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Reproduction

Reproduct^{n} is the process by which new individual of a species are produced and genetic informat is passed from one generation to another.

Importance of sexual reproduction :-

- unique combinat^{n} of parental genes during process
  - this speeds up adaptation.
  - helps in losing harmful genes

Thus in adverse conditions, sexual reproduction is advantageous

Variation :

- Hermaphroditism e.g. tapeworm, barnacles, clams
- Sex reversal : e.g. Bluehead wrasse, coral reef fish (longest female changes to male in absence of male)

Male reproductive system :

Primary organ - Testis
Secondary organ - helps in maturation

Testicles : • suspended from the body
• covered by tunica albuginea
• Contains tightly coiled tubules, seminiferous tubules.

Seminiferous tubules contains spermatogonial cells in diff. stages of development and sertoli cells. B/w seminiferous tubules are present interstitial cells or Leydig cells

- Sertoli cells provide nutrition to the cell and hold the cell.

-

Fun^{n} of sertoli cells.

- form barrier b/w the plasma & mature cell sperm
- nourish developing sperm
- Respond to FSH and testosterone to stimulate spermatogenesis
- Secrete inhibin which inhibits release of FSH
- Absorb and destroy the defective sperm.

Function of Interstitial cells:

- ~~Form barrier b/w plasma & mature sperm~~
- ~~no~~
- secrete testosterone in respond to LH

- The testis is suspended in the scrotum so that the temp. can be mean kept lower than the body because Spermatogenesis cannot take

Epididymis

- It store the sperms for maturation.

Vas deferens.

- It's a transport tube for sperm from epididymis to urethra
- Spermatozoa are stored in the ampulla of the V.D until the time of ejaculation

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Accessory sex glands :

- **Seminal Vesicle** : It is a paired structure. Lying posterior to and at the base of urinary bladder
  - It is a leaf structure
  - Secrete alkaline fluid containing fructose for sperm nutrition.

- **Prostate gland** : Its a single gland that surrounds the superior portion of urethra. It secretes a milky acidic fluid

- **Cowper's gland or bulbourethral glands** : beneath the prostate on either side of membranous urethra. Secretes alkaline substance and mucus.

Semen

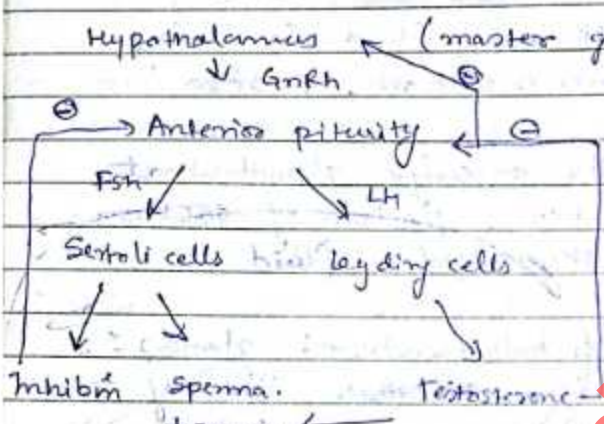
- Mixture of sperm, secretions of seminal vesicle (60%), prostate (25%) and bulbourethral glands (5%)
- Alkaline pH (7.20 – 7.60)
- Activates sperm after ejaculation
- Neutralizes acidic env. of male urethra & female vagina
- Provides transportation medium & nutrition to sperms.

Ejection and ejaculation

Erection : Sexual stimulation results in ↑ed blood flow to penis, dilating it involves parasympathetic reflex.

Ejaculation: propulsion of semen from urethra to exterior sympathetic reflex.

Hormonal control of the testis



GnRh - Gonadotropin releasing hormone
↳ acts on the gonadotrophs present in the anterior pituitary [adeno hypophysis]

FSH : Follicles stimulate hormone (Gonadotrophic hormone)
↓
acts on Sertoli cells and promotes spermatogenesis and produces inhibin

LH - Leutinizing hormone
acts on Leydig cells and produces testosterone then this will lead to spermatogenesis
↳ testosterone also helps in maintenance and development of secondary sexual characteristic like building up of muscles, beard formation etc.

Feed back mechanism :- when the secretion of one hormone regulates its own secretion

Trophic hormones are those which acts on another endocrine organ and regulating its secretions.

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Spermatogenesis

- Production of mature sperm.

- Spermatogonia undergo series of mitotic division and the last mitotic division gives rise to 1° spermatocytes that enter meiosis. The series of mitotic divisions allows for continual proliferation of spermatogonia and replacement of spermatogonia.

Lumen

After meiosis, haploid spherical spermatids differentiate into spermatozoa. meiosis and differentiation takes place in the adluminal compartment. Each generation of cells is attached by intercellular cytoplasmic bridges. This, each generation of divides synchronously in mitosis. Some cells degenerate during the process.

Production of Sperm from primordial germ cells known as PGC. The PGC is divide to form A, spermatogoa. They are stem cells and at maturity they divide to make type A_2 spermatogonia A_2 divides mitotically to form A_3 which produces A_4 spermatogonia. A_4 spermatogonia form intermediate or I type spermatogonia which then form B type spermatogonia that are the precursor of spermatocytes. 1° spermatocytes undergo 1st meiotic division the form 2°

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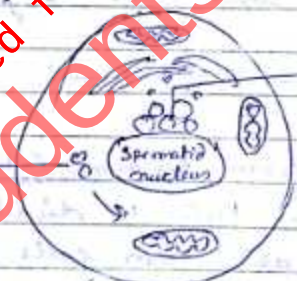
Spermatocyte this completes the 2nd meiotic division to form haploid cells c/d spermatid. The spermatids are connected by the cytoplasmic bridges through which the cells can communicate with each other. As the divisions proceed from A1 spermatogonia to spermatid, the cell moves further from the basement membrane of the seminiferous tubule and closer to the lumen.

Spermeogenesis - The spermatids though haploid still can not function as male gamete. They undergo a differentiation process c/d Spermeh. Spermeogenesis to become functional spermatozoa.

The golgi phase of Spermatid Differentiation

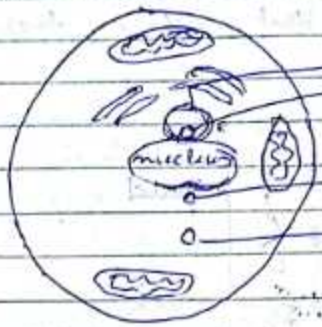
1) Construction of acrosomal Vesicle from golgi apparatus



Step 1: Smaller Vesicles of golgi fuse, giving rise to larger secretory granules c/d proacrosomic granules. The centrioles start to migrate to position beneath the nucleus i.e. opposite to the acrosomal Vesicle.

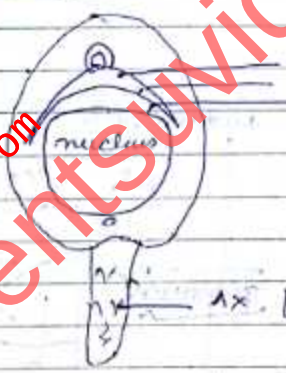
Step 2: The Vesicle fusion continues to give a large acrosomic Vesicle. The proximal centriole (PC) will give rise to developing axoneme, the

Central portion of tail.



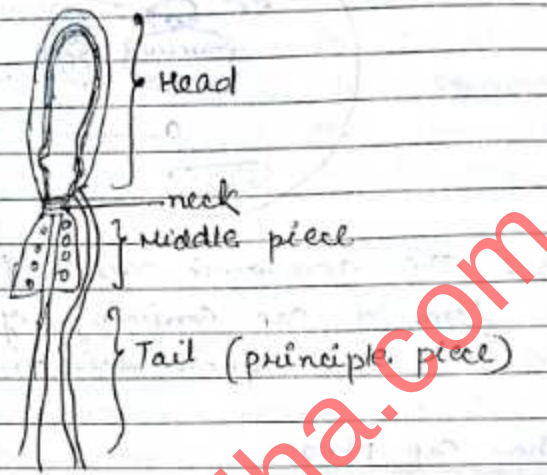
Step 3 : The acrosomic vesicle flatten & begins to form a cap consisting of an outer acrosomal membrane and inner acrosomal membrane.

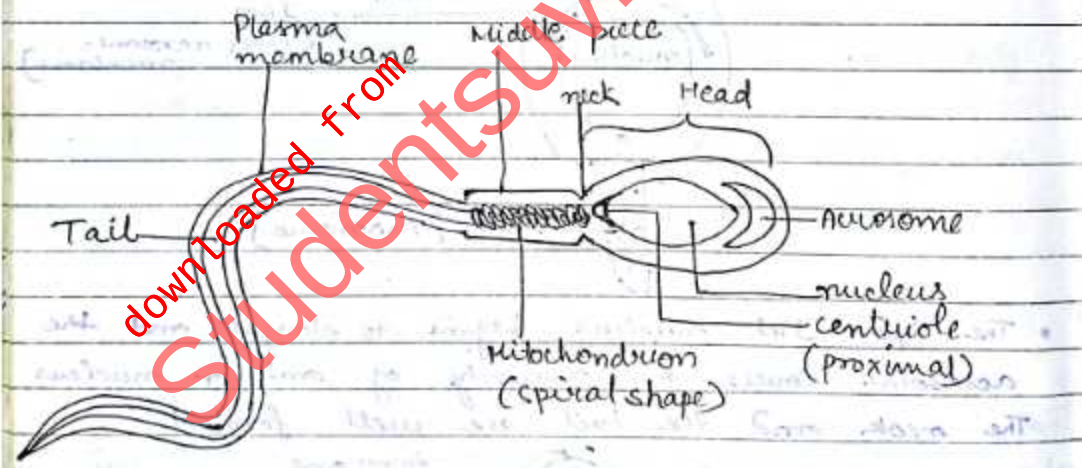
The Cap phase



- The spermatid nucleus begins to elongate and the acrosome covers the majority of anterior nucleus. The neck and the tail are well formed.

- The mitochondria forms the spiral assembly along the flagella that defines the middle piece.





- External reproductive structure consists of 2 sets of labia surrounding clitoris and vaginal opening.
- Internal system consists of pair of gonads, ovaries & system of ducts & chamber.

- 2 ovaries are located in the abdominal cavity and covered by tunica albuginea. They are attached to uterus through mesentries. Each ovary contain follicles (different stage of oocytes). each follicle consists of one egg cell surrounded by one or more layers of follicle cells. Follicle produces 1° female sex hormone estrogen. Follicle cell nourish & protect the developing egg cell.

A woman is born with abt. 400,000 follicles. Only several hundreds of which will release eggs during a female's reproductive years.

Oogenesis

- At the end of haploid we get one egg cell

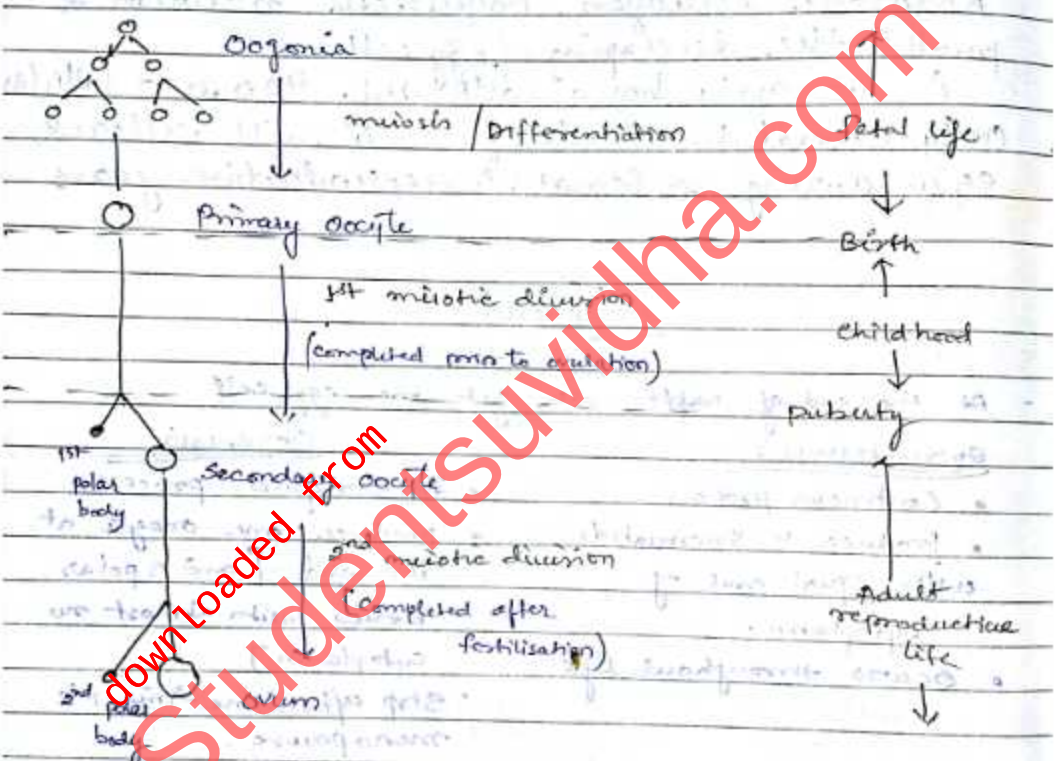
Spermatogenesis	Oogenesis
• Continous process	• Interrupted process
• Produce spermatids with small cytoplasm.	• produce one oocyte at the end [and 3 polar bodies with almost no cytoplasm]
• occurs throughout life	• Stop after some time i.e menopause.

PGC [Primodial Germ Cell]

Primodial Germ cell → Oogonium [Before Birth] → primary oocyte [at birth] arrested at diplotene stage of prophase I

Under FSH influence 1 of the primary oocyte will resume meiosis at puberty

Once it resumes meiosis on the 14 day there is a surge of LH and at this 1° oocyte convert to 2° oocyte and meiosis II started then it stops / arrested at metaphase II stage when [in fallopian tube] till the time of fertilisation. If fertilisation does not takes place then meiosis II will not completed.

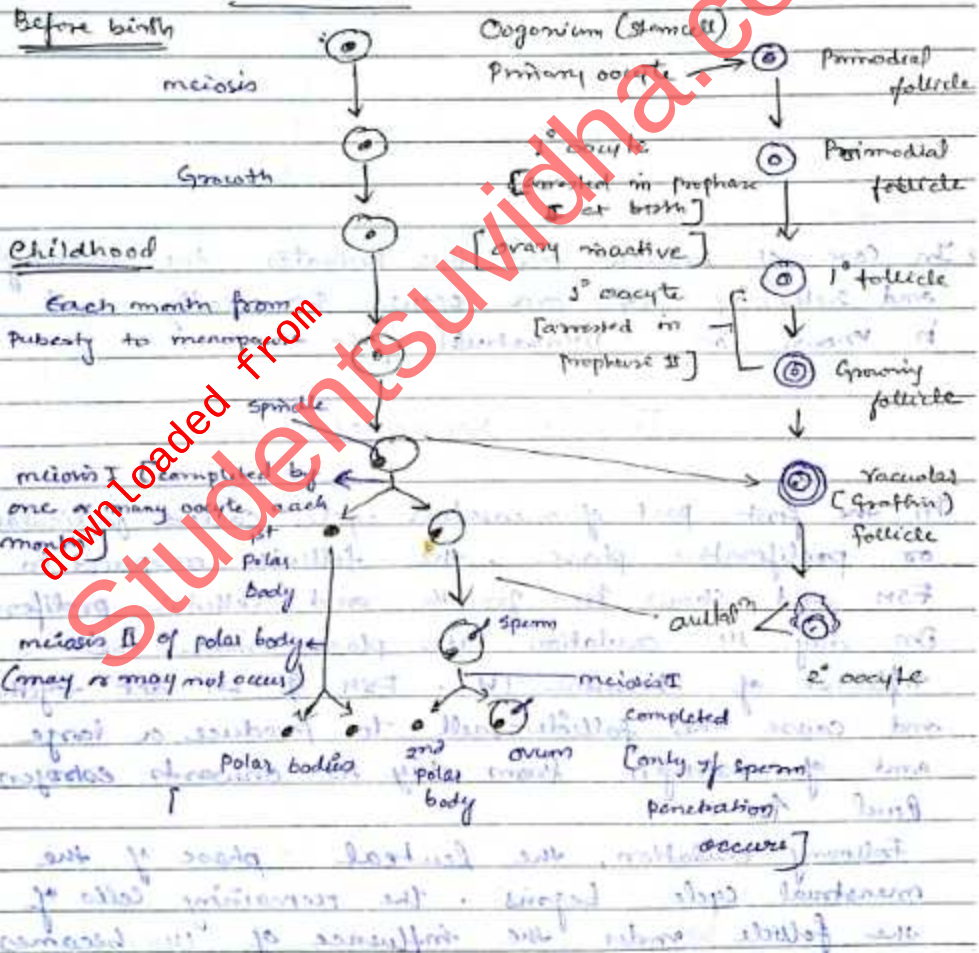


Appro. 1,000 or so Oogonia divide rapidly from 2nd to 7th month of gestation to roughly forms 7 million germ cells. After the 7th month most of the Oogonia die and the remaining enter the first meiotic division as the 1° oocyte. They are then arrested in 1st meiotic prophase at diplotene stage and stays like that.

till puberty. After onset of puberty gps of oocytes periodically resumes meiosis.

- When the subsequent stages are arrested the nucleus of the oocyte ↑es in size. The ↑se in size is due to a large amt of nuclear sap. The bloated nuclei of advance oocyte is referred to as germinal vesicle.

Meiotic events



- At puberty, under the influence of FSH, the 1° oocyte resumes

- In case of humans and other primates, the maturing and releasing of ova occurs periodically and is known as menstrual cycle

Female Reproductive Cycle

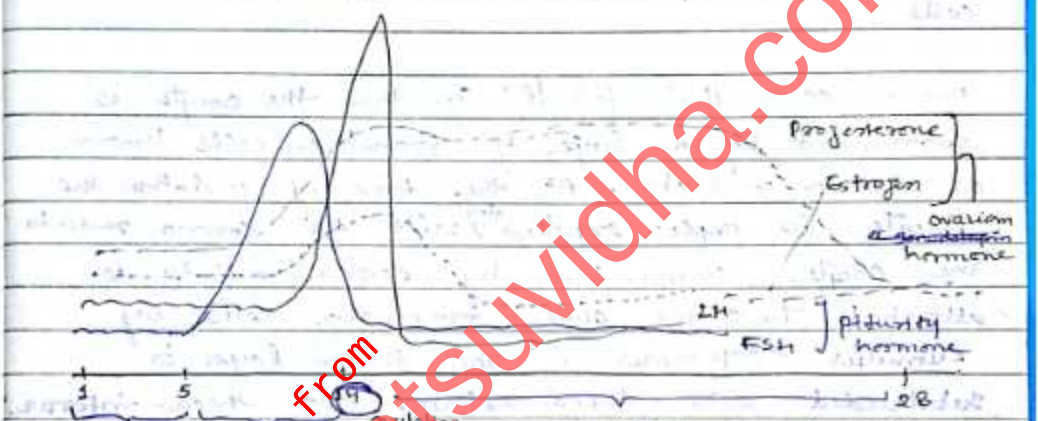
In the first part of menstrual cycle called follicular or proliferative phase, the follicles respond to FSH and show the growth and cellular proliferation. On day 14 ovulation takes place under the influence of hormone LH. FSH & LH act together and cause the follicle cell to produce a large amt of estrogen from day 10 onwards estrogen level rise.

Following ovulation, the luteal phase of the menstrual cycle begins. The remaining cells of the follicle under the influence of LH becomes

Q Hormonal regulation of menstrual cycle

Corpus luteum and secrete progesteron. This prepares the uterus for blastocyst implantation by thickening its wall and making it more vascular. If the ovum is not fertilise the corpus luteum degenerate and becomes the corpus albicans. The progesterone secretion ceases and the uterus wall slaighed off.

Menstrual cycle



Follicular development :

Primordial follicle will contain the 1° oocyte surrounded by a single layer of flattened epi. cells known as granulosa cells.

1° follicle contain the 1° oocyte surrounded by a single layer of granulosa cells. These cells are now cuboidal in shape. Also, the Zona pellucida will very clearly seen. [Its a glycoprotein

layer above or surrounding oocyte.]

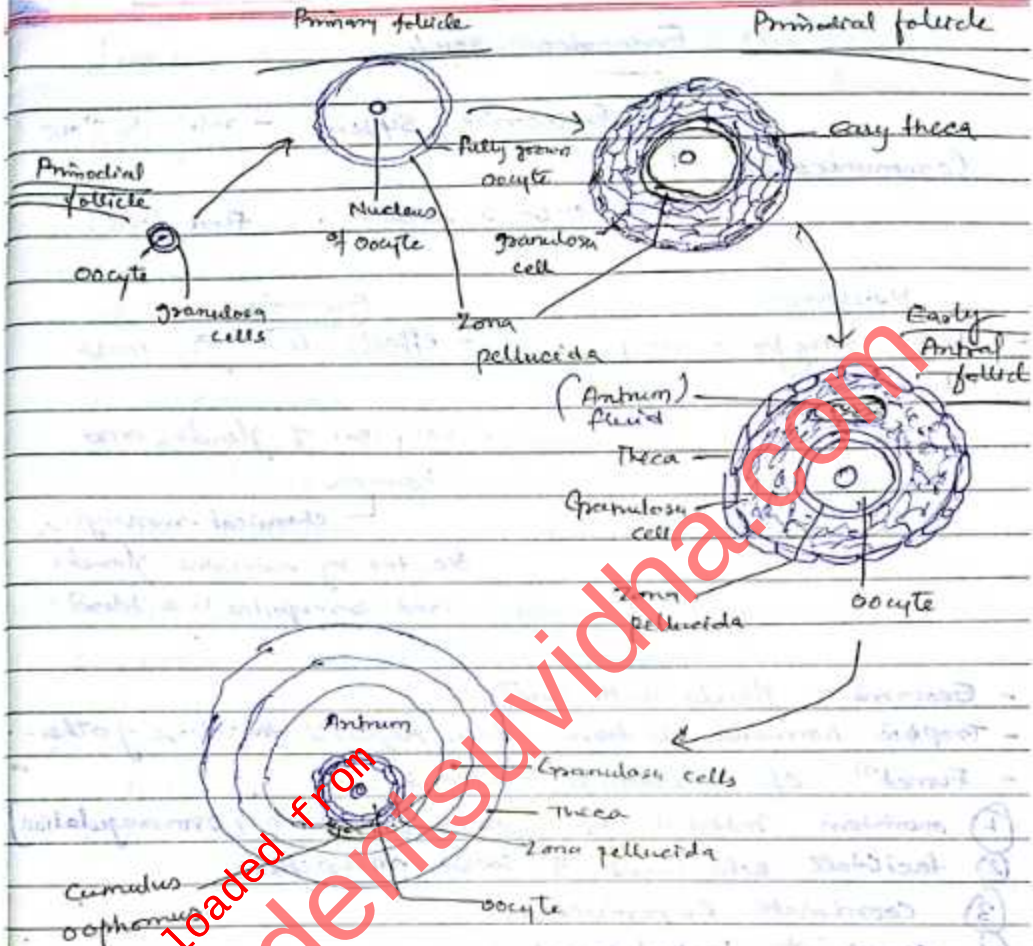
2° follicle - also known as pri-antral follicle. It contains the 1° follicle surrounded by zona pellucida and many layers of granulosa cells

3° follicle - It contains the oocyte, granulosa cells and also a fluid filled cavity called antrum. The granulosa cells are surrounded by thecal cells.

mature or graffian follicle: In this the oocyte is surrounded by a layer of granulosa cells known as corona radiata. At the time of ovulation the oocyte is expelled expelled with the corona radiata The oocytes surrounded by corona radiata is attached to the wall granulosa cells by cumulus oophorus. The theca layer is subdivided into theca externa and theca interna There is large fluid-filled cavity occupy almost the entire follicle and is known as antrum.

Corpus luteum: After ovulation the remaining follicle cells develop into the corpus luteum.

Corpus albicans - Abt 2 weeks after ovulation, the corpus luteum degenerates to form the corpus albicans.



Mature follicle or
Graffian follicle