

## 3

# NUTRITION: THE DIGESTIVE AND RESPIRATORY SYSTEMS

The systems involved in the process of nutrition are the digestive, respiratory, circulatory and excretory systems. The unit begins by giving a detailed description of the digestive and respiratory systems. We will identify their components and will link them to the specific processes in which they are involved.

During the first sections of the unit we will cover the digestive processes that take place in the different parts of the digestive system (mouth, stomach and intestine). We will also look at how certain glands participate in the process, how food is transformed into nutrients and how the process of absorption works.

Then, the second part of the unit describes the respiratory system and how gas exchange occurs. This section has lots of diagrams aimed at enhancing the students' understanding of the respiratory system and the process that it is involved in.

The final section describes healthy habits that will help prevent conditions that affect the respiratory and digestive systems; we will also describe some of the most common illnesses that affect them.

## Objectives

### LEARNING OBJECTIVES

- Connect the stages of the process of nutrition to each of the systems involved.
- Recognise the components of the digestive and respiratory systems and understand how they work.
- Explain the main processes of digestion using diagrams and graphic representations.
- Explain how gas exchange occurs in an organism.
- Recognise the main illnesses related to the digestive and respiratory systems and describe habits and healthy lifestyle choices that can help prevent them.

## Mixed-ability needs

In order to meet the needs of students of different abilities, a wide variety of classroom resources are provided as complements or alternatives to the work in the unit: worksheets, lesson summaries and slide presentations with core content and curricular adaptations. Also, since science combines many skills, it is important to pair up students of mixed abilities, so that they can support each other.

The mixed-ability resources are to be used at the teacher's discretion, although each lesson contains suggestions.

## Suggested Timing

This unit can be worked on over a period of four weeks (approximately 12 sessions). The number of sessions should be determined by the interest that students show for the content and by the general unit planning.

Sections	N.º of sessions
Warmer	1
1. Human nutrition	½
2. The digestive system	½
3. Digestion	4
4. The respiratory system	2
5. Healthy habits: illnesses of the digestive and respiratory systems	2
Consolidation	1
Work and experimentation techniques	1
Final task	1

UNIT LESSON PLAN		
Contents	Assessment criteria	Learning outcomes
<b>Human nutrition</b>	1. Explain essential processes that relate to nutrition.	1.1. Identify the systems involved in nutrition. (MCST, LL, LC)
<b>Anatomy of the digestive system</b>	2. Recognise the parts of the digestive system.	2.1. Identify, using graphic representations, the parts of the digestive system. (MCST, LL, LC)
<b>Physiology of the digestive system: digestion</b>	3. Associate the different stages of digestion to each of the organs of the digestive system.	3.1. Relate organs to structures of the digestive system. (MCST, LL, LC, CAE)
	4. Recognise the function of glands during digestion.	4.1. Associate the digestive organs with the specific roles they play in the digestive process. (MCST, LL, LC, CAE, SCC)
<b>Anatomy and physiology of the respiratory system</b>	5. Recognise the parts of the respiratory system and their functions.	5.1. Identify, using graphic representations, the parts of the respiratory system. (MCST, LL, LC, SCC)
	5. Relate the different organs and systems with their functions.	5.2. Associate the structures of the respiratory system with their function. (MCST, LL, LC, SCC)
<b>Healthy habits: illnesses of the digestive and respiratory systems</b>	6. Understand how gas exchange takes place.	7.1. Identify the most common illnesses that are linked to the respiratory and digestive systems. (MCST, LL, LC, SCC)

**LC:** Linguistic communication; **MCST:** Mathematical competence and basic competences in science and technology; **DC:** Digital competence; **LL:** Learning to learn; **SCC:** Social and civic competence; **SIE:** Sense of initiative and entrepreneurship; **CAE:** Cultural awareness and expression.

UNIT CONTENT MAP

STUDENT RESOURCES

Oxford investigation >>>>>>

Interactive activities >>>>>>

Talking book >>>>>>

Video 1: How does digestion work?

**Weblink 1:** The layers of a tooth  
**Weblink 2:** The stomach and its role in digestion  
**Weblink 3:** Pancreas  
**Weblink 4:** Liver  
**Weblink 5:** Small intestine  
**Science experiment:** Simulation of intestinal absorption

**Weblink 6:** Respiratory system: Labelling interactive  
**Video 2:** Gaseous exchange between alveoli and capillaries  
**Animation:** Gas exchange

Unit 3. Nutrition: the digestive and respiratory systems

1. Human nutrition

2. The digestive system

3. Digestion

- 3.1. Digestive process: mouth
- 3.2. The digestive process in the stomach
- 3.3. The digestive process in the small intestine

4. The respiratory system

- 4.1. Respiratory tract
- 4.2. Gas exchange
- 4.3. Pulmonary ventilation

Concept map  
Presentation

Weblink 5 Worksheet

Video 2 Worksheet

TEACHER RESOURCES

Reinforcement worksheets >>>>>>

Curricular adaptation worksheets >>>>>>



Oxford investigation



Interactive activities



Talking book

**Weblink 7:** Nutrition

**Weblink 8:** Antismoking campaign highlights how cigarettes 'Rot the body from the inside'

**Weblink 9:** Fist bumps 'cleaner than handshakes'

**5. Healthy habits: illnesses of the digestive and respiratory systems**

- 5.1. Digestive system: health
- 5.2. Illnesses of the digestive system
- 5.3. Taking care of the respiratory system
- 5.4. Illnesses related to the respiratory system

**Consolidation**

**Work and experimentation techniques**

Starch digestion

**Final task**

Anti-smoking campaign

**Concept map**  
**Presentation**

**Extension worksheet**  
**Competence test**  
**Unit tests**



Reinforcement worksheets



Curricular adaptation worksheets

## TEACHING SUGGESTIONS

## 3 NUTRITION: THE DIGESTIVE AND RESPIRATORY SYSTEMS

**YOU WILL LEARN TO...**

- Connect the stages of the process of nutrition to each one of the systems involved.
- Recognise the components of the digestive and respiratory systems and understand how they work.
- Explain the main processes of digestion using diagrams and graphic representations.
- Explain how gas exchange occurs in an organism.
- Recognise the main illnesses related to the digestive and respiratory systems and describe habits and healthy lifestyle choices that can help prevent them.

**Final task**

**Anti-smoking campaign**

Images are a very powerful way to convey a message and give information, especially to younger generations. In this project you will use the power of images to make younger individuals aware of the consequences of smoking.

In order to do so, you will create a poster that can be used as part of an anti-smoking campaign.



Smoking clogs the arteries and causes strokes.



Protect kids: do not make them breathe tobacco smoke.



Are they manipulating you?  
LET'S PROHIBIT TOBACCO ADVERTISING,  
PROMOTION AND SPONSORSHIP  
WORLD NO TOBACCO DAY 31ST MAY

What are the functions of the systems that are involved in human nutrition?

Do you remember what we call the glands that discharge their secretions in the digestive system?

Digestion and food absorption occur in the digestive system. What is the relationship between them?

Thanks to the respiratory system we can mainstream the oxygen that our cells need. Do you know how it goes from the lungs to the tissues?

Ulcers can affect the digestive system. Do you know of any other digestive system conditions or illnesses and how to prevent them?

Ask students: *Do nutrients contain food? Or does food contain nutrients?* They should remember the difference between food and nutrients as we studied nutrients and nutrition in depth in unit 2. Students discuss their ideas in pairs. Make sure they understand that food contains nutrients and that we need those nutrients to cover energy, functional and structural needs.

Say: *The young people in the picture are eating sandwiches. Discuss with your partner the kind of nutrients found in the foods they are eating. For example, white bread has simple carbohydrates.* Students work in their pairs for a couple of minutes noting down the foods eaten by the young people in the picture as well as the nutrients found in them. Ask: *How does our body obtain the nutrients we need from food? (by digesting the nutrients)*

Ask students to read the objectives in pairs or groups. When they have finished they should discuss the objectives' meaning and explore any prior knowledge they may have. Students should have a good understanding of nutrition, parts of the digestive and respiratory systems. Perhaps they already know some information about how respiratory systems work.

Create a spidergram on the board (or ask groups to draw their own on large pieces of paper) and allow students to contribute concepts and ideas that relate to the unit or the objectives (knowledge about the digestive and respiratory systems). Discuss as a class.

Finally, ask students to draw their own spidergram in their notebooks. This activity can be revisited at the end of the unit, for assessment. Students can add distinct elements to it, using different colours each time different concepts are learned.

Next, students watch the following video in order to inspire them. The video explains how digestive system works. After seeing it, students will begin to understand how complex digestion is as well as the many organs that are involved in the process. Before playing it, ask questions so that the students can think about them while watching it. Students should take notes as they watch.

Before watching the video, students can share their prior knowledge of these questions. Do not worry if they are unsure as the video will stimulate and provide answers to the questions. Discuss students understanding of the video as well as their answers to the five questions presented.

■ *What happens during the digestion?* (During digestion large molecules are broken down into smaller soluble ones that are absorbed by the blood plasma and lymph and transported where the body can use them.)

■ *What are enzymes?* (Enzymes are biological catalysts: they break down food molecules.)

■ *What is the gut?* (The long tube that forms the digestive system is referred to as the gut.)

■ *Are all enzymes the same?* (No, each part of the gut has

different types of enzymes that do different jobs. Amylase, protease and lipase are the names of three different enzymes.)

- *Where are enzymes produced?* (In the pancreas, small intestine, salivary glands and the stomach.)
- *What does bile do?* (Bile is made in the liver and is released into the small intestine to neutralise the stomach acid.)

#### Video 1: HOW DOES DIGESTION WORK?

This video is part of TED-Ed and gives a simple, clear and entertaining explanation about how the digestive process works.

The following questions are designed to continue to spark students' thoughts:

- *What are the functions of the systems that are involved in human nutrition?*

The digestive system converts food so cells can absorb it.

The respiratory system captures oxygen needed by cells for metabolism.

The circulatory system carries nutrients and oxygen to the cells and removes waste substances.

The excretory system releases waste products.

- *Do you remember what we call the glands that discharge their secretions in the digestive system?*

They are the saliva glands, liver and pancreas.

- *Digestion and food absorption occur in the digestive system. What is the relationship between them?*

Digestion involves the transformation of complex molecules into simpler nutrients. In this way nutrients can be transported to the cells and then absorbed: large molecules cannot cross cell membranes.

- *Thanks to the respiratory system we can mainstream the oxygen that our cells need. Do you know how it goes from the lungs to the tissues?*

Oxygen enters the bloodstream through a thin layer surrounding the alveoli. Once in the blood, oxygen is carried by the haemoglobin in red blood cells to the various body tissues that need it.

- *Ulcers can affect the digestive system. Do you know of any digestive system conditions or illnesses and how to prevent them?*

You could mention tooth cavities, ulcers or gastroenteritis.

Tooth cavities can be prevented by maintaining a proper oral hygiene and going to the dentist regularly.

To prevent ulcers avoid very hot or spicy foods that may damage the gastric mucosa, prolonged treatment of certain medicines without stomach protectors and stressful situations.

Gastroenteritis can be prevented by making sure that we handle food hygienically.

#### PRESENTATION

Use the slideshow presentation to show the different sections in the unit and to evaluate students' prior knowledge. The slides can stimulate student participation, as students can be asked about certain topics before they study them. This tool can also be used as revision at the end of the unit.

Point out the **Final Task** to students: **Anti-smoking campaign.** Ask them to read the text briefly, in pairs, to find out the main objectives of the investigation. Students should then explain the task to the class, using full sentences. Write some sentence openers on the board to help them if necessary: *In this investigation we will... We will also have to create...*

Ask: *How does smoking harm our health? Does smoking provide us with any health benefits?*

Discuss students' ideas.

Explain that the steps to carry out the final task are on the *Final Task* page.

At the end of the first session introduce the vocabulary suggested in the section **Study skills** (page 63): *alveoli, asthma, bile, bolus, cardia, duodenum, egestion, epiglottis, larynx, microvilli, nutrition, parotid, pylorus, pleura, chyle, chyme, saliva, ulcers, intestinal villi, pulmonary ventilation, gallbladder.*

As a class, read the definitions of these words, or ask students to define the words themselves using dictionaries or any other available resource. Tell students to scan the unit in order to locate the words in the list above. When they find the word they should put their hands up and explain where in the unit it can be found.

Ask: *Which image would you use to represent the term ulcer? And how about alveoli?* Discuss students' ideas. Then ask them to make their own visual dictionary. It might be interesting to add any words seen during the video *How does digestion work?* given that it provided illustrations and animations. When they have finished ask students to share their work with the class.

In addition, students could work in groups to create graphic organisers in their notebooks. Graphic organisers allow students to interact with the word in a variety of ways, from a variety of angles, to reach a fuller understanding of its meaning.

In groups, the students should write a word in the middle of a rhombus and label each corner *synonym, sentence, picture and definition.* They should then find or create a definition for the word; find a synonym or create a small phrase that means the same (2-5 words); put the word into a sentence and finally, create a picture that embodies its meaning.

#### CONCEPT MAP

To introduce the contents of the unit, you could show an incomplete conceptual map and ask students to complete the gaps, either in their notebook or orally with the whole group. This will help students visualise the links between the different contents of the unit. This tool can also be used as revision at the end of the unit.

#### OXFORD INVESTIGATION

It starts with an introduction of the unit with some preliminary questions and the final task that should be carried out after finishing the activities. The final task is normally a practical problem whose solution demands a variety of learning skills and research. Students will be given the idea that in particular activities they will learn concepts and/or the procedures that will be used to sort out the practical problem.

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### 1. HUMAN NUTRITION

Multicellular organisms, such as humans, are unable to access nutrients directly. Nutrients, which are found in parts of **food**, are complex mixtures of substances that our body has to transform in order to be able to use them.

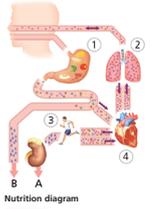
Multicellular organisms need organs, grouped in systems, to prepare and distribute nutrients to the cells and release waste products generated by cellular activity.

Digestive, respiratory, excretory and circulatory system all play a role in **nutrition**.

- Digestive system:** introduces foods into the body, and prepares and transforms it to enable its use by cells.
- Respiratory system:** obtains the necessary oxygen cells need and eliminates carbon dioxide (CO<sub>2</sub>) produced during cell metabolism.
- Circulatory system:** transports nutrients and oxygen to cells and releases waste substances.
- Excretory system:** releases waste substances outside the organism.

All four systems are intimately interlinked, fulfilling two main functions: providing cell nutrition and eliminating waste products.

The endocrine and nervous systems control and coordinate the whole function of nutrition: they detect nutritional needs as well as alterations in the internal organism; they activate relevant organs to provide us with nutrients and oxygen; they coordinate the transportation of nutrients and oxygen to the tissues that need them and eliminate waste products that alter the internal equilibrium.



**Apply**

1. Look at the image and answer the following questions:

- Identify which systems corresponds to which number.
- What do the two arrows at the bottom of the diagram represent?

**Key concepts**

- In order to provide cells with the substances they need, different systems have to function in a coordinated way.
- There are four systems involved in nutrition: respiratory, digestive, excretory and circulatory.

### 2. THE DIGESTIVE SYSTEM

The **gastrointestinal tract** and the **accessory glands** form the **digestive system**.

**Gastrointestinal tract:** it is about 8 metres long and its shape varies (it narrows and widens). It starts in our mouths and ends at our anus and it has the following parts: oral cavity, pharynx, esophagus, stomach, small intestine and large intestine.

An inner cell layer called a **mucous membrane** makes up the gastrointestinal tract. It's internally protected by a lubricant substance called **mucus** and it's surrounded by muscular layers: a longitudinal one, a second one which is circular and an oblique third, located in the stomach. When these layers contract they push food down the digestive tract.

The mucosa in the stomach and intestine contain glands that secrete a protective mucous and others that secrete **digestive juices**. Glands in the stomach produce gastric juices and glands in the intestine secrete intestinal juices.

**Accessory or ancillary glands** are organs that discharge their secretions in the digestive system. They are:

- Salivary glands,** found in the mouth where saliva is released.
- The liver,** located in the upper right abdomen, which releases secretions into the intestine.
- The pancreas,** located behind the stomach, which also releases secretions into the intestine.

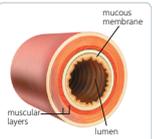
**Apply**

4. How does the digestive tract, being over 8 metres long, fit inside our bodies?

5. Why do you think it's so long?

**Key Concepts**

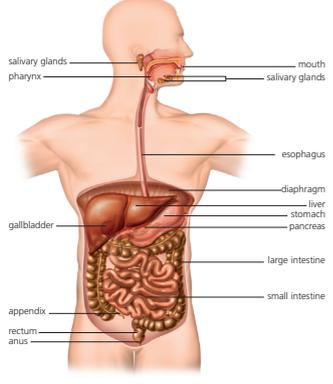
- The digestive system obtains nutrients from food. The gastrointestinal tract has different regions and a series of glands that release secretions into it.



**Section of the digestive tract**

**Understand**

6. Look at the image and answer the following questions: What type of tissue lines the small intestine? Mention some of its characteristics.



**Human digestive system**

**Key Concepts**

- The digestive system obtains nutrients from food. The gastrointestinal tract has different regions and a series of glands that release secretions into it.

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## 1. Human nutrition

Ask students to recall the names of the nutrients studied in unit 2, and what foods humans can obtain them from. Encourage students to use complete sentences, for example: *We can obtain carbohydrates from pasta.*

Students read the first two paragraphs. Ask: *Why do multicellular organisms need organs?* (To prepare and distribute nutrients to the cells and release waste products.) Then ask students to name some organs.

In pairs, students read the next section describing the systems involved in nutrition. When they have finished familiarising themselves with the terms, students can complete question 1 in pairs.

Write the names of the four systems in one column on the board. Then write the explanations about their roles (see bullet points on page 44) in another column. Do not make the systems correspond with their relevant explanations. Instead, students match the system with their role in pairs. Ask students to write sentences in their notebooks using the information on the board. For example: **The excretory system releases waste substances outside the organism.**

Students read the last two paragraphs. Ask: *What does the expression "intimately interlinked" mean? Which systems are responsible for coordinating the whole process? How do they do it?* (The expression intimately interlinked means that they work together in many complex ways. The endocrine and nervous system are responsible for the coordination process). When they have finished answering the questions, make sure they understand the importance of the endocrine and nervous system (detecting nutritional needs, activating organs, coordinating the transport of nutrients and oxygen, and so on).

Question 2 can be done as a whole class activity. Students stand up if the statement is true or they remain sitting down if they think that the statement is false. Students can complete question 3 in pairs or groups in order to motivate discussion. Make sure that students understand that unicellular organisms are only formed by one cell, so they do not have tissues, organs and systems. This makes the process of nutrition much simpler.

To end the section students read the information in the *Key concepts* section.

## 2. The digestive system

Ask: *Which two main parts form the digestive system?* Students start reading the information to find out that the two parts are the gastrointestinal tract and the accessory glands. Write the following questions on the board:

■ *How long is the gastrointestinal tract? Why is it so long?* (About 8 metres long. It is so long because otherwise the process of digestion would not be completed.) Ask students how long 8 metres is. If possible, measure it out in the classroom, a corridor or the playground. Students could work it out by lying on the ground in a line and adding up their heights.

■ *What are its parts?* (Oral cavity, pharynx, esophagus, stomach, small intestine and large intestine)

■ *What is the gastrointestinal tract made up of?* (An inner cell layer called a mucous membrane makes up the gastrointestinal tract. It's internally protected by a lubricant substance called mucus and it's surrounded by muscular layers.)

■ *What does the mucosa in the stomach and intestine contain?* (The mucosa in the stomach and intestine contain glands that secrete a protective mucous and others that secrete digestive juices.)

■ *What are the accessory glands? What are their names?* (Accessory or ancillary glands are organs that discharge their secretions in the digestive system. Their names are salivary glands, liver and pancreas).

Students work in pairs to answer the questions above. Discuss their answers when they have finished.

Students could add the two terms to their graphic organisers. They could draw the tube that starts in our mouths and ends at our anus, making sure it widens and narrows to create all its different sections. They should label the following parts: oral cavity, pharynx, esophagus, stomach, small intestine and large intestine.

If sculpting materials are available students could make a model of the gastrointestinal tract; if you use recycled materials you could make a life size replica of it and label its parts. In addition they should make replicas of the accessory glands (salivary glands, liver and pancreas). This group activity will help students visualise the gastrointestinal tract and the ancillary glands.

Then students complete activities 4 and 5 independently as they will have a very good understanding of the anatomy of the digestive tract. Then, they complete question 6 in pairs and discuss their answers as a whole class.

To practise key vocabulary, write the following incomplete sentence that comes from the Key concepts section:

■ *The digestive system obtains \_\_\_\_\_ from food. The \_\_\_\_\_ tract has different regions and a series of \_\_\_\_\_ that release \_\_\_\_\_ into it.*

(Answers: secretions, glands nutrients, gastrointestinal)

Students complete the sentence with the words.

#### EXTRA RESOURCES

AUDIO  
TALKING BOOK  
PDF  
REINFORCEMENT WORKSHEET 1  
CURRICULAR ADAPTATION WORKSHEET 1  
INTERACTIVE ACTIVITIES

## Answer key

### Apply

- Look at the image and answer the following questions:
  - Identify which systems corresponds to which number.
    - Digestive
    - Respiratory
    - Locomotor
    - Circulatory
  - What do the two arrows at the bottom of the diagram represent?
 

A: Excretion  
B: Defecation

### Understand

2.  Listen and say true or false. Correct the false sentences.

  - Our body needs to transform food in order to use the nutrients found in it.  
True
  - The respiratory system doesn't obtain any nutrients.  
False, it obtains oxygen from the air.
  - All the systems involved in nutrition work together in order to provide the main function of nutrition: to provide cells with nutrition.  
False. All the systems involved in nutrition work together in order to provide the two main functions of nutrition: provide cells with nutrition and release waste products.
  - The nervous and endocrine systems control and coordinate all the systems involved in nutrition.  
True

### Analyse

- How do unicellular organisms perform the function of nutrition?  
Because they are so small unicellular organisms can take nutrients directly from the environment and release the waste substances.
- How does the digestive tract, being over 8 metres long, fit inside our bodies?  
Because it is folded inside the body. A great example of how it is folded is the small intestine.
- Why do you think it's so long?  
Because both digestion and absorption depend on the contact of food with the intestinal walls, so the longer it is and the more surface it has, the better the digestion of food and the absorption of nutrients.

### Understand

- Look at the image and answer the following questions: What type of tissue lines the small intestine? Mention some of its characteristics.  
It is epithelial tissue, consisting of cells arranged side by side without intercellular substance. The epithelium is thin and is not keratinised to facilitate absorption of food. It is also associated with mucus secreting glands that protect the gut from the attack of by digestive enzymes. In some sections, glands secreting digestive juices are scattered.

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### 3. DIGESTION

**Digestion** is the process by which foods are transformed into simpler substances (**nutrients**), so they can be utilised by our cells.

Due to a range of mechanical and chemical processes that take place in the digestive system, foods undergo a range of transformations.

- Mechanical processes:** such as chewing and the muscular action of different organs that contribute by crushing and mixing foods with digestive juices.
- Chemical processes:** performed by **digestive enzymes** found in digestive juices. When these enzymes mix with food, chemical reactions occur that break down the substances found in food and transform them into simpler components.

#### 3.1. Digestive process: mouth

The actual process of **digestion** starts in the stomach; however, three other processes prepare the food inside the mouth: salivation, chewing and swallowing.

##### 3.1.1. Salivation

When we place food in our mouths we start salivating. Sometimes salivation can occur just by smelling or seeing food.

**Saliva** is a watery liquid released by the salivary glands, which are located under the tongue and on the sides of the mouth.

The functions of saliva are the following:

- It starts the digestion of starch molecules**, which are present in many foods (bread, potatoes, rice...) and transforms them into simpler sugars. In order to do this, saliva has a digestive enzyme named **amylase**, which breaks down the most complex sugars.
- It destroys some bacteria** by using an enzyme named **lysozyme**. Its antibacterial action protects the mouth against infection and reduces the possibility of suffering from cavities.
- It eases the bolus** into the pharynx and esophagus. Saliva contains **mucin**, a mucous substance that lubricates and mixes with food. As a result, foods go through the pharynx and esophagus easily without causing damage.

**Analyse**

- The tongue ensures that food is chewed properly and that it mixes with saliva. What type of tissue is most of the tongue formed of? Why do you think that is?
- Why do you think your mouth starts salivating when you see or smell a food you like?
- What are enzymes from a chemical point of view?
- Taste receptors are located inside the mouth; they are mostly found on the tongue. Why do we savour foods better if there is more saliva in our mouths?
- Saliva does not always have the same amounts of water and amylase. Why do you think this is?

#### 3.1.2. Chewing

**Chewing** is a mechanical process by which foods are ground and crushed into smaller chunks to facilitate their digestion.

**Teeth** are the structures responsible for grinding and crushing. Teeth are very hard and they are formed by calcium and fluorine compounds. There are different types of teeth, and each type fulfils a different function.



Incisor

They cut food.



Canine (fang)

Used to tear.



Premolar

They crush and crumble.



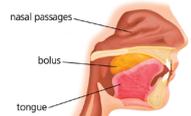
Molar

A **dental formula** is the way of representing the number and type of a mammal's teeth by numbering them in the following way: eight numbers separated by a line, four on the upper jaw and four on the lower jaw, that identify the number of incisors, canines, molars and premolars located in the middle, upper and lower jaws, respectively.

The first set of teeth we have develop when we are infants. There are 20 of them that form the **baby teeth** (or **milk teeth**). Baby teeth have all emerged by the time a child is three years old and they tend to start falling out when a child is 5 or 6 years old. They are progressively substituted by 32 permanent (adult) teeth, 16 teeth on each jaw: four incisors, two canines, four premolars and six molars.

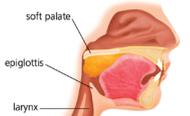
##### 3.1.3. Swallowing

Swallowing begins once the bolus has formed. The tongue pushes the bolus towards the **pharynx**, also known as the throat, and from there it goes to the **esophagus**, which ends in the **stomach**. There are three main stages:



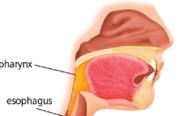
nasal passages  
bolus  
tongue

1. The bolus is driven to the bottom of the oral cavity when the tongue pushes itself against the palate.



soft palate  
epiglottis  
larynx

2. A series of reflexes makes the palate close the nasal passages the larynx rise, and the epiglottis close its upper orifice. The bolus enters the pharynx.



pharynx  
esophagus

3. Another reflex helps the bolus to pass into the esophagus.

As we swallow, the upper orifice of the larynx remains closed and it is not possible to breathe. When this happens, the bolus cannot enter the respiratory tract as it could cause choking or suffocation.

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## 3. Digestion

To activate students' prior knowledge, ask: *What parts does the gastrointestinal tract have?* (oral cavity, pharynx, esophagus, stomach, small intestine and large intestine) You could write the names of the parts on large pieces of card. Ask six students to stand in front of the class and give each student a card (not in the correct order). The rest of the class tell them where to stand so the parts are in the correct order.

Now say: *Name the accessory glands.* (salivary glands, the liver, the pancreas) Ask: *What is another name for the oral cavity?* (the mouth) *Where are the salivary glands?* (in the mouth) *What other parts of the mouth are used in the digestive process?* (the teeth and the tongue)

Ask students to read the first section and then discuss it in pairs. Make sure students understand our bodies have to reduce the size of food, quite considerably, in order to obtain energy from it. This is due to the microscopic size of our cells: the biggest cell cannot use even the smallest fragment of food directly. It has to be processed first. Our cells are not formed by fragments of chocolate, spinach, cheese or any other food; instead, cells absorb chemical substances that form chocolate, spinach, cheese or any other food.

In pairs, students take turns to explain the mechanical and chemical processes that take place in the digestive system. Ask volunteers to explain to the class the meaning of both processes.

### 3.1. Digestive process: mouth

Ask: *Where does the process of digestion start?* (The actual process of digestion starts in the stomach, however three other processes occur in the mouth in preparation). Discuss students'

responses. Then they read the small paragraph to check their answers. Ask: *Which three processes occur in the mouth?* (Salivation, chewing and swallowing) Discuss the meaning of the three terms. Students could mime each process to show understanding.

Next, students complete question 7 pairs. In order to help student determine the type of tissue forming the tongue prompt them by moving your tongue and reminding them that it moves! Check students' answers with the whole class.

#### 3.1.1. Salivation

Ask: *What happens in your mouth when you see or smell food you really like?* Discuss students' responses. Establish that when we place food in our mouth we start salivating.

Students read the three functions of saliva. Ask: *Which two enzymes can be found in saliva? What do they do?* It might be good for students to add both amylase and lysozyme into their graphic organisers. Alternatively get them to create a visual representation of the enzymes to help them remember their function. After discussing saliva and some of its properties as well as the enzymes found in it, students should be able to complete question 8, 10 and 11 in pairs. Complete question 9 as a whole class activity, in which students take turns to try to define what enzymes are in their own words.

#### 3.1.2. Chewing

First, students read the definition of chewing which is highlighted in grey as well as the following paragraph that describes teeth. Ask: *What are teeth made of? What are the four different types of teeth?* (Teeth are made of calcium and fluorine compounds. The four types of teeth are incisor, canine, premolar and molar).

Write: *incisor*, *canine*, *premolar* and *molar* on the board. Students can use a piece of paper cut into eight pieces. On four pieces of paper they write the names of the different types of tooth and on the other four they draw them. Then they put them facing down and mix them to play a memory game.

Once they have finished, discuss the relationship between the shape of the tooth and its function.

Ask students to answer the following three questions:

■ *What is a dental formula?*

(A dental formula is the way of representing the number and type of a mammal's teeth by numbering them in the following way: eight numbers separated by a line, four on the upper jaw and four on the lower jaw, that identify the number of incisors, canines, molars and premolars located in the middle, upper and lower jaws, respectively.

■ *How many teeth do children less than 6 years old have? (20 teeth)*

■ *How many teeth do adults have? (32 teeth)*

Next students complete question 12 independently. Students can use the following link with a diagram to answer the question.

#### Weblink 1: THE LAYERS OF A TOOTH

Simple diagram of a tooth displaying the four layers that compose it: enamel, cementum, dentine and pulp.

### 3.1.3. Swallowing

Students read the paragraph and whilst they are doing so, write the following terms on the board: *bolus*, *pharynx*, *esophagus*. Students locate the terms in the diagrams. Next, they read the explanations in the diagram.

Write the three steps described in the diagram (not in order) and get students to sequence them. Finally ask them to look at the diagram again and explain how the larynx closes as we swallow and it is not possible to breathe. Then students complete activity 13 in pairs. Check their answers as a whole class.

#### EXTRA RESOURCES

AUDIO  
TALKING BOOK  
PDF  
REINFORCEMENT WORKSHEET 2  
CURRICULAR ADAPTATION WORKSHEET 2  
INTERACTIVE ACTIVITIES  
SCIENCE EXPERIMENT: SIMULATION OF INTESTINAL ABSORPTION

## Answer key

### Analyse

7. The tongue ensures that food is chewed properly and that it mixes with saliva. What type of tissue is most of the tongue formed of? Why do you think that is?

The tongue is a muscle formed mainly by muscle tissue. This is because it needs to move. It moves food past the teeth and it

intervenes during the mastication process.

8. Why do you think your mouth starts salivating when you see or smell a food you like?

Because our sense detect the presence of food and our body prepares for eating by starting the salivation process. It is reflex caused by the information captured by the senses.

9. What are enzymes from a chemical point of view?

They are proteins that perform specific actions to facilitate determined chemical reactions.

10. Taste receptors are located inside the mouth; they are mostly found on the tongue. Why do we savour foods better if there is more saliva in our mouths?

Because saliva dissolves some of the food molecules facilitating their contact with taste receptors.

11. Saliva does not always have the same amounts of water and amylase. Why do you think this is?

Because the secretion of saliva and its components is conditioned by certain reflexes. Reflexes happen in response to certain stimuli such as the type of food we eat or even smell or sight. Certain foods, such as citrus, provoke our organism to produce a bigger quantity of water to reduce the acidity. Other foods, such as pasta, will result in an increased secretion of amylase in order to start breaking down complex sugars .

### Apply

12. Describe the dental formula you can see in the picture. Do the teeth represented belong to an adult or an infant?

The dental formula is 2123/2123. The teeth belong to an adult.

### Understand

13. Which phases of the process of swallowing are voluntary and which are involuntary?

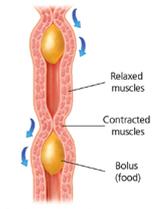
The first stage involves pushing the tongue against the palate and it is a voluntary act. The following stages that take the bolus to the esophagus are involuntary because they are reflexes.

### Create

14. Dental pieces are formed by various superimposed tissue layers. Find out what they are and make a drawing showing their arrangement inside a tooth.

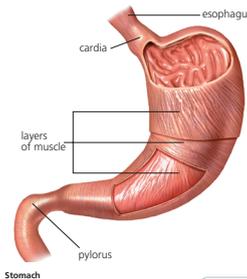
The layers are pulp, cement, dentin and enamel. Students should make a diagram showing those parts.

3
+



**Peristaltic movements**

**Valve:** a membranous fold in a narrow conduit that can open and close, maintaining the flow of fluids in only one direction; it closes by responding to any pressure from reverse flow



**Stomach**

### 3.2. The digestive process in the stomach

The downward movement of the bolus in the esophagus is performed by the contraction of two layers of muscle found in its walls, creating a movement called **peristaltic movement**.

The stomach is at the end of the esophagus. Separating the stomach and esophagus is a **valve** known as the **cardia**, which stops reflux from happening. Connecting the stomach and the small intestine is another valve known as the **pylorus**.

When the bolus enters the stomach, the stomach muscles start to contract. The bolus remains in the stomach for 3 to 4 hours and it mixes with **gastric juices** secreted by the glands located in the inner layer of the stomach.

Gastric juices contain pepsin and hydrochloric acid:

- Pepsin:** is an enzyme that starts protein digestion, breaking proteins down into smaller fragments of variable sizes known as **peptides**.
- Hydrochloric acid:** fulfils two functions. It activates pepsin enzymes and supports them by helping the disintegration of food fibres. Additionally it destroys bacteria that may be present in food.

After food has mixed with gastric juices in the stomach, it's transformed into a more fluid substance known as **chyme**.

The stomach is formed by three muscular layers, which perform massaging motions to mix the chyme. The inner layer is covered in mucus that protects it from the effects of hydrochloric acid and enzymes.

The longer the food stays in the stomach, more and more gastric juice is secreted, making the mixture more acidic and liquid. When it reaches a high level of acidity, the pylorus opens and the chyme enters the small intestine.

Secretion of gastric juices is an involuntary act that begins as soon as we see food and as food enters our mouth.

Fats (over four hours) and proteins (three hours) are the nutrients that take the longest to enter the small intestine. On the other hand, carbohydrates only stay for approximately one and a half hours.

**Remember**

15. Explain how peristaltic movements are produced.

**Understand**

16. What would happen if gastric juices did not contain hydrochloric acid?

17. Which is denser: a bolus or chyme? Which of them contains more digestive enzymes?

**Analyse**

18. Vomiting can happen for a variety of reasons, but how is vomit discharged to the exterior of the organism?

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3. Nutrition: The digestive and respiratory systems 49

### 3.3. The digestive process in the small intestine

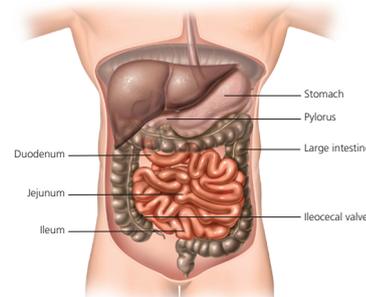
The **small intestine** is a tube that is around 6 or 7 metres long. It is located between the pylorus, where it joins with the stomach, and the **ileocecal valve**, which separates the small intestine from the large intestine.

The small intestine is divided into three sections: **duodenum**, **jejunum** and **ileum**.

**Duodenum:** is the initial section, only 25 cm long, and shaped like a horseshoe.

**Jejunum:** is the middle section and it is also the longest part of the small intestine.

**Ileum:** is the final section that ends in the large intestine.



Sections of the small intestine

After the pylorus opens, the chyme travels from the stomach into the small intestine (duodenum). Once in the duodenum, chyme mixes with digestive secretions released by the small intestine, as well as secretions from two other organs: the pancreas and liver.

#### 3.3.1. Pancreas

The pancreas is a glandular organ located in the abdomen behind the stomach. It has a greyish-white colour. It has two main functions:

- It produces **hormones** (insulin and glucagon) that regulate the quantities of glucose in our body and their accumulation in the liver.

- It secretes **pancreatic juice**, which is released into the duodenum through the ampulla of Vater, in which the pancreas and liver ducts join.

Pancreatic juice contains enzymes capable of digesting the different types of molecules present in foods (carbohydrates, fats and proteins), as well as **sodium bicarbonate**, which neutralises the chyme's acidity and stops intestinal cells from being harmed.

Gastric, intestinal and pancreatic juices, as well as bile (produced by the liver), are only secreted when there is food in the digestive tube that needs to be digested.

#### Analyse

19. Why do you think some people have a little bit of sodium bicarbonate when they suffer from heartburn?

20. Why do ulcers occur in the duodenum but not in the jejunum or ileum?

## 3.2. The digestive process in the stomach

Remind students of the parts of the gastrointestinal tract by sticking the cards on the board in the wrong order and asking students to tell you the correct order. (oral cavity, pharynx, esophagus, stomach, small intestine and large intestine) Ask: *What happens to food after it has been swallowed?* (It passes into the esophagus, goes down the esophagus and enters into the stomach.) Give students cues to help them produce a sentence: *It passes into the ..., goes down the ... and enters into the ...*

Say: *Now we are going to find out what happens during that journey.* Students read the first three paragraphs in groups and take notes about the process. Ask them to locate key vocabulary using the diagrams. Then in groups, students write a summary of the process in their notebooks. Students complete activity 15 independently in their notebooks.

Students read the rest of the page in pairs. Check understanding by asking: *What are peptides?* (protein fragments) *What is chyme?* (a mixture of food and gastric juices) *How long does food stay in the stomach?* (Fats stay in the stomach for over four hours, proteins for three hours and carbohydrates for one and a half hours.)

You might want to mention laparoscopic surgery, which is used to observe the higher part of the digestive tract (esophagus, stomach and duodenum). It is performed using a flexible tube that is used to observe and even to intervene. This procedure is used to diagnose and treat stomach ulcers, tumours and other obstructive alterations. The following link can be used to explore the procedure as well as the stomach and its functions.

### Weblink 2: THE STOMACH AND ITS ROLE IN DIGESTION

This website provides detailed information about the stomach using simple language that students can understand. It also has information about laparoscopic surgery.

Tell students to add any new terms from this section to their graphic organisers. Then, they complete questions 16 and 17 in pairs. Complete question 18 as a whole class in order to generate discussion. If students need help ask them to think about how food travels down the esophagus.

## 3.3. The digestive process in the small intestine

Students should remember from the beginning of the unit that the small intestine is a very large tube, especially if you made life size models. Ask: *Can you remember the valve that separated the stomach from the esophagus?* (cardia) Say: *Read the text to find the name of the valve that separates the stomach from the small intestine. Then find the name of another valve and its function.* Make sure students understand that the pylorus separates the stomach from the small intestine and that the ileocecal valve separates the small intestine from the large intestine.

Next, students read about the different sections of the small intestine. Then ask students to close their books. Write the names of the three sections of the small intestine making a column on the board. Parallel to the first column; create a second one with the short descriptions written in the textbooks. Students match them up. When finished ask: *Which two organs secrete substances when the chyme is in the small intestine?* (pancreas and liver)

### 3.3.1. Pancreas

Ask: *We know that the pancreas releases substances into the small intestine, but why?* (Because it contains enzymes that can digest the different types of molecules found in foods and sodium bicarbonate, which neutralises the chyme's acidity). Students read the text in pairs and whilst they do so write the following question on the board: *What are the two main functions of the pancreas?* Make sure students understand that it produces hormones that regulate glucose and it also produces pancreatic juice.

Students read the last two paragraphs of the section and ask: *What is pancreatic juice made of?* Discuss students' answers. You could use the following link on the interactive whiteboard, or alternatively, students can use the link at home.

#### Weblink 3: PANCREAS

This website provides great anatomical models in three dimensions of all the parts of the body. In addition it provides detailed explanations.

Finally, discuss what an ulcer is with students. Then students complete activities 19 and 20 on their own. These could be set as homework.

#### EXTRA RESOURCES

AUDIO  
TALKING BOOK  
PDF  
REINFORCEMENT WORKSHEET 3  
CURRICULAR ADAPTATION WORKSHEET 3  
INTERACTIVE ACTIVITIES

## Answer key

### Remember

- 15.** Explain how peristaltic movements are produced.

Peristaltic movements are produced due to the coordinated contractions and expansions of musculature of the gastrointestinal tract. The tube expands and contracts pushing the food downwards.

### Understand

- 16.** What would happen if gastric juices did not contain hydrochloric acid?

If gastric juices did not have hydrochloric acid the enzyme pepsin would not be activated. Furthermore, bacterial would not be eliminated and fibres that form certain foods would not disintegrate.

- 17.** Which is denser: a bolus or chyme? Which of them contains more digestive enzymes?

Chyme is more fluid, because it contains the bolus plus gastric juices. Chyme has more enzymes.

### Analyse

- 18.** Vomiting can happen for a variety of reasons, but how is vomit discharged to the exterior of the organism?

What causes vomit to be discharged are contractions of the muscles of the stomach that release the chyme outside the body.

- 19.** Why do you think some people have a little bit of sodium bicarbonate when they suffer from heartburn?

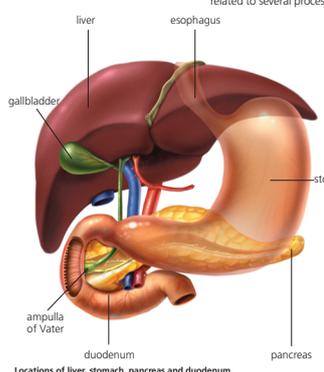
Sodium bicarbonate neutralizes the acidity of gastric juice, so some people take some of it when they suffer from heartburn.

- 20.** Why do ulcers occur in the duodenum but not in the jejunum or ileum?

The duodenum is the next part after the stomach and receives the acidic chyme. Therefore, injuries can occur in the mucosa. However, the acidity of chyme is neutralized by the sodium bicarbonate contained in pancreatic juice. When the chyme reaches the jejunum it cannot injure the mucous membranes; it is even less likely to do any injuries when it reaches the ileum.

### 3.3.2. The liver

The **liver** is an organ located in the right upper part of the abdomen. It has a violet colour due to the great amounts of blood in it and it performs a variety of functions related to several processes (digestive and excretory, amongst others).



As part of the digestive process, the liver produces **bile** released into the duodenum through the **ampulla of Vater**.

Bile is not secreted continuously, but it is stored in the **gallbladder**, a bag-like organ next to the duodenum, and is only released when food enters the intestine.

Unlike gastric and pancreatic juices, bile does not contain digestive enzymes, but a different type of substance known as **bile salts**.

Bile salts intervene in the emulsification of fats: fats are transformed into very small drops, helping enzymes found in digestive juices break down fats.

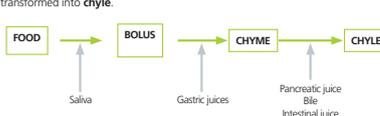
The liver also performs other functions. It captures and destroys most toxic molecules that enter the body, such as the ones found in alcoholic drinks and medications.

### 3.3.3. Digestion

Most digestive processes take place in the small intestine, as the chyme mixes with pancreatic juice and bile as well as **intestinal juices**.

Intestinal juice is produced by the small intestine's mucous glands. It is similar to pancreatic juice and it contains enzymes that are capable of digesting all types of molecules found in foods.

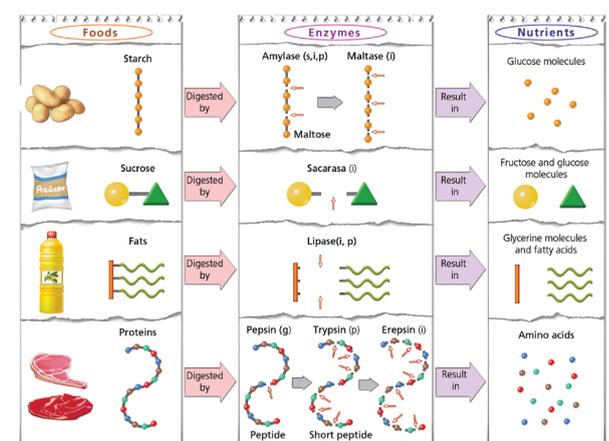
When the chyme mixes with the bile, pancreatic and intestinal juices, it is transformed into **chyle**.



**Summary of the process of the progressive incorporation of digestive liquids**

During the process of digestion a range of chemical reactions take place, transforming foods into nutrients.

### 3.3.4. From food to nutrients



The origin of digestive enzymes: saliva (s), gastric juice (g), pancreatic juice (p) and intestinal juice (i)

After digestion, foods are reduced to simpler molecules that function as nutrients for cells:

- **Monosaccharides** or **simple sugars**, such as glucose or fructose, obtained from more complex carbohydrates.
- **Glycerol and fatty acids**, which are obtained from fat.
- **Amino acids**, obtained from the digestion of proteins.

These nutrients must be distributed to the tissues where cells will use them to obtain energy or make new molecules.

**Remember**

22. Which digestive juices are involved in the digestion of fats?

**Analyse**

23. Listen while looking at the diagram on this page and say true or false.

24. Sometimes it is necessary to remove the gallbladder. Would someone without a gallbladder stop producing bile? What would the consequences be for such an individual?

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3. Nutrition: The digestive and respiratory systems 51

### 3.2.3. The liver

Before you start this section, ask: Can you remember the names of the three accessory glands? (salivary glands, liver and pancreas) If students can't remember, they say they can look in the first part of this unit (page 45). Say: Now we are going to find out more about the liver.

Read the section as a whole class and as you are doing so, students find answers to the following questions:

- *Where is the liver?* (The liver is located in the right upper part of the abdomen).
- *What does the liver do in the process of digestion?* (It produces bile released into the duodenum through the ampulla of Vater).
- *What are bile salts?* (Bile salts are found in bile and they intervene in the emulsification of fats: fats are transformed into small drops, helping the enzymes found in digestive juices break them down).
- *Which other functions does the liver do?* (It captures and destroys most toxic molecules that enter the body, such as the ones found in alcoholic drinks and medications).

Explain to students that they are going to write a newspaper article about the liver. They can use the questions above as a structure, but they need to use a journalistic style. Students work in mixed ability pairs to write their newspaper articles.

To make it more interesting, students could work in groups to write three articles: one about the liver, another one about digestion and the last one about how food transforms into nutrients. Obviously, do so once the whole double spread has been covered and students have an understanding of the concepts. An example of a basic newspaper article would be like this:

### THE LIVER RELEASES BILE SALTS!

By John Digestion, Health correspondent.

It has been confirmed that the liver produces bile. "Bile is a substance that contains bile salts," explained a leading biologist, "they intervene in the emulsification of fats." Fats are then transformed into very small drops by bile salts. This helps the enzymes break them down efficiently.

Students can use the following web link to find additional information to include in their article. In there they can find details about the anatomy and physiology of the liver. Then students can complete question 21 and 22 in pairs.

#### Weblink 4: LIVER

This website provides great anatomical models in three dimensions of all the parts of the body. In addition it provides detailed explanations.

### 3.3.3. Digestion

Ask: *Where does the process of digestion take place?* Students may say that digestion takes place in the stomach. However make sure they understand that the process starts in the mouth, as the bolus is prepared. The process continues in the stomach as the chyme is formed, but most digestive processes take place in the small intestine when the chyme mixes with pancreatic and intestinal juices as well as bile.

Students read the section and then they look at the diagram *Summary of the process of the progressive incorporation of digestive liquids*. In pairs, they take turns to explain the journey of a mouthful of food until it becomes chyle.

Encourage them to add details and use key vocabulary, for example: *Food enters the mouth and mixes with the saliva becoming the bolus. The bolus is then pushed down into the stomach using peristaltic movements. In the stomach it mixes with the gastric juices and it becomes chyme. Chyme is then released into the small intestine where it mixes with pancreatic and intestinal juices as well as bile. It then becomes chyle.*

### 3.3.4. From food to nutrients

Ask students to recall the different types of nutrients studied in the previous unit, as well as all the different substances our body produces to digest food. Write them on the board.

Say: *We know that chyle, saliva, and the gastric juices have enzymes. Enzymes transform the food we eat into nutrients. Students study the diagram in pairs and read the information below the diagram. Ask: Which molecules are obtained once the enzymes have completed their work?* (Monosaccharides or simple sugars, such as glucose or fructose, obtained from more complex carbohydrates. Glycerol and fatty acids, which are obtained from fat. Amino acids, obtained from the digestion of proteins.) Students answer questions 21 and 22 in pairs.

Students could create a diagram based on the diagram The origin of digestive enzymes: *saliva (s), gastric juice (g), pancreatic juice (p) and intestinal juice (i)* (page 51) in groups using large pieces of card. The diagram should display the digestive system, whilst paying attention to the parts that contribute to the process of digestion (saliva glands, pancreas, liver, stomach, small intestine, and so on). Arrows could point to the parts just mentioned, so students can add images and information about the role of those parts. For example, we could explain that the saliva glands produce saliva that contains amylase. Amylase breaks down starch into glucose molecules. We could show the process of how starch is broken down using the images in the diagram.

Allow students to spend some time doing this activity. The key is that they transform the diagram on page 51 using their previous knowledge of the digestive process into a large diagram that shows the parts of the digestive system and how the process of digestion transforms food into nutrients. After completing their diagrams and sharing their work with the class, they complete question 23 in pairs. They listen to the statement and they use the diagram to check its veracity. They could use true or false cards or mini whiteboards to answer. If the statement is false, students have to correct it.

Open up question 24 for a whole class discussion. If students need help ask them to think if it would be difficult to digest fats if we did not have a gallbladder.

#### EXTRA RESOURCES

AUDIO  
TALKING BOOK  
PDF  
REINFORCEMENT WORKSHEET 4  
CURRICULAR ADAPTATION WORKSHEET 4  
INTERACTIVE ACTIVITIES

## Answer key

### Analyse

21. Look at the image and answer the following question: 1 and 2 represent fats and proteins respectively. What are molecules 3 and 4?

Molecules labelled 3 are glycerine and fatty acids and molecule 4 is an amino acid.

### Remember

22. Which digestive juices are involved in the digestion of fats?

Pancreatic and intestinal juices. The digestion of fats produces glycerine and fatty acids.

### Analyse

23.  Listen correct the false sentences while looking at the diagram on this page and say true or false.

a) Amylase and lipase enzymes are involved in the digestion of potatoes.

False. Amylase and maltase enzymes are involved in the digestion of potatoes. Lipase is involved in the digestion of fats.

b) The final nutrients we obtain from sugar are fructose and glucose molecules.

True.

c) The human body needs more enzymes to digest olive oil than to digest meat.

False, meat needs more enzymes.

d) We obtain glucose as the final nutrient from both potatoes and sugar.

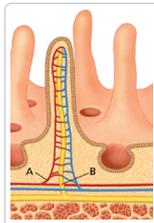
True.

### Analyse

24. Sometimes it is necessary to remove the gallbladder. Would someone without a gallbladder stop producing bile? What would the consequences be for such an individual?

The gallbladder has to be removed when large stones, difficult to remove, block the flow of bile. Bile is still produced after the removal, as the producer of bile is the liver. The consequences of this operation are that the individual would not produce the right amount of bile and will struggle to digest fatty foods.

3



Absorption

**Analyse**

25. Identify the route (A or B) the following molecules will take as they are absorbed: glucose, fatty acids, amino acids, glycerine and minerals.

### 3.3.5. Food absorption

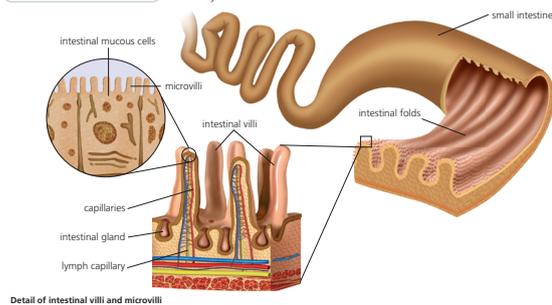
**Food absorption** refers to the passage of nutrients to our blood. This allows those nutrients to be distributed across the whole organism.

The inner layer of the small intestine is covered in creases, known as **villi** (3000/cm<sup>2</sup>), which are full of microscopic blood capillaries that collect nutrients obtained after digestion.

In order to increase the surface area as well as increasing the absorption of nutrients, the plasma membrane that forms villi has extra creases known as **microvilli**. This increases the total surface area to 400m<sup>2</sup>.

Nutrients resulting from the digestion process, as well as water, minerals and vitamins that don't need to be digested, need to reach different cells in the body. They all need to go from the intestine into the blood, so they can be distributed throughout the body. Most go through the small intestine's mucosa and enter blood capillaries. Even though the small intestine has a great capacity for absorption, being capable of transferring up to 1 million glucose molecules per square centimetre every second into the blood, most of the water we ingest is actually absorbed in the large intestine.

The by-products of fat digestion are not directly absorbed by blood capillaries in the small intestine, but are absorbed by capillaries that are part of the lymphatic system.



Detail of intestinal villi and microvilli

#### Understand

26. What would happen if we did not have villi and microvilli in our small intestine?

#### Analyse

27. Why do you think herbivores have a longer digestive tube than carnivores?

### 3.4. The digestive process in the large intestine

Once nutrients have been ingested in the small intestine, the remaining food waste enters the large intestine through the ileocecal valve.

The **large intestine** is the end part of the digestive tube. It's shorter (1.5 m) than the small intestine, but has a larger circumference and does not have villi or microvilli.

There are three main sections: the **cecum**, **colon** (itself subdivided into three further sections: ascending, transverse and descending) and **rectum**.

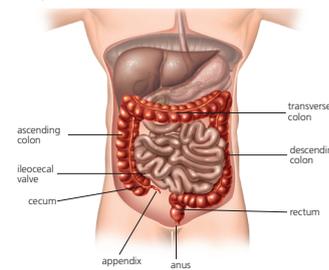
■ The **cecum**: this is the first section, it's shaped like a bag and has a narrow extension, the appendix.

■ The **colon**: this part of the large intestine is where **sympiotic**\* bacteria of the intestinal flora develop. Certain vitamins, such as B<sub>12</sub> and K, are produced in the colon.

■ The **rectum**: the final section that ends in the anus.

Absorption of most water and minerals takes place in the large intestine; **faeces** compact to form stools.

Undigested food waste advances by peristalsis and is expelled to the outside through the anus by a mechanism called **defecation**. Faeces contain intestinal mucosa cells, bacteria and food waste.



Sections of the large intestine

#### Analyse

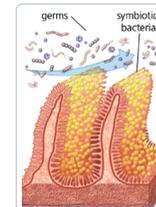
29. Why is it possible to suffer from dehydration when someone has severe diarrhea? What would be a sensible approach to this situation?

30. What are the benefits of the regular consumption of fermented food?

#### Create

31. Some scientists believe that the appendix is a vestigial organ. What does this mean? Find out about the functions of the appendix and write a short report.

\***Symbiotic**: used to describe the organisms that interact with each other because they live in close physical association, typically to the advantage of both

Intestinal wall  
Relationship between the germs that reach the intestine with food and symbiotic bacteria.

#### Analyse

28. What is the meaning of the term **symbiotic**? What do you think the blue arrow symbolises?

#### Key concepts

■ The process of digestion involves a series of mechanical and chemical processes that take place in the digestive tube.

■ Once food has been digested, nutrient absorption takes place. Due to the process of absorption, nutrients go through the intestinal mucosa so they can reach the organism's blood.

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3. Nutrition: The digestive and respiratory systems 53

### 3.3.5. Food absorption

The purpose of digestion is to incorporate into the blood the nutrients obtained after digestive enzymes have completed their work. This process takes place in the small intestine. Ask: *Can you remember how long the gastrointestinal tract is? Why do you think is that long?* (8 metres). Students discuss in pairs.

Make sure they understand that the small intestine absorbs the nutrients as they travel through it. That is why it is so long. Students read the information in the first three paragraphs. Say: *Look at the diagram named Absorption in question 25. Ask: How do villi, microvilli and the intestinal folds increase the surface area of the small intestine?* Discuss this with students using the diagram on the bottom of the page, *Detail of intestinal villi and microvilli*.

Students could create illustrations of villi, microvilli and intestinal folds to add to their graphic organisers. Before completing question 25, students need to understand that glucose, amino acids and minerals will be absorbed by blood vessels. Fatty acids and glycerine are absorbed by lymph vessels. Then students can complete question 26 independently. Question 27 can be completed in pairs. If students need help mention that plant foods are harder to digest.

Use the following link for students to continue to explore the small intestine at school using computers, or perhaps at home. They could write a small report about the small intestine using the information in their books as well as the web page.

### Weblink 5: SMALL INTESTINE

This link is from the BBC and describes the small intestine using simple language. You can use a worksheet related to this weblink in order to test student's knowledge of the small intestine in terms of function and description.

### 3.4. The digestive process in the large intestine

Students need to know that although nutrients are absorbed in the small intestine, the large intestine also fulfils specific functions. Ask them to read the first three paragraphs to find out characteristics of the large intestine as well as the names of its three parts. Ask: *Can you remember all of the parts of the small intestine?* (Jejunum, duodenum and ileum). *What are the names of the parts of the large intestine?* (Cecum, colon and rectum)

Write the names of the parts of the large and small intestine on the board using a random order. Students work independently to sort the parts into *Parts of the small intestine* and *Parts of the large intestine*. To make the activity extra challenging, tell students to sequence the parts in order (duodenum, jejunum, ileum, cecum, colon and rectum) Students do this exercise without using the books if possible. Then they study the structure of the large intestine by looking at the diagram *Sections of the large intestine*.

Students read the remaining parts of the section. Ask: *What does the large intestine absorb?* (The large intestine absorbs water and minerals.)

Read the definition of symbiotic and discuss the meaning of the term with students. Then students discuss in pairs their thoughts about question 28. Get them to share with the class. Students complete question 29 and 30 independently. Ask students to research the appendix and its role as a vestigial organ. Then they can complete question 31 in class or as homework.

As a plenary spend some time discussing how many people develop obsessions with losing weight. It is important students understand that miracle diets do not exist and that they can be dangerous. The key to losing weight is having a balanced diet and doing exercise regularly.

Ask students to read the information found in the **Key concepts** section in pairs. Can they develop the ideas presented? Perhaps they could name some of the mechanical and chemical processes involved in digestion and explain how food is then absorbed and waste products released.

#### EXTRA RESOURCES

AUDIO  
TALKING BOOK  
PDF  
REINFORCEMENT WORKSHEET 5  
CURRICULAR ADAPTATION WORKSHEET 5  
INTERACTIVE ACTIVITIES

### Answer key

#### Analyse

**25. Identify the route (A or B) the following molecules will take as they are absorbed: glucose, fatty acids, amino acids, glycerine and minerals.**

Glucose, amino acids and minerals will be absorbed by the blood vessels. The lymph capillaries will absorb fatty acids and glycerine.

#### Understand

**26. What would happen if we did not have villi and microvilli in our small intestine?**

The function of the villi and microvilli is to increase the surface absorption of digested food in the small intestine. In this way although food moves at speed through the digestive tract, the body has enough time to absorb nutrients. If we did not have villi and microvilli we would not be able to absorb the nutrients.

#### Analyse

**27. Why do you think herbivores have a longer digestive tube than carnivores?**

Animal foods are rich in nutrients and have high digestibility. Therefore, carnivores do not need to have an excessively long gut. By contrast, foods of plant origin are harder to digest, because the cells that form them need to break down. This requires the help of certain microorganisms, so the digestive process is slower and requires a longer digestive tract to carry it out.

**28. What is the meaning of the term *symbiotic*? What do you think the blue arrow symbolises?**

The term symbiotic is used to describe the organisms that interact with each other because they live in close physical association, typically to the advantage of both. Bacteria that live in symbiosis in our intestine feed on waste substances and at the same time protect us against infection from other bacteria. The blue arrow refers to the release of germs that are not capable of sticking to the intestinal mucous because of the protective action of symbiotic bacteria.

**29. Why is it possible to suffer from dehydration when someone has severe diarrhea? What would be a sensible approach to this situation?**

Diarrhoea produces fast movements of the large intestine and it does not allow time for the colon to absorb the water. Diarrhoea can cause dehydration and in certain cases patients need to be hydrated via their blood.

**30. What are the benefits of the regular consumption of fermented food?**

Yogurt and similar foods contain live bacteria that regenerate and maintain the intestinal flora, necessary for the production of certain vitamins and for the correct formation of faeces.

#### Create

**21. Some scientists believe that the appendix is a vestigial organ. What does this mean? Find out about the functions of the appendix and write a short report.**

Vestigial organs are evolutionary remnants that do not perform any function, so they tend to disappear. Our appendix is an outgrowth of the large intestine. As far as we know, it does not perform any function in the present human species. However, the wall has lymphoid structures, so it probably plays a role as a secondary immune organ.

Some scientists think that the appendix is a vestigial organ that was part of a larger large intestine: our herbivore ancestors used it to digest cellulose.

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### 4. THE RESPIRATORY SYSTEM

As well as nutrients, cells in our body need oxygen in order to perform cell **respiration**. It is during this process that the combustion of nutrients takes place, releasing energy. As a result of cell respiration, waste products are created (CO<sub>2</sub> among others) that have to be released.

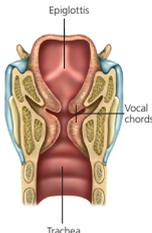
The respiratory system obtains oxygen from the air and provides it to the blood in the circulatory system. Blood carries the oxygen into the cells and takes away carbon dioxide so it can be released.

The respiratory tract and lungs form the respiratory system.

■ **Respiratory tract:** this is made up of tubes or airways that collect oxygen and prepare it for cell consumption. These are: the nasal cavities, pharynx, larynx, trachea, bronchi and bronchioles.

Inside the larynx there are two ring-shaped folds (**vocal chords**). They create sounds when the passage of air makes them vibrate. These sounds change depending how the tongue, teeth and lips are positioned, and the way that air passes through the mouth or nasal passages.

■ **Lungs:** this is where the gas exchange between blood and air takes place (O<sub>2</sub> and CO<sub>2</sub>).



Location of the vocal chords inside the larynx

nasal cavity

pharynx

epiglottis

larynx

trachea

right lung

left lung

bronchi

bronchiole

heart

diaphragm

Structure of the respiratory system

**Analyse**

32. When do we breathe faster: when we are sitting down or when we are running? Why?

#### 4.1. Respiratory tract

When air reaches the lungs, it needs to be clean, humid and warm. This preparation process takes place in the respiratory tract:

■ **The nasal cavity:** this is the place where air enters the body. In the first section, the internal wall has several capillaries, which warm up the air because they carry blood (blood has the same temperature as the body does). In addition, the presence of nooks and crannies in the nasal cavities increases the length of the journey air goes on within the body, making it warmer. Mucous purifies and humidifies the air.

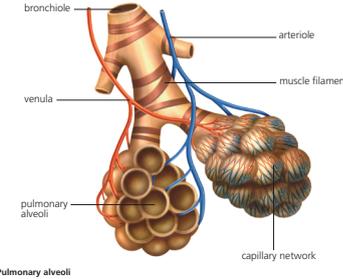
■ **The pharynx:** this area is common to the respiratory and digestive tracts. Foods continue their journey into the esophagus, while air passes into the larynx. On the side walls of the pharynx there are **tonsils**, which produce white blood cells.

■ **The larynx:** entry into the larynx is regulated by a fibrous structure known as the **epiglottis**, which closes when food is being ingested to prevent the organism from choking or suffocating. The walls of the larynx are formed of cartilage that continually keeps it open. From the larynx, air goes into the trachea.

■ **The trachea:** this tube of about 12 cm has open cartilage rings at its back. There is mucous present in the interior of the trachea that traps foreign particles in the air. In addition there are certain cells with vibrating filaments known as **cilia**.

Cilia move mucous, filled with foreign particles, towards the larynx, where it is redirected to the esophagus and stomach.

■ **Bronchi and bronchioles.** The trachea is divided into two bronchi, each one enters a different lung and branches into progressively smaller ducts named bronchioles. Bronchioles do not have cartilage rings. They end in tiny sacs, called **pulmonary alveoli**, which are the true protagonists of gas exchange. Each person has about 400 million alveoli.



Pulmonary alveoli

**Understand**

34. Why is it not possible to eat and breathe simultaneously?

**Analyse**

35. Why is it more difficult to breathe in a dry climate than in a humid one?

36. What would happen if we didn't have cilia in our trachea?

**Apply**

33. What type of cell is displayed in the image (see A and B)?

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3. Nutrition: The digestive and respiratory systems 55

## 4. The respiratory system

Begin by brainstorming the parts of the respiratory system. Then ask: *How do we obtain the oxygen we need to live and how do we release harmful CO<sub>2</sub>?* Help students explain using full sentences by prompting: *We obtain ... by ... and we release ... by ...*

Then ask the students to read the information in the section. Ask: *What are the two main parts of the respiratory system? Which parts is the respiratory tract divided in?* Establish that the respiratory tract and lungs form the respiratory system. Practice pronunciation of the parts of the respiratory tract. Ask: *Apart from respiration, which other functions does the larynx do?* Make sure that students understand that the vocal chords, located in the larynx, help us make sounds and talk.

At this point students could add new terminology to their graphic organisers. Students could work in groups to create illustrations of each of the individual parts using the diagram *Structure of the respiratory system to support their work*. Additionally they could create large images on card and cut them out to make a model of the respiratory system using a collage technique. Then students complete question 32 independently. This could be done as a practical experiment, where students measure how many times they breathe in during a minute when sitting, and then again just after running. When they have finished they share their answers.

### 4.1. Respiratory tract

Students read the section in pairs to find out characteristics of the parts of the respiratory tract. Since they have a good understanding

of the parts of the respiratory tract and what they look like, they should continue to work in groups using the models made at the beginning of this section. They could label the parts with their relevant characteristics and function. Then, each group could make a short presentation that explains how air travels into the bronchi and bronchioles using their models.

Make sure students understand that cells form the mucosa, so point their attention to the diagram *Section of the mucosa that covers the respiratory tract*. Complete question 33 as a whole class. Write *cilia cell* and *glandular cell* on the board. Explain that the cilia cell has long filaments, so we can see A is a cilia cell. Glandular cells produce mucous, so B is a glandular cell.

Next use the following link on the interactive whiteboard, or alternatively, students use laptops or computers to complete the virtual quiz. How fast can they label the respiratory system?

#### Weblink 6: RESPIRATORY SYSTEM LABELING INTERACTIVE

Simple interactive game that allows students to label a diagram of the respiratory system. It counts the mistakes and times the students as they complete the task.

After exploring the section, link and working with their models, students can complete question 34, 35 and 36 in pairs. Check their answers as a whole class.

**EXTRA RESOURCES**

AUDIO  
TALKING BOOK  
PDF  
REINFORCEMENT WORKSHEET 6  
CURRICULAR ADAPTATION WORKSHEET 6  
INTERACTIVE ACTIVITIES

**Answer key****Analyse**

- 32.** When do we breathe faster: when we are sitting down or when we are running? Why?

We breathe faster when we are running because our bodies need more oxygen.

**Apply**

- 33.** What type of cell is displayed in the image (see A and B)?

Cell A is a cilia cell and cell B is glandular cell.

**Understand**

- 34.** Why is it not possible to eat and breathe simultaneously?

Because the epiglottis closes when we swallow stopping any food from going down the respiratory tract.

**Analyse**

- 35.** Why is it more difficult to breathe in a dry climate than in a humid one?

Because pulmonary alveoli are covered by a watery thin layer, which helps the diffusion of respiratory gases. Dry weather conditions reduce the watery layer and the respiratory process becomes less efficient.

- 36.** What would happen if we didn't have cilia in our trachea?

Then certain microorganisms and impurities will reach our lungs and possibly cause infections.

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### 4.2. Gas exchange

The group formed by bronchi, bronchioles, alveoli and an extensive network of capillaries, constitutes the **lungs**: highly elastic bodies whose appearance resembles that of a sponge.

We have two lungs: the **right lung**, which has three parts called lobes and the **left lung**, which only has two lobes.

Lungs are enveloped by the **pleura**: a sheet composed of two membranes. In between both membranes there is a liquid that allows them to stay together and slide smoothly.

After traveling through the respiratory tract, air filled with oxygen reaches the pulmonary alveoli, where gas exchange occurs.

Pulmonary alveoli only have a layer of flat cells (endothelium) and are covered by a network of capillaries that facilitate gas exchange between air and blood.

Oxygen is exchanged between air and blood by the process of diffusion: oxygen travels from the area where its concentration is greater to the area where it is lower.

Oxygen concentration is higher in our alveoli than in our blood. Carbon dioxide concentration is lower in our alveoli than in our blood.

The oxygen found in air goes into the blood, after passing through the alveolar wall and the wall of the capillary, to be transported to the body's cells.

Carbon dioxide found in the blood passes to the alveoli. The air in the alveoli mixes with the carbon dioxide and it is released as we exhale.

Gas Exchange

pulmonary alveoli

pulmonary capillary

tissue capillaries

cells

Air in the alveoli needs to be renewed constantly for gas exchange to function effectively. This process is called **pulmonary ventilation**, although it is more commonly referred to as breathing (true respiration occurs in our cells).

**Evaluate**

37. Air obtained from the trachea is 16% oxygen and 4.6% carbon dioxide. At another point, it contains 20.5% oxygen and 0.4% carbon dioxide. Which composition represents air being inhaled? And which represents air being exhaled? Justify your answer.

### 4.3. Pulmonary ventilation

The intercostal muscles and the **diaphragm** (muscle that separates the thorax from the abdomen) are responsible for **pulmonary ventilation**.

It has two stages: the entrance of air or **inspiration**, and the release of air after gas exchange has occurred or **expiration**.

**Inspiration**: this is the respiratory movement in which air enters the lungs. The diaphragm flattens and lowers as the ribs rise outwards, increasing the capacity of the ribcage. As the ribcage widens its walls pull from the pleura, which are joined to the lungs. The lungs become enlarged, increasing their volume, and air enters them.

**Expiration**: this is the respiratory movement that releases air from the lungs. The diaphragm relaxes, curves and rises as the ribs sink, reducing the ribcage capacity. As a result, the ribcage shrinks and its walls pull from the pleura forcing the lungs to reduce their volume and release the air inside them.

**Inspiration**

Air enters  
Ribcage increases its volume  
The diaphragm contracts, flattens and lowers itself

**Expiration**

Air exits  
Ribcage decreases its volume  
The diaphragm relaxes, curves and rises

Stages of pulmonary ventilation

While resting, pulmonary ventilation is performed 16 times every minute. If we are exercising, pulmonary ventilation can be 8 to 10 times more frequent.

Air is renewed constantly during pulmonary ventilation: during normal conditions pulmonary ventilations transports about 8 litres of air every minute; however, it can transport up to 100 litres.

Our body uses precise mechanisms to regulate oxygen demands adequately, immediately accelerating pulmonary ventilation when more oxygen is needed and vice versa.

**Understand**

38. Why is pulmonary ventilation slow when we are asleep?

39. Why does condensation form in winter when we exhale air onto a window?

**Key concepts**

- The respiratory system is made up of respiratory tracts and lungs.
- Gas exchange occurs in the pulmonary alveoli.
- Pulmonary ventilation has two stages: inspiration and expiration. These two stages take place due to the action of the diaphragm and intercostal muscles.

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3. Nutrition: The digestive and respiratory systems 57

## 4.2. Respiratory tract

Students need to understand that the sole reason for the respiratory system to exist is to exchange gases between air and the blood. This section describes the process, which takes place in the pulmonary alveoli. It is worth emphasising that in the space between the two lungs, called the mediastinum, we find the esophagus, heart, the pulmonary arteries and veins. If appropriate, extend the information provided on this page, indicating that red blood cells pass along the narrow capillaries surrounding the alveoli, thanks to the elasticity of the blood cells.

Students read the section in pairs and take notes, then answer the following questions:

- *What is the difference between the left and right lung?* (The right lung has three lobes and left one only two.)
- *Describe the lungs.* (They are highly elastic bodies whose appearance resembles that of a sponge.)
- *What is the pleura?* (It is a sheet composed of two membranes that envelopes the lungs.)

Once they have finished students change partners and, using their notes only, they take turns to explain to each other the answers to the three questions. Next, they complete activity 37 in pairs.

Finally, show this video, which is a great resource for students to visualise the process of gas exchange. When students finish watching the video, they can try to explain the process of gas exchange in 30 seconds using key vocabulary. They should use the diagram Gas exchange to support their 30-second explanations.

### Video 2: GASEOUS EXCHANGE BETWEEN ALVEOLI AND CAPILLARIES

This short animation explains the process of gas exchange as it gradually zooms into pulmonary alveoli. Video 2 worksheet contains some questions to test students' knowledge.

## 4.3. Pulmonary ventilation

To introduce this section, ask students to breathe in and out, thinking about what happens in their body during this process. Ask some students to explain. *When we breathe in, our lungs... . When we breathe out our lungs... .*

Ask: *What are the scientific terms for breathing in and breathing out? What else happens during pulmonary ventilation?* Students read the first section of the text and look at the diagrams. Discuss their answers as a whole class.

Students could create 3-D models of the respiratory system using recycled materials. Clear plastic bottles could simulate the lungs, newspaper, or magazine pages to create a pleura, and some tubes to simulate the respiratory tract. String or a bendy material could create the ribcage. This is just a suggestion, students could use any materials they want; the aim is to create a model that they can use to explain the processes of inspiration and expiration as well as to familiarise themselves with the parts involved. Students could also search on the Internet to find ways to make a model.

Students read the last three paragraphs. Ask: *Why does the rate of pulmonary respiration change so much?* Then, students complete question 38 and 39 in pairs in order to promote discussion.

To practise the key vocabulary about the respiratory system, write the following sentences on the board, for students to complete. Students can then check their answers by looking at the Key concepts section.

- *The respiratory system is made up of \_\_\_\_\_ and \_\_\_\_\_.*
- *Gas exchange occurs in the \_\_\_\_\_.*
- *Pulmonary ventilation has two stages: \_\_\_\_\_ and \_\_\_\_\_. These two stages take place due to the action of the \_\_\_\_\_ and intercostal muscles.*

(Pulmonary alveoli, diaphragm, lungs, inspiration, respiratory tracts, intercostal muscles and expiration.)

#### EXTRA RESOURCES

AUDIO  
TALKING BOOK  
PDF  
REINFORCEMENT WORKSHEET 7  
CURRICULAR ADAPTATION WORKSHEET 7  
INTERACTIVE ACTIVITIES

## Answer key

### Evaluate

- 37.** Air obtained from the trachea is 16% oxygen and 4.6% carbon dioxide. At another point, it contains 20.5% oxygen and 0.4% carbon dioxide. Which composition represents air being inhaled? And which represents air being exhaled? Justify your answer.

The air that contains less oxygen (16%) and carbon dioxide (4.6%) is being exhaled. This is because it has already lost some oxygen and carbon dioxide has been incorporated.

### Understand

- 38.** Why is pulmonary ventilation slow when we are asleep?

Because pulmonary respiration depends on our oxygen needs. When we are resting the energy needs are minimal.

- 39.** Why does condensation form in winter when we exhale air onto a window?

Condensation is formed by the water droplets that deposit themselves on a cold surface. This process shows that we release water vapour as we exhale during respiration.

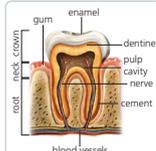
### 5. HEALTHY HABITS: ILLNESSES OF THE DIGESTIVE AND RESPIRATORY SYSTEMS

The following pages explain the way certain habits can contribute to the health of the digestive and respiratory systems, as well as the most frequent illnesses that can affect those systems.

#### 5.1. Digestive system: health

In order to look after the organs that are part of the digestive system follow the steps below:

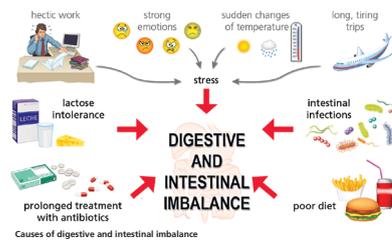
- Chew food slowly, making sure that all food is crushed properly. By doing this, you'll help the digestive process and stimulate salivation.
- Brush your teeth after each meal in order to eliminate any small pieces of food. Also, use dental floss to clean areas that the toothbrush can't reach.
- Visit the dentist at least once a year.
- Do not eat or drink foods that are very hot. They can irritate the mucus in our mouth, pharynx and even the esophagus. Do not eat too many spicy foods as they can irritate the mucus in the stomach.
- Wash your hands before eating or preparing food.
- Avoid eating out of meal times to prevent the digestive system from functioning non-stop.
- Ensure foods you prepare or eat are in perfect condition in order to prevent food poisoning.
- Eat foods that have  **fibre**  as they help intestinal movements, allowing foods and faeces to travel through our body more easily.
- Do not consume alcohol. Regular alcohol consumption can cause irreversible damage to the liver and pancreas and can be responsible for stomach and esophageal cancer.



Structure of a molar

#### Analyse

40. Poor hygiene causes the accumulation of bacteria between the gums and teeth. Look at the image and explain why our molars hurt when we have cavities.



Causes of digestive and intestinal imbalance

#### 5.2. Illnesses of the digestive system

The organs of the digestive system can suffer from a range of conditions. Some of them can be found in the table below.

<b>The mouth</b>	
<b>Cavities</b>	This is the destruction of the tooth enamel caused by the bacterial decomposition of food remains lodged between the teeth.
<b>Gingivitis</b>	Painful inflammation of the gums, where they bleed and redden.
<b>Pyorrhoea</b>	This is the inflammation and infection of the ligaments and bones that support the teeth.
<b>The stomach</b>	
<b>Gastritis</b>	This condition occurs due to an irritation of the gastric mucosa, causing it to become inflamed. It produces symptoms such as heartburn.
<b>Ulcers</b>	Ulcers are wounds caused by the destruction of gastric mucosa. They are usually located in the stomach or duodenum.
<b>The liver</b>	
<b>Hepatitis</b>	Hepatitis is an inflammation of the liver caused by certain viruses, the abusive consumption of alcohol or certain medicines.
<b>Cirrhosis</b>	A serious illness that destroys hepatic cells.
<b>Gallstones</b>	Also referred to as stones, these are solid particles composed of cholesterol or the minerals found in bile.
<b>The intestine</b>	
<b>Gastroenteritis</b>	An intestinal infection caused by certain bacteria in water or food. Some forms of this illness, such as cholera and typhoid, are very serious conditions and can cause death.
<b>Appendicitis</b>	Inflammation of the appendix characterised by intense pain, vomiting and fever. It's usually caused by bacterial infection.
<b>Constipation</b>	This condition is characterised by difficulty passing stools due to the low mobility of the large intestine.
<b>Diarrhea</b>	This occurs when food travels through the large intestine very fast, due to intense and rapid contractions. Faeces are very runny (liquid) because no water is absorbed.
<b>Celiac disease</b>	An autoimmune disease characterised by a chronic infection of the jejunum. It's caused by the body reacting adversely to exposure to gluten, a type of vegetable protein.
<b>Colon cancer</b>	This is a malignant tumour that begins in the colon and may invade other organs. It often develops from polyps or bulges forming in the mucosa.



Stomach ulcers



Inflamed appendix  
Appendicitis

#### Analyse

41. Why does the use of antibiotics for a prolonged time cause intestinal imbalances?
42. Why does chewing your food aid digestion?
43. Why do gallstones affect the way fats are digested?

#### Create

44. Investigate Crohn's disease and then create a short presentation about it.
45. What is cholera? Research this condition and write a short report about it.

## 5. Healthy habits: illnesses of the digestive and respiratory systems

The first double spread describes healthy habits and the most common illnesses of the digestive system. It is important students know the causes of the illnesses so they can prevent them, however the most important thing is to emphasise the importance of having positive healthy habits.

It is also important to know certain risks associated to foods that are not dependent on eating habits, such as accidental infections (Salmonella or other bacteria and viruses that cause gastroenteritis). In this regard it is important to remind the importance of guidelines for personal hygiene, such as washing hands before eating, and also the tips on food hygiene, which we have studied before.

### 5.1. Digestive system: health

Ask students to use their knowledge of the digestive system parts and think about ways in which we could make sure it is well looked after. Discuss their contributions and write them on the board. Then, get students to read the health tips in this section.

For this section students could create posters that persuade people to look after the digestive system. They should use attention grabbing designs and images as well as interesting slogans that encourage people to have healthy habits that ensure the well being of the digestive system. They can work in groups using a range of art materials. Then, students complete question 40 in pairs. If needed discuss what cavities are, although they probably have first hand experience of cavities themselves.

In addition, students can use the following web link to find additional information about how to look after our digestive tract from a dietary point of view.

#### Weblink 7: NUTRITION

This web page displays simple tips on how to eat healthily and keep our digestive system in good shape.

### 5.2. Illnesses of the digestive system

Ask students if they remember, or if they know, any illnesses that are related to the digestive system. Discuss students' contributions by locating the organ(s) affected and describe the symptoms. Then, read the list of illnesses in the section as a whole class concentrating on the pronunciation of the terms.

Next put students in groups of four and provide them with photocopies (one per group, if possible enlarged ones) of the table displaying common illnesses of the digestive system. Ask students to cut the table into individual strips and then into cells. Tell them to shuffle them. Next, groups work together to match up the name of the illness with its description without using their books. Give groups five minutes to complete the task.

When the first group has finished, ask all the other groups to stop. Check that they have matched them up correctly. If not, they have to shuffle them all and start again. The first group to match up all the illnesses with the correct descriptions wins.

As students are doing the sorting activity, write the names of all the illnesses on the board and create a table with following labels:

mouth, stomach, liver and intestine. Students help you sort the conditions according to the organ that they affect. Then they complete question 41 as a whole class. Discuss how antibiotics work by destroying bacteria (both harmful and beneficial bacteria) if students don't know already. Students complete questions 42 and 43 in pairs. Question 44 and 45 are to be completed at home as part of their homework as they need to research Crohn's disease and cholera. Alternatively provide students with information about both conditions to research in class.

#### EXTRA RESOURCES

AUDIO  
TALKING BOOK  
PDF  
REINFORCEMENT WORKSHEET 8  
CURRICULAR ADAPTATION WORKSHEET 8  
INTERACTIVE ACTIVITIES

### Answer key

#### Evaluate

- 40.** Poor hygiene causes the accumulation of bacteria between the gums and teeth. Look at the image and explain why our molars hurt when we have cavities.

Because bacteria destroy the enamel of the tooth, leaving the nerve unprotected and exposed to feelings of pressure, heat, cold or the action of the substances released during the inflammatory process after an infection.

- 41.** Why does the use of antibiotics for a prolonged time cause intestinal imbalances?

Because antibiotics destroy the symbiotic bacteria in our intestine as well as the pathogens that it aims to destroy. This stops the protective action of symbiotic bacteria and can cause imbalances, such as diarrhoea.

- 42.** Why does chewing your food aid digestion?

Because food is broken into smaller pieces facilitating the job of the digestive enzymes. Poor chewing of the food decreases the effectiveness of digestion.

- 43.** Why do gallstones affect the way fats are digested?

Because gallstones stop the bile from being released properly. The enzymes in the bile are responsible for breaking down fats, so a lack of bile causes poor digestion of fats.

#### Create

- 44.** Investigate Crohn's disease and then create a short presentation about it.

Crohn's disease is a chronic disease of the small intestine. It is thought to be an autoimmune disease, in which an impaired immune system attacks its own intestine causing inflammation.

- 45.** What is cholera? Research this condition and write a short report about it.

Cholera is a bacterial infection that causes serious intestinal disorders, as well as severe diarrhoea that can lead to dehydration and death. It is contracted by drinking water contaminated with faecal matter.

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### 5.3. Taking care of the respiratory system

These are some of the recommendations that we can follow in order to keep our respiratory organs healthy.

■ Do not smoke. The regular consumption of tobacco can cause serious harm to the respiratory tract and the lungs. When tobacco burns, certain carcinogenic substances are produced; they are inhaled with the smoke and they increase the smoker's chances of getting cancer. They can also lead to chronic bronchitis and emphysema. Smoking is related to some of the most serious pulmonary illnesses. Passive smokers, especially children, can also get the illnesses described.

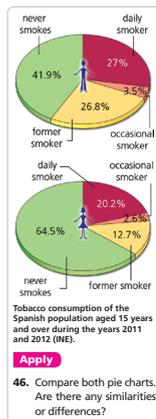


Lungs of a non-smoker (A) and lungs of a smoker (B)

■ Try to avoid sudden changes of temperature as such changes increase the risk of contracting respiratory illnesses. In addition, people that suffer from asthma can have difficulty breathing as their bronchia contracts if the temperature drops and becomes very cold.

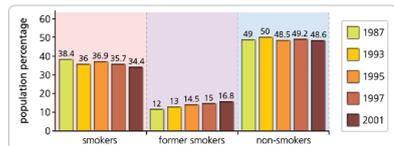
■ Do physical exercise regularly. Practising a sport increases pulmonary ventilation, as the muscles need more oxygen. Regular physical activity increases lung capacity and mobilises the mucus of the respiratory tracts.

■ Try to avoid being in contact with dust and atmospheric contaminants. Particles floating in the air and contaminating gases irritate the respiratory mucosa and can promote the development of several throat, larynx, tracheal and bronchial conditions.



#### Apply

46. Compare both pie charts. Are there any similarities or differences?



#### Analyse

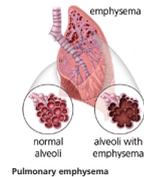
47. Look and answer:

- Can you identify any trends in the smokers group?
- Do they coincide with trends in the non-smokers group? Why?

### 5.4. Illnesses related to the respiratory system

Illnesses related to the respiratory system are caused by infections or an inflammation of the mucosa.

Infectious illnesses	
<b>Nasal catarrh, pharyngitis, sinusitis, bronchitis, pneumonia</b>	These are infectious diseases that have a variety of names depending on the location of the infection: nose, pharynx, tonsils, bronchi, bronchioles or lungs, respectively. The affected area swells up and mucus secretion increases. Other symptoms may include a cough, fever or localised pain.
<b>Flu</b>	A widespread viral disease that causes a winter pandemic every ten to fifteen years. It can be deadly to high-risk groups, such as the elderly and people who suffer from heart disease, lung infections or other chronic infections.
Non-infectious illnesses	
<b>Aphonia</b>	Difficulty emitting sounds due to the inflammation of the vocal chords.
<b>Sinusitis</b>	Inflammation of the sinus cavities of certain bones in the skull that are connected to the nostrils.
<b>Allergic rhinitis</b>	The presence in the air of certain substances (pollen grains, dust, fungi, among others) can trigger reactions, known as allergies. They can manifest themselves through symptoms such as a runny nose, itching or sneezing.
<b>Asthma</b>	As a result of certain infectious processes or an allergic reaction, there is a contraction of the bronchi, complicating the passage of air and making it more difficult to breathe. This causes a feeling of breathlessness and anxiety.
<b>Chronic bronchitis</b>	Irritation of the bronchial lining caused by a variety of factors including smoke and air pollutants. The disease is characterised by frequent coughing, chest pain and asthma.
<b>Emphysema</b>	This produces an enlargement of the pulmonary alveoli, causing them to break.
<b>Pleurisy</b>	This is an inflammation of the pleura. It causes severe pain (especially when coughing), fever and sometimes pleural fluid spills.
<b>Lung and throat cancer</b>	These are malignant tumours characterised by the uncontrolled growth of a mass of lung/throat tissue that invades and destroys adjacent tissues. The development of such tumours is closely related to smoking.
<b>Chronic obstructive pulmonary disease (COPD)</b>	This is characterised by an inflammation of the bronchi and the destruction of lung tissue. The inflammation blocks the flow of air obstructing its passage to the lungs. The most common cause is smoking, and its symptoms are coughing, shortness of breath and tiredness.



#### Key concepts

- Certain illnesses that relate to the digestive system can be caused by infections, a lack of hygiene or poor lifestyle habits.
- Exposure to certain substances can damage the respiratory mucosa or promote the onset of cancer.
- A balanced diet, good hygiene and avoiding alcohol and tobacco consumption help prevent serious illnesses related to the respiratory and digestive systems.

#### Analyse

48. Why do we produce more respiratory mucous when we have a cold?

### 5.3. Taking care of the respiratory system

This second part describes healthy habits and common illnesses of the respiratory system. It is important to spend some time explaining the consequences of tobacco consumption. This is important because students will have to create a poster for their antismoking campaign later on at the end of the unit.

Students read the four bullet points that explain health recommendations. When they have finished ask them the following questions in order to check their understanding of the text. Ask: *Why should we try to avoid sudden changes of temperature? Why should we exercise regularly?* Students discuss in pairs and try to form full sentences, for example: *Exercising increases pulmonary respiration; regular exercise expands our lung capacity and mobilises the mucus.*

If appropriate, students can use the following link to research antismoking campaigns in order to inspire their own one.

#### Weblink 8: ANTISMOKING CAMPAIGN HIGHLIGHTS HOW CIGARETTES 'ROT THE BODY FROM THE INSIDE'

Article describing the Anti-smoking campaign of Public Health England. It has images that students can use as inspiration for their posters.

Perhaps after this they could create a plan for their posters in groups, or at least jot down some ideas. Then complete activities 46 and 47 and have a class discussion about the consequences of smoking.

### 5.4. Illnesses related to the respiratory system

Other common respiratory diseases students should be familiar

with at this age are respiratory infections. Although not always easy to avoid, perhaps ideas on how to prevent their spread could be discussed (cover your mouth with your arm, rather than the hand when coughing or sneezing; wash hands after and avoid sharing objects like glasses or cutlery when we believe we have had contact with sick people or if we are sick ourselves).

This amusing article explains how scientists have proved that fist bumping is much more hygienic than handshakes. Students should read it and then they could think of more hygienic ways of greeting someone.

#### Weblink 9: FIST BUMPS 'CLEANER THAN HANDSHAKES'

This article from the BBC explains how scientists from Aberystwyth University in Wales have proven that hand shaking is very unhygienic and that there are other, cleaner ways of greeting someone.

Students read the table of common illnesses in pairs. Discuss ways in which we could prevent non-infectious diseases and make sure you emphasise the importance of not smoking once again. Then they could create visual representation of the illnesses of the respiratory system and add them to the graphic organisers. Discuss how the body reacts to some of these illnesses, such as flu or colds. Certain areas swell up and there is an increased production of mucous to protect the body against microorganisms. Then, students can complete question 48 independently.

To practise the key vocabulary about the respiratory system, write the following sentences on the board, for students to complete. Students can then check their answers by looking at the Key concepts section.

■ Certain illnesses that relate to the digestive system can be

caused by \_\_\_\_\_, a lack of \_\_\_\_\_ or poor lifestyle habits.

- Exposure to certain \_\_\_\_\_ can damage the respiratory mucosa or promote the onset of cancer.
- A ... , good hygiene and avoiding \_\_\_\_\_ and \_\_\_\_\_ consumption help prevent serious \_\_\_\_\_ related to the respiratory and digestive systems.

(Tobacco, alcohol, hygiene, balanced diet, illnesses, substances.)

#### EXTRA RESOURCES

AUDIO  
TALKING BOOK  
PDF  
REINFORCEMENT WORKSHEET 9  
CURRICULAR ADAPTATION WORKSHEET 9  
INTERACTIVE ACTIVITIES

### Answer key

#### Apply

- 46.** Compare both pie charts. Are there any similarities or differences?

Because bacteria destroy the enamel of the tooth, leaving the nerve unprotected and exposed to feelings of pressure, heat, cold or the action of the substances released during the inflammatory process after an infection.

#### Analyse

- 47.** Look and answer:

- a) Can you identify any trends in the smokers group?

Over the 16 year period there has been a small reduction in the number of smokers.

- b) Do they coincide with trends in the non-smokers group? Why?

The increase of non-smokers is related to the decrease of smokers. There is a correlation.

- 48.** Why do we produce more respiratory mucous when we have a cold? .

Amongst others, mucus has the function of capturing microorganisms found in the body. There are many of these microorganisms when you suffer from a cold. The reaction of the organism, as a defence system, is to increase the production of mucus.

3

## CONSOLIDATION

## Human nutrition

49. Explain why carbohydrates, fats and proteins are important for our bodies.
50. Why is the respiratory system involved in the function of nutrition?
51. Identify the terms that relate to the following definitions:
- A large gland located on the upper part of the abdomen.
  - This organ produces trypsin.
  - A substance located in the trachea that captures unwanted particles.
  - A section of the intestine that is before the rectum.
  - A secretion that helps the passage of bolus.
  - This enzyme is produced in the stomach.
  - Inspired air goes through this organ as it warms up.
  - This organ is part of the respiratory and digestive systems.

## Digestive system

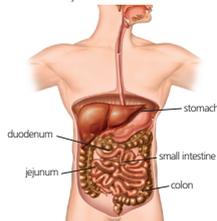
52. What are the annexed glands of the digestive system?
53. What separates the chest cavity from the abdominal cavity? What part of the digestive tract is in the thoracic cavity?
54. Why do you think the stomach has three layers of muscle, while the rest of the digestive system only has two?
55. Explain how the digestive system prepares foods so it can be absorbed by all body cells.
56. The liver, as well being involved in the digestion process, performs other functions. What are they?

## Digestion

57. Describe the function of the following components of saliva: water, mucus and amylase.
58. Which of the following processes are essential for the complete digestion of oil?
- Production of pepsin
  - Secretion of bile
  - Chewing
  - Swallowing
  - Production of lipase
59. Athletes consume glucose when they're performing intense exercises. What are the advantages of consuming glucose instead of certain foods like bread and potatoes?

60. Match each organ found in the diagram to the following functions:

- Glucose absorption
- Chyme formation
- Sodium bicarbonate secretion
- Water absorption
- Formation of chyle



61. The following table displays the quantities of nutrients (g) found in a meal as well as the quantity of the same nutrients found in faeces. Can you make any conclusions after studying the data?

	Nutrients in food	Nutrients in faeces
Carbohydrates	300 g	Cellulose (18 g); otherwise insignificant quantities.
Lipids	50 g	1 g
Proteins	80 g	Insignificant quantities
Water	1200 g	80 g
Minerals	9 g	0.5 g
Vitamins	0.01 mg	0

62. Name the enzymes involved in protein digestion and explain where they come from.

63. Copy and complete the following table:

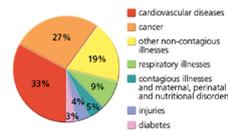
Enzyme	Organ	Function
Trypsin	...	...
Lipase	...	...
...	...	Starts the digestion of proteins
...	...	Digests sucrose
...	Salivary glands	...

## The respiratory system

64. What are the pleura?
65. Why do you think the group of each bronchus with the bronchioles formed from it is called bronchial tree?
66. Why is the trachea reinforced with cartilage rings?
67. What special characteristics do alveoli have in order to facilitate the passage of respiratory gases through them?
68. When the work of cilia and tracheal mucus is not enough, the body uses two other mechanisms to eject particles found in the airways. What are they?

## Healthy habits: illnesses of the respiratory and circulatory systems

69. Look at the following pie chart. Does it support the view that smoking is one of the greatest threats to our health?



70. Why do we sometimes suffer from heartburn?
71. What is the function of the pharynx when our body tries to protect itself from infection?

72. Why does air reach our lungs clean, humid and warm?

73. Why do we have to cover our mouths when we cough or sneeze?

## READ AND UNDERSTAND SCIENCE

## Microbiota composition

The human intestine hosts an enormous quantity of microorganisms, approximately 100 trillion (ten times more than the total number of cells found in the body). Microorganisms found in the intestine are mostly bacteria (belonging to over 1000 species). Every individual has a different microbiota composition that varies, although all people host a range of microorganisms that they have in common.

The human microbiota is created in the early stages of life as we are exposed to microorganisms; however, it may vary depending on our age, diet, geographical location, intake of food supplements or drugs, as well as other environmental factors.

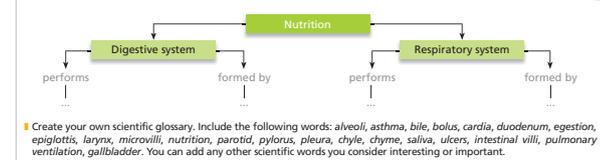
Intestinal microorganisms perform an essential role. They ensure our intestines are healthy as well as influencing our immunological system. Changes in the intestinal microbiota of an individual can potentially increase the risk of contracting infections.

EFUIC (European Food Information Council) October 2013

- How can the intestine host such a high number of microorganisms?
- Why is intestinal microbiota often compared with a fingerprint?
- How can food or antibiotics affect intestinal microbiota?
- Sometimes we can see adverts for products that are rich in probiotic substances. Find out what probiotics are and how they relate to intestinal microbiota.

## STUDY SKILLS

- Create your own summary of the unit using the Key concepts. Add other important information.
- Copy the following diagram and add the missing information to create a conceptual map of the unit.



- Create your own scientific glossary. Include the following words: alveoli, asthma, bile, bolus, cardia, duodenum, egestion, epiglottis, larynx, microvilli, nutrition, parotid, pylorus, pleura, chyle, chyme, saliva, ulcers, intestinal villi, pulmonary ventilation, gallbladder. You can add any other scientific words you consider interesting or important.

62

3. Nutrition: The digestive and respiratory systems 63

## Human nutrition

49. Explain why carbohydrates, fats and proteins are important for our bodies.

Carbohydrates are primarily energy substances; lipids can be energetic, have structural or regulatory functions; Proteins are the major structural molecules.

50. Why is the respiratory system involved in the function of nutrition?

The respiratory system is responsible for the addition of oxygen to the lungs, which is then distributed to the cells. The cells use oxygen to obtain energy from nutrients.

51. Identify the terms that relate to the following definitions:

- a) A large gland located on the upper part of the abdomen.

Liver

- b) This organ produces trypsin.

Pancreas

- c) A substance located in the trachea that captures unwanted particles.

Mucus

- d) A section of the intestine that is before the rectum.

Colon

- e) A secretion that helps the passage of bolus.

Saliva

- f) This enzyme is produced in the stomach.

Pepsin

- g) Inspired air goes through this organ as it warms up.

Nose

- h) This organ is part of the respiratory and digestive systems.

Pharynx

## Digestive system

52. What are the annexed glands of the digestive system?
- Saliva glands, liver and pancreas

53. What separates the chest cavity from the abdominal cavity? What part of the digestive tract is in the thoracic cavity?

The diaphragm. The esophagus is in the thoracic cavity.

54. Why do you think the stomach has three layers of muscle, while the rest of the digestive system only has two?

The stomach has three layers of muscle (longitudinal, circular and oblique) because its mechanical digestive action is much more intense than other organs in the digestive system. In addition, the stomach makes more complex movements than the esophagus and small intestine.

55. Explain how the digestive system prepares foods so it can be absorbed by all body cells.

Food consists of large molecules that cannot cross the cell membrane. The function of the digestive system is to break these molecules into smaller ones that can be carried by the

circulatory system to the various tissues. Then they can be absorbed by cells and used during cell metabolism.

- 56.** The liver, as well being involved in the digestion process, performs other functions. What are they?

The liver stores glycogen as a reserve substance, synthesises certain proteins and participates in the excretion process, eliminating substances from the blood that could be harmful to the body.

## Digestion

- 57.** Describe the function of the following components of saliva: water, mucus and amylase.

Water: helps food to dissolve.

Mucus: lubricates and makes swallowing easier.

Amylase: breaks down starch

- 58.** What cell has more mitochondria, one found in muscle tissue or one found bone tissue? Why?

- a) Production of pepsin
- b) Secretion of bile
- c) Chewing
- d) Swallowing
- e) Production of lipase

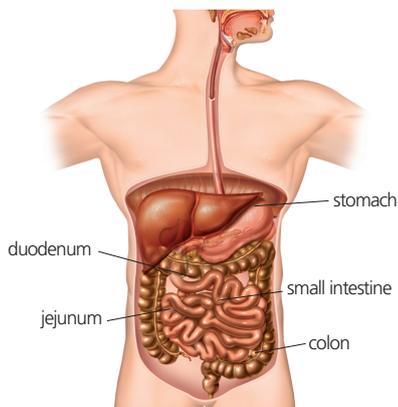
In order to digest oil we have to swallow, secrete bile and produce lipase for the digestion process.

- 59.** Athletes consume glucose when they're performing intense exercises. What are the advantages of consuming glucose instead of certain foods like bread and potatoes?

It refers to the connective tissue that binds other tissues when organs are formed and which forms the outer boundary of the organs.

- 60.** What type of tissue is predominant in the following organs?

- a) Glucose absorption. Small intestine
- b) Chyme formation. Stomach
- c) Sodium bicarbonate secretion. Duodenum
- d) Water absorption. Colon
- e) Formation of the chyle. Duodenum and first part of the jejunum



- 61.** The following table displays the quantities of nutrients (g) found in a meal as well as the quantity of the same nutrients found in faeces. Can you make any conclusions after studying the data?

	Nutrients in food	Nutrients in faeces
Carbohydrates	300 g	Cellulose (18 g); otherwise insignificant quantities.
Lipids	50 g	1 g
Proteins	80 g	Insignificant quantities
Water	1 200 g	80 g
Minerals	9 g	0.5 g
Vitamins	0.01 mg	0

The conclusions are obvious:

- There are nutrients, which are incorporated into the body completely and will not appear in faeces. This is the case of vitamins and proteins.
- Some nutrients are absorbed in large quantities, but not completely (lipids, water and mineral salts).
- Carbohydrates are a special case because cellulose (dietary fibre constituent) is not absorbed and is found in faeces; the rest is incorporated into the body almost entirely.

- 62.** Name the enzymes involved in protein digestion and explain where they come from.

First pepsin, found in gastric juices, breaks down protein molecules into smaller fragments. Trypsin, from pancreatic juice, breaks the fragments into smaller pieces and then erepsin, found in intestinal juices, breaks them down into amino acids.

- 63.** Copy and complete the following table:

Enzyme	Organ	Function
Trypsin	Pancreas	Digests sucrose
Lipase	Pancreas, small intestine	Digests fats
Pepsin	Stomach	<b>Starts the digestion of proteins</b>
Sucrase	Small intestine	<b>Digests sucrose</b>
Amylase	<b>Salivary glands</b>	Digests starch

## The respiratory system

- 64.** What are the pleura?

It's a film that surrounds the lungs. It consists of two membranes; in between them there is a liquid that allows them to stay together and glide smoothly.

- 65.** Why do you think the group of each bronchus with the bronchioles formed from it is called bronchial tree?

Because it branches out like a tree.

**66. Why is the trachea reinforced with cartilage rings?**

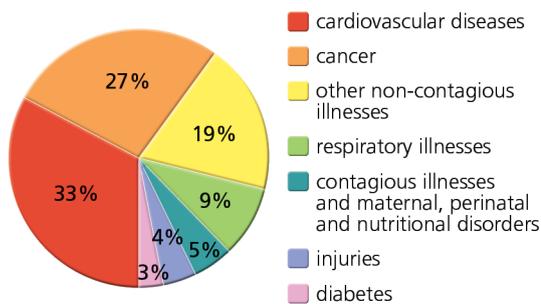
To stop it from collapsing when we bend our necks or receive pressure in the area.

**67. What special characteristics do alveoli have in order to facilitate the passage of respiratory gases through them?**

The alveoli are surrounded by a single layer of flattened cells (endothelium) that are covered by a rich network of capillaries. The capillaries facilitate the exchange of gases between air and blood.

**68. When the work of cilia and tracheal mucus is not enough, the body uses two other mechanisms to eject particles found in the airways. What are they?**

Coughing and sneezing.

**Healthy habits: illnesses of the respiratory and circulatory systems****69. Look at the following pie chart. Does it support the view that smoking is one of the greatest threats to our health?**

Yes, because smoking is the most common cause of respiratory illnesses, cancer or cardiovascular disease.

**70. Why do we sometimes suffer from heartburn?**

Because there is an excess hydrochloric acid, usually as a result of ingestion of certain foods.

**71. What is the function of the pharynx when our body tries to protect itself from infection?**

Tonsils, located in the side walls of the pharynx, produce white blood cells that defend our body from organisms causing infections.

**72. Why does air reach our lungs clean, humid and warm?**

As you breathe in through your nose air passes through mucus that is highly irrigated by blood vessels and moisturises and heats the air. In addition, the nose hairs and mucus trap harmful particles that may be in the air.

**73. Why do we have to cover our mouths when we cough or sneeze?**

Coughing and sneezing expel droplets of saliva that may contain pathogens. We cover our mouths to avoid infecting others.

**READ AND UNDERSTAND SCIENCE****a) How can the intestine host such a high number of microorganisms?**

Due to its length as well as the small size of bacteria: about 100 times smaller than our cells.

**b) Why is intestinal microbiota often compared with a fingerprint?**

Because the composition of the microbiota is different in each person as it depends on many factors: the first microorganisms to which we are exposed in the early stages of life, our age, diet, geographic area, medicines we take, etc.

**c) How can food or antibiotics affect intestinal microbiota?**

Food in the early years of life affects the intestinal microbiota. As our diet changes throughout our life we will have bacteria that has a preference for the type of nutrient we are digesting.

Antibiotics alter the composition of the microbiota, because they destroy symbiotic bacteria as well as pathogens.

**d) Sometimes we can see adverts for products that are rich in probiotic substances. Find out what probiotics are and how they relate to intestinal microbiota.**

Probiotics are foods that have had non-pathogenic live microorganisms added to them that contribute to the balance of the intestinal microbiota and strengthen the immune system.

**Study skills**

Open answer

**EXTRA RESOURCES**

PDF:

COMPETENCE TEST

CONCEPT MAP

EXTENSION WORKSHEET

UNIT TESTS

INTERACTIVE ACTIVITIES

PRESENTATION



### Starch digestion

It is possible to observe how starch (a complex carbohydrate comprised of glucose molecules) begins to be digested as it mixes with the amylase present in our saliva, as you shall see. In addition, you will do a scientific experiment to see how temperature affects digestive action.

**Materials**

- 3 test tubes
- Rack
- Mortar

- Funnel
- Filter
- Lugol's solution

- Beaker
- Wooden tweezers
- Bread

**Procedure**

- Number the test tubes '1', '2' and '3'.
- Place some breadcrumbs in water and use the mortar to mash them up. You should obtain a whitish liquid. Filter the liquid and then pour it into three different test tubes.
- Pour some of your saliva through the funnel into test tubes 2 and 3.
- Pour 300 ml of water into the beaker. Place test tubes 1 and 2 in the beaker and warm them up gently; do not boil the water.
- Remove the test tubes using the wooden tweezers and place them on the rack to cool.
- Perform the Lugol test in all test tubes. Do so by adding a drop of Lugol solution to each test tube. Lugol solution is a substance that will react by changing colour when it is in the presence of starch and sugar.
- Finally perform the Biuret test. This process will help you find existing proteins.
- Collect data in the following table. If the reaction was very strong use the symbols ++, if the reaction is moderate use the symbol +. Finally use the symbol – if the reaction did not occur.

	Test tube 1	Test tube 2	Test tube 3
Reaction	...	...	...

- Create a scientific report that includes photographic evidence of your scientific experiment. Make sure that your report answers the following questions:
  - What is the objective of the scientific experiment?
  - What are the different variables and what is your hypothesis?
  - What is the function of test tube 1 and why did we only warm up test tubes 1 and 2?
  - What conclusions can you make from your scientific experiment? Do the results obtained corroborate your hypothesis?
  - Look at your conclusions and describe the activity of amylase.

### Anti-smoking campaign

The objective of this research task is to identify some of the harmful effects of tobacco, as well as the relationship between smoking and certain illnesses. After completing the research stage you will create a poster that displays tobacco's negative effects.

**1. Research**

- Why is smoking addictive?
- What types of substances are found in cigarettes?
- What are some of the adverse effects smoking produces?
- Which illnesses are related to smoking?
- What are the benefits of giving up smoking?
- How many people die as a result of smoking every year?

**2. Presentation**

In order to present your results, you will create a poster:

- Make sure the poster is attention grabbing and easy to read.
- Remember that the aim of the campaign is to make an impact; your poster should not have too much information, but instead it should have a clear message.
- Emphasise the benefits of giving up smoking.

**Procedure**

In order to complete this investigation, follow these steps:

**Research**

- Find out which tobacco components are the most harmful.
- Research illnesses that are related to smoking and how they affect an individual's health.
- Find out the annual percentage of deaths caused directly or indirectly by smoking.
- Create a list of reasons to stop smoking.

**Organising data**

- Create an attention-grabbing title.
- Select relevant images and information.
- Use graphs to represent numerical data.

**Obtaining and verifying your results**

- Always verify your findings.
- Make sure that your images and graphs convey the message you are trying to deliver clearly.

**SELF-ASSESSMENT**

After completing the investigation, answer the following questions:

- Have you referred to a variety of sources? How reliable are they?
- Have you created your own original design?
- Have you found enough information to answer the questions in the *Research* section?
- Rate your poster on a scale of 1 to 5.

## Starch digestion

At the beginning of this activity pupils will have to place saliva in test tubes. Sometimes pupils might say that they do not produce enough saliva. In this case ask them to hold a small drink of water in their mouths and leave it there for a small period of time.

If students have no previous training they might need help identifying the variables as well as the control test tube. Discuss the problems of having slight inaccuracies when controlling variables as well as the objective of the experiment, which is to find out if temperature affects the digestive action of amylase. Before completing the experiment get students to formulate their own hypothesis.

By doing this science experiment students will achieve the following key competences:

- **Mathematical competence and basic competences in science and technology (MCST)**
- **Learning to learn (LL)**
- **Sense of initiative and entrepreneurship (SIE)**

## Answer key

- Create a scientific report that includes photographic evidence of your scientific experiment. Make sure that your report answers the following questions:
  - What is the objective of the scientific experiment?**  
To find out if temperature affects the digestive action of amylase.

- What are the different variables and what is your hypothesis?**

The independent variable is the temperature. The dependent variable is the action of amylase, as measured by the amount of starch remaining after operation.

- What is the function of test tube 1 and why did we only warm up test tubes 1 and 2?**

Test tube 1 is the control test tube. Test tube 2 was heated up to see if there were differences with the one that was not warmed up. Test tube 1 was heated up to check that the differences are not due to something that happened to the bread, and verify that it is the action of amylase.

- What conclusions can you make from your scientific experiment? Do the results obtained corroborate your hypothesis?**

Amylase acts better at body temperature and even at slightly higher temperatures, provided it is not too high as to destroy the enzyme. The hypothesis corroboration would depend on the students' hypothesis, so it is an open answer.

- Look at your conclusions and describe the activity of amylase.**

Amylase starts the digestion of starch molecules, which are present in many foods (bread, potatoes, rice, and so on) and transforms them into simpler sugars. In order to do this, amylase breaks down the most complex sugars into simpler ones. The temperature of the body ensures amylase can perform its function adequately.

## Anti-smoking campaign

The final task of this unit aims to help students become aware of the dangers of smoking. They will research this harmful addiction and how it affects the body in order to then create an anti-smoking campaign that will convince people to never touch a cigarette.

In addition it might be useful to look again at the weblink *ANTISMOKING CAMPAIGN HIGHLIGHTS HOW CIGARETTES 'ROT THE BODY FROM THE INSIDE'*. This will inspire students to create attention grabbing anti-smoking campaigns.

Make sure the students understand that they have to create a poster.

On page 43 we introduce the final task to the students.

On page 65 we explain how to do the investigation and the poster.

- In the section **Research** there are questions aimed at sparking students' ideas as well as shape their investigation and anti-smoking campaign.
- The **Presentation** section will give students guidance on how to create their posters.
- The **Procedure** section indicates the steps needed to complete the research, organise the information collected and how to draw conclusions and confirm research.
- The **Self Assessment** section at the end allows students to reflect about their work.

The learning outcome that will be reinforced during this task is:

### 4.1. Recognises healthy nutritional habits

An example of how to assess the final task is shown here:

0 = not handed in      1 = very basic      2 = well done      3 = excellent

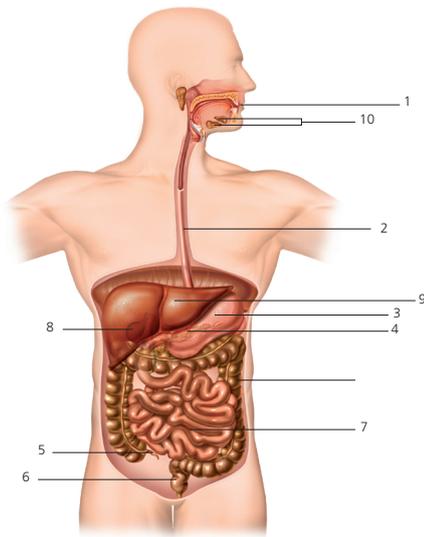
	0	1	2	3
<b>POSTER</b>				
The poster's format and organisation are suitable.				
The main ideas of the poster are suitable.				
The balance between the amount of images and text is adequate.				
It uses correct terminology; the message is clear.				
It presents the data in an attention grabbing way and is well organised.				
The student can answer the questions the teacher and other students ask				

Evaluable learning outcomes	Assessment tools	Excellent 3	Satisfactory 2	In process 1	Not achieved 0	Points
1.1. Identify the systems involved in nutrition. (MCST, LL, LC).	1, 2, 3, 55, 56, 57	Identifies the criteria correctly and resolves all the activities correctly.	Identifies most criteria correctly and resolves most activities correctly, with mistakes in a few of them.	Identifies few criteria correctly and resolves the activities but making quite a lot of mistakes.	Answers in an incorrect way or does not answer.	
2.1. Identify, using graphic representations, the parts of the digestive system. (MCST, LL, LC).	4, 5, 6, 58, 59, 60, 61, 62	Identifies the components correctly and resolves all activities correctly.	Identifies most components correctly and resolves most activities correctly, with mistakes in a few of them.	Identifies few components correctly and resolves the activities but making quite a lot of mistakes.	Answers in an incorrect way or does not answer.	
3.1. Relate organs to structures of the digestive system. (MCST, LL, LC, CAE).	8, 9, 12, 14, 20, 26, 28, 29, 33	Establishes the relationships without mistakes.	Establishes the relationships with a few mistakes.	Establishes the relationships but with a lot of mistakes.	Answers in an incorrect way or does not answer.	
4.1. Associate the digestive organs with the specific roles they play in the digestive process. (MCST, LL, LC, CAE, SCC).	7, 10, 11, 13, 15, 16, 17, 18, 19, 22, 23, 24, 25, 27, 30, 32, 63, 64, 65, 66, 67, 68, 69	Identifies the organs correctly and relates them to their function.	Identifies most organs correctly and relates them to their function.	Identifies few organs correctly and relates few of them to their function.	Answers in an incorrect way or does not answer.	
5.1. Identify, using graphic representations, the parts of the respiratory system. (MCST, LL, LC, SCC).	35, 36, 37, 70, 71	Identifies the components correctly and resolves all activities correctly.	Identifies most components correctly and resolves most activities correctly, with mistakes in a few of them.	Identifies few components correctly and resolves the activities but making quite a lot of mistakes.	Answers in an incorrect way or does not answer.	
5.2. Associate the structures of the respiratory system with their function. (MCST, LL, LC, SCC).	34, 38, 39, 41, 42, 43, 72, 74	Identifies the organs correctly and relates them to their function.	Identifies most organs correctly and relates them to their function.	Identifies few organs correctly and relates few of them to their function.	Answers in an incorrect way or does not answer.	
6.1. Explain the movement of gases across the alveolar membrane during inspiration and expiration.	40, 73	Explains the concept correctly.	Explains the concept in an incomplete way.	Explains the concept with mistakes.	Answers in an incorrect way or does not answer.	
7.1. Identify the most common illnesses that are linked to the respiratory and digestive systems. (MCST, LL, LC, SCC).	21, 31, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 75, 76, 77, 78, 79	Gives many valid examples and their causes.	Gives quite a few examples and their causes.	Gives very few valid examples and their causes.	Answers in an incorrect way or does not answer.	

### Objectives, contents and methodology

TYPES OF RESOURCES AND METHODOLOGY USED TO MEET OBJECTIVES	
●	Interactive activities. Elaboration and verification of a hypothesis
○	Search for information on the Internet.
▶	Watch videos.
▣	Analyse images.
■	Analyse texts (news articles, scientific articles, etc).

SECTIONS	OBJECTIVES AND CONTENTS	METHODOLOGY	
<b>Levels of organisation</b>	Identify key levels of organisation of living matter.	▶	●
	Identify to which level organisation different biological elements belong.	●	
	<b>Concepts:</b> Levels of biological organisation, biosphere, community, population, organism, system, organ, tissue, cell, biomolecule, bioelement.		
<b>The cell</b>	Analyse the organisation of eukaryotic animal cells.	▶	
	Identify the different cell organelles and analyses their function.	▶	●
	<b>Concepts:</b> Organisation of eukaryotic cells, cell organelles.		
<b>Exchange between cells and the environment</b>	Identify the main characteristics of eukaryotic and prokaryotic cells.	○	
	<b>Concepts:</b> Prokaryotic, eukaryotic cell, cell nucleus, cell organelles, cell membrane, cell wall.		
<b>Types of tissues</b>	Identifies the main tissues that form the human body.	▶	●
	Analyses the function of each of the different tissues.	●	
	<b>Concepts:</b> Epithelial, connective, muscular and nerve tissues.		
<b>Investigation</b>	Analyses the organs that compose the different systems of the human body.	●	
	Identifies and locates the main organs of the human body.	▶	●
	<b>Concepts:</b> Digestive, excretory, respiratory and circulatory systems.		



1. Identify the organs marked by the arrows in the diagram:

1. Mouth
2. Esophagus
3. Stomach
4. Pancreas
5. Colon
6. Rectum
7. Small intestine
8. Gallbladder
9. Liver
10. Salivary glands

2. Order the following nutrients from lowest to highest according to their caloric value.

Lipids, proteins, carbohydrates

3. Explain the function of the gastric juices in digestion.

The bolus remains in the stomach for 3 to 4 hours and it mixes with gastric juices secreted by the glands located in the inner layer of the stomach. The gastric juices break down the bolus.

Gastric juices contain pepsin and hydrochloric acid:

Pepsin: is an enzyme that starts protein digestion, breaking proteins down into smaller fragments of variable sizes known as peptides.

Hydrochloric acid: fulfills two functions. It activates pepsin enzymes and supports them by helping the disintegration of food fibres. Additionally it destroys bacteria that may be present in food.

4. What is the role of the liver in digestion?

As part of the digestive process, the liver produces bile released into the duodenum through the ampulla of Vater.

Unlike gastric and pancreatic juices, bile does not contain digestive enzymes, but a different type of substance known as bile salts. Bile salts intervene in the emulsification of fats: fats are transformed into very small drops, helping enzymes found in digestive juices break down fats.

5. Describe intestinal juice. What happens when it mixes with the bile and pancreatic juices?

Intestinal juice is produced by the small intestine's mucous glands. It is similar to pancreatic juice and it contains enzymes that are capable of digesting all types of molecules found in foods. When it mixes with the bile and pancreatic juices it becomes chyle.

6. What processes take place in the large intestine?

Absorption of most water and minerals takes place in the large intestine; faeces compact to form stools.

Undigested food waste advances by peristalsis and is expelled to the outside through the anus by a mechanism called defecation. Faeces contain intestinal mucosa cells, bacteria and food waste.

7. Describe the air path from the moment of inspiration until it reaches the alveoli.

Nostrils; nasal passages; pharynx; larynx; trachea; bronchi; bronchioles and alveoli.

8. Explain how gas exchange occurs in the alveoli as well as the cells of tissues.

In the alveoli, oxygen passes into the blood and carbon dioxide is taken from the blood into the alveoli. In the tissue the contrary occurs, the oxygen enters the cell and carbon dioxide exits the blood.

9. What is the function of the following structures?

a) Pleura:

a sheet composed of two membranes. In between both membranes there is a liquid that allows them to stay together and slide smoothly.

b) Diaphragm:

muscle that separates the thorax from the abdomen. It is involved in pulmonary respiration.

10. Describe the following illnesses:

a) Hepatitis

Inflammation of the liver (in many cases is a various serious condition) caused by certain viruses, abusive consumption of alcohol or certain medicines.

b) Pulmonary emphysema

It involves an enlargement of the pulmonary alveoli causing them to break.

**1. What are the different functions of saliva?**

The functions of saliva are the following:

It starts the digestion of starch molecules, which are present in many foods (bread, potatoes, rice... ) and transforms them into simpler sugars. In order to do this, saliva has a digestive enzyme named amylase, which breaks down the most complex sugars.

It destroys some bacteria by using an enzyme named lysozyme. Its antibacterial action protects the mouth against infection and reduces the possibility of suffering from cavities.

It eases the bolus into the pharynx and esophagus. Saliva contains mucin, a mucous substance that lubricates and mixes with food. As a result, foods go through the pharynx and esophagus easily without causing damage.

**2. Explain the difference between bolus, chyme and chyle.**

These are names given to food as it passes through the digestive tract.

**Bolus:** food that has been chewed and mixed with saliva. It passes to the stomach.

**Chyme:** in the stomach the bolus mixes with gastric juices and the stomach digests it into a more liquid substance called chyme.

**Chyle:** in the duodenum the chyme mixes with intestinal and pancreatic juices and bile, and becomes a more liquid substance called chyle.

**3. What is the digestive function of the pancreas?**

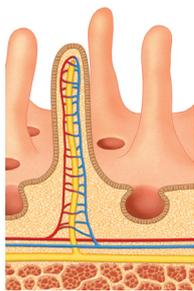
It produces hormones (insulin and glucagon) that regulate the quantities of glucose in our body and their accumulation in the liver.

It secretes pancreatic juice, which is released into the duodenum through the ampulla of Vater, in which the pancreas and liver ducts join.

**4. What is the function of the digestive enzyme pepsin?**

It's an enzyme that starts protein digestion, breaking proteins down into smaller fragments of variable sizes known as peptides.

**5. Identify the function of the structures represented in the image and also name them:**



1. Intestinal villi
2. Capillaries
3. Lymph capillary

The function of intestinal villi is to increase the absorptive surface of the intestine. Through the cells of the intestinal mucosa nutrients are incorporated into capillaries or, in the case of certain molecules, such as fatty acids, to the lymphatic capillaries.

**6. What is the function of the larynx?**

It carries air into the lungs and it also stops food from entering the respiratory tract using a structure named the epiglottis.

**7. Identify the systems and explain their function:**

■ On the side walls of the pharynx we have the tonsils, which are small glands that produce white blood cells.

■ Inside our respiratory tract there is mucus that traps foreign particles present in the air.

■ In the trachea there are cells with vibrating filaments called cilia. The cilia move the mucus (full of impurities) into the pharynx, and from there it is driven into the esophagus and stomach.

**8. Identify the organs and structures that form the respiratory system.**

The respiratory tract and lungs form the respiratory system:

■ Respiratory tract: this is made up of tubes or airways that collect oxygen and prepare it for cell consumption. These are: the nasal cavities, pharynx, larynx, trachea, bronchi and bronchioles.

Inside the larynx there are two ring-shaped folds (vocal chords). They create sounds when the passage of air makes them vibrate. These sounds change depending how the tongue, teeth and lips are positioned, and the way the air passes through the mouth or nasal passages.

■ Lungs: this is where the gas exchange between blood and air takes place ( $O_2$  and  $CO_2$ ).

**9. Describe the process of pulmonary respiration.**

It has two stages: the entering of air, or inspiration, and the release of air after gas exchange has occurred, or expiration.

■ Inspiration: this is the respiratory movement in which air enters the lungs. The diaphragm flattens and lowers as the ribs rise outwards, increasing the capacity of the ribcage. As the ribcage widens its walls pull from the pleura, which are joined to the lungs. The lungs become enlarged, increasing their volume, and air enters them.

■ Expiration: this is the respiratory movement that releases air from the lungs. The diaphragm relaxes, curves and rises as the ribs sink, reducing the ribcage capacity. As a result, the ribcage shrinks and its walls pull from the pleura forcing the lungs to reduce their volume and release the air inside them.

**10. Describe the following illnesses:**

**a) Gastroenteritis**

These are intestinal infections caused by bacteria present in the water or food. Some, such as cholera and typhoid, are very serious and can even be fatal.

**b) Asthma**

In some infections that affect the bronchi, or in certain allergic reactions, the contraction of muscles in the bronchi as well as their excessive secretion impedes the passage of air; this causes breathlessness and distress.