ORGAN SYSTEMS IN ANIMALS

INTRODUCTION

- Living organisms are evolved from the simplest form to complex level of organization.
- Cells are the basic fundamental units of an organism. These are grouped to form tissues, the tissues into organs and the organs form the organ systems forming an entire organism.
- The different organs and organ systems of an organism function by depending on one another with harmonious coordination.
- When we ride a bicycle, our muscular system and skeletal system work together to move our arms for steering and legs for pedaling.
- Our nervous system directs our arms and legs to work. Simultaneously, respiratory, digestive and circulatory systems work to provide energy to the muscles.
- All the systems work together in coordination to maintain the body in a homeostatic condition of an organism.
- Organ and organ systems have appeared first in the Phylum platyhelminthes and continues till mammals.
- Similar groups of cells form tissues like muscle tissue, nervous tissue, etc. Tissues are organised to form organs like heart, brain, etc.
- Two or more organs together form organ systems and perform common functions like digestion, circulation, nerve impulse transmission in co-ordination via digestive system, circulatory system, nervous system respectively.
- Division of labour is found among the various organ systems

ORGAN SYSTEMS IN ANIMALS

Organ Systems	Organs	Functions
Integumentary system	Skin and skin glands	Protection, Excretion, etc.
Skeletal system	Skull, Vertebral column, Sternum, Girdles and Limbs	Give support, shape and form to the body.
Muscular system	Muscle fibres	Contraction and relaxation resulting movement.
Nervous system	Brain, spinal cord and nerves.	Conduction of nerve impulse.
Circulatory system	Heart, blood and blood vessels	Transportation of respiratory gases, nutritive substances and waste products.
Respiratory system	Respiratory tract and Lungs	Breathing
Digestive system	Digestive tract and digestive glands	Digestion, Absorption, Egestion
Excretory system	Kidneys, ureters, urinary bladder and urethra.	Elimination of nitrogenous waste products.

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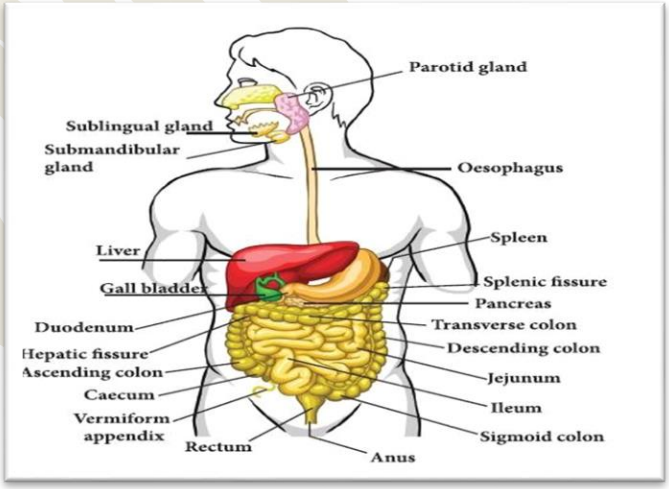
Reproductive system	Testes and ovary	Gamete formation and development of secondary sexual characters.
Sensory system	Eyes, nose, ears, tongue and skin	Sight, smell, hearing, taste and touch.
Endocrine system	Pituitary, Thyroid, Parathyroid, Adrenals, Pancreas, Pineal body, Thymus, Reproductive glands, etc.	Co-ordinates the functions of all organ systems.

HUMAN DIGESTIVE SYSTEM

- Food we eat contain not only simple substances like vitamins and minerals but also complex substances such as carbohydrates, proteins and fats.
- The body cannot use these complex substances unless they are converted into simple substances.
- The five stages of nutrition process include ingestion, digestion, absorption, assimilation and egestion
- The process of nutrition begins with intake of food, called ingestion.
- The breakdown of large complex insoluble food molecules into small, simpler soluble and diffusible particles by the action of digestive enzymes is called digestion.

PARTS OF THE BODY CONCERNED WITH THE DIGESTION OF FOOD FORM THE DIGESTIVE SYSTEM.



PARTS OF HUMAN DIGESTIVE SYSTEM

The digestive system consists of two sets of organs

- **ALIMENTARY CANAL (DIGESTIVE TRACT/GASTRO-INTESTINAL TRACT):**

(It is a passage starting from the mouth and ending with the anus.)

- **DIGESTIVE GLANDS:**

Glands associated with the alimentary canal are the,

- **Salivary glands, gastric glands, pancreas, liver and intestinal glands.**

STRUCTURE OF THE ALIMENTARY CANAL

- Alimentary canal is a muscular coiled, tubular structure.
- It consists of mouth, buccal cavity, pharynx, oesophagus, stomach, small intestine (consisting of duodenum, jejunum and ileum), large intestine (consisting of caecum, colon and rectum) and anus.

MOUTH

- The mouth leads into the buccal cavity.
- It is bound by two soft, movable upper and lower lips.
- The **buccal cavity** is a large space bound above by the palate (which separates the wind pipe and food tube), below by the throat and on the sides by the jaws.
- The jaws bear teeth.

TEETH

- Teeth are hard structures meant for holding, cutting, grinding and crushing the food.
- In human beings two sets of teeth (Diphyodont) are developed in their life time.
- The first appearing set of 20 teeth called temporary or milk teeth are replaced by the second set of thirty two permanent teeth, sixteen in each jaw.
- Each tooth has a root fitted in the gum (Theocodont). Permanent teeth are of four types (Heterodont), according to their structure and function namely incisors, canines, premolars and molars.

DENTAL FORMULA

- Dental formula represents the number of different type of teeth present in each half of a jaw (upper and lower jaw).
- The types of teeth are denoted as,

incisors (i), canine (c), premolars (pm) and molars (m). The dental formula is presented as:

For Milk teeth in each half of upper and lower jaw:

2, 1, 2

2, 1, 2

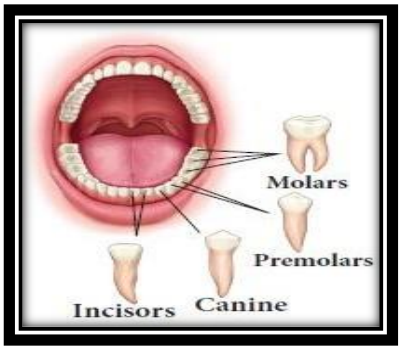
= 10 x 2= 20

For Permanent teeth in each half of upper and lower jaw:

2, 1, 2, 3

2, 1, 2, 3

= 16 x 2= 32



DIFFERENT KINDS OF TEETH AND THEIR FUNCTION

Types of teeth	Number of teeth	Functions
Incisors	8	Cutting and biting
Canines	4	Tearing and piercing
Premolars	8	Crushing and grinding
Molars	12	Crushing, grinding and mastication

SALIVARY GLANDS

Three pairs of salivary glands are present in the mouth cavity.

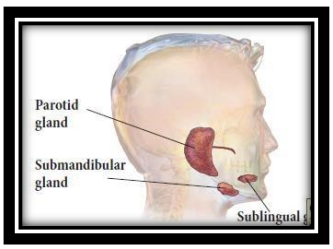
They are

- parotid glands,
- sublingual glands and
- submaxillary or submandibular glands

❖ Parotid glands are the largest salivary glands, which lie in the cheeks in front of the ears (in Greek Par - near ; otid - ear)

❖ b. Sublingual glands are the smallest glands and lie beneath the tongue.

❖ c. Submaxillaryor Submandibular glands lie at the angles of the lower jaw.



SALIVARY GLANDS

- The salivary glands secrete a viscous fluid called saliva, approximately 1.5 liters per day.
- It digests starch by the action of the enzyme **ptyalin** (amylase) in the saliva which converts starch (polysaccharide) into maltose (disaccharide).
- Saliva also contain an antibacterial enzyme called **lysozyme**.

TONGUE

- The tongue is a muscular, sensory organ which helps in mixing the food with the saliva. The taste buds on the tongue help to recognize the taste of food.
- The masticated food in the buccal cavity becomes a bolus which is rolled by the tongue and passed through pharynx into the oesophagus by swallowing.
- During swallowing, the epiglottis (a muscular flap-like structure at the tip of the glottis, beginning of trachea) closes and prevents the food from entering into trachea (wind pipe).

PHARYNX

- The pharynx is a membrane lined cavity behind the nose and mouth, connecting them to the oesophagus.
- It serves as a pathway for the movement of food from mouth to oesophagus.

OESOPHAGUS

- Oesophagus or the food pipe is a muscular-membranous canal about 22 cm in length.
- It conducts food from pharynx to the stomach by peristalsis (wave-like movement) produced by the rhythmic contraction and relaxation of the muscular walls of alimentary canal.

STOMACH

- The stomach is a wide J-shaped muscular organ located between oesophagus and the small intestine. The gastric glands present in the inner walls of the stomach secrete gastric juice.
- The gastric juice is colourless, highly acidic, containing mucus, hydrochloric acid and enzymes rennin (in infants) and pepsin.
- Inactive pepsinogen is converted to active **pepsin** which acts on the proteins in the ingested food. **Hydrochloric acid** kills the bacteria swallowed along with food and makes the medium acidic while the mucus protects the wall of the stomach.
- The action of the gastric juice and churning of food in the stomach convert the bolus into a semi-digested food called **chyme**. The chyme moves to the intestine slowly through the pylorus.

SMALL INTESTINE

- The small intestine is the longest part of the alimentary canal, which is a long coiled tube measuring about 5 – 7 m.
- It comprises three parts- duodenum, jejunum and ileum.

DUODENUM

It is C-shaped and receives the bile duct (from liver) and pancreatic duct (from pancreas).

JEJUNUM

It is the middle part of the small intestine. It is a short region of the small intestine

- The secretion of the small intestine is intestinal juice which contains the enzymes like **sucrase**, **maltase**, **lactase** and **lipase**.

ILEUM

- It forms the lower part of the small intestine and opens into the large intestine.
- Ileum is the longest part of the small intestine. It contains minute finger like projections called **villi** (one millimeter in length) where absorption of food takes place.
- They are approximately 4 million in number. Internally, each villus contains fine blood capillaries and lacteal tubes,
- The small intestine serves both for digestion and absorption.
- It receives the bile from liver and the pancreatic juice from pancreas in the duodenum.
- The intestinal glands secrete the intestinal juices

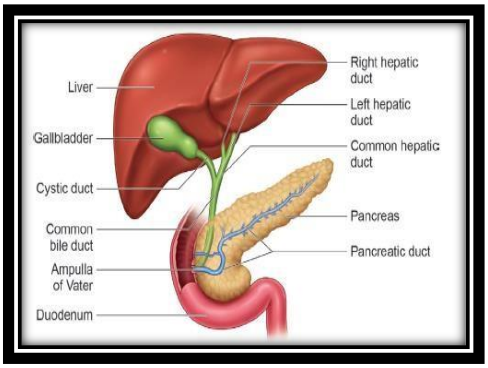
LIVER

- It is the largest digestive gland of the body which is reddish brown in colour.
- It is divided into two main lobes, right and left lobes. The right lobe is larger than the left lobe.
- On the under surface of the liver, gall bladder is present. The liver cells secrete **bile** which is temporarily stored in the gall bladder.
- Bile is released into small intestine when food enters in it. It has **bile salts** (sodium glycolate and sodium tauraglycolate) and **bile pigments** (bilirubin and biliviridin).
- Bile salts help in the digestion of fats by bringing about their **emulsification** (conversion of large fat droplets into small ones).

FUNCTIONS OF LIVER

- Controls blood sugar and amino acid levels.
- Synthesizes foetal red blood cells.
- Produces fibrinogen and prothrombin, used for clotting of blood.
- Destroys red blood cells.
- Stores iron, copper, vitamins A and D.
- Produces heparin (an anticoagulant).
- Excretes toxic and metallic poisons.
- Detoxifies substances including drugs and alcohol..

PANCREAS



- It is a lobed, leaf shaped gland situated between the stomach and duodenum.
- **Pancreas** acts both as an **exocrine gland** and as an **endocrine gland**.
- The exocrine part of the pancreatic gland secretes pancreatic juice which contains three enzymes- lipase, trypsin and amylase which acts on fats, proteins and starch respectively.
- The gland's upper surface bears the **islets of Langerhans** which have endocrine cells and secrete hormones in which **α (alpha) cells** secrete **glucagon** and **β (beta) cells** secrete **insulin**.

BILE DUCT AND PANCREATIC DUCT OPENING INTO DUODENUM

- The intestinal glands secrete intestinal juice called **succusentericus** which contains enzymes like maltase, lactase, sucrase and lipase which act in an alkaline medium.
- From the duodenum the food is slowly moved down to ileum, where the digested food gets absorbed

ABSORPTION OF FOOD

- Absorption is the process by which nutrients obtained after digestion are absorbed by villi and circulated throughout the body by blood and lymph and supplied to all body cells according to their requirements.

ASSIMILATION OF FOOD

- Assimilation means the incorporation of the absorbed food materials into the tissue cells as their internal and homogenous component.
- The final products of fat digestion (fatty acids and glycerol) are again converted into fats andexcess fats are stored in adipose tissue.
- The excess sugars are converted into a complex polysaccharide, glycogen in the liver. The amino acids are utilized to synthesize different proteins required for the body.

LARGE INTESTINE

- The unabsorbed and undigested food is passed into the large intestine.
- It extends from the ileum to the anus. It is about 1.5 meters in length. It has three parts-
- **caecum, colon** and **rectum**.
- The caecum is a small blind pouch like structure situated at the junction of the small and large intestine.

- From its blind end a finger – like structure called **vermiform appendix** arises.
- It is a **vestigeal (functionless) organ** in human beings.
- The colon is much broader than ileum. It passes up the abdomen on the right (**ascending colon**), crosses to the left just below the stomach (**transverse colon**) and down on the left side (**descending colon**).
- The rectum is the last part which opens into the anus. It is kept closed by a ring of muscles called anal sphincter which opens when passing stools.
- The undigested or unassimilated portion of the ingested food material is thrown out from the body through the anal aperture as faecal matter. This is known as **egestion** or **defaecation**.

DIGESTIVE ENZYMES

Digestive glands	Enzymes	Substrate (nutrient)	Products of digestion
Salivary glands	Ptyalin (Salivary amylase)	Starch	Maltose
Gastric glands	Pepsin	Proteins	Peptones
	Rennin (in infants)	Milk protein or caseinogen	Curdles milk to produce casein protein
Pancreas	Pancreatic amylase	Starch	Maltose
	Trypsin	Proteins and peptones	Peptides and amino acids
	Chymotrypsin	Protein	Proteoses, Peptones, Polypeptide, tri and dipepetides
	Pancreatic lipase	Emulsified fats	Fatty acids and Glycerol
Intestinal glands	Maltase	Maltose	Glucose and Glucose
	Lactase	Lactose	Glucose and Galactose
	Sucrase	Sucrose	Glucose and Fructose
	Lipase	Fats	Fatty acids and Glycerol