Biology 224
Human Anatomy and Physiology - II
Week 1; Lecture 1; Monday
Dr. Stuart S. Sumida

Review of Early Development of Humans

Special Senses

Review:

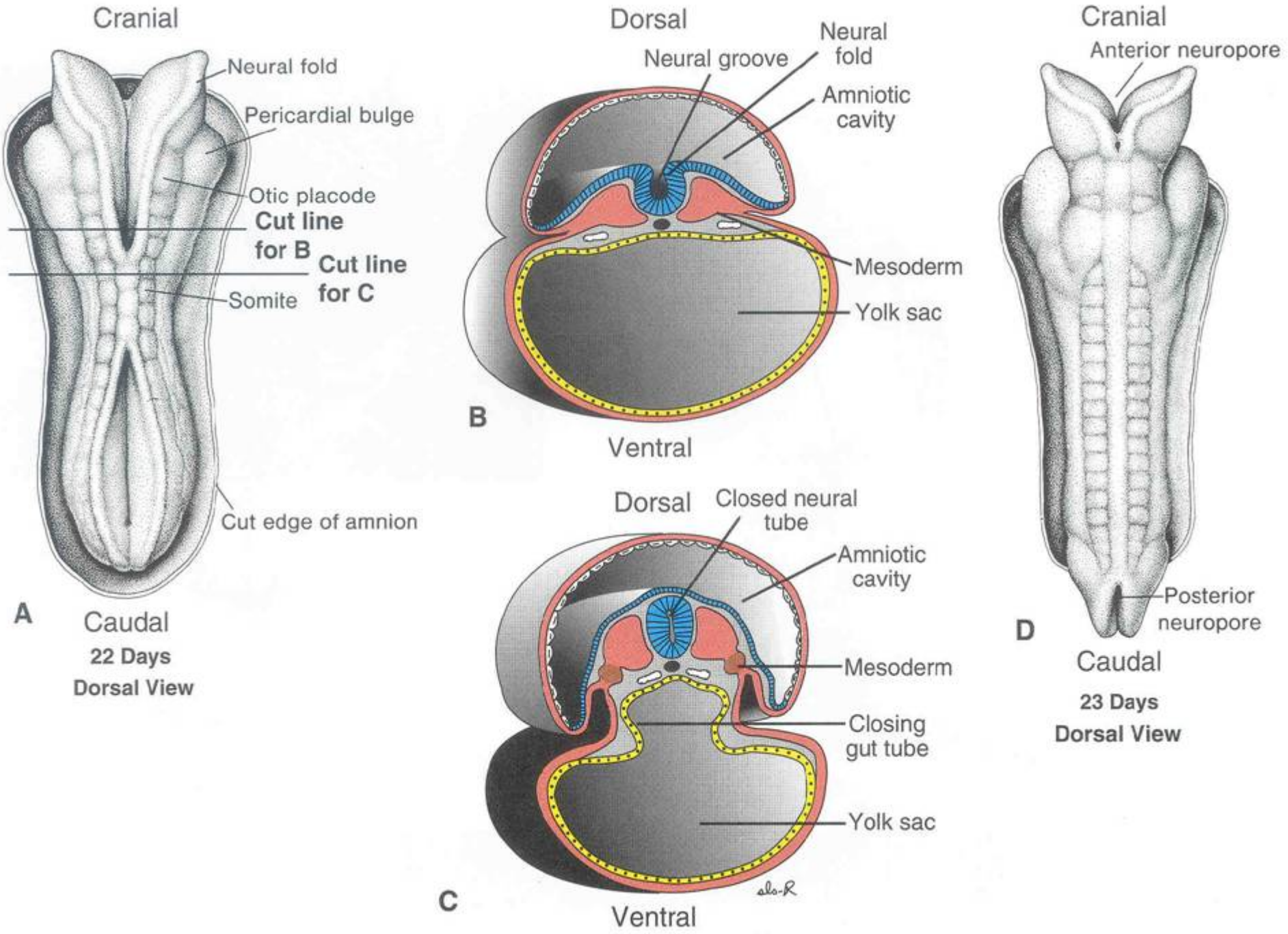
Historical and Developmental Perspectives

Ontogeny

Early embryological development

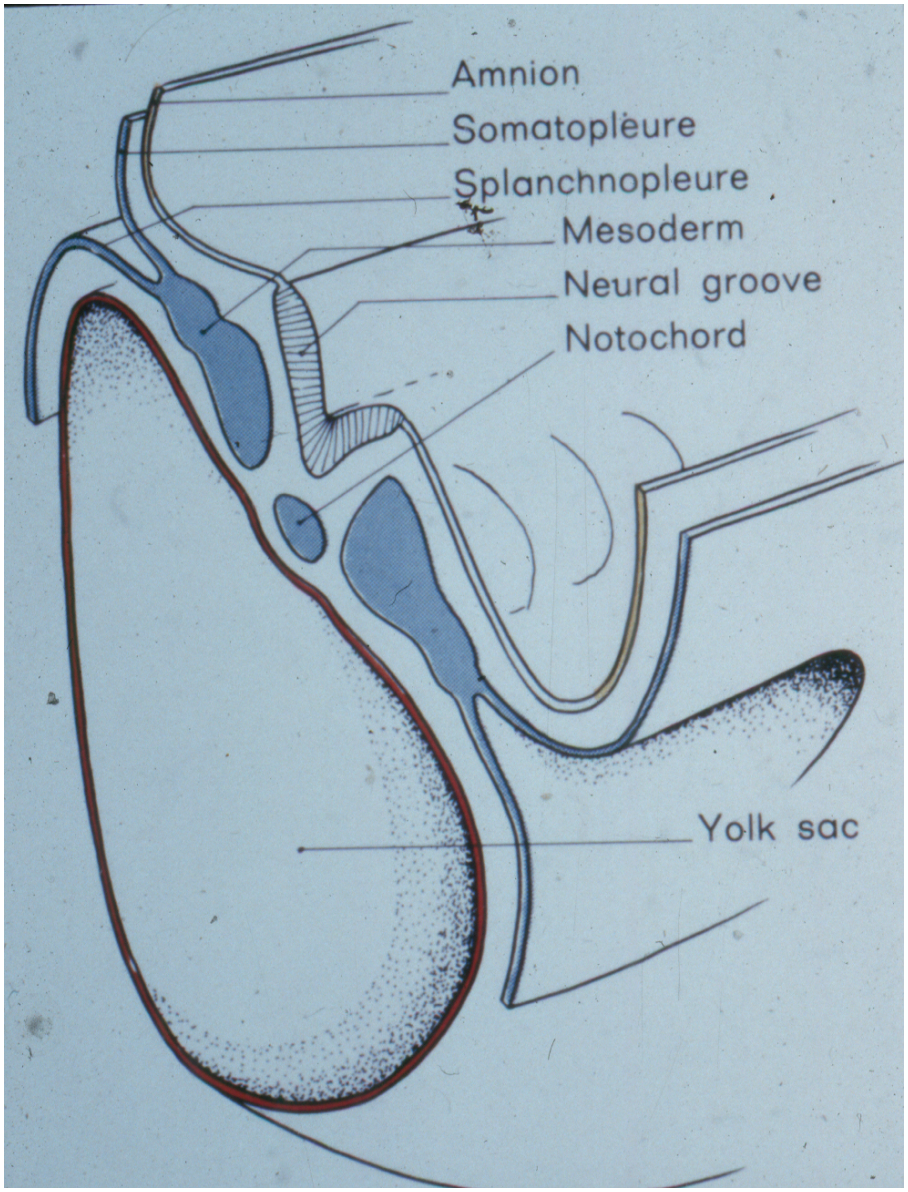
Cross-section of the body

Chordate features – dorsal hollow nerve cord, notochord, gut tube, certain blood vessels, muscle blocks, and coelom.


Cranial
Neural fold
Pericardial bulge
Otic placode
Cut line for B
Cut line for C
Somite
Cut edge of amnion
A
Caudal
22 Days
Dorsal View
Dorsal
Neural groove
Neural fold
Amniotic cavity
Mesoderm
Yolk sac
B
Ventral
Dorsal
Closed neural tube
Amniotic cavity
Mesoderm
Closing gut tube
Yolk sac
C
Ventral
Cranial
Anterior neuropore
Posterior neuropore
D
Caudal
23 Days
Dorsal View

Concurrent events:

Neural folds to
Neural Groove

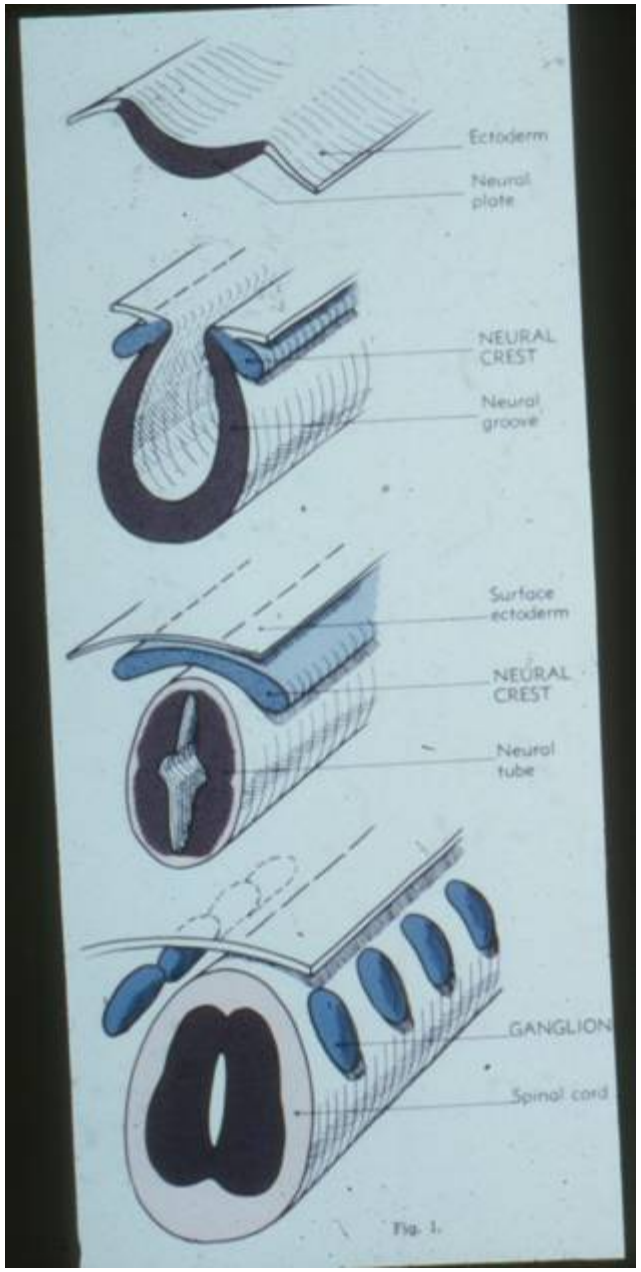


Mesodermal structures

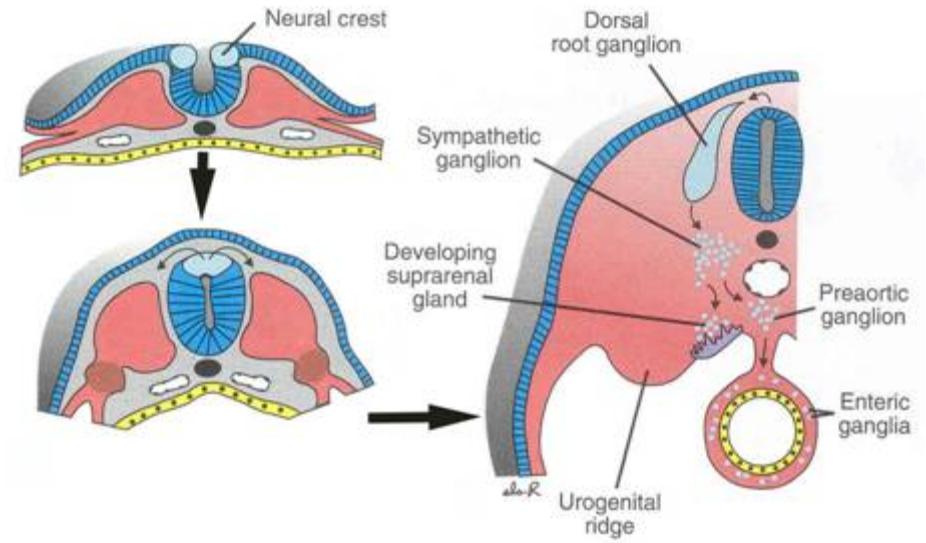
- Paraxial mesoderm
- Lateral mesoderm
- Intermediate mesoderm
- Somites
  - Segmental structures - how many in the head, neck, thorax, abdomen, pelvis, and in what remains of the tail. What is the total number of of segments in the body?

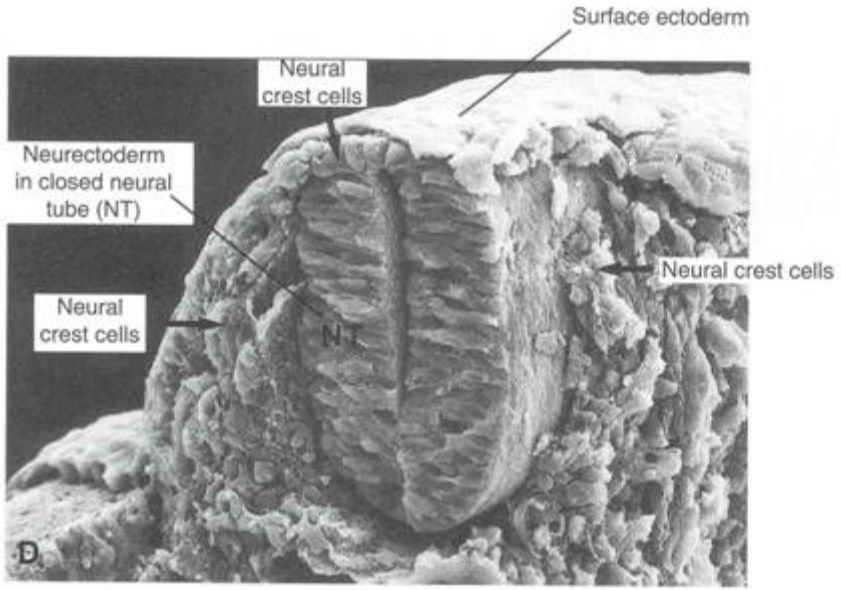
Early Development Continued:

- Dorsal hollow nerve tube
- Neural crest
- Further differentiation of the mesoderm



Neural Crest Development


Neural crest
Dorsal root ganglion
Sympathetic ganglion
Developing suprarenal gland
Preaortic ganglion
Enteric ganglia
Urogenital ridge


Surface ectoderm
Neural crest cells
Neurectoderm in closed neural tube (NT)
Neural crest cells
Neural crest cells
NT
D

23 Days

Structures Visible in the Basic Cross-Section of the Body (Embryo or Adult!)

- Coelom
- Somatopleure
- Splanchnopleure
- Parietal Peritoneum
- Visceral Peritoneum
- Dorsal mesentery
- Ventral mesentery

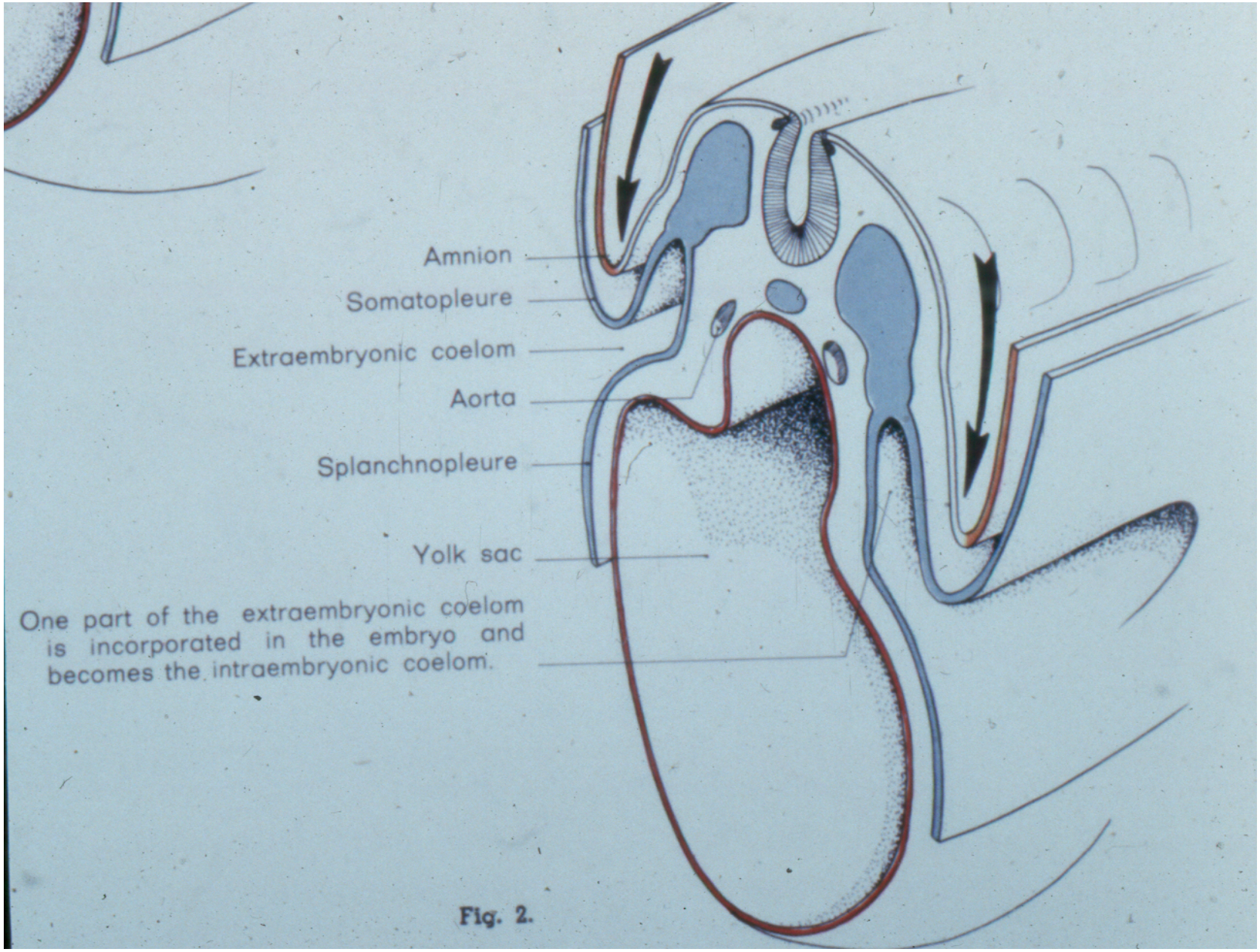
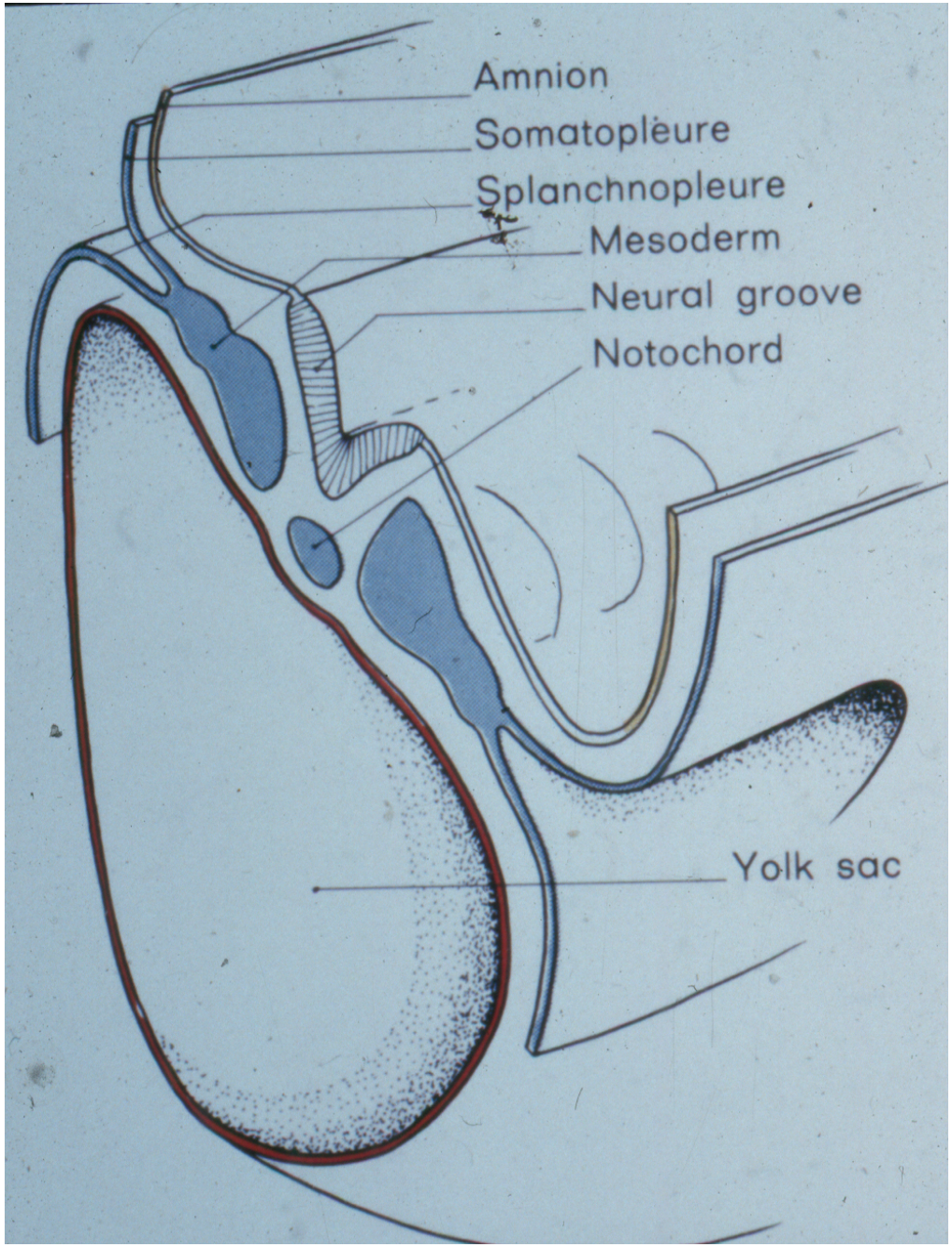

Amnion
Somatopleure
Extraembryonic coelom
Aorta
Splanchnopleure
Yolk sac
One part of the extraembryonic coelom is incorporated in the embryo and becomes the intraembryonic coelom.

Fig. 2.


Amnion
Somatoplèure
Splanchnopleure
Mesoderm
Neural groove
Notochord
Yolk sac

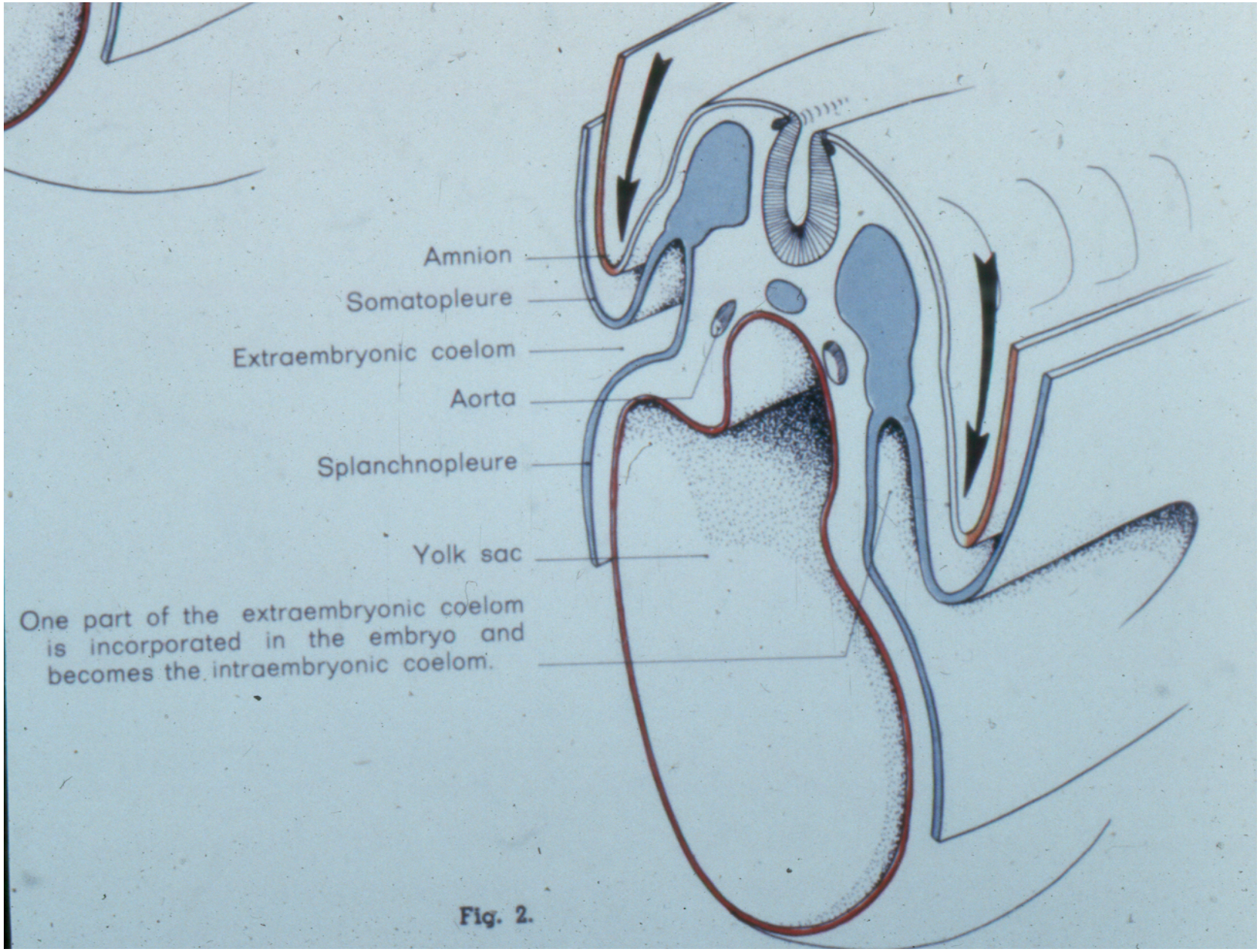

Amnion
Somatopleure
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Fig. 2.

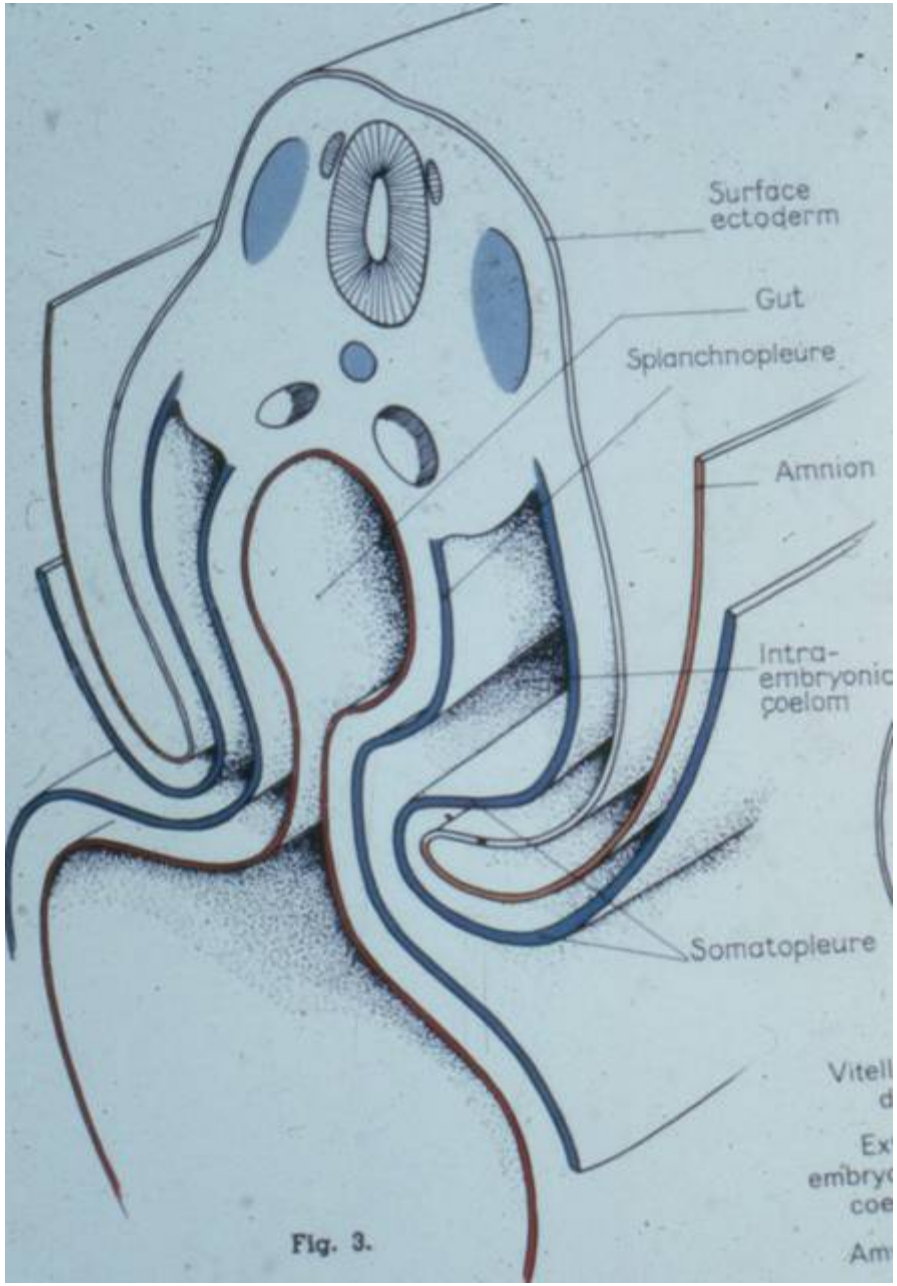
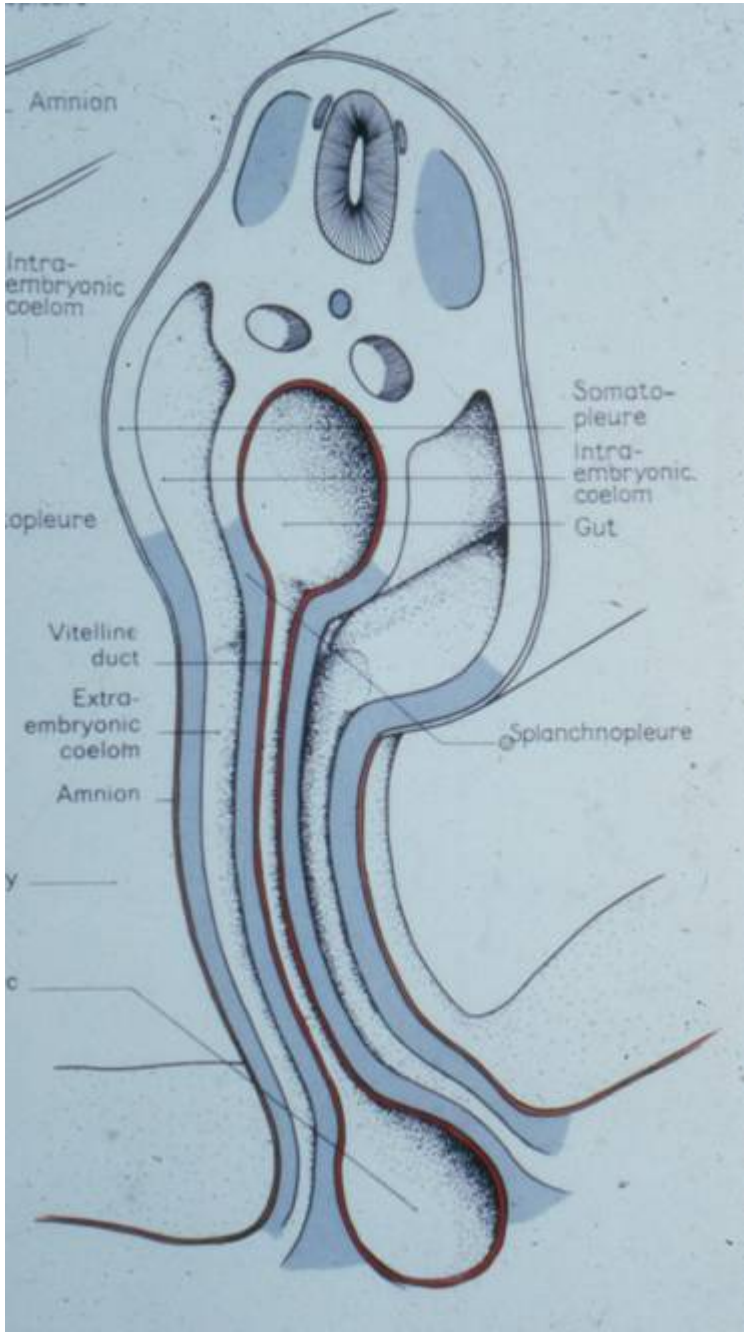
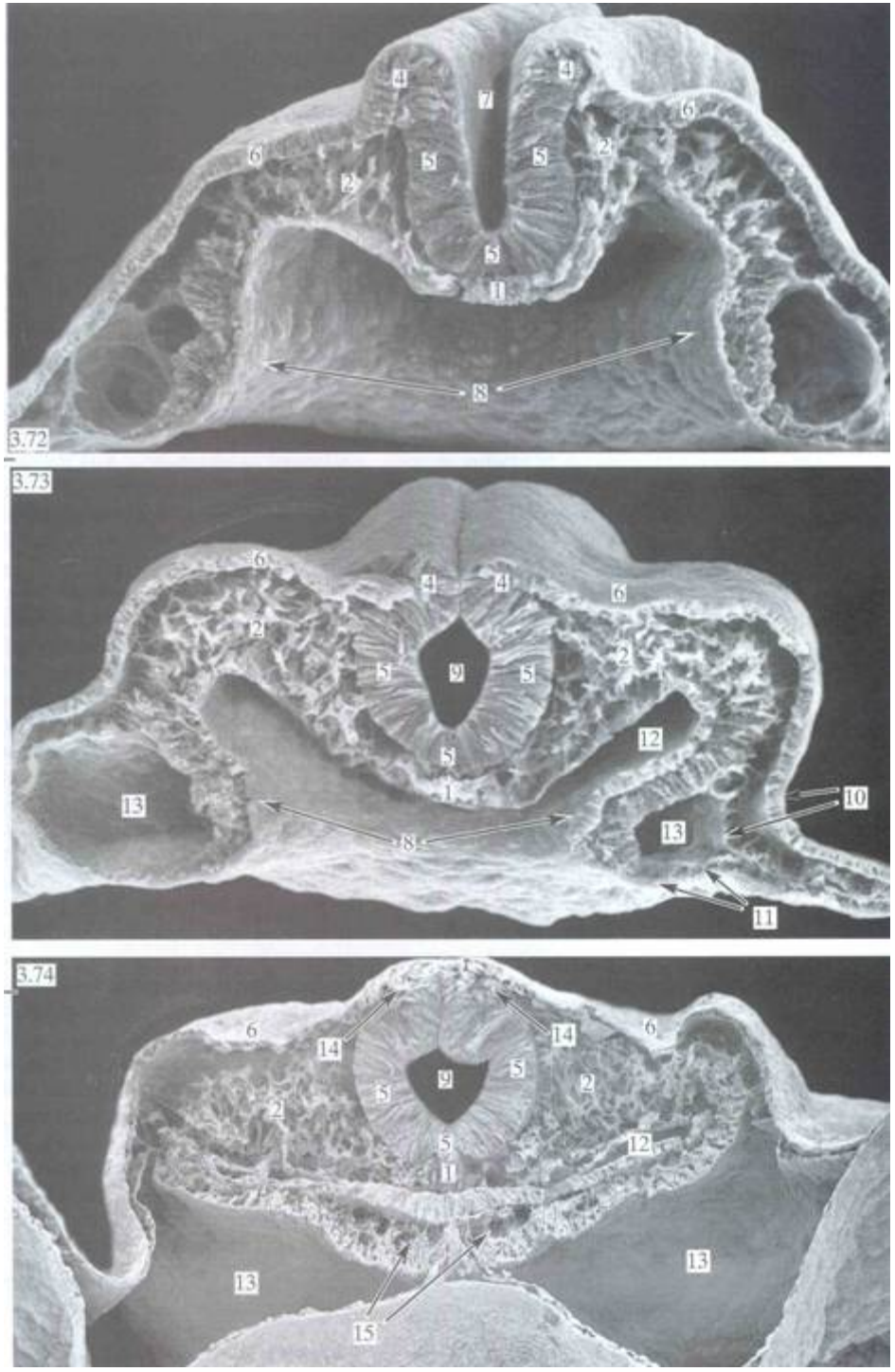
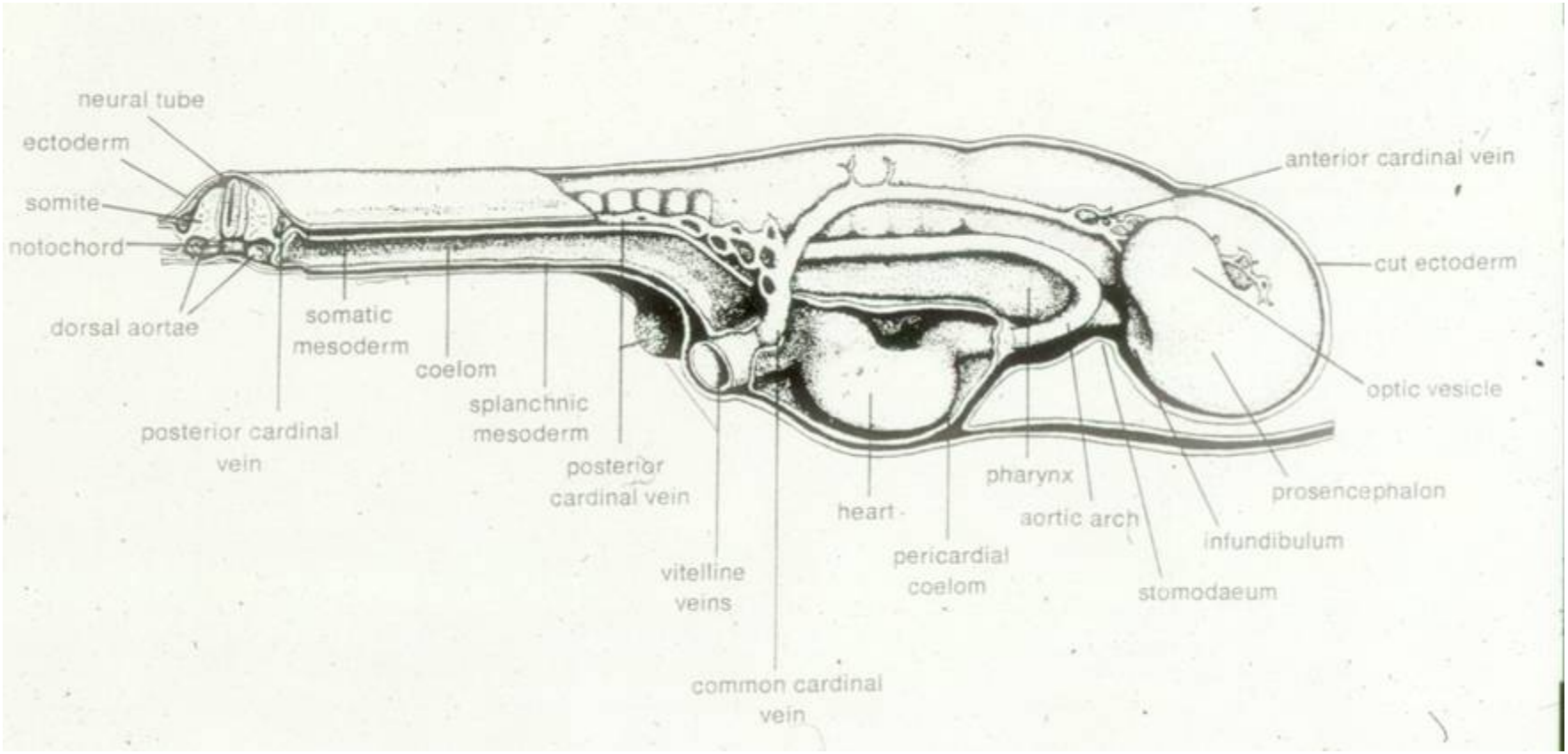

Surface ectoderm
Gut
Splanchnopleure
Amnion
Intra-embryonic coelom
Somatopleure

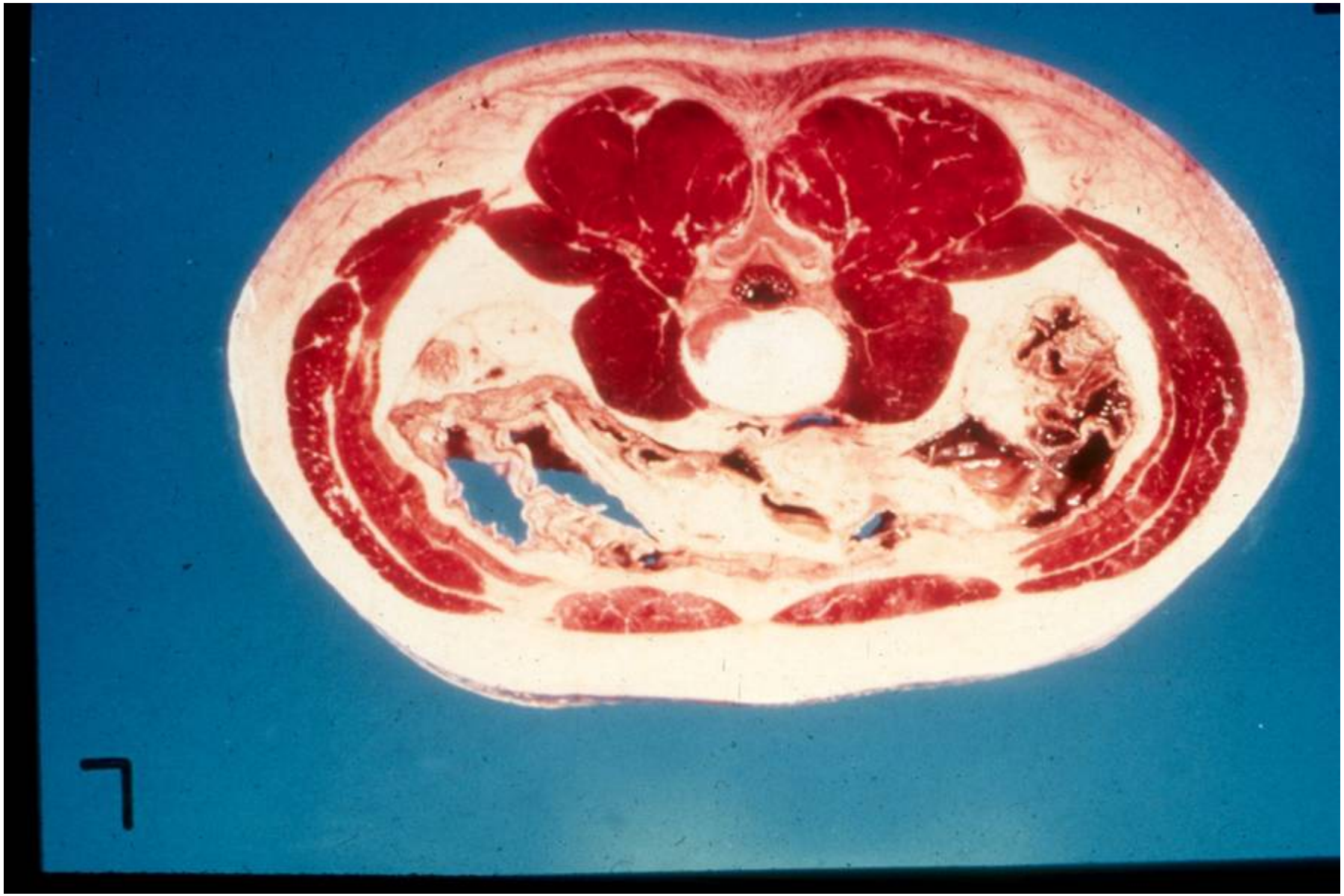
Fig. 3.

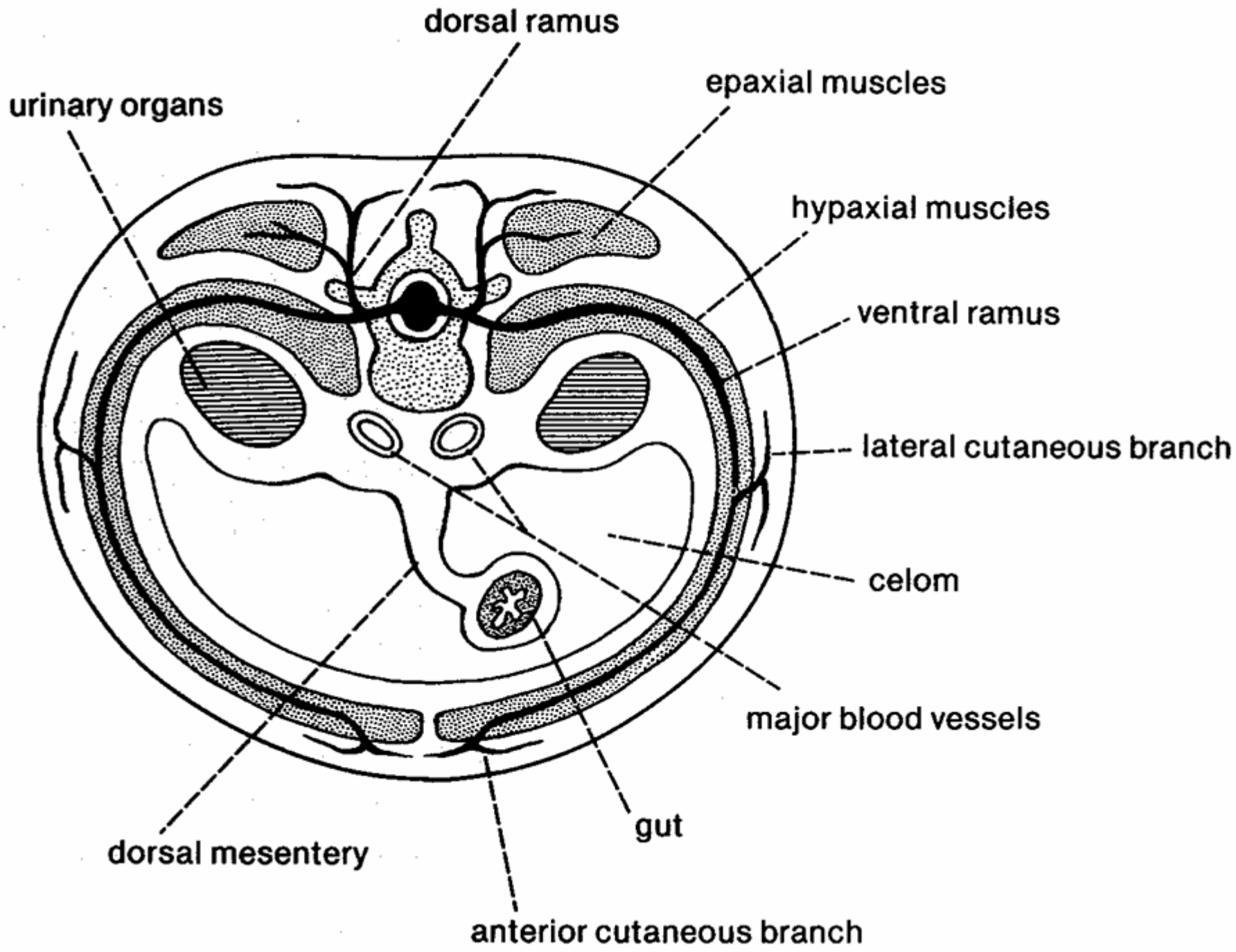

Amnion
Intra-
embryonic
coelom
Somato-
pleure
Intra-
embryonic
coelom
Gut
Vitelline
duct
Extra-
embryonic
coelom
Amnion
Splanchnopleure

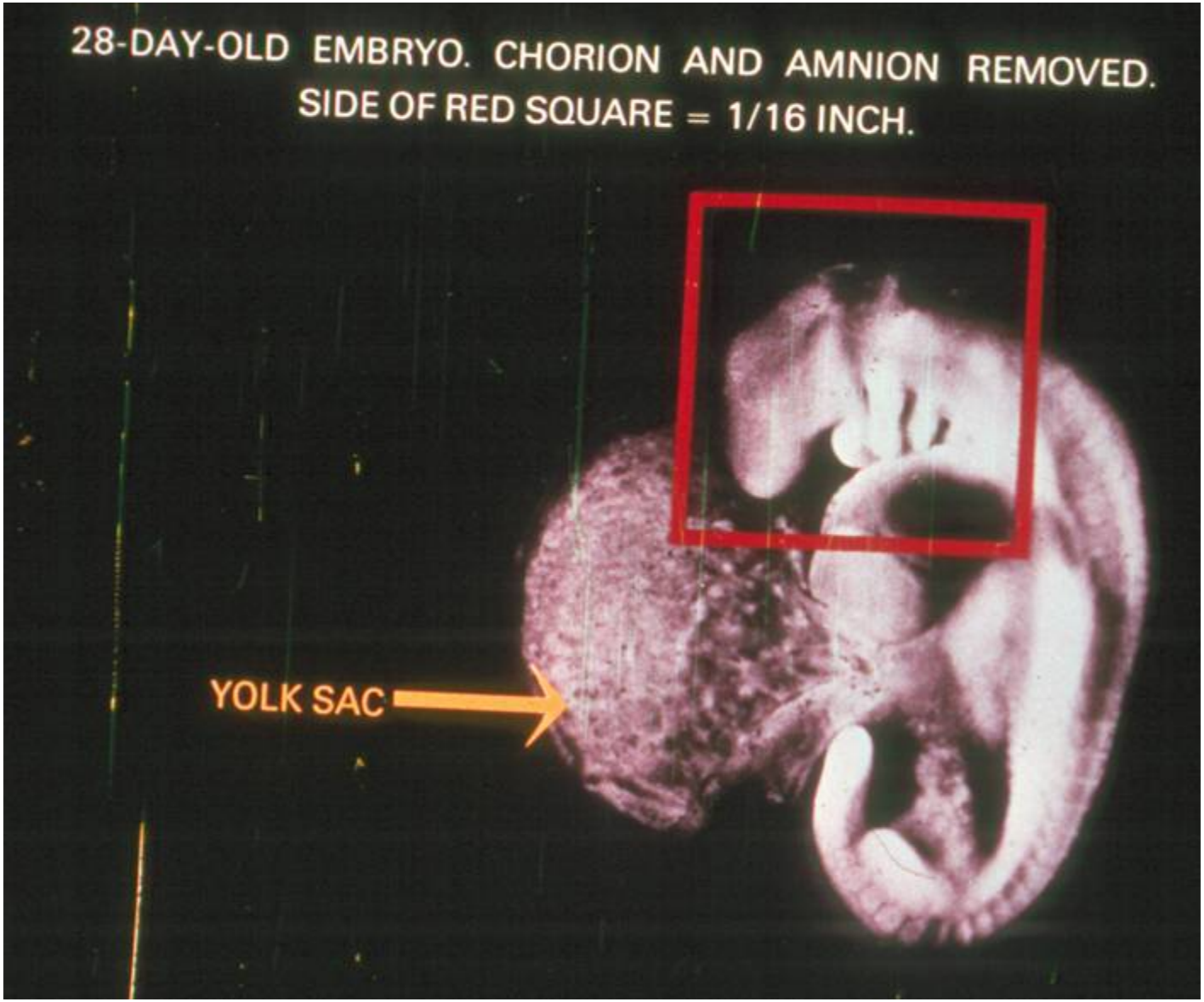

3.72
4
7
6
5
2
11
8
3.73
9
12
10
13
1
3.74
14
15

Trans-segmental structures versus Segmental structures


neural tube
ectoderm
somite
notochord
dorsal aortae
somatic mesoderm
coelom
splanchnic mesoderm
posterior cardinal vein
posterior cardinal vein
vitelline veins
common cardinal vein
heart
pericardial coelom
pharynx
aortic arch
stomodaeum
infundibulum
prosencephalon
optic vesicle
cut ectoderm
anterior cardinal vein



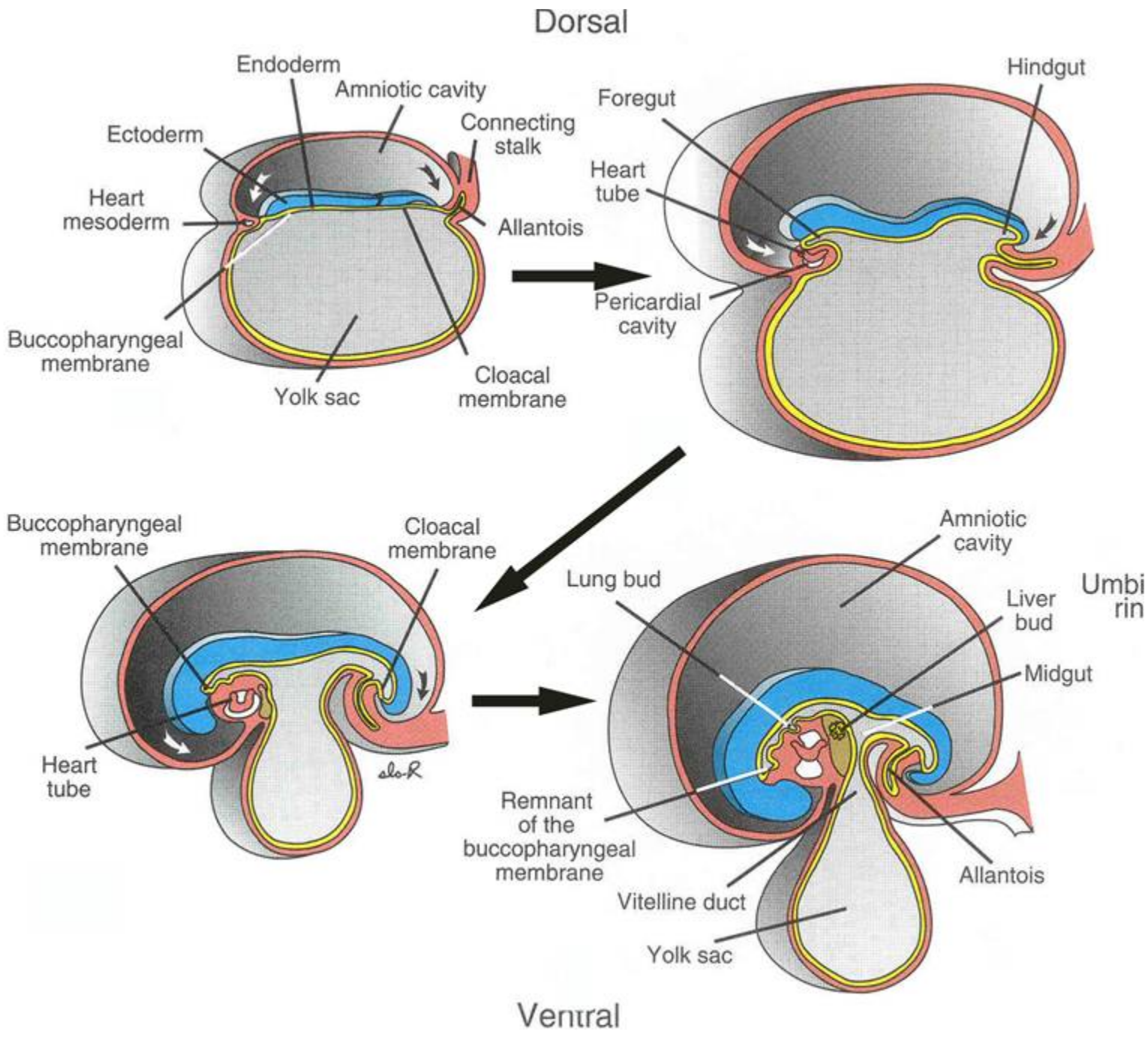

dorsal ramus
epaxial muscles
urinary organs
hypaxial muscles
ventral ramus
lateral cutaneous branch
celom
major blood vessels
gut
dorsal mesentery
anterior cutaneous branch



Gill slits / Gill pouches

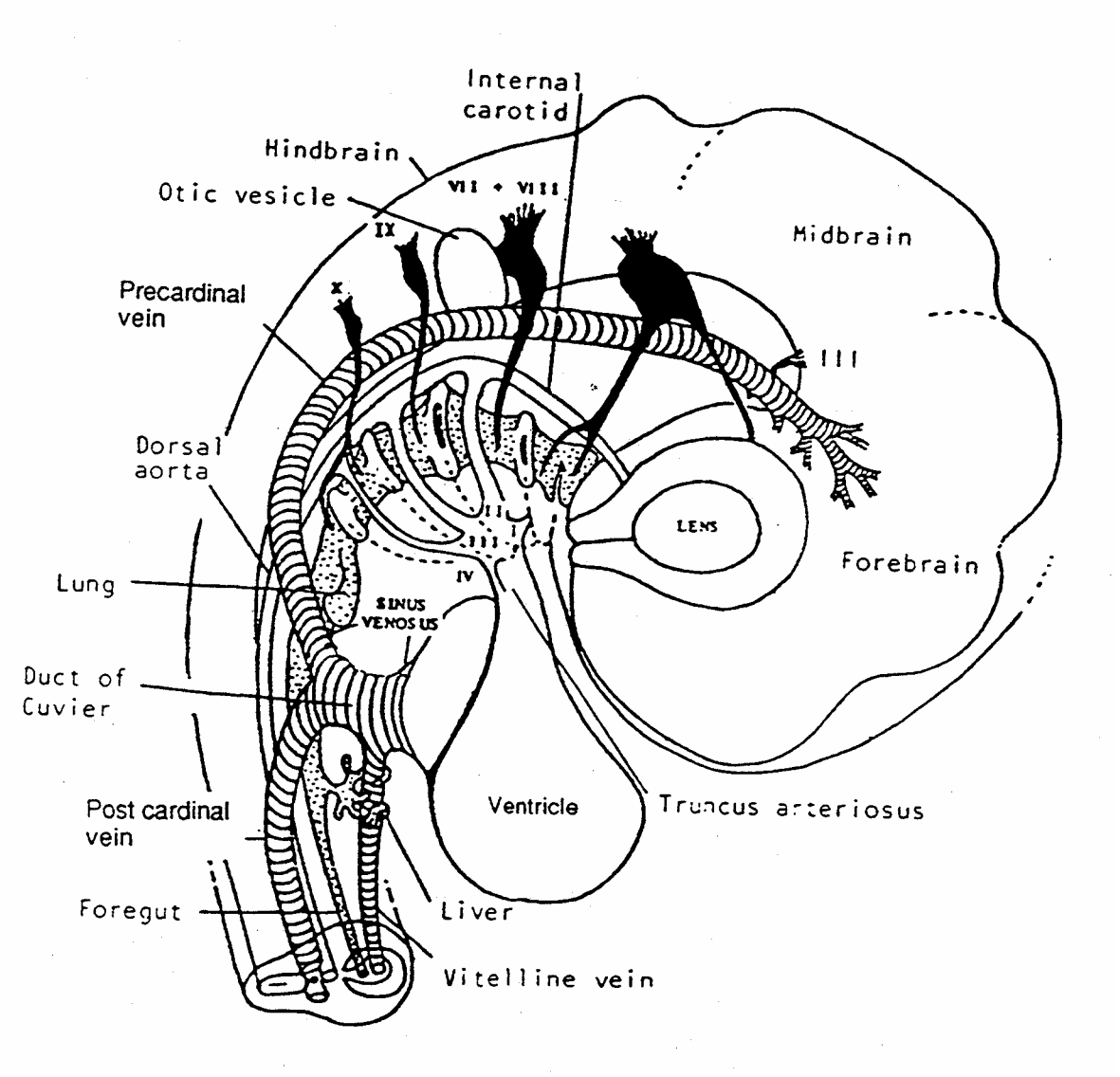
Further endodermal development:

- Lateral folds
- Oropharyngeal membrane
- Embryonic foregut
- Embryonic hindgut

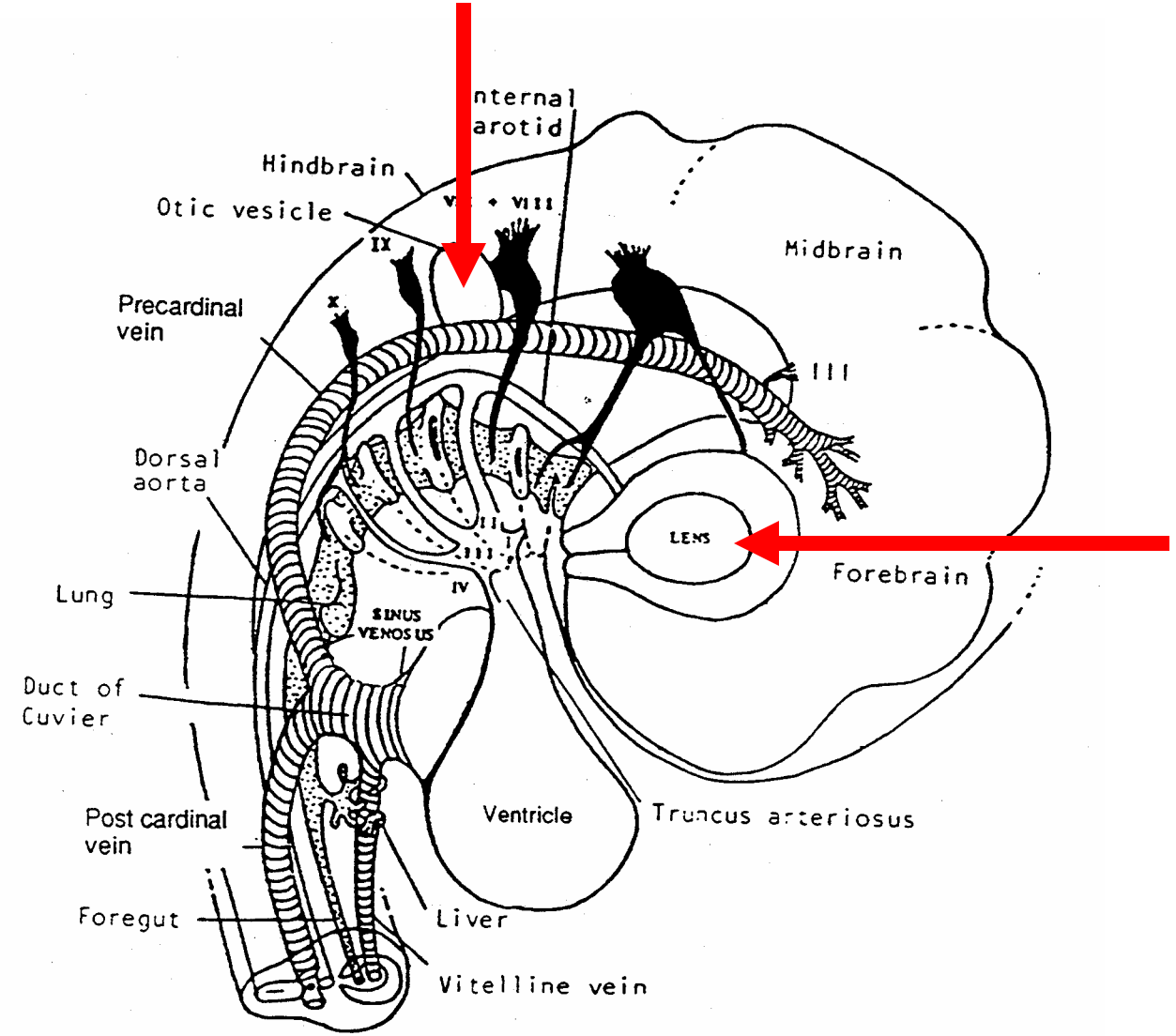

Dorsal
Endoderm
Amniotic cavity
Ectoderm
Connecting stalk
Heart mesoderm
Allantois
Buccopharyngeal membrane
Yolk sac
Cloacal membrane
Hindgut
Foregut
Heart tube
Pericardial cavity
Buccopharyngeal membrane
Cloacal membrane
Heart tube
Amniotic cavity
Lung bud
Liver bud
Midgut
Remnant of the buccopharyngeal membrane
Vitelline duct
Yolk sac
Allantois
Ventral

Special Senses

See in Chapter ½ of your Laboratory Manual....



See in Chapter 1/2 of your Laboratory Manual....



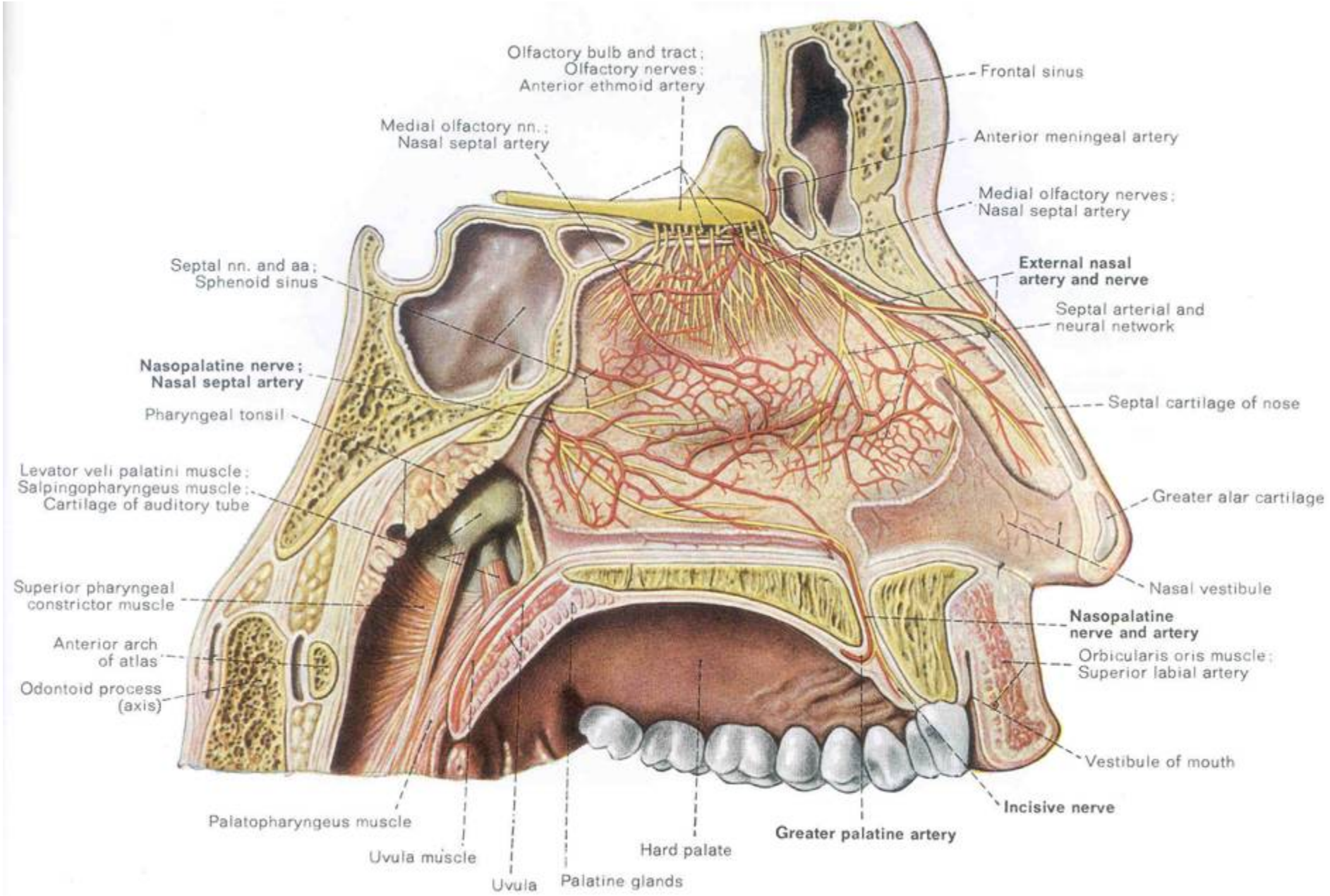
Special Sense: Smell

Hard and Soft Palate(s) separate nasal pharynx from oral pharynx.

Right and left sides separated by nasal septum (made up of vomer and perpendicular plate of ethmoid).

Free-floating nasal conchae held in place by connective tissue.
-Increase surface area.

Sensory innervation of nasal cavity by Olfactory Nerve, Cranial nerve I.


Olfactory bulb and tract;
Olfactory nerves;
Anterior ethmoid artery
Frontal sinus
Medial olfactory nn.;
Nasal septal artery
Anterior meningeal artery
Medial olfactory nerves;
Nasal septal artery
Septal nn. and aa;
Sphenoid sinus
External nasal
artery and nerve
Septal arterial and
neural network
Nasopalatine nerve;
Nasal septal artery
Septal cartilage of nose
Pharyngeal tonsil
Levator veli palatini muscle;
Salpingopharyngeus muscle;
Cartilage of auditory tube
Greater alar cartilage
Nasal vestibule
Superior pharyngeal
constrictor muscle
Nasopalatine
nerve and artery
Anterior arch
of atlas
Orbicularis oris muscle;
Superior labial artery
Odontoid process
(axis)
Vestibule of mouth
Incisive nerve
Palatopharyngeus muscle
Greater palatine artery
Uvula muscle
Hard palate
Uvula
Palatine glands

Special Sense: Vision

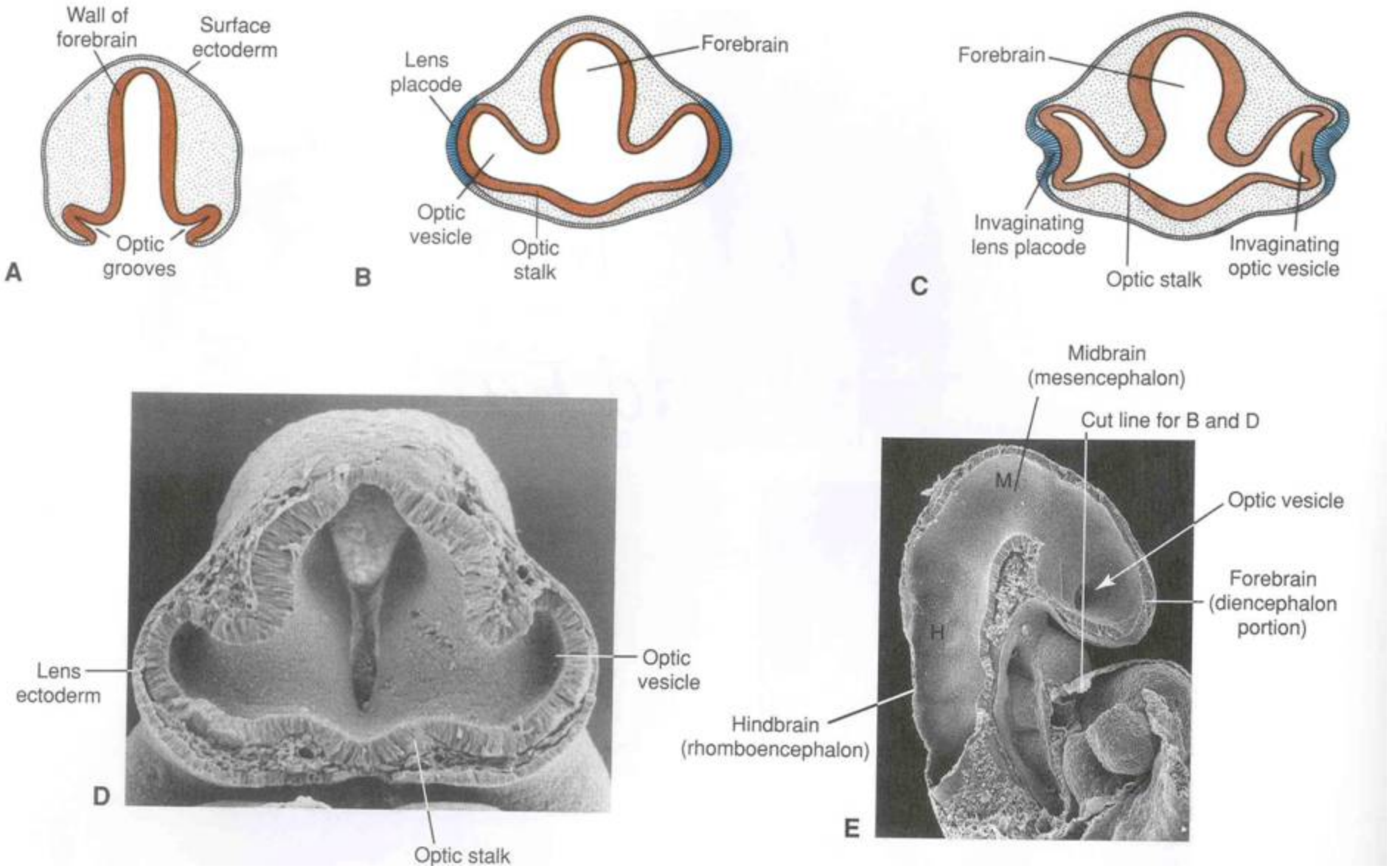
Eye starts out as photosensitive lobe of brain underlying surface of skin.

Lobe eventually becomes two-layered cup = retina.

Connected to brain by “stalk” that is the OPITC NERVE (cranial nerve II).

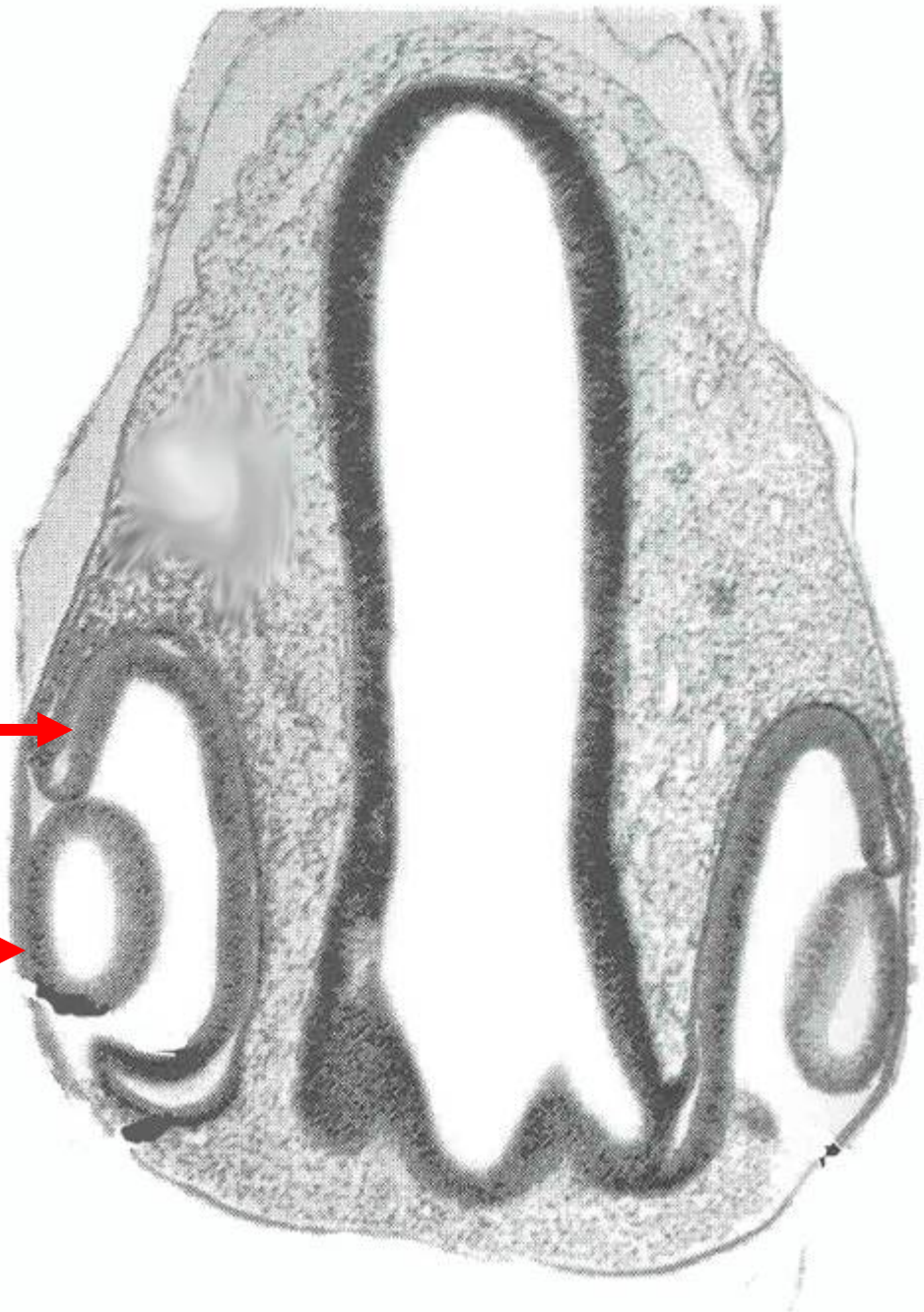
Lens from ectodermal placode.

Marginal cells of retina become specialized as MUSCLE CELLS that regulate opening of pupil:
Sphinctor pupillae (parasympathetically regulated)
Dilator pupillae (sympathetically regulated)


Wall of forebrain
Surface ectoderm
Optic grooves
A
Lens placode
Forebrain
Optic vesicle
Optic stalk
B
Forebrain
Invaginating lens placode
Optic stalk
Invaginating optic vesicle
C
Lens ectoderm
Optic vesicle
Optic stalk
D
Midbrain (mesencephalon)
Cut line for B and D
M
H
Optic vesicle
Forebrain (diencephalon portion)
Hindbrain (rhomboencephalon)
E

Developing Retina

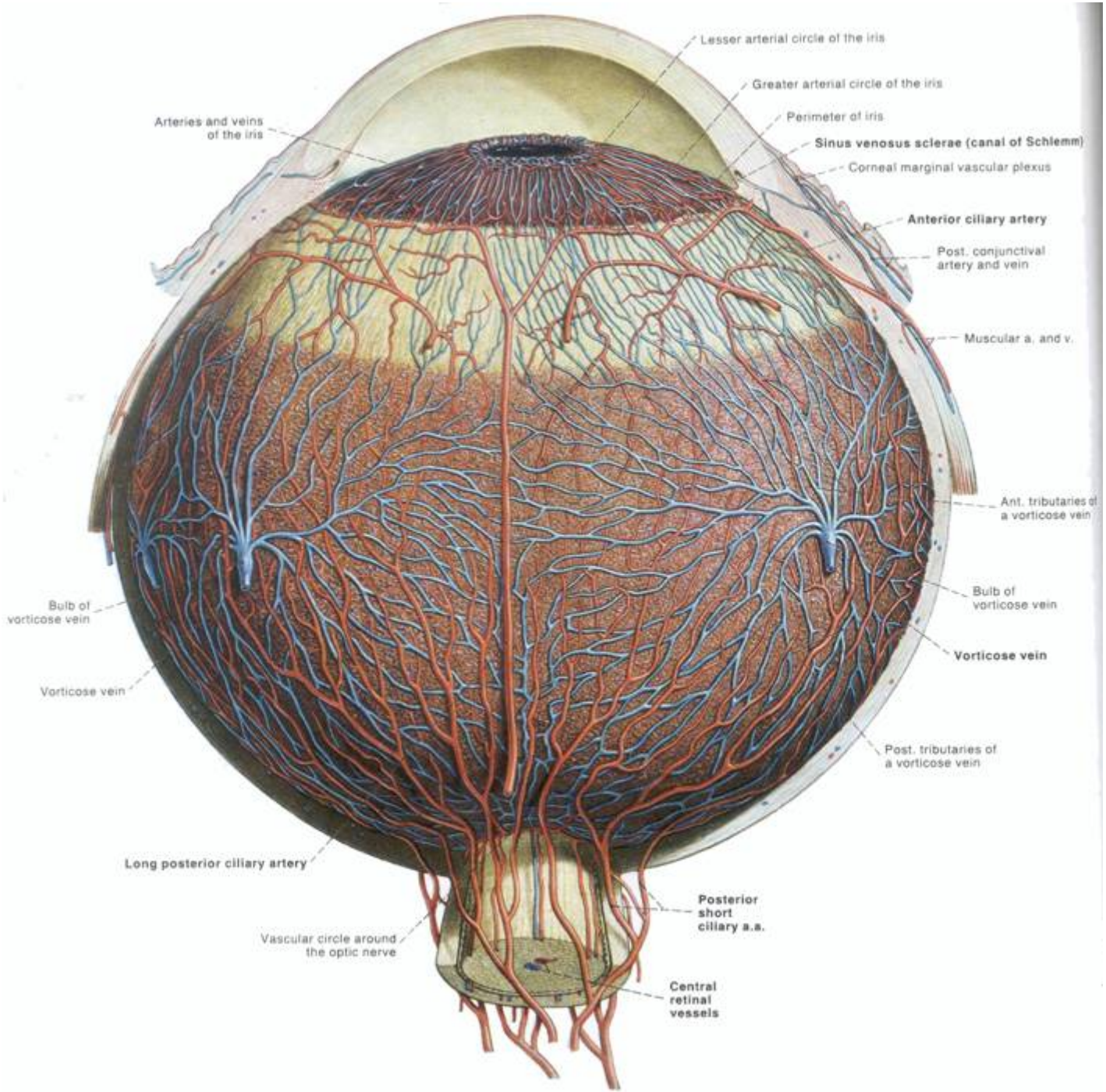
Developing Lens



Cells derived from NEURAL CREST condense around retina:

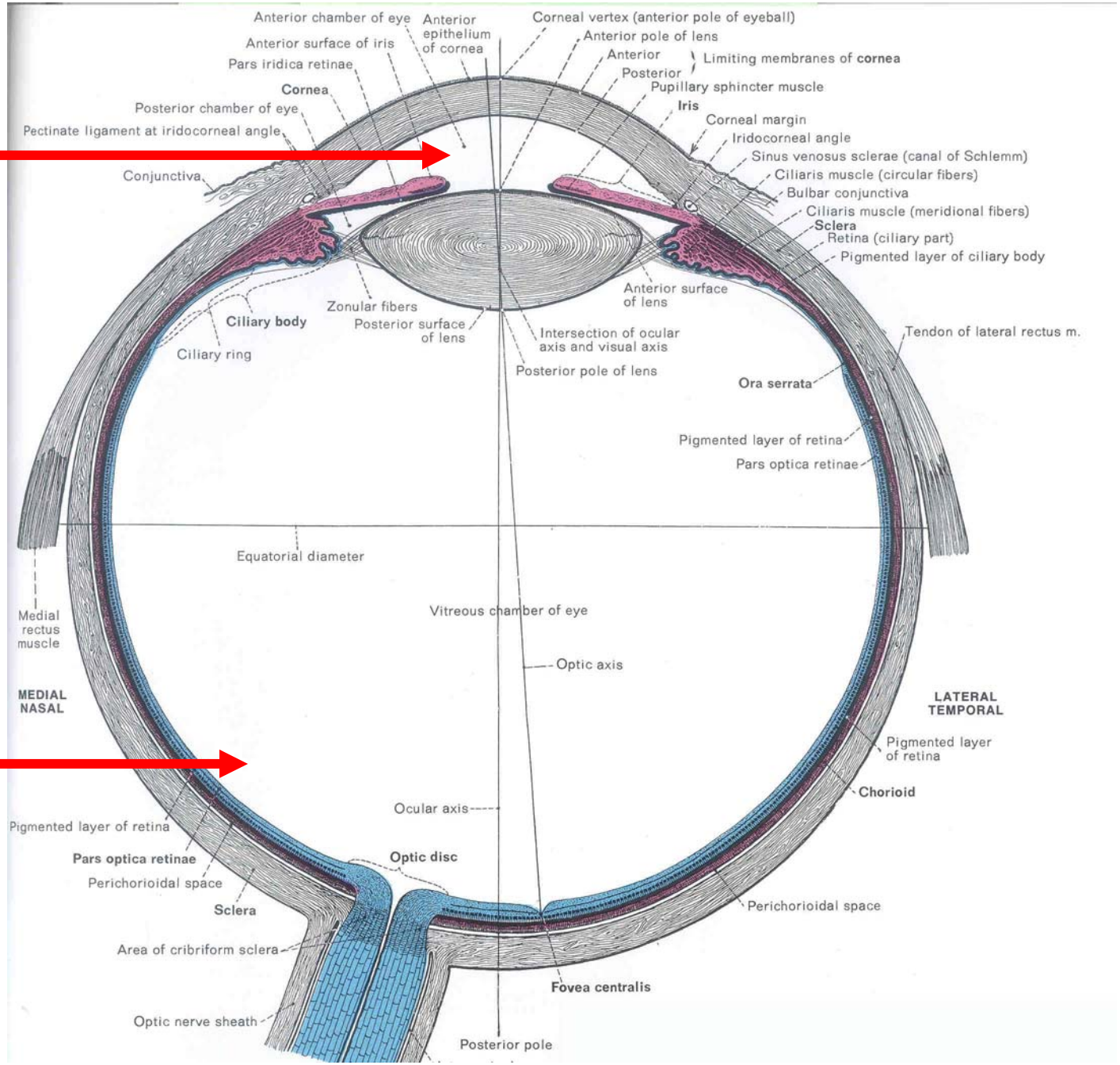
CHOROID – vascular layer lying directly up against retina.

Superficial, more fibrous layer – clear in front = CORNEA; white-pigmented remainder = SCLERA.


Lesser arterial circle of the iris
Greater arterial circle of the iris
Arteries and veins of the iris
Perimeter of iris
Sinus venosus sclerae (canal of Schlemm)
Corneal marginal vascular plexus
Anterior ciliary artery
Post. conjunctival artery and vein
Muscular a. and v.
Ant. tributaries of a vorticose vein
Bulb of vorticose vein
Bulb of vorticose vein
Vorticose vein
Vorticose vein
Post. tributaries of a vorticose vein
Long posterior ciliary artery
Posterior short ciliary a.a.
Vascular circle around the optic nerve
Central retinal vessels

Aqueous Chamber Of Eye

Vitreous Chamber Of Eye



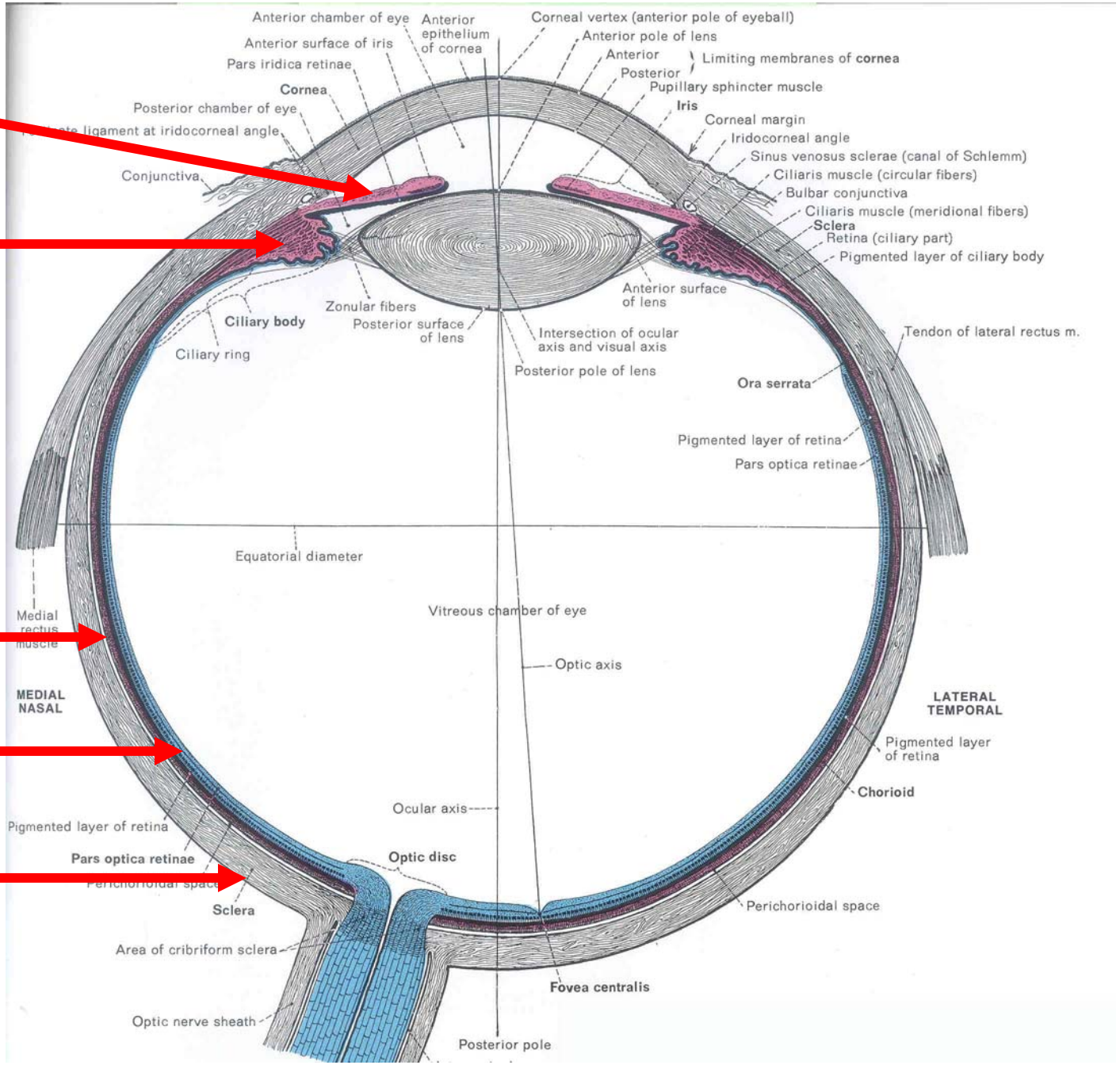
Iris

Ciliary Body

Choroid

Retina

Sclera



FOCUSING:

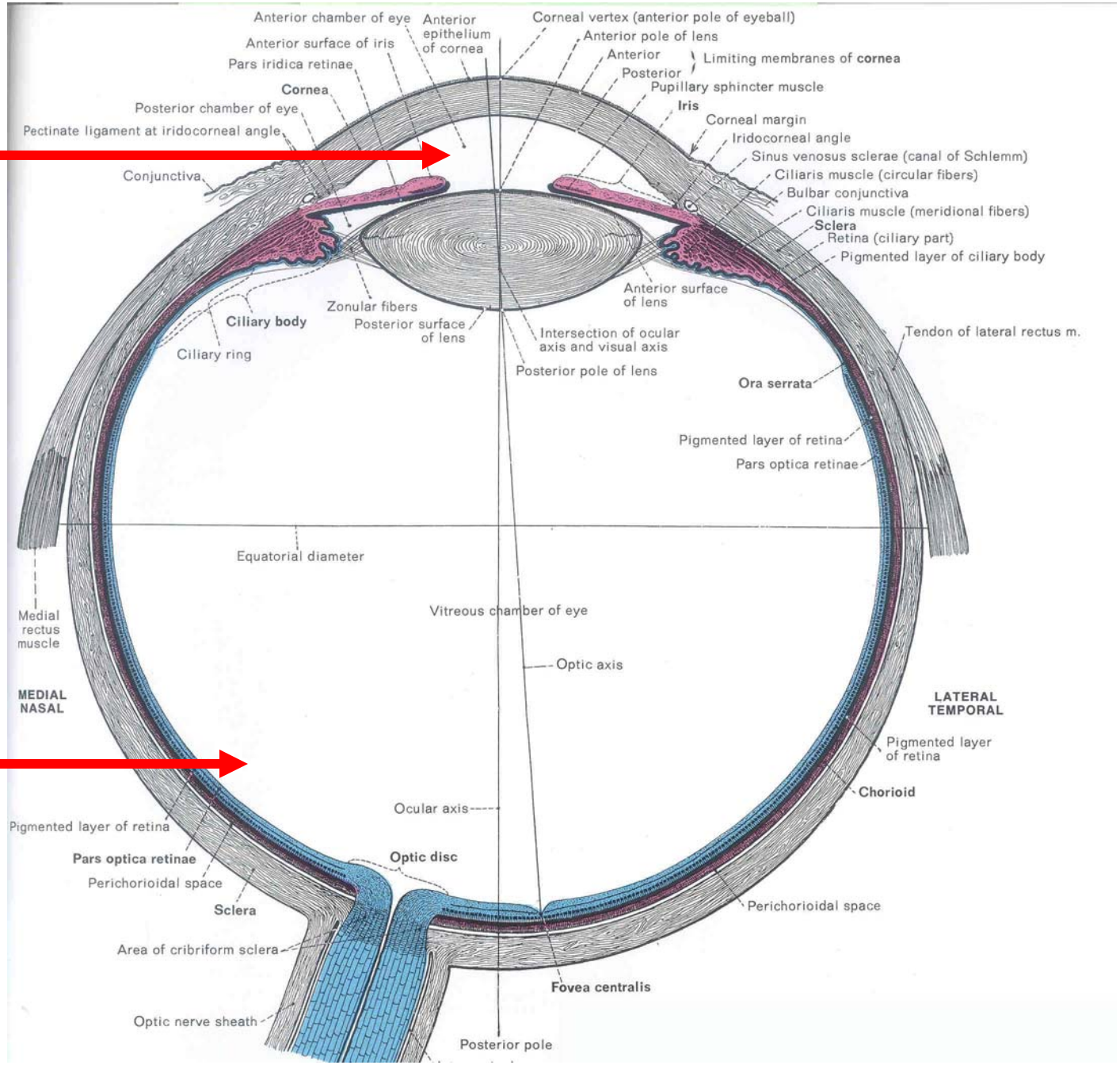
Distance focus need FLATTER LENS – less curvature, greater focal length. Normally, lens is held somewhat flat by taut ligaments.

Close-up focus – ciliary muscles contract, relieve tension on ligaments, allow lens to get more spherical. Greater curvature, lesser focal length.

With age, lens hardens, so even with ciliary muscle action, it can’t change shape.

Aqueous Chamber Of Eye

Vitreous Chamber Of Eye



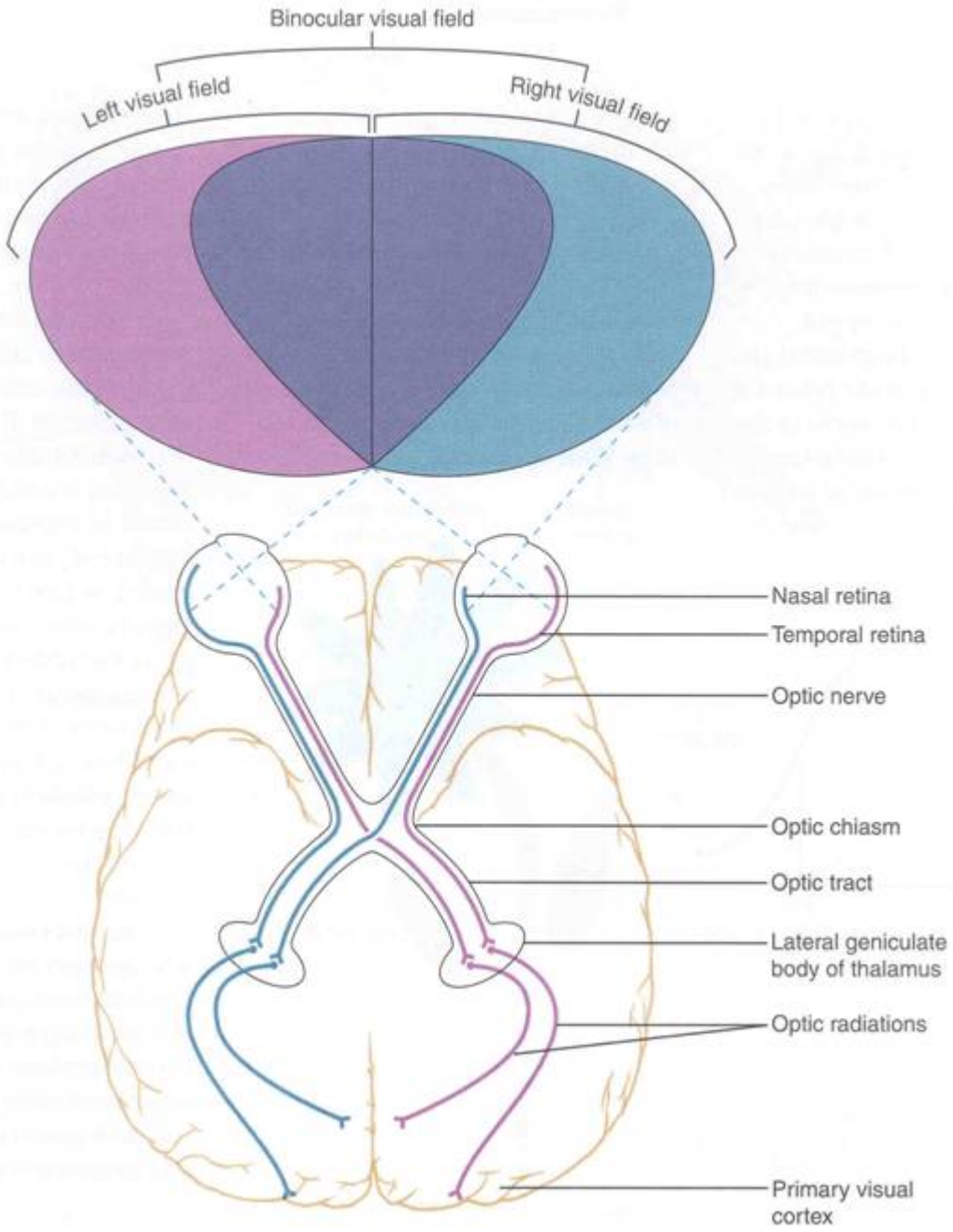
PHOTORECEPTION:

Light hits rods (simply light-sensitive) and cones (specifically color-sensitive).

Pigments (light sensitive proteins) abosrb light, and change configuration. This changes permiability of cell.

(However) When light is absorbed by a photosensitive cell, it is NOT depolarized. It is HYPERPOLARIZED. Once signal gets to optic nerve, it travels as a normal nerve would.

Usually takes multiple cells being stimulated to “sense light”.

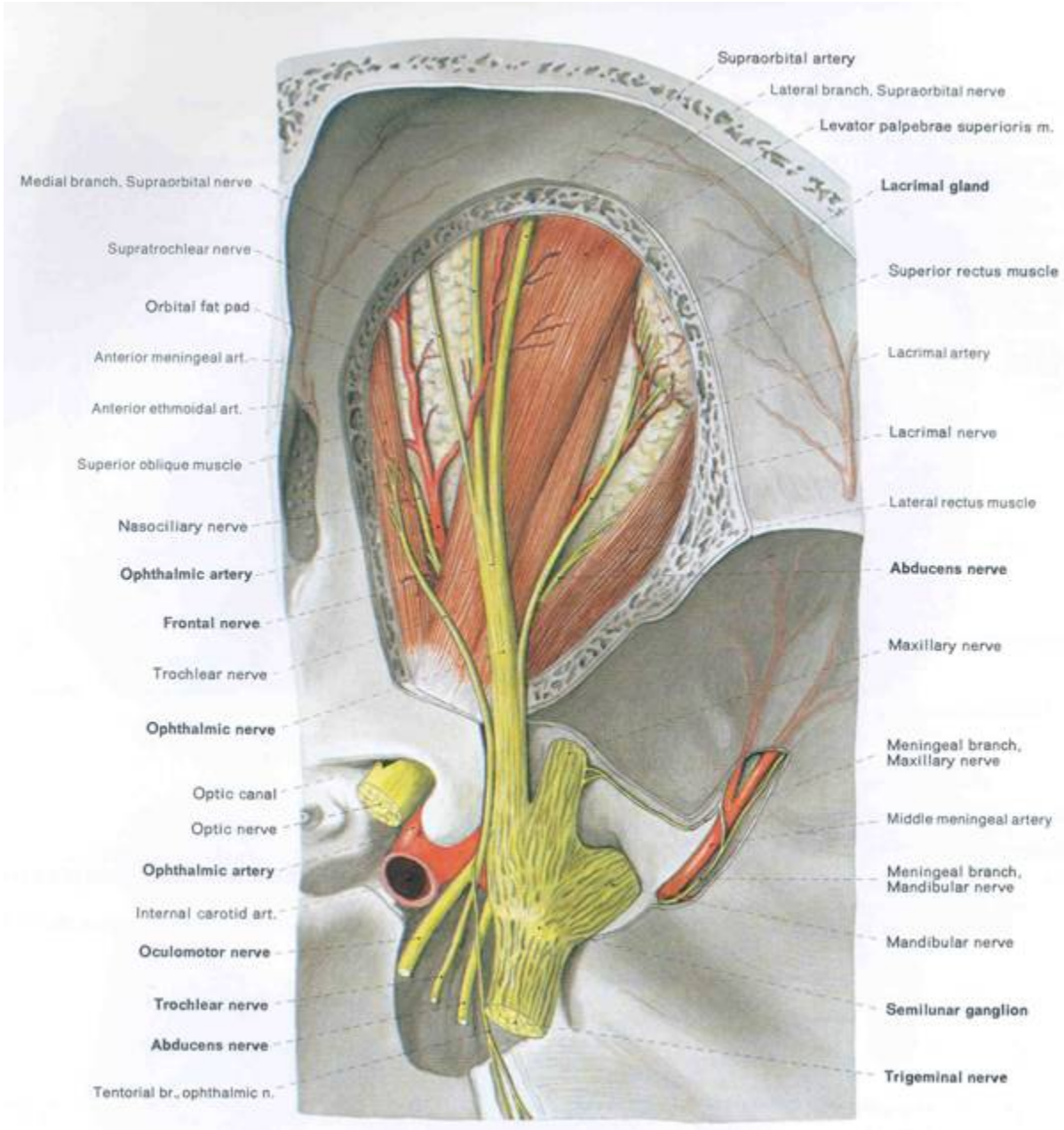

Binocular visual field
Left visual field
Right visual field
Nasal retina
Temporal retina
Optic nerve
Optic chiasm
Optic tract
Lateral geniculate body of thalamus
Optic radiations
Primary visual cortex

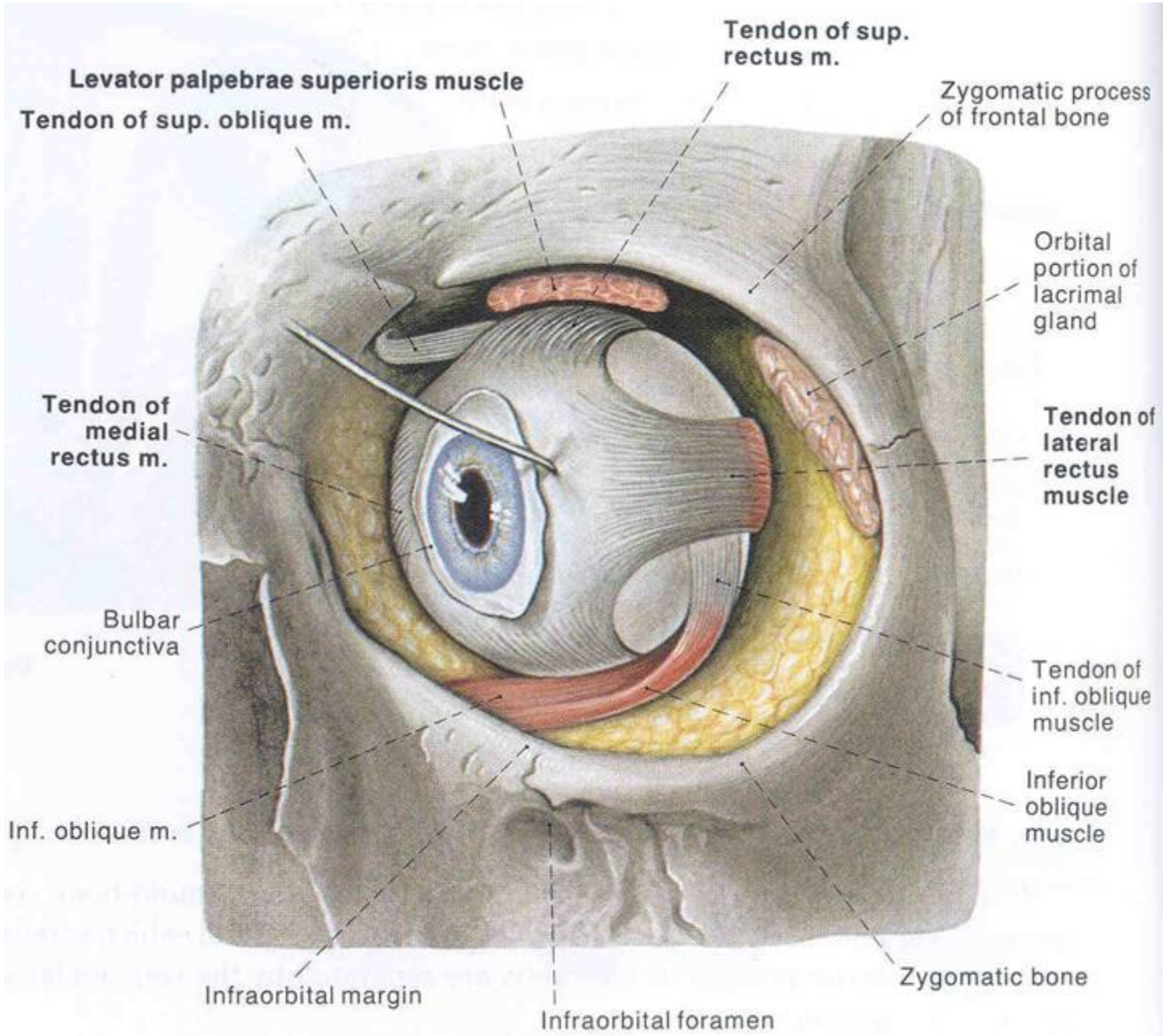
EYEBALL MOVING MUSCLES:

Rectus Muscles
- Superior rectus - III
- Inferior rectus - III
- Lateral rectus - VI
- Medial rectus - III

Oblique muscles
- Superior oblique - IV
- Inferior oblique - III

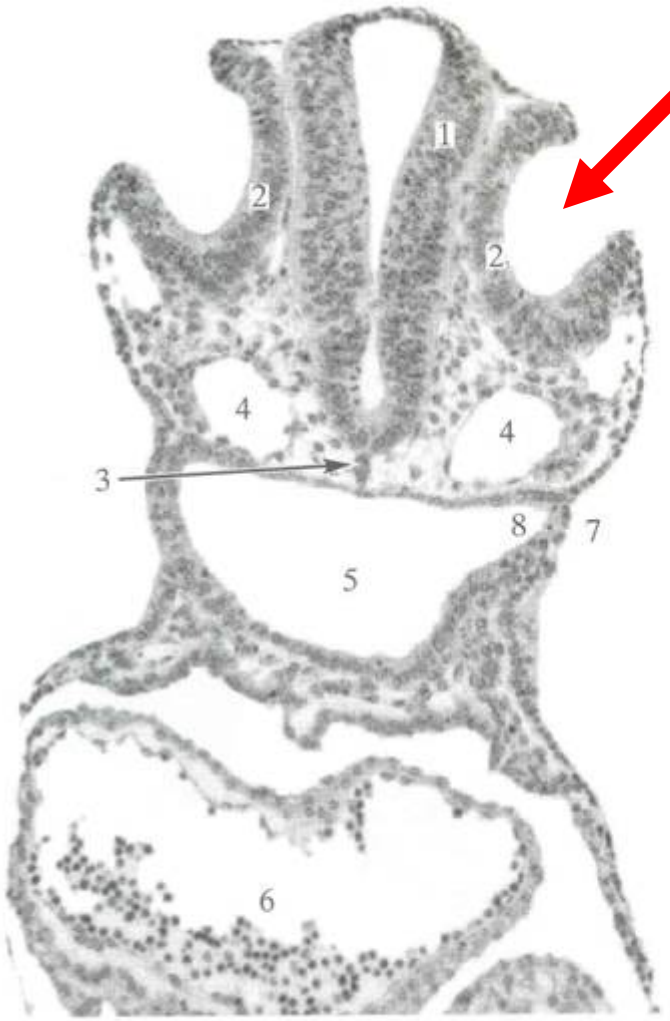
Lavator palpebrae superioris - III

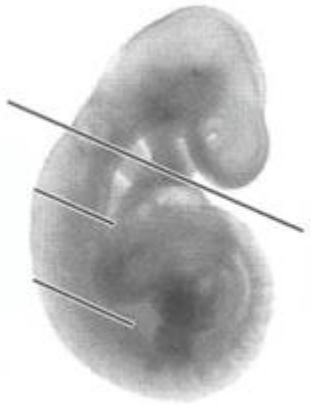

Supraorbital artery
Lateral branch, Supraorbital nerve
Levator palpebrae superioris m.
Medial branch, Supraorbital nerve
Lacrimal gland
Supratrochlear nerve
Superior rectus muscle
Orbital fat pad
Lacrimal artery
Anterior meningeal art.
Anterior ethmoidal art.
Lacrimal nerve
Superior oblique muscle
Lateral rectus muscle
Nasociliary nerve
Abducens nerve
Ophthalmic artery
Frontal nerve
Maxillary nerve
Trochlear nerve
Ophthalmic nerve
Meningeal branch, Maxillary nerve
Optic canal
Optic nerve
Middle meningeal artery
Ophthalmic artery
Meningeal branch, Mandibular nerve
Internal carotid art.
Mandibular nerve
Oculomotor nerve
Trochlear nerve
Semilunar ganglion
Abducens nerve
Trigeminal nerve
Tentorial br., ophthalmic n.


Tendon of sup. rectus m.
Levator palpebrae superioris muscle
Tendon of sup. oblique m.
Zygomatic process of frontal bone
Orbital portion of lacrimal gland
Tendon of medial rectus m.
Tendon of lateral rectus muscle
Bulbar conjunctiva
Tendon of inf. oblique muscle
Inferior oblique muscle
Inf. oblique m.
Zygomatic bone
Infraorbital margin
Infraorbital foramen

Special Sense: Hearing & Balance

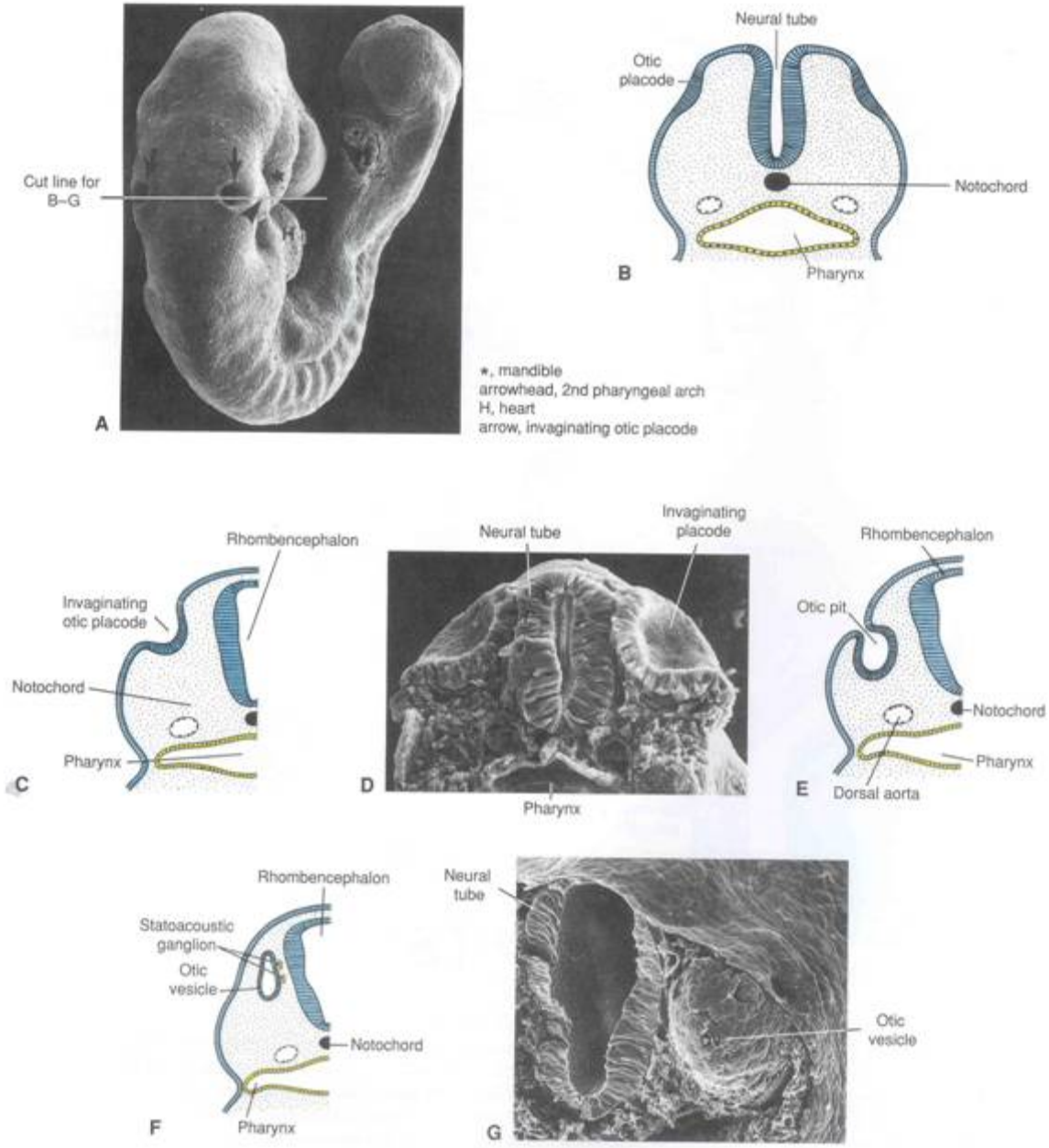
Otic Vesicle





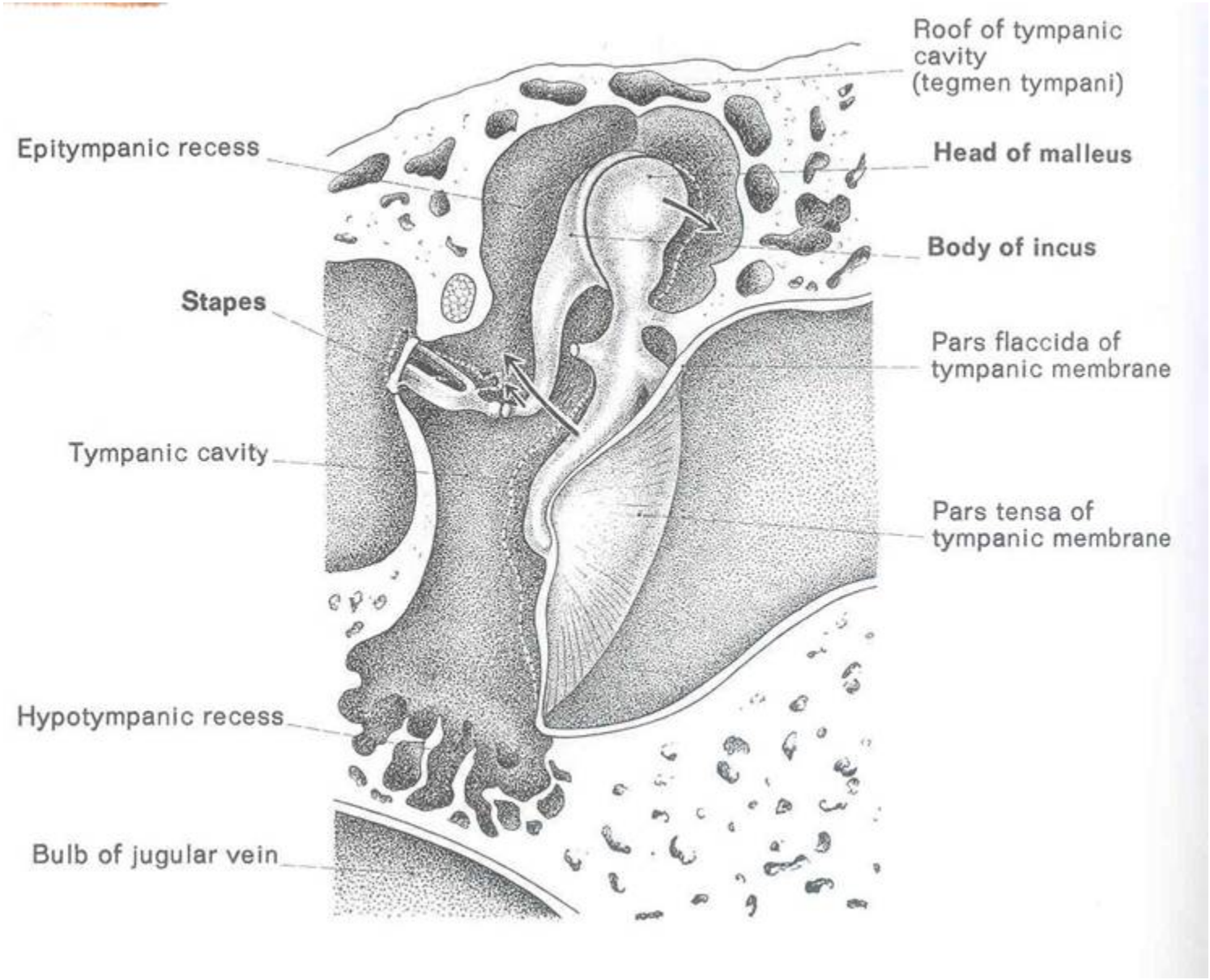
4.59

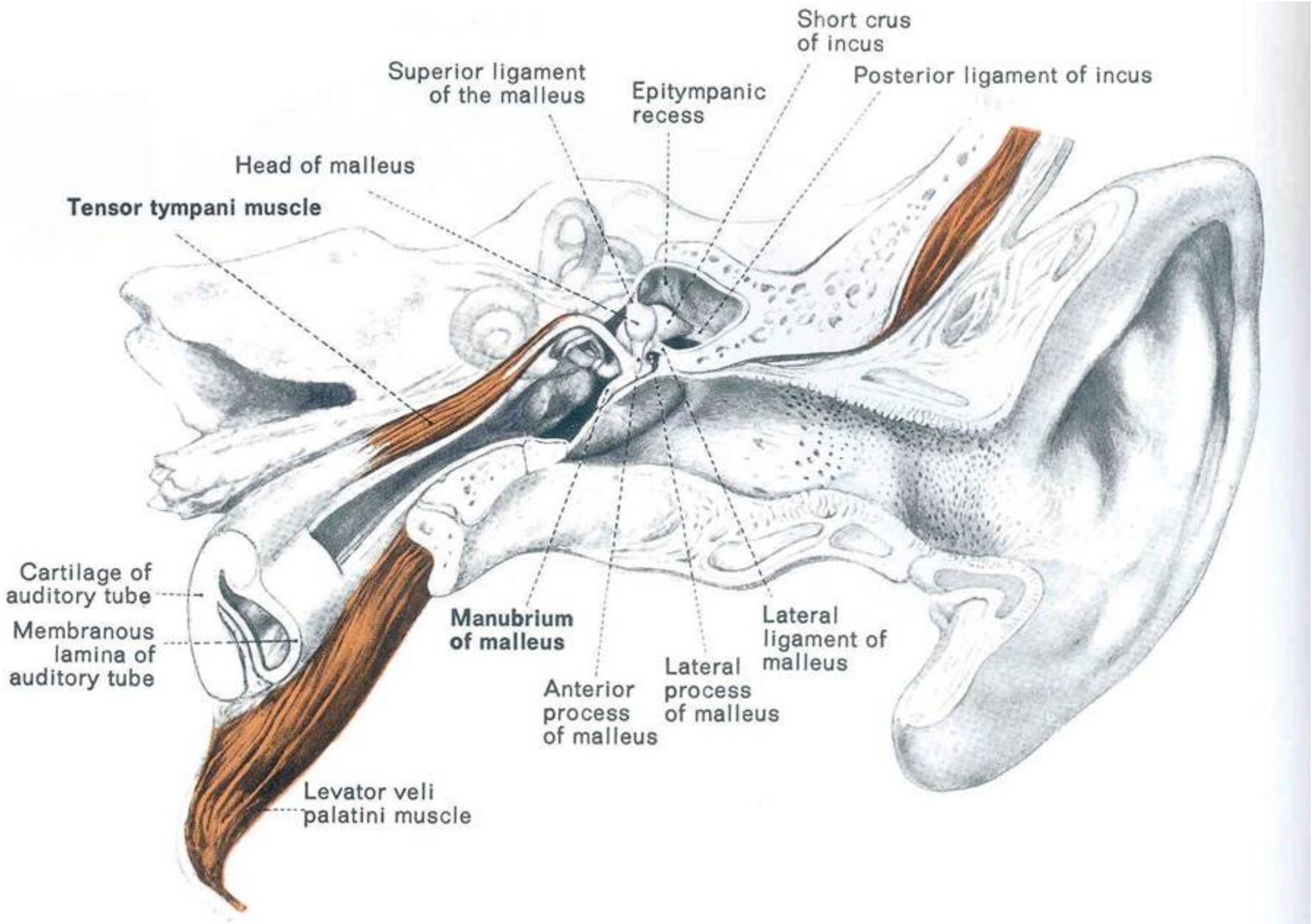
Early Development of the Ear

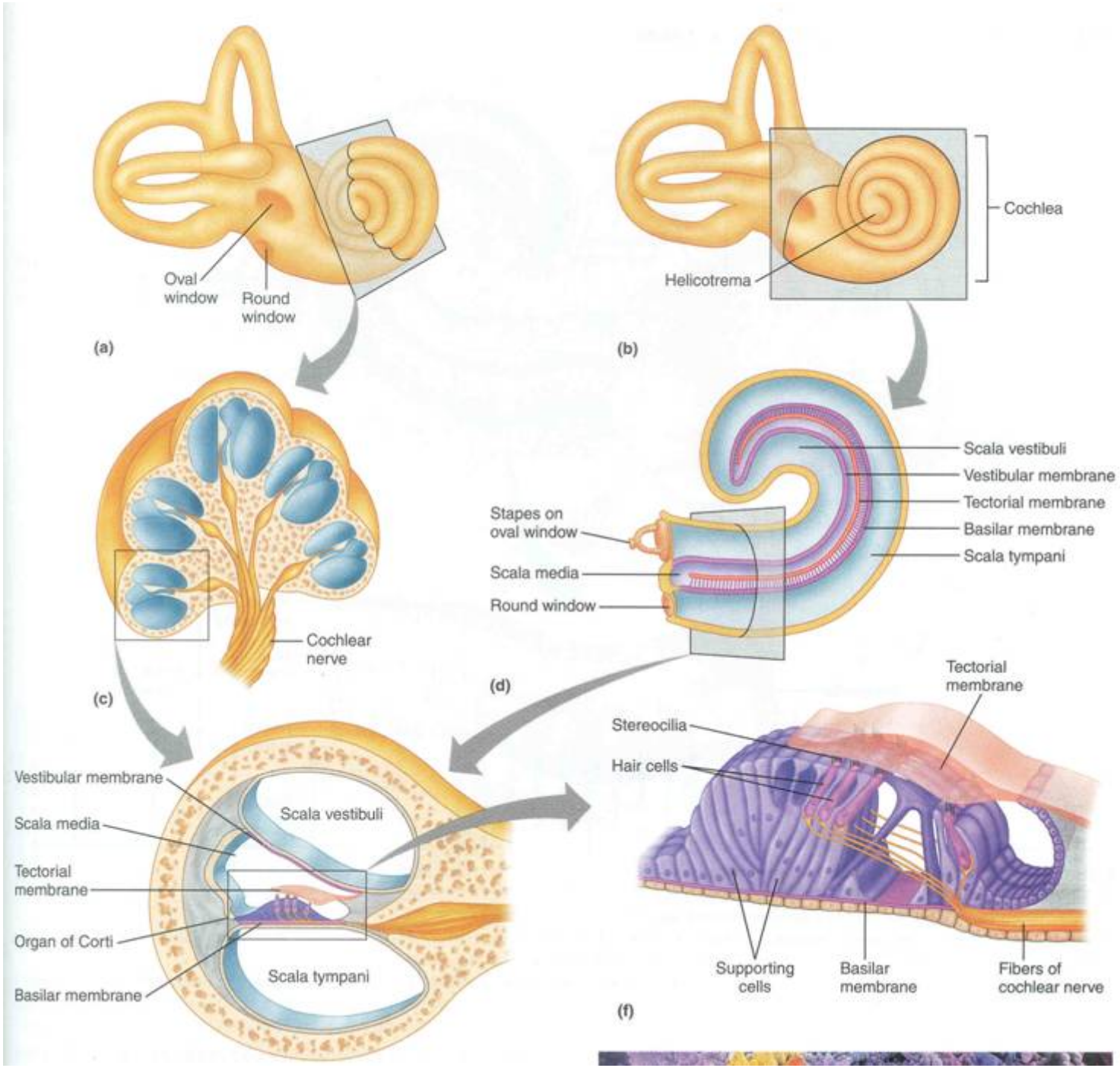


The ear consists of three different parts: the **external ear**, **middle ear**, and **internal ear**. The internal ear forms from **otic placodes (thickened ectoderm)** that develop on both sides of the hindbrain during the 4th week of development (**A** and **B**). These placodes invaginate to form otic vesicles (**C**–**G**).

Middle Ear Ossicles

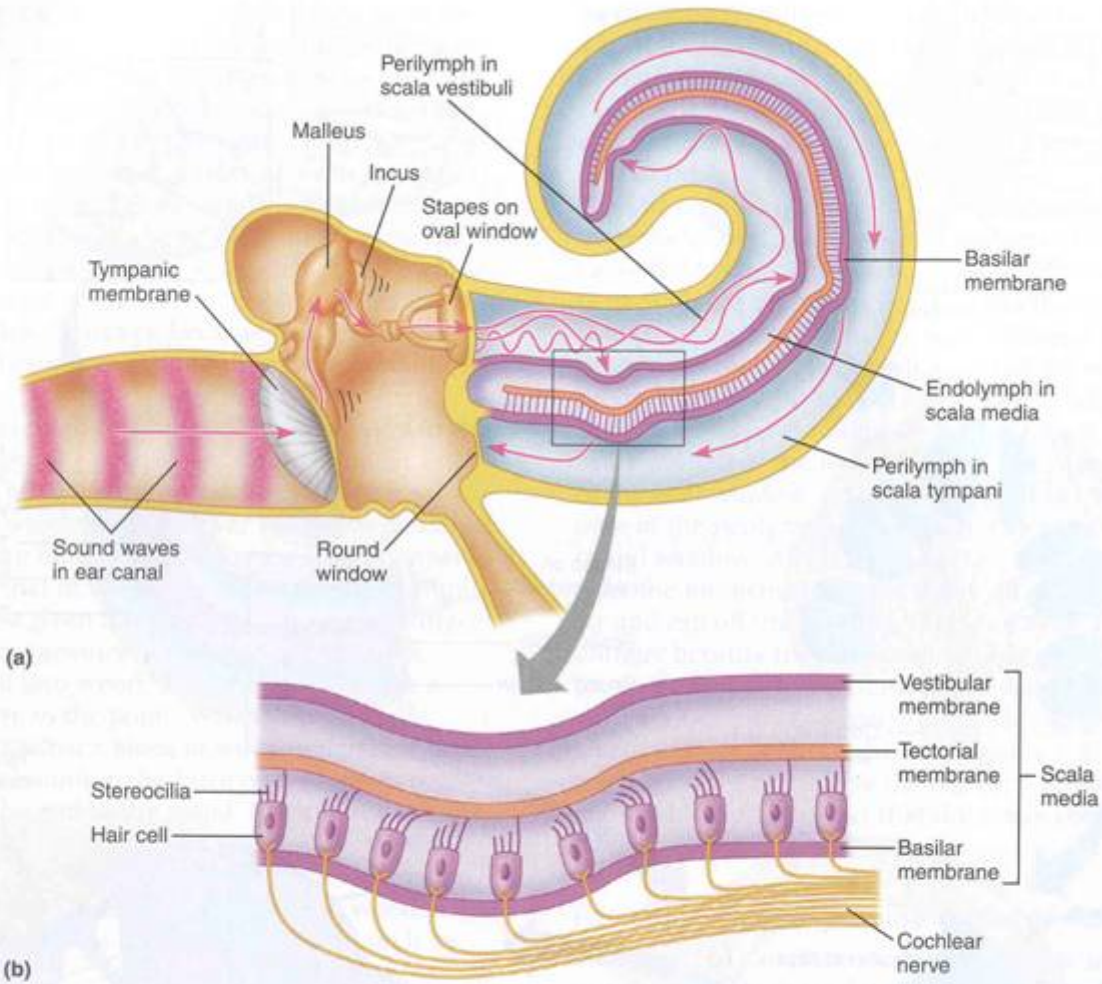



Short crus of incus
Superior ligament of the malleus
Epitympanic recess
Posterior ligament of incus
Head of malleus
Tensor tympani muscle
Cartilage of auditory tube
Membranous lamina of auditory tube
Manubrium of malleus
Anterior process of malleus
Lateral process of malleus
Lateral ligament of malleus
Levator veli palatini muscle


Oval window
Round window
(a)
Helicotrema
Cochlea
(b)
Cochlear nerve
(c)
Stapes on oval window
Scala media
Round window
Scala vestibuli
Vestibular membrane
Tectorial membrane
Basilar membrane
Scala tympani
(d)
Vestibular membrane
Scala media
Tectorial membrane
Organ of Corti
Basilar membrane
Scala vestibuli
Scala tympani
Tectorial membrane
Stereocilia
Hair cells
Supporting cells
Basilar membrane
Fibers of cochlear nerve
(f)

Sense of Hearing:

- Pressure waves in inner ear distort sensory hair cells.
- Distortion changes membrane.
- Membrane permiability changes
- Sodium ions flood in.
- Depolarization of cell.
- Action potential.



Conduction of sound waves in the ear. (a) Sound waves that enter the ear through the pinna and external auditory meatus strike the tympanic membrane, causing it to vibrate. The ossicles vibrate in response to the tympanic membrane and transmit the vibrations to the oval window. The vibrating oval window causes waves in the fluid (perilymph) of the cochlea. (b) Waves in the perilymph cause deflection of the membranes in the cochlea. When the membranes oscillate, the stereocilia of the hair cells bend, causing the opening or the closing of potassium channels.