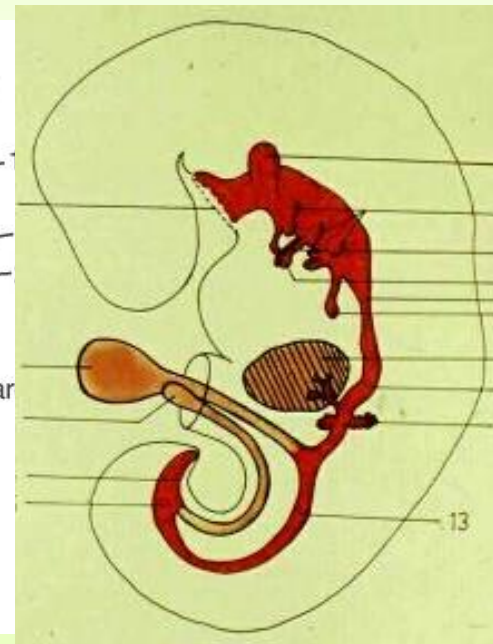
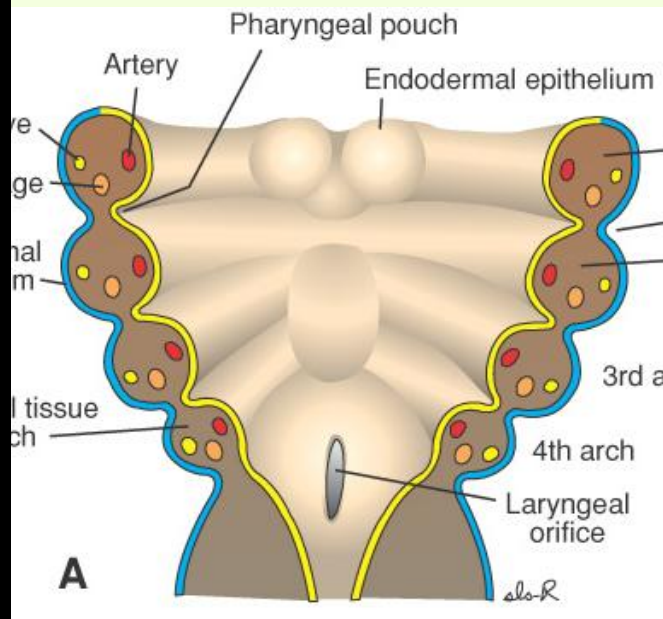


# THE BRANCHIAL APPARATUS DEVELOPMENT OF THE TONGUE



Dr. Andrea D Székely

# GILLS IN FISH AND AMPHIBIA



They develop from the branchial pouches and fissures where **ECTODERM** overlies **ENDODERM** without a 3rd, **MESODERMAL**, layer between the two.

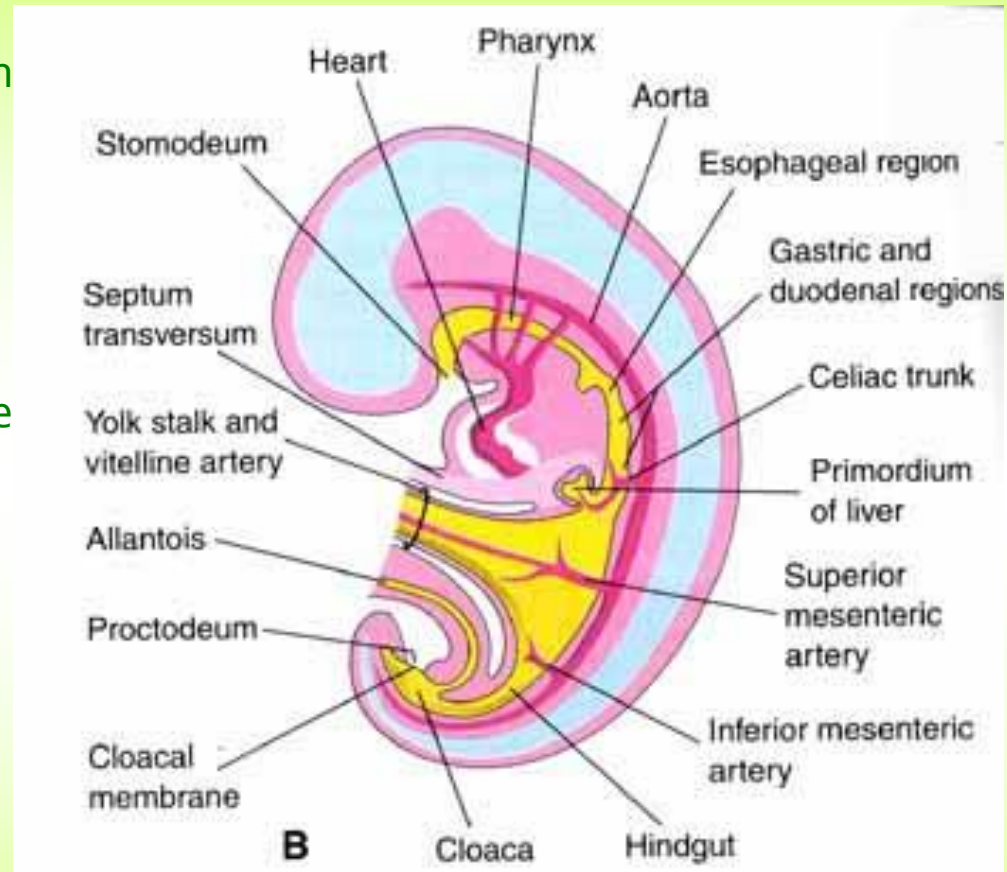
# EARLY DEVELOPMENT OF THE FOREGUT

The **gastrointestinal tract** develops from the **primordial gut**, formed during the 4th week.

It is closed at its cranial end by the **oropharyngeal membrane** and at its caudal end by the **cloacal membrane**.

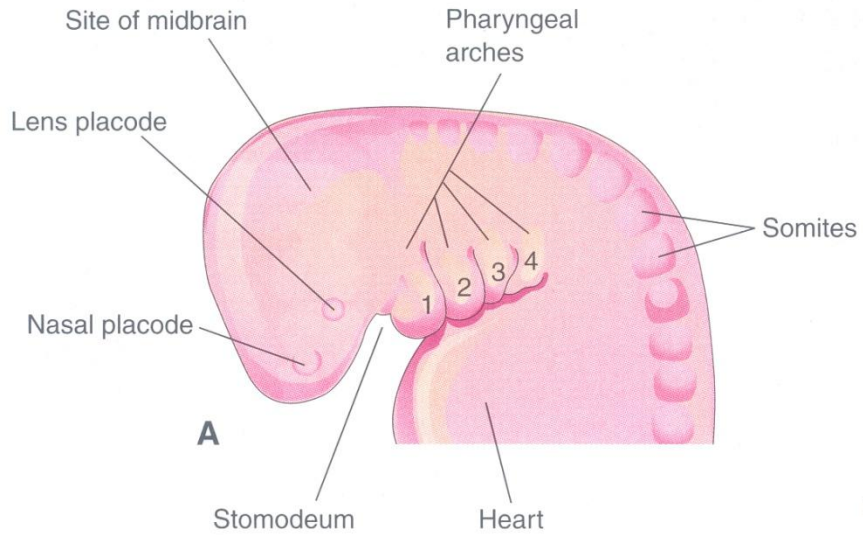
The **endoderm** of primordial gut gives rise to the most of the epithelium and glands of the GI tract.

The epithelium at the cranial and caudal ends of the GI tract is derived from the **ectoderm** of the stomodeum (mouth) and proctodeum (anal pit).

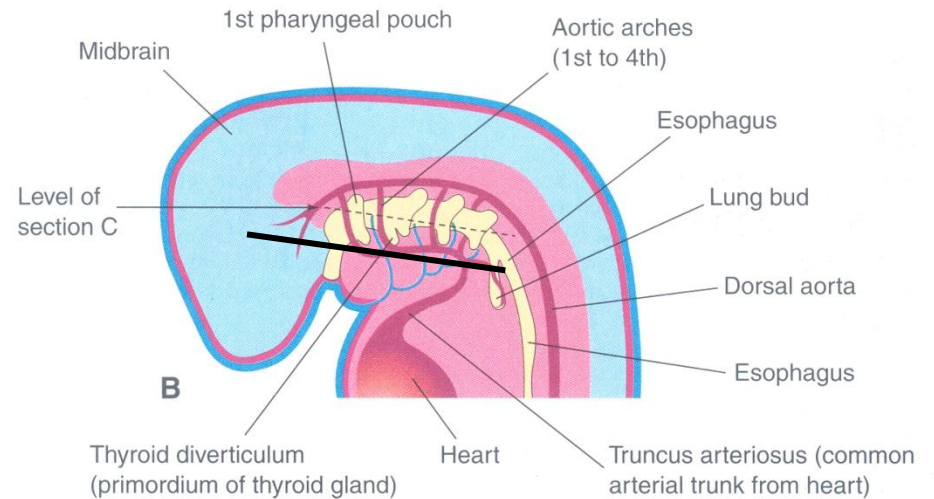


The primitive gut is commonly divided into three parts:  
**foregut, midgut and hindgut**

# CRANIAL PART OF THE FOREGUT

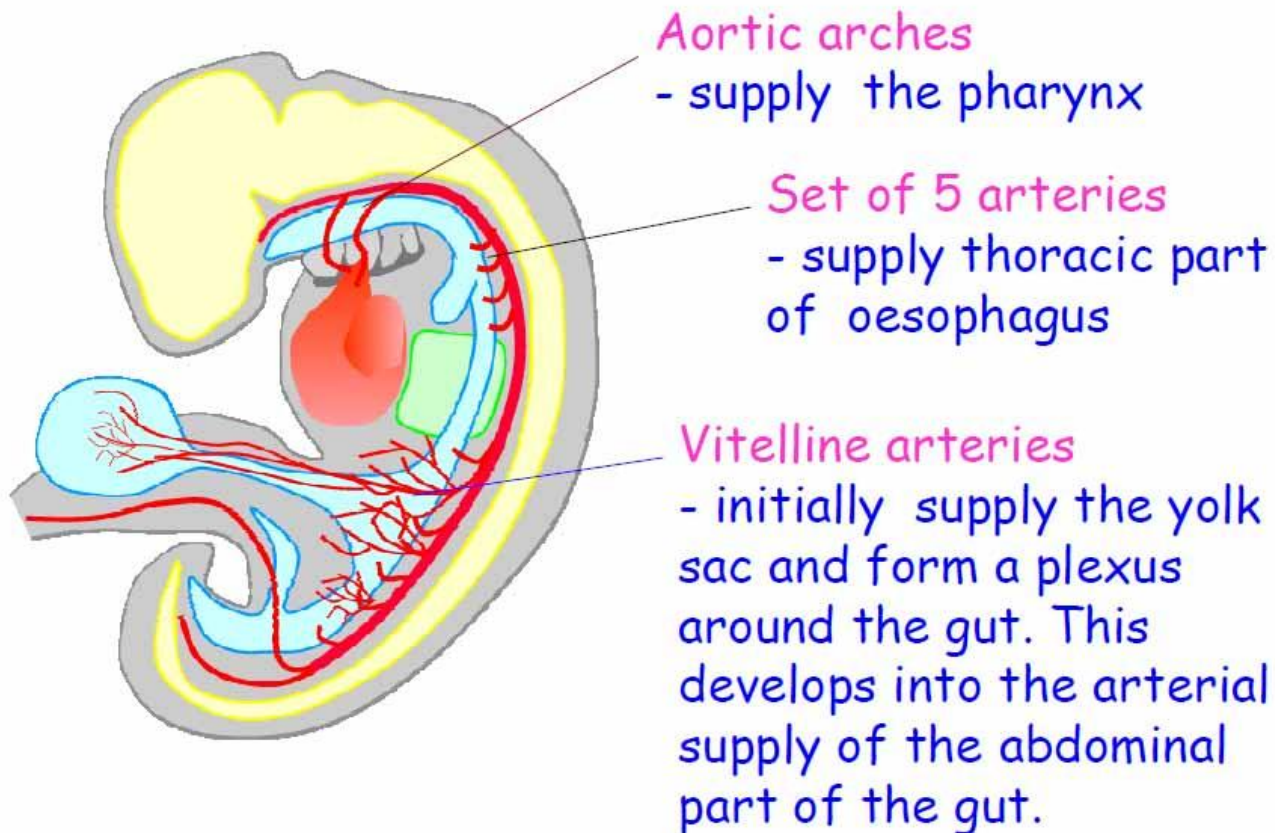


pharynx  
esophagus  
respiratory system

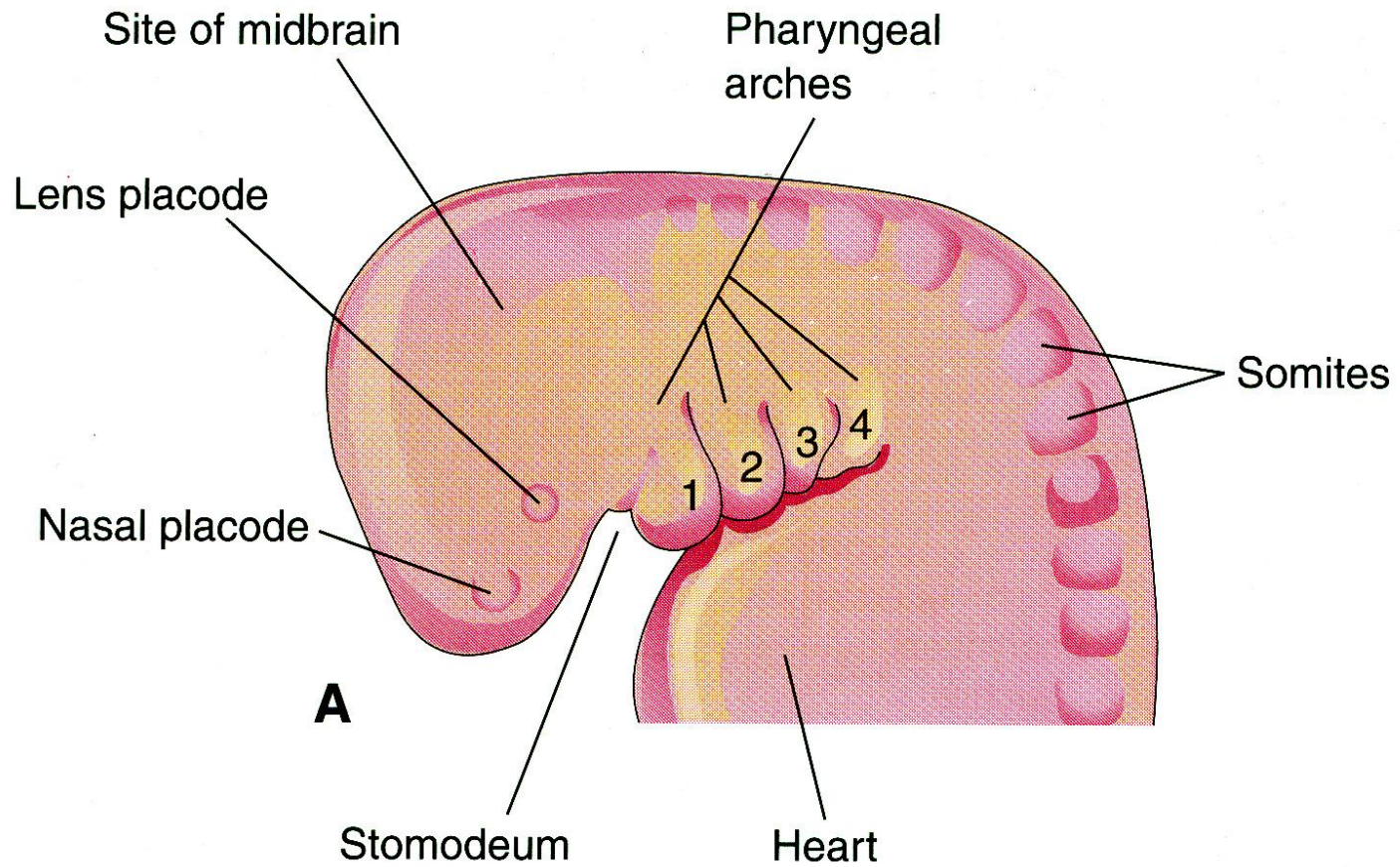


# BLOOD SUPPLY TO THE FOREGUT, MIDGUT AND HINDGUT

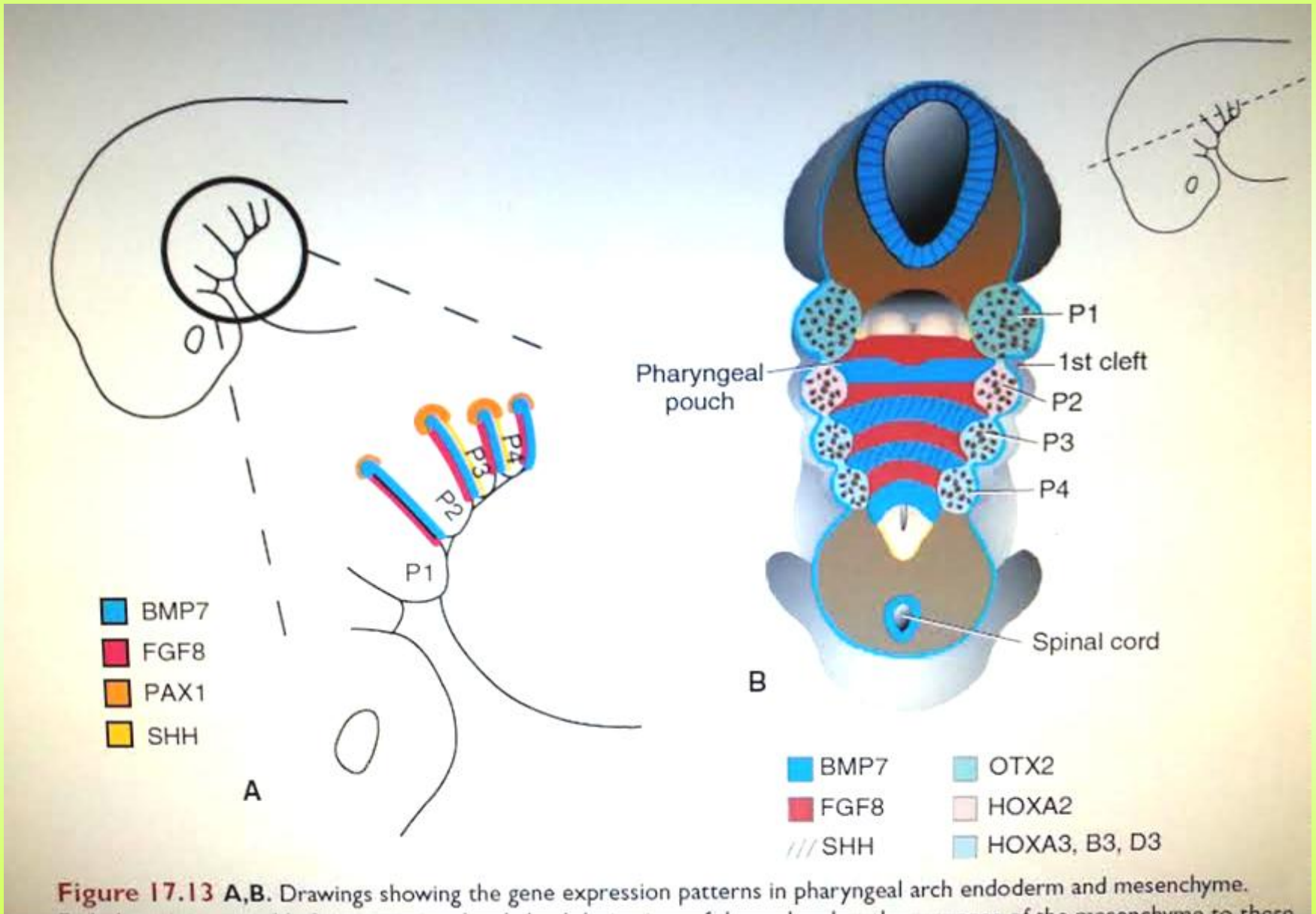
The dorsal aorta supplies arteries to the gut



# 4TH WEEK DEVELOPMENT OF THE PHARYNGEAL ARCHES



# GENE EXPRESSION PATTERN



Derivates of pharyngeal folds	Arch number	Aortic arch	Cranial nerve	Examples of branchiomeric muscles	Skeletal derivates	Derivates of pharyngeal pouch
external auditory meatus	I	mandibular	V	trigeminal	muscles of mastication etc.	malleus, incus, sphenomandibular lig., Meckel cart.
	II	hyoid	VII	facial	muscles of facial expression etc.	stapes, styl. proc., stylohyoid lig., part of hyoid cart.
neck	III	hyoid	IX	glossopharyng.	m. stylopharyngeus	parts of hyoid cart.
	IV	internal carotid artery	X	vagus	pharyngeal and laryngeal musculature	laryngeal cart.
		right subclavian artery, aorta				

I middle ear auditory tube

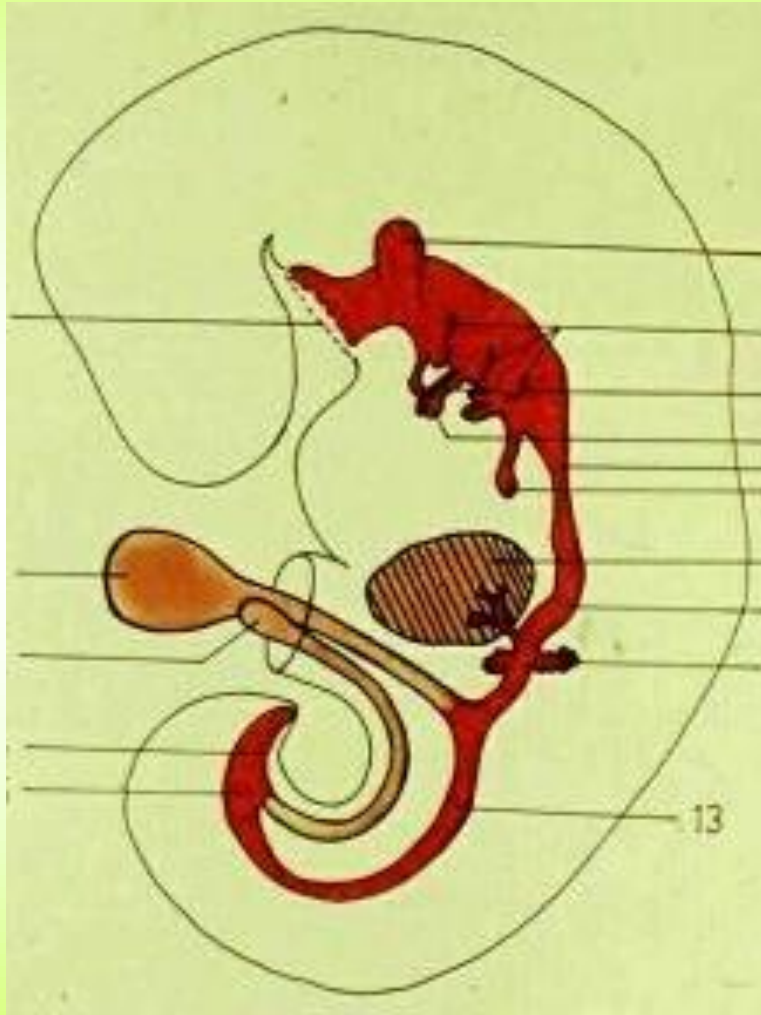
II supra-tonsillar fossa

III thymus, parathyr. gland

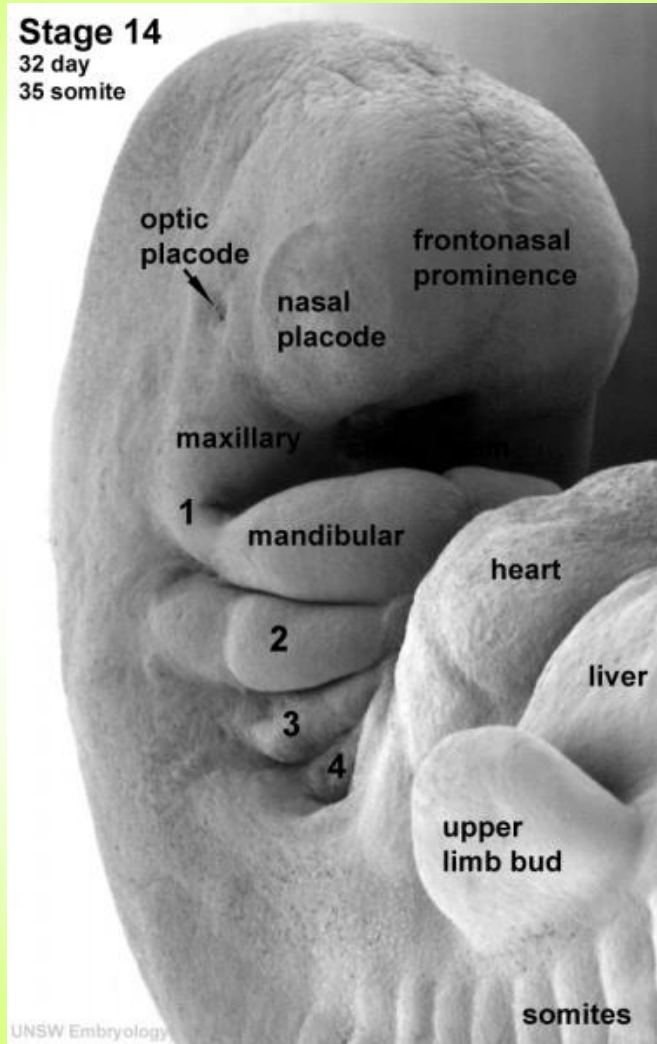
IV thymus parathyr. gland ultimobranch. body



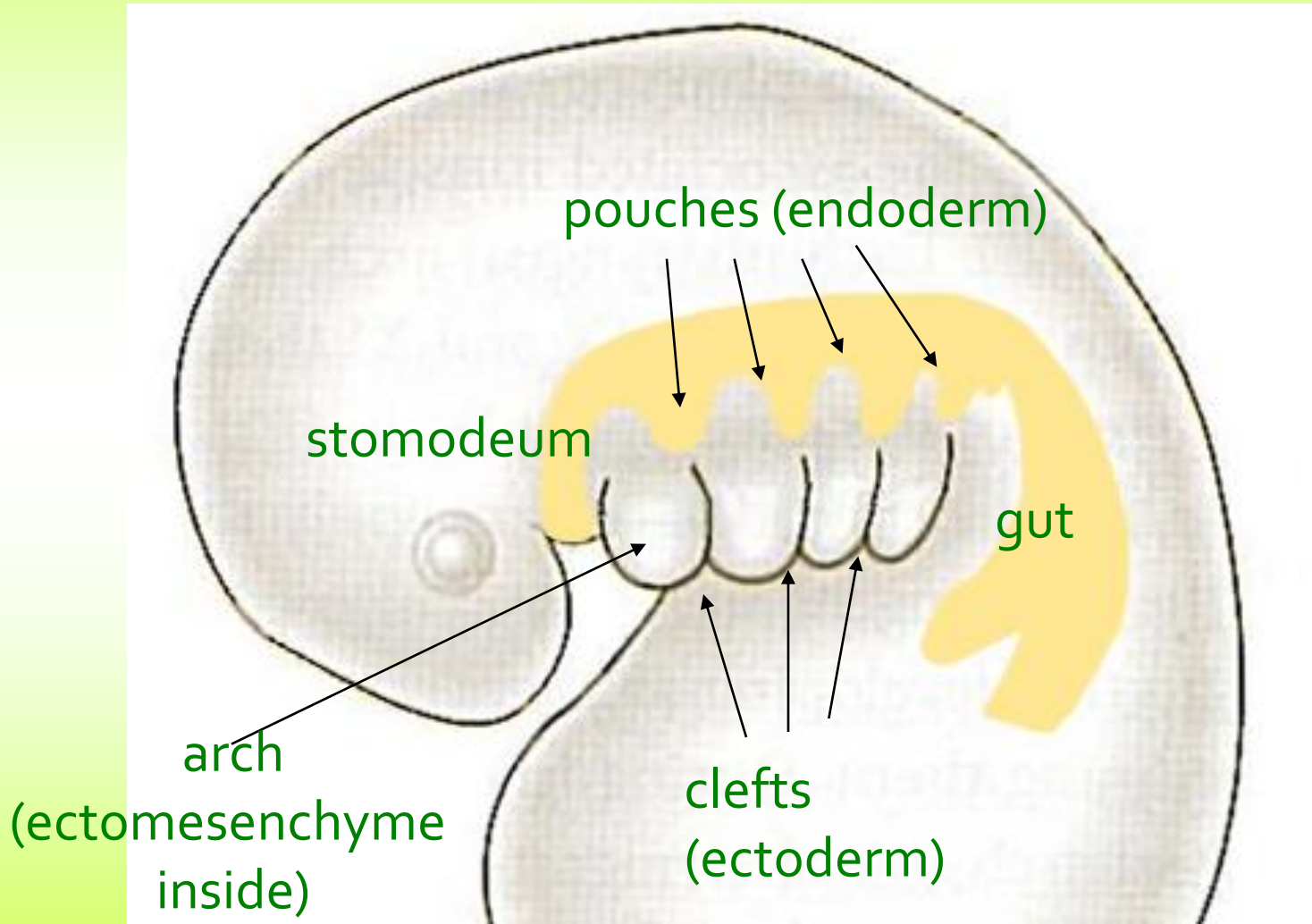
# PHARYNGEAL (BRANCHIAL) APPARATUS



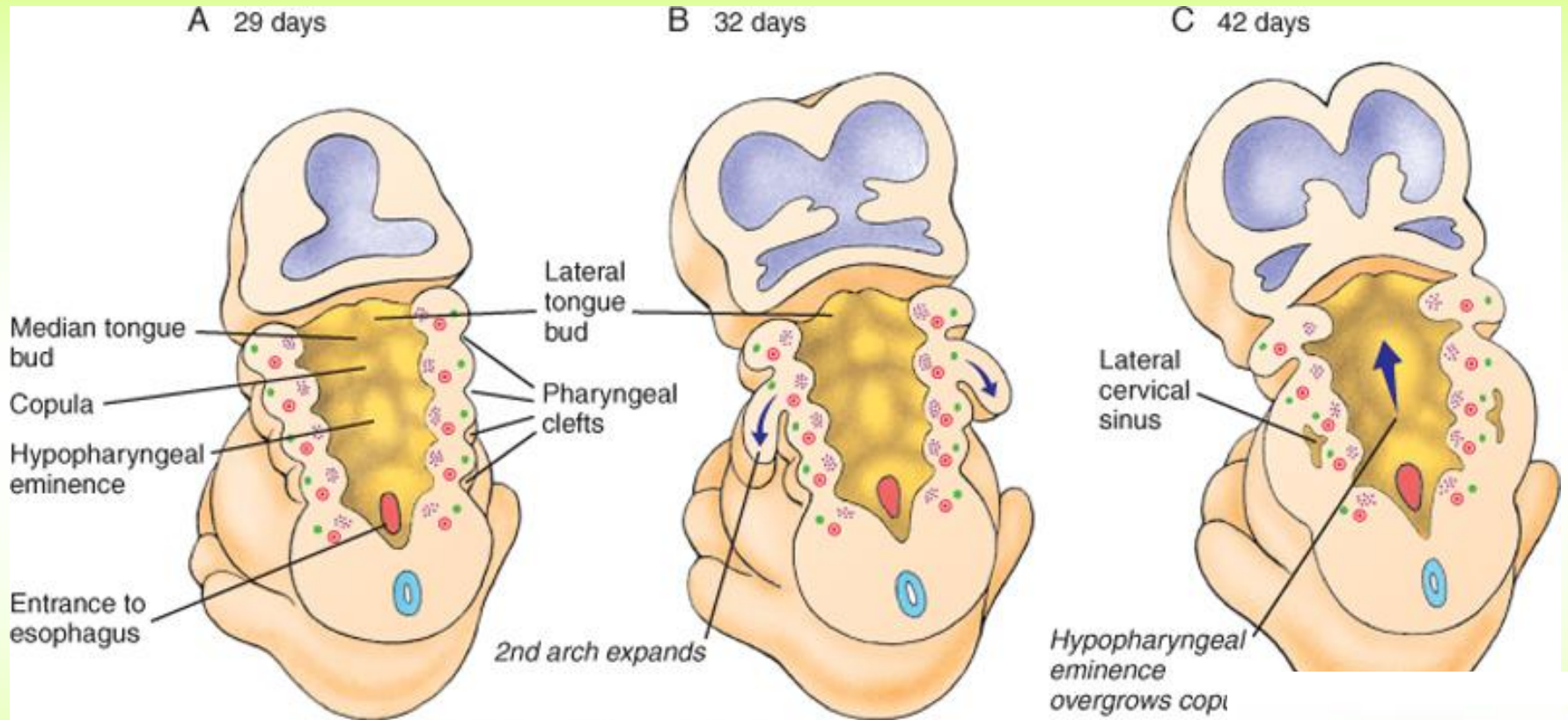
**Stage 14**  
32 day  
35 somite



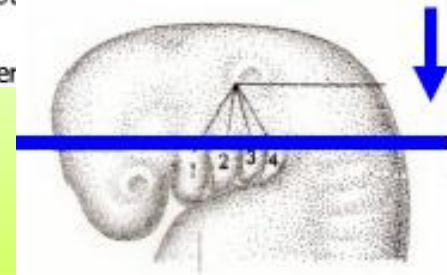
# 4TH WEEK DEVELOPMENT OF THE PHARYNGEAL ARCHES



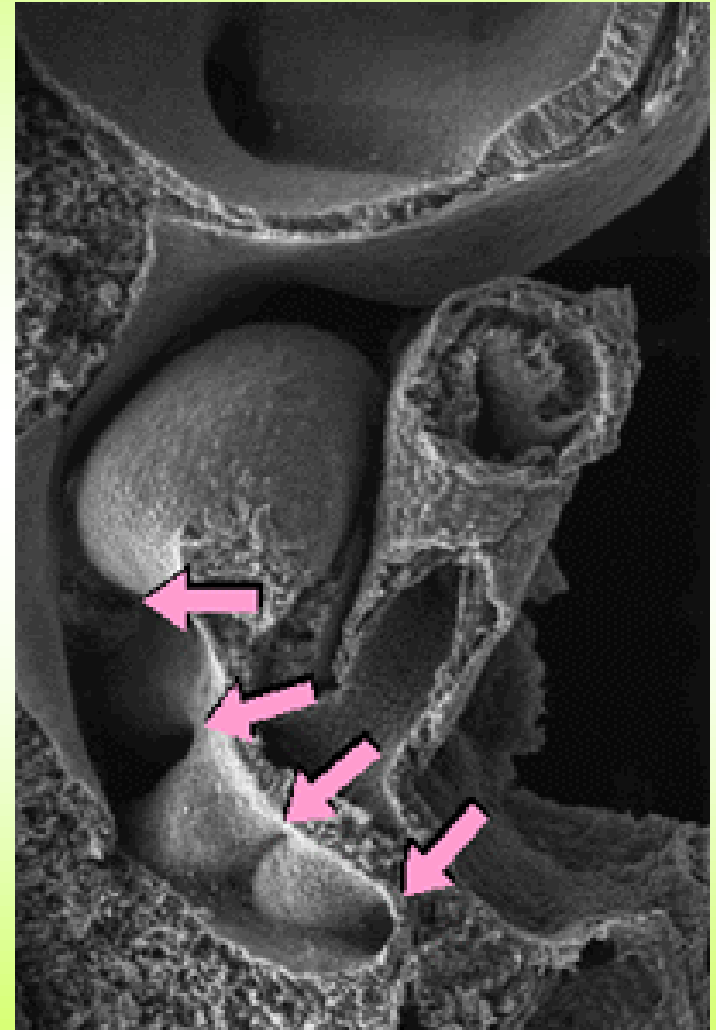
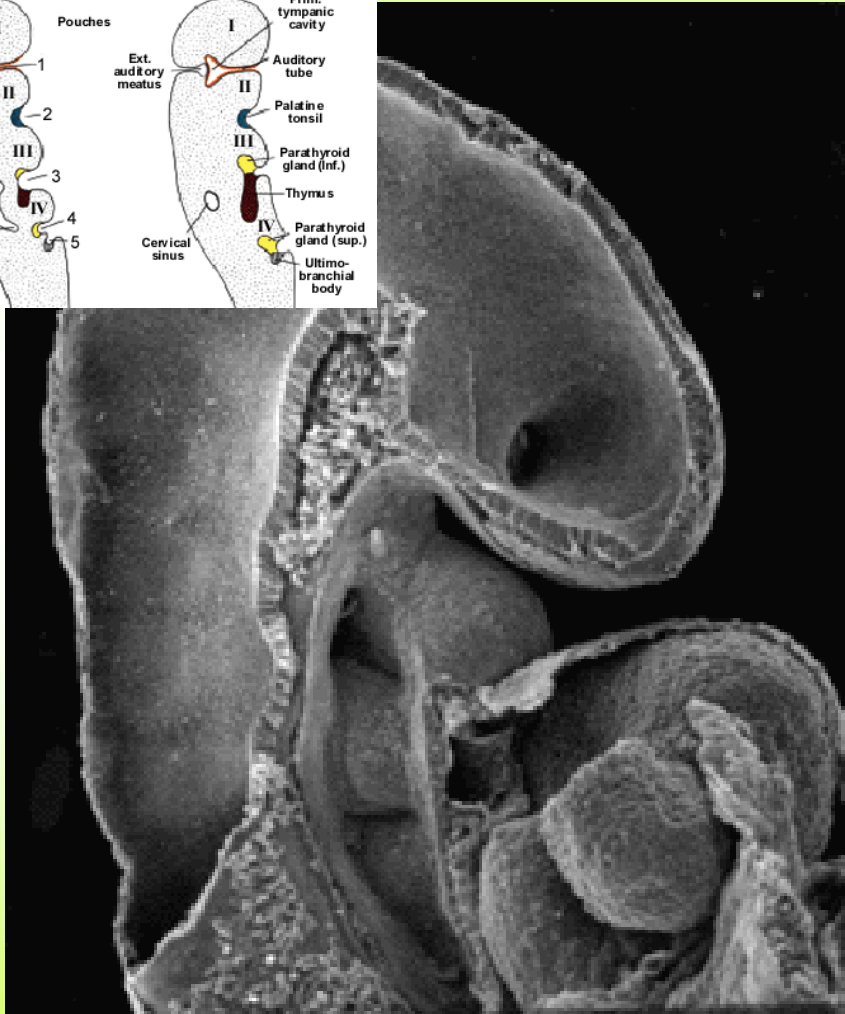
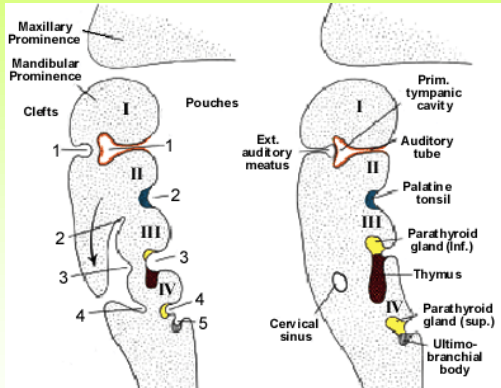
# PHARYNGEAL (BRANCHIAL) APPARATUS



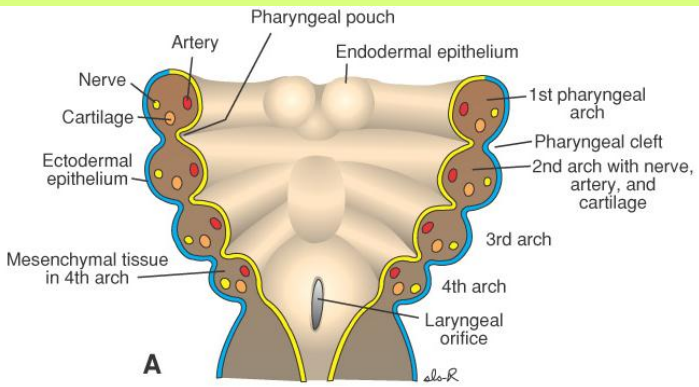
Schoenwolf et al: Larsen's Human Embryology, 4th Edition.  
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# SCANNING EM - PRIMITIVE PHARYNX 1.

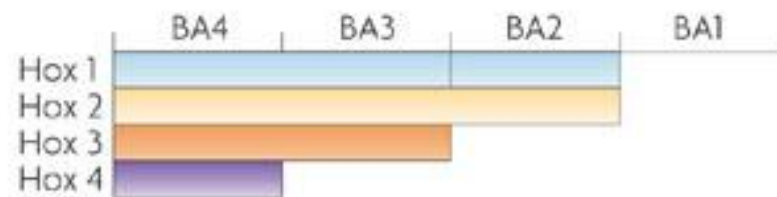
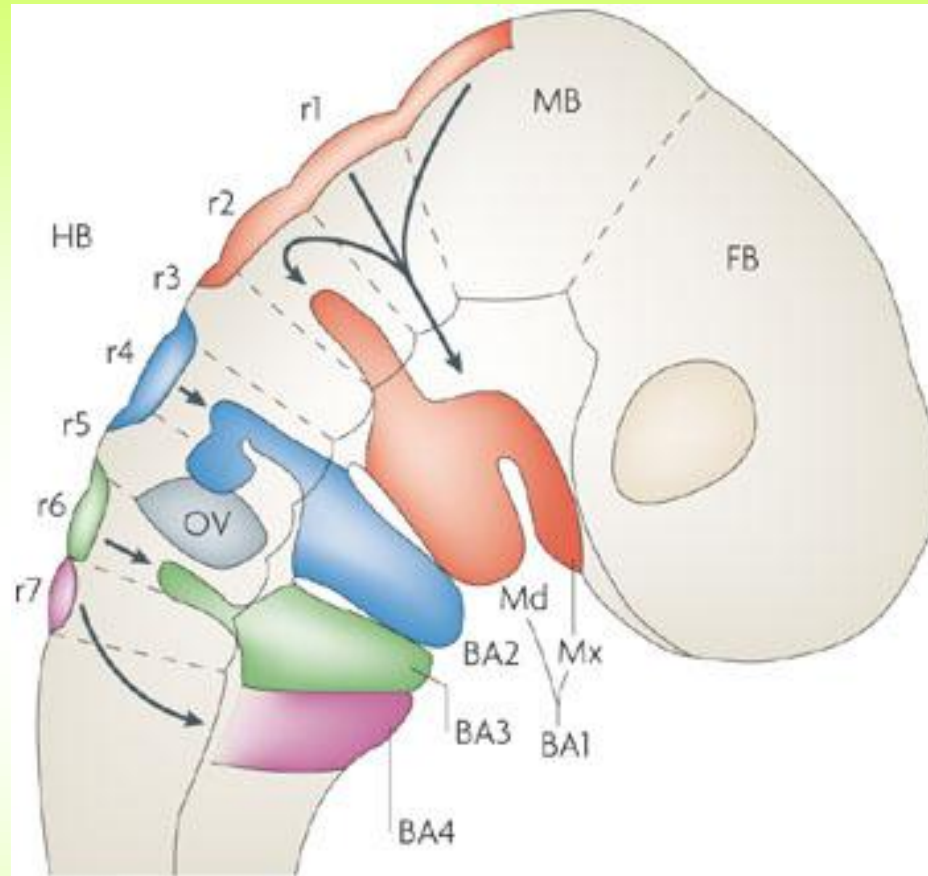


# SCANNING EM - PRIMITIVE PHARYNX 2.

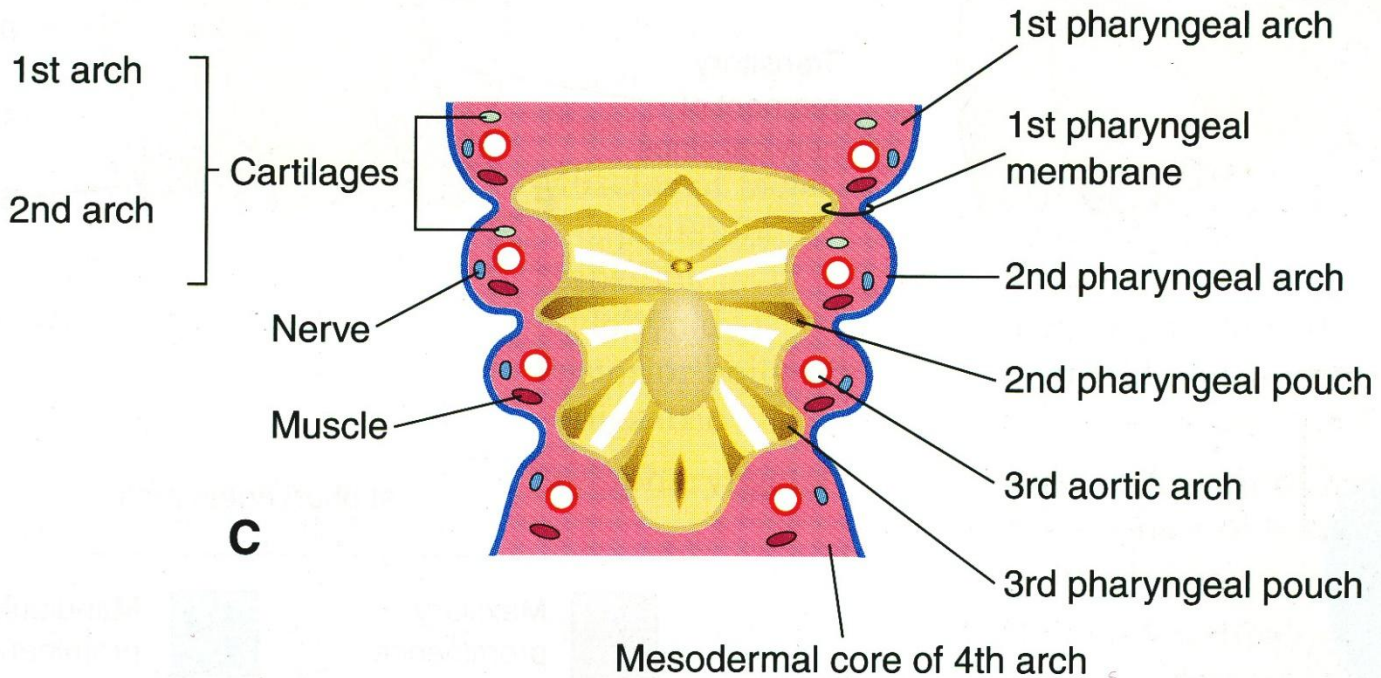


# PHARYNGEAL APPARATUS

# HOX genes



# PHARYNGEAL ARCHES, GROOVES AND PHARYNGEAL POUCHES



## Germ Layer Derivatives



Ectoderm

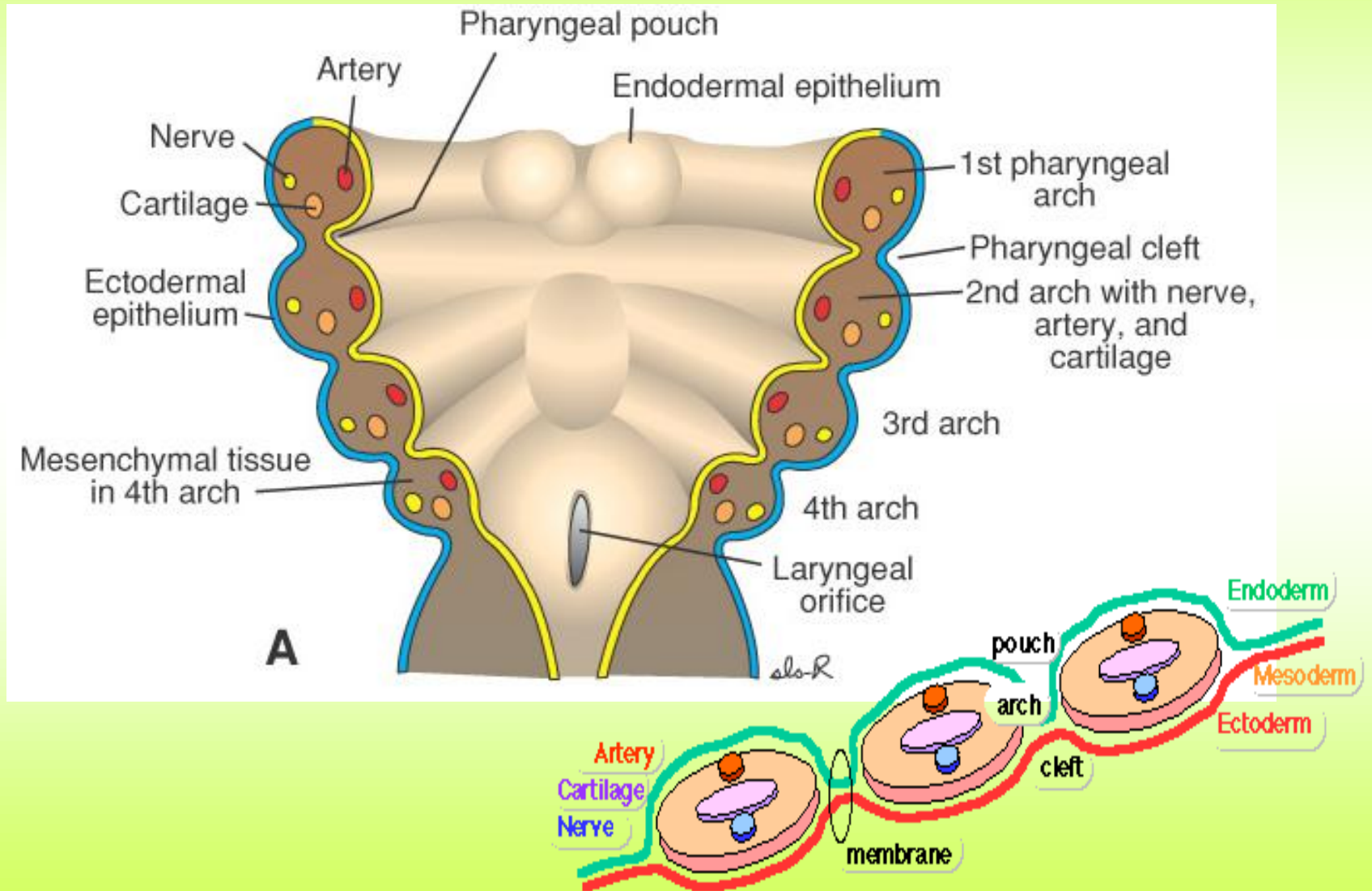


Endoderm



Mesoderm

# PHARYNGEAL ARCHES, FISSURES AND POUCHES





# PHARYNGEAL POUCHES 1.

## 1st fissure

external acoustic meatus

## 1st pouch

auditory tube, tympanic cavity

1st membrana obturans (tympanic membrane)

## 2nd pouch

palatine tonsil-to-be

## 3rd pouch

## 4th pouch

parathyroid-to-be

thymus primordium

## 5th pouch

ultimobranchial body

## 2nd - 3rd - 4th fissure

cervical sinus

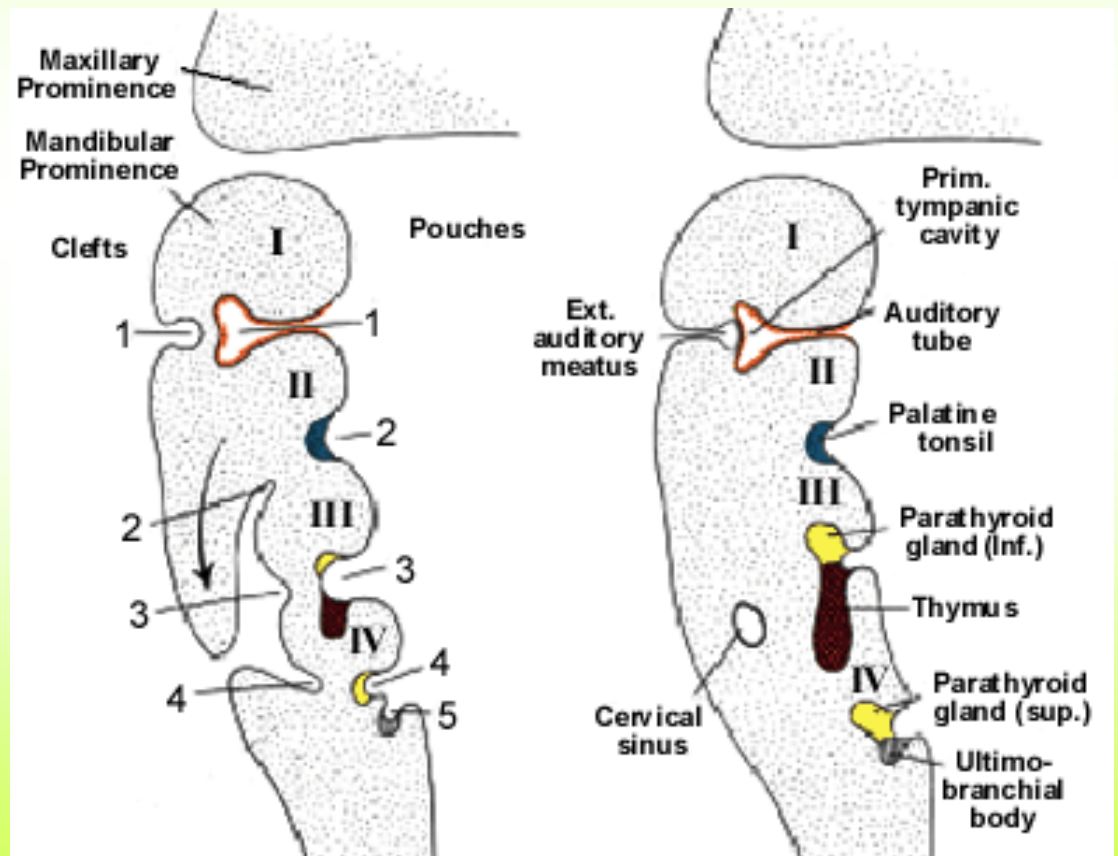
*tongue*

*Meckel cartilage*

*Reichert cartilage*

*trachea*

*oesophagus*



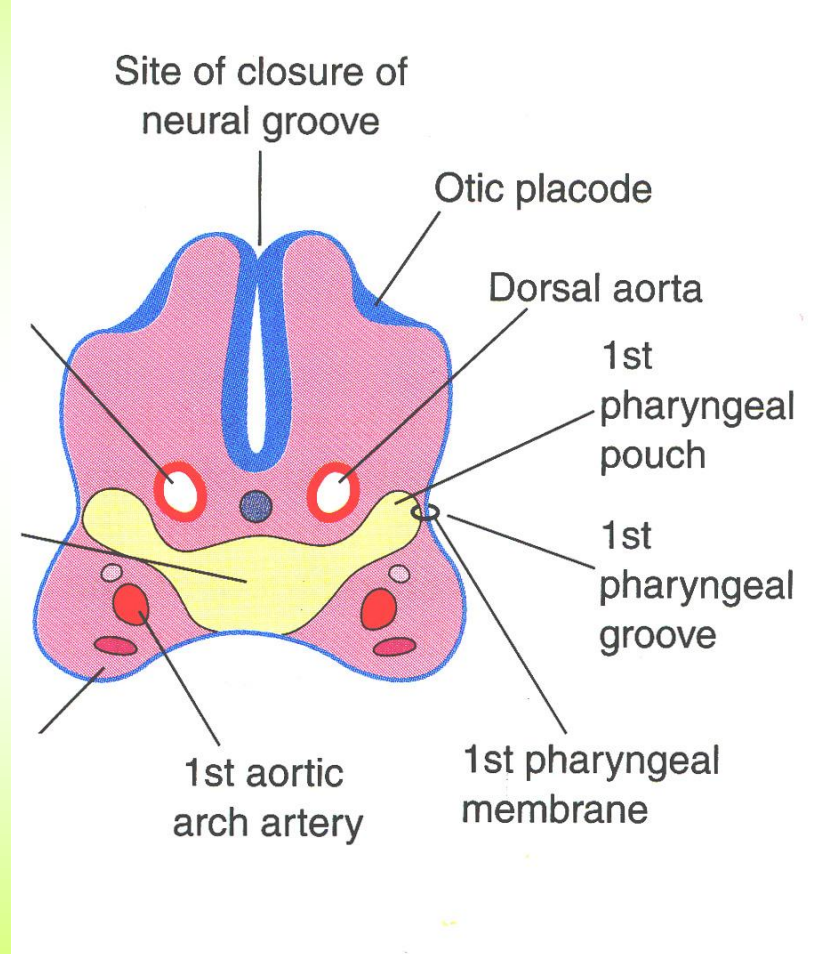
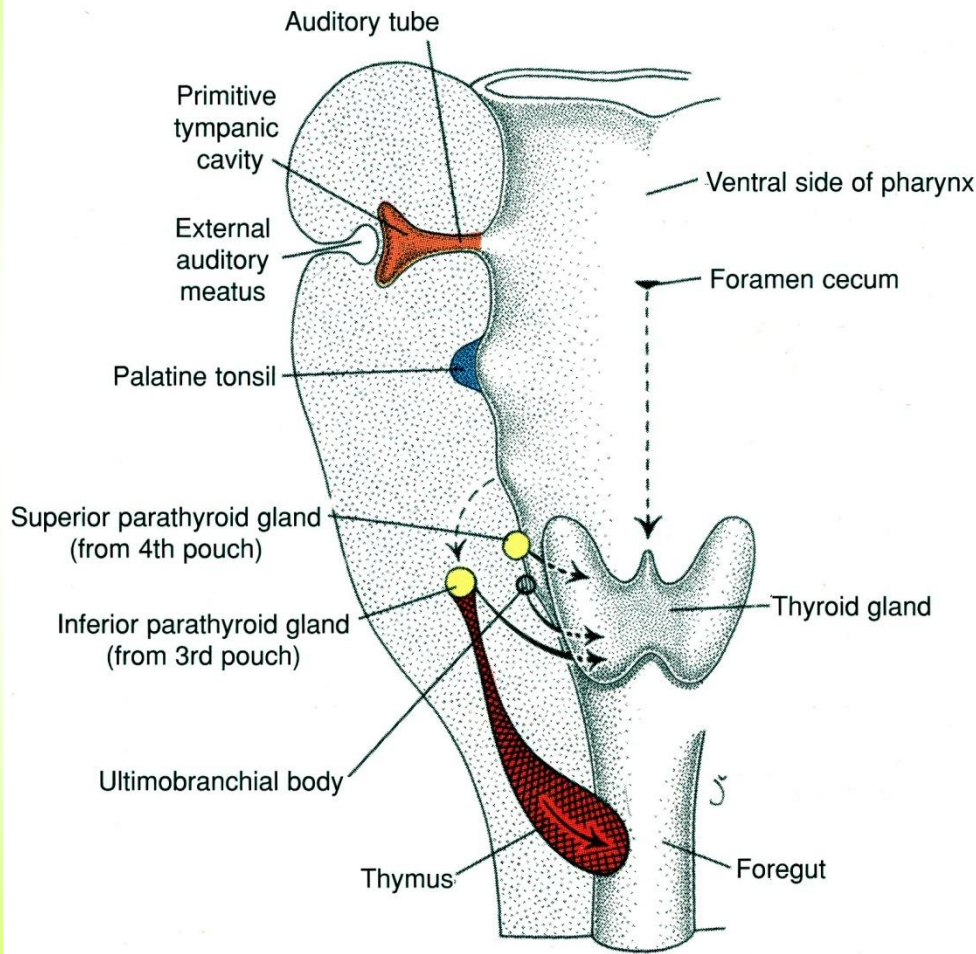
## Branchial Apparatus

*Made by: dr. Károly Altdorfer and dr. János Hanics - Semmelweis University Medical School - Department of Anatomy, Histology and Embryology, Budapest, 2009.*

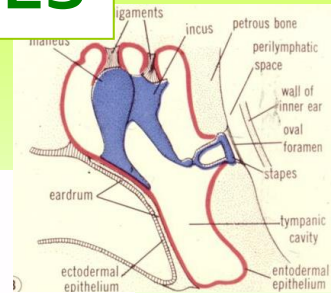
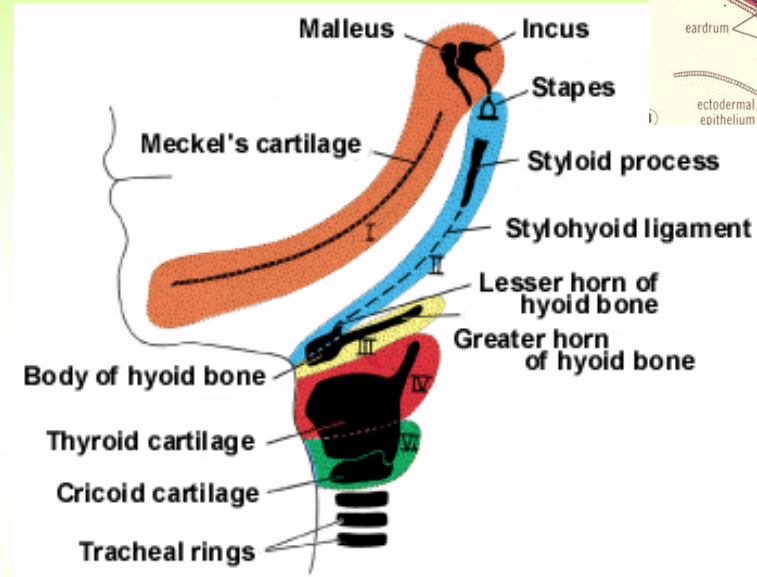
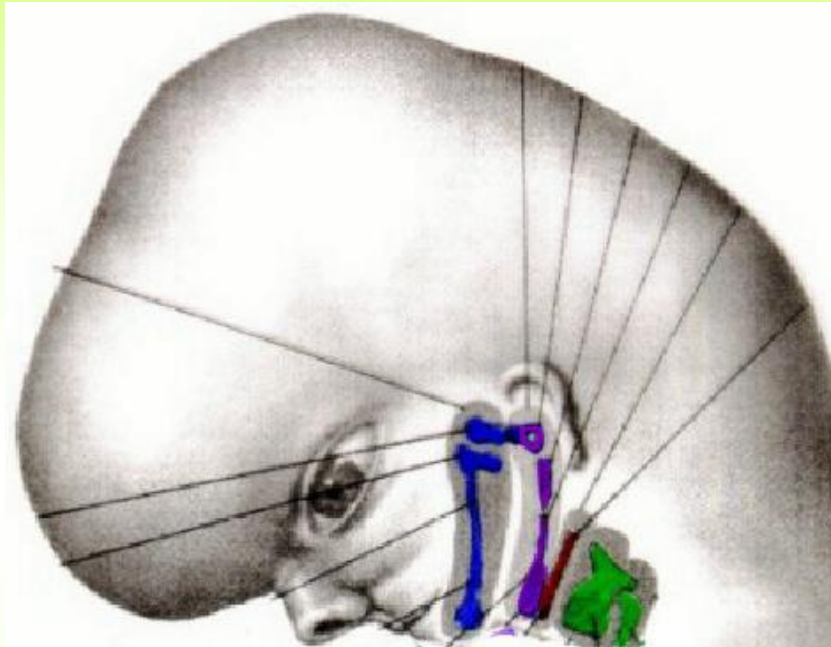
	Mesenchyme					Ectoderm		Endoderm
	Artery	Cartilage <sup>1</sup>	Bone <sup>1</sup>	Ligament <sup>1</sup>	Muscle <sup>2</sup>	Nerve		
Pharyngeal arch							Clefts	Pouches
I. (mandibular)	(Maxillary artery)	Meckel's (as model for mandible)	Mandible (intramembranous ossification); Malleus; Incus; (*)	Sphenomandibular lig.; Ant. lig. of malleus	Mm. of mastication; Tensor tympani; Tensor veli palatini; Mylohyoid; Digastric ant. belly;	Mandibular nerve (V/3.)		
							C1: External ac. meatus; ext. epithelium of tympanic membrane	P1: Auditory tube; Tympanic cavity; Int. epithelium of tympanic membrane
II. (hyoid)	(Stapedial artery; Hyoid artery)	Reichert's	Stapes; Styloid process; Hyoid (lesser horn and upper part of body)	Stylohyoid lig.	Muscles of facial expression; Stylohyoid; Digastric post. belly; Stapedius; Platysma (from Opercular proc.)	Facial nerve (VII.)		
							C2: (Cervical sinus)	P2: Epithelium of tonsillar fossa
III.	Internal carotid (prox. part)		Hyoid (greater horn and lower part of body)		Pharynx (upper part); Stylopharyngeus	Glossopharyngeal nerve (IX.)		
							C3: (Cervical sinus; Cervical vesicula)	P3: (Thymus) Inferior parathyroid glands
IV.	Left: Arch of aorta; Right: Right subclavian artery (prox. part)	Thyroid cartilage			Pharynx (lower part); Larynx: cricothyroid	Vagus nerve (X.) (Superior laryngeal nerve)		
							C4: (Cervical sinus)	P4: Thymus; Superior parathyroid glands
V. (**)		Thyroid cartilage			Pharynx and larynx muscles (n. XI.: arytenoid)	Vagus nerve (X.) + Accessory nerve (XI.)		
								P5: Ultimobranchial body, C-cells in thyroid gland
VI.	Right: Right pulmonary artery; Left: Left pulmonary artery and ductus art. Botalli	Cricoid cartilage (?)			Larynx muscles ('Intrinsic')	Vagus nerve (X.) (Recurent laryngeal nerve)		

1: derivatives of neural crest (ecto-mesenchyme); 2: derivatives of paraxial mesoderm or somite (mesoderm); (\*) partially forms the maxilla (from the maxillary process of the first pharyngeal arch); (\*\*) Some authors don't give derivatives for fifth pharyngeal arch but mention them at the sixth pharyngeal arch.

# PHARYNGEAL POUCHES 2.



# PHARYNGEAL ARCHES - CARTILAGES



## I First (Mandibular)

### Arch -

1. Malleus
2. Incus
3. Ant. Ligament Of malleus
4. Sphenomandibular ligament

## II Second (Hyoid) Arch

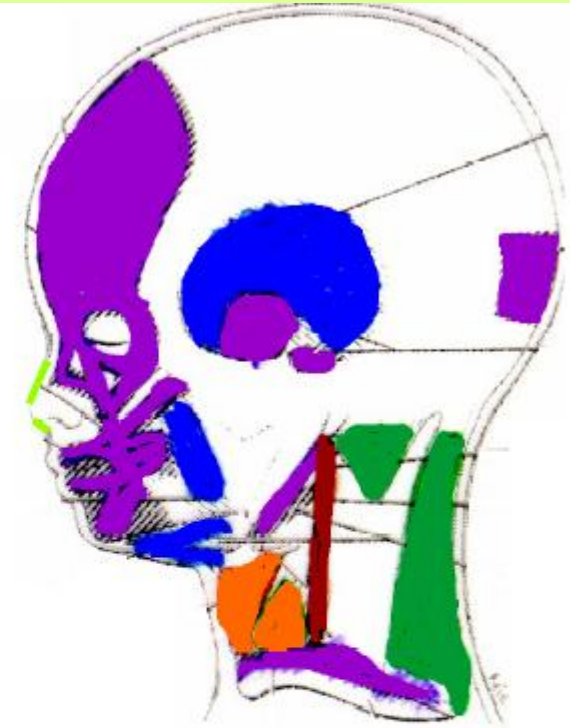
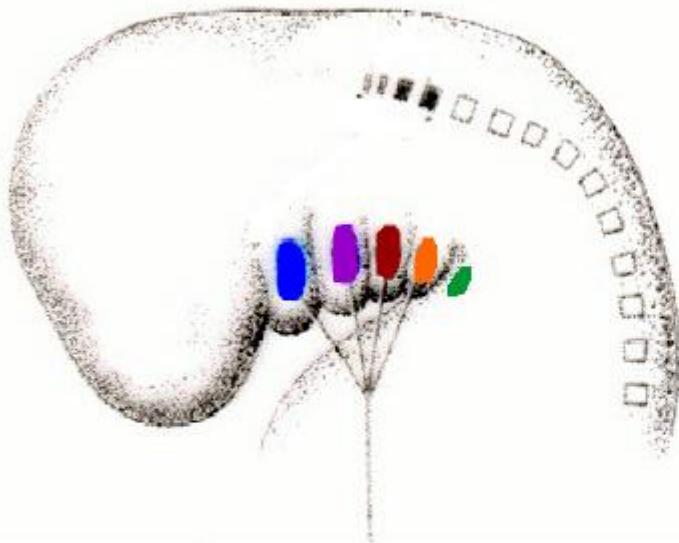
1. Stapes
2. Styloid Process
3. Stylohyoid Ligament
4. Lesser horn, Upper 1/2 body Hyoid

## III Third Arch -

- Lower 1/2  
Body, Greater  
Horn Of hyoid

## IV Fourth (Sixth) Arch - Cartilages Of larynx

# PHARYNGEAL ARCHES - MUSCLES



Innervated by

**First -**  
**Trigeminal**  
**V**

**Second -**  
**Facial**  
**VII**

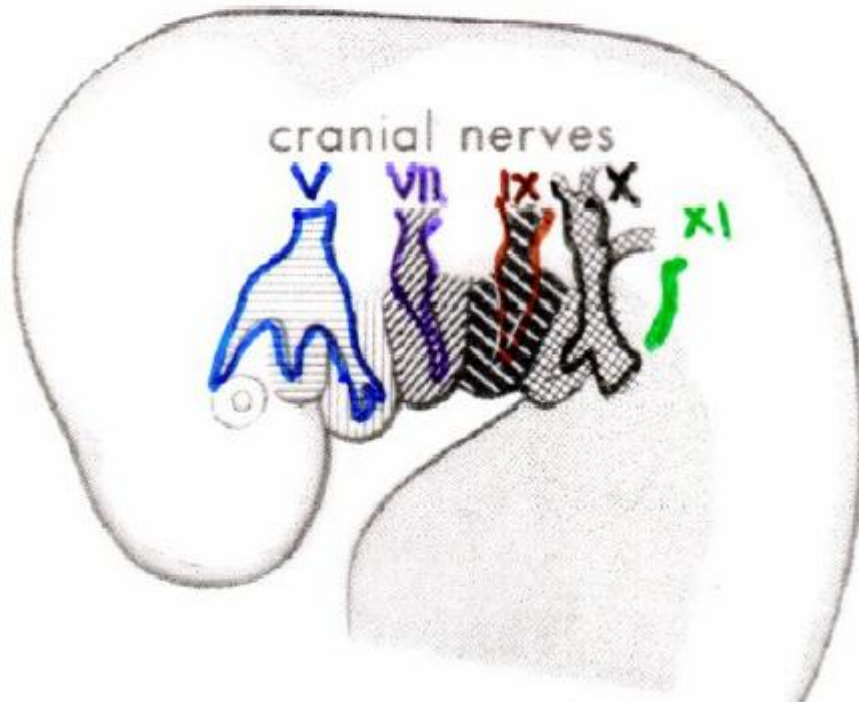
**Third**  
**Glosso-**  
**pharyngeal**  
**IX**

**Fourth**  
**Vagus**  
**X**

**Sixth**  
**Accessory**  
**XI**

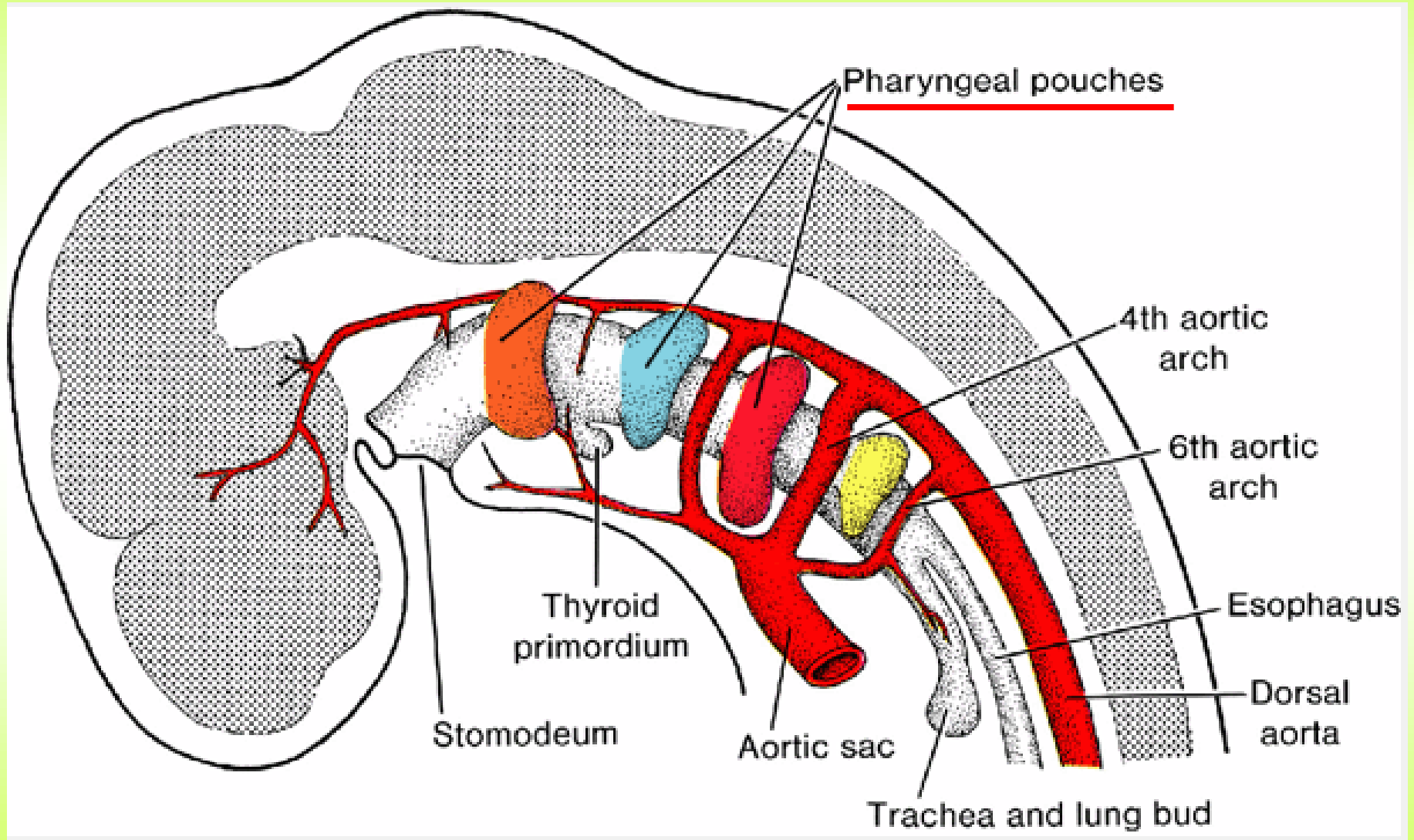
# PHARYNGEAL ARCHES - NERVES

**Muscles of Arches are innervated by Cranial Nerves**

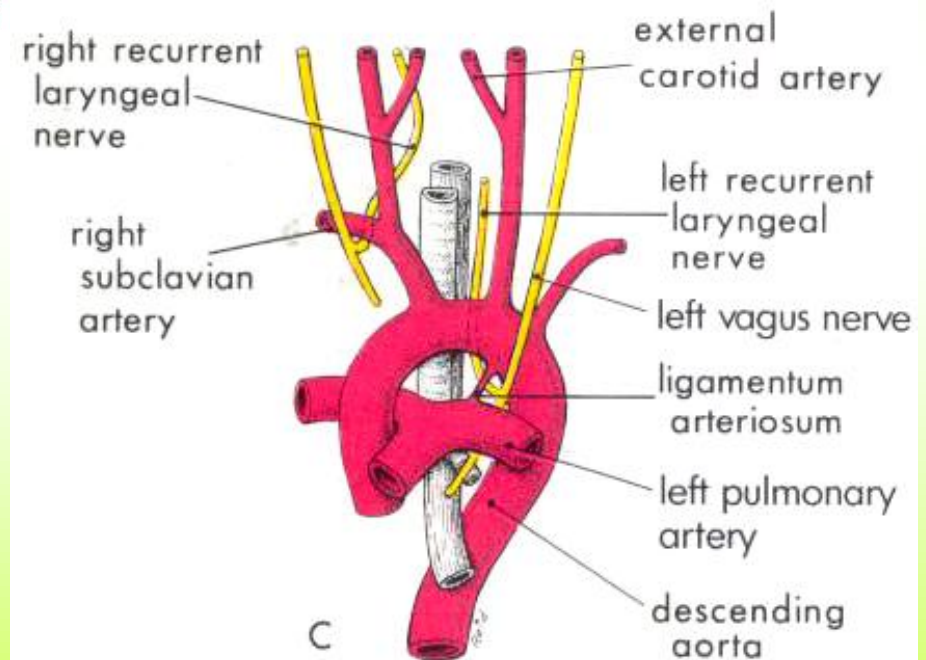
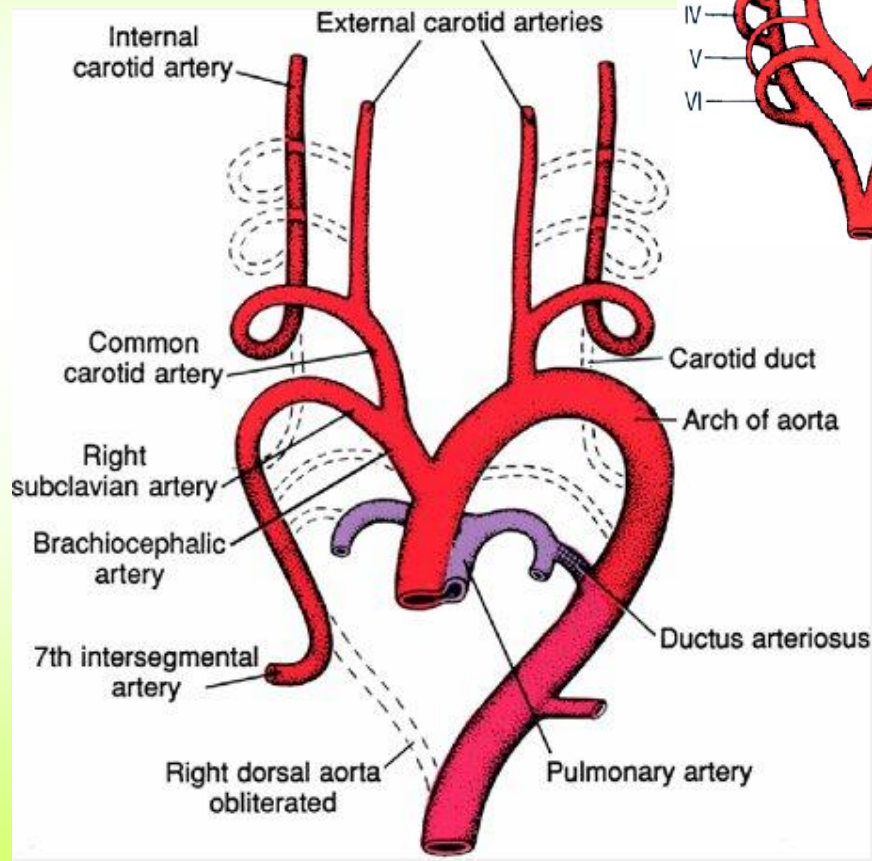
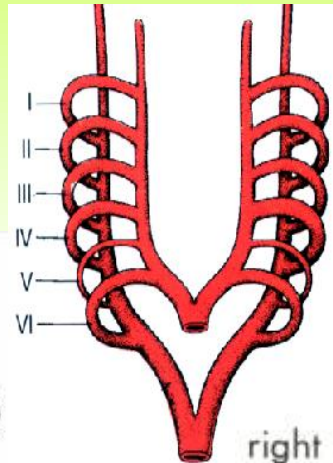


- 1) **First Arch – Trigeminal (V)**
- 2) **Second Arch – Facial (VII)**
- 3) **Third Arch – Glossopharyngeal (IX)**
- 4) **Fourth Arch – Vagus (X)**
- 5) **Caudal Sixth – Accessory (XI)**

# SEGMENTAL AORTIC ARCHES



# DERIVATIVES OF THE AORTIC ARCHES





# DEVELOPMENT OF THE TONGUE

## Anterior 2/3

End of 4th week - 3 protrusions emerge in the floor of the primitive pharynx  
Derive from the mesenchyme of the 1st cartilage

**PAIRED LATERAL TUBERCLE**  
**TUBERCULUM IMPAR**

The lateral tubercles grow over the tub. impar and fuse in the midline  
(*median lingual sulcus*)

## POSTERIOR 1/3

Derives from the mesenchyme of the 1st cartilage

**COPULA**

from the 2nd branchial arch (ventromedial part)

**HYPOBRANCHIAL EMINENCE**

from the 3-4th arch (ventromedial part)

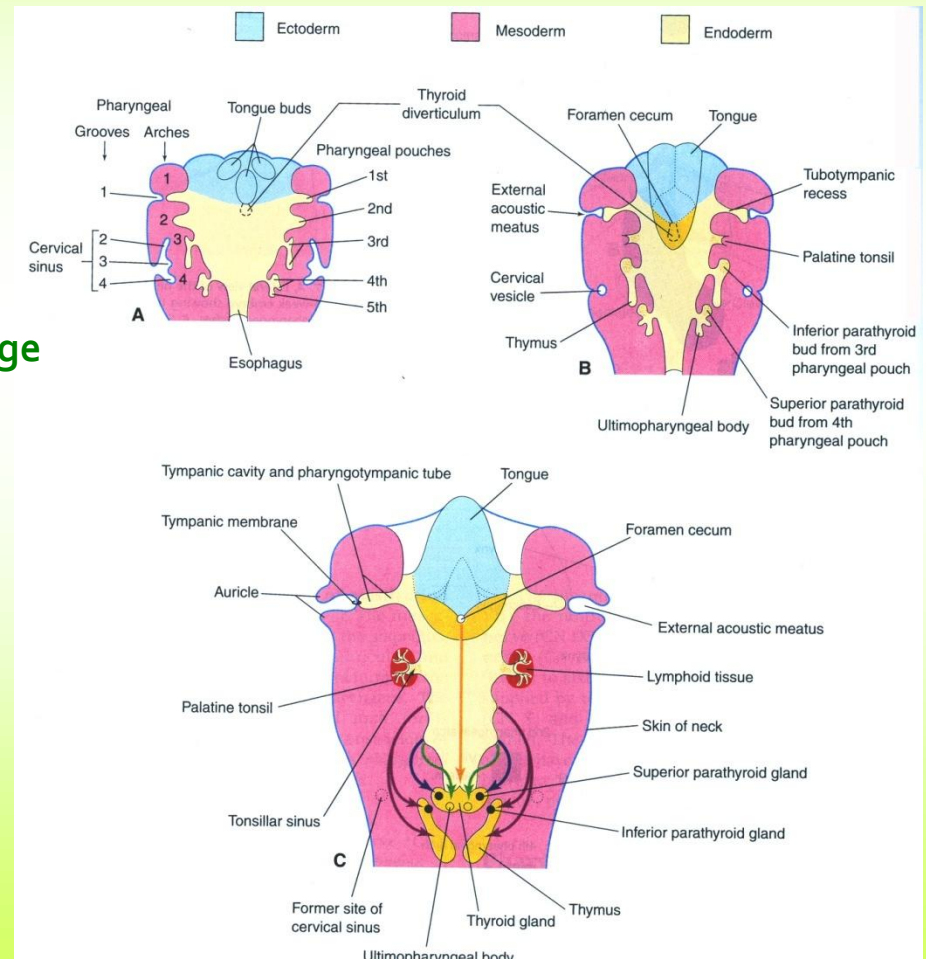
## Lingual epithelium

anterior 2/3                      ectoderm  
posterior 1/3                      endoderm

## Extrinsic/intrinsic muscles

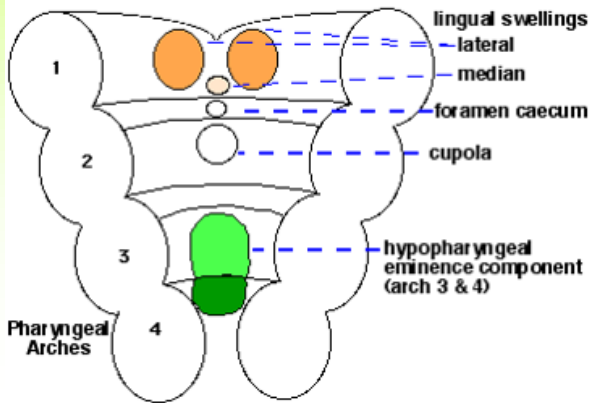
occipital myotomes (CN 12)

**CONNECTIVE  
TISSUE**

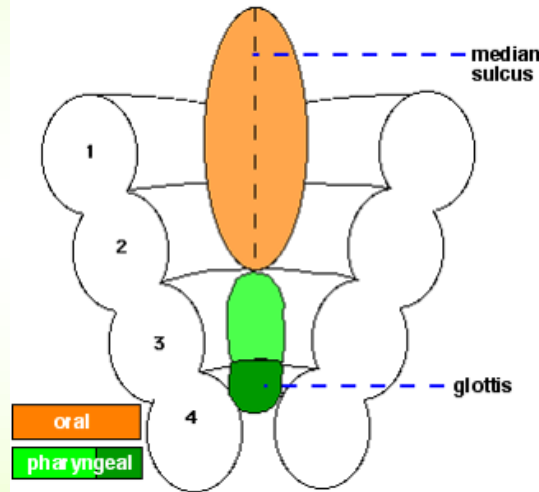


# DEVELOPMENT OF THE TONGUE

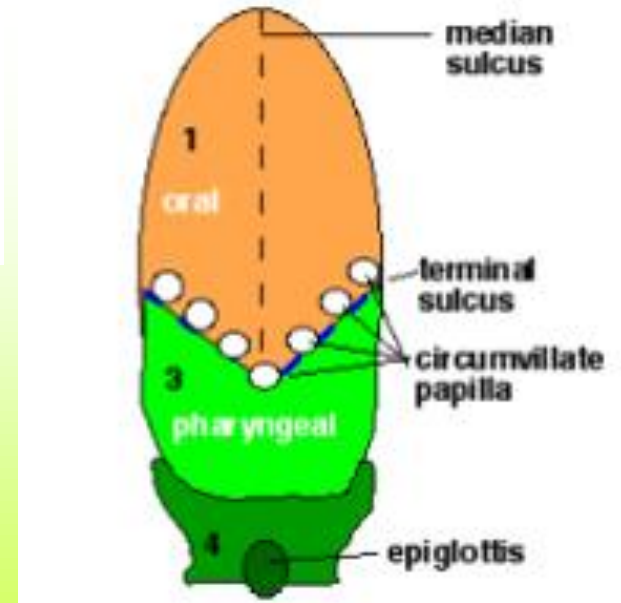
Development of the Tongue (part 1)



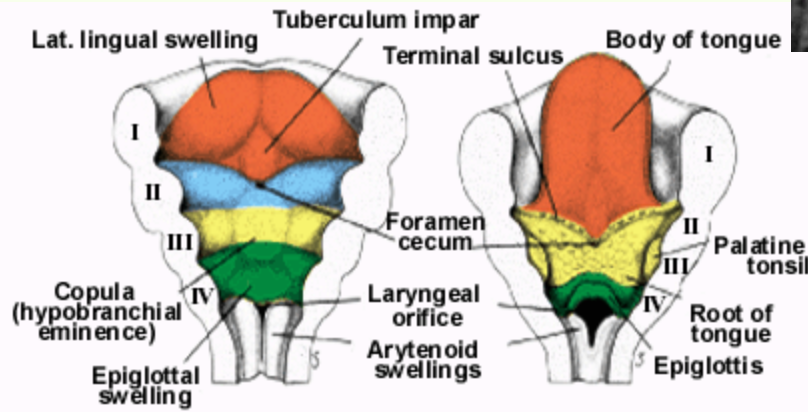
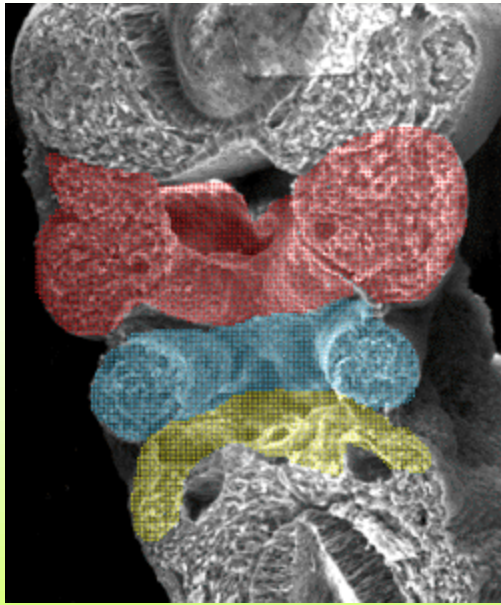
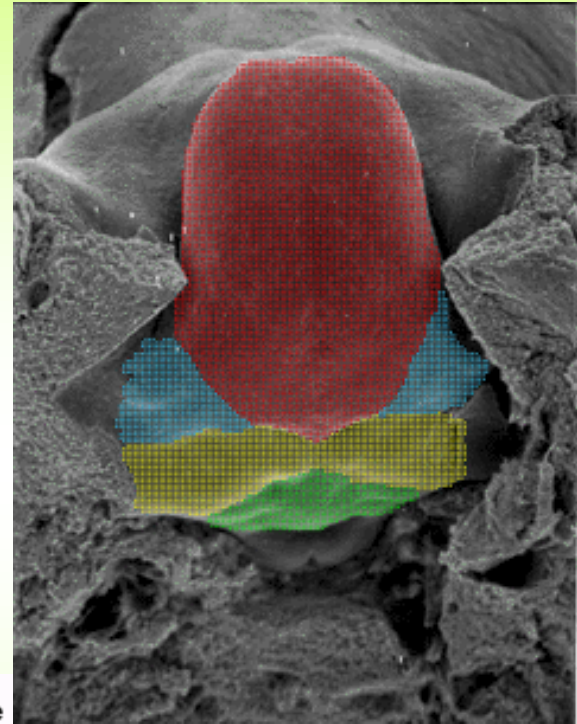
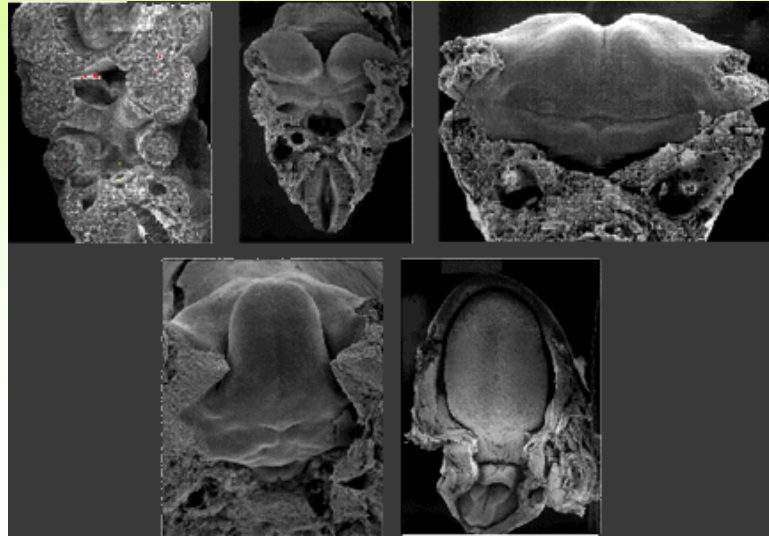
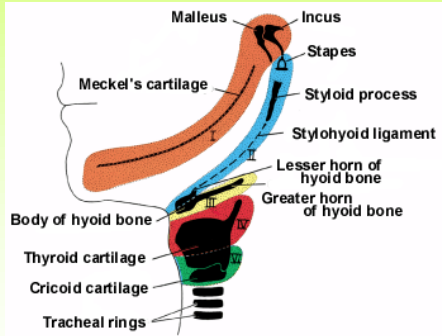
Development of the Tongue (part 2)



Development of the Tongue (part 3)



# SCANNING EM - LINGUAL PRIMORDIA

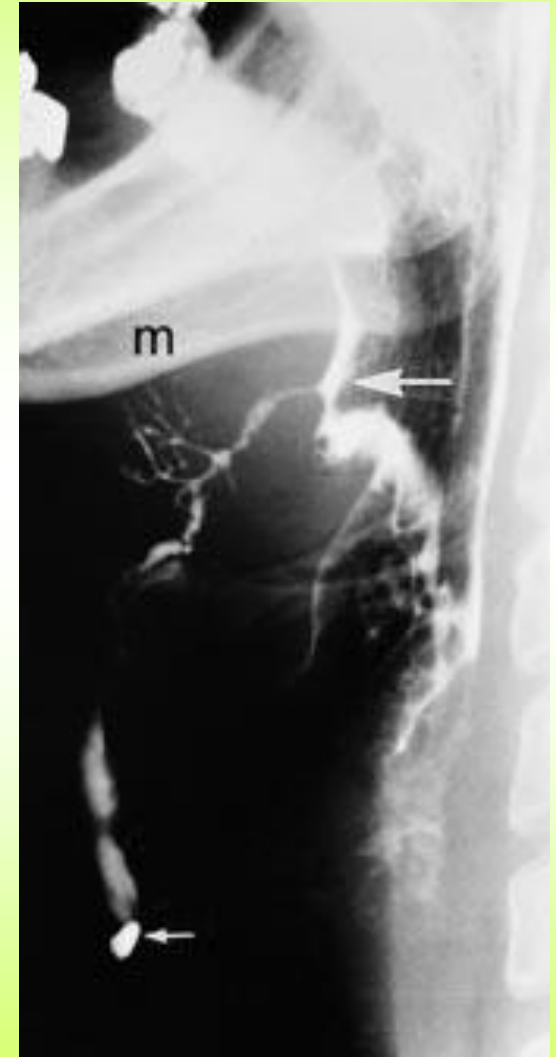
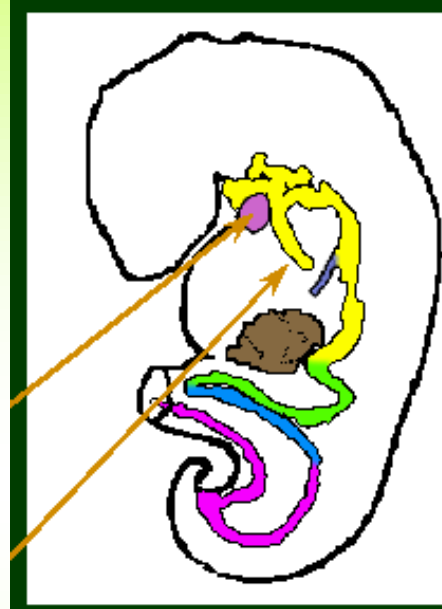


# SUMMARY TABLE OF THE LINGUAL DIVISIONS & NERVES

Tongue Primordia	Pharyngeal Arch	Cranial Nerve	Derivatives
Tuberculum impar & lateral lingual swellings	1 <sup>st</sup> arch	CN 5/3	<b>Connective tissue</b> of tongue <i>carrying</i> CN 5/3 ( <i>lingual nerve, general sensation</i> ) + <i>Mucosa of anterior 2/3 of tongue lies above this part (ECTODERM!)</i>
	2 <sup>nd</sup> arch	CN 7 (chorda tympani)	<b>Connective tissue</b> of tongue <i>carrying</i> CN 7 ( <i>chorda tympani</i> ) taste - anterior 2/3 of tongue
Copula and hypopharyngeal (hypobranchial) eminence	3 <sup>rd</sup> and 4 <sup>th</sup> arches	CN 9 and CN 10	<b>Connective tissue</b> of the tongue <i>General sensation and taste in the posterior 1/3 of tongue (CN9)</i> <i>General sensation and taste at the epiglottis (CN10)</i> + <i>Mucosa of posterior 1/3 of tongue lies above this part (ENDODERM!)</i>
Occipital somites		CN 12	all intrinsic tongue muscles; all extrinsic tongue muscles (except for palatoglossus)

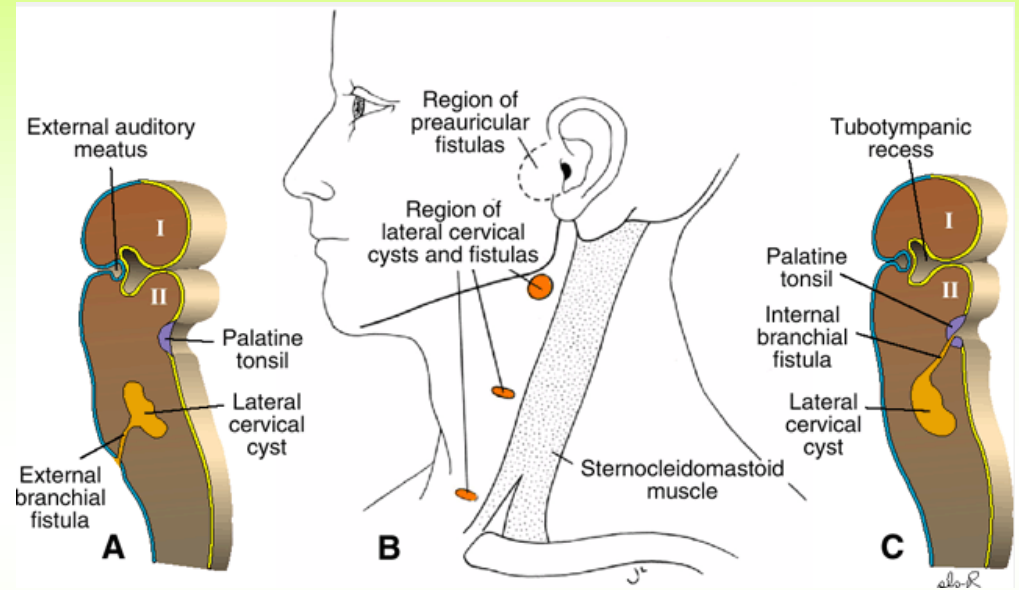
# DEVELOPMENTAL MALFORMATIONS 1.

*Ductus thyreoglossus* - a duct penetrates the mesenchyme from the foramen cecum, which by bifurcating forms the 2 lobes of the thyroid gland. In case the lumen of the duct does not disappear (*ductus thyreoglossus persistens*) it may contribute to the formation of median cervical cysts. They often form fistules too.



# DEVELOPMENTAL MALFORMATIONS 2.

*IF the cervical sinus persists* -  
fistules and/or cysts may be produced.  
They will open along the sternocleidomastoid muscle.



# FISTULIZATION

