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MATRIC NO: 18/MHS01/262

LEVEL: 200LEVEL

COURSE: EMBRYOLOGY

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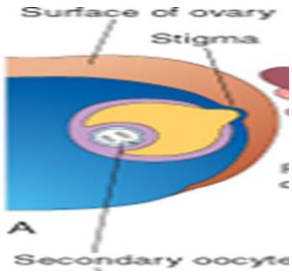
DATE: 29/04/2020

QUESTIONS

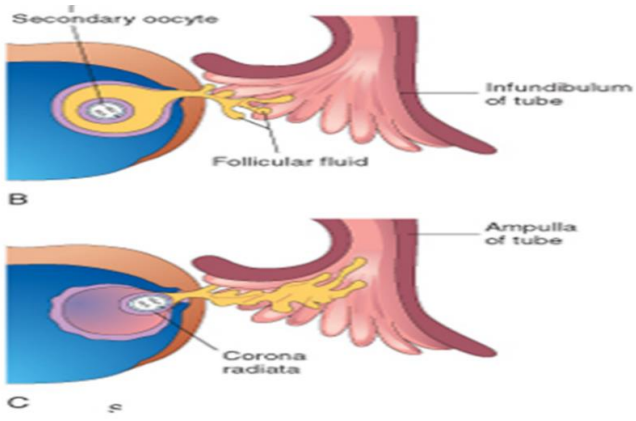
1) DISCUSS OVULATION
2) DIFFERENTIATE BETWEEN MEIOSIS 1 AND MEIOSIS 2
3) DISCUSS THE STAGES INVOLVED IN FERTILIZATION
4) DIFFERENTIATE BETWEEN MONOZYGOTIC TWINS ANS DIZYGOTIC TWINS

1) OVULATION

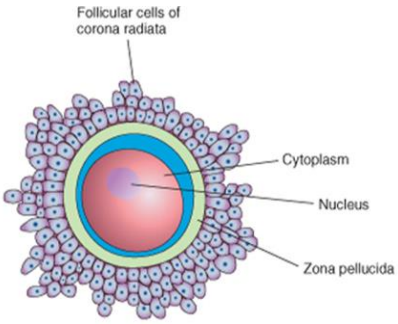
- Ovulation is the removal of a mature secondary oocyte from an ovarian follicle. Ovulation occurs around the middle of the ovarian cycle.
- The process of ovulation is triggered by **a surge in the production of luteinizing hormone.** Ovulation usually comes approximately 12 to 24 hours after this surge.
- Following the surge in production of luteinizing hormone, a cystic swelling or bulge is formed at the surface of the ovarian wall, which is an avascular spot called **stigma.** The luteinizing hormone production surge, which is elicited by high estrogen levels in the blood, causes the stigma to bulge out forming a vesicle.



- The surge in the production of luteinizing hormone increases the activity of **collagenase and prostaglandin**. Collagenase activity causes the digestion of the connective tissue surrounding the follicular wall. Prostaglandin causes local muscular contractions on the smooth muscle in the theca externa. All these activities, along with intrafollicular pressure, causes the stigma to rupture, expelling the secondary oocyte along with the follicular fluid and the surrounding follicular cells of the cumulus oophorus.



- The expelled secondary oocyte is surrounded by **zona pellucida.** The cells of the cumulus oophorus rearrange themselves radially around the zona pellucida to form cells of the **corona radiata.**



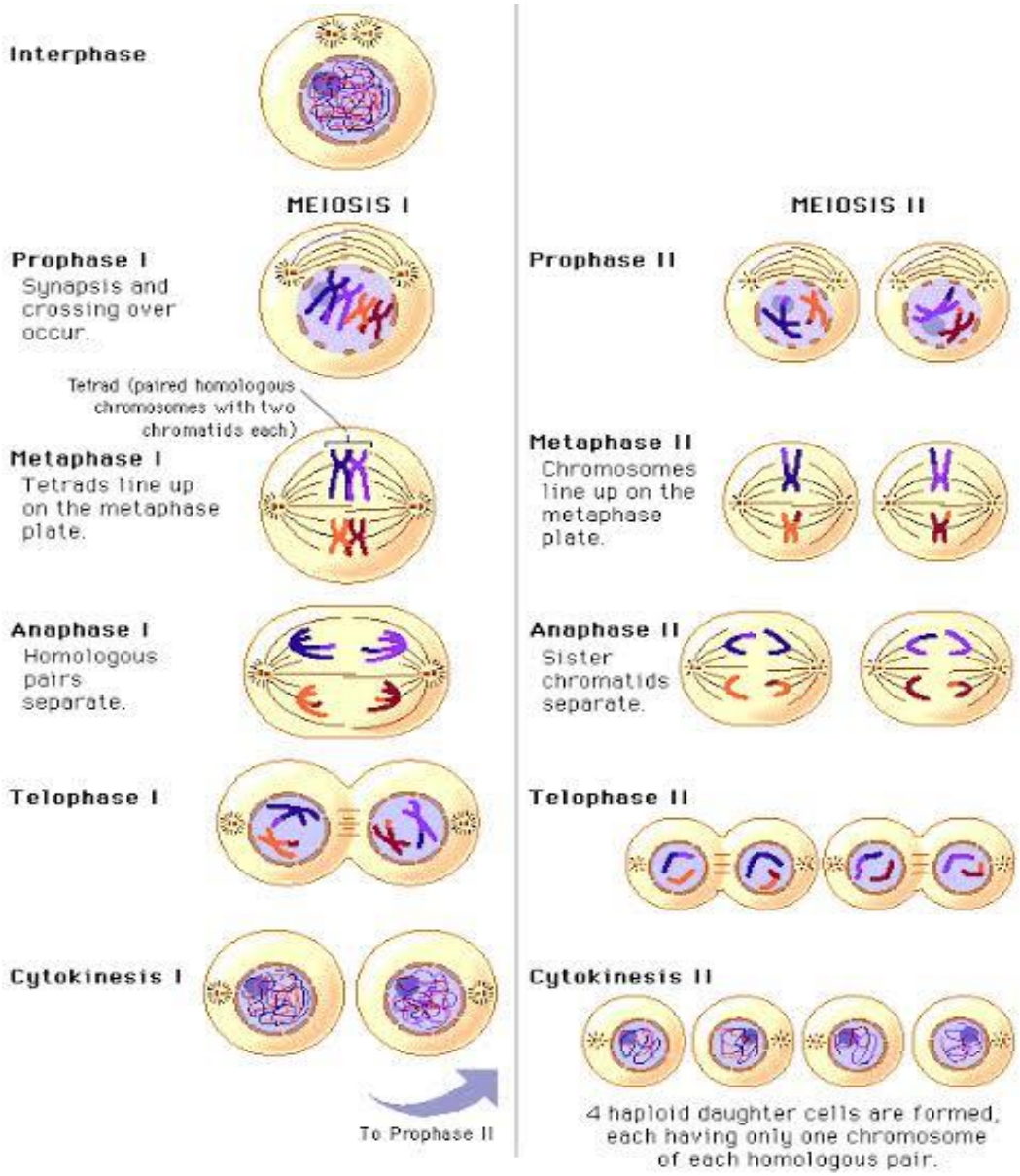
2) **DIFFERENCES BETWEEN MEIOSIS I AND MEIOSIS II**

NOTE: **Meiosis is a special type of cell division that involves two meiotic cell divisions. It results in the production of four daughter cells with each having haploid number of chromosomes. Below are the differences between the first and second meiotic divisions.**

	Meiosis I	***Meiosis II***
1) DEFINITION AND NATURE	Meiosis I is a heterotypic division and it's the first cell division of meiosis.	Meiosis II is a homotypic division and it's the second cell division of meiosis.
2) SUB-PHASES	Prophase I, metaphase I, anaphase I and telophase I	Prophase II, metaphase II, anaphase II and telophase II
3) NUMBER OF CELLS PRODUCED	Two haploid daughter cells are produced.	Four haploid daughter cells are produced.
4) CROSSING OVER AND GENETIC RECOMBINATION	Chromosomal crossing over and genetic recombination occurs during prophase I of this meiotic division	No chromosomal crossing over and genetic recombination occurs during prophase II
5) CHIASMA FORMATION	Chiasma formation occurs at prophase I of this meiotic division	No chiasna formation is absent at prophase II
6) SYNAPSIS	Synapsis occurs at prophase I of this meiotic division.	No synapsis occurs at prophase II
7) DURATION	A complex division and takes more time	Comparatively less complex and takes less time
8) HOMOLOGOUS CHROMOSOMES	Homologous chromosomes are present at the beginning	A pair of sister chromatids are present at the beginning.

9) INTERPHASE	Proceeded by interphase	No interphase takes place between meiosis I and meiosis II
10) SPLITTING OF CENTROMERE	Does not take place	Centromeres split and sister chromatids separate
11) ALSO CALLED	Reduction division	Equational division

DIAGRAMATIC REPREESENTATION



3) STAGES INVOLVED IN FERTILIZATION

NOTE: **Fertilization is the fusion of the male gamete (sperm) and the female gamete (oocyte) to give rise to a zygote. Fertilization takes place in the *ampulla* of the uterine tube, and takes approximately *24 hours*. Fertilization is a sequence of coordinated events which include six stages.**

A. Passage of sperm through the corona radiata of oocyte
B. Penetration of the zona pellucida of oocyte
C. Fusion of plasma membrane of the sperm and oocyte
D. Completion of second meiotic division and the formation of the female pronucleus
E. Formation of male pronucleus
F. Formation of zygote

A. Passage of a sperm through the corona radiata:

- For sperms to pass through the corona radiata, they must have been capacitated. Capacitation is the removal of the glycoprotein coat and seminal plasma proteins from the plasma membrane that overlies the acrosomal region of the spermatozoa. Only capacitated sperms can pass freely through the corona radiata.

B. Penetration of the zona pellucida:

The zona pellucida is a glycoprotein shell surrounding the oocyte. It facilitates and maintains sperm binding and induces the acrosome reaction

- The acrosome of the sperm, which is intact, binds with a zona glycoprotein (zona protein 3) on the zona pellucida.
- The sperm releases acrosomal enzymes **(acrosin)** which allows it 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. Lysosomal enzymes are released from cortical granules that are lining the plasma membrane of the oocyte. These enzymes alter properties of the zona pellucida, causing it to

i. Prevent sperm penetration and

ii. Inactivate the binding sites for spermatozoa on the zona pellicida surface so that only one sperm would to be able to penetrate the oocyte, preventing dispermy.

C. Fusion of plasma membranes of the oocyte and sperm

- 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

D. Completion of the second meiotic division of oocyte and formation of female pronucleus

- The penetration of the oocyte by a sperm activates the oocyte into completing the second meiotic division and forming a **mature secondary oocyte** and a **second polar body.**
- The nucleus of the mature secondary oocyte is called the f**emale pronucleus**

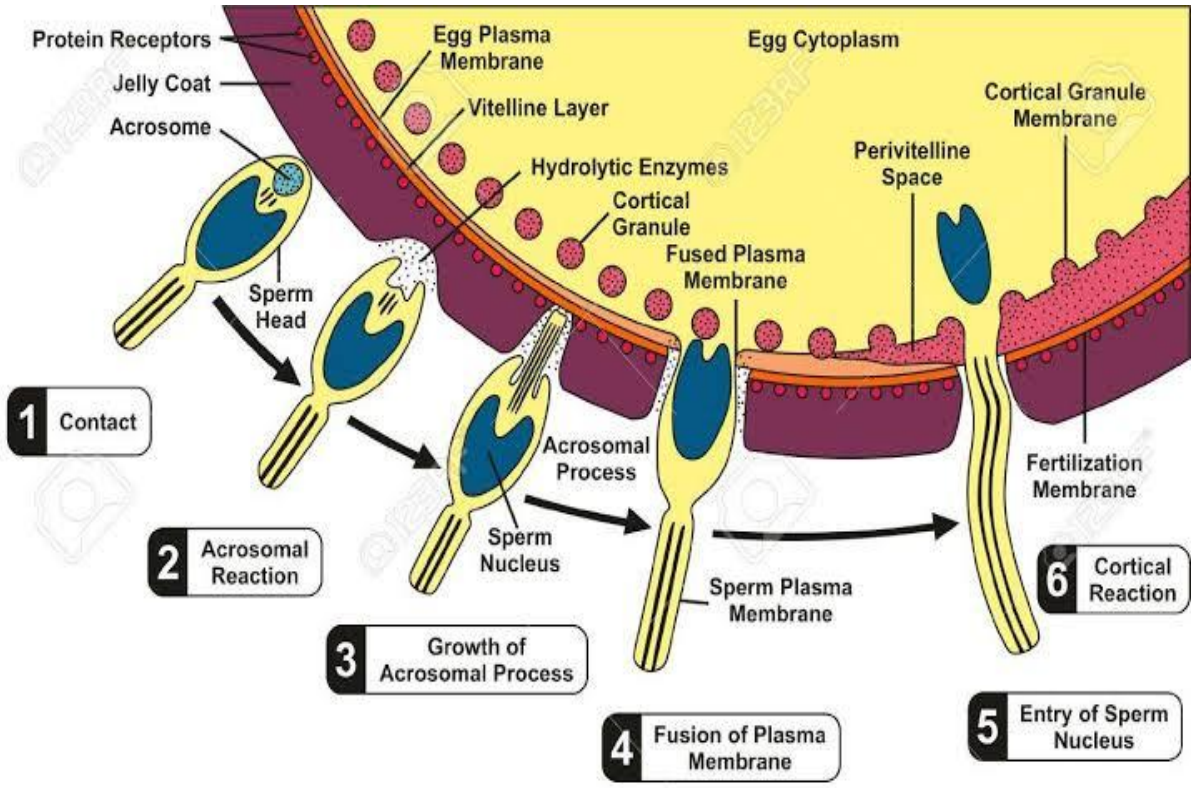
E. Formation of the male pronucleus

- Within the cytoplasm of the oocyte, the nucleus of the sperm enlarges to form the male pronucleus, and the tail of the sperm degenerates
- 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.**

F. Formation of a zygote

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

DIAGRAMATIC REPRESENTATION



4) DIFFERENCES BETWEEN MONOZYGOTIC AND DIZYGOTIC TWINS

NOTE: The process where we have two conceptus developing at the same time is called twinning. There are two types of twins;

i. **Monozygotic twins**
ii. **Dizygotic twins**

	MONOZYGOTIC	**DIZYGOTIC**
1) Definition	Developed from a singular fertilized embryo which splits into two. Monozygotic twins are two offsprings that develop from one zygote.	Developed from two independent but simultaneous fertilization events. Dizygotic twins are two offsprings that develop from two separate zygotes
2) *Genetic composition*	Monozygotic twins are genetically identical. *Since they originate from the same fertilized egg and are fertilized by the same sperm, they share the same DNA.*	Dizygotic twins are as genetically non identical. *Since they originate from two fertilized egg and fertilized by two sperms, they do not share the same DNA.*
3) Gender	Monozygotic twins are always the same gender.	Dizygotic twins can be different gender.
4) Cause	Due to the random splitting of the zygote into two embryos.	Due to two separate eggs fertilized by two sperms.
5) Placenta, amniotic sac and chorionic sac	Zygotes develop within the same chorionic sac and share the same placenta.	Zygotes have separate amniotic sac, chorionic sac and placenta**.**
6) Name	They are called identical twins.	They are called fraternal twins.

7) *Physical appearance*	Monozygotic twins have extremely similar appearance. But can be affected by some environmental factors.	Dizygotic twins may have the same appearance or different appearance.
8) *Hereditary*	Not hereditary	Hereditary
9) *Blood type*	Monozygotic twins always have the same blood type	Dizygotic twins can have different blood types
10)Worldwide population	One-third of all twins worldwide are monozygotic	Two-third of twins world-wide are dizygotic
11)Twin Transfusion syndrome (TTS)	There's a high TTS risk in monozygotic twins	There's much lower TTS risk in dizygotic twins when compared with monozygotic twins

DIAGRAMATIC REPRESENTATION