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**Histology and Embryology /2rd Stage**
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**Week 1(Day 1-7) of devlopment**

# Fertilization

Refers to the union of a haploid oocyte with a haploid spermatozoon to produce a diploid zygote (a single cell capable of developing into a new individual) which occurs in the ampulla of the uterine tube.

Spermatozoa are not able to fertilize the oocyte immediately upon arrival in the female genital tract but must undergo

## (a) capacitation

Capacitation is a period of conditioning in the female reproductive tract that in the human lasts approximately 7 hours. Much of this conditioning, which occurs in the uterine tube, after that occure epithelial interactions between the sperm and mucosal surface of the tube. During this time a glycoprotein coat and seminal plasma proteins are removed from the plasma membrane that overlies the acrosomal region of the spermatozoa. Only capacitated sperm can pass through the corona cells and undergo the acrosome reaction.

## (b) acrosome reaction.

The acrosome reaction, which occurs after binding to the zona pellucida, is induced by zona proteins. 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;

200 to 300 million spermatozoa normally deposited in the female genital tract, only 300 to 500 reach the site of fertilization. Only one of these fertilizes the egg. 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. Both binding and the acrosome reaction are mediated by the ligand ZP3, a zona protein. Release of acrosomal enzymes (acrosin) allows sperm to penetrate the zona, 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**. fusion of genetic material of the oocyte and the sperm and This results in zygote

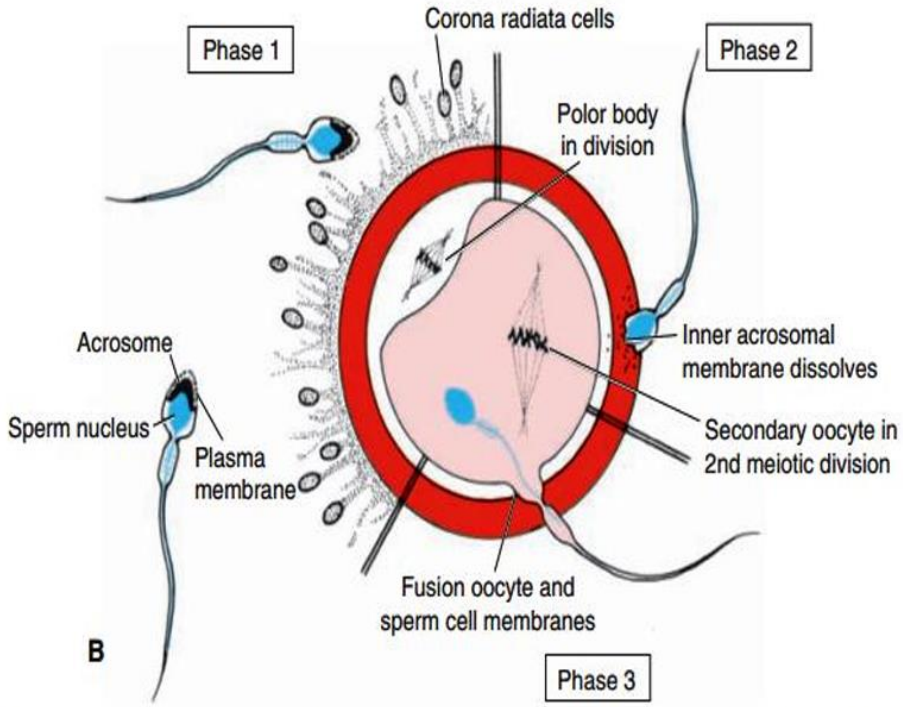



**Figure 3.5** **A.** Scanning electron micrograph of sperm binding to the zona pellucida. **B.** The three phases of oocyte penetration. In phase 1, spermatozoa pass through the corona radiata barrier; in phase 2, one or more spermatozoa penetrate the zona pellucida; in phase 3, one spermatozoon penetrates the oocyte membrane while losing its own plasma membrane. Inset shows normal spermatocyte with acrosomal head cap.

## Syngamy

is a term that describes the successful completion of fertilization, that is, the formation of a zygote. Syngamy occurs when the male and female pronuclei fuse and the cytoplasmic machinery for proper cell division exists.

**The results of fertilization**

(a) determination of genetic sex of embryo

(b) restoration of diploid number of chromosomes

(c) initiation of cleavage

## Cleavage

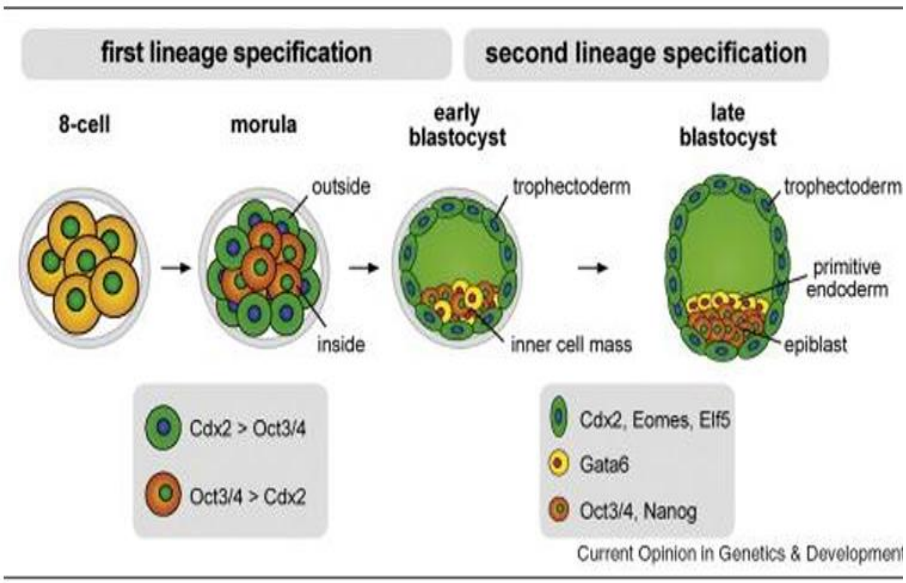
This term refers to the series of mitotic divisions by which the large zygote is fractionated into numerous cells. These cells, which become smaller with each cleavage division, are known as blastomeres. cleavage begins with a zygote, progresses through compaction to a morula stage and terminates at the start of the blastocyst (blastula) stage.

## Morula

Is a solid ball of blastomeres, within a zona pellucida. A morula typically consists of 16 to 64 blastomeres = four to six cell divisions. Blastomeres become compacted and the cells divided into :

1- outer blastomeres:- they are destined to become trophoblasts which form the chorion & amnion (fetal membranes);

2- inner blastomeres:- they are destined to become inner cell mass which forms the embryo .




## Blastocyst (or blastula)

Basket – shape structure consists of a large number of blastomeres arranged to form a hollow (fluid filled) sphere/cylinder containing an inner cell mass (embryoblast), a collection of cells localized inside one pole (end) of the blastula. The surface cells of the blastocyst are designated trophoblasts, and the fluid cavity is called a blastocoele. Eventually the blastocyst attaches to the uterine wall (implantation).

## Implantation

Implantation is the very early stage of pregnancy at which the conceptus adheres to the wall of the uterus. At this stage of prenatal development, the conceptus is a blastocyst. It is by this adhesion that the foetus receives oxygen and nutrients from the mother to be able to grow. In humans, implantation of a fertilized ovum is most likely to occur about 9 days after ovulation, ranging between 6 and 12 days. Stages of implantation:-

A. The zona pellucida must degenerate for implantation to occur.

B. The blastocyst implants within the posterior superior wall of the uterus.

C. The blastocyst implants within the functional layer of the endometrium during the secretory phase of the menstrual cycle.

D. The trophoblast differentiates into cytotrophoblast and syncytiotrophoblast

## Abnormal implantation

Ectopic tubal pregnancy (ETP)

1. ETP occurs when the blastocyst implants within the uterine tube due to delayed transport.

2. The ampulla of the uterine tube is the most common site of an ectopic pregnancy.

3. ETP is most commonly seen in women which suffering of endometritis or pelvic inflammatory disease.

4. ETP leads to uterine tube rupture and hemorrhage if surgical intervention (i.e., salpingectomy) is not performed.

5. ETP presents with abnormal uterine bleeding, unilateral pelvic pain, increased levels of human chorionic gonadotropin (hCG) (but lower than originally expected with uterine implantation pregnancy), and a massive first-trimester bleed.

## placenta previa

Abnormal implantation of zygot where the blastocyst implants close to the internal os (opening) of the cervix, so that later in development, the placenta bridges the opening ( placenta previa ) and causes severe, even life threatening bleeding (very bright red) in the second part of pregnancy and during delivery.