

# 7 *Digestion*

## Answers

### The chemical breakdown of food

(PB page 105)

- 1 a)** glucose  
**b)** amino acids (information from page 93 of the Pupil's Book)
- 2 They break down large molecules of food into smaller molecules that can pass into the body and supply the cells with nutrients.

### Early ideas about digestion

(PB page 106)

- 1 by the drawings of an artist
- 2 very life-like, because the bodies were set in life-like poses
- 3 Descartes's work in mathematics and astronomy led him to believe that things moved like machines. When he saw drawings of Vesalius's work he also believed this to be true of the body. Borelli extended Descartes's ideas by showing how muscles pull the bones and how the bones act as levers. He developed his machine-like idea to include the stomach.
- 4 The metal casing and gauzes would have been ground up along with the meat.
- 5 Digestion in the stomach is a chemical process.
- 6 No, because the hawk naturally regurgitates undigested food.

### Along the alimentary canal

(PB pages 107 and 108)

- 3 It makes the food easier to swallow and starts carbohydrate digestion.
- 4 waves of muscular contraction in the walls of the alimentary canal that push the food along
- 5 kills many kinds of bacteria and helps pepsin to digest protein

### A hole in the stomach

(PB page 109)

- 1 a)** The stomach only produces digestive juices when food is present.  
**b)** He could predict that the stomach will make juices when food enters it.

- 2 Food stimulates the stomach to produce digestive juices.
- 3 enzymes
- 4 Bread and cabbage are digested more easily than meat and cooked meat is digested more easily than raw meat.
- 5 Bread and parsnips are most easily digested. Fish is more easily digested than potatoes. Food stayed in the stomach for between 1½ and 2 hours.
- 6 Because this is the temperature at which the juice naturally meets the food: having the temperature higher or lower would alter the rate of reaction.
- 7 The answer depends on the pupil's attitude to science and their views on human experimentation. This question can be discussed along with a discussion of animal experimentation on page 96 of the Pupil's Book.

### Along the alimentary canal

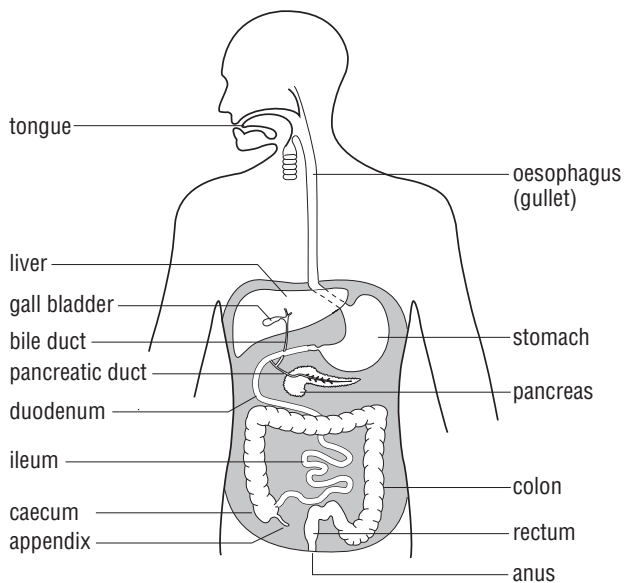
(PB pages 111 and 112)

- 6 Produced in the liver; it breaks fat into small droplets to help fat-digesting enzymes.
- 7 proteins into amino acids, fats into fatty acids and glycerol, carbohydrates into sugar
- 8 through the walls of the small intestine
- 9 Water is removed from it and some dissolved vitamins are absorbed.
- 10 Faeces are removed from the body.
- 11 a)** carbohydrase  
**b)** protease
- 12 lipase
- 13 It is made in the liver and stored in the gall bladder.
- 14 pancreas
- 15 There is a larger surface area of the fat in contact with the enzyme.

### End of chapter questions

(PB page 113)

- 1 Pupils should be given WORKSHEET 7.4 (TRB page 61) for this question.



2 The account should include the following points:

- a) the purpose of the teeth is to break down the food into smaller particles: the cutting action of the incisor teeth; the tearing action of the canine teeth; the grinding action of the molars and premolars
- b) the purpose of saliva: the action of the saliva to lubricate the food particles and make them easier to swallow; the action of salivary amylase in breaking down starch molecules in the bread
- c) the movement of the food to the stomach by the peristaltic action of the muscles in the oesophagus
- d) the action of the hydrochloric acid in the stomach in providing the conditions in which pepsin can work upon the protein molecules in the chicken meat
- e) the general warmth of the body providing the optimum temperature for the enzymes to work
- f) the bile breaking down the butter or margarine in the sandwich into small particles on which lipase from the pancreas can act, leading to the production of fatty acids and glycerol
- g) the action of carbohydrase and protease from the pancreas in the breakdown of the starch in the bread to simple sugars and the protein in the chicken meat to amino acids
- h) the absorption of these small molecules through the wall of the small intestine

- i) the reabsorption of water, secreted by the alimentary canal during the digestion process, in the large intestine
- j) the action of the fibre in the bread which is not digested and forms a solid substance on which the muscles of the gut can push and move the food along the digestive system
- k) the egestion of the undigested food

## End of chapter test

### WORKSHEET 7.5 (TRB page 62)

- 1 They cannot pass through the wall of the small intestine.
- 2 physical breakdown and chemical breakdown of food
- 3 to break down food into small pieces
- 4 to speed up the breakdown of large molecules in food into smaller ones
- 5 Saliva; makes food easier to swallow and contains enzymes which begin starch digestion.
- 6 peristalsis
- 7 the stomach; hydrochloric acid
- 8 bile; liver
- 9 small intestine
- 10 Water and some vitamins are removed from it.

## Activities

### Activity 7.1 Investigating enzyme action

#### *The chemical breakdown of food* (PB page 105)

#### WORKSHEET 7.1 Investigating enzyme action (TRB page 58)

This activity can be used after the work in the Pupil's Book. The investigation is set as a challenge that pupils can work on together in groups. Alternatively a plan may be worked out by a whole class discussion.

#### Preparation

- Class set of worksheet
- Eye protection
- Amylase solution (ensure the powder cannot be inhaled during the preparation of the solution, to prevent an allergic reaction)
- Starch suspension (1%)
- Iodine solution

- Beakers
- White cavity tiles
- Dropping pipettes
- Stop clocks
- Stirrers
- Tissue paper

**Safety**  

- Iodine in solutions stronger than 1 M is harmful by inhalation, skin contact and may be irritating to the eyes.
- Eye protection must be worn when using iodine.
- Personal hygiene: hands must be washed thoroughly after practical work.

**Answers**

- 1 The plan should include a strategy for extracting a sample from the mixture every 30 seconds, putting it onto a drop of iodine and observing the colour. The pupils may suggest stirring the drop to mix the sample and the iodine. Any stirrer used should be wiped with a tissue after use with each drop.
- 2 Starch would be present if the iodine turned black or blue-black.
- 3 The iodine would not change colour.
- 4 The colour would become progressively paler with each sample until it eventually remained unchanged.
- 5 A sample of starch solution should be tested at the same time as the experimental mixture.

**Activity 7.2 Investigating protein digestion**

*A hole in the stomach* (PB page 109)

**WORKSHEET 7.2 Investigating protein digestion** (TRB page 59)

Use this activity after the work on the stomach on page 108 of the Pupil's Book. It may also be used as an extension activity to the work on Beaumont's investigations (PB page 109). The investigation is set as a challenge that pupils can work on together in groups or a plan may be worked out by a whole class discussion.

During the planning stage the issue of what volumes of solutions to use will probably arise. The pupils may suggest more food than enzyme: they should be advised to use 2 cm<sup>3</sup> egg white, 1 cm<sup>3</sup> pepsin and three drops of dilute (0.5 M) hydrochloric acid. The pupils should suggest that

the mixture is kept at body temperature (37°C) in a water bath. The pupils may wish to set up the warm 'stomach' before giving it a 'meal'.

The activity can be extended by asking the pupils to devise a way to investigate the effect of temperature on the digestion process.

**Preparation**

- Class set of worksheet
- Eye protection
- Egg-white suspension
- Pepsin solution (1%)
- Dilute hydrochloric acid (0.5 M)
- Beakers to make water baths
- Test-tubes
- Access to a warm water tap
- Thermometers
- Dropping pipettes
- Measuring cylinders
- Stop clocks

**Safety**  

- Make sure eye protection is worn when acid and enzyme solutions are being used.
- Personal hygiene: hands must be washed thoroughly after practical work.

**Answers**

- 1 The plan should feature the following points. 2 cm<sup>3</sup> of egg-white suspension should be put into a test-tube. 1 cm<sup>3</sup> of pepsin and three drops of dilute hydrochloric acid should be added. The mixture should be put into a water bath at 37°C. The pepsin may be warmed to 37°C before it is mixed and the food warmed a little (below 37°C) to simulate cooked food being eaten. The time at which the substances are mixed should be noted. The mixture should be checked every minute for signs of it becoming less cloudy and the time noted when the mixture is clear.

The experiment can be repeated with the water bath set at warmer and cooler temperatures to measure the effect of temperature change on the speed of reaction. The experiment should be repeated three times at each temperature (including 37°C) to produce more reliable results.

- 2 Digestion is complete when the mixture has turned clear.