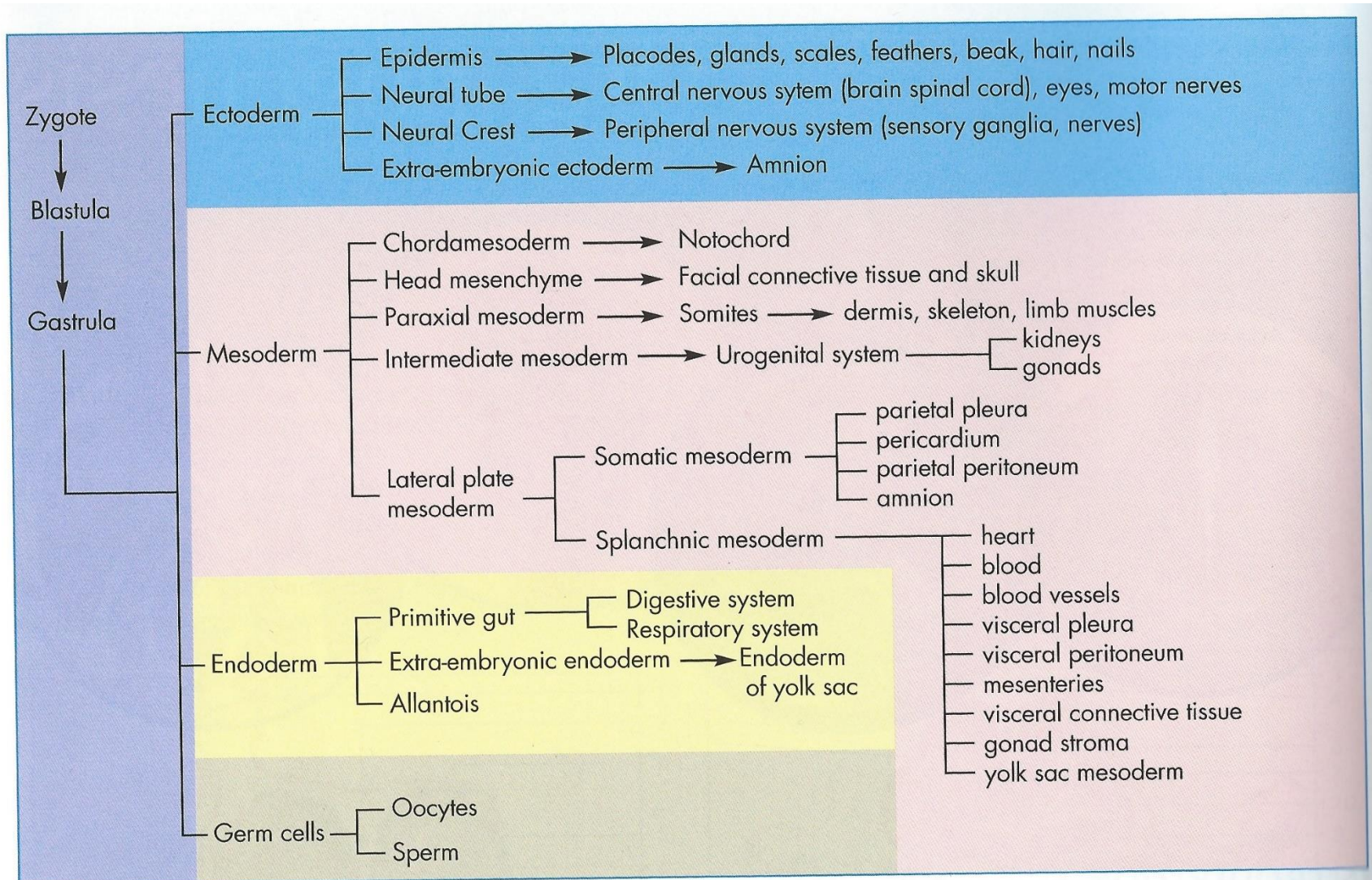


# Organogenesis

# Embryonic germ layer derivatives



Embryonic germ layer derivatives of vertebrates. The origins of all the organs can be traced back to the germ layers.

# Differentiation of neural tube

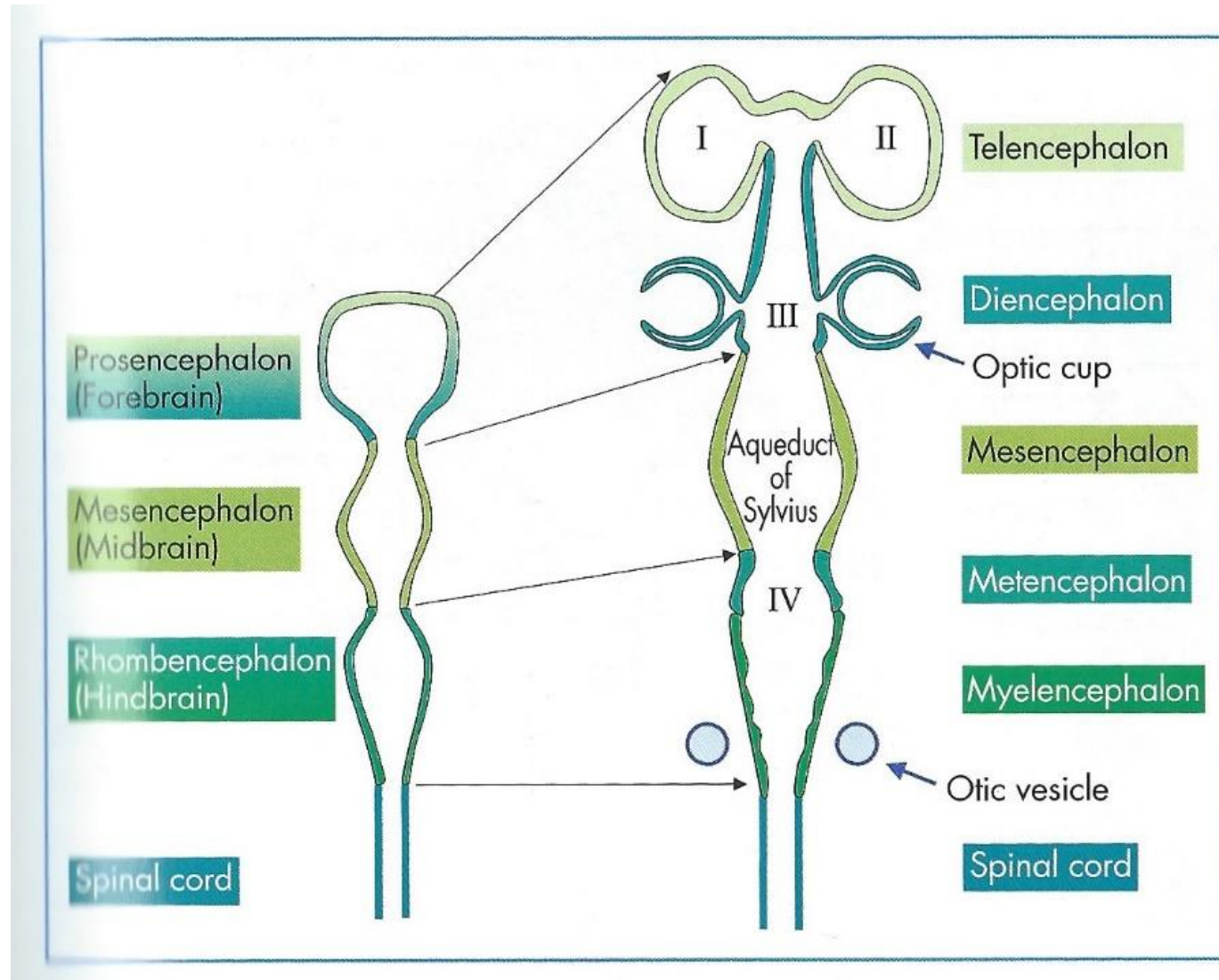
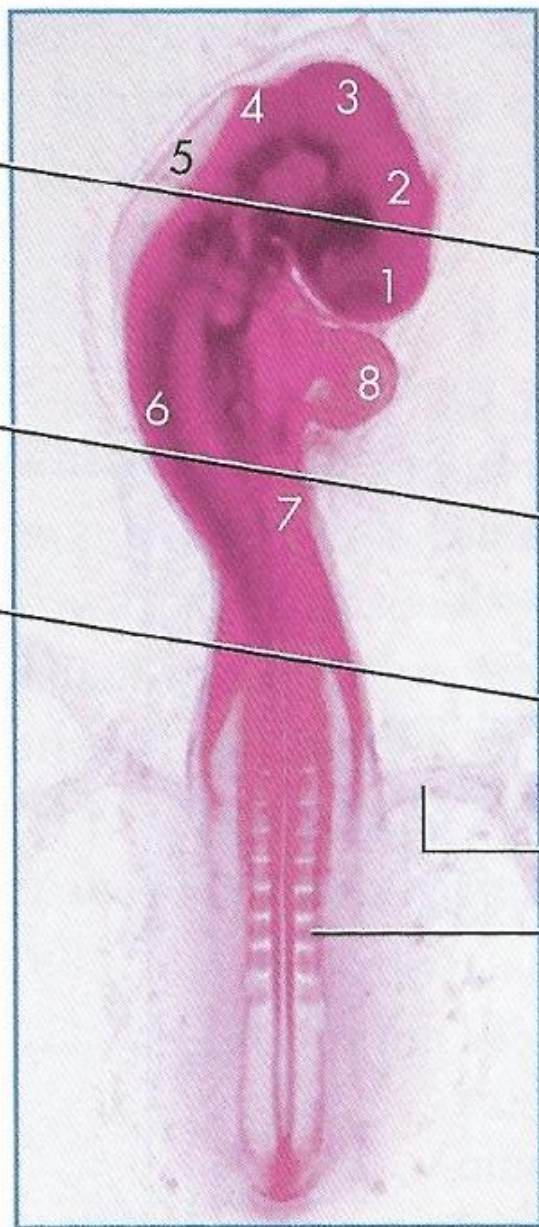




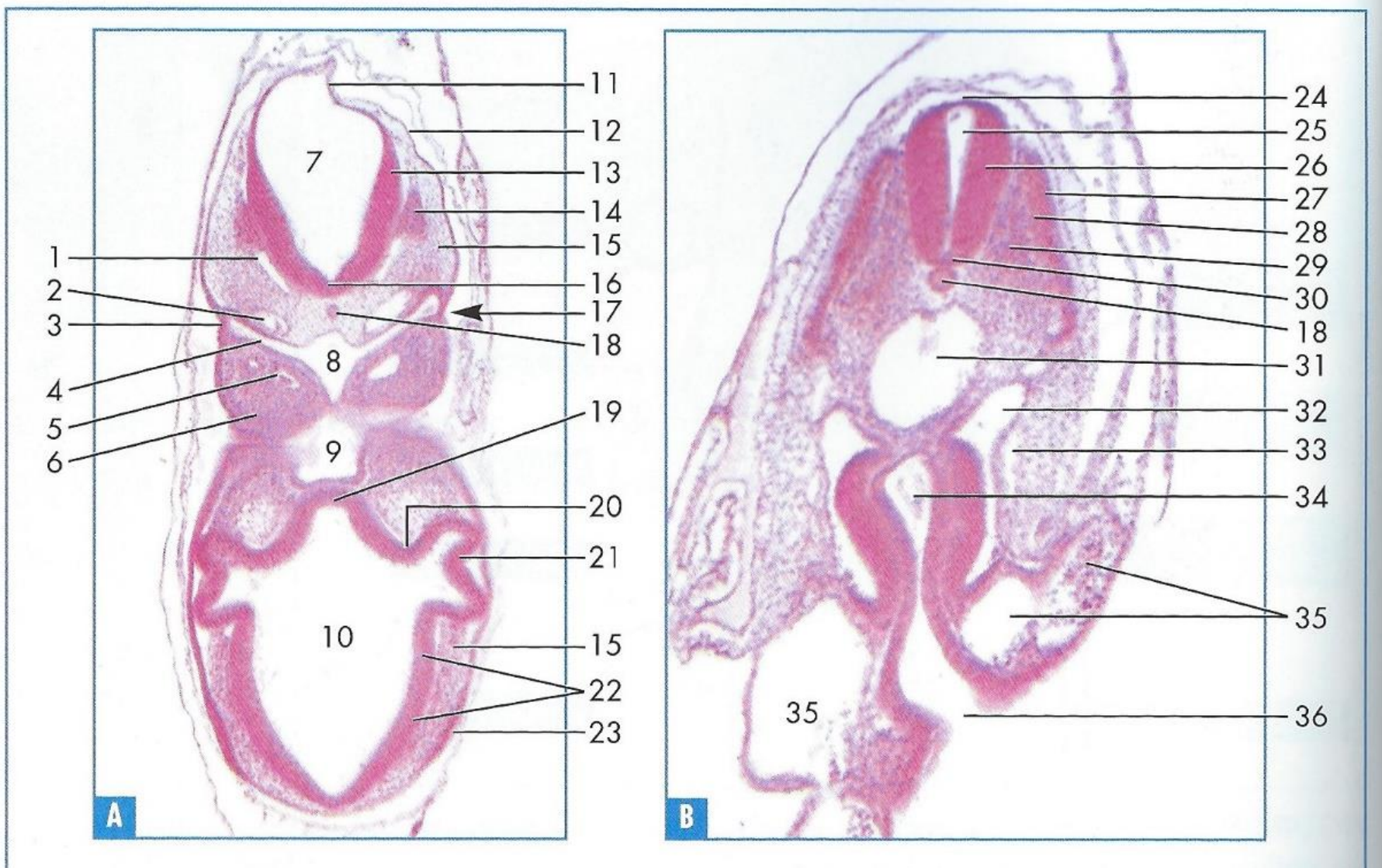
Fig.  
9.4A

Fig.  
9.4B

Fig.  
9.14



- 1=telencephalon
- 2=diencephalon
- 3=mesencephalon
- 4=metencephalon
- 5=myelencephalon
- 6=spinal cord
- 7=cranial intestinal portal
- 8=heart
- 9=vitelline artery
- 10=somite



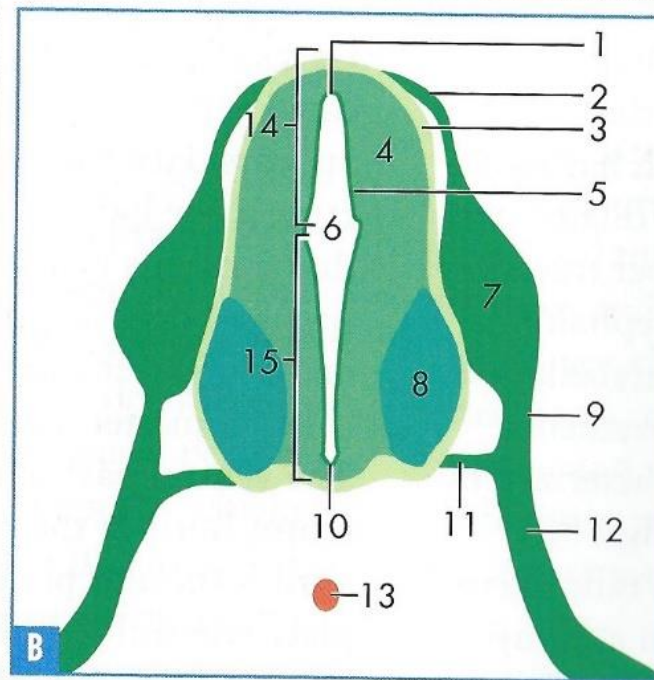
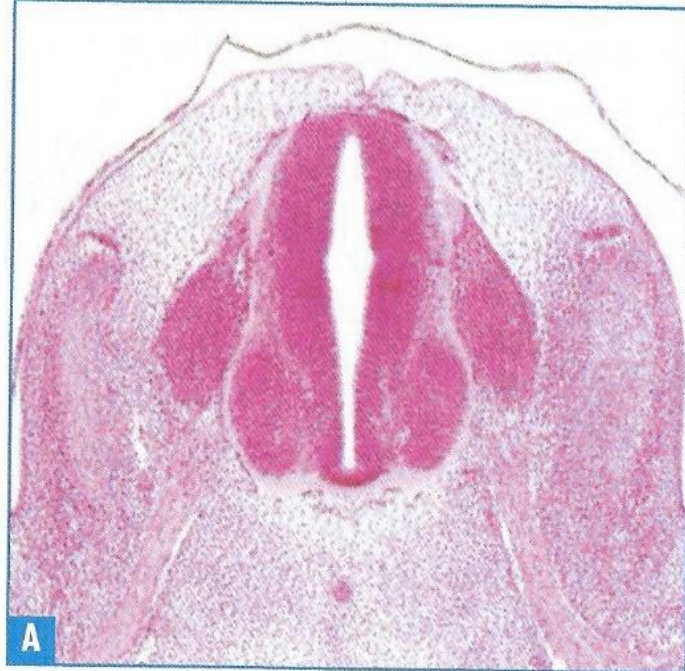
# Divisions of the Brain

- Telencephalon
  - Cerebrum
  - Olfactory lobes (smell)
- Diencephalon
  - Optic cups (eyes)
  - Thalamus and hypothalamus
  - Infundibulum (posterior pituitary)
    - Anterior pituitary forms from ectodermal tissue (Rathke's pouch)
- Metencephalon
  - Cerebellum and pons
- Myelencephalon
  - Medulla

# Peripheral nerves

- Cranial nerves
  - Exit ventral surface of brain
- Spinal nerves
  - Formed from neural tube and neural crest cells
    - Dorsal root – sensory nerves
    - Ventral root – motor nerves

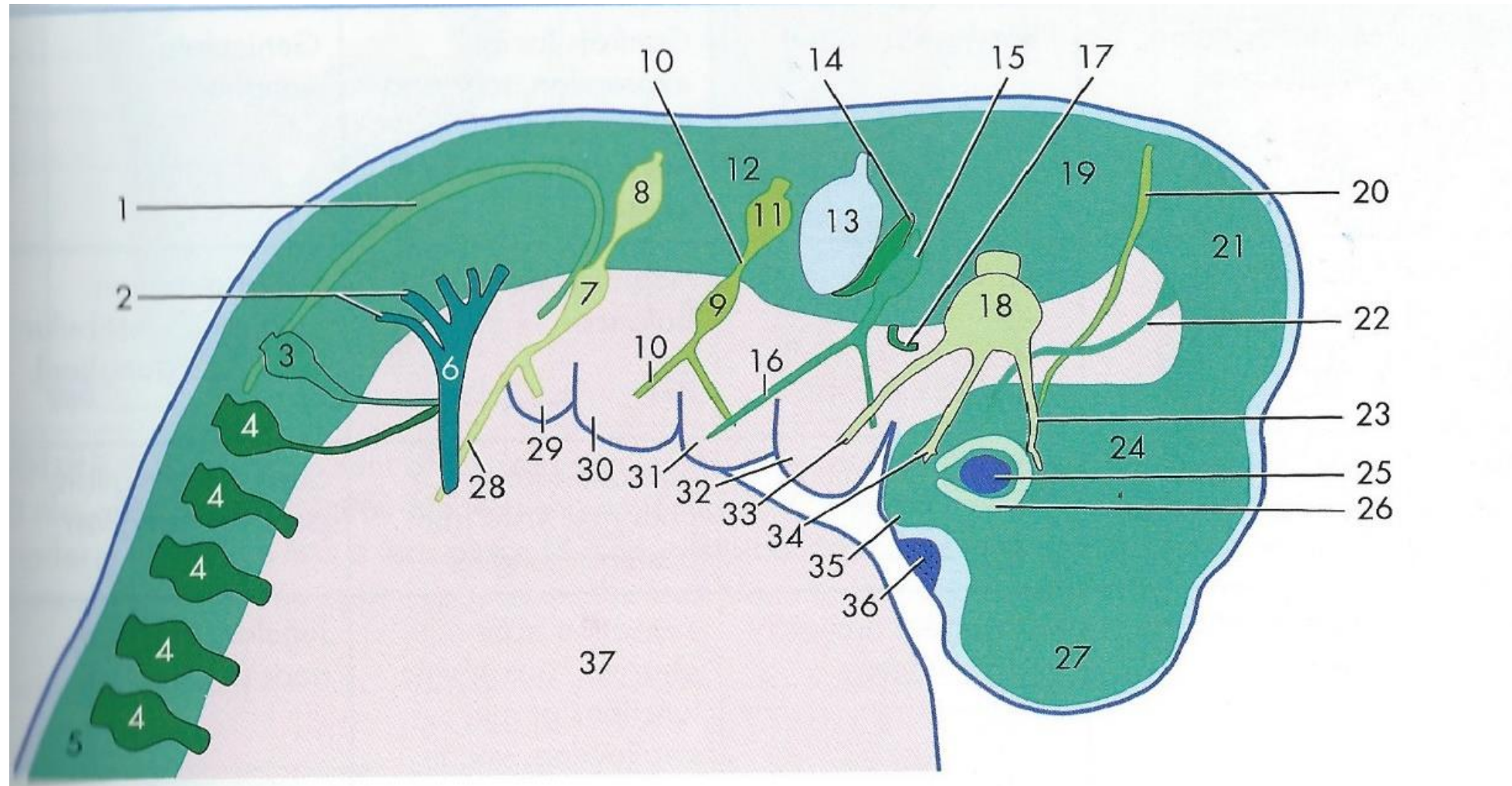




- 1=roof plate
- 2=dorsal root axons
- 3=marginal layer
- 4=mantle layer (intermediate zone)
- 5=ependymal layer (ventricular zone)
- 6=spinal canal
- 7=spinal ganglion (dorsal root ganglion)

- 8=motor horn of spinal cord
- 9=dorsal root
- 10=floor plate
- 11=ventral root
- 12=spinal nerve
- 13=notochord
- 14=alar plate
- 15=basal plate

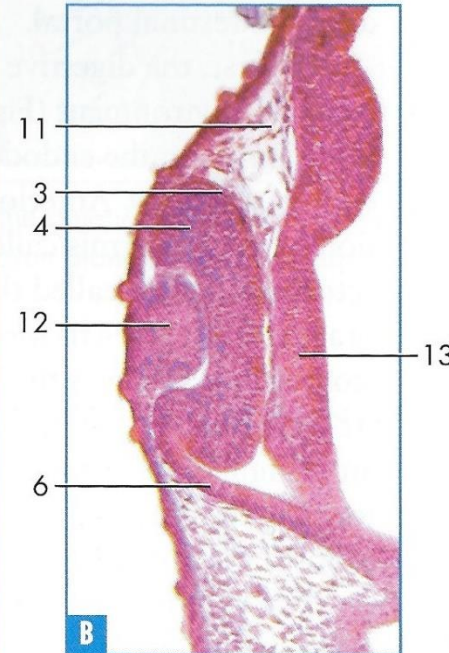
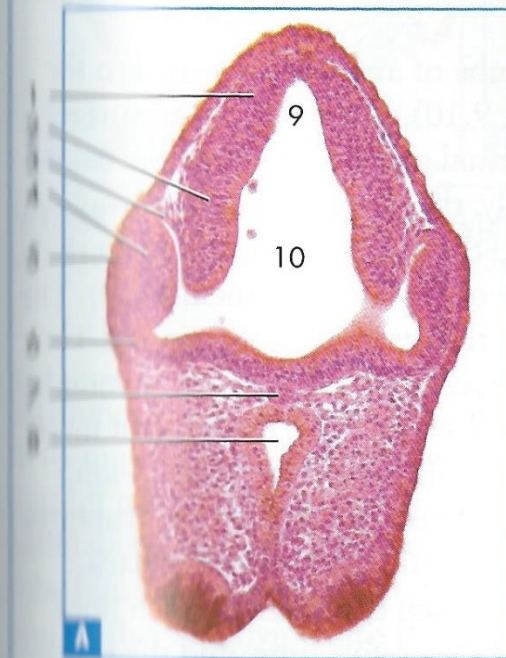




# Special senses

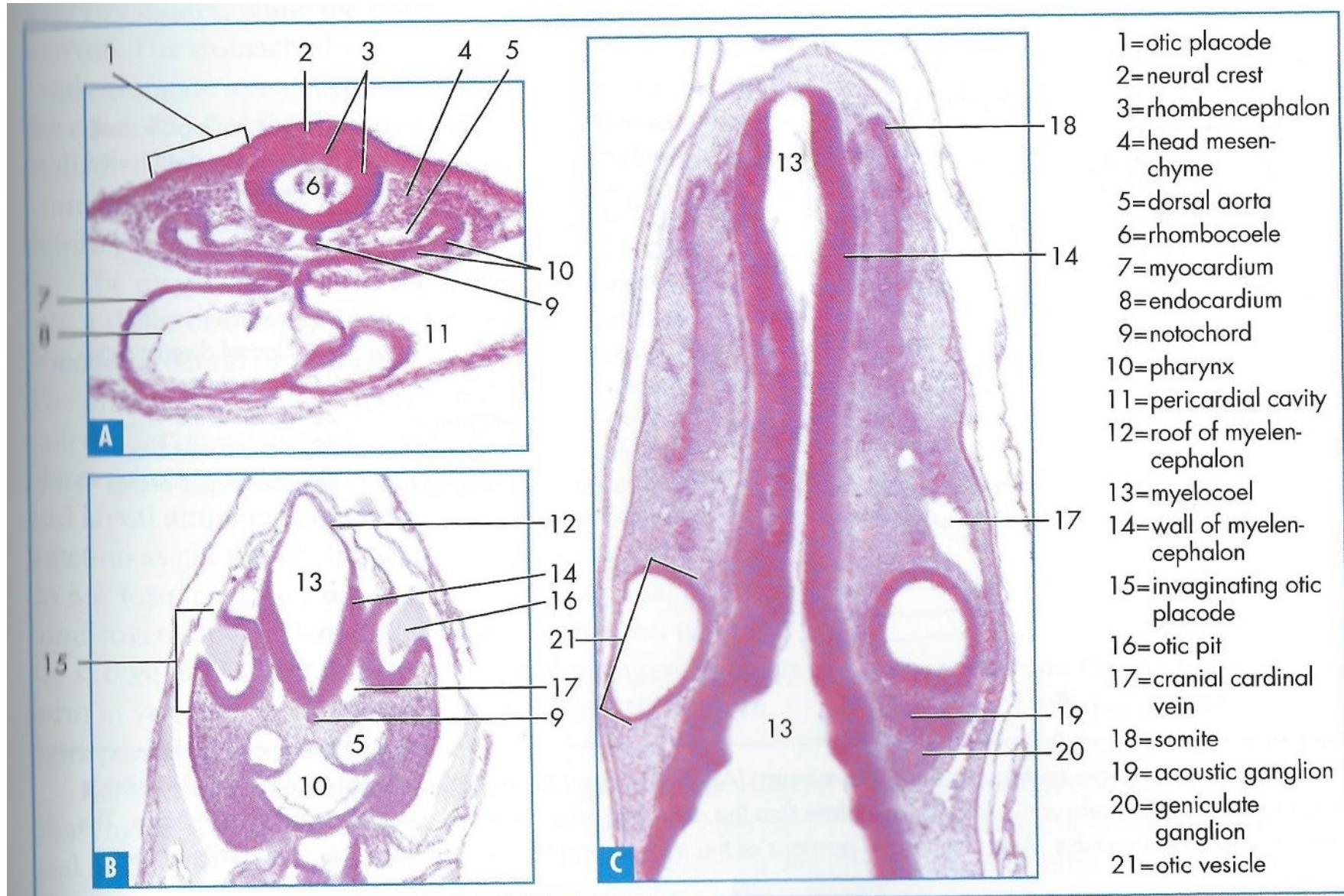
- Derived from ectodermal tissue
  - Evolved from skin surface receptors
  - Placodes – thickened areas that develop specialize receptors
    - Olfactory – smell (chemosensory)
    - Otic (auditory) – hearing (mechanosensory)
    - Optic – sight (light sensing)
- Form pits that connect with neuron in neural tube

**FIGURE 9.7** Whole mount of a 3-7 mm frog tadpole showing the plane of section in Figs. 9.8 and 9.11.



- 1 = mesencephalon
- 2 = prosencephalon
- 3 = pigmented retina
- 4 = sensory retina
- 5 = lens placode
- 6 = optic stalk
- 7 = notochord
- 8 = foregut
- 9 = mesocoele
- 10 = prosocoele
- 11 = head mesenchyme
- 12 = lens
- 13 = diencephalon
- 14 = optic nerve



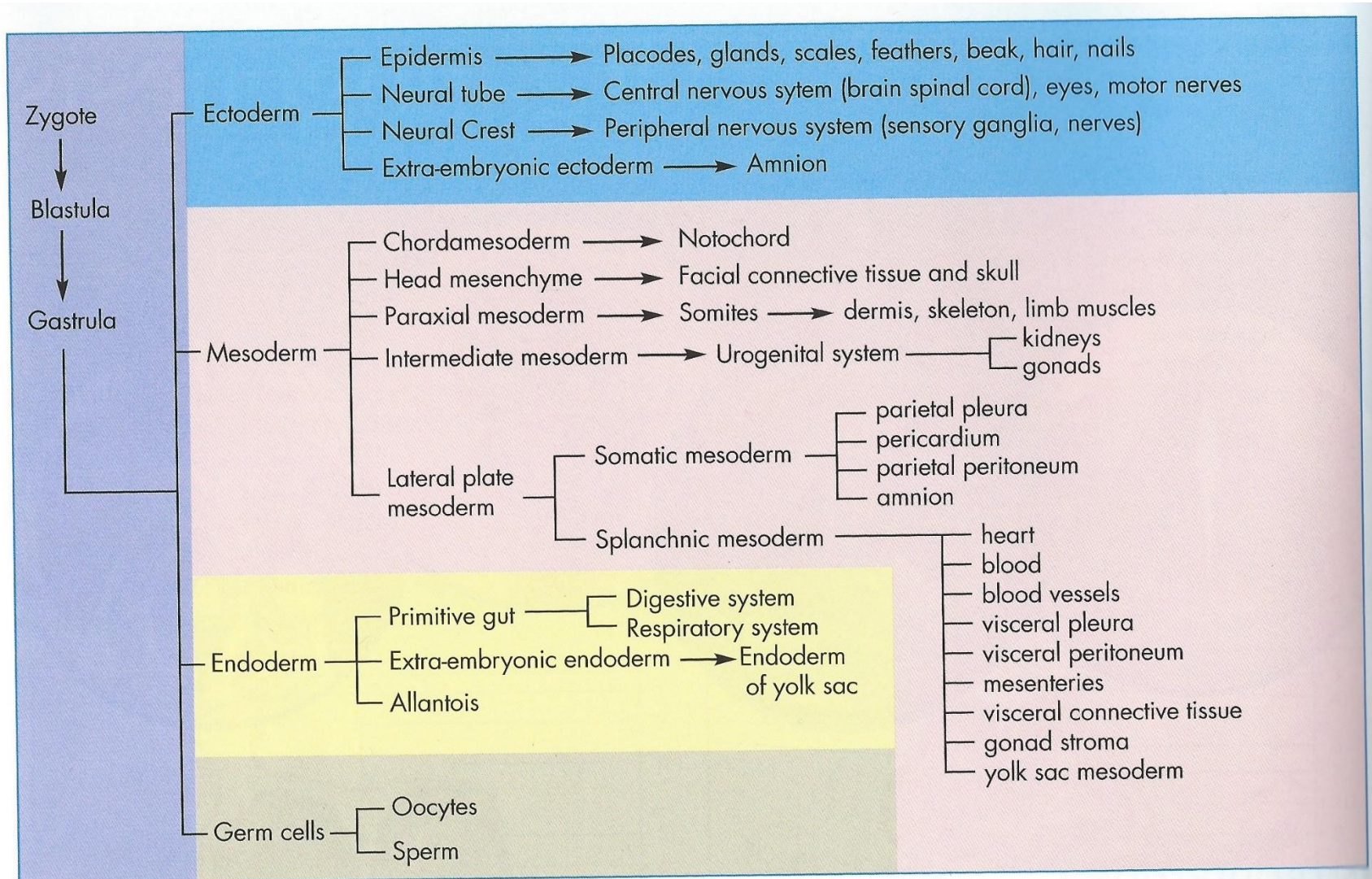


# Bilateral organism

- Special senses concentrated at anterior end
- Useless unless you do something with information.
- Brain developed at anterior end to process information and react.



# Embryonic germ layer derivatives

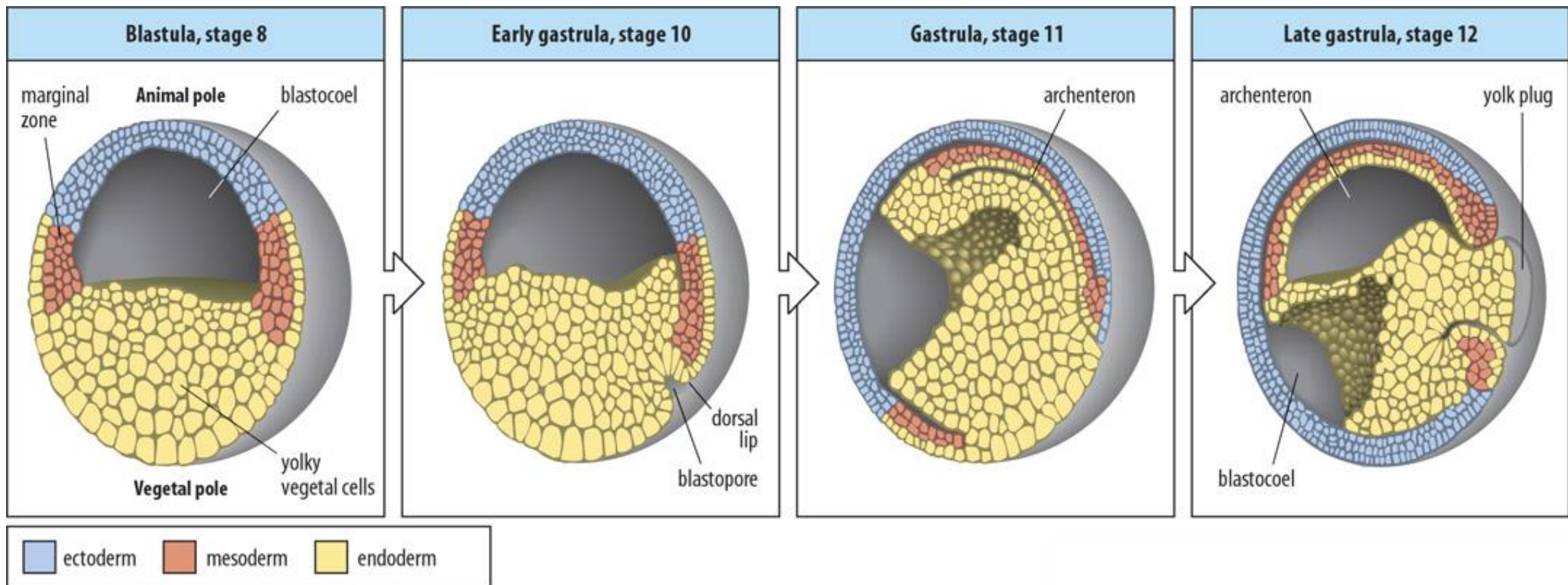


Embryonic germ layers of vertebrates. The origins of all the organs can be traced back to the germ layers.



# Holoblastic eggs

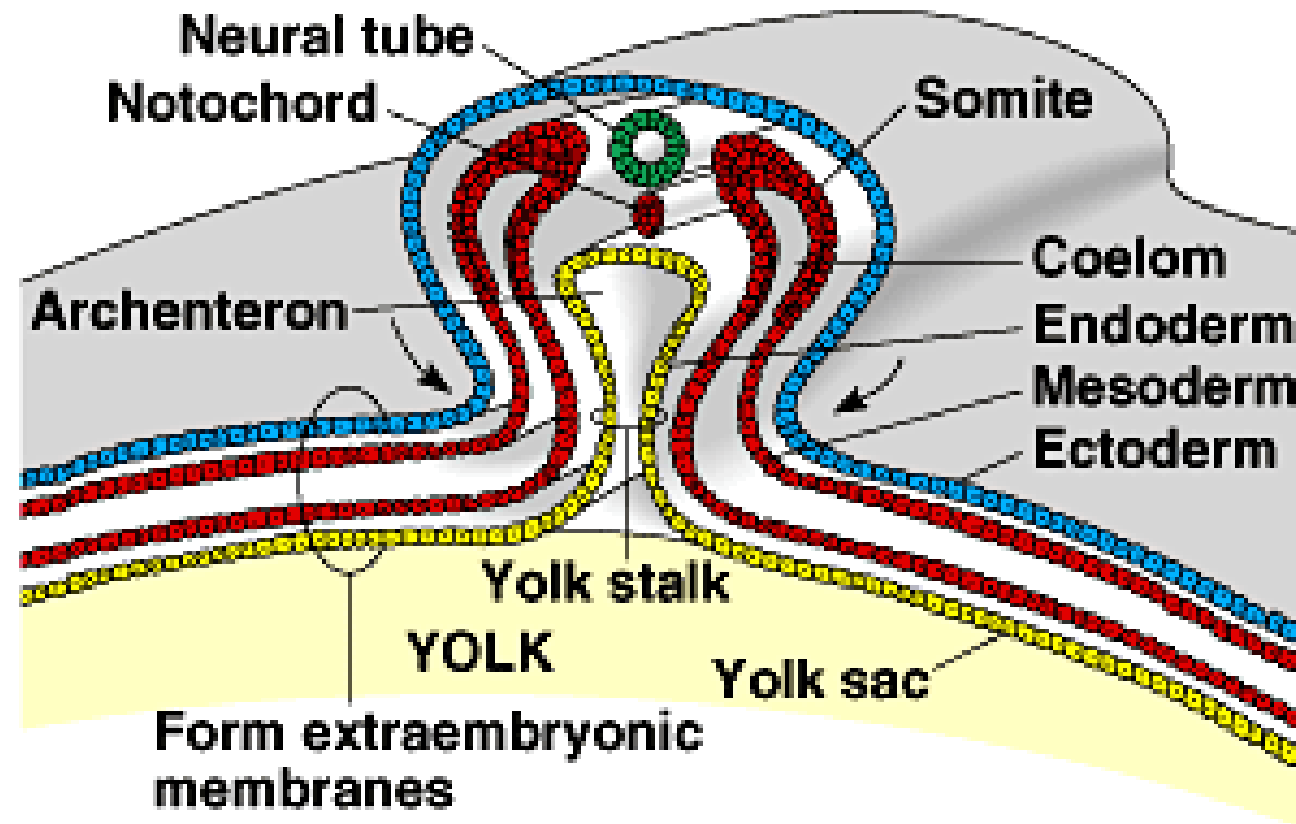
- Pharynx, alimentary canal and lungs develop from archenteron



# Amniote endoderm development

- Pharynx, alimentary canal and lungs develop from pinching in of body folds
- Starts as tube that begins anterior and moves posterior
  - Cranial intestinal port open at posterior end
  - Diverticuli (sack-like outgrowth) form the different sections of the digestive system and respiratory system
- Endoderm forms the inner surface of the digestive system
- Splanchnic mesoderm surrounds the endoderm and forms the smooth muscle of the digestive tract



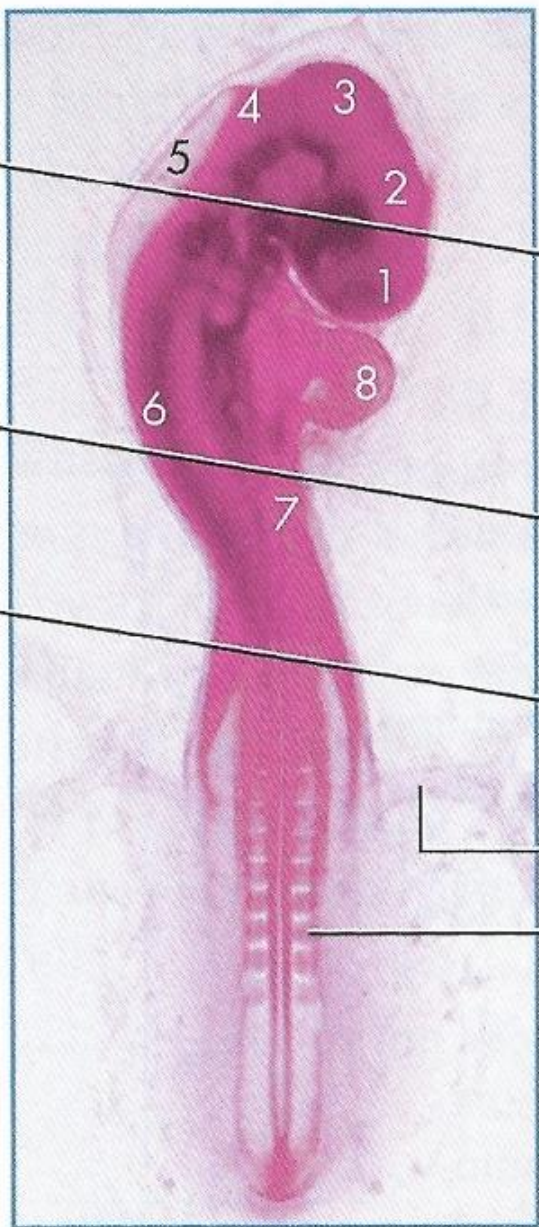


### ③ Early organogenesis

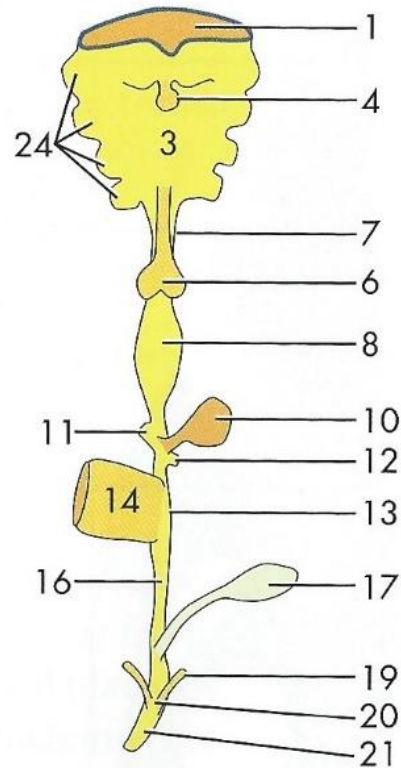
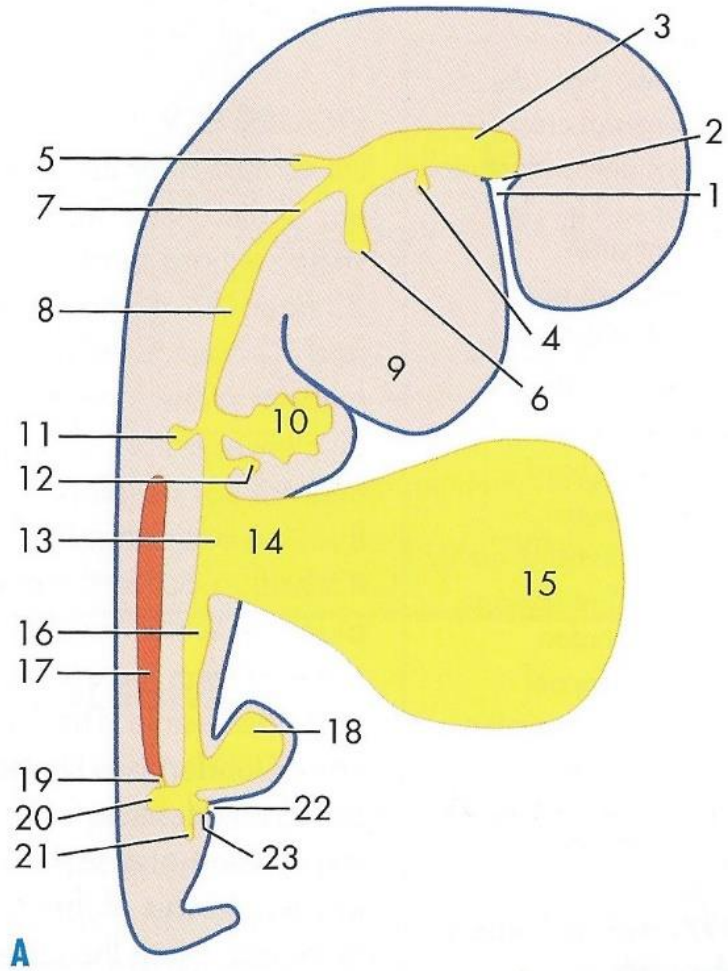
Fig.  
9.4A

Fig.  
9.4B

Fig.  
9.14



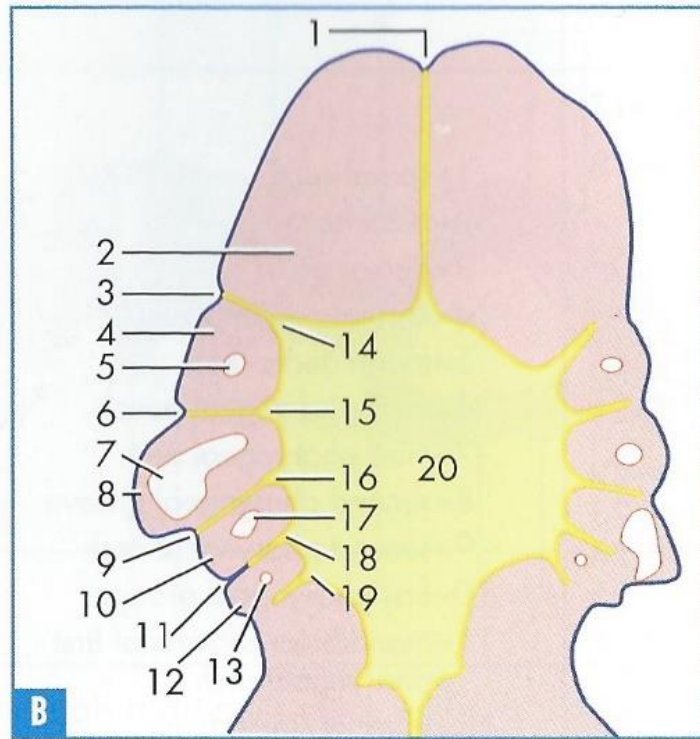
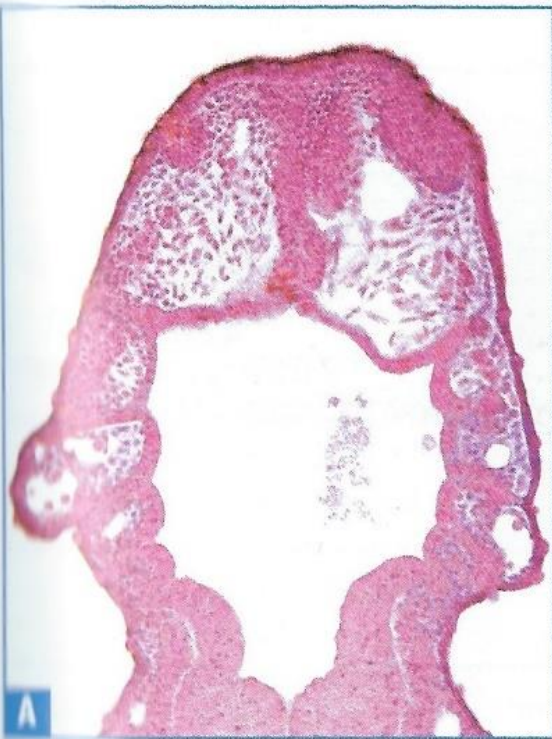
- 1=telencephalon
- 2=diencephalon
- 3=mesencephalon
- 4=metencephalon
- 5=myelencephalon
- 6=spinal cord
- 7=cranial intestinal portal
- 8=heart
- 9=vitelline artery
- 10=somite



- 1=stomodeum
- 2=oral plate
- 3=pharynx
- 4=thyroid diverticulum
- 5=air bladder diverticulum
- 6=lung diverticulum
- 7=esophagus
- 8=stomach
- 9=heart
- 10=hepatic (liver) diverticulum
- 11=dorsal pancreas diverticulum
- 12=ventral pancreas diverticulum
- 13=small intestine

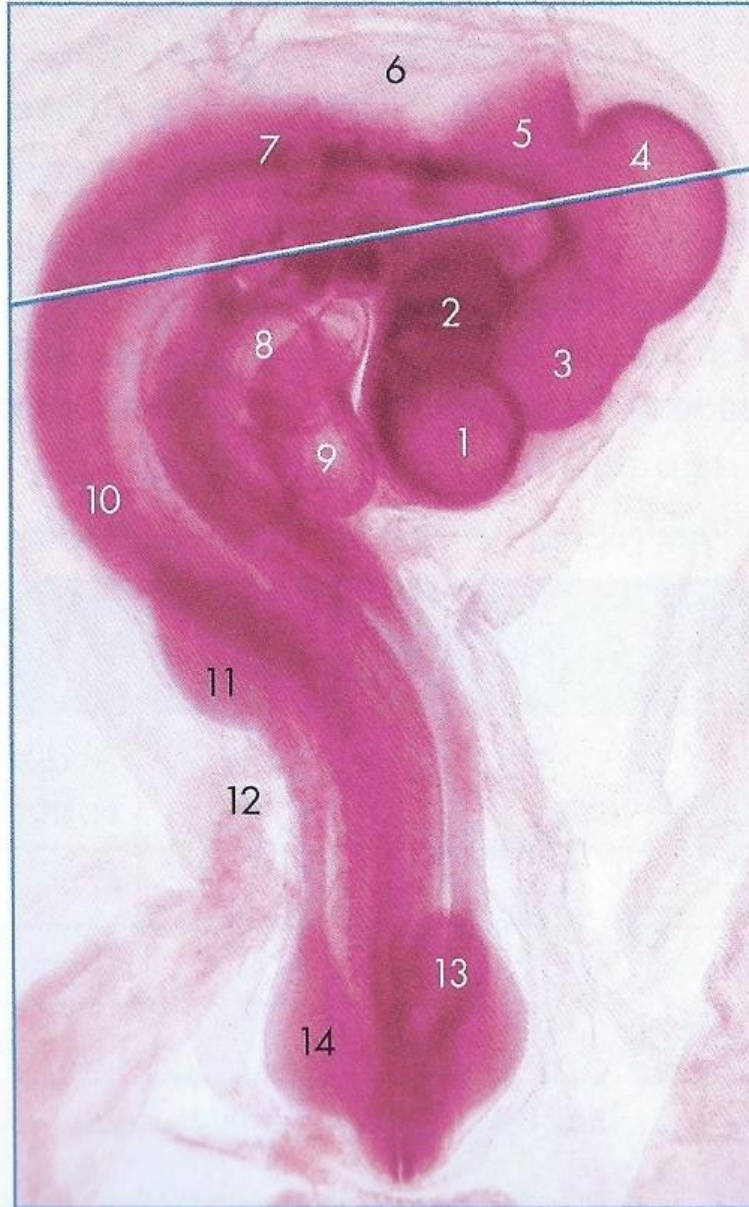
- 14=yolk stalk (yolk duct)
- 15=yolk sac diverticulum
- 16=large intestine
- 17=mesonephros
- 18=allantoic/bladder diverticulum
- 19=mesonephric duct
- 20=cloacal diverticulum
- 21=postanal gut
- 22=proctodeum
- 23=cloacal membrane
- 24=pharyngeal arches





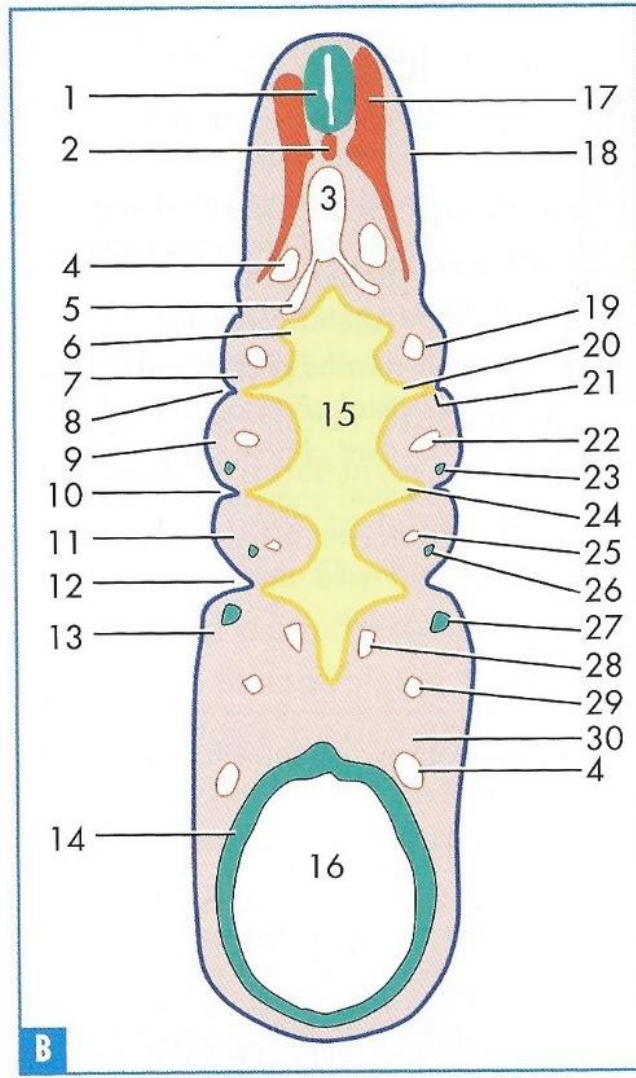
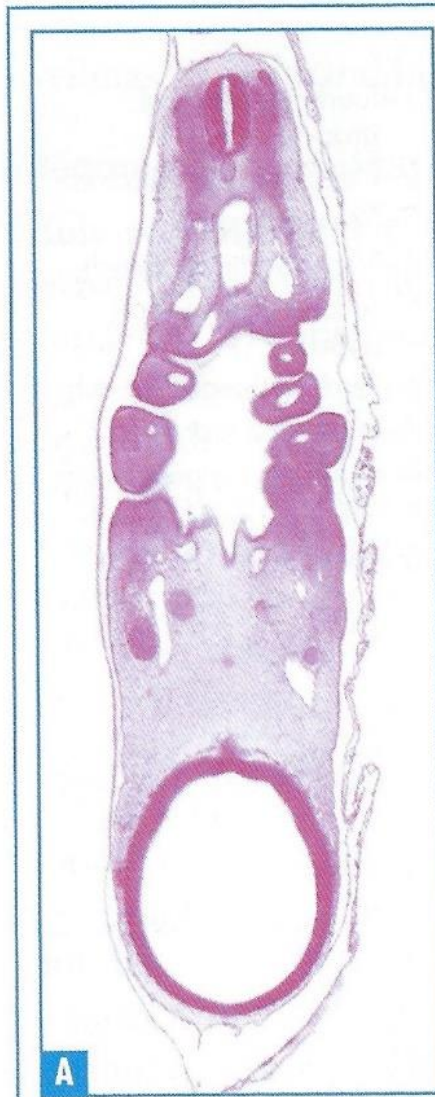
- 1=stomodeum
- 2=pharyngeal arch 1 (mandibular arch)
- 3=first pharyngeal groove
- 4=second pharyngeal arch (hyoid arch)
- 5=second aortic arch
- 6=second pharyngeal groove
- 7=third aortic arch
- 8=third pharyngeal arch
- 9=third pharyngeal groove
- 10=fourth pharyngeal arch (hyoid arch)

- 11=fourth pharyngeal groove
- 12=fifth pharyngeal arch
- 13=fifth aortic arch
- 14=first pharyngeal pouch
- 15=second pharyngeal pouch
- 16=third pharyngeal pouch
- 17=fourth aortic arch
- 18=fourth pharyngeal pouch
- 19=fifth pharyngeal pouch
- 20=pharynx



- 1=telencephalon
- 2=eye
- 3=diencephalon
- 4=mesencephalon
- 5=metencephalon
- 6=myelencephalon
- 7=otic vesicle
- 8=atrium
- 9=ventricle
- 10=spinal cord
- 11=wing bud
- 12=vitelline blood vessels
- 13=allantois
- 14=hindleg bud



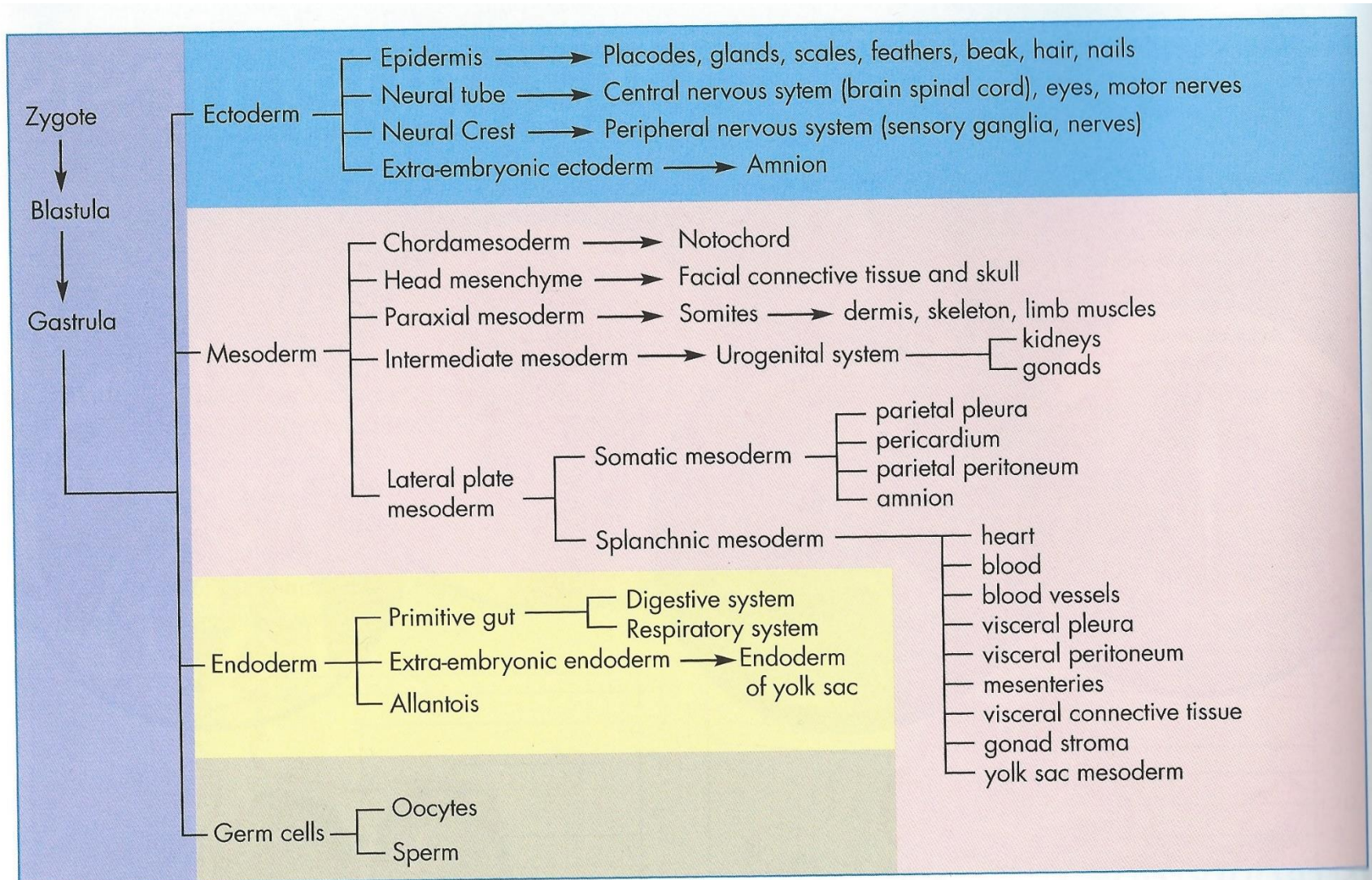


- 1=spinal cord
- 2=notochord
- 3=dorsal aorta
- 4=cranial cardinal vein
- 5=fourth aortic arch
- 6=third pharyngeal pouch
- 7=third pharyngeal arch
- 8=second pharyngeal groove
- 9=second pharyngeal arch
- 10=first pharyngeal groove
- 11=mandibular process of first pharyngeal arch
- 12=edge of stomodeum
- 13=maxillary process of first pharyngeal arch
- 14=mesencephalon
- 15=pharynx
- 16=mesocoele

- 17=somite
- 18=epidermis
- 19=third aortic arch
- 20=second pharyngeal pouch
- 21=closing plate
- 22=second aortic arch
- 23=facial nerve
- 24=first pharyngeal pouch
- 25=first aortic arch
- 26=mandibular branch of trigeminal nerve
- 27=maxillary branch of trigeminal nerve
- 28=internal carotid artery
- 29=ophthalmic vein
- 30=head mesenchyme



# Embryonic germ layer derivatives

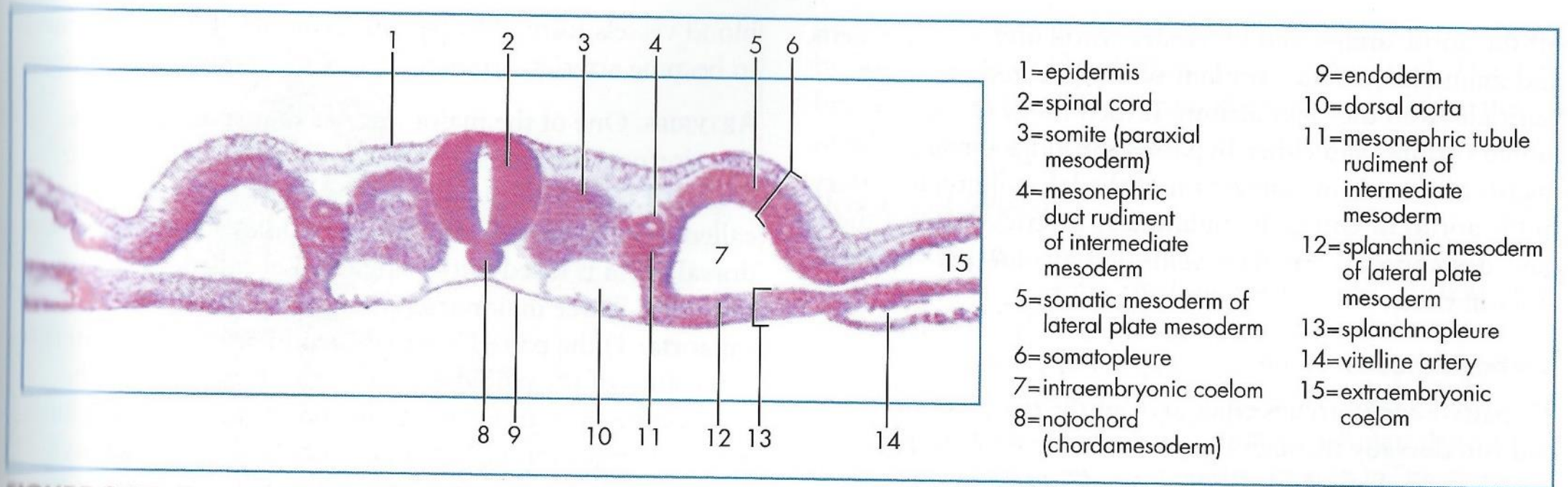


Embryonic germ layer derivatives of vertebrates. The origins of all the organs can be traced back to the germ layers.



# Somite formation

- Derived from paraxial mesoderm
- Three regions
  - Dermatome – integument of back
  - Myotome – muscles
  - Sclerotome – cartilage

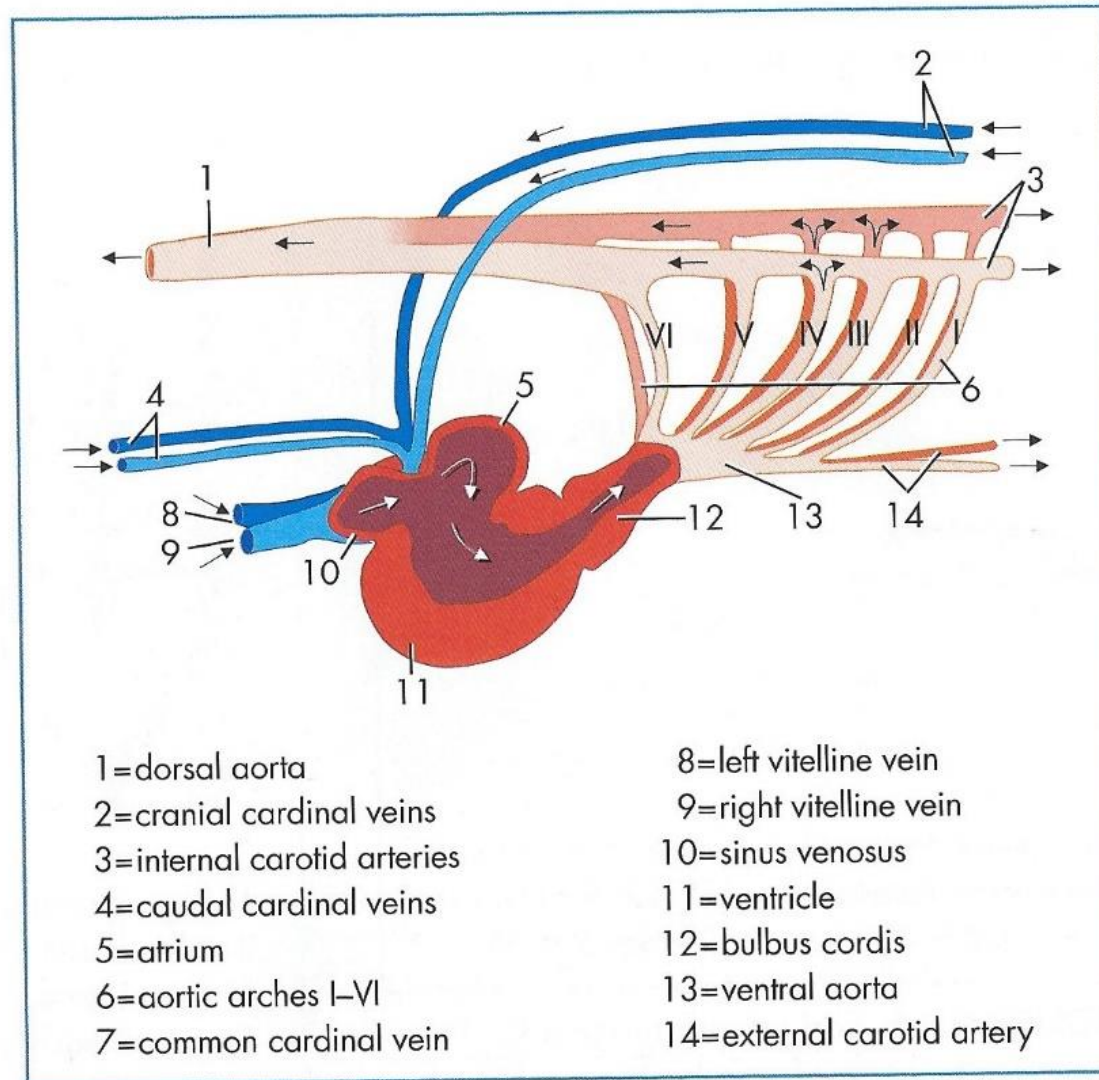


**FIGURE 9.14** Transverse section through a 48-hour chick embryo showing several types of mesoderm. The plane of section is shown in Fig. 9.3.

# Heart development

- Derived from splanchnic mesoderm
  - Two thickened areas split to form tubes that then fuse to form heart tube
- The heart tube develops into four sections
  - Sinus venosus, atrium, ventricle, bulbus cordis
    - Atria divide in half to form a left and right atria
    - Ventricles divide in half for mammals and birds

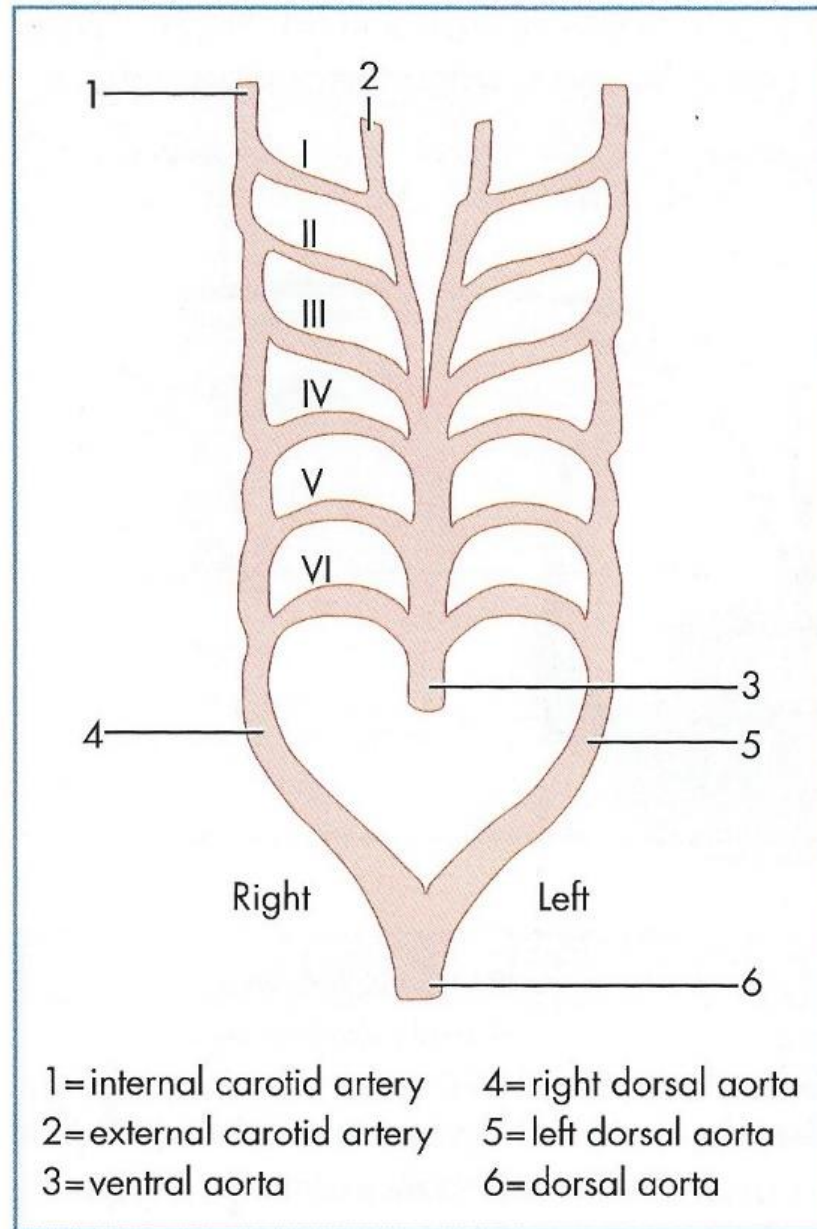




**FIGURE 9.15** Diagram of the embryonic frog heart and associated blood vessels. View is lateral and anterior is to the right. Regions of the heart, and six paired aortic arches (I-VI) are shown. Arrows indicate the direction of blood flow.

# Vascular development

- Derived from lateral plate mesoderm
- Forms six paired aortic arches
- Degeneration and reorganization of aortic arches is species specific





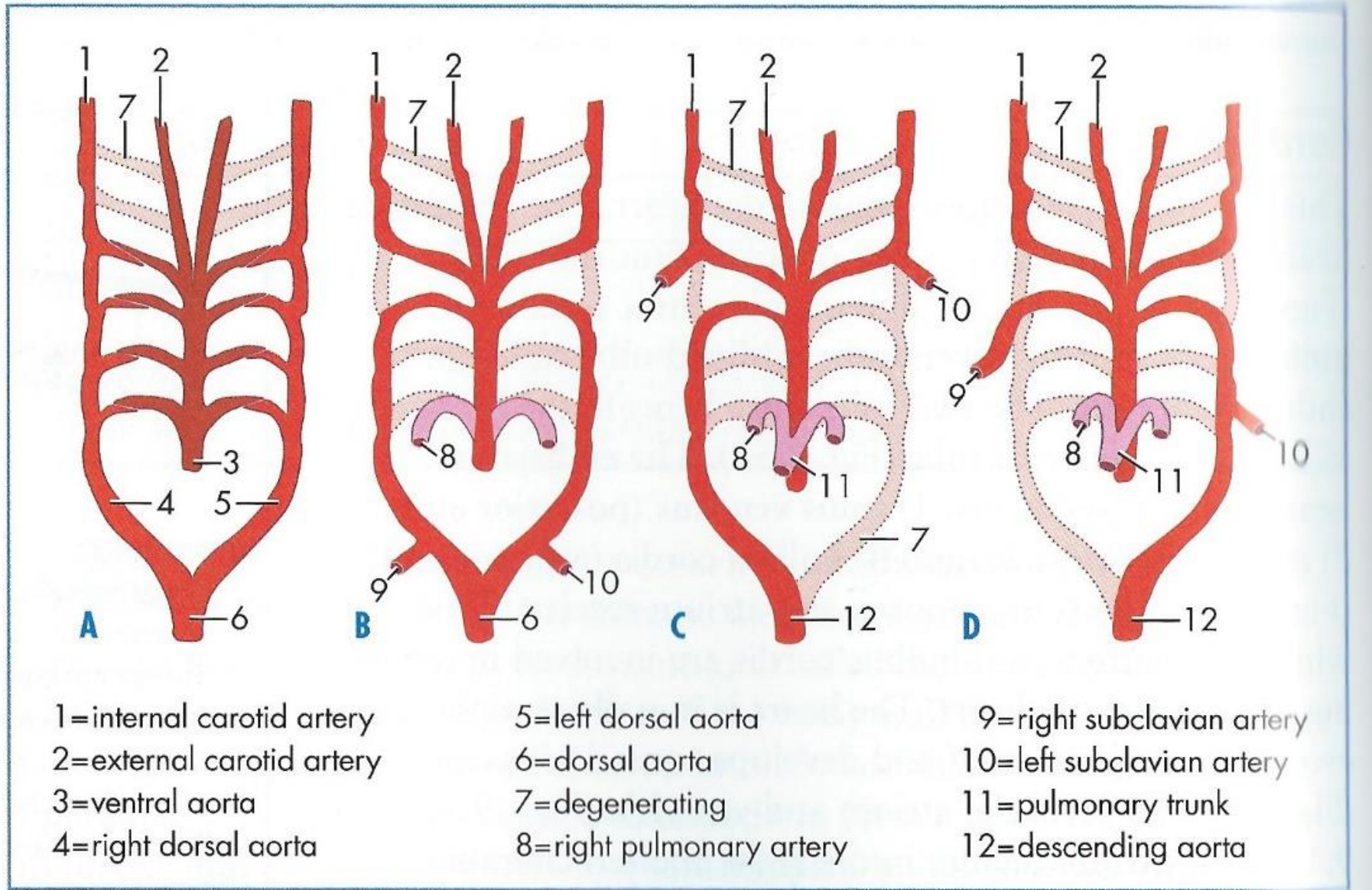
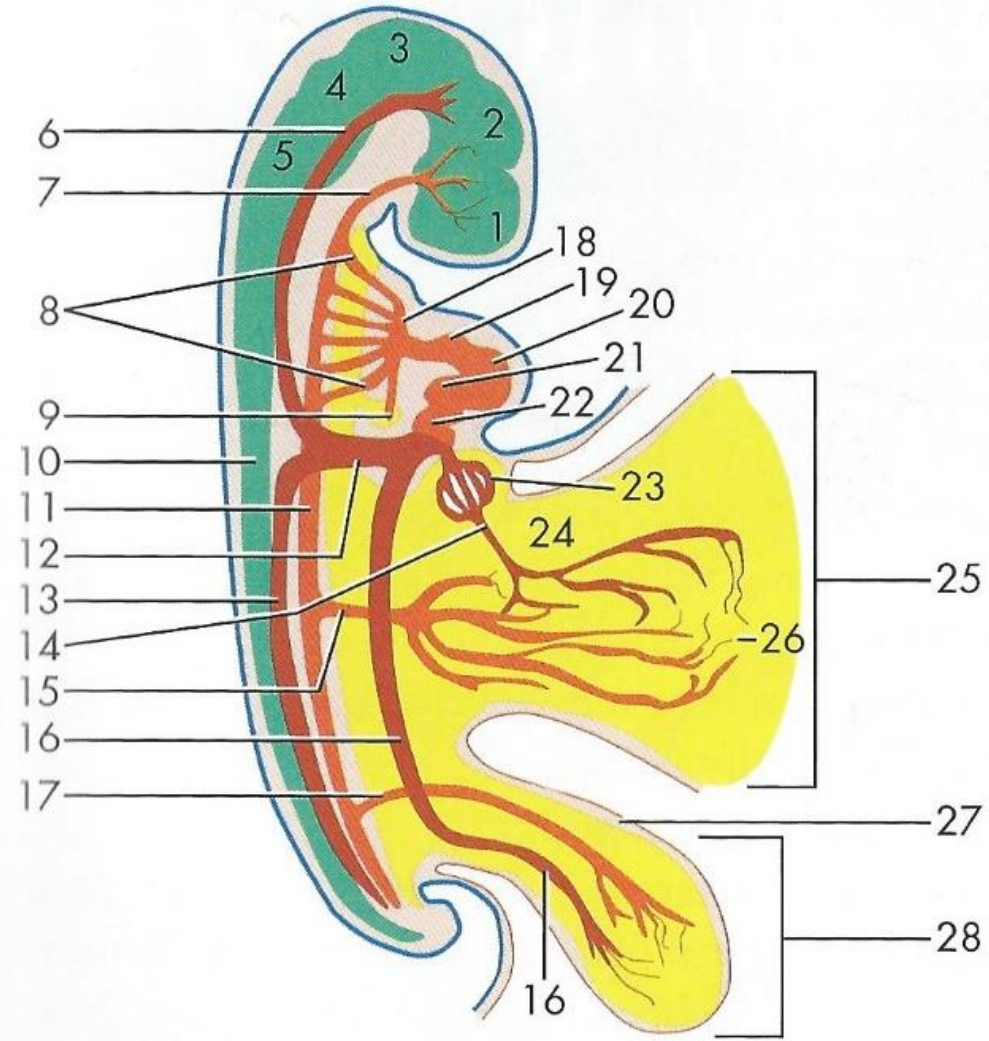


FIGURE 17.5 The development of the arterial system. (A) Early stage. (B) Intermediate stage. (C) Late stage. (D) Final stage.

# Embryonic circulation

- Cardinal system – head and body wall
- Vitelline system – yolk sack
- Hepatic veins – liver
- Allantoic vessels – gas exchange and waste removal
  - Develop into umbilical vessels in mammals





# Kidney development

- Derived from intermediate mesoderm
- Three pairs of embryonic kidneys form
  - Pronephros – primary kidney of frog embryo
  - Mesonephros – permanent kidney in frog, embryonic kidney of some amniotes
  - Metanephros – permanent kidney of amniotes
- Only one pair of kidneys are permanent, the rest degenerate

