

Energy from food

This grid shows the basic concepts met in this topic, together with a scheme of cognitive progression for each concept. Opportunities to cover learning and progression are given. Working Scientifically concepts are integrated throughout the materials.

Conceptual statement	Cognitive progress					
	Remembering (a)	Understanding (b)	Applying (c)	Analysing (d)	Evaluating (e)	Synthesising & creating (f)
Renewable or non-renewable energy resources have advantages and disadvantages.	State the meaning of: hydroelectricity, geothermal, biomass/biofuel, solar energy, wind energy, tidal power.	Describe advantages and disadvantages of different [renewable, non-renewable] energy resources.	Suggest ways in which our use of fossil fuels/non-renewable fuels can be reduced.	<p>Explain how the Sun is the ultimate source of the energy used in [hydroelectric, wind, wave] power.</p> <p>Explain the idea of a 'carbon neutral' fuel.</p> <p>Explain why biofuels are not necessarily carbon neutral.</p>	<p>Defend or oppose a decision in favour of using an energy resource in a certain area.</p> <p>Evaluate ways of reducing consumption of fossil fuels.</p>	Decide and explain the best energy resources to use in an area.
Fuels are used to release energy, usually by combustion.	<p>State the meaning of: fuel, combustion, renewable, non-renewable.</p> <p>Name the three sides of the fire triangle.</p> <p>Recall examples of renewable and non-renewable fuels and their sources.</p>	<p>Describe the factors that make up a good fuel.</p> <p>Describe how ethanol can be produced and used.</p> <p>Describe what happens in a fuel cell.</p>		Compare the temperature rise of water when some fuels are burnt.	<p>Evaluate alternative fuels compared with fossil fuels.</p> <p>Evaluate data on burning fuels to deduce the [best value for money, best energy per gram of fuel].</p>	
Energy can be stored and transferred in different ways.	<p>Recall the forms in which energy can be stored.</p> <p>Recall the different ways in which energy can be transferred.</p>	<p>Identify situations in which energy is stored.</p> <p>Identify situations in which an energy transfer is taking place.</p>	Describe energy transfer chains for given situations.			

Conceptual statement	Cognitive progress					
	Remembering (a)	Understanding (b)	Applying (c)	Analysing (d)	Evaluating (e)	Synthesising & creating (f)
Body mass is related to diet and exercise.	Recall the factors that affect the amount of energy needed in a person's diet. Describe the factors that affect body mass. State the meaning of: obese.	Explain the differing energy needs of people of different ages and activity levels. Describe the effects of obesity on health.	Calculate the energy requirements for a particular person or activity. Calculate and use the body mass index (BMI) to draw conclusions.	Examine rates of obesity in an area and suggest reasons for any trends.		
Some substances are used as energy resources.	Recall some substances that are used as sources of energy.	Describe how energy is released from [food, fuels].	Explain the source of the energy in [food, fuels].			

Objectives

Developing:

- L5-6** Compare the temperature rise of water when some fuels are burnt.
- L4-5** Identify situations in which energy is stored.
- L5** Identify situations in which an energy transfer is taking place.
- L4** Recall the factors that affect the amount of energy needed in a person's diet.
- L4** Describe the factors that affect body mass.
- L4** Recall some substances that are used as sources of energy.

Securing:

- L4-5** Explain the differing energy needs of people of different ages and activity levels.

Exceeding:

- L5** Calculate the energy requirements for a particular person or activity.

Focused Working Scientifically Objectives

This topic provides an opportunity to focus on key Working Scientifically skills.

- L5** Use ratio notation to compare things.
- L5** Simplify and use ratios.

Student materials

Topic notes

- Energy is an abstract concept and unless discussed carefully is likely to lead to misconceptions which could cause difficulty in later topics. See the Background information for this unit for more detail.

Be prepared

Exploring 2 asks students to look at the nutrition information on food labels.

STARTERS

1: Energy brainstorm

L3-5 BA

This is the first occasion that students will have come across various words connected with energy in a scientific context. Brainstorm about energy by asking questions such as: 'Does it take energy to lift a book onto a shelf?'; 'Does it take energy to leave the book resting on the shelf?'.

The **(AT)** presentation *What needs energy?* provides some photos where energy transfers and needs can be identified. This establishes the idea that many things need energy to allow them to happen.

Follow this by asking about things that store energy, eliciting the idea that fuels such as oil or petrol, natural gas and food are stores of energy or energy resources. You could also ask them to say which things they think need a lot of energy and which may not need much energy. Keep the results of this exercise to revisit at the end of 7Ib Plenary 4, when students will have looked at energy in food, types of energy and energy transfers.

Brainstorming students' ideas allows you to find out how much they know and if there are any serious misconceptions that need to be addressed. In particular, students may know roughly what fuels are but many may also believe that electricity is a fuel.

Course resources

AT: Presentation *What needs energy?*

2: Ideas about energy**L4-5 BA**

The **(AT)** interactive *Ideas about energy* asks students to decide whether some statements about energy are correct or incorrect. Rolling over the various statements will provide more information. You could use this as part of the brainstorming session suggested in Starter 1 or as a separate activity to find out what students' ideas about energy are. Students are not expected to give correct responses to everything until they have studied the whole unit but they could jot down their initial ideas to revisit later.

Course resources**AT:** Interactive *Ideas about energy*.**3: Quick Quiz****L3-5 BA**

Use the 7I Quick Quiz for baseline assessment for this unit. Students can use the 7I Quick Quiz Answer Sheet to record their answers. Either use the whole Quick Quiz (which can be revisited at the end of the unit) or use only the Quick Quiz questions for this topic (which can be revisited at the end of this topic or at the end of the unit).

Course resources**ASP:** 7I Quick Quiz; 7I Quick Quiz Answer Sheet.**EXPLORING TASKS****1: Energy in food****L3-5 Prac WS**

Students compare at least three different foods to determine how much energy is stored in each type. The fairest comparison is given by using a known and fixed volume of water, holding the food a similar distance from the boiling tube each time and using similar sized pieces of food. Ideally the pieces of food should be the same mass but this may be difficult at this level.

Developing: Students complete a missing words exercise on Worksheet 7Ia-2 to help them to plan their investigation. If possible, these students should be given pieces of food all of the same mass.

Securing: Worksheet 7Ia-3 provides a method and questions to help students to present their results and draw conclusions. The worksheet guides students to work out the temperature change in the water per gram of food but it would also be helpful if students have looked at the Working Scientifically pages in the Student Book first (Explaining 3).



This practical activity is often carried out using nuts. However students allergic to nuts can suffer extreme reactions if they are in the same room as burning nuts. Even if allergic students are excluded from the room, you may have a student who does not know they are allergic. It is far safer to use crackers, crispbread or other foods. The lab must be well ventilated because smoke or fumes may cause problems for those with asthma. Students must not eat any of the foods.

The coils of wire can be made from any metal rod that is malleable and does not melt at the temperature of the foods being burnt. Steel welding rods are suitable (do not use thoriated welding rods) and a cork borer sharpener can be used as a suitable template to wind the metal around.

**Course resources****AP:** Worksheets 7Ia-2; 7Ia-3.**Equipment** (per group)

Crisps, crackers, bite-sized cereals or other foods such as crispbreads, together with the packets (for energy information), measuring cylinder, boiling tube, clamp and stand, thermometer, water, pin stuck into a cork with the point outwards, coil of wire mounted in cork, Bunsen burner, heatproof mat, eye protection.

2: Comparing foods using labels**L4**

The **(AT)** presentation *How do foods compare?* asks students to compare the energy values of different foods. It shows labels from various foods and asks students questions designed to help them to extract information and compare them. Students could also examine food labels they have brought in themselves and sort them into high-, medium- and low-energy foods.

Course resources**AT:** Presentation *How do foods compare?***Equipment**

Selection of food labels with nutritional information (optional).

3: How much do you eat?**L4-5**

Discuss with students what happens if their bodies get too much food, or too little (this issue will need to be treated sensitively). Use this as a lead in to the importance of knowing how much energy is contained in different foods and hence to the joule as a unit of measurement.

The **(AT)** spreadsheets *What do you eat?* and *What else do you eat?* contain information about various foodstuffs, set up so that students can enter the number of portions of each that they eat each day or week, and so estimate the amount of energy they take in. This can be used to follow up the initial discussion. *What else do you eat?* provides instructions, helping students to set up the calculations for themselves.

Course resources

AT: Spreadsheets *What do you eat?*; *What else do you eat?*.

4: Expedition food**L5-6**

The **(AT)** spreadsheet *Expedition food* takes Exploring 3 further by asking students to select what foods to take on a three-day expedition. Start by discussing how much energy they would need, using the information in chart C and the caption to photo D on Student Book spread 71a Energy from food. Establish that they would need more than their normal daily energy needs. They should plan on something like 12 000 kJ per day. In practice a three-day expedition would only involve carrying food for two breakfasts (on the second and third days) and two evening meals (on the first and second days), with enough food for three packed lunches. However, for simplicity the average daily energy requirement can be used.

Securing: The first sheet provides data about the energy values of foods per 100 g and portion sizes. Students can enter formulae into the cells to work out the energy per portion and the energy can then be used to make a running calculation at the top of the sheet.

Exceeding: Higher-attaining students could also consider other factors in menu planning, such as how much room the food will take up and its mass (or its weight). The second sheet in the spreadsheet includes cooking instructions so that students can consider potential problems on an expedition with limited cooking facilities. The third sheet will give students some ideas about the other factors to be considered. In general, dried food is best as you are not then carrying around unnecessary water (as you would with tinned fruit, for example), but if such

foods require lengthy cooking then additional fuel will need to be carried.

Groups could compare their menus and discuss any differences.

Course resources

AT: Spreadsheet *Expedition food*.

5: Comparing foods**L4-6 WS**

Worksheet 71a-4 provides questions about converting results to temperature rise per gram of food burnt and working out ratios. You may need to show students how to simplify a ratio by dividing both numbers by the smallest number.

Developing: Work through the sheet with students, discussing the answers with them.

Securing: Students work in pairs to answer the questions, then hold a class feedback session to check understanding.

The **(AT)** presentation *Comparing foods* provides worked answers for the questions on the sheet. Use this to help students with areas they are struggling with.

Course resources

AP: Worksheet 71a-4.

AT: Presentation *Comparing foods*.

EXPLAINING TASKS**1: 71a Energy and changes (Student Book)****L4 BA**

This spread introduces the idea of energy and shows a large image of a theme park. The **(AT)** video *Energy transfers at a theme park* illustrates rides and activities at a theme park for discussion into the different ways in which energy is being stored. Ask students to identify changes in the picture or the image, and suggest where the energy for these changes comes from. Students can jot down their ideas and revisit them in later topics. For this task, it is recommended to turn the sound off so that students do not hear the commentary.

Course resources

AT: Video *Energy transfers at a theme park*.

2: 71a Energy from food (Student Book)**L4-6 FA**

This spread explains that humans and other animals get their energy from food and outlines

Energy

the reasons why different people need different amounts of energy in their food. The page refers to mass rather than weight when discussing the effects of taking in more energy than they need. This is done for consistency with measurements of mass in practical work and on the following pages. If necessary, introduce mass as the amount of substance/stuff in an object. The **(AT)** interactive *Exercising energy transfers* asks students to discuss how energy is provided to our muscles. Worksheet 71a-1 is the Access Sheet. Question 8 can be used for formative assessment.

Assessment: Students work in pairs or small groups to agree on the answer. Encourage them to provide a full explanation, such as the one given in the answers.

Feedback: Ask for a volunteer to read out their answer and then ask the rest of the class for suggestions for correcting and/or improving the answer.

Action: Exploring 3, Exploring 4 or Exploring 5 could all help to consolidate the ideas presented in this topic.

Course resources

AP: Worksheet 71a-1.

AT: Interactive *Exercising energy transfers*.

3: 71a Fair comparisons and ratios (Student Book)

L5-6 **FA** **WS**

These pages explain how to deal with experimental results from food tests that are not all based on burning the same mass of food by working out the temperature rise per gram of food. Ratios are then described as other ways of comparing quantities. Skills Sheet MS 1 may be useful to support students who struggle with ratio notation or simplification of ratios. You may need to show students how to simplify a ratio by dividing both sides by the smallest number.

Question 3 can be used for formative assessment.

Assessment: Students work out the answers to Question 5.

Feedback: Ask for a volunteer to give their answer to the first part and explain how they worked it out. Ask others to decide whether or not the answer is correct and if there is a different way of working it out. Repeat for part b.

Action: Exploring 5 can be used as a follow-up activity if students need more practice in calculating ratios.

Course resources

AP: Skills Sheet MS 1.

PLENARIES

Most plenaries can be used for formative assessment. Suggested assessment, feedback and action strands of formative assessment can all be modified. See the ASP for further information and ideas on formative assessment.

1: Quick Check

L4-5 **FA**

Assessment: Students answer the questions on the 71a Quick Check sheet and indicate how confident they are in their answers. Students may need calculators for this work.

Feedback: Students swap sheets and mark their partner's work by checking it against the Student Book. When students have their own sheets back, ask for a show of hands to determine which (if any) questions a significant number of students got wrong, or were not confident in their answers for.

Action: The Quick Check sheet prompts students to consider how they can improve their recall of facts and their understanding. Ask students to discuss this in small groups and then take feedback from the class.

Course resources

ASP: 71a Quick Check.

2: Quick Check WS

L4-5 **FA** **WS**

Assessment: Students answer the questions on the 71a Quick Check WS sheet.

Feedback: Students work in small groups and compare their answers. They correct any mistakes found during this discussion and then use smiley faces to indicate their confidence in the agreed group answers. They can then check these against the answers provided.

Action: The **(AT)** presentation *Quick Check WS worked answers* provides worked answers for the questions on the sheet. Use this to help students with areas they are struggling with.

Course resources

ASP: 71a Quick Check WS.

AT: Presentation *Quick Check WS worked answers*.

3: Thinking skills

L4-5 **FA**

Assessment:

Consider All Possibilities: A person is getting thinner. (Possible answers: they are eating less food than they need to maintain their size; they are eating the same amount of food but exercising

more; they have had liposuction/surgery to make them thinner; they have something wrong with them and cannot extract all the energy from the food they eat.)

Consider All Possibilities: Ben needs to eat more than Hilary. (Possible answers: Ben is a teenager and Hilary is a toddler; Ben is more active than Hilary; Ben and Hilary have similar activity levels but Ben is trying to gain weight.)

Plus, Minus, Interesting: There should be no energy stored in sugar. (Possible answers: **Plus** – we could eat lots of sweet things without gaining mass/weight; **Minus** – sugar would still be bad for our teeth so this might lead to more tooth decay!; **Interesting** – could the countries that grow sugar produce enough to meet the demand? We already have artificial sweeteners that taste sweet without providing any/much energy.)

Feedback: Ask students to choose a best answer from their group and consider why they think it is the best.

Action: Identify any ideas that are missing and share them with the class. If understanding is poor then revise the need for energy and the energy available in foods at the start of the next lesson.

The **AT** presentation *71a Thinking skills* can be used for this activity.

Course resources

AT: Presentation *71a Thinking skills*.

4: Ranking foods

L4 FA

Assessment: Students work in small groups to sort a list of foods into high-, medium- and low-energy content per 100 g. They can use the cards on Worksheet 71a-5. Alternatively, give each student one of the cards from the worksheet and allocate three areas of the classroom as high, medium and low energy. Students move to the area they think their food should be in. Students' ideas at this point may be largely based on guesswork, unless they have carried out Exploring 3, 4 or 5.

Feedback: The **AT** presentation *Ranking foods* asks students to rank foods by different measures. The foods are given in alphabetical order but can be sorted by energy content.

If students have worked in groups, they can compare their groupings with the energy values. If this has been done as a whole class activity, project

the spreadsheet and sort it into energy order. Entering numbers to define the boundaries between high and medium energy content, and between medium and low, will colour the different foods according to their group. Students can then work out who in their group is in the wrong place and move accordingly.

Action: Ask students to think of a way of remembering which foods have the most and least energy. For example, in general, sweet or fatty foods have more energy per 100 g than other foods.

Course resources

AP: Worksheet 71a-5.

AT: Presentation *Ranking foods*.

HOMEWORK TASKS

1: Energy and you 1

L4

Worksheet 71a-6 contains straightforward questions on the content of this topic.

Course resources

AP: Worksheet 71a-6.

2: Energy and you 2

L4

Worksheet 71a-7 contains questions on the content of this topic.

Course resources

AP: Worksheet 71a-7.

3: Climbing the Matterhorn

L5

Worksheet 71a-8 challenges students to select information to work out energy requirements for an activity and the amount of food needed to provide this.

Course resources

AP: Worksheet 71a-8.

ActiveLearn

Three ActiveLearn exercises are available for this topic: Energy from food 1; Energy from food 2; Energy from food 3.