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Question

1.Discuss ovulation

Answer: In humans, ovulation occurs about midway through the menstrual cycle, after the follicular phase. The few days surrounding ovulation (from approximately days 10 to 18 of a 28-day cycle), constitute the most fertile phase. The time from the beginning of the last menstrual period (LMP) until ovulation is, on average, 14.6 days, but with substantial variation among females and between cycles in any single female, with an overall 95% prediction interval of 8.2 to 20.5days.

The process of ovulation is controlled by the hypothalamus of the brain and through the release of hormones secreted in the anterior lobe of the pituitary gland, luteinizing hormone (LH) and follicle-stimulating hormone (FSH).In the preovulatory phase of the menstrual cycle, the ovarian follicle will undergo a series of transformations called cumulus expansion, which is stimulated by FSH. After this is done, a hole called the stigma will form in the follicle, and the secondary oocyte will leave the follicle through this hole. Ovulation is triggered by a spike in the amount of FSH and LH released from the pituitary gland. During the luteal (post-ovulatory) phase, the secondary oocyte will travel through the fallopian tubes toward the uterus. If fertilized by a sperm, the fertilized secondary oocyte or ovum may implant there 6–12 days later.

2.Diffrentiate between meiosis1 and meiosis 2

Answer:

a. In meiosis1homologous chromosomes separate, while in meiosis 2, sister chromatids separate.

b. Genetic recombination (crossing over) only occurs in meiosis1 and not in meiosis 2

c. Meiosis 2 produces 4 haploid daughter cells, whereas Meiosis 1 produces 2 diploid daughter cells.

3. Discuss the stages involved in fertilization.

Fertilization is more of a chain of events than a single, isolated phenomenon. Interruption of any step can lead to fertilization failure.

**Sperm capacitation:** Freshly ejaculated sperm are unable or poorly able to fertilize. Rather, they must first undergo a series of changes known collectively as capacitation. Capacitation is associated with removal of adherent seminal plasma proteins, reorganization of plasma membrane lipids and proteins. Capacitation occurs while sperm reside in the female reproductive tract for a period of time, as they normally do during gamete transport. The length of time required varies with species, but usually requires several hours. The sperm of many mammals, including humans, can also be capacitated by incubation in certain fertilization media.

**Sperm-Zona Pellucida Binding:** Binding of sperm to the zona pellucida is a receptor-ligand interaction with a high degree of species specificity. The carbohydrate groups on the zona pellucida glycoproteins function as sperm receptors. The sperm molecule that binds this receptor is not known with certainty, and indeed, there may be several proteins that can serve this function.

**The Acrosome Reaction:** The acrosome reaction provides the sperm with an enzymatic drill to get throught the zona pellucida. The same zona pellucida protein that serves as a sperm receptor also stimulates a series of events that lead to many areas of fusion between the plasma membrane and outer acrosomal membrane. Membrane fusion (actually an exocytosis) and vesiculation expose the acrosomal contents, leading to leakage of acrosomal enzymes from the sperm's head.

As the acrosome reaction progresses and the sperm passes through the zona pellucida, more and more of the plasma membrane and acrosomal contents are lost. By the time the sperm traverses the zona pellucida, the entire anterior surface of its head, down to the inner acrosomal membrane, is denuded. Sperm that lose their acrosomes before encountering the oocyte are unable to bind to the zona pellucida and thereby unable to fertilize.

**Penetration of the Zona Pellucida:** The constant propulsive force from the sperm's flagellating tail, in combination with acrosomal enzymes, allow the sperm to create a tract through the zona pellucida. These two factors - motility and zona-digesting enzymes- allow the sperm to traverse the zona pellucida. Some investigators believe that sperm motility is of overriding importance to zona penetration, allowing the knife-shaped mammalian sperm to basically cut its way through the zona pellucida.

**Sperm-Oocyte Binding:** Once a sperm penetrates the zona pellucida, it binds to and fuses with the plasma membrane of the oocyte. Binding occurs at the posterior (post-acrosomal) region of the sperm head.

The molecular nature of sperm-oocyte binding is not completely resolved. A leading candidate in some species is a dimeric sperm glycoprotein called fertilin, which binds to a protein in the oocyte plasma membrane and may also induce fusion. Interestingly, humans and apes have inactivating mutations in the gene encoding one of the subunits of fertilin, suggesting that they use a different molecule to bind oocytes.

**Egg Activation and the Cortical Reaction:** Prior to fertilization, the egg is in a quiescent state, arrested in metaphase of the second meiotic division. Upon binding of a sperm, the egg rapidly undergoes a number of metabolic and physical changes that collectively are called egg activation. Prominent effects include a rise in the intracellular concentration of calcium, completion of the second meiotic division and the so-called cortical reaction.

The cortical reaction refers to a massive exocytosis of cortical granules seen shortly after sperm-oocyte fusion. Cortical granules contain a mixture of enzymes, including several proteases, which diffuse into the zona pellucida following exocytosis from the egg. These proteases alter the structure of the zona pellucida, inducing what is known as the zona reaction.

4. Differentiate between Monozygotic twins and Dizygotic twins

Monozygotic twins result from the fertilization of one egg and sperm. The embryo then further splits into two resulting in two individuals which are identical twins while dizygotic twins result from fertilization of 2 different eggs with 2 different sperms resulting in fraternal twins.