

Unit 8A Food and digestion

About the unit

In this unit pupils learn:

- about different foods and how they can be combined to produce a balanced diet
- how food is broken down by digestion so it can be used by the body, for energy, growth and repair

In scientific enquiry pupils:

- consider the extent to which evidence about diet can lead to firm conclusions
- use a model to explore digestion
- use chemical tests to identify food types
- present and interpret data from secondary sources
- draw conclusions from observations and explain these using scientific knowledge
- investigate a question about nutrition using secondary sources of information

This unit is expected to take approximately 8 hours.

Where the unit fits in

This unit draws on ideas about food and nutrition developed in the key stage 2 programme of study. It builds on unit 5A 'Keeping healthy' in the key stage 2 scheme of work and on unit 7A 'Cells'.

The particle model of matter is introduced in unit 7G 'Particle model of solids, liquids and gases' and is revisited in this unit in the context of digestion.

The unit relates to other units that focus on life processes in humans: unit 8B 'Respiration' and unit 9B 'Fit and healthy', which revisits the concept of a healthy diet.

The energy transfer ideas of unit 7I 'Energy resources' are used in the context of digestion. Energy should be distinguished from 'stuff' (food as the energy resource or fuel).

This unit relates to unit 8A(i) 'Exploring materials (food)' and unit 9A(i) 'Selecting materials (food)' in the design and technology scheme of work.

Expectations

At the end of this unit

in terms of scientific enquiry

most pupils will: use secondary sources of information to generate graphs or displays relevant to questions asked; recognise that interpretation of evidence about questions of health and diet may be difficult; identify and control relevant variables when investigating the action of an enzyme

some pupils will not have made so much progress and will: find information from selected secondary sources about food and diet; generate graphs or displays relevant to questions asked; with help, control relevant variables when investigating the action of an enzyme

some pupils will have progressed further and will: choose secondary sources to provide the information needed about food and diet; explain why interpretation of evidence about questions of health and diet may be difficult

in terms of life processes and living things

most pupils will: name nutrients, fibre and water as part of a balanced diet, identifying examples of foods in which they are found, and describe the role of the main nutrients in the body; use a model to describe how large molecules are broken down during digestion and describe the role of blood in transporting products of digestion around the body

some pupils will not have made so much progress and will: name some groups of nutrients and identify some examples of foods in which they are found; describe a balanced diet; recognise that blood transports products of digestion around the body

some pupils will have progressed further and will: explain why some nutrients have to be broken down before they can be used by the body and why some foods cannot be digested by humans

Prior learning

It is helpful if pupils:

- know that food is needed for activity and growth, and that an adequate and varied diet is needed to maintain health
- know that matter, including food, consists of particles, *eg molecules*, which can differ in size
- recognise that food provides energy for the body

Health and safety

Risk assessments are required for any hazardous activity. In this unit pupils:

- carry out chemical tests on a range of foods
- investigate the effect of saliva on starch
- plan and carry out their own investigation into enzyme activity

Model risk assessments used by most employers for normal science activities can be found in the publications listed in the *Teacher's guide*. Teachers need to follow these as indicated in the guidance notes for the activities, and consider what modifications are needed for individual classroom situations.

Language for learning

Through the activities in this unit pupils will be able to understand, use and spell correctly:

- scientific words relating to the structure of organisms, *eg intestine, villus*
- more specialised words relating to nutrition, *eg carbohydrate, protein, enzyme*
- words and phrases with similar but distinct meanings, *eg take in and absorb, feeding and digestion*
- words that extend their vocabulary, *eg absorption*

Through the activities pupils could:

- show relationships between ideas by using links which show purpose, *eg in order to, so that*, and reservations, *eg although, unless, if*
- select relevant information and link to other information, from a range of sources
- distinguish facts from hypotheses/theories/opinions and consider how far information is complete and helpful

Resources

Resources include:

- secondary sources to explore the constituents of food, *eg diet software, CD-ROMs, dietary information leaflets, video clips of TV advertisements, other literature, which may include articles from magazines*
- a range of foodstuffs for testing, sufficient to provide several samples rich in each of the major chemical groups in food, including foods that are found in the diet of other countries
- illustrative material relating to advertising claims for foods, *eg from magazines*
- database and spreadsheet software
- simulation software illustrating digestion and transport of substances in the blood
- a collection of food packaging, including cereal packets showing nutritional contents
- media reports, magazine, newspaper and television advertisements relating to food and diet

Out-of-school learning

Pupils could:

- visit a supermarket to find out more about foods
- look at menus and labels in fast-food outlets
- read articles in magazines and newspapers about issues relating to food and diet, *eg for athletes, pregnant women, very young children*
- find out about conflicts in dietary advice, and world food shortages
- extend their ideas about diet during holidays and visits to other families
- use the internet to find information and advice on food and diet, *eg www.nutrition.org.uk*

Pupils should learn:

Pupils:

What's in food and why is it important?

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| <ul style="list-style-type: none"> • that foods are a source of raw materials for the body • that foods are the energy resource to maintain the body's activities (growth, repair and movement) | <ul style="list-style-type: none"> • Use a true/false quiz to assess and revise pupils' knowledge and understanding of food and diet. Provide a selection of terms used in the quiz and ask pupils to link related terms together. These terms can be used again at the end of the unit when reviewing work to monitor progress in learning. Ask them about work carried out in key stage 2. Review the main reasons why we need food. | <ul style="list-style-type: none"> • identify some reasons why food is important, <i>eg as raw material, for growth, for energy</i> | <ul style="list-style-type: none"> • Teachers will be aware of the need to treat issues about diet with sensitivity, including being aware of the diet in other countries and cultures. • This activity is designed to find out what pupils know and understand about food and diet. Teachers will need to bear this in mind in later work. • In key stage 2, pupils are likely to have grouped similar foods together and discussed which provide materials for growth and which are more immediate sources of energy. Most pupils will not have formally classified foods as proteins, carbohydrates, etc. |
| <ul style="list-style-type: none"> • that foods contain a mix of proteins, carbohydrates, fats, vitamins, minerals, fibre and water • to use chemical tests to identify proteins, carbohydrates and fats • to work safely with chemicals • to present results to highlight significant points | <ul style="list-style-type: none"> • Ask pupils to use the nutritional information panel from cereal packets to identify the main nutrients contained in food, and establish that carbohydrates, proteins, fats, fibre and water form the bulk of food. • Demonstrate food tests to identify protein, starch, sugars, fats, and water, ensuring that pupils are aware of the health and safety requirements for these tests. • Provide a range of foods, <i>eg 15 samples</i>, and ask pupils working in groups to use the food tests to identify the presence of nutrients in the foods. Help pupils to share results and produce a Venn diagram showing foods which have different combinations of the nutrients. • Discuss with pupils the importance of water in the diet, what the sources of water are and whether it should or should not be counted as a nutrient. | <ul style="list-style-type: none"> • identify foods which are rich in particular nutrients • use chemical tests to identify proteins, carbohydrates and fats • work safely with chemicals • construct a Venn diagram showing the combinations of nutrients in each food sample tested | <ul style="list-style-type: none"> • Extension: pupils could be asked to find out about how mammals in desert conditions obtain sufficient water in their diet. <p>⚠ Safety</p> <ul style="list-style-type: none"> – appropriate risk assessments should be made in relation to the proteins, carbohydrates and fats used and the reagents used to test for them – very dilute sodium hydroxide (0.2 mol dm^{-3}) should be used in the Biuret test for protein – Benedict's (not Fehling's) solution should be used in the tests for sugars – if ethanol (highly flammable) is used to test for fats, ensure no naked flames are used and remind pupils how to heat a test tube of liquid safely – pupils should not eat the food tested because of possible contamination – beware of foods containing nuts. <p>If pupils with known allergies are present, follow appropriate procedures after risk assessment</p> |

Learning objectives

Pupils should learn:

- that vitamins and minerals are present in smaller amounts than the other constituents of food
- how to search for information in databases or spreadsheets
- to frame a question that can be investigated
- to decide whether to use first-hand or secondary data
- to use and interpret ICT-generated graphs
- that protein is important for growth and repair and that carbohydrates and fats more commonly provide energy

Possible teaching activities

- Extend pupils' understanding of a balanced diet by providing software on diet containing information about the nutritional content of a range of foods.
- Depending on the nature of information provided, help pupils to frame appropriate questions to investigate, *eg Which foods contain starch and fat?*, and to use the spreadsheet to produce and interpret graphs. Ask them to compare the results obtained with the Venn diagram from the previous activity and to suggest reasons for differences.
- Help groups of pupils to use the results of their investigations to produce a summary leaflet about one type of food constituent, including information about foods that are a good source of it and the role of this food constituent in the diet.
- Bring together all the leaflets as a class booklet and establish the main role of each type of food in the diet.

Learning outcomes

Pupils:

- use ICT to produce graphs or displays relevant to the question asked
- use data to show that vitamins and minerals are present in foods in smaller amounts than the other nutrients
- describe, *eg in an information leaflet*, good sources of one nutrient and the importance of that nutrient in the diet
- identify the main role of proteins, carbohydrates and fats in the diet

Points to note

- Pupils should be reminded that information is normally given in terms of 100g of food and that this may not be a standard portion. They could scale the values up or down according to the standard portions and assess the nutritional value of a typical meal. This provides an opportunity to reinforce ideas about making fair comparisons.
- Extension: pupils could use information in a database or spreadsheet to answer questions, *eg*
 - *Are foods containing protein more expensive than other foods?*
 - *What are the sources of protein for a vegetarian?*
 - *How does the nutritional content of a prepared microwave meal compare with that of a similar freshly prepared cooked meal?*

Which foods provide a balanced diet?

- that a healthy diet contains a balance of foodstuffs
- Introduce the idea that there are many different healthy and balanced diets by inviting pupils from a variety of backgrounds to describe some of the main features of their own or their family's diet. Suggest that pupils ask senior members of their family to describe the type of diet they had when they were children.
- Use food packaging, advertising claims, media reports, or recorded television advertisements as a stimulus to raise questions, *eg*
 - *Can too much salt be harmful?*
 - *What is a healthy diet?*
 - *Should children and adults have the same diet?*
 - *Are low-calorie alternatives always preferable?*
 - *How do diets of different cultures differ?*
- Raise the issue of what exactly is meant by a 'healthy' balanced diet.
- explain that a healthy diet contains a balance of six groups of chemicals (proteins, carbohydrates, fats, vitamins, minerals, fibre) and water
- Teachers will be aware of the need to ensure that pupils are sensitive to differences between each other's individual diets as well as the diet of their families and friends.
- Whilst the concept of a balanced diet is easy for pupils to understand, the media present much conflicting dietary advice, which may be biased according to its source.
- Extension: pupils could find out about the special diets of other pupils and consider the reasons why the balance of constituents within these diets is different and important.

Learning objectives

Pupils should learn:

- to distinguish facts from theories/hypotheses/opinions
- to show relationships between ideas, by using links which show purpose and reservations

Possible teaching activities

- Ask pupils to use information from a variety of secondary sources to find out more about one question from those already raised by pupils or others, eg
 - *What foods should you eat to reduce the chance of heart disease?*
 - *What do athletes eat at different stages of training?*
 - *What does a pregnant woman need in her diet?*
 - *What are 'organic' foods and how are they different from other foods?*
 - *Are breakfast cereals really good for you?*
- Discuss with pupils what they have found out and the extent to which they have confidence in the information they used.

Learning outcomes

Pupils:

- critically assess the sources of secondary data, and use selected sources for a purpose
- identify factual information and distinguish it from an opinion/claim, focusing on the language used
- recognise when presenting results that knowledge is incomplete and interpretation of evidence is difficult

Points to note

- This provides an opportunity for considering an area of science in which our knowledge is incomplete and interpretation of the available evidence is difficult.

- to select relevant information and link to other information from a range of sources
- to recognise where evidence is not sufficient to draw firm conclusions

- Ask pupils to produce a report of their findings and conclusions in an interesting and appropriate format, eg *display work, an advisory leaflet for a particular target group, a class debate, a radio interview script.*
- Remind pupils about earlier work on food chains and contrast the diet of animals with the range of the human diet.

- select relevant information
- indicate where knowledge is not sufficient to draw a firm conclusion
- represent information in a format appropriate to the audience

- Leaflets and posters providing information on diet are available from many sources, including health promotion units and health organisations, eg *the British Heart Foundation, British Nutrition Foundation, food manufacturers, food marketing organisations, eg The National Dairy Council, food retailers and the media.*
- Many of these organisations also provide internet sites presenting dietary information. Pupils could be encouraged to explore these.
- Extension: pupils could be asked to find out about the diet of another mammal and to compare the range of nutrients it provides with those in the human diet.

Checking progress

- to generate questions about nutrients and diet

- Ask pupils to produce a quiz sheet to test knowledge and understanding about food and diet and exchange with other pupils, who can use them to assess their knowledge and understanding.

- generate appropriate questions together with answers related to the content of the unit

Pupils should learn:

Pupils:

What happens to food inside the digestive system?

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| <ul style="list-style-type: none"> • that the digestive system consists of a tube through which food passes • to interpret the relationship between a model gut and the digestive system • to suggest explanations for observations | <ul style="list-style-type: none"> • Ask pupils for their ideas about what happens to food once it has been eaten. Develop the idea that food enters a tube running through the body, and that this, and associated organs, make up the digestive system. Build up their suggestions into a sequence of events commencing with feeding, followed by absorption and ending with elimination of faeces. • Explain that what happens to food inside this tube can be explored using a model, <i>eg a model gut made from visking tubing filled with a 'starch meal'; a software simulation</i>. Ask pupils about how they tested for starch earlier and help them to test the contents of the 'gut' and the surrounding water for starch. Ask pupils to explain their observations and to consider the implications of nutrients from food entering the body. • Ask pupils to interpret their findings in the light of their previous assumptions. | <ul style="list-style-type: none"> • describe how food passes along a digestive tube which runs through the body • offer suggestions about what happens to food as it passes through this tube • make links between the model gut and the digestive system • use scientific knowledge to explain observations | <ul style="list-style-type: none"> • Most pupils will not have studied digestion at key stage 2, although they will have ideas about what happens to food inside the body. This unit focuses on what digestion involves and why it is necessary, rather than on the structure of the digestive system or on the detail of how and where particular foods are digested. • The use of the model gut will allow pupils to investigate the processes going on inside the intestine, and to appreciate the importance of the process. Using a model such as a sieve with chickpeas and sand may help some pupils. • Pupils are introduced to the particle model in unit 7G 'Particle model of solids, liquids and gases' and to ideas about atoms and molecules in unit 8E 'Atoms and elements'. |
| <ul style="list-style-type: none"> • that foods contain starch, protein and fat, which have molecules that are too large to be absorbed by the body • that sugars, vitamins and minerals are generally smaller and can be absorbed by the body • that large molecules are broken down by enzymes in the gut to form smaller molecules, which pass through the wall of the small intestine • how models can be used to represent and explain complex processes | <ul style="list-style-type: none"> • Check pupils' understanding of the relationship between size of food molecules and ease of absorption, <i>eg by showing them models representing molecules of starch, protein, fat, sugars, vitamins and minerals</i>. Ask pupils which of these make up most of the foods they eat and challenge them to suggest what must happen to the large molecules. Ask them to predict which will be absorbed most easily, with reasons. • Establish that digestion involves breaking larger molecules into smaller ones. Introduce the idea that digestion involves enzymes which act on large, insoluble molecules to break them down into smaller, soluble molecules. Help pupils to set up a model gut containing saliva and starch, and to test the contents of the water for sugar and the contents of the model gut for starch. | <ul style="list-style-type: none"> • state that small molecules can pass through the wall of the small intestine • explain that starch, protein and fat molecules are too large to be absorbed • explain that specific vitamins and minerals are generally smaller and can be absorbed by the body • produce a sequence of diagrams to illustrate that larger molecules are broken down to form smaller molecules in the gut | <ul style="list-style-type: none"> • Plants' production of starch from glucose for storage is introduced in unit 9A 'Inheritance and selection'. Minerals, <i>eg calcium</i>, and vitamins, <i>eg vitamin C</i>, are considered in more detail in unit 9B 'Fit and healthy'. • Interlocking bead models can be used to represent large and small molecules and to model the process of breakdown of molecules, such as starch into sugar molecules. Although such models do not accurately represent the structure of fats, they do help to get across the idea of complexity. <p> Safety – ensure pupils use their own saliva and that used test tubes are placed in disinfectant. Staff who clean apparatus should use gloves</p> |

Pupils should learn:

Pupils:

What do digestive enzymes do?

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| <ul style="list-style-type: none"> • that food is digested by enzymes in the gut to form smaller molecules • to represent a complex process using diagrams and text | <ul style="list-style-type: none"> • Through questioning, elicit pupils' ideas about digestive enzymes as a means of breaking down larger molecules. Establish that the water outside the tubing in the model represents the blood system. Ask them to explain the process, <i>eg using animations from CD-ROMs or video, or interlocking bead models of large molecules</i>. Ask pupils to draw a sequence of diagrams and then write an explanation in their own words. | <ul style="list-style-type: none"> • state that food is digested by enzymes in the gut to form smaller molecules and that these pass into the blood • describe the processes involved, <i>eg by drawing diagrams, by using models, in writing</i> | <ul style="list-style-type: none"> • Viewing animation of the process is very useful in helping pupils to internalise what is going on. • Extension: pupils could produce a 'flicker-book' animation to represent the process. |
| <ul style="list-style-type: none"> • to identify factors relevant to a particular context • to plan how to control variables • to explain their results using knowledge of the human digestive system • to show relationships between ideas by using links that show purpose and reservation | <ul style="list-style-type: none"> • Remind pupils of the range of food types with large molecules and explain that in addition to enzymes the conditions inside the gut assist the breakdown of large molecules, <i>eg body temperature</i>. Ask the pupils to discuss what other substances are found in the stomach. After the discussion inform the pupils that hydrochloric acid is produced by the lining of the stomach. • Provide them with an opportunity to investigate the action of a particular enzyme, <i>eg trypsin acting on the gelatine of exposed and developed black-and-white photographic film; protease acting on albumen</i>. • Ask pupils to suggest what might affect how well the enzyme digests the food, <i>eg pH, temperature</i>, and help them to plan an investigation, identifying what they are going to measure and which variables they will need to control. Ask pupils to produce an account of their investigation, relating what they found out to the conditions in the gut. | <ul style="list-style-type: none"> • suggest relevant variables, <i>eg pH, temperature</i> • identify a way to keep variables, <i>eg temperature, constant</i> • identify the conditions under which digestion occurs, <i>eg at a temperature of 37°C</i>, and relate these to their results | <ul style="list-style-type: none"> • At this stage, pupils do not need to know the names of specific digestive enzymes, although some pupils might find these out for themselves. • In unit 7E 'Acids and alkalis' pupils may have found out about the use of acid in the human digestive system. • The effect of pH changes on enzyme activity could be monitored using ICT. • Extension: pupils could find out which is the best washing powder for an egg yolk stain, <i>eg biological or non-biological</i>. Be aware that some pupils may be allergic to biological washing powders. <p> Safety – pupils' plans must be checked for health and safety before practical work begins. Remind pupils how to safely heat test tubes of acid and other substances</p> |

Where are the products of digestion used?

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| <ul style="list-style-type: none"> • that the products of digestion are transported in the blood to other parts of the body • that some food material cannot be digested and is egested | <ul style="list-style-type: none"> • Remind pupils about the way in which the body uses food, <i>eg for energy, for growth</i>, and ask them how the products of digestion reach other parts of the body. Use secondary sources, <i>eg video clips, ICT simulations</i>, to show how simple molecules, <i>eg glucose molecules</i>, are transported to cells, <i>eg in the muscles</i>. • Ask pupils which of the food types they hadn't considered during the work on the products of digestion. Establish that fibre and undigested food is passed through the gut and egested in faeces. | <ul style="list-style-type: none"> • state that the blood transports products of digestion to every cell in the body • use models to describe how smaller molecules are transported in the blood • state that some food material cannot be digested and is passed out of the body as faeces | <ul style="list-style-type: none"> • At key stage 2 pupils are likely to have learnt about blood being pumped around the body by the heart, but not about the role of the blood in transporting the products of digestion to other parts of the body. The body's use of glucose in respiration is covered in unit 8B 'Respiration'. • Extension: pupils could be asked to find out why grass is not a source of food for humans. |
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Learning objectives

Pupils should learn:

Possible teaching activities**Learning outcomes**

Pupils:

Points to note**Reviewing work**

- to relate knowledge and understanding of food types to the processes of digestion
- Provide pupils with an appropriate selection of terms related to food and digestion and ask them to use these to make a concept map. Discuss pupils' maps with them, asking them to identify areas of difficulty and challenging them to make and explain new connections.
- identify appropriate connections between ideas in this unit and explain their reasoning
- A concept map can show connections between different ideas in a particular topic. Pupils may have made concept maps in key stage 2.