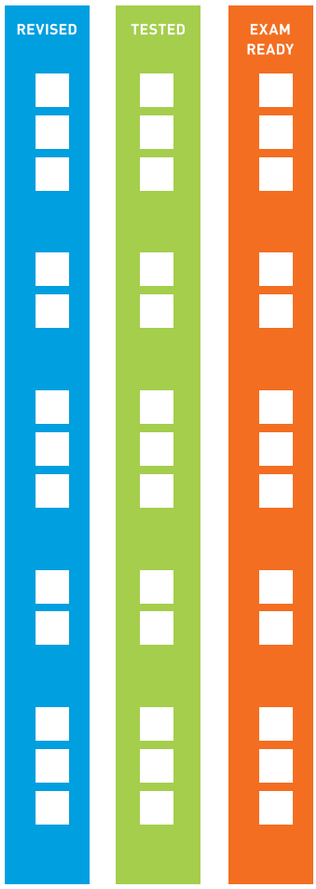
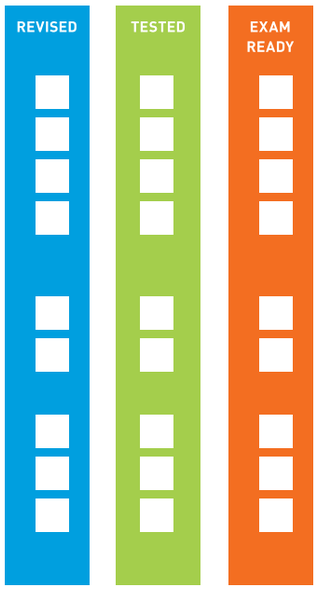
# My revision planner





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# 2 Organisation

## Animal tissues, organs and systems

### Levels of organisation in living organisms

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Larger multicellular animals have several levels of organisation. From smallest to largest, they are:

1 Cells are the basic building blocks of all life.
2 Tissues are groups of cells with a similar structure and function.
3 Organs are groups of tissues that perform a specific function.
4 Organ systems are groups of organs with similar functions.
5 Organisms are made from organ systems.

**Table 2.1** Examples of levels of organisation.

| Organisational level | Examples |
|---|---|
| Cell | Nerve cell, muscle cell |
| Tissue | Nervous tissue, skin |
| Organ | Brain, heart |
| Organ system | Nervous system, digestive system |
| Organism | Human, frog |

**Revision activity**

Draw out this table with only the headings along the top and the first column on the left. Try to fill in the rest of the table from memory to help you to revise.

### The human digestive system

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Your digestive system is about nine metres long and runs from your mouth to your anus.

It breaks down the large, **insoluble** bits of food that you eat. These are broken down into smaller, **soluble** pieces that can be absorbed into your blood. Once this happens they are transported around your body to the cells that need them.

**Insoluble**: Cannot dissolve.

**Soluble**: Can dissolve.

#### Functions of the parts of the digestive system

The locations of the parts of your digestive system are shown in Figure 2.1. The functions of these components are found in Table 2.2.

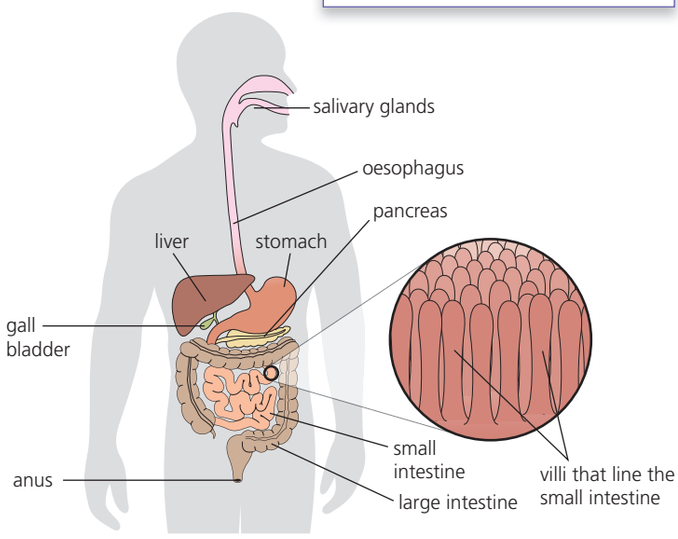


**Figure 2.1** The digestive system showing the location of the villi.

**Table 2.2** The parts of the digestive system and their functions.

| Component | Function |
|---|---|
| Salivary glands | Salivary glands in your cheeks produce saliva. This saliva lubricates food as it passes along your oesophagus. Saliva also contains a carbohydrase **enzyme** called amylase that begins the break-down of carbohydrates into sugars. |
| Oesophagus | This short tube connects your mouth and stomach. |
| Stomach | Your stomach is a small bag about the size of your fist. It has ridges that allow it to increase in size when you eat food.<br><br>Food is mixed with stomach acid to kill any **pathogens**. Stomach acid does not break down food. Protease enzymes are mixed with food to begin the break-down of proteins. |
| Liver | Food does not pass though the liver. The liver produces **bile**, which breaks down fats into smaller sections. This process is called emulsification. It increases the surface area of the food to allow lipase enzymes to work more effectively. |
| Gall bladder | Food does not pass through the gall bladder. Bile is stored in the gall bladder before being released into the small intestine. |
| Pancreas | Food does not pass through the pancreas. It produces carbohydrase, protease and lipase enzymes and releases these into the small intestine. |
| Small intestine | Digested food is absorbed into the blood in the small intestine. It is about six metres long.<br><br>The surface of the small intestine is not smooth. It possesses millions of tiny finger-like projections called villi. These villi increase the surface area of the small intestine to allow more nutrients to be absorbed into the blood.<br><br>Food is pushed through your small intestine by a process called **peristalsis**. This process is the rhythmical contraction and relaxation of muscles in the lining of the small intestine. This movement forces lumps of food along it. |
| Large intestine | All that is left of your food when it leaves the small intestine is water and fibre that you cannot digest. The large intestine absorbs water from this food, leaving fibre which forms your solid waste (faeces). |
| Anus | This opening controls when you release faeces when you go to the toilet. |

**Enzyme**: A biological molecule that speeds up a chemical reaction.

**Pathogen**: A disease-causing micro-organism (bacterium, fungus or virus).

**Bile**: A green-coloured liquid produced by your liver, stored by your gall bladder and released into your small intestine to break down fats.

**Peristalsis**: The rhythmical contraction of muscle behind food in your digestive system to push it along.

**Revision activity**

Draw out this table with only the headings along the top and the first column on the left. Try to fill in the rest of the table from memory to help you to revise.

**Revision activity**

Pushing a tennis ball through a pair of tights is a good model for peristalsis pushing a bolus of food along your digestive system.

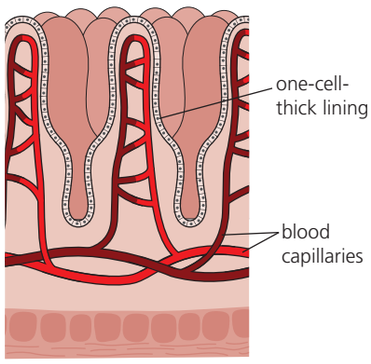


**Figure 2.2** Villi are small, hair-like structures in your small intestine. Villi increase the surface area over which molecules of digested food are absorbed.

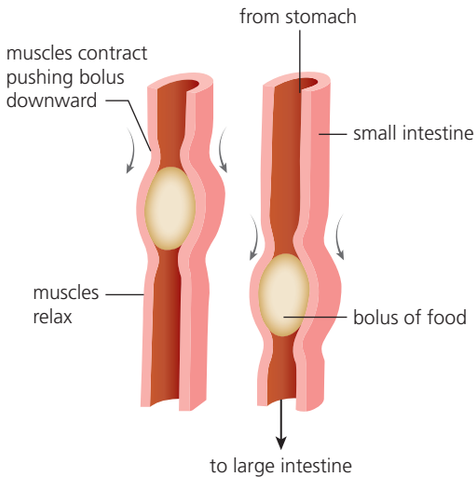


**Figure 2.3** The rhythmical contraction and relaxation of the muscles that line much of the digestive system is called peristalsis.

## Required practical 4

### Food tests

**Aim:** To use qualitative reagents to test for a range of carbohydrates, **lipids** and proteins.

**Equipment:** Spotting tile, boiling tube, iodine solution, distilled water, Benedict's solution, water bath, Biuret solution, bung.

**Method and results – starch test:**

1 Place a small amount of food onto a spotting tile.
2 Add two drops of iodine solution.
3 If the food turns blue or black, starch is present.
If it remains brown (the colour of iodine solution) then no starch is present.

**Method and results – glucose test:**

1 Place a small amount of food in a boiling tube.
2 Add 10 $cm^3$ of distilled water.
3 Add 10 drops of Biuret solution to the boiling tube.
4 Heat in a water bath at 80 °C for 10 minutes.
5 If the solution turns orange or green, glucose is present.
If it remains blue (the colour of Benedict's solution) then no glucose is present.

**Method and results – protein test:**

1 Place a small amount of food in a boiling tube.
2 Add 10 $cm^3$ of distilled water.
3 Add 10 drops of Biuret solution to the boiling tube.
4 If the solution turns a light lilac colour, then protein is present.
If it remains blue (the colour of Biuret solution) then no protein is present.

**Method and results – oils test:**

1 Place a small amount of food in a boiling tube.
2 Add 10 $cm^3$ of distilled water.
3 Place bung in boiling tube and shake vigorously.
4 If an oil is present an emulsion will form and the water will turn cloudy.

**Lipids**: Fats or oils, which are insoluble in water.

# Enzymes

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Enzymes are biological catalysts. They speed up reactions and are not used up in them. This section focuses on the enzymes present in your digestive system. These enzymes break down large molecules of food into smaller ones. They are called break-down enzymes. There are other enzymes, however, that do the reverse. They join smaller molecules together to make larger ones. The enzyme involved in protein synthesis does this, for example. These are called synthesis enzymes.

**Exam tip**

You should be able to relate your knowledge of enzymes to metabolism.

## Human digestive enzymes

There are three types of digestive enzyme. The molecules of food that they break down are called **substrates**. The three types of enzymes, their substrates and products and where they are found are shown in Table 2.3.

**Substrate**: The molecule on which an enzyme acts.

**Table 2.3** The enzymes, substrates and products of the digestive system.

| Enzyme | Substrate | Product | Location |
|---|---|---|---|
| Carbohydrase | Carbohydrates | Sugars | Mouth, pancreas and small intestine |
| Protease | Proteins | Amino acids | Stomach, pancreas and small intestine |
| Lipase | Fats and oils (lipids) | Fatty acids and glycerol | Pancreas and small intestine |

**Revision activity**

Draw out this table with only the headings along the top and the first column on the left. Try to fill in the rest of the table from memory to help you to revise.

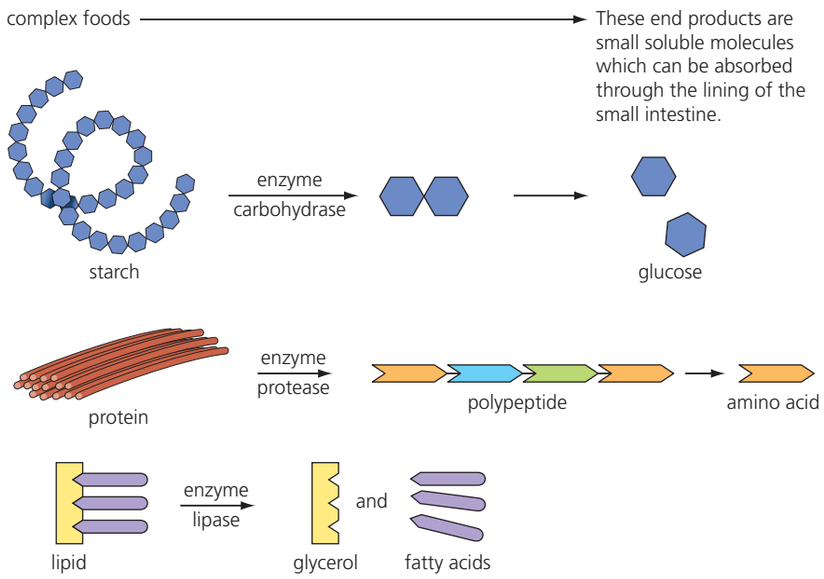


**Figure 2.4** The break-down of complex food molecules into small, soluble molecules that can be used.

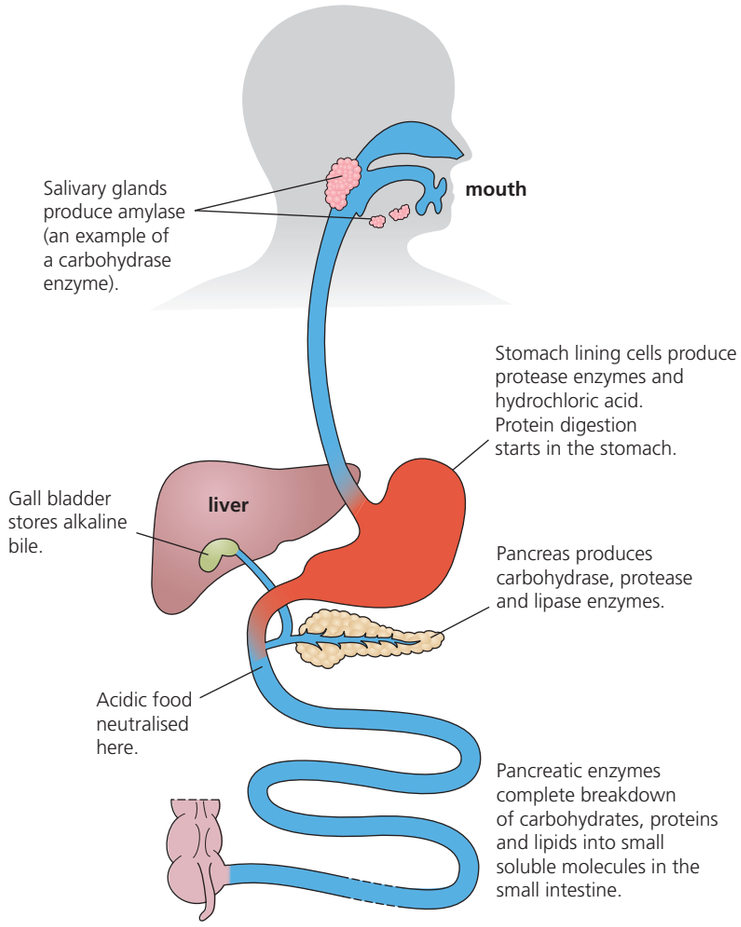


**Figure 2.5** Digestive enzymes control reactions that take place in the digestive system. No enzymes are made or used in the oesophagus, liver (bile is not an enzyme), gall bladder, large intestine or anus.

## Bile

Bile is not an enzyme. It does not break down lipids into fatty acids and glycerol as lipase enzymes do. Bile is an emulsifier. It breaks down large globules of fat into smaller ones. This process increases the surface area that lipase enzymes can then work on. This process speeds up their digestion.

Bile is also an alkaline substance. It neutralises any excess stomach acid at the beginning of the small intestine. This process provides the enzymes in the small intestine with their optimum pH.

**Exam tip**

You should be able to recall the locations where digestive enzymes are produced (see Table 2.3). You should also be able to state simple word equations for these break-down enzymes.

**Typical mistake**

Bile is not an enzyme. It is a chemical substance that emulsifies (breaks down) fats.

## The lock and key theory

Enzymes are specific for their substrates like keys are specific for their locks. So, protease enzymes will not break down lipids, just as the key to your house will not open your parent's car. For an enzyme to break down a substrate, the substrate must fit into the enzyme, just like a key fits into a lock. So, the shape of the enzyme and substrate must match, just like keys and locks. This model is called the **lock and key theory**.

**Lock and key theory**: A model that explains the action of enzymes.

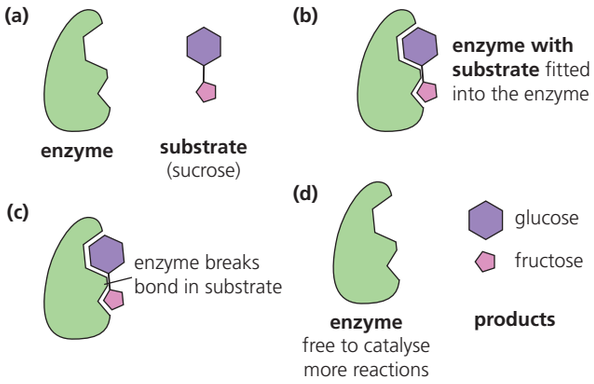


**Figure 2.6** How a digestive enzyme breaks down a substrate. Here the substrate is sucrose and the products are glucose and fructose.

At optimum pH and temperature, the shapes of the enzyme and substrate fit together perfectly. When we move away from the optimum pH or temperature, the shape of the **active site** changes. This change makes it harder for the enzyme and substrate to fit together and so slows the rate at which the enzyme works. This in turn slows the reaction. If extremes of pH or temperature are reached, the shape of the active site is permanently changed. The enzyme's active site becomes **denatured** and will no longer function.

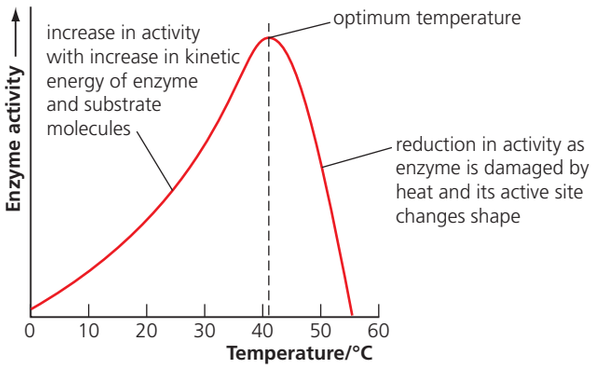


**Figure 2.7** This graph shows the effect of temperature on the activity of an enzyme.

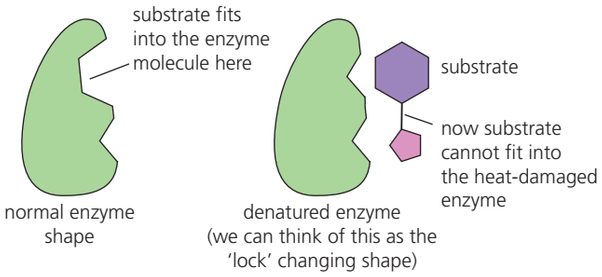


**Figure 2.8** Extremes of temperature and pH denature enzymes by altering the shape of their active site, so the substrate can no longer fit.

**Exam tip**

You should be able to use the lock and key theory to explain how enzymes work.

**Active site**: The region of an enzyme that binds to its substrate.

**Denatured**: A permanent change to an enzyme as a result of extremes of pH and temperature that stop it working.

**Exam tip**

You should be able to relate the activity of enzymes to their temperature and pH.

**Exam tip**

You should be able to calculate the rate at which chemical reactions occur.

**Exam tip**

As well as the lock and key theory, enzyme activity at higher temperatures can be explained by particle theory. At higher temperatures, molecules have more kinetic energy so move faster. This means that they are more likely to collide with substrates.