

## Chapter- 2 – Reproduction in Plants and Animals

### STUDY MATERIAL- 6

#### DOUBLE FERTILIZATION IN ANGIOSPERMS

The process of fusion of male gamete with the female gamete to form zygote ( $2n$ ) is known as fertilisation.

The fusion of one male gamete with egg and that of another male gamete with a secondary nucleus is called **double fertilisation**. It is the characteristic feature of only angiosperms. All angiosperms are characterised by a unique process called double fertilisation.

Double fertilisation is significant because it involves the use of both the male gametes produced by a pollen grain. It consists of two fusions and results in the formation of two products.

1. **First fertilisation** involves the fusion of one male gamete with the egg cell which result in a **zygote**. The zygote develops into an embryo which subsequently develops into a new plant.
2. **Second fertilisation** involves the fusion of the second male gamete with two polar nuclei and the product is **PEN** (Primary endosperm nucleus), which develops to form a nutritive tissue called endosperm for developing an embryo.

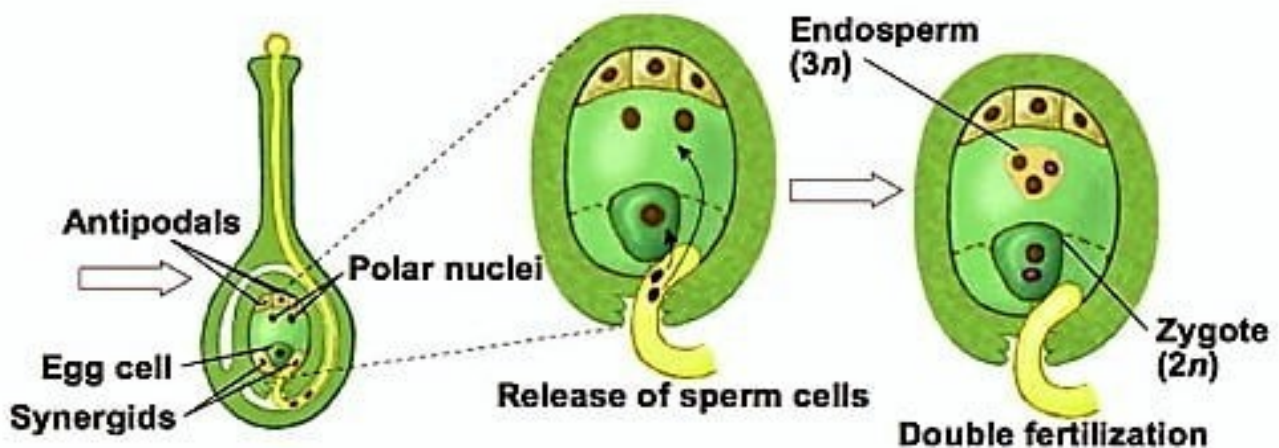
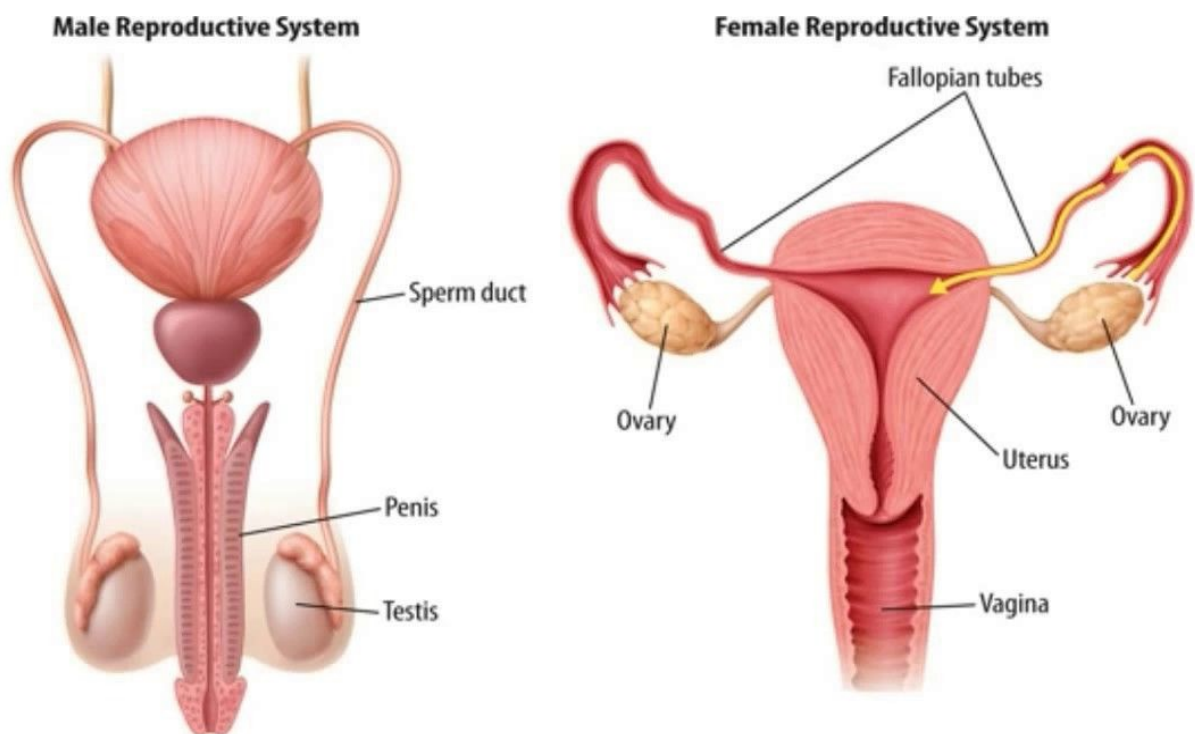


Fig: Double fertilization in angiosperms

# **REPRODUCTION IN HUMANS**

The organs of the reproductive system are divided into the primary and accessory parts.

1. The primary reproductive parts include the gonads (testes in males and ovaries in females) which produce the sex cells (or gametes) the sperms and eggs.
2. The accessory reproductive parts include all those structures which help in the transfer and meeting of two kinds of sex cells leading to fertilization and in the growth and development of the egg up to the birth of the baby.



The organs of the male reproductive system produce sperm and deliver it to the female reproductive system.

The female reproductive system produces eggs and provides a place for a new human to grow and develop before birth.

## **MALE REPRODUCTIVE SYSTEM**

The organs of the male reproductive system are specialized for the following functions:

- To produce, maintain and transport sperm (the male reproductive cells) and protective fluid (semen)
- To produce and secrete male sex hormones

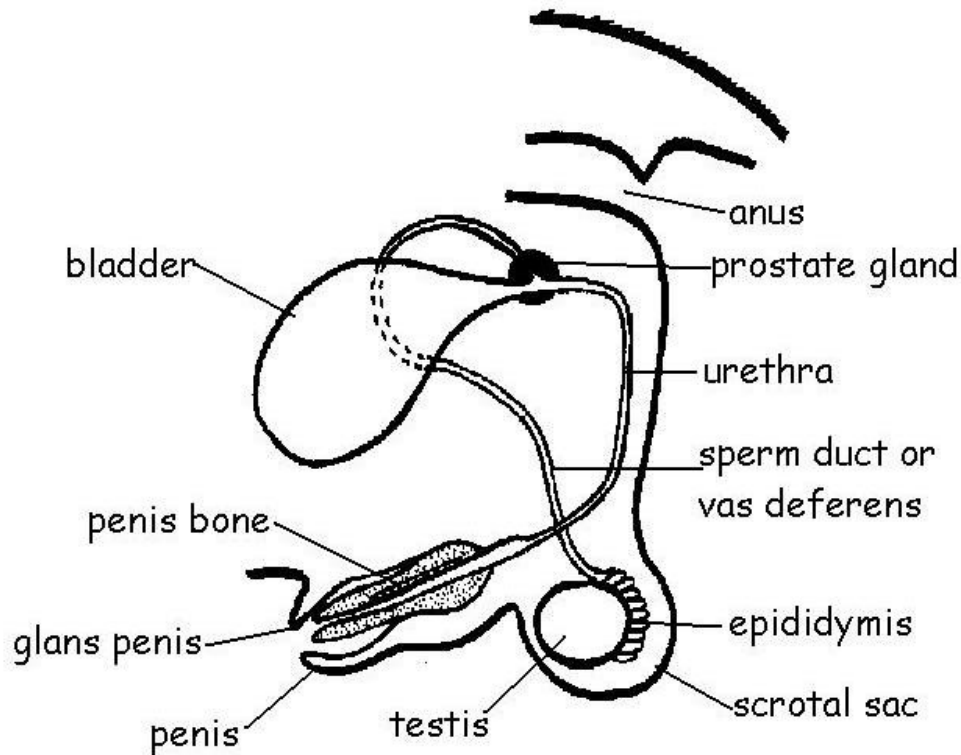


Fig: Male Reproductive System

## 1. TESTIS

The testes are oval bodies that average about 1.5 to 3 inches (4 to 7 centimetres) in length. The testes have two primary functions:

- Producing sperm
- Producing testosterone (the primary male sex hormone)

During the last two months before birth, or shortly after birth, they descend into the scrotum, a pouch that extends below the abdomen, posterior to the penis. Although this location of the testes, outside the abdominal cavity, may seem to make them vulnerable to injury, it provides a temperature about 3° C below normal body temperature. This lower temperature is necessary for the production of viable sperm.

## **2. SCROTUM**

This is the loose pouch-like sac of skin that hangs behind and below the penis. It contains the testicles (also called testes), as well as many nerves and blood vessels. The scrotum acts as a "climate control system" for the testes. For normal sperm development, the testes must be at a temperature slightly cooler than body temperature. Special muscles in the wall of the scrotum allow it to contract and relax, moving the testicles closer to the body for warmth or farther away from the body to cool the temperature.

## **3. EPIDIDYMIS**

The epididymis is a long, coiled tube that rests on the backside of each testicle. It functions in the carrying and storage of the sperm cells that are produced in the testes. It also is the job of the epididymis to bring the sperm to maturity, since the sperm that emerge from the testes are immature and incapable of fertilization. During sexual arousal, contractions force the sperm into the vas deferens.

## **4. VAS DEFERENS**

The vas deferens is a long, muscular tube that travels from the epididymis into the pelvic cavity, to just behind the bladder. The vas deferens transports mature sperm to the urethra in preparation for ejaculation.

## **5. URETHRA**

The urethra is the tube that carries urine from the bladder to outside of the body. In males, it has the additional function of expelling (ejaculating) semen when the man reaches orgasm. When the penis is erect during sex, the flow of urine is blocked from the urethra, allowing only semen to be ejaculated at orgasm.

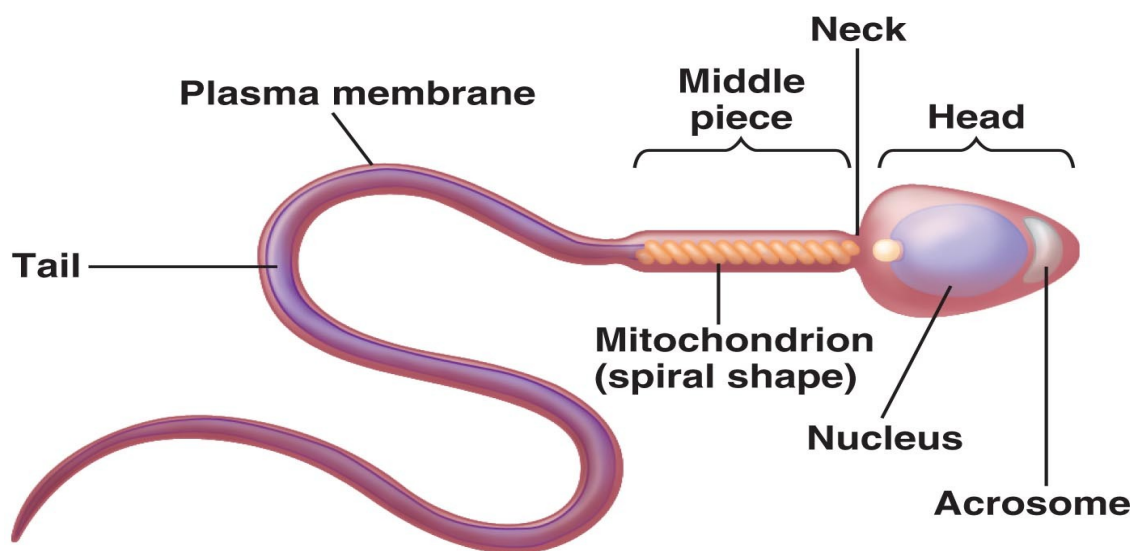
## **6. PENIS**

The penis and the urethra are part of the urinary and reproductive systems. Penis is the muscular, copulatory organ and also discharge sperms when stimulated.

## ACCESSORY GLANDS

- **SEMINAL VESICLES** — the seminal vesicles are sac-like pouches that attach to the vas deferens near the base of the bladder. The seminal vesicles produce a sugar-rich fluid (fructose) that provides sperm with a source of energy and helps with the sperms' motility (ability to move). The fluid of the seminal vesicles makes up most of the volume of a man's ejaculatory fluid, or ejaculate.
- **PROSTATE GLAND** — the prostate gland is a walnut-sized structure that is located below the urinary bladder in front of the rectum. The prostate gland contributes additional fluid to the ejaculate. Prostate fluids also help to nourish the sperm. The urethra, which carries the ejaculate to be expelled during orgasm, runs through the centre of the prostate gland.
- **BULBOURETHRAL GLANDS** — the bulbourethral glands or Cowper's glands, are pea-sized structures located on the sides of the urethra just below the prostate gland. These glands produce a clear, slippery fluid that empties directly into the urethra. This fluid serves to lubricate the urethra and to neutralize any acidity that may be present due to residual drops of urine in the urethra.

## STRUCTURE OF SPERMS



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Fig: Sperm Cell

Sperm cells are gametes (sex cells) that are produced in the testicular organ (gonad) of male human beings and animals.

Like the female gamete (Oocyte), sperm cells carry a total of 23 chromosomes that are a result of a process known as meiosis. In both animals and human beings, among many other organisms, these cells are involved in the sexual mode of reproduction which involves the interaction of male and female gametes.

The final step in the development of sperm is called spermiogenesis. In this process, the spermatids formed from spermatogenesis become mature spermatozoa, or sperm.

A sperm cell consists of a head, body (mid-section) and a tail. Each of these parts is equipped with various molecules and smaller structure that allow the sperm as a whole to function properly.

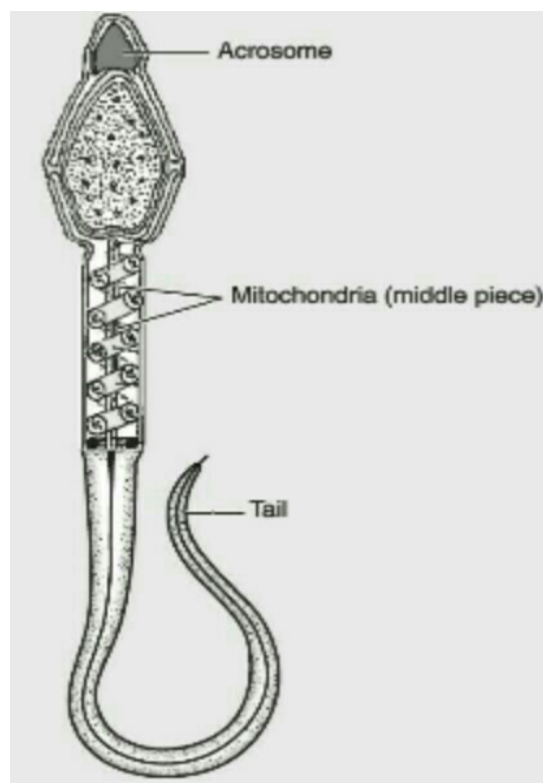


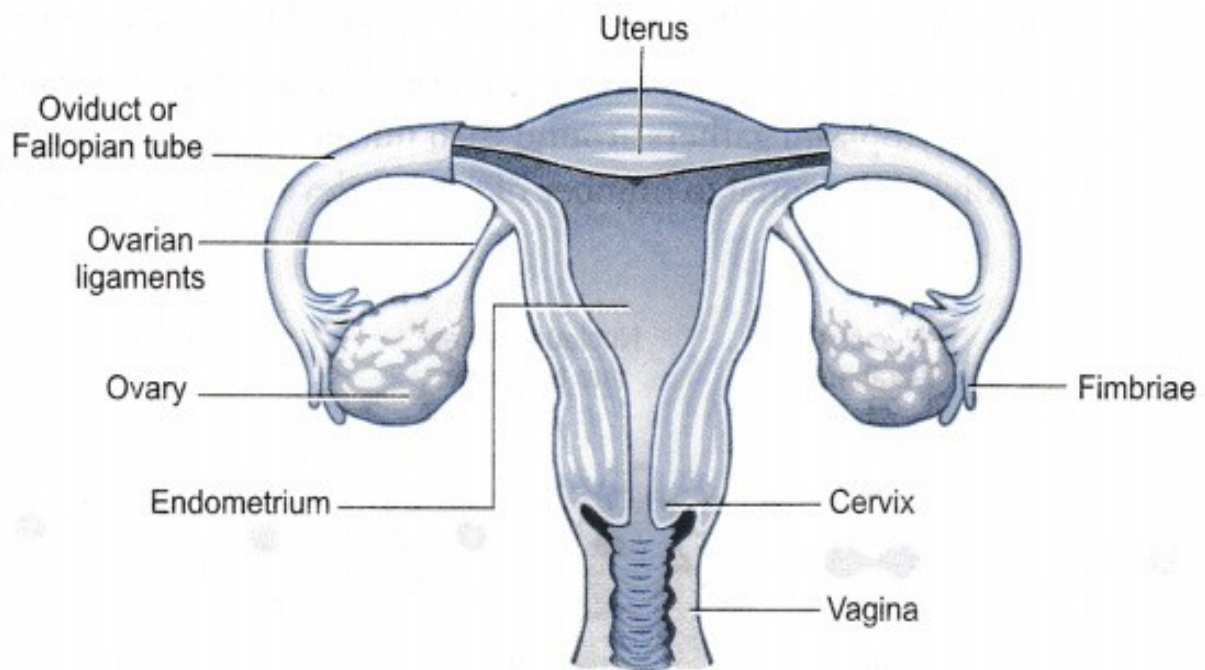
Fig: Parts of a sperm cell

The head, also called the nuclear region, contains the 23 chromosomes surrounded by a nuclear membrane. The tip of the head is covered by an acrosome, which contains enzymes that help the sperm penetrate the female gamete.

The midpiece, metabolic region, contains mitochondria that provide adenosine triphosphate

The tail or locomotor region, uses a typical flagellum for locomotion.

## **FEMALE REPRODUCTIVE SYSTEM**



**Fig: Female Reproductive System**

### **1. OVARY**

The primary female reproductive organs, or gonads, are the two ovaries. Each ovary is a solid, ovoid structure about the size and shape of an almond, about 3.5 cm in length, 2 cm wide, and 1 cm thick.

- They also produce ova (singular-ovum), the female gametes.
- Ovaries produce female sex hormones such as oestrogen and progesterone

Ova are produced from oocyte cells that slowly develop throughout a woman's early life and reach maturity after puberty. Each month during ovulation, a mature ovum is released. The ovum travels from the ovary to the fallopian tube, where it may be fertilized before reaching the uterus.

## 2. FALLOPIAN TUBES

These are narrow tubes that are attached to the upper part of the uterus and serve as pathways for the ova (egg cells) to travel from the ovaries to the uterus. Fertilization of an egg by a sperm normally occurs in the fallopian tubes. The fertilized egg then moves to the uterus, where it implants to the uterine lining.

The fallopian tubes end in a funnel-shaped structure called the infundibulum, which is covered with small finger-like projections called fimbriae. The fimbriae swipe over the outside of the ovaries to pick up released ova and carry them into the infundibulum for transport to the uterus. The inside of each fallopian tube is covered in cilia that work with the smooth muscle of the tube to carry the ovum to the uterus.

## 3. UTERUS

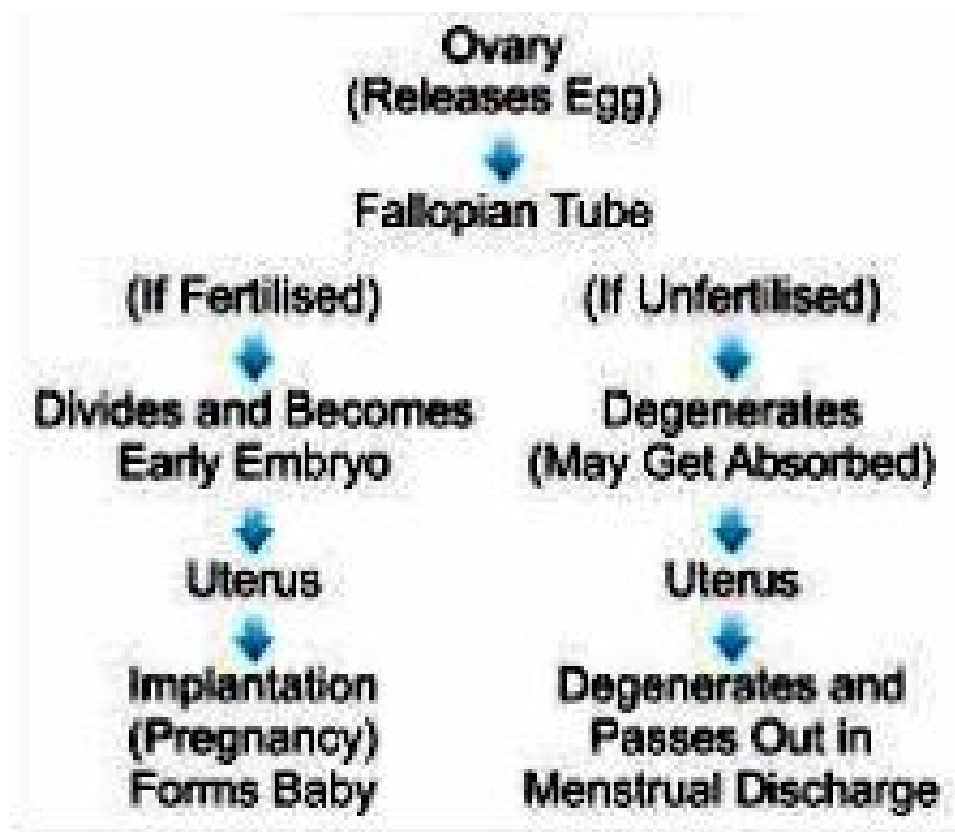
The uterus is a hollow, muscular, pear-shaped organ located posterior and superior to the urinary bladder. Connected to the two fallopian tubes on its superior end and to the vagina (via the cervix) on its inferior end, the uterus is also known as the womb, as it surrounds and supports the developing foetus during pregnancy. The inner lining of the uterus, known as the endometrium, provides support to the embryo during early development. The visceral muscles of the uterus contract during childbirth to push the foetus through the birth canal.

## 4. VAGINA

The vagina is also known as the birth canal. The **vagina** is an elastic, muscular tube that connects the cervix of the uterus to the exterior of the body. It is located inferior to the uterus and posterior to the urinary bladder. The vagina functions as the receptacle for the penis during sexual intercourse and carries sperm to the uterus and fallopian tubes. It also serves as the birth canal by stretching to allow delivery of the foetus during childbirth. During menstruation, the menstrual flow exits the body via the vagina.



## THE COURSE AND FATE OF EGG INSIDE FEMALE BODY



If there is no fertilization, the egg disintegrates and the uterine lining starts shedding on the 28<sup>th</sup> day (menstruation).

On the other hand if the egg is fertilized, it gets implanted or fixed in the wall of the uterus and there is no menstrual discharge.

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