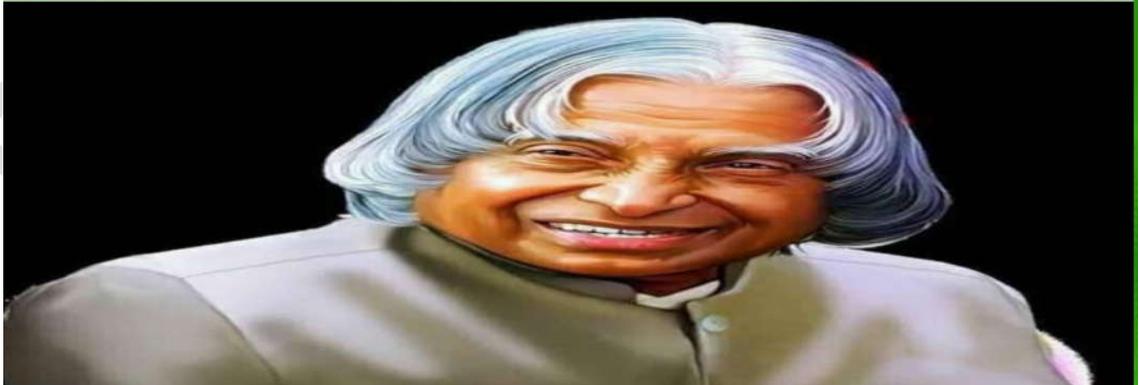


KAMARAJAR HIGHER SECONDARY SCHOOL, BOMMAIKUTTAIMEDU, NAMAKKAL-19



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2.HUMAN REPRODUCTION

Four main functions of Human Reproductive System:

- To produce the gametes namely sperms and ova
- To transport and sustain the gametes
- To nurture the developing offsprings.
- To produce hormones.

Major events in reproduction:

- Gametogenesis** : Formation of gametes by spermatogenesis and oogenesis.
- Insemination** : Transfer of sperms by the male into the female genital tract.
- Fertilization** : Fusion of male and female gametes to form zygote.
- Cleavage** : Rapid mitotic divisions of the zygote which convert the single cell. zygote into a multicellular structure called *blastocyst*.
- Implantation** : Attachment of blastocyst to the uterine wall.
- Placentation** : Formation of placenta which is the intimate connection between foetus and uterine wall of the mother for exchange of nutrients.
- Gastrulation** : It is a process by which blastocyst is changed into a gastrula with three primary germ layers.
- Organogenesis** : Formation of specific tissues, organs and organ system from three germ layers.
- Parturition** : Expulsion of the foetus from the mother's womb.

Functions of Primary Reproductive Organ:

- Testis is responsible for producing sperm.
- Ovary is responsible for producing ova.
- Hormones secreted by pituitary gland and gonads are help in the development of
 - Secondary sexual character.
 - Maturation of reproductive system
 - Regulation of normal functioning of reproductive system.

Functions of accessory reproductive organ:

- They help in transport and to sustain the gametes.
- They help to nurture the developing offsprings

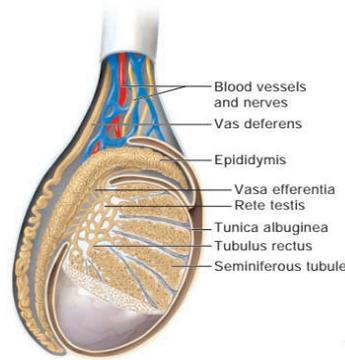
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Male Reproductive System

Male reproductive system consists of

- A pair of testis
- Accessory ducts
- Accessory glands
- External genitalia

Testes:



- It is the primary male sex organ
- They are paired ovoid bodies
- They are located in the scrotum.

Scrotum:

- It is a sac of skin
- It hangs outside the abdominal cavity
- It acts as a *thermoregulator* for spermatogenesis.

Reason:

- Viable sperms cannot be produced at normal body temperature.
- Scrotum is placed outside the abdominal cavity- which provide a temperature 2-3 °C lower than that of normal internal body temperature.

Semniferous tubule:

- Each testes is covered by an outermost fibrous called *tunica albuginea*.
- It is divided into **200 - 250** lobules by septum.
- Each lobules containing **2-4** highly coiled tubule called *semniferous tubules*.
- Semniferous tubule - is the site for sperm production.
- **Reason:** It forms **80%** of testicular substance.
- It consists of two types of cells - **Sertoli cells**
 - **Spermatogonic cells**

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KAMARAJAR HIGHER SECONDARY SCHOOL, BONMAIKUTTAIMEDU, NAMAKKAL-19**i) Sertolicells: (Nurse cells)**

- It is elongated and pyramidal in shape.
- **Function** – It provides nourishment to sperm till maturation.
- It secretes a hormone inhibitin which involved in negative feed back mechanism.

ii) Spermatogonic cells:

- These cells are differentiated to produce *spermatozoa* by meiotic cell division.

iii) Leydig cells: (Interstitial cells)

- They are embedded in the soft connective tissue surrounding the somniferous tubule.
- They are endocrine in nature.
- Function : It secrete androgens namely testosterone which initiates the process of spermatogenesis.
- They also contain some immune competent cells.

Accessory ducts:

- They consists of rete testis, vasa efferentia, epididymis and vas deferens.

Tubulus rectus:

- Semniferous tubules of each lobe converge to form *tubular rectus*.
- It conveys the sperm into retetestis.

Rete Testis:

- It is a tubular net work
- It is located on the posterior side of the testis.

Vasa - efferentia:

- The sperms leaves the rete testis and enter the epididymis through vasa – efferentia.

Epididymis:

- It is a single highly coiled tube.
- It temporarily stores the spermatozoa
- They undergo physiological maturation and acuire increased motility and fertilizing capacity.

Vas deferens:

- The epididymis leads to the vas deferens
- It joins to the seminal vesicle to form the ejaculatory duct- which passes through the prostate gland and opens into the urethra.

Urethra:

- It is the terminal portion of male reproductive system.
- It is used to convey both urine and semen at different times.
- It originates from the urinary bladder and extends through the penis by an external opening called *urethral meatus*.

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KAMARAJAR HIGHER SECONDARY SCHOOL, BOMMAIKUTTAIMEDU, NAMAKKAL-19**Accessory gland of male reproductive system:**

- It includes a pair of seminal vesicles, and bulbourethral gland (Cowper's gland) and a single prostate gland.

Seminal vesicles:

- It secretes an alkaline fluid called *Seminal plasma*.
- Seminal plasma contains fructose sugar, ascorbic acid, prostaglandins and a coagulating enzyme called *vesiculase*, which enhances sperm motility.

Bulbo urethral gland: (Cowper's gland)

- They are inferior to the prostate gland
- Their secretions helps in the lubrication of the penis.

Prostate gland:

- It encircles the urethra and is just below the urinary bladder.
- It secretes a slightly acidic fluid that contains citrate, enzymes and prostate specific antigens.

Seminal fluid: (semen)

- It is a milky white fluid.
- It contains sperms and seminal plasma (secretion of seminal vesicles, prostate gland and cowper's gland)

Function:

- It acts as a transport medium
- Provides nutrients
- Contains chemical that protect and activate the sperms
- Facilitate their movement.

Penis:

- It is the male external genital organ
- It functions as a *male copulatory* organ.
- It is made up of special tissues that help in the erection of penis to facilitate insemination.
- The enlarged end of the penis is called **glans penis**.
- Glans penis is covered by a loose fold of skin called **foreskin** (or) **prepuce**.

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Female Reproductive System

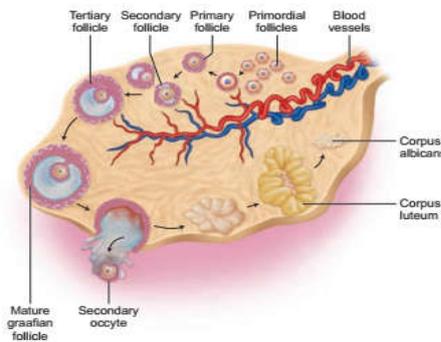
Female reproductive system:

- It is more complex than male reproductive system.
- **Reason:** In addition to gamete formation, it has to nurture the developing foetus.
- It consists of
 - a pair of ovaries
 - a pair of oviducts
 - uterus
 - cervix
 - vagina and
 - external genitalia
- These are located in the pelvic region.

Function of female reproductive system:

- Female reproductive organ along with mammary gland are integrated structurally and functionally to support the process - Ovulation
 - Fertilisation
 - Pregnancy
 - Child birth and
 - Child care

Ovaries:



- It is a primary female sex organ.
- It produce female gamete - **Ovum**.
- They are elliptical in structure and about **2-4 Cm** long.
- They are located on each side of the lower abdomen.
- Each ovary is covered by a thin cuboid epithelium called **germinal epithelium**.
- Below the germinal epithelium is a dense connective tissue - **tunica albuginea**.
- The germinal epithelium which encloses **ovarian stroma**.

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- The stroma is differentiated into.

i) Cortex:

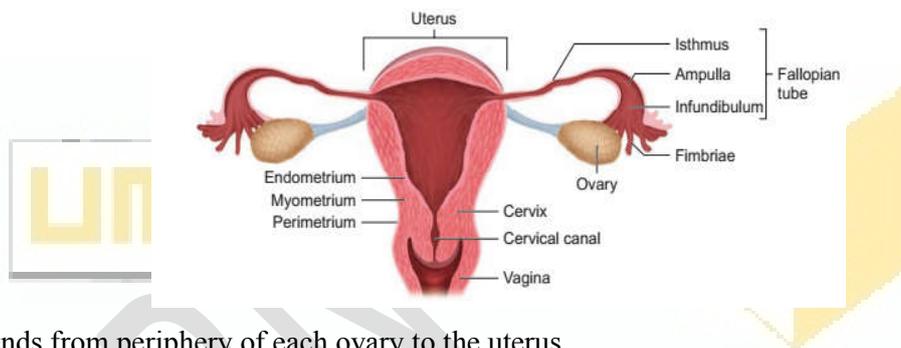
- It is the outer region of stroma.
- It appears dense and granular due to the presence of ovarian follicles in various stages of development.

ii) Medula:

- It is the inner region of stroma.
- It is made up of loose connective tissue, with abundant blood vessels, lymphatic vessels and nerve fibres.
- The ovary remains attached to the pelvic wall and the uterus by an ovarian ligament called **Mesovarium**.

Female accessory organ:

- The fallopian tube, uterus and vagina constitutes the female accessory organ.

Fallopian tube: (Uterine tube (or) Oviducts)

- It extends from periphery of each ovary to the uterus.
- It has three parts:
 - Proximal part** - It is funnel shaped infundibulum.
 - The edge of the infundibulum have many finger like projections called **fimbriae** which help in collection of ovum after ovulation.
 - Central part** - The infundibulum leads to a wider central part called **ampulla**
 - Terminal part** - It is a short and thick walled called **Isthmus**.
 - It connects ampulla and infundibulation to the uterus.

Uterus: (Womb)

- It is a hollow thick walled, muscular, highly vascular and inverted pear shaped structure.
- It is lying in the pelvic cavity between the urinary bladder and rectum.
- The major portion of the uterus is the **body**.
- The rounded region superior to the body is **fundus**.
- The uterus opens into the vagina through a narrow **cervix**.

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- The cavity of the cervix called **cervical canal** communicates with
 - vagina through external orifice
 - uterus through internal orifice.
- The cervical canal along with vagina forms the **birth canal**.

Membrane of uterine wall:

- The wall of uterus has three layers of tissues.

i)	Outer most layer	thin membrane of serous layer	Perimetrium
ii)	Middle layer	thick muscular	Myometrium (Involves strong constriction during pregnancy)
iii)	Inner layer	thick glandular layer	Endometrium (involved cyclic changes during menstrual cycle)

Vagina:

- It is a large fibro muscular tube that extends from cervix to the exterior.
- It is a *female copulatory* organ.

Female External genital organ: (Vulva)

- The female reproductive structure lie external to vagina is called **external genital organ**.
- It constitutes labia majora, labia minora, hymen and clitoris.

Accessory gland:**i) Bartholin glands:**

- They are located posterior to the left and right of the opening of vagina.
- They secrete mucus to lubricate the vagina.
- They are homologous to *bulbourethral gland* of the male.

ii) Skene's glands:

- They are located on the anterior wall of the vagina and around the lower end of the urethra.
- They secrete a lubricating fluid.
- They are homologous to *prostate gland* of the male.

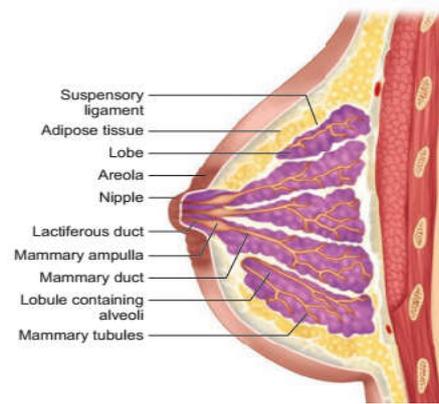
Hymen:

- The external opening of the vagina is partially closed by a thin ring of tissue called **hymen**
- It is often torn during first coitus
- Sometimes it can be torn due to
 - Sudden fall (or) joint
 - During strenuous physical activities such as cycling, horseback riding etc.
- So therefore it cannot be considered as an indicator of woman's virginity.

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Mammary gland:



- They are modified sweat glands present on both sexes.
- In male, it is a rudimentary one.
- In female, it is a functional one.
- A pair of mammary glands are located in thoracic region.
- It contains glandular tissue and variable quantities of fat with a median nipple.
- The nipple is surrounded by a pigmented area called **areola**.
- Several sebaceous gland called areolar glands are found on the surface which reduce craking of the skin of the nipple.
- Internally, each mammary gland consists of **20-25 lobes**,
- They are separated by fat and connective tissues.
- Each lobe is made up of lobules which contain **acini (or) alveoli**.
- The alveoli are lined by epithelial cells.
- Cells of alveoli secretes milk.
- The alveoli open into mammary tubules.
- The tubules of each lobe joins to form a **mammary duct**.
- Several mammary ducts join to form wider **mammary ampulla**.
- The mammary ampulla is connected to **lactiferous duct**, in the nipple.
- Under the nipple, each lactiferous duct expands to form **lactiferous sinus** which serves as a reservoir of milk.
- Each lactiferous duct opens separately by a minute pore on the surface of the nipple.

Development of Breast:

- The normal development of breast begins at puberty and with progress changes during each menstrual cycle.
- In non pregnant women, they are largely underdeveloped.
- The breast size is largely due to amount of fat deposits.
- The size of the breast does not have on influences on the efficiency of lactation.

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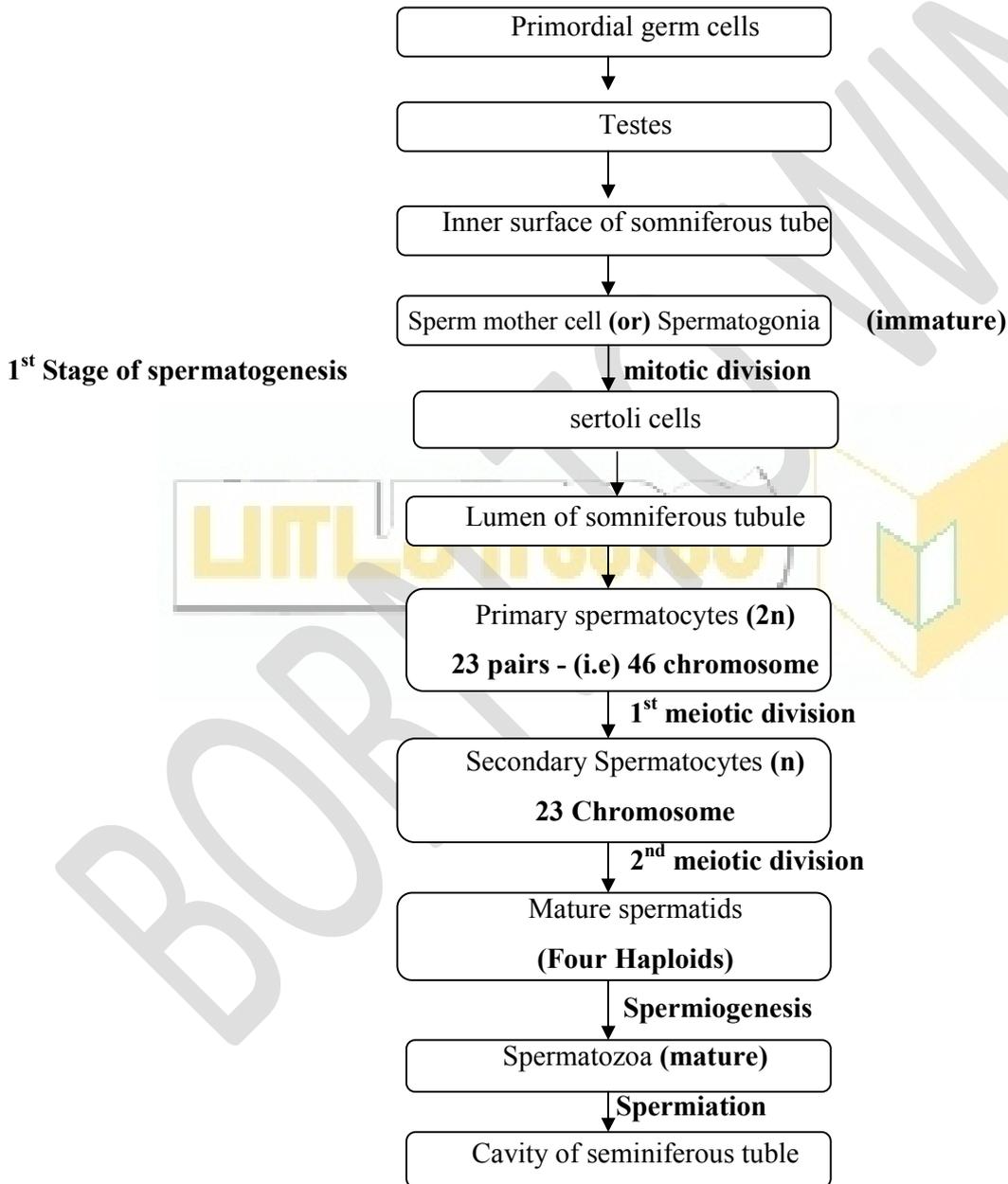
Gametogenesis:

- It is the process of formation of gametes (Sperms and Ovum) from the primary sex organs in all sexually reproducing organisms.
- Meiosis plays an important role in the process of gametogenesis.

Spermatogenesis:

- It is the sequence of events in the seminiferous tubules of the testis that produce the male gametes- *Sperm*.

During development:

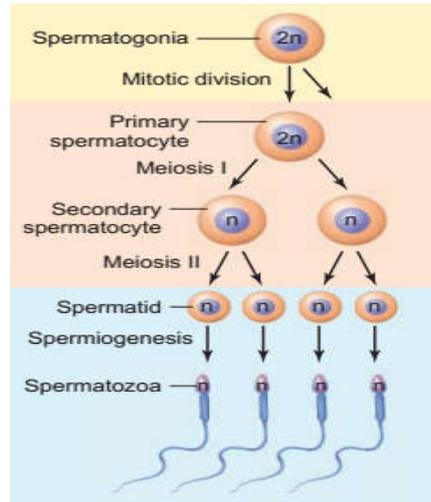
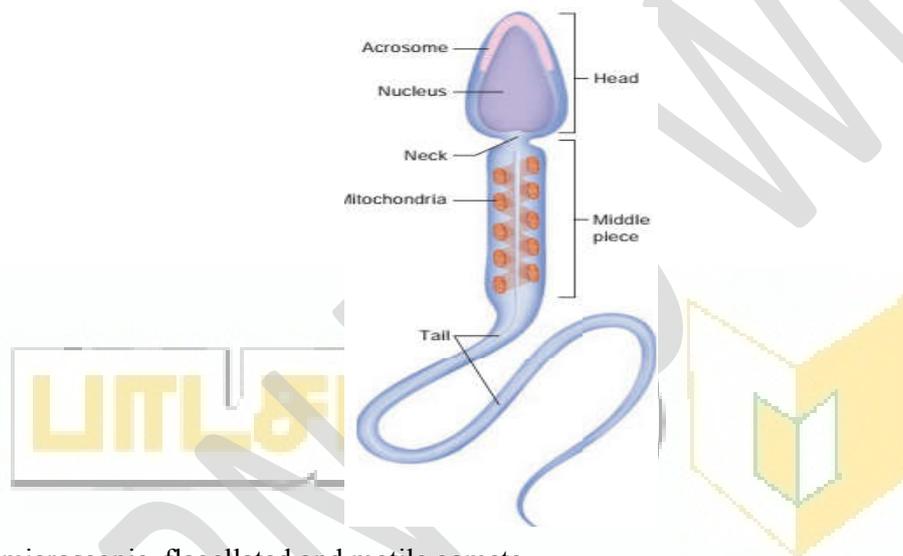


Note:

- The whole process of spermatogenesis takes about 64 days.
- The sperm production remains nearly constant at a rate of about 200 million sperms per day.

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**Structure of Human Spermatozoan:**

- It is a microscopic, flagellated and motile gamete.
- The whole body of sperm is enveloped by plasma membrane.
- It is composed of four parts.

i) Head:

- It consists of acrosome and nucleus
- **Acrosome:** - It is a small cap like pointed structure, present at the tip of the nucleus
 - It is formed from golgibody
 - It contains hyaluronidase, a proteolytic enzyme known as *sperm lysine*.
 - **Function:** helps to penetrate the ouum during fertilization.
- **Nucleus:** It is flat and oval in shape

ii) Neck:

- It is very short which connect the head and middle piece
- It contains - **Proximal centriole** - Plays a role I first division of zygote
 - **Distal centriole** - Gives rise to the axial filament of the sperm.

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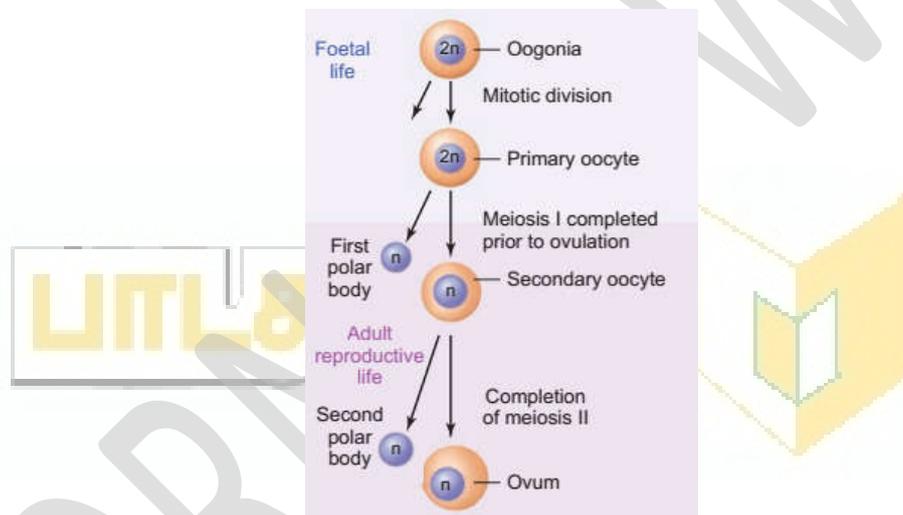
iii) Middle piece:

- It contains mitochondria which is spirally twisted around the filament called **mitochondrial spiral** (or) **nebernkern**.
- It produces energy in the form of ATP molecules for the movement of sperms.

iv) Tail:

- It is the longest part of the sperm
- It is slender and tapering.
- It is formed of central axial filament (**axoneme**) and outer protoplasmic sheath.
- The lashing movements of the tail push the sperm forward.
- The human male ejaculates about **200-300 billions** of sperm during coitus.
- It is estimated that **60%** of sperms have normal shape and **40%** must show vigorous motility for normal fertility.

Oogenesis:

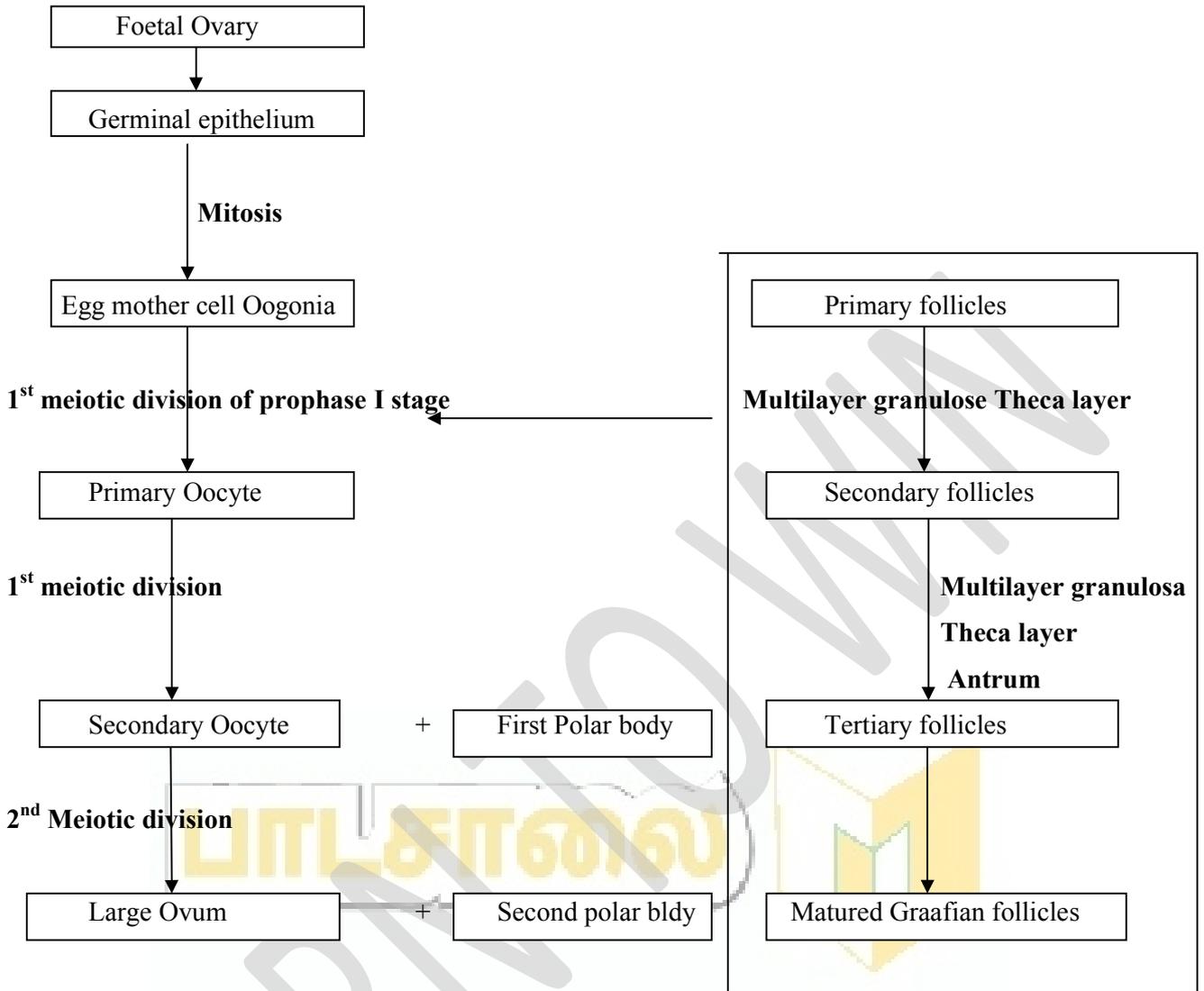


- It is the process of development of female gamete (or) ovum (or) egg in the ovaries.

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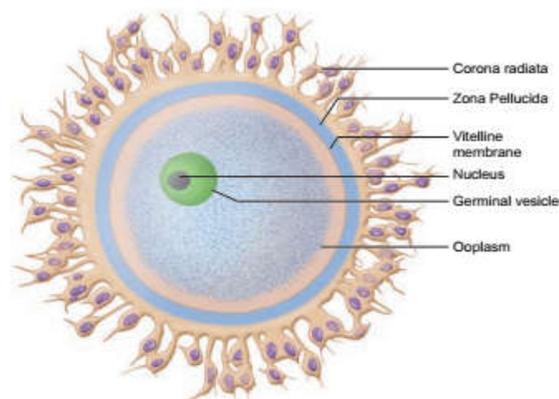
During Foetal development:



If Fertilization not take place:

- Second meiotic division is never completed and the egg disintegrates.
- It the end of gametogenesis, in females, each primary oocyte gives rise to only one haploid ovum.

Structure of Ovum:



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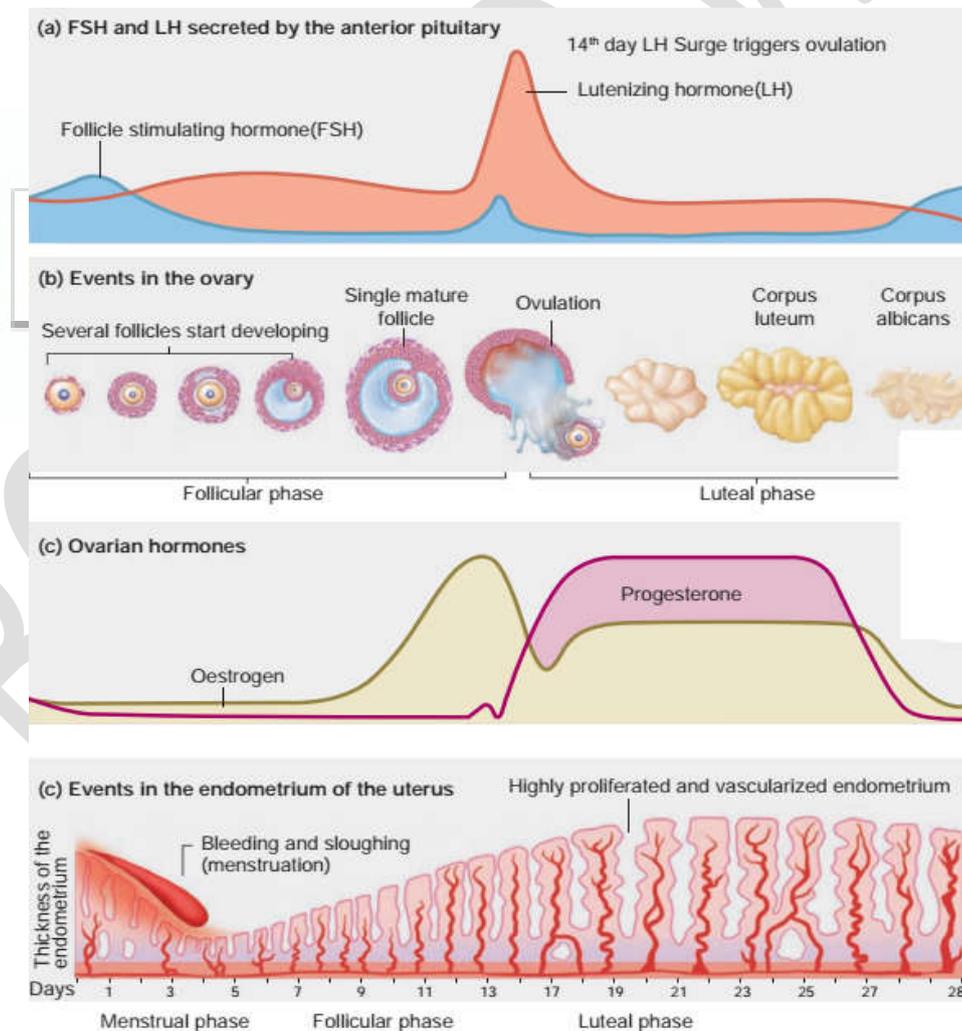
- Human ovum is non cleidoic, alecithal and microscopic in nature.
- The cytoplasm is called *Ooplasm*
- The nucleus is called *germinal vesicle*.
- It is surrounded by three coverings

i	Inner	Thin	Transparent membrane	Vitelline membrane
ii	Middle	Thick	Protective separative membrane	Zonapellucida
iii	Outer	Thick	Coat of follicular cells	Corona radiata

- Between the vitelline membrane and zonapellucida is a narrow *perivitelline* space.

Menstrual Cycle: (Ovarian Cycle)

- It is the cyclic changes occurs in the endometrium in every 28 days during the reproductive life of female (from puberty (Menarch) to menopause) except during pregnancy.
- Cyclic menstruation is an indicator of normal reproductive phase.

Phases involved in menstrual cycle.

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KAMARAJAR HIGHER SECONDARY SCHOOL, BOMMAIKUTTAIMEDU, NAMAKKAL-19**i) Menstrual phase:**

- The cycle starts with the menstrual phase (1-5 days)
- During this phase, menstrual flow occurs and last with in 3-5 days.

Reason:

- Menstruation occurs only if the released ovum is not fertilized.
- It is due to decline in the level of progesterone and oestrogen

Results:

- It results in breakdown of endometrial lining of the uterus and its blood vessels.
- Absence of menstruation may be an indicator of pregnancy.

Other factors:

- Stress, hormonal disorder and anemia.

ii) Follicular phase: (proliferative phase) (5-13 days)

- This phase is induced by the secretions of gonadotropins like FSH and LH.
- It stimulates follicular development
- The primary follicle in the ovary grows to become fully matured Graafian follicle.
- The mature graafian follicle releases the hormone oestrogen.
- **Functions of Oestrogen:** The endometrium regenerates through proliferation.

iii) Ovulatory phase: (14th day)

- Both FSH and LH attain peak level in the middle of the cycle. (**above 14th day**)
- Maximum secretion of LH during the mid cycle called "**LH surge**".
- It induces the rupture of the Graafian follicle and releases the ovum (**secondary Oocyte**) from the ovary wall into the peritoneal cavity.
- This process is called as **ovulation**.

iv) Luteal phase: (secretory phase) (after 15 days)

- During this phase the remaining part of the graafian follicle is transformed into a transitory endocrine gland called **corpus luteum**.
- Corpus luteum secrete large amount of progesterone.

Functions of progesterone:

- It is essential for the maintenance of the endometrium.

During fertilization:

- It paves way for the implantation of the fertilized ovum.
 - The uterine wall secretes nutritious fluid in the uterus for the foetus (**Hence: It is called secretory phase**)
- During pregnancy all events of menstrual cycle stop and there is no menstruation.

In the absence of fertilization:

- The corpus luteum begins to degenerate completely

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- It leaves a scar of tissue called **corpus albicans**
- It also initiates the degeneration of the endometrium leading to menstruation making the next cycle.

Menstrual Hygiene:

- **Importance of menstrual hygiene:** Good health, well being, dignity empowerment and productivity of women.
- **Impacts of poor menstrual hygiene:**
 - Increased stress levels
 - Fear
 - Embarrassment
- This can keep girls inactive during such periods leading to absenteeism from school

Materials to be used to manage menstruation:

- Clean and safe absorbable cloth materials
- Napkins pads
- Tampons
- Menstrual cup

Management of menstrual hygiene:

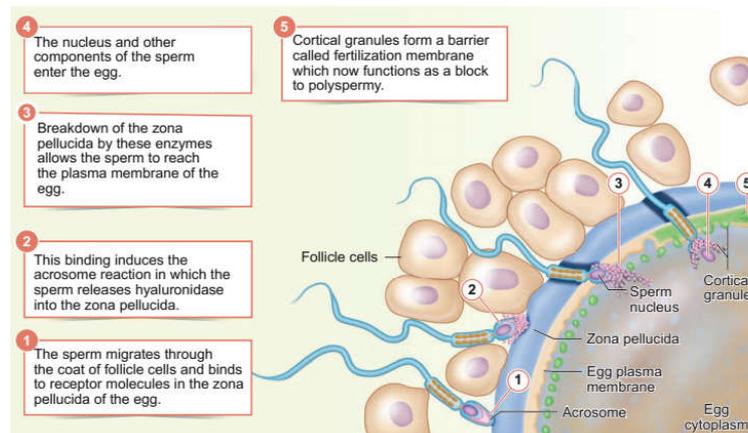
- Changing sanitary materials 4-5 Hours as per requirement, provides comfort, cleanliness and protection from infections.
- It also helps in enhancing the quality of life of women during menstrual period.

Disposal method of sanitary material:

- Used sanitary napkins should be wrapped paper and disposed.
- It should not be thrown in open areas (or) drain pipe of toilets.
- Flushing of sanitary napkins in the drain pipes cause choking of the drainage line leading to water pollution.

Fertilisation:

- It is the process of haploid sperm fuses with a haploid ovum to form a fertilized egg (or) diploid zygote.



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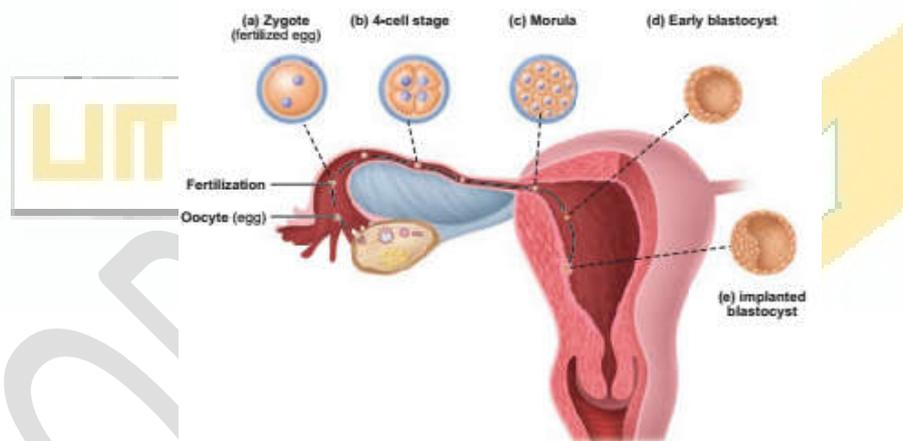
Capacitation:

- The sperm deposited in the female reproductive tract undergoes *capacitation*.
- It is a biochemical event that enables the sperm to penetrate and fertilize the egg.
- Fertilisation occurs only if the ovum and sperms are transported simultaneously to the ampullary isthmic junction of the fallopian tube.

Process of insemination:

- The sperm penetrate the multiple layers of follicular cells which are around the ovum forming the **corona radiata**.
- The follicular cells are held together by an adhesive cementing substance called **hyaluronic acid**
- The acrosomal membrane distegrates, releasing the **hyaluranidase** during sperm entry through the corona radiata and zona pellucida.
- This is called **acrosomal reaction**.
- Once fertilization occurs, cortical granules from the cytoplasm of the ovum form a barrier called **fertilization membrane** around the ovum, preventing further penetration of other sperms to avoid **polyspermy**.

Implentation:



- The first cleavage produces two identical cells called **blastomeres**.
- These produce 4 cells, 8 cells and soon.
- A loose collection of cells forms a berry shaped cluster of 16 (or) more cells after 72 hours of fertilization called **morulla**.
- The smooth muscles of the fallopian tube relax by progesterone.
- The dividing embryo takes **4-5 days** to move uterine cavity from fallopian tube, and finally gets implanted in the uterine wall.
- At this point, the embryo consists of a fluid filled hollow ball of about thousand of cells called **blastocyst**.
- A blastocyst consists of - **trophoblast** - a single layer of large flattened cells.

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- **inner cell mass** - a small cluster of 20 -30 rounded cells

- The inner cell mass develops into embryo and embedded in the endometrium of uterus.
- This process is called **implantation** and results in pregnancy.

Ectopic pregnancy:

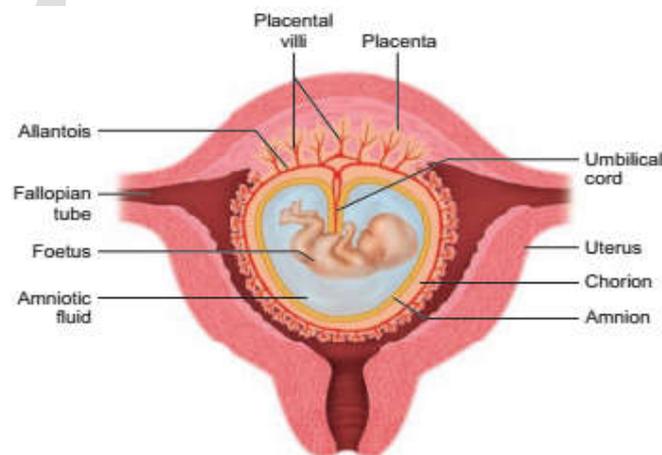
- The fertilized ovum is implanted out side the uterus results in ectopic pregnancy.
- About **95%** of ectopic pregnancy occur in the fallopian tube
- **Causes:**
 - Internal bleeding
 - Infection
 - Death due to rupture of fallopian tube.

Maintenance of pregnancy and Embryonic development:**Gastrulation:**

- The inner cell mass in the blastula is differentiated into **epiblast** and **hypoblast** immediately after implantation.
- The epiblast is **ectoderm** and hypoblast is **endoderm**
- The cells between the epiblast and hypoblast forms the **mesoderm**.
- The transformation of the blastocyst into a gastrula with the primary germ layers by the movement of the blastomeres is called **Gastrulation**.
- Each germ layer gives rise to specific tissues, organs and organ systems during organogenesis.

Functions of Embryonic monbranes:

- They protects the embryo from
 - dessication
 - mechanical shock
- They help in
 - absorption of nutrients
 - exchange of gases.

Extra Embryonic membranes:

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i) Amnion membrane:

- It is a double layered, translucent membrane
- It is filled with amniotic fluid.
- **Function:** - It provides a buoyant environment to protect the developing embryo from injury.
 - It regulated the temperature of the foetus
 - It provides a medium in which the foetus can move.

ii) Yolk sac:

- It form a part of the gut
- It is the source of the earliest blood cells and blood vessels.

iii) Allantois membrane:

- It forms a small out pocketing of embryonic tissue at the caudal end of the yolk sac.
- It is the structural base for the umbilical cord which links the embryo to the placenta
- It becomes the part of the urinary bladder.

iv) Chorion membrane:

- It is the outermost membrane
- It encloses the embryo and all other membranes
- It also helps in the formation of placenta.

Chorionic villi:

- The trophoblast cells in the blastocyst sent out several finger like projections called **chorionic villi**
- They are surrounded by sinuses that contain maternal blood
- **Function:** They carry foetal blood

Placenta:

- The chorionic villi and the uterine tissues form the disc shaped placenta
- It is a temporary endocrine gland during pregnancy
- **Function:** - It connects the foetus to the uterine wall through umbilical cord.
 - It is a organ by which the nutritive, respiratory and excretory functions are fulfilled.

Germ Layers

The primitive germ layers serves as the *primitive tissues* from which all body organs develop

Ectoderm :

- It gives rise to
 - central nervous system (**Brain & Spinalcord**)
 - Peripheral nervous system
 - Epidermis and its derivatives
 - Mammary glands

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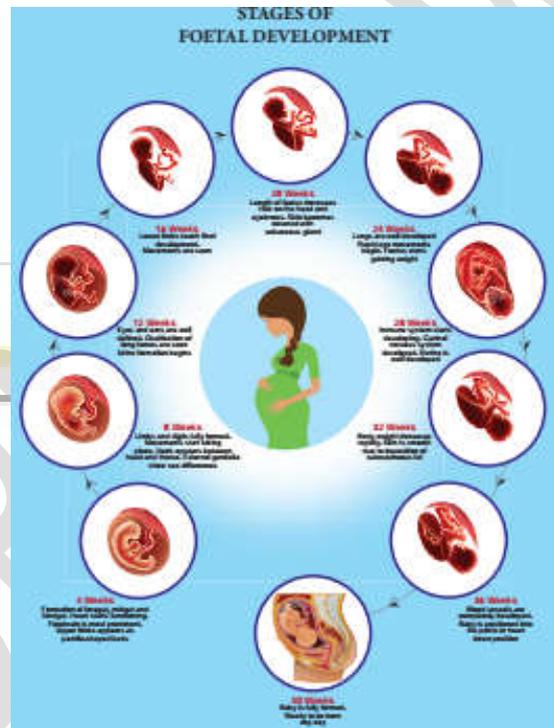
Mesoderm :

- It gives rise to - connective tissues
- Cartilage and bones
- Muscles
- Organs of Urinogenital system
(*Kidney, Ureter and gonads*)

Endoderm :

- It gives rise to - Epithelium of gastrointestinal and respiratory tract
- Liver
- Pancreas
- Thyroids
- Parathyroid

Gestation Period :



- Human pregnancy lasts for about **280 days** (or) **40 weeks** and called it as **gestation – period**
- It can be divided for convenience into three trimesters of three months each

First Trimester :

- It is the main period of organogenesis.
- Heart, limbs , lungs, liver and external genital organs are well developed.

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- The face is well formed with features
- Eyelids and eyelashes
- Eye blinks
- Body is covered with fine hair,
- Muscle tissues develops
- Bones become harder.

Third Trimester:

- The foetus is fully developed
- It is ready for delivery by the end of nine months

Secretion of Hormone during pregnancy :***Hormones for normal pregnancy :***

- Human chorionic Gonadotropin (**HCG**)
- Human chorionic somatomammotropin (**HCS**)
- Human placental lactogen (**HPL**)
- Oestrogen
- Progesterone
- Relaxin → helps in relaxation of the pelvic ligaments at the time of parturition

Secretion of Hormones only during pregnancy :

- Human chorionic Gonadotropin (**HCG**)
- Human placental lactogen (**HPL**)
- Relaxin

Hormones essential for supporting foetal growth :

- Oestrogen
- Progesterone
- Cortisole
- Prolactin
- Thyroxine

Parturition and Lactation :***Parturition :***

- It is the completion of pregnancy and giving birth to the baby.

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- The series of events that expels the infant from the uterus is collectively called labour.

Braxter – Hick’s contractions:

Throughout the pregnancy the uterus undergoes periodic episodes of weak and strong contractions called

Braxter – Hick’s contraction.

- It leads to false labour

Foetal ejections reflex: (Ferguson reflex)

- As the pregnancy progresses, increase in the oestrogen concentration promotes uterine contraction
- The uterine contractions facilitate moulding of the foetus and downward movement of the foetus .
- The descent of the foetus causes dilation of cervix of the uterus and vaginal canal resulting in a neuro humoral reflex called **Foetal ejection reflex** (or) **Ferguson reflex**

Parturition (or) child birth :

- The ferguson reflex initiates the secretion of oxytocin from neurohypophysis.
- It brings about the powerful contraction of the uterine muscles.
- It leads to the expulsion of the baby through the birth canal.
- This sequence of events is called as **parturition** (or) **child birth**

Relaxin :

- It is a hormone secreted by the placenta.
- It also found in the corpus luteum.

Functions:

- It promotes parturition – by relaxing the pelvic joints
- by dilatation of the cervix with continued powerful contractions
- The amnion ruptures and the amniotic fluid flows out through vagina, followed by the foetus.
- The placenta along with remains of umbilical cord called “**after birth**” is expelled out after delivery.

Clostrum :

- It is a yellowish, nutrient rich fluid produced by mammary gland of human female
- It has less lactose than milk and almost no fat but contains more proteins, vitamin A and minerals
- It is loaded with immune, growth and tissue repair factors.
- It is also rich in IgA antibody
- This helps to protect the infant’s digestive tract against bacterial infection
- It acts as a natural antimicrobial agent to actively stimulate the maturation of infant’s immune system.

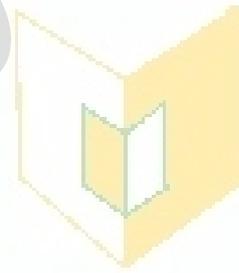
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Importance of Breast milk:

- Breast milk is the ideal food for infant
- **Reasons** It contains all the constituents in suitable concentration and is easily digestible.
- It is fully sufficient till about 6 months of age
- All infants must be breast fed by the mother to ensure the growth of a healthy baby
- No artificial feed can substitute the first milk, with all its natural benefits and therefore should be definitely fed to the baby after birth.

புத்தகம்



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