

Name: _____ () Class: _____ Date: _____

JURONG WEST SECONDARY SCHOOL
SECONDARY FOUR – SCIENCE (BIOLOGY) (5088)

Chapter 12: Reproduction in Human

Learning Outcomes:

- define **sexual reproduction** as the process involving the **fusion of nuclei of male and female gametes** to form a **zygote** and the production of **genetically dissimilar** offspring
- identify** the male reproductive system and **state the functions** of: testes, scrotum, sperm ducts, prostate gland, urethra and penis
- identify** the female reproductive system and **state the functions** of: ovaries, oviducts, uterus, cervix and vagina
- outline the menstrual cycle** with reference to the alternation of menstruation and ovulation, the natural variation in its length, and the fertile and infertile phases of the cycle with reference to the effects of progesterone and oestrogen only
- describe **fertilisation** and **early development of the zygote** simply in terms of the formation of a ball of cells which becomes implanted in the wall of the uterus
- discuss the transmission of **human immunodeficiency virus (HIV)** and methods to reduce transmission

(a) define *sexual reproduction* as the process involving the fusion of nuclei of male and female gametes to form a zygote and the production of genetically dissimilar offspring

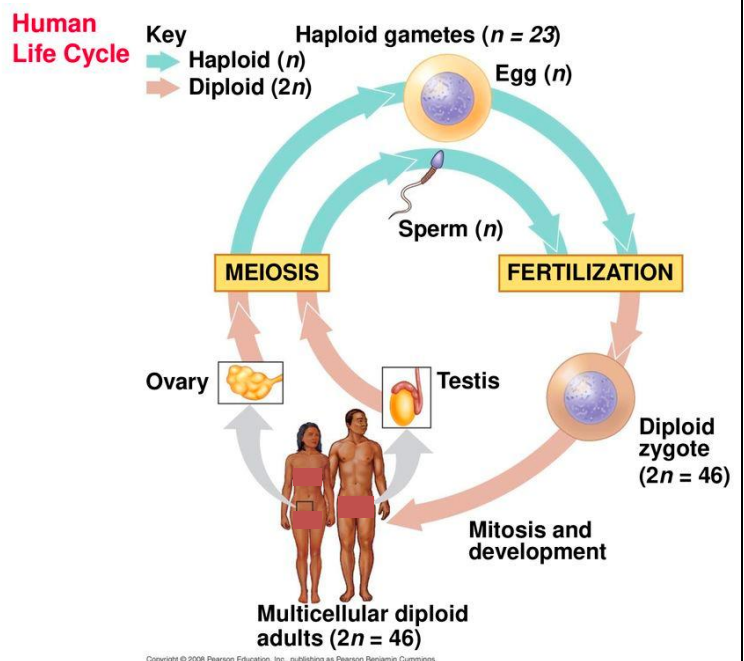
Sexual reproduction is a process involving the **fusion** of **nuclei** of male and female **gametes** (sex cells) to form a **zygote** and the production of genetically **dissimilar** offspring.

Gametes in Humans

- Male gametes – **Sperm**
- Female gametes – **Egg (ovum)**
- Produced in the respective reproductive organs
 - Testes** in male,
 - Ovaries** in female
- Gametes contain **half the number of chromosomes (haploid)** as compared to the normal body cell (**diploid**)

Examples

- 46 chromosomes in normal human cell, gametes contain 23 chromosomes**
- 78 chromosomes in normal chicken cell, gametes contain 39 chromosomes**
- 18 chromosomes in normal radish cell, gametes contain 9 chromosomes**



Fertilisation of gametes

- **Nucleus** of **sperm** (23 chromosomes) fuses with **nucleus** of **ovum** (23 chromosomes) to form a **zygote** (46 chromosomes)
- The **zygote** undergoes **normal cell division (mitosis)** to form **embryo** then the **foetus** and finally a **baby**
- All cells in the baby contain **46 chromosomes**



Why should gametes be haploid?

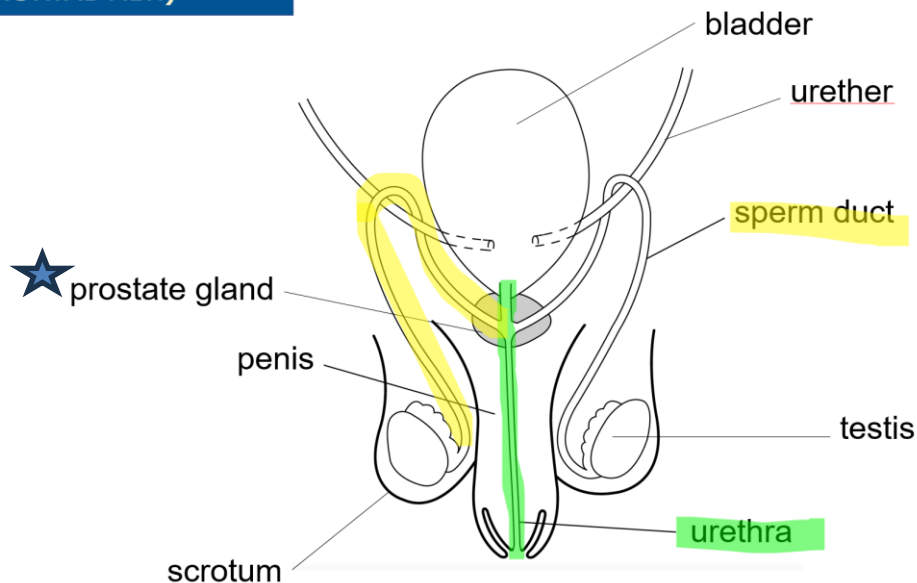


So that after each fertilisation event, the number of chromosomes does not double, and the diploid number of chromosomes is restored.

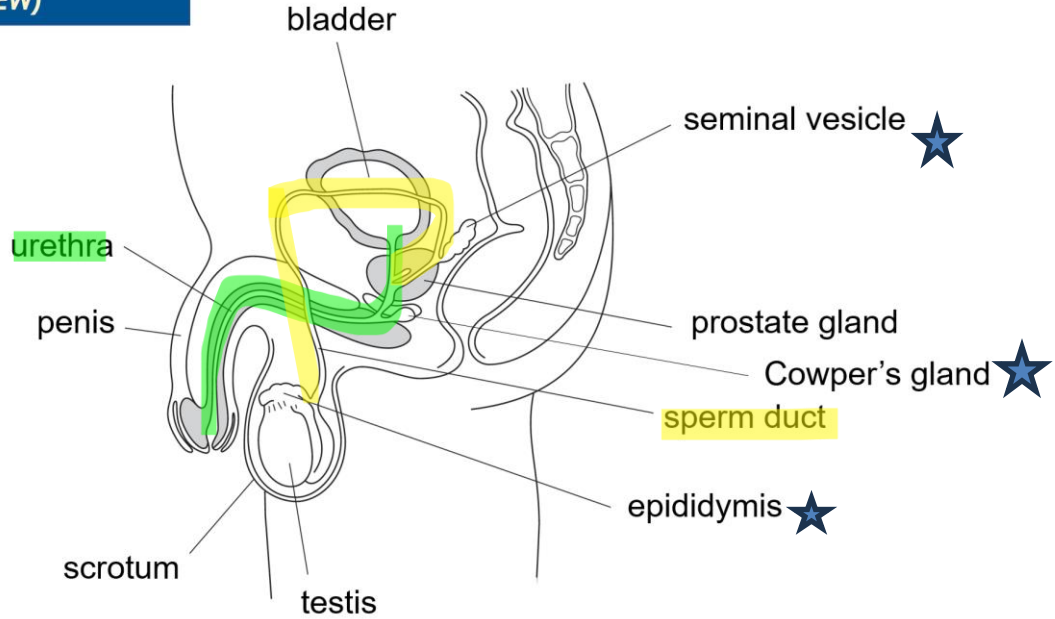
(b) identify the male reproductive system and state the functions of: testes, scrotum, sperm ducts, prostate gland, urethra and penis

1. Male Reproductive System

MALE REPRODUCTIVE SYSTEM (FRONTAL VIEW)



MALE REPRODUCTIVE SYSTEM (SIDE VIEW)

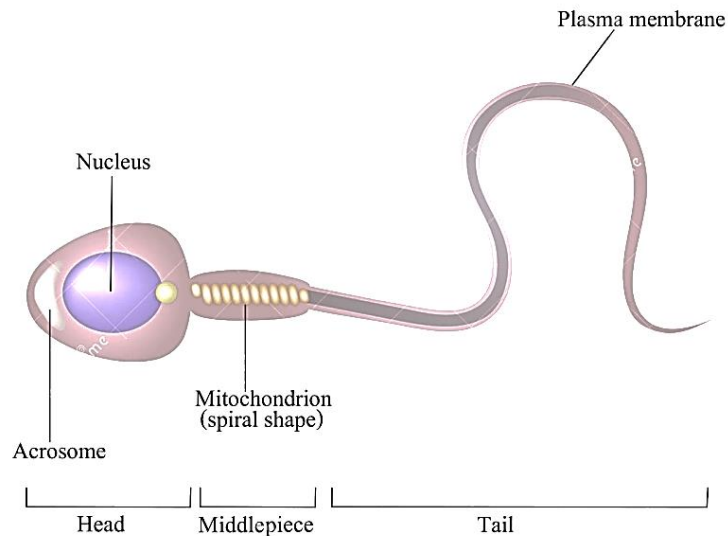


I. Parts and Functions of the Male Reproductive Parts

Parts	Functions
Testis (plural: testes)	- There are 2 testes Produces sperm Produces male hormones such as testosterone, which maintain development and maintenance of secondary sexual characteristics in males.
Scrotum	- The testes lies between the thighs in a pouch-like sac called scrotum - Scrotum lies outside the human body. <i>Why does the testes need to be outside the body?</i> They are outside the abdominal cavity to maintain a lower temperature, crucial for sperm development
Epididymis	Stores inactive sperms from the testes for several days - During ejaculation, sperms are forcefully expelled from epididymis to the sperm duct which travels behind the bladder and is joined by the seminal vesicle, and then exits the penis through the urethra.
Sperm Duct	- Also known as vas deferens - During ejaculation, the sperm cells from the epididymis are propelled through the sperm duct (see epididymis)
Glands: 1. Prostate gland 2. Cowper's gland 3. Seminal vesicle	- The glands secrete a fluid which mixes with the sperms → form semen - Fluid contains nutrients and enzymes: nourish the sperms and stimulates them to swim actively

Urethra	- A tube that passes from the bladder through the center of the penis to the outside of the body - Both semen and urine pass out of the body through the urethra
Penis	- An erectile organ Deposits sperms into vagina of the female during sexual intercourse

II. Parts and Function of the Male Gametes



- Also called spermatozoa
- Numerous sperms are produced throughout the life of a matured male human

Structure of sperm

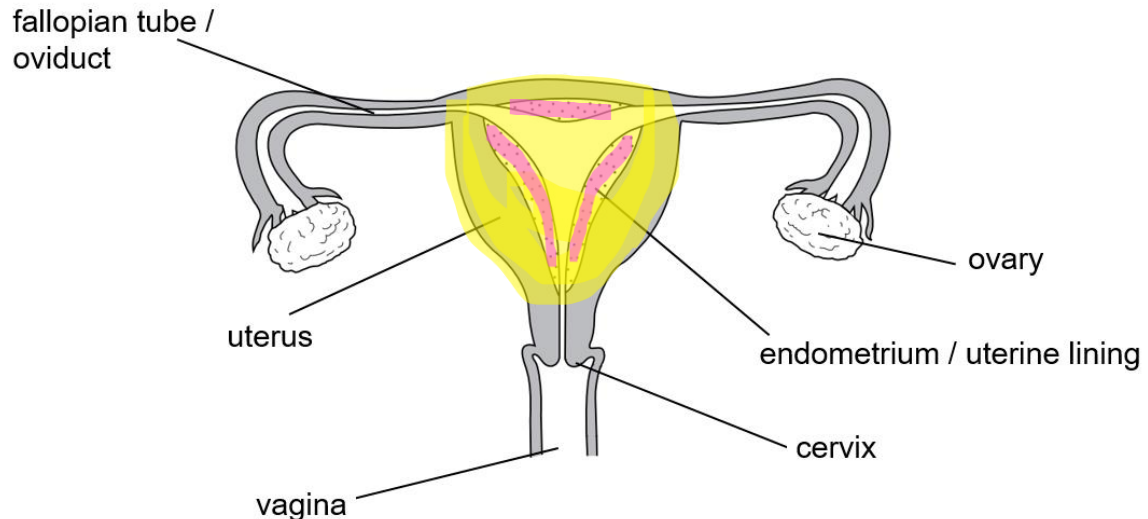
- Made up of three parts: Head, Middle piece and the Tail
 - Head**
 - Contains nucleus which carries haploid set of chromosomes (23 chromosomes in human sperm cell)
 - ★ **Acrosome** in head is a **vesicle** containing **enzymes** that breaks down part of egg membrane during fertilization so that the sperm can penetrate the egg
 - Middle piece**
 - Contains numerous **mitochondria** to **release energy** for sperm to swim towards egg
 - Tail (flagellum)**
 - Enables the sperm to swim towards the egg
 - Sperm is **motile** (can move on its own)



Can you describe the pathway taken by a sperm?

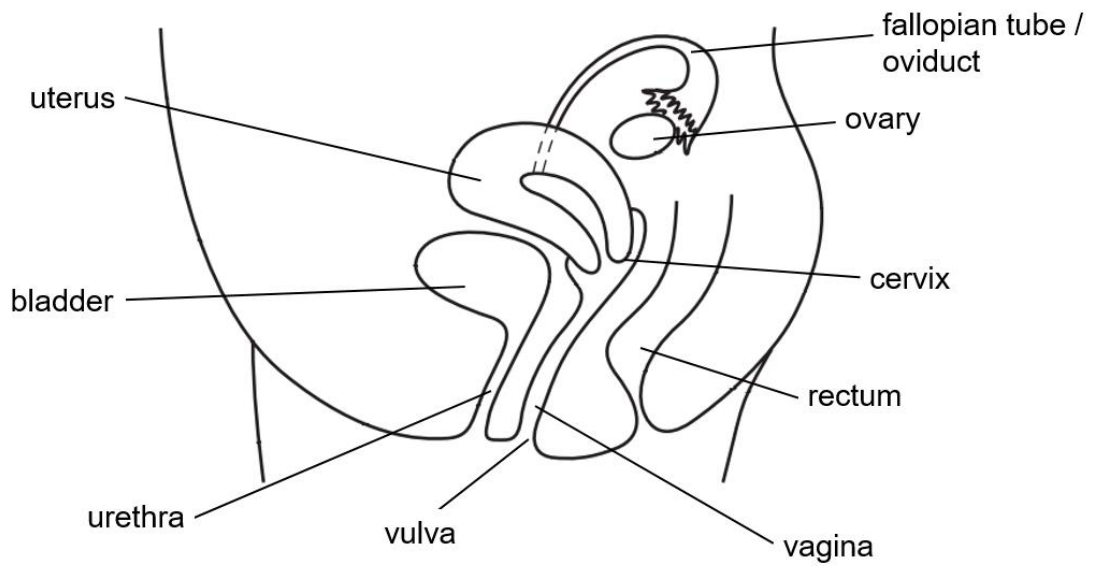
(c) identify the female reproductive system and state the functions of: ovaries, oviducts, uterus, cervix and vagina

**FEMALE REPRODUCTIVE SYSTEM
(FRONTAL VIEW)**

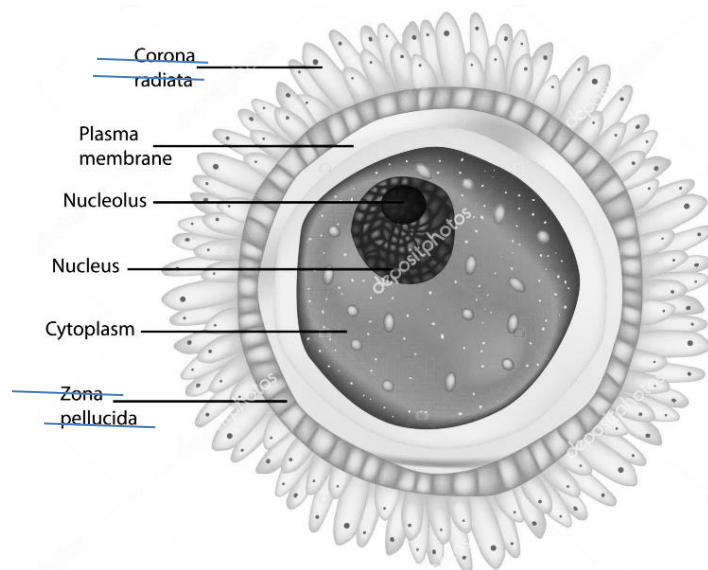


Parts	Functions
Ovary	• There are two ovaries • Produces Eggs • Contains many follicles (immature eggs) which contain oocytes which mature into ova (singular: ovum = egg) • The process of releasing ova is called ovulation • When the eggs become mature, they are released from the ovaries. • Produce hormones (e.g. progesterone and estrogen)
Fallopian tubes	• Matured egg is released into the fallopian tube • Narrow, muscular tube leading from the ovary to the uterus • It has a funnel like opening lying close to the ovary ○ Makes it easier for the egg to enter the fallopian tube • Egg is usually fertilised in the fallopian tube ○ The fertilised egg is known as the zygote
Uterus	• The place where the development of the fetus occur • Elastic muscular walls contract to push the fetus during birth • The soft, smooth inner lining of the uterus is called uterine lining or endometrium. ○ This is where the embryo implants and develops (See section on menstruation)
Cervix	• Lower portion of the uterus that joins the vagina • Opening of the cervix allows menstrual blood to flow out and into the vagina during menstruation
Vagina	• Also known as the birth canal • Semen is deposited at the vagina during sexual intercourse

FEMALE REPRODUCTIVE SYSTEM (SIDE VIEW)



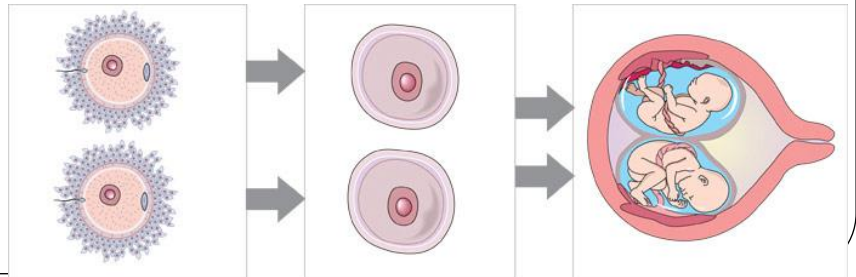
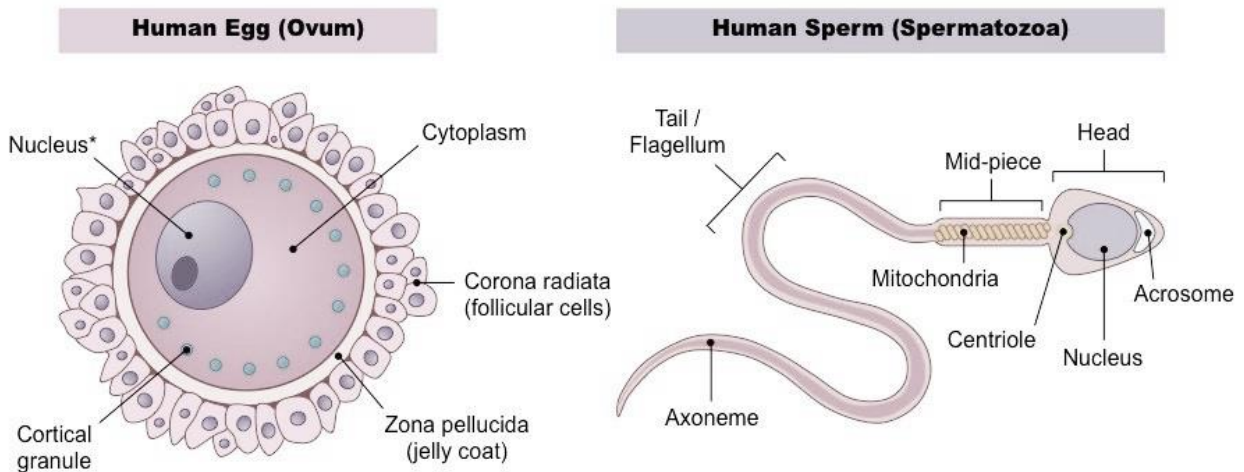
II. Parts and Function of the Female Gametes



- Large nucleus containing **haploid** set of chromosomes (**haploid: half the no. of normal chromosomes**)
- Has a **outer jelly coat** which needs to be broken down by the sperm
- A woman is born with all the potential eggs she will ever have.
- Usually **one mature egg** is released every month until menopause

EXTENSION: Twins

- **Identical twins**
 - Produced from **one fertilised egg** (zygote)
 - Zygote divides into two cells and each cell develops to form a baby
 - Both babies have the same genes and they are identical
- **Fraternal twins or non-identical twins**
 - **Two eggs are released** into the fallopian tube at about the same time
 - **Two eggs are fertilized by two different sperms**
 - Two zygotes formed DO NOT contain the same genetic materials
 - They may be of different gender
 - They do not look alike

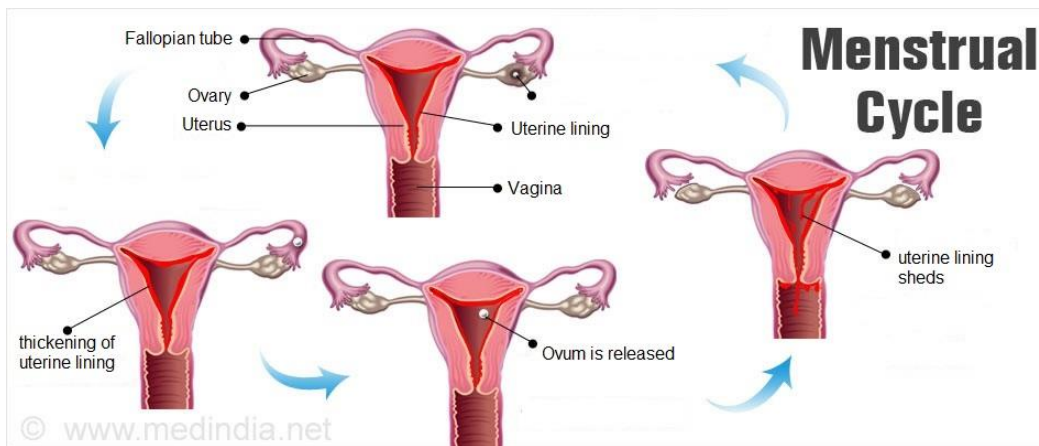
**3. Differences between male and female gametes**

Feature	Male gamete (Sperm)	Female gamete (Egg)
Structure	• Head, middle piece and tail • Nucleus contains either X or Y chromosome • 60 μm long	• Spherical • Nucleus has one X chromosome • Diameter between 120 μm to 150 μm
Motility	• Motile • Beating movement of the tail enables it to swim	• Non-motile • Cilia and peristalsis of the fallopian tube moves the egg along the tube into the uterus

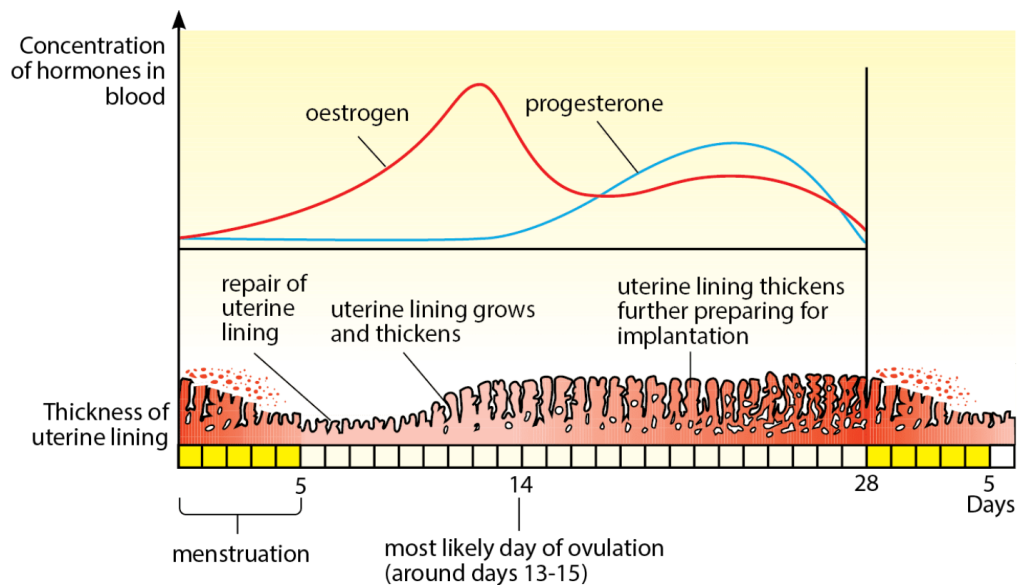
Numbers	- Numerous produced from puberty onwards 20 million to 100 million released per ejaculation	- Number of eggs determined at birth (both ovaries produce about 500 eggs in total) - One egg released a month
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(d) outline the **menstrual cycle** with reference to the alternation of menstruation and ovulation, the natural variation in its length, and the fertile and infertile phases of the cycle with reference to the effects of **progesterone** and **oestrogen** only

The Menstrual Cycle



- Average cycle is about **28 days**
- Factors affecting the duration of the menstrual cycle:
 - Unbalanced diet / malnutrition
 - Illness
 - Emotional stress
- Menstrual cycle is controlled by the hormones **oestrogen** and **progesterone**



Menstruation (Day 1 – Day 5)

- Uterine lining breaks down and flows from the uterus out of the body through the vagina
- Both oestrogen and progesterone levels are low

Repair and Growth of Uterine Lining (Day 6 – Day 10)

- Uterine lining is repaired and thickened
- It becomes thick and spongy with blood vessels
- Oestrogen level starts to increase from Day 6 – Day 10
 - Oestrogen causes the repair and growth of the uterine lining

Fertile Period (Day 11 – Day 15)



- Uterine lining continues to grow and thicken
- About day 11-12, oestrogen concentration in the blood peaks.
- Day 14 is day of ovulation where egg is released
 - Ovum / egg can survive for one to two days after it is released
- Oestrogen level remains high until Day 14 when ovulation occurs and decreases after.
- Progesterone level starts to increase after ovulation
- Fertile period is the length of time where fertilisation is possible
 - WHY? Sperms can survive about 3 to 4 days in the female



Maintain Period (Day 16 – Day 28)

- Uterine lining thickens further and becomes well-supplied with blood capillaries
- Preparation for implantation of embryo (if fertilisation occurs)
- High concentration of progesterone causes:
 - Further thickening and maintenance of the uterine lining
 - Inhibit ovulation (of another egg)

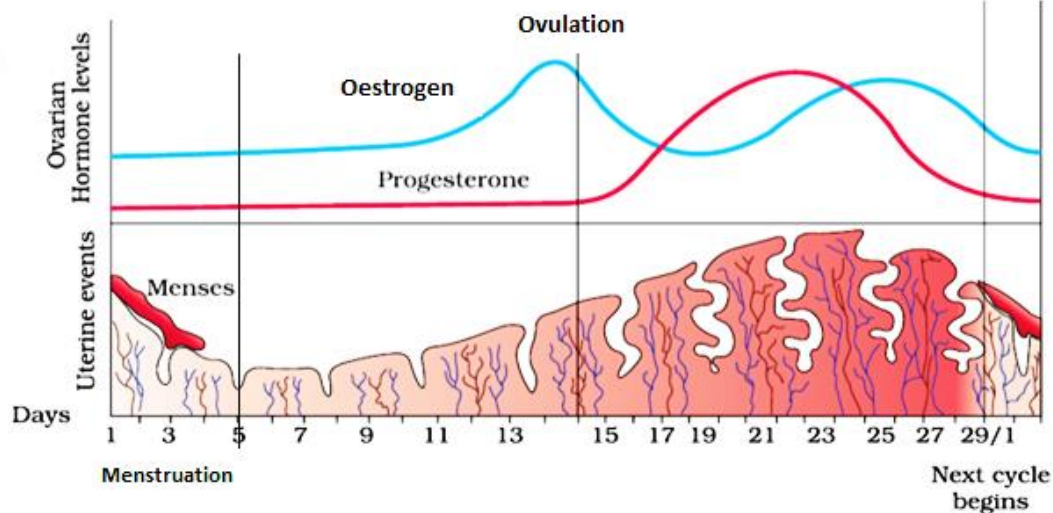


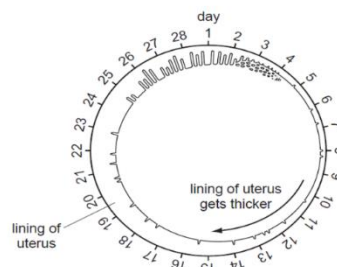
Fig. 1

With reference to Fig. 1, describe the **role** of hormones **oestrogen** and **progesterone** in controlling the menstrual cycle.

Oestrogen builds up the uterine lining while progesterone thickens and maintains the uterine lining.

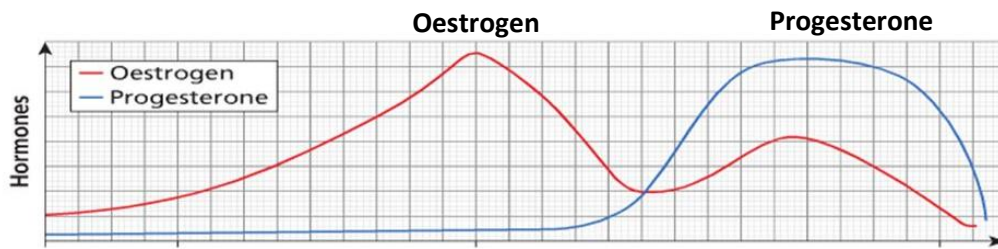
1. Day 1 to 5, oestrogen and progesterone levels are low. This causes menstruation to take place.
2. From day 6 to 12, oestrogen levels increase. This causes the uterine lining to increase in thickness. Progesterone levels remain low during this period.
3. On day 12, oestrogen concentration is the highest – this causes **ovulation** on day 14.
4. After ovulation on Day 14, **oestrogen levels decrease**, but **progesterone levels increase**. The progesterone levels continue to increase until day 22 to **maintain the uterine lining and further thicken it**.
5. After Day 22, progesterone levels start to decrease, while oestrogen levels are of moderate concentration. This causes the uterine lining to maintain its thickness till day 28, before the next round of menstruation begins.

39 The diagram shows the changes that occur to the uterus lining during the menstrual cycle.



When do the following stages occur in this cycle?

	bleeding	lining starts to break down	uterus lining thickens
A	days 13 – 14	days 6 – 25	days 1 – 4
B	days 1 – 4	days 26 – 27	days 6 – 25
C	days 6 – 25	days 1 – 4	days 26 – 27
D	days 1 – 4	days 13 – 14	days 6 – 25

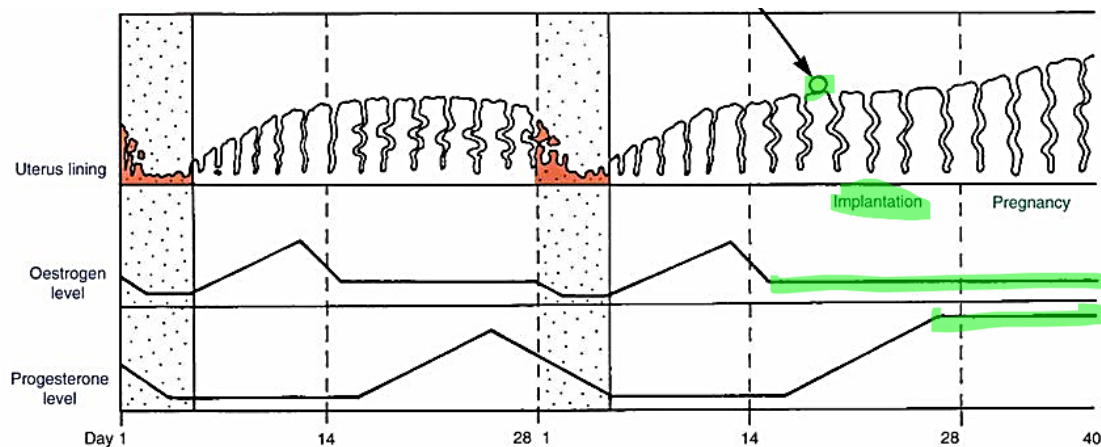
What happens if NO fertilisation occur?

1. The egg breaks down.

2. Progesterone level start to drop.

3. Without progesterone, the thickened uterine lining cannot be maintained, so it starts to break down.

4. The lining flows from the uterus together with some blood through the vagina. This marks the start of menstruation for the next cycle.

What happens if fertilisation occurs?

1. The fertilised egg becomes a **zygote**.

2. Zygote develops into an **embryo** as it moves along the **fallopian tube** by **mitosis** (cell division)

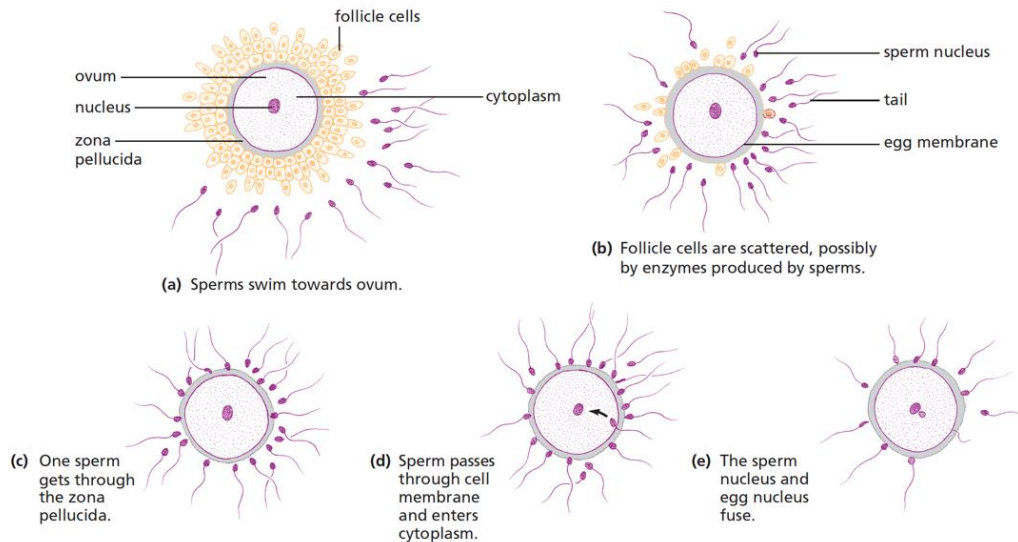
3. Embryo **embeds** itself in the uterine lining

4. Embryo secretes an **enzyme** to ensure level of **progesterone** remains **high**

5. **Placenta** will take over the production of the hormones **oestrogen** and **progesterone** once it is formed.

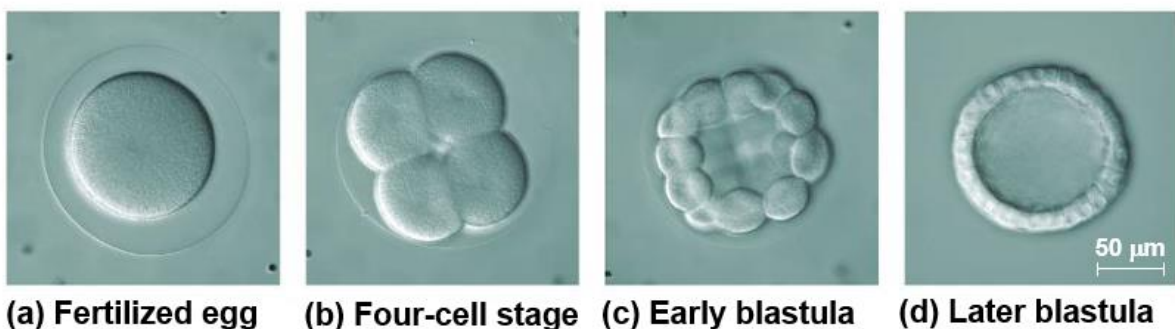
(e) describe **fertilisation** and **early development of the zygote** simply in terms of the formation of a ball of cells which becomes **implanted** in the wall of the uterus

Fertilisation



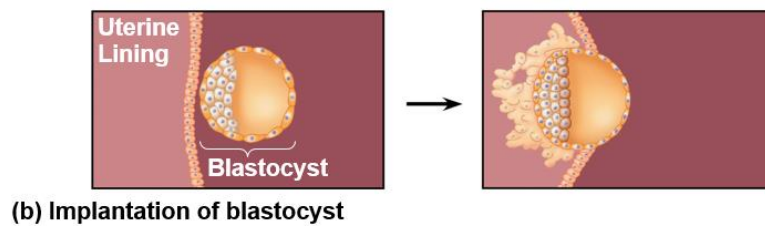
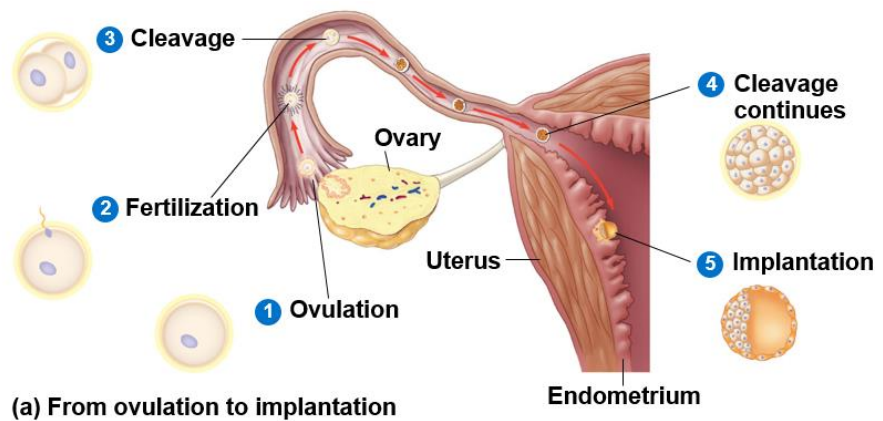
- The **egg** released from the ovary is surrounded by a few layers of **follicle cells**.
- The **acrosome** of the sperm releases an **enzyme** to **disperse** the follicle cells and to **break down part of the membrane**.
- **Only one sperm nucleus enters the egg.**
- Haploid sperm nucleus fuses with haploid egg nucleus to form a diploid zygote/fertilised egg.
- Once fertilisation occurs, the membrane changes so that no other sperms can enter.

Development of Embryo



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IMPLANTATION



- **Cilia** lining at the inner surface of the **fallopian tube** **sweep** the **zygote** along the fallopian tube towards the **uterus**.
- In the fallopian tube, the **zygote divides by mitosis** (cell division) to form a **ball of cells** called **embryo**
- It takes about **5 days** for the embryo to reach the uterus
- **Embryo** then gets embedded into the uterine lining
 - Process is called **implantation**
 - Implantation occurs about **seven days** after fertilisation

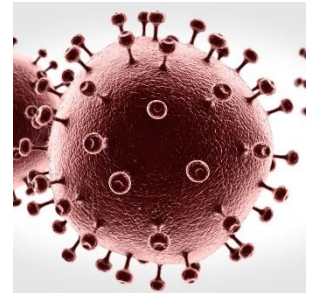
(f) discuss the transmission of human immunodeficiency virus (HIV) and methods to reduce transmission

Sexually Transmitted Infection (STI)

- Diseases spread through sexual intercourse
- STIs are caused by a **bacteria** or **viruses**
- Ways in which STIs are transmitted:
 - when semen it comes into contact with the membrane in vagina
 - when fluid in the vagina comes into contact with the membrane in urethra
 - when blood of an infected person gets into the bloodstream of an uninfected person.

Acquired Immune Deficiency Syndrome (AIDS)

- Caused by Human Immunodeficiency Virus (HIV)
- Referred to the most advanced stage of HIV infection
- HIV destroys the immune system
- Infection that are normally mild may prove to be fatal to a person with AIDS/ HIV Infection



Modes of Transmission of AIDS

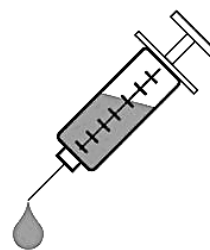


Unprotected sexual intercourse with an infected partner



Vertical transmission
(from mother to child)

- in utero
- during delivery
- breastmilk



Injection drug use
(rare: infected blood/blood products)



HIV infection

<https://www.ck12.org/biology/hivaids/lesson/HIV-and-AIDS-BIO/>

Prevention and Control

To reduce the risk of getting infected with HIV:

1. Keep to one sex partner or do not have sex
2. Males should wear a condom if they are not sure whether their partners or themselves are infected with HIV.
3. Do not abuse drugs. Drug addicts tend to share needles
4. Do not share instruments that will most likely break the skin and be contaminated with blood

To control the spread of HIV:

5. **Educate** the public on the impact of AIDS
6. Educate the young on AIDS
7. Create public awareness on AIDS
8. Pass laws to control the spread

Reflection on the Chapter:

LEARNING OBJECTIVES	HAVE I LEARNT THEM? HOW DO I KNOW I HAVE LEARNT? TRY TO ANSWER THE FOLLOWING LO. WHICH ARE THE ONES I AM STILL NOT SURE OF?
(f) Identify on diagrams, the male reproductive system and give the functions of: testes, scrotum, sperm ducts, prostate gland, urethra and penis (g) Identify on diagrams, the female reproductive system and give the functions of: ovaries, oviducts, uterus, cervix and vagina	
(h) Briefly describe the menstrual cycle with reference to the alternation of menstruation and ovulation, the natural variation in its length, and the fertile and infertile phases of the cycle with reference to the effects of progesterone and oestrogen only	
(i) Briefly describe fertilisation and early development of the zygote simply in terms of the formation of a ball of cells which becomes implanted in the wall of the uterus	
(j) Discuss the spread of human immunodeficiency virus (HIV) and methods by which it may be controlled.	