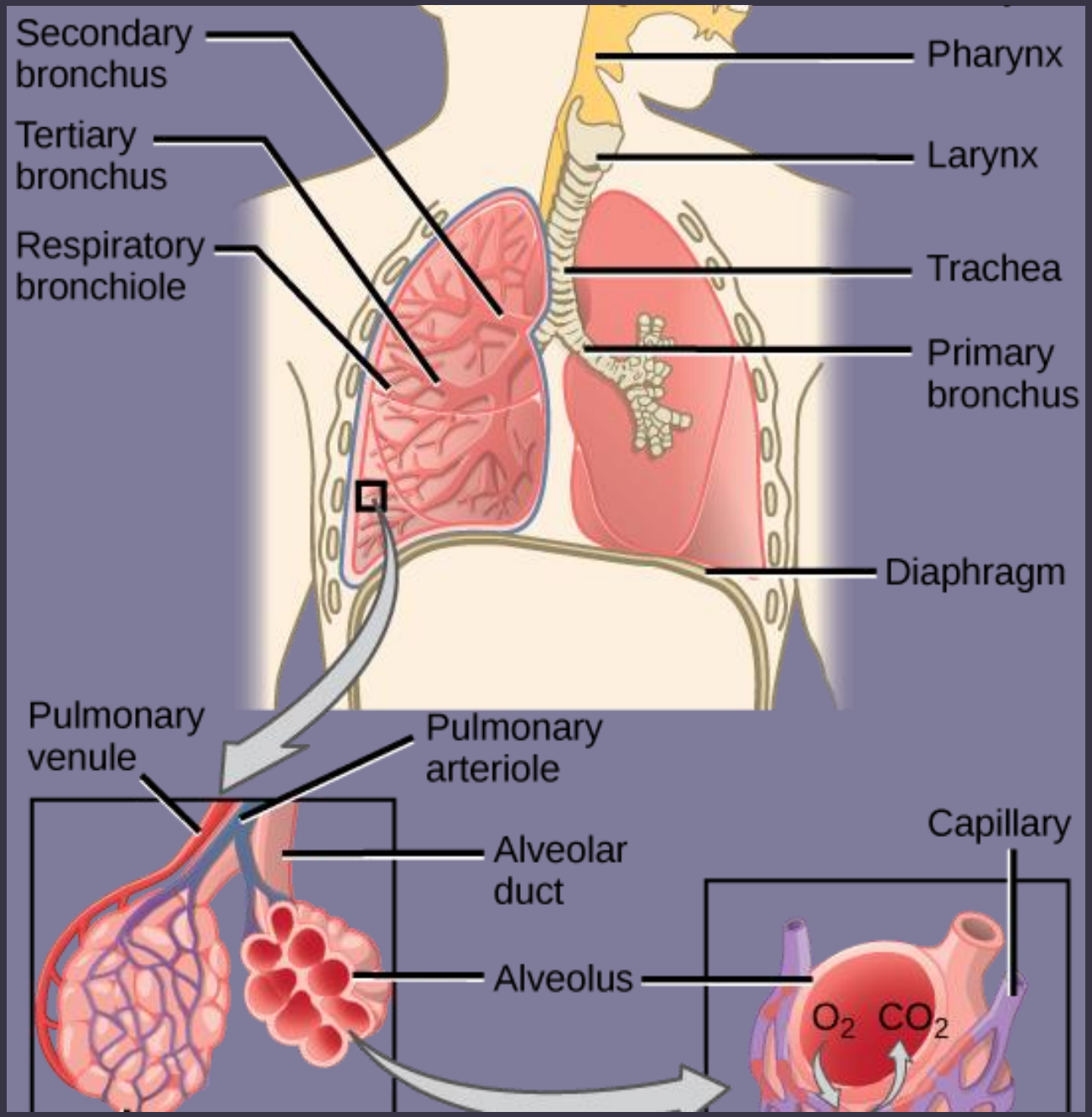
KAZAN FEDERAL (VOLGA REGION) UNIVERSITY
INSTITUTE OF FUNDAMENTAL MEDICINE AND BIOLOGY
DEPARTMENT OF MORPHOLOGY AND GENERAL PATHOLOGY

Lecture 2

Respiratory system. Development

Zaikina Elvira Ildarovna,
MD, PhD, Senior lecturer

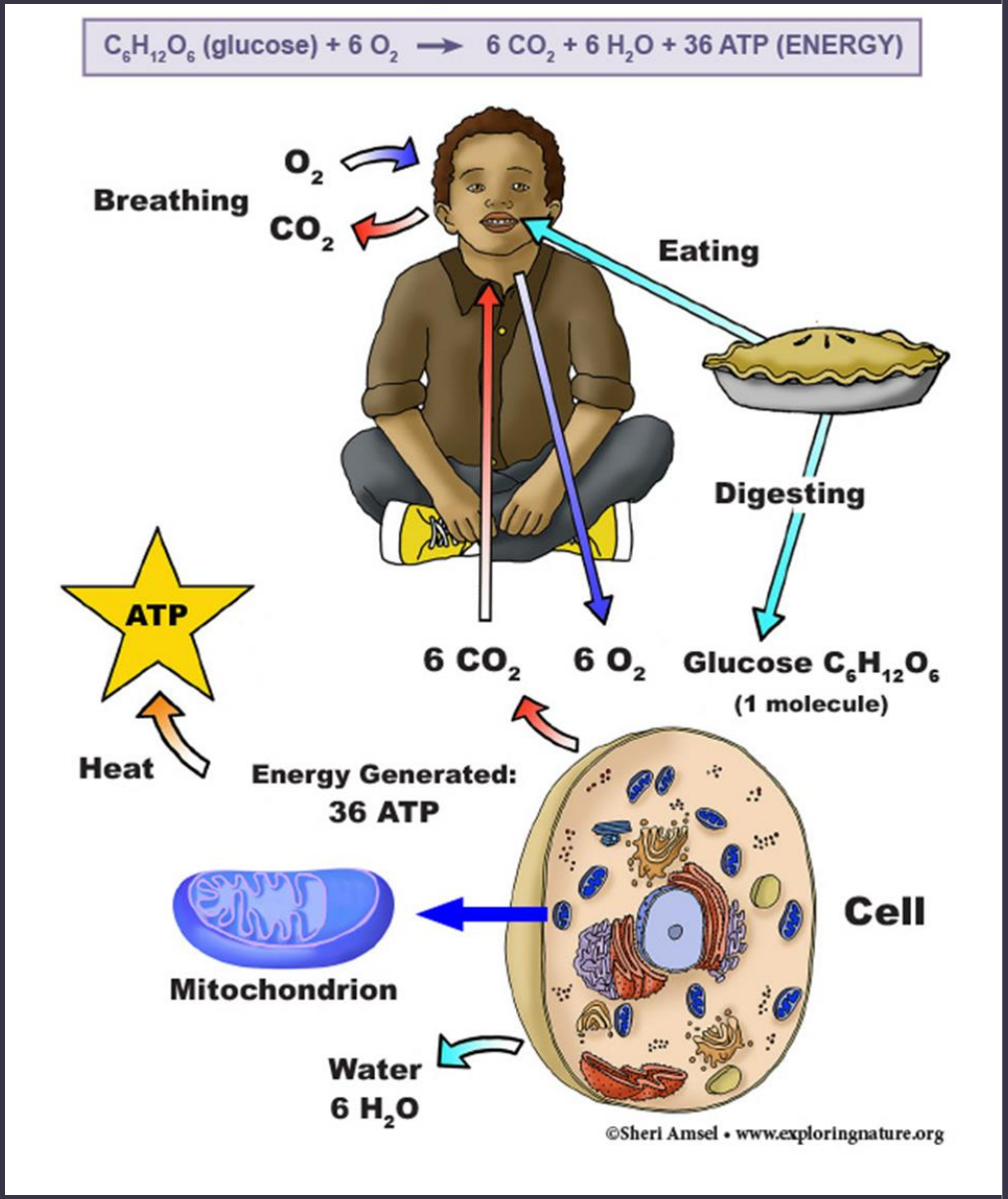


Respiratory system

is a biological system consisting of specific organs and structures used for the process of respiration in an organism

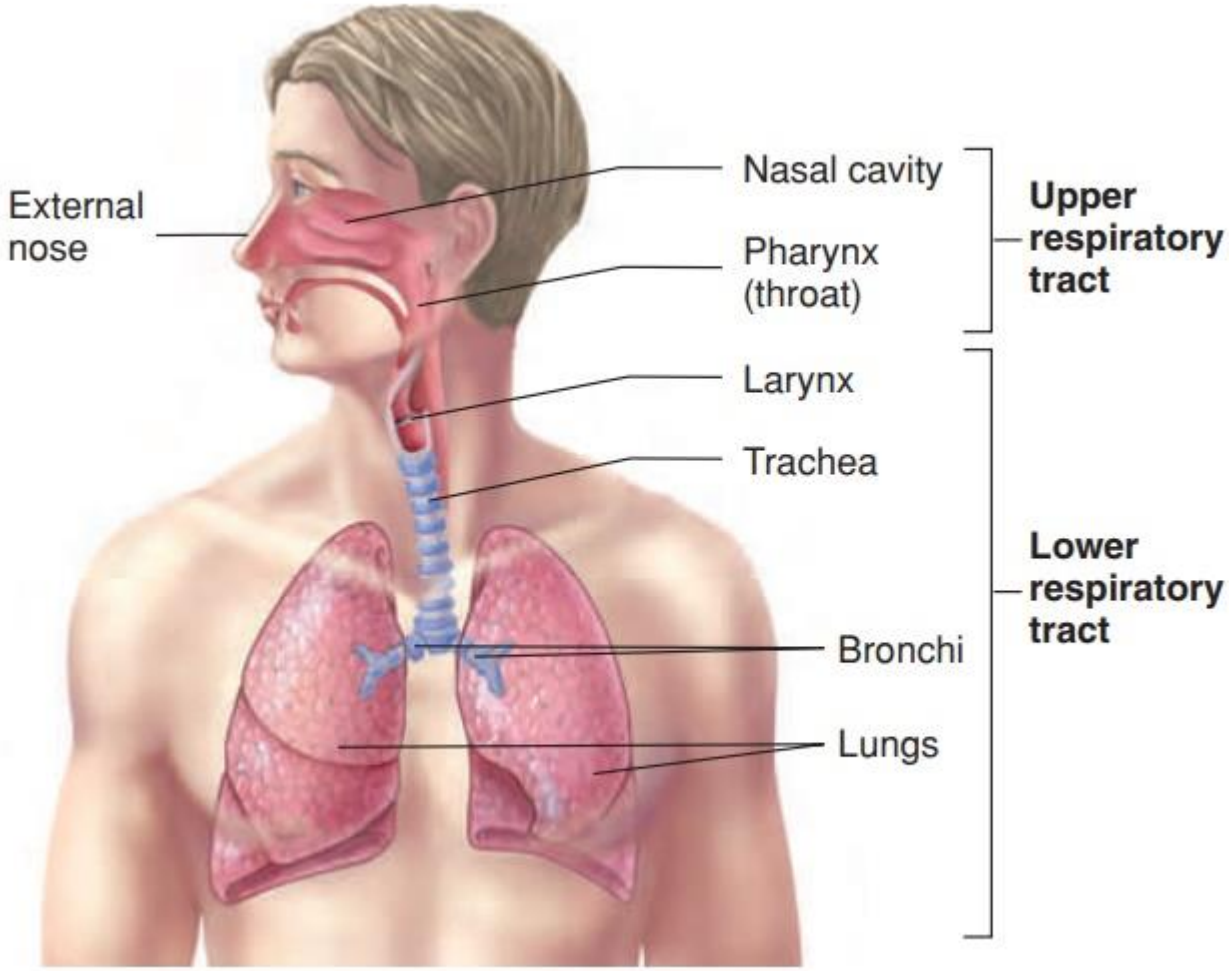
Breathing and Respiration

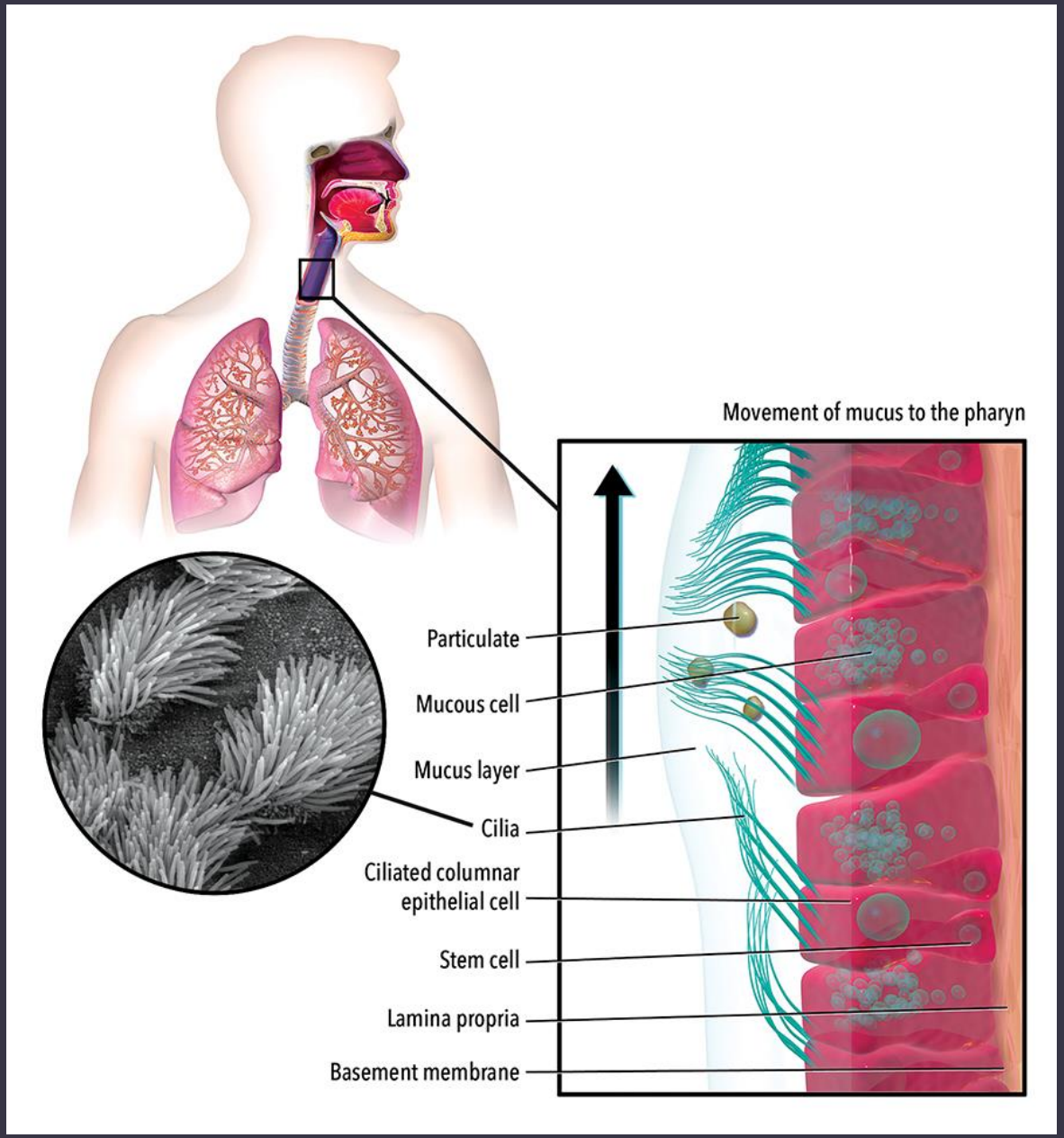
- BREATHING is the mechanical action of getting air in and out of the lungs.
- RESPIRATION is the chemical reaction that provides the energy that makes the organism function. It occurs in the cells, more precisely in the mitochondria (the powerplant of the cell).



Breathing	Cellular Respiration
Definition	
Breathing involves the process of inhaling oxygen and exhaling carbon dioxide	Cellular respiration is the process of breaking down glucose to produce energy, which is then used by cells to carry out the cellular function.
Process Occurrence	
Breathing takes place in the lungs. Also involves the nose, mouth and pharynx	Respiration takes place in cells
Type of Process	
Breathing is voluntary as well as an involuntary physical process. (For example, breathing during sleep is involuntary. Voluntary breathing is observed when we sing, speak, swim or for relaxation techniques)	Respiration is an involuntary chemical process.
Production of Energy	
There is no production of energy in this process.	Energy is produced and released in the form of ATP.
Cellular Activity	
As it occurs outside cells, it is called the extracellular process. (Occurs between the organism and the external environment)	As it occurs inside cells, it is called the intracellular process.
Enzyme used	
No enzymes are used during the process.	A large number of enzymes are used during the process.
Associated Organs	
Breathing occurs through respiratory organs, including the nose, lungs, etc.	Respiration takes place in cells and cell organelles, including mitochondria, etc.

Systema respiratorium

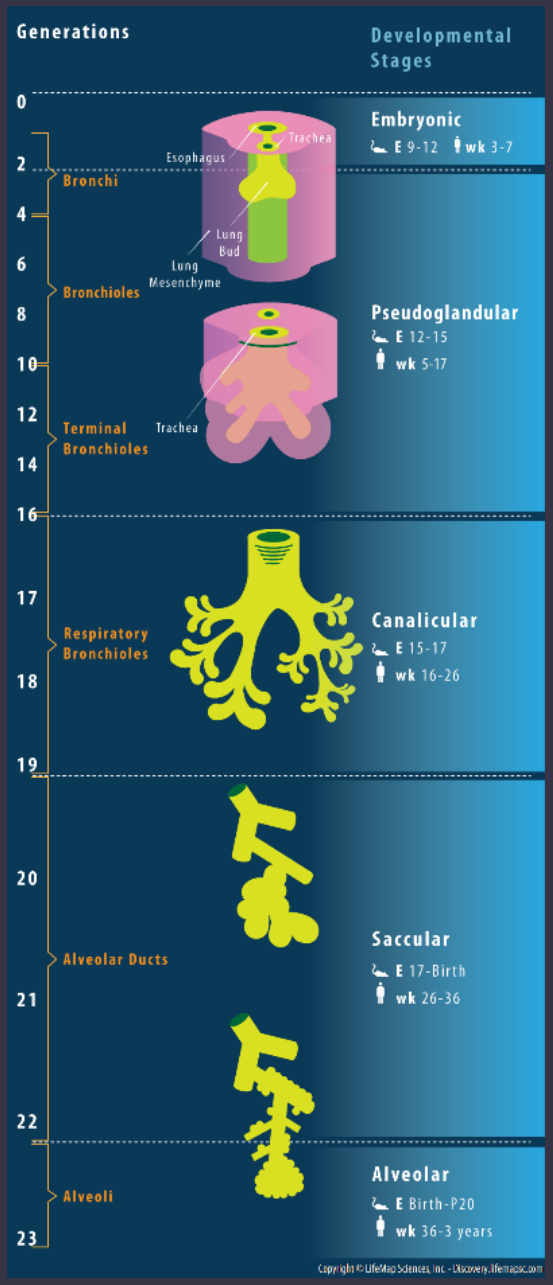




- The inner surface of the airways is lined by the mucous membrane which is covered by *ciliated columnar epithelium* and contains numerous glands secreting the mucus.
- Due to this the inspired air is <u>cleaned</u>, <u>humidified</u> and <u>warmed</u>.

The development of the respiratory system

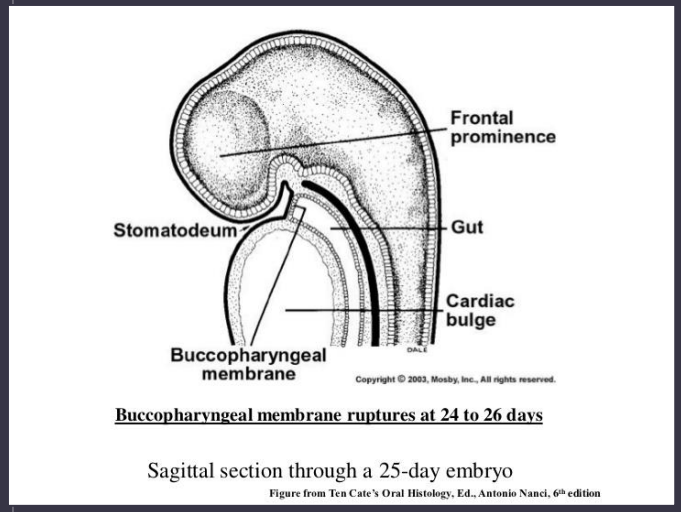
The upper respiratory tract

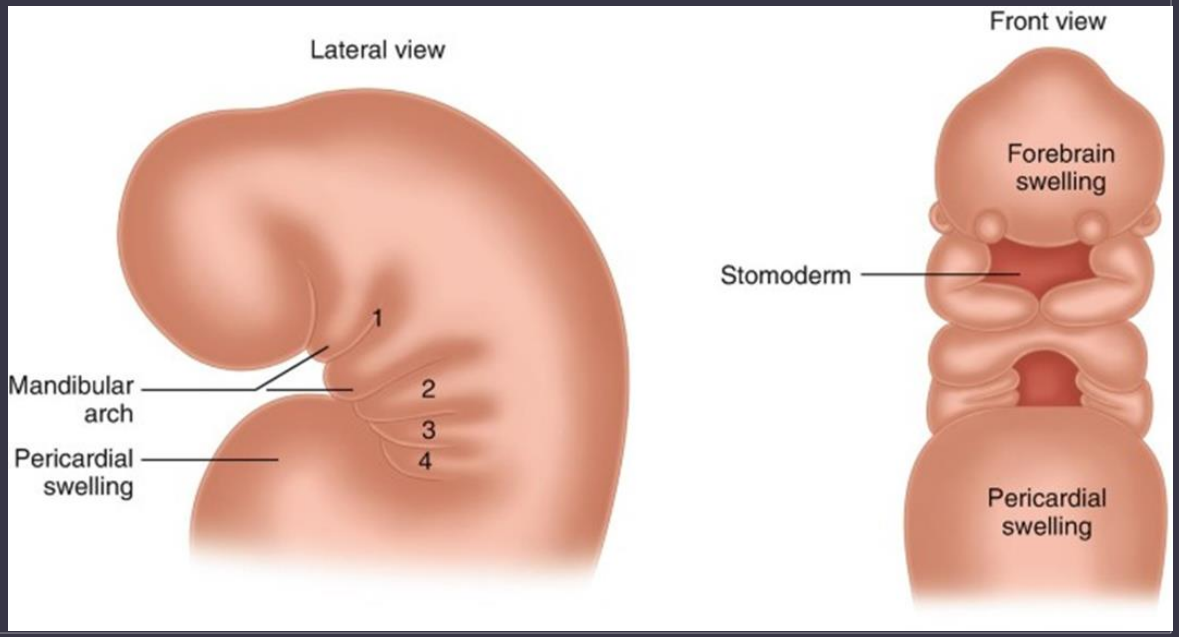


Development of the face (from 4th to 8th weeks)

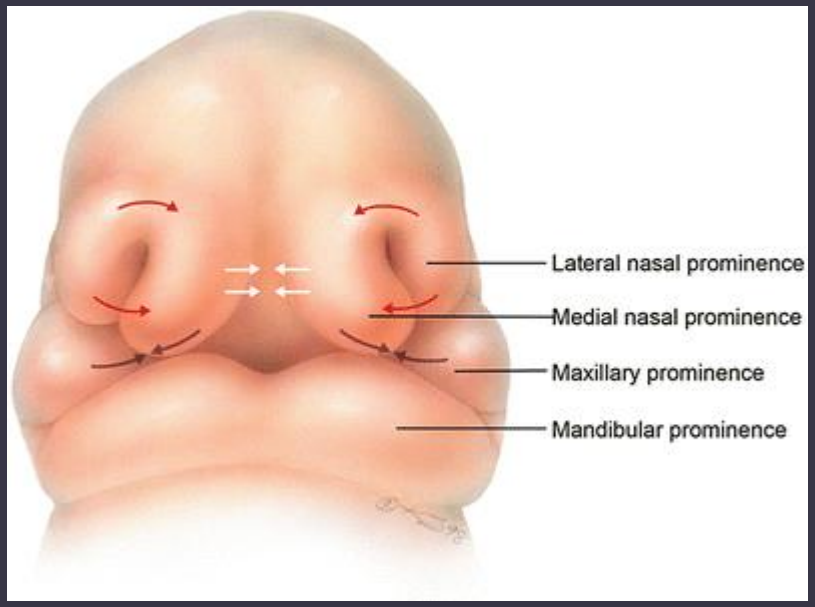
1. Development of the primitive mouth – stomodeum (beginning of the 4th week)

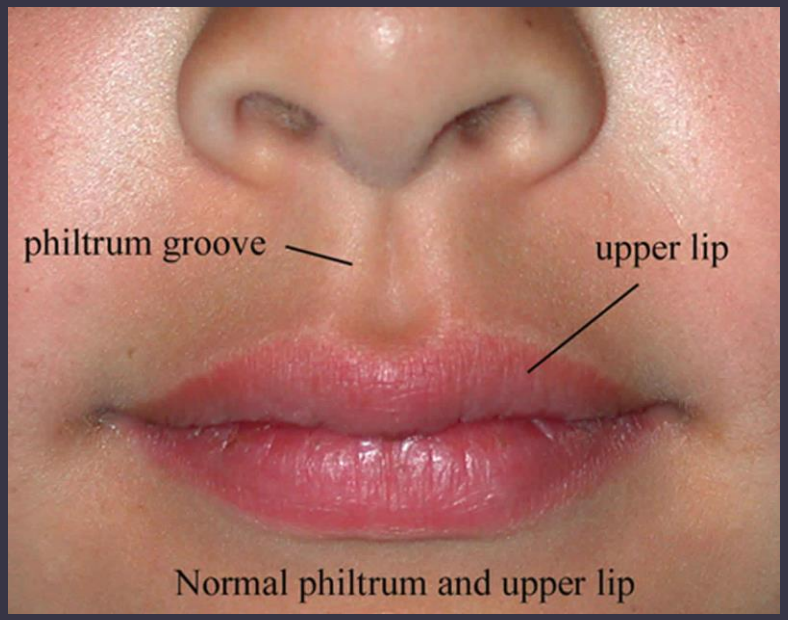
2. Rupture of oropharyngeal membrane (the 24th day)
3. Development of the nasal cavity **(**from the end of the 4th week**)**
4. Rupture of oronasal membrane (the 6th week)
5. Development of **paranasal air sinuses** from diverticuli of nasal walls during late fetal life & after birth

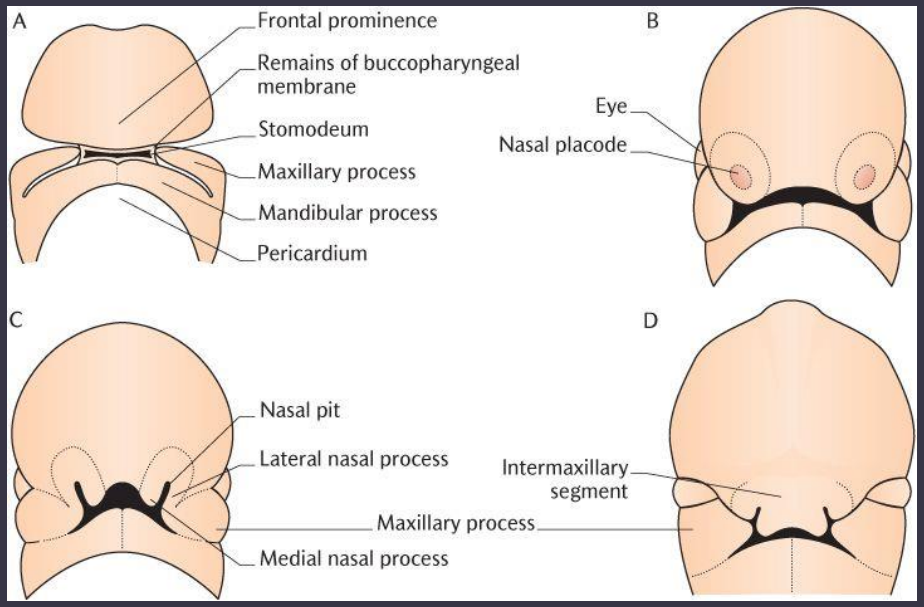




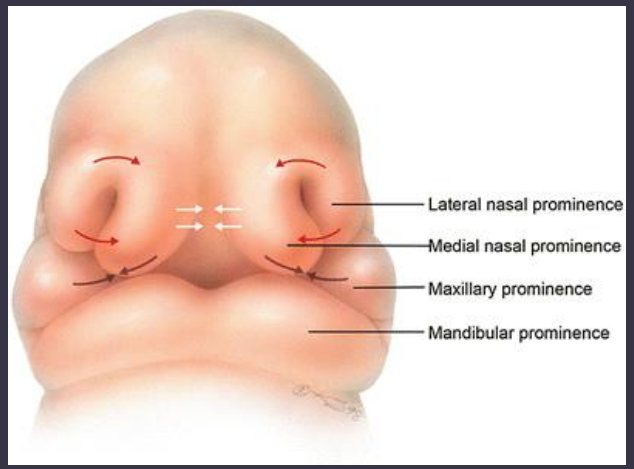
- The frontonasal process rises from the neural crest and covers the forebrain. It will give rise to two medial nasal processes and two lateral nasal processes.
- By the tenth week, the inter-maxillary process will form the nasal bridge and the philtrum of the upper lip.

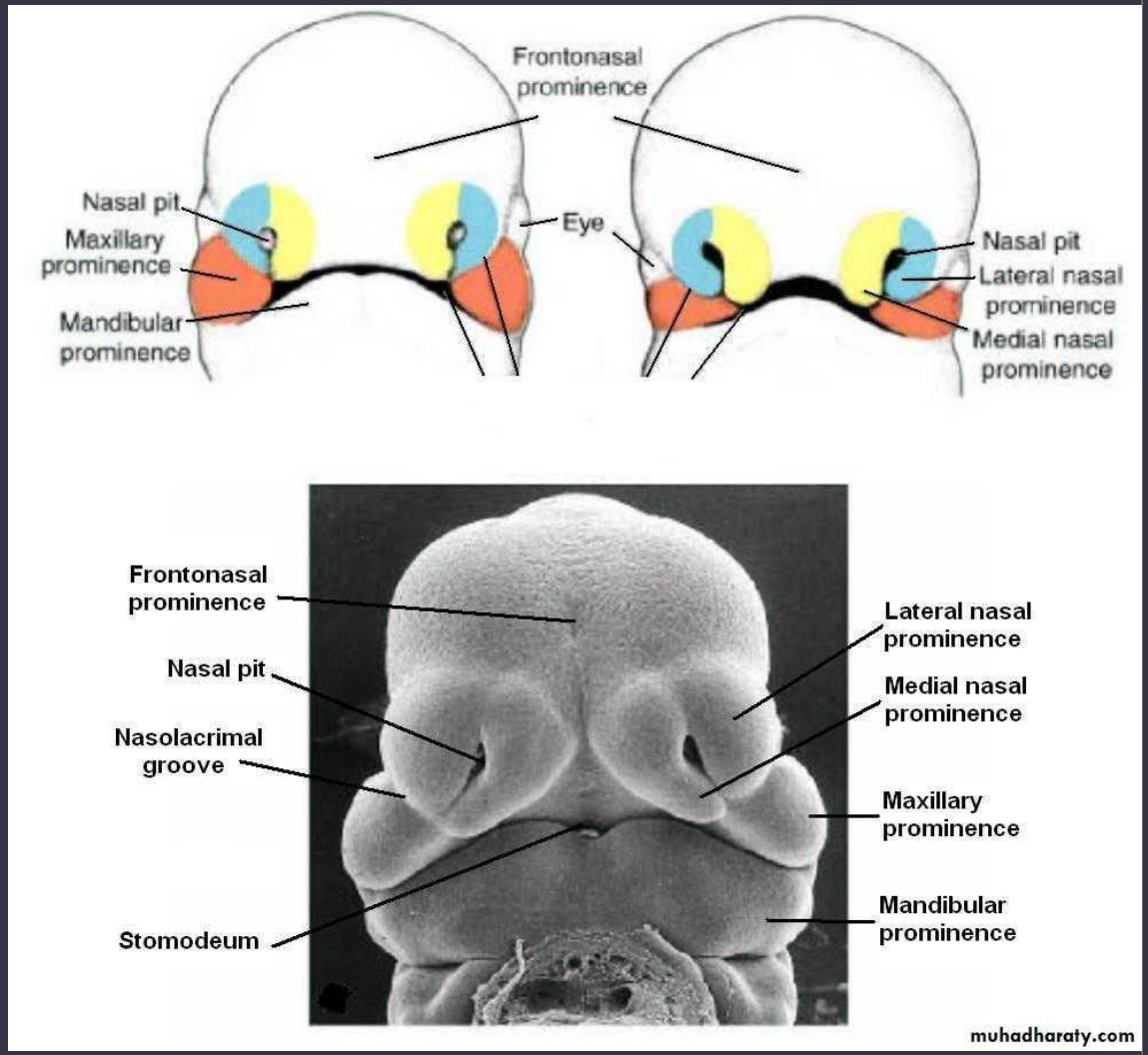




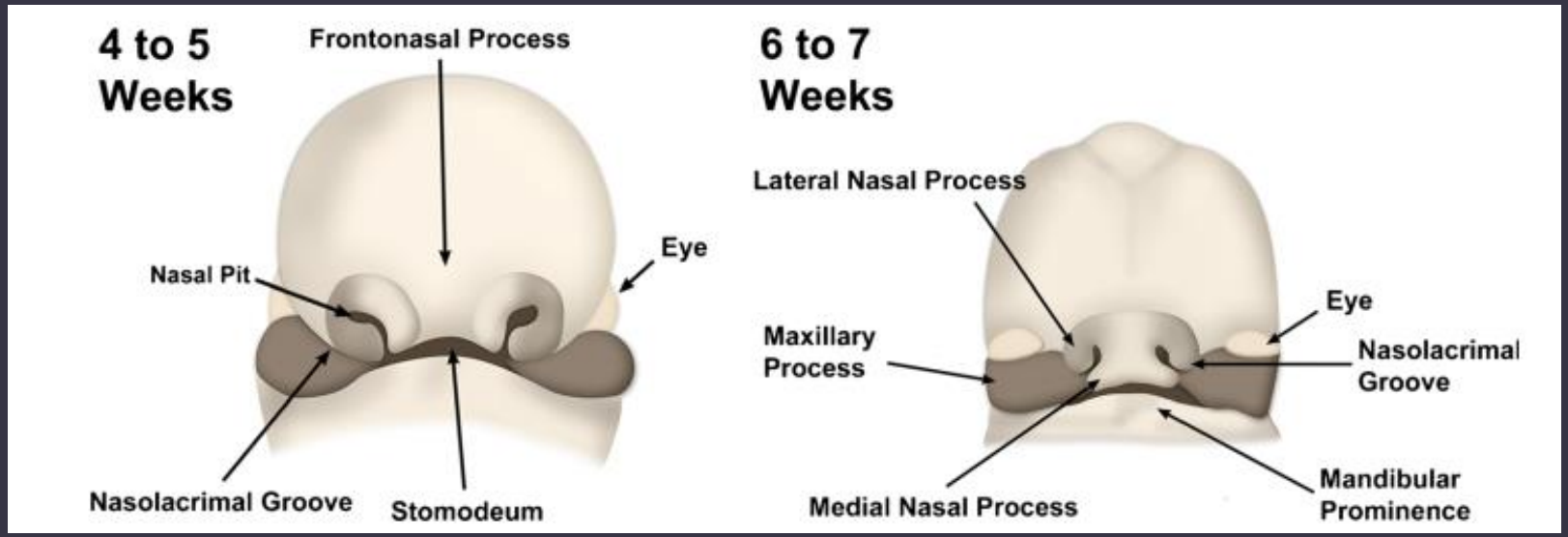


- The tissues of the 1st (mandibular) pharyngeal arch originates from mesoderm and the neural crest.
- The 1st arch will give rise two mandibular processes and two maxillary processes (proximal part of the arch).
- The maxillary processes will later form to a pair of palatal processes.





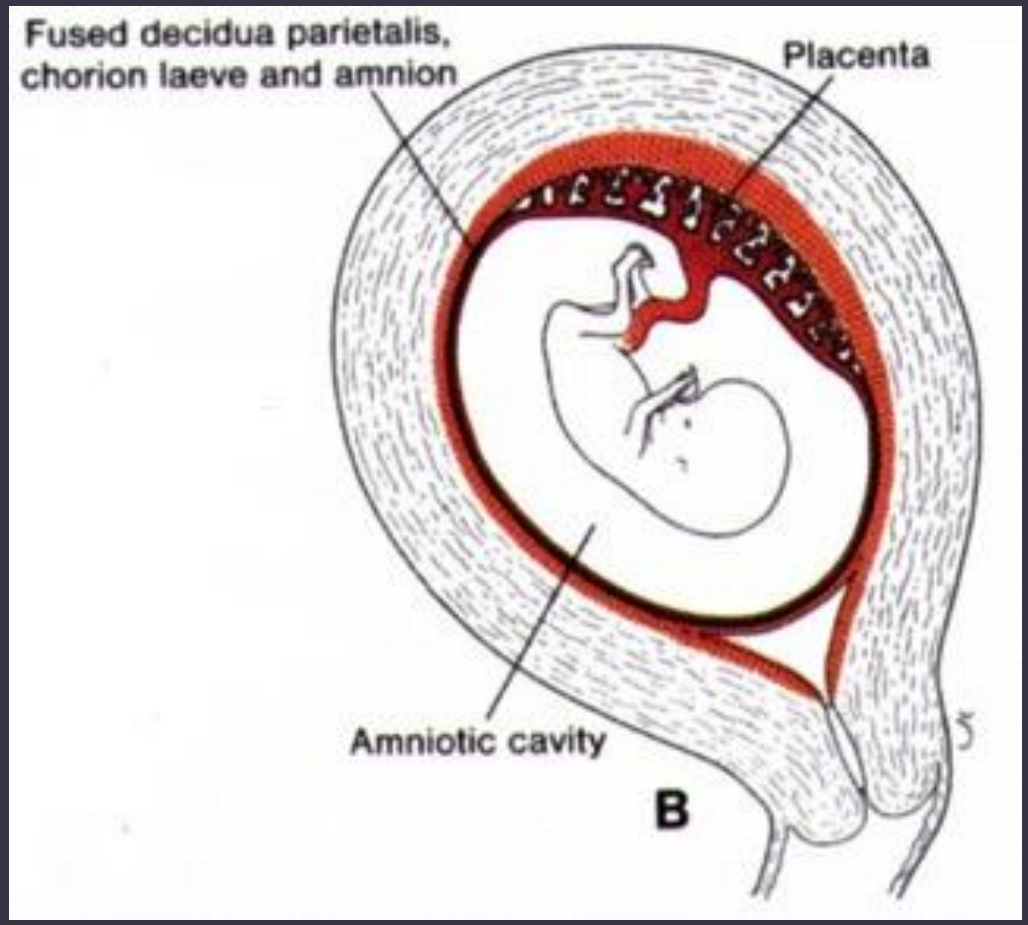
Schematic of frontonasal region in embryological development.



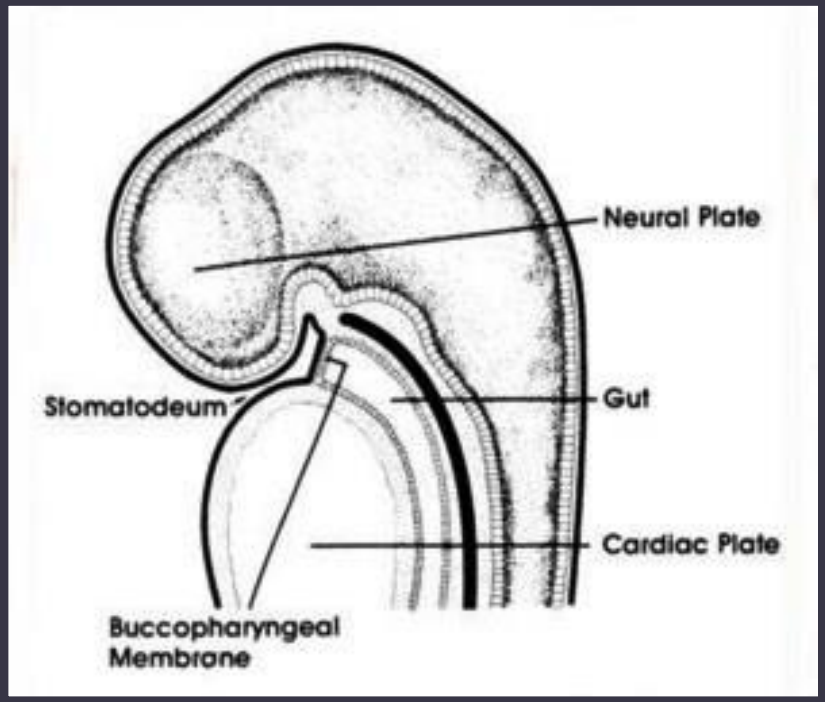
- The maxillary prominences and median nasal prominences progressively migrate toward the midline.
- The nose forms from fusion of the medial and lateral nasal prominences.
- The upper lip forms from the fusion of the medial nasal prominence and maxillary prominence on each side.
- The nasolacrimal grooves form as a gap between the lateral nasal prominence and the maxillary prominence

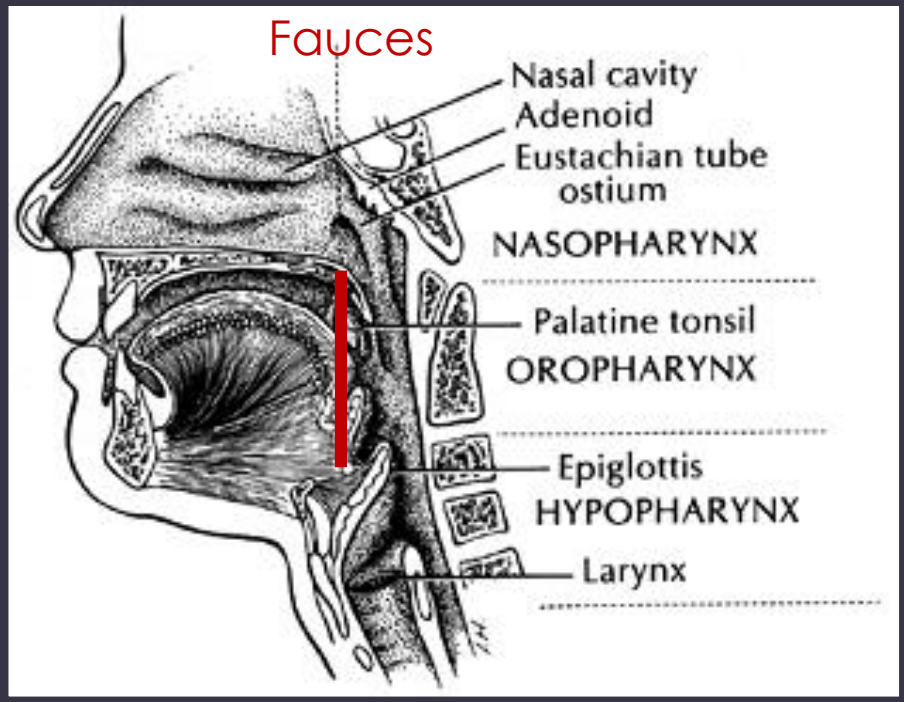
Rupture of buccopharyngeal membrane

- Fetus swallow amniotic fluid – stimulation of growth of digestive system organs
- Organs of the respiratory system are isolated from fluid by epithelial cells growth ("stoper")



Rupture of buccopharyngeal membrane





Stomodeum → Oral cavity

Buccopharyngeal/oropharyngeal membrane → Fauces

Ectoderm → Epithelial lining of oral cavity, teeth

Ectoderm → Parotid and submandibular salivary glands

Endoderm (foregut) → Epithelial lining of pharynx

Endoderm (foregut) → Sublingual salivary gland

Ratke`s pouch → Adenohypophysis

Prominence	Derivatives
Frontonasal	Forehead, bridge of nose, medial and lateral nasal prominences
Medial nasal	Philtrum, primary palate, upper 4 incisors and associated jaw
Lateral nasal	Sides of the nose
Maxillary (1st pharyngeal arch)	Cheeks, lateral upper lip, secondary palate, lateral upper jaw
Mandibular (1st pharyngeal arch)	Lower lip and jaw

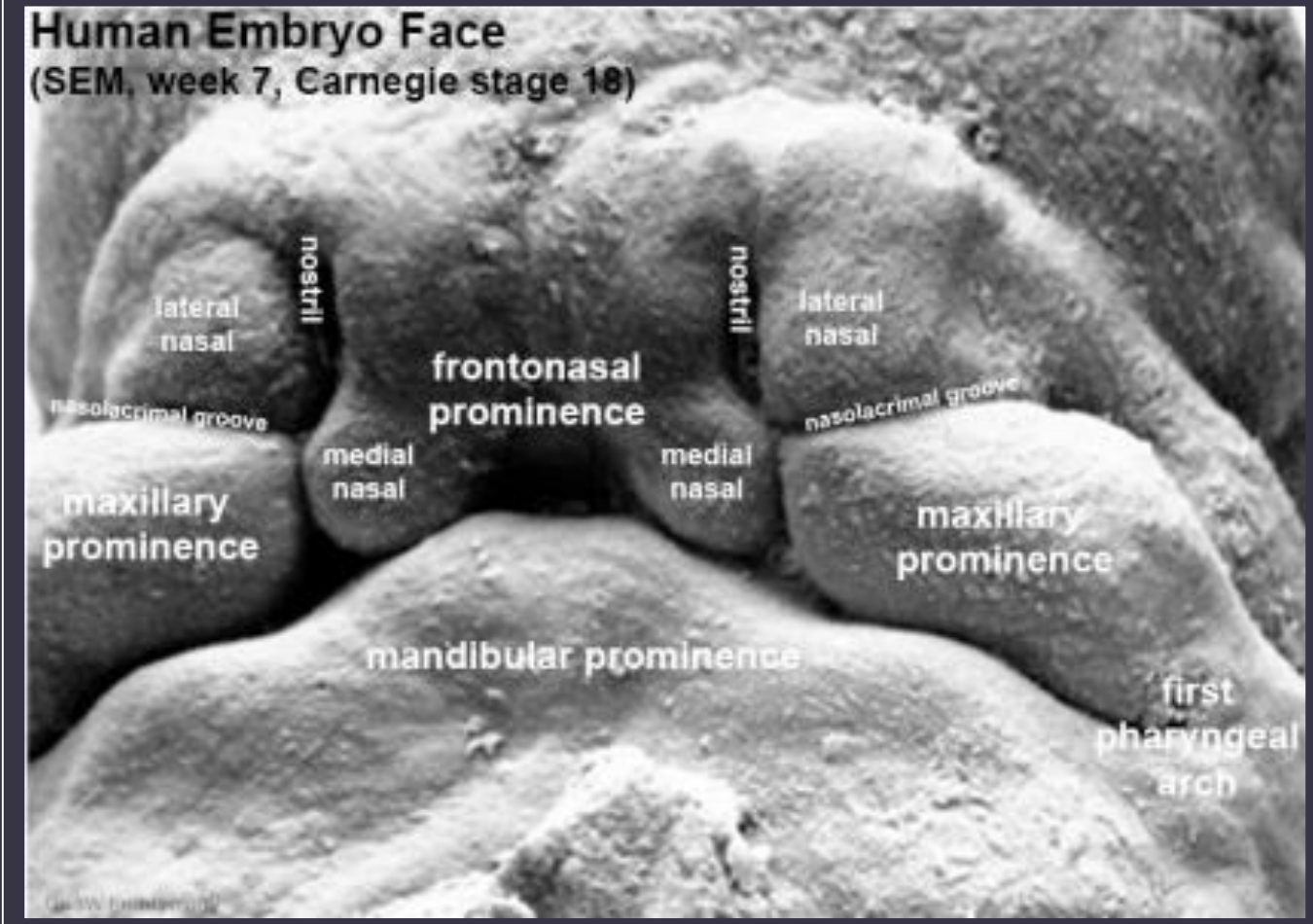
Development of the primitive mouth (*Stomodeum*)

It develops from five facial primordia:

– Frontonasal prominence

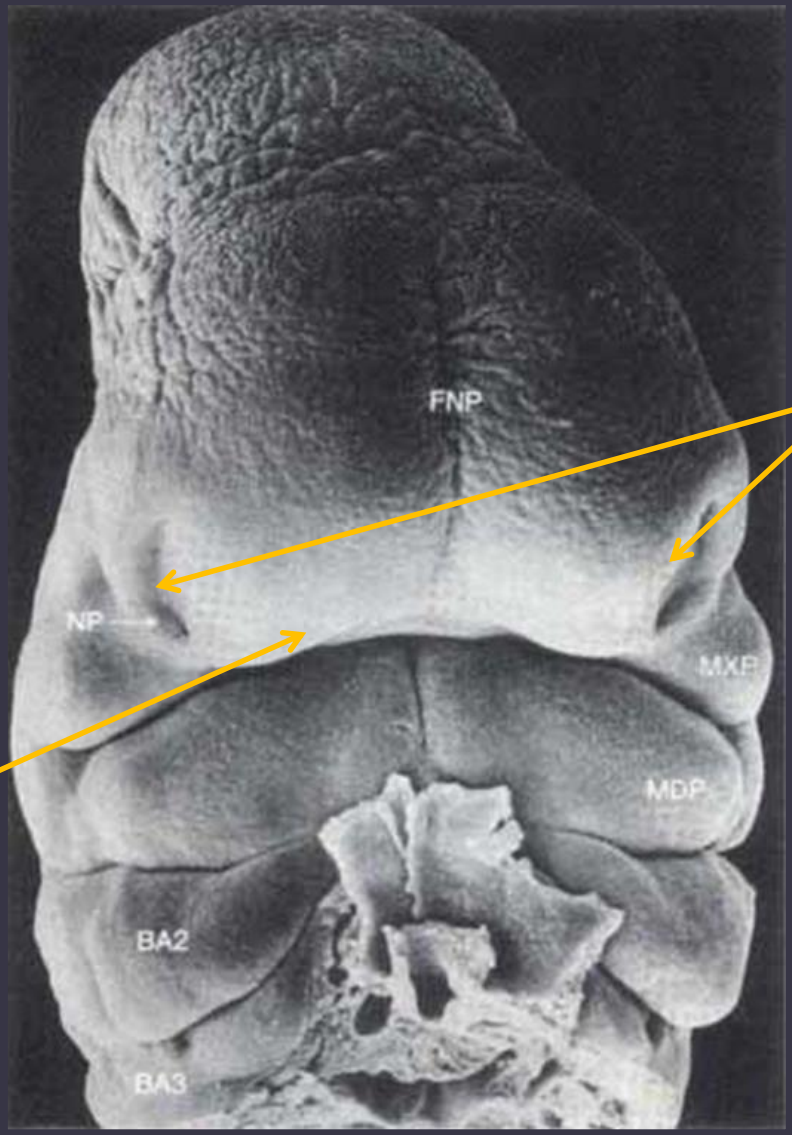
– Paired maxillary prominences

– Paired mandibular prominences



Medial and Lateral Nasal Prominences form a boundary of Naris

Stomodeum and nasal placodes



Nasal placodes

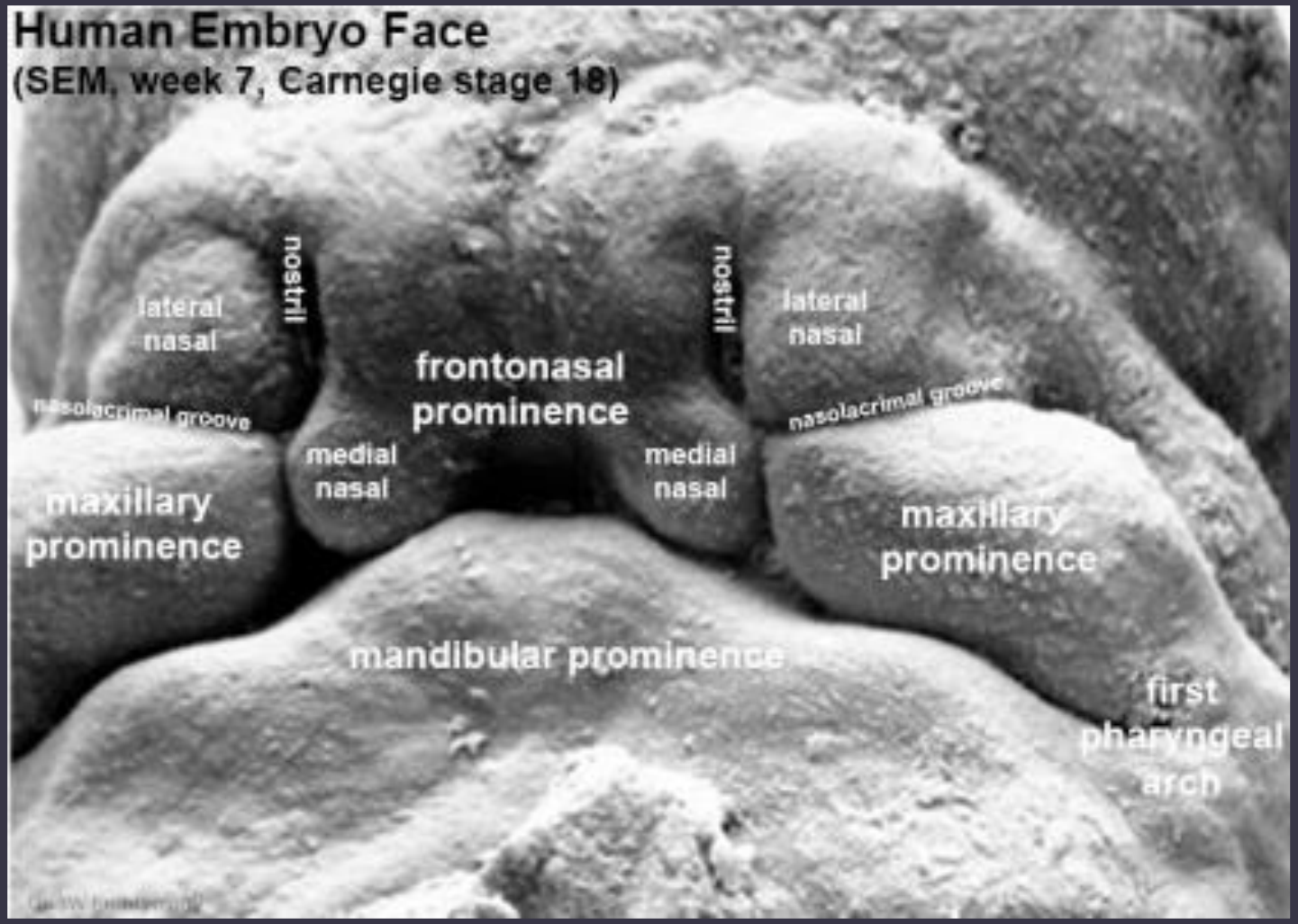
-bilateral right and left oval thickenings of surface ectoderm,
the end of the 4th week

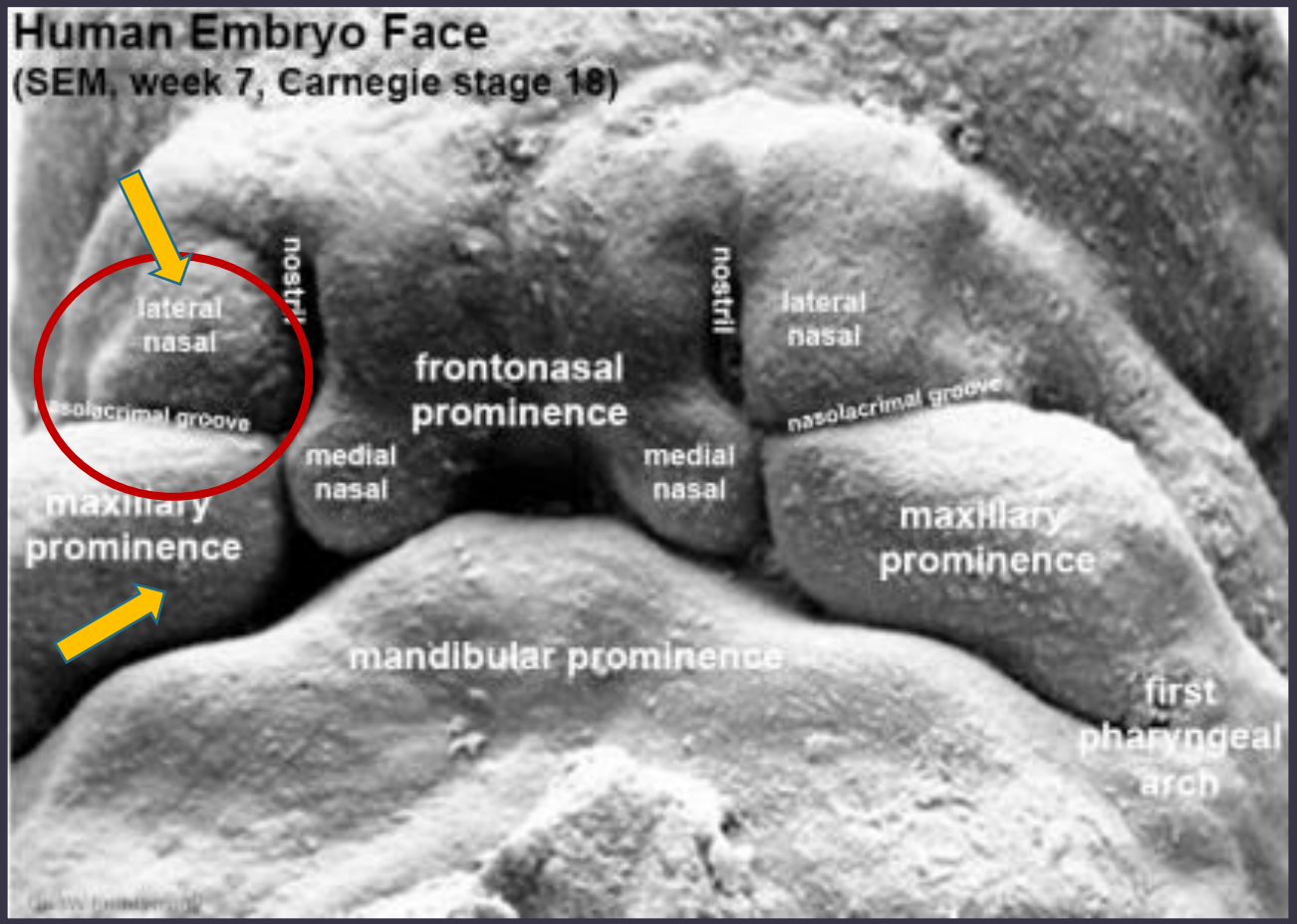
Stomodeum (future oral cavity)

Nasal placodes → Nasal pits → Nasal sacs

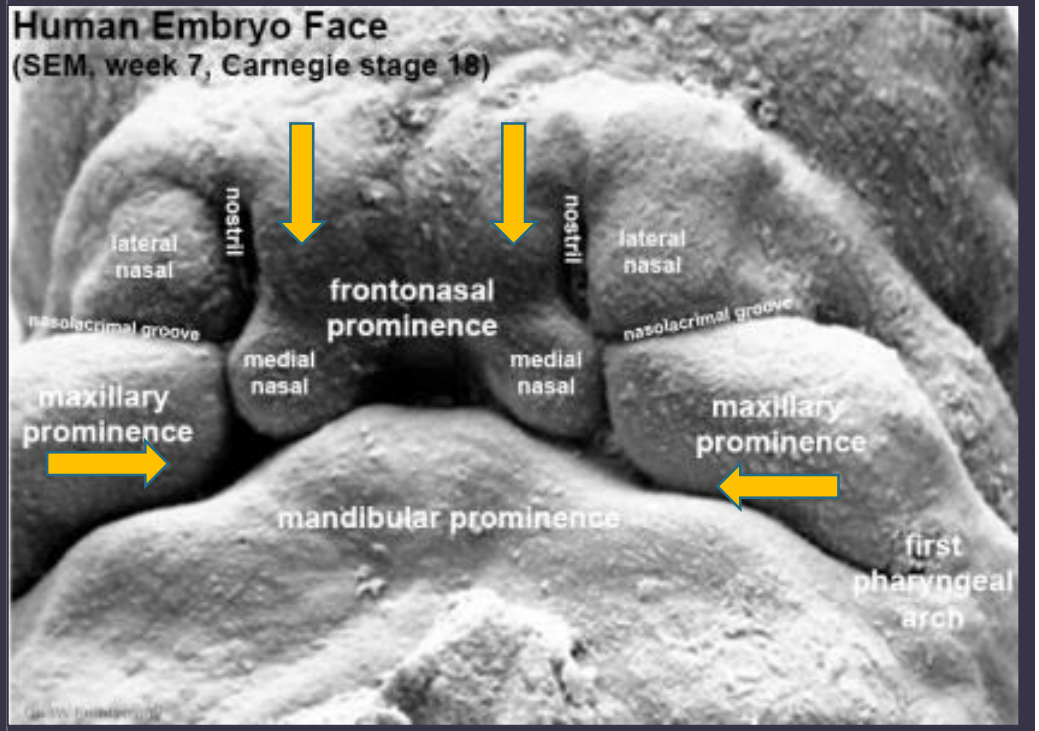
Nasal placodes

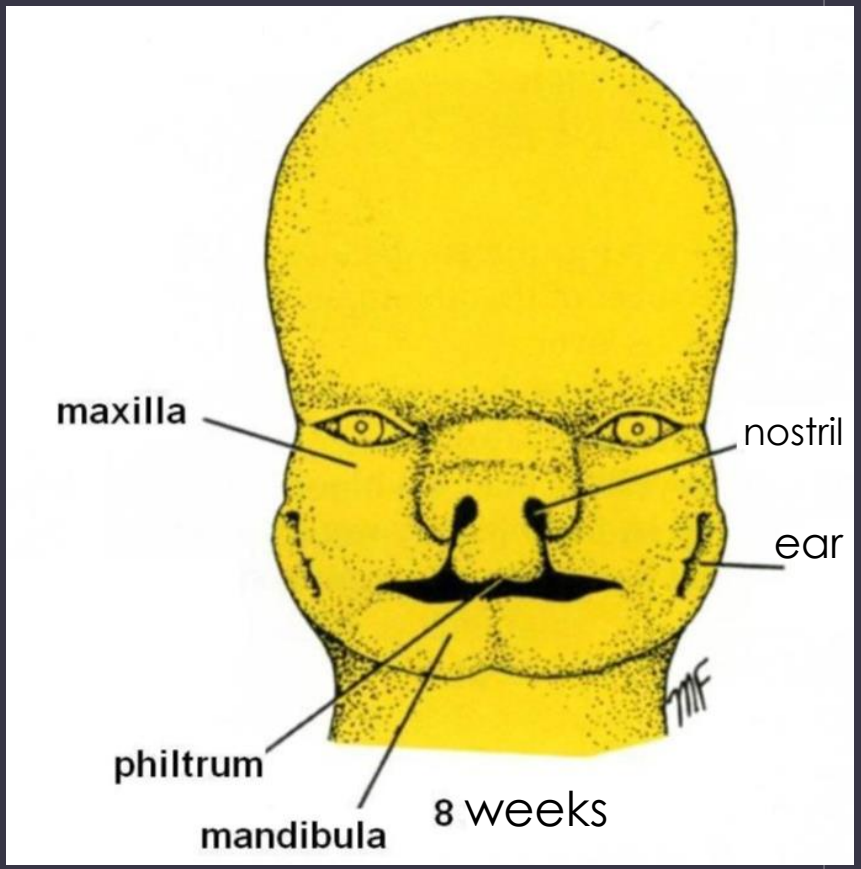
- divide frontonasal prominence into medial nasal and lateral nasal processes



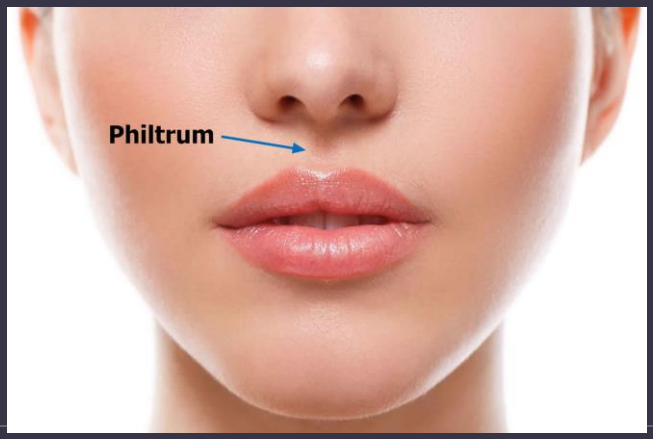


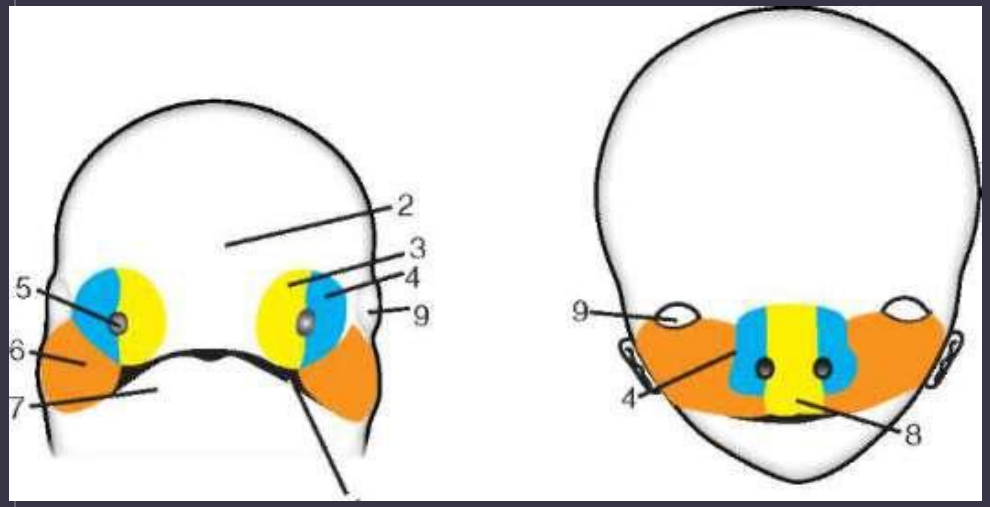
Maxillary prominences and lateral nasal process fuse, between them remains nasolacrimal groove (nasolacrimal canal in future)

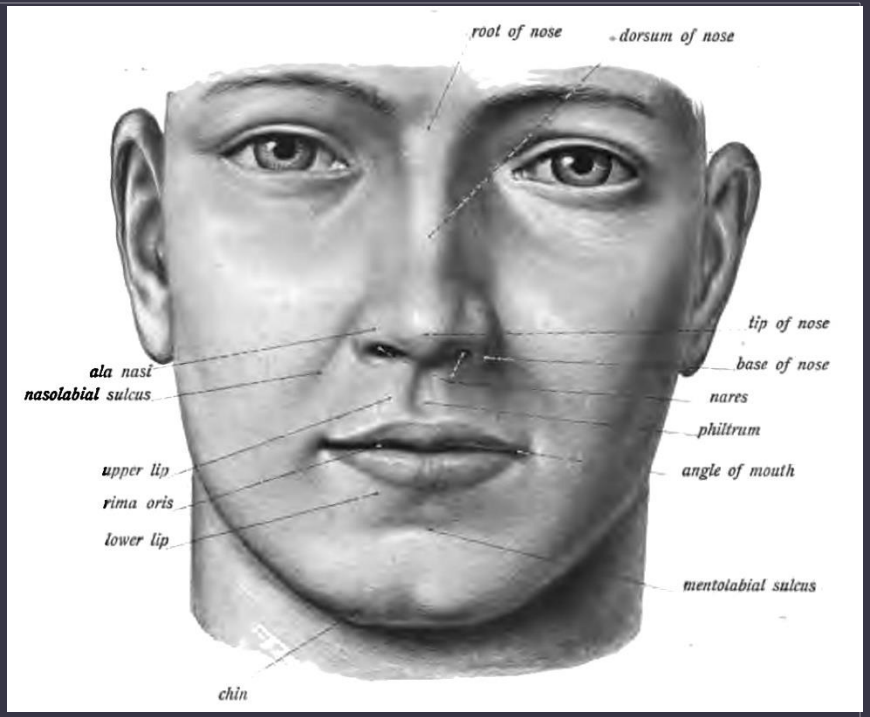




7-8th weeks – intensive growth of the medial nasal processes between maxillary prominences – formation of philtrum
- fusion of medial nasal processes with maxillary prominences – formation of the upper lips







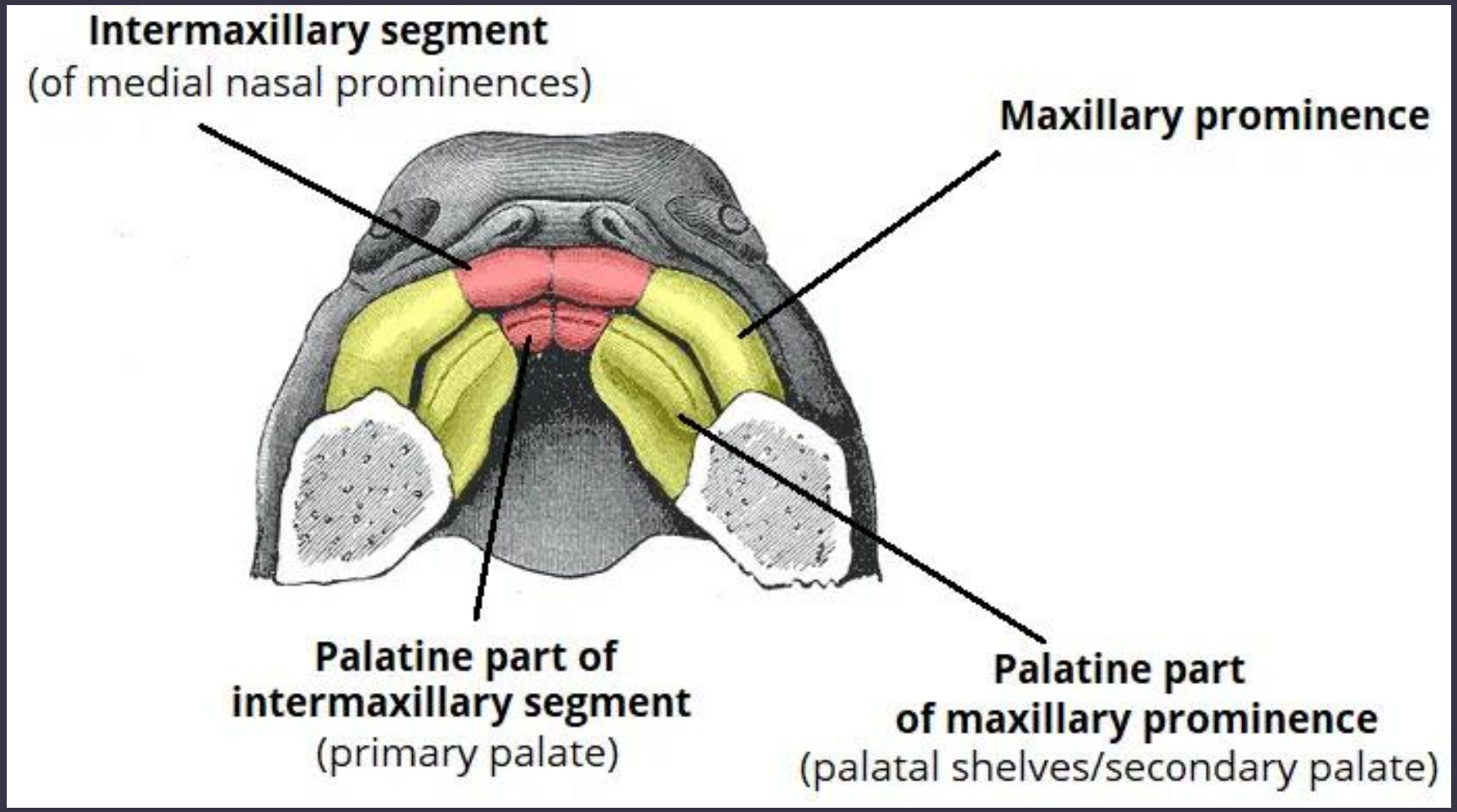
Medial nasal processes → The root, dorsum and apex of external nose, philtrum, nasal septum

Lateral nasal processes → The lateral aspect of external nose, nostrils

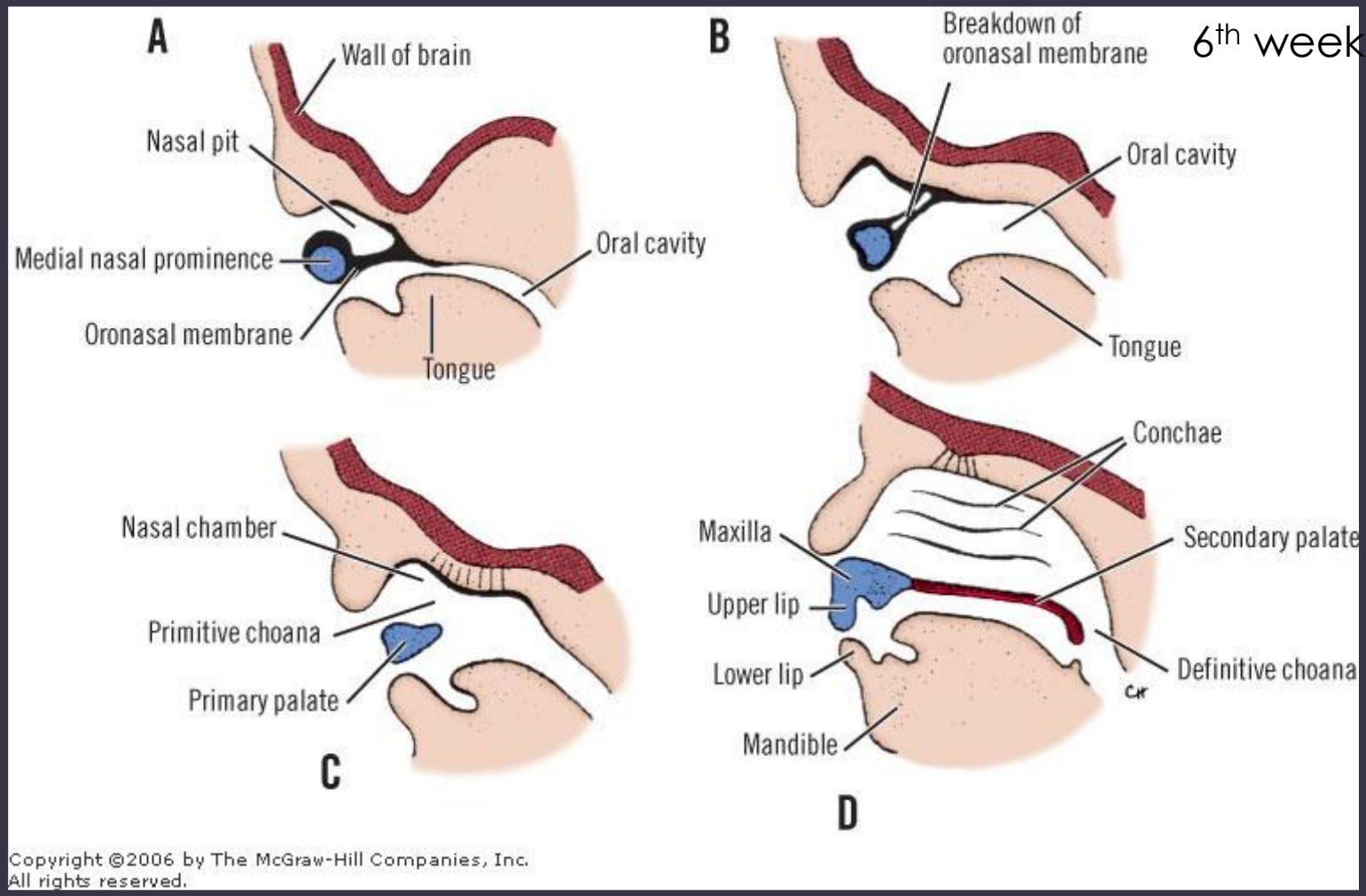
Maxillary prominences → The maxillae, lateral parts of the upper lips, the hard palate

Mandibular prominences → The mandible, lower lips

Development of the Palate

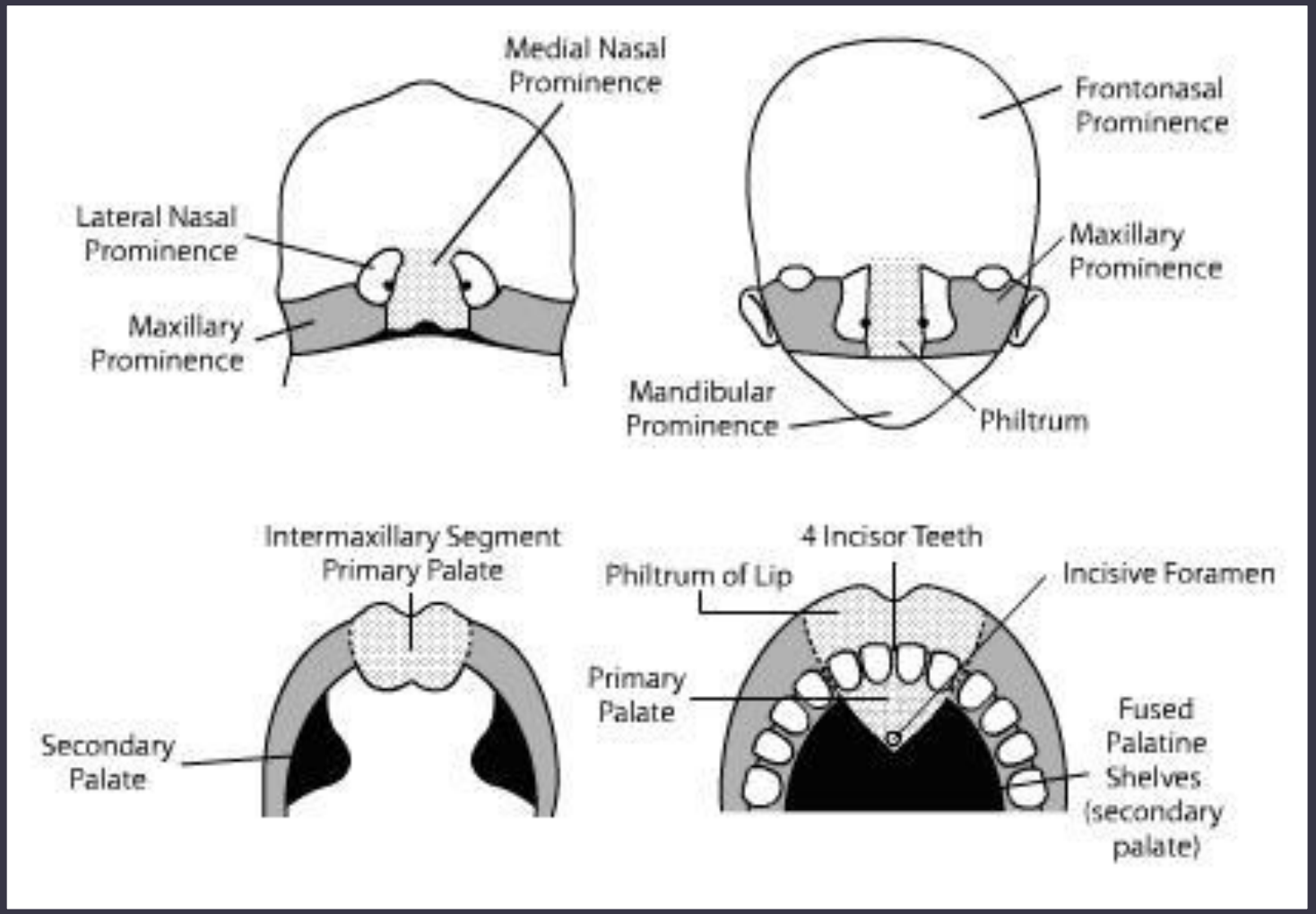


Development of nasal cavity and palate



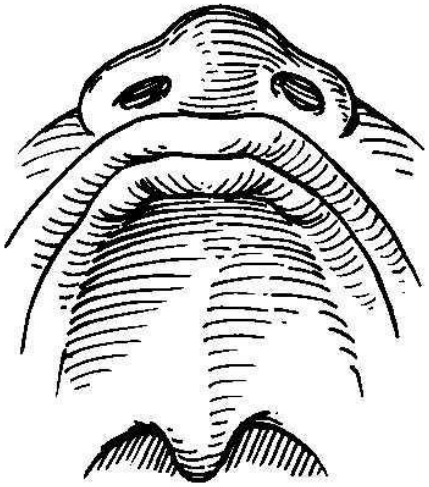
- **Rupture of oronasal membrane (6th week)**
- **Development of choana**
- **Development of primary and secondary palate**

Development of nasal cavity and palate

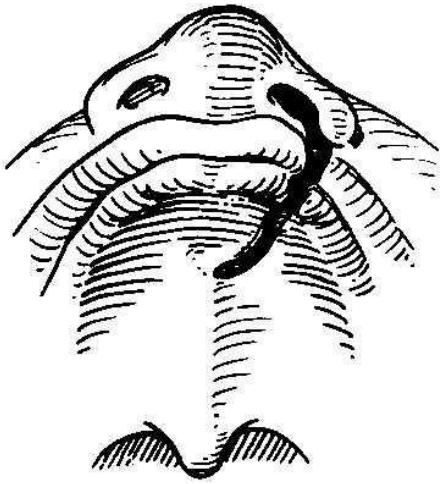


Nasal septum, incisive bone & central part of upper lip develop from merged medial nasal prominences

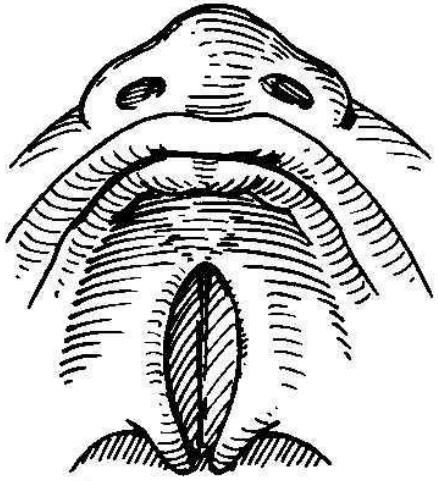
Development of the palate and palate cleft



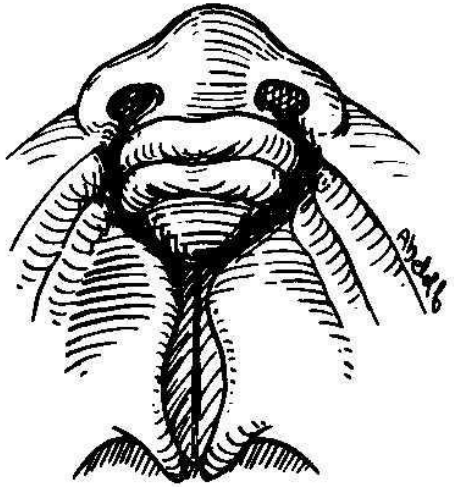
Normal



Anterior cleft only



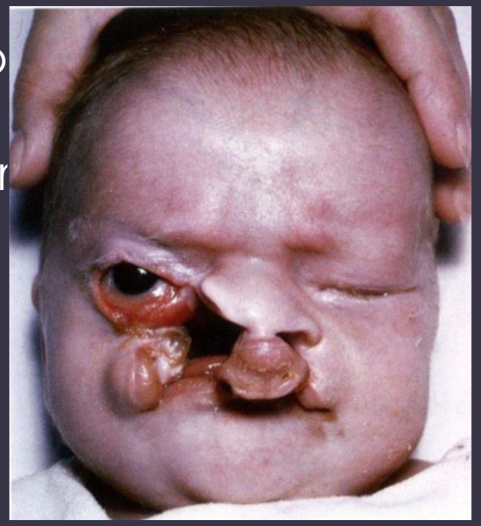
Posterior cleft only



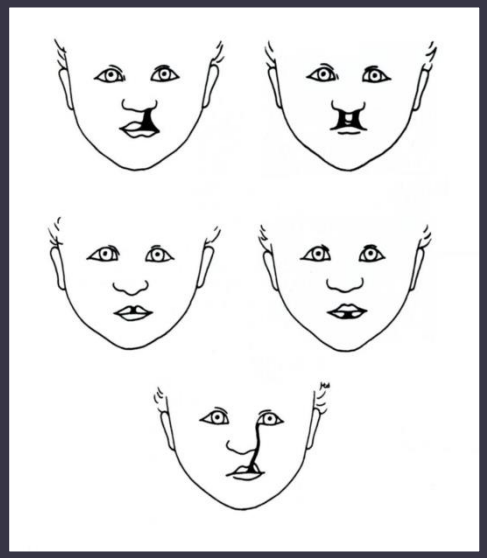
Compound cleft

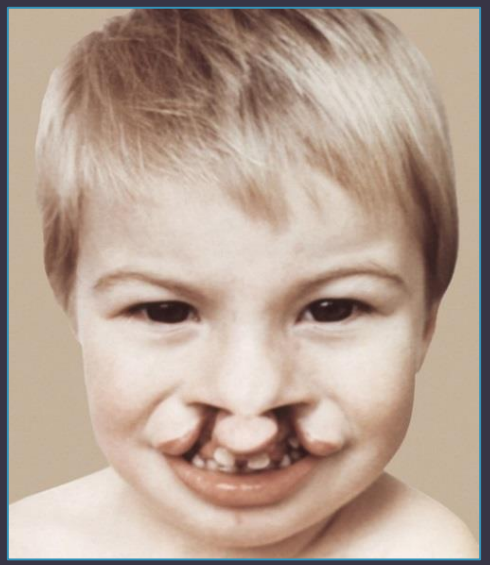
Congenital anomalies of middle face

1. Oblique cleft of the face (persistent nasolacrimal groove)
– It connect mouth to medial palpebral angle of the orb
– Nasolacrimal duct is present as open grove
It results from failure of fusion of lateral nasal and maxillar prominences

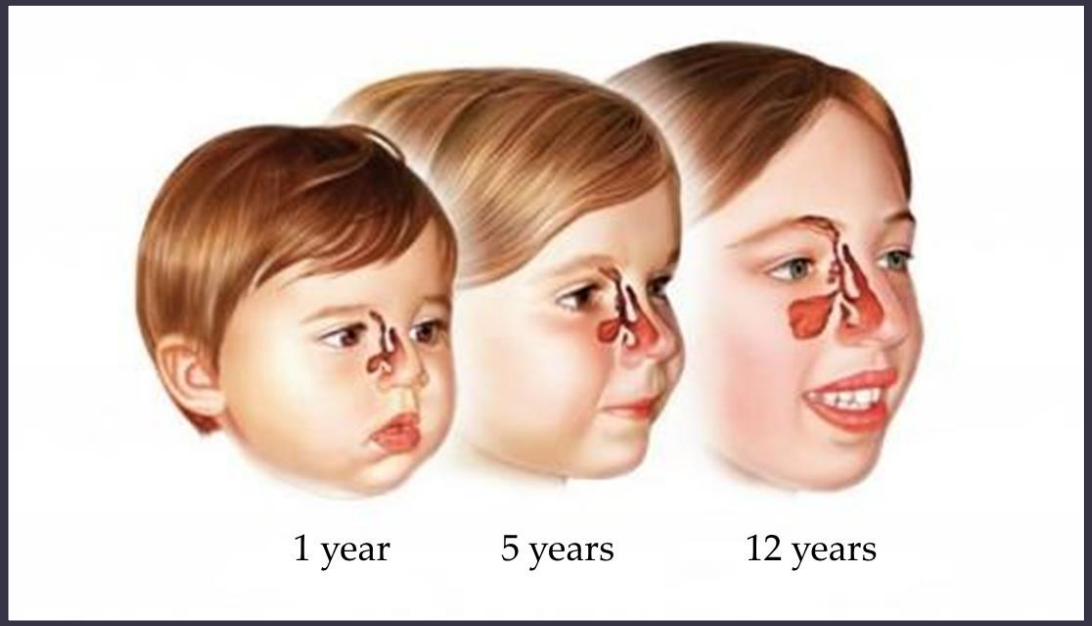


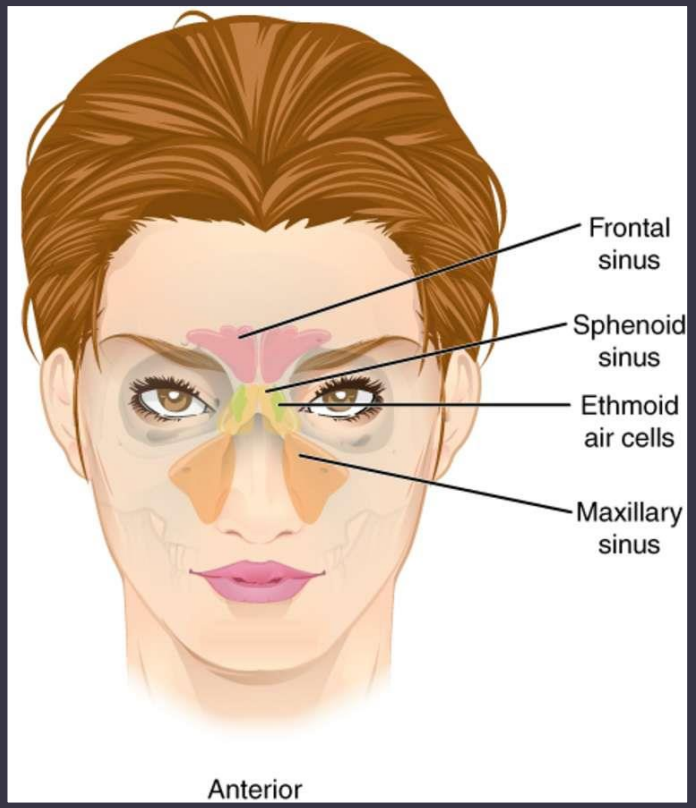
2. Cleft of upper lip, superior alveolar arch and palate
– It results from failure of fusion of medial nasal and maxillary prominences
They could be unilateral or bilateral



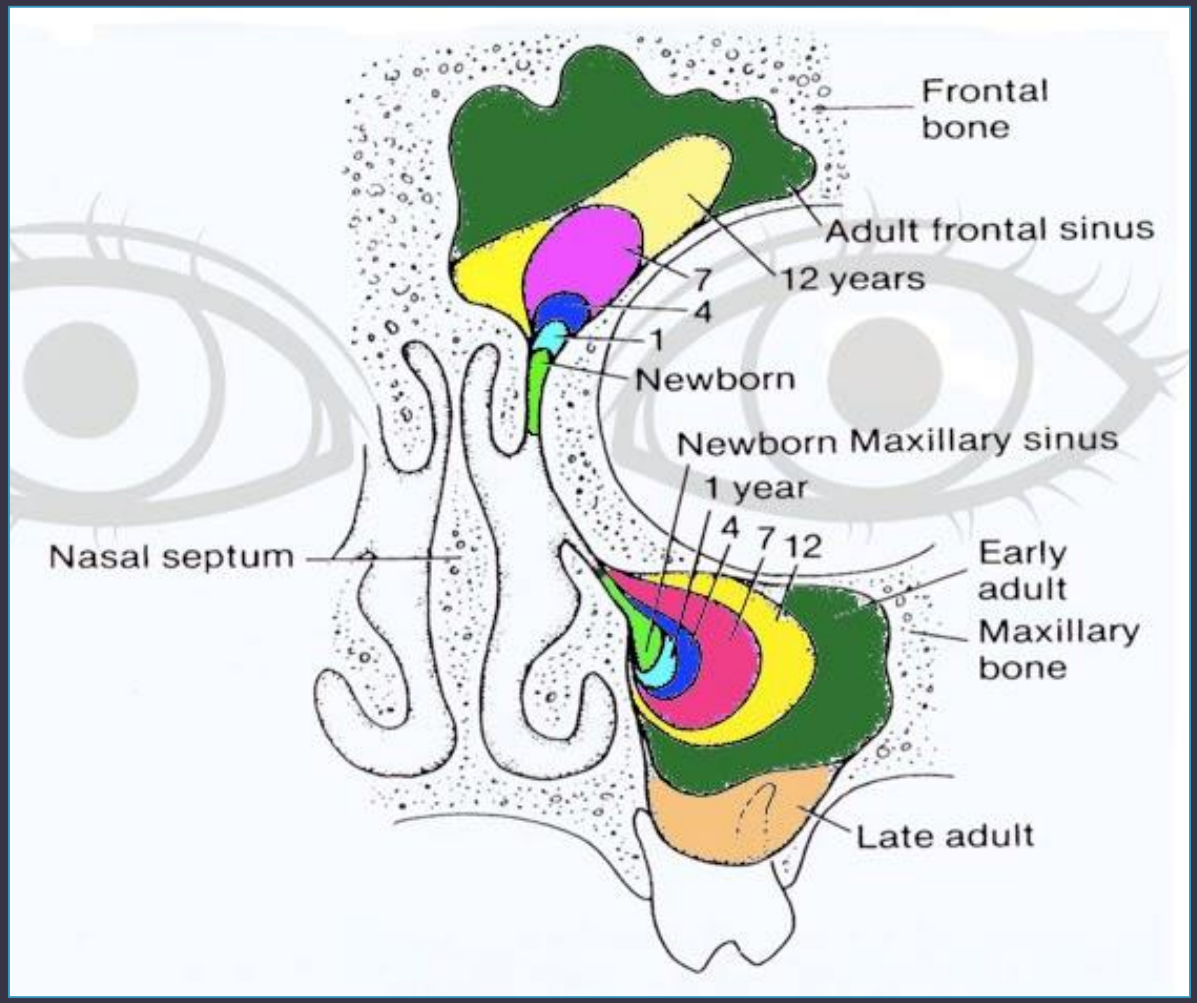


Paranasal air sinuses



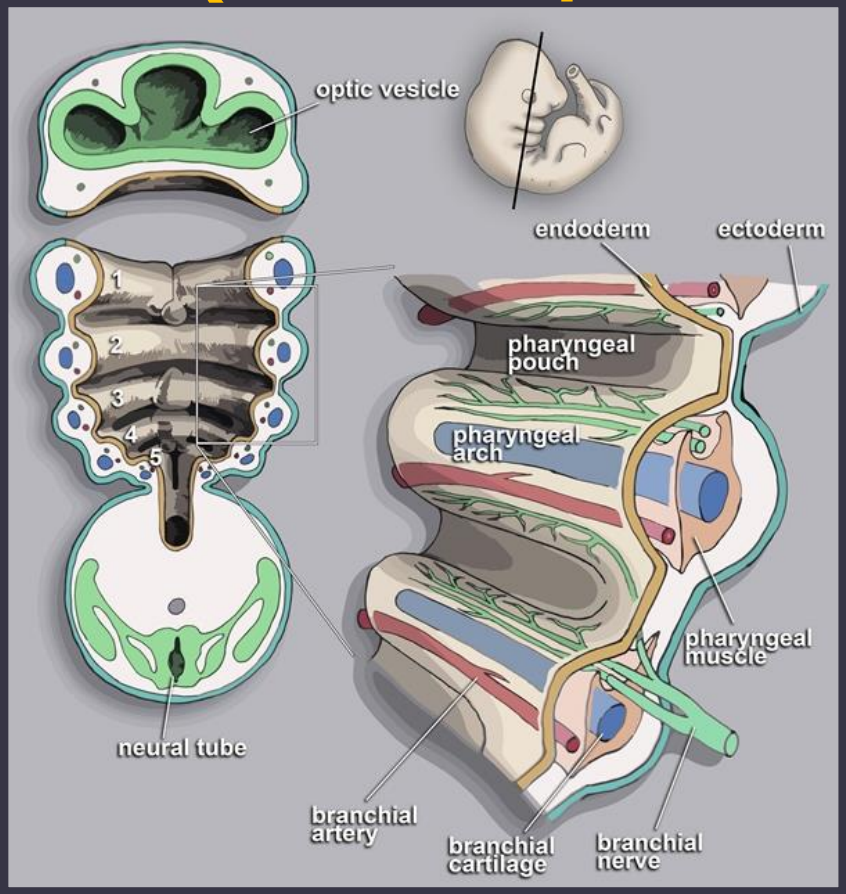


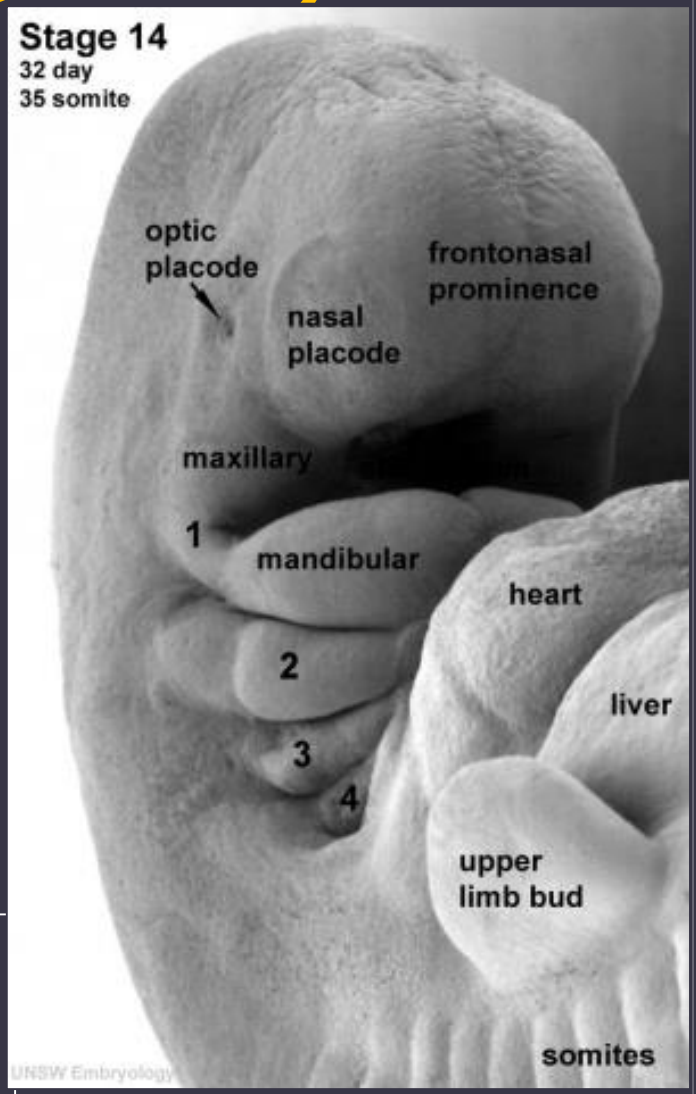
-facial skull bones which contain air spaces lined with mucous membrane
-make the skull light
-impart resonance to voice
-act as conditioning chambers for inspired air



- Sinuses appear on 12th week of gestation
- Rapid growth till 12-years after birth
- Growth together with facial skull bones
- Growth of maxillary sinus stops with eruption of last molars

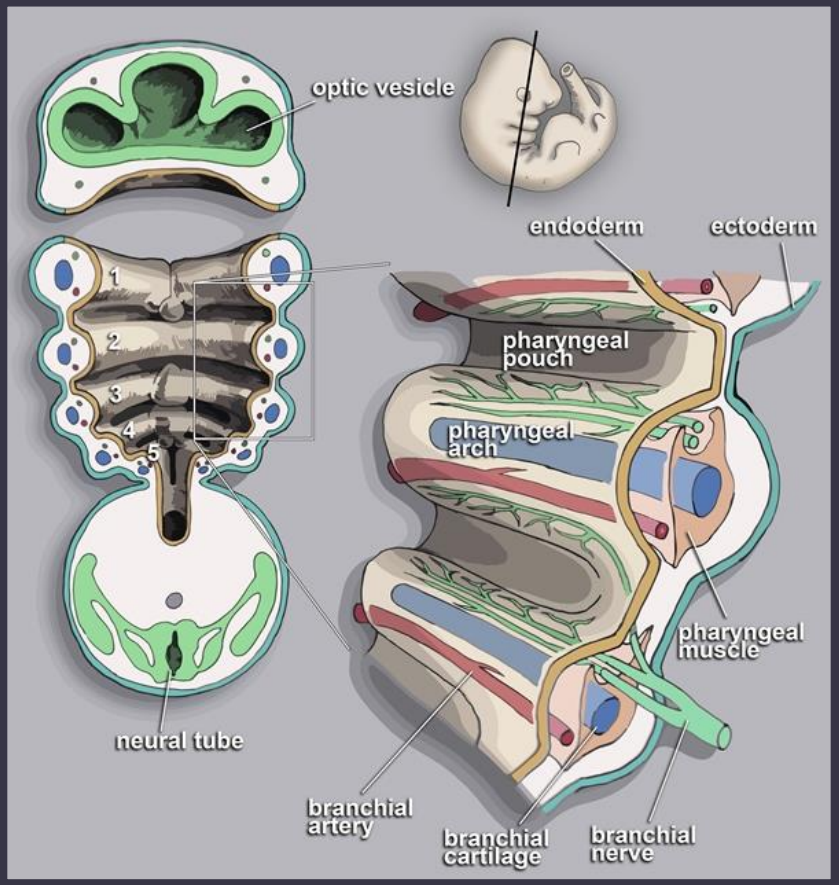
Development of branchial apparatus (arches, pouches, grooves)

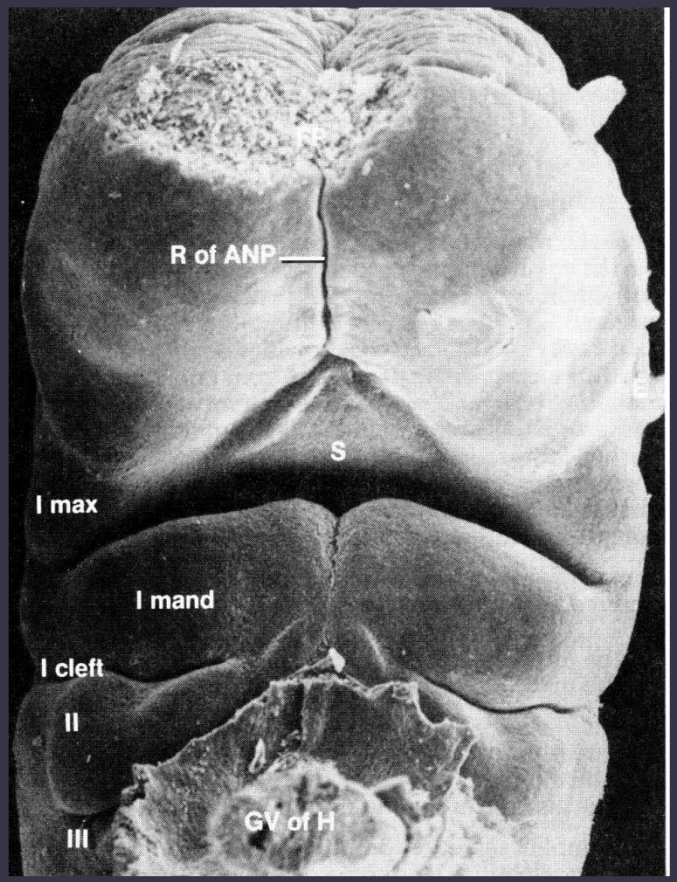




The 4th week - neural crest cells migrate through the mesenchyme to the future head and neck region, forming elevations of mesoderm on each side of the primitive pharynx

Pharyngeal arches





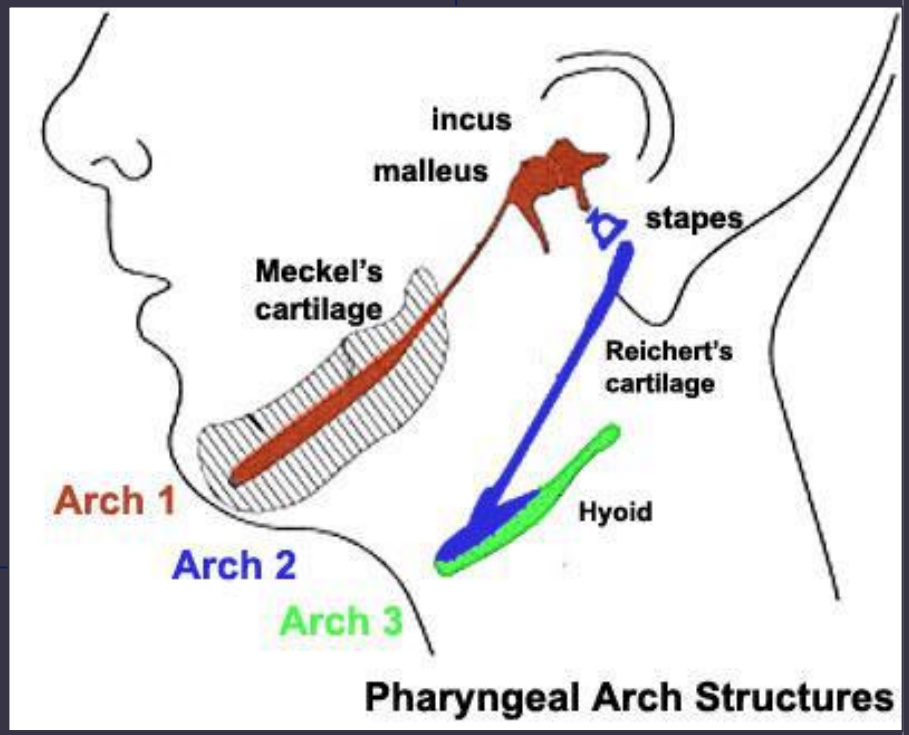
- a series of mesodermal outpouchings on both sides of the developing pharynx
- covered with:
- Ectoderm outside – formation of pharyngeal clefts
- Endoderm inside – formation of pharyngeal pouches

The 1st Pharyngeal arch (mandibular)

Develop:

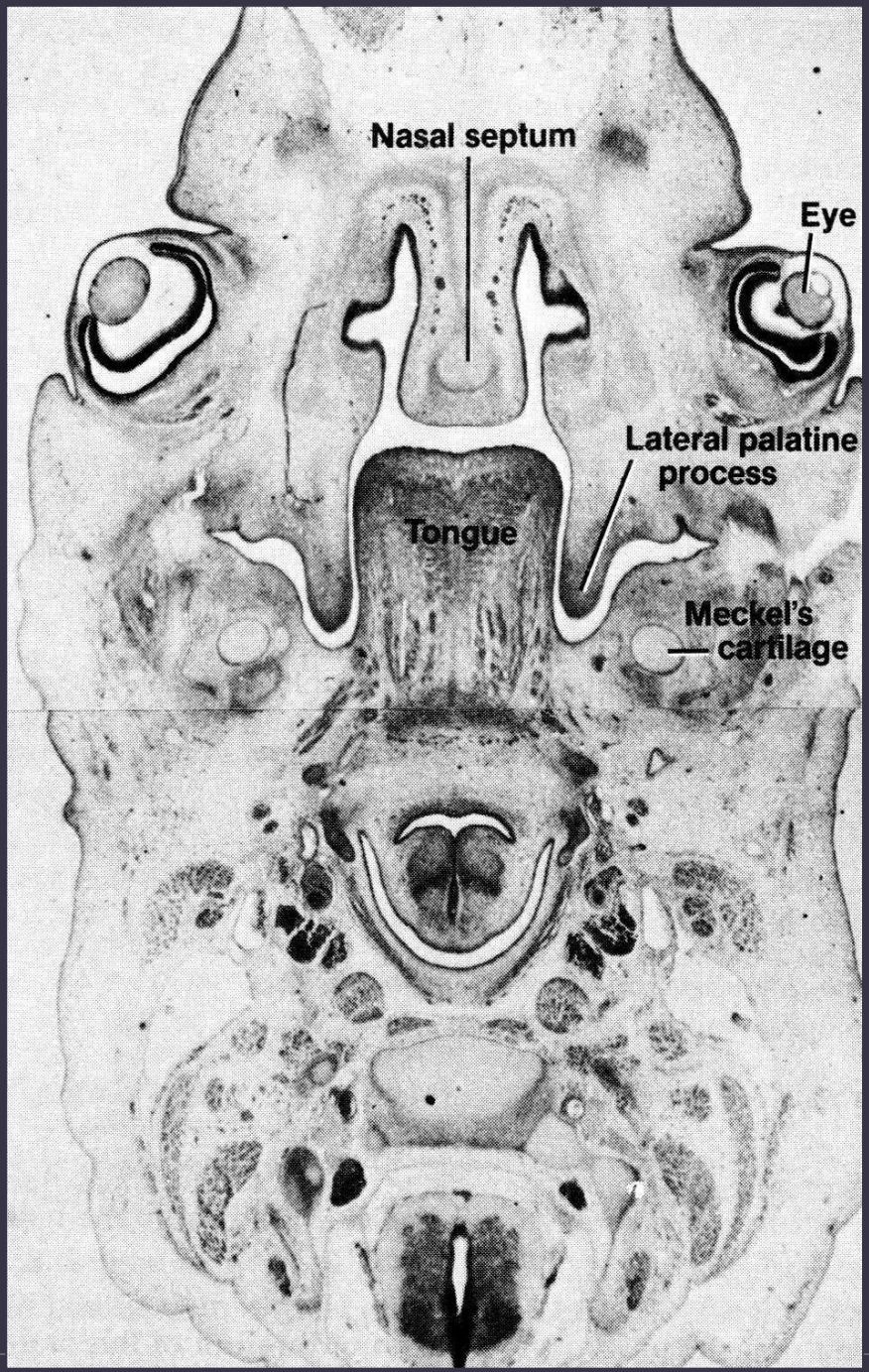
- masticatory muscles
- m. mylohyoideus, m. digastricus (venter anterior)
- m. tensor veli palatini, m. tensor tympani
- Lips
- Jaws
- Palate
- Anterior 2/3 of the tongue
- Porus accusticus externus
- Membrana tympanica
- Malleus and incus
- External ear (anterior part)

- Innervated by trigeminal nerve (V)



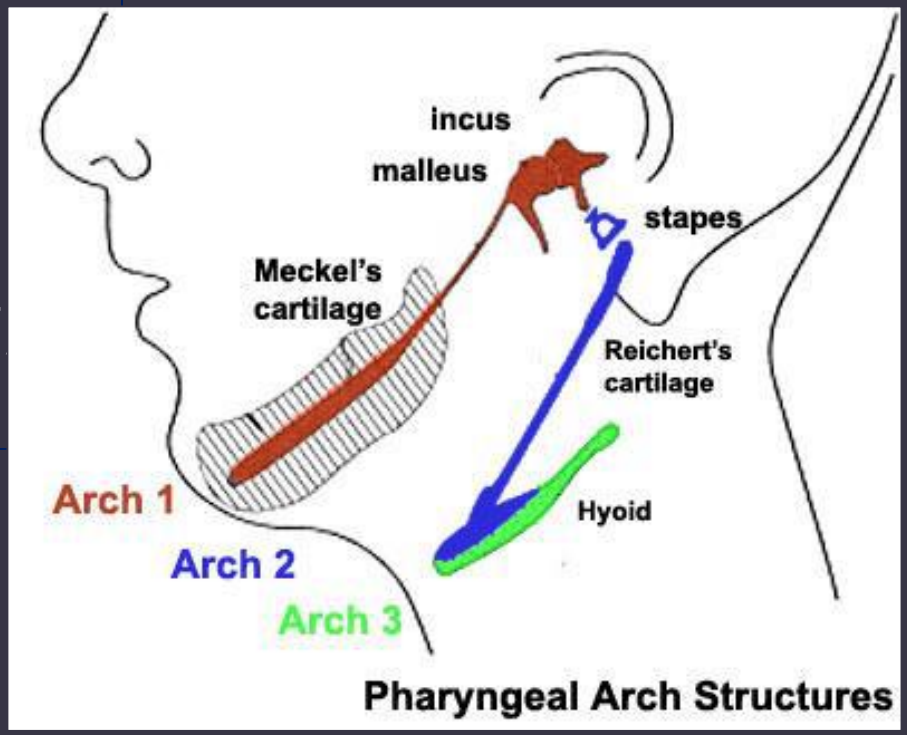
Meckel`s cartilage – mandible

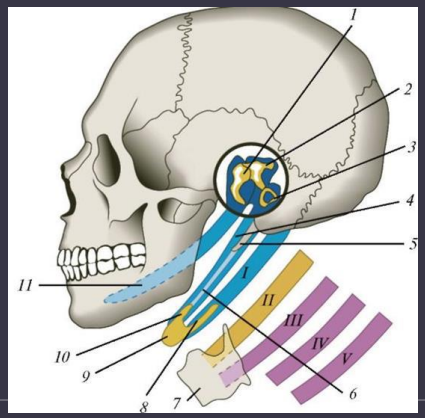
NB! Mandible buds are paired!



The 2nd Pharyngeal arch (hyoid)

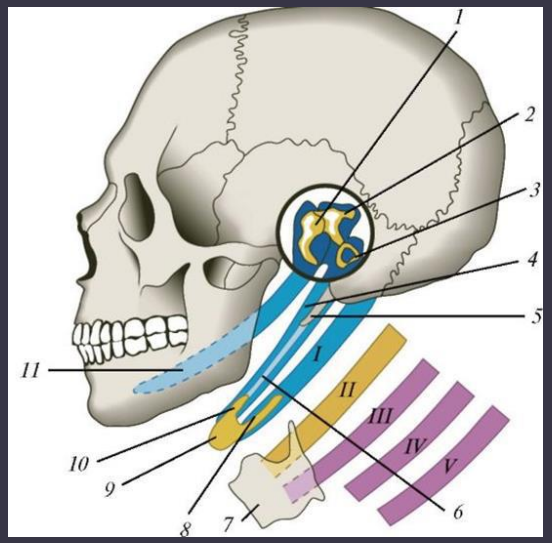
- Innervated by facial nerve (VII)
- mimic muscles
- m. digastricus (venter posterior)
- m. stylohyoideus
- Stapes and m.stapedius
- Processus styloideus
- Hyoid bone
- Tonsilla palatina
- External ear (posterior part
- Anterior 2/3 of the tongue

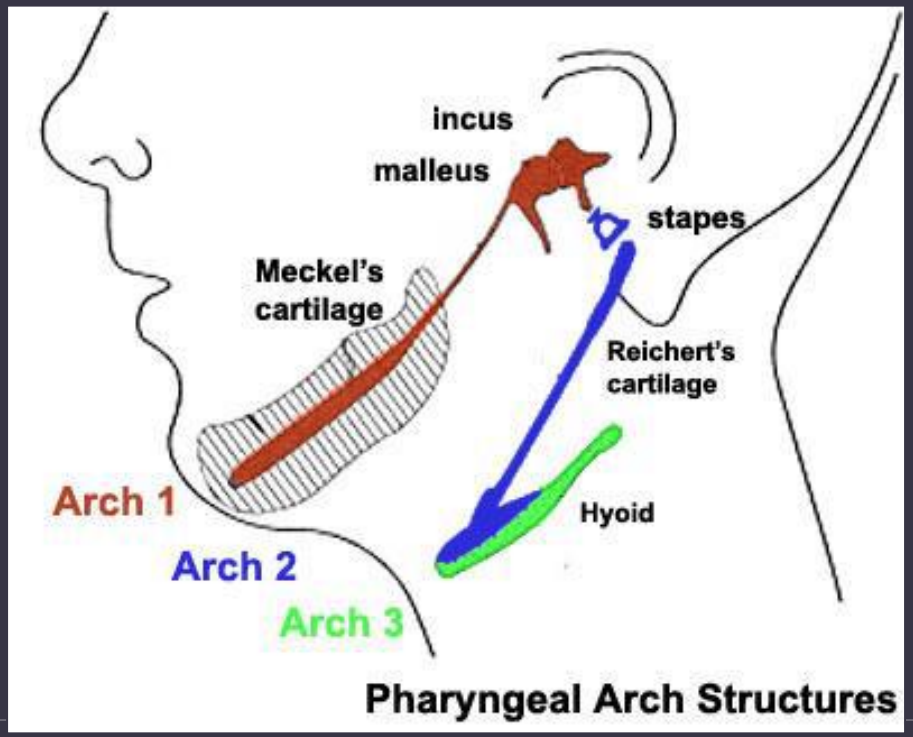




The 3rd Pharyngeal arch

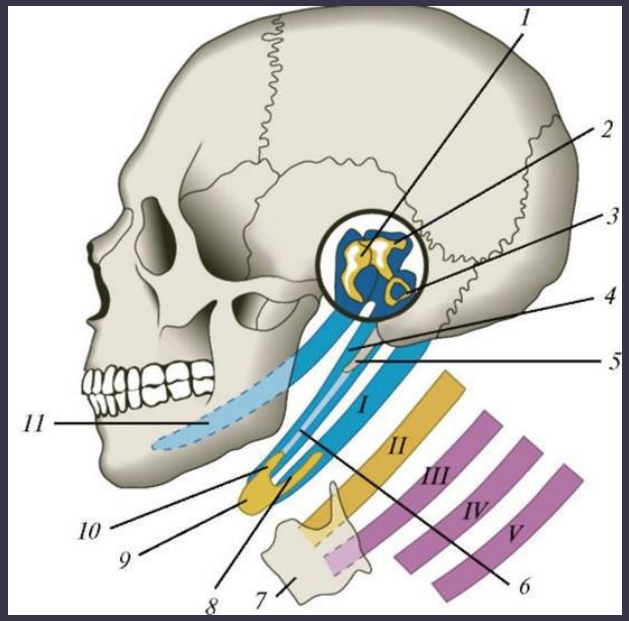
- Innervated by glossopharyngeal (IX) nerve
- muscles of the palate
- m. stylopharyngeus
- Hyoid bone
- Thymus
- Posterior 1/3 of the tongue

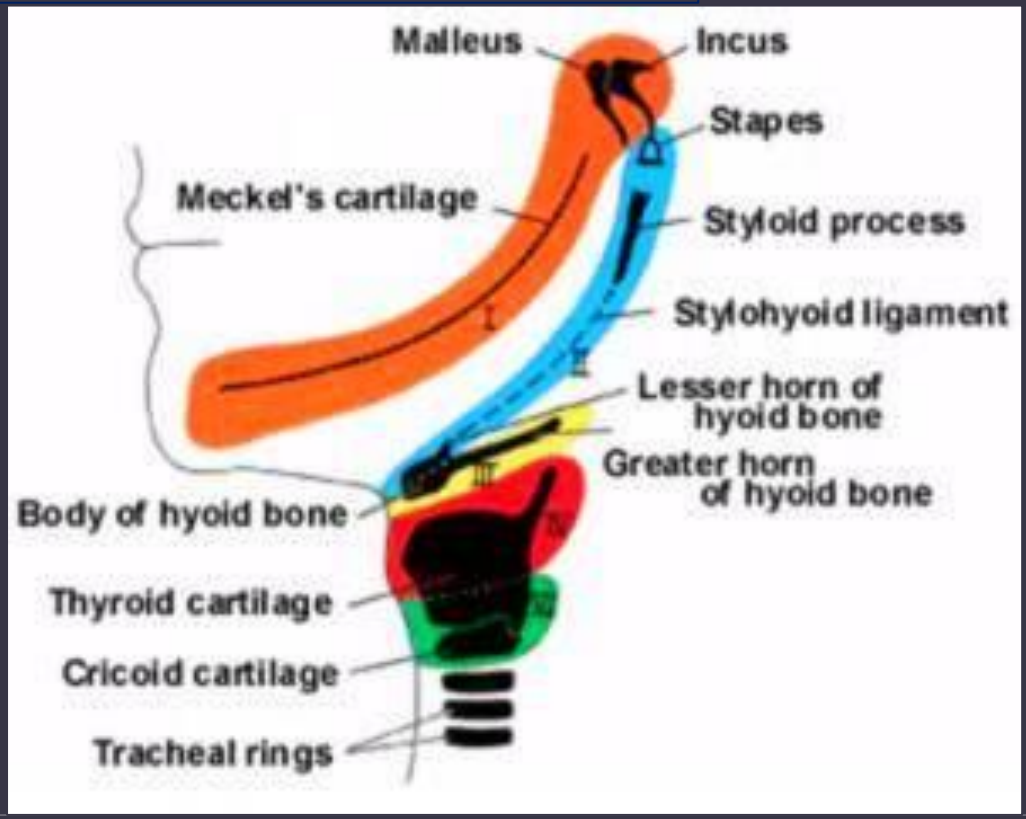




The 4th and the 6th Pharyngeal arches

- Innervated by vagal (X) nerve
- Muscles of the palate and pharynx
- Cartilages and muscles of the larynx
- Thymus
- Root of the tongue





Development of the tongue

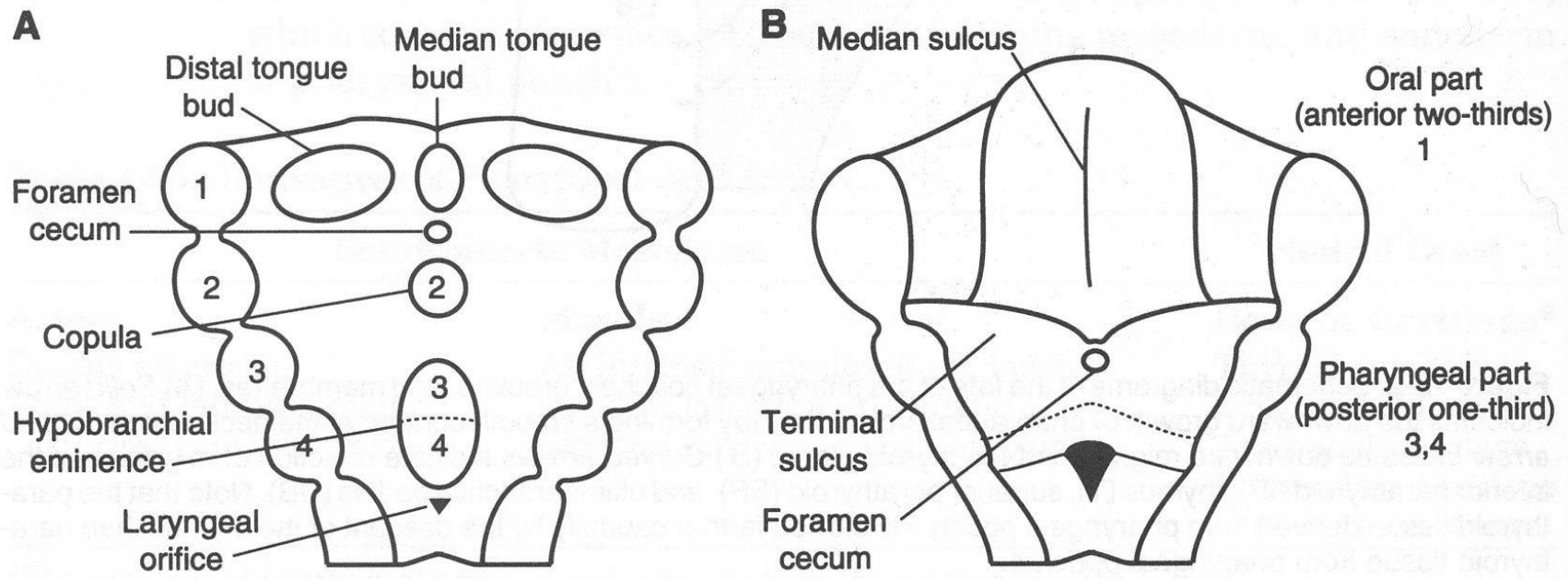
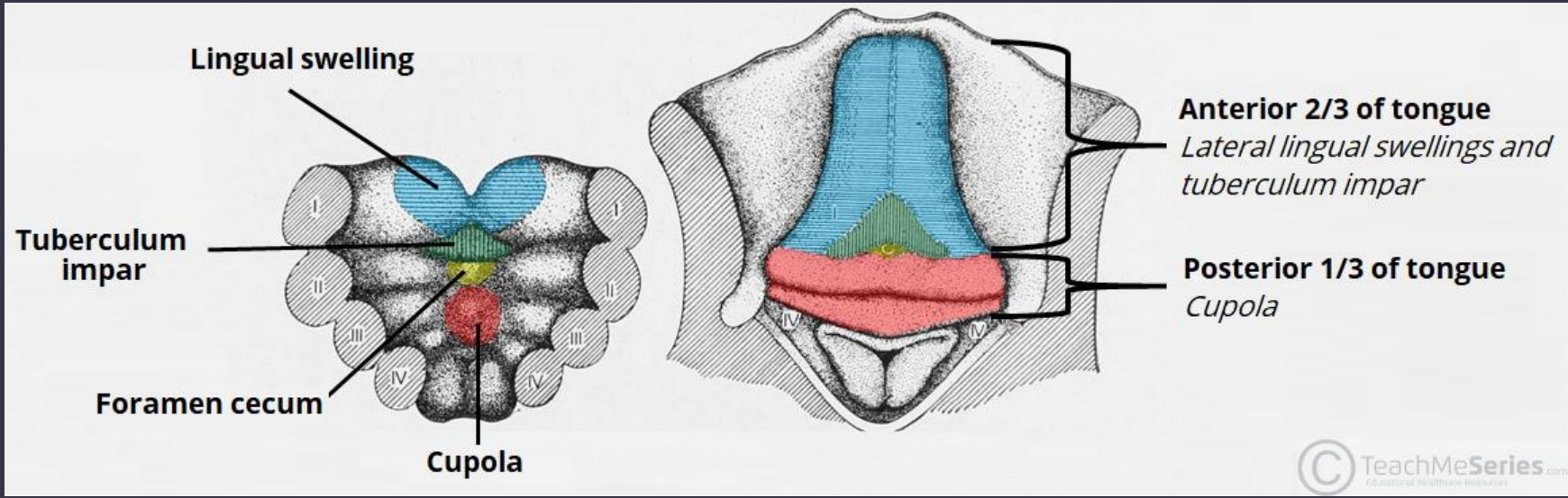


Figure 12-3. Diagram showing the development of the tongue. (*A*) At week 5. (*B*) In the newborn.

Tongue parts	Tongue buds	Origin of the bud	Fusion	Innervation
Anterior 2/3 of the tongue	-Median bud -2 distal buds	Pharyngeal arch 1,2	Median sulcus	CN V, CN VII
Posterior 1/3 of the tongue	- Copula	Pharyngeal arches 3	Sulcus terminalis Foramen cecum	CN IX
Root of the tongue	- Hypobranchial prominence	Pharyngeal arch 4,5		CN X

Development of the tongue



Tongue parts	Tongue buds	Origin of the bud	Fusion	Innervation
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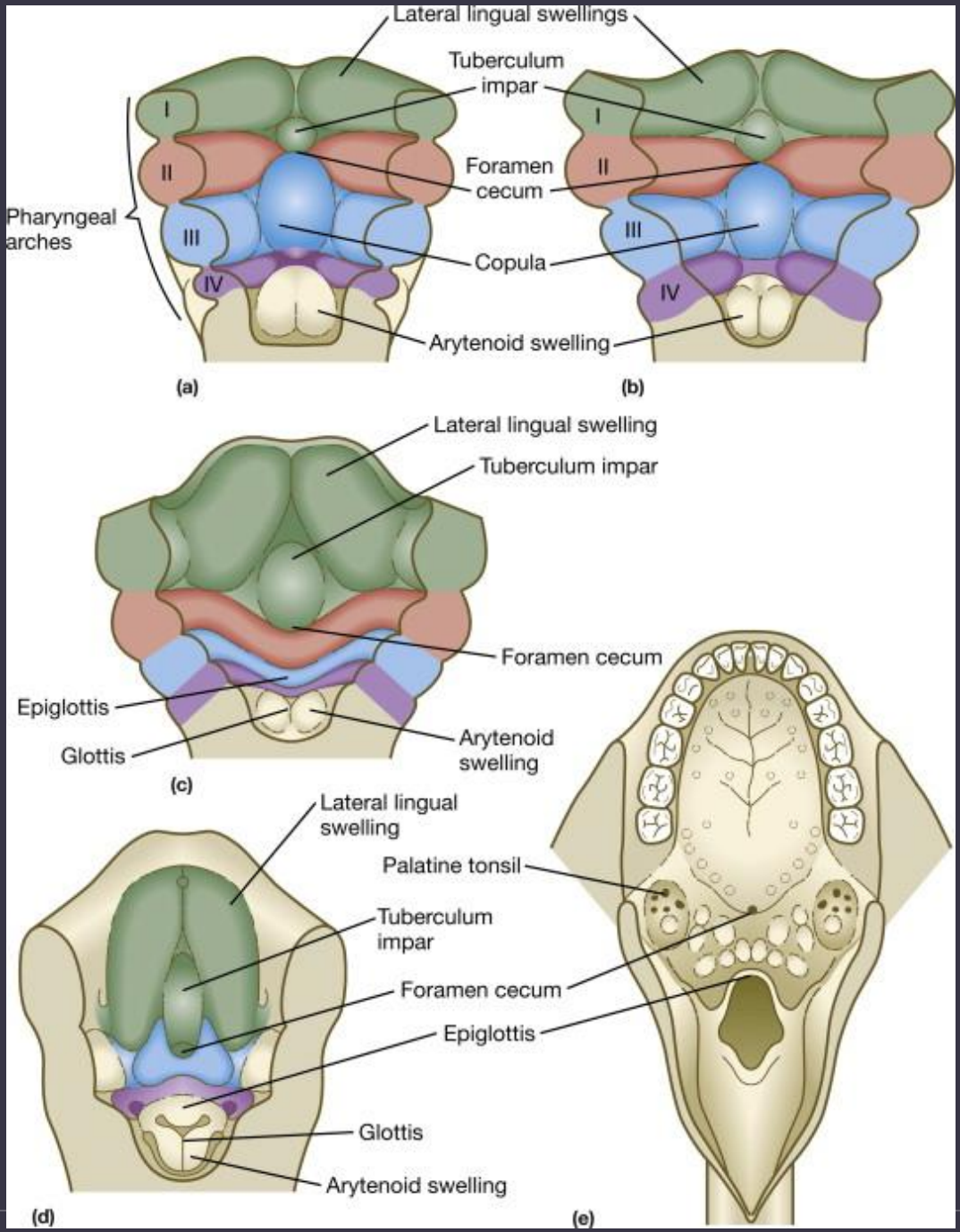
Posterior 1/3 of the tongue	- Copula	Pharyngeal arches 3	Sulcus terminalis Foramen cecum	CN IX
Root of the tongue	- Hypobranchial prominence	Pharyngeal arch 4,5		CN X


Lateral lingual swellings
Tuberculum impar
Foramen cecum
Copula
Arytenoid swelling
Pharyngeal arches
I
II
III
IV
(a)
(b)
Lateral lingual swelling
Tuberculum impar
Foramen cecum
Epiglottis
Glottis
Arytenoid swelling
(c)
Lateral lingual swelling
Tuberculum impar
Foramen cecum
Epiglottis
Glottis
Arytenoid swelling
(d)
Palatine tonsil
(e)

Pathology of the tongue development

1. Aglossia
2. Microglossia, which is always combined with other defects and syndromes, like Moëbius syndrome
3. Macroglossia, which is commonly associated with cretinism, Down's syndrome, Hunter's syndrome, Sanfilippo syndrome and other types of mental retardation
4. Accessory tongue
5. Long tongue
6. Cleft or Bifid tongue, condition very usual in patients with the orodigitofacial syndrome
7. Glossitis Rhombica Mediana, a developmental malformation
8. Lingual thyroid.

Ankyloglossia

- Fixation of the tongue to the floor of the mouth, causing restricted movement.

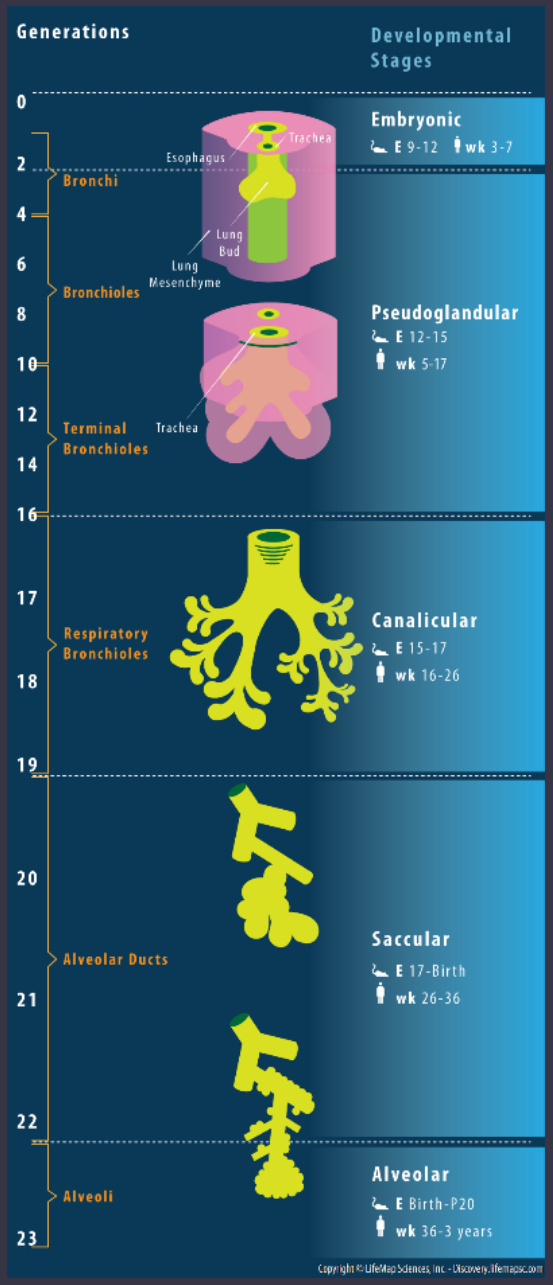
- CLINICAL FEATURES
- Speech disorders
- Deformities in occlusion
- Difficulties in swallowing

- It can be either complete ankyloglossia or partial ankyloglossia (tongue tie)

- Complete ankyloglossia occurs as a result of fusion between the tongue and the floor of the mouth. Can be surgically treated by frenulectomy.
- Partial ankyloglossia occurs as a result of short lingual fraenum or due to a fraenum which attaches too near the tip of the tongue. It is self corrective.

The development of the respiratory system

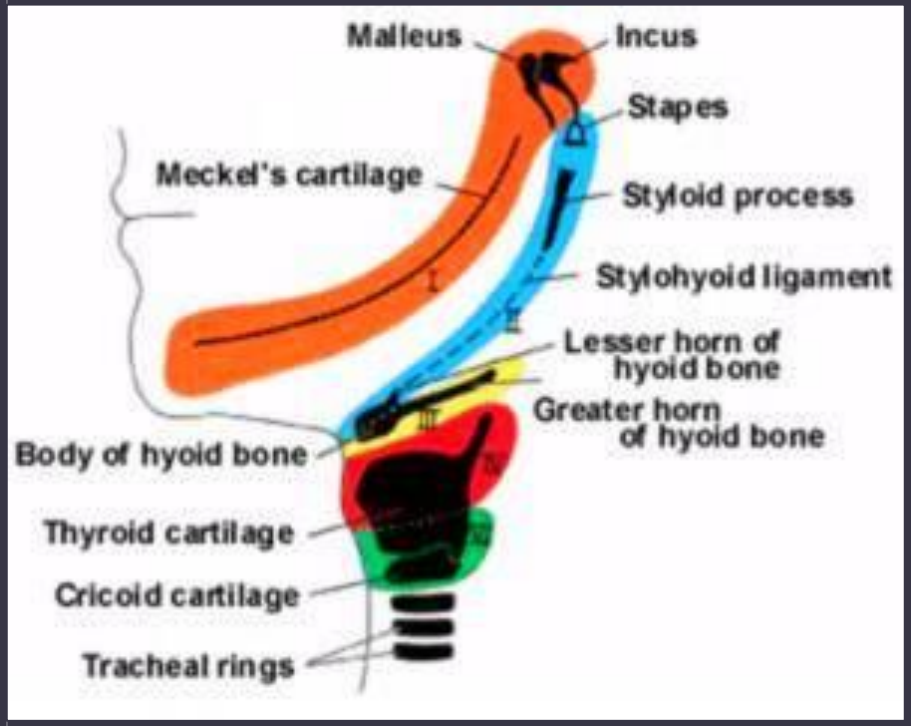
The lower respiratory tract

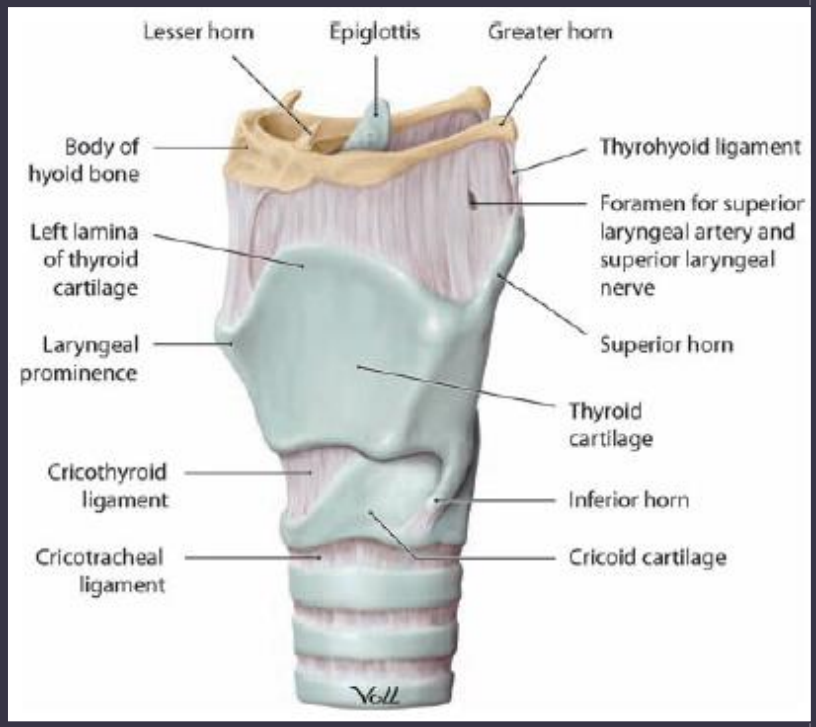


Development of the larynx

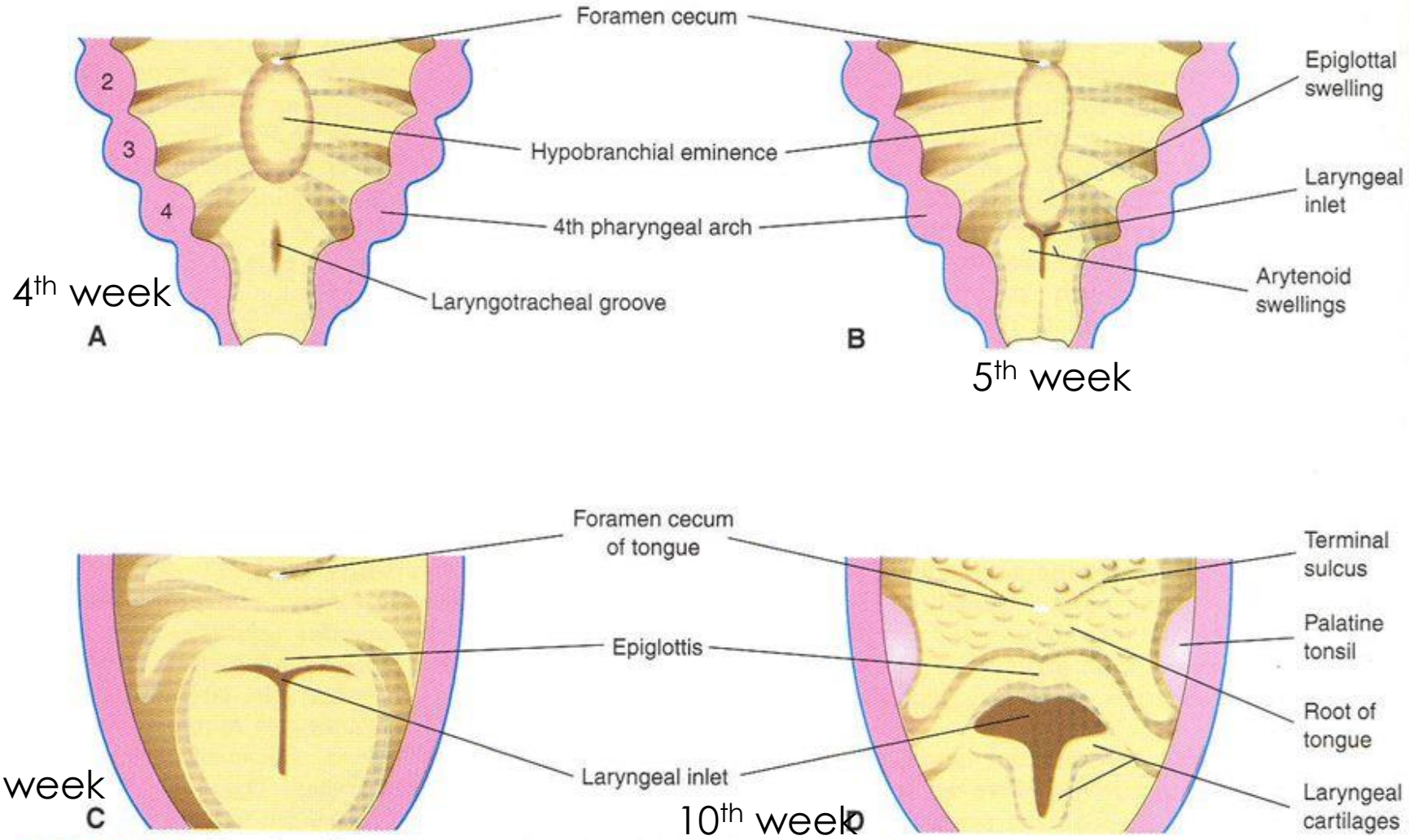
- the 4th and the 6th Pharyngeal arches

- Innervated by vagal (X) nerve
- Muscles of the palate and pharynx
- Cartilages and muscles of the larynx
- Thymus





Development of Laryngeal Inlet



■ **Figure 11–3.** Drawings illustrating successive stages in the development of the larynx. *A*, 4 weeks. *B*, 5 weeks. *C*, 6 weeks. *D*, 10 weeks. The epithelium lining the larynx is of endodermal origin. The cartilages and muscles of the larynx arise from mesenchyme in the fourth and sixth pairs of pharyngeal arches. Note that the laryngeal inlet or aditus changes in shape from a slitlike opening to a T-shaped inlet as the mesenchyme surrounding the developing larynx proliferates.

Development of the trachea

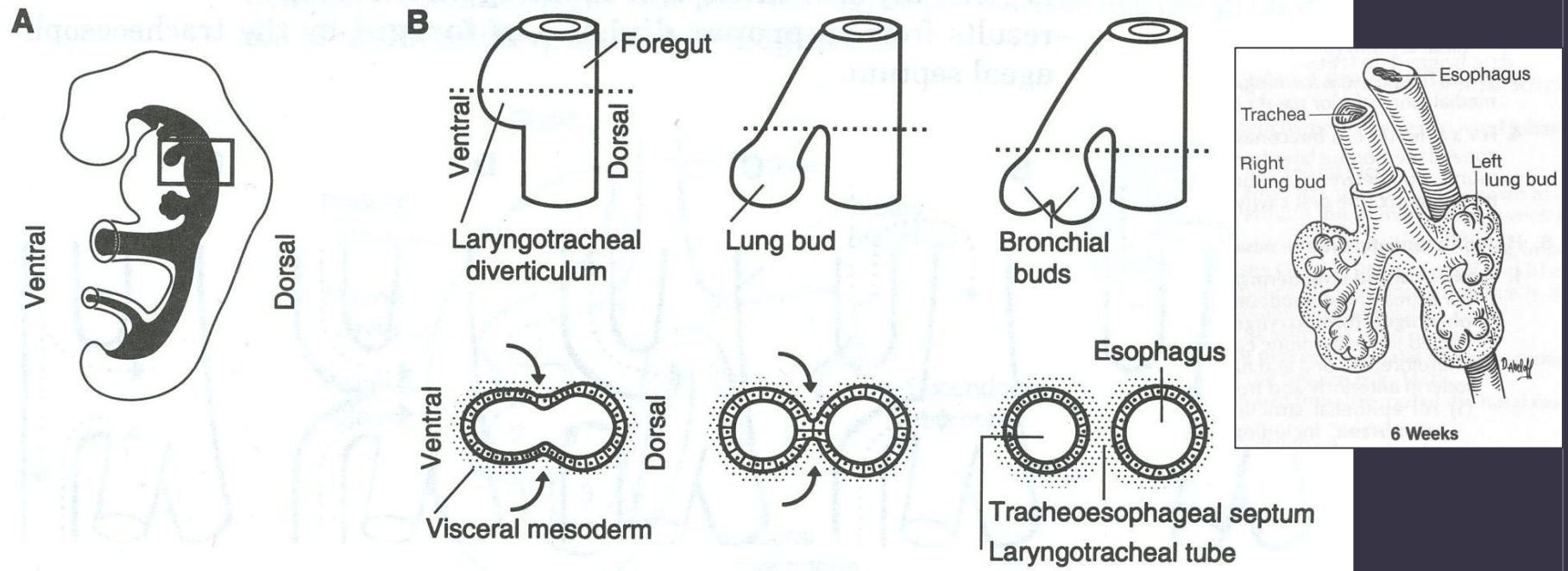


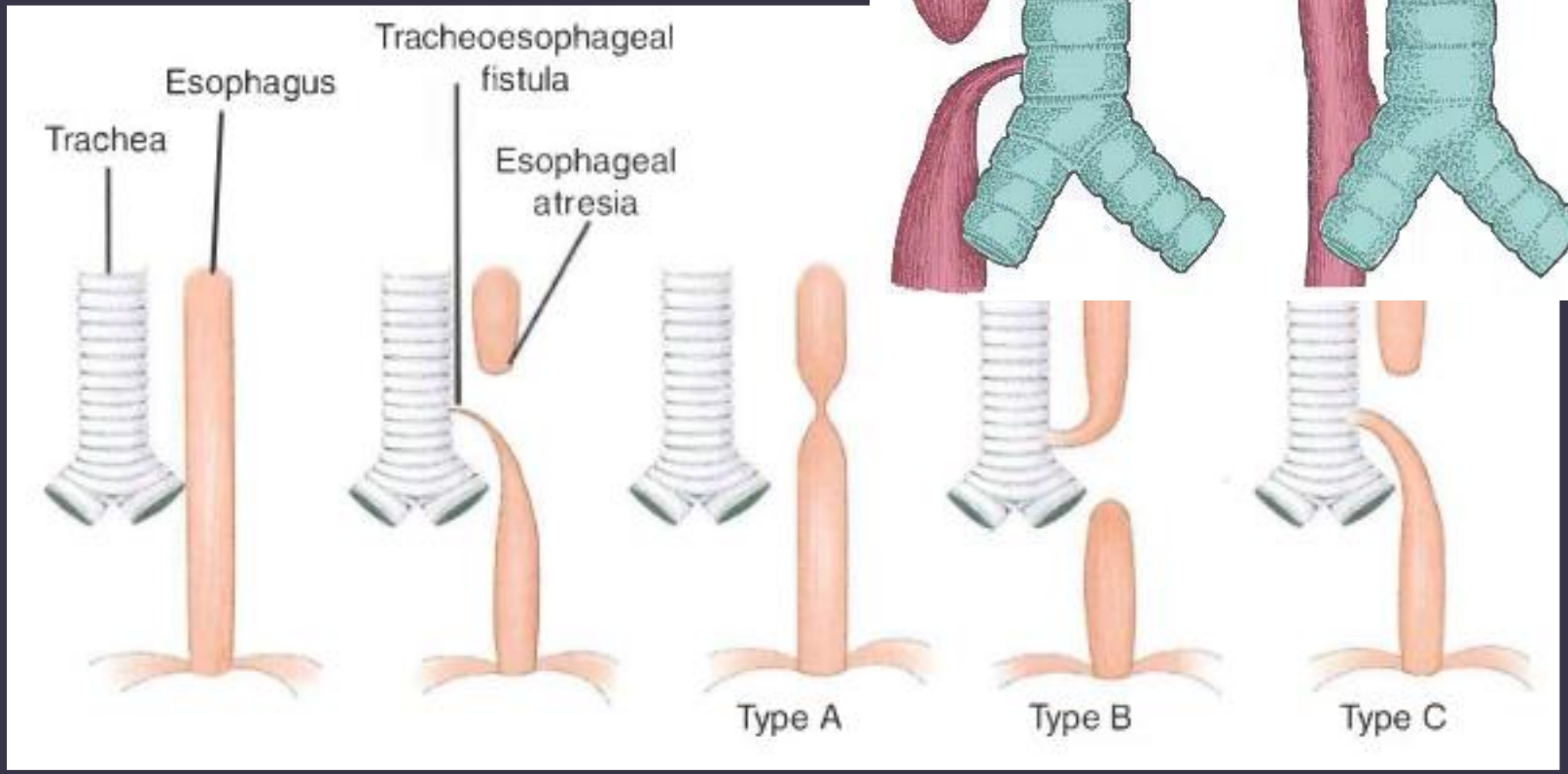
Figure 11-1. Early development of respiratory system. (*A*) Lateral view of an embryo at day 25, showing the entire primitive gut tube. The area in the *rectangle* indicates the portion of foregut involved in respiratory development. This area is enlarged in *B*. (*B*) Relationship of the laryngotracheal diverticulum and foregut. *Curved arrows* indicate the movement of the tracheoesophageal folds.

Endoderm ➡ Epithelium and glands of the lower airway

Mesoderm ➡ Connective tissue, cartilage, muscle, vessels and adventitia

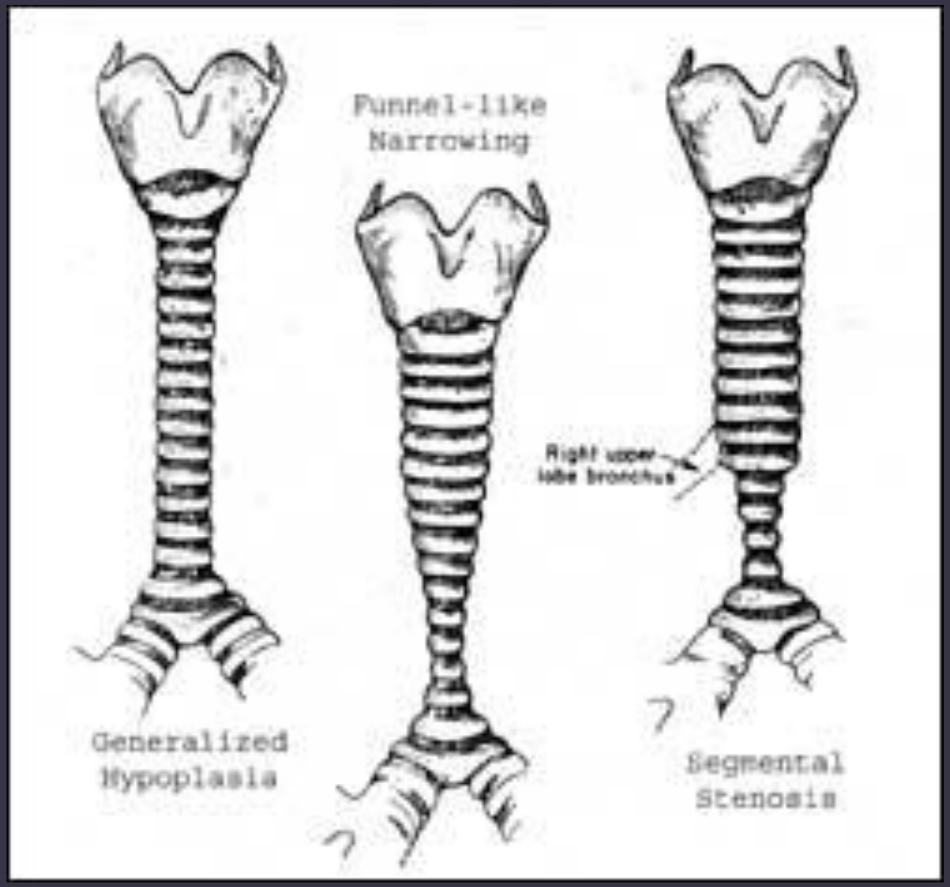
Congenital anomalies of trachea

1. Tracheoesophageal fistula – communication between trachea and esophagus



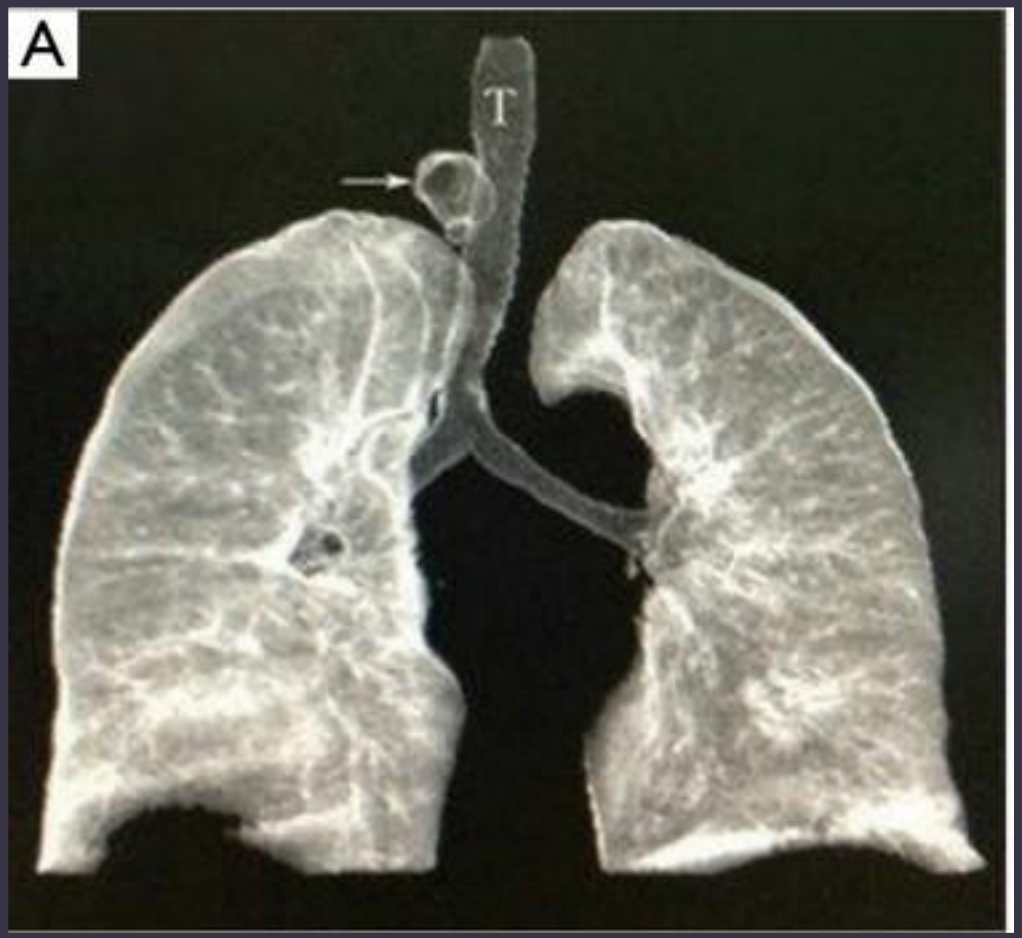
Congenital anomalies of trachea

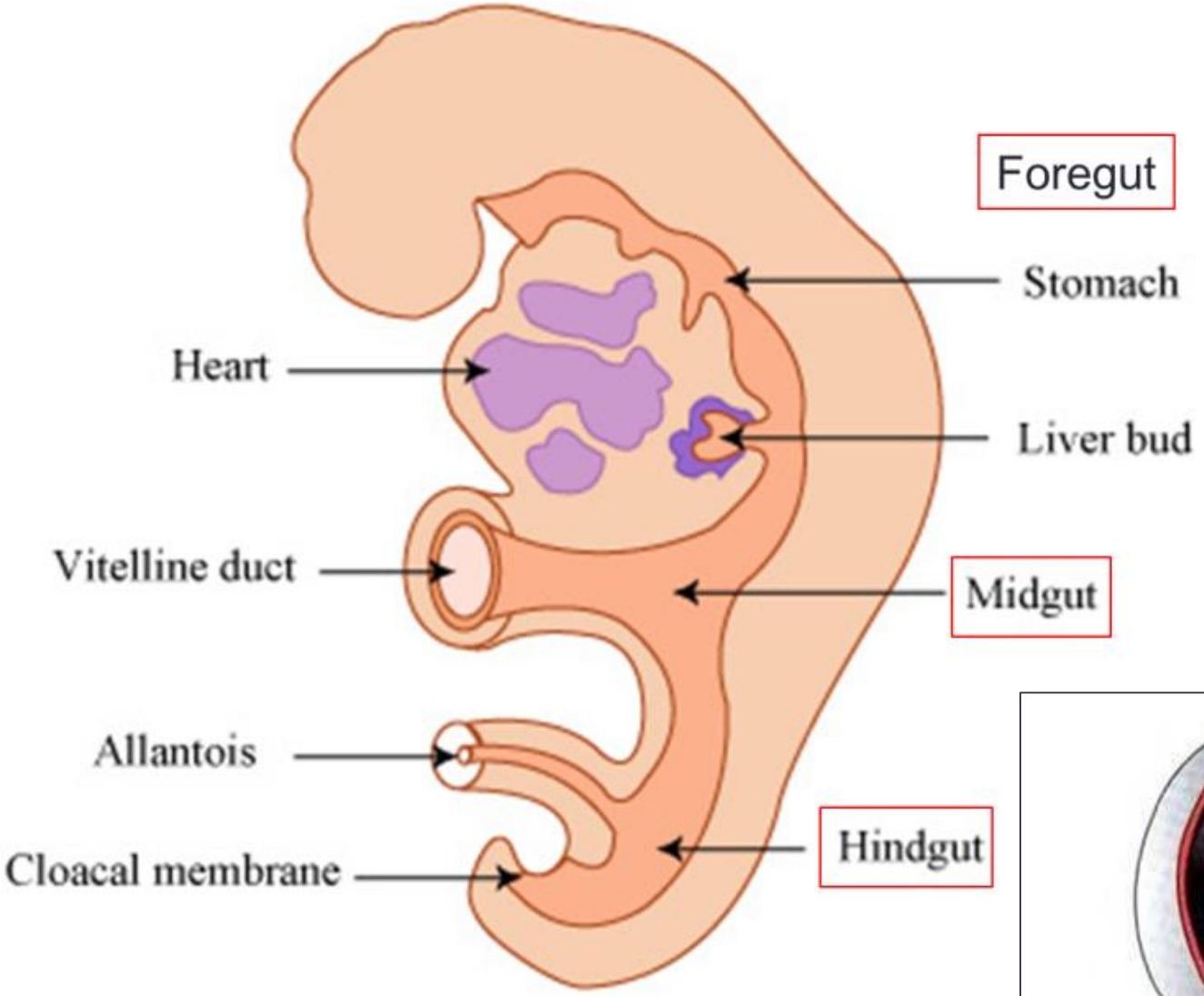
2. Tracheal Stenosis (narrowing) and Atresia (closure)

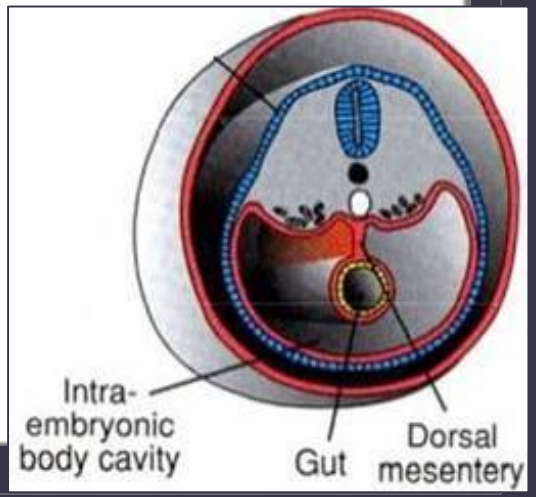


Congenital anomalies of trachea

3. Tracheal diverticulum



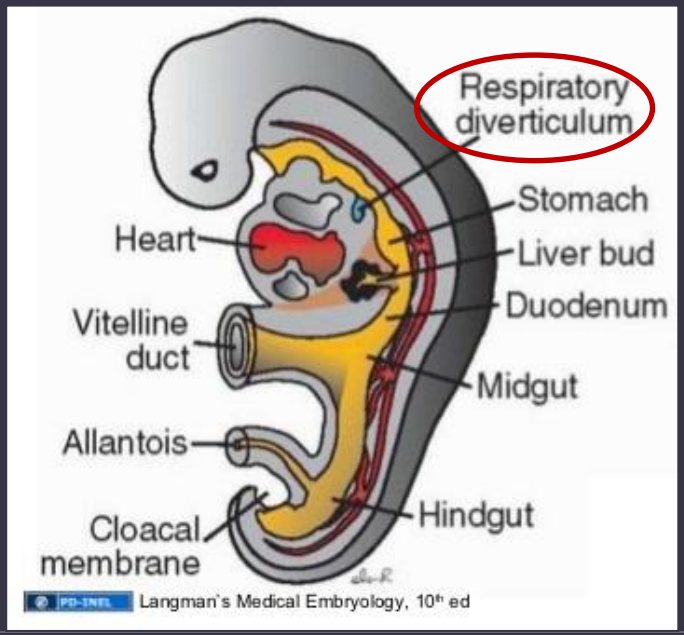

Foregut
Stomach
Heart
Liver bud
Vitelline duct
Midgut
Allantois
Hindgut
Cloacal membrane


Intra-
embryonic
body cavity
Gut
Dorsal
mesentery

From foregut develop:

- Esophagus
- Stomach
- Duodenum (proximal part)
- Liver, pancreas, gall bladder
- Respiratory tube

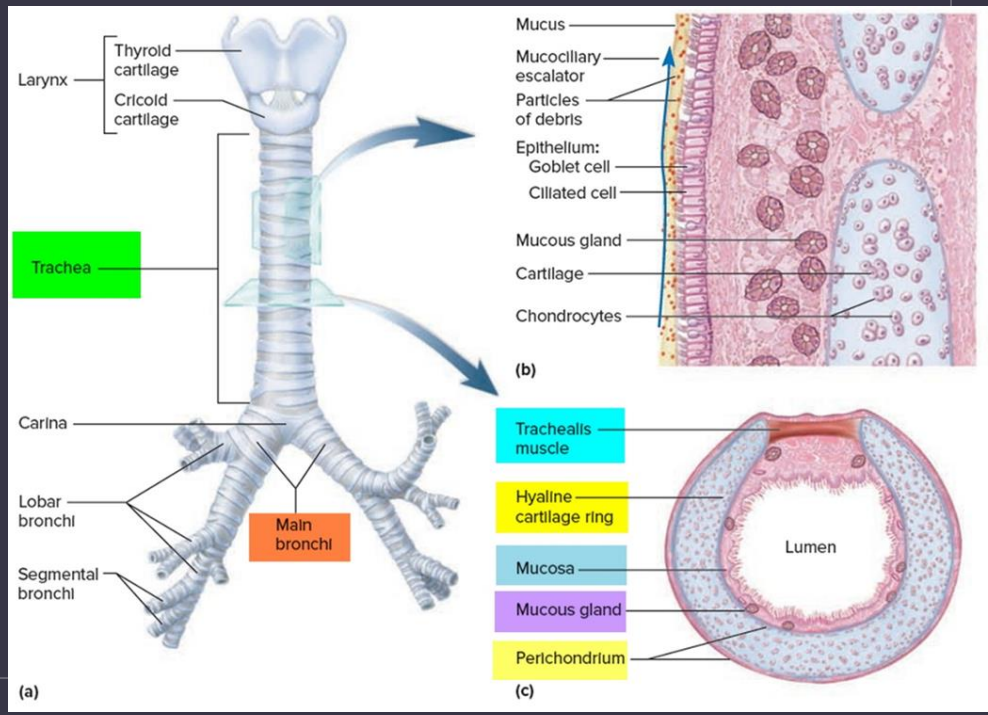
Blood supply – *truncus coeliacus*
Sympathetic innervation – *n. splanchnicus major*
Parasympathetic innervation – *n.vagus*



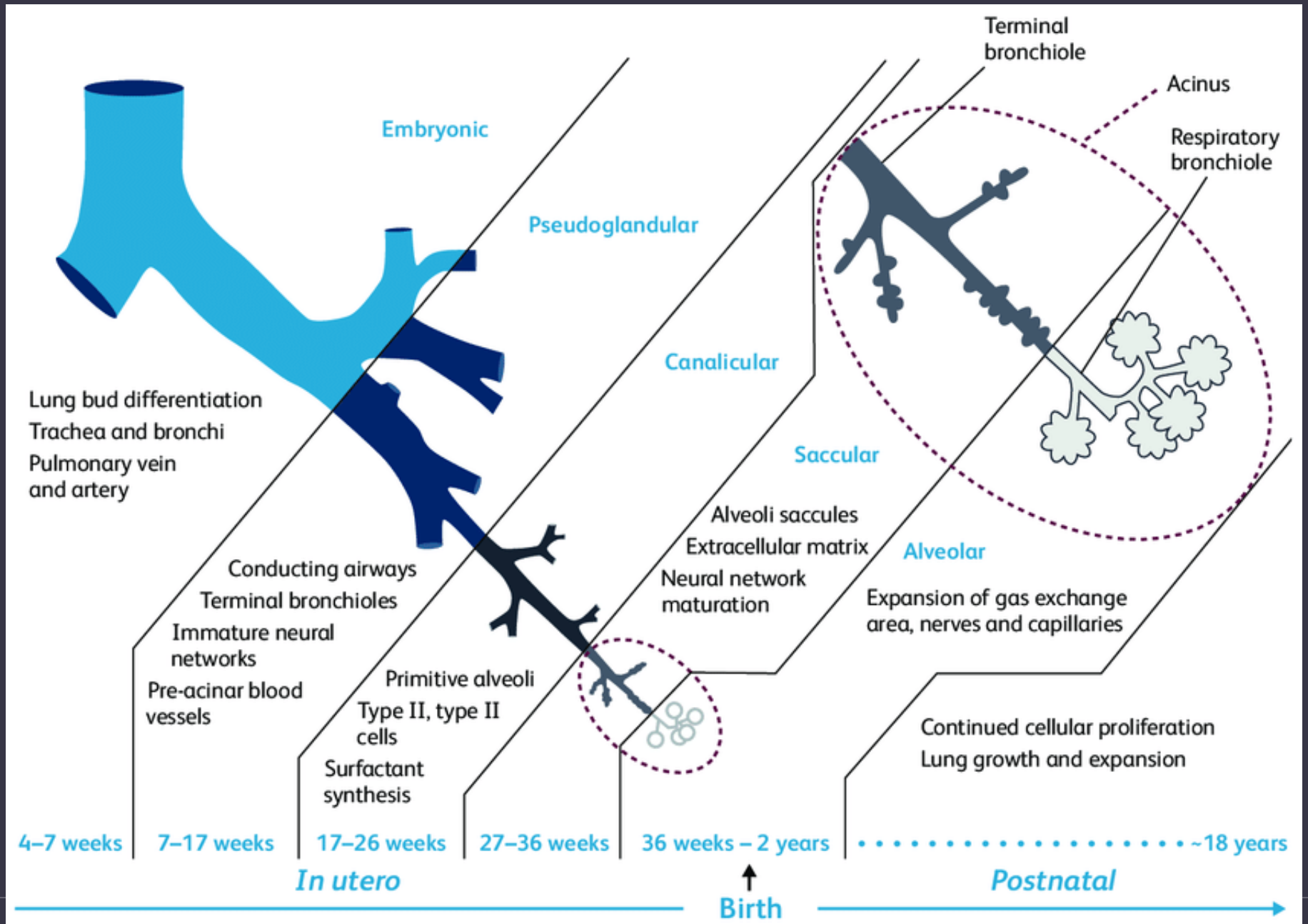
Tubular organ layers development

- Mucosa
  - Epithelial lining and glands - Derived from endoderm
  - Lamina propria
  - Muscularis mucosae
- Submucosa
- Muscularis externa/cartilages
- Adventitia/Serosa

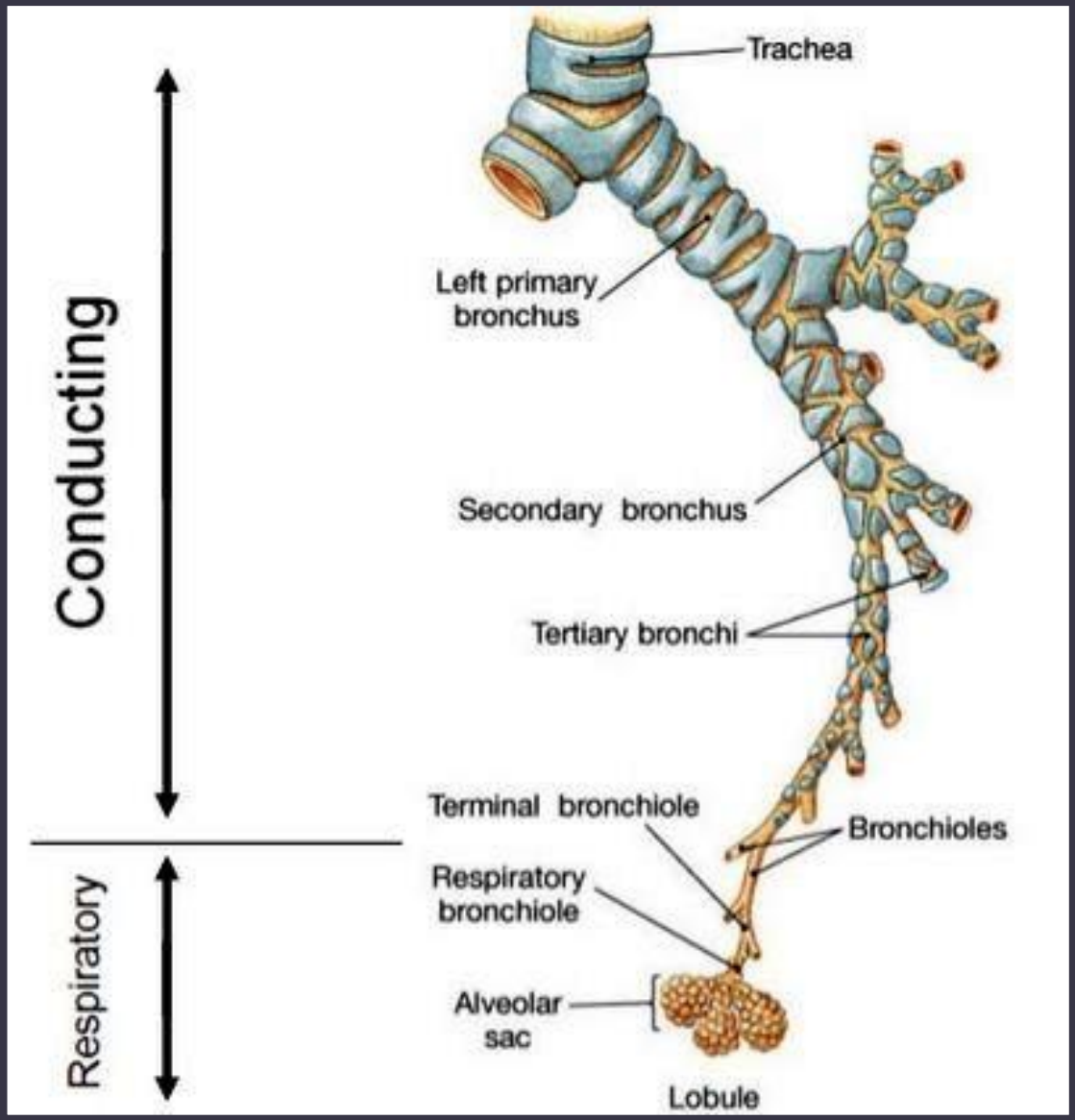
Derived from visceral mesoderm



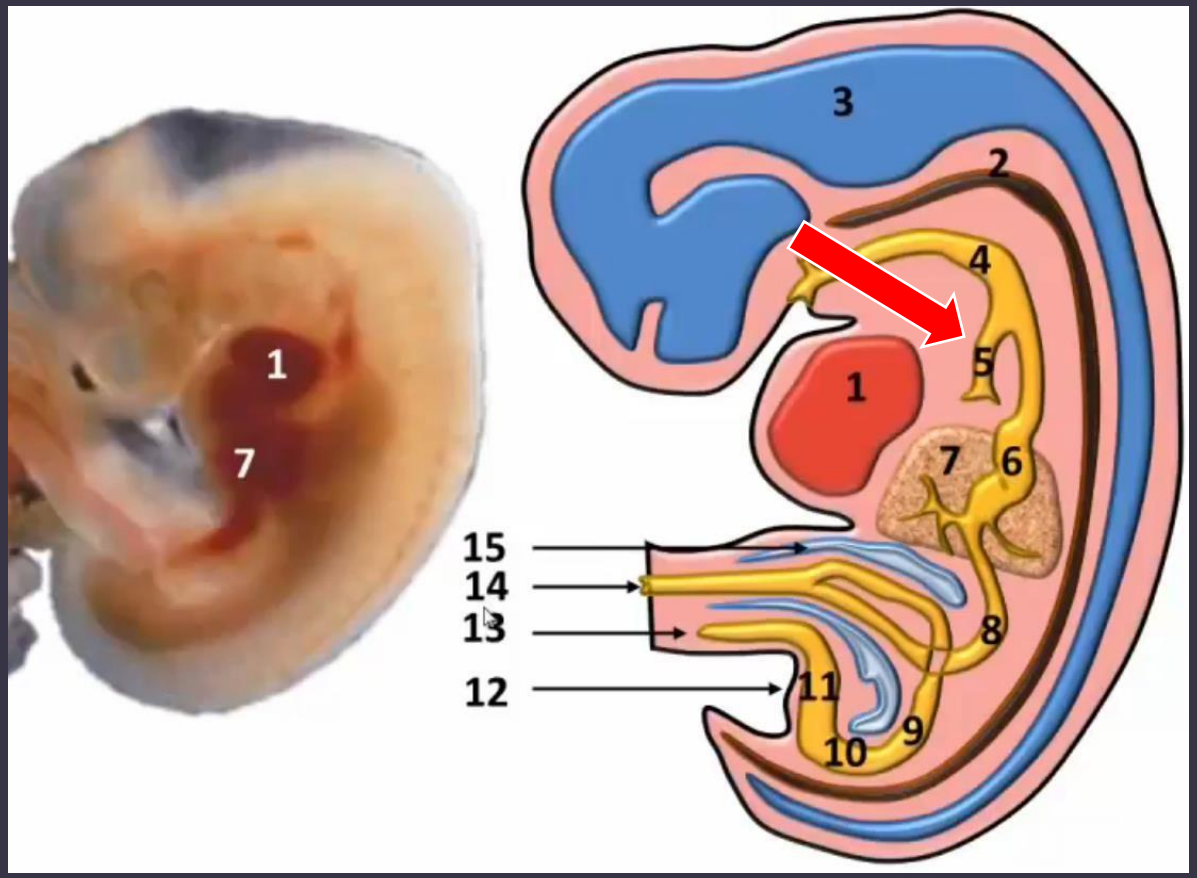
Five phases of development of the lungs



Development of the bronchi



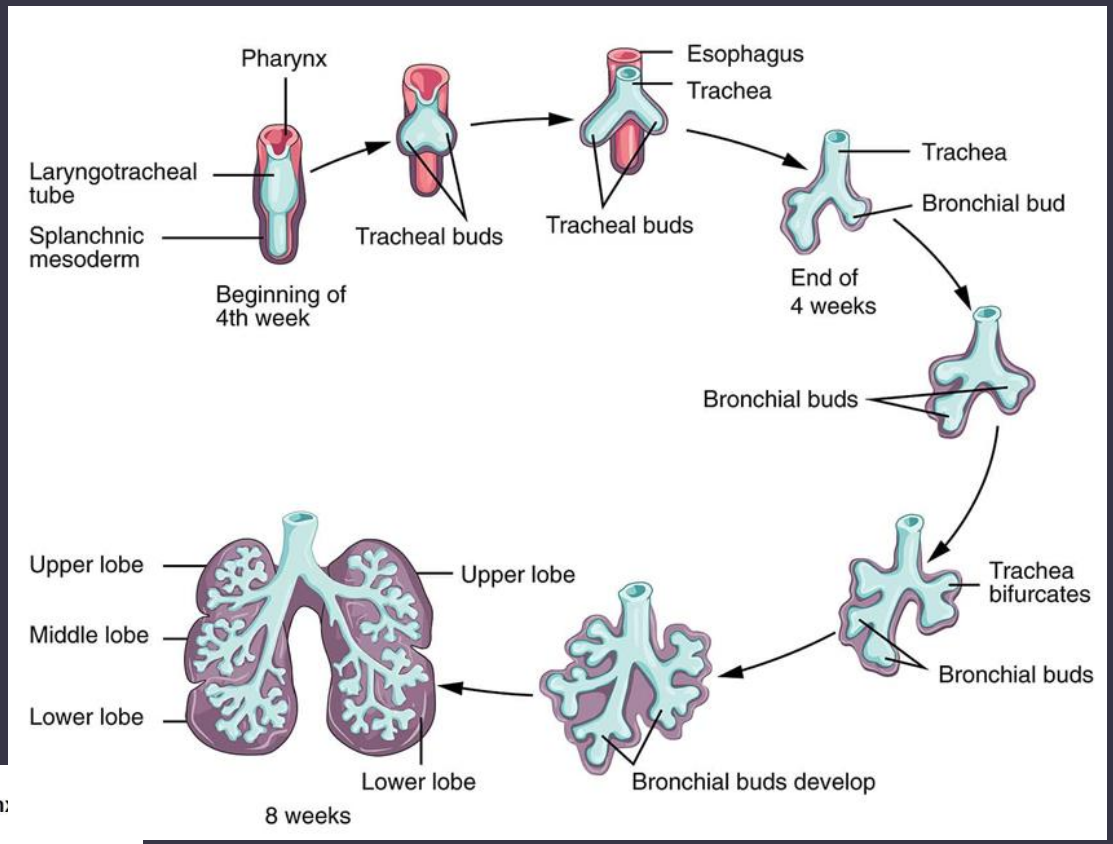
embryo, 5 week

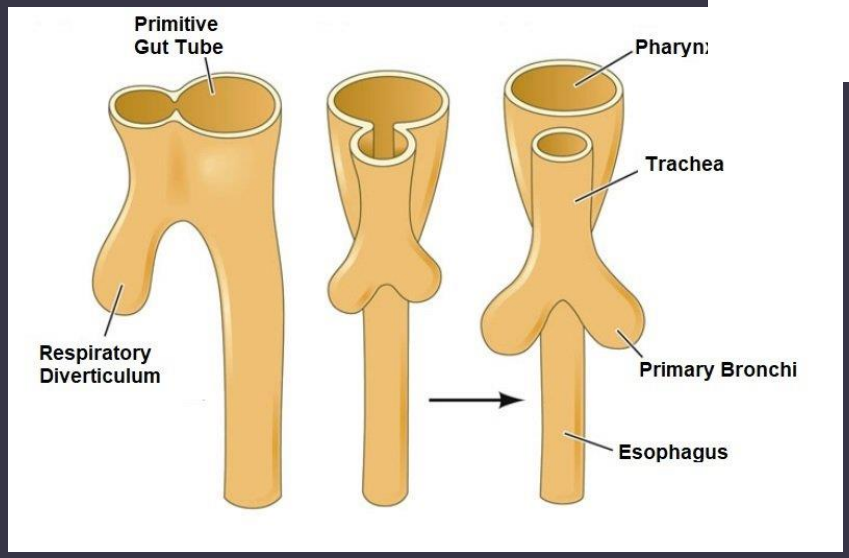


1 – heart
2 – chorda
3 – brain vesicles and neural tube
4 – oesophagus
5 – respiratory diverticulum
6 – stomach
7 – liver
8, 9 – midgut form yolk loop,
10 – hindgut
11 – cloaca
12 – cloacal membrane
13 – allantoise
14 – yolk stalk/duct
15 - coelom

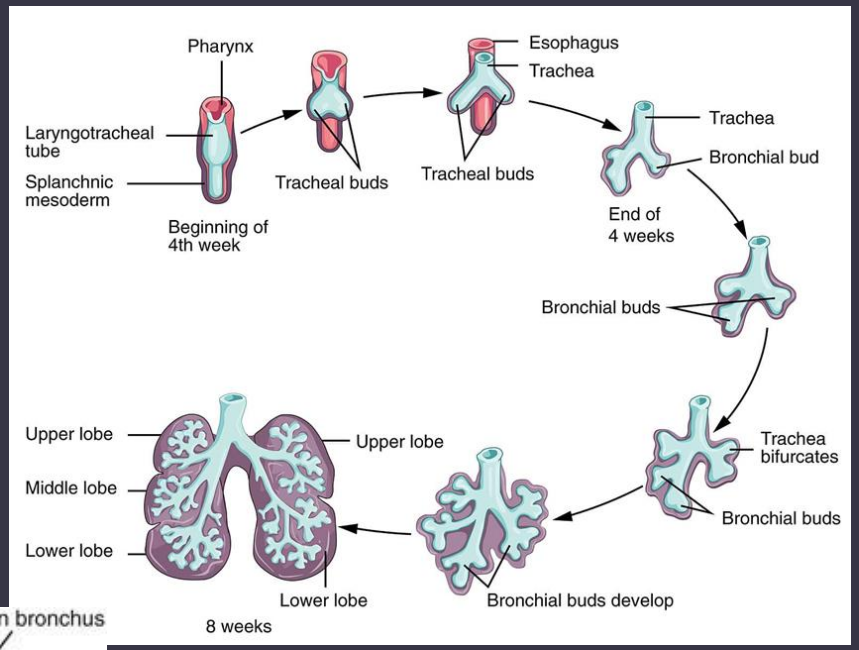
1. Embryonic Phase

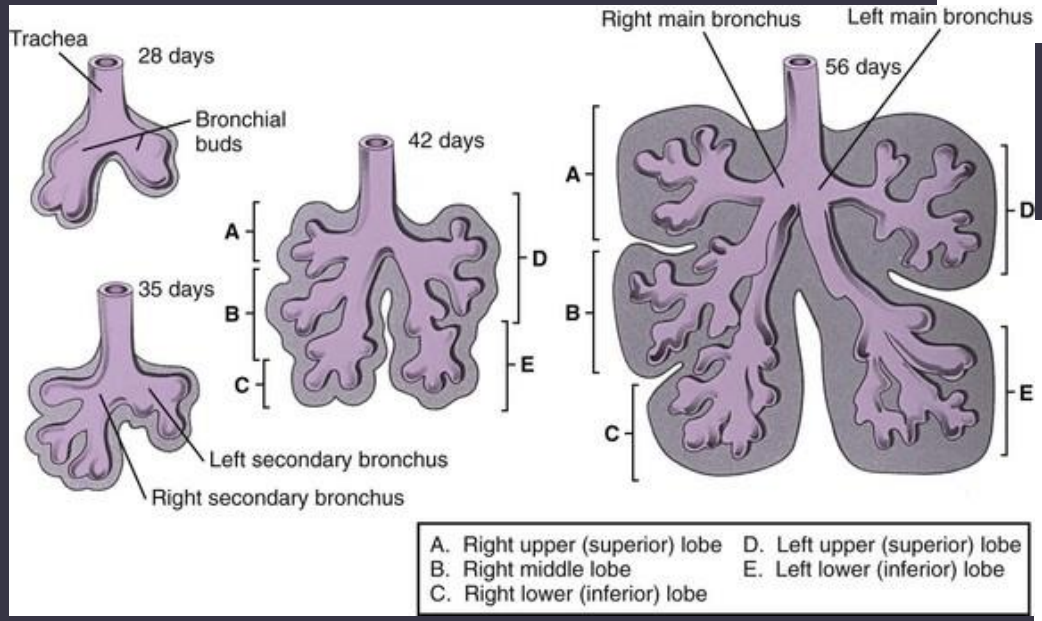
The distal end of the lung bud bifurcates into the right and left primary bronchial buds, whereas the proximal end (stem) forms the trachea and larynx.

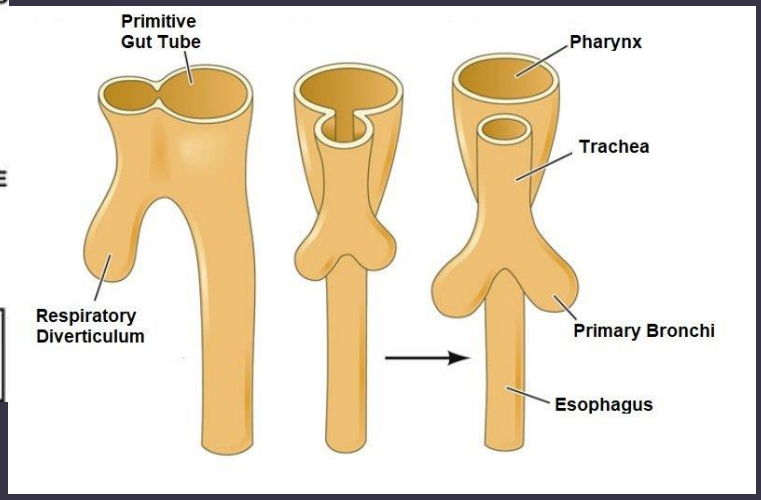




- By the fifth week of gestation, the primary bronchial buds form three secondary bronchial buds on the right side and two on the left
- Each secondary bronchial bud gives rise to ten tertiary bronchial buds on both sides, demarcating the end of the embryonic phase



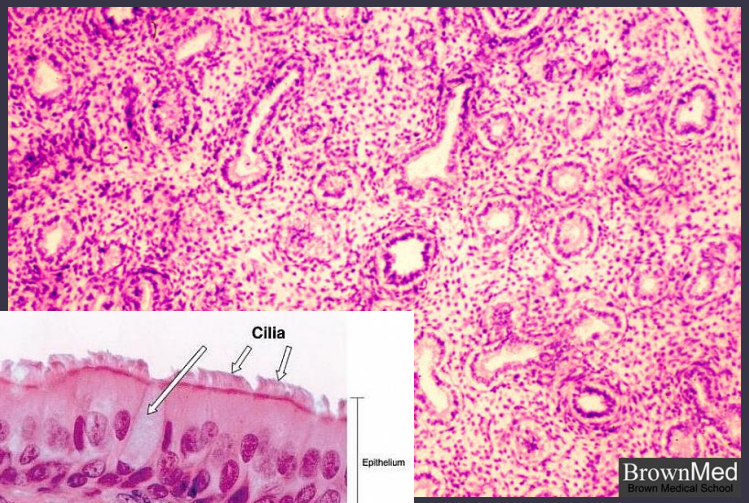


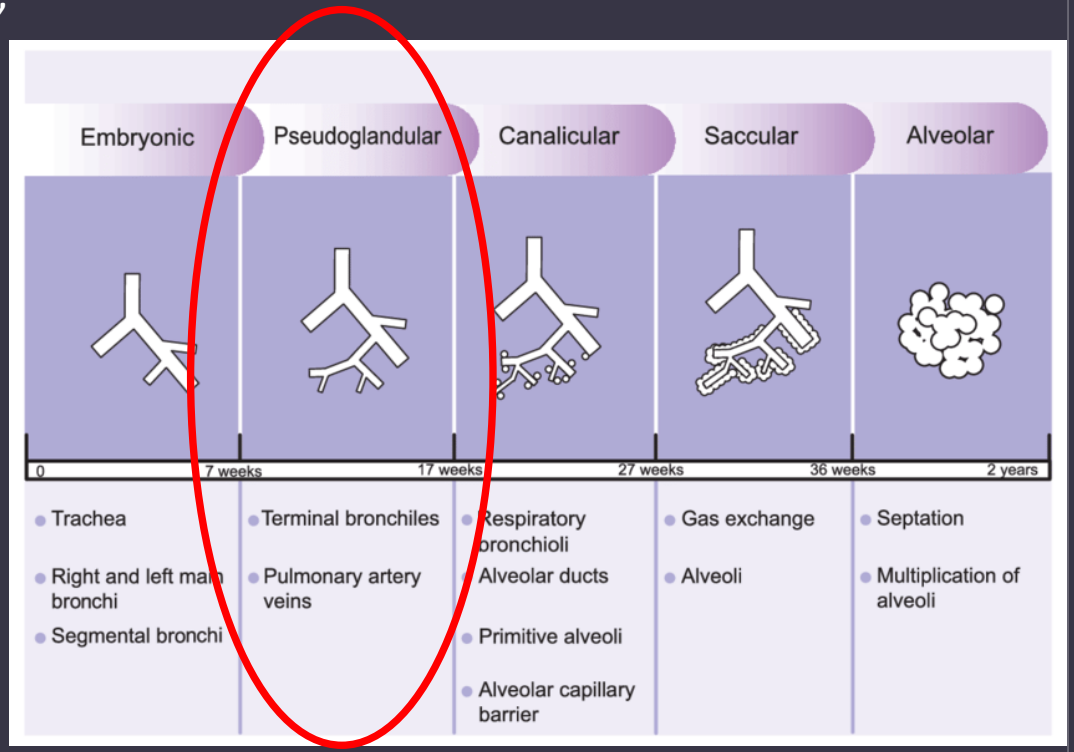


2. Pseudoglandular phase

- takes place during between the sixth and sixteenth week of gestation.
- The respiratory tree undergoes twelve to fourteen more generations of branching, resulting in the formation of terminal bronchioles.

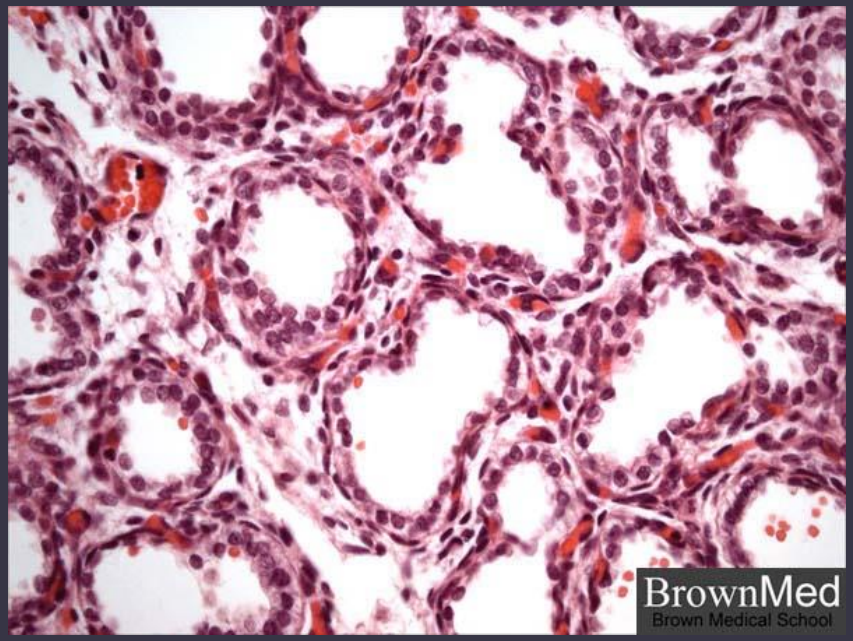
- This passageway will be lined with a specific type of respiratory epithelium, simple columnar epithelium (ciliated) transitioning to simple cuboidal epithelium (some cilia).

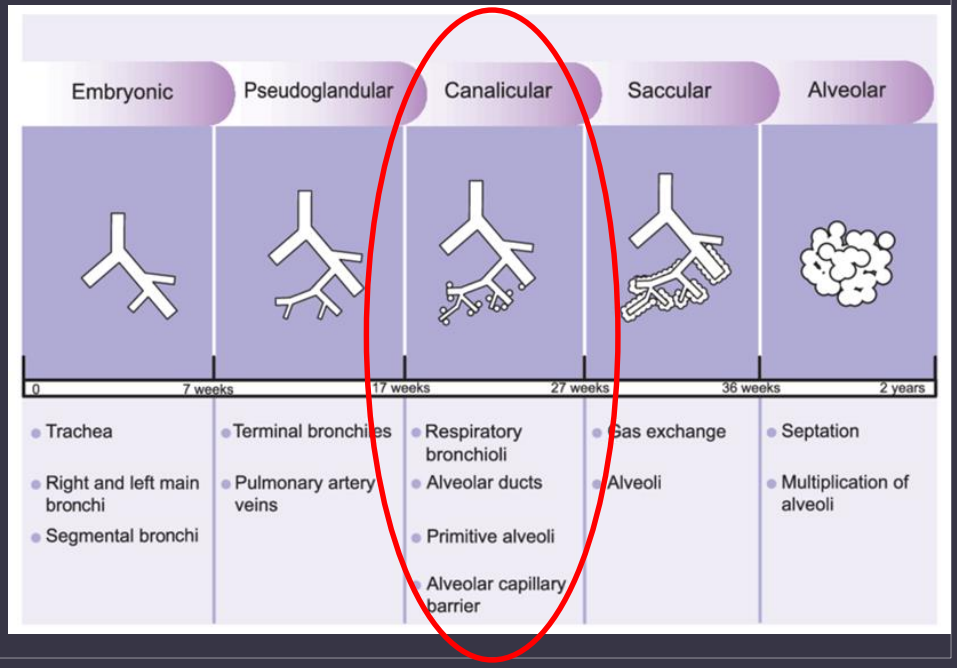




3. Canalicular phase

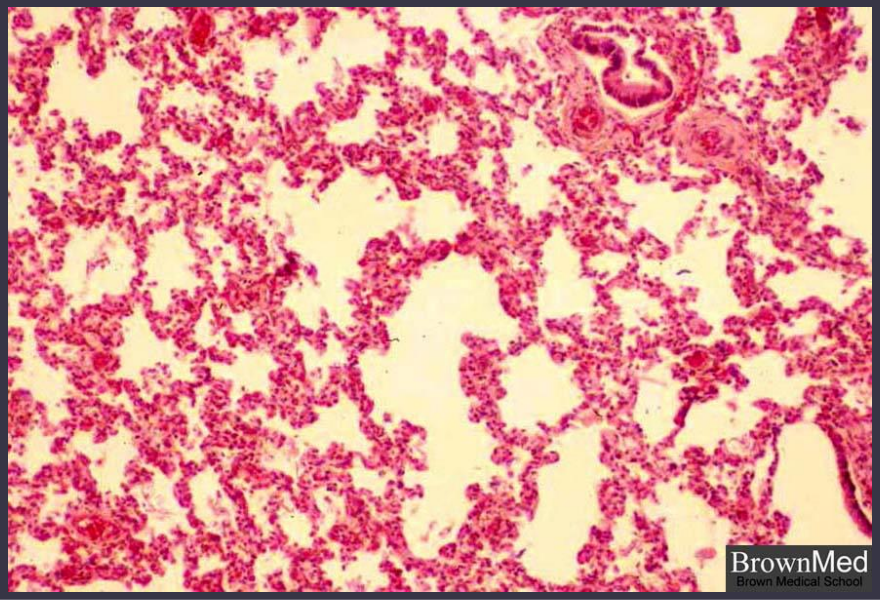
- canalicular phase takes place during the sixteenth and twenty-eighth week of gestation.
- Each terminal bronchioles further divide into respiratory bronchioles, which become surrounded with an increase in vascularization.

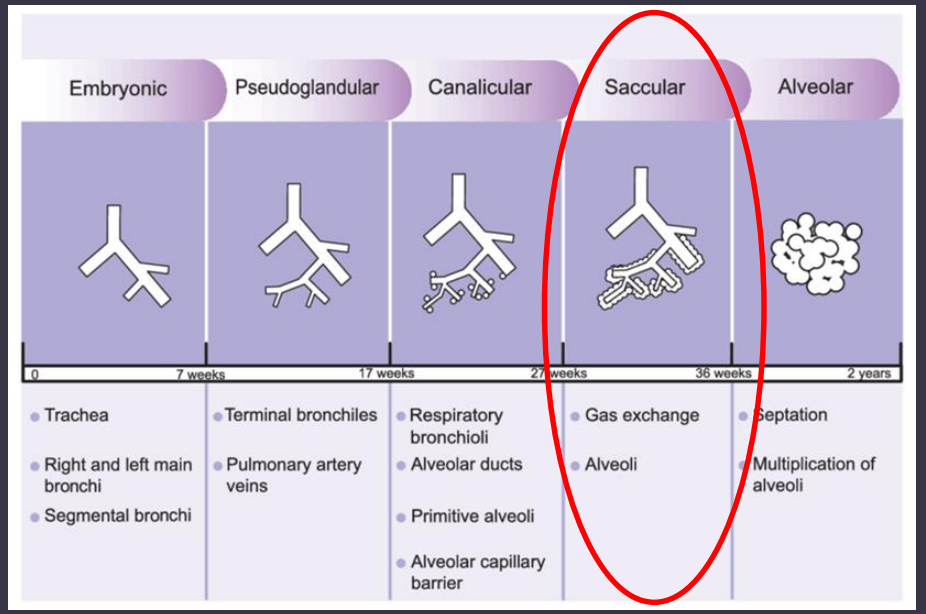




4. Saccular phase

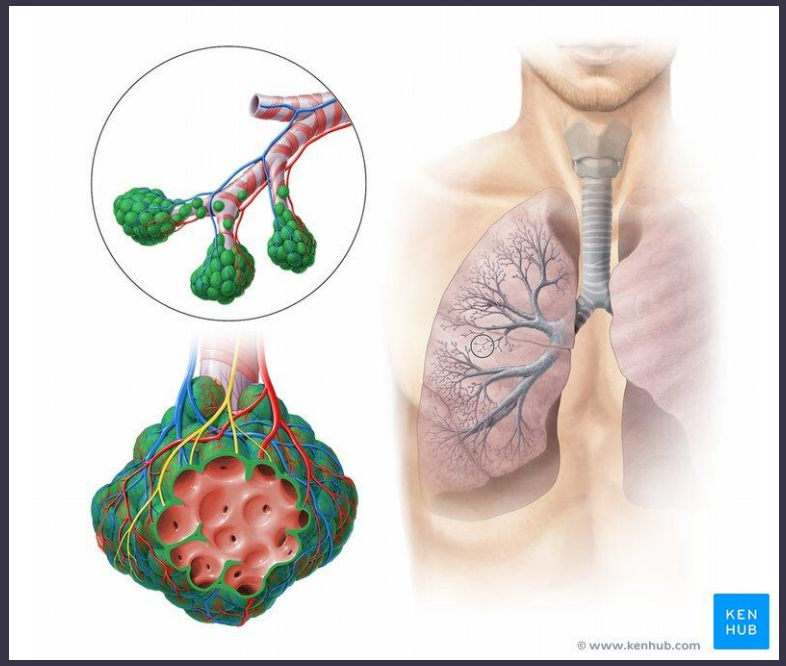
- takes place between the twenty-eighth and thirty-sixth week of gestation.
- The respiratory bronchioles give rise to a final generation of terminal branches.
- These branches become invested in a dense network of capillaries, forming the terminal sacs (primitive alveoli) that are lined with type I and type II alveolar cells.

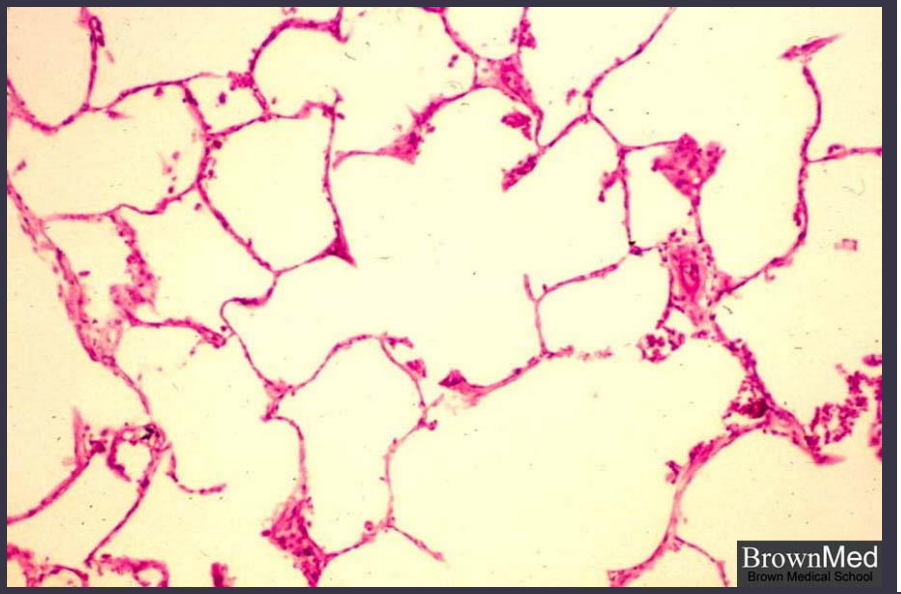


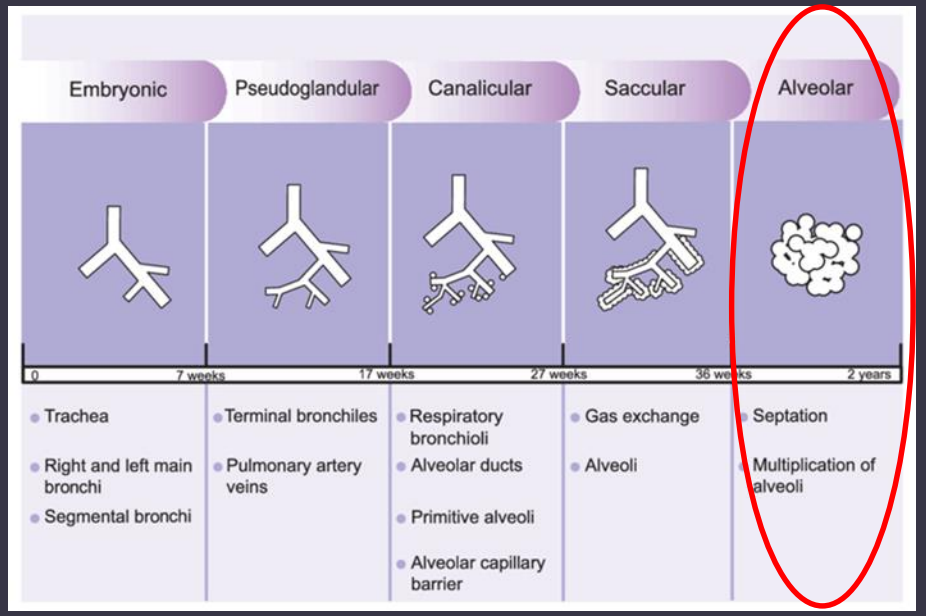


5. Alveolar phase

- The alveolar phase is characterized by the maturation of the alveoli, a process that takes place during the end of fetal life and many years after birth.

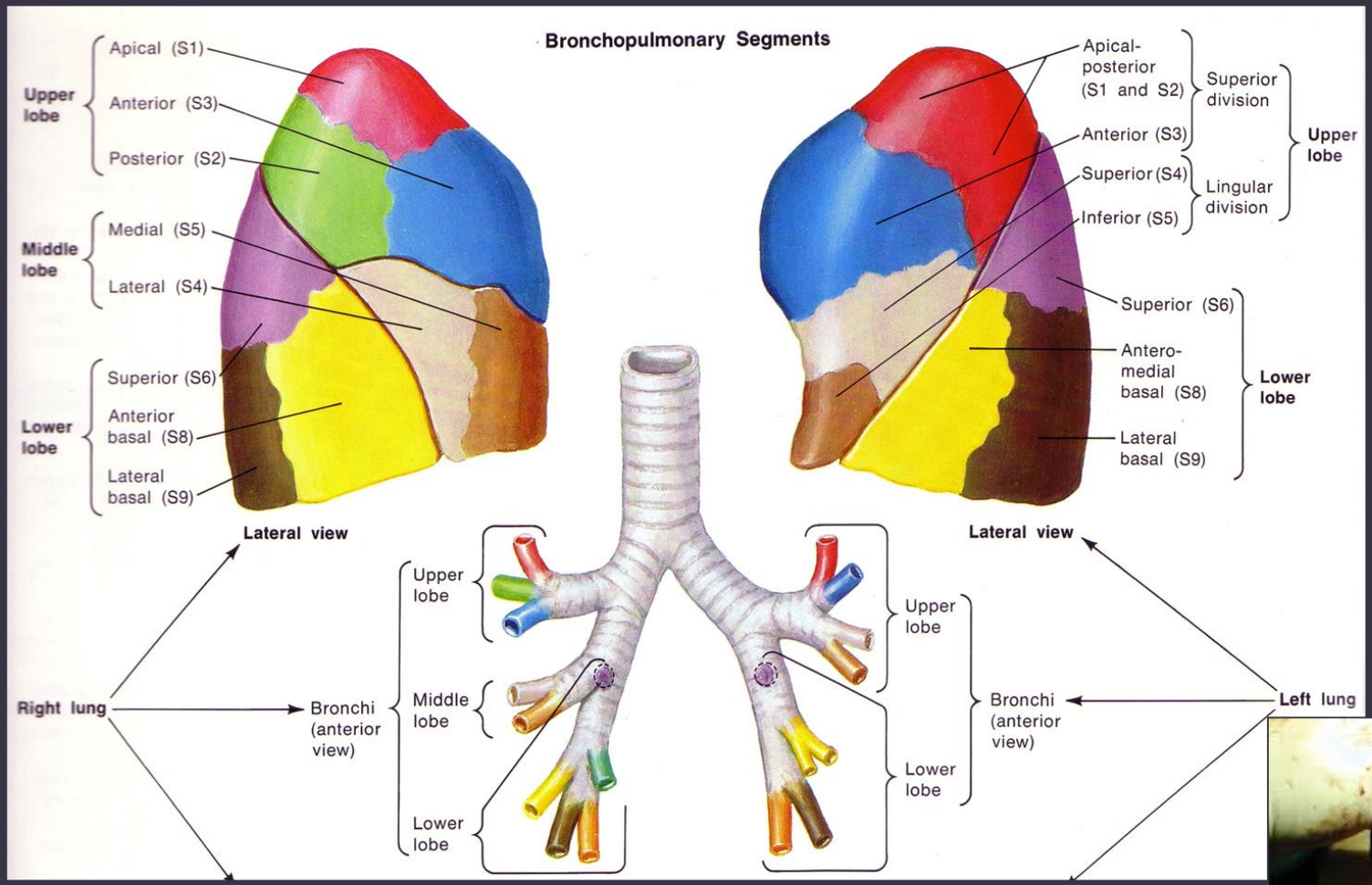


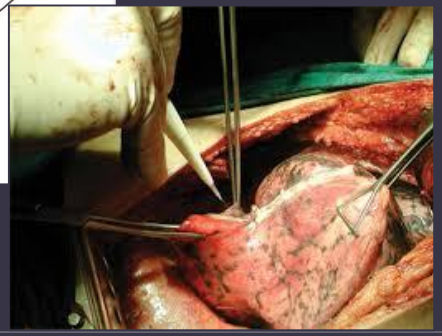




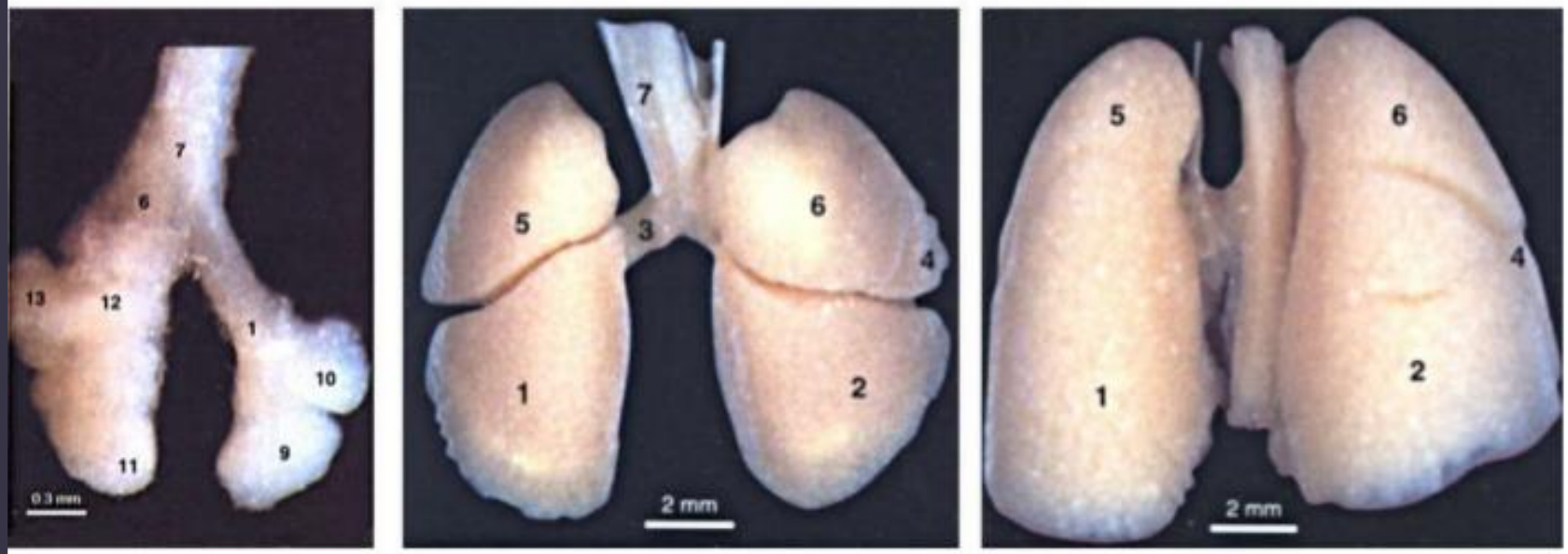
Bronchopulmonary segments

- is a segment of lung tissue supplied by a tertiary (segmental) bronchu



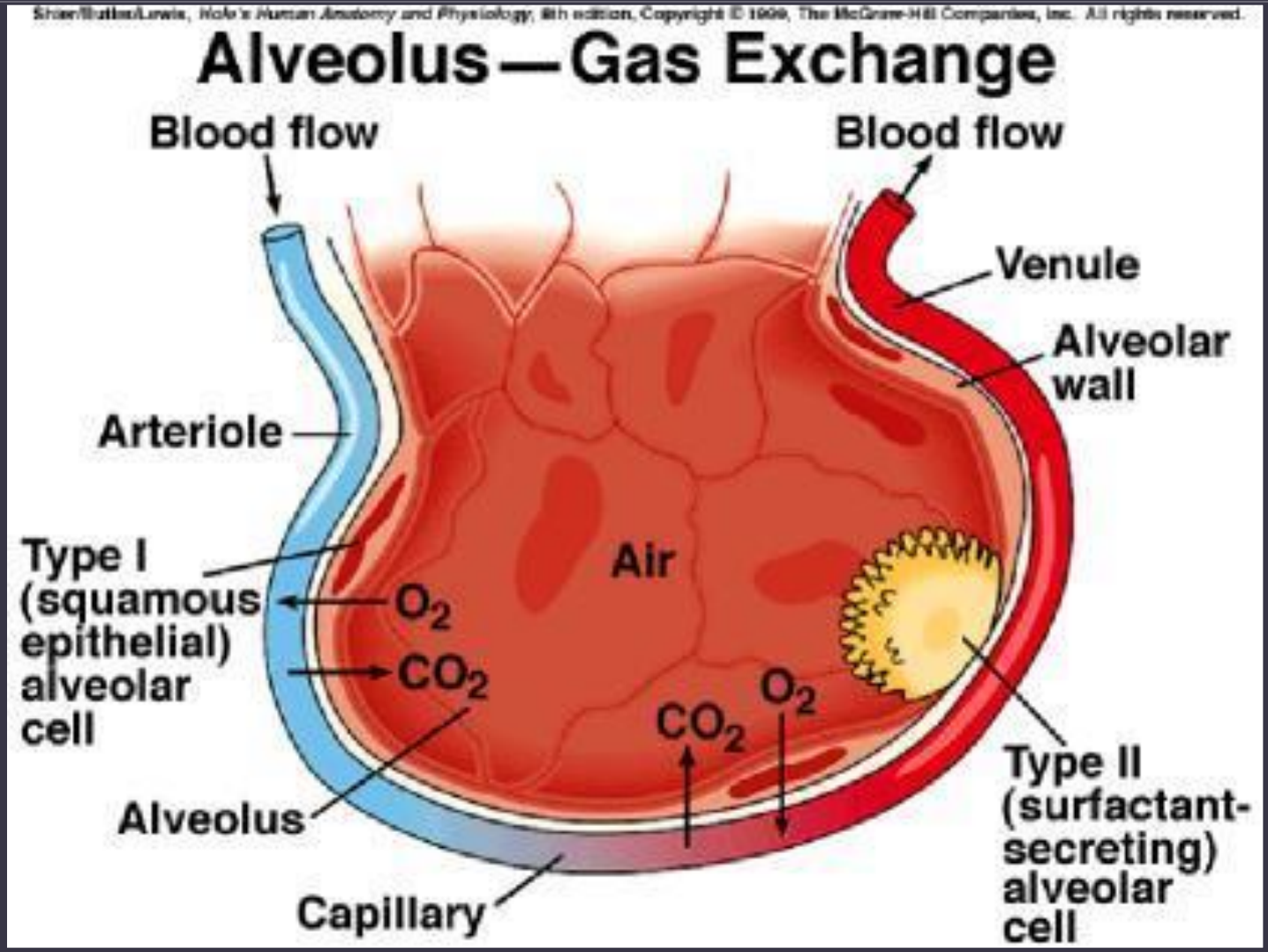


Development of the human lung



Day 41-44 | Week 9 | Week 10

7 trachea; 1 Left main bronchus; 6 right main bronchus; others lobes

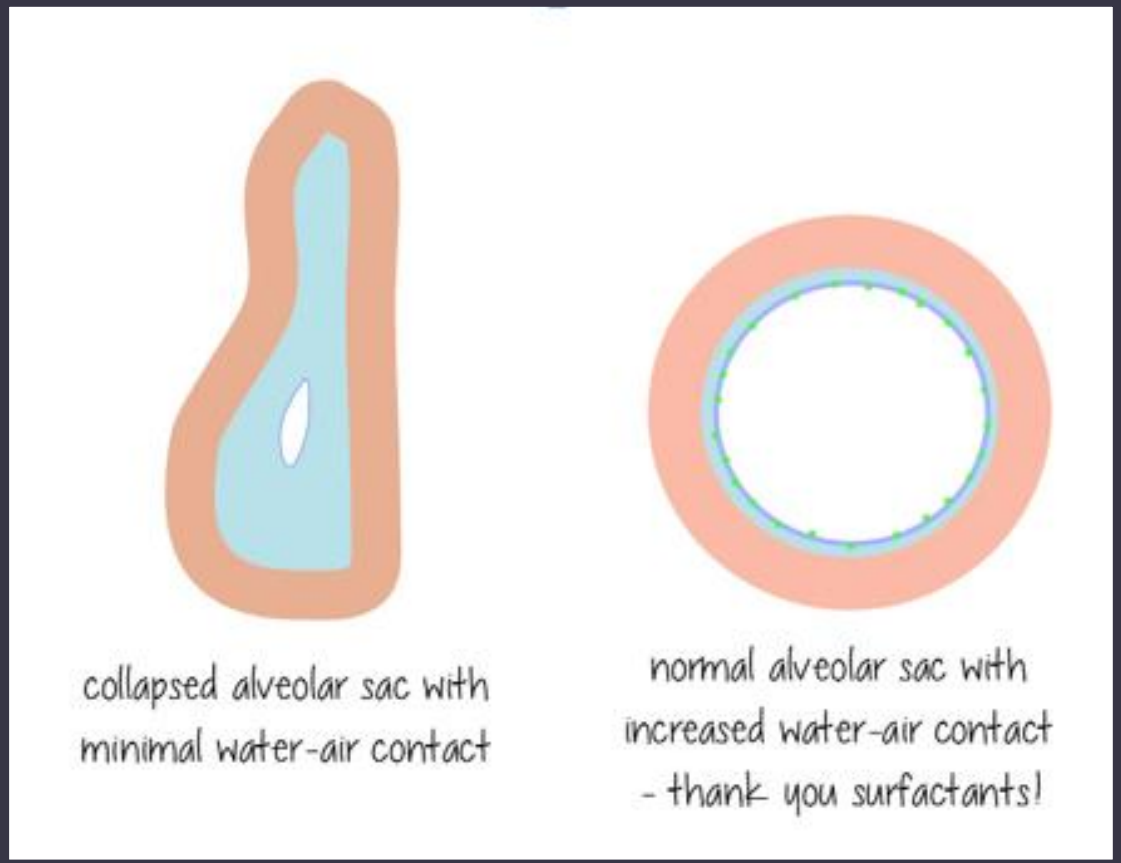


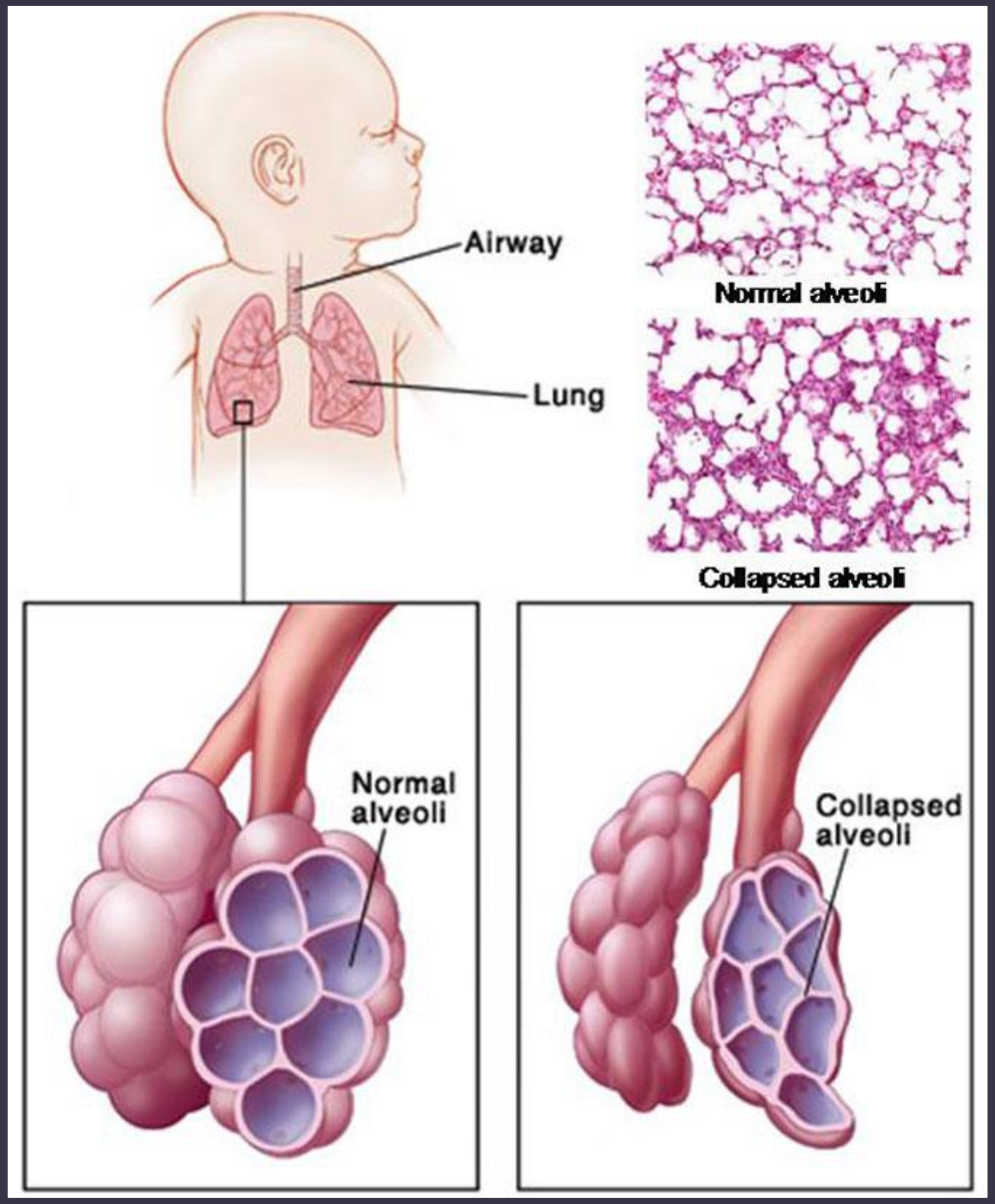
Type I pneumocytes – thin, flat cells that make up part of the blood-air barrier

Type II pneumocytes – cells, that produce surfactant

Pulmonary surfactant

- a surface-active lipoprotein complex (phospholipoprotein) formed by type II alveolar cells. By adsorbing to the air-water interface of alveoli it reduces surface tension and prevents collapse of the lung (atelectasis) at the end of expiration.





Premature fetuses born between week 25 and 28 can survive with intensive care!

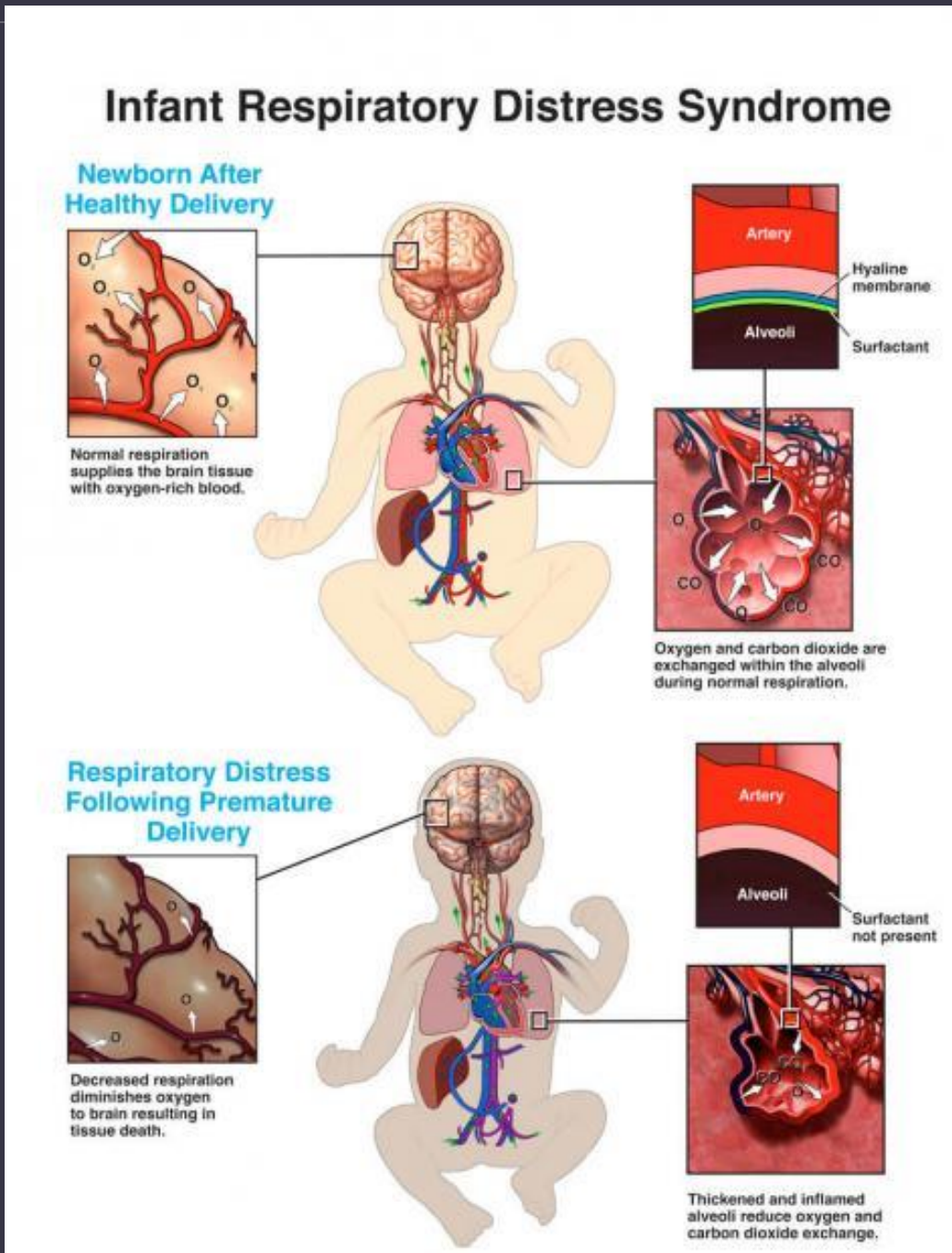
This is the earliest point at which fetus can survive.

Adequate vascularization and surfactant levels are the most important factors for the survival of premature infants!

Changes that occur after birth

After birth, the circulation of fetal blood through the placenta ceases:
– Delivery of oxygenated blood to fetus via umbilical vein ceases–
Hypoxia of all tissues is increasing
– Respiratory centers of the brain stem are stimulated by carbon dioxide
– Inspiratory muscles contract, thoracic cage is expanded
– Expansion of the lungs and **First Breath** takes place
– Inspired air enters respiratory passageways, pushes the contained fluids out of the way and inflates the bronchial and respiratory trees
– Infant's lungs begin to function and newborn infant utters a loud cry

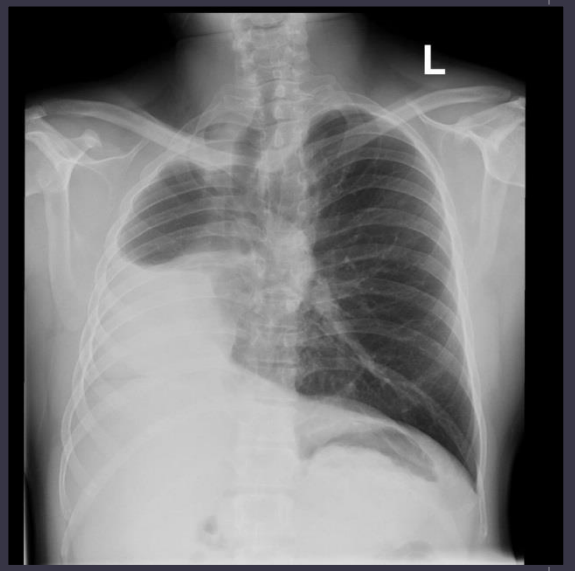
- IRDS usually occurs when the baby's lungs have not produced enough surfactant
- Surfactant is made up of proteins and fats, helps keep the lungs inflated and prevents them collapsing.
- A baby normally begins producing surfactant sometime between weeks 24 and 28 of pregnancy.
- Most babies produce enough to breathe normally by week 34.
- IRDS occurs most often in babies born before their due date, usually before 28 weeks of pregnancy.
- Less often, RDS can affect full-term newborns.



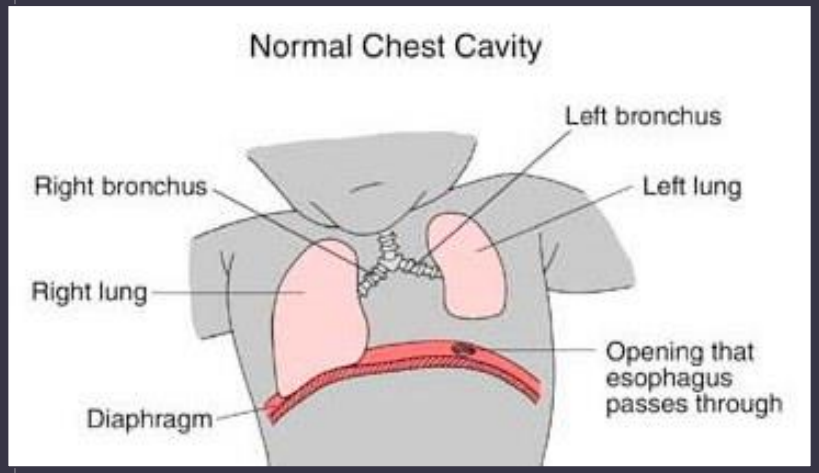
http://www.nucleuscatalog.com/

Congenital abnormalities

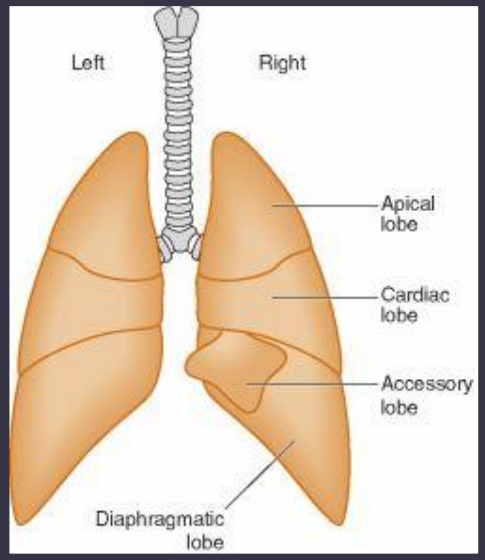
- Congenital Lung Cysts
- Agenesis of Lungs or one Lung
- Lung Hypoplasia
- Accessory Lung
- Lobe of Azygos Vein



Agenesis of the right lung

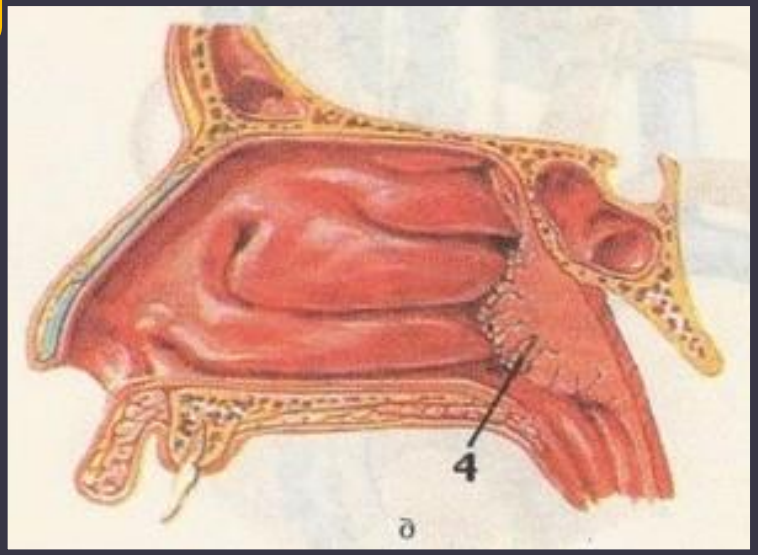


Lung hypoplasia



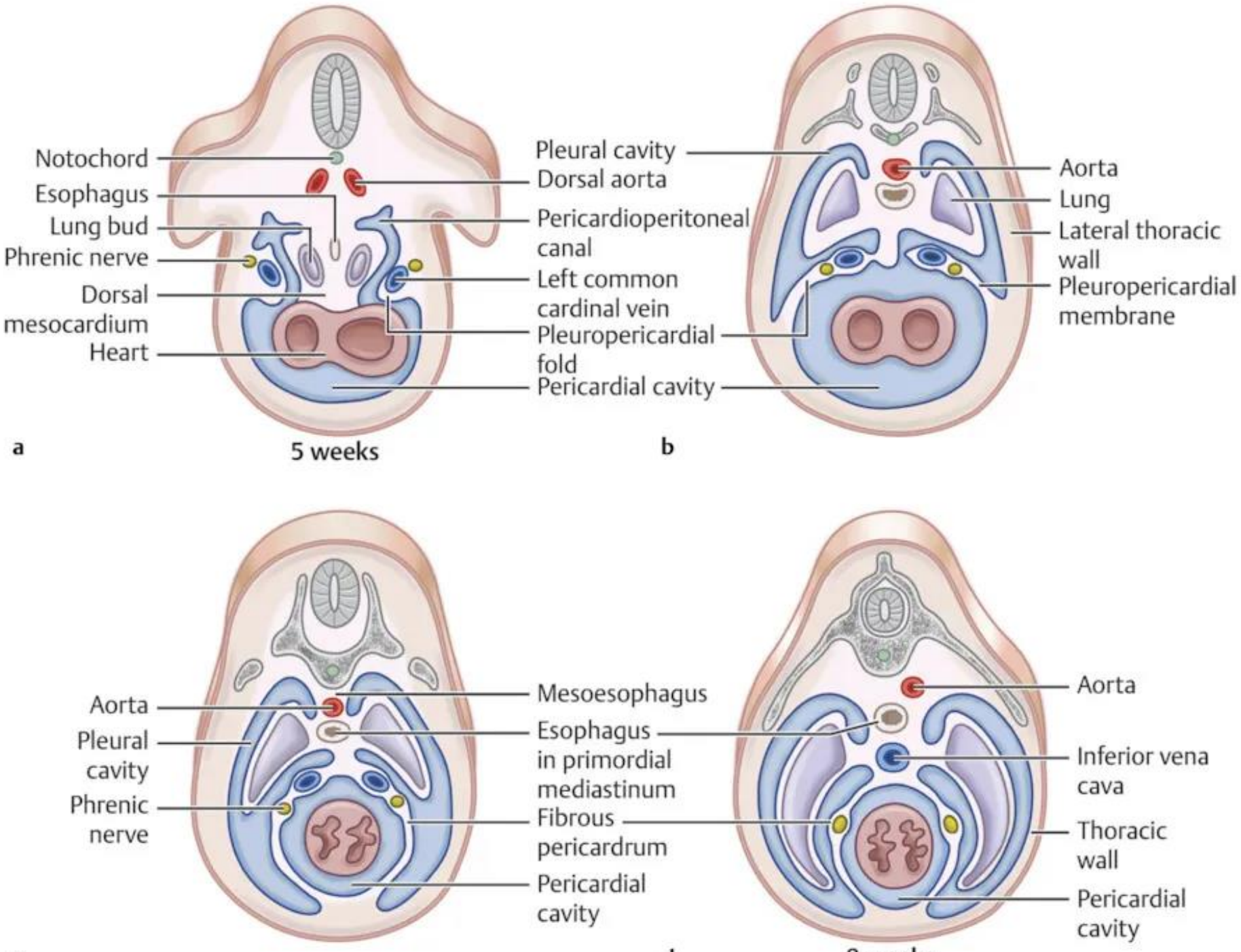
Accessory lobe

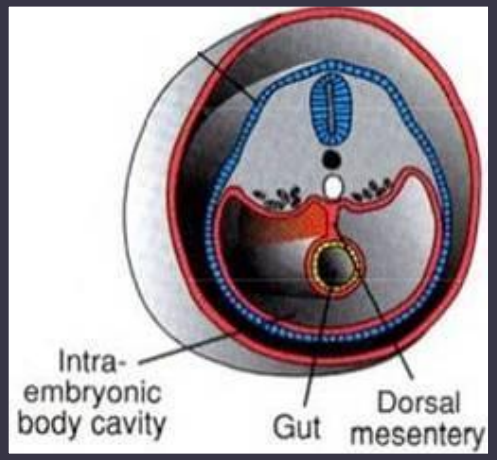
Absence of nasal breathing

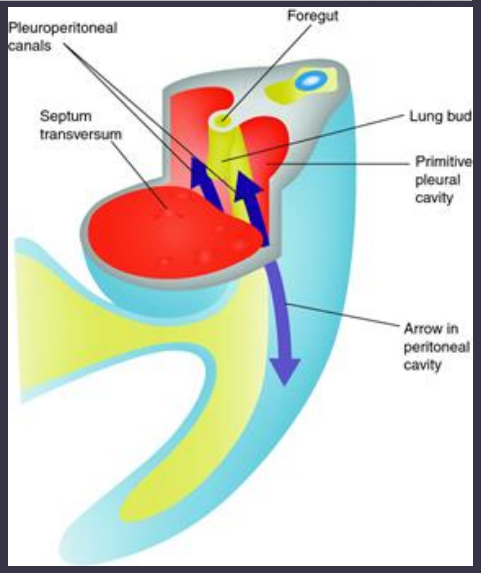


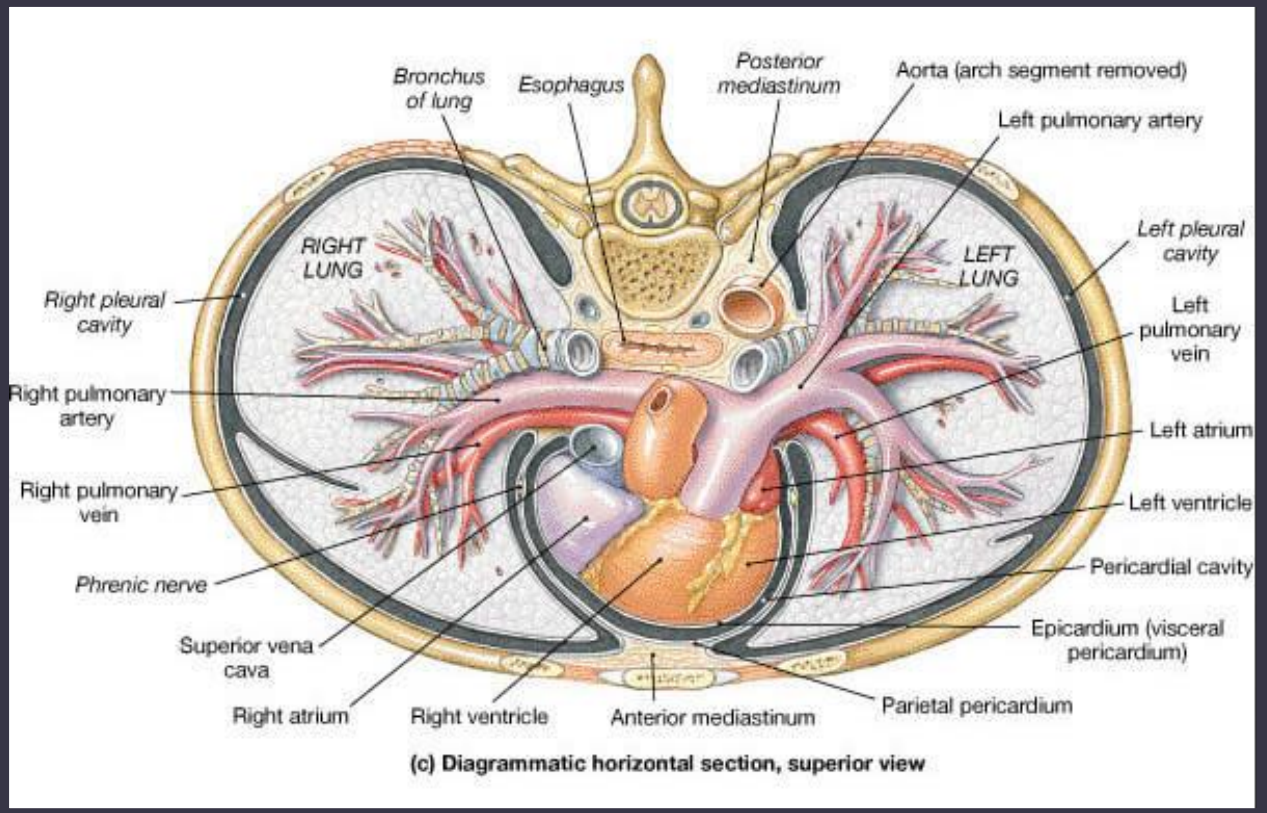
Consequences:

- Retarded development of the nose
- Inflammation of the nasal cavity
- Small chin
- Wrong position of the tongue
- Problems with speech and phonation
- Increased salivation
- Anterior position of the head – problems with cervical part of the vertebral column
- Retarded physical development , passive – hypoxia
- Retarded mental development – hypoxia of the brain
- Weak muscles of the lips – changes in teeth position and malocclusion
- Temporomandibular joint disorders, etc.


Notochord
Esophagus
Lung bud
Phrenic nerve
Dorsal mesocardium
Heart
Pleural cavity
Dorsal aorta
Pericardioperitoneal canal
Left common cardinal vein
Pleuropericardial fold
Pericardial cavity
a
5 weeks
b
Aorta
Lung
Lateral thoracic wall
Pleuropericardial membrane
Aorta
Pleural cavity
Phrenic nerve
Mesoesophagus
Esophagus in primordial mediastinum
Fibrous pericardrum
Pericardial cavity
Aorta
Inferior vena cava
Thoracic wall
Pericardial cavity



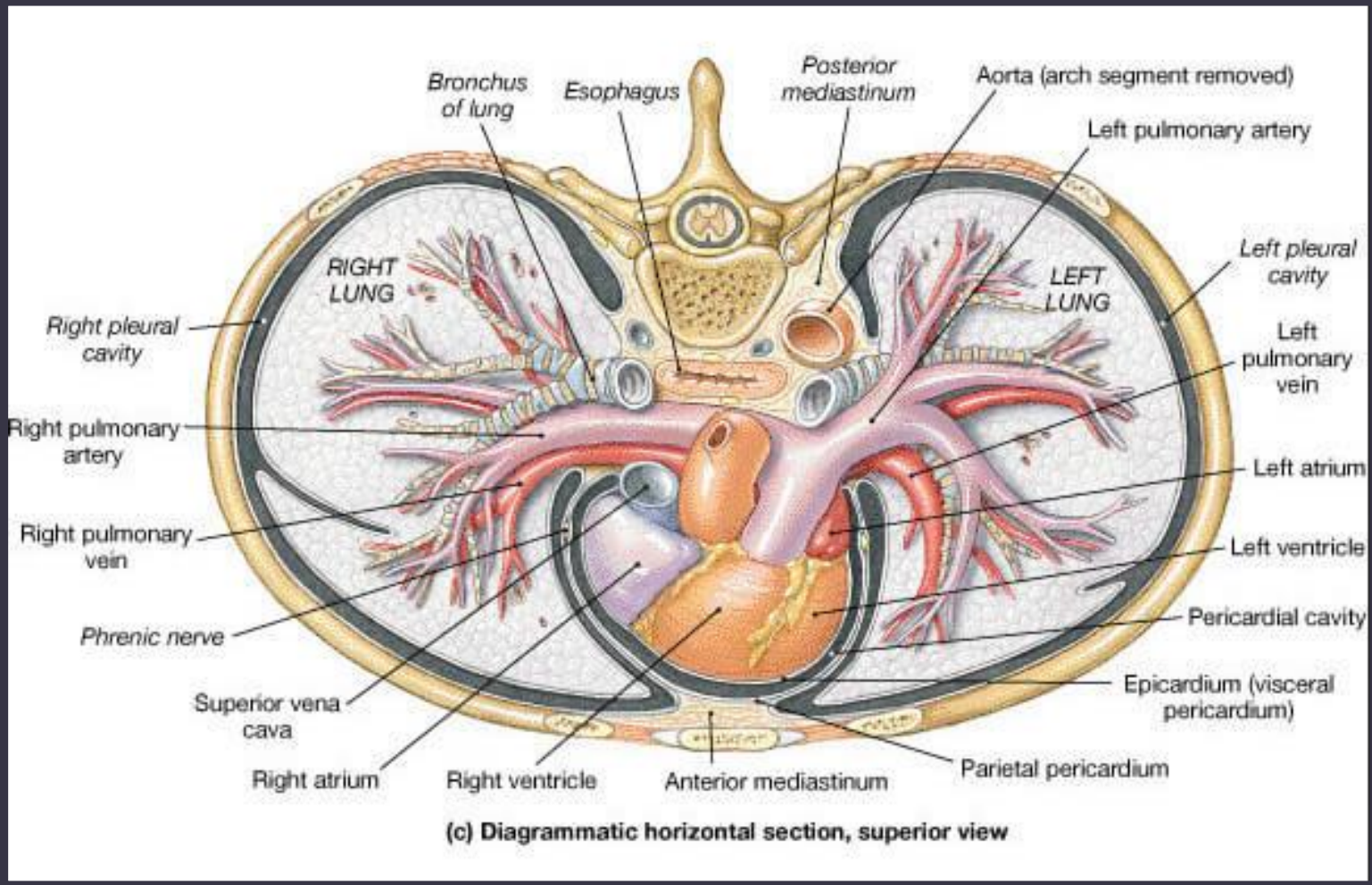




Primary gut (foregut) ⟹ Hollow organs (trachea, bronchi)

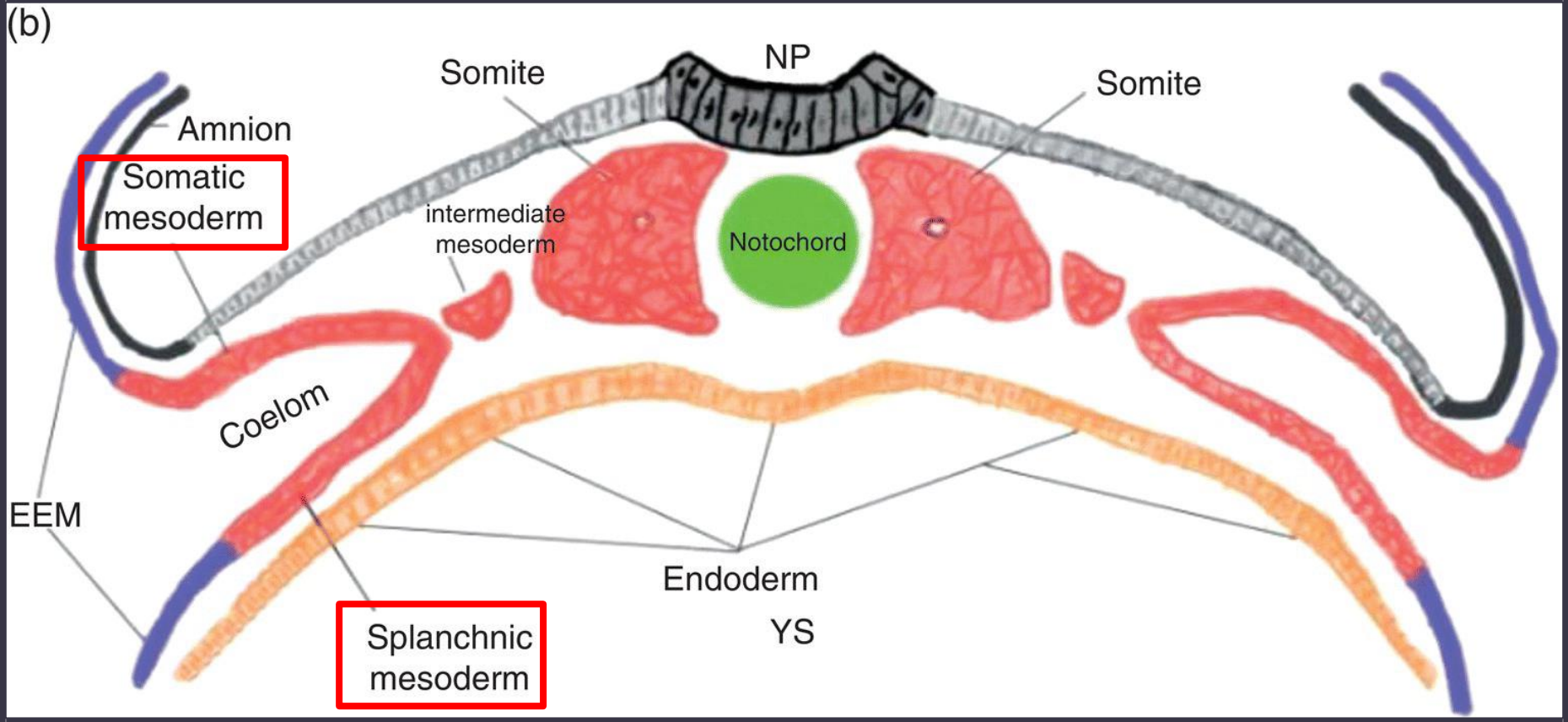
Intraembryonic cavity ⟹ Pleural cavity

Development of the pleura and pleural cavities



Pleura **– serose membrane lining lungs and walls of the thoracic cavity**
- is derived from intraembryonic mesoderm

Lateral mesoderm forms two plates: somatic and splanchnic



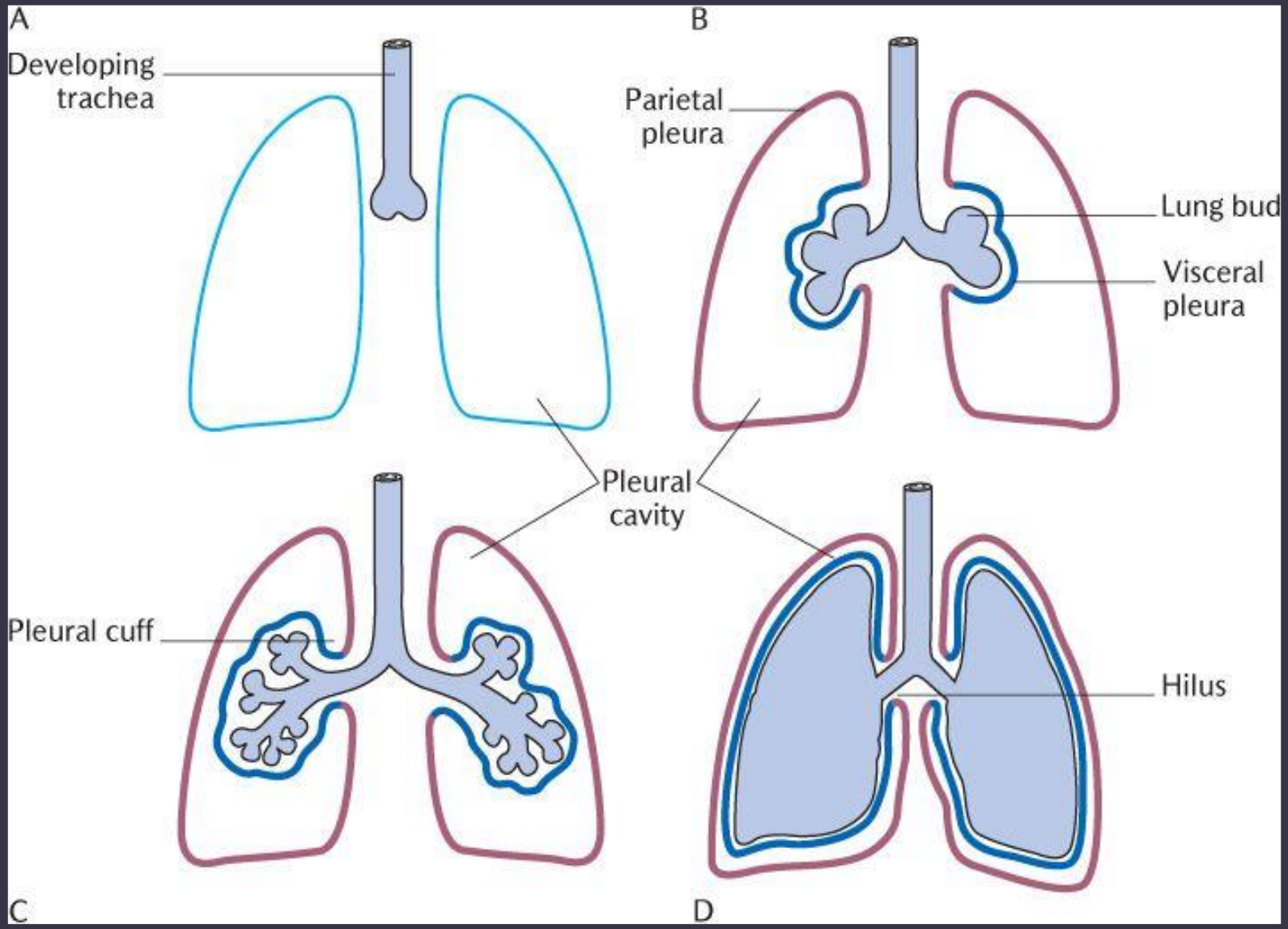
EEM, extraembryonic mesoderm; YS, Yolk sac; NP, neural plate.

Intraembryonic body cavity(coelom) → Pleural cavity

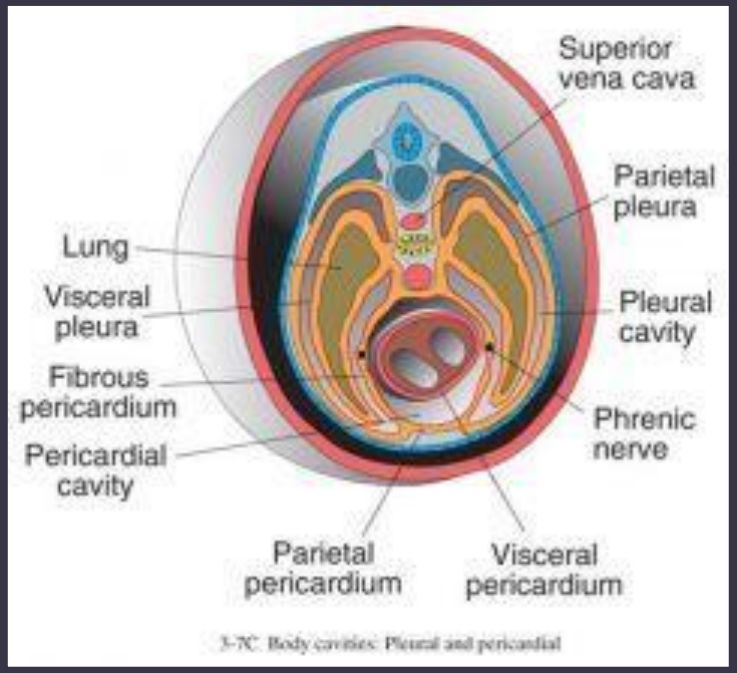
Somatic mesoderm → Parietal pleura

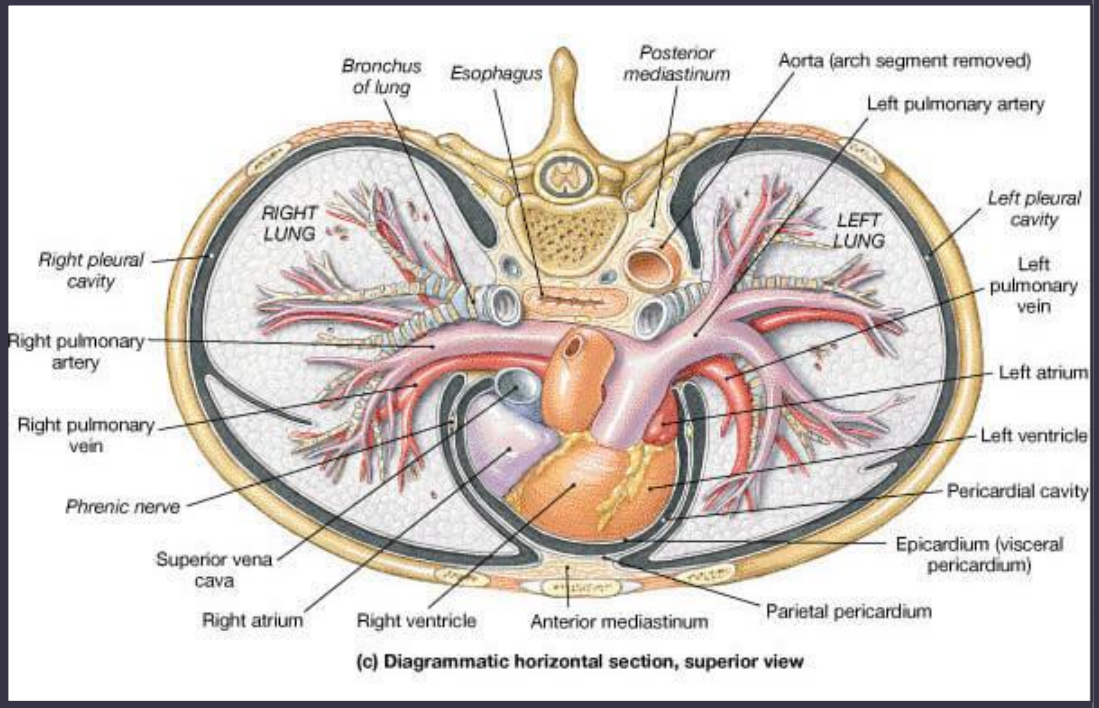
Splanchnic mesoderm → Visceral pleura

Development of pleura

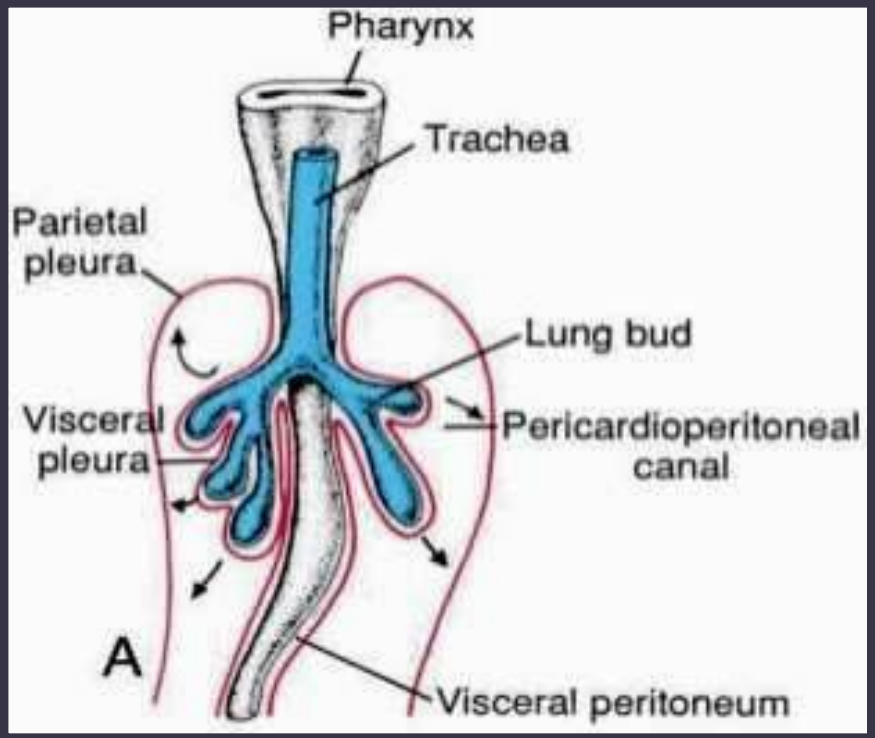


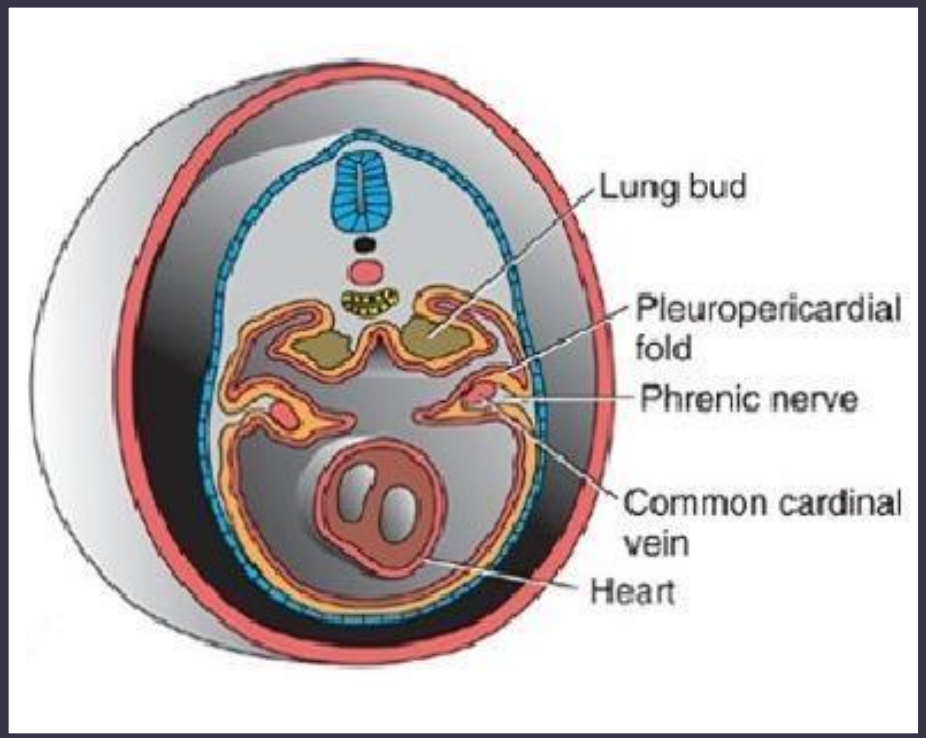
Development of the pleura and pleural cavities



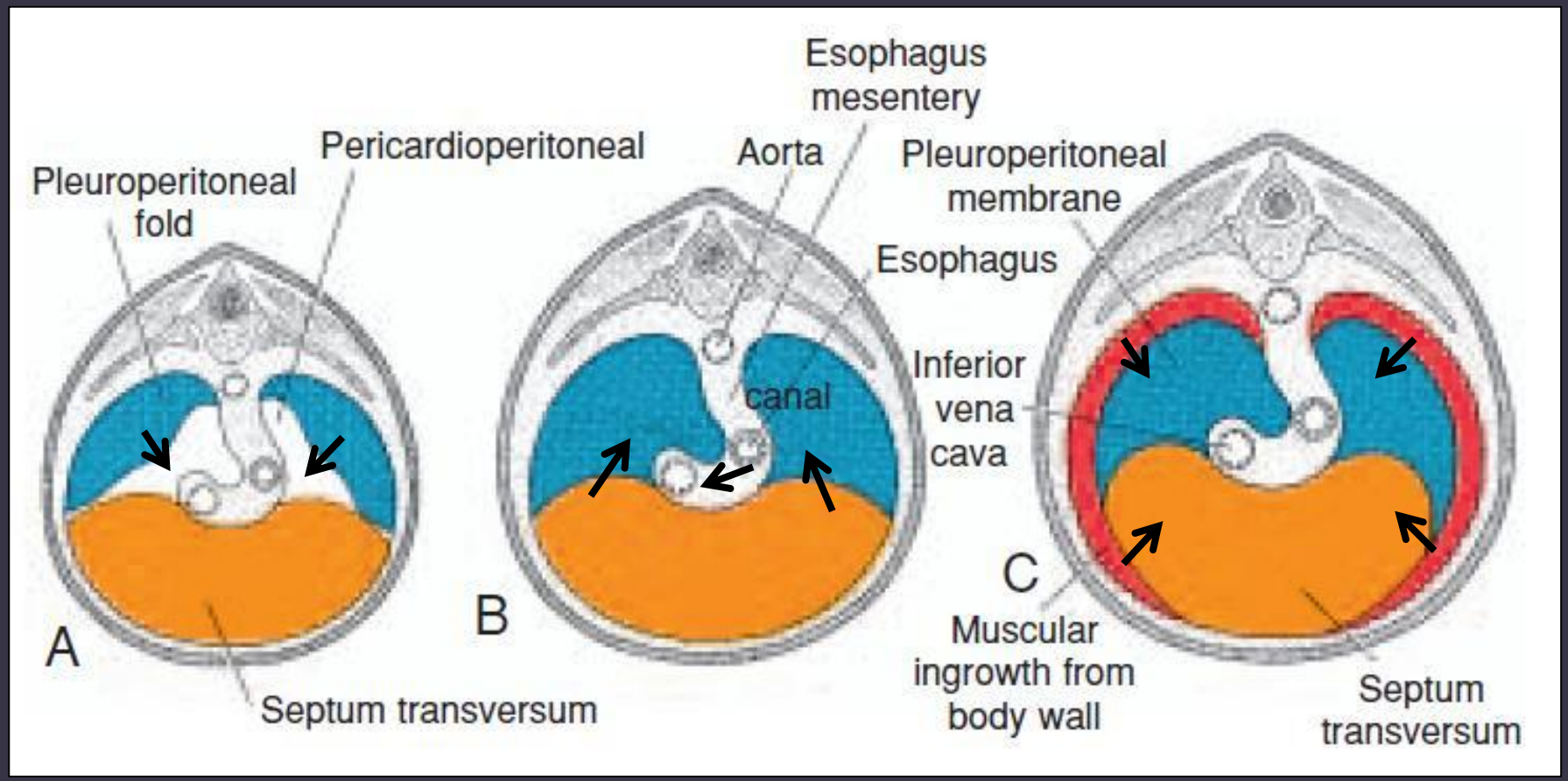


Development of the pleura and pleural cavities





Expansion of the lung buds into the pericadioperitoneal canals. At this stage, the canals are in communication with the peritoneal and pericardial cavities.



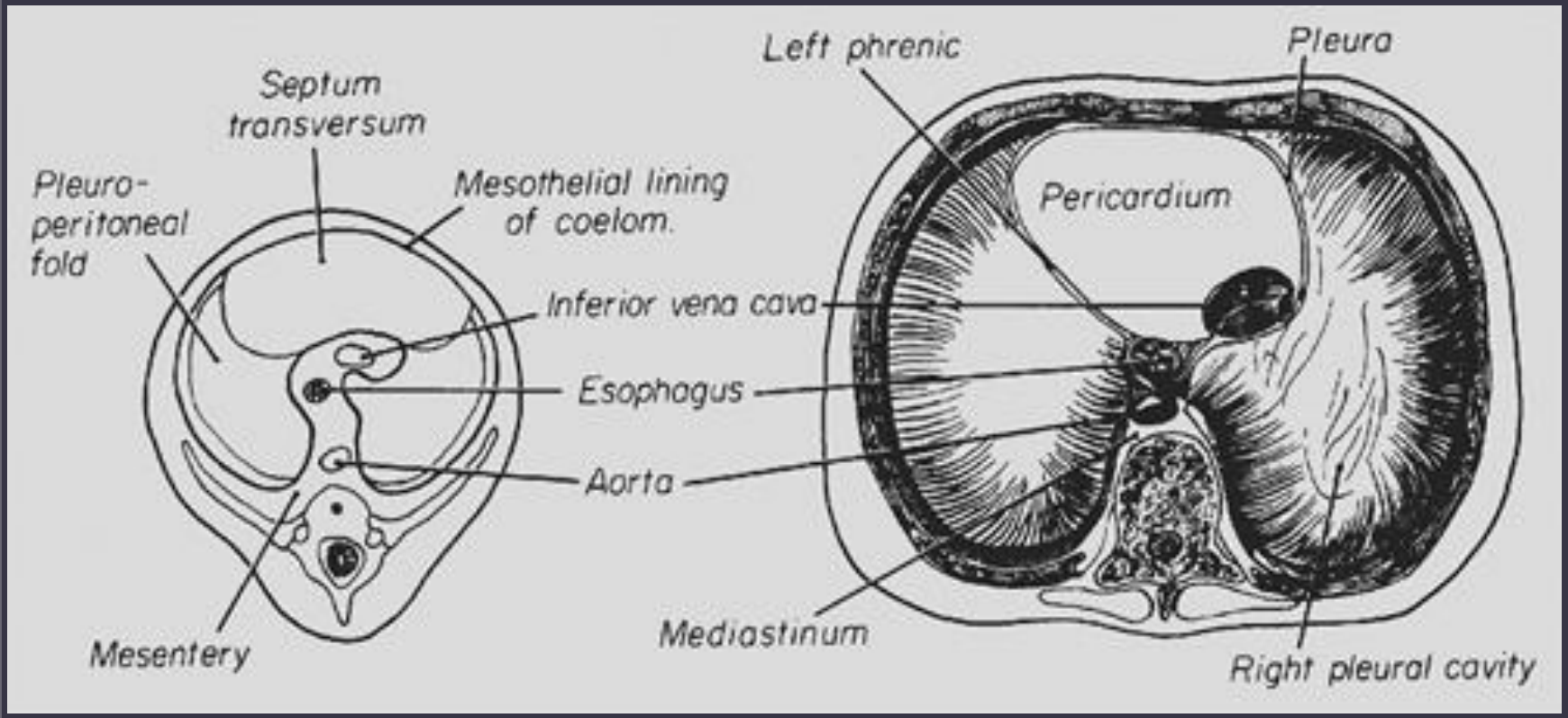
Diaphragm develops from 4 sources:

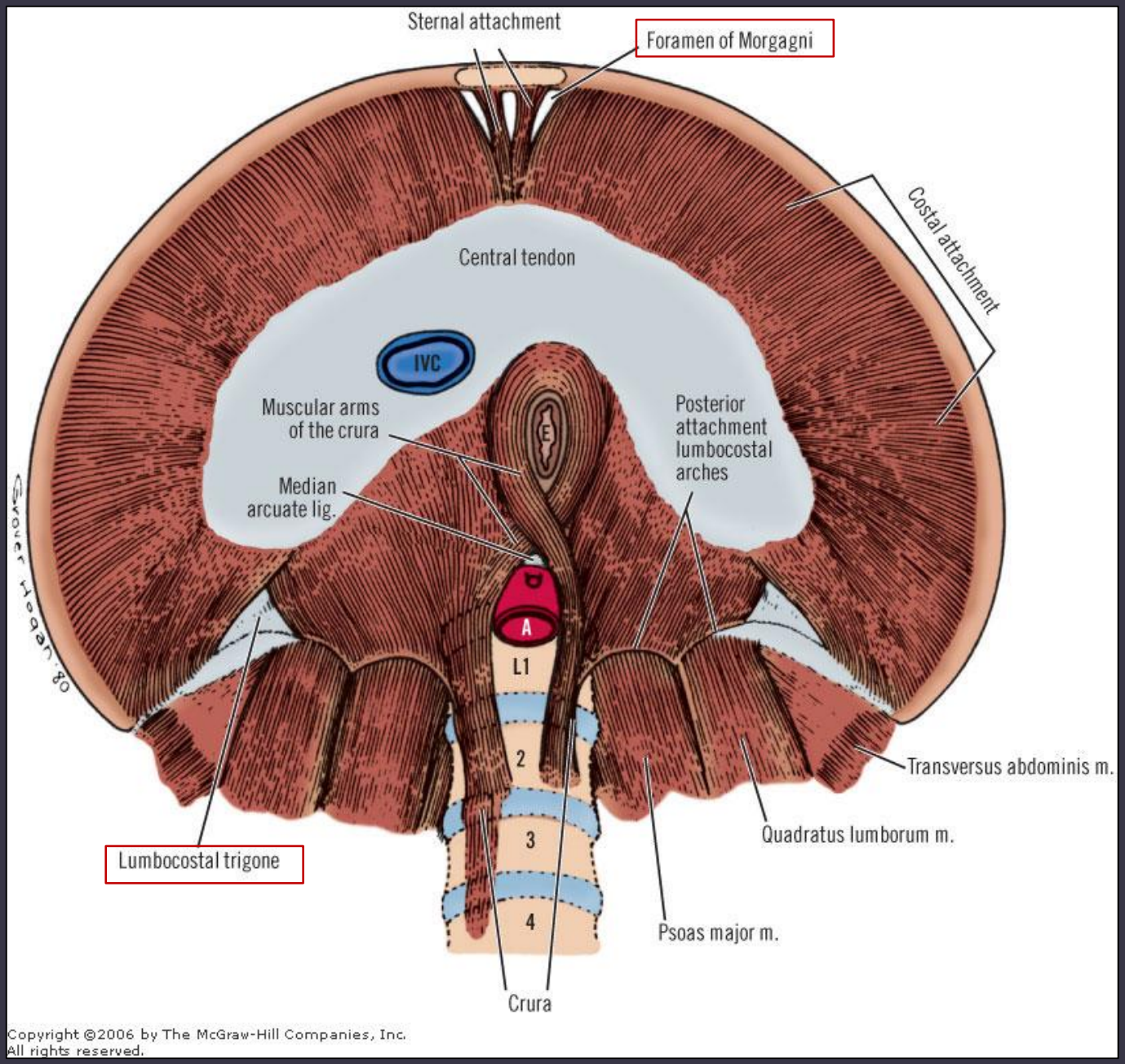
–1) Septum Transversum

–2) Pleuroperitoneal Membranes (folds)

–3) Dorsal Mesentery of Esophagus

–4) Body Wall


Septum transversum
Pleuro-peritoneal fold
Mesothelial lining of coelom.
Inferior vena cava
Esophagus
Aorta
Mesentery
Left phrenic
Pleura
Pericardium
Mediastinum
Right pleural cavity


Sternal attachment
Foramen of Morgagni
Costal attachment
Central tendon
IVC
Muscular arms of the crura
Median arcuate lig.
Posterior attachment lumbocostal arches
E
A
L1
2
3
4
Transversus abdominis m.
Quadratus lumborum m.
Lumbocostal trigone
Psoas major m.
Crura
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The trachea is lined with pseudostratified ciliated columnar epithelium with goblet cells. This epithelium is derived from

1) Neuroectoderm
2) Endoderm
3) Ectoderm
4) Visceral mesoderm
5) Mesoderm of 4^{th} and 6^{th} pharyngeal arches

2

Smooth muscle, connective tissue, and cartilage of primary bronchi are derived from which of the following sources?

1) Neuroectoderm
2) Endoderm
3) Ectoderm
4) Visceral mesoderm
5) Mesoderm of 4^{th} and 6^{th} pharyngeal arches

4

Components of blood-air barrier in the lungs are derived from which of the following sources?

1) Ectoderm only
2) Visceral mesoderm only
3) Visceral mesoderm and ectoderm
4) Endoderm and ectoderm
5) Visceral mesoderm and endoderm

5

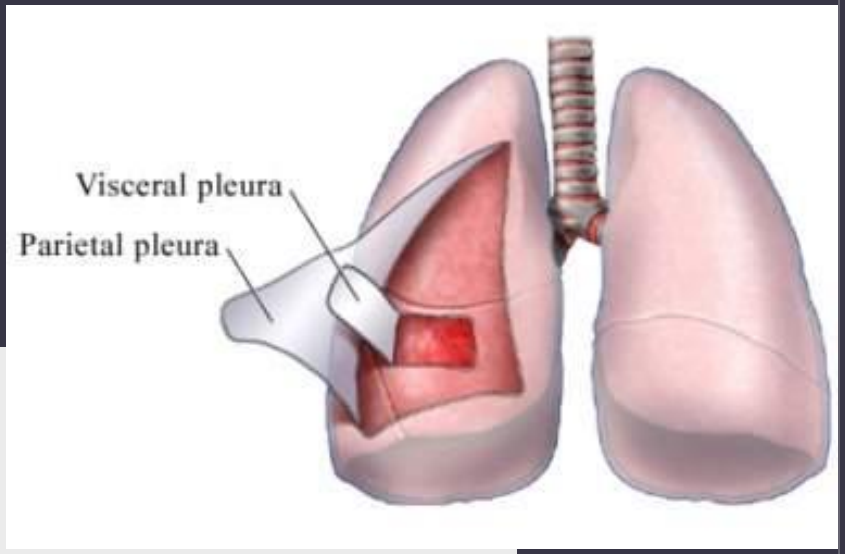
The laryngotracheal tube initially is an open communication with the primitive foregut. Which of the following embryonic structures is responsible for separating these two structures?

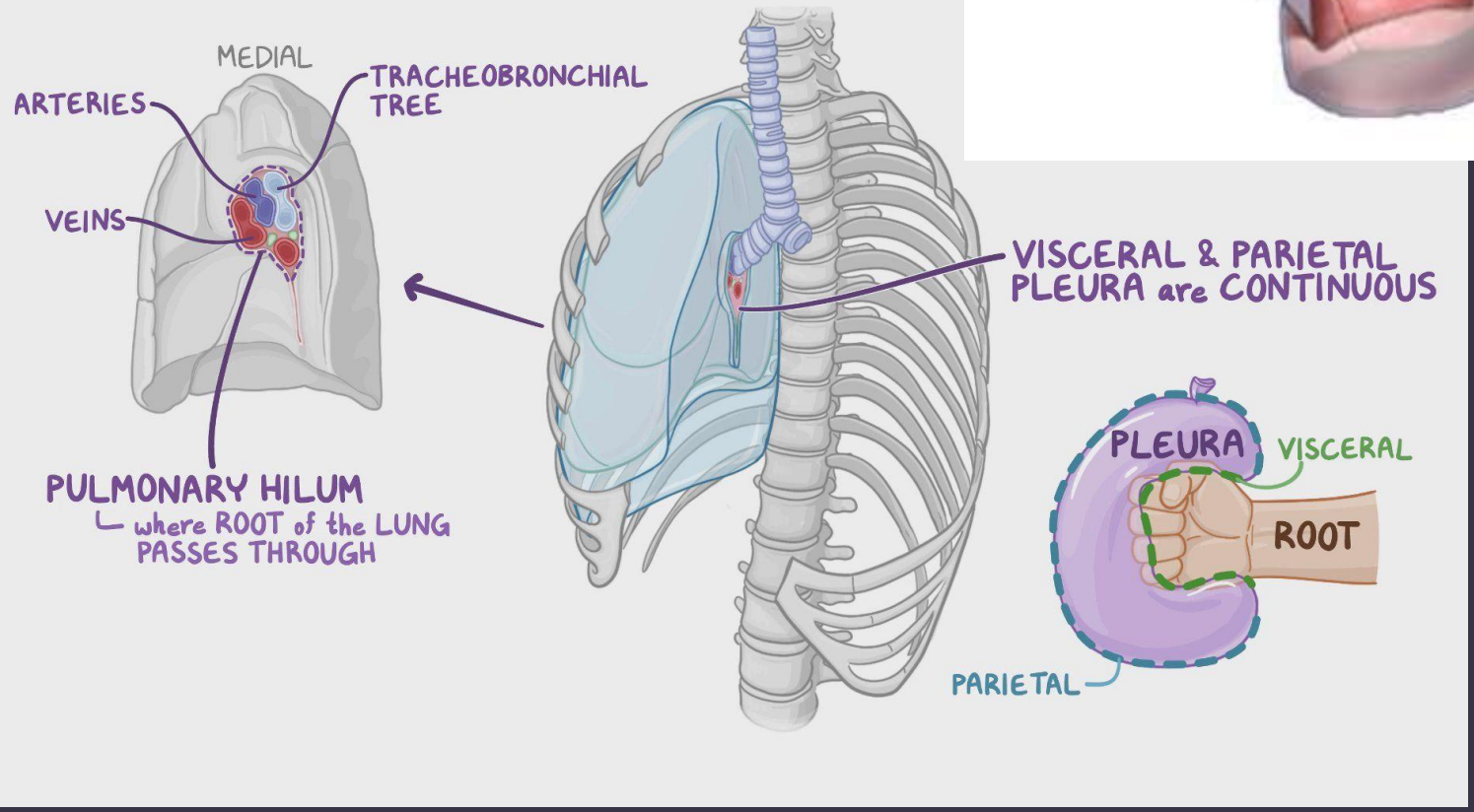
1) Laryngotracheal tube
2) Posterior esophageal folds
3) Laryngoesophageal diverticulum
4) Tracheoesophageal septum
5) Bronchopulmonary segment

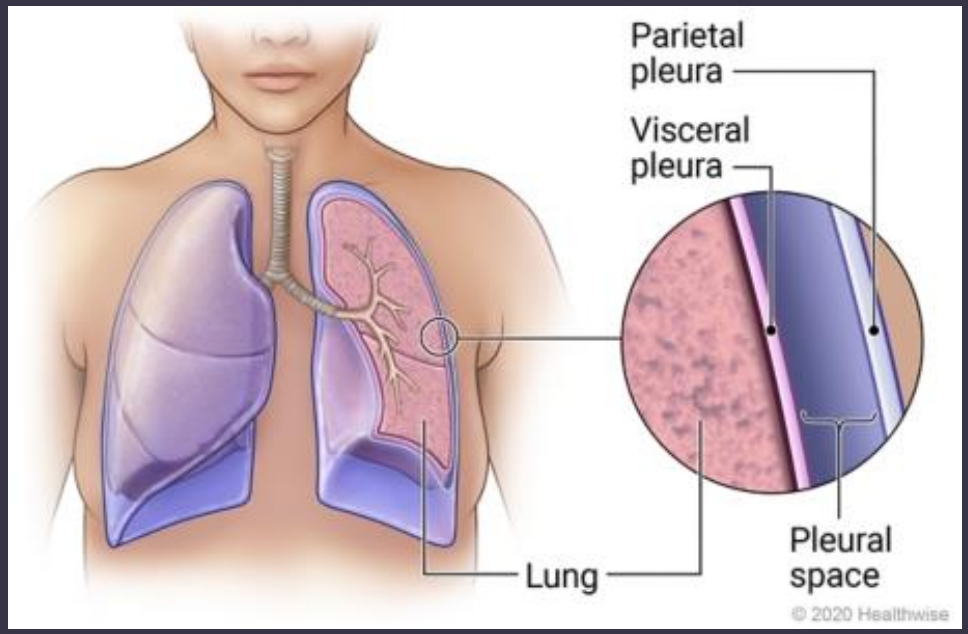
4

Pleura

- Serous membrane covering the lung and lining the thoracic walls.
- <u>Consists of two layers</u>: visceral and parietal







Parietal pleura

↓

Is adhered to the inner surface of the thoracic walls

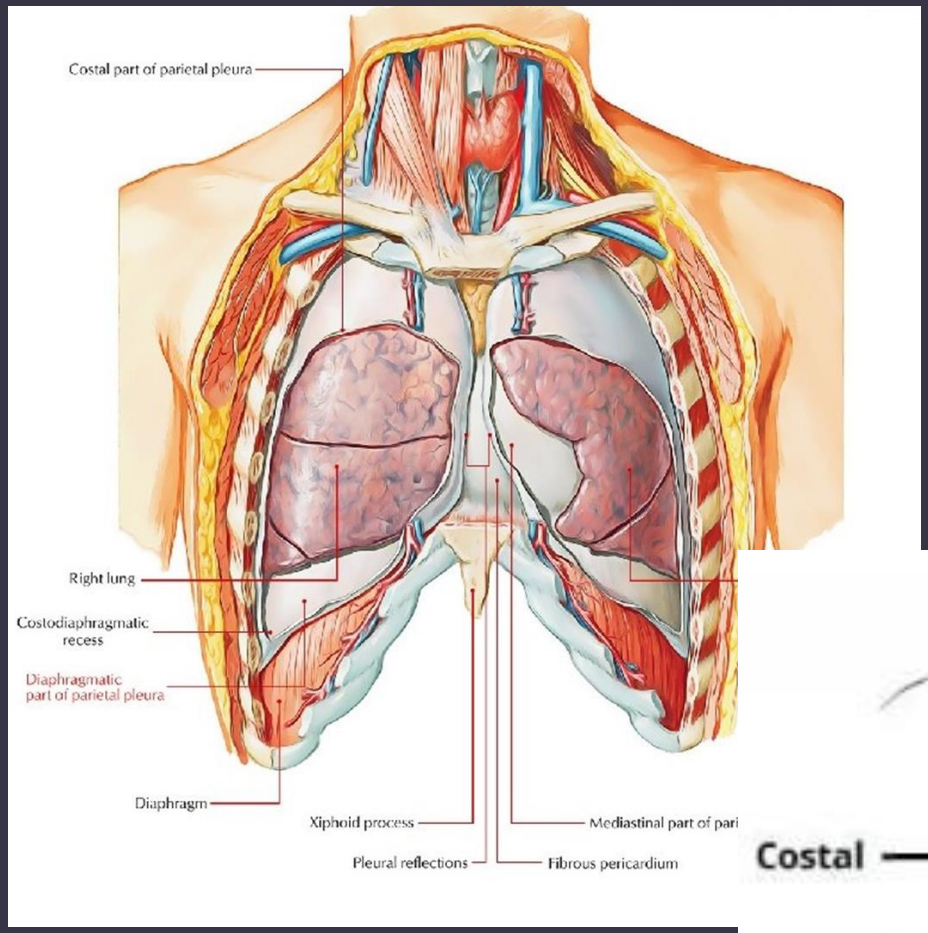
Visceral pleura, pleura pulmonalis

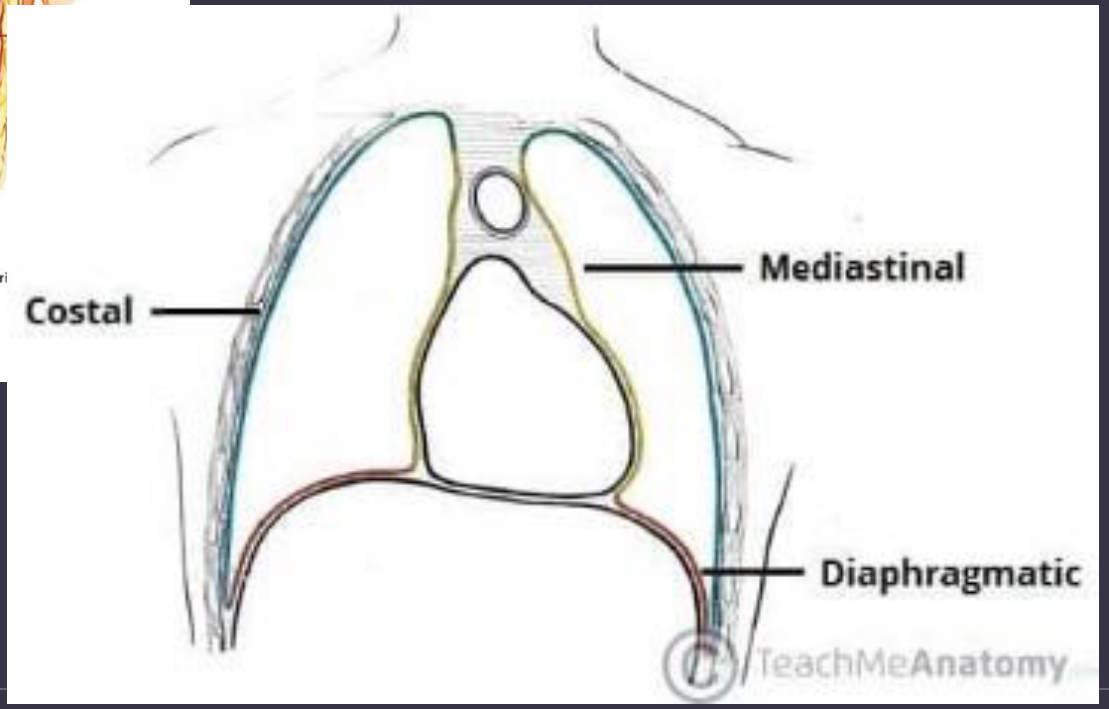
↓

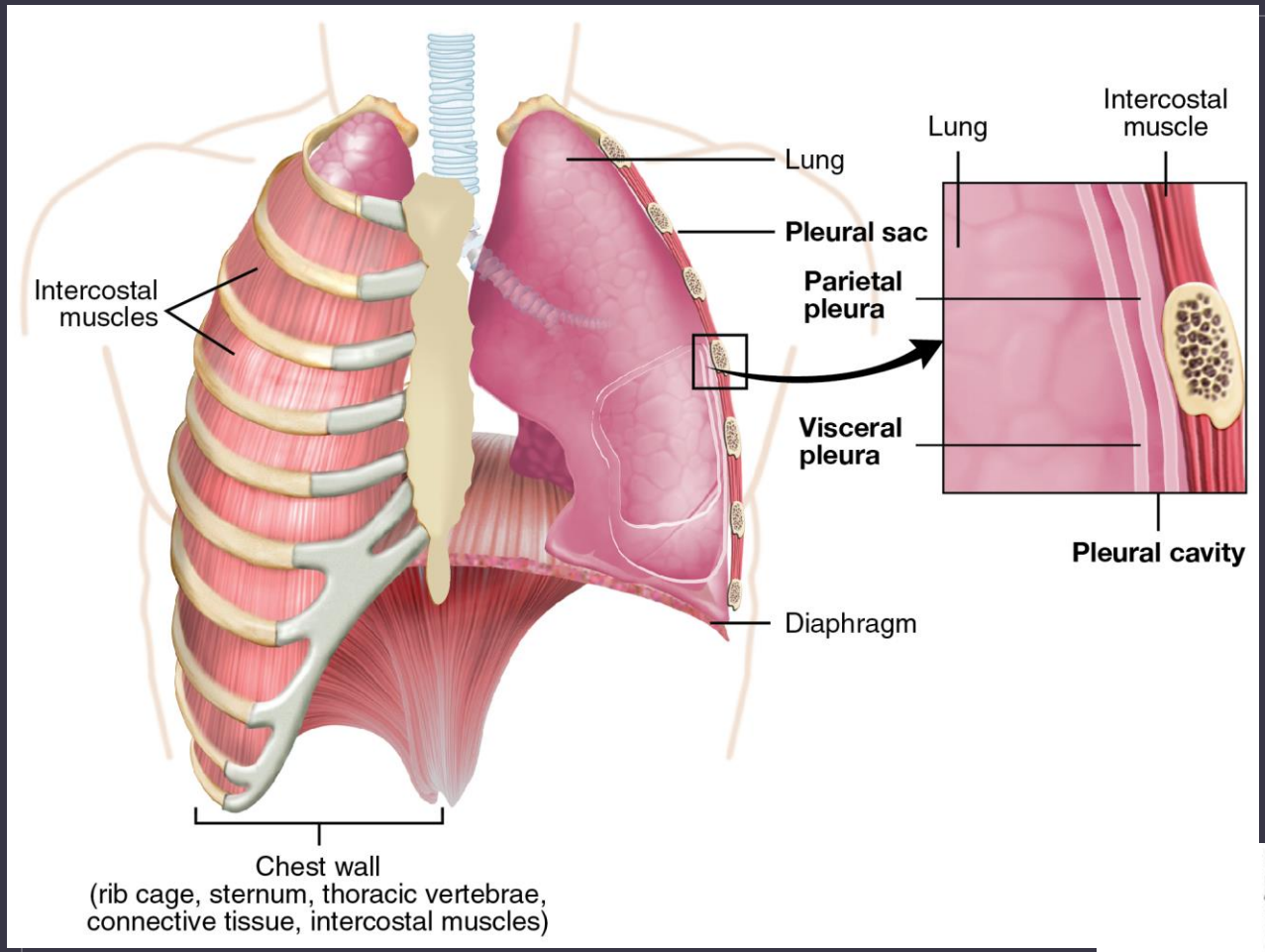
Adherent to the lung over all its surfaces

Along the surface of the lung's root the visceral pleura is continuous with the parietal pleura lining the walls of the thoracic cavity and limiting the mediastinum from the sides.

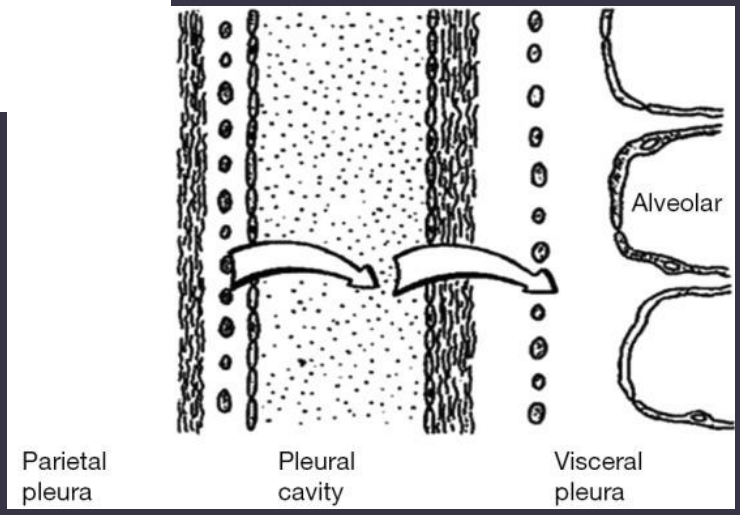
Parietal pleura

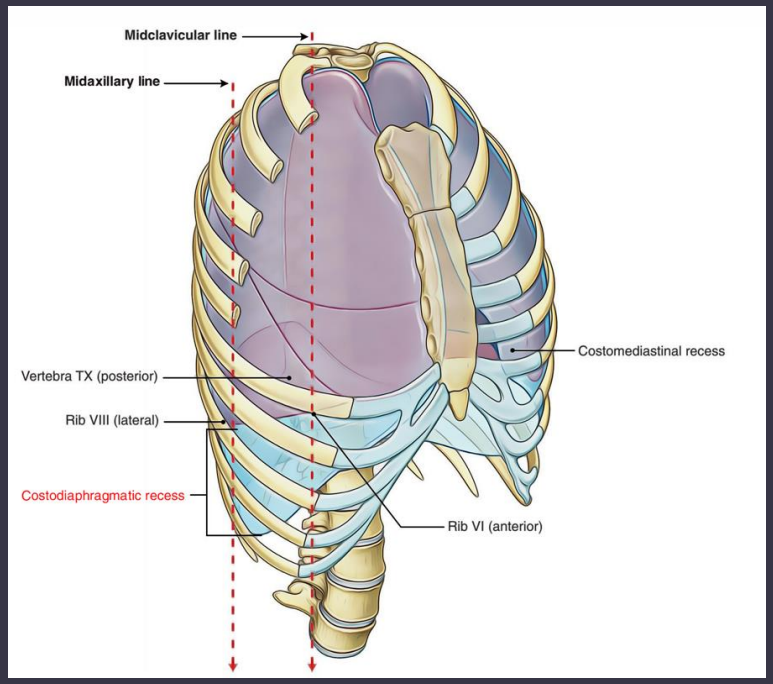






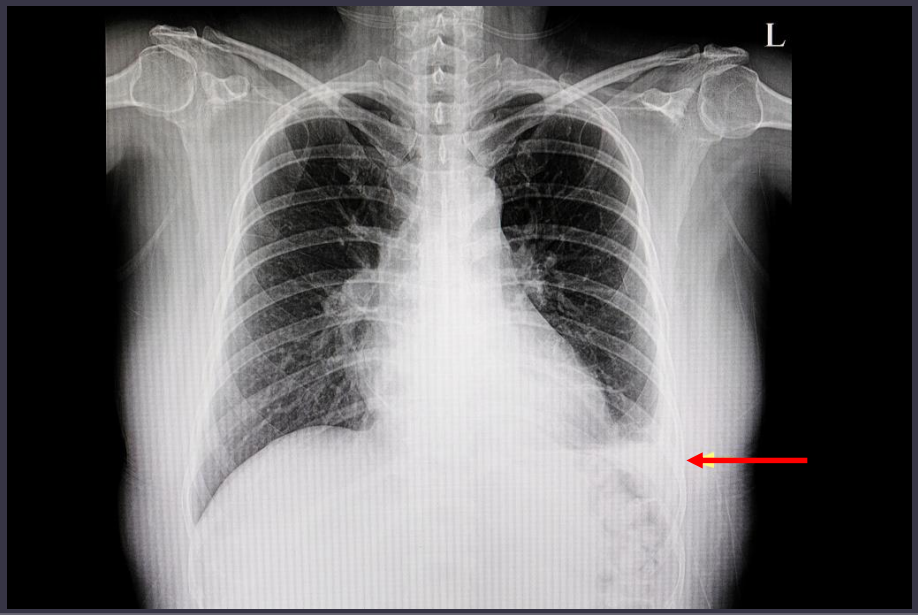
Pleural cavity – slit-like space between the parietal and visceral pleurae





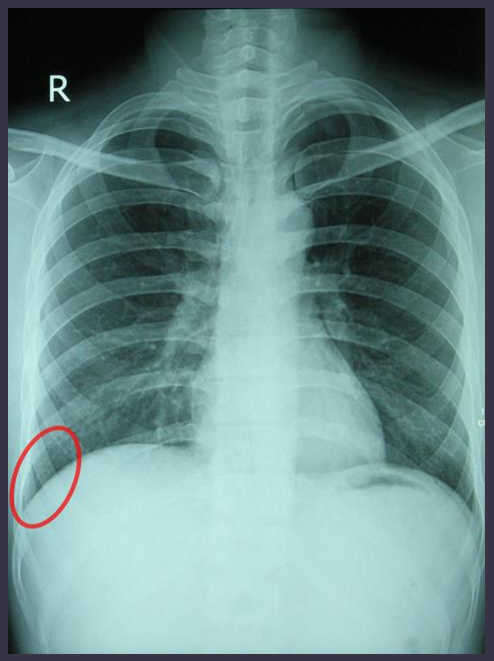
Pleural recesses (sinuses)

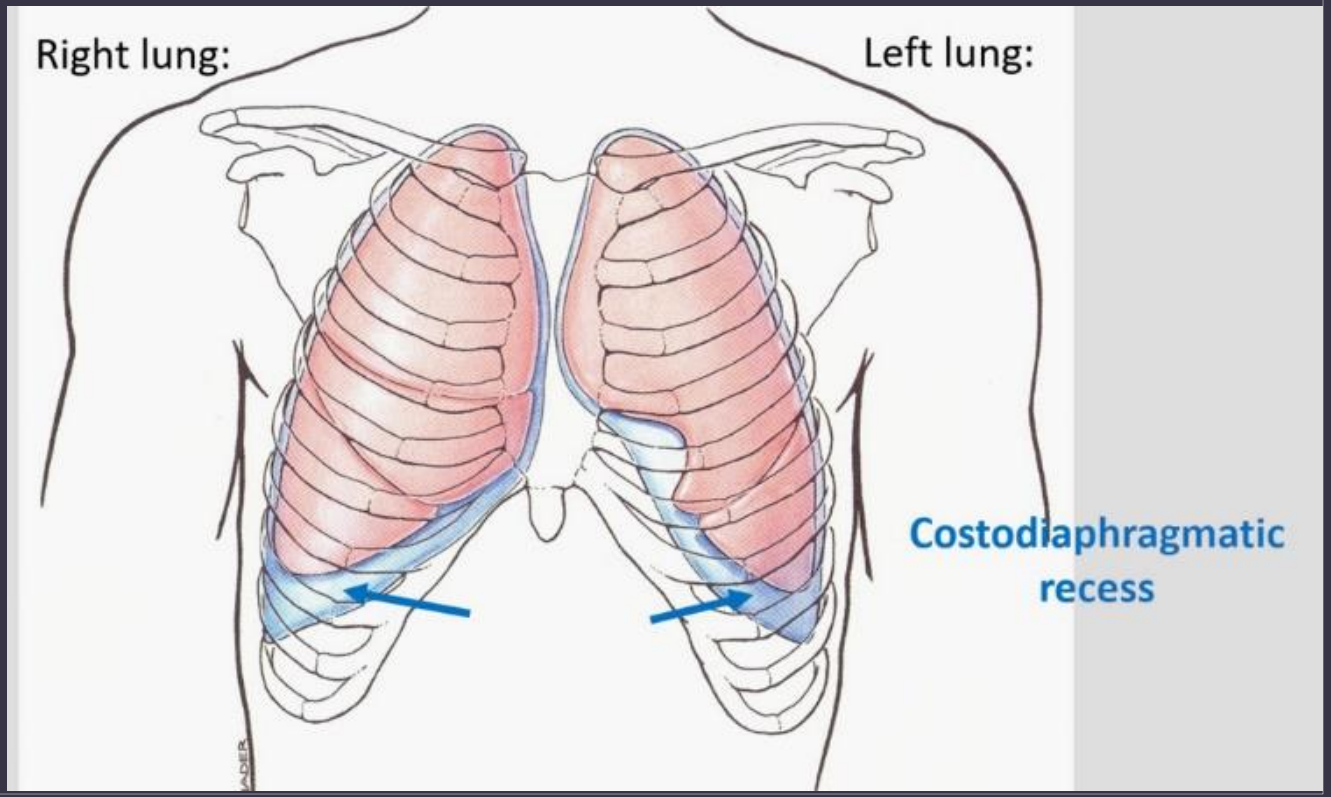
- formed in the places where one part of the pleura is continuous with another part.
- they are reserve spaces of the right and left pleural cavities.
- when the pleura is inflamed, and the processes of the production and absorption of the serous fluid are disordered, the recesses may accumulate this fluid.



Costodiaphragmatic recess

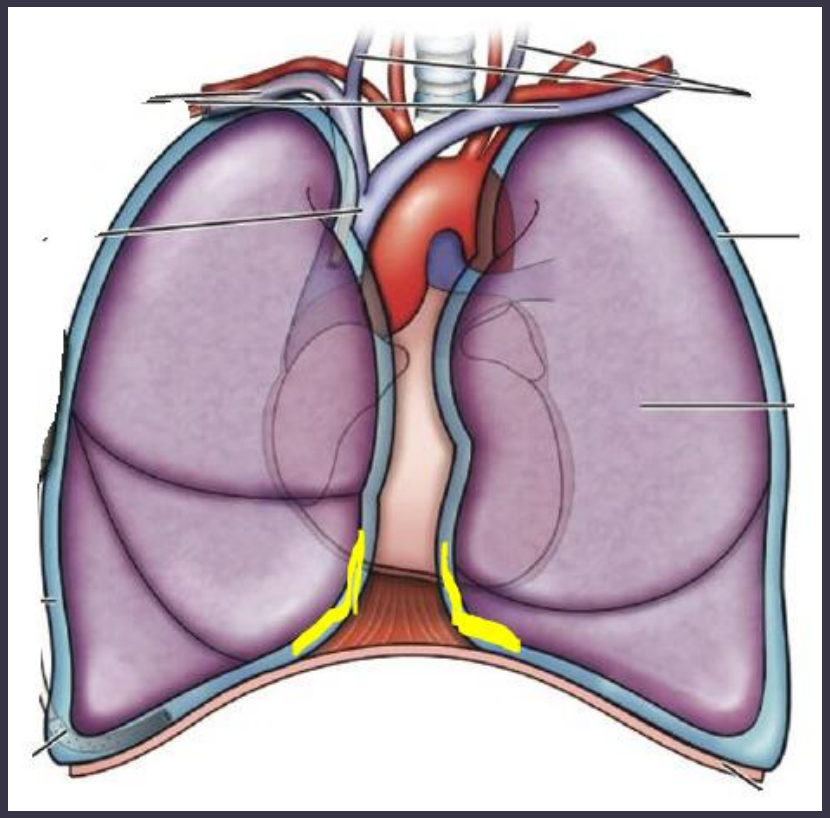
- Where the costal part is continuous with the diaphragmatic part;
- The deepest one

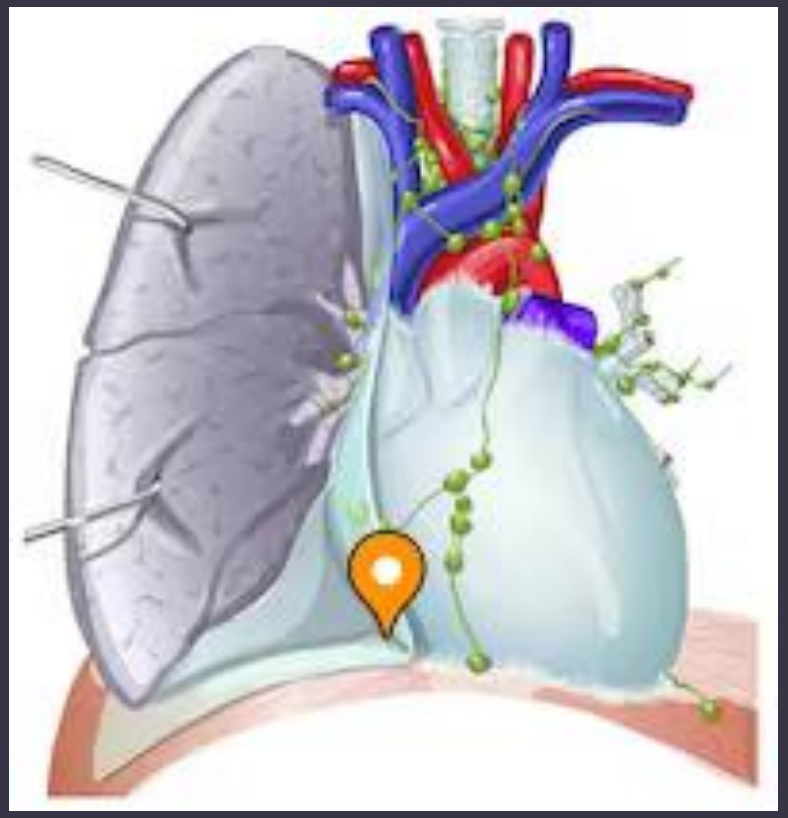




Phrenicomediastinal recess

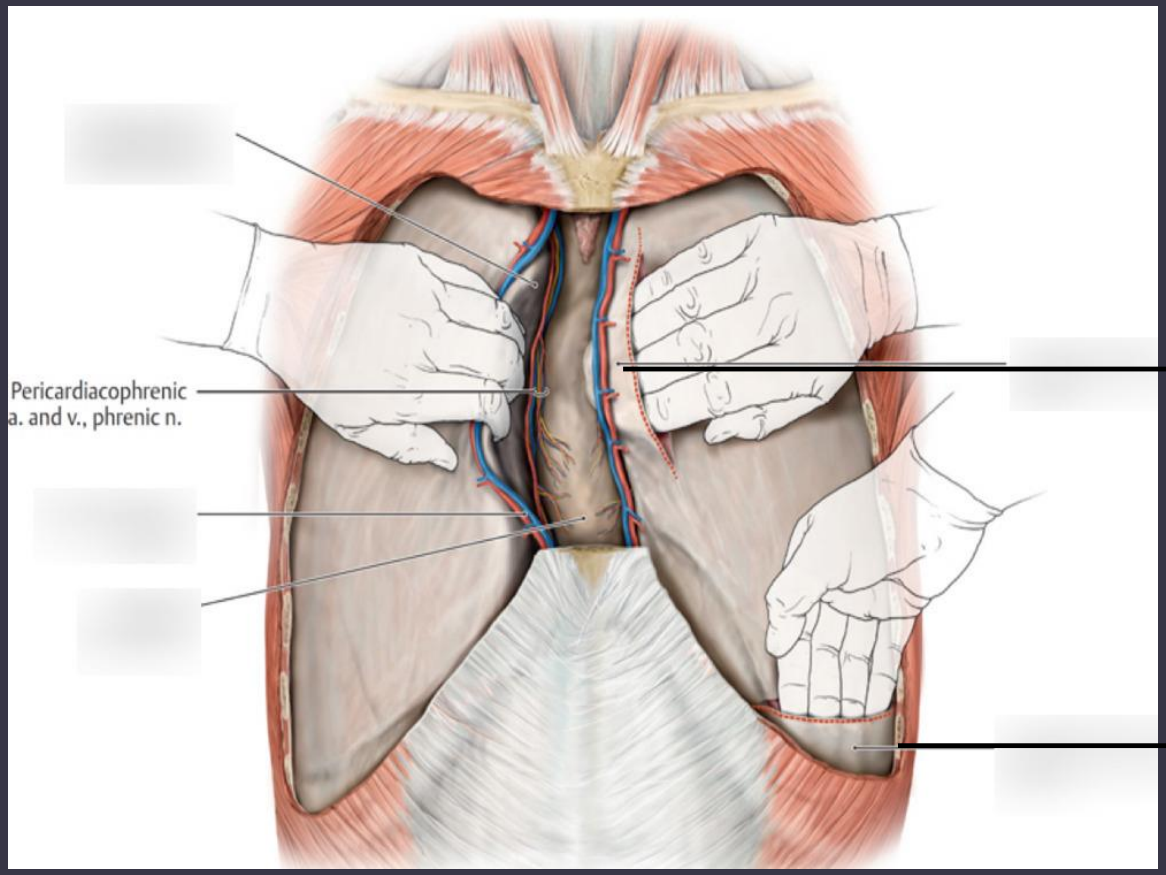
- Between the mediastinal and diaphragmatic parts of the pleura
- It is not very deep
- It is arranged in the sagittal plane





Costomediastinal recess

- Formed between the anterior portion of the costal part and the mediastinal part
- The smaller recess



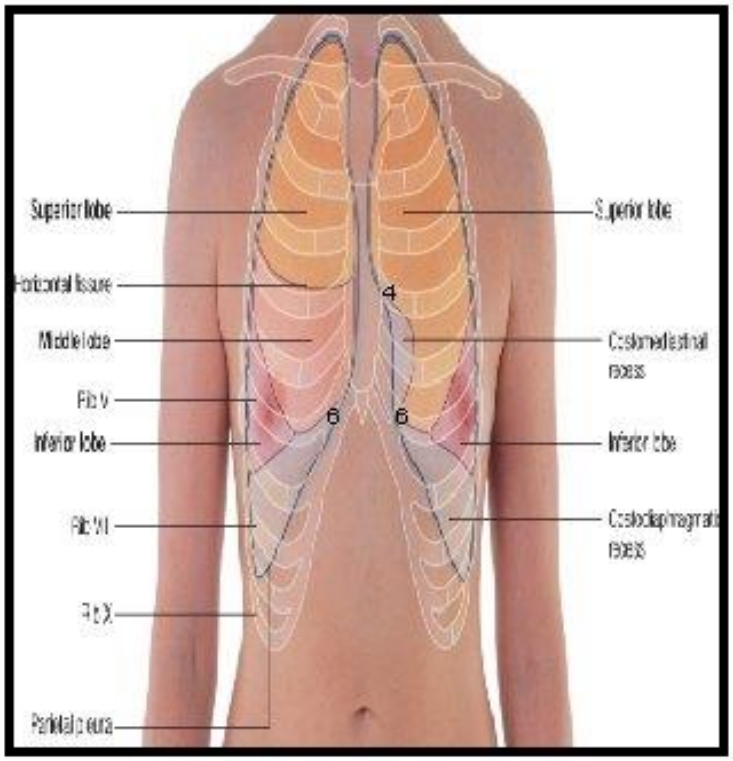
recessus costomediastinalis

recessus costodiaphragmaticus

Vertebromediastinal recess

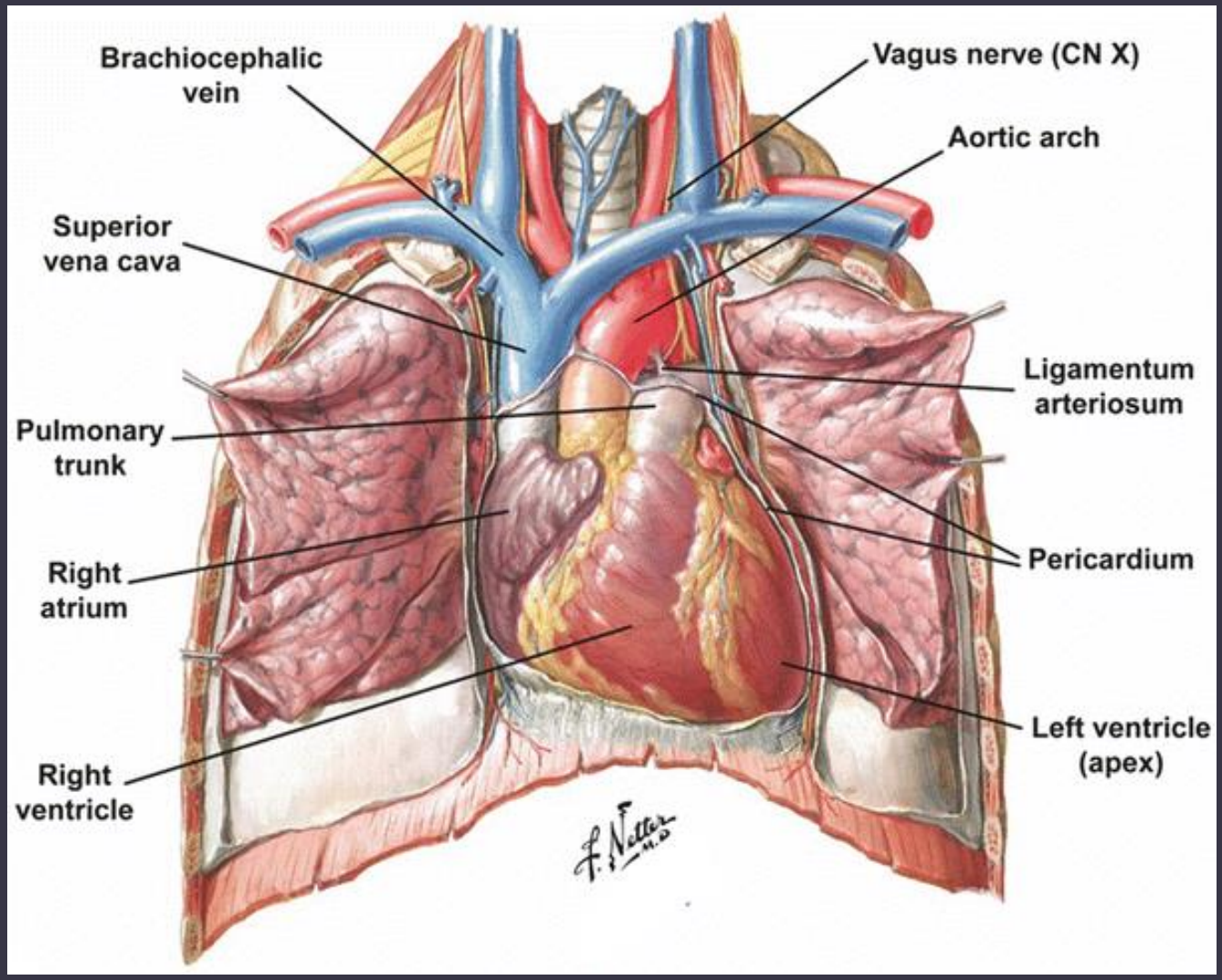
- Where the mediastinal part of the pleura continues to cover the thoracic part of the vertebral column

SUFACE ANATOMY OF PLEURA



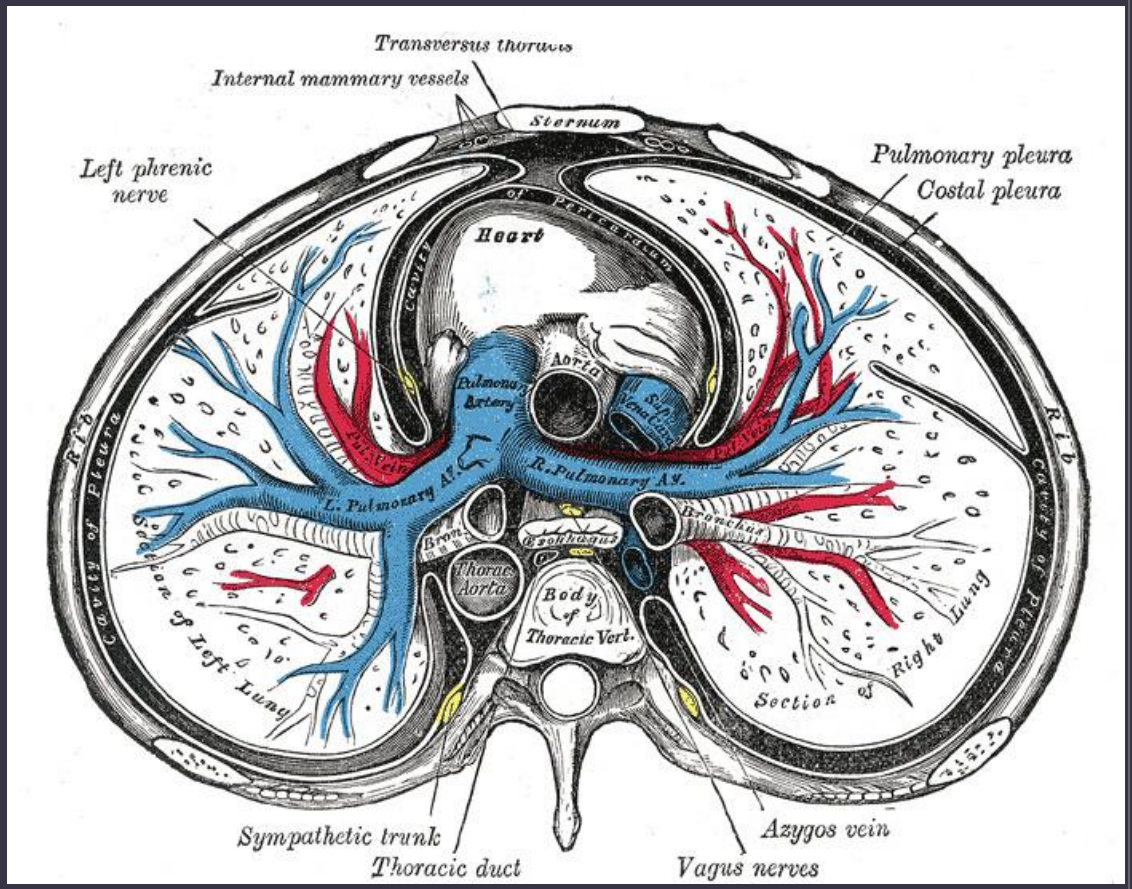
- **Apex:** lies one inch above the medial 1/3 of the clavicle.
- **Right pleura: The anterior margin** extends vertically from sternoclavicular joint to 6th costal cartilage.
- **Left pleura: The anterior margin** extends from sternoclavicular joint to the 4th costal cartilage, then deviates for about 1 inch to left at **6th costal** cartilage to form **cardiac notch**
- **Inferior margin :** passes around the chest wall, on the **8th** rib in midclavicular line, **10th** rib in **mid-axillary line** and finally reaching to **the last thoracic spine.**
- **Posterior margin : along the vertebral column** from the **apex** to the **inferior margin.**

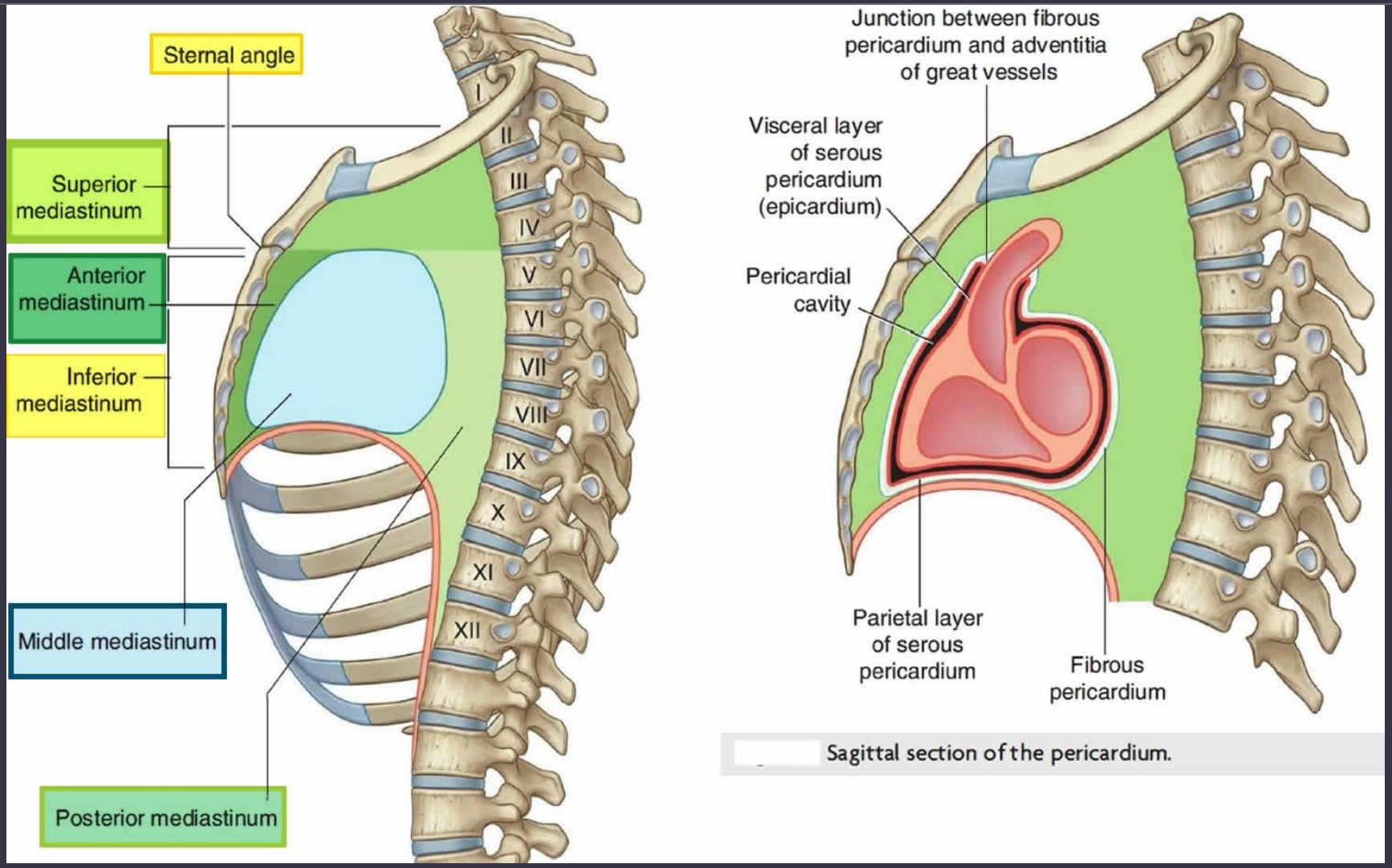
Mediastinum is a complex of the organs situated between the right and left pleural cavities



The mediastinum is limited

- anteriorly by the sternum
- posteriorly by thoracic vertebrae
- laterally by the right and left mdiastinal parts of the parietal pleura
- above it extends to the superior thoracic aperture
- below it reaches the diaphragm

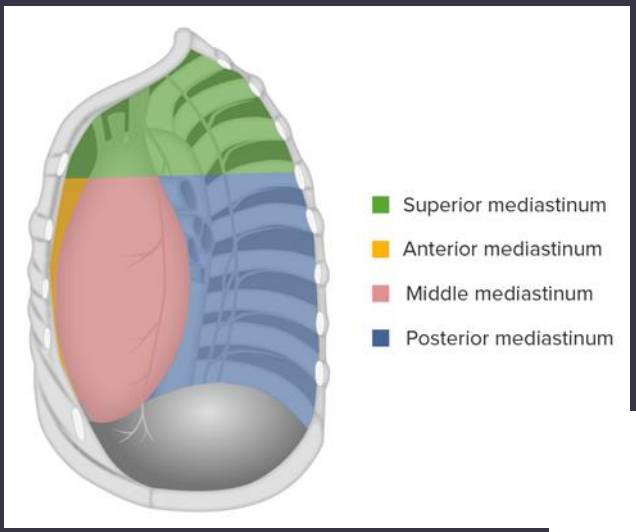




1.Superior mediastinum,

2. Inferior mediastinum, which is further partitioned into:

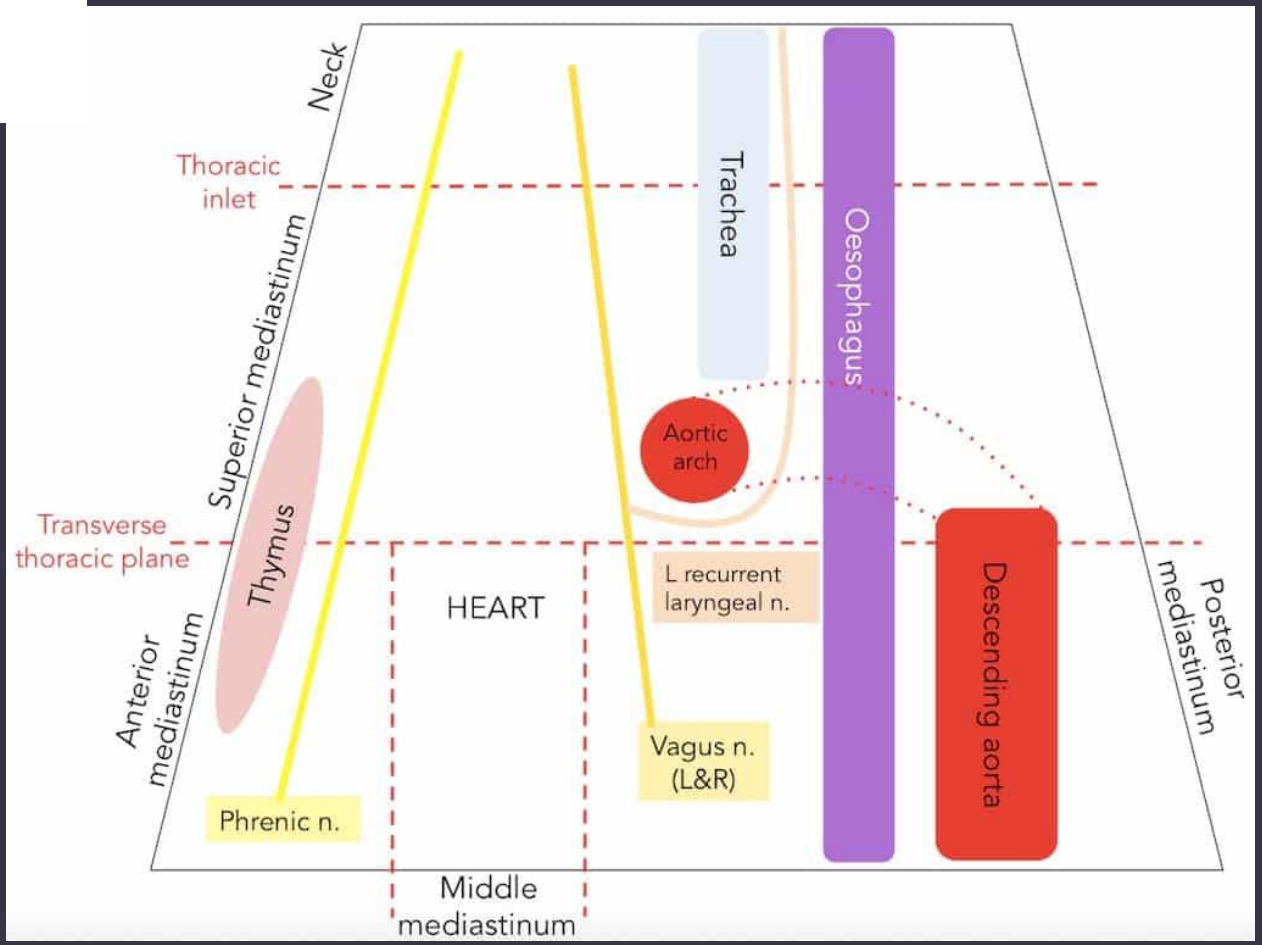
- anterior,
- middle,
- posterior mediastinum by the pericardial sac.

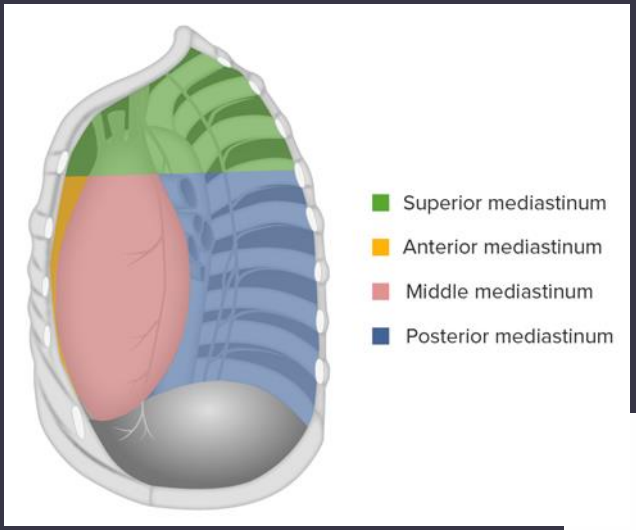


The anterior mediastinum is between the sternal body anteriorly and the anterior part of the costal pleura posteriorly.

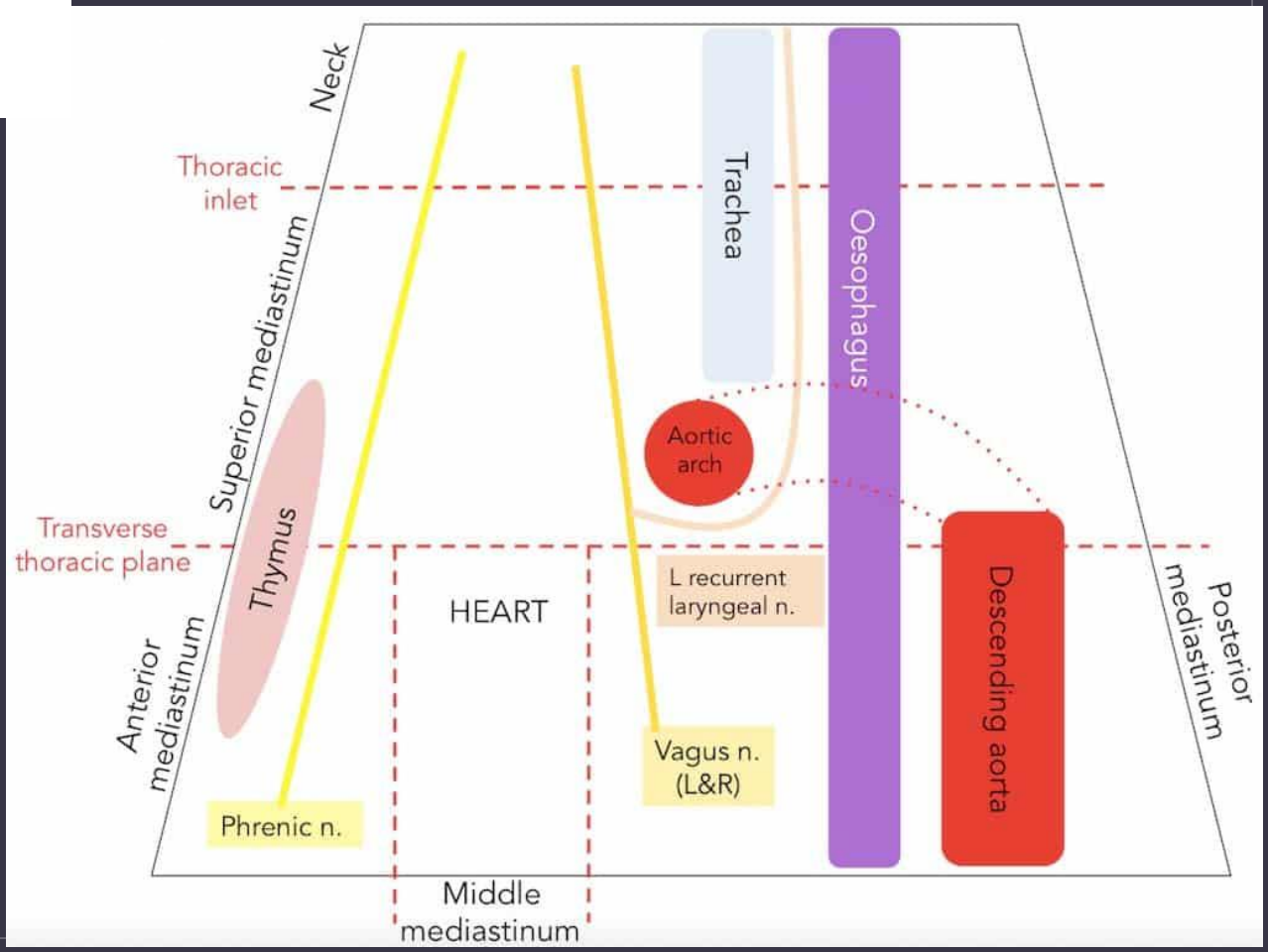
It includes

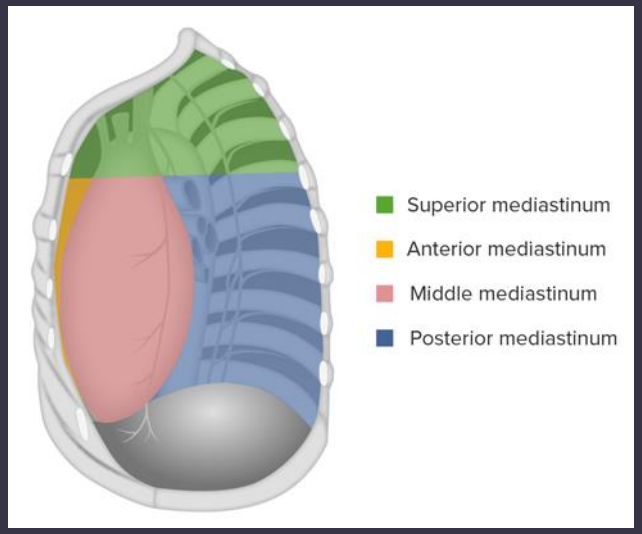
- ✓ the internal thoracic vessels
- ✓ the parasternal, anterior mediastinal and prepericardial lymph nodes.





The middle mediastinum contains the heart with the pericardium, the roots of the great vessels, the roots of the lungs and the tracheobronchial lymph nodes. Also the phrenic nerves and pericardiophrenic vessels pass here.

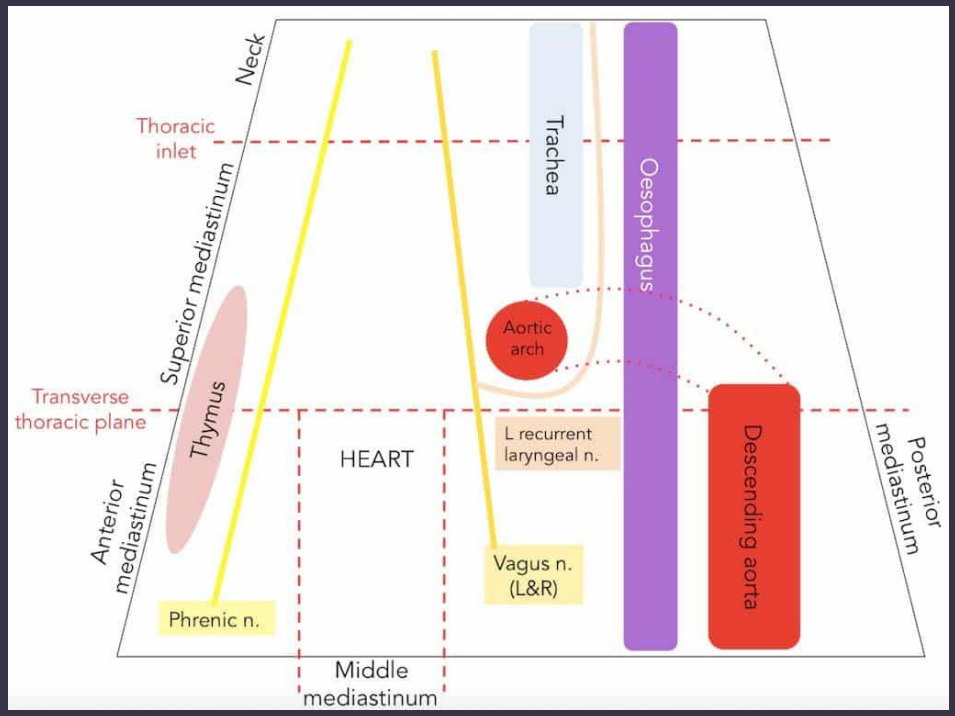




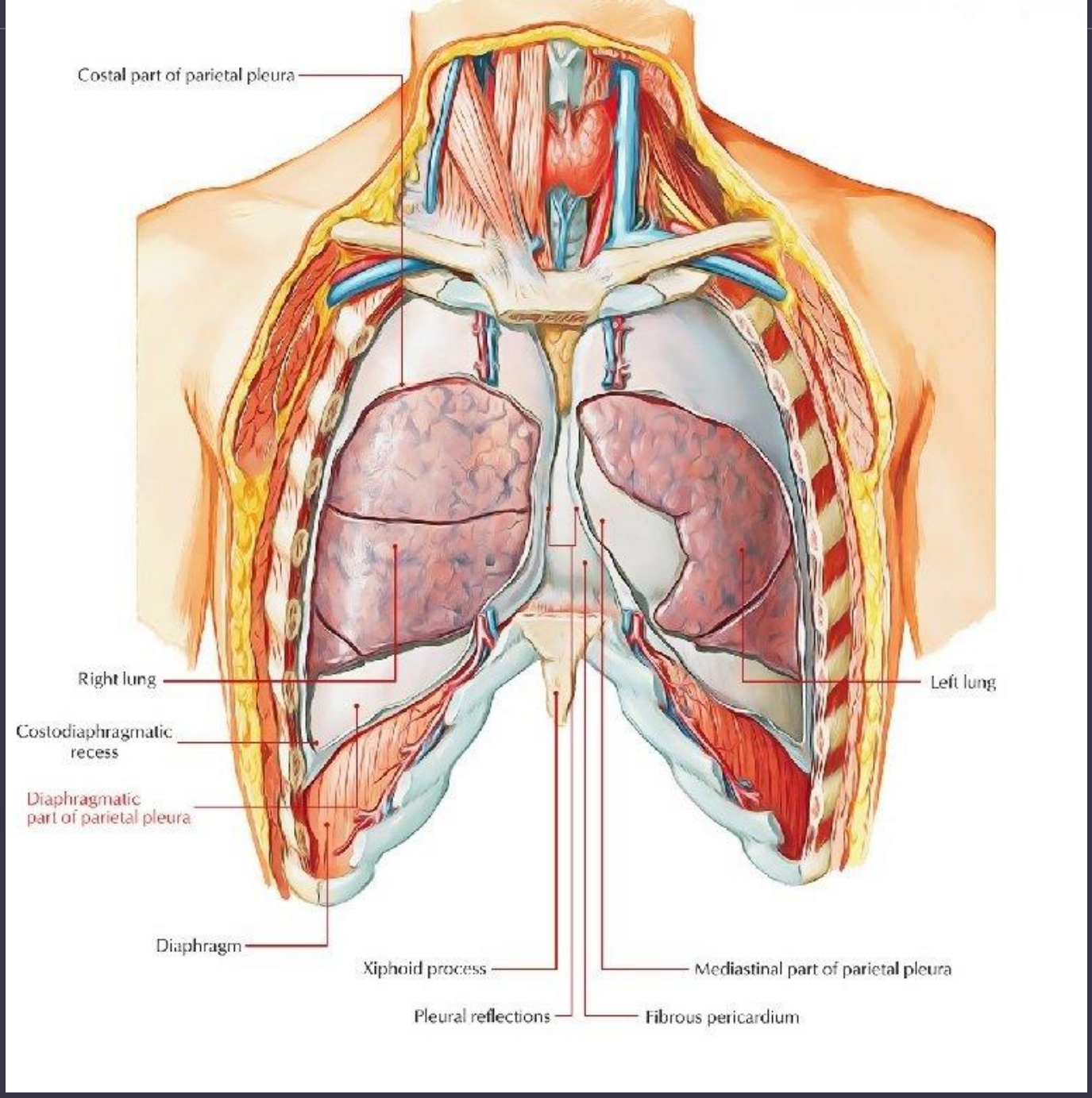
The posterior mediastinum is bounded by the pericardium anteriorly: by the thoracic part of the vertebral column and ribs posteriorly.

It includes:

- ✓ the thoracic part of the descending aorta,
- ✓ azygos and hemiazygos veins,
- ✓ right and left sympathetic trunks,
- ✓ the vagus and splanchnic nerves,
- ✓ lymphatic thoracic duct,
- ✓ the middle and inferior portions of the thoracic part of the oesophagus,
- ✓ the posterior mediastinal and prevertebral lymph nodes.



Thank you for your attention!


Costal part of parietal pleura
Right lung
Costodiaphragmatic recess
Diaphragmatic part of parietal pleura
Diaphragm
Xiphoid process
Pleural reflections
Fibrous pericardium
Mediastinal part of parietal pleura
Left lung