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# System of the Human Body

## (a) Digestive System

The complete process of nutrition is divided into five stages :

1. Ingestion
2. Digestion
3. Absorption
4. Assimilation
5. Defecation

**1. Ingestion** : Taking the food into the mouth is called Ingestion.

**2. Digestion** : Conversion of nonabsorbable food into absorbable form. The digestion of the food is started from the mouth.

1. Saliva is secreted by salivary gland in mouth in which two types of enzymes are found, ptyalin and maltase. They convert starch into simple sugar and make it digestible.

2. In human secretion of saliva is approximately 1.5 litre per day.

3. The nature of saliva is acidic (pH 6.8)

4. From the mouth the food reach into stomach through food pipe.

5. No digestion takes place in food pipe.

### Digestion in Stomach

1. The foods lies approximately for four hours in stomach.

2. After reaching the food in stomach gastric glands secretes the gastric juice. This is a light yellow acidic liquid.

3. Hydrochloric acid secreted from the Oxyntic cells of the stomach kills all the bacteria coming with food and accelerates the reaction of enzymes. Hydrochloric acid makes the food acidic by which ptyalin reaction of the saliva end.

4. The enzymes in the gastric juice of stomach are – Pepsin and Renin.

5. Pepsin breaks down the protein into peptones.

6. Renin breaks down the Caseinogen into Casein.

### Digestion in Duodenum

1. As soon as the food reaches the duodenum bile juice from liver combines with it. Bile juice is an alkaline and it turns the acidic medium of food into alkaline.

2. Here, pancreatic juice from pancreas combines with food. It contains three types of enzymes :

(i) **Trypsin** : It converts the protein and peptone into polypeptides and amino acid.

(ii) **Amylase** : It converts the starch into soluble sugar.

(iii) **Lipase** : It converts the emulsified fats into glycerol and fatty acids.

### Small Intestine

3. Here, the process of digestion completed and absorption of digested foods start.

4. From the wall of small intestine, intestinal juices secretes. The following enzymes contain :

(i) **Erepsin** : It converts the remaining protein and peptone into amino acids.

(ii) **Maltase** : It converts the maltose into glucose.

(iii) **Sucrase** : It converts the sucrose into glucose and fructose.

(iv) **Lactase** : It converts the lactose into glucose and galactose.

(v) **Lipase** : It converts the emulsified fats into glycerol and fatty acids. Intestinal juice is alkaline in nature.

In a healthy people approximately 2 litres of intestinal juice secretes every day.

3. **Absorption** : Reaching of digested foods into blood is called absorption.

1. The absorption of digested foods takes place through small intestinal villi.

4. **Assimilation** : Use of absorbed food in the body is called assimilation.

**5. Defecation :** Undigested food reaches into large intestine where bacteria turns it into faeces, which is excreted through anus.

### **The main organs participating in digestion :**

**Liver :** This is the largest gland of the human body. Its weight is approximately 1.5 – 2 kilogram.

1. Bile is secreted through liver only. This bile accelerate the reaction of enzymes present in the intestine.
2. Liver convert excess of amino acid into ammonia by deamination. These ammonia are further converted into urea by ornithine cycle. Urea comes out from body through kidney.
3. Liver converts some quantity of protein into glucose during deficiency of carbohydrate.
4. In carbohydrates metabolism liver converts the excess of glucose found in blood into glycogen and stores it into hepatic Cell as reserve nutrients. If the necessity of glucose arises the liver convert reserve glycogen into glucose. Thus, it regulates the quantity of glucose in the blood.
5. In case of decrease of fat in food liver converts some of the parts of the carbohydrates into fat.
6. The production of fibrinogen protein takes place by liver which helps in clotting of blood.
7. The production of Heparin protein takes place in liver which prohibit the clotting of blood inside the body.
8. The dead RBC is destroyed by the liver only.
9. The liver reserve some quantity of iron, copper and vitamin.
10. It helps in regulating the body temperature.
11. Liver is an important clue in investigating a person's death that has been due to poison in food.

**Gall Bladder :** Gall bladder is a pear shaped sac, in which the bile coming out of liver is stored.

1. Bile comes into the duodenum from gall bladder through the bile duct.
2. Secretion of bile into the duodenum takes place by reflex action.
3. Bile is a yellowish-green coloured alkaline liquid, whose pH value is 7.7
4. The quantity of water is 85% and the quantity of bile pigment is 12% in water.

**The Main functions of bile are as under :**

- (i) It makes the medium of food alkaline so that pancreatic juice can work.
- (ii) It kills the harmful bacteria coming with food.
- (iii) It emulsifies the fats.
- (iv) It accelerates the bowel movement of intestine by which digestive juices in the food mix well.
- (v) It is helpful in the absorption of vitamin K and other vitamins mixed in fats.

In case of obstruction in bile duct, liver cells stop taking bilirubin from blood. As a result, bilirubin spreads throughout the body. This is called jaundice.

**Pancreas :** This is the second largest gland of the human body. It acts as simultaneously endocrine and exocrine type of gland.

1. Pancreatic juice secretes out of it in which 9.8% water and the remaining parts contain salt and enzymes. It is alkaline liquid, whose pH value is 7.5–8.3. It contains the enzymes which can digest all the three types of food materials (like carbohydrates, fat and protein), therefore it is called complete digestive juice.

**Islets of Langerhans :** This is a part of the Pancreas.

1. It was discovered by the medical scientist Langerhans.
2. From its  $\beta$  cell- insulin, from  $\alpha$  cell-glucagons and from  $\delta$  cell-somatostatin hormones are secreted :

**Insulin :** It is secreted by  $\beta$ -Cell of islets of Langerhans which is a part of the pancreas.

1. It was discovered by Banting and Best in the year 1921.

2. It controls the process of making glycogen from glucose.
3. Diabetes is caused due to the deficiency of insulin.
4. Excessive flow of insulin causes Hypoglycemia in which one loses the reproducing capacity and vision deterioration.

**Glucagon : It re-converts the glycogen into glucose.**

**Somatostatin** : This is a polypeptide hormone which increases the duration of assimilation of food.

### (b) Circulatory System

The discovery of blood circulation was done by William Harvey in the year 1628.

There are four parts under it -

- (i) Heart
- (ii) Arteries
- (iii) Veins
- (iv) Blood.

**Heart** : It remains safe in the pericardial membrane. Its weight is approximately 300 grams.

Heart of the human is made up of four chambers. In the anterior side there is a right auricle and a left auricle. In the posterior side of the heart there is a right ventricle and a left ventricle persist.

1. Between the right auricle and the right ventricle there is a tricuspid valve.
2. Between the left auricle and left ventricle there is a bicuspid valve.
3. The blood vessels carrying the blood from the body towards the heart is called vein.
4. In the vein there is impure blood i.e. carbon dioxide mixed blood. Its exception is pulmonary vein, which always carry pure blood. Pulmonary vein carries the blood from lungs to left auricle. It has pure blood.

5. The blood vessels carrying the blood from the heart towards the body is called artery.
6. In artery there is pure blood i.e. oxygen mixed blood. Its exception is pulmonary artery.
7. Pulmonary artery carries the blood from right ventricle to lungs. It contains impure blood.
8. In the right part of the heart, there remains impure blood i.e. carbon dioxide mixed blood and in the left part of the heart there remains pure blood i.e. oxygen mixed blood.
9. The artery carrying blood to the muscles of the heart are called coronary arteries. Any type of hindrance in it causes heart attack.

**Course of circulation :** Mammals have double circulation. It mean blood have to cross two times from heart before circulating throughout the body.

1. Right auricle receive impure blood from the body which goes into right ventricle. From here the blood went into pulmonary artery which send it to the lung for purification. After purification it is collected by pulmonary vein which bring it back to heart in left auricle. From auricle it went into left ventricle. Now this purified blood is went into aorta for different organ of body.

**This circulation is done is a cardiac cycle.**

**2. Cardiac cycle :** Rhythmic systole (Contraction) and diastole (relaxation) of auricle and ventricle constitutes a cardiac cycle.

**3. Heart beat :** Heart keeps beating rhythmically throughout the life. There is a node from which originate contraction of heart.

**(i) Sino auricular node (SA node) :** It is a specialised area of cardiac muscle fiber in right auricle. SA node is also known as pace maker as it generates each wave of cardiac impulse.

**(ii) Auriculo – Ventricular node (AV node) :** AV node is present close to the interatrial septum near the right AV aperture. Wave of contraction is picked up by AV node which spread through.

1. Wave of excitation is picked up by AV node which spread through AV bundle of muscles fibers present on inter arterial septum as well as inter-ventricular septum.

2. Artificial pace maker : When SA node becomes defective or damaged, the cardiac impulses do not generate. This can be cured by surgical grafting of an artificial pace maker an electric device in the chest of the patient. It stimulate the heart electrically at regular intervals.
3. Systole and diastole of the heart are collectively called heart beat. In the normal condition the heart of the human beats 72 times and in a single beat it pumps approximately 70 ml blood.
4. The blood pressure of a normal human is 120 / 80. (Systolic – 120 and Diastolic – 80).
5. Blood pressure is measured by sphygmomanometer.
6. Thyroxin and adrenaline are the hormones which independently controls the heart beat.
7. The CO<sub>2</sub> present in the blood accelerates the heart beat by reducing the pH.

### **(c) Lymph Circulatory System**

1. The light yellow fluid found in the inter-cellular intervals between different tissues and cells is called lymph.
2. Lymph is a fluid whose composition is like blood plasma, in which nutrient, oxygen and various other substances are present.
3. The corpuscles found in lymph are called lymphocytes. In fact, these are White Blood Corpuscles (WBC).
4. Lymph flows only in one direction from tissue towards heart.

### **Functions of lymph :**

- (i) The lymphocytes present in lymph helps to prevents the body from diseases by killing the harmful bacteria.
- (ii) Lymph form the lymphocytes.
- (iii) The node found in lymph vessels are called lymph node works as a filter in the human body.
- (iv) Lymph helps in healing the wounds.



(v) Lymph circulates different material from tissues to veins.

#### (d) Excretory System

**Excretion** : Removal of nitrogenous substances formed during metabolism from the body of human is called excretion. Normally excretion means the release of nitrogenous excretory substances like urea, ammonia, uric acid etc.

The main excretory organs of human are as follows —

(i) Kidneys, (ii) Skin, (iii) Liver and (iv) Lungs.

**(i) Kidneys** : The main excretory organ in human and other mammals is a pair of kidneys. Its weight is 140 grams. There are two parts of it. Outer part is called cortex and the inner part is called medulla. Each kidney is made up of approximately 1,30,00,000 kidney ducts which are called nephrons. Nephron is the structural & functional unit of the kidney. There is a cup like structure in the every nephron called Bowman's capsule. Glomerulus of thin blood vessels are found in the Bowman's capsule which is made up of two types of arterioles.

**(i) Afferent arteriole** : Which carries the blood to the glomerulus.

**(ii) Efferent arteriole** : By which the blood is taken out of the glomerulus.

1. The process of filtration of liquids into the cavity of Bowman's capsule, is called ultra filtration.
2. The main function of the kidneys is purification of blood plasma i.e. to excrete the unwanted nitrogenous waste substances through urination.
3. The supply of blood to kidneys takes place in large quantity in comparison to other organs.
4. In the kidneys average 125 ml per minute blood is filtrated i.e. 180 liters per day. Out of it 1.45 liters urine is formed daily and the remaining is absorbed back by the cells of nephron and mix into the blood.
5. In the normal urine there is 95% water, 2% salt, 2.7% urea and 0.3% uric acid.
6. The colour of the urine is light yellow due to the presence of urochromes in it. Urochrome is formed by the dissotiation of haemoglobin.
7. Urine is acidic. Its pH value is 6.

**8.** The stone formed in the kidneys is made up of calcium oxalate.

**(ii) Skin :** Oil gland and sweat glands found in the skin respectively secrete sebum and sweat

**(ii) Liver :** Liver cells play the main role in excretion by converting more and more amino acids and ammonia of blood into urea.

**(iii) Lungs :** The lungs excrete two types of gaseous substances carbon dioxide and water vapour. The excretion of some substances like garlic, onion and some spices in which vapour component excreted by the lungs.

**Hemodialysis :** Process of removal of excess urea from the blood of patient using artificial kidney.

### **(e) Nervous System**

Under this system thin thread like nerves are spread throughout the body. After receiving the information of environmental changes from the sensitive organs, it spreads them speedily like electrical impulses and establishes working and coordination among different organs.

Nervous System of human is divided into three parts :

**(1) Centred Nervous System**

**(2) Peripheral Nervous System**

**(3) Autonomic Nervous System.**

**1. Central Nervous System** – Part of the nervous system which keeps control on the whole body and on nervous system itself is called Central Nervous System. The Central Nervous System of human is made up of two parts - Brain and Spinal Cord.

Brain is covered by membrane called meninges. It is situated in a bony box called cranium which protect it from external injury.

**(A) Fore Brain :** The weight of the brain of the human is 1350 grams.

**(i) The function of the Cerebrum :** This is the most developed part of the brain. This is the centre of wisdom, memory, will power, movements, knowledge and thinking. The analysis and coordination of muscular movement received from sense organs.

**(ii) The function of thalamus :** It is the centre of the pain, cold and heat.

**(iii) The function of hypothalamus :** It controls the hormonal secretion from endocrine glands. Hormones secreted from posterior pituitary gland secrete through it. This is the centre of hunger, thirst, temperature control, love, hate etc. Blood pressure, metabolism of water, sweat, anger, joy etc. are controlled by it.

**(B) The function of Corpora quadrigemina :** This is the centre of control on vision and hearing power.

### **(C) Hind Brain**

**(i) Function of cerebellum :** It is some what at the back of head and consist of two cerebellar hemisphere like cerebrum. It is large reflex centre for coordination of muscular body movements and maintenance of posture.

**(ii) Pons :** It act as bridge carrying ascending and descending tracts between brain and spinal cord.

**(iii) Medulla :** It is posterior most part of brain and continuous into the spinal cord. It connect and communicate the brain with spinal cord. It contains the cardiac respiratory and vasomotor centres that control complex activity like heart action, respiration, coughing, sneezing etc.

1. The brain of the human is covered in the cranium which protects it from external injury. Brain is covered by membrane called meninges.

2. Spinal cord : The posterior region of the medulla oblongata forms the spinal cord. Its main functions are :

**(a)** Coordination and control of reflex actions i.e. it works as the centre of the reflex actions.

**(b)** It carries the wave coming out of brain.

**Note :** Reflex action was first discovered by the scientist, Marshall Hall.

**2. Peripheral Nervous System :** Peripheral Nervous System is made up of the nerves arising from brain and spinal cord. These are called cranial and spinal nerves respectively. There are sensory, motor and mixed nerve. »- There are 12 pairs of cranial nerves and 31 pairs of spinal cord found in a human.

The unit of nervous tissues is called Neuron or nerve cell.

**3. Autonomic Nervous System :** Autonomic Nervous System is made up of some brain nerves and some spinal cord nerves. It supplies nerves to all the internal organs and blood vessel of the body. Langley, first presented the concept of Autonomic Nervous System in the year 1921. There are two parts of Autonomic Nervous System :

- (i) Sympathetic Nervous System
- (ii) Parasympathetic Nervous System.

**Functions of Sympathetic Nervous System :**

- (i) It narrows the blood vessels in the skin.
- (ii) By its action hair gets erected.
- (iii) It reduces the secretion of salivary glands.
- (iv) It increases the heart beat.
- (v) It increase the secretion of sweat glands.
- (vi) It stretches the pupil of eye ball.
- (vii) It relax the muscles of urinary bladder.
- (viii) It reduces the speed of contraction & relaxation of intestine.
- (ix) The rate of respiration increase.
- (x) It increases the blood pressure.
- (xi) It increases the sugar level in the blood.
- (xii) It increases the number of Red Blood Corpuscles in the blood.
- (xiii) It helps in clotting of blood.
- (xiv) Collective impact of this affects fear, pain and anger.

**Functions of Parasympathetic Nervous System :**

The functions of this system is normally the opposite of Sympathetic Nervous System. For example :

- (i) It widens the lumen of blood vessels but except the coronary blood vessels.
- (ii) It increases the secretion of saliva and other digestive juices.
- (iii) The contraction of pupil is caused by this.
- (iv) It creates contraction in the other muscles of the urinary bladder.
- (v) It creates contraction and motion in intestinal walls.
- (vi) The effect of this nervous system collectively creates the occasion of rest and joy.

#### (f) Skeletal System

**The skeletal system of human is made up of two parts :**

- (a) Axial skeleton and
- (b) Appendicular skeleton.

**(a) Axial skeleton :** The skeleton, which makes the main axis of the body is called axial skeleton. Skull, vertebral column and bones of chest comes under it. There are 80 bones in axial skeleton.

**(i) Skull :** There are 29 bones in it. Out of these, 8 bones jointly protect the brain of the human. The structure made up of these bones is called forehead. All the bones of the fore head remain joined strongly by the sutures. There are 14 bones in addition to this which form the face. Six ear ossicles and one hyoid bone.

**(ii) Vertebral Column :** The vertebral column of the human is made up of 33 vertebra. All the vertebra are joined by intervertebral disc.

Vertebra is made flexible by these intervertebral disc. We divide the whole vertebral column into the following parts —

1. Its first vertebra which is called atlas vertebra holds the skull.

**Functions of vertebral column :**

- (i) Holds the head.
- (ii) It provides the base to the neck and body.

(iii) It helps the human in standing, walking etc.

(iv) It provides flexibility to the neck and body by which a human can move its neck and body in any direction.

(v) It provides protection to spinal cord.

**(b) Appendicular skeleton : The following are the parts of it -**

(i) Foot bones – Both hands and feet have 118 bones.

(ii) To hold the fore limb and hind limb on the axial skeleton in human there are two girdles.

2. The girdle of fore limb is called pectoral girdle and girdle of hind limb is called pelvic girdle.

3. Pectoral girdle joined with forelimb is called humerus and the bone from pelvic girdle join to hindlimb is called femur.

**Functions of the skeletal system :**

(i) To provide a definite shape to the body.

(ii) To provide protection to soft parts of the body.

(iii) To provide a base to the muscles for joining.

(iv) To help in respiration and nutrition.

(v) To form Red Blood Corpuscles.

4. The total number of bones in a human's body - 206

5. The total number of bones during childhood - 300

The total number of bones of head

- 29 (fore head-8, facial-14, ear-6 ,hyoid -1)

The total number of bones in vertebral column,  
initially-33

After development

- 26 (5 sacral fuse into 1 and 4 caudal fuse into 1)

The total number of bones of ribs  
24

The largest bone of the body  
Femur (bone of thigh)

The smallest bone of the body  
Stapes (bone of ear)

The name and number of bones of some specific regions —

**Note :**

- (i) The muscles and bones are join together by tendon.
- (ii) The muscle which join bone to bone is called ligaments.

**(g) Endocrine System**

**(a) Exocrine glands :** Gland which have duct are called exocrine gland. Secretion of enzymes pass through it. Example – Lactic gland, Sweat gland, Mucous gland, Salivary gland etc.

**(b) Endocrine gland :** These are ductless gland. Hormones are secreted by these gland. Hormones are sent to the different parts of the body through blood plasma. **Example** – Pituitary gland, Thyroid gland, Parathyroid gland etc.

Functions and effect of the main endocrine system of the human body and hormone secreted by them —

**1. Pituitary gland :** It is situated in a depression of the sphenoid bone of the fore head. This is called sella – tunica.

1. Its weight is approximately 0.6 grams.

2. This is also known as master gland. Pituitary gland is controlled by hypothalamus.

**The functions of the hormones secreted by Pituitary gland :**

**(i) STH hormone (Somatotropic hormone) :** It controls the growth of the body especially the growth of bones. By the excessiveness of STH gigantism and acromegaly are caused, in which height of the human grows abnormally. Lack of STH causes dwarfism in human.

**(ii) TSH hormone (Thyroid Stimulating Hormone) :** It stimulates the thyroid gland to secrete hormone.

**(iii) ACTH Hormone (Adrenocorticotropic Hormone) :** It controls the secretion of adrenal cortex.

**iv) GTH Hormone (Growth Hormone) :** It controls the functions of gonads. This is of two types :

**(a) FSH Hormone (Follicle - Stimulating Hormone) :** In male it stimulates spermatogenesis in the seminiferous tubules of the testis. In female, it stimulates the Graffian follicles of the ovary to secrete the hormone Oestrogen.

**(b) LH Hormone (Luteinizing Hormone) :** Interstitial cell stimulating hormone – , secretion of testosterone hormone takes place in male and in case of female estrogen hormone secreted.

**(v) LTH Hormone (Lactogenic Hormone) :** Its main function is to stimulate secretion of milk in breasts for infants.

**(vi) ADH Hormone (Antidiuretic Hormone) :** It causes increase in blood pressure. It is helpful in maintaining the water balance in the body and reduce the volume of urine.

**2. Thyroid gland :** This is situated below the larynx on both side of respiratory trachea in throat of human.

The hormones secreted by it are Thyroxine and Triiodothyronine. Iodine is secreted in more quantity.

### **Functions of Thyroxin :**

**(i)** It increases the speed of cellular respiration.

**(ii)** It is necessary for the normal growth of the body particularly for the development of bones, hair etc.

**(iii)** The normal functions of reproductive organs depend on the activeness of thyroid gland.

**(iv)** It controls the water balance of the body in coordination with the hormones of pituitary gland.

### **Diseases Caused by the Deficiency of Thyroxin :**



**(i) Cretinism :** This disease affects the children. The mental and physical retardness of the child.

**(ii) Myxedema :** In this disease which normally attack during youth the metabolism does not take place properly which causes reduction in heart beat and blood pressure.

**(iii) Hypothyroidism :** This disease is caused due to a chronic deficiency of thyroxin hormone. Due to this diseases the normal reproduction is not possible. Sometimes due to this disease human becomes dumb and deaf.

**(iv) Goitre :** This disease is caused by the deficiency of iodine in food. In this disease the shape of the thyroid gland enlarges abnormally.

### **Diseases caused by the Excessiveness of Thyroxin :**

**Exophthalmic Goitre :** In this disease eyes get bulging out of the eye socket with increased metabolic rate.

**3. Parathyroid gland :** This is situated in the right back of the thyroid gland of the throat. Two hormones are secreted by it :

**(i) Parathyroid hormone :** This hormone is secreted when there is a deficiency of calcium in the blood.

**(ii) Calcitonin :** This hormone is released when there is excess of calcium in the blood is present.

Hence, hormone secreted by parathyroid gland controls the quantity of calcium in blood.

**4. Adrenal gland :** There are two parts of this gland – (i) outer part is cortex and (ii) inner part is medulla.

### **Hormones secreted by cortex and their function –:**

**(i) Glucocorticoids :** This controls the metabolism of carbohydrate, protein and fat.

**(ii) Mineralocorticoids :** Its main function is reabsorption of ion by kidney ducts and to control the quantity of other on in the body.

**(iii) Sex hormone :** It controls the sexual behaviour and secondary sexual characters.

**Note : (i)** Cortex is e

