# Human Reproduction

@anjit

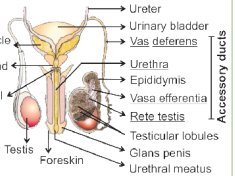
## 1 INTRODUCTION

- Humans are sexually reproducing viviparous organisms
- Reproductive system is composed of
  - Primary sex organs– Site for gamete formation
  - External genitalia– Involved in copulation
  - Accessory ducts
  - Accessory glands
  - } Facilitate transport of gametes

## Human Reproductoin

## 2 THE MALE REPRODUCTIVE SYSTEM

- **Location**: Pelvic region
- **Seminal plasma** from these contains fructose, calcium enzymes
- Its secretions **lubricate from the penis**
- Vas deferens receives a duct from seminal vesicle and opens into the urethra as the **Ejaculatory duct**

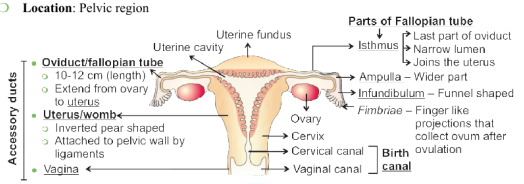



**External genitalia of Male/Penis:**

| Parts | Features |
|---|---|
| **Urethra** | Orginates from the urinary bladder and extends through the penis |
| **Special tissues** | Help in erection of penis to facilitate insemination |
| **Glans penis** | Enlarged end of penis covered by loose fold of skin called **foreskin** |

## 3 FEMALE REPRODUCTIVE SYSTEM

- **Location**: Pelvic region




- **Uterine wall consists of three layers:**
  **1. Endometrium** - Lines lumen, glandular and undergoes cyclic changes during menstruation
  **2. Myometrium** - Thick layer of smooth muscles that show strong contractions during delivery
  **3. Perimetrium**-External thin membrane

**External Genitalia of Female:**

| Parts | Features |
|---|---|
| **Mons pubis** | Cushion of fatty tissue covered by skin and pubic hair |
| **Labia majora** | Fleshy folds of tissues that extend down mons pubis and surround the vaginal opening |
| **Labia minora** | Paired folds of tissues under the labia majora |
| **Clitoris** | Tiny finger like structure which lies at the upper junction of labia minora above the urethral opening |
| **Hymen** | • Membrane that partially covers the opening of vagina<br>• Can be torn while – sudden falling , horse riding, cycling , insertion of vaginal tampon.<br>• May or may not be torn during the first coitus so its presence or absence is not reliable indicator of virginity or sexual experience. |

## 4 PRIMARY SEX ORGANS

| Parameters | Male | Female |
|---|---|---|
| **Organ** | Testis | Ovary |
| **Number** | 2 | |
| **Shape** | Oval | Almond |
| **Location** | Outside abdominal cavity in a pouch called **scrotum** | Lower abdomen, one on each side |
| **Dimension** | Length 4-5 cm, Width 2-3 cm | Length 2 to 4 cm |
| **Covering** | Dense connective tissue (outermost) | Thin epithelium (outermost) |
| **Functions** | Sperm formation, synthesise steroidal **testicular** hormones like androgens | Ova formation, synthesise steroidal **ovarian** hormones like estrogen and progesterone |
| **Compartments** | 250 testicular lobules<br>• 1-3 coiled seminiferous tubules/ lobule | Peripheral **cortex** and inner **medulla** zones in ovarian stroma have follicles in various developing stages |

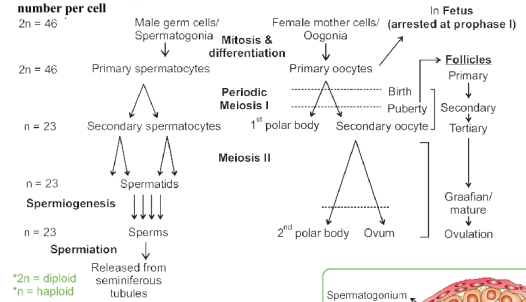
| • **Cells lining the seminiferous tubules** | **Functions** |
|---|---|
| 1.Male germ cells/spermatogonia<br>2.Sertoli cells | Sperm formation<br>Provide nutrition to the germ cells |

- Scro tum helps in maintaining the temperature 2 to 2.5°C lower than body temperature, necessary for **spermatogenesis**.
- Interstitial spaces outside seminiferous tubules contain **immunocompetent** cells and **Leydig cells**
- Ovary is connected to pelvic wall and uterus by **ligaments**.

## 5 GAMETOGENESIS

**Process of gamete formation**

| Parameters | Male | Female |
|---|---|---|
| **Term** | Spermatogenesis | Oogenesis |
| **Process begins** | At puberty | During embryonic development |
| **Ploidy & chromosome number per cell** | | |




**Characteristics**

- Single layer of granulosa cells
- More layers of granulosa cells and a **new theca layer**
- Completion of meiosis I (*Reduction division*)
- Fluid filled cavity **antrum** and theca layers are organised into external and internal layers
- Secondary oocyte forms **acellular zona pellucida** around it

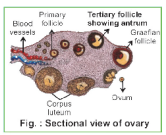


Fig. : Sectional view of ovary

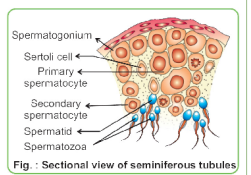


Fig. : Sectional view of seminiferous tubules

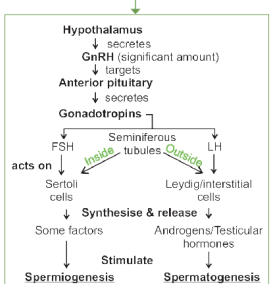
- No more oogonia are formed and added after birth
- A large number of follicles degenerate from birth to puberty so only **60,000- 8 0,000 primary follicles are left in each ovary at puberty**.
- **Meiosis** in oogenesis results in **unequal sized cells** and the secondary oocyte retains bulk of the nutrient rich cytoplasm of the primary oocyte
- Fate of polar body is not certain
- During the embryonic development, a couple of million gamete mother cells (oogonia) are formed within each fetal ovary

**Spermioge nesis** is transformation of **spermatids** to sperms and sperm head is embedded in **Sertoli cells**

## 6 SEMEN

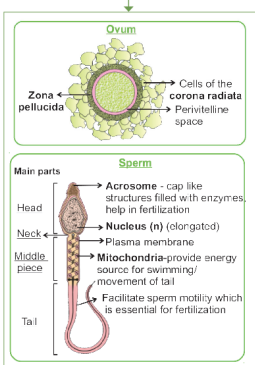
- Secretions of epididymis and vas deferens are essential for maturation and motility of sperms
- **Male ejaculates** about 200-300 million sperms during a coitus.
- **For normal fertility** :
  - 60 % sperms must have normal shape and size
  - **40 % of 60 % sperms must show vigorous motility**

## 7 HORMONAL REGULATION IN MALES




- The function of male sex accessory ducts and glands are maintained by the testicular hormones (androgens)

## 8 STRUCTURE OF GAMETES




## 9 HORMONAL REGUALTION IN FEMALES AND MENSTRUAL CYCLE

- The cycle of events starting from one menstruation till the next one is termed **menstrual cycle**
- **Characteristic** of female primates → Monkeys, Apes, Humans
- **Begins** at puberty – **menarche**
- **Ceases** at 50 years – **menopause**
- **Reproductive phase**
  - **Cycle occurs if ovum remains unfertilized**
  - **Lack of cycle** may be an indication of – Pregnancy, stress, poor health, etc.
  - Average duration in humans = 28/29 days

**Menstrual cycle**

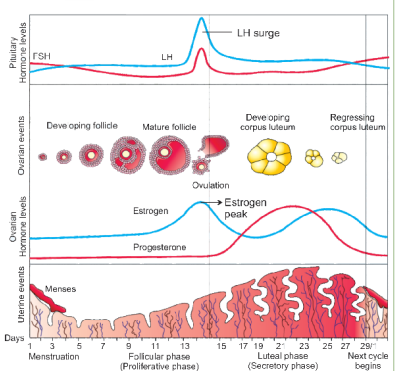
- Changes in the ovary and the uterus are induced by changes in the levels of pituitary and ovarian hormones

| Phase | Duration | Hormones & their effects | Events in ovary | Events in uterus |
|---|---|---|---|---|
| **Menstrual** | 3-5 days | Drastic decline in progesterone | Corpus luteum degenerates | • Breakdown of endometrial lining and its blood vessels which forms liquid that comes out through vagina constituting **menstrual flow** |
| **Follicular or Proliferative phase** | Variable | Gradual increase in FSH and LH that stimulate secretion of estrogen from follicles | Primary follicle gradually matures to Graafian follicle | • Endometrium regenerates through proliferation |
| **Ovulation** | 14th day (Middle of cycle) | FSH and LH at peak, **(LH surge)** | Rupture of Graafian follicle and release of only one ovum/cycle | • Proliferation of endometrium continues |
| **Luteal or Secretory** | **Fixed (14 days)** | Secretion of progesterone and estrogen | Remnants of the Graafian follicle transforms into corpus luteum | • Endomerium is maintained<br>• If ovum remains unfertilized, endometrium is sloughed off, marking a new cycle |

Reproductive cycle

**Menstrual Hygiene**

1. Maintenance of hygiene and sanitation during menstruation is very important
2. Take bath and clean yourself regularly use sanitary napkins/home made pads
3. Change sanitary pads after every 4-5 hrs.
4. Dispose of used sanitary napkins properly by wrapping it in used paper.
5. After handling the napkin wash hands with soap




- **If ovum gets fertilized, endometrium is maintain ed by progesterone** necessary for implantation and other events of pregnancy.
- During pregnancy all events of menstrual cycle stop

# Human Reproduction

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## 1 INRODUCTION

- **Sequence of reproductive events occurring in humans include:**

Gametogenesis
↓
Insemination
↓
Fertilization
↓
Implantation
↓
Gestation
↓
Parturition/Birth

## 4 SEX OF A BABY IS DETERMINED BY THE FATHER

| Parameters | Female | Male |
|---|---|---|
| Chromosome pattern | XX | XY |
| Gametes formed | X X | X Y |
| Fusion of gametes | XX XX (Female) | XY XY (Male) |

- 50% male gametes carry X chromosome and 50% carry Y chromosome
- Zygote would carry either XX or XY depending on whether the sperm carrying X or Y fertilizes the ovum

## 2 PATH FOLLOWED BY GAMETES IN FEMALE REPRODUCTIVE SYSTEM

- During coitus, semen is released from male reproductive tract by the penis into the female reproductive tract i.e., the vagina by process termed **Insemination**

| Sperms | Oocyte |
|---|---|
| Released in vagina | Released in body cavity |
| Swim through ↓ Cervix | Captured by ↓ Fimbriae |
| enters ↓ Uterus | ↓ Infundibulum |
| Reach | |

Ampulla (site of fertilisation)
↓
Fusion of gametes/**syngamy**/**Fertilization**
(vital element of sexual reproduction)

- Fertilization can only occur if the **ovum** and **sperms** are **transported simultaneously** to the ampullary region. This is the reason why not all copulations leads to fertilization and pregnancy

## 3 CHANGES IN GAMETES DURING FERTILISATION

Secretions of **Acrosome part of sperm**
↓ allow
Entry of sperm into cytoplasm of oocyte through zona pellucida and plasma membrane

- Changes in zona pellucida prevent entry additional sperms and **ensures that only one sperm can fertilise an ovum**

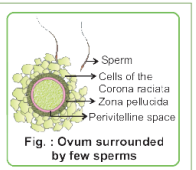


Fig. : Ovum surrounded by few sperms

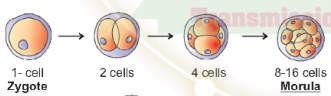
Inducing completion of Meiosis II of secondary oocyte
Form
- *Cytoplasmically unequal 2nd meiotic division*

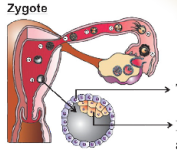
2nd Polar body **(n)** (1) | Ovum/ootid **(n)** (1) | Sperm **(n)**
Nuclei fuse
*(Released in Perivitelline space)*
**Zygote** (2n)

❍ **Characteristics**
- Vital link that ensures continuity of species between organism of one generation and the next.
- Sex of a child is decided at this stage

## 5 DEVELOPMENT OF THE ZYGOTE

- Every sexually reproducing organism, including human beings begin life as a single cell *i.e.*, the **zygote**.
- The process of development of embryo from zygote is called **embryogenesis**.
- During embryogenesis, zygote undergo **cell divisions** and **cell differentiation**
- Cleavage starts as zygote moves through isthmus to the uterus
- Daughters formed after cleavage are called **Blastomeres**




- **Trophoblast** – Outer layer of blastomeres attaches to endometrium
- **Inner cell mass** – Inner group of cells attached to trophoblast → Differentiates into embryo with three germ layers

The inner cell mass contains certain cells called **stem cells** which have the potency to give rise to all the tissues and organs.

After attachment, uterine cells divide rapidly and cover the blastocyst.
Embedding of blastocyst in endometrium is called **Implantation**
Leads to ↓ **Pregnancy**

❍ Germ layers
- Outer – Ectoderm
- Middle – Mesoderm
- Inner – Endoderm

} These together give rise to all tissues/organ in adults

## 6 CHANGES AFTER IMPLANTATION

| Embryo/Foetus | Mother |
|---|---|
| Finger like projections appear on the trophoblast called **chorionic villi** | Uterine tissue |

Interdigitate to form **(Structural and functional unit between embryo/foetus and mother)**

❍ **Functions:** ← Placenta →
- Supply of $O_2$ and nutrients to the embryo
- Removal of $CO_2$ and excretory/waste materials produced by the embryo
- **Acts as endocrine tissue:**
  - –hCG/human chronic geonadotropin
  - –hPL/human placental lactogen
  } Produced only during pregnancy
  - –Relaxin (Also secreted by ovary in later phase of pregnancy)
  - –Estrogens
  - –Progestogens
  - –Cortisol
  - –Prolactin
  - –Thyroxine

  } **Increase several folds during pregnancy essential for supporting:**
  - Foetal growth
  - Metabolic changes in mother
  - Maintenance of pregnancy

❍ Placenta is connected to the embryo through an **umbilical cord** which helps in the transport of substances to and from the embryo

## 7 GESTATION PERIOD

- Average duration of pregnancy in
  - Dog ~ 63 days
  - Cat ~ 63 days
  - Elephant ~ 18-22 months
  - Human ~ 9 months

**Major events during gestation period in humans:**

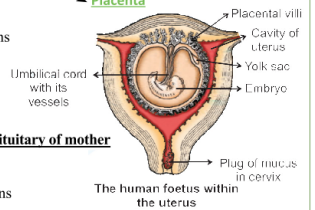
| Trimester | Month | Week | Event |
|---|---|---|---|
| 1st | I | 4 | Heart is formed, sign of growing foetus noticed by listening to the heart sounds through stethoscope |
| | II | 8 | Foetus develops limbs and digits |
| | III (end) | 12 | Most of major organ systems are formed including external genital organs |
| 2nd | V | 20 | First movement of foetus, Apperance of hair on head |
| | VI(end) | 24 | Body is covered with the fine hair, Eyelids separate, Eyelashes are formed |
| 3rd | IX (end) | 36 | Foetus is fully developed and is ready for delivery |

## 8 PARTURITION

- **Defined as delivery of the foetus (Child birth)**
- **Signals for parturition originals from** Fully developed foetus
  Placenta

Lead to
Mild uterine contractions
called
**Foetal ejection reflex**
triggers release of
**Oxytocin from posterior pituitary of mother**
Causes
Strong uterine contractions
leading to
Expulsion of baby through birth canal **(Parturition)**
followed by
Expulsion of placenta

This is positive feedback loop



The human foetus within the uterus

* **Oxytocin** is synthesized by its **source gland hypothalamus** but released from posterior pituitary

❍ Child birth is induced by a complex **neuroendocrine mechanism** involving **cortisol, estrogens and oxytocin.**
❍ **Doctors inject oxytocin to induce delivery**

## 9 MAMMARY GLANDS AND LACTATION

- Functional mammary gland is characteristics of all female mammals
- Paired structures (Breasts) that contain variable amount of fat and
- **Mammary glands**
  - Undergo differentiation during pregnancy
  - Secrete milk after child birth that helps mother in feeding new born baby by process called **lactation**.
- Milk produced during initial few days of lactation is called **colostrum** which contains several antibodies, absolutely essential to develop resistance for the new born babies
- Breast feeding during the initial period of infant growth is recommended by doctors for bringing up a healthy baby.

Glandular tissue
divided into ↓
(15-20) **Mammary lobes**
contain ↓
**Mammary alveolus**/ cluster of cells (*secrete and store milk*) in their lumen
opens into ↓
**Mammary tubules**
join to form ↓
**Mammary duct**
Many join to form ↓
**Mammary ampulla**
connected to ↓
**Lactiferous duct**
(Through which milk is sucked out)

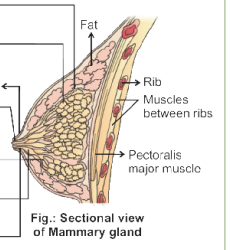


Fig.: Sectional view of Mammary gland