Chapter

1

Nutrition - Food supplying system

Food is needed by all living organisms mainly for growth and repair. Several organisms need food to maintain body temperature as well. A large variety of substances are taken as food from single celluar organisms like amoeba to the complex multicellular organisms like the human body. Even with in the human body the cells require a wide variety of substances as food. The mode of acquiring food also varies from cell to cell and organism to organism.

You have studied in your previous classes about how different organisms get their food. Let us recall some of them.

- *How do heterotrophs get their food?*
- *How do autotrophs get their food?*

Let us study about autotrophic and heterotrophic modes of nutrition and find out why most plants are called as autotrophs.

Autotrophic Nutrition

We know that autotrophs are the organisms capable of using light energy to synthesize chemical compounds. They acquire nutrients like some minerals and water from the soil as well as some gases from the air. They are capable of producing complex compounds like carbohydrates, proteins, lipids etc. from these very simple substances. These compounds produced by them are utilized for providing energy to most of the living organisms and all animals including human beings.

Most of the things that we eat are obtained from plants. Even if we depend on animal products, we would find that those animals depend on

plants for their food. But what plants do use to carry out their life processes?

Scientists have been working for centuries to find out how plants carry out these life processes. We know that among all life processes, the process of photosynthesis makes plants "the universal food provider" for all living organisms.

You have studied something about photosynthesis in your earlier classes. Von Helmont and other scientists believed that plants get their food material not only from soil but also from other sources.

- *Can you think of some raw materials needed for photosynthesis?*
- *What could be the end products of the process of photosynthesis?*

Let us study the process of photosynthesis in detail to know more about this.

Photosynthesis

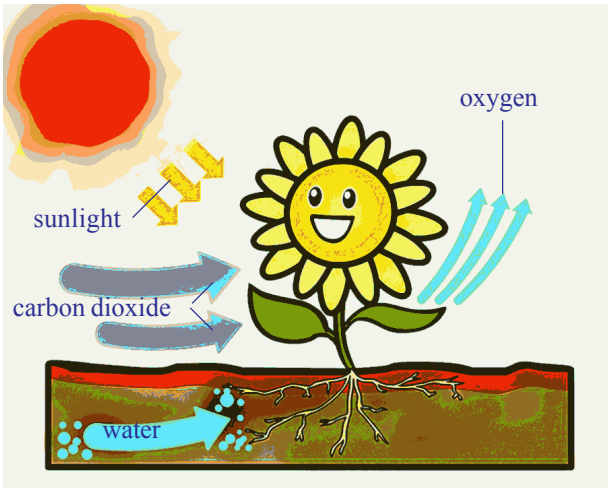


fig-1: Photosynthesis

Photosynthesis is the process by which plants containing the green pigment 'chlorophyll' build up complex organic molecules from relatively simple inorganic ones, using sun light as an energy source. The process of photosynthesis is very complex .There are several steps in it and several intermediary compounds are formed. Scientists had tried to formulate a simple equation for photosynthesis over past 200 years. An equation that was readily accepted and is still widely used is the one formulated and proposed by C.B. Van Neil in the year 1931 which is as follows. His opinion was, "for each molecule of carbohydrate formed, one molecule of water and one molecule of oxygen is produced". This is a very simplified equation and does not reflect the complexity of the process of photosynthesis, yet we shall use it for now.

$$CO_2 + 2H_20 \xrightarrow[\text{Chlorophyll}]{\text{Light}} CH_2O + H_20 + O_2$$

What would be the reaction to show that glucose ($C_6H_{12}O_6$) is being synthesized? Write down a balanced equation to show this.

(Refer chemical equations and reactions, carbon and its compounds chapters).

Do you know?

Van Neil first worked on purple sulphur bacteria and found light plays a specific role in photosynthesis. Instead of H_2O they used H_2S as a starting material. Here no oxygen is liberated during photosynthesis instead, elemental sulphur is evolved. Later he envisioned a similar process for photosynthesis in plants and proposed the above mentioned equation. Later Robert Hill showed O_2 is released from water. Then the equation was modified as follows (Modifications are still being made).

$$6CO_2 + 12H_20 \xrightarrow[\text{Chlorophyll}]{\text{Light}} C_6H_{12}O_6 + 6H_20 + 6O_2$$

It is known that plants synthesize carbohydrates, the smaller simpler ones first and from them, the more complex ones like starch and cellulose. Plants are also capable of synthesizing all other compounds like proteins, fats etc.

Animals are not capable of synthesizing carbohydrates and they have to depend on plants for the same.

Can we state that photosynthesis is the basic energy source for most of the living world? Why, why not?

Let us examine the presence of carbohydrates in plant parts .

Activity-1

Presence of starch (a type of carbohydrate) in leaves

Let us take a leaf from a plant (we can select such plants that have soft thin leaves) well exposed to sun light.

Arranage apparatus as shown in figure.

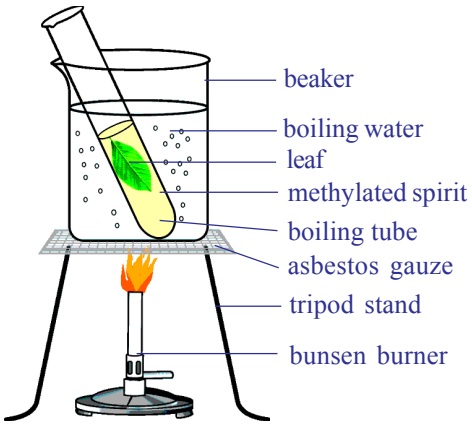


fig-2(a): Leaf boiling in methylated spirit

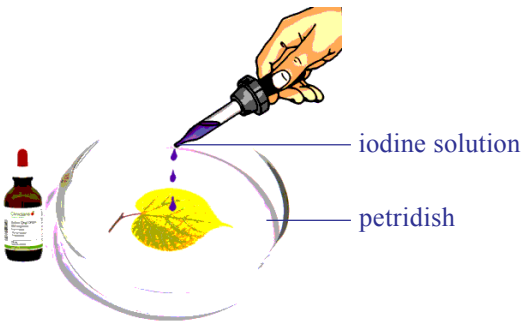


fig-2(b): Iodine test

Boil the leaf in methylated spirit over a water bath. It becomes pale-white due to the removal of chlorophyll. Observe the leaf.

Take the leaf carefully from test tube by using a brush.

Spread the leaf in a petridish and add a few drops of tincture iodine/ betadine solution on it. Again observe the leaf.

- *What do you see?*

The presence of starch will be indicated by a blue-black colour. Do you think solar energy transforms into chemical energy by the process of photosynthesis? Try doing the same test on the leaf of a potted plant kept in the dark for around 10 days to test the effect of sun light.

Materials essential for the process of Photosynthesis

What are the materials that you think would be essential for the synthesis of carbohydrates in the process of photosynthesis? (Hint: Equation proposed by Van Neil)

- *Do you think the equation tells us about all the materials involved?*

It took scientists over 300 years to find out about them. We still do not know about several materials involved in the process.

Let us study how scientists experimented to find out about some of the materials required for the process of photosynthesis.

Water and Photosynthesis

In class VII we already studied how Von Helmont found that water was essential for the increase of plant mass.

He did not know about photosynthesis then. Later, it was found that increase in plant body mass or material occurred due to the process of photosynthesis. We shall study more about it in the following sections.

Read the chapter on 'Nutrition in Plants' in class VII discuss with your friends and write a note on Von Helmont's experiment focusing on how he concluded that water was important for plant growth and increase in body mass.

Air and Photosynthesis

Let us discuss an experiment on photosynthesis. We have studied some experiments in our earlier classes. This one helps us to find out about the role of air in the process of photosynthesis. It is interesting to learn about the experiment which was one of the several milestones in the gradual development of our understanding of Photosynthesis.

Joseph Priestly (1733-1804) in 1770 performed a series of experiments

that revealed the essential role of air on the growth of green plants (photosynthesis was still not known to scientists at that time). You may recall, Oxygen was discovered by Priestly in 1774 the name oxygen was coined later by Lavoisier in the year 1775. Priestly observed that a candle burning in a closed bell jar, soon gets extinguished. Similarly, a mouse would soon suffocate in a closed space of the bell jar. He concluded that a burning candle or an animal, both somehow, damage air. When he placed a mint plant in the same bell jars, he found that the mouse stayed alive and the candle when lighted from outside continued burning in the presence of the mint plant. Priestly hypothesized as follows: 'Plants restore air what breathing animals and burning candles remove'.

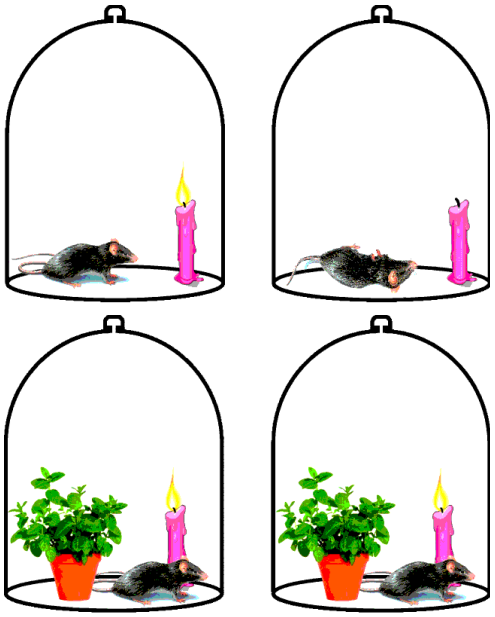


fig-3: Priestly experiment

What had Priestly done to introduce the mint plant without disturbing the experimental set up?

How did he light the candle from outside?

Priestey's experiment confirmed that gaseous exchange was going on and plants were giving out a gas that supported burning and was essential for the survival of animals.

But how do plants take in air and utilize carbon dioxide for photosynthesis and oxygen for respiration?

How do they make the choice?

Massive amounts of gaseous exchange occur through the stomata (usually present in leaves) as long as they are open .While plants also carry on gaseous exchange through loose tissues on stems, roots etc.

It is actually at the level of the organelles involved in the process of photosynthesis and respiration that the choice of the gas required is made.

Activity-2

Carbon dioxide is necessary for Photosynthesis

We need a destarched plant to start with. For destarching we need to keep the plant in the dark for nearly a week to remove the starch (destarching) from the leaves.

Arrange the apparatus as shown in the figure.

- Take a wide mouthed transparent bottle.

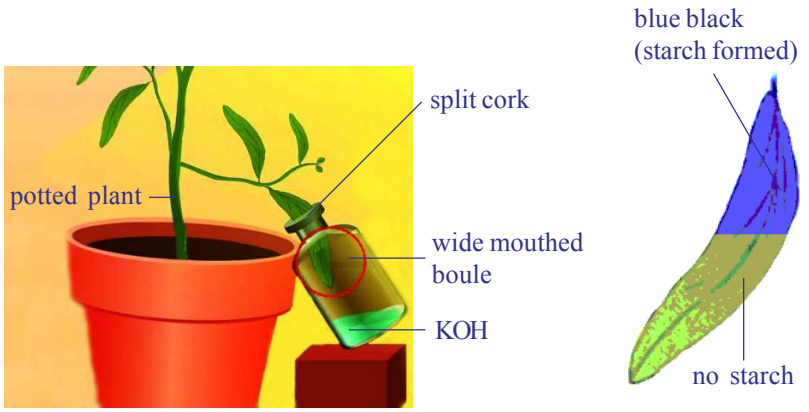


fig-4: Mohl's half leaf experiment

- Put potassium hydroxide pellets or potassium hydroxide solution in the bottle. Potassium hydroxide absorbs carbon dioxide.
- Insert splitted cork in the mouth of the bottle.
- Insert one of the leaf of destarched plant (through a split cork) into transparent bottle containing potassium hydroxide dioxide pellets/ potassium hydroxide solution.
- Leave the plant in sunlight.
- After a few hours, test this leaf and any other leaf of this plant for starch. As mentioned in activity-1.
- The leaf which was exposed to the atmospheric air becomes bluish-black, and the one inside the flask containing potassium hydroxide which absorbs carbon dioxide in the bottle becomes brown instead of blue-black, showing that carbon dioxide is necessary for photosynthesis.
- *Why was the plant kept in dark and then in sun light ?*
- *Why did we study two leaves in this experiment?*

We have so far discussed the role of water and gasses in the process of photosynthesis. Scientist who had been working on these lines had observed some other factors that affect the process of photosynthesis.

Light and Photosynthesis

In Priestley's time, scientists didn't understand about energy, but later on much was discovered about it. If energy is released when carbon dioxide and water is formed by combining oxygen with carbon and hydrogen, then what about the reverse?. What about forming oxygen again and putting it back in the air. Eventually, scientists learned that the energy situation would also reverse. Oxygen formation would use up energy. That means if plants

form oxygen they have to get energy to make it possible. Where did the energy come from?

A Dutch scientist, Jan Ingenhousz (1730-1799), found the answer. He studyed the way in which plants formed oxygen. In 1779, he noticed that it happened only in the presence of light. In an experiment with the aquatic plant, Hydrilla, he observed that in bright sunlight, small bubbles formed around the green parts while in the dark they did not form. He also found that the gas present in the bubbles was oxygen.

It was further confirmed when Engelman in the early 20th century ingeniously detected the point of maximum rate of photosynthesis. He used a strand of algae and exposed it to different colours of light (the colours that we see in a rainbow) He then used oxygen sensitive bacteria and found they crowd around areas illuminated with red and blue rays of light. This led to more studies on effect of light on photosynthesis, the role of different coloured compounds called pigments in plants and the utilization of light energy.

Lab Activity

Oxygen is produced during photosynthesis in the presence of light

- Arrange the apparatus as shown in the figure. Make two identical sets.
- Place some water plant like Elodea or Hydrilla in a short stemmed funnel and keep it in a beaker containing water.
- Invert a test-tube full of water over the stem of the funnel. Ensure that the level of water in the beaker is above the level of stem of the inverted funnel.

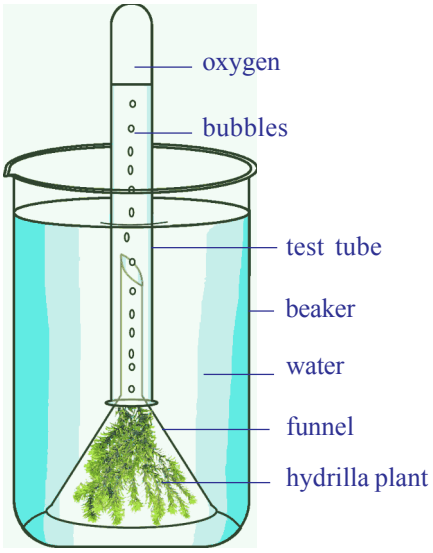


fig-5: Hydrilla experiment

Place one apparatus in the sun and the other in the dark for at least 2-3 hours. You would see that in place of water there is air that fills in the set up kept in sun. It is actually a gas that will collect in the test-tube. Observe the other set up kept in dark. Is there any difference in the amount of gas collected?

Test the gas in the test-tube by inserting a glowing match stick or incense stick which would burst into flames. This shows the presence of oxygen.

- What precautions do you need while removing test tube from the beaker. Discuss with your teacher.

Activity-3

Sunlight is necessary to form starch in green plants

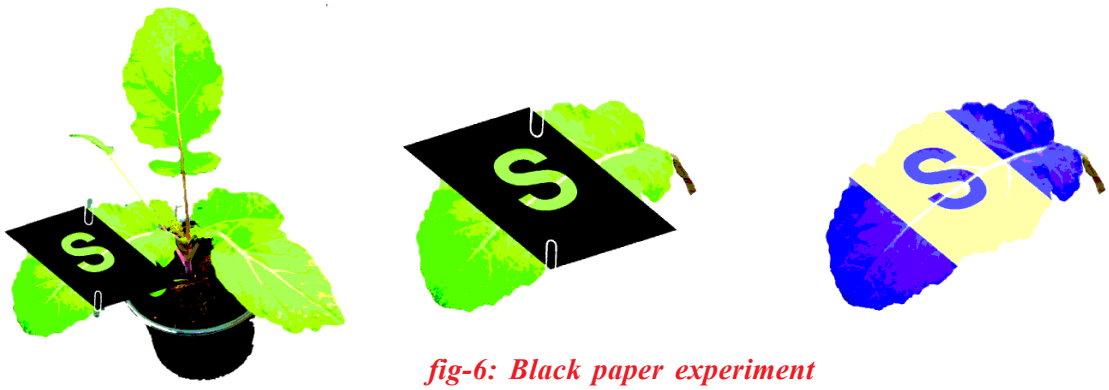


fig-6: Black paper experiment

- Take a potted plant with destarched leaves. Remember the process of destraching leaves mentioned in activity-1.
- Cover one of its leaves with black paper on which a design is cut. Fix the paper on the leaf in such a manner that light does not enter the dark part.
- Place this potted plant in sun light.
- After few hours of exposure to bright sunlight, test the leaf which is covered by black paper for the presence of starch.
- *Which part of leaf turms blue black? What about the remaining part?*
- *Observe the colour of leaf stained with iodine. Can you tell why it is stained differently?*
- It will be observed that only the parts of the leaf, which could get light through the cut out design, turns blue-black showing the presence of starch.

Chlorophyll and Photosynthesis

Ingenhousz wanted to find out more about photosynthesis and carried out several other experiments. He proposed that only green plant parts could carry out the process of photosynthesis.

What about plants having coloured leaves? How is it that new leaves which look dark red in colour in several plants turn green? Do plants having reddish or yellowish leaves also carry out photosynthesis? What made plants carry out photosynthesis while even green coloured animals (like some birds)could not? Questions like these remained challenges until scientists could isolate the green coloured substance from plant parts and study its nature.

Establishment of Ingenhousz's proposition came after several experiments till the mid 20th century when scientists could also locate the site of photosynthesis and even isolate it. Around four decades after Ingenhouszs' proposition scientists could only isolate the green substance to observe its nature and find out whether photosynthesis could be carried out with it. This had become possible in the year 1817 due to the work of two scientists Pelletier and Caventou who obtained an extract of the green colored substance and named it 'chlorophyll' meaning green leaf.

It was also found that pigments other than green could also aid in the process of photosynthesis by passing on the energy of sunlight trapped by them to chlorophyll.

- *But where is chlorophyll and other pigments present in the plant?*

Where does Photosynthesis take place?

Try to name some parts where you think photosynthesis occurs.

- *Do you think the new reddish leaves of plants also carry out photosynthesis? What could be the role of their colour?*

The exact location of the photosynthetic part or a part containing chlorophyll was not known till another 6 decades after Pelletier and Caventou discovered chlorophyll. It was believed to be spread in the cells of green plant parts. In 1883, Julius Von Sachs, observed that chlorophyll in plant cells is not spread through out the entire cell. It is rather found in organelles within the cell. Such organelles were named as 'chloroplasts'. These are present in large numbers in the cells (around 40 – 100) of parts like the stomatal guard cells and ground tissues of plants .

You have studied about Chloroplast in Class IX. Let us observe the figure.

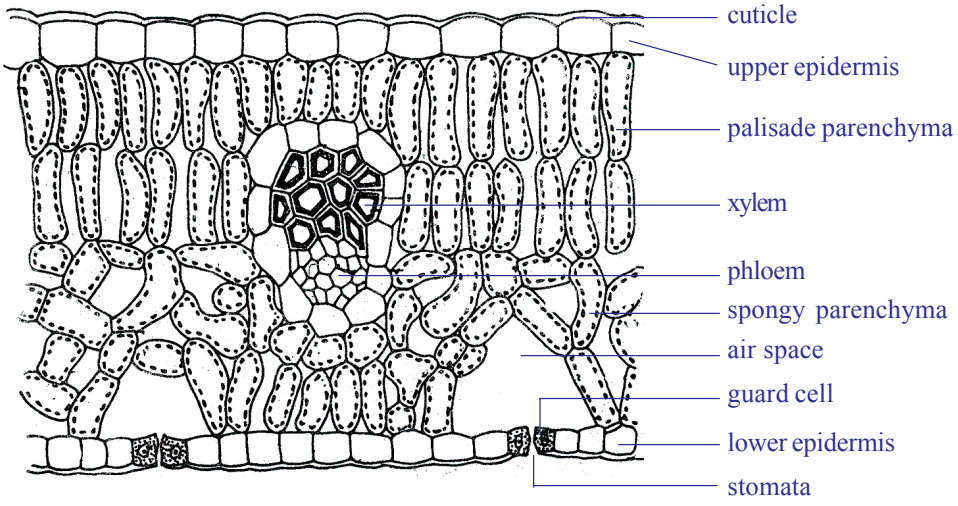


fig-7(a): T-S of leaf

- *What makes chloroplast appear completely different from other cell organelles?*

Do you know?

If a cell is broken up, the chloroplasts also break into pieces, so it becomes a very difficult task to isolate them to study the different steps of photosynthesis.It was not until 1954, that Daniel I. Arnon was able to break up plant cells so gently that whole chloroplasts could be obtained that could carry through photosynthesis.

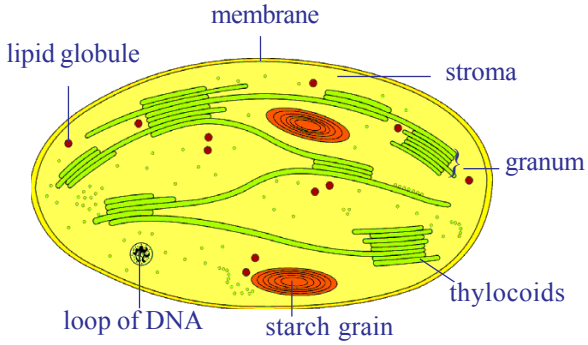


fig-8: T-S of chloroplast

It has been found that the chloroplast is a membranous structure, consisting of 3 membranes. The third layer forms stacked sack like structures called as granum. It is believed to be a site for trapping of solar energy. The intermediary fluid filled portion is called as stroma. It is believed to be responsible for enzymatic reactions leading to the synthesis of glucose, which in turn join together to form starch.

Substances found in chloroplast which capture sunlight are called photosynthetic pigments. There are several types of photosynthetic pigments involved in the process to produce organic molecules like glucose in plants.

Chlorophyll is such a pigment which contain one atom of megnisium. It is similar in structure to the heam of haemoglobin. (The iron containing red pigment that transports oxygen in blood.) Two major kinds of chlorophylls are associated with thylakoid membranes. Chlorophyll 'a' is blue-green in colour and chlorophyll 'b' is yellow-green colour. Around 250 to 400 pigment molecules are grouped as light harvesting complex or photosynthetic unit in each granum. Such innumerable units function together in chloroplasts of green plants in the process of photosynthesis.

During photosynthesis several events occur in the chloroplast some of them are:

1. Conversion of light energy to chemical energy
2. Splitting of water molecule
3. Reduction of carbondioxide to carbohydrates

Light is required to initiate several events while several may continue even in absence of it. That would mean, once light energy has been captured it can help reactions to continue even in the dark. Light dependent events

or reactions are called light reactions and it has been found to take place in grana, while the rest are called light independent or dark reactions and they occur in the stroma.

Mechanism of Photosynthesis

1. Light dependent reaction (Photochemical phase)

In this reaction light plays a key role. A series of chemical reactions occur in a very quick succession initiated by light and therefore the phase is technically called the photochemical phase or light dependent reaction. The light reaction takes place in chlorophyll containing thylakoids called grana of chloroplasts. Several steps occur in the light dependent reaction.

Step-I : The chlorophyll on exposure to light energy becomes activated by absorbing photons. (Photon is the smallest unit of light energy)

Step-II: The energy is used in splitting the water molecule into two component ions named hydrogen (H^+), hydroxyl ion (OH^-).

$H_2O \rightarrow H^+ + OH^-$

The reaction is known as photolysis, which means splitting by light (photo means light, lysis means breaking). This was discovered by Hill. Hence it is also called Hill's reaction.

Step-III: The highly reactive ions of water undergo quick change as described below.

OH^- ions through a series of steps produce water (H_20) and Oxygen (O_2). Water may be used by the plant inside, but O_2 is useually released into the atmosphere. H^+ ions undergo series of changes in dark reaction. compounds that can trap energy like ATP (Adenosine Tri phosphate) and NADPH (Nicotinamide Adenosine Dinucleotide Hydrogen Phosphate) are formed at the end of the light reaction.

2. Light independent reaction (Biosynthetic phase)

This reaction does not require the presence of light and extension of the phases after day time may occur in some plants (time gap between the two being less than even one thousandth of a second) and some times even in the dark.

This is also called dark reaction. But the term dark reaction or light independent reaction does not mean that they occur when it is dark at night. It only means that these reactions are not depend on light. H^+ Ions produced in photolysis are immediately picked up by special compound NADP to form NADPH. In the dark phase the hydrogen of the NADPH is used to combine it with CO_2 by utilizing ATP energy and to produce glucose

($C_6H_{12}O_6$). This synthesis occurs in a number of steps using certain special intermediate compounds (mainly RUBP- Ribulose bis Phosphate) and enzymes. Finally the glucose is converted to starch.

Plants are capable of surviving under a range of situations, from very hot, dry and brightly lighted conditions to wet, humid and dimly lighted ones. The requirement of light and other factors varies from one plant to another.

Heterotrophic Nutrition

In the living world all organisms are capable of surviving under different conditions and acquring their food in different ways. We have studied about organisms that can capture light to produce their food. These are autotrophic in nature. While those that can not are heterotrophic.

How do organisms obtain their nutrition

Depending on the type and availability of food organisms can assort to a range of strategies of food intake and use. Some organisms break down the food materials outside the body and then absorb it. For example, bread moulds, yeast, mushrooms etc. which are called saprophytes. Some other organisms derive nutrition from plants or animals without killing them. This type of parasitic nutritive strategy is used by a wide variety of organisms like Cuscuta, lice, leaches and tape worms. Others take in whole material and break it down inside their bodies. What can be taken in and broken down depends on the bodys' design and it's function.

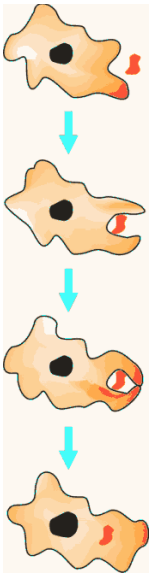


fig-9(a): Nutrition in Ameoba

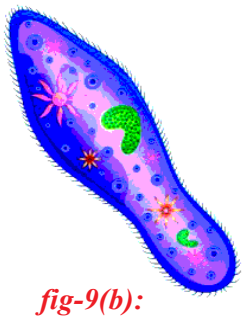


fig-9(b): Nutrition in Paramoecium

Since the food and the way it is obtained differs, the digestive system is also different in various organisms. In single celled organisms, like amoeba the food may be taken in by the entire surface but as the complexity of the organism increases, different parts become specialized to perform different functions.

For example amoeba [fig-9(a)] takes in food using temporary finger like extensions (pseudopodia) of the cell surface which fuse over the food particle forming food vacuole. Inside the food vacuole, complex substances are broken down into simpler ones. Then diffuse into the cytoplasm. The remaining undigested material is moved to the surface of the cell and thrown out. In Paramoecium [fig-9(b)], which is also a unicellular organism the cell has a definite shape. Food is taken in at a specific spot. Food is moved to the spot by the movement of cilia which covers the entire surface of the cell, where the food is ingested (cytostome).

Parasitic nutrition in Cuscuta

fig-10: Haustoria in cuscuta

Dodder (genus Cuscuta) is a leafless, twining, parasitic plant belongs to morning glory family (Convolvulaceae). The genus contains about 170 twining species that are widely distributed throughout the temperate and tropical regions of the world.

The dodder contains no chlorophyll (Cuscuta reflexa has been found to have very small amount of chlorophyll) and instead absorbs food through haustoria. They are rootlike structures that penetrate the tissue of a host plant and may kill it. The slender, string like stems of the dodder may be yellow, orange, pink, or brown in colour. It's leaves are reduced to minute scales. The dodder's flowers, in nodule like clusters, are made up of tiny yellow or white bell-like petals.

The dodder's seed germinates, forming an anchoring root, and then sends up a slender stem that grows in a spiral fashion until it reaches a host plant. It then twines around the stem of the host plant and forms haustoria, which penetrate through it. Water is drawn through the haustoria from the host plant's xylem, and nutrients are drawn from its phloem. Meanwhile, the root rots away after stem contact has been made with a host plant. As the dodder grows, it sends out new haustoria and establishes itself very firmly on the host plant. After growing in a few spirals around one host shoot, the dodder finds its way to another, and it continues to twine and branch until it resembles a fine, densely tangled web of thin stems enveloping the host plant. Identify plants in your surroundings which are parasitic on other plants.

Nutrition in Human Beings

Human digestive system is very complex in nature. Different parts are involved and perform different functions by using various digestive juices and enzymes.

Let us observe the figure of digestive system and label the parts.

The alimentary canal is basically a long tube extending from the mouth to the anus. We can see that this tube has different parts. Various regions are specialized to perform different functions.

- *What happens to the food once it enters our body?*

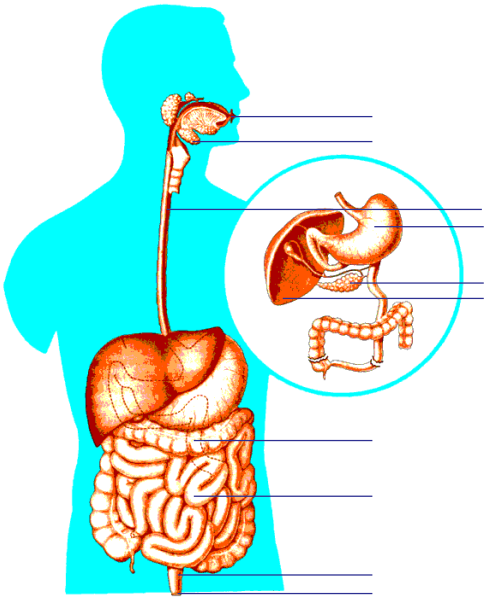


fig-11: Alimentary canal of man

We eat various types of food which has to pass through the same digestive tract. It also has to be converted to substances small enough to be utilised by our body. This needs various processess that can be studied as follows.

Passage of food through alimentary canal or gut

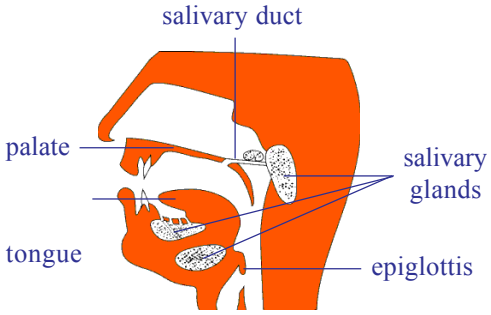


fig-12: Buccal cavity

Food is cut and crushed by our teeth in the mouth and mixed with saliva to make it wet and slippery (also called as mastication). Saliva is secreted by three pairs of salivary glands. Two pairs are located at the side of the jaw and below the tongue. One pair is located in the palate. Saliva mainly contains an enzyme amylase (ptyalin) which helps in the breakdown of complex carbohydrates to simple ones. The tongue helps in mixing the food and pushing it into the next part. The lower jaw also helps in the whole process.

We can find out the effect of salivary amylase on carbohydrates to observe what might be happening in our mouth.

Activity-4

- Refer to activity - 7 action of saliva on wheat flour in the chapter Co ordination of life processes.

'Thats the way with our body'. You can also perform the activity by using 'Ganji' (boiled rice water)

The soft food mixed with saliva passes through oesophagus or food pipe by wave like movements called peristaltic movement to the stomach.

At the stomach, food gets churned with gastric juice and HCl. Now the food is in semisolid condition. The digestion of food goes on as most proteins are broken down into smaller molecules with the help of enzyme pepsin acting on them.

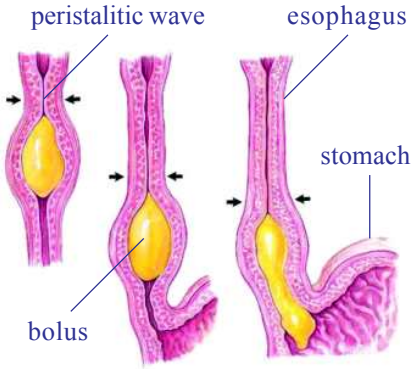


fig-13: Peristaltic movement

Food in the form of a soft slimy substance where some proteins and carbohydrates have already been broken down is called chyme. Now the food material passes from the stomach to the small intestine. Here the ring like muscles called pyloric spincters relax to open the passage into the small intestine. The spincters are responsible for regulating the opening of the passage such that only small quantities of the food material may be passed into the small intestine at a time.

The small intestine is the longest part of the alimentary canal. It is the site of further digestion of carbohydrates, proteins and fats. It receives the secretion of liver and pancreas for this purpose. These juices render the internal condition of the intestine gradually to a basic or alkaline one.

Fats are digested by converting them into small globule like forms by the help of the bile juice secreted from liver. This process is called emulsification.

Pancreatic juice secreted from pancreas contains enzymes like trypsin for carrying on the process of digestion of proteins and lipase for fats.

Walls of the small intestine secrete intestinal juice which carry this process further that is small molecules of proteins are broken down to further smaller molecules. The same is the condition with fats. Carbohydrate digestion that started in the mouth and did not occur in the stomach, resumes now as the medium gradually changes to an alkaline one and the enzymes become active for carbohydrate breakdown.

Activity-5

Studying the enzymes chart

Let us study the chart showing different enzymes and digestive juices and their functions.

Table-1: some enzymes and juices of the gut

S.No.	Enzyme/Substance	Secreted by	Secreted into	Digestive juice	Acts on	Products
1	Ptyalin (salivaryamylase)	Salivary glands	Buccal cavity	Saliva	Carbohydrates	Dextrins and maltose
2	Pepsin	Stomach	Stomach	Gastric juice	Proteins	Peptones
3	Bile (No enzymes)	Liver	Duodenum	Bile juice	Fats	Emulification breaking down of largef ats into small globules
4	Amylase	Pancreas	Duodenum	Pancreatic juice	Carbhoydrates	Maltose
5	Trypsin	Pancreas	Duodenum	Pancreatic juice	Proteins	Peptones
6	Lipase	Pancreas Intestinal wall	Duodenum	Pancreatic juice Intestinal juice	Fats	Fatty acids and glycerol
7	Peptidases	Small Intestine	Small Intestine	Intestinal juice	Peptides	Amino acids
8	Sucrose	Small Intestine	Small Intestine	Intestinal juice	Sucrose (Cane Sugar)	Glucose

- *Name the enzymes which act on carbohydrates?*

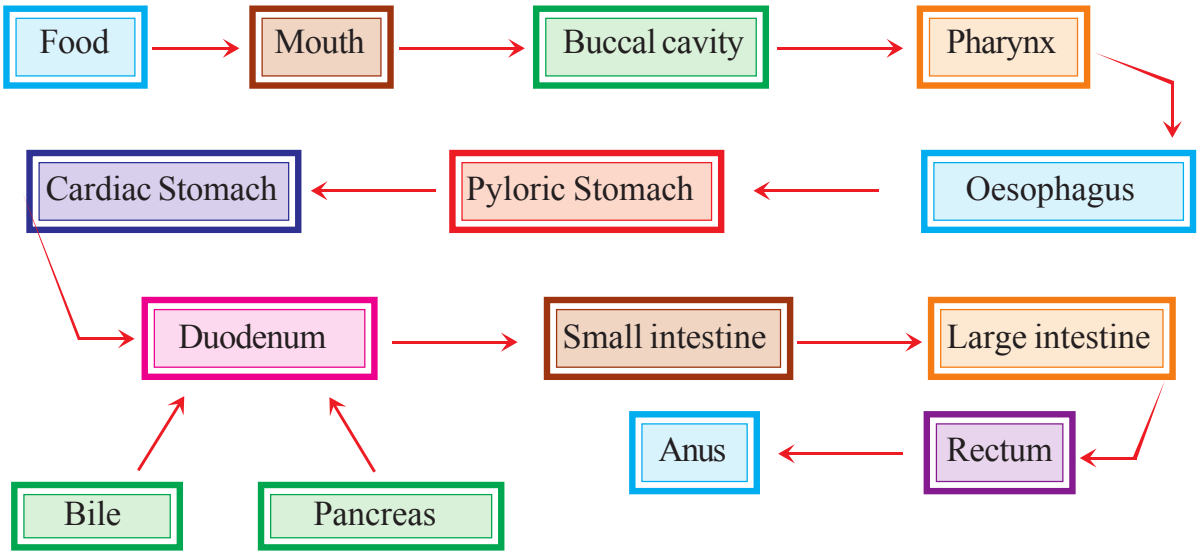
- *Which juice contains no enzymes?*
- *What are the enzymes that act on proteins?*

Transport of the products of digestion from the intestine into blood (through the wall of intestine) is called absorption. Internally, intestinal wall has a number of finger like projections called villi. The villi increase the surface area for absorption. Blood vessels and lymph vessels are present in the form of a network in the villi.

Products of digestion are absorbed first into the villi and from here into the blood vessels and lymph vessels. Thus after maximum absorption of food in the small intestine the rest passes into the large intestine. Here most of the water present is taken up from this material. This material is then expelled through the anus which is the last part of the alimentary canal. This passage of undigested material from the body by the way of anus is called defecation. Food that passes out of the anus still contains considerable amount of proteins, fats and carbohydrates, roughages or fibres of either carbohydrates or proteins. We will learn some more points about the coordination about digestive system with other systems in the chapter coordination in life processess.

Flow chart of human digestive system

- *What do you think is the process of digestion?*
- *What are its major steps?*



Health aspects of the alimentary canal

The human alimentary canal usually functions remarkably well considering how badly we treat it on occasions! Sometimes it rebels, and we either feel sick or have indigestion.

Vomiting is the body's method of ridding itself of unwanted or harmful substances from the stomach. The peristaltic movements of the stomach and oesophagus reverse their normal direction and the food is expelled. There are many causes of vomiting, but one of the most common is over eating, especially when the food contains a high proportion of fat. Vomiting also occurs when we eat something very indigestible or poisonous.

When we have a greenish vomit usually called as 'bilious' or 'liverish', we get a bitter taste and it is often the result of having eaten 'rich' meals over several days. The liver is unable to cope with the excessive fat and we get a feeling of nausea.

Indigestion is a general term used when there is difficulty in digesting food. Healthy people can usually avoid problems related to digestion by:

a) having simple, well balanced meals

b) eating them in a leisurely manner

c) thoroughly masticating the food

d) avoiding taking violent exercise soon after eating food

e) Drinking plenty of water and having regular bowel movements.

A more serious form of indigestion is caused by stomach and duodenal ulcers. These conditions occur more often in people who may be described as hurried or worried. Thus, ulcers occur more often in busy people who get into the habit of hurrying over meals and rushing from one activity to another without sufficient rest. Those who are able to relax, who are not continually tensed up, and who live at a slower pace, seldom get ulcers. You studied about recent researches in the peptic ulcers caused by some bacteria in class IX.

Proper functioning of all life processess require adequate amount of food in all living organisms. It is not just the intake of food but its assimilation and expulsion of wastes that play an important role. In take of fibre rich food avoids constipation.

Diseases due to mal nutrition

We know that food is the main source to maintain biological processes in a perfect manner. Our diet should be a balanced one which contains proper amount of carbohydrates, proteins, vitamins, mineral salts and fats. Two third of world population is affected by food related diseases. Some of them are suffering by consuming high calorific food. Most of them are facing various diseases due to lack of balanced diet. It is very important to discuss about food deficiency diseases.

Eating of food that does not have one or more than one nutrients in required amount is known as mal nutrition. Poor health, will full starvation, lack of awareness of nutritional habits, socio economic factors are all the reasons for mal nutrition in our country.

Mal nutrition is of three types

1. Calory malnutrition,
2. Protein malnutrition,
3. Protein calory malnutrition.

Let us observe harmfull effects of mal nutrition in children.

fig-14: Kwashiorkor

1. Kwashiorkor disease: This is due to protein deficiency in diet. Body parts become swollen due to accumulation of water in the intercellular spaces. Very poor muscle development, swollen legs, fluffy face difficult to eat, diarrhoea, dry skin are the symptoms of this disease.

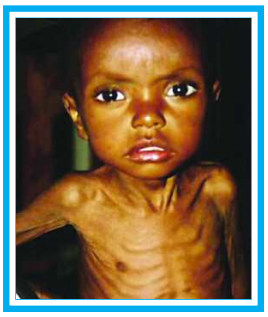


fig-15: Marasmus

2. Marasmus: This is due to deficiency of both proteins and calories. Generally this disease occurs when there is an immidiate second pregnancy or repeated child births. Lean and week, swelling limbs, less devoloped muscles, dry skin, diarrhoea, etc., are the symptoms of this disease.

3. Obesity: This is due to over eating and excess of energy in take. It is a big health hazard. Obese children when grows, they will be target of many diseases like diabetes, cardio vascular, renal, gall bladder problems. Discuss about junk foods and other food habits which leads to obesity.

fig-16: Pellegra

Vitamin deficiency diseases

Vitamins are organic substances. They are micro nutrients required in small quantities. Actually vitamins are not synthesised in the body, we do not generally suffer from vitamin deficiency. The source of vitamins to our body is through two ways. One is diet and other is bacteria present in the intestain that synthesises and supplies vitamins to the body.

Vitamins are classified into two groups. One is Water soluble vitamins (Be-complex, vitamin C) and other is fat soluble vitamins (vitamin A, D, E and K). Let us study the following chart showing vitamins available sources and deficiency diseases.

Vitamin	Resources	Deficiency diseases	Symptoms
Thiamine (B1)	Cereals, oil seeds, vegetables, milk, meat, fish, eggs.	Beri beri	Vomitings, fits, loss of appetite, difficulty in breathing, paralysis.
Riboflavin (B_2)	Milk, eggs, liver, kidney, green leafy vegetables.	Glossitis	Mouth cracks at corners, red and sore tongue, photophobia, scaly skin.
Niacin (B_3)	Kidney, liver, meat, egg, fish, oil seeds.	Pellagra	Dermatitis, diarrhoea, loss of memory, scaly skin.
Pyridoxine (B_6)	Cereals, oil seeds, vegetables, milk, meat, fish, eggs, liver.	Anaemia	Hyper irritability, nausea, vomiting, fits.
Cyanocobalamine (B_{12})	Synthesised by bacteria present in the intestine.	Pernicious anaemia	Lean and week, less appetite.
Folic acid	Liver, meat, eggs, milk, fruits, cereals, leafy vegetables.	Anemia	Diarrhoea, loss of leucocytes, intestinal mucus problems.
Pantothenic acid	Sweet potatoes, ground nuts, vegetables, liver, kidney, egg.	Burning feat	Walking problems, sprain.
Biotin	Pulses, nuts, vegetables, liver, milk, kidney.	Nerves disorders	Fatigue, mental depression, muscle pains.
Ascorbic acid (C)	Green leafy vegetables, citrus fruits, sprouts.	Scurvy	Delay in healing of wounds, fractures of bones.
Retinol (A)	Leafy vegetables, carrot, tomoto, pumpkin, papaya, mango, meat, fish, egg, liver, milk, cod liver oil, shark liver oil.	Eye, skin diseases	Night blindness, xeropthalmia, cornea failure, scaly skin.
Calciferol (D)	Liver, egg, butter, cod liver oil, shark liver oil, (morning sun rays).	Rickets	Improper formation of bones, Knocknees, swollen wrists, delayed dentition, week bones.
Tocoferol (E)	Fruits, vegetables, sprouts, meat, egg, sunflower oil.	Fertility disorders	Sterility in males, abortions in females.
Phylloquinone (K)	Green leafy vegatables, milk.	Blood clotting	Delay in blood clotting, over bleeding.

Key words

Glucose, starch, cellulose, chloroplast, grana, stroma, light reaction, dark reaction, heterotrophic nutrition, parasitic nutrition, haustoria, Alimentary canal, salivary glands, peristaltic movement, amylase, ptyalin, pepsin, chyme, sphincter, digestion, pancreas, enzymes, villi, bile juice, lipase, fat, liver, emulsification.

What we have learnt

- Autotrophic nutrition involves the intake of simple inorganic materials like some minerals, water from the soil. Some gases from the air. By using an external energy source like the Sun to synthesis complex high energy organic material.
- Photosynthesis is the process by which living plant cells containing chlorophyll, produce food substances [glucose & starch] from Carbon dioxide and water by using light energy. Plants release oxygen as a waste product during photosynthesis.
- Photosynthesis process can be represented as

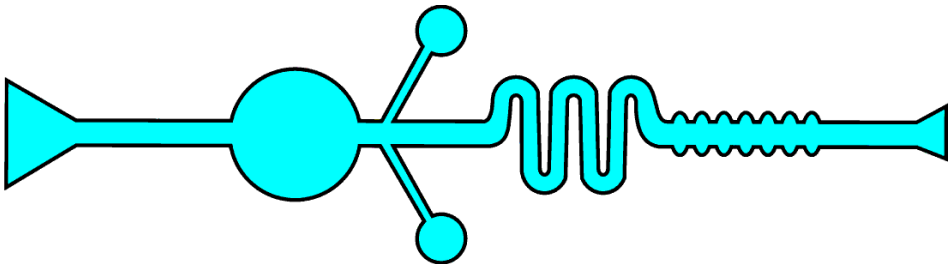
  $6CO_2 + 12H_2O \xrightarrow[\text{Chlorophyll}]{\text{light}} C_6H_{12}O_6 + 6H_2O + 6O_2$
- The materials required for photosynthesis are light: Carbon dioxide, Water, photosynthetic pigment chlorophyll.
- Chloroplast are the sites of photosynthesis. Light reaction takes place in the grana region and light independent reaction takes place in the storma region.
- The end products of photosynthesis are Glucose water and Oxygen.
- During photosynthesis the important events which occurs in the chloroplast are
  a) Conversion of light energy into chemical energy
  b) Splitting of water molecule
  c) Reduction of carbon dioxide to carbohydrates
- Heterotrophic Nutrition involves the intake of complex material prepared by other organisms.
- The form of nutrition differs depending on the type and availability of food material as well as how it is obtained by the organism.
- In single celled organisms the food may be taken in by the entire surface but as the complexity of the organism increases different parts becomes specialized to perform different functions.
- The large complex food molecules such as carbohydrates, proteins , lipids, etc., are broken down in to simple molecules before they are absorbed and utilized by the animals. This process of breaking down of complex molecules into simple molecule is called digestion.
- In human beings the food eaten is broken down in various steps with the help of enzymes secreted by digestive glands which are associated with the alimentary canal and the digested food is absorbed in small intestine to be sent to all cells in the body.

- The digestive system includes the alimentary tract and several associated organs. The functions of system are as follows :
  a) Ingestion: Taking of food into the body
  b) Digestion: Breaking up of complex food substances into the simple substances by specific enzymes. So that they can be used by the body.
  c) Absorption: The passage of digested food through the walls of alimentary tract (particulars in small intestine) into circulatory system.
  d) Defecation: The passage of undigested material from the body by the way of anus.

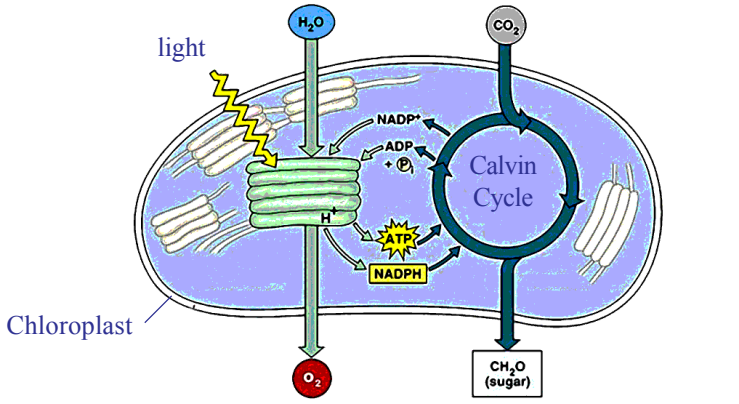
Improve your learning

1. Write differences between (AS1)
   a) autotrophic nutrition - heterotrophic nutrition
   b) Ingestion - digestion
   c) Light reaction - dark reaction
   d) Chlorophyll - chloroplast
2. Give reasons (AS1)
   a) Why photosynthesis is considered as the basic energy source for most of living world?
   b) Why is it better to call the dark phase of photosynthesis as a light independent phase?
   c) Why is it necessary to destrach a plant before performing any experiment on photosynthesis?
   d) Why is it not possible to demonstrate respiration in green plant kept in sunlight?
3. Give examples (AS1)
   a) Digestive enzymes
   b) Organisms having heterotrophic nutrition
   c) Vitamins
   d) Food deficiency diseases
4. Where do plants get each of the raw materials required for photosynthesis?(AS1)
5. Explain the necessary conditions for autotrophic nutrition and what are its by products?(AS1)
6. With the help of chemical equation explain the process of photosynthesis in detail? (AS1)
7. Name the three end products of photosynthesis? (AS1)
8. What is the connecting substance between light reaction and dark reaction? (AS1)
9. Most leaves have the upper surface more green and shiny than the lower ones why? (AS1)
10. Explain the structure of chloroplast with a neatly labeled sketch. (AS1)
11. What is the role of acid in stomach? (AS1)
12. What is the function of digestive enzyme? (AS1)
13. How is the small intestine designed to absorb digested food, explain. (AS1)
14. How do fats digested in our bodies? Where does this process takes place? (AS1)
15. What is the role of saliva in the digestion of food? (AS1)
16. What will happen to protein digestion as the medium of intestine is gradually rendered alkaline? (AS1)
17. What is the role of roughages in the alimentary track? (AS1)
18. What is malutrition explain some nutrition deficiency diseases. (AS1)
19. How do nongreen plants such as fungi and bacteria obtain their nourishment? (AS2)
20. If we keep on increasing CO_2 concentration in air what will be the rate of photosynthesis?(AS2)

21. What happens to plant if the rate of respiration becomes more than the rate of photosynthesis?(AS2)
22. Why do you think that carbohydrates are not digested in the stomach?(AS2)
23. What process you follow in your laboratory to study presence of starch in leaves?(AS3)
24. How would you demonstrate that green plant release oxygen when exposed to light?(AS3)
25. Visit a doctor and find out keeping in view of digestion. Prepare a chart and display in your classroom. (AS4)
    i) Under what condition does a patient need to become a drip of glucose.
    ii) Till when does a patient need to be given a glucose.
    iii) How does the glucose help the patient to recover.
26. If there were no green plants, all life on the earth would come to an end! Comment?(AS5)
27. Draw a neatly labeled diagram of chloroplast found in leaf, and it's role in photosysthesis?(AS5)
28. Draw the label diagram of human digestive system? List out the parts where peristalasis takes place. (AS5)
29. Raheem prepared a model showing the passage of the food through different parts of the elementary canal? Observe this and label it's parts. (AS5)



30. Observe the following diagram and write a note on light dependent, light independent reactions.(AS5)



31. Almost all the living world depends on plants for food material. How do you appreciate the process of making food by the green plants?(AS6)
32. Even a hard solid food also becomes smooth slurry in the digestive system by the enzymes released at a perticular time. This mechanism is an amazing fact. Prepare a cartoon on it. (AS6)
33. What food habbits you are going to follow after reading this chapter? Why? (AS7)

Fill in the blanks

1. The food synthesized by the plant is stored as _____.
2. _____ are be sites of photosynthesis.
3. Pancreatic juice contains enzymes for carrying the process of digestion of _____ and _____.
4. The finger like projections which increases the surface area in small intestine are called_____.
5. The gastric juice contains _____ acid.
6. _____ vitamin sysnthesised by bacteria present in intestine.

Choose the correct answer

7. Which of the following organisms take the food by parasitic nutrition? ( )
   a) Yeast b) Mushrooms c) Cuscuta d) Leeches
8. The rate of Photosyntesis is not affected by: ( )
   a) Light Intensity b) Humidity C) Temperature d) Carbon dioxide concentration
9. A plant is kept in dark cupboard for about forty eight hours before conducting any experiment on Photosynthesis in order to : ( )
   a) Remove chorophyll from leaves b) Remove starch from leaves
   c) Ensure that no photosynthesis occurred d) Ensure that leaves are free from the starch
10. The digestive juice without enzyme is ( )
    a) Bile b) Gastric juice c) Pancrtatic juice d) saliva
11. In single celled animals the food is taken ( )
    a) By the entire body surface b) Mouth c) Teeth d) Vacuoles
12. Which part of the plant takes in carbondioxide from the air for photosynthesis ( )
    a) Root hair b) Stomata c) Leaf veins d) Sepals