Unit :- 2 (1 long + short)

Development of Biology

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→ Development of frog :-

study of stages of early development of embryo is called embryology. 'Aristotle' is regarded as the father of embrology.

→ Terminologies of development of Biology :-

* Gametogenesis :- the process of formation of haploid gametes from diploid germ cells.

* Fertilization :- the process of fusion of male and female gametes to produce zygote for ~~cliverage~~.

cleavage

* ~~cliverage~~ :- The process of mitotic division of zygote to form multicellular embryo.

* Morulation :- the process of formation of multicellular morula.

* Gastrulation :- the process of formation of Gastrula.

* Organogenesis :- The process of development of tissue and organs from germinal layer.

* Neurulation :- the process of formation of Nerve cord.

* Notogenis :- the process of formation of Noto cord.

* Metamorphosis :- The process of transformation of larva to adult.

(*) Gametogenesis in Animals :-

The biological process in which haploid gametes are form from diploid germ cell is called gametogenesis. During this process the germinal cell of gonads undergoes mitosis and meiosis cell division due to which haploid cell called gametes are formed.

On the basis of types of gametes gametogenesis is divided into two types :-

(1) Spermatogenesis (2) Oogenesis.

(1) Spermatogenesis :- (Male gemetogenesis)

The process of formation of sperm within testes is called spermatodenesis. During this process germinal cell undergoes progressive and morphogenic development and the entire process of spermatogenesis is divided into 3 phase.

(a) Multiplication phase :-

In this phase, primary germ cell undergoes mitotic cell division to produce 4 spermatogonia cell sperm mother cell from each germ cell. Therefore, the number of diploid germinal cell is increase.

(b) Growth phase:-

In this phase each spermatogonia increase in size due to accumulation of nutrients and replication of genetic materials. In this phase spermatogonia develop into diploid primary spermatocytes. (4 times)

* Imp Difference between:-

Spermogenesis	Oogenesis
(1) Male gamete produce sperm.	(1) Female gamete produce egg.
(2) Primary germ cell is responsible for the formation of 4 sperm.	(2) primary germcell is responsible for the formation of egg.
(3) Spermatogenesis is increased by 4 times.	(3) Oogenesis is increased by 10 times.
(4) Polar bodies are not formed.	(4) Polar bodies are formed.
(5) It starts from puberty to until death.	(5) It starts from embryonic development up to menopause.

(c) Maturation phase:- Each primary spermatocyte undergoes two successive maturation division. The first maturation division is mitotic to form two haploid secondary spermatocyte. Each spermatocyte further undergoes second maturation division which produce four haploid daughter cell called Spermatids.

Transformation or maturation of non-motile rounded spermatids into mature motile and tail spermatozoa which is called Spermiogenesis. Spermatids are attached to sertoli cells which provide nutrient and support. The spermatids transfer into sperm by losing large amount of cytoplasm condensation of nucleus and formation of flagellated tail. After maturation of sperm they are release into cavity of seminiferous tubules called Spermination.

→ Significance of spermatogenesis.

1) It produce haploid sperm (n) which fertilize with egg to produce diploid zygote i.e (2n)
2) It keeps the same pair of chromosome as in offspring.
3) It multiplies in number of germ cell where single cell produces 16 sperm which are essential to ensure fertilization process.

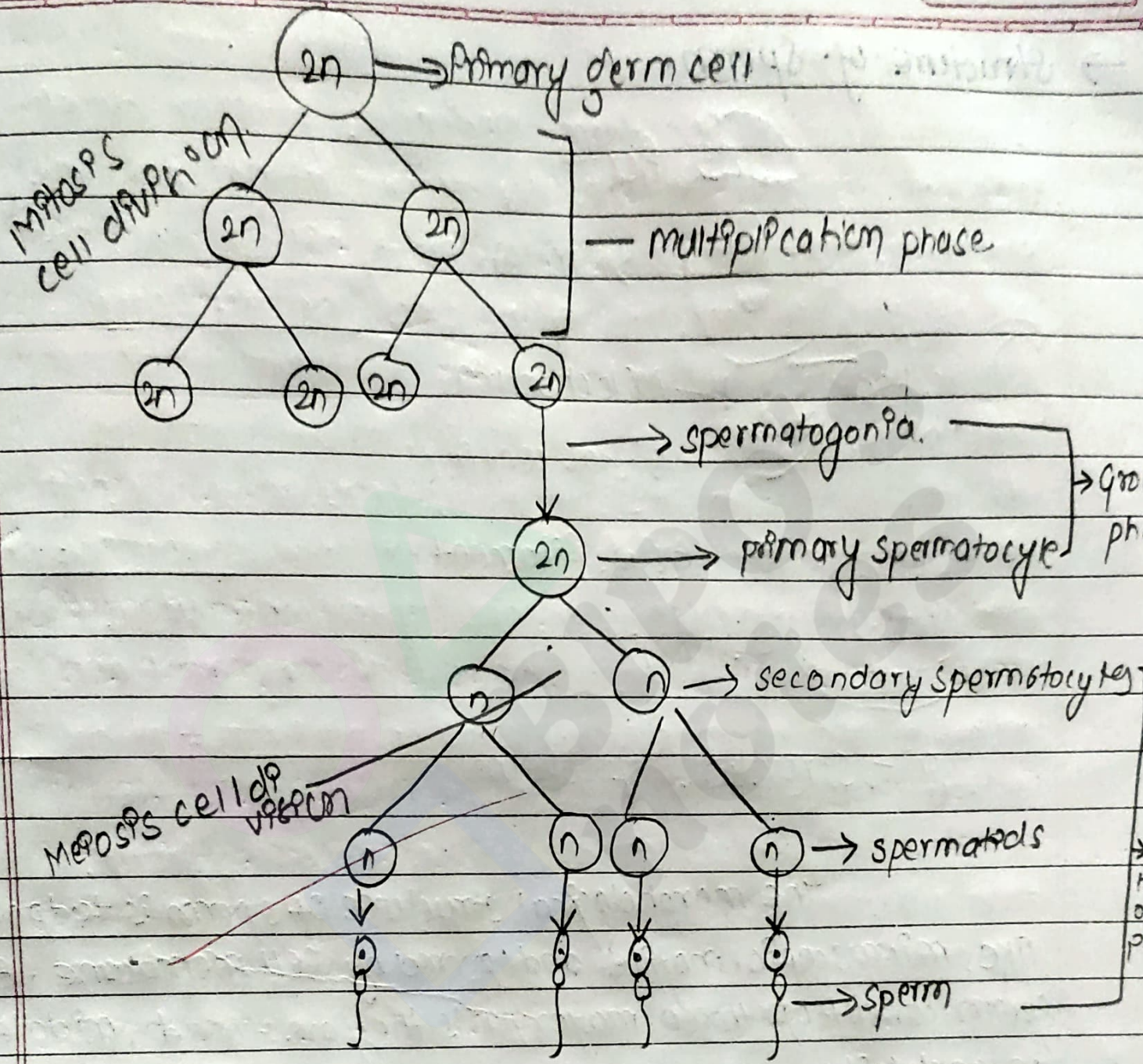

fig:- process of spermatogenesis.

→ Structure of Sperm.

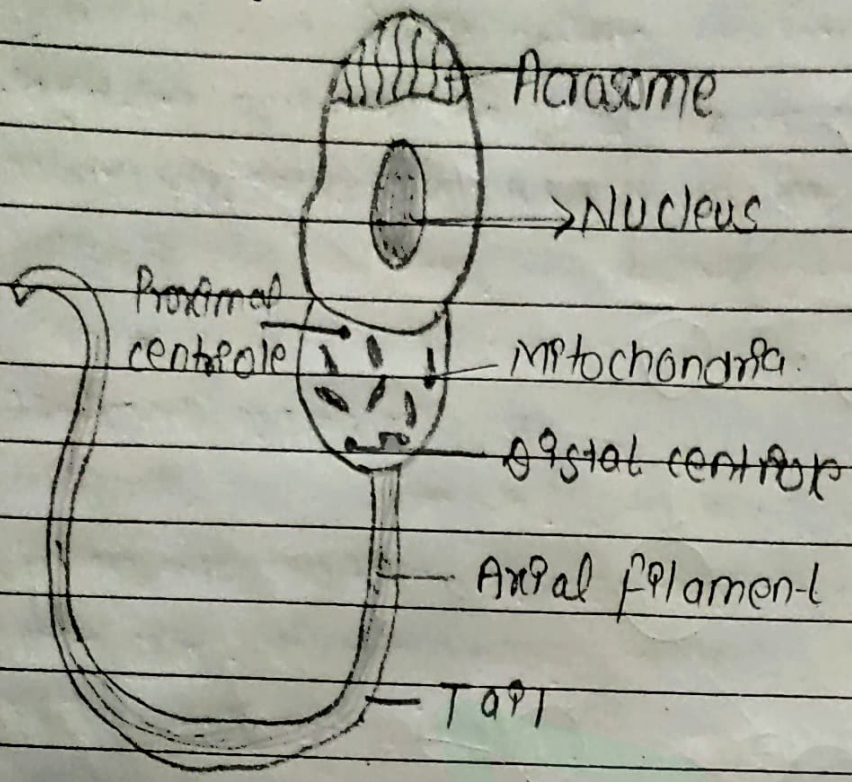

Fig:- structure of sperm

The morphological structure of sperm is tadpole like microscopic, motile and covered by cell membrane. Each sperm consist of three major parts they are:- head, middle piece and tail.

1) Head :- the anterior and wider part of sperm is known as head which consist cytoplasm, nucleus and achrosome. the acrosome is cap like structure which is part of modified golgi body which produce protolytic enzyme called lysin to penetrate the egg membrane during fertilization.

(2) Middle part: The middle part of ~~sperme~~ sperm is narrow then head part which consist mitochondria and centriole. The mitochondria provide energy whereas centriole provide important part in formation of spindal fibre during clevage process.

(3) Tail: The terminal part of sperm is tail which is long and filamentous consisting of microtubules and cytoplasm covering with cell membrane. The main function of tail is to create ~~a~~ movement and change direction during swimming ~~swing~~ for fertilization

* Process of Oogenesis:-

The process of formation of egg in Ovary is called Ooderesis. Oogenesis is called metagametogenesis or female gametogenesis. In this process primary germ cell undergoes further successive developmental stage to produce one ovum from each germ cell. The whole process of Oogenesis is complete under 3 stages.

(1) Multiplication phase:-

The germinal epithelial cell of ovary undergoes mitotic cell division twice to produce four diploid Oogonia from each germ cell. This phase of development to increase number of Oogonia from germinal cell is called multiplication phase. In this stage Oogonia from a group which is called egg nest.

(ii) Growth phase:- (8 times increase in size)

An oogonium undergoes further development stage to increase in size by accumulating nutrients and other cell organelles like DNA, RNA, ribosomes, golgi body etc. Such diploid cell are immature and called primary oocyte.

(iii) Maturation phase:-

In this stage primary oocyte undergoes two successive maturation division to produce secondary oocyte and Ova. During this process, first maturation division is meiosis-I cell division to produce two unequal and haploid cell called primary oocyte and smaller first polar body.

In second division secondary oocyte is further divided by meiosis-II cell division to produce one large ova and 3 small second polar body. Hence, the division is unequal which form smaller polar body and ova that may contain no cytoplasm. The first polar body again divide to produce two polar bodies in successive development and they become degenerate by providing nutrition.

* Significance of Oogenesis:-

→ Oogenesis produce haploid ova which fertilize with sperm to produce zygote with same number of chromosome.
→ It transfer genetic material to offspring through eggs.
→ It help to continue the race.

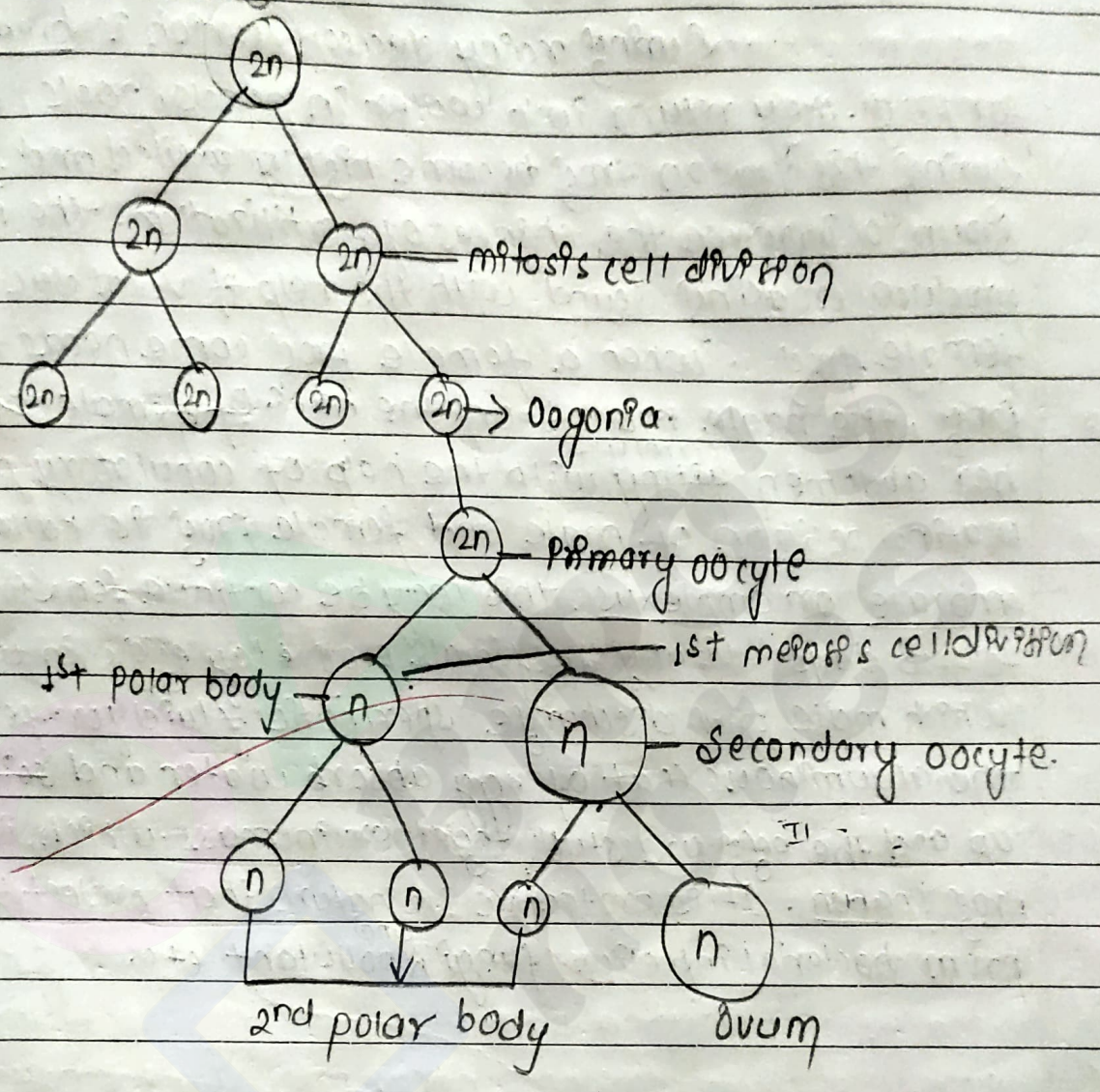

fig:- process of Oogenesis.

Mating behaviour of frog (copulation):-

During rainy season, which is breeding season for frog they return into water in ponds, pools, ditches etc. During this season frog become highly excited and gather in group to increase the chances of fertilization. The male frog produce croaking sound with the help of vocal sac to attract female frog. When a female frog come nears the male frog, the male mounts on the back of female ~~a~~ clasps her abdomen firmly with the help of copulatory pads. The mating position of male and female frog is called sexual embrace or amplexus. This may be continue for several hour to few days. Finally the female frog elay eggs in water on which male frog discharge spermatic fluid for fertilization. The albuminous coat of egg absorb water and ~~got~~ swells up and the eggs are stuck together in mass which is called frog spawn. It is protective in nature that protect the eggs from bacterial infection, fungi and pollutant etc.

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Development of frog:-

* Early embryonic development.
  - fertilization.
  - cleavage. / segmentation.
  - Morula.
  - Blastula.
  - Gastrula.

(1) Fertilization:-

In frog, fertilization is external that takes place in water. The female frog lays eggs during copulation which absorb water and swells up to receive up sperm. Therefore the sperm swim and began to penitrate ~~it~~ through the external membrane of egg called vitelline membrane. The penetration begins in water and out of the body which complets within half an hour of egg laying. Those eggs which fails to receive sperm will degenerate within a day. Hence, the consecutive event that occurs during fertilization can be described as below:-

(1) The sperm swims and come in contact with vetelline membrane of egg.

(2) Then the egg develop into cone of ~~cor~~ reception at animal pole through which sperm can penetrate some what ~~small~~, raised small structure at the vetelline membrane of egg which is called fertilization or cone of reception.

(3) The acrosome of sperm release prolytic enzyme called sperm lysin which dissolve the vitelline membrane.

(4) At the same time the sperm lost its tail only the head and

middle part of the sperm in enter into the egg.

(5) Vetelline membrane is converted into thick and tough fertilization membrane which seprate and checks the entry of other sperm during fertilization.

(6) Hence, the egg with plasma membrane is free to rotate inside fertilization membrane due to which animal poles locates at upperside and vegetal pole to locates at lower side of egg.

(7) Such fertilization of egg which occurs with only one sperm is called monosperny.

(8) After the entry of sperm into fertilization membrane, the egg get matured developing two polar bodies and centrosome

(9) Such nucleus of male gametes in the cytoplasm of egg is called male pro-nucleus and the nucleus of female gamete is called female pro-nucleus.

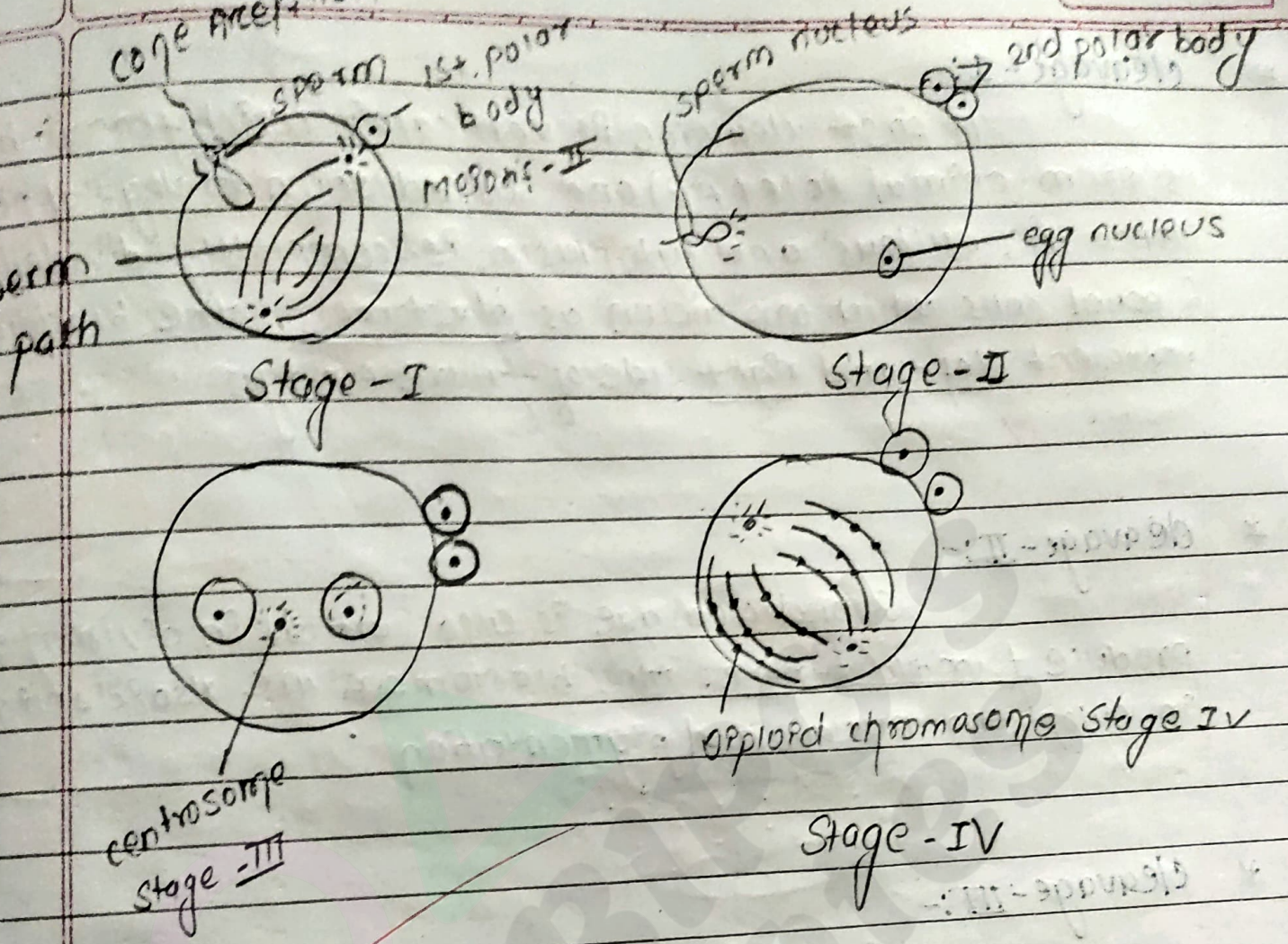
(10) The male pro-nucleus moves in certain part in the cytoplasm of egg and fused with female pronucleus to form zygote which is called fertilization. and the path followed male pronucleus is called fertilization path.

(11) Hence, the zygote develops animal pole, vegetal pole and grey cresent.

(12) The animal pole is dark and melanin pigmented, vegetal pole is white with yolk and grey cresent is grey in colour,

(13) The animal pole locates at upper side vegetable pole located at lower slide and the grey cresent locates just opposite to pole of reception.

(14) Hence, the zygote is formed which is about 1.4 - 1.8 mm in diameter.



* Cleavage / segmentation:-

After 2-3 hours of fertilization the zygote under goes series of sucessive development to form tadpole and adult frog. The process of repeated mitotic division of zygote to produce multicellular embryo is called cleavage or segmentation process. In frog cleavage is holoblastic in nature. In which zygote is completely divide. The whole process of cleavage is describe under following step:-

* cleavage - I:-

The first cleavage is vertical in which furrow beg ins from animal pole (AP) and passed down to vegetal pole. Hence the nucleus and cytoplasm is completely divided int 2 equal cells which are known as blastomere. The blastomer represent left and right side of future embryo.

* cleavage - II:-

Second cleavage is also vertical in division to produce four blastomere. The blastomere are also identical in cytoplasm, nucleus and pigmentation.

* cleavage - III:-

Third cleavage is horizontal which start after the half and hours of second cleavage. Third cleavage produ eight blastomere of unequal size. The upper four cell are smaller and pigmented called micromere whereas lower four cell are longer called macromere/megamere.

* cleavage - IV :-

The fourth cleavage takes place about 30 mi nutes later of III-cleavage. It is also vertical in division and produce 16 cells embryo. Out of them eight blastomere are micromere and remaining 8 ~~micromere~~ blastomere are megamere

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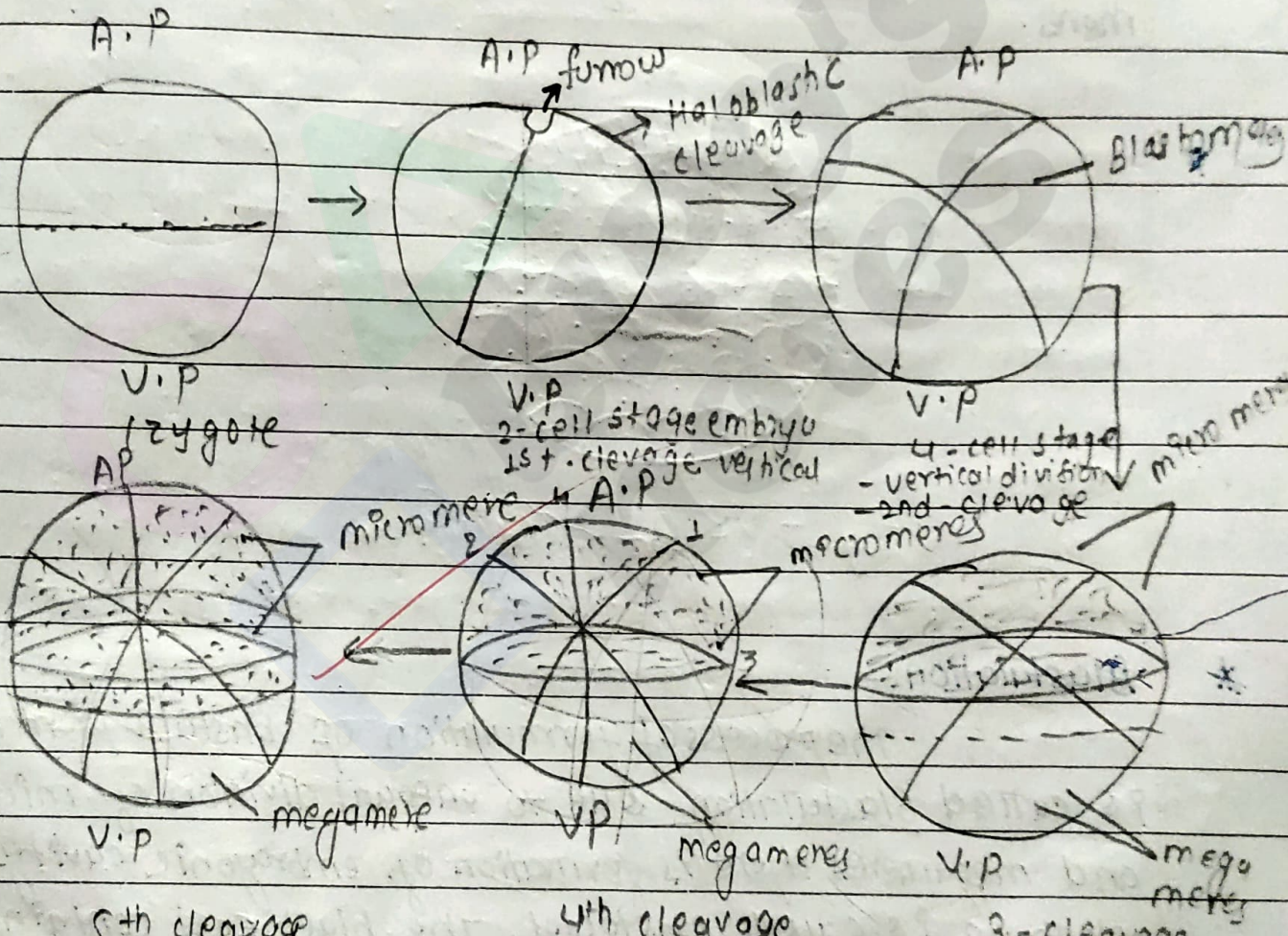
Cleavage-V :-

The fifth cleavage is horizontal and produce 32 cell embryo in which 16 cells are micromere and other 16 cell are megamere. After fifth cleavage, cleavage becomes irregular. The micromeres divides much faster than megameres because the presence of large amount of yolk which delay the division.



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* Morula:-

As a result of irregular segmentation, embryo becomes solid mass of cell and looks like more or less mulberry fruits. This is called Morula and the process of formation of morula is called morulation. Animal pole of morula is composed of large number of small, Black and yolk-free micromeres and vegetal pole is compared of large, white and yolk contain megameres.

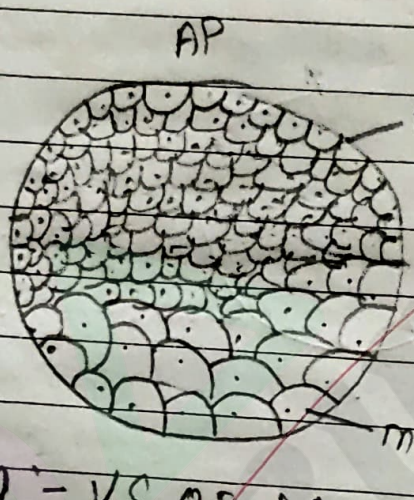

Fig:- VS of Morula in frog

* Blastulation:-

The process of formulation of blastula from morula is called Blastulation. Due to unequal division of micromeres and megameres there is formation of embryonic cavity in blastula is called Blastocoel. The blastocoel contain of fluid containing carbohydrate and albomen produce by blastomere that provide nutrition for developing embryo and prevent the bastula from collapsing. Hence, the bastula of frog is coeloblastula that means bastocoel is large, central having cavity.

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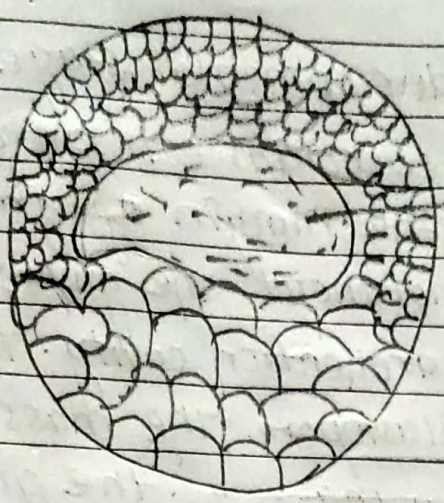

* Glastrulation:-

Gastrula is final stage of early embryonic development in frog and the process of formation of gastrula is called glastrulation. It includes significant changes in embryo such as: differentiation of cell, transformation of monoblastic blastula into diplo blastic gastrula and establishment of three germ layer such as:- ectoderm, endroderm and mesoderm in past gastrulation stage.

Following events are takes place in the process of glastrulation:-

(1) Epi boly:-

The process of spreading micromere over megamere due to fast mitotic division is called epiboly. During epi boly micromere divide faster over megamere to coves all parts of vegetal pole except yolk plug.

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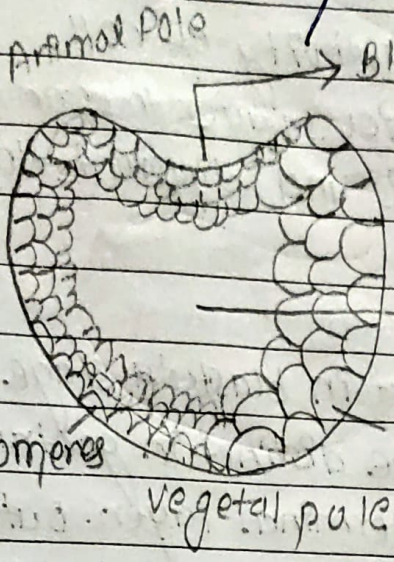
* Imboly/ Invagination:-

Another developmental stage of gastrulation is Imboly in which mesochordal cell grow inward forming small ~~group~~ groove and the margin of grey crescent and slightly behind presumptive notochord. The groove further divided and represent primitive archention cavity. The opening of archenteron cavity is called Blastopore. The mass of cell bulg out of these blastopore ~~and a mass of~~. The gradual contraction of ~~four~~ lip from all side exert pressure all over the mass of megamere to form yolk plug. Hence, this stage is also yolk plug stage. During this process endo~~mes~~dermal cell roll over ventral ~~leaf~~ lip which is called involution and embryo develop two layer called ectoderm and endoderm in gastrula.

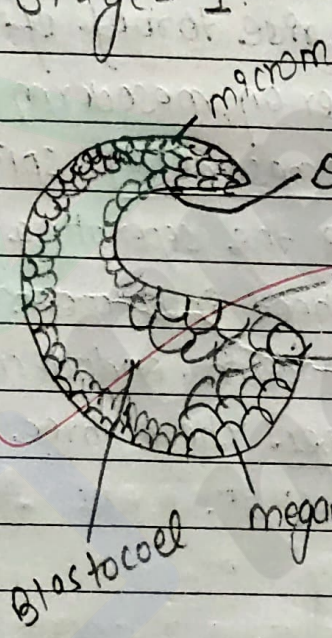
* Rotation of Embryo:-

At the time of development of Archention cavity the space of blastocoel is reduce and displace to anterior side in vegetal pole. Hence the gradual development of Embryo shift the centre of gravity being free to rotate inside the fertilization membrane. Therefore the embryo swings anti-clockwise in 90° to adjust Archenteron cavity upward in Animal pole and Blastopore horizontally to posterior pole. The archenteron cavity develop in mouth whereas blastopore develope anus in frog. Such animal are called Deuterostomes

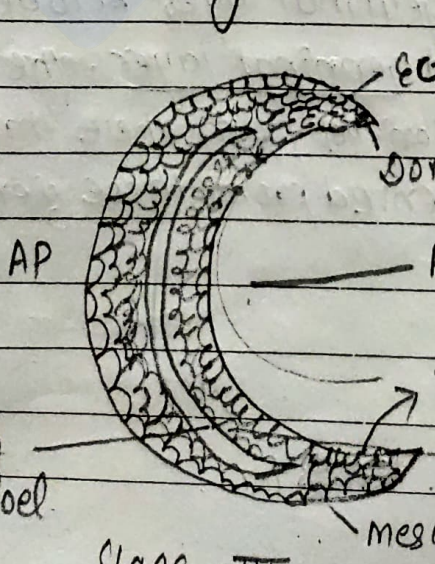
* Stage on Gastulation:-



Stage - I



Stage - II



Stage - III

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* Significance of Gastrulation:-

1) Increasment in metabolic activity of cell
2) Organization of cell into various layer to form various organs
3) Increasment of morphogenesis and differentation of cell.

* Formation of 3 germ layer.

Differentation of cell is start in blastula stage whereas the ectoderm and endoderm become distinct in gastrula stage and gave rise to well established germinal layer. Outer layer of embryo form by micromere give rise to ectoderm whereas inner layer of micro and mega mere give rise to roof of archenteron which is called mesoendoderm. later on mesoderm is seperate and gave rise to ectoderm from endomesoderm. splitting start from dorsal surface of middle line the seperating, arrangement arrange themselve in the form of sheet in between ectoderm and endoderm. these three layer ectoderm, endoderm and mesoderm are called primary germinal layer. These three layer develop various organ of larval body.

* Fate of germinal layer.

The three germinal layer ectoderm, endoderm and mesoderm are called germinal layer. The entire body of tadpole and adult frog is derived from these three layer. the various tissue and organ derived from these germinal layer are described below:-

(i) Fate of ectoderm:-

1) Epidermis and epidermal gland of skin.
2) Entire nervous system including brain, spinal cord and nerves.
3) Carpal cartilage and cartilage of visceral arches.
4) Conjuctiva, lens, cornea and retina of eyes.
5) Pituitary gland, Ademal gland and pineal gland.
6) Nasal & olfactory epithelia.
7) Enamel of teeth.
8) Buccal cavity and Rectum.

ii) Fate of mesoderm:-

(1) Dermis of skin
(2) ~~Muscular tiss~~ Muscular tissue.
(3) Most of the endo skeleton including notochord, bone and cartilage in adult.
(4) Heart, Bloodvessel and spleen.
(5) Dentine of teeth.
(6) Excreatory, reproductive, blood vascular system and lymphatic system.
(7) pre-cardium and pleural membrane.
(8) Cortex of adrenal gland
(9) Choroid of eyes.

iii) Fate of Endoderm:-

(1) Mucus membrane of entire alimentary canal.
(2) All digestive gland.
(3) Liver and pancrease.
(4) Urinary Bladder.

(5) Trachea, bronchi & lungs.
(6) Middle layer and eustachian tube.
(7) Thyroid and pra-thyroid gland, thymus and anterior end of pituitary gland.

Post embryonic development
(Organogenesis / organogeny).

Gastrulation process is complete in 80 hours after fertilization. Post-gastrula development is concern with differentiation of various embryonic tissues and organs from three primary germ layer. These phase of development is called organogeny.

The main changes during organogeny are as follow:-

(1) Notogenesis (Formation of Notochord)

Notogenesis is process of formation of notochord and it is formed by following steps:-

1) Notochord is developed from mesoderm so it is mesodermal in origin.
2) Endomesodermal cell present in the mid-dorsal roof of archenteron that seperate from adjacent mesoderm cell.
3) These cell form a solid, cylindrical rod called notochord. It cell become vacuolated
4) Later on notochordal sheath is developed around the notochord. the outer layer of sheath is elastic and inner layer is rigid with fibres.

(5) Notochord lies parallel to and just below the neural tube
(6) Later on the notochord gradually replaced by ~~vertebral~~ vertebral column

ii) Neurulation:- (formation of neural tube)

The process of formation of nerve chord is called Neurulation process. After gastrulation neurulation process is proceed as follows:-

(1) The nervechord develop from ectoderm. so it is ectodermal in origin.
(2) The ectodermal cell at animal pole thicken to form neural plate or medullary plate.
(3) The lateral margin of neural plate becomes more thicker to form ~~neural pore folds ford~~ neural fold.
(4) The neural plate gradually sink downward forming a groove called neural groove.
(5) Due to further sinking of neural plate both end of neural plate meet and join together for the formation of neural tube
(6) ~~Even the~~ Eventually, neuron tube seperates from ectoderm layer and sink inward and lies just below the ectoderm at animal pole.
(7) At the front end neural tube remains open for short time through an aperture called neuropore.
(8) posteriorly the neuro canal communicate for some time with archenteron by ~~neuro archentary canal~~. neurenteric canal.
(9) finally a closed tubular nervous system is formed which later on form brain and spinal cord.

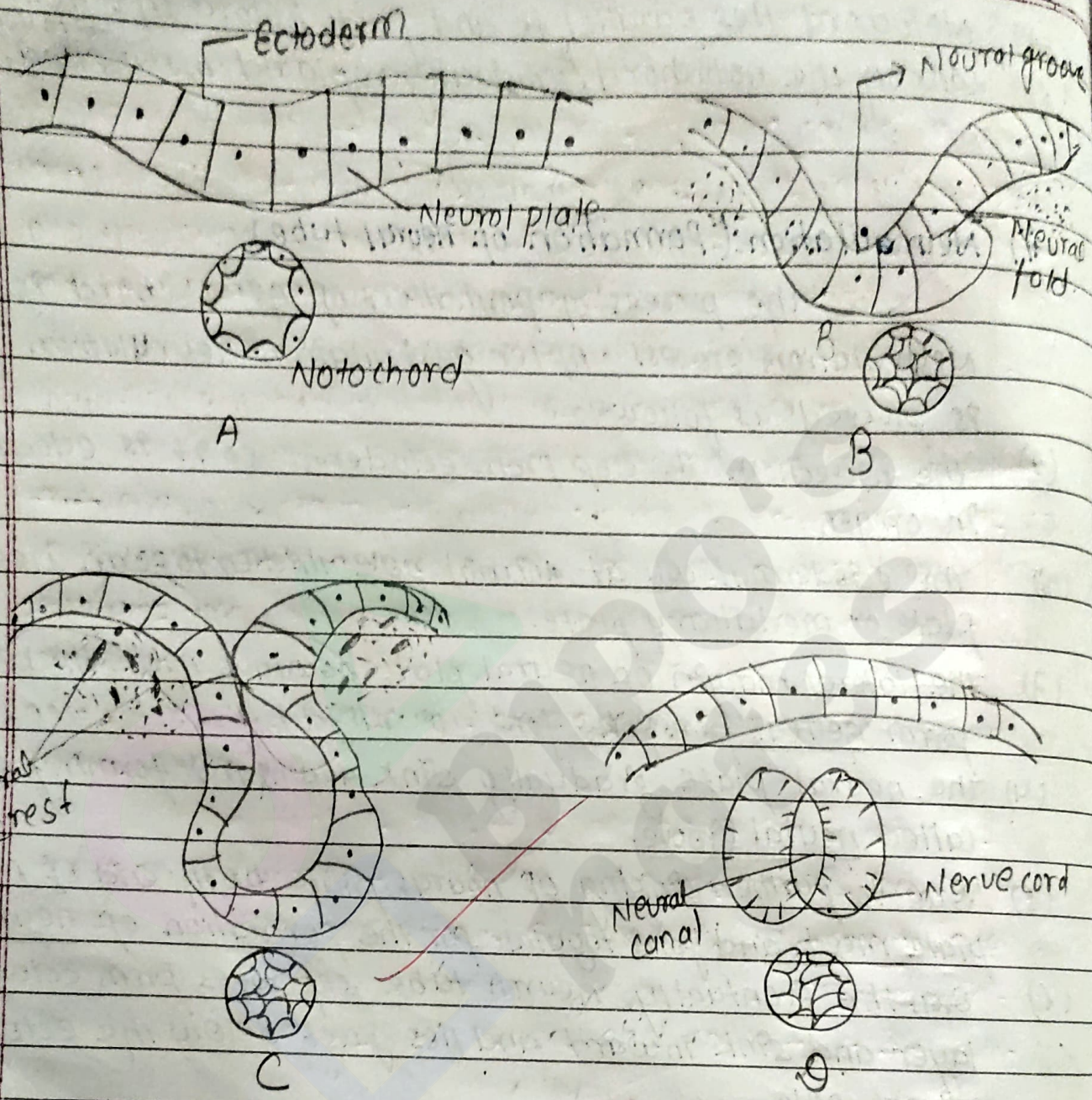

fig:- process of formation of Nerve cord.

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* Formation of coelom:-

(1) coelom is ~~mesoder~~ formed by mesoderm so it is mesoderm al in origin.

(2) Mesodermal layer is break down into two thin layer:- Outer somatic layer located beneath the skin where as inner visceral layer located around the wall of archenteron.

(3) Between these two mesodermal layer a narrow cavity is formed called Splanchnocoel. which marks the begining of coelom.

(4) Splanchnocoel extend downward to become continous with outer side below the ~~ge~~ gut (intestine) to appear U-shaped in section such type of coelom is called schizocoel which is formed by splitting mesoderm.

(5) The somatic layer of coelom unite with ectoderm to form body wall ~~which~~ while ~~te~~ the viseral layer united to form gut wall.

(6) As a result continuous cavity is formed called coelom or body ~~ge~~ cavity between body wall and gut wall.

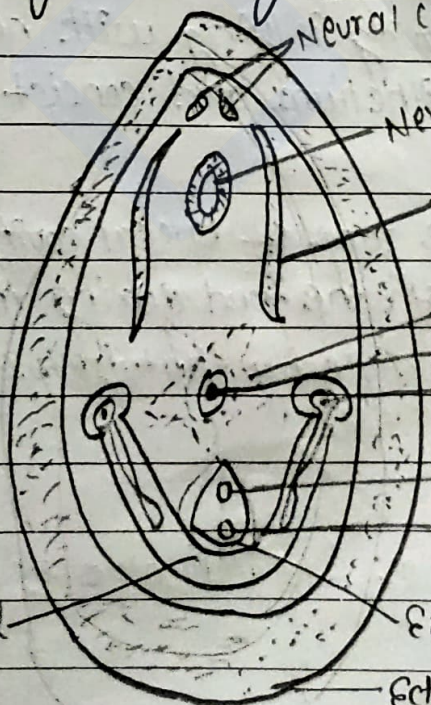
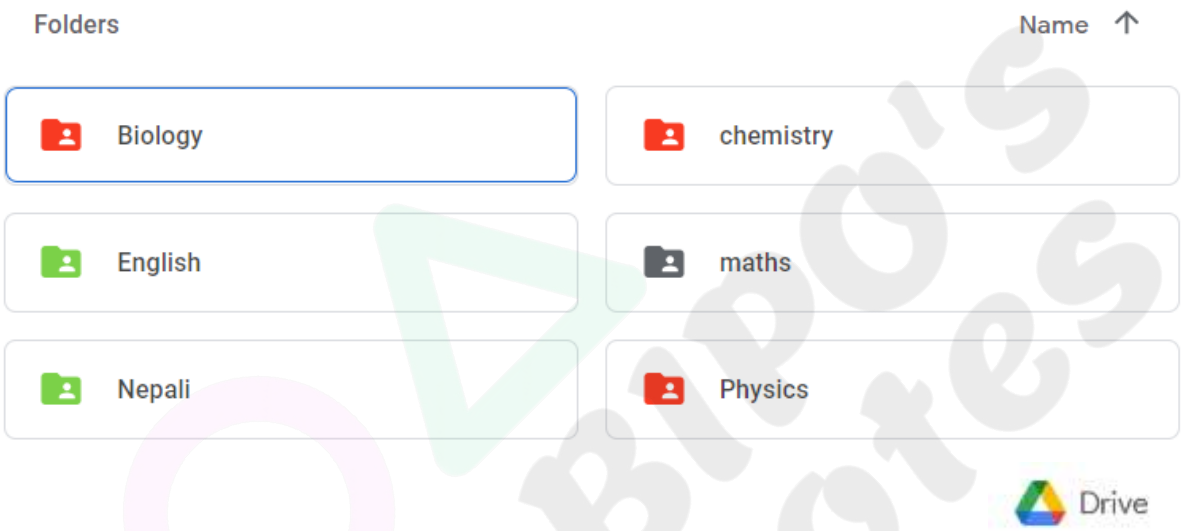


Fig:- Formation of coelom.

Bipin Khatri

(Bipo)

Class 12 complete notes and paper collection.



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