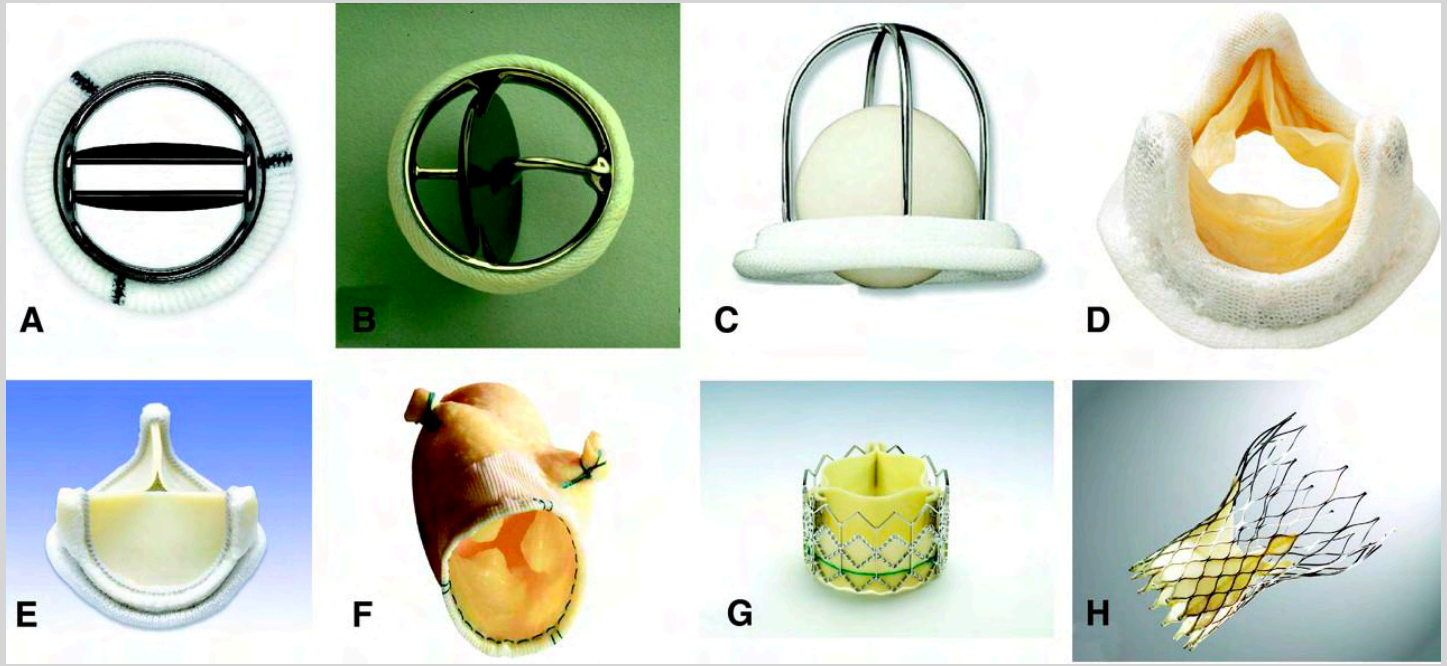




AORTIC VALVE STENOSIS







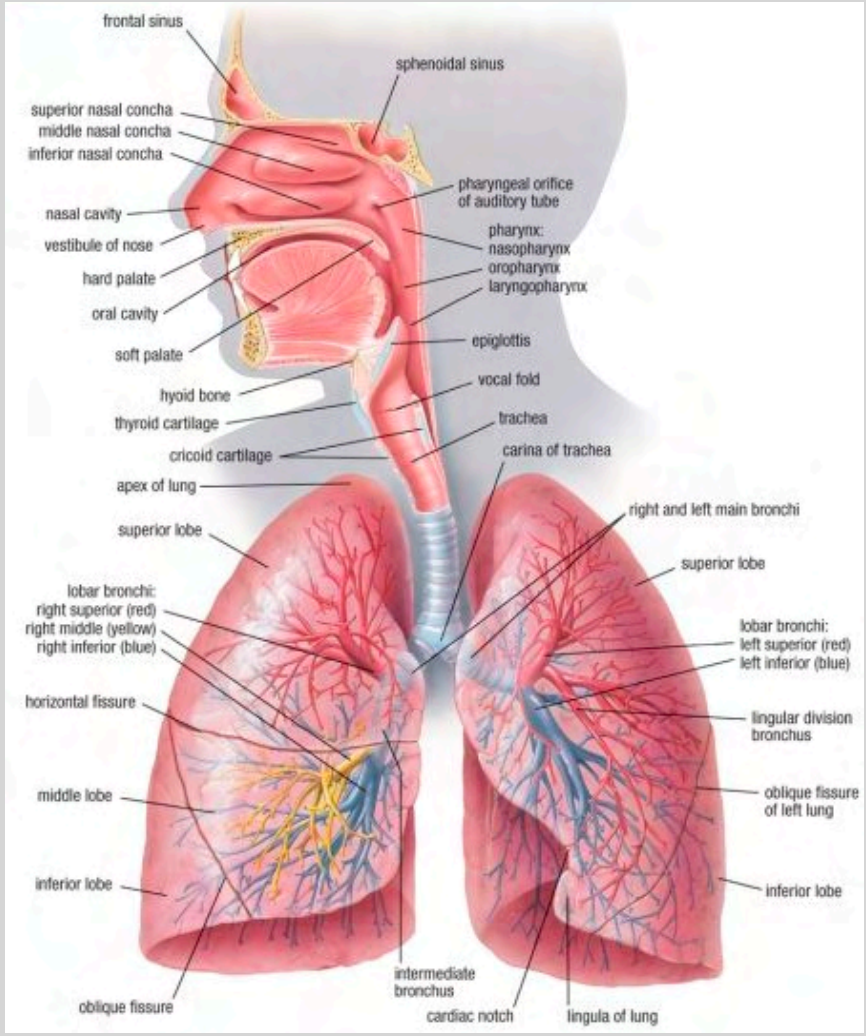
THE LUNGS

RESPIRATORY SYSTEM

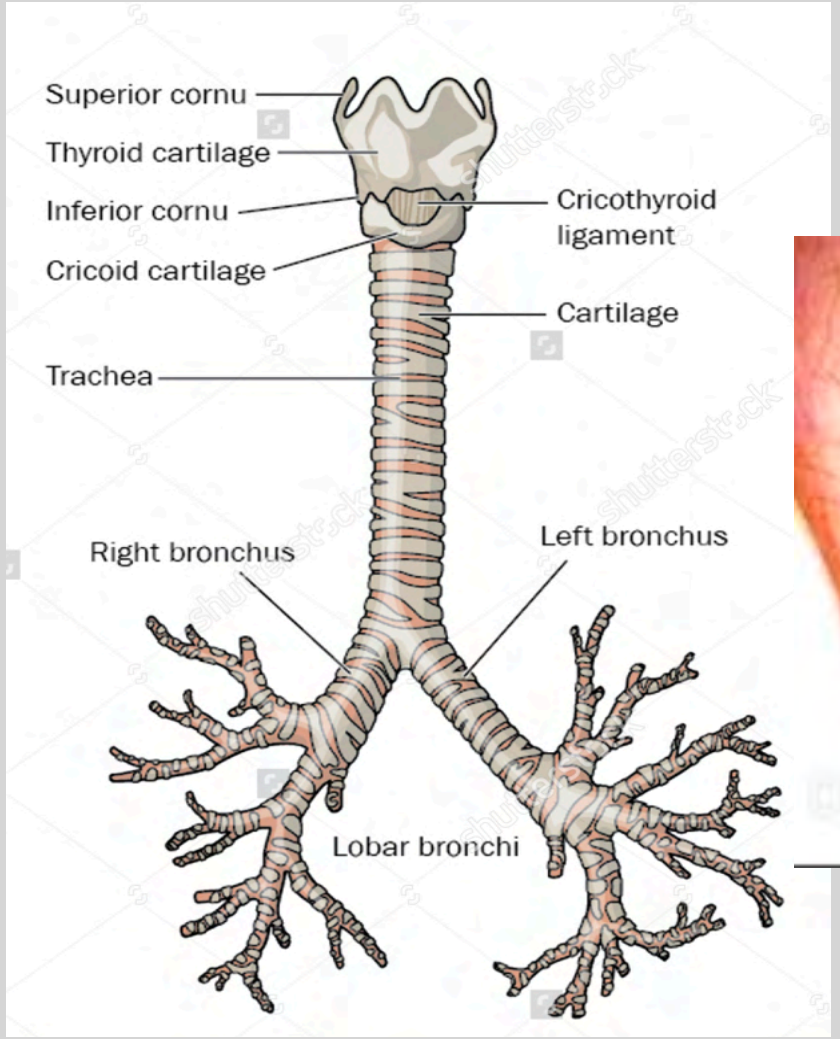
- Functions of the respiratory system
  - Gas exchange
  - Speech
  - Acid-base homeostasis
  - Renal physiology - ACE

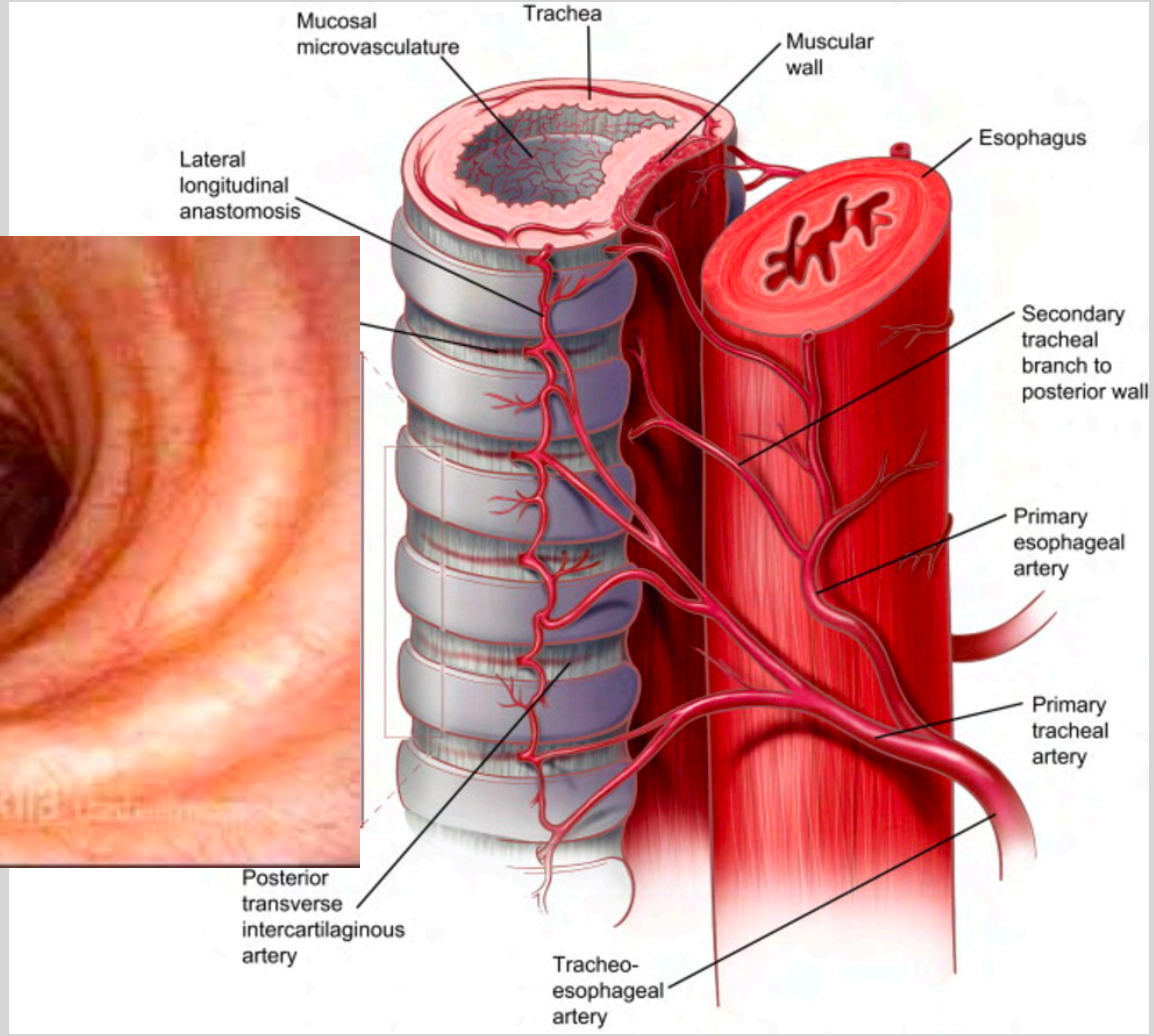
RESPIRATORY SYSTEM

- **Upper respiratory tract**
  - Nose through to the larynx
- **Lower respiratory tract**
  - Trachea to the alveoli



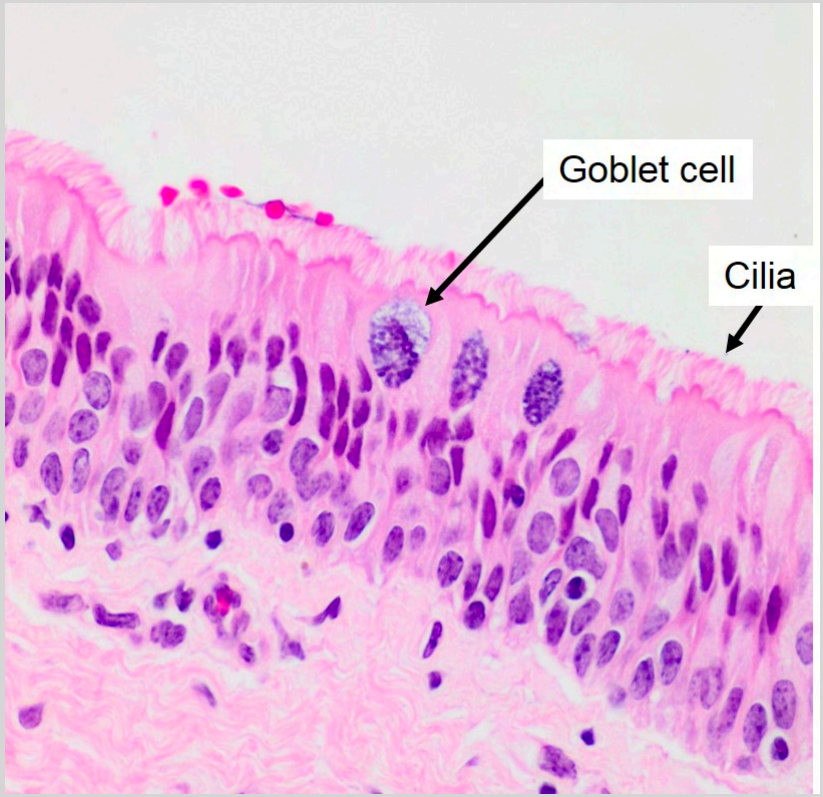
TRACHEA

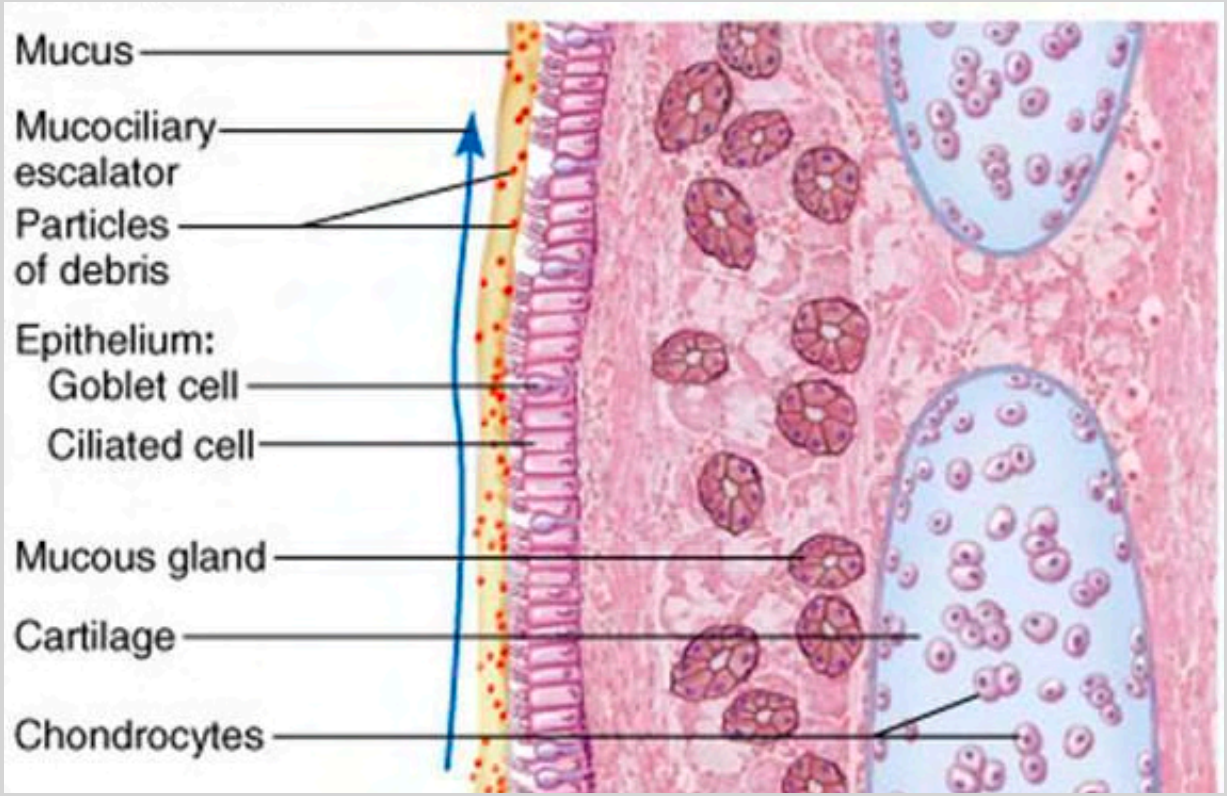

Superior cornu
Thyroid cartilage
Inferior cornu
Cricoid cartilage
Cricothyroid ligament
Cartilage
Trachea
Right bronchus
Left bronchus
Lobar bronchi


Mucosal microvasculature
Trachea
Muscular wall
Esophagus
Lateral longitudinal anastomosis
Secondary tracheal branch to posterior wall
Primary esophageal artery
Primary tracheal artery
Posterior transverse intercartilaginous artery
Tracheo-esophageal artery

MUCO-CILIARY ESCALATOR

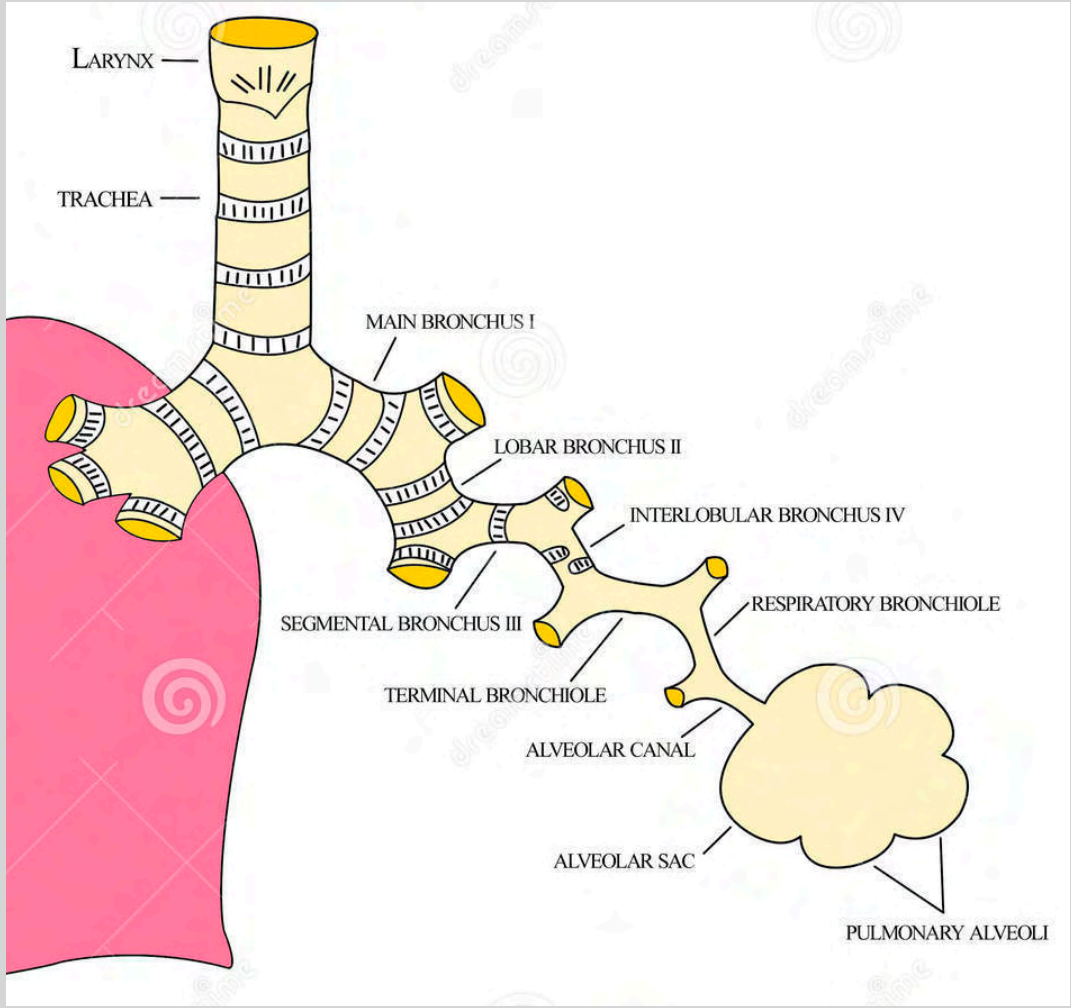
- Pseudostratified columnar epithelium

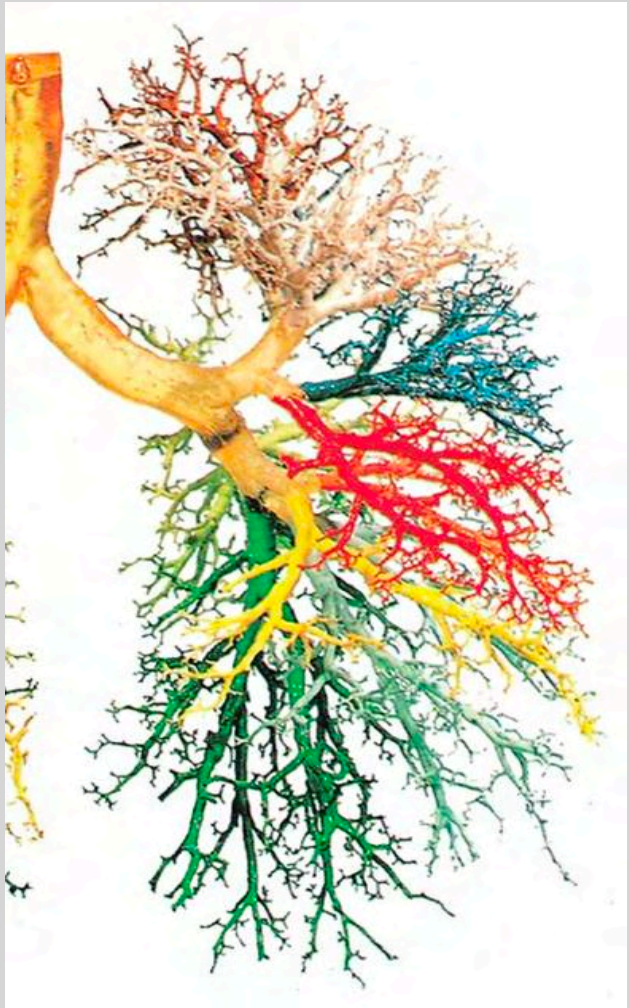




BRONCHIAL TREE

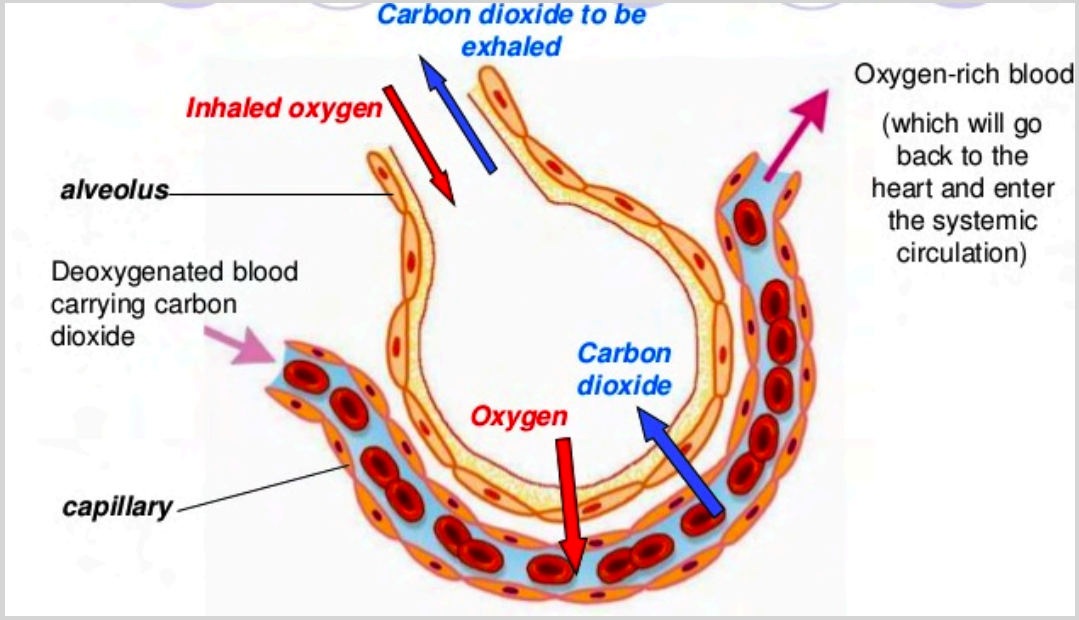
- Trachea
- Main bronchi
- Lobar bronchi
- Segmental bronchi
- Bronchioles
- Terminal bronchioles
- Respiratory bronchioles
- Alveolar sacks

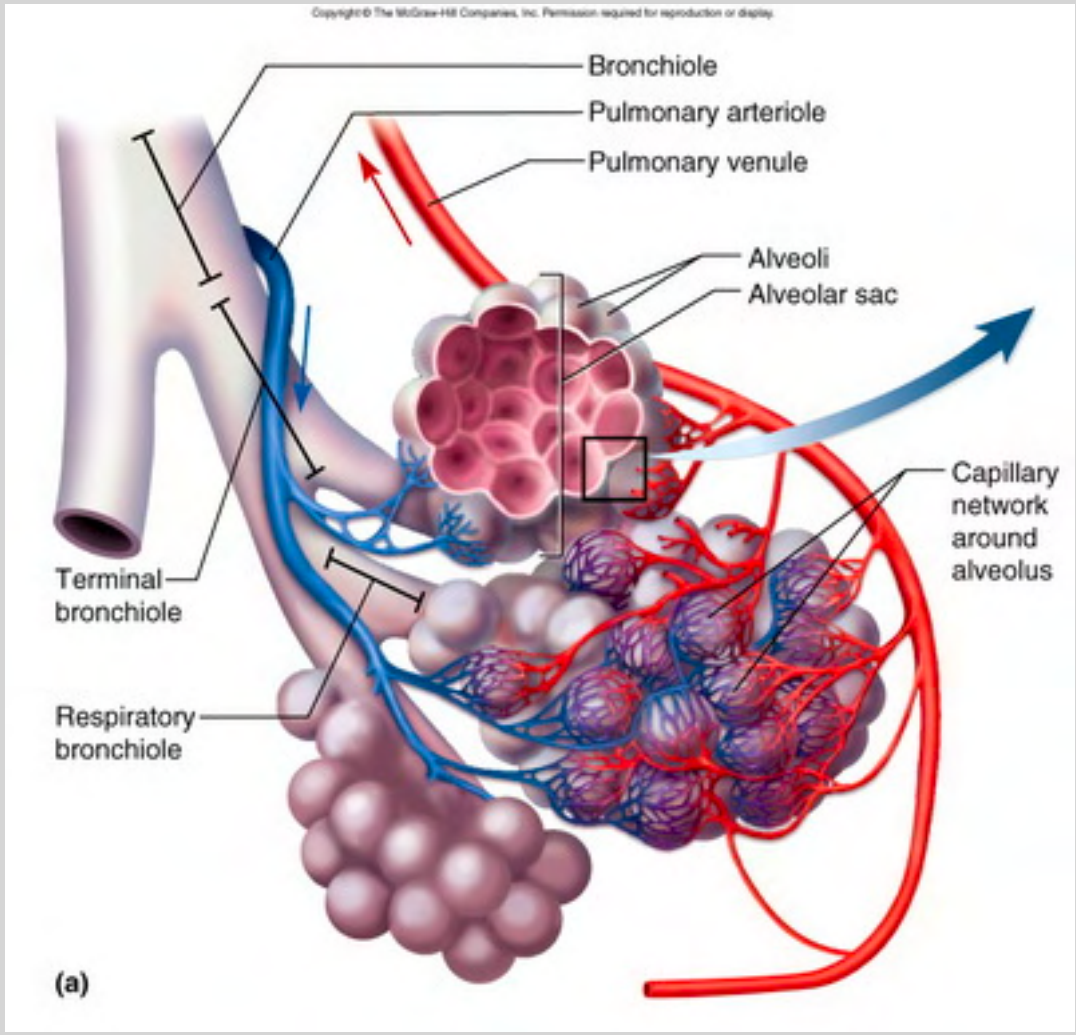




ALVEOLI

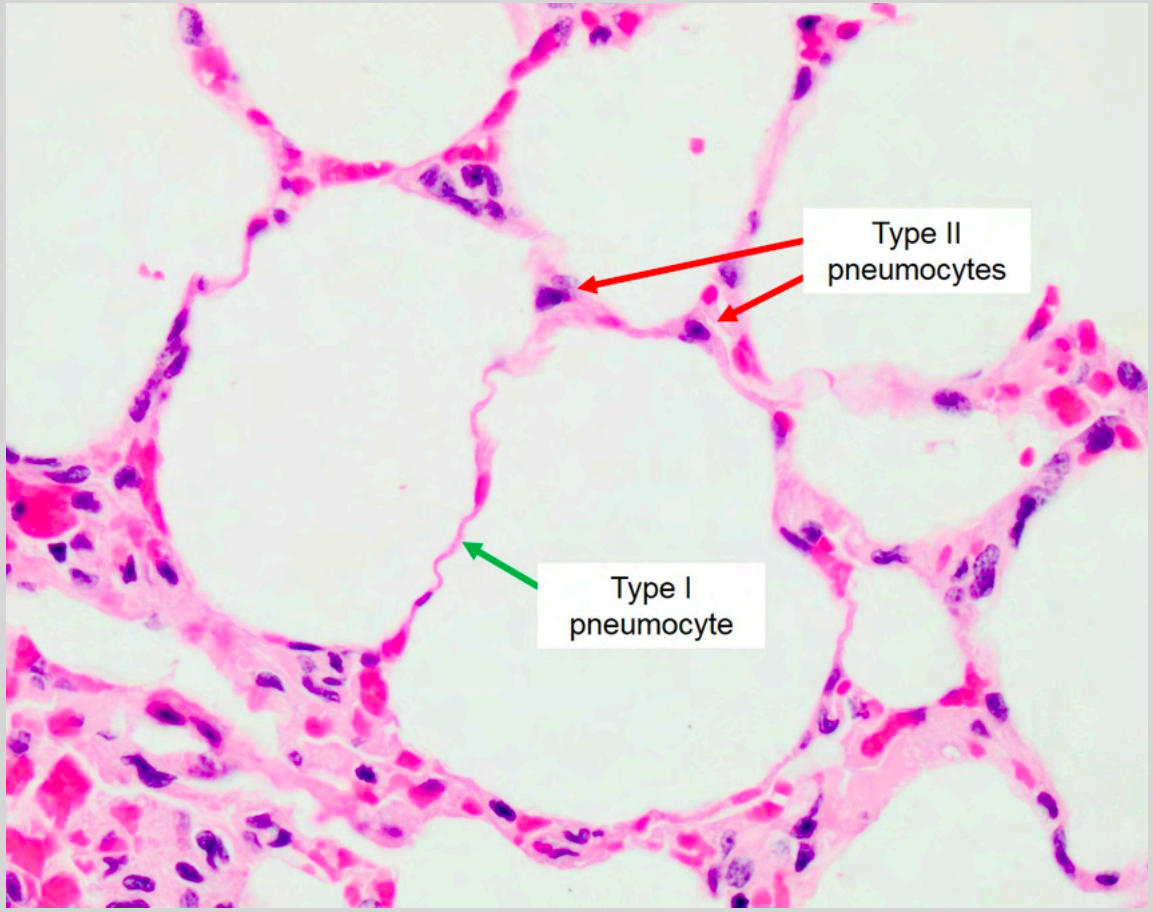
- Site of gas exchange
  - Large surface area
  - Thin epithelium
  - Minimal interstitial space





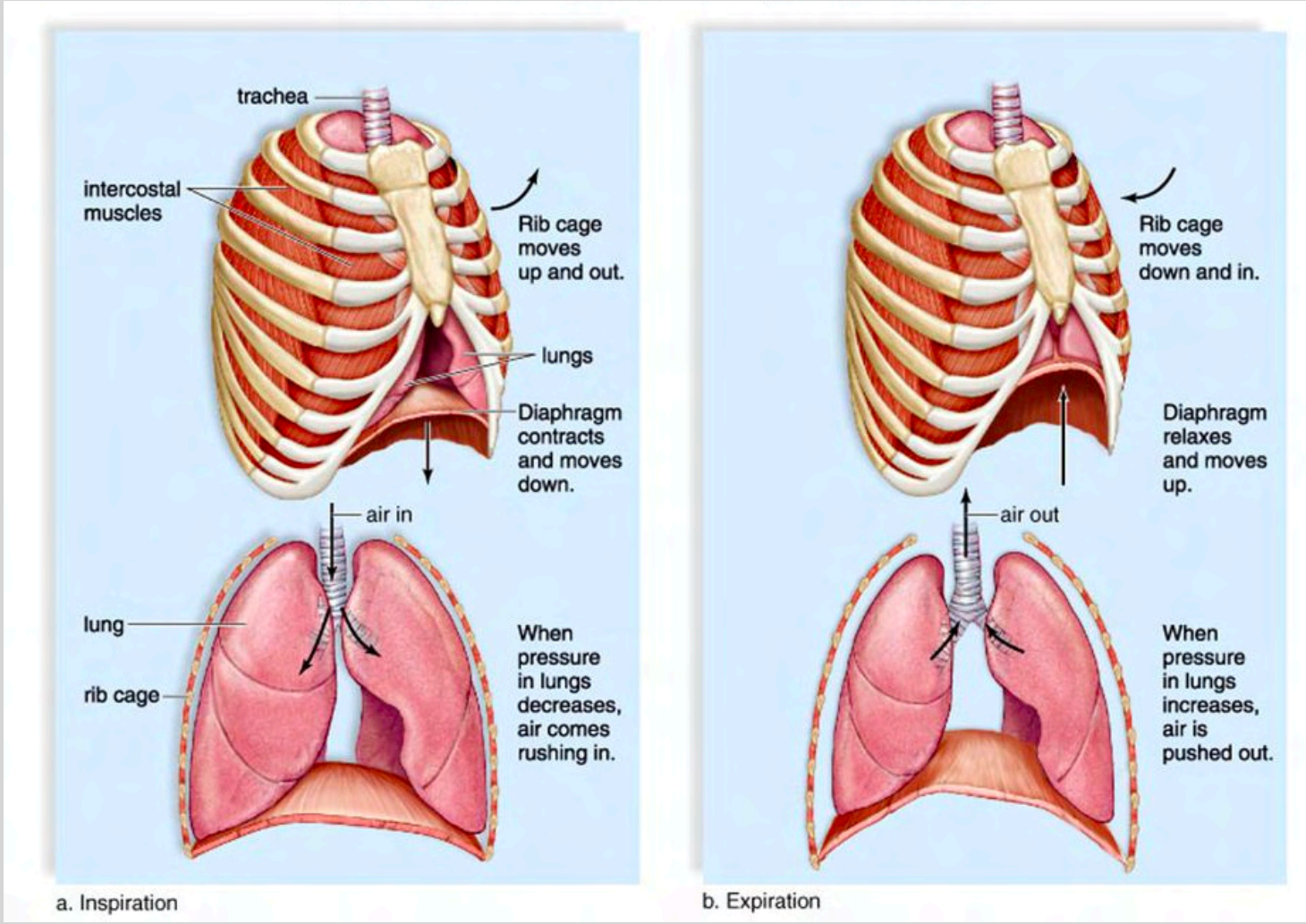
ALVEOLI

- **Type I pneumocytes**
  - Involved in gas exchange
- **Type II pneumocytes**
  - Produce surfactant to prevent alveoli from collapsing during exhalation
- **Type III pneumocytes**
  - Alveolar macrophages – phagocytose dust and other particles

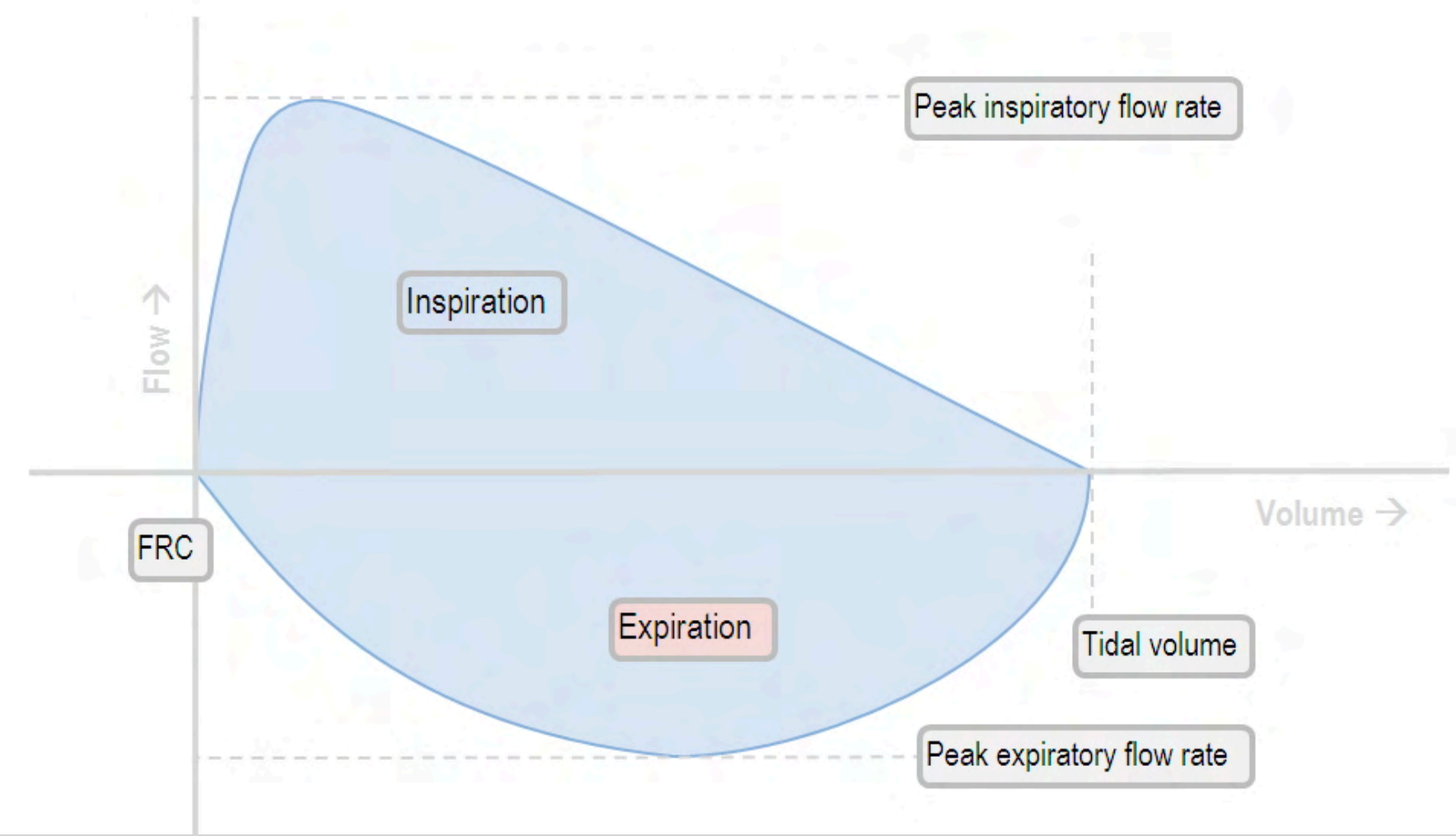


LUNGS

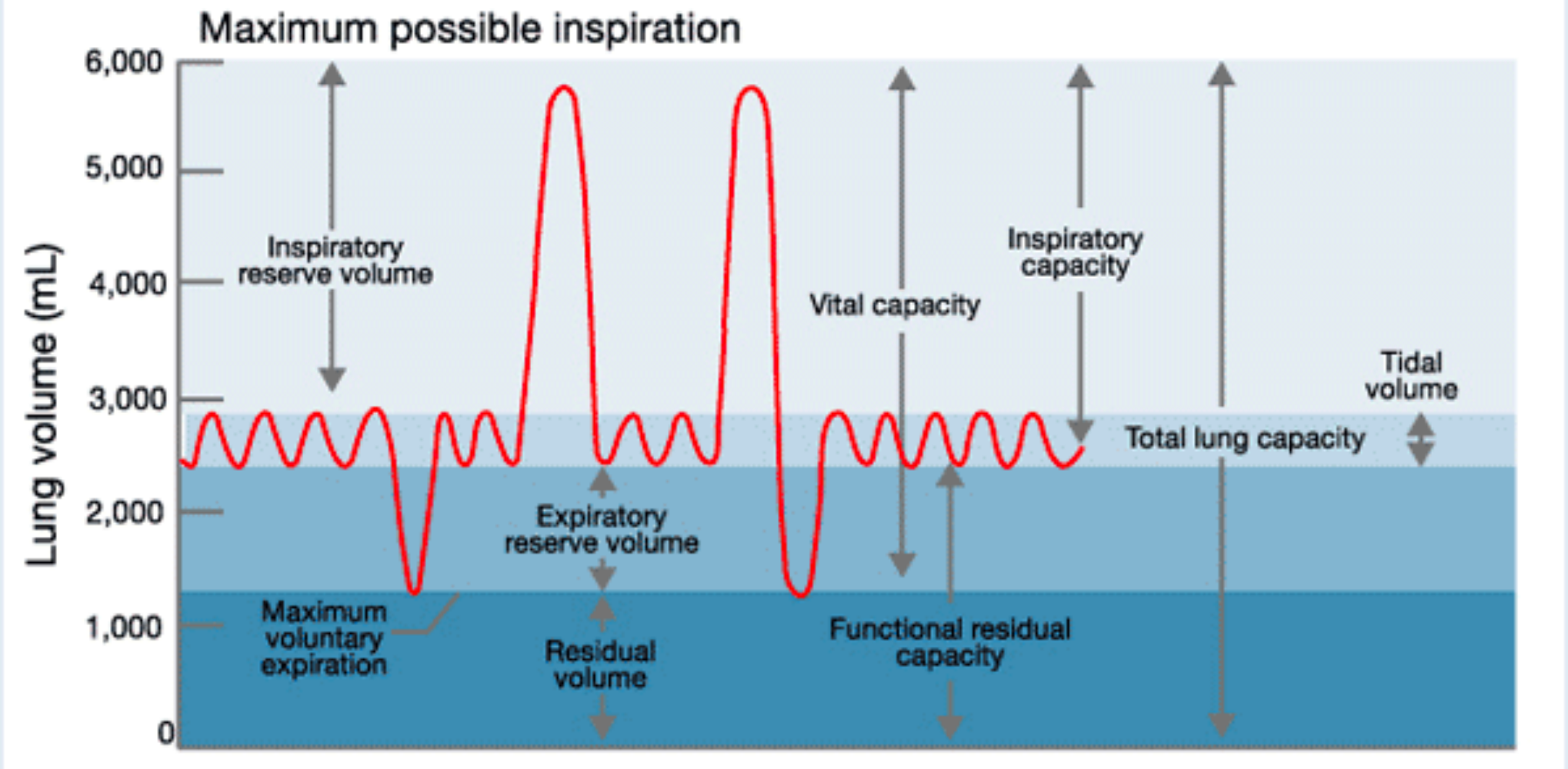
INSPIRATION / EXPIRATION



LUNG FLOW-VOLUME LOOPS

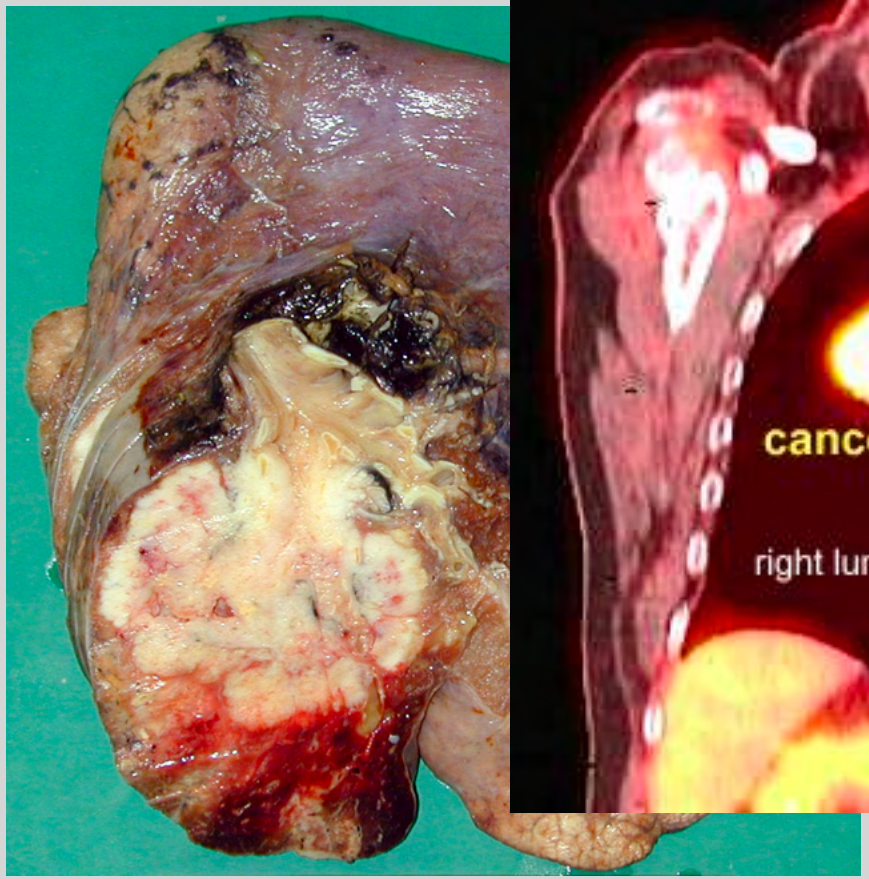


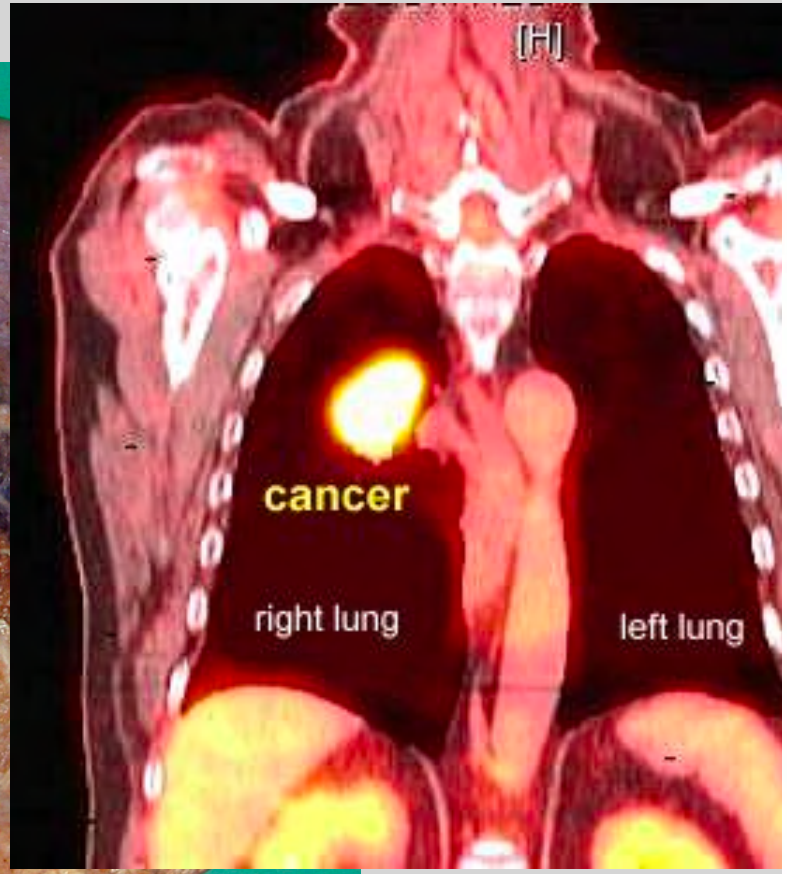
LUNG VOLUMES

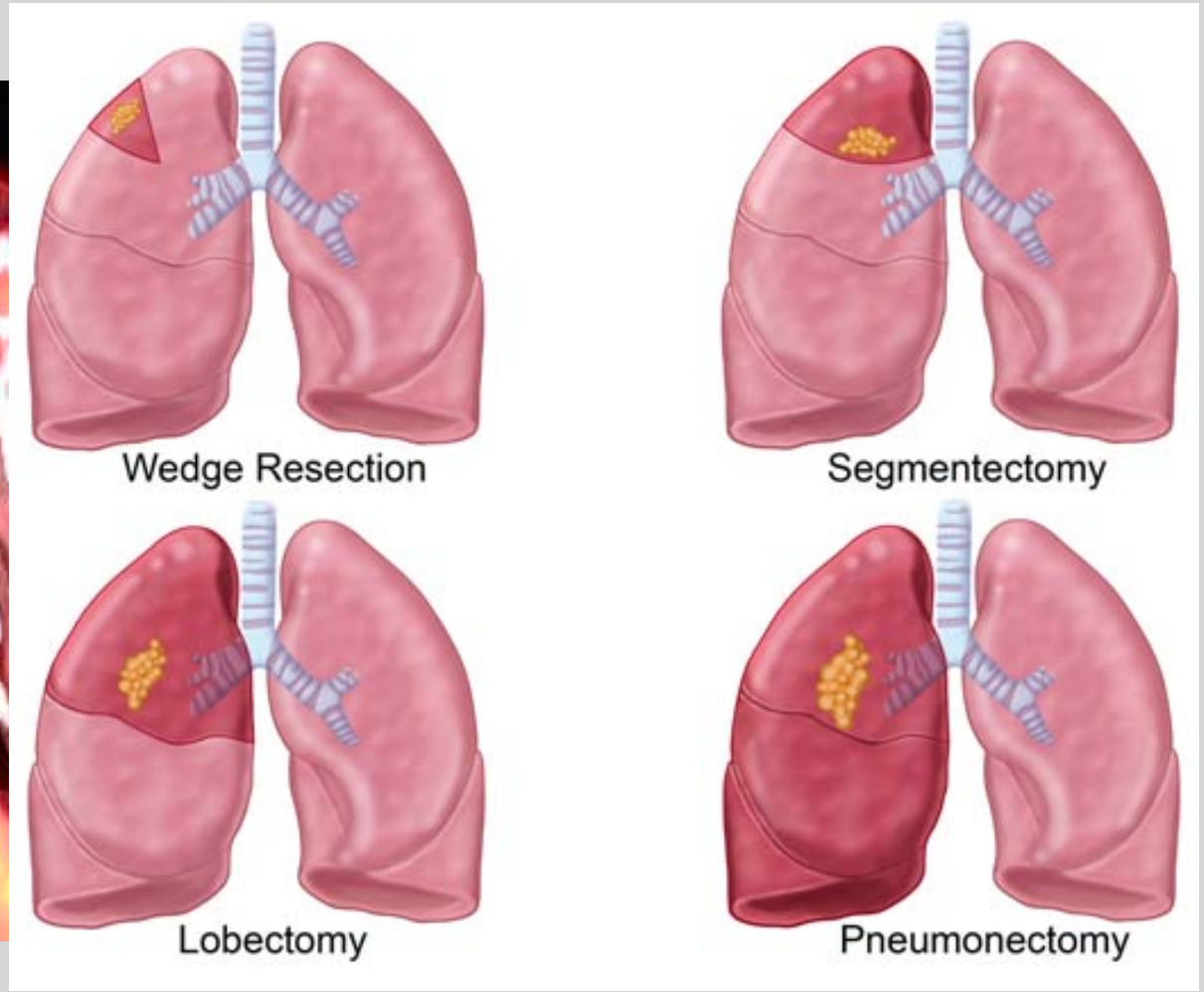


SURGICAL LUNG DISEASE

Lung cancer







SUMMARY

- Overview of cardiac and respiratory anatomy and physiology
- Insight into cardiothoracic surgical disease