→ from Greek word - embryon, the unborn, embryo
and -logia is the branch of biology that studies the
the prenatal development of gametes Friday
fertilization and development of embryos 26.07.19
and fetuses. 1

EMBRYOLOGY

An egg results from fertilization of an egg cell.

Eggs

Types of Eggs:-

Types of Eggs

* on the basis of amount of yolk.

1.) Alecithal eggs → In this types of egg yolk is negligible.
for Ex - Human egg

2.) Microlecithal or Oligolecithal Eggs → The amount of yolk is very small in these types of eggs.
for Ex - Eggs of amphioxus, eutheria, metatheria and Echinoderm.

3.) Mesolecithal eggs → In this types of eggs the amount of yolk is moderate (neither more nor less)
for Ex - Eggs of amphibians and lungfish.

4.) Polylecithal or Macrolecithal or Megalecithal eggs → In this types of eggs are with large amount of yolk are present.
for Ex - Insects eggs, Birds, Reptiles and Prototheria mammals.

Scanned by CamScanner

* On the basis of distribution of yolk

1) Isolecithal or homolecithal eggs → The yolk is evenly or homogenously distributed in these eggs.
For ex- Rice olecithal, Alecithal eggs.

2) Telolecithal eggs → The yolk is concentrates in one part of the egg.
For ex- Mesolecithal eggs of amphibians (moderately telolecithal)

Discoidal eggs
A type of telolecithal and meg alecithal eggs, where the yolk is in enormous quantity and concentrated in one part of the egg. Thus only a disc of cytoplasm called germinal disc remain in the egg which is located at the other pole of egg. (Heavily telolecithal).
For ex- Eggs of reptiles, birds and prototheria mammals.

3) Centrolecithal Eggs → Meg alecithal eggs where the enormous amount of yolk and located in the centre and cytoplasm in the form of superficial layer around the yolk.

Scanned by CamScanner

For ex → Insects eggs.

* on the basis of shell. - 3 TYPES

1.) Cleidoic eggs → Eggs surrounded by a hard shell are known as cleidoic eggs.
These eggs are found in those animals which have a terrestrial mode of life or which lay eggs on land. These eggs have more amount of yolk. These are adaptation to terrestrial mode of life. Shell prevents the egg from dessiciation.
For ex → Eggs of reptiles, Birds, Terrestrial insects and prototherians.

• Reptiles eggs are leathery eggs.

2.) Non-cleidoic eggs → Eggs which are not surrounded by a hard shell are called non-cleidoic eggs.
All viviparous animals (Mammals and alloiparous animals which lays eggs in water amphibians).

Egg oocyte or Ovum with the egg membranes are terminal as the egg. The nucleus of egg is also called Germinal Vesicle
Oocytes is surrounded by membrane.

Scanned by CamScanner

formed as egg membranes.

NOTE :-

Majority of eggs are oval but eggs of insects are long and cylindrical.

→ Smallest eggs are of 50 μm in polychaeta
→ Largest eggs are of an Ostrich.

Classification of Egg membranes

1.) Primary / egg membrane - This type of membrane is secreted by the oocyte itself.
For ex- Vitelline membrane, chorion in insects, Zona pellucida (in mammals)
or,
Formed by the egg itself inside the ovary

2.) Secondary egg membrane - Formed by the ovarian tissue before the egg leave the ovary.

3.) Tertiary egg membrane - Formed during passage of the egg in the oviduct.
For ex- Egg of toad and egg of bird.

Scanned by CamScanner

Friday
2-8-2019
5

Parthanogenesis

greek word parthenos - virgin
genesis - creation

This is peculiar mode of sexual reproduction in which egg development occurs without the fertilization is known as parthanogenesis.
For Ex - Honey Bee, Apple (Lord Jesus Mother's name without father).

- Parthanogenesis was first discovered by Owen in 1849. The individual so formed is called Parthynot.
- Parthanogenesis is literally means a virgin birth.
- In biological terms it simple means an fully unfertilised ovum will give to rise to a functioning adult.
- Parthanogenesis is a type of asexual reproduction and applies only to animal.
- The Botonical counter part is called Apomixis. It has never been reputed in animals, birds eggs reported as in of parthanogenesis origin never has.
- It is only found in Several unique

Scanned by CamScanner

fish, amphibians and lizard.

Parthanogenesis may be differentiated between two types —

1.) Natural or 2.) Artificial Parthano-genesis.

1.) Natural Parthanogenesis (unfertilized) → It is also called virginal reproduction and regularly occurs in life cycle of lower forms.

- In some species it is the only mode of reproduction while in other it is mode of reproduction as well as mechanism of sex determination or sex reproduction.

V.V.I. - Adult produced in this way a haploid or diploid chromosome numbers.

It is of 2 types

a.) Complete parthanogenesis or
b.) Incomplete parthanogenesis.

a.) Complete parthanogenesis — It is also called obligatory parthanogenesis.

- In certain species of aphids and phyllo-pods which sporadically consist of

Scanned by CamScanner

exclusively of males or females.

- Male occurs rarely, therefore every individuals arises from an unfertilized eggs.
- It constituents a highly distinct type of genetic system in which sexuality has been entirely abolished and recombination of gene is no longer possible.

Insects have no sexual phase and no male they depend exclusively on the parthanogenesis for the self reproduction.

b.) Incomplete Parthanogenesis → The life cycle of certain insects includes two generations, the sexual generation and the parthanogenetics generations, both of which alternates to each other. In such cases the diploid eggs produce female and the unfertilised eggs produced the male. This types of parthanogenesis partial or cyclic parthanogenesis.

- In bees, wasps and aphids one or more parthanogenesis generation alternate with a bisexual one usually in an annual cycle.

* Natural parthenogenesis is also divided into Haploid and Diploid Parthenogenesis

i) Haploid Parthenogenesis → It is also called a Arrhenotoky.

- In hymenoptera, coleoptera, thysanoptera and rotifera and arachnida male arises from the unfertilized eggs. (insect groups) and consisquently haploid while female forms fertilized eggs and so are haploids.

ii) Diploid parthenogenesis → It is also known as Thelytoky. Here the reduction division is aborting (बंद) and diploid eggs are formed which develop without fertilisation.

This is again 2 types :-

Ameiotic parthenogenesis
Meiotic parthenogenesis

→ Ameiotic Parthenogenesis → In trichonisicus (isopoda), Daphnia pulex (preta) Campeloma rufum (mollusca) weevils and longed-horned grasshopper (कीड़ा) the first meiotic division which is reduction division is completely suppressed and only one meiotic division

Scanned by CamScanner

resulting in diploid eggs which develop into new individual without fertilisation.

- It is also known as Apomeiotic Parthenogenesis.

→ Meiotic Parthenogenesis → Certain eggs develops by the usual process of oogenesis but at certain stage diplosis or doubling of chromosome numbers and production of diploids eggs occurs. Such eggs develop into the haploid individual and this phenomenon is known as meiotic parthenogenesis.

Ex - Crustacean, Hymenoptera and Lepidoptera.

[just like n → 2n] In this parthenogenesis

The diploids of the diploid the thelytoky may occur by following methods.

(self)

* By Autofertilization :- In certain cases the oocytes divides meiotically up the formation of ovum/ootid and secondary polocyte.

But the ootid/ovum and secondary polocyte unite together to form a diploid egg, which develop into a new individuals.

Scanned by CamScanner

For Ex - Artemia salina (crustacea and various organisms).

* By restitution :- Sometimes in primary oocytes Karyokinesis forms a nucleus of the secondary oocytes and nucleus of the first polocyte. But the Karyokinesis is not followed by the cytokinesis. The chromosomes of both daughter nuclei are unarranged on a equator and undergo and second meiotic division to form a diploid ootids and diploid polocyte.

The diploid ootids or ovum the develop into a parthanogenetic diploid individual. This type of diplosis is known as Tokogenesis.
For Ex - order hymenoptera and lepidoptera.

9) Artificial Parthanogenesis (by other agents)

- The eggs which always develop into to the young individuals by the fertilisation sometimes may develop parthanogenetically under certain artificial condition.
- This type of parthanogenesis is known as artificial parthanogenesis. It may be

Scanned by CamScanner

Friday
Date 9/08/2019
Page 11

included by various chemical and physical means.

V.V.I The following physical means cause the parthenogenesis are as follows :-

a.) Temperature → The range of the temperature may induce parthenogenesis in the egg. For instance when the egg is a transferred from the 38°C to 10°C. The parthenogenesis is induced.

b.) Electric Shock → It can cause parthenogenesis.

c.) Ultra violet light → It can also cause parthenogenesis.

d.) When the egg are picked by the fine glass needle the development of the eggs are takes place parthenogenesis.

The following chemicals has been found to cause parthenogenesis in the normal egg.

V.V.I
- chloroform ($CHCl_3$)
- Strychnine
- Hypertonic and Hypotonic.
- chloride of Cl^+, Ca^{++}, Na^+, Mg^{++}

Scanned by CamScanner

- Acid such as butyric acid, latic acid, olic acid and other fatty acid.
  for Solvents - Xylene, alcohol, benzene and acetone.
- urea and Sucrose.

Imp **Significance of Parthanogenesis**

→ The parthanogenesis serves as the means for the determination of sex in the honey bees, wasps.

→ The parthanogenesis supports the chromosomes theory of Inheritance.

→ The parthanogenesis is the most simple, stable and easy process of reproduction.

→ The parthanogenesis eliminates the variation from the population.

→ It is the best way of high rate of multiplication in certain insects.
  for Ex - Aphids.

→ It causes the polyploidy in the organism (3n)

→ The parthanogenesis encourages develo-

Scanned by CamScanner

-pment of the advantageous mutant character. (Sudden change)

→ The parthanogenesis checks the non-adaptive combination of genes which may be cause due to mutation.

→ Due to parthanogenesis there is no need for the organisms, too (pairing) mate their energy in the process of mating, but it allows them to utilize the amount of energy in the feeding and reproduction.

→ The parthanogenesis avoid the sterility in the recattes.

Friday
Date 09/08/2019
Page 14

The Structure of a Typical Ovum

Ovum is the female gamete. Oocytes or ovum with the egg membrane are called the egg. It stores food required for the entire process of development in the form of yolk. The nucleus of egg is called Germinal vesicle.

It has 3 important functions:-

1.) It supplies a haploid set of chromosomes to the future embryo.

2.) It contributes almost all cytoplasm to the zygote.

3.) It supplies food to the developing embryo.

Shape And Size

- Typically, the eggs are spherical or oval in shape.
- But in a few animals like insects, the eggs are elongated and cylindrical in nature.

Scanned by CamScanner

- Eggs are generally larger than the sperm and average somatic cells.
- The size of a mature egg depends on the amount of yolk present in it.
- The smallest known egg is that of mouse (0.07 mm); the birds possess larger eggs.
- Ostrich lays the largest egg having a diameter of about 85 mm.
- The egg is covered externally by a plasma membrane or plasmalemma. Within the plasma membrane is the granular cytoplasm.

Organisation of Egg Cytoplasm

- The cytoplasm of egg cell is known as ooplasm.
- It is granular and contains in addition to the usual cellular organelles certain other inclusions like yolk, pigments and cortical granules.
- The peripheral layer of ooplasm is more viscous and gelatinous.
- It is known as the egg cortex which is provided with many microvilli and cortical granules. The microvilli are formed by the outpushings of the plasmalemma and they help in transportation of substances from the outside into the ooplasm during the development of egg.

Scanned by CamScanner

- The cortical granules are very small spherical bodies varying in diameter from 0.8 μm to 2 μm. They are membrane bound and are formed from golgi complex. They contain homogenous and granular mucopolysaccharides.
- Cortical granules are present in the eggs of sea urchins, frogs, fishes, bivalve Mollusces, several annelids and certain mammals.

Yolk

- Nutritive substances are stored in the cytoplasm of egg in the form of yolk or deutoplasm.
- This stored food is utilized by the embryo for its early development. The process of formation of yolk is known as vitellogenesis.
- The yolk is a complex material consisting of proteins, fats, carbohydrates, inorganic salts, vitamins, enzymes, pigments and water.
- The yolk may be called "protein yolk" when it has more proteins than lipids, or "fatty yolk" when it has

Scanned by CamScanner

more ____ than the proteins.

- Most animal eggs contains both kind of yolk. Since the yolk is heavier, large quantities of yolk, such as those of the frog and chick the accumulation of yolk is one region is so marked that they are known as telolecithal eggs.

- In eggs containing lesser amount of yolk, like those of Amphioxus and in all the yolk is distributed more uniformly, hence they are known as isolecithal or homolecithal.

Pigment Granules

- It is the present in the cytoplasm of eggs of many species. The granules may be brown, black, red, yellow, green or grey in colour.

- As the pigment granules are not common to all eggs, they do not play any significant role in development.

Polarity

- The constituents of eggs are not uniformly distributed throughout the cytoplasm.
- These are distributed in such a way that two poles distinct can be identifi

Scanned by CamScanner

-ed in the eggs.

- These poles are known as animale pole and vegetal pole.
- The cytoplasm is concentrated in the upper portion or animal hemisphere and the yolk material is concentrated in the lower portion or vegetal hemisphere.
- A plane passing through these two poles constitute the polar axis.
- The nucleus is always located in the polar axis, more or less toward is the animal pole
- The yolk shows a gradation from the animal pole towards the vegetal pole. There is also a metabolic gradation along the polar axis.
- Metabolic processes are highest at the animal pole and progressively diminish towards the vegetal pole.

Classification of Egg

1) On the basis of the amount of yolk Eggs are grouped into 4 types on the basis of the amount of yolk present in them.

a) Alecithal Egg :- when the egg

Scanned by CamScanner

contains no yolk, it is called alecithal egg. The egg of eutherian mammals.

b) Microlecithal Egg :- When the egg contain, small or negligible amount of yolk it is said to be microlecithal.

- Rover and Balinsky named these eggs as oligolecithal eggs.

for Ex - Amphioxus, Tunicate.

c) Mesolecithal Egg :- In amphibians, Dipnoi and Petromyzon the amount of yolk present in moderate and is not high. Hence these eggs are also named as mesolecithal eggs.

d) Macrolecithal or Megalecithal Egg When the egg contains large amount of yolk it is said to be macrolecithal or megalecithal egg.

- It is also called polylecithal egg.

For Ex - bony fishes, amphibians, reptiles and birds, trophotenia etc.

2) On the basis of the distribution of yolk :-

Scanned by CamScanner

a.) Isolecithal or homolecithal egg :-
In these eggs, the very little amount of yolk present is uniformly distributed throughout the ooplasm. For Ex - (echinoderms, Amphioxus, mammals).
- This condition is usually observed in eggs with very little amount of yolk.

b.) Telolecithal Egg :- In eggs containing moderate or large quantity of yolk, the distribution of yolk is not uniform.
- It is concentrated more towards the vegetal pole. Such a type of egg, in which the yolk is concentrated towards one pole, is called telolecithal egg.

It may further classified into 3 types.

i) Slightly Telolecithal
- This type of egg contains only a small quantity of yolk which is distributed unevenly.
- The vegetal pole has the highest conc" and the animale pole the lowest conc" for Ex - eggs of fishes.

ii) Moderately Telolecithal
- This type of egg contains a moderate

quantity of yolk which is distributed unevenly. Due to high conc^{n} of yolk in the vegetal hemisphere, the nucleus is shifted more towards the animal hemisphere. For Ex- Amphibian Egg.

iii) Extremely Telolecithal Egg
In this type of egg, due to the heavy deposition of yolk, the entire vegetal hemisphere and a major portion of the animal hemisphere are occupied by yolk. Due to this extremely uneven distribution of yolk, the cytoplasm and nucleus are displaced towards the animal pole. For Ex- Reptilian and avian Egg.

c.) Centrolecithal Egg
Egg of many arthropods and some cold blooded vertebrates are described as centrolecithal.
They are relatively large and elongate and have a very great amount of yolk.
The nucleus lies at the geometric centre of the yolk mass, surrounded by a small amount of cytoplasm.
A thin cytoplasmic layer covers the surface of the yolk.
Fine strands of cytoplasm extend from the peripheral layer to the zone occupied by the nucleus.

Scanned by CamScanner

3.) On the basis of Shell.

a.) Cleiodoic Eggs:- Eggs are surrounded by a hard shell and it is a cleidoic eggs.

- These eggs are found in those animals which have a terrestrial mode of life or which lay eggs on land.
- These eggs have more amount of yolk.
- These are adaptation to terrestrial mode of life.
- Shell prevents the eggs from desiccation for ex- Eggs of reptiles, birds, terrestrial insects and prototherians.

→ Reptiles are leathery eggs.

b.) Non-cleiodoic :- Egg which are not surrounded by a hard shell are called Non-cleiodoic eggs.

- All viviparous animals (Mammals and all oviparous animals which lay eggs in water Amphibians.)

Discoidal Egg

- A type of Telolecithal and Megalecithal eggs, where the yolk is in enormous quantity and concentrated in one part of the egg.
- This only a disc of cytoplasm called

germinal disc remain in the egg which is located at the other pole of egg.

Mosaic Egg

- In certain eggs, every portion is predetermined with respects to its potentialities for further development.
- If a small portion of such an egg is removed, a defective embryo is formed.
- This is because removal of a portion results in a permanent loss from the egg.
- The remaining portion of the egg cannot make compensatory development to make good the lost part. Such an egg, in which the future development potentialities are predetermined in the form of a mosaic, is called mosaic or determinate Egg.
- for ex- (Annelids, Molluscs and Ascidians)

Regulative Egg

- In vertebrates and most of the invertebrates, the development potentialities are not predetermined in the eggs.
- Removal of a small portion of the egg, or even one or two early blastomeres will not affect the normal development.
- This type of egg in which the further development potentialities are not predetermined is known as Regulative / Indeterminate.

-nate egg.

Egg Membranes.

- The oocytes is surrounded by a membrane is termed as Egg membranes
- The eggs are well protected by egg membranes.
- The membranes are produced either by the egg itself or by the follicle cells of the ovary or by the genital ducts (oviduct) of the female mother. Accordingly, the egg membrane are classified into 3 types —

1) Primary membrane 2) Secondary membrane and 3) Tertiary membrane

1) Primary membrane - The membranes secreted by egg cytoplasm (ooplasm) constitute the primary membrane.
- They are closely attached to surface of the egg.
- The primary membranes are named differently in the different membrane. They are —

a) Vitelline membrane → the egg immediately
- It is the membrane covering the egg.
- It is found in all the eggs in structure.

b) Chorion membrane
- Commonly found in egg of Amphioxus,

Scanned by CamScanner

molluscs, Echinoderms, amphibians, birds etc.

- It is very thin and transparent.
- Vitelline membrane is closely attached to the plasma membrane of egg.
- It is formed of muco polysaccharide and fibrous protein.
- The space formed between it and the plasma membrane is called perivitelline space filled with a fluid called perivitelline fluid.

{plasma membrane
↓
It resembles the plasma membrane of a cell.}

c.) Chorion

- It is found in the eggs of lower chordates like fishes (Scyllia). it is a product of surface ooplasm.

d.) Zona Radiata

- The egg of the shark Scyllium canicula, has a primary membrane produced by the surface ooplasm.
- The outer membrane is the vitelline membrane and the inner membrane has a radiating appearance and hence called Zona radiata.
- The eggs of teleost fishes are also covered by Zona radiata.

e) Zona pellucida

- All mammals eggs are surrounded by a membrane

called Zona pellucida is also named as zone radiata.

- It is so named because it gives a striated appearance under the microscope.
- The striations are due to the presence of microvilli and macrovilli (desmosomes) in this zone.
- The microvilli are produced by the surface of the egg and microvilli are produced by follicle cells. They produce into the zona pellucida.

2. Secondary Membrane - It is produced by the follicle cells (cells found around the developing oocytes) of the ovary.
- These membranes are usually tough and impermeable.

The Secondary Membranes are as follows:-

a.) Chorion
- This is a common outer covering in the eggs of insects, ascidians and cyclostomes (Myxine). It is found outside the vitelline membrane. As the chorion is tough and impermeable. It is provided with one or more openings called micropyles through which the sperms enter the egg.

b.) Corona Radiata

Scanned by CamScanner

- It is found in mammalian eggs.
- This membrane is formed of a layer of follicle cells.
- The cells are radially arranged around the Zona Pellucida.

3. Tertiary Membrane — It is produced by the oviduct.

The tertiary membranes are as follows-

a.) White Albumen

- It is found in the egg of hen.
- It is found out side the vitelline membrane
- It is formed of 3 layers —
  - * an inner less dense albumen
  - * a middle dense albumen and * an outer less dense albumen.
- The albumen is formed of water and protein.

b.) Shell Membrane

- The shell membrane is formed around the albumen in the egg of hen.
- It is a double membrane.
- The two membrane adhere closely and are separated by an air space at the blunt end of the egg.
- This membrane is formed of Keratin.

c.) Shell

- The shell is the outer covering of land

and real eggs.

- It is formed of calcium carbonate.
- It is white or brown in colour.
- It contains as many as 7000 minute pores.
- These pores are 0.04 - to 0.05 mm in diameter.
- They are filled with a proteinous substance called collagen.

d.) Jelly Coat

- The amphibian eggs are surrounded by a gelatinous covering called jelly coat.

e.) Mermaid's Purse

- It is the egg case of some cartilaginous fishes. It is a protective hard shell secreted by the shell glands present in the oviduct.
- The shape of the purse varies from group to group.
- Generally, it is rectangular in shape.
- The corners of the shell are drawn out into four long twisted elastic filaments which serve to attach the eggs to seaweeds.
- In dog-fish Scyliorhinus, development is completed within this purse.

Scanned by CamScanner

Sunday
Date 11/08/2019
09

Spermatogenesis (gametogenesis)

- Gametogenesis is the phenomenon of the production of haploid sex cell.
- ovum by ♀ and spermatozoa by ♂.
- In sexually reproducing organism.
- The production of ovum is called oogenesis and the production of spermatozoa is called spermatogenesis.

Spermatogenesis

- It is a process by which sperm mother cell or spermatogonium develops into mature spermatozoa.

- It takes place in the testis inside the seminiferous tubules.

Structure of testis

- The paired testis is surrounded by thick capsule tunica albuginea from which project a conical mass of connective tissue, mediastinum testis (Corpus). which contain around 300 lobuli testis.

- Each lobuli testis contains 1 to 4 coiled seminiferous tubules.
- The seminiferous tubules are separated by the interstitial cell.

Scanned by CamScanner

- The inside of the tubules are lined with germinal epithelium which consist of 2 types of cells — Spermatogonic cell and Sertoli cell.
- Spermatogonic cell or the germinal epithelium develops into spermatozoa and the Sertoli cell provide nourishment for the developing spermatozoa.

Spermatogenesis can be divided into 2 phase —

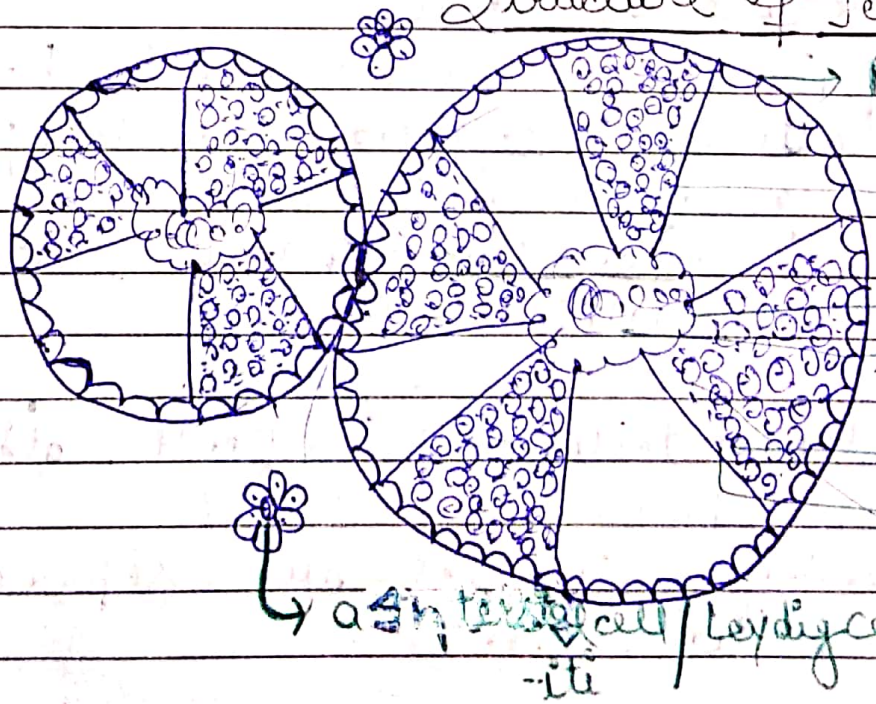
1. Formation of Spermatid
2. Spermatogenesis

1. Formation of Spermatid

It is also divided into 3 phase

a) Multiplication Phase b) Growth phase c) Maturation phase

Structure of Testis



Scanned by CamScanner

* Spermiogenesis - It is the final stage of spermatogenesis, which includes the maturation of spermatids into mature motile spermatozoa. Spermatid is a roundless circular cell containing a nucleus, golgi apparatus, centriole & mitochondria. All components takes part in forming the sperm - about 31.

a.) Multiplication Phase - During this phase, the primary germ cells multiply by mitosis and the end products are called Spermatogonia.

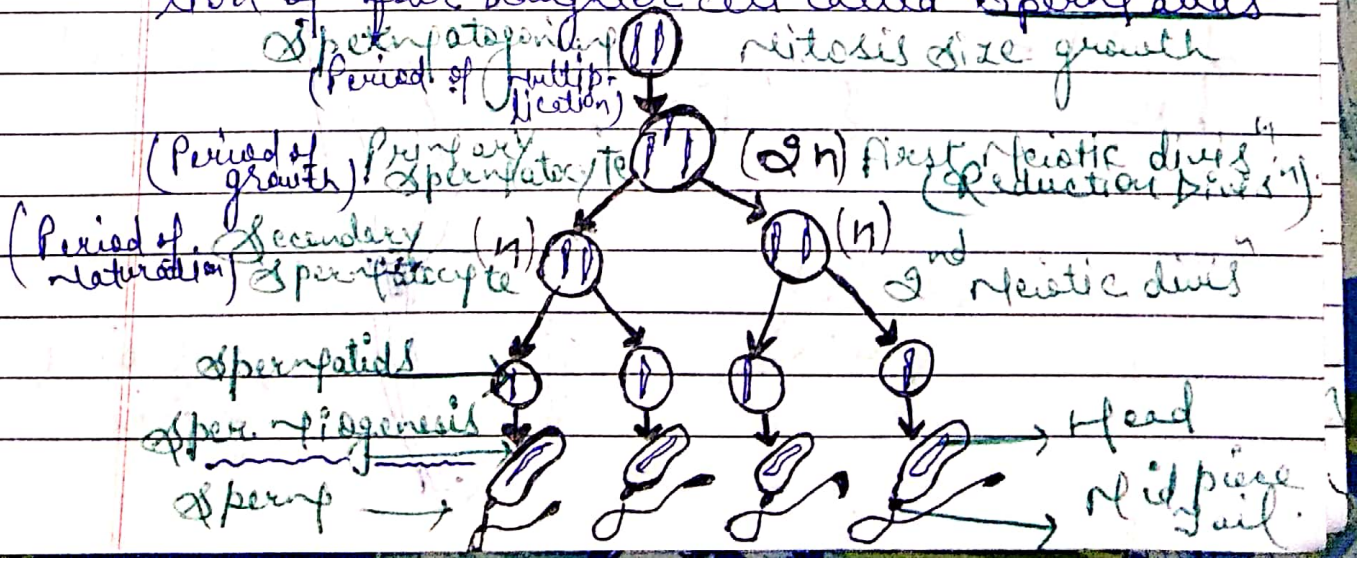
- No. of chromosome in (Spermatogonia) is 2n.
  (Sperm mother cell)

b.) Growth Phase - The Spermatogonia do not divide for sometime, but increase in size by accumulating nutritive material from the supporting cells.

- In mammals such supporting cells are called Sertoli cells.
- The large Spermatogonia are called Spermatocytes.

c.) Maturation Phase - During the phase of maturation, the primary spermatocytes divide by meiosis consisting of two successive division.

- The first division is reduction (2n → n).
- This cells are called Secondary Spermatocytes.
- 2nd division is equational resulting in the formation of four daughter cell called Spermatids.

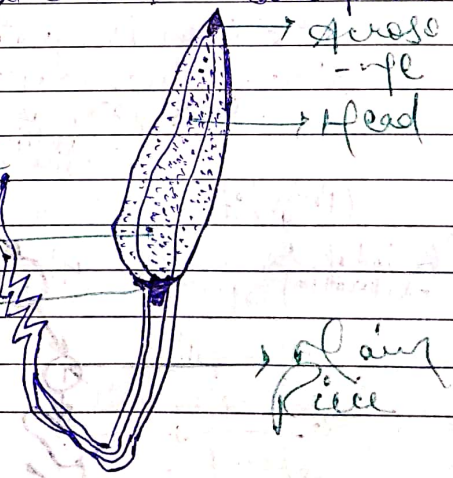


Scanned by CamScanner

2.) Spermiogenesis (Spermatoleosis)

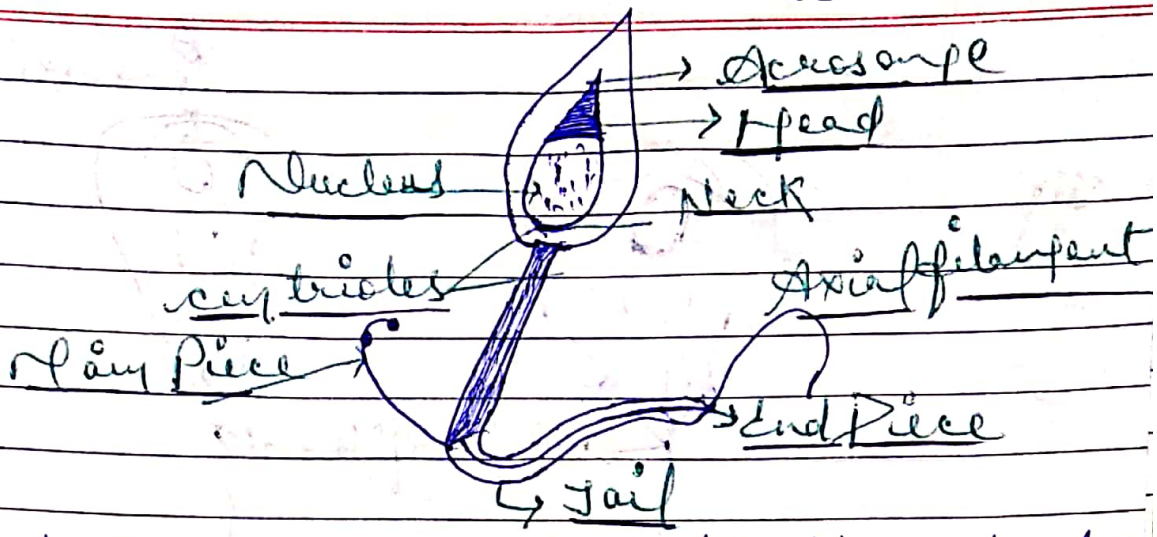
- It is the 2nd phase of spermatogenesis
- In this phase spermatids converting into sperm by metamorphosis.
- The spermatids is a typical cell containing a nucleus and cytoplasmic organs such as mitochondria, golgi body, centriole and nucleus.
- Nucleus contains haploid no. of chromosome
- During spermatogenesis following transformation occur in spermatids.
- The large spherical nucleus becomes smaller by losing water and usually changes it's shape into elongated structure.
- The golgi body contains into a cap called Acrosome in front of the nucleus.
- The nucleus and the acrosome combindly, form the head of the developing sperm while the cytoplasm with mitochondria and centrioles move downwards and form the cylindrical middle piece behind the head.

fig A -



Scanned by CamScanner

Fig B-

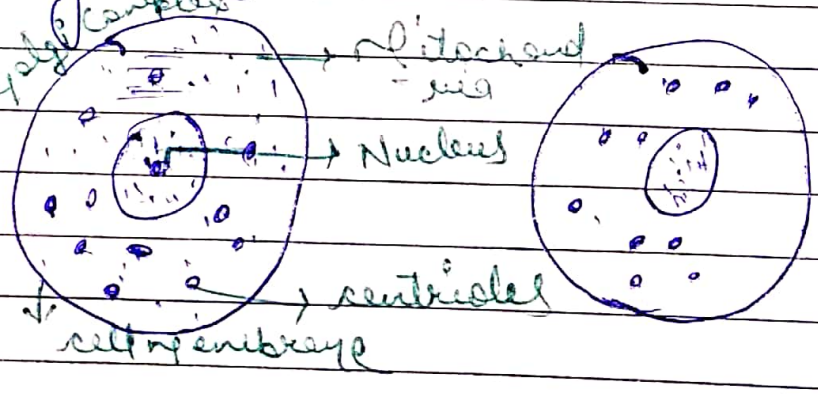


- The two centrioles of middle piece develop axial filament which are bunched into a single thread and extend behind in the form of a long versatile tail.
- Thus, spermatids is transformed into a motile sperm divided into head, middle piece and tail.

Significance of Spermatogenesis

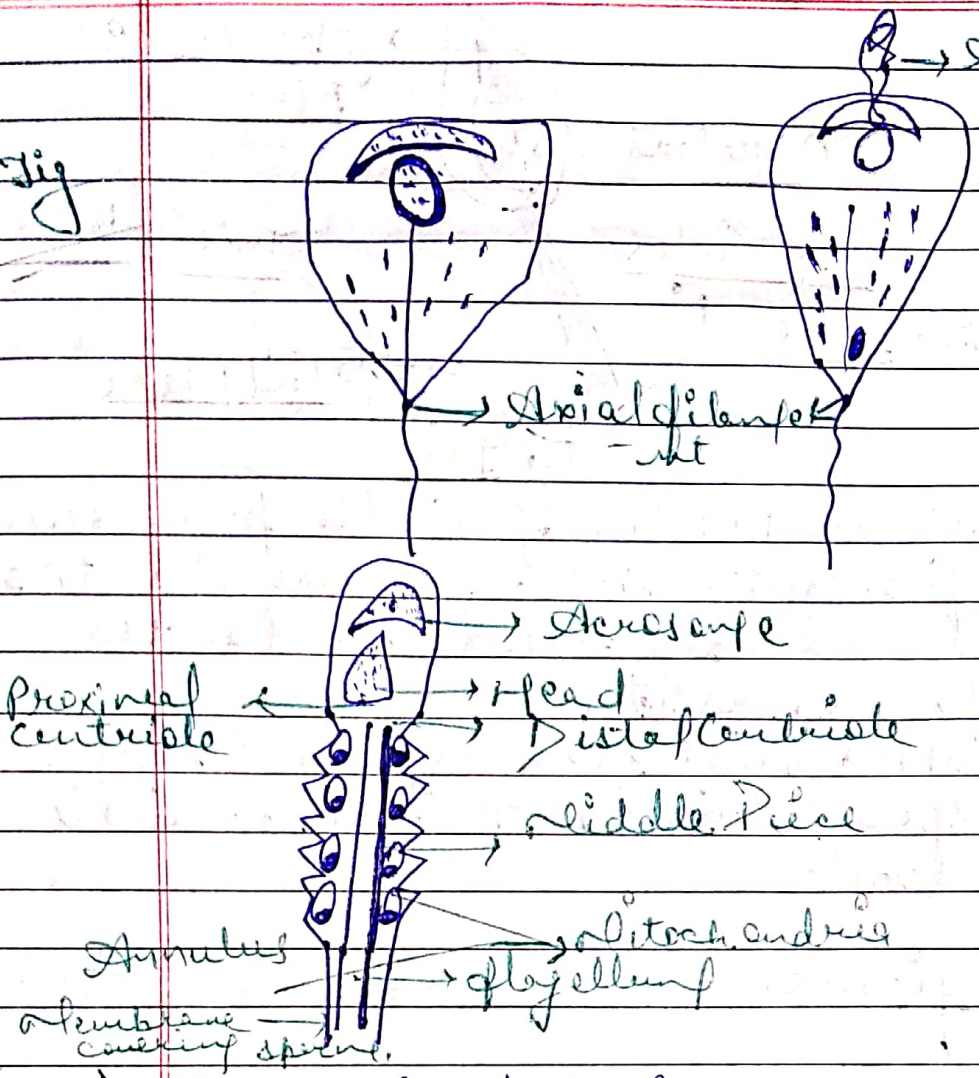
→ Produce haploid sperms.
→ Crossing over may occur during meiosis first, so producing variations.
→ Proves evolutionary relationships Spermatogenesis.

Fig- spermatogenesis



Scanned by CamScanner

Fig



→ The main is to increase the sperm motility by reducing weight & development of locomotory structures.

Sunday
11/08/2019
35

Cleavage

The process of cleavage or segmentation is one of the earliest mechanical activity in the conversion of a single-celled egg into a multicellular embryo. It is initiated by the sperm during fertilization. However, in the parthenogenetic eggs cleavage can commence without the influence of fertilization.

- The process of cleavage or cellulation happens through repeated mitotic division.
- These division results in cells is called Blastomere
- In later stages of development, the blastomere occupy different region and differentiate into several type of body cell.
- As the cleavage progress the resultant daughter cell/nuclei/the blastomere, get reduced in size
- During cleavage there is no growth of blastomere the total size and volume of the embryo remain same.
- The cleavages resulting compactness of blastomere called Morula, it gets transformed into blastula. while the wall of the blastula is called Blastoderm, the central cavity is called Blastocoel
- The first cleavage of frog's egg was observed by Thomas Hyde Dayrell in 1735.
- The entire process of cleavage in frog's egg was studied by Prevost and Dumas in

V.V.S.

Scanned by CamScanner

1824.

Characteristic of Cleavage

- All divisions are mitotic and consiquently the (Eggs of sea urchin division of the blastomeres can be observed every 30 min.)
- The cell size reduceds continuously as the cleavage proceed.
- The general shape of the embryo does not change for the formation of a cavity among the dealing cell. This is called Blastocoel.
- cytoplasmic substances transferred into nuclear substances, but the qualitative changes in the chemical compositions in the eggs are very few.
- A great increase in the synthesis of DNA takes place because it is needed for duplication of chromosome.
- The ratio of nucleus to cytoplasm is very low at the beginning of cleavage but at the end it is brought to the level found in ordinary somatic cells.
- During cleavage oxygen consumption is greatly increases.
- The constituent part of ooplasm remain ~~m~~ altered during cleavage.

Scanned by CamScanner

V.1.1) # The Planes / Pattern of cleavage

The egg can be divided from different planes during cleavages.

A) i) Depending on the position of the cleavage furrows the planes of cleavage are:—

i) Meridional cleavage → The plane of cleavage lies on the animal vegetal axis. It bisects both the poles of the egg. Thus, the egg is divided into 2 equal halves.

ii) Vertical cleavage → The cleavage furrows may lie on either side of the meridional plane. The furrows pass from animal to vegital pole. The cleavage cells may be unequal in size.

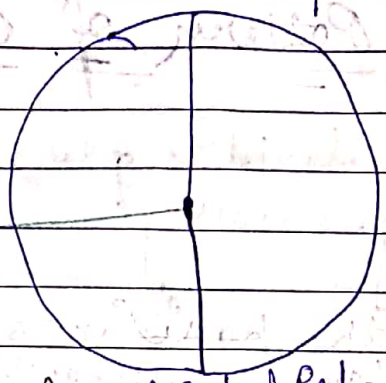
iii) Equatorial cleavage → The cleavage plane bisect the egg at right angles to the main axis.

- It lies on the equatorial plane.
- It divides the egg into two halves.

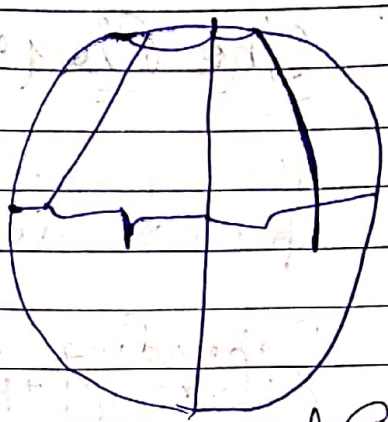
iv) Latitudinal cleavage → It is similar to the equatorial plane, but it lies on either side of the equator.

- It is also called as Transverse or horizontal cleavage.

Fig — A) i)



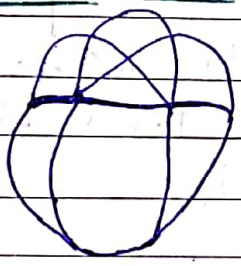
ii)



Meridional Plane

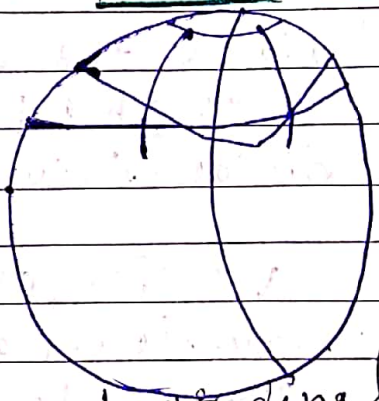
Vertical Plane

iii)



Equatorial Plane

iv)



Latitudinal Plane

V.V.I

B) The Nature of cleavage —
It is controlled by the amount of distribution of yolk.

(Cleavage is controlled by cytoplasm not nucleus).

i) Holo - Blastic or Complete cleavage
ii) Meroblastic or Incomplete "

i) Holo blastic or Complete cleavage
The entire eggs divided by each

Scanned by CamScanner

Note → In amphibians the cell divided into Blastula → gastrula → Neurula → Tadpole.

cleavage furrow. (रेखा)

It of 2 types

a) Equal holoblastic cleavage.

- When the daughter blastomeres are approximately of the same size.
- The total cleavage is called equal holoblastic cleavage.
- It occurs in micro and iso lecithal cells. for Ex - Sponges, echinoderms, lower chordates (tunicates, amphioxus) marsupial and eutherian mammals.

b) Unequal holoblastic cleavage

- If the daughter blastomeres are unequal in size, the complete division of egg is referred to as unequal holoblastic cleavage.
- This is the case with mesolecithal and telolecithal eggs of cyclostomes, elasmobranch fishes, dipnoi, amphibians and cephalopod (mollusca).
- In these eggs, the third cleavage give rise to four small and four large blastomeres
- The smallest blastomeres are called micromeres found towards animal pole and larger one micromeres or megameres found towards vegetal pole.

ii) Meroblastic or Incomplete cleavage.

- It is also called partial or Incomplete

→ In fishes meroblastic cleavage happens.

Lucky Date / / Page 40

cleavage

- The division furrow divides into a small amount of active cytoplasm on the periphery remains undivided.
- This cleavage takes place in mesolecithal or polylecithal egg. For Eg - In fishes.

It is also two types

a) Superficial / meroblastic cleavage
- This type of incomplete cleavage is found in centrolecithal eggs.
  For Ex - Insects and Many other arthopods.
- At the beginning of cleavage the nucleus located in the centre of the yolk divided rapidly, then the daughter nuclei start moving away from the centre of the egg.
- Each nucleus remains surrounded by small portion of poisonal centre cytoplasm.
- When the nuclei reach the surface of the egg, the cytoplasm surrounding them fishes with the superficial layer of cytoplasm.
- Lateral furrow (गड्ढा) / (खांचा) going inward from the surface divide the cytoplasm.
- In this way, layer of superficial or peripheral cell surrounds, and

undivided central yolk mass.

b.) 1) Disc-coidal cleavage
In a large yolky telolecithal egg of bony fishes, birds, reptiles and egg laying mammals, the cleavage remain restricted to a disc-shaped area of active cytoplasm called Blastodisc at the animal pole. The remaining yolk filled part of the egg shows no division.
Such incomplete cleavage is called a disc-coidal cleavage and a results in a disc of cells resting upon the undivided yolk.

c.) Based upon the Symmetry of pattern of cleavage has been recognised :—

i) Radial cleavage iii) Spiral cleavage
ii) Bilateral cleavage iv) Bilateral cleavage

i) Radial cleavage - In this cleavage pattern of division takes place in such a manner that all the blastomeres are placed in radially symmetrical fashion around the polar axis. When such an egg is viewed from the poles, the blastomeres seems to be arranged in a radially symmetrical form.
For Ex - Sponges, echinoderms, sea-

Scanned by CamScanner

urchin, sea cucumber, Amphioxus.

ii) Biradial cleavage - This pattern of cleavage is found in ctenophores. Four blastomere arise by the usual two meridional cleavage.
- The third cleavage plane is vertical resulting in a formation of a curved plate of 8 cells arrange in two rows. Each.
- In the rows, the central cells are larger than end cells.

v.s. iii) Spiral cleavage - The spiral cleavage is diagonal to the polar-axis.
- In this type, the spindles for the third cleavage, instead of being erect, are oriented diagonally so that the resulting upper tier of cells is displaced sidewise.
- The upper 4 cells are placed over the junctions between the four lower cells. The upper smaller cells are called micromeres and lower larger cells are known as macromeres.

- The spiral cleavages results due to oblique positions of the mitotic spindles. This type of cleavage is called the spiral type because the four spindles during the third cleavage are arranged in a sort of spiral.

Scanned by CamScanner

The turn of the spiral as seen from the animal pole may be in a clockwise direction (dextral) or in a counterclockwise direction (sinistral). Moreover, the spindles are alternatively tilted obliquely to the dextral and sinistral dir^{n}, so that successive generations of blastomeres are oriented in a twisted fashion.

- The pattern of cleavage characterizes the egg of annelids, molluscs, (certain) nemerteans and some of the platyhelminths.

iv) Bilateral Cleavage :- In this pattern of cleavage, the blastomeres are so arranged that the right and left side becomes distinct. This cleavage pattern is dependent upon differences in the size of the blastomeres.

- In this case, two of the first four blastomeres may be larger than the other two, thus establishing a plane of bilateral symmetry in the developing embryo.
- Subsequent cleavages may make the bilateral arrangement of the blastomeres still more obvious.

For Ex - Nematodes, Cephalopod molluscs, some echinoderms and tunicates.

v) Based upon the potentiality of the

Scanned by CamScanner

blastomeres for the future development.
It is of 2 types -
a.) Determinate cleavage
b.) Indeterminate cleavage

a.) Determinate cleavage - The developmental fate of each embryonic cell is established very early. If a cell is isolated from the four cell stage, the embryo will not fully develop. This is because the fate of each blastomere is predefined in the early embryonic stage itself.
Features
For Ex. Annelids, molluscs and ascidians which produce mosaic type of eggs exhibit determinate cleavage.
- It is also known as mosaic cleavage.

b.) Indeterminate cleavage - Early embryonic cells retain capacity to develop into a complete embryo if isolated from other cells. Cleavage produces blastomeres which are qualitatively equipotential or totipotent. When they are isolated, they develop into complete embryos.
- This is because the fates of blastomeres are not predetermined in the early embryonic periods.
For Ex - Vertebrates and certain Invertebrates. [ex. Hydra, echinoderms]
- It is also known as regulative cleavage.

Scanned by CamScanner

Laws of Cleavage

Apparently, they have several cleavage patterns. However, all cleavages follow a common procedure. The cleavages are governed by certain basic principles in ...

1. Sach's law → • It is produced by Sach in 1877.

- Cells tend to divide into equal daughter cells.
- Each new division plane tends to intersect the preceding plane at right angle.

2. Balfour's law → • It is given by Balfour in 1885.

- The speed or rate of cleavage in any region of egg is inversely proportional to the amount of yolk it contains.
  ↳ food storage material provide energy.

Influence of yolk on cleavage.

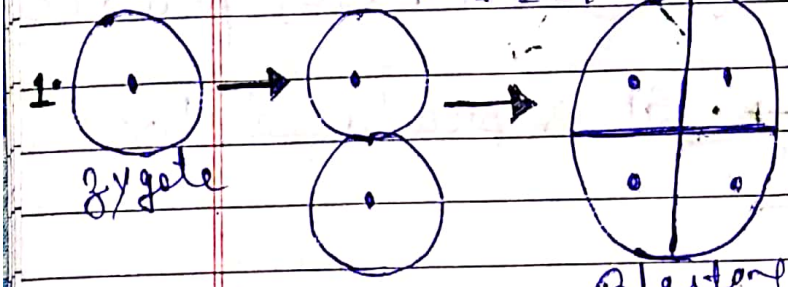
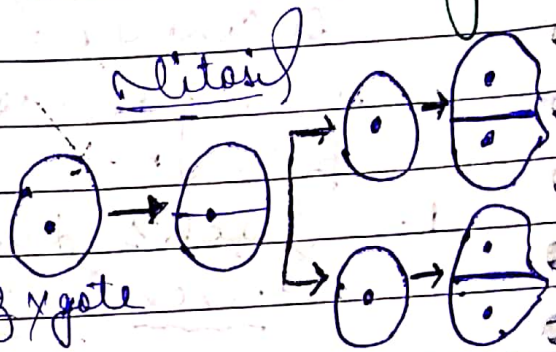
- Yolk is needed for embryonic development. However the fertilised egg has to undergo all stages of development and results in a suitable "young form" initiating next generation.
- Somehow with the influences of yolk, the developmental processes are so adapted and modified that a well-formed

Scanned by CamScanner

embryo will result.

v.i

Q. What is the difference between cleavage and mitosis?

Cleavage	Mitosis
	
2. Repeated cell division.	2. Cell division is followed by cell growth.
3. No cell growth	3. Cell Growth and size of daughter cell remain same.
4. Occurs during early embryonic development.	4. Occurs for growth and repair of body.
5. Nuclear cytoplasmic ratio increases until it will becomes equal to adult cell ratio.	5. Nuclear cytoplasmic ratio results constant.

Scanned by CamScanner

Oogenesis...

The origin and development of gametes is called gametogenesis.

It may be divided into Spermatogenesis and oogenesis.

Oogenesis → • It is the development of female sex cells called ova or eggs in the female gonad or Ovary.

• It is comparable to Spermatogenesis so far as nuclear changes are concerned but the cytoplasmic specialisation in oogenesis is different from Spermatogenesis.

It is divided into 3 phases:-

1. Multiplication phase
2. Growth Phase
3. Maturation Phase.

1. Multiplication Phase

The primary germinal cells of the ovary with the diploid no. of chromosomes (2n) divide & form a large no. of daughter cells known as Oogonia.

one large ovum

no. of polar body

1st polar body

may divide into 2 polar bodies or may not divide it all.

- Thus, only one functional gamete is form and the two or three polar bodies soon degenerate
- In vertebrates the 1st polar body is formed after the primary oocytes is released from the ovary and has entered into the oviduct.
- The 2nd polar body is formed only when the sperm has enter into ovum during fertilization.

Ripening of Eggs

- Oogenesis is followed by the formation of protective covering called Egg membrane.
- Primary membrane is formed surrounding the plasma membrane of ovum and is secreated by the ovum itself. It is called vitelline membrane in frog and zona pellucida in Rabbit.
- The secondary membrane is called chorion is formed from ovarian follicle cells.
- The tertiary membrane are secreated in oviduct when the ovum passes from

Scanned by CamScanner

ovary to guilde the egg white (albumen) calcareous shell (made up by calcium) etc. come under this catepory.

- The right ovum is spherical or ovum and non-motile.
- The top most point is animal pole and the bottom point is vegetal pole.
- The density of yolky cytoplasm increases from the animal pole towards the vegetal pole.

25/08/2019

Significance of Oogenesis

[In gametogenesis also nutrition is significance].

- The process lead to formation of germ cells or gametes
- The normal body cell is known as somatic cells are diploid (2n) where the germ cells are haploid (n).
- During fertilisation one haploid sperm unite one haploid ovum to form a normal diploid somatic cells. Thus keeping the chromosomes number constant generation after generation.
- During first maturation division the resulting of paternal and maternal genes takes place resulting in variations.

V.V.I.

Difference between Spermatogenesis & Oogenesis...

Spermatogenesis

* Growth phenomenon in nucleus and

cytoplasm are not produced in Sperm atocytes.

- Each Spermatocytes produces four functional Spermatid of equal size.
- During Maturation
  - Nucleus remain small which may contract during Spermiogenesis into a compact and elongated mass.
  - Nuclear fluid is small in amount.
  - Nuclear maturation takes place before cytoplasmic differentiation.
- Nucleus and cytoplasm becomes polarised along a long anterior posterior axis. Nucleus occupies almost the anterior end.
- Little amount/quantity of food substances is stored between cytoplasm.
- Considerable quantity of cytoplasm is discarded and some golgi material, centrioles, mitochondria are omitted.
- Specific membrane are not formed around the Sperm.
- Capable of producing androgametic cells helping in fertilization.
- Active metabolic stage is assume before fertilization event.

Oogenesis

- Growth phenomenon are much

pronounced in the oocytes. It involve both nucleus and cytoplasm.

- ★ Each oocytes produces 1 large functional ootids and 3 small aborting polocytes.
- ★ During Maturation
  - Nucleus is enlarged greatly
  - Nuclear fluid increases considerably.
  - Nuclear maturation takes place simultaneously with cytoplasmic differentiation.
- ★ Usually the nucleus is shifted towards the animal pole while the cytoplasmic material become polarised towards vegetal pole.
- ★ Considerable quantity of food substances is stored which is composed of carbohydrates and proteins.
- ★ Cytoplasm is increased with the formation of basic [illegible] stuff.
- ★ Specific membranes are formed around the egg.
- ★ Capable of producing enzymes which helps the fertilization process.
- ★ Metabolic process are slowed down before fertilization event.

Scanned by CamScanner

Sunday
Date 25/08/19
Page 54

FERTILIZATION

The union of cytoplasm and pronuclei of male and female gamete is known as fertilization.
The fertilization is the most commonly used method for reproduction of diploid zygote in the sexually reproducing organisms of metazoa and metaphyta.
In the process of fertilization the haploid male gamete (sperm, zoospore or pollen grains) which carries the paternal genetic information of the male parent, unites with the haploid female gamete (ovum or egg), which carries the genetic information of female parent to form a diploid zygote. (The zygote alternately produced a diploid multicellular organism by the several repeated and organised mitotic division and cellular differentiation).

V.V.I

Types of Fertilization

The fertilization always occur on the aquatic media such as sea water, fresh water or intracoelomic (body) fluid of maternal individual.

1) Internal fertilization :- If the fertil-

-lization occur inside the body of the organism is called the internal fertilization.
These animal possess specialized sex organs for receiving and transmitting the sperm perform internal fertilization
Ex- Reptiles, birds, mammals.

2.) External fertilization :- If the fertilization occurs in outside the body of the organisms is called External fertilization.
It is commonly found in various invertebrates and chordates.

Activities In fertilization

1. Contact and recognition between sperm and egg
- Freshly ejaculated sperm must be activated known as capacitation.
- The sperm after capacitation swims towards the ova.
- They are attracted to the ova by different mechanisms
- chemotactic attraction occure in many organisms.

2. Regulation of sperm entry into egg.
- when the sperm reaches the chorona radiata (in human) or the vetalline membrane (Sea urchin.)
- sperm undergoes acrosomal reaction, in which the contents of the acrosomes, the proteolytic enzymes are released.
to break

- The enzymes helps the sperm to make it way into and through zona pellucida or vitelline membrane, which have specific sperm receptors and act as barrier to interspecific fertilization.

3. The activation of egg and insemination.
- As soon as the acrosomal filament touches the egg surface, the ooplasm protrudes out at the point of contact into cone (उभार) like process known as fertilisation cone.
- The fertilisation cone may be cylindrical, conical, or irregular.
- When the fertilisation cone is irregular in shape it contain many pseudopodia like process of the ooplasm.
- The fertilisation is composed of plasma membrane and hyaline cytoplasm.
- The fertilisation cone engulf the sperm and the sperm which is surrounded by the hyaline cytoplasm moves inwards the penetration of the sperm in the egg is known as **Insemination**
- Immediately, after the insemination a thin membrane is formed around the plasma membrane of the egg.
- The fertilisation membrane prevents the intrance of future sperms in the eggs.

4. Amphimixes
(fusion of genetic material of both sperm & egg.)

- During the insemination the entire sperm may enter the egg as in the mammals or tail of the sperm remain outside the egg as in the echinoderm.
- In certain cases as in nereis the tail of sperm and the the middle piece of the sperm remain outside the egg and only the head of the centrosome enter in the egg.
The nucleus of the sperm is known as male pronucleus
- The male pronucleus swells up by absorbing the water from the surrounding of egg and it becomes vesicular. The compactly arrange chromatin material of the male pronucleus becomes finally granular.
- The centrioles of the sperm is surrounded by the centrosomes and microtubules which forms astral rays.
- The male pronucleus and the centrioles moves towards the egg pronucleus.
- The path is prepared by enzymatic action of the sperm acrosome is for a penetration path.
- In the case of sea urchin and vertebrates, the two pronuclei (male & female) close to each other and the close contact takes place between the two. The nuclear envelop is broken at the point of contact and the nuclear content of both pronuclei are intermingled. The endoplasmic reticulum forms a

Scanned by CamScanner

new solumen nuclear envelop around a both pronuclei and form a zygote nucle
- Incase of Ascaris, Annelids, Mollusca this type of fusion of two pronuclei does not occur. In the sea animals the centrioles form the achromatic spindle form the microtubules of the cytoplasm and both male and female nuclei come close to each other, their nuclear envelop are dissolved.
- The paternal and maternal homologous chromosome get arranged on the equator of the acromatic figure and the first cleavage division of eggs occurs After this division the nuclear envelop is formed around the chromosome of the daughter nuclei.

5. Post Fertilisation change in the Egg.
- The zygote becomes ready for the cleavage and formation of the embryo.
- The Oxygen consumption of the zygote increases enormously.
- The produce synthesis started.

KINDS OF FERTILISATION

(1.) MONOSPERMIC FERTILISATION
In most animals usually only one

Sperm enters in the eggs. This types of fertilisation is known as monospermic fertilisation.

It is found in cyclostrate, annelids, echinoderms, bony fishes, frog and mammals.

(2.) POLYSPERMIC FERTILISATION → when many sperms enters in the egg

It may be of 2 types ↓

a) Pathological poly Spermic fertilisation

At the certain abnormal condition when in a monospermic type of egg many sperms enter into the egg. This condition is k/a Pathological polyspermic fertilisation.

- These types of eggs does not develop further and die soon.

b) Physiology poly Spermic fertilisation.

In animals with large yolky eggs such as mollusca, chordates reptiles and birds the polyspermic fertilisation usually occurs. Such polyspermic fertilisation is k/a physiology polyspermic fertilisation.

- In these cases many sperms enters in the eggs but only one units with the egg pronucleus and rest are degenerated soon.

(3.) Poly Andri

When two male pronuclei unite with a female pronucleus the union is known as Poly-andri. For Ex - Man & Rat.

Scanned by CamScanner

(4.) Polygamy

When two eggs pronuclei unite with single male pronucleus the phenomenon is k/a polygamy. For Ex- Seaurchin, Polychaete worms and Rabbits → (animals)

Y.N.U.

* Gynogenesis

When only sperm activates the eggs but it pronucleus does not unite with the egg. This phenomenon is known as Gynogenesis. For Ex - Planarians and Nematodes

Significance of fertilisation

- The fertilisation ensures the usual specific diploidy of the organism by the fusion of the male and female pronuclei
- The fertilisation establishes definite polarity in the eggs.
- The fertilisation provides new genetic constitution to the zygote.
- The fertilisation activates the egg for the cleavage.
- The fertilisation increases the metabolic activities and rate of the protein synthesis of the cell.
- The fertilisation initiates the eggs to start cleavage and embryogenesis.

Scanned by CamScanner

- Fertilisation combines characters of two parents, thus, introducing variations and making the resulting individuals better equipped for the struggle for existence. This happens only in cross fertilisation.

Fertilising And Anti Fertilising

- The cause of agglutination of sperm and zoa reas study by Lilly
- → He observed that fertilising and anti fertilising occurs in the eggs and sperms respectively.
- → They are directly involving reaction between egg and Spermatozoa.

Fertilising

- Egg releasing a substance called fertilisi-ng. It is located in the plasma membrane.
- Fertilising is a gel form of lycoprote-in.
- It's function is following

→ It causes clumping of sperm
→ It triggers acrosomal react in the sperm
→ It prevents poly spermy
→ Fertilising release from matured egg.

Anti fertilising

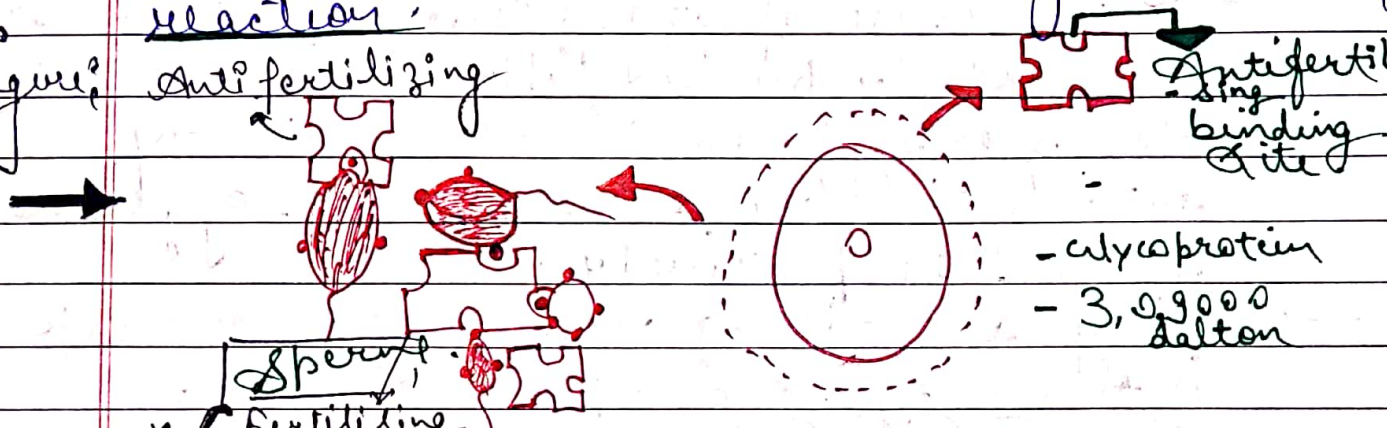
- It is a protein form on the surface of sper-ms
- The reaction between fertilising and anti-

Scanned by CamScanner

fertilising many sperm bind to a single molecule of fertilising.

- Reaction b/w fertilising & antifertilising is species to specific same
- As a result only the sperm of species is able to fertilise the egg.
- This reaction called like antigen antibody reaction.

Figure: Antifertilizing



* Fertilising and Antifertilising reactions: *
Species Specific like antigen antibody reaction

Friday
6/09/2019.

Date
Page 65

Development of Amphioxus (upto formation of coelom)...

- Amphioxus is a cephalochordate animal. It's life history in the early stage shows resemblance with ascidian.

Amphioxus is unisexual animal but sexual dimorphism. Amphioxus shows 26 pairs of gonads (ovary).

- They are present from 15th myotomal segment to 51.
- These gonads have no guts. When mature the overlapping tissue of the gonad will rupture and gametes are liberated into atrium of amphioxus. They will come out into the water through the axtripore.

Gametes of Amphioxus

1. Spermatozoon in Amphioxus

→ The mature male sex cell called spermatozoa.
→ It has a typical structure
→ It contains a spherical head very short middle piece and a long tail.
→ on the head acrosome is present. Head shows a big nucleus. Around the nucleus thin sheet of cytoplasm is present it is called Manchette
→ The middle piece is small with mitochondrial matrix called Nebenkern

→ The tail is long and shows movement.

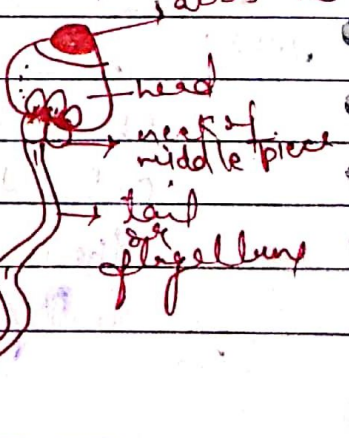
Q. Ovum / egg / ovum in Amphioxus

→ The mature female sex cell called ovum.
→ It is small and 0.12mm in diameter.
→ It is a microlecithal egg.
→ The cytoplasm around the nucleus with few yolk.
→ It's nucleus is eccentric lying at the animal pole.
→ In the peripheral cytoplasm yolk is absent it is granular or is called cortical plasm.
→ The plasma membrane surrounds the cytoplasm around this, there is a neutral polysaccharide membrane is present called vitelline membrane. In between these two layers perivitelline space is present.
→ The vegetal pole becomes posterio dorsal side of the embryo
→ The animal pole becomes antero-ventral side of embryo. Hence a gradient polarity is establish in the egg.
→ The egg undergoes its first maturation division before it leaves the ovary.

fig a.



fig b.



Scanned by CamScanner

Fertilization In Amphioxus

- It is external
- As soon as the egg comes in contact with water the vitelline membrane will separate from plasma membrane.
- The egg is surrounded by a number of sperms one sperm will make its entry through the content of the egg vegetal pole. At this time the no. of changes takes place in the cortico plasm. Now membranes are formed with unite with vitelline membrane
- So that no other sperm can enter into the egg.
- The head and middle piece of the sperm will enter into ooplasm of the egg
- The egg nucleus undergoes second maturation division.
- Second polar body is pushed into previtelline membrane space.
- The sperm nucleus and middle piece will show 180°C twist and moves towards the egg nucleus. Both the nuclei will unite thus a zygote nucleus is formed.

Fate Map of fertilized egg of Amphioxus

- CONKLIN In 1939 studied the fate map of Amphioxus.
- In 1962 "TUNGUNTUNG" described the egg of Amphioxus, 4 regions are clearly seen

Scanned by CamScanner

1.) Clear cytoplasm occupying the animal pole will mainly become epiderm or ectoderm
2.) The granular yolky cytoplasm near vegetal pole will become endoderm.
3.) The crescent shaped cytoplasm of the posterior side will become mesoderm.
4.) Opposite to the mesodermal crescent another crescent is present which becomes presumptive nervous system. The lower part will develop into notochord.

Post fertilization event

First cleavage → After one and half hours of fertilisation meridonial cleavage takes places. It is from anterior to posterior end. The result of this cleavage is two equal blastomeres are formed.

Second cleavage → ~~The result of this cleavage is~~ It is also a meridonial but it is at right angle to the first one, because of this cleavage four equal blastomeres are formed.

Third & fourth cleavage → It is in double plane Both are in meridonial way extending from animal pole to vegetal pole. Eight macromeres and eight micromeres are resulted.

Fifth cleavage → It is latitudinal. It is in double plane ~~is~~ stage is called is reached.

Scanned by CamScanner

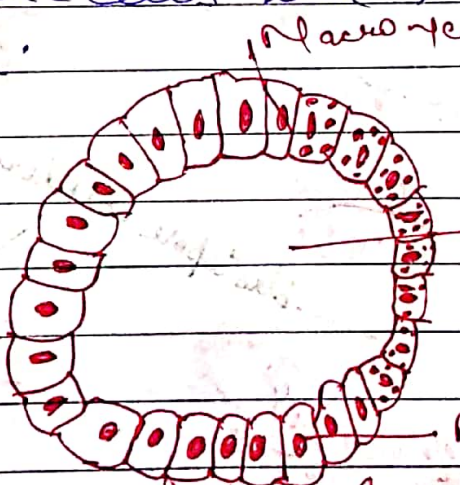
6th cleavage → These division are approximately meridional. 64 blastomeres are formed.

After this cleavage it is difficult to follow the pattern.

V.V.I

Blastulation In Amphioxus

- From the 7th cleavage onward irregular cleavage will occur
- The cell of the vegetal pole will be right slowly where as the cells of the animal pole will divide in quick way.
- Bcoz of this blastomere of the animal pole will be small and blastomere towards vegetal pole will be bigger.
- The cells are usually loosely packed it is called morula Stage.
- In the centre of the cell mass, a jelly substance appears. It will push the blastomere outside hence, a single layered blastula is formed. It includes a fluid filled cavity called blastocoel. this is called blastula stage.
- The blastocoel appears at the 4 celled stage as the cells are round and they don't unite.



Cross Section of blastula stage of Amphioxus

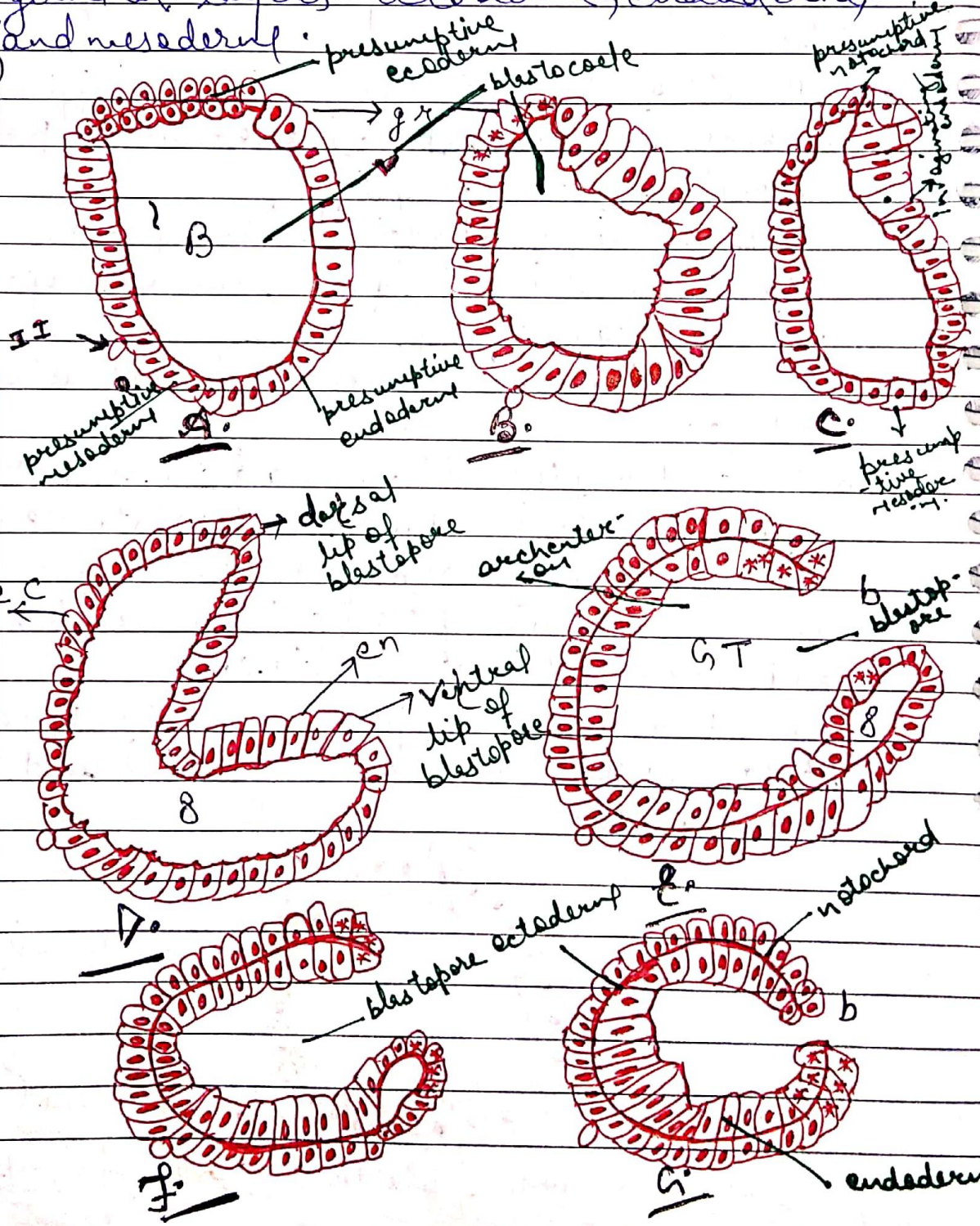
1st Date

Lucky Date / / Page 70

Gastrulation in Amphioxus

In Amphioxus blastula is converted into gastrula and involves cell movement called morphogenic movement. This movement may include invagination, involution, epiboly, emboly, etc. form 3 primary germinal layers. ectoderm, endoderm, and mesoderm.

Figure: Gastrulation of Amphioxus



* Gastrulation in Amphioxus
* Gastrulation in Frog

Scanned by CamScanner

Saturday
Date 07/09/2019
Page 71

- The blastula of amphioxus contain the potential endodermal cells at the vegetal pole called Hypoblast which forms the floor of the blastula. The presumptive organ forming cell (notochord, mesoderm, epidermal)
- The epiblast constituent the roof of a blastula. The blastocoel is large. The dorsal crescent (prisumptive neural and notochordal cells) lies in the future dorsal lip region of the blastopore while the ventral crescent occupy the ventral lip.
- With the onset of gastrulation, and increase of mitotic activity is absorb in the dorsal and ventral crescent region. With the activity of the different cells the endodermal plate invaginate into the blastocoel. During this process of invagination, the dorsal portion moves at a faster rate to touch a point which marks the anterior end of the developing embryo.
- The notochordal cells occupying the mid dorsal region of the blastopore, involute and occupy a mid dorsal position in the developing archenteron.
- Then the ventral crescent gradually converge on either side of the notochordal cells. Thus the roof of the archenteron is composed of mesodermal and notochordal cells.
- This process of erabolly is accompanied by epiboly, where the ectodermal and neural cells extend along the anterior-posterior dir. The extention of ectodermal cells and the

Scanned by CamScanner

proliferation, involution and infolding of presumptive endodermal, notochordal and mesodermal cells results in the formation of double layered embryo. External layer forms the ectoderm

- The internal layer has a dorsomedian area of notochordal cells with 2 bands of meso-dermal cells. The rest of the inner layer is formed of endodermal cells. Rapid cells proliferation, accompanied by emboly and epiboly (ingression) causes an antero-posterior elongation of gastrula.
- As the developing gastrula elongates in the antero-posterior direction, the ventral crescent is gradually shifted dorsalward along the inner lateral side of the blastoporal lip. As a result of conversions, the mesoderm comes to lie on the two sides of the notochordal material at the dorsal blastoporal lip.
- At the end of gastrulation the blastopore becomes smaller and is closed by ecto-dermal overgrowth.
- A neuro-enteric canal is formed between the archenteron and developing neural tube.

Scanned by CamScanner

V.V.I.

Meaning of Gastrulation / Basic Mechanism in Gastrulation / Method used to Study Gastrulation / Morphogenic Movement of cells in Gastrulation.

Gastrulation :- The blastula passes in to the stage called Gastrula by the process of gastrulation. This process is extremely important in the ontogenetic (future) part process of animals because the blue print of the future organisation is set down during this phase.

18/09/19

Q. What is Gastrulation? Show the major event of gastrulation also explain gastrular morphogenic movement.

- Gastrulation is a embryonic process that brings about the reorganization (VENTIN) and displacement of organ forming areas of a blastula
- It converts a simple-layered one-layered (monodermic) blastula into two-layered (didermic). Eg:- Amphioxus or often a 3 layered (tridermic) eg: all vertebrates embryonic stage.

Blastula → Gastrula

- The single layered of blastula is K/a blastoderm, ectoblast and protoderm. The result ant three-layers of gastrula -

a) the outer ectoderm,
b) the middle mesoderm, and

Scanned by CamScanner

c). the inner endoderm.
Also commonly known as germ layer.

- During gastrulation, the cavity of the blastula (blastocoele) is obliterated and a new cavity called Archenteron or gastrocoel (cavity of gastrula) enclosed by endoderm is formed.

- During gastrulation embryo acquires a clear-cut antero-posterior polarity and bilateral symmetry.

Major Events of Gastrulation

1.) Morphogenetic movements occurs.
2.) The rhythm of cellular division (cleavage) is slowdown or almost inhibited.
3.) Growth, if any, is insignificant.
4.) The type of metabolism changes and the rate of oxidation is intensified.
5.) The nucleus become more active in controlling the activities of the embryonic cells. The influence of the paternal chromosomes becomes evident during gastrulations.
6.) During gastrulation Chemodifferentiation is stated by synthesis of new & different kinds of protein molecule.

Gastrular Morphogenic Movement

The movement of the blastomeres from one place of the embryo to

another to establish a particular form or structure is a common embryological procedure. This type of cell movement is called formative or morphogenetic movement. Because it results in the generation of a particular structure arrangement.

V.V.I. Such the morphogenetic movement occur in the embryo during blastulation, gastrulation, tubulation and organogenesis.

The following 2 basic types of morphogenetic movements/patterns are involved in gastrulation :-

1. Epiboly & Emboly

1. Epiboly - Means "growing on" or "extending upon."
   - It represents the natural tendency of epithelial sheet to expand into free area over a substratum. Epibolic sheets are usually outside, or ectodermal and tend to envelop and surround inner sheath.
   - Sometimes sheath expand towards a single point on a surface. This type of epibolic movement is called Convergences.

Note The morphogenetic movement of an adult animal are of a reversible nature while, the morphogenetic movements of gastrula are irreversible nature.

Scanned by CamScanner

d. Embaly

- This is just opposite to epibaly.
- In Embaly sheath fold in or invaginating, a sheet migrates inside a cell aggregate or beneath another layer because of local changes in cell shape or motility.
- Embolic movements includes invagination, involution and ingression, movement displacing future ectoderm and mesoderm into the interior of the embryo.

21/09/19

e. Invagination

- It is the sinking (in pocketing) of a layer of cells and is similar to punching in of an expanding layer at a specific point. The reverse of invagination is ivagination

f. Involution

- It is turning in of an expanding layer of a specific point. In involution, a surface layer of cells turns inside itself and continues to expand along the inner surface of the superficial layer.
- Thus in involution, cells which are at same distance, from the point of invagination, move to the margin of the site of the invagination flow over it and move inside.

c. Ingression or Polyinvagination

Scanned by CamScanner

Amniote → An animal whose embryo develops in an amnion and chorion and has an allantois, a mammal, bird or reptiles.

In this of embolty, small groups of independent cells separate from a primary epithelial layer and migrate into the blastocoele cavity or other embryonic spaces as a new layer.

For ex: In primitive streak of Amniote embryos, cells may sink inside as individuals, changing their relations to each other in the process.

Delamination

It is a type of ingression that forms an inside sheet by mass separation of layers from an epithelium.

Concrescence

The movement of masses of cells towards each other and their fusion one cell mass is called concrescence. It occurs during the development of the feathers of birds.

Cell Proliferation

In the gastrulation of amphioxus and frog the number of cell increases by the process of mitosis is called cell proliferation.

Divergence

It is opposite of convergence.

Found in → Reptiles, birds and mammals.

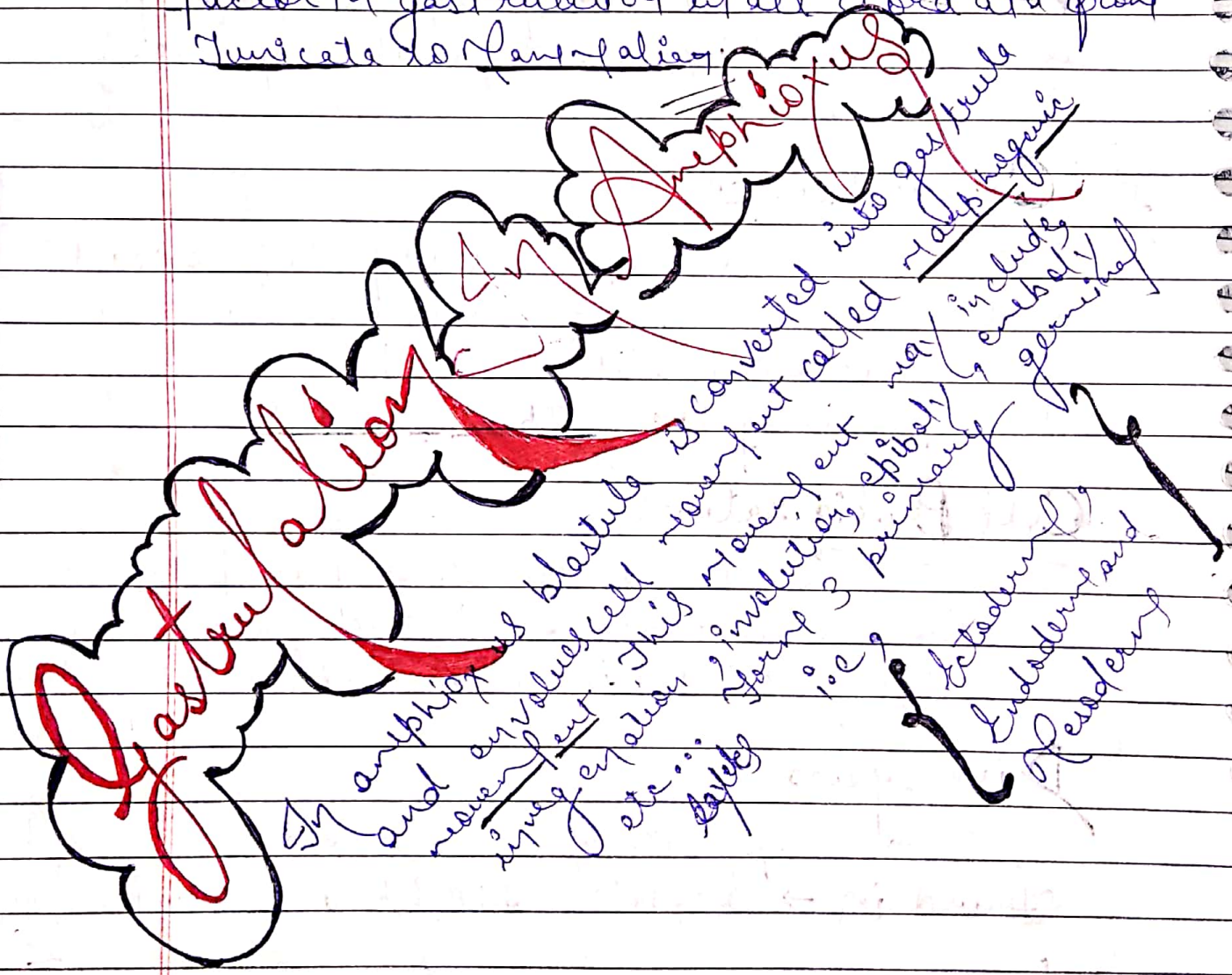
Extension

During extension entire gastrula

Scanned by CamScanner

begins to elongate in the antero-posterior axis.

The elongation of the presumptive neural and epidermal areas externally and of the notochordal, mesodermal and endodermal materials. After they have move inwards beneath the neural plate and epidermal material are the example of extension. The extension of cellular masses is a prominent factor in gastrulation in all chordata from Tunicata to Mammalian.



Scanned by CamScanner

2nd Note

- The process of gastrulation in amphioxus started which there are about 500 cells in the embryo (9th & 10th cleavage).
- It involves three basic types of morphogenetic of the embryonic cells.

1. Epiboly - Expansion of the ectodermal cells.
2. Invagination - It is type of emboly.
3. Involution - Emboly of notochordal and mesodermal cells.

- Gastrulation also involves the obliteration of blastocoel and formation of a new cavity called Gastrocoel or Archenteron which remains communicated to the exterior by the blastopore.
- In Amphioxus, the process of gastrulation is initiated when the blastoderm at the vegetal pole becomes flat and subsequently bends inwards, so that whole embryo, instead of being spherical becomes converted into a cup-shaped structure, having a large cavity called Archenteron, in open communication with the exterior by the blastore.
- On the other side that was originally the vegetal pole of the embryo.
- The cup has double walls, an external and internal epithelial layers, both of which remains continues with each other over the rim of the cup shaped embryo called "Gastrula".
- The circular rim of the blastopore is termed the "lip".

Scanned by CamScanner

Friday
Date 04/10/19
Page 80

Development of extra embryonic in chick

- In the development of every vertebrate certain tissue do not directly enter into the formation of embryo proper.
- These tissue rather help in the care and maintainance of the embryo.
- Collectively these parts are referred to as extra embryonic membrane.

In a chick well developed system of extra embryonic membrane are found which is following :—

i) Yolk sacs
ii) Amnion
iii) Chorion
iv) Allantois

i) Yolk Sacs

- It is the first extra embryonic membrane
- It appears after 16 hours of incubation.
- It develops from splanchnopleure which contain endoderm and mesoderm layer.

On the Basis of Nature of contact It is of 3 types —

a) Non-deciduate type Placenta
b) Deciduate Type
c) Contra Deciduate type Placenta

- The splanchnopleure forming a close gut, it

will grow over yolk and become yolk sac.
- The primitive gut is present about the yolk sac. This yolk region is in contact with mid gut.
- Finally, the yolk sac is communicated with mid gut through an opening by narrow stalk called yolk stalk or umbilical stalk.

The narrow canal within the yolk stalk is termed as yolk duct.

FUNCTION

- It surrounded protected, digest the yolk and supply it to embryo.
- It also perform respiration, during the early stage of development.

ii) **Amnion**

- In the development of embryo, Amnion and chorion are closely associated
- Amnion is bag like covering over the embryo; it separates the embryo from internal environment.
- Amnion is developed from somatopleuric amniotic folds. These folds are head fold, lateral fold and tail fold.
- At about, 30 hours of incubation, in front of the head of the embryo a head fold is developed, and it is called amniotic head fold.
- At about 3rd day of incubation amniotic tail fold is developed. It grows opposite to amniotic head fold.
- As the amniotic fold grow centripetaly, they

Scanned by CamScanner

fuse to form continuous membrane which constitute two sac around the embryo. At the end of 4th day the embryo is completely enclose in a cavity called amniotic cavity bounded by amnion.

- The space between amnion and chorion is called sero-amniotic cavity or exocoel.
- Amnion is formed from ectoderm and mesoderm.

FUNCTION OF AMNION & AMNIOTIC FLUID

- Protect the embryo from sock.
- Protect the embryo from sudden change of temperature.
- Protect the embryo from desiccation/drying. (desiccation → The process of becoming completely dry.)
- Provide buoyancy to embryo.

iii) Chorion

- It is made up of ectoderm and mesoderm.
- It is outside layer of extra embryonic somatic mesoderm.
- It is closely associated with amnion.

FUNCTION

- The extra embryonic coelom is filled with a fluid. It gives protection to the developing embryo.
- The coelom give space for developing allanto-is
- Chorion combined with allantois and act as a respiratory organ.

Scanned by CamScanner

Splanchnic → relating to the viscera or internal organs, especially those of the abdomen.

iv) Allantois

- In chick, it develops from the ventral part of chordal end of the hind gut
- It develops at third day of incubation.
- About the 3rd day of incubation, a region of the floor of the hind gut begins to bulge out a diverticulum which gives rise to allantois.
- It consist of an inner endoderm and outer splanchnic layer of mesoderm.
- Allantois remains posterior to yolk sac and expand very rapidly penetrating into the extra embryonic coelom.
- The distal end of allantois enlarges into an allantoic vesicle and the proximate part becomes, the allantoic stalk.
- The allantois arises within the body of the embryo.
- The mesoderm of the chorion and mesoderm of the allantois will unit to form chorio-allantoic membrane.
- As the embryo is growing the allantoic and yolk stalk are brought together.

Note Anamniotes :- Animal which has no extra embryonic membrane. Eg:- Fish, Amphibians.
Amniotes :- Animal which has extra embryonic membrane. Eg:- birds, reptiles and mammals.

- The mesodermal layers will unit, it is called umbilical stalk. It is covered by somatic umbilicus.

Scanned by CamScanner

FUNCTION

- It digest the albumin
- It stores excretory product.
- Allantois is richly vascularised hence, it work as respiratory organ.
- In later development, the allantoic circulation will absorb calcium from the shell.
- This calcium is used in construction of bones in young ones.

Fig and Chart → Page No - 87 and 88

Placenta In Mammals Development

→ The placenta is an embryonic structure which originates from the foetal and maternal tissue for the transport of the nutrients and O2 from the mother to the foetus.

→ Placenta is not common to all mammals. It is develop well in uteria.

→ Based upon the point of origin of placenta, there are 2 parts:

i) Foetal Placenta - Furnished by the extra embryonic membrane.

ii) Maternal Placenta - Develop from the endometrium.

Classification of Placenta

A) On the basis of type of a foetal membrane involve

B) Distribution and type of villi

C) Barrier between maternal and foetal blood.

d) On the basis of Nature of Contact.

(A) On the basis of foetal membrane involve.

a) Chorionvitelline placenta / yolk sac placenta.

* In some marsupials, the allantois remain relatively small, and never makes contact with the chorionic sac whereas the yolk sac becomes very large and get fused with chorion.

* The chorionic blood vessels are connected with the vitelline blood vessels of the yolk sac.

Scanned by CamScanner

* The yolk sac contains major share in the formation of placenta.
  Ex- Marsupials, Didelphys.

b) Chorio allantoic placenta.
* In some marsupials and all ungulate mammals, the yolk sac remain rudimentary and the allantois become well-developed and vascularised to fuse with chorion. The chorion allantoic villi constitute the placenta.
* In these animal yolk sac placenta is not seen. This type of placenta is called chorio allantoic placenta.

* The chorio allantoic villi grow out and get attached with uterine wall.
  Eg:- Perissodactyls and uterine mammals.

Extra
◎. On the Basis of Nature of Contact
It is of 3 types.
a.) Non-Deciduate type Placenta
b.) Deciduate type Placenta
c.) Contra Deciduate type Placenta

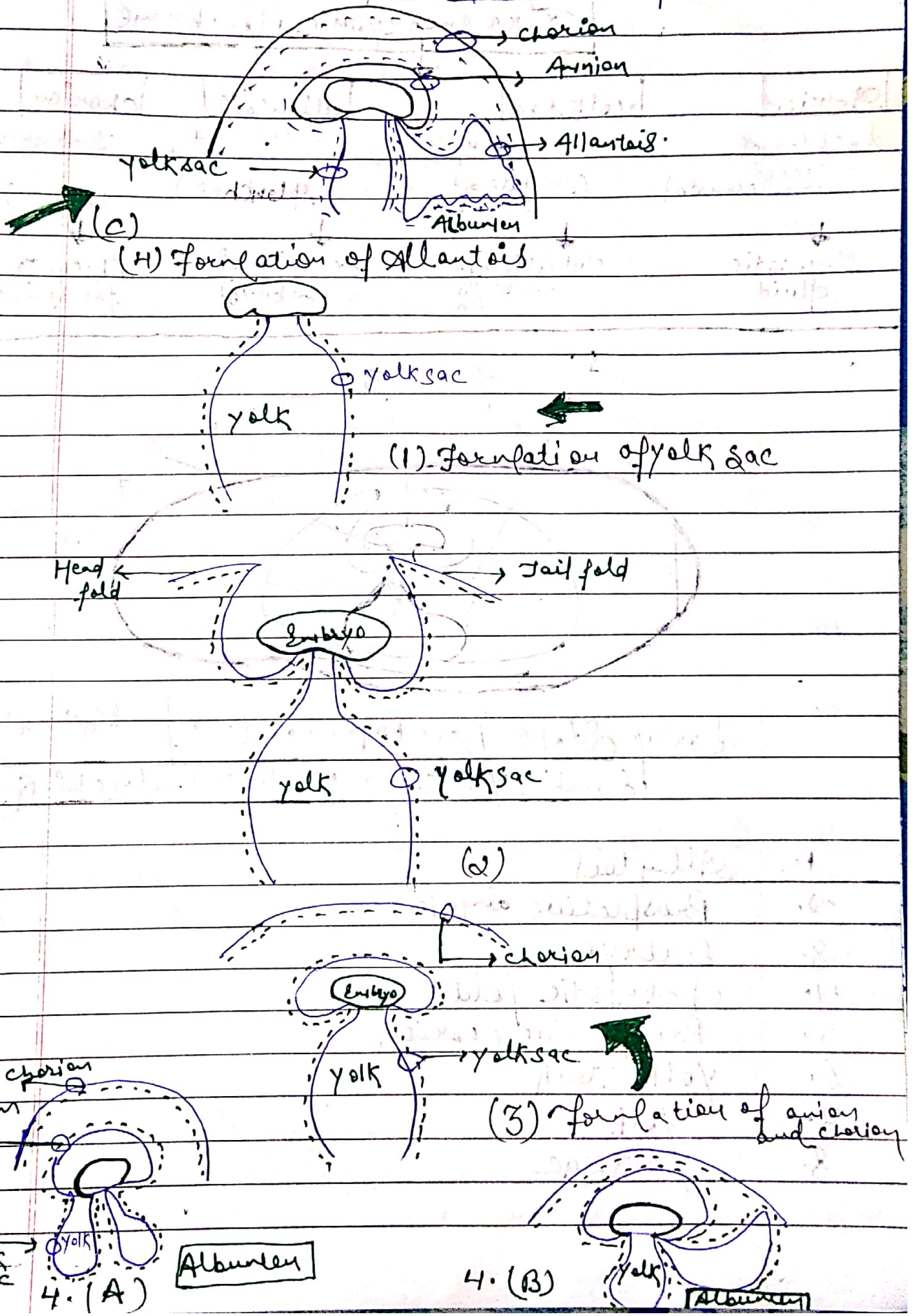
a.) Non-Deciduate Type Placenta
- Here the implantation is superficial.
- The chorionic villi are simple projections they lie in contact with uterus.
- The villi are initially form by the trophoblast but later on the blood vessels and connective

Pg-89

Scanned by CamScanner

Figure...

Extra embryonic membrane of chick.

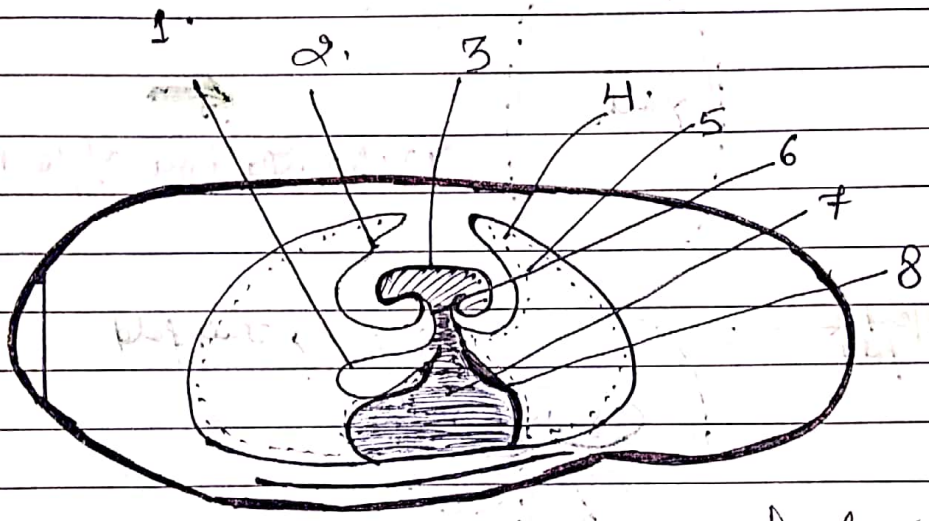


Scanned by CamScanner

Saturday
Date 05 10 19
Page 88

Extra embryonic Membrane

Amnion	yolksac	Allantois	chorion
Ectoderm + Mesoderm (somato)	Endoderm + fused mesoderm (somato and splanch)	Endoderm + mesoderm (splanchno)	Trophoblast + Mesoderm (somato)
↓	↓	↓	↓
Amniotic fluid	Nutrition for embryo	Excretion of embryo	Placenta formation



Early Stage Development of Extra-Embryonic Membrane In chick.

1. Allantois
2. Prospective amnion
3. Embryo
4. Amniotic folds
5. Prospective chorion
6. Yolk stalk
7. Yolk
8. Yolk sac

Scanned by CamScanner

tissue are extended to them.
- They have a loose contact.
- There is no fusion
- At the time of birth of embryo uterus is not damaged. No bleeding occurs at the time of parturication.

Ex:- ungulate, cetaceans, sirenins, lemurs. cow, giraffe, bear, buffalo etc.

b.) Deciduate Type Placenta.
- Here the degree of intimacy between maternal and foetal tissue is great.
- The allanto chorodic villi penetrates into utelline villi. They are intimately fuse.
- At the time of birth uterus is damaged. Bleeding occurs, the uterine wall enters into formation of placenta is called deciduous.

Ex:- Primates, rodintia, insectivora, chiropetra Human etc.

c.) Contra Deciduate Type Placenta.
- It is a modified type of Deciduate Placenta.
- In this placenta there is a loss of maternal tissues and foetal portion of placenta both of them are absorbed in C Situ. by maternal leucocytes.
- Here villi are branched.
- At the time of child birth villi doesnot come out from the crypt easily.

Ex:- Rat

V.V.I.

Classification of the placenta According to the Mode of Implantation :-

Implantations is the first step in developme-

Scanned by CamScanner

-nt of placenta. In most cases implantation is preceded by a closed interaction of embryonic trophoblast and endometrial epithelial cell that is known as addition or attachment.

There are 3 types —

1.) Superficial or Central Implantation
→ The embryo is implanted in the centre of the lumen of the uterus.
→ The embryo is attached to the surface of uterine endometrium
For Ex:- Ruminants, Pigs, Horse, Carnivours. (rabbit, dog)

2.) Eccentric Implantation
→ The embryo implants towards one side of the uterine lumen.
→ Endometrial folds surrounds the embryo.
For Ex:- Rat, Mice, Squirrel.

3.) Interstitial Implantation
→ The embryo chorionic sac penetrates dip into the substances of the uterine wall and develop imbedded in it.
For Ex:- Human beings, Apes, Guinea Pigs (गिनी पिग)

Scanned by CamScanner

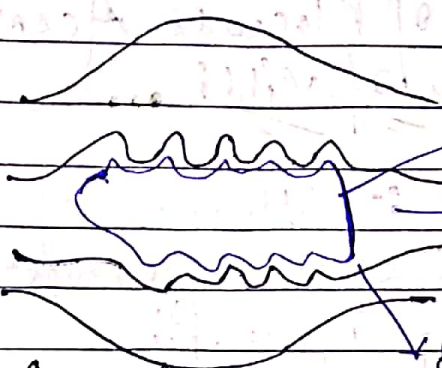


Fig 1). Central or Superficial implantation.

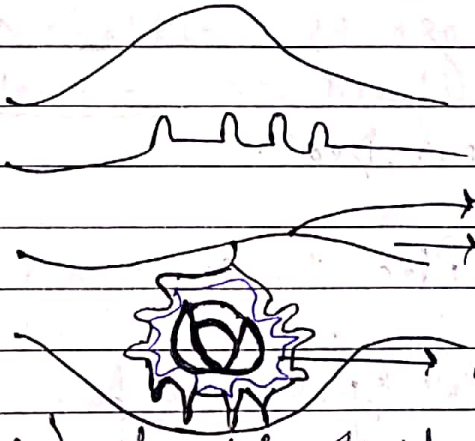


Fig 2). Eccentric Implantation

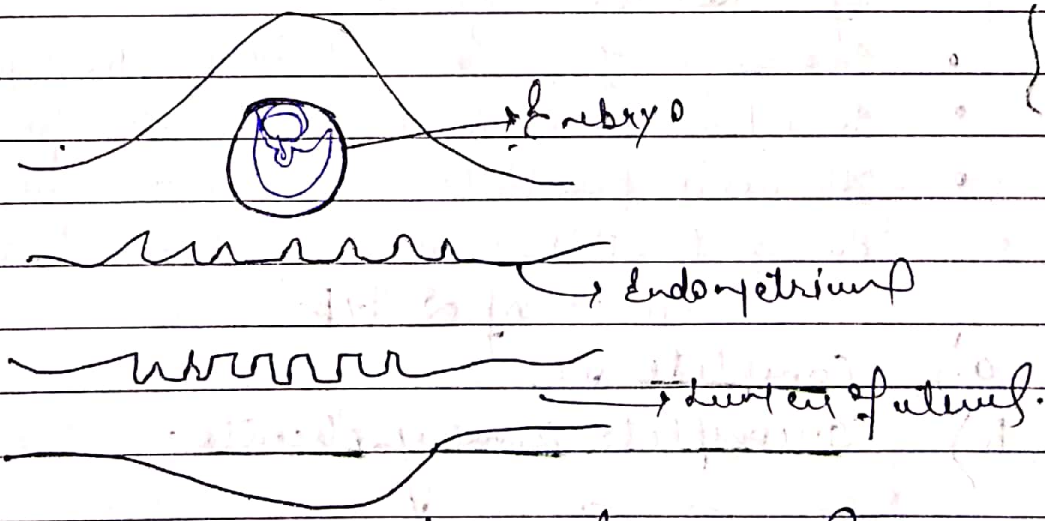


Fig 3). Interstitial implantation.

Scanned by CamScanner

4th Classification of Placenta According to the Distribution of Villi ...

1. Diffuse Placenta :- Villi are uniformly distributed on the surface of the blastocyst except at the extreme. For Eg: Horse, Pig.

2. Cotyledonary Placenta :- The villi are arranged in groups. Each groups is called cotyledons.
   - Each cotyledons fixed into carunclas of uterus.
   For Eg: Ship, Cow, Deer.

3. Intermediate Placenta :- It is a rare type.
   It shows free villi on cotyledons.
   In these ✗ For Eg :- Giraffe.

(1, 2, 3 — Not damaged during parturition)

4. Zonary Placenta :- The villi are in the form of transverse zones.
   - In a dog a single gardel type present.
   - In a fox two gardel villi are present.
   - The villi penetrates into uterine walls. Hence during parturation uterine wall are damaged.

   (NOTE)

   It is of 2 types
   a.) Complete or
   b.) Incomplete Zonary Placenta.

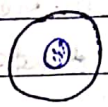
5. Discoidal Placenta :- On the entire surface of blastocyst the villi are in the form of disc. When the embryo is growing it moves away from the uterus. Hence it look like a disc.

Scanned by CamScanner

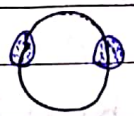
These villi are intemately connect with uterus. Hence during parturation such uterine tissue is damaged.

It is of 3 types—

a.) Cotyledonary Placenta.
Villi are limited to a single disc.
Ex:- Insectivores



b.) Bidiscoidal Placenta
Villi are limited in two disc.
Ex:- Bear



c.) Metadiscoidal Placenta
In later the beginning villi are uniformely present on the entire embryo but later they are limited to one disc.
Ex:- Human Being.

8/10/19 Tuesday

9th Classification of Placenta According to histological Intimacy of foetal & maternal tissue...

- There are total a 86 layers of tissue separating maternal and foetal blood. There are 3 layers of foetal extra embryonic membranes in the chorio-allantoic placenta of mammals, all of which are components of the mature placenta
1. Endothelium lining allantoic capillaries
2. Connective tissue in the form of chorioallantoic mesoderm.
3. Chorionic epithelium, the outermost layer of foetal membrane derived from trophoblast.

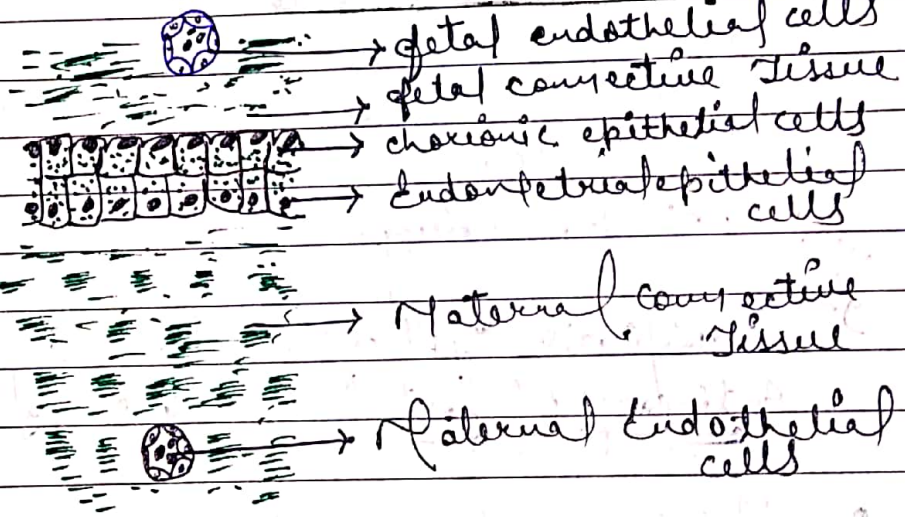
Scanned by CamScanner

There are also 3 layers on the maternal side but the tenth number of these layers which are retained - that is, not destroyed in the process of placentation - varies greatly among species.

(1) Endothelium lining endometerial blood vessels.
(2) Connective tissue of the endometrium.
(3) Endometrial epithelial cells.

According to number of layers of cells present between foetus and uterus blood supply the placenta is classified into five types —

Figure :



a) Epithelio chorial Placenta :→ The foetal chorion is in contact with epithelium of the uterus hence it is called Epithelio-chorial Placenta. In between foetal, membrane parts 6 layers are present. If all the six layers are present the placenta is called Epithelio-chorial Placenta. For Ex:- Pig, Horse (ungulates mmares)

b) Syndesmose chorial Placenta:→ The allanto-chorionic villi with pierce into the

uterus of the mother, the chorion will come in contact with syndesmose of mother's uterus. Hence, it is called Syndesmose chorial.

For Ex:- Sheep, Cow.

c.) Endothelio chorial Placenta:→ The chorion of the foetus will come in contact with the endothelium of mother's uterus. Hence, it is called Endothelio-chorial Placenta.

For Ex:- Dog, Carnivores.

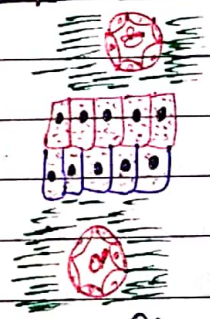
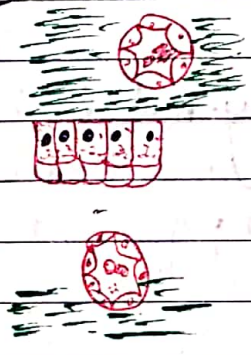
d.) Hemochorial Placenta:→ The Placental connections are more intimate. The chorion of foetus will float in the blood pools of mother's uterus. Hence it is called hemochorial placenta.

For Ex:- Bat, Man, Primates, Insectivores.

e.) Hemoendothelial Placenta → Hence, guinea-pig will float in mother's blood. Hence it is called Hemoendothelial Placenta.

For Ex:- Rat, Rabbit.

Figure

Epithelio chorial	Endothelio chorial	Hemochorial
		
For Ex:- Cow, Pig, Horse	Ex- Dog, Cat	Ex- Human, Rodents

Scanned by CamScanner

FUNCTIONS OF PLACENTA

There are 8 types of functions of placenta:

a.) **Anchorage**:- Placenta serves as adhesion or anchorage of the developing embryo with the uterine wall.

b.) **Nutritional Role**:- The foetus gets its nutrition from the maternal blood.

- Monosaccharide's, lipids, amino acids, vitamins and hormones pass by diffusion or active transport. Macromolecules of polysaccharides, lipids and proteins are absorbed by the trophoblast cells by pinocytosis. Water and electrolytes such as chlorides and phosphates of sodium, potassium and magnesium pass by diffusion from mother of foetus.

c.) **Respiratory Role**:- Gaseous exchange takes place by diffusion across the foetal membrane. O_2 diffuses from maternal blood into the foetal blood, while reverse diffusion takes place in case of CO_2.

d.) **Excretory Role**:- Waste Products like urea, uric acid and creatinine are eliminated via placenta, from the embryonic blood to the maternal blood stream by diffusion. The kidneys of mother removes these wastes of foetal metabolism along with her own waste products.

e.) **Storage Function**:- Glycogen, fats and some inorganic salts are stored in the pla-

Scanned by CamScanner

reserve to be utilized when diet of the foetus is inadequate.

f.) Enzymatic Function:- Placenta produces various enzymes such as diamine oxidase, oxytocinase and phospholipase-A2, which protects the foetus.

g.) Endocrine Functions:- Placenta acts temporarily as an endocrine organ. It secretes many hormones such as estradiol, progesterone, chorionic gonadotropin in most mammals and also placental lactogen in human female. In some animals, such as rabbit, human females etc, the placenta is a significant source of relaxin, that relaxes the pelvic ligaments to facilitate child birth.

h.) Immunological Role:- Placenta acts as a barrier against transportation of microbes into the embryo. However, antibodies which have developed in the blood of a mother who has acquired immunity against certain diseases like diphtheria, scarlet fever, small pox and measles are passed on to the foetus who become passively immunized to these illness in the first period after birth.

Scanned by CamScanner

Tuesday
Date 8.10.19
Page 98

V.V.I

Development of Heart in Chick Embryo

- The formation of heart (Cardiogenesis) in vertebrates is one of the most significant event in embryonic development.
- The heart is a mesodermal organ, which differentiate initially from the ventral edges of lateral plate mesoderm.
- Primarily, the cardiac primordia are paired which however becomes fused to form a single organ. The process of cardiogenesis in different vertebrates forms a essentially singular.

The Event of Development of Hearts

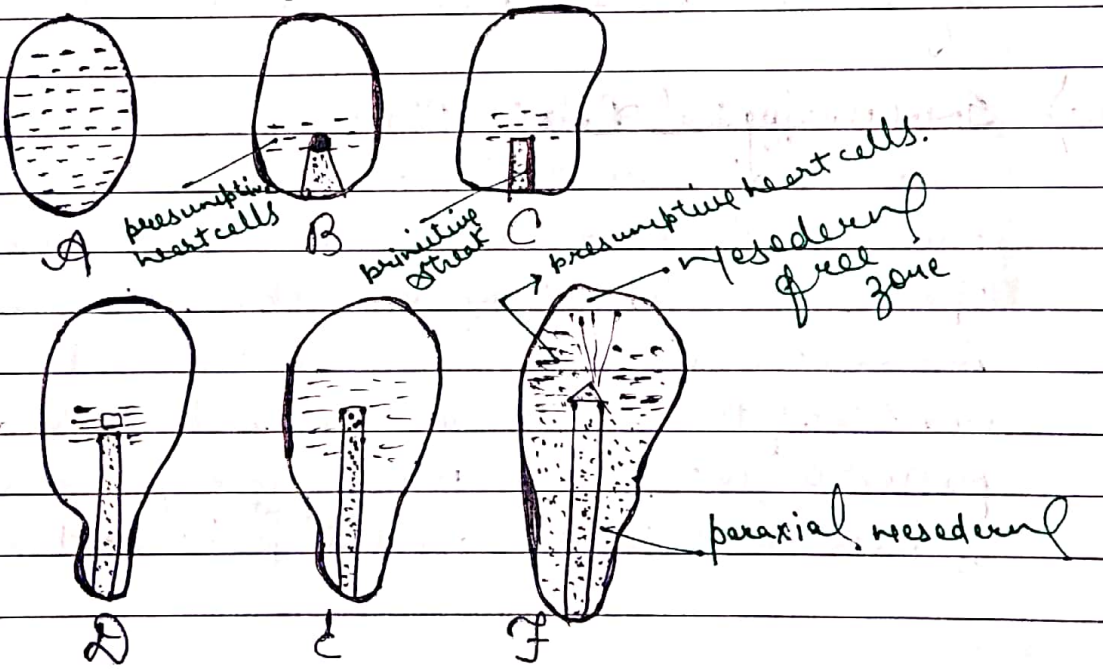


Fig:- Showing the localisation of presumptive heart cells in the blastodisc of chick..

Scanned by CamScanner

Wednesday
Date 9/10/19
Page 99

- The localisation of heart forming cells occurs at the onset of gastrulation in the embryo of all vertebrates.
- With the movement of cells of the epiblast form the primitive streak heart forming cells become restricted to the epiblastic region anterior to the developing primitive streak.
- With the migration of epiblastic cells to form the mesodermal layer, the heart forming cells concentrated about Hensen's node.
- The heart forming cells then migrate to join the mesoderm and move laterally. When the definite primitive streak is formed, the heart forming cells take a lateral position as pair cardiac primordia.
- Each primodium is capsule of developing a whole heart. If the paired primordia are prevented from fusion, two independently beating heart (cardiac bifida) will result in embryo.
- Before the formation of heart, the presumptive heart forming cells aquires specific bio-chemical characteristic from their neighbours and have an inherent capacity of undergoing self differentiation.
- The presumptive heart forming cells are rich in glycogen which is retained throughout its differentiation. So, the heart forming cells become differentiated from other cells by having high glycolytic metabolism.

Scanned by CamScanner

- In course of development of heart the paired cardiac primordia comes together in the mid ventral line. This is brought about by the 4 types of morphogenetic movement.

a) Folding Movements of Ectoderm and Endoderm:- This movement of the endoderm to develop into crescentic pouch of the anterior intestinal portal and early foregut is of great importance. The presumptive heart-forming cells use the endodermal layer as the substratum for their migratory activity. The folding movements bring the paired cardiac primordia together in the midline to develop into an unpaired median tube.

b) Formation of Amyiocardiac Vesicles:-

- This process of development of embryonic coelom or amyiocardiac vesicle is also important in heart formation with the formation of head fold and initiation of foregut, the lateral plate mesoderm in the region of cardiac primordia splits to form a dorsal layer (somatic mesoderm) and a ventral layer (splanchnic mesoderm).

- The coelomic space thus enclosed by these two layers is called the early pericardial or amniocardiac vesicles. With the separation of the somatic and splanchnic mesoderm, all the presumptive heart forming cells move

Scanned by CamScanner

ventrally in the splanchnic mesodermal layer. Because of this reason, this thickened crescentic splanchnic mesoderm is called by Mollier (1906) as the 'cardiogenic plate'

c) Cell movement in the splanchnic Mesoderm and the subsequent migration of the Mesodermal (splanchnic) cells:-
Prior to the formation of coelomic space, the precardial mesodermal reticulum consists of a homogeneous loose meshwork of stellate mesenchyme. Within the meshwork small clusters of tightly packed cells are present which move actively from their lateral position to form the tubular heart.

d) Formation of Angioblasts :- With the development of cardiogenic plate, angioblasts are found in the region of the original amniocardiac vesicle. The conversion of the precardial cells to angioblasts is the first sign of histological differentiation in Cardiogenesis.

These cells migrate either singly or in small clusters out of the mesoderm and form a loose layer (vascular layer of Pander) in the meso-endodermal space. This layer forms the endocardium of the heart and in the posterior region it produces the blood islands.

- These islands produce the endothelium of the remaining vasculature, erythroblasts and blood plasma.

Scanned by CamScanner

Formation of Primitive Tubular Heart

- As stated earlier, the primordial endocardial cells begin to differentiate independently as a pair of delicate tubular hearts. These paired tubular hearts are arranged on either side of the anterior intestinal portal (the opening from the yolk into the foregut).
- The folding movement of the ectoderm and endoderm to form the head fold and foregut causes the migration of the paired tubular hearts together when they fuse to form an unpaired tubular heart tube.
- The paired rudiments meet and fuse when the foregut is separated from the yolk sac. This process begins at 7 to 8 somite stages in chick and is completed when the embryo comes to 9 somite stage.
- Each of the paired rudiments has an inner endothelial lining (endocardium) and the outer is the epimyocardium.
- Simultaneously with the migration of splanchnic mesoderm anteromedially and separation from the folding ectoderm, it becomes thickened to form paired epimyocardia. This layers develops lateral into the thick myocardium and a thin non-muscular epicardium (or visceral pericardium)

The changes undergone by the tubular heart to form adult heart are essentially:-

i) Constrictions to form chambers.

ii) Differential growth and thickening of the myocardium resulting in the formation of thin-walled receiving parts and thick-walled forwarding parts.
iii) Kinking of the chambers – possibly due to rapid growth within crowded quarters.
iv) Formation of septa, valves, etc.

Functional changes in cardiogenesis

The definitive function of the heart starts as the paired cardiac tubes fuse and the contraction begins as soon as the primitive ventricle is formed. So the heart is the organ which begins its function at an early stage of development. Contraction starts in the myocardium along the right margin of the posterior end of the ventricle. Gradually, the contraction involves the whole ventricular wall which contracts synchronously, i.e., periods of contraction alternating with periods of rest. Meanwhile the Atria develop which also contract at a more rapid rate. The atria control the rate of concentration of the heart as a whole. These concentrations set the contained blood in motion. Eventually pacemaker or sinoauricular node develops which takes the controls of the contractility of heart as a whole.

18/10/19

DEVELOPMENT OF BRAIN IN CHICK EMBRYO

- The first important morphogenesis change

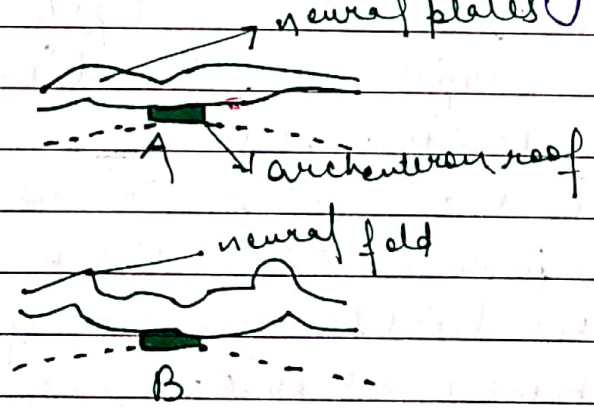
Scanned by CamScanner

following gastrulation is the development of central nervous system (CNS) (Brain).

- In chick embryo it's development sign from 32 to 38 hours of incubation.
- The central nervous system is starts as a simple tubular nerve tube which is cores of development transfer into brain and spinal cord and their associated structure.
- The morphogenic process involves in this process are called Neuralisation. It includes a) the separation of neural material from the embryonic ectoderm.

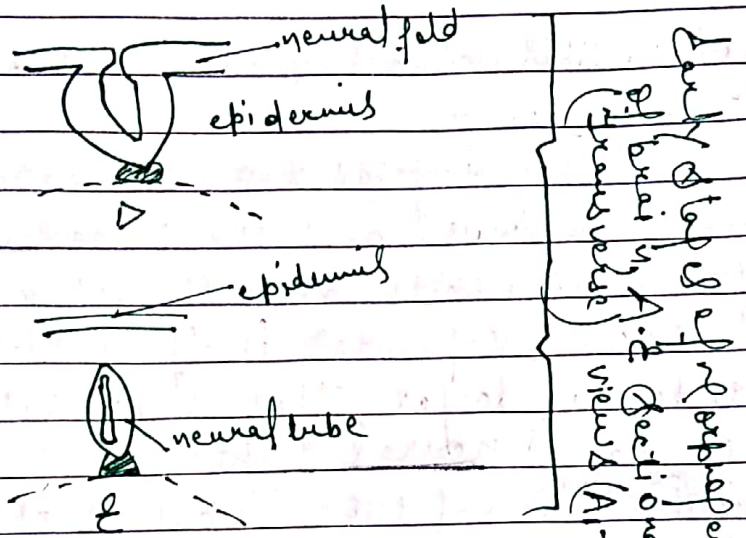
b.) Their migration inward to form a hollow nerve tube together with the segregation of neural crest cell.

- The nerve tube differtiate into the brain and spinal cord, while neural crest cell developed into neuroblast and many other structure



Scanned by CamScanner

the food canal. conv.



Events in Neural Morphogenesis

- After the completion of gastrulation the ectoderm of the future dorsal side of the developing side embryo tends to condense to form a thick and compact neural plate with elevated margin. This thickened part is called neural (medullary) plate or neural placode.
- The depression appears along the entire length of neural plate which folds downward to form a neural groove. The formation of the neural groove is associated with the median and dorsal movement of the ectodermal layer attached to the lateral edges of the neural plate.
- The raised or folded margin of the neural groove is called neural fold.
- The lateral neural fold rised and meet along the

middle line. This union begins from the anterior and runs posteriorly.

- With the union of the folds the outer ectodermal layer becomes continuous and the inner nervous layer, after fusion with corresponding part forms a tube and separates itself from the upper ectodermal layer. This tube like structural is called neural tube.
- The cavity of the neural tube is called the neural canal which is broader at anterior end and opens to the exterior through an opening called neural pore.

The neural pore ultimately close the development.

Structural differentiation of the neural tube.

The differentiation of neural tube into the brain and spinal cord depends upon many intrinsic and extrinsic factors. The anterior part of the neural tube transforms into the brain while the posterior narrow part becomes elongated to form the spinal cord.

The broad anterior part is demarcated from the narrow posterior part by isthmus. Remarkable changes occur in the anterior part during its conversion into the brain.

This is caused by :-

a) Unequal thickening of the neural tube wall
b) Invaginations or evaginations of the wall and,

c) Various types of bending or folding (flexure formation).

Immediately after the formation of the neural tube, the anterior part swells up and two constrictions develop to divide the anterior part into 3 general regions:-

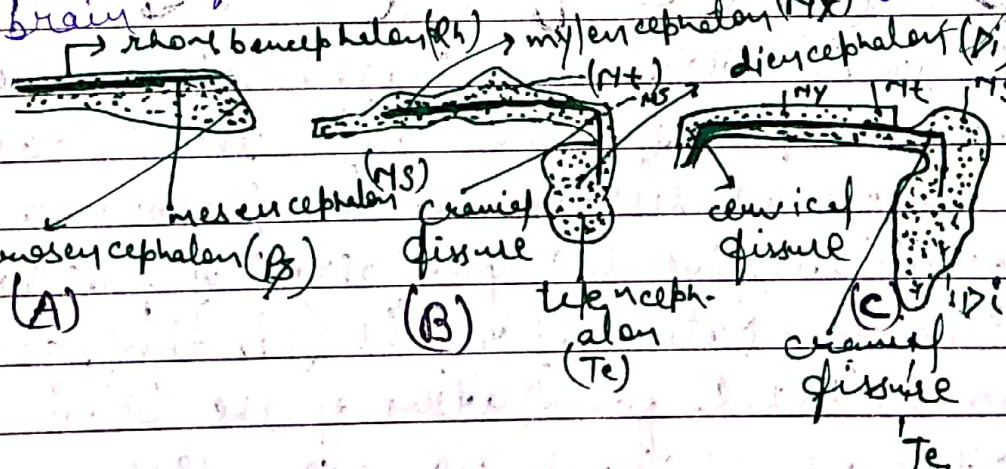
1.) Prosencephalon
2.) Mesencephalon, and
3.) Rhombencephalon

In course of development, prosencephalon and rhombencephalon become further subdivided thus giving rise to 5 parts:-

Telencephalon, Diencephalon, Mesencephalon, Metencephalon and Myelencephalon.

Many factors are responsible in brain morphogenesis. Differential growth and intraventricular pressure are regarded to be the important morphogenetic factors in brain development, especially the flexure formation relates the development of flexures and different regions of the brain.

Fig

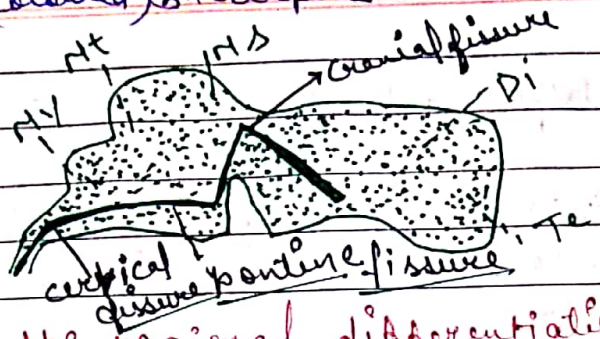


Scanned by CamScanner

Neurulation is the process in which the neural plate, a flat structure of ectodermal tissue in the vertebrate embryo, folds to form the neural tube, a hollow tube that gives rise to the brain and spinal cord.

Lucky Date / / Page 108

[Prepare diagram (coloured) & Ketchpen]



Showing the regional differentiation of brain and the formation of flexures in chick. A) 18 hours B) 22 hours C) 4 days D) 8 days.

19/10/19

* [Casual Analysis in Brain Morphogenesis]

- The anterior part of the neural tube swell up considerably to form brain vesicles
- Considerable amount of cell-division and cell movement occur during the process. The different parts of the brain in course of its development induce the formation of structures like optics, ~~auditory~~ and nasal placodes on the outer ectodermal covering.

Development of Eye in Chick Embryo

The eye is a very complicated structure & unit. The development of eye needs the incorporation of different tissue which follow and orderly fashion to give the geometry of pattern.

The formation of eye is intimately associated with the formation of the brain. By 22 hours of incubation the differentiation of brain region can be observed.

The development of eye is discussed

under 3 steps.

1. Development of sensory area
2. " " lens
3. " " associated structure

1. Development of Sensory area —

a) formation of optic placode and optic vesicle.

The primordial eye rudiment lies at the very anterior end of neural plate in the form of the two closely placed oval area, one on either side of the midd line. They are lined below by mesoderm. In course of the formation of brain, these two lateral sides of the forebrain, which are destined to be the future diencephalon, become thickened.

These parts are known as optic placodes. These two placodes extend laterally as small blunt bulgings, which become known as optic vesicles. The vesicles elongate through the loose mesenchyme towards the epidermis covering and remain connected with the brain by a narrow stalk called optic stalk.

b.) formation of optic cup

As the optic vesicle touches the ectoderm, the ectoderm cells elongate perpendicularly, to the region of contact to form the lens placode, which invaginates to form lens vesicle. With the invagination of lens placode to form lens vesicle, the optic vesicle reverses its outward bulging and turns inwards to form the optic cup to accomodate the lens. The optic cup is double-walled.

Scanned by CamScanner

Such inpushing takes place asymmetrically and continues obliquely into the optic stalk. Near the optic stalk, a slit is left in the ventral side which is called choroid fissure. This fissure acts as an outlet for optic nerve. The blood vessels also find an inpasse into the optic cup.

The outer wall of the optic cup remains thin and gives rise to pigmented retina while the inner wall (neural retina) becomes greatly thickened and elaborated to transform into light sensitive retina.

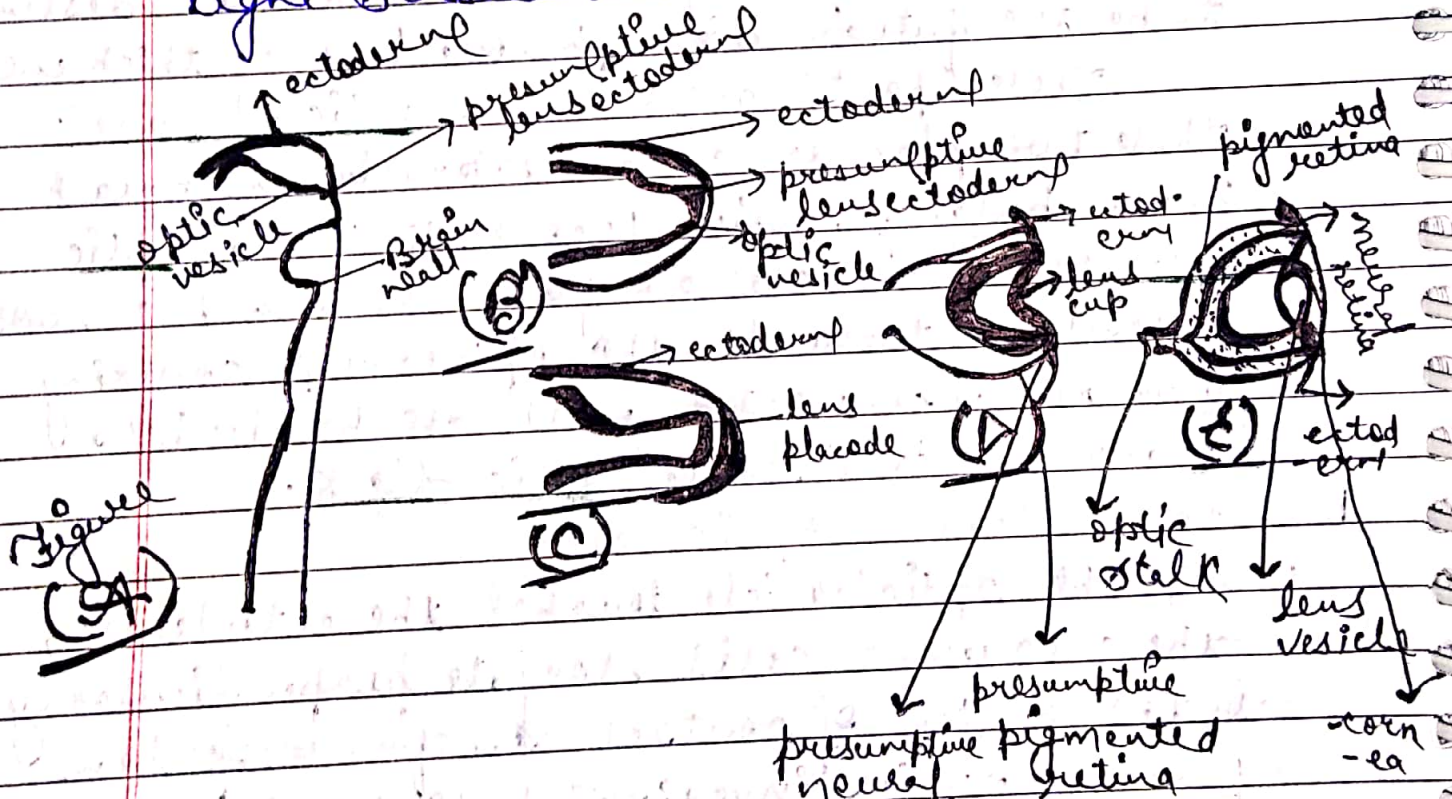


Figure showing the developmental stages of optic cup, lens and cornea ...

Scanned by CamScanner

c) Formation of Retina and optic Nerve

The inner lining of the optic cup transforms into light sensitive retina, which by turn into light insensitive differentiates into 7 layers of nervous elements. The neural retina gives rise to rods and cones and some other types of cells with which the visual cells synapse.

The histogenesis of retina is divided into 3 phases :-

i) A phase of cell multiplication
ii) A phase of cellular readjustment and,
iii) A phase of final differentiation

- Rods and cones are arranged in the outer part i.e, towards the pigmented layer of the optic cup. The position of visual cells is due to the migration and stratification of neural layer of the retina. The fibre of rods and cones unite with the fibres of the ganglionated layer of the retina.
- These fibres converge towards the optic stalk to form the optic nerve.

2. Development of lens - The region of the outer ectoderm which comes in contact with the optic vesicle thickness and is known as lens placode.
- The placode invaginates to form a lens pit or lens cup. The two ends of the lens cup unite and remain within the space between optic cup and outer ectoderm. It is the called lens vesicle.

Scanned by CamScanner

- The inner cells of the vesicle transform into lens fibres and the cell layer next to ectoderm forms the epithelium of the lens.
- At about 96 hours in chick embryo, the lens cavity becomes reduced and the cells of the median all of the lens become elongated to obliterate the lens cavity.
- The cytoplasm of the cells becomes clear and these cells transform into lens fibres. The extreme elongation of the cells is evidenced by the placement of their nuclei in the equatorial region of the lens and the cells are stretched extending from one surface of the lens to the other.
- A lens fibre may reach 10 mm as seen in man.

3.) Development of Associated Structures

a) Choroid and Sclera

The optic cup and optic stalk becomes invested with the layer of mesenchyme which laterally forms an outer densely fibrous layer called Sclera and an inner pigmented and richly vascularised layer called choroid.

b) Conjunctiva, Cornea and Aqueous Humor

After the detachment of the lens the ectodermal epithelium forms a cell-free living. Along the inner border of the ectodermal epithelium lies the mesenchyme, which forms the Sclera. The inner epidermal layer is called conjunctiva and inner mesenchymal continuing

Scanned by CamScanner

of sclera is known as cornea. The transparency of cornea is vital for the admission of light into the cavity of eye.

The cornea is composed of an outer epithelial layer (derived from ectoderm) and a post epithelial stroma (derived from invaginating mesenchymal cells). In the stroma layer of collagen fibres accumulate parallel to the surface. The stroma undergoes significant bio-chemical changes and undergoes dehydration.

Due to loss of water and suppression of pigmentation the cornea attains perfect transparency. A space develops between lens and cornea, which is called anterior chamber. A watery fluid, called aqueous humor accumulates within the space.

IRIS → The choroid layer extends in front of the lens to form a circular curtain known as Iris. which has a hole in the centre called Pupil.

The iris is pigmented and possesses papillary muscles which regulate the diameter of the Pupil. The iris develops from the pigmented retina.

CILIARY MUSCLES → The pigmented outer layer of the optic cup together with mesenchymal elements extends in front to form ciliary muscles or ciliary bodies.

VITEROUS HUMOR → The cavity between lens and retina is known as posterior chamber, It becomes filled with a gelatinous matrix called

Scanned by CamScanner

vitreous humor.

MUSCLE OF THE EYE → Several muscles are formed by the condensation of outer head mesenchyme. These muscles are induced in rotating the eye-ball within the orbit.

EYELID → The outer most epidermal layer in front of the eye becomes skin. It split into the two folds to form the eyelids. In different vertebrates the shape of eyelids varies.

EVENTS OF EYE DEVELOPMENT

Events of eye development maybe divided into 3 phases :-

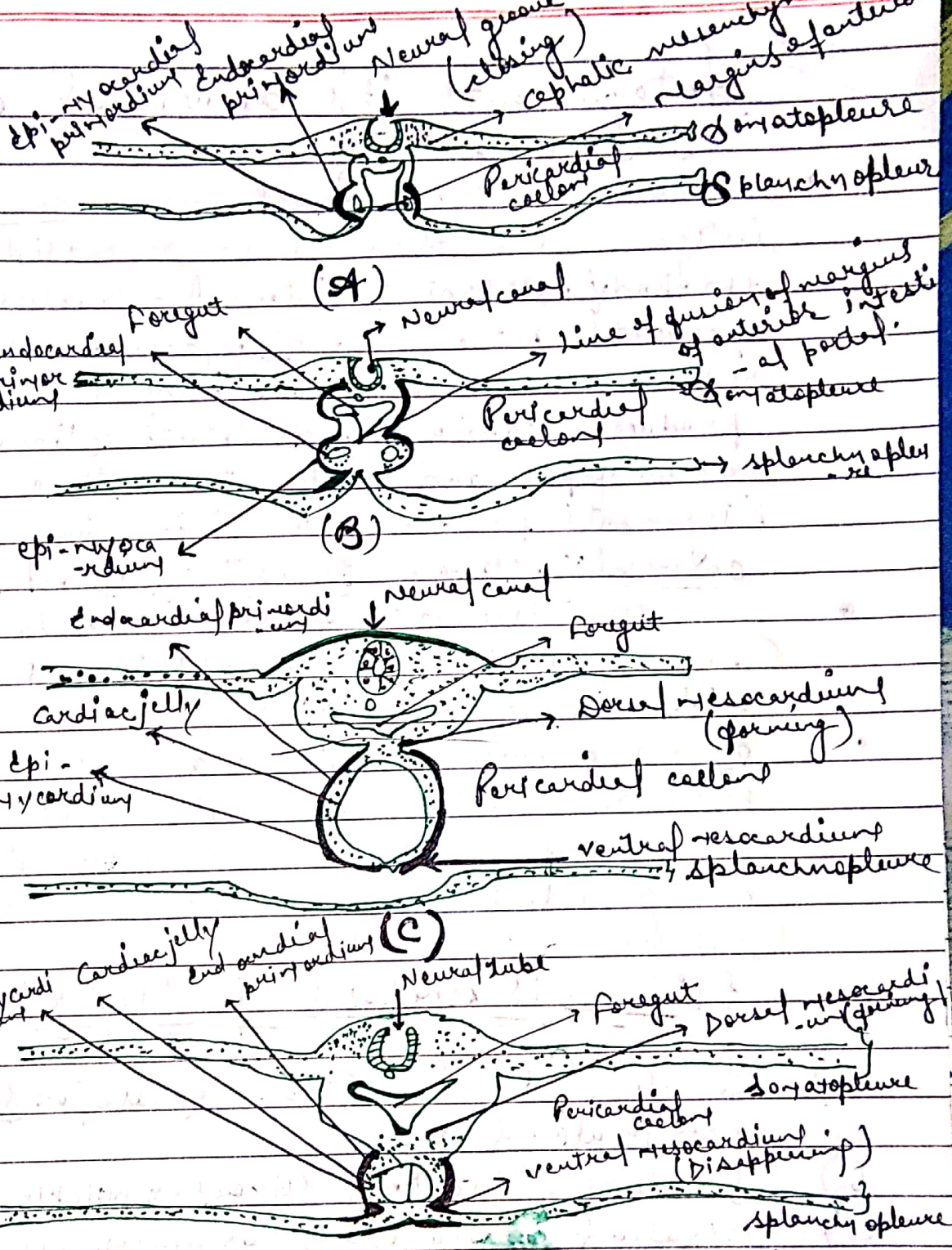
a) Phase of Induction
b) Phase of cells differentiation and oriation and
c) Phase of mechanical tension

The work carried by large number of workers has revealed that no organ is formed if there is any disturbance in the first phase. But at the same time only the occurence of first phase cannot form the organ.

The disturbance in the second phase i.e phase of cell differentiation, produces numerous deviations in the different rudiments of eye. The third phase creates the form and size of the organ and it is a ~~off~~ off.

there considerably.

Figure



→ Diagrams of transverse sections through the pericardial region of chick at various stages to show the formation of the heart...

V.V.I

Integuments it's derivatives and Function.

- The word integuments means covering. The integumented system cover outside of the body. It protects internal structure the prevents the embryo of infectious agents, reduces water loss, regulates body temperature, produces vitamin D and detects stimuli such as touch, pain and temperature. Since the integuments perform several functions, it is commonly referred to as Jacks of all trades.
- The integuments or skin is the largest organ of the body, making up 16% of body weight with a surface as area of 18 ft^2
- Skin as a dynamic organ in a constant state of change, as cells of the outer layer are continuously shed and replaced by inner cells moving up to the surface deeper layer to the superficial.

Epidermis is composed of 4 layers

a) Stratum basale or Stratum basal or Stratum germinativum layer.
b) Stratum spinosum (spinous or prickle cell layer)
c) Stratum granulosum (granular cell layer)
d) Stratum corneum (horny layer)

→ In addition the Stratum lucidum is a thin layer of translucent cell found in thick epidermis
→ It represents a transition from the Stratum granulosum and Stratum corneum and is

not usually seen in this epidermis. Together the stratum spinosum and stratum granulosum are sometimes referred to as the Malphigian layer.

a) Stratum Basale

- Inner most layer of epidermis which lies adjacent to the dermis, comparise mainly dividing and non dividing Keratinocytes, which are attached to the basement membrane by hemidesmosomes.
- As Keratinocytes divide and differentiate, they move from this deeper layer to the surface.
- Making up a small proportion of the basal cell population is the pigment called Melanin producing melanocyte.
- Merkel cells are also found in the basal layer with large no. in touch sensitive sites such as the finger tips and lips. They are closely associated with the cutaneous nerves and seems to be involved in light touch sensation.

b) Stratum Spinosum

- As basal cells reproduce and mature they move towards the outer layer of skin, initially forming the stratum spinosum. Intercellular bridges, the desmosomes, which appear as prickels at a microscopic level connect the cells. Langerhans cells are dendritic immunologically active cells derived from the bone marrow and are found on all epidermal layer but are mainly located in the middle of this layer. They play a significant role in immune reaction of the skin, acting as antigen presenting cells.

Scanned by CamScanner

c) Stratum granulosum :- Continuing their transition to the surface the cells continue to flatten, lose their nuclei and their cytoplasm appears granular at this level.

d) Stratum Corneum :- The final outcome of keratinocytes maturation is found in the Stratum Corneum, which is made up of layer of hexagonal shaped non viable cornified cells known as corneocytes.

- In most areas of the skin there are 10-30 layers of stacked corneocytes with the palms and soles having most. Each corneocytes is surrounded by a protein envelop and is filled with water retaining keratin proteins.
- The movement of epidermal cells to this layer usually takes about 28 days and is known as the epidermal transit time.

Dermoepidermal junction / basement membrane.

- This is a complex structure composed of 3 layers
- Abnormalities here result in the expression of rare skin disease such as bullous pemphigoid and epidermolysis bullosa
- The dermal epidermal junction, flatters during ageing which accounts in part for some of the visible signs of ageing.

Dermis

It is found below the epidermis and is composed of a tough, supportive cell matrix. Two layers comprise the dermis -

Scanned by CamScanner

(i) A thin papillary layer (ii) A thicker reticular layer

- The papillary dermis lies below and connects with the epidermis. It contains thin loosely arranged collagen fibres. Thicker bundles of collagen run parallel to the skin surface in the deeper reticular layer which extends from the base of the papillary layer to the subcutis tissue. The dermis is made up of fibroblasts, which produce collagen, elastin and structural proteoglycans, together with immune components mast cells and macrophages.
- Embedded within fibrous tissue of the dermis are the dermal vasculature, lymphatics, nervous cells and fibres, sweat glands, hairs roots and small quantity of striated muscle.

(3) Subcutis: This is made up of loose connective tissue and fat, which can be up to 3cm thick on the abdomen.

(4) Blood and lymphatic Vessels: The dermis receives a rich blood supply. A superficial terminal plexus is formed at the papillary and reticular dermal boundary by branches of the subcutis artery. Branches from this plexus form capillary loops in the papillae of the dermis each with a single loop of capillary vessels, one arterial and one venous.

Nerve Supply

- The skin has a rich innervation with the hands, face and genitalia having the highest density of nerves.
- All cutaneous nerves have their cells bodies in the dorsal root ganglia and both myelinated and non-myelinated fibres are found. Free sensory nerve

endings lies in the dermis where they detect pain, itch and temperature.

- Specialized corpuscular receptors also lie in the dermis allowing sensations of touch to be received by Meissner's corpuscles and pressure and vibration by Pacinian Corpuscles.

Derivative Structure of the Skin

Foreg:- Hair, nails, sweat glands.

Function of the Integuments In Vertebrates

1.) Protection :-

- The integument or skin protects the body from the entry of foreign bodies and prevent from the mechanical injuries.
- The hard dermal and epidermal scales that protects the skin from surface abrasion and also the soft tissues which lie beneath it.
- Hair, bristles and spines are employed for offensive and defensive purpose.
- The impervious integument helps the body from loss of water.

2.) Thermoregulation :-

- The integument of warm-blooded animals regulates the body temperature. Feather of birds, sweat glands and blubber of mammals helps in the regulation of body temperature. Deep covering of the hairs help in the conservation of heat, specially during winter.

3.) Storage of food :-

In whales, seals and sea cows, a subdermal fat layer forms a thick layer called blubber.

Scanned by CamScanner

which acts as food storage.

4.) Excretion:- The integument of some aquatic vertebrates (eg - aquatic amphibians) serves as an organ for excretion. During ecdysis the waste material which is stored in the corneal layer of the skin is shed. Sweat of the sweat glands aids in removing nitrogenous wastes from the body.

5.) Respiration:- The moist skin of common eel, mud skippers and swamp eel also serve respiration. The skin of amphibians is moist and highly glandular that help air in contact with the skin to be interchanged and thus performs accessory respiration. In plethodontid salamanders, the lungs are absent, so rely totally on cutaneous respiration.

6.) Secretion:- The skin acts as an organ of secretion. The different glands are located in the skin those help the vertebrates in different ways for survival.

- Fishes possess numerous mucous glands in the skin that secrete abundant mucous.
- The slimy mucus of the fish skin reduces resistance during swimming. The poison glands of fishes, amphibians and snakes are used for protection and predation.
- Mammary glands, scent glands, and sebaceous glands are present in the skin and serve different functions.

7.) Locomotion:- Various types of integument or its derivatives also serve different types of locomotion.

- The fins of fishes, webbing aquatic amphibians, terrapins and aquatic birds, scutes in snakes, adhesive pads in climbing lizards, feathers in birds & patagium in flying lizards helps in different modes of locomotion.

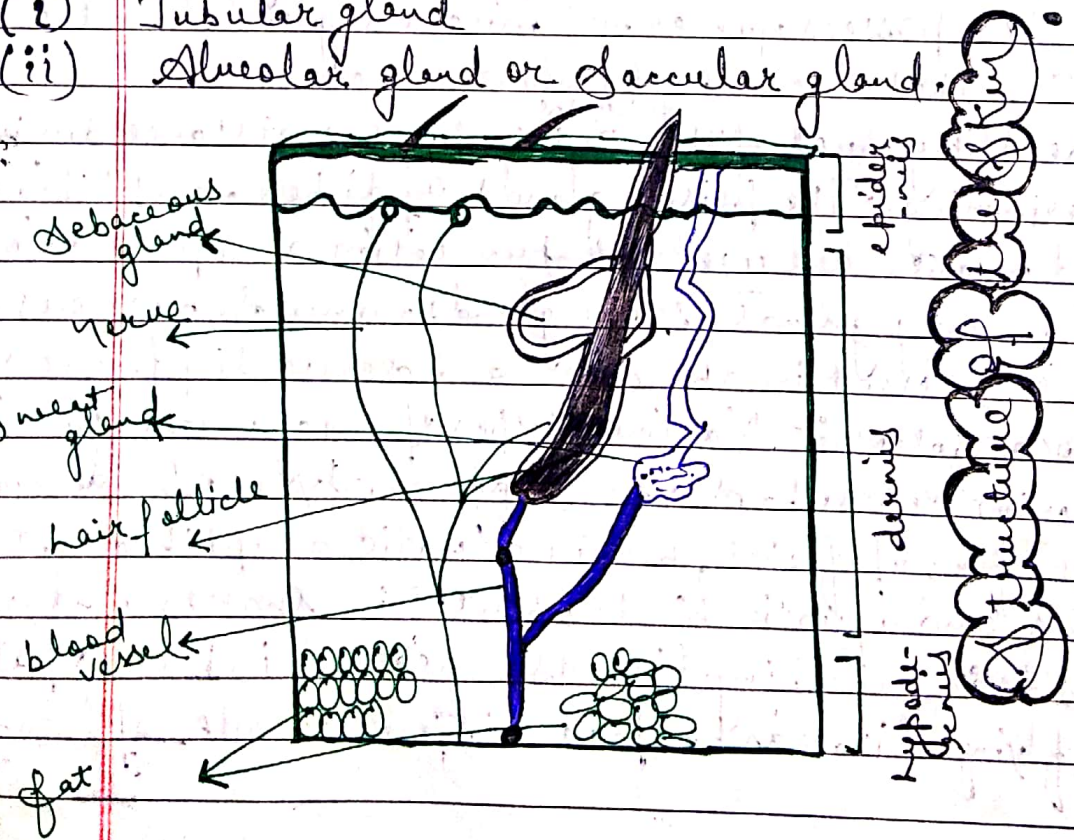
Epidermal Derivative Structure of the Skin

Epidermal Gland - Epidermal glands are formed from the malpighian layer of the epidermis. They arises from the epidermis and often penetrates the dermis. They are unicellular or multicellular, tubular or alveolar and simple and compound gland. These are lined by cuboidal or columnar cell.

a) Unicellular gland :- Are single modified cells known as mucous cells or goblet cells. They secrete a protein mucin which combined with water to form mucous which lubricates the surface of the body.
They are present in amphioxus, cyclostomes fishes and larva of amphibians.

b) Multicellular gland :- It is of 3 types —

(i) Tubular gland
(ii) Alveolar gland or saccular gland.



Scanned by CamScanner

i) Tubular glands :→ This is the multicellular tube of uniform diameter formed as in growth of malpighian layer into the dermis.
Ex:- glands of moles on the margin of human eyelids
- Tubular glands may become coiled, deep in the dermis Ex:- Sweat or Sudoriferous glands of mammals. They may divide into many tubules which are may called compound tubular gland. Ex:- Mammary glands of females and of males in monotremes and primates etc. And gastric gland in stomach.

ii) Alveolar or Saccular glands → This are multicellular down growths of the Malpighian layer into the dermis, having a tubular duct whose terminal parts form a rounded expansion to become flask-shaped. Eg:- Mucous and poison glands of amphibians
- It may branch into many lobules which finally open into a common duct, they are. They called compound alveolar glands. Eg:- Mammary glands of eutherians, and salivary glands.

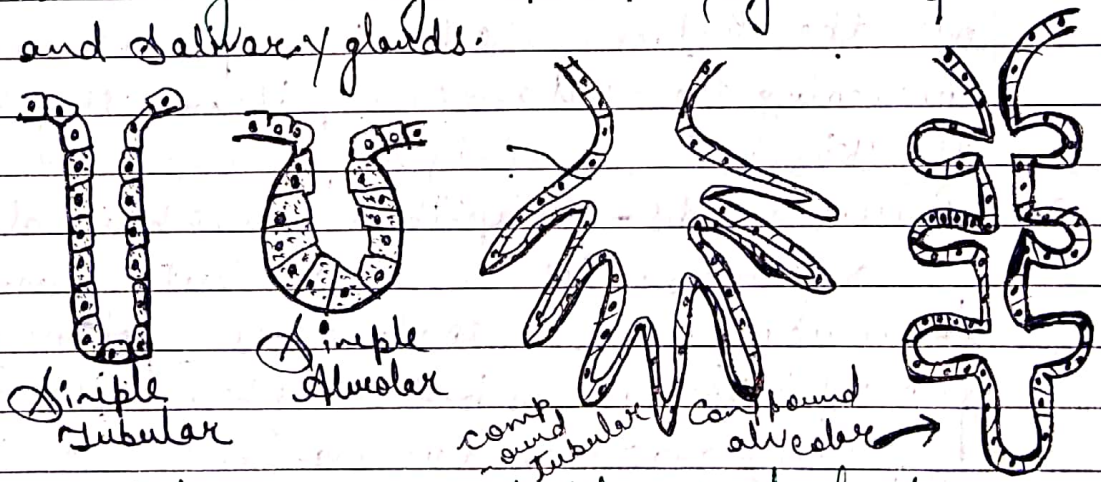


Fig :- Different types of Epidermal glands

Scanned by CamScanner



Compound tubulo-alveolar

Types of Epidermal glands According to function, the epidermal glands of vertebrates are of the following types -

1. **Mucus gland** - They may be unicellular or multicellular. The unicellular glands are mucous gland cells, granular cells and beaker cells of amphioxus, cyclostomes and fishes. They secrete mucus which keeps the skin moist and slippery, and also affords protection against bacteria & fungi.
   - Mucus cells and granular cells lie near the surface, but the beaker cells lie more deeply and extend from the Malphigian layer of the surface.
   - Multicellular mucous glands are alveolar found in some fishes and amphibians. They occur all over the surface of the body and produce mucus for lubricating the skin and in amphibians they keep the skin moist to aid in respiration.
2. **Poison glands** - Amphibians also have alveolar poison glands which are larger but less numerous than mucus glands. In toad masses of poison glands from parotoid glands behind the head. The secretion of poison glands has a burning taste and is used as a defence. Caecilians have giant poison glands.
   - Some tubular glands are found on the feet and suctorial discs of tree frogs which aid in climbing. Tubular glands are also found on

Scanned by CamScanner

the swollen glandular thumb parts of male frogs and toads during the breeding season. They aid in clasping the female during amplexus.

3. Luminescent Organs or Photophores - They are found in longitudinal rows near the ventral side of the body in those fishes which live in deep sea where no lights penetrates.
   - Each photophore is a group of epidermal cells lying in the dermis.
   - Each photophore has a lower layer of luminous cells below which is a layer of reflecting pigment cells, and the upper layer of mucous cells forms a lens. The glandular cells produce phosphorescent light which is transmitted to the outside by other cells. The light helps to attract the prey of deep sea fishes.
4. Femoral Glands - It is found in male lizards eg. (Uromastix) below the thighs in row from the knee to the cloaca. They secrete a sticky substance which hardens into short spines that are using for holding the female during copulation.
5. Uropygial Glands - These are the only glands in birds, and they are best developed in aquatic birds. Uropygial glands are branched alveolar glands located on the dorsal side at the base of the tail or uropygium in the form of swelling.
   - They secrete an oil contains ponatum which is picked up with the beak and used for preening and waterproofing the feathers.

V.V.I

6. Sweat Glands - The largest no. and variety of epidermal glands are found in the skin of mammals.

Scanned by CamScanner

- They are tubular or alveolar and multicellular.
- Sudorific or sweat glands are long, coiled tubular glands embedded deep in the dermis. Their upper part forms a duct which opens on the surface by a pore and the lower coiled part lies in the dermis. Surrounded by a network of blood capillaries.
- Sweat is secreted by sweat glands continuously, may or may not be visible. It contains a large amount of water having dissolved salts of sodium, potassium and urea.
- Sweat removes some metabolic wastes and regulates the body temperature by evaporation.
- Sweat glands are not uniformly distributed. In man they are more numerous on palms, soles and arm pits.
- In cats, rats, and mice they are confined to the soles of the feet. In rabbit they are around the lips. In bats on the sides of head, In ruminants on the muzzle and the skin between the digits and in hippopotamus they are found only on the pinnae.
- There are no sweat glands in Tachyglossus, Sirenia and Cetacea. In some mammals the secretion of sudorific glands is red-coloured. In hippopotamus it is red and spreads on the head and back. The male giant Kangaroo Macropus rufus secretes red sweat. Modified sudorific glands form glands of Moll in the margins of the human eyelid in connection with eye-lashes.

- Ceruminous glands in the external ear passages of mammals are modified sweat glands and secrete a waxy substance which combines with the secretion of sebaceous glands to form earwax which catches dust. Oil glands form ceruminous glands in the external ears of some gallinaceous birds.

7. Sebaceous Glands:- Sebaceous glands are alveolar glands opening in hair follicles containing hairs.
- They also independently open at the skin surface around the genital organs, tip of the nose, and edges of the lips. Sebaceous glands secrete an oil (Sebum) to lubricate the hairs and also cover the skin with a film of oily coating. The oily secretion of this glands contains waxes, fatty acids, and cholesterol, which makes the skin pliable.
- This glands are absent in Plants (pangolin) and Sirenia and cetacea which practically have no hairs. Modified Sebaceous glands form Meibonian glands in the eyelids, each has a long straight duct into which separate alveoli open.
- They produce an oily secretion which forms a film over the lacrimal fluid or tears holding them evenly on the surface of the eyeball for keeping the eye moist, in weeping the oily film are broken & tears flow out. Ceruminous glands of external auditory meatus are modified sebaceous glands. Their greasy or waxy secretions called the cerumen traps the insects and dust particles.

8. Scent Glands:- Scent glands are modified seba-

Scanned by CamScanner

-ceous glands or sweat glands. Their secretion is an allurement to the opposite sex. Scent glands are located in the deer family on the head near the eyes.

- Skunks and carnivores have scent glands around the anus, and pigs and goats have scent glands between their toes.

9) Preputial Glands- These are found in many kinds of mammals. In beaver, large sacs containing a secretion known as Castoreum lie beneath the skin on either side of penis and open by ducts into the prepuce.

7/11/19 V.V.I. 10.) Mammary Glands-. These are characteristic of mammals. They secrete milk generally in the females for nourishment of the young. In monotremes both sexes may secrete milk, this condition is called gynaecomastism which is not a normal condition. Mammary glands of monotremes are compound tubular glands, while in other mammals they are compound alveolar.

- Mammals glands of monotremes have no nipples, they open into pits by the surface of the skin, and the young ones obtain milk by licking tufts of hairs. In others the mammary glands open by their ducts separately into a nipple.
- The nipple is a raised outgrowth of the breast, bearing opening of mammary glands (true teats)
- The false teat has an elongated cistern into which the mammary glands open by their ducts. From the cistern a tube leads

Scanned by CamScanner

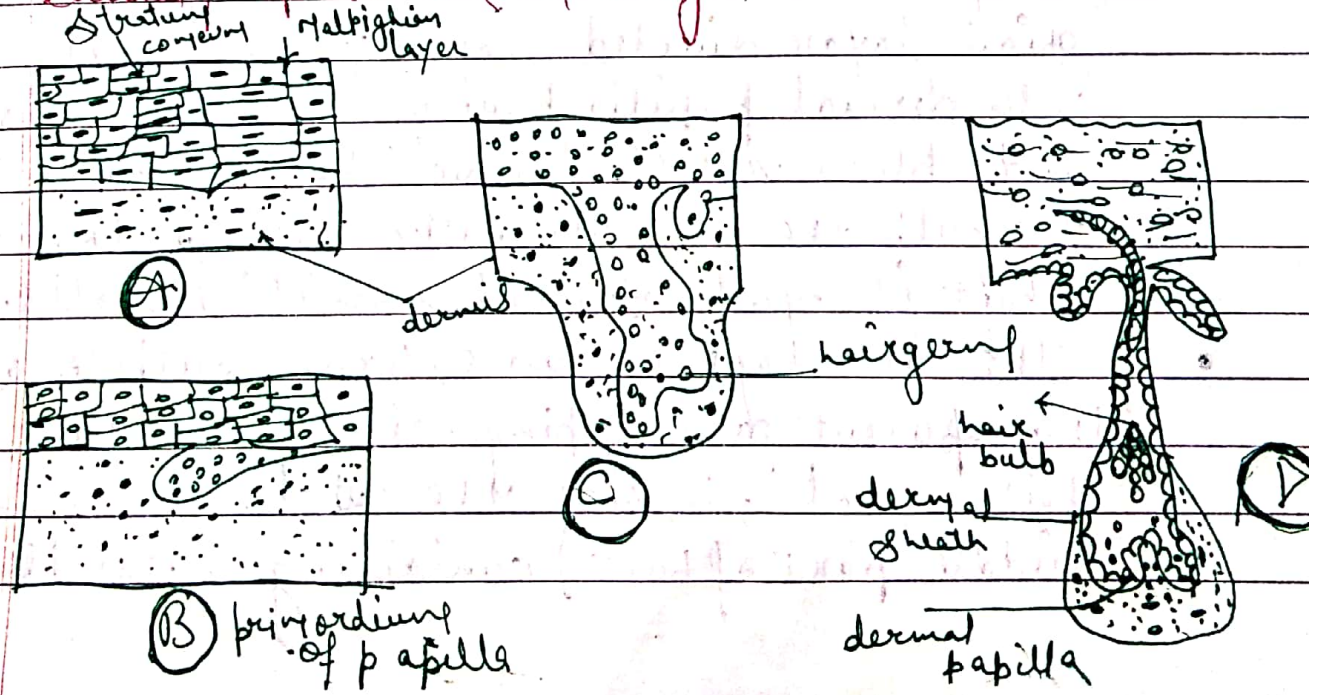
to the surface of the nipple.

- Mammary glands along with fat form integumentary sheddings called mammae or breasts. The number and location of mammae varies in different mammals. The number ranges from two in many mammals to 25 in opossum. Mammae may run along two ventral milk lines from the arm pits to the groin, or they may be axillary, thoracic, abdominal or inguinal in position.

V.V.I

HAIR

- It is found only in mammals. It projects at an acute angle from the skin. Hair covers the entire integument in most furred mammals, but in others only traces are left, such as whales have only a few coarse hairs on the snout.
- But during development the body of the embryos of all mammals is covered with a coating of fine hair called lanugo which is usually shed before birth and replaced by a new one. Hair is entirely epidermal in origin.



Scanned by CamScanner

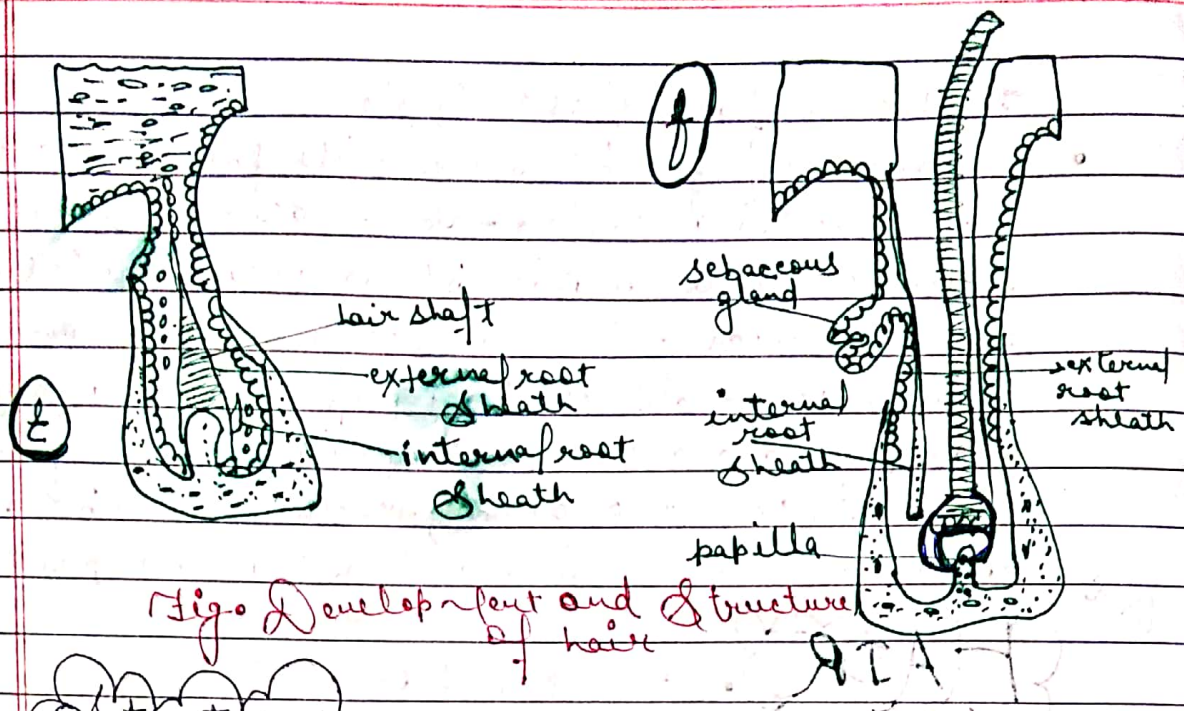


Fig. Development and structure of hair

Structure

- Hairs are not modified scales but are new outgrowths of the epidermis only. A hair has an upper projecting shaft and a lower root lying in a hair follicle which is a sunken pit in the dermis. The shaft is made of only dead, keratinised cells. The part of the hair protruding above the skin is dead.
- At the base of the follicle the root is expanded into a bulb and growth of the hair takes place only in the root where the cells of the malpighian layer divided actively. Below the bulb is a dermal papilla having connective tissue and blood vessels, it nourishes the hair. Beyond the bulb the cells gradually die so that the shaft is made of dead cornified cells.
- The hair shaft has an external cuticle of transparent overlapping cells which have lost their nuclei, inside the cuticle is a cortex (middle part of hair) containing shrivelled cells

Scanned by CamScanner

and pigments, and a central core or medulla having air spaces. In the follicle the hair root is surrounded by two layers of hairs sheath cells forming an outer and inner root sheaths. They do not extend beyond the follicle. A sebaceous gland opens into the upper part of the hair follicle for oiling the hair.

- An arrector pili muscles composed of smooth fibres extends from the upper part of the dermis to the basal part of the hair follicle on the side towards which the hair slopes. It pulls the hair base causing the hair to stand when an animal is confronted with danger. Hair does not project vertically but at an acute angle from the skin.

Scanned by CamScanner