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OVULATION

Around the middle of the ovarian cycle, the ovarian follicle, under the influence of FSH and LH, undergoes a sudden growth spurt, producing a cystic swelling or bulge on the surface of the ovary. A small avascular spot, the stigma, soon appears on this swelling. Before ovulation, the secondary oocyte and some cells of the cumulus oophorus detach from the interior of the distended follicle. 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 . The stigma soon ruptures, expelling the secondary oocyte with the follicular fluid . Expulsion of the oocyte is the result of intrafollicular pressure, and possibly by contraction of smooth muscle in the theca externa (sheath) owing to stimulation by prostaglandins.

STAGES INVOLVED IN FERTILIZATION

Passage of a sperm through the corona radiata. Dispersal of the follicular cells of the corona radiata surrounding the oocyte and zona pellucida appears to result mainly from the action of the enzyme hyaluronidase released from the acrosome of the sperm , but the evidence of this is not unequivocal. Tubal mucosal enzymes also appear to assist the dispersal. Movements of the tail of the sperm are also important in its penetration of the corona radiata . ● Penetration of the zona pellucida. Passage of a sperm through the zona pellucida is the important phase in the initiation of fertilization. Formation of a pathway also results from the action of enzymes released from the acrosome. The enzymes esterase, acrosin, and neuraminidase appear to cause lysis (dissolution or loosening) of the zona pellucida, thereby forming a path for the sperm to enter the oocyte. The most important of these enzymes is acrosin, a proteolytic enzyme. ● Once the sperm penetrates the zona pellucida, a zona reaction, a change in the properties of the zona pellucida, occurs that makes it impermeable to other sperms. The composition of this extracellular glycoprotein coat changes after fertilization. The zona reaction is believed to result from the action of lysosomal enzymes released by cortical granules near the plasma membrane of the oocyte. The contents of these granules, which are released into the perivitelline space , also cause changes in the plasma membrane that make it impermeable to other sperms. ● Fusion of cell membranes of the oocyte and sperm. The plasma or cell membranes of the oocyte and sperm fuse and break down in the area of fusion. The head and tail of the sperm enter the cytoplasm of the oocyte , but the sperm’s cell membrane (plasma membrane) and mitochondria remain behind. ● Completion of the second meiotic division of the oocyte and formation of the 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 . Following decondensation of the maternal chromosomes, the nucleus of the mature oocyte becomes the female pronucleus. ● Formation of the male pronucleus. Within the cytoplasm of the oocyte, the nucleus of the sperm enlarges to form the male pronucleus (see, and the tail of the sperm degenerates. Morphologically, the male and female pronuclei are indistinguishable. During growth of the pronuclei, they replicate their DNA-1 n (haploid), 2 c (two chromatids). The oocyte containing the two haploid pronuclei is called an ootid, the nearly mature oocyte after the first meiotic divisions have been completed

As the 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 ● The zygote is genetically unique because half of its chromosomes came from the mother and half from the father. The zygote contains a new combination of chromosomes that is different from those in the cells of either of the parents. This mechanism forms the basis of biparental inheritance and variation of the human species. Meiosis allows independent assortment of maternal and paternal chromosomes among the germ cells . Crossing over of chromosomes, by relocating segments of the maternal and paternal chromosomes, “shuffles” the genes, thereby producing a recombination of genetic material. The embryo’s chromosomal sex is determined at fertilization by the kind of sperm (X or Y) that fertilizes the oocyte. Fertilization by an X-bearing sperm produces a 46,XX zygote, which develops into a female, whereas fertilization by a Y-bearing sperm produces a 46,XY zygote, which develops into a male.

Fertilization ● Stimulates the penetrated oocyte to complete the second meiotic division ● Restores the normal diploid number of chromosomes (46) in the zygote ● Results in variation of the human species through mingling of maternal and paternal chromosomes ● Determines the chromosomal sex of the embryo ● Causes metabolic activation of the ootid (nearly mature

 MONOZYGOTIC TWINS DIZYGOTIC TWINS

 DEVELOPED BY TWO EGGS AND DIFFERENT SPERM DEVELOPED FROM A SINGLE EGG

 FERTILLIZED BY A SINGLE SPERM CELL

TWO FETUSES GROW IN THE SAME PLACENTA

 TWO FETUSES GROW IN TWO DIFFERENTMEMBRANE

**Meiosis**

* is the cell division that takes place in the germ cells to generate male and female gametes, sperm and egg cells, respectively

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|  MEIOSIS 1*Synapsis*: pairing of 46 homologous duplicated chromosomes*Crossing over*: exchange of largesegments of DNA*Alignment*: alignment of 46 homologous duplicated chromosomes at the metaphase plate*Disjunction*: separation of 46 homologous duplicated chromosomes from each other; centromeres do not split.*Cell division*: formation of two secondary gametocytes (23 duplicated chromosomes, 2N). MONOZYGOTIC TWINS MONOZYGOTIC TWINS SPERM DEVELOPED FROM A SINGLE EGG FERTILLIZED BY A SINGLE SPERM CELL TWO FETUSES GROW IN THE SAME PLACENTA IDENTICAL GENETIC PROFILEALWAYS OF THE SAME SEX IDENTICAL TWINS   | MEIOSIS2Synapsis: absent.Crossing over: absent.Alignment: alignment of 23 duplicated chromosomes at the metaphase plate.Disjunction: separation of 23 duplicated chromosomes to form 23 single chromosomes; **centromeres split** Cell division: formation of four gametes (23 single chromosomes, 1N).DIZYGOTIC TWINS DEVELOPED BY TWO EGGS AND DIFFERENTTWO FETUSES GROW IN TWO DIFFERENTMEMBRANE  COMPLETELY DIFFERENT GENETIC PROFILE MAY BE SAME OR OPPOSITE SEXFRATENAL TWINS  |