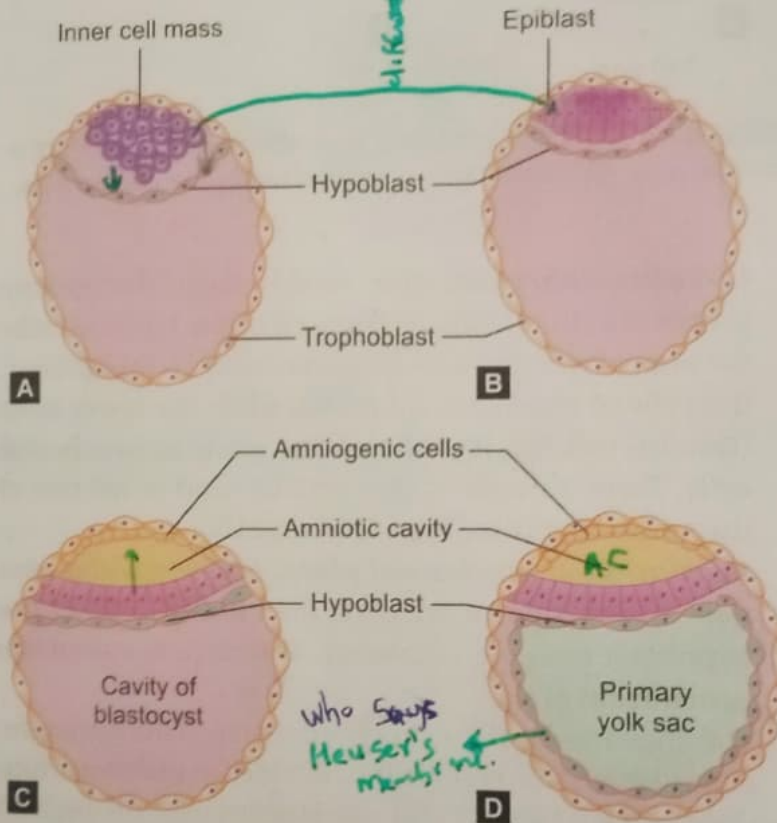


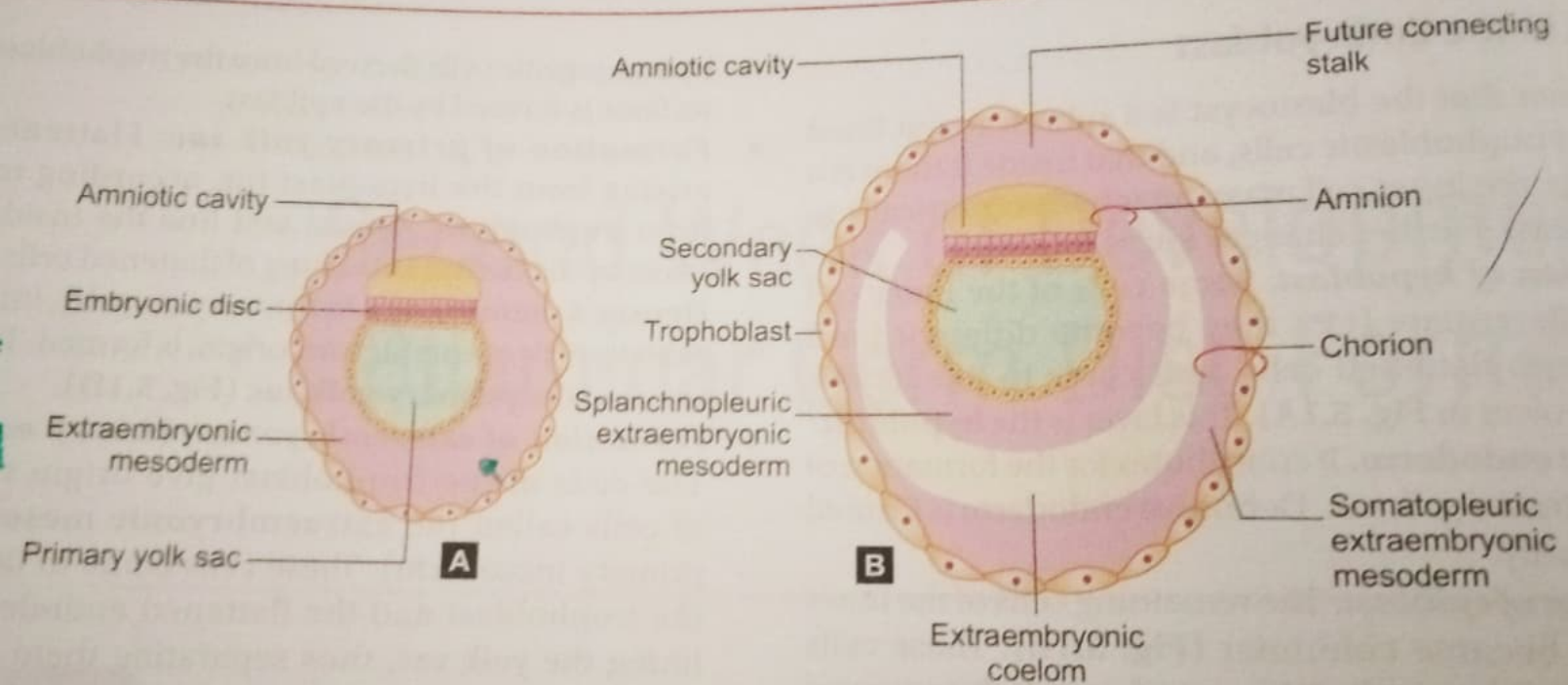


formation of extra embryonic mesoderm
extra embryonic coelom

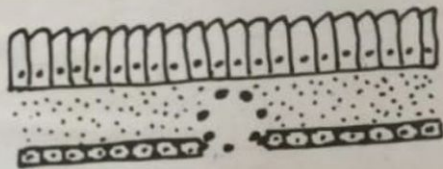
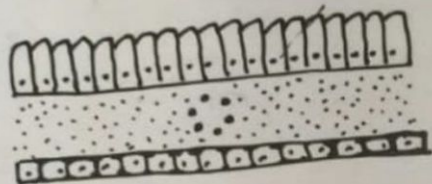
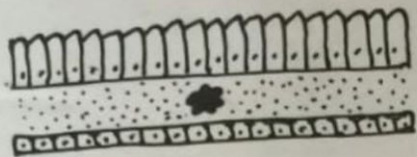




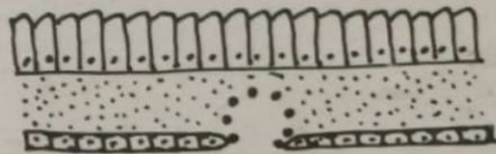
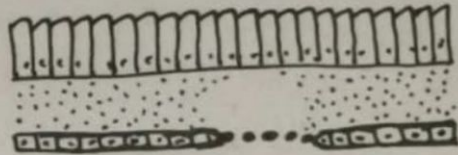
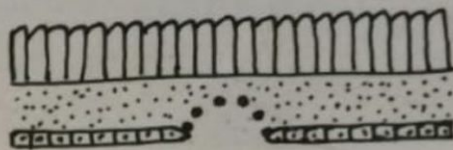
FIGS. 5.1A TO D: Differentiation of endoderm and ectoderm, and the formation of the amniotic cavity and the yolk sac.

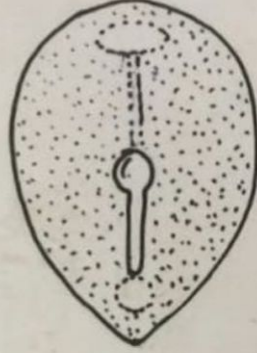


FIGS. 5.2A AND B: Formation of extraembryonic mesoderm and extraembryonic coelom. Note carefully, the composition of the amnion, and of the chorion.

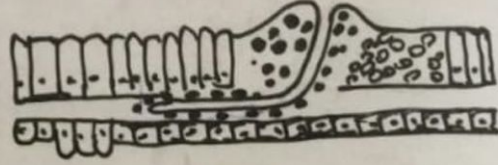
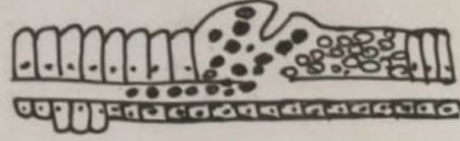
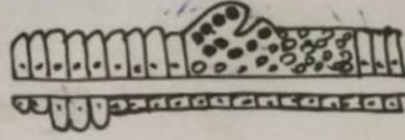
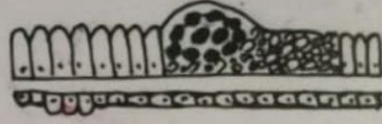


development of notochord transverse section

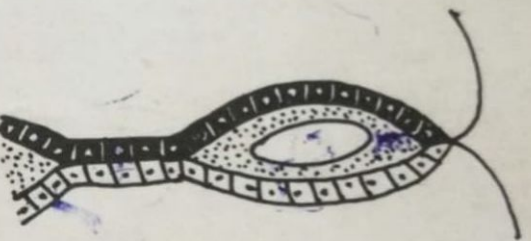




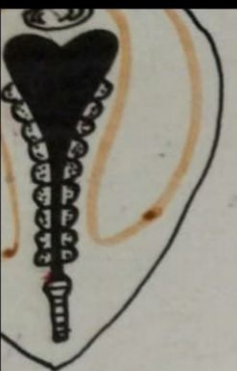
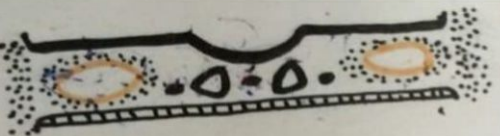
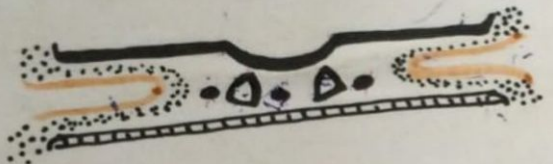
formation of primitive knot

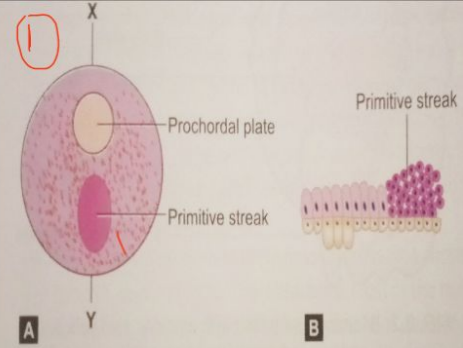


section through embryonic disc at axis

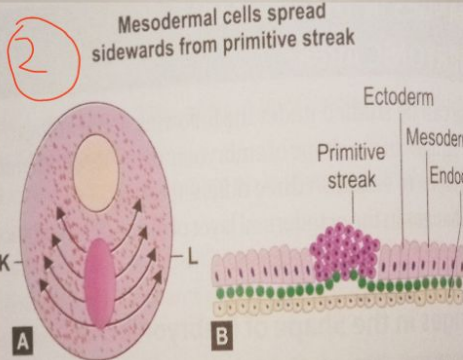


intra embryonic coelom





FIGS. 6.3A AND B: Appearance of primitive streak. 'B' is a section along axis XY shown in 'A'.



FIGS. 6.4A AND B: Formation of intraembryonic mesoderm. 'B' is a section along axis KL in 'A'.

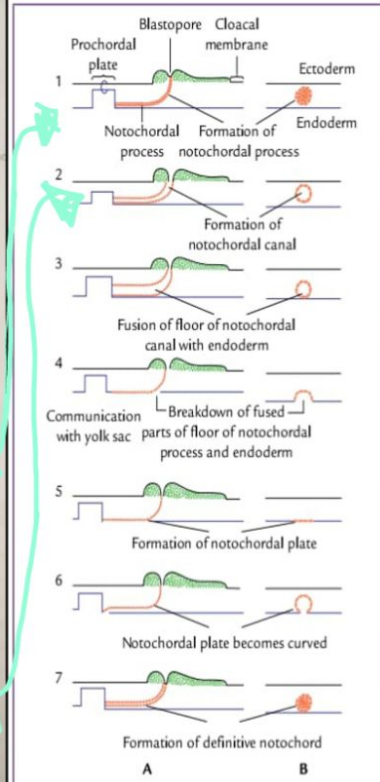
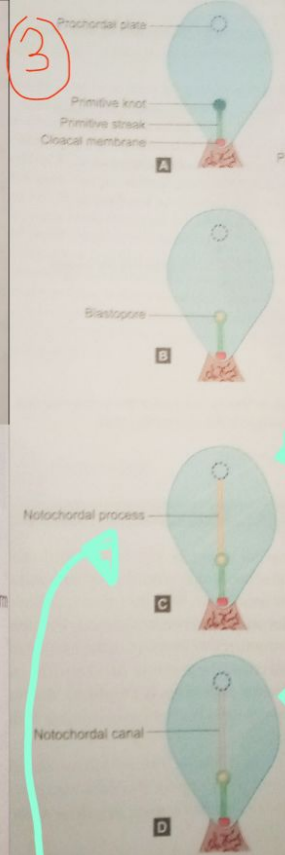


FIG. 5.2 Stages of formation of notochord. A. As seen in longitudinal section (left side). B. As seen in the horizontal section (right side).

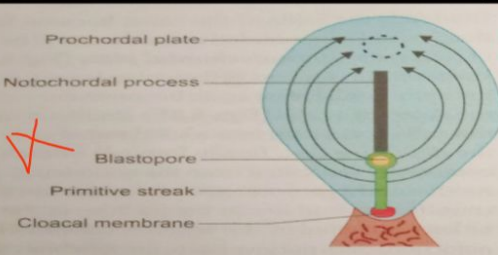


FIG. 6.9: Proliferating intraembryonic mesoderm from primitive node and primitive streak.

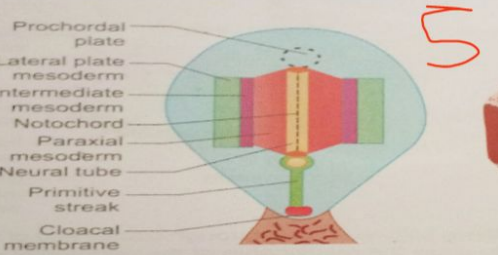
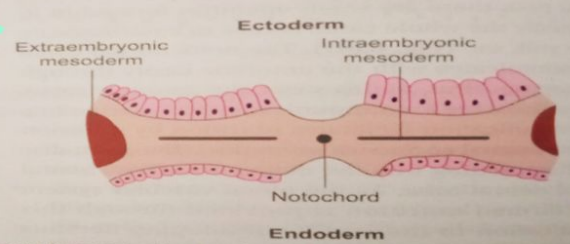


FIG. 6.10: Subdivisions of intraembryonic mesoderm.

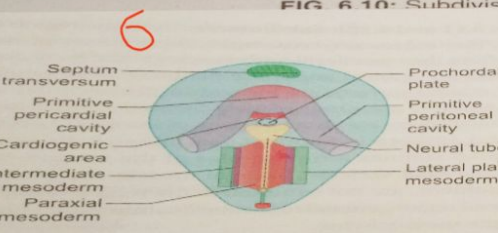
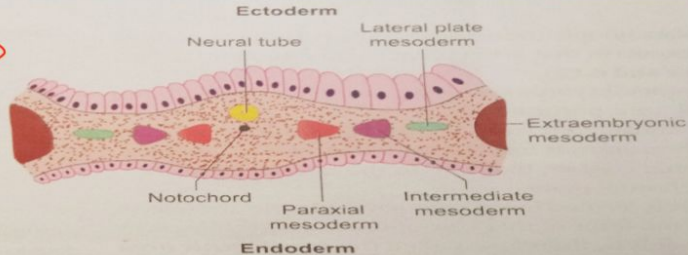


FIG. 6.11: Formation of intraembryonic coelom and its subdivisions.

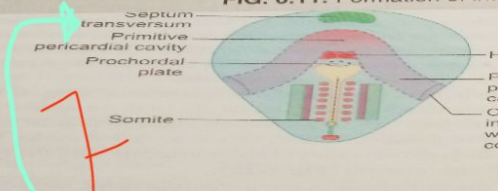
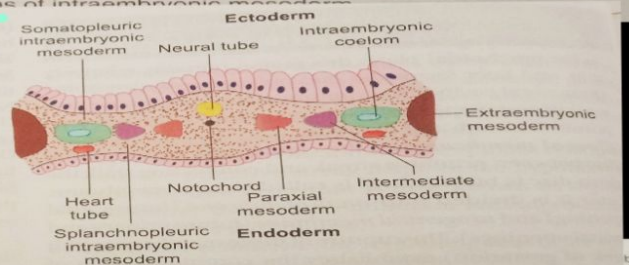


FIG. 6.12: Communication between intraembryonic coelom and extraembryonic coelom. Structures in the midline of germ disc before folding.

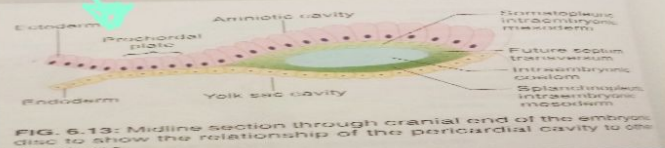
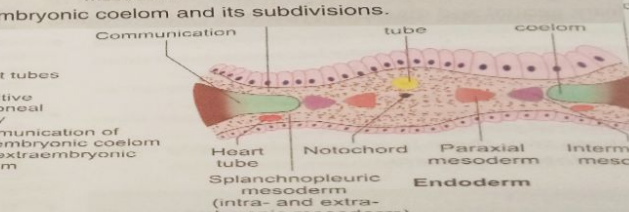


FIG. 6.13: Midline section through cranial end of the embryo. Structures in the midline of germ disc before folding.

ect
meso
Endo

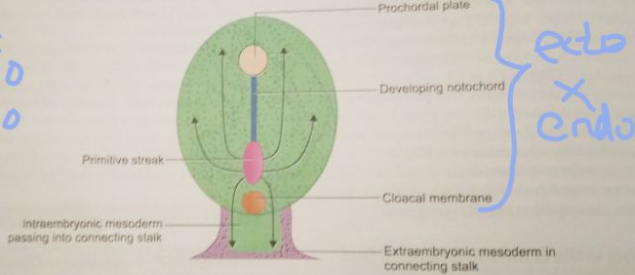


FIG. 5.5: Spread of intraembryonic mesoderm. Note that the mesoderm comes to lie between ectoderm and endoderm in all parts of the embryonic disc except at the: (1) prochordal plate, (2) cloacal membrane and (3) region of the notochord.

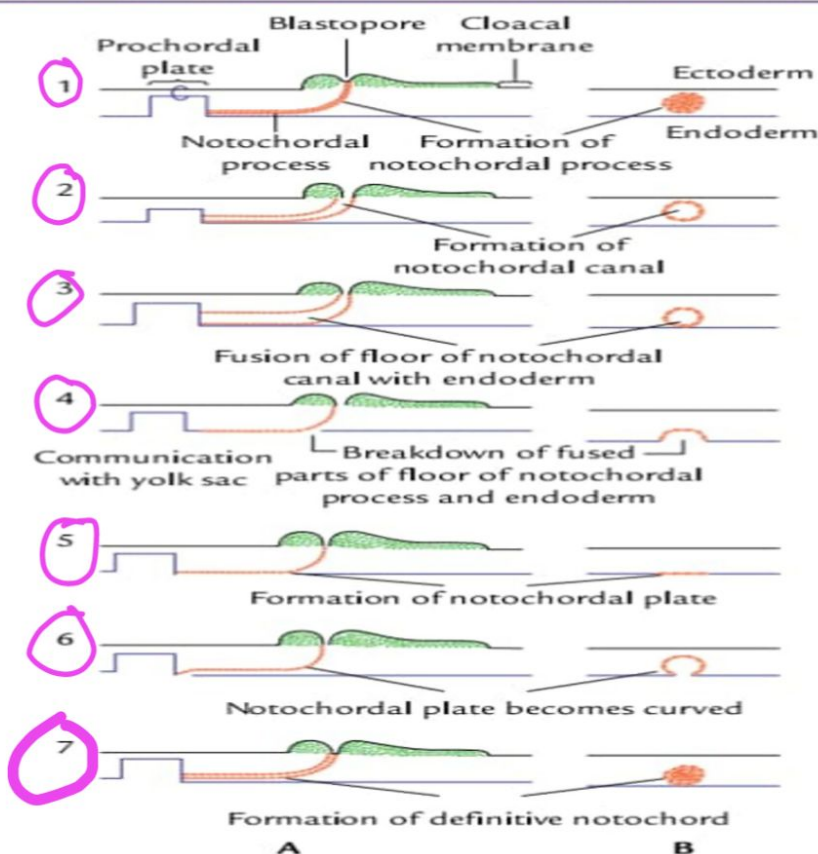
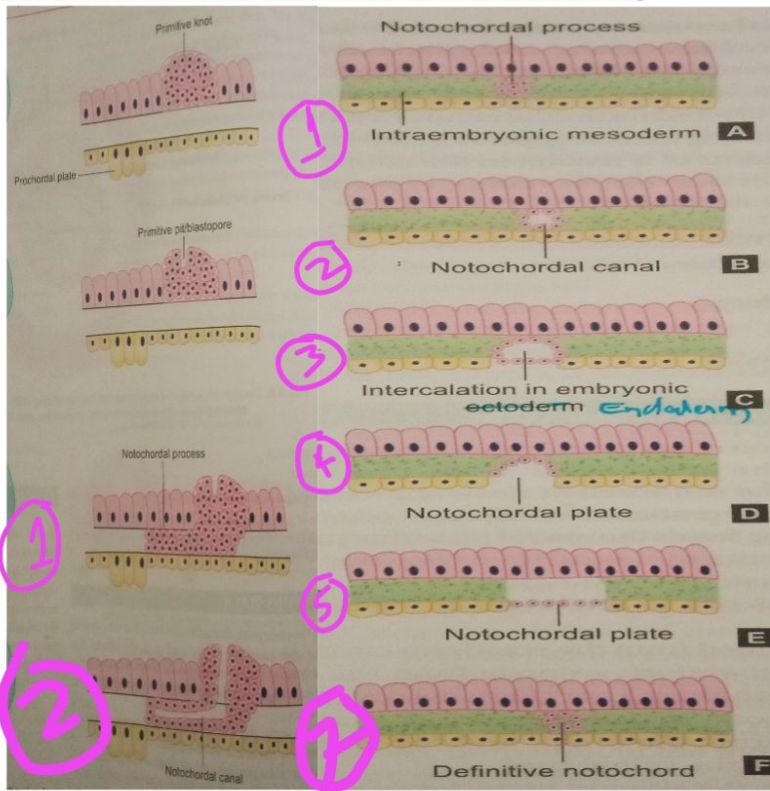
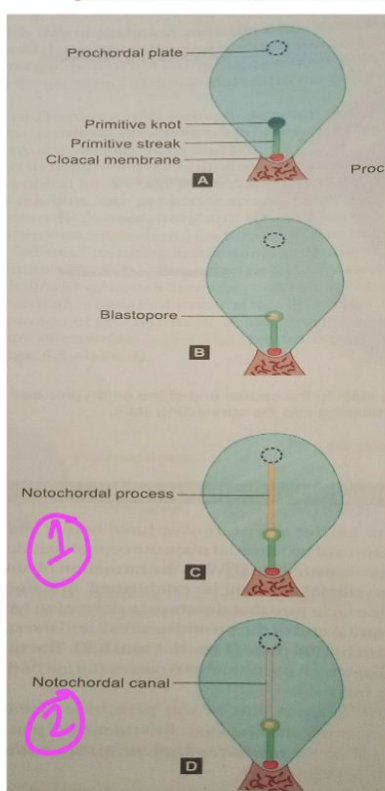


Fig. 5.2 Stages of formation of notochord. A. As seen in longitudinal section (left side). B. As seen in the horizontal section (right side).



Ecto
Meso
Endo

Prochordal plate
Developing notochord
Primitive streak
Cloacal membrane
Intraembryonic mesoderm passing into connecting stalk
Extraembryonic mesoderm in connecting stalk

Ecto
~~Meso~~
Endo

FIG. 6.5: Spread of intraembryonic mesoderm. Note that the mesoderm comes to lie between ectoderm and endoderm in all parts of the embryonic disc except at the: (1) prochordal plate, (2) cloacal membrane and (3) region of the notochord.

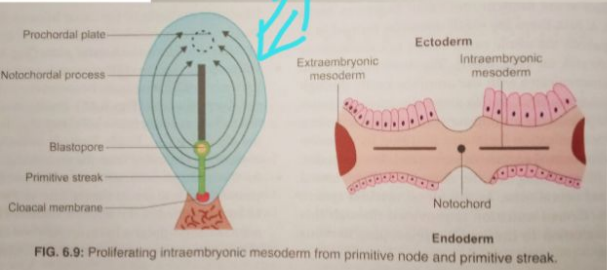


FIG. 6.9: Proliferating intraembryonic mesoderm from primitive node and primitive streak.

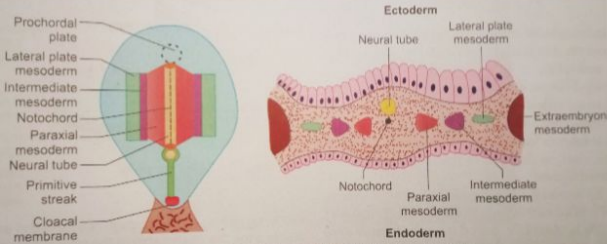


FIG. 6.10: Subdivisions of intraembryonic mesoderm.

The intraembryonic mesoderm now becomes subdivided into three parts (Figs. 6.10 to 6.12):

1. Mesoderm, on either side of the notochord, becomes thick and is called the **paraxial mesoderm**.
2. More laterally, the mesoderm forms a thinner layer called the **lateral plate mesoderm**.
3. Between these two, there is a longitudinal strip called the **intermediate mesoderm**.

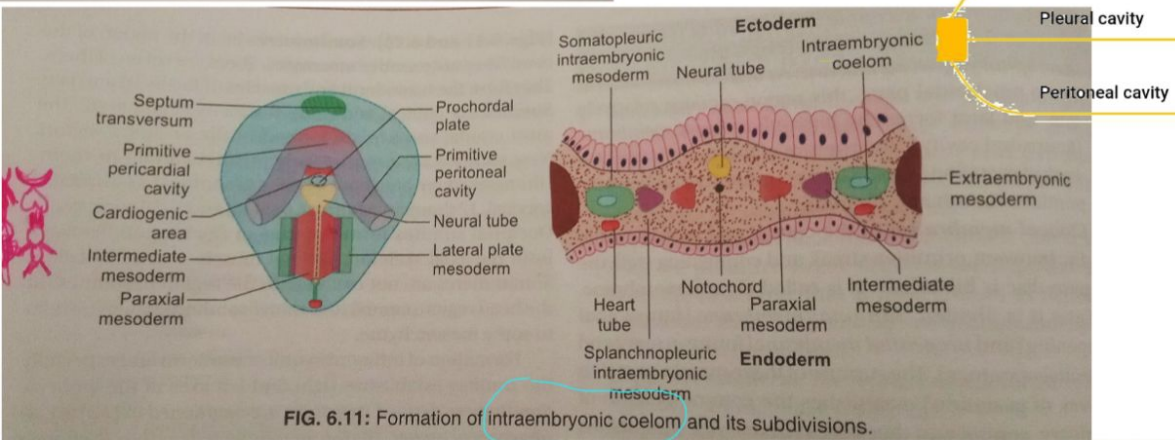


FIG. 6.11: Formation of intraembryonic coelom and its subdivisions.

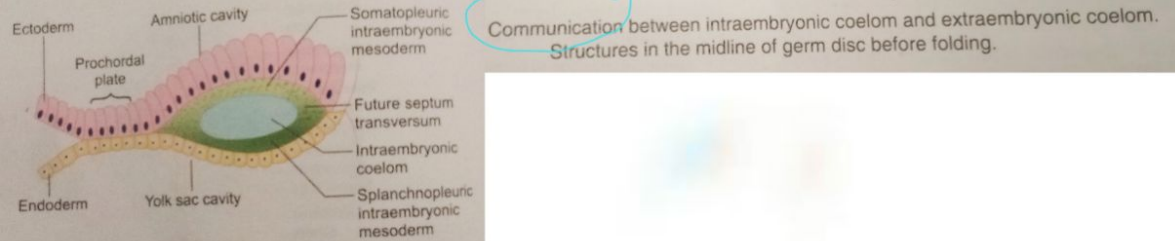
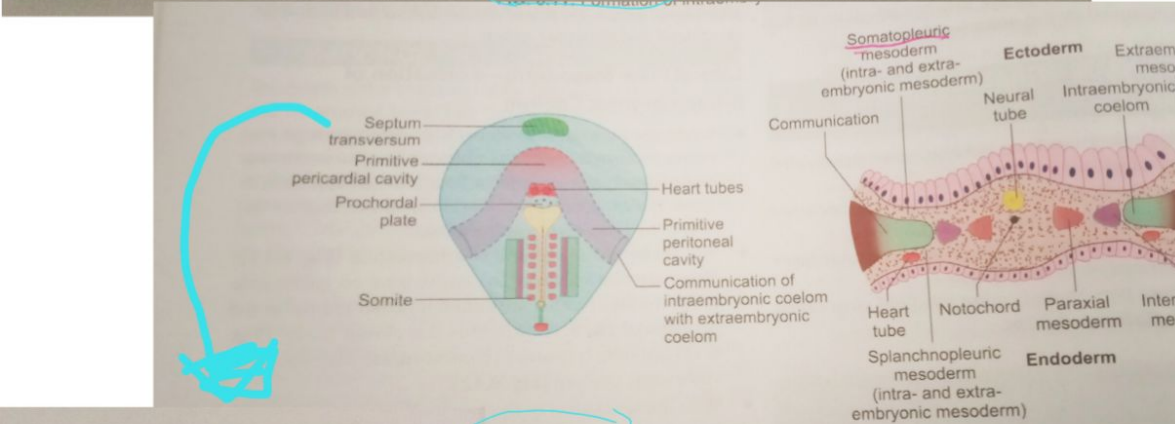
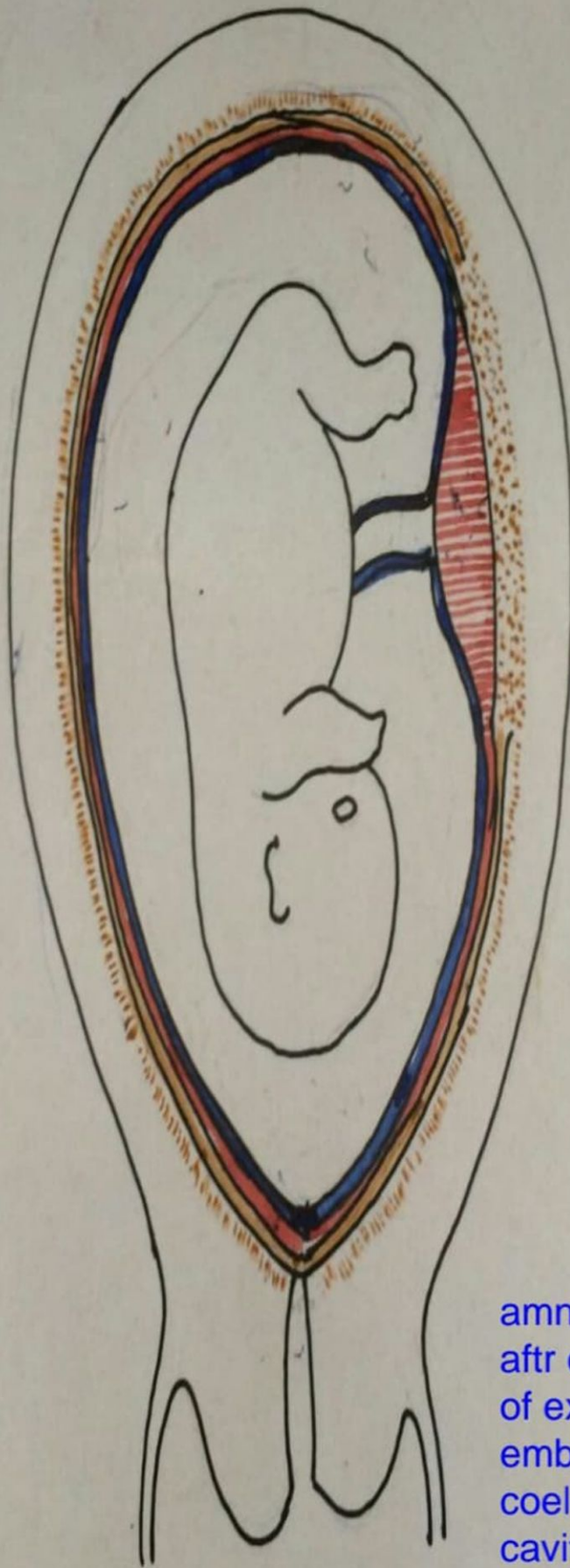
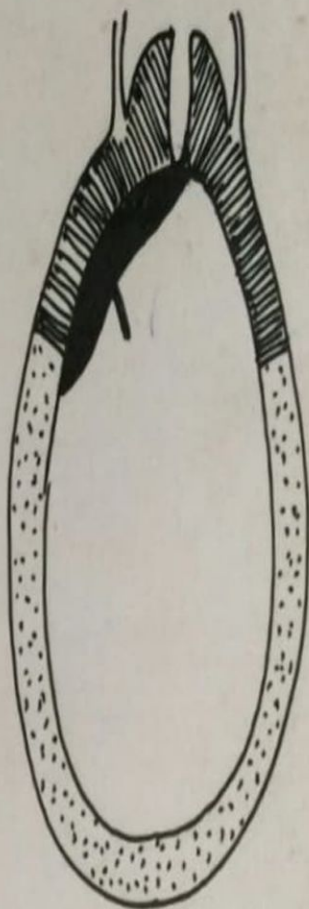
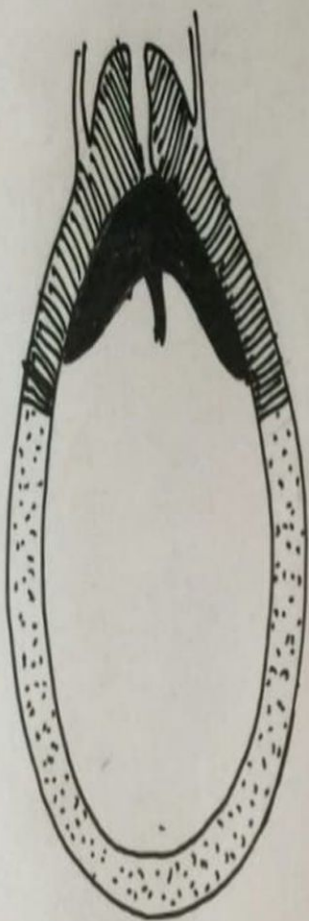


FIG. 6.13: Midline section through cranial end of the embryonic disc to show the relationship of the pericardial cavity to other structures.



amniotic cavity
after obliteration
of extra
embryonic
coelom n uterine
cavity



abnormal attachment of placenta



PLACENTA (FIG. 6)

- Formed from two sources:
 - Fetal source — **chorion frondosum**
 - Maternal source — **decidua basalis**
- The essential part of placenta is chorionic villi surrounded by maternal blood and fetal blood circulates through capillaries in villi.
- Syncytiotrophoblast part of trophoblast proliferates and grow towards the decidua basalis and capsularis.
- Trophoblast proper with primary mesoderm forms chorion.
- Lacunar spaces appear within the syncytiotrophoblast and decidua basalis.
- Trabeculae containing cords of syncytial cells are present between these lacunar spaces.
- Lacunae enlarge and contain uterine vessels.
- Then the cytotrophoblast extends in to the core of trabeculae, converts them in to **primary chorionic villi**.
- Now lacunar spaces are called **intervillous spaces**.
- In the development of chorionic villi it undergoes 3 stages:
 - Primary villi** consisting of a central core of cytotrophoblast covered by syncytiotrophoblast.
 - Secondary villi** having layers extraembryonic mesoderm, cytotrophoblast and syncytiotrophoblast.
 - Tertiary villi** having blood capillaries in extraembryonic mesoderm.
- Cytotrophoblast spreads outwards at tips of primary villi, resulting in outer cytotrophoblastic shell.
- Primary mesodermal cells invade central core of primary villi to form secondary villi.
- Fetal vessels derived from umbilical vessels appear within primary mesoderm, forming the tertiary villi.
- Tertiary chorionic villi attached to decidua basalis forms the chorion frondosum. Rest of the villi attached to the embryonic pole degenerates. This results in the formation of placenta from chorion frondosum and decidua basalis.

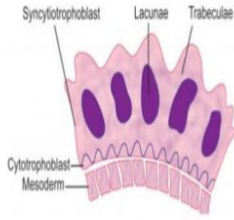


Fig. 6: Chorionic villi formation

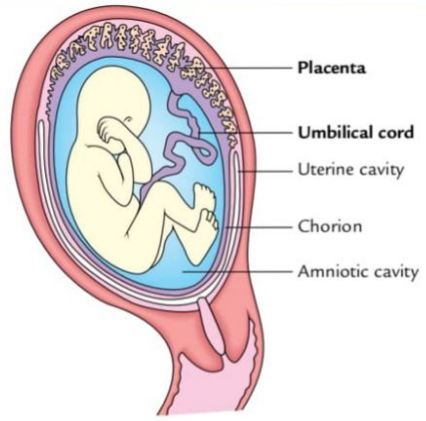


Fig. 6.20 Umbilical cord and well-developed placenta. Note amnion and chorion are fused.

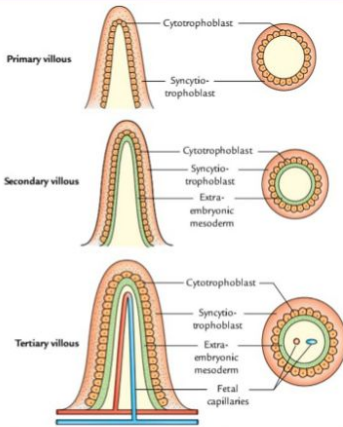


Fig. 6.11 Three stages of development of villi. Figures on the right side are the sectional views of three types of villi.

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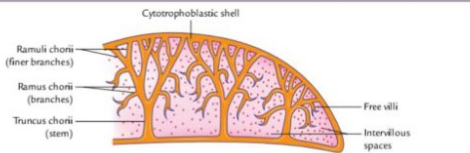


Fig. 6.12 Anchoring villi. Note each anchoring villi consists of a stem called *truncus chori*, which divides into a number of branches called *ramus chori*, which in turn divides into a number of finer branches called *ramuli chori*.

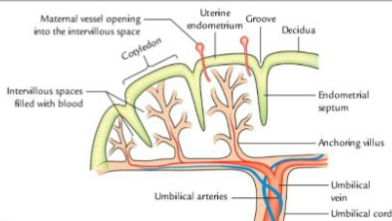


Fig. 6.14 Formation of cotyledons (lobes) of placenta. Placenta consists of 15–20 cotyledons, and each cotyledon contains 2–3 anchoring villi.

- Placenta previa (Fig. 6.7):** Normally the blastocyst implants along the posterior wall of the cavity of body of the uterus and the developed placenta is attached to the *upper uterine segment* (upper two-third of the body). Occasionally, the blastocyst implants near the internal os and then the developed placenta is attached to the *lower uterine segment* (lower one-third of the body of uterus). It is termed **placenta previa**.

The various degrees of placenta previa are as follows (Fig. 6.7).

- First degree:** The attachment of the placenta does not extend up to the internal os.
- Second degree:** The attachment of the placenta extends up to the internal os but does not cover it.
- Third degree:** The edge of the placenta covers the internal os but when the os dilates during child birth the placenta no longer occludes it.
- Fourth degree:** The placenta completely covers/bridges the internal os even when the os is fully dilated during childbirth. The placenta previa of the fourth degree is also sometimes termed '*central placenta previa*'.

The placenta previa, especially the fourth degree, can cause severe bleeding after the first trimester of pregnancy or during parturition (i.e., birth of the baby).

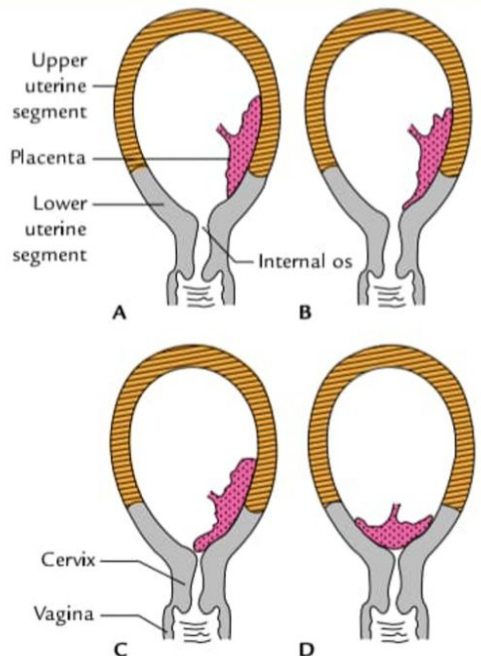
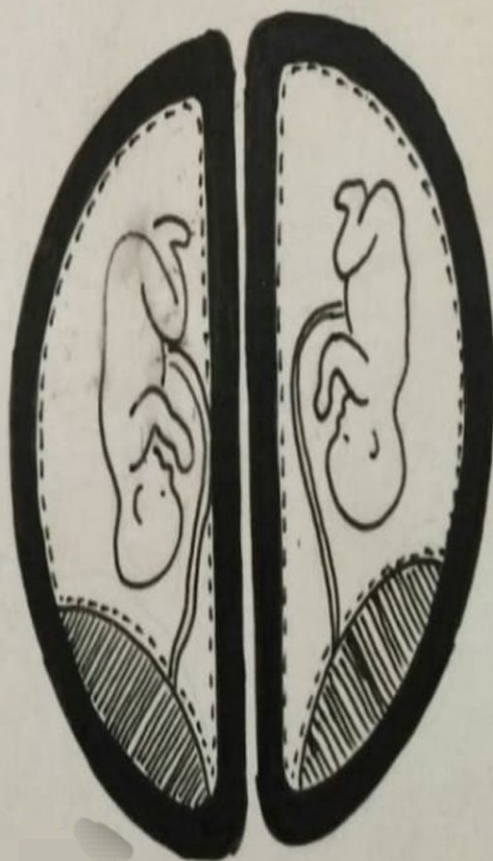
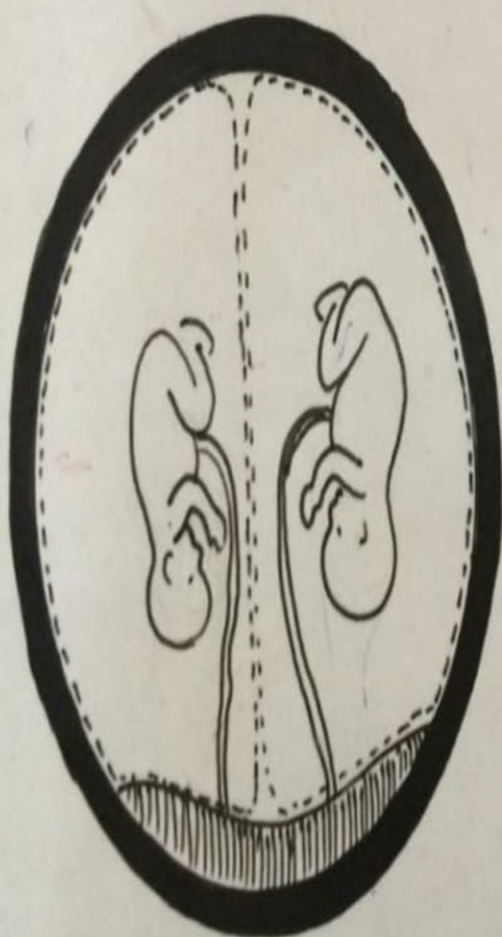
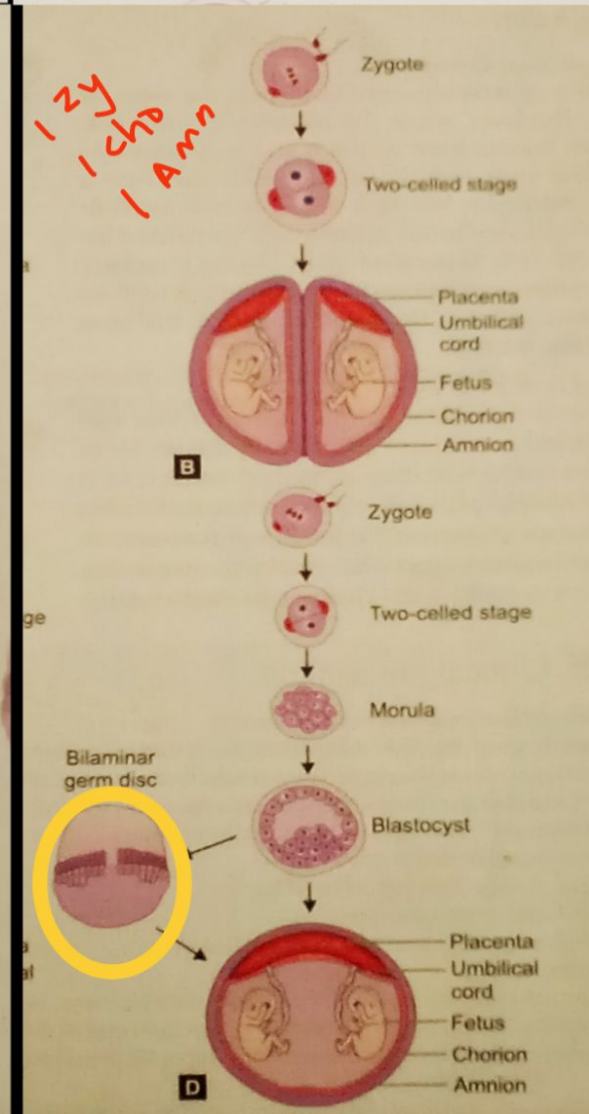
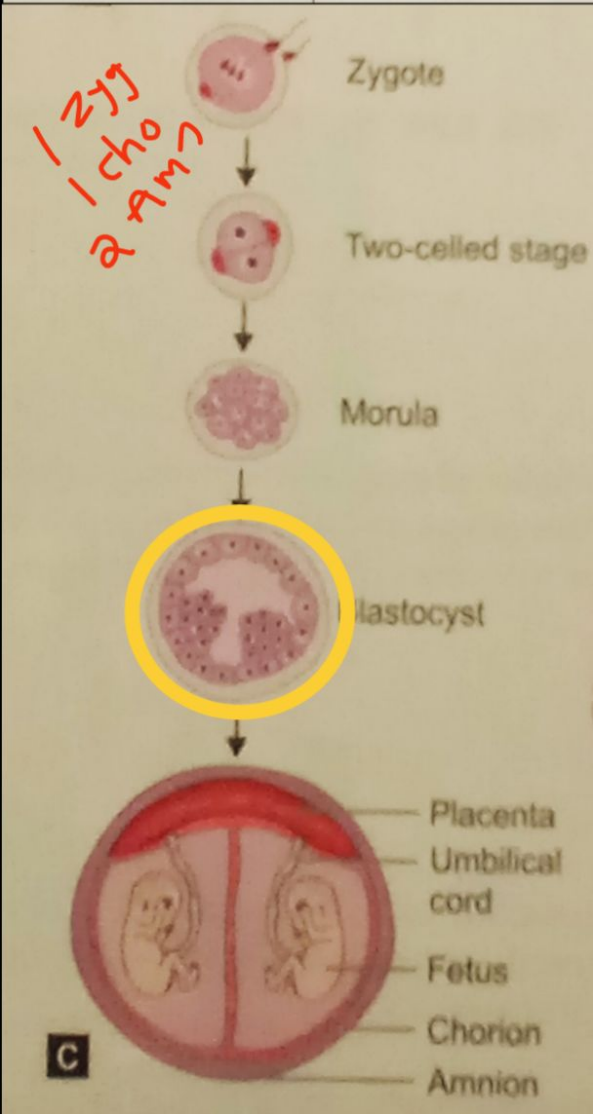
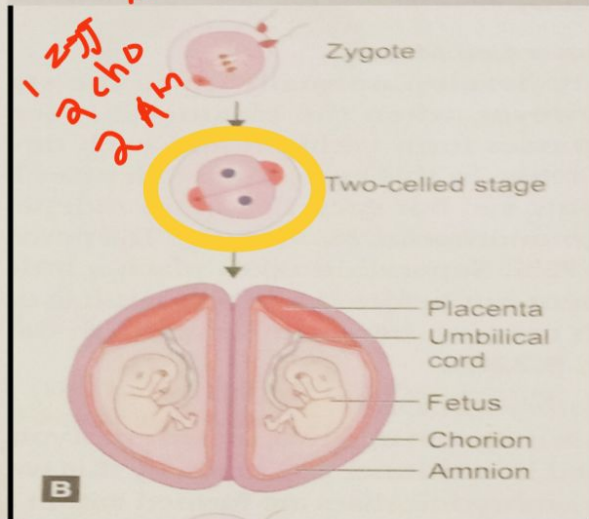
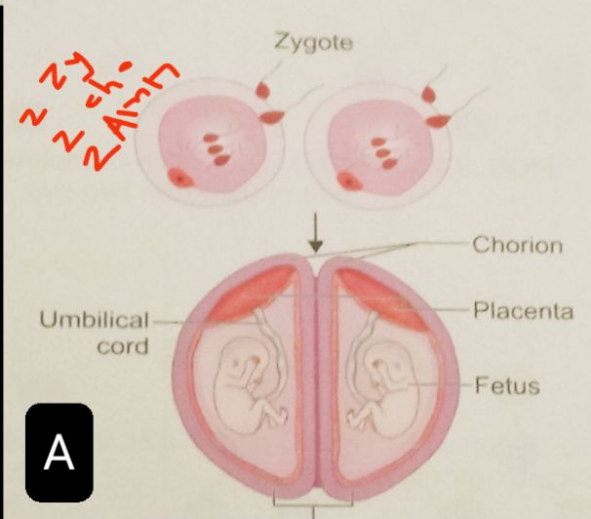
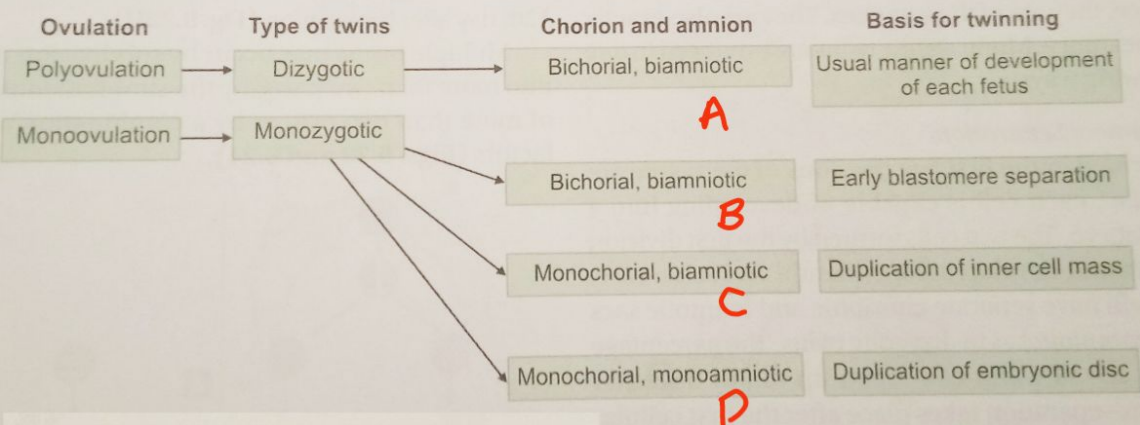


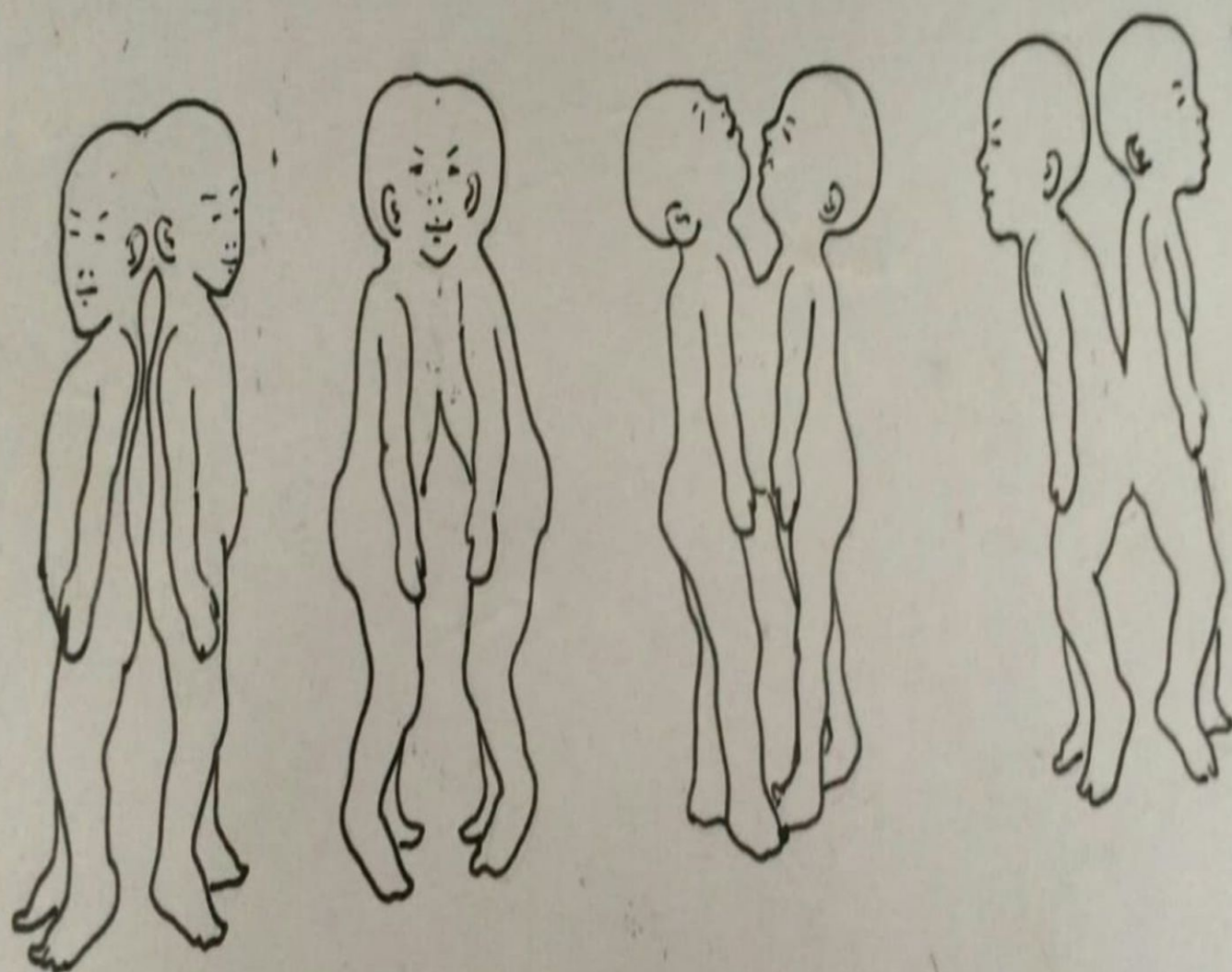
Fig. 6.7 Types of placenta previa. A. First degree. B. Second degree. C. Third degree. D. Fourth degree.



FULL PASS
CMC

FLOWCHART 9.2: Twinning—types and basis.





conjoints twins

Twins have a high incidence of morbidity and mortality due to preeclampsia, congenital anomalies, premature delivery, etc.

1. **Conjoint (Siamese) twins:** This condition is seen in monozygotic twins. Monozygotic twins in which the inner cell mass (embryoblast) does not completely split. In this condition, two fetuses are joined to each other by a tissue bridge.

Classification of conjoint twins: The conjoint twins are classified into following four types based on the site and extent of fusion (Fig. 6.24).

- (a) Craniophagus: Fusion of heads
- (b) Thoracophagus: Fusion of thorax
- (c) Cephalothoracophagus: Fusion of head and thorax
- (d) Pygophagus: Fusion of sacral regions

The conjoint twins can be separated only if they have no vital parts in common.

N.B. Phagus = Fastened

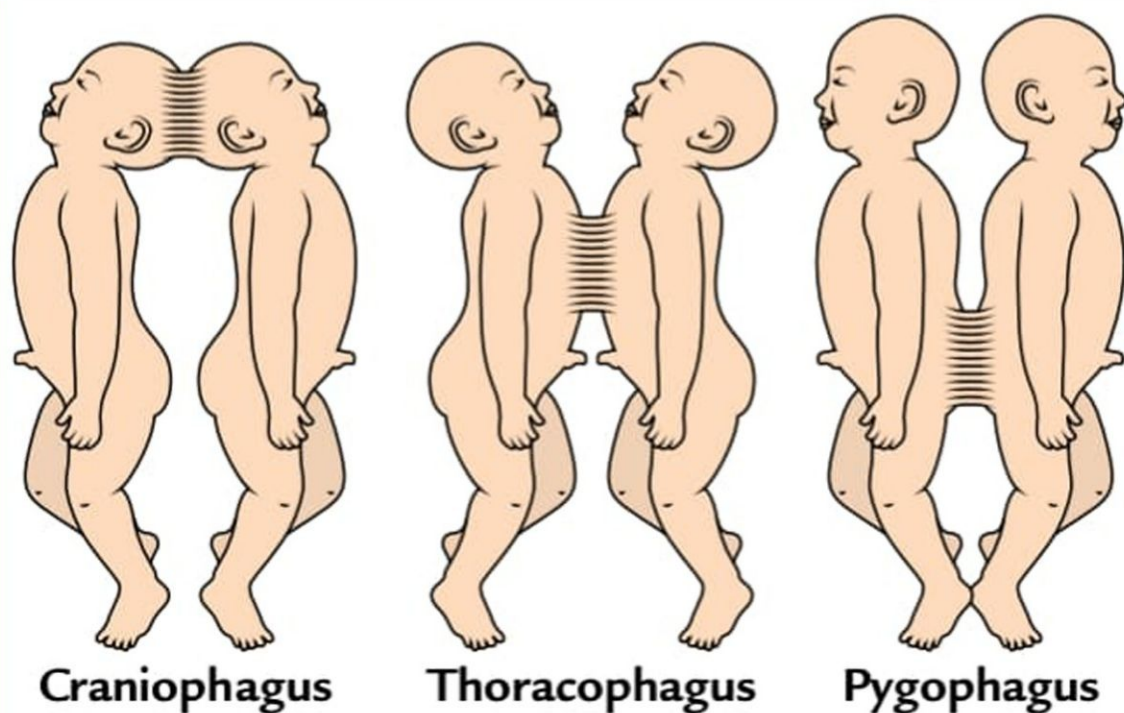
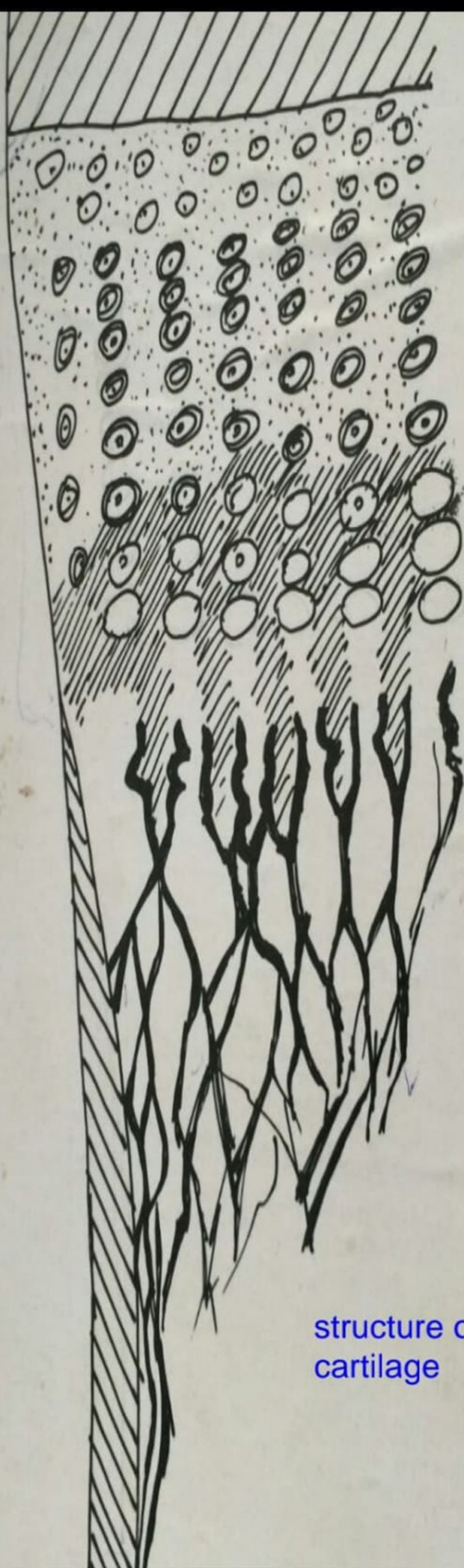


Fig. 6.24 Types of conjoined twins.



structure of epiphseal
cartilage

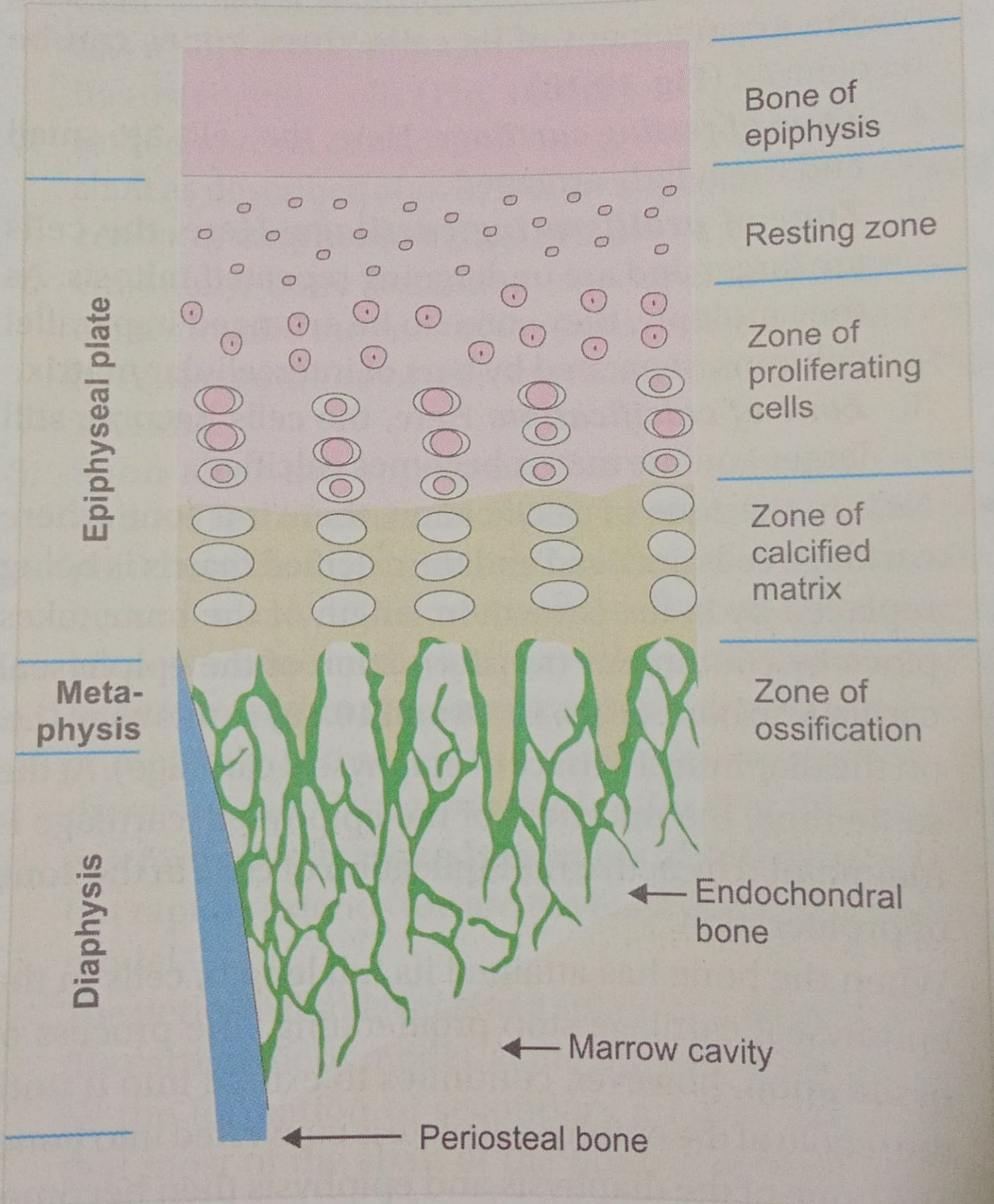
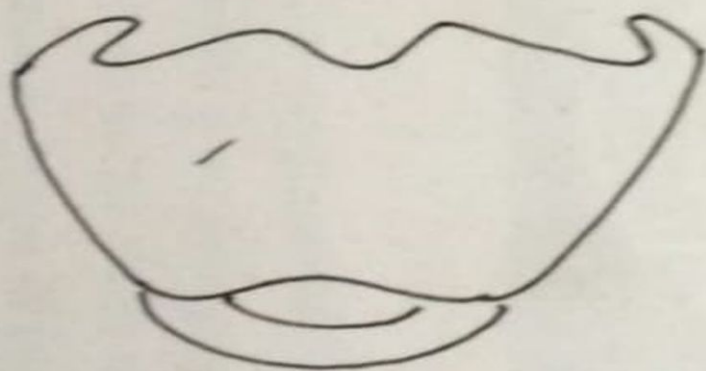
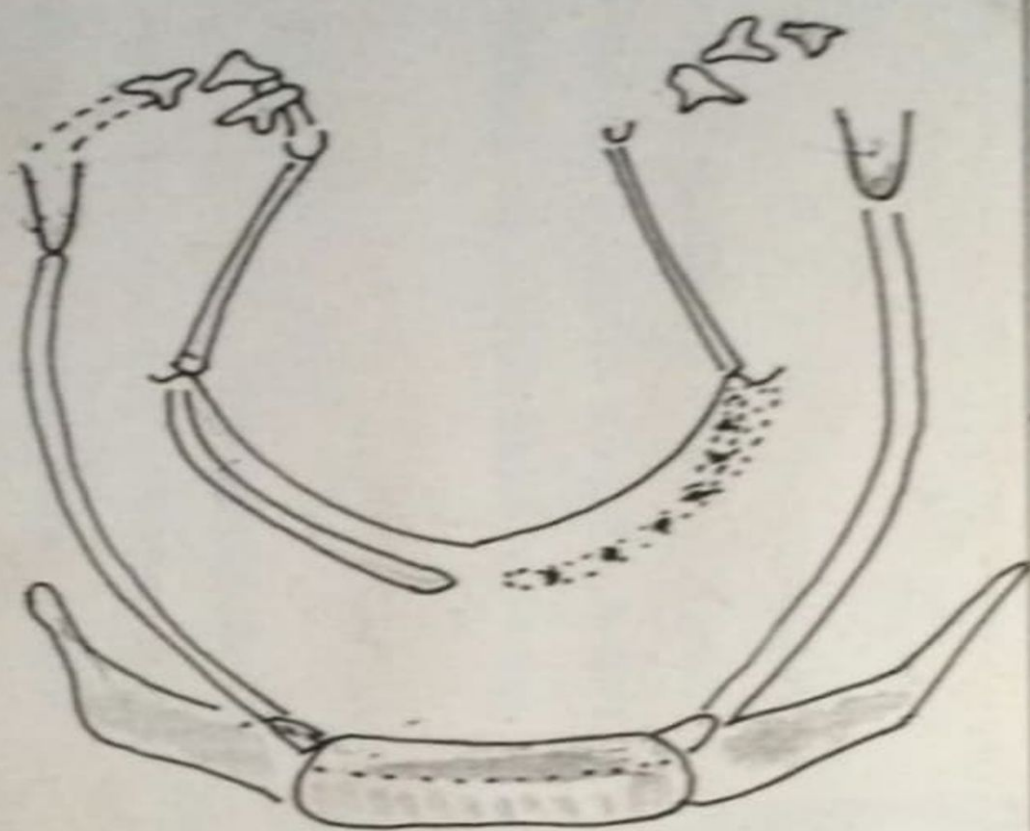
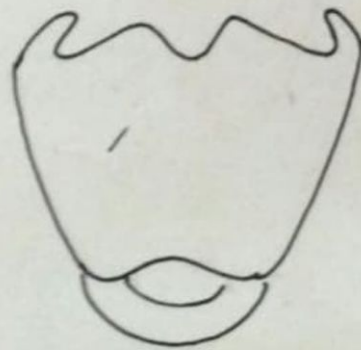
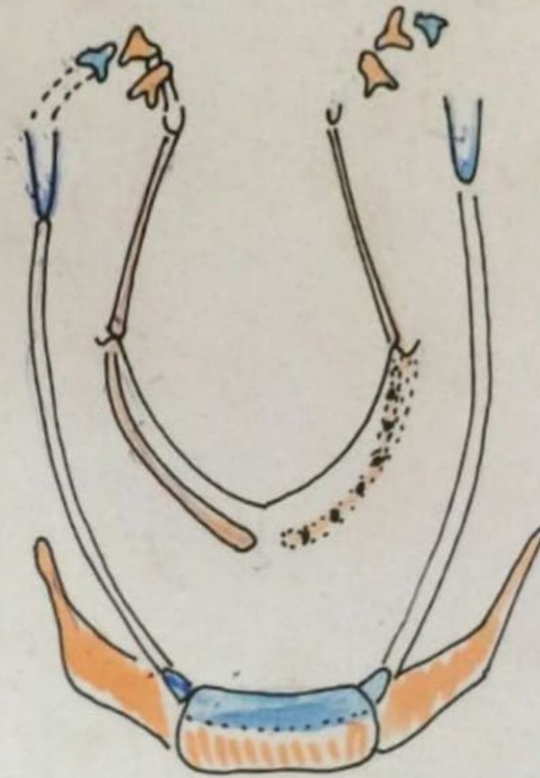


FIG. 10.18: Structure of epiphyseal cartilage.



fate of pharyngeal cartilage



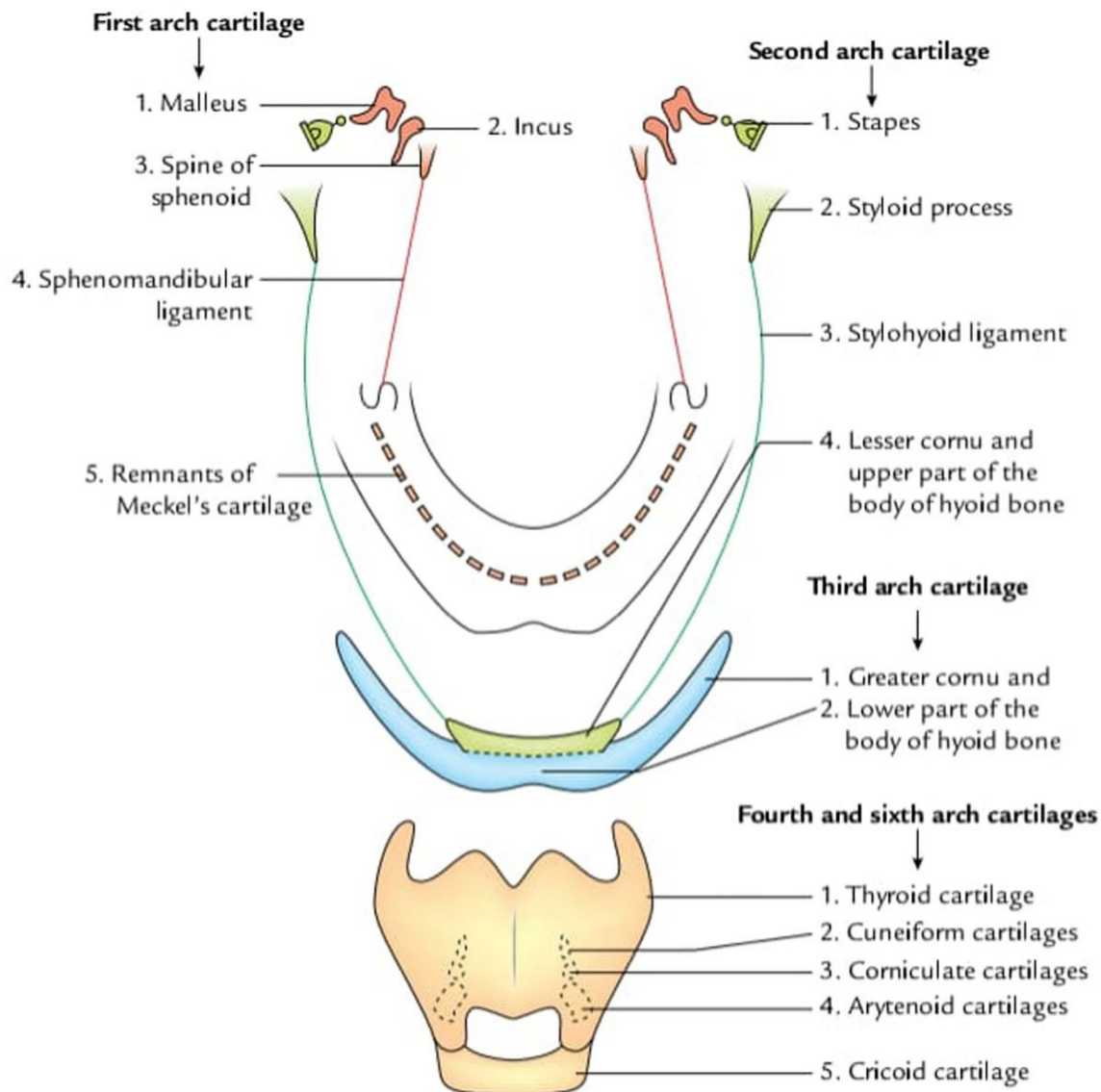
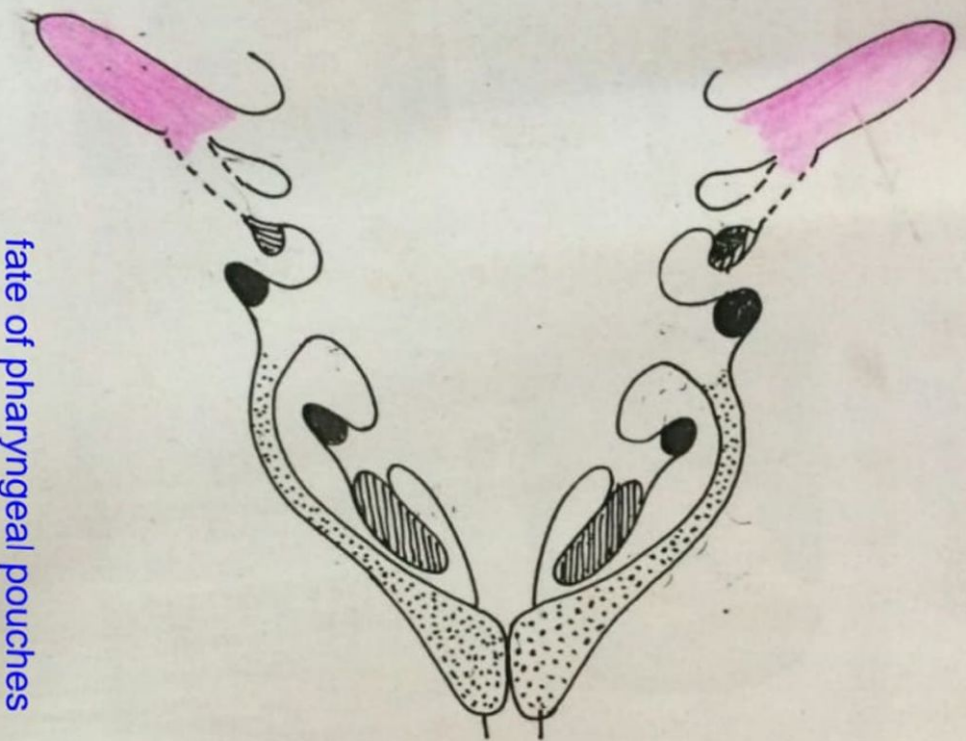
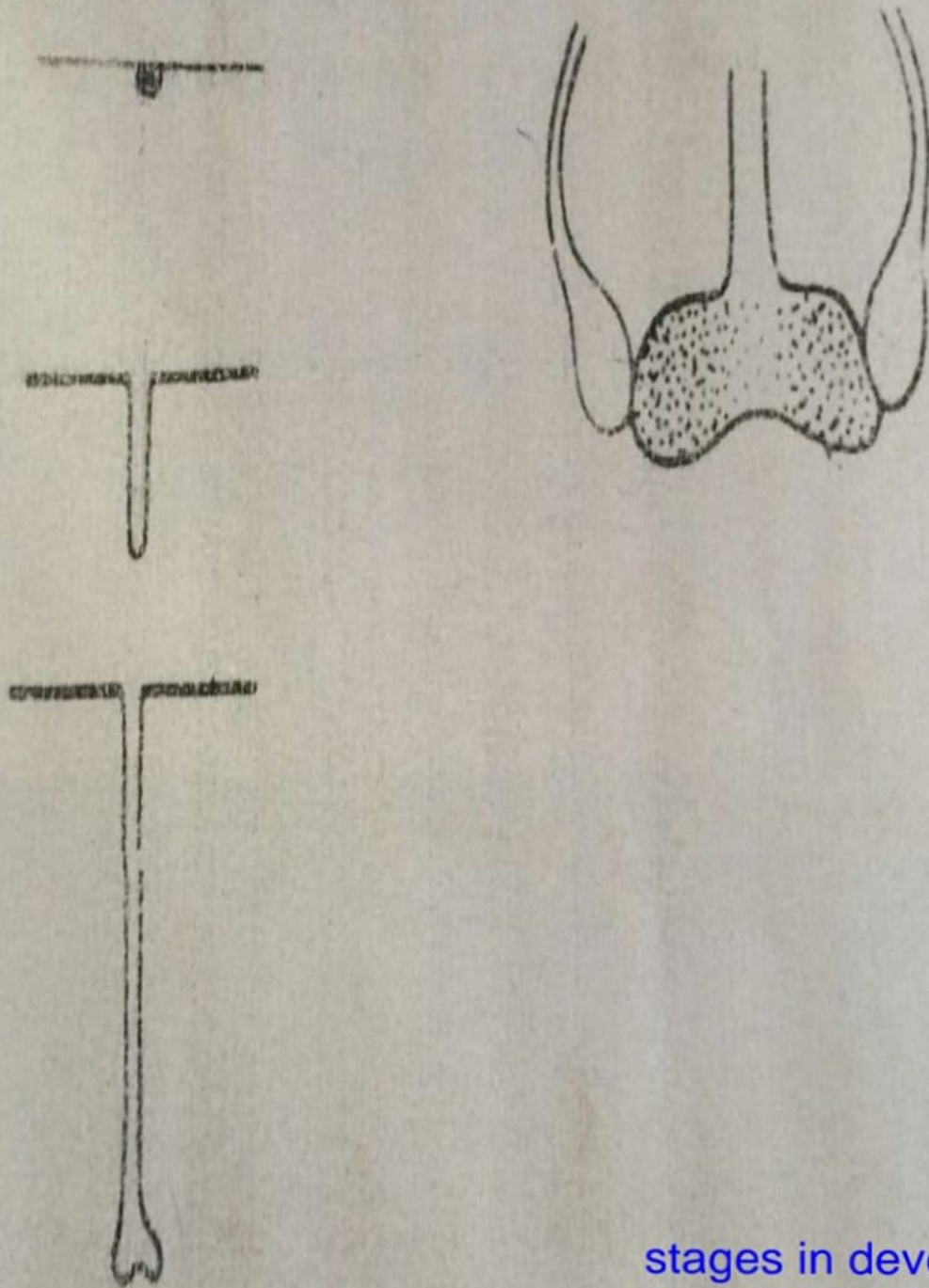


Fig. 10.7 Structures derived from various arch cartilages (frontal view). Structures derived from first arch cartilage (red color), structures derived from second arch cartilage (green color), structures derived from third arch cartilage (blue color), and structures derived from fourth and sixth arch cartilages (yellow color).





fate of pharyngeal pouches



stages in devepmnt of
thyroid gland..

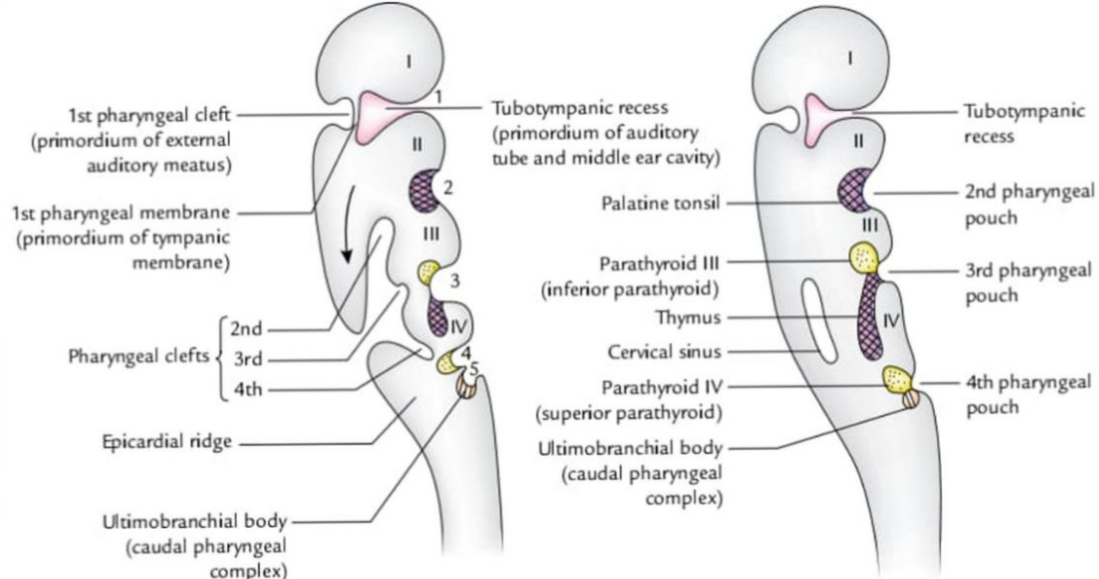


Fig. 10.9 Structures derived from pharyngeal pouches and clefts, and formation of cervical sinus. Note the second arch grows over the third and fourth arches, thus buying the second, third, and fourth pharyngeal clefts to form the cervical sinus.

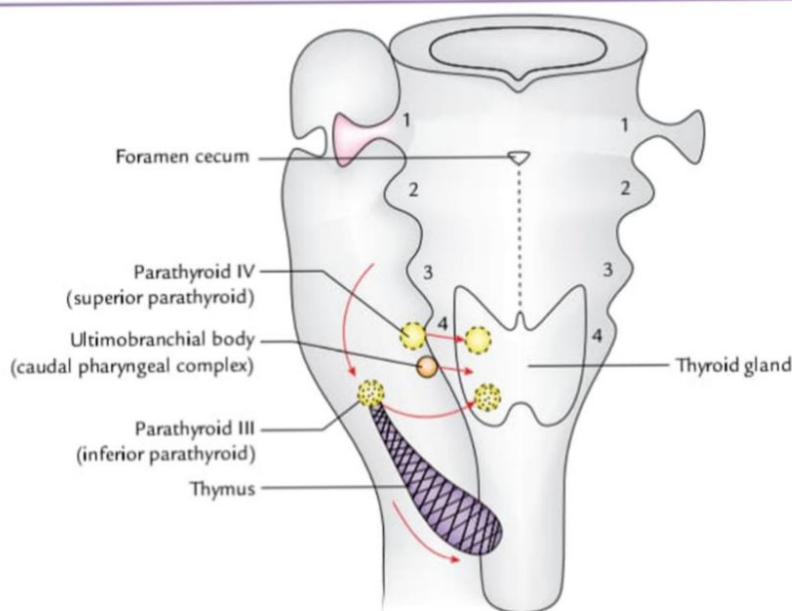


Fig. 10.10 Migration of parathyroid and thymus glands. Note that the thyroid glands originate at the level of foramen cecum and descends to the levels of first tracheal ring.

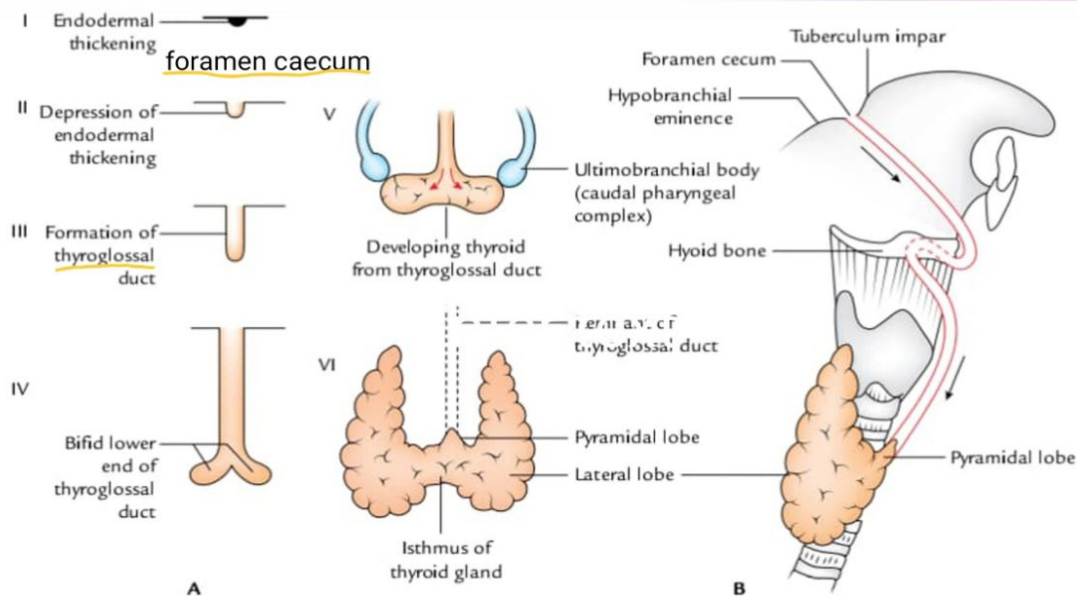
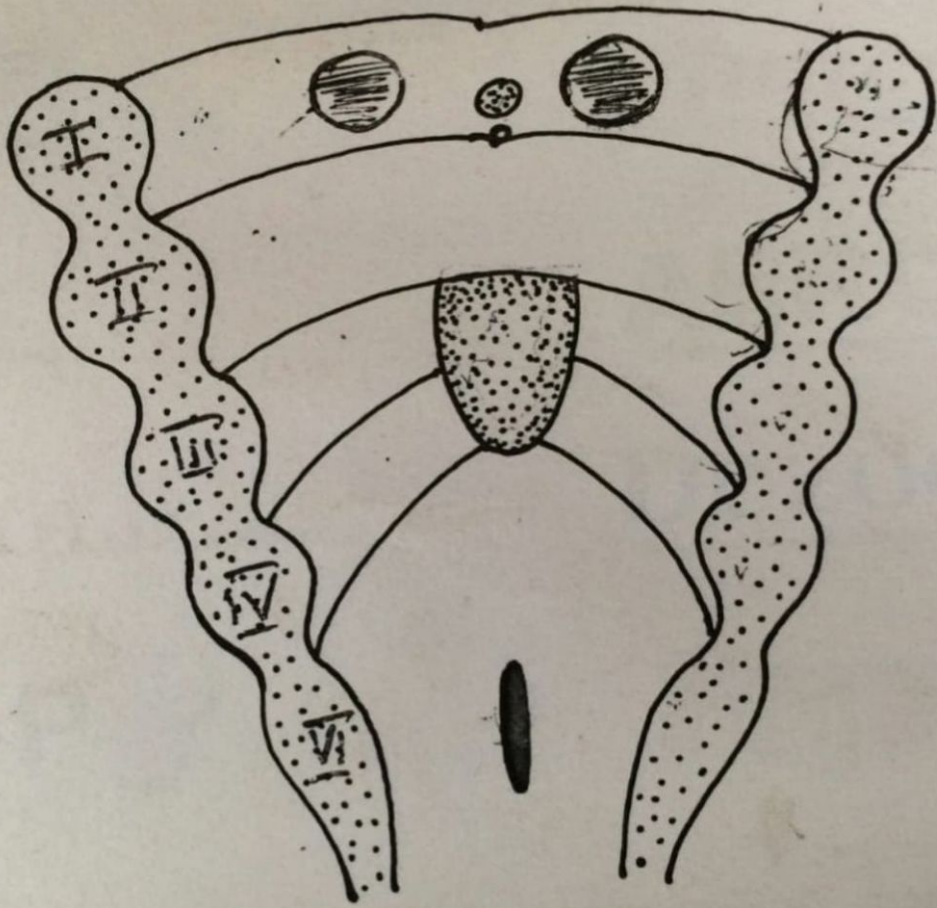
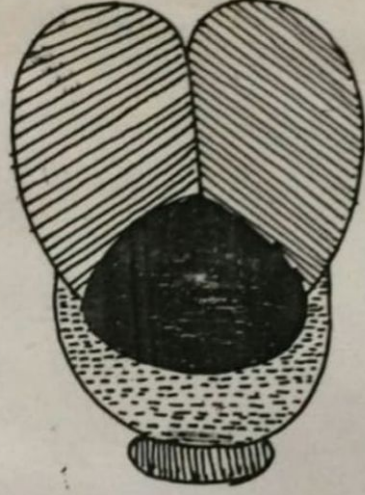
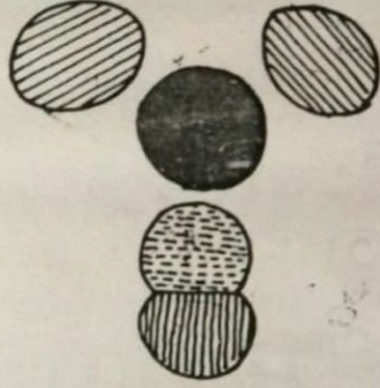


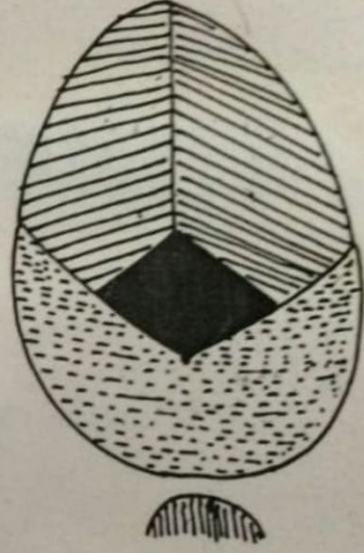
Fig. 11.7 Development of the thyroid gland. A. Stages of development. B. Pathway of the thyroglossal duct.

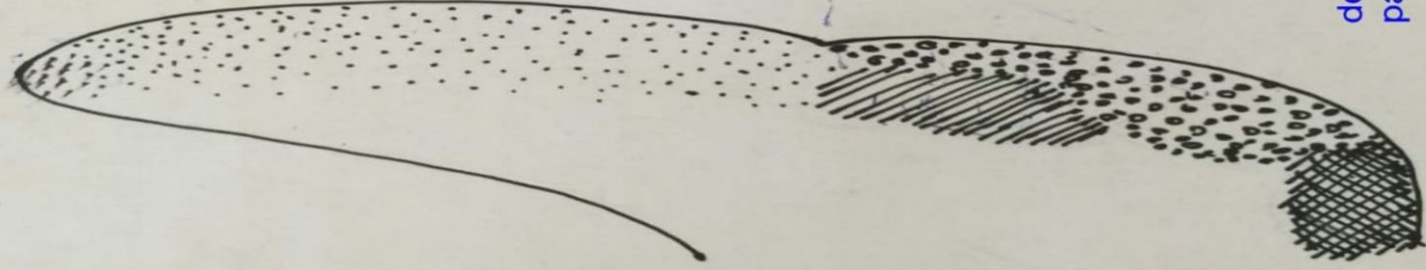


development of tongue



development of tongue from different parts





devepmnt of tongue from diffrent
parts

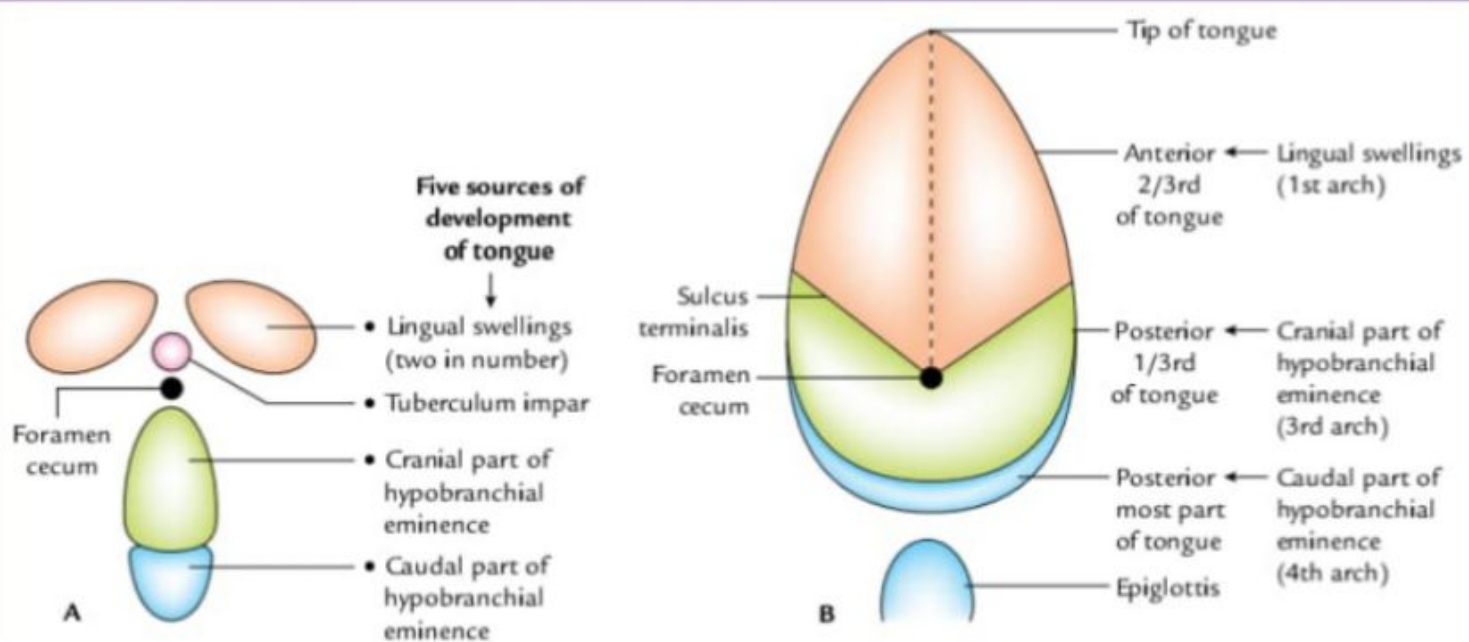
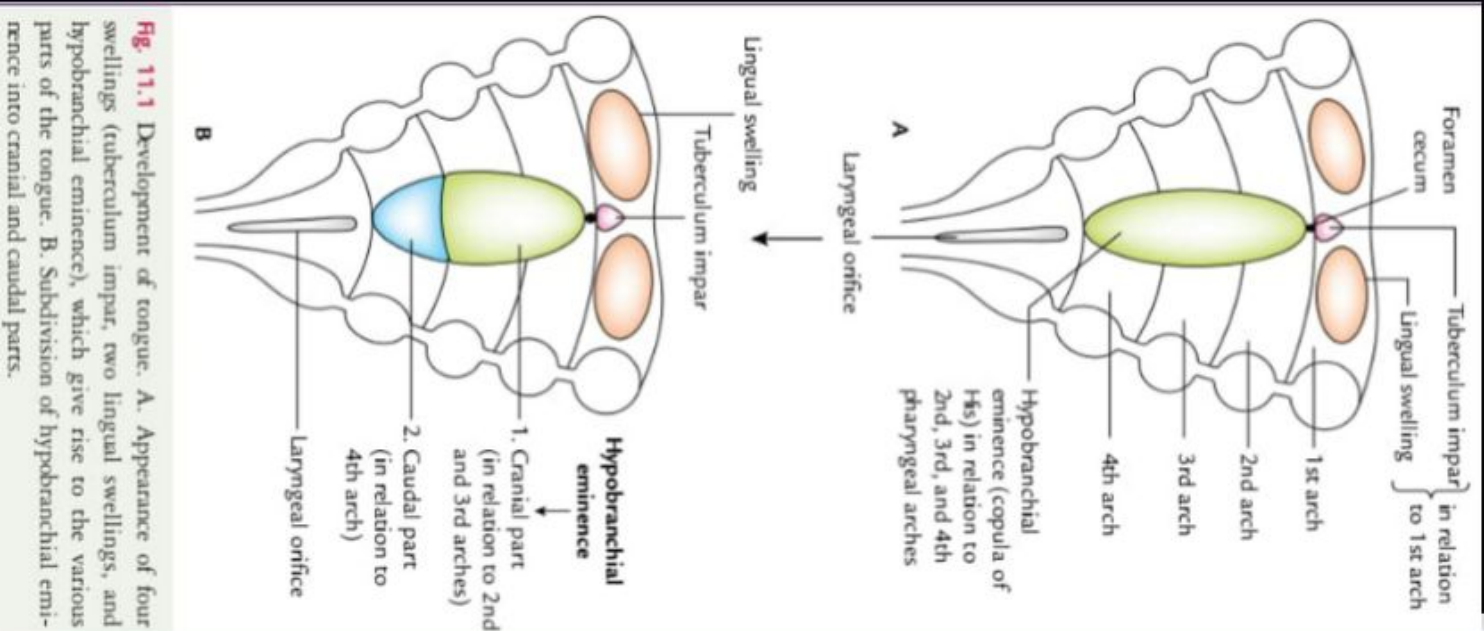


Fig. 11.2 Schematic diagram to show development of various parts of the tongue from different sources. A. Five sources of development. B. Definitive tongue.

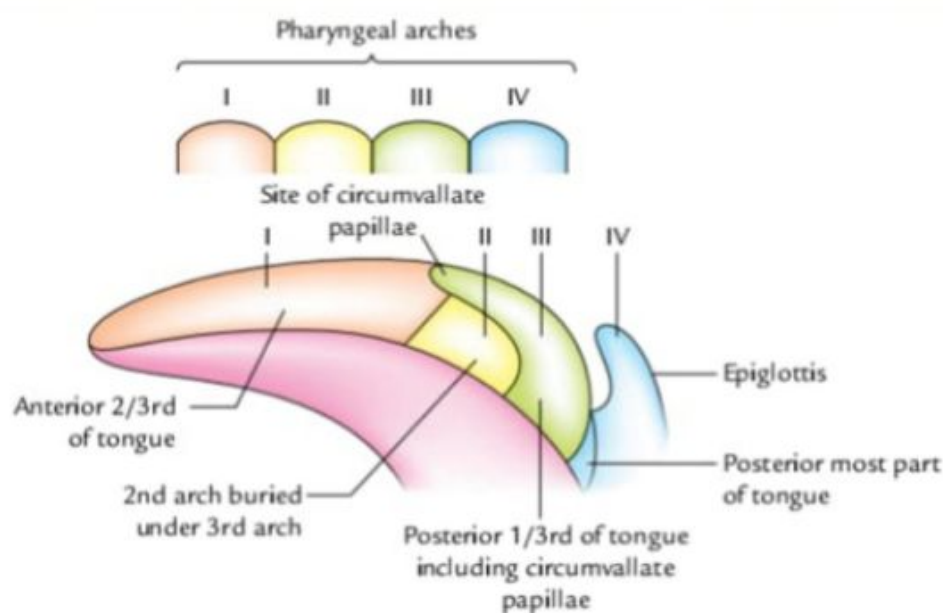
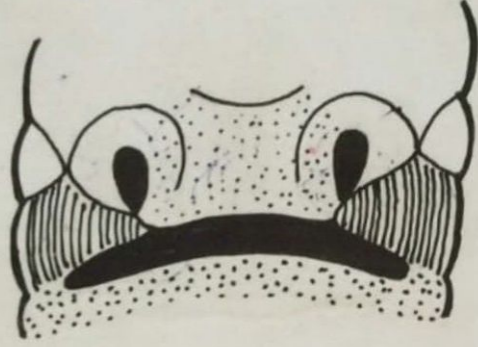
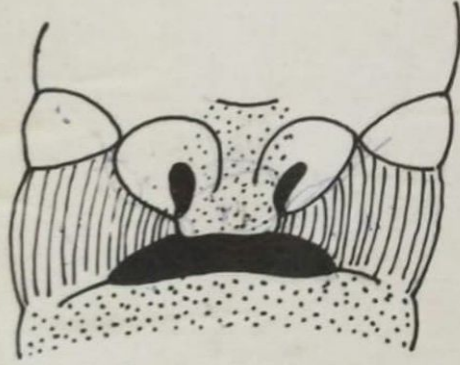


Fig. 11.3 Overgrowth of third arch over the second arch. Note second arch is buried under third arch.



devepmnt of face

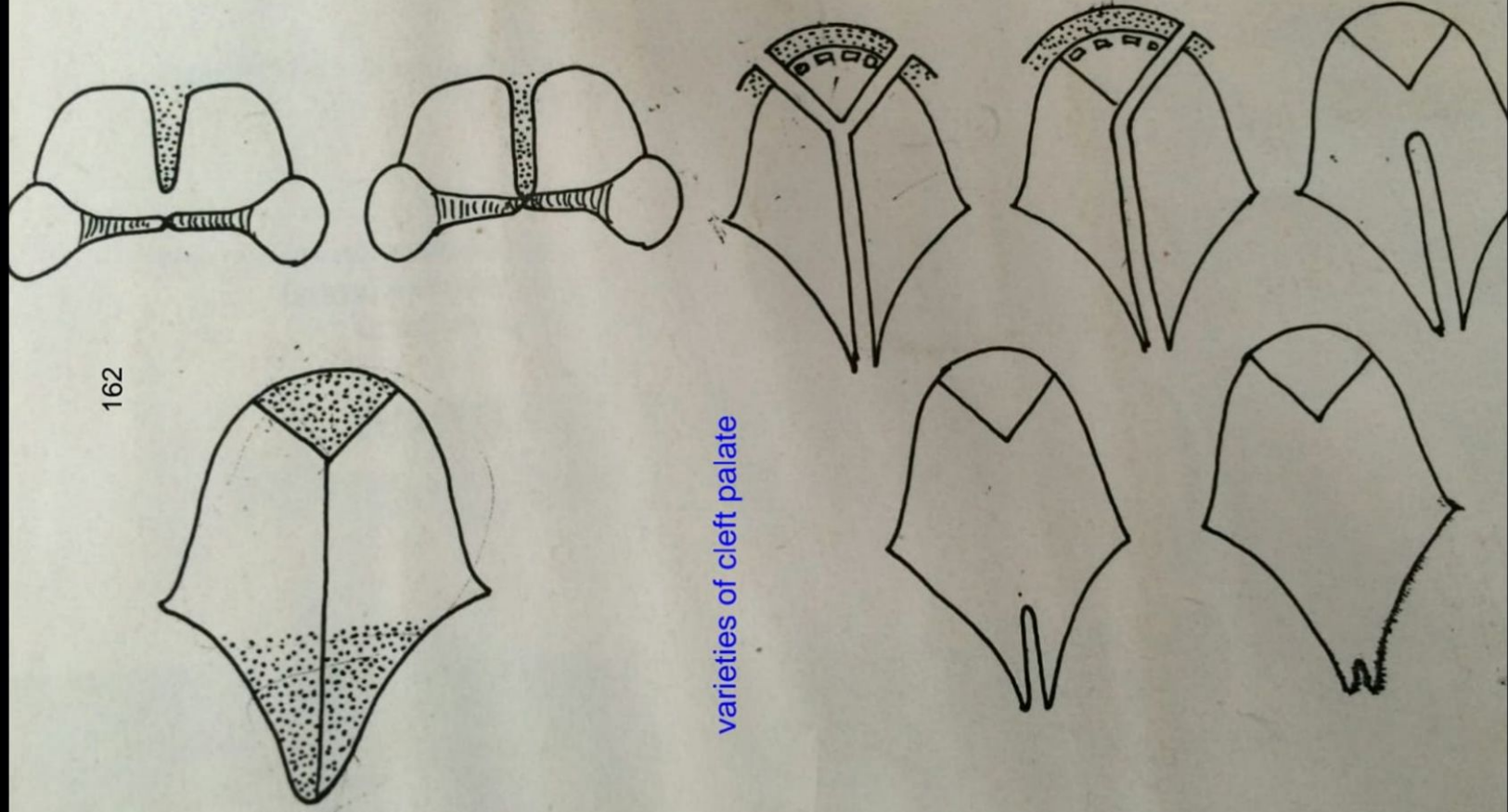
stages in developmt of face



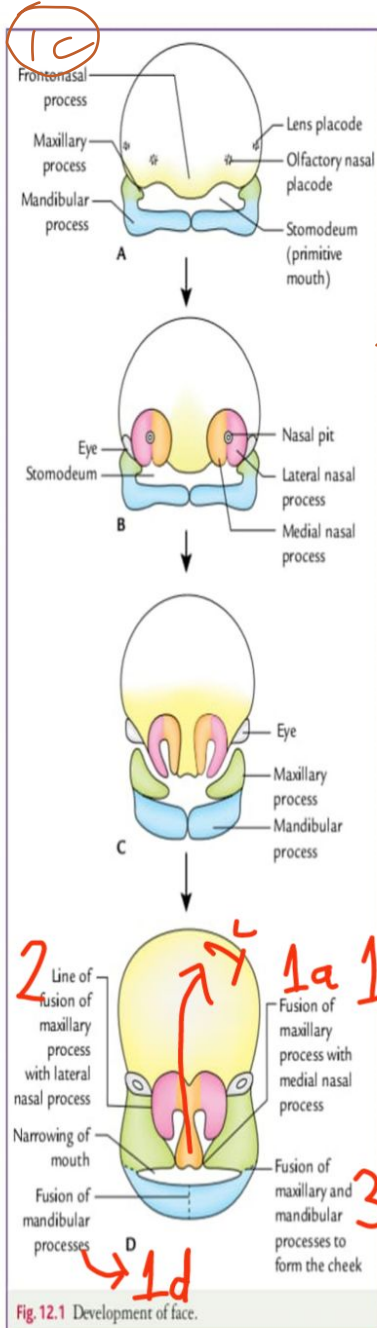


varieties of
harelip





varieties of cleft palate



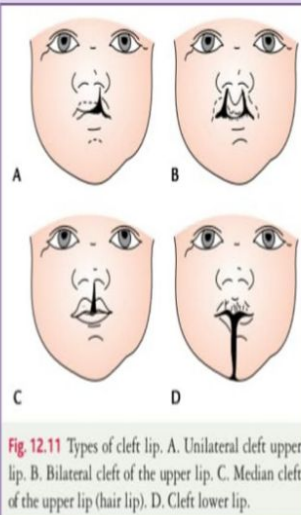
1. Cleft lip: It commonly occurs in the upper lip. The incidence of cleft lip is 1 in 1000 births and 60-80% of children involved are males. The cleft upper lip presents three varieties (Fig. 12.11).

- Unilateral cleft lip:** It occurs due to failure of fusion of maxillary process with the medial nasal process of the same side.
- Bilateral cleft lip:** It occurs due to failure of fusion of maxillary processes with the frontonasal process.
- Central cleft lip/hair lip:** It occurs due to failure of development of philtrum of the upper lip from the frontonasal process.

Very rarely the two mandibular processes may fail to fuse in the midline to cause cleft lower lip.

2. Oblique facial cleft (also called orbitofacial fissure Fig. 12.12): It is a rare congenital anomaly of the face, which occurs when maxillary process fails to fuse with the lateral nasal process. The fissure extends from medial angle of the eye to the upper lip. Consequently, the nasolacrimal duct is exposed to the exterior. This anomaly is usually bilateral.

3. Microstomia (small mouth) and macrostomia (large mouth): Lateral angles of oral fissure are formed at the junction of the maxillary and mandibular processes. Initially the lateral angle of mouth extends much laterally close to auricle. Subsequently in normal conditions the angles of mouth gradually shift medially by fusion between the maxillary and mandibular processes till normal adult position is reached. The excessive fusion of these processes lead to microstomia and arrest of this fusion leads to macrostomia.



4. Cleft palate: The defective fusion of various segments of palate gives rise to clefts in the palate. These vary considerably in degree, leading to varieties of cleft palate as follows:

Complete cleft palate (Fig. 12.13)

Unilateral complete cleft palate occurs if maxillary process on one side does not fuse with the premaxilla. It is always associated with the cleft lip on the same side.

Development of Face, Nose, and Palate

Bilateral complete cleft palate occurs if both the maxillary processes fail to fuse with the premaxilla. In this type, secondary palate is divided into two equal halves by a median cleft with an anterior V-shaped cleft separating the premaxilla completely.

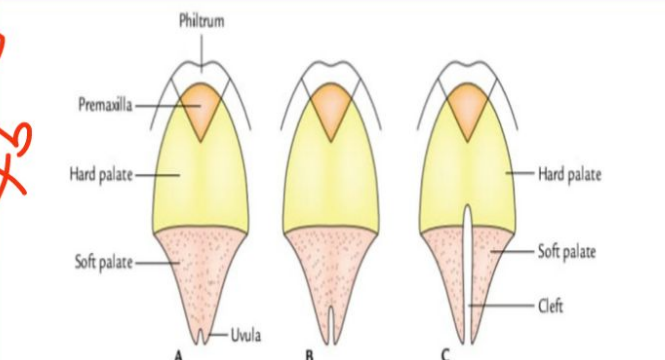
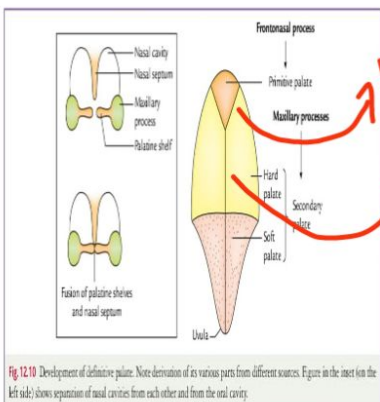
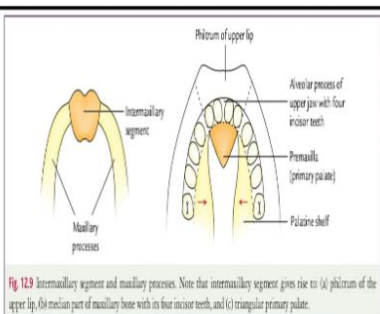
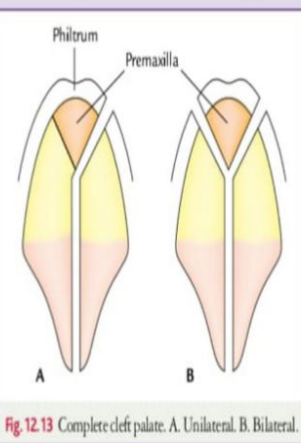
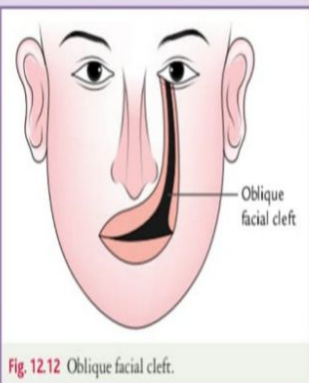
(b) Incomplete or partial cleft palate (Fig. 12.14): The following types may occur.

- **Bifid uvula:** Cleft involving only uvula. It is of no clinical importance.

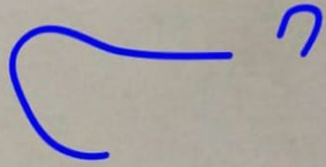
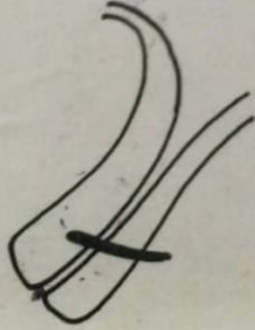
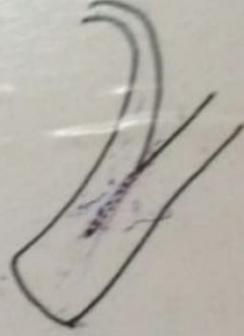
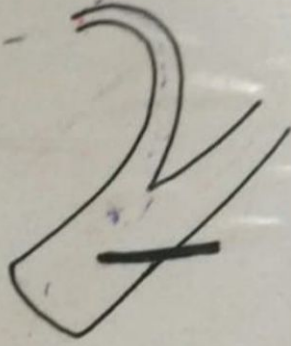
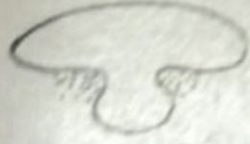
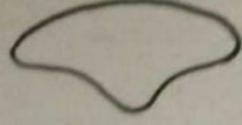
Cleft of the soft palate: Involving uvula and adjoining part of the soft palate.

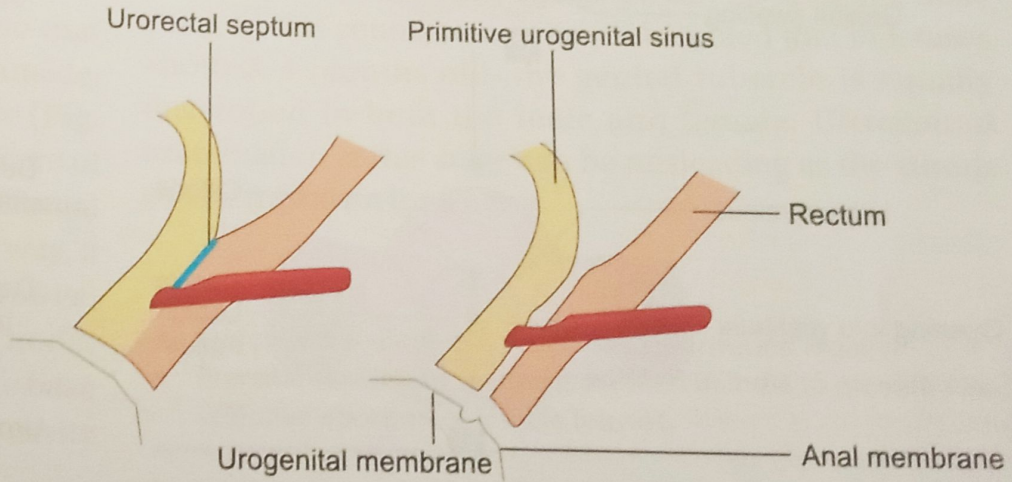
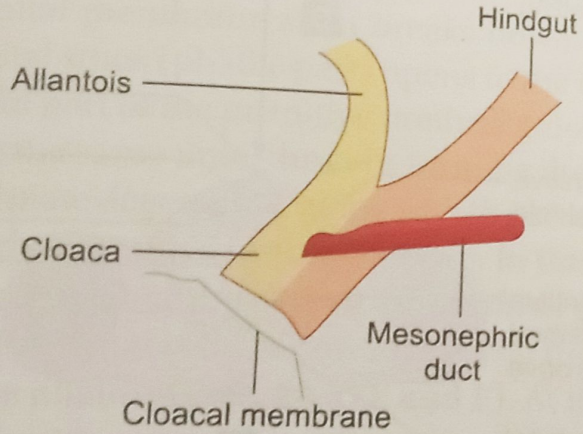
Cleft of the soft palate: Involving uvula, whole of the soft palate, and extends into the hard palate.

Clinical photographs of cleft lip and cleft palate are shown in Fig. 12.15.

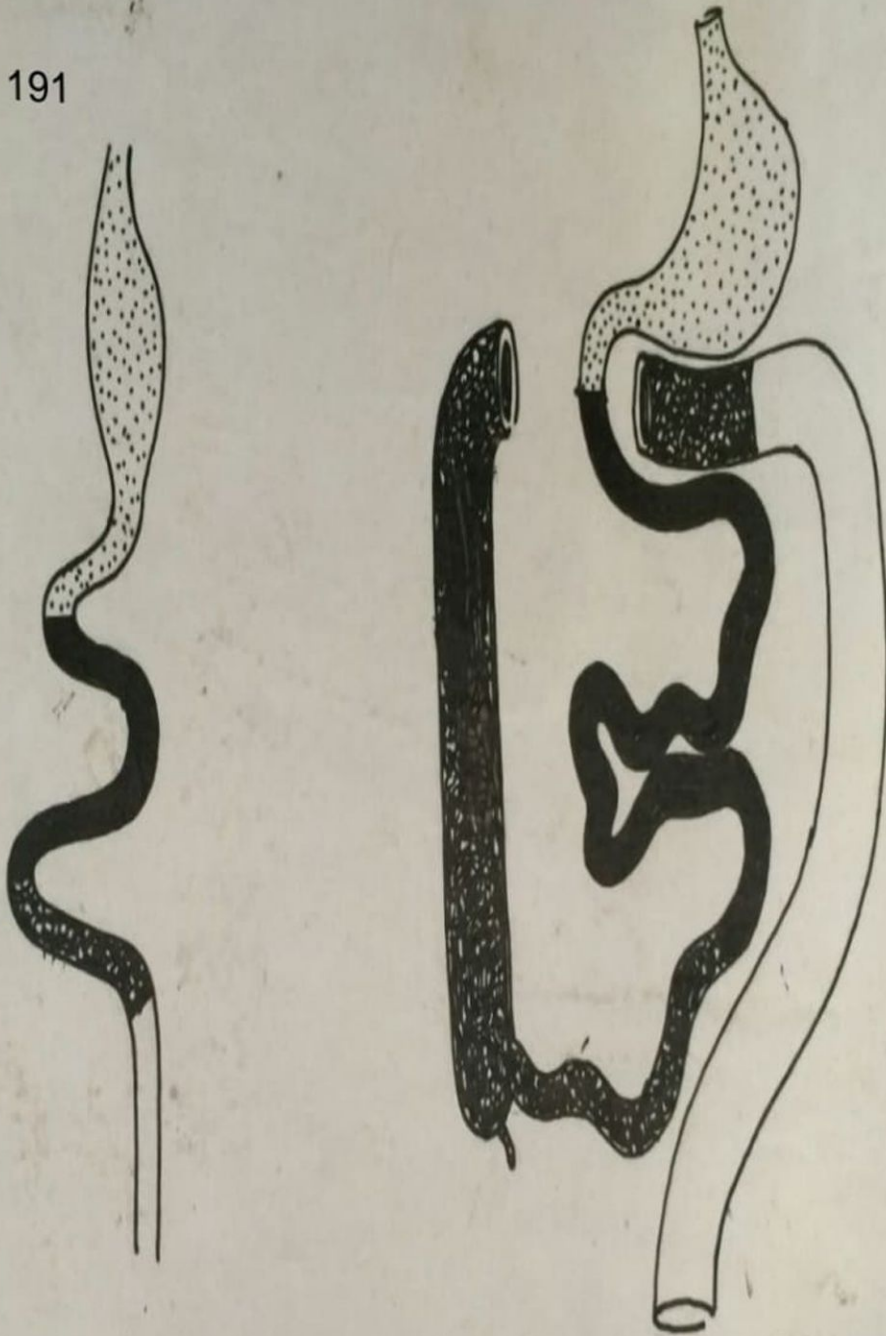


formation of urorectal septum





191



derivation of various
parts of gut

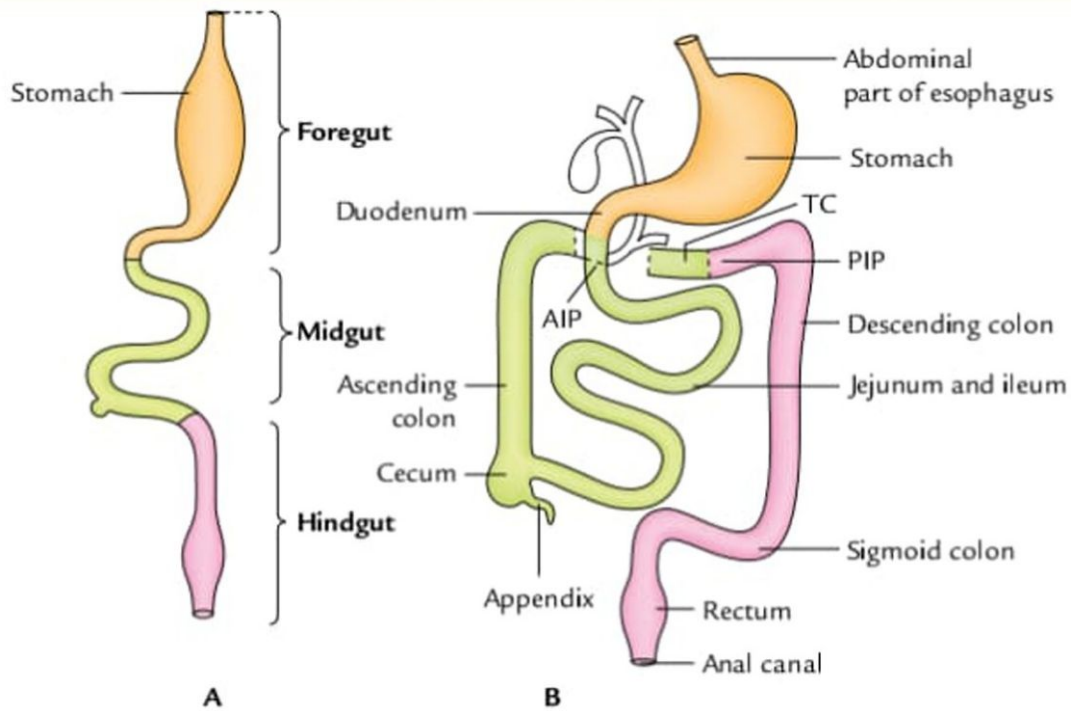
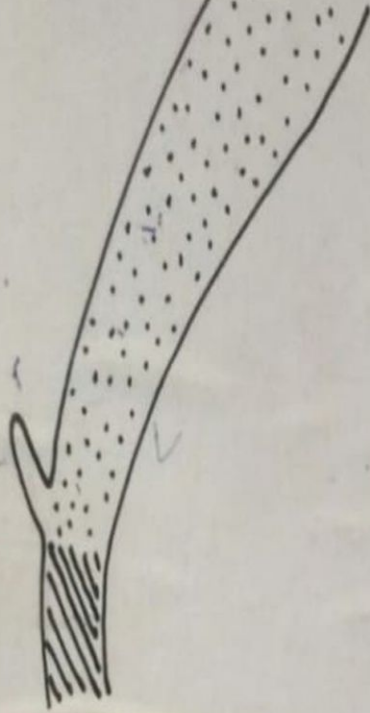
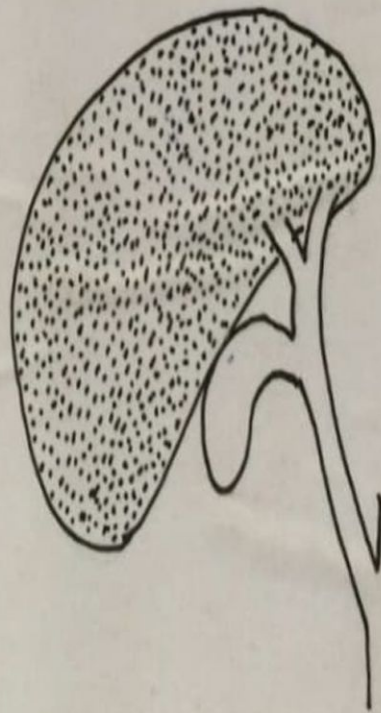


Fig. 13.5 Derivatives of various abdominal parts of the gut. A. Primitive gut. B. Adult gut. TC = transverse colon; AIP = anterior intestinal portal; PIP = posterior intestinal portal.

pg 202



developmnt of biliary appartus



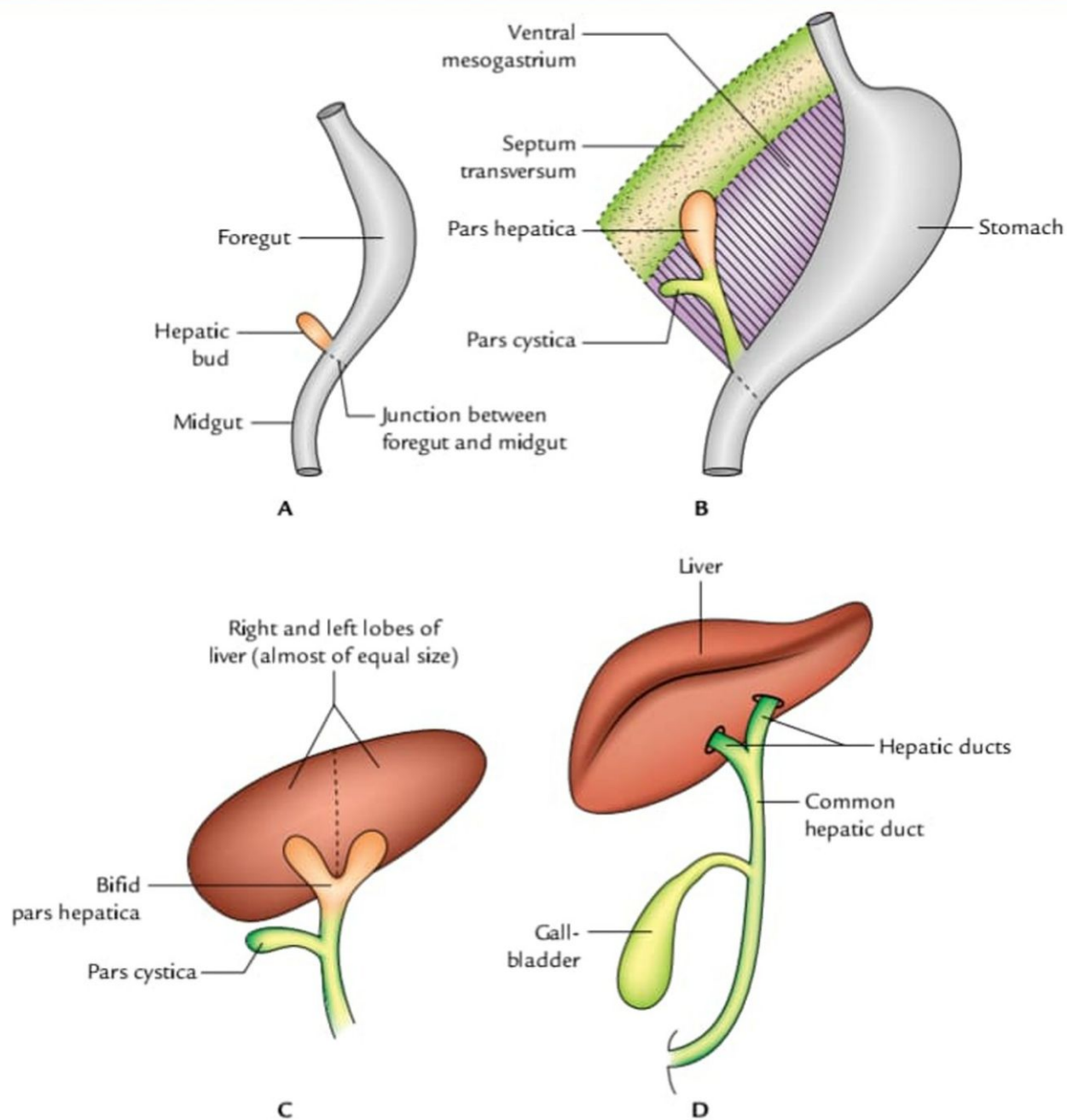
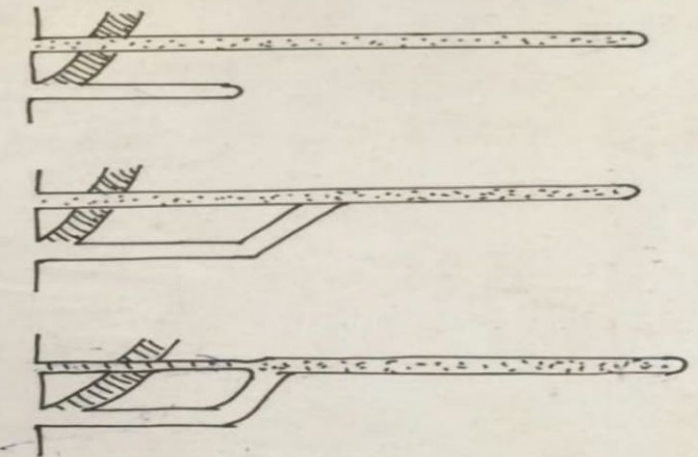
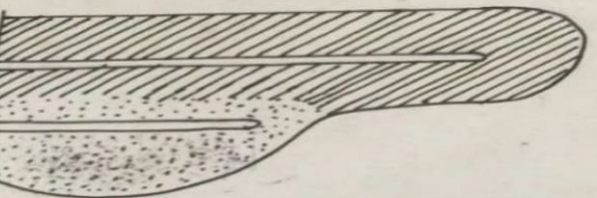
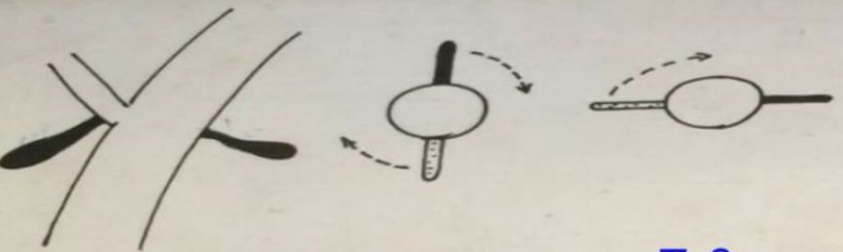


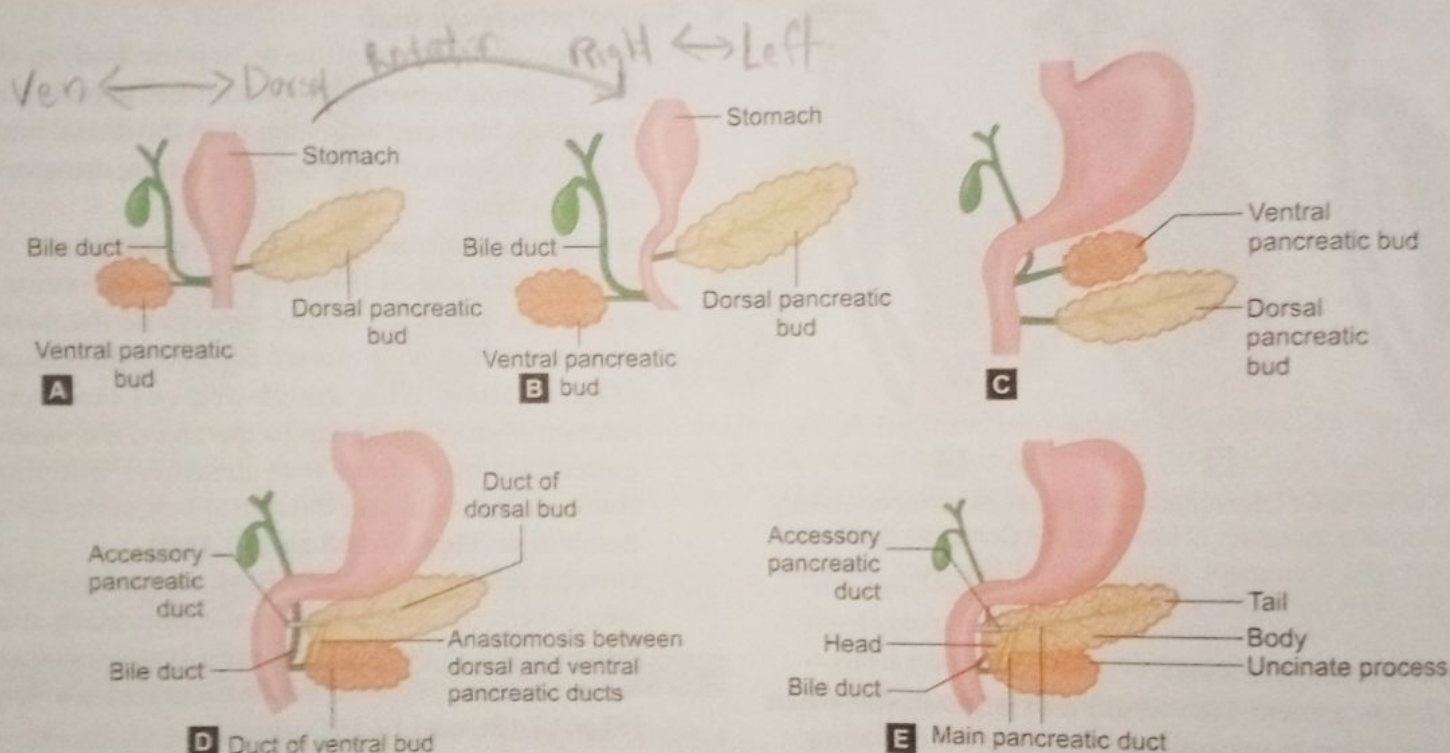
Fig. 14.1 Successive stages of the development of the liver. A. Hepatic bud arising from foregut at its junction with the midgut. B. Growth of hepatic bud towards septum transversum through ventral mesogastrium. Note the subdivision of hepatic bud into pars hepatica and pars cystica. C. Division of pars hepatica into right and left portions. D. Fully formed liver and gallbladder along with their ducts.



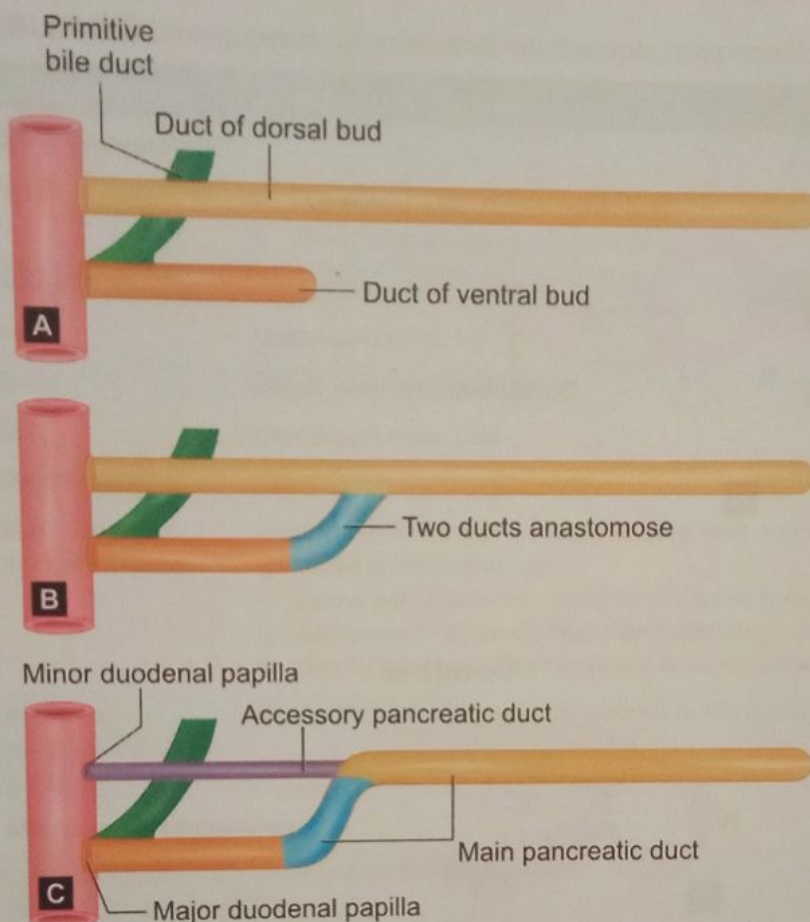


development of
pancreatic duct system





FIGS. 17.18A TO E: Development of pancreas: (A) Appearance of dorsal and ventral pancreatic buds before rotation of gut; (B) Rotation of ventral and dorsal pancreatic buds with rotation of duodenal loop; (C and D) Shifting of ventral pancreatic bud to the left along with bile duct; (E) Fusion of dorsal and ventral pancreatic buds.



FIGS. 17.20A TO C: Formation of duct system of pancreas. Distal part of main pancreatic duct is derived from the distal part of duct of dorsal bud, communication between dorsal and ventral ducts and from the duct of ventral bud. Accessory pancreatic duct is derived from the proximal part of dorsal pancreatic duct.



A



B



C

DEVELOPMENT OF LUNGS BUDS OF HUMAN EMBRYO

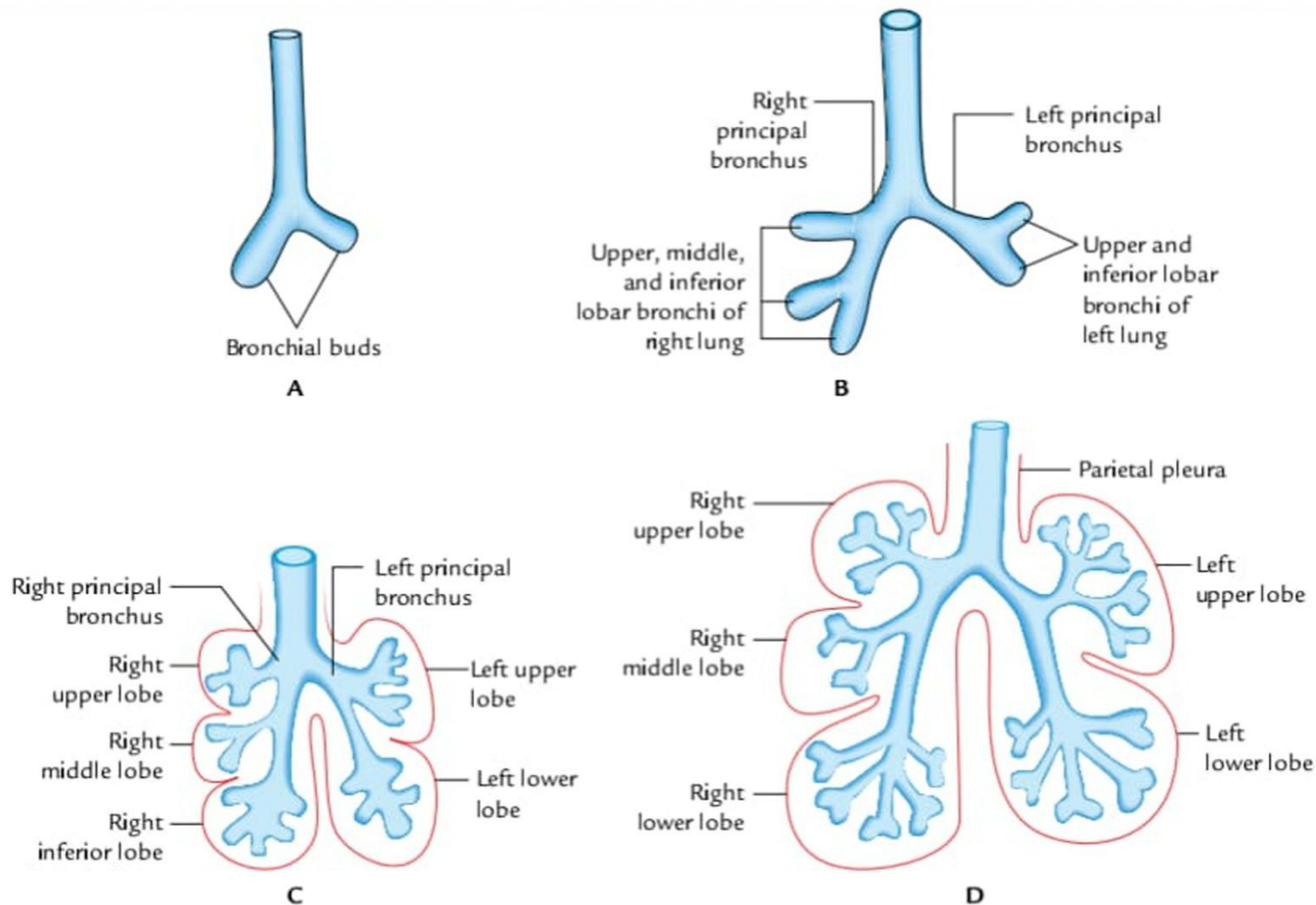
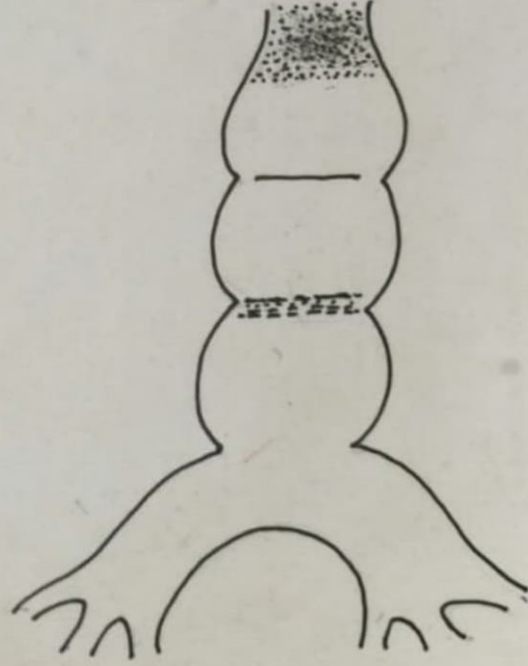
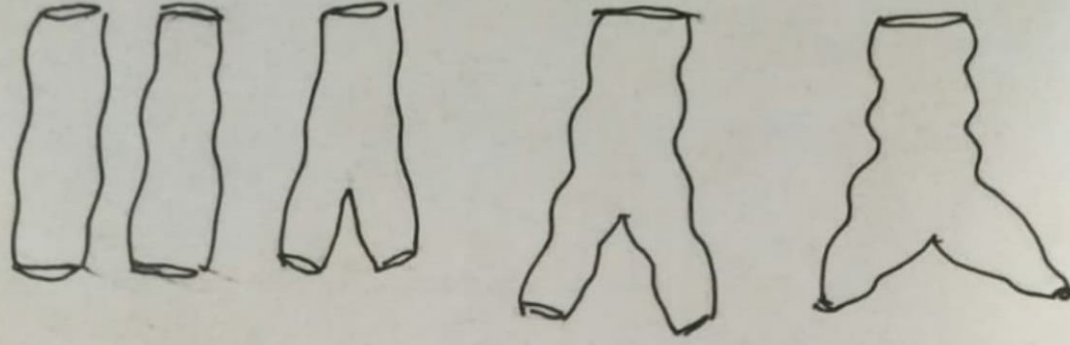
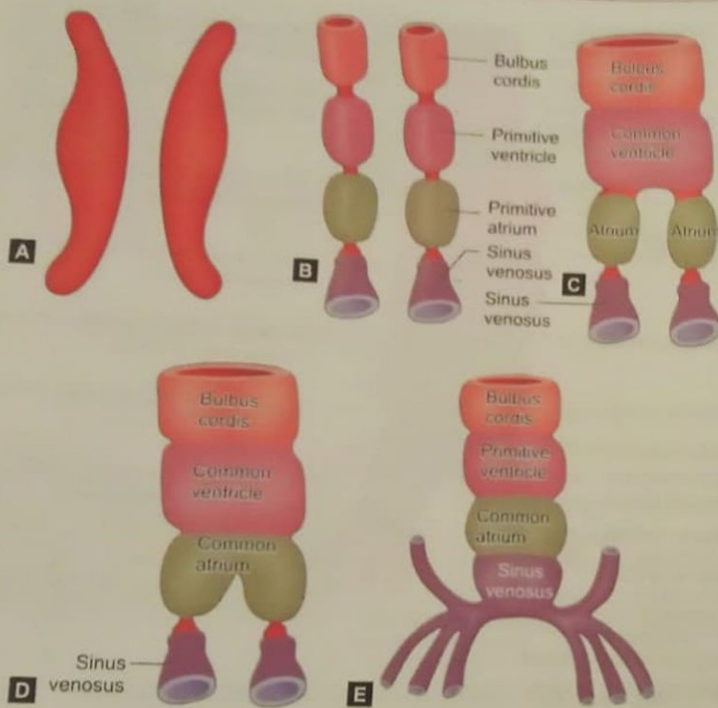


Fig. 16.7 Successive stages in the development of bronchi and lungs. A. At 4 weeks. B. At 5 weeks. C. At 6 weeks. D. At 8 weeks.

pg231



development of heart



FIGS. 19.7A TO E: (A) Right and left heart tubes; (B to E) Progressive fusion of tubes from cranial to caudal end. Fusion of sinus venosus is partial.

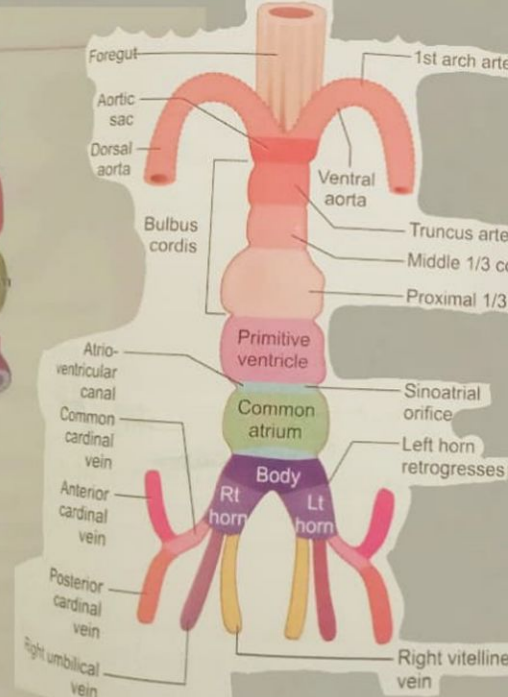


FIG. 19.8: Subdivisions of fused heart tube.

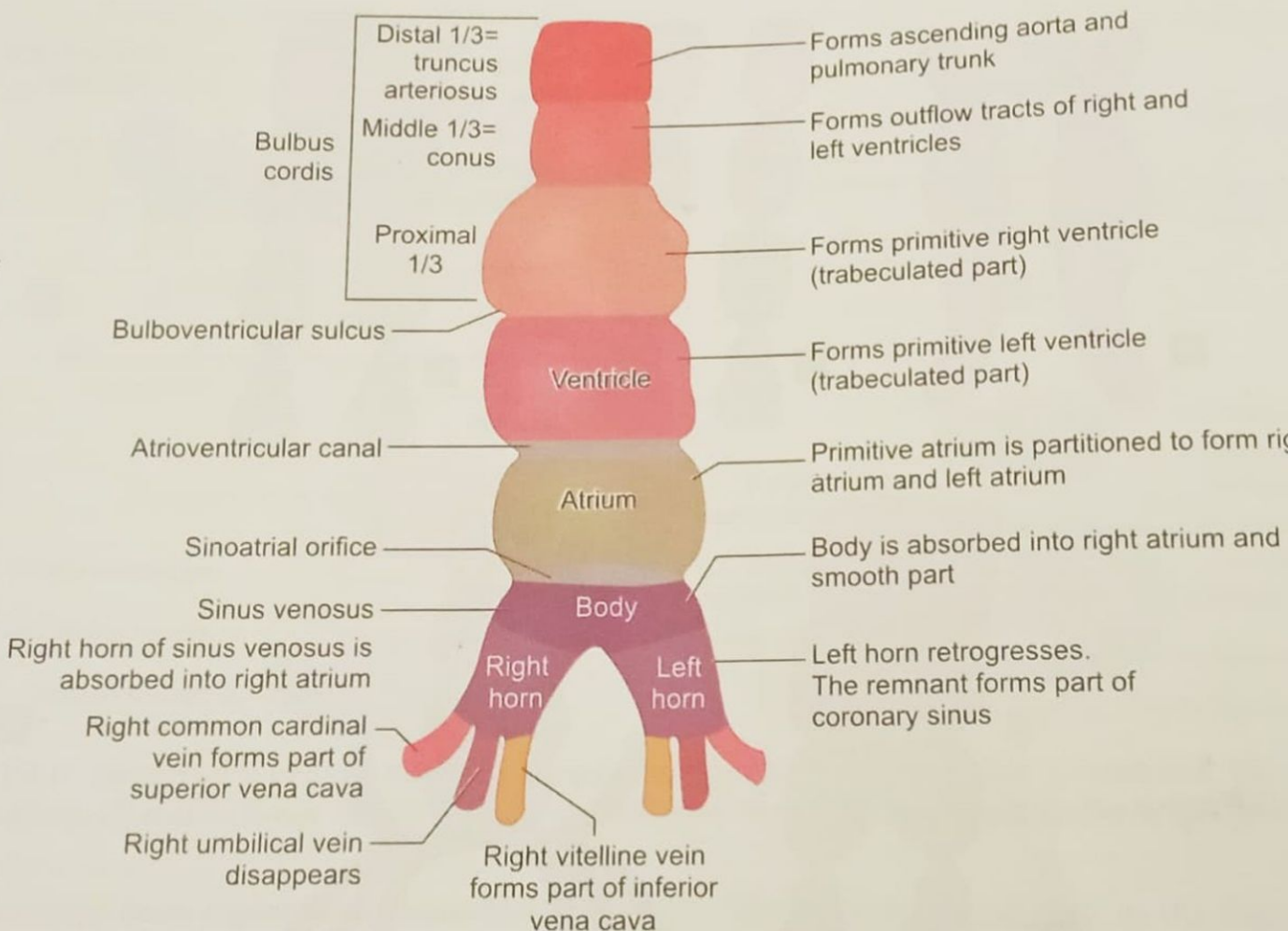
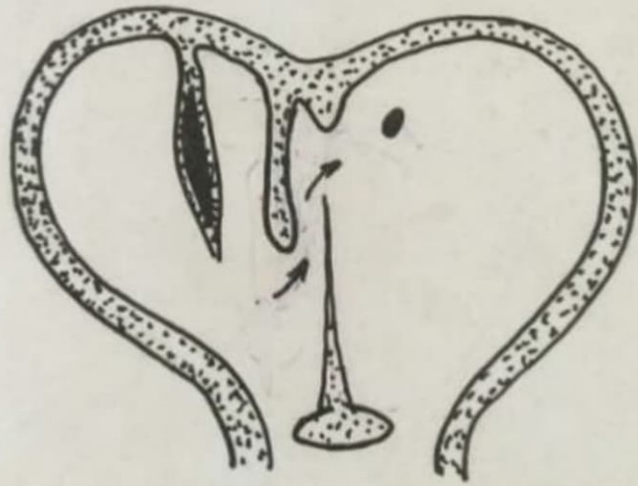
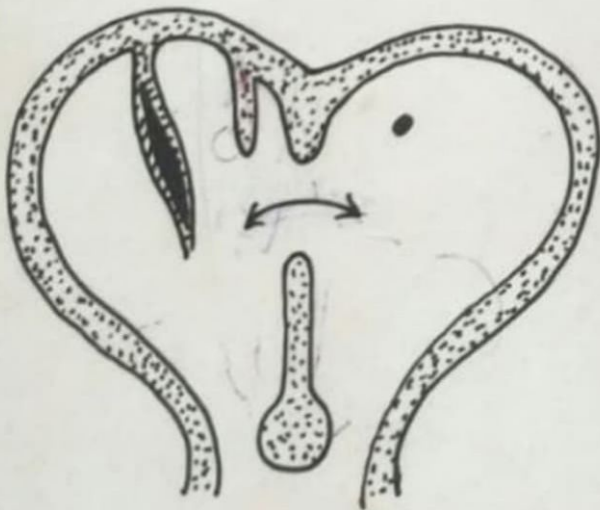
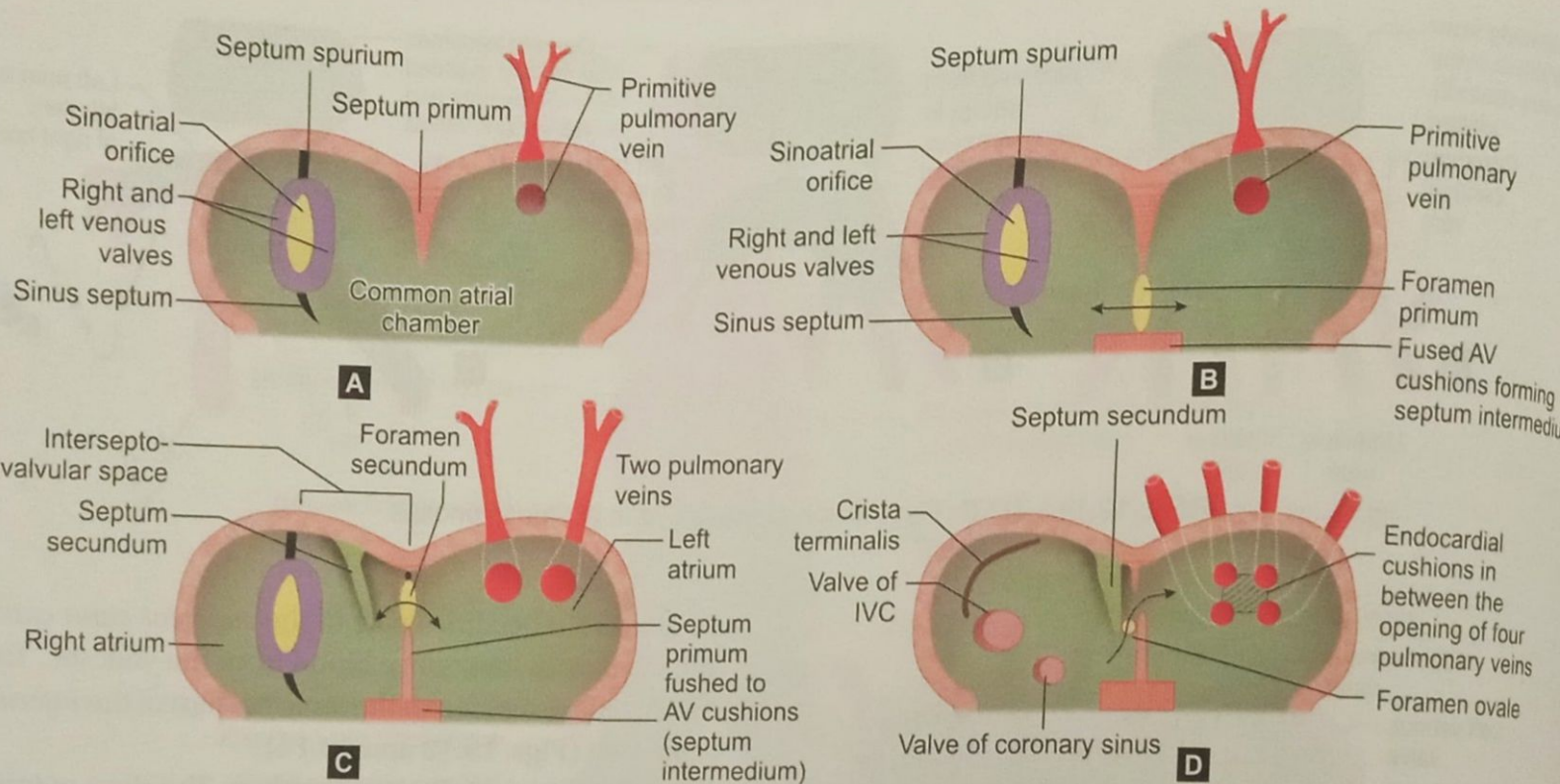


FIG. 19.9: Main subdivisions of the heart tube and their fate.

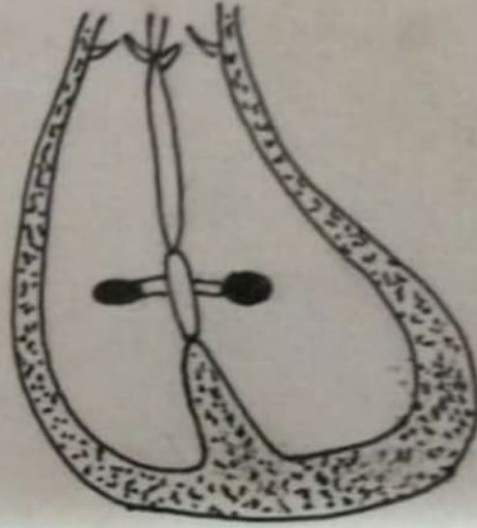
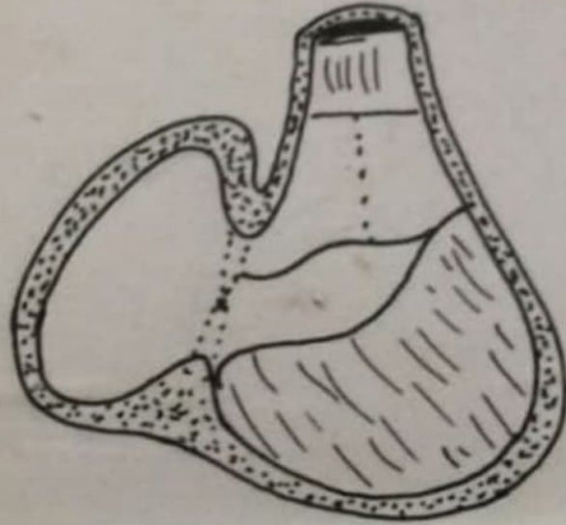
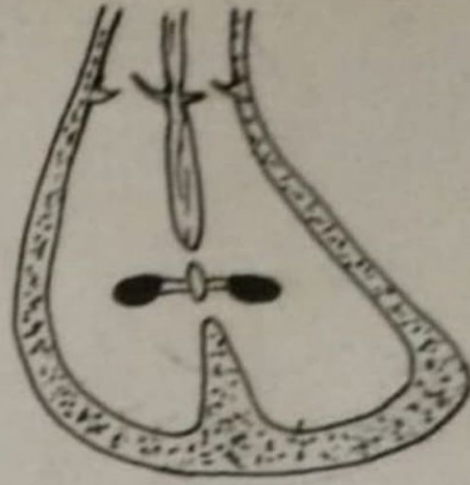
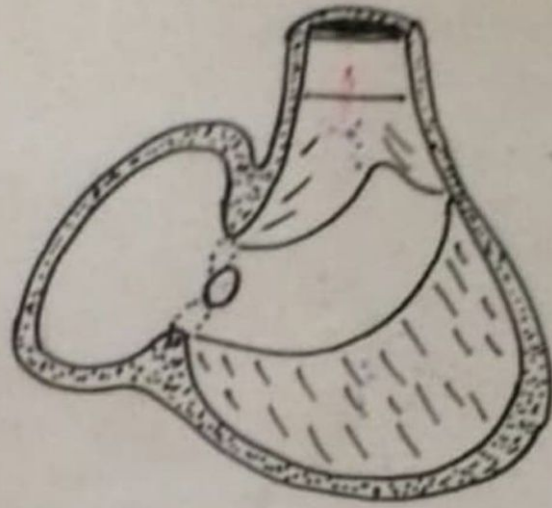
pg234



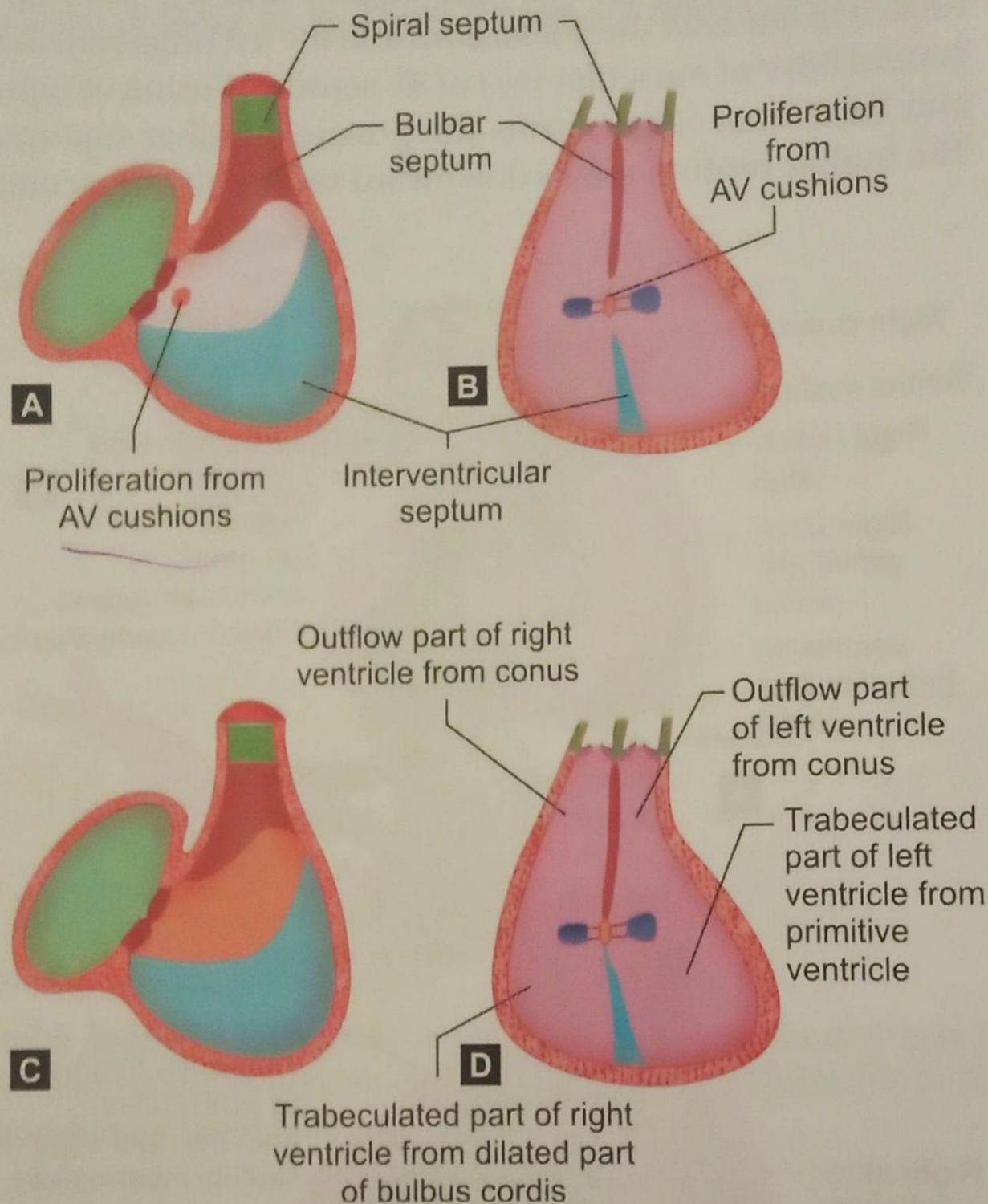
development of inter atrial septum



FIGS. 19.13A TO D: Sinoatrial orifice and venous valves in right atrium. Formation of interatrial septum. (A) Septum primum appears; (B) Septum primum grows toward fused AV cushions (septum intermedium). The gap between them is the foramen primum; (C) Septum primum fuses with atrioventricular (AV) cushions. At the same time, the upper part of the septum primum degenerates to form the foramen secundum. The septum secundum is formed to the right of the septum primum; (D) Septum secundum overlaps the free edge of septum primum. Blood now flows from left to right through the oblique cleft between the two septa. Incorporation of pulmonary veins into the left atrium is shown. (IVC: inferior vena cava)



formation of inter
ventricular septum



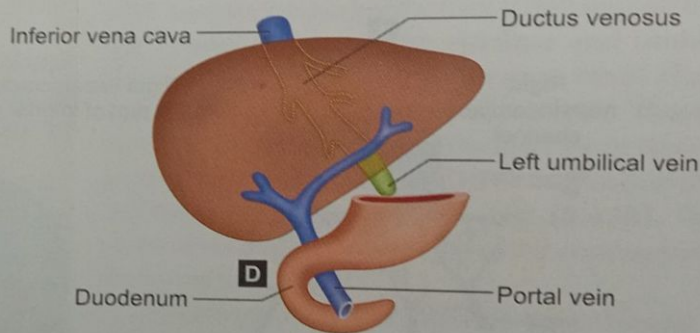
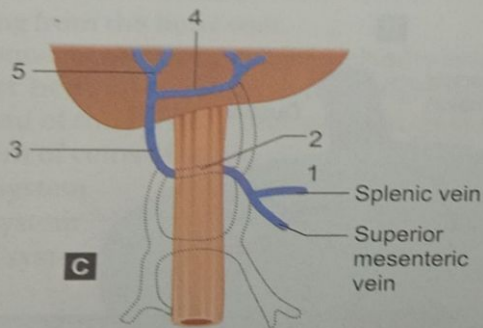
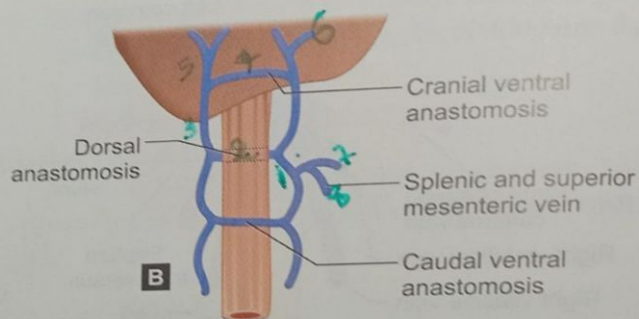
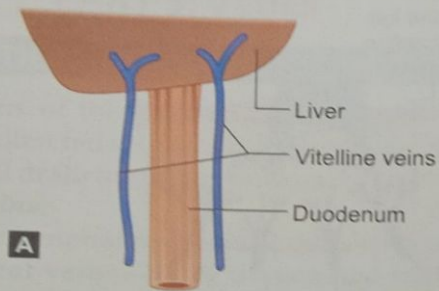
FIGS. 19.19A TO D: Two stages in the formation of the ventricular septum. (B) and (D) correspond to (A) and (C) respectively. (A) Bulbar septum grows down from above, and interventricular septum grows upward from below; (C and D) The gap between the bulbar septum and the interventricular septum is filled in by proliferation from atrioventricular (AV) cushions. For explanation of orientation of these figures, see legend to **Figures 19.18A and B**.

252



development of aortic arches

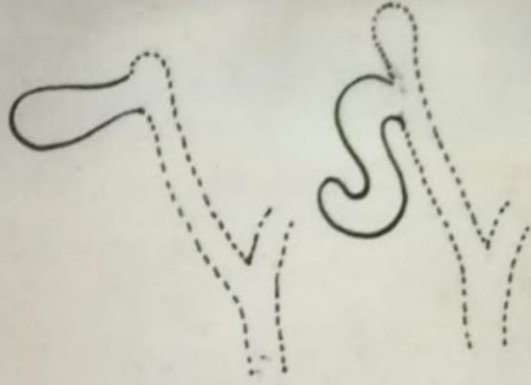
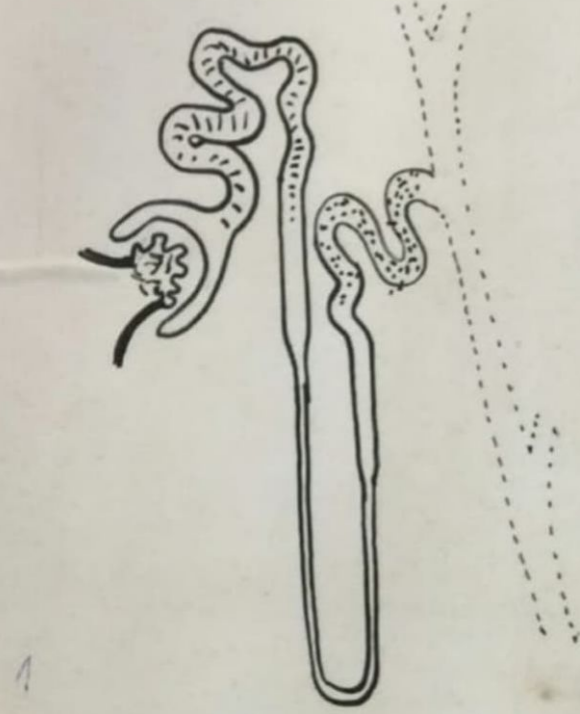
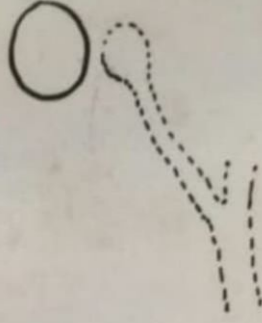


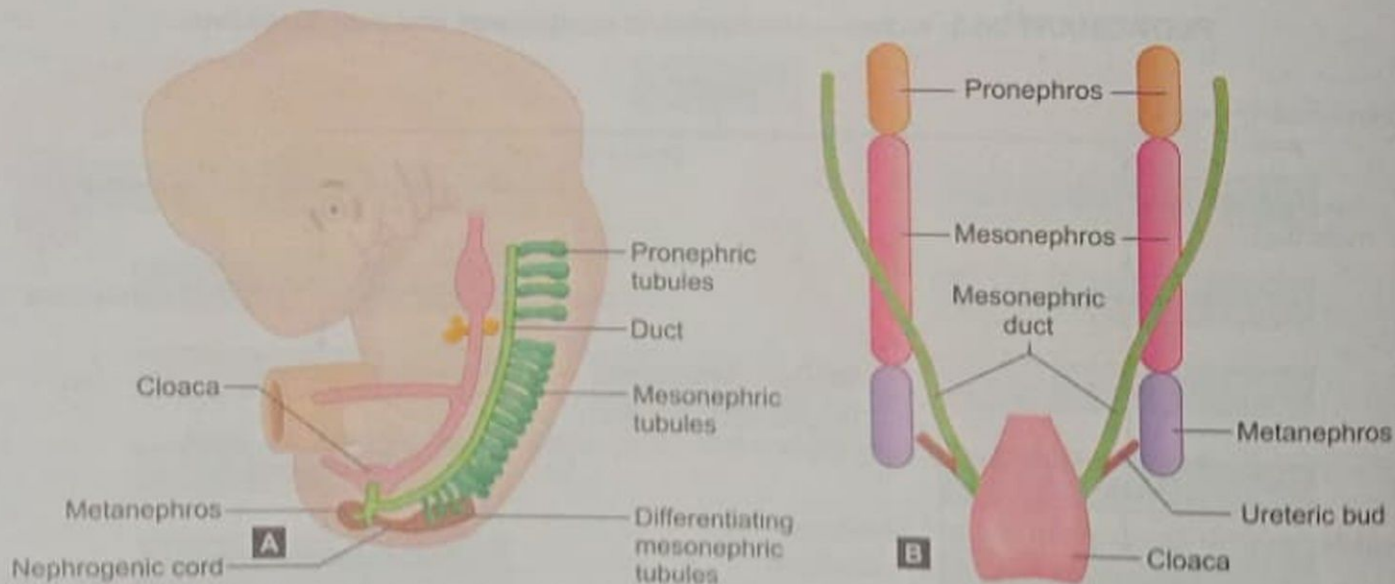


FIGS. 19.48A TO D: Development of the portal vein. (A) Right and left vitelline veins; (B) Vitelline veins joined by three transverse anastomoses: cranial ventral, caudal ventral and middle dorsal; (C) Some of the veins disappear. The portal vein is formed from: (1) Part of left vitelline vein. (2) Dorsal anastomosis. (3) Part of right vitelline vein. (4) The cranial ventral anastomosis becomes right branch; (5) Right vitelline cranial to cranial ventral anastomosis forms right branch; (D) The left umbilical vein ending in left branch of portal vein and the ductus venosus connecting it with inferior vena cava.



development of nephrons





FIGS. 20.4A AND B: (A) Lateral view of embryo showing pronephros, mesonephros and metanephros; (B) The mesonephric duct opening into the cloaca and giving off the ureteric bud.

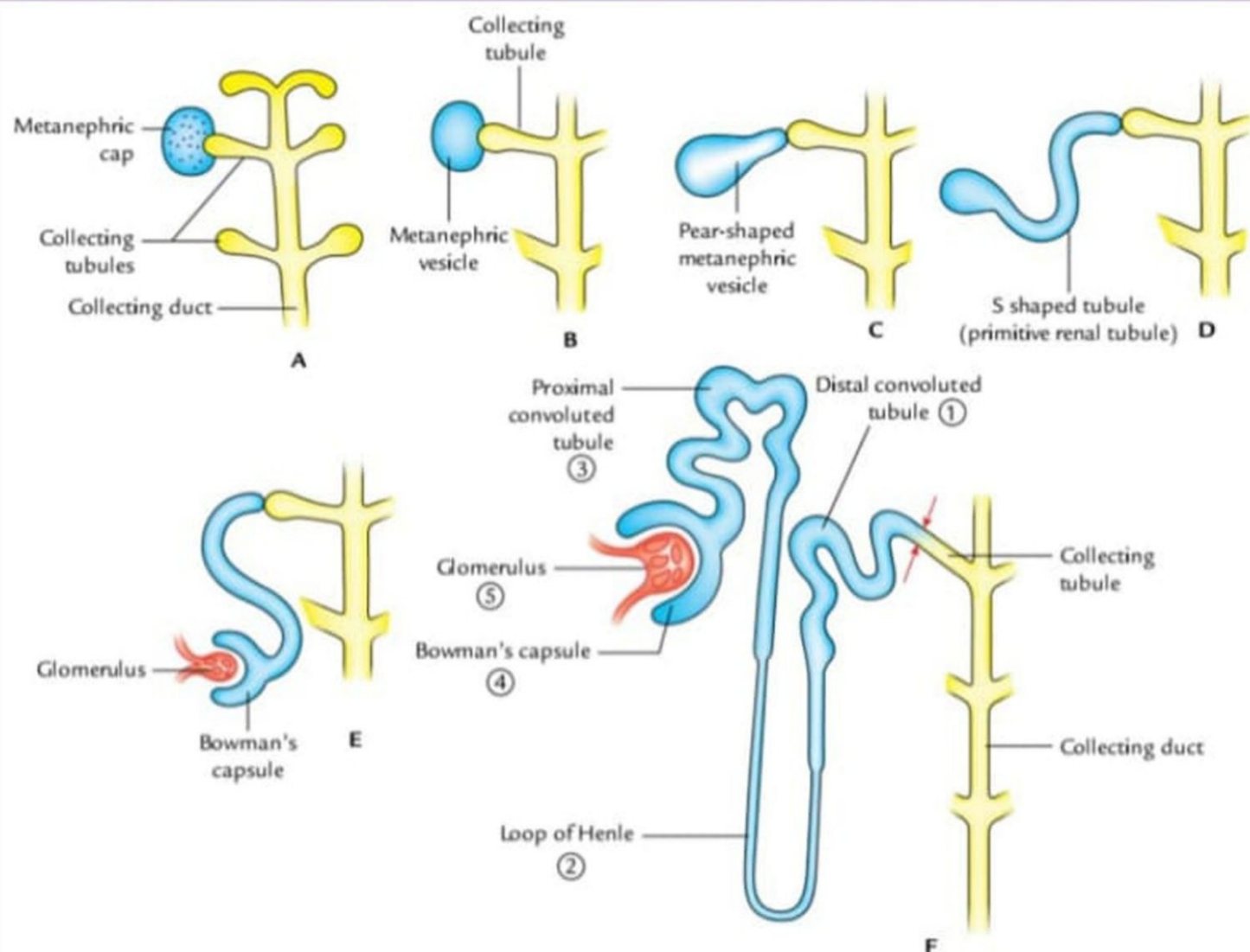
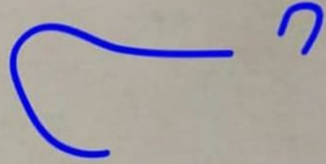
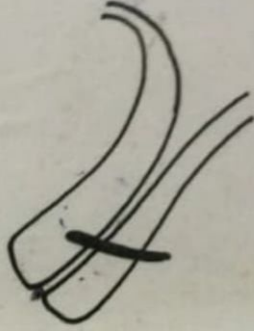
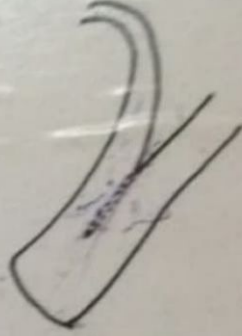
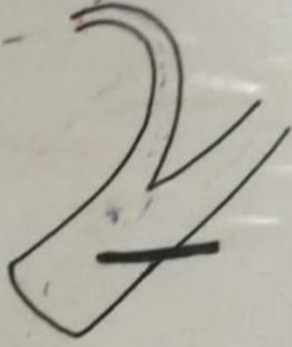
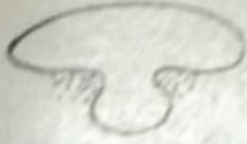
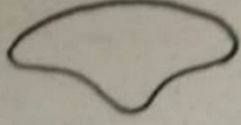


Fig. 20.6 Stages of development of nephron (excretory system of the kidney consisting of 3 million nephrons). Note each nephron consists of distal convoluted tubule (1), loop of Henle (2), proximal convoluted tubule (3), Bowman's capsule (4), and glomerulus (5). Arrows (red) indicate the place where excretory unit (blue) establishes a communication with the collecting system (yellow).

formation of urorectal septum



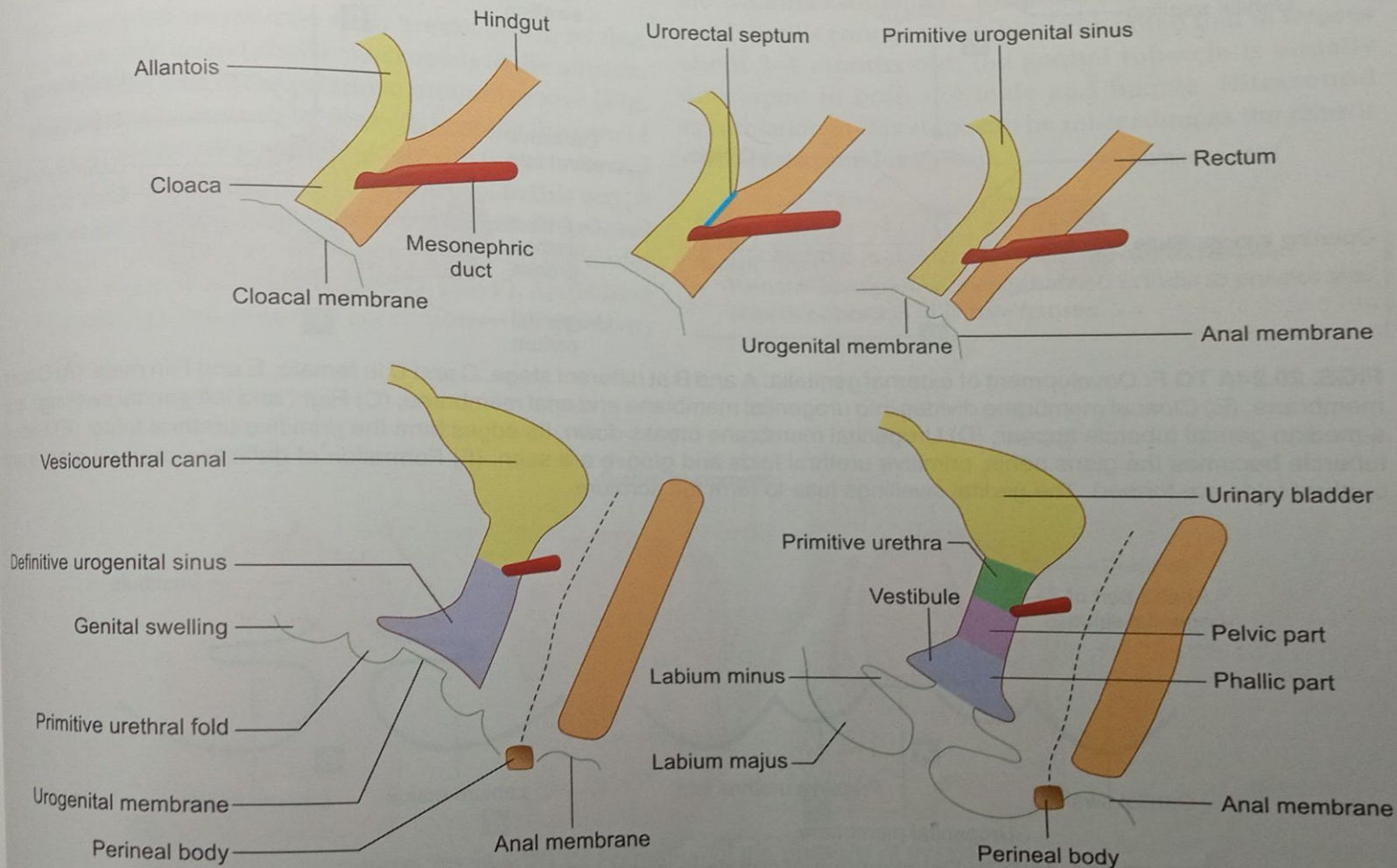
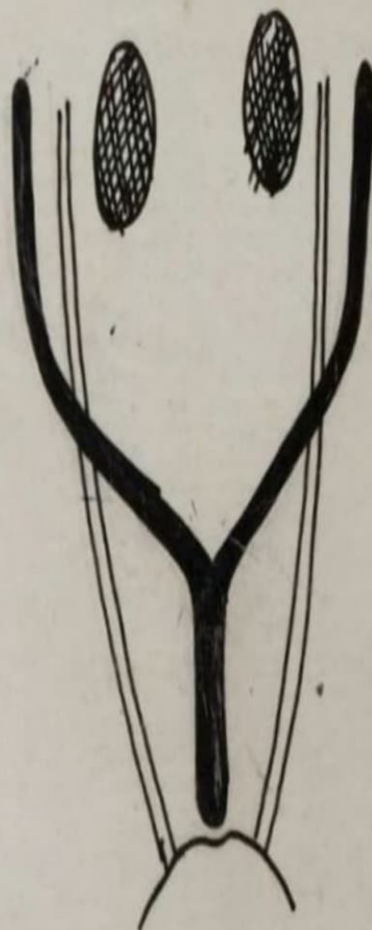
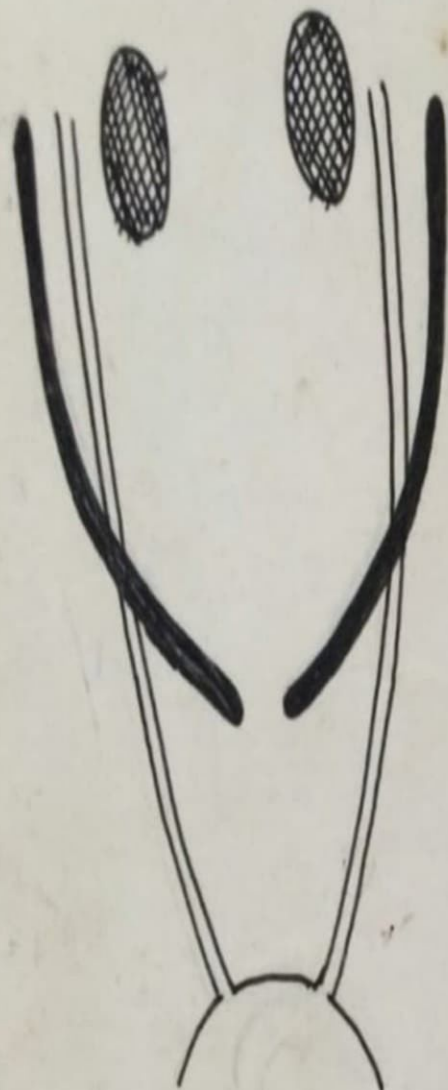
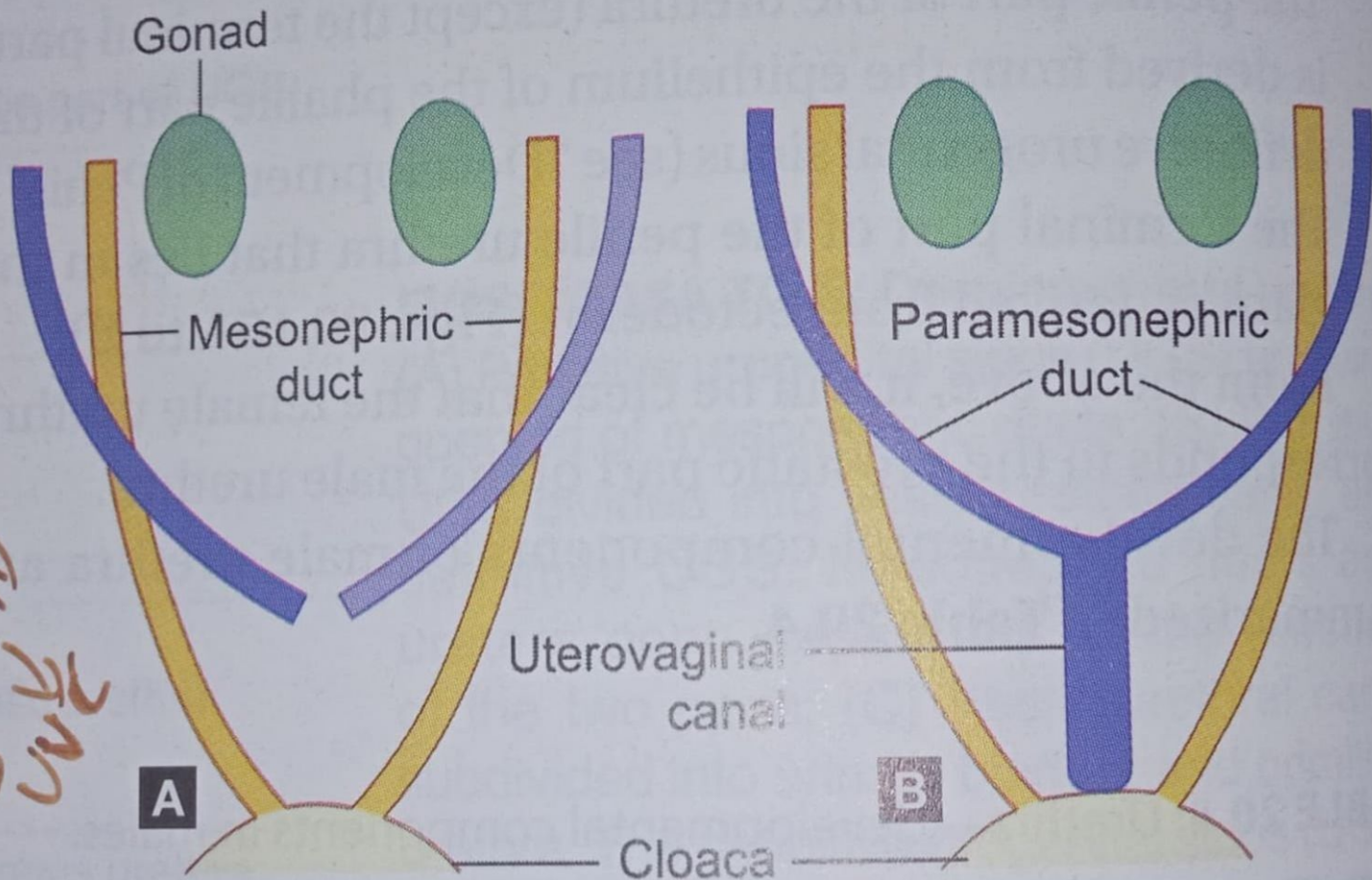


FIG. 20.23: Subdivisions of primitive urogenital sinus and cloacal membrane.



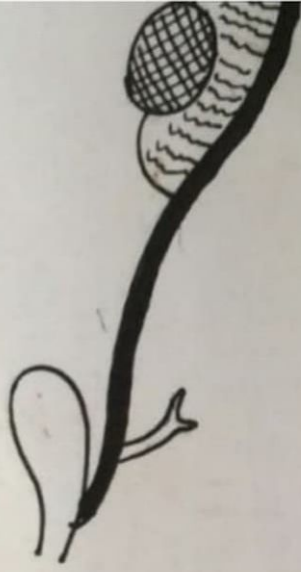
devepmnt of urovaginal
canal

PMR BMD
VVC

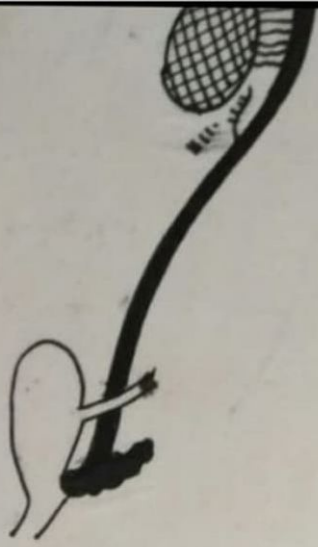
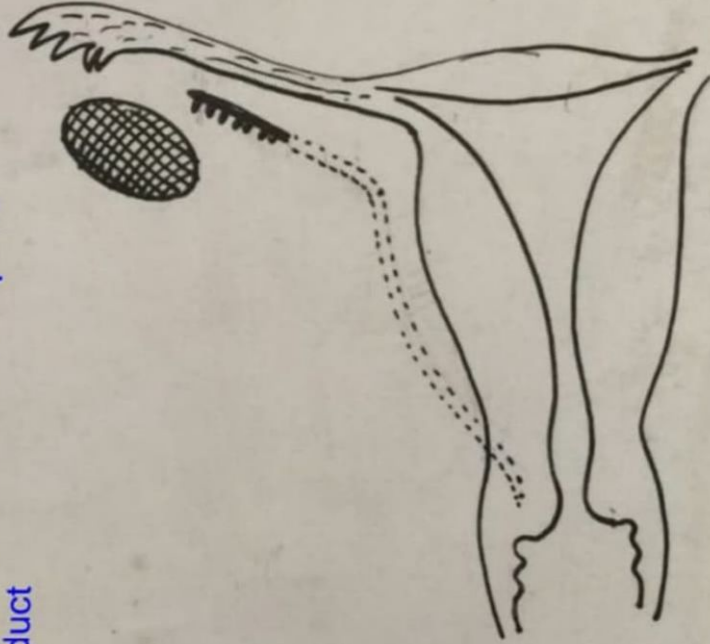


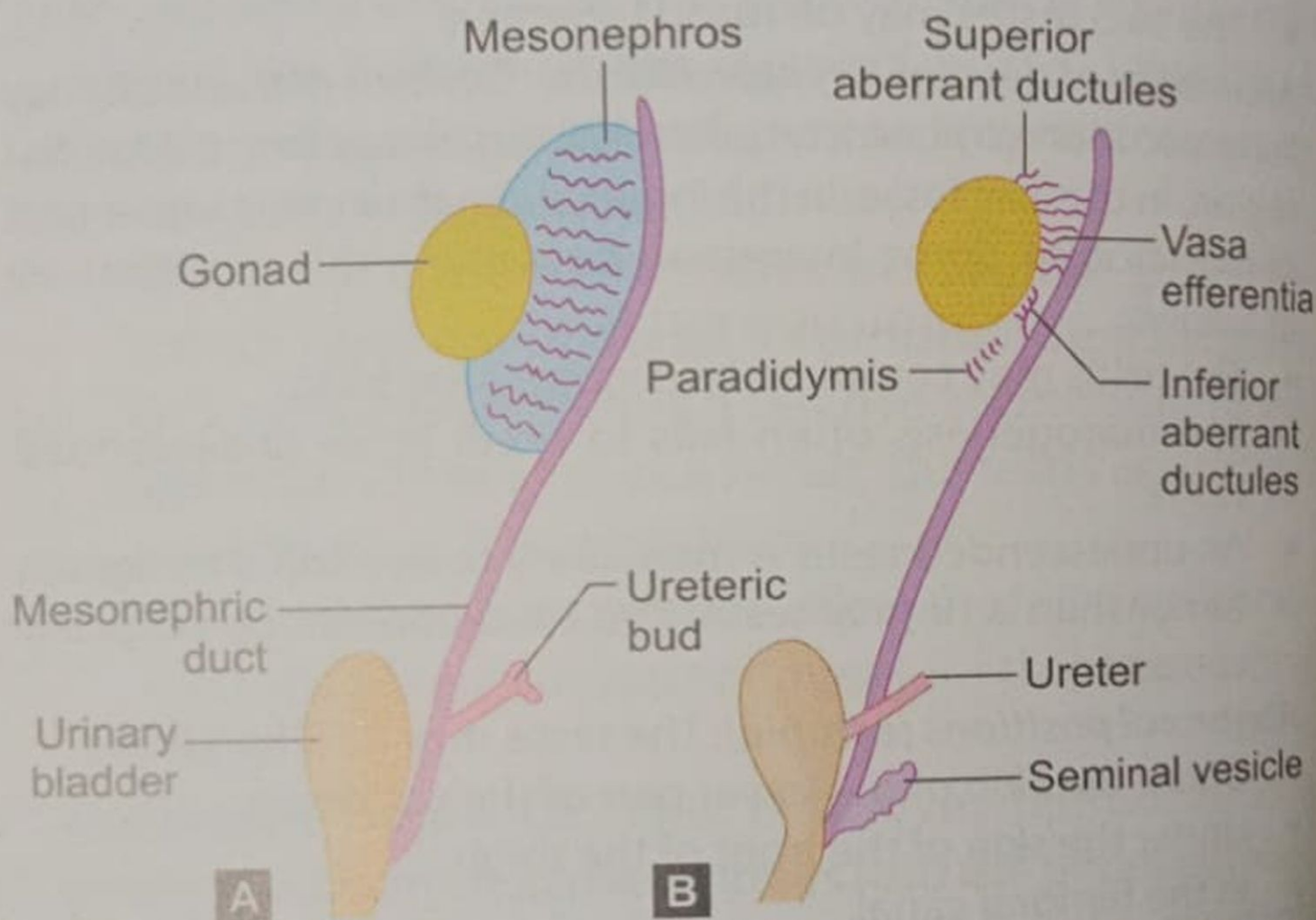
FIGS. 20.19A AND B: Formation of uterovaginal canal by fusion of the caudal parts of paramesonephric ducts.

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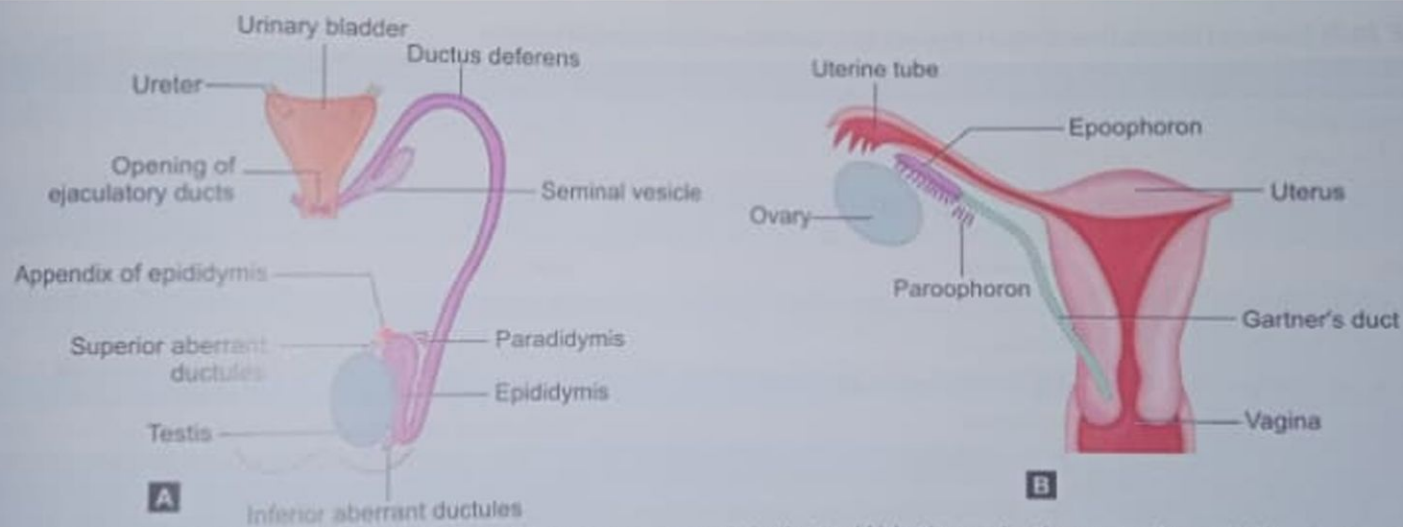


derivatives of mesonephric
duct

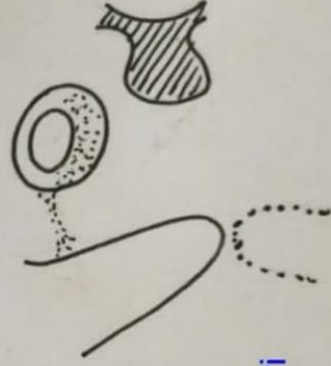




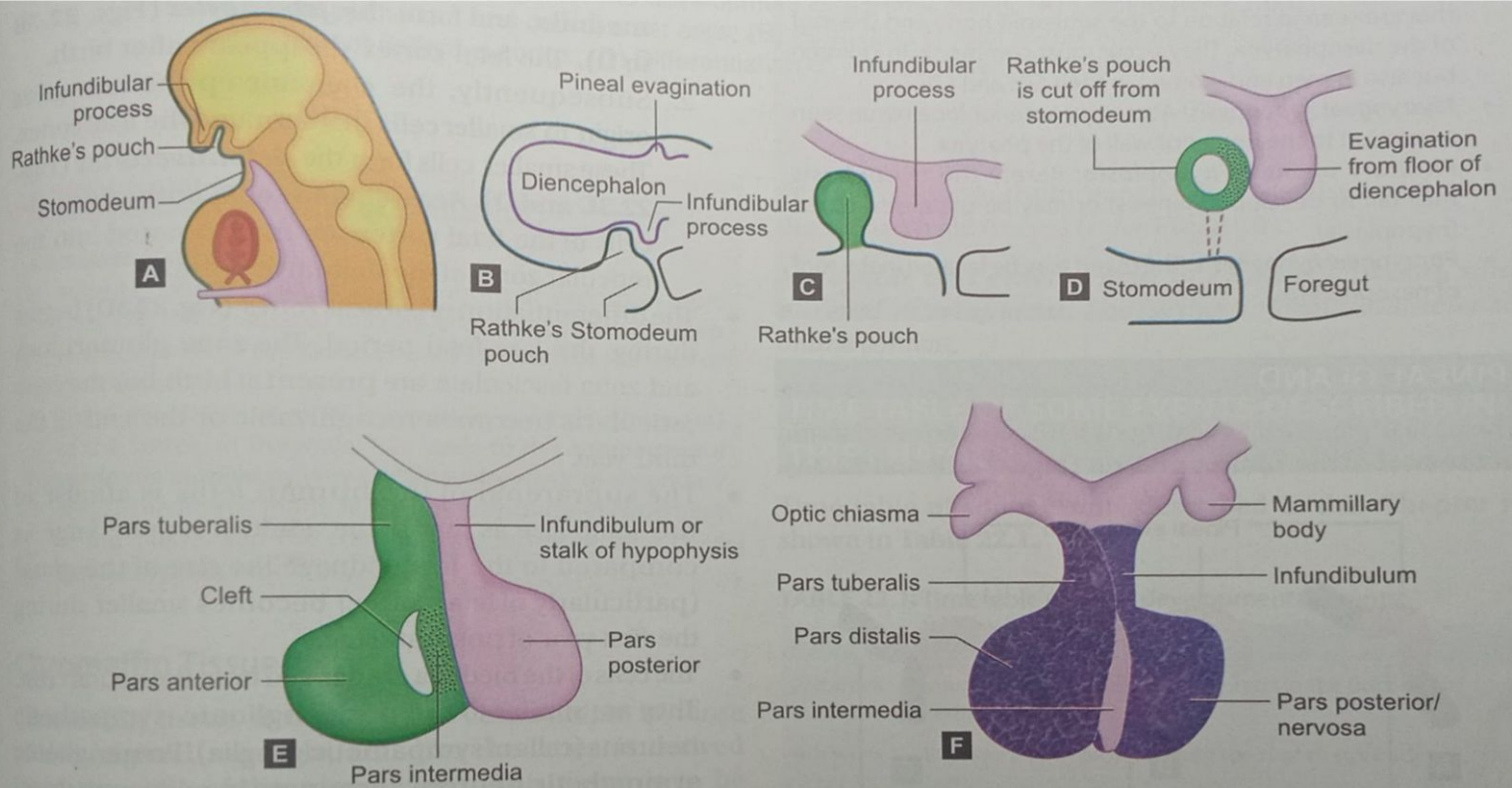
FIGS. 20.41A AND B: (A) Mesonephric duct, early stage; (B) Mesonephric duct in the male, before descent of the testis.



FIGS. 20.42A AND B: Some structures derived from the mesonephric ducts. (A) In the male, these are the epididymis, the ductus deferens, seminal vesicles and ejaculatory duct. The appendix of the epididymis is a vestigial remnant; (B) In the female, most of the duct disappears, some remnants are seen as the duct of epoophoron or Gartner's duct. For complete list of derivatives of the mesonephric ducts see text.

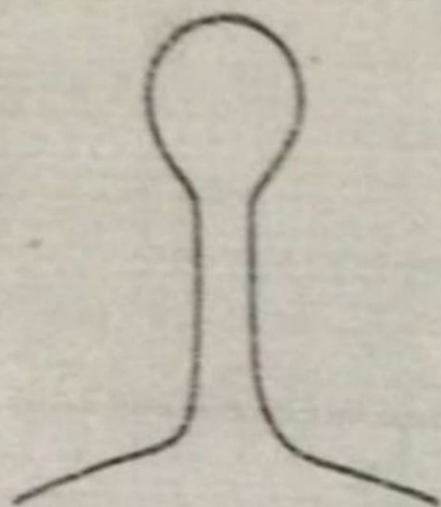


development of hypophysis cerebri

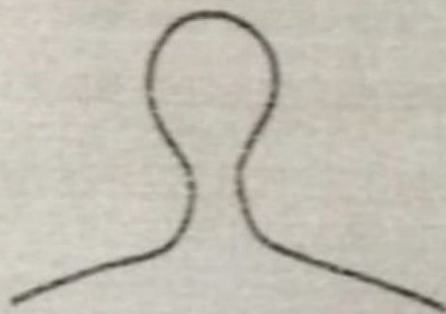


FIGS. 22.1A TO F: Development of hypophysis cerebri. (A) Rathke's pouch and infundibular process; (B and C) Approximation of the two developmental components of pituitary gland; (D) Rathke's pouch separating from stomodeum; (E) Closely placed developmental components and their subdivisions; (F) Microscopic appearance of pars anterior, intermedia, and posterior.

3



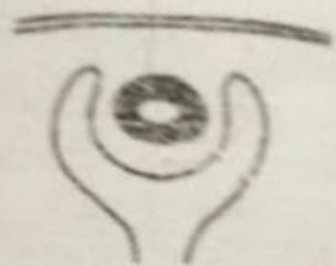
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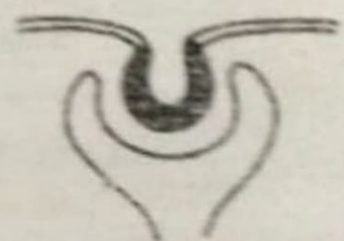
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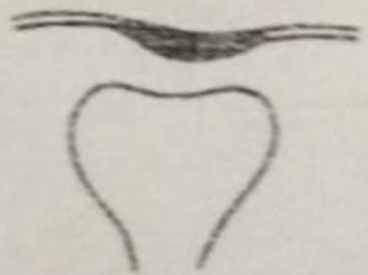
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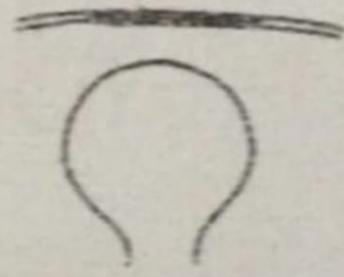
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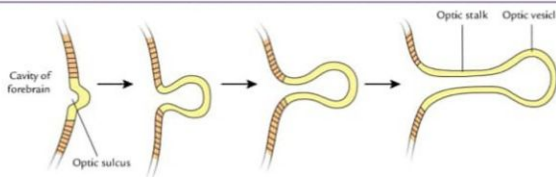


Fig. 24.2 Formation and development of the optic vesicle.

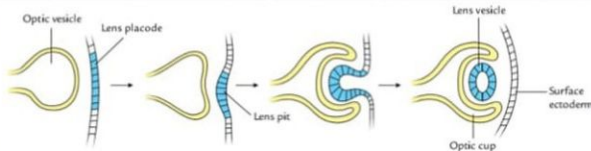
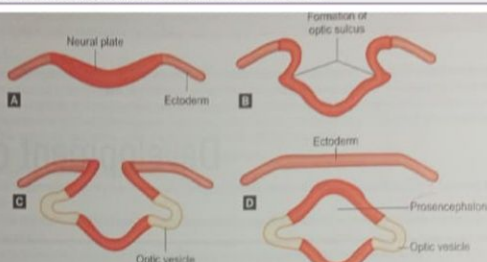
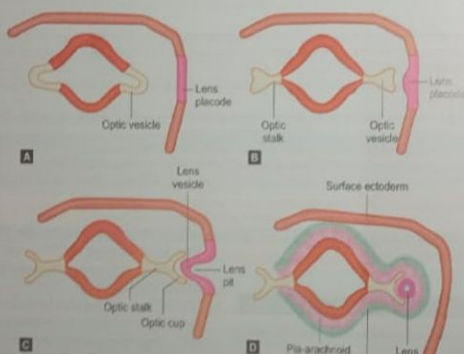


Fig. 24.3 Development of the lens vesicle and its invagination into the optic cup.



FIGS. 23.1A TO D: Formation of the optic vesicle.



FIGS. 23.2A TO D: (A) Formation of lens placode; (B) Deepening of lens placode and optic cup; (C) Formation of the optic stalk and its invagination into the optic cup; (D) Lens vesicle and optic cup, meningeal coverings for developing optic cup and lens vesicle.

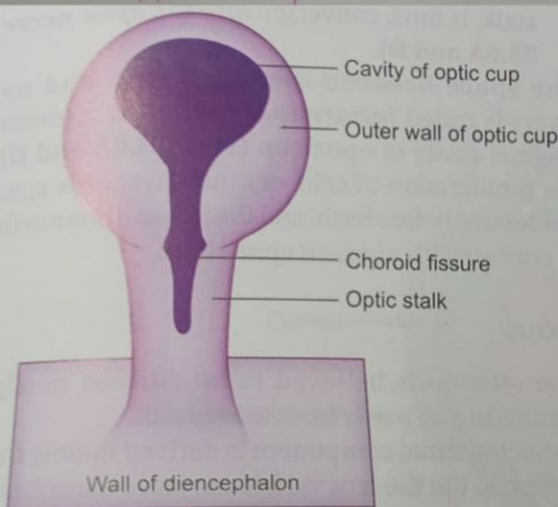
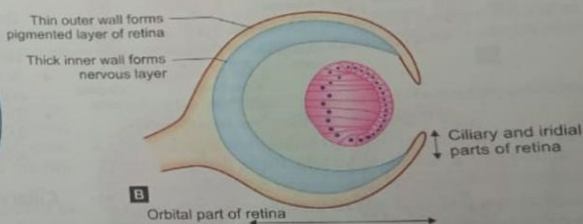
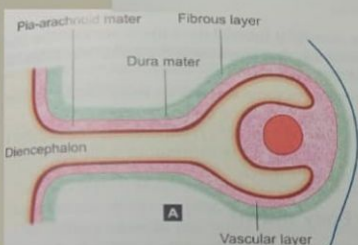
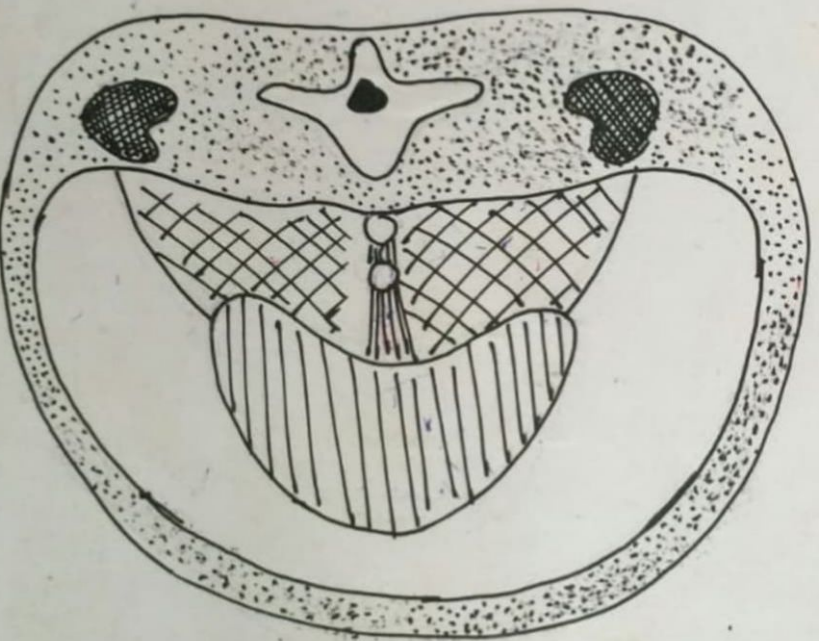


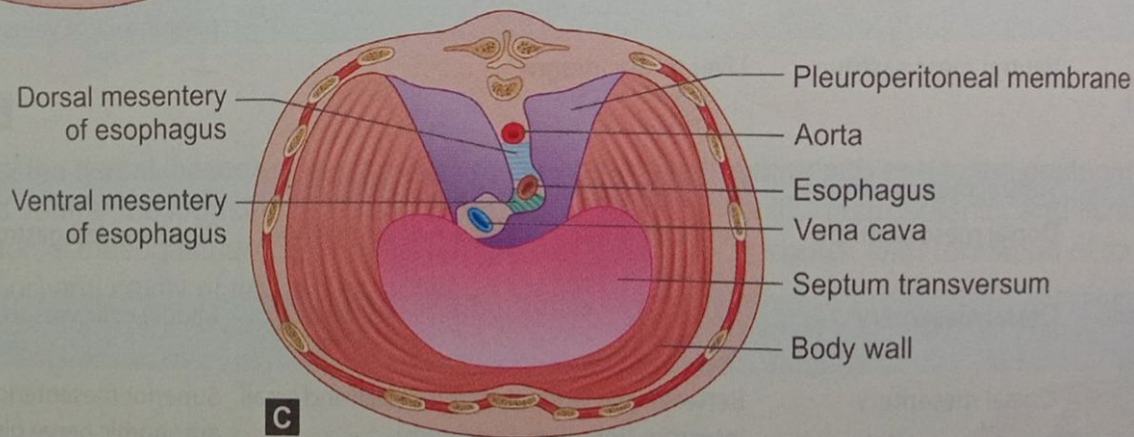
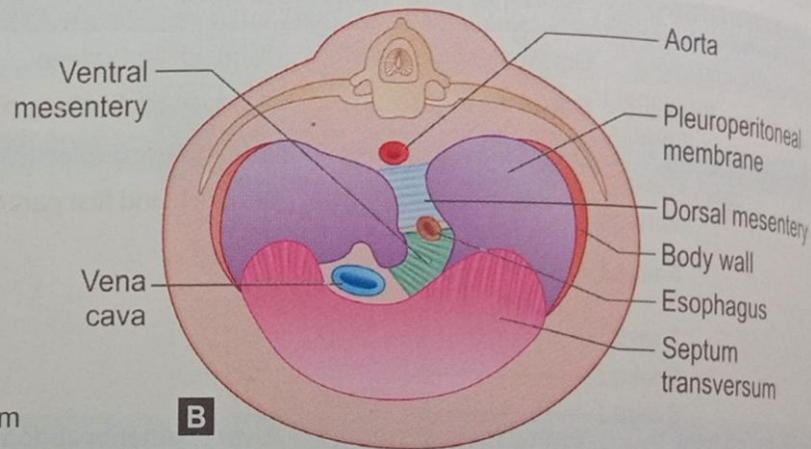
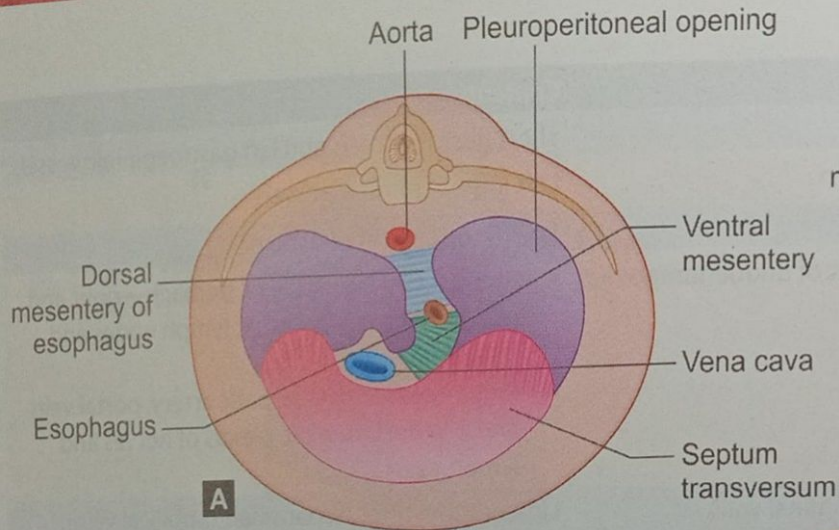
FIG. 23.3: Optic cup and stalk seen from below to show the choroidal fissure.



FIGS. 23.4A AND B: (A) Developing optic cup surrounded by extensions of pia-arachnoid and dura mater; (B) Subdivisions of the optic cup.



development of the diaphragm



FIGS. 18.16A TO C: Development of diaphragm: (A) Pleuroperitoneal canals, septum transversum and mesenteries of esophagus; (B) Closure of pleuroperitoneal canal their closure; (C) Expansion from body wall.