

3

NUTRITION: THE DIGESTIVE AND RESPIRATORY SYSTEMS

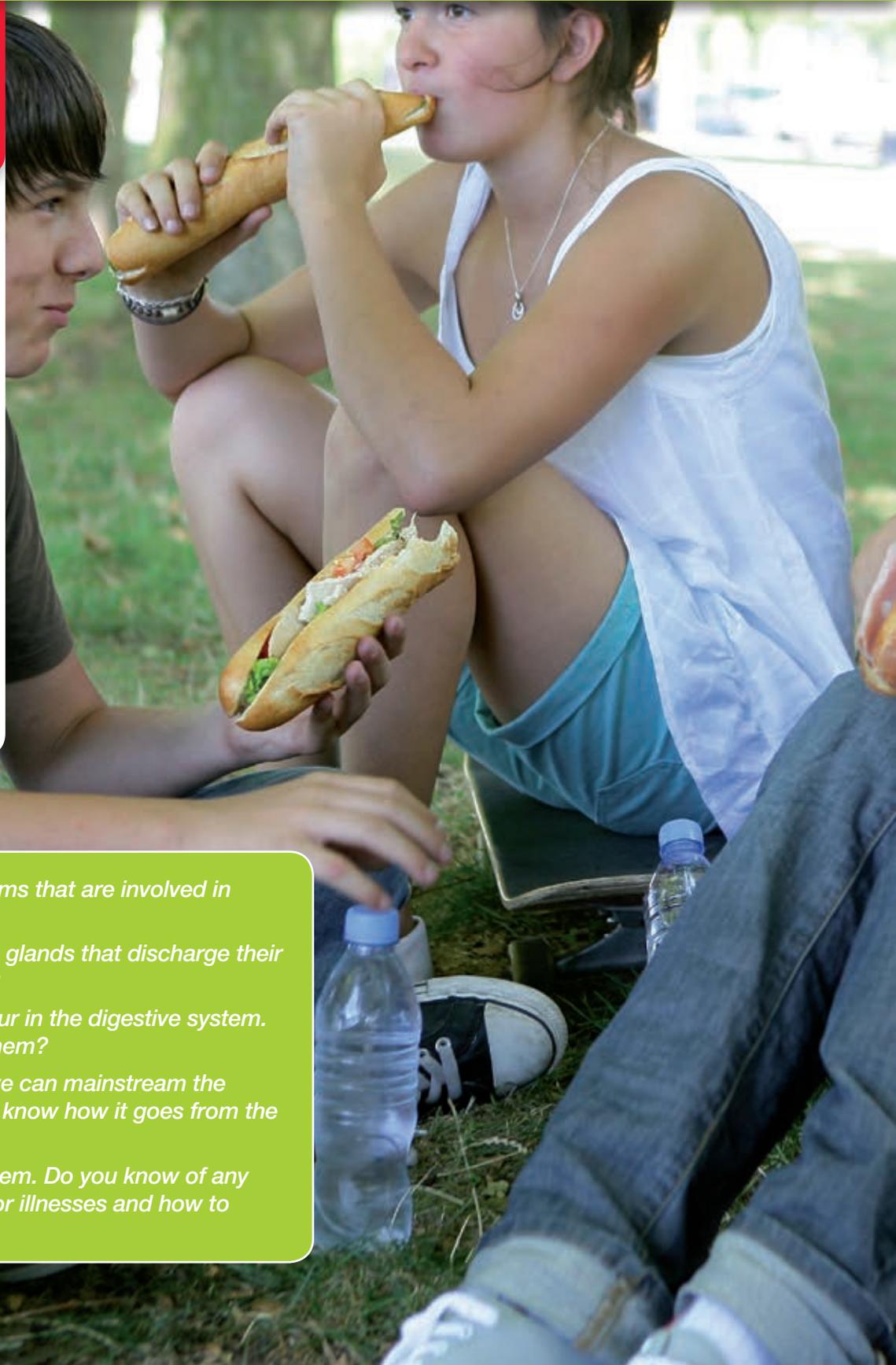
YOU WILL LEARN TO...



- Connect the stages of the nutrition process to 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.
- Carry out a research task



- 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?*





Final task



Anti-smoking campaign

Images are a very powerful way to convey a message and give information, especially to the younger generation. In this task 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 31 MAY

1. HUMAN NUTRITION

Multicellular organisms, such as humans, are unable to access nutrients directly. Nutrients, which are found in **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 systems 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 oxygen cells need and eliminates carbon dioxide (CO_2) produced during cell metabolism.

■ **Circulatory system:** transports nutrients and oxygen to cells and releases waste substances.

■ **Excretory system:** releases waste substances outside the organism.

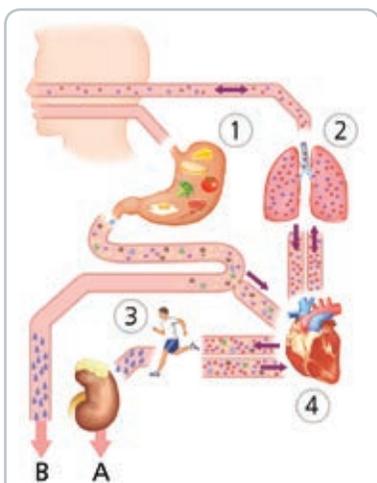
All four systems are interlinked, fulfilling two main functions: providing cell nutrition and eliminating waste products.

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.



digestive system excretory system
respiratory system circulatory system

Systems involved in human nutrition



Nutrition diagram

Apply

- Look at the diagram 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.

Understand

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

Analyse

- How do unicellular organisms perform the function of nutrition?

2. THE DIGESTIVE SYSTEM

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

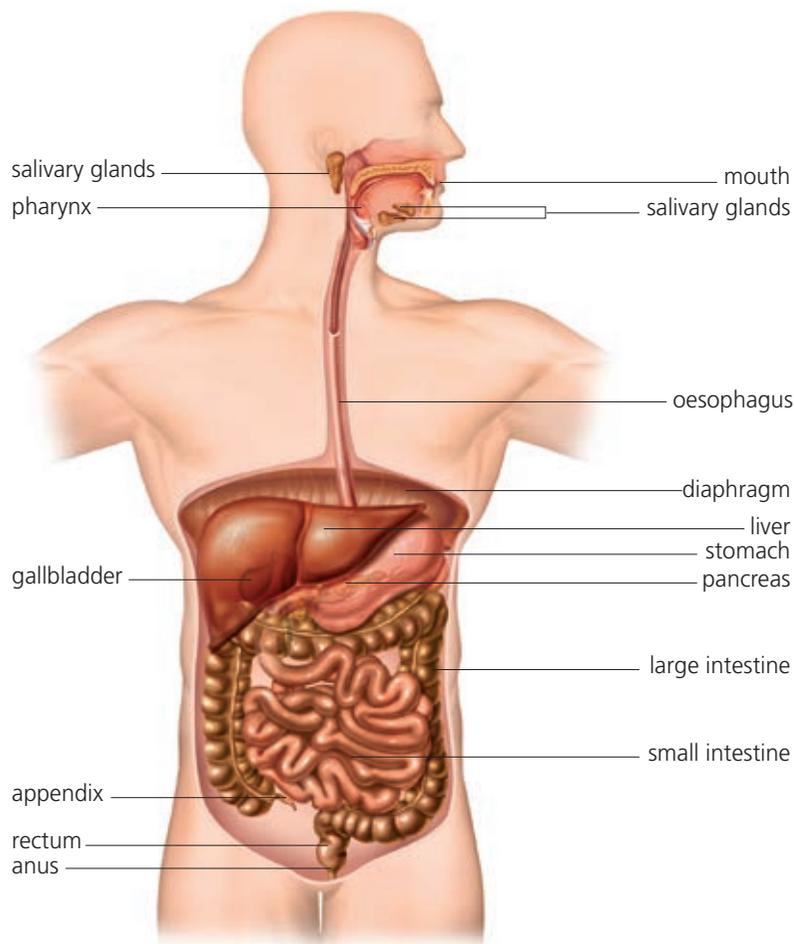
■ **Gastrointestinal tract:** it is about eight metres long and its shape varies (it narrows and widens). It starts in our mouth and ends at our anus and it has the following parts: oral cavity, pharynx, oesophagus, stomach, small intestine and large intestine.

An inner cell layer called a **mucous membrane** makes up the gastrointestinal tract. It's internally protected by a lubricant substance called **mucus** and is 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 mucus and others that secrete **digestive juices**. Glands in the stomach produce gastric juices and glands in the intestine secrete intestinal juices.

■ **Accessory** or **ancillary**¹ **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.

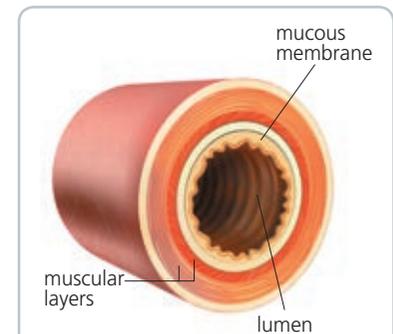


Human digestive system

Analyse

4. How does the digestive tract, being over 8 metres long, fit inside our bodies?
5. Why do you think it's so long?

¹**ancillary:** providing necessary support to the primary operation of a system



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.



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.

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

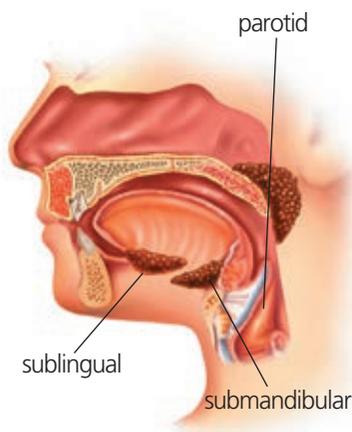
When we place food in our mouths we start salivating. Sometimes salivation can occur just by smelling or seeing food.

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 bolus²** into the pharynx and oesophagus. Saliva contains **mucin**, a mucous substance that lubricates and mixes with food. As a result, foods go through the pharynx and oesophagus easily without causing damage.

²**bolus:** a small rounded mass of a substance, especially of chewed food at the moment of swallowing



Position of the three pairs of salivary glands

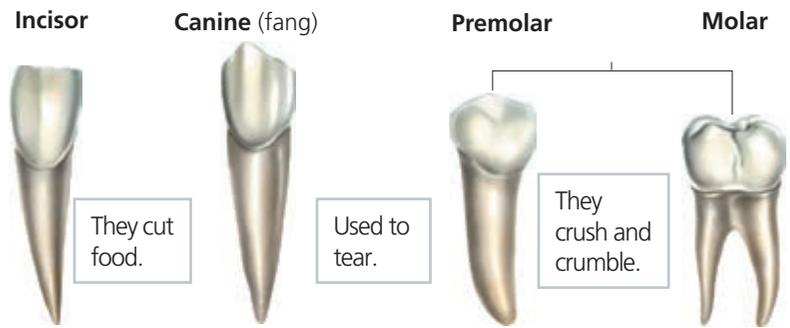
Analyse

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?
8. Why do you think your mouth starts salivating when you see or smell a food you like?
9. What are enzymes from a chemical point of view?
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?
11. 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.

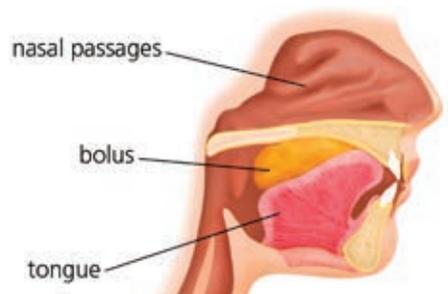


A **dental formula** is the way of representing the number and type of a mammal's teeth by numbering them in the following way: eight numbers separated by a line, four on the upper jaw and four on the lower jaw, that identify the number of incisors, canines, molars and premolars located in the middle,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

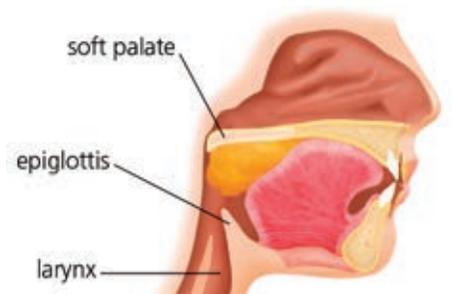
The first set of teeth we have develop when we are infants. There are 20 of them that form the **baby teeth** (or **milk teeth**). Baby teeth have all emerged by the time a child is three years old and they tend to start falling out when a child is 5 or 6 years old. They are progressively substituted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

3.1.3. Swallowing

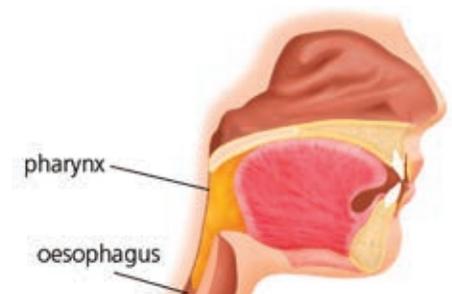
Swallowing begins once the bolus has formed. The tongue pushes the bolus towards the **pharynx**, also known as the throat, and from there it goes to the **oesophagus**, which ends in the **stomach**. There are three main stages:



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

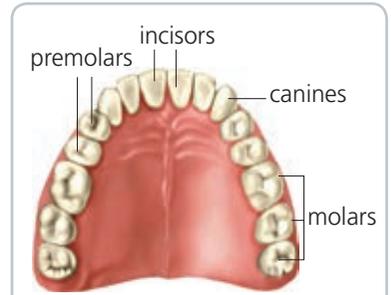


2. A series of reflexes makes the palate close the nasal passages, the larynx rise, and the epiglottis close its upper orifice. The bolus enters the pharynx.



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

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.



Human dentition

Apply

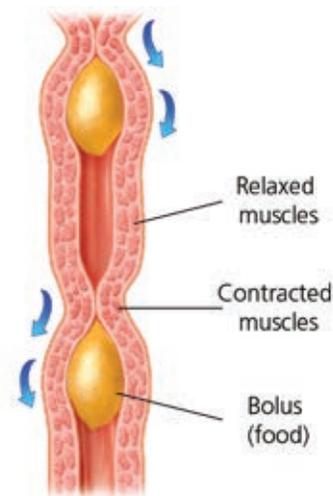
12. Describe the dental formula you can see in the picture. Do the teeth represented belong to an adult or an infant?

Understand

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

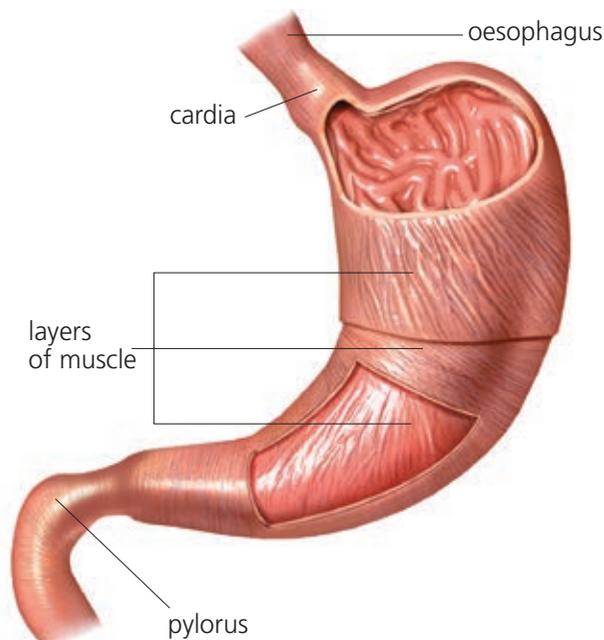
Create

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.



Peristaltic movements

³**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 oesophagus 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 oesophagus. Separating the stomach and oesophagus is a **valve**³ 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 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?

3.3. The digestive process in the small intestine

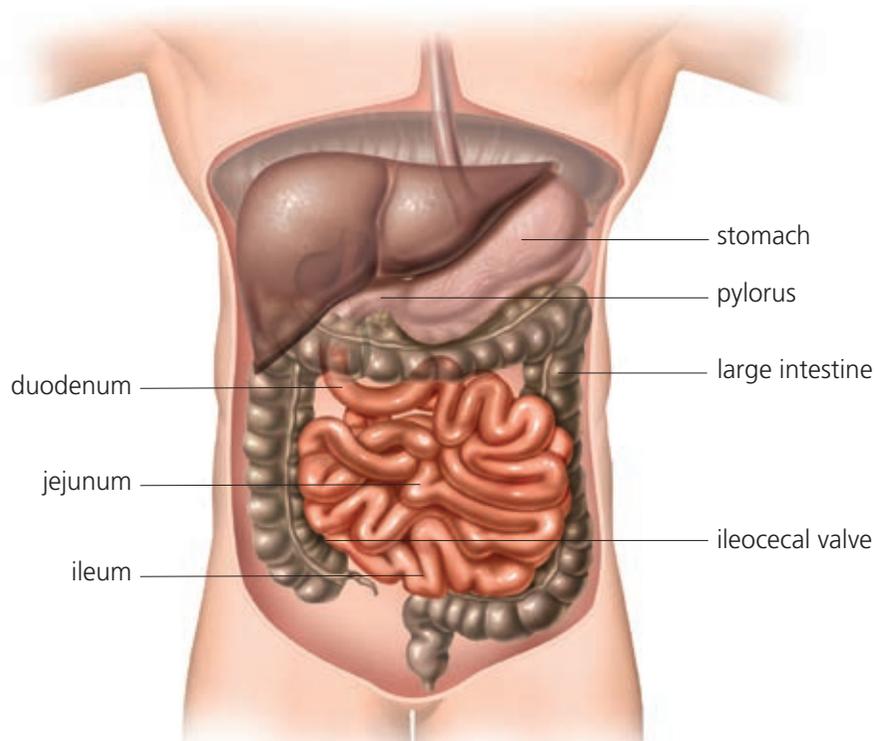
The **small intestine** is a tube that is around six or seven metres long. It is located between the pylorus, where it joins with the stomach, and the **ileocecal valve**, which separates the small intestine from the large intestine.

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.

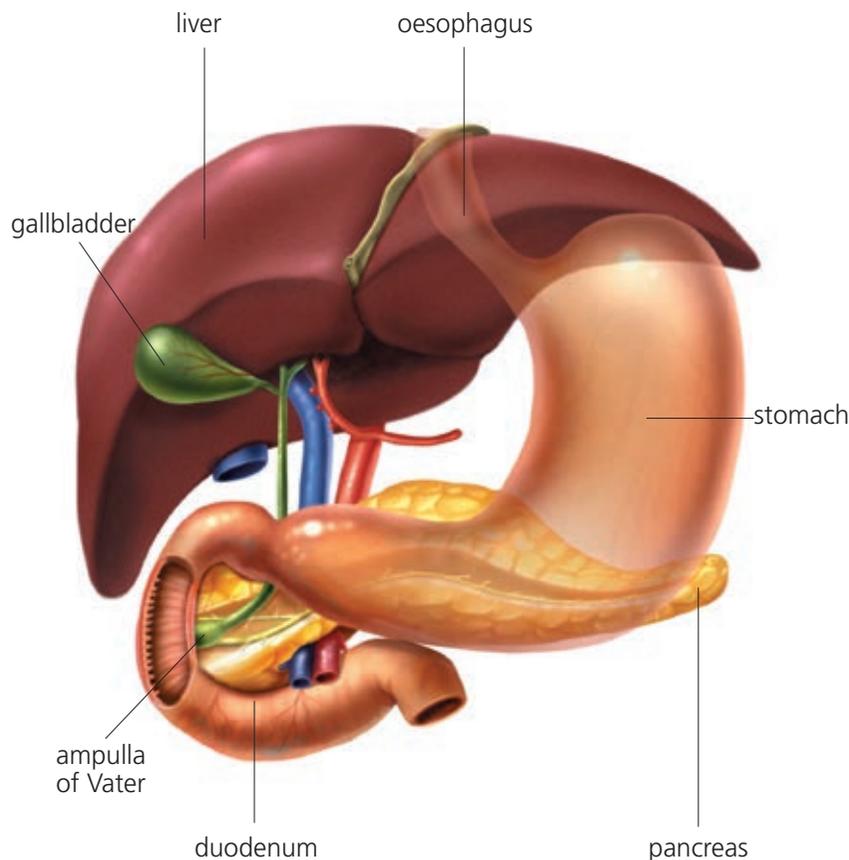
Gastric, intestinal and pancreatic juices, as well as bile (produced by the liver), are only secreted when there is food in the digestive tract that needs to be digested.

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?

3.3.2. 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 amount of blood in it and it performs a variety of functions related to several processes (digestive and excretory, amongst others).



Locations of liver, stomach, pancreas and duodenum

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 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.

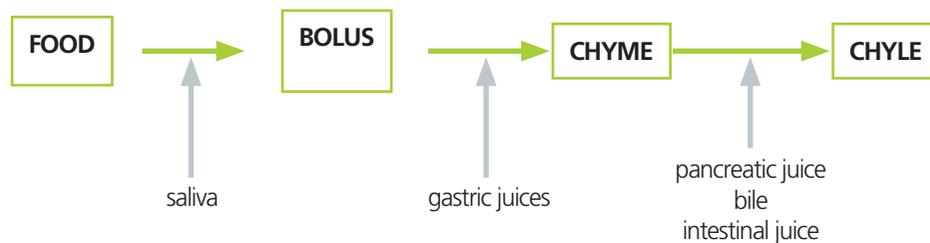
The liver also performs other functions. It captures and destroys most toxic molecules that enter the body, such as the ones found in alcoholic drinks and medications.

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.

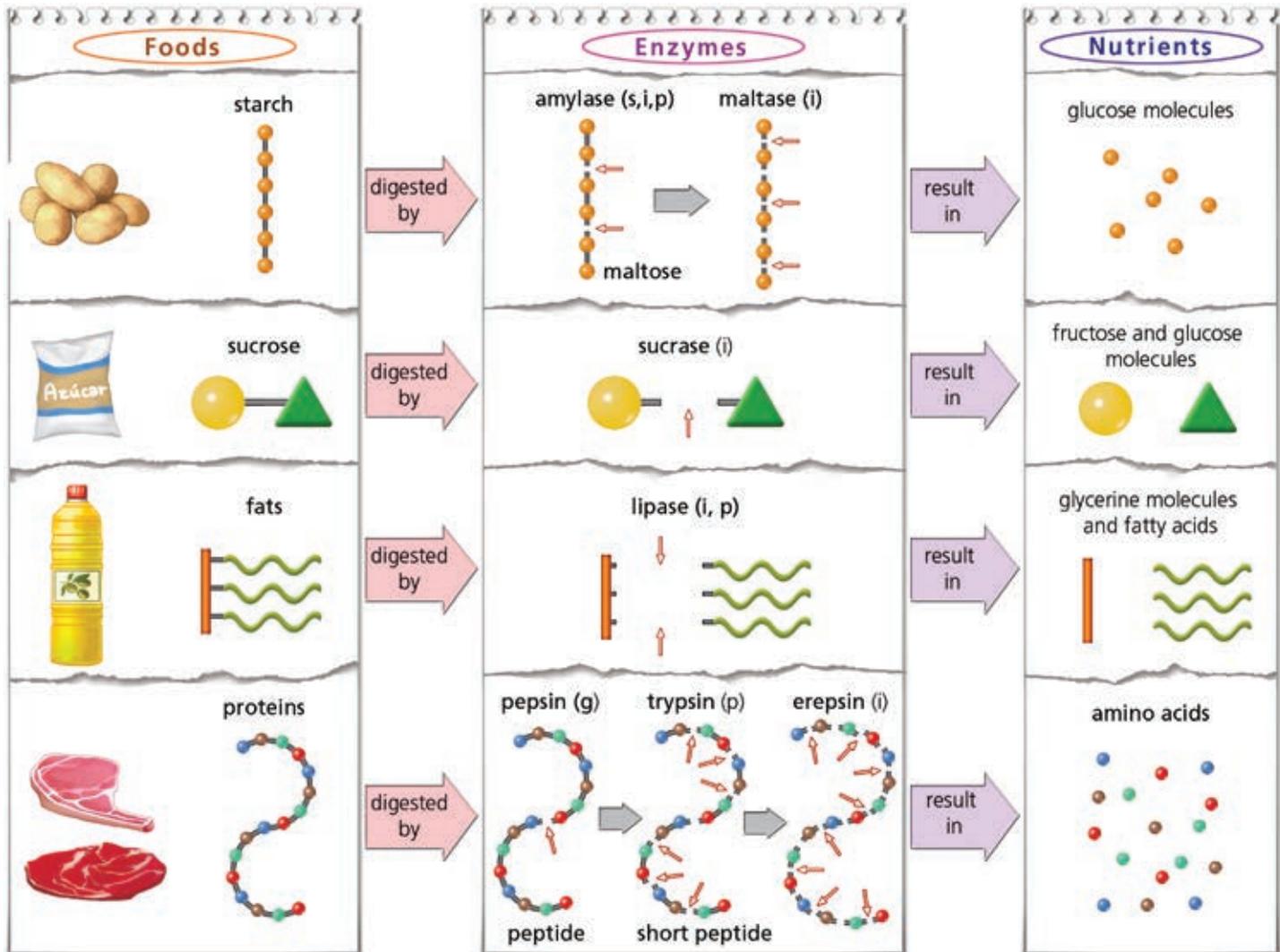


Digestion diagram

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?

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:

- **Monosaccharaides** 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.

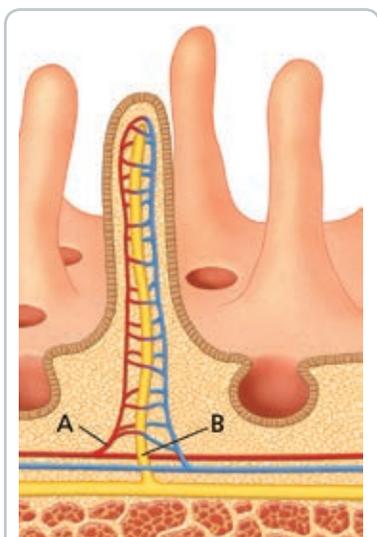
These nutrients must be distributed to the tissues where cells will use them to obtain energy or make new molecules.

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?



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

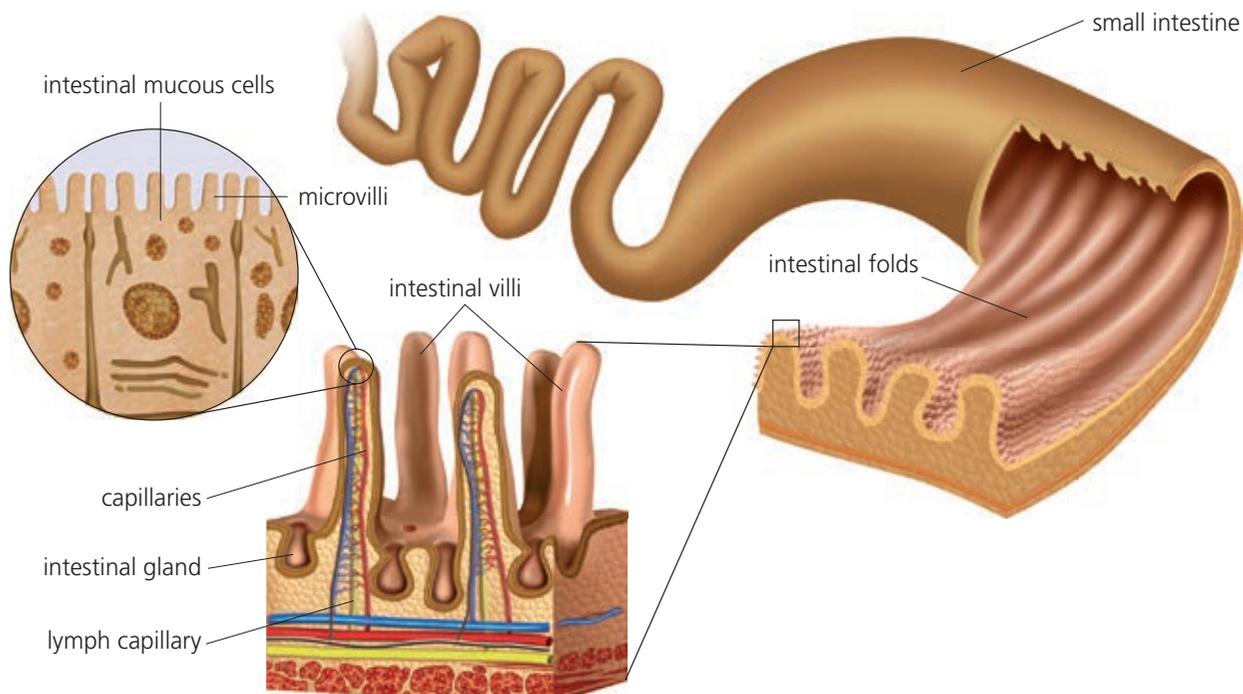
Food absorption refers to the passage of nutrients to our blood. This allows those nutrients to be distributed across the whole organism.

The inner layer of the small intestine is covered in creases, known as **villi** ($3000/\text{cm}^2$), 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^2 .

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 tract 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.

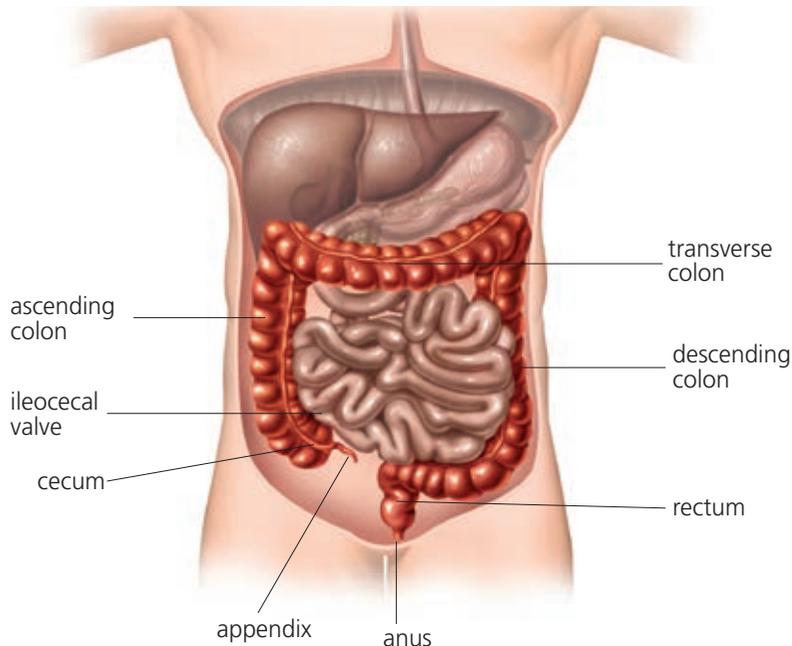
The **large intestine** is the end part of the digestive tract. It's shorter (1.5 m) than the small intestine, but has a larger circumference and does not have villi or microvilli.

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 **symbiotic**⁴ bacteria of the intestinal flora develop. Certain vitamins, such as B₁₂ 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

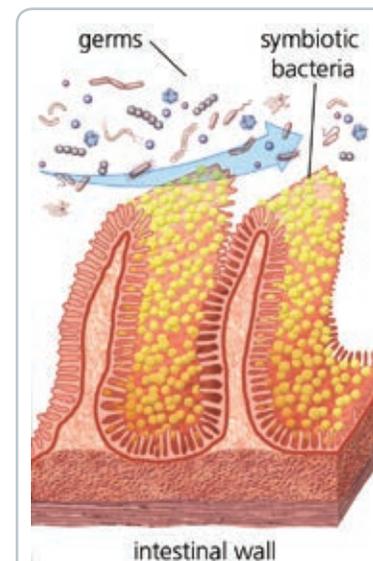
Analyse

29. Why is it possible to suffer from dehydration when someone has severe diarrhoea? 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.

⁴symbiotic: used to describe the organisms that interact with each other because they live in close physical association, typically to the advantage of both



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 tract.
- 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.

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_2 among others) that have to be released.

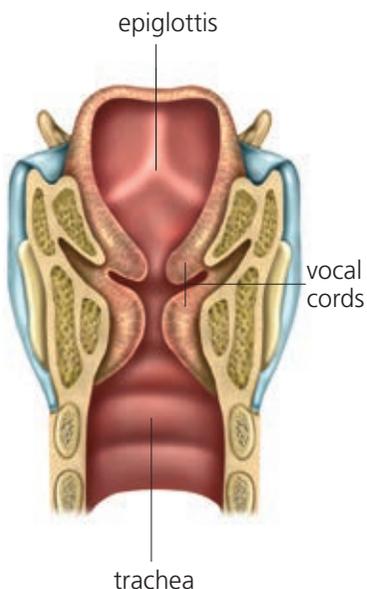
The respiratory system obtains oxygen from the air and provides it to the blood in the circulatory system. Blood carries the oxygen into the cells and takes away carbon dioxide so it can be released.

The respiratory tract and lungs form the respiratory system.

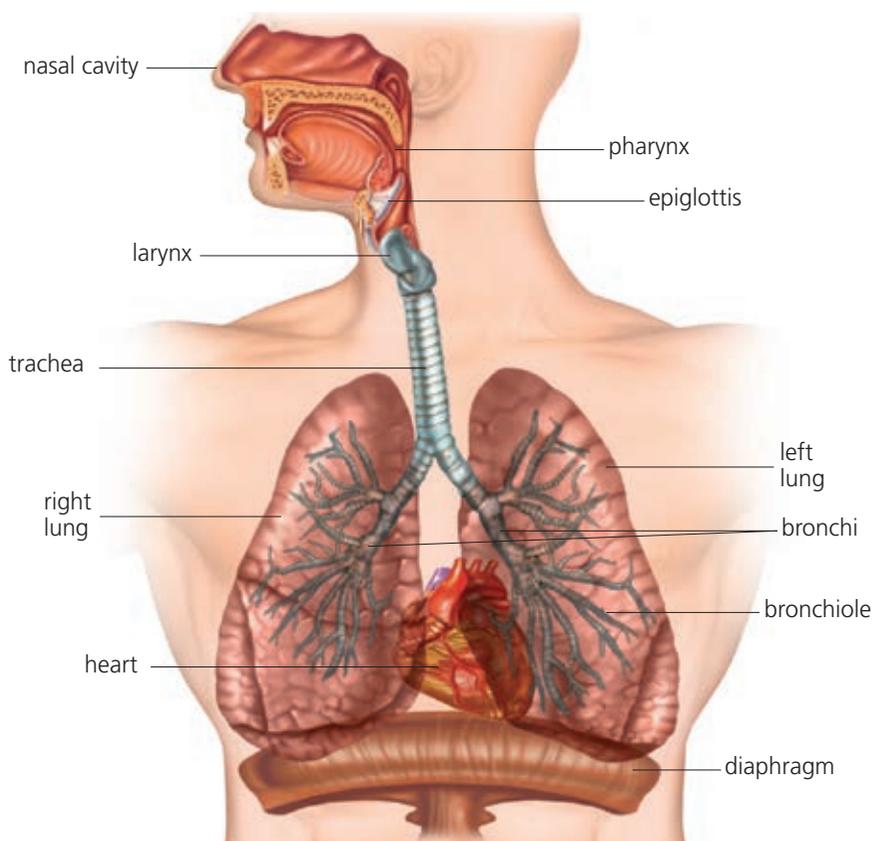
■ **Respiratory tract:** this is made up of tubes or airways that collect oxygen and prepare it for cell consumption. These are: the nasal cavities, pharynx, larynx, trachea, bronchi and bronchioles.

Inside the larynx there are two ring-shaped folds (**vocal cords**). 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_2 and CO_2).



Location of the vocal cords inside the larynx



Structure of the respiratory system

Analyse

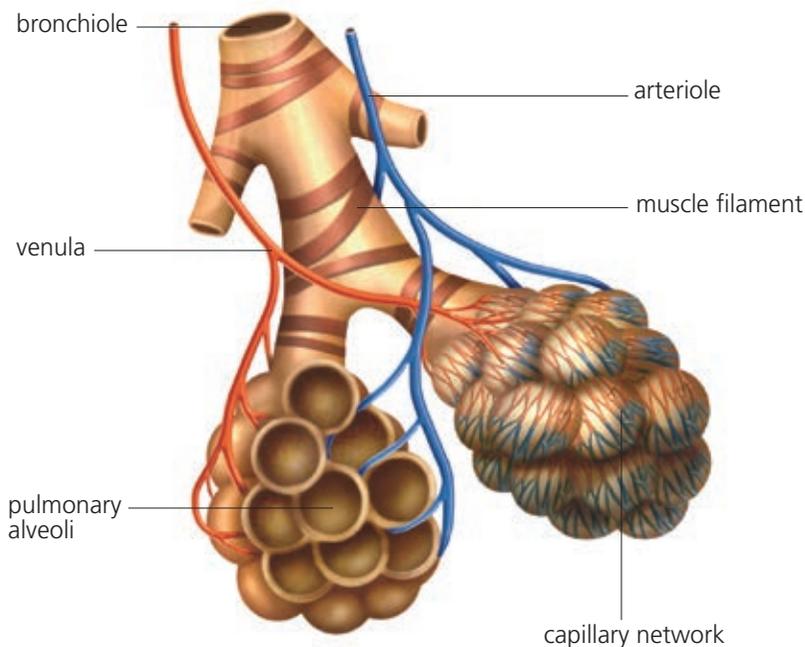
32. When do we breathe faster: when we are sitting down or when we are running? Why?

4.1. Respiratory tract

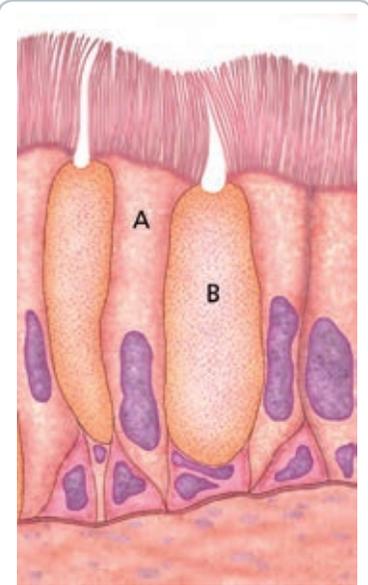
When air reaches the lungs, it needs to be clean, humid and warm. This preparation process takes place in the respiratory tract:

- **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. Mucus purifies and humidifies the air.
- **The pharynx:** this area is common to the respiratory and digestive tracts. Foods continue their journey into the oesophagus, 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 the back. There is mucus 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 mucus, filled with foreign particles, towards the larynx, where it is redirected to the oesophagus 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



Section of the mucosa that covers the respiratory tract

Apply

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

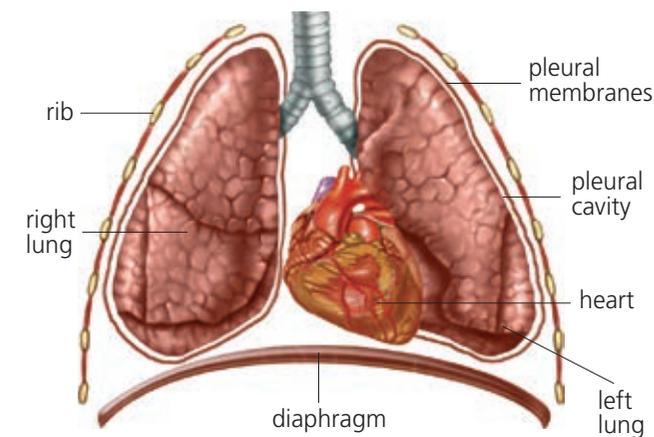
Understand

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?

4.2. Gas exchange



The lungs and pleura

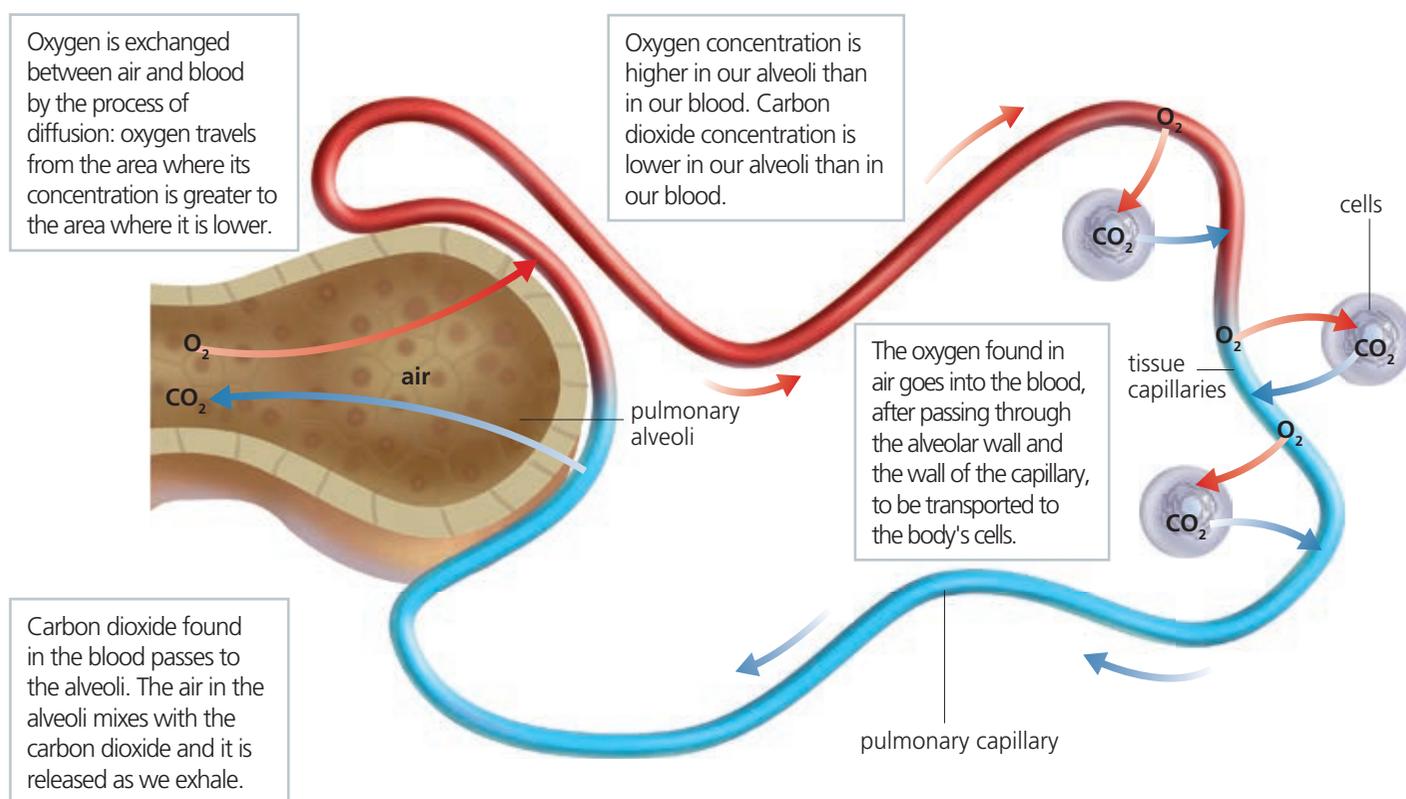
The group formed by bronchi, bronchioles, alveoli and an extensive network of capillaries, constitutes the **lungs**: highly elastic bodies whose appearance resembles that of a sponge.

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 travelling 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.



Gas Exchange

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.

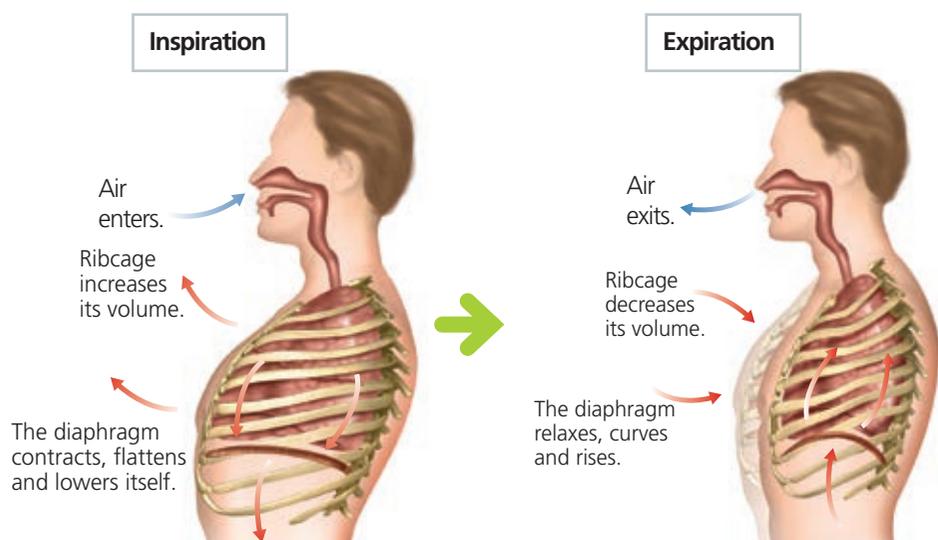
4.3. Pulmonary ventilation

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.



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 ventilation 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.

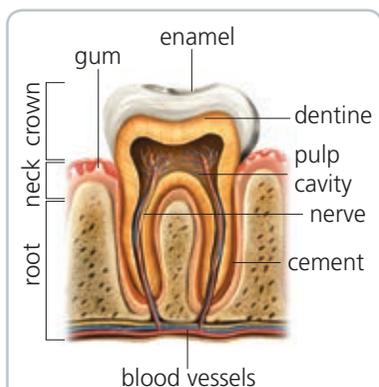
5. HEALTHY HABITS: ILLNESSES OF THE DIGESTIVE AND RESPIRATORY SYSTEMS

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:

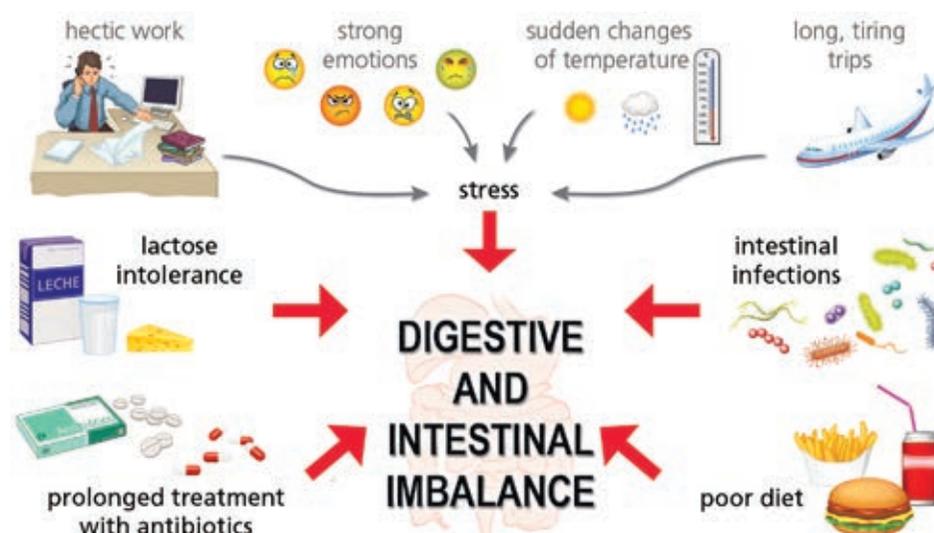
- Chew food slowly, making sure that all food is crushed properly. By doing this, you'll help the digestive process and stimulate salivation.
- Brush your teeth after each meal in order to eliminate any small pieces of food. Also, use dental floss to clean areas that the toothbrush can't reach.
- Visit 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 oesophagus. 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 oesophageal 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.

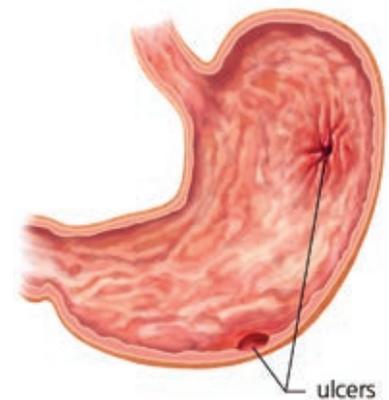


Causes of digestive and intestinal imbalance

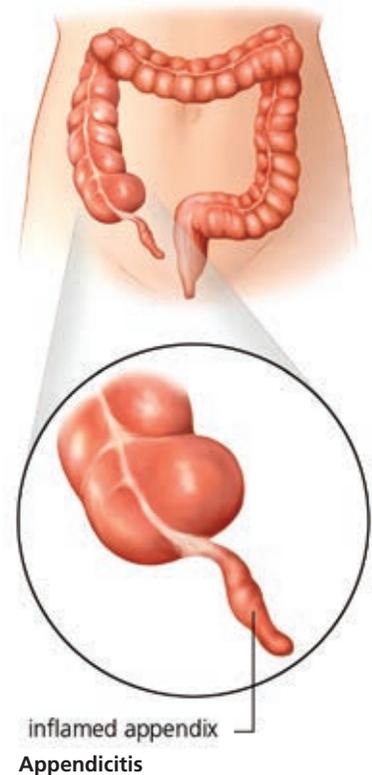
5.2. Illnesses of the digestive system

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

The mouth	
Caries	This is the destruction of the tooth enamel caused by the bacterial decomposition of food remains lodged between the teeth.
Gingivitis	Painful inflammation of the gums, where they bleed and redden.
Pyorrhoea	This is the inflammation and infection of the ligaments and bones that support the teeth.
The stomach	
Gastritis	This condition occurs due to an irritation of the gastric mucosa, causing it to become inflamed. It produces symptoms such as heartburn.
Ulcers	Ulcers are wounds caused by the destruction of gastric mucosa. They are usually located in the stomach or duodenum.
The liver	
Hepatitis	Hepatitis is an inflammation of the liver caused by certain viruses, the abusive consumption of alcohol or certain medicines.
Cirrhosis	A serious illness that destroys hepatic cells.
Gallstones	Also referred to as stones, these are solid particles composed of cholesterol or the minerals found in bile.
The intestine	
Gastroenteritis	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.
Appendicitis	Inflammation of the appendix characterised by intense pain, vomiting and fever. It's usually caused by bacterial infection.
Constipation	This condition is characterised by difficulty passing stools due to the low mobility of the large intestine.
Diarrhoea	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.
Celiac disease	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.
Colon cancer	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



Analyse

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

Create

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

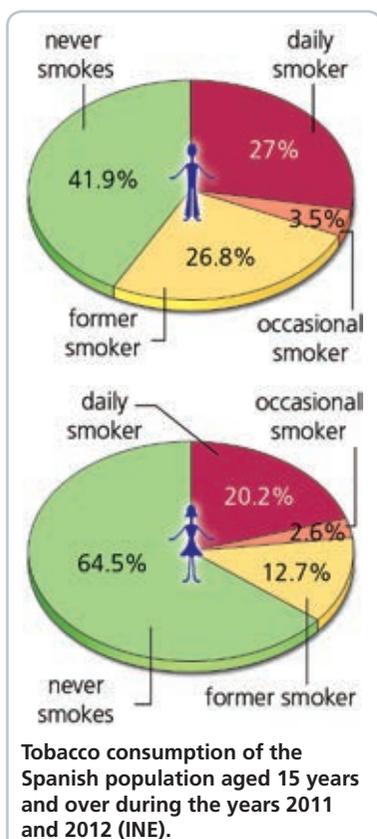
5.3. Taking care of the respiratory system

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.



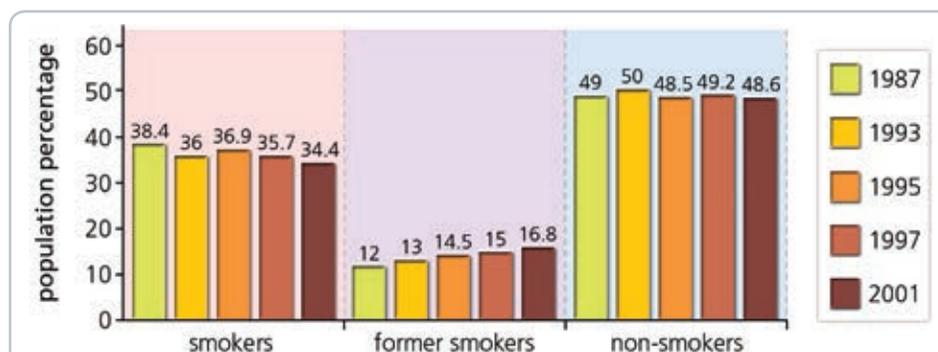
Lungs of a non-smoker (A) and lungs of a smoker (B)



Apply

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

- 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 bronchi contract 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.



Smoking frequency in the Spanish population over a 16-year period.

Analyse

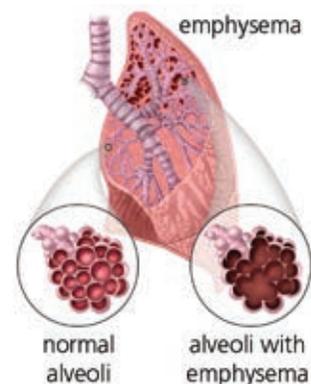
47. Look and answer:

- 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	
Nasal catarrh, pharyngitis, tonsillitis, bronchitis, pneumonia	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.
Flu	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	
Aphonia	Difficulty emitting sounds due to the inflammation of the vocal cords.
Sinusitis	Inflammation of the sinus cavities of certain bones in the skull that are connected to the nostrils.
Allergic rinitis	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.
Asthma	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.
Chronic bronchitis	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.
Emphysema	This produces an enlargement of the pulmonary alveoli, causing them to break.
Pleurisy	This is an inflammation of the pleura. It causes severe pain (especially when coughing), fever and sometimes pleural fluid spills.
Lung and throat cancer	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.
Chronic obstructive pulmonary disease (COPD)	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.



Pulmonary emphysema



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 mucus when we have a cold?

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.

The digestive system

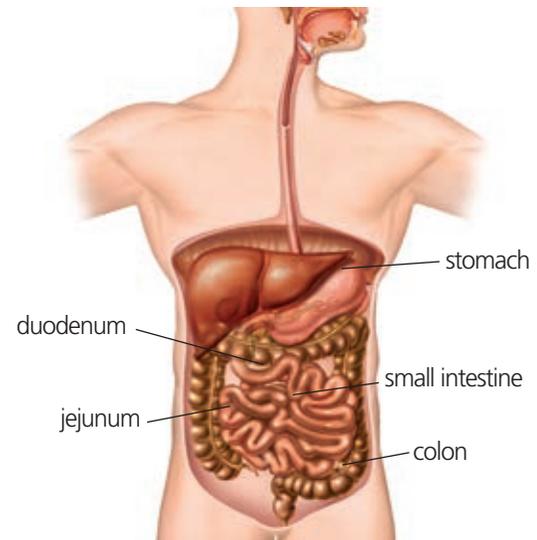
- 52.** What are accessory glands of the digestive system?
- 53.** What separates the chest cavity from the abdominal cavity? What part of the digestive tract is in the thoracic cavity?
- 54.** Why do you think the stomach has three layers of muscle, while the rest of the digestive system only has two?
- 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	1 200 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:

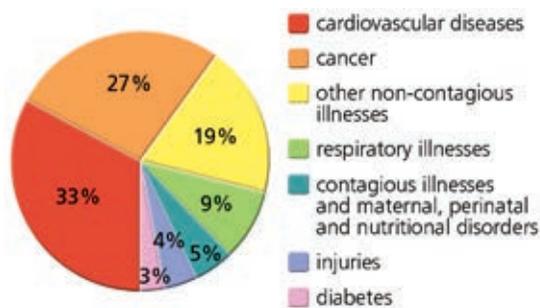
Enzyme	Organ	Function
trypsin
lipase
...	...	starts the digestion of proteins
...	...	digests sucrose
...	salivary glands	...

The respiratory system

64. What are the pleura?
65. Why do you think the group of the bronchi with the bronchioles formed from them is called the 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 digestive and respiratory 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 1 000 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.

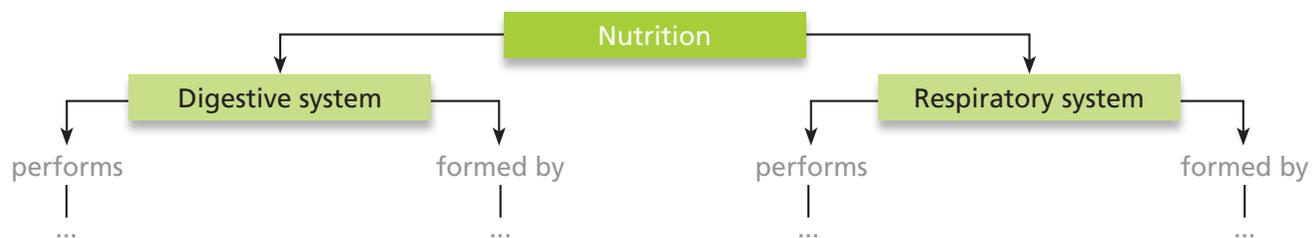
Intestinal microorganisms perform an essential role. They ensure our intestines are healthy as well as influencing our immunological system. Changes in the intestinal microbiota of an individual can potentially increase the risk of contracting infections.

EUFIC (European Food Information Council)
October 2013

- a) How can the intestine host such a high number of microorganisms?
- b) Why is intestinal microbiota often compared with a fingerprint?
- c) How can food or antibiotics affect intestinal microbiota?
- 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.

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 concept 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.

You can record your summary and listen to it as many times as you like to revise.



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 science experiment to see how temperature affects digestive action.

Materials



- 3 test tubes
- rack
- mortar
- funnel
- filter
- Lugol's solution
- beaker
- wooden tweezers
- bread

Procedure



1. Number the test tubes 1, 2 and 3.
2. 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.
3. Pour some of your saliva through the funnel into test tubes 2 and 3.
4. 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.
5. Remove the test tubes using the wooden tweezers and place them on the rack to cool.
6. 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.
7. Finally, perform the Biuret test. This process will help you find existing proteins.
8. 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

1. Create a laboratory report that includes photographic evidence of your science experiment. Make sure that your report answers the following questions:
 - a) What is the objective of the science experiment?
 - b) What are the different variables and what is your hypothesis?
 - c) What is the function of test tube 1 and why did we only warm up test tubes 1 and 2?
 - d) What conclusions can you make from your science experiment? Do the results obtained corroborate your hypothesis?
 - e) 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 your research, follow these steps:

Search for information

- 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.

Organise the information

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

Draw conclusions and check your research

- 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 task, 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.