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17/MHS01/310

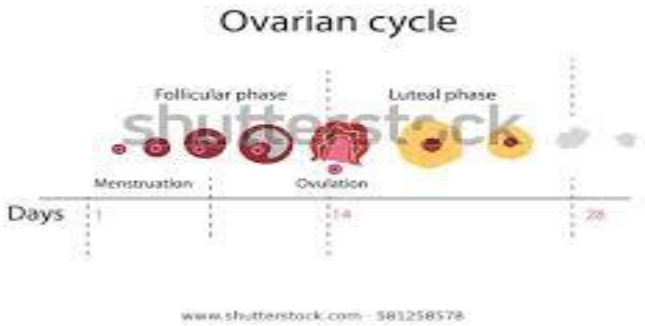
EMBRYOLOGY ASSIGNMENT

MBBS

200 LEVEL

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

1. Ovulation occurs as a result of a surge in the amount of luteinizing hormone in the middle of the ovarian cycle. This is the release of the mature secondary oocyte from the ovarian follicle. Due to an abrupt increase in the luteinizing hormone (LH), meiosis one is completed by the primary oocyte. The follicle then enters into preovulatory mature vesicular stage. Meiosis two is also initiated, but the oocyte is arrested in metaphase approximately 3 hours before ovulation. Ovulation, which is triggered by a surge of luteinizing hormone usually follows the LH peak by 12 to 24 hours. Increase in the production of LH causes increase in the activity of collagenase and increase in the production of prostaglandin which helps in local muscle contraction. During ovulation, the cells (cumulus oophorus) float out with the secondary oocyte and rearrange themselves around the mature secondary oocyte to form the corona radiata. Ovulation is then completed.

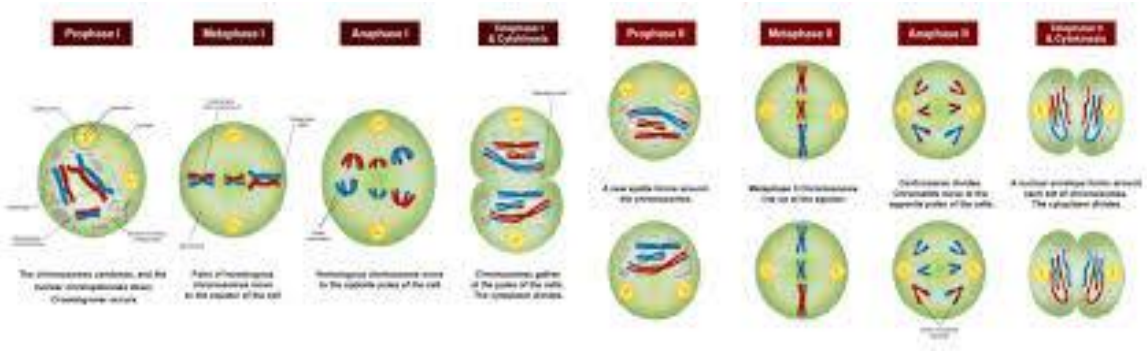


- Clinical correlate: pain during ovulation is known as middle pain because it usually occurs in the middle of the menstrual cycle. Other signs of ovulation include; increased urge for sex, changes in the cervical mucus, tenderness of the breasts, swollen vulva or vagina. Failure to ovulate in some women is known as anovulation because of a low concentration of gonadotropins.

2. Differentiate between meiosis I and meiosis II.

MEIOSIS I	MEIOSIS II
1. Prophase 1 -synapsis occurs: homologous duplicated chromosomes lie side by side -crossing over occurs -chiasma formation 2. Metaphase I: (Alignment) -46 homologous duplicated chromosomes align at the equator 3. Anaphase I -46 homologous duplicated chromosomes separate and move toward the poles -centromeres do not split	1. Prophase II -synapsis of homologous duplicated chromosomes is absent -crossing over of homologous duplicated chromosomes is absent -chiasma formation does not occur 2. Metaphase II -23 homologous duplicated chromosomes align at the equator 3. Anaphase II -23 homologous duplicated chromosomes separate and move toward the poles -centromeres split

4. Telophase I -two daughter cells are formed and they become 23 homologous duplicated chromosomes 5. Meiosis I is a reduction division of 4N to 2N	4. Telophase II -four daughter cells are formed and they become 23 single stranded homologues 5. Meiosis II is a reduction division of 2N to N.



3. Fertilization is the process by which the male and female gametes fuse and occurs in the ampullary region of the uterine tube. The process takes approximately 24 hours. Only 1% of sperm deposited in the vagina may enter the cervix where they may survive for many hours. Spermatozoa are not able to fertilize the oocyte immediately upon arrival in the female genital tract but must undergo **1) capacitation and 2) the acrosome reaction.**

- Capacitation is a period of conditioning in the female reproductive tract that lasts approximately 7 hours. Much of this conditioning occurs in the uterine tube and involves epithelial interactions between the sperm and the mucosal surface of the tube. A glycoprotein coat and seminal plasma proteins are removed from the plasma membrane that overlies the acrosomal region of the spermatozoa. Only capacitated sperms can pass through the corona cells and undergo the acrosome reaction.
- The **acrosome reaction** occurs after binding to the zona pellucida and is induced by zona proteins. This reaction culminates in the release of enzymes needed to penetrate the zona pellucida including; acrosin and trypsin-like substances.

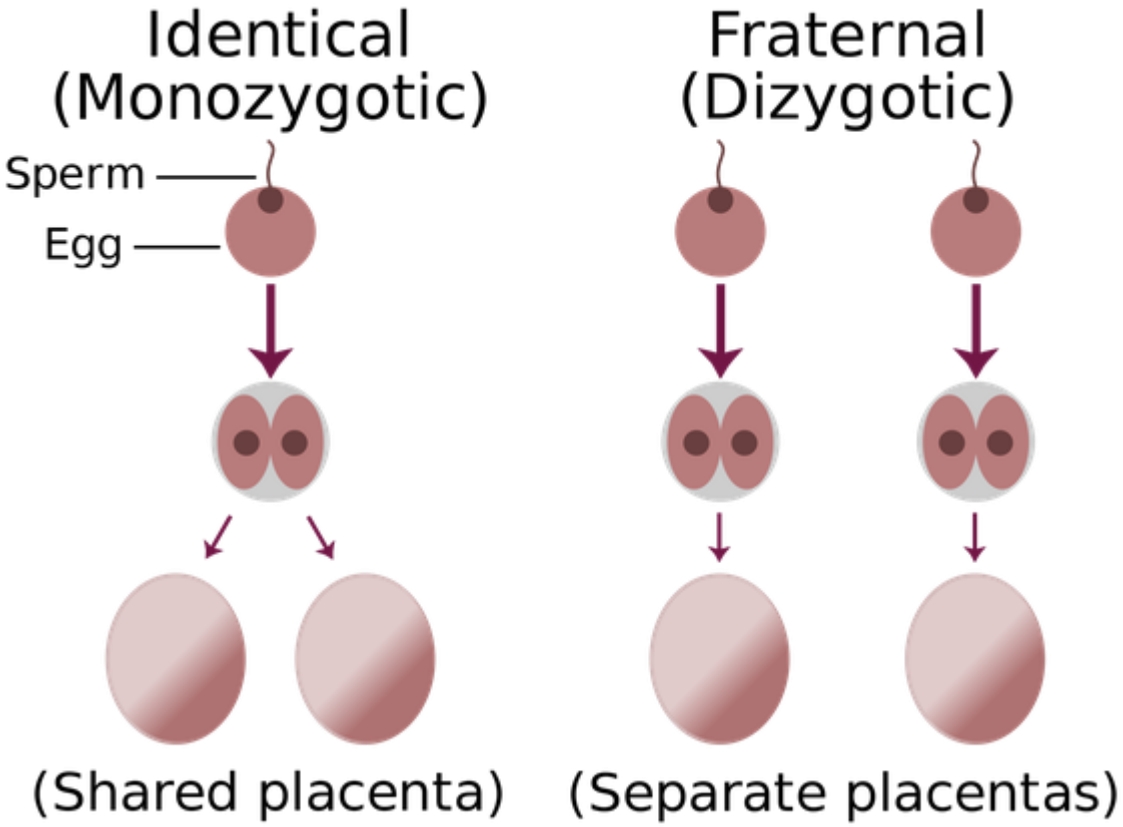
The stages of fertilization include:

- **Stage 1: Penetration of the Corona Radiata**
  Of the 200 to 300 million spermatozoa normally deposited in the female genital tract, only 200 to 500 reach the site of fertilization. Only one of these fertilizes the egg. Capacitated sperm pass freely through corona cells.
- **Stage 2: Penetration of the Zona Pellucida**
  The zona pellucida is a glycoprotein shell surrounding the egg that facilitates and maintains sperm binding and induces the acrosome reaction. Release of acrosomal enzymes allows sperm to penetrate the zona, thereby coming in contact with the

plasma membrane of the oocyte. Permeability of the zona pellucida changes when the head of the sperm comes in contact with the oocyte surface. This contact results in release of lysosomal enzymes from cortical granules lining the plasma membrane of the oocyte. These enzymes in turn alter the properties of the zona pellucida.

- **Stage 3: Fusion of the Oocyte and Sperm Cell Membranes**
  The plasma 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 Second Meiotic Division and Formation of Female Pronucleus**
  As soon as the sperm penetrates the oocyte, the second meiotic division is completed and a mature oocyte and second polar body are formed. The nucleus of the mature oocyte is then referred to as the female pronucleus.
- **Formation of Male Pronucleus**
  The tail of the sperm degenerates and the nucleus enlarges to become the male pronucleus.
- **Formation of Zygote**
  The female and male pronuclei fuse to give rise to a zygote. Fertilization is then completed.

4. **Dizygotic twins:** approximately 90% of twins are dizygotic or fraternal twins. Their incidence increases with maternal age and fertility procedures. They result from the simultaneous shedding of two oocytes and fertilization by different spermatozoa. They are non identical because the two zygotes have totally different genetic constitutions. The zygotes implant individually in the uterus and usually each develops its own placenta, amnion and chorionic sac.
   Monozygotic twins: they develop from a single fertilized ovum and are also known as identical twins. They result from splitting of the zygote at various stages of development. Splitting of the zygote usually occurs at the early blastocyst stage.


Identical
(Monozygotic)
Sperm
Egg
(Shared placenta)
Fraternal
(Dizygotic)
(Separate placentas)