

The Reproductive System

Learning Outcome C14 & C15

Learning Outcome C14

- Analyse the functional interrelationships of the structures of the male reproductive system

Student Achievement Indicators

Students who have fully met this learning outcome are able to:

- Identify and give functions for each of the following:
 - ✓ testes scrotum
 - ✓ epididymis
 - ✓ ductus (vas) deferens
 - ✓ prostate gland
 - ✓ Cowper's glands
 - ✓ seminal vesicles
 - ✓ penis
 - ✓ urethra
- Describe the path of sperm from the seminiferous tubules to the urethral opening
- List the components seminal fluid, and describe the functions of each component
- Identify the tail, midpiece, head, and acrosome of a mature sperm and state their functions
- Describe the functions of testosterone
- Describe the homeostatic regulation of testosterone levels by the hypothalamus, anterior pituitary, and testes

Learning Outcome C15

- Analyse the functional interrelationships of the structures of the female reproductive system

Student Achievement Indicators

Students who have fully met this learning outcome are able to:

- Identify and give functions for each of the following:
 - ✓ ovaries (follicles and corpus luteum)
 - ✓ oviducts (fallopian tubes)
 - ✓ uterus
 - ✓ endometrium
 - ✓ cervix
 - ✓ vagina
- Describe the functions of estrogen
- Describe the sequence of events in the ovarian cycle, with reference the follicular phase, ovulation, and the luteal phase
- Describe the sequence of events in the uterine cycle, with reference to menstruation, the proliferative phase, and the secretory phase
- Describe the control of the ovarian and uterine cycles by hormones including gonadotropin-releasing hormone (GnRH), follicle-stimulating hormone (FSH), luteinizing hormone (LH),
- estrogen, and progesterone
- Describe the hormonal changes that occur as a result of implantation, including
 - ✓ production of human chorionic gonadotropin (HCG) to maintain the corpus luteum
 - ✓ increased production of progesterone by the corpus luteum
- Describe a positive feedback mechanism involving oxytocin

Female

- The female gonads are paired ovaries that lie on each side of the upper reproductive cavity
- Oogenesis is the production of an egg (female gamete)
- Ovulation is the process by which an egg bursts from an ovary and usually enters an oviduct



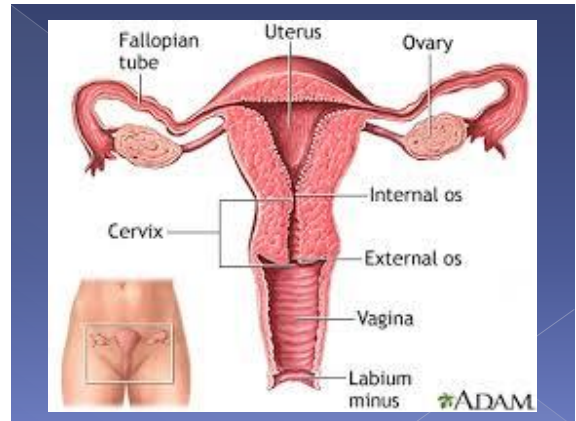
Female

The Genital Tract

- The oviducts, are also called fallopian tubes, they extend from the uterus to the ovaries
- The oviducts are not attached to the ovaries; they have finger like projections called fimbriae that sweep over the ovaries
- When an egg bursts from an ovary during ovulation, it is usually swept into an oviduct by a combined action of the fimbriae and the beating of the cilia that line the oviducts.
- An egg can live 6-24 hours in the oviduct unless it is fertilized.
- Fertilization occurs in the oviduct and a zygote is formed
- The developing embryo arrives at the uterus after several days and implants itself in the uterine lining.

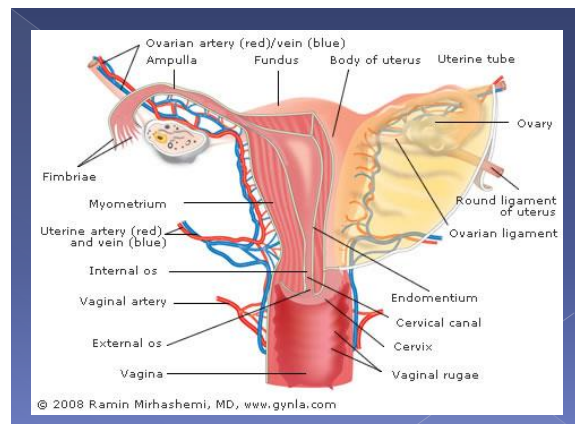
Female

- The uterus is a thick-walled muscular organ about the size and shape of an inverted pear.
- The uterus lies above the bladder
- The oviducts join the uterus at its upper end
- While at the lower end of the genital tract the cervix is attached to the vagina.
- Development of an embryo takes place in the uterus (AKA womb).
- The uterus is capable of expanding to over 30 cm wide to accommodate a growing baby.
- The lining of the uterus is known as the endometrium and takes part in the formation of the placenta



Female

- The endometrium supplies the baby with nutrients needed for embryonic and fetal development
- The endometrium has two layers:
 1. A basal layer
 2. Inner functional layer
- In a non-pregnant female this functional layer varies in thickness according to the uterine cycle (aka menstrual cycle).
- A small opening in the cervix leads to the vaginal canal (aka the birth canal).
- The urinary and reproductive systems are not connected in females.



Female

The Ovarian Cycle

- The ovaries are made up of an inner medulla and outer cortex
- Each cortex contains many follicles and each follicle contains an immature oocyte
- Only a small number of follicles mature and release an oocyte, because a woman usually only produces one oocyte per month during her reproductive years.
- Oocytes age as women age
- Follicles change from primary follicles to secondary follicles to vesicular follicles.
- Epithelial cells of a primary follicle surround the oocyte.

Female

- Pools of follicular fluid surround the oocyte in a secondary follicle.
- In a vesicular follicle, a fluid filled cavity increases to the point that the follicle wall balloons out on the surface of the ovary.
- The primary oocyte divides producing two haploid cells
- One is the secondary oocyte: one polar body
- The vesicular follicle bursts releasing the secondary oocyte.
- Once the vesicular follicle has lost this secondary oocyte, it develops in the corpus luteum, which is a gland that produces progesterone

Female

- If a sperm reaches the secondary oocyte, fertilization occurs which completes meiosis.
- An egg with 23 chromosomes and a polar body results
- When a sperm nucleus unites with the egg nucleus, a zygote with 46 chromosomes is produced.
- If fertilization does not occur, the corpus luteum begins to disintegrate after 10 days.
- The ovarian cycle can be divided into two phases

Female

Follicular Phase

- Follicle-Stimulation Hormone (FSH) is produced by the anterior pituitary gland, which promotes the development of a follicle in the ovary, which secretes estrogen and some progesterone.
- As estrogen levels rise in the blood the anterior pituitary gland stops secreting FSH and the follicular phase comes to an end.
- As estrogen levels rise a large amount of GnRH (gonadotropin releasing hormone) is released from the hypothalamus which leads to surges of luteinizing hormone (LH) production by the anterior pituitary gland and to ovulation at about day 14 of the 28 day cycle.

Female

Luteal Phase

- LH promotes the development of the corpus luteum, which secretes progesterone and some estrogen.
- As progesterone blood level rises, LH secretion decreases which allows the degeneration of the corpus luteum.
- As the luteal phase comes to an end, the low levels of progesterone and estrogen cause menstruation to begin.
- to ovulation at about day 14 of the 28 day cycle.

Female

The Uterine Cycle

1. Day 1-5
 - ✓ A low level of progesterone and estrogen in the body cause the endometrium to disintegrate and its blood vessels to rupture.
 - ✓ One day of the cycle, a flow of blood and tissue passes out of the vagina (menstruation).
2. Day 6-13
 - ✓ Increase production of estrogen by a new ovarian follicle in the ovary causes the endometrium to thicken and become vascularized.
 - ✓ This is called the proliferative phase of the uterine cycle

Female

3. Day 14
 - ✓ Ovulation begins, an egg is release
4. Day 15-28
 - ✓ Increased production of progesterone by the corpus luteum in the ovary causes the endometrium to triple in thickness and the uterine glands mature producing a thick mucus secretion.
 - ✓ This is called the secretory phase of the uterine cycle.
 - ✓ The endometrium is not prepared to receive the developing embryo.
 - ✓ If this does not occur than the corpus luteum in the ovary degeneration, and the low level of sex hormone causes menstruation to occur.

Female

5. Menstruation
 - ✓ During menstruation arteries that supply the uterine lining constrict and capillaries weaken
 - ✓ Blood from the damaged vessels, detaches layer of lining (not all at once).
 - ✓ Menstrual flood contain mucous, blood and tissue.
 - ✓ Fibrinolysis is an enzyme released by dying cells which prevents the blood from clotting.

Female

6. Lasts 3-10 days (if fertilization & pregnancy occurs)
 - ✓ If an egg is fertilized an embryo begins development as it travels down the oviducts to the uterus.
 - ✓ The endometrium is prepared for the embryo to implant into the uterine wall.
 - ✓ The placenta originates from both maternal and fetal tissue; this is the region where there is an exchange between mother and fetus.
 - ✓ The placenta produces human chorionic gonadotropin (HCG) which maintains the corpus luteum in the ovary until the placenta begins to produce its own progesterone and estrogen (this is the hormone that pregnancy tests detect).
 - ✓ Shuts down pituitary glands so that no new follicle can mature.
 - ✓ Maintains placenta so the corpus luteum is not needed
 - ✓ Usually no menstruation occurs during pregnancy

Female

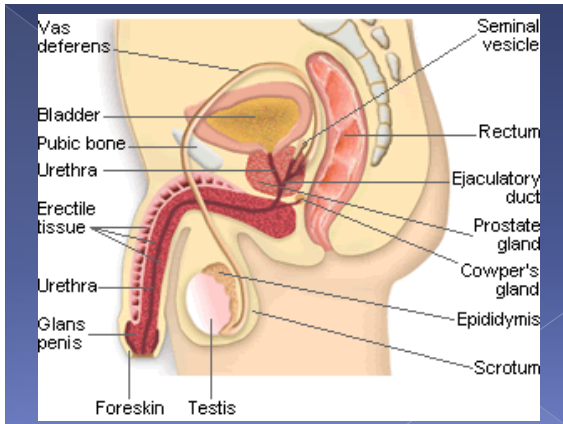
Estrogen & Progesterone

- Estrogen is responsible for secondary sex characteristic
- Females tend to be round because the have a greater accumulation of fat beneath the skin
- Larger pelvic girdle
- Breast development
- Larger buttocks
- More of a lower back curve

Male

- The male gonads are paired testes, which are suspended within the sac-like scrotum.
- The testes begin their development inside the abdominal cavity but descend into scrotal sacs during the last two months of fetal development.
- If testes do not descend, sterility results (inability to produce offspring)
- The scrotum helps lower temperature; sperm need a lower temperature in order to survive.
- Sitting for extended amount of time in front of a computer, TV can cause an increase in temperature in the scrotum and lower the sperm count.





Male

- Each testis is composed of one to three tightly coiled seminiferous tubules, each tubule is packed with cells undergoing spermatogenesis, which is the production of sperm
- Mature sperm have three main parts:
 - ✓ Head – contains nucleus which is covered by a cap known as an acrosome, which stores enzymes needed to penetrate the egg
 - ✓ Middle piece
 - ✓ Tail
- Sperm generally do not live longer than 48 hours in the female reproductive tract.
- The male sex hormone, testosterone is secreted by cells that lie between the seminiferous tubules and are known as interstitial cells.

Male

Genital Tract

- Sperm are produced by the testes and stored in the epididymis, which are tightly coiled ducts laying outside the testes.
- Sperm maturation is required in order for sperm to swim to eggs
- When the sperm have matured they leave the epididymis and enter the vas deferens where they may be stored.
- Each vas deferens passes into the abdominal cavity, where it curves around the urinary bladder and empties into the ejaculatory duct.
- This ejaculatory duct connects to urethra
- At the time of ejaculation the sperm leaves the penis as fluid known as semen (seminal fluid)

Male

- The pair of seminal vesicles at the base of the bladder an each duct joins with the vas deferens
- The prostate gland is a single donut shaped gland that surrounds the upper portion of the urethra just below the urinary bladder.
- The bulbourethral glands are pea-sized organs that lie underneath the prostate on either side of the urethra
- These secretions cause semen to be slightly basic (allow sperm to survive), contains the sugar fructose (energy source) and contains prostaglandins which are chemicals that cause the women's uterus to contract helps propel sperm forward.

Male

Hormonal Regulation in Males

- The hypothalamus has ultimate control of the testes, because it secretes gonadotropin-releasing hormone (GnRH) that stimulates
- The anterior pituitary to secrete gonadotropic hormones
- There are two gonadotropic hormones (in both males and females)
- Follicle-Stimulation Hormone (FSH) stimulates production of sperm in seminiferous tubules, which release the hormone inhibin.
- Inhibin is released when there is adequate sperm and it inhibits further FSH from being synthesized
- Luteinizing Hormones (LH)

Male

- Controls the production of testosterone by the interstitial cells
- Testosterone is the main sex hormone in males, it is essential for normal development of sex organs.
- It also brings and maintains male secondary sex characteristics that develop during puberty
- Males are generally taller, and have broader shoulders and legs
- Deeper voices, due to a larger larynx and vocal cords
- Males have hair on the chest, face and occasionally back
- Males have greater muscular development
- Testosterone also leads to receding hairline and