

## Embryology of GI Tract

الاسلايدات من 15-33 في المجموعة الثانية قرأت قراءة سريعة , لكنها مطلوبة , الرجاء دراستها مباشرة من الاسلايدات غير ذلك فالشيت تغطي كل حرف هو بالاسلايد ضمن ترتيب يسهل و يبسط الحفظ

### 1-Development of Oral cavity

\*\*the mouth has 2 sources of development:

- (1) depression in the stomatodeum (ectoderm)>>> floor of oral cavity
- (2) cephalic end of the foregut (endoderm)

\*\*Buccopharyngeal membrane (3) : separates the two points ( (1) + (2) )... disappears during the

3<sup>rd</sup> week so connection will occur between the oral cavity (1) and the foregut (2)

(ترقيمه برقم 3 جاء لتسهيل الحفظ و ربطه بأسبوع اضمحلاله )

\*\* An imaginary line (at the site of this membrane) is created, separating the ectodermic origins (anterior to the line) from the endodermic origins (posterior to the line)

>>> This line extends to:

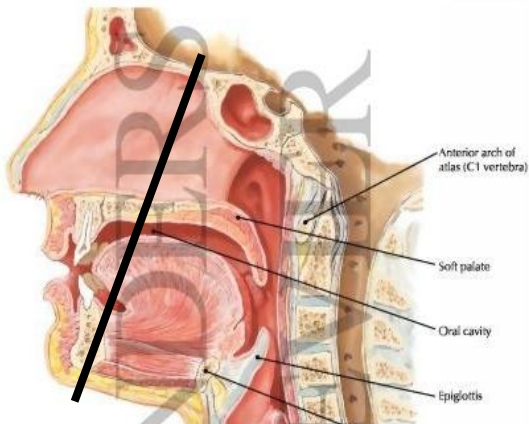
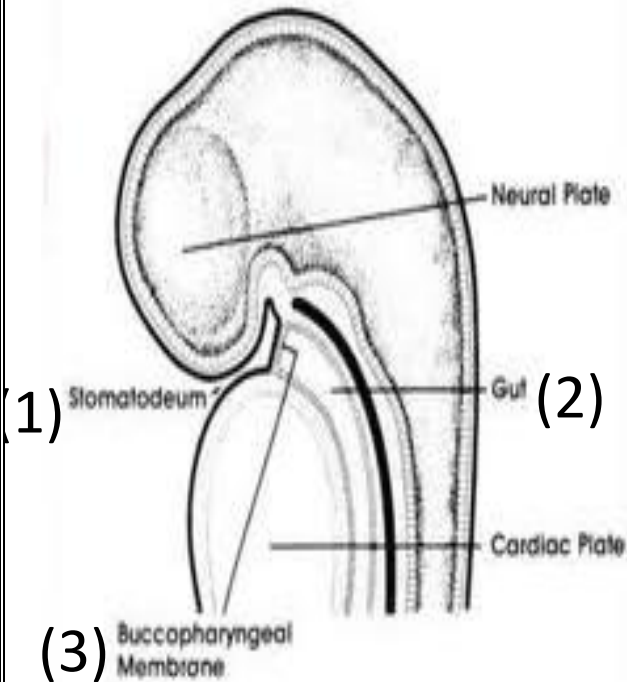
- body of sphenoid (posterior!)
- Soft palate (middle)
- Inner surface of the mandible, inferior to the incisor teeth (ant.)

>>> Ectodermic origins (Ant. To the line )

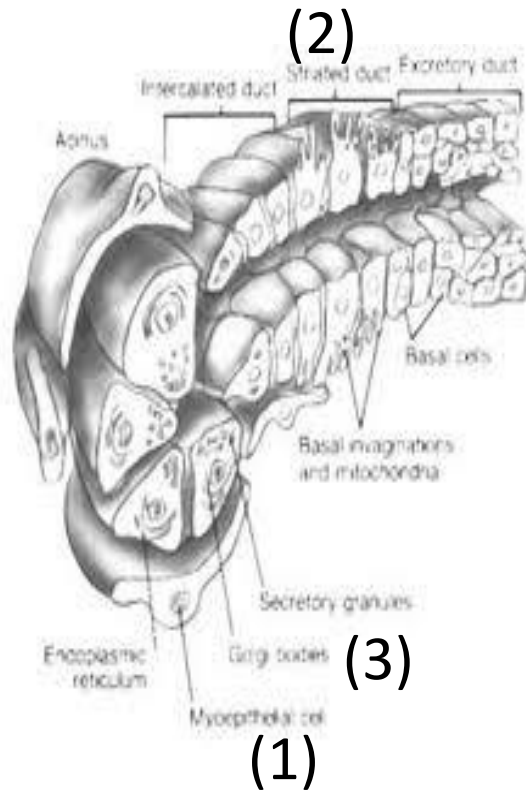
- Hard palate
- Sides of the mouth
- Lips
- Enamel of the teeth

>>> endodermic origins (Posterior to the line )

- Tongue
- soft palate
- palatoglossus & palatopharyngeal folds
- floor of mouth



## 2- Development of the salivary glands



\*\* During the 7<sup>th</sup> week , a solid outgrowth of cells arises from the walls of the developing mouth (mucosa ) to invaginate and grow into the underlying mesenchyme C.T (1) that condense to form:

-the capsule of gland

- septa ( + blood vessels & lymphatic )>>> divide the gland into different lobes and lobules

>>>The Capsule and septa >> mesoderm

\*\* The epithelial buds will go through repeated branching to form solid ducts (2) ( canalization )

\*\* the ends of these ducts >>> form the secretory acini (3)

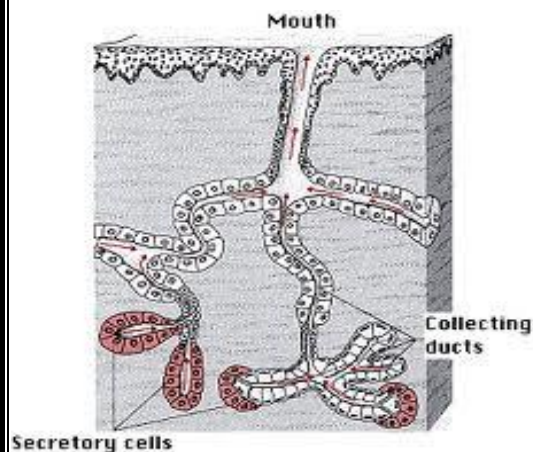
>>> both ducts and acinis go through canalization

>>> the difference between Endocrine and Exocrine ducts , that the endocrine ducts disappear during development while the exocrine ducts will stay

\*\* Ducts and acini of

- Parotid >>> Ectoderm

- Sub ( mandibular & lingual ) >>> Endoderm

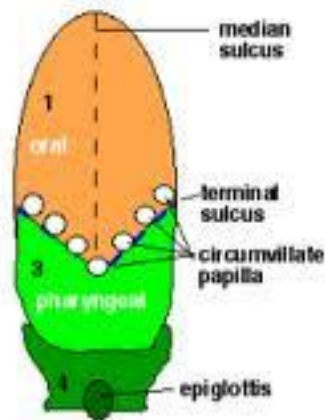


## 2- Development of the Tongue

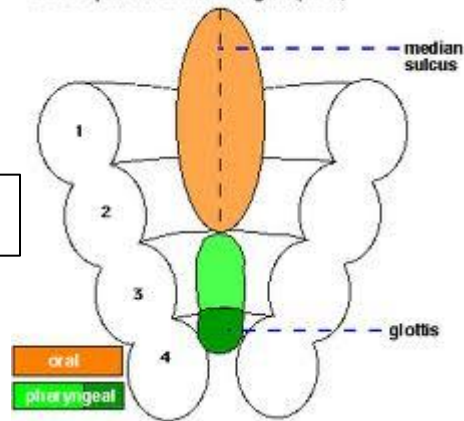
\*\*floor of pharynx consist of 4 arches on each side, each arch has 3 types of tissue; (ectoderm, mesoderm & endoderm)

لو تکرتم تدرسوا المعلومات ادناه مزامنة لربطها مع الصور المرفقة, اختصارا للوقت ☺

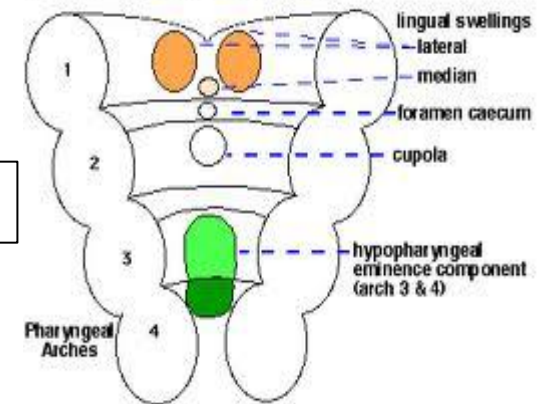
Development of the Tongue (part 3)



Development of the Tongue (part 2)



Development of the Tongue (part 1)



### Anterior 2/3

\*\*\*Two lateral lingual swellings and one medial swelling, the tuberculum impar >>>originate from the first pharyngeal arch (at 4<sup>th</sup> week)

>>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 innervations to this area is by the mandibular branch of the trigeminal nerve (lingual branch )

>> Special sensory innervations (taste) to the anterior two thirds of the tongue is provided by the chorda tympani branch of the facial nerve

## Posterior 1/3

\*\*\*A second median swelling, the copula, or hypobranchial eminence, is formed by mesoderm of the second, third, and part of the fourth arch.

Forming the posterior part or root of tongue.

>>> sensory innervations to this part is supply by the glossopharyngeal nerve

indicates that tissue of the third arch overgrows that of the second. That's why we considered circumvallates papillae ( terminal sulcus ,V-shaped groove that separate the body of the tongue from the posterior part ) as parts of posterior 1/3(embryological ) although they are in the anterior 2/3 (anatomically)

## Epiglottis and the extreme post. Part of tongue

\*\*\* a third median swelling, formed by the posterior part of the fourth arch, marks development of the epiglottis.

>>>Immediately behind this swelling is the laryngeal orifice, which is flanked by the arytenoids swellings.

>>> innervated by the superior laryngeal nerve, reflecting their development from the fourth arch.

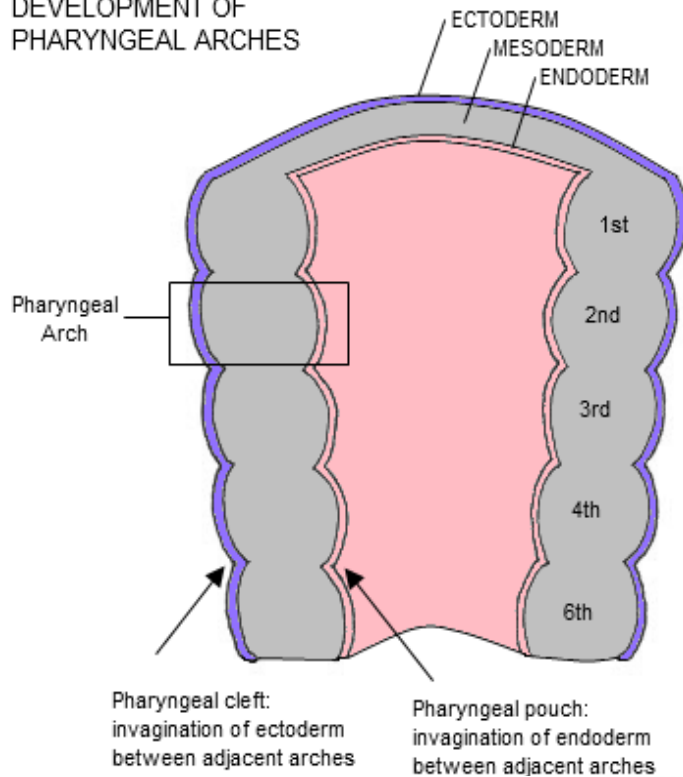
## Muscles of tongue

\*\*\* some of the tongue muscles probably differentiate in situ, but most are derived from myoblasts originating in occipital somites

>>>is innervated by hypoglossal nerve.

## 2- Development of the pharynx

DEVELOPMENT OF PHARYNGEAL ARCHES



\*\*the floor of the pharynx, consist of 3 types of tissue: ( ecto , endo and mesoderm )

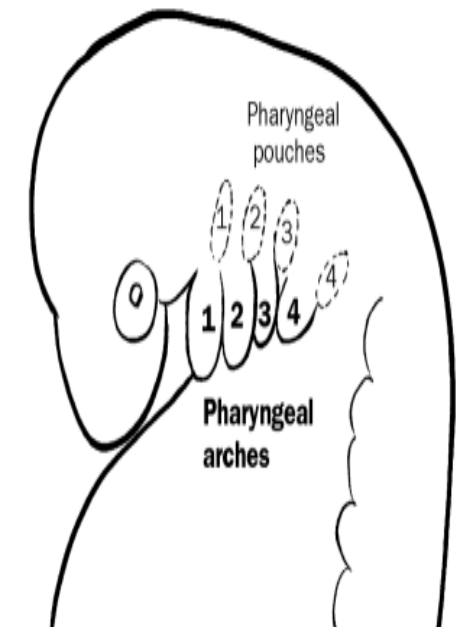
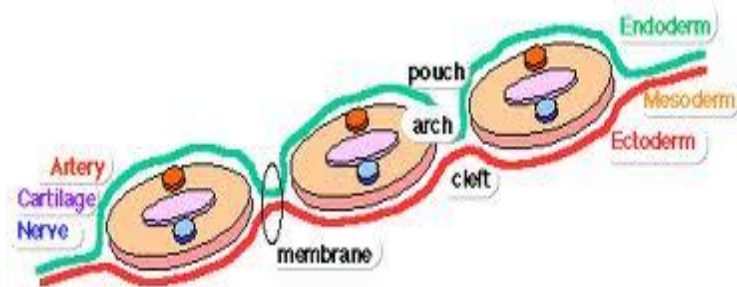
\*\*The pharynx develops in the neck from the endoderm of the foregut.

>>>The endoderm is separate from the surface ectoderm by mesenchyme , which splits up on each side to 5-6 arches , each arch form a swelling on the surface of the wall of the foregut.

>>> the result of these swellings :

- a series of clefts between the arches on the Ectodermal side ... pharyngeal clefts
- Similar grooves are found on the lateral walls of the foregut , on the endodermal side ....Pharyngeal pouches

>>>the foregut on this level is known as the pharynx



## 2- Development of the Ant.Abd.wall

**\*\*Following the segmentation of the mesoderm** (each segment has its own innervations)

>> > the lateral plate mesoderm divides into:

- somatopleuric mesoderm >>> parietal that form serous membrane that line the peritoneal, pleura & pericardial cavities

**@from where the muscles of ant. Abdominal wall is derived**

> skin and other layers that lie in front of the ant.abd.muscles are derived from ectoderm

**@ 3 layers are formed :**

- 1) Ext. oblique
- 2) Int.oblique
- 3) Trans. Abdominus

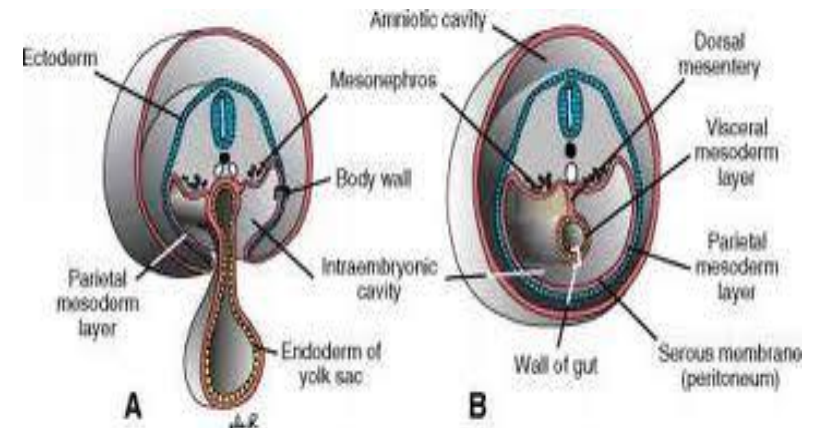
}

**Nerve supply :**  
ventral rami of spinal nerves  
( thoracic )

these muscles form aponeurosis >> that form rectus sheath

-Splancholeptic mesoderm>>> visceral mesoderm form serous membrane that line each organ

**## both layers are lined by endo and ectoderm**

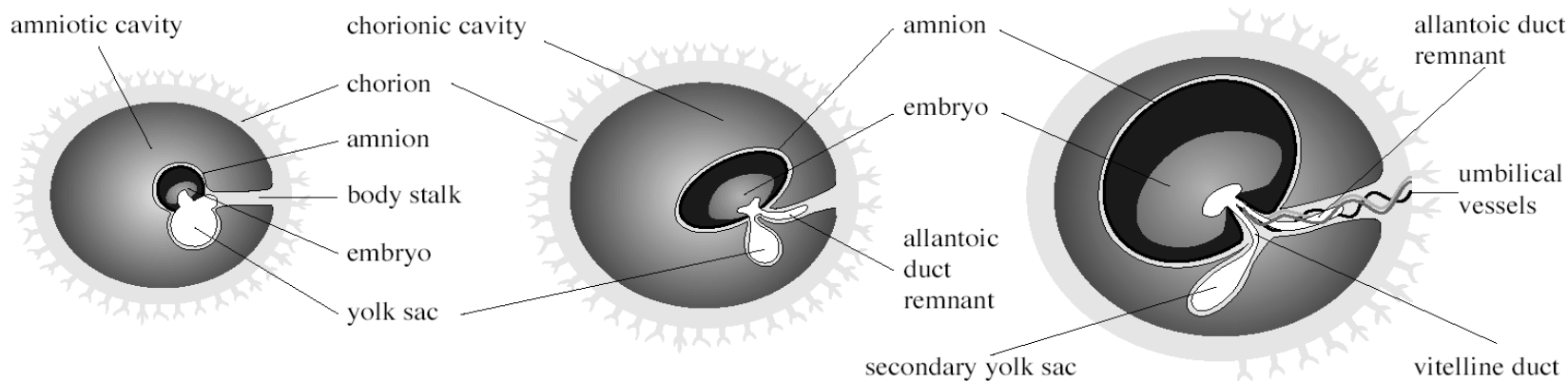


>>>rectus abdominus muscle retains the indications of the segmental origin (the presence of tendinous intersections) >>> myotomes

>>>abd. Wall right and left sides of mesenchyme fuses together at 3 months into the midline to form the linea alpa. Before that , they make anterior and posterior wall around rectus abdominus muscle > rectus sheath... lina alpa and rectus muscle lies within the sheath

## 2- Development of the umbilicus and the umbilical cord

**\*\*The amnion and the chorion fuse together to form amniotic cavity around the embryo , The amnion encloses the body stalk and the yolk sac with their blood vessels to form the tubular umbilical cord**



### Simple Double Bleb Stage

earliest detection at 5 weeks GA,  
embryo 2 mm in length

### Vitelline Duct

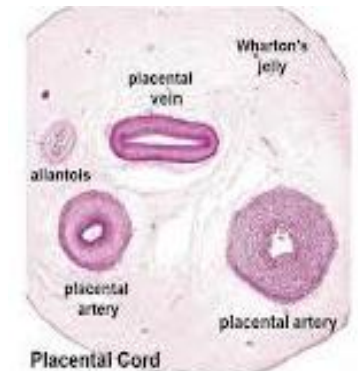
8 weeks GA

### Early Coiled Umbilical Cord

9 weeks GA

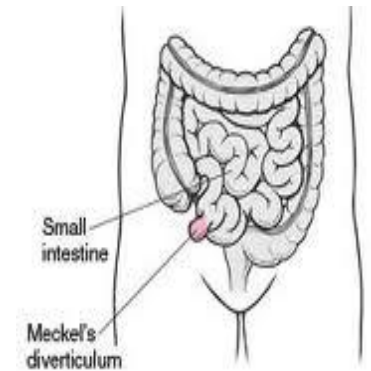
>>The mesenchyme core of the cord (whartons jelly) form a loose connective tissue which embed the following:

- Remains of yolk sac
- Vittelline duct (vittellointestinal ) , connects the umbilicus to the midgut (intestine ) .if not obstructed >> Meckel's diverticulum
- Remains of allantois
- Umbilical blood vessels >>> 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

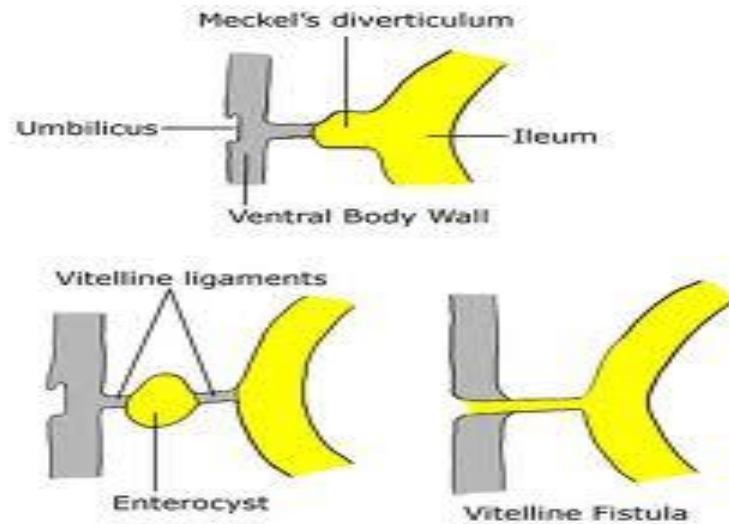


## **\*\*Vitelline Duct Abnormalities**

- a small portion of the vitelline duct persists on the antimesenteric border of ileum >>> forming an outpocketing , Meckel's diverticulum or ileal diverticulum .
- in 2-4% of people , 2 feet (40-60 cm ) from the ileocecal valve , 2 inches in length , 2 types of tissue > heterotopic pancreatic tissue and gastric mucosa
- may cause ulceration , bleeding or perforation , symptoms at this level suspected to be appendicitis



- Sometimes both ends of the vitelline duct transform into fibrous cords, and the middle portion forms a large cyst, an enterocystoma, or vitelline cyst .....> portions of small intestine may protrude out through the umbilicus if not obstructed





## 2- Development of the lung buds

**\*\*the respiratory diverticulum (lung bud) appears as an outgrowth from the ventral wall of the foregut (pharynx ) at the 4<sup>th</sup> week .**

**\*\* the location & the time of lung bud appearance are determined by signals from the surrounding mesenchyme > heredity box or gene box , these signals including fibroblasts growth factors (FGFs)> instruct endoderm .**

**\*\*epithelium of the internal lining ( larynx, trachea, and bronchi, as lungs) , >> endodermal origin**

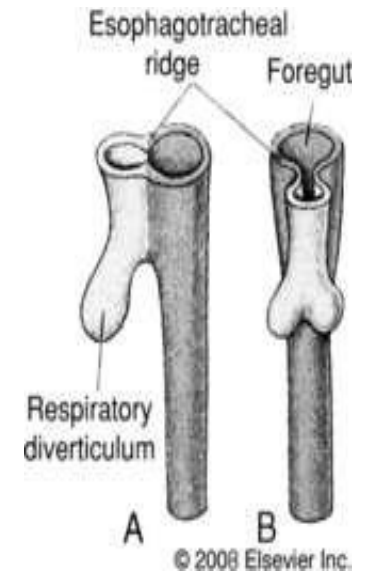
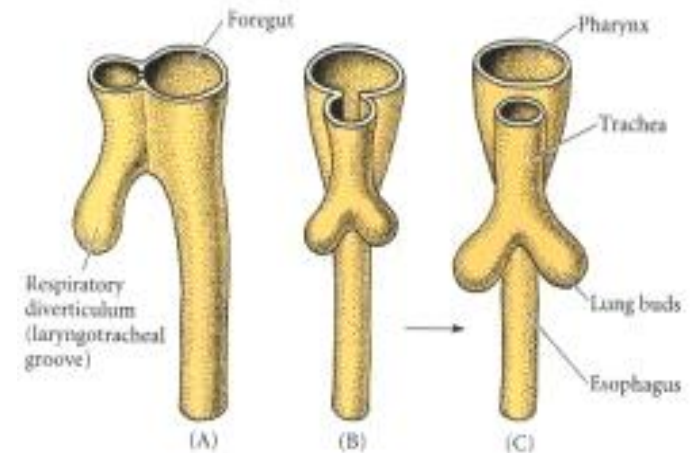
**\*\*The cartilaginous, muscular, and connective tissue components of the trachea and lungs >> derived from splanchnic mesoderm surrounding the foregut.**

**\*\*skin & other layers >> ectodermal origin**

>>>Initially the lung bud is in open communication with the foregut (A)

>>>diverticulum expands caudally,two longitudinal ridges, the tracheoesophageal ridges>> separate it from the foregut (A+B) ,,, 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 (C)

**\*\*respiratory primordium maintains its communication with the pharynx through the laryngeal orifice**



## Quick summary

\* **Mouth** ,, 2 sources : stomodeum (ectoderm )  
 cephalic end of foregut ( endoderm )

} separated by buccopharyngeal membrane / rupture at 3<sup>rd</sup> week

| Anterior to the line<br>Ectoderm | Imaginary line            | Posterior to the line<br>Endoderm        |
|----------------------------------|---------------------------|--|
| Hard palate                      | Body of sphenoid          | Soft palate                              |
| Sides of the mouth               | Soft palate               | Tongue                                   |
| lips                             | Inner surface of mandible | Palato ( glossus +<br>pharyngeal ) folds |
| Enamel of the teeth              |                           | Floor of mouth                           |

\* **Salivary gland** ,, cells arises from mucosa at 7<sup>th</sup> month >> grow into mesenchyme , forming ducts by canalization + acini at the end

- the capsule and septa >> mesoderm in origin
- parotid >> ectoderm
- submandibular and sublingual >> endoderm

\* **Pharynx** ,, >>> endodermal origin

pharyngeal clefts on the ectodermal side  
 pharyngeal pouches on the endodermal side

\* **Tongue** ,, at 4<sup>th</sup> week

|                       | Derived from   | Sensory innervations /motor                                |
|-----------------------|--|--|
| <b>Ant 2/3</b>        | 1 <sup>st</sup> pharyngeal arch ( 2 lat.lingual swelling + 1 <sup>st</sup> median )  | Mandibular branch of trigeminal<br>taste >> chorda tympani |
| <b>Posterior 1/3</b>  | Mesoderm of 2 <sup>nd</sup> , 3 <sup>rd</sup> & part of 4 <sup>th</sup> arch ( 2 <sup>nd</sup> median<br>swelling , copula ) | Glossopharyngeal nerve                                     |
| <b>Epiglottis</b>     | 4 <sup>th</sup> arch ( 3 <sup>rd</sup> median swelling )   | Superior laryngeal nerve                                   |
| <b>Tongue muscles</b> | Myoblasts of occipital somites   | Hypoglossal nerve / motor                                  |

FOREIGN

\* [http://www.youtube.com/watch?v=VG\\_DJqEB1\\_8](http://www.youtube.com/watch?v=VG_DJqEB1_8)  
<http://www.youtube.com/watch?v=s2cNCUL1r3A>  
الرجاء مشاهدتها حتى تترسخ الافكار و المعلومات (©)

## Esophagus

\*\* At first is short then lengthens rapidly with descent of the heart and lungs

\*\* The muscular coat >> (derived from splanchnic mesenchyme )

- 1- striated muscles in the upper 2/3 ,, innervated by vagus
- 2- smooth muscles in lower 1/3 ,, innervated by splanchnic plexus

\*\*Esophageal Abnormalities :

### 1) Esophageal atresia ( blind sac )

prevents normal passage of amniotic fluid into the intestinal tract, resulting in accumulation of excess fluid in the amniotic sac (polyhydramnios)>>> congenital abnormalities in respiratory tract .

stomach may filled with air (air passes from trachea toward stomach )

projectile vomiting , during milk sucking

### 2) tracheoesophageal fistula >>> result of

- 1-spontaneous posterior deviation of the tracheoesophageal septum.
- 2-mechanical factor pushing the dorsal wall of the foregut anteriorly

- most common form > proximal part of the esophagus ends as a blind sac ( atresia ) , and the distal part is connected to the trachea by a narrow canal ( fistula ) just above the bifurcation (A)

- Other types of defects in this region occur much less frequently ~ 1-2%

-(C) is easily solved by surgical interfere

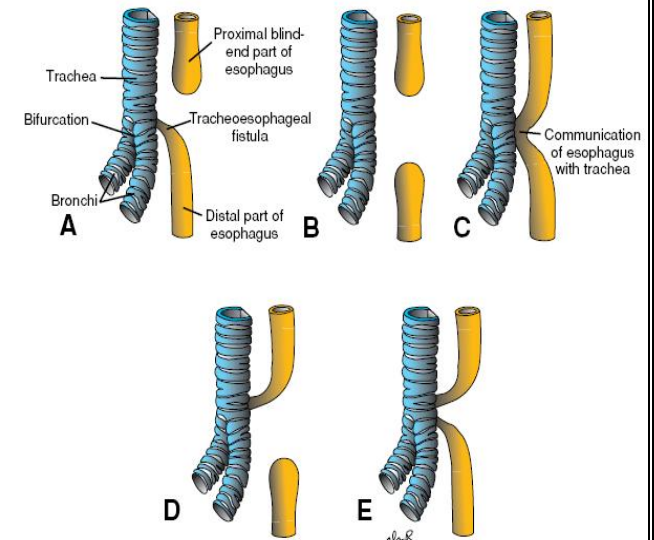
### 3) esophageal stenosis : narrowing of the lumen ,, usually at lower 1/3

caused by : 1-incomplete recanalization

2-vascular abnormalities

3-accidents that compromise blood flow

### 4) congenital hiatal hernia : esophagus fails to lengthen sufficiently and the stomach is pulled up into the esophageal hiatus through the diaphragm



### Development of the glands

- \*\* derived from epithelium cells that project into underlying C.T >>> 1- exocrine ; maintain contact with surface via ducts  
2- endocrine ; lose the direct contact with surface , duct degenerate during development >>>1. Cords  
2. Follicles

### Development of Stomach

>>> 4<sup>th</sup> week : - fusiform dilation of foregut

- The cephalic and caudal ends of the stomach originally lie in the midline
- attached to the dorsal body wall by the dorsal mesogastrium and to the ventral body wall by the ventral mesogastrium.

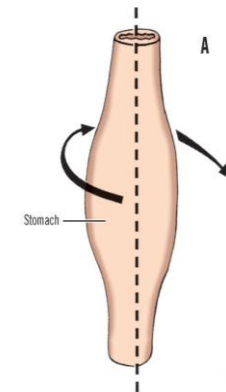
>>> following weeks :

appearance and position change greatly as a result of >>>different rates of growth in various regions of its wall  
>>>changes in position of surrounding organs

## positional changes : explained by assuming that it rotates around a longitudinal and an anteroposterior axis  
rotation and disproportionate growth alter the position of these mesenteries.

1) around longitudinal axis ; rotates 90° clockwise causing

- its left side & left vagus nerve to face anteriorly
- its right side & right vagus nerve to face posteriorly >> grows faster than the anterior portion, forming the greater and lesser curvatures
- pulls the dorsal mesogastrium >> left , creating a space behind the stomach called the omental bursa ( lesser sac
- pulls the ventral mesogastrium to the right.

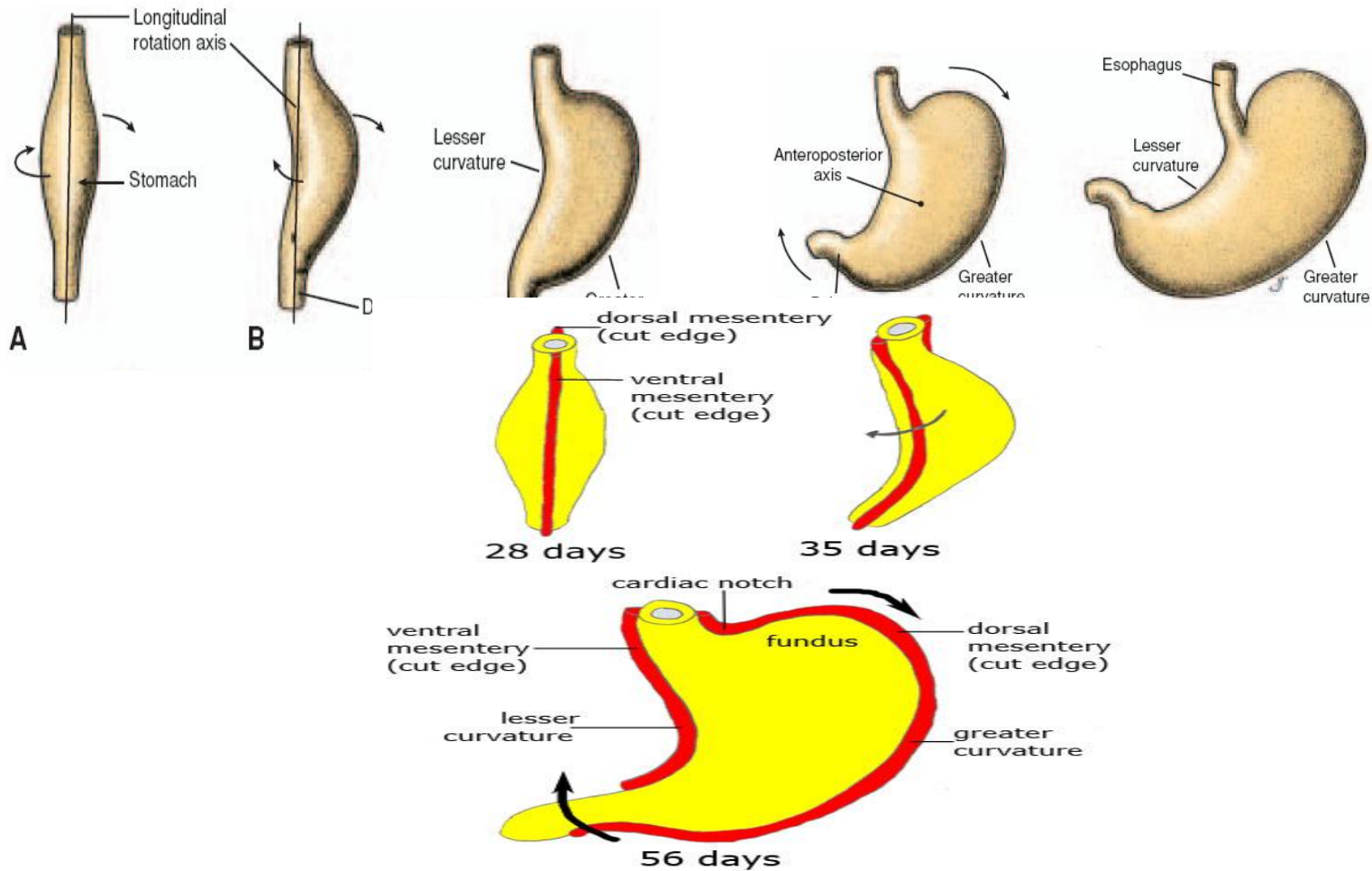


2) around anterioposterior axis , causing :

- caudal or pyloric part moves to the right and upward
- cephalic or cardiac portion moves to the left and slightly downward

لمزيد من الفهم , الرجاء الاطلاع على الفيديو في اللينك ادناه :

[http://www.youtube.com/watch?v=AscKR\\_cQExY](http://www.youtube.com/watch?v=AscKR_cQExY)



hence , at final position, its axis running from above left to below right.

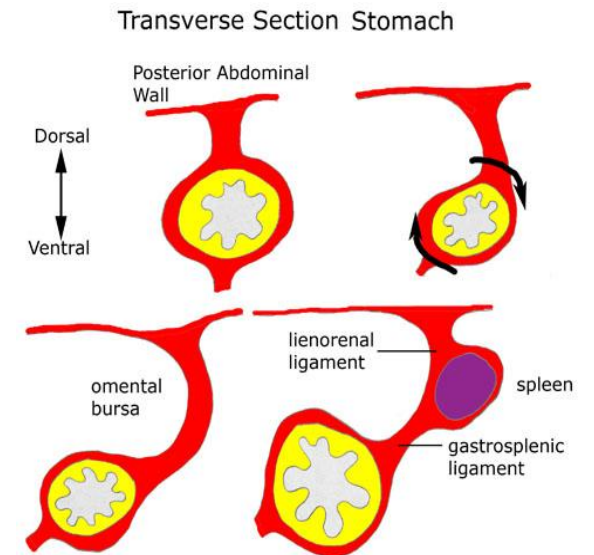
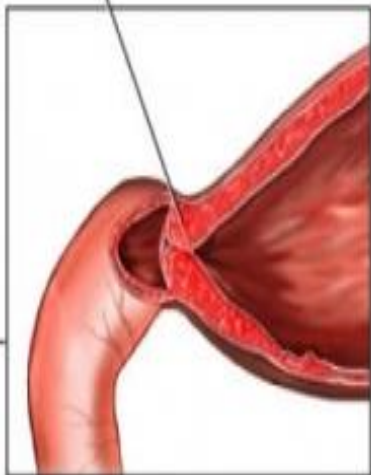
>>> the fifth week :

- \* spleen primordium >> appears as a mesodermal proliferation between the two leaves of the dorsal mesogastrium
- \* With continued rotation , dorsal mesogastrium lengthens >> portion between spleen and dorsal midline swings to the left and fuses with the peritoneum of the posterior abdominal wall >> spleen becomes intraperitoneal ,,,, then connected to the body wall in the region of the left kidney by the lienorenal ligament and to the stomach by the gastrosplenic ligament
- \* The posterior leaf of the dorsal mesogastrium and the peritoneum along this line of fusion degenerate
- \* Lengthening and fusion of the dorsal mesogastrium to the posterior body wall also determine > final position of the pancreas

>>> Abnormalities

- 1) Pyloric stenosis : when the circular and, to a lesser degree, the longitudinal musculature of the stomach in the region of the pylorus hypertrophies : most common in infants, believed to develop during fetal life.(3-6) weeks

Narrowed (stenosed) pyloric sphincter



>>> 3<sup>rd</sup> week :

- intraembryonic mesoderm on each side of the midline differentiates into (paraxial , intermediate and a lateral plate )
- When intercellular clefts appear in the lateral mesoderm, the plates are divided into two layers:  
the somatic mesoderm layer and the splanchnic mesoderm layer
- The latter is continuous with mesoderm of the wall of the yolk sac
- The space bordered by these layers forms the intraembryonic cavity (body cavity) . . . At first the right and left sides of the cavity are in open connection with the extraembryonic cavity, but when the body of the embryo folds cephalocaudally and laterally, this connection is lost
- The peritoneal cavity is derived from the intraembryonic coelom caudal to the septum transversum

