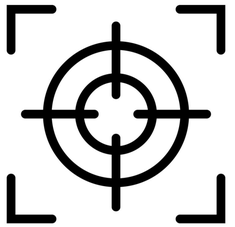
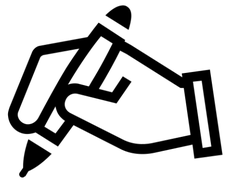
Topic 16:
Reproduction in humans

Chapter Analysis



FOCUS

- straightforward chapter
- linked to homeostasis & hormones



EXAM

- commonly tested in MCQ and structured questions
- tested once in section B in the past 5 years

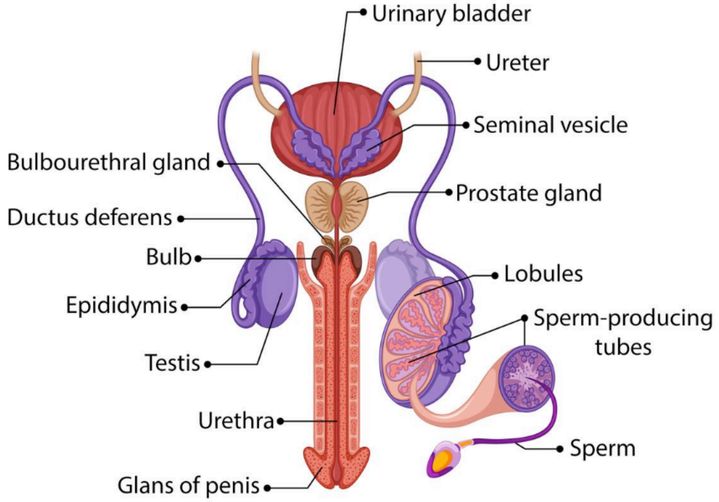
WEIGHTAGE

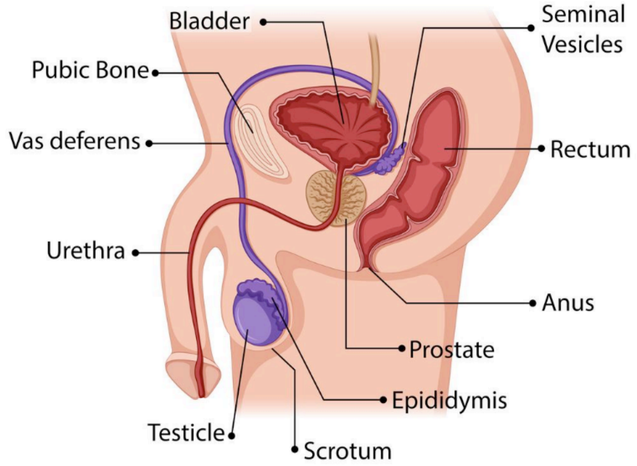
- Constitute to around 6.5% in Paper 2 in the past 5 years

Key Concept

male reproduction system
female reproduction system

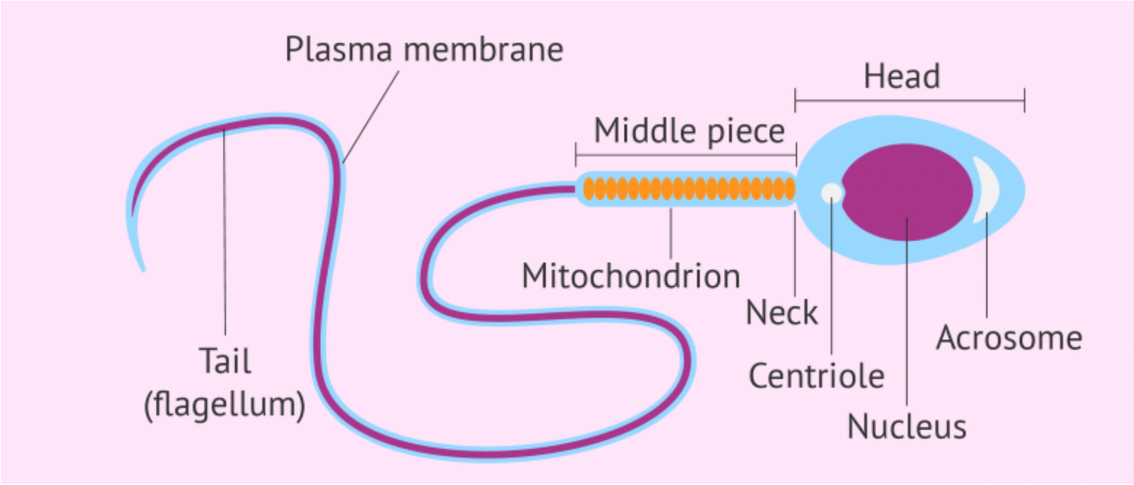
male reproductive system





Testes	• **Produces sperms** (male gametes) • Produce **male sex hormones** e.g. testosterone. Male sex hormones are responsible for development and maintenance of secondary sexual characteristics.
Epididymis	Where sperms are stored
Scrotum	• Testes are held in the scrotum, which are pouch-like sac outside the body • This allows the scrotum to be at a **lower temperature than body temperature**, which is **essential for sperm production**.
Sperm ducts / Vas deferens	Transport sperm from the epididymis to the urethra.
Prostate gland	• Together with Seminal vesicle and Cowper's gland/Bulbourethral gland, these 3 glands secrete fluid that is mixed with sperms to make semen • The fluids contain **nutrients and enzymes** which **nourish and activate the sperm**, allowing them to swim actively.
Urethra	• Urethra is a tube which passes from the bladder • passage for **urine and semen to pass out of the body**
Penis	• Penis is an erectile organ, containing **erectile tissue**, which allows the spaces within the tissue to be **filled up with blood.** • When filled with blood, the penis becomes **erect and hard**, allowing it to enter the vagina of a woman during sexual intercourse to deposit semen.

sperm cell



Head

- The head is about 2.5 μm wide.
- It contains a large **nucleus** with small amounts of cytoplasm. The nucleus carries a haploid number of chromosomes.
- **Acrosome** is a vesicle **containing enzymes**. The enzymes **break down part of the egg membranes** so that the sperm can penetrate the egg during fertilisation.

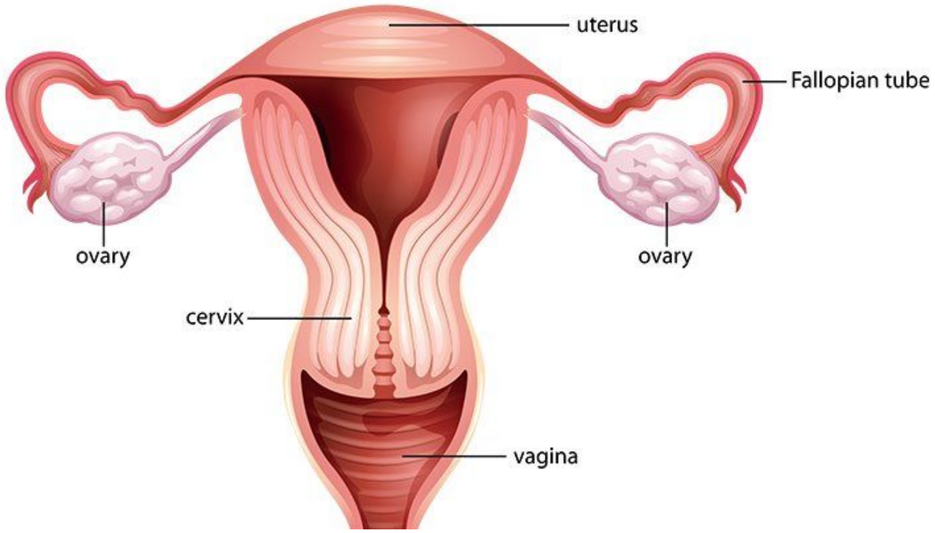
Middle piece

- The middle piece contains numerous mitochondria, which provides energy for the sperm to swim towards the egg.

Tail (flagellum)

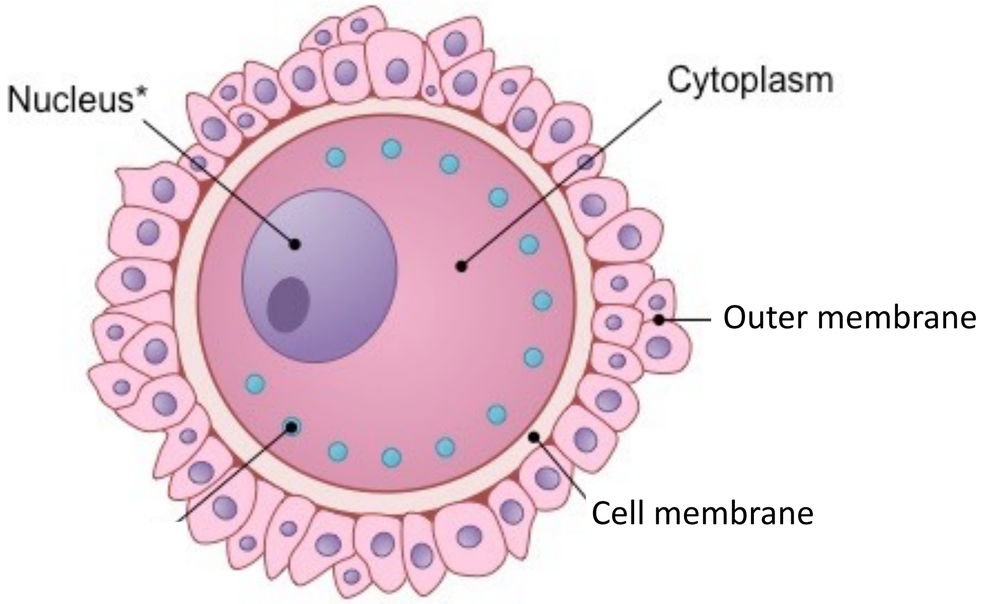
- It carries out beating movement to swim towards the egg

female reproductive system



Ovaries	• **Produces ova** (S:ovum), female gamete • Produce **female sex hormones** e.g. estrogen and progesterone. Female sex hormones are responsible for development and maintenance of **secondary sexual characteristics.**
Oviducts / Fallopian tubes	• Narrow muscular tube where ovary **releases the ovum** into and leads to uterus • **Cilia** on the inner lining help move the ovum to the uterus. • Where fertilisation happens
Uterus	• The uterus is a thick muscular organ. • The uterus is lined by **uterine lining** or endometrium • The endometrium is **richly supplied with blood vessels**. - It is broken down every month and flows out of the body in the process called **menstruation**. - It is the site of **implantation of the embryo** post-fertilisation. • Uterus is where **foetus develops** during pregnancy
Cervix	• The cervix is a circular ring of muscle that **opens into the vagina**. • It enlarges during birth to allow the passage of the foetus.
Vagina	• Birth canal through which the baby is born. • Where sperm is deposited during sexual intercourse.

Ovum (Egg cell)

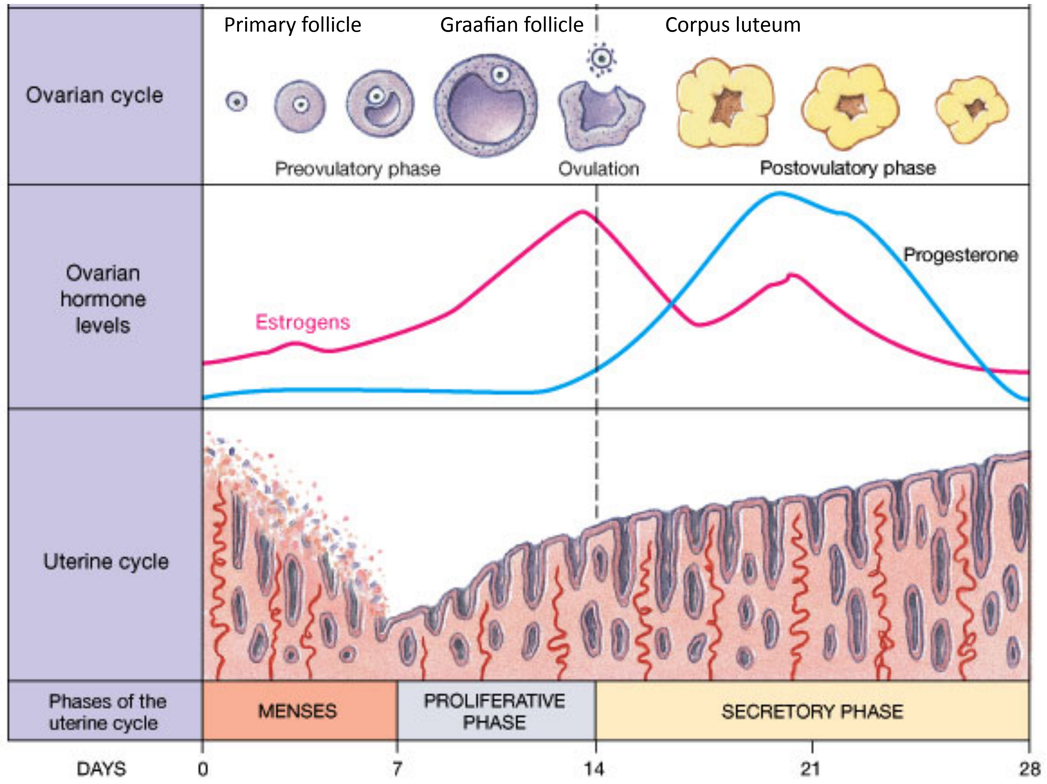


- The egg is spherical and about 120 µm - 150 µm wide (almost 50 times larger than sperm)
- Has a large **nucleus** containing haploid set of chromosomes.
- Has **abundant cytoplasm** which may contain a small amount of yolk.
- **Surrounded** by a plasma membrane and an **outer membrane.**

Key Concept

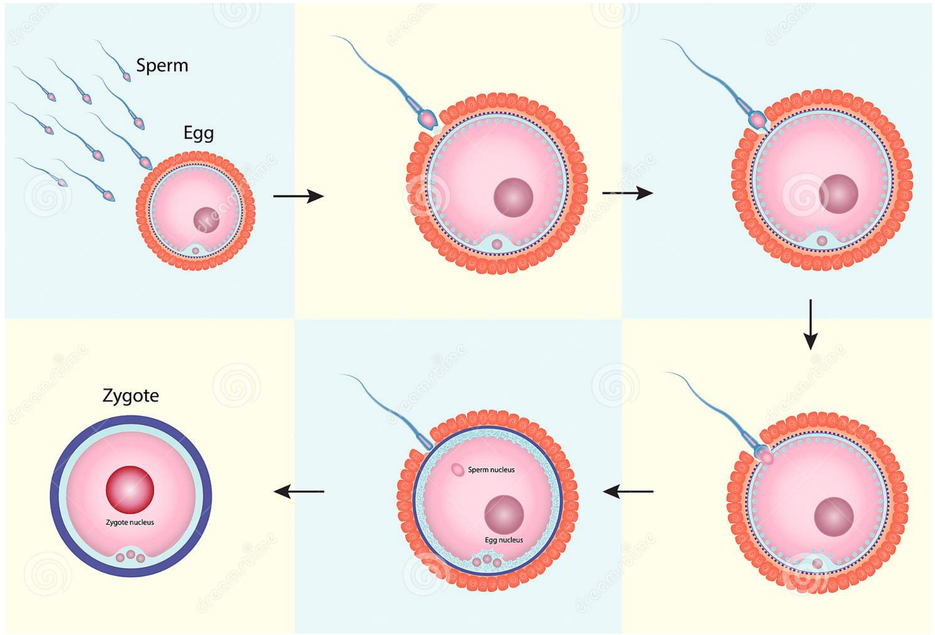
menstrual cycle
fertilisation
implantation

menstrual cycle



Day 1 - 5	**Menstruation** • The **endometrium breaks down** and flows out of the body through the vagina.
Day 6 - 13	• The ovaries **secrete estrogen** which stimulates **repair and growth** of the endometrium. It becomes **thick** and s**pongy with blood vessels.** • Estrogen prevents maturation and development of more ova
Day 14	**Ovulation** • **a mature ovum is released** from the one ovary to oviduct. • Estrogen level starts to fall and secretion of progesterone is stimulated.
Day 15 - 28	• The ovaries **secrete progesterone**, which **maintains the endometrium** by causing it to **thicken further** and preparing for implantation of zygote. • Progesterone inhibits ovulation
Day 28	• Secretion of **progesterone and estrogen decline sharply** at the end of cycle • If there is no implantation, The endometrium is **no longer maintained** and disintegrates. • The cycle repeats.

Fertilisation

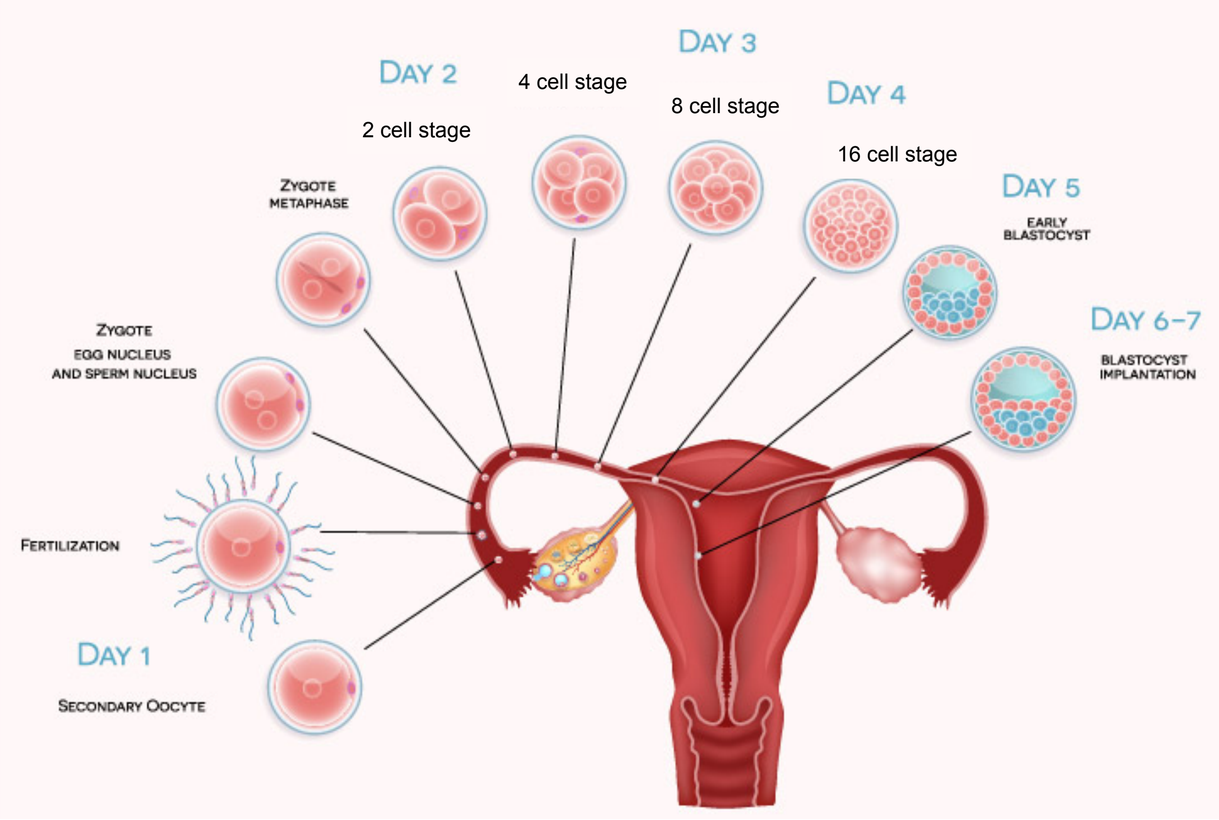


1. During sexual intercourse, **semen** containing sperms is **deposited into the vagina** of a woman.
2. The **sperms swim up the oviducts** and encounter the ovum.
3. The **acrosome** of the sperms release **enzymes** to disperse the layer of cells surrounding the ovum and break down the outer membrane of the ovum.
4. **The sperm nucleus fuses with the egg nucleus.** This process is called **fertilisation, forming zygote**
5. The plasma membrane of the egg undergoes a change as soon as a single sperm has entered, preventing other sperms from entering.
6. The remaining sperms eventually die.

FERTILE PERIOD

- The **fertile phase** of the cycle is from **day 11 to 17.**
- This is because **sperms can survive for 2 to 3 days** in the female reproductive system, thus **sperms** deposited in the vagina from **day 11** onwards **can fertilise the ovum** which is **released on day 14** from the ovaries
- The **ovum can survive for 1 to 2 days** after ovulation; hence fertilisation is possible up till day 17.
- Other days of the menstrual cycle are infertile phase.

Implantation



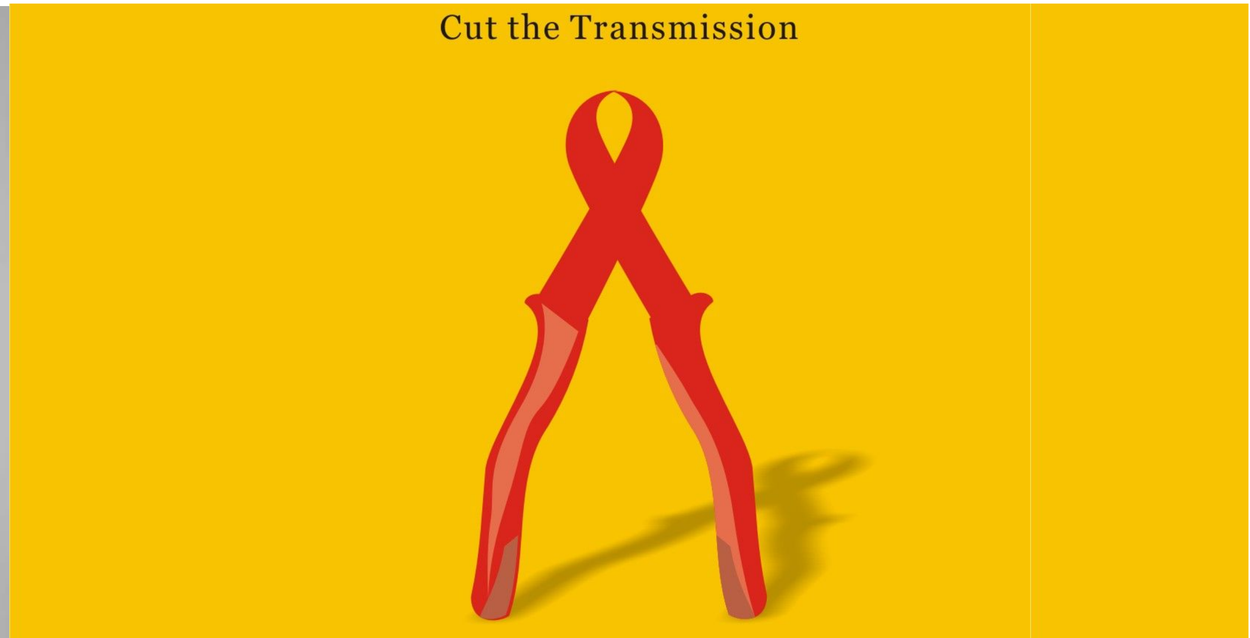
After fertilisation, the level of **progesterone** will continue to r**emain high** to **maintain the uterine lining**, so zygote **can be implanted** into the uterine lining and continue to **grow and develop into a foetus**

<u>Implantation</u>

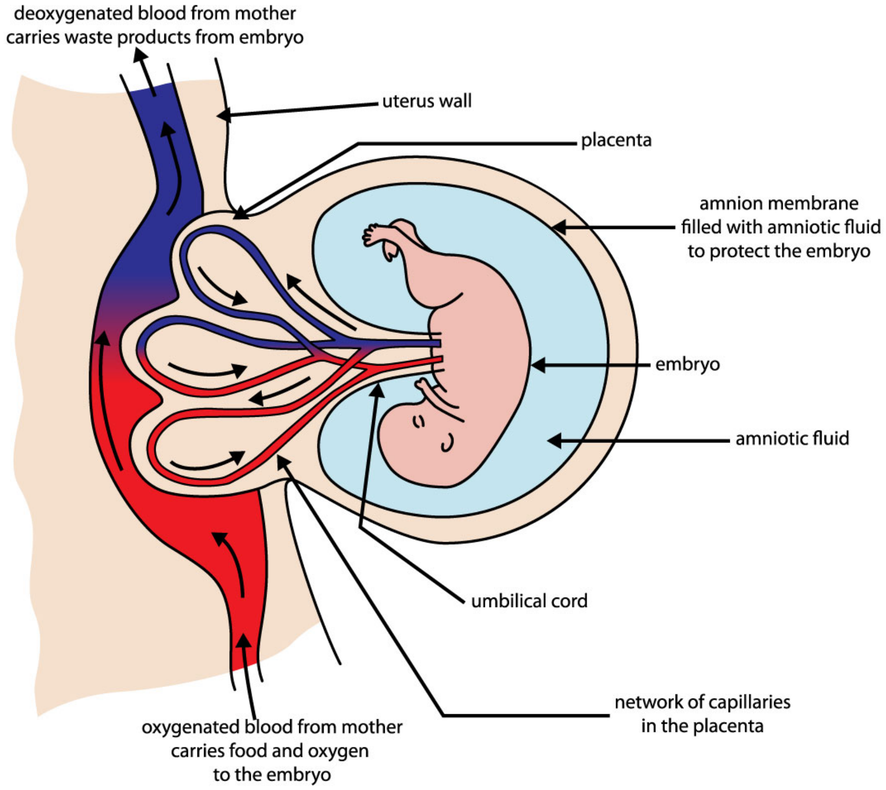
1. **Cilia** lining the oviduct **sweep** the fertilised egg or zygote along the oviduct.
2. **Peristaltic movement** of the oviduct also help the zygote move towards the uterus.
3. The **zygote divides by mitosis** to form a hollow ball of cells called the **embryo**.
4. It takes about **five days** for the embryo to reach the uterus.
5. The developing embryo moves down the uterus and eventually embeds itself in the uterine lining.

Key Concept

placenta
umbilical cord
amniotic cavity
HIV



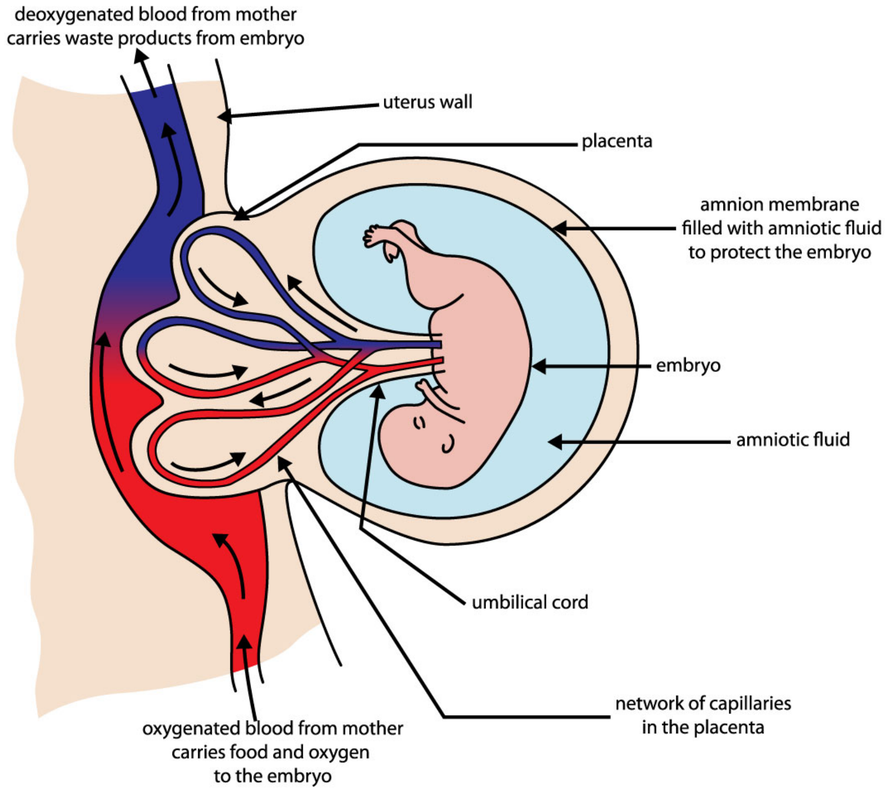
placenta



- After implantation, tissues growing out from the embryo grow into the endometrium, forming the **placenta.**
- The placenta is an organ that contains both maternal and embryonic blood vessels.
- **Functions of placenta**
  (a) **Provide nutrients** such as glucose, amino acids and mineral salts and oxygen **from maternal blood to the embryo**
  (b) **Remove waste materials** such as urea and carbon dioxide from the foetus
  (c) Allows **protective antibodies** to diffuse from maternal blood into embryonic blood
  (d) Provides a barrier **preventing the mixing of maternal blood and embryonic blood** because
  - Maternal **blood pressure is much higher** than embryonic blood pressure and would damage vital tissues.
  - The embryo might have a **different blood group**, which can resulting in agglutination when blood is mixed which is fatal

  (e) **Produces progesterone** which maintains the endometrium during pregnancy

umbilical cord and amniotic cavity



The **umbilical cord** attaches the embryo to the placenta.

- One **umbilical vein** transports oxygenated blood and food substances from the placenta to the foetus.
- Two **umbilical arteries** transport deoxygenated blood and metabolic waste products from the foetus to the placenta.

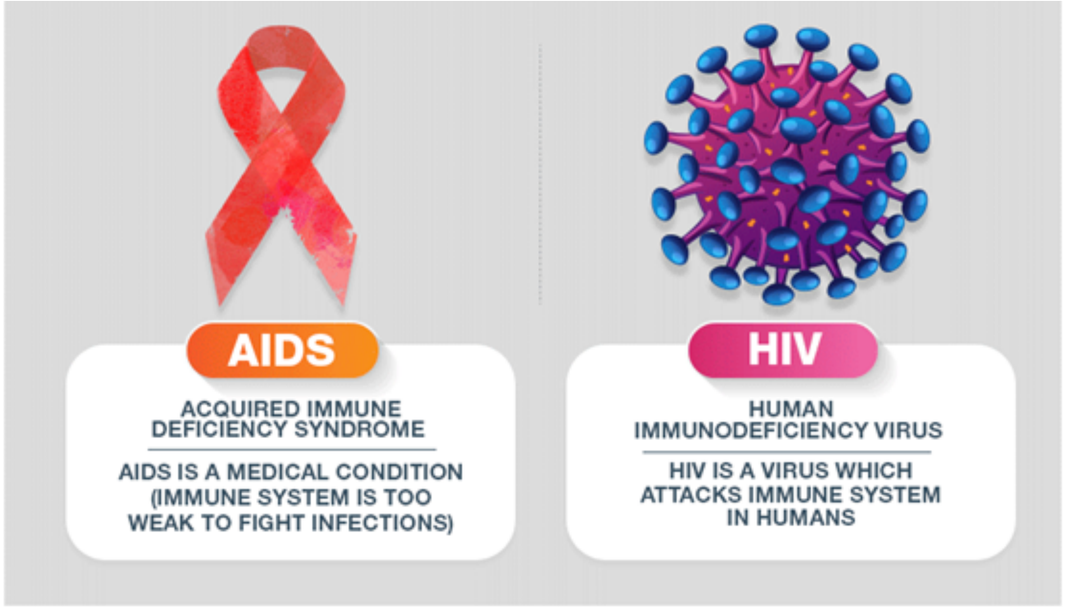
Amniotic sac develops at the same time as the placenta.

- The **membrane encloses the embryo** in a fluid-filled space known as the amniotic cavity.
- It secretes fluid known as amniotic fluid

Amniotic fluid

- Acts as a **cushion** to **absorb shock** and protect the fetus against mechanical injury.
- Allows the foetus to **move freely**.
- **Prevents** the foetus from **dehydration**.
- Maintains a **constant temperature** for optimum development of the fetus.
- Acts as **lubricating fluid** for the passage of the baby **during birth**.

Human Immunodeficiency Virus (HIV)



1. **Acquired Immune Deficiency Syndrome (AIDS)** is a **sexually transmitted disease** that is caused by **Human Immunodeficiency Virus (HIV)**
2. HIV is a virus that attacks immune cells thus progressively **reduces the effectiveness** of the infected person's **immune system** in protecting him from infection.
3. AIDS is the most advance stage of HIV

Symtoms of AIDS

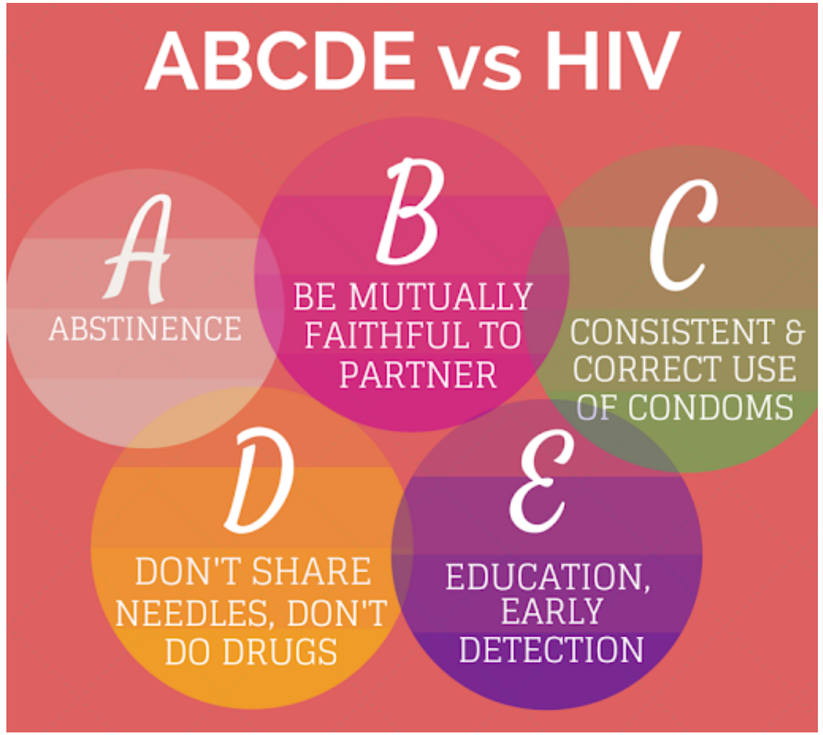
- Persistent fever, sweat, swollen glands, chills, weakness and weight loss
- Pneumonia
- Tuberculosis
- Chronic diarrhoea
- Brain infection
- Tumours such as Kaposi's sarcoma (cancer of the blood vessels) and cervical cancer in women

Mode of transmission of HIV

Exchange of bodily fluid NOT including saliva

- By sexual intercourse with an infected person
- By sharing and reusing contaminated needles during intravenous drug use, tattoos and piercing
- By receiving a blood transfusion from an infected donor
- During pregnancy and childbirth. An infected mother could pass on the disease to her child

Control spread of HIV



1. Abstinence
2. Be responsible of having sex with only one partner
3. Use a condom during sex reduces the risk of infection.
4. Needles must be new and sterilised for tattoos, piercings or acupuncture
5. Infected mothers should undergo antiretroviral therapies and give birth by caesarean section to minimise risk of transmission to the foetus.
6. Reduce drug abuse as drug addicts usually share syringes to inject drugs
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