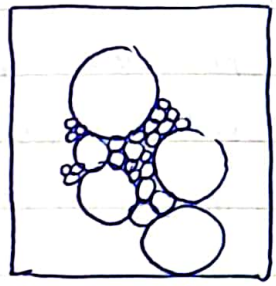
Chick development

Telolecithal egg development
↳ contains large amount of yolk, concentrated in the vegetal pole
→ affects the cleavage furrows

- Egg to chick takes three weeks (21 days) after fertilization & incubation
→ hen lay one egg per day from the left only (the right ovary degenerate in development)
→ egg is formed & fertilized in the oviduct
→ egg is laid in the blastula stage
↳ embryonic development stays, until favorable conditions such as: temperature – when a hen sits on her egg she humidity & movement provides all thes conditions

Hen Reproductive system



telolecithal

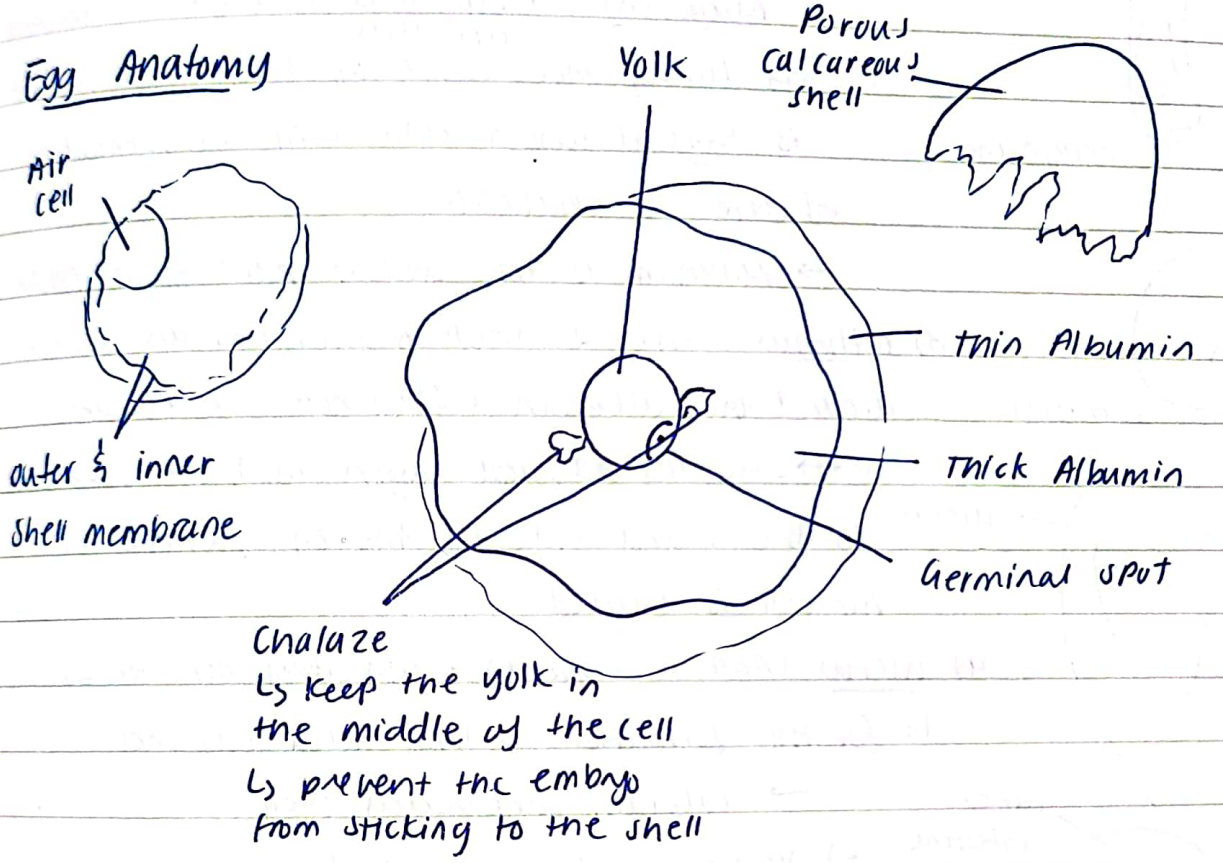
- Ovary - have small & large follicles
↳ follicles takes position depending on the amount of yolk present
concentrated towards the vegetal pole
yolk is provided from the liver (transffered through blood)

Rooster Reproductive system

- testes - have 2 testes
↳ the process of spermato genesis is continuous
→ has 2 vas deferens that opens into a papilla
↳ rudimentary
→ located on the back wall of the cloaca
↳ connects 2 systems, the digestive & the reproductive system

• The sperm will travel from the cloaca of the male to the cloaca of the female
  ↳ sperm will be activated & travel to the oviduct
    → they will reside in the infundibulim, waiting for the release of the mature follicle

Egg Anatomy

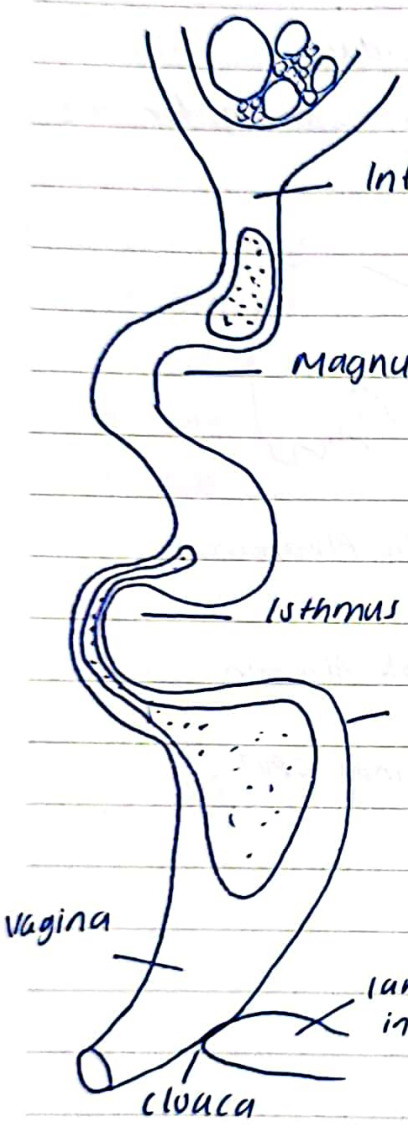


• Porous calcareous shell - cuticle layer
  ↳ prevent contamination
  ↳ facilitate respiration
  ↳ water insoluble - made up of glycoproteins w/ carbohydrates & fats

• Yolk is used as nurishment
  ↳ germinal disc - nucleus in little amount of cytoplasm
    → surrounded by 2 tightly adhered whitish membranes
      vitelline membrane - tightly adhered to the cell membrane

• Shell membrane < outer / inner
  ↳ prevent bacterial infection ↳ prevent drying ↳ facilitate respiration

Hen oviduct structure



1) Infundibulum - pick the ovum
   - ↳ site of which fertilization occur
   - → the sperm will travel from the uterus to the infundibulum to fertilize the egg
2) Magnum - albumin is secreted surrounding the yolk
   - ↳ during movement in the magnum it is twisted which results in the formation of the 2 chalazae
   - → Magnum is the widest part of the oviduct
3) Isthmus - the 2 shell membranes are secreted around the albumin (stay here for 4 hours)
   - → 2 tightly adhered layers that are separated in the round side of the egg, where the Air cell is located
4) Uterus (AKA shell gland) - egg stay here for 20 hours
   - ↳ for the formation of the calcareous shell
   - → calcium carbonated shell
5) Vagina - egg released through the cloaca

Chick Development

1) Select eggs for incubation < similar sized, undamaged
2) Swab contaminated eggs with 70% Alcohol, before incubation.
3) Set incubator at 37-38 °C
   - ↳ humidity 60-65% for 1-18 days
   - ↳ increase the humidity after hatching up to 65-70%.
4) Turn the egg to distribute the heat to prevent the embryo to stick to the shell or from dying by the lethal effect of heat.
5) Hatching rate range between 50% to 75% of the fertile eggs.

6) After chick hatching, don't remove directly from the incubator for 1-2 days

↳ to allow to the feathers to dry & flush up

HOW can the chick remain 2 days without food?

Due to the high amount of yolk, the chick remains feeding from the yolk sac

↳ the nervous & muscular systems will develop & coordinate in these 2 days

7) Vaccinate the chick or add antibiotic to the water that is given to them.

Egg Candling

↳ Shining light through egg shell to observe what happens inside

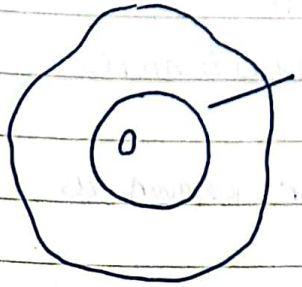
→ it can't be known whether the egg is fertilized or not before 3 days of incubation

↳ After 3 days, embryonic development takes place which can be observed by performing egg candling.

How to Egg candle?

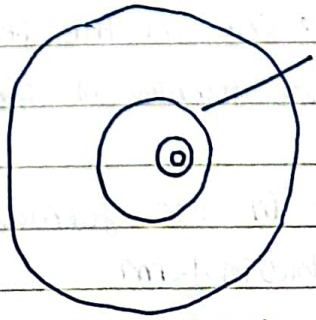
1) light is held up to the rounded end of the egg to illuminate the shell's contents
2) darker shell = brighter light
3) Eliminate unfertilized eggs to avoid contamination

Blastodisc (unfertilized)



.Small irregular whitish spot

Blastoderm (fertilized)

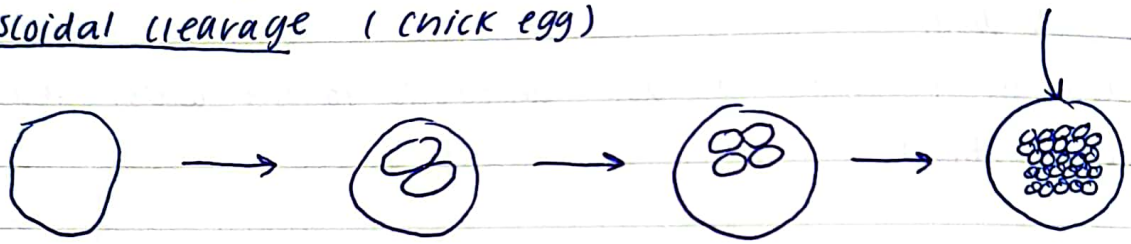


large regular "bulls eye"

Type of cleavage - depend on the amount of yolk present in the egg cytoplasm

- Meroblastic cleavage - in case of Telolecithal egg (high amount of yolk)
  ↳ the cleavage furrow will not be able to pass through from the animal pole to the vegetal pole
  ↳ cleavage will occur in the germinal disc
  → in case of fertilization it will transform to blastoderm

A) Discoidal cleavage (chick egg)



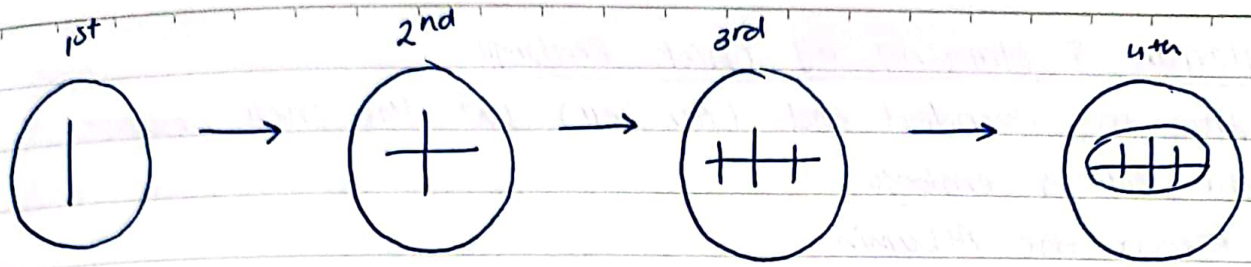
B) superficial cleavage (fruitfly (centrolecithal egg)

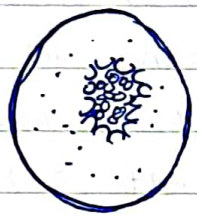
the cells are going to cleave surrounding the egg

Meroblastic & discoidal cleavage

- 1st cleavage furrow is vertical → give 2 blastomeres
- 2nd cleavage furrow is horizontal → give 4 blastomeres
- 3rd cleavage furrow is vertical → give 8 blastomeres
  ↳ involve 2 cleavage furrow
  → one on the left & one on the right
- 4th cleavage furrow is circular → give 16 blastomeres

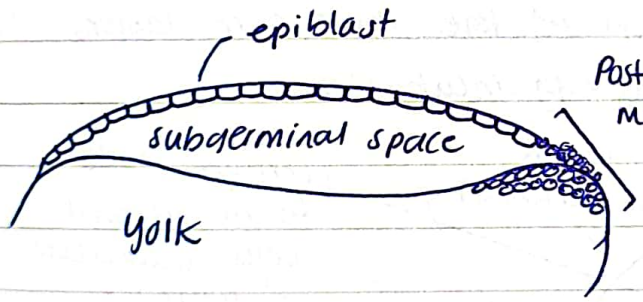
↳ Result in the formation of a cell layer known as the blastoderm





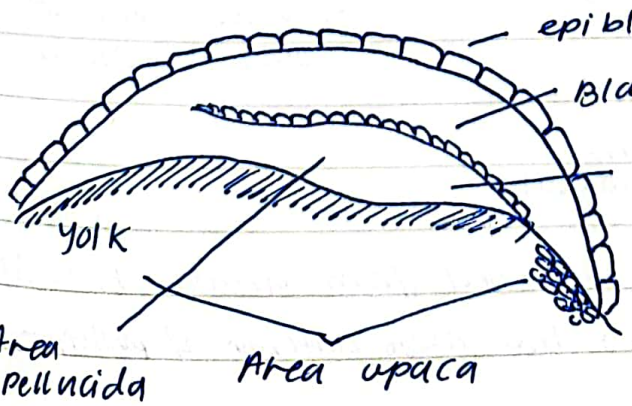
* The horizontal & circular cleavage will form several ~~small~~ small cavities
  → these cavities will fuse together & form a subgerminal space → under the blastoderm
  ↳ separate the blastoderm from the yolk

Blastula formation - This process occur after the fertilization of the egg in the first part of the oviduct known as the ~~fertiliz~~ infundibilum.

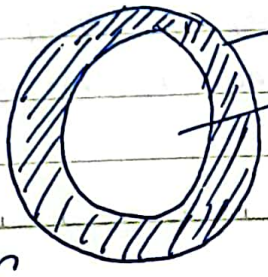


Posterior marginal zone (PMZ) → organizer cell
↳ affect fate of other cells
→ lead the endodermal cells into the subgerminal without contacting the yolk
↳ forming 2nd layer AKA endoderm

* delaminated of the cells of the epiblast and the migrating cells from the PMZ form the hypoblast layer (future endoderm)



* This happens as soon as the hen lays the egg into the oviduct



cross section

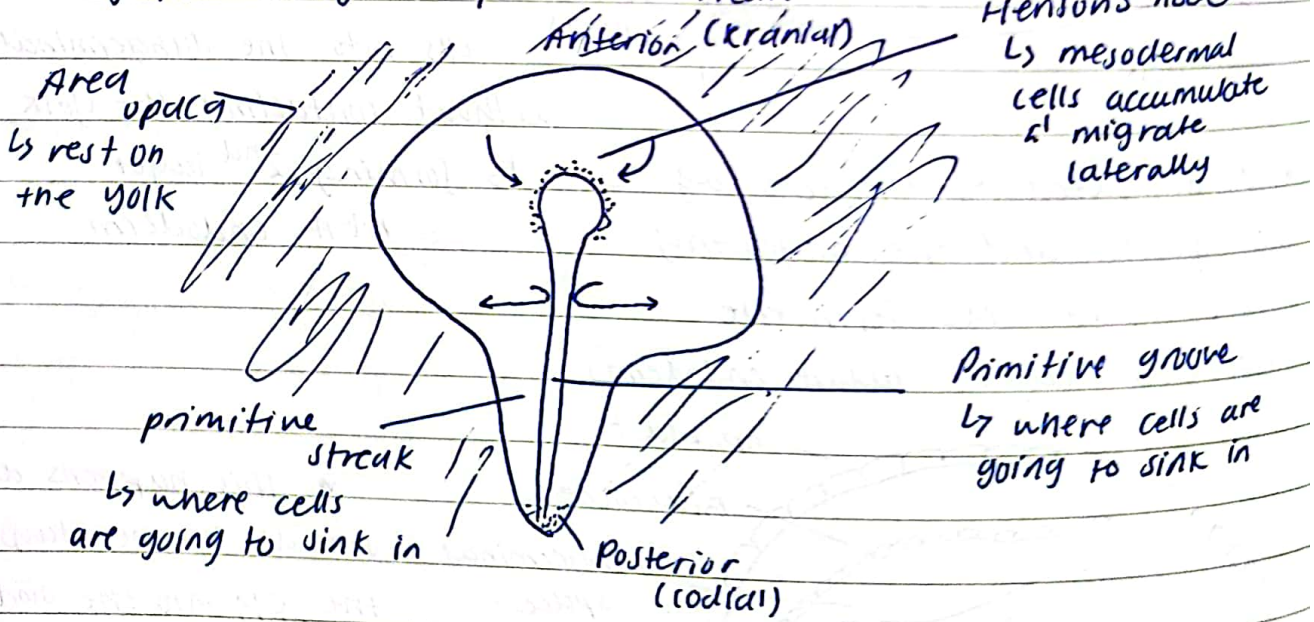
Isolation & staining of Chick Embryo

1) from the rounded end (Air cell) cut the shell, expose the yolk & embryo
2) Remove the Albumin
3) Place the egg in a saline solution
4) Place the embryo on a glass slide
5) fix the embryo by adding formalin or aceto-alcohol
6) wash embryo with 50% and 70% alcohol
7) stain the embryo by Mayer's carmalum or erosion stain
8) dehydrate the embryo in 70%, 80%, 90%, 100% ethanol to remove water
9) clear in two changes of xylene
10) Mount the embryo by DPX mounting medium
11) observe under the microscope

Gastrulation in Chick - formation of the three germ layers

↳ occur after 18-16 hours of egg incubation

↳ formation of the primitive streak



* The shape of the Area Pellucida changed from circular to ovoid (elongated) due to the growth in the ~~neck~~ anterior & posterior sides

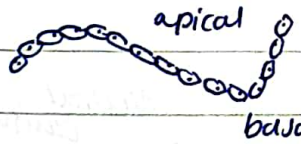
- from the accumulated mesoderm will form the notocord
  ↳ signal for the epiblast cells to thicken & elongate to form the neural blade

Steps of the primitive streak formation:

1) Epiboly - proliferation of epiblast cells (by mitosis)
   ↳ epiblast cells will elongate in shape

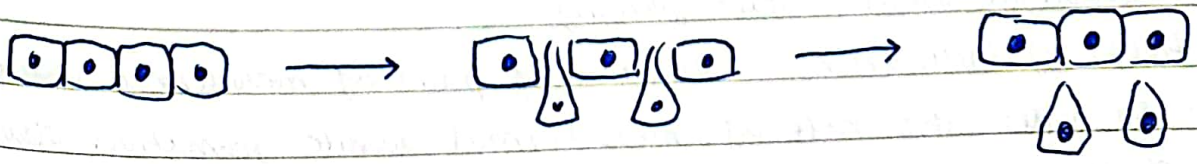
2) Convergence - migration of proliferating cell at the midline of the posterior portion of the area pellucida
   ↳ epiblast cells will move forward to form the primitive streak

3) Invagination - accumulated cells in the primitive streak move inward / sink in towards the blastocoel

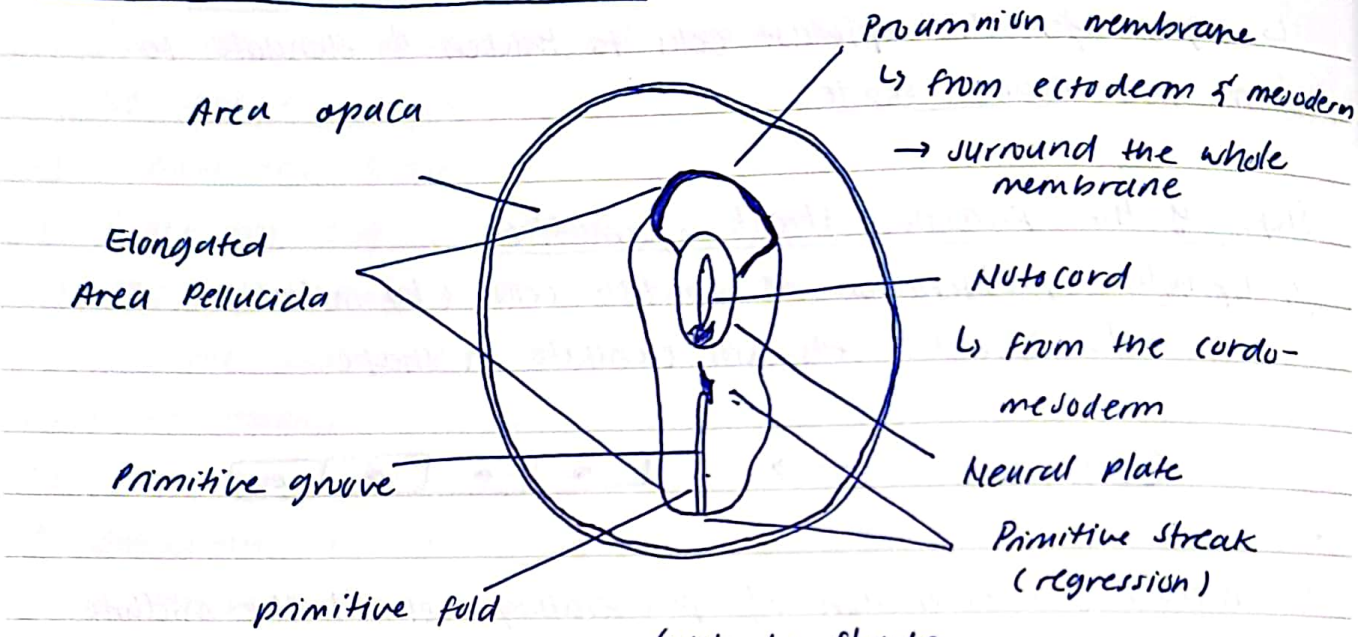


4) Divergence - invaginated cells will move
   ↳ lateral-ward → to form the third layer, mesoderm
   ↳ forward → to replace the old hypoblast layer

5) Ingression (delamination) - cells change in behavior
   ↳ from epithelial cells to freely migrating mesenchymal cells

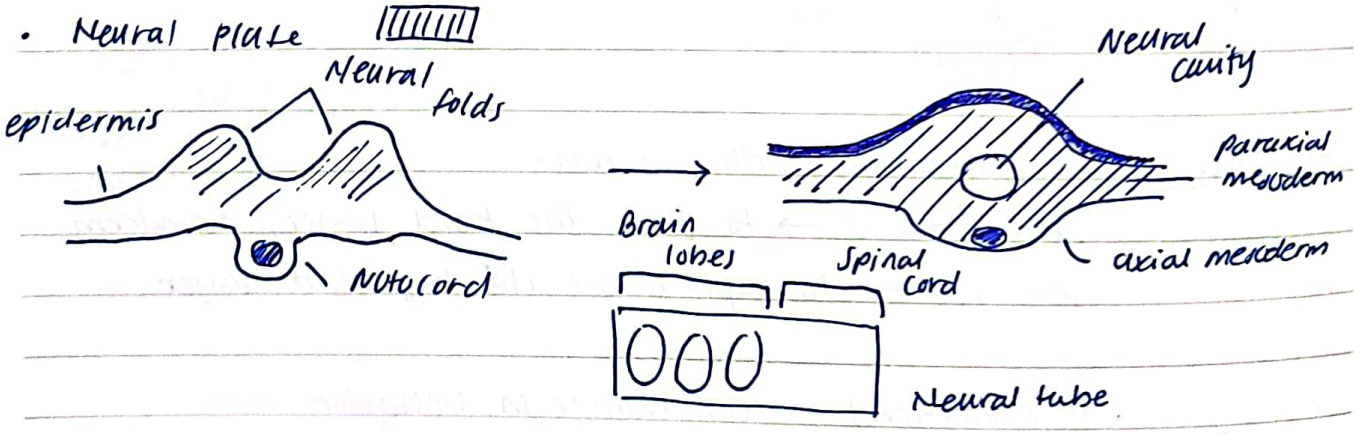


Notochord & Neural Plate stage (16 - 19 hours chick embryo)



Gastrula Stage

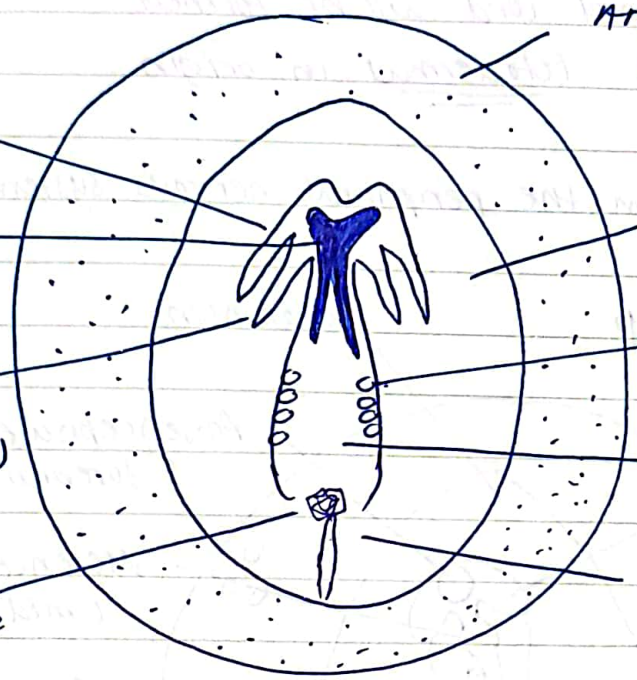
- At the axial part of the embryo, some mesodermal cells will separate & accumulate
  - ↳ cells known as corda-mesoderm
    - → mesoderm that will form the notochord
- One notocord is formed, it will signal for epiblast cells to thicken & elongate
- Neural plate



- Starting from 21 hours of incubation & up to 50 hours
  - ↳ mesodermal somites start forming
    - Hours of incubation = 20 + x of pairs of mesodermal somites

* After 50 hours the rate of mesodermal somite formation slows down & the equation gives wrong number

24 hours chick Embryo (by counting # of mesodermal somites)



- mesodermal somites - form vertebrae
  - ↳ ribs
  - ↳ skin
  - ↳ dorsal muscles
- The neural tube will form the
  - ↳ Brain - anteriorly
  - ↳ spinal cord - posteriorly

* At the posterior side - gastrular stage
* At the anterior side - organogenesis stage

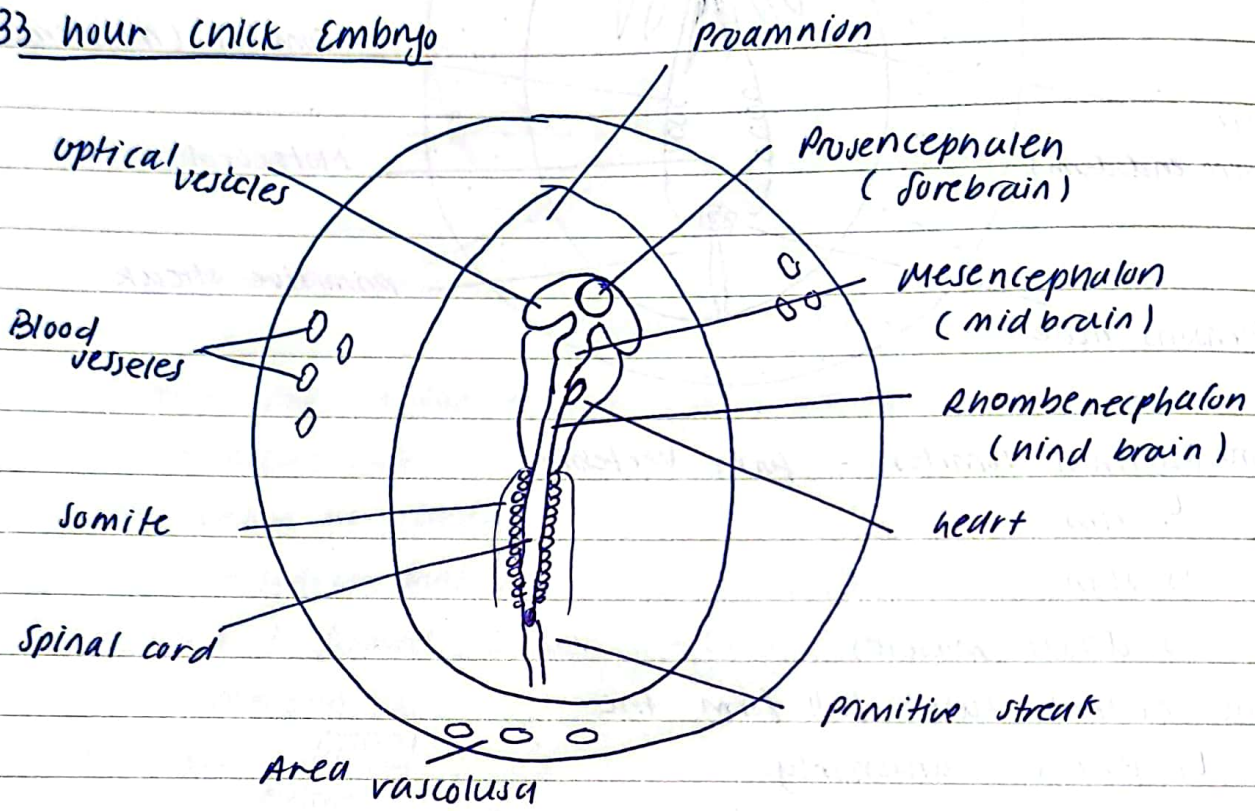
Neurulation

1) Separation of the corda-mesoderm from the mesoderm
2) Corda - mesoderm signal for the ectoderm to form neural plate
3) Neural plate will start to form 2 neural folds
4) Neural folds will merge & form the neural tube

- from the neural tube
  ↳ brain & spinal cord will be formed
- Nervous system is Ectodermal in origin

* Neuroclasts will form the peripheral nervous system

33 hour chick Embryo



- The neural tube will divide into 11 successive vesicles
  → Neurosomes
- Forebrain forms the optic vesicles
  ↳ Optic vesicles are prosencephalen in origin
- The Heart is visible
- The Embryo has 13 pair of mesodermal somites
- Area Opaca → Area vascolusa
  ↳ due to blood vesseles

48 hour Chick Embryo

- Embryo twists (AKA Cranial torsion)
  - ↳ towards the right side
    - → rest on the yolk w/ it's left side (ventral side attached to the yolk sac)
- 2 Lateral body folds
  - ↳ future feathers
    - → arise from ectoderm & mesoderm
- Tail bud
  - ↳ future limps
- Tail fold
  - ↳ future tail
    - → arise from ectoderm & mesoderm
- The optic vesicles will transform to a cup(s)
- Auditory vesicles appear on each side of the hind gut
  - ↳ Rhombencephalon
    - → arise from the ectoderm
- Noto cord lies underneath the spinal cord