Embryology → Systemic

Early Fetal Development :

Fertilization ↔ Fusion of Sperm and Oocyte / ovum → resulting in **Zygote formation**

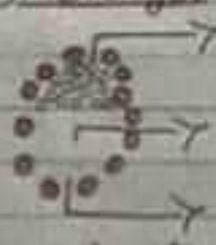
② Most common site for fertilization → **Ampulla of fallopian tube**

③ Fertilization occurs Within **1 day of ovulation**

④ **Zygote** → 46 Chromosomes Containing cell

⑤ After Zygote formation of Morula (uterine cavity)
Morula → 16 Cell Containing Compact Ball
formed at day 3 in Uterine Cavity

⑥ After Morula formation of Blastocyst
Blastocyst



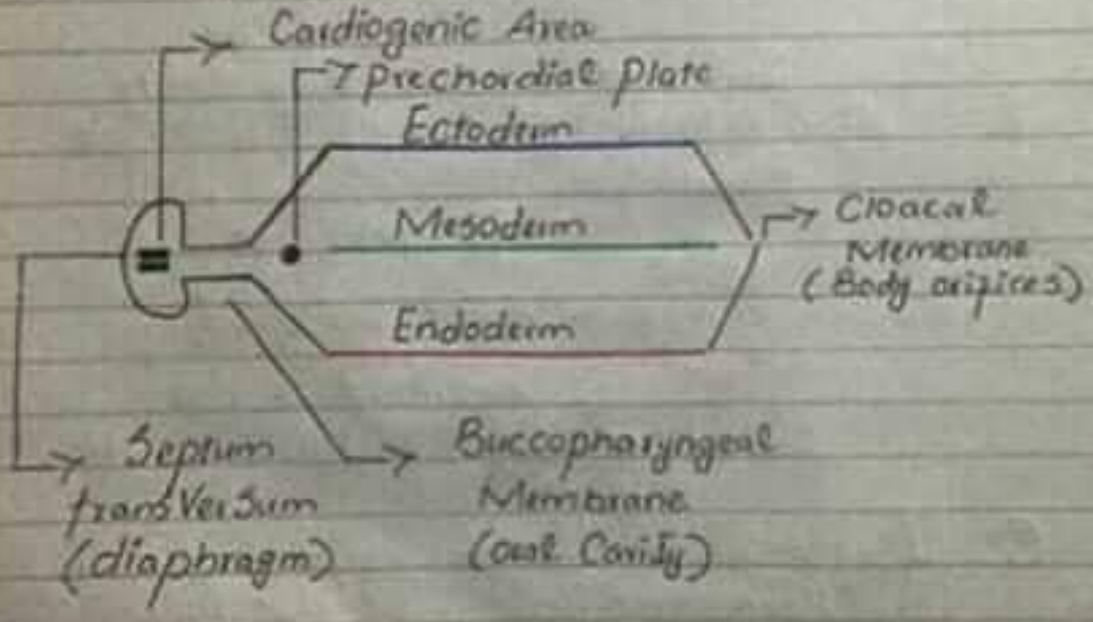
formed at day 5 in Uterine Cavity

⑦ **Implantation** → Implantation of Blastocyst Within Wall of Uterus
Occurs **6 days after fertilization**
And Completed at day 11 of Gestation

⑧ Within Week 2 of Gestation → 2 layers
↓
Bilaminar Germ Disc (Epiblast, Hypoblast)

⑨ Within Week 3 of Gestation → 3 layers
↓
Trilaminar Germ Disc (Ectoderm, Mesoderm, Endoderm)

⑩ Gastulation → process that forms trilaminar Embryonic / germ disc. Establishes
- Ectoderm
- Mesoderm
- Endoderm germ layers



Anterior End of Embryo

Posterior End of embryo

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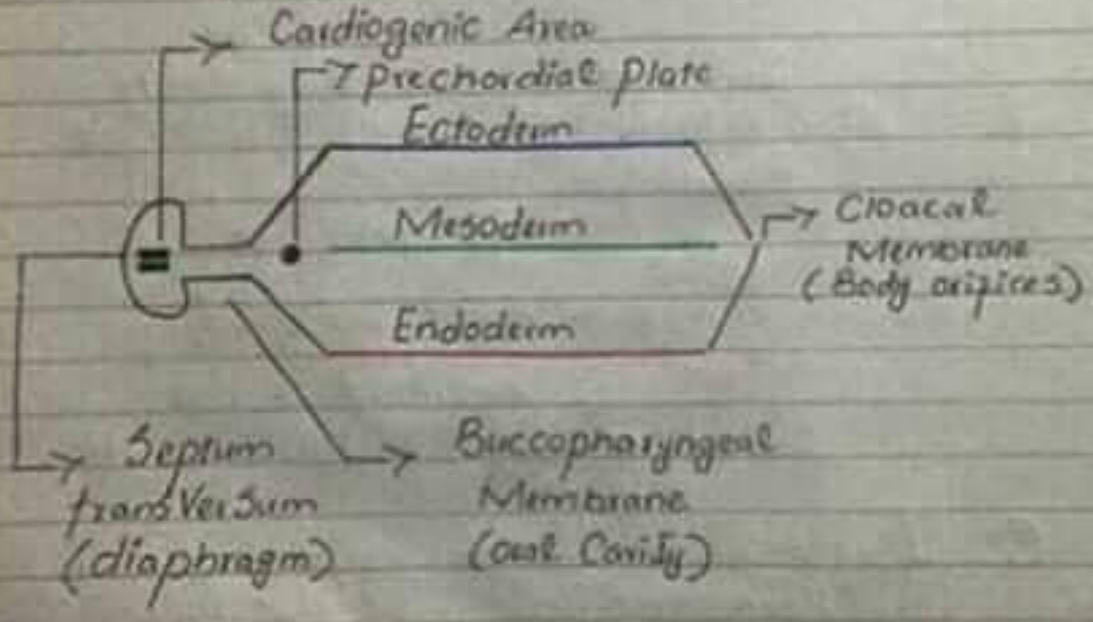


Anterior End of Embryo

Posterior End of embryo

Embryologic Derivatives:

Ectoderm
- Surface ectoderm
- Neuroectoderm
- Neural Crest

Surface Ectoderm Derivatives
- Glands
  - Anterior pituitary Gland (from Rathke pouch)
  - parotid Gland
  - Sweat Gland
  - Mammary Gland
- Face
  - lens of eye
  - Sensory Organs of ear
  - Olfactory Epithelium
  - Oral Cavity Epithelium
- Skin → Epidermis
- Anal Canal → below pectinate line

Neuroectoderm Derivatives: think CNS
- Brain
  - posterior pituitary gland, pineal gland
  - CNS Neurons
  - CNS cells (Oligodendrocytes, astrocytes, Ependymal cells)
- Spinal Cord, Neural Tube
- Retina and optic Nerve

Neural Crest Derivatives: Think PNS

- PNS → dorsal root & Celiac ganglion, Cranial Nerves, Schwann cells, ANS
- Melanocytes
- Odontoblasts
- Parafollicular/C cells of Thyroid
- Chromaffin cells of Adrenal Medulla
- Meninges → pia and arachnoid
- Skull Bones
- Aorticopulmonary Septum

Mesoderm Derivatives:

- Muscle
- Bone
- Connective tissue
- Peritoneum
- Notochord
- Dura Mater, Microglia

Nucleus pulposus of Intervertebral Disc is the postnatal derivative of Notochord.

- Genital System → Vagina, testes, ovaries
- Urinary System → Kidney, Adrenal Cortex
- GIT → Spleen, Wall of gut tube
- CVS, lymphatics Blood
- Skin → Dermis

Mesodermal Defects → VACTERL

Vertebral defects
Anal atresia
Cardiac defects
Tracheo-Esophageal defects
Renal defects
Limb defects (bone and muscle)

Endoderm Derivatives:

- Anal Canal → above pectinate line
- Urethra
- Luminal Epithelial Derivatives

↓

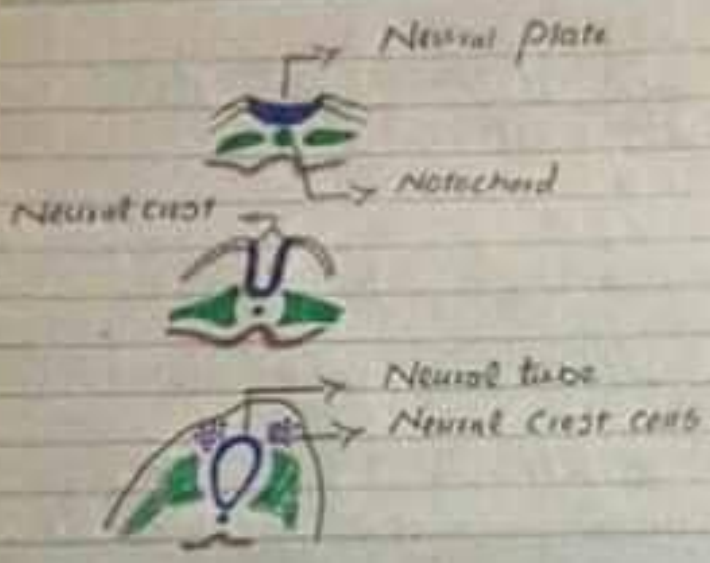
Lungs, Liver, gallbladder, Pancreas
Eustachian tube, Thymus, parathyroid,
Thyroid follicular cells

(22) Weeks 3-8 (Embryonic Period) →

- Organogenesis
- Extremely Susceptible to Teratogens
- Neural Tube formed by Neuroectoderm and closes by Week 4.

Neural Tube Development:-

- Notochord Induces overlying ectoderm to differentiate into Neuroectoderm and form the Neural plate
- Neural plate gives rise to the Neural tube and Neural Crest cells
- Notochord becomes Nucleus pulposus of Intervertebral disc in Adults



- Neural tube / Neuropores → fuse by Week 4.
  pore

Neural Tube Defects:-

- Neuropores fail to fuse (4th Week) → persistent Connection b/w Amniotic Cavity and Spinal Canal
  Associated With Low folic Acid Intake before Conception and during pregnancy.
- Elevated α-fetoprotein / AFP in amniotic fluid and maternal Serum
  AFP produced by Fetus
- Confirmatory Test → ↑ acetylCholinesterase (AChE) in amniotic fluid

Types of Neural tube Defects:-

Spina bifida Occulta →

- failure of bony Spinal Canal to close
- No Structural herniation
- Seen at lower Vertebral levels

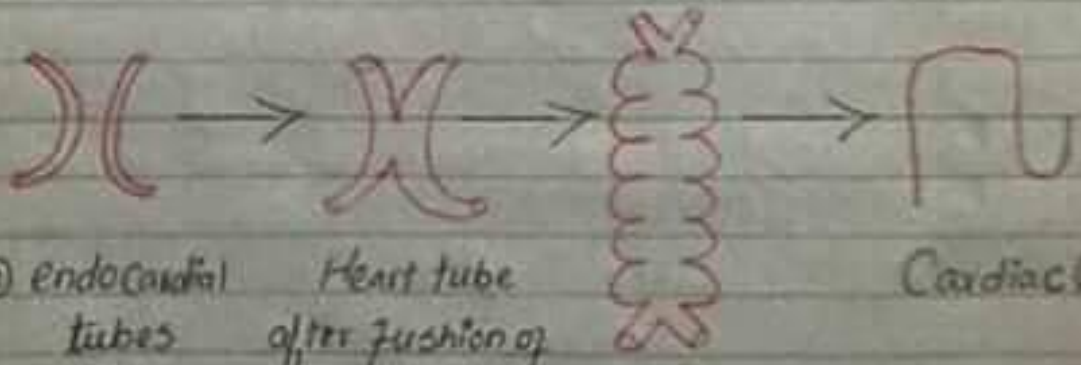
- Dura is intact
- Associated Wd Tuft of hair OR Skin dimple at level of bony defect

Meningocele ⟶
- Meninges but not the Spinal Cord herniate Through Spinal Canal defect
- Normal AFP

Meningomyelocele ⟶
- Meninges and Spinal Cord both herniate Through Spinal Canal defect

⑫ Week 4 ⟶ First Functional Organ in Vertebrate embryos: Heart
Beats spontaneously by Week 4 of Gestation

Heart Morphogenesis:
- Cardiac Looping



② endocardial tubes

Heart tube after fusion of two endocardial tubes

↓
Elongation, dilatation and Constriction of Heart tube

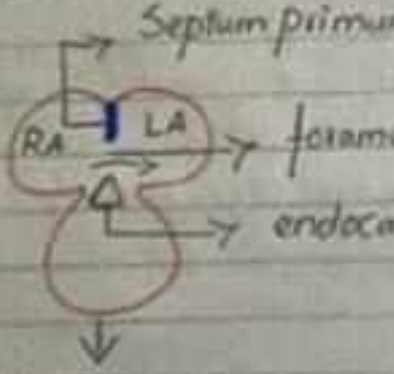
Cardiac loop

Primary Heart tube loops to establish L-R polarity, Defect in L-R polarity Can lead to Dextrocardia → Heart is pointed toward the right side of Chest

Dextrocardia Seen in Kartagener Syndrome OR primary Ciliary Dyskinesia

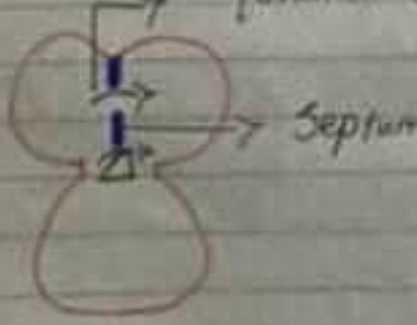
- Septation of the Chambers:

Atria:



- Septum primum grows toward endocardial cushion, Narrowing f. primum

AtrioVentricular Canal



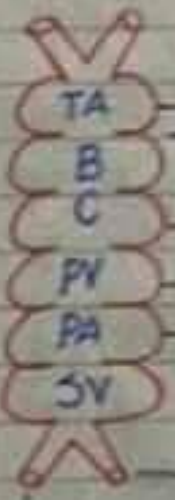
- foramen primum disappears, foramen Secundum form in Sptum primum

- Septum Secundum develop

Valve Development:

- Mitral / Tricuspid → Derived from Endocardial cushions of outflow tract.
- Aortic / pulmonary → ↑
- → Derived from fused endocardial cushions of the Atrioventricular/AV Canal.

Heart Embryology:



Embryonic Structure	Give Rise to
Truncus Arteriosus	• Ascending Aorta & pulmonary trunk
Bulbus Cordis	• Smooth parts/outflow tract of L and R Ventricles
Primitive Ventricle	• Trabeculated part of L and R ventricles
Primitive Atria	• Trabeculated part of L and R Atria
Left horn of SV	• Coronary Sinus
Right horn of Sinus Venosus (SV)	• Smooth part of R. Atrium

- Primitive pulmonary Vein → Give rise to Smooth part of Left Atrium
- Right Common Cardinal Vein & Rt Anterior Cardinal Vein → SVC