

Unit 4.2

The digestive system

context

Without food, the body dies. Food supplies the body with the energy and the nutrients it needs for growth and for keeping it in good health. Digestion

breaks down food as it passes through the digestive system, allowing its nutrients to pass into the bloodstream for use where they are needed in the body.

Digestion: Food for life

Aerobic respiration is the process that cells normally use to get the energy they need to function. One of the reactants needed in this reaction is glucose ($C_6H_{12}O_6$), a type of sugar. Glucose reacts with oxygen (O_2), which is provided by the respiratory system, to form carbon

dioxide (CO_2), water (H_2O) and the all-important energy. The equation for this reaction is:



Without glucose, cells die. **Digestion** is the process in which food is broken into smaller and simpler substances, such as the glucose the cells need. Once small enough, these nutrients pass into the bloodstream to be transported to the parts of your body that need them. There they pass into the cells of the tissues and organs that need them. Digestion provides the body with necessary carbohydrates, sugars, proteins, fats, vitamins, minerals, fibre and water.



The digestive system

The digestive system consists of:

- a six to seven metre-long tube known as either the **digestive tract**, **alimentary canal**, or simply the gut. This is the tube along which food travels and in which food is processed and broken down into smaller components.
- several organs, such as the pancreas, that branch off from the digestive tract. These organs secrete special chemicals known as enzymes, which assist in processing particular types of food. Roughly eight litres of enzymes are produced each day.

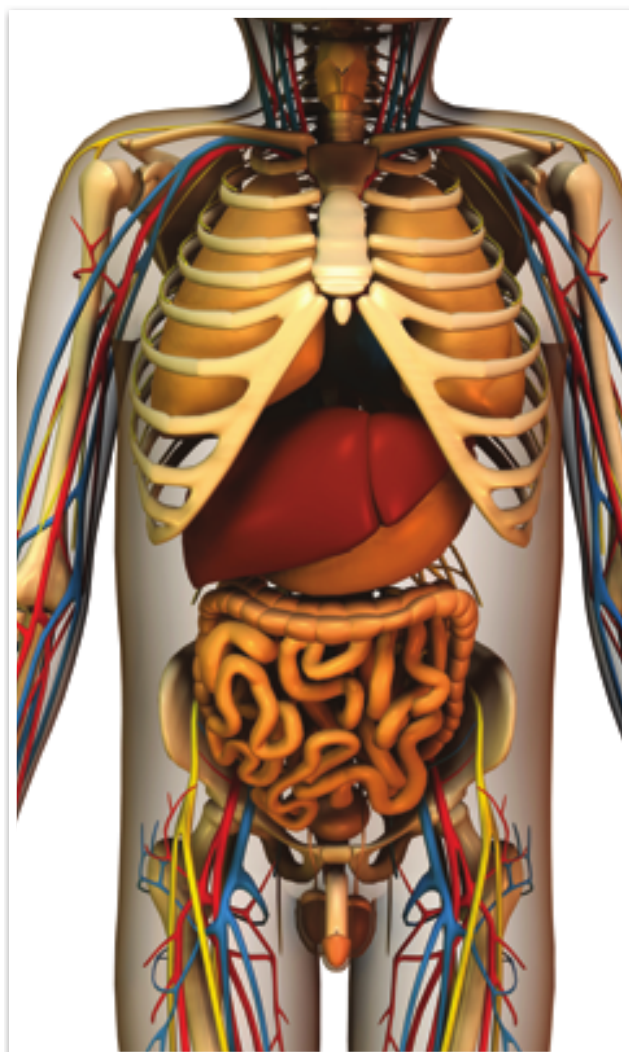


Fig 4.2.1 Artwork of the digestive system, showing how it fits in with other body systems.

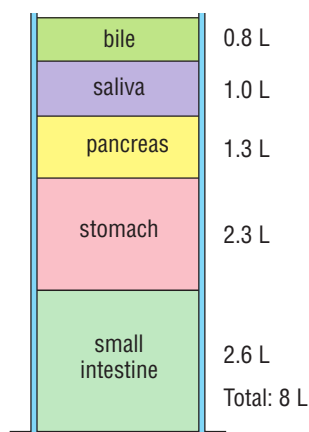


Fig 4.2.2 The amount of digestive juices you produce each day.

The digestive system

Digestion starts when food is placed into the mouth and ends when waste is released from the anus. The whole trip normally takes about 24 hours. The time food spends in each part of the digestive system is shown in the table below.

| Part of digestive system | Approximate time spent there |
|--------------------------|------------------------------|
| Mouth | 1 minute |
| Oesophagus | 3 seconds |
| Stomach | 2 to 4 hours |
| Small intestine | 1 to 4 hours |
| Large intestine | 10 hours to several days |

The process of digestion

Eating

You physically break down your food when you eat, mashing it into smaller pieces. This is known as **mechanical digestion**. Another form of digestion, **chemical digestion**, also starts in the mouth. Saliva contains enzymes, which chemically break down the food it mixes with. About one litre of saliva (which is made up of water, mucus and the enzyme **amylase**) is produced every day. Amylase begins breaking down starch into glucose. Food and saliva form a smooth lump called a **bolus**. Water and mucus help make the bolus slippery so that it is easily swallowed.

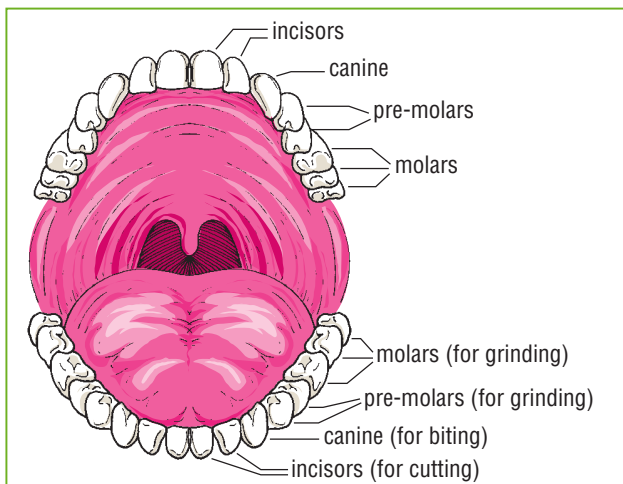


Fig 4.2.3 Different teeth help with different tasks.

Science Clip

No-chew food

Spiders cannot chew their food because they have no teeth, apart from their fangs. Instead, spiders inject enzymes into their prey, dissolving their **innards** (internal organs of the body), which the spider then sucks up. Crocodiles can't chew either. They use their teeth to rip their food into smaller bits.

Swallowing

When you swallow, circular muscles around your oesophagus contract and relax. They form a wave-like movement known as **peristalsis** that pushes the bolus along the oesophagus and towards the stomach. Peristalsis pushes so hard that it allows you to swallow food and drink when lying flat or even upside down.

Churning and mixing

Muscles in the stomach churn food, helping it mix with **gastric juice**. About two litres of gastric juice are produced every day. It contains:

- the enzyme **pepsin**, which helps break down large protein molecules and fats
- **hydrochloric acid** (HCl), which helps the pepsin and kills harmful bacteria.

The entrance and exit of the stomach are controlled by rings of muscles called **sphincters**. A sphincter at the top of the stomach stops acid and partly digested food from rising up into the oesophagus. Another sphincter at the bottom of the stomach protects the lower digestive tract from acid. Every minute or so it lets partly digested, semi-liquid food, called **chyme**, to pass through into the duodenum.

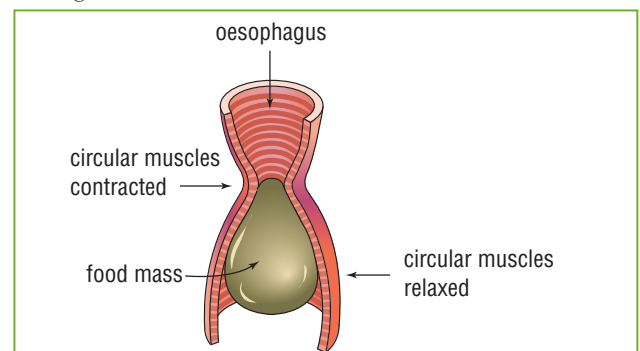


Fig 4.2.4 Peristalsis is like squeezing a marble through a section of rubber tube that normally is slightly narrower than the marble.



Science Clip

Beware the smiling monkey!

Sharks and crocodiles lose teeth when hunting. Sharks have up to 12 000 teeth organised in multiple rows ready to move forward to replace lost ones. Crocodiles simply grow new ones. The front teeth of mice and rats grow constantly because they are constantly wearing away. A hippopotamus has 40 teeth, whereas the narwhal has only one, in the form of a long horn protruding from its forehead. Get out of the way if a monkey bares its teeth when 'smiling'...it is ready to attack! It won't smile at all if friendly, but will smack its lips together at you.

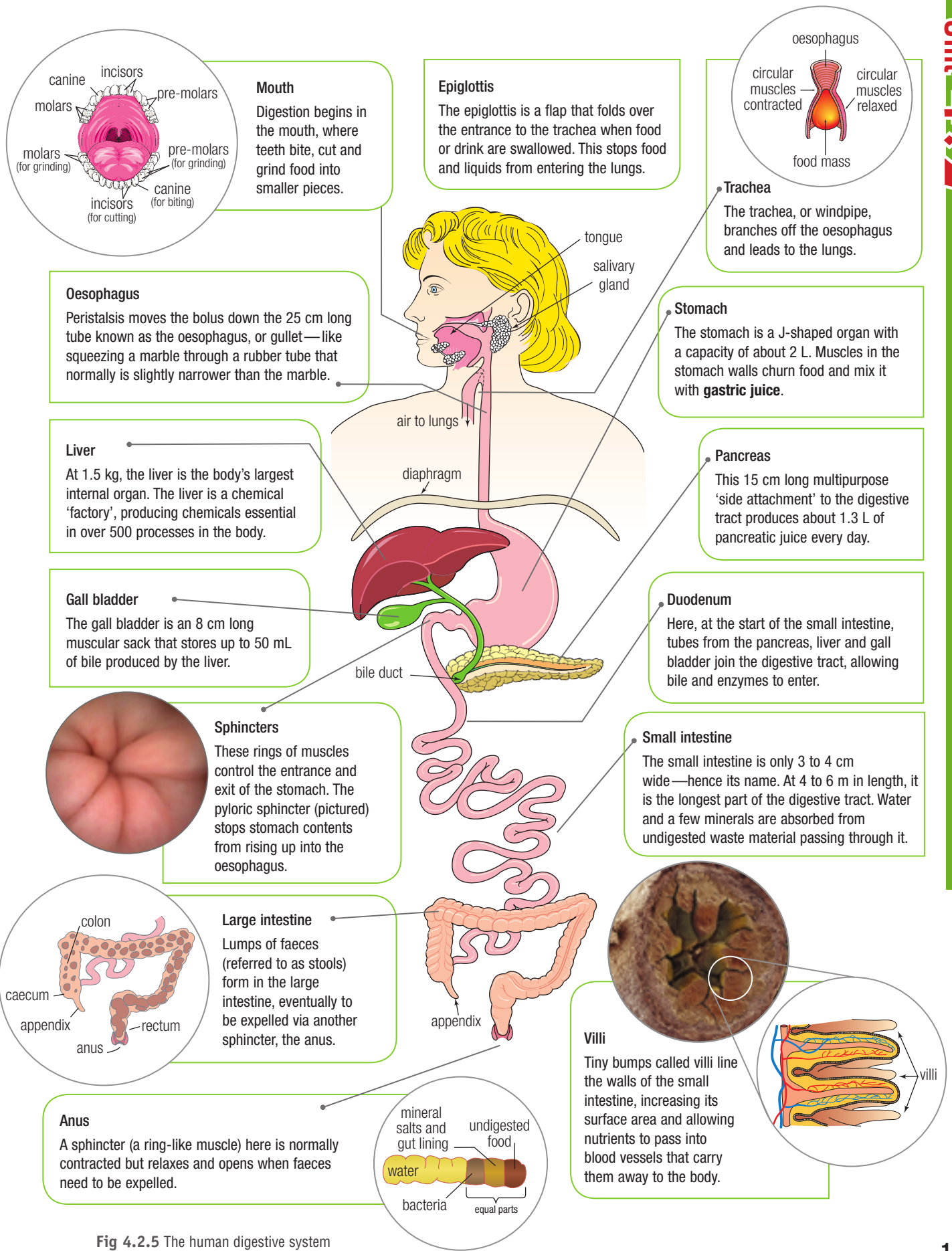


Fig 4.2.5 The human digestive system