

2023/24 Academic Year **Biology** Lesson Note for Grade **11**

Unit Five: The human body systems

5.1. Human Musculoskeletal Systems

Musculoskeletal system is a body structure made up of bones of the skeletons, muscles, cartilages, tendons, ligaments, joints and connective tissues.

Musculoskeletal systems bind organs together, support stability, allow bodily movements and produce blood cells for the body (bone marrow) and stores minerals

The human musculoskeletal system comprises:

1. **Muscles** keep bones in place and enable movements.
2. **Joints and cartilages** connect bones to bones and prevent them from rubbing against each other.
3. **Tendons** connect muscles to bones.
4. **Connective tissues:** internal skeletal system parts favoring positions and movements
5. **Ligaments** are fibrous connective tissues that attach bone to bone.

5.1.1. Types of muscles

The human body is composed of three types of muscles:

1. Cardiac muscles
2. Skeletal muscles
3. Smooth muscles

1. The Cardiac muscles

The cardiac muscle (heart muscle) forms a thick middle layer between the outer layer of the heart wall (pericardium), and the inner layer (endocardium) with blood supplied to circulate via the coronary circulation.

It is composed of tissues of the wall of the heart called **myocardium**.

Individual cardiac muscle cells are joined together by intercalated discs and are encased by collagen fibers to form the extracellular

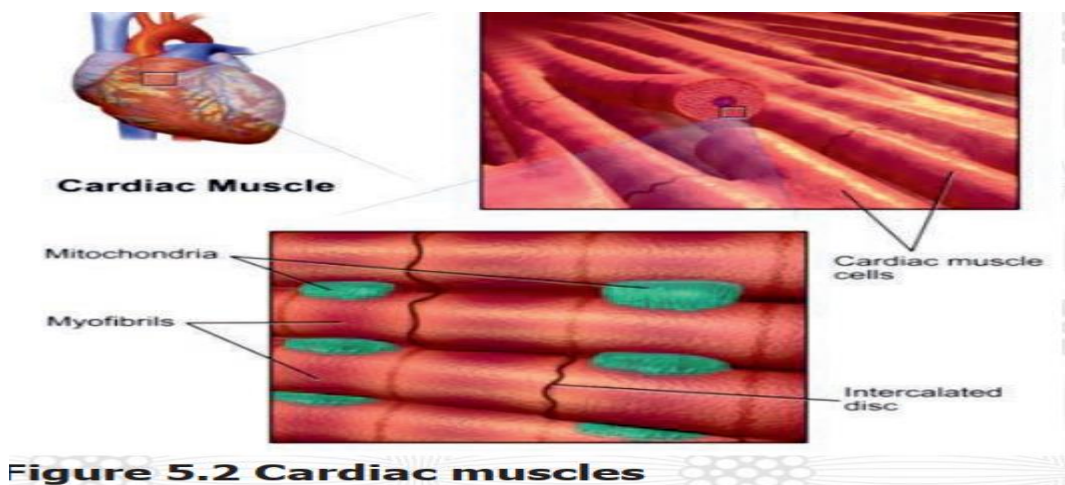
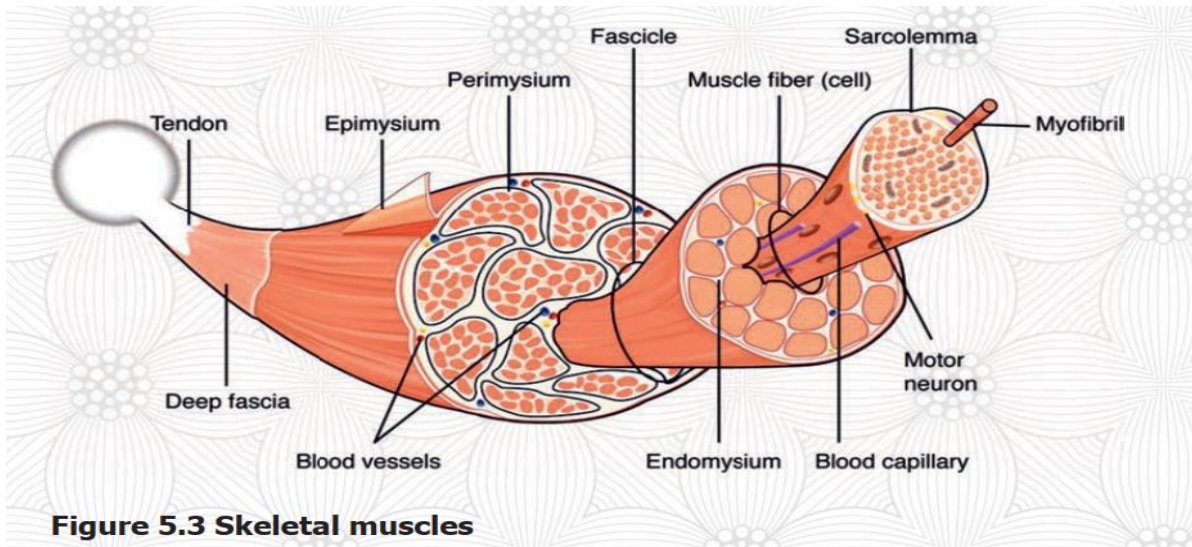


Figure 5.2 Cardiac muscles

2. The Skeletal Muscle

The skeletal muscles are attached to bones and are composed of 30 to 40% of total body mass. They allow the body to perform a wide range of movements and functions such as voluntary controlled systems on works. The skeletal muscle fibers innervated by a single motor axon are called a **motor unit**.



3. The Smooth Muscles

They are involuntary, non-striated and unconsciously controlled muscles that control the flow of substances within the lumens.

They are found in the walls of hollow organs: the stomach, intestine, bladder, uterus and walls of passageways of the blood and lymph vessels, respiratory tracts, urinary and reproductive systems, in the eyes and the ciliary muscles.

The smooth muscle cells of the skins are the erector of pili causing hair to stand erect in response to cold, heat or fear.

5.1.2. Mechanism of actions of skeletal muscles

Mechanisms of action of muscles are the process of activations of muscle cells to generate tension or contract for movements.

Most of the cytoplasm consists of myofibrils of cylindrical bundles of two types of filaments of thick filaments of myosin and thin filaments of actin where each is organized as a chain of contractile unit called sarcomeres.

Actin and myosin are both proteins found in every type of muscle tissue where the thick myosin filaments and thin actin filaments work together to generate muscle contractions and movement.

Myosin is a type of molecular motor that converts chemical energy released from ATP into mechanical energy used to pull the actin filaments along causing muscle fibers to contract and generate. Actin filaments, together with myosin are responsible for many types of cell movements. The most noticeable form of movement is muscle contraction, which has provided the model for understanding actinmyosin interactions and the motor activity of myosin molecules.

Troponin is a complex system of three regulatory proteins integral to muscle contraction in skeletal muscles. In a relaxed muscle, tropomyosin blocks the attachment site for the myosin cross bridge preventing contraction. The binding of myosin to actin causes cross bridge formation and contraction of the muscle.

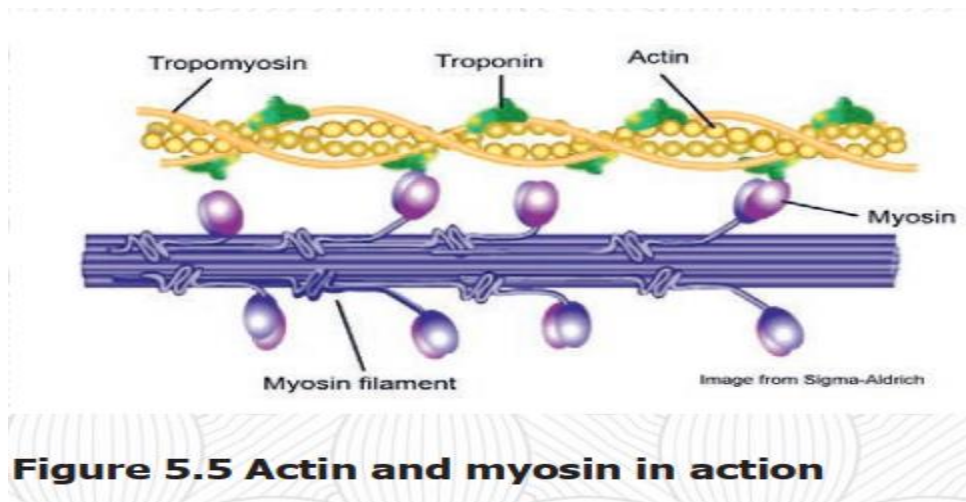


Figure 5.5 Actin and myosin in action

Mechanism of actions in muscles:

1. **Muscle activation:** the motor nerve stimulates an action potential (impulse) to pass down a neuron to the neuromuscular junction and stimulates the sarcoplasmic reticulum to release calcium into the muscle cell.
 2. **Muscle contraction:** Calcium floods into the muscle cells bound with troponin allowing **actin** and **myosin** to bind, in which the actin and myosin cross bridges bind and contract, using ATP as energy that all cells use to fuel activity.
 3. **Recharging:** ATP is re-synthesized (remanufactured), allowing actin and myosin to maintain a strong binding state.
- Relaxation:** relaxation occurs when stimulation of the nerve stops and pumps Calcium back into the sarcoplasmic reticulum breaking the link between actin and myosin. Actin and myosin return to unbound state causing the muscle to relax, but relaxation failure occurs if ATP is no longer available.

Contraction : occurs when the two-inter-digitizing filaments, the thin actin and the thick myosin filaments, slide pass each other.

There are three types of muscle contractions:

1. **Isometric:** does not change the length (Figure 5.6a).
2. **Concentric:** shortening the muscle (Figure 5.6b).
3. **Eccentric:** lengthening the muscle fibers (Figure 5.6c)

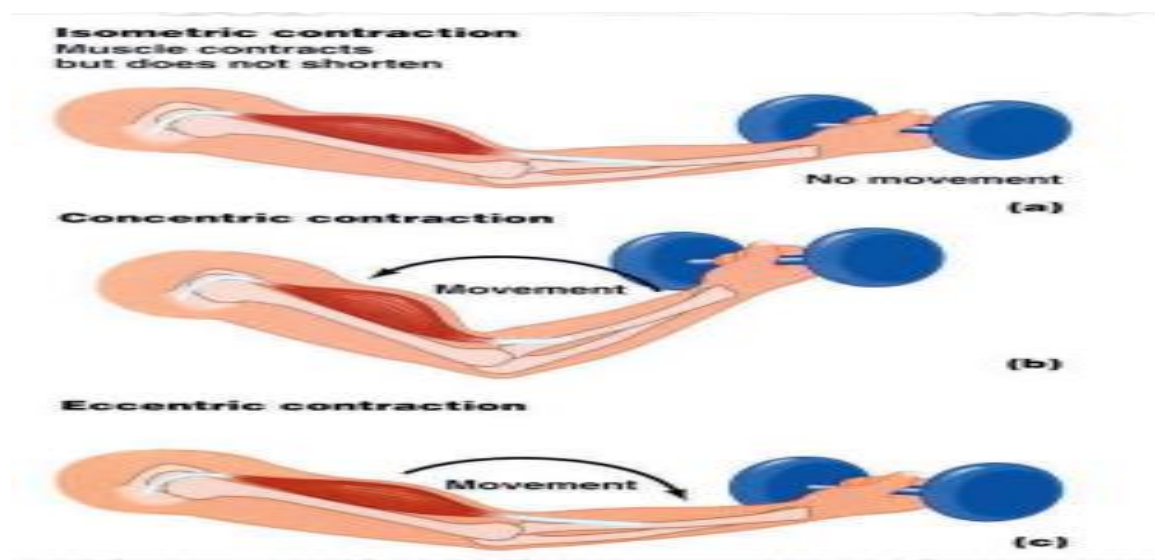


Figure 5.6 Types muscle contractions

5.1.3. The human axial and appendicular skeletons

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Humans are born with over 300 bones, but many of the bones fuse between birth and the end of maturity and remain with the average number of 206 bones in an adult skeleton. Bones have three different layers made from three different kinds of cells.

The general structure of bones is a combination of a protein called collagen and a molecule called calcium phosphate that weave together to form a strong and lightweight structure.

Bones are composed of four types of cells. These are:

- ☐ **Osteoblasts** involve in new bone formation.
- ☐ **Osteocytes** are mature bone cells that help to mature bones of newborns.
- ☐ **Osteoclasts** break down bones and help them to form into correct shapes.
- ☐ **Osteoprogenitor** are important in repair of fracture.

Based on their shapes, there are four different types of bones in the human body:

1. **Long bones** have long and thin shapes. Femur and tibia (bones longer than wide)
2. **Short bones** have squat and cubed shapes. Carpus (bone of wrists)
3. **Flat bones** have flattened and broad surfaces.
4. **Irregular bones** have shapes that do not conform to the above three types. Vertebrae, sacrum, coccyx, temporal, mandible, palatine, nasal, etc.
5. **Sesamoid bones** are small, flat bones and are shaped similarly to a sesame seed. Small sesame seed-like bones that are embedded in the muscles.

Functions of bones:

1. **Support body and helping move:** bones hold up body **stability**, keep from collapsing to the ground, movement and body posture.
2. **Protecting the internal organs:** bones keep organs to be safe from hard impacts, punctures, and other forms of injury (ribs protect the heart and lungs, and the skull protects the brain).
3. **Producing blood cells:** certain types of bones make platelets, red blood cells, and white blood cells inside bones.
4. **Storing and releasing fat:** certain bones store fat and release when body needs energy.
5. **Storing and releasing minerals:** bones store necessary minerals when the levels are too high in the blood and release minerals when the body needs them (calcium, phosphorus, and vitamin D).

1. The axial skeleton

It consists of the skull, trunk, and pelvis bones of the medial core of the body.

The skull is composed of the cranium bones fitting together at joints (sutures) and the facial bones forming the lower front part, consisting of the eye, the ear, the nose, and the mouth cavities. Axial skeleton includes the jaw, or mandible, the upper jaw, or maxilla, the zygomatic, or cheekbone, and the nasal bone. The rib cage (thoracic cage) forms the thorax (chest) portion of the body and consists of 12 pairs of ribs with costal cartilage and the sternum.

Table 5.2 Parts of the axial skeleton parts

Parts of the axial skeleton	Number of bones	Functions
Skull (Cranium 8+Facial 14)	22	It holds and protects the brain.
Ossicles (both ears, 3+3)	6	Auditory
Hyoid (neck)	1	Holds the head
Thoracic (rib cage)	24	It protects the heart and lungs.
Thorax (sternum)	1	Bind and handle the abdomen
Vertebral column	26	Holds up human body
Total bones	80	

2. The appendicular skeleton

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It is the portion of the skeleton that consists of 126 bones out of a total of 206 bones and supporting appendages. It includes skeletal elements, limbs, shoulder-supporting girdle, pectoral, pelvic girdle, and joined appendages. It is involved in the locomotion of lower limbs and manipulation of objects in the upper limbs.

Table 5.3 Parts of the appendicular skeleton

Appendicular skeleton parts	Number of bones
Shoulder girdles	4
Pelvis	2
Arms and forearms	6
Thighs and legs	8
Hands	54
Feet and ankles	52
Sum	126

Total number of bones in the human body = axial + appendicular = 80 + 126 = 206

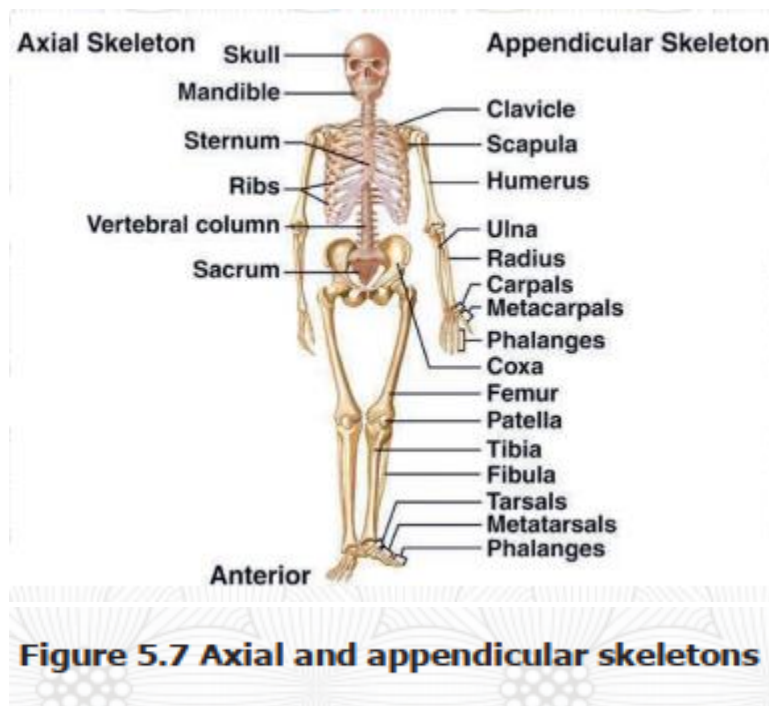


Figure 5.7 Axial and appendicular skeletons

5.1.4. Joints

Joints are the parts of the body where two or more bones meet with binding tissues and allow the body to produce movements.

- 1. The ball and socket joint:** the rounded head of one bone sits in the cup of another bone to permit movement in all directions (shoulder and hip joints).
- 2. Hinge joints:** like a door, a joint that opens and closes in one direction along one plane only (elbow and knee joints).
- 3. Condylloid joints:** joints that do not rotate but allow movements (finger and jaw).
- 4. Pivot joints** are rotary or trochoid joints in which one bone swivels in a ring (ulna, radius, and neck).
- 5. Gliding joints:** a plane joint that allows only limited movement by slipping smooth surfaces over one another (wrist joint).
- 6. Saddle joint:** enables movement back and forth, side to side, and cannot rotate (thumb base).

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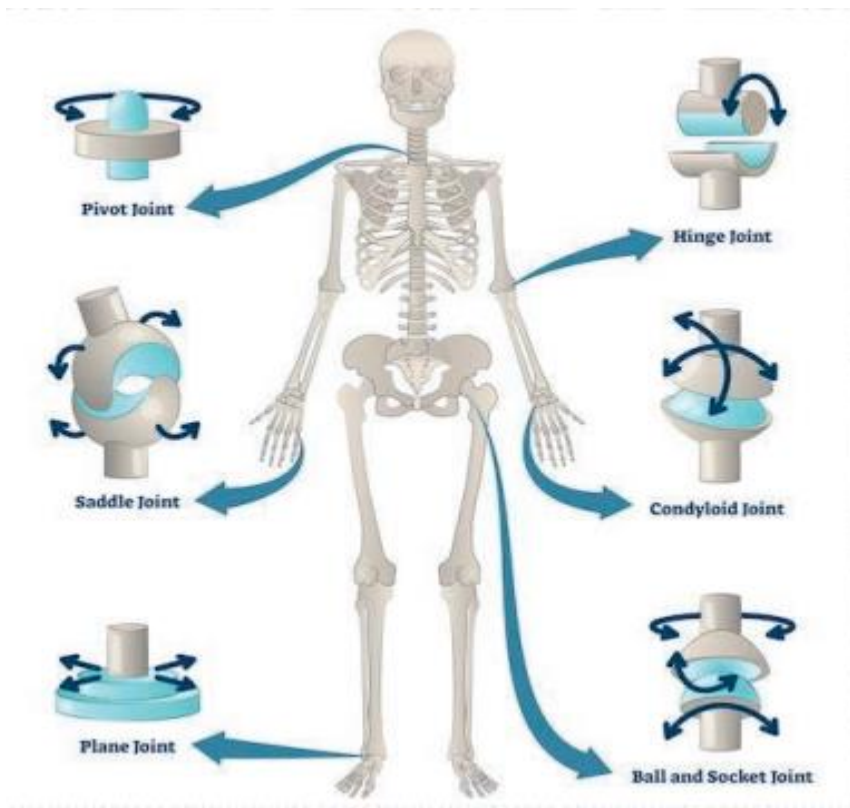


Figure 5.8 Major human joints

5.2 The reproductive system

The function of the human reproductive system is to produce and deposit sperms in males and egg cells in females.

5.2.1. Human reproductive system (Male and Female)

The male reproductive systems

The male reproductive system contains the external genital organs (penis, testes, and the scrotum) and internal parts (prostate gland, vas deferens, and urethra) that work together to produce sperm (male gametes), male sex hormones, and other components of the semen

1. The penis

The penis is the male copulatory organ. The penis contains soft, spongy tissue as well as muscles, fibrous tissue, veins, arteries, and the urethra. It has urinary and sexual functions. The sexual function of the penis can be described as two stages: erection and ejaculation.

An erection is the stiffening of the penis caused by sexual arousal and/or physical stimulation. It is also normal for erections to occur during sleep and upon waking. An erection occurs when there is an increased flow of blood into the corpus cavernosa and corpus spongiosum. During an erection, arteries supplying the erectile tissues will dilate (widen), causing the penis to engorge (fill) with blood. The engorgement compresses the veins through which blood usually exits the penis. This "traps" the blood and helps sustain the erection.

2. Urethra

The urethra is a tube that connects the urinary bladder to the urinary meatus for the removal of urine from the body. In males, the urethra allows for the passage of urine from the bladder to the outside of the body (urination) and is also responsible for the expulsion of sperm during ejaculation.

3. The scrotum

The scrotum is a sack of thick skin that protects the testes and controls the temperature of the testes for suitable sperm creation. It contains seminal vesicles, vas deferens, testicles (testes), and prostate gland that constitute all the remaining components of the male reproductive system.

4. Testes

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Testes are oval pair bodies found in the scrotum with two primary functions: Production of testosterone or male sex hormones and sperm (spermatogenesis).

Table 5.4 summary of male reproductive structures and their function

Structure	Function
testes	• produce sperm cells • produce the hormone testosterone
seminiferous tubules	• produce immature sperm cells
epididymis	• matures and stores sperm cells in coiled tubules
vas deferens	• carries sperm from the epididymis to its junction with the urethra
seminal vesicle	• secretes fructose into the semen, which provides energy for the sperm
prostate gland	• secretes an alkaline buffer into the semen to protect the sperm from the acidic environment of the vagina
Cowper's gland	• secretes mucus-rich fluids into the semen that may protect the sperm from acids in the urethra
urethra	• carries semen during ejaculation • carries urine from the bladder to the exterior of the body
penis	• deposits sperm into the vagina during ejaculation • contains the urethra

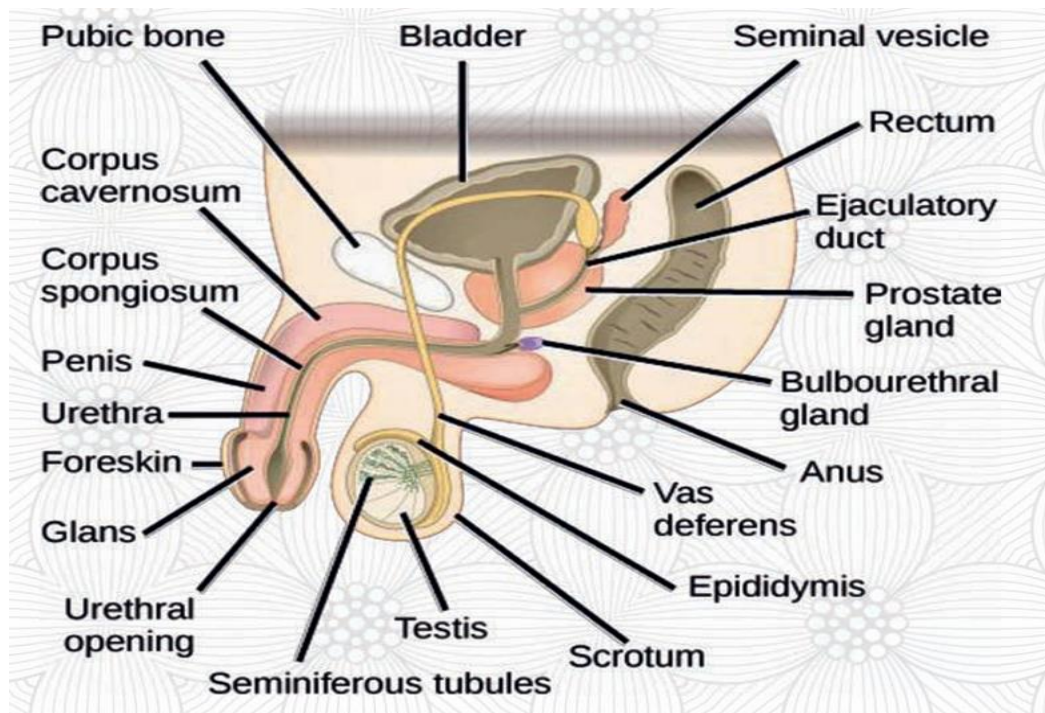


Figure 5.9 Male reproductive systems

The Female Reproductive Systems

The female reproductive system includes the ovaries, fallopian tubes, uterus, vagina, accessory glands, and external genital organs. Its functions include producing gametes called eggs, secreting sex hormones (such as estrogen), providing a site for fertilization, gestating a fetus if fertilization occurs, giving birth to a baby.

The internal reproductive organs include:

- **Labia majora:** The labia majora (“large lips”) enclose and protect the other external reproductive organs. During puberty, hair growth occurs on the skin of the labia majora, which also contain sweat and oil-secreting glands.

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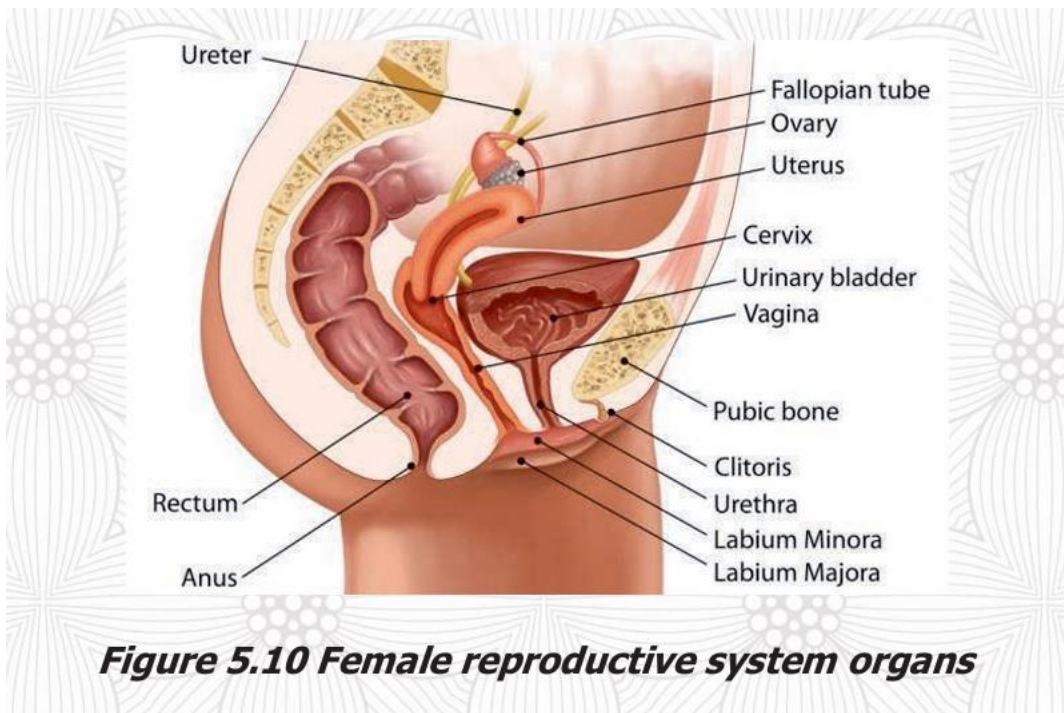
- **Labia minora:** The labia minora (“small lips”) can have a variety of sizes and shapes. They lie just inside the labia majora, and surround the openings to the vagina (the canal that joins the lower part of the uterus to the outside of the body) and urethra (the tube that carries urine from the bladder to the outside of the body). This skin is very delicate and can become easily irritated and swollen.
- **Bartholin’s glands:** These glands are located next to the vaginal opening on each side and produce a fluid (mucus) secretion.
- **Clitoris:** The two labia minora meet at the clitoris, a small, sensitive protrusion that is comparable to the penis in males. The clitoris is covered by a fold of skin, called the prepuce, which is similar to the foreskin at the end of the penis. Like the penis, the clitoris is very sensitive to stimulation and can become erect.

The internal reproductive organs include:

- **Vagina:** The vagina is a canal that joins the cervix (the lower part of the uterus) to the outside of the body. It is also known as the birth canal.
- **Uterus (womb):** The uterus is a hollow, pear-shaped organ that is the home to a developing fetus. The uterus is divided into two parts: the cervix, which is the lower part that opens into the vagina; and the main body of the uterus, called the corpus. The corpus can easily expand to hold a developing baby. A canal through the cervix allows sperm to enter and menstrual blood to exit.
- **Ovaries:** The ovaries are small, oval shaped glands that are located on either side of the uterus. The ovaries produce eggs and hormones.
- **Fallopian tubes:** These are narrow tubes that are attached to the upper part of the uterus and serve as pathways for the ova (egg cells) to travel from the ovaries to the uterus. Fertilization of an egg by sperm normally occurs in the fallopian tubes. The fertilized egg then moves to the uterus, where it implants into the uterine lining.

Table 5.5 Summary of female reproductive structures and their function

Structure	Function
ovaries	• produce the hormones estrogen and progesterone • site of ova (egg cell) development and ovulation
fallopian tubes (oviducts)	• carry the ovum from the ovary to the uterus • usually the site of fertilization
fimbria	• sweep the ovum into the oviduct following ovulation
uterus (womb)	• pear-shaped organ in which the embryo and fetus develop • involved in menstruation
cervix	• separates the vagina from the uterus • holds the fetus in place during pregnancy • dilates during birth to allow the fetus to leave the uterus
vagina	• extends from the cervix to the external environment • provides a passageway for sperm and menstrual flow • functions as the birth canal



5.2.2 Gametogenesis

Gametogenesis is the process where of formation and development of specialized generative cells, gametes (oocytes/sperm), from bipotential primordial germ cells.

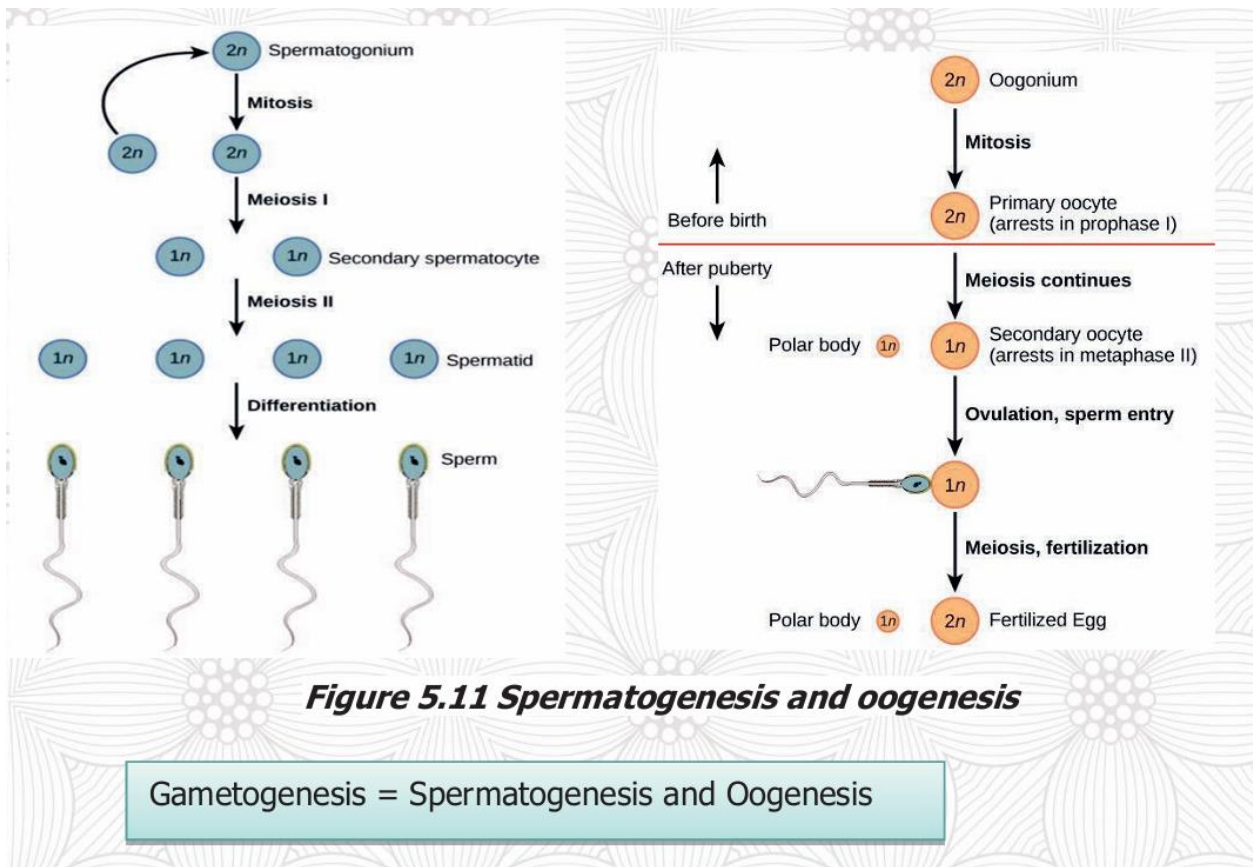
Gametogenesis is a process where a haploid daughter cell (n) is formed from a diploid mother cell ($2n$) through meiosis. This process is called spermatogenesis in male that produces spermatozoa and oogenesis in female that produces ova.

Spermatogenesis

Spermatogenesis is the process by which haploid (n) spermatozoa develop from germ cells in the seminiferous tubules of the testis. The testes also produce the male hormone called androgen (testicular hormone). Germinal epithelium lines the seminiferous tubules. The majorities of cells here are cuboidal and called primordial germ cells or PGCs. These immature male germ cells undergo successive mitotic and meiotic divisions to produce sperms. The diploid primordial germ cells are present in the lining of the seminiferous tubules of testis. Some cells which are tall and somatic are called Sertoli cells. They help in the nourishment of the developing sperms and are also called nurse cells. At sexual maturity, the undifferentiated primordial germ cells or PGCs of seminiferous tubules divide several times by mitosis to produce large number of sperm mother cells or spermatogonia. Spermatogonia are diploid and possess 46 chromosomes. They then go through mitotic division and generate primary spermatocytes which undergo meiosis to form two haploid cells known as secondary spermatocytes. Each secondary spermatocyte has 23 chromosomes. Second meiotic division occurs in secondary spermatocytes, resulting in production of four equal and haploid spermatids. The spermatids are transformed into spermatozoa (sperm) by the process of spermiogenesis. These develop into mature spermatozoa, also known as sperm cells. Maturation of the sperm cells takes place in the epididymis where it is secreted in the form of semen during puberty.

Oogenesis

Oogenesis is the development of female egg cells found in the outermost layers of the ovaries germ cell oogonium and ends with one to two million cells in the embryogenesis. It undergoes the primary oocyte development that begins with meiotic division. Oogenesis arrests division as it develops in the follicle and gives rise to a haploid (n) cell oocyte of a smaller polar body called oogenesis.



Phases of the menstrual cycle

The menstrual cycle is the process of discharge of blood and other things through the vagina of a woman every month from puberty to menopause excluding pregnancy. It is a natural periodical process that brings changes in the female reproductive system which is responsible for the pregnancy.

- It includes changes that occur in the ovary and the uterine walls simultaneously as a result of changes in the level of hormones in the blood.
- Two significant events occur within the female reproductive organs: the first is the release of a single ovum from one of the ovaries and, the second is that the uterine endothelium is prepared for the plantation of a fertilized ovum. If the ovum is not fertilized, the lining is released which results in menstruation. Menstruation occurs when the uterine lining sheds, resulting in blood that exits the body via the vagina. The duration of the cycles averages about 28 days. However, the period that might differ in different women can range from 20 days to 45 days. The difference in the duration is associated with decreased fertility.

Phases (events) of menstrual cycles are:

- **The follicular phase:**

is the event when the anterior pituitary produces and secret estrogens called follicles stimulated hormones (FSH) that inhibit the secretion of negative feedback to prevent the growth of other follicles.

- **The ovulation phase:**

an event when ovulation takes place in the midway through the cycle (days 12-14) and estrogen stimulates the anterior pituitary to secret luteinizing hormones (LH) as positive feedbacks to surge the release of an egg (secondary oocyte) as ovulation.

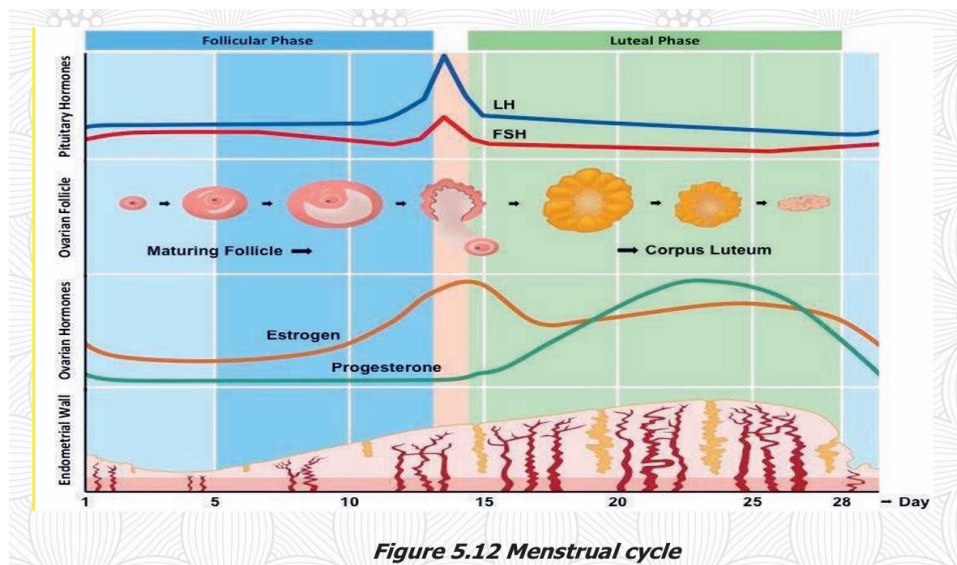
- **The Luteal phase:**

rupture follicle develops into a slowly degenerating corpus luteum to secret high levels of progesterone and lower levels of estrogen. Both estrogen and progesterone act on the uterus to thicken the endometrial lining in preparation for pregnancy and inhibit the secretion of FSH and LH to prevent any follicle from developing.

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• The Menstruation phase:

in the menstrual cycle, if fertilization occurs, the embryo develops, implants in the endometrium and release hormones to sustain the corpus luteum. If fertilization fails, the corpus luteum degenerates, estrogen and progesterone levels drop and forms corpus albinos after two weeks. The endometrium is not maintained longer and its layer is eliminated from the body as menstrual blood or period.



Feedbacks to menstrual cycle:

- Estrogen hormone promotes the secretion of the ovulation of the menstrual cycle.
- During days 12–14, estrogen provides positive feedbacks to the hypothalamus and pituitary gland to accelerate the production of estrogen leading to ovulation.
- Progesterone involves in the menstrual cycle and promotes gestation or the carrying of a fetus to maintain the endometrium of the uterus.
- The uterus walls dilation continue by contracting and stretching until the birth of a baby.

Table 5.6 Menstrual cycle

Phases	Days	Events
Menstrual Phase	1- 4	Menstruation occurs
Follicular Phase	5-13	Follicle matures and endometrium develops
Ovulation phase	14	Ovary releases an egg
Luteal Phase	15-28	Follicle becomes the corpus luteum and endometrium prepares for an egg

5.2.2 Positive and negative feedbacks to control the menstrual cycle

A feedback mechanism is a physiological regulation system in the body that works to return the body to its normal internal state, commonly known as homeostasis. The “positive feedback” is the process in which the end products of an action cause more of that action to occur in a feedback loop. In a menstrual cycle, it is a period (days 12–14) during when estrogen stimulates the hypothalamus of the brain to release Gonadotropin Releasing Hormones (GnRH) that stimulates the anterior pituitary gland to secrete Luteinizing Hormones (LH) and Follicle Stimulating Hormones (FSH)

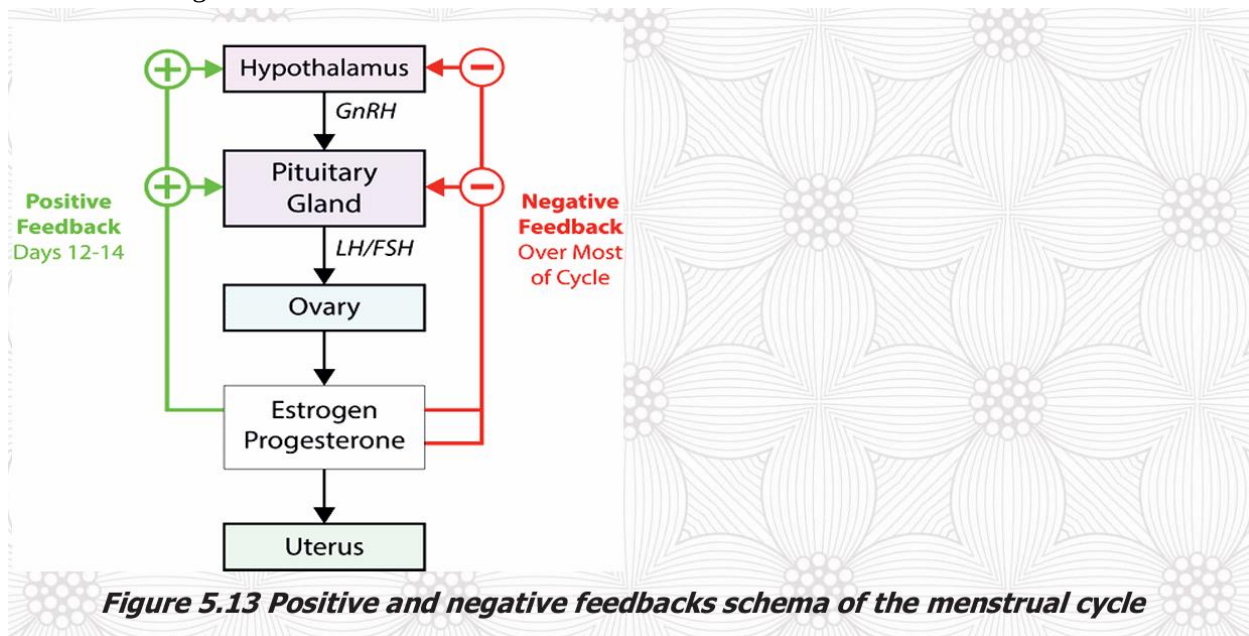
1. **Luteinizing Hormone (LH)** LH is a gonadotrophic hormone for regulating the function of the testes in men and ovaries in women.
 - In men, it stimulates cells in the testes to produce testosterone to support sperm production.

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- In women, it carries out different roles in the two halves of the menstrual cycle. In weeks one to two of the cycle, the hormone stimulates the ovarian follicles to produce the female sex hormone estradiol. Around day 14 of the cycle, a surge in LH levels causes the ovarian follicle to rupture and release a mature oocyte (egg) from the ovary called ovulation. For the remainder of the cycle (weeks three to four), the remnants of the ovarian follicle form a corpus luteum to produce progesterone required to support the early stages of pregnancy. The rise of the levels LH is a negative feedback and too much LH is an indicator of infertility

2. Follicle Stimulating Hormone (FSH)

FSH is a hormone that plays a role in sexual development, reproduction and affects ovaries and testicles. Women are born with all the eggs and the ovarian reserve consists of one to two million eggs at birth of which around 400,000 eggs reach puberty, 400 eggs mature and ovulate throughout our reproductive years. The brain releases the hormone at the beginning of each cycle to stimulate ovaries to grow follicles and eggs for ovulation. The progesterone maintains the uterine lining or thickness of the uterus wall and lesser it for happening pregnancy. The rise in FSH stimulates the growth of the follicle in the ovary, produces the increasing amounts of estradiol and reduces the release of gonadotrophin hormone as negative feedback. During each menstrual cycle, is a rise in FSH secretion in the first half of the cycle (follicular phase) stimulates follicular growth in the ovary leading to ovulation. The ruptured follicle forms a corpus luteum that produces high levels of progesterone (luteal phase) and at the end of the cycle, the corpus luteum breaks down, progesterone production decreases and the next menstrual cycle begins as follicle stimulating hormone levels start to rise again. In negative feedbacks, the mechanism of biochemical pathway turns off, the egg fails of fertilization, the corpus luteum dies, progesterone levels drop and the uterine lining breaks down and the woman is having a period or menstruation. The positive feedback leads to ovulation and the negative feedback leads to menstruation.



5.2.3 Fertilization and pregnancy

1. Fertilization

Fertilization is the union of human egg and sperm cells in the ampulla of the fallopian tube to produce a zygote. The process of fertilization occurs when 23 sets of chromosomes from a spermatozoon and 23 sets of chromosomes from an egg cell fuse together. The fertilized egg (zygote) divides repeatedly as it moves down the fallopian tube to the uterus. About six days after fertilization, the embryo attaches to the lining of the uterus, usually near the top. This process is called implantation and it is completed within nine or ten days.

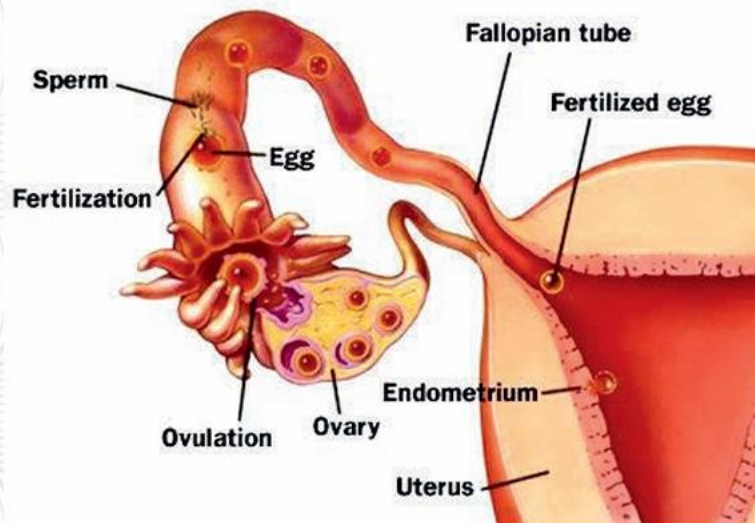


Figure 5.14 Fertilization

3. Pregnancy

Pregnancy or gestation period is the period in which the fetus develops inside a woman's womb or uterus. Pregnancy lasts about 40 weeks (280 days) to delivery counted from the last menstrual period. A pregnancy with more than one fetus at a time is called a multiple pregnancy (twin or triplet).

The followings are signs and symptoms of pregnancy:

- Missed periods, tender breasts and morning sickness (nausea, vomiting)
- Hunger and frequent urination
- Pregnancy test confirms pregnancy

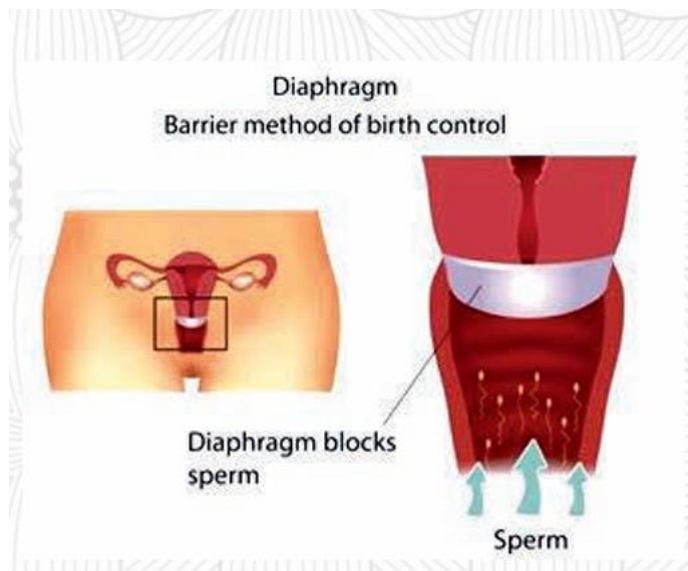
4. 5.2.4 Mechanism of action of contraceptives

The intentional Contraception refers to process of preventing pregnancy through the use of various hormonal drugs, devices, sexual practices, chemicals, and surgical procedures. People use contraception for a range of reasons such as to plan family size, reduce pregnancy related risk, reduce teenage pregnancies, have healthy babies, prevent sexually transmitted diseases like HIV/AIDS, and to balance the population growth with economic growth.

Based on their mechanisms of action, contraceptives can be categorized as barrier or non-barrier contraceptives.

1. **Barrier mechanism of contraceptives:** Devices that provide a physical barrier between the sperm and the egg. Examples include the male condom, female condom, diaphragm, and cervical cap. Condoms (male and female) are the only contraceptive methods that helps prevent sexually transmitted infections (STIs).

Diaphragm is a small and soft silicon dome placed inside the vagina to stop sperm from entering the uterus where it forms a physical barrier between the man's sperm and the woman's egg like a condom



2. **Non-barrier contraceptives:** Types of contraceptive methods such as chemical barriers or spermicides, oral contraceptive pills, intrauterine devices (IUD), hormonal implants, hormone injections, post pill and contraceptive ring.

Chemical barriers or spermicides are sperm-killing substances, available as foams, creams, gels, films or suppositories, which are often used in female contraception in conjunction with mechanical barriers and other device



Figure 5.17 different spermicide contraceptives

Oral contraceptive pills

are combined hormonal pills with Oestrogen and progesterone. Oral contraceptive pill (COC) is a type of birth control that is designed to be taken orally by women. The pill contains two important hormones: progesterone and estrogen. The pill prevents the ovaries from releasing an egg each month (ovulation). It also thickens the mucus in the neck of the womb, so it is harder for sperm to penetrate the womb and reach an egg. It thins the lining of the womb, so there is less chance of a fertilized egg implanting into the womb and being able to grow. Progesterone-only pills (POP) prevent pregnancy by thickening the mucus in the cervix to stop sperm reaching an egg. The progesterone-only pill can also stop ovulation. The progesterone-only pill needs to be taken every day to work.

The copper-coated intrauterine device (IUD)

is a small T-shaped device made from material that contains (coated) progesterone hormone or plastic and copper. The IUD fitted inside a woman's uterus by trained healthcare providers does not allow the sperm to fertilize the egg and

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prevent pregnancy. It may also make it harder for a fertilized egg to implant in the uterus as it thickens the cervical mucus and thins the uterine lining.

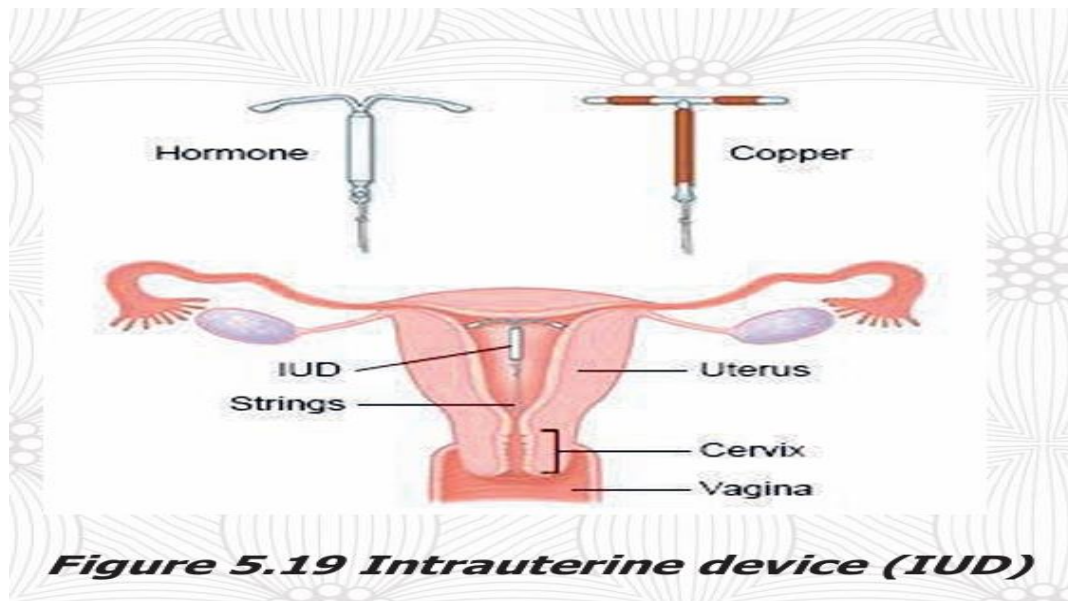


Figure 5.19 Intrauterine device (IUD)

Contraceptive implant: is a small flexible plastic rod placed under the skin in your upper arm by a doctor or a nurse and lasts for three years releasing the hormone progesterone into the bloodstream to prevent pregnancy.

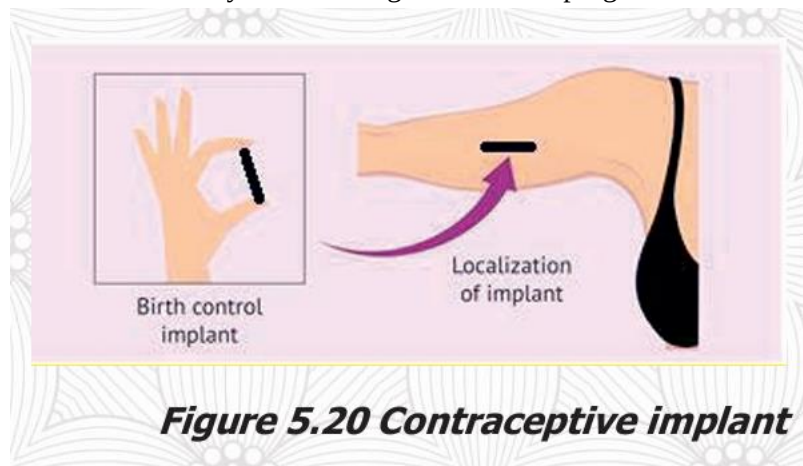


Figure 5.20 Contraceptive implant

Contraceptive injection

Contains a synthetic version of the hormone progesterone DEPO Provera, which is a well-known brand name for medroxyprogesterone acetate, a contraceptive injection. It prevents the body from producing its own hormones and releasing eggs from the ovaries. However, an estimated 6% of people using Depo-Provera will get pregnant.

Post pill

is a hormonal oral contraceptive tablet used as an emergency contraceptive to prevent pregnancy within 72 hours. It contains the hormone levonorgestrel, a progestin that prevents ovulation, block fertilization or keep a fertilized egg from implanting in the uterus. Post pill is an emergency oral contraceptive pill (ECP) used to prevent pregnancy after unprotected sex.

Contraceptive ring (vaginal ring)

Releases a continuous dose of the hormones estrogen and progesterone into the bloodstream to prevent pregnancy.



Figure 5.23 Contraceptive Ring

Sterilization:

is a permanent method of contraception, suitable for people who are sure they never want children or do not want any more children. Sterilization procedures for women tubal ligation. The procedure for men is called vasectomy. Tubal ligation prevents an egg from traveling from the ovaries through the fallopian tubes and blocks sperm from traveling up the fallopian tubes to the egg. Vasectomy blocks or cuts each vas deferens tube, keeping sperm out of your semen. Sperm cells stay in the testicles and are absorbed by the body. Starting about 3 months after a vasectomy, the semen won't contain any sperm, so it can't cause pregnancy.

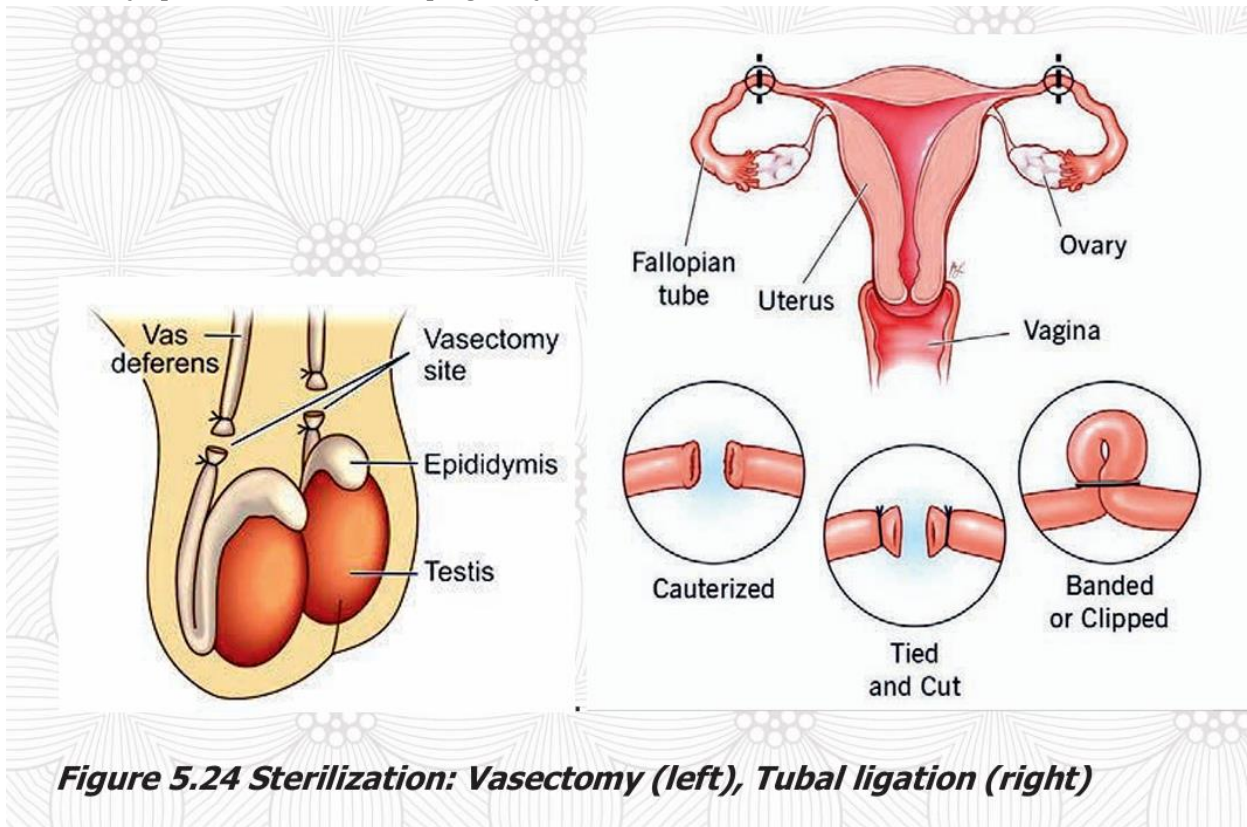


Figure 5.24 Sterilization: Vasectomy (left), Tubal ligation (right)

Methods	Failure rate	Mode of action	Advantage	Disadvantage
Oral Contraceptives	0.3-5	Inhibit ovulation; may affect endometrium and cervical mucus and prevent implantation	Highly effective and regulate menstrual cycle	Minor discomfort in some women, should not be used by women over age 35 who smoke
Injectable contraceptives Depo-Provera	About 1	Inhibit ovulation	Effective and long-lasting	Irregular menstrual bleeding, fertility may not return for six to 12 months after contraceptive is discontinued
Intrauterine device (IUD)	1-1	Stimulates inflammatory responses and prevent implantation	Provides continuous protection, highly effective for several years	Cramps, increased menstrual flow and risks of pelvic inflammatory diseases and infertility; not recommended for women who have not had a child
Spermicides, foams, jellies and creams	3-20	Chemically kill sperm	No known side effects; can be used with a condom or diaphragm to improve efficacy	Messy, must be applied before intercourse
Diaphragm Contraceptives	3-14	Mechanically blocks entrance to cervix	No side effects	Must be inserted prior to intercourse and left in place for several hours afterward
Condom	2.6-14	Mechanically prevent sperm from entering vagina	No side effects; some protection from STIs and HIV	Slightly decreased sensation for male and could break (torn)
Sterilization Tubal ligation	0.04	Prevent ovum from leaving uterine tube	Most reliable method	Requires surgery and considers permanent
Vasectomy	0.15	Prevent sperm from leaving vas deferens	Most reliable method	Requires surgery and considers permanent

Table 5.6 Summary of contraceptives

5.2.5 Causes of infertility in humans Infertility

Is the inability of a person to reproduce by a natural way. Female infertility is the inability to get pregnant (conceive) after unprotected sex. Male infertility refers low sperm production, abnormal sperm function, or blockages that prevent the delivery of sperm and consequently protect the ejaculation of adequate healthy sperm cells.

5.2.6.1 Causes of infertility in women

The cause of female infertility is ovulatory problems manifested by the sparse or absent menstrual periods.

Causes of infertility in females:

- Thyroid problems: it prevents ovulation by making both overactive and underactive.
- Pelvic surgery complications include fallopian tube damage and scarring, as well as cut ovaries
- Cervical mucus problems: harder mucus does not let sperms to swim into vagina.
- Fibroids: non-cancerous growths in or around the womb affect fertility.
- Endometriosis: growths in the womb lining the endometrium block the ovaries.
- Pelvic inflammatory diseases cause infections of the upper female genital tract.
- Sterilization is a choice not to have any more children.
- Medicines and drugs: their uses and misuses have side effects that cause infertility.

Examples:

1. Drugs like marijuana, cocaine, and heavy cannabis use tobacco.
2. Medicines such as blood pressure medications, anti-depressants, and anti-psychotics.
3. Misuses of drugs and alcoholic drink

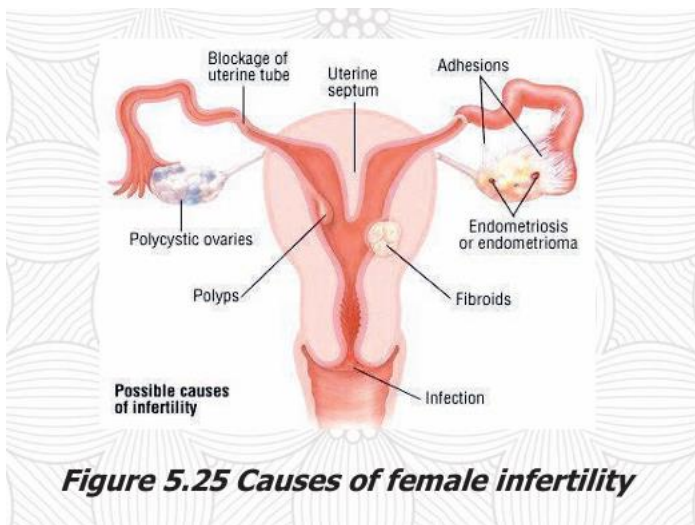


Figure 5.25 Causes of female infertility

5.2.6.2 Infertility in men

Male infertility is the production of low, abnormal, and dysfunctional sperm and blockages that prevent the adequate delivery of sperm. Chronic health problems, illnesses, injuries, inherited disorders, hormonal imbalances, dilated veins around the testicle, or a condition that blocks the passage of sperm and contribute to male infertility.

Symptoms of male infertility:

1. Immotile sperms facing harder to swim to the egg
2. Discomfort, pain and swelling or a lump in the testicle area
3. Surgery of the groin, testicle, prostate, penis, or scrotum
4. Lower sperm count (fewer than 15 million sperm per milliliter of semen or a total sperm count of less than 39 million per ejaculate).

Risk factors linked to male infertility:

- Smoking tobacco, using alcohol, and drug
- Being overweight and exposed to toxins
- Having repeated past or present STD infections
- Overheating and trauma to the testicles

5.2.6 The major sexually transmitted infections (STIs) in Ethiopia

5.2.7.1 Types of sexually transmitted infections and preventions

More than 20 types of sexually transmitted infections or diseases spread through unprotected sexual intercourse. The major causative agents or pathogens, are bacteria, viruses, and parasites.

Bacterial infections diseases

A. Bacterial Vaginosis

Bacterial vaginosis is a type of vaginal inflammation caused by the overgrowth of bacteria naturally found in the vagina. Bacterial vaginosis increases the risk of developing a post-surgical infection and causes infections of the uterus, fallopian tubes, and infertility.

- Causative agent: bacterial vaginosis
- Means of transmission: sexual contacts
- Symptoms: vaginal discharge (thin, gray, white or green), foul-smelling or fishy vaginal odor, vaginal itching and burning during urination.
- Prevention/treatment: protective sexual contact and medical treatments
- The prevalence of Bacterial Vaginosis in Ethiopia ranges from 2.8–19.4%.

B. Chlamydia

Chlamydia is a common sexually transmitted infection (STI) that's caused by a

bacteria called *Chlamydia trachomatis* (*C. trachomatis*). Chlamydia infections spread through sexual contact, when vaginal fluid or semen containing the bacteria that causes chlamydia travels from one person to another.



Figure 5.27 Diseases of Chlamydia

C. Syphilis **Syphilis** is a life-threatening disease that affects the brain, nervous system, eyes, heart, and several other organs and develops through four stages of symptoms

Table 5.7 Stages of syphilis development

Stages	Timing	Symptoms
Primary syphilis	3-4 weeks after exposure.	Formation of non-itchy and painless chancres on genital skin and mucosa.
Secondary syphilis	4-8 weeks after the appearance of a primary chancre.	Rash on hands and soles of feet.
Latent syphilis	Early (< 1 year) after infection. Late (>1 year) after infection	No symptoms (asymptomatic)
Tertiary/late syphilis	1-10 years after infection.	Gummatous lesions, cardiovascular syphilis, late neurological complications.

Causative agent: *Treponema pallidum*

- Means of transmission: sexual contacts Gummatous lesions, cardiovascular syphilis, late neurological complications.
- Symptoms: form sores around the genitals, anus, rectum or mouth tend to last 3-6 weeks, appearing as a non-itchy rash of rough, brownish or red spots on the palms of the hands, soles of the feet, lesions in the mucous membranes, the mouth, vagina or anus. Swollen lymph nodes, hair loss, headache, weight loss, muscle fatigue, fever that appear around 21 days after infection.
- Prevention/treatment: protective sexual contact and medical treatment



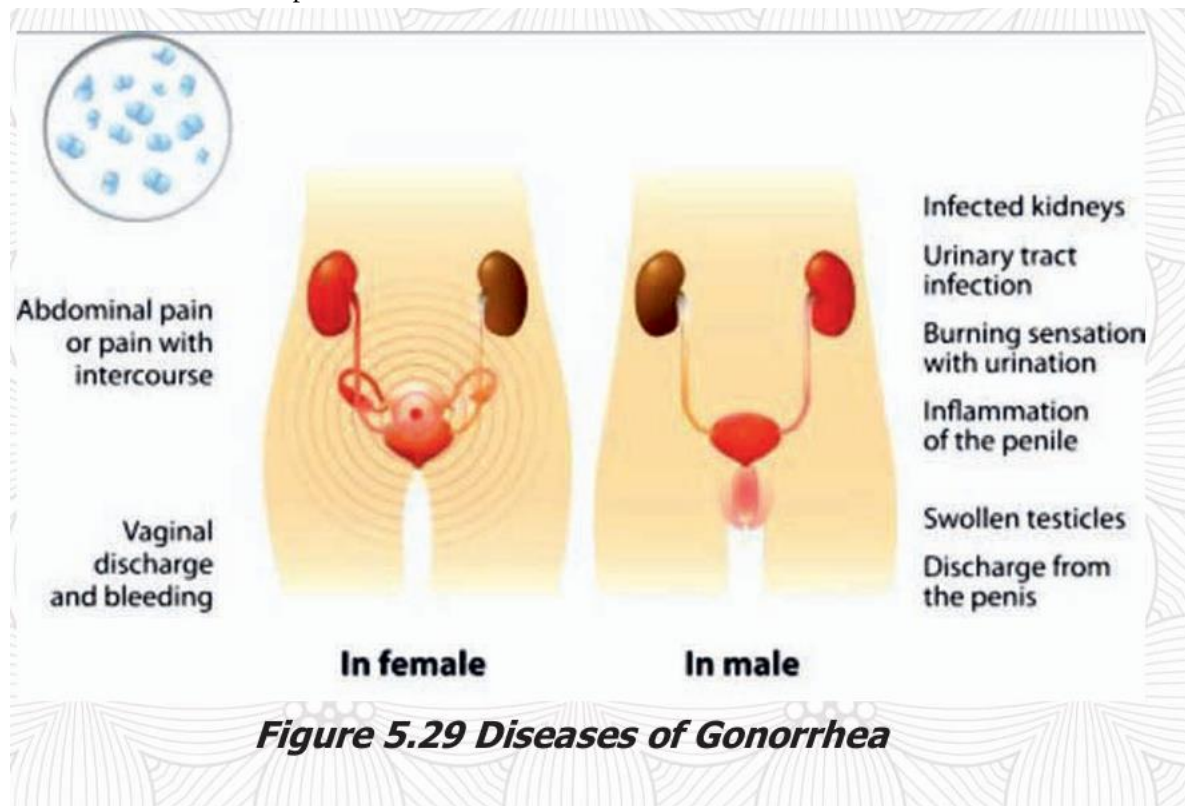
Figure 5.28 Diseases of Syphilis

D. Gonorrhea Gonorrhea

is an infectious disease of the bacterium *Neisseria gonorrhea*. It is highly contagious and can lead to life-threatening complications if not well treated.

Its transmission is through touches of an infected area of the body, thrives in warm, moist parts of the body (vagina, penis, mouth, rectum and eye). It spreads during sexual contact.

- Causative agent: the bacterium *Neisseria gonorrhea*
- Means of transmission: spreads by sexual contacts
- Symptoms: painful urination and abnormal discharge from the penis or vagina. Men may experience testicular pain and women may experience pain in the lower stomach. In some cases, gonorrhea has no symptoms.
- Prevention/treatment: protective sexual contact and medical treatments



E. Chancroid Chancroid

Is a curable sexually transmitted disease caused by the infection of bacterial species *Haemophilus ducreyi*.

Is a highly contagious, painful necrotizing genital ulcer accompanied by inguinal lymphadenopathy.



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Viral infections diseases

A. Genital herpes

Genital herpes is a sexually transmitted infection caused by two types of the herpes simplex virus (HSV). These are HSV-1 and HSV-2.

Human Simplex Virus 1 (HSV-1) is a virus that affects the mouth and spreads through of and saliva or a herpes-related sore around the mouth.

Human Simplex Virus 2 (HSV-2) affects the genital, anal, and mouth and is transmitted through intercourse.



Figure 5.31 Genital herpes diseases

B. Genital warts

Genital warts are sexually transmitted infections caused by the human papillomavirus (HPV). They can cause pain, discomfort, and itching. The human papillomavirus (HPV) is a group of viruses that affect the skin, mucous membranes, throat, cervix, anus, and mouth. It increases the risk of cervical and throat cancer and spreads through sex.



Figure 5.32 Disease of HPV

B. Molluscum contagiosum

Molluscum contagiosum is a contagious viral skin infection caused by a poxvirus called Molluscum contagiosum virus that affects both adults and children.

- Causative agent: Molluscum contagiosum virus
- Means of transmission: by skin to skin contacts
- Symptoms: a small round bumps and indents on skin disappearing soon

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- Prevention/treatment: protective self-hygiene



Figure 5.33 Disease of Molluscum contagiosum

C. Human Immunodeficiency Virus (HIV)

is a virus that attacks the human immune system cells that fight against the body infections. HIV makes a person vulnerable to other infections and diseases. Without treatment, HIV infection advances in stages, getting worse over time gradually destroys the immune system and eventually causes acquired immunodeficiency syndrome (AIDS). Human Immunodeficiency Virus (HIV) belongs to a class of viruses known as retroviruses. It attacks a specific type of immune system cell called CD4 helper cells or T cells and Ribosome, Golgi apparatus and endoplasmic reticulum organelles. HIV weakens the body, makes the body harder to fight off infections.

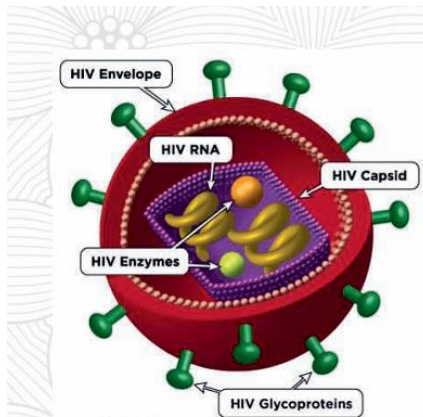


Figure 5.34 HIV structure

Key

HIV capsid: HIV's core that contains HIV RNA

HIV envelope: the outer surface of HIV.

HIV enzyme: proteins that carry out steps in the HIV life cycle.

There are three stages of HIV infection:

1. Acute HIV infection is the earliest stage from 2 to 4 weeks after infection and people show flu-like symptoms, such as fever, headache, and rash. At this stage, HIV multiplies rapidly and spreads throughout the body. The virus attacks and destroys the infection fighting CD4 cells (CD4 T lymphocytes) of the immune system.
2. Chronic HIV infection is the second stage from 1 to 7 years. It is also called asymptomatic HIV infection or clinical latency at which HIV continues to multiply in the body and usually advances to AIDS.
3. AIDS is the final stage from 10 years and above. This is the most severe stage of HIV infection in which HIV severely damages the immune system and the body cannot fight off opportunistic infections such as tuberculosis and tumors, and the number of CD4 cells decreases. People at AIDS stage have a CD4 count of fewer than 200 cells/mm³. Without treatment, people with AIDS

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typically survive about 3 years (Figure 5.35). The healthy immune system's CD4 counts are between 500 and 1600 cells/mm³.

D. Hepatitis B

is a viral infection that attacks the liver and causes both acute and chronic liver diseases. Once a person is infected with Hepatitis B, the virus remains in the semen, blood and other bodily fluids. People with acute hepatitis B develop liver cancer diseases cirrhosis and hepatocellular carcinoma that causes liver failure leading to death. Vaccines prevent hepatitis B disease effectively and make safe. The World Health Organization (WHO) estimated that about 296 million people were living with chronic hepatitis B infections in 2019 with 1.5 million new infections each year and 820 000 deaths from cirrhosis and hepatocellular carcinoma (liver cancer).

- Causative agent: viruses
- Means of transmission: Sexual contact with infected persons ,Uses of non-sterile injections ,Puncturing the skin with sharp objects infected with virus , Blood and bodily fluids
- Symptoms: yellowing of the skin and eyes (jaundice), dark urine, extreme fatigue, nausea, vomiting and abdominal pain
- Prevention/treatment: protective sexual contact and safe from any contact of bodily fluids or contaminations.

Parasites

Among parasites, trichomoniasis and pubic lice are the most prevalent causative agents of sexually transmitted infections

A. **Crabs (Pubic lice)** Crabs are pubic lice attaching to pubic hair and sometimes affect the hair in the armpits, moustache, beard, eyelashes or eyebrows. Pubic lice spread during close physical and sexual contact and are transmitted via shared towels or bed linen.

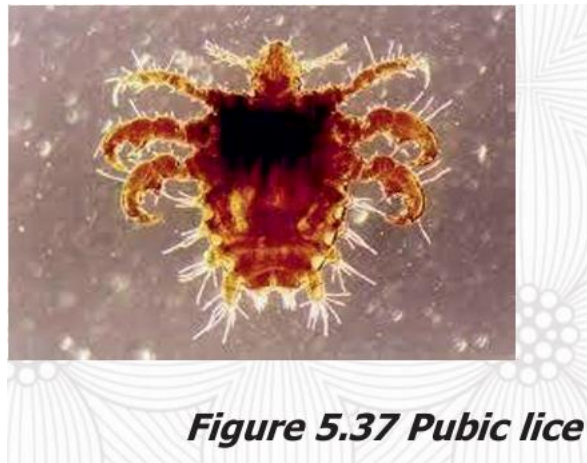


Figure 5.37 Pubic lice

B. Trichomoniasis

is a common sexually transmitted infection caused by the parasite *Trichomonas vaginalis*

- Causative agent: *Trichomonas vaginalis*
- Means of transmission: sexual contact
- Symptoms: in women (a large amount of a thin, often foul-smelling discharge from the vagina — which might be clear, white, gray, yellow or green; genital redness, burning and itching; pain with urination or sex; discomfort over the lower stomach area). In men (itching or irritation inside the penis, burning with urination or after ejaculation, discharge from the penis).
- Prevention/treatment: protective sexual contact and medical treatments



Figure 5.38 Trichomoniasis vaginalis

C. Scabies

are contagious skin diseases that develop due to a mite. Scabies spreads from person to person through direct skin-to-skin contact. It can also be spread by using clothing, sheets, towels or furniture that has touched an infected person's skin. Scabies is considered as STI because it often spreads during sex.



Figure 5.39 Diseases of Scabie

5.2.8. Epidemiology of STIs in Ethiopia

Epidemiology is the study of the transmission causation, outbreak, surveillance, monitoring of a disease and the application of this study to the control and treatment of the disease.. Epidemiology of STIs is the systematic study of sexually transmitted infections, identify and understand the causes, symptoms and ways of transmission. Even though there is little information on the incidence and prevalence of STIs in Ethiopia, the problem of STIs is generally believed to be similar to that of other developing countries. About 1.4 million people are infected with STIs every day. In Ethiopia, the highest reported rates of STIs are found among 15–24-year olds.

5.2.8.1 Risks of STIs epidemic in Ethiopia

Risks of STIs epidemic include:

- Having unprotected sex. Having sex with an infected partner who isn't wearing a latex condom significantly increases the risk of getting an STI. Improper or inconsistent use of condoms can also increase risk.
- Having sexual contact with multiple partners.
- Having a history of STIs. Having one STI makes it much easier for another STI to take hold.
- Being forced to engage in sexual activity.
- Misuse of alcohol or use of recreational drugs.
- Injecting drugs. Needle sharing spreads many serious infections, including HIV, hepatitis B and hepatitis C.
- Being young. Half the new STIs occur in people between the ages of 15 and 24.

5.3 Harmful traditional practices

Harmful traditional practices that affect the physical and mental health of individuals are actions against the rights of people. In Ethiopia, the currently recorded harmful traditional practices has accounted for about 20 of which 50% deals with mutilation of skins and related parts, whereas the female genital mutilation (FGM) alone has accounted for 73% of the practices.

5.3.1.1 Harmful traditional practices affect reproductive health.

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1. Early marriage is forcing underage girls to get married based on cultural norms to perpetuate poverty. It has a wide-ranging impact on girls, causing them to drop out of school, become pregnant, and face long-term health risks.
2. Kidnapping or is abduction to make the girl a wife unwillingly.
3. Gender-based violence, or any form of unwanted sexual contact (sexual abuse or harassment), or even violence within a relative or marriage.
4. Female Genital Mutilation (FGM) is one of the harmful traditional practices that involve the partial or total removal of external female genital organs.

5.4 Family planning

Is the ability to anticipate and attain a desired number of children, the spacing and timing of births, and the materials of individuals and couples to establish a family.

deals with issues related to marital situation, career considerations, financial position and the number of children and a choice of a woman wishing to have or no children.

is concerned with ensuring the resources required for raising the children, time, social, financial, and environmental conditions.

5.4.1 Risks related to the lack of family planning

- The risk of maternal health means that a mother requires care during pregnancy, childbirth, and the postpartum period.
- Both early and late motherhood have increased the risk that teenagers could face a higher risk of life complications and deaths.
- When mothers suffer from illness, get sick or have health problems, the whole family could be threatened
- Complications of pregnancy and childbirth leads to abortions, disability and lower incidence of deaths.

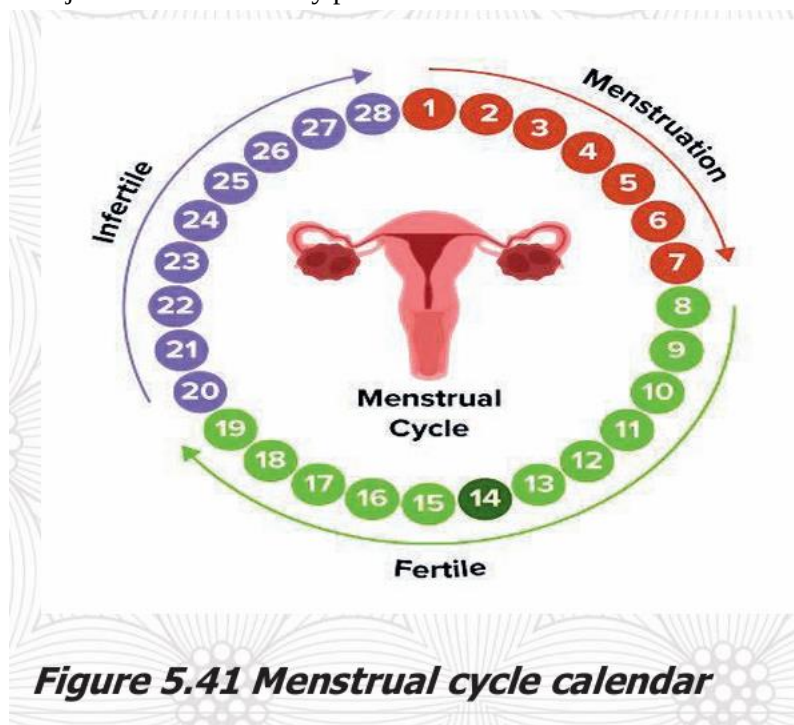


5.4.2 Family planning actions

The family calendar includes:

- Prevention of unwanted pregnancy
- Safe family from STIs, counseling plans and fertility management

- Adequate resources for couples to prevent unwanted pregnancy
- Waiting at least 6 months after a miscarriage or abortion
- Adoption as another option used to build a family.
- Birth control and assisted reproductive technology
- Adjustment of the family plan calendar to the natural menstrual cycle



5.4.3 Family planning services

- Pregnancy testing and counseling
- Pregnancy- achieving services (preconception health)
- Basic counseling on infertility
- Counseling on sexually transmitted diseases
- Breast and pelvic examinations
- Breast and cervical cancer screening

5.5 Effects of alcohol use, chewing Khat, cannabis and other drug uses on STIs transmission and unwanted pregnancy

5.5.1 The effects of alcohol uses

The normal blood alcohol limit for euphoria is 0.1%, but the increase in alcohol intake damages many parts of the human body functions.

Alcohol use has the following negative effects:

- Too much intake of alcohol causes acute effects on parts of our bodies. For example, a higher concentration of blood alcohol (0.25 to 0.30%) causes sleepiness and confusion.
- Prolonged excessive alcohol intake increases dementia (poor nutritional status).
- Alcohol damages the brain (vitamin deficiencies) and the liver (causing cirrhosis).
- Heavy alcohol drinking causes a J-shaped legs, colorectal and colon cancer, violence, traffic accidents and death.
- Gulping up more alcohol causes a coma and death.
- Alcoholic drinks cause 6.2% of males' and 1.1% of females' deaths globally.
- Alcohol drinking is associated with risky sex and transmission of HIV.

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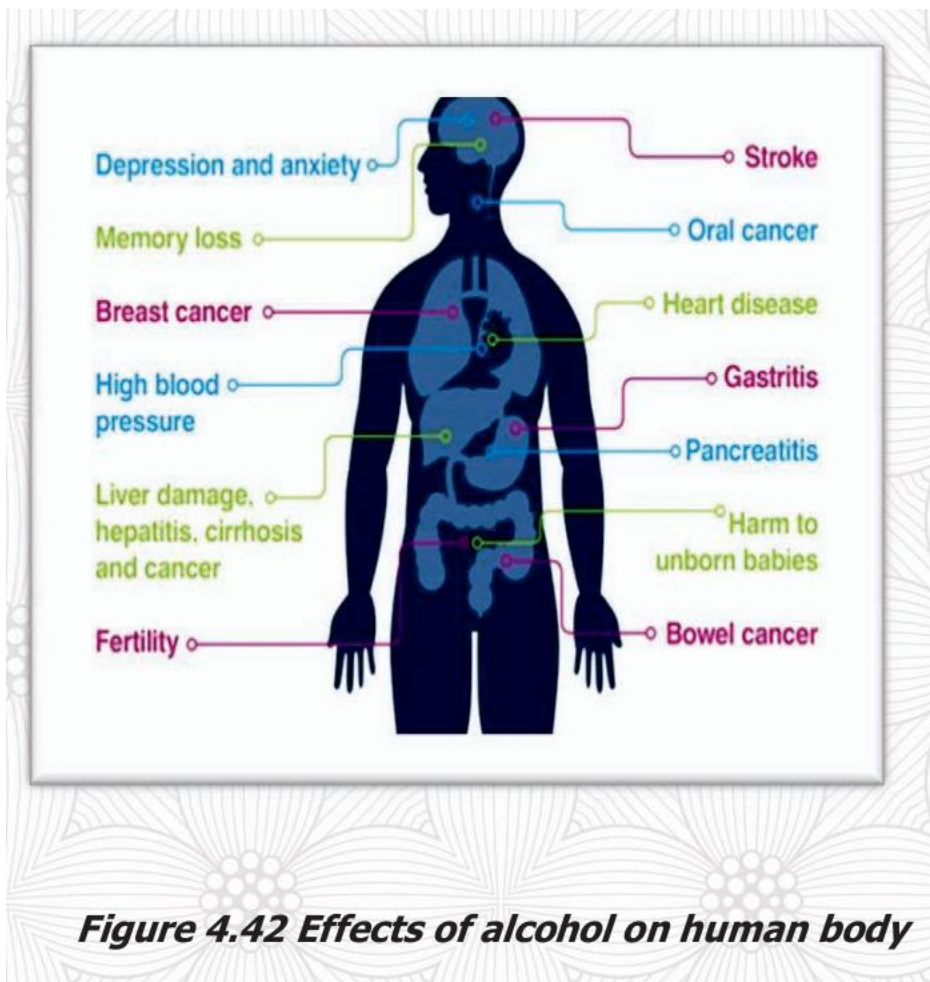


Figure 4.42 Effects of alcohol on human body

5.5.2 Effects of chewing Khat

Khat is a shrubby plant (*Catha edulis*) that people chew its leaves as a recreational stimulant and a psychoactive drug. It has become a popular chewable cosmopolitan leaf among users living in Ethiopia and widespread in the Horn and Eastern Africa, Europe, and North America. In Eastern Ethiopia, it is chewed by nearly 30% of adolescent girls and over 70% of adolescent boys. There are about twenty million people worldwide who chew Khat leaves. When khat is chewed, it stimulates the central nervous systems of human beings because the leaves of Khat contain a stimulant drug called cathinone.

Chewing Khat leaves has the following negative effects:

1. Hypertension, stomatitis, esophagitis, gastritis, and constipation.
2. Acute coronary syndrome (coronary artery spasm) and myocardial infarction
3. Metabolic disorders, diabetes mellitus, hepatitis, and liver cirrhosis.
4. Impotency or loss of sexual drive in libido among aphrodesia (male users)

Table 5.8 Effects of using Khat leaves

Khat leaves	Effects of chewing
Immediate term	Alertness, Arousal, Concentration, Confidence, Constipation Euphoria, Friendliness, Hyperactivity, Increased blood pressure, Increased heart rate, Insomnia, Psychosis, suppressed appetite, Talkativeness, thought disorder, Verbosity etc.
Long term	Depression, infrequent hallucinations, impaired inhibition, increased risk of myocardial infarction (heart attack), Psychosis in extreme cases in the genetically predisposed and oral cancer leading to death in indeterminate terms.

5.5.3 Effects of drug uses

Drugs are biochemical components mostly extracted from some plant species.

1. Marijuana

is a drug prepared from dried leaves and flowers of a plant called Marijuana plant (*Cannabis sativa*), which is stronger than any other form with high potency strains known as sinsemilla or hashish and extracts. Marijuana harms the brain, breathing system, heart, child development, and muscular system coordination.



Figure 5.43 Cannabis sativa

2. Cocaine

is an addictive stimulant drug made from the leaves of the coca plant *Erythroxylum coca* native to South America. Cocaine harms the cardiovascular system, gastrointestinal system, and nervous system.



Figure 5.44 Erythroxylum coca

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3. **Heroin** Heroin is a very addictive drug made from morphine, a psychoactive (mind-altering) substance taken from the resin of the seedpod of the opium poppy. Similarly, heroin has also negative effects on our health.



Figure 5.45 Papaver somniferum

4. **Inhalants** Inhalants are chemicals that can be found in ordinary household or workplace products that people inhale on purpose to get in high mood. In fact, chemicals found in the products can change the way the brain works and cause other problems in the body.

Generally, drugs have the following side effects

- Increasing the risk of illness and infection
- Heart conditions range from abnormal heart rates to heart attacks, collapsed veins, and blood vessel infections from injected drugs.
- Nausea and abdominal pain lead to changes in appetite and weight loss.
- Increased strain on the liver that puts the person at risk of significant liver damage or liver failure.
- Seizures, stroke, mental confusion, and brain damage are all possibilities.
- Problems associated with memory, attention, and decision-making, which make daily living more difficult

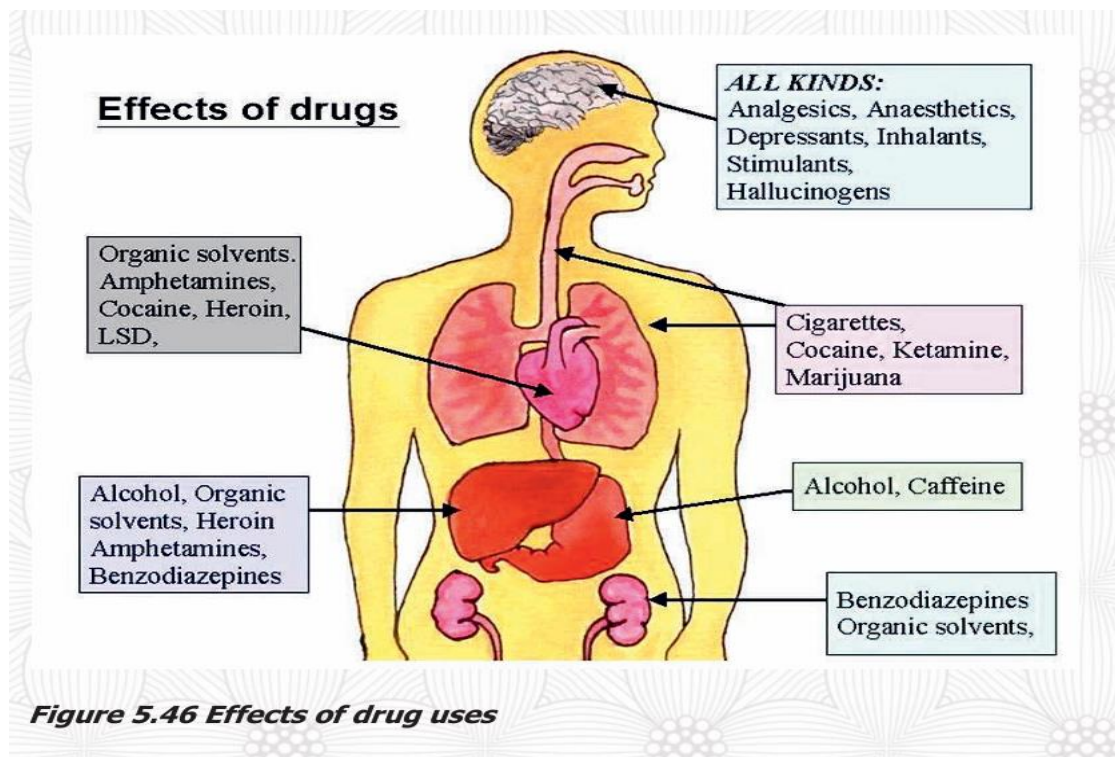


Figure 5.46 Effects of drug uses

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