

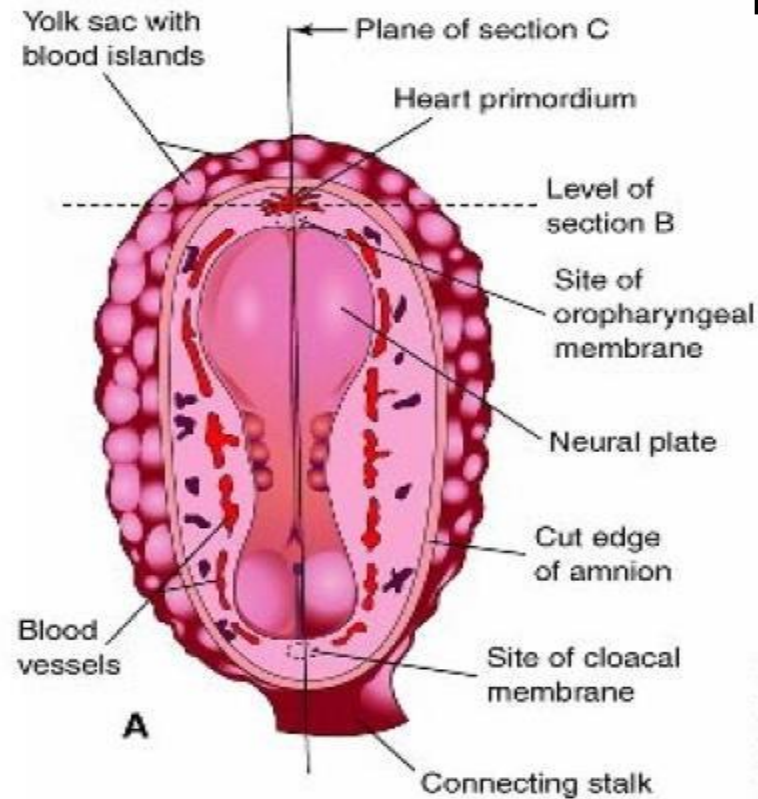


University of Kragujevac  
Faculty of Medical Sciences  
Integrated Academic Studies of Medicine  
Department of Histology and Embryology

# Special embryology 1

# **Cardiovascular system**

# Cardiogenic region



Endocardial tubes

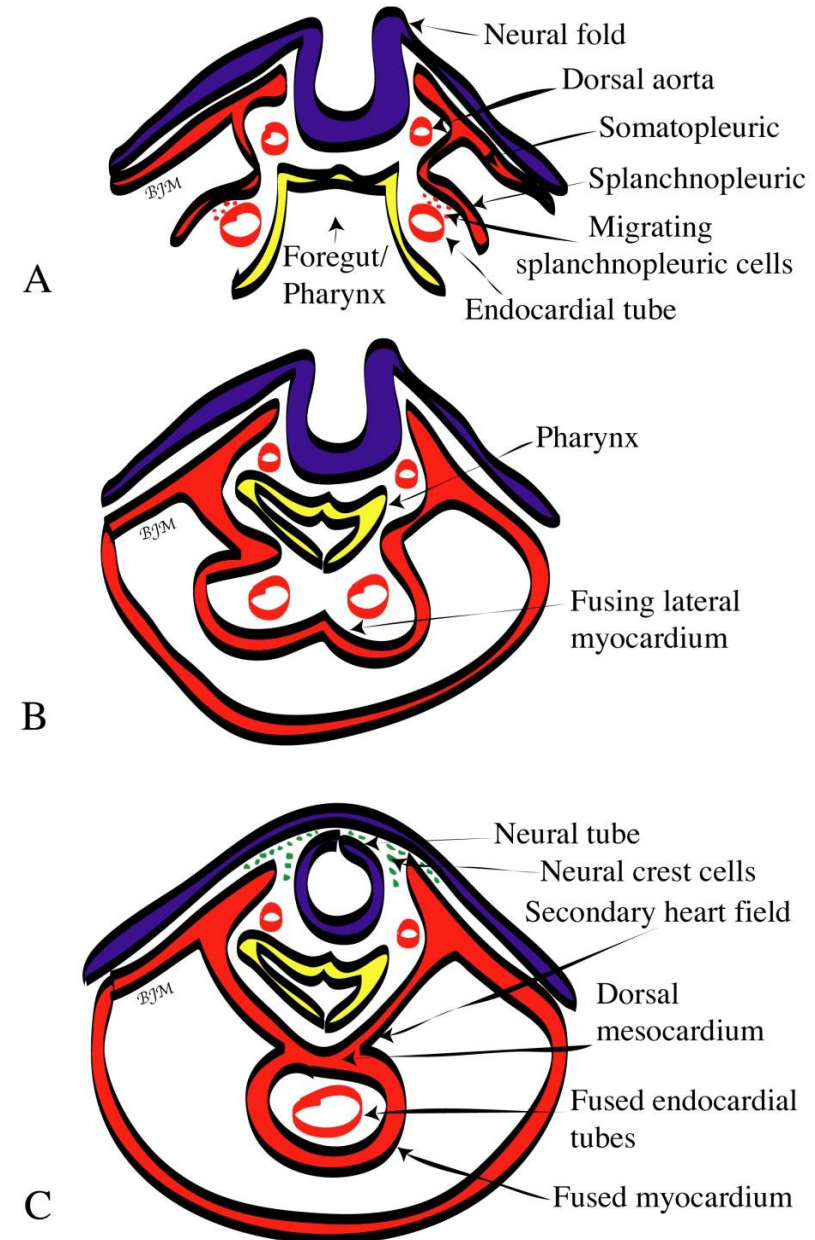
Dorsal aorta

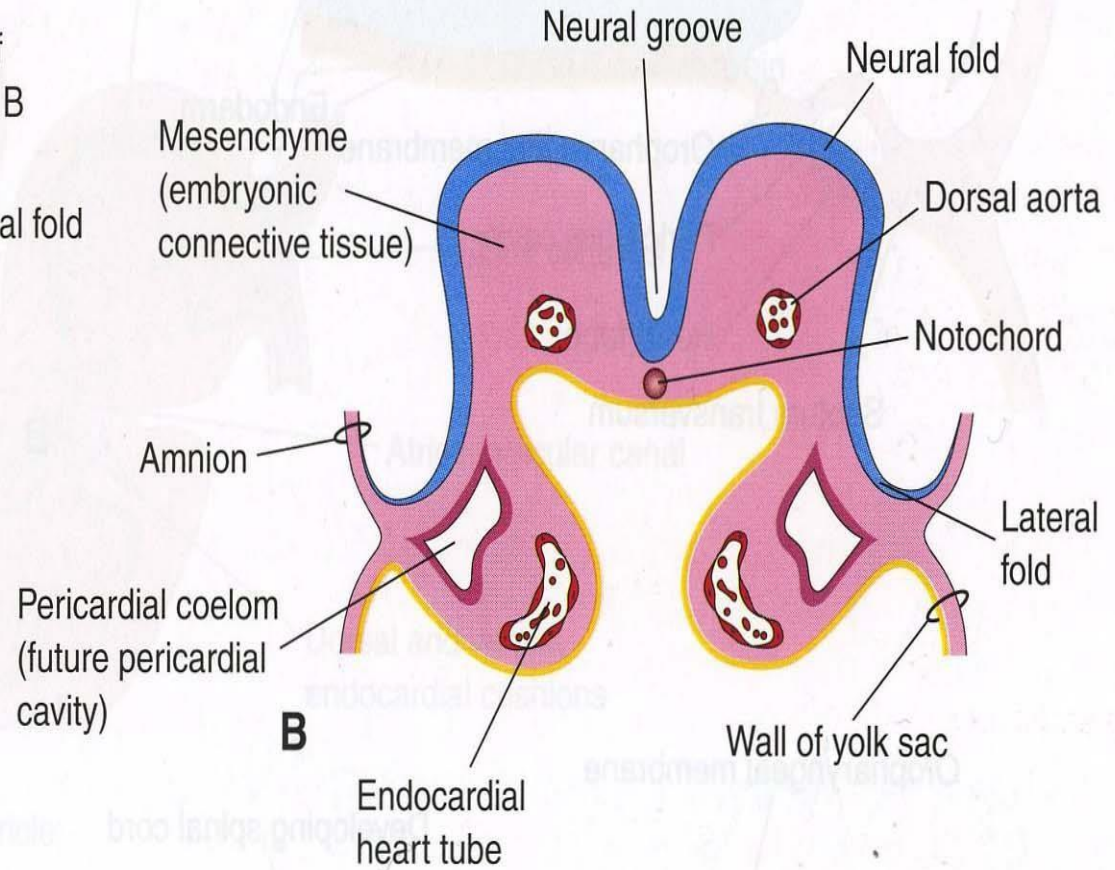
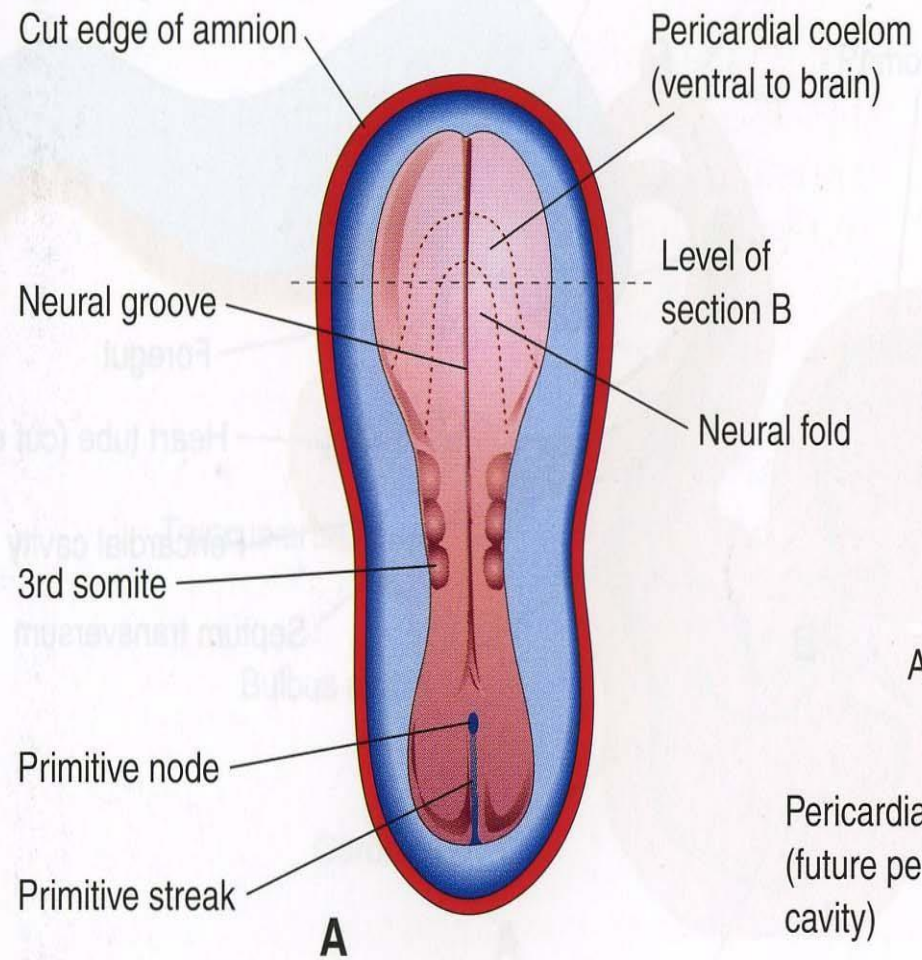


- The heart begins to develop in the third week in the heart region located in the lateral parts of the embryonic disc (mesoderm cardiogenicum in splanchnopleural mesoderm)
- This region is localized cranial and lateral to the neural plate.
- Initially, small blood vessels are formed through vasculogenesis that form a horseshoe plexus where the future heart will form.

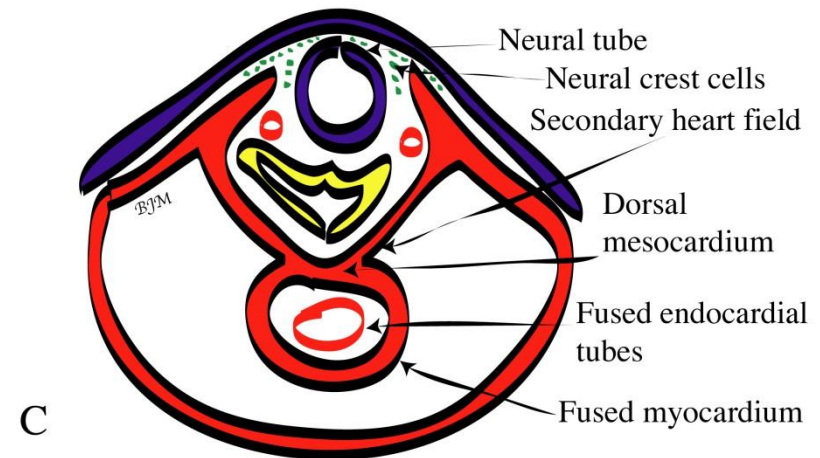
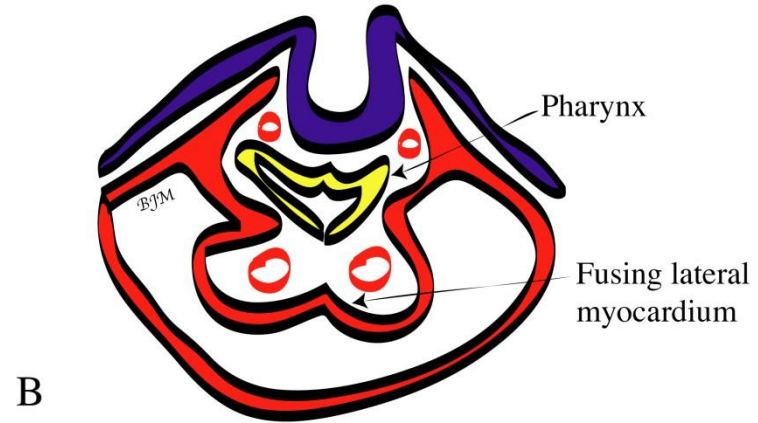
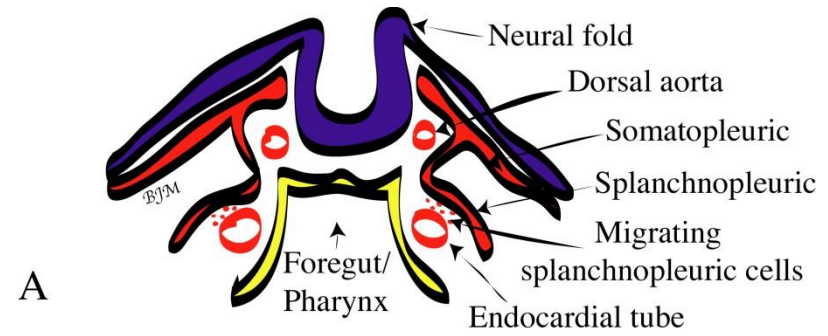
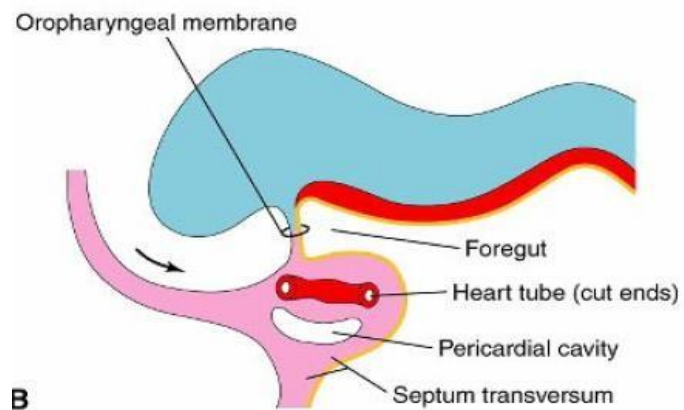
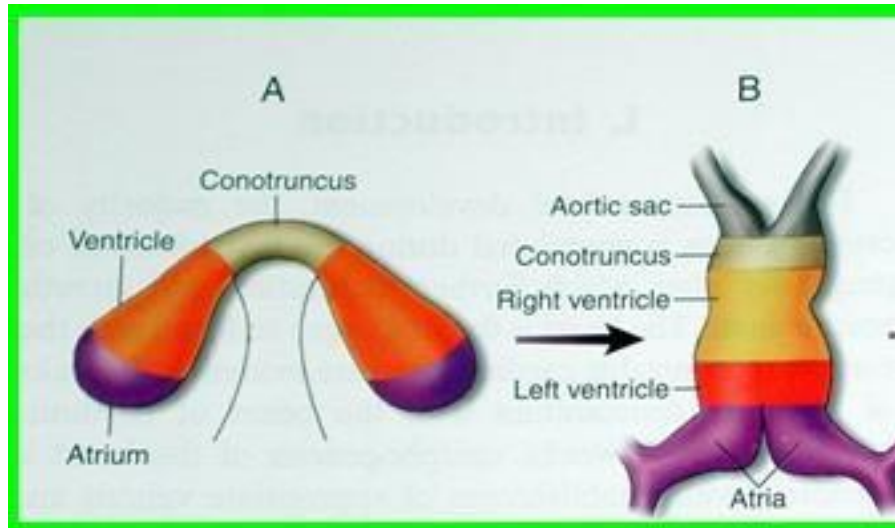
# Bending of the embryo

- After that, during the latero-lateral and cephalo-caudal bending of the embryo, the cephalic fold grows and the endocardial tubes move from the cephalic to the thoracic region.
- The endocardial tubes merge into a single heart tube and the heart primordium is formed.
- The cranial ends of the dorsal aortas retract ventrally and form the dorsoventral loop or the first aortic arch.
- In the period from the fourth to the fifth week, a series of four or more aortic arches will develop (as part of the formation of the pharyngeal arches).

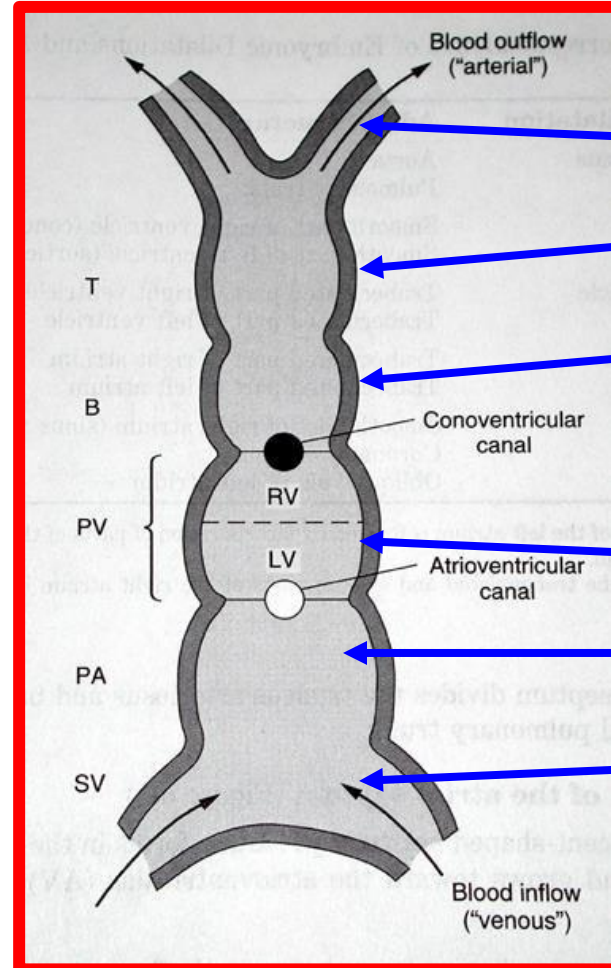
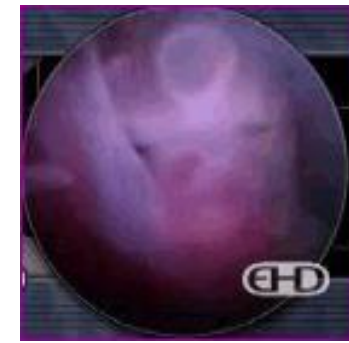






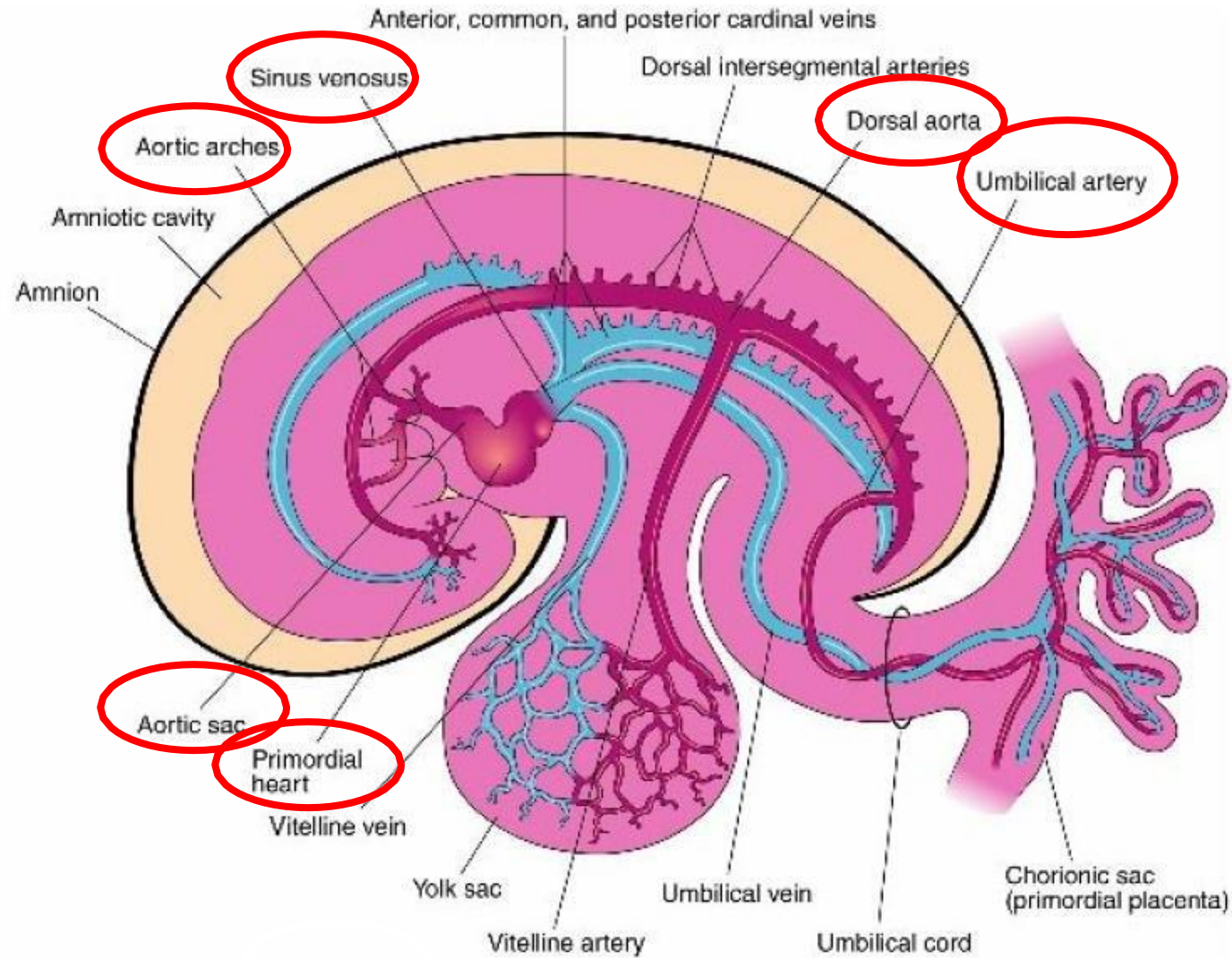


# Structure of the primary heart tube



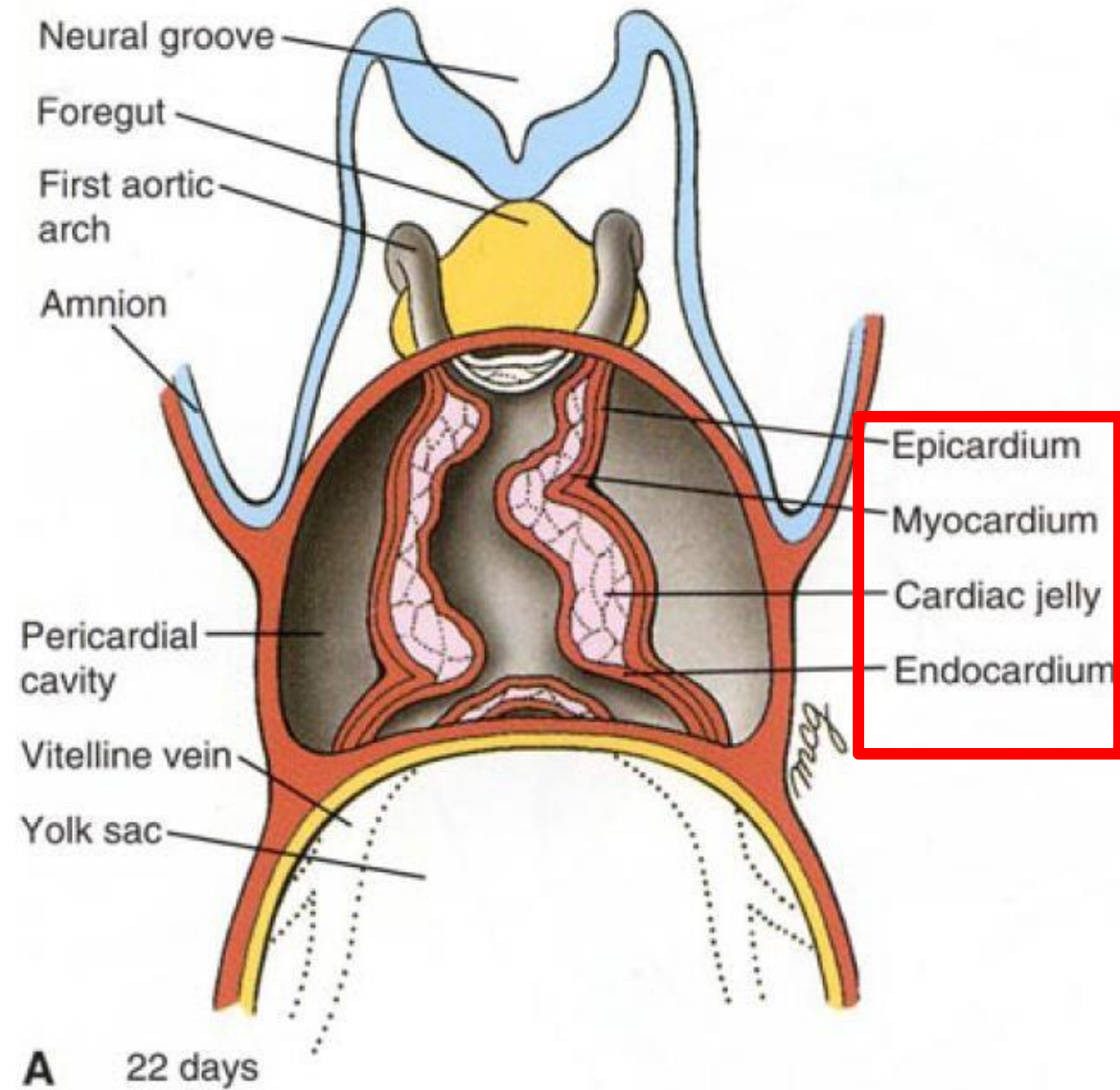
- Arterial trunk
- Conotruncus (truncus)
- Bulbus cordis
- Primitive chamber
- Primitive atrium
- *Sinus venosus*

# Blood vessels of the embryo (day 26)

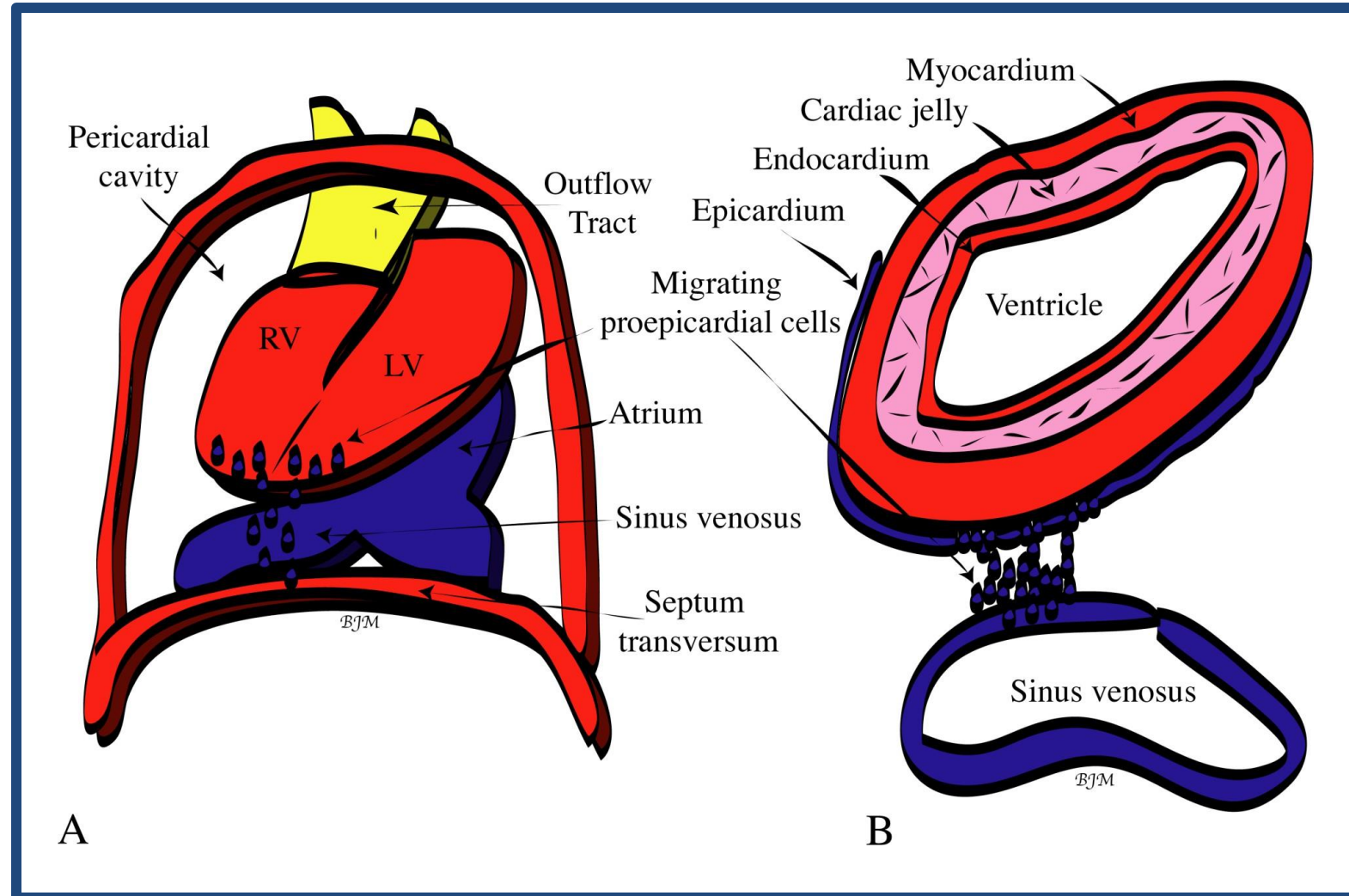




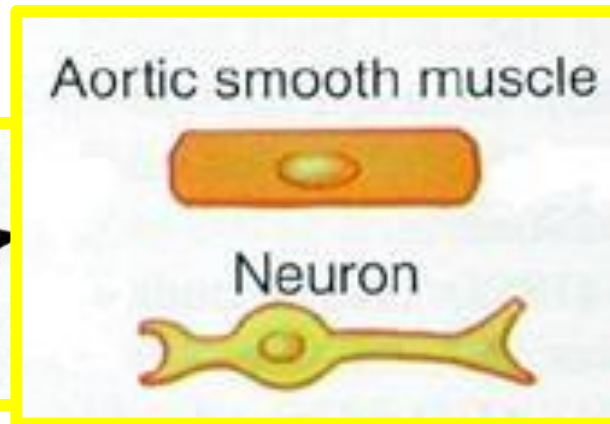
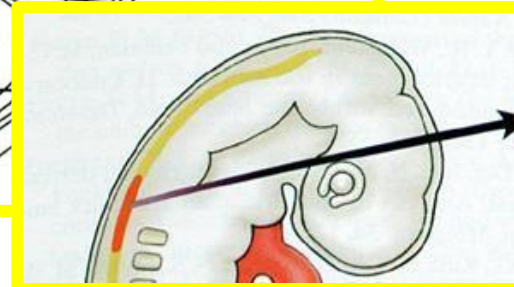
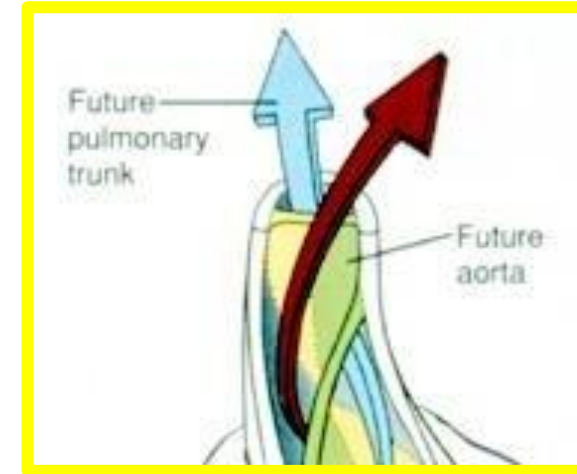
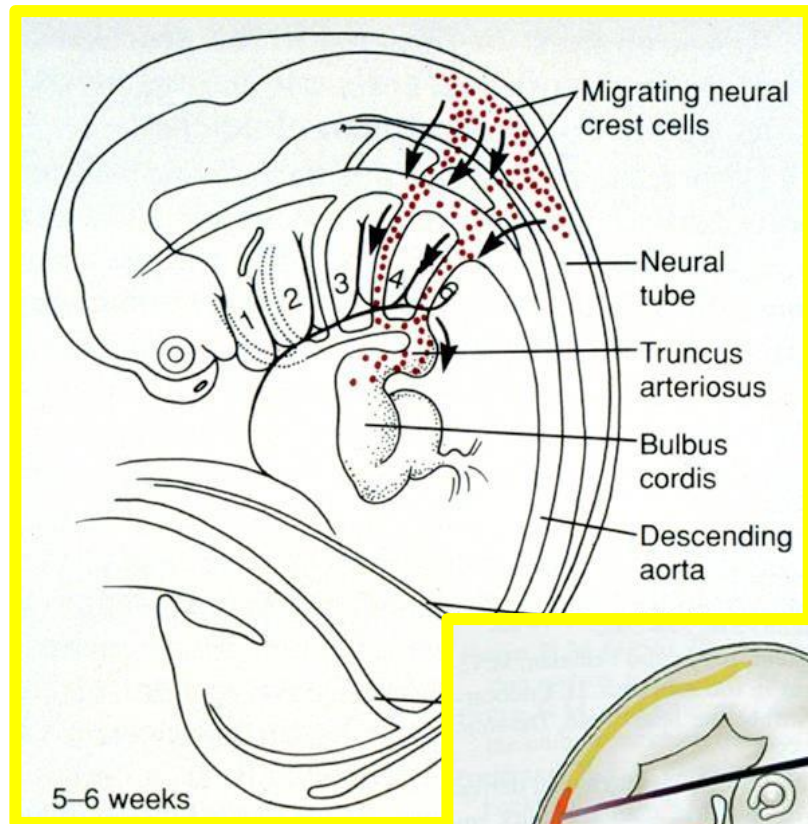
# Structure of the heart tube



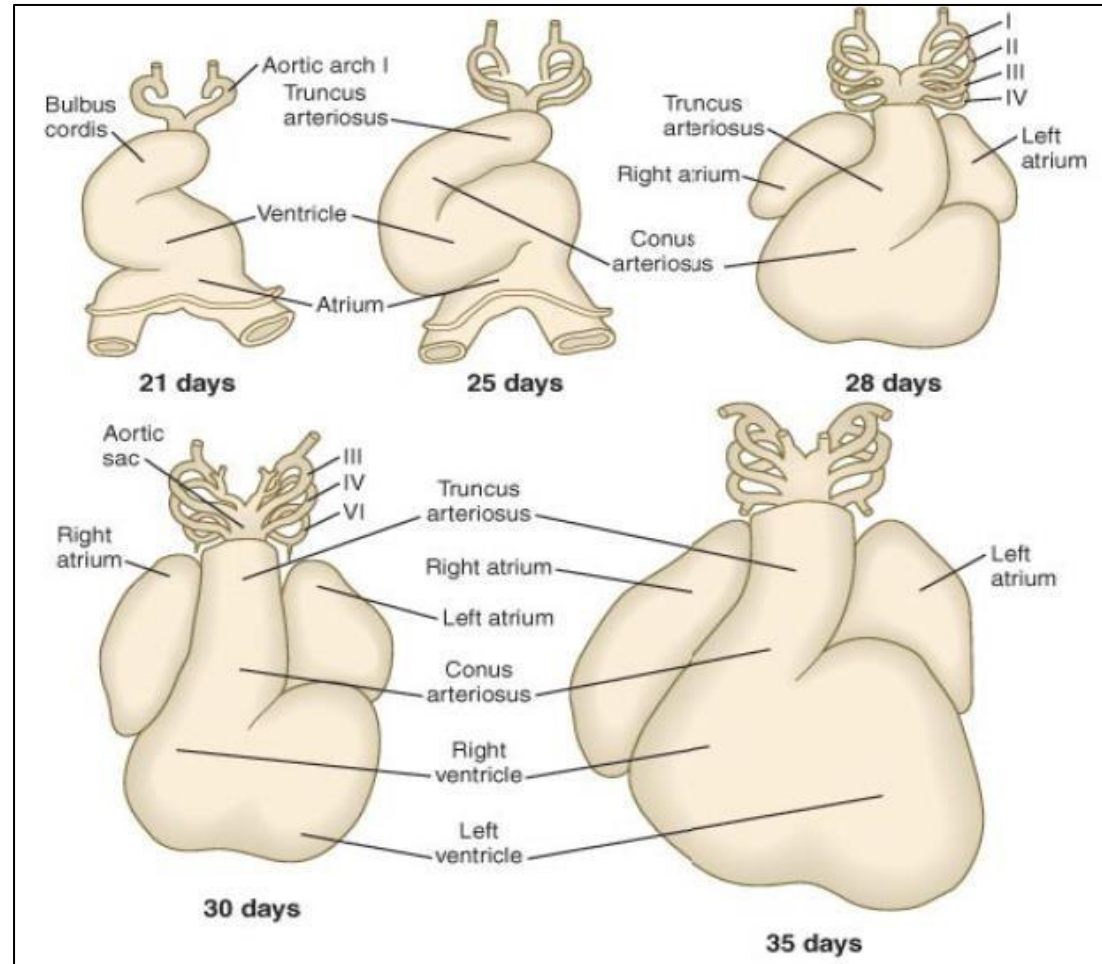
# Origin and migration of proepicardial cells



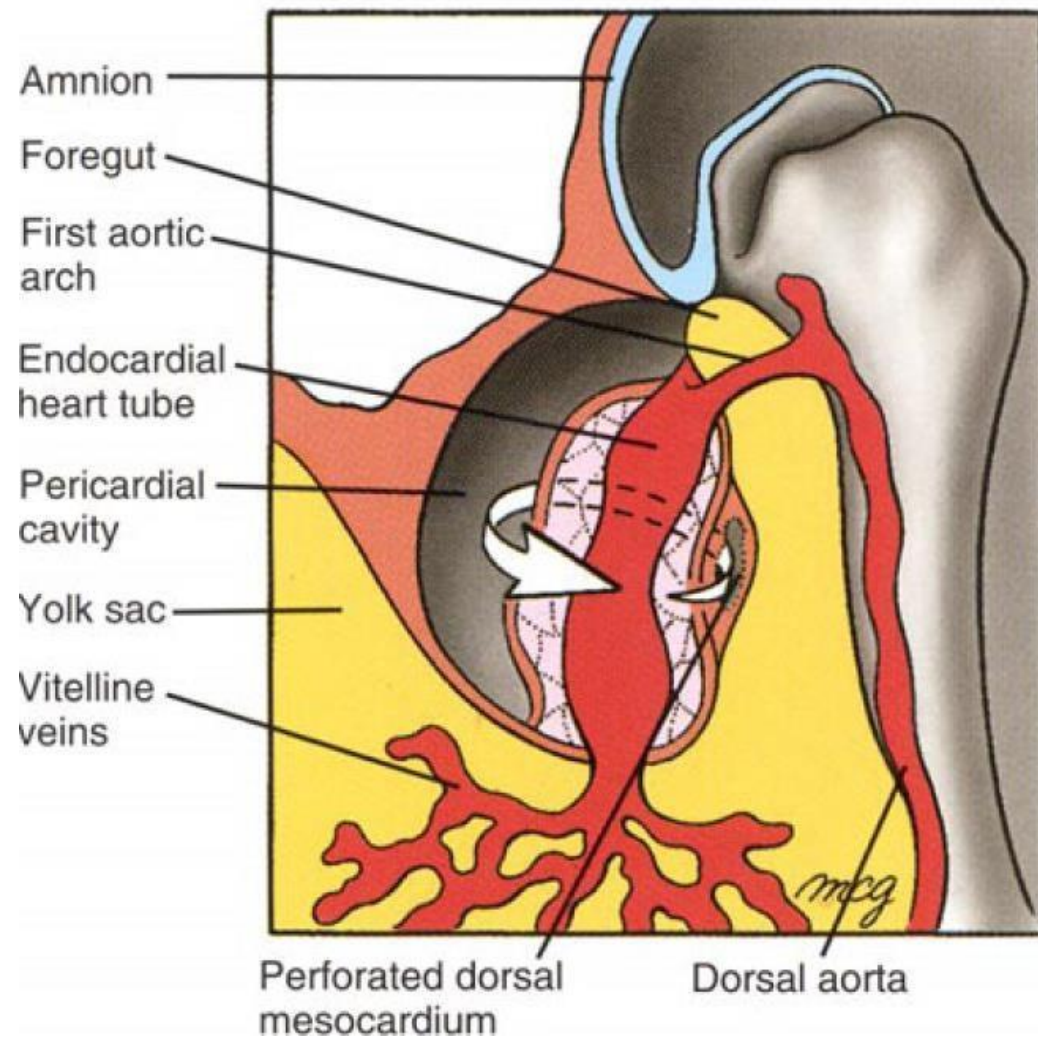
# Cell populations in the embryonic heart

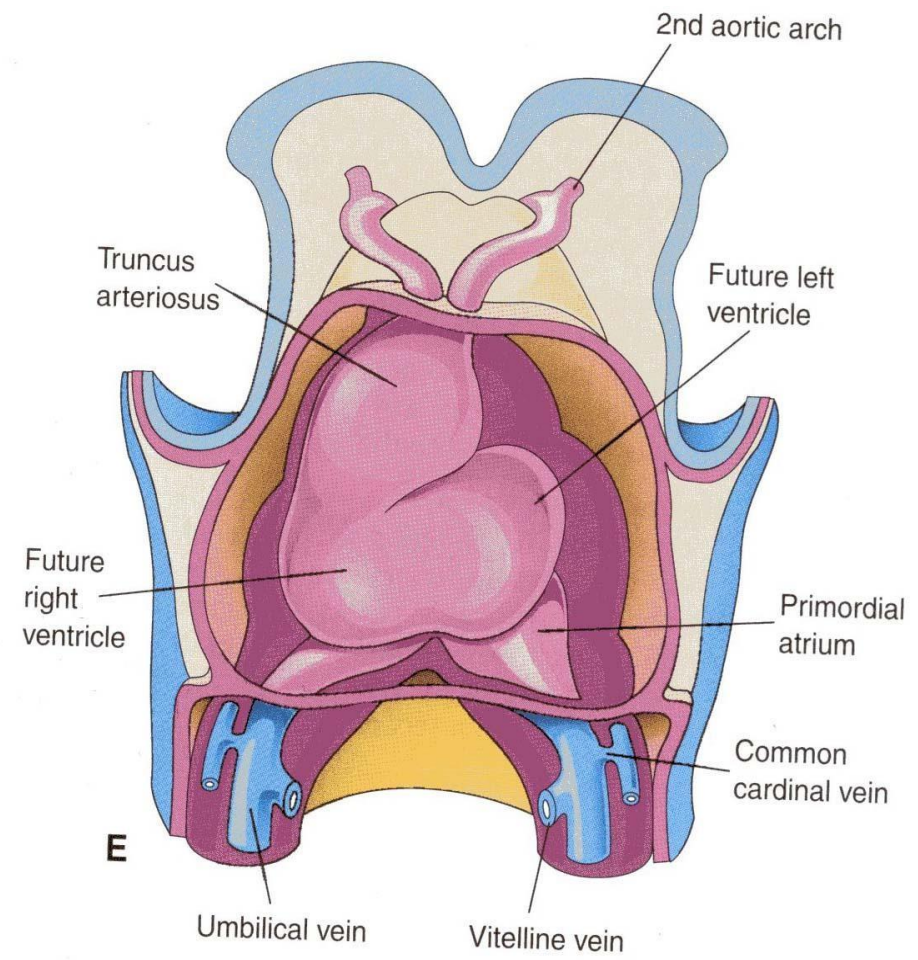
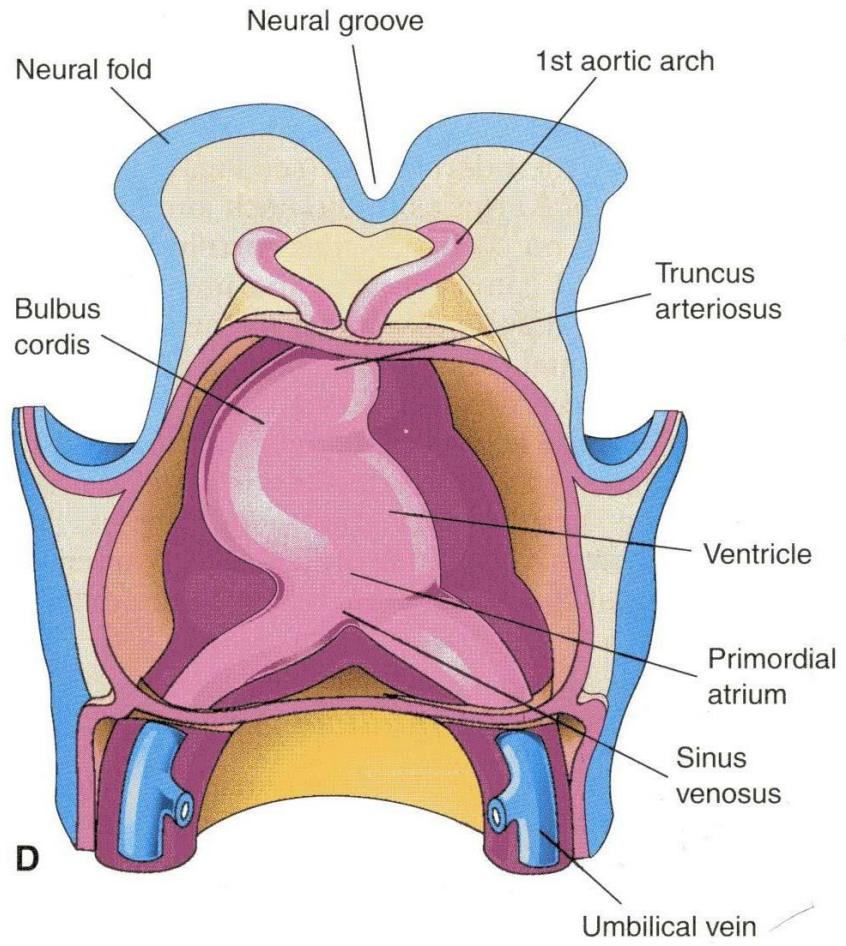


# Heart tube remodeling

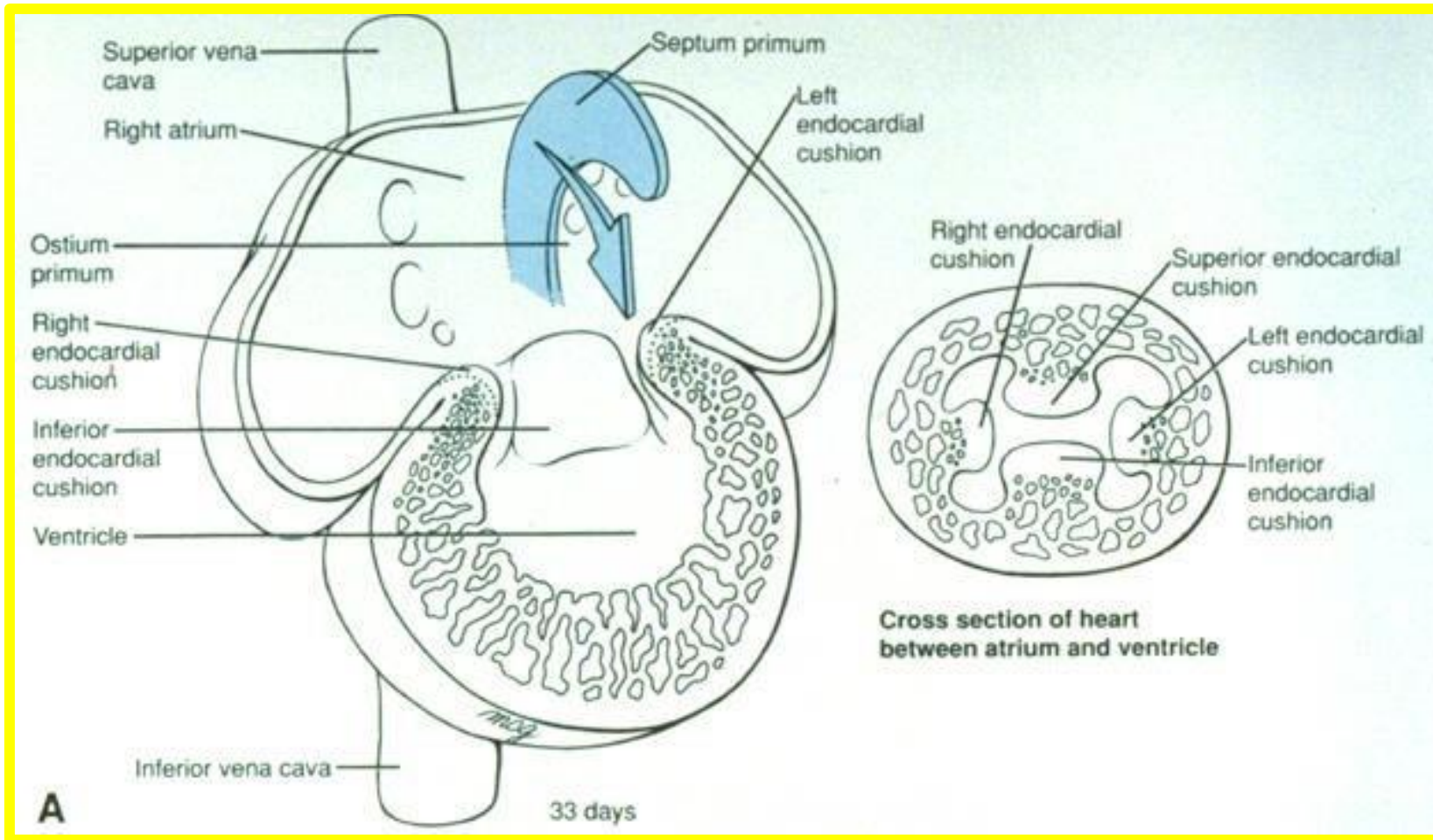






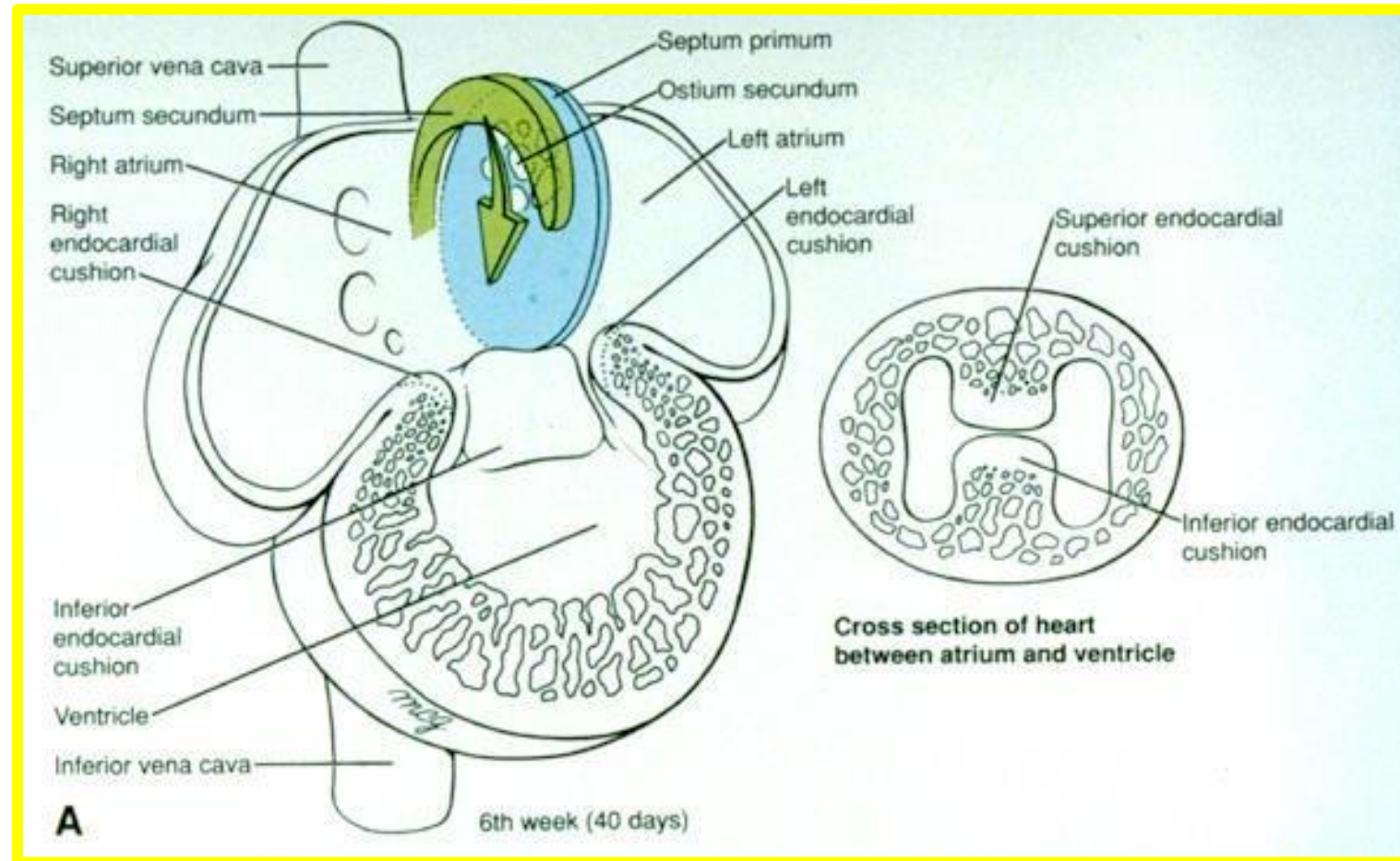


# Atrial septum formation





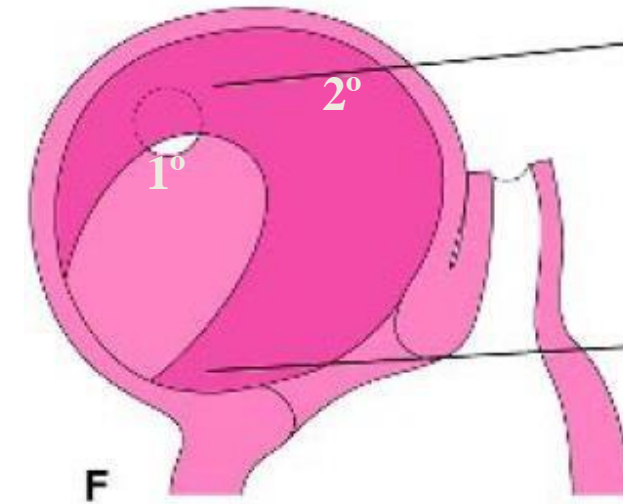
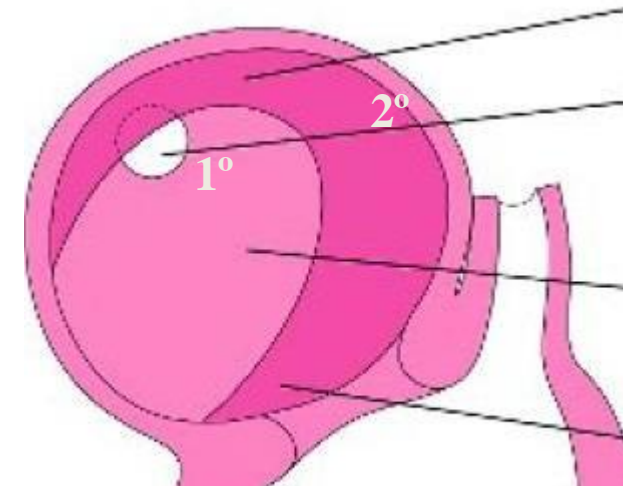
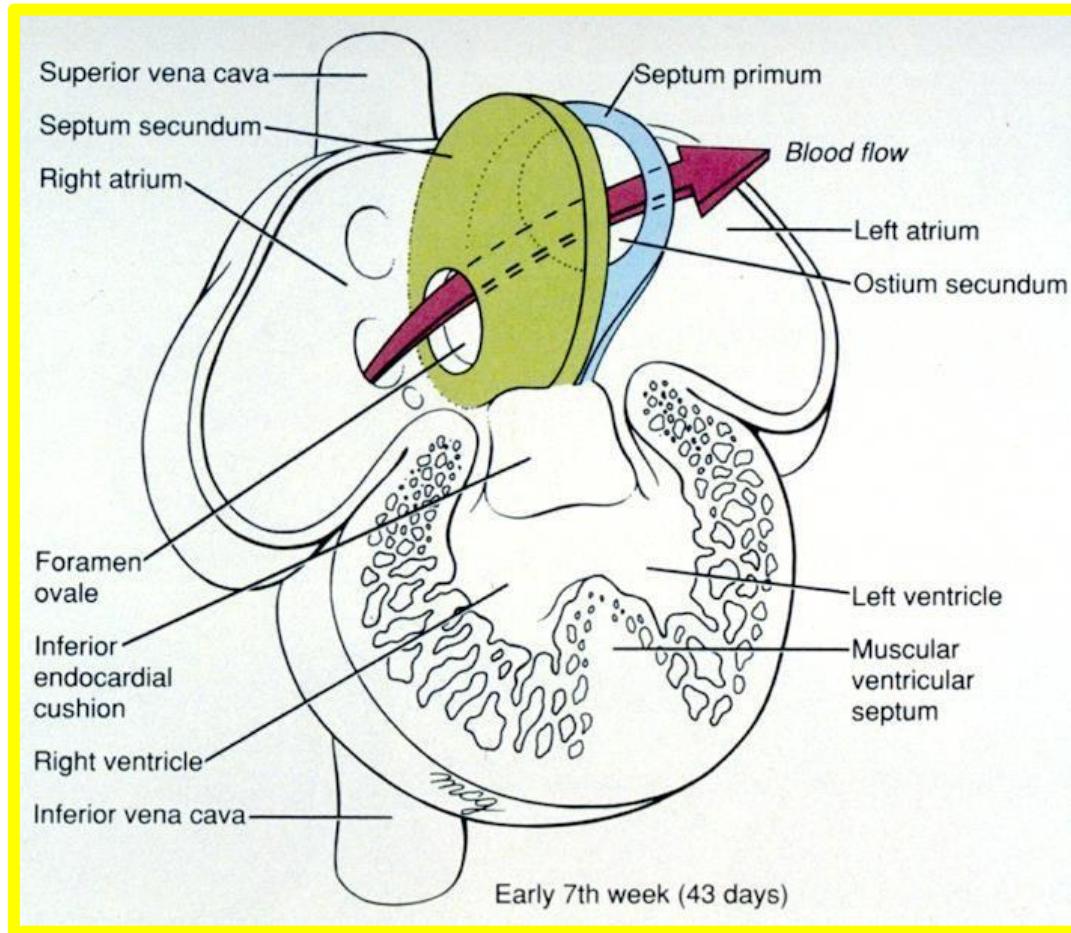
# *septum secundum*

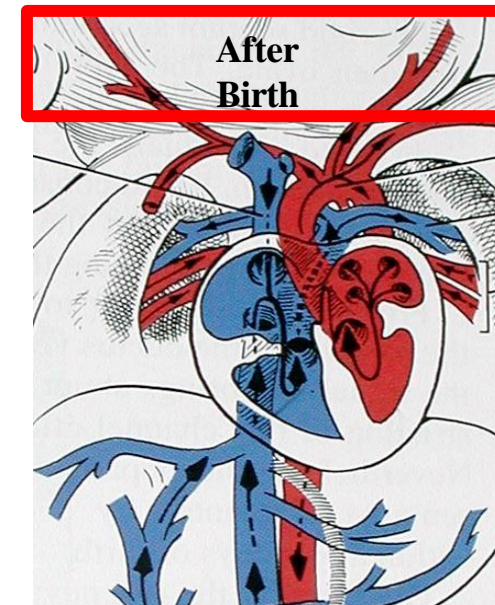
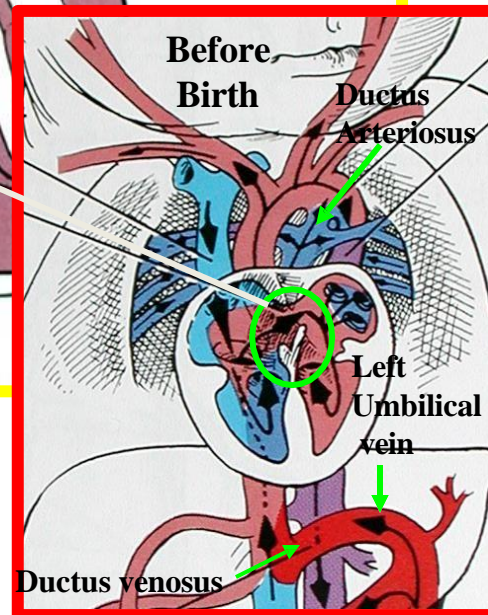
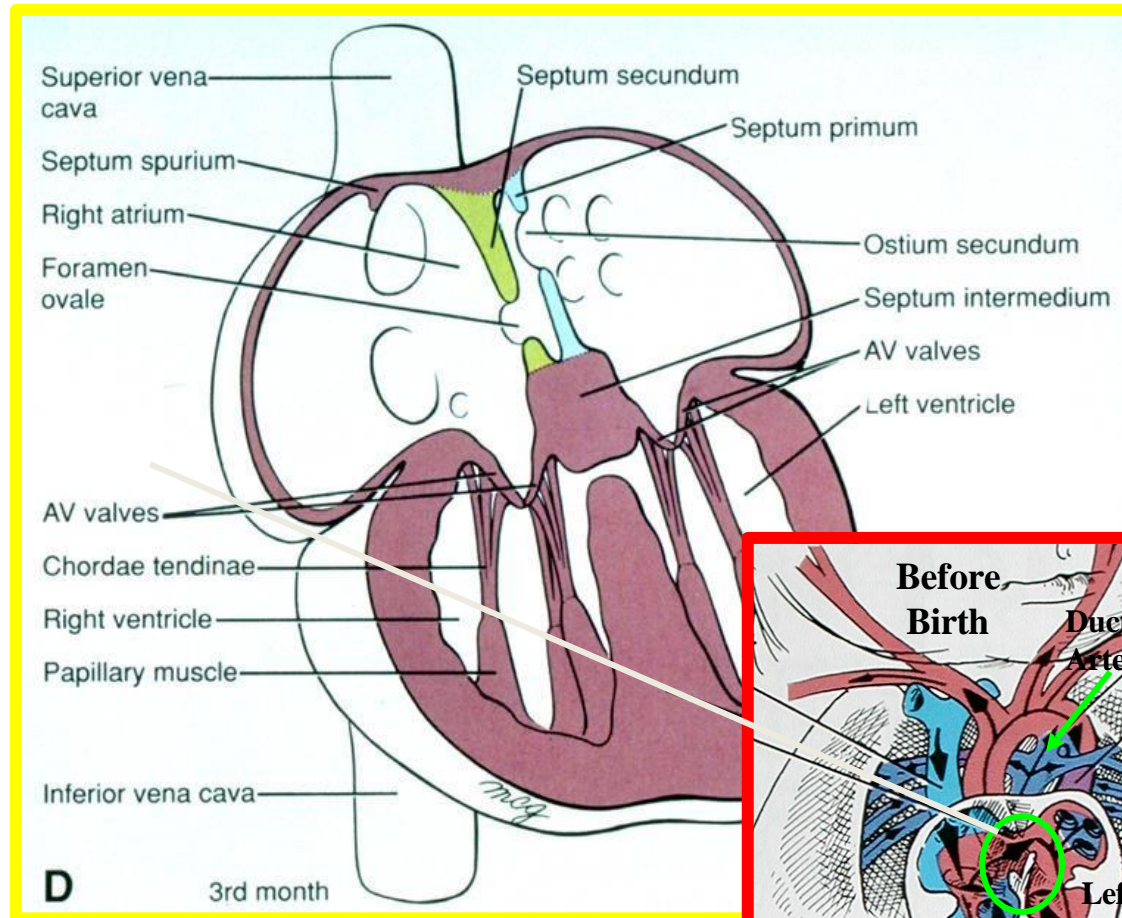


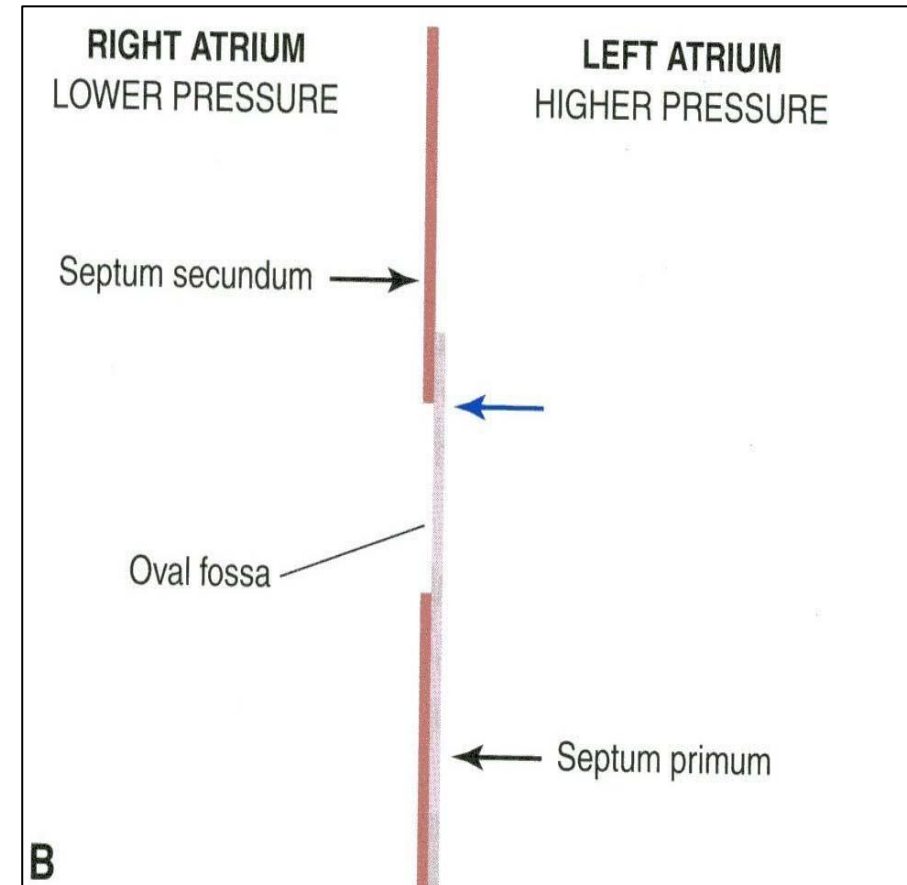
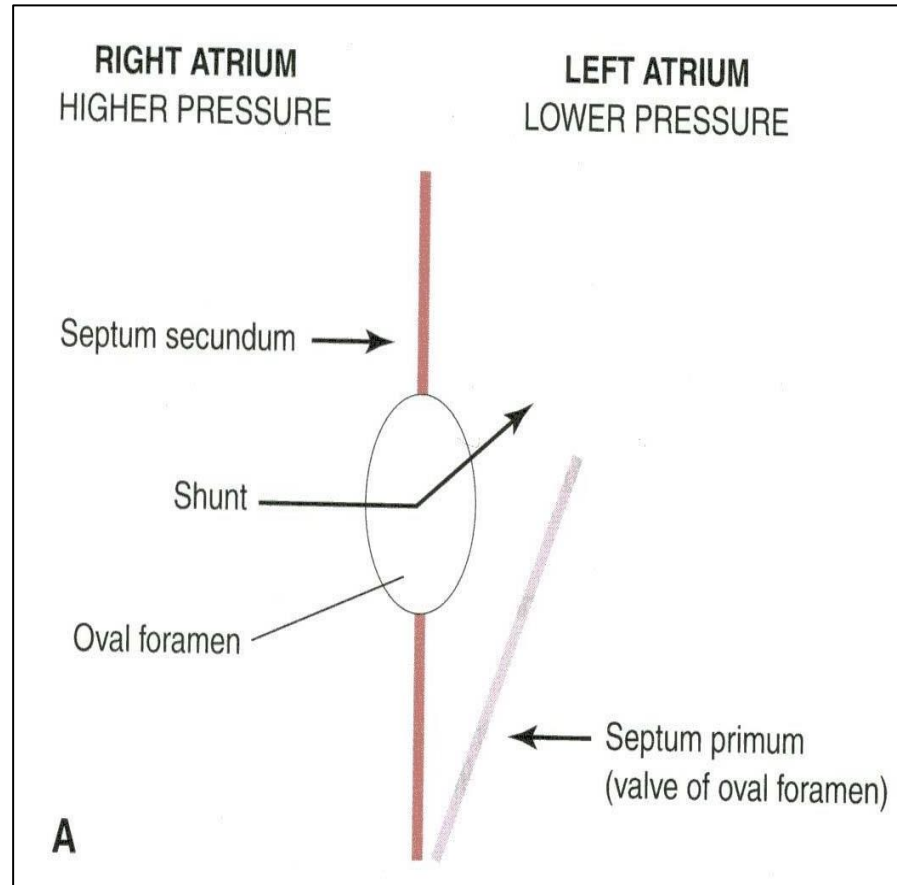


# Ventricular septum formation

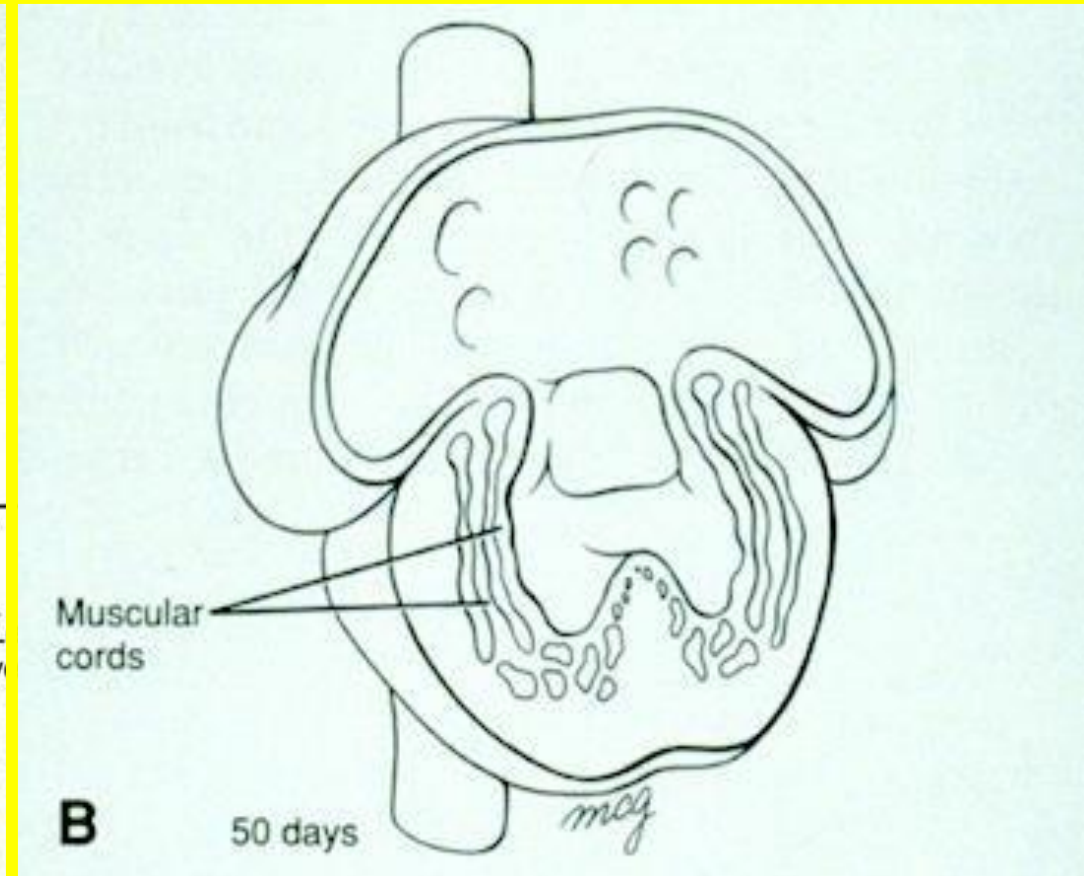
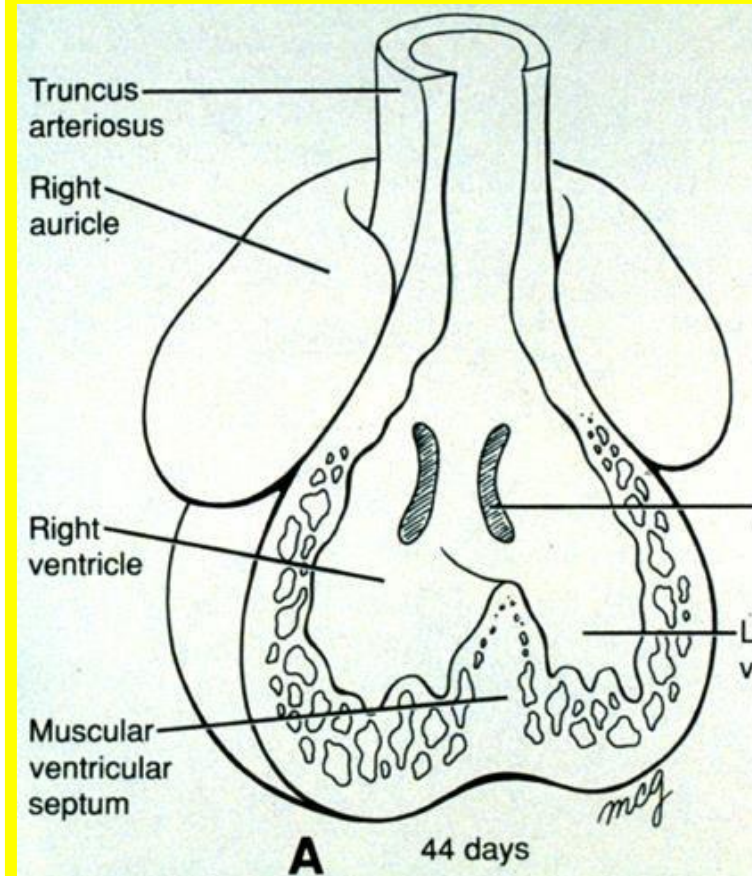
## *foramen ovale*



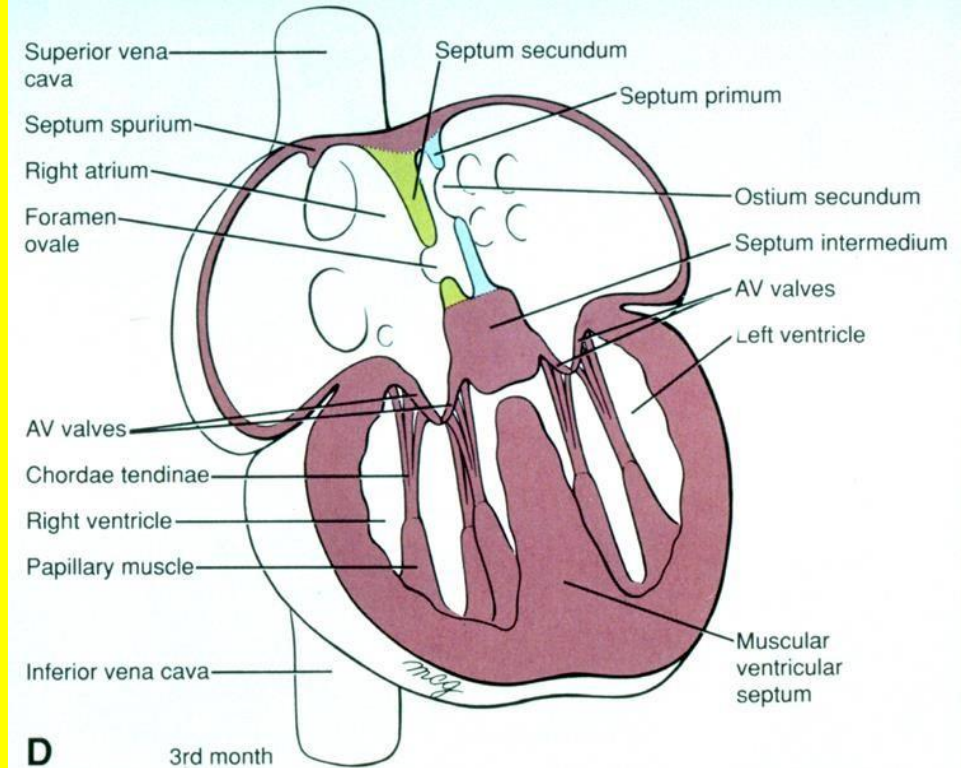
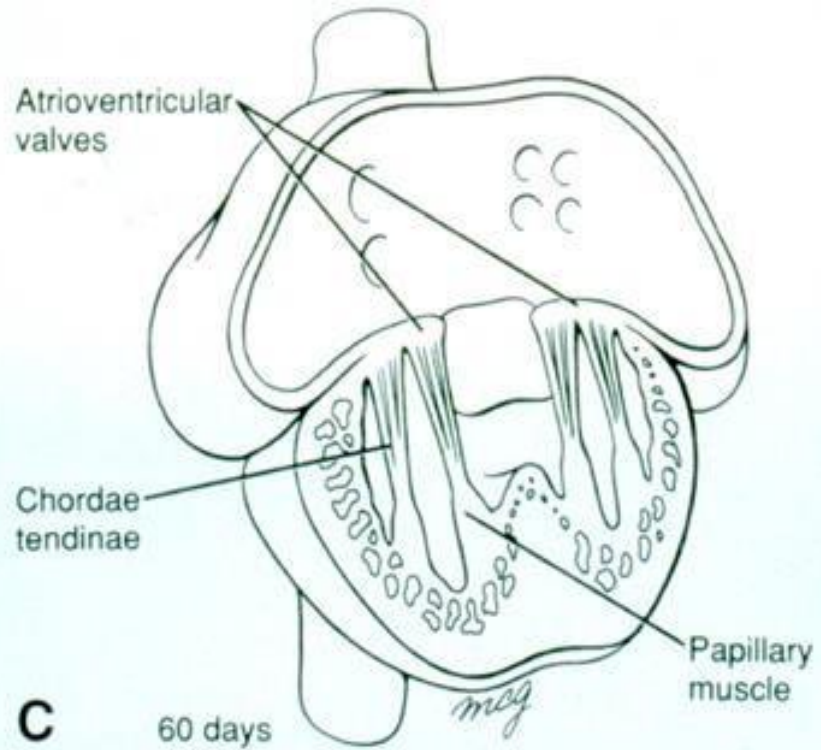


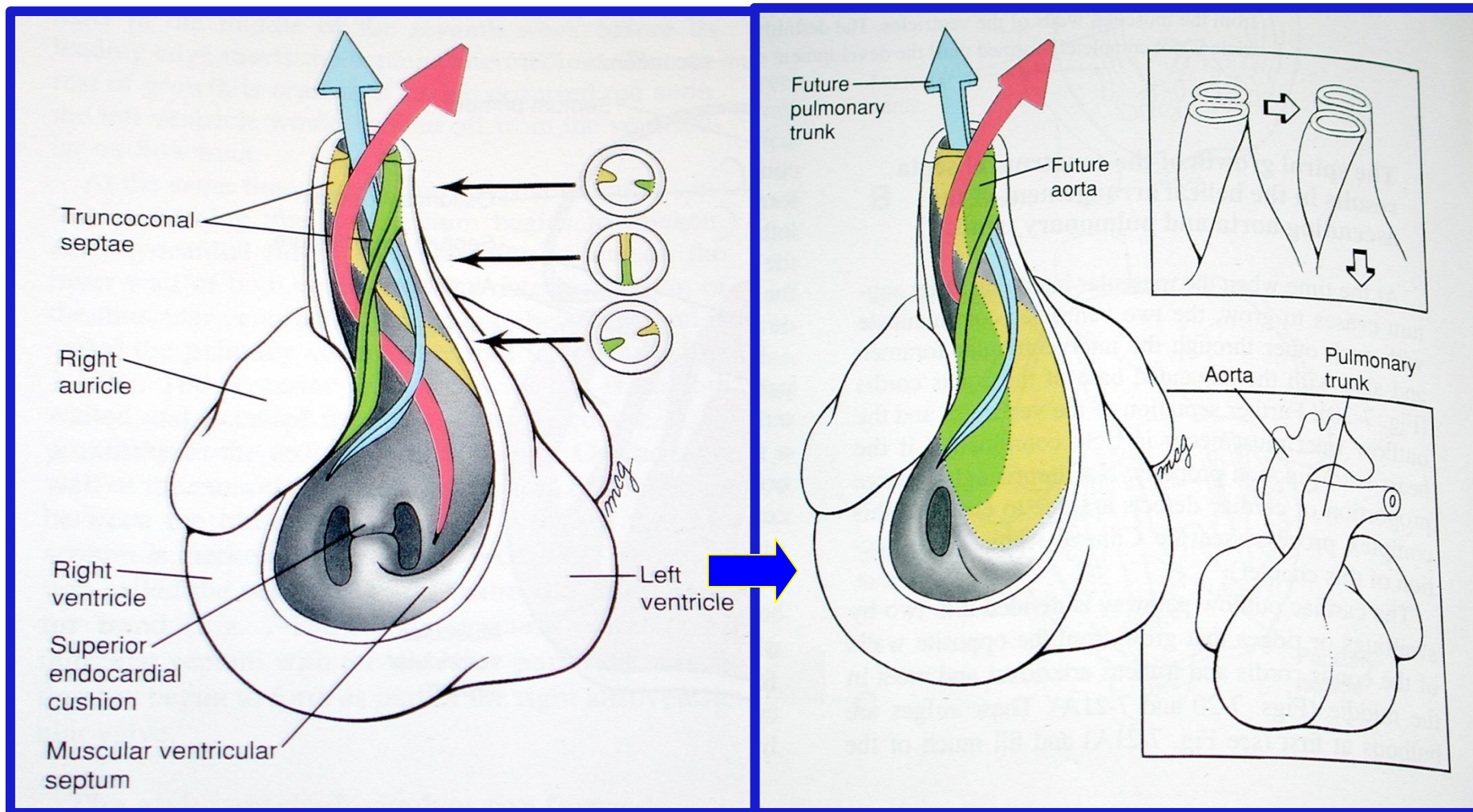




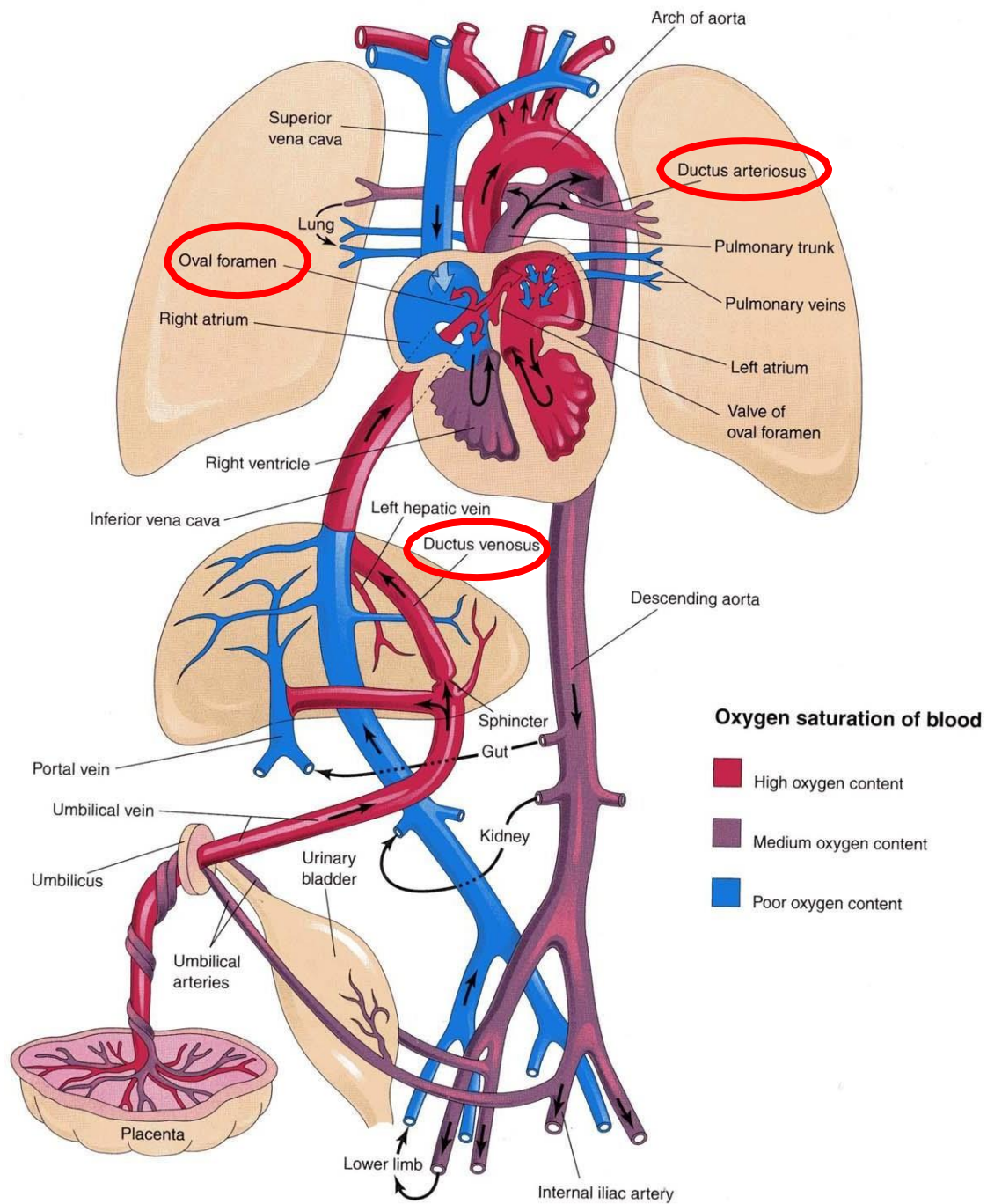






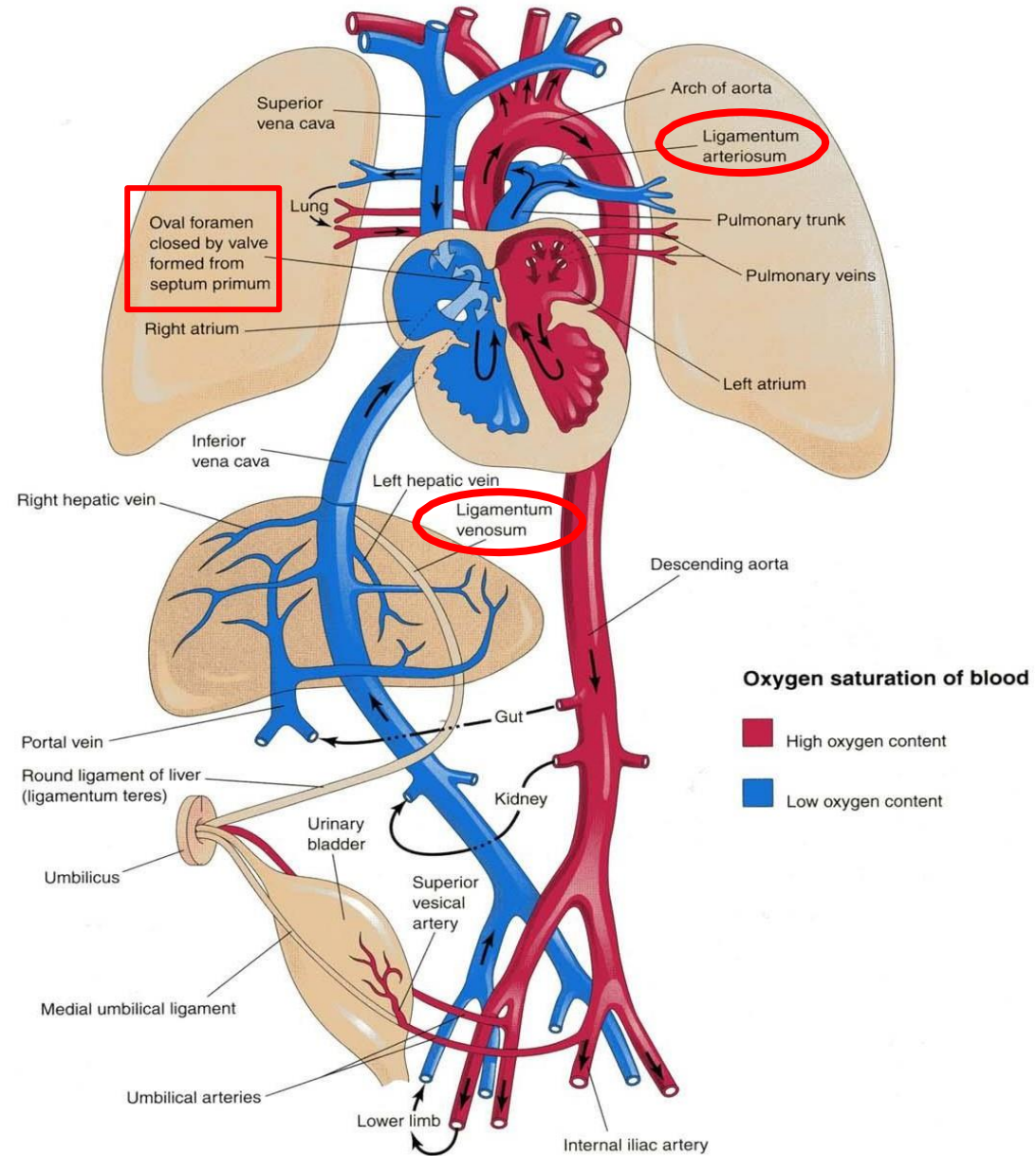






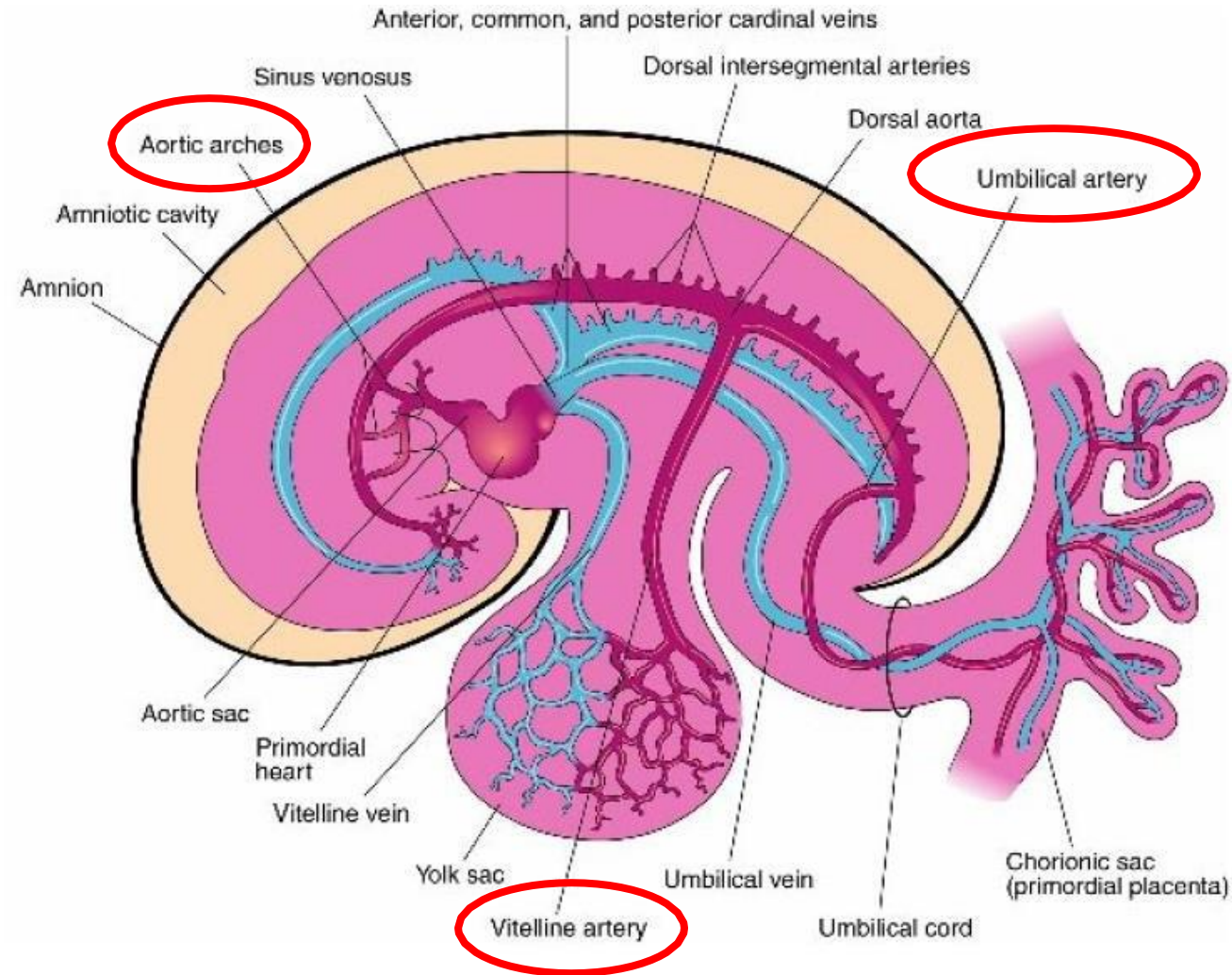
## Fetal blood flow

- Blood flow from the placenta
- towards the heart.
- Three shunts allow the liver and lungs to be bypassed:
  - *Ductus venosus*
  - *Foramen ovale*
  - *Ductus arteriosus*

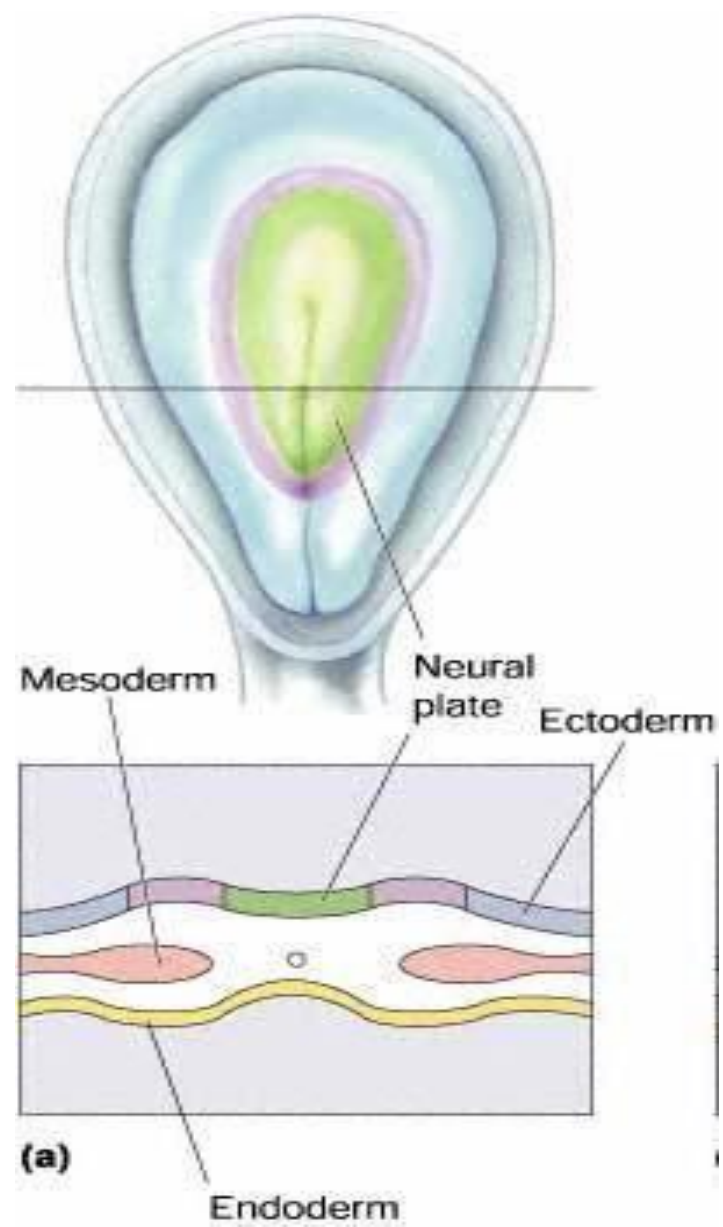


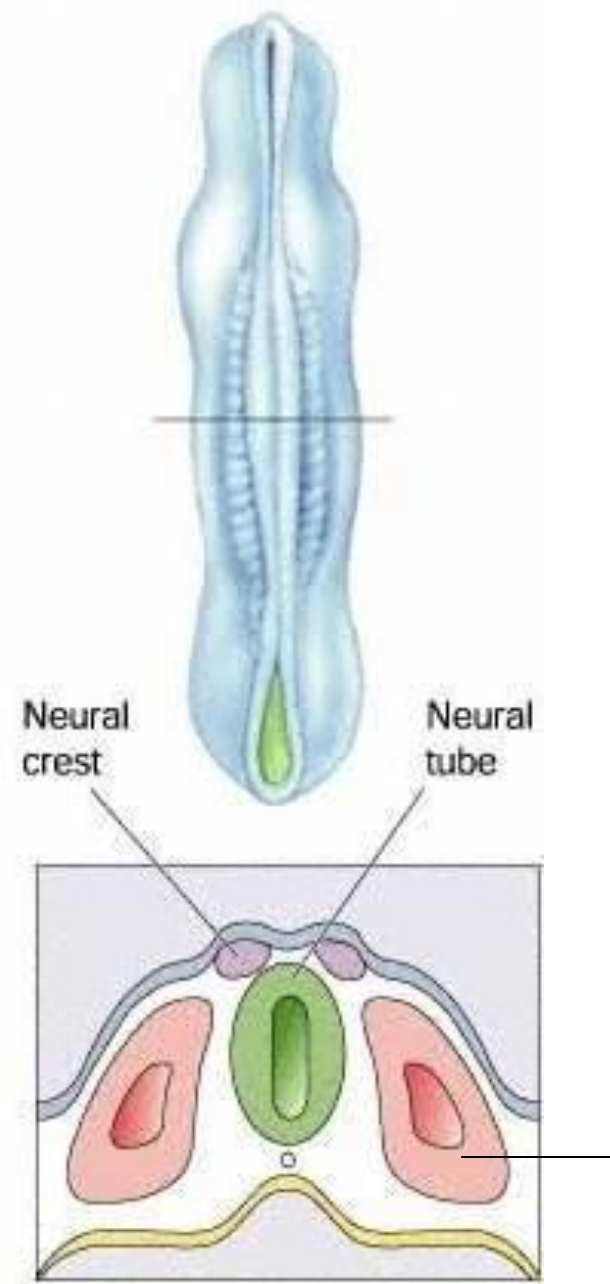


# Blood vessels of the embryo (day 26)



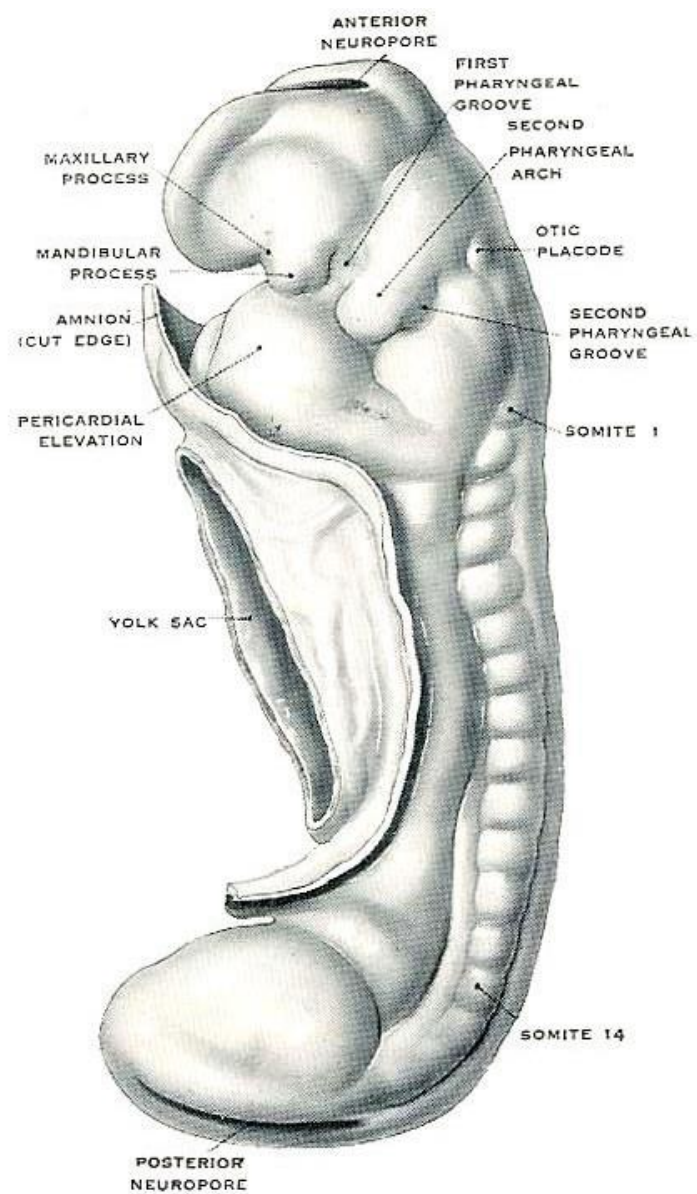
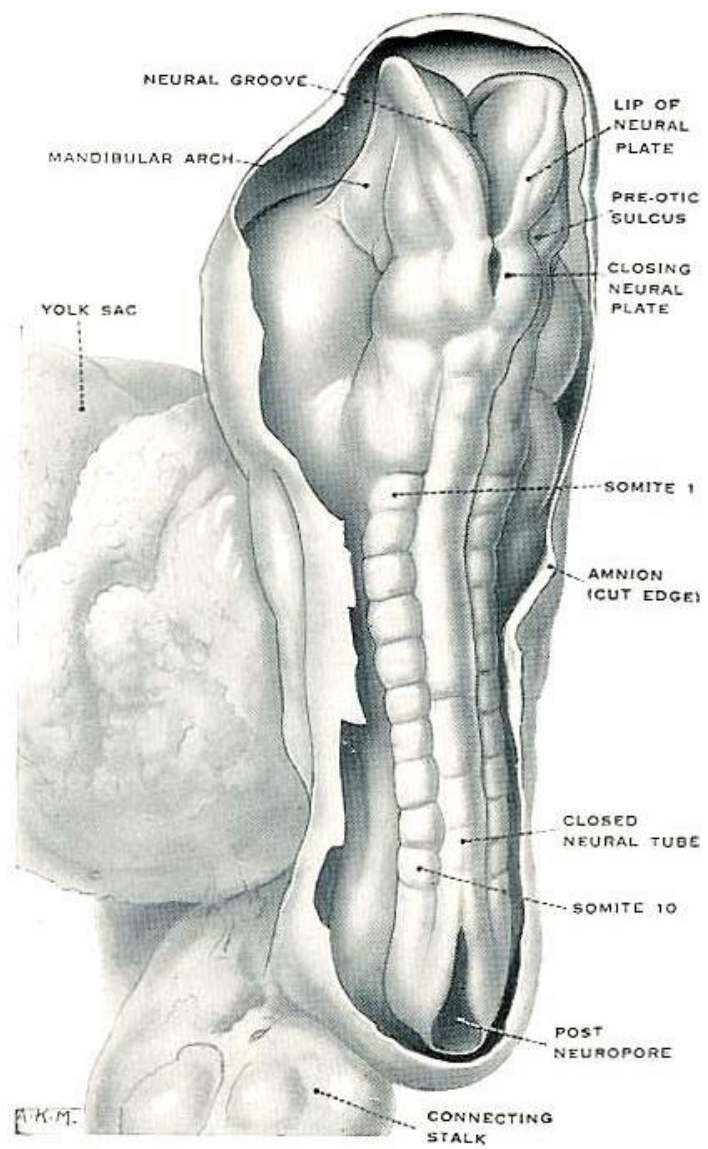
**Nervous system**

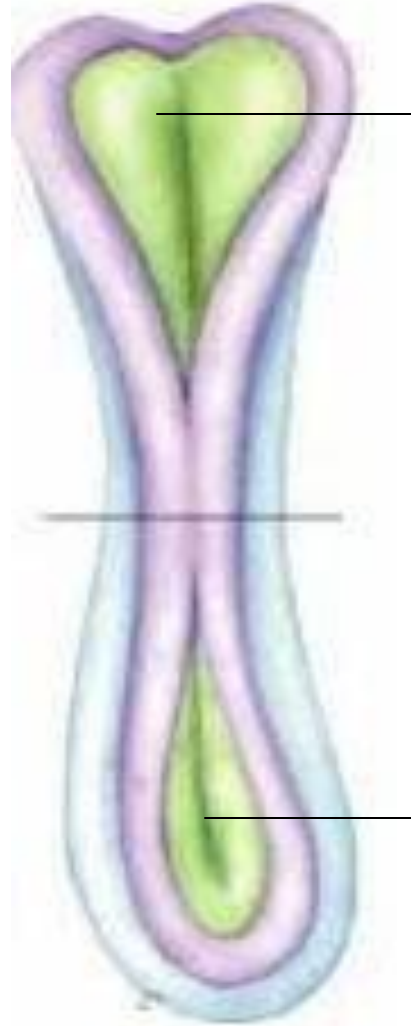




(d)



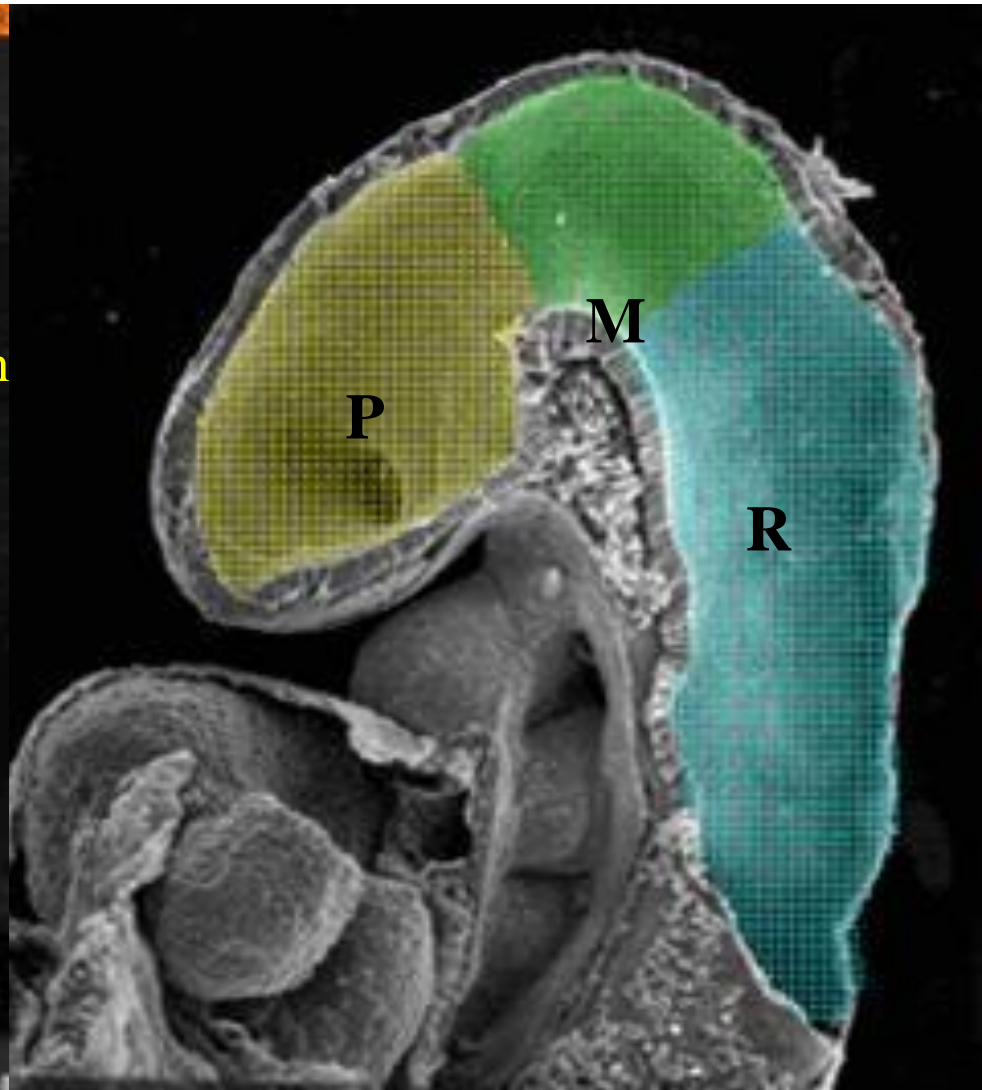
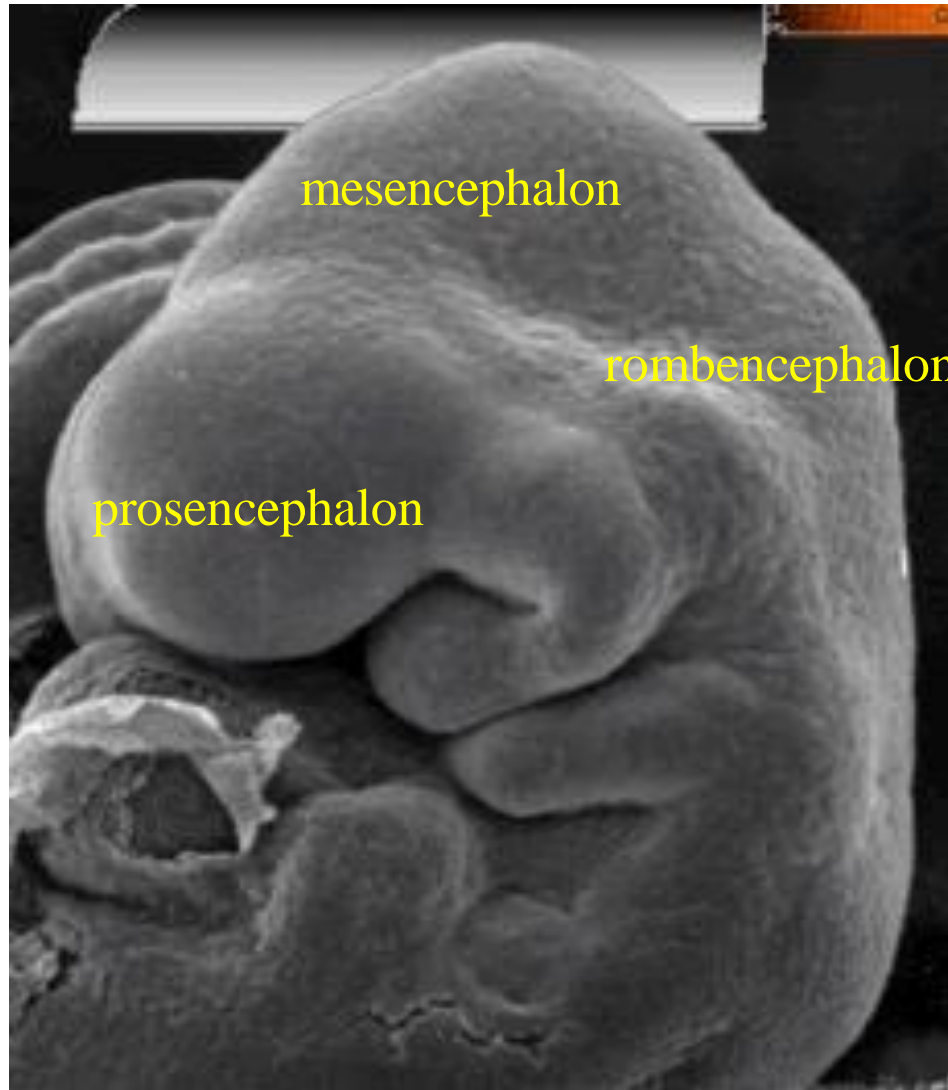




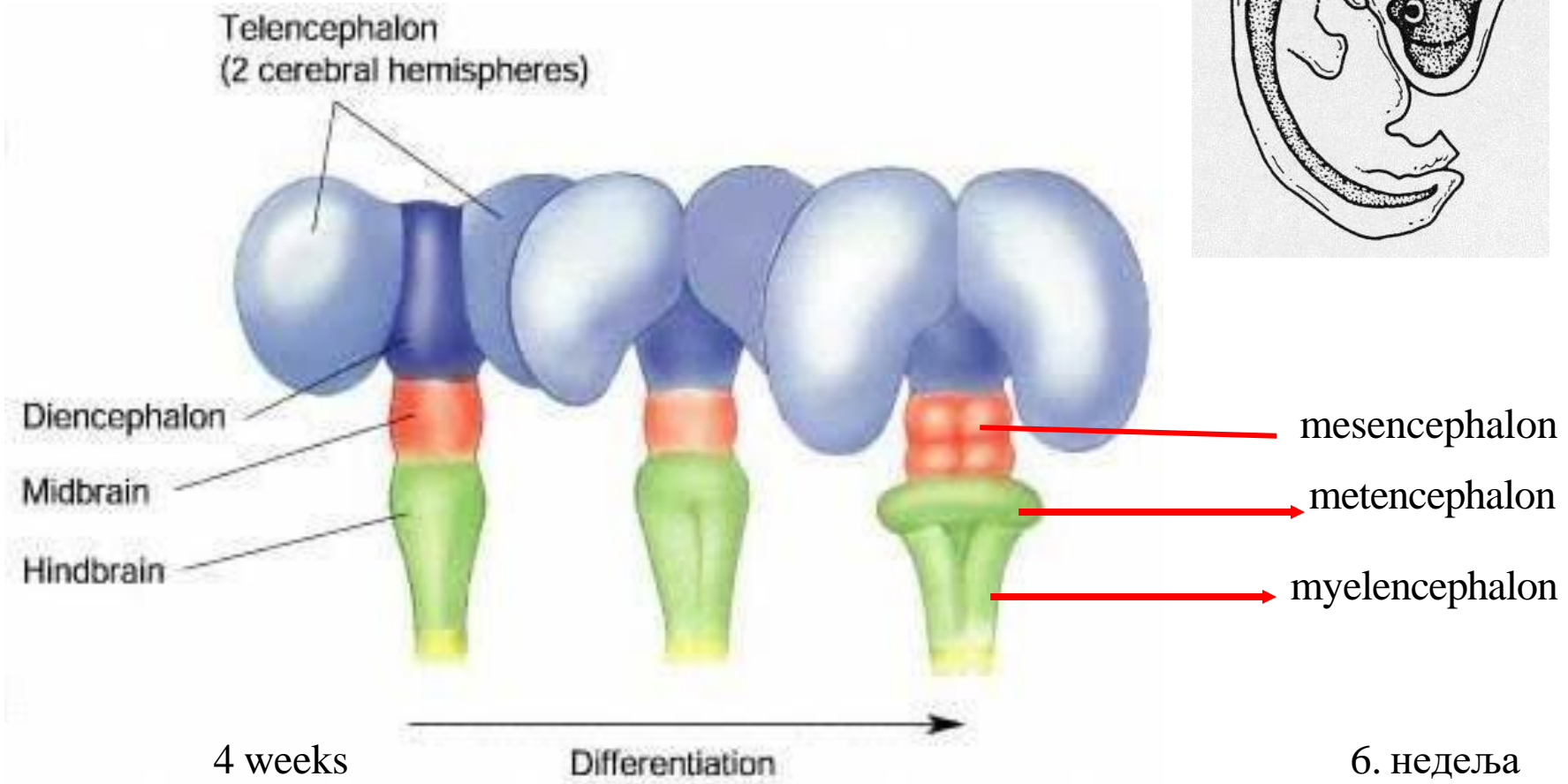
Anencephaly

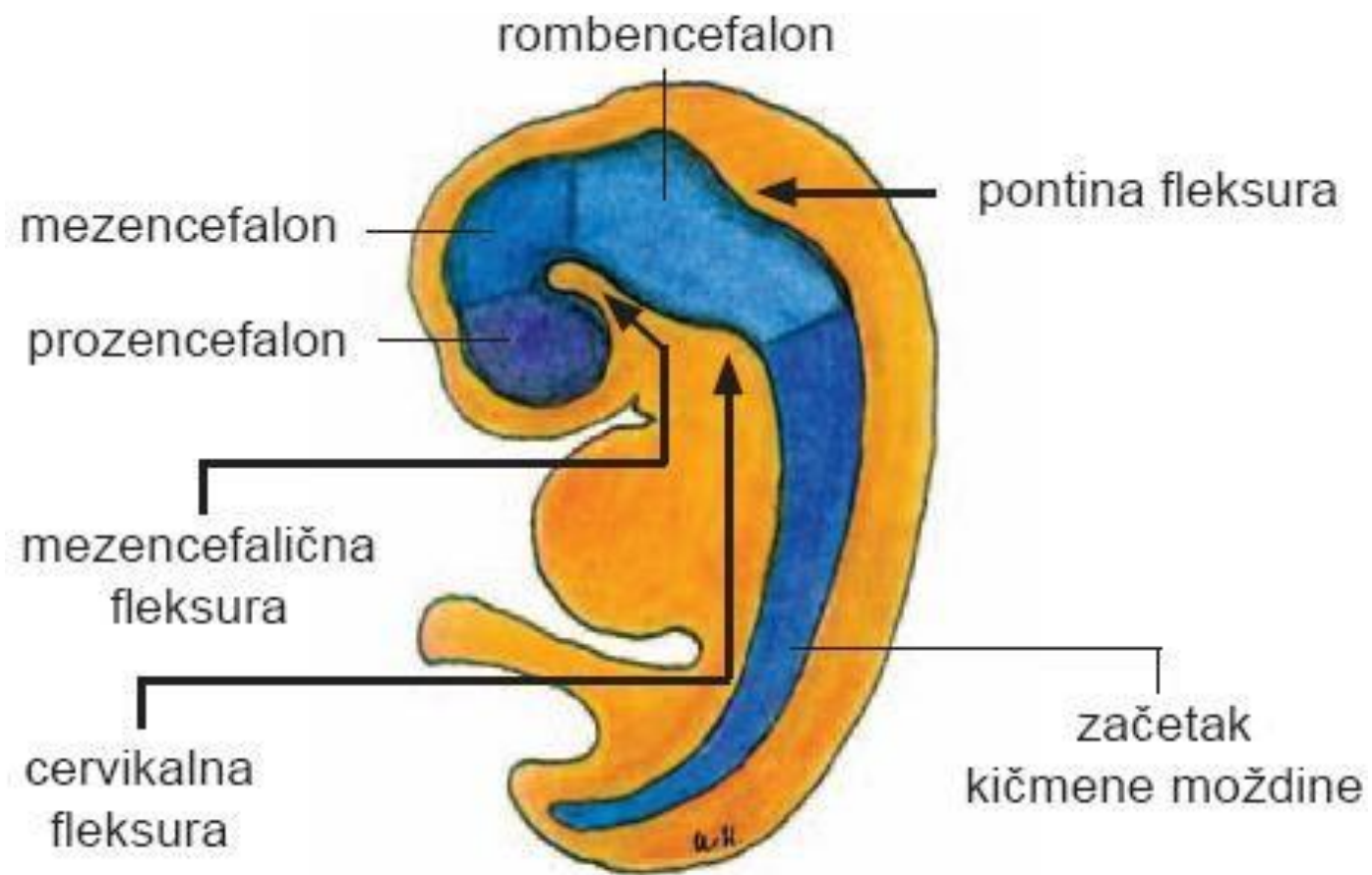


Spina bifida

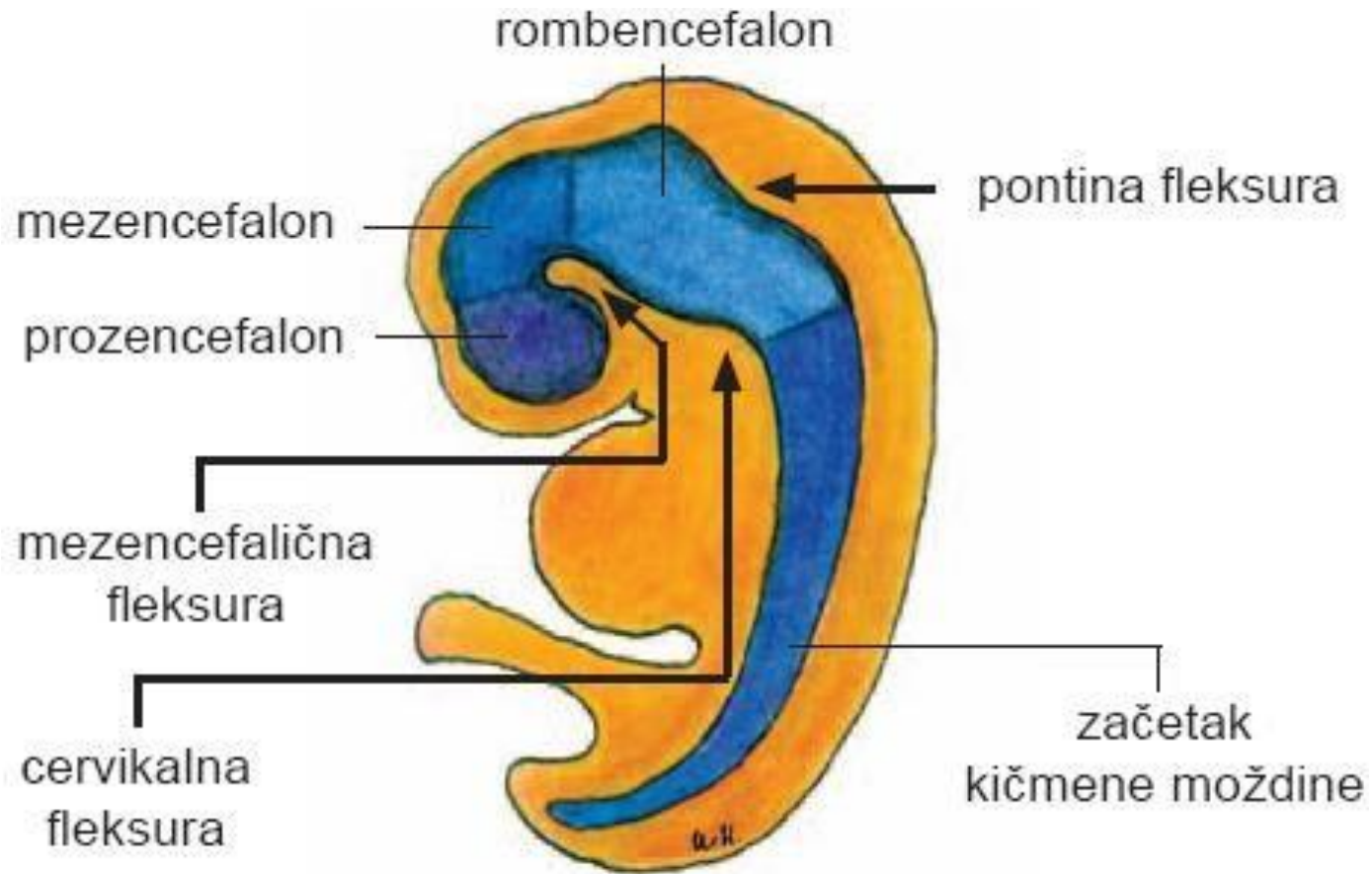








# Савијање možдane цеви - флексури



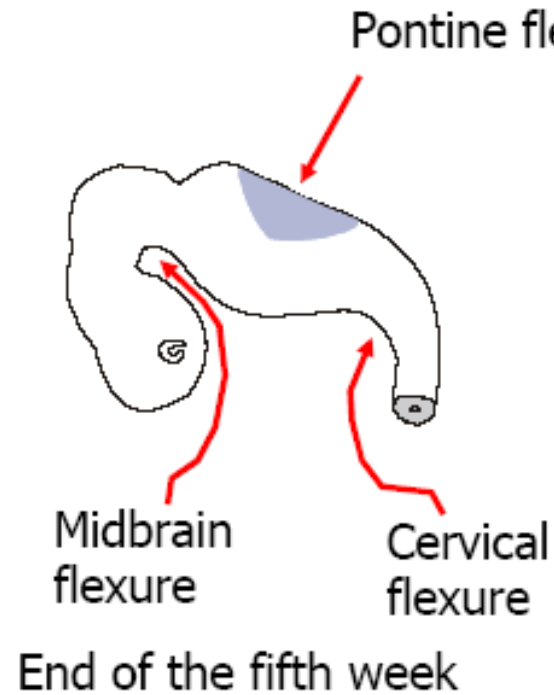
- У петој недељи такође почиње и дорзално савијање нервне цеви (у нивоу развијајућег понса) и том приликом настаје трећа - **понтинa флексура**.
- Понтинa флексура до 8. недеље раздвоји **метенцефалон** и **мијеленцефалон**.
- Шупљине у хемисферама теленцефалона формираће **латералне коморе**, у диенцефалону **трећу комору**, док ће се у ромбенцефалону развити **четврта комора**.



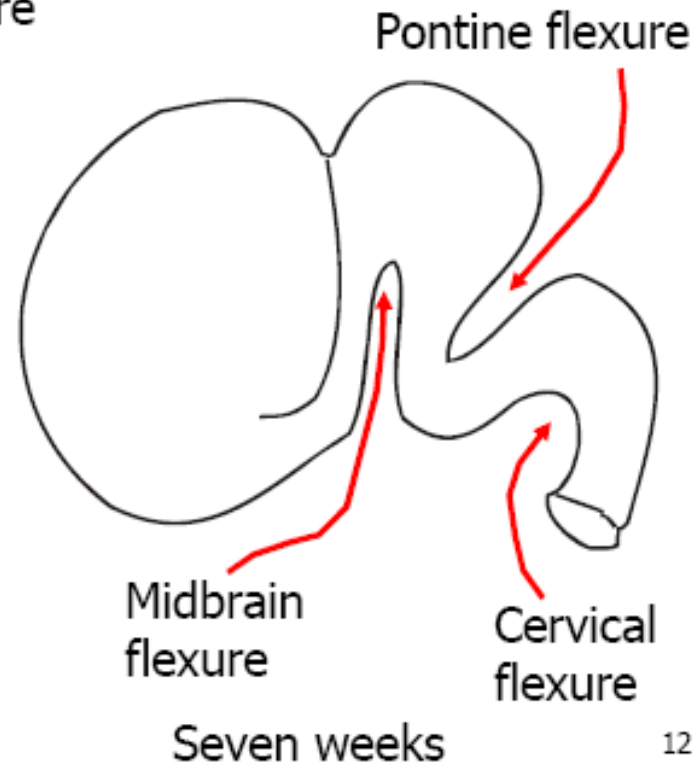


# Three Flexures

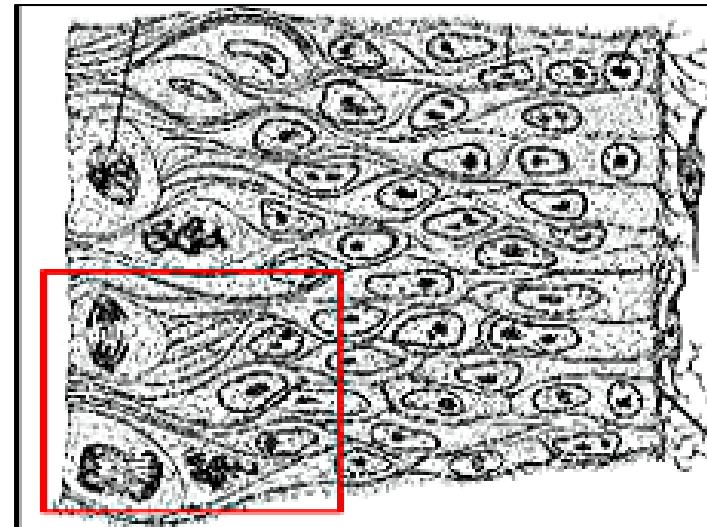
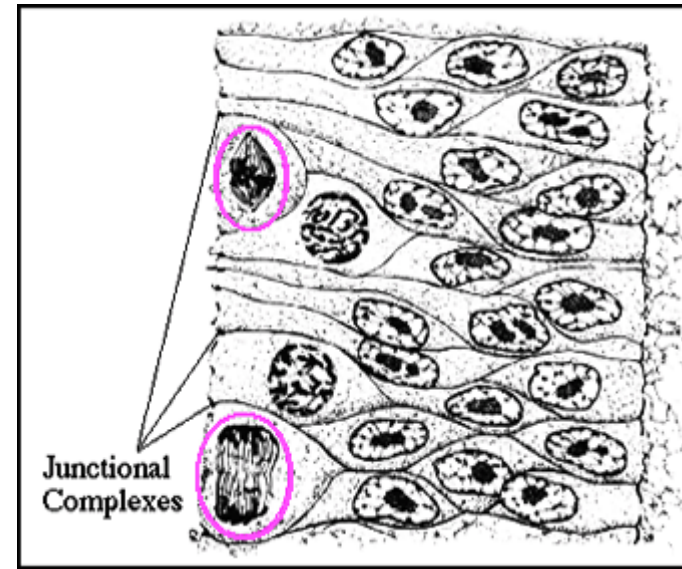
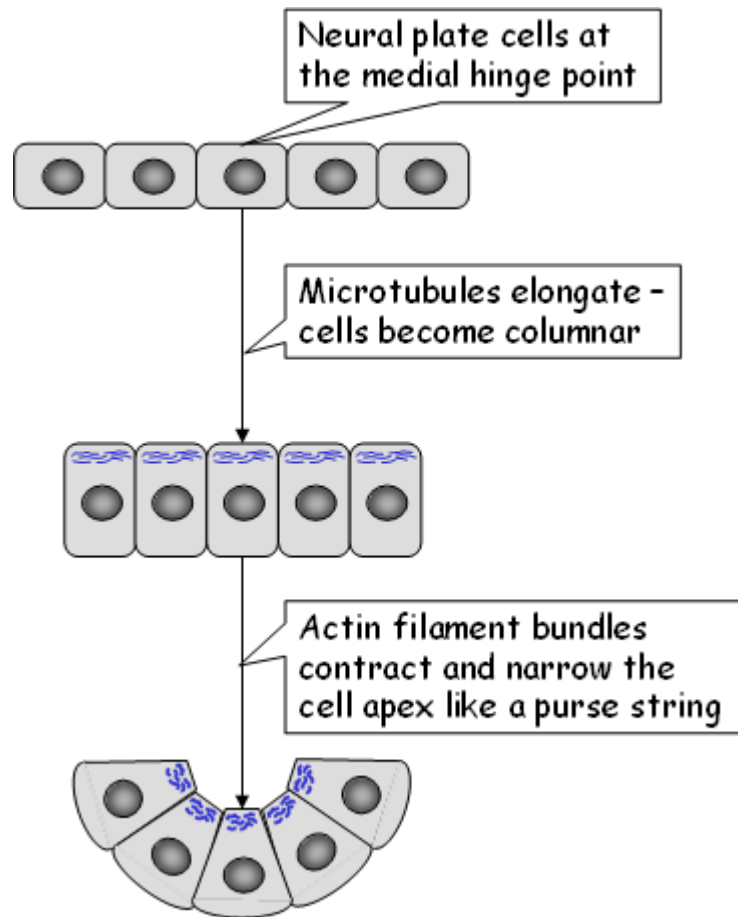
NRS 202 H

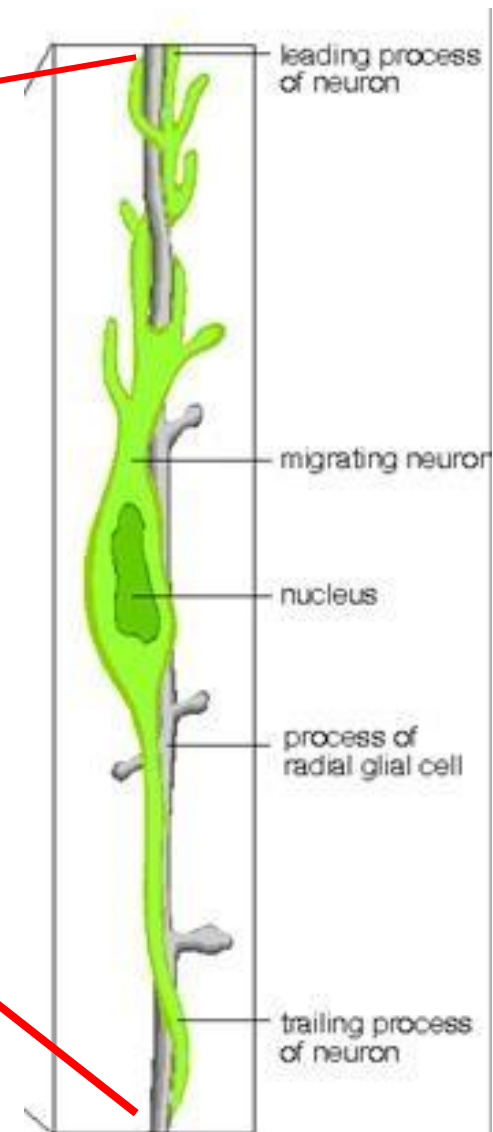
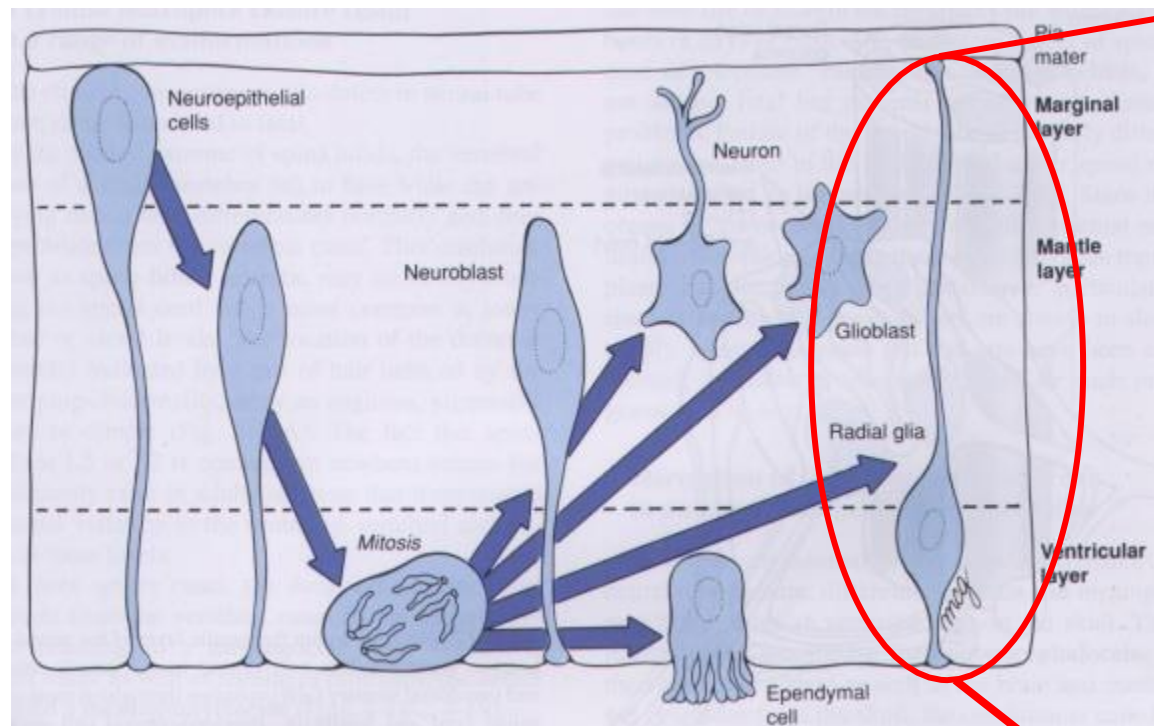


11 Embryology II

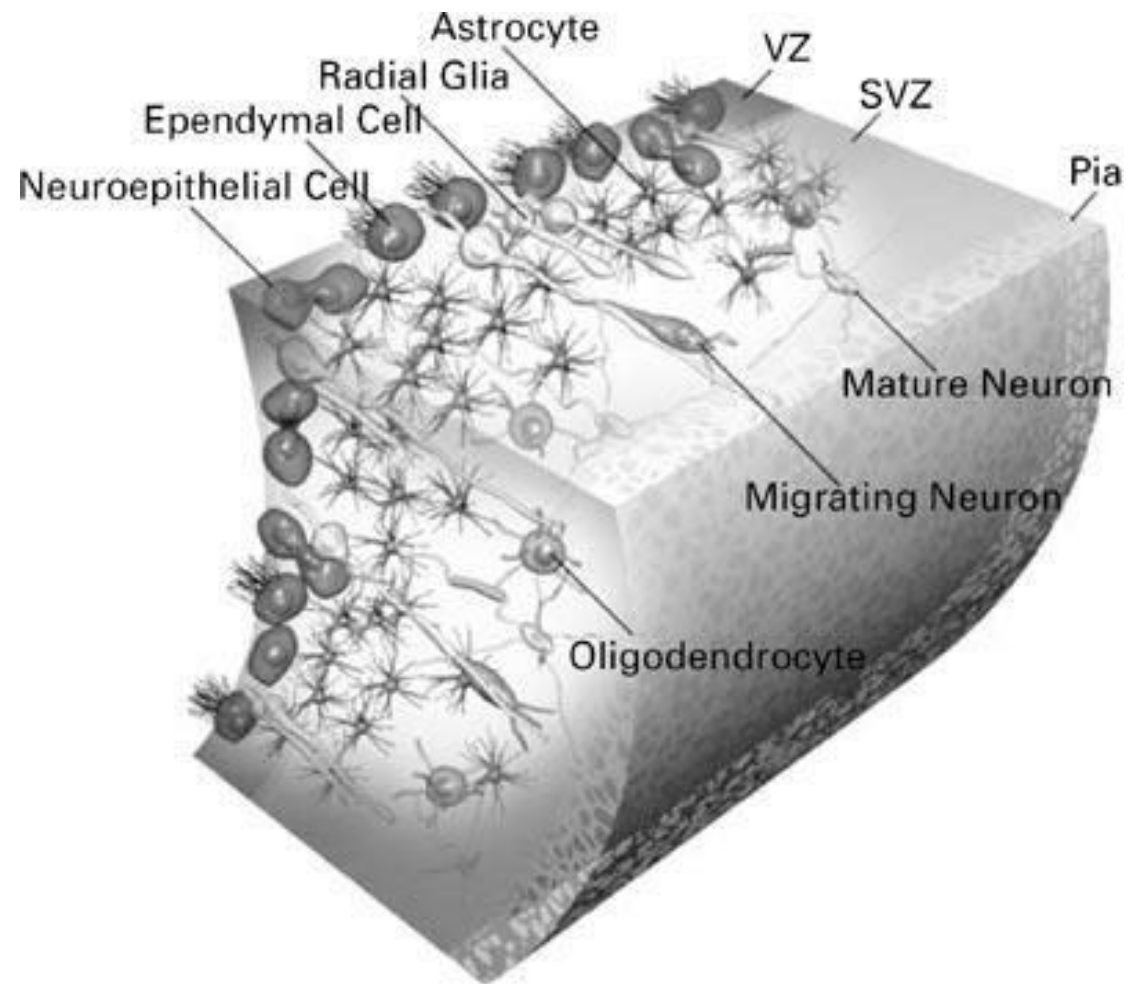
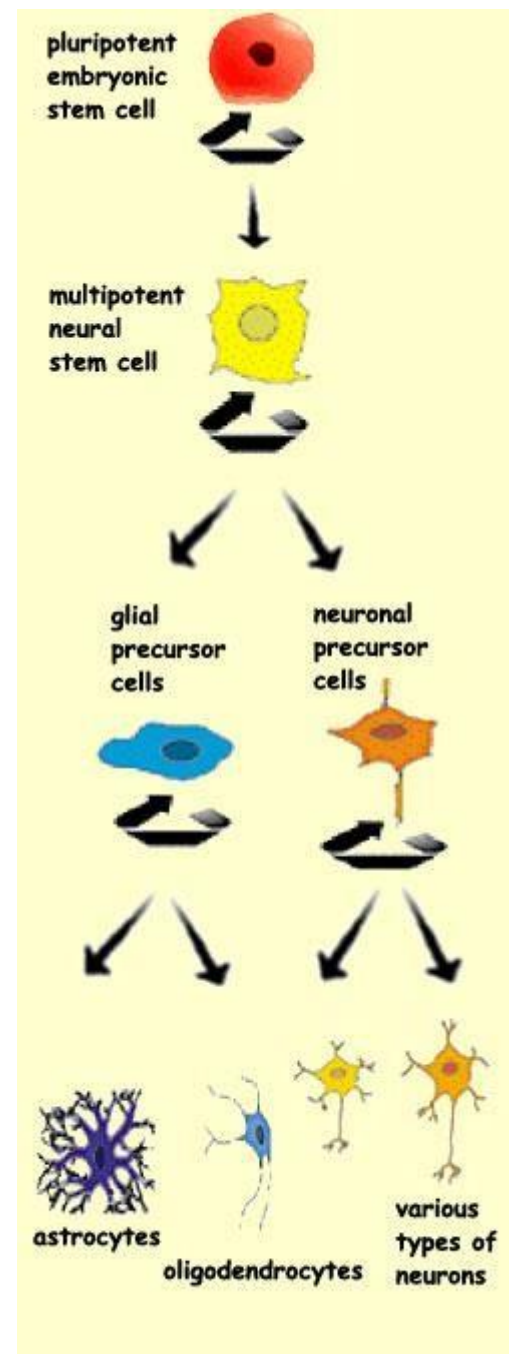


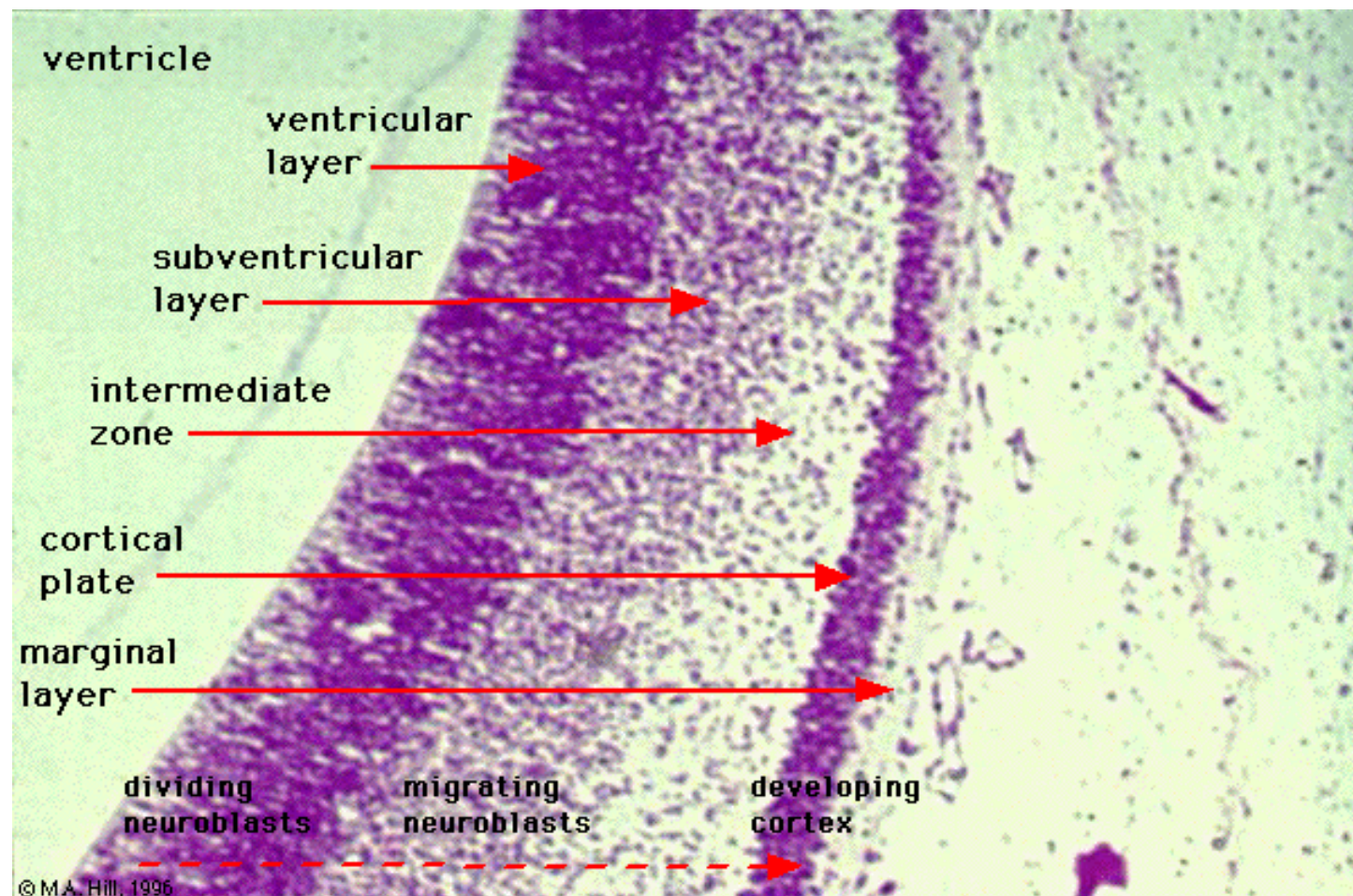
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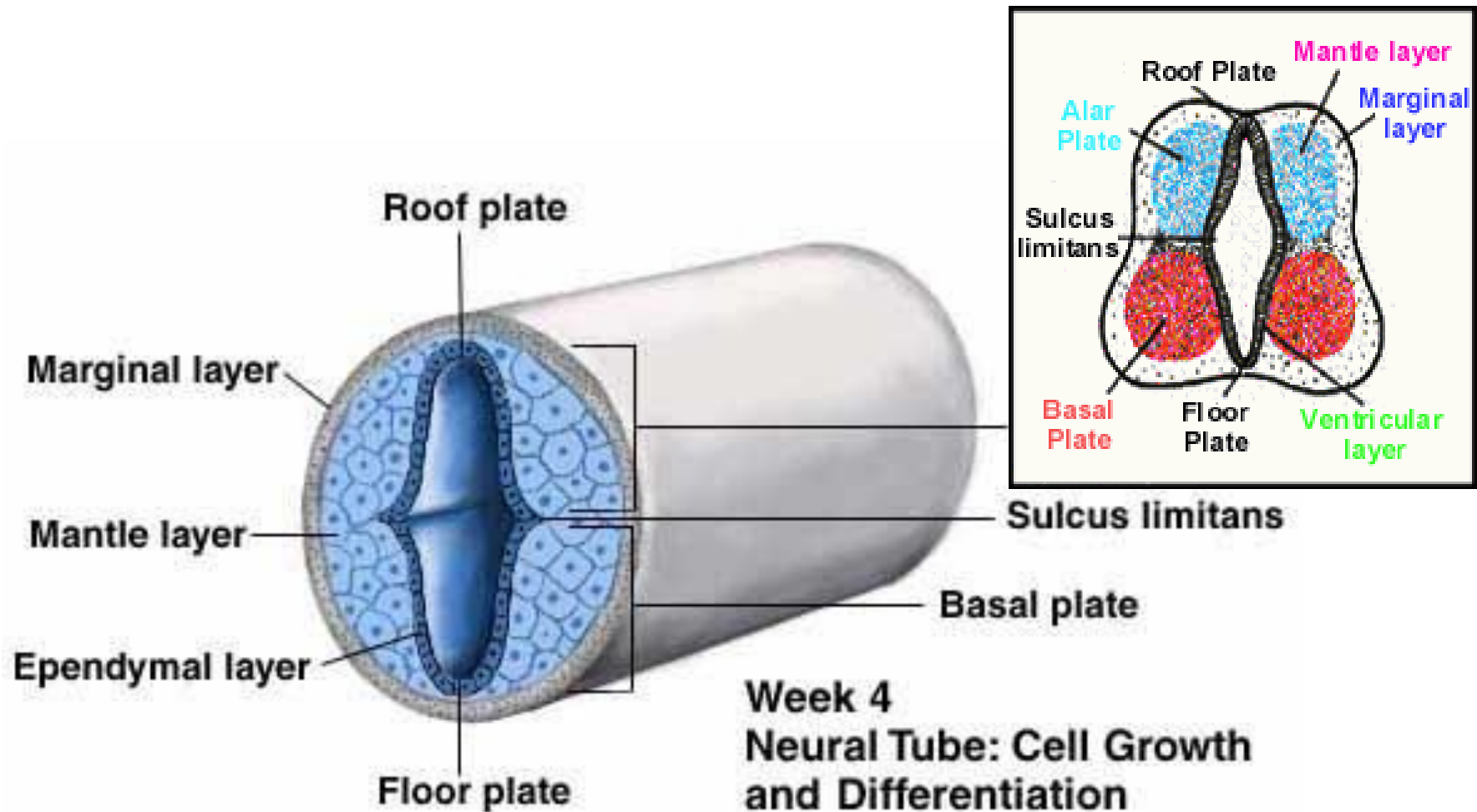


Newborn  
A

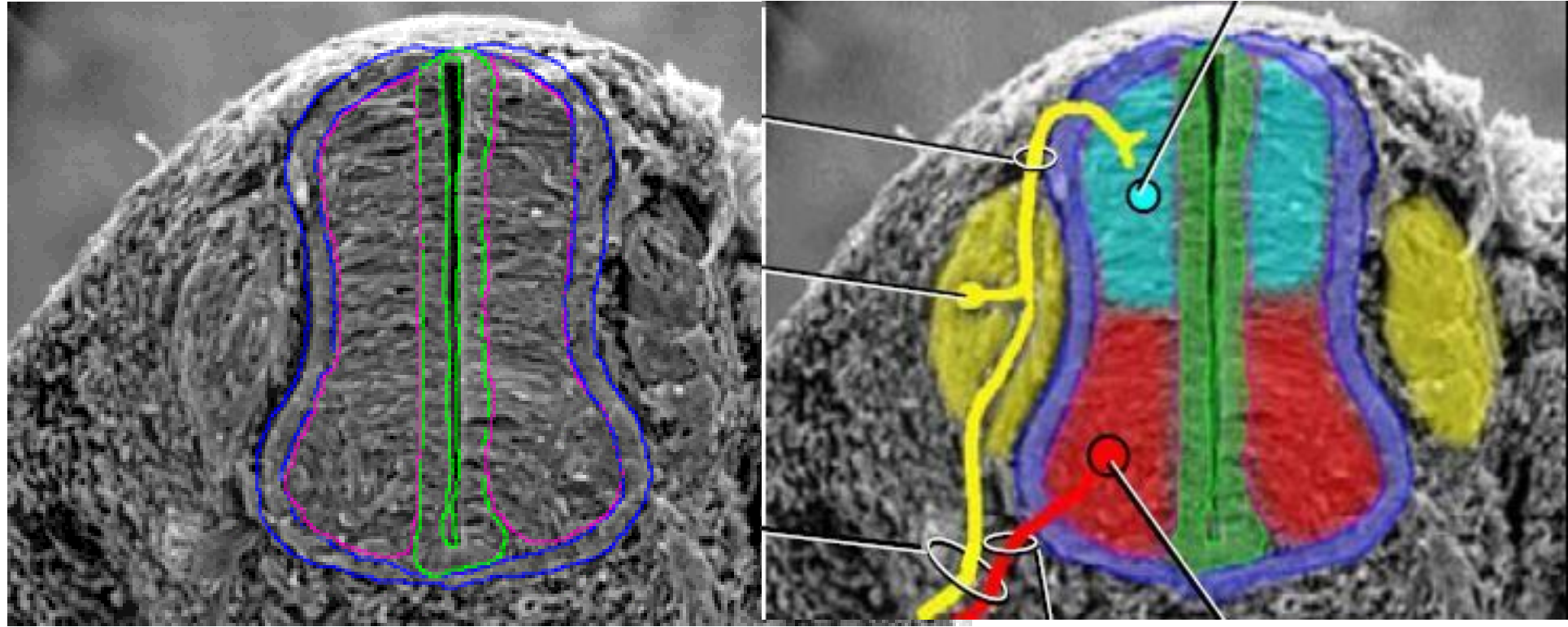
1 month  
B

6 months  
C

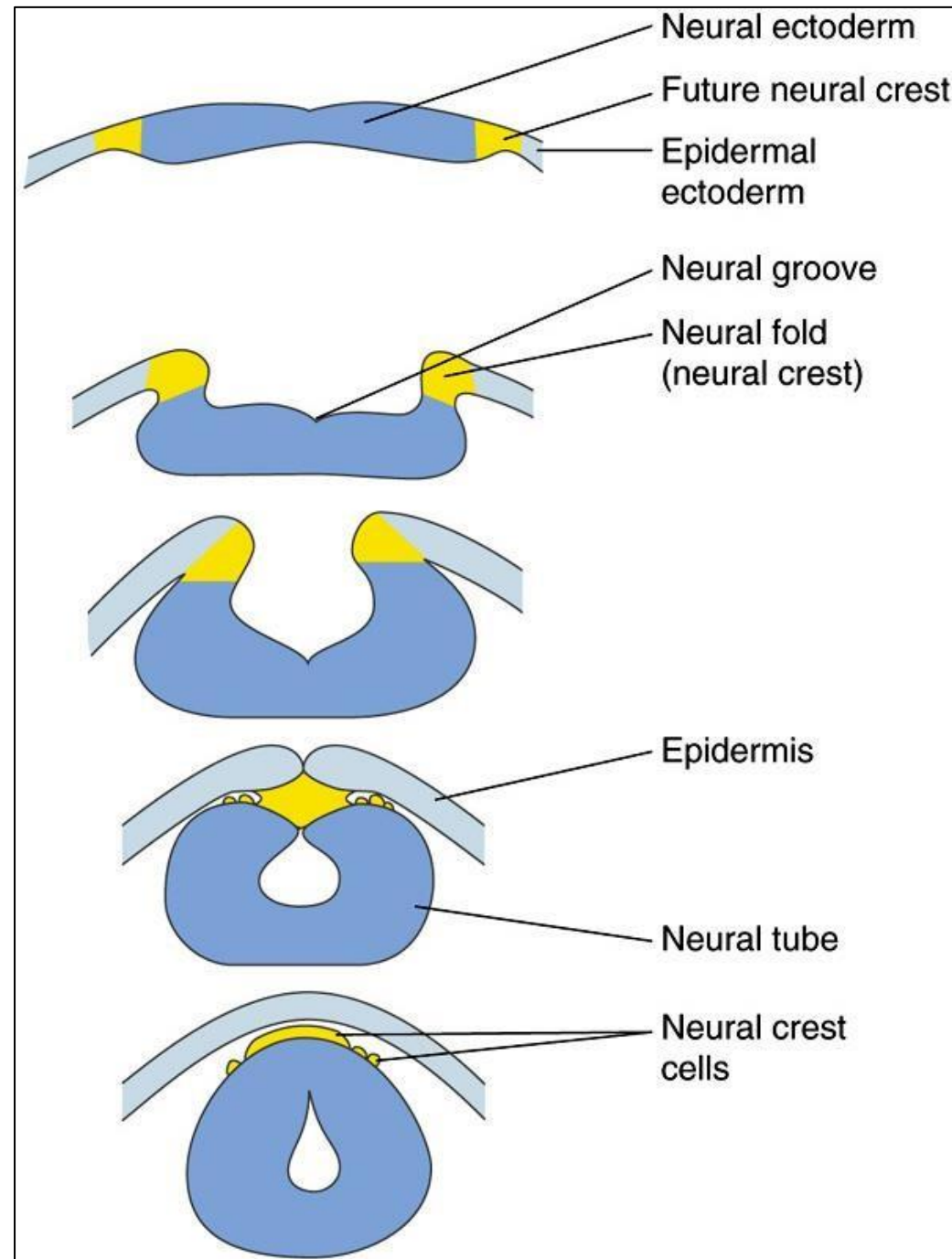
2 years  
D

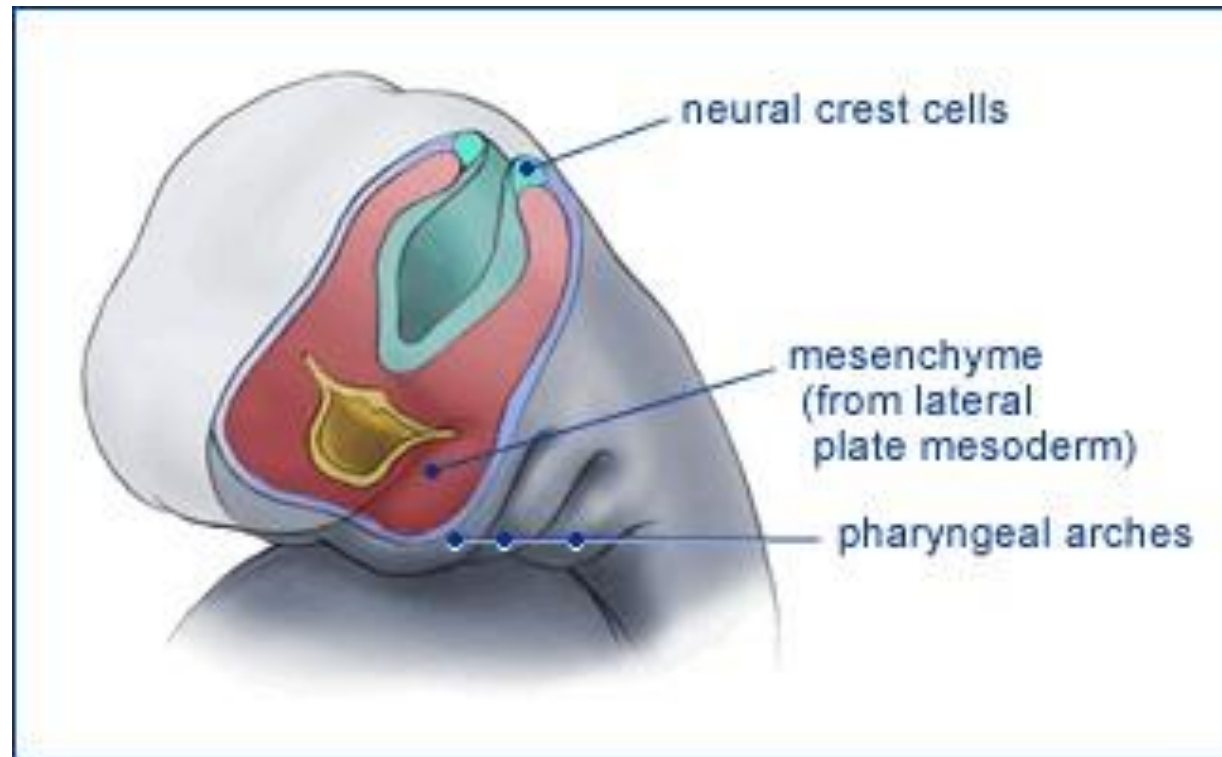
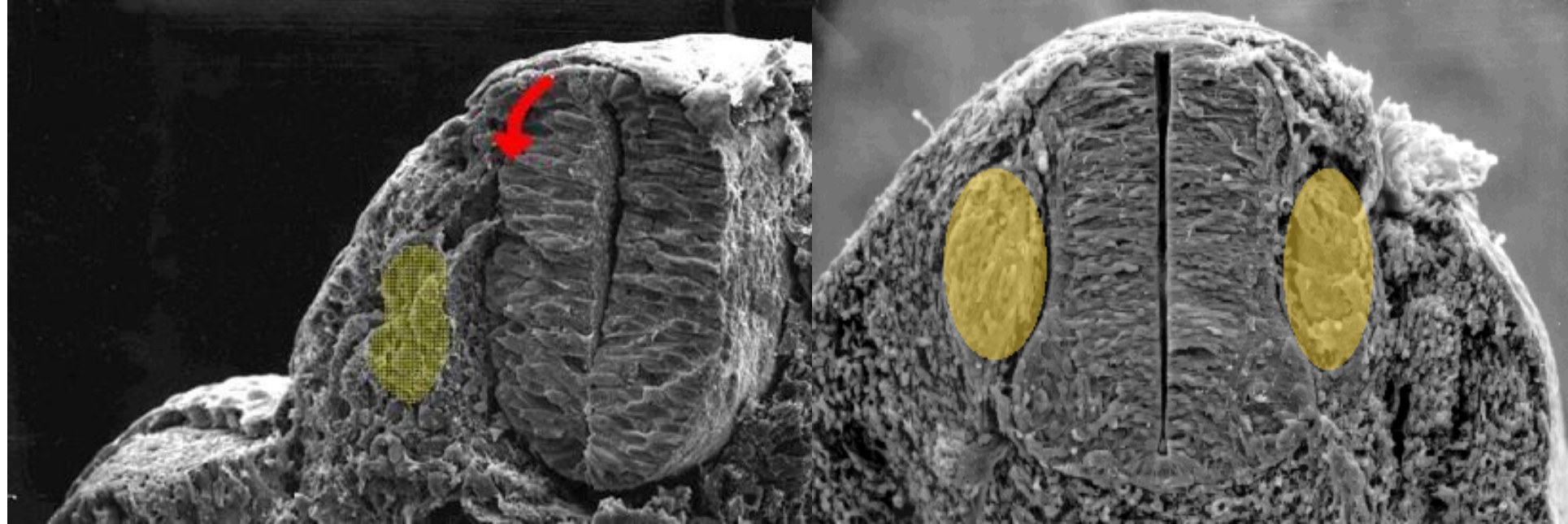


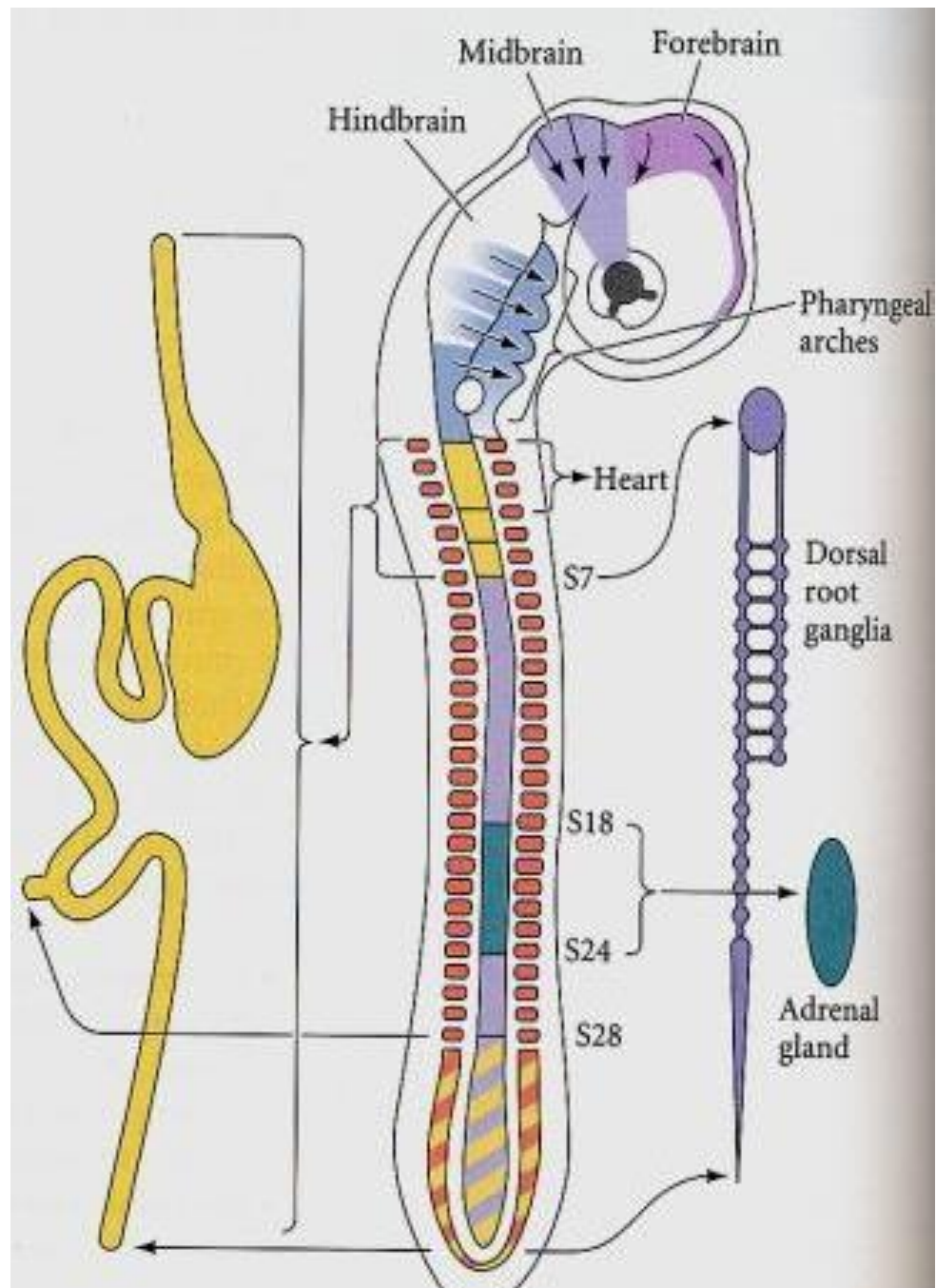




# Peripheral nervous system - neural crest





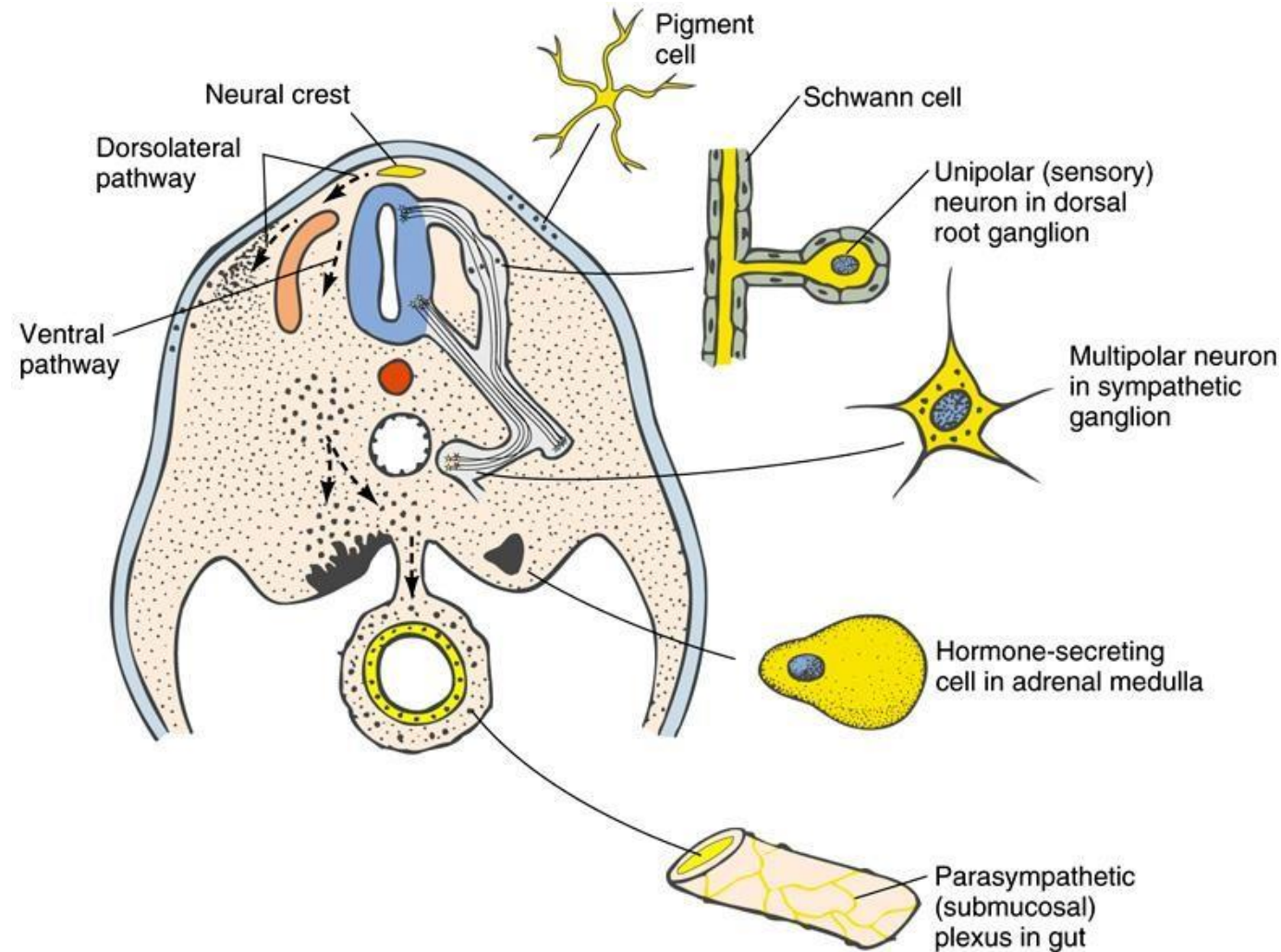




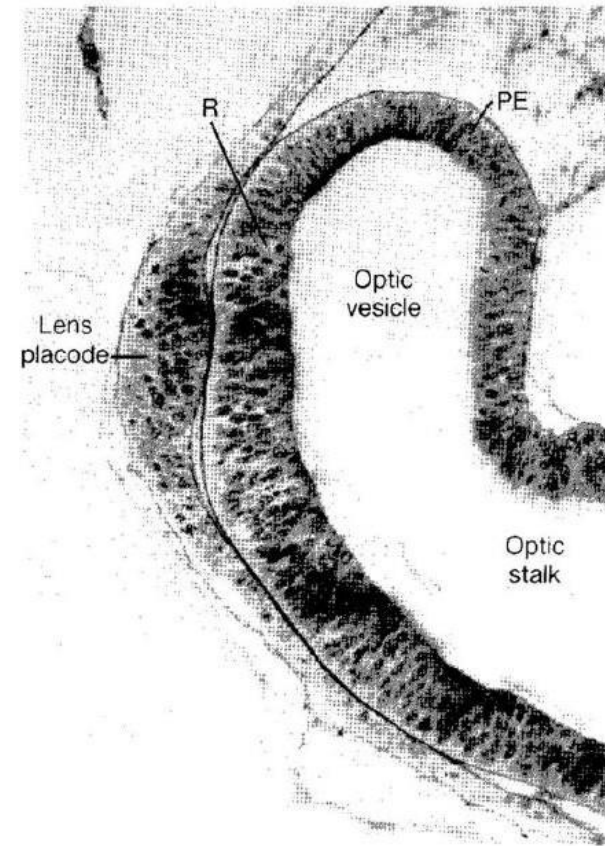
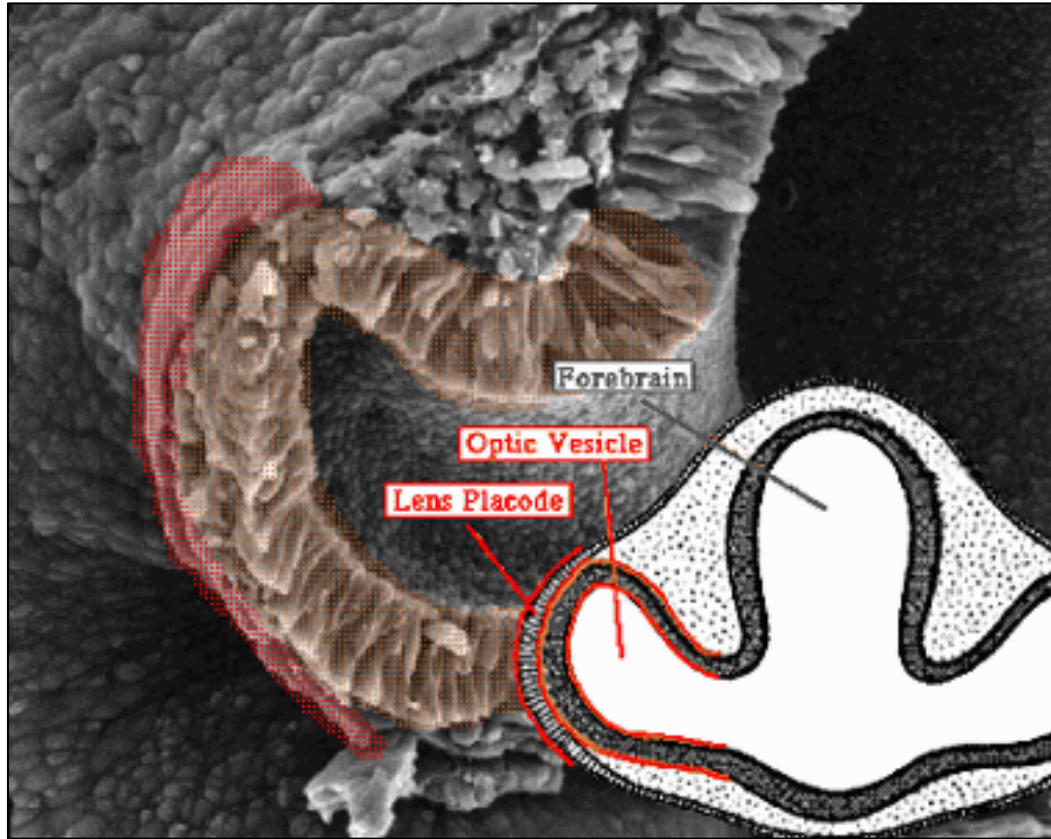
# Периферни нервни систем

- **Периферни нервни систем (ПНС)** (кранијални, спинални висцерални нерви, ганглиони) настаје из три извора:
- **Нервне цеви** - даје моторни део ПНС
- **Нервног гребена** - даје сензитивни део ПНС
- **Мезодерма** - ствара потпорне ћелије(фибробласти)
- **Ектомезенхима** који диференцијацијом даје везивне омотаче периферних нервних влакана: ендонеуријум, перинеуријум и епинеуријум.

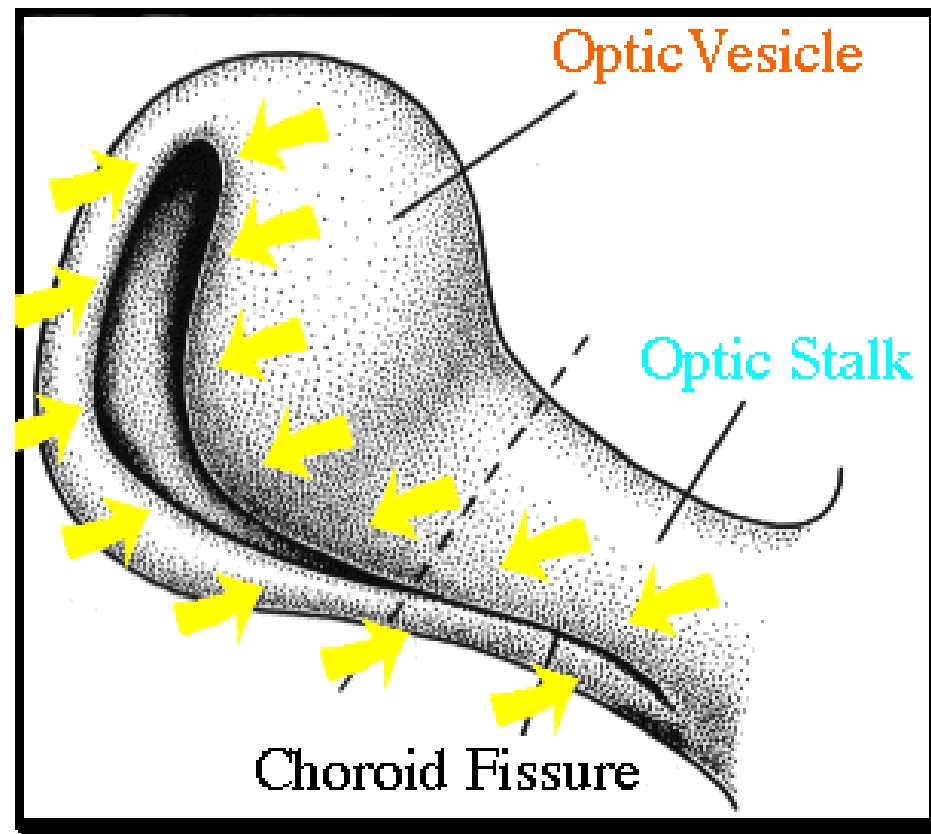
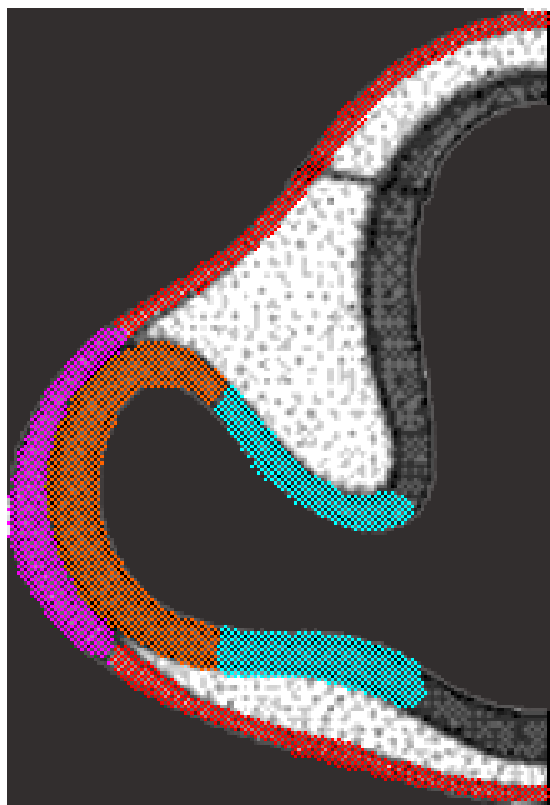
# Pathways of neural crest cell migration and derivatives

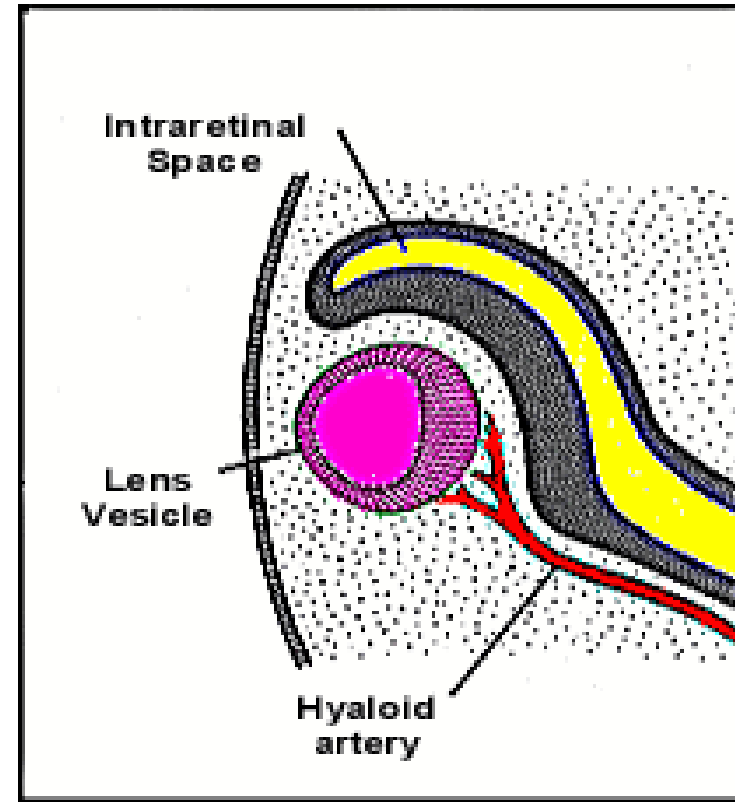
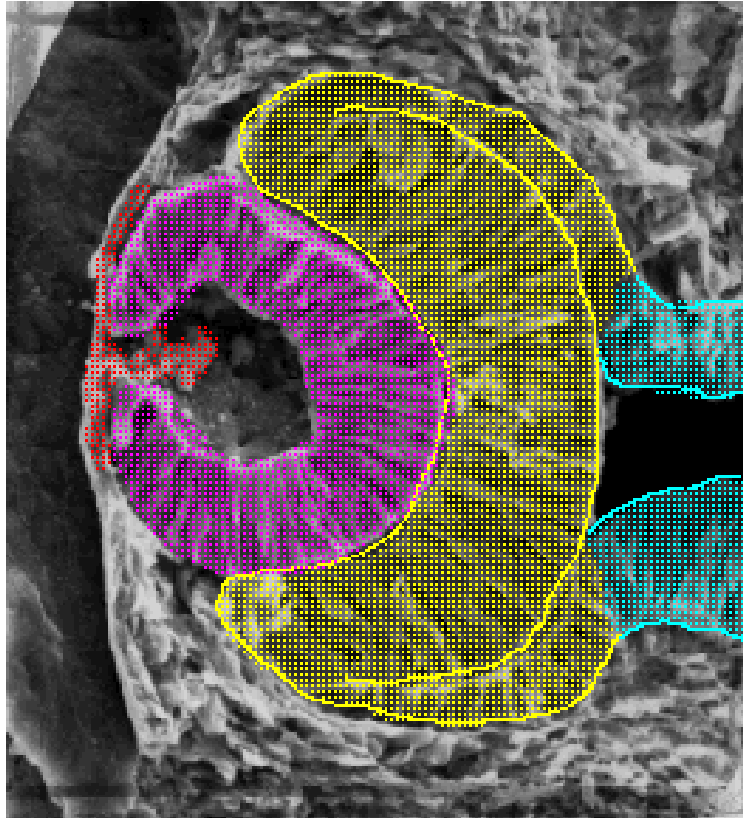


**Eye and ear**

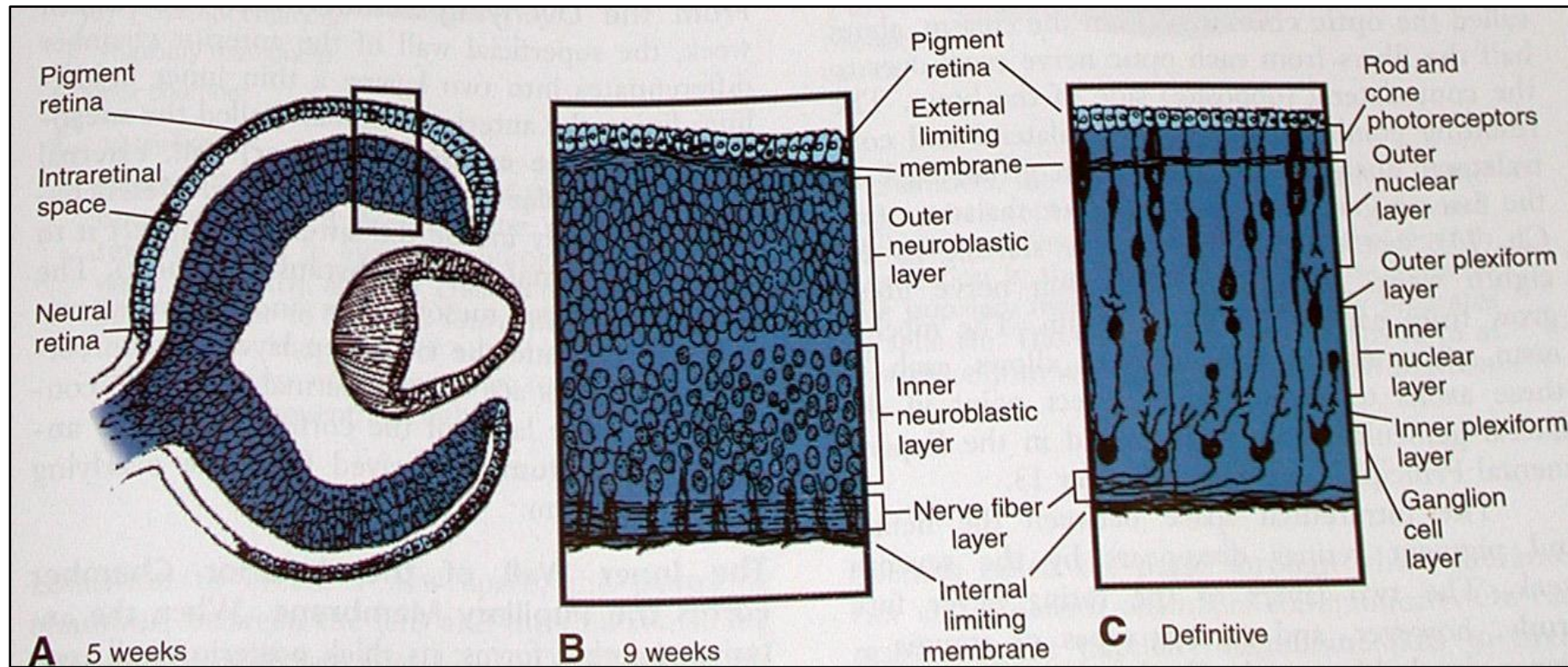


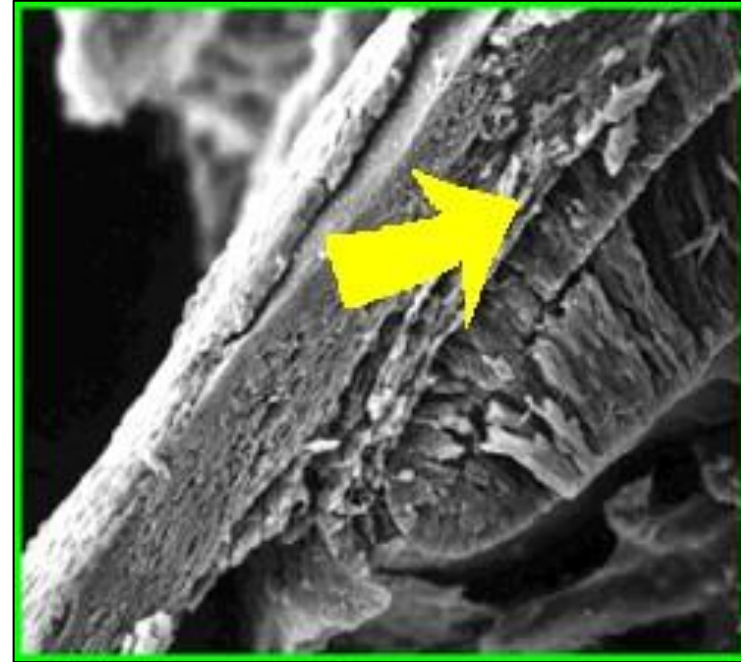
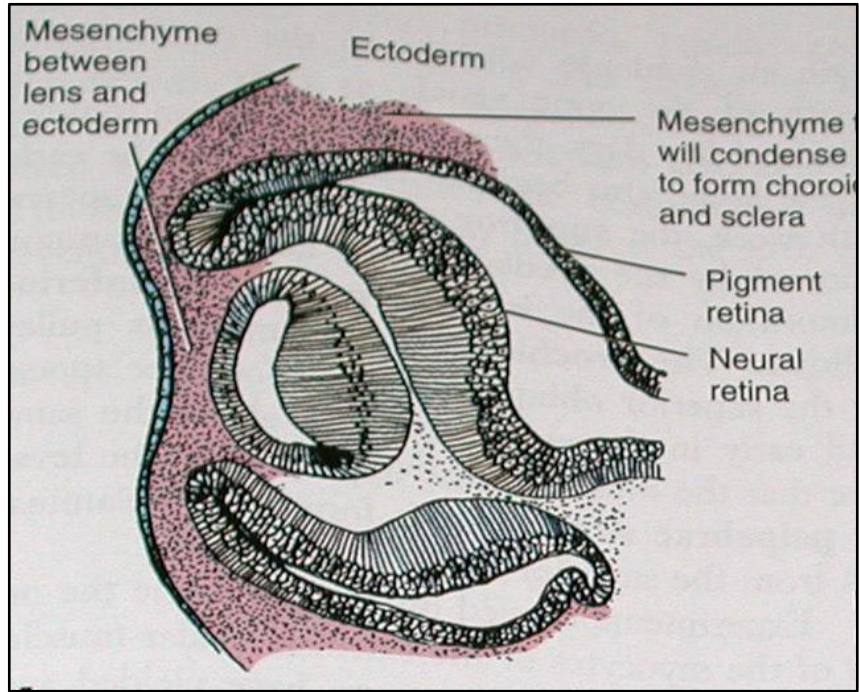




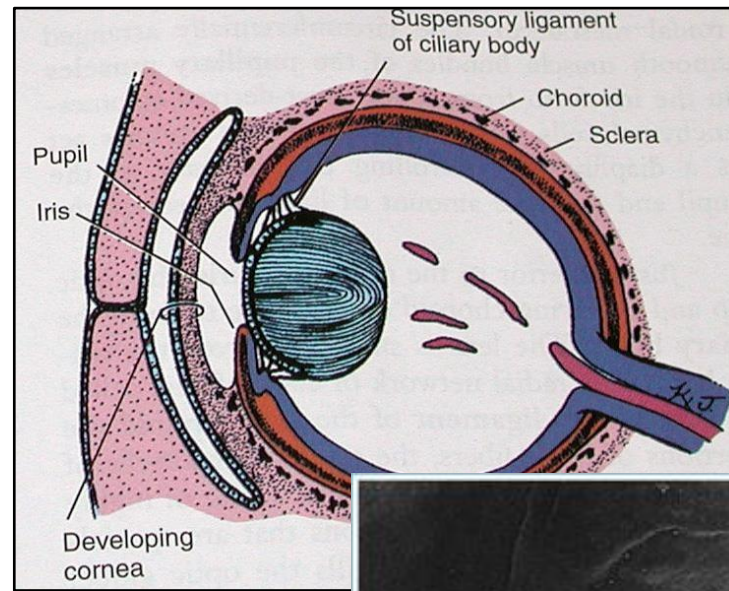


# Development of the retina

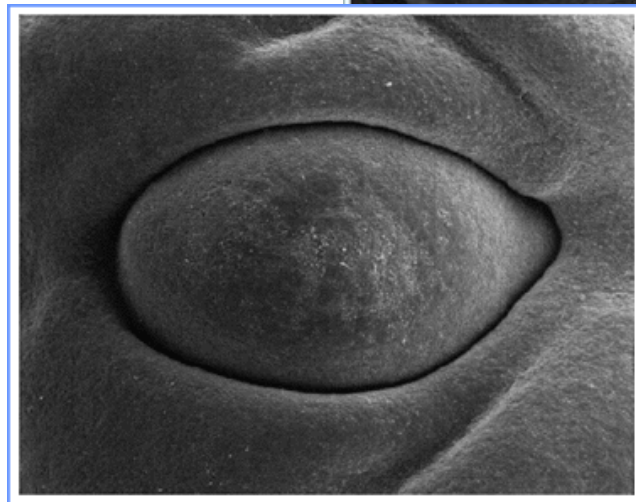
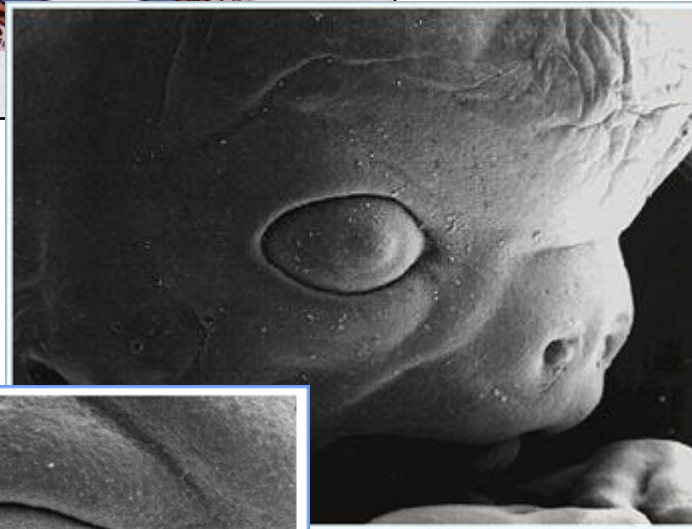








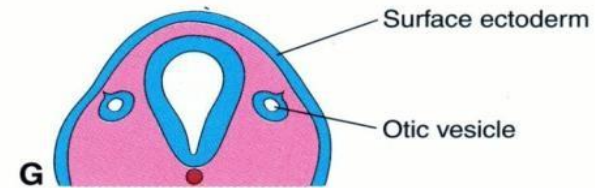
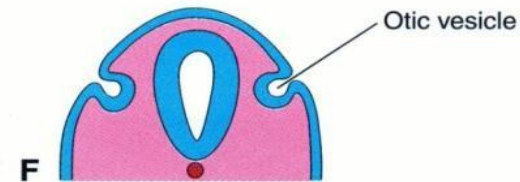
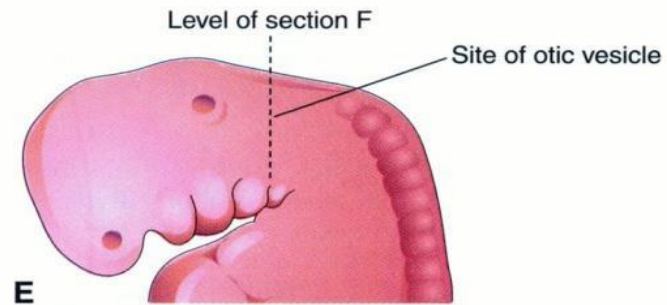
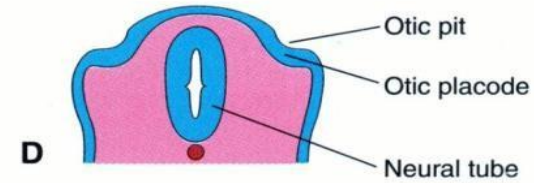
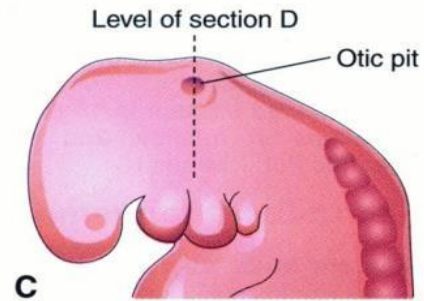
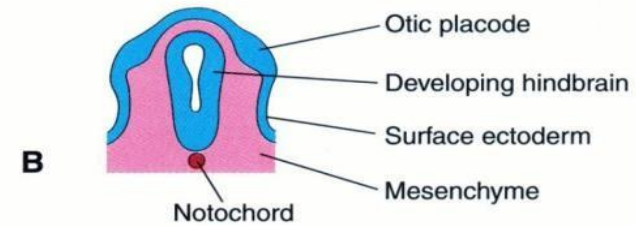
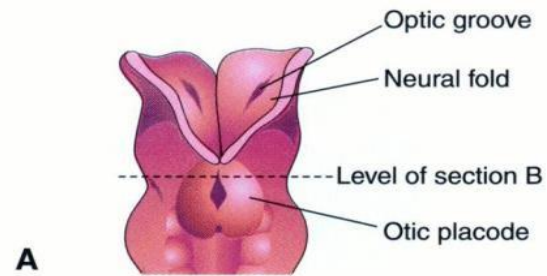
# Eyelid development



# **Ear development**

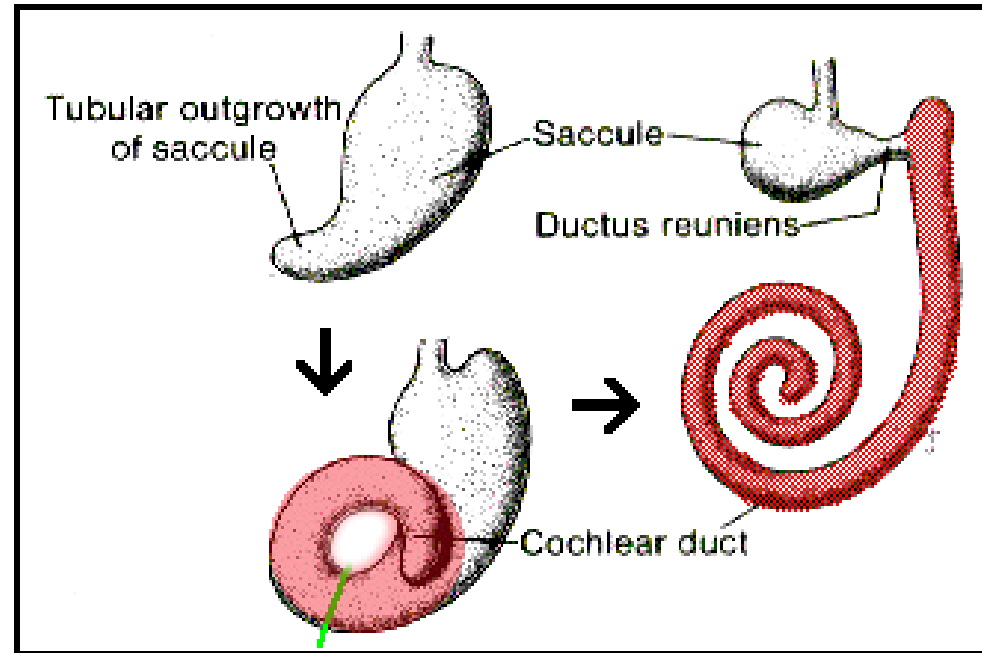
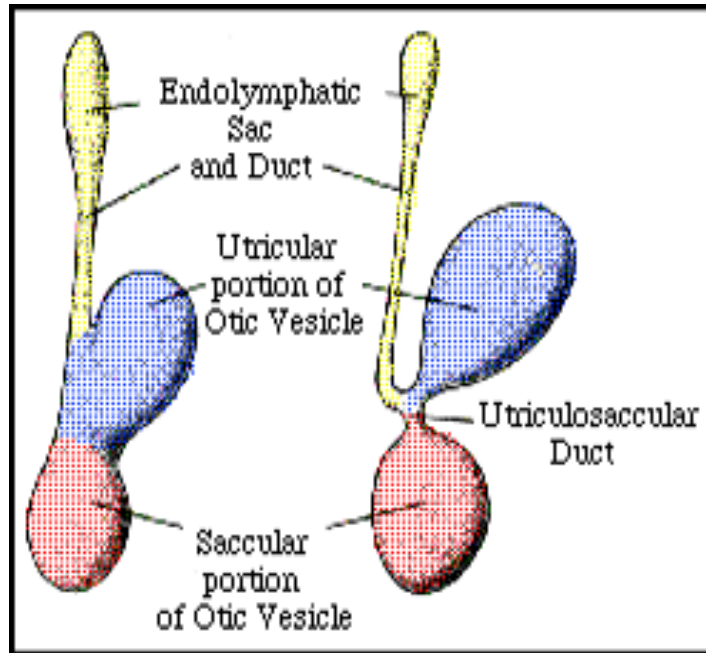
# Ear development

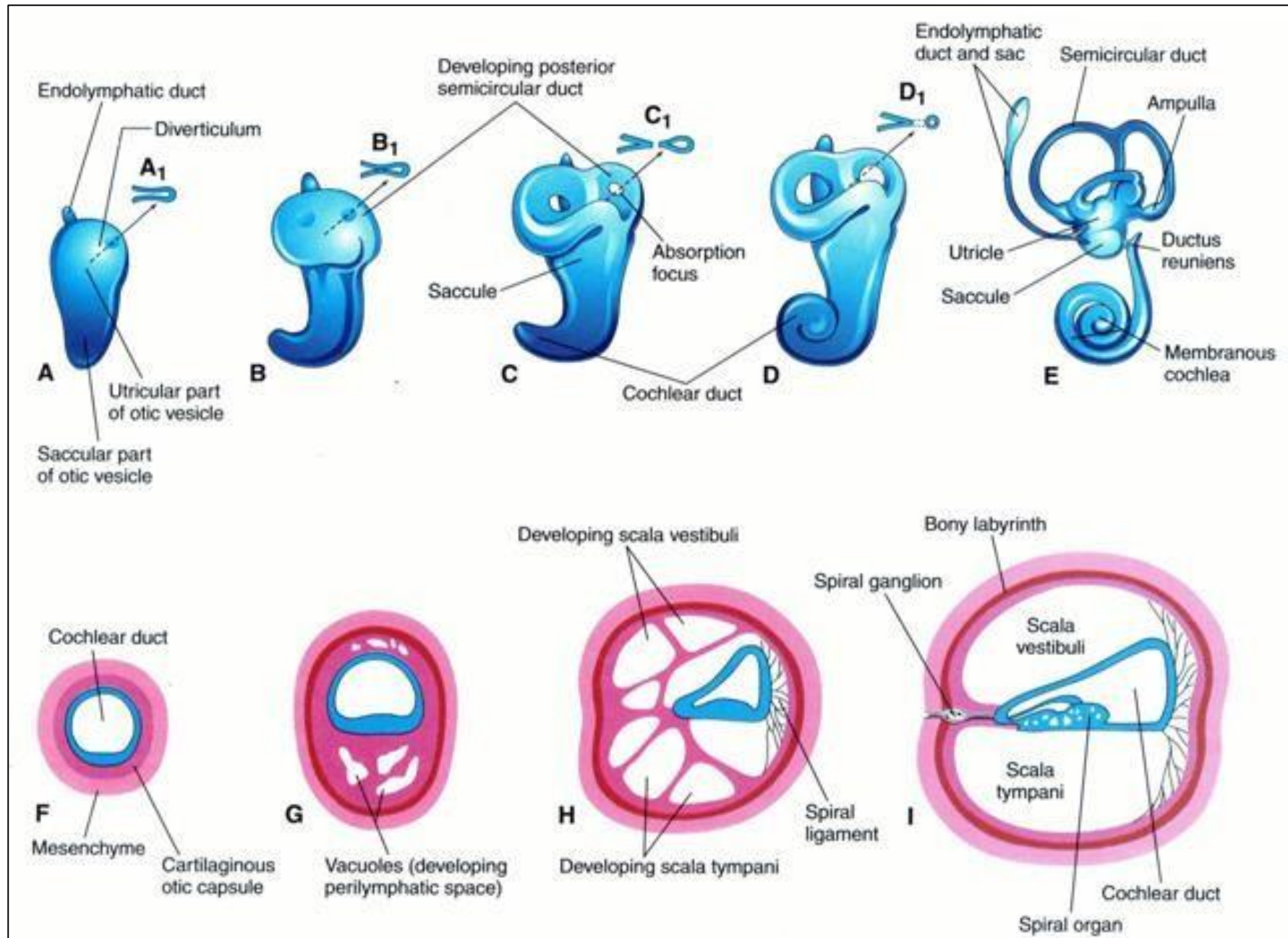
- The following participate in the formation of the ear:
- Superficial ectoderm - inner and outer ear.
- Ectomesenchyme - middle ear.
- Endoderm of the first pharyngeal cord - middle ear.
- During the 22nd day, they arise from the surface ectoderm at the level of the rhombencephalon
- otic placodes.
- The otic placodes represent the beginning of the membranous labyrinth, as well as the sensory organs of hearing and balance, the statoacoustic ganglion and the vestibulocochlear nerve.

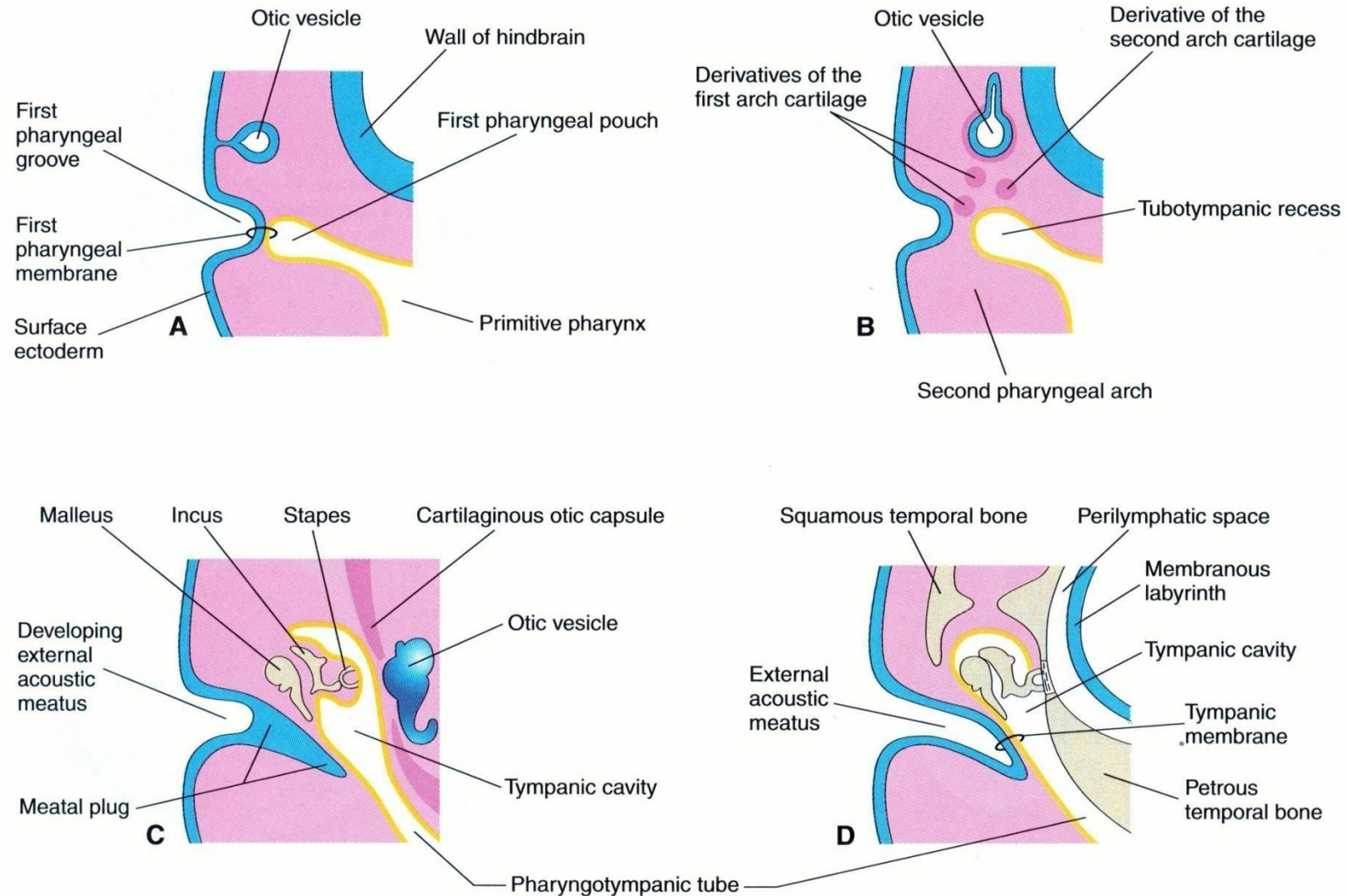


■ **Figure 19-16.** Drawings illustrating early development of the internal ear. *A*, Dorsal view of a 4-week-old embryo (about 22 days), showing the otic placodes. *B*, *D*, *F*, and *G*, Schematic coronal sections illustrating successive stages in the development of otic vesicles. *C* and *E*, Lateral views of the cranial region of embryos, about 24 and 28 days, respectively.



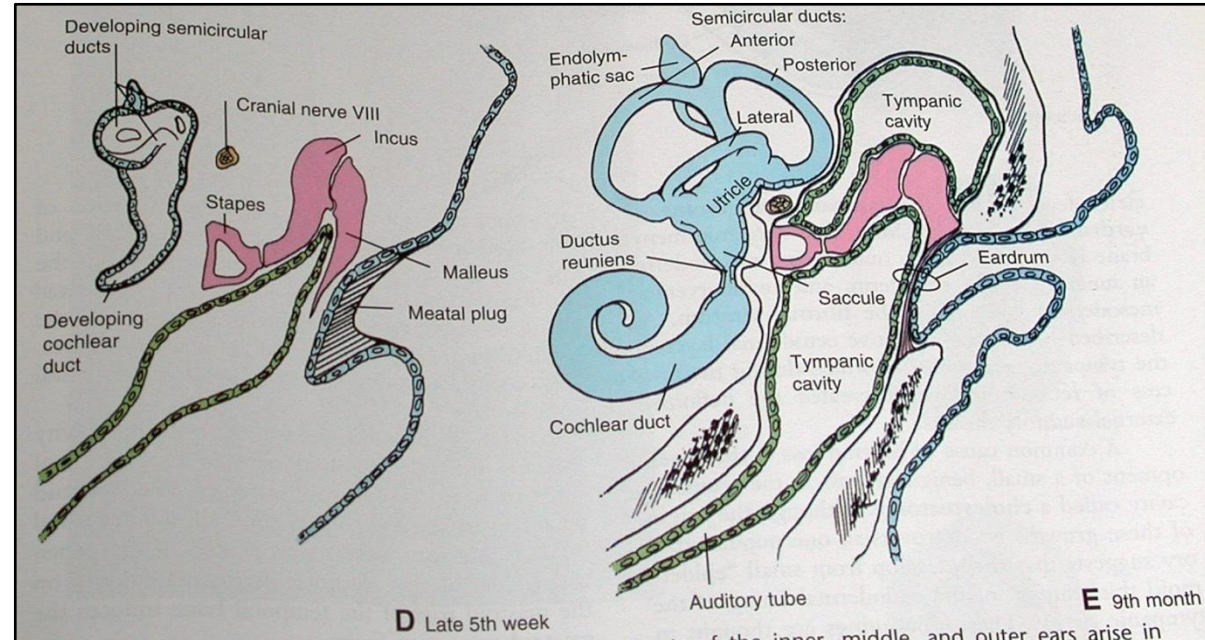
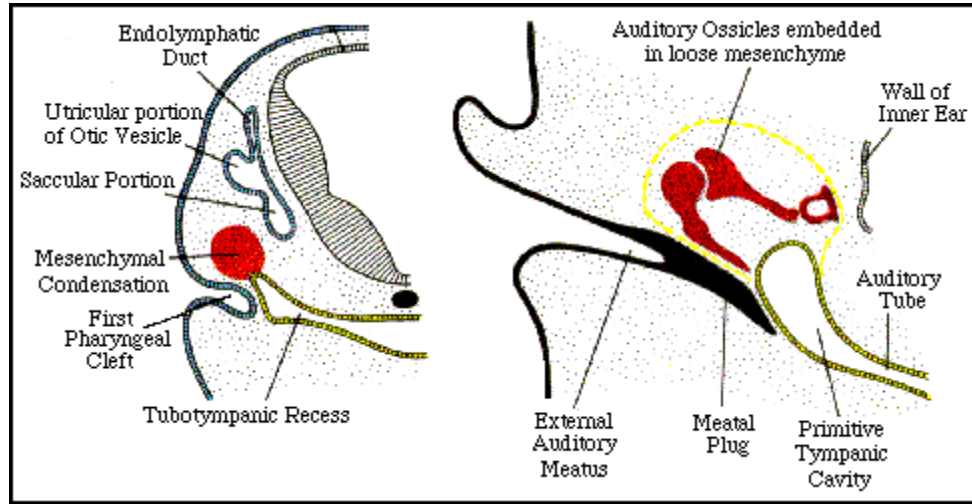






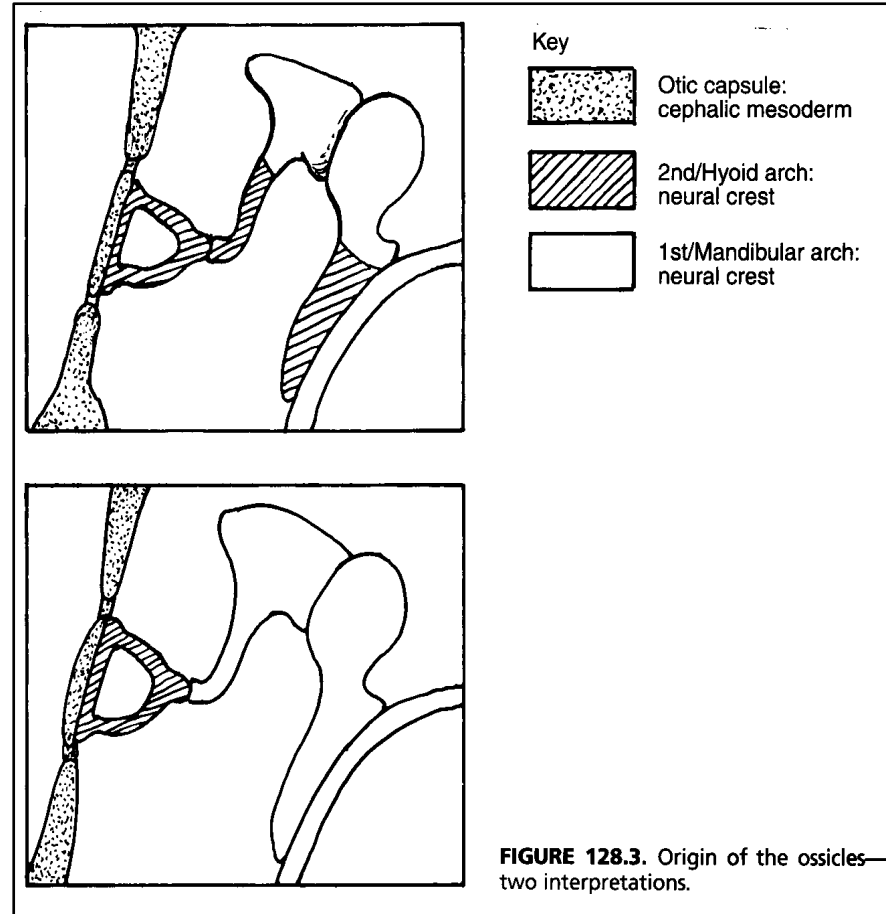
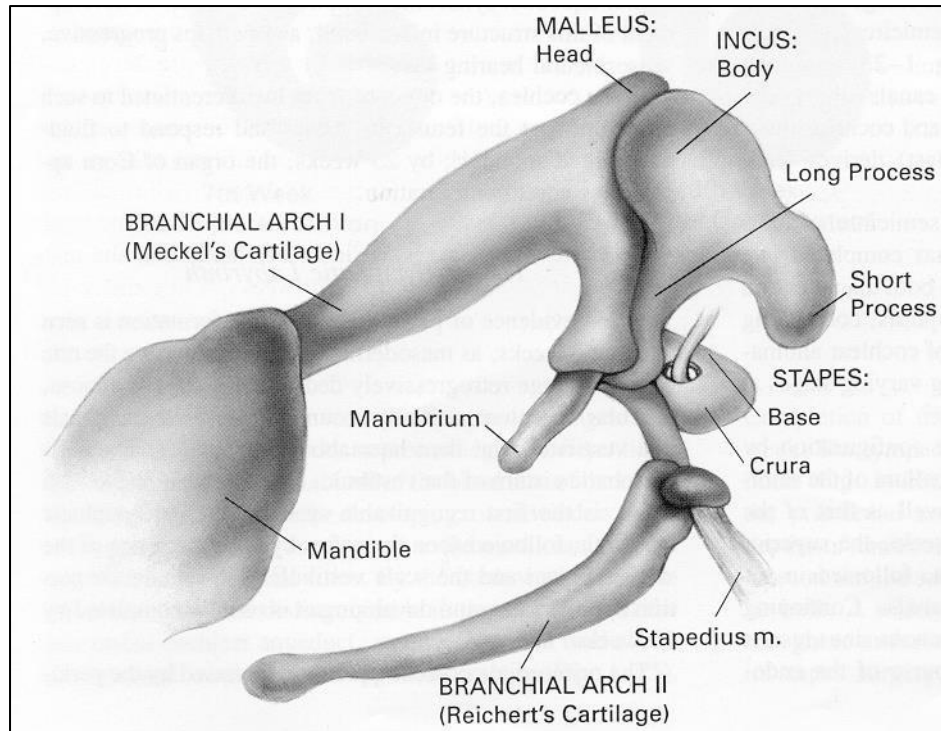
■ **Figure 19-19.** Schematic drawings illustrating development of the external and middle ear. Observe the relationship of these parts of the ear to the otic vesicle, the primordium of the internal ear. *A*, 4 weeks, illustrating the relation of the otic vesicle to the pharyngeal apparatus. *B*, 5 weeks, showing the tubotympanic recess and pharyngeal arch cartilages. *C*, Later stage, showing the tubotympanic recess (future tympanic cavity and mastoid antrum) beginning to envelop the ossicles. *D*, Final stage of ear development, showing the relationship of the middle ear to the perilymphatic space and the external acoustic meatus. Note that the tympanic membrane develops from three germ layers: surface ectoderm, mesoderm, and endoderm of the tubotympanic recess.

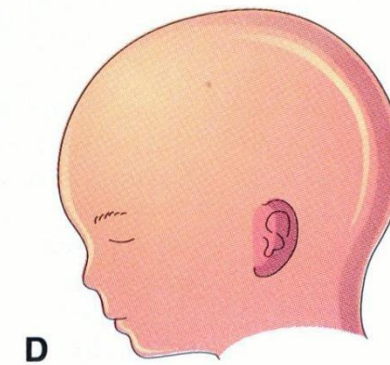
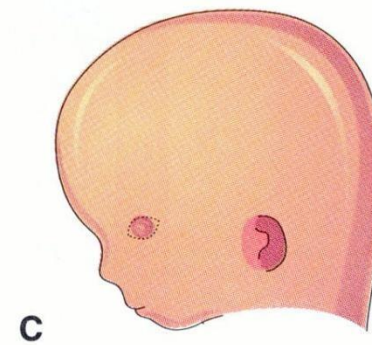
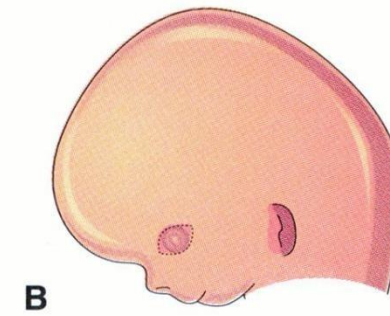
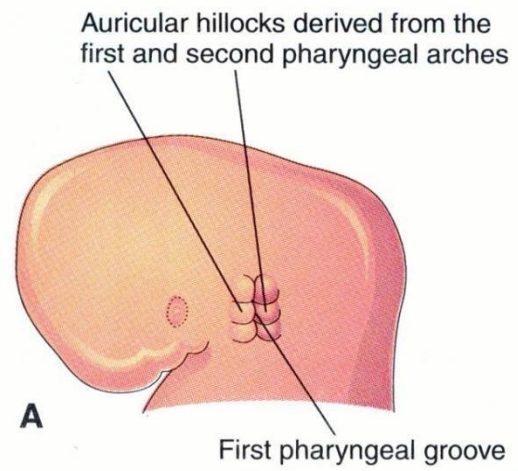
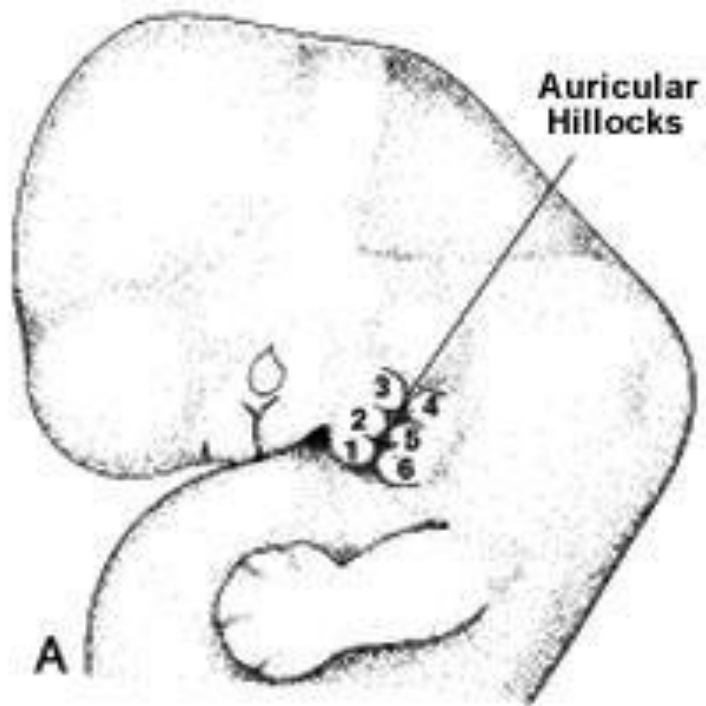




of the inner, middle, and outer ears arise in



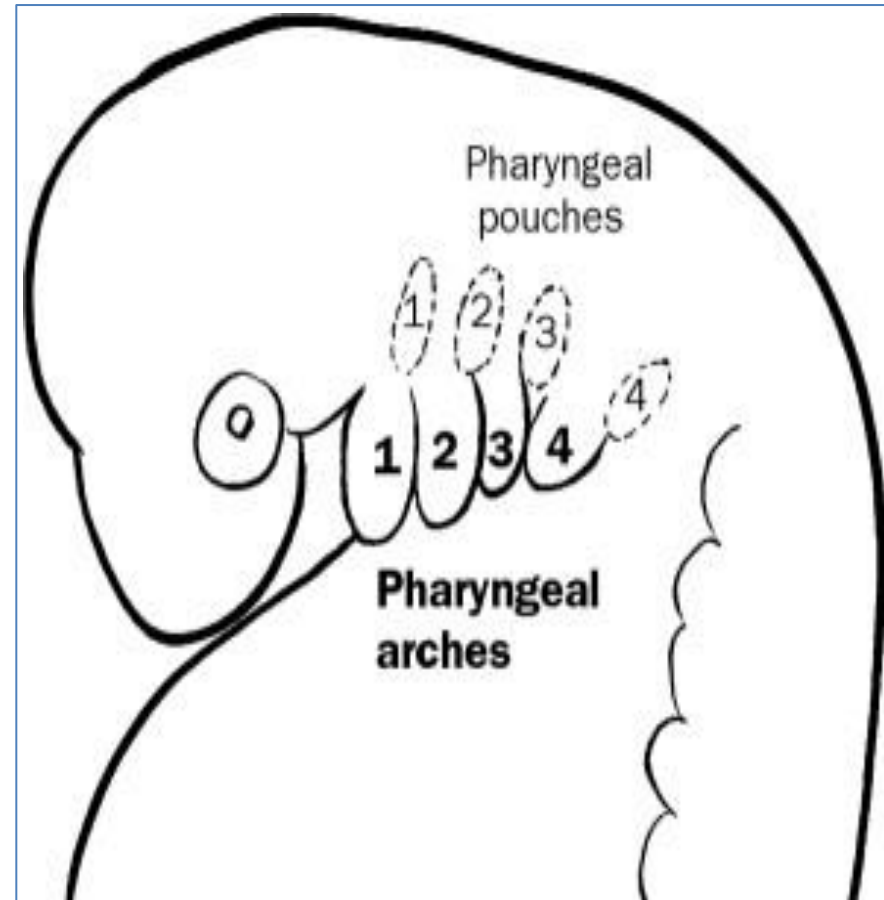




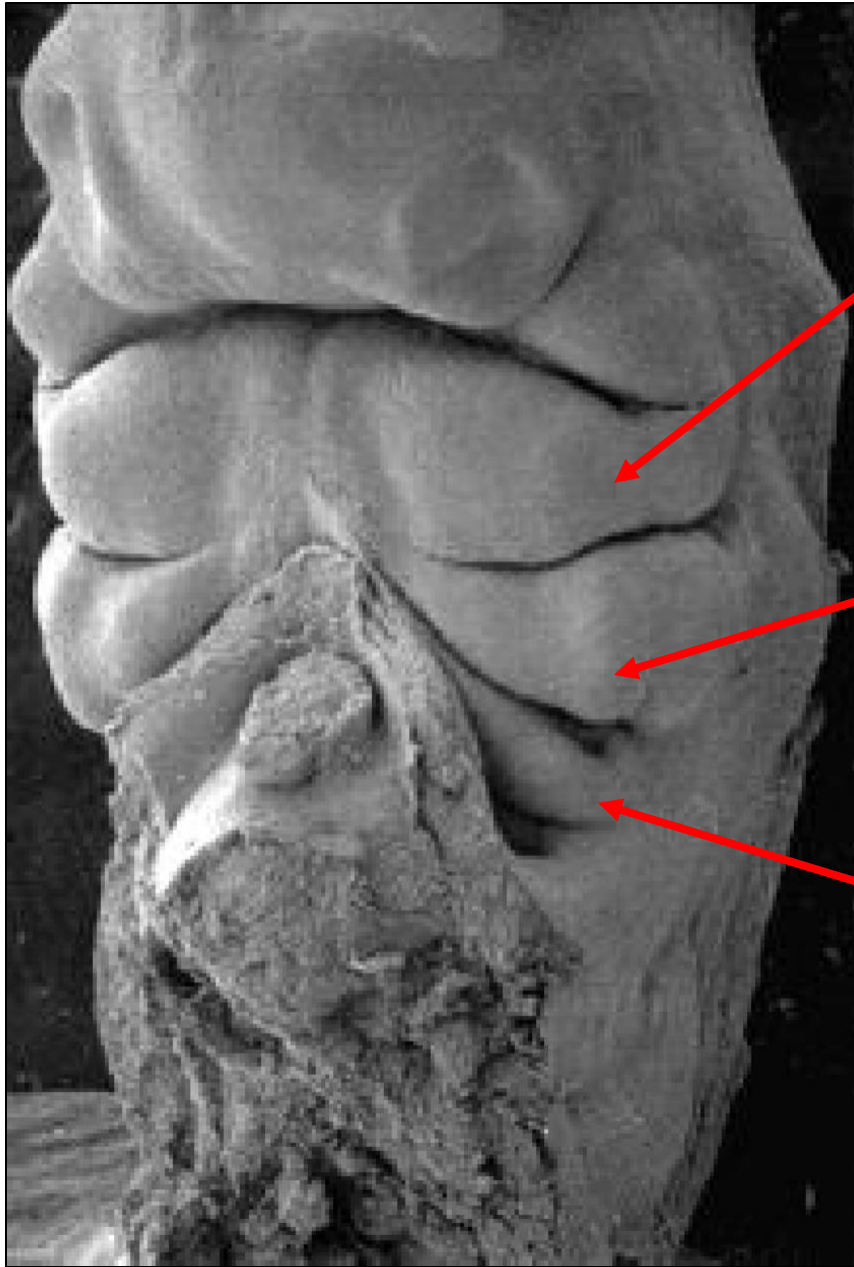
# **PHARYNGEAL SYSTEM**

# Pharyngeal system

- The pharyngeal system is an embryonic structure that is created in the area of the future face and neck at the beginning of the fourth week of development.
- It consists of five pairs of mutually parallel, cylindrical tissue thickenings that surround the front and sides of the beginning of the pharynx and are called pharyngeal arches.
- Pairs of pharyngeal arches indicate
- with ordinal numbers - I, II, III, IV, and VI.
- In humans, the fifth pair is very poorly developed or completely missing.



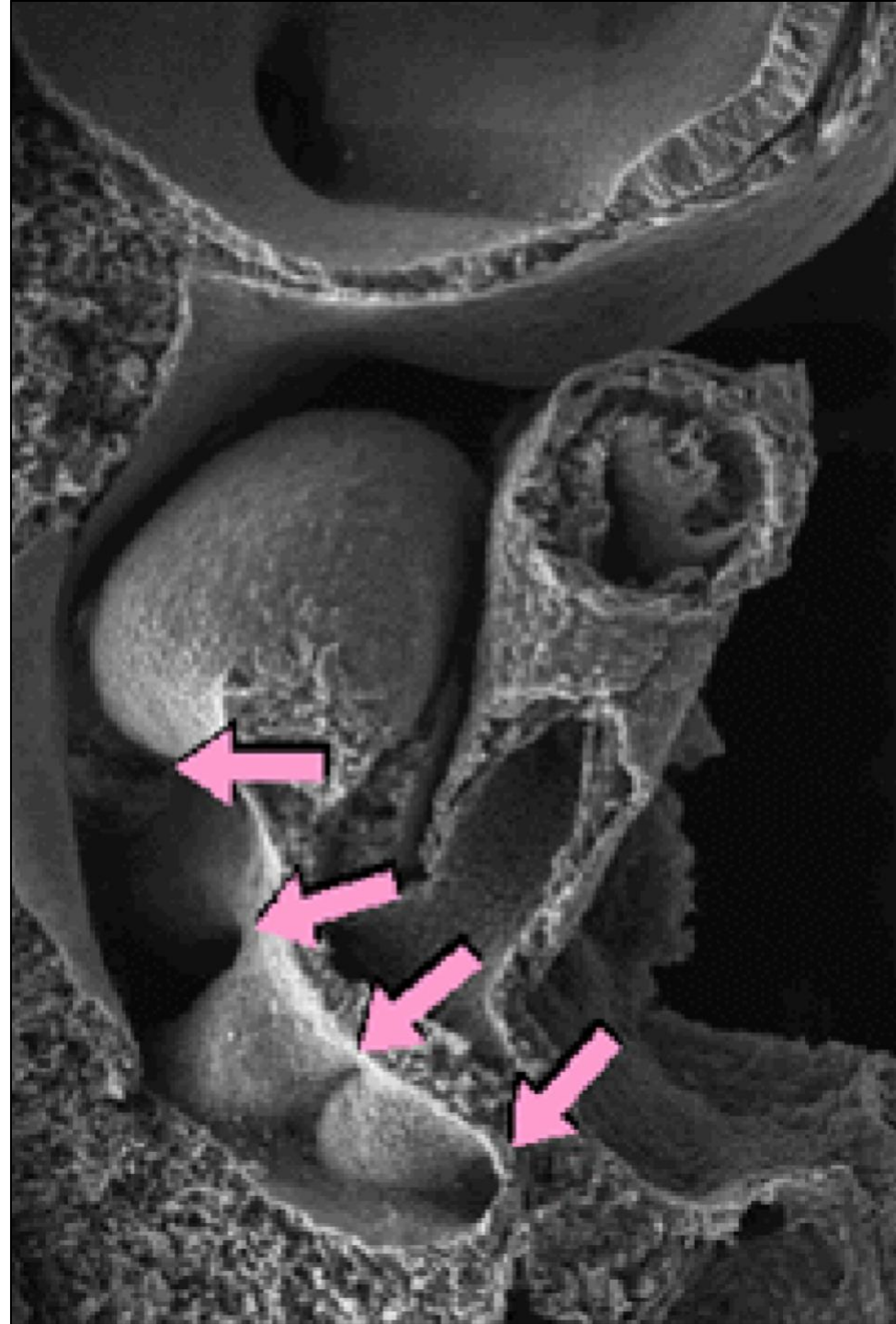


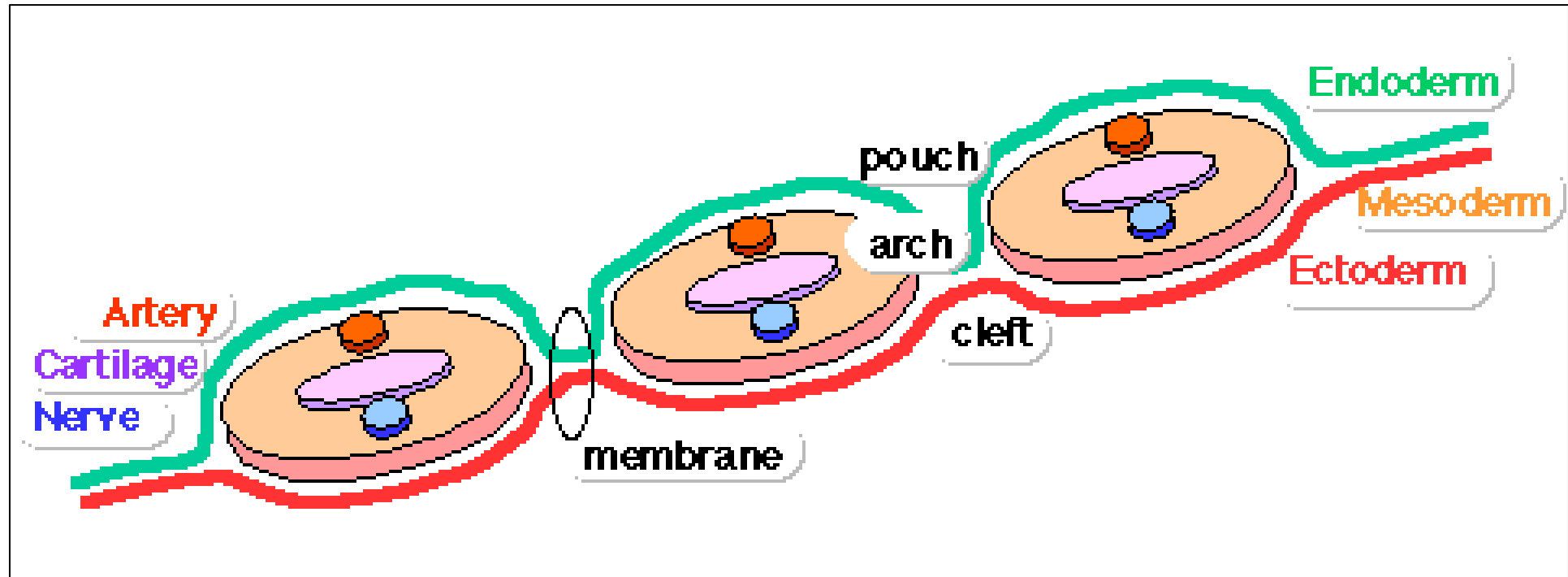


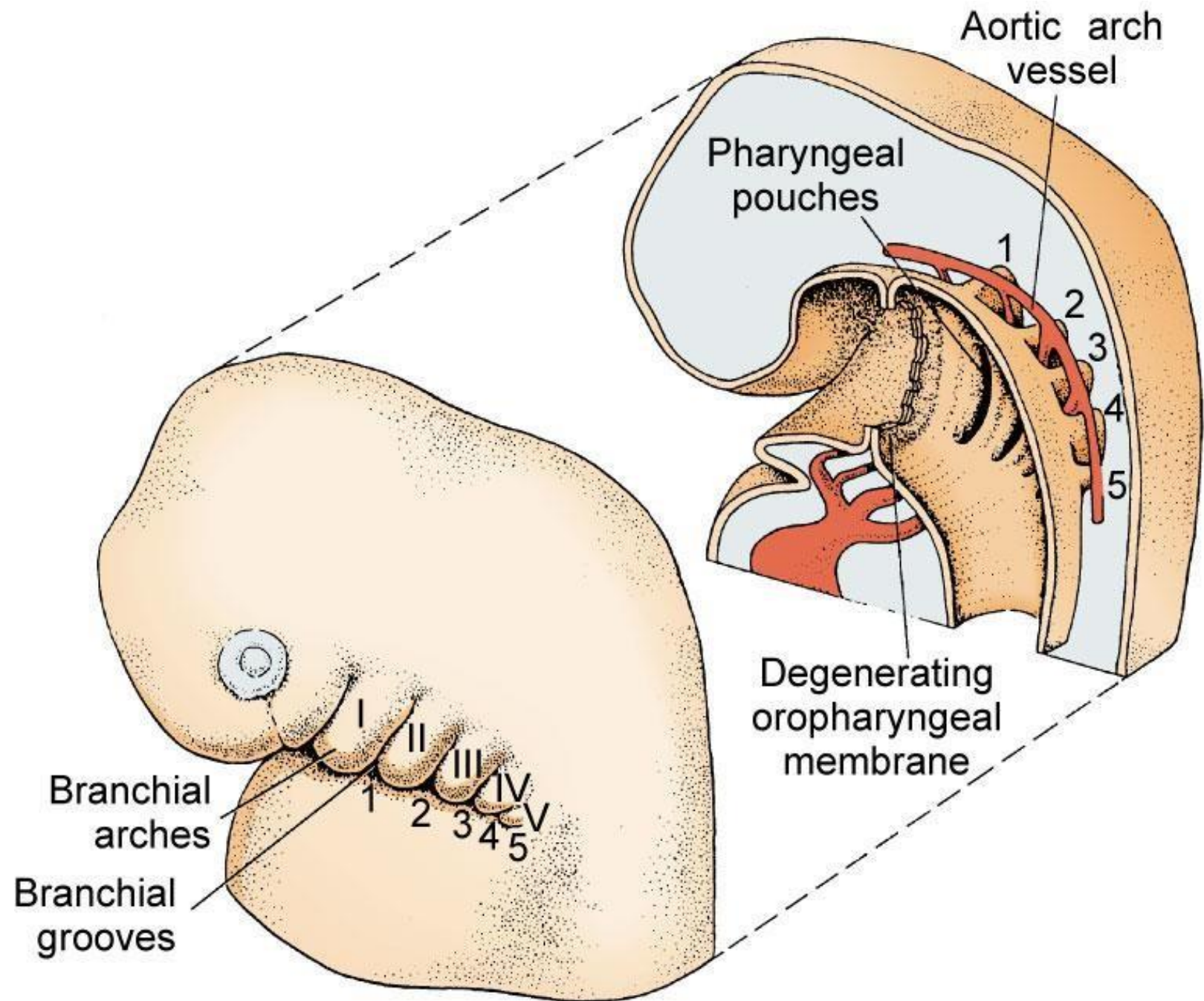
**First pharyngeal arch**  
**(maxillary and mandibular process)**

**Second pharyngeal arch**  
**(hyoid process)**

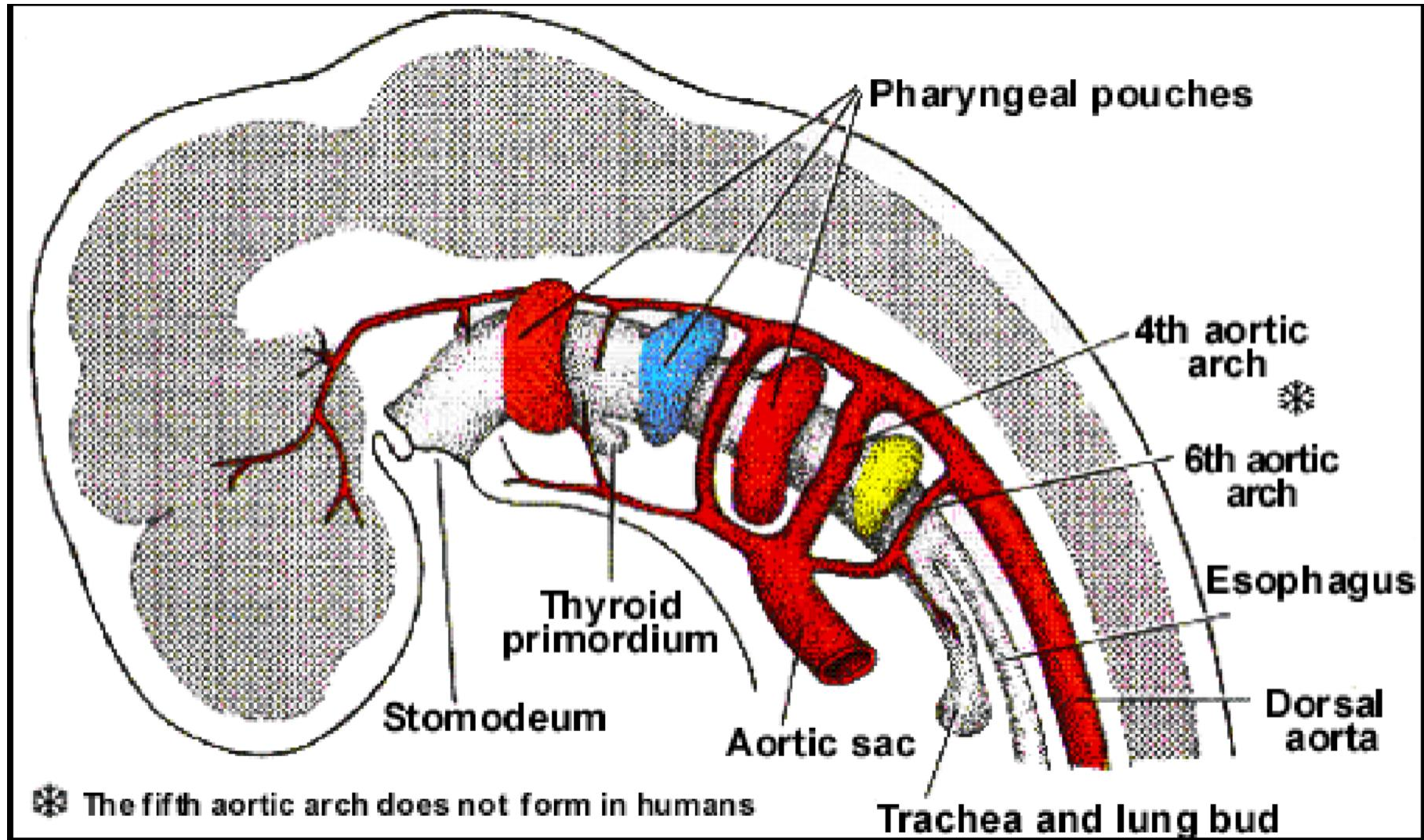
**Third pharyngeal arch**









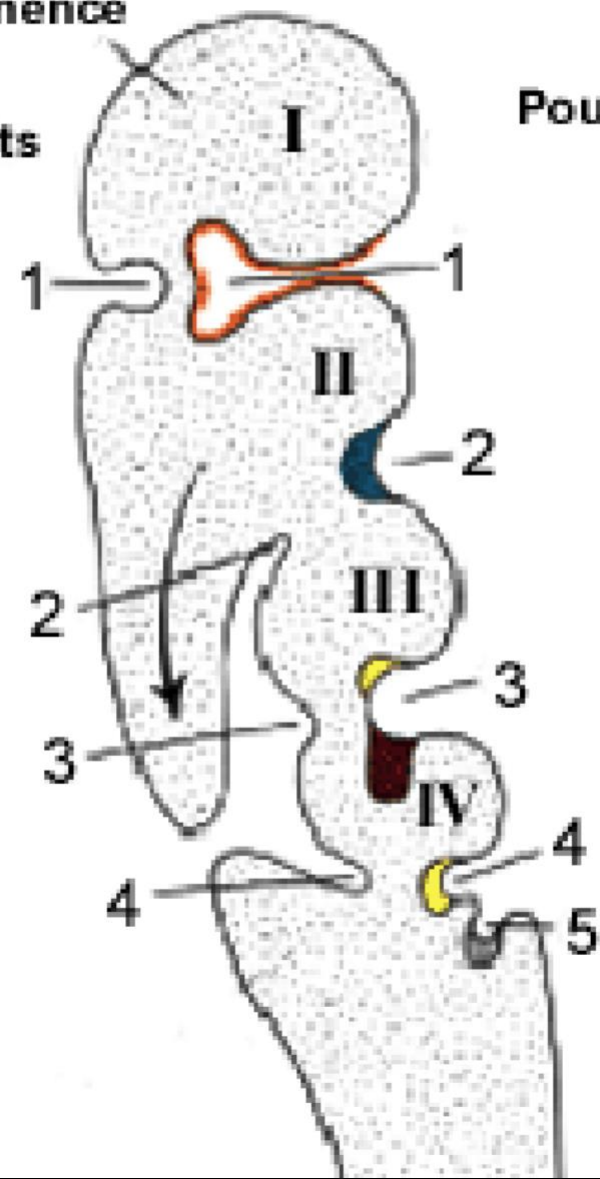


Maxillary Prominence

Mandibular Prominence

Clefts

Pouches



Ext. auditory meatus

Cervical sinus

Prim. tympanic cavity

Auditory tube

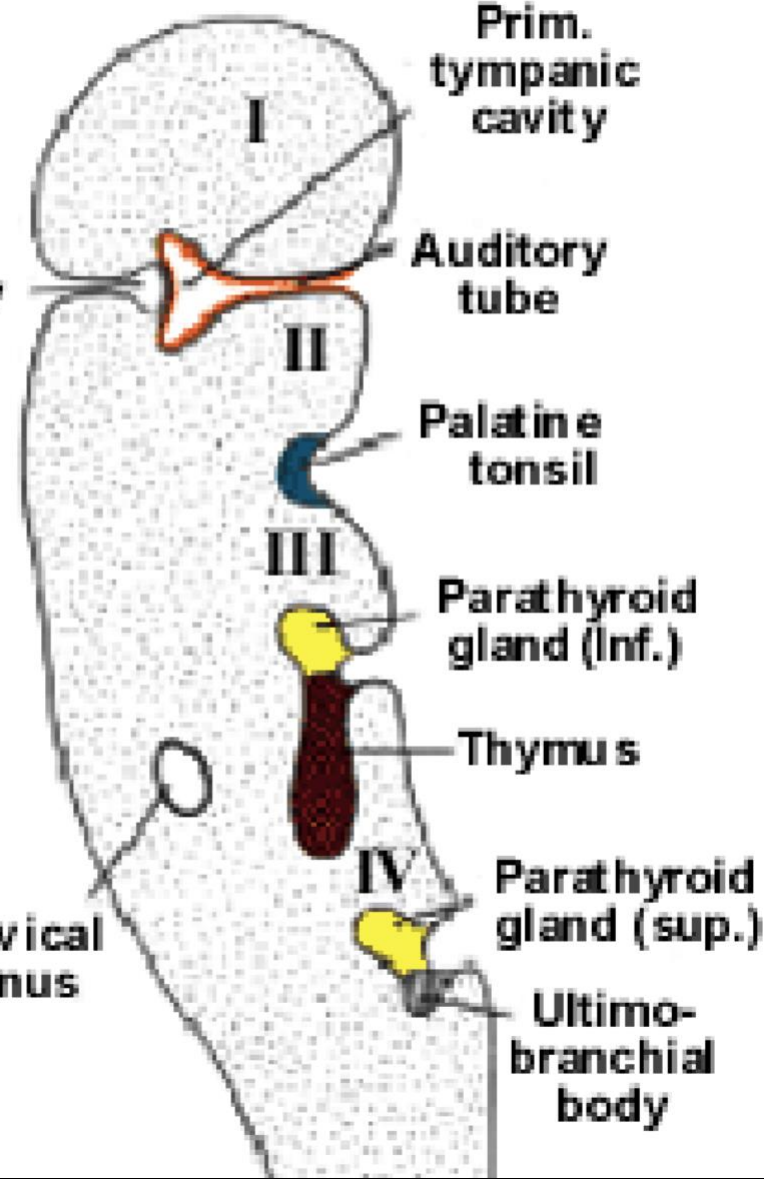
Palatine tonsil

Parathyroid gland (Inf.)

Thymus

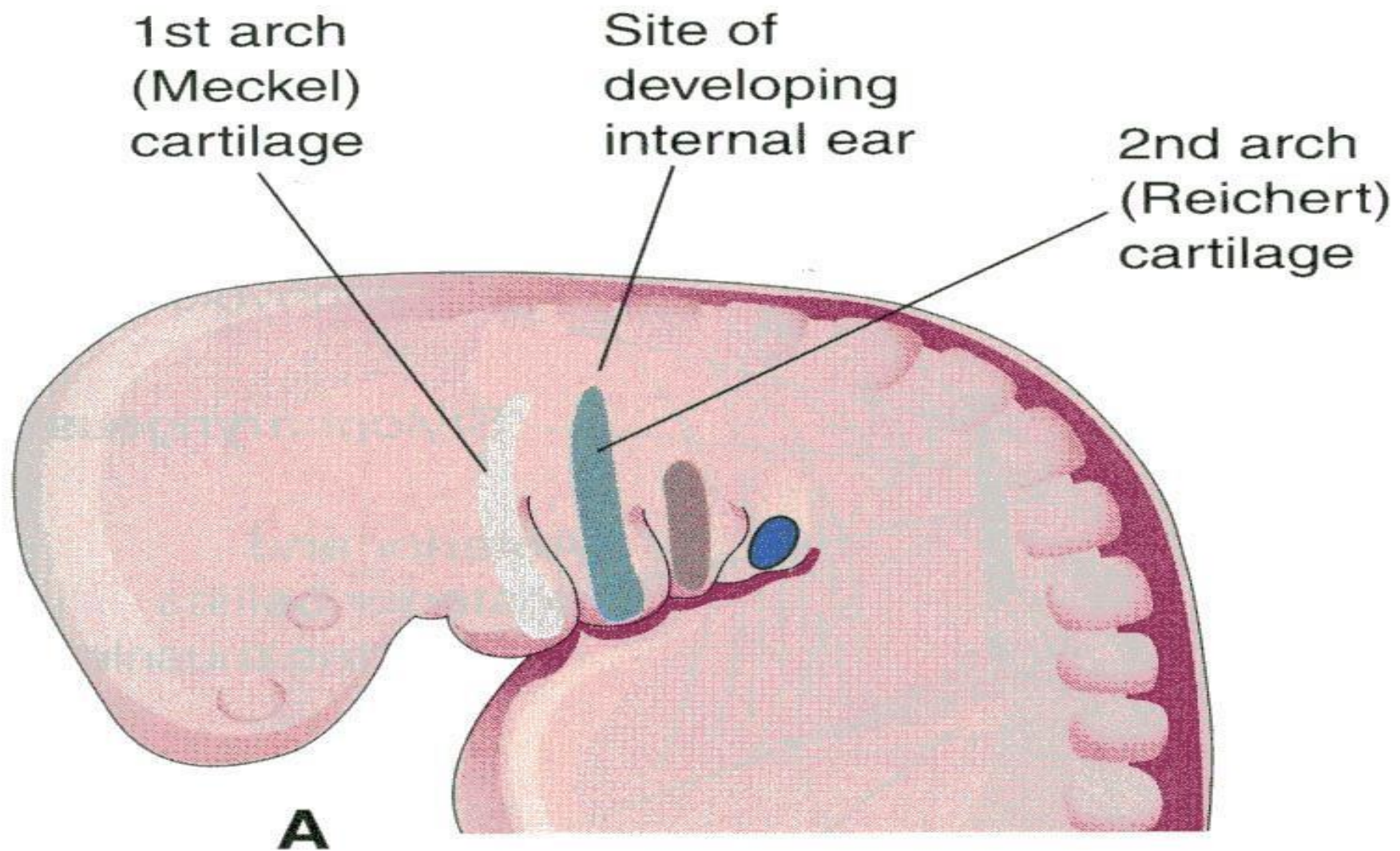
Parathyroid gland (sup.)

Ultimo-branchial body



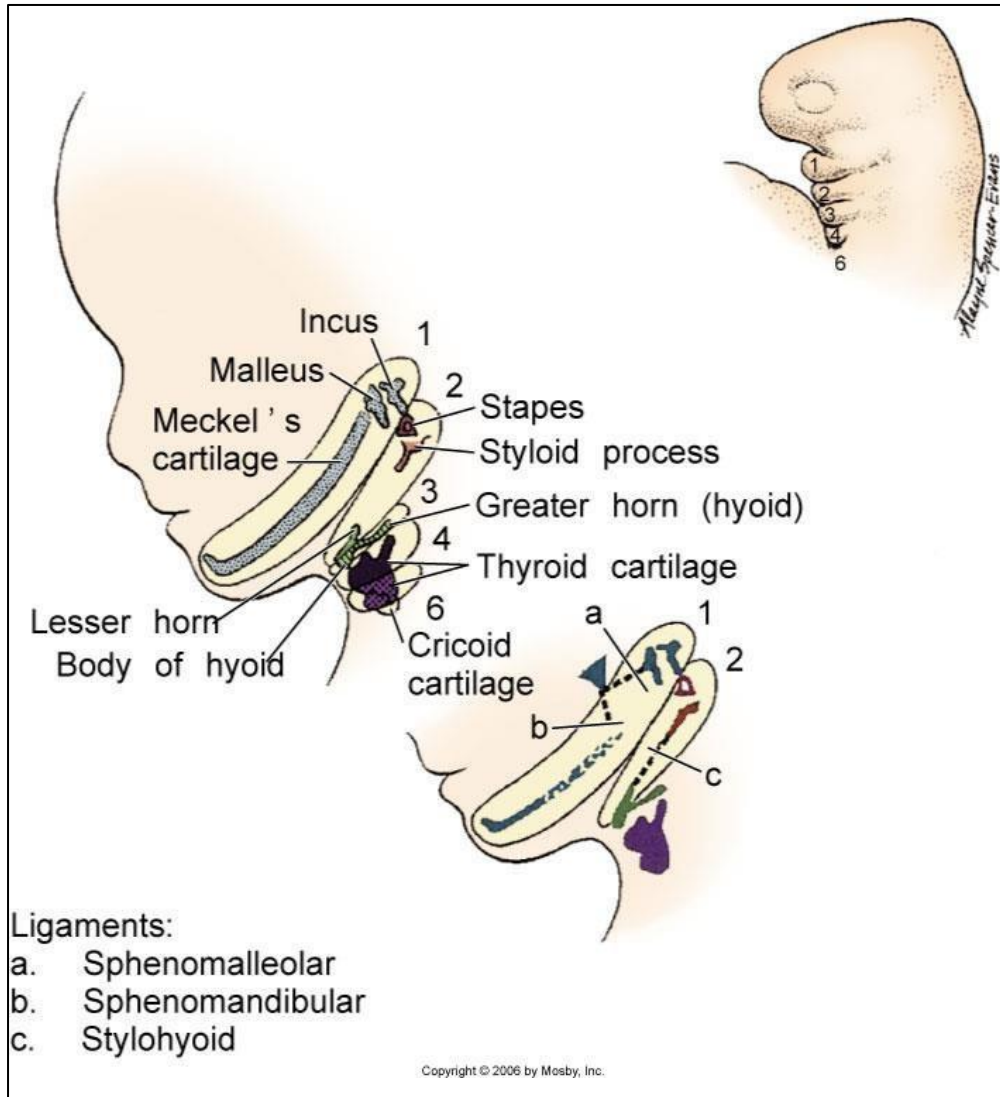


FARINGEALNI USECI	FARINGEALNI LUKOVI				FARINGEALNI ŠPAGOVI
	moždani živac	mišići	komponente skeleta	aortni lukovi	
spoljašnji ušni kanal	I	V n. trigeminus	mastikatorni, milohioideus, prednji trbuh digastrikusa, tenzor timpani, tenzor veli palatini	I	I
	II	VII n. facijalis	mimični, stapedius, stilohioideus, zadnji trbuh digastrikusa	III	III
vratna fistula	II	IX n. glosofaringeus	stilofaringeus	II	II
	III	III		III	III
	IV	X n. laringeus superior (grana n. vagusa)	krikotiroideus, levator veli palatini, konstriktori faringsa	IV	IV
	VI	X n. laringeus rekurens (grana n. vagusa)	unutrašnji mišići laringsa, skeletni mišići jednjaka	V	V
				VI	VI
					srednje uvo auditivna tuba
					nepčani krajnik
					timus, donje paratireoidne žlezde
					gomje paratireoidne žlezde
					ultimobranijalno telo

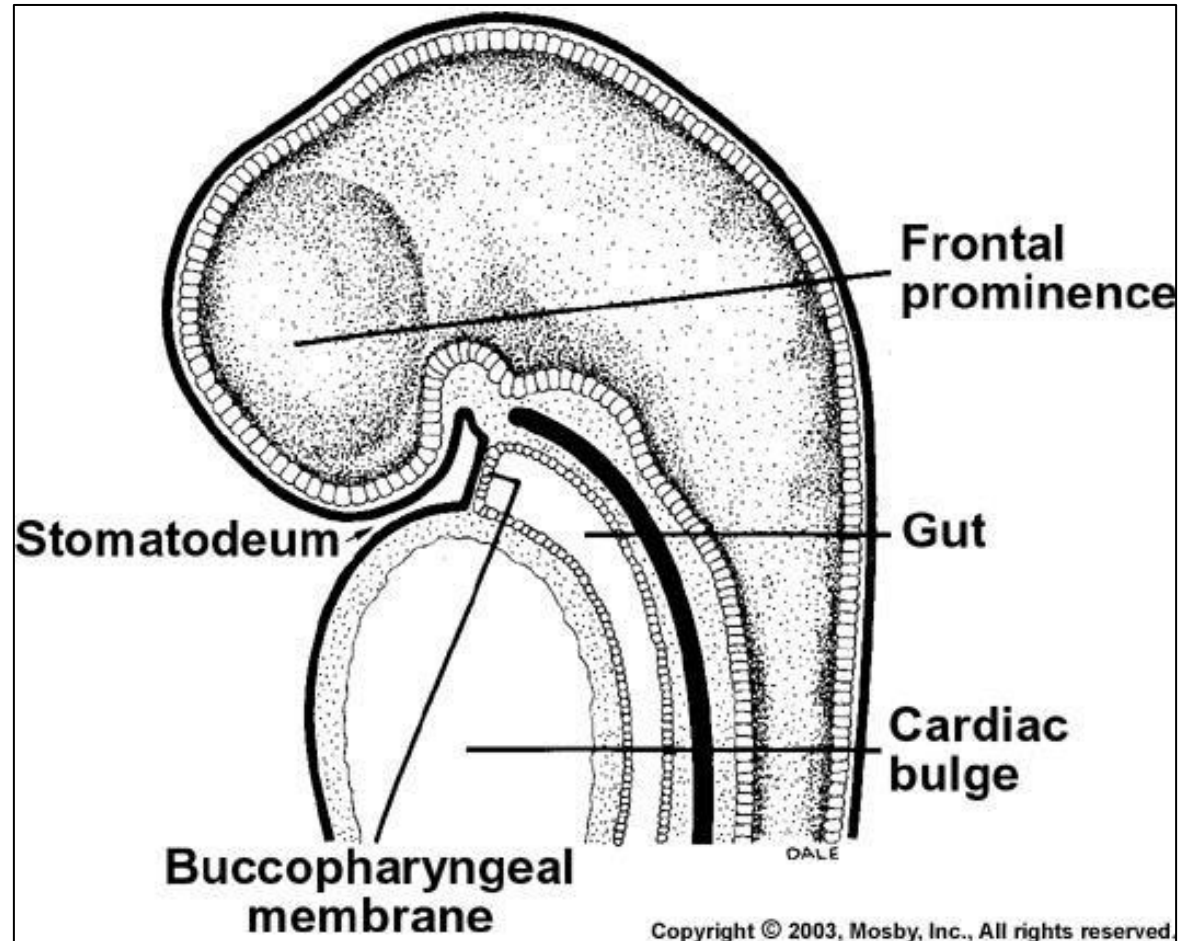


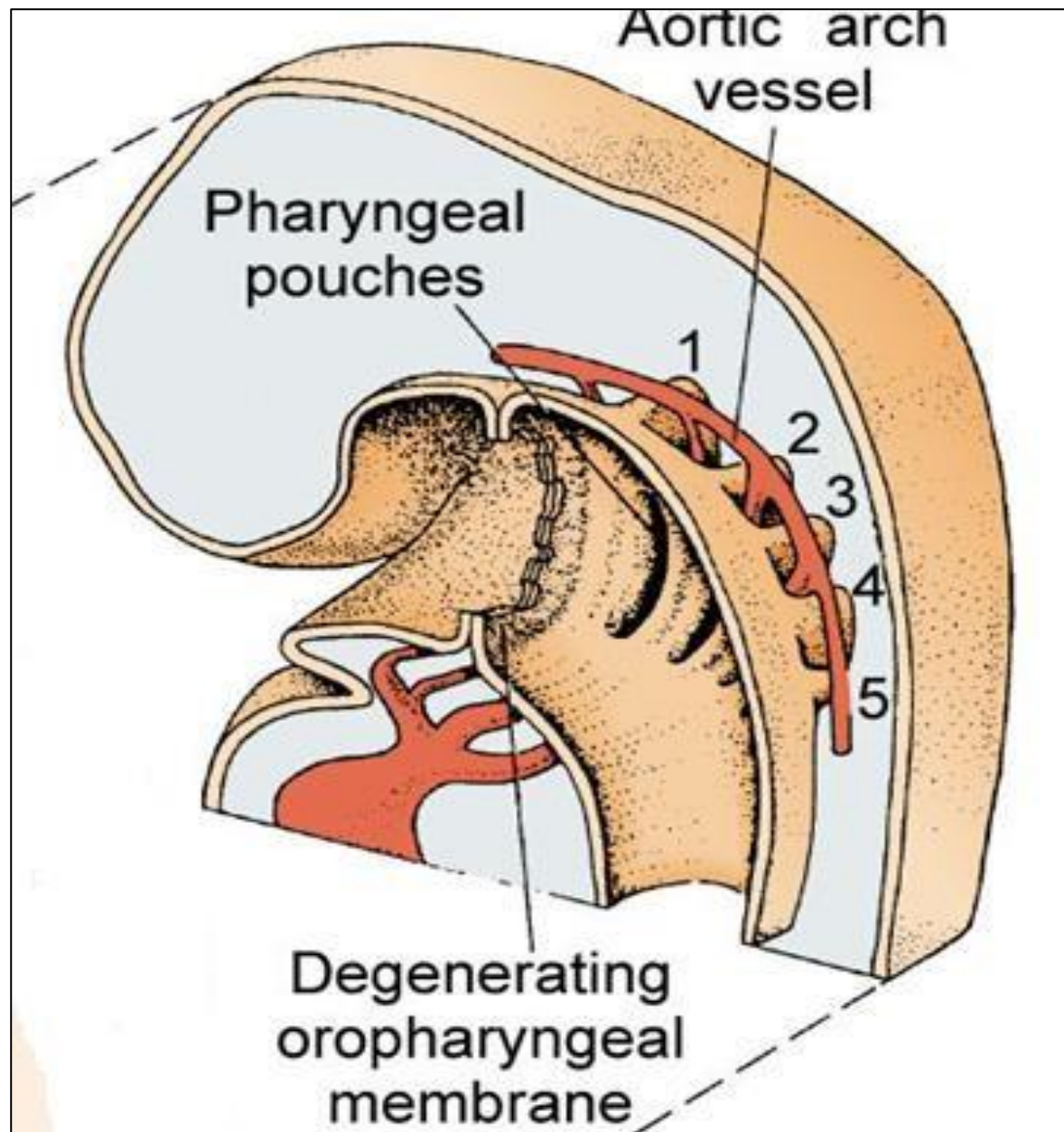
Хрסקавице фарингеалних лукова





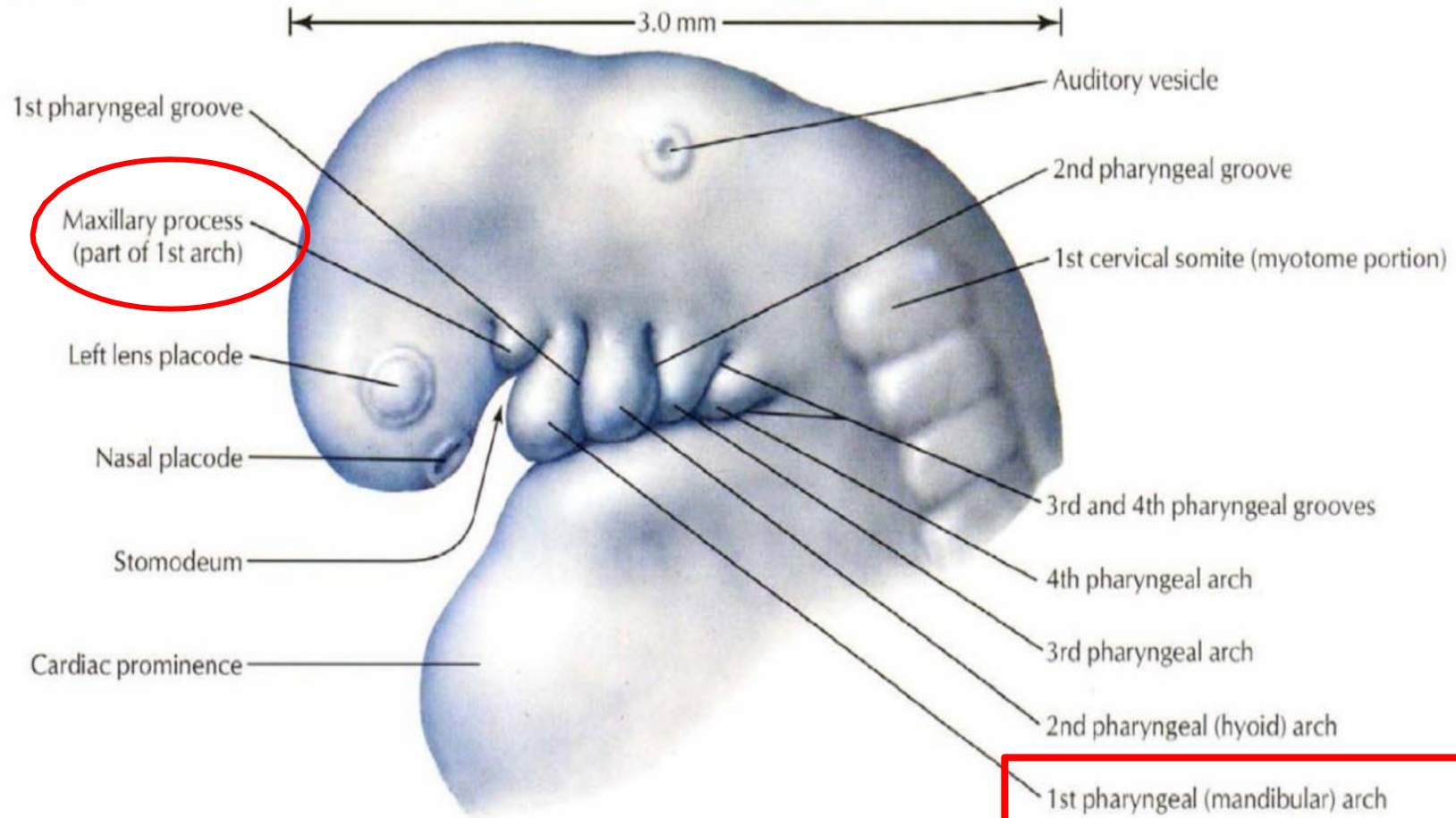
# Development of the oral cavity



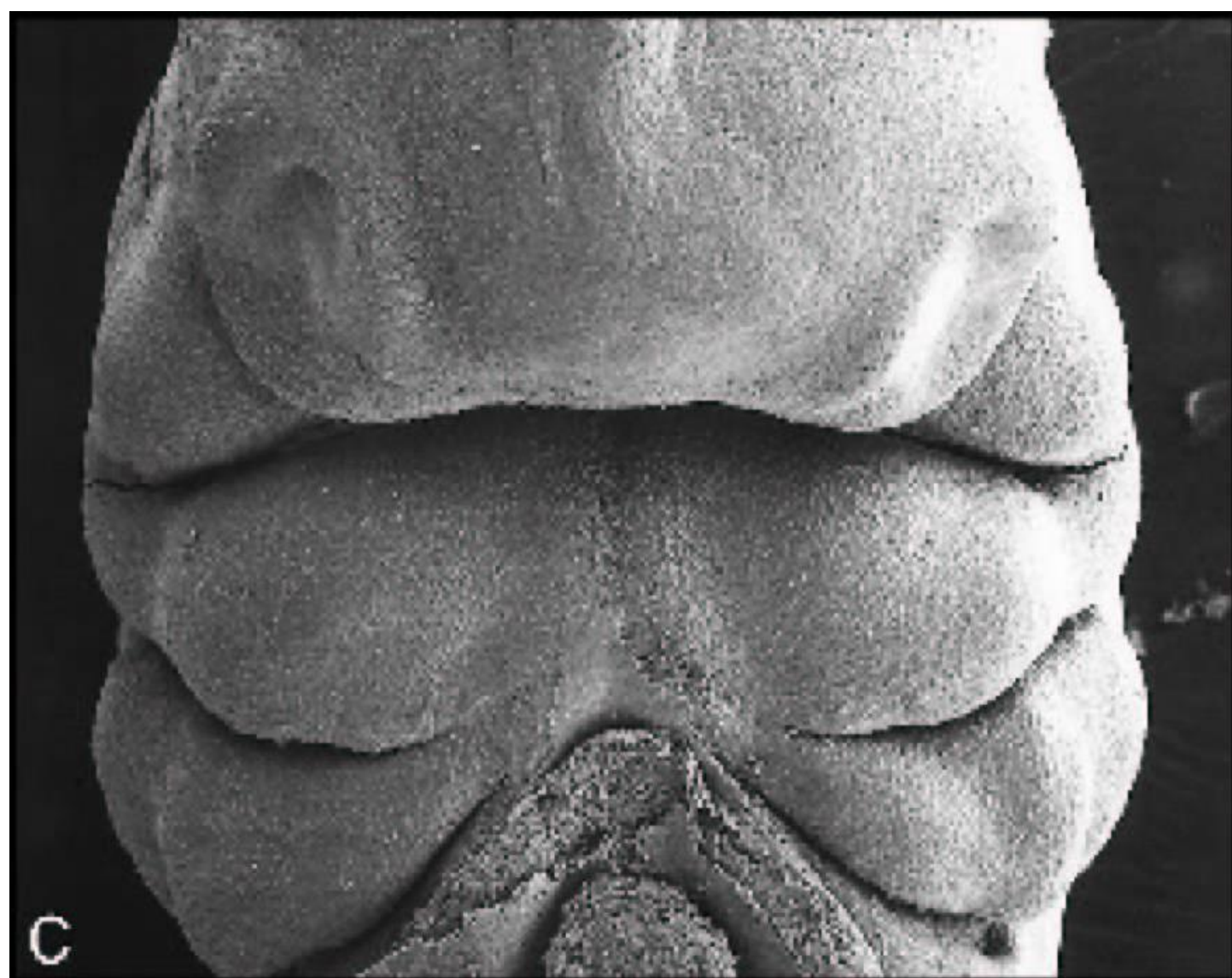


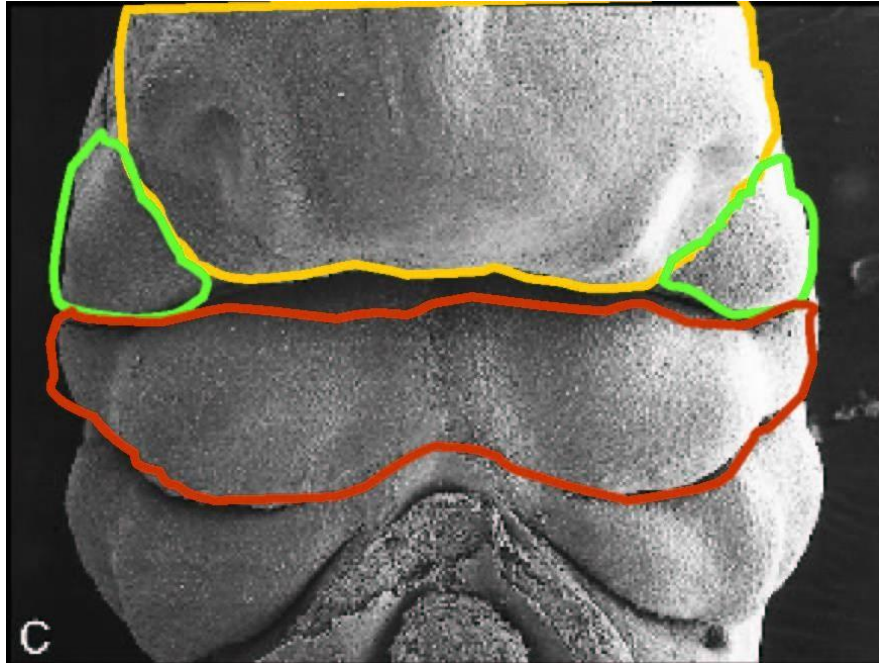
Embryo at 4 to 5 weeks

Lateral view

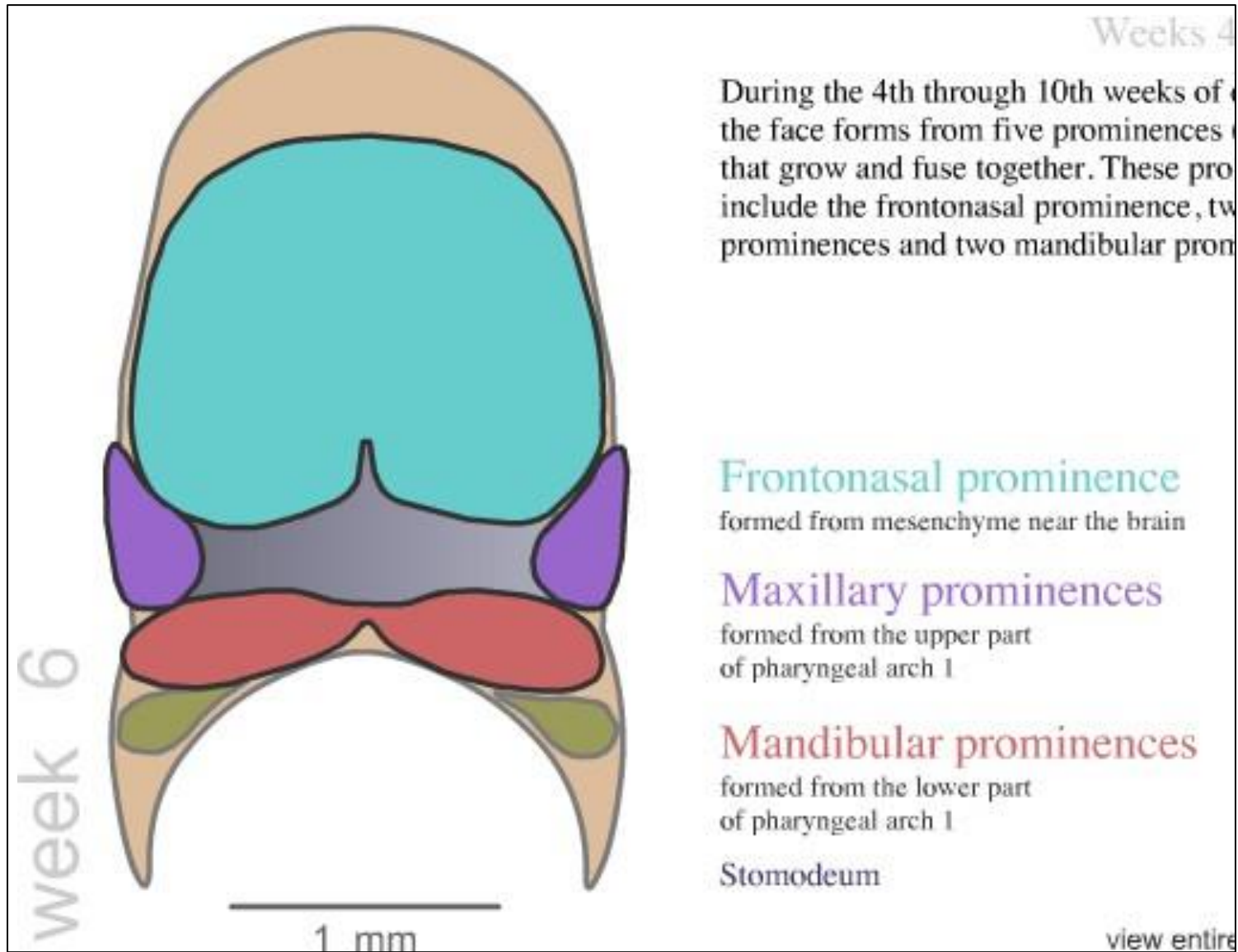




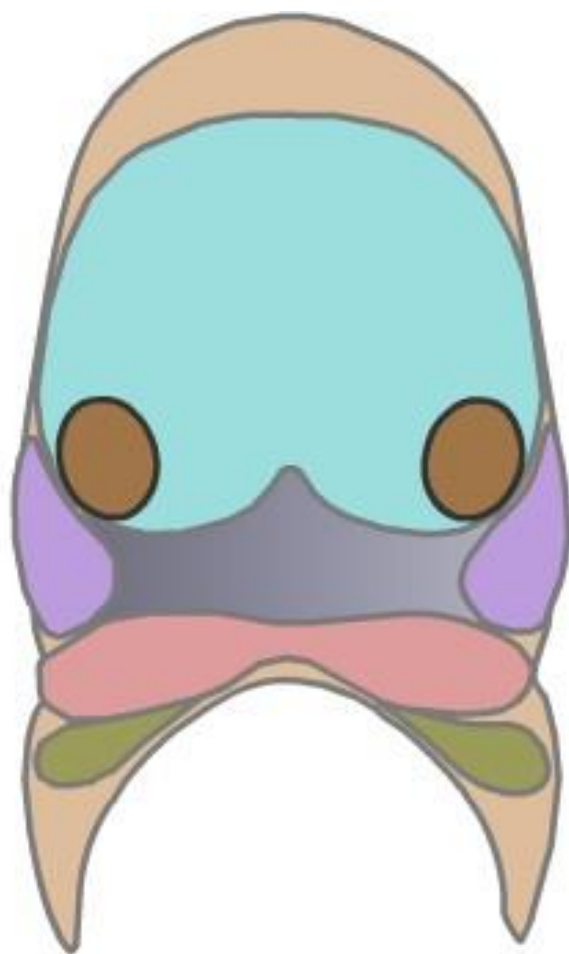




Frontonasal  
prominence  
Maxillary  
prominence  
Mandibular  
prominence



week 6



1 mm

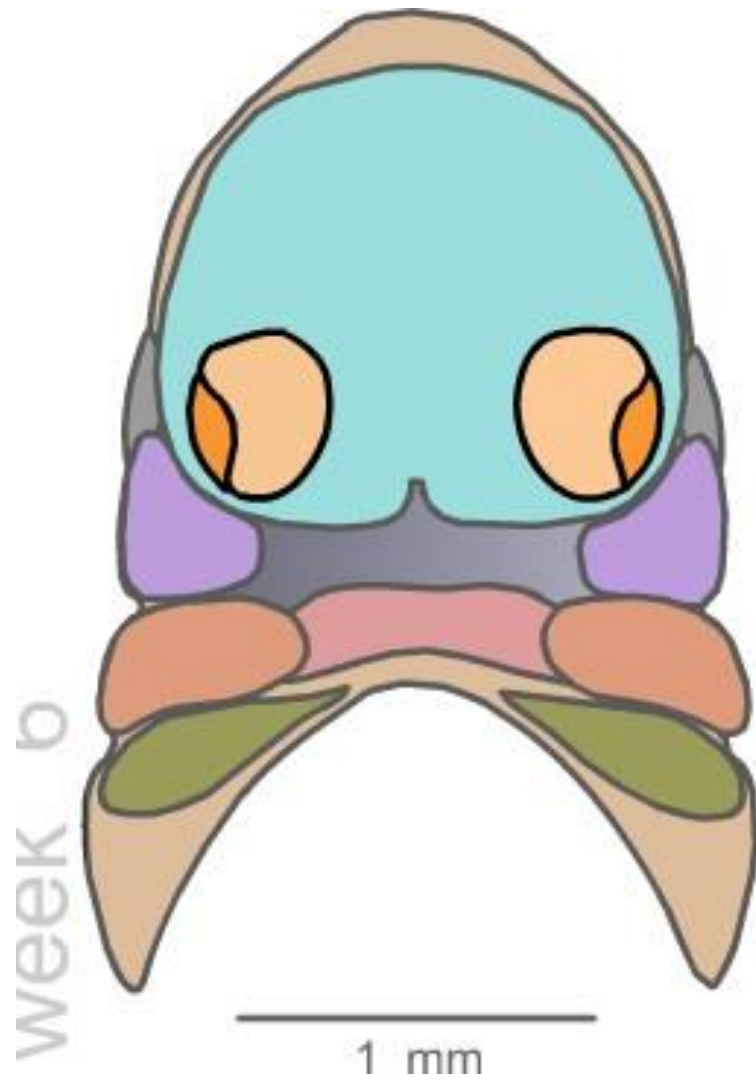
During the 5th week, the frontonasal prominence develops two thickenings near its lateral margins, the nasal placodes.

Frontonasal prominence

Nasal placodes

view ei





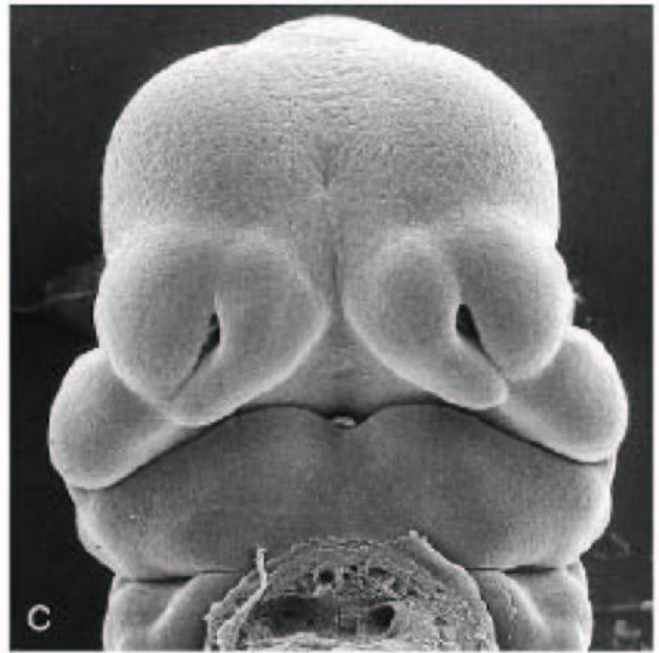
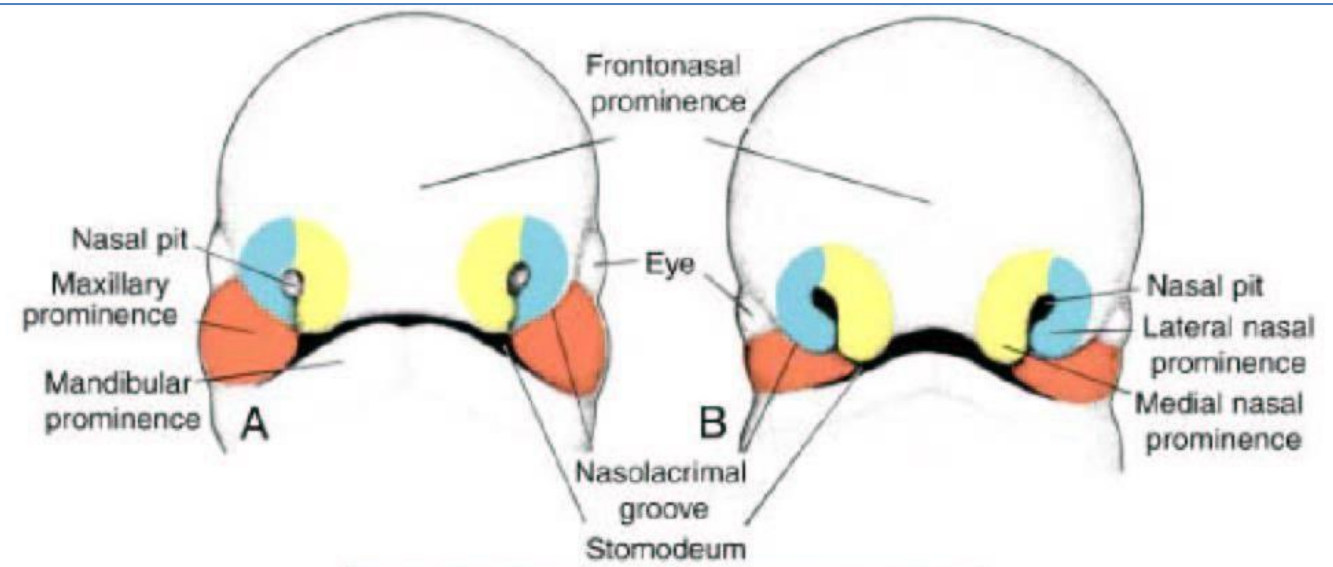
The rest of the nasal placode may be seen as a lateral nasal process (prominence) at the sides of the nasal process (prominence).

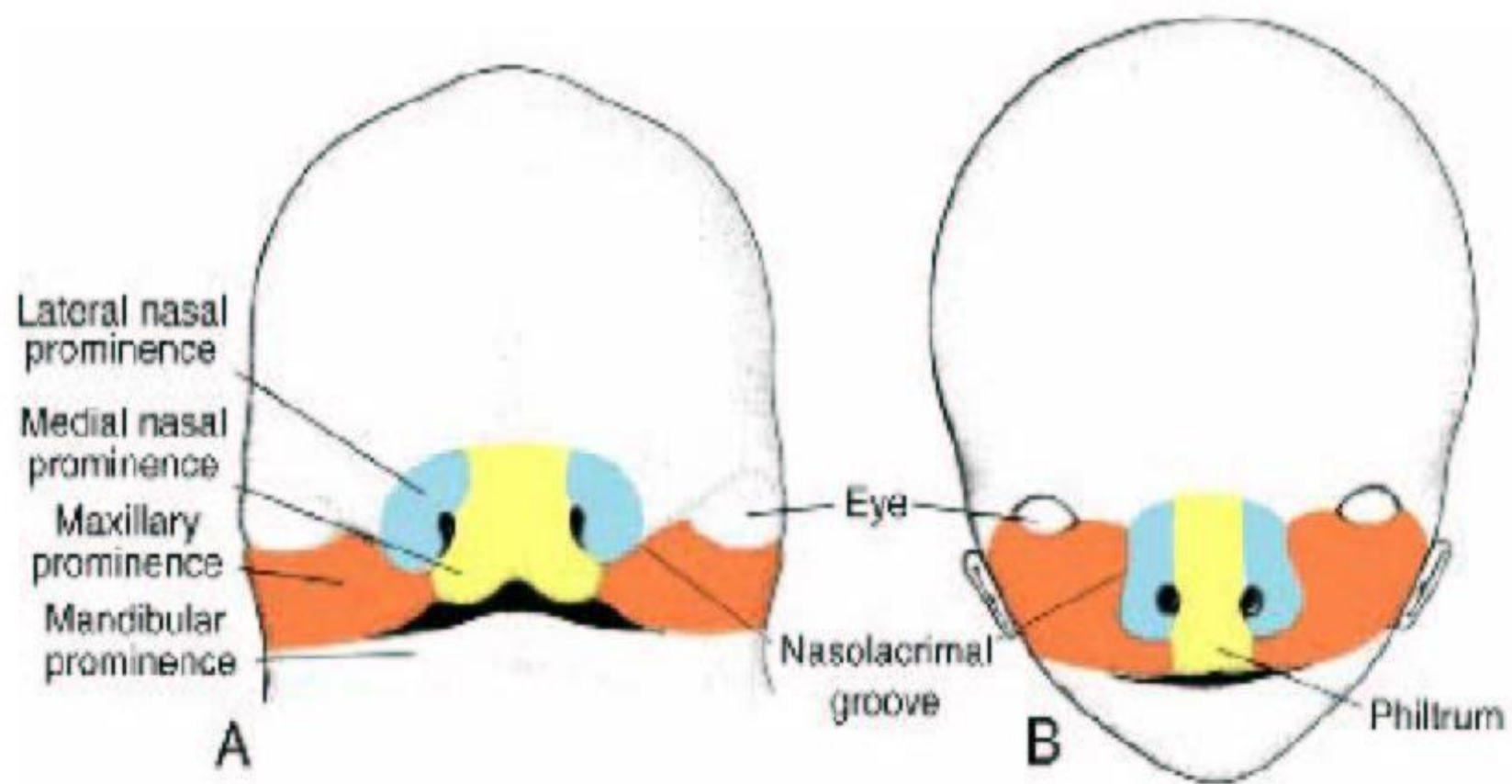
Medial nasal processes

Lateral nasal processes

Maxillary prominences

view entire



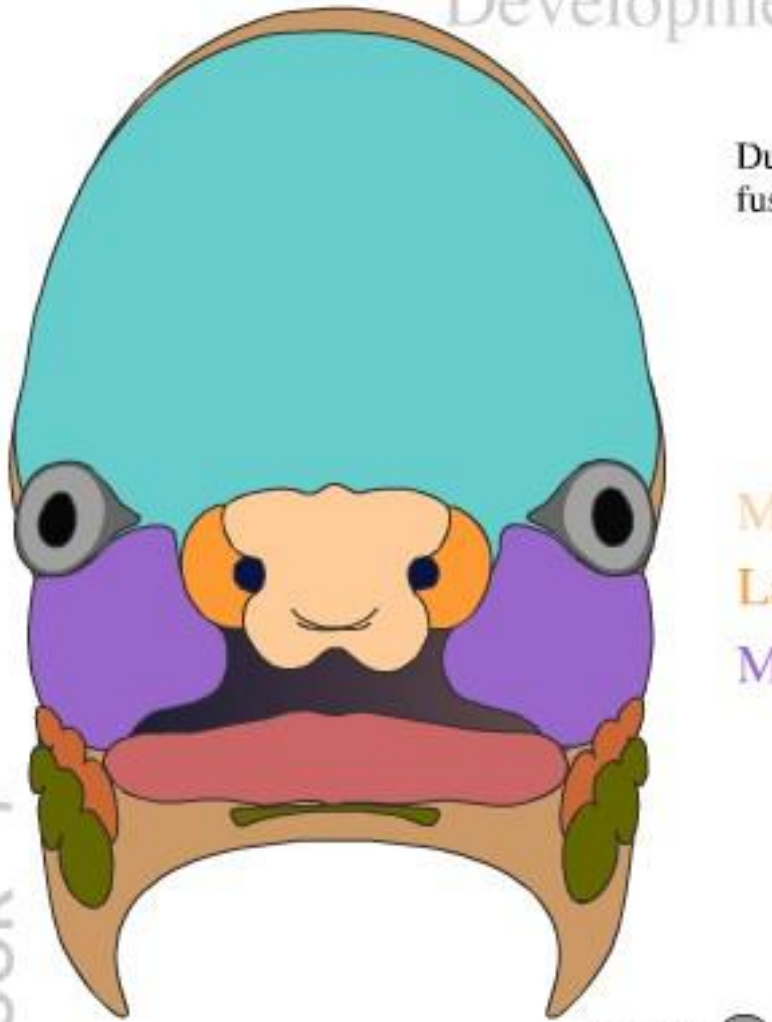


# Development of the Face a

Week

During the 7th week, the two medi  
fuse to form the intermaxillary seg

week 7



1 mm

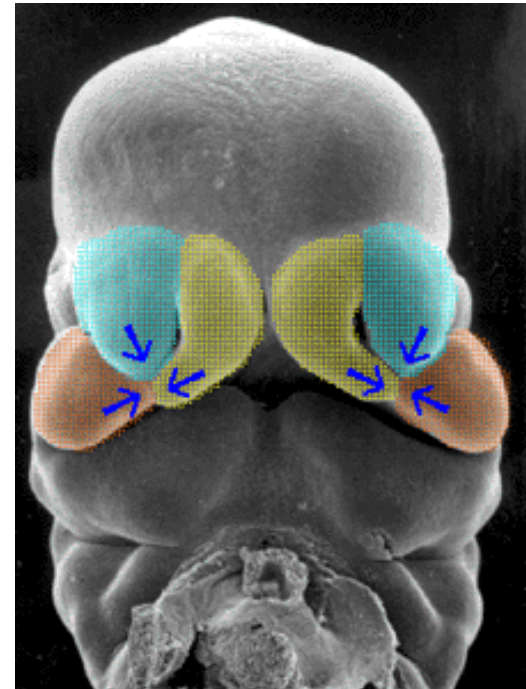
repeat

Medial nasal processes

Lateral nasal processes

Maxillary prominences

view e



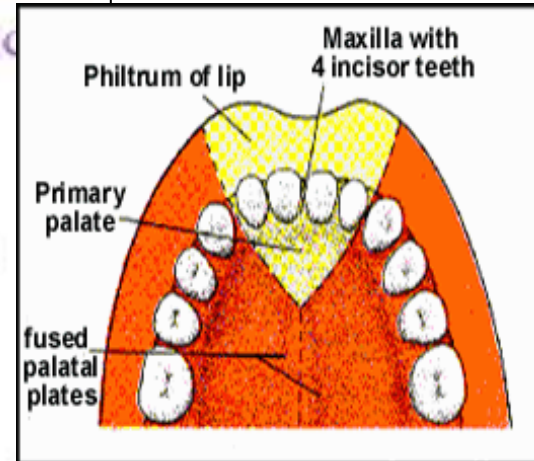




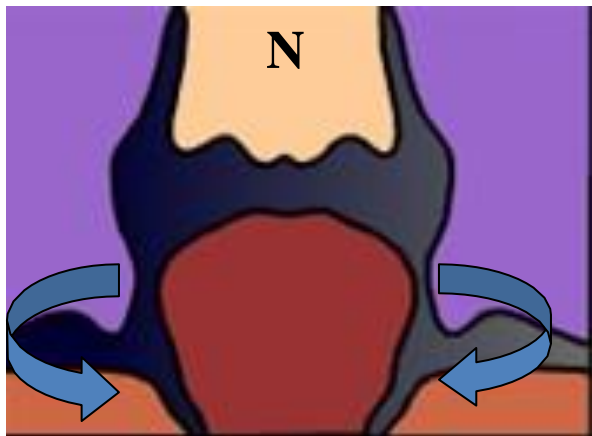
1 mm

Intermaxillary segment  
Lateral nasal processes  
Maxillary prominences

W  
C



view 4



PAPILA INCISIVUM

