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**UNIT
05**

Animal Reproduction
Female reproductive System

**SAMPATH
LANKADHEERA**

B.Sc. (Hons), M.Sc.



Live Biology
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New Syllabus

SAMPATH LANKADHEERA

Unit
05

Reproduction
Female Reproductive System

ADVANCED LEVEL

Biology

Unit - 05

Animal Reproduction

o Female reproductive system

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**Unit
05**

Animal Reproduction

○ Female reproductive system

Smart Note

SAMPATH LANKADHEERA

B.Sc. Hons. M.Sc. (Biotechnology)

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Competency Level 5.8.3: Inquires into structure and functions of the female reproductive system

Number of Periods : 10

Learning Outcomes:

- briefly states the structures and functions of the female reproductive system with models/diagrams
- briefly describes the major steps of oogenesis with its hormonal regulation
- briefly describes the structures of human ovaries
- briefly describes the structure and the functions of each parts of the human ovum
- briefly describes the menstrual cycle
- illustrates the hormonal regulation and the structural changes of ovaries and endometrium that occur in menstrual cycle using appropriate graphs
- states what menopause is
- identifies the main components of the female reproductive system using models /diagrams (Practical work)
- appreciates the complexity of the human reproductive systems

Suggested Teaching- Learning Process

- Provide students with unlabeled diagram/ models/ charts of female reproductive system and guide them to label the parts of it.
- Guide students to relate the structure of the female reproductive system to its function.
- Describe the oogenesis and its hormonal regulation using charts/video clips/ diagrams.
- Use diagrams/ models/ video clips to describe the structure of the human ovum and guide the students to relate the structure of the human ovum to its function.
- Use relevant graphs/ diagrams/ charts/ models/ video clips to describe the hormonal regulation and the structural changes that occur in menstrual cycle.
- Use relevant charts/ graphs to explain the hormonal fluctuations in blood women during menstrual cycle.
- Explain menopause.

Assessment and Evaluation

- Conduct a written test on oogenesis and its hormonal regulation



Structure and Function of the Human Female Reproductive System

- Main internal structures of the female reproductive system consists of two ovaries (female gonads), two oviducts, uterus and vagina.

Ovaries:

- The female gonads are the two ovaries, They are found on either side of the uterus and are held in place in the abdominal cavity by ligaments.
- In the ovary, female gametes are stored and developed prior to ovulation.
- Ovaries also produce female sex hormones that are needed for physiological changes during the reproductive cycle.
- The ovaries have two tissue layers: outer the cortex and inner the medulla, The outer layer of each ovary consists of connective tissues covered by germinal epithelium, The outer layer contains ovarian follicles in various stages of maturity.
- Each follicle consists of an oocyte, which is a partially developed egg surrounded by support cells. Support cells protect and nourish the oocyte during its development.
- The ovum is discharged from the ovary at secondary oocyte stage of oogenesis with the first polar body.
- This secondary oocyte divides into the mature ovum (egg) and a second polar body if a sperm penetrates the secondary oocyte. Human ovum is a round cell with 23 maternal chromosomes and relatively large cytoplasm and is surrounded by numerous supporting cells. In addition, there is a clear layer present between plasma membrane of the ovum and the supporting cells (Zona pellucida).

Oviducts:

- The oviduct or the fallopian tube extends from the uterus toward a funnel like opening at each ovary, The dimensions of this tube vary along its length (near the uterus is narrow as a human hair).
- After ovulation, cilia on the inner epithelial lining of the oviduct help collect the egg by drawing fluid from the body cavity into the oviduct.
- Then With the help of Wave contractions of the oviduct the cilia convey the egg down the oviduct to the uterus.

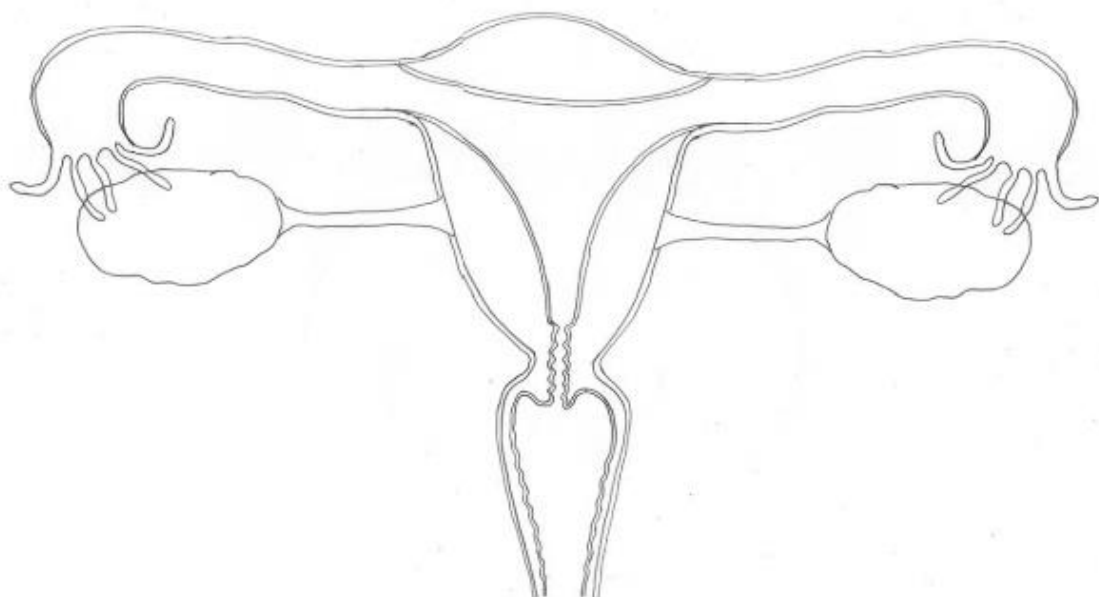
Uterus:

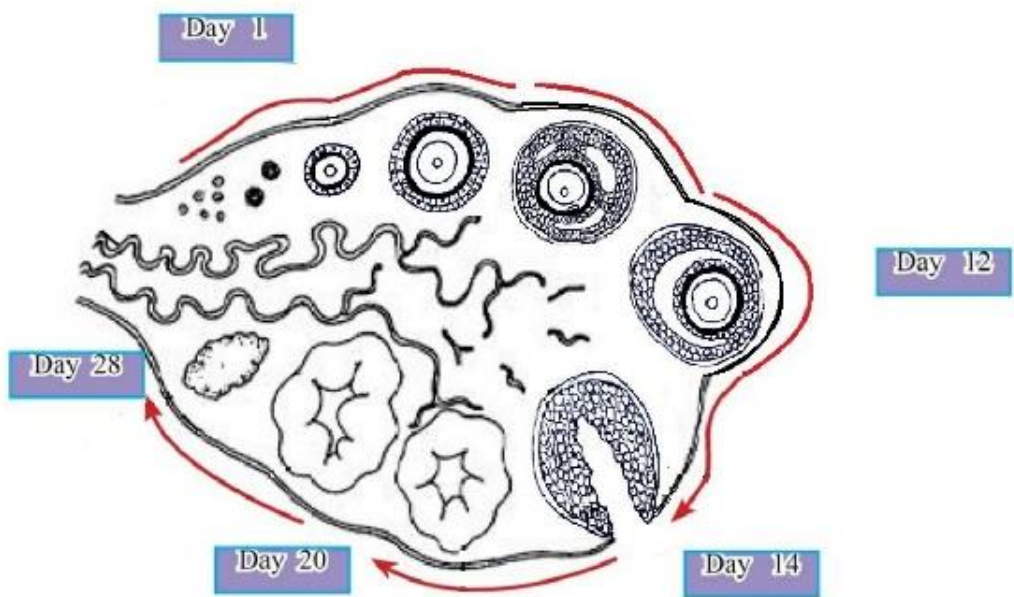
- The uterus or the Womb is a thick, pear shaped chamber.
- Its walls are muscular, which allows it to expand during pregnancy to accommodate the fetus and its inner lining (endometrium) is highly vascularized.
- The distal end of the uterus narrows to form a neck, called the cervix that opens into the vagina.

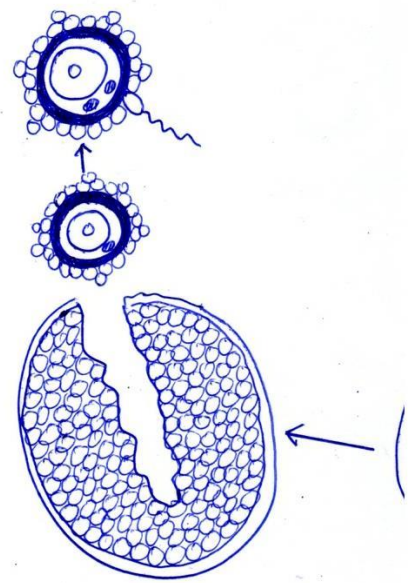
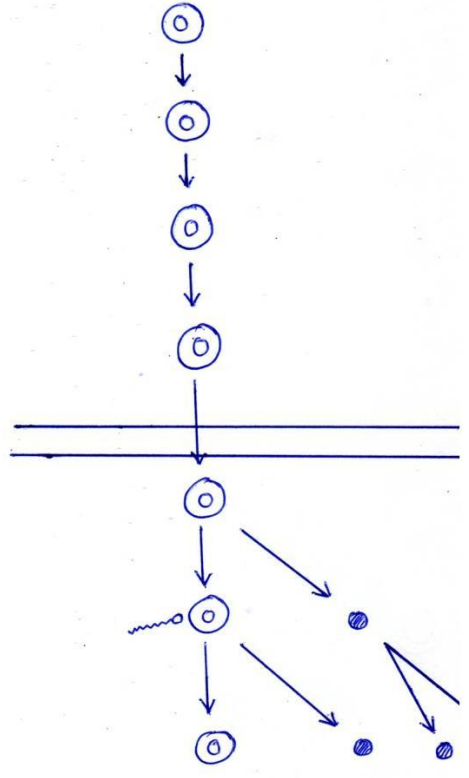
Vagina:

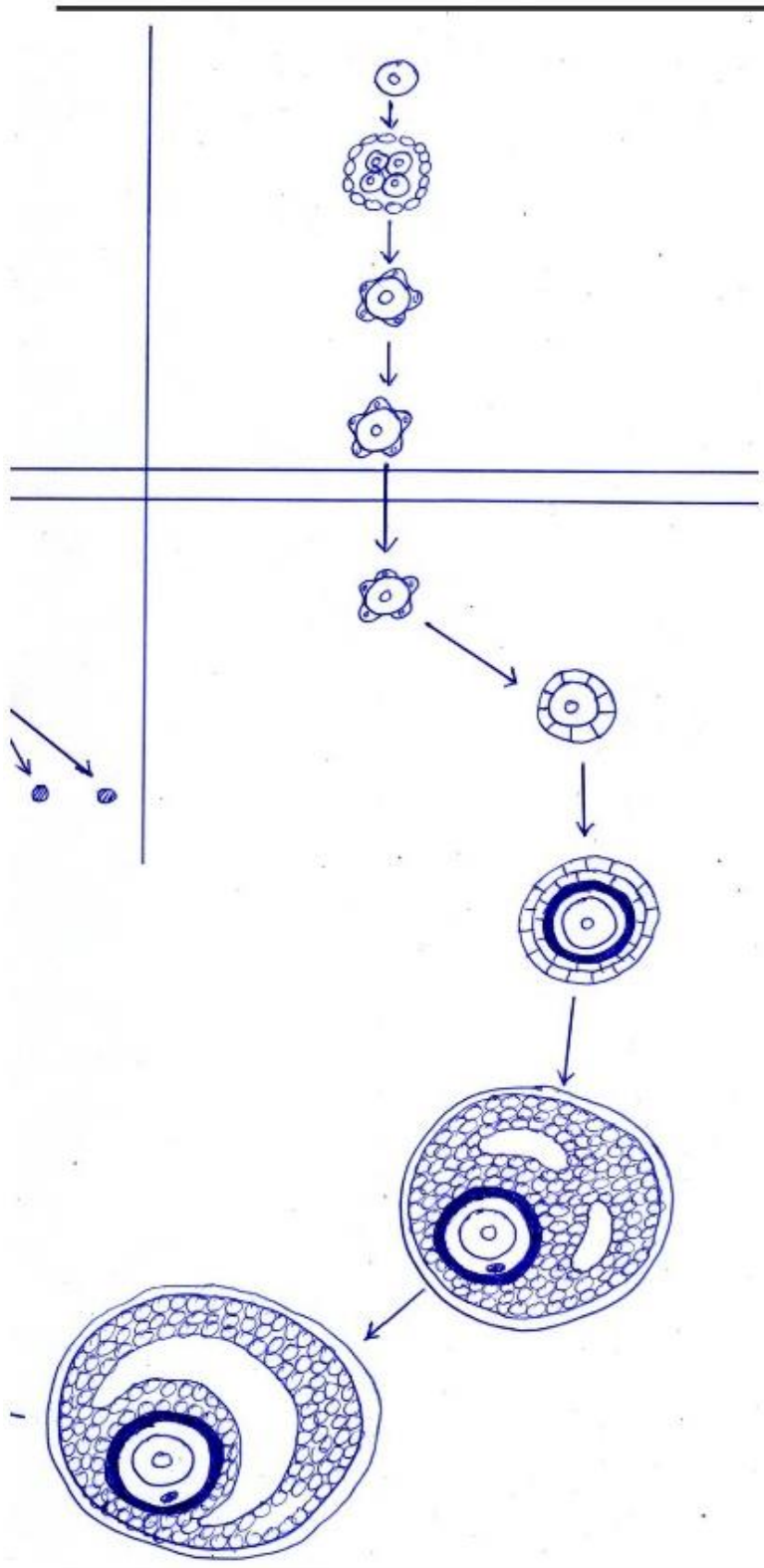
- This is a muscular but elastic chamber with a stratified epithelium
- The vagina connects external and internal organs of reproduction.
- It is the site where sperm is deposited and also serves as the birth canal.

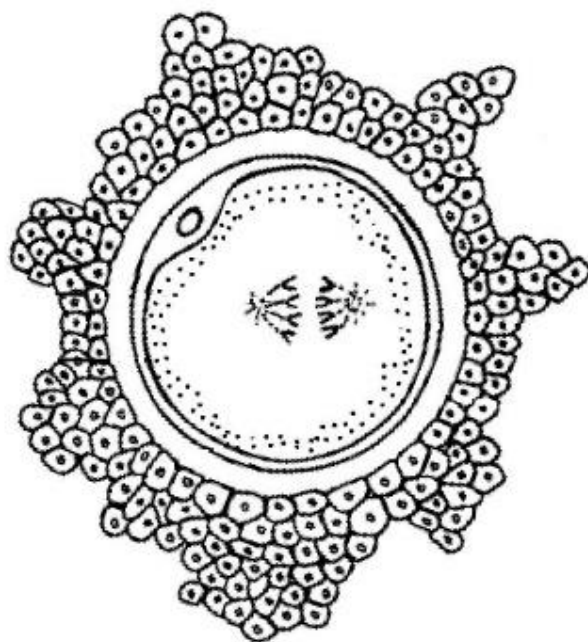












Oogenesis

- In the human female, the development of mature oocytes takes a long time, Immature eggs are formed in the ovary of a developing female embryo.
- But these eggs complete their development many years or even decades later.
- In oogenesis, cytokinesis during meiosis is unequal, with almost all the cytoplasm segregated to a single daughter cell.
- This large cell develops to become the egg, The other products of meiosis, which are smaller cells are known as polar bodies.
- These polar bodies eventually degenerate. Unlike spermatogenesis, the mitotic divisions that occur during oogenesis in human females are thought to be complete before birth and the production of mature gametes ceases at about the age 50 years, Unlike in spermatogenesis, during oogenesis there are also long interruptions.

Main steps in oogenesis

- Oogenesis begins in the female embryo with the mitotic division of primordial germ cells that give rise to oogonia. Then oogonia divide by mitosis to form cells that begin meiosis, but stops at prophase I before birth.
- Each of these developmentally arrested cell is called a primary oocyte. Each primary oocyte is found within a small follicle, a cavity lined with protective cells.
- At birth, the ovaries together contain about 1-2 million primary oocytes. Out of these about 500 fully mature between the puberty and the menopause.
- Beginning at puberty, follicle stimulating hormone (FSH) periodically stimulates a small group of follicles to resume growth and development.
- Out of these only one follicle fully matures each month, During this time the primary oocyte. Within the follicle completes meiosis I and produces a secondary oocyte and the first polar body. Then the meiosis II starts, but stops at the metaphase.
- The secondary oocyte arrested in meiosis II is released at ovulation (with the first polar body), when its follicle breaks open. If a sperm penetrates the secondary oocyte, meiosis II completes and the secondary oocyte divides into the mature ovum and a second polar body.
- Both meiotic divisions involve unequal cytokinesis, with the smaller cells becoming polar bodies, which will degenerate eventually.
- If a sperm penetrates, there is a single mature egg (ovum) containing a sperm head at the end of oogenesis. The fusion of the haploid nuclei of the sperm and the ovum is called fertilization
- The ruptured follicle left behind after ovulation develops into the corpus luteum.
- Corpus luteum secretes estradiol and progesterone hormones which help to maintain the uterine lining during pregnancy.
- If the egg is not fertilized, the corpus luteum degenerates and leaves a small ,permanent scar of fibrous tissue called corpus albicans on the ovary surface.
- A new follicle matures during the next cycle.



Hormonal control of the human female reproductive cycles

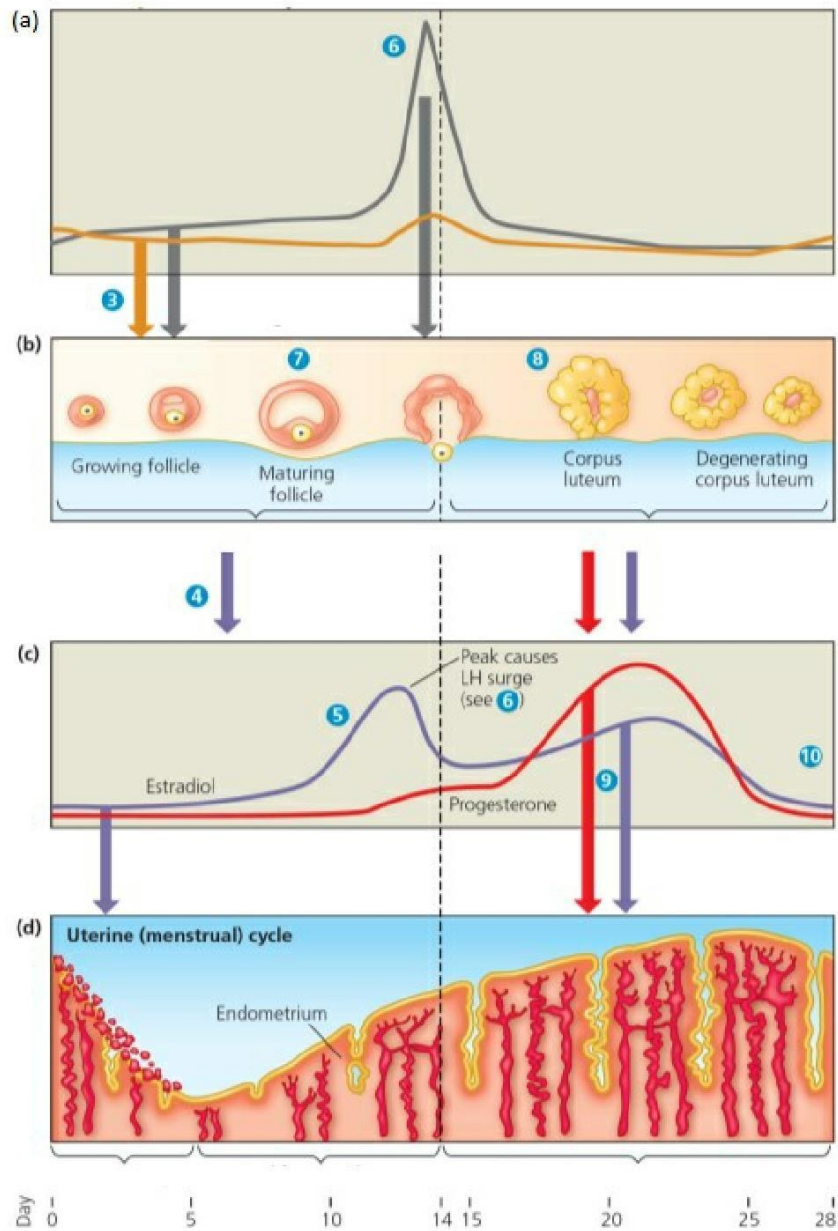
- Although males produce sperms continuously, females produce ova in cycles.
- There are two linked reproductive cycles in a human female during their reproductive years; the ovarian cycle and the uterine cycle (or the menstrual cycle).
- The uterine cycle consists of changes that occur about once a month in the uterus and these cyclic changes in the uterus are controlled by the ovarian cycle, which is cyclic events that occur in the ovaries.
- Both of these cycles are regulated by hormonal activities which link the two cycles, synchronizing ovarian follicle growth and ovulation with the establishment of a uterine lining which supports the development of embryo.











Ovarian cycle

- Ovarian cycle comprises follicular phase and luteal phase
- The period during which the follicle grows and the oocyte matures is referred to as the follicular phase.
- At the beginning of follicular phase, GnRH from the hypothalamus stimulates the anterior pituitary to secrete small amounts of FSH and LH.
- FSH stimulates follicle growth, aided by LH.
- Cells of the growing follicle start to make estradiol hormone. Therefore the estradiol level rises slowly during the follicular phase.
- The low levels of estradiol inhibit the secretion of gonadotropin hormones from the anterior pituitary (negative feedback) so that LH and FSH are kept at relatively low levels in the follicular phase.
- When estradiol secretion by the growing follicle starts to increase sharply, high levels of estradiol stimulate the hypothalamus to increase GnRH secretion which in turn stimulates the anterior pituitary to sharply rise the FSH and LH secretion especially producing a LH surge (through positive feedback mechanism).
- By this time the maturing follicle, containing a fluid-filled cavity has enlarged, forming a bulge at the surface of the ovary. About a day after the LH surge, the follicular phase ends at ovulation.
- In response to both FSH and the peak in LH level, the follicle and adjacent wall of the ovary rupture, releasing the secondary oocyte which is called ovulation.
- The luteal phase of the ovarian cycle takes place after ovulation. In the luteal phase, LH stimulates the follicular tissue within the ovary to transform into a glandular structure called the corpus luteum.
- The corpus luteum secretes progesterone and estradiol, which then exert negative feedback on the hypothalamus and pituitary.
- This feedback reduces LH and FSH secretion to very low levels and thereby prevents the maturation of another egg in the ovary.
- If there is no pregnancy, the low gonadotropin levels at the end of luteal phase promotes disintegration/ degeneration of the corpus luteum.
- Disintegration/degeneration of corpus luteum leads to the sharp decline in production of its hormones.
- As a result the negative-feedback of estradiol and progesterone on the hypothalamus and pituitary are removed.
- This enables the pituitary to produce FSH to stimulate the growth of a new follicles thereby starting the next ovarian cycle.

2. Uterine (menstrual) cycle

- Uterine cycle consists of proliferative phase, secretory phase and menstrual flow phase.

Proliferative phase: Before ovulation, steroid hormones of the ovary stimulate the uterus to prepare for support of an embryo, Growing follicles secrete estradiol that stimulates the endometrium to thicken, This is referred to as the proliferative phase in the uterine cycle.

- Therefore the follicular phase of the ovarian cycle coordinates with the proliferative phase of the uterine cycle

The secretory phase starts after ovulation. After ovulation, estradiol and progesterone that are secreted from the corpus luteum stimulate the maintenance and further development of the lining of the uterus by enlarging the arteries and growth of the endometrial glands,

- These glands secrete nutrient fluid that can sustain an early embryo if fertilization occurs,
- Hence, the luteal phase of the ovarian cycle is coordinated with the secretory phase of the uterine cycle.

Menstrual flow phase:

- If implantation of an embryo does not occur, the corpus luteum disintegrates which results in the drop in ovarian hormones. This brings about the end of the secretory phase.
- As a result, arteries constrict and thereby the uterine lining disintegrates and causes the shedding of endometrial tissues and fluid.
- This is the menstrual flow phase of the uterine cycle. The cyclic shedding of the blood-rich endometrium from the uterus, a process that occurs in a flow and which lasts for a few days through the cervix and vagina is called menstruation.



Menopause

- This is the cessation of ovulation and menstruation in a woman. Usually menopause takes place between the ages of 45 and 55 years.
- During this time the ovarian supply of oocytes runs out and the estrogen production by the ovary decreases. Ovaries become less responsive to the hormones FSH and LH produced by the anterior pituitary.

PRACTICAL NO.30

Study of female reproductive system using models or diagrams

Expected Learning Outcomes

1. Observes and identifies parts of female reproductive system.
2. Uses the microscope to identify follicles of different stages in the human ovary.
3. Elaborates on the electron microscopic structure of human ovum.
4. Observes and identifies the cross section of the uterine wall.
5. Observes developmental stages & position of the foetus within uterus at every trimester.
6. Identifies different components of human placenta.
7. Relates the structure to the functions performed by the various parts.

Materials and Equipment

- Chart of vertical sectional view of the lower abdominal region of a female showing the reproductive organs as well as the urinary system.
- A transverse section of the human ovary.
- Electron micrograph of a human ovum.
- A section/diagram/chart/model showing the uterine wall.
- A section/diagram/chart/model of the human placenta.
- Charts showing the foetus inside the womb at each trimester.
- Microscope

Instructions

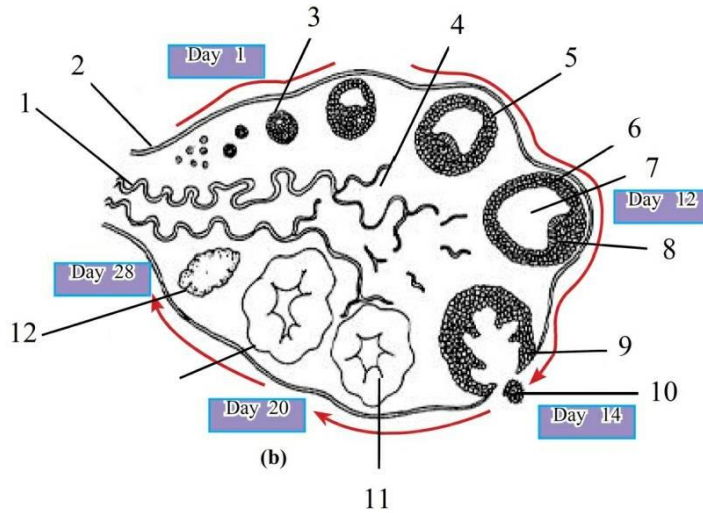
- Allow the students to study the chart carefully and understand the structure and relative positions of different organs of the female reproductive system.
- Lead a discussion on the relationship of structure of different organs of the female reproductive system to their functions.



1. What are the main parts of female reproductive system?

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2. Label following diagram which shows main parts of an ovary.



3. What is the tissue layer found on the outermost region of the ovary?

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4. What are the main 2 regions of the ovary?

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5. Briefly describe the structure of oviduct

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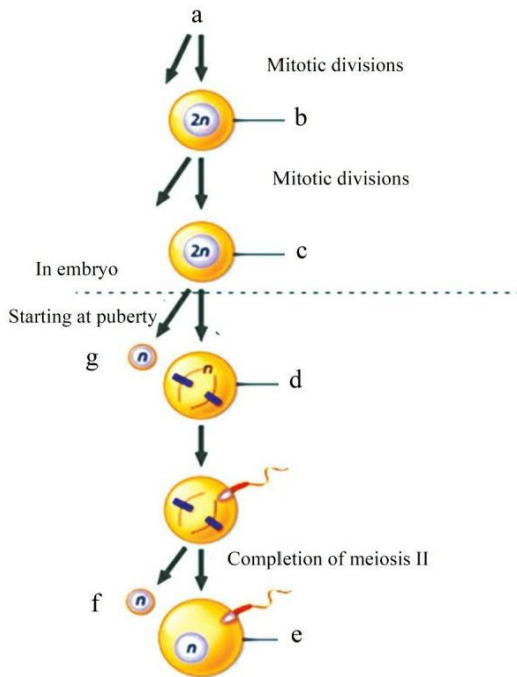
6. Explain how oviduct help to collect the egg.

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7. Describe the structure of womb/uterus.

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9. Label stages from a to g of oogenesis.



10. State 2 main stages of reproductive cycle of human females.

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(vi) Describe effect of estradiol and progesterone on uterus.

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11. State function of following components of the egg

- Cortical granules -
- Zona pellucida -
- Perivitelline space -
- Genetic materials -
- Lipid droplets -

