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QUESTIONS

- 1) Discuss ovulation
- 2) Differentiate between meiosis 1 and meiosis 2
- 3) Discuss the stages involved in fertilization
- 4) Differentiate between monozygotic twins and dizygotic twins

ANSWERS

1. Ovulation is the release of an oocyte from the ovarian follicle. Few days before ovulation, under the influence of Follicle-Stimulating Hormone and Luteinizing Hormone, the secondary follicle grows rapidly to a diameter of about 25 mm to become mature vesicular/ mature secondary or Graafian follicle. In line with final development of the vesicular follicle, there is an abrupt increase in Luteinizing Hormone that causes the primary oocyte to complete meiosis I and the follicle to enter the preovulatory mature vesicular stage. Then, Meiosis II is also initiated, but the oocyte is arrested in metaphase approximately 3 hours before ovulation. The surface of the ovary begins to bulge locally, and at the apex, an avascular spot, the stigma, appears.

For the oocyte to be released, 2 events must take place which are influenced by Luteinizing Hormone (LH) surge:

- The high concentration of LH increases collagenase activity, resulting in digestion of collagen fibers (connective tissue) surrounding the follicle.
- Prostaglandin levels also increase in response to the LH surge and cause local muscular contractions in the ovarian wall

These contractions extrude the oocyte, which together with its surrounding follicular (granulosa) cells from the region of the cumulus oophorus, this causes ovulation in which oocyte floats out of the ovary. Some of the cumulus oophorus cells then rearrange themselves around the zona pellucida to form the corona radiata.

2. Differences between Meiosis 1 and Meiosis 2

Starts as diploid; ends as haploid	Starts as haploid; ends as haploid
It is a reductive division	It is an equational division
Homologous chromosome pairs separate	Sister chromatids separate
Synapsis and Crossing over occurs	Synapsis and Crossing over does not occur
Complicated division process	Simple division process
Sister chromatids in prophase have convergent arms	Sister chromatids in prophase have divergent arms
Equatorial plane is centered	Equatorial plane is rotated 90°
Ends with 2 daughter cells	Ends with 4 daughter cells

3. The stages involved in fertilization are;

- **Passage of a sperm through the corona radiata:** For sperms to pass through the corona radiata, they must have been capacitated i.e removal of the glycoprotein coat and seminal plasma proteins from the plasma membrane that overlies the acrosomal region of the spermatozoa. Only capacitated sperm can pass through the corona radiate.
- **Penetration of the zona pellucida:** The zona is a glycoprotein shell surrounding the egg that facilitates and maintains sperm binding and induces the acrosome reaction. Release of acrosomal enzymes (acrosin) allows sperm to penetrate the zona pellucida, thereby coming in contact with the plasma membrane of the oocyte. As soon as the head of a sperm comes in contact with the oocyte surface, the permeability of the zona pellucida changes. When a sperm comes in contact with the oocyte surface, lysosomal enzymes are released from cortical granules lining the plasma membrane of the oocyte. In turn, these enzymes alter properties of the zona pellucida to; prevent sperm penetration and inactivate binding sites for spermatozoa on the zona pellicida surface. Only one sperm seems to be able to penetrate the oocyte
- **Fusion of plasma membranes of the oocyte and sperm:** The plasma or cell membranes of the oocyte and sperm fuse and break down at the area of fusion. The head and tail of the sperm enter the cytoplasm of the oocyte, but the sperm's plasma membrane remains behind
- **Completion of the second meiotic division of oocyte and formation of female pronucleus:** Penetration of the oocyte by a sperm activates the oocyte into completing the second meiotic division and forming a mature oocyte and a second polar body. The nucleus of the mature ovum/oocyte is now called the female pronucleus.
- **Formation of the male pronucleus:** Within the cytoplasm of the oocyte, the nucleus of the sperm enlarges to form the male pronucleus and the tail of the sperm degenerates.
- **Fusion of Male and Female Pronuclei to form a Zygote:** The male pronucleus fuses with the female pronucleus to form an ootid which later forms a zygote. An Ootid is an oocyte containing two haploid pronuclei.

4. Difference between monozygotic twins and dizygotic twins

Monozygotic Twins	Dizygotic Twins
Developed from a single egg which was fertilized by a single sperm cell	Developed from two eggs fertilized by two different sperm cells
Two fetuses grow in the same placenta	Two fetuses grow in two different membranes
Have almost identical genetic profile	Completely different genetic profile
Always of the same sex	May be of the same or opposite sex
May have the same physical and mental characteristics	May look alike or different; may behave similarly or differently
Also called “identical twins”	Also called “fraternal twins”