Write short notes on two of the following;

1. Spermatogenesis
2. Testosterone
3. Semen
4. Male orgasm
5. Male infertility

# **Spermatogenesis**

Spermatogenesis is the process by which [haploid](https://en.m.wikipedia.org/wiki/Haploid) [spermatozoa](https://en.m.wikipedia.org/wiki/Spermatozoa) develop from [germ cells](https://en.m.wikipedia.org/wiki/Germ_cell) in the [seminiferous tubules](https://en.m.wikipedia.org/wiki/Seminiferous_tubules) of the [testis](https://en.m.wikipedia.org/wiki/Testis). This process starts with the [mitotic division](https://en.m.wikipedia.org/wiki/Mitosis) of the [stem cells](https://en.m.wikipedia.org/wiki/Stem_cell) located close to the basement membrane of the tubules. These cells are called [spermatogonial stem cells](https://en.m.wikipedia.org/wiki/Spermatogonial_Stem_Cells). The mitotic division of these produces two types of cells. Type A cells replenish the stem cells, and type B cells differentiate into primary [spermatocytes](https://en.m.wikipedia.org/wiki/Spermatocyte). The primary spermatocyte divides meiotically ([Meiosis](https://en.m.wikipedia.org/wiki/Meiosis) I) into two secondary spermatocytes; each secondary spermatocyte divides into two equal haploid [spermatids](https://en.m.wikipedia.org/wiki/Spermatids) by Meiosis II. The spermatids are transformed into spermatozoa (sperm) by the process of [spermiogenesis.](https://en.m.wikipedia.org/wiki/Spermiogenesis) These develop into mature spermatozoa, also known as [sperm cells](https://en.m.wikipedia.org/wiki/Sperm). Thus, the primary spermatocyte gives rise to two cells, the secondary spermatocytes, and the two secondary spermatocytes by their subdivision produce four spermatozoa and four haploid cells. Spermatozoa are the mature male [gametes](https://en.m.wikipedia.org/wiki/Gamete) in many sexually reproducing organisms. Thus, spermatogenesis is the male version of [gametogenesis](https://en.m.wikipedia.org/wiki/Gametogenesis). In [mammals](https://en.m.wikipedia.org/wiki/Mammal) it occurs in the [seminiferous tubules](https://en.m.wikipedia.org/wiki/Seminiferous_tubules) of the male [testes](https://en.m.wikipedia.org/wiki/Testes) in a stepwise fashion. Spermatogenesis is highly dependent upon optimal conditions for the process to occur correctly, and is essential for [sexual reproduction](https://en.m.wikipedia.org/wiki/Sexual_reproduction). [DNA methylation](https://en.m.wikipedia.org/wiki/DNA_methylation) and [histone modification](https://en.m.wikipedia.org/wiki/Histone_modification) have been implicated in the regulation of this process. It starts at [puberty](https://en.m.wikipedia.org/wiki/Puberty) and usually continues uninterrupted until death, although a slight decrease can be discerned in the quantity of produced sperm with increase in age.

Spermatogenesis starts in the bottom part of seminiferous tubes and, progressively, cells go deeper into tubes and moving along it until mature spermatozoa reaches the lumen, where mature spermatozoa are deposited. The division happens asynchronically; if the tube is cut transversally one could observe different maturation states. A group of cells with different maturation states that are being generated at the same time is called a spermatogenic wave. Spermatogenesis produces mature male gametes, commonly called *sperm* but more specifically known as *spermatozoa*, which are able to fertilize the counterpart female gamete, the [oocyte](https://en.m.wikipedia.org/wiki/Oocyte), during [conception](https://en.m.wikipedia.org/wiki/Conception_(biology)) to produce a single-celled individual known as a [zygote](https://en.m.wikipedia.org/wiki/Zygote). To preserve the number of chromosomes in the offspring – which differs between [species](https://en.m.wikipedia.org/wiki/Species)– one of each gamete must have half the usual number of chromosomes present in other body cells. Otherwise, the offspring will have twice the normal number of chromosomes, and serious abnormalities may result. In humans, chromosomal abnormalities arising from incorrect spermatogenesis results in congenital defects and abnormal birth defects ([Down syndrome](https://en.m.wikipedia.org/wiki/Down_syndrome), [Klinefelter syndrome](https://en.m.wikipedia.org/wiki/Klinefelter_syndrome)) and in most cases, [spontaneous abortion](https://en.m.wikipedia.org/wiki/Spontaneous_abortion) of the developing fetus

Spermatogenesis takes place within several structures of the [male reproductive system](https://en.m.wikipedia.org/wiki/Male_reproductive_system). The initial stages occur within the testes and progress to the [epididymis](https://en.m.wikipedia.org/wiki/Epididymis) where the developing gametes mature and are stored until [ejaculation](https://en.m.wikipedia.org/wiki/Ejaculation). The [seminiferous tubules](https://en.m.wikipedia.org/wiki/Seminiferous_tubule) of the testes are the starting point for the process, where [spermatogonial stem cells](https://en.m.wikipedia.org/wiki/Spermatogonial_Stem_Cells) adjacent to the inner tubule wall divide in a centripetal direction beginning at the walls and proceeding into the innermost part, or *lumen* to produce immature sperm. Maturation occurs in the epididymis. The location [Testes/Scrotum] is specifically important as the process of spermatogenesis requires a lower temperature to produce viable sperm, specifically 1°-8 °C lower than normal body temperature of 37 °C (98.6 °F. Clinically, small fluctuations in temperature such as from an athletic support strap, causes no impairment in sperm viability or count. For humans, the entire process of spermatogenesis is variously estimated as taking 74 days  and approximately 120 days Including the transport on ductal system, it takes 3 months. Testes produce 200 to 300 million spermatozoa daily. However, only about half or 100 million of these become viable sperm. At all stages of differentiation, the spermatogenic cells are in close contact with Sertoli cells which are thought to provide structural and metabolic support to the developing sperm cells. A single Sertoli cell extends from the basement membrane to the lumen of the seminiferous tubule, although the cytoplasmic processes are difficult to distinguish at the light microscopic level. Sertoli cells serve a number of functions during spermatogenesis, they support the developing gametes in the following ways:

* Maintain the environment necessary for development and maturation, via the [blood-testis barrier](https://en.m.wikipedia.org/wiki/Blood-testis_barrier)
* Secrete substances initiating meiosis
* Secrete supporting testicular fluid
* Secrete [androgen-binding protein](https://en.m.wikipedia.org/wiki/Androgen-binding_protein) (ABP), which concentrates [testosterone](https://en.m.wikipedia.org/wiki/Testosterone) in close proximity to the developing gametes.
* Secrete hormones affecting pituitary gland control of spermatogenesis, particularly the polypeptide hormone, [inhibin](https://en.m.wikipedia.org/wiki/Inhibin).
* Phagocytose residual cytoplasm left over from spermiogenesis.
* Secretion of [anti-Müllerian hormone](https://en.m.wikipedia.org/wiki/Anti-M%C3%BCllerian_hormone) causes deterioration of the Müllerian duct.
* Protect spermatids from the immune system of the male, via the [blood-testis barrier](https://en.m.wikipedia.org/wiki/Blood-testis_barrier)
* Contribute to the [spermatogonial stem cell](https://en.m.wikipedia.org/wiki/Spermatogonial_Stem_Cells) niche.

The process of spermatogenesis is highly sensitive to fluctuations in the environment, particularly [hormones](https://en.m.wikipedia.org/wiki/Hormone) and temperature. Testosterone is required in large local concentrations to maintain the process, which is achieved via the binding of testosterone by [androgen binding protein](https://en.m.wikipedia.org/wiki/Androgen_binding_protein) present in the seminiferous tubules. Testosterone is produced by interstitial cells, also known as [Leydig cells](https://en.m.wikipedia.org/wiki/Leydig_cell), which reside adjacent to the seminiferous tubules. Dietary deficiencies (such as vitamins B, E and A), [anabolic steroids](https://en.m.wikipedia.org/wiki/Anabolic_steroids), metals (cadmium and lead), x-ray exposure, [dioxin](https://en.m.wikipedia.org/wiki/Polychlorinated_dibenzodioxins), alcohol, and infectious diseases will also adversely affect the rate of spermatogenesis. Exposure to pesticides also affects spermatogenesis.

**SEMEN**

[Spermatozoa](https://en.m.wikipedia.org/wiki/Spermatozoon), in this case human, are a primary component in normal semen, and the agents of fertilization of female [ova](https://en.m.wikipedia.org/wiki/Ovum). Semen, also known as seminal fluid, is an organic [fluid](https://en.m.wikipedia.org/wiki/Fluid) that contains [spermatozoa](https://en.m.wikipedia.org/wiki/Spermatozoon). It is secreted by the [gonads](https://en.m.wikipedia.org/wiki/Gonad) (sexual glands) and other sexual organs of [male](https://en.m.wikipedia.org/wiki/Male) or [hermaphroditic](https://en.m.wikipedia.org/wiki/Hermaphrodite) [animals](https://en.m.wikipedia.org/wiki/Animal) and can [fertilize](https://en.m.wikipedia.org/wiki/Fertilization) the [female](https://en.m.wikipedia.org/wiki/Female) [ovum](https://en.m.wikipedia.org/wiki/Ovum). In humans, seminal fluid contains several components besides spermatozoa: proteolytic and other enzymes as well as fructose are elements of seminal fluid which promote the survival of spermatozoa, and provide a medium through which they can move or "swim". Semen is produced and originates from the [seminal vesicle](https://en.m.wikipedia.org/wiki/Seminal_vesicle), which is located in the pelvis. The process that results in the discharge of semen is called [*ejaculation*](https://en.m.wikipedia.org/wiki/Ejaculation). Semen is also a form of genetic material. In animals, semen has been collected for cryoconservation. resources is a practice that calls for the collection of genetic material in efforts for conservation of a particular breed. Depending on the [species](https://en.m.wikipedia.org/wiki/Species), spermatozoa can fertilize ova externally or internally. In [external fertilization](https://en.m.wikipedia.org/wiki/External_fertilization), the spermatozoa fertilize the ova directly, outside of the female's sexual organs. Female [fish](https://en.m.wikipedia.org/wiki/Fish), for example, [spawn](https://en.m.wikipedia.org/wiki/Spawn_(biology)) ova into their aquatic environment, where they are fertilized by the semen of the male fish.

During [internal fertilization](https://en.m.wikipedia.org/wiki/Internal_fertilization), however, fertilization occurs inside the female's sexual organs. Internal fertilization takes place after [insemination](https://en.m.wikipedia.org/wiki/Insemination) of a female by a male through [copulation](https://en.m.wikipedia.org/wiki/Copulation_(zoology)). In most [vertebrates](https://en.m.wikipedia.org/wiki/Vertebrate), including [amphibians](https://en.m.wikipedia.org/wiki/Amphibian), [reptiles](https://en.m.wikipedia.org/wiki/Reptile), [birds](https://en.m.wikipedia.org/wiki/Bird) and [monotreme](https://en.m.wikipedia.org/wiki/Monotreme) mammals, copulation is achieved through the physical mating of the [cloaca](https://en.m.wikipedia.org/wiki/Cloaca) of the male and female. In [marsupial](https://en.m.wikipedia.org/wiki/Marsupial) and [placental mammals](https://en.m.wikipedia.org/wiki/Placentalia), copulation occurs through the [vagina](https://en.m.wikipedia.org/wiki/Vagina). During the process of [ejaculation](https://en.m.wikipedia.org/wiki/Ejaculation), sperm passes through the [ejaculatory ducts](https://en.m.wikipedia.org/wiki/Ejaculatory_duct) and mixes with fluids from the [seminal vesicles](https://en.m.wikipedia.org/wiki/Seminal_vesicle), the [prostate](https://en.m.wikipedia.org/wiki/Prostate), and the [bulbourethral glands](https://en.m.wikipedia.org/wiki/Bulbourethral_gland) to form the semen. The seminal vesicles produce a yellowish viscous fluid rich in fructose and other substances that makes up about 70% of human semen. The prostatic secretion, influenced by dihydrotestosterone, is a whitish (sometimes clear), thin fluid containing proteolytic enzymes, citric acid, acid phosphatase and lipids.[[3]](https://en.m.wikipedia.org/wiki/Semen#cite_note-Mann1954-3) The bulbourethral glands secrete a clear secretion into the lumen of the [urethra](https://en.m.wikipedia.org/wiki/Urethra) to lubricate it. [Sertoli cells](https://en.m.wikipedia.org/wiki/Sertoli_cell), which nurture and support developing [spermatocytes](https://en.m.wikipedia.org/wiki/Spermatocyte), secrete a fluid into seminiferous tubules that helps transport sperm to the genital ducts. The ductuli efferentes possess cuboidal cells with [microvilli](https://en.m.wikipedia.org/wiki/Microvillus) and [lysosomal](https://en.m.wikipedia.org/wiki/Lysosome) granules that modify the ductal fluid by reabsorbing some fluid. Once the semen enters the ductus epididymis the principal cells, which contain [pinocytotic vessels](https://en.m.wikipedia.org/w/index.php?title=Pinocytotic_vessel&action=edit&redlink=1) indicating fluid reabsorption, secrete glycerophosphocholine which most likely inhibits premature [capacitation](https://en.m.wikipedia.org/wiki/Capacitation). The accessory genital ducts, the [seminal vesicle](https://en.m.wikipedia.org/wiki/Seminal_vesicle), [prostate glands](https://en.m.wikipedia.org/wiki/Prostate_gland), and the [bulbourethral glands](https://en.m.wikipedia.org/wiki/Bulbourethral_gland), produce most of the seminal fluid. Seminal plasma of humans contains a complex range of [organic](https://en.m.wikipedia.org/wiki/Organic_compound) and inorganic constituents.

The seminal plasma provides a nutritive and protective medium for the spermatozoa during their journey through the female reproductive tract. The normal environment of the [vagina](https://en.m.wikipedia.org/wiki/Vagina) is a hostile one (c.f. [sexual conflict](https://en.m.wikipedia.org/wiki/Sexual_conflict)) for [sperm](https://en.m.wikipedia.org/wiki/Sperm) cells, as it is very [acidic](https://en.m.wikipedia.org/wiki/Acidic)(from the native microflora producing [lactic acid](https://en.m.wikipedia.org/wiki/Lactic_acid)), viscous, and patrolled by immune cells. The components in the seminal plasma attempt to compensate for this hostile environment. Basic [amines](https://en.m.wikipedia.org/wiki/Amines) such as [putrescine](https://en.m.wikipedia.org/wiki/Putrescine), [spermine](https://en.m.wikipedia.org/wiki/Spermine), [spermidine](https://en.m.wikipedia.org/wiki/Spermidine) and [cadaverine](https://en.m.wikipedia.org/wiki/Cadaverine) are responsible for the smell and flavor of semen. These alkaline bases counteract and buffer the acidic environment of the vaginal canal, and protect [DNA](https://en.m.wikipedia.org/wiki/DNA) inside the [sperm](https://en.m.wikipedia.org/wiki/Sperm) from acidic denaturation. Semen is typically translucent with white, grey or even yellowish tint. Blood in the semen can cause a pink or reddish colour, known as [hematospermia](https://en.m.wikipedia.org/wiki/Hematospermia), and may indicate a medical problem which should be evaluated by a doctor if the symptom persists. After ejaculation, the latter part of the ejaculated semen [coagulates](https://en.m.wikipedia.org/wiki/Coagulation) immediately, forming globules, while the earlier part of the ejaculate typically does not. After a period typically ranging from 15 – 30 minutes, [prostate-specific antigen](https://en.m.wikipedia.org/wiki/Prostate-specific_antigen) present in the semen causes the decoagulation of the seminal coagulum. It is postulated that the initial clotting helps keep the semen in the vagina, while [liquefaction](https://en.m.wikipedia.org/wiki/Liquification) frees the sperm to make their journey to the ova. The components and contributions of semen are as follows:

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| --- | --- | --- |
| Gland(s) | Approximate fraction | Description |
| [testes](https://en.m.wikipedia.org/wiki/Testes) | 2–5% | Approximately 200 million – 500 million spermatozoa (also called *sperm* or *spermatozoans*), produced in the [testes](https://en.m.wikipedia.org/wiki/Testes), are released per ejaculation. If a man has undergone a [vasectomy](https://en.m.wikipedia.org/wiki/Vasectomy), he will have no sperm in the ejaculation. |
| [seminal vesicles](https://en.m.wikipedia.org/wiki/Seminal_vesicles) | 65–75% | [Amino acids](https://en.m.wikipedia.org/wiki/Amino_acids), [citrate](https://en.m.wikipedia.org/wiki/Citrate), [enzymes](https://en.m.wikipedia.org/wiki/Enzyme), [flavins](https://en.m.wikipedia.org/wiki/Flavin_group), [fructose](https://en.m.wikipedia.org/wiki/Fructose)(2–5 mg per mL semen, the main energy source of sperm cells, which rely entirely on sugars from the seminal plasma for energy), [phosphorylcholine](https://en.m.wikipedia.org/wiki/Phosphorylcholine), [prostaglandins](https://en.m.wikipedia.org/wiki/Prostaglandin)(involved in suppressing an immune response by the female against the foreign semen), [proteins](https://en.m.wikipedia.org/wiki/Protein), [vitamin C](https://en.m.wikipedia.org/wiki/Vitamin_C). |
| [Prostate](https://en.m.wikipedia.org/wiki/Prostate) | 25–30% | [Acid phosphatase](https://en.m.wikipedia.org/wiki/Acid_phosphatase), [citric acid](https://en.m.wikipedia.org/wiki/Citric_acid), [fibrinolysin](https://en.m.wikipedia.org/wiki/Fibrinolysin), [prostate specific antigen](https://en.m.wikipedia.org/wiki/Prostate_specific_antigen), [proteolytic enzymes](https://en.m.wikipedia.org/wiki/Proteolytic_enzyme), [zinc](https://en.m.wikipedia.org/wiki/Zinc). (The zinc level is about 135±40/mL for healthy men. Zinc serves to help to stabilize the DNA-containing [chromatin](https://en.m.wikipedia.org/wiki/Chromatin) in the sperm cells. A zinc deficiency may result in lowered fertility because of increased sperm fragility. Zinc deficiency can also adversely affect [spermatogenesis](https://en.m.wikipedia.org/wiki/Spermatogenesis).) |
| [Bulbourethral glands](https://en.m.wikipedia.org/wiki/Bulbourethral_glands) | < 1% | [Galactose](https://en.m.wikipedia.org/wiki/Galactose), [mucus](https://en.m.wikipedia.org/wiki/Mucus)(serve to increase the mobility of sperm cells in the vagina and cervix by creating a less viscous channel for the sperm cells to swim through, and preventing their diffusion out of the semen. Contributes to the cohesive jelly-like texture of semen), [pre-ejaculate](https://en.m.wikipedia.org/wiki/Pre-ejaculate), [sialic acid](https://en.m.wikipedia.org/wiki/Sialic_acid). |

A review found that the average reported viscosity of human semen in the literature was 3–7 cP. Semen quality is a measure of the ability of semen to accomplish fertilization. Thus, it is a measure of fertility in a man. It is the sperm in the semen that is the fertile component, and therefore semen quality involves both sperm quantity and sperm quality.