

# Human Reproduction

## Scope

TOPIC	SUBTOPIC	KEY INFORMATION
<b>HUMAN REPRODUCTION</b>	Male reproductive system	<ul style="list-style-type: none"> <li>Structure of the male reproductive system, using a diagram, with labels and functions (only parts given in Examination Guidelines)</li> </ul>
	Female reproductive system	<ul style="list-style-type: none"> <li>Structure of the female reproductive system, using a diagram with labels and functions (only parts given in Examination Guidelines)</li> </ul>
	Puberty	<ul style="list-style-type: none"> <li>Main characteristics/changes (male &amp; female)</li> </ul>
	Spermatogenesis & oogenesis	<ul style="list-style-type: none"> <li>Exactly as stated in the Examination Guidelines</li> </ul>
	Ovarian & Menstrual cycles (incl. hormones & negative feedback)	<ul style="list-style-type: none"> <li>Refer to Mind the Gap (MTG) for the structure of the ovary, using a diagram/graph, showing the primary follicles, the Graafian follicle and the corpus luteum</li> <li>Includes the uterine and ovarian cycles and days per month + endometrium changes</li> <li>The role of FSH, oestrogen, progesterone &amp; LH in these processes</li> <li>Negative feedback between progesterone and FSH</li> </ul>
	Development of the zygote to a blastocyst (blastula)	<ul style="list-style-type: none"> <li>Order in the development of structures as well as difference between a morula and a blastocyst</li> </ul>
	Development of the foetus during gestation	<ul style="list-style-type: none"> <li>Structure of the developing foetus in the uterus, using a diagram</li> <li>Functions of the:               <ul style="list-style-type: none"> <li>✓ Chorion and chorionic villi</li> <li>✓ Amnion, amniotic cavity and amniotic fluid</li> <li>✓ Umbilical cord (including umbilical artery and umbilical vein)</li> <li>✓ Placenta</li> </ul> </li> </ul>



*Adapted from DBE revision guidelines*

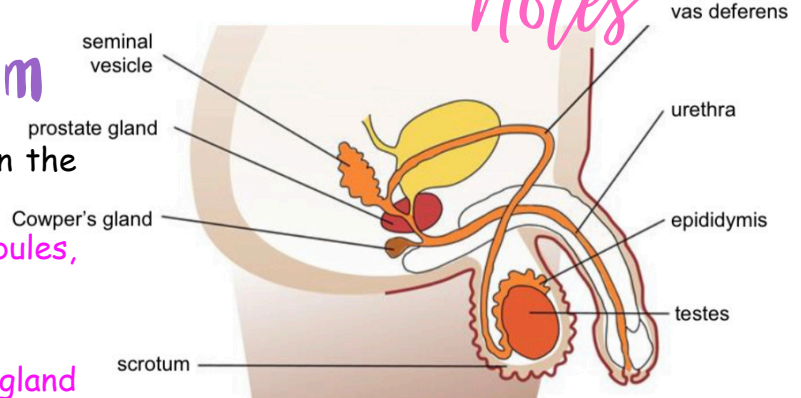
# Human reproduction

Notes

## Male reproductive system

consists of:

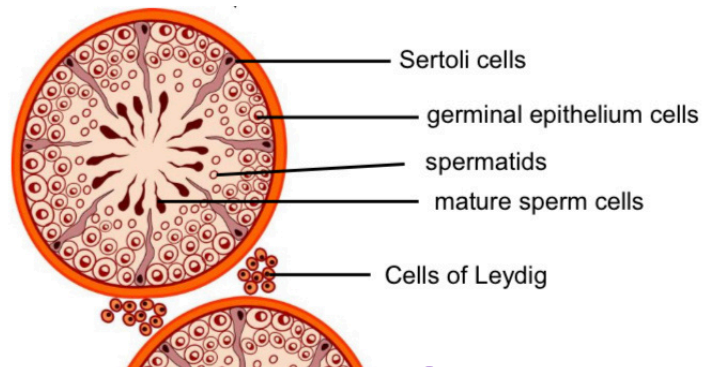
- the main male sex organ - a pair of **testes** in the scrotum
- various ducts and tubules - **seminiferous tubules**, **epididymis**, **vas deferens** and the urethra
- accessory glands - **prostate gland**, **Cowper's gland** and **seminal vesicles**
- the external genitalia - **penis**



## Seminiferous tubules

The testes contain seminiferous tubules which are lined by germinal epithelium cells which produce sperm cells.

Some of the cells develop into **Sertoli cells** which provide nutrients for the spermatids to become mature sperm cells. The seminiferous tubules are surrounded by connective tissue that contain the **Cells of Leydig** which produce testosterone.



Part	Structure	Function
testes	oval shaped glands, suspended in the scrotum	produce sperm cells and the hormone testosterone
scrotum	skin sac that holds the testes	protects the testes and holds the testes "outside" the body, at 2°C lower than body temp.
epididymis	coiled tubule on the outside of the testes but still in the scrotum	temporarily stores spermatids until they mature into sperm cells
vas deferens	muscular tube passing from the epididymis to the urethra	transports sperm from the epididymis to the urethra
urethra	tube which runs through the penis	transports urine and semen out of the body
prostate gland	gland found below the bladder, at the point where the urethra begins; the largest accessory gland	produces a nutrient-rich fluid that provides energy for the sperm cells
Cowper's glands	small pair of glands found below the prostate gland.	produces mucus that helps with the movement of sperm cells
seminal vesicles	medium sized pair of glands attached to the end of the vas deferens	produces alkaline fluid to neutralise vaginal acids which would kill sperm

## Male sex hormone

**Testosterone** has the following functions:

- development of the male secondary sexual characteristics
- stimulating the maturation of sperm cells

## Gametogenesis

Formation of gametes

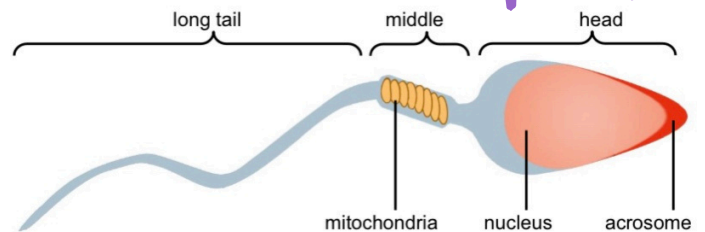
in males it is called **spermatogenesis**

Under the influence of testosterone, the diploid germinal epithelial cells (2n) lining the seminiferous tubules go through meiosis

Each cell that goes through meiosis produces 4 haploid spermatids (n)

Each spermatid matures to form a haploid sperm cell

## Sperm cell



- The **head** contains the nucleus which contains 23 chromosomes.
- The **acrosome** (in the head) contains enzymes that dissolve the outer layer of the egg allowing fertilisation to occur.
- The **middle portion** contains **mitochondria** which provides energy for the movement of the sperm cell.
- The **long tail** allows the sperm cell to swim faster through fluid.

# Human reproduction

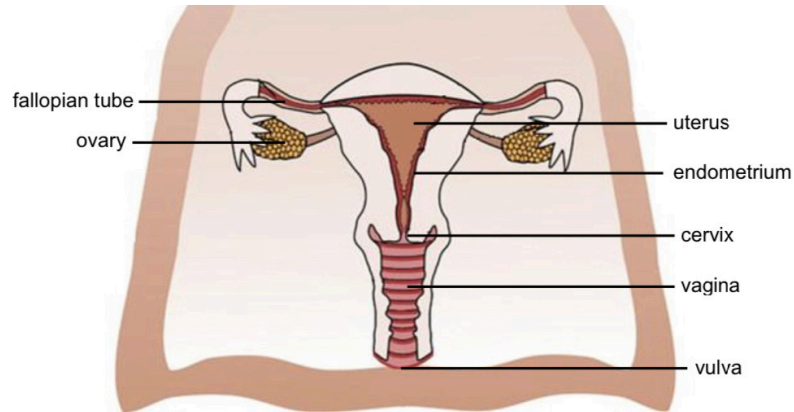
## Notes

## Female reproductive system

consists of:

- the main female sex organ - the ovaries
- the ducts - fallopian tubes
- the accessory organs - the uterus and the vagina
- the external genitalia - the vulva

Part	Structure	Function
ovaries	found as a pair, one on either side of the uterus, and surrounded by germinal epithelium	produce egg cells, secrete the hormones progesterone and oestrogen
fallopian tubes	connect the ovaries to the uterus – are lined with ciliated columnar epithelium which helps the movement of the egg cells	transports egg cells from the ovary to the uterus; the site of fertilisation
uterus	hollow, pear-shaped organ	houses and protects the embryo and foetus during pregnancy
endometrium	inner lining of the uterus	site of implantation and where the placenta forms
cervix	lower, narrow opening of the uterus	stretches and opens to allow the baby through during childbirth
vagina	muscular tube which runs from the cervix to the exterior	receives the penis and semen during sexual intercourse; the birth canal; passage for menstrual blood
vulva	opening to the vagina; covered by two vagina covers called the labia	protects the entrance to the vagina



## Female sex hormones

**Oestrogen** has the following functions:

- development of the female secondary sexual characteristics
- thickens endometrium

**Progesterone** has the following function:

- Maintain the thickness of the endometrium

## Gametogenesis

**Formation of gametes**

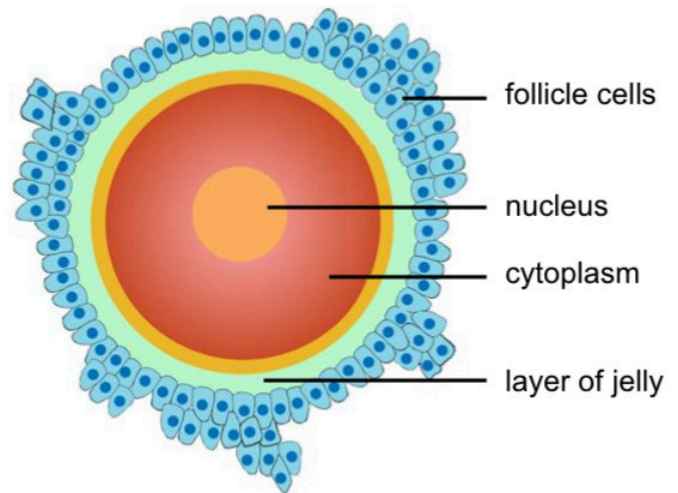
in Females it is called **oogenesis**

The diploid germinal epithelium cells (2n) of the ovaries go through the process of mitosis to form many follicles. Every 28 days, the **follicle stimulating hormone** (FSH) stimulates one follicle. Only one cell inside of that follicle enlarges and goes through the process of meiosis.

Out of the 4 (four) haploid cells produced through meiosis, only one cell will survive to form a mature ovum.

The other three cells from meiosis will degenerate.

## The ovum



- The **nucleus** contains 22 autosomes and one sex chromosome (X)
- The **cytoplasm** nourishes the egg
- The **jelly layer** provides protection for the early developmental stages of the fertilised egg



# Human reproduction

## Notes

### Puberty in males and females

**Puberty** is the period during which males and females reach sexual maturity. Puberty usually begins between the ages of 11 to 15, though it may occur much earlier or later depending on the individual. During puberty the sex hormones are produced which stimulate gametogenesis and sexual maturity. At the same time secondary sexual characteristics develop.

Males	Females
male sex hormone testosterone is produced	female hormones oestrogen and progesterone are produced
growth of hair around the scrotum (pubic hair)	growth of hair around the vulva (pubic hair)
growth of hair in the armpits	growth of hair in the armpits
growth of hair on the face	
larynx enlarges / voice becomes deeper	
muscles enlarge and the shoulders become wider	the hips become wider and fat is deposited below the skin
penis and the testes enlarge	development of breasts

# Human reproduction

## Notes

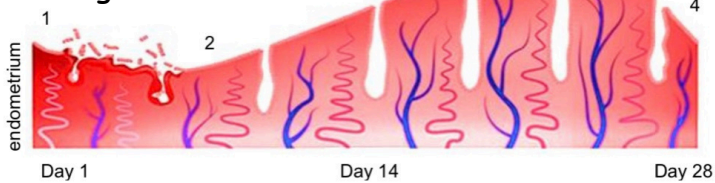
## The menstrual cycle

28 day cycle that consists of two cycles:

- Ovarian cycle
- Uterine cycle

## Uterine cycle

Changes in the uterus



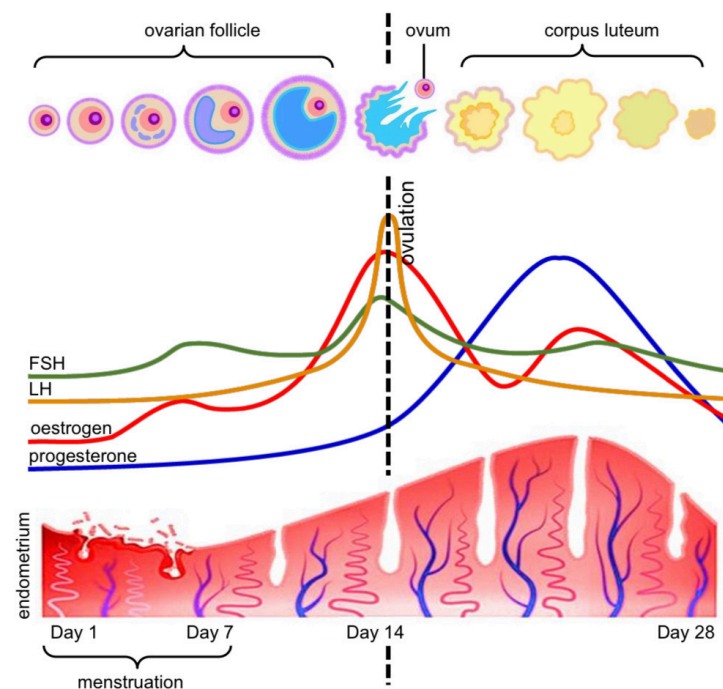
The endometrium breaks down and is released (**menstruation**) for about 4-7 days.

The endometrium is stimulated by oestrogen to become **thicker, vascular** and **glandular**.

**Progesterone** stimulates the endometrium to become even thicker and develop more blood vessels and glands in preparation for possible **implantation** of the fertilised ovum.

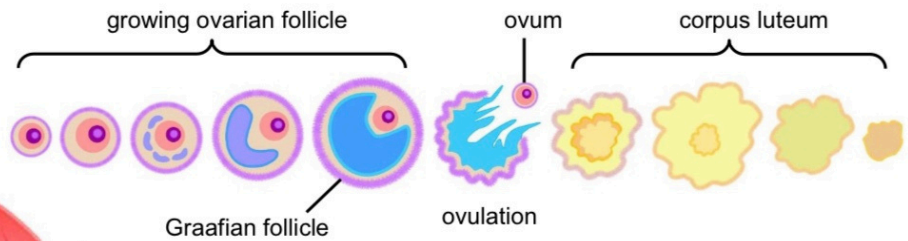
If fertilisation doesn't take place, menstruation begins again.

## Hormonal control



## Ovarian cycle

Changes in the ovary



**FSH** stimulates a primary follicle to become a **Graafian follicle** which contains a **mature ovum**. Graafian follicle produces the hormone **oestrogen**, increasing the oestrogen levels in the blood.

On day 14, mature ovum is released (**ovulation**) stimulated by the **Luteinising Hormone (LH)** which is released by the **pituitary gland**.

LH converts ruptured Graafian follicle to the **corpus luteum**. The corpus luteum secretes the hormone **progesterone** increasing the levels of progesterone in the blood.

If fertilisation took place the corpus luteum remains large. If fertilisation did not take place, the corpus luteum degenerates.

## Negative feedback

If the ovum is fertilised, the corpus luteum remains active and continues secreting progesterone. Increased levels of progesterone in the blood inhibit the secretion of the follicle stimulating hormone. As a result, no further development of the follicle occurs.

If the ovum is not fertilised, the corpus luteum degenerates. Progesterone in the blood will drop, FSH secretion will no longer be inhibited. A new follicle develops.

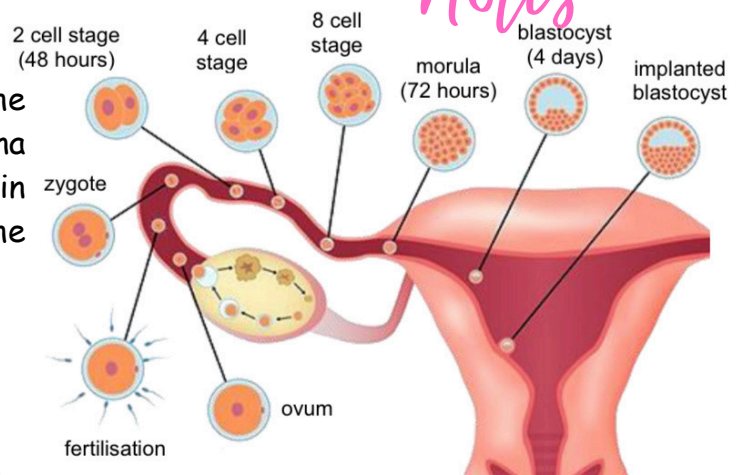
# Human reproduction

## Fertilisation

During **copulation** the penis is inserted into the vagina, sperm cells are released into the vagina when the male ejaculates. If the ovum is present in the **fallopian tube**, the haploid sperm fuses into the haploid ovum to form a diploid **zygote**.

## formation of Blastula

The zygote divides by mitosis to form a **morula**, the morula further divides by mitosis to form a **blastula/blastocyst**.



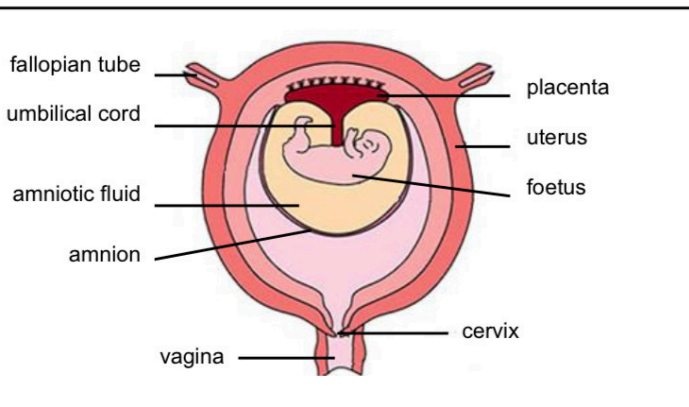
## Implantation

The blastula moves from the fallopian tube into the uterus. It secretes enzymes that make the uterus soft and embeds itself into the endometrium.

The blastula forms extra-embryonic membranes (**amnion & chorion**).

The chorion extends into **chorionic villi** (finger-like outgrowths) and form a placenta (Secretes progesterone).

The blastula is now an **embryo**.



## Functions of parts

### Amnion with **amniotic fluid**

- Protects the foetus against mechanical injury (shock-absorber)
- Prevents dehydration
- Maintains the temperature of the foetus
- Allows for free-movement of the foetus as it grows and develops

### **Umbilical cord** Consist of

- two **umbilical arteries** which carry deoxygenated blood and waste products from the foetus to the placenta.
- One **umbilical vein** which carries oxygenated blood, nutrients, water and other substances from the placenta to the **foetus**.

The **placenta** has the following functions:

- It is the point of attachment of the foetus to the mother
- It allows for diffusion of nutrients from the mother to the foetus
- It allows for the diffusion of oxygen from the mother to the foetus and for the diffusion of carbon dioxide from the foetus to the mother (gas exchange)
- It allows for the diffusion of waste products from the foetus to the mother
- After 12 weeks, the placenta secretes progesterone to maintain the pregnancy

**Gestation** last for 40 weeks or 280 days



# Human reproduction

## Terminology

Biological term	Description
<b>Acrosome</b>	The vesicle which contains enzymes found in the head of a sperm cell
<b>Amniotic fluid</b>	A fluid that protects the human embryo against injuries and large-scale temperature changes
<b>Blastocyst/blastula</b>	A hollow ball of cells formed from the zygote
<b>Chorion</b>	The outermost membrane found around the embryo/foetus
<b>Copulation</b>	The introduction of the male sex organ into the female sex canal, followed by a discharge of semen.
<b>Endometrium</b>	The inner lining of the uterus where implantation of the embryo occurs
<b>Fallopian tube</b>	Part of the female reproductive system where fertilisation occurs
<b>Fertilization</b>	When the nucleus of the sperm cell fuses with the nucleus of the ovum
<b>Follicle stimulating hormone/FSH</b>	The hormone responsible for the development of follicles in the ovary
<b>Gestation</b>	The period between fertilization and birth when the foetus develops in the womb
<b>Implantation</b>	The attachment of the fertilized ovum or blastocyst to the wall of the uterus at the start of pregnancy.
<b>Luteinising hormone/LH</b>	The hormone responsible for ovulation and the formation of the corpus luteum
<b>Oestrogen</b>	The hormone that causes the thickening of the endometrium and is produced by the Graafian follicle
<b>Oogenesis</b>	The production of female gametes through meiosis
<b>Prolactin</b>	A hormone produced by the pituitary gland/hypophysis that stimulates milk production in human females
<b>Puberty</b>	The stage in humans when sexual maturity is reached in males and females
<b>Spermatogenesis</b>	The production of male gametes through meiosis
<b>Testosterone</b>	A hormone that stimulates the maturation of sperm and stimulates puberty in males
<b>Vas deferens</b>	The male reproductive tube that connects the testis with the urethra
<b>Zygote</b>	The diploid cell formed by the process of fertilisation