



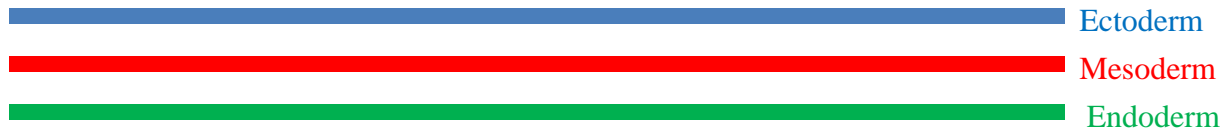
# Pharyngeal (Branchial) Apparatus

Dr. Heba Kalbouneh DDS, MSc, DMD/PhD  
Professor of Anatomy and Histology

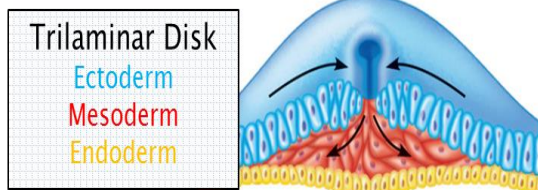
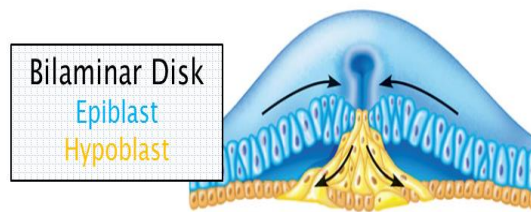
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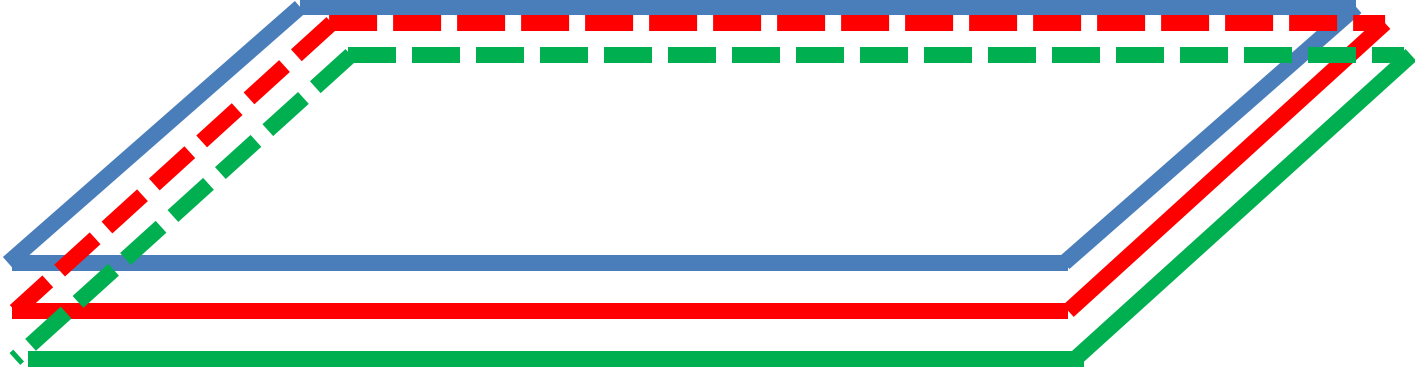
## Bilaminar disc (2<sup>nd</sup> week)

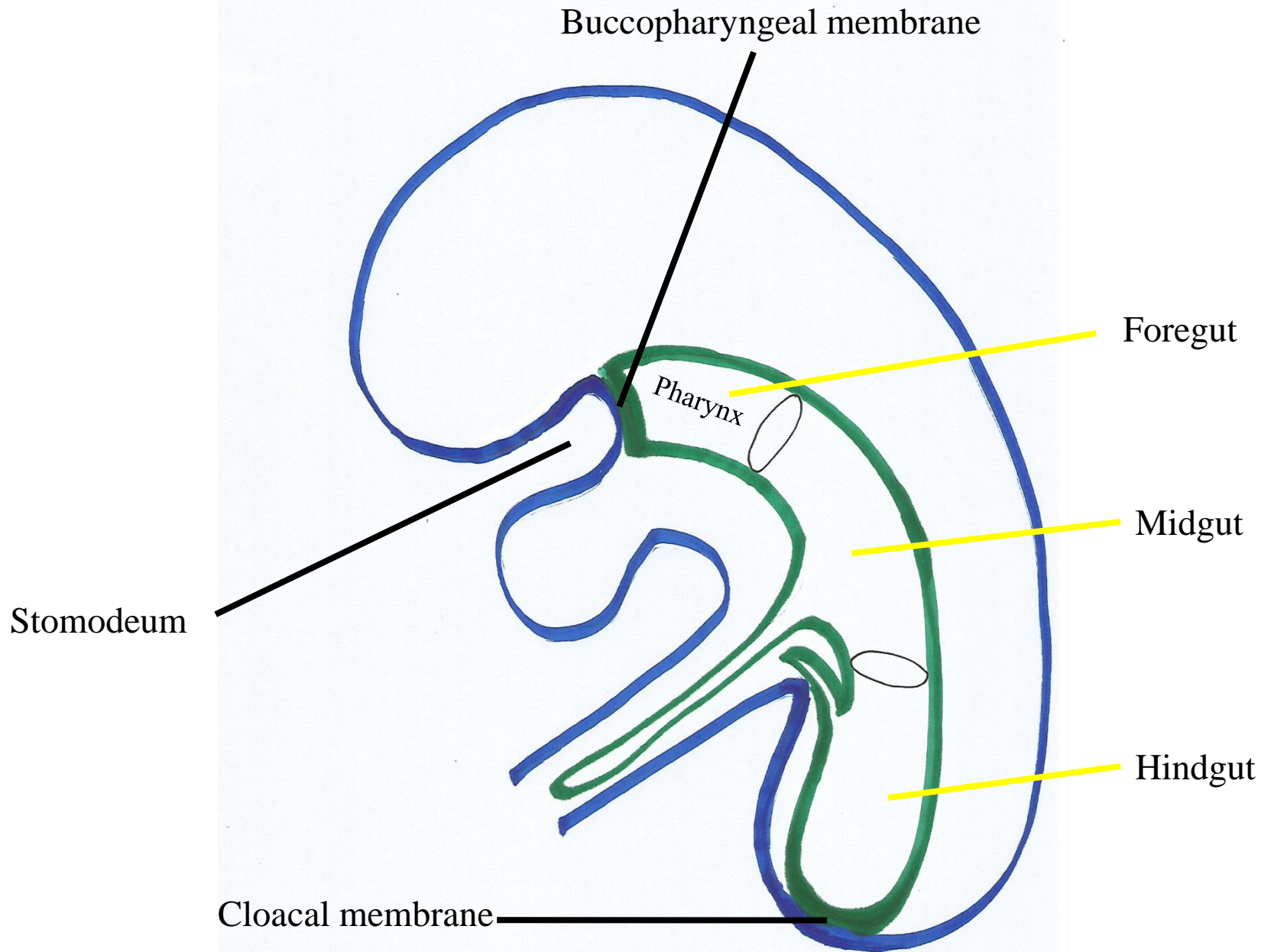


## Trilaminar disc (3<sup>rd</sup> week)



- Fates of Epiblast Cells
1. Migrate to space between epiblast and hypoblast: form **Mesoderm**.
  2. Replace hypoblast layer: form **Endoderm**.
  3. Stay put: form **Ectoderm**.





Note that the ectoderm and endoderm are in direct contact with each other (no mesoderm in between) in only two places:

**The buccopharyngeal membrane:** cranially

**The cloacal membrane:** caudally

The buccopharyngeal membrane lies between stomodeum and the pharynx

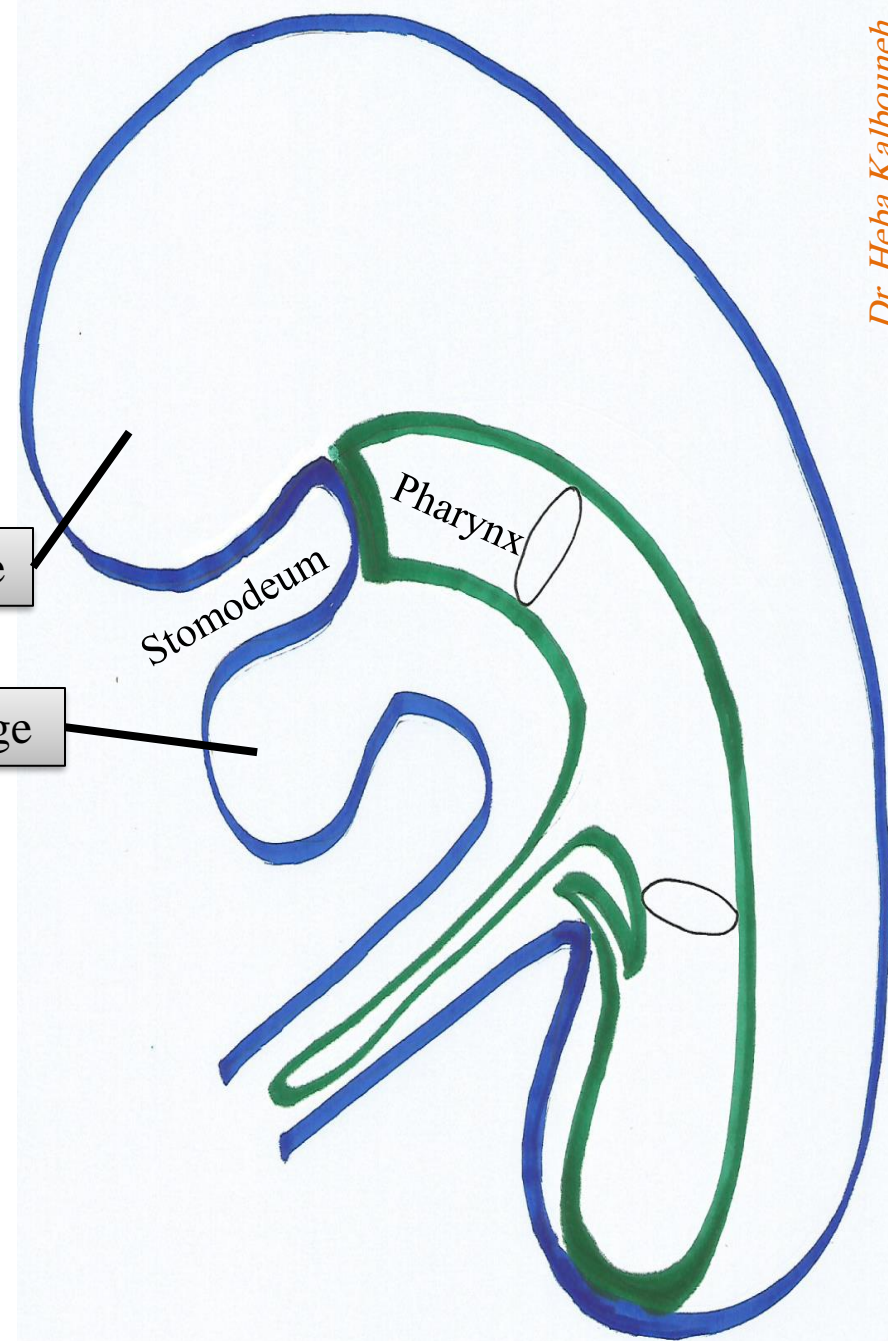
The **stomodeum** is a depression between the forebrain bulge and the pericardium bulge

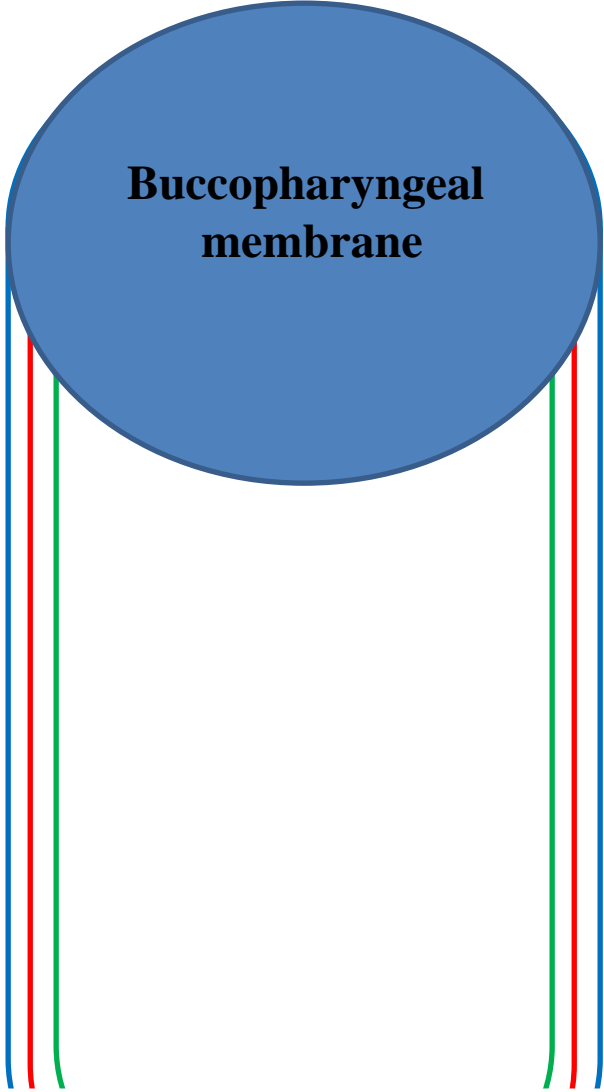
Stomodeum will form the **nasal and oral cavities**

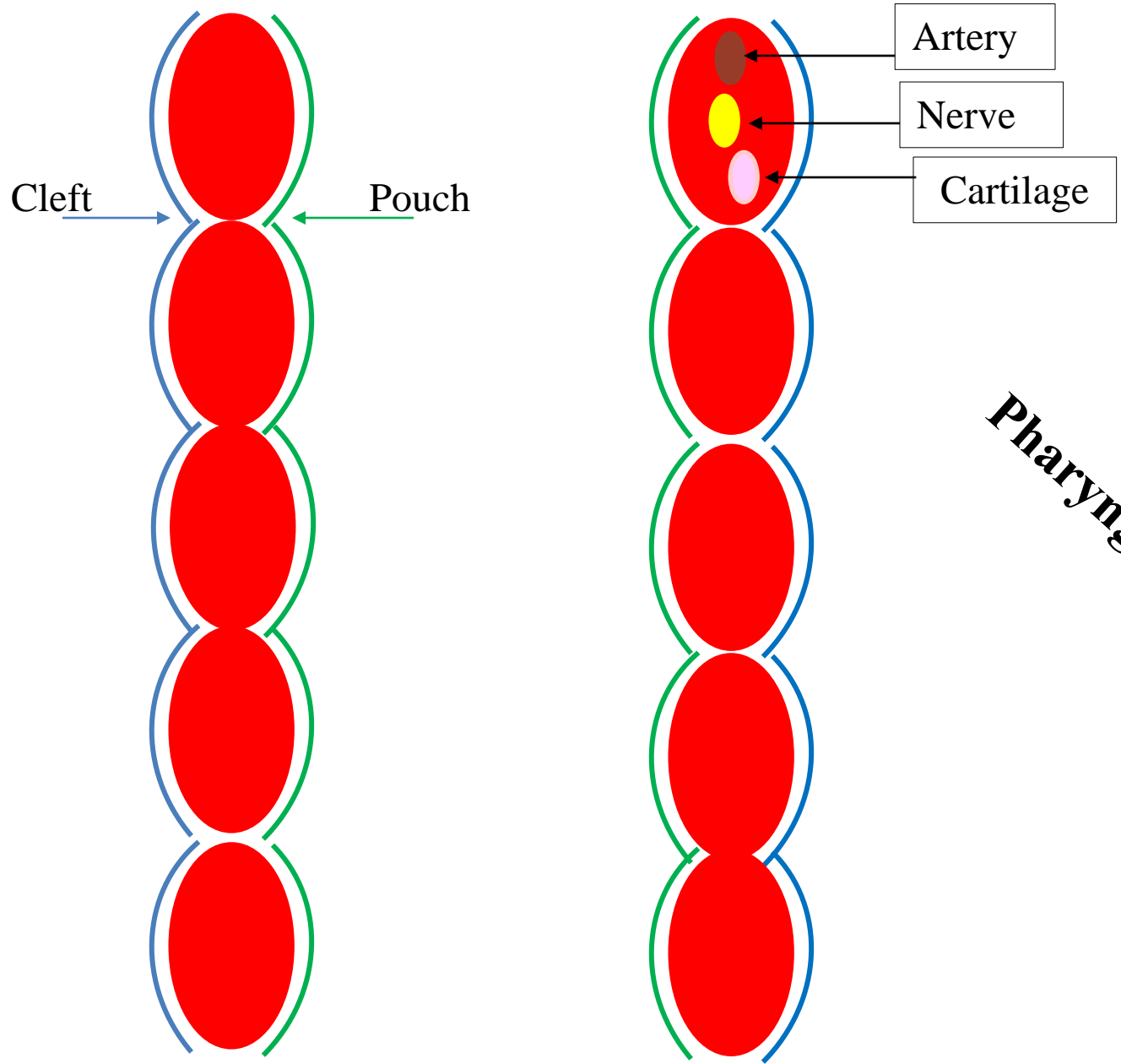
By the fourth week, the buccopharyngeal membrane breaks down so that the stomodeum communicates with the foregut

Forebrain bulge

Pericardium bulge





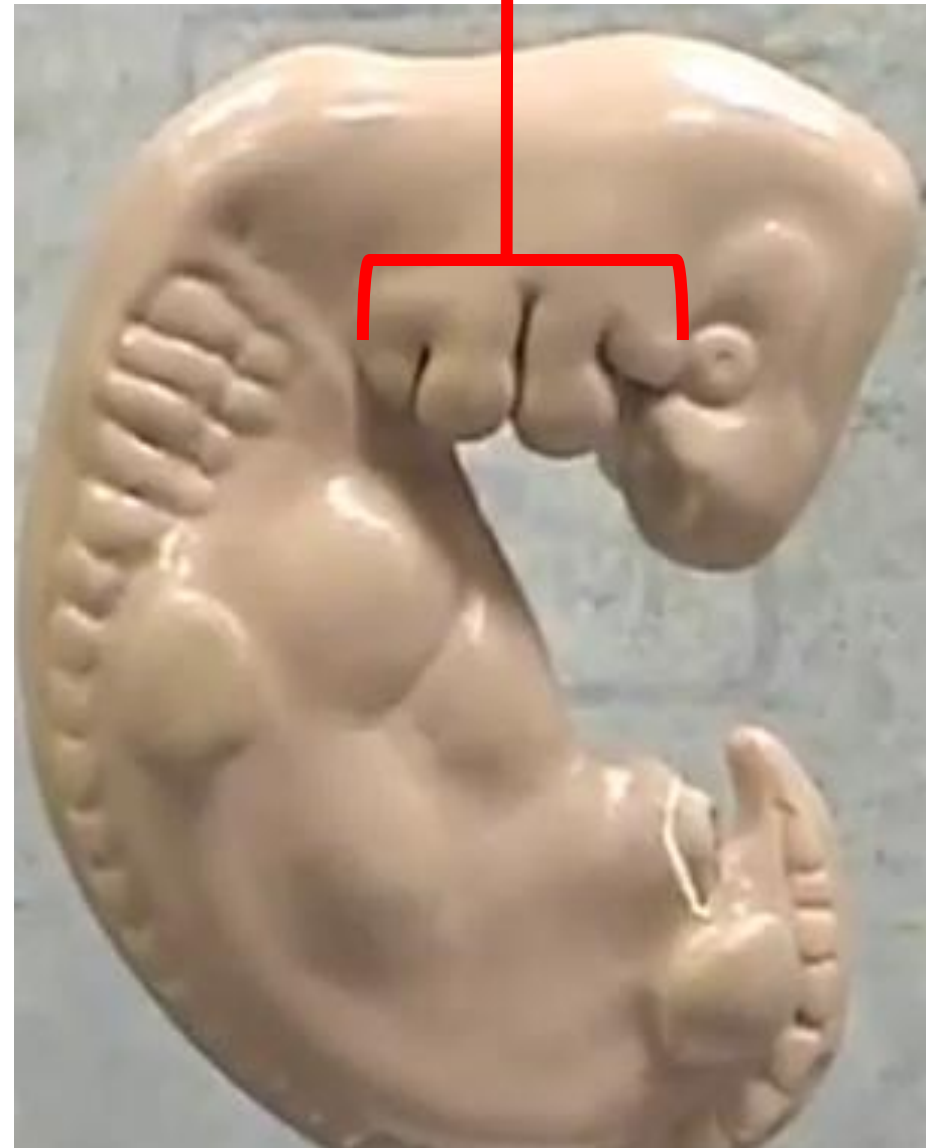


**Pharyngeal apparatus**

# Pharyngeal (Branchial) Arches

- ✓ They are 6 mesodermal thickenings on both sides of pharynx
- ✓ They appear in the 4<sup>th</sup> and 5<sup>th</sup> weeks
- ✓ Arches are covered with ectoderm (externally) and lined with endoderm (internally)
- ✓ Arches are separated from each other by 4 clefts on outer surface which is covered with ectoderm
- ✓ Arches are separated from each other by 5 pouches on inner aspect (cavity of pharynx) which are lined with endoderm

## Pharyngeal arches





# Pharyngeal arches

Primordia of the eye

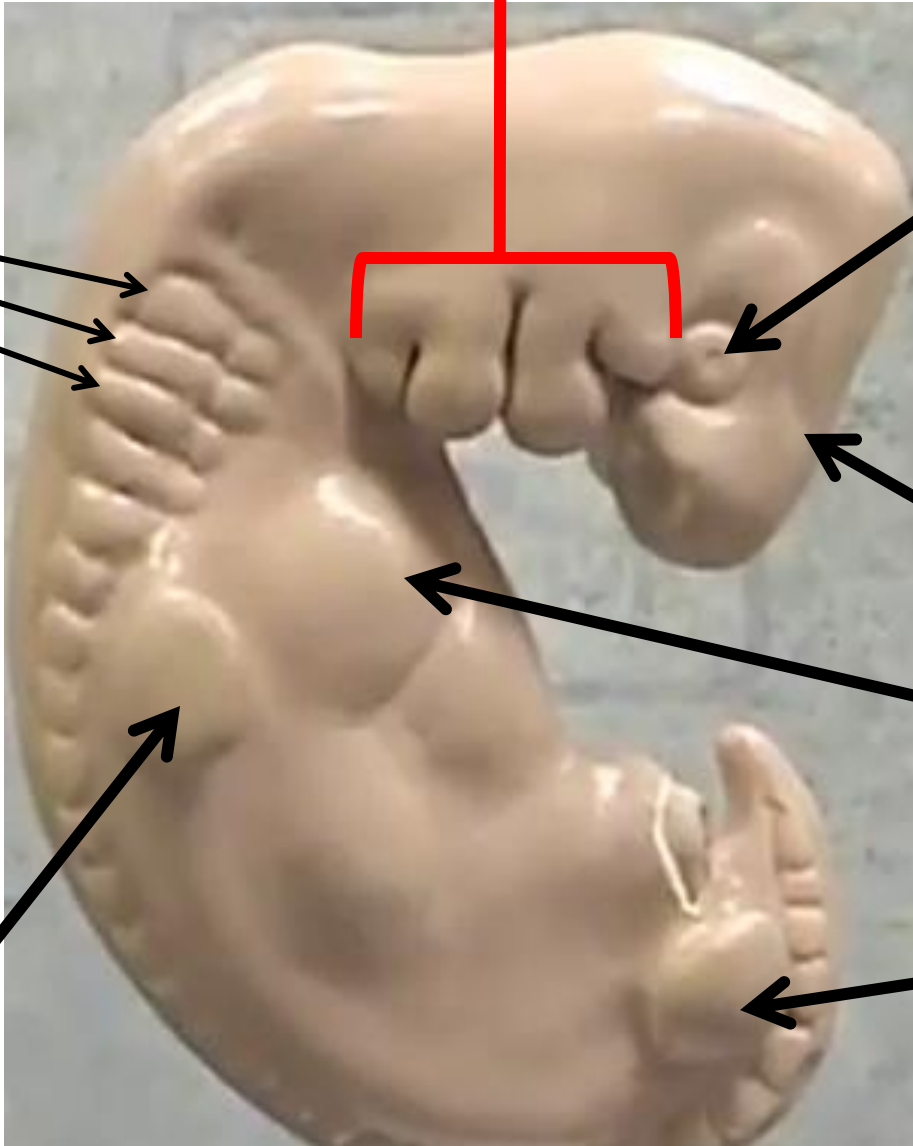
Somites

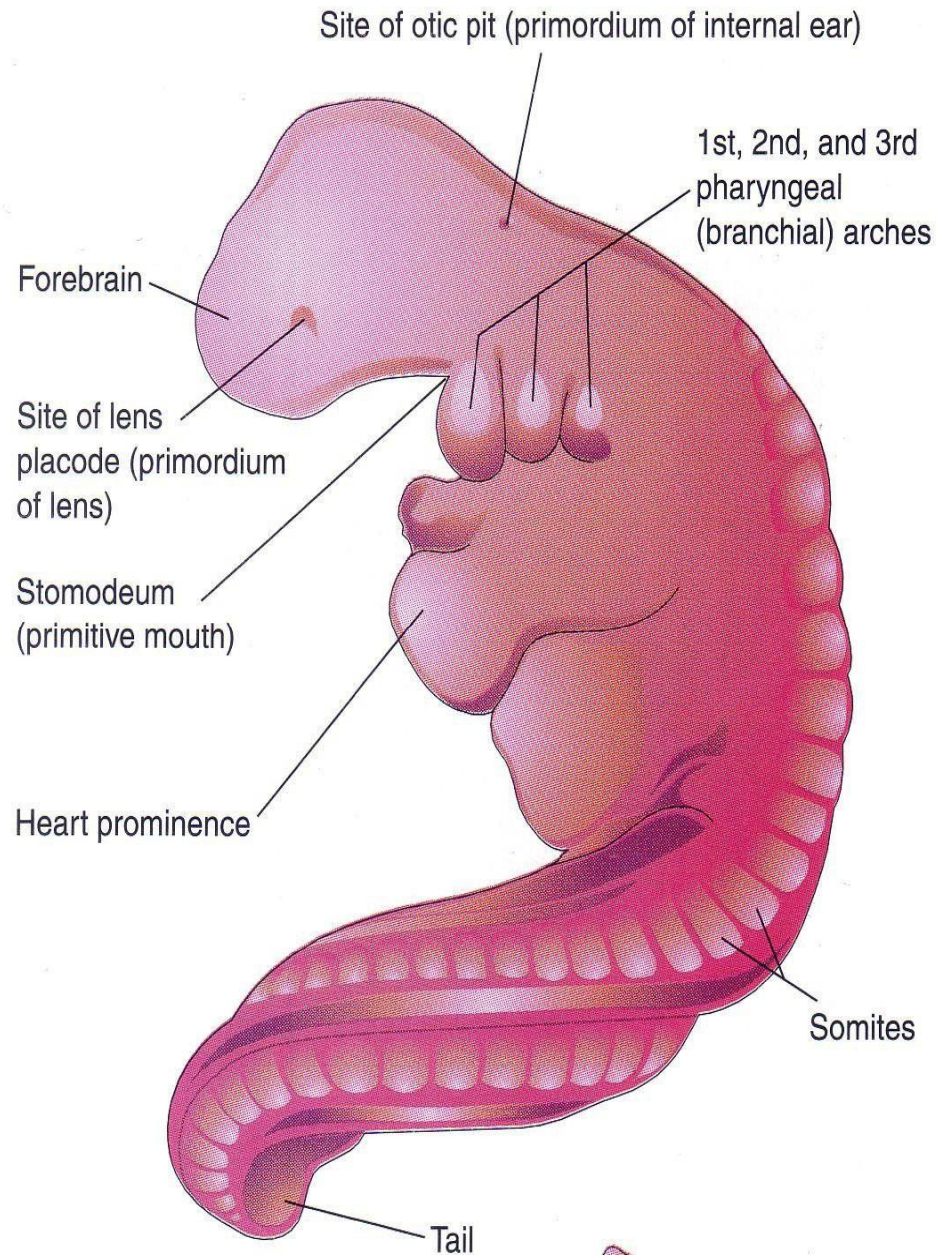
Forebrain bulge

Pericardium bulge

Lower limb bud

Upper limb bud

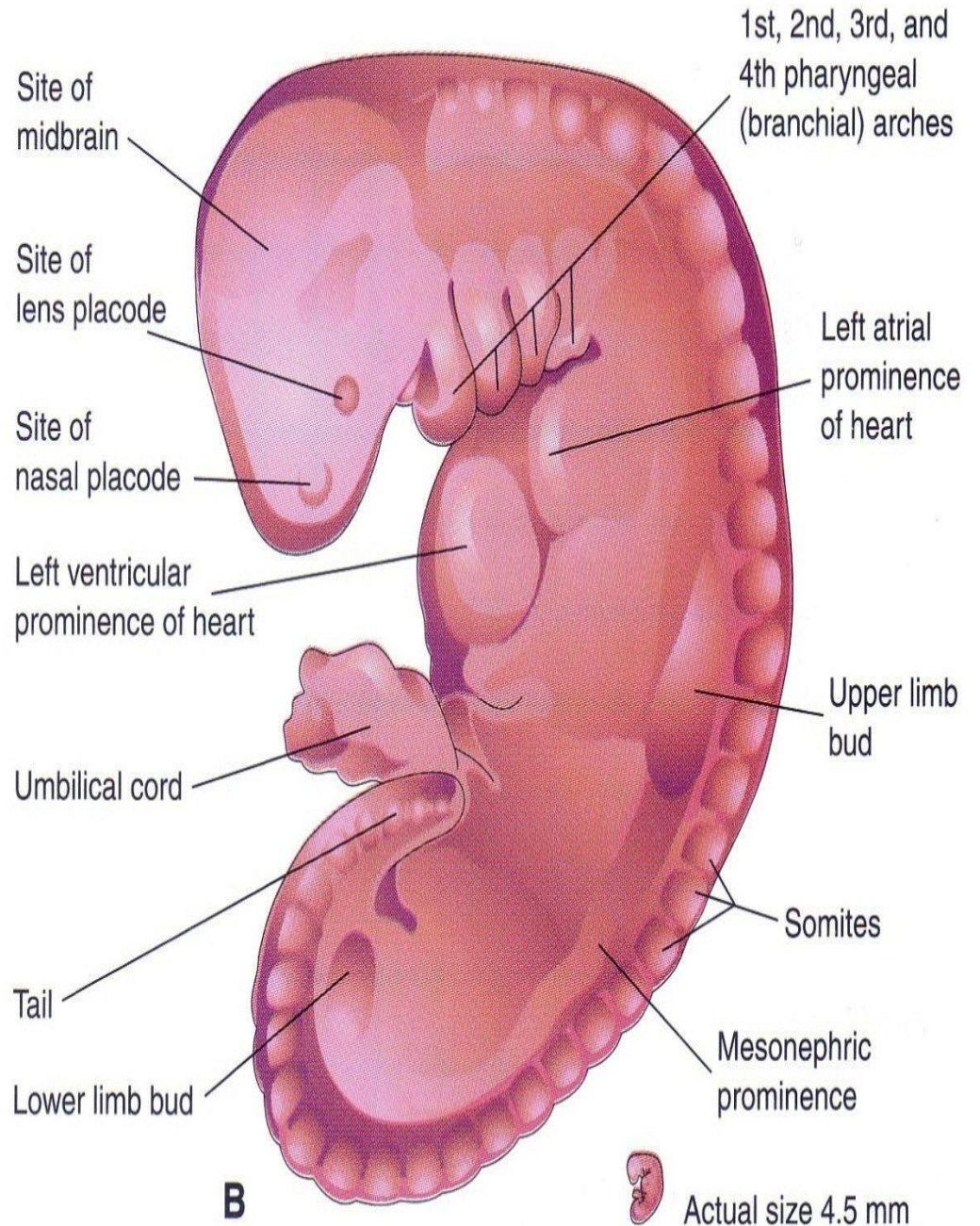




**B**



Actual size 4.0 mm



A

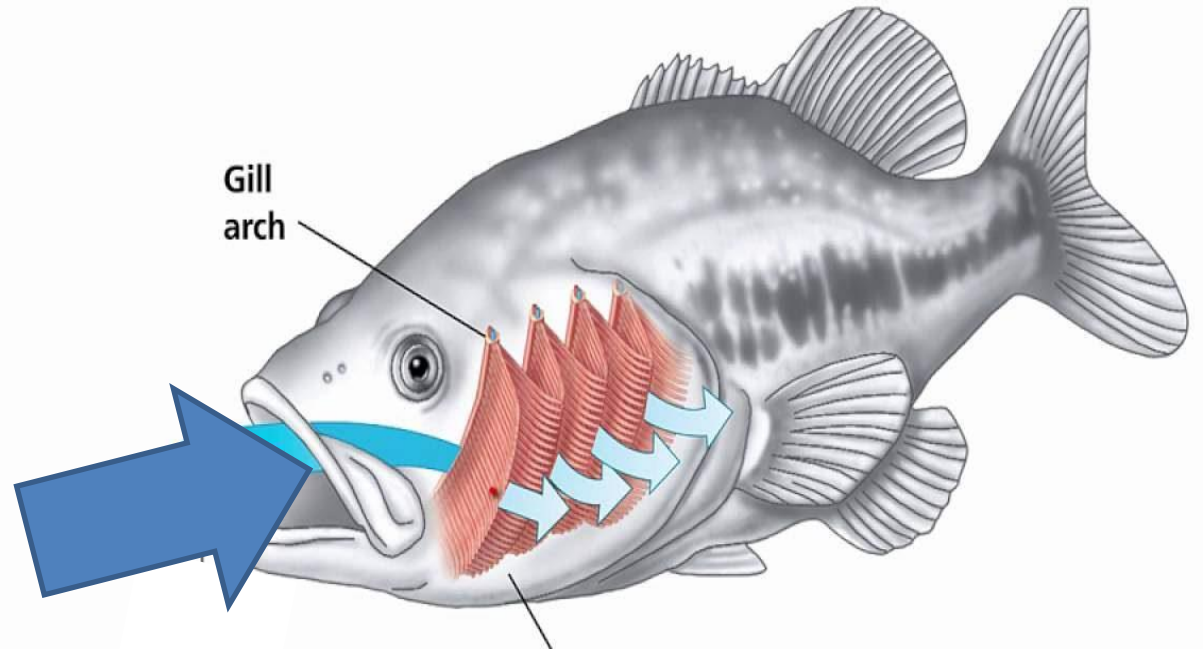
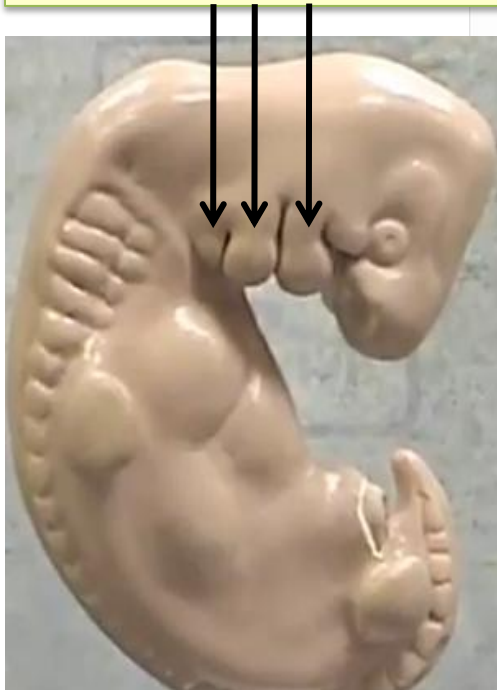
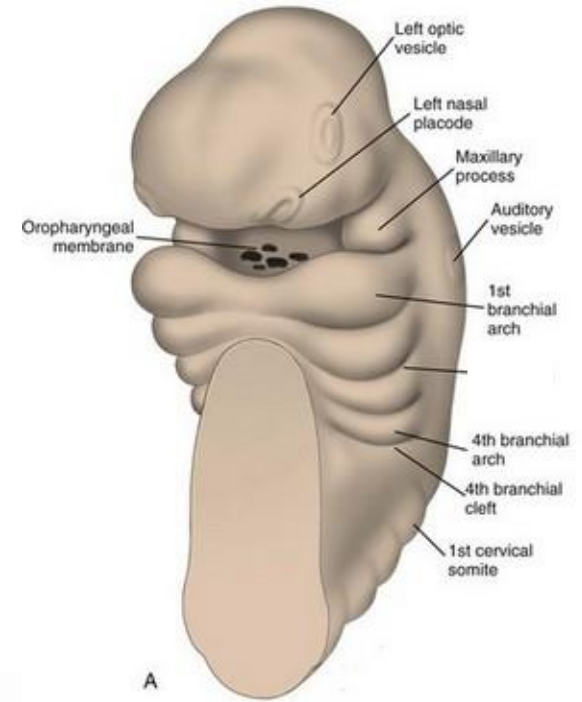
B

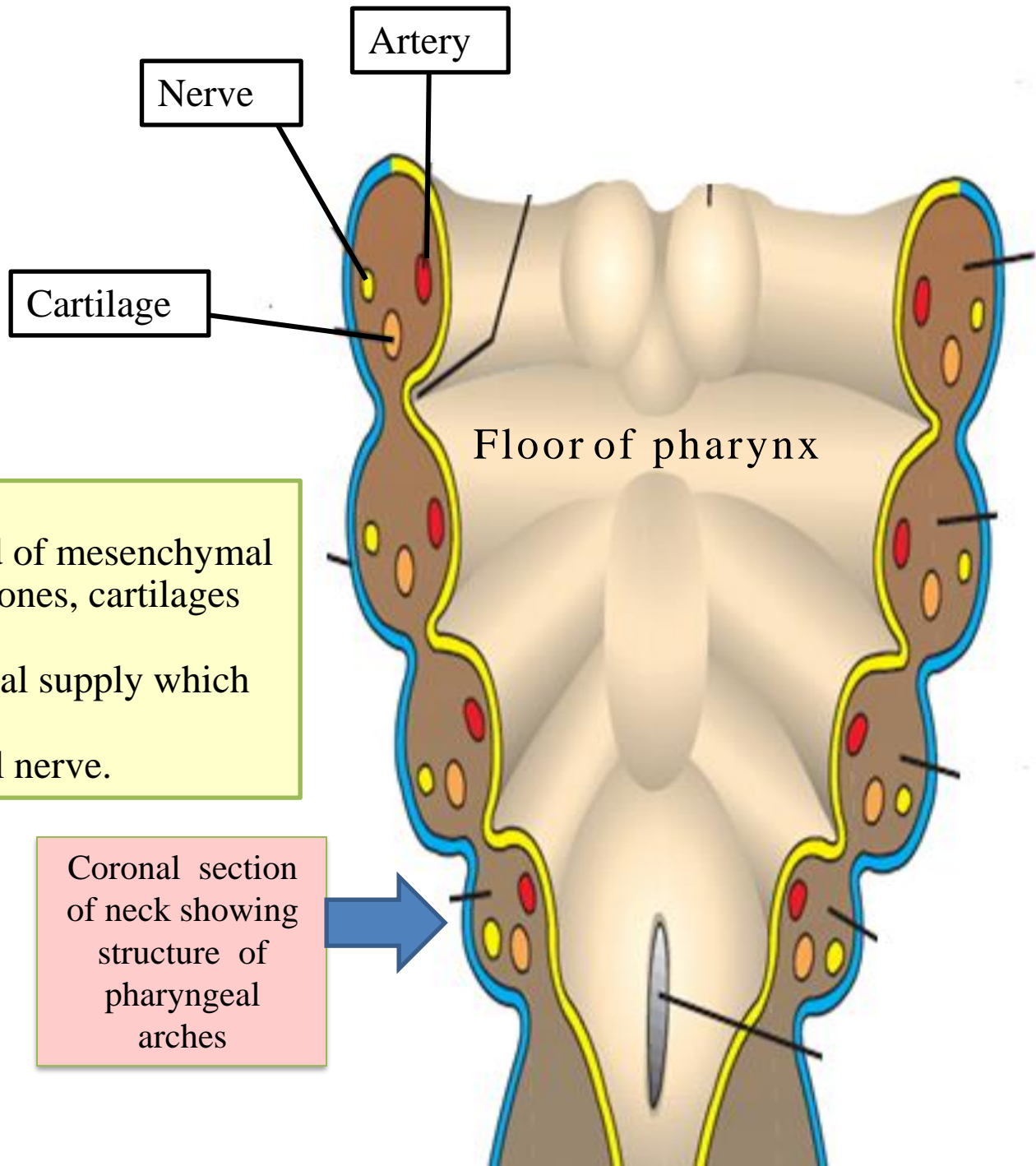
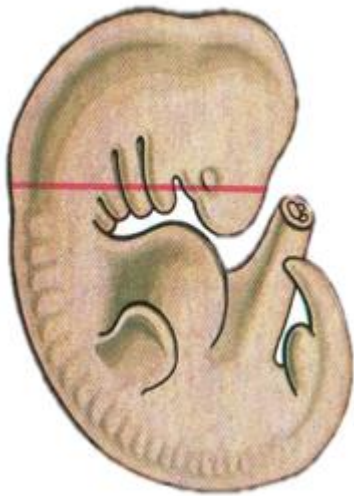
# Why pharyngeal arches?

In human embryo, the arches form on the sides of the pharynx

# Why branchial arches?

Pharyngeal arches resemble the gills of the fish in shape  
Gills=branchia





**Structure of each arch**

- Each arch is composed of mesenchymal cells that give rise to bones, cartilages and muscles.
- Each arch has an arterial supply which is called aortic arch.
- Each arch has a cranial nerve.

Coronal section of neck showing structure of pharyngeal arches

# Nerve supply of pharyngeal arches

**Mandibular & Maxillary nerves** supplies derivatives of **1<sup>st</sup> arch**

**Facial nerve** supplies derivatives of **2<sup>nd</sup> arch**

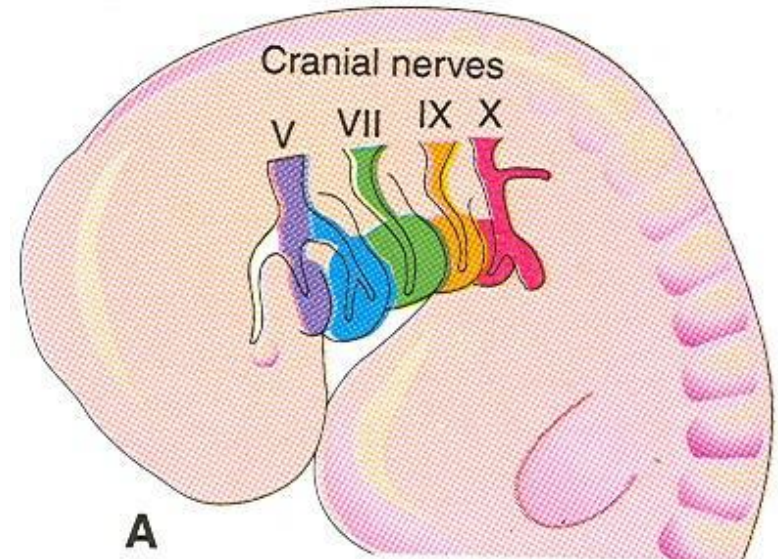
**Glossopharyngeal nerve** supplies derivatives of **3<sup>rd</sup> arch**

**Superior laryngeal nerve (vagus nerve)** supplies derivatives of **4<sup>th</sup> arch**

**Recurrent laryngeal nerve (vagus nerve)** supplies derivatives of **6<sup>th</sup> arch**

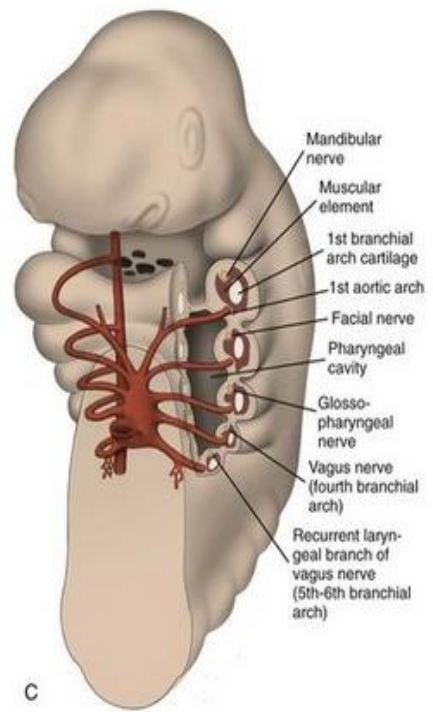
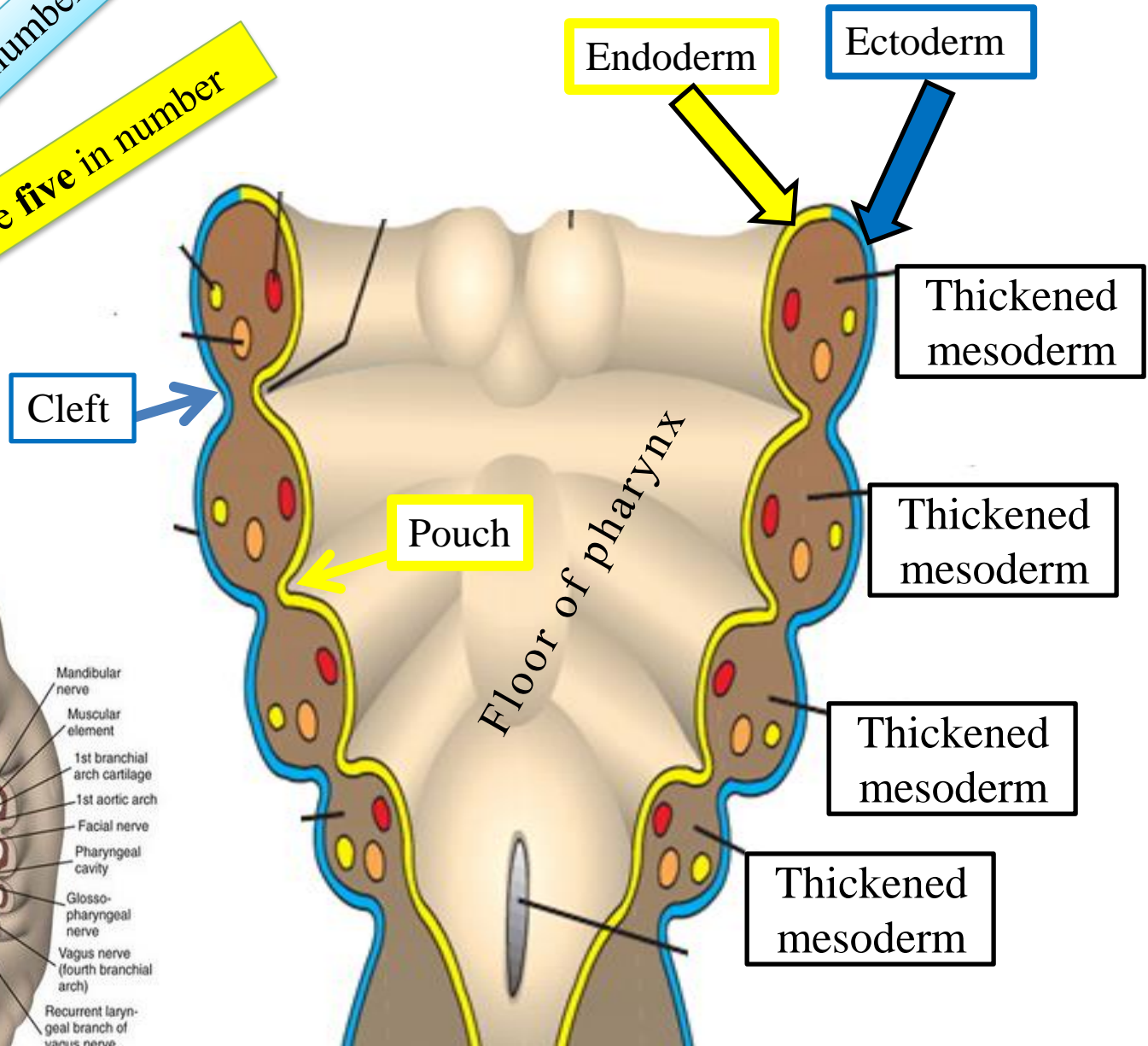
Each nerve supplies the mucosa and muscles derived from the arch

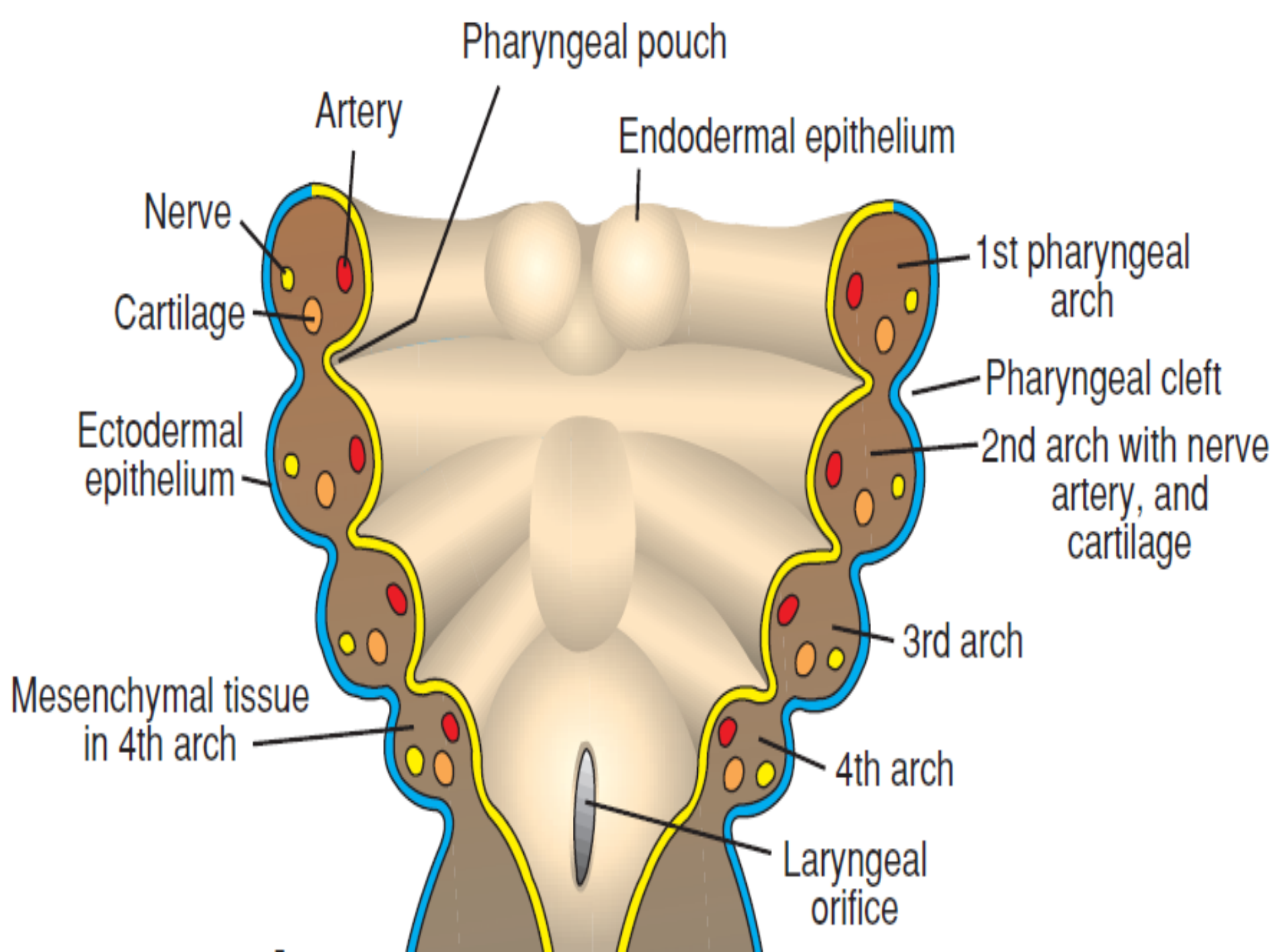
Each arch has its own cranial nerve and wherever the muscle cells migrate, they carry their nerve component with them



Clefts are **four** in number

Pouches are **five** in number





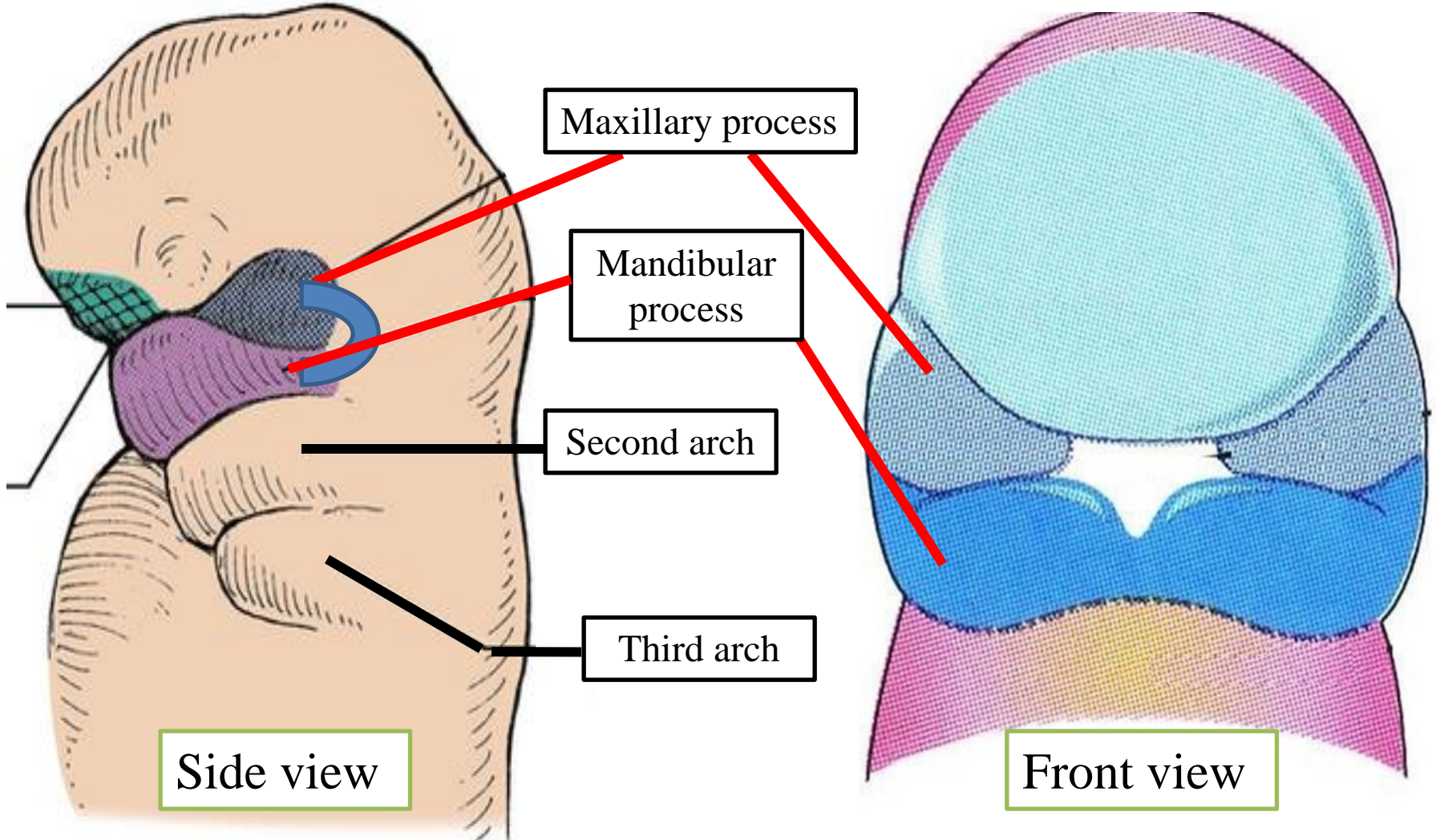


**First arch has 2 processes:**

1- Maxillary process

2- Mandibular process

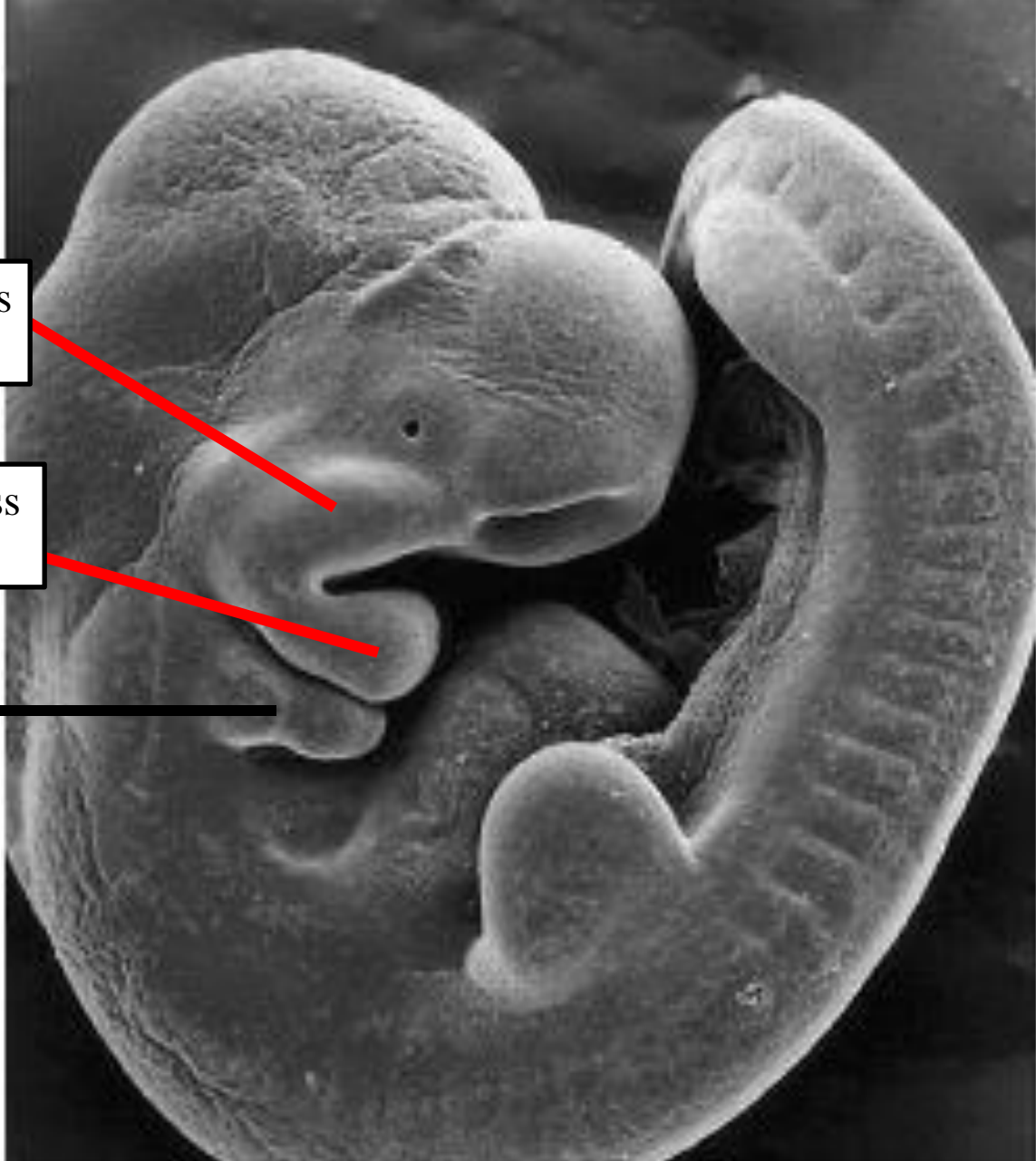
**Both processes grow forward**



Maxillary process  
of first arch

Mandibular process  
of first arch

Second arch



- ✓ **Maxillary process** is a forward growth of **dorsal end of 1<sup>st</sup> pharyngeal arch**
- ✓ **Mandibular process** is a forward growth of **ventral end of 1<sup>st</sup> pharyngeal arch**

Maxillary process  
of first arch

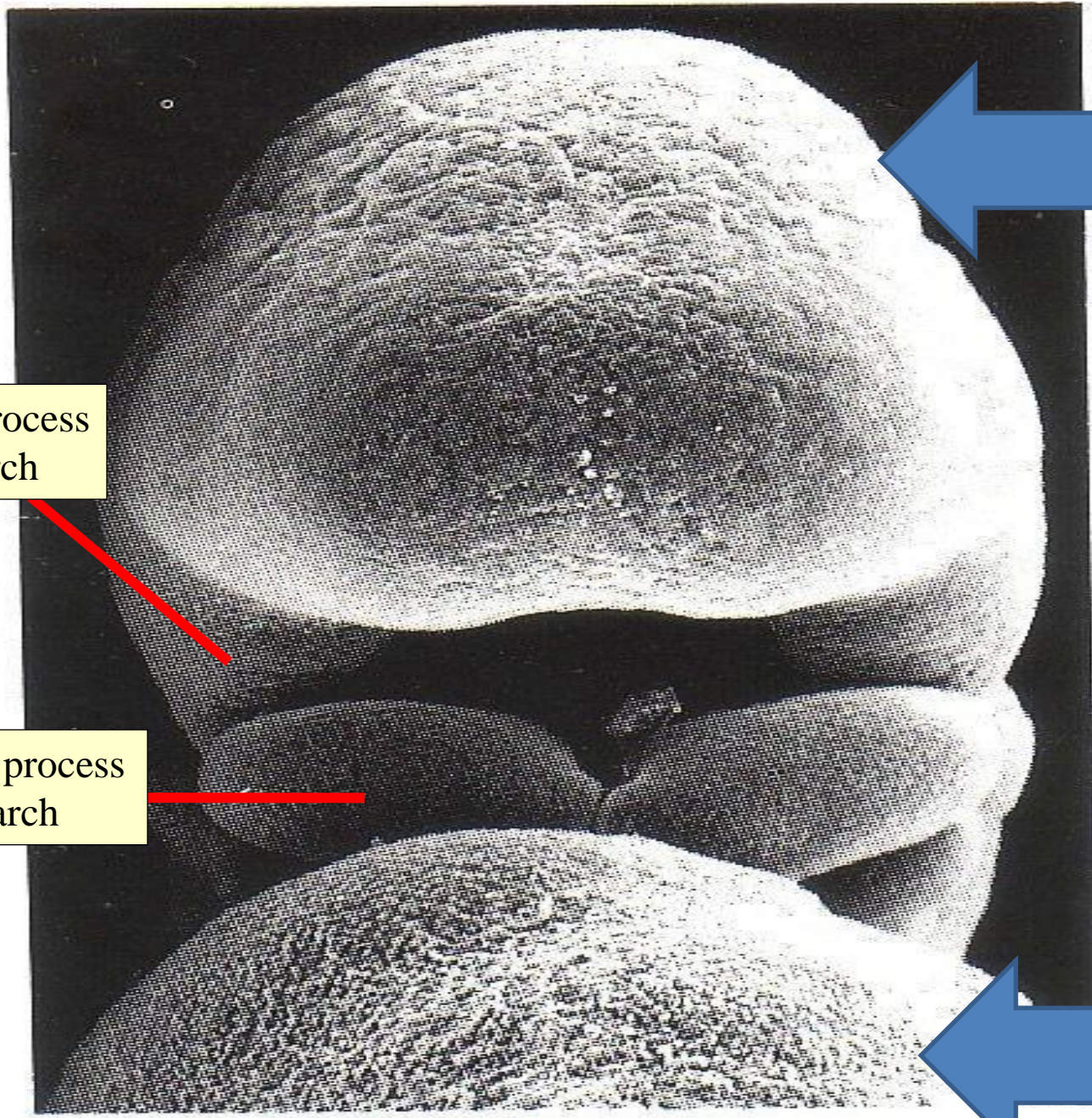
Mandibular process  
of first arch

Forebrain bulge

Pericardium  
bulge

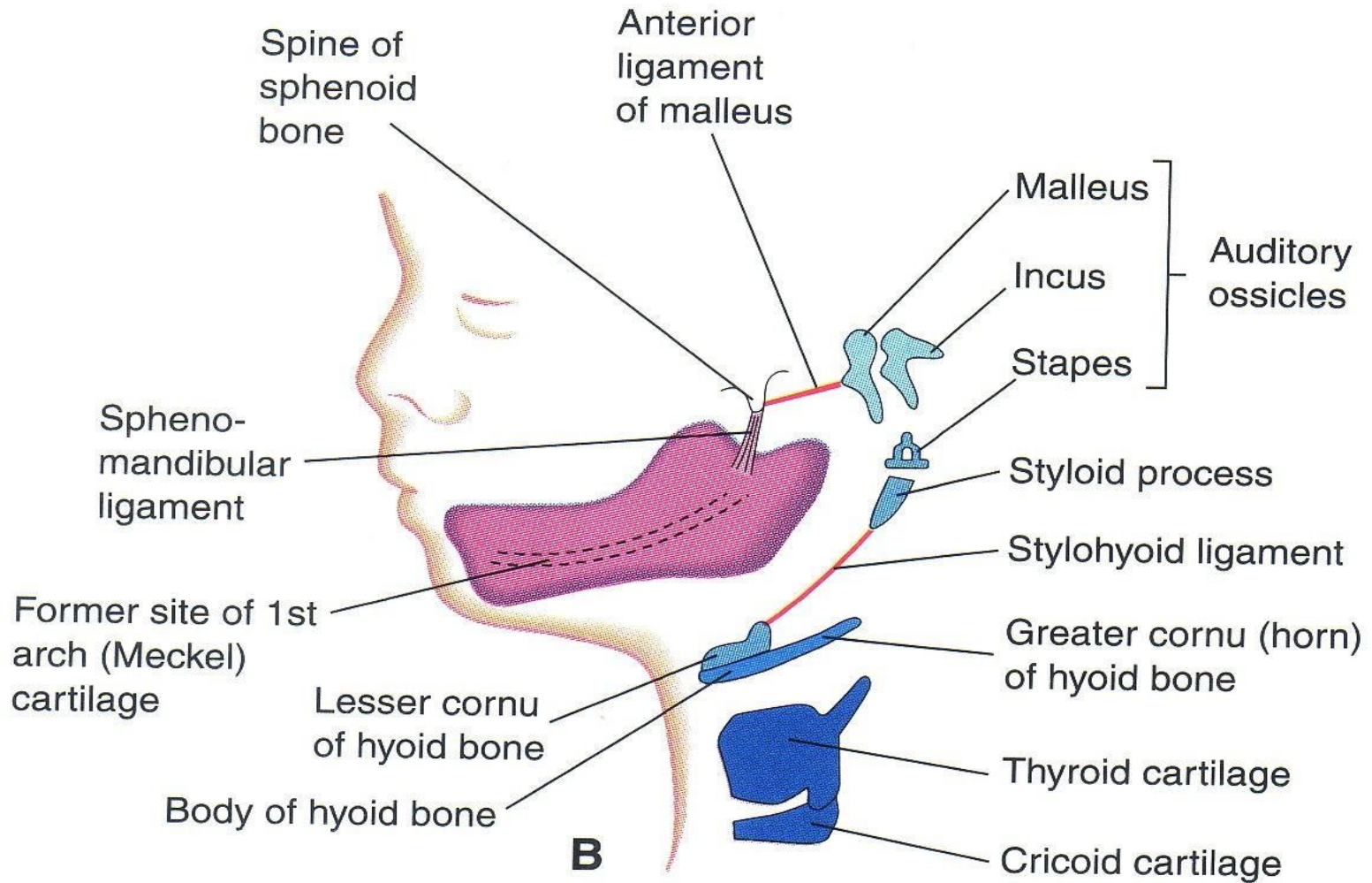
Fourth Week

*Dr. Heba Kalbouneh*




# **Derivatives of pharyngeal arches**

# Derivatives of pharyngeal arches



 Third arch cartilage

 Fourth and sixth arch cartilages

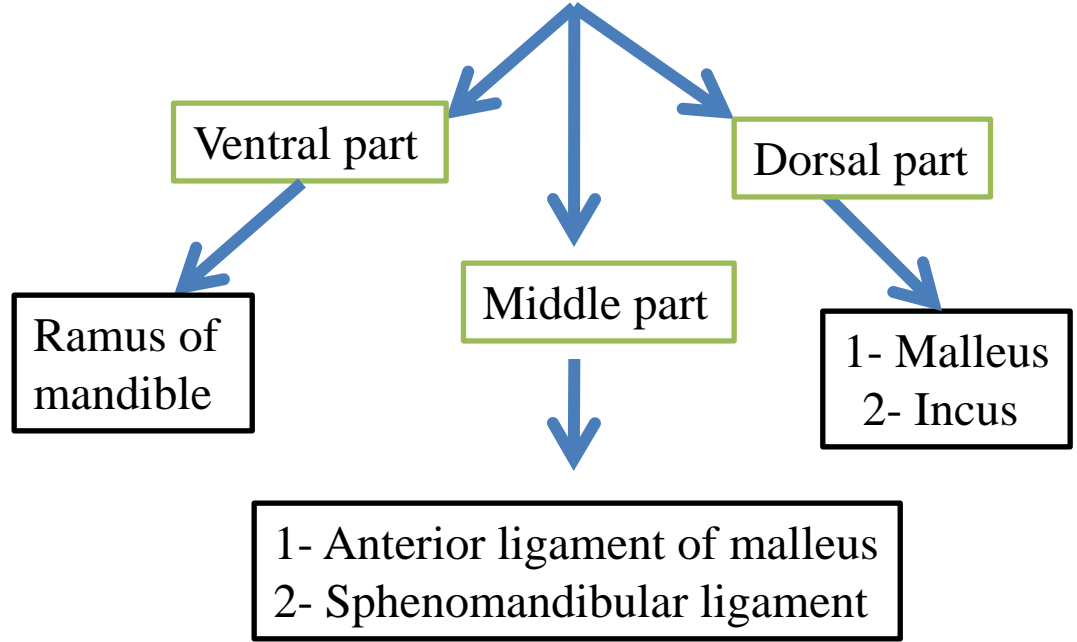
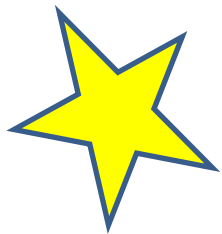
# Derivatives of first pharyngeal arch

**Maxillary process forms:**

1. Lower part of temporal bone
2. Zygomatic bone
3. Maxilla

**Mandibular process forms**  
Meckel's cartilage

## Meckel's cartilage

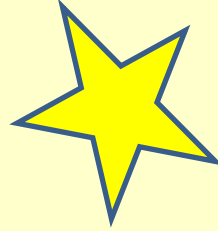


**N.B** The rest of the mandible is formed by intramembranous ossification

## Muscles of first pharyngeal arch:

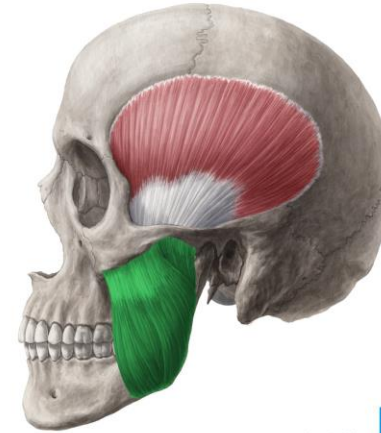
Are the muscles supplied by the **mandibular nerve**:

1. Muscles of mastication
2. Tensor tympani
3. Anterior belly of digastric
4. Mylohyoid
5. Tensor veli palatini



*The nerve supply to the muscles of the first arch is provided by the mandibular branch of the trigeminal nerve. Since mesenchyme from the first arch also contributes to the dermis of the face, sensory supply to the skin of the face is provided by ophthalmic, maxillary, and mandibular branches of the trigeminal nerve.*

Masseter & Temporalis



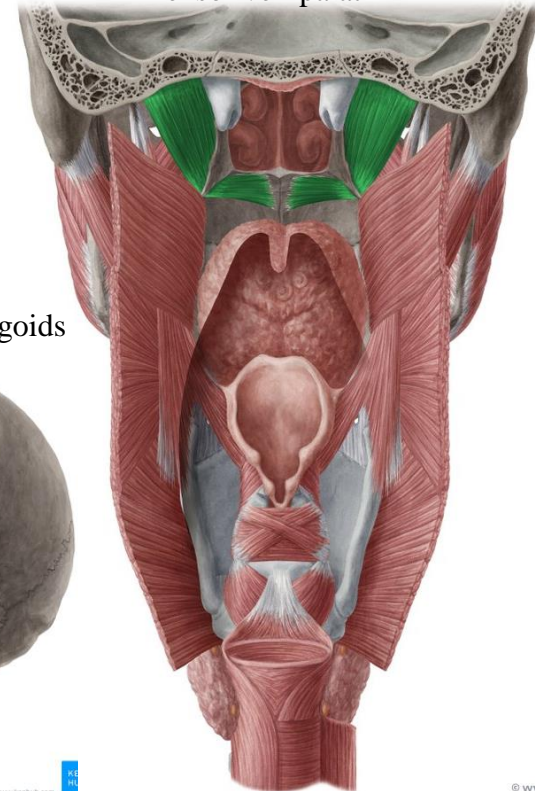
Mylohyoid



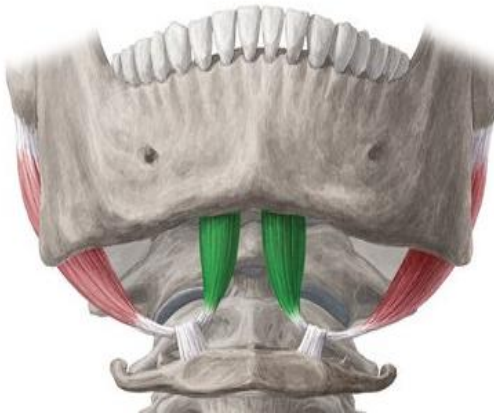
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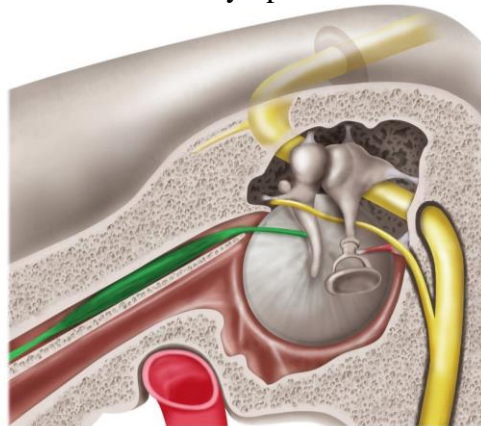
Tensor veli palatini



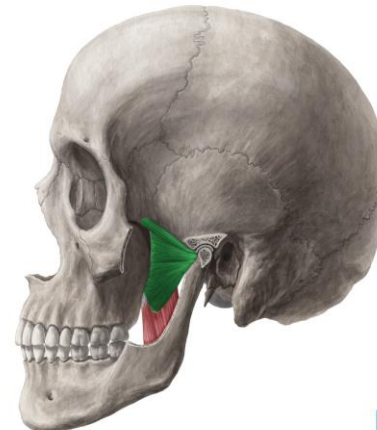
Anterior belly of digastric



Tensor tympani



Medial & Lateral pterygoids



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# Derivatives of second pharyngeal arch



The cartilage of the second or hyoid arch  
(Reichert's cartilage)

## Reichert's cartilage

Ventral part

Dorsal part

Middle part

- 1- Upper part of the body of hyoid bone
- 2- Lesser horn of the hyoid bone

- 1- Stapes
- 2- Styloid process

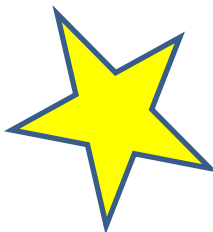
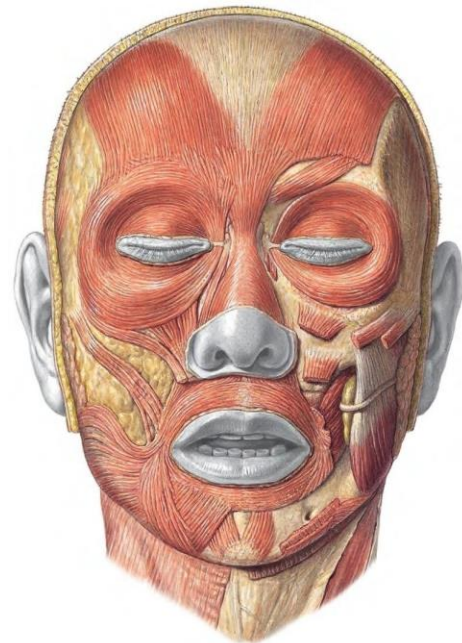
Stylohyoid ligament



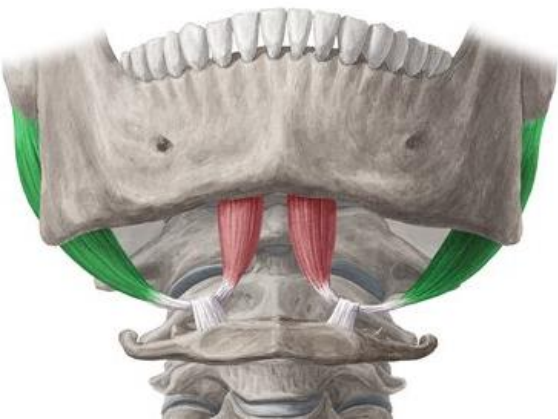
Muscle of facial expression

**Muscles of second pharyngeal arch:**  
Are the muscles supplied by the **facial nerve** :

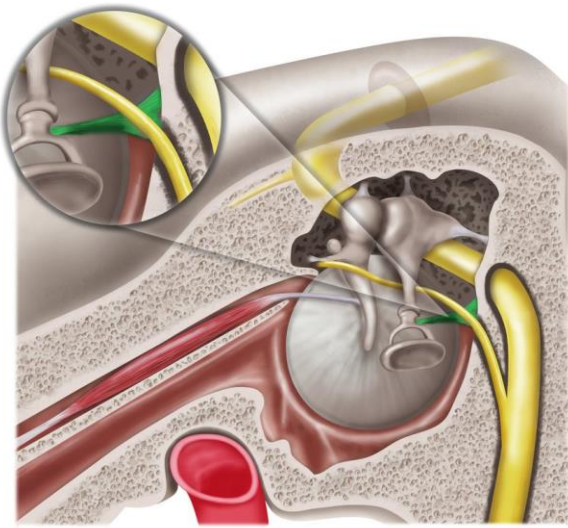
- 1- Muscle of facial expression
- 2- Stapedius
- 3- Stylohyoid
- 4- Posterior belly of the digastric



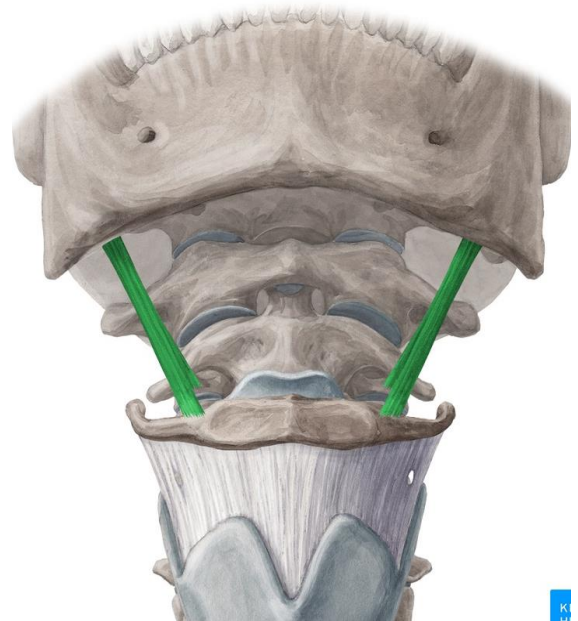
Posterior belly of the digastric



Stapedius



Stylohyoid



## Derivatives of third pharyngeal arch

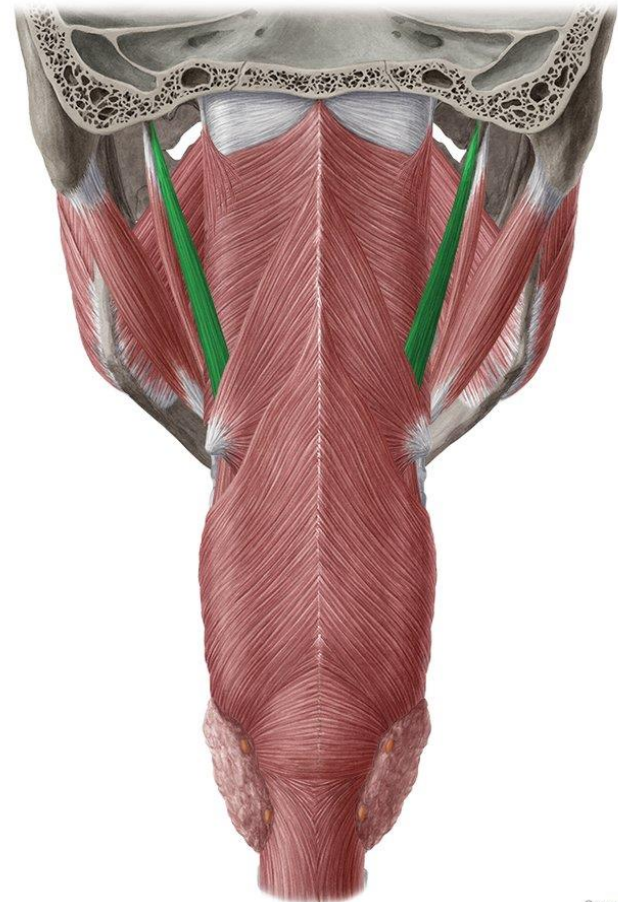
The cartilage of the third pharyngeal arch produces:

- 1- Lower part of the body of hyoid
- 2- Greater horn of hyoid bone

### Muscles of third pharyngeal arch:

Only one muscle supplied by  
**Glossopharyngeal nerve:**  
Stylopharyngeus muscle

Read only  
Digestive system

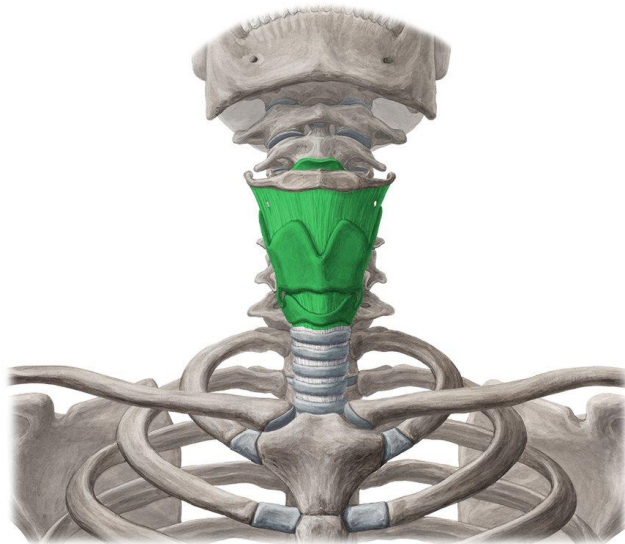


# Derivatives of fourth pharyngeal arch

Read only  
Respiratory system

The cartilage of the fourth pharyngeal arch produces:  
Laryngeal cartilages

**Muscles of fourth pharyngeal arch:**  
Only one muscle (Cricothyroid muscle)  
Supplied by **Superior laryngeal nerve (vagus)**

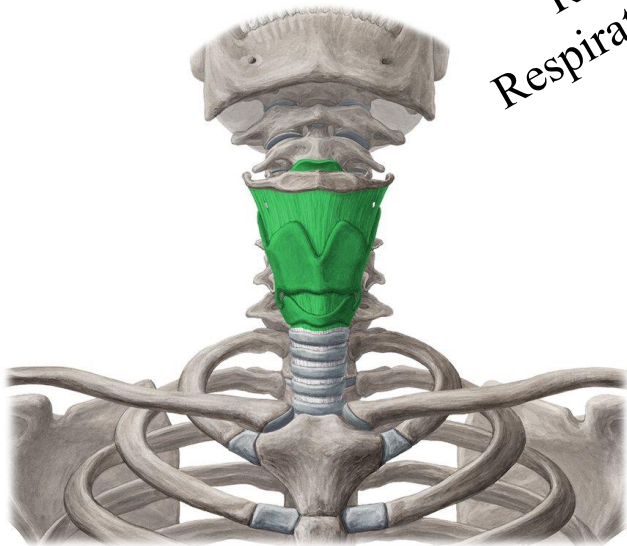


# Derivatives of sixth pharyngeal arch

The cartilages of the sixth pharyngeal arch produce:  
Laryngeal cartilages

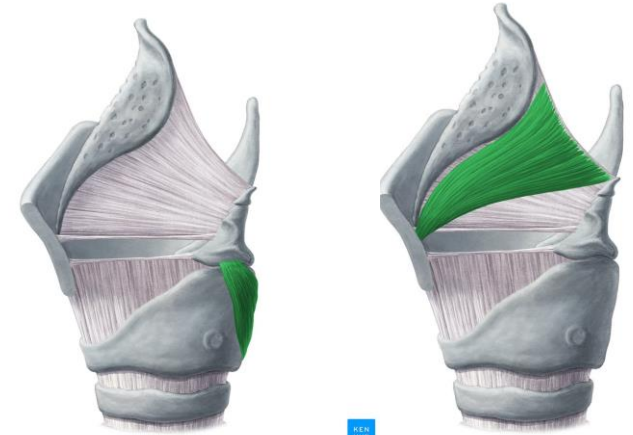
**Muscles of sixth pharyngeal arch:**  
All laryngeal muscles (except cricothyroid)  
Supplied by **Recurrent laryngeal nerve (vagus)**

Read only  
Respiratory system



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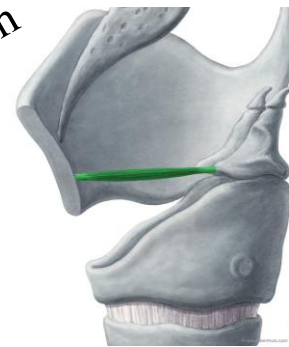


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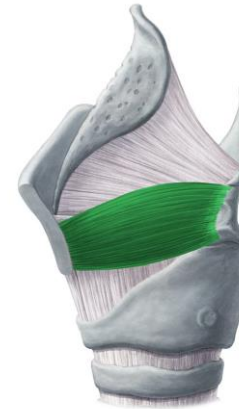
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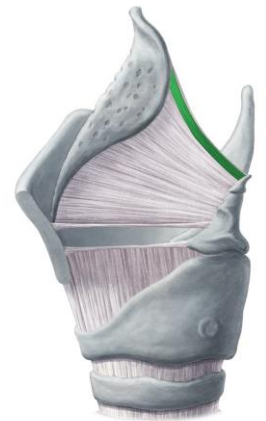
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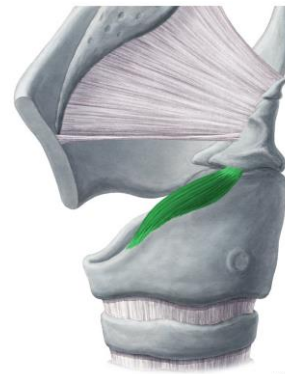


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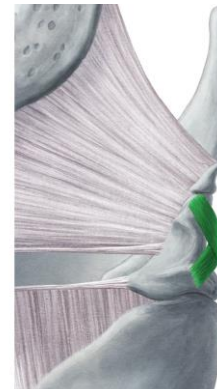


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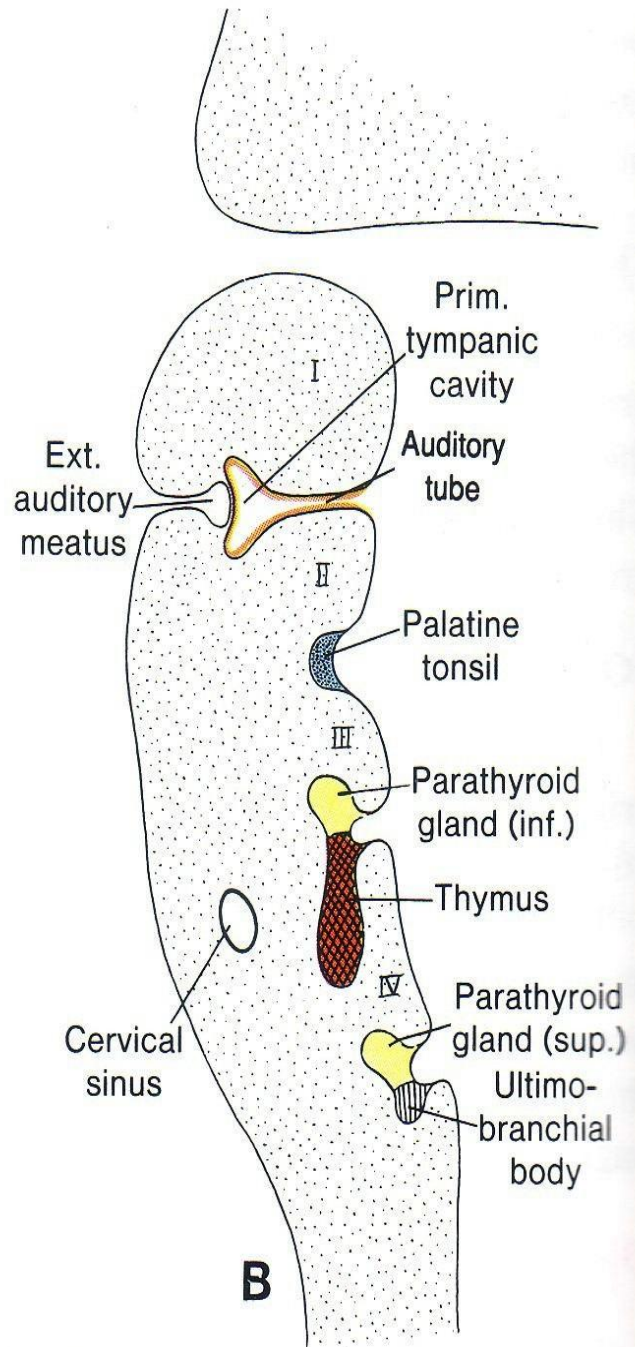
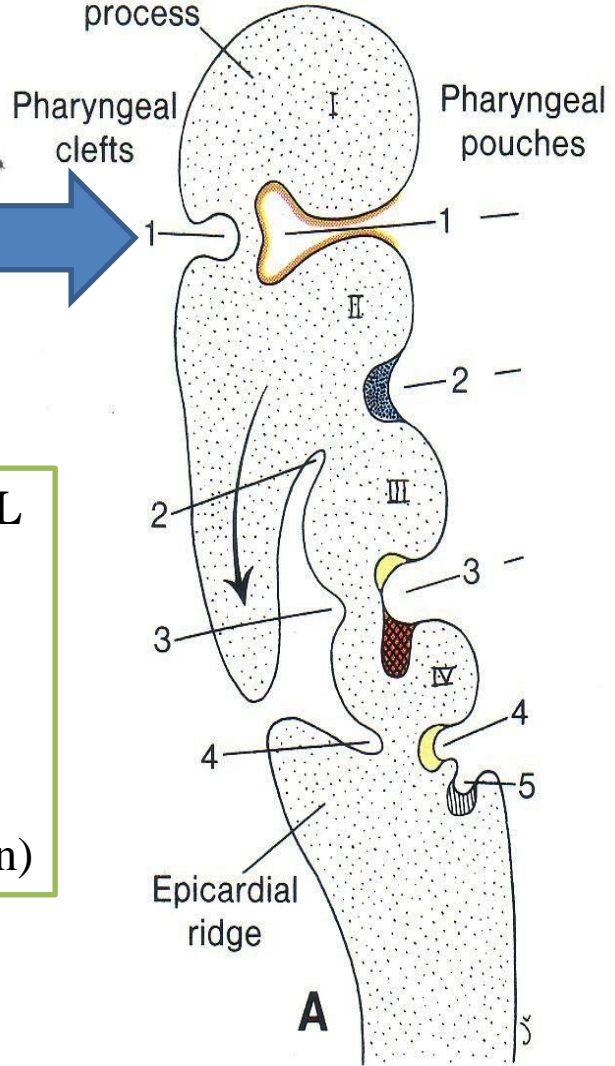
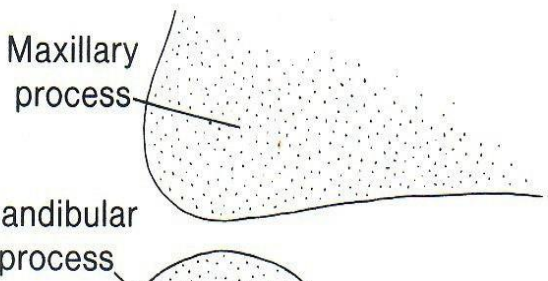
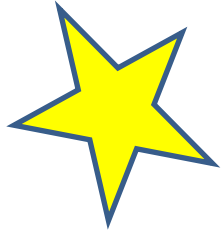
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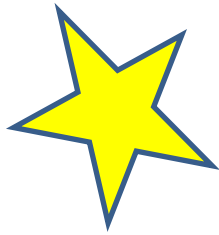
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# **Fate of pharyngeal clefts**



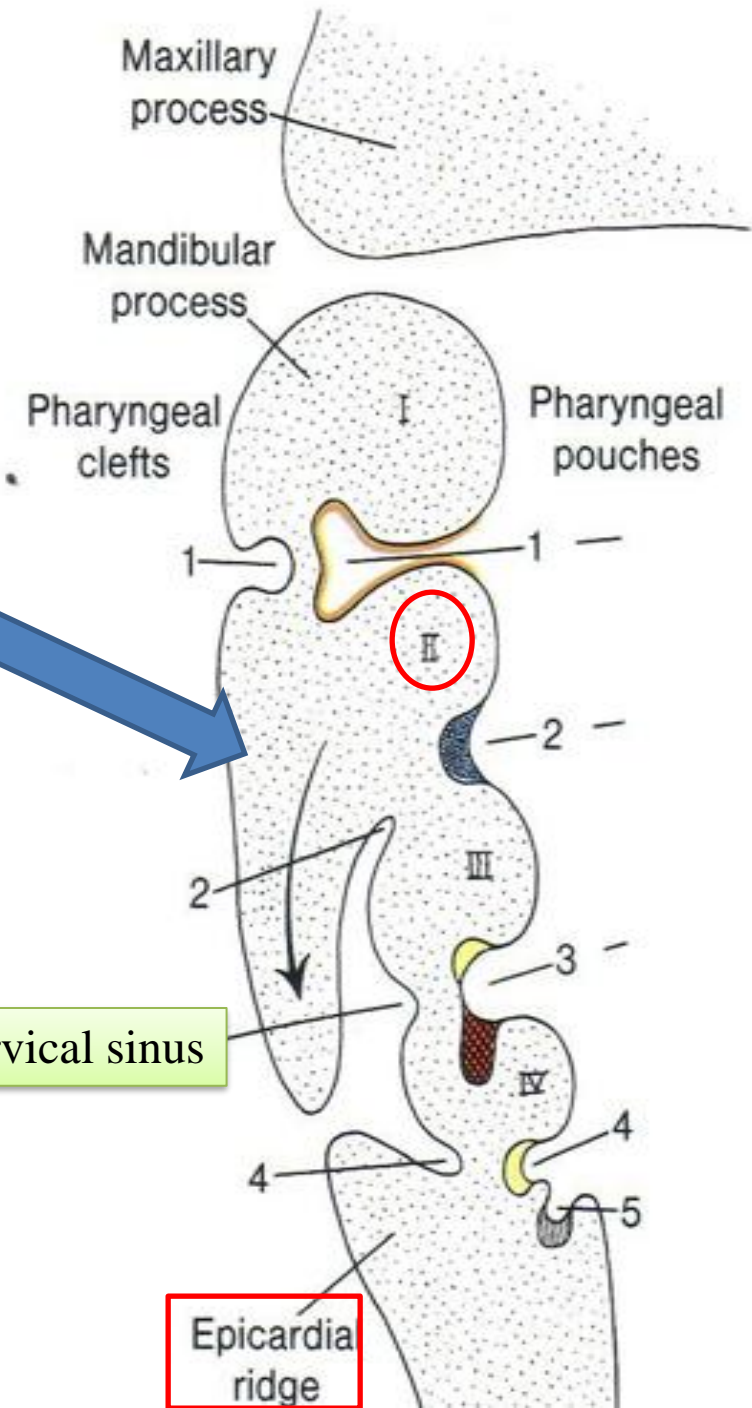
FIRST PHARYNGEAL CLEFT
Forms:
1- External auditory meatus
2- Outer layer of tympanic membrane (skin)



## 2<sup>nd</sup> 3<sup>rd</sup> and 4<sup>th</sup> PHARYNGEAL CLEFTS

Note the downward growth of 2<sup>nd</sup> arch

- Downward growth of 2<sup>nd</sup> arch will cover the other clefts with a space in between called **cervical sinus**.
- Cervical sinus becomes smaller till it is completely obliterated



Cervical sinus

Epicardia ridge



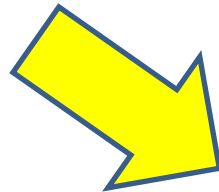
## Cervical (branchial) cyst

Remnant of cervical sinus

Can form a fluid filled cyst in the neck



The cervical cyst is usually not visible at birth but becomes evident as it **enlarges during childhood.**



Presents as a slowly enlarging lateral neck mass typically located in the lateral aspect of the neck, arising at any point along the anterior border of the **sternocleidomastoid muscle**. These cysts may intermittently swell, particularly in association with upper respiratory tract infections.



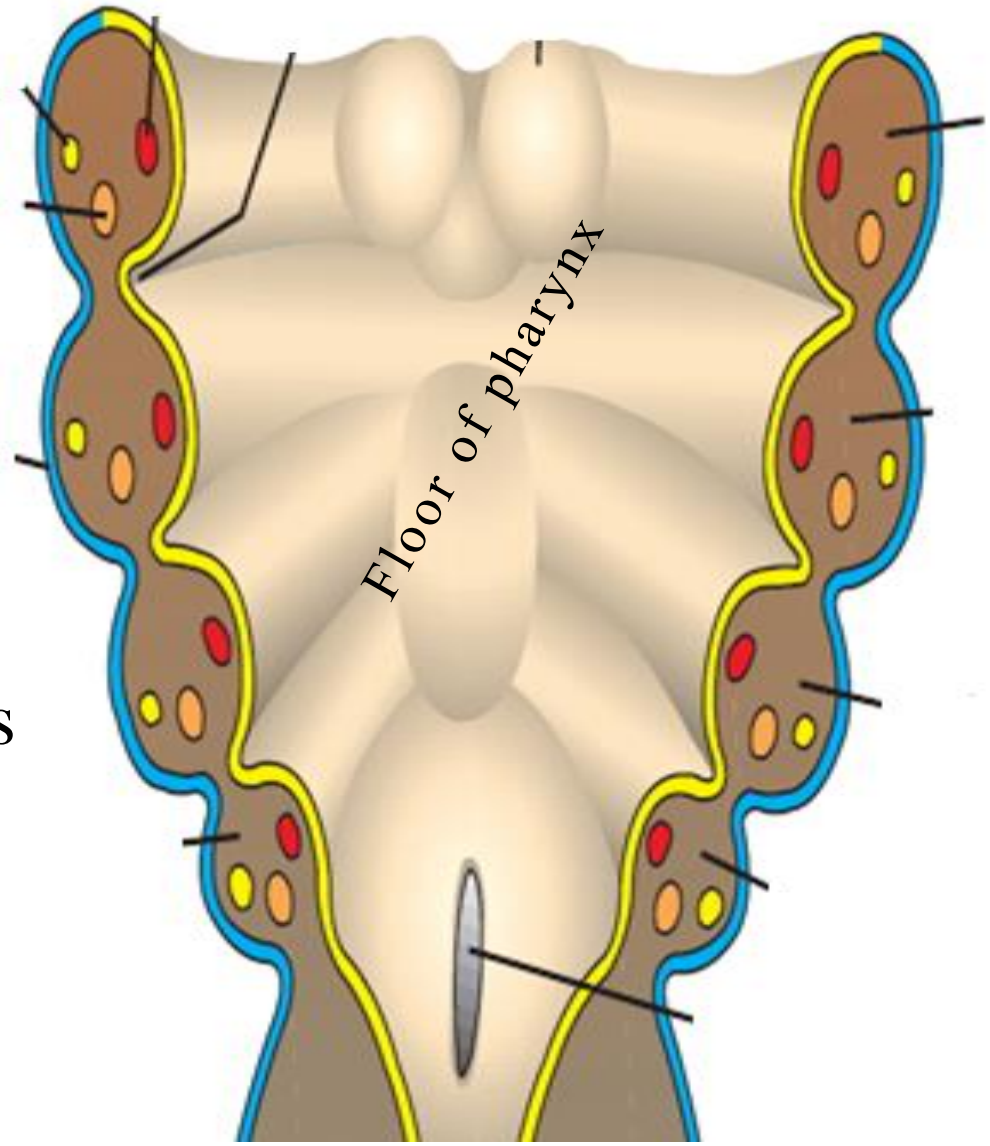
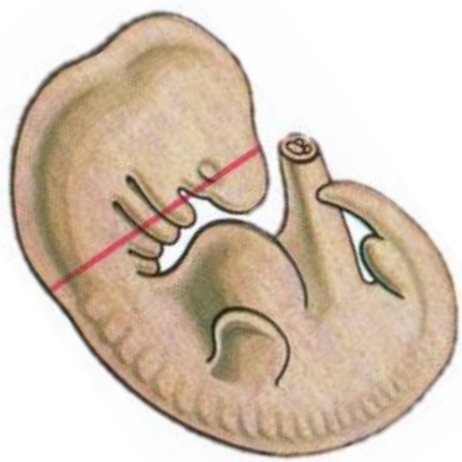
# **Fate of pharyngeal pouches**

# Fate of pharyngeal pouches

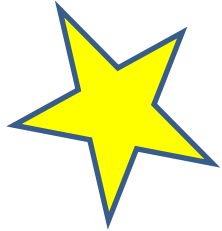
Arch	Ventral part	Dorsal part
First pouch	Occupied by the developing tongue	Inner mucous layer of tympanic membrane, middle ear and Eustachian tube
Second pouch	Occupied by the developing tongue	Palatine tonsils
Third pouch	Thymus gland	Inferior parathyroid glands
Fourth pouch	Unknown	Superior parathyroid glands
Fifth pouch	Ultimo-branchial body which forms parafollicular cells in thyroid	

Endocrine system

Only first and second pouches are covered in MSS



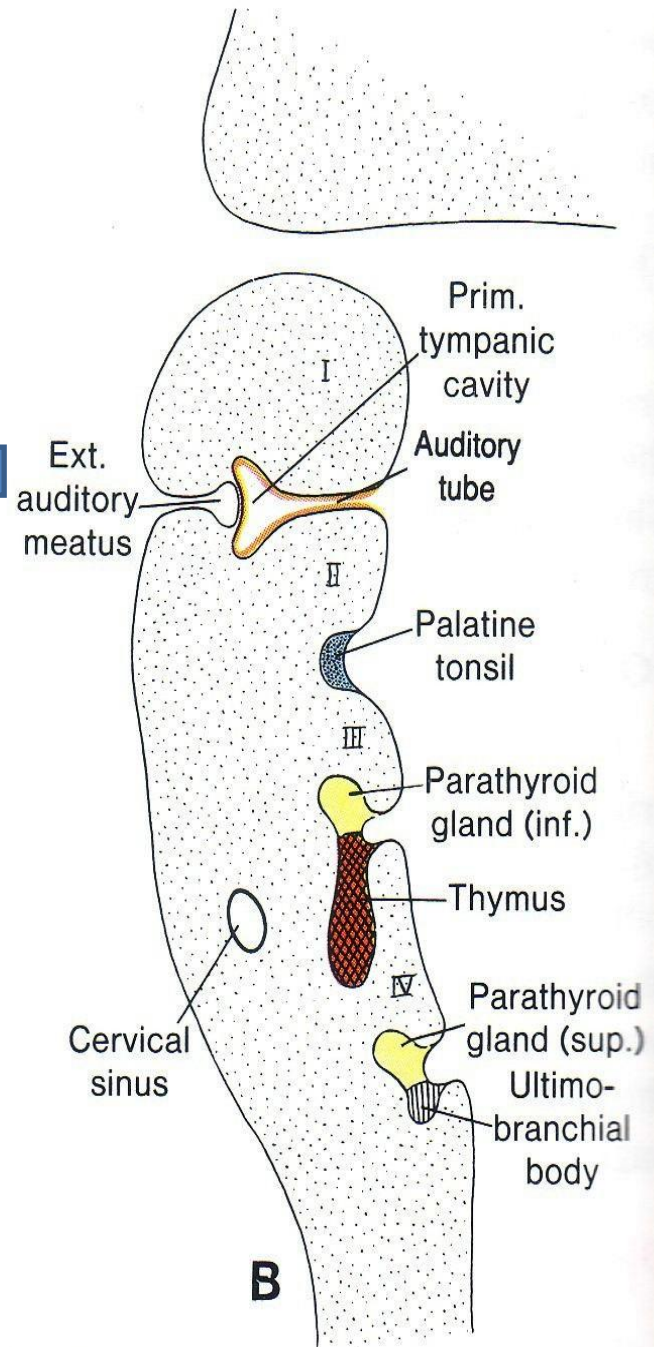
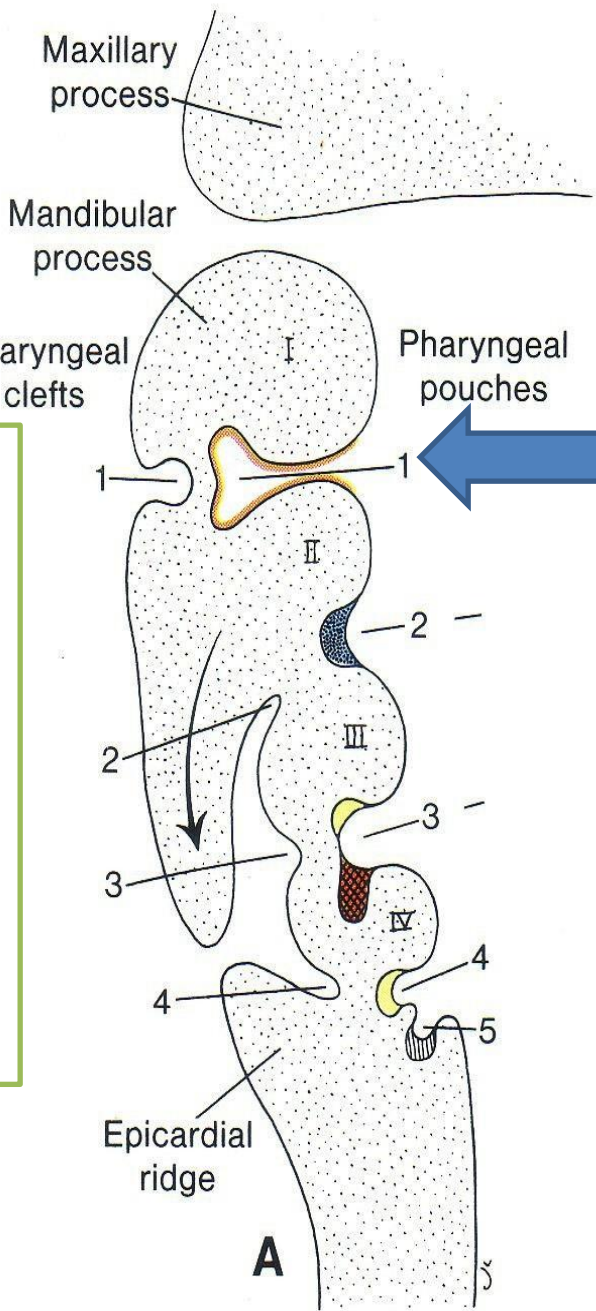
Note that the ventral parts of the pouches form the floor of the pharynx



**FIRST PHARYNGEAL POUCH (Dorsal end)**

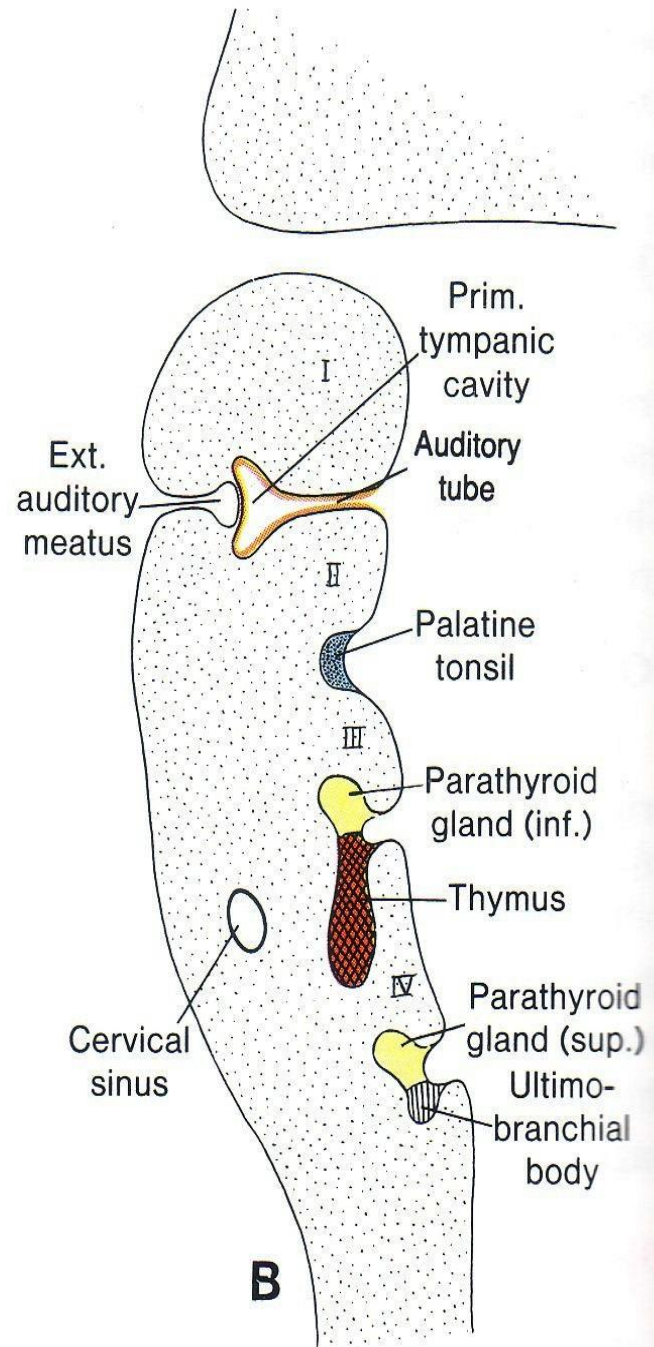
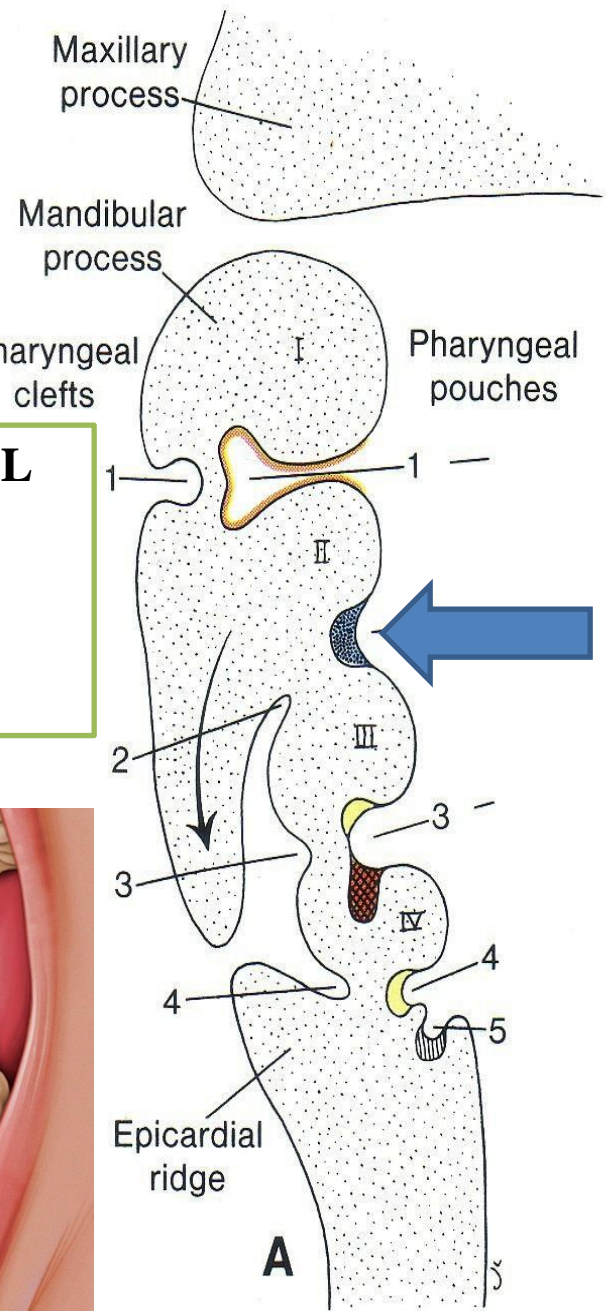
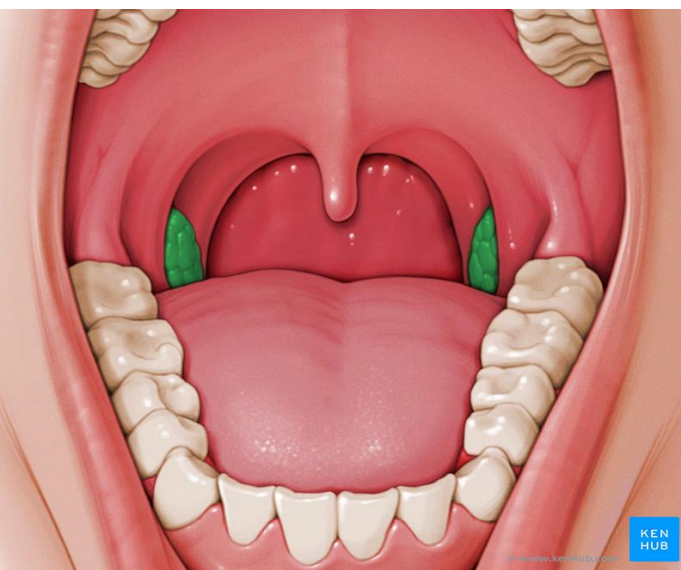
Forms:

- 1- Inner layer of tympanic membrane (mucous membrane)
- 2- Middle ear
- 3- Eustachian tube





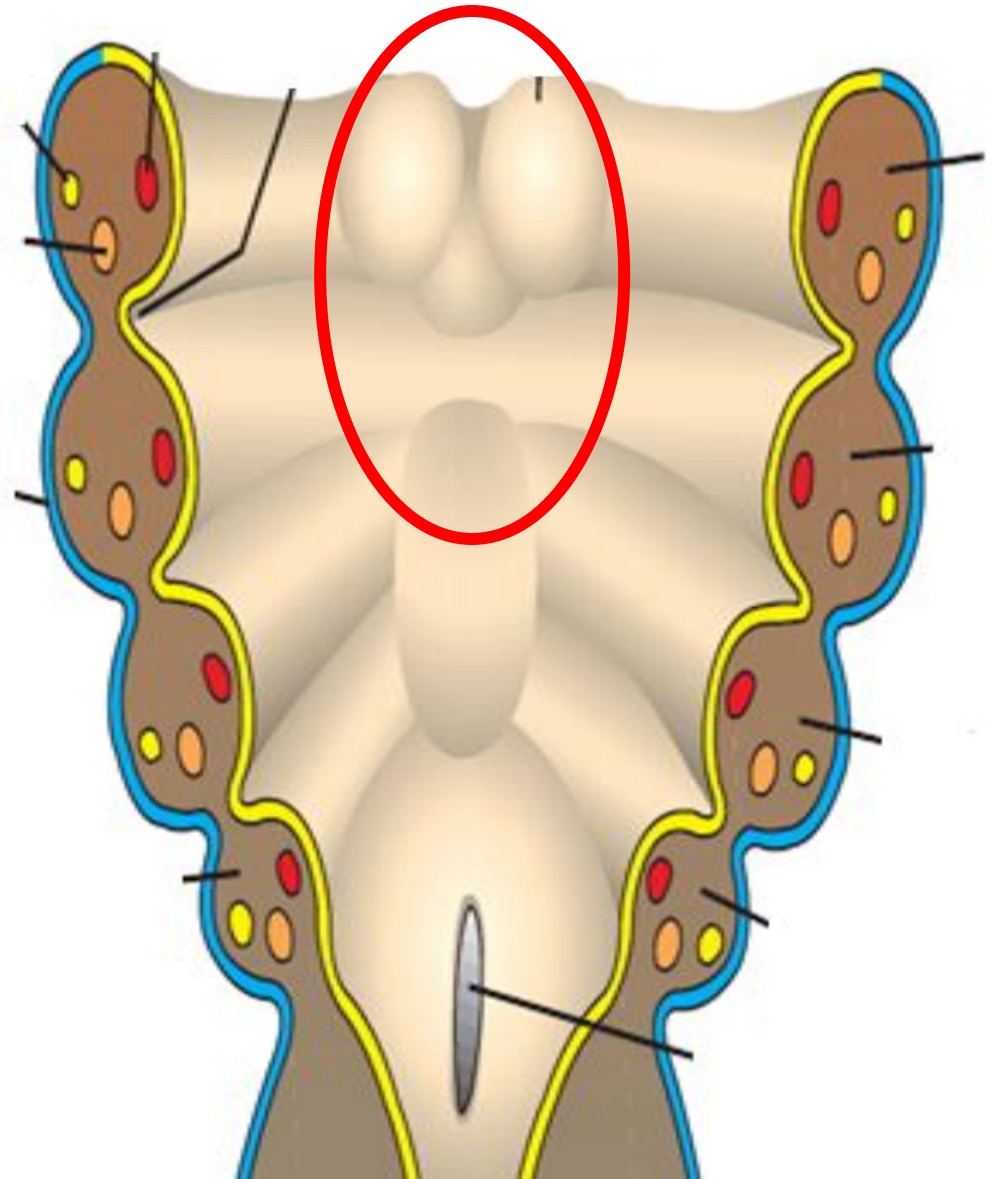
**SECOND PHARYNGEAL POUCH (Dorsal end)**  
Forms:  
Palatine tonsils

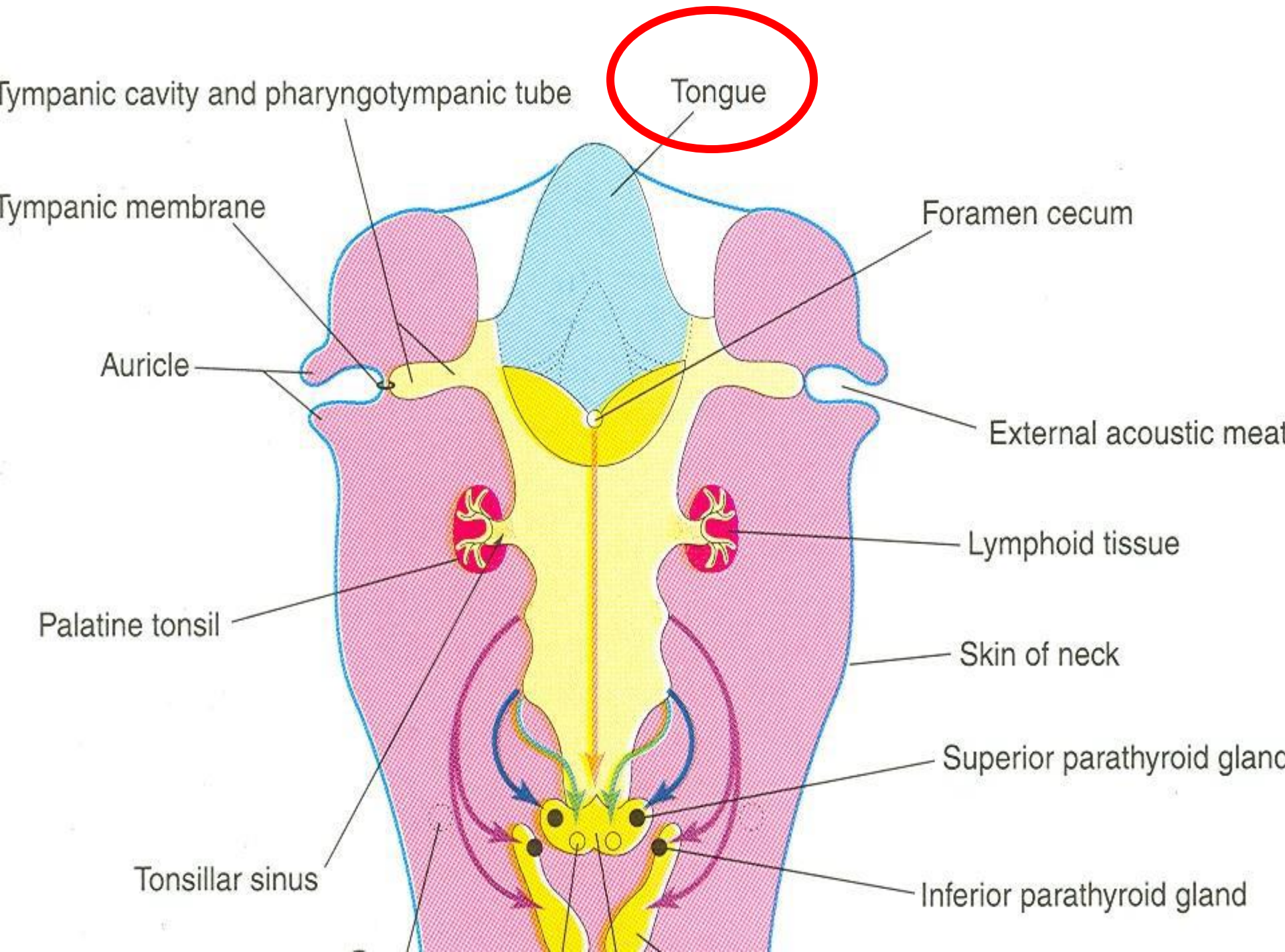


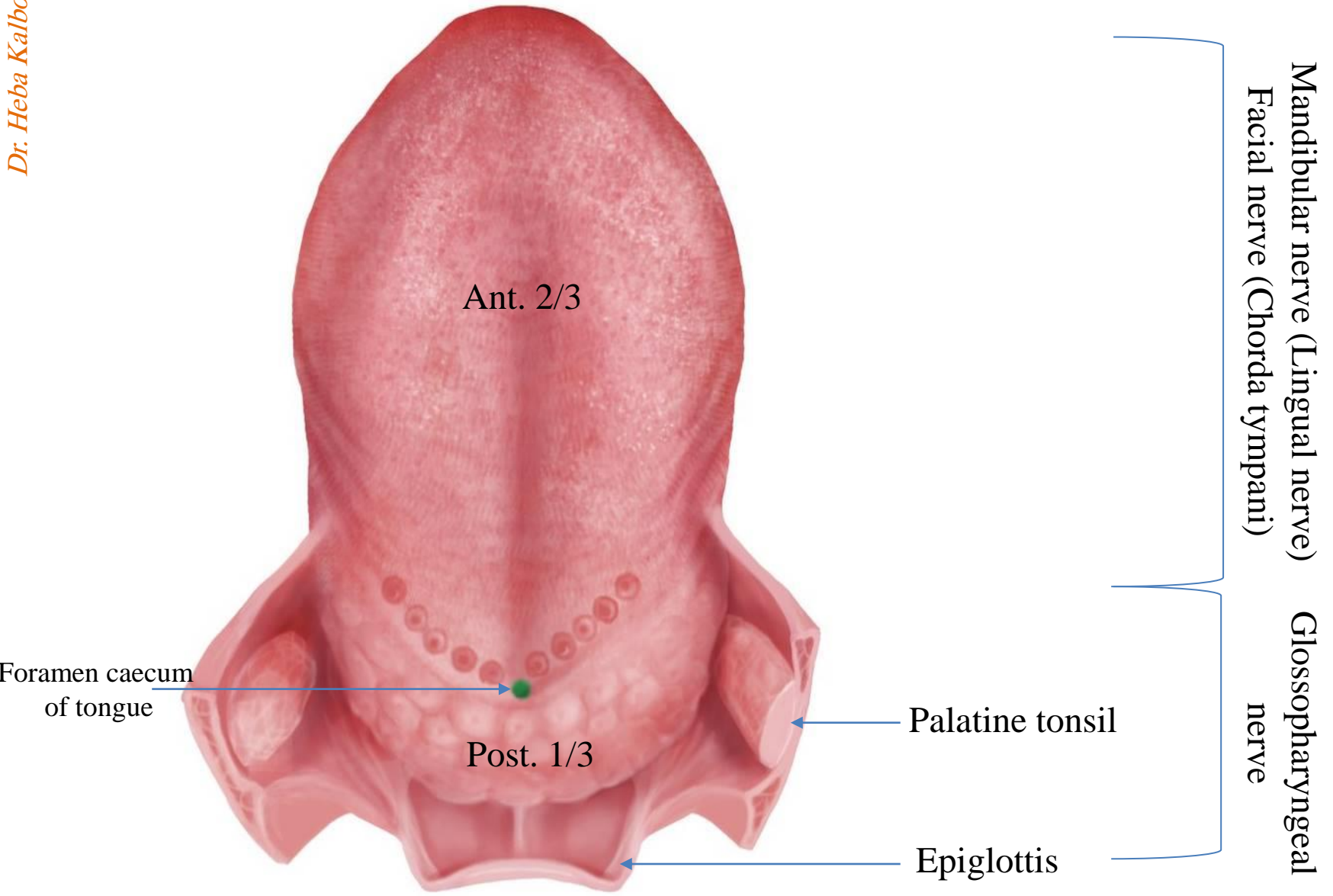
Note: the **ventral ends of the first and second pharyngeal pouches** are occupied by the **developing tongue**

Note: Pre-trematic nerve crosses from one arch to other, e.g. chorda tympani n. (branch of facial n.) supplies anterior 2/3 of tongue (taste sensation).

Note: the mandibular nerve supplies anterior 2/3 of tongue (general sensations)









### THIRD PHARYNGEAL POUCH

#### Ventral part:

Forms:  
Thymus

#### Dorsal part

Forms:  
Inferior parathyroid gland

Note: The thymus migrates in a caudal and a medial direction, pulling the inferior parathyroid with it

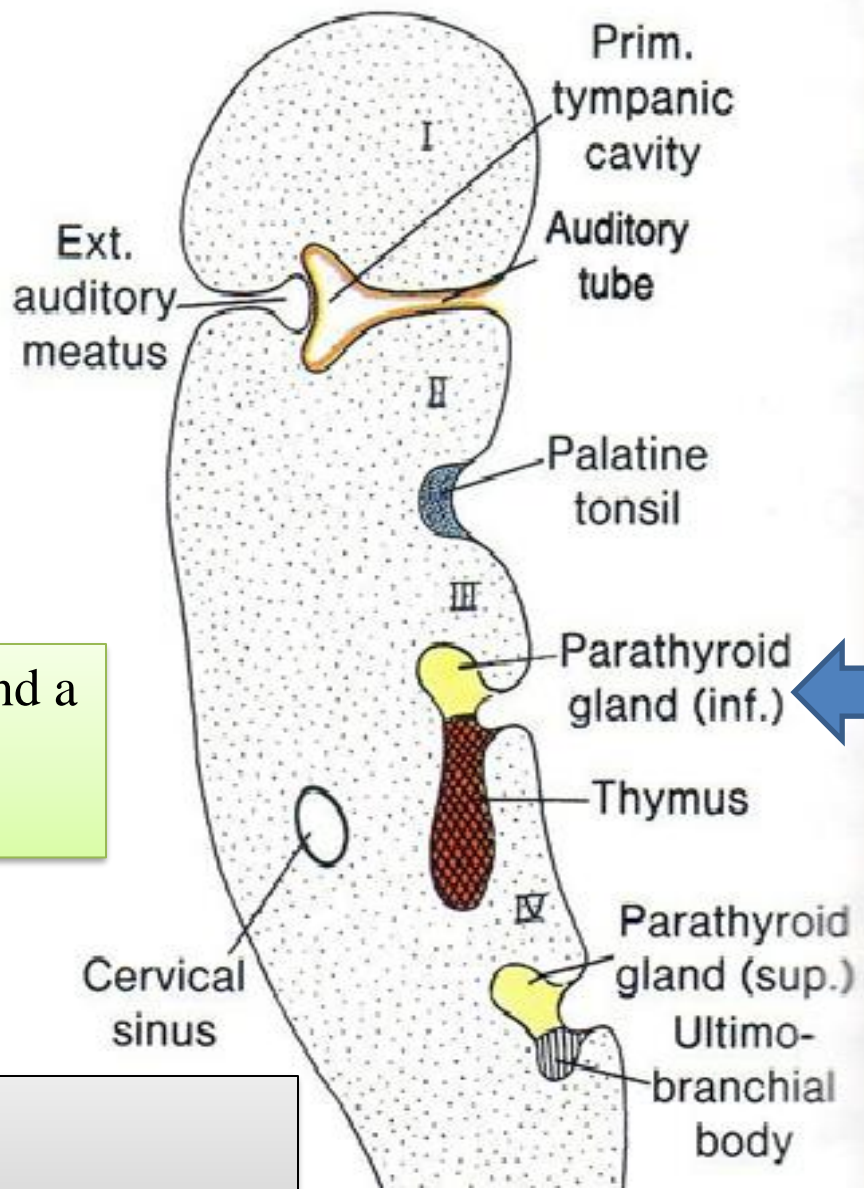
Read only  
Endocrine system

Note:

**Postnatal** →

**Thymus:** lies in the thorax behind the sternum

**Inferior parathyroid glands:** lie on the posterior surface of thyroid gland



Read only  
Endocrine system

## FOURTH PHARYNGEAL POUCH

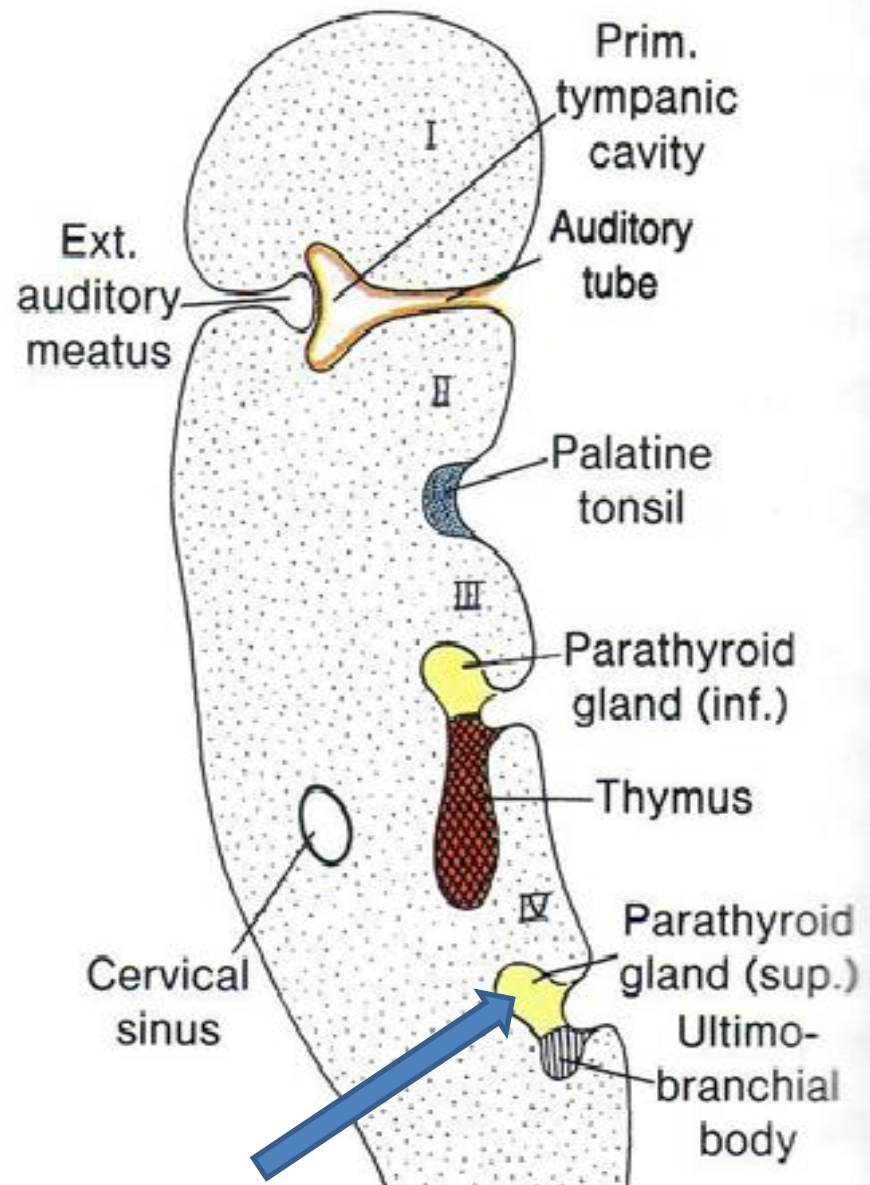
**Ventral part:**

Unknown

**Dorsal part**

Forms:

Superior parathyroid gland



Note:

**Superior parathyroid glands:** lie on the posterior surface of thyroid gland

Read only  
Endocrine system

### FIFTH PHARYNGEAL POUCH

Forms

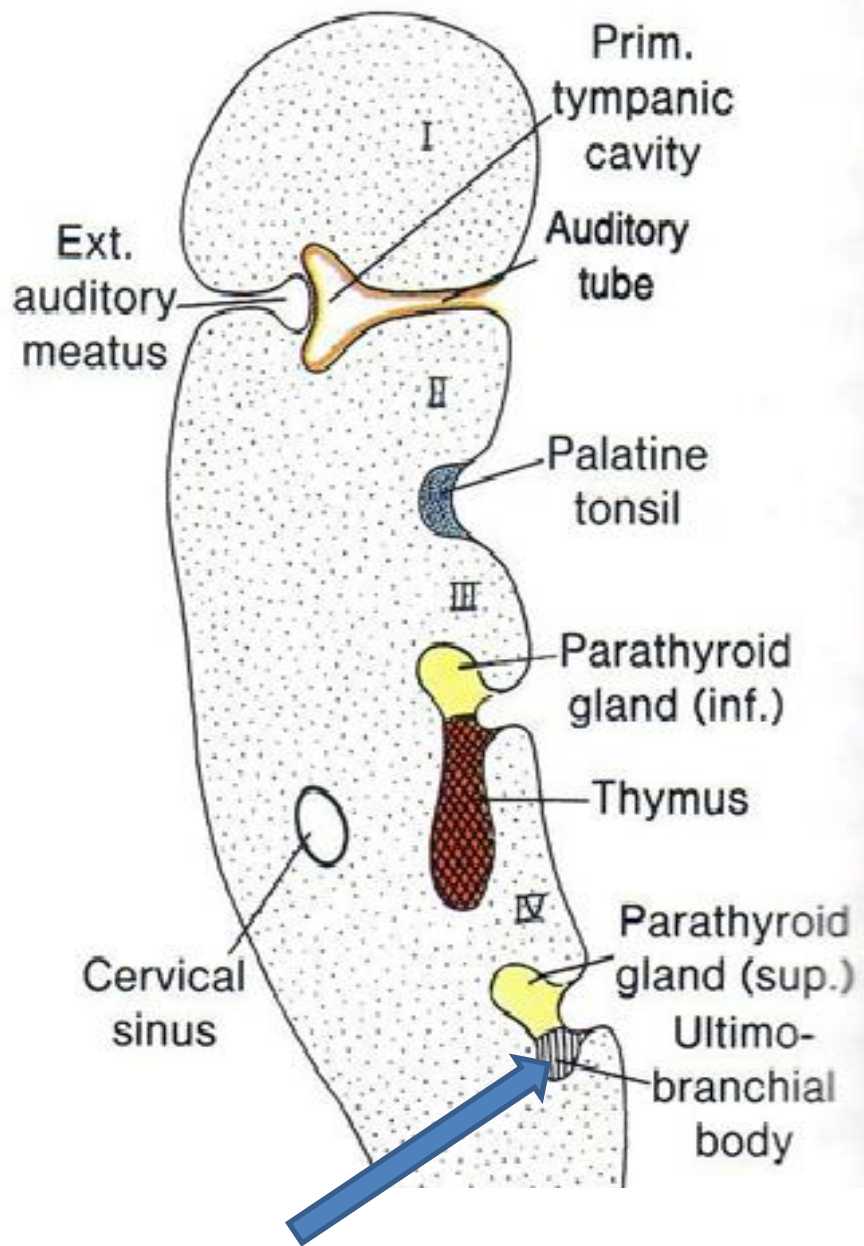
#### Ultimobranchial body:

Is incorporated into the thyroid gland.

Cells of the ultimobranchial body give rise to the parafollicular, or C cells of the thyroid gland

Note:

The thyroid tissue is made up of two types of cells: follicular cells and parafollicular cells.



Auditory tube

Primary tympanic cavity

Ext. auditory meatus

Palatine tonsil

Ventral side of pharynx

Foramen cecum

Sup. parathyroid gland (from 4th pouch)

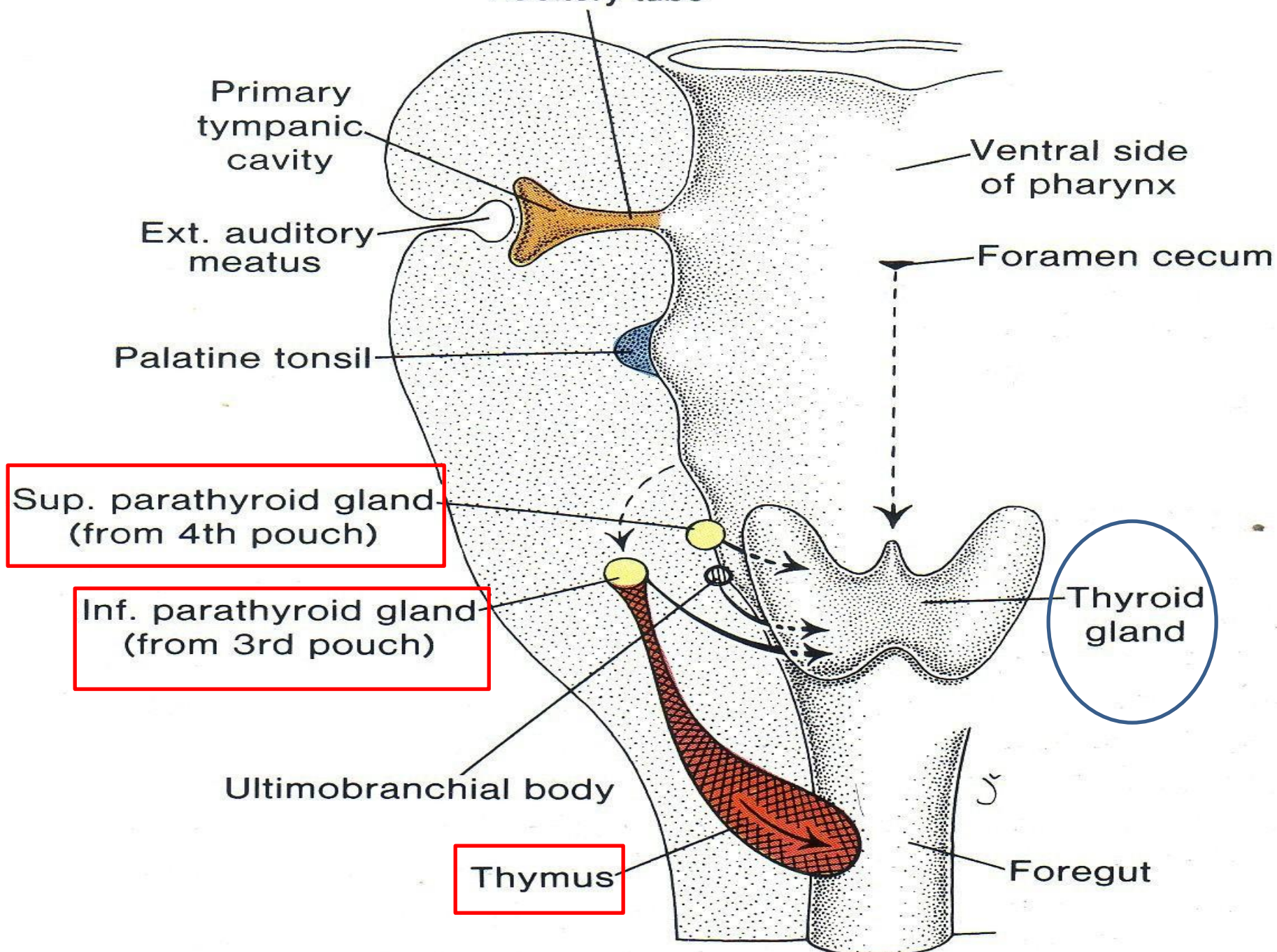
Inf. parathyroid gland (from 3rd pouch)

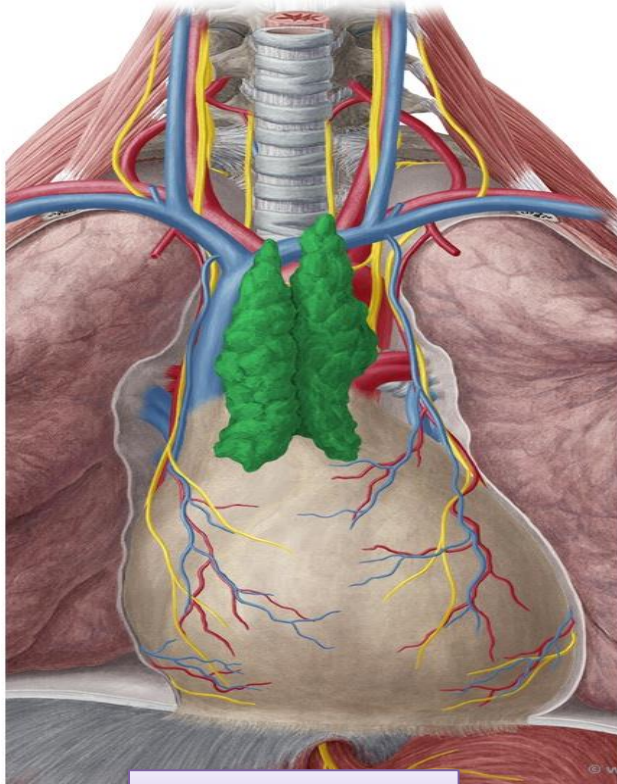
Thyroid gland

Ultimobranchial body

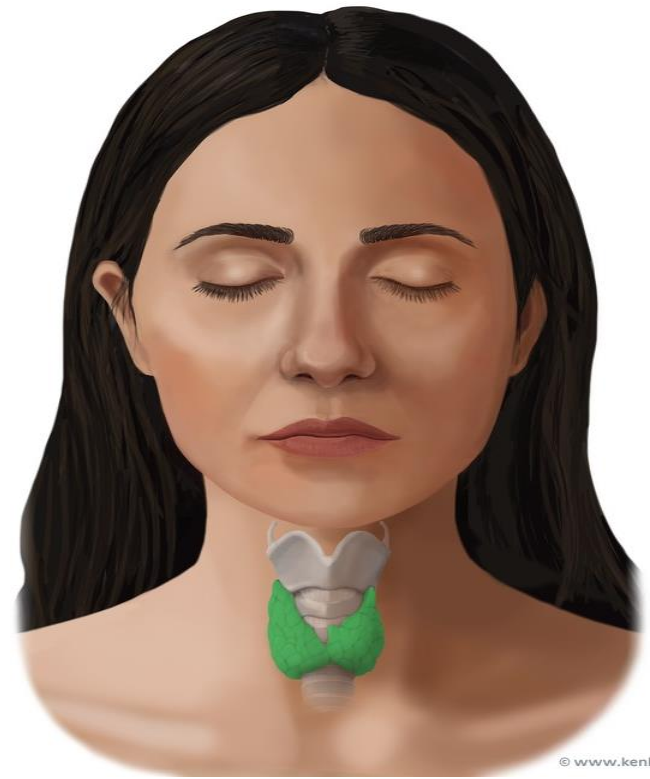
Thymus

Foregut





Thymus gland



Thyroid gland

Read only  
Endocrine system

### **Congenital Anomalies**

- 1- Ectopic thymus: in the neck
- 2- Ectopic parathyroid : especially the inferior parathyroid (in thorax)
- 3- Cervical cyst

