

# الجهاز الهضمي علم الأجنة

رقم المحاضرة: 1

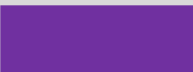


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## دلالات الألوان:

- شرح الدكتور باللون **الأحمر** 

- كلام الدكتور من الاسلايدات تحتة خط

- مهم من شرح الدكتور باللون **البنفسجي** 

- المعلومات الخارجية باللون **الأزرق** 

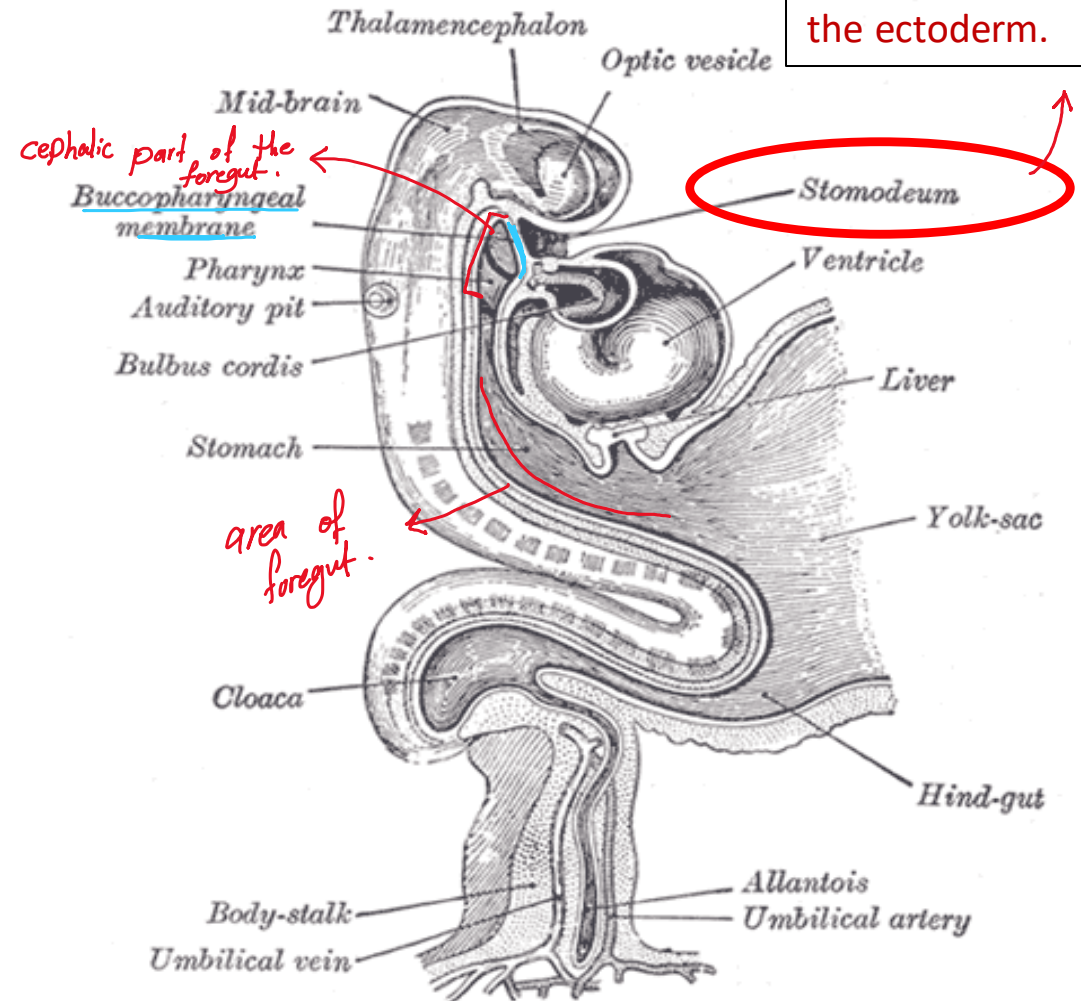
# Gi tract Embryology 1

An easy lecture, don't worry 😊

# Development of the oral cavity

- The mouth has 2 sources of development:
- 1. depression in the stomodeum (lined with ectoderm)
- 2. cephalic end of the foregut (lined with endoderm)
- These two points are separated by the buccopharyngeal membrane
- During the 3<sup>rd</sup> week of development the membrane disappears

The stomodeum is present in the oral cavity. The depression in the stomodeum, being outside, originates from the ectoderm.



**We will start with the development of the oral cavity, we have two sources of development: 1) stomodeum ( found in oral cavity ) , the depression on the stomodeum is indeed on the outside of the embryo and originates from ectoderm.**

**2) Cephalic end of the foregut which originates from endoderm.**

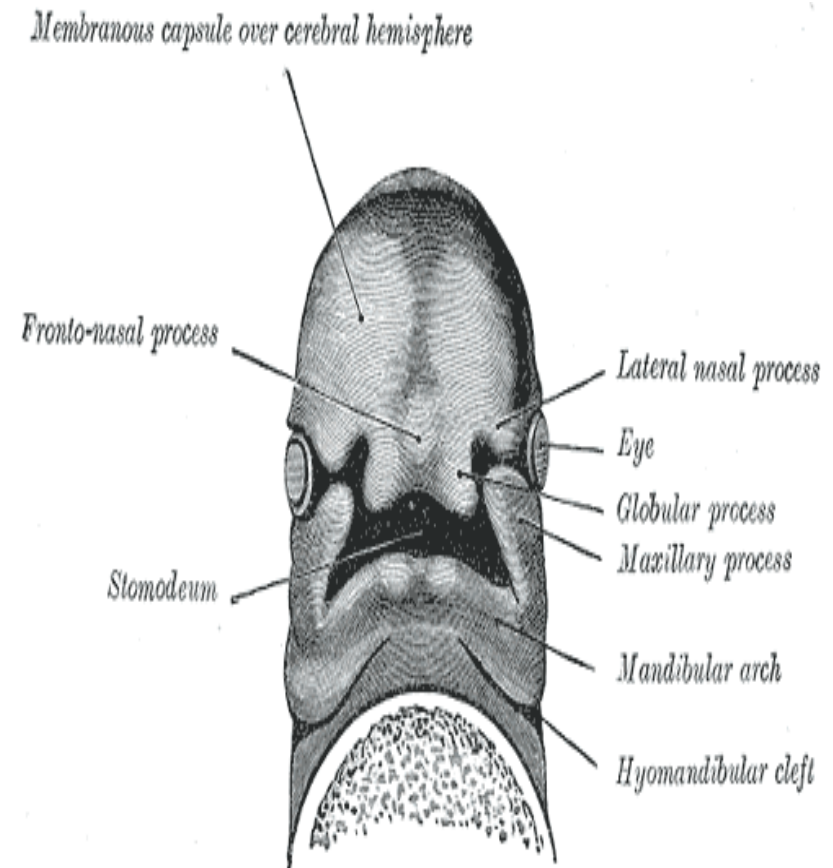
**-The development of the oral cavity involves both ectodermal and endodermal contributions, the ectodermal origin is the depression anterior to stomodeum . And the endodermal origin is the cephalic part of the foregut (behind stomodeum, opposite to the stomodeum).**

**We have membrane behind the stomodeum, called buccopharyngeal membrane \*bucco \* means oral (ectodermal)**

**\*pharyngeal\* means pharynx (endodermal) .**

**-The membrane is supposed to disappear by the third week, but it's still considered an important landmark.**

- If the membrane persists (we create an imaginary line), it will extend to:
- Body of sphenoid
- Soft palate
- Inner surface of the mandible, inferior to the incisor teeth
- Structures that are anterior to this plane are ectodermic in origin (epithelium) like:
  1. Hard palate
  2. Sides of the mouth
  3. Lips
  4. Enamel of the teeth



- Structures situated posterior to this plane are derived from endoderm:
  1. Tongue
  2. Soft palate
  3. Palatoglossus and palatopharyngeal folds
  4. Floor of the mouth

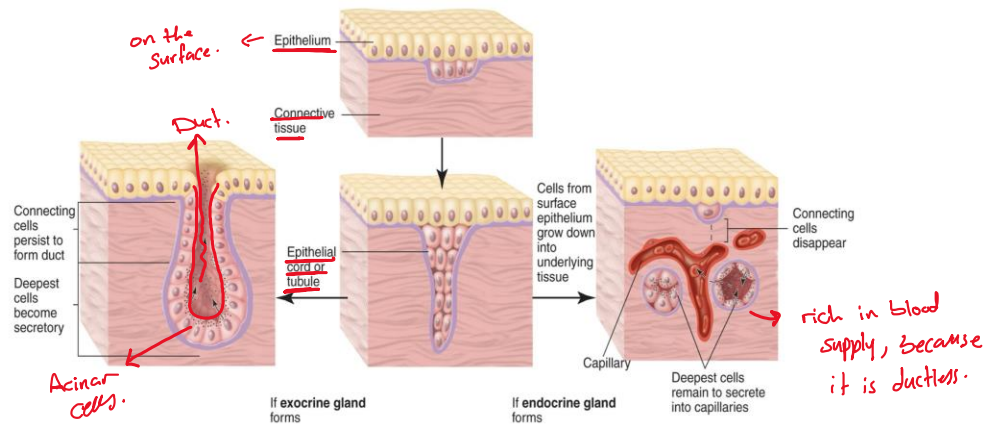
**The buccopharyngeal membrane begins in the body of sphenoid, passes the soft palate and then to the inner surface of the mandible inferior to the incisor teeth. Note that the line of the buccopharyngeal membrane is oblique, running from upward to downward in an anterior direction. This means that if you imagine a line tracing the position of the buccopharyngeal membrane within the embryo, it slants downwards and forwards when viewed from a perspective above the embryo, moving from a higher position at the top (upward) to a lower position at the bottom (downward) toward the front (anterior) of the embryo.**

**-structures that are anterior to this plane are ectodermal in origin, while all structures behind this plane are endodermal in origin. (you should memorize anterior and posterior structures which are mentioned in the slides) .**



# Development of the salivary glands

We are concerned with three pairs of large salivary glands: the parotid gland, the submandibular gland, and the sublingual gland.



Dr. explained this picture, but it is not present in the slides.

- Most glands are formed during development by proliferation of epithelial cells so that they project into the underlying connective tissue.
- Some glands retain their continuity with the surface via a duct and are known as **EXOCRINE GLANDS**, as they maintain contact with the surface.
- Other glands lose this direct continuity with the surface when their ducts degenerate during development. These glands are known as **ENDOCRINE** glands, and they lose contact with the surface.
- Endocrine glands are either arranged in cords or follicles.

**Most glands are formed during development by proliferation of epithelial cells (after a signal) so that they project into the underlying connective tissue (invagination to the connective tissue to form epithelial cord or tubule)**

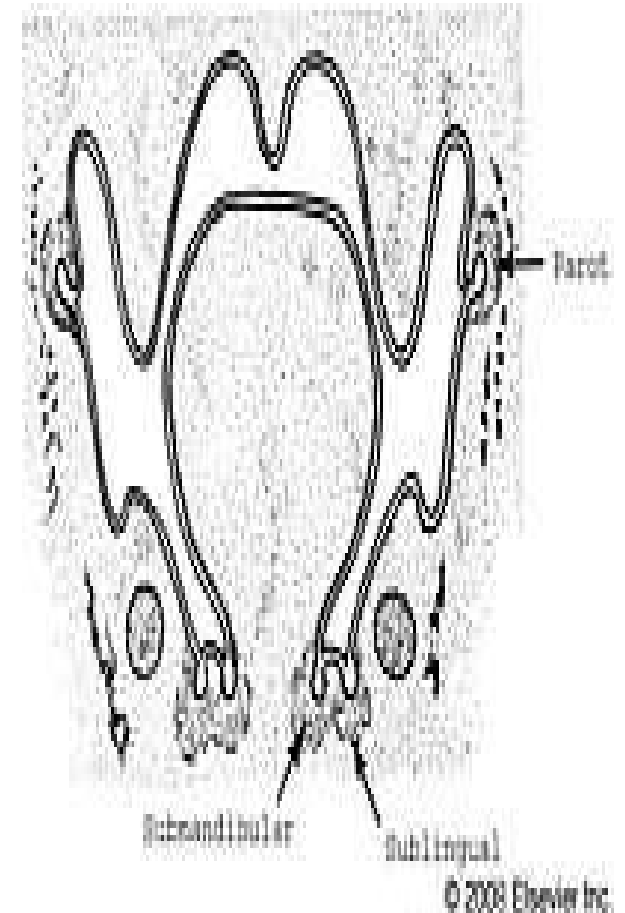
- **If it is an exocrine gland (like in pancreas), the end will form acinar cells, followed by the development of ducts from the inside after colonization.**
- **But if it is an endocrine gland, after proliferation the end will transform to gland (not acinus). It will lack ducts, leading to degeneration, and these glands are typically arranged in cords (suprarenal gland) or follicles (thyroid follicle). So in the end, only the follicles (circular) or the cords will persist.**

**\*Differences between endocrine and exocrine glands :**

- Endocrine glands** , secrete hormones and it is ductless but rich in blood supply .
- Exocrine glands** , secrete enzymes ,and it is in a contact with the surface through duct .

# Development of the salivary glands

- During the 7<sup>th</sup> week it arises as a solid outgrowth of cells from the walls of the developing mouth (begins from the epithelium of the oral cavity, mouth)
- Then these cells will grow into the underlying mesenchyme
- Then the epithelial buds will go through repeated branching to form solid ducts eventually
- Then the ends of these ducts will open to form the secretory acini by invagination, and they will both go through canalization



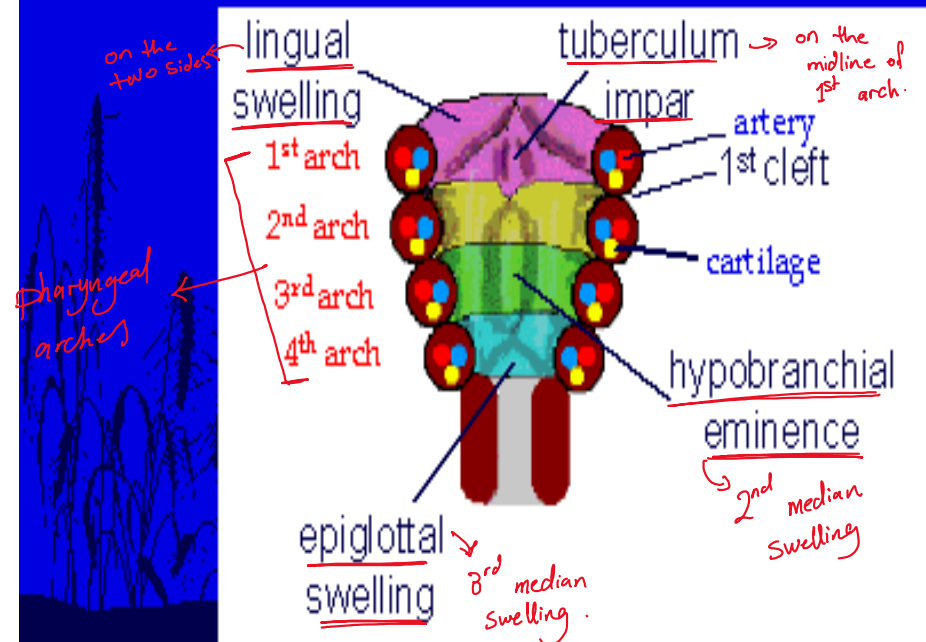
- The surrounding mesenchyme will condense to form:
- The capsule of the gland
- Septa that divide the gland into different lobes and lobules
- The ducts and acini of the parotid gland are both derived from the ectoderm
- Submandibular and sublingual glands are derived from the endoderm

- ❖ **The most important thing about exocrine glands is that they are surrounded by a capsule. The connective tissue surrounding the capsule then forms septa, which will further divide into lobes and lobules.**
- ❖ **The ducts found in the parotid gland include (in the form of) intercalated ducts and striated ducts.**
- ❖ **Parotid gland is ectodermal in origin .**
- ❖ **Submandibular and sublingual are endodermal in origin ( inside oral cavity) .**

# Tongue

## Development of the Tongue

- Tongue develops where the stomodeum and pharynx meet.



So, in summary, we have 3 median swellings:

- 1- tuberculum impar (1st arch)
- 2- second medial swelling (2nd, 3rd, 4th)
- 3- third medial swelling (posterior of 4th)

- The tongue appears in embryos of approximately 4 weeks (after a signal) in the form of two lateral lingual swellings and one medial swelling, the tuberculum impar (these structures develop first)
- These three swellings originate from the first pharyngeal arch.
- A second median swelling, the copula, or hypobranchial eminence, is formed by mesoderm of the second, third, and part of the fourth arch. So, it's mainly from third, may extend below the epiglottis (4th arch).
- Finally, a third median swelling, formed by the posterior part of the fourth arch, marks development of the epiglottis.

# Development of the tongue

**To sum up, how does the tongue develop?**

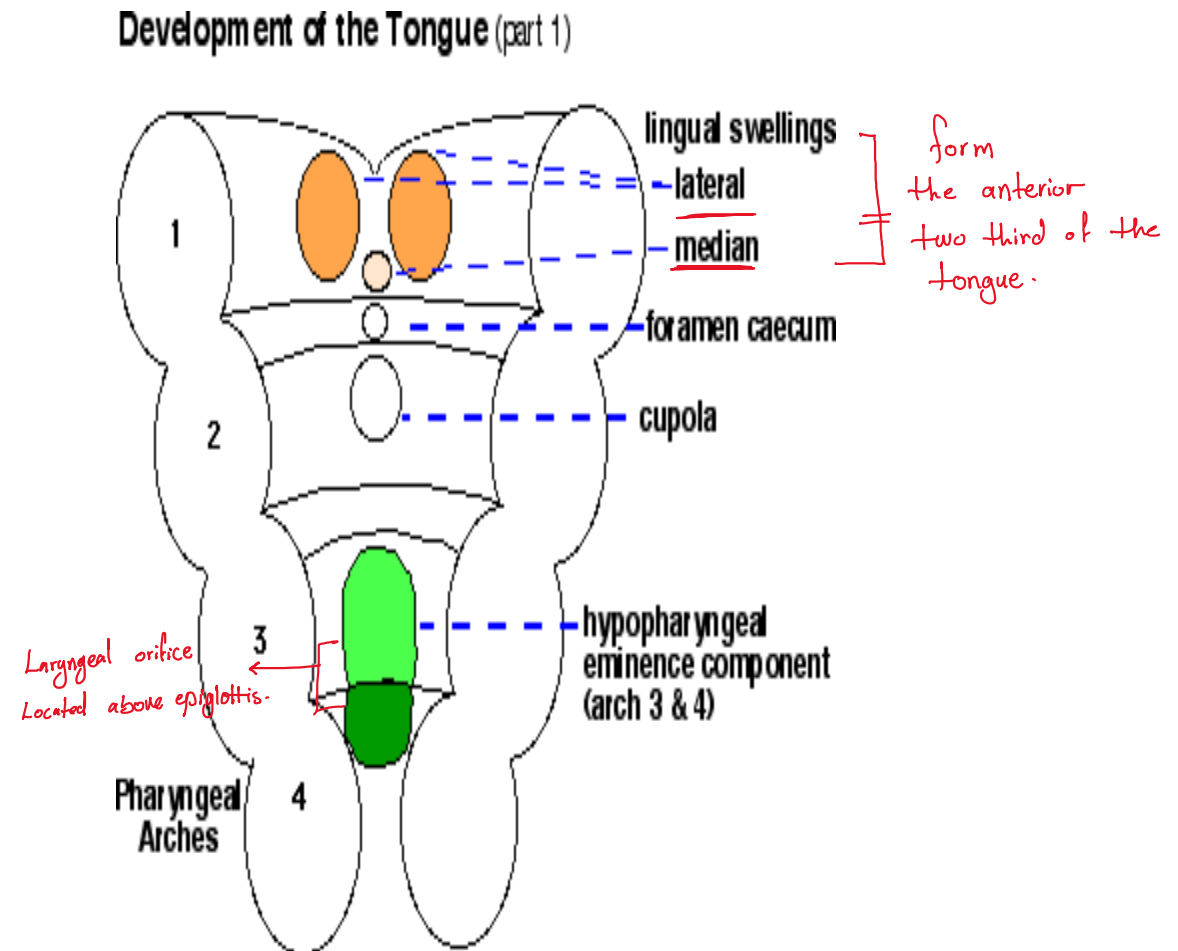
- 1. Anterior part originating from the 1st pharyngeal arch which possesses three swellings.**
- 2. Posterior part originating from the other pharyngeal arches, mainly the 3rd and 2nd, can be 4th.  
We call it hypobranchial or copula.**

**These two will fuse together to form the tongue.**

(Checkpoint 🌟 : you're halfway through this lecture!!)

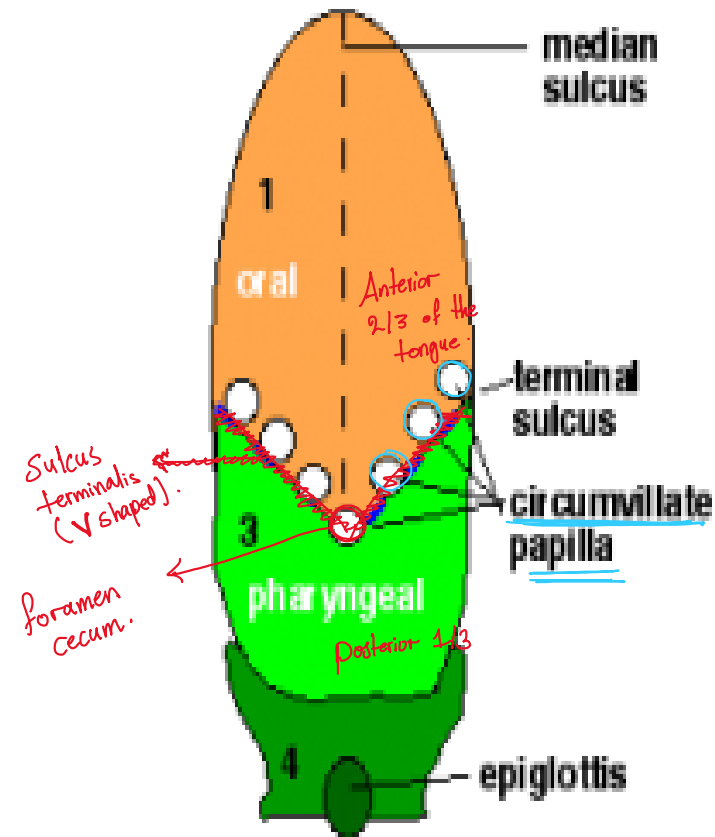
رَبَّنَا آتِنَا فِي الدُّنْيَا حَسَنَةً،  
وَفِي الْآخِرَةِ حَسَنَةً، وَقِنَا عَذَابَ النَّارِ  
🌸 🌸 🌸  
اللَّهُمَّ اغْفِرْ لِلْمُسْلِمِينَ وَالْمُسْلِمَاتِ،  
وَالْمُؤْمِنِينَ وَالْمُؤْمِنَاتِ، الْأَحْيَاءِ مِنْهُمْ  
وَالْأَمْوَاتِ

- Immediately behind this swelling is the **laryngeal orifice** (above epiglottis), which is flanked by the arytenoids swellings
- As the lateral lingual swellings increase in size, they overgrow the tuberculum impar and merge, forming the anterior two-thirds, or body, of the tongue
- Since the mucosa covering the body of the tongue originates from the first pharyngeal arch, sensory innervation to this area is by the mandibular branch of the trigeminal nerve. (general sensation for the anterior two third is from the lingual nerve which is a branch from mandibular nerve and the taste sensation from facial nerve)
- The body of the tongue is separated from the posterior third by a V-shaped groove, the terminal sulcus



- The posterior part, or root, of the tongue originates from the second, third, and part of the fourth pharyngeal arch.
- The fact that **sensory innervation to** this part of the tongue is supplied by the **glossopharyngeal nerve** indicates that tissue of the third arch overgrows that of the second. **glossopharyngeal nerve** mainly originates from third pharyngeal arch .
- The epiglottis and the extreme posterior part of the tongue are innervated by the **superior laryngeal nerve, reflecting their development from the fourth**

### Development of the Tongue (part 3)



(Am I the only one who sees a corn cob here? 🌽 😊)

**Note that the circumvillate papilla originated from the posterior compartment during development, this is why it remains supplied by glossopharyngeal even though after development it glides to become anterior to sulcus terminalis.**



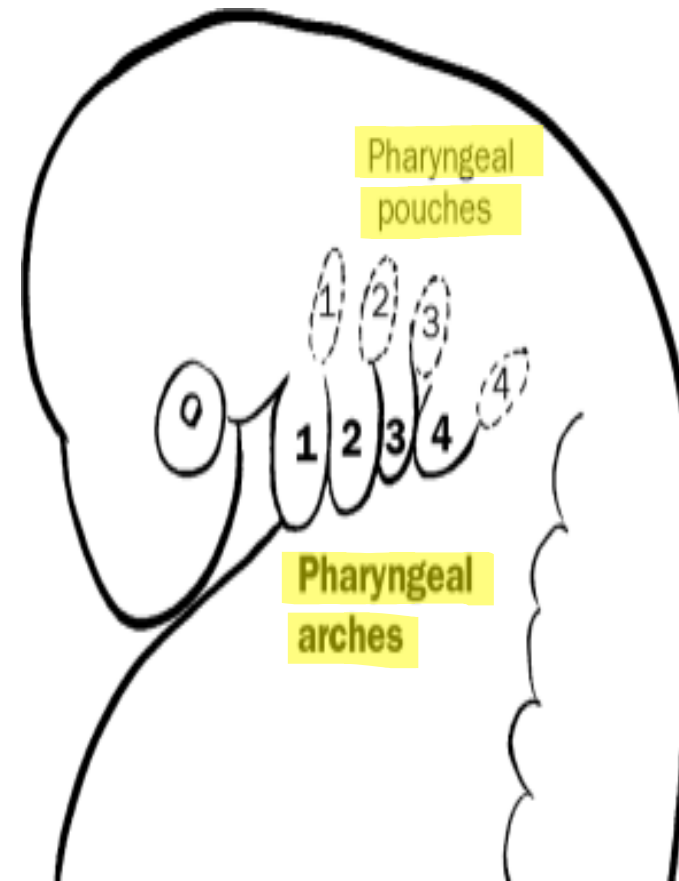
- Some of the tongue muscles probably differentiate in situ, but most are derived from myoblasts originating in **occipital somites**. occipital somites = innervated by hypoglossal nerve (motor), EXCEPT: palatoglossal (accessory through vagus)
- Thus, tongue musculature is innervated by the **hypoglossal nerve**.
- **Special sensory innervation (taste)** to the anterior two thirds of the tongue is provided by the **chorda tympani**
- **branch of the facial nerve, while the posterior third is supplied by the glossopharyngeal nerve** (sensory).

**Remember:** الدكتور ركز عليهم

- ❖ **Sulcus terminalis separates the tongue into anterior and posterior parts.**
- ❖ **In the course of development, circumvallate papillae, originally situated in the posterior aspect of the tongue, receive innervation from the glossopharyngeal nerve. Despite their initial location, as development progresses, they undergo a migration or repositioning to the anterior portion of the tongue.**

# Development of the pharynx

- The pharynx develops in the neck from the endoderm of the foregut
- The endoderm is separate from the surface ectoderm by mesenchyme
- The mesenchyme in each side splits up to 5-6 arches
- Each arch forms a swelling on the surface of the walls of the foregut
- As a result of these swellings, a series of clefts are seen between the arches (pharyngeal clefts).
- Similar grooves are found on the lateral walls of the foregut (pharyngeal pouches)
- The foregut on this level is known as the pharynx



- **Pharynx came from pharyngeal arches which form internally the pharyngeal pouches .**
  - **Between the pharyngeal arches and pouches there is a cleft .**
- **Pharyngeal arches covered internally by endoderm and externally by ectoderm. The arch itself is mesenchyme.**
  - **The development of the pharynx specifically happens in the endoderm.**
- **The internal endoderm is separated from the surface ectoderm by mesenchyme.**
  - **The foregut of the pharynx comes from the upper 4 pouches .**

# Development of the anterior abdominal wall

- Following the segmentation of the mesoderm (in the middle between ectoderm & endoderm), the lateral mesoderm divides into:
- Somatic layer (outer)
- Splanchnic layer (inner)
- Both lined by endo and ectoderm
  
- The ant. Abdominal wall is derived from the somatopleuric mesoderm and they retain their innervation from the ventral rami of the spinal nerves

Somatic means wall, plueric refers to pleura

- The somatopleuric mesoderm then tangentially divides into three layers:
- Ext. oblique
- Int. oblique
- Trans. Abdominus

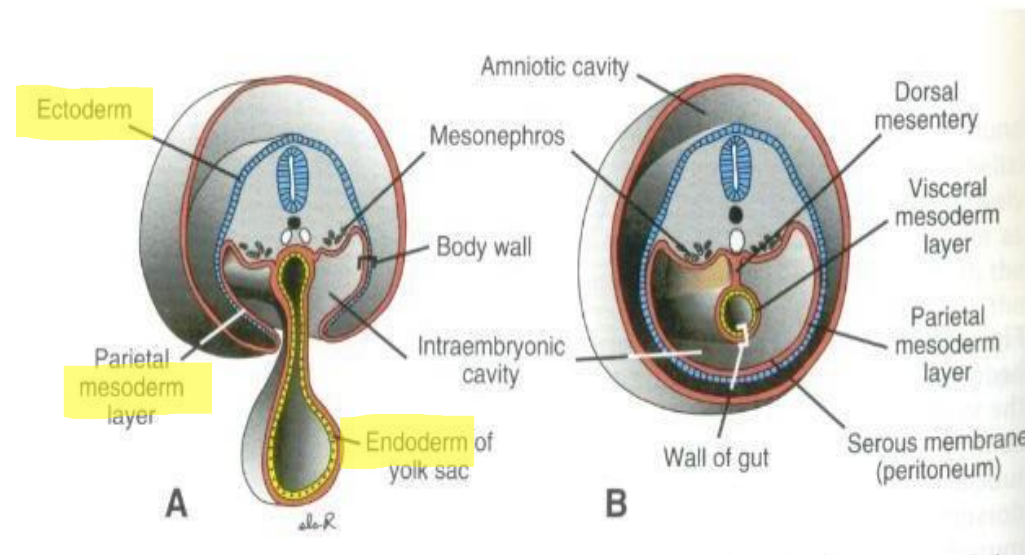
The somatopleuric continues downward. So, these muscles with their innervation, come from somatopleuric mesoderm.

That's why the abdominal muscles are innervated by lower 6 thoracic nerves; since they descend from above.

# Lateral Plate Mesoderm Further Divides into Somatopleuric mesoderm and Splanchnopleuric mesoderm.

Somatopleuric mesoderm becomes parietal mesoderm which form serous membranes that line the peritoneal, pleural, and pericardial cavities.

Splanchnopleuric mesoderm becomes visceral mesoderm which form serous membranes that line each organ.



**The rectus abdominus muscle came from the myotome , the presence of tendinous intersections is due to the separations in the myotome.**

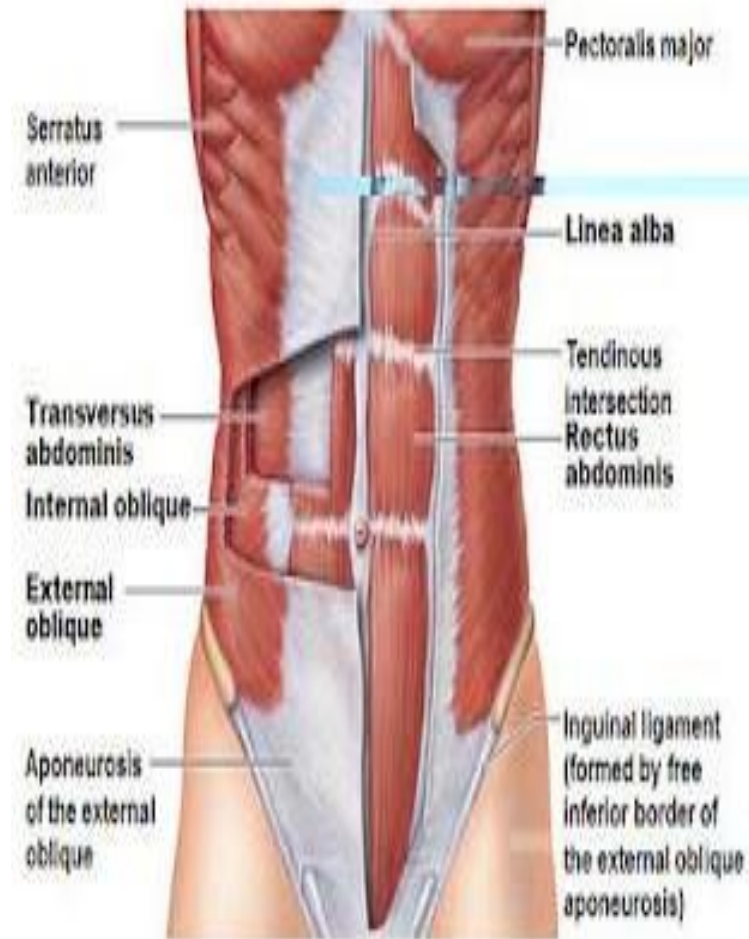
- The rectus abdominus muscle retains the indications of the segmental origin (the presence of tendinous intersections)
- Finally the abd. Wall right and left sides of mesenchyme fuses together at 3 months into the midline to form the linea alba.

*Insertion* →

**Characteristics of this muscle:**

- Originate from myotome
- Present inside the rectus sheath
- Tendinous intersections

- On either side of the linea alba the rectus muscles lies within their rectus sheaths



# Development of the umbilicus and the umbilical cord

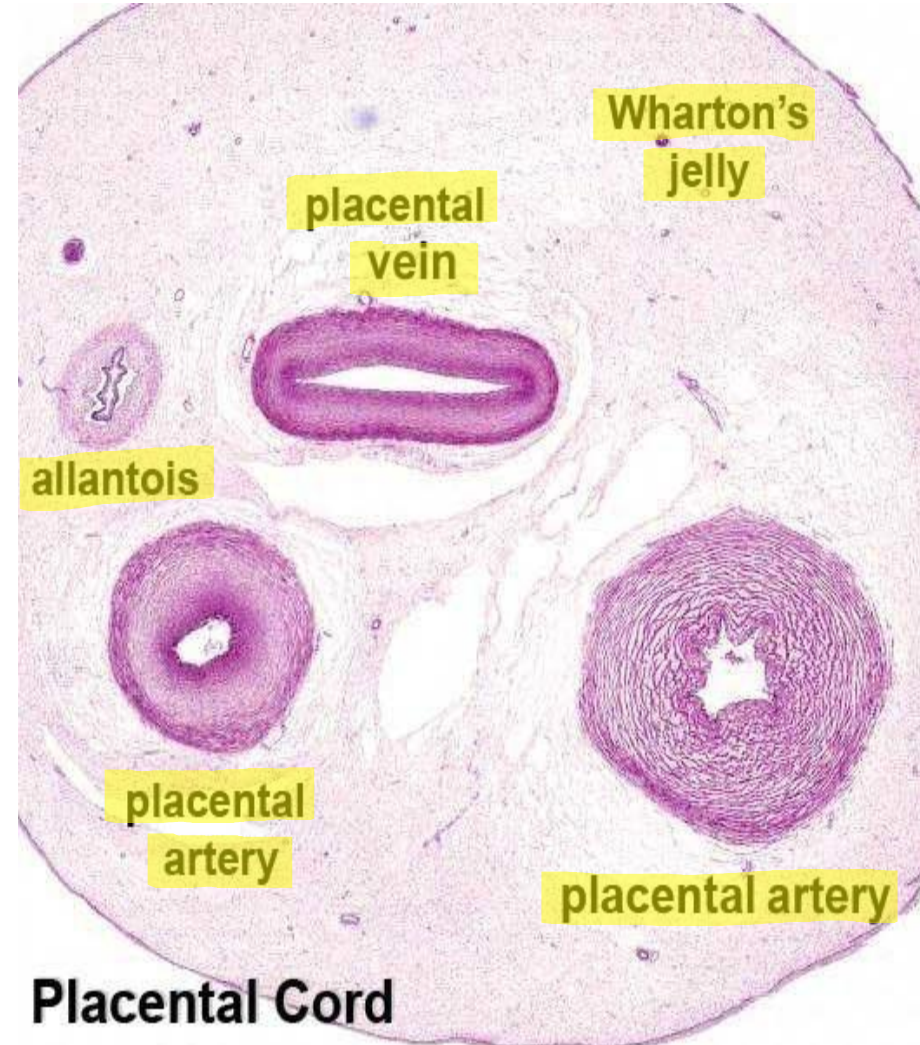
- The amnion and the chorion fuse together
- The amnion encloses the body stalk and the yolk sac with their blood vessels to form the tubular umbilical cord.

## What is inside the umbilical cord?



- The mesenchyme core of the cord (wharton's jelly) form a loose or mucoïd connective tissue which embed the following:
  - Remains of yolk sac (like allantois)
  - Vittelline duct
  - Remains of allantois
  - Umbilical blood vessels
- We have 2 arteries that carries deoxygenated blood from the fetus to the chorion (placenta).
- 2 veins carry oxygenated blood from the placenta
- but the right vein will soon disappear/obliteration, transforms to ligamentum teres. So, only ONE vein remains.

it's important to know the structures:-

Intersection of the umbilical cord, showing a vein, two arteries, wharton's jelly (which is a mucoïd connective tissue that fills the umbilical cord).

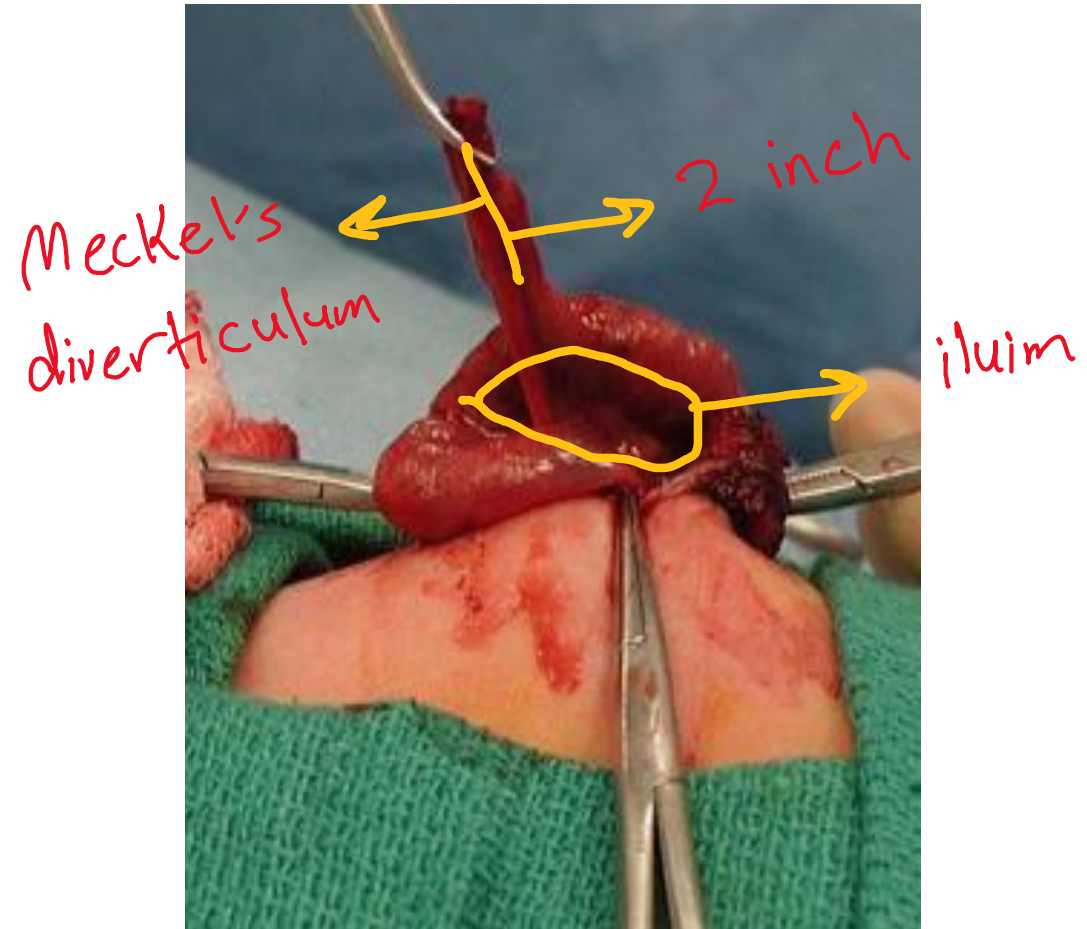




- **Umbilical cord is a connection between the placenta in the uterus to the umbilicus of the fetus .**
- **The right vein will convert into ligamentum teres .**
- **"خُدُوا بِالْكَوَاالِ"   → The arteries here carry deoxygenated blood , while the veins carry oxygenated blood . يعني عكس القاعدة .**

# Vitelline Duct Abnormalities

- In 2 to 4% of people, a small portion of the vitelline duct persists, forming an outpocketing of the ileum, Meckel's diverticulum or ileal diverticulum.
- In the adult, this diverticulum, approximately 40 to 60 cm from the ileocecal valve on the antimesenteric border of the ileum, does not usually cause any symptoms.
- However, when it contains heterotopic pancreatic tissue or gastric mucosa, it may cause ulceration, bleeding, or even perforation.

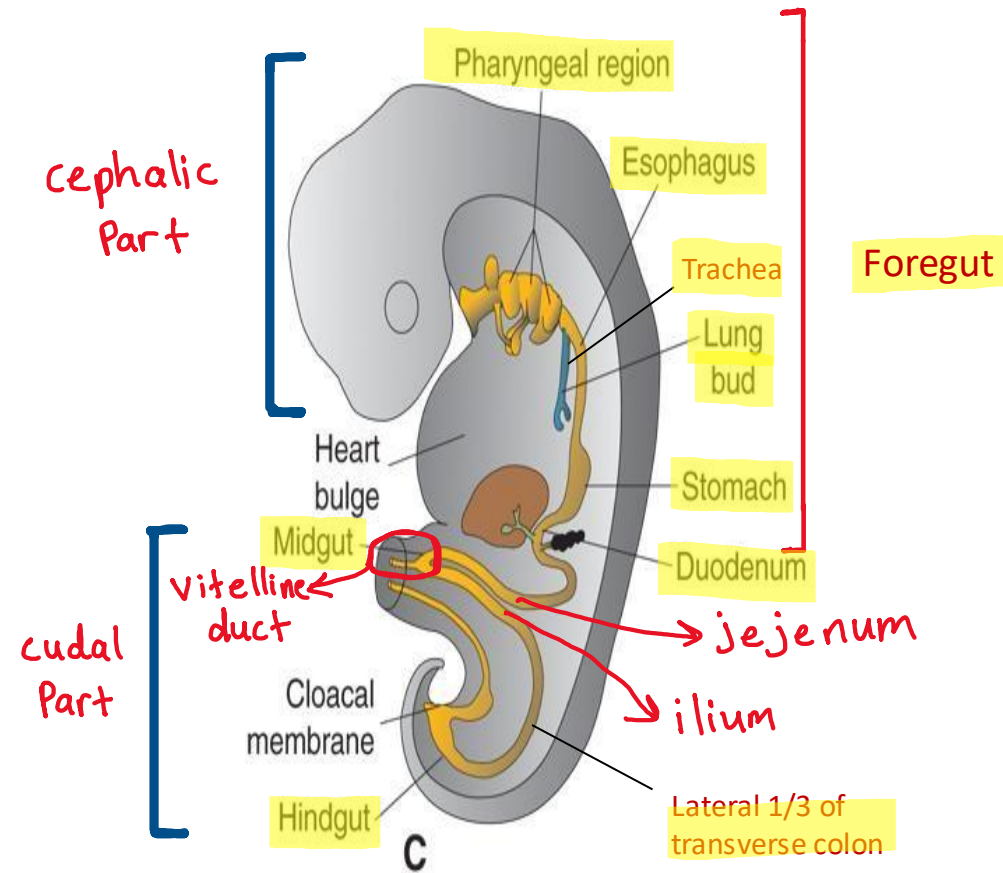


- **Vitelline duct present between the midgut ( especially the ileum) and umbilicus, it's open in embryo but normally undergoes obliteration (closes) after birth and form fibrous tissue.**
  - **Meckel's diverticulum located 2 feet from the ileocecal junction on the right side.  
(Notice: 2%, 2 inches, 2 feet)**
- **Meckel's diverticulum causes the same symptoms as appendicitis due to its presence on the right side, 2ft, on the same zone. It causes severe pain in the right side ( right iliac fossae ) due to the presence of pancreatic or gastric tissue, which may lead to inflammation, perforation, bleeding & peritonitis(if the secretion sneaks outside).**
- **So, in a surgical operation, the surgeon will notice the normal morphology of the appendix. But when checking the ileum, we might find Mickel's/ileal diverticulum.**

- Sometimes both ends of the vitelline duct transform into fibrous cords, and the middle portion forms a large cyst (includes fluid), an enterocystoma, or vitelline cyst

# Formation of the Lung Buds and esophagus

- When the embryo is approximately 4 weeks old, the **respiratory diverticulum (lung bud)** appears as an outgrowth from the ventral wall of the foregut
- The location of the bud along the gut tube is determined by signals from the surrounding mesenchyme, including fibroblast growth factors (FGFs) that “instruct” the endoderm.
- Hence **epithelium of the internal lining of the larynx, trachea, and bronchi, as well as that of the lungs, is entirely of endodermal origin.**
- The **cartilaginous, muscular, and connective tissue components** of the trachea and lungs are derived from **splanchnic mesoderm** surrounding the foregut



6-1C Lung bud initiation and branching

In embryology, we divide the gut into 3 parts: "ممنوع تغيب عن ذهنك"

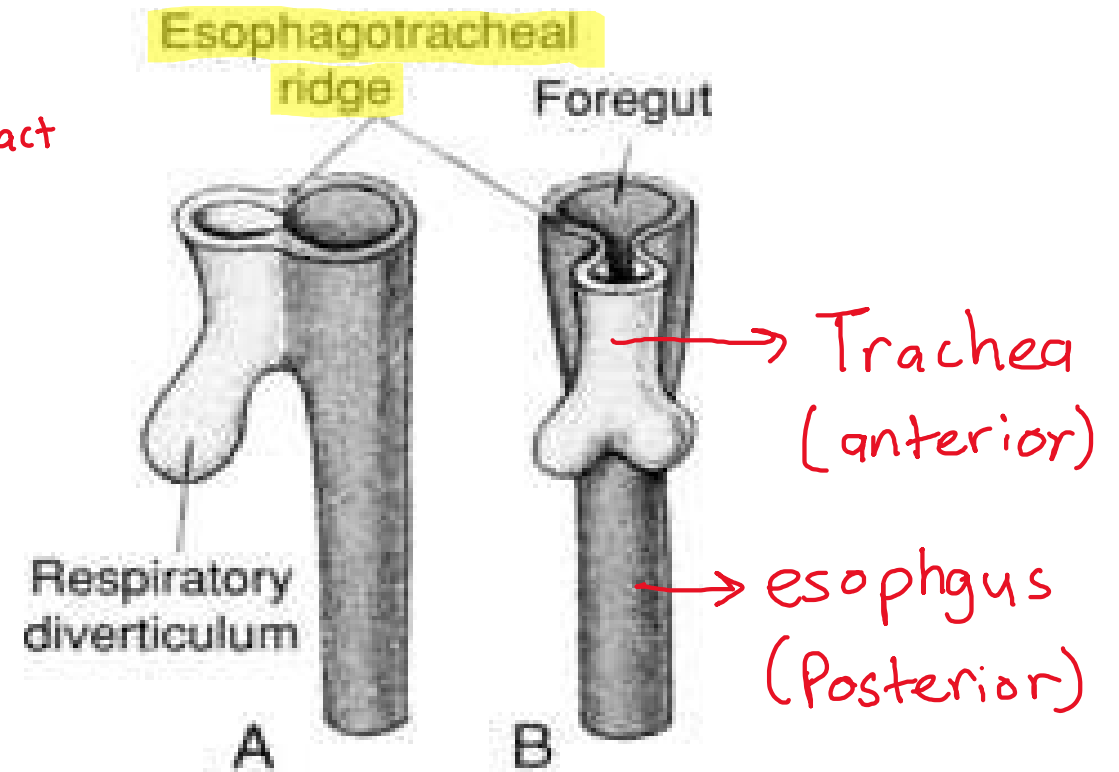
1. **Foregut:** ends at the upper half of the duodenum, or at the liver bud. So, it includes the stomach, esophagus and the upper ½ of duodenum. Blood supply: celiac trunk.
2. **Midgut:** includes the rest of the duodenum, jejunum, ileum, vitelline duct and the large intestine 'till the proximal 2/3. Blood supply: superior mesenteric artery.
3. **Hindgut:** includes the lateral 1/3 of transverse colon, descending colon, sigmoid, rectum and upper ½ of anal canal. Blood supply: inferior mesenteric artery.

**\*At 4<sup>th</sup> week** there is a stimulation on the anterior surface of the foregut (in the front of the esophagus), these signals cause proliferation of the cells which form lung buds (the beginning of the whole respiratory tract). Starting with trachea then bronchi then bronchioles and finally the alveoli of the lung.

- Initially the lung bud is in open communication with the foregut
- When the diverticulum expands caudally, however, two longitudinal ridges, the tracheoesophageal ridges, separate it from the foregut *respiratory tract*
- Subsequently, when these ridges fuse to form the tracheoesophageal septum, the foregut is divided into a dorsal portion, the esophagus, and a ventral portion, the trachea and lung buds

So, in normal conditions, the ridge will form then → septum then → separation between foregut (esophagus) and lung bud (trachea).

- The respiratory primordium maintains its communication with the pharynx through the laryngeal orifice



**At the beginning in the formation of the lung bud: there was a connection between the esophagus and trachea, but they should be separated from each other EXCEPT in the opening of the epiglottis.**

**( Digestive tract and respiratory tract should be separated from each other).**

**Finished!! <3**

Thank you  



قُلْ لِلطَّيِّبِ إِذَا مَا جِئْتَ تَنْصَحُهُ

كُنْ يَا طَيِّبٌ قَبِيلَ الطَّبِّ إِنْسَانًا

نصفُ الدَّوَاءِ بِشَفْرِ مَنْكَ مَبْتَسِمٍ

يَسْقِي الْعَلِيلَ، عَلَى الْأَلَامِ تَحْنَانًا

أَحْسَنُ إِلَيْهِ إِذَا مَا كَانَ ذَا عَوَزٍ

فَاللَّهُ يُجْزِي عَلَى الْإِحْسَانِ إِحْسَانًا

يُسعدنا أخذ آرائكم واقتراحاتكم  
فيما يتعلق بتفريغات الفريق، عبر  
الفرم التالي:

[https://docs.google.com/forms/d/e/1FAIpQLSdN9YK7ry3f5EtqmJAzL1lqa9ogsCGEEVrFH9DfBd8IIAN1Eg/viewform?usp=sf\\_link](https://docs.google.com/forms/d/e/1FAIpQLSdN9YK7ry3f5EtqmJAzL1lqa9ogsCGEEVrFH9DfBd8IIAN1Eg/viewform?usp=sf_link)