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COURSE: ANATOMY- EMBRYOLOGY

LEVEL: 200

ASSIGNMENT:

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 a mature egg from the female ovary; the release enables the egg to be fertilized by the male sperm cells. Normally, in humans, only one egg is released at one time; occasionally, two or more erupt during the menstrual cycle. The egg erupts from the ovary on the 14th to 16th day of the approximately 28-day menstrual cycle. If not fertilized, the egg is passed from the reproductive tract during menstrual bleeding, which starts about two weeks after ovulation. Occasionally, cycles occur in which an egg is not released; these are called anovulatory cycles. Prior to eruption from the ovary, an egg first must grow and mature. Until stimulated to grow, the primary egg cell passes through a period of dormancy that may last several years. The egg cell is surrounded by a capsule of cells known as the follicle. The follicular wall serves as a protective casing around the egg and also provides a suitable environment for egg development. As the follicle ripens, the cell wall thickens and a fluid is secreted to surround the egg. The follicle migrates from within the ovary’s deeper tissue to the outer wall. Once the follicle reaches the surface of the ovary, the follicular wall thins. Pressure caused by the follicle and fluid against the ovary’s surface causes bulging of the ovarian wall. When the follicle ruptures, the egg and fluid are released along with some torn patches of tissue. The cells, fluid, and egg are directed into the nearby fallopian tube, which serves as a passageway by which the egg reaches the uterus and as a site for fertilization of the released egg by sperm.

 The hormones that stimulate ovulation are produced in the pituitary gland; these are known as the [follicle-stimulating hormone](https://www.britannica.com/science/follicle-stimulating-hormone) and [luteinizing hormone](https://www.britannica.com/science/luteinizing-hormone). After the egg leaves the ovary, the walls of the follicle again close, and the space that was occupied by the egg begins to fill with new cells known as the corpus luteum. The corpus luteum secretes the female hormone progesterone, which helps to keep the uterine wall receptive to a fertilized egg. If the egg is not fertilized, the corpus luteum stops secreting progesterone about nine days after ovulation. If the egg becomes fertilized, progesterone continues to be secreted, first by the corpus luteum and then by the placenta, until the child is born. Progesterone blocks the release of more hormones from the pituitary gland, so that further ovulation does not normally occur during pregnancy.

2. Differences between meiosis 1 and meiosis 2

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| Meiosis 1 | Meiosis 2 |
| Two cells are produced  | Four cells are produced |
| It is a heterotypic type of division | It is a homotypic divison |
| It reduces the chromosome number in the daughter cell | It equalizes the chromosome number of both parents and daughter cells |
| Crossing over and genetic recombination occur | Crossing over and genetic recombination do not occur |
| Homologous chromosomes are present at the beginning | Individual, bivalent chromosome are present at the beginning |
| Chromosomal cross-over occurs during prophase 1 | No chromosomal cross-over occurs during prophase 2 |
| Splitting of centromeres does not take place | Centromere splits and sister chromatid separates |
| It is complex and takes a longer time | It is comparatively less simple and takes a short time |
| Preceded by interphase | No interphase takes place |

3. Fertilization is the union of the sperm and oocyte and it takes place at the ampulla of the uterine tube. Fertilization process takes approximately 24 hrs. (1 day). Ovulation coincides with menstrual cycle (and it usually takes up to 3-5 days). There are six stages involved in fertilization:

i) Passage of sperm through the corona radiate

ii) Penetration of the zona pellucida

iii) Fusion of plasma membrane of the oocyte and sperm

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

v) Formation of the male pronucleus

vi) The formation of zygote

PASSAGE OF SPERM THROUGH THE CORONA RADIATA

For sperm to pass freely, it has to be capacitated by the removal of glycoprotein coat and seminal plasma proteins from the plasma membrane that overlies the acrosomal region of the spermatozoa. 200-300 million sperms are deposited at the female genital tract but only 300- 5oo reach the fertilization site. It start from the head.

PENETRATION OF THE ZONA PELLUCIDA

Zona pellucida is a glycoprotein shell surrounding the egg that facilitates and maintains sperm binding and induces the acrosome reaction. Both binding and the acrosomal reaction are mediated by the ligand ZP3 a zona protein. Release of acrosomal enzymes (acrosin) allows sperm to penetrate the zona pellucida thereby coming in contact with the plasma membrane of the oocyte. Immediately the head of the sperm comes in contact with surface of the oocyte, the permeability of the zona pellucida changes. This contact results in release of lysosomal enzymes from cortical granules lining the plasma membrane of the oocyte. In turn, these enzymes alter properties of the zona pellucida to present sperm penetration and inactivate species- specific receptor sites for spermatozoa on the zona surface. This prevents poly spermy. Acrosome breaks away from the sperm to help it pass through the zona pellucida.

FUSION OF PLASMA MEMBRANE 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 THE OOCYTE AND FORMATION OF THE FEMALE PRONUCLEUS

The sperm penetrates the oocyte thereby activating it to complete the second meiotic division and forming a mature oocyte and a second polar body.

FORMATION OF 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 two pronuclei each having haploid number of chromosomes (23). The oocyte containing two haploid pronuclei is called an Ootid.

FORMATION OF ZYGOTE

The two pronuclei fuse into a single diploid aggregation of chromosomes, the ootid becomes a zygote. The chromosomes in the zygote becomes arranged on a cleavage spindle preparation for cleavage of the zygote.

4.) Differences between monozygotic and dizygotic twins

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| Monozygotic twins | Dizygotic twins |
| They are genetically identical | They are as genetically similar as would be the case with any other, non-identical sibling |
| They are developed by splitting of a fertilized embryo into two | They are developed by two simultaneous fertilization events |
| Their blood types are the same | Their blood types are different |
| It is not hereditary | It is hereditary |
| They are always the same gender | They are of different genders  |
| They are known as identical twins | They are known as fraternal twins |