

CLIL MultiKey lesson plan

LESSON PLAN

Subject: Biology

Topic: Digestion

Age of students: 16-18

Language level: B1/B2

Time: 45/60 min

Lesson 1: Human digestive system

Content aims:

After completing the lesson, the student will be able to:

List internal organs that take part in digestion.

Explain functions of internal organs that take part in digestion.

Illustrate the way digestive system works.

Conclude how we can improve the workout of the intestine.



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Language aims:

After completing the lesson, the student will be able to:

Use new vocabulary within the topics.

Describe the processes of digestion using new terms.

Analyze the main ideas and details in texts related to the topic 'Digestion'.

Vocabulary: abdomen, alimentary canal, digest, digestion, digestive, ingestion, egestion, saliva, mouth cavity, crush, grind, break down, chew, chyme, bolus, gullet(oesophagus), stomach, acid(ic), bile, peristalsis, intestine, mucus, villus/villi, colon, anus, faeces, water-soluble, fat-soluble

Necessary resources: diagrams, texts, worksheets, internet resources .

Learning methods: work with texts, demonstration, visualisation, talk, brainstorm.

Procedure steps:

The teacher announces the topic "**Digestion. Human digestive system**"

1.**Introducing necessary vocabulary.** The teacher discusses and writes on the board all words that could be derived from the word „digest”(DIGESTIVE,DIGESTION.INDIGESTION)

2.**Brainstorm activity** in pairs: which internal organs take part in digestion?(mouth,teeth, gullet,stomach,small and large intestine, liver,pancreas.)



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3.Students are offered **a worksheet** (handout 1) and fill in the missing words(organs of the digestive system). Then students read out their answers.

4.Students **watch a short video** (3:48) on digestive system."Digestive system for kids".

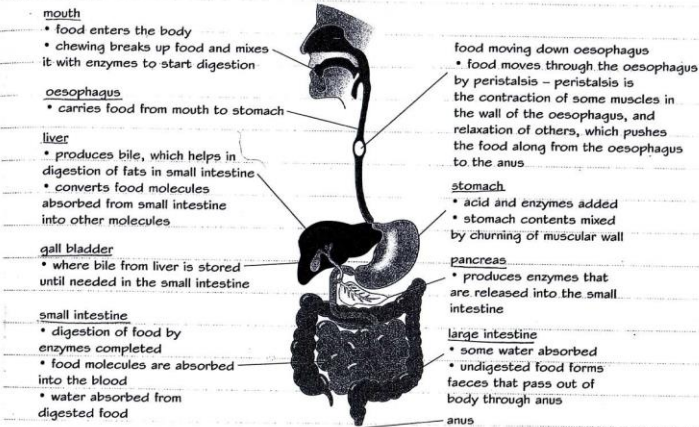
<https://www.youtube.com/watch?v=bFcZvJp0bpU>

5.**After watching activities**-students fill in the table.(handout 2)



The digestive system

There are many organs in the digestive system. These organs work together to digest food and allow food molecules to be absorbed into the body.



complete this table. The first row has been done for you.

Part of alimentary canal	Juices secreted	What the juices contain	What is digested	Any other points
Mouth	Saliva	Water, mucus, amylase	Starch is digested to maltose by amylase	Teeth grind food into smaller pieces, increasing the surface area for enzymes to act on
Stomach				
Small intestine				
Large intestine: Colon Rectum				

Handout 2. ↑

Key for the table: ↑

Stomach-gastric juice/HCL-hydrochloric acid and protease,pepsi/food(protein molecules are broken down into smaller chains)turns into liquid/bacteria are killed by acid;

Small intestine-bile and pancreatic juice/bile contains salt,pancreatic juice contains sodium hydrogencarbonate and enzymes/starch is broken down to maltose, proteins –into polypeptides, fats-to fatty acids and glycerol/acid is neutralised by sodium hydrogencarbonate, villi absorb the digested food

Large intestine-water is left/water,salts, mucus and rubbed off cells/water and salts pass into blood/undigested fibre exits the alimentary canal.

6. Reflection/speculations on topic:

Teacher asks questions:

- what is the role of teeth?(They break down food physically, grind food)
- how can we improve the workout of the intestine?(We can eat more products containing roughage/fibre).
- why do we need villi in the intestine?(They enlarge the surface of the absorption).

*Source: Keith Kelly,Science.Macmillan,2008.



Lesson 2 : The digestive system.

Content aims:

After completing the lesson, the student will be able to:

Illustrate the way digestive system works.

Evaluate presentation about the digestive system.

Explain the role of the teeth in digestion.

Language aims:

After completing the lesson, the student will be able to:

Use new vocabulary within the topics.

Describe the processes of digestion using new terms.

Analyze the main ideas and details in texts related to the topic 'Digestion'.

Vocabulary: abdomen, absorb, absorption, alimentary canal, digest, digestion, digestive, ingestion, egestion, saliva, mouth cavity, crush, grind, break down, chew, chyme, bolus, gullet(oesophagus), stomach, acid(ic), bile, peristalsis, intestine, mucus, villus/villi, colon, anus, faeces, water-soluble, fat-soluble



1.Students watch and listen to their peer's presentation about the digestive system.(15min)

2.Students are asked questions by the presenter.

3.Students ask questions to the presenter.

4.Students evaluate the presentation.

5.Teacher's evaluation and coments.



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Attachment *:

Presentation evaluation

Variant A

	Criteria	5 excellent	4 good	3 satisfactory	2 Almost satisfactory	1 unsatisfactory	Score
CONTENT LANGUAGE	concepts / principles	acquired <i>all</i> basic concepts and principles of the topic	acquired <i>most</i> of the concepts and principles of the topic	acquired <i>some</i> basic concepts and principles of the topic	acquired <i>only a few</i> concepts and principles of the topic	it acquired <i>none</i> of the concepts and principles of the topic	
	Explanation Evaluation	structured, clear and comprehensive explanation; good personal evaluation	really well structured, clear and <i>adequate</i> explanation; good personal evaluation	clear explanation, with a <i>small number of errors</i> ; good personal evaluation	explanation shows <i>deficiencies</i> in terms of logical structuring and explanation	explanation is <i>severely deficient</i> in terms of logical structuring and formulation; poor personal evaluation	
	Accuracy	excellent grammatical control and appropriate use of vocabulary	<i>good</i> grammatical control and generally appropriate use of vocabulary	<i>few</i> mistakes in grammar and vocabulary use do not lead to misunderstanding	noticeably makes mistakes in grammar and vocabulary use but the message is generally clear	systematic grammar mistakes and the narrow range of vocabulary makes the message meaningless	
	Fluency & Interaction	express him/herself with a high level of fluency and ease	express him/her self and interact with a <i>good</i> degree of fluency	express him/her self and interact with a <i>reasonable</i> degree of fluency	manage the discourse and the interaction <i>with</i> some help and must be helped	communication is totally dependent on repetition, clarification and repair	

Variant B

Presentation quality (8points):

Content(glossary,number of slides,sources)2p

Design 2p

Language 2p

Feedback (tasks or questions to the audience) 2p

Presentation skills (8 points)

Language(accuracy) 2p

Posture and Gestures 2p

Contact with the audience 2p

Knowledge of the topic 2p

Questions (4 points) (the audience asks the presenter questions))

Language(accuracy) 2p

Response (ability to answer listeners' questions) 2p

Assessment scale (In Latvia – highest mark- 10)



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1	2	3	4	5	6	7	8	9	10
2	4	6	9	12	13	15	17	19	20

6. The teacher offers students to do tasks on worksheets.(Worksheet 1, By teacher's choice)

7.The teacher and students compare answers.

8.The students are offered tasks (1.,2.,3. By teacher's choice. Task 3 is extremely optional as it is too much in detail about our teeth and demands the introduction of the new vocabulary. Option: it can be given to someone who is going to study dentistry).

Attachments

1. Worksheet for the topic "Digestive system"

(*Source: Keith Kelly,Science.Macmillan,2008.)

2.Handout 2.Tasks 1.,2.,3.)

(*Source: Keith Kelly,Science.Macmillan,2008.)

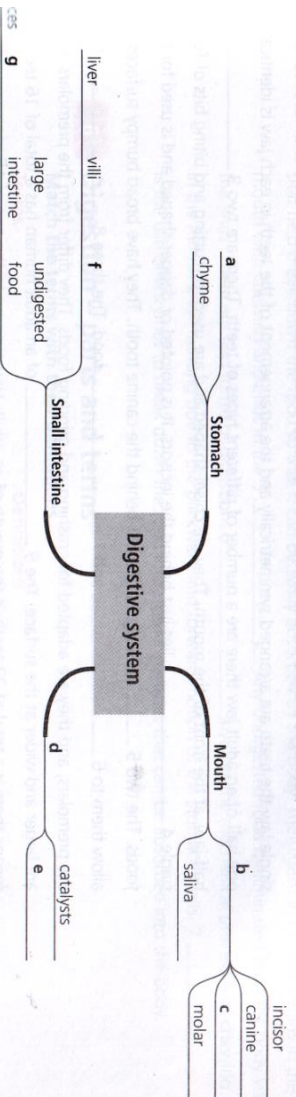


A Working with words

1 Digestion word map

Write these words in the correct places on the word map.

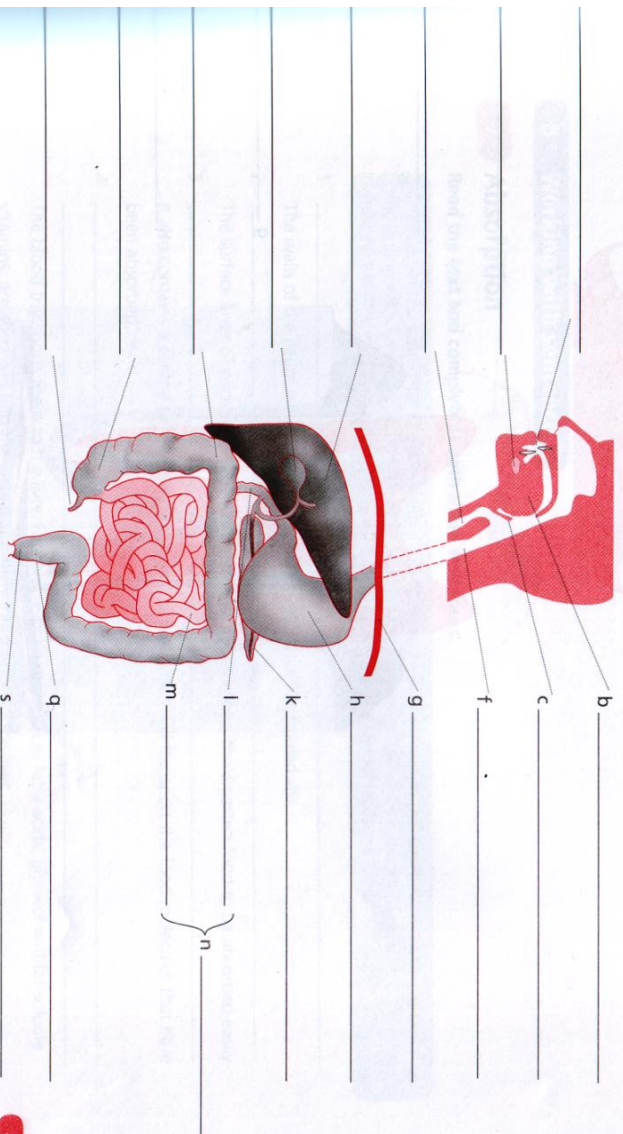
anus digested food enzymes gastric juices inhibitors premolar teeth



2 The human digestive system

Look at the diagram of the digestive system and write the labels in the correct places.

anus appendix caecum diaphragm duodenum
 epiglottis closes entrance to trachea when food is being swallowed
 gall bladder stores bile ileum large intestine removes water from undigested food
 liver produces bile oesophagus pancreas rectum salivary gland produces saliva
 small intestine digests and absorbs food stomach mixes food with gastric juice
 teeth cut and grind food tongue mixes food with saliva trachea (breathing tube into lungs)



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Tasks for vocabulary revision and sentence structure.(Can be used in tests as well)

1.Match the terms with their definitions(Can be cut and read out by students)

1	digestion	A	enzymes are also described with this term
2	the epiglottis	B	these are finger like projections which increase the surface area of the ileum to increase the rate of absorption of digested foods
3	the ileum and the duodenum	C	these are the four types of teeth humans have the duodenum
4	the ileum	D	these are the organs which are part of the small intestine
5	the villi	E	this is the instrument which prevents swallowed food from entering the windpipe
6	defecation	F	this is the job of inhibitors
7	defecation	G	this is the name of the hard white coating on the teeth.
8	incisors, canines, premolars,	H	this is the only living portion of the tooth with nerves



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	molars		
9	the pulp	I	this is where the absorption of digested food takes place
10	biological catalysts	K	this is the process by which faeces are eliminated from the body
11	to slow down biological processes	L	this is the process by which food is broken down to smaller molecules, which the body can easily absorb.

2.

The human digestive system

Read the text and fill in the missing words.

The digestive system is mainly a long tube that runs from the 1 _____ to the 2 _____. This tube is called the 3 _____, or alimentary canal. The alimentary canal is associated with the organs of the liver, gall bladder and pancreas. These organs assist digestion by secreting 4 _____ that help break down the food so that it can be easily absorbed by the body. The digestion of food begins in the mouth with chewing and ends in the 5 _____. Any undigested food is eliminated from the body via the anus. There are two forms of digestion. 6 _____ involves the mechanical processes of chewing in the mouth and churning due to the backward and forward motion of the stomach walls. 7 _____ is the use of enzymes to break down the food into smaller particles that can be absorbed into the body.



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Keys

1. Matching

1	2	3	4	5	6	7	8	9	10	11
K	E	D	I	B	J	C	G	H	A	F

2. Open close

1	2	3	4	5	6	7
mouth	anus	gut	enzymes	small intestine	physical	chemical



3 The role of the teeth in digestion

Fill in the gaps with these words.

canine crush digestion grind human incisors jaw molars premolars wisdom

There are four different types of teeth found in the 1 _____ mouth, set in an upper jaw and a lower jaw. Each type plays a particular role in the physical 2 _____ of large chunks of food. In a single jaw the teeth are arranged symmetrically and the arrangement of the teeth in each jaw is identical. In one half of an adult jaw there are a number of different types of teeth. There are two 3 _____ in a half-jaw, at the front of the mouth. They are chisel-shaped and are used for cutting and biting bits of food. The single 4 _____ lies just behind the incisors. It is pointed or dagger-shaped and is used for tearing foods. The two 5 _____ lie just behind the canine tooth. They have broad bumpy surfaces, which allow them to 6 _____ and 7 _____ food. The three 8 _____ lie behind the premolars, and they are adapted for crushing and grinding foods. They differ from the premolars in that they are larger and wider at the surface. The 9 _____ of an adult human has a total of 16 teeth, which means there is a total of 32 teeth in the mouth of an adult. However, up to the age of 16 years you might not have your last set of molars in each jaw. These molars are usually called 10 _____ teeth and usually appear some time after your 17th birthday.

Keys for Working with words A

1.

a	b	c	d	e	f	g
gastric juices	teeth	Premolar (priekšdzeroklis)	enzymes	Inhibitors(enziīmi,kaspalēninabioloģiskosprocesus)	digested food	anus

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2. a teeth cut and grind food **b** tongue mixes food with saliva(siekalas) **c** epiglottis closes entrance to trachea when food is being swallowed **d** salivary glands produce saliva **e** trachea(breathing tube into lungs) **f** oesophagus(barībasvads) **g** diaphragm **h** stomach mixes food with gastric juice **l** liver produces bile(žults) **j** gall bladder(žultspūslis) stores bile **k** pancreas(aizkuņģadziedzeris) **l** duodenum(divpadsmitpirkstu zarna) **m** ileum(tievāzarnu trakta nobeigums) **n** small intestine(tievās zarnas) digests and absorbs food **o** large intestine(resnās zarnas) removes water from undigested food **p** caecum(aklā zarna) **q** rectum(taisnā zarna) **r** appendix anus.

Key

3.Insertion

1	2	3	4	5	6	7	8	9	10
human	digestion	incisors	canine	premolars	crush	grind	molars	jaw	wisdom



Lesson 3.The digestive system.(Cont.)

Content aims

After completing the lesson, the student will be able to:

List internal organs that take part in digestion.

Explain functions of internal organs that take part in digestion.

Language aims

After completing the lesson, the student will be able to:

Use new vocabulary within the topics.

Describe the processes of digestion using new terms.

Analyze the main ideas and details in texts related to the topic 'Digestion'.

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Vocabulary: abdomen, absorb, absorption, alimentary canal, digest, digestion, digestive, ingestion, egestion, saliva, mouth cavity, crush, grind, break down, chew, chyme, bolus, gullet(oesophagus), stomach, acid(ic), bile, peristalsis, intestine, mucus, villus/villi, colon, anus, faeces, water-soluble, fat-soluble, swallow.

Procedure:

1.The teacher offers a text with gaps.(Handout 1, task 2) **Students** do the task, after read out loudly.

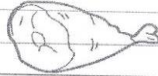



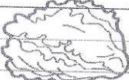



BIOLOGY

The digestive system.

one stop clil

1 Write.

Proteins help you grow	Vitamins keep you healthy	Carbohydrates give you energy
		
		

2 Complete the text with the words in the box.

The digestive system converts food into nutrients. Our body absorbs these nutrients. Proteins, vitamins and carbohydrates are nutrients. The digestive system also excretes waste.

The digestive process starts in the mouth. The (1) _____ chew the food. The food mixes with saliva. Enzymes in the saliva help break down the food.

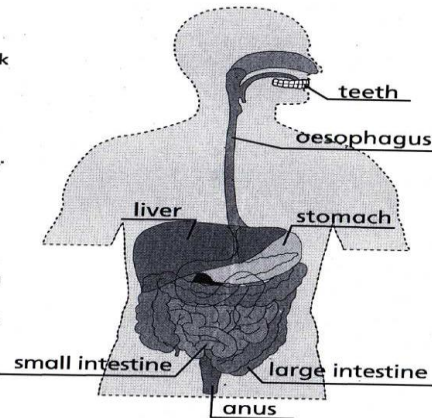
We swallow the food and it enters the (2) _____. This is a long tube that goes from the mouth to the (3) _____. The stomach breaks down the food and mixes it with a very strong acid.

The food leaves the stomach and enters the (4) _____ intestine. Here bile and enzymes break down the food so that the body can absorb it. The liver produces the bile and the pancreas produces the enzymes. The small intestine is where most of the digestive process takes place.

The food leaves the small intestine and goes into the (5) _____ intestine.

Finally, solid waste leaves the body through the anus.

large oesophagus teeth
stomach small



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2.Listening activity. Teacher hands out the sets of cut cards with vocabulary to pairs of deskmates(Handout 2).

Science materials

chewing and saliva	turn the food into a paste
swallowing	stomach
acids break it down	small intestine
digestion continues	useful substances
absorbed into the blood	peristalsis
circular muscles	squeezing action
large intestine	rids itself of waste

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Handout 2 ↑



Science materials

distancing

The digestive system

Orientation

What do you know about the digestive system?

Vocabulary

Check you know what the words on the cards mean and how to pronounce them.

Pronunciation

digestion /daɪ'dʒestʃən/
saliva /sə'lɑ:və/
intestine /ɪn'testɪn/
muscle /mɜ:sl/
peristalsis /perɪ'stælɪsɪs/
blood /blʌd/
stomach /'stʌmək/
paste /peɪst/
chewing /tʃu:'wɪŋ/
squeezing /skwi:zɪŋ/
acids /'æsɪdz/

Procedure

- 1 Put the word and phrases into what you think is the correct order.
- 2 Listen to the text and check they are in the correct order.
- 3 Practise telling your partner about the digestive system using the words and phrases.
- 4 Work with your partner to reconstruct the text and produce a written version. Be ready to go public.
- 5 Compare your written version with the original text.

Original text Oxford Student's Dictionary (OUP)

When you eat something your chewing and saliva turn the food into a paste. Swallowing sends it to the stomach where acids break it down. Food then passes into the small intestine where digestion continues and useful substances are absorbed into the blood. In a process called peristalsis the circular muscles in the intestine force the food along with a squeezing action. Finally, undigested food passes into the large intestine and your body rids itself of the waste.

Students read what is written on cards. Teacher reads the „story” and students have to put the cards in the correct order while listening. (Handout 3)

Handout 3. [↑](#)

3. Revision quiz. The teacher offers 10 questions to answer . (Handout 4- or to write on interactive whiteboard).

DIGESTION QUESTIONS:

- 1) What is alimentary canal?
- 2) Which is its longest section?
- 3) How long does food travel through alimentary canal?
- 4) What does it depend on?
- 5) What is absorption?
- 6) What modes of digestion do you know?
- 7) What is ingestion/egestion?
- 8) What are the functions of mucus?



9)What is the role of bile?

10)What is villi? Why do we need them?

To find answers to the questions they still cannot, students have to read the text. (Handout 5).(Clean variant-for students, underlined-for teachers).(Text on pages 62-63 about teeth has been omitted).

Digestion and Absorption

The food we eat travels through a single long tube, running all the way from the mouth to the anus. This tube is the alimentary canal. To get to body cells, food molecules must pass through the walls of this canal, and into the blood. Only small molecules can do this, so large molecules in the food are broken down to small ones in the process called digestion. This process is carried out by enzymes.

The alimentary canal

The organs of the alimentary canal

Figure 5.1 shows the human alimentary canal. This is a long tube, wide in some parts and narrow in others, which leads all the way from the mouth to the anus. The tube is about 7m long – it can fit inside a person because parts of it are coiled round and round. In fact, the alimentary canal varies in length, because some parts of it, especially the small intestine, have muscles in the wall which make the tube wriggle around as food passes through.

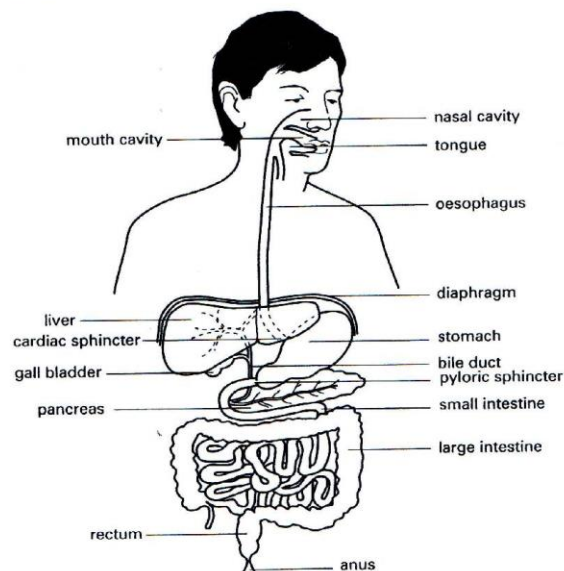


Figure 5.1 ■
The human digestive system.



Figure 5.2 This X-ray shows the large intestine. Towards the centre left of the picture, you can see a small thread-like structure, which is the appendix. Leading upwards from here, on the left, is the first part of the colon, which then runs across the top, and down the right-hand side, with a few twists and turns on the way. The rectum can be seen at the bottom of the photograph. The vertebral column is faintly visible in the background.

On Figure 5.1, follow the path the food takes. It enters the **mouth**, and then travels through the **oesophagus**. This takes it past a 'gateway' called the **cardiac sphincter** and into the **stomach**. It may stay here for a while, before passing out through another gateway, the **pyloric sphincter**, into the **small intestine**. This is called 'small' because it is quite narrow, but is actually much the longest section of the alimentary canal. The food travels round and round the coils of the small intestine, and enters the **large intestine**, which goes up, across and down. The remains of the food eventually leave the alimentary canal through the **anus**.

The length of time that this journey takes varies from person to person, and from day to day. On average, it takes about 10 hours for the food to reach the large intestine. It may then quite quickly pass from here through the anus, or it may wait in the large intestine for more than a day. The speed with which it passes through partly depends on the amount of fibre in the food.

The remains of food which eventually pass out of the anus are rather different from the food that goes into the mouth! What happens to it in between, and why?

Breaking down the food

The alimentary canal, as you have seen, is a tube passing right through the body. The food inside it is separated from the rest of the body by the walls of the alimentary canal. Before the food can get into the blood, or into any of the body cells, it must pass through these walls. This is called **absorption**.

The walls are made of living cells. These cells will only allow small molecules to pass through them. Big molecules, such as proteins or polysaccharides (starch, for example) cannot get through.

This means that the big molecules in the food we eat have to be broken down to small ones before they can be absorbed. First, large lumps of food are broken down into smaller pieces. This is called **mechanical digestion**, and is done by teeth, and muscles in the stomach wall. Then the big molecules in the pieces of food are broken into smaller ones. **Enzymes** do this. This process is called **chemical digestion**.

Mechanical digestion

Teeth

Figure 5.3 (overleaf) shows the four kinds of human teeth. At the front of the mouth are the **incisors**. These help to bite off pieces of food to take into the mouth. On either side of them are canines, which are more pointed than incisors. Human use their canines rather like incisors, but in some animals they are long and pointed, and are used for killing prey. ('Canine' means 'dog tooth'.) Behind these are the

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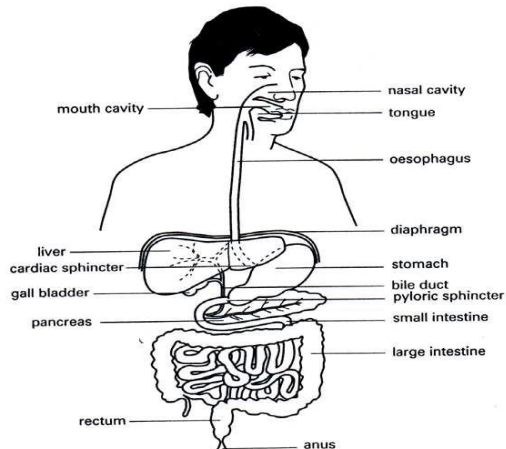


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Teeth

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- **Carbohydrases** digest carbohydrates. **Amylase** is a starch-digesting enzyme, which breaks starch molecules into the two-unit molecules of **maltose**. Maltose is then broken down to **glucose** by the enzyme **maltase**.

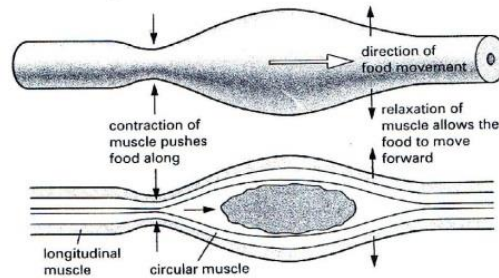
- **Proteases** digest proteins. First, the protein molecules are broken into shorter lengths, called **polypeptides**. The polypeptides are then broken down into their individual **amino acids**.

- **Lipases** digest fats. The fat molecules are broken down into **fatty acids** and **glycerol**.

In all of these reactions, water is added to the large molecules as they are broken into the smaller ones. The reactions are therefore called **hydrolysis reactions**. 'Hydro' means 'water', and 'lysis' means 'breaking apart'.

As the food passes along the alimentary canal, these enzymes are mixed with it. Different enzymes work in different parts of the alimentary canal. Muscles in the walls of the alimentary canal help to churn the food and enzymes inside it around, so that they get well mixed up. We shall follow the path taken by the food, and look at what happens to it in each part of the alimentary canal. The food is moved along the alimentary canal by **peristalsis** as shown in Figure 5.7.

Figure 5.7 ■ Food is pushed through the alimentary canal by a process called **peristalsis**. Circular muscles in the wall of the alimentary canal contract behind the food, squeezing in on it and pushing it forward. The circular muscles just ahead of the food relax, making it easy for the alimentary canal to be pushed wider as the food passes through.



The mouth

The correct biological name for taking food into the mouth is **ingestion** – not to be confused with **indigestion**! We ingest food using the teeth, lips and tongue.

Inside the mouth, **saliva** is mixed with the food. Saliva is a watery liquid made in the salivary glands. It contains the carbohydrase enzyme **amylase**. The amylase begins to break starch in the food into **maltose**. If you chew for a long time on a piece of bread, you can begin to taste the sweet maltose produced from the starch in the bread. Saliva also contains the slippery substance **mucus**. In fact, mucus is made along the whole length of the alimentary canal; its function is to help the food to slide along easily.

While the food is in the mouth, teeth chew the food. Chewing breaks the food down into smaller pieces (but not into smaller *molecules* – this has to be done by enzymes), increasing its surface area and so making it easier for enzymes to get at every bit of it.

The chewed food, mixed with saliva, is then swallowed. It goes into the oesophagus, which passes it swiftly into the stomach.

The stomach

People sometimes use the word 'stomach' to mean the lower part of the body, between the ribs and the hip bones. The proper name for this part of the body is the **abdomen**. The stomach is really a widened out part of the digestive system. It lies just below the ribs, on the left-hand side of the body.

The stomach has a volume of up to 5 litres. It isn't always as big as this – it has muscles and elastic tissue in its walls which allow it to change its size and shape.

At each end of the stomach, there are rings of muscle around the tubes that enter and leave it, shown in Figure 5.8. These are called **sphincter muscles**. When they contract, they close off the tube. When you swallow food, the **cardiac sphincter** muscle relaxes, allowing the food into the stomach, and then contracts. If the **pyloric sphincter** also contracts, then the food is trapped in the stomach. It is often held in the stomach for several hours. While it is there, a fluid is secreted by the cells in the stomach lining. The fluid is called **gastric juice** (which means 'stomach juice'), and contains **hydrochloric acid** and a **protease**.

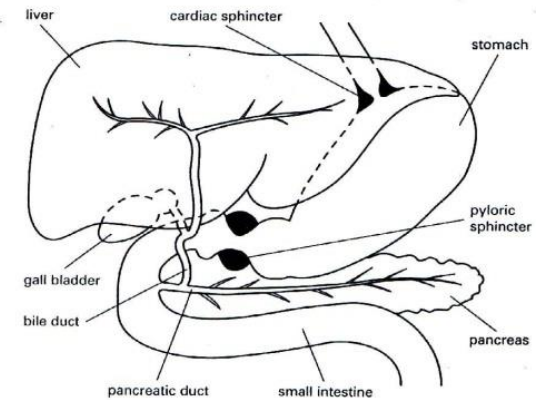


Figure 5.8 ■ A more detailed view of the stomach, liver and pancreas.

CLIL MultiKey lesson plan

✓

- **Carbohydrases** digest carbohydrates. **Amylase** is a starch-digesting enzyme, which breaks starch molecules into the two-unit molecules of **maltose**. Maltose is then broken down to **glucose** by the enzyme **maltase**.

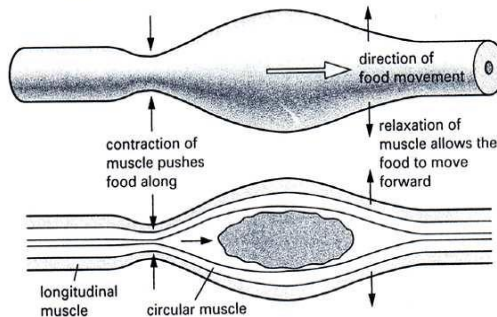
- **Proteases** digest proteins. First, the protein molecules are broken into shorter lengths, called **polypeptides**. The polypeptides are then broken down into their individual **amino acids**.

- **Lipases** digest fats. The fat molecules are broken down into **fatty acids** and **glycerol**.

In all of these reactions, water is added the large molecules as they are broken into the smaller ones. The reactions are therefore called **hydrolysis reactions**. 'Hydro' means 'water', and 'lysis' means 'breaking apart'.

As the food passes along the alimentary canal, these enzymes are mixed with it. Different enzymes work in different parts of the alimentary canal. Muscles in the walls of the alimentary canal help to churn the food and enzymes inside it around, so that they get well mixed up. We shall follow the path taken by the food, and look at what happens to it in each part of the alimentary canal. The food is moved along the alimentary canal by **peristalsis** as shown in Figure 5.7.

Figure 5.7 ■
Food is pushed through the alimentary canal by a process called **peristalsis**. Circular muscles in the wall of the alimentary canal contract behind the food, squeezing in on it and pushing it forward. The circular muscles just ahead of the food relax, making it easy for the alimentary canal to be pushed wider as the food passes through.



The mouth

The correct biological name for taking food into the mouth is **ingestion** – not to be confused with indigestion! We ingest food using the teeth, lips and tongue.

Inside the mouth, **saliva** is mixed with the food. Saliva is a watery liquid made in the salivary glands. It contains the carbohydrase enzyme **amylase**. The amylase begins to break starch in the food into **maltose**. If you chew for a long time on a piece of bread, you can begin to taste the sweet maltose produced from the starch in the bread. **Saliva** also contains the slippery substance **mucus**. In fact, mucus is made along the whole length of the alimentary canal; its function is to help the food to slide along easily.

grind

While the food is in the mouth, teeth chew the food. Chewing breaks the food down into smaller pieces (but not into smaller *molecules* – this has to be done by enzymes), increasing its surface area and so making it easier for enzymes to get at every bit of it.

The chewed food, mixed with saliva, is then swallowed. It goes into the oesophagus, which passes it swiftly into the stomach.

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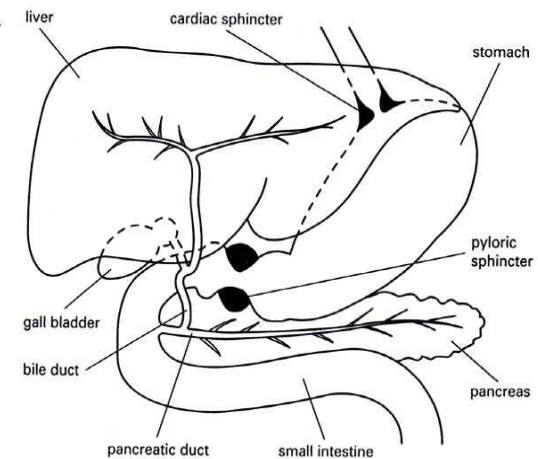


Figure 5.8 ■
A more detailed view of the stomach, liver and pancreas.

Hydrochloric acid is a strong acid, and can damage living cells very badly. So can pepsin – cells contain a lot of protein, and pepsin could digest this protein and kill the cells. To protect the cells lining the stomach from these two dangerous substances, there is a thick layer of mucus covering the whole of the inner surface of the stomach wall. Nevertheless, sometimes so much acid is secreted that it begins to eat through this wall. It leaves a raw, sore patch called an **ulcer**.

The purpose of having hydrochloric acid in the stomach is to kill bacteria in the food. All food, however clean, contains bacteria. Some of these might be harmful, and the acid in the stomach helps to destroy them.

Pepsin begins to break down protein molecules into smaller chains called polypeptides. Unlike most enzymes, it works best at a very low pH – it has to, because of the hydrochloric acid.

While the food is in the stomach, the muscles in the stomach walls contract and relax rhythmically, churning the food around and mixing it up with the hydrochloric acid and pepsin. After an hour or so, the food is almost liquid.

Question

5.2 Suggest reasons for each of the following:

a People who do not make much gastric juice are more likely to suffer from food poisoning than other people.

b It is known that excitement or anger increases the amount of gastric juices secreted. People with stressful lives are more likely to suffer from stomach ulcers than other people.

The small intestine

The food leaving the stomach enters the **small intestine**. Here, juices from two glands are poured onto it. These glands are the **liver** and the **pancreas**.

Bile is the juice from the liver. The liver makes bile all the time, and it is stored in the **gall bladder** until needed. When food from the stomach enters the small intestine, bile is squirted along the **bile duct** (Figure 5.9) and mixes with the food.

Bile is a watery, greenish liquid. It helps with digestion of fats. Fats are difficult to digest, because they are not soluble in water. This makes it difficult for lipase (the fat-digesting enzyme) to get at them. Bile contains **salts**, which help to form the fat into tiny droplets that can float in liquid. This is

called **emulsification**, and it makes it easier for the fat to be digested, and to be absorbed.

Pancreatic juice is the juice from the pancreas. It flows along the **pancreatic duct** into the small intestine. Pancreatic juice contains **sodium hydrogencarbonate**, and also several enzymes.

Sodium hydrogencarbonate helps to neutralise the acidic food that has entered the small intestine from the stomach. This is important because the enzymes that digest food in the small intestine will not work in acidic conditions. It also helps to stop the acid from the stomach damaging the walls of the small intestine.

The enzymes in pancreatic juice include all three kinds of digestive enzymes – **carbohydrase**, **protease** and **lipase**. The carbohydrase is **amylase**, which, just like the amylase in saliva, breaks down starch to maltose. The protease is called **trypsin**, and breaks down proteins to polypeptides. **Lipase** breaks down fats to fatty acids and glycerol.

Absorption

Absorption in the small intestine

Figure 5.9 shows part of the wall of the small intestine. It is covered with very small, wriggling, finger-like projections called **villi**. Each villus is about 1 mm long.

The cells on the surface of the villi have two jobs to do. First, they produce enzymes which finish the digestion of the food. Any remaining complex sugars, such as maltose, are broken down to simple sugars, such as glucose. Polypeptides are broken down to amino acids.

Second, the villi **absorb** the digested food. Simple sugars, amino acids, fatty acids and glycerol, vitamins and inorganic ions are all absorbed into the villi so that they can pass into the blood and be transported to the cells that need them.

Figure 5.10 (overleaf) shows a section through a villus. Inside it are **blood capillaries** and a **lacteal**. The sugars, amino acids, vitamins and inorganic ions are absorbed into the blood capillaries. The fatty acids and glycerol are absorbed into the lacteal. (You will find out much more about blood capillaries and lacteals in chapter 7.)

The structure of the villi is designed to help this absorption happen quickly and efficiently. Features of the villi which help with this are:

- Their tiny size – this means that the food molecules only have a very small distance to travel from the inside of the intestine to the blood capillaries and lacteals.
- The large number of them – there can be as many as 40 villi on just one square millimetre of the intestine wall. This greatly increases the surface area across which absorption can happen.



Figure 5.9 The inner surface of the small intestine, magnified about 200 times, showing some of the thousands of villi.

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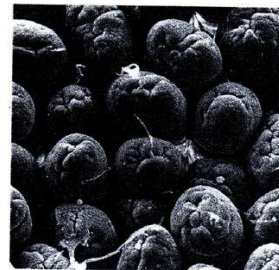


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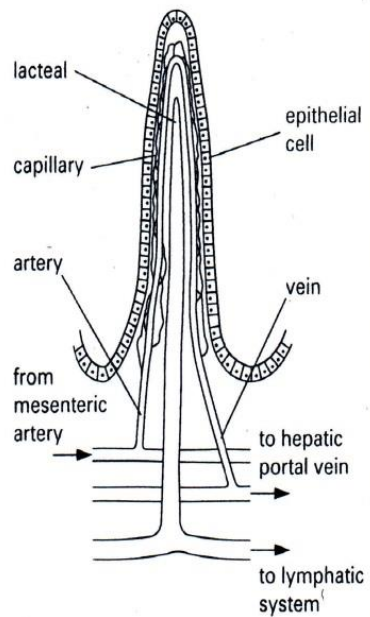


Figure 5.10 A vertical section through a villus.

- Their muscles – villi have muscles inside them, which can make the villi squirm around, so bringing them into contact with much more food inside the intestine than if they kept still.

The large intestine

After the food has been through the small intestine, it passes into the **large intestine**. There may not be very much food left by now, because much of it will have been absorbed into the blood. All that is left is fibre and water.

As the food is moved along the first part of the large intestine, called the **colon**, water and salts pass through its walls and into the blood. What is left – mostly fibre, mixed with mucus and cells that have rubbed off the walls of the alimentary canal as the food passed through it – carries on into the **rectum**. It may stay here for a while, before being passed out through the **anus** as **faeces**. The removal of faeces from the body is called **egestion**.

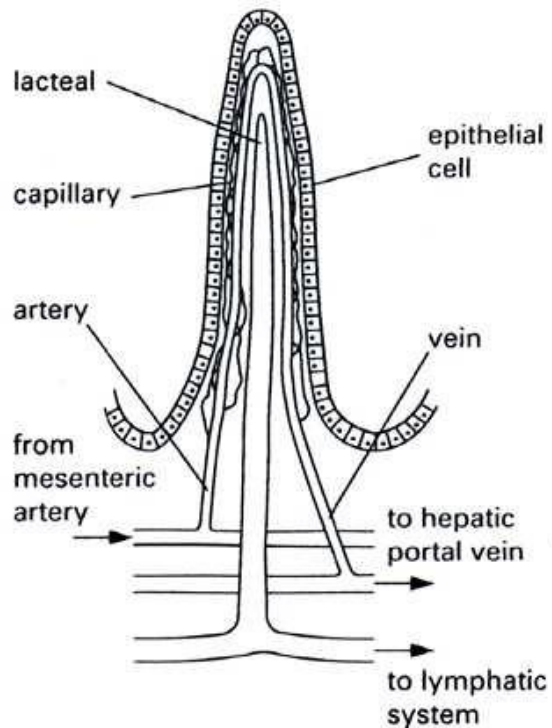


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Key:

1. A long tube which leads from the mouth to the anus.
2. The small intestine.
3. On average -10 hours.
4. On the amount of fibre. Other factors: Health problems, amount of food, water consumed.
5. The passage of food through the walls of the alimentary canal.
6. Mechanical and chemical.
7. Taking food into mouth. The removal of faeces from the body.
8. To help the food to slide along easily.
9. It helps to digest fats.
10. Small finger-like projections covering the walls of intestine.
They increase the surface area of absorption.



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*Optional activity-digestion song. Watch online-

https://www.youtube.com/watch?v=OKWPIM_qluo

