# DOSR IN ZOOLOGY

SUBJECT : CPT 2.2 DEVELOPMENTAL BIOLOGY

ORGANOGENESIS - DEVELOPMENT OF SOMITES.

Arfath unnisa
DOSR IN ZOOLOGY
Tumkur University

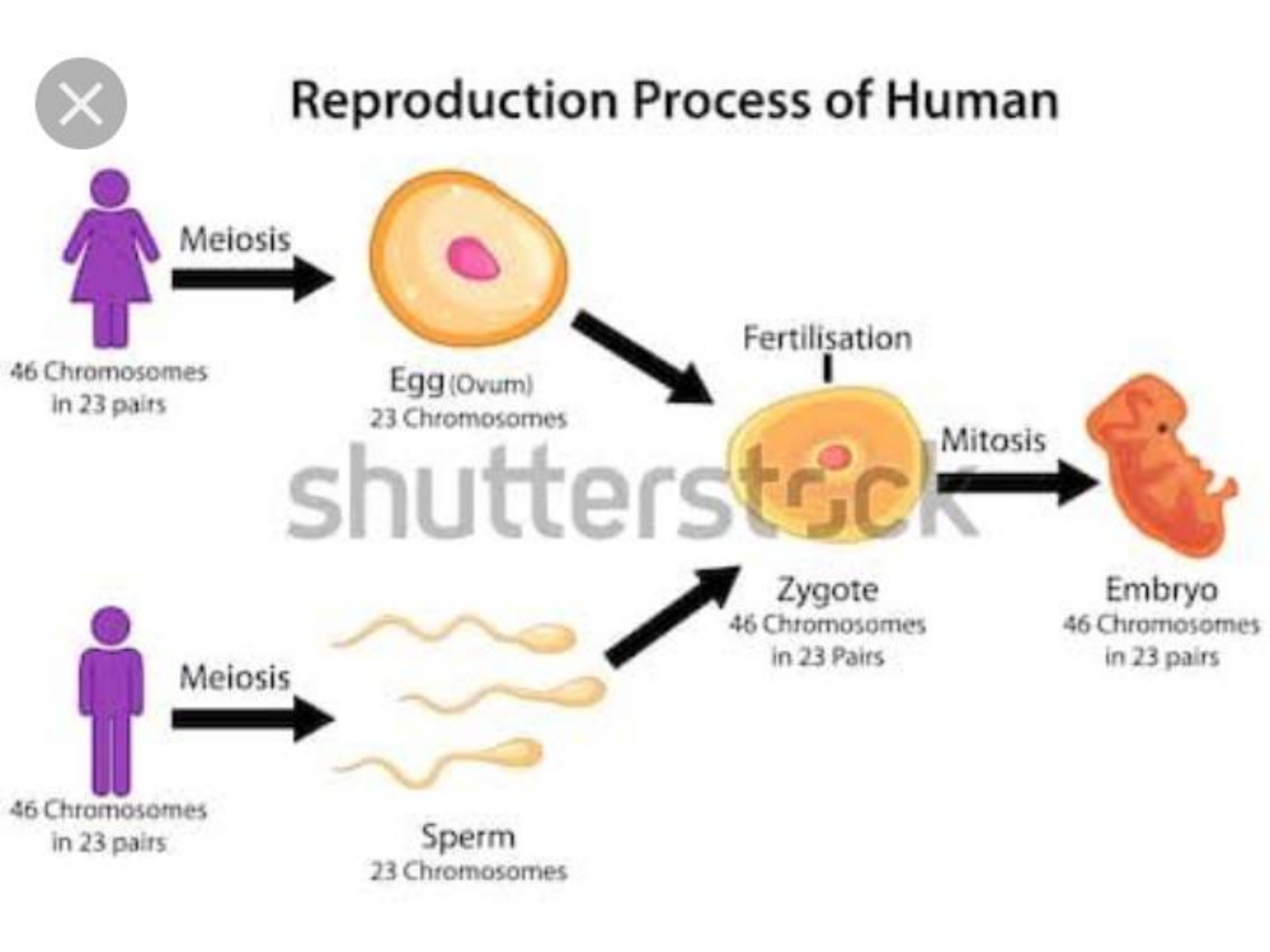
# INTRODUCTION

Reproduction is the ultimate aim of all organism in the world. All organism reproduce sexually or asexually to form a new organism.. Then how this new oragnism was formed? And why the morphology is differ from species to species. What are the processes that occur during the reproduction.

How does an adult body produce yet another body? How does the fertilised egg give rise to adult? All these questions arise from the process of reproduction.

- Reproduction mainly involves the following steps they are

1. fertilisation
2. Blastulation
3. Gastrulation
4. ORGANOGENESIS
5. development
6. Birth


Reproduction Process of Human
Meiosis
46 Chromosomes
in 23 pairs
Egg (Ovum)
23 Chromosomes
Fertilisation
Mitosis
Zygote
46 Chromosomes
in 23 Pairs
Embryo
46 Chromosomes
in 23 pairs
Meiosis
46 Chromosomes
in 23 pairs
Sperm
23 Chromosomes
shutterstock

# ORGANOGENESIS

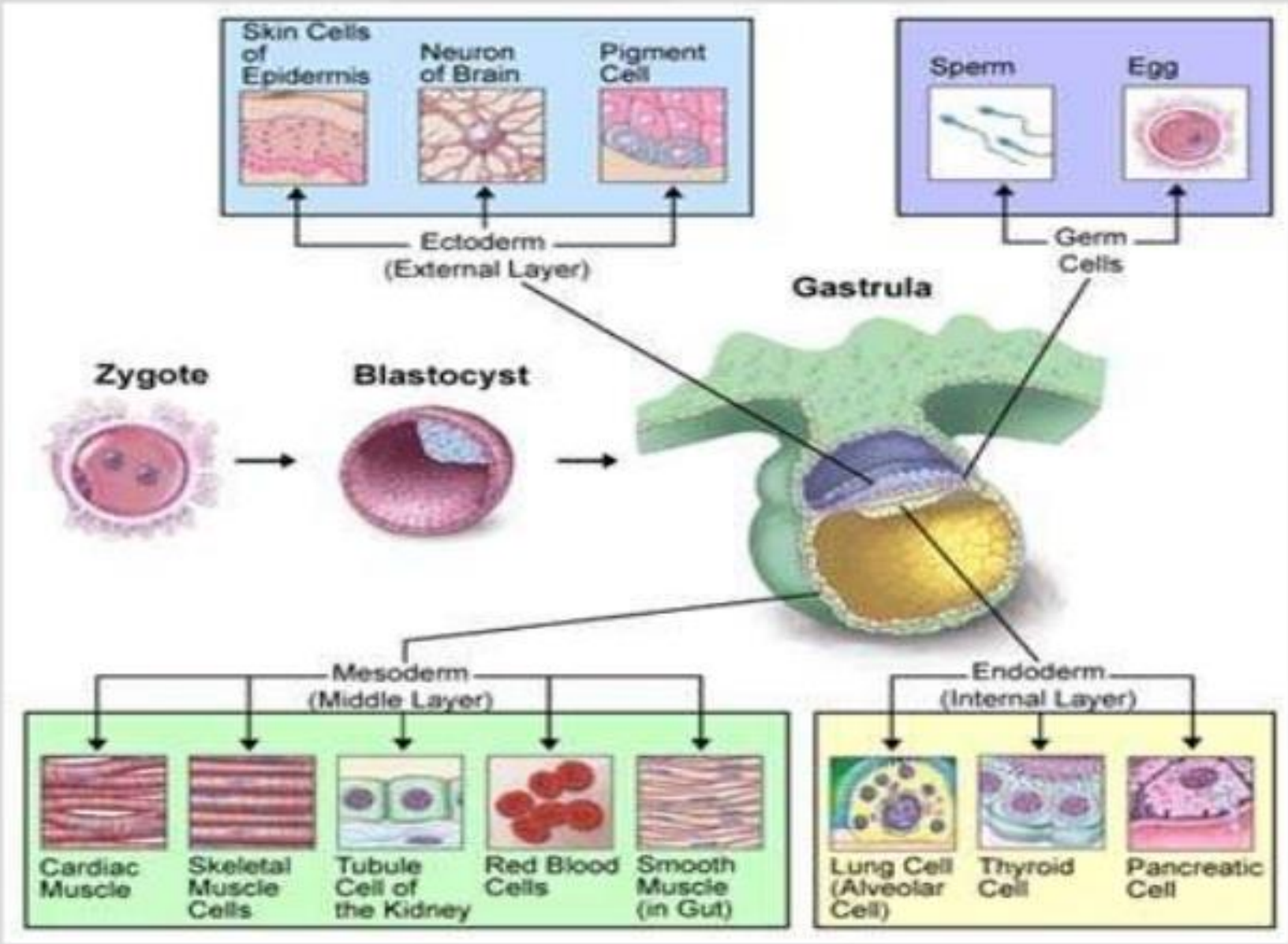
ORGANOGENESIS in embryology, the series of organised integrated processes that transforms an amorphous mass of cells into a complete organ in the developing embryo.  It's a phase of embryonic development that starts at the end of gastrulation and continues until birth. During ORGANOGENESIS 3 germ layers formed from gastrulation: ectoderm endoderm and mesoderm form the internal organs. The cells of each germ layer undergo differention,a process where less specialised cells become more specialised through genes.

Cell differentiation driven by cell signaling cascades. Differentiation is influenced by extracellular signals such as growth factors that are exchanged to adjacent cells which is called juxtracrine signalling or neighbouring cells over short distance which is called paracrine signaling. Intracellular signals consists of a cell signaling itself(autocrine signaling), also play a role in organ formation . These signaling pathways allows for cell rearrangement and ensure that organs form at specific sites within the organism.

ORGANOGENESIS continues until the definitive characteristic of the organ achieved.

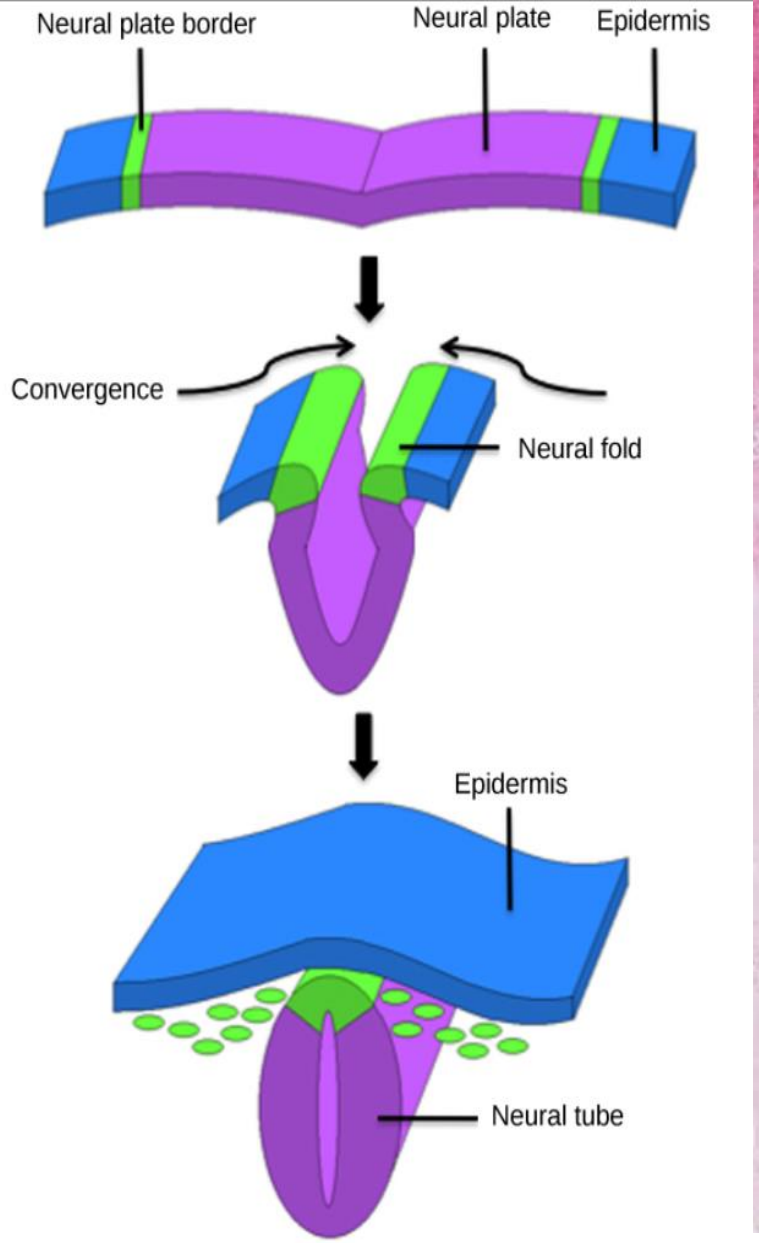
This must occur many times as zygote become fully developed organism

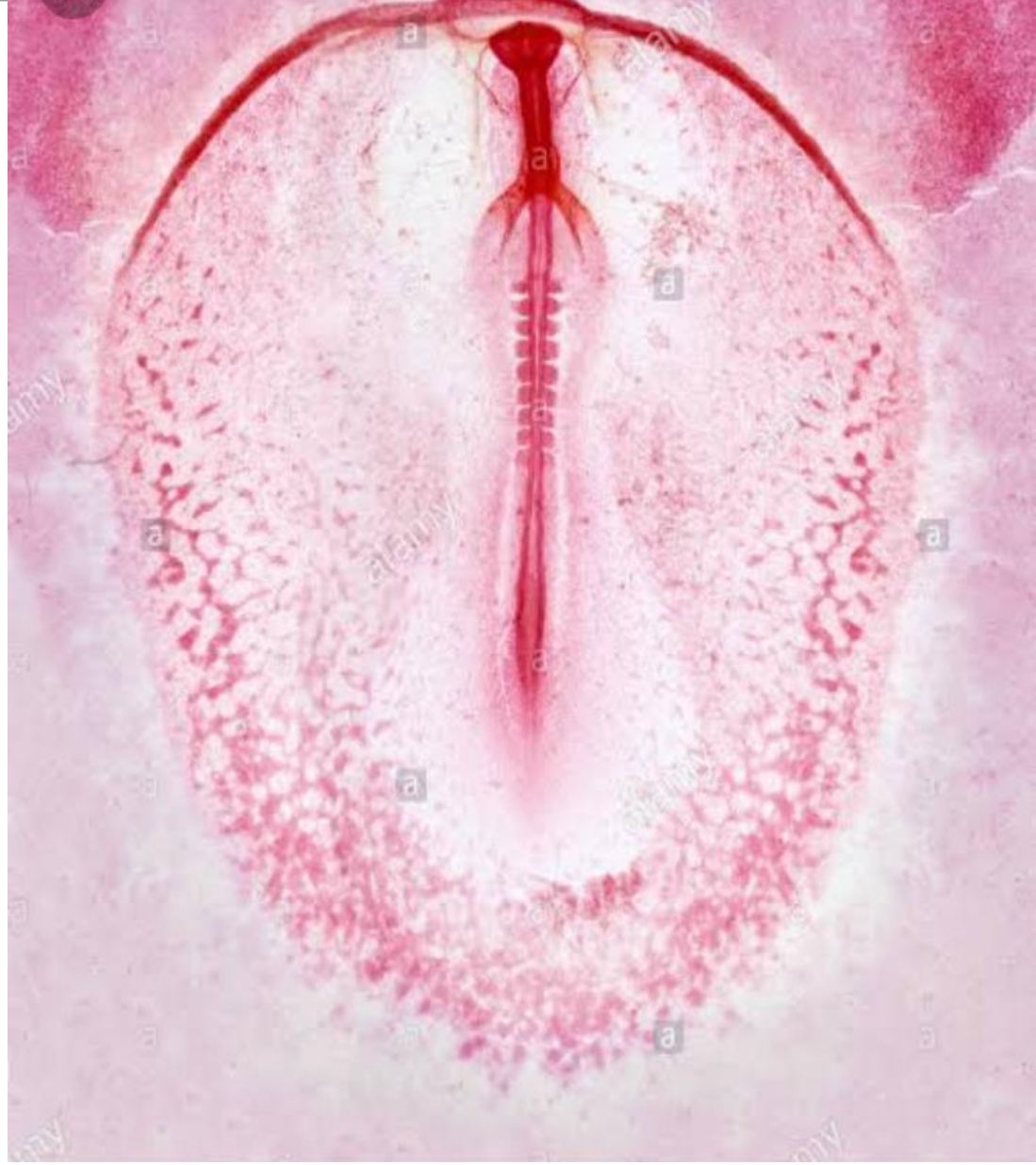
The embryonic stem cells express specific set of genes which determine particular organs


Skin Cells of Epidermis
Neuron of Brain
Pigment Cell
Sperm
Egg
Ectoderm (External Layer)
Germ Cells
Gastrula
Zygote
Blastocyst
Mesoderm (Middle Layer)
Endoderm (Internal Layer)
Cardiac Muscle
Skeletal Muscle Cells
Tubule Cell of the Kidney
Red Blood Cells
Smooth Muscle (in Gut)
Lung Cell (Alveolar Cell)
Thyroid Cell
Pancreatic Cell

# DEVELOPMENT OF SOMITES OR SOMITOGENESIS

Segmentation of body plan is a highly conserved physical feature across all vertebrates speceis. In vertebrates one of the primary steps in ORGANOGENESIS neural tube formation. The mesoderm that lies on either side of the vertebrates neural tube will develop into various connective tissues of body. A spatial pattern of genes expression reorganised the mesoderm into group of cells called somites. These somites will further develop into ribs, lungs, segmental muscles.



Notochord formation in early embryonic stage

The mesoderm also forms notochord, which is rod shaped and acts as central axis of the animal body. Somites formation and role in developing body plan = somites are blocks of mesoderm that are located on either side of neural tube in the developing embryo.... As somites matures , the outer cells transforms from mesenchymal to epithelial cells, creating a distinct boundary between individuals somites. Somites eventually differentiate and developed into dermis , skeletal muscles, cartilage, bones, tendons and vertebrats.

Somites also determines the migratory path of neural crest cells and axons of spinal nerves. The process of somites formation is called as **SOMITOGENESIS.** It mainly depend on 5 important components.

1. Periodicity
2. fissure formation
3. epithelialization
4. specification
5. Differentiation

Formation begins as paraximal **mesoderm** cells organise into whorls of cells called somitomeres. As somites mature the outer cells transforms from mesenchymal to epithelial cells , creating a distance boundary between individual somites. Distinct region of each somites become specific tissue and cell types as the body mature.

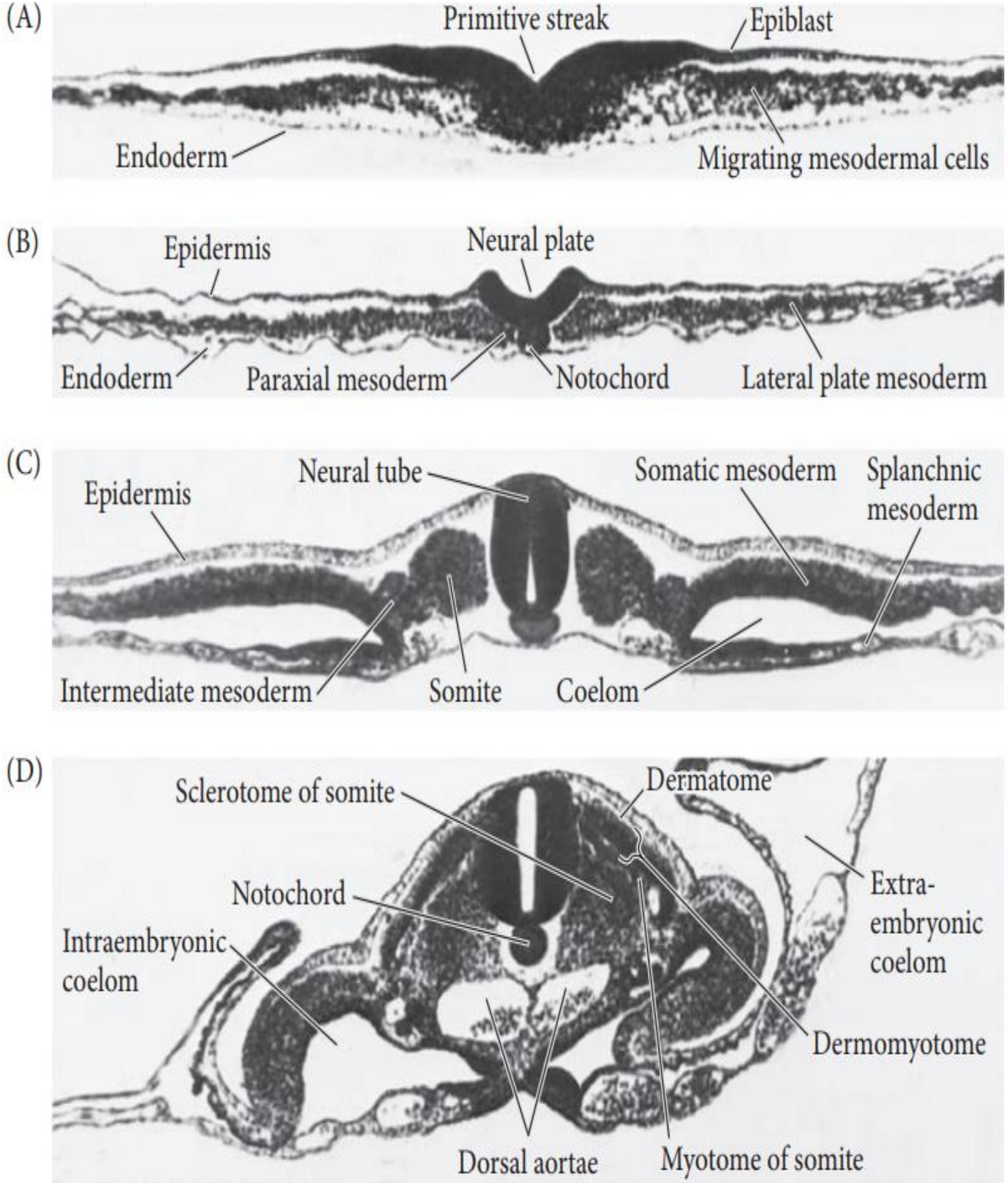
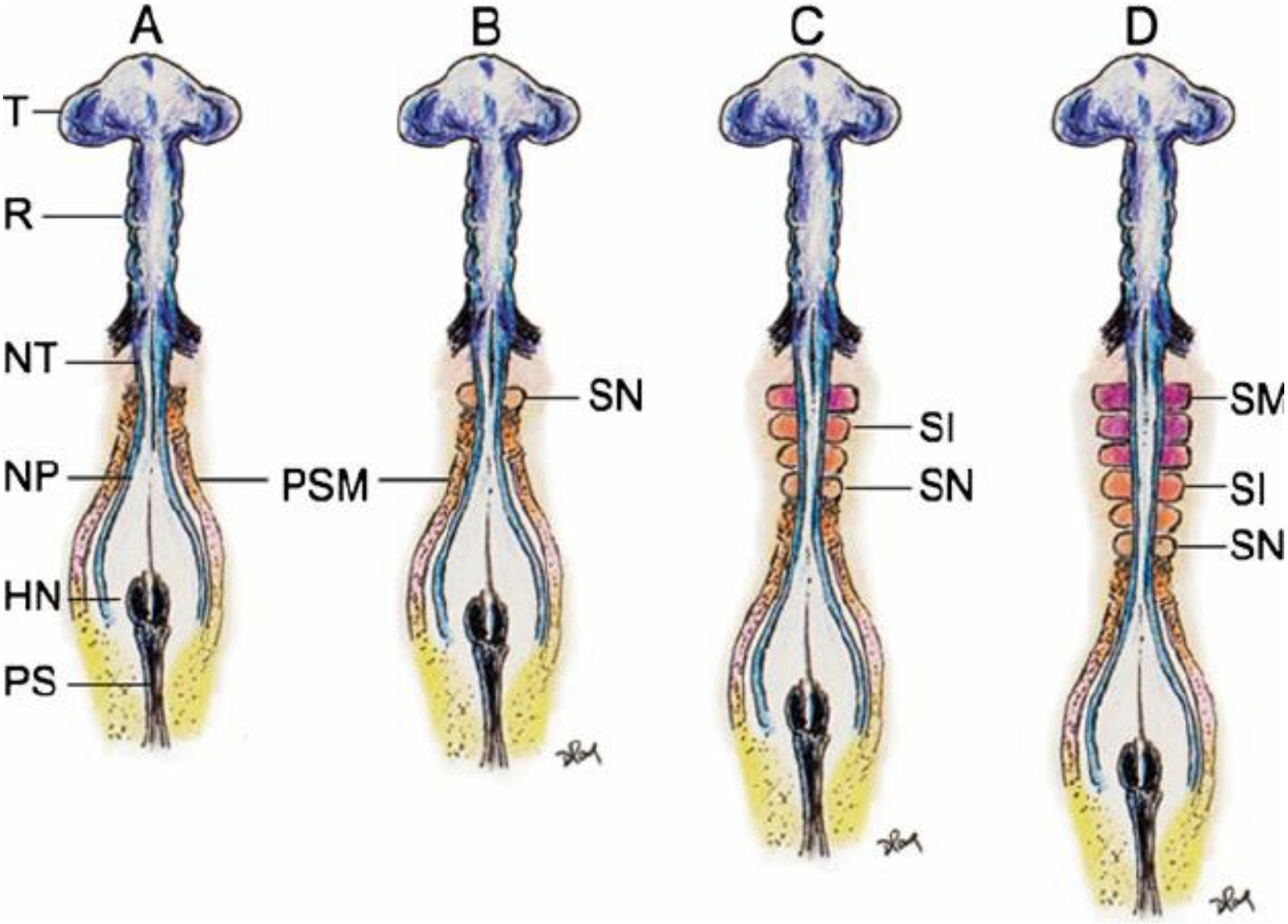



**FIGURE 17.2** Gastrulation and neurulation in the chick embryo, focusing on the mesodermal component. (A) Primitive streak region, showing migrating mesodermal and endodermal precursors. (B) Formation of the notochord and paraxial mesoderm. (C,D) Differentiation of the somites, the coelom, and the two dorsal aortae (which will eventually fuse). (A–C) 24-hour embryos. (D) 48-hour embryo. (E,F) Color-coded schematic of one half of a somite from a 48-hour embryo in cross section (E) with the derivative structures those somitic cells contribute to in the adult (F). (E,F adapted from Lawson and Harfe 2015; Scaal 2015.)

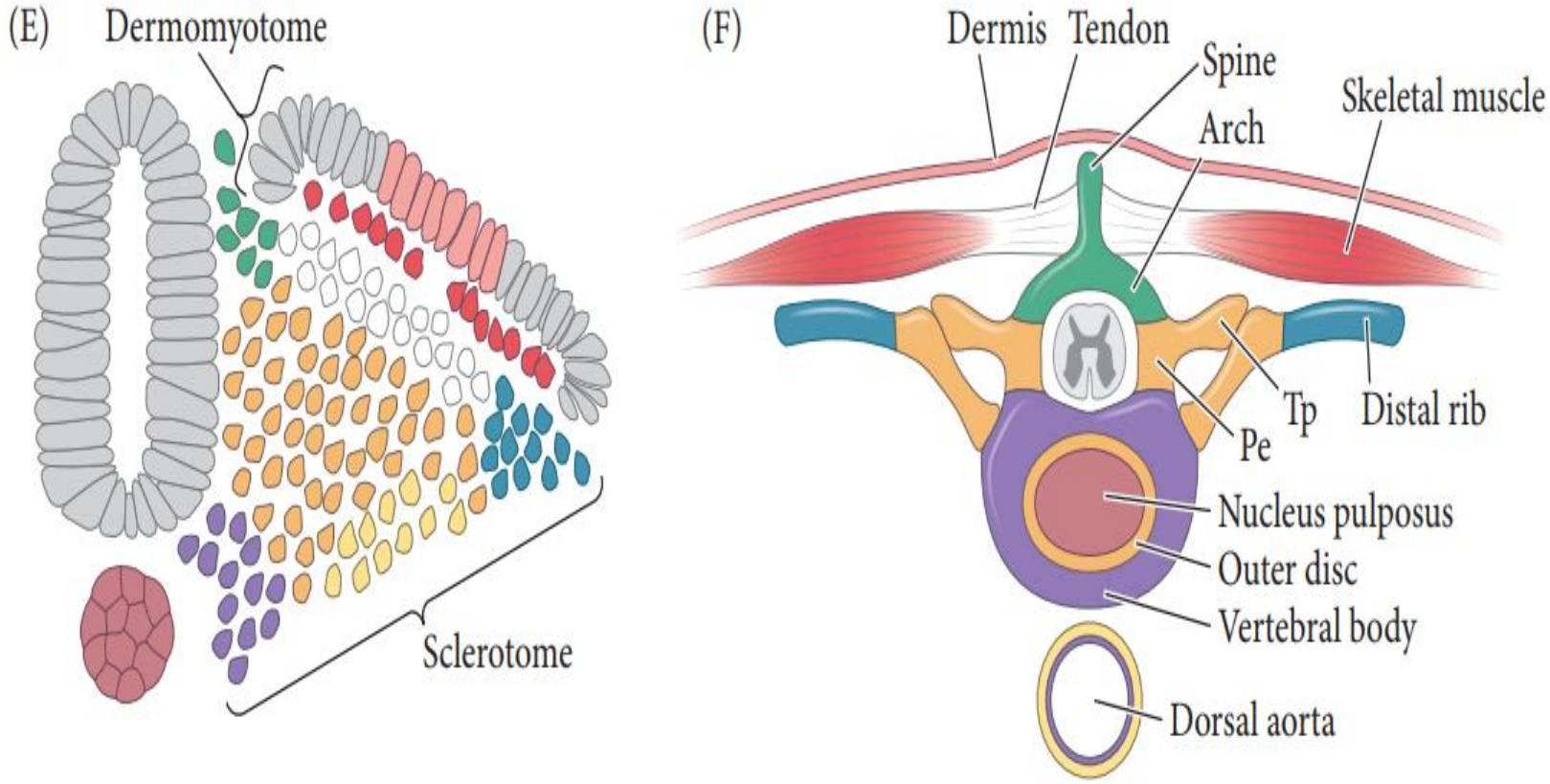
cells divided into paraxial mesoderm intermediate mesoderm and lateral plate mesoderm . The early paraxial mesoderm directly adjacent to the notochord lacks somites , it takes the form of bilateral streak of contineous mesenchymal cells, referred to as the presomatic mesoderm (PSM) also known as segmental plate. As studied extensively in amniotes, when the primitive streak is regressing and neural folds begin to gather at the centre of the embryo, the cells of the presomatic mesoderm will positioned adjacent to the neural tube.


A
B
C
D
T
R
NT
NP
HN
PS
PSM
SN
SI
SN
SM
SI
SN

The regions of head and mesoderm and trunk and their derivatives can be summerised as follows

1. The central region of trunk mesoderm is the chardamesoderm ( axial). This tissue forms notochord,a transient tissue whose major functions are patterning of neural tube, establishing anterior-posterior body axis. Notochord cells are hydrostatically pressurised with large vacuoles to provide a rigid rod like structure for developing embryo. Despite of many notochord cells succubing to apoptosis clearance,the gelly like intervertebral disc known as nucleus pulposes is derived from notochord cells.

2.Flanking notochord on both sides is the paraxial or somitic, mesoderm. The tissues developing from this region will be located in the back of embryo, surrounding the spinal cord and, for some muscle descendants, in the limb and central ( abdominal wall) regions. Before those reions can be populated, the cells of the paraxial mesoderm will form somites- transitory epithelial blocks of mesoderm cells on either side of the back. ( dermis , muscle, skeletal eliments as ribs)




- Arthrotome: vertebral joints (Pe, Tp), proximal rib, outer disc
- Dorsomedial sclerotome: spine, arch
- Ventrolateral sclerotome: distal rib
- Ventromedial sclerotome: vertebral body
- Notochord: inner disc/nucleus pulposus
- Ventral posterior sclerotome: endothelial precursor: outer dorsal aorta
- Syndetome: tendons
- Myotome
- Dermatome: dermis

The anterior most paraxial mesoderm does not segment; it becomes the head mesoderm, which ( along with neural crest) forms the skeleton, muscles, and connective tissue of the face and skull.

3. The intermediate mesoderm is positioned directly lateral to the paraxial mesoderm and forms the urogenital system, consisting of kidney, the gonads and their associated ducts. The outer ( cortical) portion of the adrenal gland also derives from this region.

4.Away from the notochord, the **lateral plate mesoderm** give rise to the heart,blood vessels,blood cells of the circulatory system as well as to the lining of the body cavity. It also gives rise to the pelicans limb skeleton ( but not the limb muscle, which are somitic in origin). Lateral plate mesoderm also helps form a series of extraembryonic membranes that are important for transporting nutrients to the embryo.
5. Anterior to the trunk mesoderm is the head mesoderm,consisting of unsegmented paraxial mesoderm and prechordal mesoderm. This region provides the head mesenchyme that

Forms much of the connective tissues and musculature of the head. The muscles derived from the head mesoderm from differently than

those formed from the somites. Not only do they have their own set of transcription factors,but the head and trunk muscles are affected by different types of muscular dystrophies.

# CONCLUSION

During the development of the animal, embryo undergoes many phases of development. These are very important in forming normal offspring any defect in ORGANOGENESIS cause difference in morphology of that animal.
Study of ORGANOGENESIS and SOMITOGENESIS gives the complete picture of formation of an animal.

# REFERANCES

1. Gilbert, Scott. DEVELOPMENTAL BIOLOGY. 8th ed. Sunderland MA. Sinauer associated.2006,27,445-453.
2.https://embryo.asu.edu
3. WWW.Lumenlearning.com
4. Https://en.m.wikipedea.org
5.WWW.Youtube.com


Thank You