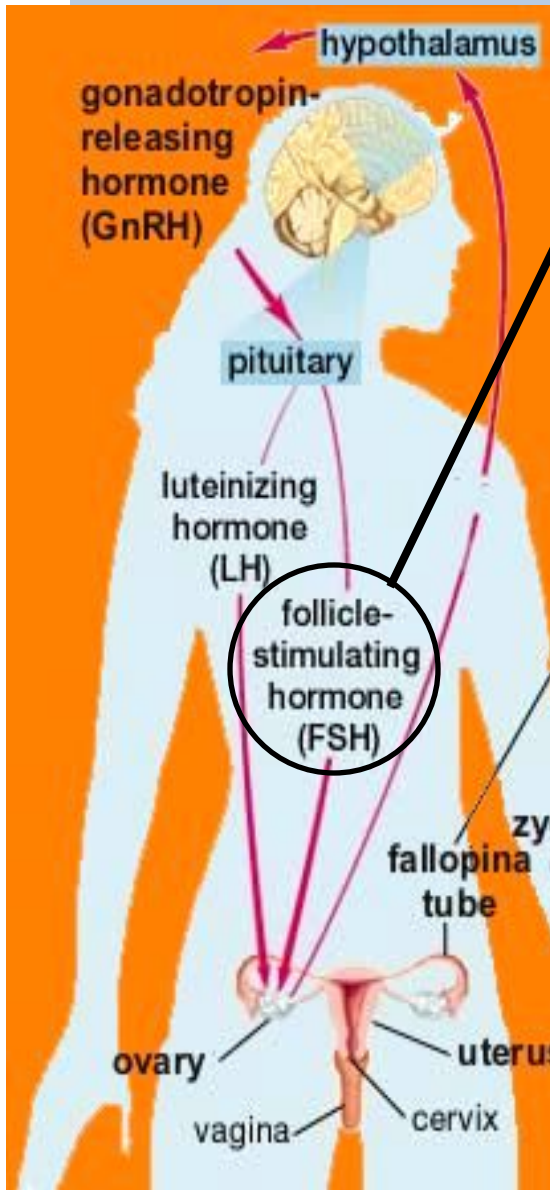


# Ovarian cycle



At the beginning of each ovarian cycle, 15 to 20 primary (preantral) stage follicles are stimulated to grow under the influence of FSH.

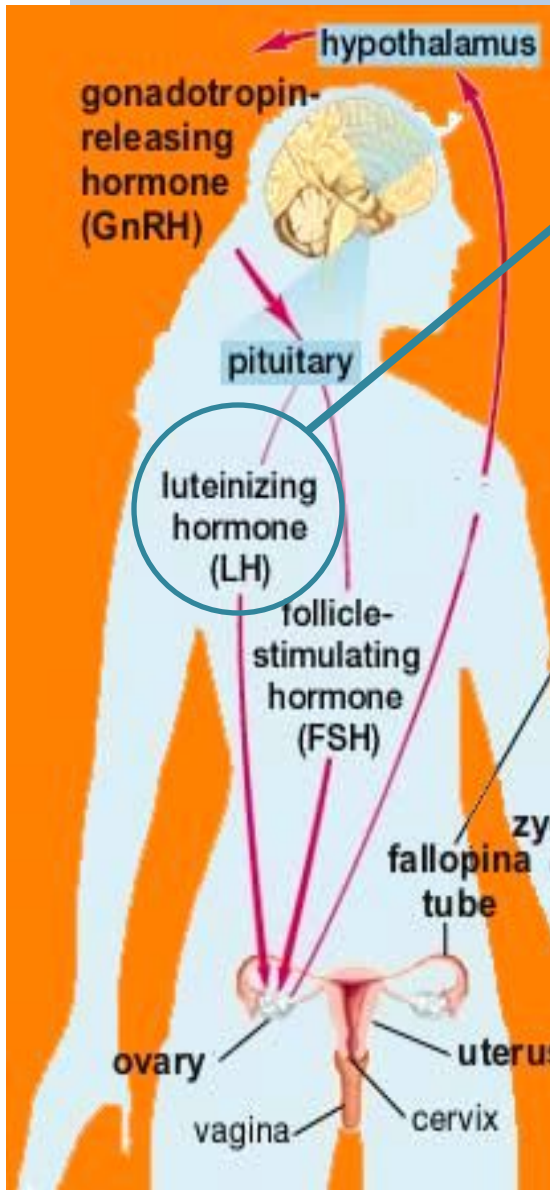
**But only one oocyte is ovulates**

FSH also stimulates maturation of **follicular (granulosa)** cells surrounding the oocyte.

granulosa and thecal cells produce estrogens that

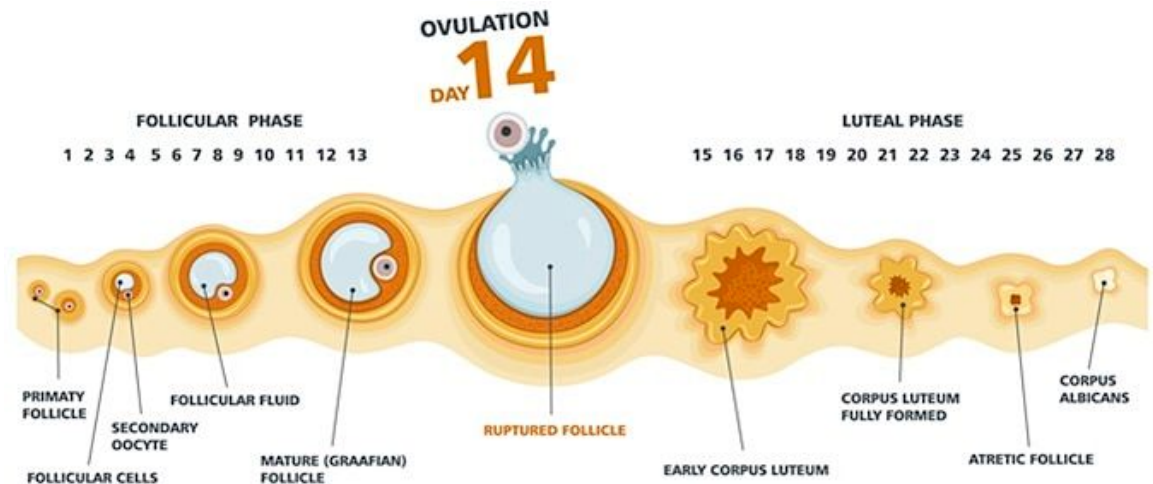
- (a) cause the uterine endometrium to enter the follicular or **proliferative phase**;
- (b) cause thinning of the cervical mucus to allow passage of sperm; and
- (c) stimulate the pituitary gland to secrete LH.

# Ovarian cycle



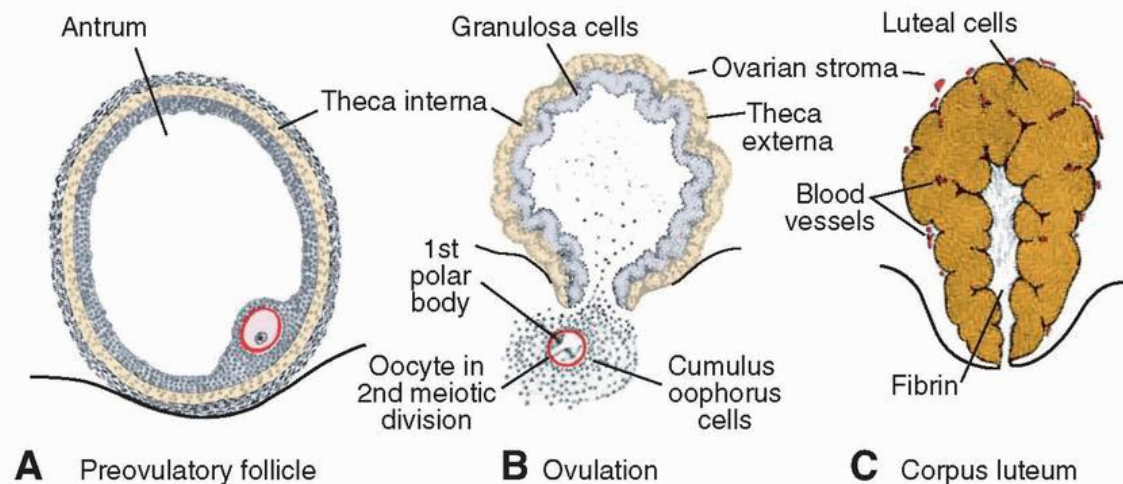
At mid-cycle, there is an **LH surge** that cause

- Elevates concentrations of maturation-promoting factor, causing oocytes to complete meiosis I and initiate meiosis II;
- Stimulates production of progesterone by follicular stromal cells (**luteinization**); and
- Causes follicular rupture and ovulation.

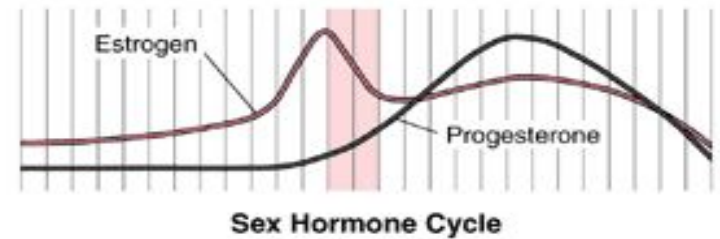
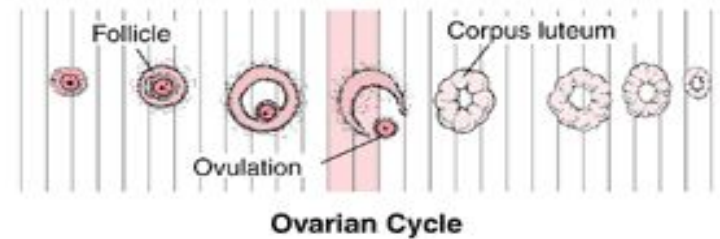
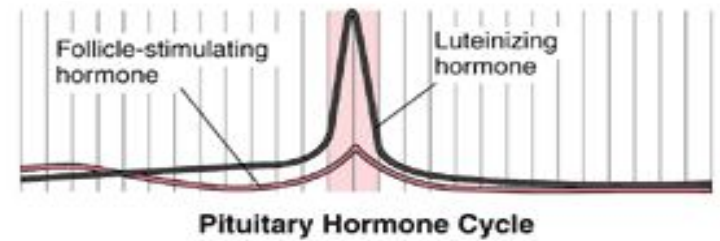


# Ovarian cycle

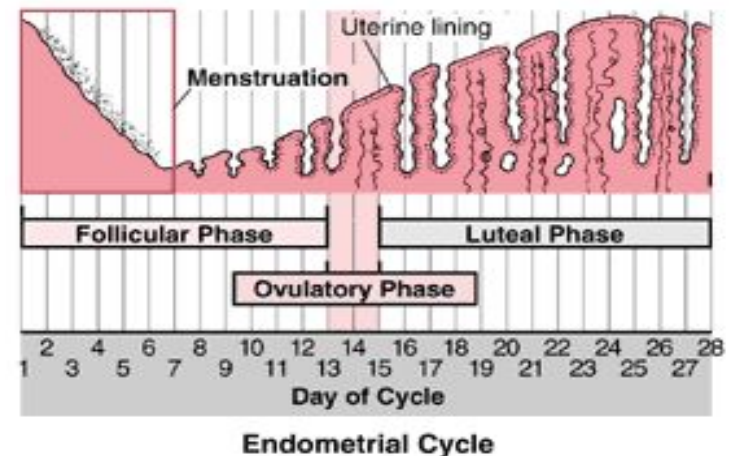
- The high concentration of LH increases the **collagenase activity**, resulting in digestion of collagen fibers surrounding the follicle. **Prostaglandin levels** also increase in response to the LH surge and cause local muscular contractions in the ovarian wall.
- Those contractions extrude the oocyte, which together with its surrounding granulosa cells from the region of the cumulus oophorus, breaks free (**ovulation**) and floats out of the ovary. Some of the cumulus oophorus cells then rearrange themselves around the zona pellucida to form the **corona radiata**.



- After ovulation, granulosa cells remaining in the wall of the ruptured follicle, together with cells from the theca interna, are vascularized by surrounding vessels. Under the influence of LH, these cells develop a yellowish pigment and change into **lutean cells**, which form the **corpus luteum** and secrete the hormone **progesterone** (Fig. 2.2C).

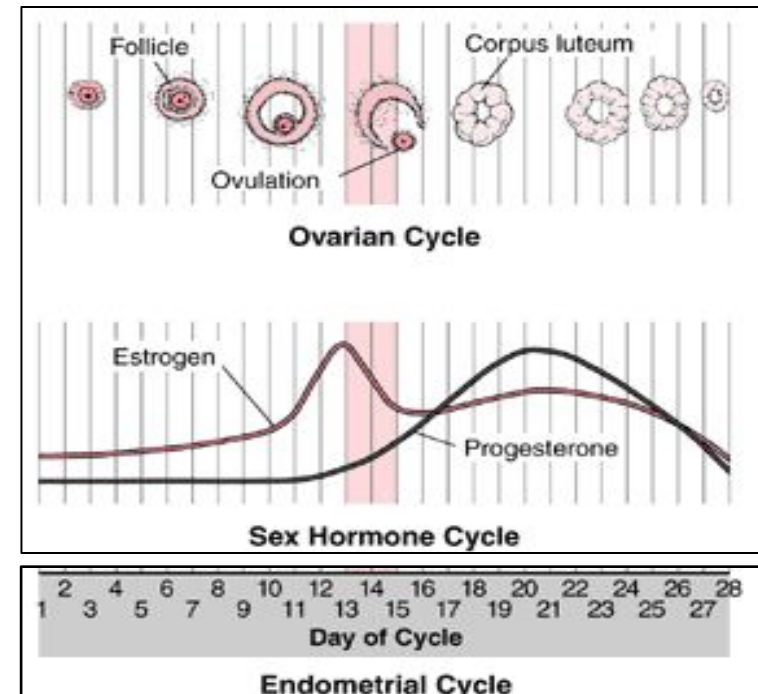


- Progesterone, together with estrogenic hormones, causes the uterine mucosa to enter the **progestational** or **secretory stage** in preparation for implantation of the embryo.



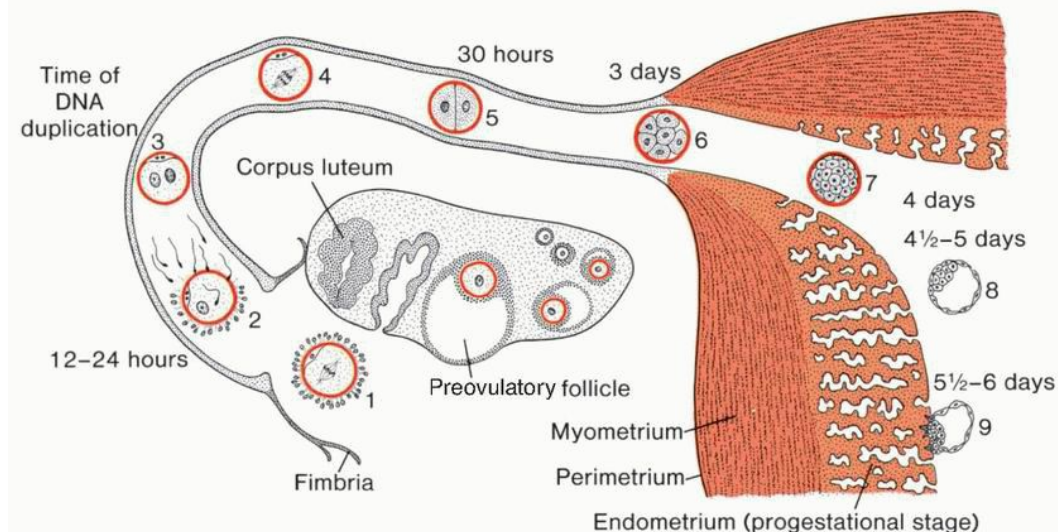
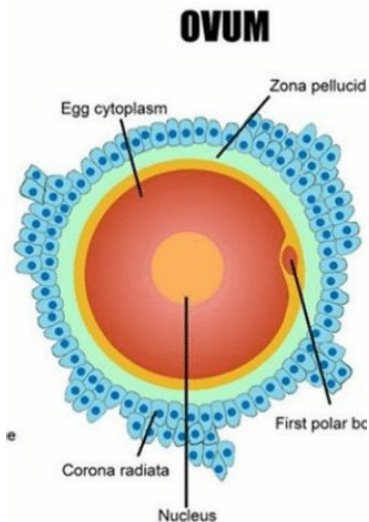
- If fertilization does not occur, the corpus luteum reaches maximum development approximately 9 days after ovulation.
- Subsequently, the corpus luteum shrinks because of degeneration of lutean cells and forms a mass of fibrotic scar tissue, the **corpus albicans**.
- Simultaneously, progesterone production decreases, precipitating menstrual bleeding.

- If the oocyte is fertilized, degeneration of the corpus luteum is prevented by **human chorionic gonadotropin (hCG)**, a hormone secreted by the syncytiotrophoblast of the developing embryo.
- The corpus luteum continues to grow and forms the **corpus luteum of pregnancy**.

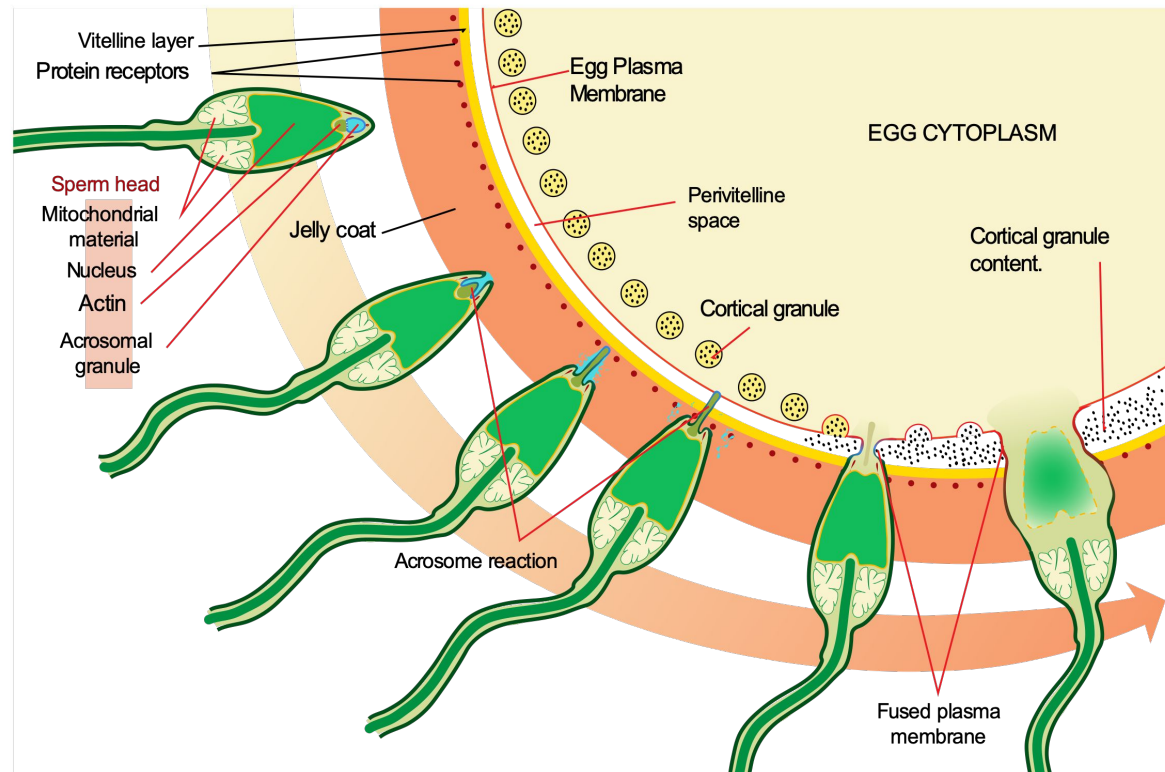


# Fertilization

- Fertilization, the process by which male and female gametes fuse, occurs in the **ampullary region of the uterine tube**.
- Spermatozoa are not able to fertilize the oocyte immediately upon arrival in the female genital tract but must undergo:
  1. **Capacitation** is a period of conditioning in the female reproductive tract that in the human lasts approximately 7 hours. During this time a glycoprotein coat and seminal plasma proteins are removed from the sperm plasma membrane that overlies the acrosomal region of the spermatozoa. Only capacitated sperm can pass through the corona cells and undergo the acrosome reaction.

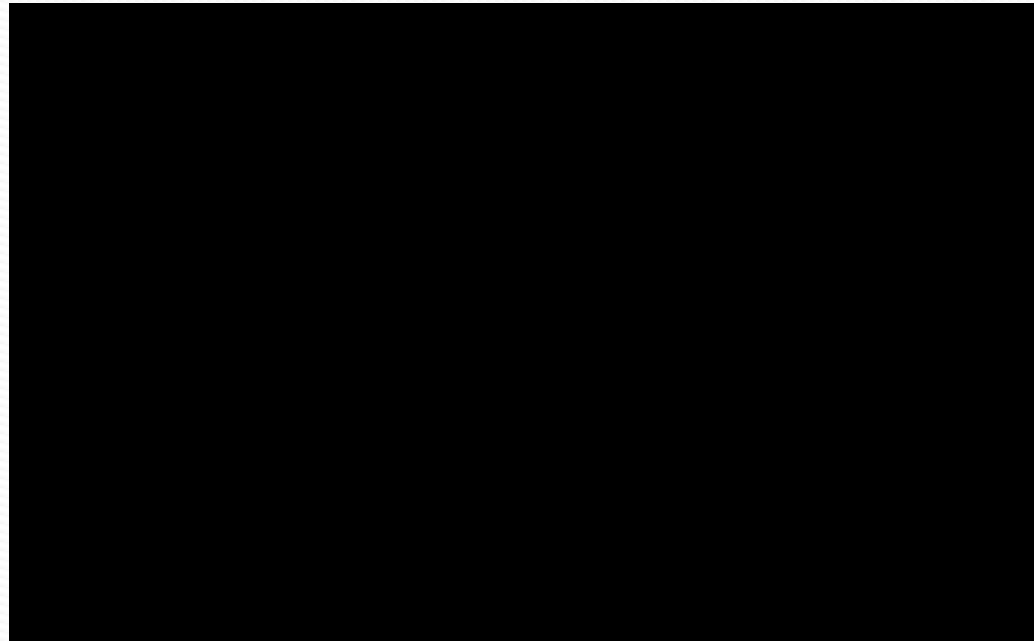


2. **The acrosome reaction**, which occurs after binding to the zona pellucida. This reaction culminates in the release of enzymes needed to penetrate the zona pellucida, including acrosin and trypsin-like substances.



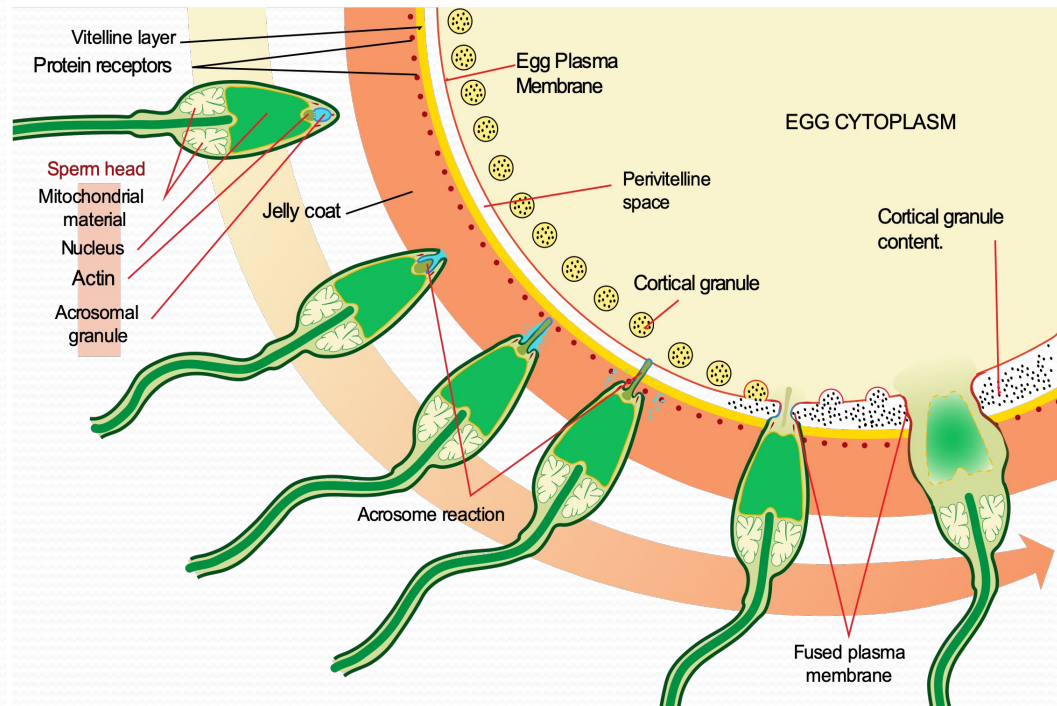
## The phases of fertilization include

- **PHASE 1: PENETRATION OF THE CORONA RADIATA:**  
Capacitated sperm pass freely through corona cells
- **PHASE 2: 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.



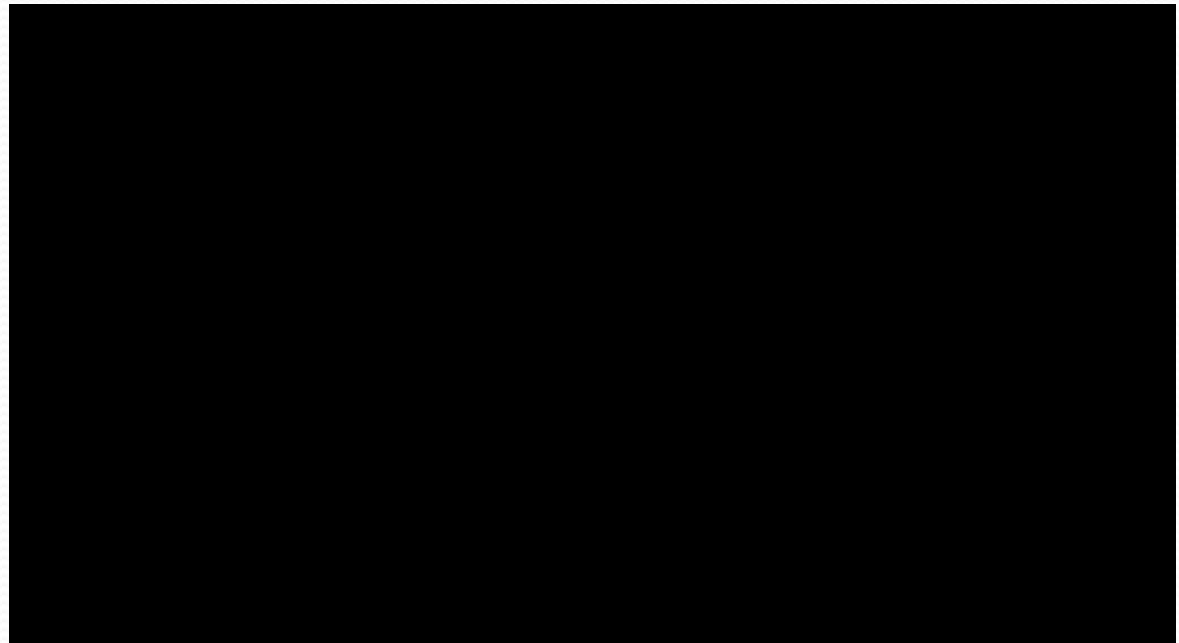


- Permeability of the zona pellucida changes when the head of the sperm comes in contact with the oocyte surface. This contact results in release of lysosomal enzymes from cortical granules lining the plasma membrane of the oocyte. In turn, these enzymes alter properties of the zona pellucida (**zona reaction**) to prevent sperm penetration and inactivate species-specific receptor sites for spermatozoa on the zona surface.



- **PHASE 3: FUSION OF THE OOCYTE AND SPERM CELL MEMBRANES:**

The plasma membranes of the sperm and egg fuse. In the human, both the head and tail of the spermatozoon enter the cytoplasm of the oocyte, but the plasma membrane is left behind on the oocyte surface.



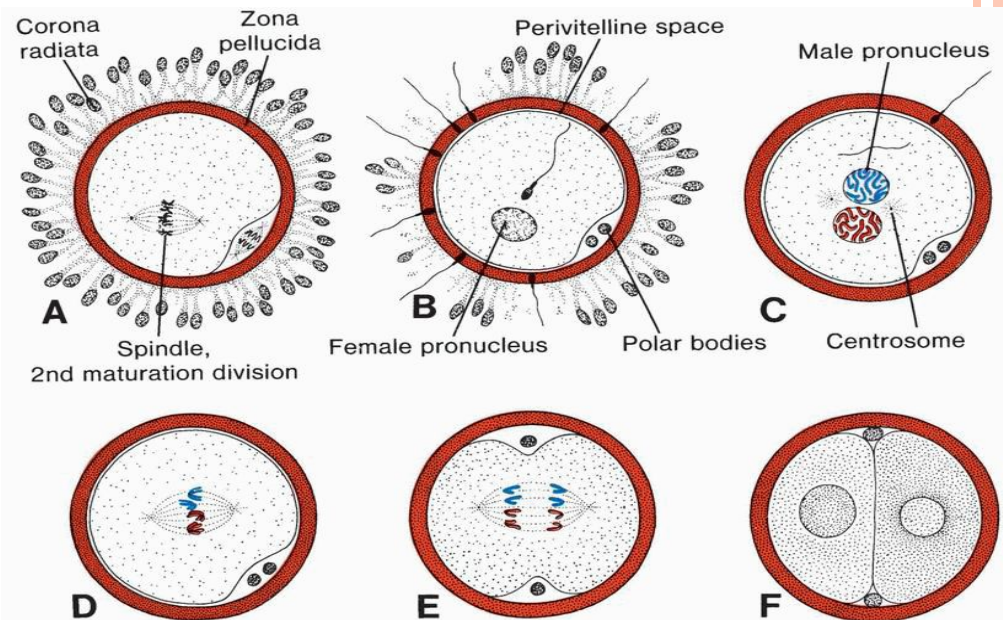
□ As soon as the spermatozoon has entered the oocyte, the egg responds in three ways:

1. **Cortical and zona reactions.** As a result of the release of cortical oocyte granules, which contain lysosomal enzymes,
  - (a) the oocyte membrane becomes impenetrable to other spermatozoa, and
  - (b) the zona pellucid alters its structure and composition to prevent sperm binding and penetration. These reactions prevent polyspermy (penetration of more than one spermatozoon into the oocyte).
  
2. **Resumption of the second meiotic division.** The oocyte finishes its second meiotic division immediately after entry of the spermatozoon and formation of the **female pronucleus**
  
3. **Metabolic activation of the egg.**



- The fertilized spermatozoon, moves forward until it lies close to the female pronucleus. Its nucleus becomes swollen and forms the **male pronucleus**
- **The male and female** pronucleus must replicate its DNA, chromosomes organize on the spindle in preparation for a normal mitotic division. The 23 maternal and 23 paternal (double) chromosomes split longitudinally at the centromere, and sister chromatids move to opposite poles, providing each cell of the zygote with the normal diploid number of chromosomes and DNA.

As sister chromatids move to opposite poles, a deep furrow appears on the surface of the cell, gradually dividing the cytoplasm into two parts.



## :THE MAIN RESULTS OF FERTILIZATION ARE AS FOLLOWS

- ❑ **Restoration of the diploid number of chromosomes**, half from the father and half from the mother. the zygote contains a new combination of chromosomes different from both parents.
- ❑ **Determination of the sex** of the new individual. An X-carrying sperm produces a female (XX) embryo, and a Y-carrying sperm produces a male (XY) embryo.
- ❑ **Initiation of cleavage**. Without fertilization, the oocyte usually degenerates 24 hours after ovulation.



## Cleavage and blastocyst formation

