Section 4: Nutrition, conservation and ecology
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Section 4: Nutrition, conservation and ecology

Theme: Problem solving and creativity

Learning Outcomes
By the end of this section, you will have:

- told a story about problems in a local area and given students the opportunity to work out the reasons for the problems and to suggest a sensible course of action;
- supported students in using their knowledge of nutrients to plan a day's diet;
- organised students into groups to conduct research within their community and present it to the class.

Introduction
When your students start to look for a job, the qualifications that they have will obviously be very important. However, potential employers will also be looking for people who are creative and who are able to solve problems; they will be looking for people who can think for themselves. Students can sometimes view science as a subject that provides absolute answers that lead to technological advances which can be used directly to solve practical problems. In reality, many problems have cultural and economic perspectives that must be considered as well. Scientists must consider all perspectives when seeking solutions which will be successful in the real world. They need to be creative and able to work effectively with others. The case studies and activities in this unit are designed to show you how you can give your students the opportunity to be creative, to develop their thinking skills and to work effectively with others. They will fit into your normal teaching of nutrition, ecology and conservation. Some general strategies are given in Resource 1.

1. Using a story to think about local issues

Working effectively with others entails listening carefully to what they say. You need to respect, and also critically analyse, their knowledge and opinions. Students should be able to present their own knowledge and ideas in a clear and honest manner. They need to learn to work together to come up with solutions acceptable to all. There should be give and take on all sides. This is an important and difficult skill to acquire. Students will become more proficient at it the more they practise it.

In Activity 1 and Case Study 1, we ask students to consider the possible benefits of applying their knowledge of ecology and conservation to a real problem. However, they also need to take into account the views of people who may be resistant to change. They not only need to look for ways to persuade local people of the benefits of change, but
should also consider whether the local community may know of factors that scientists have not considered. **Case study 1** shows how one teacher used the story to revise certain topics. The activity uses a story to create interest and then a table to record key points.

### Case study 1: Using a story to make revision fun

Christina Majula has a dilemma. She is keen to show her students that what they learn about ecology and conservation in school is very relevant to the daily lives of us all. She also wants the students to do well in their exams but is struggling to finish the syllabus. She plans a revision lesson which includes a story (**Resource 2**) to illustrate a real problem which biological knowledge and understanding could help resolve. Christina has prepared five posters which she will use as a circus of activities with her class. The posters will act as revision of the topic she has just covered with the class. Each poster provides information relevant to the problem (**Resource 3**). Christina reads the story to the class. She then divides the students into five groups. Each group has 10 minutes to look at each poster. She asks them to read the information and to note down some advice to the villagers with an explanation of why that would help solve their problems. She then gathers her students around the front and asks each group to report on what they have learned from one of the posters. Finally, she asks them to imagine that they were Kabwe. How could he convince the village headman that the ideas they were suggesting would work? He is young and new to the area, whereas the village headman is held in great respect. People are not likely to listen to what Kabwe has to say. The students became very animated and interested in a problem that some of them recognised.

### Activity 1: Using a story to highlight a controversial issue

Tell the students you are going to read them a story about a village with problems. Ask them to note down the problems the village has faced, while you are reading. Read Kabwe’s story (**Resource 2**) quickly. After you have done this ask the students to tell you about the problems the village faced. They should have noted the lack of wild fruits, the poor harvests, low rainfall and lack of water (see **Resource 2**). Now put a table on the board with two headings: Kabwe’s views; Chanda Bwalya’s views. Ask students to take turns to read a paragraph and after each paragraph, add points to the table. Then organise them into groups and ask them to produce a poster suggesting ways of improving the situation. They should use their knowledge of science to suggest some solutions, but they should also think about who they would consult to help them and how they will convince the headman and villagers to adopt their ideas.

### 2. Thinking about nutrition

As you know, there is a lot to learn in science. You will find that if you can present the information in the form of a problem or issue, then it will be much more interesting for the students – much better than simply copying notes or listening to a lecture. In **Case study 2** and **Activity 2** we apply this idea to nutrition. Your textbook will explain the need for a balanced diet and give examples of foods rich in particular nutrients. In this activity, we ask students to create their own menu for a day. Students will enjoy the opportunity to
make their own decisions about what they could eat and to compare these with their friends’ choices. They will also reinforce their knowledge of the basic ideas and terminology of the topic. The case study shows how one teacher used this as an opportunity to differentiate the work. (Resource 4 has more information on catering for students with different abilities). Just as with Activity 1, students will apply their scientific knowledge to a practical problem with a wide range of possible answers. A key aspect of the problem-solving approach is the development of the students’ ability to think for themselves and to find and justify an answer that is unique. This helps students to realise that success in science is not simply a matter of learning and remembering facts from a textbook.

Case study 2: Differentiating work

Mrs Kaddu is teaching nutrition to her students. She knows that it is important that the whole class knows the main types of food required for a healthy diet. She also knows that some of the students in the class are particularly able. She decides to set two different tasks for students, depending on how easy or difficult they find science. This will help maintain the interest of the students who find science easy and extend their abilities. She uses Activity 2 but also prepares some extra materials. These include two tasks that will challenge the more able students to use detailed nutritional information and provide them with an opportunity to practise their numeracy skills. She gives these students information on the energy content of foods in kilojoules and gives them values for the energy requirements of an active teenage girl and boy. She also gives them information on the energy needed for different types of activity. This provides a range of possible extension work. All the students in her class have work that is suitable for their current stage of development and ability. You can see the extension work Mrs Kaddu made in Resource 5.

Activity 2: Working in groups to learn about nutrition

Organise your students into groups of three to five. Ask them to use the textbook or Resource 5 to identify foods that they eat regularly which are rich in proteins, carbohydrates, fats or vitamins and minerals. Discuss their lists and remind them of the idea that some nutrients (e.g. carbohydrates) are needed in much larger quantities than others (e.g. vitamins and minerals). Approximate amounts of the daily requirements of some nutrients are shown on the resource sheet. Explain that actual amounts will vary according to how old you are, how active you are, whether you are a boy or a girl and how big you are. Ask each student to design a menu for the day that would give them a balanced diet as well as being nice to eat.

If there is time at the end of the lesson, some students could read out their diets. Alternatively, students could exchange their work with their neighbour and read their diets.

3. Conducting research on local food issues

Encouraging students to ask questions and giving them choices about their work are both important when you are teaching them to be creative and to solve problems. By conducting their own research on a topic of their choice, they have ownership of the problem and will develop other skills alongside learning about science. The work they
produce could even be of interest to future employers. They have freedom to choose an area of interest and to research it in their own time and in their own way. While this activity will take the students some time to complete, it does not take up much class time and it will give them an opportunity for independent learning. Case study 3 shows what students can do by simply making use of friends and families and Activity 3 also shows what else they could do if they have access to a library or computers. They will practise sorting through a range of information and presenting it in a poster or booklet to their colleagues. You could explain that this is an important way that scientists communicate their research to other scientists at international conferences.

Case study 3: Research using friends and family

Mr Saiti is worried that some of the pupils in his class do not get a good balanced diet. Many have family plots at home for growing food, but these do not always yield a good harvest. He decides to set his class a competition to research good techniques for growing crops on a small scale. They should base their research on talking to people they know and other people in the community. He wants them to use their scientific knowledge to explain the techniques that they hear about. He divides the class into groups of four students. He asks each group to display their findings in a poster and tells them that there will be a prize for the best plan. He puts the judging criteria (Resource 6) on the classroom wall so that the students can see what he will be looking for and plan their work accordingly. Hari’s group are very enthusiastic. Hari goes down to the local market. He picks the stall with the nicest looking vegetables and chats to the owner about how he grows them. Sakina’s aunt works in a local clinic. Sakina asks her about the sorts of illnesses that local people have and as a group they work out what sort of food would help improve local diets and reduce the likelihood of illness due to nutrient deficiencies.

Mr Saiti has already noticed a small plot of land that belongs to the school, but which is not being used. He has asked the headteacher if he could use this plot with his class to develop a small garden to grow vegetables and fruit. The headteacher has agreed to his request.

Activity 3: Organising a research project

Divide your class into groups of up to four students. Explain that you would like them to identify a local food issue to research. Give them time in class to decide on the issue they will research and to plan how they will carry out their research. Encourage them to talk to their family and other friends to identify a local issue or concern. If possible, they could also use a library or the internet. You could spend a short time with the whole class doing a brainstorming activity to generate ideas for suitable topics. Resource 6 has some ideas to start the students thinking. Tell them they have 3 weeks to do the research and prepare a poster, a set of leaflets or a scrap book that will be displayed in the classroom. When they have done this allow them time in the lesson to go round the exhibition and to evaluate each others’ work.

Resource 1: Problem Solving and Creativity

Teacher resource to support teaching approaches
Problem solving and creativity

Through being resourceful and engaging and providing variety, you will be able to motivate your students. If you are willing and able to solve problems and be creative, you will be able to help your students develop these skills. And it is not as difficult as it might seem!

Creativity

Creativity is about the ability to think. It is not just about remembering, but also applying, suggesting, extending, modelling, and offering alternatives. It is something that you can model for your students. Students need to be encouraged to think differently and come up with original ideas. They also need to feel confident in the reception they will get before they make such suggestions.

Some teachers will naturally be very creative, but some will not – and that is fine as long as you are resourceful and willing to try new ideas. A creative teacher, for example, will take the TESSA Secondary Science units and apply the strategies we suggest to different contexts. You could use news items from radio, television or newspapers and relate this to the science you are teaching. You can set open-ended tasks and allow students to make choices about how they present their work. You may take some risks in your teaching. Above all, you will create an atmosphere of excitement and enquiry with dramatic demonstrations, enthusiasm or amazing and unbelievable facts.

Strategies to promote creativity

Get students to:

- write a story to illustrate a scientific principle
- draw a picture to illustrate a scientific principle
- make up a play
- make a model
- take part in a role play (e.g. be the particles in a solid, liquid or gas)
- make up a poem or a rap
- think up alternative explanations for something they see
- write a letter or newspaper article or podcast.

Problem solving

Helping students to develop problem-solving skills is a frequently cited goal of science teachers. As with creativity, you can model these skills in your own classroom. For example, if you can’t answer a student’s question, you can come back next lesson with a solution and explain how you worked it out and why you found it hard. Being able to solve problems involves developing thinking skills. There are various strategies that you can adopt to help children develop these skills (Wellington and Ireson, 2008):
Encouraging student-generated questions. The act of asking questions requires engagement and creative thought, two core cognitive strategies.

Being clear about ‘purpose’. Students should be encouraged to ask: what is this all about? ‘What does this relate to?’ ‘Why do you want us to do this?’ – rather than embark on activities in an unthinking, recipe-following fashion.

Setting open-ended activities. Teachers should set activities that can be tackled in a variety of ways so that children have to think about how they will tackle the problem.

Planning. Teachers need to provide opportunities for children to plan their problem-solving strategy in a systematic way.

Paraphrasing. It is well known that you really get to know and understand ideas when you try to teach them to someone else. Giving children opportunity to paraphrase an explanation will help them to understand difficult ideas and to be aware of their own learning.

Learning to learn (metacognition). Teachers can encourage children to become more conscious of their learning by getting them to think about why they don’t understand and what strategies helped them that might be useful in the future.

Reference

Resource 2: Kabwe’s Story

Teacher resource for planning or adapting to use with pupils

Kabwe’s story

Kabwe, a 21-year-old man, is a newly appointed Basic School Diploma teacher. He was recently recruited from Kasama Teacher Training College to teach grades 8 and 9 at Katoma Basic School in Chinsali District of Zambia. In order to familiarise himself with this new school, Kabwe went to meet the local village headman, 75-year-old Chanda Bwalya. Kabwe wanted to shed some light on the history of the village and the development and future of the school.

Kabwe noticed that there were problems in the village. There were very few trees in the area, recent harvests had been poor and there were low levels of rainfall. Some of the children in his class did not come to school very often and several of them had protruding tummies, and small legs showing a lot of suffering and hunger.

Chanda Bwalya, the local village headman, praised the ancient days when they founded the village; there was plenty of water in the surrounding streams, and large number of large wild trees with fruits which engulfed the new village. They used to get large crop harvests from very small portions of land they had tilled. It was their custom to use the shifting cultivation system known as chitemene for farming, which involved growing maize or food in one field until it no longer produced enough food then shifting to another area. The trees had provided fruits but also firewood and charcoal. Now the area is a semi-desert. The plants are growing stunted, the yield is poor and there are very few trees left.

Chanda Bwalya blamed the crop failure, lack of wild fruits and the lack of water in most of the streams on misfortune which had befallen the village. Respect for the ancestors had
reduced drastically and no yearly rituals for thanking them had been conducted for several years. Chanda also blamed the schools for the bad manners they were teaching the children such as stopping the villagers from cutting trees and planting maize for several years in one garden. The issue of planting new trees was not a village problem but God’s problem as he comes to replace the trees after some time. Chanda Bwalya hinted at the bad times they were going through and was hopeful that things would change for the better once certain solutions were introduced such as paying homage to the ancestors, respect of elders and many more.

Kabwe, the teacher, reminded the village headman that there were no new trees coming up to replace the ones that had been cut down and this was causing the area to become desert. He suggested they planted trees and changed to new methods of organic farming. The old man refused to agree with Kabwe reminding him that he was too young to understand how God and our ancestors replace the lost trees. He should first spend some time in this village and then he would experience the growth of new trees. Chanda Bwalya suggested that Kabwe was too young to understand how these problems had befallen his village and its school.

Kabwe, after listening to the old man for over 2 hours, became more tense in his mind and started contemplating how he would manage his new job in such an environment and what he could do to change the existing beliefs and norms to more modern approaches so that the pupils and the community could move forward and their health could improve. The poor health of most of his pupils worried him and the newly created desert in an area which previously had large trees and the poor harvests the people were experiencing concerned him.

The next day, Kabwe returned to his classroom. Overnight he had fully reflected on the stories he had heard from old Chanda Bwalya. He was determined to help the village find a solution to their problems.

Notes on Kabwe’s story

Below are some problems in the village that your students should be able to identify. See what ideas they think of themselves before you share these with them.

1. Poor crop harvests.
2. No wild fruit or other forest foods such as mangos which can supplement diet.
3. Poor nutrition of some pupils — affecting health and school attendance.
4. Low rainfall.
5. Greatly reduced water flow in local streams.
6. Soils lacking in nutrients and becoming dry and desert like.
7. Resistance to organic or different farming methods, e.g. the same crops grown on a plot of land every year; not using animal manure and collecting organic waste to make compost.
8. Loss of native forest trees.
9. Poor communication and mutual understanding between traditional villagers, such as the headman who feels that traditional ways and respect for ancestors is being lost, and younger people from outside the village with new ideas.

Here are some questions you could get your students to think about:

- Why was their village lacking wild fruits?
● Why was the area resembling a desert?
● What was causing the shortage of water in streams which used to be perennial?
● Why were the harvests from their parents’ gardens yielding very little?
● What measures would they take to resolve these problems in their village?
● Who should they consult to assist with resolving these problems?
● What examples would they show to the local people that these problems could be resolved?

Resource 3: Background knowledge for Kabwe’s story

Background information / subject knowledge for teacher

Solutions using biological knowledge

Knowledge and understanding of natural interactions between living organisms and their environment, including soil and water availability, can be applied to situations where human intervention has created problems. It can be used to develop solutions to help alleviate the problems.

Main areas of biology syllabus which relate to this story

1. Nutrient cycles such as the nitrogen cycle and carbon cycle.
2. Problems associated with human population growth and depletion of resources.
4. Effects of human activity in causing deforestation, soil erosion, drought, flooding, loss of biodiversity (genetic material for future crop breeding and potential economic resources such as yet undiscovered medicines).
5. Components of a healthy diet.

Scientists and communication

As well as doing and understanding science themselves, scientists must be able to explain scientific ideas to the general public and persuade them of the advantages of new techniques where appropriate. They need good communication skills. This includes listening to the views of others, analysing them critically and being prepared to learn from others. Some problems need to be solved by taking account of a balance of scientific, economic and cultural considerations.

In this story, the headman laments the lack of respect for ancestors. Biologists have a respect for the natural environment. It may be that common ground can be found by negotiation.
Listening is also important as the local knowledge of community members can be extremely valuable. This is internationally recognised as an important concept. Such knowledge should not be stolen nor its holders exploited.

**Poster 1  The nitrogen cycle and the carbon cycle**

Harvesting crops reduces the carbon and nitrogen going back into the soil.

**Diagram 1  Nitrogen cycle**
Methods of conserving and renewing soil fertility

**Application of manure, compost or artificial fertilisers:** Removing crops at harvest interrupts natural nutrient cycles and prevents nutrients from dead remains returning to the soil to replenish nutrients. To make good the losses, farmers can apply manure, compost or artificial fertilisers. Animal manure decays to give nutrient salts. It also supplies humus which improves the water holding capacity of soils.

**Crop rotation:** If crops are chosen carefully this can reduce the amounts of any one mineral which is removed from the soil. It also reduces the likelihood of harmful pests and parasites building up in the area and adversely affecting crop yields. A leguminous crop is often included in the rotation so nitrogen levels can be built up in the soil due to the action of the nitrogen-fixing bacteria in their root nodules.
**Poster 2  Human population growth – depletion of resources**

As the population grows, more food is needed. If it is not available, people suffer from malnutrition. Also, people need to make a living and they often do so by selling resources such as timber from rainforests.

**Malnutrition**

This is caused by not eating enough of all the necessary components of a healthy diet. The main components of a healthy diet are protein, carbohydrate, lipid, vitamins, minerals and water.

**Why traditional practices that used to be successful now need to be modified**

Traditional practice of ‘slash and burn’ agriculture did no long-term damage to forests when population densities were low. Given time, the ‘bush fallow’ between clearances provided a natural rotation system that allowed the forest and its soil time to recover. Human population expansion and competing land uses such as plantation agriculture (rubber, oil palm) and hydroelectric power schemes have reduced the fallow period. In addition to subsistence farming systems, forests are being removed for fuel wood gathering. Also, they are now being removed at an increasing rate by commercial logging for tropical hardwood timber (mainly for rich countries), for wholesale burning and clearing for cattle ranching (beef at cheap prices).

**Poster 3  Soil fertility, resource management and improved farming practices**

**Organic practice**

Organic practice focuses on maintaining a healthy and fertile soil using animal manure and compost rather than artificial fertilisers. This provides nutrients and also increases the water holding capacity of the soil. It also advocates using crop rotation. Where possible, rainwater should be collected. The need for watering can be reduced by improving the soil and growing appropriate plants. Native species should be grown where possible. Natural wildlife areas should be encouraged adjacent to crops so crop pests are controlled by natural predators.

**Sustainable resource use**

Where forests are cut down, for example as a timber resource, this should be done in a sustainable way. This means, with thought for future generations, i.e. as trees are cut down, new saplings should be planted.

**Poster 4  The effects of human activity**
Water and nutrient availability and soil erosion

Deforestation accelerates desertification by reducing rainfall. When the forest trees are cut down, the water cycle is disrupted. The reduction in transpiration (the evaporation of water vapour from the surface of the plants) results in fewer clouds and less rainfall in the vicinity. Surrounding forests are threatened by desiccation. As the land becomes hotter and drier, more of the soil is eroded.

Rainforest soils are poor in nutrients. In rainforests, virtually all the nutrients are in the organic matter of the forest canopy. Normally when dead organisms fall to the floor and are decomposed into nutrients, these nutrients are quickly reabsorbed into the living plants. If, however, the forest is felled and the trees removed, the soil nutrient source is removed too, so soils quickly become nutrient poor. The soil is of little use even for subsistence agriculture and soil erosion usually follows.

Forests are often on uplands and on watersheds. They catch and hold large amounts of rain and release the water slowly and reliably into rivers and streams. Deforestation of uplands disrupts regular water supplies and can result in much disastrous flooding of the plains below.

Trees help to stabilise soil. Deforestation results in soil erosion. This means food production is affected and can result in hunger and economic losses. Reservoirs and water supplies can silt up and harbours and estuaries must be continually dredged to keep them open.

Loss of biodiversity

Forests are extremely species rich. Their destruction will lead to innumerable extinctions of unknown and little known species, with consequent loss of genetic variety and potential resources.
Forests and climate change

Forests are an important carbon sink (together with plankton in the oceans). This is an important role within the carbon cycle. Removal of forests contributes to an increase in atmospheric carbon dioxide, which can lead to climate changes due to the greenhouse effect.

**Poster 5  Components of a healthy diet**

If there is not enough of the necessary types of food available, people will suffer from malnutrition. Malnutrition is caused by not eating enough of all the necessary components of a healthy diet. The main components of a healthy diet are protein, carbohydrate, fat, vitamins, minerals and water.

**Sources of the main nutrients**

<table>
<thead>
<tr>
<th>Food</th>
<th>Rich source of</th>
<th>Moderate source of</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>Starch, fibre</td>
<td>Protein, B vitamins, many minerals</td>
</tr>
<tr>
<td>Starchy roots and fruits</td>
<td>Starch, fibre</td>
<td>Some minerals, vitamin C if fresh, vitamin A if yellow or orange</td>
</tr>
<tr>
<td>Beans and peas</td>
<td>Protein, starch, some minerals, fibre</td>
<td>B vitamins</td>
</tr>
<tr>
<td>Oilseeds</td>
<td>Fat, protein, fibre</td>
<td>B vitamins, some minerals</td>
</tr>
<tr>
<td>Fats and oils</td>
<td>Fat</td>
<td>Vitamin A if orange or red</td>
</tr>
<tr>
<td>Dark to medium-green leaves</td>
<td>Vitamins A and C, folate</td>
<td>Protein, minerals</td>
</tr>
<tr>
<td>Orange vegetables</td>
<td>Vitamins A and C</td>
<td>Fibre</td>
</tr>
<tr>
<td>Orange fruits</td>
<td>Vitamins A and C</td>
<td>Fibre</td>
</tr>
<tr>
<td>Citrus fruits</td>
<td>Vitamin C</td>
<td>Fibre</td>
</tr>
<tr>
<td>Milk</td>
<td>Fat, protein, calcium, vitamins</td>
<td></td>
</tr>
<tr>
<td>Eggs</td>
<td>Protein, vitamins</td>
<td>Fat, minerals (not iron)</td>
</tr>
<tr>
<td>Meat</td>
<td>Protein, fat, iron</td>
<td></td>
</tr>
<tr>
<td>Fish</td>
<td>Protein, iron</td>
<td></td>
</tr>
<tr>
<td>Liver</td>
<td>Protein, iron, vitamins</td>
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</tbody>
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**Resource 4: Differentiating work**

- **Background information / subject knowledge for teacher**

**Differentiating work for students of varying abilities**

As you know, each pupil has different abilities. There can also be a significant difference in age between the oldest and youngest pupil in the class. Some students will learn more effectively by reading a book, some by carrying out a practical activity and some by
listening to and absorbing spoken instructions. Some will understand the work very easily, some will take more time. Some will work very quickly through any task you set, some will work slowly. It is impossible for you as a teacher to take all the differences into account all the time, but there are things that you can do to support individuals within a class.

If you have a class of 40 or more pupils this might sound like a daunting task. There are two important things that you need to do to be able to effectively cater for everyone in your class:

1  **Know your students.** You need to give them opportunities to work in groups and listen to their conversations; you need to mark their written work; you need to ask questions of individuals in class and you need to encourage them to ask you questions if they don’t understand or just want to know more. When you know who understands easily, who finds science difficult, who likes to talk, who likes to write, who likes to draw and who likes doing experiments, you will be in a much better position to help individuals.

2  **Know your subject.** It is unrealistic to expect everyone to remember and understand everything that you do. Students who find science difficult will be overwhelmed if you try to tell them everything. You need to break each topic down into simple steps and make sure that everyone understands the most important ideas. You also need to know how to challenge students who have grasped the basic ideas.

You can cater for the range of abilities within your group in two main ways:

### Differentiating by outcome

This involves setting some questions that get progressively more difficult. Everyone gets as far as they can. Alternatively, you can set open-ended tasks in which students demonstrate what they can do. This also enables you to give them a choice about how they present their work, which can be very motivating. You may find that the degree of support that you need to provide to individuals, pairs or small groups within the class varies significantly.

### Differentiating by task

For this, you set different students, or groups of students, different tasks. For example, in a practical session some pupils could have instructions provided for them in written form and some could have them in diagram form and some could have a combination of both.

You could provide a set of questions that cover the basic ideas that you judge that everyone needs to understand and a set that are more challenging. The students who you expect to get a grade A could be given the more challenging ones.

### Learning style

There is a lot of research that suggests that different students prefer to learn in different ways. The three learning styles that are more commonly referred to are visual, audio and kinesthetic, i.e. some students prefer diagrams and pictures, some learn best by listening and some prefer to be able to do things.
As a teacher you cannot be expected to cater for all the students all the time, but a good teacher will make sure that their lessons contain activities that cover all three learning styles.

There is a tendency to expect students to do a lot of listening. You should make sure that your students also get to do experiments or activities that involve moving around the room and talking about science. Encourage them to use mind maps and diagrams or pictures to summarise key ideas, rather than simply copying notes off the board.

Resource 5: Data on food and energy

Teacher resource for planning or adapting to use with pupils

Food
A healthy diet requires adequate amounts of protein, carbohydrate, fat, vitamins, minerals and water.

A rough guide to daily requirements is as follows:

- protein 50 g
- carbohydrate 300 g
- fat 65 g
- fibre 30 g
- vitamin A 730 μg
- vitamin C 60 mg
- iron 11 mg (males), 15 mg (females)
- calcium 1300 mg.

Note the different units for different nutrients:

- 1 mg = 1/1000 g
- 1 μg = 1/1000 mg.

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<td>folate</td>
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</tr>
<tr>
<td>Orange vegetables</td>
<td>Vitamins A and C</td>
<td>Fibre</td>
</tr>
<tr>
<td>Orange fruits</td>
<td>Vitamins A and C</td>
<td>Fibre</td>
</tr>
<tr>
<td>Citrus fruits</td>
<td>Vitamin C</td>
<td>Fibre</td>
</tr>
<tr>
<td>Milk</td>
<td>Fat, protein,</td>
<td>Fibre</td>
</tr>
<tr>
<td></td>
<td>calcium, vitamins</td>
<td></td>
</tr>
</tbody>
</table>
Eggs  Protein, vitamins  Fat, minerals (not iron)
Meat  Protein, fat, iron
Fish  Protein, iron
Liver  Protein, iron, vitamins

Sources of vitamins

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Good sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>Liver, fish liver oils, egg yolk, milk and dairy products, green leafy vegetables (especially kale, amaranth, sweet potato, cowpea and cassava leaves), yellow and orange-coloured fruits and vegetables (carrots, pumpkin, mango, papaya, oranges), orange-coloured sweet potato, palm oil</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Cod-liver oil, oily fish, liver, egg yolk</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Vegetable oils (such as maize, soybean and sunflower oils), nuts, soybeans, cereals, egg yolk</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>Green leafy vegetables, vegetable oils, egg yolk, beef, mutton, poultry</td>
</tr>
<tr>
<td>Thiamine (vitamin B₁)</td>
<td>Millets, sorghum, wheat, maize, dried beans, rice, liver, kidney, beet, nuts</td>
</tr>
<tr>
<td>Riboflavin (vitamin B₂)</td>
<td>Green leafy vegetables, liver, kidney, milk, cheese, eggs, whole grains</td>
</tr>
<tr>
<td>Niacin (nicotinic acid and nicotinamide)</td>
<td>Lean meat, poultry, fish, groundnuts, dried beans, wheat, yam, potato</td>
</tr>
<tr>
<td>Pantothenic acid</td>
<td>Kidney, fish, egg yolk, most vegetables, most cereals</td>
</tr>
<tr>
<td>Pyridoxine (vitamin B₆)</td>
<td>Meat, poultry, fish, egg yolk, whole grains, banana, potato, dried beans, lentils, chickpeas</td>
</tr>
<tr>
<td>Biotin (vitamin H)</td>
<td>Groundnuts, dried beans, egg yolk, mushrooms, banana, grapefruit, watermelon</td>
</tr>
<tr>
<td>Folic acid</td>
<td>Green leafy vegetables (losses from cooking can be high), fresh fruits (especially orange juice), dried beans, peas, nuts, egg yolk, mushrooms, banana, liver</td>
</tr>
<tr>
<td>Vitamin B₁₂ (cyanocobalamin)</td>
<td>Liver, kidney, chicken, beef, fish, eggs, milk, cheese</td>
</tr>
</tbody>
</table>

Extension activities: food and energy

We need energy to stay alive and carry out our daily activities. This energy comes from the food we eat. Energy is measured in units called joules (J). One joule is quite a small amount of energy, so we usually use kilojoules (kJ) to measure our energy requirements.

1 kilojoule = 1000 joules.

Teenagers should eat enough food to provide them with between 10 000 and 15 000 kJ each day. The exact amount required will vary according to size (mass), age, sex (in general boys need more than girls) and activity.

On average, a teenage girl needs 11 000 kJ of energy each day.

On average, a teenage boy needs 13 000 kJ of energy each day.
Task 1

Plan a diet for a day for a teenage boy or girl. The food you select and the amounts of each food should be enough to meet the energy requirements of an average teenager as given above. Do not forget to include snacks as well as main meals.

Use the information in the table below to help you. You will need to estimate how many grams of each food you will require before you calculate the energy it provides.

Energy content of some common foods

<table>
<thead>
<tr>
<th>Food</th>
<th>Energy content in kJ per 100g</th>
<th>Food</th>
<th>Energy content in kJ per 100g</th>
</tr>
</thead>
<tbody>
<tr>
<td>Milk</td>
<td>272</td>
<td>Rice</td>
<td>1504</td>
</tr>
<tr>
<td>Eggs</td>
<td>662</td>
<td>Banana</td>
<td>318</td>
</tr>
<tr>
<td>Chicken</td>
<td>771</td>
<td>Melon</td>
<td>96</td>
</tr>
<tr>
<td>White fish</td>
<td>289</td>
<td>Orange</td>
<td>147</td>
</tr>
<tr>
<td>Oily fish</td>
<td>796</td>
<td>Spinach</td>
<td>88</td>
</tr>
<tr>
<td>Haricot beans</td>
<td>1073</td>
<td>Biscuits (sweet, rich)</td>
<td>2078</td>
</tr>
<tr>
<td>Broad beans</td>
<td>289</td>
<td>Bread (brown)</td>
<td>993</td>
</tr>
<tr>
<td>Lentils</td>
<td>1236</td>
<td>Bread (white)</td>
<td>1060</td>
</tr>
<tr>
<td>Green peppers</td>
<td>88</td>
<td>Pasta</td>
<td>1525</td>
</tr>
<tr>
<td>Potato</td>
<td>364</td>
<td>Maize meal</td>
<td>1350</td>
</tr>
<tr>
<td>Cassava</td>
<td>667</td>
<td>Yams</td>
<td>462</td>
</tr>
</tbody>
</table>

You can record your diet plan in a table like the one below.

Energy content of a sample diet for a teenager for one day

<table>
<thead>
<tr>
<th>Meal</th>
<th>Food item</th>
<th>Amount of this food in g</th>
<th>Energy content of this food in kJ per 100g</th>
<th>Total energy provided by this food item in your diet</th>
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</tbody>
</table>

- Calculate the overall total energy in kJ that your diet will provide.
- How does this compare with the average requirements for a teenager of your sex?

Diet, energy and activity

Your energy requirements will vary according to your activities. The table below shows the energy requirements for different activities.

Energy requirements for different activities
### Task 2

Plan a day where you do various activities for a certain length of time.

A day lasts 24 hours or 1440 minutes.

Activities (and their durations) you might choose could be sleeping, 480 minutes; eating, 50 minutes; swimming, 70 minutes and so on.

Work out how many kilojoules of energy you would need for each activity.

You could record your answer in a table like the one below.

#### Activities in a day and energy required to perform them

<table>
<thead>
<tr>
<th>Activity</th>
<th>Minutes</th>
<th>Energy required per minute for this activity in kJ</th>
<th>Total energy required for the duration of this activity</th>
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</thead>
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</tbody>
</table>

- Calculate the overall total energy in kJ that your activity plan would require.
- How does this compare with the amount of energy your diet in Task 1 would provide?

### Resource 6: Suggestions for conducting and assessing research

- Background information / subject knowledge for teacher
Suggestions for research

- Nutritional values of local foods not mentioned in national textbook.
- The organic movement.
- Mother’s milk or powdered milk?
- Health problems associated with obesity.
- How our diet has changed. (Encourage students to interview grandparents – if possible use a recording device.)
- Can we believe adverts about food?
- What are the main causes of malnutrition in our country?
- Assess the nutritional value of the meals served in the dining hall of students in a boarding house of a senior high school in your locality.
- Determine the calorific value of the meals served to pupils under the school feeding programme of the government.

Criteria to evaluate the projects

The criteria used by Mr Saiti in (Case study 3) to judge the competition he set his class to research good techniques for growing crops on a small scale were as follows:

1. Have the pupils taken note of the existing conditions in the plot?
2. Have they suggested what tests, if any, they will do to find out more about how the plot is suited to crop growing?
3. Have they suggested what preparatory work must be done before planting, including what measures they have taken to prevent stray animals from invading the plot?
4. Have they researched what crops are grown successfully in the locality by other people?
5. Have they tried to choose a mix of crops that will provide all the requirements of a healthy diet?
6. What special conditions do these crops need and how could they meet these conditions?
7. What plans have been made for looking after the crops?
8. How will they organise a water supply for the plot?
9. How will they prepare for and deal with potential pests or disease?
10. When would planting take place?
11. When would harvesting take place?
12. What do they suggest is done with the harvest?
13. Have they thought ahead about what would be planted in future years (crop rotation) and how they can recycle nutrients (composting)?
14. What plans do they have for making other people aware of the scheme?

Criteria for evaluating research projects

These criteria relate to Activity 3 and the score card below.
1 Has the group stated the aims of their research clearly?
2 Has the group collected sufficient evidence from a range of reliable resources?
3 What scientific knowledge and understanding from their biology course has the group used in their research?
4 How clearly have they explained the results of their research findings?
5 To what extent have they used diagrams in an imaginative and creative way to explain their findings?
6 Do you think they have covered the main issues in their chosen area of research? Are there any additional questions you think they should have considered?
7 Is the project attractively presented? Is there an appropriate amount of text – not too much and not too little? Does the layout make you want to read it?
8 Have they suggested areas in which their research could be continued if they had more time to develop it?
9 Is there evidence that all members of the group have made an appropriate contribution to the work, using their particular skills?

For each poster, evaluators should give a score for how it was rated on each criterion. Scores can be between 1 and 5:

5 Excellent
4 Very Good
3 Good
2 Needs more attention
1 Needs a lot more attention.

Score card

<table>
<thead>
<tr>
<th>POSTER NUMBER</th>
<th>QUESTION SCORE</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<td>Question 1</td>
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<td>Question 3</td>
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<td>Question 7</td>
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<td>Question 8</td>
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<td>Question 9</td>
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<td>TOTAL SCORE</td>
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</tbody>
</table>

Return to Science (secondary) page