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200 LEVEL

Assignment

QUESTION 1

Ovulation

- This is the release of an oocyte from the ovarian follicle
- In a few days before ovulation, under the influence of **FSH** and **LH**, the secondary follicle grows rapidly to a diameter of about 25 mm to become mature vesicular/ mature secondary or Graafian follicle
- Coincident with final development of the vesicular follicle, there is an abrupt increase in LH that causes;

1. the primary oocyte to complete meiosis I
2. and the follicle to enter the preovulatory mature vesicular stage

- Meiosis II is also initiated, but the secondary oocyte is arrested in metaphase approximately 3 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

➢ For the oocyte to be released, 2 events occur *which are caused by LH surge:*

I. it increases collagenase activity, resulting in digestion of collagen fibers (connective tissue) surrounding the follicle

II. 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 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

➢ **Note:**

- Ovulation is triggered by a surge of LH production
- Ovulation usually follows the LH peak by 12 to 24 hours
- The **LH surge**, elicited by the high estrogen level in the blood, appears to cause the stigma to balloon out, forming a vesicle

QUESTION 2

The key difference between meiosis I and meiosis II is that meiosis I is the first **c**ell division of meiosis that produces two haploid cells from a diploid cell while meiosis II is the second cell division that completes the meiosis by producing four haploid cells.

What is Meiosis I?

Meiosis I is the first cell division of meiosis. There is interphase before meiosis I. It runs for a longer time. Meiosis I consists of four sub-phases namely Prophase I, Metaphase I, Anaphase I, and Telophase I. During prophase I, chromosomes condense and pair up and align with the homologous chromosomes. Then these homologous chromosome pairs, exchange their genetic materials between them by forming chiasmata. Herein, the exchange of homologous parts between homologous chromosomes is known as crossing over, and it is responsible for the genetic variation.

Figure 01: Meiosis I

After crossing over, these pairs move to the metaphase plate and arrange beside it during the metaphase I. Spindle from each pole begin to attach with the centromeres of the chromosomes. Each chromosome attaches with one spindle coming from one pole. Hence, two homologous chromosomes attach with the spindles coming from opposite poles. When anaphase I starts, spindles become shorten and pull homologous chromosomes apart to opposite poles. Once, the chromosomes reach two poles of cells, telophase I begins by forming a nuclear membrane and enclosing the chromosomes. At this stage, the haploid set of chromosomes are present in each nucleus. Then the chromosomes condense again, and two cells appear. That completes the meiosis I.

What is Meiosis II?

Meiosis II is the second phase of meiosis, in which longitudinal division of the duplicated chromatids and further cell division take place. During meiosis II, daughter cells produced by meiosis I continue their further division so that each daughter cell coming from meiosis I produces two gametes. Similar to meiosis I, meiosis II also has four subphases namely Prophase II, Metaphase II, Anaphase II and Telophase II. These phases are very much similar to the sub-phases of meiosis I. Meiosis II resembles the mitotic cell division. Furthermore, meiosis II is shorter than the meiosis I.

Figure 02: Meiosis II

During the prophase II, chromosomes condense and nuclear membranes break. Chromosomes move apart. Furthermore, spindles develop from each pole. Chromosomes line up at the metaphase plate individually. During the metaphase II, two spindles; one from each pole attach with the centromere of

each chromosome. Then the anaphase II begins. Spindles become shorten. Hence, centromeres split and sister chromatids separate from each other. Sister chromatids are pulled towards the opposite poles. During the telophase II, nuclear membranes reform and enclose the haploid sets of chromosomes creating four haploid cells. That is the end of meiosis II.

DIFFERENCE BETWEEN MEIOSIS 1 AND 2

Meiosis 1	**Meiosis 2**
First cell division of meiosis	Second cell division of meiosis
Sub phases includes; prophase I metaphase I anaphase I and telophase I	Sub phases includes; prophase II metaphase II anaphase II and telophase II
Number of cells produced are 2	Number of cells produced are 4
Chromosome number becomes half	Chromosome number does not divide into two
Heterotypic division	Homotypic division
Duration is longer	Duration is shorter

QUESTION 3

STAGES INVOLVED IN FERTILIZATION

- **Fertilization**

- This is the **union** of the **sperm** and **oocyte**
- The usual site of fertilization is the **ampulla** of the uterine tube
- The fertilization process takes **approximately 24 hours**
- It is a sequence of coordinated events which include the following stages

I Passage of a sperm through the corona radiata:

- For sperms to pass through the corona radiata, they must have been capacitated (removal of the glycoprotein coat and seminal plasma proteins from the plasma membrane that overlies the acrosomal region of the spermatozoa)

Note:

- ❖ Only capacitated sperms can pass freely through the corona radiata

II. **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
- The intact acrosome of the sperm binds with a zona glycoprotein (ZP3/ zona protein 3) on the zona pellucida
- 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

III. 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

IV. 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**

V. 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

Note

- ❖ Since all sperm mitochondria degenerate, all mitochondria within the zygote are of maternal origin (i.e., all mitochondrial DNA is of maternal origin)
- Morphologically, the male and female pronuclei are indistinguishable
- The oocyte now contains 2 pronuclei, each having haploid number of chromosomes(23)
- The oocyte containing two haploid pronuclei is called an **ootid**

VI. The 2 pronuclei fuse into a single diploid aggregation of chromosomes, the ootid becomes a zygote

- ➢ The chromosomes in the zygote become arranged on a **cleavage spindle** in preparation for cleavage of the zygote

QUESTION 4

DIFFERENCE BETWEEN MONOZYGOTIC TWIN AND DIZYGOTIC TWIN

	Monozygotic twins	**Dizygotic twins**
	Developed by the splitting of a fertilized embryo into two	Developed by two separate simultaneous fertilization events
	cause is not known	Caused by either IVF or hereditary predisposition
	Genetic vodes are nearly identical	Genetic codes are same as any other sibling
	Gender is the same	Gender is different
	Blood types are the same	Blood types are different
	Appearance is extremely similar but may be affected by environmental factors	Appearance is similar as any other siblings
	Not hereditary	Hereditary