FERTILIZATION

Conception, Fecundation, Syngamy, Impregnation

The fusion of an ovum with a sperm to initiate the development of a new individual organism.

🔍 Reproductive functions  ♂ Male & Female

About Fertilization

The process of fertilization involves a sperm fusing with an ovulated oocyte (Pic.1). The process begins with ejaculation during copulation, when hundreds of millions of sperm are released into the vagina. Millions of these sperm are overcome by the acidity here and millions more may be blocked from entering the uterus by thick mucus in cervix. Of those that do enter, thousands of sperm are destroyed by female immune system. Sperms have to reach the distal part of fallopian tube, because oocyte cannot survive the 72 hour journey to the uterus. They are reduced to a few thousand survivors on this journey. Their effort is facilitated by uterine contractions - usually takes from 30 minutes to 2 hours. If the sperm do not encounter an oocyte immediately, they can survive in the fallopian tube for another 3-5 days. Hence, fertilization can still happen a few days before ovulation. In comparison, an oocyte can survive independently for only approximately 24 hours following ovulation. Intercourse more than a day after ovulation will therefore usually not result in fertilization.

Capacitation

During the journey, fluids in the female reproductive tract prepare the sperm for fertilization in a process called capacitation. The fluids improve the motility of the sperm. They also modify the sperm membrane, thinning the membrane in such a way that will help facilitate the release of the digestive enzymes, which are essential penetration the oocyte. Sperm must undergo the process of capacitation in order to be able to fertilize an oocyte. If they reach the oocyte before completion of capacitation, they will be unable to penetrate the oocyte's thick outer layer of cells, because freshly ejaculated sperm is unable or poorly able to fertilize.

Reaching the oocyte

To stream the right direction to the oocyte, sperms response to increasing temperature of distal parts of female reproduction tract and to chemical attractants released from the corona radiata cells. To reach the oocyte itself, the sperm must overcome two protective layers surrounding the oocyte. The sperm first pass through the cells of the corona radiata. First few sperm undergo a spontaneous acrosomal reaction, which does not require contact with the zona pellucida. The reaction digest the corona radiata by the digestive enzymes. That's why the first sperm, which reaches the oocyte, does not fertilize. Then, upon contact with the zona pellucida, the sperm bind to receptors in the zona pellucida. This initiates a process called the acrosomal reaction in which the enzyme-filled „cap” of the sperm head, called the acrosome, releases its stored digestive enzymes (Pic. 2). These enzymes clear a path through the zona pellucida, which surrounds the oocyte, that allows sperm to reach the oocyte. Finally, a single sperm makes contact with sperm-binding receptors on the oocyte's plasma membrane (Pic. 3). After that, both plasma membranes fuse and whole sperm enter the oocyte cytoplasm.

The block of polyspermy

When the first sperm fuses with the oocyte, it is necessary to prevent polyspermy, which means penetration by more than a single sperm. This is critical because if more than one sperm were to fertilize the oocyte, the resulting zygote would be a triploid organism with three sets of chromosomes. This is incompatible with further development. First block of polyspermy is very fast. It involves a near instantaneous change in sodium ion permeability upon binding of the first sperm, depolarizing the oocyte plasma membrane and preventing the
fusion of additional sperm cells. The fast block sets in almost immediately and lasts for about a minute, during which time an influx of calcium ions following sperm penetration triggers the second mechanism, the slow block. This one is called as the cortical reaction, which involves the release of cortical granules from the oocyte. The cortical reaction leads to a modification of the zona pellucida and establishes a permanent barrier to sperm entry, because of the hardening of zona pellucida.

**The zygote**

Although sperm reaches the oocyte, the oocyte has not yet completed meiosis. All secondary oocytes remain arrested in metaphase of meiosis II until fertilization. Only upon fertilization as an activation stimulus by penetrated sperm does the oocyte complete meiosis. The unneeded complement of genetic material that results is stored in a second polar body that is eventually ejected. At this moment, the oocyte has become an ovum, the female haploid gamete. The two haploid nuclei derived from the sperm and oocyte and contained within the egg are decondensed and transformed to form pronuclei. They expand and replicate their DNA in preparation for first cell cycle. The pronuclei then migrate toward each other and then together to the centre of the oocyte. Their pronuclear membranes disintegrate, and both genetic materials fuse a shuffle to form an unique individual. This is the final step of the fertilization and results in a formation of diploid zygote contains all the genetic instructions necessary to develop into a foetus.

**Twins**

In some cases, there could be two offsprings procuded by a single pregnancy, also called as twins. Twins can be developed from just one zygote (monozygotic, "identical" twins), when a zygote is splitted in two embryos, or can be developed from two different oocytes and each of them is fertilized by separate sperm (dizygotic, "fraternal" twins).

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**Find more about related issues**

**Diagnoses**

- **Adenomyosis**
  Medical condition characterized by the presence of ectopic endometrial tissue within the myometrium.
  Learn more at: [www.fertilitypedia.org/therapy/diag/adenomyosis](http://www.fertilitypedia.org/therapy/diag/adenomyosis)

- **Amenorrhoea**
  The absence of a menstrual period in women of reproductive age.
  Learn more at: [www.fertilitypedia.org/therapy/diag/amenorrhoea](http://www.fertilitypedia.org/therapy/diag/amenorrhoea)

- **Anorexia Nervosa**
  An eating disorder characterized by the maintenance of a body weight below average, fear of gaining weight, and a distorted body image.
  Learn more at: [www.fertilitypedia.org/therapy/diag/anorexia-nervosa](http://www.fertilitypedia.org/therapy/diag/anorexia-nervosa)

- **Anovulation**
  Failure of the ovaries to release an oocyte over a period of time generally exceeding 3 months.
  Learn more at: [www.fertilitypedia.org/therapy/diag/anovulation](http://www.fertilitypedia.org/therapy/diag/anovulation)

- **Aspermia**
  Male diagnosis connected with male infertility characterised by the complete absence of semen.
  Learn more at: [www.fertilitypedia.org/therapy/diag/aspermia](http://www.fertilitypedia.org/therapy/diag/aspermia)

- **Azoospermia**
  Complete absence of sperm in the ejaculate of a man.
  Learn more at: [www.fertilitypedia.org/therapy/diag/azoospermia](http://www.fertilitypedia.org/therapy/diag/azoospermia)
Cervical mucus defect
Condition causing cervical mucus too thick and hostile to allow the sperm to penetrate the cervix.
Learn more at: www.fertilitypedia.org/therapy.diag/cervical-mucus-defect

Cervical stenosis
Narrowing of cervix - the opening to the uterus.
Learn more at: www.fertilitypedia.org/therapy.diag/cervical-stenosis

Cryptozoospermia
Male infertility diagnosis characterized by extremely low concentration of sperm in semen.
Learn more at: www.fertilitypedia.org/therapy.diag/cryptozoospermia

Ejaculatory disorders
A class of sexual disorders defined as the subjective lack of normal ejaculation.
Learn more at: www.fertilitypedia.org/therapy.diag/ejaculatory-disorders

Endometriosis
A state in which pieces of the tissue alike to the lining of the uterus (endometrium) grow in other parts of the body.
Learn more at: www.fertilitypedia.org/therapy.diag/endometriosis

Fallopian tube blockage
An obstruction prevents the egg or sperm from traveling down the tube, thus making fertilization impossible.
Learn more at: www.fertilitypedia.org/therapy.diag/fallopian-tube-blockage

Hematosalpinx
Hematosalpinx is a medical condition involving bleeding into the fallopian tube.
Learn more at: www.fertilitypedia.org/therapy.diag/hematosalpinx

Hydrosalpinx
A hydrosalpinx is an abnormal pouch containing liquid in a fallopian tube.
Learn more at: www.fertilitypedia.org/therapy.diag/hydrosalpinx

Hypogonadism
A medical term which describes a diminished functional activity of the gonads – the testes and ovaries.
Learn more at: www.fertilitypedia.org/therapy.diag/hypogonadism

Hypospermia
A condition in which a man has an unusually low ejaculate (or semen) volume.
Learn more at: www.fertilitypedia.org/therapy.diag/hypospermia

Idiopathic male infertility
A condition in which fertility impairment occurs spontaneously or due to an unknown cause.
Learn more at: www.fertilitypedia.org/therapy.diag/idiopathic-male-infertility

Menstrual cycle disorders
An abnormal condition in a woman’s menstrual cycle.
Learn more at: www.fertilitypedia.org/therapy.diag/menstrual-cycle-disorders

Non-obstructive azoospermia
Complete absence of sperm in the ejaculate due to testicular failure.
Learn more at: www.fertilitypedia.org/therapy.diag/non-obstructive-azoospermia
Obesity
A disease of excess body fat that can have a negative effect on health, leading to reduced life expectancy and other health problems.
Learn more at: www.fertilitypedia.org/therapy/diag/obesity

Oligomenorrhea
Light or infrequent menstrual flow at intervals of 39 days to 6 months or 5–7 cycles in a year.
Learn more at: www.fertilitypedia.org/therapy/diag/oligomenorrhea

Oligozoospermia
Semen with a low concentration of sperm and is a common finding in male infertility.
Learn more at: www.fertilitypedia.org/therapy/diag/oligozoospermia

Orchitis
An inflammation of the testes, involving swelling and heavy pains.
Learn more at: www.fertilitypedia.org/therapy/diag/orchitis

Pelvic Inflammatory Disease
Infection of the upper part of the female reproductive system and a common complication of some sexually transmitted diseases.
Learn more at: www.fertilitypedia.org/therapy/diag/pelvic-inflammatory-disease-do-rf

Prostatitis
An inflammation of the prostate gland.
Learn more at: www.fertilitypedia.org/therapy/diag/prostatitis

Pyosalpinx
A distally blocked Fallopian tube filled with pus.
Learn more at: www.fertilitypedia.org/therapy/diag/pyosalpinx-do-rf

Retrograde ejaculation
The semen, which would normally be ejaculated via the urethra, is redirected to the urinary bladder.
Learn more at: www.fertilitypedia.org/therapy/diag/retrograde-ejaculation

Sperm autoantibodies
Antibodies that bind to sperm, inhibiting their movement, stopping recognition and entry into the egg.
Learn more at: www.fertilitypedia.org/therapy/diag/sperm-autoantibodies

Teratospermia
Teratospermia is a condition characterized by the presence of sperm with abnormal morphology that affects fertility in males.
Learn more at: www.fertilitypedia.org/therapy/diag/teratospermia

Testicular cancer
Cancer that develops in the testicles.
Learn more at: www.fertilitypedia.org/therapy/diag/testicular-cancer

Tubal ligation
A permanent form of female sterilization, in which the fallopian tubes are severed and sealed or "pinched shut", in order to prevent fertilization.
Learn more at: www.fertilitypedia.org/therapy/diag/tubal-ligation

Tubal phimosis
The type of blockage that affects the part of the fallopian tube end towards the ovary.
Learn more at: www.fertilitypedia.org/therapy/diag/tubal-phimosis
Undescended testes
In the case of cryptorchidism one or both testes are absent from the scrotum. It is is the most common etiologic factor of azoospermy in
the adult.
Learn more at: www.fertilitypedia.org/therapy/diag/undescended-testes

Uterine fibroids
The most common benign smooth muscle tumors of the uterus encountered in women of reproductive age.
Learn more at: www.fertilitypedia.org/therapy/diag/uterine-fibroids

Uterine malformations
A type of female genital malformation resulting from an abnormal development of the Müllerian duct(s) during embryogenesis.
Learn more at: www.fertilitypedia.org/therapy/diag/uterine-malformations

Uterus duplex
Congenital uterine malformation where both Müllerian ducts develop but fail to fuse, thus the woman has a "double uterus".
Learn more at: www.fertilitypedia.org/therapy/diag/uterus-duplex

Vaginismus
A physical or psychological condition in which woman cannot engage in any form of vaginal penetration.
Learn more at: www.fertilitypedia.org/therapy/diag/vaginismus

Varicocele
An abnormal enlargement of the pampiniform venous plexus in the scrotum.
Learn more at: www.fertilitypedia.org/therapy/diag/varicocele

XX male syndrome
The male sex chromosomal disorder characterized by a spectrum of clinical presentations, ranging from ambiguous to normal male
genitalia.
Learn more at: www.fertilitypedia.org/therapy/diag/xx-male-syndrome

Y-chromosome deletions
A family of genetic disorders caused by missing gene(s) in the Y chromosome.
Learn more at: www.fertilitypedia.org/therapy/diag/y-chromosome-deletions

Reproductive cells

Oocyte
A female germ cell involved in reproduction.
Learn more at: www.fertilitypedia.org/edu/reproductive-cells/oocyte

Sperm
A male reproductive cell which is able to fertilize the counterpart female gamete - the oocyte.
Learn more at: www.fertilitypedia.org/edu/reproductive-cells/sperm

Gallery
Ovulated oocyte is fertilized by sperm to form zygote. The zygote continues to the uterine to implant here. Further development continues for 9 months of pregnancy.

Sperm contacts the zona pellucida, binds to sperm receptors here and release its stored acrosomal granule (digestive enzymes) from the acrosomal cap. Then there is a clear path to fuse with the oocyte plasma membrane.

Sources

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