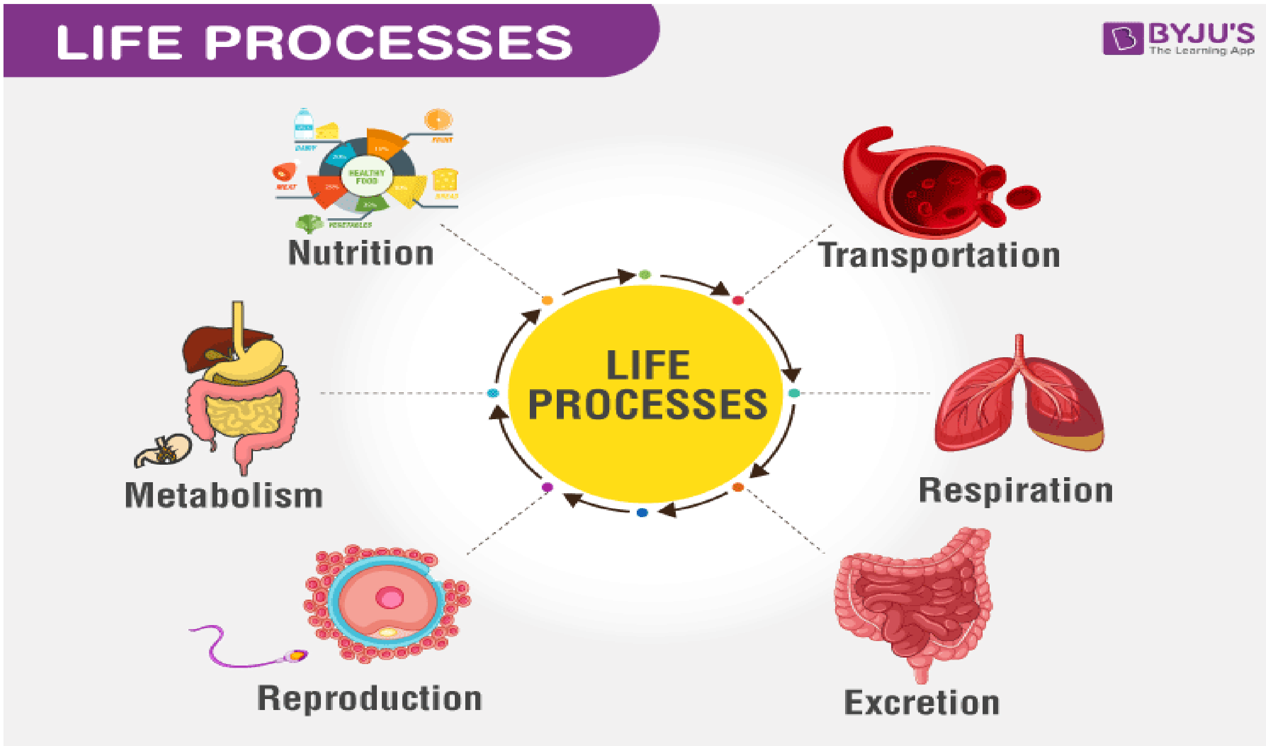
ZIAUDDIN UNIVERSITY
EXAMINATION BOARD

Biology
XII
Student Resource

Contents

SECTIONS	CHAPTERS	WEIGHTAGE IN EVALUATION
Section 3Life Processes	Respiration Homeostasis Support and Movement Nervous Coordination Chemical Coordination Behavior	23%7
Section 4 Continuity in Life	Reproduction Development and Aging Inheritance Chromosomes and DNA Evolution	19%
Section 5Biotechnology	Biotechnology Biology and Human welfare	8%

Section 1: LIFE PROCESSESS



It Includes

Chapter 1: Respiration

Chapter 2: Homeostasis

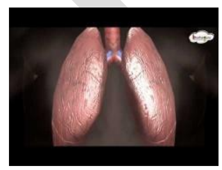
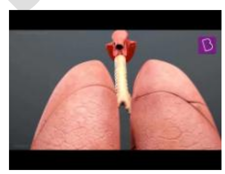
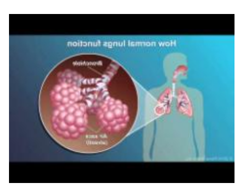
Chapter 3: Support and Movement

Chapter 4: Nervous coordination

Chapter 5: Chemical coordination

Chapter 6: Behavior

Respiration

Chapter	Student learning outcomes	Teachers must be able to	Reference web material
RESPIRATION	Student will be able to Know the properties of respiratory surface Differentiate between voluntary and involuntary control in breathing rate. Define respiratory system of man (organs of respiration, route of Air) Understand the mechanism of breathing in man. Recognize Respiratory disorders	Describe the properties of respiratory surface; Describe respiratory system of man (organs of respiration, route of Air) Describe the mechanism of breathing in man; Describe voluntary and involuntary control in breathing rate Describe the transportation of carbon dioxide and oxygen by the Blood; Respiratory disorders : state causes, symptoms and control of upper respiratory tract Infections (sinusitis, otitis) and lower respiratory tract infections (pneumonia, tuberculosis); Describe disorders of lungs (emphysema, lung cancer), list the effects of smoking on respiratory system.	 The respiratory system  Respiratory system 3D animation  Mechanism of breathing in man  Lung anatomy  Understanding of COPD

Tuberculosis	Pneumonia
Chest pain, or pain with breathing and coughing	Sweating
A fever higher in the afternoon	Chest pain
Sweating excessively at night.	Tiredness
Night chills	Shortness of breath
Tiredness that gets worse as the day goes on	Cough
Weight loss	Increased heart rate
Loss of appetite	Rapid breathing
Coughing that lasts three or more weeks with bloody sputum after a few days	Chills
	Nausea, vomiting or diarrhoea
	Confusion or mental changes in elderly patients

DISORDERS OF LUNGS

Emphysema is a type of COPD involving damage to the air sacs (alveoli) in the lungs. As a result, your body does not get the oxygen it needs. Emphysema makes it hard to catch your breath. You may also have a chronic cough and have trouble breathing during exercise. The most common cause is cigarette smoking.

Lung cancer

Lung cancer is a type of cancer that begins in the lungs. Your lungs are two spongy organs in your chest that take in oxygen when you inhale and release carbon dioxide when you exhale.

Lung cancer is the leading cause of cancer deaths in the United States, among both men and women. Lung cancer claims more lives each year than do colon, prostate, ovarian and breast cancers combined.

People who smoke have the greatest risk of lung cancer, though lung cancer can also occur in people who have never smoked. The risk of lung cancer increases with the length of time and number of cigarettes you've smoked. If you quit smoking, even after smoking for many years, you can significantly reduce your chances of developing lung cancer.

Signs and symptoms of lung cancer may include:

A new cough that doesn't go away

Coughing up blood, even a small amount

Shortness of breath

Chest pain

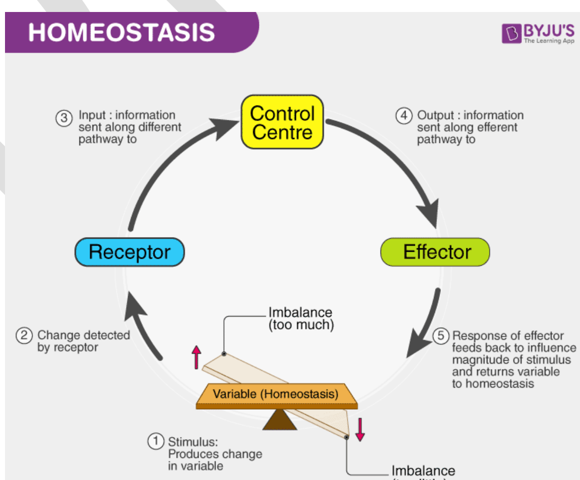
Hoarseness

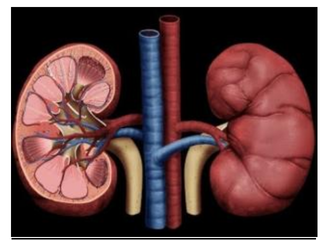
Losing weight without trying

Bone pain

Headache

Homeostasis



Chapter	Student learning outcomes	Teachers must be able to	Reference web material
HOMEOSTASIS	Students must Be able to: Understand homeostasis and its components Know about feedback system Different types of osmoregulation Understand kidney structure and function	Define homeostasis; various aspects and need for homeostasis Feedback System define the term feedback system; components of feedback system; compare positive and negative feedback with examples. osmoregulation in aquatic (fresh water and marine) and terrestrial animals define excretion; different excretory products in plants and methods by which they are stored and removed from the plant body; different types of excretory products and relationship of these wastes to the habitat of animals; Excretion in Man : metabolic waste and excretory organs in man (kidney, liver, skin); the role of liver in urea formation (urea cycle or ornithine cycle); the liver as a homeostatic organ; urinary system of man mechanism of excretion through kidney (simple filtration, reabsorption, secretion, counter current); adaptation of kidney and effect of hormones on the working of kidney, composition of urine and variation in the composition of urine and its significance; Kidney Problems; (kidney stone, renal failure) and their cure (lithotripsy, dialysis and kidney transplantation); classify animals on the basis of thermoregulation; adaptations in animals for temperature regulation (structural, physiological, behavioural); thermoregulation in mammals	 KIDNEY FUNCTIONS IN HUMAN BODY

		(human) in cold and hot environment; thermostatic function of brain and feedback control in humans; Define pyrexia (fever).	

Chapter Overview

Key points

Homeostasis is the tendency to resist change in order to maintain a stable, relatively constant internal environment.

Homeostasis typically involves negative feedback loops that counteract changes of various properties from their target values, known as set points.

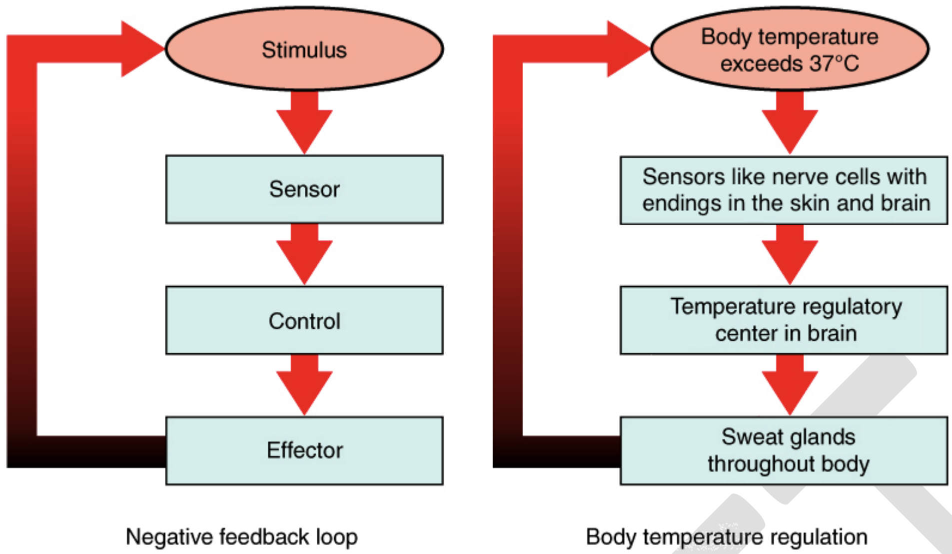
In contrast to negative feedback loops, positive feedback loops amplify their initiating stimuli, in other words, they move the system *away* from its starting state.

MAINTAINING HOMEOSTASIS

Biological systems like those of your body are constantly being pushed away from their balance points. For instance, when you exercise, your muscles increase heat production, nudging your body temperature upward. Similarly, when you drink a glass of fruit juice, your blood glucose goes up. Homeostasis depends on the ability of your body to detect and oppose these changes.

Maintenance of homeostasis usually involves negative feedback loops. These loops act to oppose the stimulus, or cue, that triggers them. For example, if your body temperature is too high, a negative feedback loop will act to bring it back down towards the set point, or target value, of 98.6\,^\circ\text F98.6∘F98, point, 6, degrees, start text, F, end text/ 37.0\,^\circ\text C37.0∘C37, point, 0, degrees, start text, C, end text.

How does this work? First, high temperature will be detected by sensors—primarily nerve cells with endings in your skin and brain—and relayed to a temperature-regulatory control center in your brain. The control center will process the information and activate effectors—such as the sweat glands—whose job is to oppose the stimulus by bringing body temperature down.



(a) A negative feedback loop has four basic parts: A stimulus, sensor, control, and effector. (b) Body temperature is regulated by negative feedback. The stimulus is when the body temperature exceeds 37 degrees Celsius, the sensors are the nerve cells with endings in the skin and brain, the control is the temperature regulatory center in the brain, and the effector is the sweat glands throughout the body.

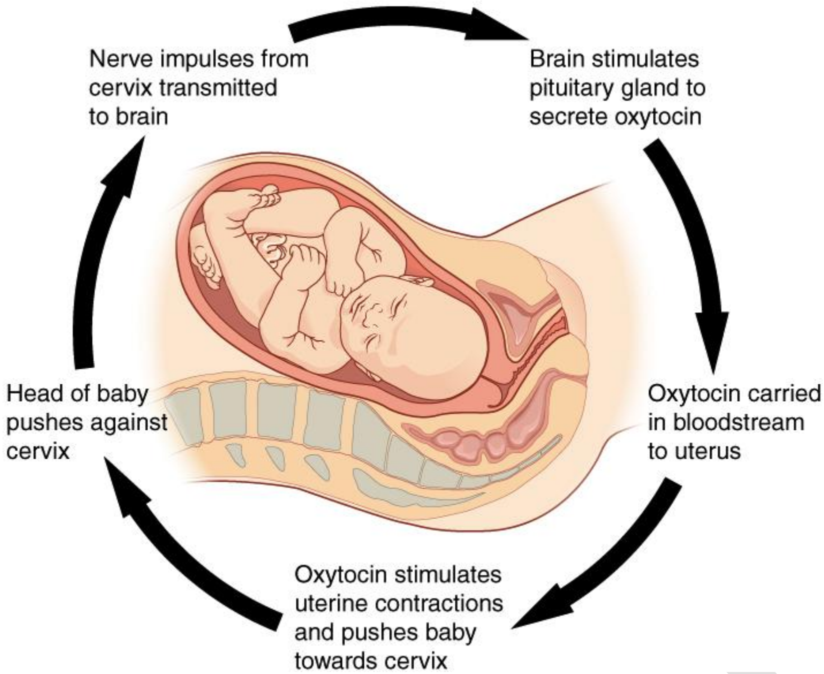
Positive feedback loops

Homeostatic circuits usually involve negative feedback loops. The hallmark of a negative feedback loop is that it counteracts a change, bringing the value of a parameter—such as temperature or blood sugar—back towards it set point.

Some biological systems, however, use positive feedback loops. Unlike negative feedback loops, positive feedback loops amplify the starting signal. Positive feedback loops are usually found in processes that need to be pushed to completion, not when the status quo needs to be maintained.

A positive feedback loop comes into play during childbirth. In childbirth, the baby's head presses on the cervix—the bottom of the uterus, through which the baby must emerge—and activates neurons to the brain. The neurons send a signal that leads to release of the hormone oxytocin from the pituitary gland.

Oxytocin increases uterine contractions, and thus pressure on the cervix. This causes the release of even more oxytocin and produces even stronger contractions. This positive feedback loop continues until the baby is born.



Normal childbirth is driven by a positive feedback loop. A positive feedback loop results in a change in the body's status, rather than a return to homeostasis. The feedback loop includes (the loops is drawn clockwise): * Nerve impulses from the cervix being transmitted to the brain * The brain stimulates the pituitary gland to secrete oxytocin * Oxytocin carried in bloodstream to uterus * Oxytocin stimulates uterine contractions and pushes baby toward cervix * Head of baby pushes against cervix * and so on in a loop!

<u>OSMOREGULATION</u>

Osmoregulation refers to the process by which living organisms maintain the constant osmotic conditions in the body. It involves the regulation of water and solute concentration of the body fluids such as potassium, sodium and chlorides so that their body fluids are maintained within homeostatic limits. In order for the cells in the body of an organism to function effectively the body fluids such as the cell contents as well as fluids outside cells such as tissue fluids, lymph and blood plasma must remain constant. Freshwater, marine and terrestrial organisms consists of varying modes adaptations for Osmoregulation that meet the challenges of these diverse environments. Therefore, this essay will disclose the patterns of Osmoregulation in aquatic and terrestrial environments.

Aquatic environment

As earlier alluded to, aquatic organisms include those which live in fresh water and also those which live in marine water.

Osmoregulation in freshwater organisms

Certain species such as Paramecium have vesicles in the cytoplasm which fills with fluid from the cytoplasm and then most of the ions are pumped out of the fluid by active transport with energy from the surrounding mitochondria. Then the vesicles loads the remaining watery fluid into the contractile vacuole whose membrane cannot allow water to escape back into the cytoplasm by osmosis and suddenly the water is reduced hence osmoregulating its content.

Furthermore, in fresh water organisms such as fishes undertake Osmoregulation through the release of excess water through the gills and through the excreting of large amounts of dilute urine. Solomon, P.E et-al (2011: 1072) adds that "these organisms tend to lose salts by diffusion through the gills into the water". In this way such organisms control the concentration of body water and salts. In addition to this, some amphibians such as frogs have their pattern of osmoregulating the body environment which is through producing large amounts of dilute urine and also active transport of salts into the body by specialised cells in the skin compensates for the loss of salt through the skin and urine.

Osmoregulation in marine environments

Another pattern of Osmoregulation in aquatic organisms occurs in marine species which involves the losing of water and gaining of salts to maintain a favourable and constant internal environment. To this, aquatic organisms adapt successfully. These organisms live in a hypertonic environment meaning that their inner water content is higher than the surrounding environment, hence they lose water by osmosis and then they gain salts from the seawater they drink by diffusion. Solomon, P.E et-al (2011:1073) adds that, "to compensate for fluid loss marine fishes drink a lot of sea water, excrete the salts through the gills and also produce a small volume of urine thereby osmoregulating their body fluids.

Then also, other marine species such as those of marine cartilaginous fishes i.e. sharks and rays have their own pattern of carrying out Osmoregulation. They have different osmoregulatory adaptations that allow them to tolerate the salt concentration of their environment. These organisms are able to accumulate and tolerate urea because their kidneys undertake the reabsorption of urea in high concentration such that their body tissues become hypertonic to their surrounding medium resulting in a net inflow of water by osmosis. Then also they excrete quantities of dilute urine and excess salt is excreted also by the kidneys and in most species by a rectal gland, hence osmoregulating the body fluids.

And for marine snakes they carry out Osmoregulation by using salivary sublingual gland to get rid of excess leaving a normal blood concentration. Additionally, some reptiles, snakes and marine birds ingest sea water and take in a lot of salt in their food. To control the concentration of salts and water they posses glands in their heads which undertake the excretion of excess salts from their blood plasma.

Osmoregulation in terrestrial environments

Organisms which live on land have a common challenge of regulating water in the body due to their contact with the atmosphere. However, each species has a particular pattern and adaptation to life on land for example insects. These, they contain an almost impermeable waxy layer which covers their exoskeletons to reduce loss of water from the body surface. Then also insects have wave-like structures in their spiracles which reduce the loss of water from tubes which connect spiracles to cells, (Taylor D.J et-al 2011).

In addition to this, water loss through excretion is prevented through the help of the malpighian tubules whose lower segment absorbs water and various salts and then the nitrogenous wastes precipitates out of the solution as solid crystals of uric acid. Thereafter, concentrated fluids of the tubules enter the rectum in which they mix with digestive wastes. From there the rectal gland absorb water again from uric acid and faeces suspension and then the dry waste is eliminated from the body as pellets. All the above adaptations form a suitable pattern for controlling and maintaining a constant osmotic condition of the insect's body.

Other terrestrial organisms i.e. invertebrates such as flateworms consists of nephridial organs with branching tubes called nephridiopores excess fluid leaves the body thereby osmoregulating the internal fluid content, and also protonephridia composed of tubes with flame cells. They also have complex nephridial organs known as metanephridia whose end opens into a coelom and the fluid from the coelom passes into the tubule bringing with it whatever it contains i.e. glucose, salts or even wastes. As the fluid moves through the tubule, needed substances like water and glucose are removed from the fluid by tubules are reabsorbed back in blood capillaries, hence carrying out Osmoregulation.

Organisms such as a Kangaroo rat carry out Osmoregulation by using its fur to prevent the loss of water to the air and also during the day it remains in a cool burrow. Mader, S.M (2010) adds that a Kangaroo rat carries out Osmoregulation by using its nasal passage which has a highly convoluted mucous membrane surface capture condensed water from exhaled air and also conserves water by producing very concentrated urine and almost dry fecal matter.

Solomon, P.E (2010:1070) states that "to animals moved on the land, natural selection favoured the evolution of structures and processes that conserve water". Thus this, facilitates Osmoregulation. The excretory system in terrestrial organisms such as birds, reptiles and mammals gives them a pattern by which they maintain fluid and electrolyte homeostasis by selectively adjusting the concentrations of salts and other blood substances and body fluids. Because this system is adapted to collect fluids from the interstitial fluids and blood it is able to control the fluid's composition by selectively returning those required by the body into the body fluids. For example; birds undertake the process of Osmoregulation by excreting nitrogen as uric acid which only releases a little water and also by efficiently reabsorbing water through their cloaca and interstine. In addition to this, birdsosmoregulate by excreting salt solution from the salt-excreting glands through their nostrils thereby maintaining a normal body fluid content. Then also, large terrestrial organisms are able to control their body fluid content because their skins are adapted to minimze the loss of water through evaporation and also by drinking water to compensate the water lost through the skin, respiratory passages and through urination, hence Osmoregulation their body fluid content. .

Furthermore, terrestrial organisms consists of a very effective and efficient kidneys enables them osmoregulate the body fluids and conserve water though a series of processes i.e. filtration, reabsorption of the needed substances by the body in the body fluids and the tubular secretion in the nephron. For example; Water passes out of the descending limb of the loop of Henle, leaving a more concentrated filtrate inside. The heavy outline along the ascending limb indicates that this region is relatively impermeable to water. NaCl diffuses out from the lower and thin part of the ascending limb. In the upper and thick part of the ascending limb, NaCl is actively transported into the interstitial fluid. The saltier the interstitial fluid becomes, the more water moves out of the descending limb. This process leaves a concentrated filtrate inside, so more salt passes out. Water from the collecting ducts moves out osmotically into this hypertonic interstitial fluid and is carried away by capillaries, hence osmoregulation is carried out,(Eckert, R et-al 2005).

Excretion in Human Body

The removal of metabolic waste products from the body is called excretion. A large number of chemical reaction occur in our body cells. The products of these chemicals reactions contain various wastes, which are called metabolic wastes.
Waste Products: in human common metabolic wastes are: CO_2, urea, uric acid, used hormones, drugs, bile pigments, excess of water and salt.
Excretory organs:
Those organs which remove metabolic wastes of the body are called organs. The excretory organs in human are:

Kidney: Kidneys are the primary excretory organs. They remove, urea in urine, nitrogenous waste, drugs and hormones, toxins, excess of salt and water , bile pigments.

Liver: Which excrete, bile pigment, cholesterol.

Skin: Skin contain sweat glands which excrete sweat. Sweat formation causes cooling. In kidney failure, more urea is excreted by the sweat glands.

Lungs: Lungs remove CO_2 and also lose water vapors.

Liver as Homeostatic Organ

Liver is the central factory of metabolism and help in homeostasis. It is the body central metabolic clearing house. It support the vital activities of the kidney. Liver perform the following homeostatic functions:
Bile Production: Liver produces a yellowish, green alkaline substance called bile. It neutralizes the acidic food. Bile is also antiseptic and acts as germ killer.

Internal structure of kidney

Internally each kidney consist of two parts:

Cortex: it is the outer darker part of kidney.

Medulla: is the inner lighter part of kidney. In medulla about 10 -15 cone like structure are present called renal pyramids. These pyramids open into a wide funnel shaped part called pelvis. The middle of medulla contains many collecting ducts which carry urine to the pelvis. Each kidney contain about one million nephrons or urinary tubules which form urine.

Cortical nephrons: Nephrons which are present only in cortex.
Juxta medullary nephrons: Nephrons arranged along the border of cortex and medulla are called juxta medullary nephrons. Tubular system of these nephron is present in the medulla.

Structure of Nephron

The structural and functional units of the kidney which produces urine is called nephron. Nephrons are held together by connective tissues. Each nephron is highly coiled tube and blind at one end. Each nephron consist of two parts:

Renal carpsule

Renal tubule

Renal Carpsule:
It is the blood filtering unit of nephron.

Bowman s capsule: The blind end of nephron form double walled cup shaped structure called Bowman’s capsule.

Glomerulus: Bowman’s capsule contain a network of blood capillaries called glomerulus. Blood enters the glomerulus through afferet arterioles and leaves through efferent arterioles.

Renal Tubule:
It is the tubular portion of nephron. It is also called filtrate refinery. It is surrounded by capillary network. Renal tubule consist of three parts:

Proximal Convoluted tubule: This is the first coiled part of renal tubule. Most of the rebsorption take place here.

Loop of henle: This the u – shaped narrow part of nephron. It helps in the reabsorption of water and salt.

Distal convoluted tubule: It is highly coiled and expended part. It lies in the cortex and help in urine formation. Several nephrons open into one collecting duct.

Urine Formation:

The function of nephron is the formation of urine.

Urine formation occur in the following steps:

Glomerular Filtration: The process of separation of liquid from the blood in the glomerulus is called glomerular filtration. Blood flows under high pressure in glomerulus. As a result some fluid is filtered out from capillary wall into Bowman's capsule. This liquid is called glomerular filtrate. This filtrate contain water, salts, glucose, amino acids, urea, vitamins. About 7.5 liter of glomerular filtrate are produced every hour.

Tubular Reabsorption: Glomerular filtrate flow out from Bowman s capsule into the tubular part of each nephron. Here the useful substances are selectively reabsorbed back into blood amino acid. Loop of henle reabsorbed water and salt.

Tubular secretion: In this step H+, K+, NH+ 4 and drug (penicillin) are removed from blood into the distal tubule of nephron. This process maintain the pH of blood.

Excretion: After reabsorption the filtrate changes into urine. This urine is collected by collecting duct into the renal pelvis. Urine come out of the kidney through ureter into urinary bladder. From here urine passes to the outside by urethra.

Effect of Hormones on the Working of Kidney

The function of kidney is under the control of three hormones:

Insulin:
Reabsoption of glucose from filtrate occur in the proximal part of nephron. This function is under the control of a hormone – insulin. Insulin is secreted by islets of langerhans in the pancrease. It reduces the level of glucose in the blood. Normal level of glucose in blood is 70 mg / 100 ml of blood. It this level falls to 30 mg/100 ml of blood death will occur. If glucose level raises to 120 mg/ 100 ml of blood, it show secretion of insulin. Excess of glucose will not be reabsorbed and excreted in the urine. This is one symptom of diabetes mellitus.

Aniduretic Hormone:
The distal part of nephron is responsible for reabsorption of water. This function is under the control of a hormone – antidiuretic hormone. ADH is secreted by the pituitary gland. Dehydration of body stimulate ADH secretion. This ADH then increases the reabsorption of water. In old age the secretion of ADH reduces in some persons. The distal part of their nephron fail to absorb water. Such person excrete huge volume of watery urine daily.

Aldosteron:
It is secreted by the adrenal gland. It stimulates active reabsoption of Na+ ions in the ascending limb of loop of Henle.

Composition of Urine

Color: Urine is yellowish in color due to the presence of urochrome.
Volume: A normal person excretes about 1.5 liters/day.
pH: it varies from 4.6 – 8. Because it depends upon the presence of H+ ions in blood.
Composition: Urine is mainly composed of the following substances:
Water = 95%
Organic and inorganic salts = 2%
Urea = 2%
Uric acid = 1%
Small amount of ammonia and cretinine.
Kidney as osmoregulatory and Excretory Organ

Kidney act as both excretory and osmoregulatory organ. Kidney kept the body fluid concentration within narrow limits. It regulate the concentration of blood in the following way:
(i) Production of dilute urine:
If the blood contains more water then less water is reabsorbed from glomerulus filtrate. As a result large volume of dilute urine is produced.
(ii) Production of concentrated urine:
If the blood is too concentrated by the shortage of water. Then more water is absorbed back into the blood from the glomerulus filtrate. As a result a small amount of concentrated blood also stimulates thirst center in the brain causing drinking of water. This restores the blood correct concentration.
(iii) Regulate acid base balance:
Kidneys also maintain the acid base balance in the body. Kidney excrete acids in urine while prevent the excessive loss of water base.

Kidney Stone

The formation of some solid structure in the kidney is called kidney stone.

Chemical composition: These stones have specific chemical nature. These stones are usually composed of:
Causes: Kidney stones are formed by high level of calcium and oxilate in blood. Calcium is found in milk, egg, fruits etc. Oxilate is present in, green vegetables, tomatoes. Sometimes these substances are deposited in the kidneys and change into stones. About 70% Kidney stones are formed due to Calcium oxilate.

Treatment: Kidney stones are usually removed by surgery i.e. operation.

Lithotripsy: The technique to break up and remove kidney stone without surgery is called lithotripsy. In this process high concentration of x- rays are passed through the stones. The stones are broken into small pieces which are removed from the kidney with urine.

Renal Failure

When the Bowman s capsulte of the nephron is damaged the filtration process is weakened, which is called renal failure. In such conditions the harmful substances remain in blood. Thus the amount of urea is increased in blood.
Treatment: Renal failure can be treated by: Dialysis or Kidney transplant.

Dialysis

The filtration and purification of blood with the help of artificial kidney machine is called Dialysis. Dialysis is a Greek word which means, “ Separation” Dialysis is not a permanent treatment.
Types: Haemodialysis and Peitoneal dialysis.

Haemodialysis:

In this process the patients blood is cleaned by a specialized machine called Dialyzer. Dialyzer contain a fluid called “Dialysate” This dialysate contain semi permeable tubes kept at body temperature. A plastic tube is surgically inserted into an artery and vein of leg or Blood from the body is transferred into the dialysis machine. This blood is allowed to flow through the tubing in the dialysate. The wastes like urea, extra water, salts diffuse out into the dialysate. After filtration the blood is returned back into body vein. Haemodialysis remove about 50 – 250 gm urea in six hours.

Peritoneal Dialysis:

Abdomen has a peritoneal cavity lined by a thin epithelium called peritoneum. Peritoneal cavity is filled with dialyssis fluid through catherter. A bag is attached to the patient abdominal cavity. Excess water and wastes pass through the peritoneum into dialysis fluid. This process require one hour and repeated several times a day.

REFERENCES

https://fscnotes0.blogspot.com/2015/09/fsc-notes-biology-part-2-chapter-15-homeostasis-notes.html

https://www.slideshare.net/bumberboy/chapter-12-homeostasis

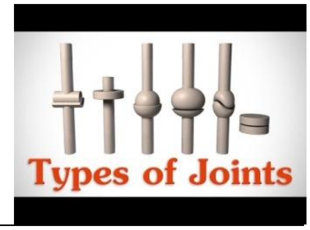
https://www.ukessays.com/essays/biology/patterns-osmoregulation-environments-3481.php

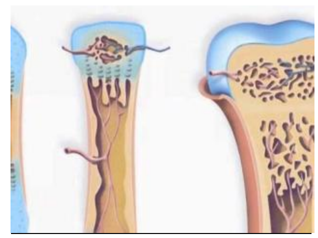
https://www.ukessays.com/essays/biology/patterns-osmoregulation-environments-3481.php

https://www.britannica.com/science/homeostasis

https://www.khanacademy.org/science/high-school-biology/hs-human-body-systems/hs-body-structure-and-homeostasis/a/homeostasis

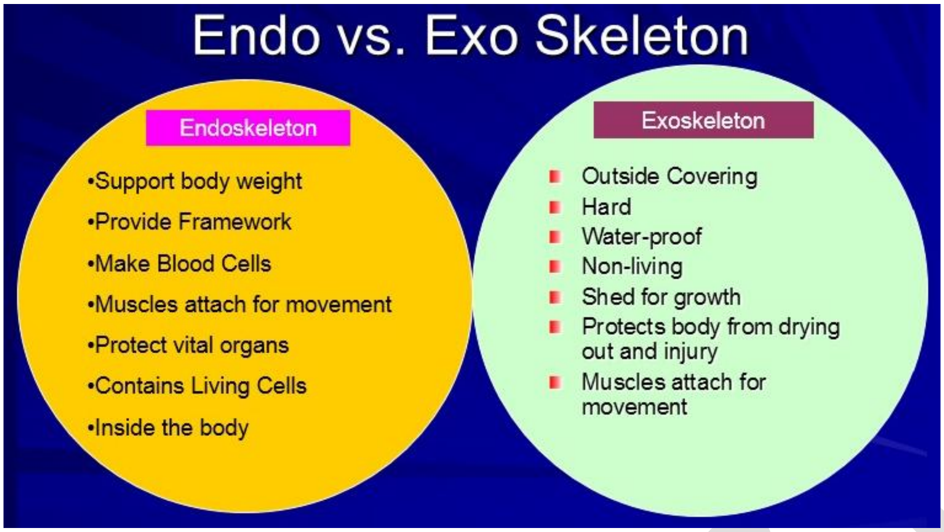
SUPPORT AND MOVEMENT

Chapter	Student learning outcomes	Teachers must be able to	Reference web material
<u>SUPPORT AND MOVEMENT</u>	Students must Be able to: Understand different types of skeleton Learn Human skeleton bones names, location in human body, structure and function Know different types of joints Study skeletal diseases and disorders	define skeleton;types of skeleton with examples (hydrostatic skeleton, exoskeleton and endoskeleton); the disadvantage of exoskeleton (ecdysis or moulting); Human Skeleton, human skeletal system (axial and appendicular skeleton), the functions of skeleton difference between bones and cartilage joints (articulation) and its types with examples the structure of synovial joint with diagram differentiate between tendon and ligament deformities of skeleton (cleft palate, microcephaly, osteoarthritis, rickets); skeleton related diseases and their control (disc slip, spondylitis, sciatica, osteoarthritis); the repairing of broken bones muscular tissue difference between voluntary and involuntary muscles different types of muscles and	 <u>TYPES OF JOINTS</u>  <u>TYPES OF BONES IN HUMAN</u>  <u>DIFFERENT TYPES OF SKELETON IN ANIMALS</u>

		their occurrence (skeletal, smooth and cardiac muscles) the structure of skeletal muscles; the process of muscle contraction (sliding filament theory of Huxley, control of muscle contraction, all or no response of muscles, muscle fatigue) abnormal muscle contraction (tetany and cramps) define antagonistic muscles; different types of antagonistic muscles which help to move shoulder in man.	 SCIENCE OF CARTILAGE  DEVELOPMENT OF BONE

Chapter Overview

THREE TYPES OF SKELETON designs are hydrostatic skeletons, exoskeletons, and endoskeletons. An exoskeleton is a hard external skeleton that protects the outer surface of an organism and enables movement through muscles attached on the inside.



Human skeleton, the internal skeleton that serves as a framework for the body. This framework consists of many individual bones and cartilages. There also are bands of fibrous connective tissue—the ligaments and the tendons—in intimate relationship with the parts of the skeleton. This article is concerned primarily with the gross structure and the function of the skeleton of the normal human adult.

The human skeleton, like that of other vertebrates, consists of two principal subdivisions, each with origins distinct from the others and each presenting certain individual features. These are (1) the axial, comprising the vertebral column—the spine—and much of the skull, and (2) the appendicular, to which the pelvic (hip) and pectoral (shoulder) girdles and the bones and cartilages of the limbs belong. Discussed in this article as part of the axial skeleton is a third subdivision, the visceral, comprising the lower jaw, some elements of the upper jaw, and the branchial arches, including the hyoid bone.

When one considers the relation of these subdivisions of the skeleton to the soft parts of the human body—such as the nervous system, the digestive system, the respiratory system, the cardiovascular system, and the voluntary muscles of the muscle system—it is clear that the functions of the skeleton are of three different types: support, protection, and motion. Of these functions, support is the most primitive and the oldest; likewise, the axial part of the skeleton was the first to evolve. Protection of the heart, lungs, and other organs and structures in the chest creates a problem somewhat different from that of the central nervous system. These organs, the function of which involves motion, expansion, and contraction, must have a flexible and elastic protective covering. Such a covering is provided by the bony thoracic basket, or rib cage, which forms the skeleton of the wall of the chest, or thorax. The connection of the ribs to the breastbone—the sternum—is in all cases a secondary one, brought about by the relatively pliable rib (costal) cartilages. The small joints between the ribs and the vertebrae permit a gliding motion of the ribs on the vertebrae during breathing and other activities. The motion is limited by the ligamentous attachments between ribs and vertebrae.

The third general function of the skeleton is that of motion. The great majority of the skeletal muscles are firmly anchored to the skeleton, usually to at least two bones and in some cases to many bones. Thus, the motions of the body and its parts, all the way from the lunge of the football player to the delicate manipulations of a handicraft artist or of the use of complicated instruments by a scientist, are made possible by separate and individual engineering arrangements between muscle and bone.

Axial Skeleton

The axial skeleton contains 80 bones.
29 bones in the head – 8 cranial, 14 facial bones and 6 auditory ossicles and the Hyoid Bone.
26 bones in the vertebral column (24 vertebrae, the sacrum, and the coccyx)
25 bones in the thorax – (the sternum and 24 ribs)

Skull Bones

The skull consists of the cranium and the facial bones. The cranium contains and protects the brain in a space designated the cranial vault. The cranium is composed of eight bones which fit together at connection points called sutures. Cranium bones-
Sphenoid
Ethmoid
Frontal
Occipital
Two Temporal
Two Parietal
People are born with separate plates which succeeding fuse to provide flexibility as the skull passes within the pelvis and birth canal throughout the birth. Throughout development, the eight separate plates of the immature bones join collectively into one single structure identified as the Skull. The mandible, only bone that remains separate from the rest of the skull.

Facial Bones

There are 14 facial bones that form the lower part of the skull. The facial bones include-
Vomer
Mandible also is known as the lower jaw
Maxilla, which is paired, which make up the upper part of your jaw
Zygomatic, which are also paired bone and are the bones that give you your cheekbones
2 lacrimal bones
2 nasal bones
2 Palatine bones
2 Inferior nasal conchae

Rib Cage

The rib cage is comprised of 12 pairs of ribs and the sternum. The rib cage protects the vital organs such as the heart and lungs. The ribs are crescents like shaped, among one end is flattened and the opposite end is rounded. The rounded ends of the ribs are joints to the thoracic vertebrae and the flattened ends come together at the sternum.

The uppermost seven pairs of ribs join to the sternum with costal cartilage and are recognized as “true ribs.” The 8th to 10th ribs have non-costal cartilage which attaches them to the ribs above. The last two ribs are described “floating ribs” because they do not connect to the sternum or to other ribs. The length of each rib extends from number one to seven and then declines pair number 12. The first rib of the thoracic cage is the shortest, widest, flattest, and most curved.

Vertebral Column

At birth, the majority have 32-34 separate vertebrae. Nevertheless, throughout normal development several vertebrae join together, transmitting a total of 24. The sacrum, made from 5 fused vertebrae and the coccyx, made from 3-5 fused vertebrae. If the coccyx and sacrum each as one vertebra, then there are will be 26 vertebrae. If the fused vertebrae all are numbered separately, then the whole number of vertebrae becomes to between 32 and 34.

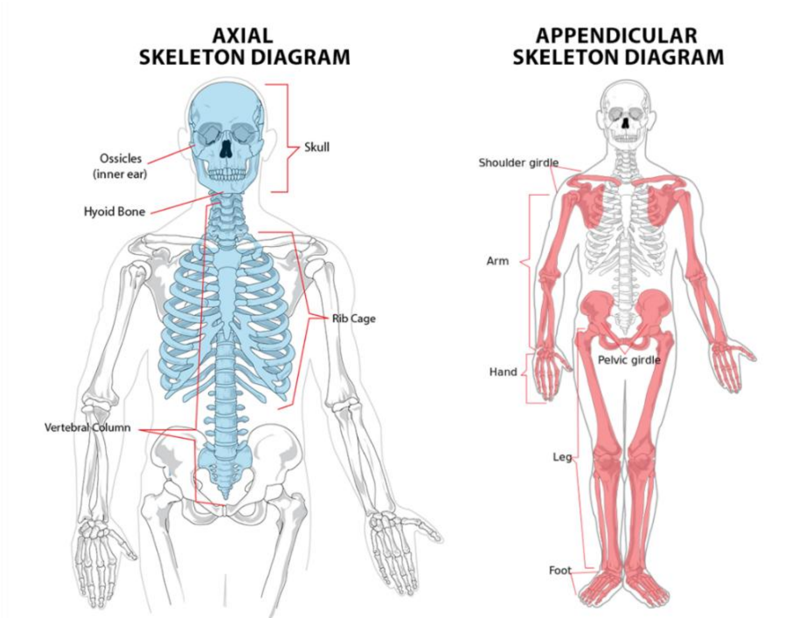
The vertebral column consists of 5 parts. The cervical vertebrae (7), thoracic (12), lumbar (5), sacral (4–5) and the coccygeal vertebrae (3–4).

Appendicular Skeleton

The appendicular skeleton consists of 126 bones.63 bones on each side. The appendicular skeleton includes-
Four(4) bones in the shoulder girdle region (clavicle and scapula each side)

Six(6)bones in the arm and forearm (humerus, ulna, and radius each side)
Fifty-eight (58) bones in the hands (carpals 16, metacarpals 10, phalanges 28 and sesamoid 4)
Two(2) pelvis bones

Eight(8) bones in the legs (femur, tibia, patella, and fibula)
Fifty-six (56) bones in the feet (tarsals, metatarsals, phalanges, and sesamoid)

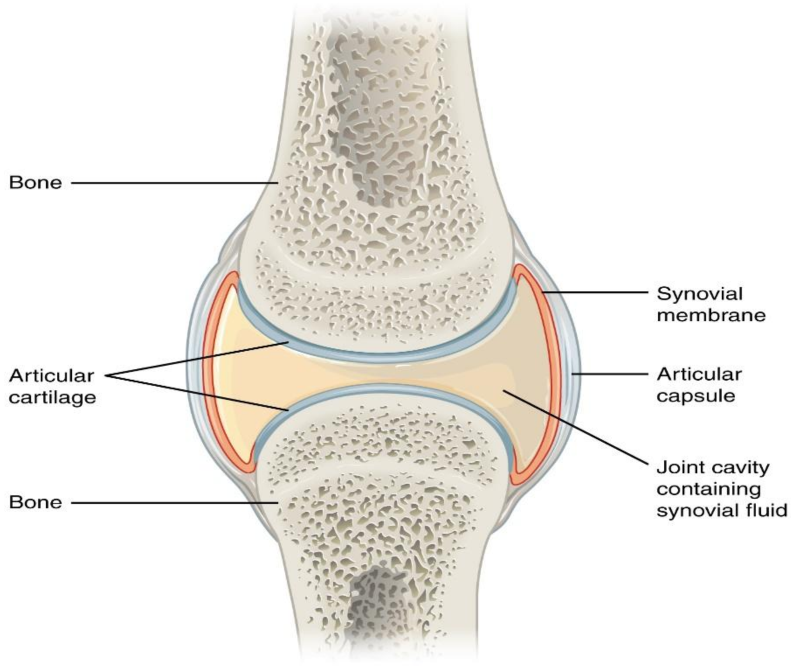


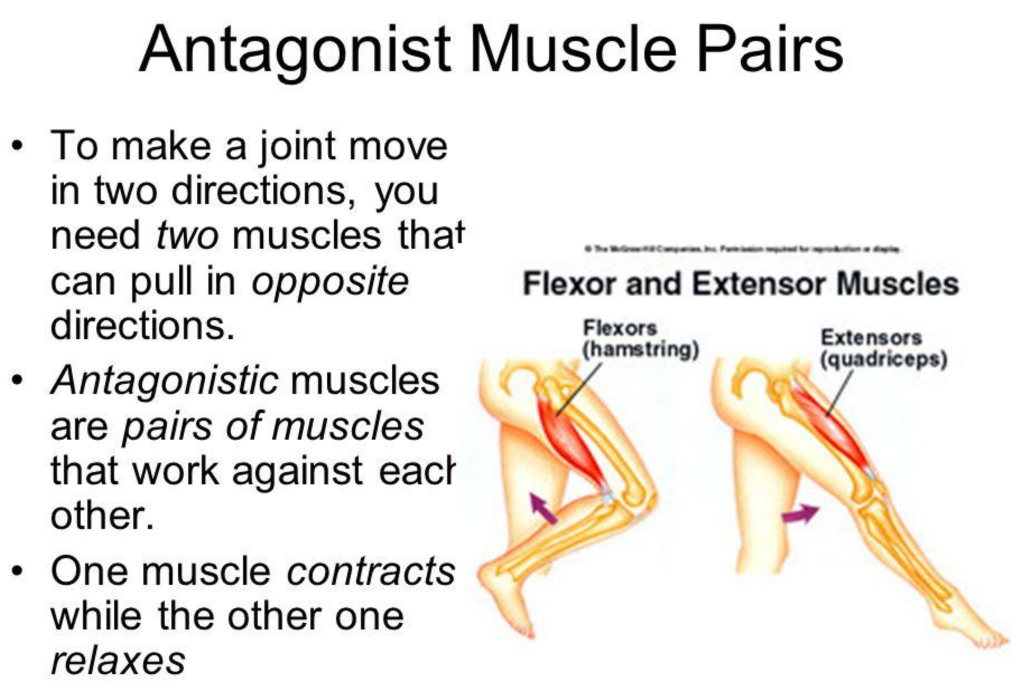
Bone	Cartilage
Bone cannot be bent or stretched.	Cartilage can bent and fold easily at certain parts.
Bone is the hardest part of the body.	Cartilage is a soft and flexible tissue.
This may break and result in a fracture.	Cartilage does not break.
Bone is made up of calcium and phosphorus.	Cartilage is made up of protein salt and connective tissue.

JOINTS

A joint, also known as an articulation or articular surface, is a connection that occurs between bones in the skeletal system. Joints provide the means for movement. The type and characteristics of a given joint determines its degree and type of movement. Joints can be classified based on structure and function.

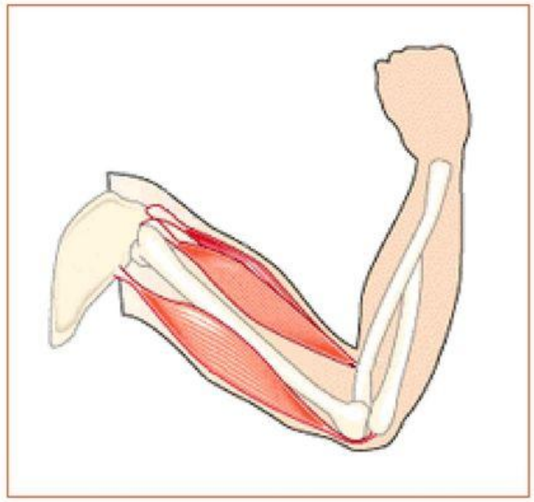
SYNOVIAL JOINT

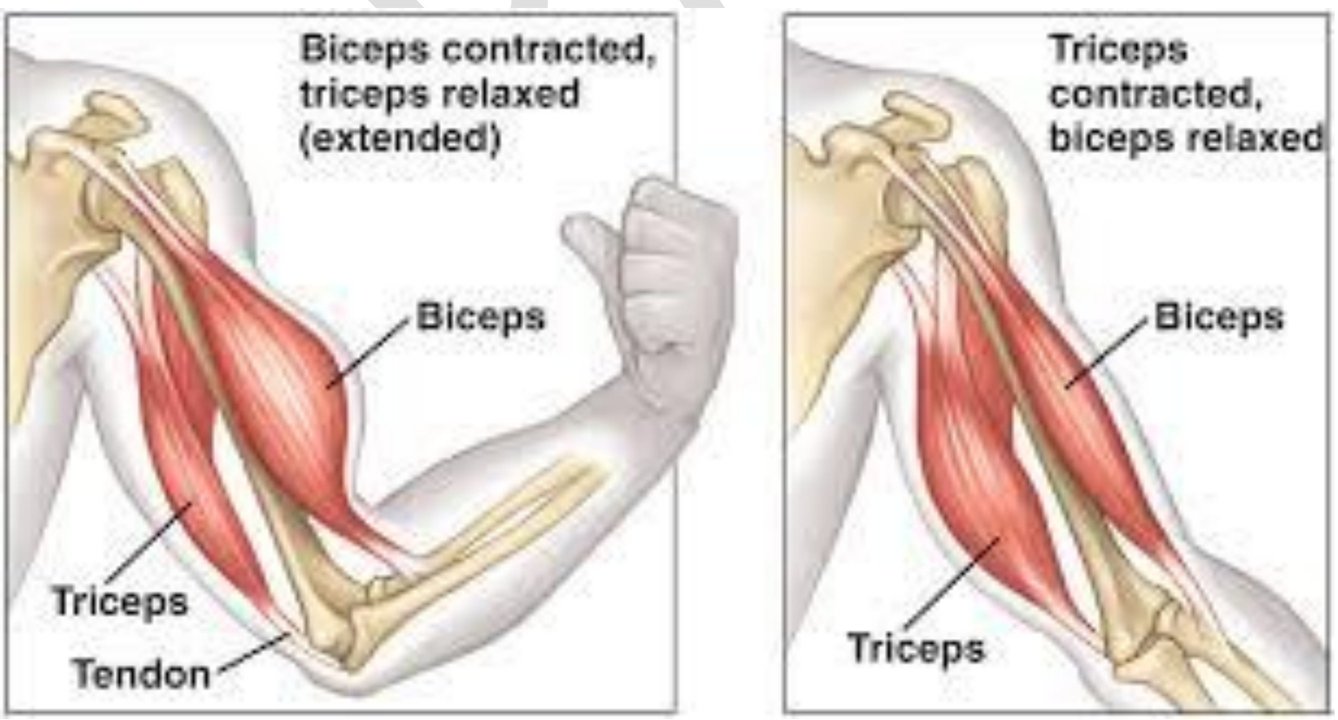




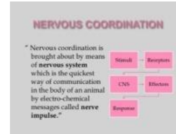
How our Muscles Work

The <u>BICEPS</u> and <u>TRICEPS</u> in our arm are an <u>ANTAGONISTIC PAIR</u>. They work as a pair and in opposite directions.





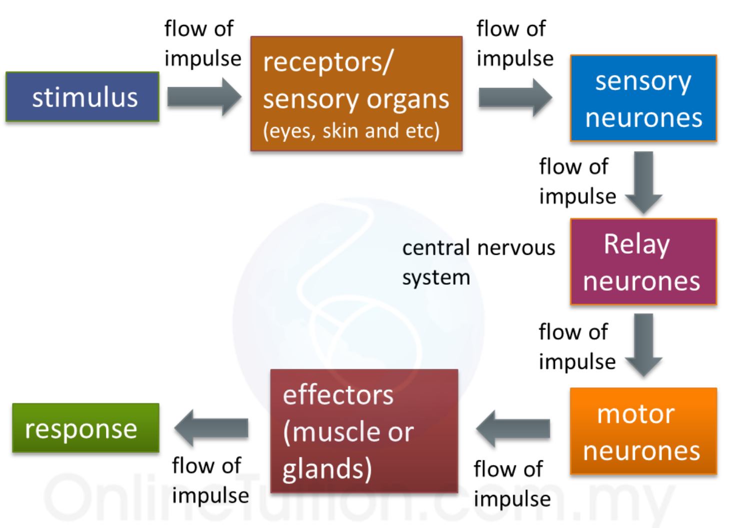
NERVOUS COORDINATION



Chapter	Student learning outcomes	Teachers must be able to	Reference web material
NERVOUS COORDINATION	Student Will Be Able To Understand Parts of human brain Types of receptors Different types of nervous system reflex action Neurons and Types of neuron Nerve impulse	define coordination and control Human brain define nervous coordination, receptors and neurons; classify receptors with examples; working of sensory receptors with special reference to skin; the structure and types of neurons; reflex arc, types of reflex arcs and reflex action by giving examples; define nerve impulse; different steps involved in initiation and propagation of nerve impulse; define synapse, pre-synapse, post synapse and neurotransmitter; differentiate between diffused and centralized nervous system; the nervous system of hydra and planaria different parts and functions of human	 CENTRALIZED NERVOURS SYSTEM  HOW NEURONS COMMUNICATES

		brain; explain the structure of spinal cord; give an account of peripheral nervous system; differentiate between sympathetic and parasympathetic nervous system; nervous disorders (Parkinson's disease, Epilepsy and Alzheimer's disease);	

Chapter overview



The pathway of impulses in the nervous coordination

DIFFERENCE BETWEEN NERVOUS COORDINATION AND CHEMICAL COORDINATION

NERVOUS TISSUE

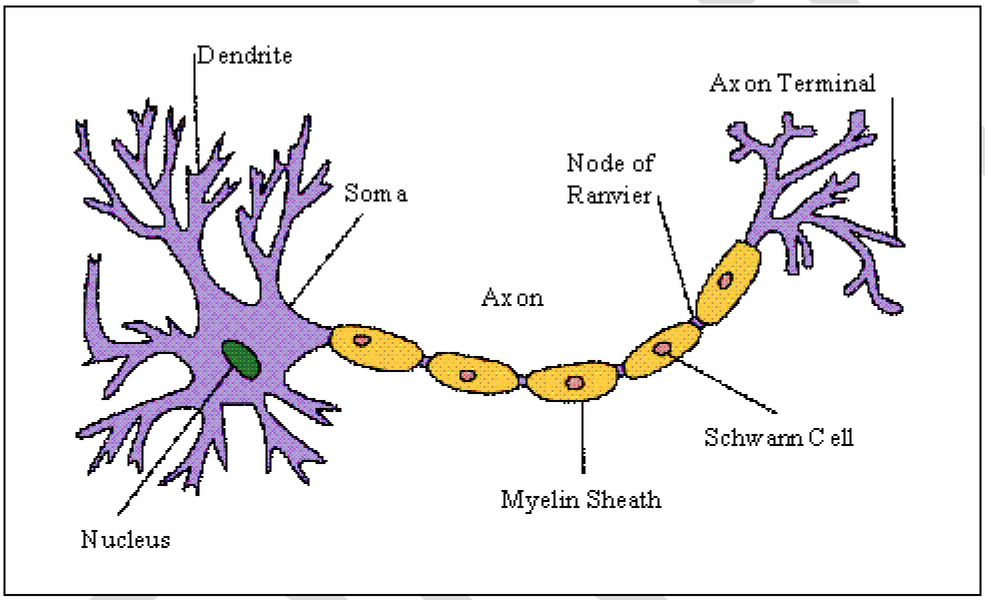
NEURON

Special kind of animal cell which can generate and conduct electric current.

STRUCURE OF NEURON:

Following are the components of neuron

1. SOMA(CELL BODY): contains cytoplasm and nucleus, contain organelle Nissl Substance which consist ribosomes
2. AXON: Long slender projection that conduct electrical impulse away from the cell body
3. DENDRITES: Tree like structures arise from soma that receive messages from neuron.
4. AXON TERMINALS: Axon terminals are distal terminations or branches of an axon



Structure of neuron

TYPES OF NEURON: (ON THE BASIS OF FUNCTION)

1. SENSORY NEURON: carries sensory information from receptor to CNS
2. MOTOR NEURON: they take commands of CNS to effector
3. INTERNEURON: they are found in CNS.

GLIAL CELLS/NEUROGLIA

Neuron in CNS are separated by smaller cell called glial cells.

Schwann cell form the myelin sheath.

FUNCTION:

- They surround neuron and hold them in place
- Provide nutrients and oxygen to neuron
- Insulate one neuron from another
- They perform trophic and phagocytic functions

NERVE IMPILSE

Definition: " Nerve impulse is a wave of electro-chemical changes which passes through body of Neuron.

Neurons work for nerve impulse. When the neurons send messages they produce electric wave.

Neuron develop impulse in the following way:

1. Resting membrane potential (RMP)
2. Action potential
3. Propagation of impulse.
4. Synapse

1. RESTING MEMBRANE POTENTIAL (RMP)

The resting (non signaling) neuron has a voltage across its plasma membrane called resting membrane potential.

- The resting potential is determined by concentration gradient of ions across membrane and by membrane permeability to each type of ion.
- In this process Na^+ ions are involved. The neurolemma (plasma membrane of neurons) carries positive charge on its outer surface and negative charge in its inner surface. When messages does not pass through nerve cell the current difference outside and inside of neurolemma is usually -64mv. This amount of current is called RMP.
- RMP is produced when the positive and negative charge outside and inside the neurolemma is different. On outer side Na^+ ion is greater and its amount is less inside the neurolemma. Potassium ions are concentrated much inside than outside the membrane. The negative charge inside is due to organic acids and protein.

2. ACTION POTENTIAL When neurolemma of neuron is affected by electric shock, touch, sound etc. the amount of positive and negative charge is distributed and a charge occurs in RMP. This is a nerve impulse.

During action potential the polarity of neurolemma first changes to +40 mv(i.e. depolarization) and then restores to -65 mv again (i.e. repolarization). This action potential is very rapid and it occurs in only few milliseconds.

The change in potential across membrane is due to the presence of Na^+ and K^+ channels in neurolemma upon stimulation, the sodium channels open and Na^+ start to transfer inside the cell, membrane potential changes from negative to zero then proceeds up to +40 mv at this stage sodium channels are automatically shutdown but simultaneous potassium channels open to allow their outward movement. As a result negative charge gradually restores (-65).

Since the sodium ion accumulate inside and potassium outside at this stage the sodium potassium pump become operational to restore the initial accumulation of sodium outside and potassium inside.

3.PROPAGATION OF NERVE IMPULSE

When action potential develops and spread along the entire length of neurolemma, it is called propagation of nerve impulse

4.SYNAPSE

The loose connection between neurons are called synapse.

PARTS OF SYNAPSE:

The synapse consists of 3 parts:

a. Pre synaptic membrane: It is the membrane of axon terminal.

b. Synaptic cleft: The narrow space between neurons is synaptic cleft.

c. Post synaptic membrane: this is the membrane of dendrites of another neuron. When it is the membrane of muscle cell it is called as motor end plate.

The nerve impulse is transferred from Pre synaptic part to the Post synaptic part at axon terminals, because at their ends vesicles are present, which contain a chemical called neuro transmitter. This neurotransmitter takes part to transfer the nerve impulse.

When a message is reached at axon terminals, the Calcium channels present there are opened. From synaptic cleft calcium ions are diffused into the calcium channels due to this process the vesicles containing neurotransmitter are connected with axon terminals and from these vesicles neurotransmitter is released into the synaptic cleft. The neurotransmitter are attached to the post synaptic membrane of dendrites of other neuron. It causes action potential and nerve impulse is started. After that this neurotransmitter is diffused back into the pre-synaptic membrane of the neurons. It can be used again in the process.

TYPES OF NEUROTRANSMITTER

Neurotransmitter are of different types, some of them have been identified such as acetylcholine, non-epinephrine, glycine, GABA, serotonin, Dopamine etc.

REFLEX ACTION

Reflex action are automatic,involuntaryresposnes which occur either due to internal and external stimuli

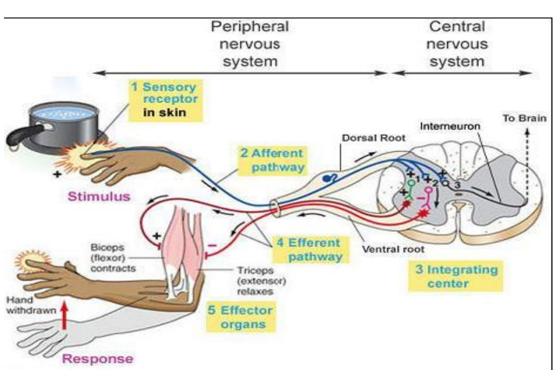
Example: Knee jerk or withdrawal of hand from hot plate.

Reflex action involves two neuron: sensory neuron and motor neuron.

Reflex Arc

Pathway of such transmission is called reflex arc. Reflex arc consist of

1. Receptor or sense organ
2. Sensory neuron
3. Reflex center (CNS)
4. Motor nerve.   Effect or (muscle/gland)



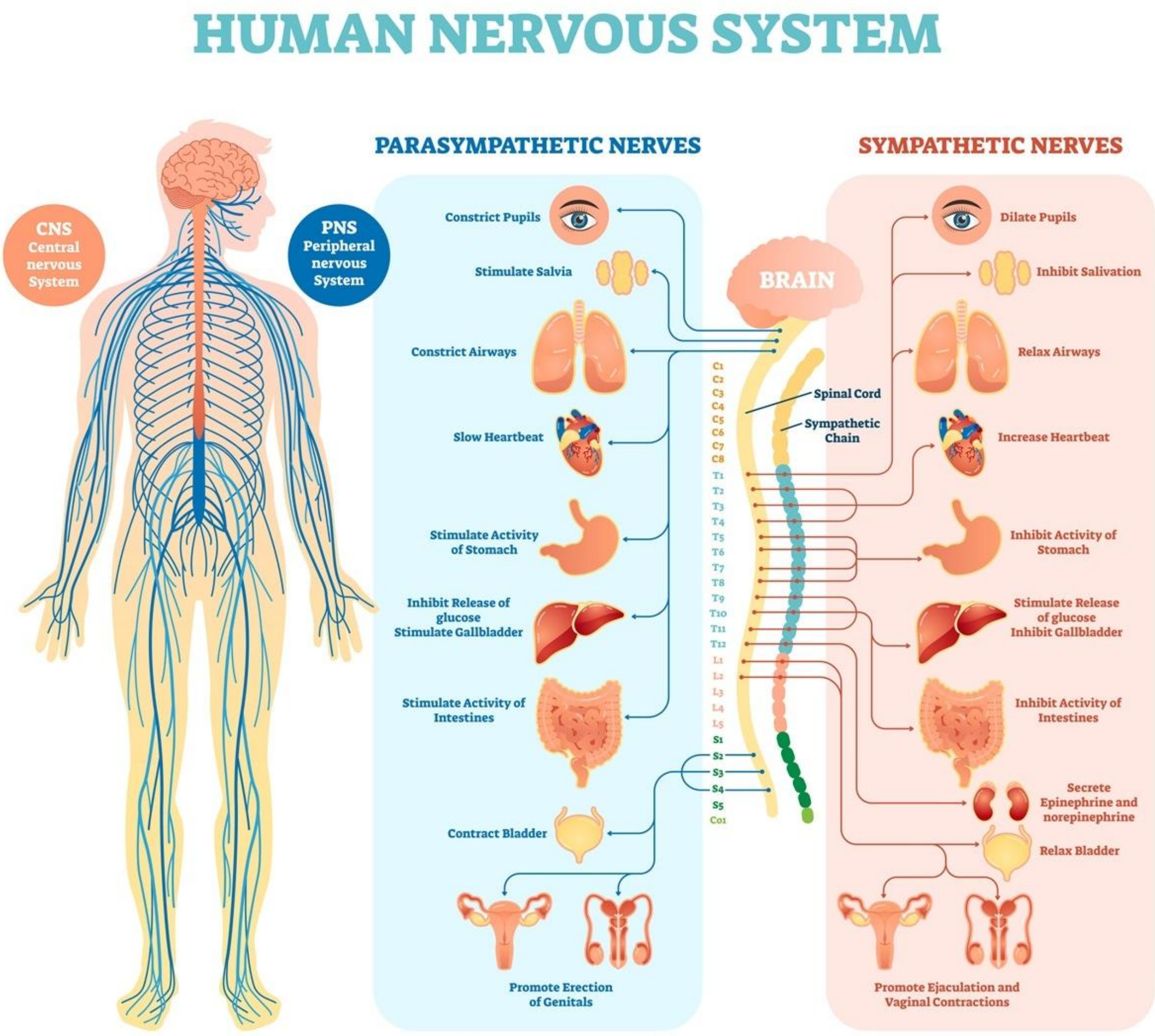
Reflex action type:

Monosynaptic: Reflex action is said to be monosynaptic when only one synapse is involved.

Polysynaptic: Reflex action is said to be polysynaptic when it involves one or more interneurons imposed between sensory and motor neurons

Reflex action and reflex arc

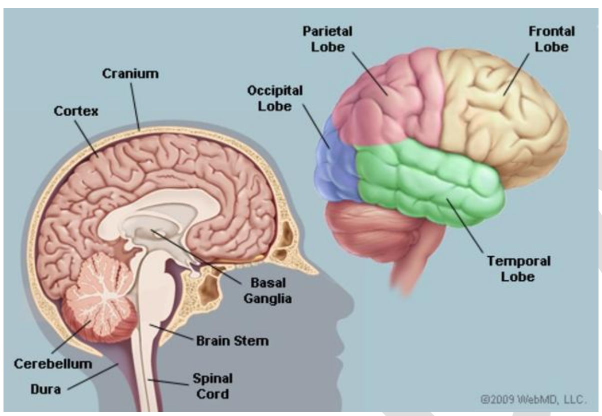
<u> HUMAN NERVOUS SYSTEM</u>



- HUMAN HAS CENTRALIZED NERVOUS SYSTEM..
- CENTRAL NERVOUS SYSTEM CONSIST OF BRAIN AND SPINAL CORD.
- BOTH CONSIST OF 100 BILLION INTERNEURON.
- BOTH ARE PROTECTED IN BONY STRUCTURES i.e., SKULL AND VERTEBRAL COLUMN

BRAIN

- ONE OF THE LARGEST AND MOST COMPLEX ORGAN
- BRAIN IS SURROUNDED BY A LAYER OF TISSUE CALLED MENINGES
- SKULL (CRANIUM) HELP PROTECT THE BRAIN FROM INJURY
- CNS DEVELOPS IN EMBRYO FROM DORSAL HOLLOW NERVE CORD AND FILLED WITH CSF(Cerebrospinal fluid)



SUBDIVISION OF BRAIN AT EARLY DEVELOPMENT STAGES

How the Human Brain Gets Its Wrinkles?

POSSIBLE REASONS:

- The human brain is relatively large and very wrinkled. Wrinkles increase the surface area for neurons.
- The reason our brains have that wrinkly, walnut shape may be that the rapid growth of the brain's outer brain — the gray matter — is constrained by the white matter. A folded brain surface has a greater surface area — which means a greater power for processing information.

CEREBRAL CORTEX(LARGEST/MOST COMPLEX PART OF BRAIN)

- IT CONTROL ALL THE CONSCIOUS ACTIVITIES
- IY IS THE PLACE WHICH IS INVOLVED IN INTELLIGENCE, REASONING, MEMORY ETC.
- FUNTIONALLY IT IS DIVIDED INTO:

i. Frontal lobe

ii. Parietal lobe

iii. Temporal lobe

iv. Occipital lobe

Frontal lobe

COORDINATES MESSAGES FROM OTHER CEREBRAL LOBES, INVOLVED IN COMPLEX PROBLEM SOLVING TASKS.

Parietal Lobe

RECEIVES SENSORY INFORMATION FROM SENSE RECEPTORS ALL OVER THE BODY

Temporal lobe

INVOLVED IN COMPLEX VISUAL TASK, BODY BALANCE, REGULATES EMOTION, PLAY STRONG ROLE IN UNDERSTANDING LANGAUGE.

Occipital lobe

RECEIVES AND PROCESSES VISUAL INFORMATION

THALAMUS

- The thalamus is a small structure within the brain located just above the brain stem between the cerebral cortex and the midbrain
- It has extensive nerve connections to both.
- The main function of the thalamus is to relay motor and sensory signals to the cerebral cortex.
- It is known as clearing house for sensory impulses as it receives them from different parts of brain and send them to appropriate part of motor cortex

LIMBIC SYSTEM

Limbic system consists of hypothalamus , Amygdala, Hippocampus, and some part of thalamus

HYPOTHALAMUS

The hypothalamus is a small region of the brain. It's located at the base of the brain, near the pituitary gland. It's very small

- The Hypothalamus is important in of homeostasis
- It regulates pituitary gland.
- It is also involved in regulation of body temperature, blood pressure, hunger, thirst , aggression, pleasure and pain.

AMYGDALA: PRODUCES SENSATION OF PLEASURE PUNISHMENT OR SEXUAL AROUSAL UPON STIMULATION.

HIPPOCAMPUS: INVOLVED IN LONG TERM MEMORY.

BRAIN STEM

The brain stem consists of the midbrain, pons, and medulla oblongata.

FUNCTION

The brain stem controls the flow of messages between the brain and the rest of the body, and it also controls basic body functions such as breathing, swallowing, heart rate, blood pressure, consciousness, and whether one is awake or sleepy.

SPINAL CORD

The spinal cord is a long, fragile tube like structure that begins at the end of the brain stem and continues down almost to the bottom of the spine.

FUNCTION

The spinal cord consists of nerves that carry incoming and outgoing messages between the brain and the rest of the body.

SPINAL CORD HAS TWO AREAS WHITE OUTER REGION CONSIST OF NEURON AND GRAY MATTER INNER CONSIST OF NERVE FIBRE

PERIPHERAL NERVOUS SYSTEM

PERIPHERAL NERVOUS SYSTEM

- From brain and spinal cord many nerves are produced which spread in various part of the body. These nerves form peripheral nervous system.

- CRANIAL NERVES: The nerves which arise from brain are called Cranial Nerves. There are 12 pairs.

- SPINAL NERVES: The nerves of spinal cord are called Spinal Nerves. There are 31 pairs.

- Through these nerves impulses are carried from body parts to the brain and spinal cord. These nerves are further divided according to their function

TYPES OF NERVOUS SYSTEM

There are two types of nervous system:

i. SOMATIC NERVOUS SYSTEM:

- The nerves which are reached to the skeletal muscles, control their movement and function, form Somatic nervous system.

- It is voluntary nervous system.

- By this nervous system man can control body parts.

ii. AUTONOMIC NERVOUS SYSTEM

- The nerves which are reached to the smooth muscles, control heart and glands form Autonomic nervous system.
- It is involuntary nervous system.
- It controls internal body organs.

TYPES OF AUTONOMIC NERVOUS SYSTEM

a. Parasympathetic nervous system

b. Sympathetic nervous system

PARASYMPATHETIC NERVOUS SYSTEM

Parasympathetic nervous system consists of some cranial nerves, spinal nerves and vagus nerves. It controls some internal stimuli during rest, such as heart beat, food digestion and contraction of pupil of eye etc.

VAGUS NERVES: each of the tenth pair of cranial nerves, supplying the heart, lungs, upper digestive tract, and other organs of the chest and abdomen.

SYMPATHETIC NERVOUS SYSTEM

This nervous system is formed by nerves present in the thoracic vertebrae and lumber vertebrae.This nervous system works at the time of emergency and fight or flight. It helps for rapid heart beat, fast breathing. Proper digestion etc. In this process a hormone epinephrine is involved.

RECEPTOR(s):

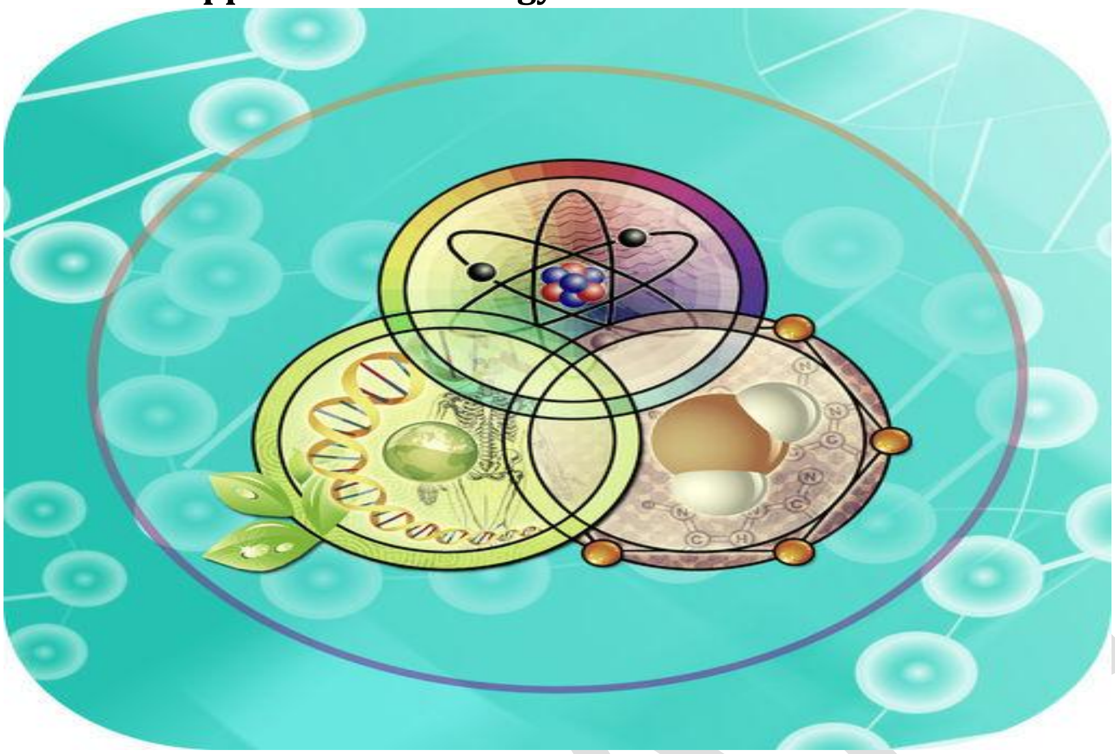
- An organ or cell able to respond to light, heat, or other external stimulus and transmit a signal to a sensory nerve.
- These are found in epithelial layer of external and internal body organs.
- Receptors convert the receiving stimuli into nerves impulses,this awareness or feeling of stimulus is called sensation. In the control Centre of nervous system, impulses are converted into perception.

KINDS OF RECEPTORS:

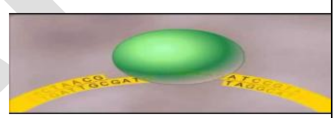
According to the sensation there are different types of receptors:

1. Thermoreceptors: These receptors receive sensation of change in temperature.
2. Chemoreceptors: These receptors receive presence of certain chemical in their surroundings.
3. Mechanoreceptors: These receptors receive sensation about touch, movement, gravity, sound, pressure etc.
4. Photo-receptors: These receptors receive light and ultraviolet rays.
5. Pain receptors: These receptors feel pain in the body organs

Section 3: Application of Biology



Biotechnology

Chapter	Skills	Understanding	Reference web material
Biotechnology	Student will: Describe the application of polymerase reaction. State the importance and limitation of DNA analysis.	Student will: • Describe the terms of genome analysis, genome map and genetic markers. • Explain tissue culture and differentiate between the organ culture and cell culture • State the objectives of the production of transgenic bacteria, transgenic plants and transgenic animals. • Define gene cloning and state the steps in gene cloning. • Describe the techniques of gene cloning through recombinant DNA technology	 Biotechnology  DNA cloning  DNA Replication  Tissue Culture

Chapter review

Genetic engineering,

It is also called genetic modificationor genetic manipulation, is the direct manipulation of an organism's genes using biotechnology.

It is a set of technologies used to change the genetic makeup of cells, including the transfer of genes within and across species boundaries to produce improved or novel organisms.

Genetic engineering is accomplished in three basic steps. These are

(1) The isolation of DNA fragments from a donor organism;

(2) The insertion of an isolated donor DNA fragment into a vector genome .

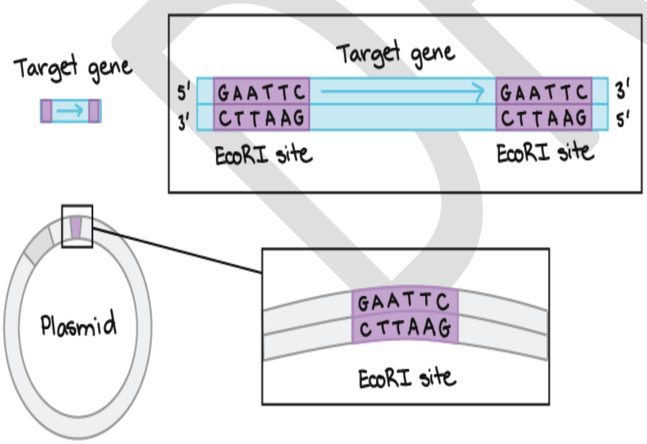
(3) The growth of a recombinant vector in an appropriate host.

Recombinant DNA

(rDNA) molecules are DNA molecules formed by laboratory methods of genetic recombination (such as molecular cloning) to bring together genetic material from multiple sources, creating sequences that would not otherwise be found in the genome.

Recombinant DNA is the general name for a piece of DNA that has been created by combining at least two strands.

Restriction enzymes are DNA-cutting enzymes. Each enzyme recognizes one or a few target sequences and cuts DNA at or near those sequences.



DNA ligase is a DNA-joining enzyme. If two pieces of DNA have matching ends, ligase can link themto form a single, unbroken molecule of DNA.

Insertion of rDNA into host

Transformation

Bacteria can take up foreign DNA in a process called transformation.

Transformation is a key step in DNA cloning. It occurs after restriction digest and ligation and transfers newly made plasmids to bacteria.

DNA Cloning

Transformation and selection of bacteria are key steps in DNA cloning.

DNA cloning is the process of making many copies of a specific piece of DNA, such as a gene. The copies are often made in bacteria.

After a ligation, the next step is to transfer the DNA into bacteria in a process called transformation.

Specially prepared bacteria are mixed with DNA (e.g., from a ligation).

The bacteria are given a heat shock, which causes some of them to take up a plasmid.

Application Of Genetic Engineering

Genetic engineering has applications in medicine, research, industry and agriculture and can be used on a wide range of plants, animals and microorganisms.

In medicine, genetic engineering has been used to mass-produce insulin, human growth hormones, follistim (for treating infertility), human albumin, vaccines, and many other drugs.

In research, organisms are genetically engineered to discover the functions of certain genes.

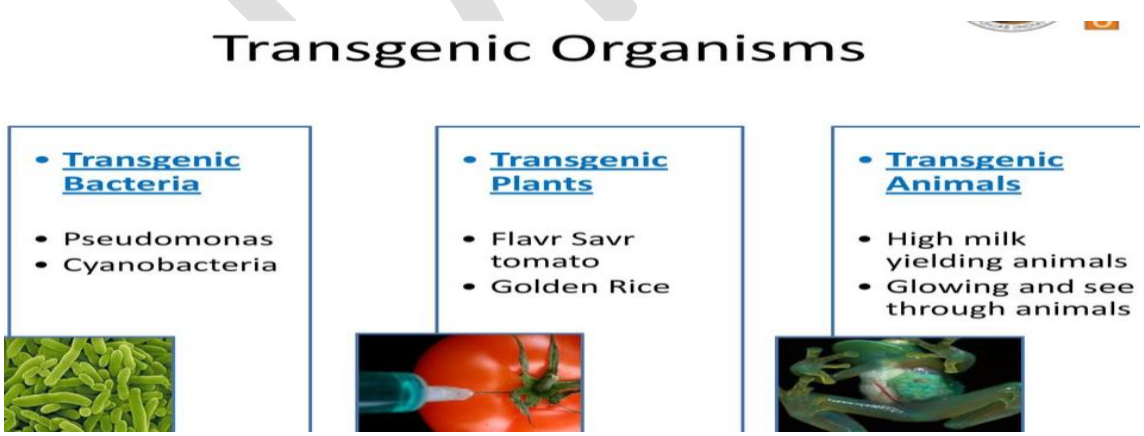
Industrial applications include transforming microorganisms such as bacteria or yeast, or insect mammalian cells with a gene coding for a useful protein.

Genetic engineering is also used in agriculture to create genetically-modified crops or genetically-modified organisms.

Cloning:

Cloning is the process of producing genetically identical individuals of an organism either naturally or artificially.

Cloning in biotechnology refers to the process of creating clones of organisms or copies of cells or DNA fragments.



Transgenic Animals

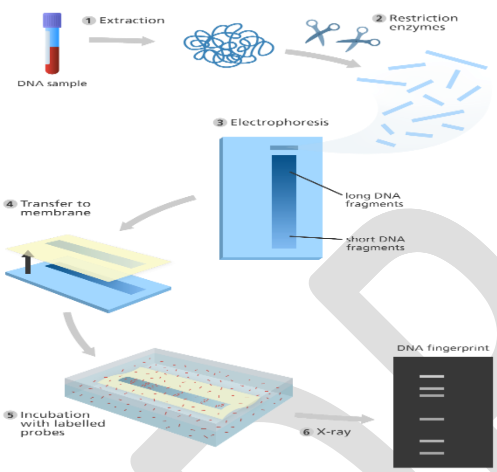
The production of transgenic livestock has the opportunity to significantly improve human health, enhance nutrition, protect the environment, increase animal welfare, and decrease livestock disease.

Transgenic Plants are the ones, whose DNA is modified using genetic engineering techniques. The aim is to introduce a new trait to the plant which does not occur naturally in the species.

Genetically Modified Bacteria were the first organisms to be modified in the laboratory, due to their simple genetics. These organisms are now used for several purposes, and are particularly important in producing large amounts of pure human proteins for use in medicine

DNA Sequencing

It isthe process of determining the nucleic acid sequence – the order of nucleotides in DNA. It includes any method or technology that is used to determine the order of the four bases: adenine, guanine, cytosine, and thymine



DNA Fingerprinting

It is a laboratory technique used to establish a link between biological evidence and a suspect in a criminal investigation. A DNA sample taken from a crime scene is compared with a DNA sample from a suspect. If the two DNA profiles are a match, then the evidence came from that suspect.

A Genomic Library

It is a collection of the total genomic DNA from a single organism. The DNA is stored in a population of identical vectors, each containing a different insert of DNA.

What is called tissue culture?

Plant tissue culture is a collection of techniques used to maintain or grow plant cells, tissues or organs under sterile conditions on a nutrient culture medium of known composition.

Plant tissue culture is widely used to produce clones of a plant in a method known as micro propagation

Reference pages

https://www.omicsonline.org/open-access/application-of-biotechnology-towards-diagnosis-and-treatment-in-veterinary-medicine-in-africa-potentials-and-future-developments-2155-952X-1000245.php?aid=80252

https://www.google.com/search?rlz=1C1GCEA_enPK880PK880&sxsrf=ACYBGNTAGblIrEh-cH7j6la54EBr_n6tcg%3A1577456850956&ei=0hQGXqffOcWelwSy0YnYDw&q=dna+fingerprinting&o

q=DNA+f&gs_l=psy-ab.1.0.0i273l2j0i67l5j0l3.41129.47560..49076...0.3..0.430.1423.2-2j0j2......0....1..gws-wiz.......0i71j0i7i10i30j0i8i7i10i30j0i13i5i10i30j0i10.3m5n-LI65mI

https://www.khanacademy.org/science/biology/biotech-dna-technology/dna-cloning-tutorial/a/bacterial-transformation-selection

https://www.tandfonline.com/doi/abs/10.1080/00207238008737419

https://www.nature.com/scitable/knowledge/library/transgenic-animals-in-agriculture-105646080/

https://www.britannica.com/science/recombinant-DNA-technology

https://www.biologyexams4u.com/2013/10/steps-in-recombinant-dna-technology.html#.XgYvJVVKjIU

https://www.britannica.com/science/genetic-engineering

https://en.wikipedia.org/wiki/Genetically_modified_bacteria

Lesson Plan

Get your budding scientists thinking with this lesson plan that examines genetic engineering. Students will watch a video to learn what genetic engineering is and see examples. Follow up with an activity to solidify facts.

Learning Objectives

After this lesson, students will be able to:

define 'genetic engineering'

explain the process of genetic engineering

describe applications of genetic engineering

debate genetic engineering

Length:

1 - 1.5 hours

Materials

Access to internet for research

Key Vocabulary

Genetic engineering
Recombinant DNA
Genetically-modified organism, GMO
Host organism
Vector
Plasmid

Curriculum Standards

Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.