Pharyngeal (Branchial) Apparatus

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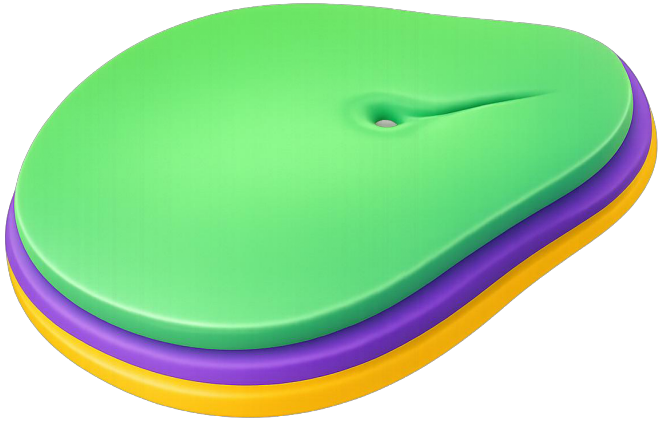
Bilaminar disc
(2nd week)

Ectoderm
Mesoderm
Endoderm

Trilaminar disc
(3rd week)



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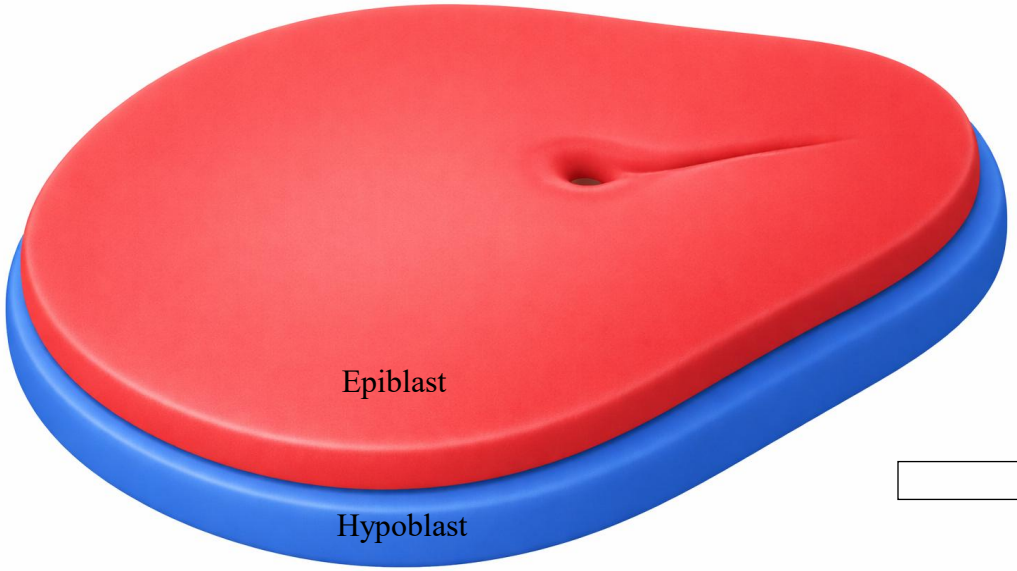
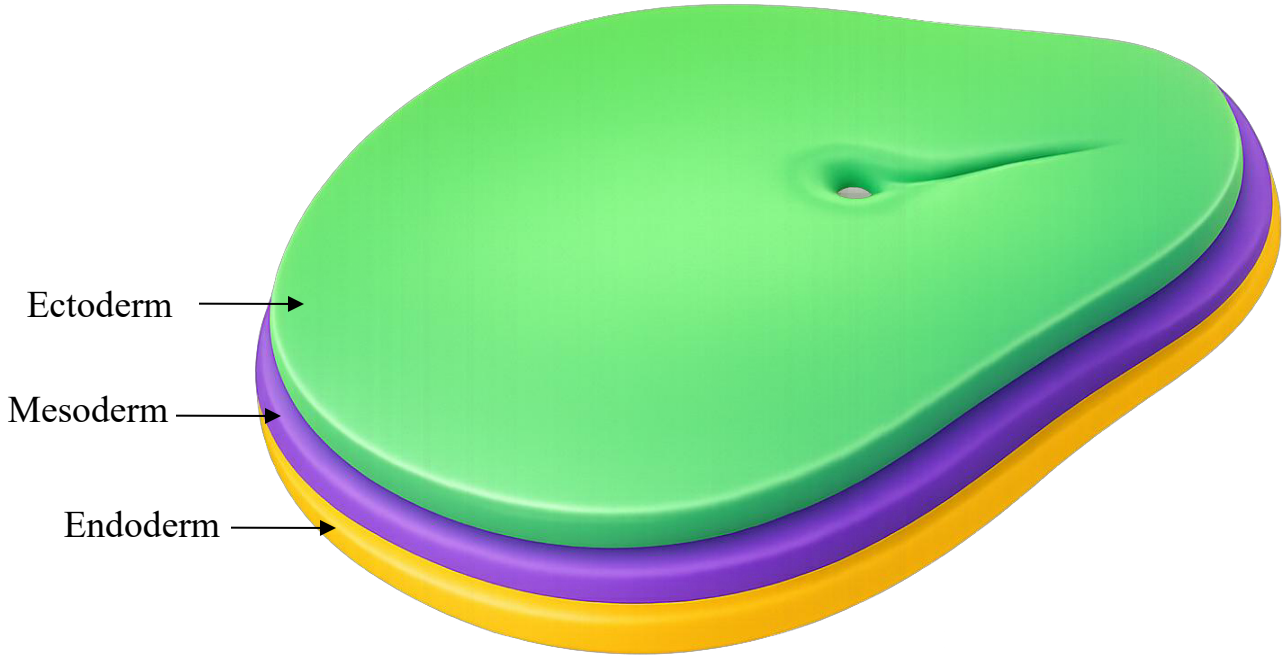
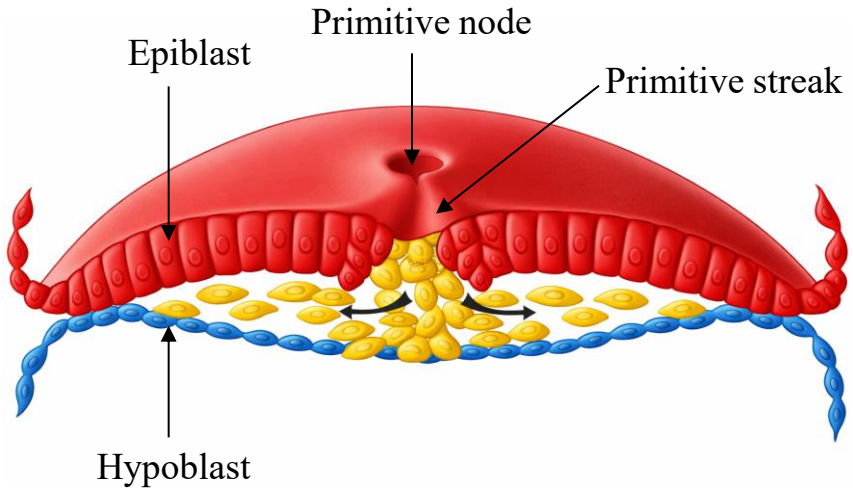


Bilaminar disc
(2nd week)



Trilaminar disc
(3rd week)



Trilaminar disc
(3rd week)

after folding

Mesoderm / Mesenchyme
its the tissue forming the filling material between outer ectoderm & inner endoderm

Connective tissue of the embryo composed of mesenchymal cells, Stem cells which have the ability to differentiate into other type of cells as Osteoblast, chondroblast & myoblast

Hematopoietic cells

the type of cells which the stem cells will differentiate into depends on the location of the stem cell in the embryo

our connective tissue now lost its ability to differentiate into different types of cells

Not only from Folding (4th week) Side to side but also Cranio-Caudal Folding

Caudally, it will form part of it mucous membrane of the urinary tract

Endoderm will form the mucous membranes of our Gut & the Glands associated with our Gut

From upper part of our Gut Respiratory tract will be formed

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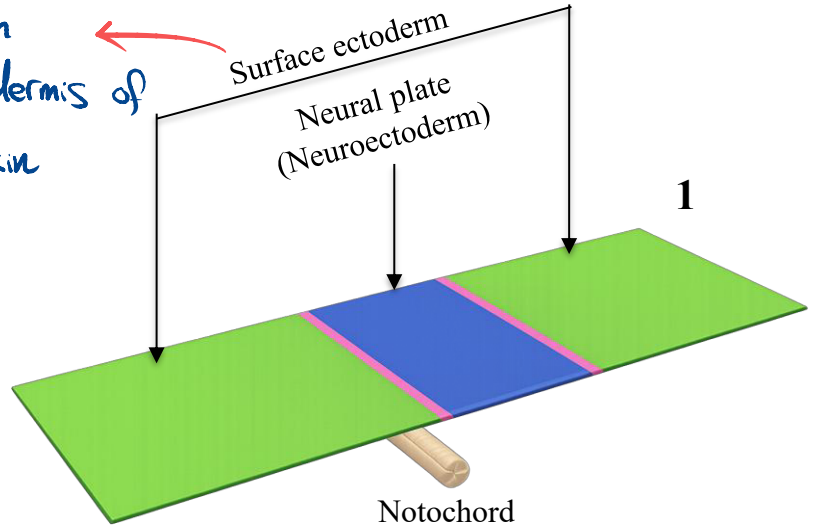
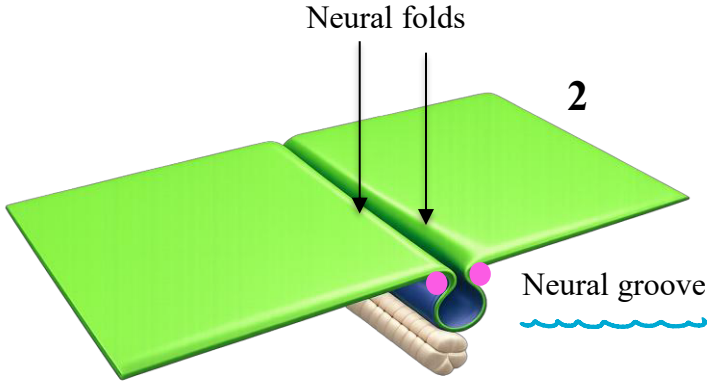
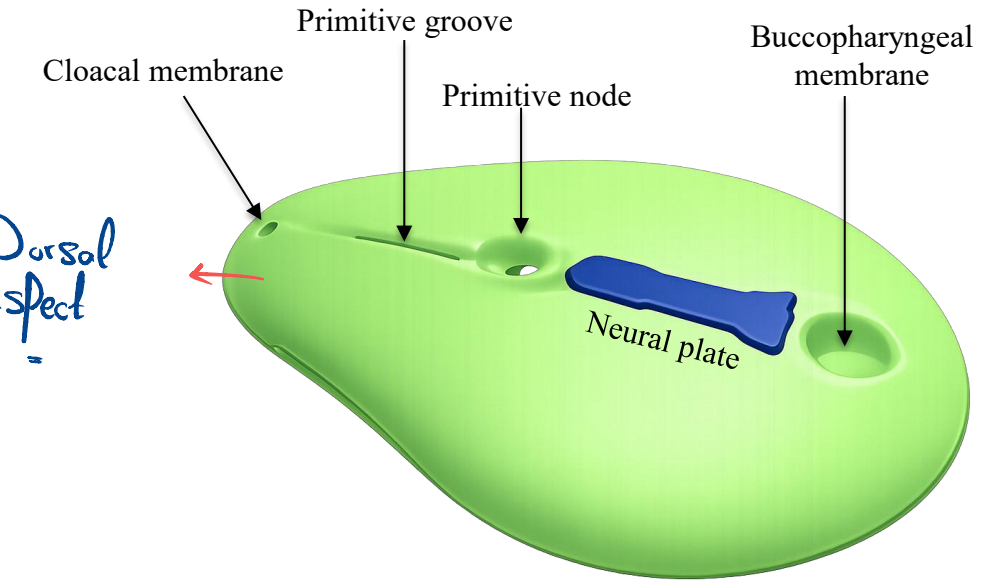
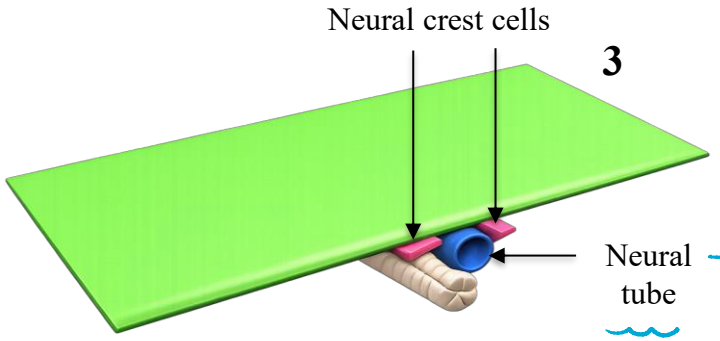
will form the epidermis of the skin



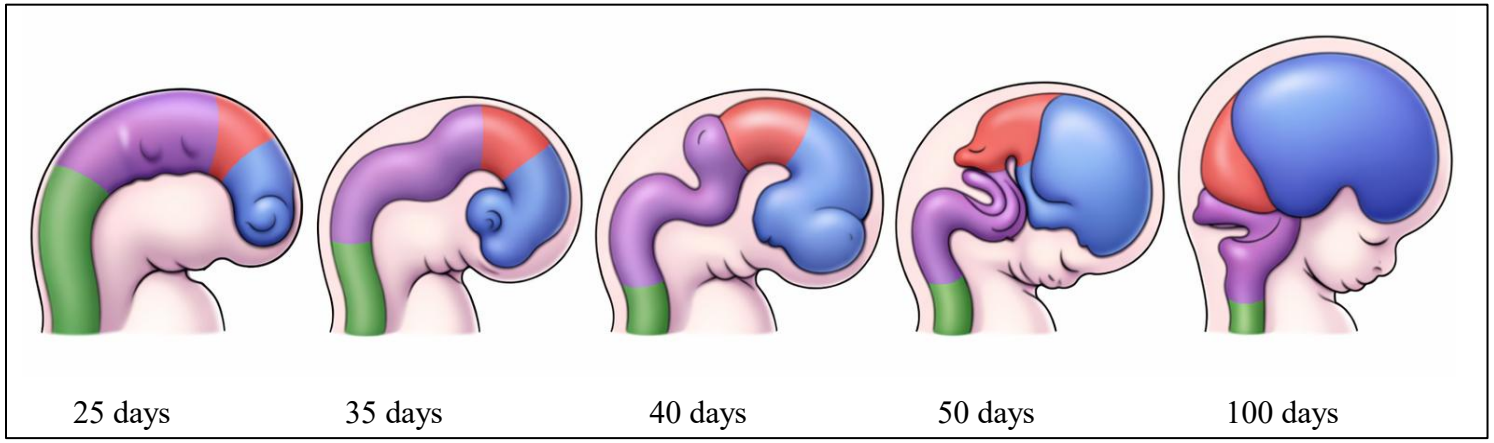


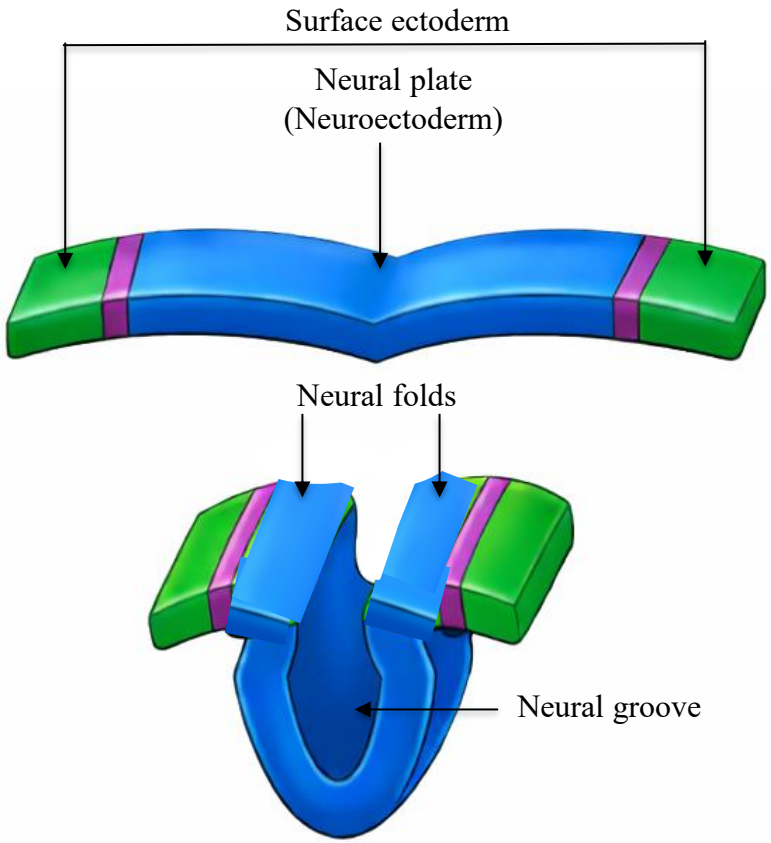


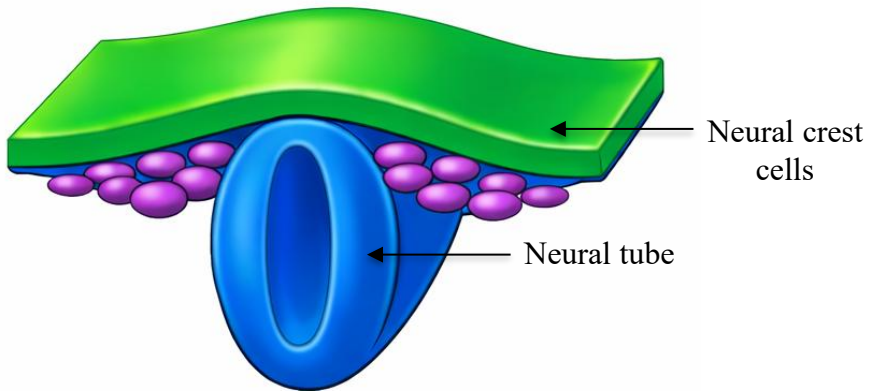
Dorsal aspect



→ Complete fusion







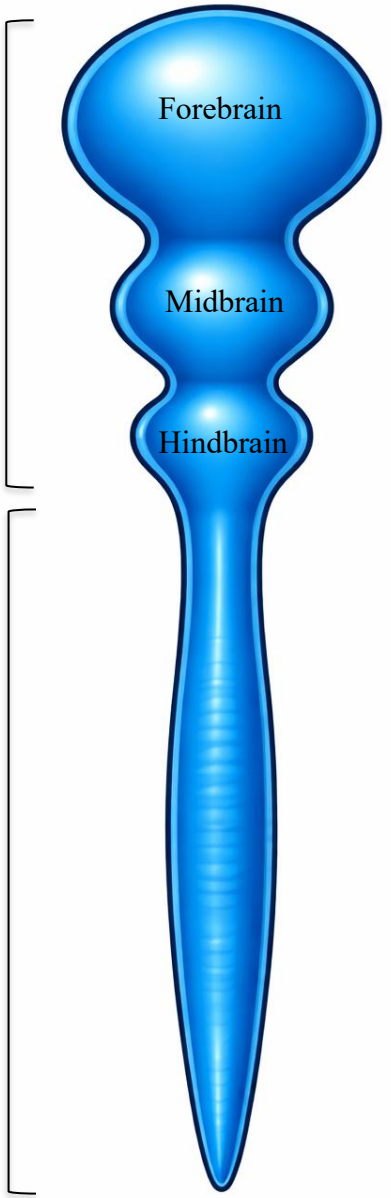
In early neural tube development, the brain forms three primary vesicles:

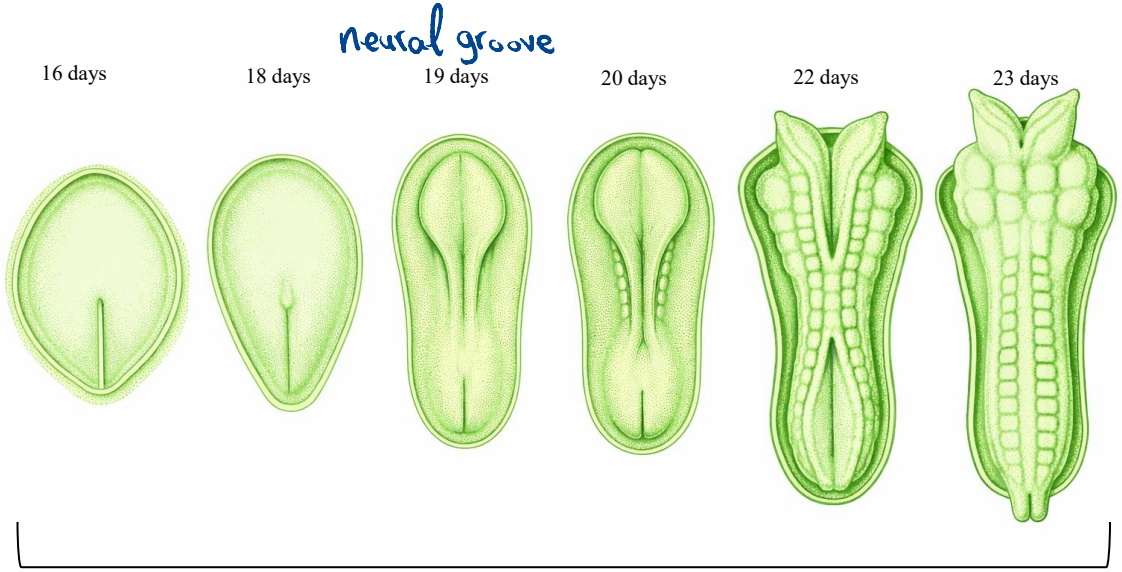
1. Forebrain
2. Midbrain
3. Hindbrain

Cranial end

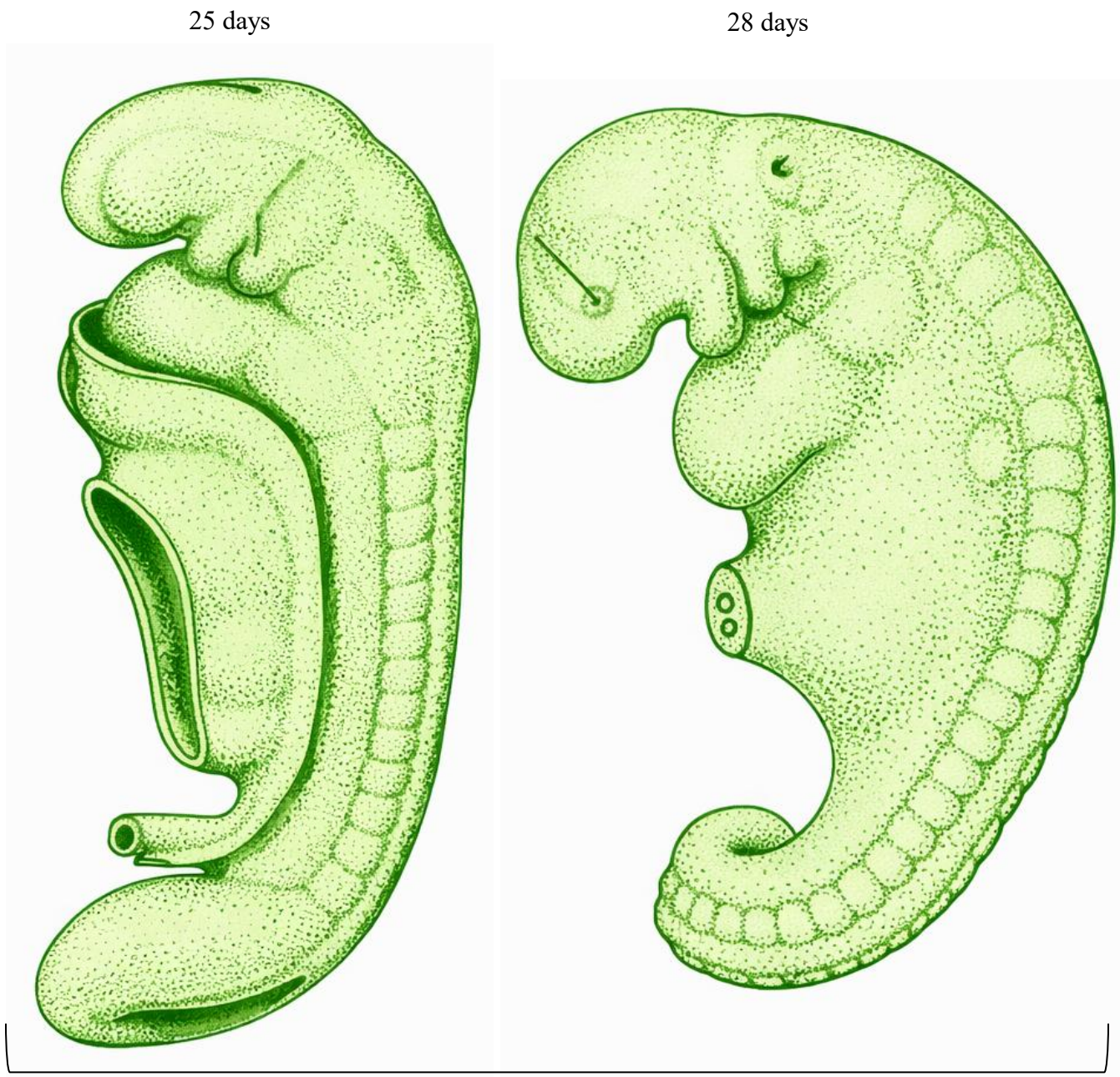
Brain

Spinal cord



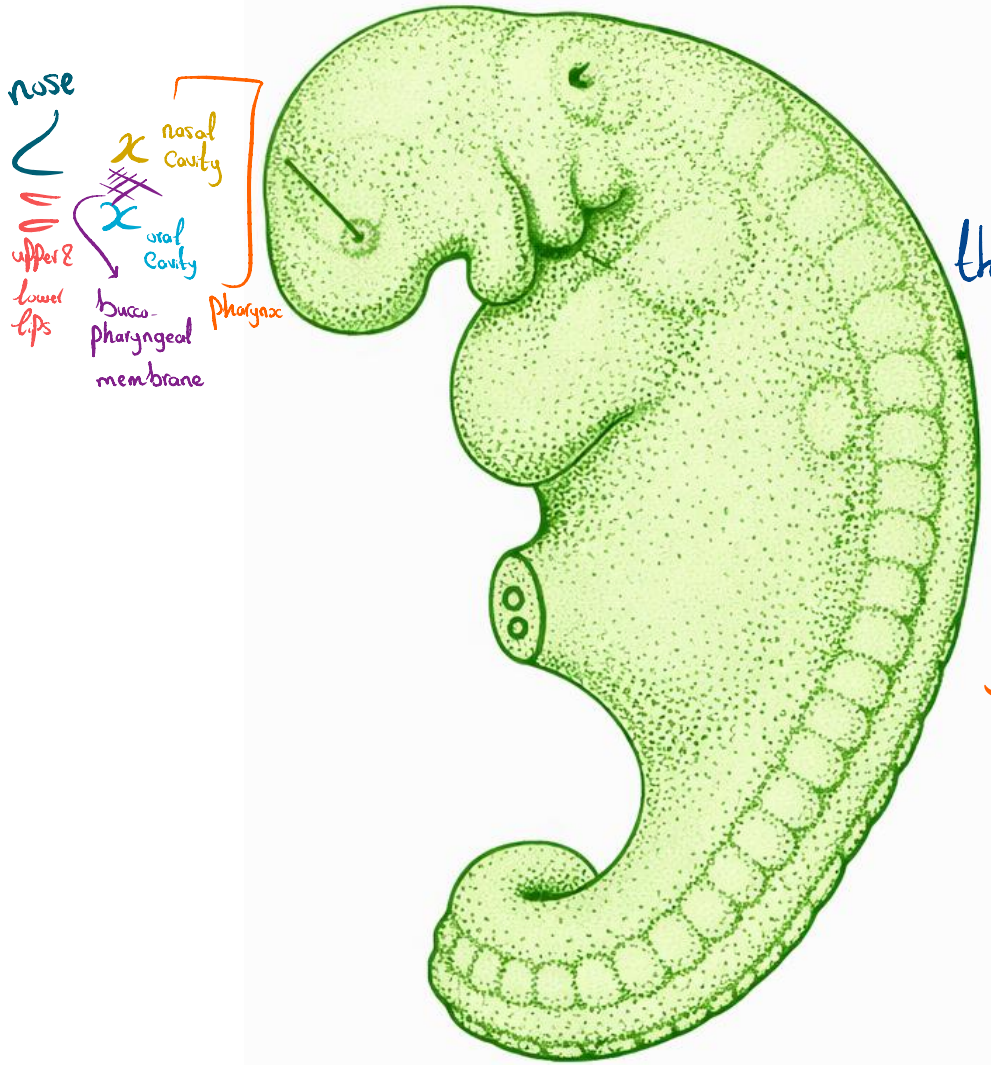


Dorsal view



Lateral view

28 days



Lateral view

no intermediate mesenchyme

Buccopharyngeal membrane

Mesenchyme

Ectoderm

Neural tube

the Area of the future head is enlarged due to the growing of the brain

most cranial part of the foregut

Foregut

Pharynx

Endoderm

heart starts to form inside the neck

Stomodeum

Midgut

future Nasal & oral Cavity

Forebrain bulge

Pericardium bulge

Hindgut

Cloacal membrane

will make urinary opening

Same here "No filling mesenchyme"

"No intermediate Mesoderm"

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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 primitive pharynx.

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

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

Later, the buccopharyngeal membrane breaks down so that the stomodeum communicates with the foregut.

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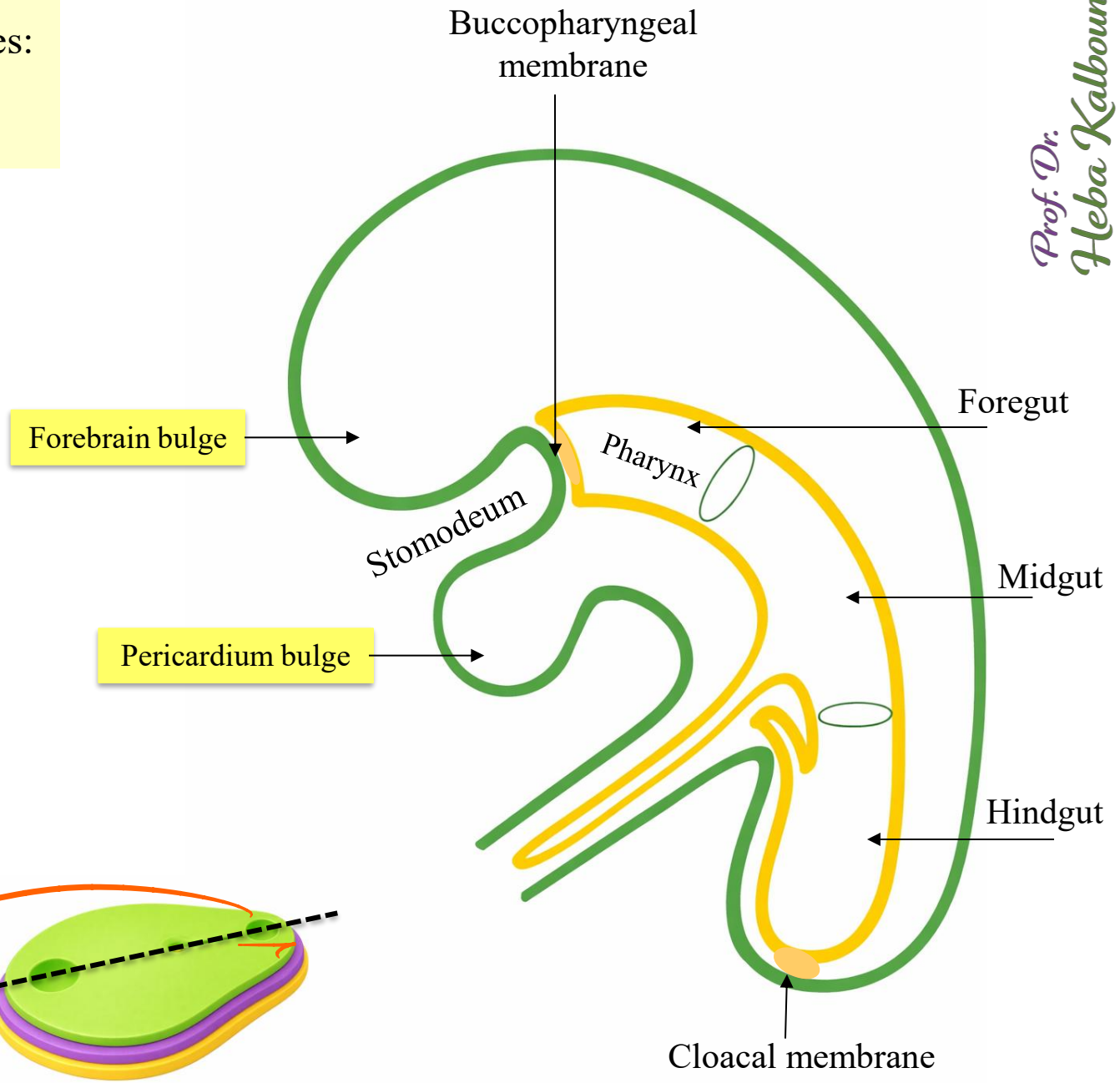
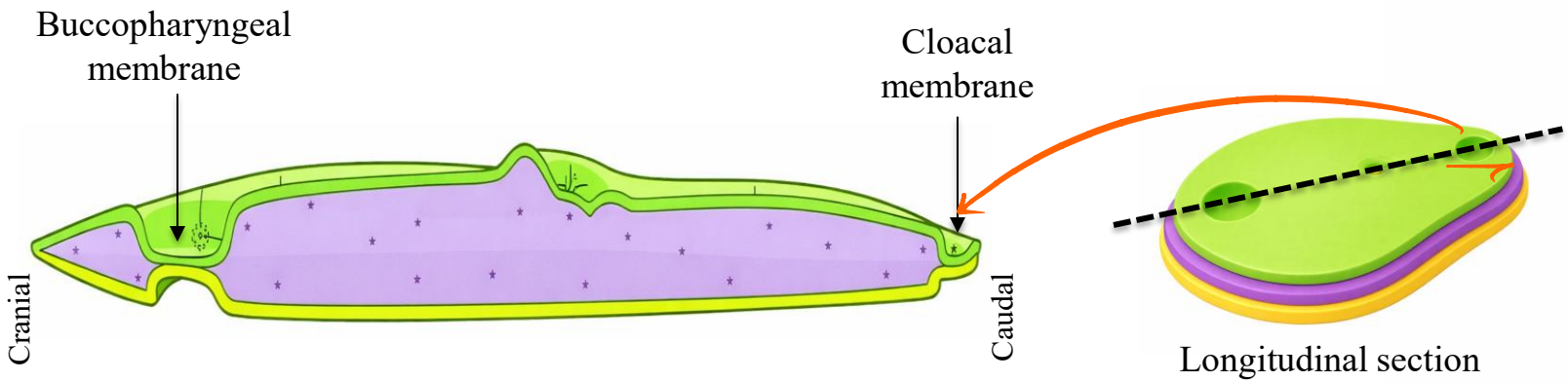
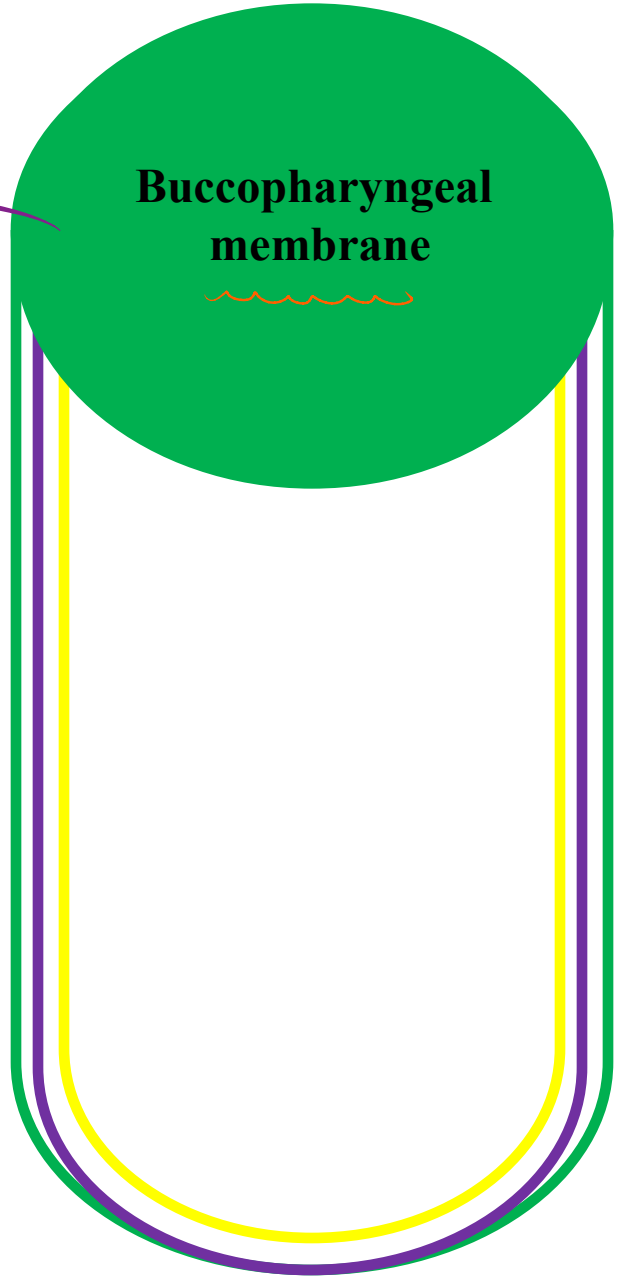
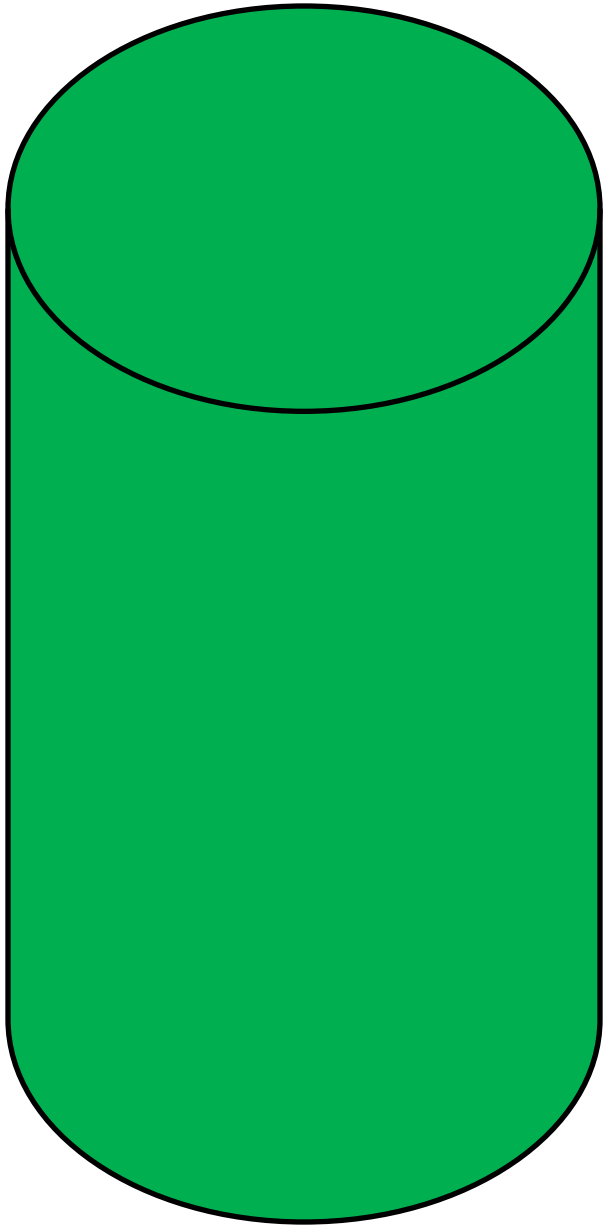


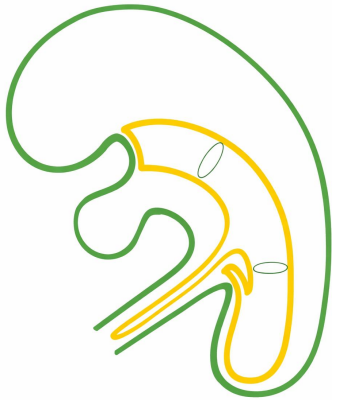


Covered by Ectoderm

Ecto
meso
Endo
Derm







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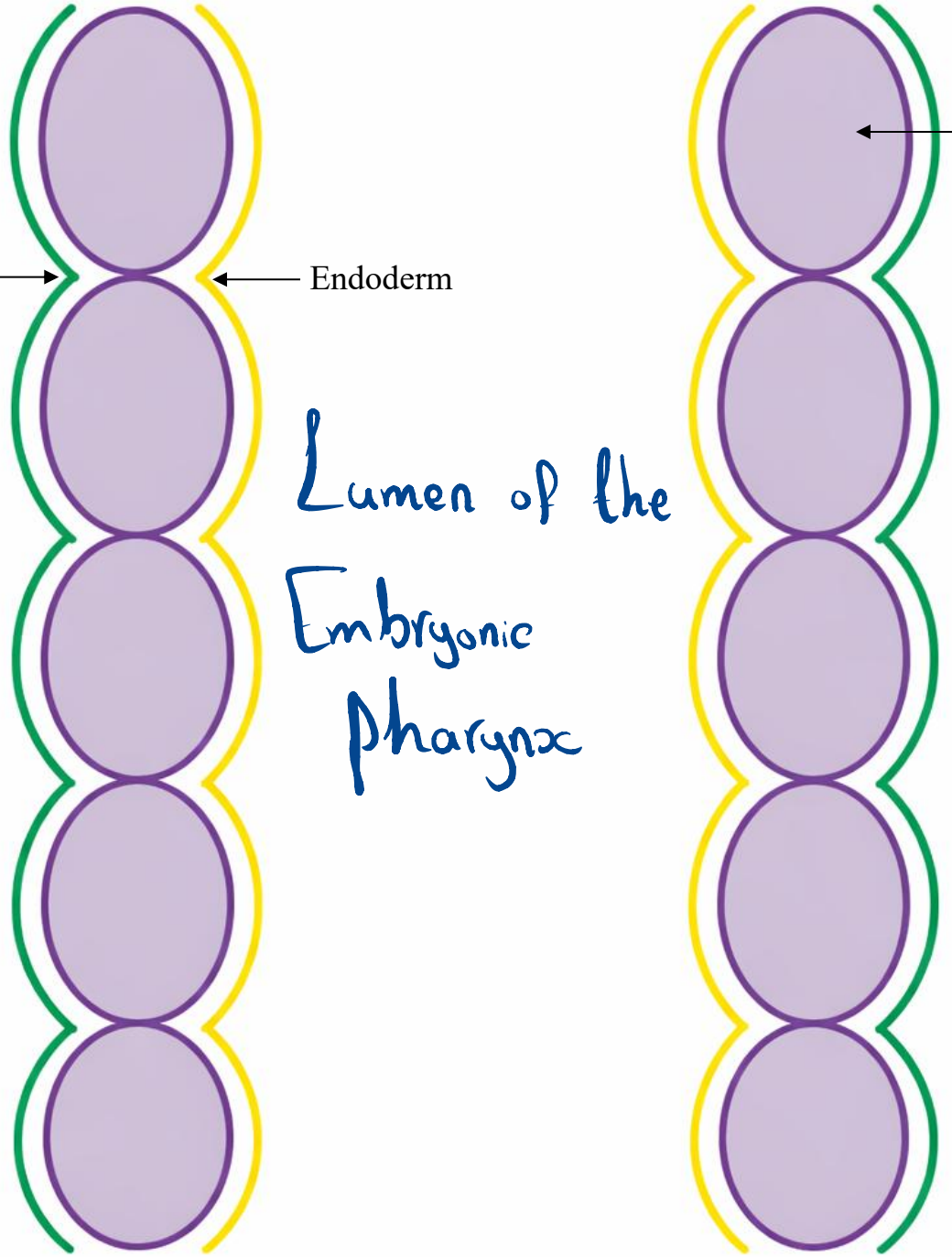
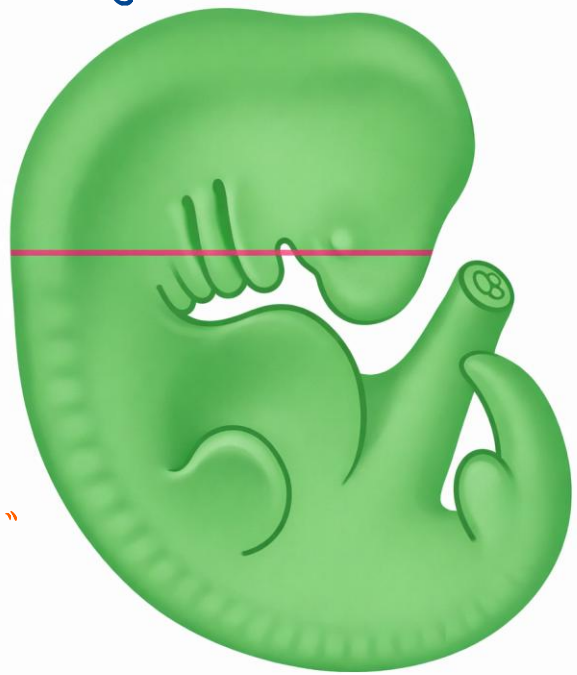


Mesenchyme ~ is going to thicking "not uniformally"

Along six lines

Lumen of the Embryonic Pharynx

* Cylindrical
* running from Dorsal to Ventral
* arched "Curved"



As they are formed at the sides of the neck "which is Cylindrical Structure"

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Pharyngeal (Branchial) Arches

- The pharyngeal arches are six paired swellings that develop in the wall of the primitive pharynx.
- Each arch consists of a core of mesenchyme covered externally by ectoderm and internally by endoderm.
- They appear during the 4th and 5th weeks of development.
- The arches are separated externally by four pharyngeal clefts (grooves) → ectoderm.
- On the internal aspect, the arches are separated by pharyngeal pouches → endoderm.

Why pharyngeal arches? Ventrodorsal cylindrical curved thickenings in the mesoderm in the both sides of Pharynx

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

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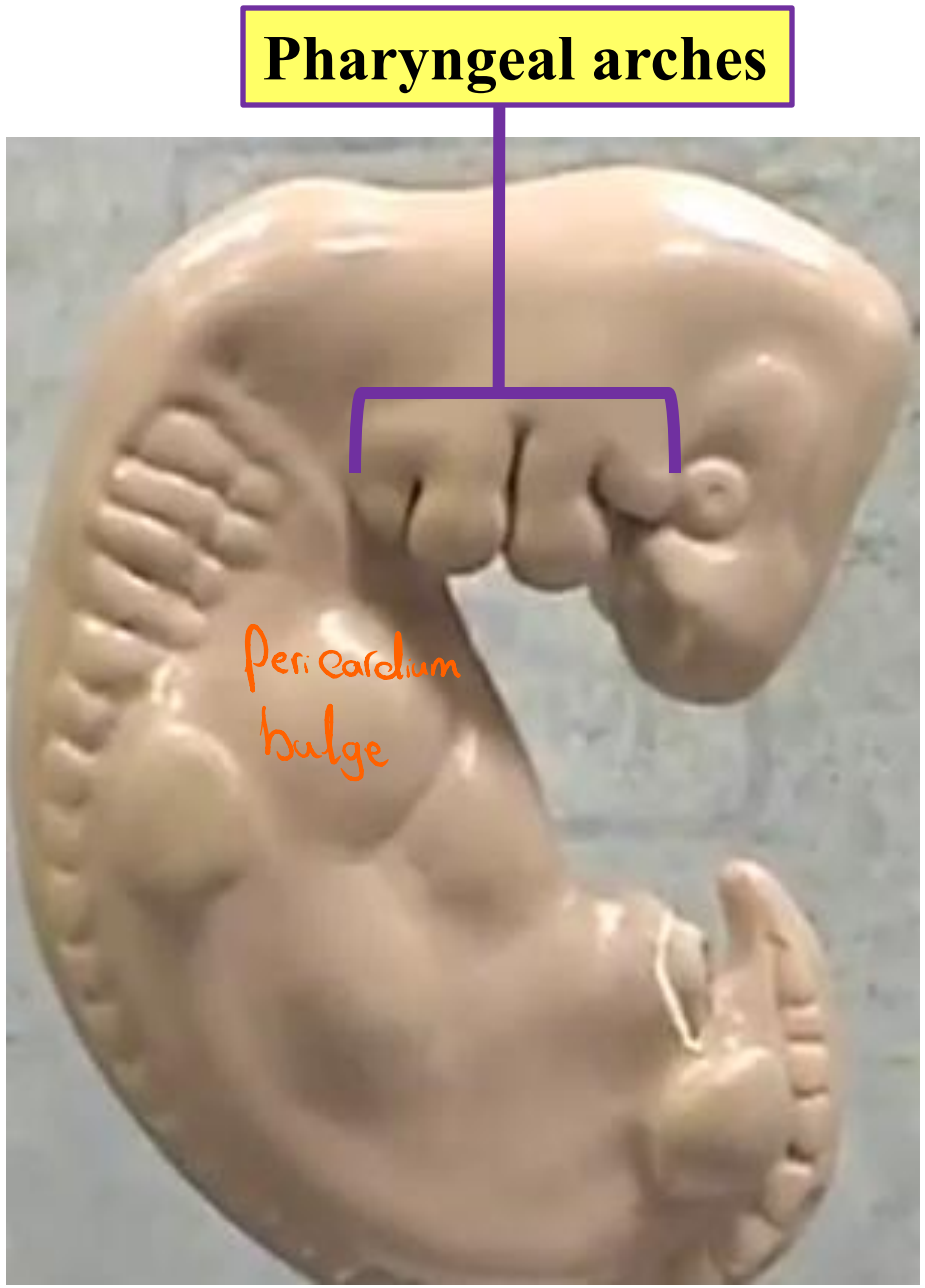
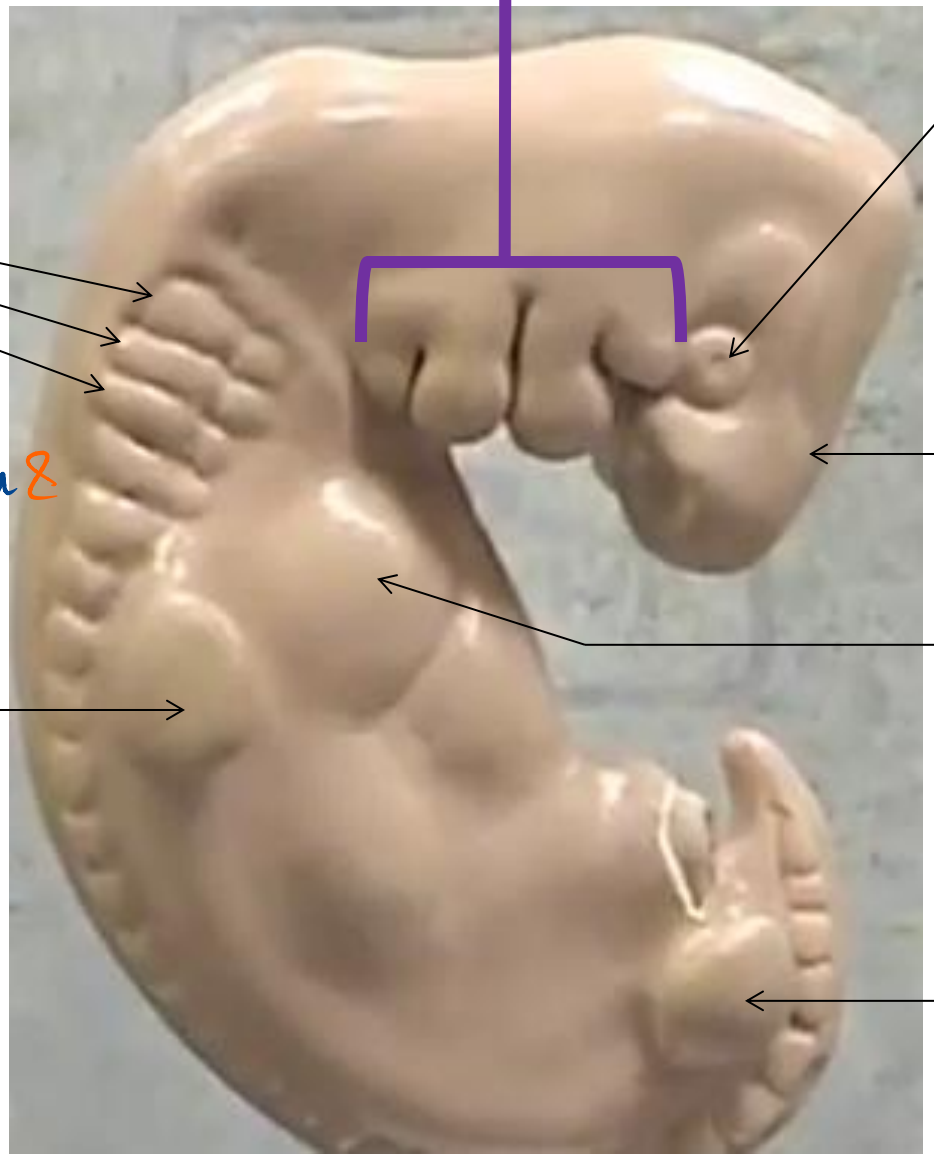
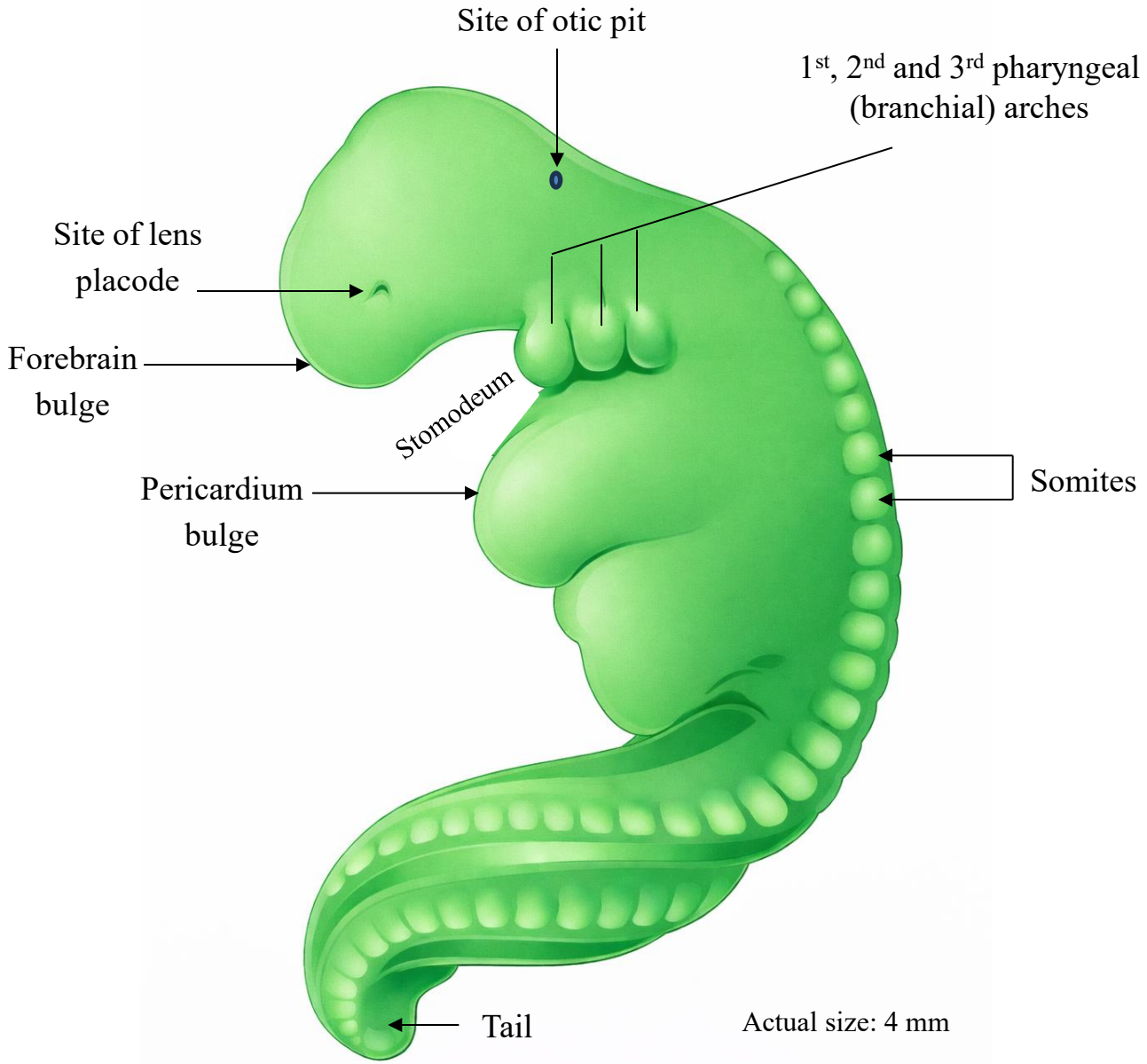



Pharyngeal arches
Primordium of the eye
Developing eye
Somites
Segments which are going to form Vertebral Column & the muscles associated with it
Forebrain bulge
Pericardium bulge
Upper limb bud
Lower limb bud



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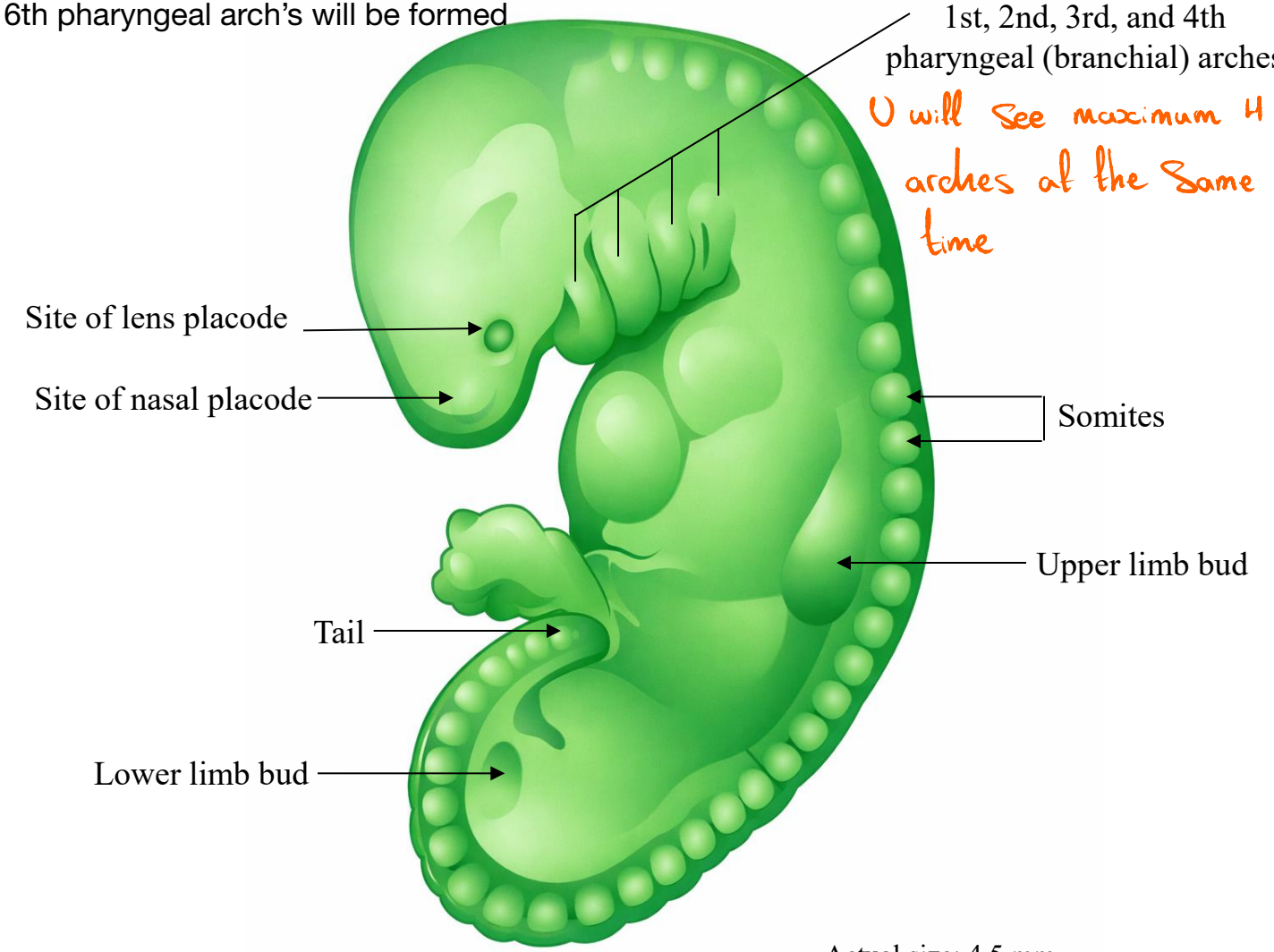
* The first 3 arches will be formed first, then the 1st arch is going to form its derivatives, then the 4th pharyngeal arch will appear while the 2nd arch is forming its derivatives, then the 5th & 6th pharyngeal arch's will be formed → Extra info...



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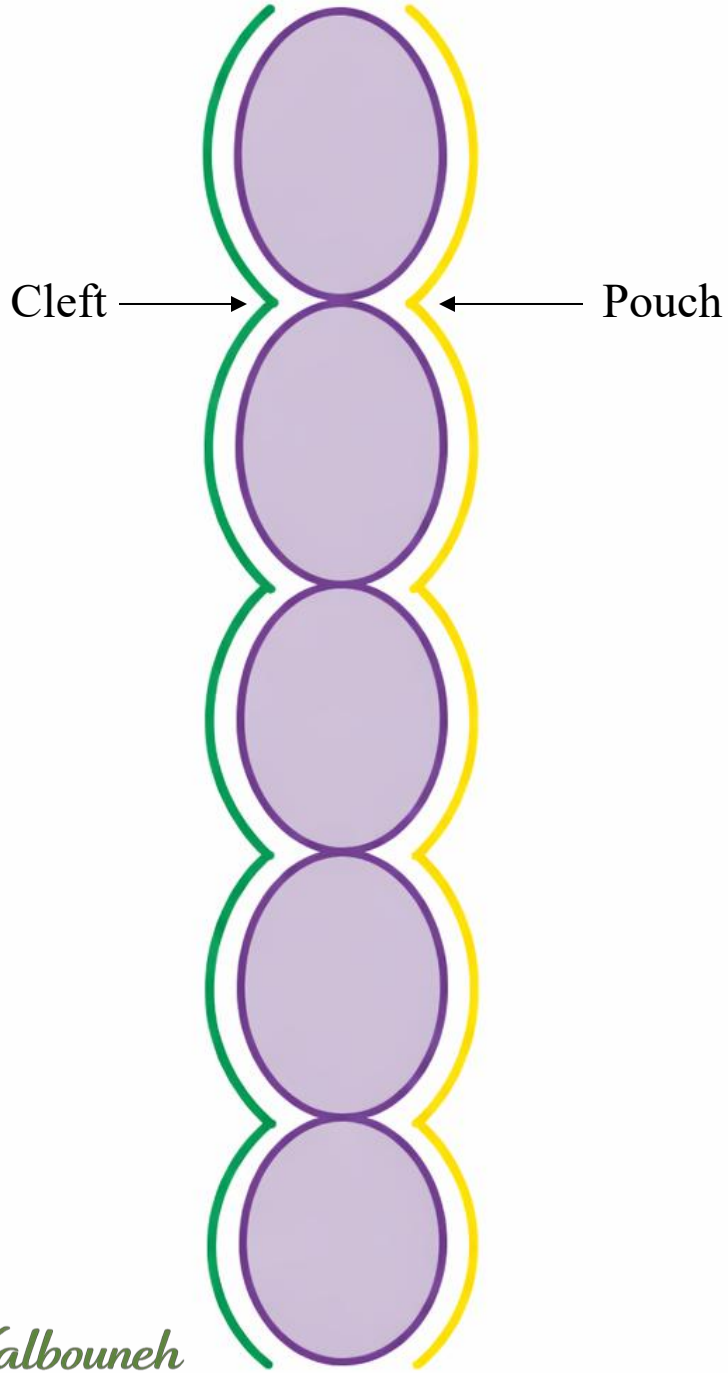
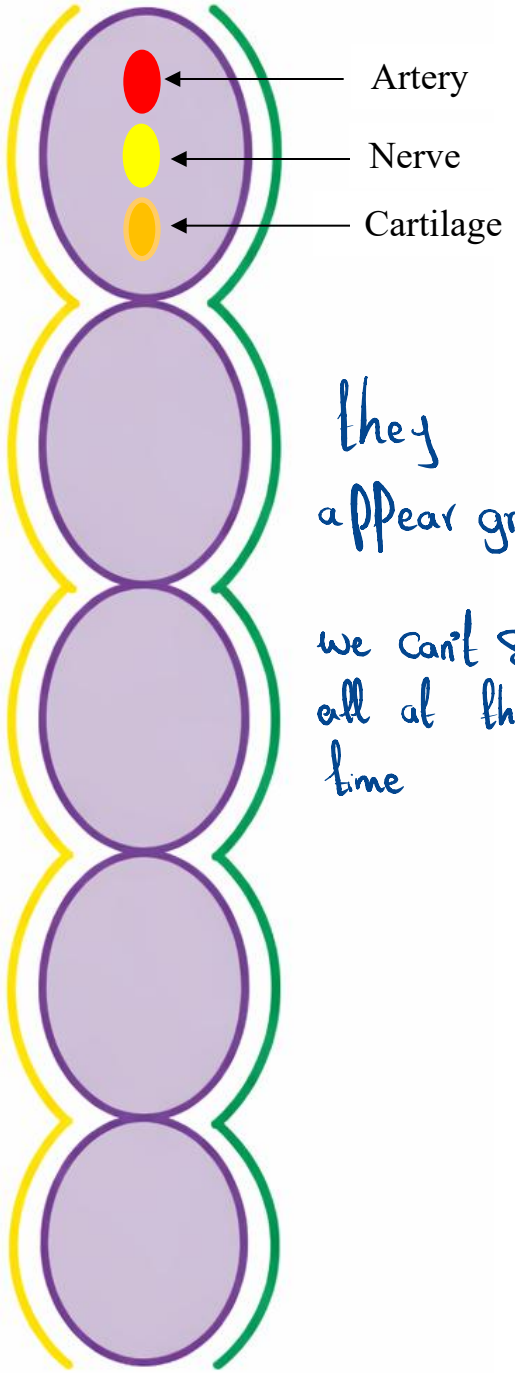


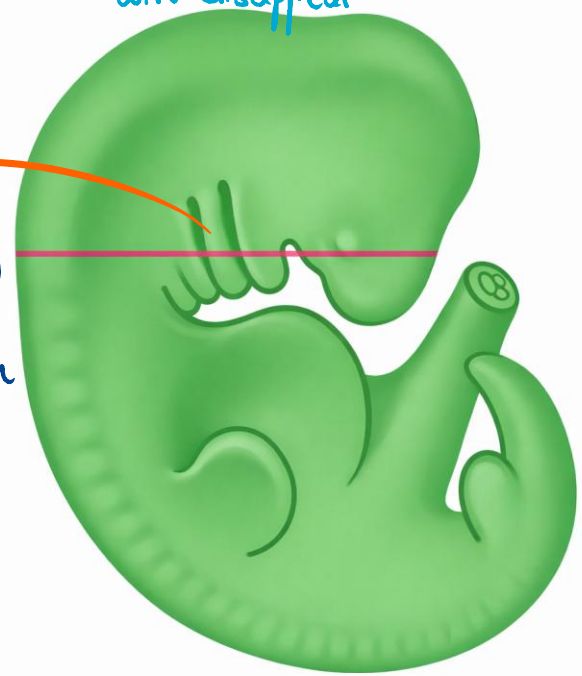


Although six arches form, the 5th arch is rudimentary or absent in humans, so only five pharyngeal pouches are recognized.

will disappear

they appear gradually

we can't see them all at the same time



Pharyngeal apparatus
(arches, clefts and pouches)

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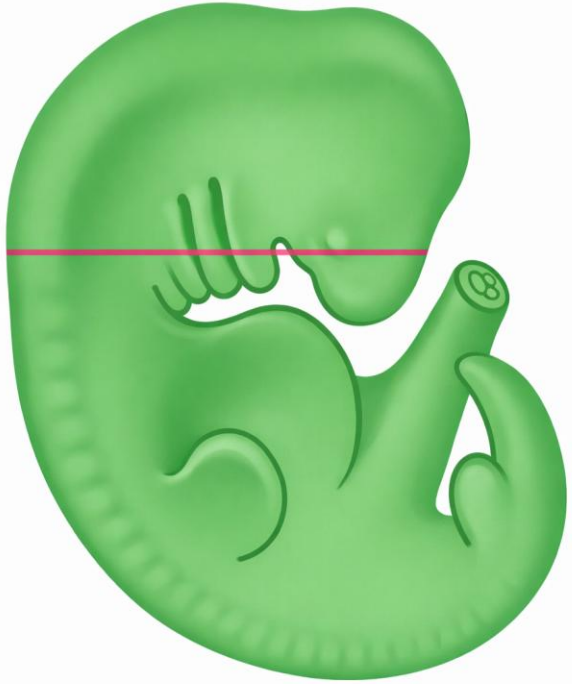
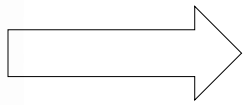
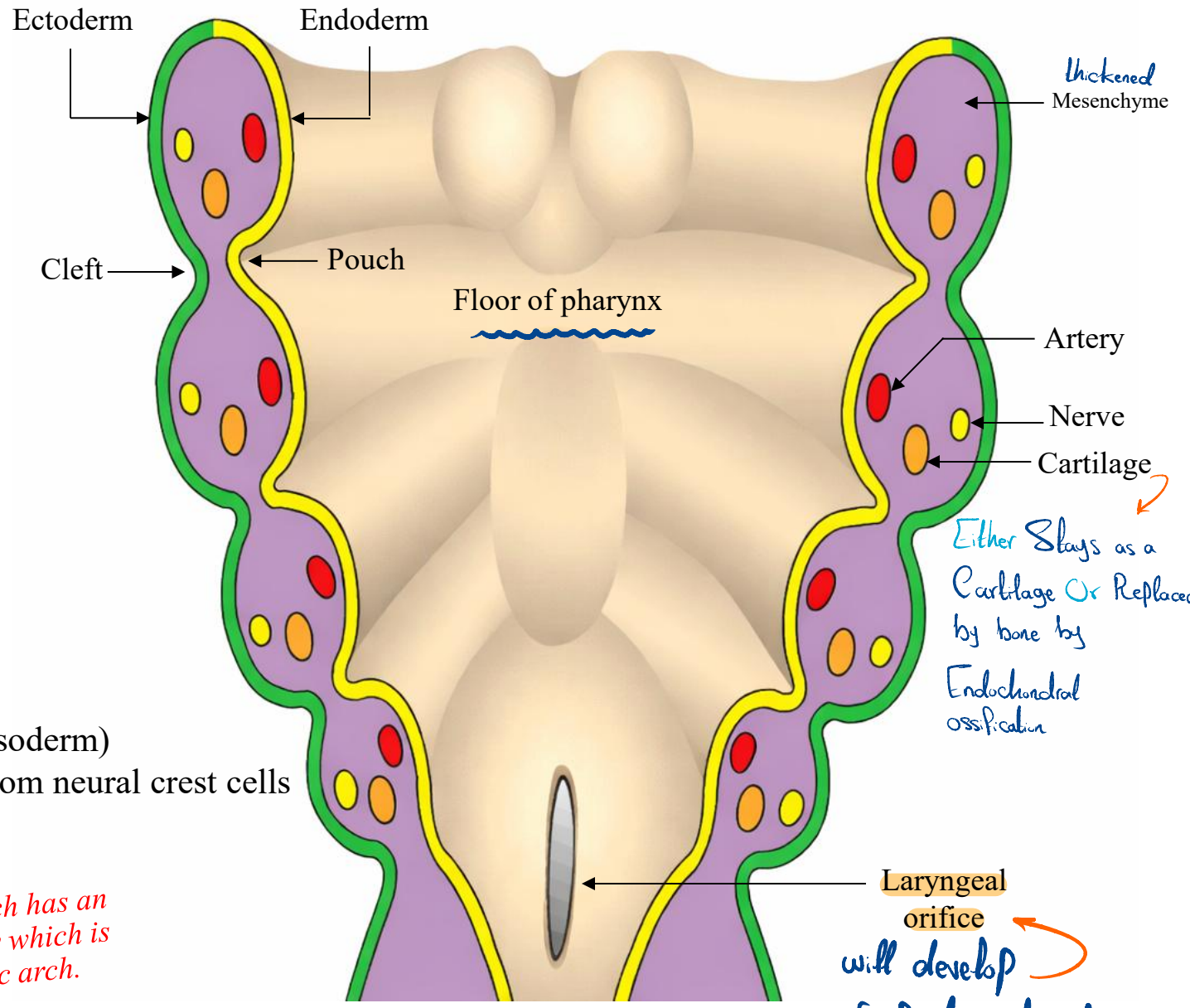






Coronal section of neck showing structure of pharyngeal arches

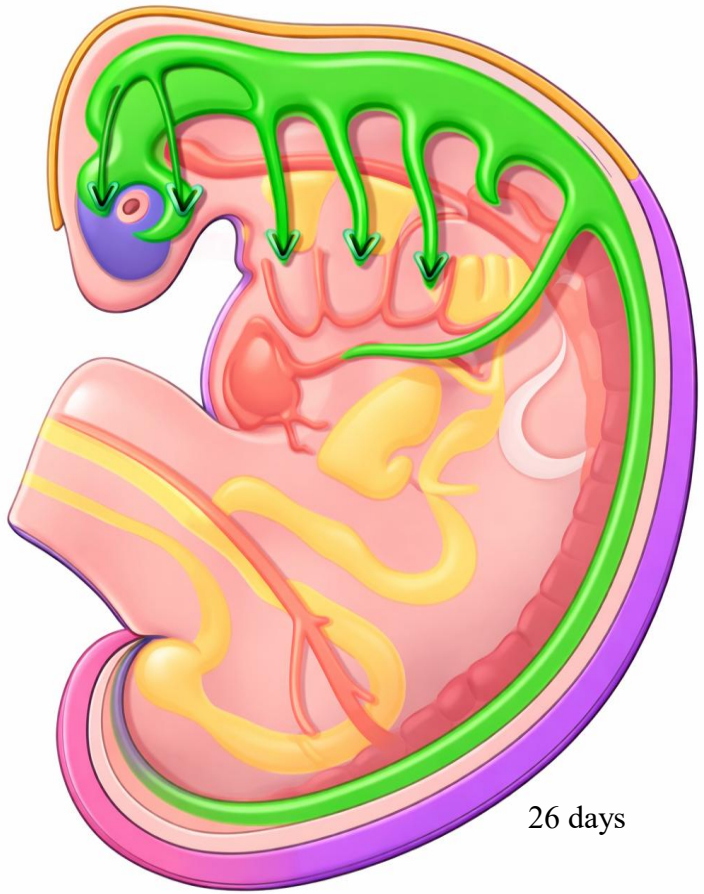
Each pharyngeal arch contains:

- Mesenchymal core (derived from neural crest cells and mesoderm)
- Cartilaginous rod (skeletal component) – mainly derived from neural crest cells
- Muscle component – derived from mesoderm
- Aortic arch artery
- Cranial nerve supplying the arch
- External ectoderm covering
- Internal endoderm lining

Note: Each arch has an arterial supply which is called aortic arch.

Nerve supply of pharyngeal arches

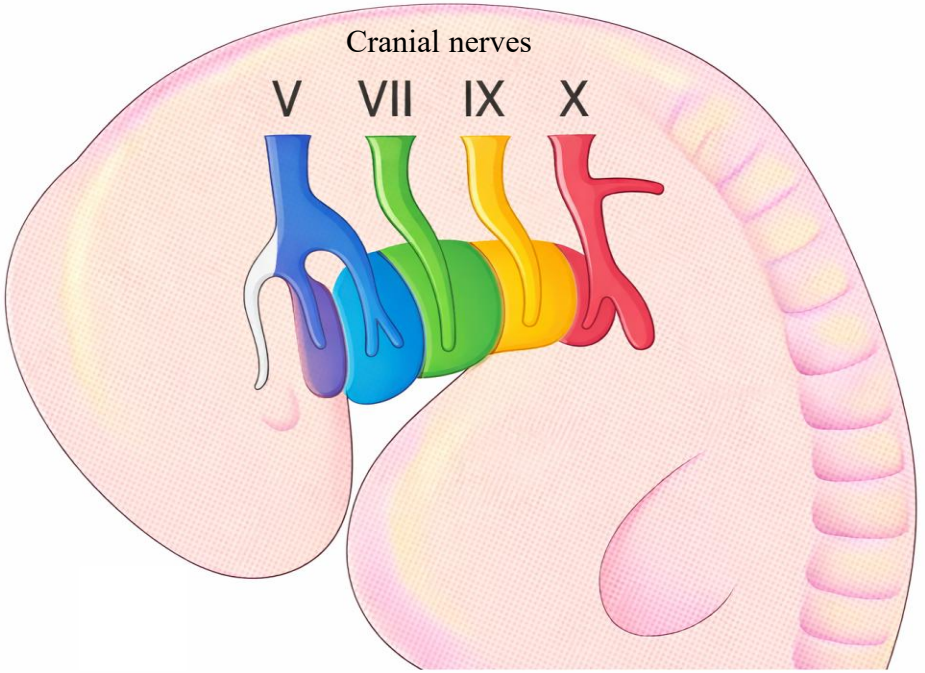
Mandibular & Maxillary nerves supplies derivatives of **1st arch**
Facial nerve supplies derivatives of **2nd arch**
Glossopharyngeal nerve supplies derivatives of **3rd arch**
Superior laryngeal nerve (vagus nerve) supplies derivatives of **4th arch**
Recurrent laryngeal nerve (vagus nerve) supplies derivatives of **6th arch**



26 days

The cranial nerves originate from brainstem nuclei in the developing neural tube, while their sensory ganglia are largely derived from neural crest cells that migrate into the head and pharyngeal arches.

Note:
The 5th pharyngeal arch is rudimentary or absent in humans.
Therefore, the arches that persist and have nerve supply are:
1st, 2nd, 3rd, 4th, and 6th arches.
This explains why Vagus nerve supplies two arches
Superior laryngeal nerve → 4th arch
Recurrent laryngeal nerve → 6th 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

Example: Muscles of facial expression migrate over the face and innervated by CN VII.

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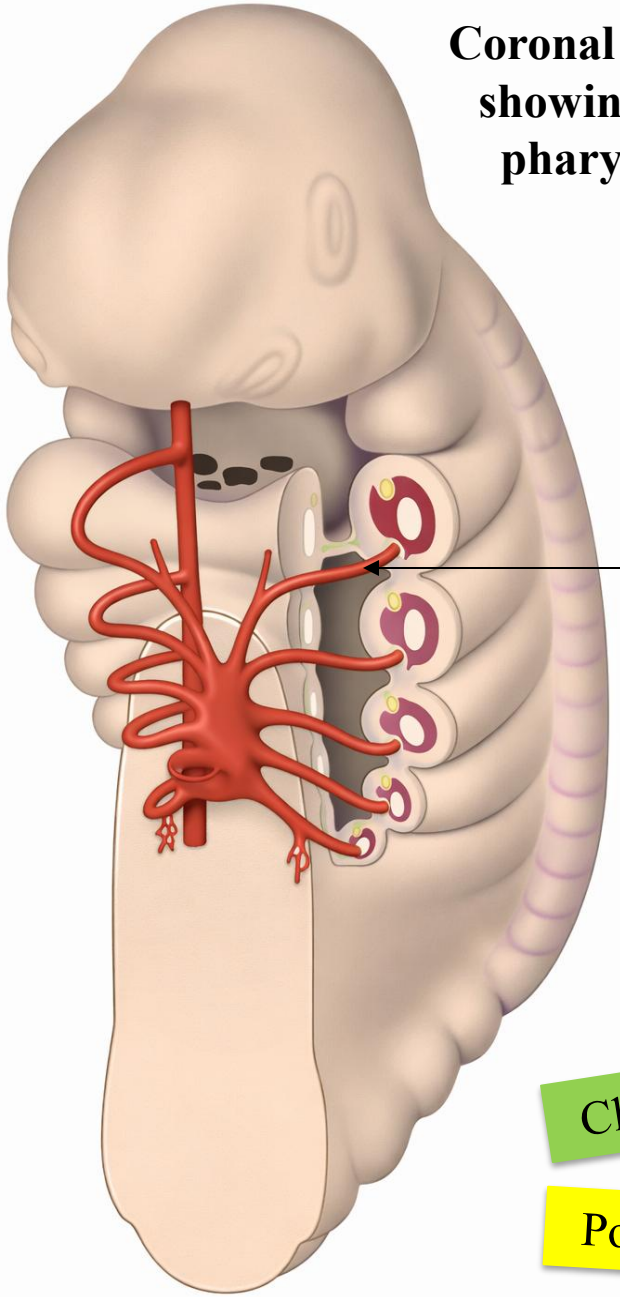
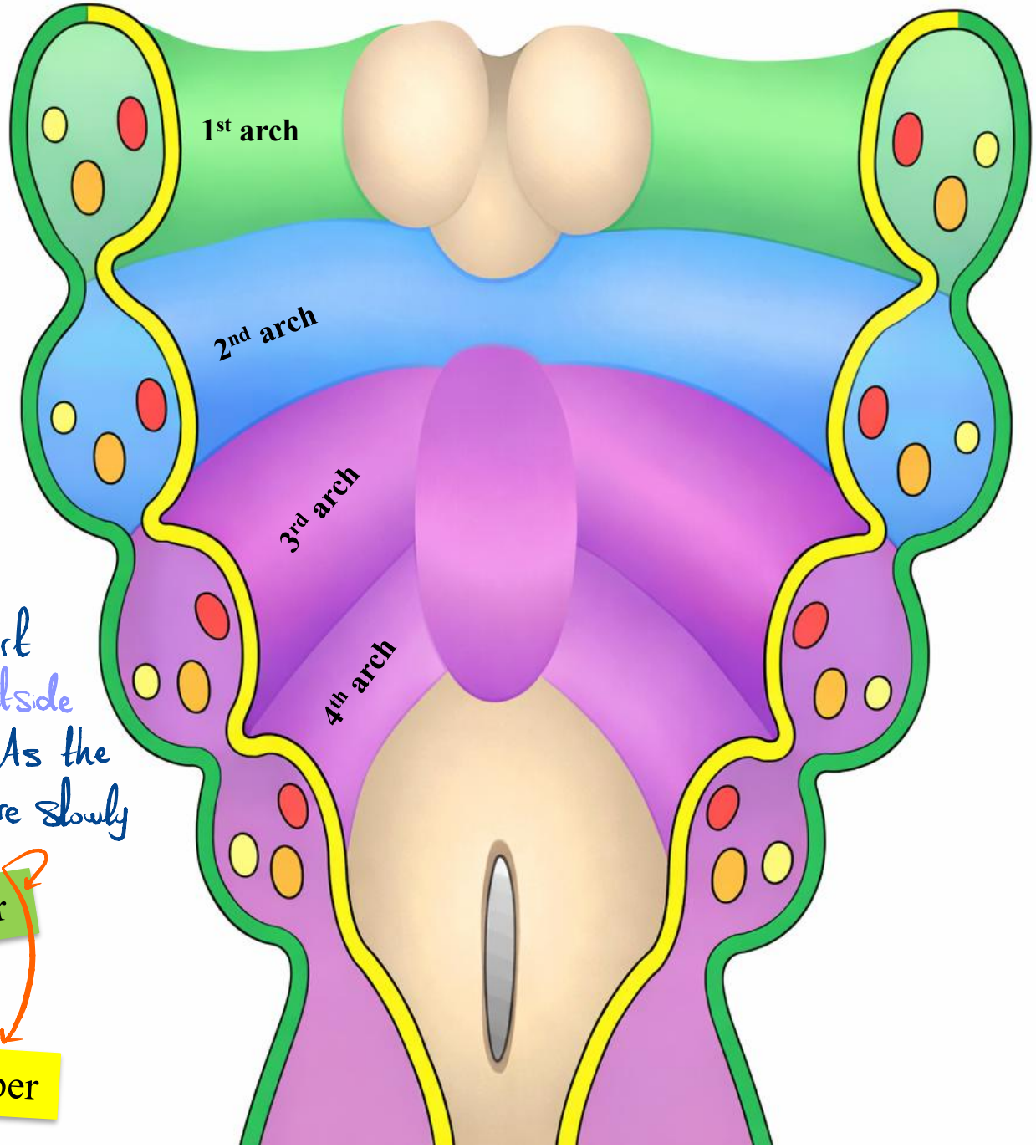
Coronal section of neck showing structure of pharyngeal arches





the 5th arch start to disappear from outside then from inside, & As the Pouches disappear more slowly than clefts, we have

Clefts are **four** in number

Pouches are **five** in number

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First arch has 2 processes: for each side

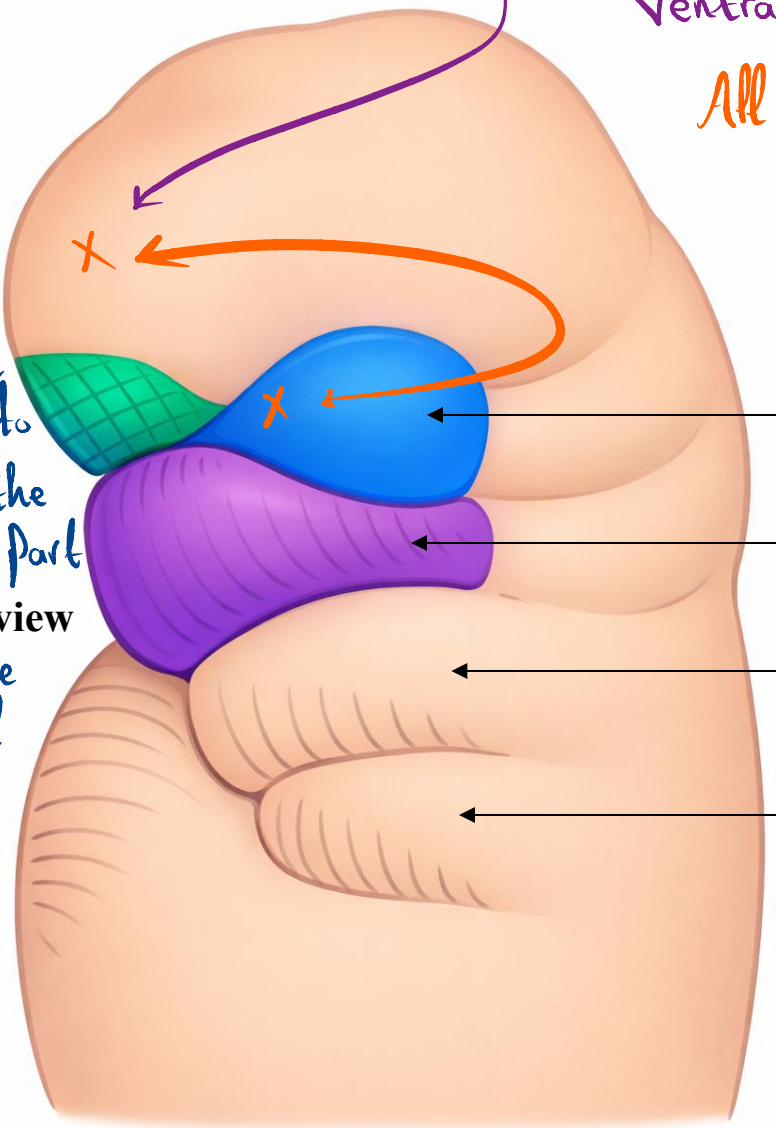
1- Maxillary process
2- Mandibular process

Both processes grow forward

"Ventrally"

All other arches / Ventral end grows ventrally, Dorsal end grows dorsally

As it going to form the lower part



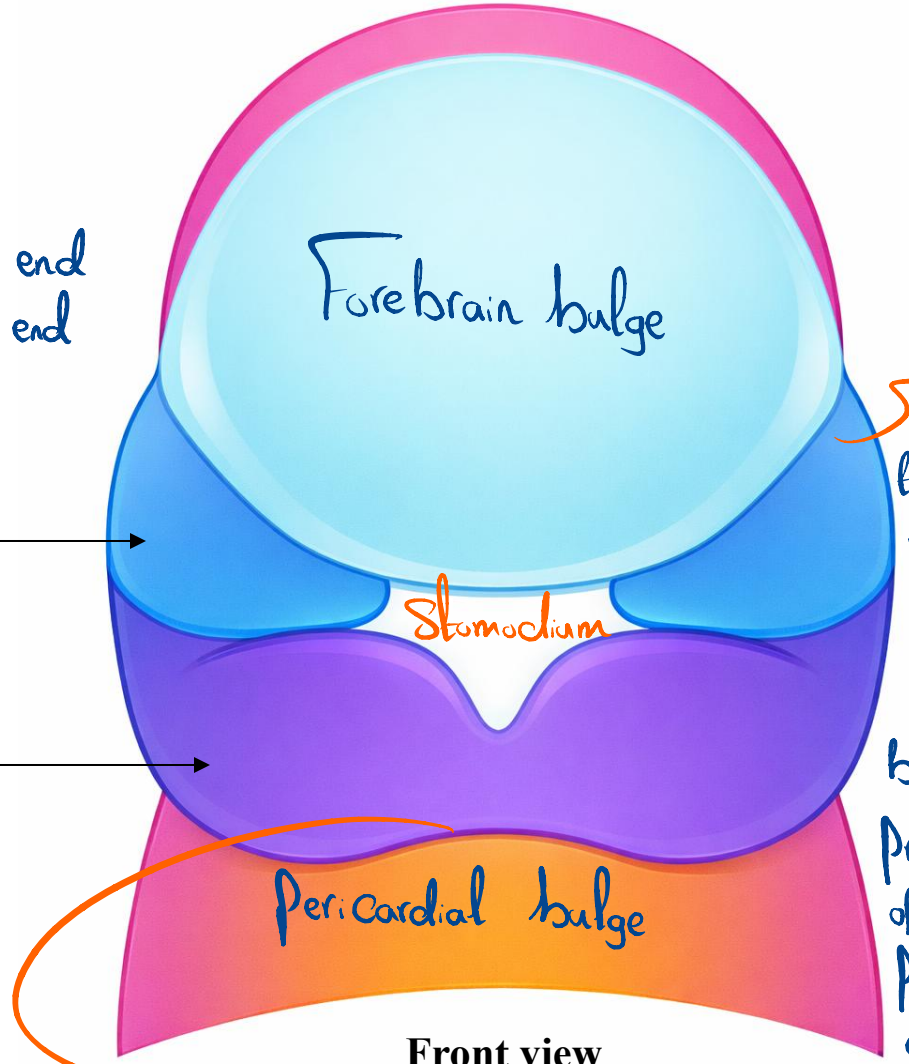
Side view of the head

Maxillary process

Mandibular process

Second arch

Third arch



Front view

will enclose the sides of the face

by the 2 processes of 1st pharyngeal arch

2 mandibular processes will enclose to form mandible

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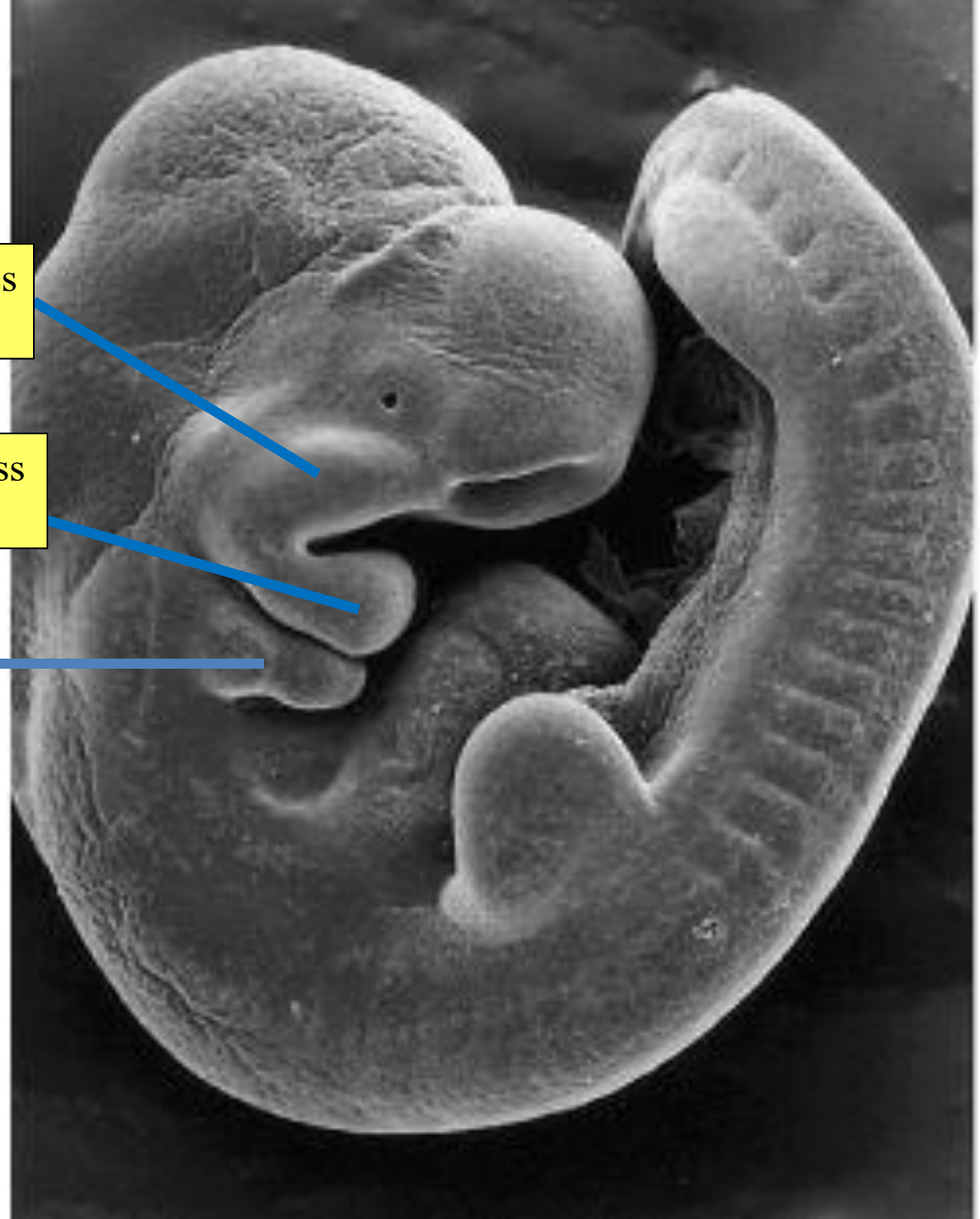
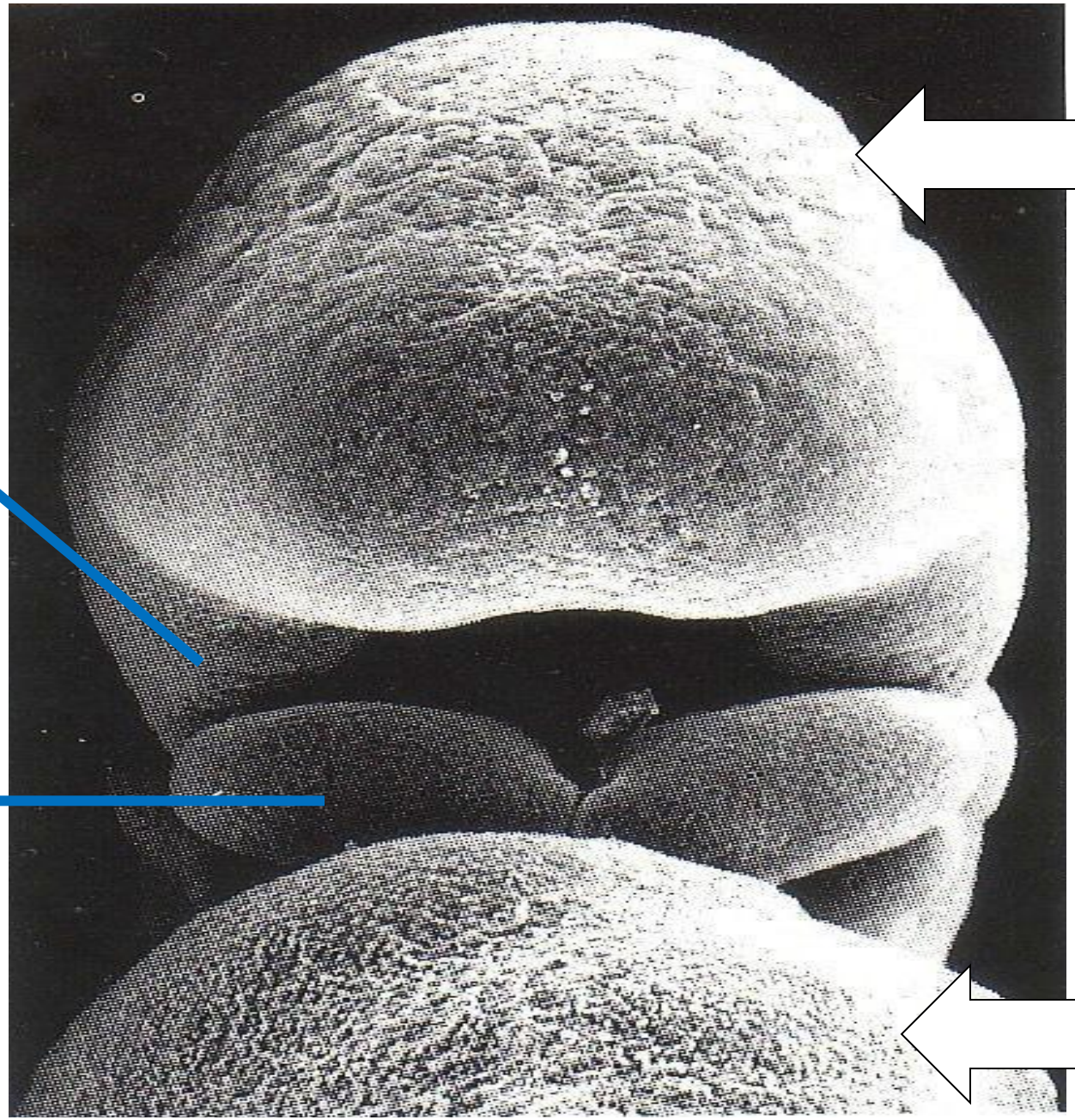
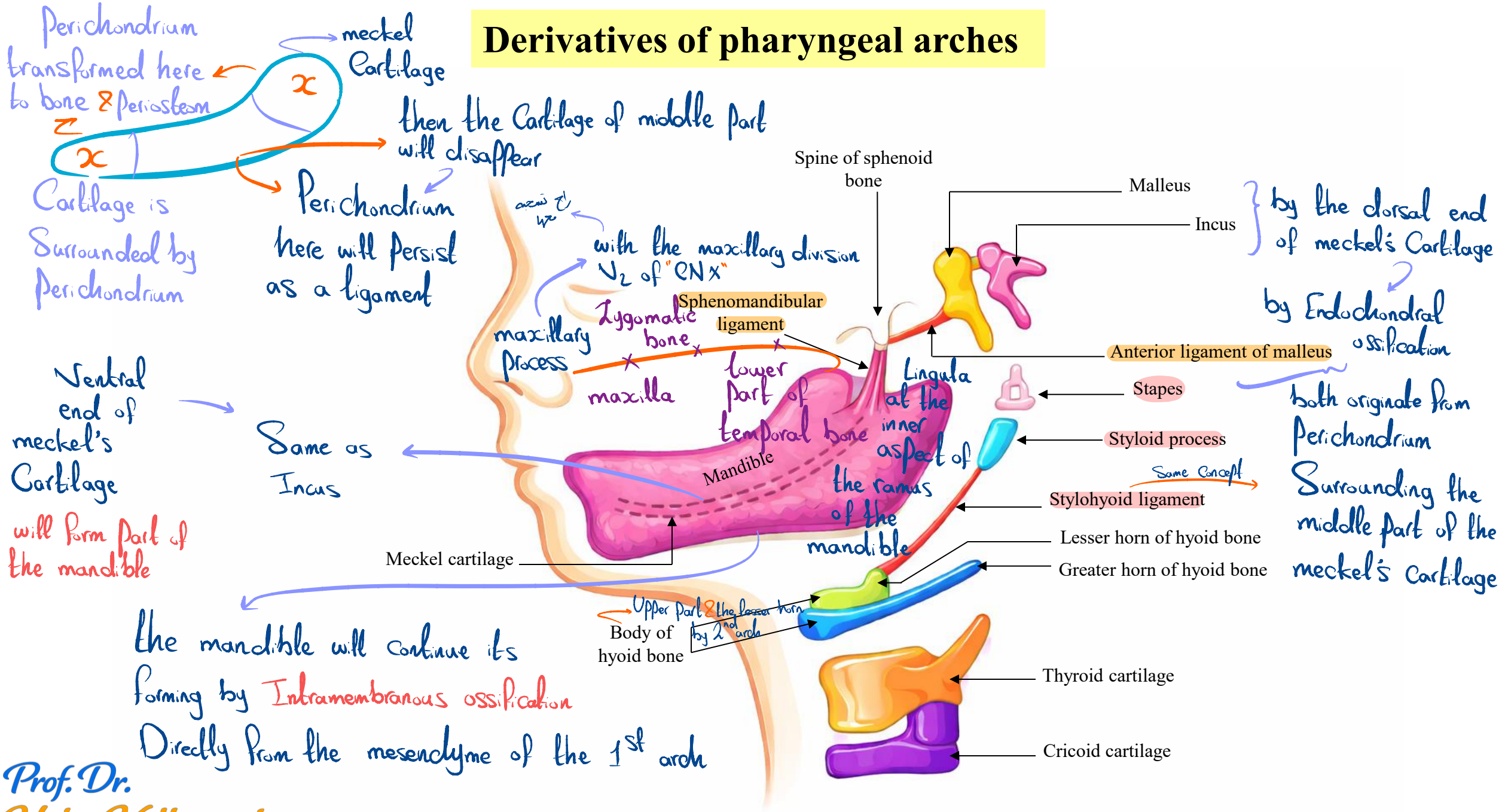


- ✓ **Maxillary process** is a forward growth of **dorsal end of 1st pharyngeal arch.**
- ✓ **Mandibular process** is a forward growth of **ventral end of 1st pharyngeal arch**



Fourth Week

Derivatives of pharyngeal arches



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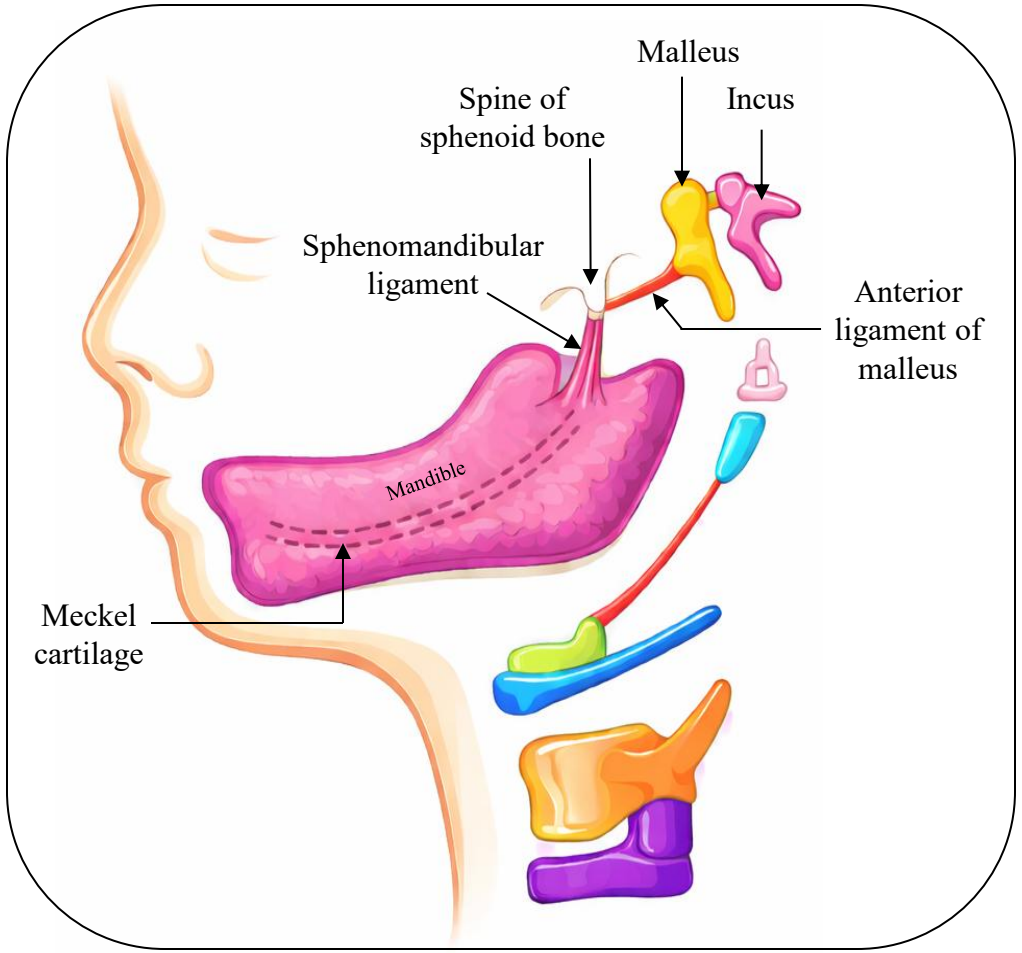
Derivatives of first pharyngeal arch

Maxillary process forms:

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



Mandibular process forms
Meckel's cartilage

Meckel's cartilage

- Ventral part
  - Ramus of mandible
- Middle part
  - 1- Anterior ligament of malleus
  - 2- Sphenomandibular ligament
- Dorsal part
  - 1- Malleus
  - 2- Incus

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

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Muscles of first pharyngeal arch:

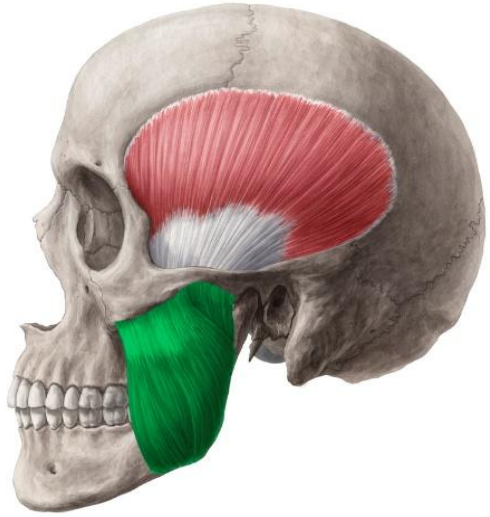
Are the muscles supplied by the **mandibular nerve**:

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

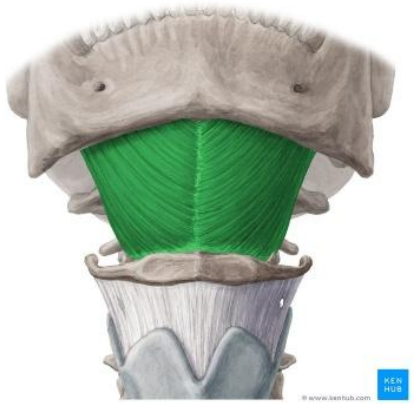
All are Supplied by Mandibular nerve

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.

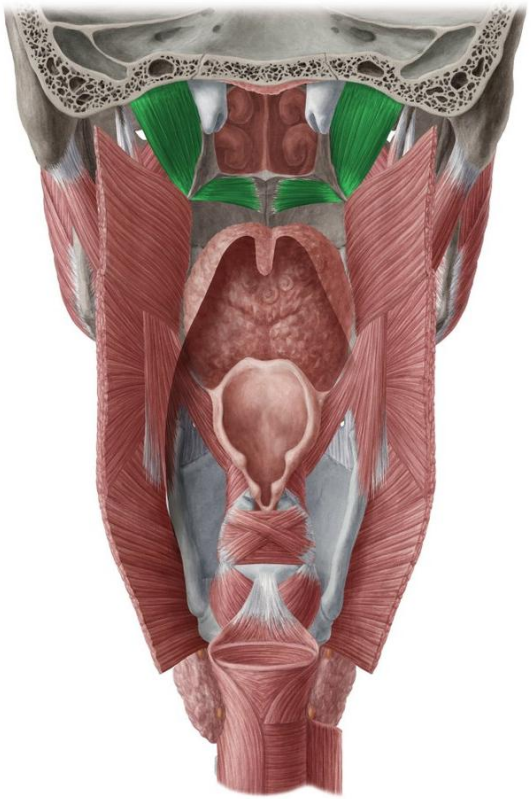
Masseter & Temporalis



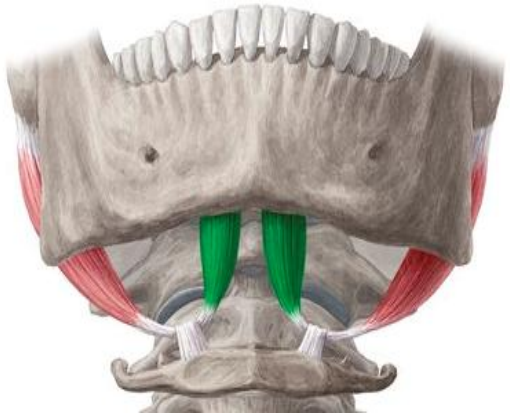
Mylohyoid



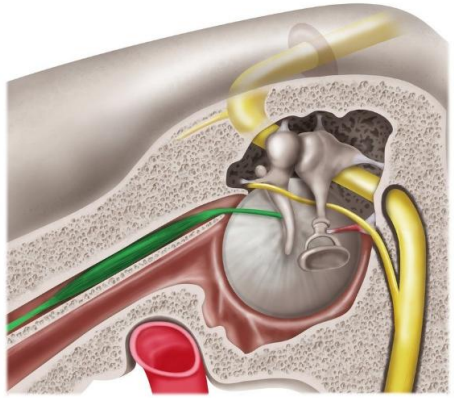
Tensor veli palatini



Anterior belly of digastric



Tensor tympani



Medial & Lateral pterygoids

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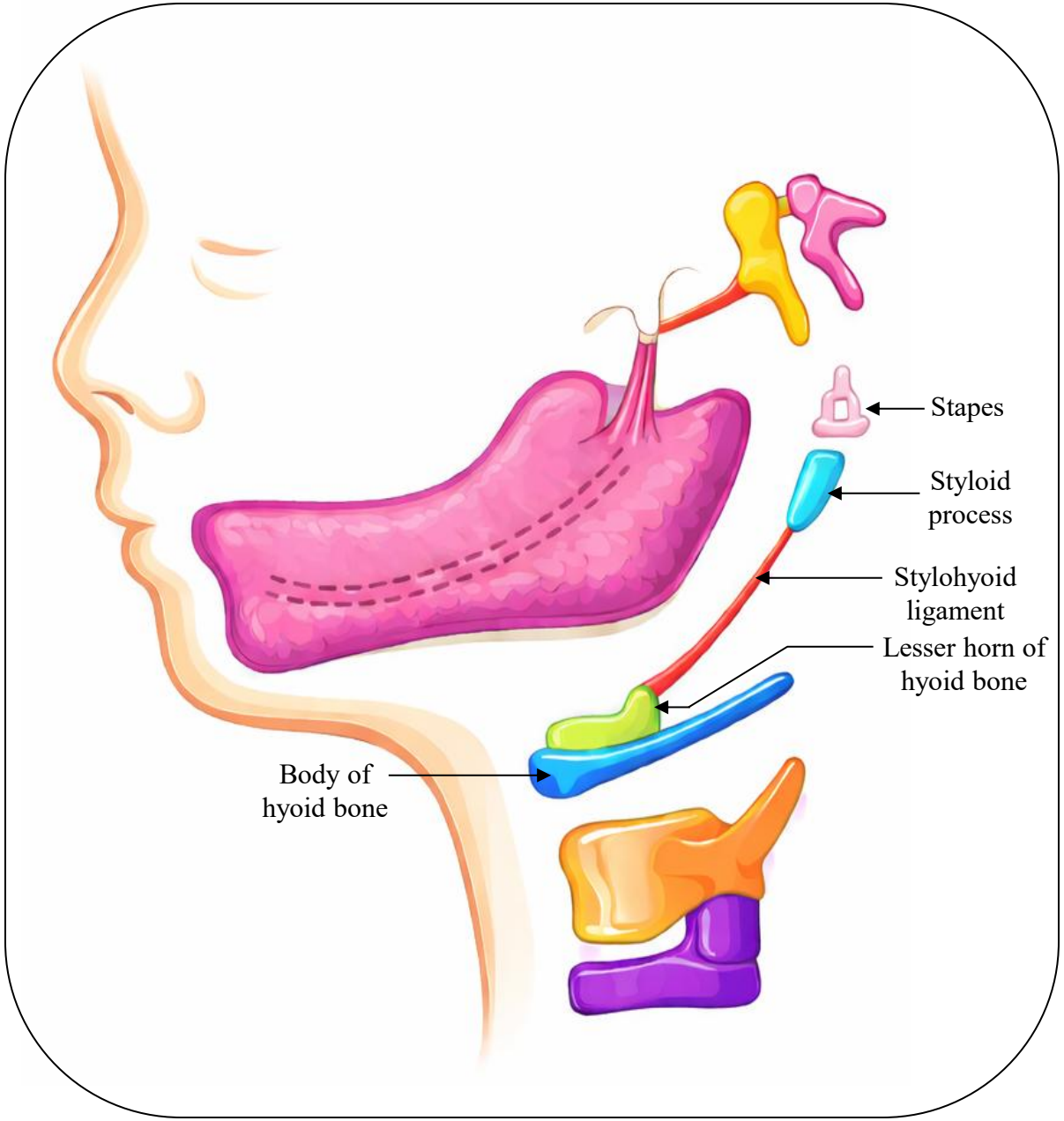
Derivatives of second pharyngeal arch



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

Reichert's cartilage

- Ventral part
  - 1- Upper part of the body of hyoid bone
  - 2- Lesser horn of the hyoid bone
- Middle part
  - Stylohyoid ligament
- Dorsal part
  - 1-Stapes
  - 2-Styloid process

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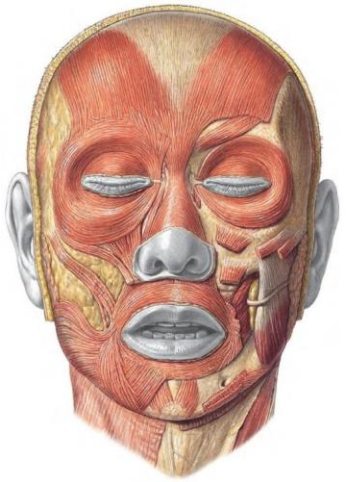
Muscles of second pharyngeal arch:

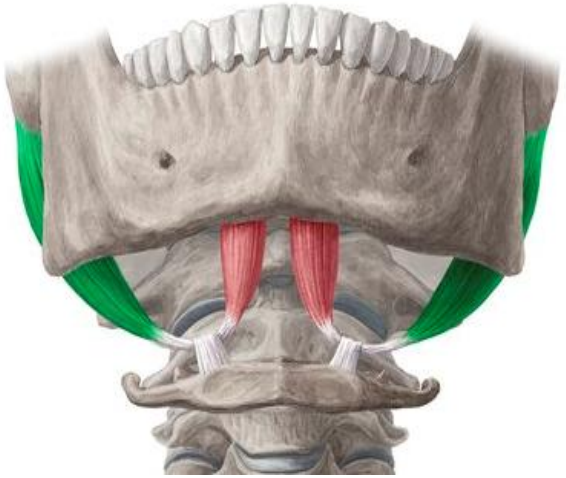
Are the muscles supplied by the **facial nerve**:

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

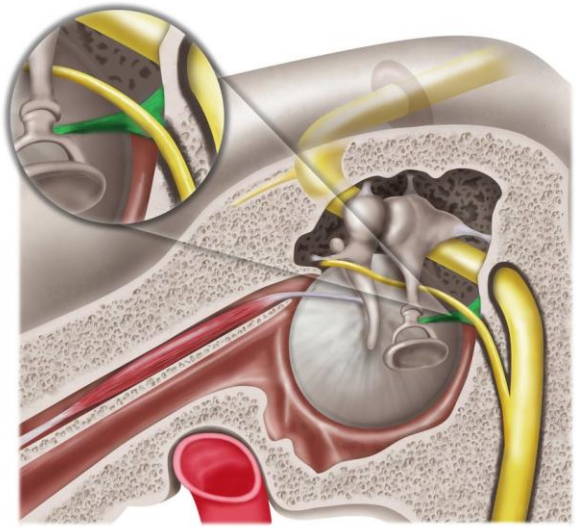
Muscle of facial expression



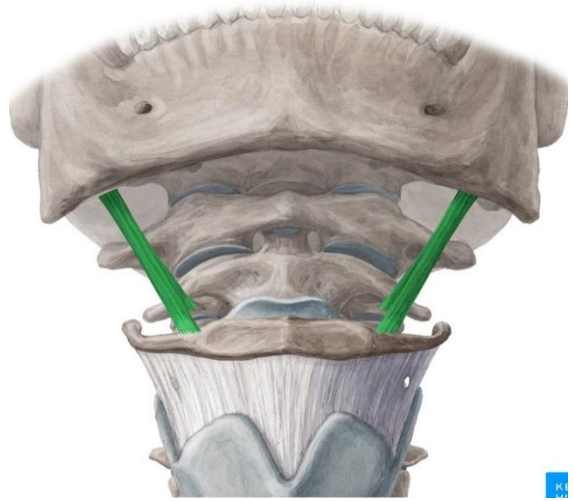
Posterior belly of the digastric



Stapedius



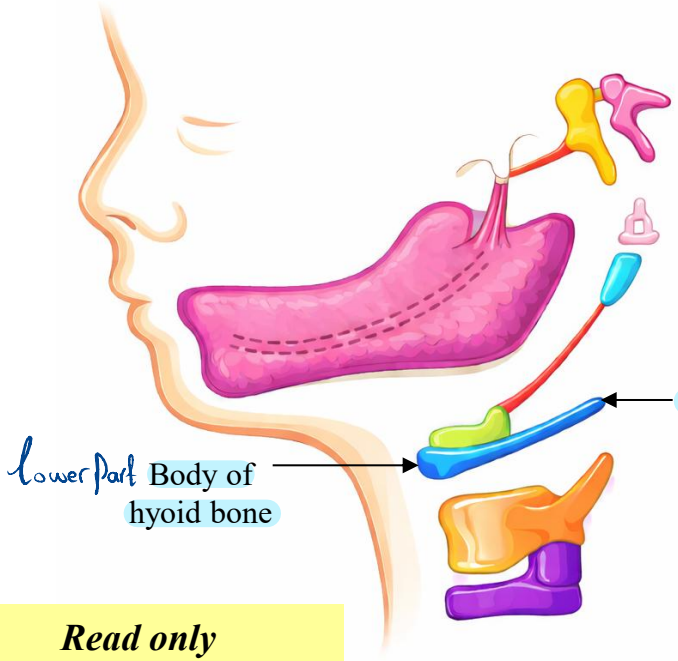
Stylohyoid

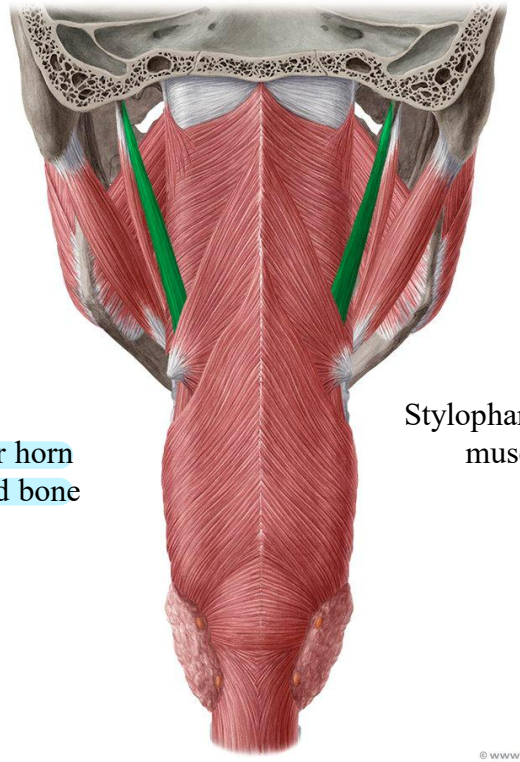


Derivatives of third pharyngeal arch

The cartilage of the third pharyngeal arch produces:
1-Lower part of the body of hyoid
2- Greater horn of hyoid bone
No ligaments

Muscles of third pharyngeal arch:
Only one muscle supplied by
Glossopharyngeal nerve:
Stylopharyngeus muscle





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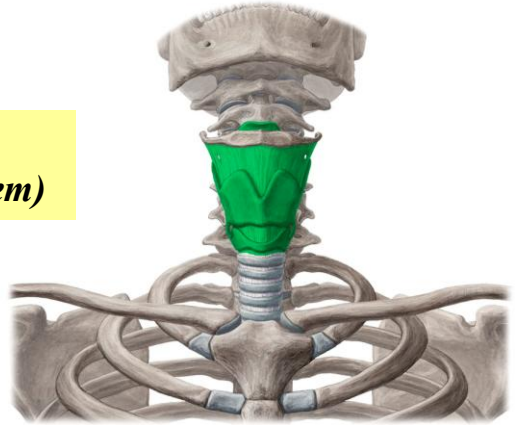
Derivatives of fourth pharyngeal arch

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)**

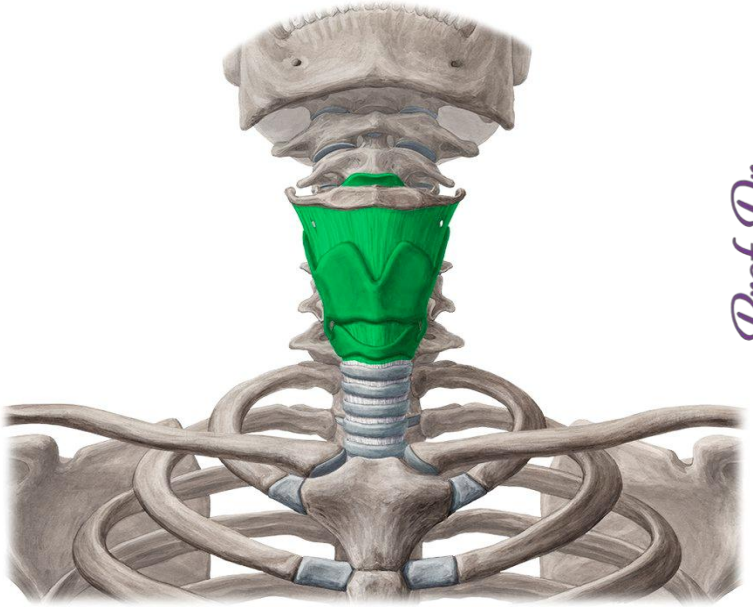
Read only
(For Respiratory System)



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 nerve)**



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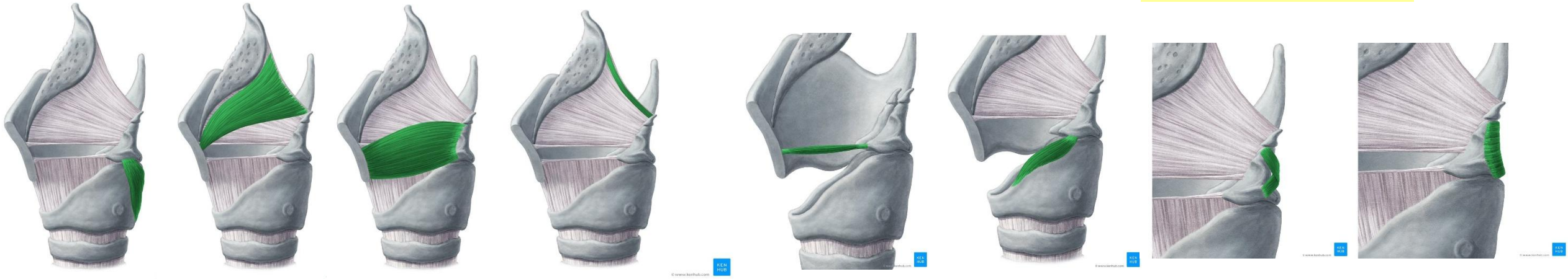
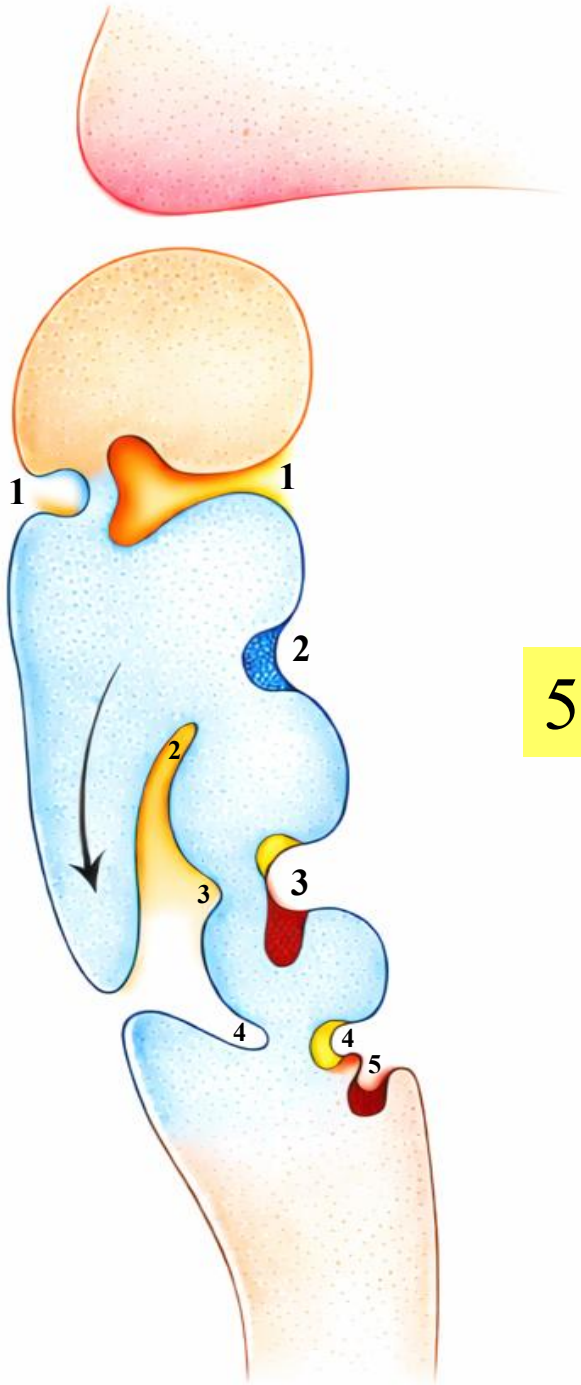


4 pharyngeal clefts



5 pharyngeal pouches

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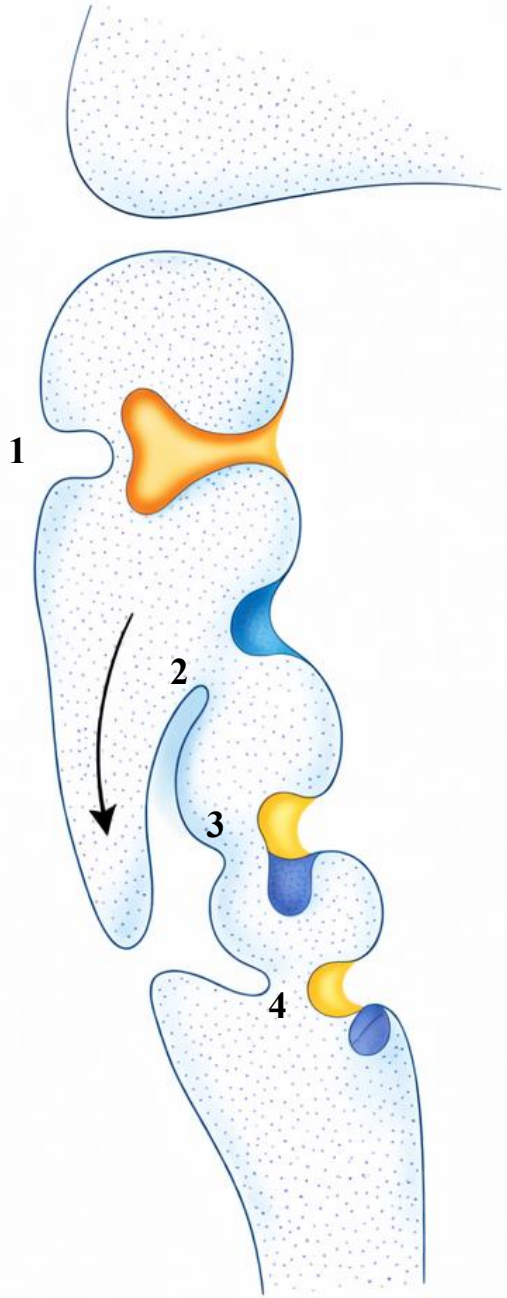

Fate of pharyngeal clefts

Clefts are **four** in number

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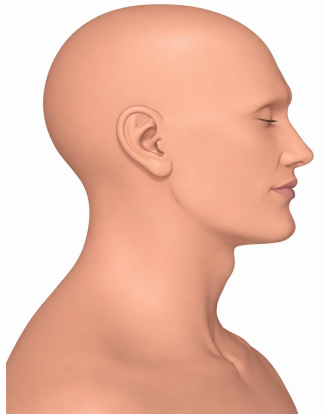
First pharyngeal cleft

Forms:

1- External auditory meatus → its dorsal end

2- Outer layer of tympanic membrane (skin)

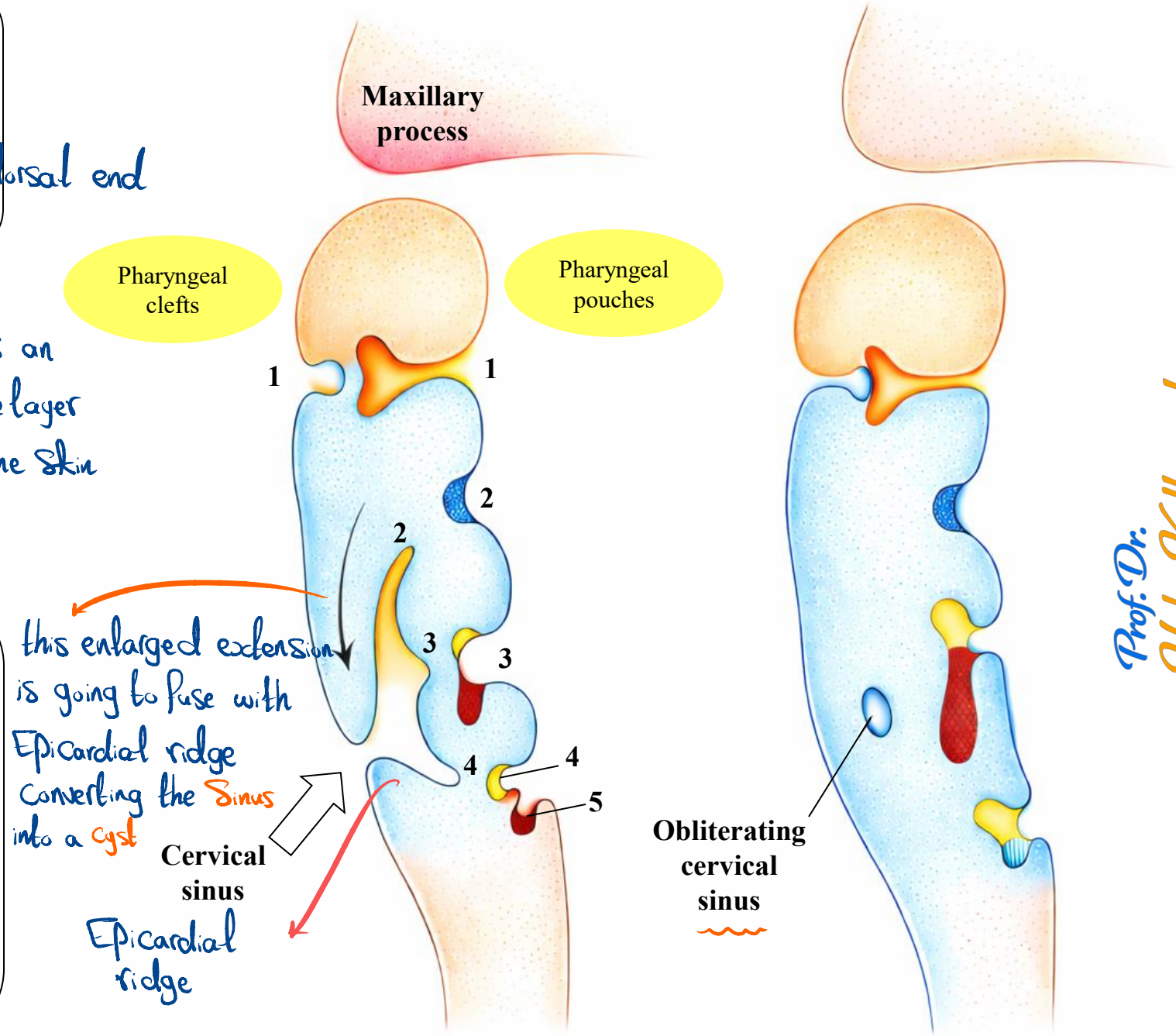


As the cleft is an Ectoderm → the layer which will form the skin

2nd 3rd and 4th pharyngeal clefts

Note the downward growth of 2nd arch

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



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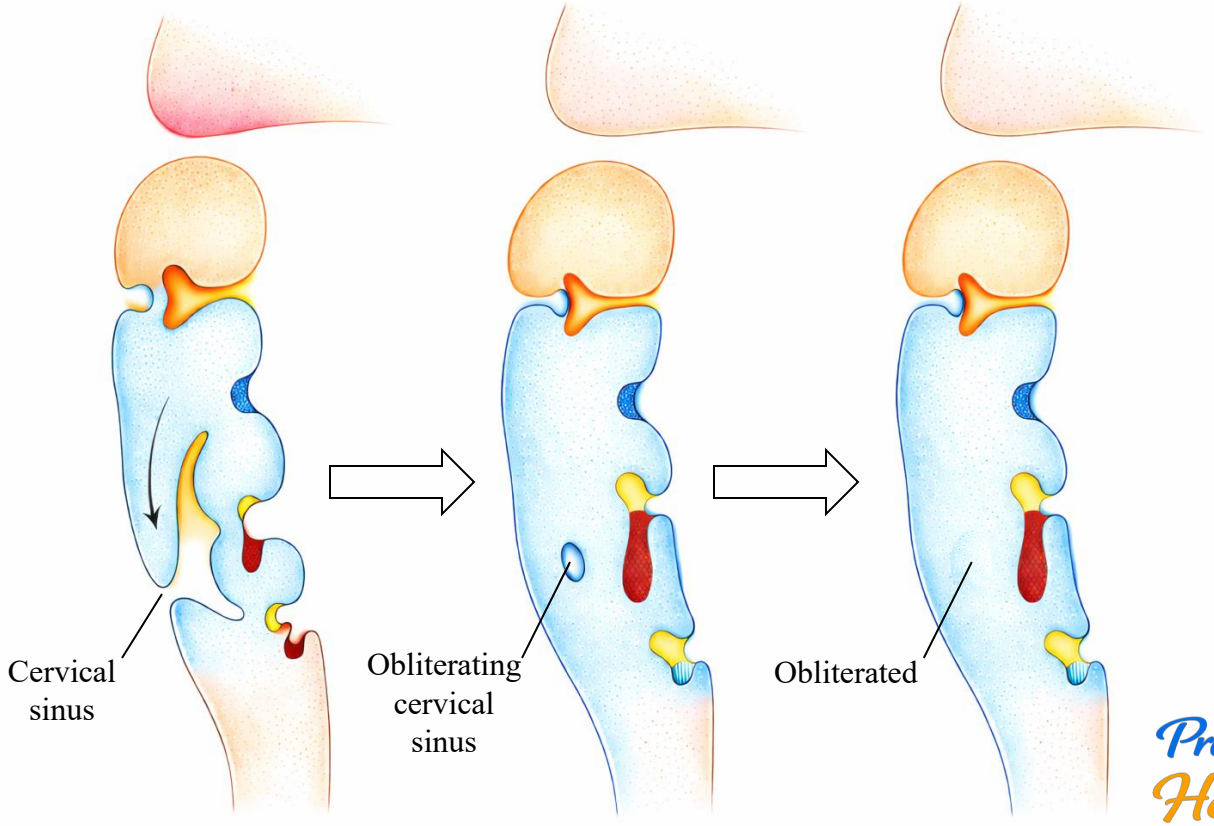
During early embryonic development, the lateral surface of the neck initially shows a segmented appearance due to the presence of the pharyngeal arches separated by pharyngeal clefts. As development progresses, the **second pharyngeal arch (hyoid arch)** grows caudally and posteriorly, extending over the third and fourth arches. This downward expansion covers the intervening clefts and forms a temporary ectoderm-lined cavity known as the **cervical sinus**, which later disappears as the tissues fuse and remodel. As a result, the initially segmented pharyngeal region becomes smooth, producing the **characteristic smooth contour of the neck** seen in normal anatomy.



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Cervical (branchial) cyst

- Remnant of cervical sinus
- Can form a fluid filled cyst in the neck

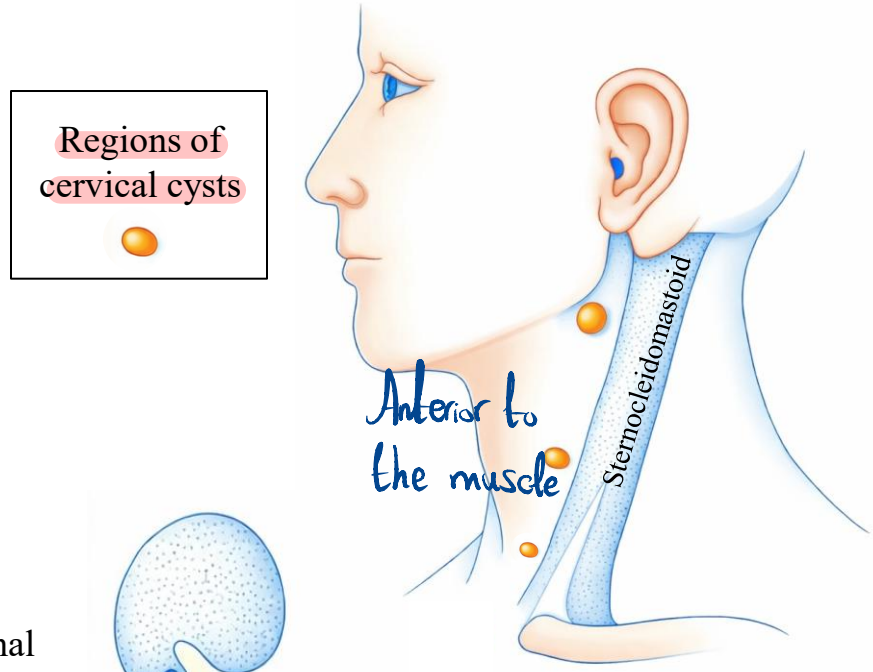
Cervical (branchial) fistula

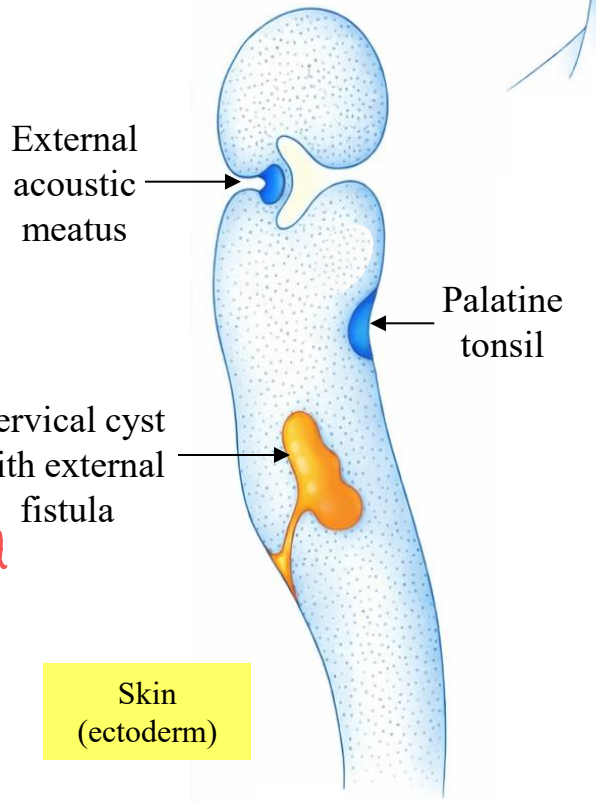
Results from persistence of the cervical sinus, forming an epithelial-lined tract. If the tract opens to the skin of the neck, it is called an external fistula; if it opens into the pharynx, it is called an internal fistula.

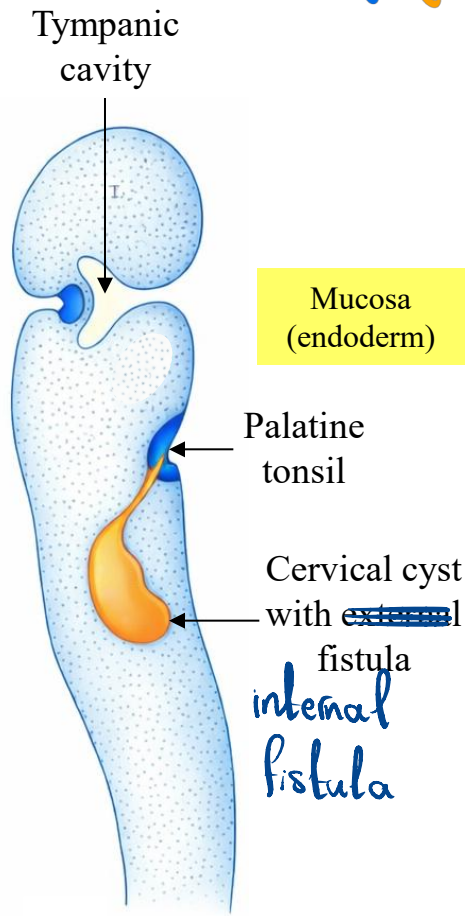
*The cervical cyst is usually not visible at birth but becomes evident as it **enlarges during childhood.***

Presents as slowly enlarging lateral neck mass on the lateral side of the neck in front of the sternocleidomastoid

At any point at the anterior border of Sternocleidomastoid







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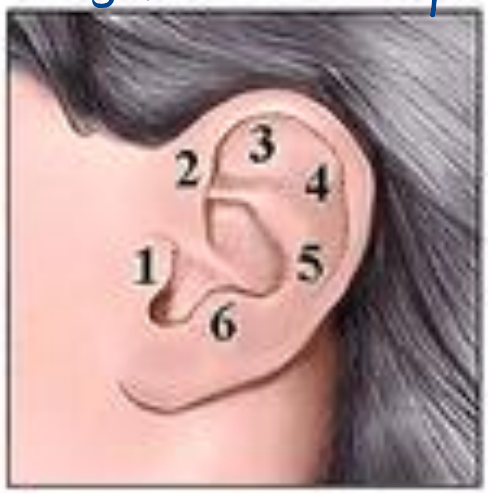
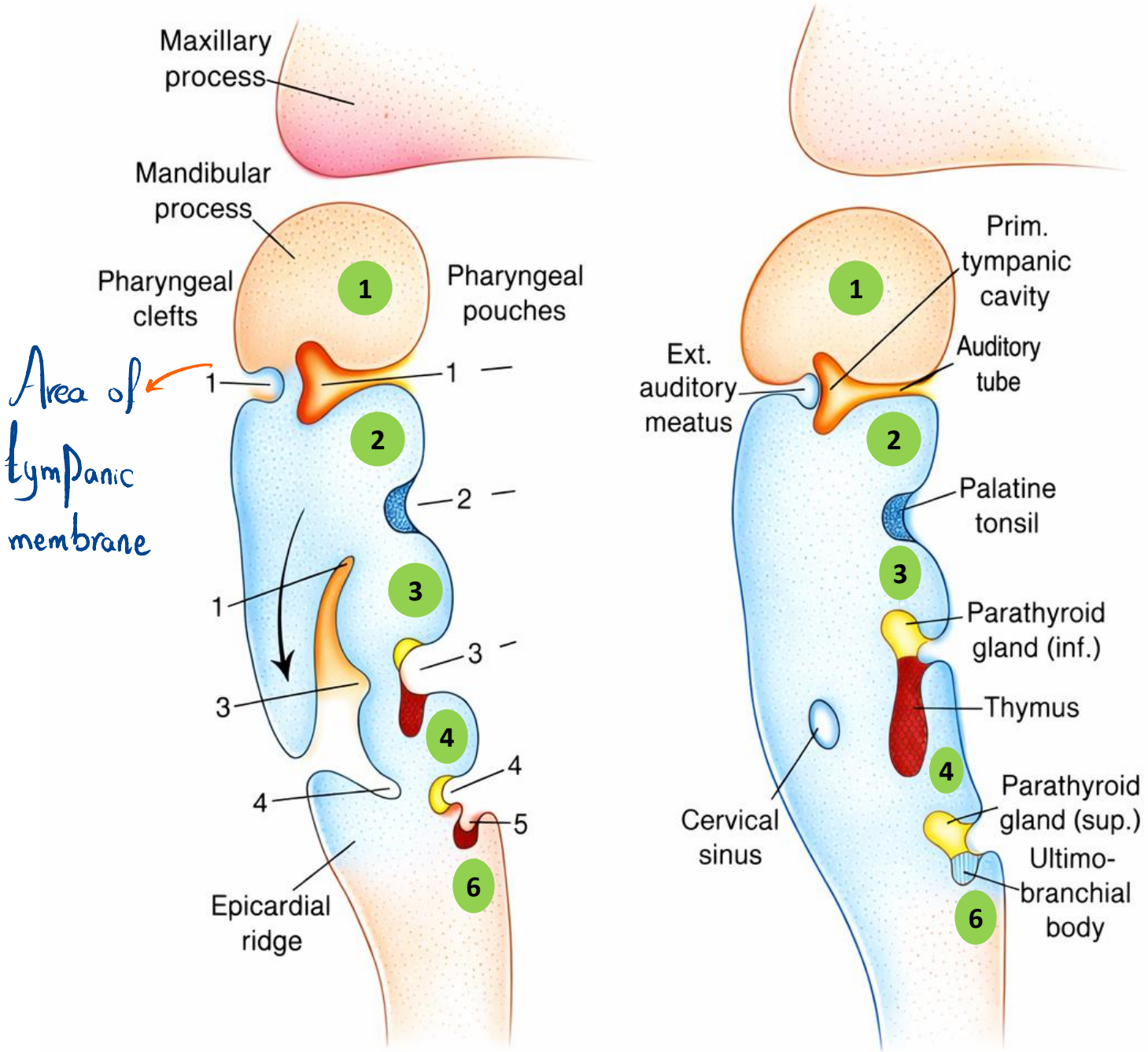
Ectodermal tubercles forming the auricle

these tubercles will be formed above & below the 1st cleft in certain locations & then they fuse to the special shape of auricle





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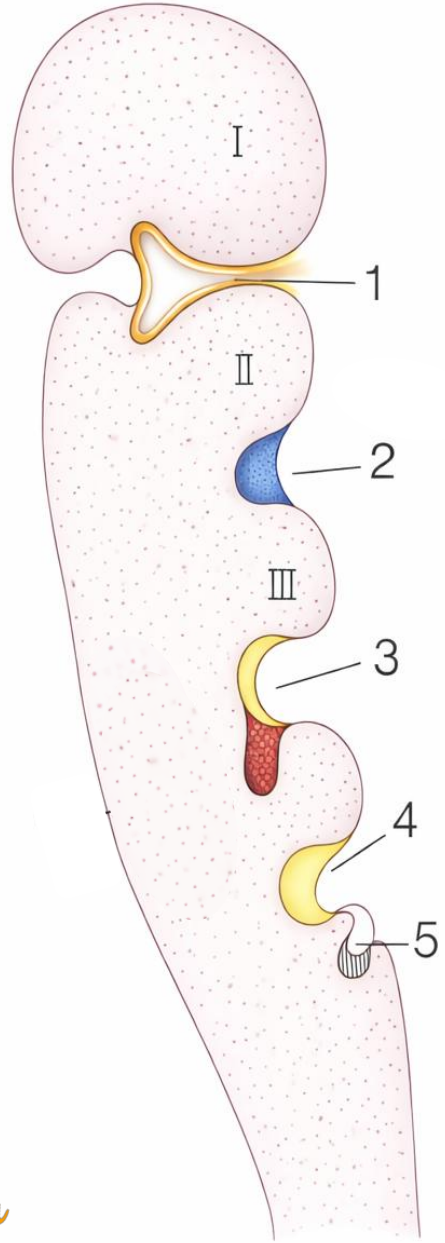

Fate of pharyngeal pouches

Pouches are **five** in number

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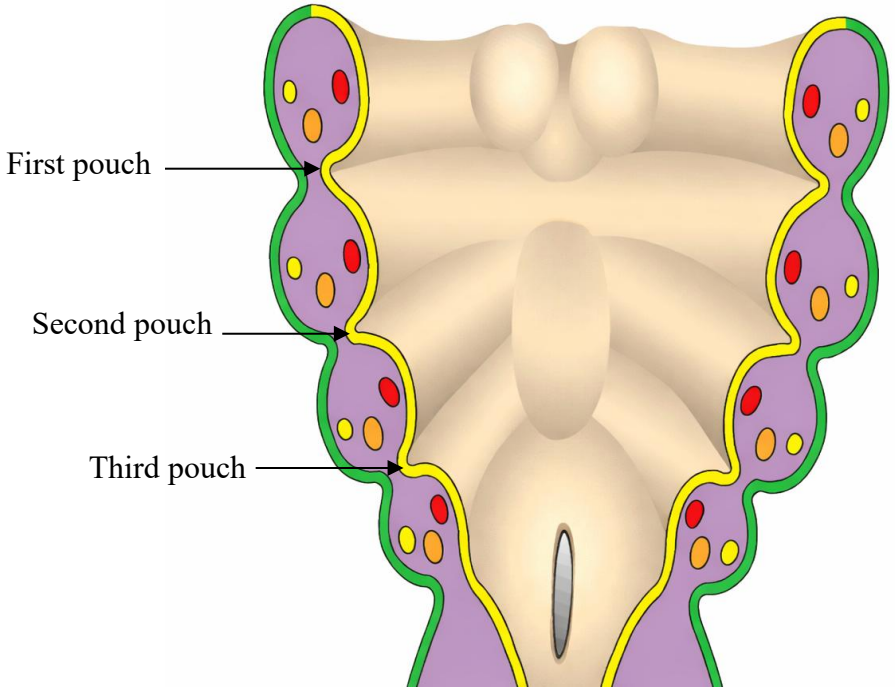
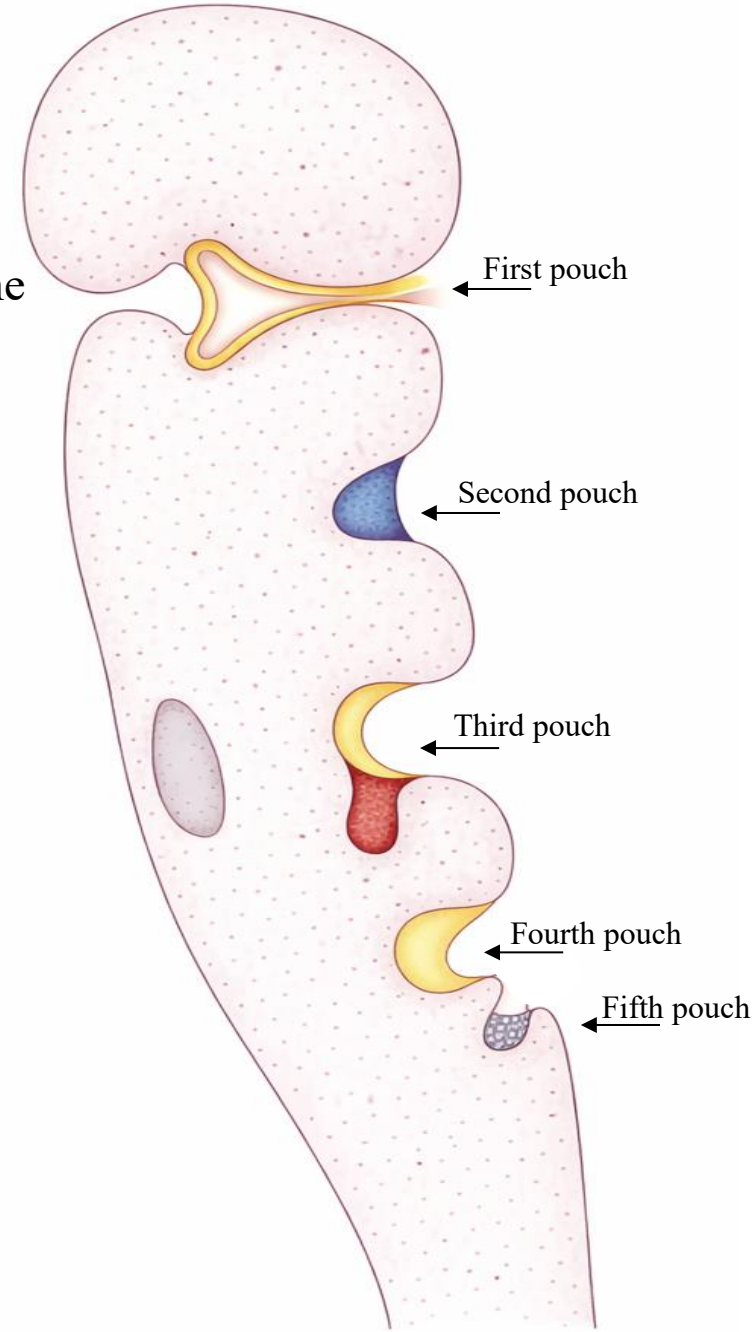
Fate of pharyngeal pouches

Only first and second pouches are covered in MSS

Pouch	Derivatives
1	Middle ear cavity, auditory tube, inner layer of tympanic membrane
2	Palatine tonsil
3	Thymus, inferior parathyroid glands
4	Superior parathyroid glands
5	Ultimobranchial body → thyroid parafollicular cells

For Endocrine System





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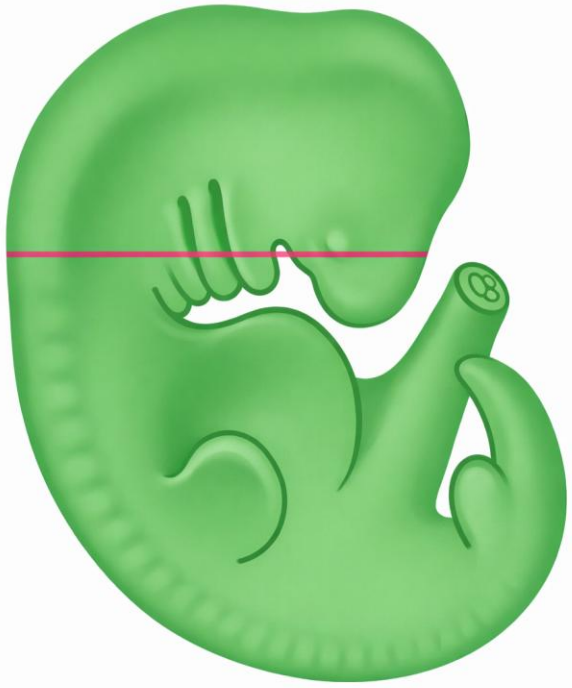
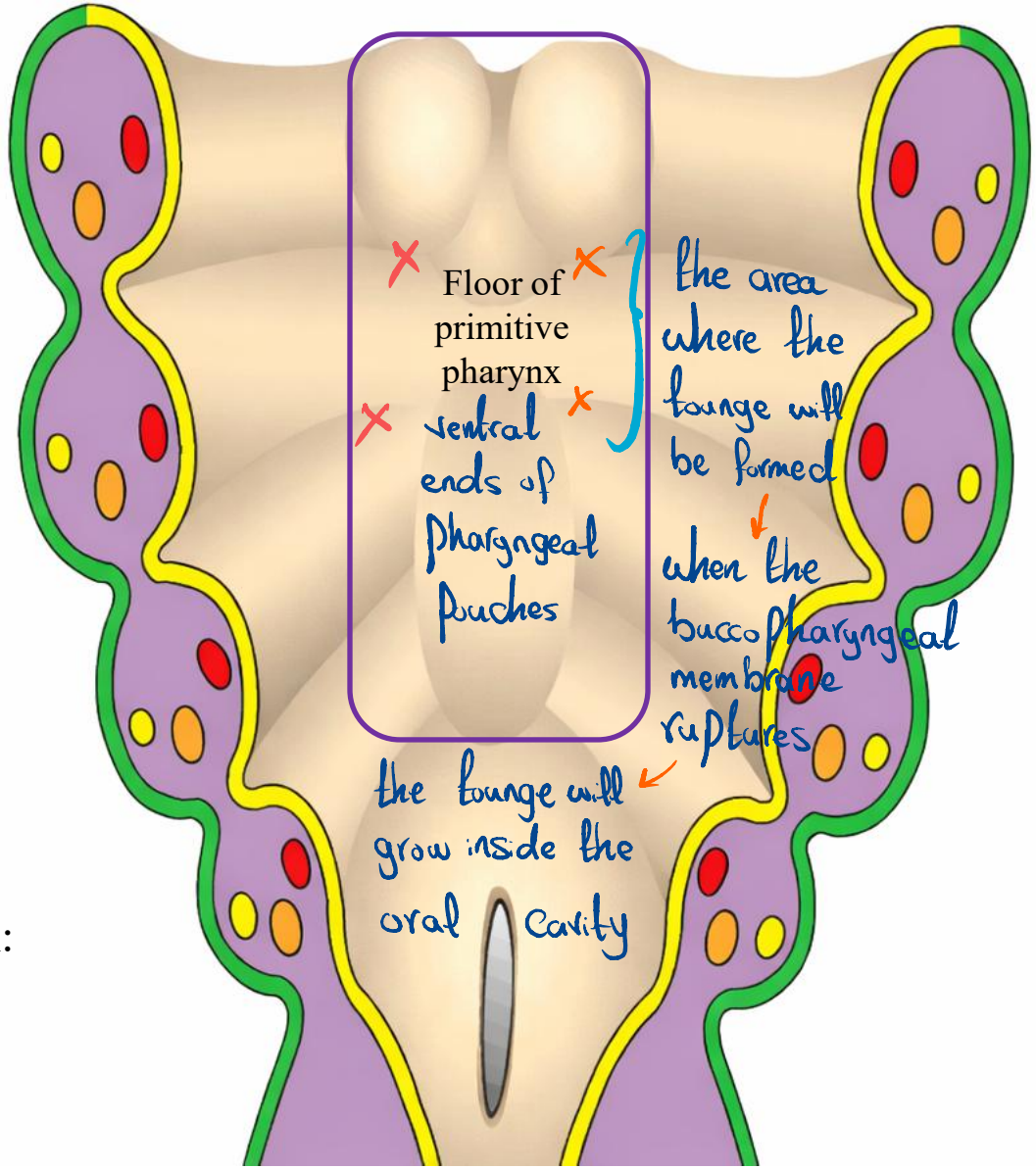


Note:

Three major structures originate from the floor of the primitive pharynx:

1. Tongue
2. Thyroid gland
3. Respiratory tract

Arise from endodermal proliferations in the floor of the primitive pharynx during the 4th week of development.



Coronal section of neck showing structure of pharyngeal arches

First pharyngeal pouch

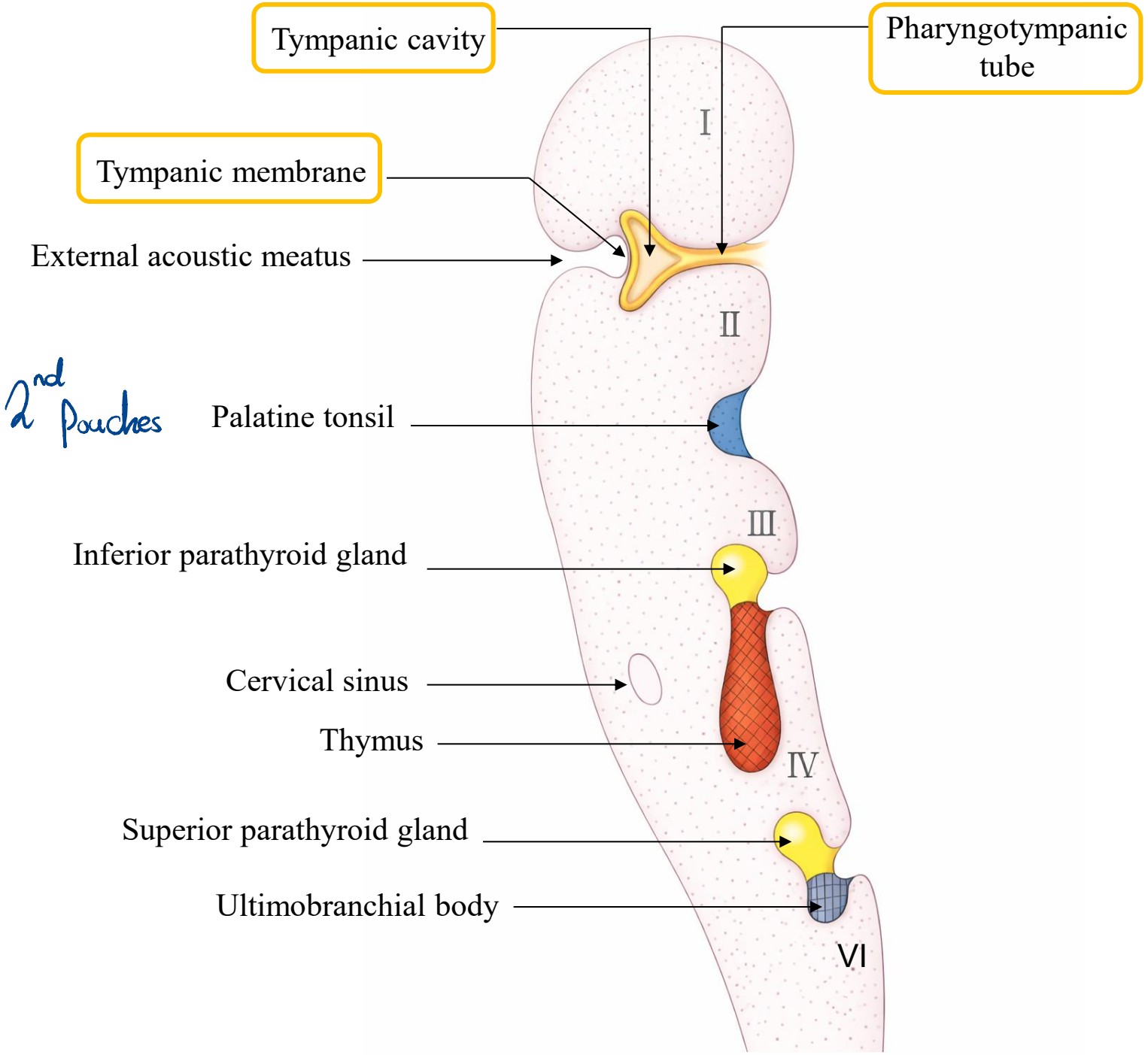
Forms:

1- Inner layer of tympanic membrane (mucous membrane)

2- Middle ear (tympanic cavity)

3- Eustachian tube (pharyngotympanic tube)

↳ Opens into the Anterior wall of the middle ear



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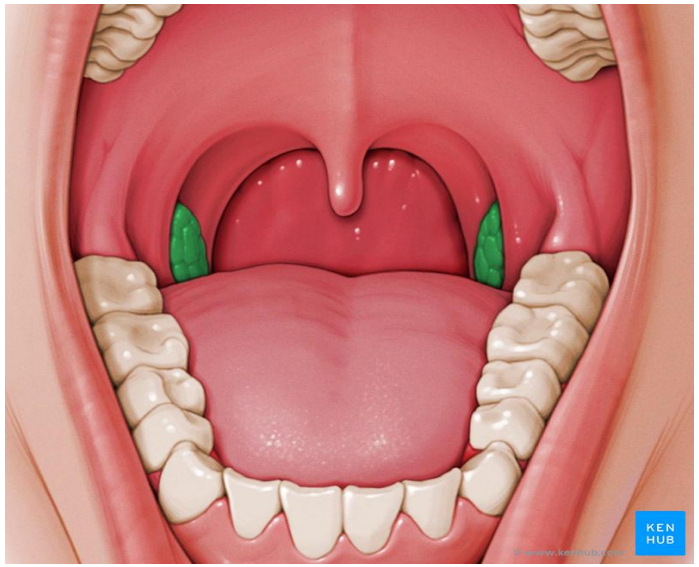
Second pharyngeal pouch

Forms:
Palatine tonsils



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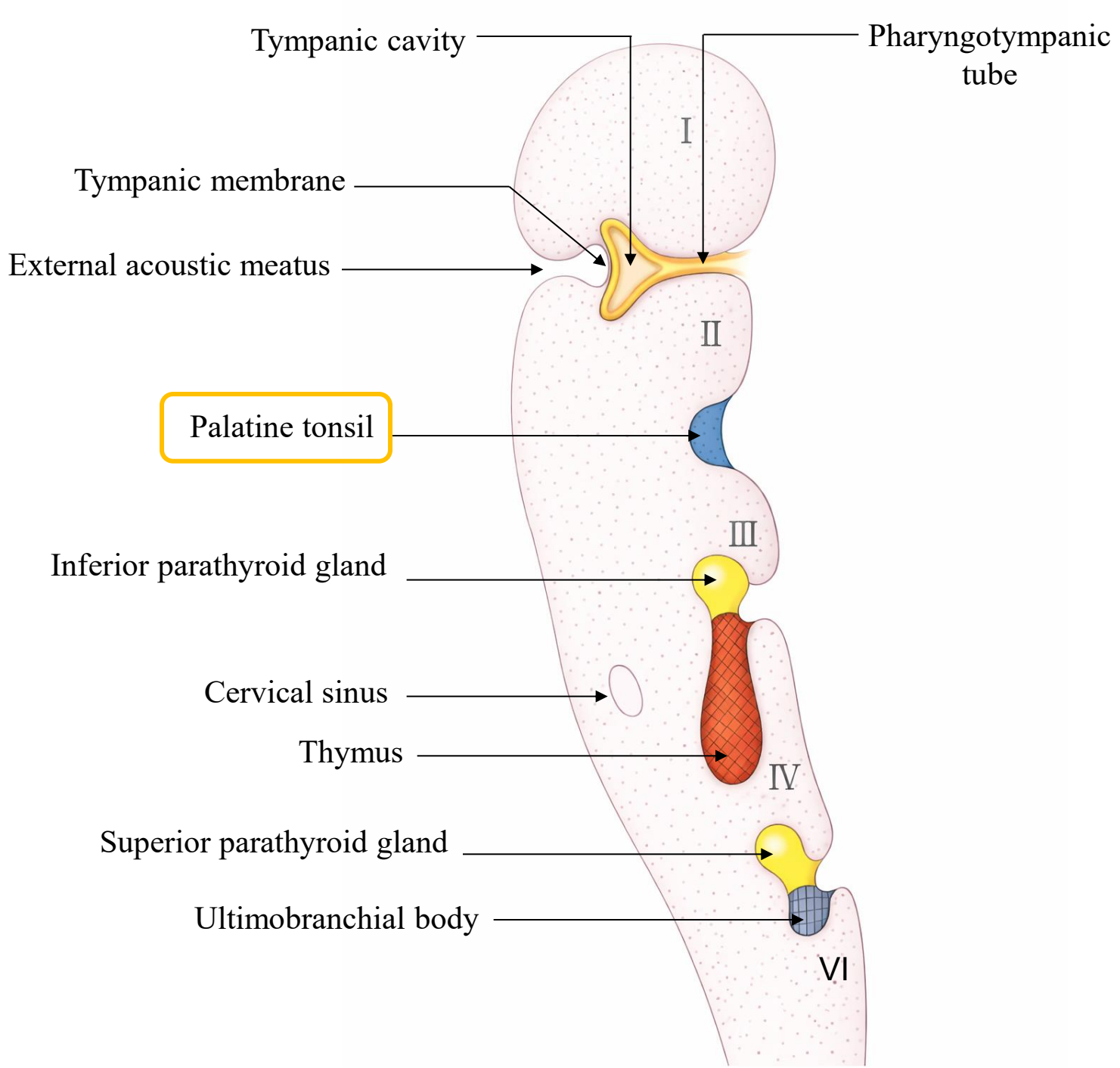
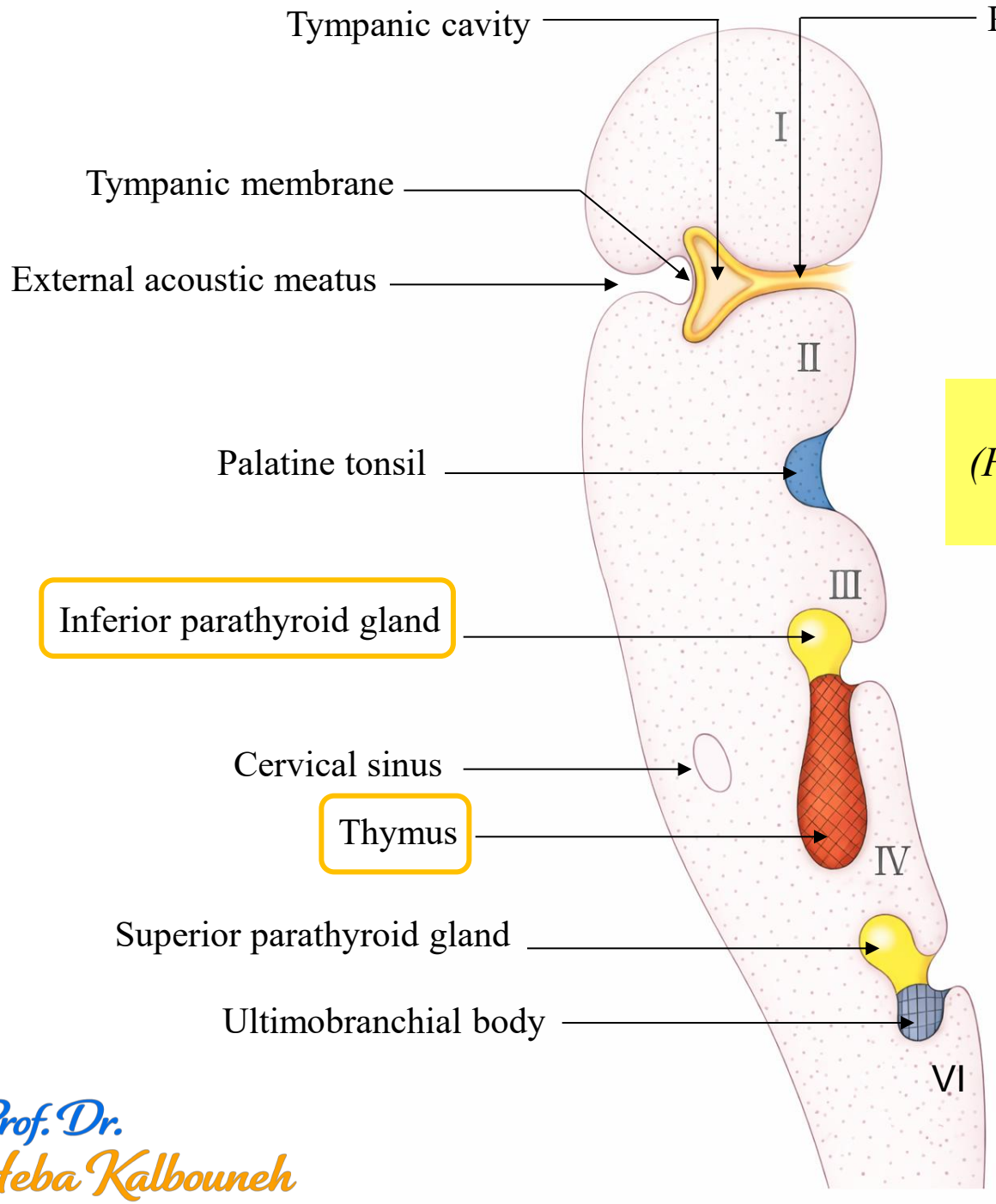


Third pharyngeal pouch

Forms:
Thymus
Inferior thyroid gland

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

Note:
Postnatal
***Thymus**: lies in the thorax behind the sternum*
***Inferior thyroid glands:** lie on the posterior surface of thyroid gland*



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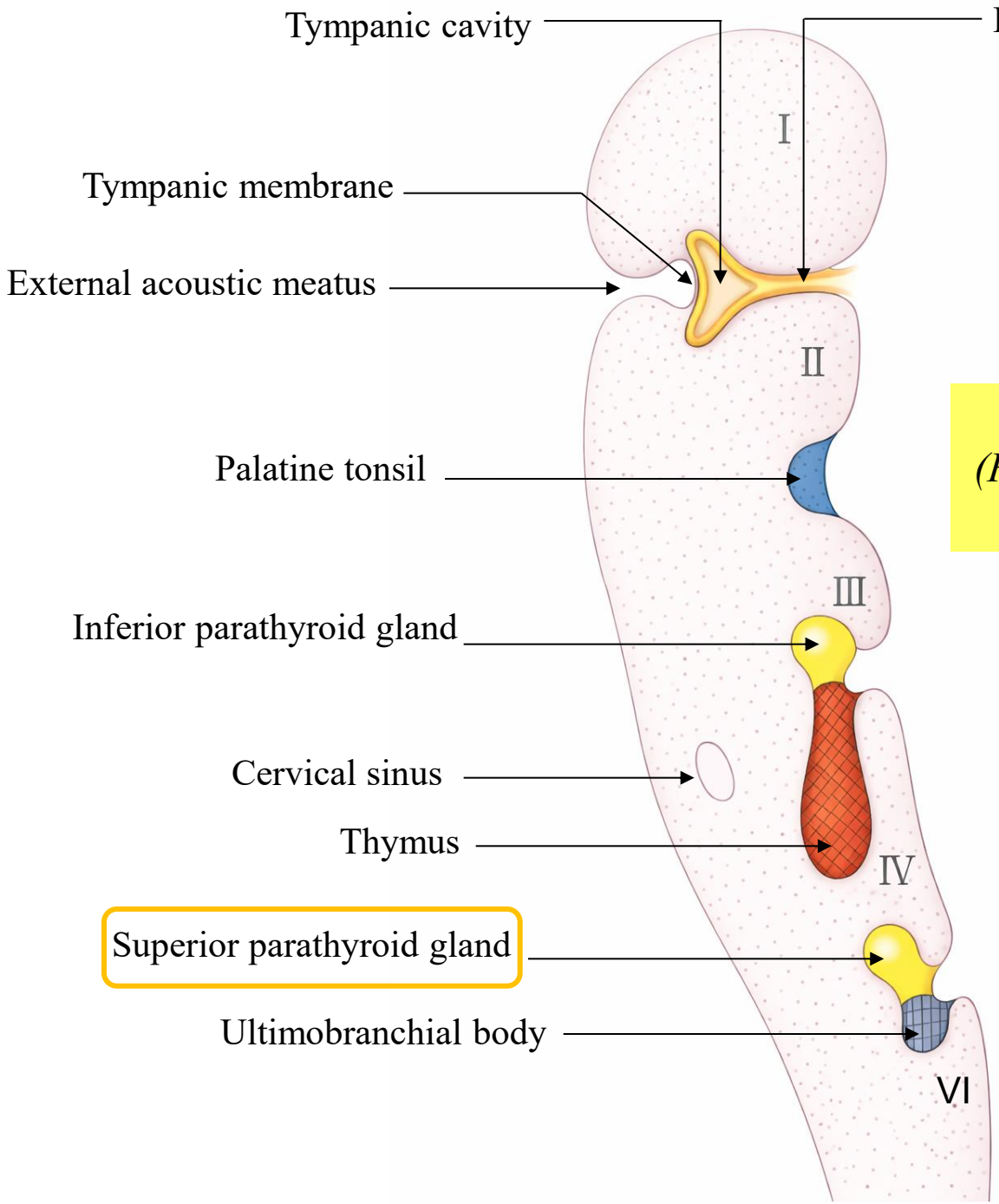
Fourth pharyngeal pouch

Forms:
Superior thyroid gland

Note:
Superior thyroid glands: lie on the posterior surface of thyroid gland



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Fifth pharyngeal pouch

Forms

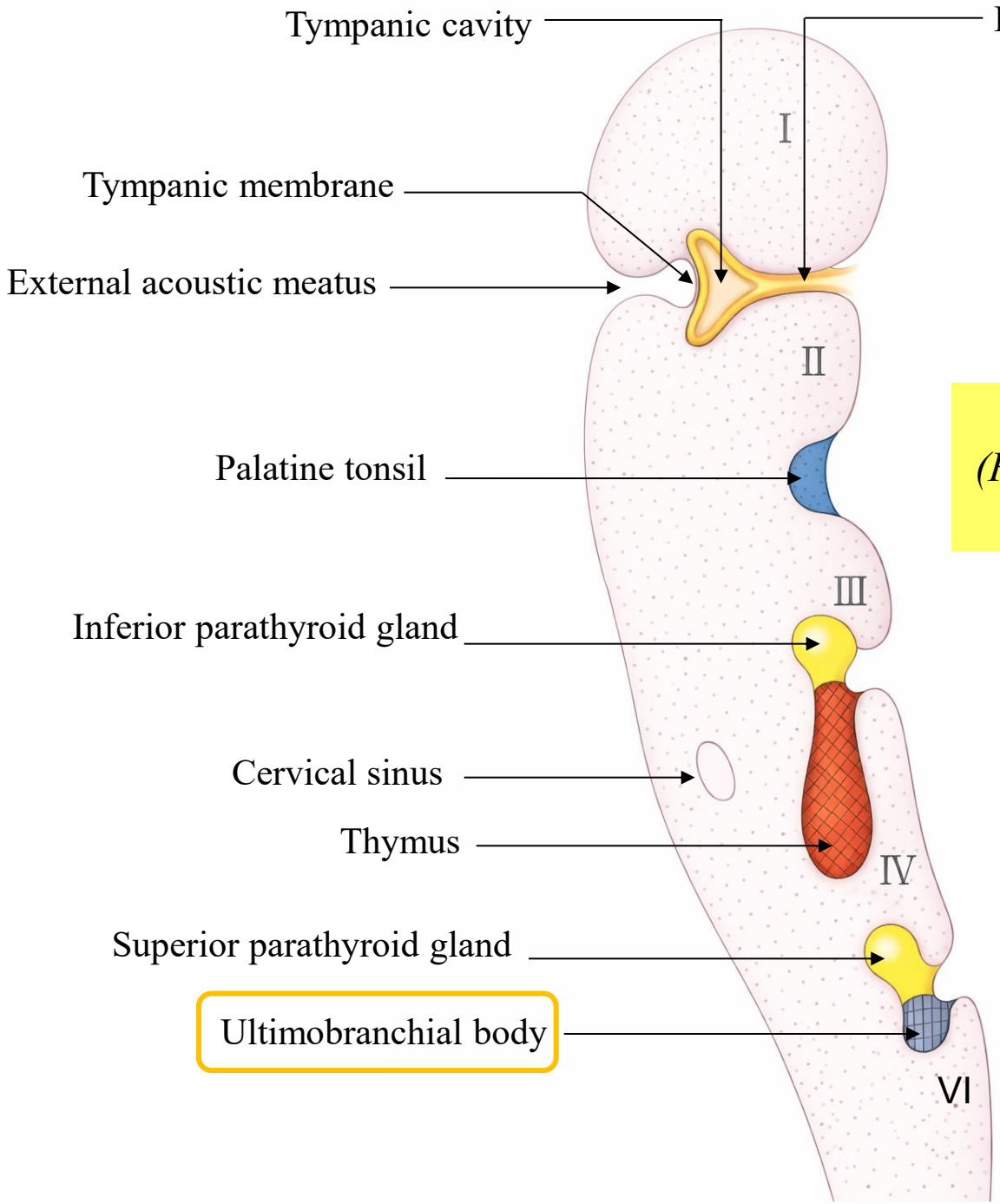
Ultimobranchial body:

Is incorporated into the thyroid gland.

Cells of the ultimobranchial body give rise to the parafollicular of the thyroid gland

Note:

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



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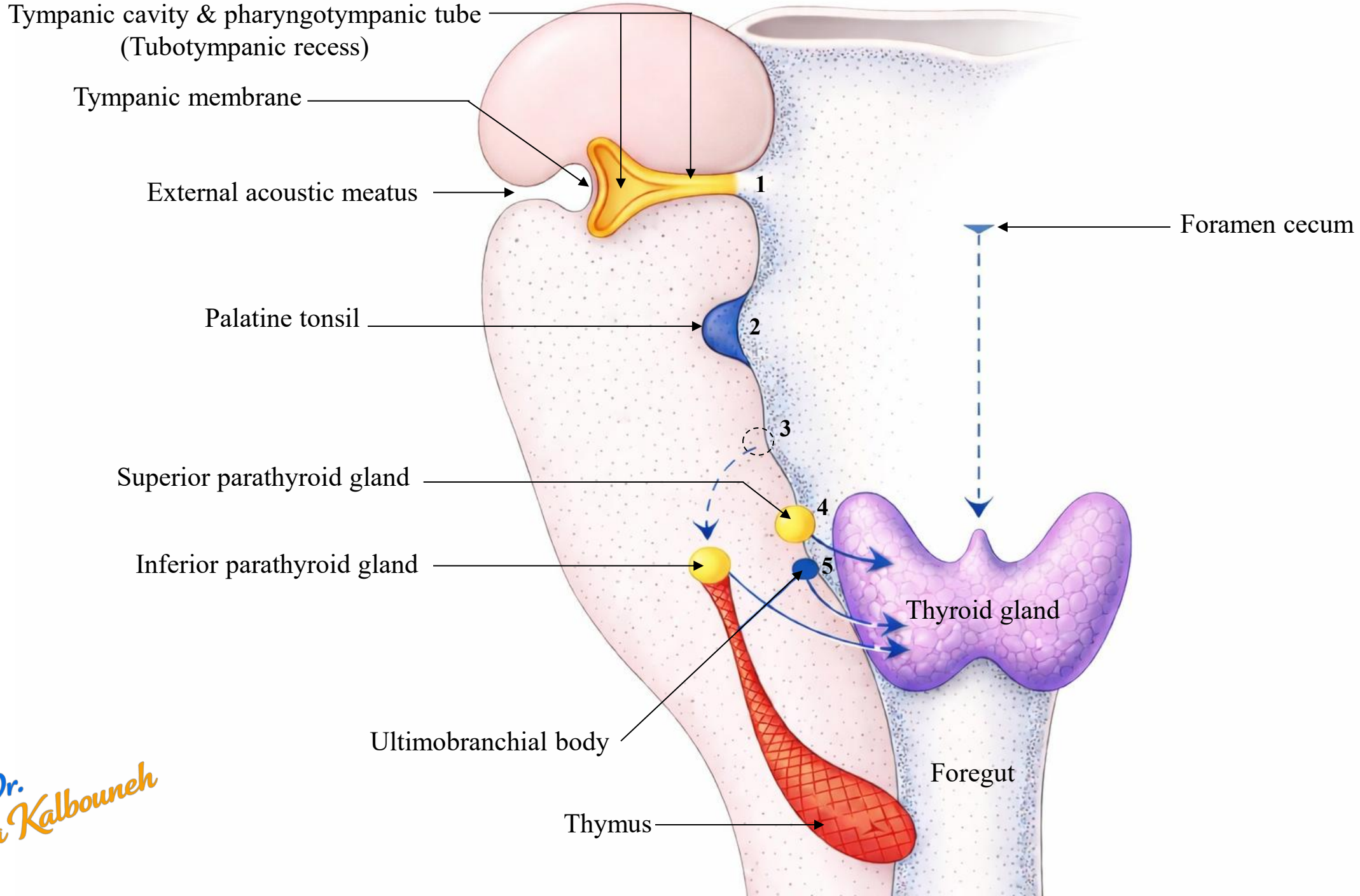

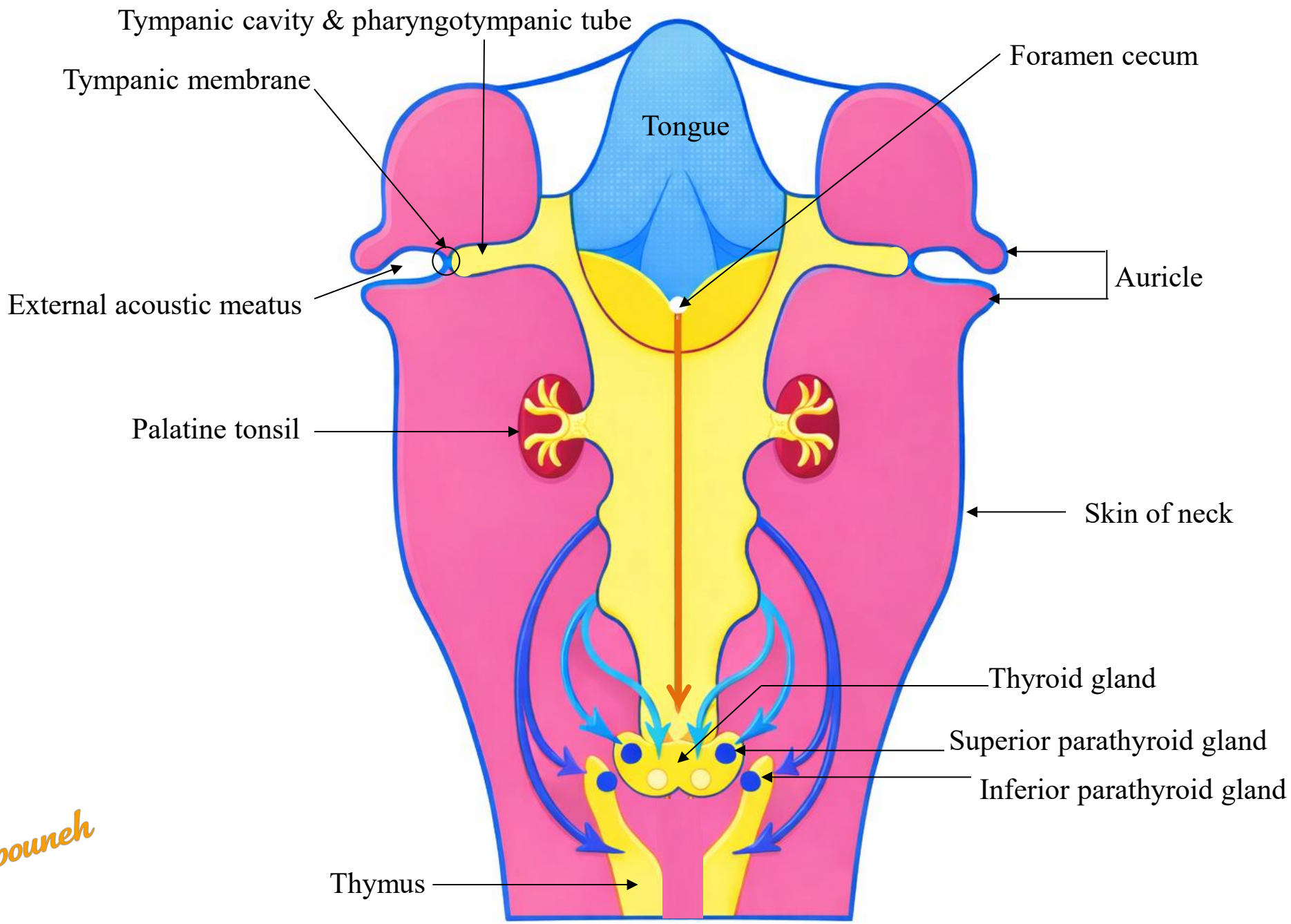

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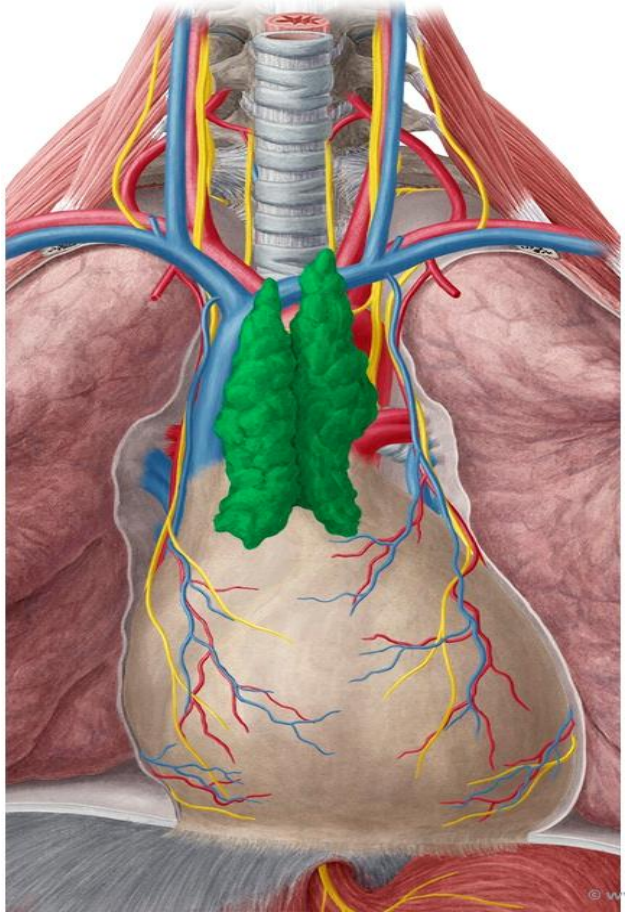
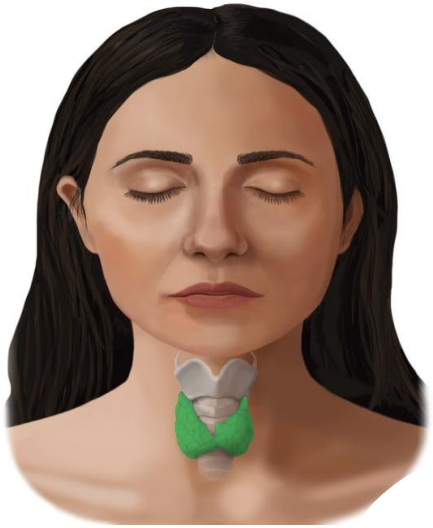
Thymus gland



Thyroid gland



Parathyroid glands

Cervical branchial cyst

Branchial Cysts - Dr Murali Mahadevan - ENT Surgeon

A cervical branchial cyst is a congenital cyst in the lateral neck caused by persistence of the cervical sinus, which normally disappears during development when the second pharyngeal arch grows downward and covers the third and fourth arches.

It usually appears as a painless swelling along the anterior border of the sternocleidomastoid muscle.
Treatment: surgical removal of the cyst.

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Congenital Anomalies

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

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