# THE BRANCHIAL APPARATUS

AND

# DEVELOPMENT OF THE TONGUE


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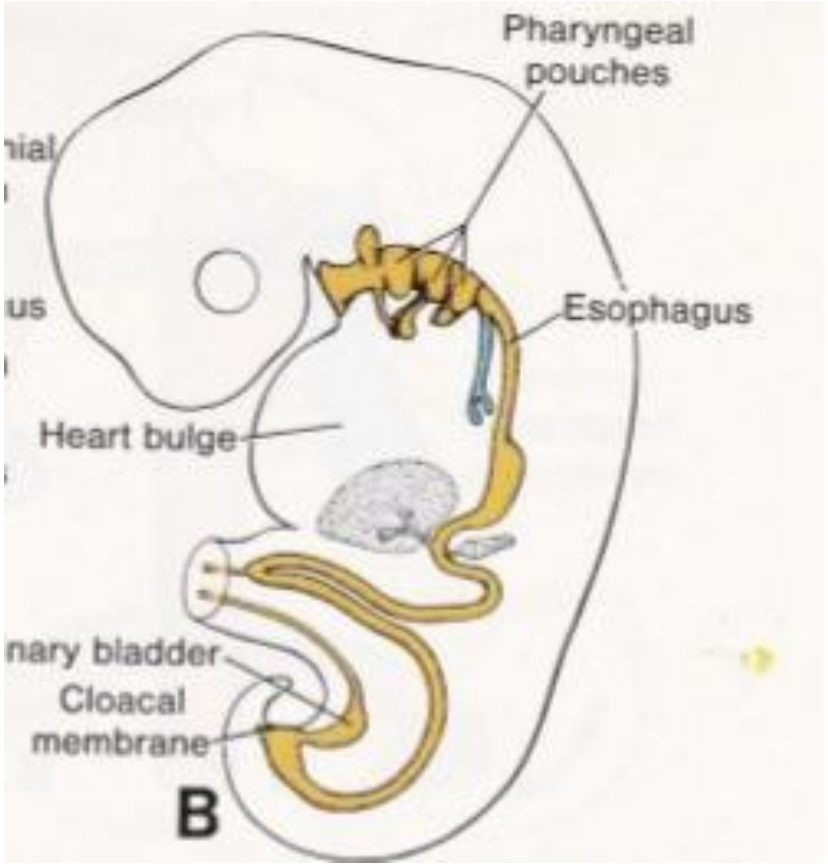
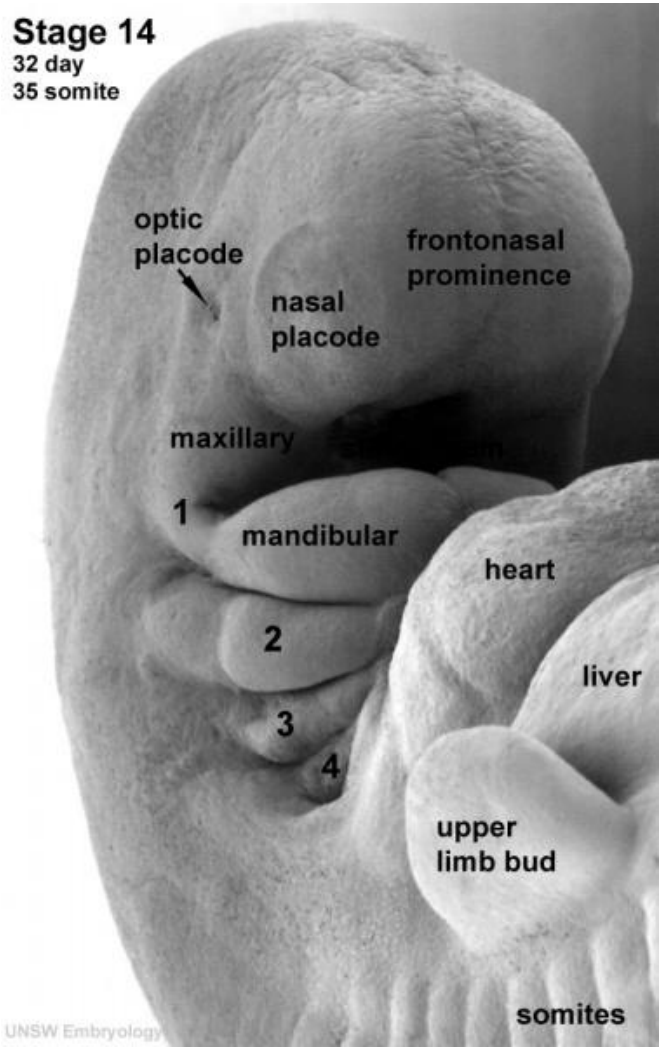
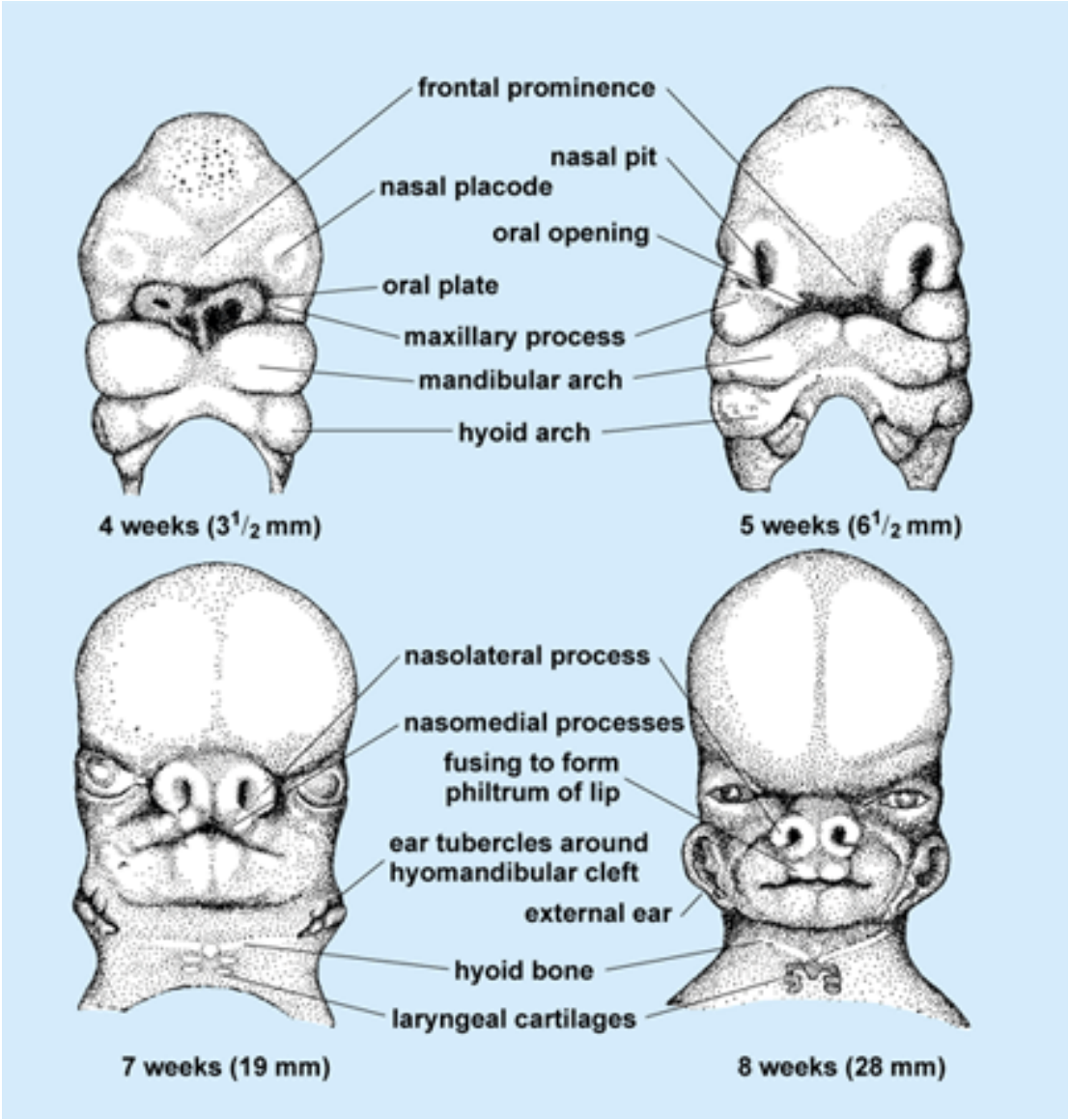
# THE PHARYNGEAL (BRANCHIAL) APPARATUS

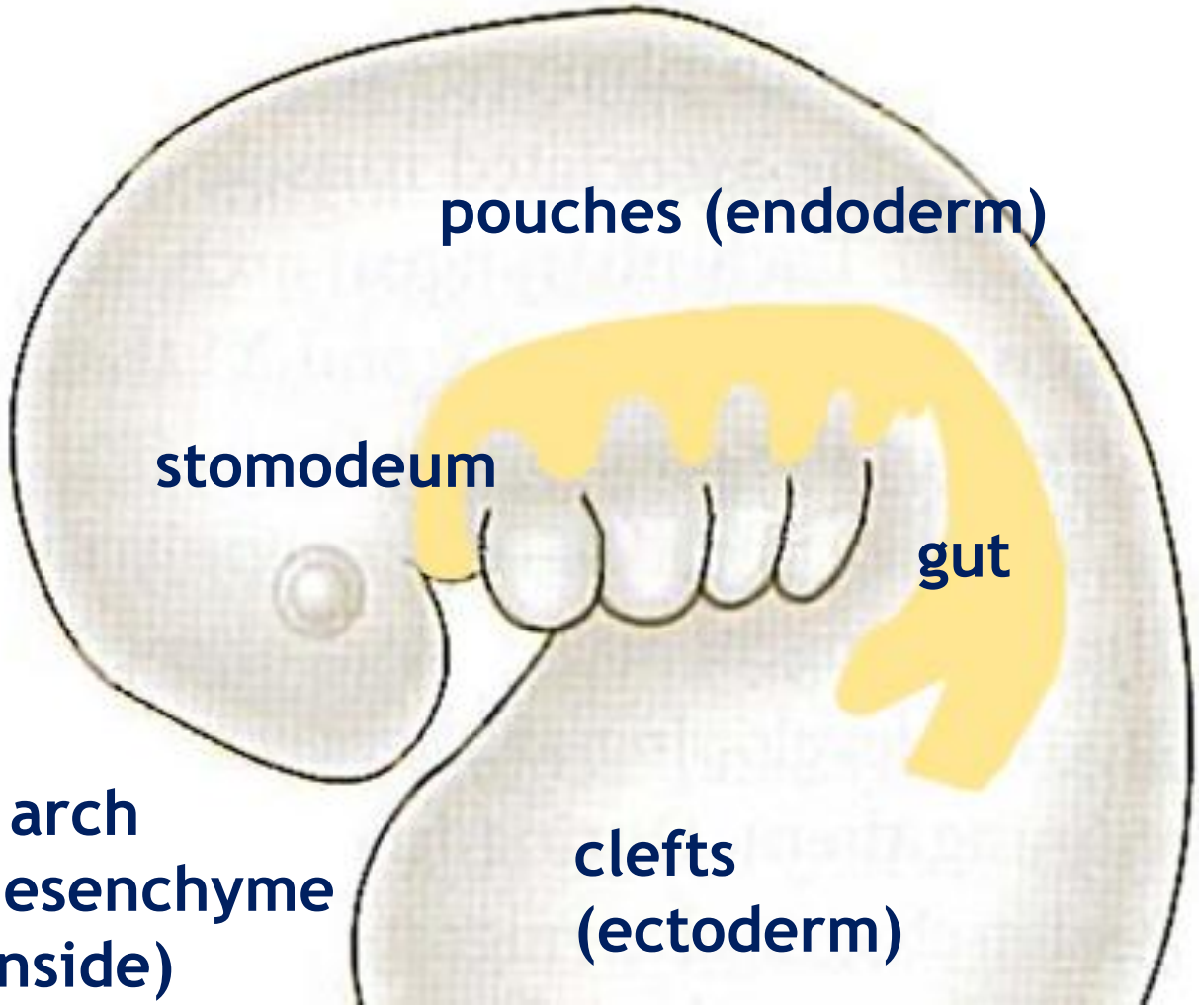


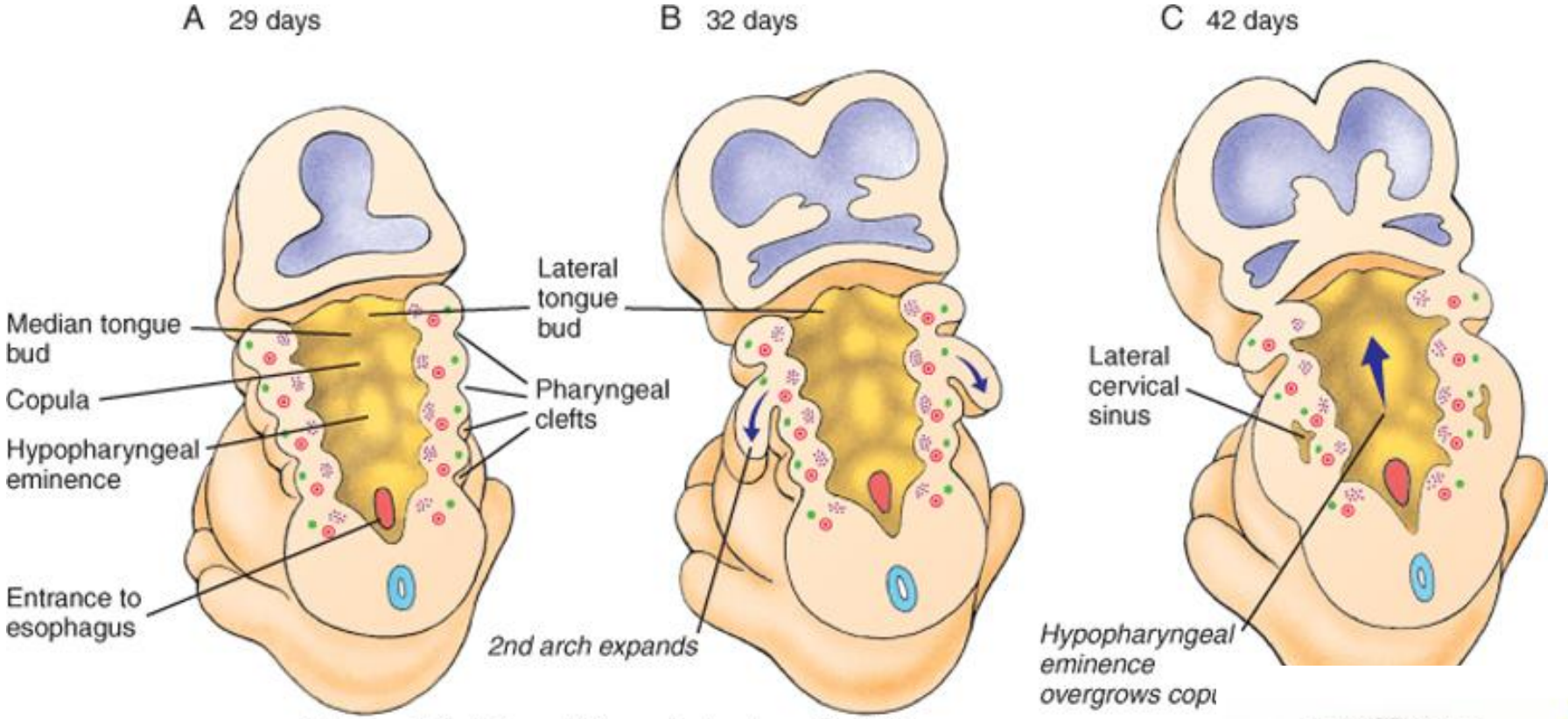
# DEVELOPMENT OF THE HEAD AND NECK



# PHARYNGEAL (BRANCHIAL) STRUCTURES



# THE BRANCHIAL APPARATUS

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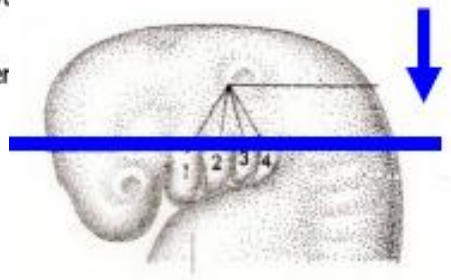
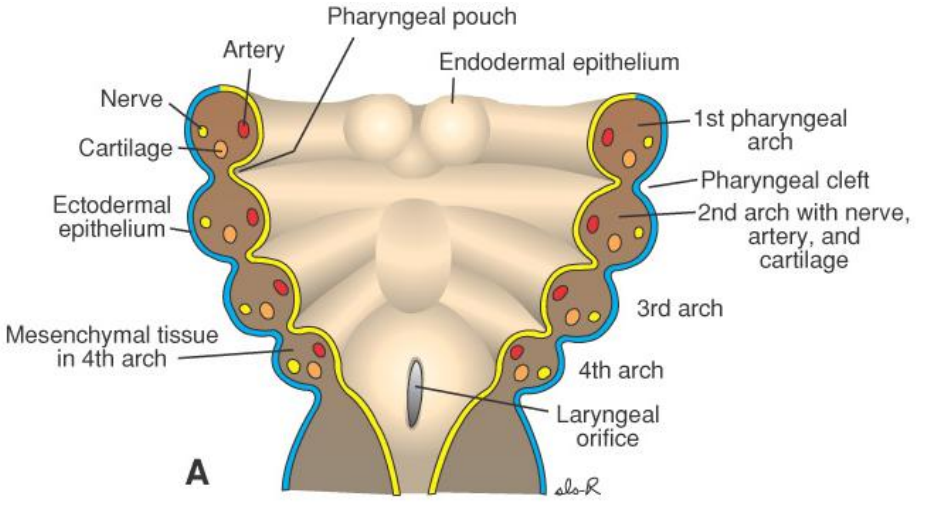


# PRIMORDIAL TERMS



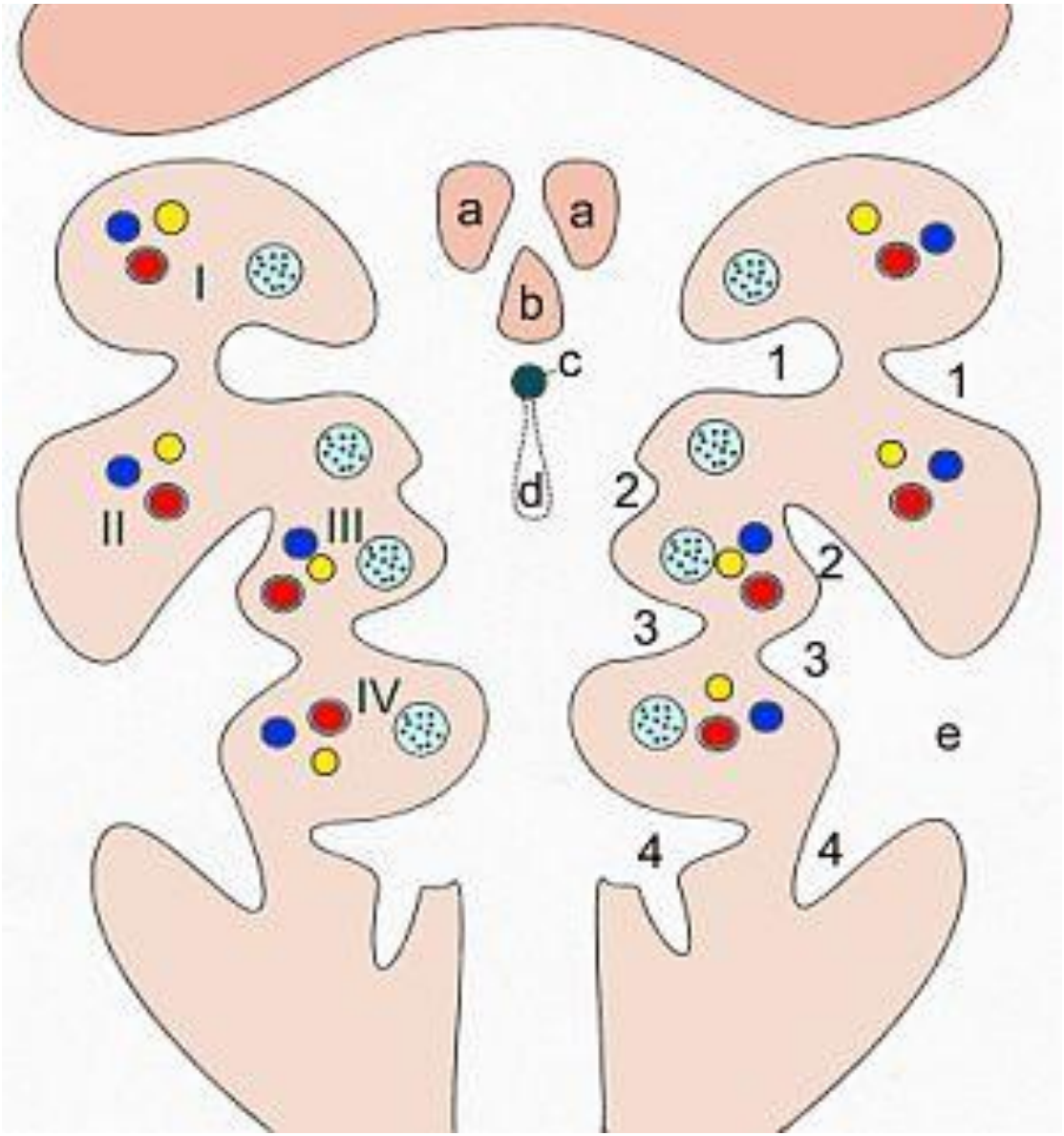

The **pharyngeal arches** form on either side of the foregut and correspond to the primitive vertebral gill bars or ***branchial arches***.

A pharyngeal arch consists of

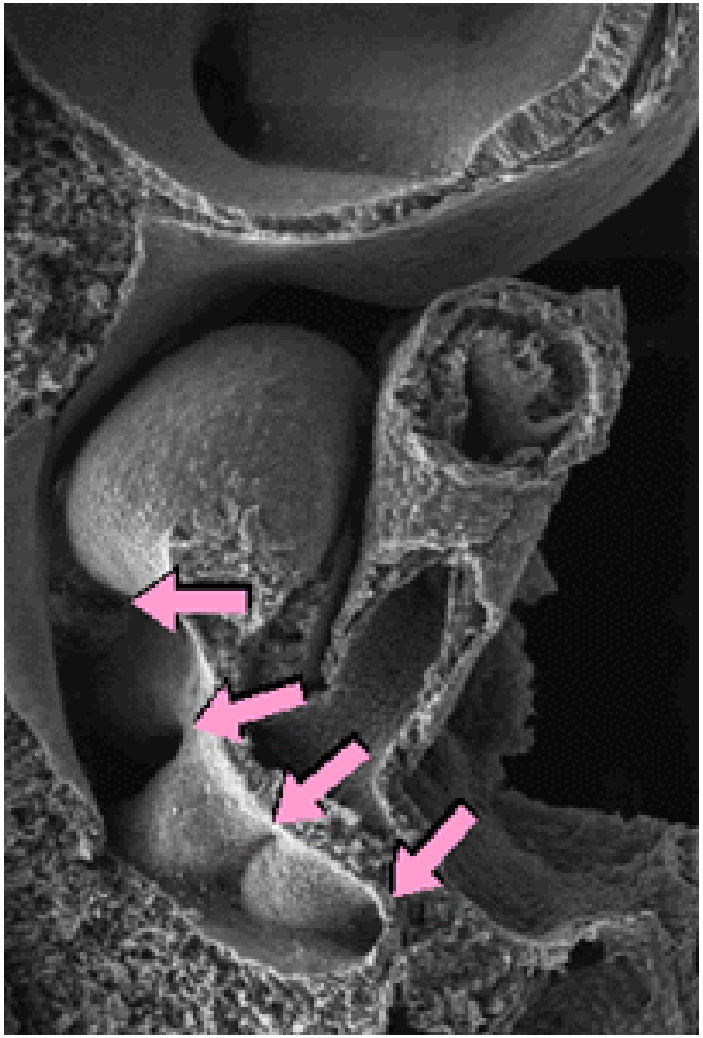
1. core of mesenchyme
2. external ectoderm
3. internal endoderm.

The arches are **separated**
- externally by a pharyngeal **cleft**
- internally by a pharyngeal **pouch**.

# OBLIGATORY COMPONENTS OF THE PHARYNGEAL APPARATUS



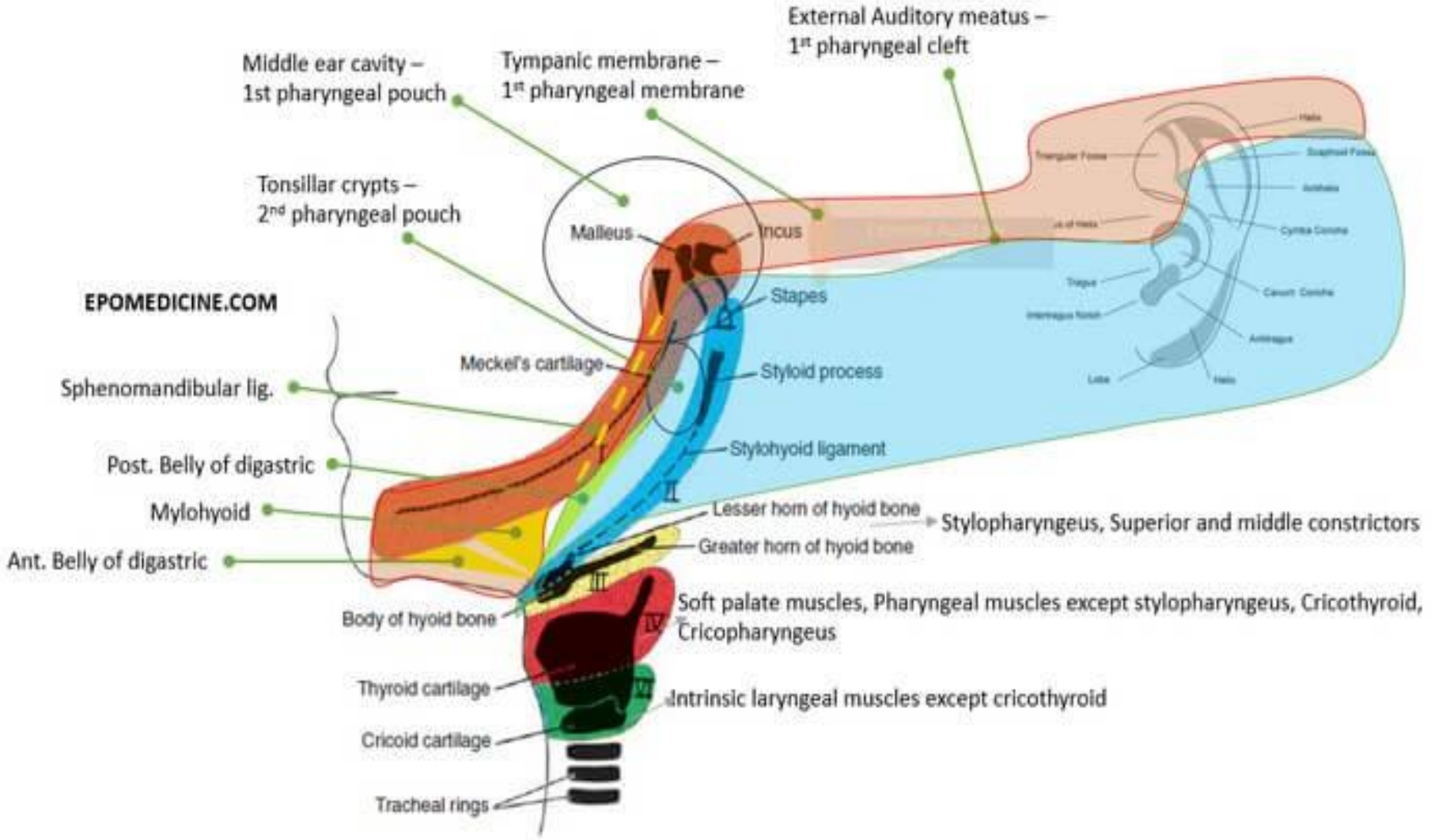
# SCANNING EM OF PRIMITIVE PHARYNX



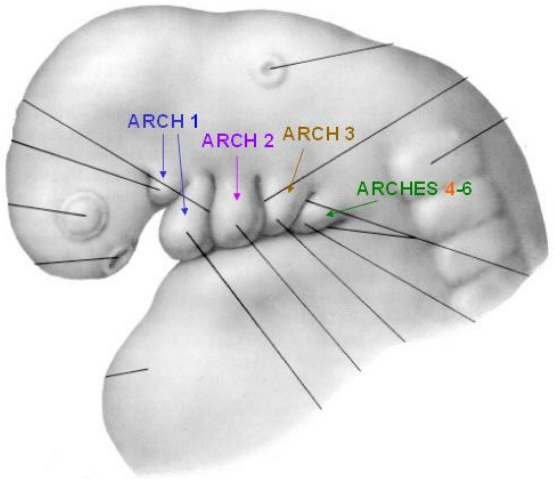
# NEXT SLIDE

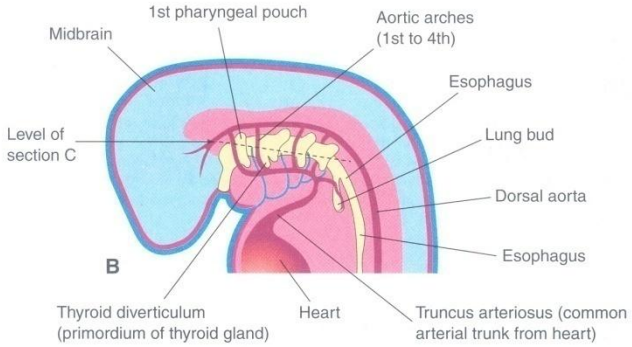
QR

# WHAT DEVELOPS FROM HERE?



# GERMINAL LAYER DERIVATIVES

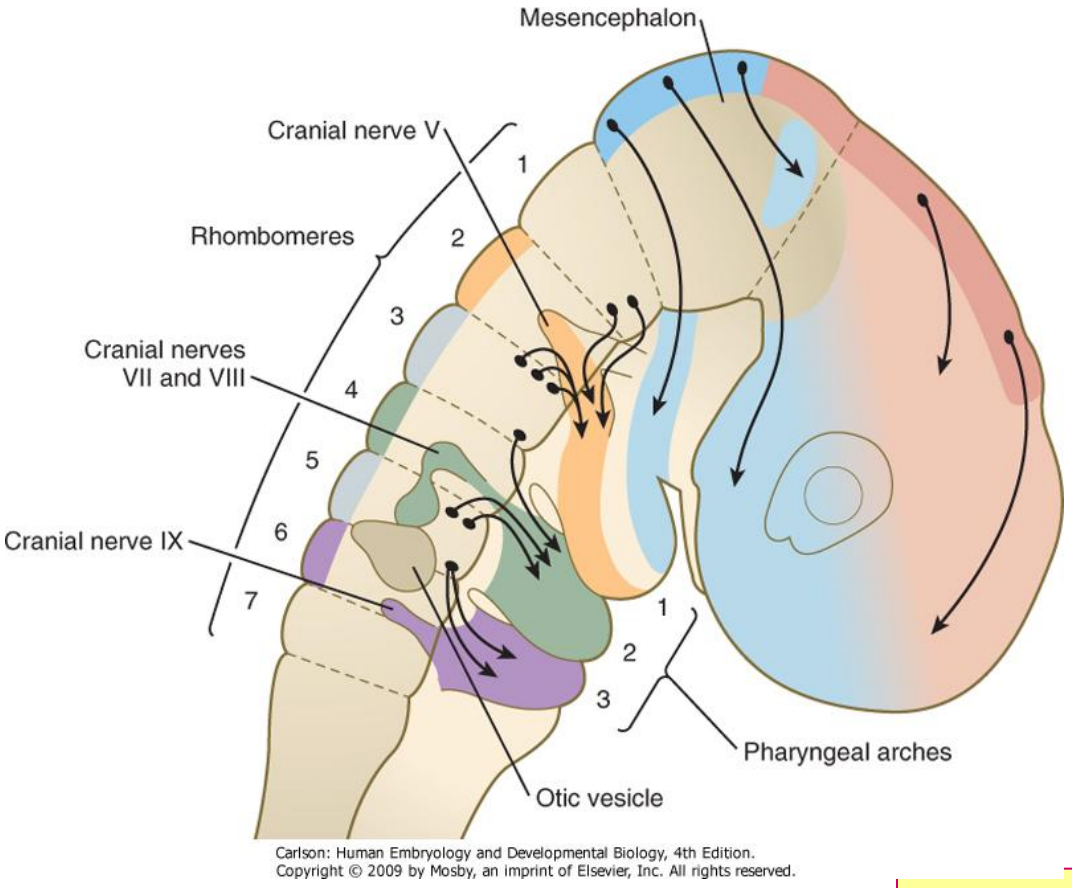



**ECTODERM** contributing to the formation of the face appears by the 4th week.

The ***oropharyngeal membrane*** (interface between **ECTODERM** and **ENDODERM**) is located in front of the later palatine tonsils. Ectodermal structures limiting the stomodeum participate in the formation of the face, as well as of the nasal and oral cavities.

# GERMINAL LAYER DERIVATIVES

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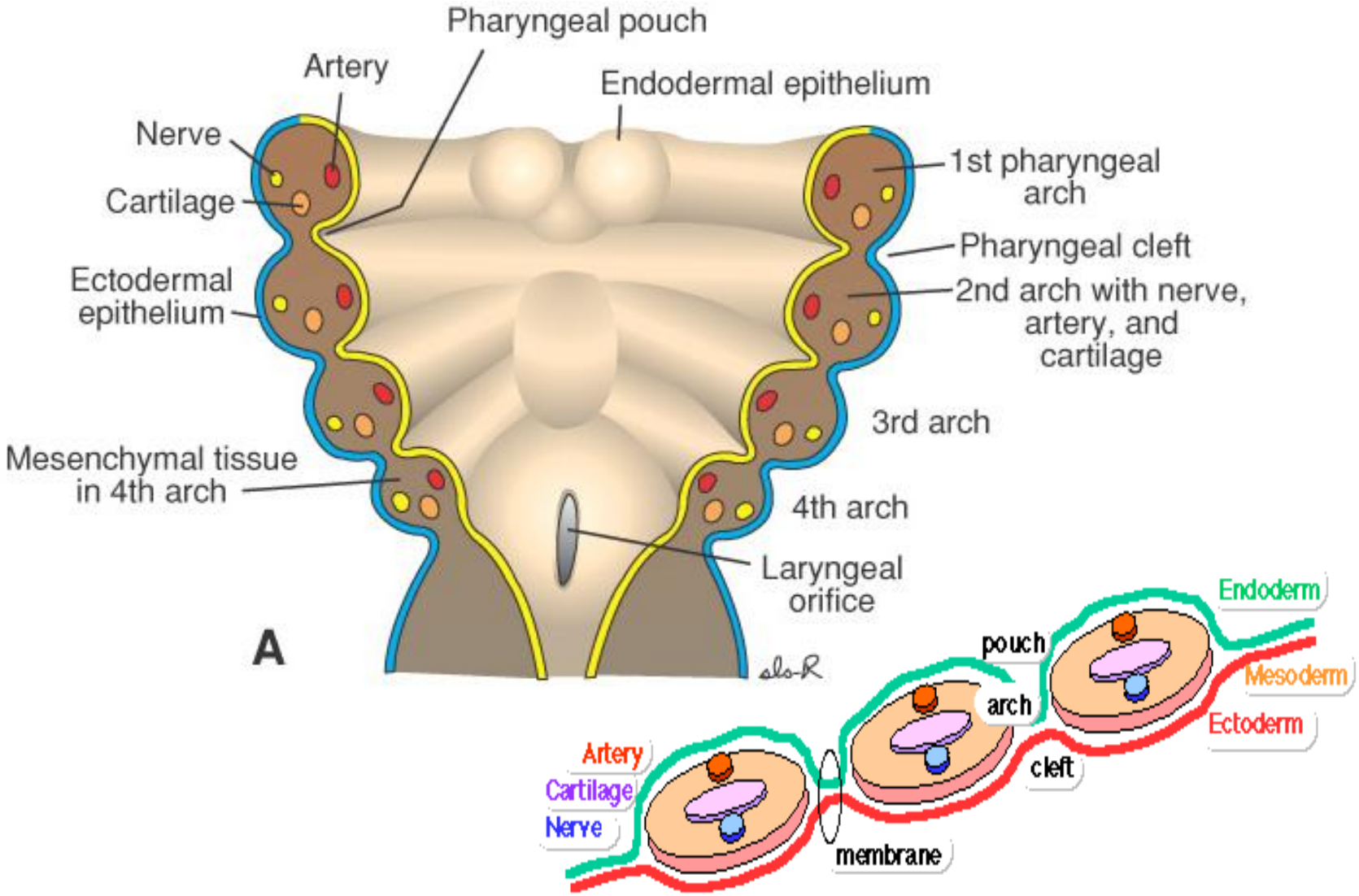
**MESENCHYME** that fills the pharyngeal arches derives from the ***neural crest***

**ECTOMESENCHYME**

# PHARYNGEAL ARCHES, FISSURES AND POUCHES



# GENE EXPRESSION PATTERN

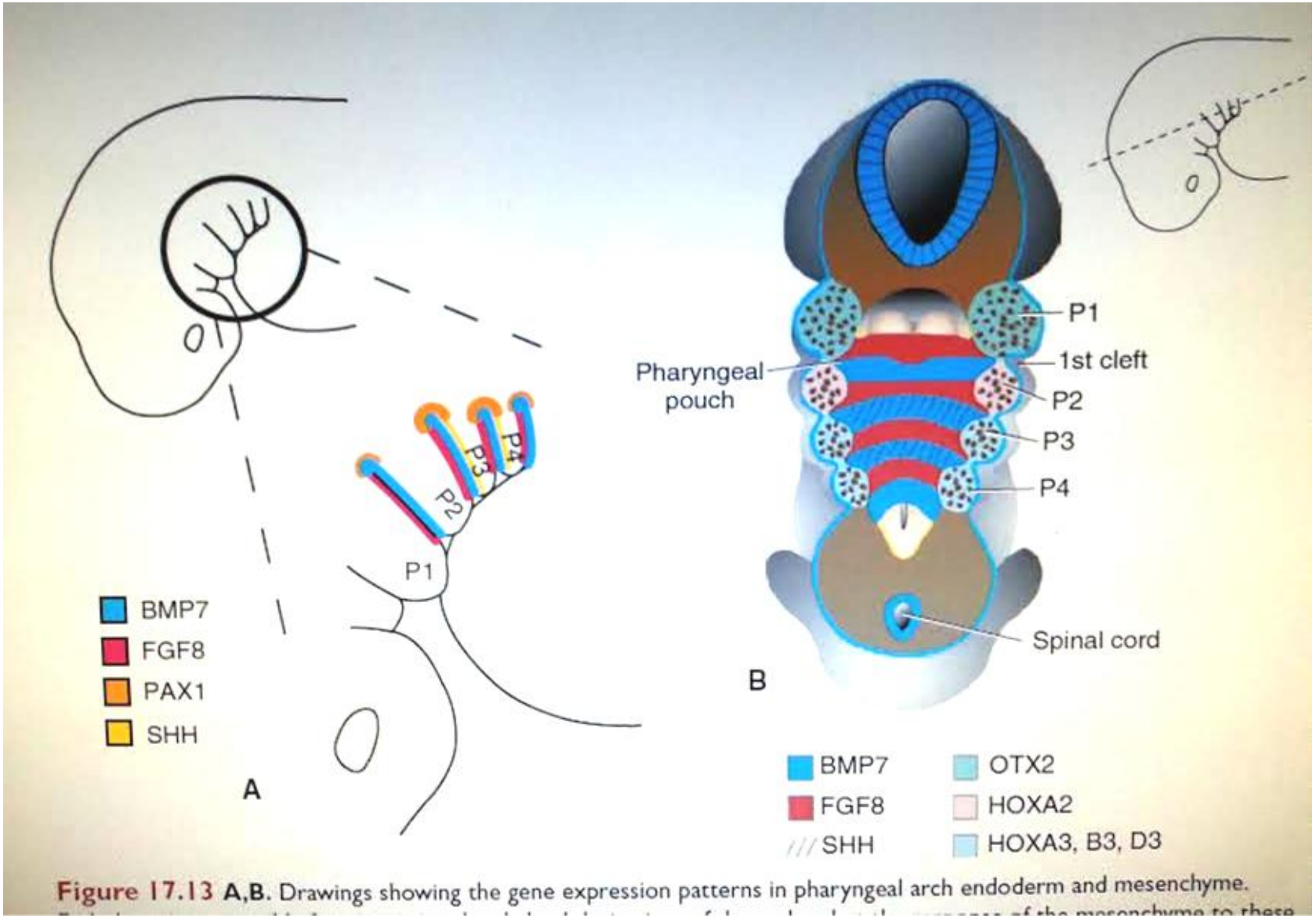
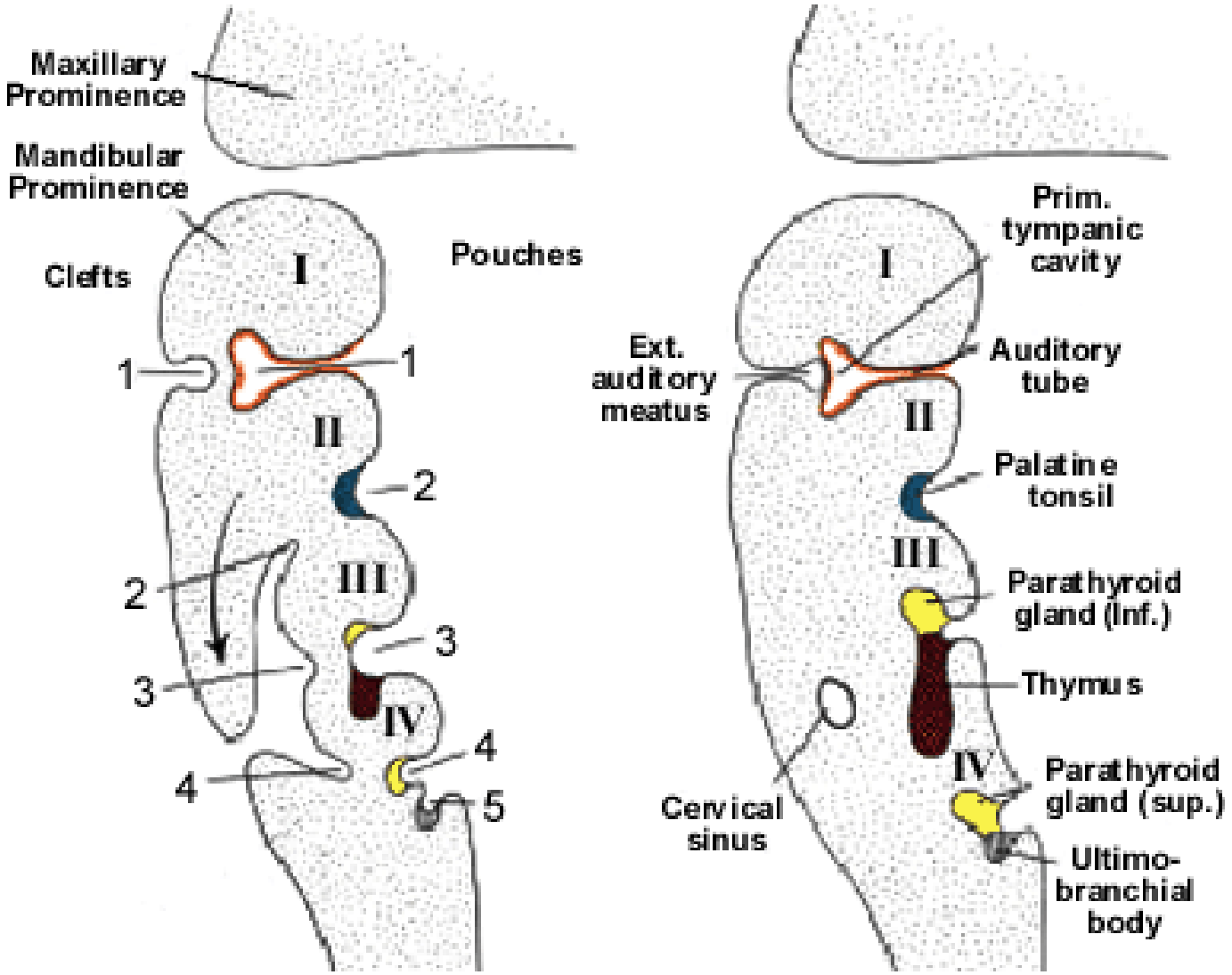



**Figure 17.13 A,B.** Drawings showing the gene expression patterns in pharyngeal arch endoderm and mesenchyme.

# PHARYNGEAL APPARATUS

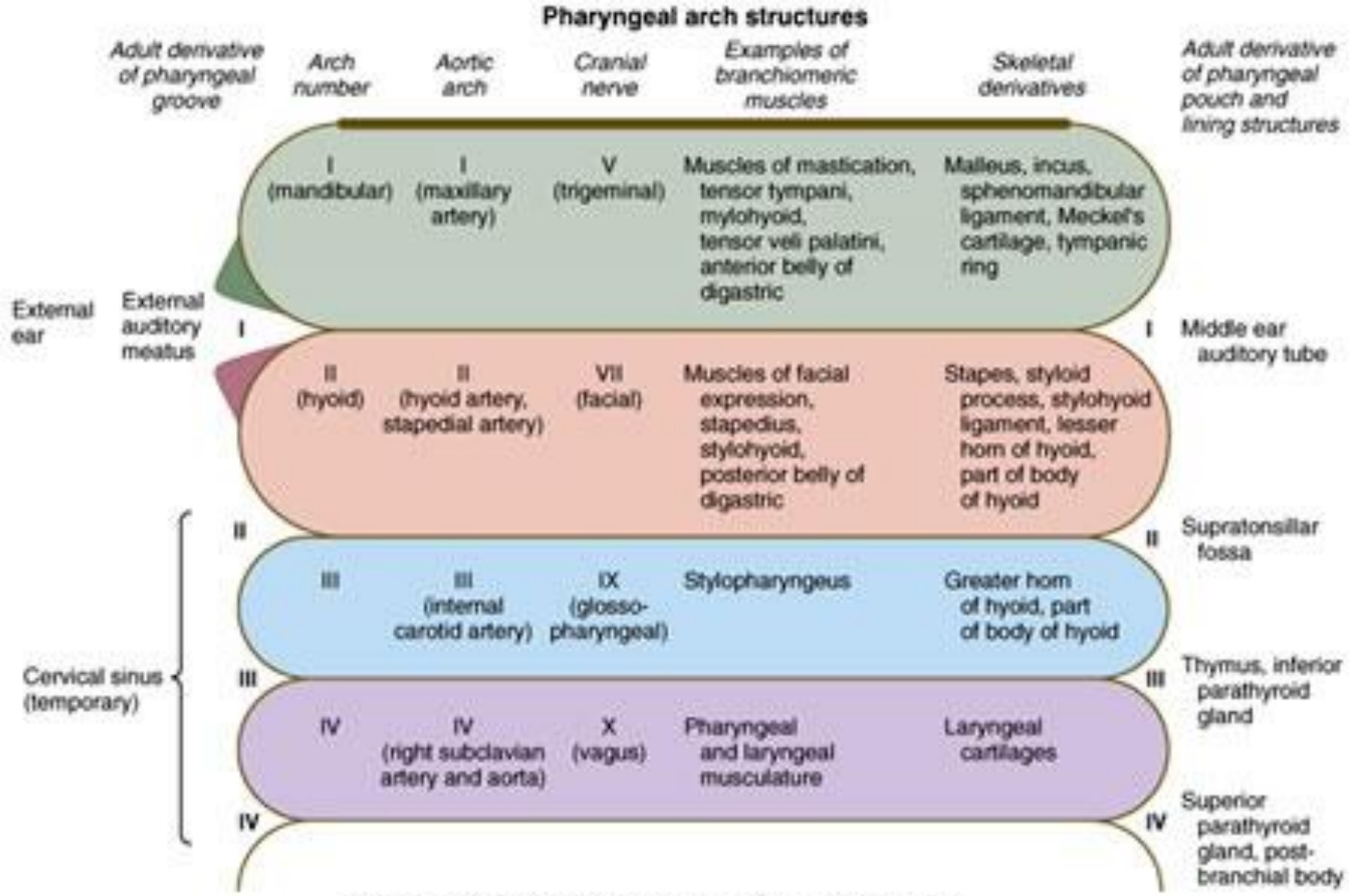


# Branchial Apparatus

*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[1] | Bone[1] | Ligament[1] | Muscle[2] | 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 mastification**; 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 | | | Phaynx 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 derivates for fifth pharyngeal arch but mention them at the sixth pharyngeal arch.

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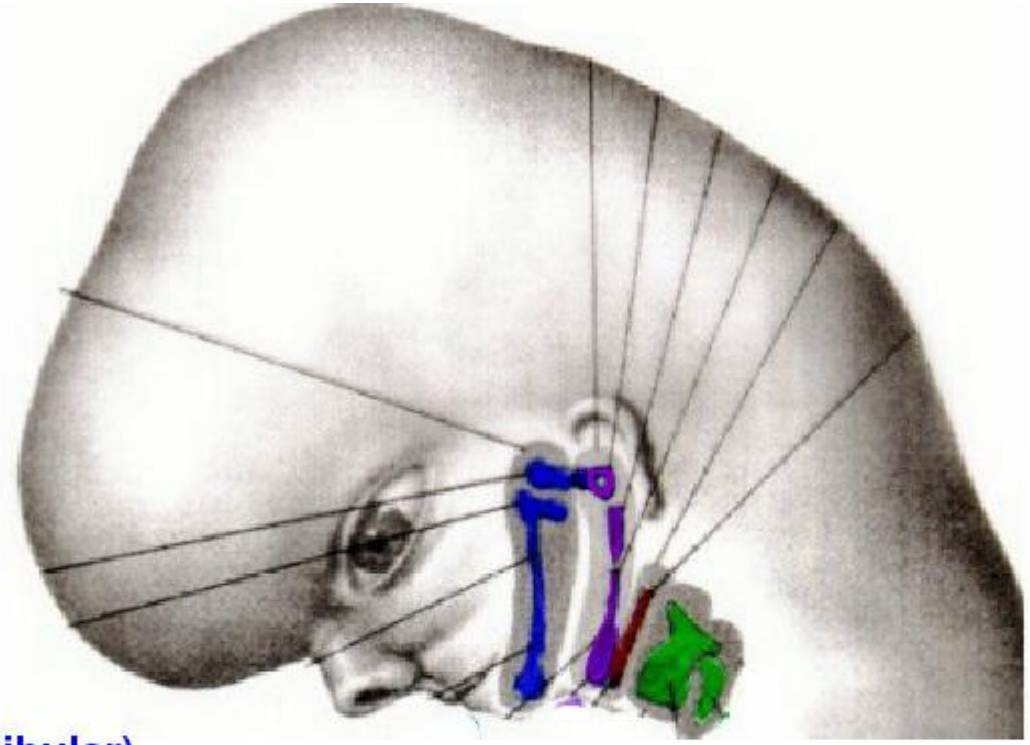
# PHARYNGEAL / BRANCHIAL DERIVATIVES

# BRANCHIAL ARCH CARTILAGES



**I First (Mandibular) Arch -**
1. Malleus
2. Incus
3. Ant. Ligament Of malleus
4. Sphenomandibular ligament

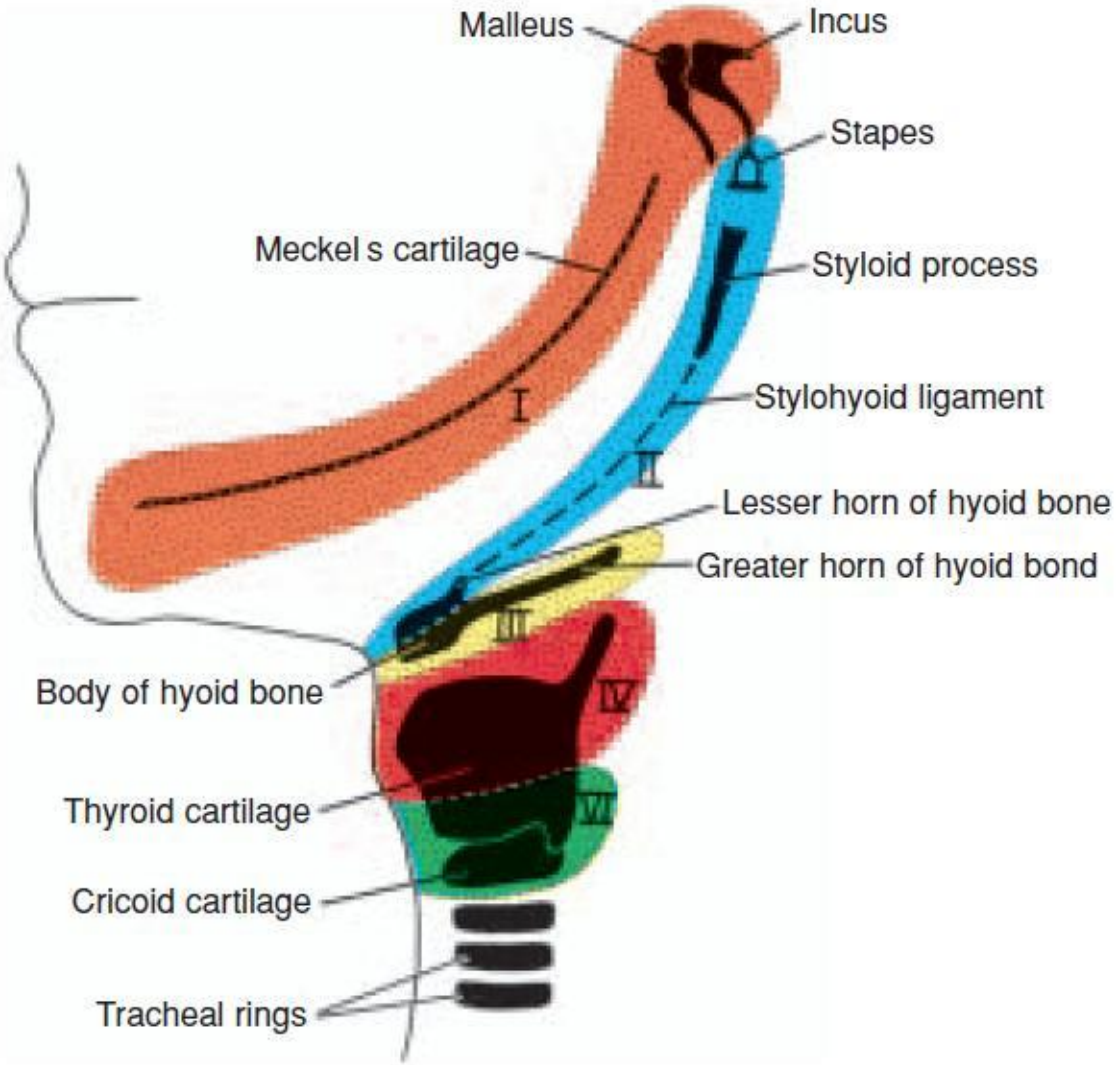
**II Second (Hyoid) Arch**
1. Stapes
2. Styloid Process
3. Stylohyoid Ligament
4. Lesser horn, Upper ½ body Hyoid

**III Third Arch -**
Lower ½ Body, Greater Horn Of hyoid

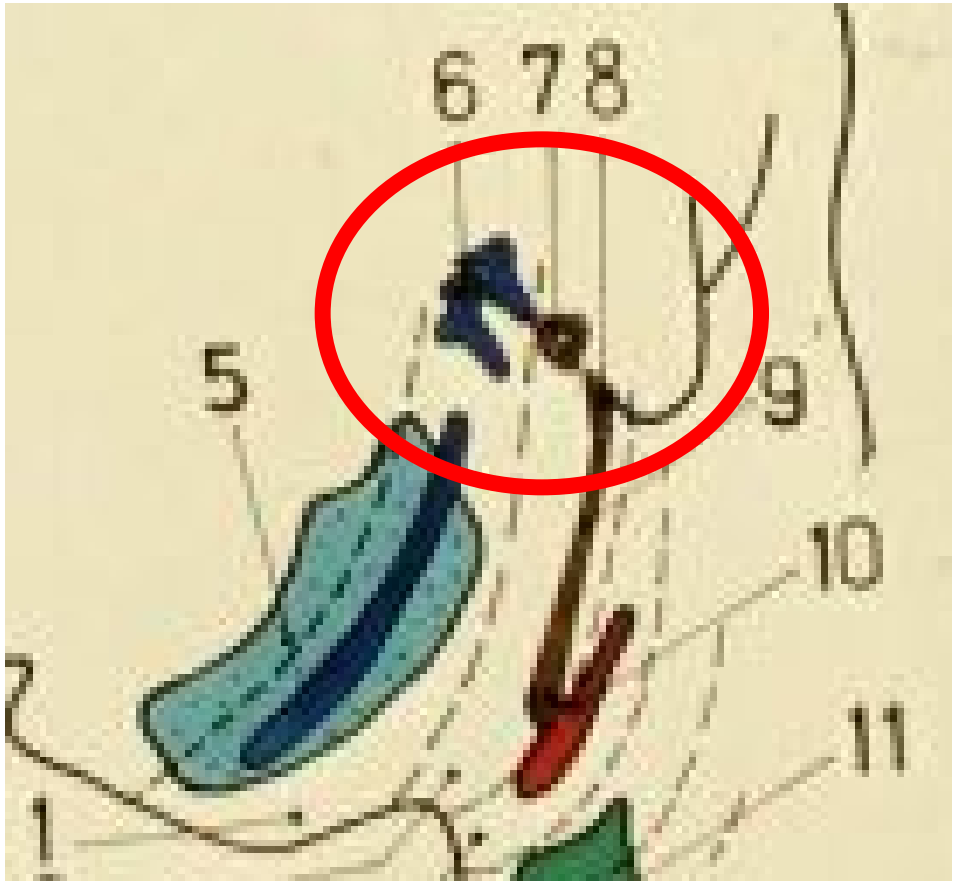
**IV Fourth (Sixth) Arch -**
Cartilages Of larynx

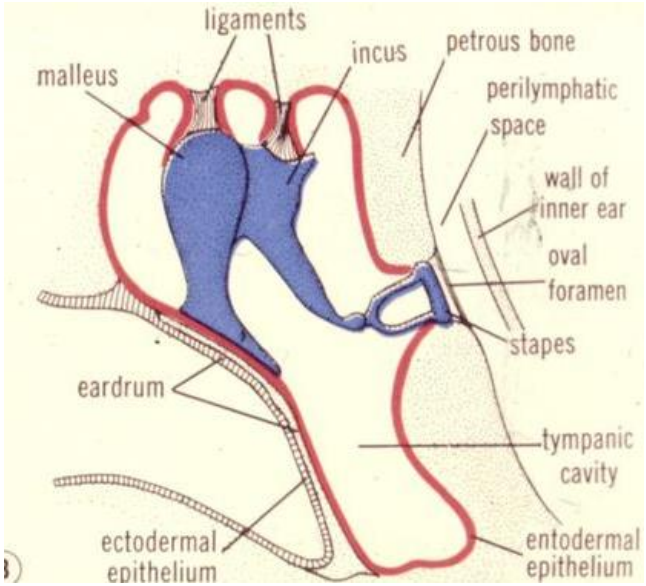
# BRANCHIAL DERIVATIVES

## *SKELETAL ELEMENTS*



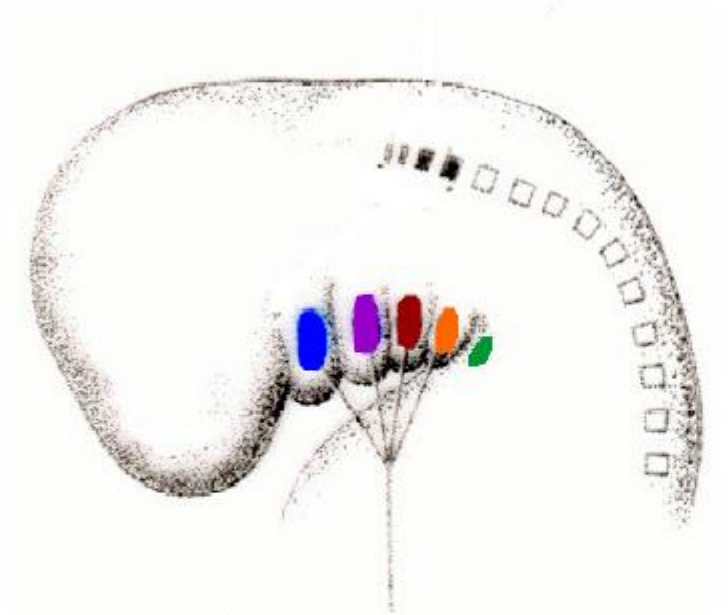
# DERIVATIVES OF THE CARTILAGES

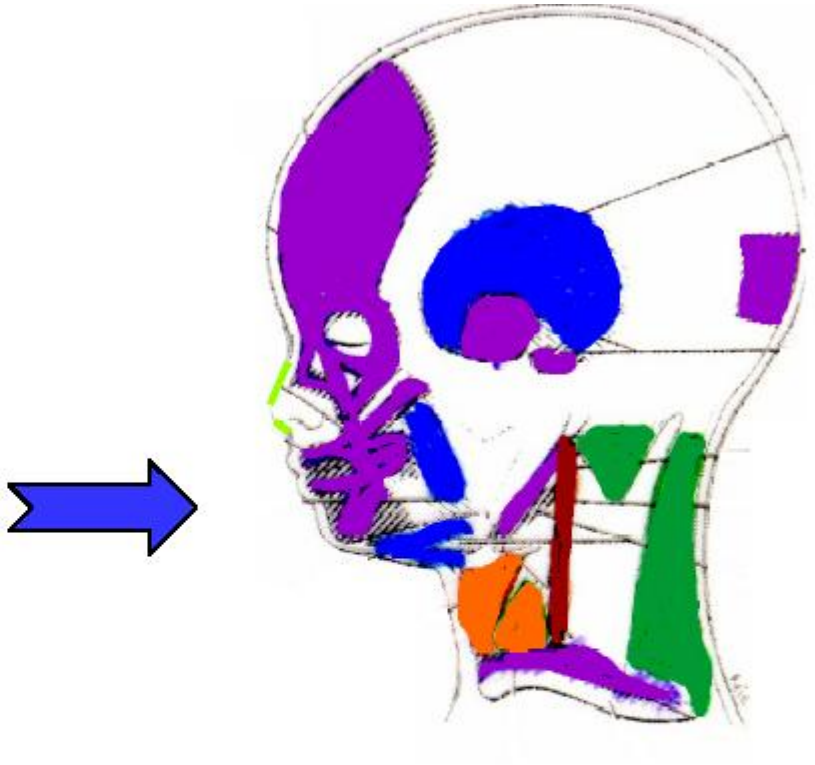



1-4. projection of arches
5. mandible
6. malleus and incus
7. stapes
8. styloid process
9. stylohyoid ligament
10. hyoid bone
11. larynx (thyroid cartilage)

# MUSCLES OF THE BRANCHIAL ARCHES

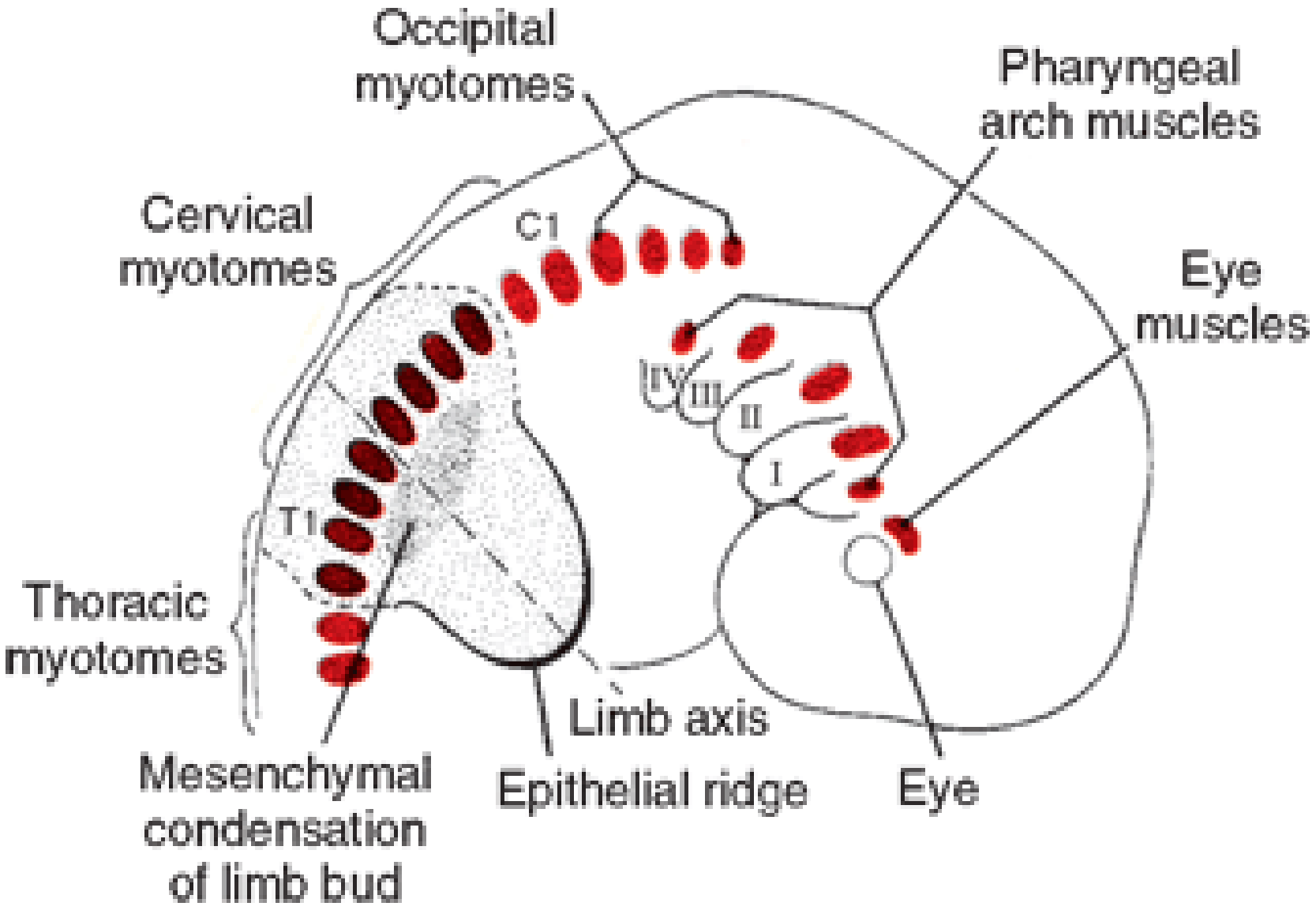




**Innervated by**

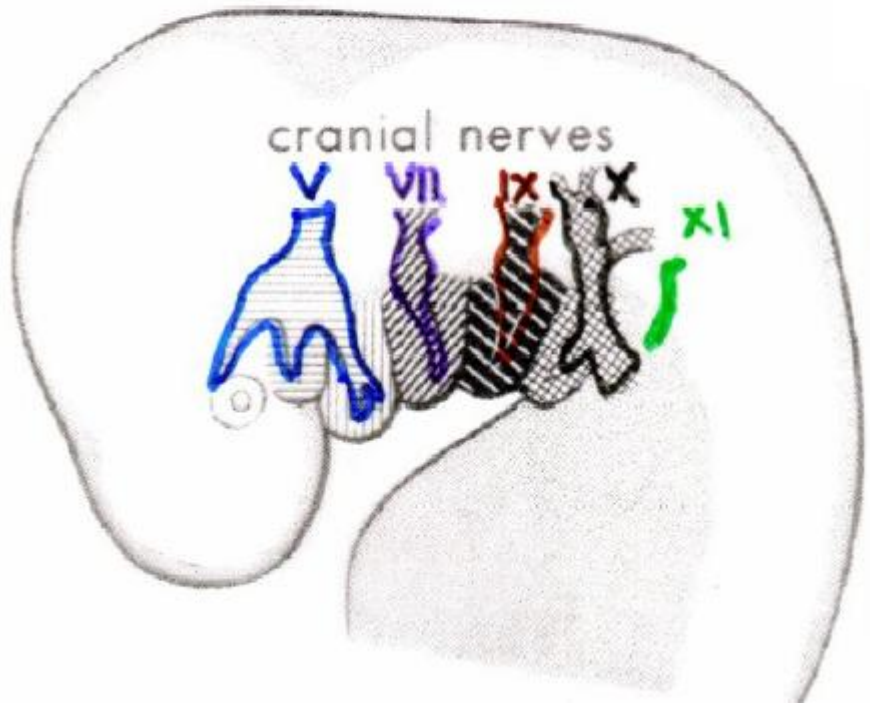
| First - | Second - | Third | Fourth | Sixth |
|---|---|---|---|---|
| Trigeminal | Facial | Glosso-pharyngeal | Vagus | Accessory |
| V | VII | IX | X | XI |

# DERIVATIVES OF MYOTOMES



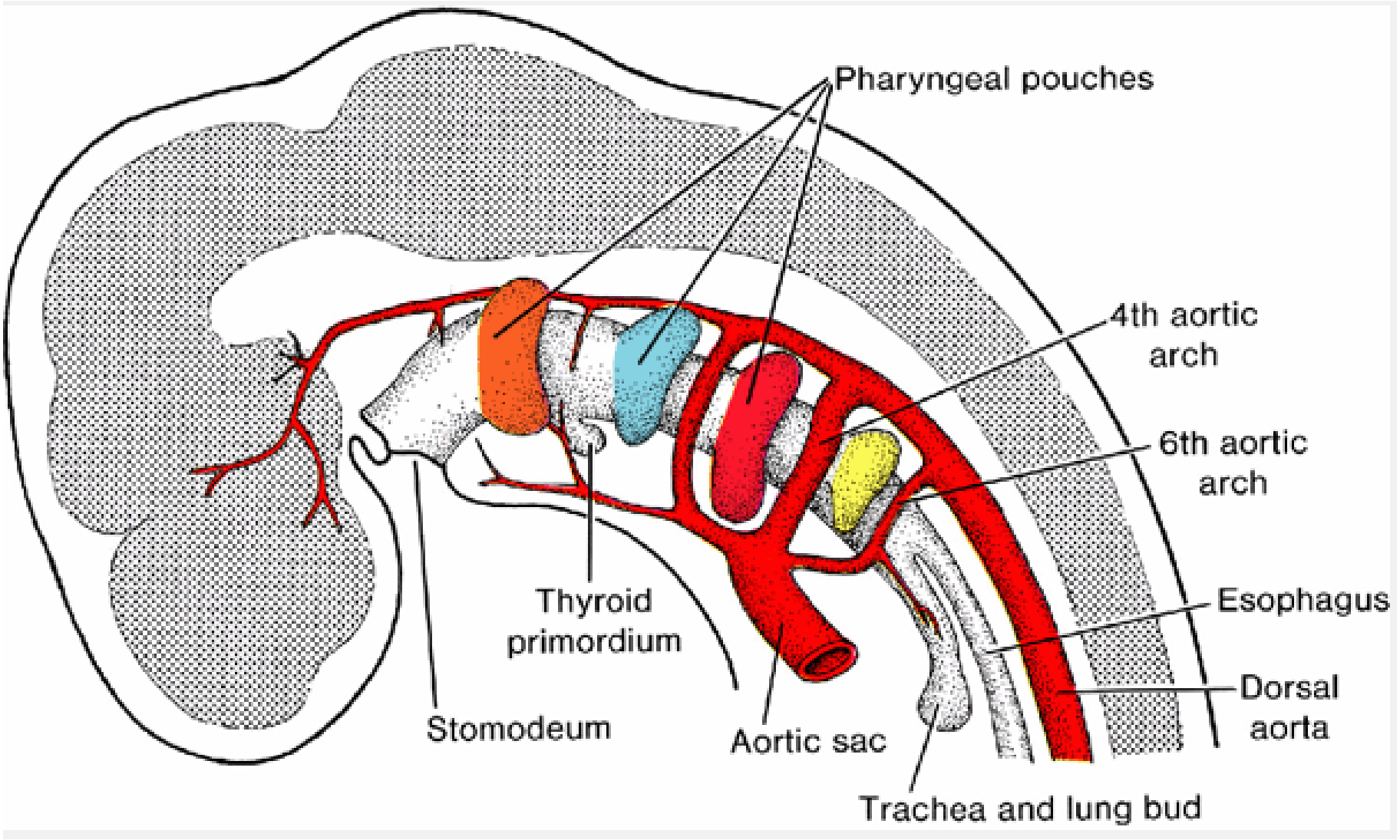
# NERVES OF THE BRANCHIAL ARCHES

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

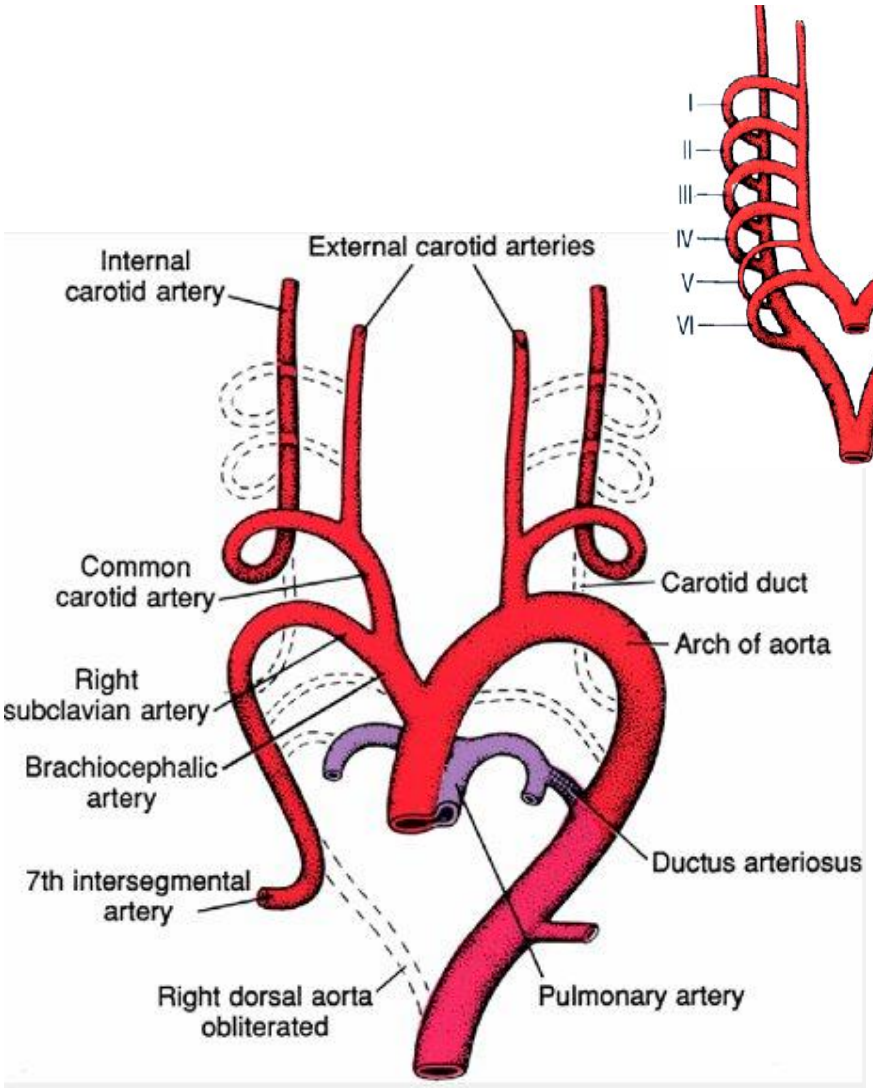


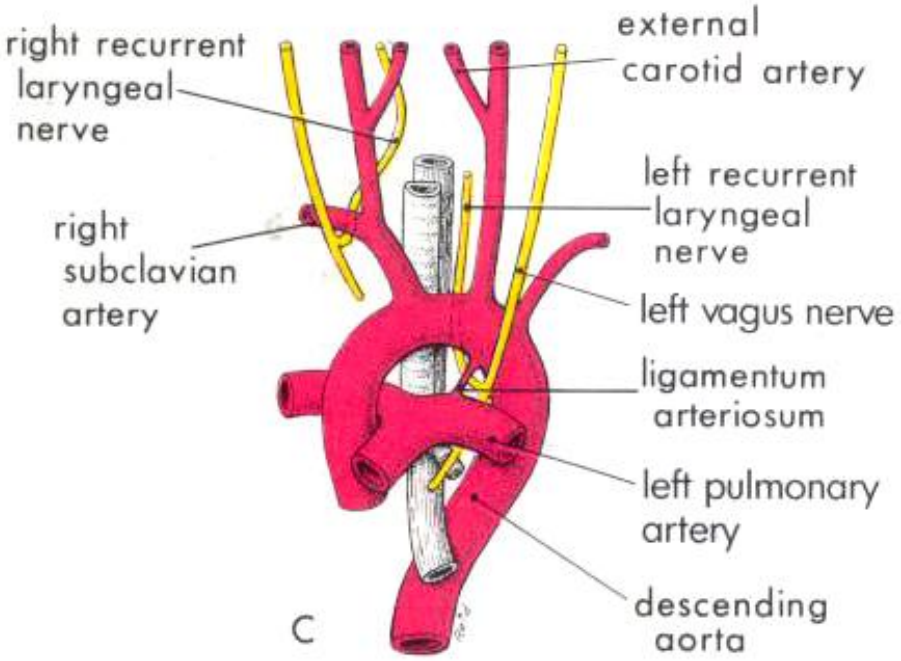

1) First Arch – Trigeminal (V)
2) Second Arch – Facial (VII)
3) Third Arch – Glosso-pharyngeal (IX)
4) Fourth Arch – Vagus (X)
5) Caudal Sixth – Accessory (XI)

# SEGMENTAL AORTIC ARCHES



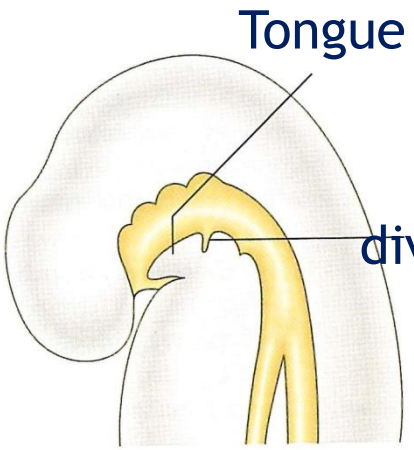
# DERIVATIVES OF THE AORTIC ARCHES



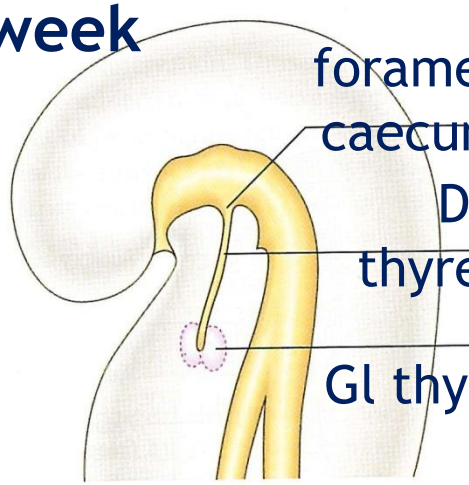



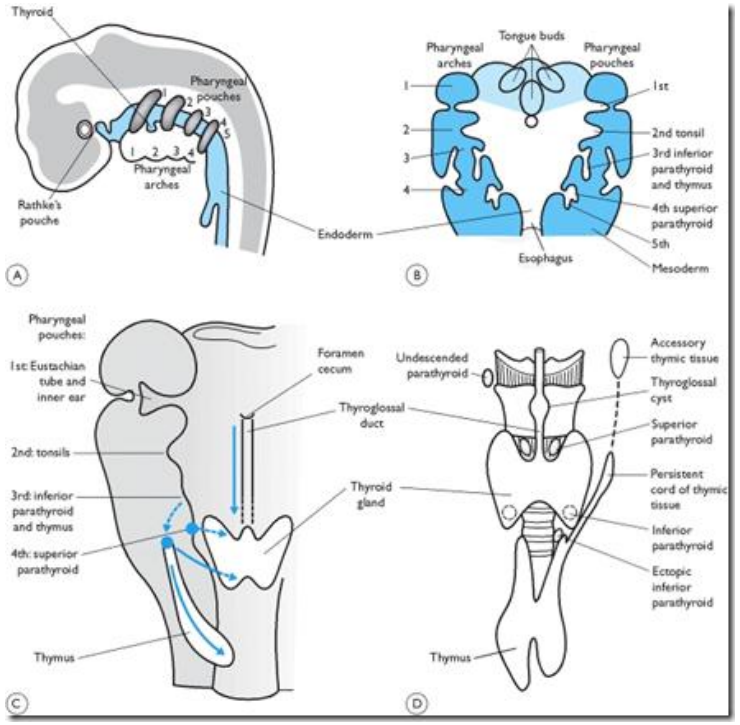
# DEVELOPMENT OF THE THYROID GLAND

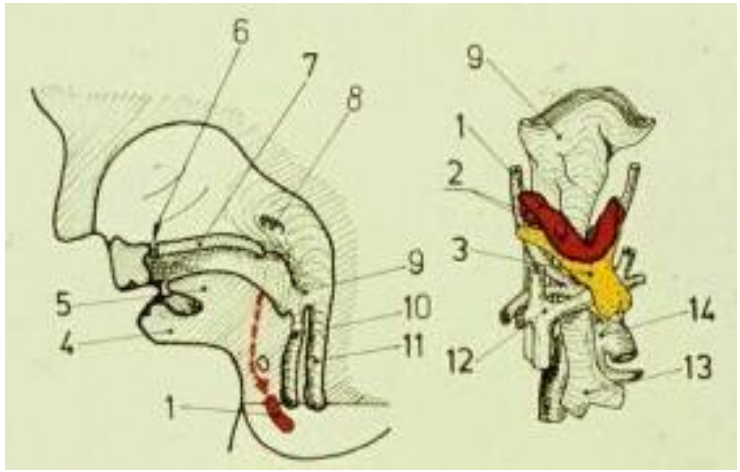
## 4. week



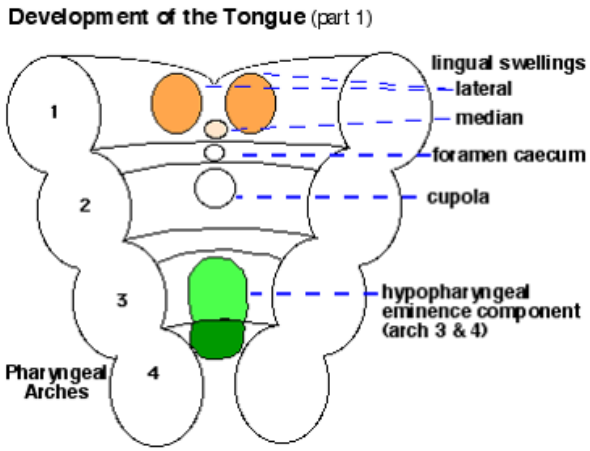

## 5. week

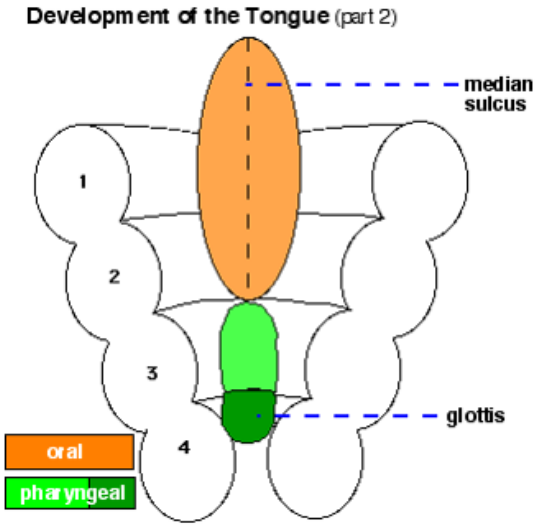


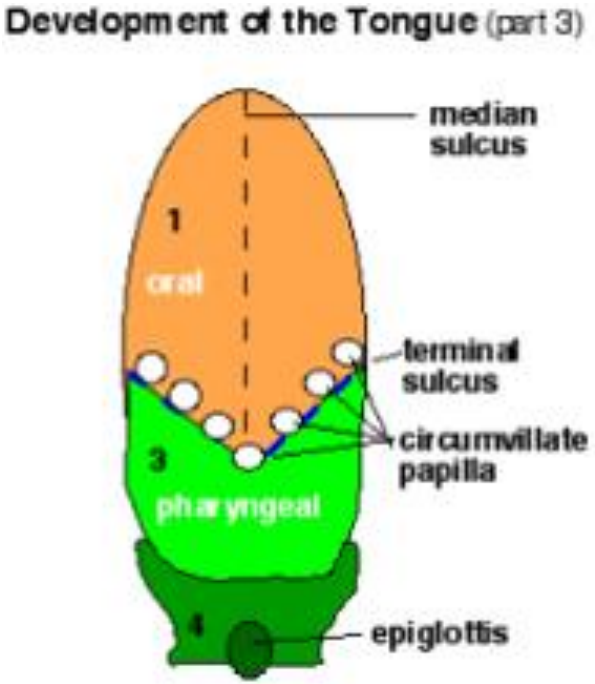



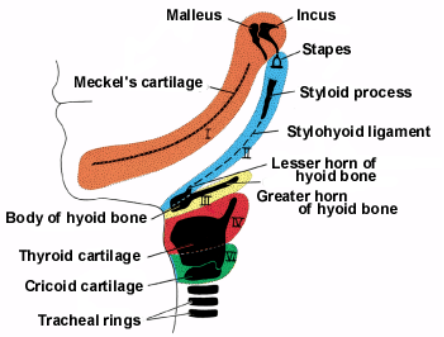
# DEVELOPMENT OF THE TONGUE

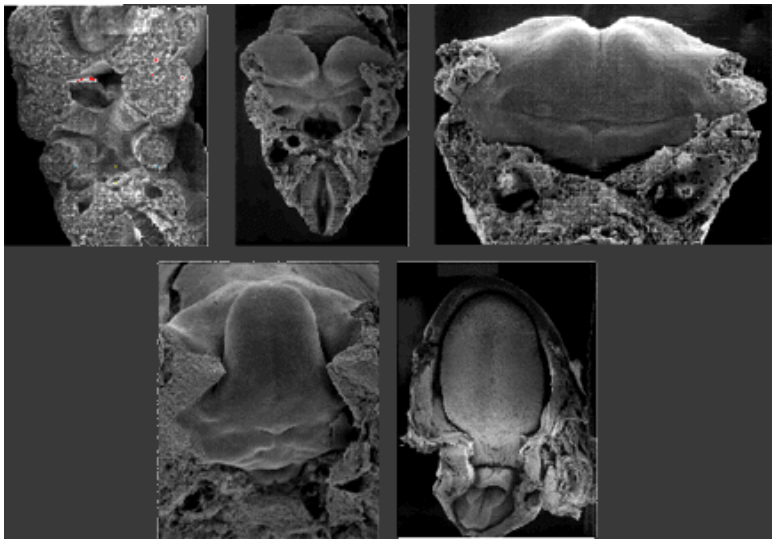


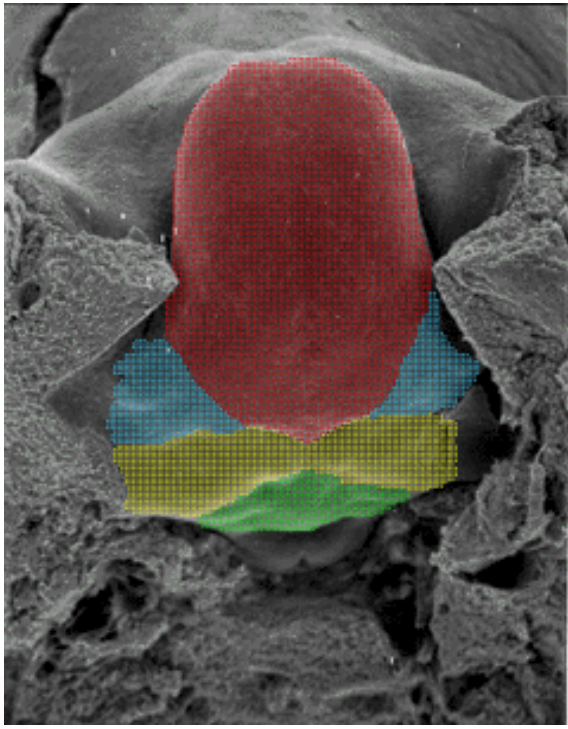



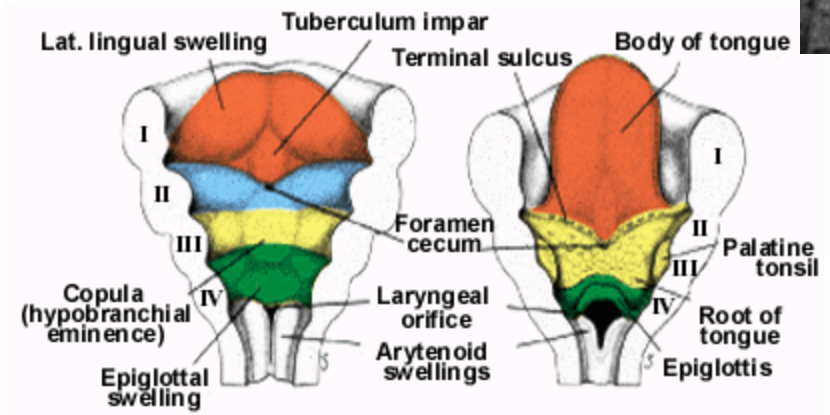



# SCANNING EM - LINGUAL PRIMORDIA

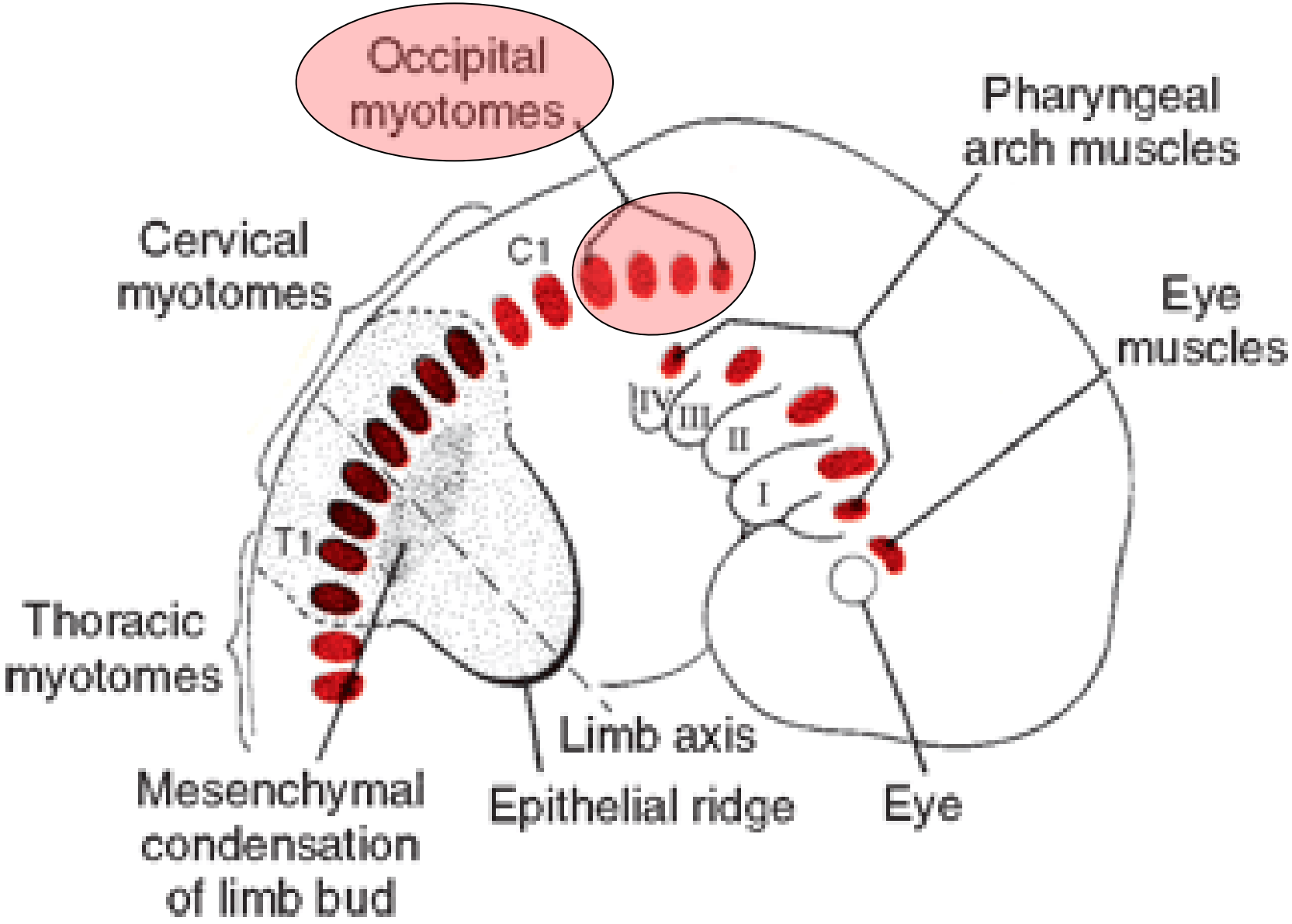







# DERIVATIVES OF MYOTOMES

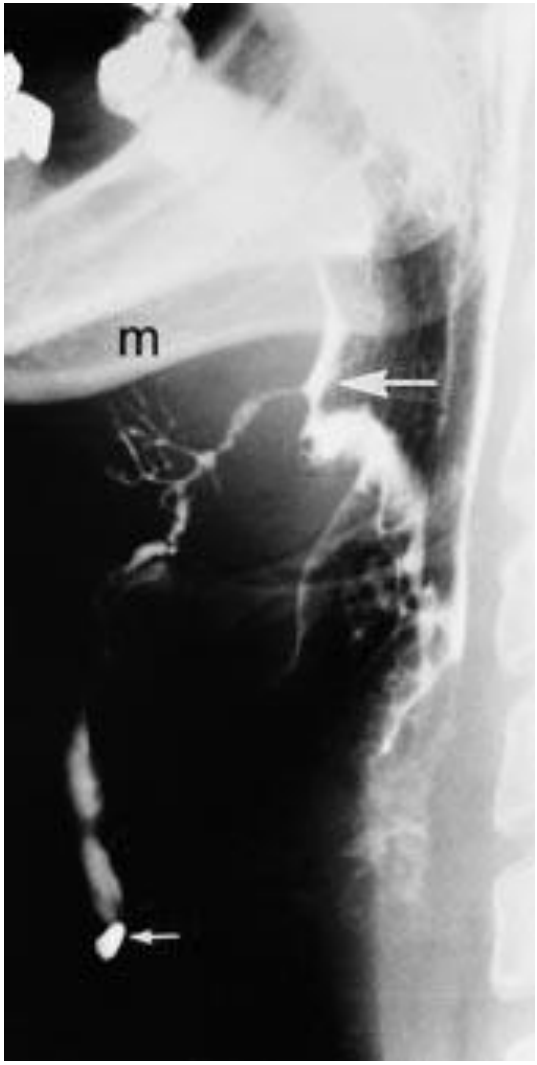


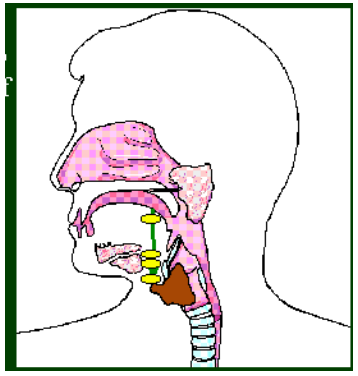
# SUMMARY TABLE OF THE LINGUAL DIVISIONS &NERVES

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

# DEVELOPMENTAL MALFORMATIONS 1.

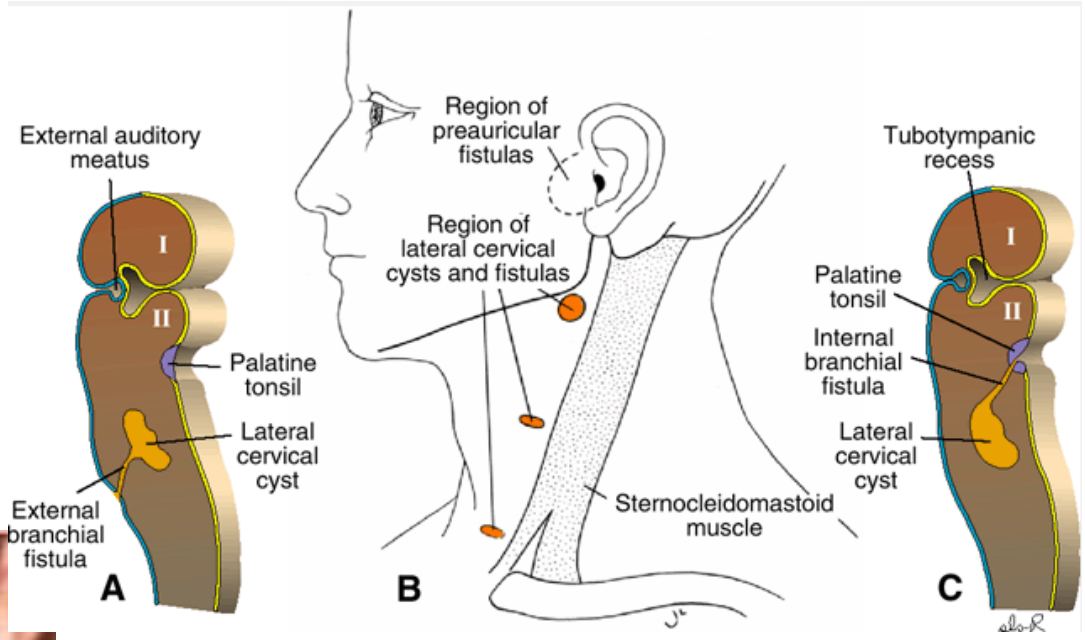
*Ductus thyreoglossus* - a duct penetrates the mesenchyme from the foramen cecum, which by bifurcating forms the 2 lobes of the thyroid gland. In case the lumen of the duct does not disappear (*ductus thyreoglossus persistens*) it may contribute to the formation of median cervical cysts. They often form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



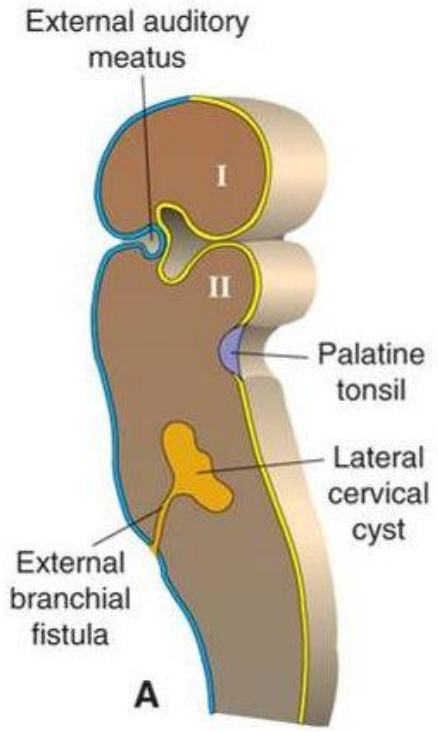



# DEVELOPMENTAL MALFORMATIONS 2.

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




# FISTULIZATION




8-4A Pharyngeal pouch defects: Cervical cysts and fistulas

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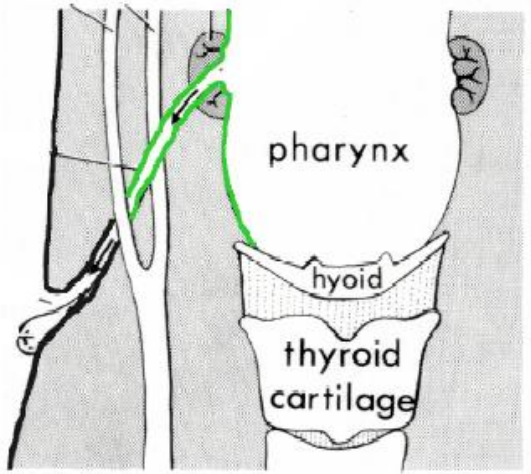
**Fig 1-** Neck fistula in the right muscular space of the neck



# THANK YOU VERY MUCH FOR YOUR ATTENTION