

NAME: USIGBE JEMIMAH OTALOWEBE

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DEPARTMENT: MEDICINE AND SURGERY

LEVEL: 200

COURSE: EMBROLOGY

ASSIGNMENT

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

ANSWERS:-

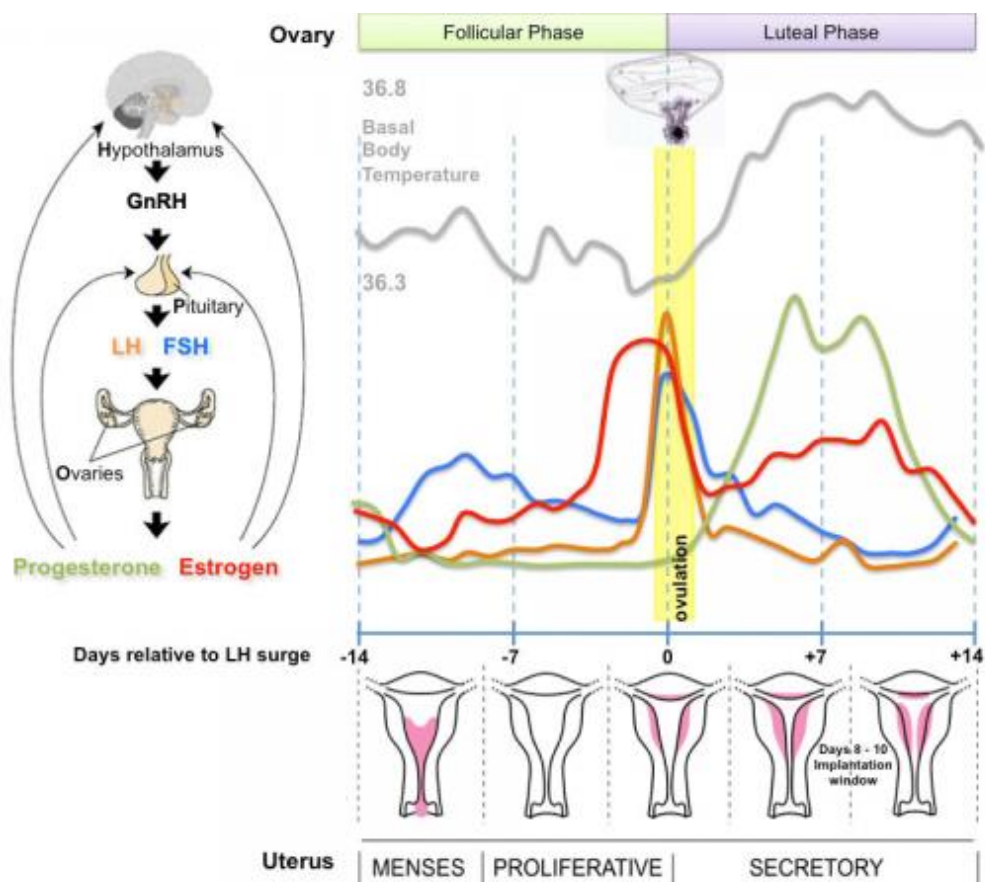
QUESTION 1

Ovulation:

This is shedding of the ovum from the ovary (that is the release of an oocyte from the ovarian follicle). In the days preceding ovulation, under the influence of FSH and LH, the secondary follicle grows rapidly to a diameter of about 25mm to become mature vesicular/mature secondary of Graafian follicle.

Coincident with final development of the vesicular (graafian) follicle, there is an abrupt increase in LH that causes primary oocyte to complete meiosis 1 and the follicle to enter preovulatory mature vesicular stage. Meiosis 2 is also initiated, but the oocyte is arrested in metaphase approximately three

hours before ovulation. In the meantime, the surface of the ovary begins to bulge locally, and at the apex, an avascular spot, the stigma, appears. The high concentration of LH increases collagenase activity, resulting in digestion of collagen fibers surrounding the follicle. Prostaglandin levels also increase in response to the LH surge and cause local muscular contractions in the ovarian wall. Those contractions extrude the oocyte, which together with its surrounding granulosa cells from the region of the cumulus oophorus breaks free (ovulation) and floats out of the ovary. Some of the cumulus oophorus cells then rearrange themselves around the zona pellucida to form the corona radiata.



- Hypothalamus releases gonadotropin releasing hormone (GRH, luteinizing hormone–releasing hormone, LHRH) -> Pituitary releases follicle stimulating hormone (FSH) and lutenizing hormone (LH) -> ovary follicle development and ovulation.
- release of the secondary oocyte and formation of corpus luteum
- secondary oocyte encased in zona pellucida and corona radiata
- Ovulation associated with follicle rupture and ampulla movement.

Question 2

Differences between meiosis 1 and meiosis 2

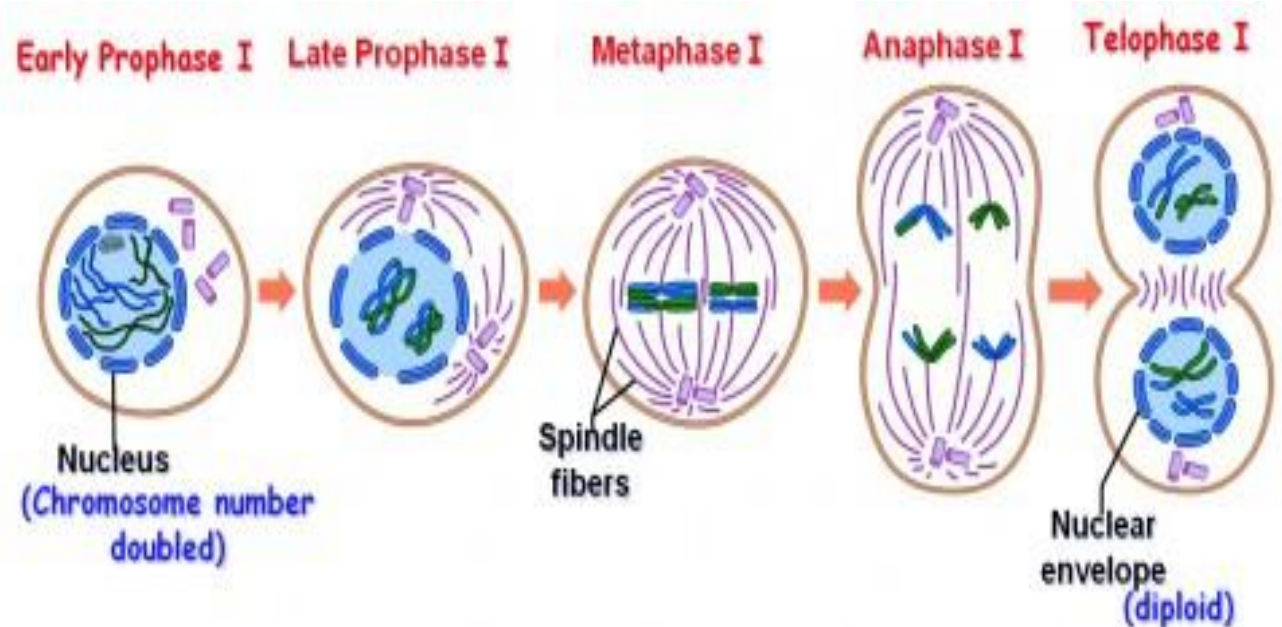
Meiosis 1	Meiosis 2
In prophase 1 three major events takes place which are synapsis, crossing over and chiasma formation.	In prophase 2, there is no synapsis, no crossing over and no chiasma formation.
In metaphase 1, alignment of 46 homologous duplicated chromosomes at the metaphase plate.	In metaphase 2, alignment of 23 duplicated chromosomes at the metaphase plate.
In anaphase 1, separation of 46 homologous, duplicated chromosomes of each other occurs.	In anaphase 2, separation of 23 chromosomes to form 23 single chromosomes.
In anaphase 2 also, the centromeres do not split	While in anaphase 2, the centromeres do split.

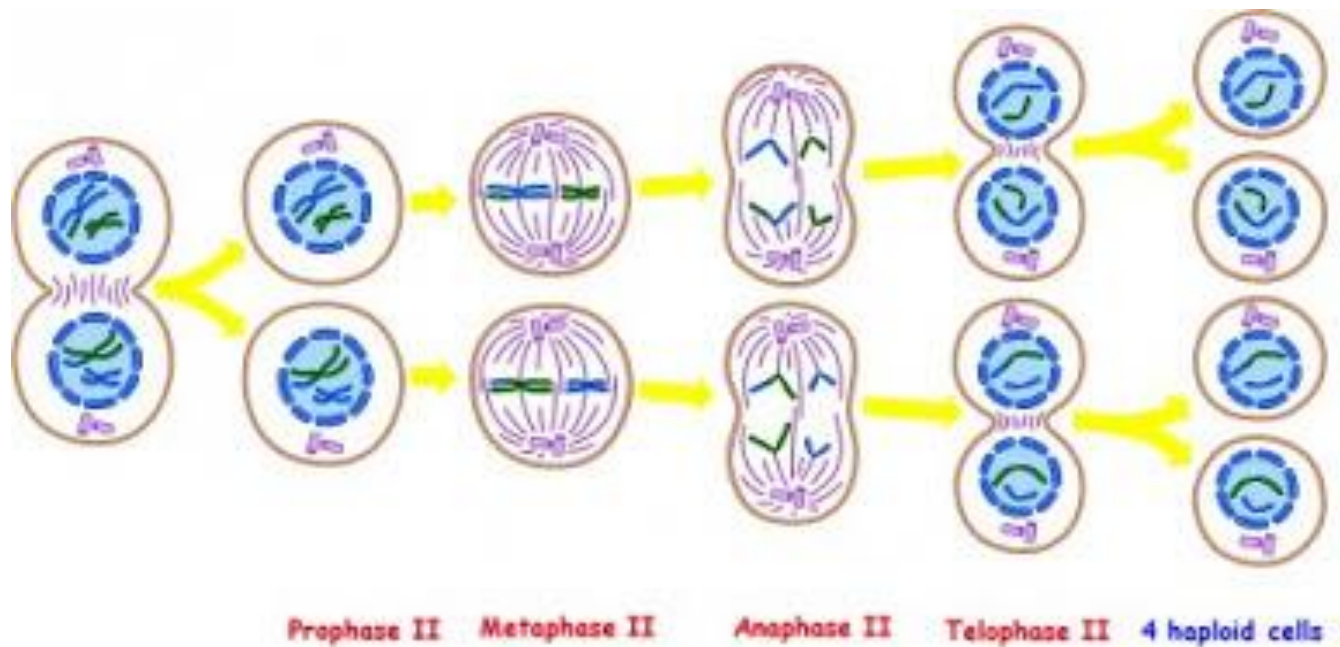
In telophase 1, formation of two secondary gametocyte (23 duplicated chromosomes $2N$) occurs.

While in telophase 2, there is formation of four gametes (23 single chromosomes $1N$).

Meiosis 1 (reduction) reduces the ploidy level from $2N$ to N .

Meiosis 2 (division) divides the remaining sets of chromosomes.





Question 3

The stages involved in fertilization:-

1) Penetration of the corona radiata:

- Of the 200 to 300 million spermatozoa normally deposited in the female genital tract only 300 to 500 reach the site of fertilization. Only one of these fertilizes the egg. It is thought that others aid the fertilizing sperm in penetrating the barriers protecting the female gametes.
- Only capacitated sperms can pass freely through the corona radiata

2) Penetration of the zona pellucida:

- The zona is a glycoprotein shell surrounding the egg that facilitate and maintain the sperm binding and induces the acrosome reaction.

- The intact acrosome of the sperm binds with a zona glycoprotein (ZP3/ zona protein 3) on the zona pellucida.
- Release of the 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 the 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 inactive binding sites for spermatozoa on the zona pellucida surface. Only one sperm seems to be able to penetrate the oocyte.

3) Fusion of the 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 sperms plasma membrane remains behind. As soon as the spermatozoon has entered the oocyte , the egg responds in three ways:

A) Cortical and zona reaction: As a result of the release of cortical oocyte granules, which contain lysosomal enzymes,

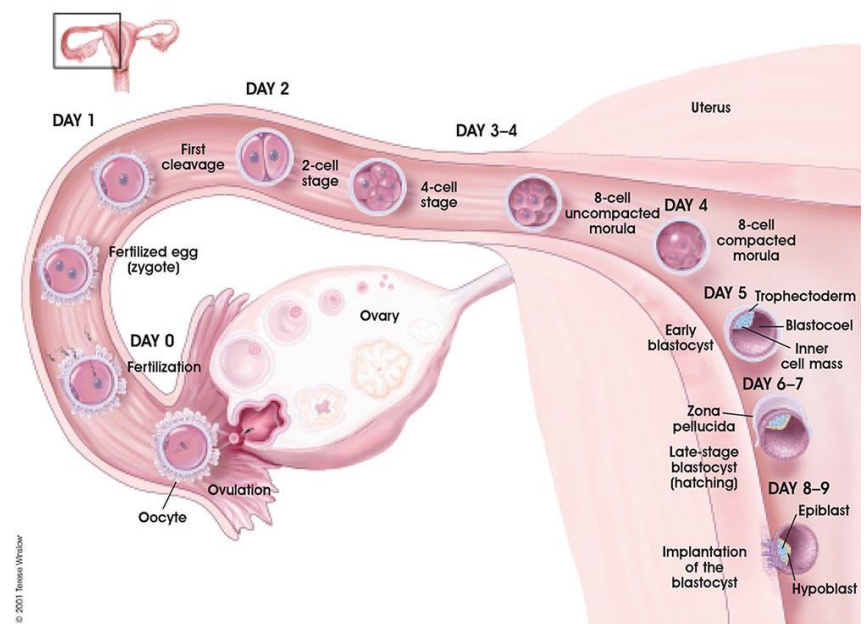
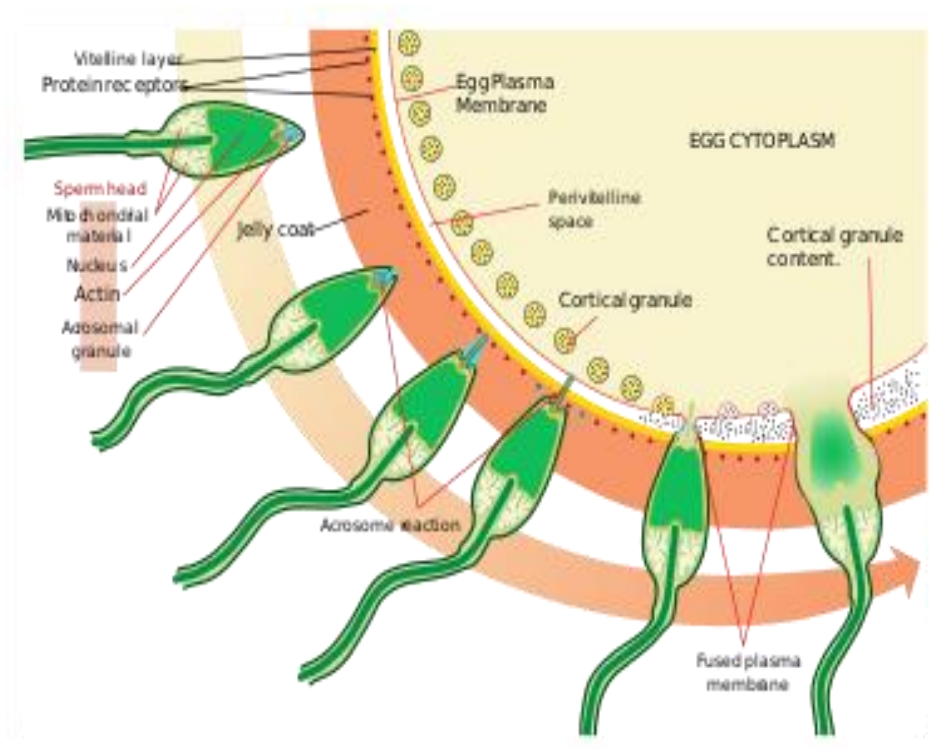
- The oocyte membrane becomes impenetrable to other spermatozoa.

- The zona pellucida alters its structure and composition to prevent sperm binding and penetration. These reactions prevent polyspermy (penetration of more than one spermatozoon into the oocyte).

B) 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.

C) Metabolic activation of the egg: the activator factor is probably carried by the spermatozoon. Activation encompasses the initial cellular and molecular events associated with the early embryogenesis.



QUESTION 4

Differences between monozygotic twins and dizygotic twins:

Monozygotic Twins	Dizygotic twins
These types of twins are genetically identical.	While these types are not genetically identical.
Developed from a single egg which was fertilized by a single sperm cell.	Developed from two eggs fertilized by two different sperm cells.
They are always of the same sex.	They maybe of same or opposite sex.
They share the same amniotic sac, chronic sac and same placenta but different umbilical cords.	They do not share the amniotic sac, chronic sac, placenta or umbilical cord.
These types of twins usually look alike.	While these types do not look alike.
They are also called identical twins.	They are also called fraternal twins.
They may have same physical and mental characteristics.	They may behave similarly or differently.