

## Female Reproductive System scripts

### Slide 2

The primary sex organs of the reproductive system are called **Gonads**. In case of females, these would be the ovaries and in case of male it would be testes. Gametes are sex cells produced by the gonads. In case of testes, they are called sperms, and in females they are called ovum or eggs. The gonads also produce hormones.

### Slide 3

In every somatic cell in our body there are 46 or 23 pairs of chromosomes. This is called a Diploid number and written as  $2n$ . But in gametes there are half the numbers of chromosomes, 23. 23 is a haploid number and written as  $1n$ . These are sex chromosomes. The sex chromosomes are X and Y chromosomes. In female eggs there are two X chromosomes. In male sperm there is one X and one Y sex chromosomes.

All the chromosomes, other than the sex chromosomes are called autosomes.

### Slide 4

**Fertilization** is when a sperm enters or penetrates an egg.

Result of fertilization is formation of **zygote**. From the zygote an entire human being will form. The zygote will start dividing as soon as it forms. The cell division of zygote or any other somatic cell is called **mitosis**. Each subsequent division will produce cells with 46 chromosomes.

But the gametes divide by the process of **meiosis** – a reduction division. It is called a reduction because 46 chromosomes will be reduced to 23. Each gamete will have 23 chromosomes. This process involves Meiosis I ( $2n$  to  $n$  number of chromosomes) and Meiosis II ( $n$  to  $n$  number of chromosomes)

### Slide 5

These are the functions of female reproductive system. We will discuss them in the subsequent slides.

- A. Production of eggs
- B. Site of Fertilization and fetal development
- C. Fetal nourishment, birth and lactation
- D. Secretion of hormones (estrogen and progesterone)

### Slide 6

In addition there are a number of secondary/accessory organs. In females they are uterine tubes, uterus, vagina, external genitalia

The vagina is also known as the birth canal. It is the tube that allows for the discharge of menstrual fluid, receipt of penis and semen, and birth of a baby.

The mucous that lubricates the vagina actually comes from the outer serous membrane and the cervix, not the mucosa. The lower end also has frictional ridges called vaginal rugae, which help to stimulate ejaculation.

#### Slide 7

The female external genitalia are collectively called the vulva. The labium majus and the labium minus are tissue folds that surround the urinary and reproductive external orifices. The clitoris is a collection of specialized cells. It has no urinary or reproductive function, but is entirely sensory. It is found on the anterior portion of the vulva between the labia. The mons pubis is adipose tissue overlaying the pubic bone and bearing most of the pubic hair.

The inner mucosa layer forms a membrane called the hymen that stretches across the opening of vaginal canal. Vaginal epithelium is stratified cuboidal epithelium.

#### Slide 8

Ovaries are attached to the uterus. Ovarian ligaments secure them to the uterus. Mesometrium which is parietal peritoneum, holds uterus, ovary, uterine tubes in position in peritoneal cavity. Remember that there are two serous layers surrounding the uterus, one is visceral (inner) and the other is parietal (outer layer). Suspensory ligaments contains ovarian artery, vein and nerves; secure ovary to pelvic wall.

#### Slide 9

The interior of the ovary is divided into the cortex and the medulla. The cortex is the outer portion and is where the germ cells and follicles develop. The medulla is primarily occupied by major arteries and veins. The egg develops inside a fluid-filled, structure called a follicle. The follicles are called according to their maturity – from Primordial follicles, then Primary follicles and Secondary follicles. There are many primordial follicles eventually only one will mature into secondary follicle to mature follicle. Another function of follicles is to nourish the developing oocyte and secrete mostly estrogen.

#### Slide 10

In the primordial follicles a primary oocyte is surrounded by a single layer of follicular cells. In the primary follicle a larger oocytes and still single layer of follicular cells surrounding it. When it matures into a secondary follicle, the oocyte is larger and the follicular cells now stratified (granulosa cells). Then in Mature (Graafian) follicles, the follicles become fluid filled cavity (antrum) with oocyte pushed to one side of the cells.

#### Slide 11

Uterine tubes are 2 muscular tubes - extend from ovary to uterus. Distal end expand to form infundibulum.

Ampulla is the middle and longest part

Isthmus is the narrower end toward uterus

Fingerlike projections called fimbriae are found at the distal end of the two uterine tubes. They direct the freshly ovulated egg into the uterine tube.

Walls of the uterine tubes from:

Innermost - mucous-lined with ciliated cells.

Middle layer - smooth muscle Peristalsis & ciliary action transport oocyte or fertilized ovum to uterus

Outer layer – serous membrane

Uterine tube is the site of fertilization. The tubes are not physically connected to the ovary, so the fimbriae are needed to help guide the egg in the correct direction. Occasionally the eggs do get lost in peritoneal cavity because of this.

Slide 12

Uterus is a thick-walled, pear-shaped muscular chamber opening into vagina. It has three anatomical segments:

1. Fundus: dome shaped superior part.
2. Body: central part.
3. Cervix: narrow inferior portion joining vagina

Below the uterus is the cervical canal. It has two openings:

opening into uterus is called Internal os and

opening into vagina is called External os.

Slide 13

Uterine wall is very important part of female reproductive system. If there is fertilization, it is here the zygote becomes implanted and the growing embryo then fetus is nurtured.

It has three layers.

1. Perimetrium- outer serosal layer.
2. Myometrium- middle muscular layer.
  - Undergoes labor contractions to expel the fetus
3. Endometrium- innermost- highly vascular epi cells – mucosal layer. This again has two layers: Stratum functionalis : It is closer to the cavity > shed during menstruation & rebuilt again if no implantation occurs. And Stratum basalis: permanent layer> builds the functional layer after each menstruation.

Vaginal canal, also known as birth canal, extends from the cervix to the exterior of the body. This is the common pathway for menstrual flow & the birth of a baby and it receives semen as well. It distends easily. Its wall is made up of outer adventitia, middle muscularis & inner mucosal layers. The pH is acidic, but it is neutralized by slightly alkaline semen

Slide 14

### Mammary Glands

Non-lactating breast consists mostly of adipose and collagenous tissue. They are modified sweat glands. The glands lie over pectoral muscle, surrounded by adipose tissue. Each breast has a pigmented projection which is called nipple. They develop during pregnancy and after pregnancy they atrophy.

Contain milk producing glands & ducts for delivery of milk when lactating.

Slide 15

### Lactating breast

- 15 to 20 lobes around the nipple
- Lactiferous duct drains each lobe

In a lactating breast this is the path of milk flow: mammary glands > lactiferous ducts > lactiferous sinus > nipple > exterior.

Hormones of pregnancy stimulate milk production.

Lactation: production & ejection of milk.

### Milk and Colostrum:

Before actual milk is produced, a thin secretion called **colostrum** similar to breast milk but contains 1/3 less fat is produced. This provides nutrition for first 1 to 3 days after birth.

Milk: water, proteins, fat, sugar, salts, lysozyme, and antibody.

Milk production- stimulated by Prolactin.

Milk ejection is controlled by Oxytocin. Many other hormones are also involved in lactation.

Slide 16

Before a girl is born, the germ cells differentiate into **oogonia (2n)**. Some of the oogonia differentiate into **primary oocyte (2n)**. The primary oocyte starts meiosis I, but does not complete it. When a girl is born, she will be born with about 2 million primary oocyte. Most of these primary oocyte will degenerate. By puberty only about 200,000 primary oocyte remain. This is the woman's lifetime supplies of eggs.

At puberty, the anterior pituitary starts secreting FSH to stimulate the maturation of follicles. The primary oocytes will resume meiosis I and it will complete it at the time of ovulation. Every month a non-pregnant and non-menopausal woman will complete ovulation and expel a **secondary oocyte(n)** from the ovary.

This process is called **ovulation**. The completion of meiosis I will produce one secondary oocyte and one polar body. The chromosomes are distributed between the secondary oocyte and the polar body. The polar body will eventually degenerate. The secondary oocyte will start meiosis II and then stops. Ovulation will take place.

The hormone LH will stimulate the release of secondary oocyte from the ovary. If the fertilization does not occur, the secondary oocyte dies. If it does occur, the secondary oocyte will complete meiosis II after penetration by the sperm and form a second polar body and the ovum. Afterwards the ovum and the sperm will fuse together and form a zygote.

Slide 17

Endoscopic View of Ovulation

Slide 18

If sperms are present in the fallopian tube, fertilization may take place. Fertilization is union of one secondary oocyte and a sperm. Secondary oocyte will complete the Meiosis II. A zygote (diploid) will form and start growing. From this point all the cell divisions are mitosis.

Slide 19

Female reproduction has two sexual cycles: the Ovarian cycle and the Uterine/Menstrual cycle. Both occur over 28 days. These two cycles are controlled by hormones.

Slide 20

Ovarian cycle is associated with maturation of egg every month. Its duration 28 days approximately. Ovulation occurs on 14<sup>th</sup> day in a 28 day cycle. It has three main events: Follicular phase, ovulation, and luteal phase.

Follicular phase from the beginning of menstruation until ovulation

day 1 to day 13 of an average cycle

FSH stimulates growth of follicles and to secrete estrogen

Menstruation - during first 3 to 5 days of cycle

Ovulation – the rupture of the mature follicle and the release of its egg - typically around day 14

Estrogen stimulates a **surge of LH** by anterior pituitary

LH induces completion of meiosis I & production of secondary oocyte and first polar body

Day 15 -28 is called Luteal phase. Now the follicle that has ovulated becomes Corpus luteum. LH stimulates and maintains the corpus luteum. The concentration of estrogen and progesterone starts rising. If the woman does not become pregnant, then Corpus luteum eventually shrinks and becomes corpus albicans – a scar like tissue.

## Slide 21

In this diagram, the different hormones under whose influences the functional layer is built back is shown. The hormones are estrogen and progesterone.

This is the picture of Menstrual Cycle. It also has four phases. In the **Proliferative phase** the functional layer of endometrium is slowly started being built back under the influence of estrogen in anticipation that the fertilized egg will be implanted in the uterus. This phase comes right after the **Menstrual phase**. Lasts from day 6 – 14. In **Secretory phase**, the functional layer is fully developed and ready to receive the fertilized egg. Corpus luteum secretes progesterone which further thickens the uterine wall. When the fertilized egg does not arrive, the functional layer starts breaking down. This is called **Premenstrual phase**, the last two days of the cycle. The **Menstrual phase** occurs with the discharge of menstrual fluid. Lasts about 5 days.

## Slide 22

Menstrual cycle is shedding & rebuilding of endometrium each month. It is controlled by ovarian hormones and closely coordinated with ovarian cycle. If no implantation occurs, then 14 days after ovulation functional layer of endometrium disintegrates. It will be discharged as 50-150 ml of blood, tissue fluid, cells etc. This phenomenon is caused by a fall in the level of estrogen & progesterone. Menstruation lasts about 5 days

## Slide 23

If we put together all the diagram then you can see the whole Female sexual cycle.

As mentioned before all Female sexual cycles are regulated by hormones. The principal hormones are estrogen & progesterone, FSH and LH. They are released in a cyclic pattern. The basic hierarchy of hormonal control is

Hypothalamus → Anterior pituitary (FSH and LH) → ovaries (Estrogen and Progesterone) → uterus

Hypothalamus will stimulate Ant. Pit to secrete FSH and LH. FSH will stimulate the ovarian follicles to secrete estrogen. LH surge just before ovulation will precipitate ovulation. After the ovulation, Corpus luteum will form which will take up the job of secreting estrogen and progesterone. If a woman does not become pregnant, the corpus luteum will degenerate into corpus albicans. It will stop secreting the hormones, and the hormone level in the body will drop. This would be the stimulus for the whole thing to start again.

All these start at puberty.