

**SUBJECT: BIOLOGY**

**CLASS: S.S. 3**

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**TOPIC: DIGESTION, ABSORPTION AND METABOLISM OF FOOD.**

Digestion is the breakdown of insoluble food materials, many of which have very large molecules, into soluble compounds having smaller molecules; that can pass in solution through the walls of the intestine and enter the bloodstream, the process of absorption. Both digestion and absorption take place in a long tube called the alimentary canal or gut.

Some of its regions (e.g. mouth, stomach, duodenum and intestine) have specific functions and accordingly specially adapted structures.

In its lining or epithelium are glands (a group of cells producing a substance (enzyme) which is used elsewhere in the body) which produce some of the digestive juices, the fluids which bring about the breakdown of food; other juices are poured into the alimentary canal through ducts from glandular organs outside it.

As the food passes through the alimentary canal, it is broken down in stages until the digestible material is dissolved and absorbed.

The undigested residue is expelled from the body through the anus. It is called egestion.

## **ENZYMES**

Digestion of food is brought about by chemicals in the digestive juices called enzymes. Enzymes are catalysts, that is, substances which accelerate the rate of chemical reactions without altering the end-products.

**Characteristics of Enzymes.**

- 1). All enzymes are proteins.**
- 2). Enzymes are destroyed by heats .i.e. at high temperatures, enzymes are denatured/destroyed.**
- 3). Enzymes are specific in nature. (It affects the rate of only one kind of reaction).**
- 4). Enzymes have their optimum temperatures. (they act best within a narrow temp.range.).**
- 5). Each enzyme acts most rapidly at a particular degree of acidity or alkalinity. (pH).**
- 6). Enzymes are organic catalysts (they alter the rate of reactions).**
  - a) Enzymes which act on starch are called amylases**
  - b) Enzymes which act on proteins are called proteinases.**
  - c) Enzymes which act on fats are called lipases**

**Movement of food through the Alimentary canal.**

**Ingestion:** It is the act of taking food into the alimentary canal through the mouth.

1. **Peristalsis:** It is the way in which food is forced down the esophagus or gullet into the stomach and subsequently into the lower regions of the alimentary canal.
2. The walls of the whole alimentary canal contain muscle fibres which run both circular and longitudinally. The circular muscles contract and relax in such a way that waves of contraction pass along the alimentary canal, pushing the food steadily onwards and preventing its movement in the reverse direction.

**Digestion in the Mouth.**

Food is mixed with saliva and chewed or masticated by the action of the teeth and tongue; this softens it and reduces it to pieces of a suitable size of swallowing and increases the surface available for enzymes to act on. Saliva contains an enzyme salivary amylase or ptylin, which acts on cooked starch (e.g. boiled yam) and begins its breakdown to a soluble sugar called maltose.

**Digestion in the stomach.**

The stomach has flexible and elastic walls. It can store relatively large amount of food, which is retained in the stomach by the closure of a ring of muscle called the pyloric sphincter at its outlet. Food from a particular meal is stored for some time and released at intervals to the rest of the alimentary canal.

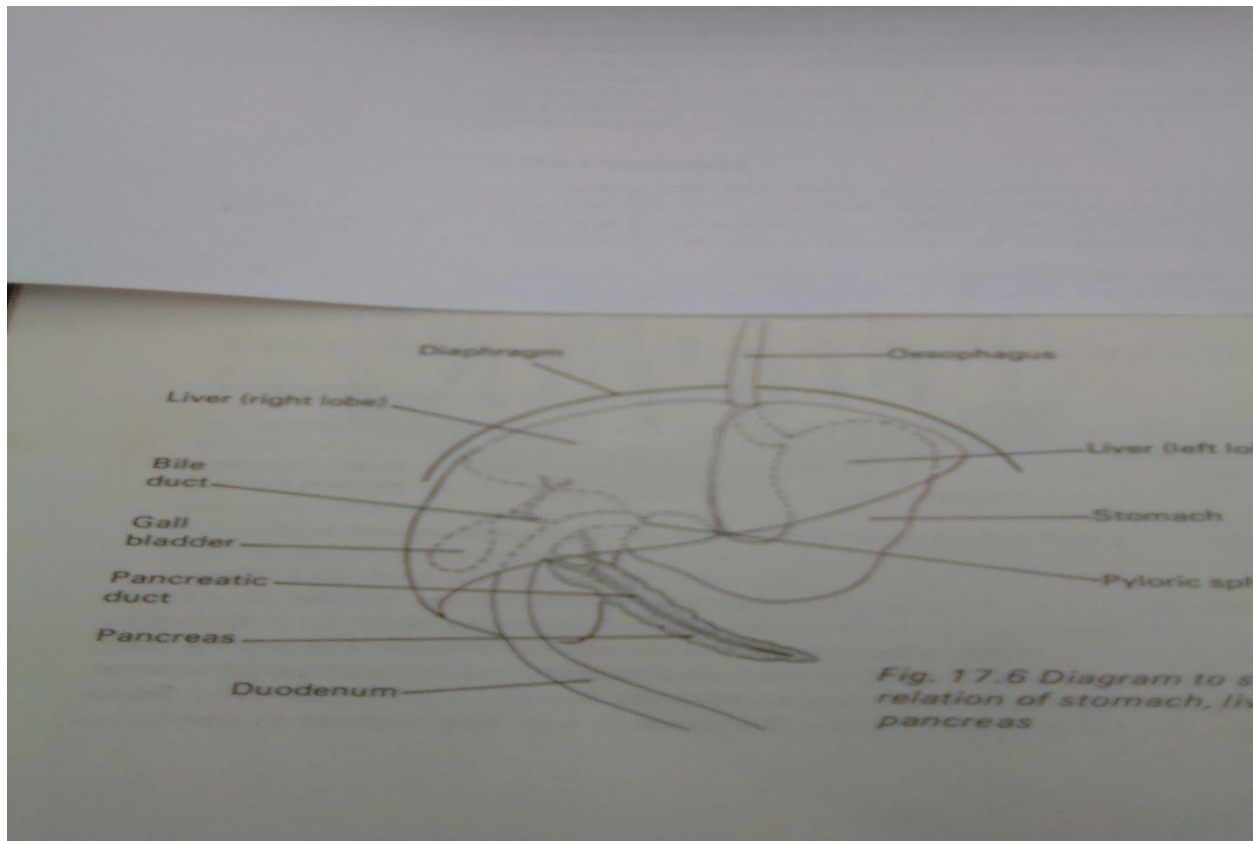
The glandular lining at the stomach produces a digestive juice, gastric juice (gastric means “of the stomach”).

Gastric juice contains the enzyme pepsin, and in young children, it may also contain another enzyme called rennin. Pepsin acts on proteins and breaks them down into more soluble compounds called peptides. Rennin, when present, clots the protein of milk. The stomach wall also secretes hydrochloric acid (HCl).

The acid provides the most suitable degree of acidity (optimum PH) for pepsin to work in and also kills many of the bacteria taken in with the food.

The stomach walls contract churning the food and gastric juice together to form a creamy fluid called chyme.

When digestion in the stomach is complete, the pyloric sphincter relaxes from time to time, each relaxation allowing a little chyme to pass through into the first part of the small intestine called the duodenum.



### Digestion in the Duodenum.

Two alkaline fluids are poured into the chyme in the duodenum, pancreatic juice from the pancreas and bile from the liver.

Both juices contain sodium hydrocarbonate which partly neutralizes the strong acid chyme. So creating the slightly acid medium favorable to the action of the pancreatic and intestinal enzymes.

The pancreas secretes pancreatic juice which contains three important enzymes.

- 1). Trypsin – It breaks down proteins to peptides.
- 2). Amylase – It breaks down starch to maltose.
- 3). Lipase – it breaks down fats/oils to fatty acids and glycerol.

Bile is a green watery fluid made in the liver stored in the gall bladder and conducted to the duodenum by the bile duct. Bile contains sodium chloride, sodium hydrogen carbonate and bile salts, but no enzymes.

Bile salts reduce the surface tension of fats, so emulsifying them, that is, dispersing them as tiny droplets.

## **Digestion in the small Intestine.**

The glands in the lining of the small intestine (ileum) secrete a digestive juice called the succus entericus; it contains the following enzymes: peptidase, maltase and lipase.

They complete the breakdown of protein, starch and fats.

- 1) Peptidase converts peptides into amino acids.
- 2) Maltase converts maltose into glucose.
- 3) Lipase converts fats/oil into fatty acids&glycerol.

Summary- Study the note and use it to complete the table below.

Region of alimentary	Digestive	Digestive juice	Enzymes in	Class of food	Substances
Canal	gland	produced	the juice	acted upon	produced
Mouth					
Stomach					
Duodenum					
Small intestine					
(Ileum)					

Note: Stomach secretes Hydrochloric acid. It provides an acid medium for pepsin action.

The acid kills most bacteria.

No absorption in the stomach except of alcohol and some drugs.

Bile in the duodenum emulsifies fats and aids their absorption.

Most absorption occurs in the ileum.

Water is absorbed in the colon (large intestine)

No digestive juice secreted in the colon

Next week topic: POLLINATION

Assignment for this week.

- 1) Explain the term pollination in flowers.
- 2) State the characteristics of wind pollinated and insect pollinated flowers.
- 3) What are the advantages and disadvantages of Cross Pollination?

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## **NUTRITION**

**NUTRITION-** It is the series of processes by which, living organisms obtain food substances and use them to provide energy and materials for their growth, activities and reproduction.

**Types of Nutrition:**

- 1) Holozoic nutrition**
- 2) Holophytic nutrition**
- 3) Saprophytic nutrition**
- 4) Parasitic nutrition**

**Holozoic Nutrition:**

In general, animals feed by taking in complex food materials from the tissues of plants or other animals: these substances are broken down by digestion into simple compounds which are then absorbed and either incorporated into the cells of the animal's body or oxidized to obtain energy.

**Holophytic Nutrition**

Most green plants, on the other hand, feed by taking in very simple substances – carbon dioxide, water, inorganic salts-and build them up into complex compounds which are either synthesized into protoplasm and cell walls or oxidized to release energy for the plant's needs.

Green plants are the earth's most important food producers.

## **PHOTOSYNTHESIS**

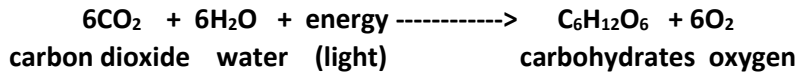
It is the process by which green plants manufacture food.

Plants contain many different kinds of compounds, like carbohydrates, proteins and fats.

Photosynthesis is from the Greek words, photo (light) and synthesis (build). Using light to build up food substances proceeds in all the green parts of the plants, but principally in the leaves.

The plant obtains the necessary carbon dioxide through its stomata, and the water (in land plants) from the soil through its root system.

The process may be summarized as follows:



**Features of Photosynthesis.**

- a) Photosynthesis takes place in the chloroplasts of plant cells, in the presence of sunlight.
- b) The raw materials of photosynthesis are carbon dioxide and water.
- c) The end products of photosynthesis are high energy containing sugars (carbohydrates). Oxygen is released as waste product.
- d) The energy needed to drive this build-up (anabolic) process comes from the sunlight absorbed by chlorophyll, the green pigment found in chloroplasts.

**Adaptation of leaves to their functions of photosynthesis.**

- i. Their broad, flat shape offers a large surface area for absorption of sunlight and carbon dioxide.
- ii. Numerous chloroplasts in the palisade cells, few chloroplasts in the spongy mesophyll cells. The palisade cells being on the upper surface receive most sunlight.
- iii. The branching network of veins provides a ready water supply to the photosynthesizing cells.
- iv. The many stomata on one or both surfaces allow the exchange of carbon dioxide and oxygen with the atmosphere.
- v. The large intercellular spaces in the mesophyll provide an easy passage through which carbon dioxide can diffuse.

**Note:** (i) The gases, carbon dioxide and oxygen, move in and out between the surrounding air and the leaves through stomatal openings on the leaf surfaces.

- ii) Water from the soil enters the root hairs by osmosis.
- iii) Most of the sugars produced are changed into starch in the leaf cells.
- iv) Starch is converted back into sugars (soluble form) to be transported to other parts of the plants where they are needed. This movement of sugars is known as TRANSLOCATION.
- v) The sugars are used as a source of energy. Some plants convert their sugars into starch to be stored in the storage organs e.g. roots, stems, fruits or seeds.

**Factors that can affect the rate of photosynthesis**

**1) External factors:**

- Light intensity/sunlight
- Carbon dioxide concentration
- temperature
- pollution

-water (availability of water)

## **2) Internal factors**

-Hormones

-chlorophyll/presence of chlorophyll/chloroplasts

-enzymes

Number/state of stomata.

Importance of Photosynthesis to life.

-Production of glucose/food.

Purification of the environment (Removal of carbon dioxide from the environment).

-Production of oxygen for respiration.

-Production of raw materials for biosynthetic products/industries.

## **WASSCE JUNE 2013 QUESTION 2**

**2(a) What is photosynthesis?**

**(b) List (i) four external factors (ii) two internal factors that affect the rate of photosynthesis.**

**(c) State FOUR importance of photosynthesis to life. (NECO 2013 QUESTION 3(b) (ii)).**

## **EXERCISES**

**1) a) Define photosynthesis.**

**b) How is the leaf adapted for photosynthesis?**

**c) Describe briefly what happens to the carbohydrates that is formed in the leaf.**

**2) State the conditions which are necessary for photosynthesis to take place.**

## **Assignment**

**Explain the following kinds of heterotrophic nutrition**

**a) Holozoic**

**b) Parasitic**

**c) Saprophytic**

**d) Carnivorous (plants) and;**

**e) Symbiotic or mutualistic.**

