

A sperm cell with a long tail and a head, and a large, textured egg cell, both glowing with a blue and purple aura against a dark blue background with small white stars.

# 6

## REPRODUCTIVE SYSTEM



### Students Learning Outcomes

After studying this chapter, students will be able to:

- Describe the role of hormones in both male and female sexual development.
- Describe the process of gametogenesis and fertilization.
- Identify, on diagrams of the parts of male reproductive system and describe their functions.
- Identify, on diagrams of the parts of female reproductive system and describe their functions.
- Explain AIDS as an example of sexually transmitted diseases.

All organisms have the ability to produce new individual or their kind. **Sexual reproduction** involves the joining (fusion) of male and female gametes.

### 6.1 FORMATION OF GAMETES AND FERTILIZATION

Animals have special organs i.e., gonads where special cells called gametes are made. The gonads in male animals are called testes (Singular: testis) where male gametes i.e., sperms are produced. The gonads in female animals are

called ovaries where female gametes i.e., egg cells or ova are produced.

## Formation of Gametes

The process of formation of gametes is called **gametogenesis**. It involves the cell division meiosis. Meiosis results in a reduction of the number of chromosomes in gametes to haploid ( $1n$ ) as compared to the diploid ( $2n$ ) number in other body cells.

### (a) Formation of Male Gametes

The formation of male gametes (sperms) is called **spermatogenesis**. This process occurs in **seminiferous tubules** of testes. Follicle stimulating hormone (FSH) along with the male sex hormone i.e., testosterone stimulate sperm production. FSH is produced by the anterior pituitary gland while testosterone is produced by testes.

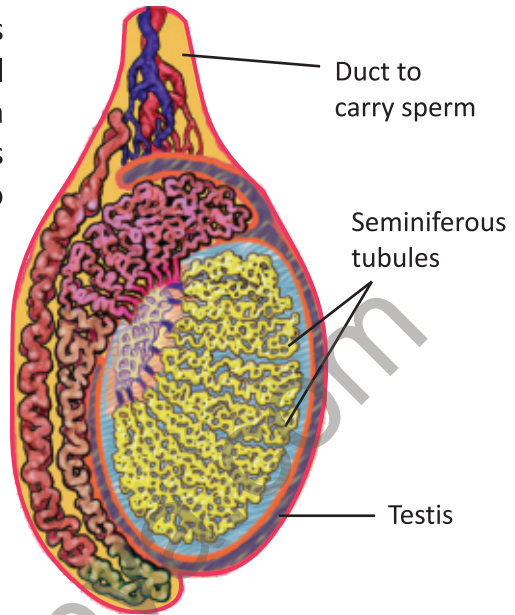


FIGURE 6.1: A testis

In seminiferous tubules, the diploid gamete mother cells, called **primary spermatocytes** are present. Each primary spermatocyte divides by meiosis-I and forms two haploid secondary spermatocytes. Each secondary spermatocyte divides by meiosis-II. In this way, four haploid **spermatids** are formed. These are immature sperms. Changes occur in spermatids and they mature into motile **sperms**.

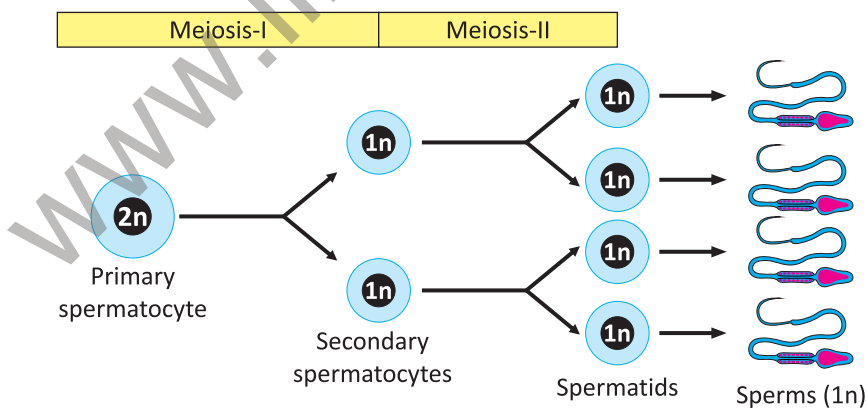


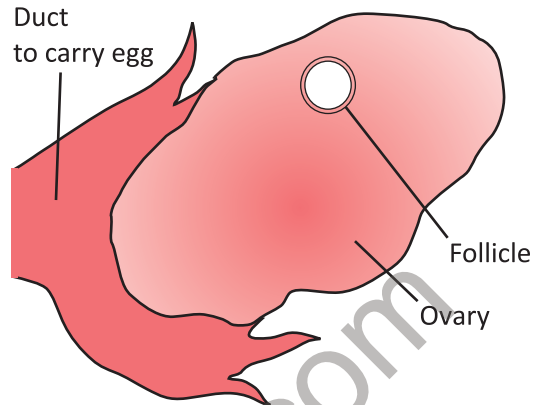
Figure 6.2: Spermatogenesis

### (b) Formation of Female Gametes

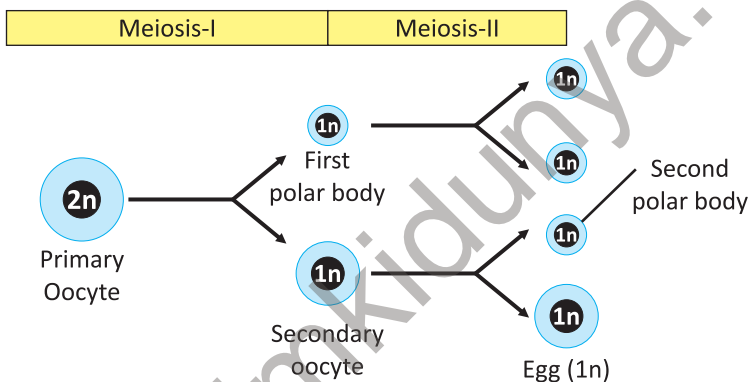
The formation of female gametes (egg or ovum) is called **oogenesis**. It

occurs in ovary in a small, fluid-filled sac called **follicle**. Follicle stimulating hormone released by the anterior lobe of pituitary gland stimulates the formation of ovum in follicle.

In follicle, there is a diploid gamete mother cell called **primary oocyte**. It divides by meiosis. As a result of first meiotic division, two haploid cells are produced. The larger cell is called **secondary oocyte** while the smaller cell is called **first polar body**. In meiosis II, secondary oocyte produces two haploid cells i.e., a **second polar body** and an **egg**.



**FIGURE 6.3:** An ovary

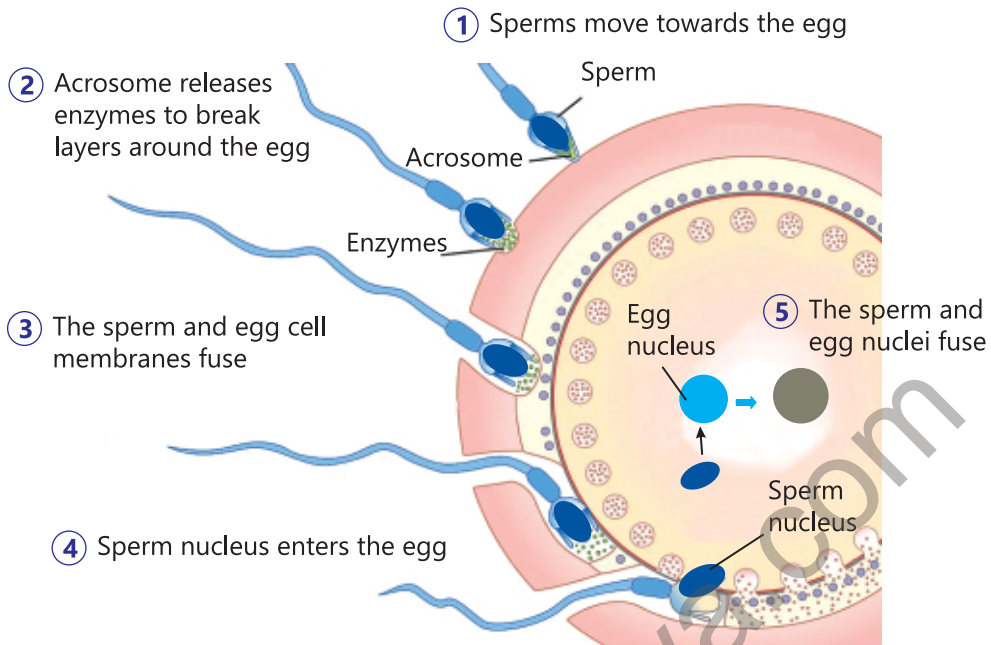


**FIGURE 6.4:** Oogenesis

## Fertilization

Fertilization means the fusion of male and female gametes to form a new cell, called zygote. In humans, fertilization occurs inside the body of female after the release of egg cell from ovary i.e., **ovulation**. Fertilization occurs in the following steps:

1. Sperms move towards the egg due to the chemical signals released by the egg or surrounding cells.
2. The acrosome, a cap-like structure on the head of the sperm, releases enzymes which digest the egg's outer layers, allowing the sperm to reach the egg cell membrane.
3. The sperm and egg cell membranes fuse. This fusion triggers reactions in egg. So, the egg's outer layers become impermeable for more sperms.



**FIGURE 6.5: Steps of fertilization**

4. After fusion of membranes, the sperm nucleus enters the egg.
5. Both nuclei fuse to form a diploid zygote.

## 6.2 > ROLE OF HORMONES IN SEXUAL DEVELOPMENT

### Hormones in Male Sexual Development

**1- Testosterone:** It is primarily produced by the testes. It initiates and regulates the development of male secondary sexual characteristics during puberty, such as deepening of the voice, growth of facial and body hair, and increased muscle mass. It is also essential for spermatogenesis.

**2- Follicle-Stimulating Hormone (FSH):** In males, it is produced by the anterior pituitary gland. It stimulates the testes to produce sperm.

**3- Luteinizing Hormone (LH):** It is produced by the anterior pituitary gland. It stimulates the production of testosterone by the testes.

**4- Gonadotropin-Releasing Hormone (GnRH):** It is released by hypothalamus. It stimulates the pituitary to release LH and FSH.

### Hormones in Female Sexual Development

**1- Oestrogen:** It is primarily produced by the ovaries. It initiates and regulates the development of female secondary sexual characteristics during puberty, such as breast development, widening of the hips, and the onset of

menstrual cycles. It also regulates the female reproductive cycle.

**2- Progesterone:** It is produced by the ovaries after ovulation. It prepares the uterus walls for implantation of fertilized egg. It maintains pregnancy by preventing contractions of the uterus.

**3- Follicle-Stimulating Hormone (FSH):** It is released from anterior pituitary gland. In females, it stimulates the growth of follicles, which contain the eggs. It also stimulates the production of oestrogen.

**4- Luteinizing Hormone (LH):** In females, it triggers ovulation (the release of an egg from the ovary) and stimulates the production of progesterone.

**5- Gonadotropin-Releasing Hormone (GnRH):** In females, it stimulates the pituitary to release LH and FSH.

## 6.3 REPRODUCTIVE SYSTEMS

### Male Reproductive System

It consists of the following parts:

**Testes:** Pair of oval-shaped glands that produce sperm and the male hormone testosterone.

The average male produces around 1,500 sperm per second — that's over 100 million per day!

**Epididymis:** A long, coiled tube attached to each testis where sperm are stored and matured.

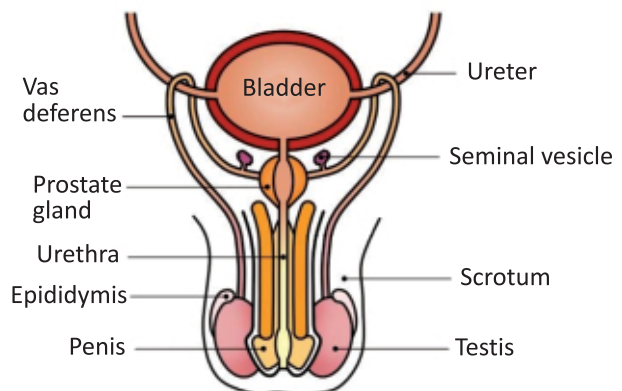
**Vas deferens:** A muscular tube that transports mature sperm from the epididymis to the urethra.

**Seminal vesicles:** Two small glands behind the bladder that produce a sugary fluid to nourish sperm.

**Prostate gland:** A walnut-sized gland below the bladder that adds protective fluid to the semen.

**Urethra:** A tube inside the penis that carries semen and urine to the outside of the body

**Penis:** An external organ that transfers sperm into female reproductive tract.



**FIGURE 6.6: Male reproductive system**

## Female Reproductive System

It consists of the following main parts:

**Ovaries:** Pair of almond-shaped glands that produce eggs (ova) and hormones like oestrogen and progesterone.

**Fallopian Tubes:** Two tubes that transport eggs from the ovaries to the uterus. Fertilization occurs here.

**Uterus:** A hollow, muscular organ where a fertilized egg implants and develops into a foetus during pregnancy.

**Cervix:** The lower, narrow part of the uterus.

**Vagina:** A muscular canal that connects the cervix to the outside.

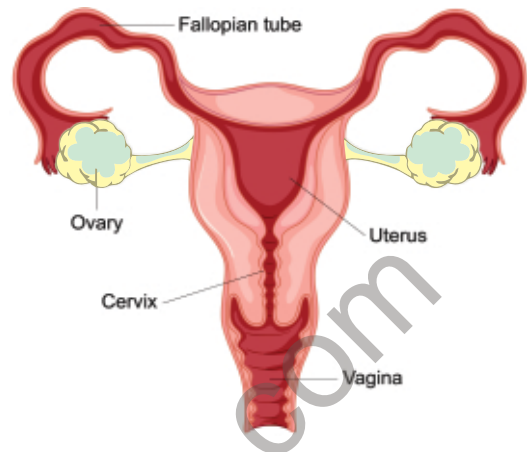


FIGURE 6.7: Female reproductive system

## 6.4 SEXUALLY TRANSMITTED DISEASES

Sexually transmitted diseases (STDs) are the infections which are primarily transmitted through sexual contact. These diseases can be caused by bacteria, viruses, or parasites. STDs often affect the genital, urinary, and reproductive organs. Common STDs include HIV/AIDS, syphilis, herpes etc. Many STDs can be asymptomatic, meaning individuals may carry and spread the infection without showing signs. If STDs are left untreated, they can lead to serious health complications such as infertility, organ damage, and other infections.

Low awareness about STDs, especially in rural areas, of Pakistan often leads to delayed treatment and serious complications like infertility.

### Acquired Immunodeficiency Syndrome (AIDS)

AIDS is a serious and life-threatening disease caused by the Human Immunodeficiency Virus (HIV). HIV primarily attacks and weakens the body's immune system, making it difficult to fight infections and certain cancers.

In Pakistan, HIV cases are increasing, particularly due to unsafe injections, unregulated blood transfusions, and lack of awareness among youth.

**Causes:** The HIV spreads mainly through sexual contact, sharing of contaminated needles, transfusion of infected blood, and from an infected mother to her child during childbirth or breastfeeding.

**Signs and Symptoms:** Early signs and symptoms are fever, fatigue, swollen

lymph nodes, and skin rashes. As the disease progresses, individuals become vulnerable to severe infections, weight loss, chronic diarrhoea, pneumonia, and certain cancers.

**Treatment:** There is no cure for AIDS. Antiretroviral therapy (ART) can control the virus, strengthen the immune system, and help patients live longer, healthier lives.



## EXERCISE

### A. Select the correct answers for the following questions.

- In which part of the body oogenesis takes place?**
  - Oviduct
  - Ovary
  - Uterus
  - Fallopian tube
- Which of the following is NOT a part of the male reproductive system?**
  - Testes
  - Uterus
  - Epididymis
  - Prostate gland
- Which hormone directly triggers ovulation?**
  - Oestrogen
  - Progesterone
  - Luteinizing hormone (LH)
  - Follicle-stimulating hormone (FSH)
- Which hormone is responsible for the development of male secondary sexual characteristics?**
  - Follicle Stimulating Hormone
  - Oestrogen
  - Testosterone
  - Leutinizing Hormone
- What is the function of a crosome?**
  - Guides the sperm towards egg cell
  - Releases enzymes that help sperm penetrate the egg's outer layers
  - Activates the egg for fertilization
  - Helps in the fusion of sperm and egg nuclei
- What is the function of the Fallopian tubes?**
  - Site of fertilization
  - Storage of eggs
  - Secretion of oestrogen
  - Transport of sperm to testes



- ii. Spermatogenesis and oogenesis
- iii. Spermatocyte and oocyte

**C. Write answers in detail.**

1. Describe the role of hormones in male sexual development.
2. Describe the role of hormones in female sexual development.
3. Describe the process of spermatogenesis.
4. Describe the functions of the major parts of male reproductive system.
5. Describe the functions the parts of female reproductive system.
6. Explain AIDS as an example of sexually transmitted diseases.

**D. Inquisitive questions**

1. Why only one egg is usually produced from one primary oocyte?
2. How does the structure of a sperm cell relate to its function?
3. What steps can individuals take to prevent HIV transmission?