بسم الله الرحمن الرحيم

FINAL | Lecture #1

GI Embryology (Pt.1)

﴿ وَإِن تَتَوَلَّوْا يَسْتَبْدِلْ قَوْمًا غَيْرَكُمْ ثُمَّ لَا يَكُونُوا أَمْثَالَكُم ﴾

اللهم استعملنا ولا تستبدلنا

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EMBRYOLOGY

Gi tract embryology 1

اللهم افتح عليّ فتوح العارفين وارزقني قوة الحفظ وسرعة
الفهم من فضلك يا خير الرازقين

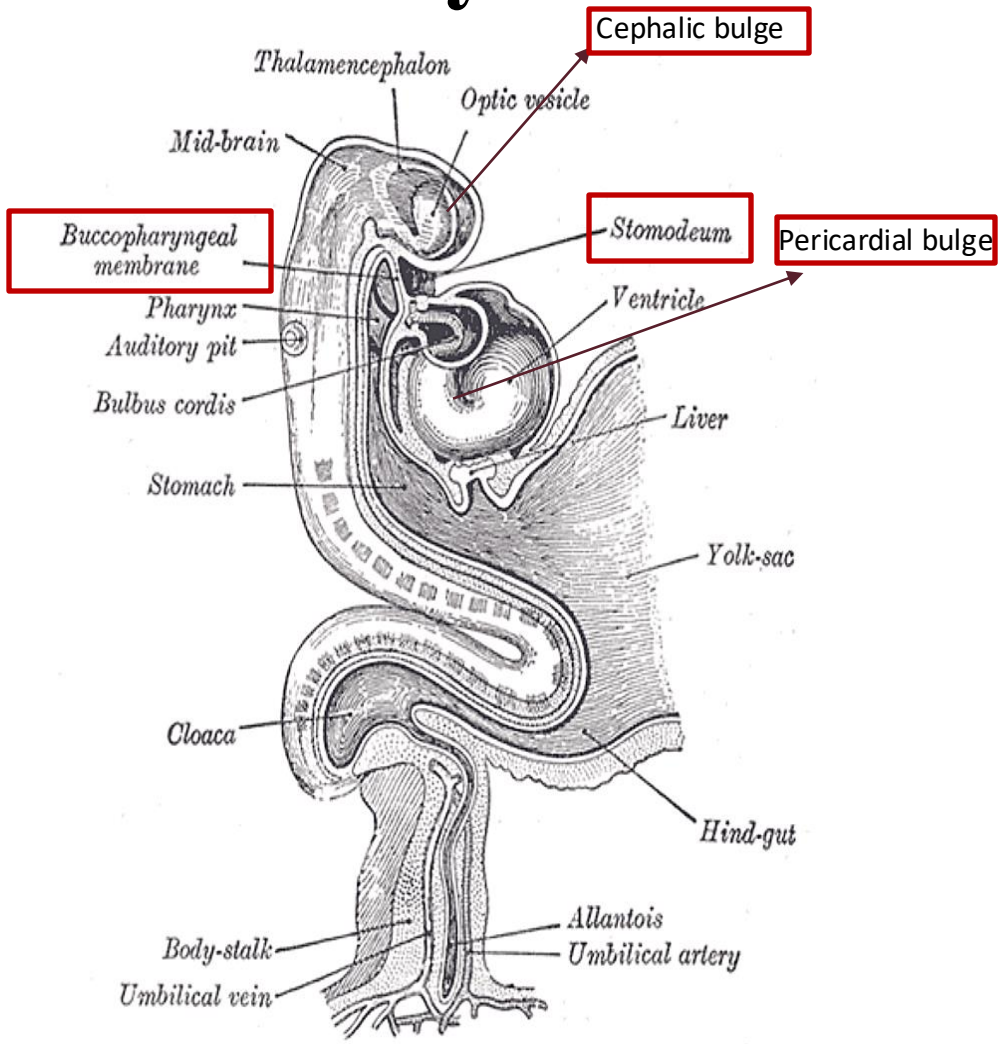
1- Development of the Oral Cavity

- The mouth has **two sources** of development:

✓ **Depression** in the **stomodeum** (lined with **ectoderm**) .

- The **stomodeum** is the ectodermal depression in the embryo that serves as the precursor of the **anterior part** of the **oral cavity.**

✓ **Cephalic end** of the foregut which is the pharynx/posterior part of the oral cavity (lined with **endoderm**)



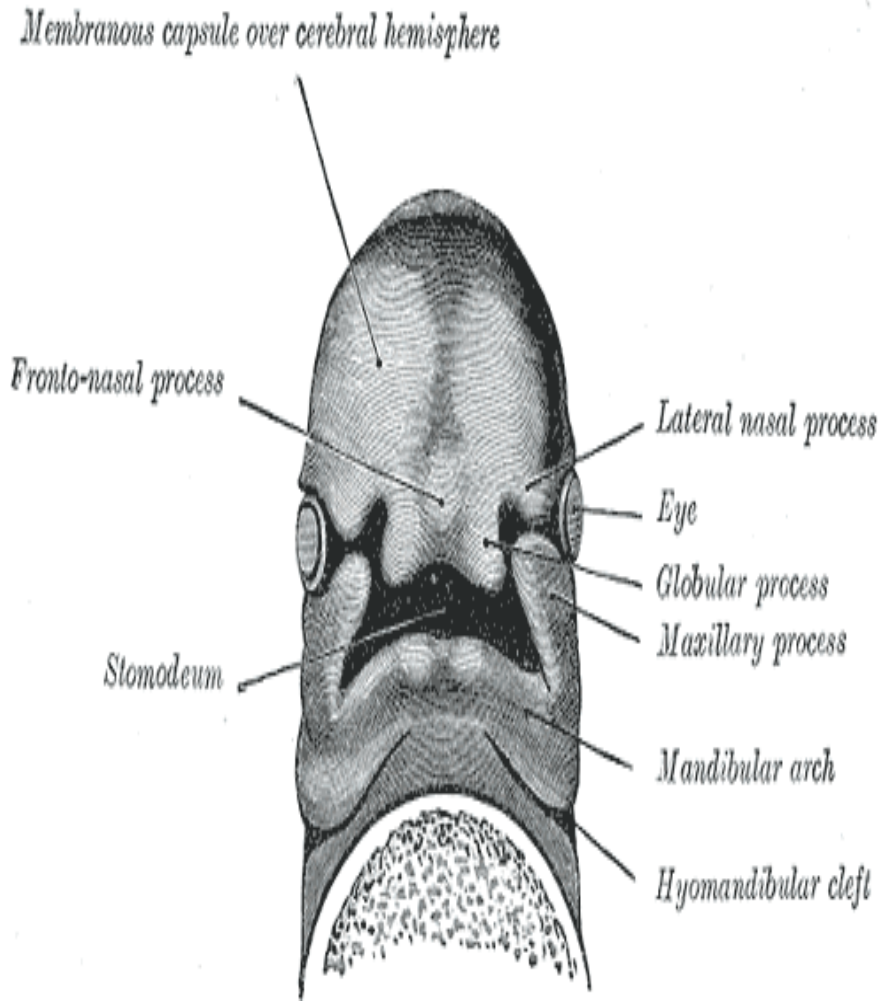
1- Development of the Oral Cavity

- These two points are separated by the **buccopharyngeal membrane** behind stomodeum. *Note the highlight in the previous slide picture*

- During the **3rd week** of development the **membrane disappears**

- If the membrane persists (we create an imaginary line), it will extend to:

1. **Body of sphenoid**
2. **Soft palate**
3. **Inner surface of the mandible, inferior to the incisor teeth**

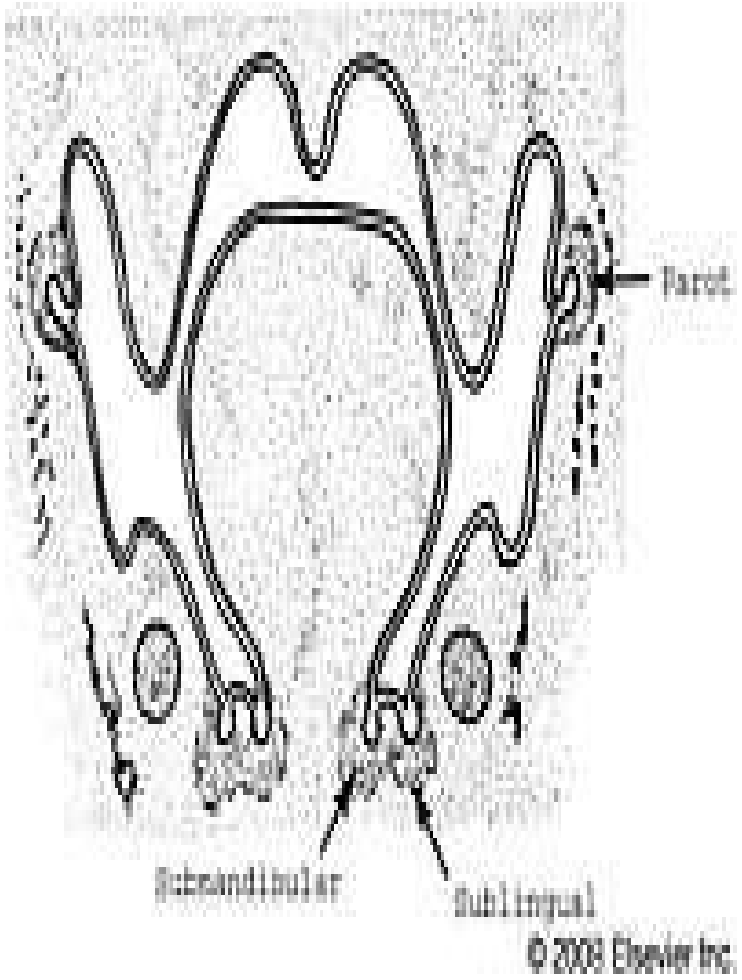


1- Development of the Oral Cavity

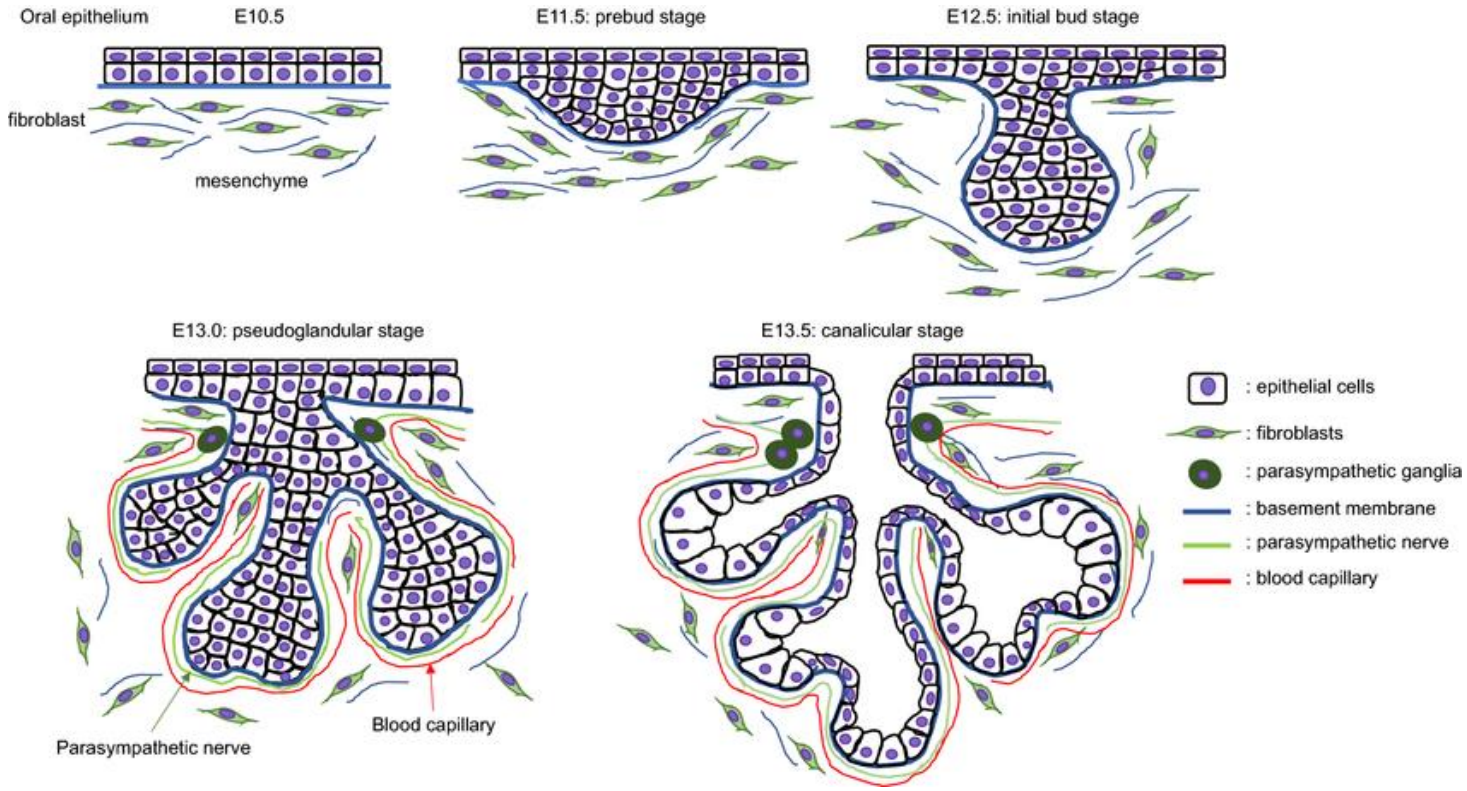
Location Relative to the Plane	Origin	Structures
Anterior to the plane	**Ectoderm (Epithelium)**	• Hard palate • Sides of the mouth • Lips • Enamel of the teeth
Posterior to the plane	**Endoderm**	• Tongue • Soft palate • Palatoglossus and palatopharyngeal folds • Floor of the mouth

2- Development of the Salivary Glands

- ✓ During the **7th week** it arises as a **solid outgrowth** of cells from the walls of the developing mouth.
- ✓ Epithelial cells receive signals-during the **7th week**- from surrounding **mesenchymal tissue proteins** that stimulate their growth.
- ✓ In response, the epithelial cells **invaginate** into the **underlying mesenchyme**.
- ✓ **Rule**: growth always takes place in the mesenchyme
- ✓ The epithelial buds will go through repeated branching to form **solid ducts**
- ✓ The ends of these ducts will form the **secretory acini**, and they will both go through **canalization**



2- Development of the Salivary Glands



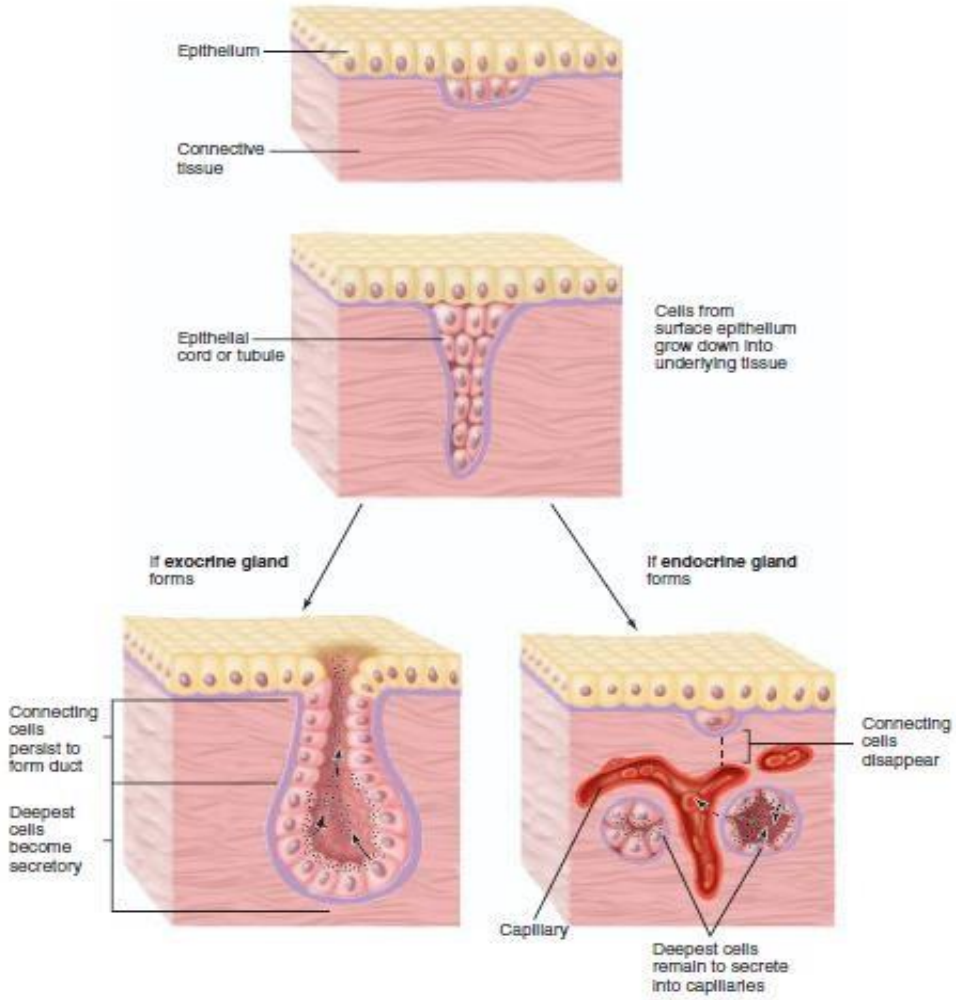
Additional graph

3- Development of the Glands

- ✓ Some glands retain their continuity with the surface via a duct and are known as **EXOCRINE** glands**, as they maintain contact with the surface** like **salivary glands.**

- ✓ 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. Like **thyroid, pituitary, and adrenal glands.**

- ✓ Endocrine glands are either arranged in **cords** or **follicles**



3- Development of the Glands

- ✓ The surrounding mesenchyme will **condense** to form:

1. **The capsule of the gland**
2. **Septa that divide the gland into different lobes and lobules**

- ✓ The ducts and acini of the **parotid gland** are both derived from the **ectoderm**

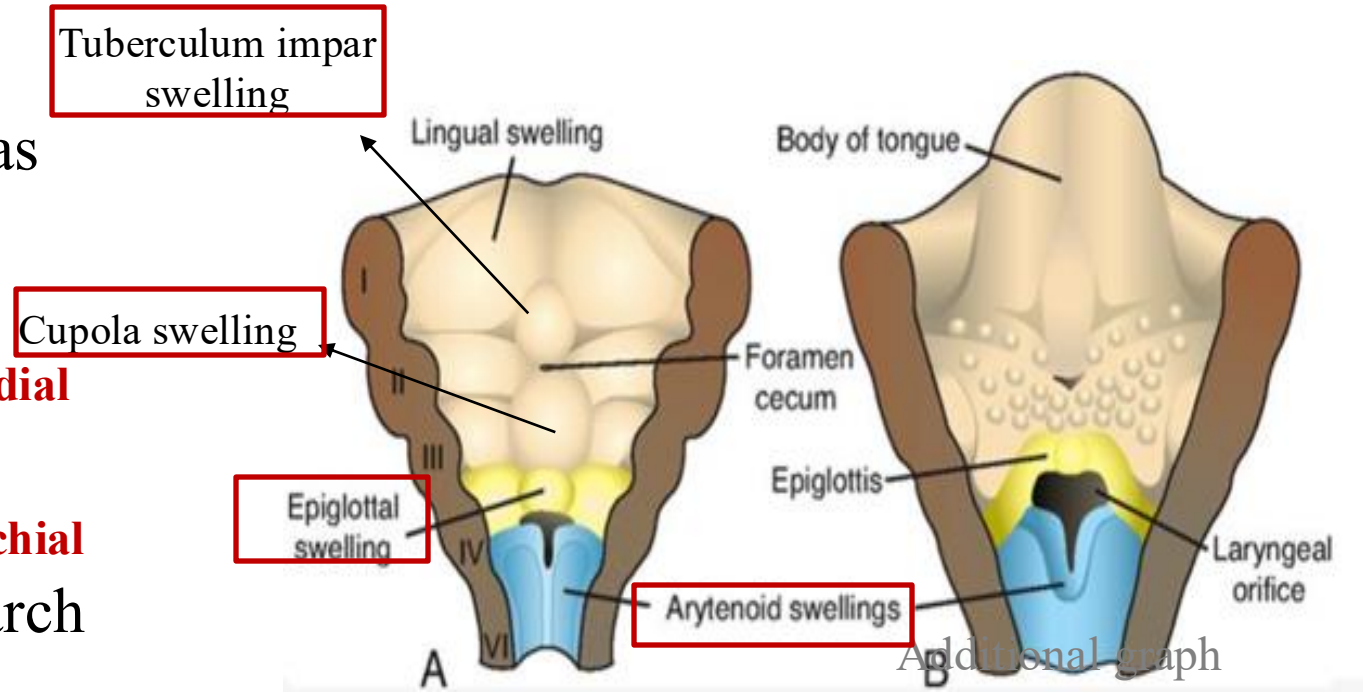
- ✓ **Submandibular and sublingual** glands are derived from the **endoderm**

4- Tongue Development

- ✓ There are 5-6 pharyngeal arches. The 1st four take part in the formation of the tongue.
- ✓ There are **4 swellings** in these arches as <u>precursors of the tounge</u>
- ✓ distributed as:

1. 3 from the first arch **[2 lateral swelling, medial tuberculum impar]**
2. and the fourth swelling **[cupola/ hypobranchial eminence]** is from 2nd 3rd upper part of 4th arch

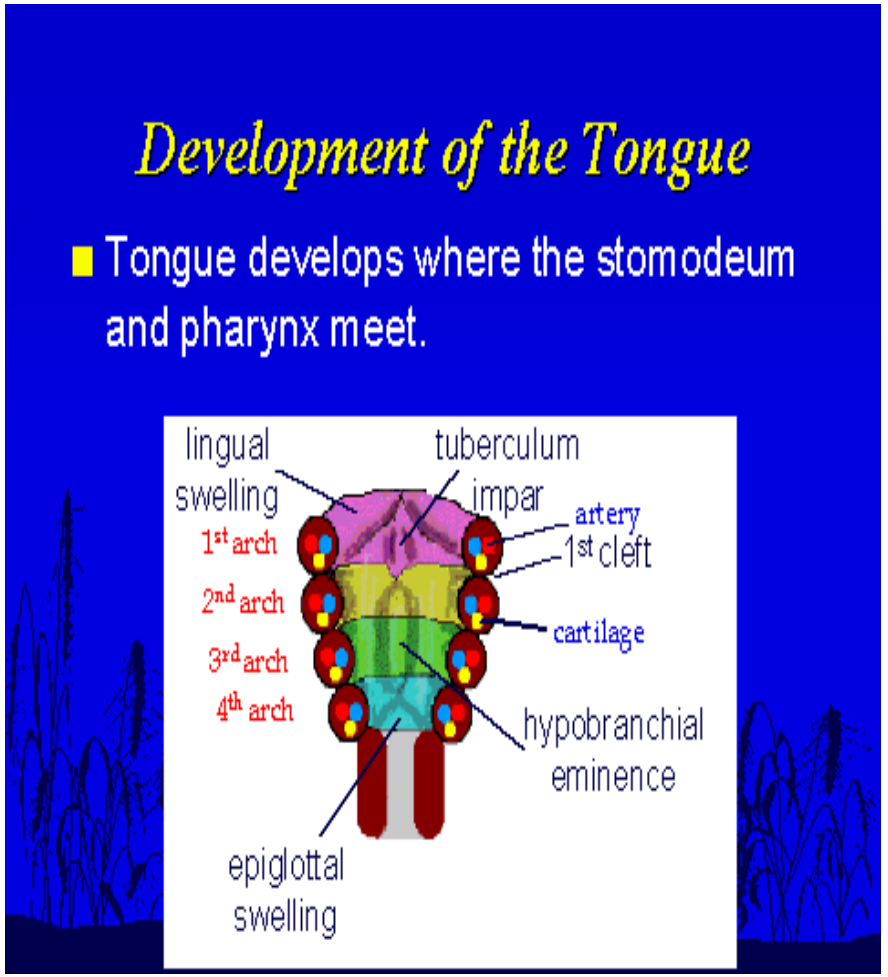
- ✓ Also there is <u>swelling for epiglottis</u> & <u>arytenoids swellings</u> Will be discussed in next slides



Additional graph

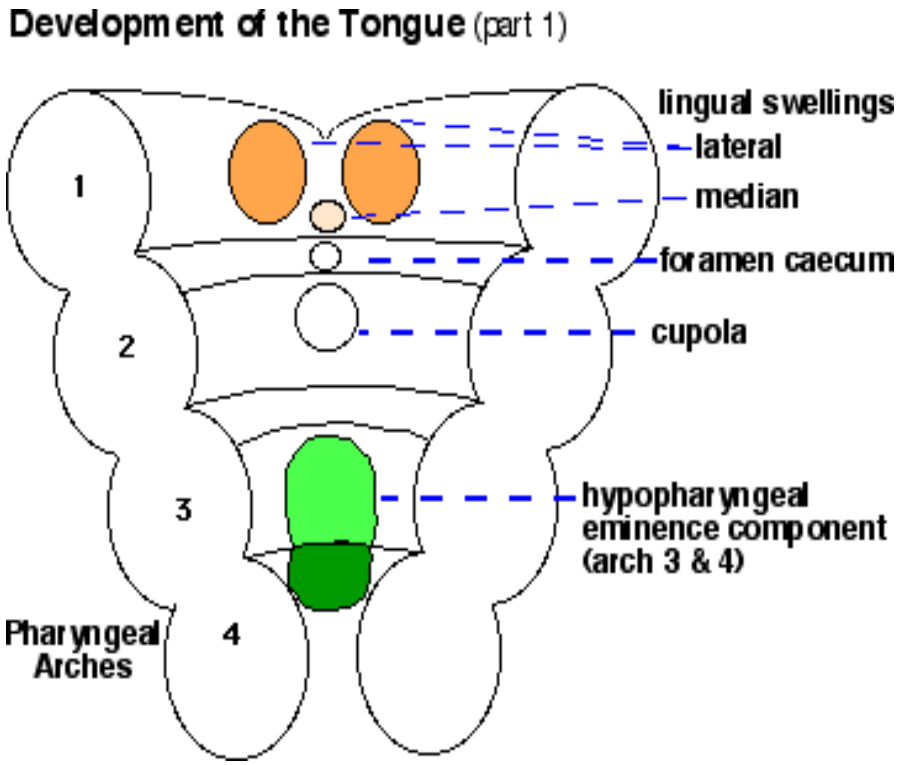
5- Anterior 2/3 of the Tounge Development

- ✓ The tongue appears in embryos of approximately **4 weeks**
- ✓ The three swellings originate from the **first pharyngeal** arch form the **anterior two-thirds, or body, of the tounge** as the lateral lingual swellings increase in size, they overgrow the tuberculum impar and merge.
- ✓ 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.**



6- Posterior 1/3 of the Tounge Development

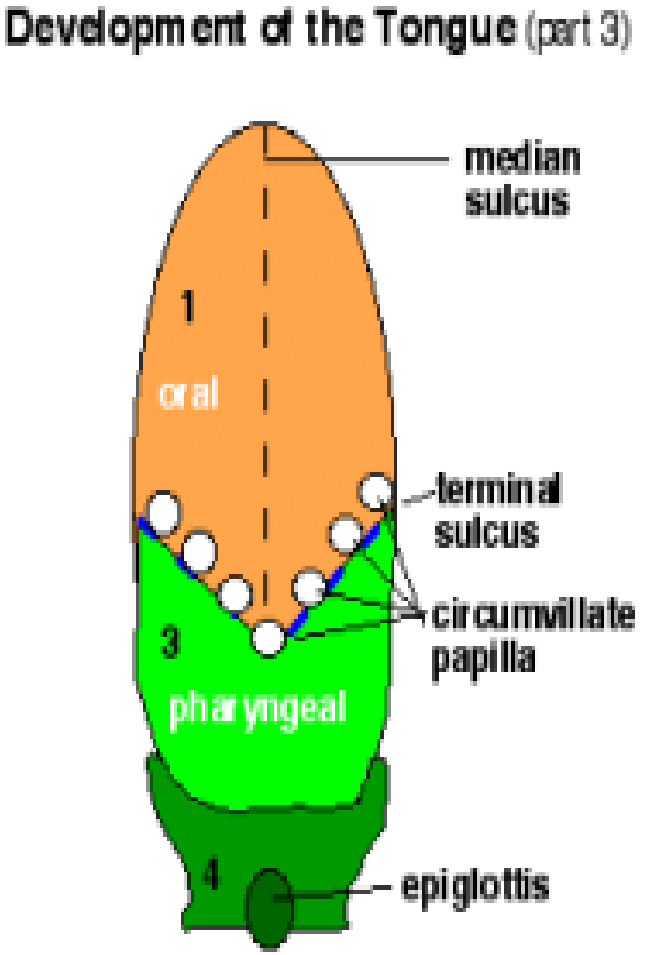
- ✓ the **copula** is the origin of the posterior part ,or the root, of the tounge.
- ✓ The **sensory** (and taste) **innervation to** this part of the tongue is supplied by the **glossopharyngeal nerve indicates that** tissue of the third arch overgrows that of the second.
- ✓ The body of the tongue is separated from the posterior third by a V-shaped groove, the **terminal sulcus**



7- Circumvallate Papillae Origin

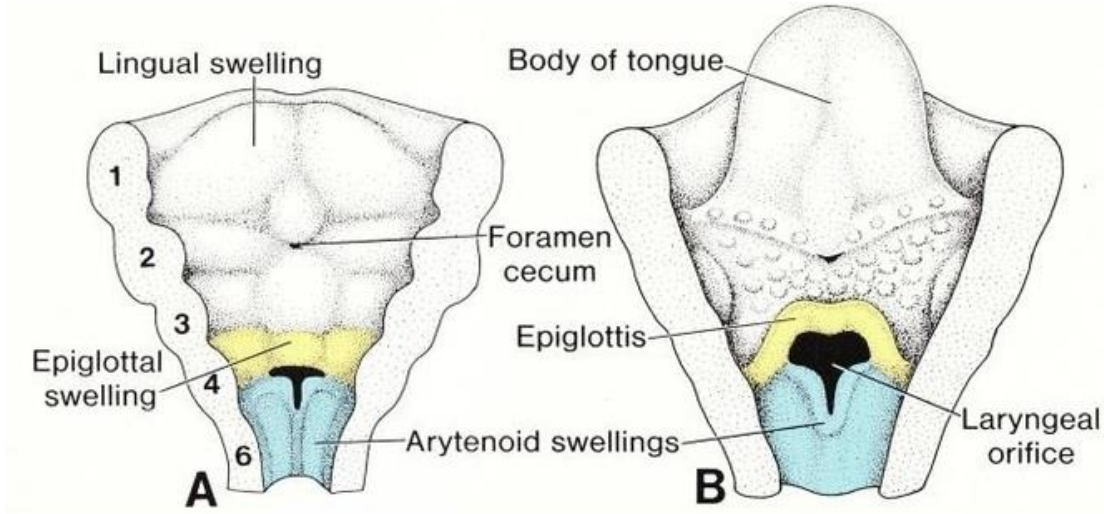
- ✓ During embryonic development, **circumvallate papillae** originate from the posterior one-third of the tongue, which is derived from the endoderm and innervated by the **glossopharyngeal nerve (CN IX).**

- ✓ Although they **later migrate anteriorly** and are found in front of sulcus terminalis in the adult tongue, **they retain their original innervation from the glossopharyngeal nerve**, reflecting their developmental origin.



8- Epiglottis & Arytenoid Development

- ✓ The swelling formed by the posterior part of the **fourth arch**, marks development of the epiglottis.
- ✓ The epiglottis and the extreme posterior part of the tongue are innervated by the **superior laryngeal nerve**, **reflecting their development from the fourth** arch.
- ✓ Immediately behind this swelling is the **laryngeal orifice, which is flanked by the arytenoids swellings**



Additional graph

9- Tounge Muscles Development

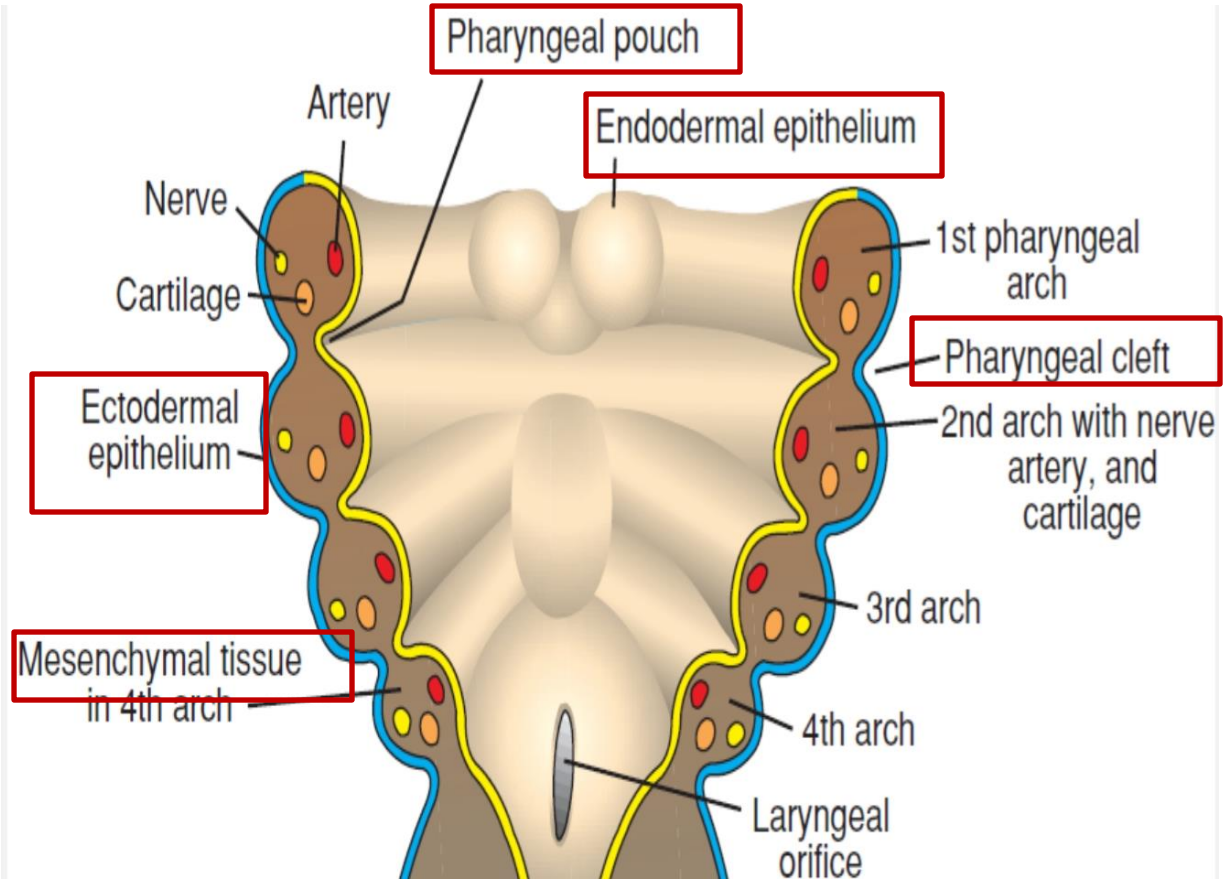
- ✓ Some of the tongue muscles probably differentiate in situ, but most are **derived from myoblasts** originating in **occipital somites.**
- ✓ Thus, tongue musculature is innervated by the **hypoglossal nerve.**
- ✓ **Special sensory innervation (taste)** to the anterior two thirds of the tongue is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

10- Development of the Pharynx

- The pharynx-in embryo- is the region of the foregut where the pharyngeal arches develop, and these arches contribute to the formation of structures in the head and neck.

- **The arches are composed of:**

1. External ectodermal layer
2. Internal endodermal layer
3. Mesenchymal layer between the above two layers



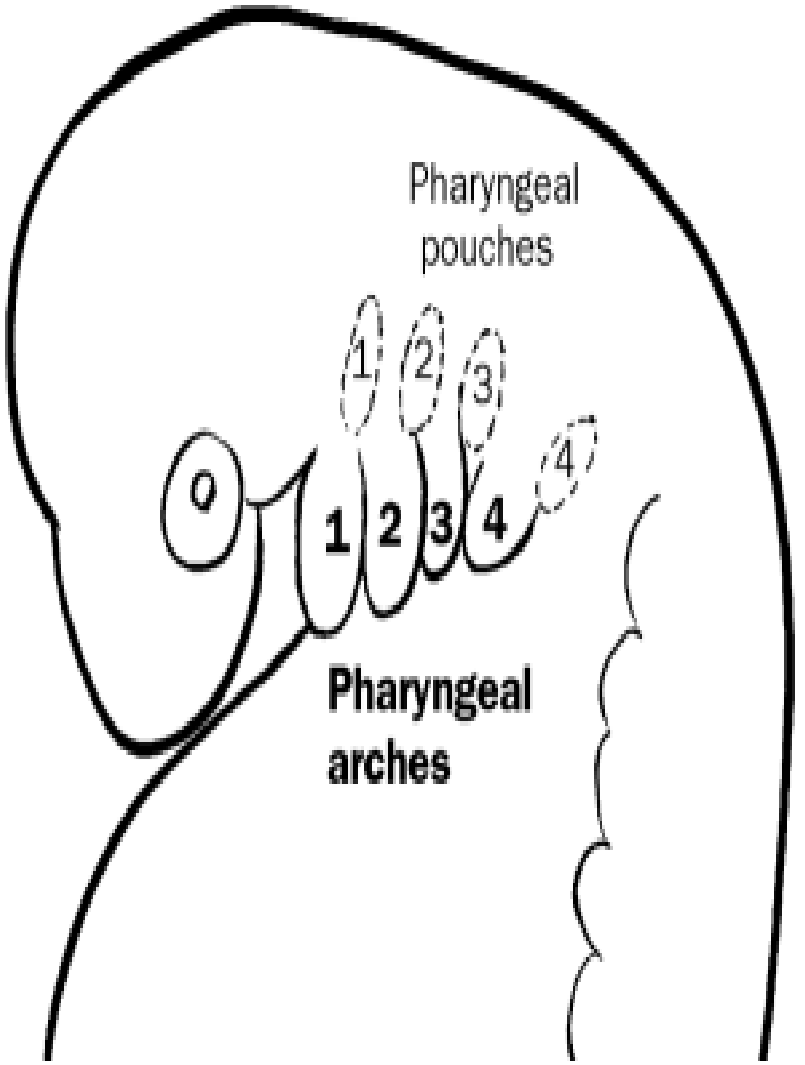
Additional graph

10- Development of the Pharynx

- ✓ Mesenchymal layer is **swollen** in each arch forming **clefts** (in ectodermal layer) and **pouches** (in endodermal layer), these two structures **separate the arches**

- ✓ The **lining epithelium** of the pharynx originats from the **endodermal** component of the pharyngeal arches including the pharyngeal pouches.

- ✓ The **muscles** and **connective tissue** of the pharynx originate from the **mesoderm**.



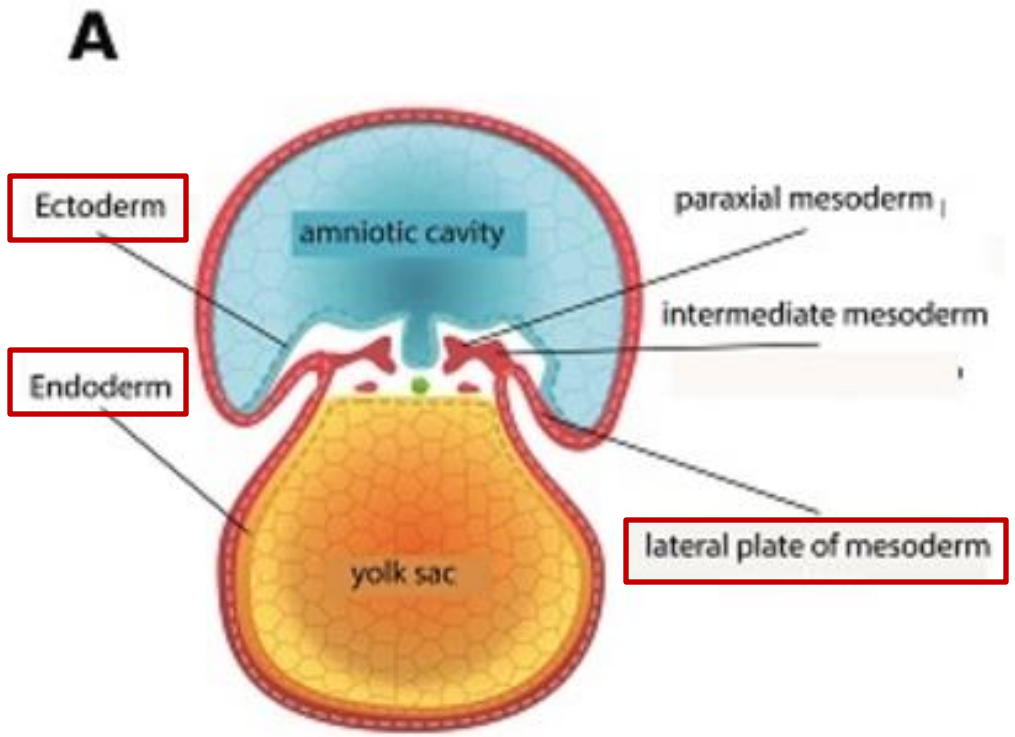
11- Development of the Anterior Abdominal Wall

This slide is not for memorization, just for clear understanding

- ✓ **Recall from introductory embryo, the stages of embryonic development:**

- ✓ [A]In the graph we can see the three layers of embryonic development, ectoderm, mesoderm and endoderm.

- ✓ **Note that:** the lateral plate of mesodermal layer is separated giving two extra-embryonic layers to line the amniotic cavity and the yolk sac.



Additional graph

11- Development of the Anterior Abdominal Wall

This slide is not for memorization, just for clear understanding

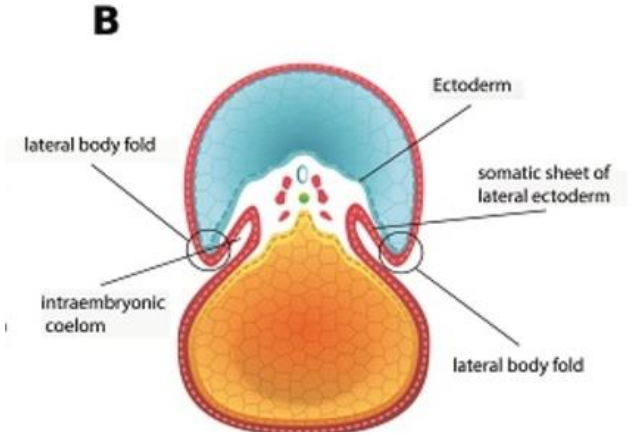
Recall from introductory embryo, the stages of embryonic development:

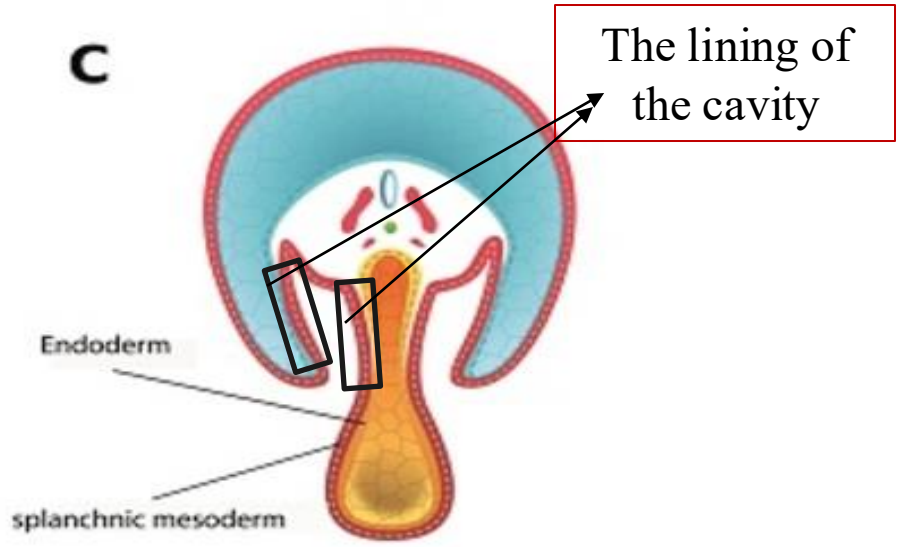
- [B] lateral body folds (Transverse fold)

- [C] Yolk sac start diminishing –getting smaller- and pushed into the embryonic body to finally have amniotic cavity surrounding the whole embryo.

- What's important in this stage is to notice how a cavity result from this process appear and is lined by **mesoderm with two origins**:

1. **The one that line yolk sac (splanchnic)**
2. **The one that line amniotic cavity (somatic)**

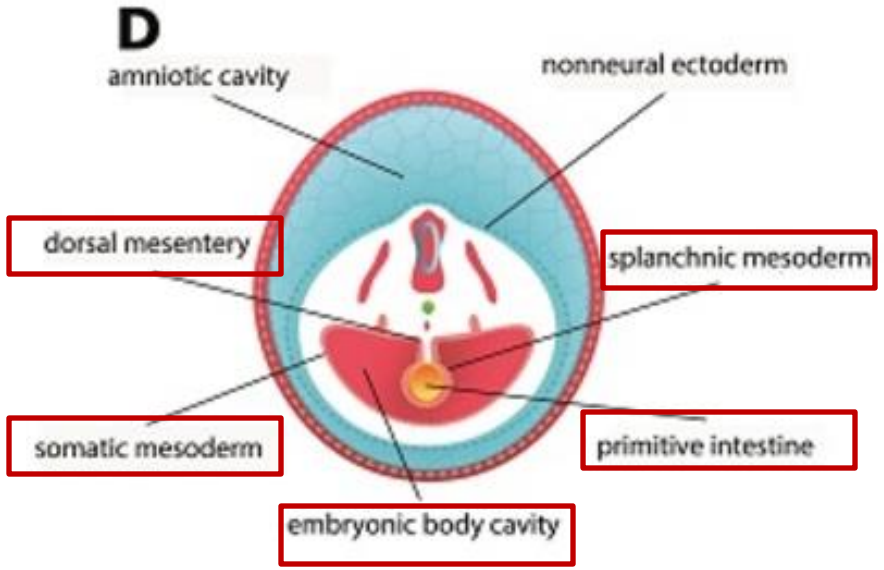




Additional graph

11- Development of the Anterior Abdominal Wall

- ✓ [D] Finally when the transverse fold end, the embryo is cylindrical, the most inner cylinder is the **primitive intestine**.
- ✓ Around the primitive intestine there is an **embryonic body cavity** lined by **Somatic Mesoderm** or called **Somatoplueric Mesoderm.**
- ✓ The **primitive intestine** is lined externally by **Splanchnic Mesoderm** or called **Splanchnopleuric Mesoderm.**
- ✓ The connection between these two linings is the **Dorsal Mesentry.**



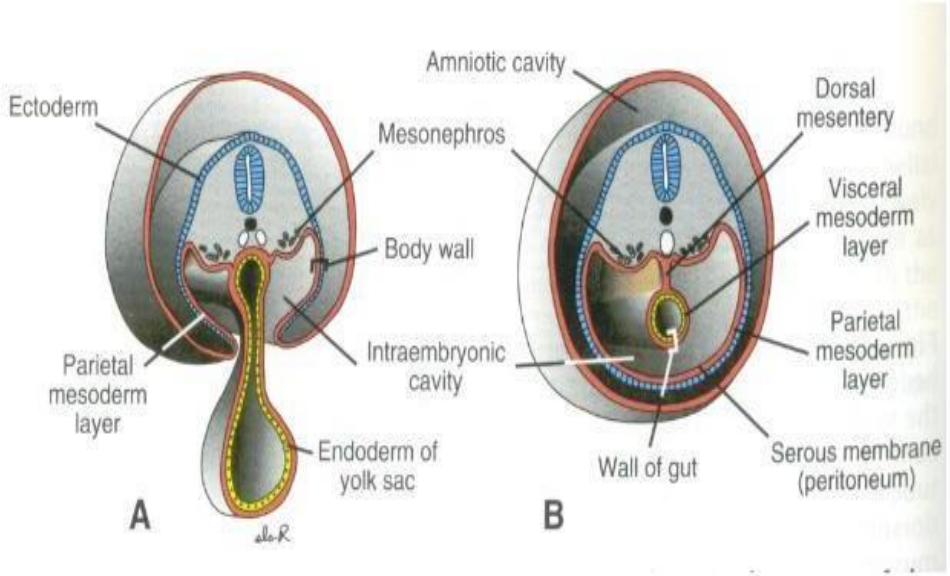
Additional graph

11- Development of the Anterior Abdominal Wall

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 **ant. Abdominal wall** is derived from the **somatoplueric mesoderm.**
- The ant. Abdominal wall retain its innervation from the ventral rami of the spinal nerves(including its muscles).
- The somatoplueric mesoderm then tangentially divides into **three layers**:

1. Ext. oblique
2. Int. oblique
3. Trans. Abdominis

- It's also the origin of rectus abdominis muscle.

11- Development of the Anterior Abdominal Wall

Note that:

- ✓ The **Somatic mesoderm** is in contact with **ectoderm** and it gives rise to the **body wall structures** like the ant. Abdominal wall as we said

- ✓ The **splanchnopleuric mesoderm** lies next to the **endoderm** (shown in yellow), and it gives rise to the **internal organ coverings** like the peritoneum, pleura, and pericardium.

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.

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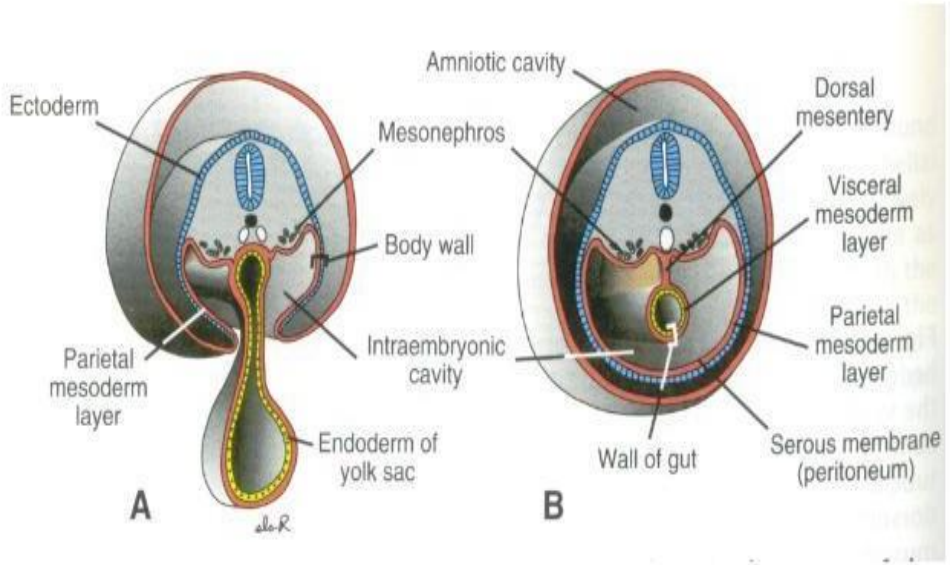
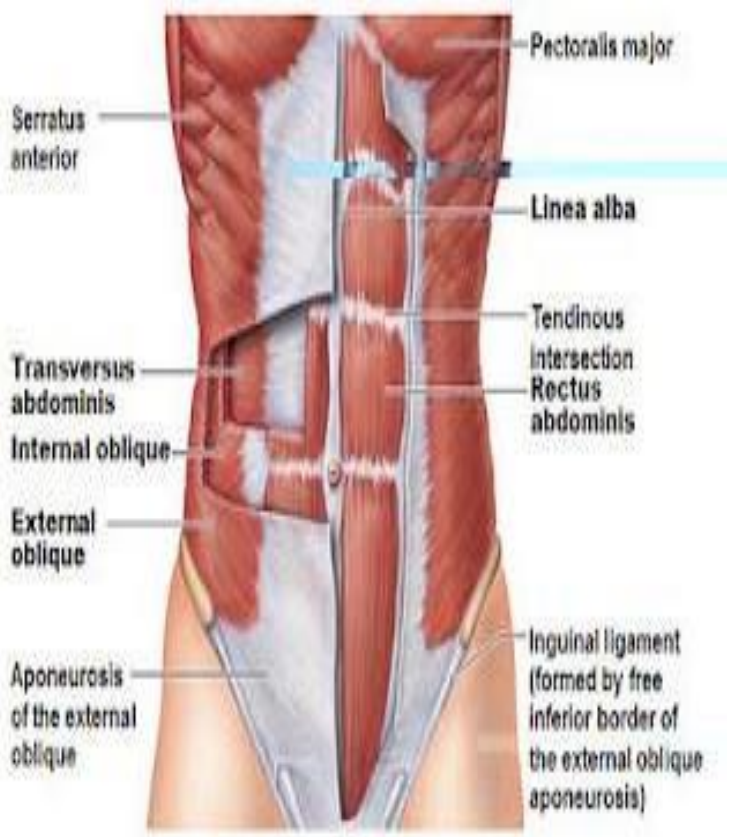


12- Development of the Rectus Abdominis Muscle

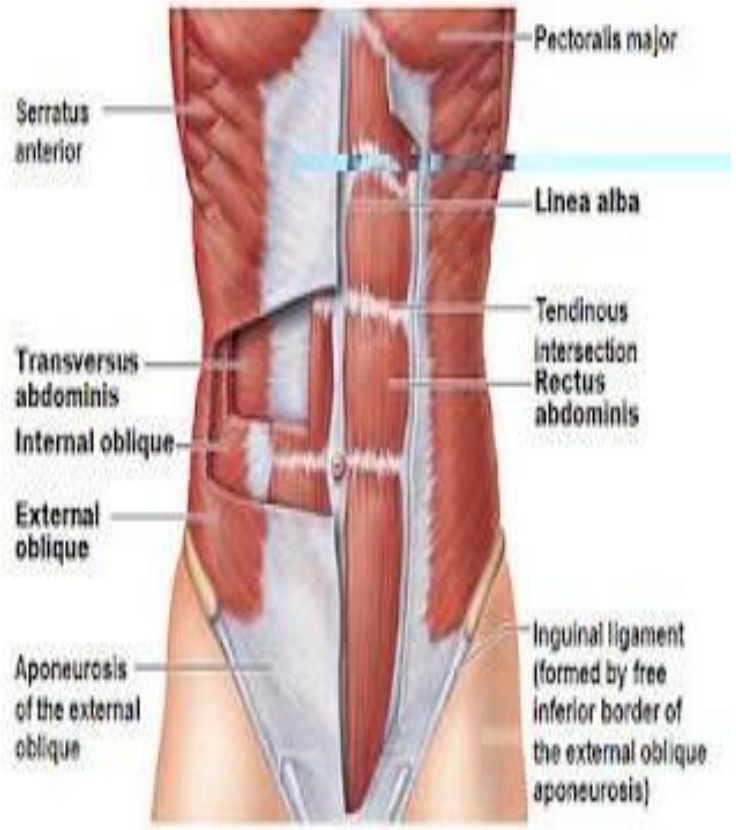
- ✓ The rectus abdominis muscle is derived from the **myotomes**, making it **segmented in origin**.
- ✓ The right and left sides of the muscle <u>start developing separately</u> then at the **3rd month** they fuse together into the midline to form the **linea alpa.**
- ✓ On either side of the lina alpa the rectus muscles lies within their **rectus sheaths**.



12- Development of the Rectus Abdominis Muscle

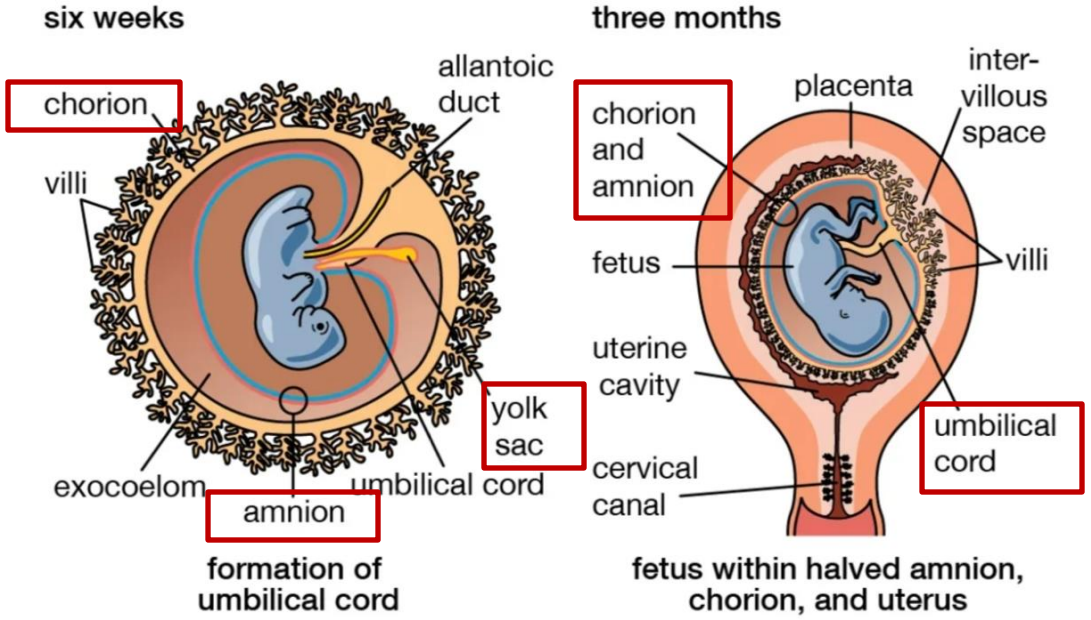
- ✓ Rectus abdominis retains indication of the segmental origin by the presence of **tendinous intersections**.

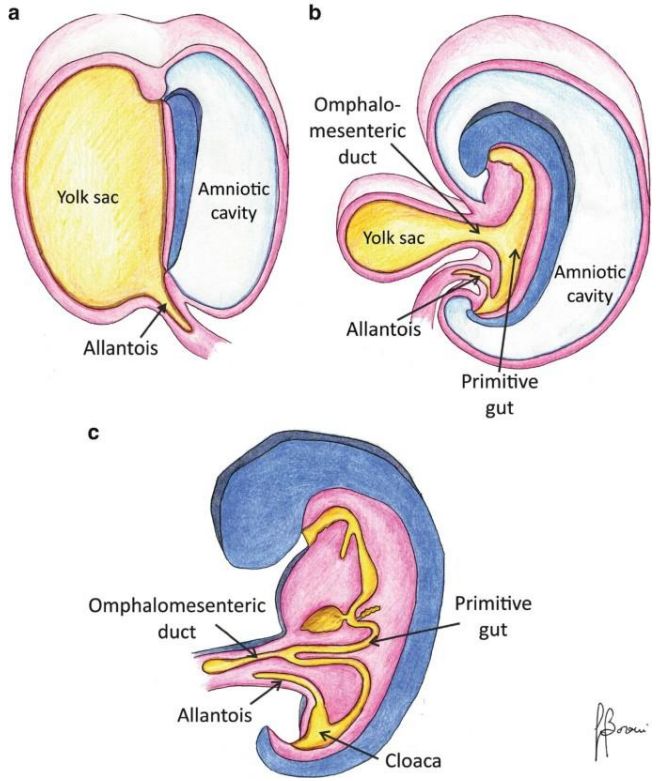
- ✓ The tendinous intersections are **firmly attached Anteriorly** to the rectus sheath, especially in its inferior portion. **This stabilizes the rectus abdominis within its sheath.**



13- 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.





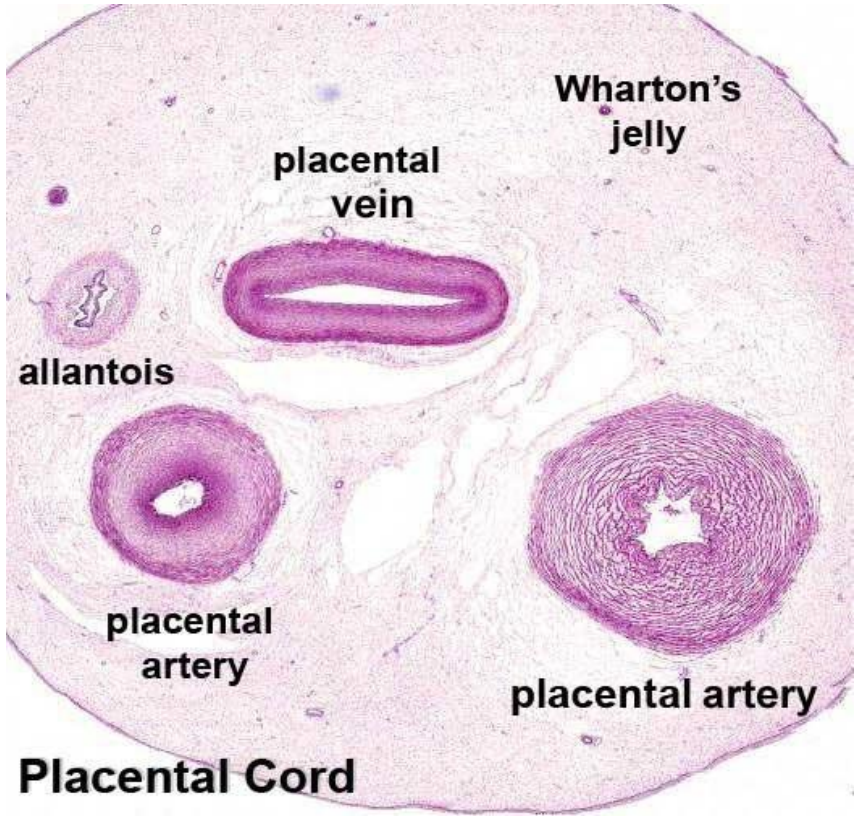
Additional graph

13- Development of the Umbilicus and the Umbilical Cord

- ✓ The umbilical cord is about 45 cm in length, it connects the embryo to the placenta.

- ✓ The mesenchyme core of the cord **(Wharton's jelly)** form a **loose connective tissue** which **embed the following**:

- ✓ Remains of yolk sac
- ✓ Vittelline duct (connected with the Midget)
- ✓ Remains of allantois (was connected with urinary bladder)
- ✓ Umbilical blood vessels
- ✓ Many stem cells



13- Development of the Umbilicus and the Umbilical Cord

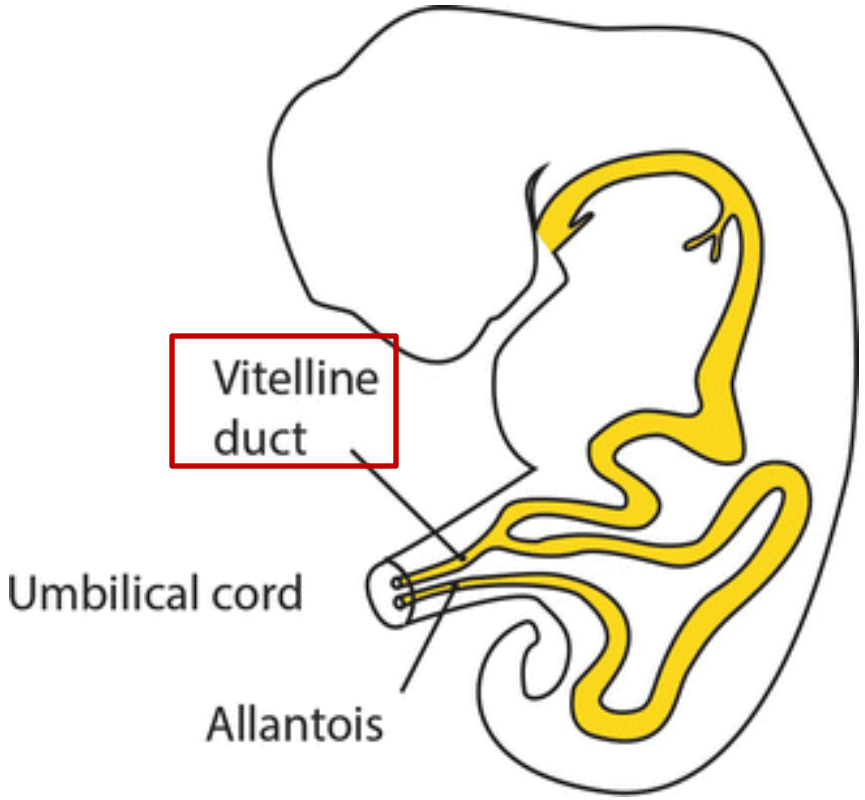
- ✓ Umbilical blood vessels:
- ✓ 2 **arteries** that carries **deoxygenated** blood from the **fetus** to the **chorion (placenta)**
- ✓ 2 **veins** that carry **oxygenated** blood from the **placenta** to **fetus**
- ✓ **The right vein** will soon disappear
- ✓ After birth **the left umbilical vein** will be obliterated and become **ligamentum teres.**

➢ Clinical relation:

The umbilicus cord nowadays is preserved because it contain lots of stem cells, incase the person need it later for any clinical reason.

14- Vitelline Duct Abnormalities

- ✓ The vitelline duct normally connects the midgut to the umbilicus during embryonic development.
- ✓ **Complete obliteration of this duct is essential.**
- ✓ In 2 to 4% of people, a small portion of the vitelline duct persists, forming an outpocketing of the ileum, this condition is called **Meckel's Diverticulum** or ileal diverticulum

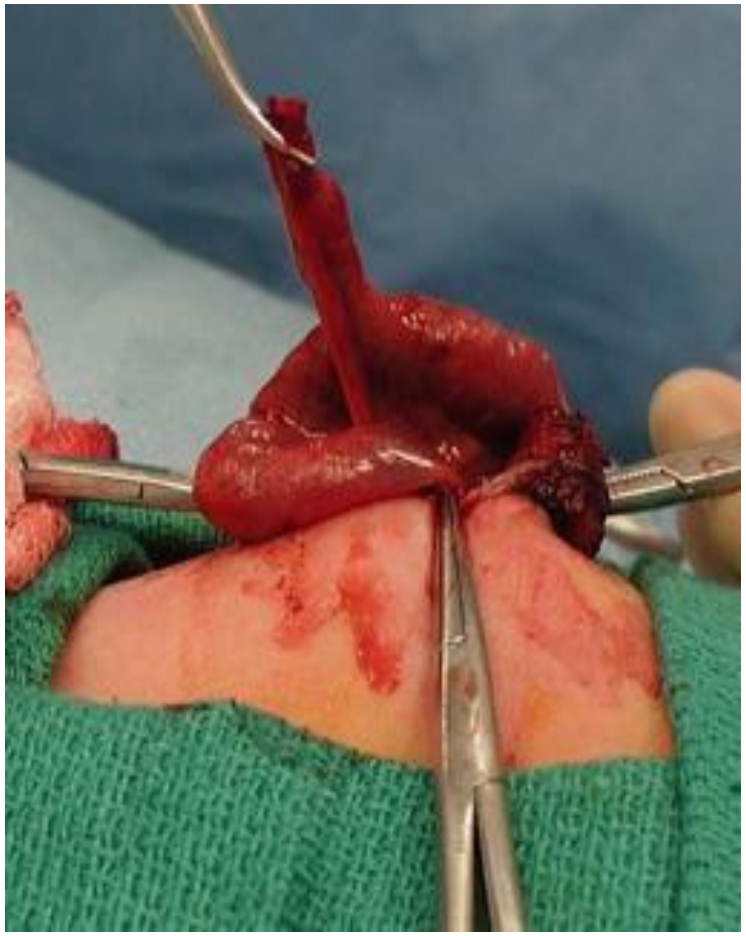


Additional graph

14- Vitelline Duct Abnormalities

- ✓ This diverticulum typically arises around **40–60 cm from the ileocecal valve** on the antimesenteric border of the ileum and measures about **2 inches in length**.

- ✓ Usually its asymptomatic ,However, **when it contains heterotopic pancreatic tissue or gastric mucosa**, it may cause **ulceration**, **bleeding**, or even **perforation** and **peritonitis.**

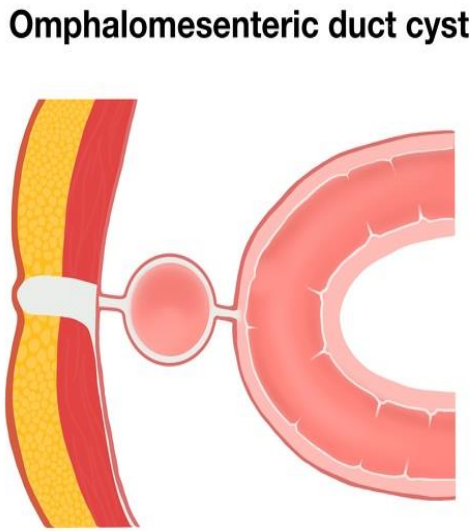


14- Vitelline Duct Abnormalities

- ✓ Sometimes both ends of the vitelline duct transform into fibrous cords, and the middle portion forms a large cyst, an **enterocystoma**, or **vitelline cyst.**

- ✓ This type of anomaly typically forms around the **2nd to 3rd month** of gestation.

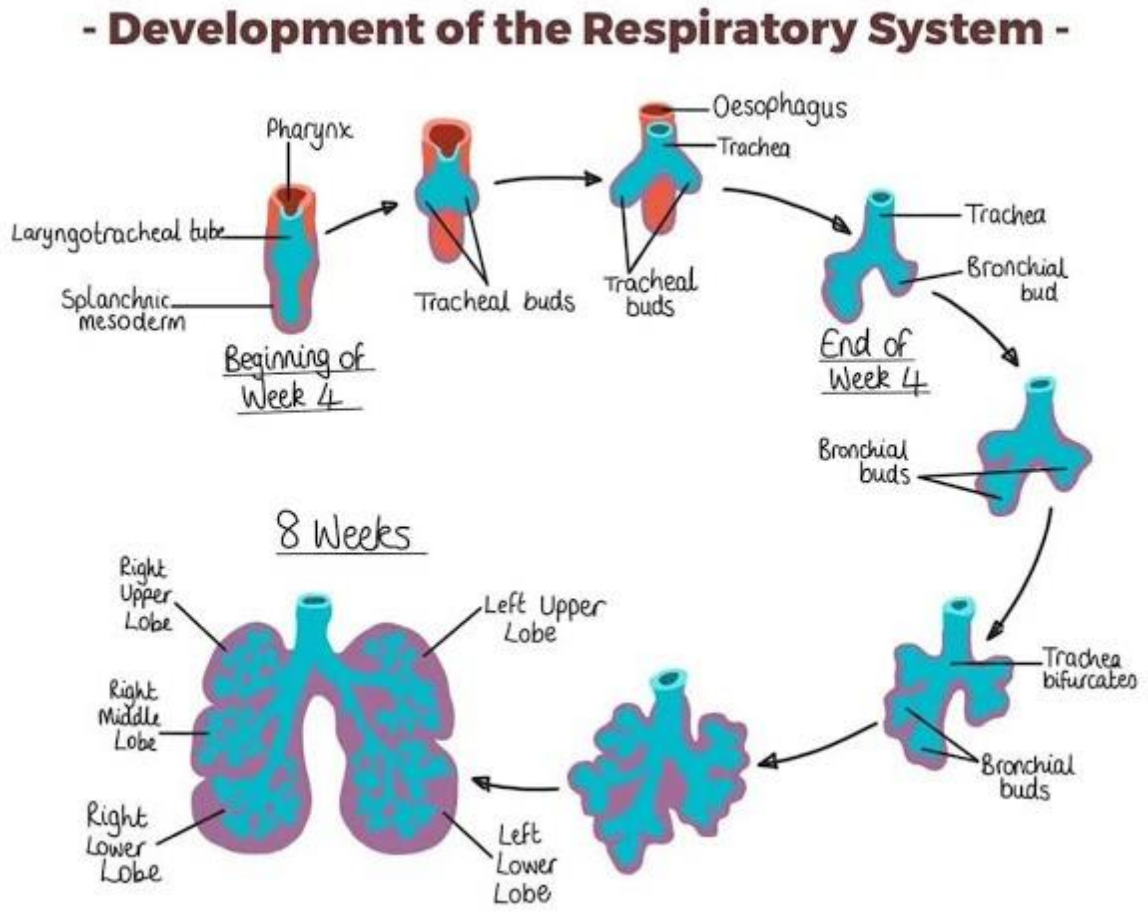
- ✓ In most cases, a vitelline cyst does not cause clinical problems, and it is usually considered a minor anomaly **unless it becomes infected or enlarged.**



Additional graph

15- Formation of the Lung Buds

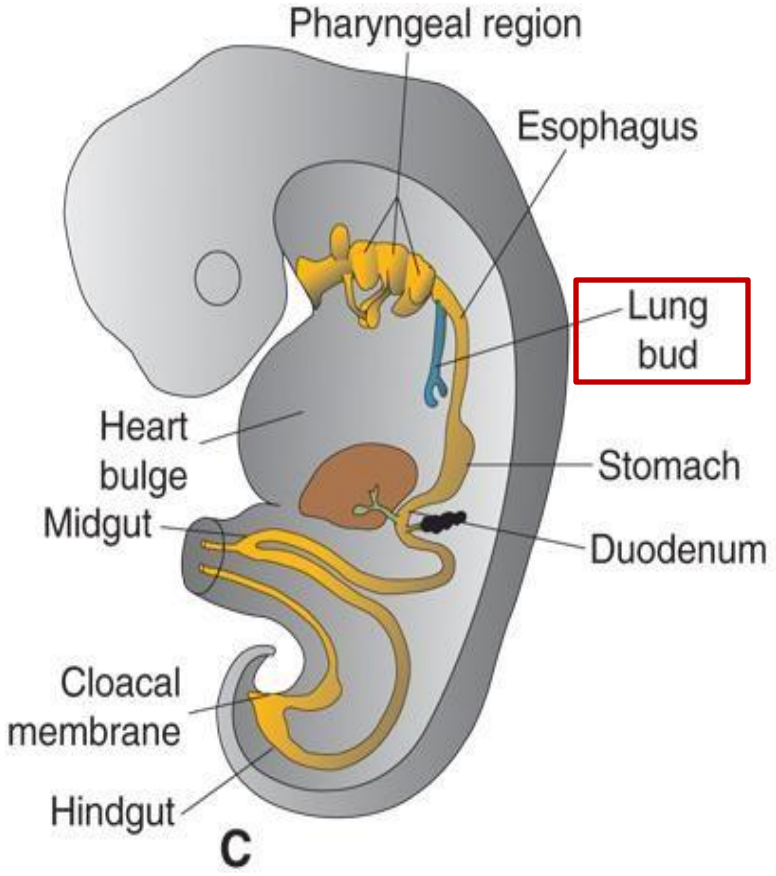
- ✓ At the **4th week** , the respiratory diverticulum (lung bud) appears as an <u>outgrowth from the ventral wall of the foregut.</u>
- ✓ The location of the bud along the gut tube is determined by signals from the surrounding mesenchyme, including **fibroblast growth factors (FGFs)** that "instruct" the endoderm.
- ✓ The lung bud **gives rise to** the **trachea, bronchi, bronchioles, and lungs.**



Additional graph

15- Formation of the Lung Buds

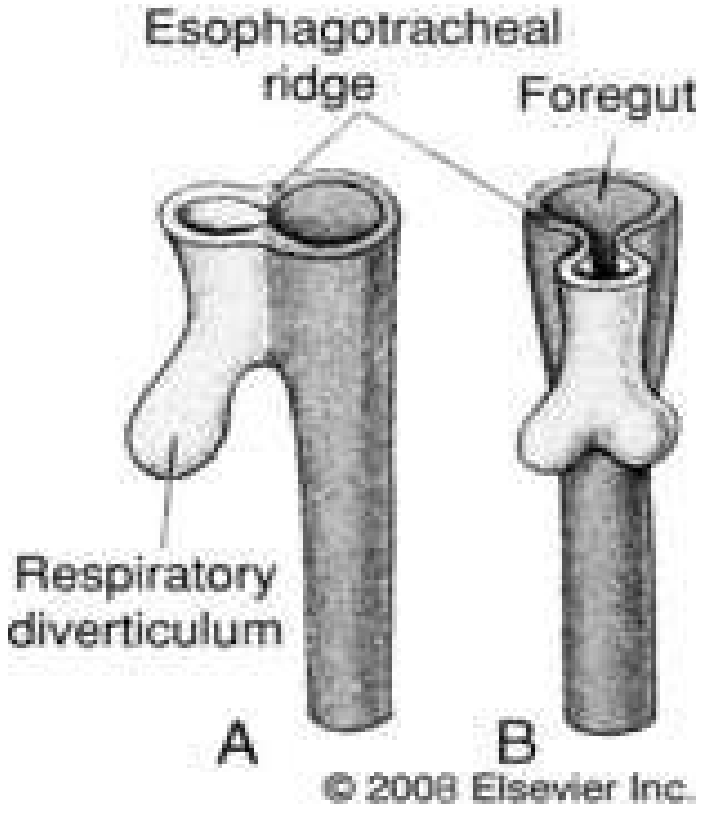
- ✓ Hence epithelium of the internal lining of the larynx, trachea, and bronchi, as well as that of the lungs, is entirely of **endodermal origin**.
- ✓ The cartilaginous, muscular, and connective tissue components of the trachea and lungs are derived from **splanchnic mesoderm** surrounding the foregut.



6-1C Lung bud initiation and branching

15- Formation of the Lung Buds

- ✓ Initially the lung bud is in open communication with the foregut.
- ✓ As the foregut elongates downward, it also gives rise to the esophagus. Meanwhile, the respiratory diverticulum **buds off**.
- ✓ A crucial step is the separation between the esophagus and lung bud, with **the epiglottis remaining as the only opening to the developing larynx and airway**.



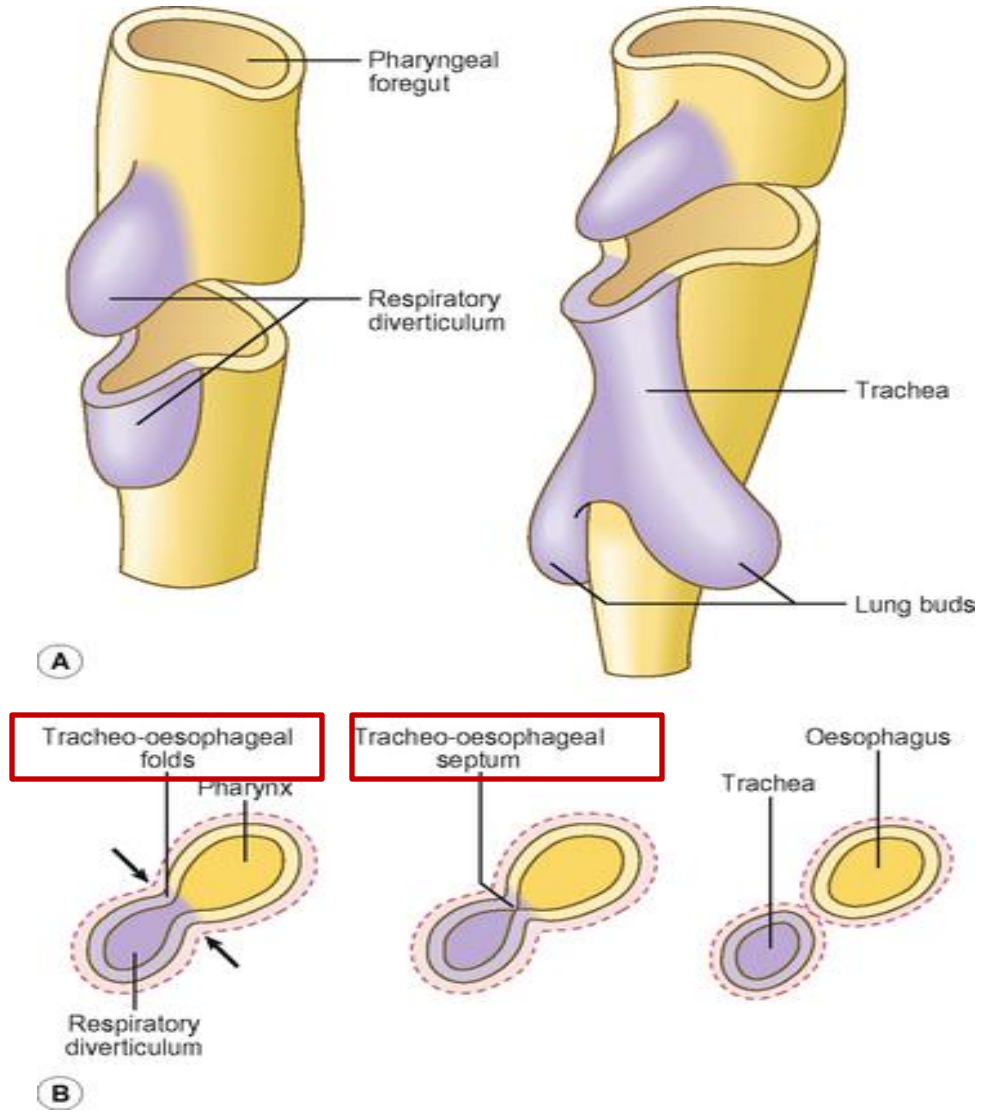
15- Formation of the Lung Buds

- ✓ When the diverticulum expands caudally, however, two longitudinal ridges, **the tracheoesophageal ridges**, separate it from the foregut ,the ridges keep growing medially.

- ✓ 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** , ech of them then will develop separately.

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

Additional graph



For any feedback, scan the code or click on it.

Corrections from previous versions:

Versions	Slide # and Place of Error	Before Correction	After Correction
V0 → V2	19	The one that line yolk sac (somatic) The one that line amniotic cavity (splanchnic)	The one that line yolk sac (splanchnic) The one that line amniotic cavity (somatic)
V2 → V3	24	The tendinous intersections are firmly attached **Posteriorly** to the rectus sheath	The tendinous intersections are firmly attached **Anteriorly** to the rectus sheath

Additional resources:

رسالة من الفريق العلمي

Ninga nerds vedio
Highly recommended

ما تنسوا أهلنا في غزة من دعائكم
يا كرام

والله لو أطلعت على الغيب لأخترت المكتوب

﴿وَعَسَىٰ أَنْ تَكْرَهُوا شَيْئًا وَهُوَ خَيْرٌ لَكُمْ﴾

فلا تيأس من روح الله

ولاتقنط من رحمته

وأحسن الظّن به

ولا تجعل للشيطان مجال عليك باليأس انتبه منه

اللَّهُمَّ صَلِّ وَسَلِّمْ عَلَى نَبِيِّنَا مُحَمَّدٍ