

1. Ovulation is the release of the secondary oocyte from the ovarian follicle and it occurs mid-way through the menstrual cycle. This is the time when a woman is most fertile and most likely to conceive if the egg is fertilized by sperm. It occurs when the ovarian follicles rupture and release the secondary oocyte and lasts for about 24 hours. This happens because of the influence of Luteinizing Hormone (LH) and Follicle Stimulating Hormone (FSH) caused by the increase in estrogen. This causes the secondary follicle to grow rapidly to become a mature vesicular/secondary follicle. It is triggered by a spike increase in amount of LH and FSH produced by the pituitary gland. Due to the increase of LH, meiosis 1 has to be completed. Then the follicle enters the preovulatory mature vesicular stage and meiosis 2 starts. The secondary oocyte is then arrested at metaphase by Maturation Promoting Factor (MPF) approximately 3 hours before ovulation. While this is going on, the surface of the ovary begins to bulge locally, and at the apex, an avascular spot, the stigma, appears.

The abrupt increase in LH will lead to an increase in production of an enzyme called Collagenase. This enzyme breaks down the collagen fibers/ connective tissues around the secondary oocyte making it weak. Also, the levels of Prostaglandin will increase. This causes local muscular on the ovarian wall so the secondary oocyte can be released. The contractions push the oocyte out along with some cells of the cumulus oophorus which then arrange themselves around the zona pellucida forming the corona radiata. After ovulation comes the formation of the corpus luteum. If the egg is fertilized it becomes the corpus luteum of pregnancy, if not it is the corpus luteum of menstruation.

Signs of ovulation include:

- Slight drop in basal body temperature i.e. the temperature of the body at rest towards ovulation and after there is a sharp increase
- Cervical mucus changes: when ovulation is near more estrogen is produced causing the cervical mucus to become stretchy and clear like egg white which helps sperm to swim towards the egg
- Increased urge for sex
- Tenderness of breast
- Sudden constant pain in the lower abdomen i.e. mittelshmerz pain
- Light spotting maybe noticed
- Swollen vagina or vulva

Although some women are not able to ovulate because they have low concentration of gonadotropins, it is called anovulation. But this does not mean the woman is going through menopause. To help an agent is given to stimulate the release of gonadotropin such as clomiphene citrate (clomid) but the risks are multiple pregnancies are higher, development of ovarian cysts, etc.

## 2. Difference between meiosis 1 and meiosis 2

Meiosis 1	Meiosis 2
Homologous chromosomes separate	The sister chromatids separate
Produces two (2) diploid daughter cells	Produces four (4) haploid daughter cells
Crossing over of chromosomes occurs	Crossing over of chromosomes does not occur

Chiasma formation	No chiasma formation
Homologous pairs align at the metaphase plate	Duplicated chromosomes align at metaphase plate
Synapses is present	Synapses is absent
It is a complex division and takes more time	It is less complex and takes lesser time
Centromeres do not split	Centromeres split
There is interphase before meiosis 1	There is no interphase between meiosis I and meiosis 2
It is a reduction division	It is an equational division

### 3. Stages in fertilization

- The sperm passes through the corona radiate: as the sperm passes it undergoes capacitation which is the removal of the glycoprotein coat and seminal plasma protein around the acrosomal region. Only capacitated sperm can freely pass through the corona radiate.
- Penetration of the zona pellucida: the sperm goes through the zona pellucida because of acrosine, a lysosomal enzyme in the acrosome. The sperm binds with zona glycoproteins on the zona pellucida. Then the cortical granules in the plasma membrane sends a message to the zona pellucide to close the binding site so no more sperm can enter and this blocks polyspermy.
- Fusion of the plasma membrane of the sperm and oocyte: here the plasma membrane of the oocyte and the sperm fuse and breakdown at the area of fusion. Also as the sperm enters the cytoplasm of the oocyte the head and tail enter but the plasma membrane is left behind.
- Completion of 2nd meiotic division and formation of female pronucleus: the penetration of the oocyte by the sperm completes the second meiotic division which forms the mature oocyte and second polar body. The nucleus of the mature oocyte then becomes the female pronucleus.
- Formation of male pronucleus: here the nucleus of the sperm enlarges forms the male pronucleus and the tail degenerates. Then the mitochondria within the zygote are of maternal origin.
- Formation of zygote: the two pronuclei fuse (the male pronucleus and female pronucleus) into a single diploid aggregation of chromosomes that i.e. the ootid which becomes the zygote.

### 4. Difference between monozygotic twins and dizygotic twins

Monozygotic twins	Dizygotic twins
When a single sperm fertilizes an oocyte then divides	When two different oocytes are fertilized by two different sperms
Forms from the same zygote	Forms from two separate zygotes
Genetically identical	Not genetically identical
They are of the same sex and look alike	They can be of different sex and do not look alike
One placenta but two umbilical cords	Separate placenta and umbilical cords
They share chorionic and amniotic sacs	They do not share chorionic and amniotic sacs
Also known as identical twins	Also known as fraternal twins
Not hereditary	Hereditary