

CHAPTER 3 -HUMAN REPRODUCTION

Key Words

Scrotum	It is a pouch-like structure outside the abdominal cavity in which the testis are situated. It helps in maintaining the low temperature of the testes (2–2.5° C lower than the normal internal body temperature) necessary for spermatogenesis.
Seminiferous tubule	In each testicular lobule 1- 3 highly coiled seminiferous tubules in which sperms are produced.
Sertoli cells	Sertoli cells provide nutrition to the male germ cells.
Leydig cell	Present in interstitial space (regions outside the seminiferous tubules). It secretes testicular hormones called androgens
Urethral meatus	It is the external opening of the penis.
Seminal plasma	Secretion of the male accessory glands (seminal vesicles, prostate and bulbourethral gland) constitute the seminal plasma.
Male accessory glands	Paired seminal vesicles, prostate and paired bulbourethral glands
Lactiferous duct	Through which milk is sucked out.
Spermatogonia	Immature diploid male germ cells (Spermatogonia) produce sperms by spermatogenesis. These are present on the inside wall of the seminiferous tubule.
Acrosome	Cap-like structure on sperm head. It contains enzymes that help fertilization of the ovum.
Semen	The seminal plasma along with the sperms constitutes the semen.
Oogonia	Gamete mother cells (oogonia) are formed within each fetal ovary which later develops into the egg.
Graafian follicle	Mature follicles formed during oogenesis. When it ruptures releases the secondary oocyte (ovum) and remaining part forms the corpus luteum.
Zona pellucida	The membrane on the secondary oocyte prevents polyspermy
Corpus luteum	After ovulation remaining parts of the Graafian follicle transform into the corpus luteum. It secretes progesterone hormone, which is essential for the maintenance of the endometrium.
Polar body	It is a small <u>haploid</u> cell that is formed during oogenesis. It can't be <u>fertilized</u> .
Cleavage	The mitotic division in the zygote is called cleavage.
Placenta	The chorionic villi and uterine tissue become interdigitated with each other and jointly form a structural and functional unit called the placenta
Chorionic villi	After implantation, finger-like projections appear on the trophoblast called chorionic villi which are surrounded by the uterine tissue and maternal blood.
Stem cell	Inner cell mass contains certain cells called stem cells which have the potency to give rise to all the tissues and organs.
Implantation	Implantation is the process in which the mammalian embryo (blastocyst) becomes attached to the endometrium of the uterus.
Fetus ejection reflex	Mild uterine contractions are generated by the placenta when the fetus is fully developed, at the time of parturition.

Gamete formation - spermatogenesis	Formation of spermatozoa
Oogenesis	Formation of ovum
Oocytes – Primary oocyte (2n)	Oogonia divide and arrest at meiotic prophase I
Secondary oocyte (n)	Formed from primary oocyte
Menstrual cycle – Menarche	Start of menstrual cycle
Menopause	Stop of menstrual cycle after age of 50 yrs
Zygote stages- Blastomere	2,4,8,16 celled stage
Blastocyst	Blastomere encysted in layers (trophoblast and inner cell mass)
Trophoblast	Outer layer of blastocyst, attached with endometrium
Inner cell mass	differentiated as the embryo
Birth hormones – Oxytocin	Uterine contraction
Relaxin	Widen cervix and helps in parturition (child birth)

Spermatogenesis and Oogenesis

Spermatogenesis

In the seminiferous tubule of testes, the male germ cells (Spermatogonia) divide mitotically to form a large number of Spermatogonia.

Spermatogonia undergo meiotic division to form primary spermatocytes.

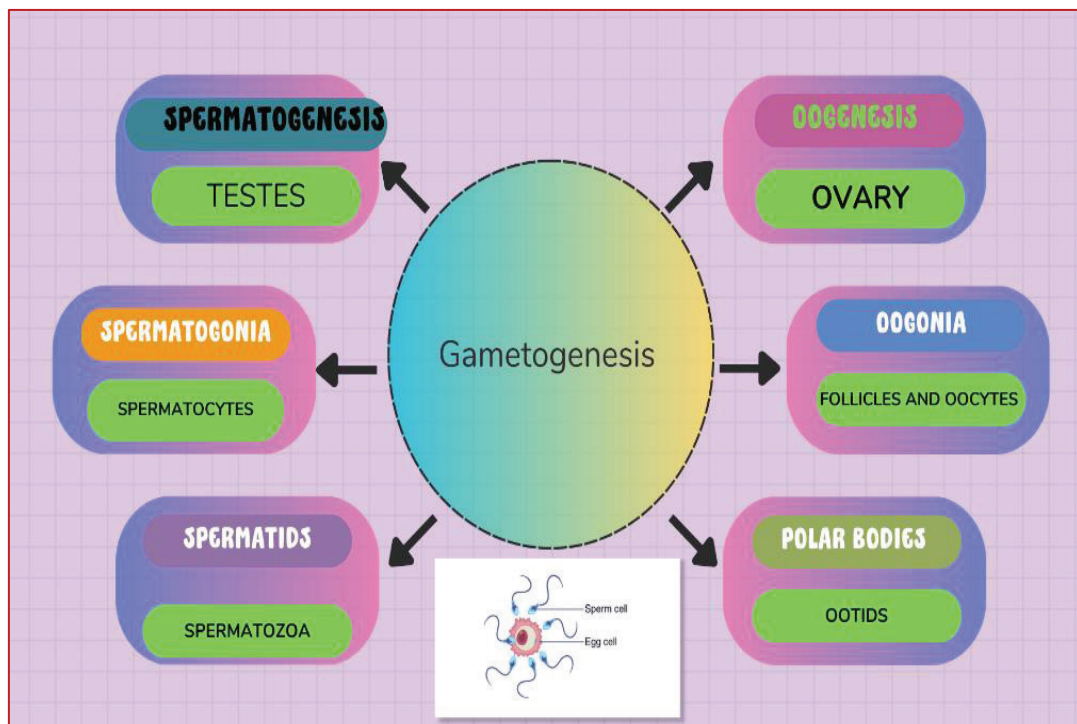
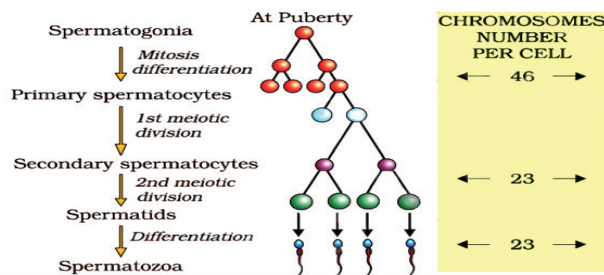
The latter form secondary spermatocytes, and finally four spermatids are formed.

Hormonal control

Gonadotropin-releasing hormone (GnRH) from the hypothalamus stimulates the anterior pituitary to secrete luteinizing hormone (LH), follicle-stimulating hormone (FSH).

LH acts at the Leydig cells and stimulates the secretion of androgens. Androgens help in spermatogenesis.

FSH acts on the Sertoli cells and secrete two factors- androgen binding protein (ABP) and inhibin which helps in spermatogenesis.



Oogenesis

In the ovary some of the germinal epithelial cells divide by mitosis to produce a large number of Oogonia.

Oogonia multiply by mitosis and form primary oocytes.

Primary oocyte is surrounded by a layer of granulosa cells and is called primary follicle.

The primary follicles converted into secondary follicles and then into tertiary follicle which is characterized by a fluid-filled cavity called Antrum.

The primary oocyte within the tertiary follicle grows in size and completes its first meiotic division which is an unequal division and forms a large secondary oocyte and tiny first polar body.

The tertiary follicle changes into the mature follicle or Graafian follicle.

The secondary oocyte forms a new membrane called Zona pellucida

The Graafian follicle ruptures to release the secondary oocyte by the process called ovulation. The remaining part of Graafian follicles acts as corpus luteum.

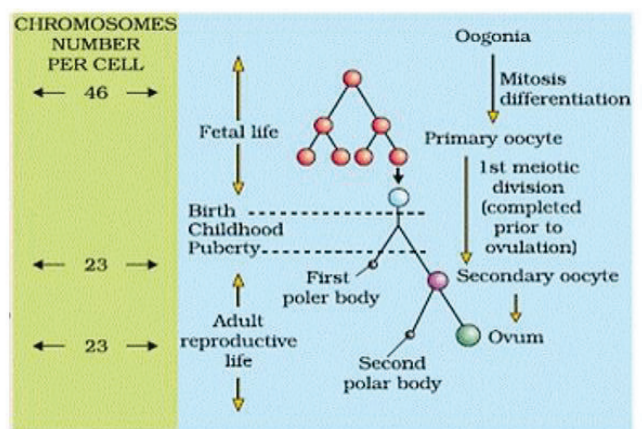
If a sperm can enter the secondary oocyte then secondary oocyte completes meiosis II and thus results in the formation of second polar body and an ovum.

Hormonal control

LH- acts on Graffian follicle and causes ovulation. FSH- responsible for follicular development

Estrogen- proliferation of endometrium layer of uterus

Progesterone- maintenance of endometrium layer and helps in pregnancy



• Menstrual phase (3-5 days)

If fertilization not takes place, the endometrial lining of the uterus breaks along with the blood vessels which releases through vagina as menses..

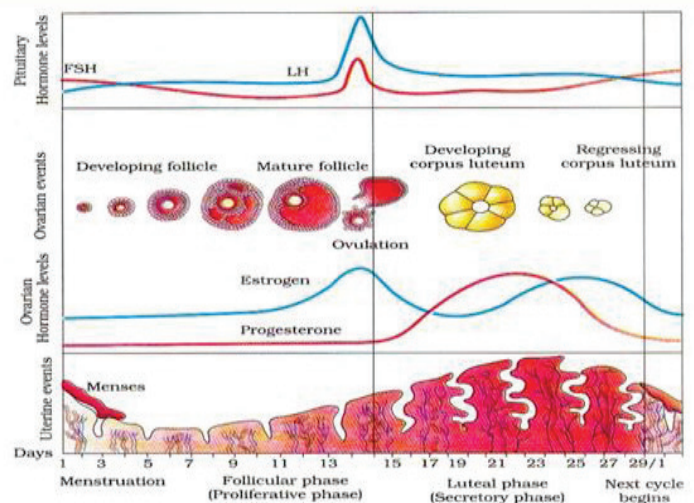
• Follicular phase

In this follicular development takes place. Endometrium regenerates through proliferation.

• Luteal phase

Graafian follicle ruptures and form yellow body called Corpus luteum.

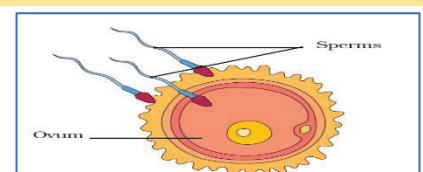
The corpus luteum secretes progesterone hormone which maintains the endometrium of uterus for implantation of the fertilized ovum.



FERTILIZATION

The fusion of sperm and ovum is called fertilization.

- Site- ampulla-isthmic junction.
- Zona-pellucida layer of the ovum block the entry of the additional sperms thus only one sperm fertilizes the ovum.



IMPLANTATION

Zygote divides mitotically and moves towards the uterus.

Zygote forms 2, 4, 8, 16 daughter cells called as Blastomere.

The embryo with 8 to 16 Blastomere is called a Morula.

The Morula transforms into blastocyst.

Blastocyst has outer layer (Trophoblast) and inner cell mass.

The Trophoblast layer forms placenta and umbilical cord while inner cell mass forms embryo.

Inner cell mass divide to cover the blastocyst which gets embedded in the endometrium of the uterus and the process is called as implantation.

PREGNANCY AND EMBRYONIC DEVELOPMENT

After implantation, finger-like projections (chorionic villi) appears on Trophoblast.

The chorionic villi and uterine tissue jointly form placenta.

The placenta is connected to the embryo through an umbilical cord.

Placenta also acts as an endocrine tissue and produces several hormones like human chorionic gonadotropin (hCG), human placental lactogen (hPL), estrogens, progestogens, etc.

In addition, during pregnancy the levels of other hormones like estrogens, progestogens, cortisol, prolactin, Thyroxine, etc., are increased several folds in the maternal blood.

Immediately after implantation, the inner cell mass (embryo) differentiates into an ectoderm (outer layer), mesoderm (middle) and endoderm (inner layer). These three layers give rise to all tissues (organs) in adults.

STAGES OF EMBRYO DEVELOPMENT

One month	Heart is formed
Two month	Development of limbs and digits
12 weeks (first trimester)	Most of the major organ systems are formed, for example, the limbs and external Genital organs are well-developed.
Fifth month	First movements and appearance of hair on the head
After 24 weeks (end of the second trimester)	The body is covered with fine hair, eyelids separate, and eyelashes are formed.
9 month	Foetus is fully developed

PARTURITION

Gestation period: The average duration of human pregnancy (9 months).

Parturition: the process of delivery of the fetus.

Parturition is a neuroendocrine mechanism. The signals for parturition originate from the fully developed fetus and placenta which induces mild uterine contractions called **foetal ejection reflex**. Due to this oxytocin hormone is released from the maternal pituitary which causes stronger uterine contractions, which in turn stimulates further secretion of oxytocin. Continuous secretion of oxytocin causes stronger and stronger contractions. This leads to the expulsion of the baby out of the uterus through the birth canal – parturition.

LACTATION

- The mammary glands of the female starts producing milk towards the end of pregnancy through the process called lactation.
- The milk produced during the initial few days of lactation is called colostrum which contains several antibodies essential to develop resistance for newly born babies.

IMPORTANT QUESTIONS**Very Short Answer Type Questions/ MCQ**

1- LH surge is responsible for-

- a- Ovulation
- b- Spermatogenesis
- c- Oogenesis
- d- Fertilization

Ans: a.

2- Spermiogenesis is

- a- Transformation of spermatozoa into spermatids
- b- Transformation of spermatids into spermatozoa
- c- Both are incorrect
- d- A is correct while b is incorrect

Ans: B

3- What is the role of polar bodies-

- a- Maintain the number of chromosomes in the ootid
- b- Prevent polyspermy
- c- Release progesterone
- d- All of these

Ans: a

4- Despite the presence of So many sperms in the vicinity of an egg cell, only one sperm enters the ovum. Why?

Ans: Because when sperm comes in contact with the ovum (Zona pellucida) & induces changes in the membrane to block entry of other sperms

5- Define spermiogenesis. Where does it occur?

Ans: The transformation of non-motile spermatids into motile spermatozoa is called spermiogenesis. It occurs inside the seminiferous tubules of the testes.

6- Name the cells which produce testosterone. What is the function of this hormone?

Ans: Interstitial cells (Leydig's cells) of the testis secrete the testosterone hormone. Function. They control secondary sexual characters.

7- The Spermatogonia cell has 46 chromosomes in human males. Give the number of chromosomes in (a) Primary spermatocyte (b) Spermatid

Ans: (a) Primary spermatocyte – 46 (b) Spermatid- 23

8- How does colostrum provide initial protection against diseases in newborn infants? Give one reason.

Ans: Colostrum contains immunoglobulin which provides immunity to the infants.

9- Name the embryonic stage which gets implanted in the uterine wall of a human female.

Ans: blastocyst stage

10- Name the hormone which causes strong uterine contraction during parturition. Does the parturition signal originate from the mother or the fetus?

Ans: Hormone - is Oxytocin

The signal originates from the placenta and fully developed fetus.

11- Where are sperm stored in males?

Ans: Epididymis