

# CHAPTER:3-REPRODUCTION IN HUMAN

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- Human :- sexual reproduction, viviparous, unisexual.
- Each sex has pair of gonads, reproductive duct and accessory structure

## REPRODUCTIVE EVENTS

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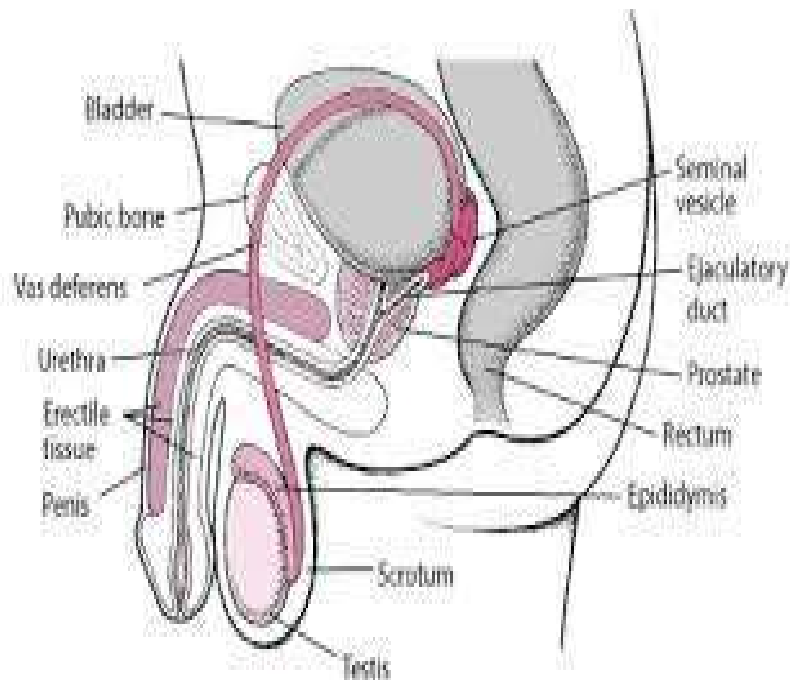
1. Gametogenesis- formation of gametes (sperms/ova)
2. Insemination—transfer of sperms in to the female genital tract
3. Fertilization—fusion of male and female gametes leading to formation of zygote
4. Implantation--development of blastocyst and its attachment to the uterine wall
5. Gestation—embryonic development (from conception to birth)
6. Parturition—delivery of the baby(childbirth)

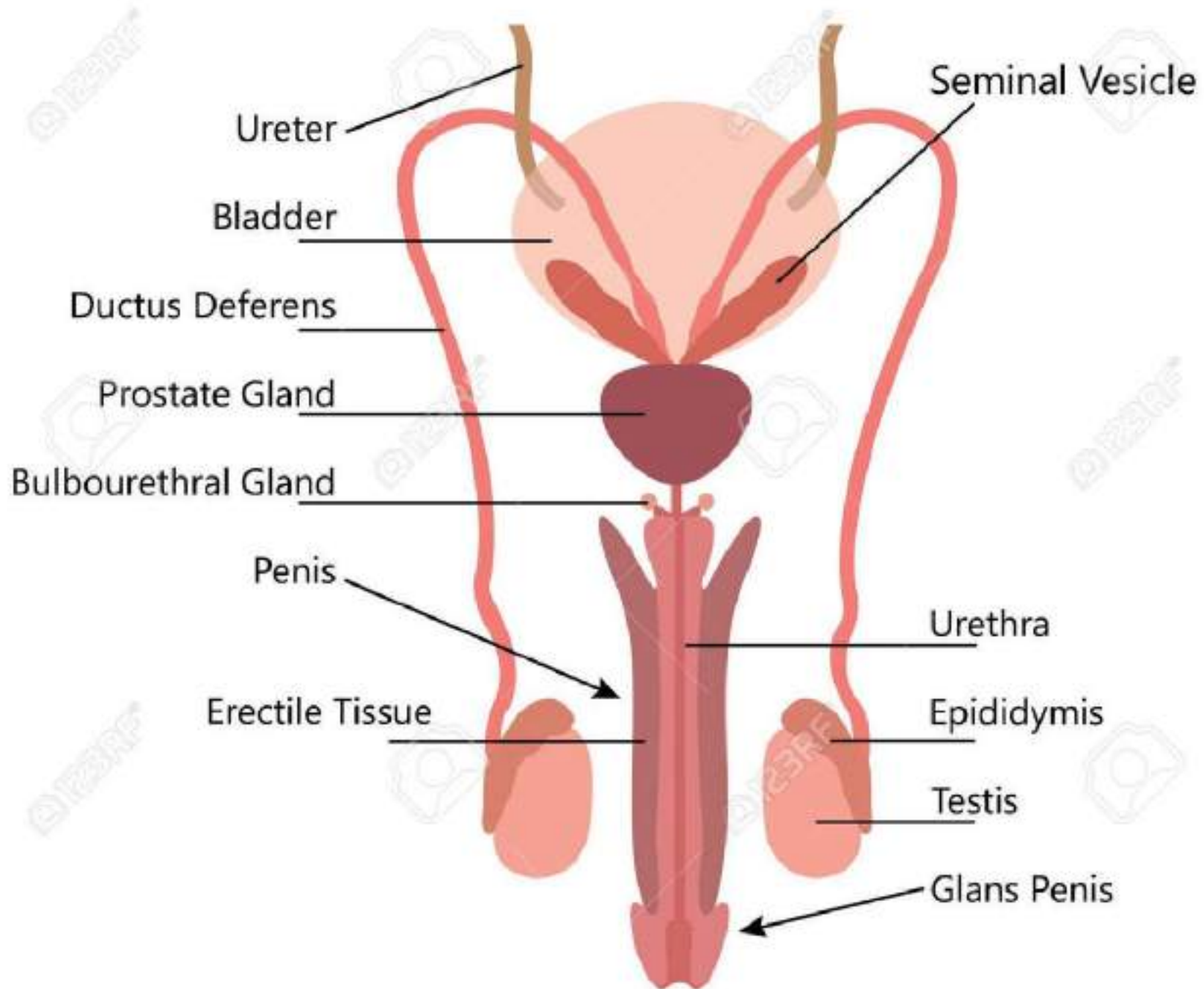
## MALE REPRODUCTIVE SYSTEM:-

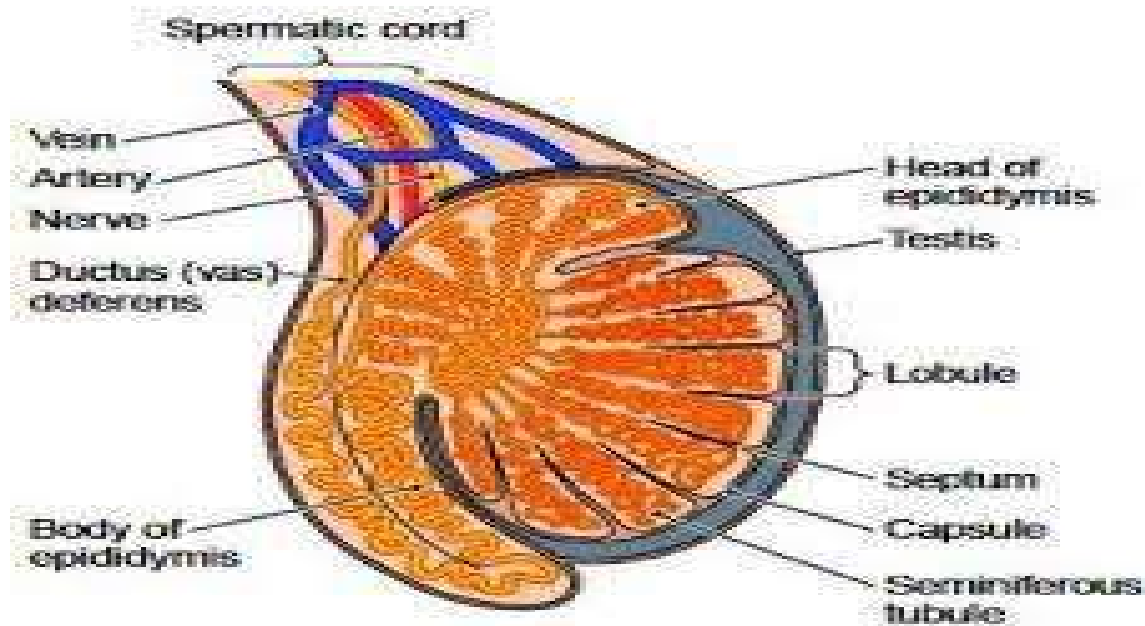
Located in pelvis region

The male reproductive system includes:-

- A pair of testis.
- Accessory ducts:-Rete testis, vasa efferentia, epididymis, vas deference.
- Accessory glands-Seminal vesicle, A prostrate gland, bulbourethral gland.
- External genitalia-Penis.

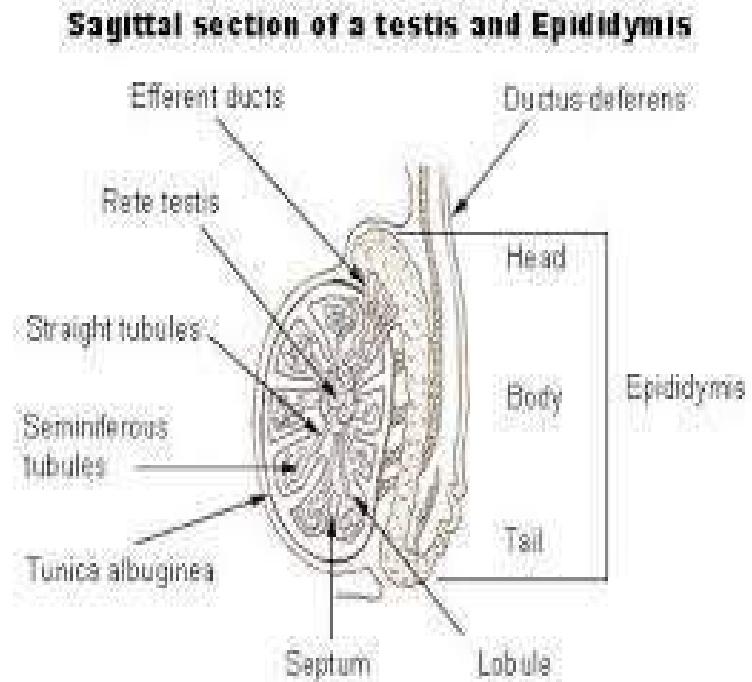
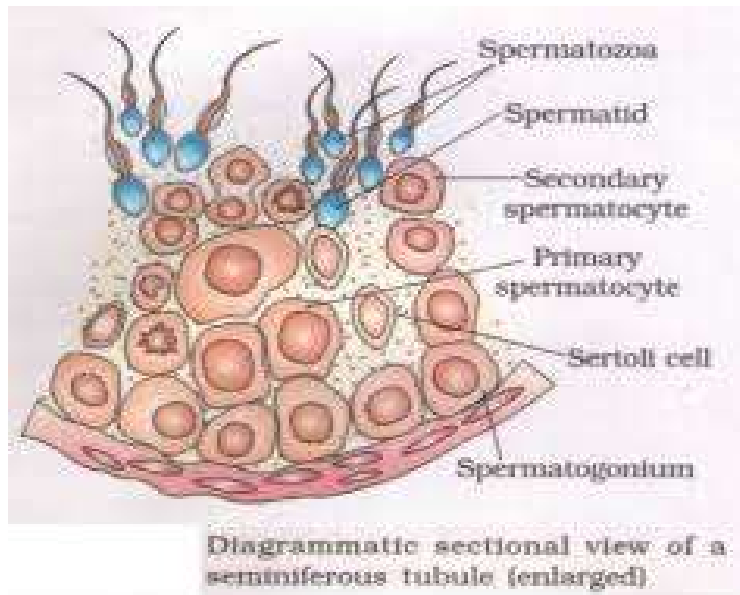






## TESTIS-

- Paired male gonads-produce sperm, hormones.
- Oval in shape, length 4-5 cm, a width 2 -3 cm.
- Situated out side of abdominal cavity within a pouch called scrotum.
- Scrotum -low temperature of testis (2-2.5 degree C lower than the body temperature )-Spermatogenesis.
- Testis is covered by a dense covering capsule tunica albuginea.
- In each testis 250 compartments called Testicular lobules.
- Each lobule -1-3 convoluted (coiled) Seminiferous tubules.



## SEMINIFEROUS TUBULES :-SPERM PRODUCTION

Lined on its inside by two types of cell

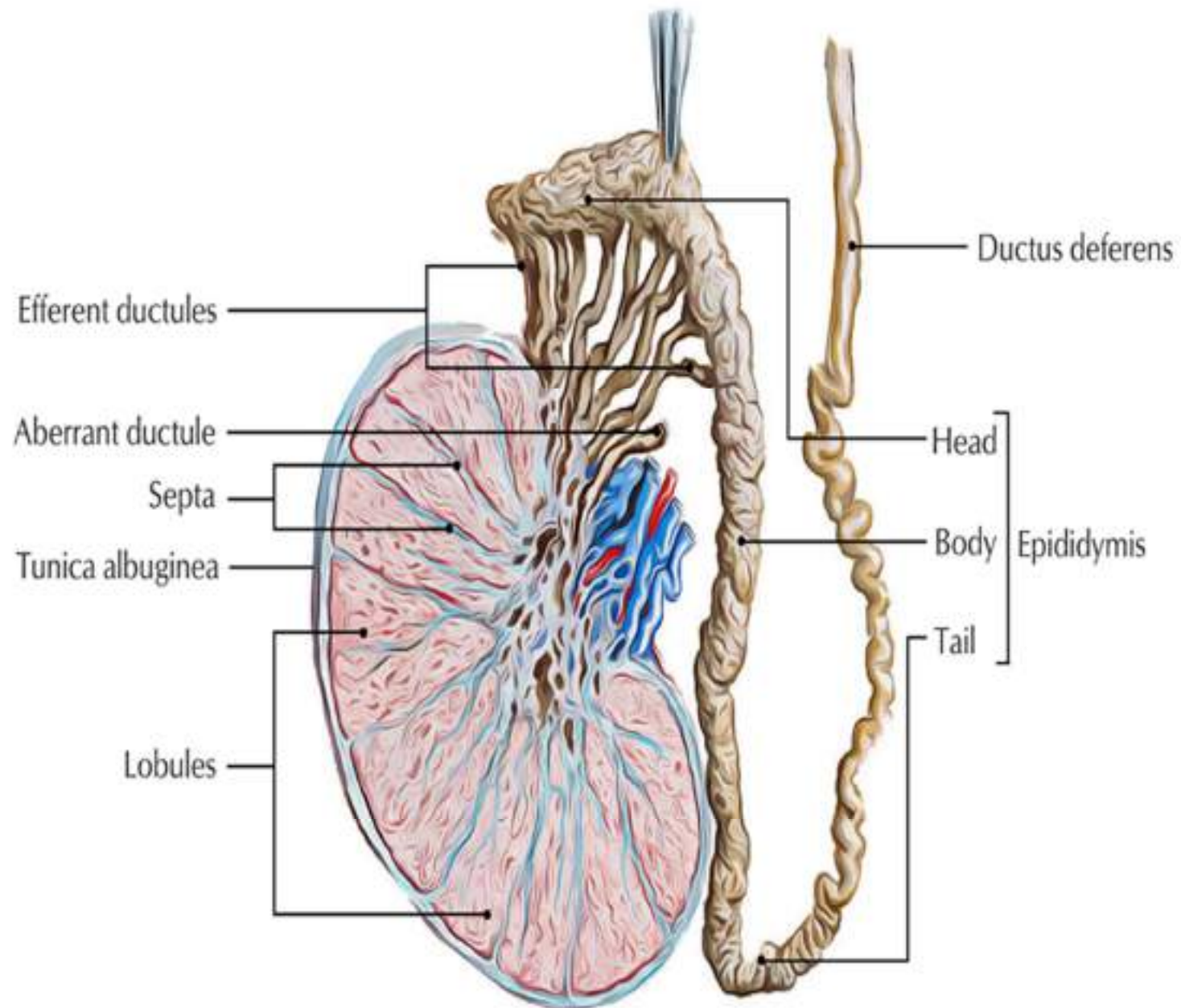
- Male germ cell-(spermatogonia) -Meiosis division -Sperm formation.
- Sertoli cells-(supporting cells) -Provides nutrition to germ cells.

Regions out side the seminiferous tubules called interstitial spaces, contains small blood vessels and interstitial cells/Leydig cell.

Leydig cell-Synthesis and secretes male hormones Androgen (Testosterone).

## ACCESSORY DUCTS

- Vase deference-receives duct-seminal vesicle.
- Opens into urethra as-ejaculatory duct.
- Function-Stores and transports sperm from testis to urethra.
- Urethra originates from urinary bladder extends through penis to external opening  
Urethral meatus.



## EXTERNAL GENITALIA-PENIS-

- External copulatory organ -external genitalia
- Made of special tissue- erection to facilitate insemination
- Enlarge distal end glans penis covered by loose skin called fore skin

# FEMALE REPRODUCTIVE SYSTEM

The female reproduction system is located in the pelvic region. It includes:

- 1.A pair of ovaries
- 2.A pair of oviduct.
- 3.Uterus
- 4.Cervix
- 5.Vagina
- 6.External genitalia.

- **oviducts, uterus, vagina** - accessory ducts
- a pair of the **mammary glands ( nourishment of offspring)**
- All parts are integrated structurally and functionally to support the processes of ovulation, fertilization ,pregnancy, birth and child canal.

## FEMALE GONAD -OVARIES-

- Ovaries are the female primary sex organs that produce female gametes-Ovum.
- It also produces several female steroid hormones-estrogen and progesterone.
- Ovaries located in the lower abdomen.

Each ovary is about 2-4 cm in length. These are connected to the pelvic wall and uterus by ligaments.

- Each ovary is covered by thin epithelium which enclose ovarian stroma.
- At the peripheral cortex follicles present and in
- medulla blood vessels and ovarian ligaments are present.

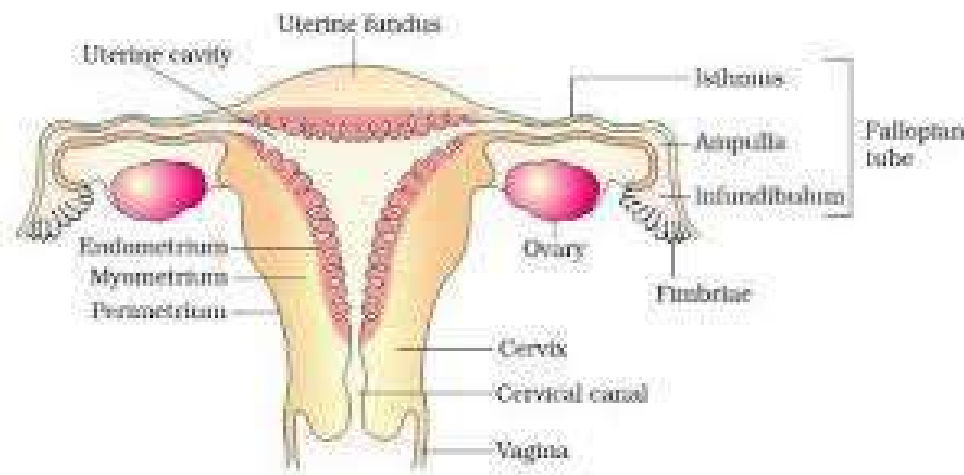


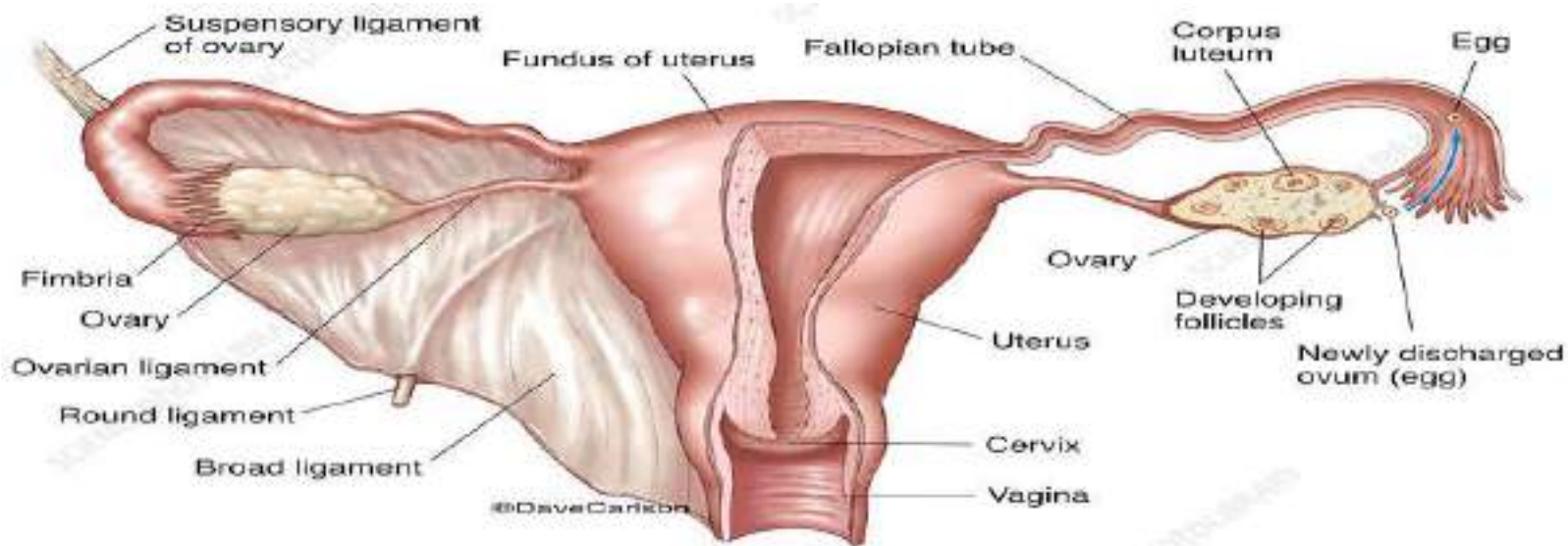
Figure 3.3 (b) Diagrammatic sectional view of the female reproductive system

## T.S. OF OVARY-

- Developing follicles in different
- stages.
- Primary follicle develops into secondary, tertiary and graafian follicle with mature ovum.
- One matures around 14<sup>th</sup> day of menstrual cycle and ruptures to release the oocyte -Ovulation.
- After release follicle filled with blood clot and then yellow cells called corpus luteum(secrets progesterone).
- Oviducts (fallopian tubules),Uterus and vagina-Accessory duct.

## ACCESSORY DUCTS-

- Oviduct fallopian tubule-10-12 length, from periphery of each ovary to uterus.
- Part closer to ovary funnel shaped infundibulum-edge finger like projection  
Fimbriae(collects of ovum after ovulation) wider part oviduct ampulla, isthmus  
has narrow lumen and joins uterus.



## THE ACCESSORY GLANDS/ORGANS

### FUNCTIONS OF THE SEMINAL VESICLES

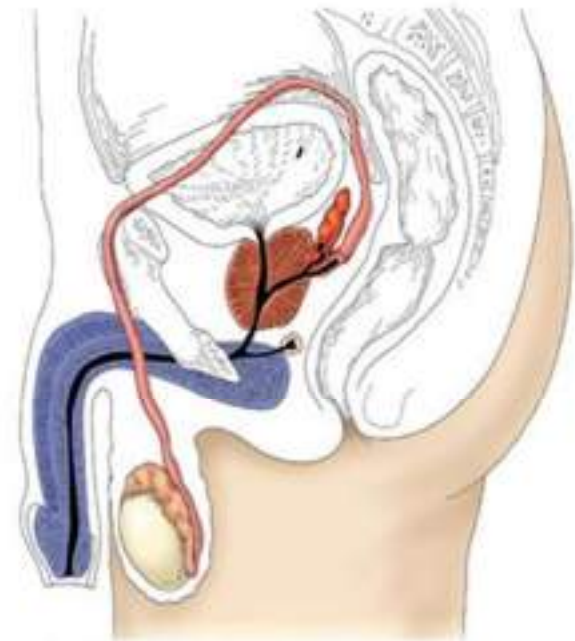
- The seminal vesicles secrete into the vas deferens an alkaline fluid (which neutralizes the acid in the vagina).
- It **secretes fructose** (which provides energy for the sperm).
- It also **secretes prostaglandins** (which increase sperm viability and stimulate female uterine contractions that help sperm move into the uterus).
- It **contributes about 40 – 60% of the total ejaculate.**

## **THE ACCESSORY GLANDS/ORGANS**

- **FUNCTIONS OF THE PROSTATE GLAND**
- It secretes a thin, milky, alkaline fluid that helps sperm viability.
- The fluid helps to neutralize the acidity of other seminal fluids.
- This helps to enhance sperm viability.
- The total secretion of the prostate accounts for about 20-30% of the total ejaculation.
- Assist in the first stage of male orgasm.

# Bulbourethral Glands

- Location
  - Inferior to the prostate gland
- Appearance
  - Tiny, pea size gland
- Function
  - Secrete a clear, thick alkaline mucus to neutralize acid from urine in the urethra.



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## UTERUS /WOMB AND VAGINA-

- Single uterus present in lower abdomen region also called womb.
- Hollow inverted pear shaped attached to pelvic wall by ligaments.
- Inside the uterus fertilized ovum grows and develops into embryo.
  - Opens into vagina through narrow cervix(cavity cervical canal).
  - Cervical canal along with vagina called Birth canal.
- The wall of the uterus has three layers of tissues:-
  - a. Perimetrium-External thin membranous.
  - b. Myometrium-middle thick layer of smooth muscles,  
strong contraction during delivery.

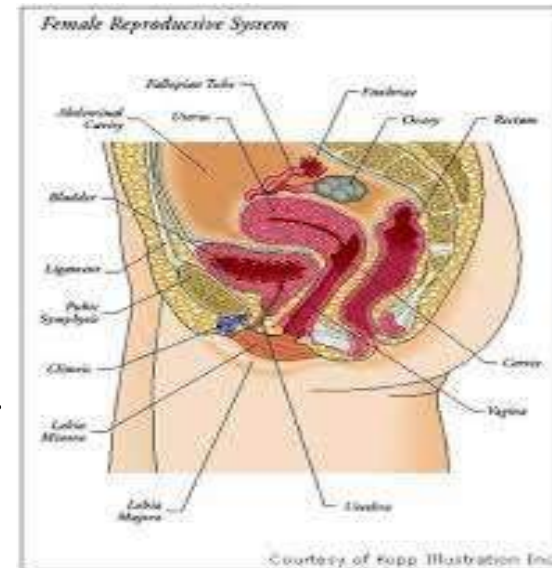
b. Endometrium- Inner glandular layer, lines uterine cavity, cyclical changes during menstrual cycle.

## EXTERNAL GENITALIA-

- Mons pubis, labia majora, labia minora, hymen, clitoris.
- Mons pubis is a pad of fatty tissue covered with hairs.
- Labia majora- fleshy folds of tissue surround the vaginal opening.
- Labia minora- Paired folds of tissue under labia majora.
- Clitoris- Tiny finger like structure, lies at the upper junction of two labia majora.

Hymen- Just inside the opening of the vagina often torn during the first coitus (intercourse).

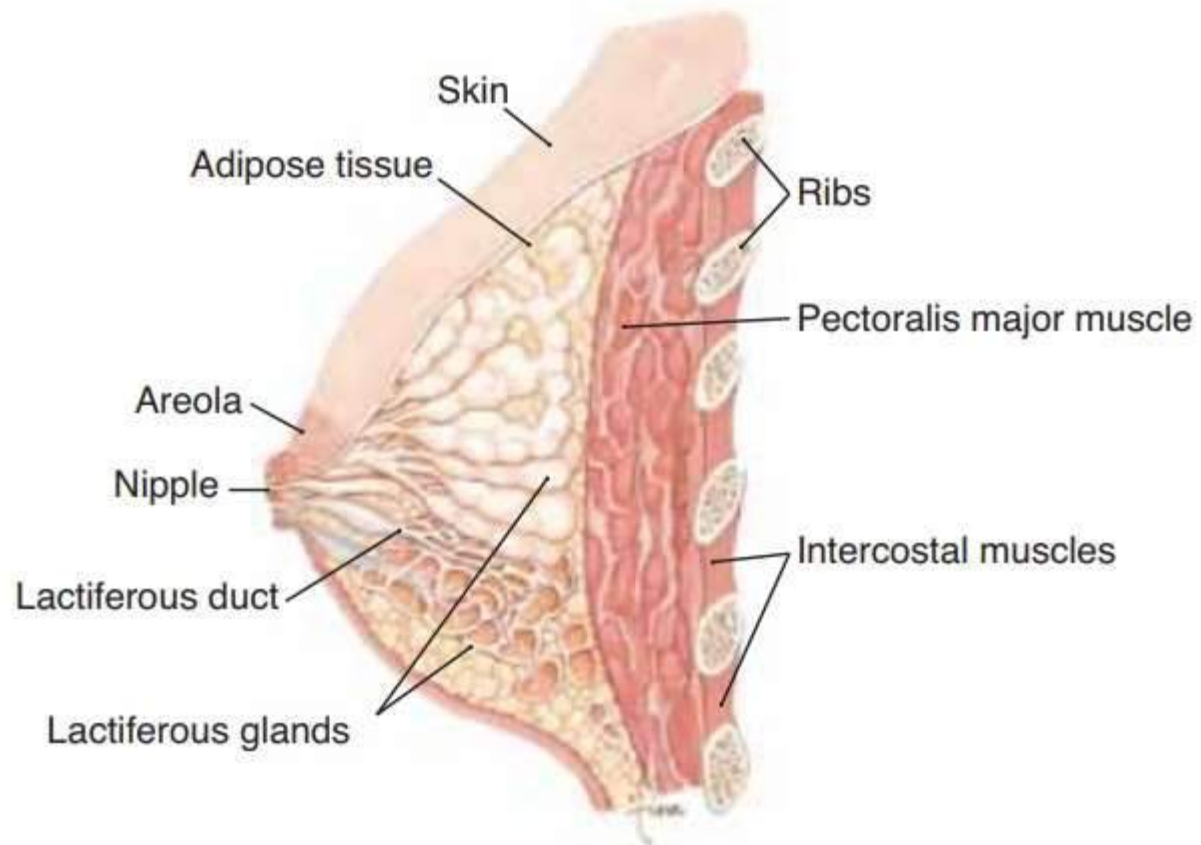
- The presence and absence of the hymen is not a reliable



indicator of virginity.

## MAMMARY GLAND-

- Paired glandular tissue variable amount of fat.
- Glandular tissue divided into 15-20 Mammary lobules containing cluster of cells called alveoli.
- Alveoli secrete milk- stored in lumen (alveoli).
- Tubules of each lobe join in mammary duct.
  - Many ducts join to form mammary ampulla-which is connected lactiferous duct through which milk is sucked out.



**Figure** Mammary gland shown in a mid-sagittal section.

## GAMETOGENESIS-

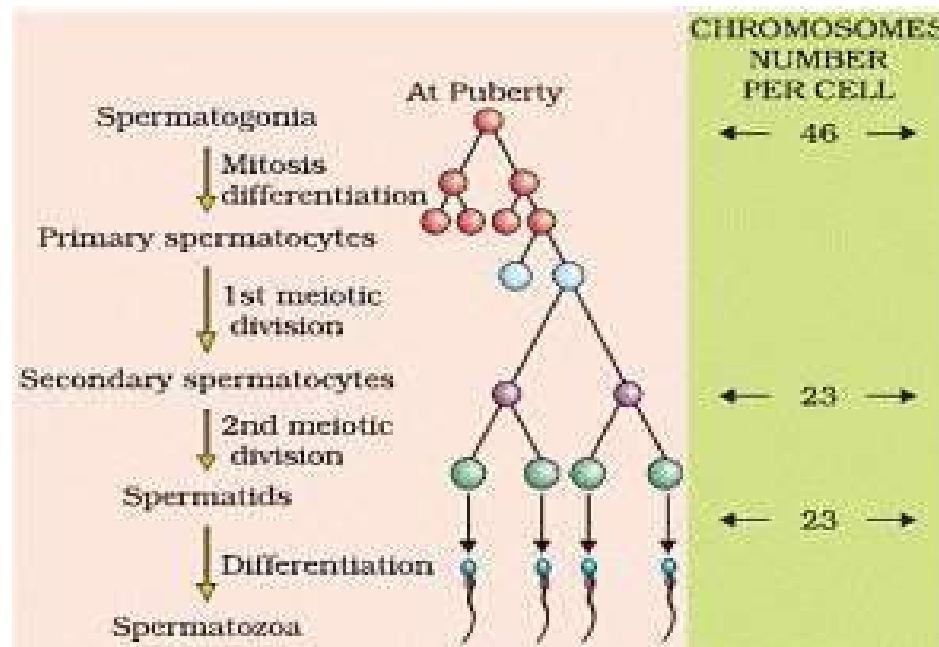
- The process of formation of haploid gametes from diploid germ cell in the gonad is called gametogenesis.
- Take place primary sex organ(Testis and ovary) and produce sperm and ova.
- In male- spermatogenesis(spermatogonia) begins at puberty.
  - In female-oogenesis(oogonia) and starts at embryonic stage.

## SPERMATOGENESIS-

It is the process of formation of spermatids. It involves three sub stages:-

### (1) Multiplication phase-

- The spermatogonia(spermatogonium) undergoes repeated mitotic division and forms large number of diploid spermatogonia cells(46).



## (2)Growth phase:

The spermatogonia cells grow in size by increasing cytoplasm and matures to form primary spermatocytes.

## (3). **Maturation phase:**

The diploid primary spermatocyte undergoes first meiosis resulting in the formation of two equal haploid cells called **secondary spermatocyte** (23 chromosomes).

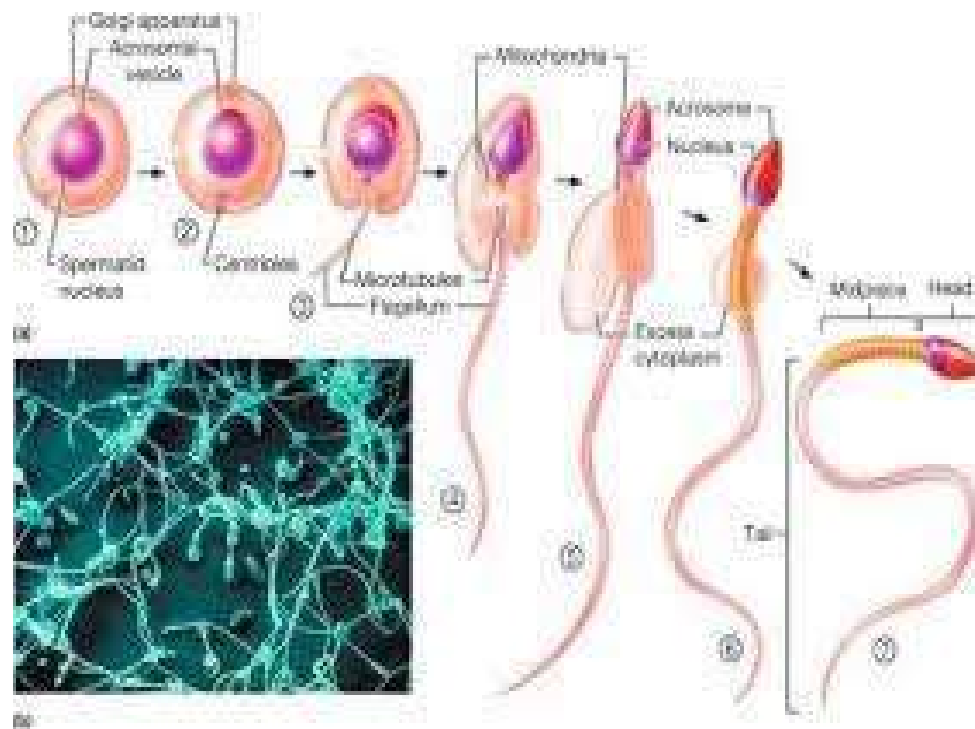
This later undergoes second meiotic division to produce four equal haploid **spermatids**

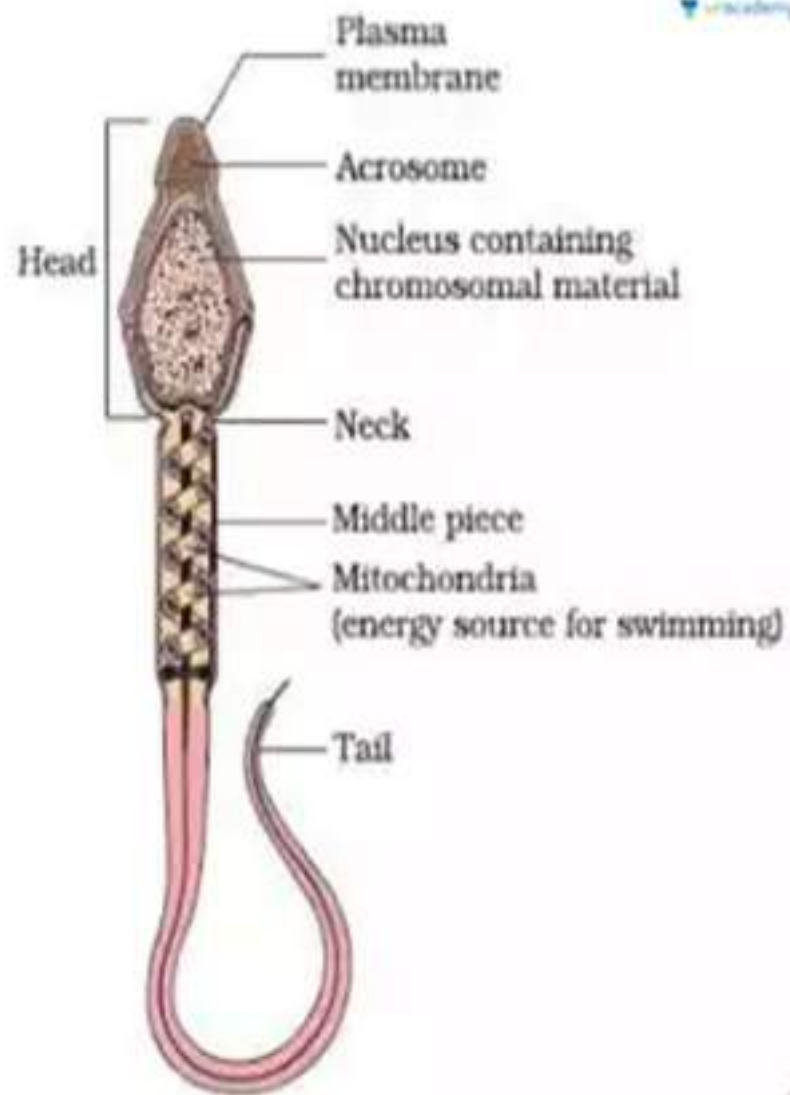
## **Spermiogenesis:**

Inactive non-motile spermatids are transformed into active motile spermatozoa (sperms)

- After spermiogenesis sperm head- embedded in Sertoli cells &

release from seminiferous tubules- **Spermiation.**





# SPERM STRUCTURE

- Plasma membrane envelops entire body.

Part of sperm	Details
Head	<ul style="list-style-type: none"><li>• Elongated haploid nucleus</li><li>• Anterior cap like acrosome</li><li>• Acrosome has hydrolytic enzymes (hyaluronidase). It is derived from Golgi complex during division - fertilization of ovum</li></ul>
Neck	Connecting head and middle piece
Middle part	<ul style="list-style-type: none"><li>• Many mitochondria (produce energy for the movement of tail - motility)</li></ul>
Tail	<ul style="list-style-type: none"><li>• Long slender</li><li>• Vibration</li></ul>

- 200-300 million sperms – one ejaculation      60% must have normal shape, size and 40% motility

## OÖGENESIS-

The process of formation of haploid female gamete ovum in the follicles of ovary is called oögenesis.

## OÖGONIA-

Gamete mother cell ( $2n$ )

At birth many million in fetal ovary

## Primary oocyte

- Prophase-I of meiotic division.
- Temporary arrested in this stage

## PRIMARY FOLLICLE-

- Primary oocyte + granulosa cells
- Many follicles degenerate from birth to puberty
- 60,000 to 80,000 in each ovary (puberty)

## SECONDARY FOLLICLE-

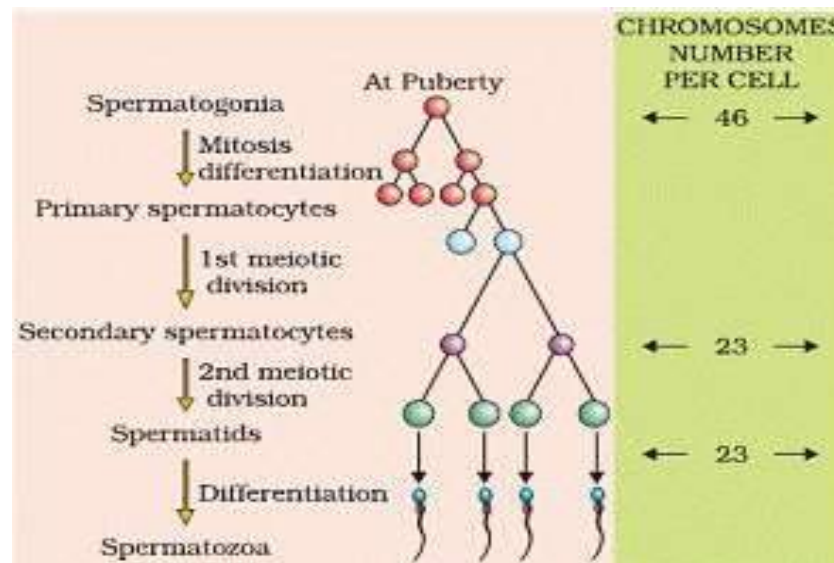
- Primary follicles surrounded by more granulosa cells & theca

## Tertiary follicle-

- Secondary follicles-fluid filled cavity-antrum
- Theca layer- theca interna (vascular) and theca externa(fibrous).
- Theca interna 10-15 layer follicle cells (membrane granulosa).
- Primary oocyte ( $2n$ ) within follicle size increase and first meiotic division-unequal large haploid secondary oocyte and first polar body .

## Secondary oocyte-

- Retain nutrient reach cytoplasm of primary oocyte.
- Tertiary follicle into graafian follicle.
- Secondary oocyte (ovum) -zona pellucida(membrane).
- Graafian follicle ruptures and release ovum



## OÖGENESIS-

The process of formation of haploid female gamete ovum in the follicles of ovary is called oögenesis.

- Oögenesis starts from embryonic stage.
- Germinal epithelium of ovary divides mitotically to produce millions of
- gamete mother cell or oogonia.
- No oogonia formed or added after birth.
- Oogonia enters into meiosis-I. It proceeds Prophase-1 , get suspended and forms primary Oocytes.
- during puberty, the primary oocyte restarts its first meiotic division.

### 1.Multiplication phase:

- Certain primary germ cells (large size & nuclei) of germinal epithelium lining ovary undergo rapid mitotic division.
  - It result in formation of group of diploid egg mother cell oogonia.
  - Each group of cells forms a rounded mass called egg nest.

## **2. GROWTH PHASE-**

- **Long duration 12-13 year.**
- **One of the diploid oogonia undergoes growth increasing in cytoplasm and accumulation of yolk and transform to enlarge oogonia called primary oocyte(2n).**
- **Other oogonia form single layered follicular epithelium-primary follicle.**
- **Primary follicle surrounded by more granulosa cell-Secondary follicle.**
- **Secondary follicle-fluid filled antral cavity-Antrum- tertiary follicle.**
- **Tertiary follicle- Graafian follicle.**

### 3. Maturation phase-

- A fully grown primary oocyte ( $2n$ ) undergoes I meiotic division results in the formation of two unequal sized haploid cells.
- The large secondary oocyte (undergoes II meiotic division to form a large ootid/ovum and a small 2<sup>nd</sup> polar body.
- Secondary oocyte forms new membrane -Zona pellucida-Graafian follicle.
- The 1<sup>st</sup> polar body also undergoes equal division to produce two cells.
- Thus during oogenesis four cells are produced. among them one is functional ootid and three are non functional polar bodies. The ootid with very little change becomes an ovum.

## **MENSTRUAL CYCLE:**

- Reproductive cycle of female primates is called menstrual cycle.
- Menstruation is the term given to the periodic discharge of blood, tissue, fluid and mucus from the reproductive organs of sexually mature females. The flow usually lasts from 3 - 6 days each month and is caused by a sudden reduction in the hormones estrogen and progesterone.
- The menstrual cycle begins when a female reaches the age of puberty. The first menstruation begins at puberty is called menarche.
- During the menstrual cycle the uterus endometrium prepares itself for implantation of a fertilized egg. If fertilization does not occur the uterine lining is shed from the body.
- Menstrual cycle repeated at an average interval of 28 days. One ovum is released in the middle usually 14th day of each menstrual cycle.

## **Phases of menstrual cycle-**

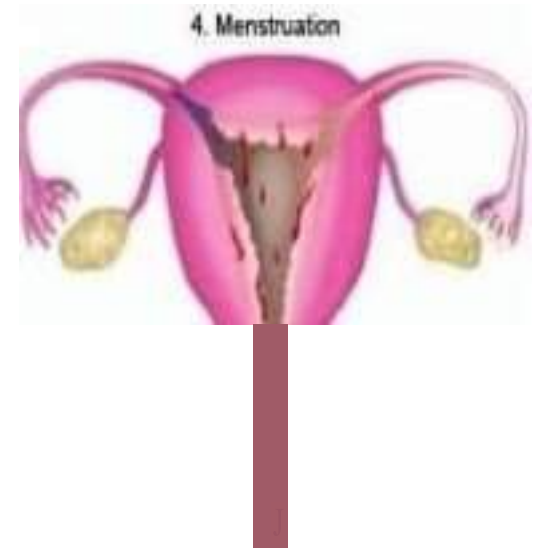
- '... The cycle can be divided into four

Phases:

1. Menstrual phase (bleeding period).
2. Follicular (before the egg is released).
3. Ovulatory phase (egg is released).
4. Leuteal (after released of the egg)

## 1. Menstrual phase (bleeding period)

- It is the 1st phase of menstrual cycle lasts for 3-5 days.
- Breakdown of endometrial lining and blood vessel occurs. It leads to bleeding comes out through vagina.
- It occurs only when ovum released and fertilization does not occurs.
  - Lack of menstruation is the indication of pregnancy.



## 2. Follicular phase:-

- 1-14 days
- Menstrual phase followed by follicular phase.
- Primary follicle grows -Graafian follicle and endometrium regenerates-proliferation.

- Gonadotrophin(pituitary gland) -FSH and LH increases .
- Estrogen secretion from growing follicles.
- FSH and LH attains peak in middle of cycle(14 day).
- Rapid secretion of LH-LH surge induces graafian follicle to rupture and release

Ovum(ovulation).

### 3.Leuteal phase/secretory phase-

- This phase begins after ovulation.
- Ruptured Graafian follicle transformed into corpus luteum. It produces large amount of **progesterone**- essential to maintain & proliferate endometrium
- Endometrium- necessary for implantation of fertilized egg/ ovum & does not shed during pregnancy
- If fertilization occurs corpus luteum grows further and pregnancy continues. Menstrual cycle stops up.
- In absence of fertilization, Graaffian follicle transforms to yellow

bodied Corpus luteum

- **Progesterone** level decreases. C. luteum degenerates to **Corpus albican**
- Decrease in Progesterone leads to menstruation
- Menstrual cycles ceases at 50years- **Menopause**.
- Cyclic menstruation is indicator of normal reproductive phase & extends between menarche & menopause.

## Fertilization and Implantation-

- Sperm contacts with zona pellucida of ovum & induces changes in membrane that blocks entry of other sperm
- Acrosome of sperm secretes lytic enzymes (hyaluronidase) helps in penetration into the ovum cytoplasm through zona pellucida & plasma membrane
- Meiotic division of secondary oocyte after



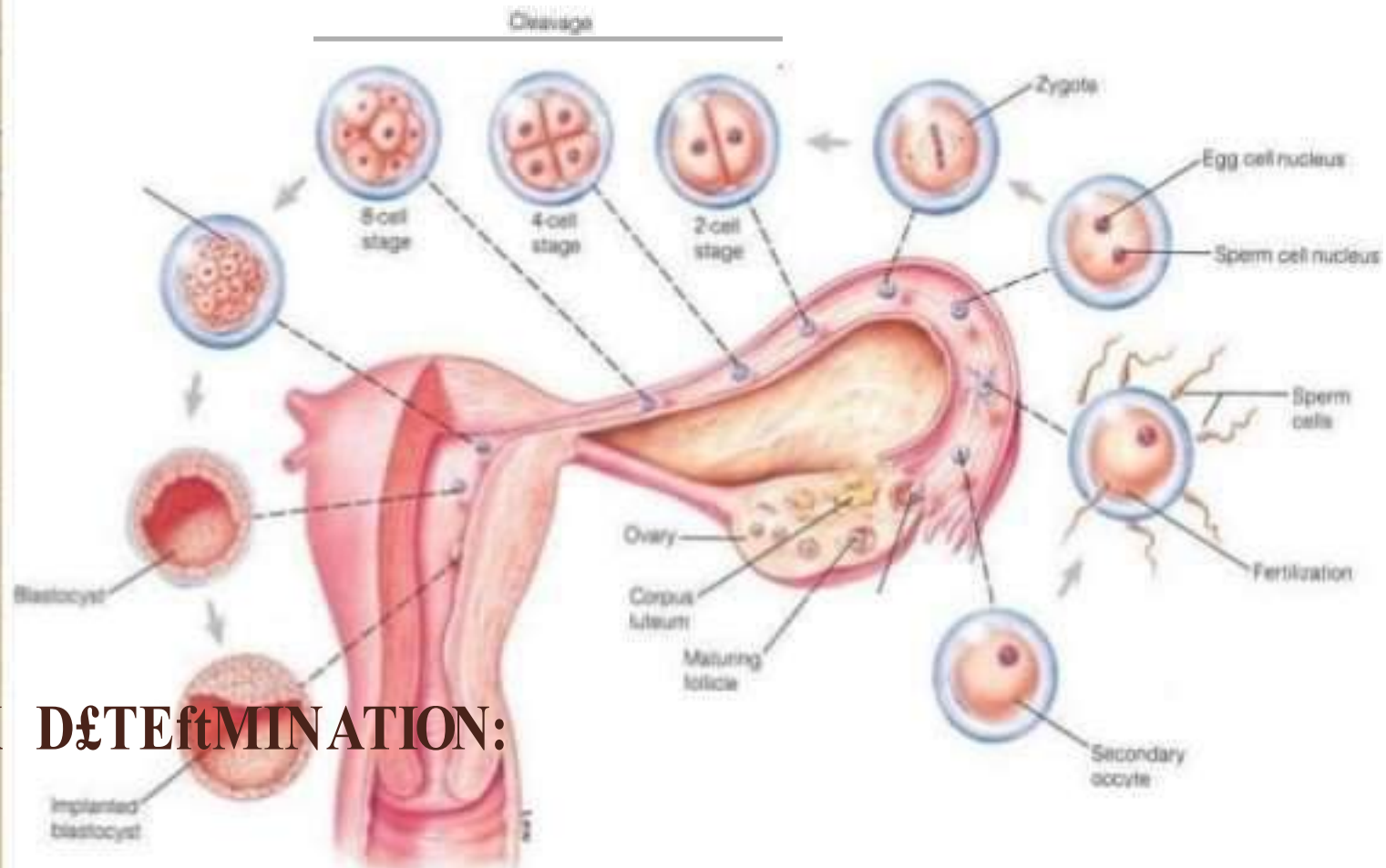
sperm enters plasma membrane of the ovum.

- Second meiotic division – second polar body and ovum / ootid —
- Nucleus of Ovum + Sperm = **Zygote**

Sex of baby decided this stage.

- During copulation (coitus) semen is released by the penis into the vagina is called *insemination*.
- The motile sperms swim rapidly, pass through the cervix, enter into the uterus and finally reach the junction of the isthmus and ampulla (ampullary-isthmic junction) of the fallopian tube
- Fertilization - if the ovum and sperms are transported simultaneously to the ampullary isthmic junction.

- The process of fusion of a sperm with an ovum is called **Fertilisation.**



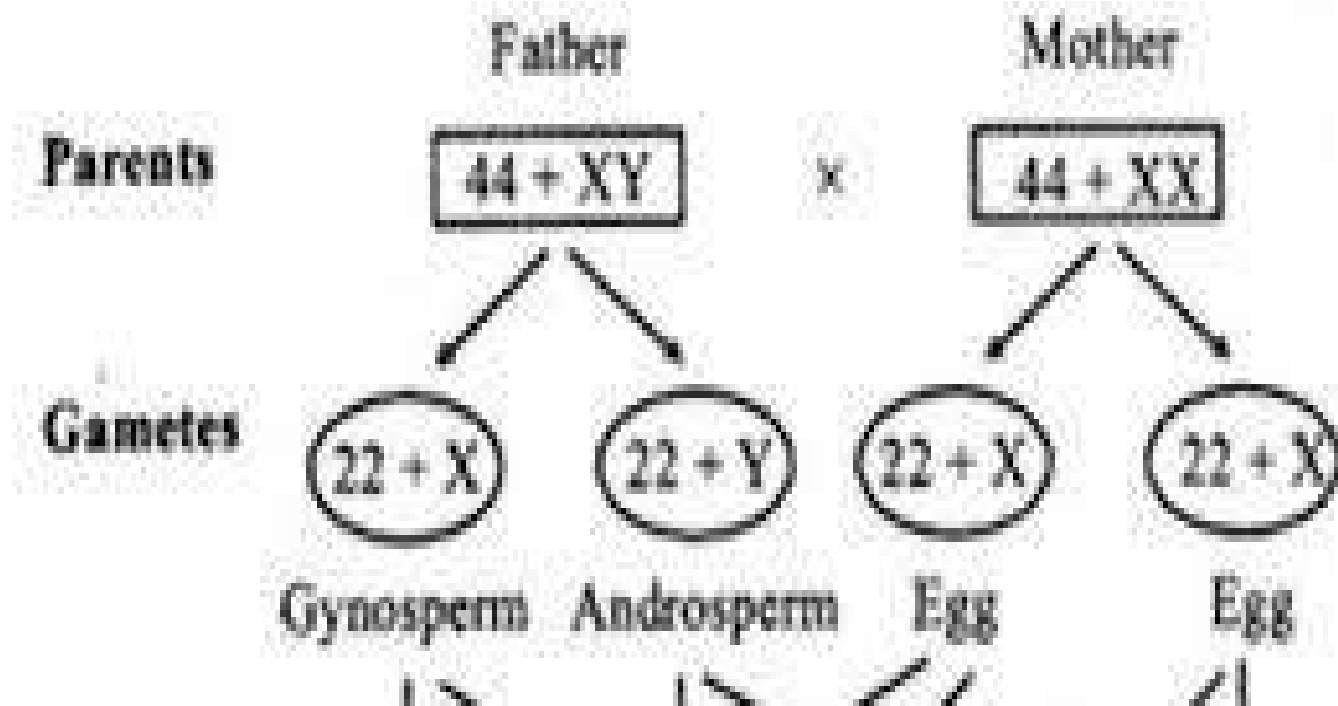
## SEX DETERMINATION:

- Sex of a baby is determined during fertilization and in the zygote.
- Sex is determined by the sex-chromosomes present in zygote.
- Human contain 2 sets of chromosome- autosome & sex chromosome.

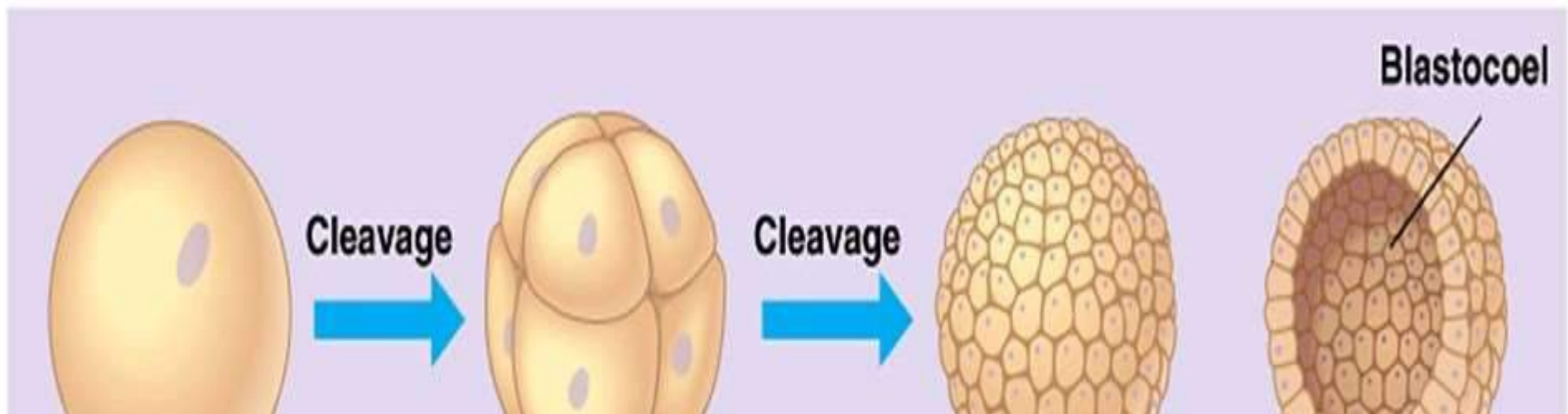
- Sex chromosome present in human female is XX and male XY.

All the female gametes (ova) produced has 22 autosome and only 'X' chromosome.

- Sperms produced by male, 50% has 22 autosome with 'X' and 50 % has 22 autosome with 'Y' chromosome.
- The fusion of sperm with Y chromosome with ovum (X) results in male baby- XY & fusion of sperm with X chromosome with ovum (X) results in female baby.(XX).
- Zygote carrying XX chromosomes develop into female and with XY chromosome develops into male.



- Zygote from isthmus (oviduct) to uterus-mitotic division, first cleavage in first 36 hrs.
- 2,4,8,16 daughter cells- blastomeres
- Embryo with 8 -16 blastomeres -**Morula**
- Morula -division continues -hollow ball called **Blastocyst**.
- The blastomeres in blastocyst arranged into two layers. An outer layer called trophoblast and an inner cells called inner cell mass.
- Trophoblast cells attaches to the endometrium. It helps in implantation and development of placenta.
- Inner cell mass gets differentiated into the embryo.
- The complete attachment of Blastocyst to the uterine endometrium is called **i m p l a n t a t i o n**.



## PREGNANCY & EMBRYONIC DEVELOPMENT

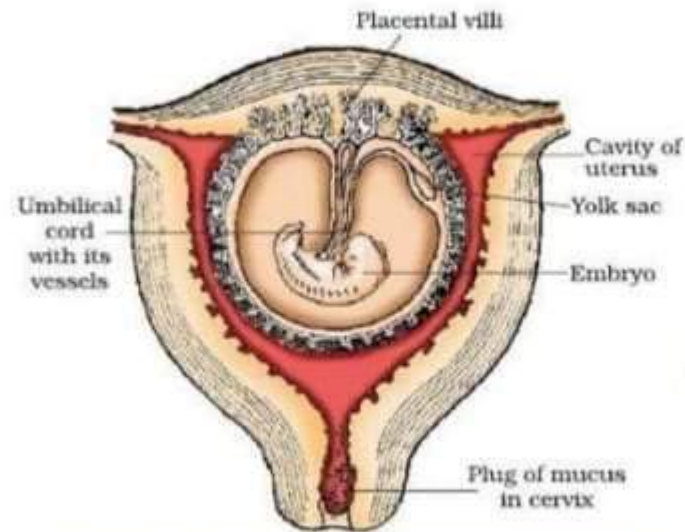
- Chorionic villi - finger like projections on trophoblast
- Villi surrounded by maternal blood, uterine tissues
- Villi & uterine tissue - interdigitated - structural & functional unit between foetus (embryo) & maternal body - Placenta
- Inner cell mass - ectoderm, mesoderm, endoderm - different organs

### **Function of Placenta:**

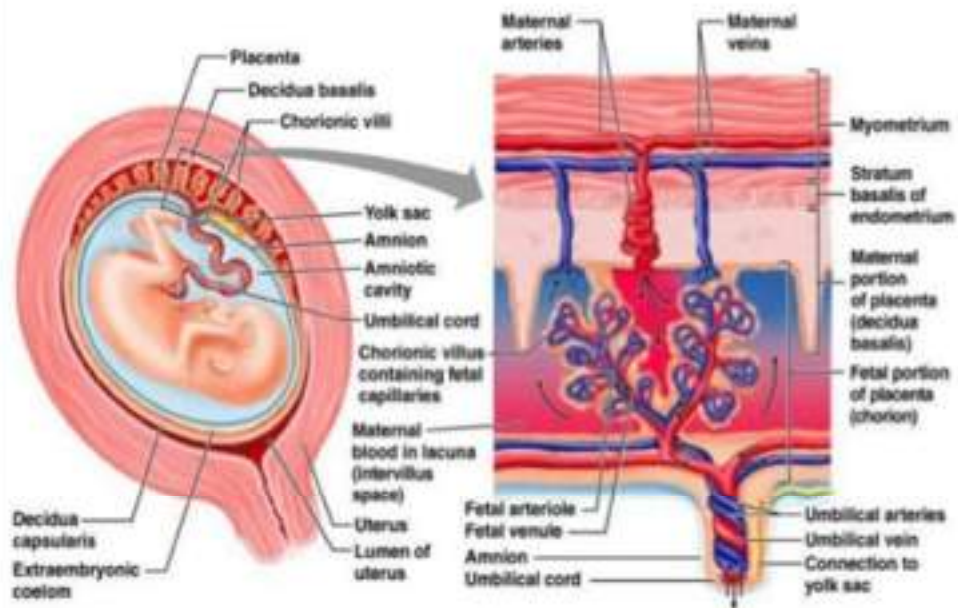
1. Helps in nutrition of embryo & Transports nutrients like amino acids, sugars, vitamins from maternal blood to fetal blood.
2. Respiration of embryo - exchange of  $O_2$  &  $CO_2$  through diffusion from fetal blood to maternal blood vice versa.
3. Excretion - nitrogenous waste like urea into maternal blood

4. Endocrine gland- estrogen, progesterone, human chorionic gonadotropin (h CG) & human placental lactogen (h PL)

s. Antibodies- diphtheria, small pox, measles etc., pass to fetus from maternal




**Figure 12.** The human foetus within the uterus



(f) 13-week fetus

(g)

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- Later phase of pregnancy **relaxin**- secreted by ovary
  - hCG ,hPL & relaxin- only during pregnancy
  - Other hormones like estrogen, progesterone, cortisol, prolactin, thyroxin- increases several fold in maternal blood
  - Hormones- supporting fetal growth, metabolic changes in mother & maintenance of pregnancy
  - After implantation- inner cell mass differentiates- outer **ectoderm** and inner **endoderm** & middle **mesoderm** soon appears- tissue & organs
  - Inner cell mass contain certain cells- **Stem** cells- potency to give rise to all tissues & organs
  - Pregnancy will last for 9 months divided as 3 trimesters - 1<sup>st</sup> :- end of 3<sup>rd</sup> month, 2<sup>nd</sup> :- end of 6<sup>th</sup> month & 3<sup>rd</sup> :- end of 9<sup>th</sup> month



## LACTATION

- Mammary gland of female undergo differentiation & produce milk towards end of pregnancy- **Lactation**
- The mammary gland starts producing milk towards the end of the pregnancy.
- Milk produced during initial days of lactation is called **colostrum**. It contains several antibodies which provide immunity (passive) or resistance to the new born baby.
- The milk production is controlled by Lacto trophic or prolactin hormone secreted by pituitary.
- Breast feeding during initial period of infant growth is recommended for bringing up a healthy baby

- 1<sup>st</sup> month- embryo heart formed
- First sign- listening heart sound through stethoscope
- 2<sup>nd</sup> month- limbs & digits, end of 12 weeks(first trimester)- major organ system- limbs, external genital organs
- 1<sup>st</sup> movement & hair on head- during fifth month
- End of 24 week (second trimester)- body covered with fine hair, eye lid separate, eyelashes formed
- End of nine month- foetus fully developed & ready for delivery



barrier- toxic chemicals & germs

. Effective



## PARTURITION

- The period of pregnancy is called **gestation** period. It is 9 months in human.
- The delivery of foetus is called **parturition**. It occurs by the contraction of uterine Myometrium.
- The signal of parturition is originated from the fully developed foetus and the placenta. It induces mild contraction of uterus called **fetal ejection reflex**.
- Hormone (adrenal gland) secreted by foetus diffuses to maternal blood & stimulate oxytocin secretion
- Oxytocin causes forceful contraction of myometrium (labour pain) & stimulates further secretion of oxytocin
- Stimulatory reflex between uterine contraction & Oxytocin secretion continues inducing stronger contraction & pushes the foetus by dilated cervix (birth canal) facilitated by **relaxin- parturition**
- After delivery the placenta is also expelled out of the uterus.



## LACTATION

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