NUTRITION IN ANIMALS

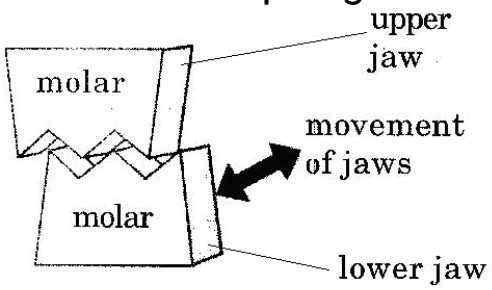
- ✓ HETEROTROPHISM
- ✓ It's a mode of nutrition that involves taking in complex food materials like carbohydrates, proteins and fats obtained from bodies of other plants and animals.
- ✓ The organisms that feed on these already synthesized foods are called heterotrophs.
- ✓ Modes of heterotrophic feeding
- ✓ Holozoic nutrition
- ✓ It involves ingestion, digestion and assimilation of complex food materials. Examples of heterotrophs are carnivores, omnivores and herbivores.
- ✓ Saprophytism
- ✓ This is a type of nutrition where organisms obtain nutrients from dead organic matter causing decomposition. Examples; Fungi and bacteria.
- ✓ Parasitism
- ✓ This is an association where one organism, the parasite, feeds on or obtains nutrients from the tissues of another living organism, the host. Examples tapeworms.
- ✓ Symbiosis
- ✓ This is an association where two organisms live together and mutually benefit from each other.
- ✓ Dentition
- ✓ This is the description of types, number and arrangement of the teeth of an animal. The type of dentition in an animal is related to the type of food that it eats.
- ✓ When all the teeth are similar in structure and size, the dentition is known as homodont e.g. Fish, frogs and crocodiles.
- ✓ When the teeth are of different type and size the dentition is known as heterodont
- ✓ Teeth are arranged in groups to occupy specific positions in the jaws i.e.
- ✓ Incisors are flat, chisel-shaped with sharp ridged edges for cutting and biting

food.
- ✓ -They have one root.
- ✓ Canines are conical with sharp pointed tips especially modified in carnivores for seizing the prey and tearing flesh.
- ✓ -They have one root.
- ✓ Premolars–They have 2 roots.
- ✓ -They have 2 cusps.
- ✓ Molars – They have 2 roots (lower molars) or 3 roots (upper molars).
  - Have 4-5 cusps.
- ✓ -Both have broad surfaces and maybe ridged with cusps on their crown for crushing and grinding food.
- ✓ **Dental formula**
- ✓ This describes the types, number and position of the teeth in the jaws of animals. In the formula, letters represent the types of teeth as follows;
- ✓ I-incisors
- ✓ C-canines
- ✓ PM-premolars
- ✓ M-molars
- ✓ The types and number of the teeth in the upper half of the jaw are written on top of similar ones in the lower half of the jaw. The type of teeth are given in the order; incisors, canines, premolars and molars eg
- ✓ I $\frac{2}{1}$ C $\frac{1}{1}$ PM $\frac{2}{2}$ M $\frac{3}{3}$
- ✓ In order to work out the total number of teeth in man, the above dental formula is multiplied by two;
- ✓ $2\left(\text{i } \frac{2}{1}\ \text{c } \frac{1}{1}\ \text{pm } \frac{2}{2}\ \text{m } \frac{3}{3}\right) = 32$

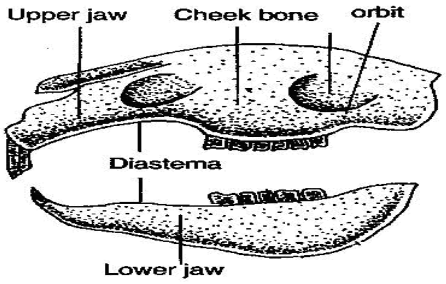
  - **Examples of Holozoic heterotrophs**
- ✓ **Herbivorous mode of feeding**
- ✓ In this mode of feeding, animals feed on plant material only. These animals are called herbivores. They are grouped as;
- ✓ -Grazers- they feed on grasses only e.g. cows, sheep etc
- ✓ -Browsers- they feed on herbs and shrubs e.g. giraffes, goats and antelopes.
- ✓ **Adaptations of herbivores**
- ✓ Most herbivores do not have upper incisors but instead have a **horny pad** against which grass is

pressed and cut by the lower incisors.

- ✓ They have a long tongue which assists in ;
- ✓ - Cutting and turning of grasses.
- ✓ - Moving the food during grinding
- ✓ Have **diastema**- This is a gap in the lower jaw between the front teeth and the molars. It creates space for the tongue to move in and out thus assisting in pulling in grass.
- ✓ The joint in the jaw is movable. This makes it possible to the lower jaw to be moved easily. When chewing the lower jaw is moved from side to side hence enable the premolars and molars to grind the food.
- ✓ The molar teeth have broad upper surfaces which provide a large surface area for grinding grass.
- ✓ The surface area of molars is further increased by cusps in the upper teeth which forms a **W** – shape and the lower teeth that form an **M**- shape eg

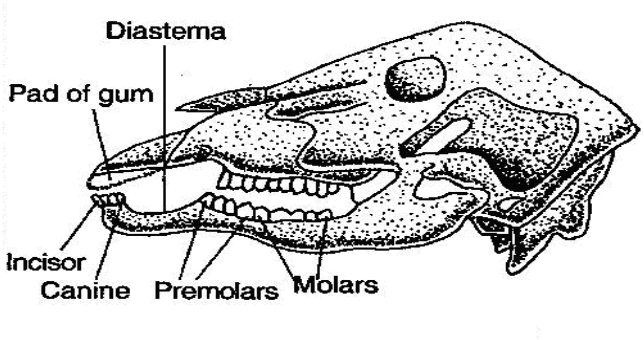


- ✓
- ✓ The teeth of molars herbivores have large pulp cavity and an open enamel in the crown, a condition which allows continuous growth to replace worn-out surfaces due to grinding.
- ✓ The lower jaw has incisors and canines which are chisel shaped. The canine teeth are either absent, very small or form tusks like in elephants.
- ✓ **Dentition of a rabbit**



- ✓ $i\ \frac{2}{1}\ c\ \frac{0}{0}\ pm\ \frac{3}{2}\ m\ \frac{3}{3} = 28$

- ✓ **Dentition of a sheep**



✓ $I\ \frac{0}{3}\ C\ \frac{0}{1}\ PM\ \frac{3}{3}\ M\ \frac{3}{3}$

✓ **Carnivorous mode of feeding**

✓ Carnivores are animals which feed exclusively on flesh. Most carnivores are hunters.

✓ Most are adapted to fast running and have well developed leg muscles that facilitate this movement eg cheetah.

✓ They also have strong jaws and sharp teeth to grasp their prey.

✓ They have 4 different types of teeth ie

✓ **Incisors**

✓ -They are chisel-shaped.

✓ -Small and pointed

- -Used for gripping and stripping flesh from the bone.

✓ **Canines**

✓ They are conical, long, sharp and curved.

✓ Used for stabbing and killing prey.

✓ They pierce and penetrate the flesh to hold firmly onto its prey to prevent it from escaping.

✓ **Premolars and molars**

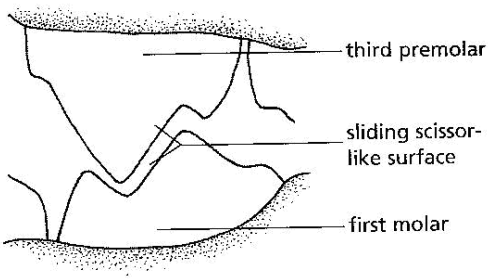
✓ They have a broad surface with pointed cusps.

✓ They meet each other to crush and crack bones.

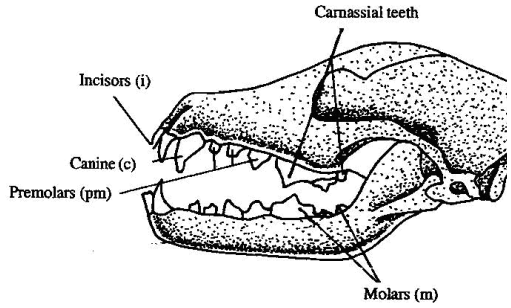
✓ **Carnassial teeth**

✓ These are the last premolars in the upper jaw and first molar on the lower jaw.

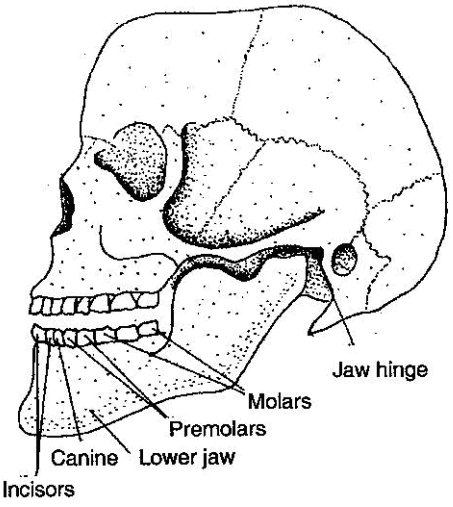
✓ They have sharp cutting edges. The upper and lower jaws carnassial teeth pass against each other during the up and down jaw movement and act as shears /scissors. They slice off meat and crack bones.

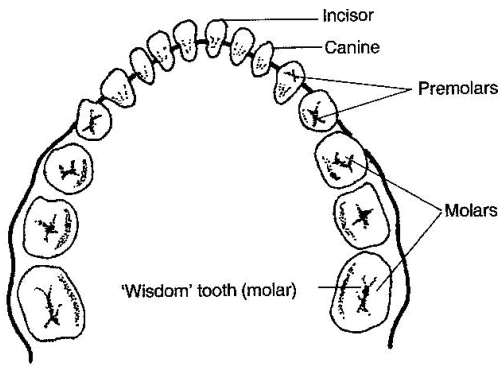


- ✓
- ✓ The jaw muscles are strong and the hinge joint between the two jaws allows only up and down movement of the lower jaw.
- ✓ Dental formula of a dog
- ✓ 2 (I $\frac{3}{}$ C $\frac{1}{}$ PM $\frac{4}{}$ M $\frac{2}{}$ =) 42
- ✓ 3 1 4 3



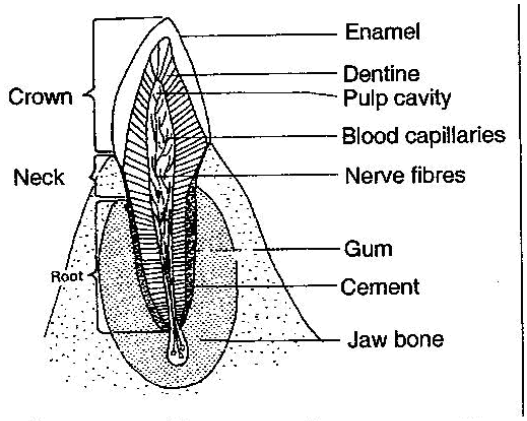
- ✓ $i\frac{3}{3}c\frac{1}{1}pm\frac{4}{4}m\frac{2}{3}=42$
- ✓ **Omnivorous mode of feeding**
  - Omnivores are animals which feed on both vegetation and flesh. They have the following types of teeth;
- ✓ **Incisors**
- ✓ They are located at the front of the jaws.
- ✓ They are chisel- shaped and this creates a flat surface with a sharp edge that makes incisor tooth suited for cutting and biting.
- ✓ **Canines**
- ✓ They are located on the left and right of the incisors. They are pointed.
- ✓ They pierce and hold the food.
- ✓ In man, canines are poorly developed and are rarely used.
- ✓ **Premolars**
- ✓ They arelocated after the canine towards the back of the jaw.
- ✓ They have broad top surfaces usually with two projections called cusps that give them a ridged appearance.
- ✓ They are used to crush and grind food.
- ✓ **Molars**
- ✓ They occupy the back of the jaw, in the cheek.
- ✓ They have broad top surfaces with 4 or 5 cusps that give them a ridged appearance.
- ✓ They are used to crush and grind food.
- ✓ **Dental formula**

- ✓ 2 (I 2 C 1 PM 2 M 3=) 32
- ✓ 2 1 2 3
- ✓ 

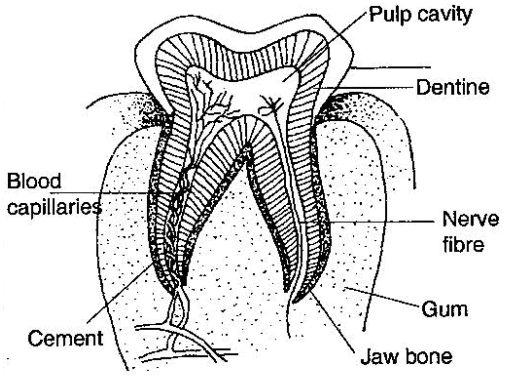
- ✓ 

- ✓ Humans have 2 sets of successive teeth. The first set is known as the milk teeth or deciduous teeth.
- ✓ They form in the jaw before birth. In a new born baby the teeth are not visible above the gum. They erupt out of the gum at about 5 months.
- ✓ At 2 years the baby has all the teeth in the mik set (20 teeth) and they are lost between the age of 6-12 years.
- ✓ Milk teeth are replaced by a second set of teeth which are larger and more permanent. An adult has 32 permanent teeth. The last molar to appear are called wisdom teethand they erupt between 17-25 years.
- ✓ Premolars and molars are also called cheek teeth.
- ✓ **Structure of a tooth**
- ✓ Externally the tooth is made up of 3 regions ie
- ✓ **Crown**- Projects above the gum.
  - **Neck**- Region between the crown and root.
- ✓ **Root** – Part embedded in the jaw.
- ✓ The crown is covered with a hard non-living layer called enamel that is made of calcium phosphate and carbonate.
- ✓ **Enamel**
- ✓ It's the outer part of the tooth and it's the hardest substance in the human body.
- ✓ Its made up of non-living tissue.
- ✓ **Functions**

- ✓ Protects the inner parts of the tooth from infection by bacteria and other micro-organisms.
- ✓ Protects the inside of the tooth from mechanical damage by hard food material such as bones,
- ✓ It provides a hard biting surface.



✓ *Vertical section through an incisor tooth*

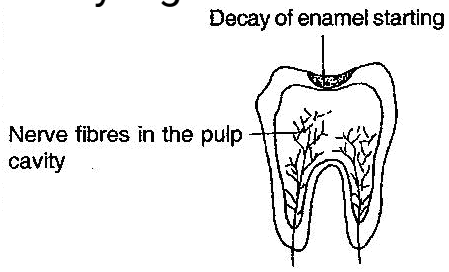


✓ *Vertical section through a molar tooth*

- ✓ **Dentine**
- ✓ This is the part found immediately beneath the enamel. Its not as hard as enamel.
- ✓ Its made up of living tissues.
- ✓ **Functions**
- ✓ Provides most of the bulk of the tooth.
- ✓ **Pulp cavity**
- ✓ Its found at the centre of the tooth.
- ✓ It contains numerous blood capillaries and sensory nerves. These enter the Pulp cavity through a small opening at the bottom part of the root.
- ✓ **Functions**
- ✓ Blood capillaries supply nutrients and oxygen to the celle of the Pulp cavity. They also transport waste materials and CO_2 from the tooth.
- ✓ The sensory nerve fibres have nerve endings that make the tooth sensitive to temperature, pain etc
- ✓ Special cells in the Pulp cavity produce dentine which contributes to the bulk of the tooth.
- ✓ **Cement**
- ✓ Its similar to the bone in structure and it lines the root and holds the root in its socket in the jaw.
- ✓ **Periodontal membrane**
- ✓ This membrane is found

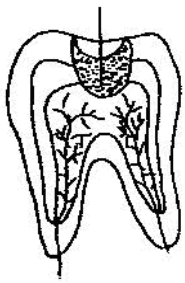
between the cement and the jaw bone in the socket of the tooth.

- ✓ **Function**
- ✓ It contains cells that secrete cement.
- ✓ It also allows the tooth to move slightly to avoid breaking during chewing.
- ✓ Dental diseases
- ✓ The sugars and starch that we eat become lodged between the teeth and the teeth cavities where they are broken down by micro-organisms. The micro-organisms use up the sugars for their own food and produce acids as waste products.
- ✓ The acids react with enamel and dentine of the teeth causing them to dissolve. A hollow area of those decayed parts is formed. When the decaying process continues into the pulp cavity, the nerves are affected and a lot of pain is felt. (Tooth ache).
- ✓ In very serious cases, the pulp cavity may be destroyed and the infection spreads to the gums.
- ✓ There are 2 main dental diseases i.e
- ✓ **Dental caries /cavities**
- ✓ This is caused by;
  - -Plaque (bacteria + saliva) found on the surface of the teeth and between the teeth. Plaque is soft and easy to remove by thorough brushing but if left to accumulate, it hardens to produce a substance called tartar which a dentist has to remove.
- ✓ -Lack of hard food.
- ✓ -Too much sweet / sugary foods.
- ✓ -Lack of calcium in the diet.
- ✓ -Lack of vitamin D.
- ✓ -Lack of cleaning of teeth.
- ✓ These have the effect of causing gradual tooth decay e.g



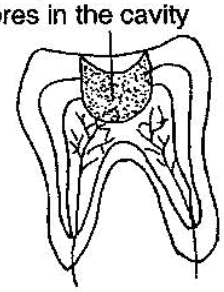
- ✓

Decay of enamel continues and affects the dentine



✓

Decay affects the nerve fibres in the cavity



✓

Hole left by the decaying areas

✓ Abscess (swelling) on the roots

✓ **Treatment**

✓ In case of small cavities (not reached pulp cavity) they can be cleaned and filled with special material to form a filling that seals and protects the tooth from further damage.

✓ Incase of deep cavities that have exposed the pulp cavity, the cavity is thoroughly cleaned to remove the bacteria and decaying food material. The resulting space is then filled with a special material which solidifies to seal the tooth. This procedure is known as root canal treatment.

✓ In very severe tooth decay, the whole tooth is removed.

✓ **Periodontal diseases**

✓ It is caused by;

✓ Lack of vitamins A and C.

✓ Lack of massage of gums.

✓ Lack of proper cleaning of gums.

✓ This disease causes the gums to become soft and flabby so that they don't support the teeth.

✓ There are 2 types of periodontal diseases ie

- **Pyorrhoea**

✓ It's a condition where the teeth become loose due to the infection of fibres holding the teeth in the sockets.

- **Gingivitis**

✓ Its characterised by;

✓ -Reddening of gums

✓ -Bleeding of gums

✓ -Presence of pus in the gums

✓ **Dental hygiene**

✓ Requires the following;

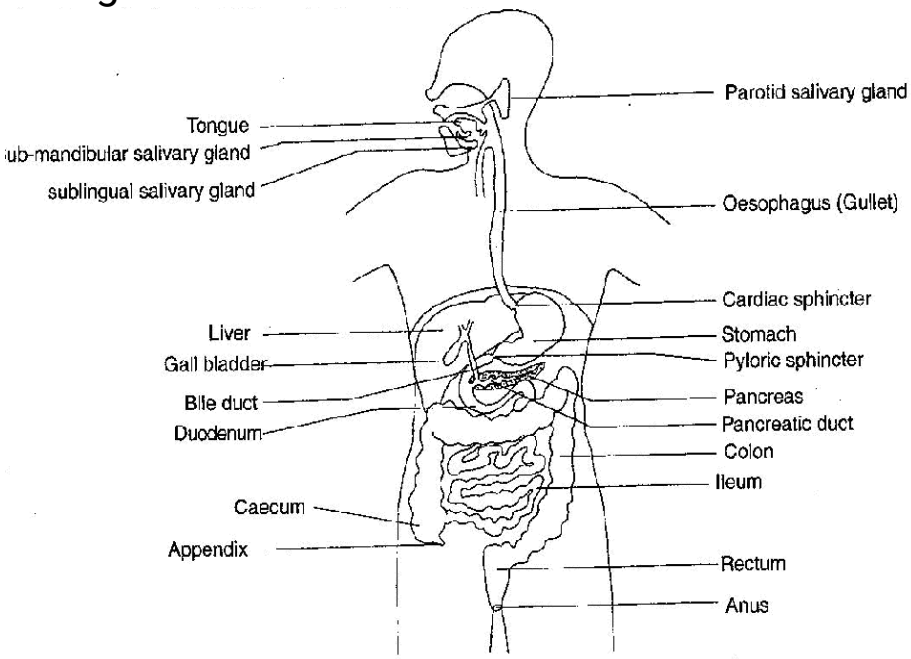
✓ Regular cleaning or

brushing of teeth after every meal. The food particles stuck between the teeth can be removed by inserting a strong nylon thread into the gaps between the teeth and pulling the thread upwards.the thread used this way is called dental floss.

- ✓ Avoid eating too much sugary foods.
- ✓ Eat hard foods eg raw carrots, cassava, yams and sugar-cane. This helps to remove the soft materials from the gums and teeth. It also helps to exercise the teeth.
- ✓ Eating diet rich in calcium, phosphate and vitamins A, C and D.
- ✓ Teeth should not be used to open beverage bottles or crack hard nuts.
- ✓ A regular visit to the dentist.
- ✓ Taking water with minute quantities of fluoride and using toothpaste with small amounts of fluoride. Fluoride helps in the formation of hard, strong teeth.

- ✓ **Digestive systems in animals**
- ✓ **Digestion** –It's the process of breakdown of complex food to simple compounds in the digestive system.
- ✓ **Digestive system**
- ✓ Digestive tracts of mammals show basic fundamental plan with slight variations which co-relate to the kind of diet each animal eats eg
- ✓ Carnivores have a relatively short digestive tracts with very much reduced and functionless caecum and appendix. This is because, the proteins which form the bulk of their diet is rapidly digested in the gut.
- ✓ Some herbivores have a very long Digestive tract with a single stomach and a large caecum and appendix especially in non-ruminants e.g rats.
- ✓ In ruminants herbivores eg cow, the stomach is 4-chambered inorder to increase the surface area for the digestion of cellulose which takes a long time.

- ✓ **Alimentary canal**
- ✓ It's also known as gut. It's a muscular tube that runs from the mouth to the anus. The walls of the alimentary canal are lined with glands and blood vessels. As food passes through this tube, it undergoes the process of digestion then the digested food material is then absorbed into the blood stream.



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- **Digestion in the mouth**

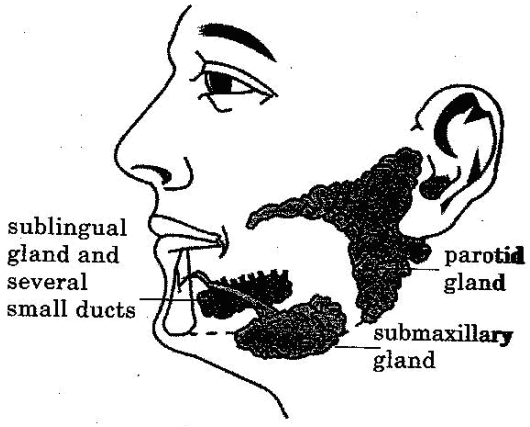
- ✓ The introduction of food into the mouth is called ingestion. The mouth opens into a large space or cavity called the buccal cavity.
- ✓ In the mouth, the food is mechanically broken down by the teeth in the process of chewing and grinding (mastication). Mastication reduces food to small particles and increases the surface area for enzymatic action.
- ✓ The tongue is a long muscular organ on the floor of the mouth.

- **Functions of tongue**

- ✓ Contains taste buds

for tasting food.

- ✓ Moves food around inside the mouth. This allows the food to mix with the saliva which is secreted from the salivary glands.
- ✓ **Saliva**
- ✓ It contains;
- ✓ Water- Acts as solvent.
- ✓ Mucus- Lubricates the food and lining of the mouth.
- ✓ Enzyme (salivary amylase / ptyalin) – Digests starch to maltose.
- ✓ The substance called mucin (water + mucus) in the saliva moistens, softens and lubricates the food.
- ✓ This makes the food easy to swallow and also the food particles are able to stick together to form balls called boluses.
- ✓ Mixing of food also allows enzymes to be in contact with most of the food.
- ✓ Three pairs of salivary glands inside the mouth cavity secrete saliva into the mouth through short tubes called ducts. The salivary glands in the mouth are;
- ✓ Two parotid glands located on each side of the mouth infront and below the ear.
- ✓ A pair of submaxillary glands located below the jaws.
- ✓ Sublingual glands located below the tongue.



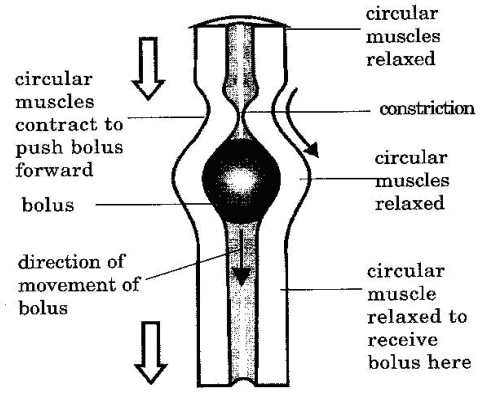
- ✓
- ✓ Saliva produced by these glands contains the enyme salivary amylase/ ptyalin. This enzyme converts starch to maltose. Ptyalin works best at a medium which is slightly alkaline.
- ✓ When the food has

been chewed enough, the tongue rolls the food into boluses (singuar bolus) then pushes the bolus into the pharynx (back of the mouth). This is the beginning of swallowing.

- ✓ The soft palate (uvula) is raised to open the gullet and close the nasal cavity while the epiglottis relaxes to close the wind pipe or trachea.These 2 actions temporarily stop the breathing process.
- ✓ Swallowing is a deliberate action but once the process begins, it can not be stopped. Once the swallowing process is complete epiglottis and uvula open the air passages and breathing continues.
- ✓ **NB** If you eat and talk at the same time, some food might get into the entrance of the trachea. This causes violent coughing to remove the food.
- ✓ The food then passes down into the gullet/oesophagus which contains circular and longitudinal muscles. Circular muscles are arranged in a circular manner inside the wall of the alimentary canal while longitudinal muscles are arranged along the length of the alimentary canal.
- ✓ When a food bolus is in oesophagus, muscles in the oesophagus walls contract and relax in a wave like manner to squeeze it along. This process is known as peristalsis.
- ✓ **Peristalsis**
- ✓ During peristalsis, the circular muscles behind the food bolus contract causing narrowing of the oesophagus in this area. This creates pressure that

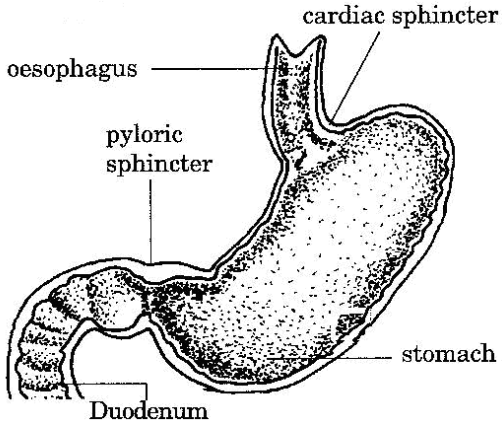
squeezes the bolus into the oesophagus, then the circular muscles relax allowing the oesophagus to receive the bolus.

- ✓ The alternate contraction, constriction and relaxation of the circular muscles in the oesophagus enables the food to be propelled into the stomach.



Digestion in the stomach

- ✓ Stomach is the thick walled muscular bag that stretches as it fills with food. Its located on the left side of the abdomen just below the diaphragm.
- ✓ A ring of muscle called cardiac sphincter is found at the point where the oesophagus opens into the stomach. There is another ring of muscle at the lower end of the stomach. This is known as pyloric sphincter.
- ✓ The two sphincter muscles control the movement of food into and out of the stomach. They help to retain the food for long periods in the stomach which can store food for 2-6 hours.



- ✓
- ✓ The stomach wall is made up of thick muscular muscles and longitudinal muscle layers. These muscles contract and relax producing movements that mix the contents

of the stomach. The mixing is known as churning and results in the formation of a fluid called chyme.

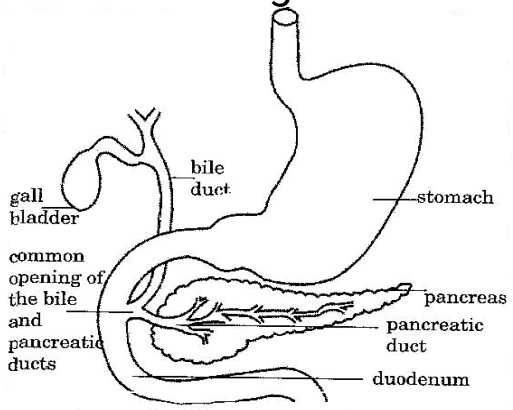
- ✓ When the stomach is empty, the muscle contractions sometimes produce a rumbling noise. This also makes one feel hunger pangs.
- ✓ The presence of the food in the stomach, smell or taste of food stimulates thesecretion of the hormone gastrin juice from the gastric glands embedded in the glandular layer of the stomach wall.
- ✓ The walls of the stomach have special epithelial cells which release mucus that forms a shield between the stomach and the gastric juice hence preventing digestion of the stomach lining by the enzymes in gastric juice.
- ✓ If the protective mucus layer breaks down, a part of the stomach lining wall may be digested causing a painful ulcer to develop (stomach ulcers).
- ✓ Some ulcers are caused by excess secretion of gastric juice due to nervousness or stress. Ulcers are treated by;
- ✓ -Proper diet
- ✓ -Medication
- ✓ -Surgery in severe cases
- ✓ **Functions of the components of gastric juice**
- ✓ **Dilute hydrochloric acid**
- ✓ The acid kills some bacteria that may be present in the food.
- ✓ It provides an acidic medium for optimum activities of pepsin enzyme.
- ✓ It changes the inactive pepsinogen to the active enzyme pepsin.
- ✓ **NB** Occassionally after a heavy meal, the high pressure in the

stomach causes some Hcl acid to leak in the oesophagus. Since it does not have a mucus lining, the Hcl causes a burning effect producing the pain called **heartburn**.

- ✓ **Pepsin**
- ✓ Its secreted as an inactive form called pepsinogen by special cells in the gastric gland. This protects the enzyme producing cells from being digested.
- ✓ Once in the stomach, pepsinogen is converted to active pepsin due to the presence of hydrochloric acid. Pepsin breaks down proteins to peptides.
- ✓ **Rennin**
- ✓ Its function is to make liquid milk to curdle – this is callled coagulation of milk. It does this by converting a soluble milk protein caseinogen into an insoluble form called casein. Pepsin can only act on milk protein when it is converted to casein.
- ✓ Coagulation of milk is important because the solid milk stays in the stomach longer for digestion to occur.
- ✓ Rennin is found mainly in young mammals becase the diet of young mammals mainly consists of milk.
- ✓ After 2-6 hours of churning and digestion, the chyme is gradually released in small amounts into the duodenum through the pyloric sphincter muscles which relax at intervals.
- ✓ **NB** Some substances like alcohol, water are absorbed directly into the blood system from the stomach.
- ✓ **Digestion in the small intestines**
- ✓ The small intestines is about 6-7 metres long in an adult human. Its made up of duodenum

and ileum

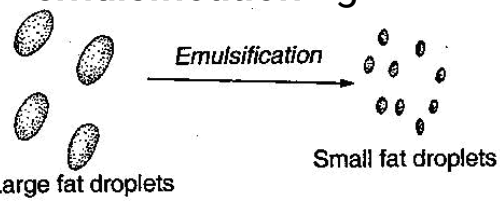
- ✓ **Digestion in duodenum**
- ✓ It's the 1st part of the small intstine. Its about 20-30 cm long and shaped like the letter C. the pancreatic duct and bile duct open into the duodenum eg



- ✓ The pancreatic duct carries pancreatic juice from the pancreas. The bile duct carries bile from the gall bladder. The two ducts join and form a common duct that empties its contents into the duodenum.
- ✓ The duodenum receives secretions from the following organs;
- ✓ The liver has specific cells which secrete bile into the gall bladder, to be stored. The gall bladder releases the bile into the duodenum through the bile duct.
- ✓ The pancreas lies just below the stomach. It's a thin, flat and cream coloured gland. It plays two major roles i.e.
- ✓ -Secretion of hormones
- ✓ -Secretion of digestive juices
- ✓ The arrival of food into duodenum stimulates the secretion of the hormone secretin from the pancreas and cholecystokinin from the duodenal wall.
- ✓ Cholecystokinin stimulates the secretion of bile from the gall bladder and secretin stimulates the secretion of pancreatic juice.
- ✓ Pancreatic juice is alkaline and contains

3 digestive enzymes i.e.

- ✓ **Pancreatic amylase**
- ✓ It breaks down any undigested starch into maltose.
- ✓ **NB** Starch digestion started in the mouth.
- ✓ **Trypsin**
- ✓ It digests proteins into peptides. This enzyme is secreted in its inactive form called trypsinogen. Trypsinogen is activated by an enzyme called enterokinase.
- ✓ **Pancreatic lipase**
- ✓ It digests lipids into fatty acids and glycerol.
- ✓ Pancreatic juice also contains sodium bicarbonate (Sodium hydrogen carbonate). It has 2 roles i.e.
- ✓ -It neutralises the acidic chyme from the stomach.
- ✓ -Creates a suitable alkaline medium for pancreatic enzymes.
- ✓ **Bile**
- ✓ It's a green liquid and contains bile salts eg sodium glycocholate and sodium taurocholate.
- ✓ **Functions of the salts are;**
- ✓ Aid in break down of fats into tiny droplets to increase surface area for digestion by pancreatic lipase. This breakdown is known as **emulsification** eg



- ✓ The salts also provide an alkaline medium in which the enzymes in pancreatic juice work best.
- ✓ They neutralise the acidic chyme from the stomach.
- ✓ NB In the absence of bile there is very little digestion of fats and most of them are voided in faeces. This may occur due to blockage of the bile duct.
- ✓ **Activity; To demonstrate**

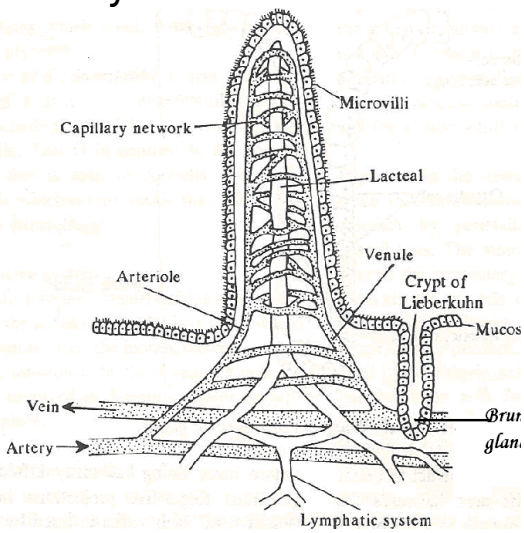
emulsification of fats

- ✓ **Materials**
  - Cooking oil
  - Test tubes
  - Measuring cylinders
  - NaHCO3 solution
  - Water
- ✓ **Procedure**
- ✓ Pour $2cm^3$ of cooking oil into two test tubes labelled A and B.
- ✓ Add $2cm^3$ of $NaHCO_3$ solution into test tube A.Rinse the measuring cylinder.
- ✓ Add $2cm^3$ of water into test tube B.
- ✓ Shake the contents in both test tubes.
- ✓ **Observation**
  - X
- ✓ **Digestion in ileum**
- ✓ It's the lower part of the small intestines and the longest section of the alimentary canal.
- ✓ Its coiled to fit in the limited abdominal space. The inner walls of the ileum contain secretory cells some of which secrete mucus and some of them secrete an alkaline fluid known as **intestinal juice** or **succus entericus.**
- ✓ The arrival of the chyme in the ileum stimulates the secretion of intestinal juice which contains 4 enzymes i.e.
- ✓ **Maltase**
- ✓ It speeds up the break down of maltose to glucose.
- ✓ **Sucrase**
- ✓ It speeds up the break down of sucrose to glucose and fructose.
- ✓ Maltase and sucrase complete the carbohydrate digestion.
- ✓ **Peptidase**
- ✓ It breaks down peptides into amino acids.
- ✓ **Lipase**
- ✓ It breaks down lipids into fatty acid and glycerol.
- ✓ The process of digestion is thus completed in the ileum. The resulting watery

emulsion of food is called **chyle** and contains soluble products of digestion ready to be absorbed.

- ✓ The entire canal is lined with an epithelial membrane that contains goblet cells which secrete mucus.
- ✓ **Functions of mucus**
- ✓ Allows smooth movement of food materials/lubricates the alimentary canal.
- ✓ Coats the wall of the alimentary canal thus protecting it from being digested by the enzymes.
- ✓ It makes the food particles to adhere to one another during swallowing and during egestion.
- ✓ **Absorption**
- ✓ This is the process by which the soluble products of digestion diffuse into the cellular lining of the villi. Absorption of alcohol, some water, water soluble vitamins (B &C) takes place in the stomach.
- ✓ Most of absorption of final products of digestion occurs in the small intestines (Ileum).
- ✓ **Adaptations of ileum**
- ✓ Its long and therefore provides a large surface area for absorption.
- ✓ Narrow so as to bring digested food into close contact with the walls of the ileum for easier absorption.
- ✓ Highly coiled inorder to slow down movement of food and thus allowing more time for digestion and absorption to take place. It also increases the surface area for digestion and absorption.
- ✓ The inner surface of the ileum has large numbers of villi and microvilli (fingerlike projections) which increase the surface area for digestion and absorption.
- ✓ Thin layer of cells

through which digested food diffuse.
- ✓ Presence of a dense network of blood capillaries in the villi into which amino acids, sugars, vitamins are absorbed. This helps to maintain a steep diffusion gradient.
- ✓ Presence of lacteals in the villi for absorption / transport of fatty acids and glycerol.
- ✓ Crypt of lieberkuhn has cells which secrete intestinal enzymes.



- ✓ **The large intestines**
- ✓ Its also called colon. Its about 1.5m in length and is composed of the caecum, appendix, colon and rectum. The walls of the large intestines have no villi. They have mucus secreting glands.
- ✓ **Functions**
- ✓ Absorbs water and this makes the contents of the large intestine to become more solid. At this point, the material is known as faeces.
- ✓ Synthesis of vitamin K.
- ✓ The mucus secreting cells produce mucus to lubricate the passage for easy movement of faeces.
- ✓ Faeces is composed of undigested roughage material, dead cells from the lining of the alimentary canal, unwanted mineral salts and bile pigments.
- ✓ The rectum stores these faeces until powerful peristaltic waves cause the sphincter muscles in the rectum to relax and the faeces are

released in a process called defaecation.

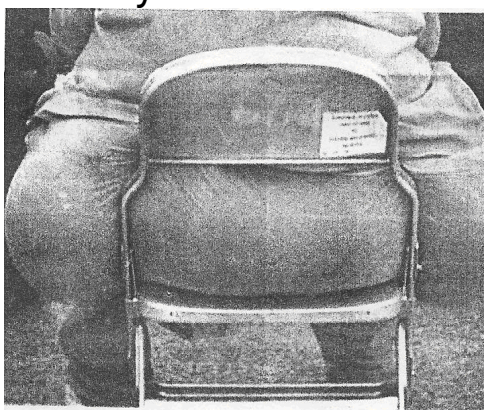
- ✓ Faeces may take 12-24 hours and even upto 3 days or more to pass to the rectum.
- ✓ A sphincter muscle at the entrance to the rectum prevents faeces from entering the rectum until its ready for elimination.
- ✓ X
- ✓ **Caecum**
- ✓ It has an appendix which forms a small projection. In some animals like rabbits, the caecum and appendix are enlarged and and contain bacteria which release an enzyme called cellulase which digests the cellulose material.
- ✓ In humans, caecum and appendix are small and do not have any function. Sometimes food may get trapped in the appendix and it decays causing an infection called appendicitis. Doctors may remove the appendix if the infection is very severe.
- ✓ Some bacteria in the large intestine form a gaseous mixture of Nitrogen, Hydrogen sulphide and flammable Hydrogen and methane. The accumulated gas called **flatus** is eliminated through the anus.
- ✓ **Assimilation**
- ✓ It's the incorporation of the products of digestion into the cell metabolism eg
- ✓ **Glucose**
- ✓ Its oxidised to release chemical energy during respiration and the excess is stored in the body as fats underneath the skin or in the form of glycogen in liver and muscle cells.
- ✓ **Fatty acids and glycerol**
- ✓ Are oxidised to release energy but most

combine into neutral fats which are stored underneath the skin to insulate the body against the cold.

- ✓ **Amino acids**
- ✓ They are used in the synthesis of proteins for the general body growth and repair of worn-out tissues. In the absence of glucose and fats, they maybe used to release energy through oxidation.
- ✓ **Vitamins**
- ✓ They are organic chemical compounds that are essential for a healthy body. They are obtained from fresh vegetables and fruits.
- ✓ Some are synthesised in the body by the activity of micro-organisms present in the gut.
- ✓ Vitamins are destroyed when the food is excessively cooked.
- ✓ Although the viitamins are required in very small quantities, they play an important role in metabolic reactions.
- ✓ Some act as co-enzymes in enzyme activiities while others influence the intake of certain substances in the body e.g vitamin D influences absorption of calcium ions in the gut.
- ✓ Vitamins are placed in two main groups i.e
- ✓ **Fat soluble vitamins**
- ✓ These are stored in the body because they can dissolve in fat already stored in the body eg A, D, E, & K.
- ✓ **Water soluble vitamins**
- ✓ They are soluble in water eg vitamin B complex and vitamin C.
- ✓ **Activity ; Test for vitamin C (Ascorbic acid)**
- ✓ Place 2cm3 of DCPIP (Dichlorophenol indophenol) into a test tube.
- ✓ Add ascorbic solution drop by drop into the test tube and shake well after each drop.

- ✓ **Observation**
- ✓ Ascorbic acid decolourises DCPIP indicator.
    - X
- ✓ **Roughage**
- ✓ It consists of indigestible material such as cellulose from the plant cell walls.
- ✓ **Functions**
- ✓ Its able to absorb water and therefore makes the faeces moist and bulky.
- ✓ Roughage mechanically stimulates the gut wall.
- ✓ Encourage contraction of muscles and peristalsis.
- ✓ Stimulates the secretion of mucus.
- ✓ The fibre is also known to reduce the risk of cancer in the colon.
- ✓ Helps in preventing diabetes.
- ✓ **NB** Lack of fibre in the diet makes the faeces compact and dry leading to constipation.
- ✓ Sources of fibres are; Cereals, fresh fruits, vegetables, brown bread.
- ✓ **Water**
- ✓ It makes about 65-70% of the total body weight. A person deprived of water will live for only a few days, whereas it is possible to survive for more than 60 days without food.
- ✓ **Functions of water**
- ✓ Acts as solvent
- ✓ Cooling of organism
- ✓ Providing a medium for transport
- ✓ Facilitate hydrolysis
- ✓ **NB** We must always take in a lot of water or fluid during any one of the following situations;
- ✓ When one has high fever.
- ✓ Diarrhoea
- ✓ Vomiting
- ✓ Sweating
- ✓ Bleeding
- ✓ Thirst is a sign that the body is short of water.
- ✓ Babies lose a lot of water than adults

because it has a large surface area to volume ratio hence the baby's fluid intake must be higher.

- ✓ **Balanced diet**
- ✓ It's the diet that contains all the food nutrients in the required amounts.
- ✓ When certain nutrients are missingin the diet or are not present in the required amounts, then deficiency diseases or disorders occur e.g
- ✓ **Kwashiorkor** –caused by lack of proteins.
- ✓ **Marasmus** –caused by starvation or lack of sufficient amounts of all nutrients in the diet.
- ✓ **Obesity** –caused by excessive intake of carbohydrates.
- ✓ 
- ✓ 
- ✓ **Factors determining energy requirements**
- ✓ Heat produced from the body comes from the oxidation of food. Heat energy is measued in units called kilojoules (kj)
- ✓ 1g of carbohydrate yields 17.1kj of energy.
- ✓ 1g of fats yields 38.8kj of energy
- ✓ 1g of proteins yields 22kj of energy
- ✓ The amount of energy required depends on the following factors
- ✓ **Basal Metabolic Rate (BMR)**
- ✓ This is the energy required to maintain the normal body functions such as breathing, heartbeat, circulation. Its about 760kj.
- ✓ Its also used to maintain constant body temperature.

- ✓ **Occupation**
- ✓ This involves the activities that one does every day and it determines the energy requirements of the person e.g a labourer pulling a cart requires more energy than an office worker.
- ✓ **Age**
- ✓ Young children have many actively dividing cells and are physically more active than adults. As they grow older they become less active physically and their energy requirements decrease e.g

Age (years)	Male	Female
2	5500	5500
5	7000	7000
8	8800	8800
11	10000	9200
14	12500	10500
18	14200	9600
25	12100	8800

- ✓ **Body size**
- ✓ Small bodied people have a large surface area to volume ratio therefore their bodies lose more heat energy to the surrounding. Such people rquire more energy giving food.
- ✓ Big bodied people have a small surface area to volume ratio therefore their bodies lose less heat energy to the surrounding. Therefore their energy requirementsis low.
- ✓ **Sex**
- ✓ Many males are more muscular than females. That means their bodies have more muscles than fat while females have a lot of fat as compared to the males hence males normally use more energy.