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## UNIT 4 ASSIMILATION OF FOOD INTO THE BODY

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In previous units you have learnt that food becomes part of you. You also know about the various nutrients that our body needs and gets through the foods we eat. This unit will deal with the process by which food is utilized in our body with digestion and absorption or assimilation of food into the body.

### Structure

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### 4.0 OBJECTIVES

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Having studied this unit, you will be able to

- describe the digestive system
- explain the process of digestion and its importance and
- explain how nutrients are assimilated into the body.

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### 4.1 INTRODUCTION

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In Unit 1 you learnt about the nutrients that your body needs. It is indeed remarkable that no matter what you eat, it soon becomes flesh and blood. The process by which the nature of food is changed in the body is called digestion.

Sometimes children swallow beads or other things which normally, you as an adult, would not. If you take the child to a doctor, he would tell you to wait and see if the child passes the beads in its stools within a day or two. Thus you have encountered one of nature's beautiful mechanisms.

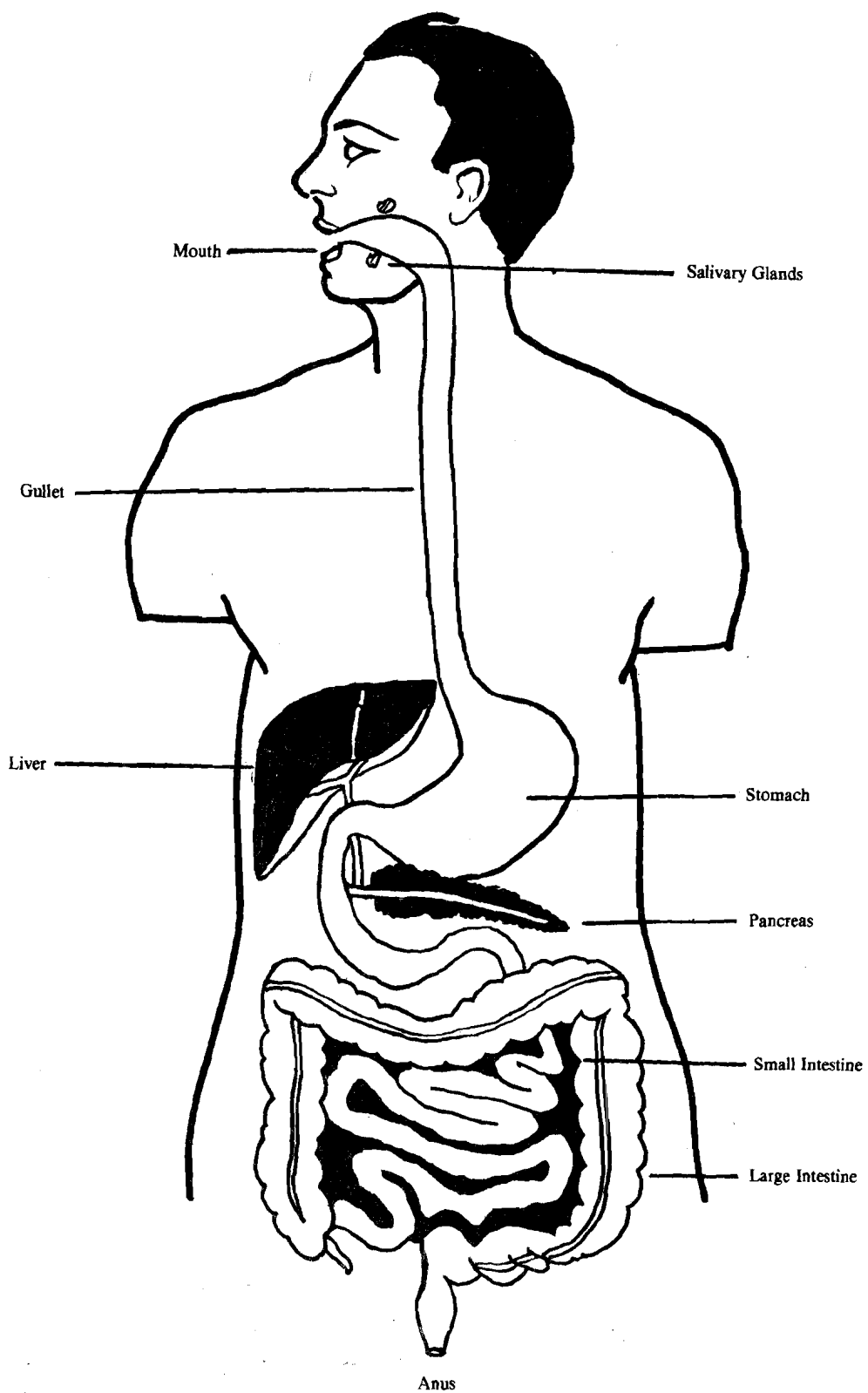
The digestive tract protects you from serious consequences. The system solves many problems for you without your making any conscious effort.

The digestive tract is nature's (or your body's) ingenious way of getting nutrients from the food ready for absorption.

The digestive tract is selective. It breaks down those materials that are nutritious for the body into particles that you can assimilate. Those particles that are left undigested pass out from the other end of the digestive tract. Your body needs energy to perform its various activities, protein both to replace the cells it has lost and to grow, and the various vitamins and minerals for bone and blood formation and for the body to work efficiently and smoothly.

One way your body tells you that it needs all these nutrients is by giving you a signal: *hunger*. When you feel hungry, you eat some food. Let us suppose you ate rice, dal and a curry, and throughout the day you have had at least 4-6 glasses of water or some other liquid. What happened to the food and the water? Where did they go? Both got digested in the body and the nutrients were then assimilated into the blood which carried the nutrients to each and every cell. Before discussing digestion and absorption, let us first see what the digestive tract is made up of.

Figure 4.1 The Digestive System



## 4.2 THE DIGESTIVE TRACT

Some of you may have encountered the term gastro-intestinal tract. This term means digestive tract. Look at Figure 4.1. It shows you the essential part of our digestive tract. You can observe that the digestive tract is a long tube-like structure beginning with the mouth and ending at the anus. Let us trace the pathway of food in the digestive tract.

Suppose you had rice and dal. You would eat (chew) the food and then swallow it. This food will actually travel a distance of about 26 feet inside you (within the digestive tract).

As you swallow, the food slides across the gullet passing over the entrance to your lungs. Whenever you swallow, your body automatically closes off your air passages, so that you do not choke. When you chew food, you are breaking it up (grinding it) into small particles. Figure 4.2 shows you diagrammatically what happens when you eat. As you read further look at this figure. It will help you understand the process of digestion. From the mouth the food goes into the stomach, where it will stay for a few hours. The stomach breaks the rice and dal into still smaller particles, mixing it at the same time with acid and an enzyme pepsin which will chemically alter the protein in your rice and dal.

From the stomach the food enters the intestines. We have a small intestine and a large intestine. The small intestine is actually 20 feet coiled tube within the abdomen. From here, food enters the large intestine. In the colon (latter portion of the large intestine) the body withdraws water, leaving behind semi-solid waste. The waste is held back here because of the strong muscles (known as sphincter muscles) of the rectum. It would be inconvenient and embarrassing if one had to excrete continuously. When the body chooses to defecate, this muscle is relaxed and the waste material is voided.

Let us sum up the path that food has to follow in the body:

Mouth (epiglottis) → Gullet (esophagus) → Stomach → Small intestine → Large intestine → Rectum (anus).

Like everything else, the digestive tract also has a set of rules:

- For food to pass smoothly through the system, it must be mixed with water. If you drink too little water the food is too compact and moves very slowly.
- For digestive enzymes to work on food, it should be finely divided and suspended in water so that every particle will be accessible to the enzymes. Once digestion is complete and all the essential nutrients are absorbed, a residue remains which is excreted. It would be wasteful and inconvenient to excrete large amounts of water with this residue. So your body withdraws some water, leaving a semi-solid mass just smooth enough and easy to pass. All this means that food is altered physically in the digestive tract.
- The enzymes of the digestive tract break down i.e. digest carbohydrate, protein and fat into smaller units. This is basically chemical alteration of food.

**Note:** The body needs many nutrients which it absorbs from food through the digestive tract. But the digestive tract digests only carbohydrates, fats and proteins although the food you eat will have many substances including vitamins, minerals, preservatives, colours, etc.

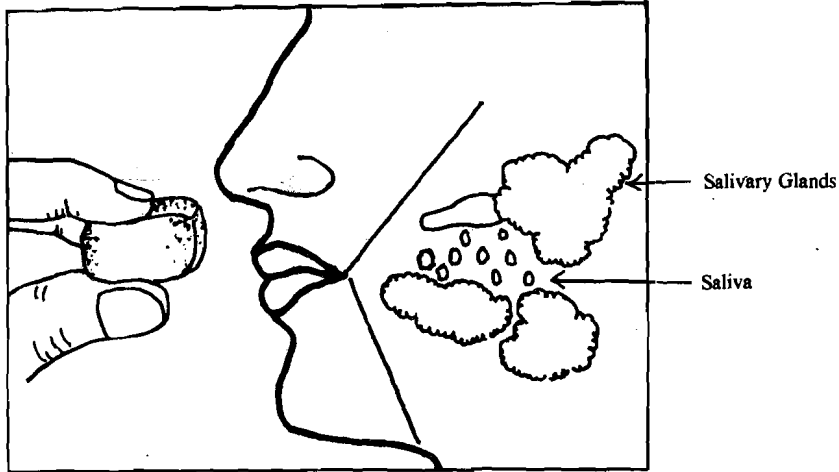
Certain glands in the body contribute the digestive juices or enzymes (Figure 4.1). These are the salivary glands, gastric glands, the liver and the pancreas. The enzymes from these glands break down proteins, fats and carbohydrates.

**DIGESTION IS THE PHYSICAL AND CHEMICAL ALTERATION OF FOOD. IT BREAKS DOWN COMPLEX MATERIALS TO SIMPLE ONES WHICH CAN BE ABSORBED INTO THE BLOOD STREAM**

From Figure 4.2 you can trace the digestive process.

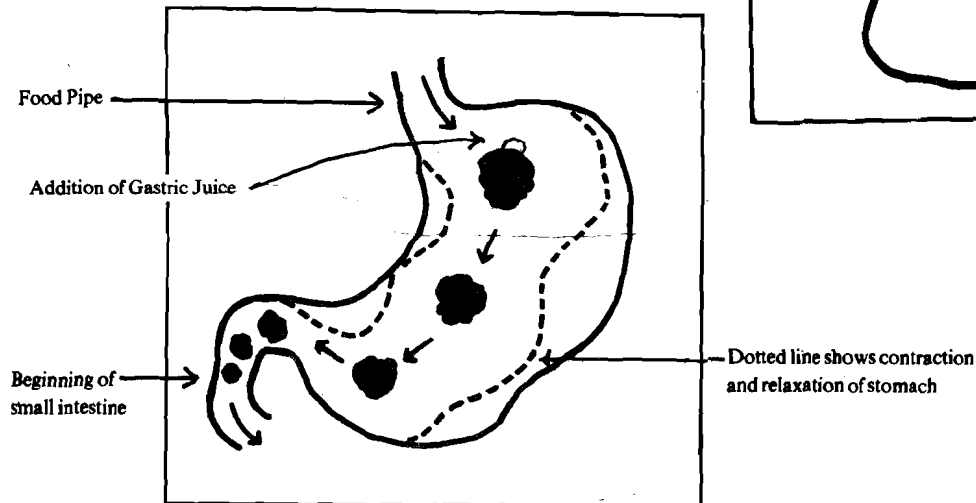
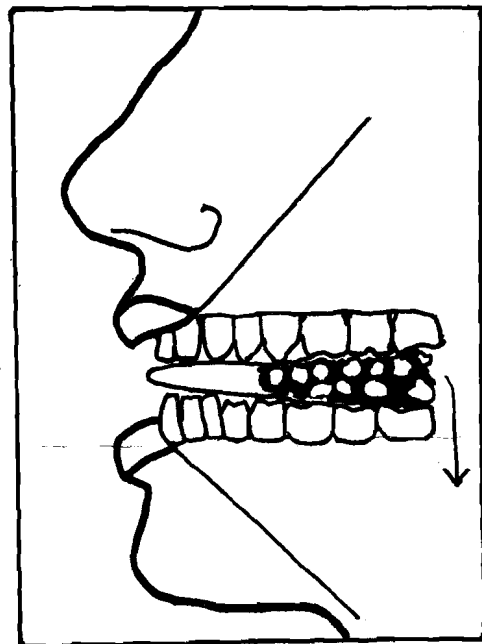
**Physical Alteration of Food:** You chew or masticate food, and thus grind it. Chewing food helps to (i) increase the surface area of food (ii) break the cell walls of cells, releasing the nutrients. In the mouth your tongue helps to mix the food with your saliva. In the

Figure 4.2 Digestion and Absorption of Food



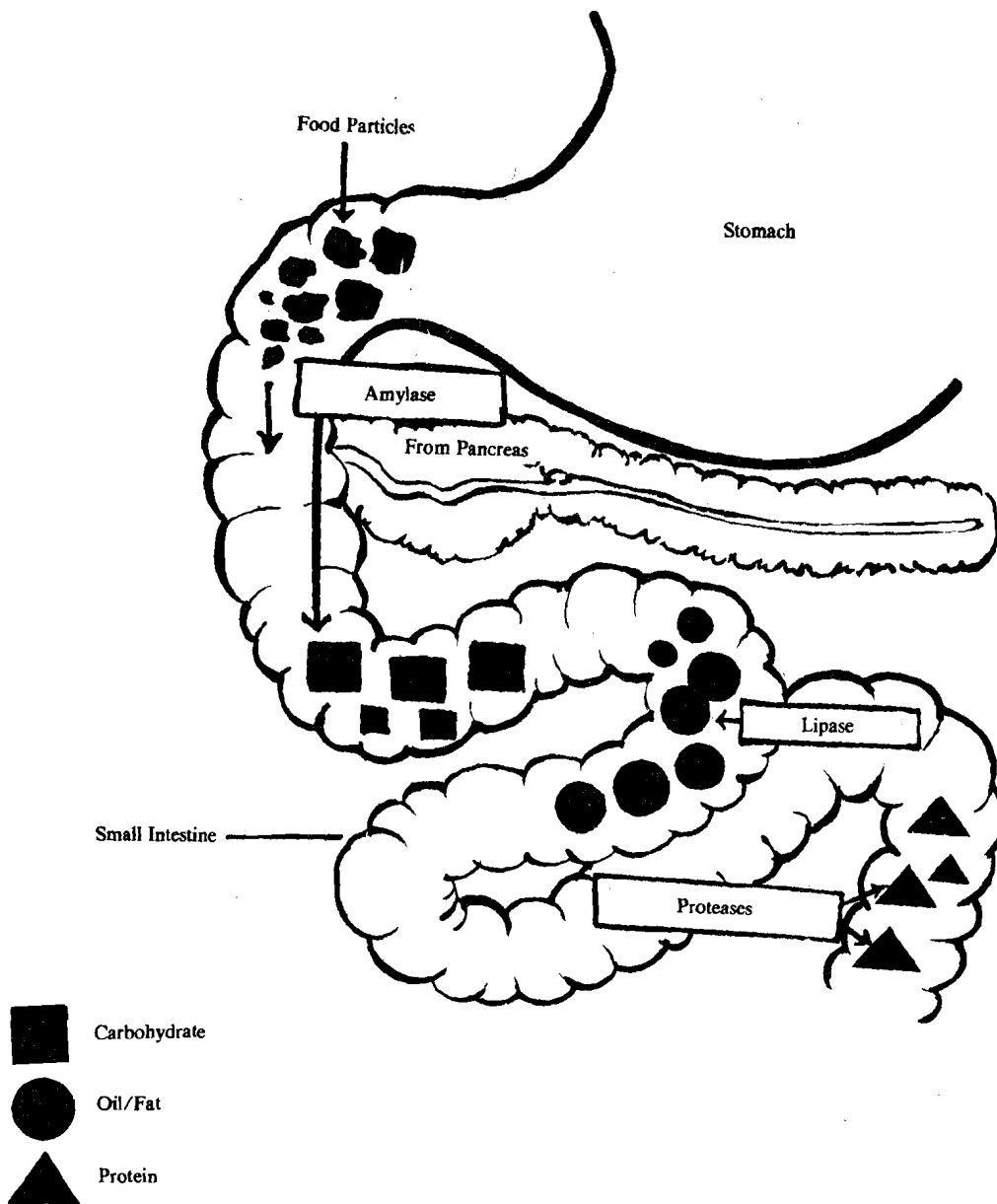
Food is mixed with saliva, (fluid/water) which is secreted by the salivary glands in response to the sight and aroma of food. When you smell food with a pleasing aroma your mouth waters, does it not? Tasty food heightens the secretion of saliva.

Food is broken up into increasingly smaller particles by chewing with your teeth. Your tongue helps to mix the food.



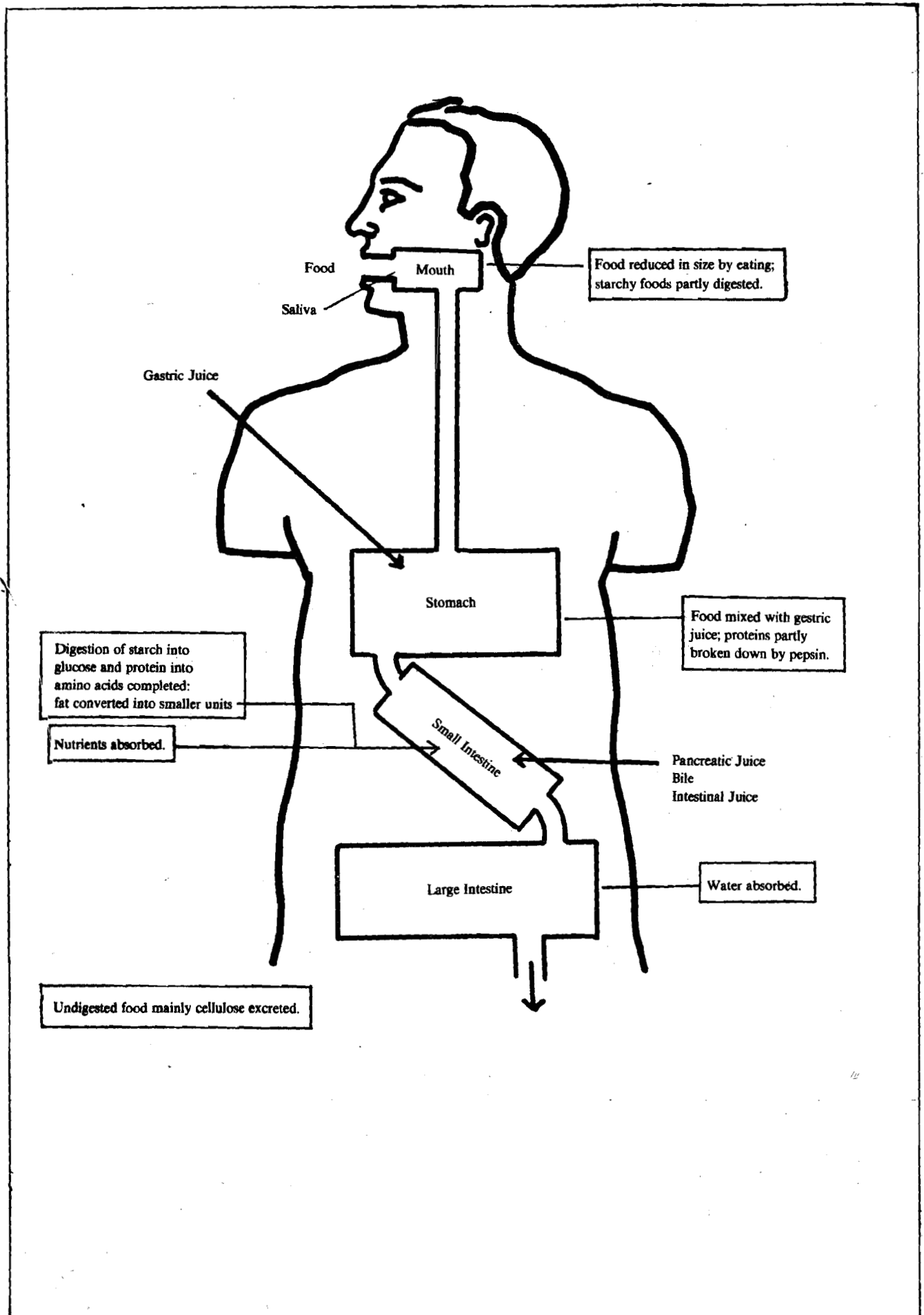
Addition of gastric juice occurs when food reaches your stomach. When food comes to the stomach, it begins to contract and relax. This breaks up food into even smaller particles and mixes it with gastric juice. Protein now begins to be broken down by proteases (enzymes) like pepsin. Fat is emulsified. Food stays in the stomach for about 2 to 3 hours and is then sent onward to the small intestine for further digestion.

Figure 4.2 (continued)



In the small intestine digestive enzymes chemically change food that you have eaten. Enzymes called amylases act directly on carbohydrate e.g. starch. Lipases hydrolyze lipids i.e. fats and oils and proteases act on proteins. Once food is changed into smaller forms and simpler units that your body can use, these forms are absorbed i.e. passed through the intestinal wall into the blood stream.

Figure 4.3 Summary of the Digestive Process



stomach food is mixed and altered further by contraction and relaxation of stomach muscles (known as peristalsis). Fat, as you know, does not mix with water. Contraction and relaxation of the stomach muscles breaks up the fat into small particles and disperses it in the watery medium or liquid in your stomach. This dispersion of fat in the liquid is called Emulsification.

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### 4.3 DIGESTION OF FOOD

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Carbohydrates, fats and proteins that are in the food are much too large to be of use to your body. Before your body can use them, it has to break them down into units which are small enough to be absorbed into the bloodstream.

Let us begin by considering carbohydrates. One of the commonest forms of carbohydrate in food is starch. Starch is made up of many small units called glucose. All carbohydrates must be broken down into small soluble units for utilization by the body.

Digestion of carbohydrate starts when you begin chewing food. Chew some bread or chapati. After sometime you will feel that it tastes sweeter. This is because saliva contains a starch-splitting enzyme called ptyalin.

In the stomach, little break down of carbohydrate occurs. In the intestines, however, the carbohydrate is completely hydrolyzed to glucose. Hydrolysis means break down of a large substance into smaller ones with the addition of water.

Just as the starch in your rice must be hydrolysed, so also the protein in your dal. Protein digestion begins in the stomach due to the action of the enzyme, pepsin. However pepsin by itself is not able to complete the digestion. Hence, in the small intestine, protein digestion is completed by other enzymes (proteases) which are secreted by the pancreas.

Fat digestion occurs mainly in the small intestine. Bile from the gall bladder breaks the fat into small particles. Thus the enzymes have more access to the fat to hydrolyze them.

Fats are also hydrolysed during digestion. Just like carbohydrate and protein, digestion of fat takes place gradually, in stages. Basically, digestion of any one carbohydrate, protein or fat is like starting with a large chain of beads and splitting this into pieces by removing one bead at a time.

Not everything you eat needs to be digested, e. g., vitamins and minerals or simple sugars like glucose. However, many times, the minerals and vitamins are bound to the fat, protein or carbohydrate in your food. Thus for these vitamins and minerals to be available for absorption, first they need to be separated from the complexes in which these are found in the food. Fat-soluble vitamins need to be dissolved in fat in order to be absorbed. Remember before absorption, the other nutrients must be dissolved in water. Therefore water is absolutely essential for absorption of most nutrients.

All along, you have read that enzymes break down or hydrolyse carbohydrates and fats. What are these enzymes, you may wonder? How exactly do they perform?

You already know:

**DIGESTION IS THE PROCESS OF BREAKING LARGER SUBSTANCES INTO  
SMALLER UNITS**

Basically the enzymes speed up hydrolysis just like a mixer hastens the grinding of food into smaller units. For hydrolysis to occur, water is absolutely essential.

Any food that has not been digested and absorbed from the small intestine goes into the large intestine. Fibre is one substance in your diet that remains undigested. If you recall, fibre is present in fruits, vegetables, in the outer skin of cereal grains and pulses. Fibre has the property of absorbing water and swelling.

In the large intestine, no new enzymes are produced and therefore no further digestion takes place. The main task of the large intestine is to remove excess water from the

undigested material. Remember that most of the break down stages in digestion involve hydrolysis and therefore need water. A lot of water passes into the large intestine. After this water is removed, the undigested material is removed from the body or excreted through the anus.

Remember that fibre is not digested. Therefore, it increases the bulk (amount) of undigested material. Also it soaks up water, just like a sponge does. As a result, if you eat sufficient fibre everyday, you can ensure that the muscles of your intestines are stimulated and defecation occurs regularly. Constipation can be thus prevented.

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## 4.4 ABSORPTION OF NUTRIENTS

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Absorption is the process by which the products of digestion pass out of the digestive tract through the cells in the intestinal wall, into the bloodstream.

Most nutrients are absorbed directly into your blood which will then distribute them to different parts of the body. Some nutrients are absorbed better in the stomach, for example vitamin B<sub>12</sub>. Minerals like calcium and iron are absorbed better in the first portion of the small intestine. Most end products of digestion of carbohydrates, fats and proteins are absorbed in the small intestine.

ABSORPTION OF CARBOHYDRATES, FATS AND PROTEINS TAKES PLACE  
AFTER THEY ARE HYDROLYZED INTO THEIR SMALLEST UNITS :  
GLUCOSE, FATTY ACIDS, AND AMINO ACIDS, RESPECTIVELY

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## 4.5 UTILISATION OF NUTRIENTS

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After being absorbed in the small intestine, the smaller units of carbohydrates, proteins (amino acids) and fats (fatty acids) are carried to the various parts of the body through the bloodstream. In the body cells, carbohydrates and fats are broken down (burnt) to produce energy in the form of heat. Carbohydrates that are in excess of the body's needs are converted into fat and are stored in the body. Proteins are used for building new cells during periods of growth and for repairing old and worn out ones when growth is complete. The smaller units of proteins, left over after completing this function are converted to body fat. However, if the calories produced by the fats and carbohydrates are not adequate for the body, proteins are also converted to energy.



### Check Your Progress

- 1 How do enzymes assist in digestion?

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- 2 Using the information you have been given in this section, explain how the following foods will be digested: bread and butter, rice and fish, an apple, coffee with milk and sugar; chapati and palak bhaji, tomato soup, chicken, dal and cucumber raita.

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## 4.6 LET US SUM UP

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Digestion of food starts in the mouth and is carried out mainly in the stomach and intestines. Food is moistened by saliva and broken up into small particles by chewing. Starch digestion begins in the mouth. Food is taken to the stomach when it is swallowed. In the stomach water is added and proteins are acted upon by proteolytic enzymes and acid.

In the intestines, amylases from the pancreatic gland digest starch and other carbohydrates, proteases act upon and hydrolyse proteins and fat is hydrolysed by lipases. All three are broken up into simple basic units and then absorbed. By the time the food reaches the large intestine, only water, fibre and some dissolved salts remain. Here, water and mineral salts are reabsorbed into the blood, leaving behind a semi-solid waste that is excreted.

After absorption from the small intestine, the nutrients are carried to body cells through the bloodstream. Here they are utilized for production of energy and for the formation of body cells, bones, blood, etc.

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## 4.7 GLOSSARY

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**Esophagus:** Food pipe (gullet)

**Hydrolysis:** A chemical reaction in which a substance is split into two products after it reacts with water.

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## 4.8 ANSWERS TO CHECK YOUR PROGRESS

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- 1 Enzymes present in the digestive tract break down, or digest carbohydrates, proteins and fats into smaller units so that these can be absorbed into the bloodstream.
- 2 Digestion of bread, rice and chapati which are carbohydrate rich foods will start in the stomach where the protein content of these foods will be broken down by the enzyme pepsin. In the small intestine, the carbohydrate or starch of these foods and sugar will be broken down into the smallest unit glucose by the enzymes called amylases. In the small intestine the proteins in the fish will also be hydrolyzed and broken down into amino acids and the fats from butter and milk will be emulsified and broken down into fatty acids. The minerals and vitamins from apple, palak, tomato and cucumber will be absorbed in the small intestine and large intestine and the fibre from these will be added to the undigested food and pass out through the anus.