

## CHAPTER → 3

## HUMAN REPRODUCTION

# NEET SLAYER

Humans → Sexually Producing → Viviparous.

\* Reproductive events in Humans → ① Gametogenesis ② Insemination ③ Fertilization ④ Implantation ⑤ Gestation ⑥ Parturition.

\* Male Reproductive System \*

Testes

Accessory Ducts

→ Rete Testes  
→ Vasa efferentia  
→ Epididymus  
→ Vasa deference

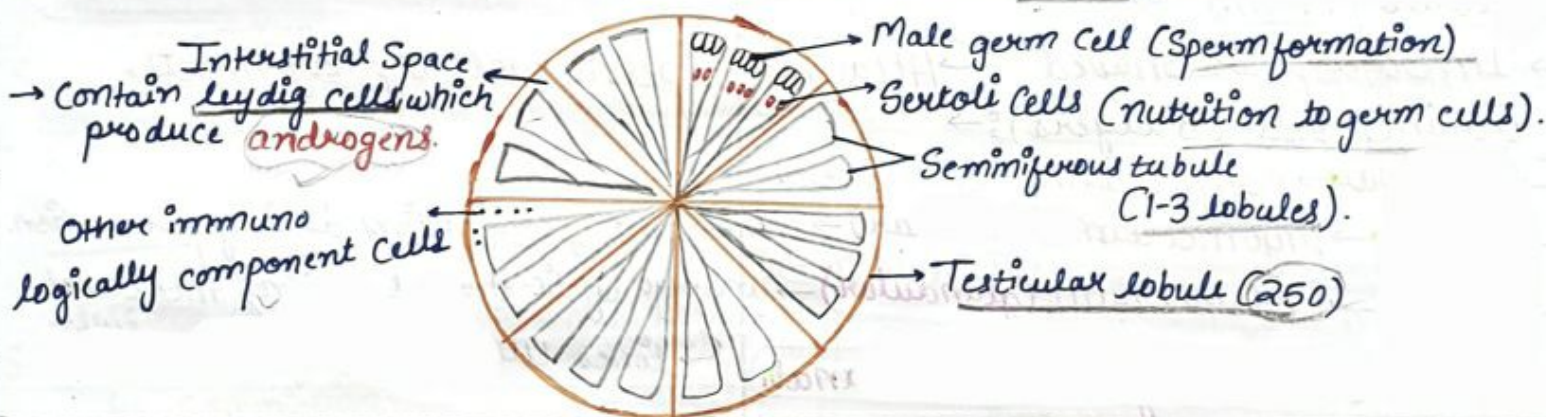
Accessory Glands

→ Seminal Vesicles  
→ Prostate  
→ Bulbourethral

External Genitalia

→ Penis

① Testes → Situated within a pouch → Scrotum.  
→ Scrotum maintains low temp. (2-2.5) for Spermatogenesis.  
Covered by dense covering → Length (4-5cm), Width (2-3cm)



\* Pathway of Sperm: → Semiferous Tubule → Rete Testes → Vas efference → Epididymis → Vas Deferens → Ejaculatory Duct → Ureter → Urethral Meatus (external opening.)  
Seminal Vesicle

\* Male External Genitalia → Penis.  
→ Made up of special tissue (erection).  
→ Enlarged end of penis (glans penis).  
→ Glans penis is covered by loose fold of skin → Foreskin.

\* Male Accessory Glands: →  
→ Seminal Vesicle (2), Prostate (1), Bulbourethral (2)  
→ Secretions → Rich in fructose, Calcium, other enzymes.  
→ Bulbourethral Secretions → Lubrication of Penis.

\* Female Reproductive System \*

Ovaries

Fallopian Tubes

Uterus

Cervix

Vagina

External genitalia.



\* Female Reproductive System + Mammary Glands →  
 Integrated structurally and functionally  $\xrightarrow{\text{To Support}}$  Ovulation, Fertilization, Pregnancy, Birth, Child Care.

\* Ovary :→  
 → Primary Sex Organ that produce gamete (ovum) & Ovarian hormone.  
 → 2-4 cm Length → Connected to pelvic wall and uterus by Ligaments.  
 → Covered by thin epithelium which encloses stroma.  
 → Stroma → 2 zones (Peripheral Cortex + Inner Medulla.)

\* Fallopian Tube (10-12cm) :→  
 → Fallopian Tube + Uterus + Vagina → Female accessory Ducts.  
 → Fimbriae (Collect Ovum) → Infundibulum (Funnel Shaped)  
 → Ampulla (Wider Part) → Isthmus (Join Uterus)

\* Uterus / Womb :→  
 → Inverted pear Shaped → Attached to pelvic wall by ligaments.

\* Uterine Wall (3 layers) :→  
 → External → Perimetrium. → (Thin Membranous)  
 → Middle → Myometrium. (muscular) → exhibit strong contraction during parturition.  
 → Inner → Endometrium. (glandular) → undergo cyclic changes during menstrual cycle.  
 → lines uterine cavity.

\* Cervical Canal + Vagina → Birth Canal.

\* Female External Genitalia :→  
 ① Mons Pubis → Cushion of fatty tissues covered by skin and pubic hairs.  
 ② Labia Majora → Fleishy fold of tissue, extend down from mons Pubis.  
 ③ Labia Minora → Paired fold of tissue under labia Majora.  
 ④ Hymen → Partially covers opening of Vagina.  
 ⑤ Clitoris → Tiny finger like projection, lies at upper junction of 2 labia minora.

\* Mammary Glands :→  
 → Glandular Tissue (milk formation) → Mammary Lobes (15-20) → Alveoli (contain cluster of cells) → Mammary Tubules (opens into)  
 → Mammary Ducts (Join to form) → Ampulla (Join to form) → Lactiferous Duct (connected to)

→ Variable Amount of Fat (Support)



# \* Gametogenesis \*

Primary Sex Organs

Gametes

Testes

Sperms

Spermatogenesis

Ovaries

Ovum

Oogenesis

} gametogenesis

\* Spermatogenesis → begins at puberty.

\* Diagram → Seminiferous Tubule.

Spermatogonia → inside wall of seminiferous tubule  
(immature male germ cells)  
46 chromosomes (2n)

multiple mitosis.

Number ↑↑↑

Some Spermatogonia (2n) called as primary spermatocyte (2n)

Secondary Spermatocytes ← formation of 2 equal haploid cells  
1<sup>st</sup> meiotic division

Secondary Spermatocyte (n) → 2<sup>nd</sup> meiosis → 4 Spermatid (n)  
Spermiogenesis

Spermatozoa (Sperms)

Released from Seminiferous tubule by Spermiation.  
Sperm head embedded in Sertoli cells.

At Puberty → ↑↑ in GnRH (Gonadotropin releasing Hormone)  
acts on Anterior pituitary Gland.  
stimulate secretion of

Luteinising Hormone

Follicle stimulating Hormone.

acts at Leydig Cells

acts at Sertoli Cells

LH stimulate synthesis and secretion of

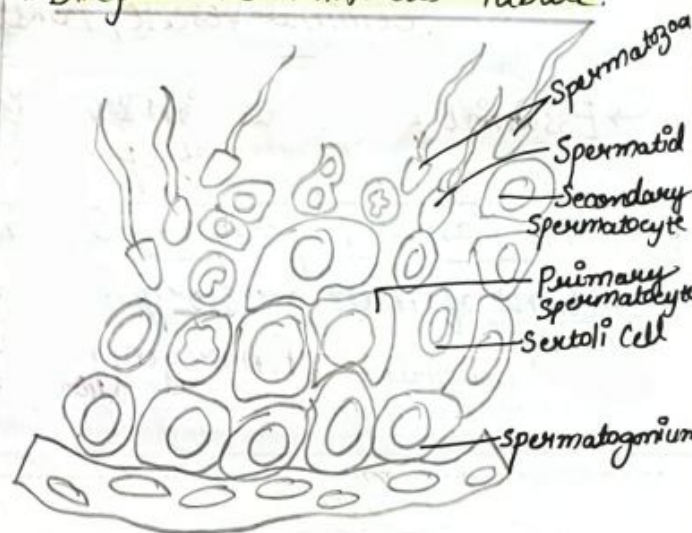
Androgens

stimulates

Spermatogenesis

Here, FSH stimulates secretion of some factors which helps in Spermiogenesis

spermatid → spermatozoa



\* Sperm → Microscopic Structure.

Plasma membrane envelops whole body of Sperm.

Head → elongated Haploid Nucleus.  
Anterior surface covered by cap like structure.  
acrosome (contains enzyme which help in fertilization)

Neck

Middle Piece → Numerous Mitochondria  
→ produce energy for movement of tail.  
→ facilitating sperm motility

\* Structure of a Sperm →



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GnRH → Hypothalamic Hormone



Human Male Ejaculates  $\rightarrow$  200-300 million Sperms  $\rightarrow$  60% Sperms  $\rightarrow$  Normal Shape and Size

Sperms released from Seminiferous tubule  
 $\downarrow$  Transported by accessory ducts.

\* Secretion of  $\rightarrow$  Epididymis, Vas deferens, Seminal Vesicle, Prostate

Bulbo

$\rightarrow$  Essential for maturation & motility of Sperms.

\* Seminal Plasma + Sperms  $\rightarrow$  Semen.

\* Functions of male accessory ducts and glands  $\xrightarrow{\text{maintained by}}$  Androgen (testicular hormone)

Semen

Sperm 10%      Seminal Vesicle 60%      Prostate + Bulbourethral 30%

\* Oogenesis.  $\rightarrow$  Initiated during embryonic stage. (In Millions)  
 (Formation of mature female gamete)

\* Oogonia (gamete Mother Cells) (couple of million), (no more added after birth)

$\downarrow$  1<sup>st</sup> meiotic division starts

Primary Oocyte

(arrested at prophase I)

Primary Oocyte + Layer of Granulosa.

primary follicle. (degenerate from birth to puberty 60,000-80,000 in each ovary)

Primary + More layers of granulosa cells + New Theca

Secondary Follicles

40% Sperms  $\rightarrow$  Vigorous Motility

Secondary follicle  $\rightarrow$  Tertiary follicle

\* characterised by fluid filled Cavity  $\rightarrow$  Antrum.

\* Theca layer  $\rightarrow$  inner theca interna, outer theca externa

at this stage, primary oocyte within the tertiary follicle.

primary oocyte grown in size & completes 1<sup>st</sup> meiotic division.

unequal division

Secondary Oocyte (n) (large)

Tiny 1<sup>st</sup> polar body (n)

Very less cytoplasm

Retains bulk of nutrient rich cytoplasm of primary Oocyte

Tertiary follicle

Mature Follicle / Graafian Follicle

Secondary Oocyte forms New membrane Zona pellucida.

Ovulation

rupture

Secondary Oocyte (Ovum) released from ovary

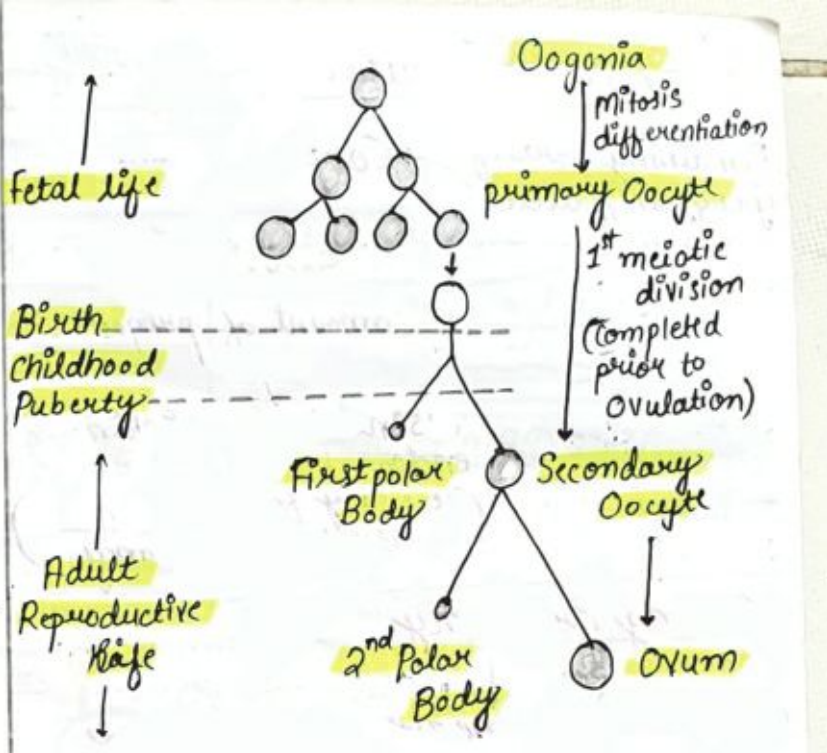
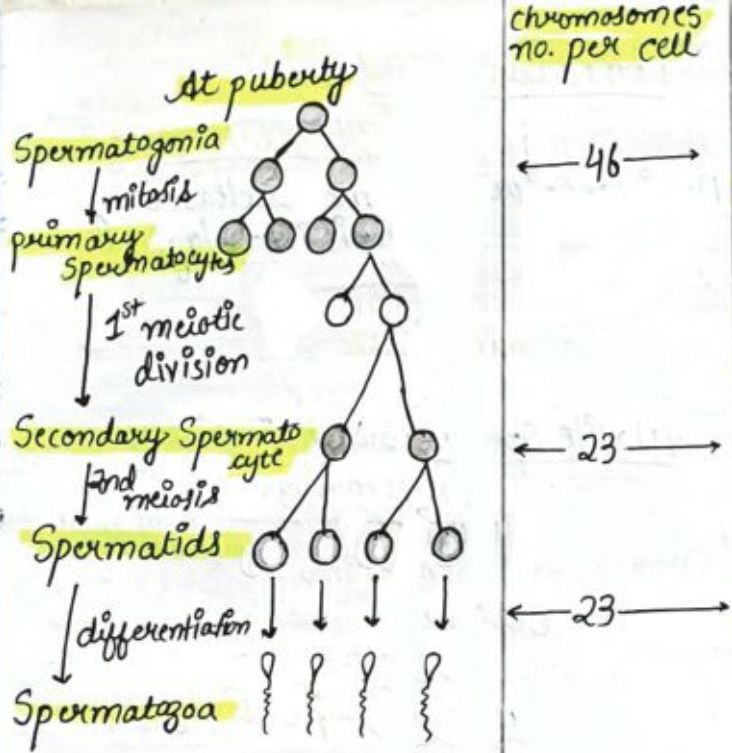
\* Zona Pellucida  $\rightarrow$  Acellular.

\* Follicular Atresia  $\rightarrow$  Death of 1<sup>st</sup> follicle

\* Spermiogenesis  $\rightarrow$

Release of Sperm from Seminiferous tubule.





# \* MENSTRUAL CYCLE → In female primates (monkeys, apes, human beings)

\* 1<sup>st</sup> Menstruation → During Puberty → Menarche.

\* Menstrual Cycle → Repeated after about 28/29 days.

\* One Ovum released (Ovulation) → During middle of each cycle, 14<sup>th</sup> day.

1<sup>st</sup> Phase of Cycle → Menstrual Phase (3-5 days) → Menstrual flow occurs due to breakdown of endometrial lining of Uterus and Blood Vessels.

\* Menstruation → If released, Ovum not fertilized

\* No Menstruation → Indication of pregnancy. Also due to stress/poor health.

## 2<sup>nd</sup> Phase → Follicular Phase

1<sup>st</sup> follicle → Graafian Follicle (These changes induced by pituitary and ovarian hormone)

Endometrium → Regenerates through proliferation

### Follicular Phase / Proliferative Phase

LH and FSH ↑↑↑ stimulates follicular development & secretion of estrogen by growing follicle.

LH & FSH → attain peak level (about 14<sup>th</sup> day)

## 3<sup>rd</sup> Phase → Ovulatory Phase / Ovulation

LH max level during middle of cycle → LH Surge induces Rupture of Graafian follicle → Release of Ovum (Ovulation / Ovulatory phase).



## 4<sup>th</sup> Phase → Luteal Phase

Remaining parts of Graafian follicle → Corpus luteum  
 Secrete large amount of progesterone  
 essential for maintaining endometrium.  
 (necessary for implantation & events of pregnancy.)

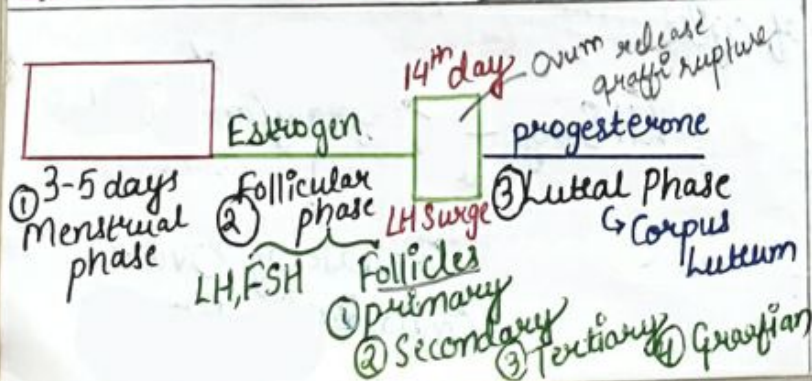
During Pregnancy  
 all events of menstrual cycle stops  
 ↓  
 No Menstruation.

In absence of fertilization  
 ↓  
 Corpus luteum degenerates  
 ↓ causes  
 Disintegration of endometrium  
 ↓  
 Menstruation  
 ↓  
 New Cycle

Around 50 years of age → Menopause

## Cyclic Menstruation

Indicator of normal reproductive phase and extends b/w menarche & menopause



## \* FERTILIZATION AND IMPLANTATION

During Coitus → Semen released by penis into Vagina.

### Insemination

Motile Sperms swim Rapidly

↓ pass through

Cervix

↓ enters into

Uterus

↓ Reach

Ampulla = Fertilization

Ovum

Fertilization only occurs when sperm and ovum transported simultaneously to ampullary region.

Not all copulation leads to fertilization  
 Fusion of Sperm with Ovum = Fertilization

### During fertilization

Sperms come in contact with  
 ⊕ Zona pellucida layer

induces changes in membrane

Block entry of additional sperm

Only one sperm can fertilize ovum.

### Acosome Secretion

Help sperm enter into cytoplasm of ovum through zona pellucida & plasma membrane.

Induces completion of meiotic division of secondary Oocyte.



Completion of 2<sup>nd</sup> meiotic division (unequal)

Second Polar Body (n)      Ovum (Ootid) (n)

Ovum (n)      Sperm (n)  
 Zygote (2n)

\* Males (XY)      \* Females (XX)  
 Ova (X) + Sperm (Y)      Ova (X) + Sperm (X)

XYO

XX ♀

\* 50% chances of male and female.  
 \* Sex of baby is determined by father.

\* Zygote → Mitosis / Isthmus (Cleavage) → towards uterus, 2, 4, 6, 8 daughter cells  
 Blastomeres

Embryo with 8-16 blastomeres  
 Morula

divides ↓ uterus

Blastocyst

Blastocyst move to uterus.

Blastomere of Blastocyst

arrange to form

Outer layer

Inner group of cells.

Trophoblast

attach to ↓ trophoblast

Attaches to endometrium

Inner Cell Mass (Stem Cells)  
 endoderm, ectoderm, Mesoderm, forms all organs

differentiated

Embryo

After attachment → Uterine cells divide

Covers Blastocyst

Embedded in endometrium

IMPLANTATION

# \* PREGNANCY AND EMBRYONIC DEVELOPMENT \*



Disintegrated with each other to form PLACENTA.

\* PLACENTA → structural and functional unit b/w embryo and maternal blood.

- Oxygen supply & nutrients to embryo.
- Removal of CO<sub>2</sub> & excretory wastes produced by embryo.
- Placenta is connected to embryo by Umbilical Cord (help in transport of substances, to and from embryo).
- Placenta acts as endocrine tissue. \*
- produces hormones like Human Chorionic gonadotropins (HCG), Human Placental lactogen (HPL), estrogen, progesterone.
- Ovary → Relaxin → Later pregnancy
- HCG, HPL, Relaxin → Only during pregnancy
- During pregnancy, Estrogen, progesterone, Cortisol, prolactin, thyroxine ↑↑ for good foetal growth, Metabolic changes in mother, Maintains pregnancy.
- After implantation, inner cell mass
  - give rise to all tissues (organs)
    - ectoderm (outer)
    - endoderm (inner)
    - mesoderm (between)
- Inner Cell mass → Certain Stem Cells
  - Have potency to give rise to all tissues and organs.

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## \* MAJOR EVENTS DURING PREGNANCY \*

1 <sup>st</sup> Month	Embryo's Heart. First Sign → Heart Sound by Stethoscope.
2 <sup>nd</sup> Month	Develops limbs and digits.
3 Month, 12 Weeks, 1 <sup>st</sup> Trimester	Most of major organs formed. e.g → Limbs and external genitalia are well developed.
5 Months	First Movements. Head on Hairs.
2 <sup>nd</sup> Trimester 24 Weeks, 6 Months	Body covered by fine hairs. Eye lids separate. Eye lashes formed.
9 <sup>th</sup> Month	Foetus fully developed. Ready for parturition.

- Duration of pregnancy → Gestation Period.
- Child Birth → Parturition.
- Parturition induced by → Complex Neuroendocrine Mechanism.

\* Mammary Glands → Differentiation → During pregnancy.

↳ produces milk towards end of pregnancy.

→ LACTATION →

Milk of first few days Colostrum. Contains several antibodies. Essential to develop resistance for new born.

## \* PARTURATION AND LACTATION \*

Fully developed foetus and placenta →

Signals

Mild Uterine Contractions

Foetal ejection Reflex

Oxytocin (from maternal pituitary)

Stronger Uterine Contractions

More Release of Oxytocin

Stronger and Stronger Contractions

placenta expelled out of uterus

Parturition



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