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Introduction

The GCSE Geography for AQA Teacher’s Resource is intended to help you to deliver the AQA 8035 specification (first teaching from September 2016).

The first part of the Teacher’s Resource contains general guidance:

- The Understanding the AQA specification section explains the latest changes to the specification content and assessment.
- The Using the Issue evaluation pages section provides advice on effective use of the Issue evaluation pages in the Student Book to help students prepare for Paper 3. It also includes sample answers to the Assess to progress questions in the Issue evaluation pages.
- The Using the Assess to progress tool section explains the Assess to progress functionality in the Cambridge Elevate enhanced edition and how to use it.
- The Using the Assess to progress question bank section provides advice about the questions in the question bank, which can be found at the back of the Student Book. It also includes sample answers to the questions.

The second part of the Teacher’s Resource consists of a set of teaching notes for each Student Book chapter, containing learning outcomes, details of required prior knowledge, opportunities for practising skills, advice on differentiation, lesson and activity ideas and guidance on using the Student Book and Cambridge Elevate enhanced resources. Answers to the Assess to Progress questions are also provided.

You can download 2-year and 3-year schemes of work from:

www.cambridge.org/gcsegeographysamples
The AQA Geography specification is based on a balanced framework of physical and human geography. As such it fulfills the Department for Education requirements for Geography at GCSE level which states that Geography should ‘enable young people to become globally and environmentally informed and thoughtful, enquiring citizens’.

The AQA Geography specification provides progression from Key Stage 3 of the National Curriculum requirements and prepares students for study at Key Stage 5 and beyond. The Specification will enable students to:

- develop their knowledge of places, environments and processes
- gain an understanding of the interactions between people and environments and how these interactions bring about change
- develop a wide range of research, presentation, analytical and evaluative skills
- apply their knowledge and understanding to real world situations and use evidence to reach well-reasoned judgements.

Students have the opportunity to study a number of contemporary core topics, including:

- the challenge of natural hazards
- climate change
- ecosystems under threat
- physical landscapes in the United Kingdom
- urban issues and challenges
- the changing economic world
- the challenge of resource management.

Within the areas of study there are a number of option choices specifically designed to offer the opportunity to study topics which may be appropriate to particular locations or which reflect individual school interests or expertise.

The specification enables teachers to use a variety of learning approaches including resource and enquiry based learning. It provides the opportunity for extended research and the development of problem solving skills.

Reflecting on the Department for Education requirements for Geography, the AQA Geography specification gives all students the opportunity to:

- Extend their locational knowledge and their understanding of the socio-economic and political context of different countries.
- Develop an awareness of the importance of inter-relationships between places.
- Develop a range of geographical skills in order to describe, explain and evaluate geographical information. This will include cartographic, graphical and statistical skills (as listed in the specification) and a general appreciation of GIS (Geographical Information Systems).
- Develop research and fieldwork skills in areas of both physical and human geography.
- Understand the complexity of particular issues and develop evaluative and decision making strategies.
- Develop an understanding of geomorphic processes and how they have shaped, and continue to shape, the landscape.
- Understand the challenge of extreme weather and climate change.
- Appreciate the diversity of global ecosystems and how bio-diversity is threatened by human development.
- Appreciate the significance of the need for sustainable management in relation to the fundamental resources of food, water and energy.
- Understand the challenges of an increasingly urban world.
- Development an understanding of the changing economic world and the issues of under-development.
Content options

The specification contains four units:

3.1 Living with the physical environment
3.2 Challenges in the human environment
3.3 Geographical applications
3.4 Geographical skills

Units 3.1 and 3.2 are divided into sections. Within each section, there are different themes. Some of the themes are required and some are optional. Refer to the specification for further details.

Unit 3.1 Living with the physical environment

<table>
<thead>
<tr>
<th>Section</th>
<th>Required themes</th>
<th>Optional themes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Section A: The challenge of natural hazards</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.1 Natural hazards</td>
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<tr>
<td>3.1.1.2 Tectonic hazards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.1.3 Weather hazards</td>
<td></td>
<td></td>
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<tr>
<td>3.1.1.4 Climate change</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Section B: The living world</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.2.1 Ecosystems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.2.2 Tropical rainforests</td>
<td>3.1.2.3 Hot deserts</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.1.2.4 Cold environments</td>
<td></td>
</tr>
<tr>
<td><strong>Section C: Physical landscapes in the UK</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1.3.1 UK physical landscapes</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>3.1.3.2 Coastal landscapes in the UK</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.1.3.3 River landscapes in the UK</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.1.3.4 Glacial landscapes in the UK</td>
<td></td>
</tr>
</tbody>
</table>

Unit 3.2 Challenges in the human environment

<table>
<thead>
<tr>
<th>Section</th>
<th>Required themes</th>
<th>Optional themes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Section A: Urban issues and challenges</strong></td>
<td>All themes</td>
<td></td>
</tr>
<tr>
<td><strong>Section B: The changing economic world</strong></td>
<td>All themes</td>
<td></td>
</tr>
<tr>
<td><strong>Section C: The challenge of resource management</strong></td>
<td>3.2.3.1 Resource management</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.2.3.2 Food</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.2.3.3 Water</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.2.3.4 Energy</td>
<td></td>
</tr>
</tbody>
</table>

Changes from 2016

The new GCSE Geography qualification brings significant changes, including:

- a new linear structure, with students sitting all of their exams at the end of the course
• the removal of tiered papers
• coursework has been replaced by a practical exam
• an increase in fieldwork requirements.

Assessment
Students will sit three exams at the end of the course:

**Paper 1**: Living with the physical environment
**Paper 2**: Challenges in the human environment
**Paper 3**: Geographical applications

Paper 3 includes an issue evaluation component, for which a pre-release booklet will be made available 12 weeks before the Paper 3 exam.
About the issue evaluation

The issue evaluation is a significant component in Paper 3: Geographical applications. This paper is a 1 hour and 15-minute written exam which is worth 30% of the GCSE and which will be based upon a pre-release resources booklet which will be made available 12 weeks prior to the exam.

The aim of the issue evaluation is to assess students’ critical thinking and problem solving skills and to provide them with the opportunity to demonstrate geographical skills and their application of knowledge. The issue which is selected will arise out of the core content but the use of resources may allow extension beyond what is directly covered in the specification. The issue evaluation is designed to be synoptic and so will cover more than one theme to enable students to develop both their physical and human geography knowledge.

What does the issue evaluation assess?

Students will be asked a series of questions about the issue which will lead to an extended piece of writing that involves making and justifying a decision. They will need to develop and use their geographical skills to put the issue in context and to be able to understand the conflicting viewpoints which people may hold about the issue. Students will need to make good use of the resources provided in order to come to a considered conclusion and will also need to use their knowledge of physical and human processes because some issues may require students to consider the physical and human implications together.

What skills do the students need to develop in order to be successful?

There are a range of skills which could be assessed as part of the issue evaluation, but also can be assessed throughout the other papers. These include:

- cartographic skills
- graphical skills
- numerical skills
- statistical skills
- the ability to use qualitative and quantitative data
- the ability to formulate enquiry and argument
- literacy skills.

For more detail about the requirements for each of these skills, please refer to the AQA specification.

What is the best way to prepare students for the issue evaluation?

The best way is to ensure students are as familiar as possible with the issue under consideration. While they will have access to the resource booklet before the exam and should be encouraged to write notes and highlight items, they will not be able to take this into the exam with them. During the exam they will have a clean copy of the resources to use.

Any activities which develop the students’ knowledge and understanding of the issue are to be encouraged. For example:

- Students should read through the resource booklet several times. On the first reading they could highlight any words or phrases which they are unsure about.
- Students should put together a glossary of all of the words that they are unsure about. They can each put forward suggestions for words to be included and then carry out some research to define and illustrate each term.
- Students should put together a table which summarises the different perspectives of key people involved in the issue. Are they for or against it? Why?
- Students could also put together a table highlighting the advantages and disadvantages of any proposed solutions to the issue. If there is more than one option they should decide which is the best, given the context, and be able to justify their decision.
• Students should carry out additional research into the issue. They could look for suitable videos, images and information which will enhance their understanding.

• Students could critically evaluate the websites that they use to find any further information. How up to date is the information? Is the information supported by data? Where has the data come from?

• If there is data contained within the resource material, students should consider spending time interrogating the data. They could display it in an appropriate graph and a discussion could be had as to what is ‘appropriate’ in this context. They could also carry out calculations such as percentage increase or decrease or calculating the mean or range of the data.

• If there are maps contained within the resource material, students should consider spending time interpreting them. They should identify any patterns and be able to describe them effectively. They should also consider how the information shown on the map supports or contradicts the viewpoints that people may have on the issue.

• If there are photographs contained within the resource material, students should consider spending time interpreting these. They should annotate the photographs to highlight key features. They should also consider how the information shown in the photographs supports or contradicts the viewpoints that people may have on the issue.

• Time should not be spent trying to guess the questions which will appear in the exam. However, it is useful for students to have the opportunity to practise typical question styles so that they know what to expect from the exam.

How should I use the issue evaluation pages in this textbook?

The issue evaluation pages in this book are designed to introduce students to the types of issues and the questions that they are likely to be asked. In the selection of the issues, thought has been given to both what the contemporary issues are around the core topics and also what issues are likely to support case studies which will be studied as part of the content. Teaching about the issue evaluation could be integrated with the teaching of the core content. A table with the issue evaluation links to the specification is shown below:

<table>
<thead>
<tr>
<th>Topic</th>
<th>Key idea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tectonic hazards</td>
<td>Management can reduce the effects of tectonic hazards.</td>
</tr>
<tr>
<td>Chapter 1</td>
<td>How monitoring, prediction, protection and planning can reduce the risks from a tectonic hazard.</td>
</tr>
<tr>
<td></td>
<td>Predicting seismic activity in China</td>
</tr>
<tr>
<td>Tropical rainforests</td>
<td>Deforestation in order to build a hydroelectric power plant creates a number of issues.</td>
</tr>
<tr>
<td>Chapter 5</td>
<td>Impacts and issues resulting from deforestation – soil erosion, loss of biodiversity, contribution to climate change, economic development.</td>
</tr>
<tr>
<td></td>
<td>Hydroelectric power generation in Madagascar’s tropical rainforest</td>
</tr>
<tr>
<td>Changing urban areas</td>
<td>Urban change in cities in the UK leads to a variety of social, economic and environmental opportunities and challenges.</td>
</tr>
<tr>
<td>Chapter 11</td>
<td>An example of an urban regeneration project to show why the area needs regeneration and how the project will improve social, economic and environmental conditions.</td>
</tr>
<tr>
<td></td>
<td>City centre regeneration: Birmingham, UK</td>
</tr>
<tr>
<td>Economic futures in the UK</td>
<td>Major changes in the economy of the UK have affected and will continue to affect employment patterns and regional growth.</td>
</tr>
<tr>
<td>Chapter 13</td>
<td>Moving towards a post-industrial economy: development of information technology, service industries, finance and research, and science and business parks.</td>
</tr>
<tr>
<td></td>
<td>Expansion of an industrial estate in Bournemouth, UK</td>
</tr>
</tbody>
</table>
Sample answers to the Issue evaluation Assess to progress answers

Chapter 1 Issue evaluation

1 Study Figure 1.36 which shows earthquakes that have occurred in China between 1949 and 2000. Which two of the following statements are true?

- Most of China’s earthquakes occur in the east of the country.
- Some earthquakes in China reach a magnitude of 8 to 9.
- In the west of the country the earthquakes are clustered together.
- There are no earthquakes in the east of the country.
- Earthquakes in China range from magnitude 5 to magnitude 9.

‘Some earthquakes in China reach a magnitude of 8 to 9’ and ‘In the west of the country the earthquakes are clustered together’

(1 mark for each correct answer)

2 MARKS

2 Suggest why the buildings in China are so vulnerable to earthquake tremors. 2 MARKS

Many of the buildings in rural China are made out of materials which are vulnerable to tremors. For example, some buildings are made from adobe which is a type of clay but which is unable to withstand even moderate tremors. Many buildings also do not follow building regulations and are not earthquake-proof.

3 Should China invest money in satellite technology for earthquake monitoring? Justify your answer. 9 MARKS + 3 SPaG MARKS

China is a country which is frequently affected by seismic activity – there have been over 600 earthquakes since 1900 with a magnitude of 6 or over and 627 000 fatalities since 1900, 23 per cent of the global total. Clearly, being able to monitor and predict earthquakes could save lives and China is therefore investing over $1 billion in new satellite technology in an attempt to do this. However, there are many arguments to suggest that China should not invest this money in a technology which is highly experimental. Firstly, there is a saying that it is not earthquakes that kill people but buildings which are poorly constructed and collapse following even moderate tremors. It would perhaps be better to spend the money on ensuring all buildings follow stringent codes so that they are less likely to collapse; this would reduce the death toll. Also, it is the western half of the country that is most vulnerable to earthquake activity and therefore it seems unfair to those who live in the east to spend such vast sums of money on something that will not benefit the whole population. Finally, even though the Chinese satellite network appears more reliable than other forms of monitoring and prediction – such as changes to groundwater, soil elevations and abnormal animal behaviour – it is still highly experimental. It also runs the risk of causing widespread panic if it predicts earthquake activity which fails to materialise. Therefore, China should probably invest in earthquake-proof buildings rather than expensive satellite technology.

Chapter 5 Issue evaluation

1 Suggest two reasons why Madagascar has suffered from deforestation. 2 MARKS

There are two main reasons why Madagascar has suffered from widespread deforestation. Firstly, the population has increased dramatically from 5.1 million in 1960 to 23.6 million in 2014. People need land on which to live and so deforestation has occurred to accommodate the extra population. Also, Madagascar is in debt – in 2014 the debt was 34.65 per cent of GDP – and so the government
has invested in the production of cash crops such as coffee, rice and beef for export. These cash crops are grown in areas which were previously covered by forest.

2 Use Figure 5.23 to describe how Madagascar’s forest cover has changed from 1950 to 2007. 4 MARKS

The forest cover in Madagascar has decreased dramatically between 1950 and 2007. At the beginning of this period most of the eastern half of the island was covered in forest. However, deforestation has decreased forest cover so that only about 10% of the original cover remains. The forest is still concentrated in the east of the island but runs in a thin and discontinuous line.

3 What is meant by the following terms:
   - shifting cultivation 2 MARKS
   - cash crop
   - Shifting cultivation – when the land is farmed for a period of time and then farmers move to another location and the land is left to recover.
   - Cash crop – growing crops to make money, not for personal consumption.

4 Should the hydroelectric power project go ahead at Toamasina? Justify your answer. 9 MARKS + 3 SPaG MARKS

There are many reasons why investing in hydroelectric power (HEP) would be a positive thing for Madagascar. Firstly, the project at Toamasina would increase Madagascar’s HEP capacity by 50 per cent which would both increase investment in renewable energy and provide energy for 20 of Madagascar’s rural villages. The project would also bring a much needed boost to the economy and the exploration phase may also bring mean positive impacts to the local people and aspects of the environment. However, there are also many disadvantages. Madagascar is one of the poorest countries in the world and so investing in an expensive project which will cost millions of dollars to both construct and maintain may divert funds from other things such as education and healthcare. Also, the project is likely to cause irreversible damage to the island’s unique ecosystems. Deforestation has already occurred on a huge scale and only 10% of the original forest cover remains. Further disruption and deforestation will need to occur to build the dam and access roads which will disrupt the habitats of animals such as the lemur. Soil, dust and emissions from construction vehicles will also lead to negative environmental effects. Consequently, whilst the development could help Madagascar economically, on balance the environmental effects are likely to be so dramatic that I believe the HEP plant should not be constructed.

Chapter 11 Issue evaluation

1 Outline two aims of the redevelopment of Birmingham’s CBD. 2 MARKS

Two of the aims of the redevelopment of Birmingham’s CBD are to improve transport links so that people can travel around the centre more efficiently and to make use of some of Birmingham’s listed buildings which are currently derelict.

2 Suggest one concern that locals may have about the Jewellery Quarter redevelopment. 1 MARK

One of the concerns is that the housing which is developed may prove too expensive for first-time buyers which will make it difficult for local people to get on to the housing ladder.

3 What is meant by the following terms:
   - brownfield site 2 MARKS
   - Central Business District?
   - Brownfield site – this is land which has previously been used for industry or commerce.
   - Central Business District – is the area, usually towards the centre of a city, where business and commerce are located.

4 ‘Birmingham’s Jewellery Quarter should be redeveloped to ensure that it serves the whole of the local community.’ To what extent do you agree with this statement? Give reasons for your answer. 9 MARKS + 3 SPaG MARKS
The redevelopment of Birmingham’s Jewellery Quarter is breathing much needed life into the area. It has provided a focal point for tourists and shoppers and has enabled previously derelict buildings to become useful again. However, whilst this redevelopment has boosted the local environment and economy some believe that it has not really focused on the needs of the locals who believe the new apartments that have been created are too expensive. The families who have lived in the area for generations and whose relatives worked in the jewellery factories which gave the area its history and name will be forced to leave. This is why it is so important that the Jewellery Quarter should be redeveloped to serve the whole of the local community. The developers have attempted to do this and the Ruskin Mill Trust is one example where local people with special needs are being catered for. It provides a community hub where people with Asperger’s syndrome can learn a trade whilst developing their social skills at the same time.

Chapter 13 Issue evaluation

1. Using Figure 13.20, describe the location of the Aviation Business Park. 3 MARKS

The Aviation Business Park is located 3 km north of Bournemouth on the Dorset/Hampshire border. The Business Park is located in a flat area in the rural urban fringe and is currently approximately 200 acres in area; the proposal is to develop a further 35 acres. While there is already development on the site the proposed expansion will be on greenfield land around the edge.

2. Explain the importance of tourism to Bournemouth’s economy. 4 MARKS

Tourism is a really important part of Bournemouth’s economy. In 2013 there were nearly 7 million visitors to Bournemouth, most of whom were day visitors. Tourism also supported over 12,000 jobs in the city, two-thirds were directly related to tourism and the remaining third were part of the tourism supply chain. In total, tourism contributed over £500 million to Bournemouth’s economy in 2013 which is around 15 per cent of the total.

3. Explain the importance of the digital economy to Bournemouth’s economy. 4 MARKS

While tourism is an important aspect of Bournemouth’s economy and has remained relatively stable, the sector which has increased most dramatically in recent years is the digital economy. 15 per cent of all companies in 2013–2014 were digital and most of these were located outside of London. Bournemouth has the fastest growing digital economy in the UK increasing 212 per cent between 2010 and 2013. It is therefore likely that, in the future, the digital economy will become increasingly important to the economy of Bournemouth.

4. ‘The Aviation Business Park should be developed in order to accommodate growth in Bournemouth’s economy.’ To what extent do you agree with this statement? Give reasons for your answer. 9 MARKS + 3SPaG MARKS

Due to the fact that Bournemouth’s digital economy is increasing so dramatically it is important to develop the Aviation Business Park to accommodate this growth and to ensure that the city’s economy develops in the future. The buildings will be able to be built to meet both current and future needs and will provide an opportunity to improve the image of the area. However, developing greenfield land brings its own problems and issues and it may take time for plans to be approved by the council due to local opposition. Transport links also will need to be built to link parts of the business park together and with the rest of Bournemouth. The development of the business park could potentially take money away from the development of tourist facilities which may impact upon this sector of the economy. However, as £45 million has already been spent on upgrading the nearby airport and 1200 jobs will be created this could offset any negative impact on other parts of the economy. Therefore, I agree that the Aviation Business Park should be developed in order to develop Bournemouth’s digital economy.

Chapter 14 Issue evaluation

1. Study Figure 14.15 which shows the location of the proposed Highthorn site. Describe the location of the site. 2 MARKS

The 1700-acre Highthorn site is located near Druridge Bay on the Northumberland coast between the villages of Ellington in the south and Widdrington in the north.

2. Outline why Highthorn may be a suitable site for the development of an opencast mine. 2 MARKS
Highthorn may be a suitable site because firstly there are significant coal resources in the area and secondly it is located over 20 km from the Northumberland National Park.

3 Suggest two groups of people who may be against the development of an open cast mine at Druridge Bay and briefly explain why they are against the development. 4 MARKS

The people living in the villages of Ellington and Widdrington may be against the proposal because if the open cast mining goes ahead it will create high levels of noise and air pollution which will negatively affect their quality of life. Tourists to Druridge Bay may also be against the development as the extraction and storage areas may not be set back enough from the beach which may mean that they either will not visit or, if they do, their experience may be negatively impacted.

4 Describe the social advantages of the proposed scheme. 4 MARKS

The company developing the mine has put forward a fund of £450 000 which will be spent on local good causes and enabling people to get into work. The proposal also includes nearly 8 km of cycle paths, footpaths and bridleways which will encourage a healthy lifestyle.

5 Should Banks Mining go ahead with their proposal for open cast mining at Druridge Bay? Justify your answer. 9 MARKS + 3 SPaG MARKS

I do not think that Banks Mining should go ahead with their proposal for open cast mining at Druridge Bay for a number of reasons. Despite the social, economic and environmental benefits to the local community which the company highlight, the development will have a predominantly negative effect on the local community. Locals will experience increased noise and air pollution which may adversely affect their health. In addition to the local impacts, the development may have significant and negative global impacts on the environment. The development of an open cast coal mine encourages a reliance on unsustainable and old-fashioned sources of energy. It would be much better instead to fund the development of renewable, clean and more sustainable sources of energy.

(Alternatively, the student may argue that the open cast mining plan should go ahead. As with the answer above, the student needs to provide reasons to support their view. These reasons should consider economic, social and environmental impacts of the plan.)
Using the Assess to progress tool

What is Assess to progress?

The Assess to progress tool allows students to answer questions through Cambridge Elevate and submit them to you for marking. To help with marking, you are provided with detailed assessment objective statements and a model answer for each question. You can assign levels for each assessment objective statement as well as an overall mark for the answer and written feedback. You can export students’ scores so that you can track their progress over time.

How does it work?

Every Assess to progress question in the Student Book has an associated widget in the Cambridge Elevate enhanced edition of the Student Book.

Students can click on the widget, which will open to show them the question and the assessment objectives that they should aim to cover in their answer. The assessment objectives have been broken down into easy-to-understand statements. Students can type in their answers and then submit them for marking.

Once submitted, the answers will appear in the teacher’s edition of the Cambridge Elevate enhanced edition. You can open and read each answer and then provide feedback.

To help with marking, a model answer is provided for each question, which you can compare with the student’s answer. You can assign a rating for each assessment objective statement. The rating system has three levels: basic, clear and detailed. You can also enter an overall number of marks for the answer, as well as providing written feedback.

Once you have marked the answer, you can return your feedback to the student via Cambridge Elevate. At this point, the student can also see the model answer along with your feedback on their own answer. They can type notes on their work, which can help with consolidation and revision.

You can export the assessment criteria scores and marks for download or upload to your school’s VLE to track students’ performance over time.
Using the Assess to progress question bank

The Assess to progress question bank contains additional exam-style questions to allow students to practise answering questions in a way that displays the full extent of their knowledge and skills. The questions help them to understand what is expected of them during assessments and know how to deliver it.

The question bank provides examples of many of the question types that students might encounter in assessments. Teachers can build on this template to create their own extra examples for students at all levels. Moreover, if students design other equivalent questions to test each other, they will gain a deeper understanding of how the questions ‘work’.

Sample answers and advice about the questions

Chapter 2 Tropical storms

This spread offers low-mark short questions and a more complex 6-mark question.

Students can practise factual recall, simple and more complex description plus application of a named example. For example, question 1 for only one mark, which expects only factual recall. Take this as an opportunity to emphasise the importance of such short questions; whilst they are straightforward, rushing them can lead to misinterpretation and the unnecessary loss of a precious mark.

**Question 2** seeks factual information based on the table and should be accessible to all ability levels, giving all students an opportunity to shine.

From question 3 students can learn that 2 marks per point means one for naming the feature and the other for added description – simple naming is not enough.

**Question 4** should stretch all students, even though the command word is ‘describe’.

Sample answers

1. Give one factor that is needed for a tropical storm to occur. **1 MARK**
   - Large areas of tropical ocean where the water temperature is greater than 26.5 °C.

2. Using the information in Table 2.1, give three kinds of damage caused by a category 4 tropical storm. **3 MARKS**
   - damage to houses, especially roofs and walls
   - fallen trees
   - damage to powerlines leaving areas without power

3. Describe two features of a storm surge. **4 MARKS**
   - high sea levels
   - huge waves causing coastal flooding

4. For either an HIC or an LIC, describe the primary and secondary effects of a tropical storm. Use an example in your answer. **6 MARKS**
   - This answer uses Hurricane Katrina, which hit the USA, an HIC, from 25 August 2005. It was the sixth strongest hurricane ever recorded in the Atlantic, so there were several primary and secondary impacts.
   - Katrina began as a low pressure weather system out in the Atlantic. Wind speeds were up to 200 km/hour.
   - A primary effect is something which occurs during the event itself, whereas a secondary effect happens afterwards. A hurricane has three key primary effects:
     - high winds
     - torrential rain
     - storm surge.
At least 1836 people died in the actual storm, but the true number is probably higher. Even in an HIC not everyone was accounted for. Many homes were destroyed and 100 000 households were left without power.

Torrential rain and the storm surge caused homes to be flooded or washed away, and many of the dead had drowned. Coast guards rescued 33 500 people. The sea defences failed, so flooding occurred several kilometres inland in Louisiana.

People found shelter at the Superdome sports ground, but there was a lot of crime there. Many people fled from New Orleans (roads were jammed) and some have never returned home.

Chapter 5 Tropical rainforests

In question 1, ‘Evaluate’ is a high level command word and so carries the maximum of 9 marks. The ‘Tip’ box guides students, perhaps in pair/small group work, to achieve quality responses.

Sample answers

1 Evaluate the success of the Plan Pacifico in the Chocó forests of Columbia in conserving the rainforest while allowing some economic development to support the local population. 9 MARKS + 3SPaG

The Plan Pacifico is a plan by the government of Columbia to use the Chocó rainforests to create wealth for the country by developing plantations, mines and new highways.

A plantation is an area used for one type of crop, such as oil palm. Colombia and Ecuador produce lots of palm oil, which they export to other countries. Aside from the value of foreign trade, plantations also add to the economy by creating employment opportunities in the area. Although the jobs are often low-paid, they provide workers with an important income stream. If the jobs are in a Fair Trade system, the workers will also have other benefits such as homes provided for them, school places for their children and adult classes in literacy and numeracy.

However, plantations require areas of the rainforest to be cleared. Clearing the rainforest reduces biodiversity and can also mean removing people from their land and homes. Plantations and mining create waste which can pollute the surrounding land and waterways, such as the Atrato River.

The reduction of rainforests can have regional and even global impacts. Rainforests act as carbon stores; removing these can release more carbon dioxide into the atmosphere and contribute to global warming. The removal of habitats can mean that some species that only live in the rainforests may become extinct.

Charities like the Worldwide Fund for Nature are involved in the Chocó Project in order to make an economic project sustainable for the region’s wildlife and the functioning of its ecosystem.

Chapter 10 Glacial landscapes in the UK

Definitions are important and an easy way for all students to gain credit. However, most definitions here in question 1 are far from easy – accuracy is essential.

The Student Book provides photographs typical of glacial landscapes, providing plenty of practice opportunities. Describing landforms (question 2(a)) is not difficult but students need to grasp the format for doing it:

- size
- shape
- colour
- location
- what is the feature adjacent to?

The ‘evaluate’ command in question 2(b) requires assessment of advantages and disadvantages in a real world economic situation.

Sample answers

1 Define these geographical terms. 5 MARKS

   a Glacier
A glacier is a slow-moving river of ice formed from compacted snow.

b  Interglacial period

An interglacial period is a warm period where the average global temperatures are around 15 °C.

c  Permafrost

Permafrost is soil that has been frozen for at least two years.

d  Snout

A snout is the end of the glacier.

e  Tundra

Tundra is vegetation found in cold environments, which is mainly composed of shrubs, grasses, mosses and lichens.

2  Identify one landscape feature in an upland glaciated area in the UK such as the Lake District, Snowdonia or the Scottish Highlands.

a  Describe two features of the landform. 4 MARKS

A pyramidal peak is a mountain severely eroded by ice. It is called a pyramidal peak because it has a high, steep-sided, pointed peak like a triangular-based pyramid in geometry, formed by three (sometimes four) flattish sides which originate from the steep backwalls of corries. The lower parts of these corries have been eroded away by glaciers, losing the typical armchair shape.

Arêtes, are steep-sided ridges (such as Striding Edge and Swirral Edge) between the original corries clearly delineate the sides of the peak. Pyramidal peaks stand up above other mountains in the landscape.

b  Evaluate the use of this landscape feature for tourist use. 6 MARKS

Landforms like pyramidal peaks have a limited tourist appeal. They are high and the walking can be challenging. The majority of visitors remain in the lower areas; it is the serious walkers who go for the heights. Helvellyn is located half-way between Ambleside at the northern end of Lake Windermere and Keswick, limiting mass access due to poorer roads and public transport. Paths are clearly marked and signposted.

The views of the surrounding Lake District are spectacular, as well as the potential to appreciate the arêtes, Striding Edge and Swirral Edge, both famous. Red Tarn is a good example of this small lake feature and offers a flatter resting point for short-term recovery.

Helvellyn is an example of a mountain ecosystem. There are rare plants and ferns, as well as heather heath. Parts of the area have SSSI status, attracting some tourists.

Chapter 17 Energy resources

Large data tables can be daunting to students but, if they can be shown how to identify key data for use and comment, a good deal of the fear is removed. Choice is the point here – not every piece of data has to be processed, making things more manageable.

For question 1 students need to be clear about the categories of country so that they choose suitable examples. Note that the marks are given for the description, not for the actual choice.

Sample answers

1  Study the data table. Choose one country for each of these categories and describe:

a  i  a post-industrial economy 1 MARK

The USA is a post-industrial economy. In a post-industrial economy, the relative importance of manufacturing decreases and the importance of services, information and research increases.

ii  an LIC 1 MARK

Malaysia is an example of a newly emerging economy (NEE). An NEE is a country in the process of moving from an LIC to a more economically developed country.
iii an NEE 1 MARK

Bangladesh is an example of a lower income country (LIC). An LIC is a country with a gross national income per capita below US$1045 (in 2014).

b Describe the changes in energy consumption per person between 2005 and 2015. 3 MARKS

Between 2005 and 2015, energy consumption increased in most LICs and NEEs, including Bangladesh, Brazil, and China. Energy consumption actually decreased slightly in some post-industrial economies, including Australia, Canada, France, Japan and the US.

2 Explain why some countries' energy consumption per person is increasing at the moment, but in others it is decreasing. 6 MARKS

The increase in energy consumption in LICs and NEEs might be a result of growing manufacturing industries requiring more energy. Also, as the economies of these countries increases, people have more money to spend on leisure and luxury goods such as electronics that use up energy. It is worth noting that most of these countries still have a lower energy consumption per person than the post-industrial economies.

The reduction in energy consumption in some post-industrial economies might be because of a decrease in manufacturing has meant fewer factories using up large amounts of energy. Technological improvements meaning that electronic devices, homes and buildings use less energy might also contribute to the reductions in energy consumption.

Ways of using the Question bank

- In class as a peer-marking exercise – all students write an answer which is then marked by another member of the class, giving an overall mark along with both positive and negative comments. Note that students are often too positive about each other and it is a way to illustrate how an examiner will approach marking their work.
- In class as a ‘think-pair-share’ exercise – the thinking section could involve individual students writing a plan for a higher mark question, then comparing with a partner and writing the best answer possible together. Sharing within a larger group can allow further improvement to achieve a 9/9 answer!
- A class or homework exercise designed to cultivate independent learning.

Overall, the question bank is intended as a flexible resource for teachers and students alike.
Introduction to Section 1: The challenge of natural hazards

**LEARNING OUTCOMES**

By the end of this section introduction, students should be able to:

- define what a natural hazard is
- identify different types of natural hazards
- identify factors affecting hazard risk.

**General notes**

The section introduction provides an overview of natural hazards, which are then examined in detail in the subsequent chapters.

**Suggested learning activities**

- Use newspaper headlines to express the idea of a hazard (where people and property are affected).
- Show photos of different hazards and get students to classify them into hazard types.
- Form discussion groups and identify factors that affect risk.
- The caption to Figure S1.1 in the Student Book contains the discussion question ‘How might a volcanic eruption lead to an outbreak of cholera?’ This could form the basis of a class discussion. Answers might include damage to infrastructure, contamination of water supply and subsequent spread of the water-borne disease.
LEARNING OUTCOMES
By the end of this chapter, students should:
• understand how the movement of plates leads to earthquakes and volcanic activity
• be able to describe the global distribution of earthquakes and volcanoes
• know the different types of volcanoes and how they are formed
• recognise the different hazards and benefits associated with living near volcanoes
• recognise the primary and secondary effects of volcanic activity
• understand how the movement of plates leads to earthquakes
• recognise the different ways that an earthquake can be measured
• recognise the primary and secondary effects of earthquakes
• know how the effects of earthquakes vary between areas of contrasting levels of wealth
• understand how the responses to earthquakes vary between areas of contrasting levels of wealth
• understand how the earthquake risk can be reduced.

Introduction

Prior knowledge
Students should have a basic knowledge gained through Key Stage 3 study of tectonic activity, including:
• a basic understanding of the structure of the Earth and plate tectonics theory
• a basic understand of how physical processes interact to influence and change landscapes.

Geographical skills
Cartographic skills can be developed using:
• Activity 1.2: Students are asked to draw a sketch of the photograph of Mount St Helens.
• Activity 1.4: Students are asked to plot data on a world map and then use their knowledge to recognise and describe distributions and patterns on maps.

Graphical skills can be developed using Activity 1.2. Students are asked to draw simple, labelled, cross-section diagrams of shield and composite volcanoes.

Communication skills can be developed using Activity 1.5. Students are asked to explain whether they agree with a news reporter who said ‘The outbreak of cholera in Haiti was inevitable’. They are also asked to explain why more people die in some earthquakes than others. Both these tasks require students to be able to communicate their ideas effectively, to develop an extended written argument and draw well-evidenced and informed conclusions.

General notes
It is important to follow the GCSE specification carefully when planning this topic. The specification focus is on tectonic hazards. This requires knowledge of the global distribution of tectonic hazards and an understanding of the physical processes taking place at different types of plate margin. The primary and secondary effects of a tectonic hazard and the immediate and long-term responses to a tectonic hazard can be investigated for either earthquakes or volcanic eruptions.

In the Student Book there are detailed studies of the great Tōhoku earthquake, which struck Japan in 2011, and the Gorkha earthquake, which struck Nepal in 2015. By completing Activity 1.5, students will be able to compare these two earthquakes to show how the effects and responses to a tectonic hazard vary between areas of contrasting levels of wealth. Japan is an example of a higher-income country (HIC) and Nepal is an example of a lower-income country (LIC).
Students will need to understand the reasons why people live in tectonic areas and a range of methods used for monitoring, prediction, planning and preparation in order to reduce the impact of a tectonic hazard. Preparation for exam questions should ensure detailed knowledge of the effects and responses to the two named examples, as well as an understanding of how management can reduce the effects of a tectonic hazard.

Additional support
Students can sometimes be unsure how to go about researching tectonic hazards. The global distribution of tectonic hazards can be explored in a number of interactive online maps. Start by downloading the Google Earth volcano data layer, accessible from the Smithsonian Institute (www.cambridge.org/links/gatd4000). This displays a photograph, geographic data and links to more detailed information available online. Students can use this to find out more about the volcanoes mentioned in Table 1.2 and Figure 1.7 and to explore any active volcanoes worldwide.

It can be difficult to understand how a seismometer works without seeing an animation. If students watch the animation on Cambridge Elevate, they will better understand how earthquake magnitude is measured on a seismometer. The US Geological Survey website (www.cambridge.org/links/gatd4001) is another helpful resource that students can use to develop their understanding of tectonic hazards. It shows real-time hazard data, monitoring data by volcano observatory and tectonic hazards alerts, which can be used to keep subject knowledge up-to-date.

Extension
The explanation of the physical processes taking place at different types of plate margin has been simplified so that it is accessible for all students. Students may like to investigate this further by looking in further detail at the characteristics of magma at different plate margins and the role of water and silica during the formation of magma and composite volcanoes at destructive plate margins.

As a consequence of recent earthquakes and volcanic eruptions around the Pacific ‘Ring of Fire’, monitoring and prediction of hazards is covering larger geographical areas and becoming more insightful. Students could be encouraged to explore what actions different countries have taken in order to reduce the impact of tectonic hazards. They could start with Japan, a country with 47 active volcanoes and the experience of numerous powerful earthquakes and tsunamis.

Worksheets
Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

**Worksheet 1.1: What happens at tectonic plate margins**, involves labelling a world map to show the distribution of tectonic plates as well as destructive and constructive plate margins. Students should appreciate why tectonic activity is concentrated at plate margins, although there are some anomalies away from plate margins, such as the hotspot located below Hawaii.

**Worksheet 1.2: The global distribution of earthquakes**, involves plotting the location of earthquakes on a world map.

Videos
Chapter 1 in the Cambridge Elevate enhanced edition includes the video clip: Why do Icelandic people live near volcanoes? The clip explains some of the benefits of living near volcanoes. The clip comes from the Iceland: living with volcanoes (DVD by Pumpkin Interactive Ltd).

Lesson ideas

1.1 What is the Earth made of?
This topic introduces students to the structure of the Earth. It compares the characteristics of oceanic and continental crust and describing the physical processes at work at the three types of plate margin.
Starter activity

- Students can start with an activity sorting the characteristics of the different layers of the Earth. Students could practise using comparative language such as ‘but’, ‘however’, ‘whereas’ in order to compare the characteristics of oceanic and continental crust.
- Directed activities related to text (DARTs) can be used to model an explanation of the formation of shield volcanoes, in preparation for students to explain the formation of composite volcanoes.

Plenary activity

- Make a graffiti wall of what students have learned today; this could be done on the board or on a digital canvas such as Padlet (www.cambridge.org/links/gatd4002). Once saved the Padlet canvas could be shown at the beginning of the next lesson as a starting point.
- Working in pairs and with books closed, ask students to explain the following terms: crust, mantle, core, tectonic plate, plate margins and tectonic hazards.
- Ask students to begin a glossary of key terms for ‘tectonic hazards’ starting with the vocabulary they learnt during the lesson.

Homework

- Provide students with a blank map of the world, preferably a Pacific-centric version. Ask students to draw the plate margins and label the Earth’s major plates. Some students may struggle, so you could provide them with a map outline with some plate margins already drawn.

Check students’ understanding

- Students should know the different characteristics of continental and oceanic crust.
- Students should be able to locate and name Earth’s major plates.
- Students need to be aware of the different directions tectonic plates travel in. This helps them to understand the location of the different type of plate boundaries.

1.2 What are the different types of plate margins and their resulting landforms?

This topic is focused on the different types of plate margins including subduction and collision zones at destructive plate margins and constructive plate margins.

Starter activity

- Provide students with an unlabelled illustration for each type of plate boundary and ask them to add labels to each of the tectonic landforms, include a word box of key terms if you want to ensure all key vocabulary is used.
- Introduce students to plate boundaries by acting out the movements of tectonic plates. If you need help watch ‘Plate Boundaries Kung Fu’ on YouTube (www.cambridge.org/links/gatd4003).

Plenary activity

- Complete a knowledge check of the physical processes at work at constructive, destructive and conservative plate margins. This could be in the form of fast-fire questions, with students writing answers on whiteboards. For example, ‘On which type of plate margin are earthquakes rather than volcanoes found?’ or ‘On which type of plate margin are fold mountains formed?’
- Start a concept map for plate margins. Get students to complete it with the information from Table 1.2.
- Create models of the different plate margins using modelling clay or plastic bricks.

Homework

- Students could further develop their understanding of the types of volcanoes associated with plate margins by exploring the US Geological Survey website (www.cambridge.org/links/gatd4004).

Check students’ understanding

- Students need to remember that plates are moving apart at constructive plate margins and towards each other at destructive plate margins.
• Students need to recognise that oceanic plates are denser and therefore are forced under the lighter continental crust at a destructive plate margin.
• Students should be able to draw labelled diagrams for each of the different plate margins.

1.3 Why is volcanic activity found near plate margins?
This topic outlines where some of the world’s 500 active volcanoes are located and explores why shield volcanoes are associated with constructive plate margins and composite volcanoes are associated with destructive plate margins. It also deals with the primary and secondary hazards associated with volcanoes.

Starter activity
• List all the earthquakes and volcanic eruptions that students are aware of. Locate and label them on a world map.
• Show video clips of volcanoes erupting, after explaining the difference between primary and secondary volcanic hazards. Then ask students to identify the primary and secondary hazards shown. Video clips could include: pyroclastic flows [www.cambridge.org/links/gatd4005]; tsunami [www.cambridge.org/links/gatd4006]; landslides [www.cambridge.org/links/gatd4007].

Plenary activity
• In pairs, ask students to share three things they learnt today.
• Play ‘Just a minute’. Students have to talk about volcanoes for a minute, without repetition or hesitation. As soon as a student repeats a key word or hesitates, the next student takes over the challenge until the minute is up.
• Write five ‘true or false?’ questions on volcanoes for students to answer.

Homework
• Students could make a 3D model of either a shield or a composite volcano, with one side showing a labelled cross-section through the volcano.

Check students’ understanding
• Students need to recognise that volcanoes occur in narrow belts along constructive and destructive plate margins. They do not occur along conservative plate margins.
• Students should be able to sketch cross-sections of composite and shield volcanoes and fully annotate the key characteristics.

1.4 Volcanic hazards
This topic explores a range of primary and secondary volcanic hazards. It then introduces the primary and secondary effects of volcanic eruptions.

Starters
• Provide students with a number of images representing the primary and secondary hazards in Table 1.4 of the Student Book. Working in pairs, ask students to sort the hazards according to how dangerous they are, compare results and discuss differences.
• Play ‘Taboo’ in pairs or as a class. Students have to describe a key term on their card (such as ‘shield volcano’) without using the word itself or five additional terms listed (such as gentle-sloping, constructive plate margin, basic lava, runny lava and shield-shaped).

Plenary activity
• Ask students to suggest how the lahar damage to the road from Mount Merapi (Figure 1.13) and devastation on the West Coast of Aceh (Figure 1.14) may impact on the local communities in the short- and longer-term. Students can then research these two disasters for homework and find out about the primary and secondary effects (see the homework section for further information).
• Use the Discussion Point in the Student Book as a plenary.
Homework

- Students can follow up the plenary activity by researching the 2010 Mount Merapi volcanic eruption and 2004 Indonesian earthquake using the BBC News search tool ([www.cambridge.org/links/gatd4008](http://www.cambridge.org/links/gatd4008)).

Check students’ understanding

- Students should be able to recognise a range of primary and secondary volcanic hazards.
- Students should know the difference between primary and secondary effects of volcanic eruptions.

1.5 Why do people live near areas of volcanic activity?

This topic outlines some of the economic and environmental benefits of living near to volcanoes. It then deals with how monitoring, prediction, planning and preparation can be used to reduce the impact of volcanic eruptions.

Starter activity

- Show an image of the different methods used to monitor a volcano and ask students to guess how the technique might work.
- Show students photographs of volcanic regions including Figures 1.15 or 1.16 in the Student Book. Ask students to think about the advantages and disadvantages of living in these tectonically-active places.

Plenary activity

- Write down a list of the key terms learnt in class today.
- Show the video clip without the sound, explaining some of the reasons why people live near volcanoes in Iceland. Ask a student to provide a running commentary, using information learned in the lesson.
- Prepare a wordsearch for students including economic and environmental benefits of living near volcanoes. Once the words are found, students can sort them under the heading economic and environmental benefits. There are a number of online wordsearch generators to make this resource.

Homework

- Students can find out why monitoring the Soufrière Hills Volcano is so important for the people of Montserrat. Data is published by the Montserrat Volcano Observatory ([www.cambridge.org/links/gatd4009](http://www.cambridge.org/links/gatd4009)).

Check students’ understanding

- The hazard risk equation will be a new concept for students, it needs to be carefully explained and applied to several examples so that students can make sense of it.
- Students should know why the effects and responses to volcanic eruptions vary between areas of contrasting levels of wealth.
- Students should be able to give specific examples of the benefits of living near active volcanoes.

1.6 Why do earthquakes occur near plate margins?

This topic deals with the global distribution of earthquakes. It then looks at why earthquakes happen and how they are measured.

Starter activity

- Provide a global map of earthquakes and a global map of population distribution. Ask students to locate where in the world there are people vulnerable to earthquakes. In addition, you could provide a map of national wealth to further refine the list of vulnerable locations.

Plenary activity

- Choose a student to be in the ‘hot seat’. The rest of the class take it in turns to ask him or her a question about earthquakes.
• Write the words ‘Richter scale’, ‘seismograph’ and ‘shallow-focused earthquakes’ on the board. Tell students that these are three answers, but what were the questions?
• Ask students to sum up what they have learnt today in three sentences, then reduce this to three key words.

Homework

• Get students to draw a cartoon strip to represent the damage caused, on the Mercalli intensity scale, as shown in Figure 1.19.

Check students’ understanding

• Students need to be aware of the wider distribution of earthquakes compared to volcanoes. For example they can be found along conservative and collision plate margins in addition to constructive and destructive plate margins.
• Students need to remember that the Richter scale is a scientific measure of the magnitude or energy released during an earthquake whereas the Mercalli scale is a subjective judgement of the observed damage caused by an earthquake.

1.7 What is the impact of earthquakes on people and places?
This topic starts by comparing the physical and human factors that influence the effects caused by an earthquake. It then explores the secondary effects of earthquakes, such as landslides, fires, disease and food shortages. Finally, methods of reducing the impact of earthquakes are outlined.

Starter activity

• Ask students why there are no powerful earthquakes in the UK. Show a newspaper report of the Kent earthquake that struck in May 2015 and was the biggest earthquake to hit Britain in seven years (4.2 on the Richter scale), causing windows to rattle.
• Provide a range of newspaper reports describing earthquakes. Ask students to highlight the primary and secondary effects that have been written about.
• Ask students to write down one thing they would like to find out about earthquakes and write it on a sticky note. Revisit these questions and try to answer some of them in the plenary.

Plenary activity

• Give students a bookmark-shaped piece of paper and ask them to summarise the key points from the lesson and make it colourful. This can then be laminated and used for revision.
• In pairs, ask students to test each other about primary and secondary effects of earthquakes.
• Create an acrostic. Students write EARTHQUAKE down the side of a page and make each letter the first letter of a word or phrase about the impacts of earthquakes.

Homework

• Students can research recent earthquakes and present the findings along with a map and picture to create an earthquake wall display. A good starting point for research is the US Geological Survey National Earthquake Information Center website www.cambridge.org/links/gatd4010.

Check students’ understanding

• It is important to remember that the death and destruction caused by an earthquake can be influenced by physical factors such as location of epicentre, depth of epicentre and geology, as well as human factors such as population density, level of development, building standards and whether the earthquake was forecast.

1.8 How can the earthquake risk be reduced?
This topic looks at why people live in areas at risk of earthquakes and strategies that can be used to reduce the risk.
Starter activity

• San Francisco is located in an earthquake zone. Show students a large version of Figure 1.21 in the Student Book and ask them if they would feel safe living there even if they knew an earthquake could strike at any time.

• Show students video footage of the first few moments of a recent earthquake caught on camera. Ask students to describe the impacts. Ideas could be grouped into social, economic and environmental impacts.

Plenary activity

• Ask students to design their own earthquake-resistant building using ideas from the Student Book or from the following Economist video clip ‘How to make a building earthquake-proof’ (www.cambridge.org/links/gatd4011).

• Draw a mind map to organise the different methods we can use to monitor and predict earthquakes and volcanoes.

• Debate the following statement ‘One day it will be possible to predict when and where earthquakes will strike’.

Homework

• Print out two images showing the aftermath of earthquakes in California, USA and Nepal. Ask students to annotate the damage shown in the images, then compare the degree of damage between the two places.

• Ask students to design a poster to inform Californians as to how to prepare for an imminent earthquake.

Check students’ understanding

• Students should be aware of the benefits of living in earthquake zones.

• Students need to understand that scientists have not been able to accurately predict when and where earthquakes might strike, but by effectively protecting and planning, the risks of death and damage when earthquakes strike can be reduced.

• Students should know how responses can vary between areas of contrasting levels of wealth.

Named Examples: the Tōhoku and Gorkha earthquakes

The last part of this chapter is concerned with the primary and secondary effects and the immediate and long-term responses to earthquakes. This chapter uses the examples of the Tōhoku earthquake, which struck Japan in 2011, and the Gorkha earthquake, which struck Nepal in 2015, as named examples. These examples are then used to show how the effects of, and responses to, a tectonic hazard vary between two areas of contrasting levels of wealth.

Starter activity

• Write the numbers 7.8, 25, 50, 600 and 1.5 million on the board at the start of the lesson, and invite speculation from students as to what they represent. These can be returned to during the plenary.

• Create jigsaw puzzles from images of the aftermath of the Tōhoku and the Gorkha earthquakes. Mix up the pieces and get students to sort them. Students can then describe the impacts of earthquakes as seen in the different images.

• Show a video clip from CCTV that captured the first minutes of the Gorkha earthquake, press pause, and ask students to say what they think happened next. There are many clips available on YouTube, including clips from downtown Kathmandu (www.cambridge.org/links/gatd4012).

• Create an image bank from the aftermath of the Tōhoku and the Gorkha earthquakes. Ask students to identify whether they are looking at images of a lower-income country or a higher-income country and justify their choices.

Plenary activity

• Create a Venn diagram with similarities and differences between the Tōhoku and Gorkha earthquakes.
• Ask students to prepare a 30-second news bulletin about one of the earthquakes, giving the key facts about the causes, effects and immediate responses.
• Use an online name generator to pick students to answer quick-fire questions about either of the two named earthquakes.
• Give students a copy of **Table 1.7** to complete. Give them a two-minute deadline to see how much they can complete in a limited time.
• Write ‘earthquakes’ in the centre of a page, then create a concept map all about earthquakes. Remember to include the relationship between concepts as well as the concepts themselves.
• Create a storyboard to show the timeline of events for either the Tōhoku or Gorkha earthquake.

**Homework**

• Further investigate the impacts and responses to the Tōhoku (Japan) and the Gorkha (Nepal) earthquakes. Visit the **Earthquake Report website** ([www.cambridge.org/links/gatd4013](http://www.cambridge.org/links/gatd4013)) for more information about the Gorkha earthquake. Visit the **NOAA website** ([www.cambridge.org/links/gatd4014](http://www.cambridge.org/links/gatd4014)) for more information about the Tōhoku earthquake. Other useful websites include news websites such as **BBC News** ([www.cambridge.org/links/gatd4015](http://www.cambridge.org/links/gatd4015)).

**Check students’ understanding**

• Students need to use named earthquakes to show how the effects and responses to a tectonic hazard vary between two areas of contrasting levels of wealth.
• Students need to know key facts about both named examples.
• Students are also required to use higher-order thinking skills to compare the causes, effects and responses to the tectonic hazards.
• Students need to be aware of the reasons why the damage and death toll is higher in poorer countries and why the earthquake risk can be greatly reduced in wealthier countries.

**Model answers to ‘Assess to Progress’ questions**

Model answers are given for questions allocated 3 marks or below. Mark schemes and model answers are provided for questions allocated marks greater than 3.

1 Explain how risks from a tectonic hazard can be reduced. **6 MARKS**

Methods of planning and protection can be used to reduce the risk of death and damage when an earthquake strikes or a volcano erupts. Planning includes emergency evacuation plans, information and warning systems. Japan’s Meteorological Agency transmit earthquake and tsunami warnings automatically on all television channels and tsunami sirens sound along coastal settlements after any marine earthquakes.

Protection includes educating people or improving building design. Protection ensures that people are educated as to what to do when disaster strikes. For example, Californians know to ‘Drop! Cover! Hold On!’ in the case of an earthquake and the Japanese are taught to run quickly to the hills to avoid death by tsunami. Earthquake-resistant building design can include using shock absorbers to absorb earthquake tremors, using steel beams to reinforce walls and having generators in place in case of disruption to power supplies. The Transamerica Pyramid is an example of an earthquake-resistant building in San Francisco.
Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Demonstrates clear knowledge of how risks from a tectonic hazard can be reduced.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Expect linked statements with reference to a range of techniques.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shows some geographical understanding of the interrelationships between places, environments and processes in the context of reducing risks from tectonic hazards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Some balance between monitoring, planning and preparation techniques.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Answer clearly developed.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Demonstrates limited knowledge of how risks from a tectonic hazard can be reduced.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Simple generic information with limited or no reference to actual techniques.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shows basic geographical understanding of the interrelationships between places, environments and processes in the context of reducing risks from tectonic hazards.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Little or no balance between monitoring, planning and preparation techniques.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Answer not developed.</td>
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</table>

2 What is:

a  a constructive plate margin **2 MARKS**

A constructive plate margin occurs where plates move apart, such as where the Eurasian and North American plate diverge at Iceland.

b  a destructive plate margin **2 MARKS**

A destructive plate margin occurs where a denser and lighter plate move together and one is subducted. This is usually an oceanic plate such as the Nazca plate being forced underneath a continental plate such as the South American plate.

c  a conservative plate margin. **2 MARKS**

A conservative plate margin occurs where plates slide past each other in opposite directions, or in the same direction but at different speeds. An example is the San Andreas Fault or margin between the Pacific plate and the North American plate.

3 Using examples, explain why people choose to live in areas at risk from tectonic hazards. **6 MARKS**

There are a number of reasons why people remain living in earthquake zones or near active volcanoes. These can be social, economic or environmental. Major earthquakes or violent volcanic eruptions happen relatively infrequently so many generations of a family can take the risk that a major disaster will not occur in their lifetime. For example, the highly unstable San Andreas Fault had a violent earthquake in 1906 but did not have another one until 1989. Other people, living in
earthquake zones like Japan, think that with good planning and preparation the risk of death is greatly reduced.

Many of the Earth’s natural resources of oil, minerals and geothermal energy are concentrated near plate margins and so the economic benefits can outweigh the risks. Over time, weathering of mineral-rich volcanic rock produces rich fertile soil which is good for growing crops and provides a valuable income for farmers. In Nepal, a million tourists a year go trekking and mountain climbing and contribute (US)$1.8 billion to the country’s economy. Employment opportunities for the local Sherpa population as guides and porters are the biggest income stream for the remote region.

Finally, tectonically active areas can often be beautiful, they offer great scenery and offer a variety of tourist attractions. Yellowstone, a volcanic caldera in the USA, draws 3 million tourists a year who come to view the geysers and other geothermal activity.

**Mark scheme**

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
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</thead>
</table>
| 2 (clear) | 4–6   | • Demonstrates clear knowledge of the reasons why people live in areas at risk from tectonic hazards.  
• Expect linked statements with reference to recent named examples.  
• Shows some geographical understanding of the interrelationships between places, environments and processes in the context of a tectonic hazard.  
• Some balance between social, economic and environmental reasons.  
• Answer clearly developed. |

| 1 (basic) | 1–3   | • Demonstrates limited knowledge of the reasons why people live in areas at risk from tectonic hazards.  
• Simple generic information with limited or no reference to recent named examples.  
• Shows basic geographical understanding of the interrelationships between places, environments and processes in the context of a tectonic hazard.  
• Little or no balance between social, economic and environmental reasons.  
• Answer not developed. |

4 a Why do volcanoes erupt at subduction zones? **4 MARKS**

Volcanoes erupt at subduction zones, where two plates move together at a destructive plate margin. When the plates meet, the thinner, denser plate is subducted, driven by the weight of the sinking plate through the process of slab-pull, under the thicker and less dense plate. The subducted plate melts in the hotter mantle. Magma forms, rises and erupts to form volcanoes parallel to the plate margin.
Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>3–4</td>
<td>• Demonstrates clear knowledge of the reasons why volcanoes erupt at subduction zones. • Expect linked statements with reference to a named example. • Shows some geographical understanding of the interrelationships between places, environments and processes in the context of tectonic processes. • Answer clearly developed.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–2</td>
<td>• Demonstrates limited knowledge of the reasons why volcanoes erupt at subduction zones. • Simple generic information with limited or no reference to a named example. • Shows basic geographical understanding of the interrelationships between places, environments and processes in the context of tectonic processes. • Answer not developed.</td>
</tr>
</tbody>
</table>

b Why do earthquakes happen at conservative plate margins? 4 MARKS

At conservative plate margins, plates either move in the same direction at different speeds or past each other in opposite directions. As these plates move past each other, stress energy can build as the plates grind and catch on each other. When the stress becomes too great, it is released and shock or seismic waves pass through the crust. These seismic waves are the earthquake.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
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<tbody>
<tr>
<td>2 (clear)</td>
<td>3–4</td>
<td>• Demonstrates clear knowledge of the reasons why earthquakes happen at conservative plate margins. • Expect linked statements with reference to a named example. • Shows some geographical understanding of the interrelationships between places, environments and processes in the context of tectonic processes. • Answer clearly developed.</td>
</tr>
</tbody>
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### Level Marks Description

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1 (basic) | 1–2   | • Demonstrates limited knowledge of the reasons why volcanoes erupt at subduction zones.  
• Simple generic information with limited or no reference to a named example.  
• Shows basic geographical understanding of the interrelationships between places, environments and processes in the context of tectonic processes.  
• Answer not developed. |

#### 5 a  How does the Richter scale measure earthquakes? 2 MARKS

The Richter scale measures the magnitude or strength of an earthquake. It is recorded using a seismometer and recorded on a logarithmic scale numbered between 0 and 10.

The Mercalli scale is a descriptive scale which notes the observed level of destruction seen and recorded on a scale of 1–12 using roman numerals I to XII.
LEARNING OUTCOMES
By the end of this chapter, students should:
• understand how global atmospheric circulation patterns work
• know the global distribution of tropical storms
• know how tropical storms are formed
• be able to describe the effects of tropical storms and how these effects are managed
• be able to explain how climate change may affect the formation and effects of tropical storms.

Introduction

Prior knowledge
Students should have a basic knowledge gained through Key Stage 3 study of weather and climate, including:
• a basic understanding of global climate and of the climate of the UK.
Students should also have a basic knowledge gained through Key Stage 3 study of natural hazards, including:
• a basic understanding of the distribution and formation of tropical storms
• a basic knowledge of the social, economic and environmental effects of tropical storms.

Geographical skills

Cartographic skills can be developed using Activity 2.2. Students are asked to use their knowledge to recognise and describe distributions and patterns on maps.

High-level thinking can be developed using the Maps from Memory activity in the ‘Where do tropical storms develop?’ topic outlined below. This enables pupils to work both individually and in a group session to develop their skills of retention. It also has the benefit of helping pupils with their revision skills.

General notes
It is important to be led by the GCSE specification when setting up teaching of this topic area. Remember, students will need to know the difference between primary and secondary effects of tropical storms, and immediate and long-term responses to storm damage. Detailed study of a named example, such as Typhoon Haiyan, is needed to bring out the differences outlined above.

Many of the activities in the topics, ‘The general model of global atmospheric circulation’ and ‘Where do tropical storms develop?’, are visual in nature and require either cartographic skills or the drawing and analysis of diagrams. Students will need to ensure there is sufficient labelling to explain the processes involved in, for instance, the formation and movement of tropical storms. The activities associated with the effects of tropical storms lend themselves more to discussion and group work, with these techniques developing wider skills of participation. Additional information to add to these discussions can be found in the weblinks in the topic ‘How might climate change affect tropical storms?’

Preparation for exam questions should ensure adequate knowledge of locations and the processes involved in the formation of tropical storms. There should be detailed concentration on the causes, effects and responses associated with named examples.

Additional support
The concepts associated with global atmospheric circulation can be difficult for some students. Start with a basic explanation of how air pressure works using a video clip, for example the Air pressure explained clip available from YouTube (www.cambridge.org/links/gatd4016). Moving on from this, students can use the
Met Office website [www.cambridge.org/links/gatd4017](www.cambridge.org/links/gatd4017) to back up their understanding from the Student Book.

Knowledge of the formation of tropical storms and their effects – social, economic and environmental – will have been developed in Key Stage 3 geography. It may be useful to revisit this previous study and, especially, case studies that students are familiar with before moving on to the more detailed understanding needed at this level.

**Extension**

The explanation of global atmospheric circulation in the first topic is a simplified one. Students may like to investigate this further by looking at localised conditions (such as the monsoon in eastern Asia) or global influences including Rossby waves and the jet streams.

Scientific knowledge of the formation of tropical storms and of the influences of climate change is constantly improving and forecasting is becoming more sophisticated and more accurate. Students could be encouraged to look at these topics in more depth.

Finally, detailed case study knowledge of the social, economic and environmental effects of tropical storms is always available on news websites including the BBC (e.g., one on Typhoon Haiyan, [www.cambridge.org/links/gatd4018](www.cambridge.org/links/gatd4018)). Students can increase their chances of exam success by researching case studies in more detail.

**Worksheets**

Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

**Worksheet 2.1: Surface wind patterns**, and **Worksheet 2.2: Distribution of tropical storms**, involve annotation of world maps and diagrams to show global surface wind patterns and the distribution of tropical storms. For the latter activity, students should ensure they use the correct names for the storms used in different parts of the world.

**Videos**

Chapter 2 in the Cambridge Elevate enhanced edition includes the video clip: The impact of Cyclone Aila. The clip describes the effects of Cyclone Aila, which struck south-western Bangladesh in May 2009. The clip comes from the Tropical Storms: Bangladesh’s Cyclone Aila (DVD by Pumpkin Interactive Ltd).

**Lesson ideas**

### 2.1 The general model of global atmospheric circulation

This topic introduces students to the general model of atmospheric circulation – comprising the Hadley Cells, the Ferrel Cells and the Polar Cells. It looks at the driving forces behind the model and also the ways it influences and controls surface wind and weather patterns.

**Starter activity**

- Discussion could centre around ‘What makes our weather?’ with answers expected to include the influence of the Sun, high and low pressure and the connections between the two.
- A demonstration of the flow from high to low pressure could be done using a pumped-up bicycle tyre.

**Plenary activity**

- There should be a check on knowledge gained about global weather patterns and how these affect the UK. Students could think about how, in particular, the prevailing winds affect the UK weather.

**Homework**

- Students could investigate how global-scale weather patterns influence the formation of either the hot deserts or the tropical rainforest. This links in with what they will learn in later chapters.

**Check students’ understanding**

- Students need to remember that winds flow from high to low pressure.
2.2 Where do tropical storms develop?
This topic defines what tropical storms are and looks at their distribution in different parts of the world. It includes a detailed look at the factors behind their formation, what sustains them and what ultimately leads to their demise.

Starter activity
- A video clip – such as Typhoon Ondoy (www.cambridge.org/links/gatd4019) or Typhoon Jelawat (www.cambridge.org/links/gatd4020) – could be used to introduce the topic followed by a knowledge-gathering exercise to find out what students remember about tropical storm formation from Key Stage 3.

Plenary activity
- The activity should concentrate on ensuring students have knowledge about the conditions needed for the formation of tropical storms. This could be done as a ‘maps from memory’ exercise, with students taking turns to add detail to a diagram, each turn lasting 30 seconds.

Homework
- The Maps from Memory could be used as the basis for homework incorporating Activity 2.2 question 2, in a detailed diagram of the conditions needed for the formation of a tropical storm.

Check students’ understanding
- Students should be aware that the UK does not experience hurricanes, although it occasionally gets the tail-end of a tropical storm with increased wind-speeds and rainfall.

2.3 How might climate change affect tropical storms?
This topic looks at the ways in which climate change has affected and will continue to affect the formation of tropical storms. It shows the impact of increasing sea surface temperatures and the results of computer modelling that suggest how storm intensity and impact may increase in the future.

Starter activity
- Knowing what they already know about the formation of tropical storms, have students think about the effects climate change may have – this could be used as a think/pair/share exercise.

Plenary activity
- Have students reconsider how climate change could affect tropical storm formation in the tropics. They can also think about whether there may be any knock-on effects felt in the UK.

Homework
- The effects of climate change on Hurricane Sandy have been well-studied in the literature. Students could research this at home – using links such as CNN (www.cambridge.org/links/gatd4021) or the Guardian (www.cambridge.org/links/gatd4022) – to add some substance to their knowledge.

Check students’ understanding
- The vast majority of scientists believe anthropogenic factors are leading to climate change, so students should believe this is happening.

2.4 What are the effects of tropical storms?
This topic examines both the primary and secondary effects of tropical storms and their associated weather conditions. It looks at both the immediate and long-term responses both from within the countries affected and the wider international community.
Starter activity

- Use the BBC news website (or other news websites) to show video clips or pictures of the impacts of a recent tropical storm.

Plenary activity

- Students can discuss the immediate and long-term effects of tropical storms, ranking which are the most important to be dealt with as a matter of urgency and which are the most effective responses over both shorter and longer timescales.

Homework

- Students could complete a creative writing piece on the personal impacts of a tropical storm from the point of view of a young person in an LIC.

Check students’ understanding

- Many students may believe that most deaths result from the initial effects of a tropical storm but there are often many more from secondary and longer-term effects. Aid moves on but the country may not have recovered sufficiently before the next storm arrives.

2.5 How can the effects of tropical storms be reduced?

This topic looks at the three main methods used to reduce the effects of tropical storms – monitoring, prediction and protection and planning.

Starter activity

- Students can be shown examples of tropical storm tracks (or can investigate them individually or in groups) on the NOAA website (www.cambridge.org/links/gatd4023) initiating a discussion on how varied they are and, therefore, difficult to predict.

Plenary activity

- Groups of students could have a further look at monitoring, prediction and protection and planning, and then have a class discussion on which of these options should receive the most funding and why.

Homework

- Students should imagine what would happen if a hurricane hit their town, drawing up an evacuation plan, identifying safe places to shelter and how local services would respond.

Check students’ understanding

- It is important that students understand the different effects and responses when tropical storms hit LICs and HICs.
- They should also be able to identify the mitigating effects that well-organised and resourced government and emergency services can bring to bear.

Typhoon Haiyan, 2013

Using the named example of Super Typhoon Haiyan in the Philippines, this topic looks at the impacts – both immediate and long term – of a tropical storm making landfall in an LIC.

Starter activity

- A good starter would be to show a Super Typhoon Haiyan video. There are a number of these available on the internet (www.cambridge.org/links/gatd4024).

Plenary activity

- Based on all the knowledge gained so far, students could discuss the question ‘What could have been done to mitigate the effects of Haiyan?’.
Homework

- Students could engage in research to find out more about the impacts of tropical storms in an HIC. They could then compare these with the impacts of Super Typhoon Haiyan.

Check students’ understanding

- Students should realise that parts of the Philippines are highly developed with quite sophisticated infrastructure – not everyone lives in poorly constructed huts.

Model answers to ‘Assess to Progress’ questions

1. Identify three conditions that are needed for a tropical storm to develop. 3 MARKS

Any three from:

- Warm sea temperatures or sea temperatures greater than 26.5°C.
- A considerable depth of warm water.
- A strong upward movement of warm, moist air.
- Locations between 5° and 20° north and south of the equator.

2. Using the information in Table 2.1, describe three kinds of damage caused by a category 4 tropical storm. 3 MARKS

Any three from:

- severe damage to houses
- collapsing roofs and walls
- fallen trees
- fallen power lines
- lack of power for weeks or months
- damage to infrastructure including roads and airports.

3. Describe two features of a storm surge. 4 MARKS

Two features need to be fully developed to gain full marks:

- low atmospheric pressure causing sea levels to rise
- strong winds driving the waves, caused by the higher sea levels, over land
- huge waves flattening everything in their path
- storm surges can be the biggest cause of death during a tropical storm.

4. Assess the extent to which the primary effects are more significant than the secondary effects of a tropical storm in a low or high income country. Use a named example in your answer. 9 MARKS + 3 SPaG MARKS

Super Typhoon Haiyan was one of the most powerful storms ever to make landfall when it hit the Philippines on 8 November 2013. The primary effects were caused by winds up to 270 km/h and high tides combined with the storm surge to give waves over 5 metres high, which inundated low-lying areas. The resulting destruction included damage to airports, ports, roads and power lines leaving many people without access to food and clean water. There was huge damage to property with five million people left homeless and a total of around 6200 dead and almost 2000 missing.

While these initial effects were shocking, the lack of resources and inability to cope with the damage to infrastructure gave long-term secondary effects that affected many more people. There was an influx of foreign aid but distribution was difficult because of the damage to roads, and people in remote areas waited weeks and months for medical aid, food and clean water to arrive. In the meantime, many hundreds of thousands were affected by diseases including cholera and malaria.
The damage caused by the first pass of the storm was undoubtedly severe but it appears that the secondary effects – increased because of a lack of the resources that an LIC has available to cope – affected many more millions of people and led to a much longer period of recovery.

Mark scheme

Both primary and secondary effects need to be considered and there must be specific reference to either HICs or LICs, preferably including named countries. Statements should follow a logical order and should be correctly spelt and punctuated with a high level of grammar. Several effects should be included:

- primary effects examples – death and personal injury, damage to property and infrastructure (roads, airports, etc.), loss of power, evacuation of people
- secondary effects examples – further death through disease, contaminated water supplies, reliance on foreign aid, disruption to events, continued loss of power, damage to crops and other impacts on the economy of the countries affected.

For full marks, answers need to be detailed, coherent and focused.

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
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<tbody>
<tr>
<td>2 (clear)</td>
<td>6–9</td>
<td>• Linked statements with reference to specific events associated with a named tropical storm from recent years. • There should be descriptions of both primary and secondary effects of tropical storms with some evaluation of their relative severity. • Provides a reasonable description demonstrating clear knowledge and understanding.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–5</td>
<td>• Simple generic information with limited or no specific information about a named tropical storm. • Answers not developed. • There may be random statements about primary or secondary effects but little or no information about their relative severity. • Demonstrates some knowledge and understanding but description is limited and lacks specific information.</td>
</tr>
</tbody>
</table>

Suggested content

There should be some specific evidence to access Level 2. Allow reference to a wide range of primary effects such as severe damage to houses, fallen trees and power lines and secondary effects including long-term loss of power, expensive rebuilding programmes and death from diseases such as cholera. Answers should include some analysis of the relative severity of the primary and secondary effects and, in LICs for instance, the recognition that the secondary effects may be more serious.

Reference should be made to a named example of a tropical storm from either an LIC or an HIC. In the Student Book example, the 270 km/h winds of Super Typhoon Haiyan in 2013 left 6000 people dead across the Philippines and a further 11 million affected. Five million were left homeless and, without the millions of dollars needed to cope, the government’s response depended to a large extent on foreign aid. Even here there were problems, with the damage to infrastructure affecting the distribution of aid supplies. It is easy to see how the immediate primary impacts were superseded by the longer-term secondary effects.
LEARNING OUTCOMES
By the end of this chapter, students should:
• be able to define what is meant by the term ‘extreme weather’
• know the types of extreme weather that the UK is likely to experience
• be able to describe the effects of extreme weather and explain how they can be reduced
• be able to describe the causes, impacts and responses for an extreme weather event.

Introduction

Prior knowledge
Students should have a basic knowledge gained through Key Stage 3 study of weather and climate, including:
• a basic understanding of global climate and of the climate of the UK
• a basic understanding of how climate has changed over time from the Ice Age to the present.

Geographical skills
Graphical skills can be developed using Activity 3.1. Students are asked to construct a climate graph for the UK and to describe the pattern.

Literacy skills can be developed using Activity 3.2, where students are asked to describe a weather event, create a fact sheet and keep a weather diary.

High-level thinking can be developed using Activity 3.3. Students are asked to carry out some research into extreme weather events and to process this information in a variety of different ways.

General notes
It is important to be led by the GCSE specification when setting up teaching of this topic area. Remember, students will need to know what is meant by the term ‘extreme weather’, the types of extreme weather likely to affect the UK and the effects of extreme weather and how they can be reduced. A specific named example, such as the 2013/2014 winter storms, should be looked at in detail.

Several of the activities in topic 3.1 What extreme weather events affect the UK? require graphical skills and the ability to annotate photographs effectively. Students will need to ensure that their graphs are drawn accurately and that annotations are clear, thorough and describe the effects of extreme weather in the UK in detail.

Many of the other activities in the chapter lend themselves to focused internet research. Appropriate weblinks have been suggested as a starting point and students should develop effective ways of managing the information that they find. If computers are unavailable during the lesson, students can be encouraged to carry out research for homework and bring their notes to the following lesson for further examination and discussion.

Preparation for exam questions should ensure adequate knowledge of the definition of ‘extreme weather’. Students will need to have detailed knowledge of the causes, impacts and responses associated with named examples.

Additional support
While a detailed knowledge of pressure systems affecting the UK is not required for this topic, students do need to have an understanding of what the UK’s weather and climate are normally like in order to determine what ‘extreme’ conditions are. These concepts can be difficult for some students. Start with a basic
explanation of the UK climate using information from the Met Office (www.cambridge.org/links/gatd4025).

A basic knowledge of weather and climate will have been developed in Key Stage 3 Geography. It may be useful to revisit this previous study and, especially, case studies or named examples that students are familiar with, before moving on to the more detailed understanding needed at this level.

Extension
Scientific knowledge of the influences of climate change is constantly improving and weather forecasting is becoming more sophisticated and more accurate. Students could be encouraged to look at these topics in more depth. The IPCC data distribution centre is a good place to start (www.cambridge.org/links/gatd4026).

Detailed knowledge, with named examples, of the social, economic and environmental impacts of extreme weather events are available on news websites including the BBC (www.cambridge.org/links/gatd4027) and Met Office (www.cambridge.org/links/gatd4028). Students can increase their chances of exam success by researching named examples in more detail.

Worksheets
Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

Worksheet 3.1: Weather forecast diary supports Activity 3.2 question 3 and involves students comparing the weather forecast with the actual observed weather conditions.

Worksheet 3.2: Impacts of the 2013/2014 winter storms supports Activity 3.4 and involves students selecting and classifying information about the causes, impacts and responses of the 2013/2014 winter storms. Students could start by using information taken from the previous topics in this Chapter and could then supplement their annotations with further research from the suggested National Trust and BBC websites identified.

Videos
Chapter 3 in the Cambridge Elevate enhanced edition includes the video clip: The impact of flooding in Tewkesbury. The clip describes the effects of the floods which struck parts of the UK in 2007. The clip comes from the Flooding in the UK: Tewkesbury (DVD by Pumpkin Interactive Ltd).

Lesson ideas

3.1 What extreme weather events affect the UK?
This topic begins by describing what the UK’s weather and climate is typically like. It highlights what Temperate Maritime climate means and explains how high and low pressure systems bring day-to-day changes to the UK’s weather. It then moves on to define what is meant by ‘extreme weather’, i.e., weather that is different to the normal pattern, and provides some examples.

Starter activity
• Students could start the topic by mind mapping everything that they already know about extreme weather in the UK. This could include definitions, examples or experiences.

Plenary activity
• There should be a check on knowledge to ensure that students understand what the normal weather conditions are in the UK and can give examples of extreme weather events.
• Students could write their own brief definitions for the key terms provided in the first topic.

Homework
• Students could explain the pattern of climate which is shown in the graph they have drawn as part of Activity 3.1. They could do this by annotating their climate graph with information.
Check students' understanding

- Students should understand that the UK has a temperate maritime climate but that this does not mean that the climate is uniform.

3.2 What are the effects of extreme weather?

This topic describes different types of extreme weather that occur in the UK. The effects of both heatwaves and snowstorms are identified and suggestions are made as to how these effects can be reduced.

Starter activity

- One of the reasons that the effects of extreme weather tend to be severe is that, because the weather is out of the ordinary, people are likely to be unprepared. Students could suggest ways in which the UK prepares for extreme weather events.

Plenary activity

- Students could consider different ways of classifying the effects of extreme weather, i.e., positive/negative; short-term/long-term; social/political/environmental/economic, etc., and give an example of each in the context of extreme weather in the UK.

Homework

- For an extreme weather event that they have studied, students should decide whether the effects were, on balance, generally positive or negative and generally short term or long term. They should also decide which effects, from a choice of social, political, environmental and economic effects, were dominant.

Check students' understanding

- It is fairly straightforward for students to list the effects of an extreme weather event. However, their ability to classify the effects in a variety of ways will allow students to access the highest grades.

3.3 Is the weather in the UK becoming more extreme?

This topic gives students a structure with which to answer this question. It first considers whether the weather in the UK has always been variable and then addresses whether extreme weather in the UK is becoming more frequent.

Starter activity

- Students should write a one-word answer on a mini-whiteboard that answers this key question. The teacher can then ask individuals briefly why they think this.

Plenary activity

- Students should revisit the one-word answer that they wrote on their mini-whiteboards at the beginning of the lesson. Has their thinking changed? They should also be able to explain their answer.

Homework

- Students could read the Guardian article (www.cambridge.org/links/gatd4029) and write a paragraph suggesting whether or not the weather is becoming more extreme in places other than the UK.

Check students' understanding

- Students should beware of simply suggesting that the UK's weather is becoming more extreme and linking this directly to climate change. The relationship is more complex than this and students should be aware that extreme weather events have occurred in the past. However, they appear to be becoming more frequent and this is likely to be due to anthropogenic climate change.

Named Example: Recent UK extreme weather: causes, impacts and responses

This topic takes the form of a named example, i.e., the 2013/2014 winter storm that brought strong winds and high rainfall totals to much of the UK.
Starter activity

• A good starter would be to show a video (such as www.cambridge.org/links/gatd4030) in order to introduce the named example.

Plenary activity

• Students could consider whether the effects of the 2013/2014 winter storms were mainly positive or negative and mainly short term or long term.
• They could also consider which effects – social, political, environmental or economic – were most dominant.

Homework

• Students could create a quiz to test a partner on the named example detail. They could swap quizzes in the following lesson and then mark each other’s answers.

Check students’ understanding

• Students need to be aware that detail is important when learning their named examples. They could discuss techniques for revision such as drawing diagrams from memory or creating a revision video to ensure that they can learn the detail.

Model answers to ‘Assess to Progress’ question

1 ‘The weather of the UK is becoming more extreme’. Use evidence to support this statement. **6 MARKS**

Extreme weather is weather that is not ordinary; it either has severe impacts or is unexpected for the time of year. There is evidence that weather in the UK, in the form of drought, storms and snowfall, is becoming more extreme. This weather is becoming more frequent and new records are being set; for example, 2012 had the wettest summer on record. It is not just extreme rainfall that has been affecting the UK, however. The years 2003–2006 received below average rainfall and the summer of 2003 was particularly warm and sunny. This led to widespread hosepipe bans across the UK in order to save water in these drought conditions.

A good example of a case study to illustrate extreme weather in the UK is the winter of 2010. In December, Scotland and north-east England were affected by strong winds and snowfall because cold air came from the Arctic. The snow was as deep as 50 cm and temperatures were below 0°C. This meant that roads were closed and people were stranded in their cars overnight. There were lots of car breakdowns and many airports and schools were closed, which was disruptive. All of this evidence supports the statement that the UK’s weather is getting more extreme.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2 (clear) | 4–6 | • Linked statements with reference to specific events in the UK over recent years.  
• There should be description of weather conditions and an indication of how the weather has become more extreme.  
• Provides a reasonable description demonstrating clear knowledge and understanding. |
### Level Marks Description

<table>
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<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
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</table>
| 1 (basic)   | 1–3   | • Simple generic information with limited or no specific information about the UK.  
• Answers not developed.  
• There may be random statements about weather conditions/events but limited link to the evidence for increasingly extreme weather.  
• Demonstrates some knowledge and understanding but description is limited and lacks specific information. |

### Suggested content

There should be some specific evidence to access Level 2. Allow reference to a wide range of extreme weather types, including droughts, severe gales, heavy snowfall and blizzards, hailstorms, thunderstorms, intense rain leading to flooding. Answers may refer to the increasing frequency of these extreme events, the high levels of rainfall, intensity of wind and high temperatures, although these may not be indicative of long-term changes in themselves, etc.

Reference should be made to extremes of temperatures and rainfall in recent years in the UK. Examples may include some of the following. In 2003 it was very hot and in the winter of 2010 there were very low temperatures and a lot of snow fell. The summer of 2012 was the wettest on record in England and the summers of 2013 and 2014 were among the warmest and sunniest in recent years. Between 2003 and 2006, the UK received below-average rainfall. In 2007 and 2008 there was flooding in Gloucestershire and northern England and several cities were flooded including Sheffield and Hull. Boscastle in Cornwall (2004), Tewkesbury in Gloucestershire (2013) and Cockermouth in Cumbria all had large numbers of houses flooded. The Somerset Levels were severely flooded in 2014, with many parts inaccessible for several weeks.

Specific evidence with named examples should be given where relevant, for example: in December 2010, winds from the north-east brought cold Arctic air and snow. Scotland and north-east England were significantly affected, with snow 50 cm deep in places. Temperatures were mainly below 0 °C, making it the coldest December in the last 100 years. Roads were closed. People were stranded in their cars overnight on the M8 and A9 in Scotland. Airports and schools were closed, including Heathrow and Gatwick, disrupting travel plans over Christmas. On 20 December, the AA reported its busiest-ever day because of car breakdowns. More people than usual were admitted into hospital because of accidents and falls. Emergency services and local authorities were all put under pressure. After areas thawed, there were problems with burst water pipes. In Northern Ireland 40 000 homes were without water.
Introduction

Prior knowledge
Students should have a basic knowledge gained through Key Stage 3 study of weather and climate, including:

- an understanding of what climate change is
- the natural and human causes of climate change
- ideas about the future climate and how scientists predict what the climate will be like
- the effects of climate change on different parts of the world.

Geographical skills

Graphical interpretation skills can be developed using the activity associated with the global temperature graph in Figure 4.1. Students need to analyse trends and take care to correctly interpret the scale and identify specific points of change.

General notes

Climate change can be a difficult subject to teach – often being viewed as inherently political in nature. There should be space made in lessons to look at the arguments of climate change sceptics but it needs to be remembered that there is a huge amount of scientific evidence that human activity is adding to the problem of global warming. The vast majority of scientists agree and this fact should lead the teaching.

As an issue of global importance, it is also likely that students will believe action should be taken to reduce the effects but may feel helpless to do so. Students should be encouraged to think about what they can do at a local level to live more sustainable lifestyles.

Preparation for exam questions should focus on the scientific evidence that climate change exists and the possible causes. Questions will focus on facts, rather than hearsay.

Additional support

Some knowledge about the causes and effects of climate change will have been developed under Key Stage 3 Geography. It may be useful to have a look at this again and also to revisit some of the basic information on the greenhouse effect to ensure students are familiar with the concepts before moving on to the more detailed understanding needed at this level.

There is an excellent animation showing how the greenhouse effect works (www.cambridge.org/links/gatd4031), which can be used as a revision tool. Students may also need help with the scientific aspects of the climate change evidence. Websites such as NASA's Climate Kids (www.cambridge.org/links/gatd4032) and a similar site from the ESA (www.cambridge.org/links/gatd4033) explain things in a simple style with lots of activities and games for students to engage with.

Extension

Climate change is a subject that lends itself well to further investigation and analysis of the scientific evidence presented. You could start, when looking at the causes of climate change, with a more detailed
study of Milankovitch cycles. A look at the man himself is also useful in showing the life of an extraordinarily interesting scientist and provoking students’ interest in scientific discovery.

Studying the website of the Intergovernmental Panel on Climate Change (the most up-to-date information can be found at www.cambridge.org/links/gatd4034) will help students to delve deeper into the scientific evidence behind current thinking and show them the way in which science influences political opinion.

Finally, students can also become aware of the alternative arguments by looking at the sites of climate change sceptics. With the knowledge developed through the chapter they should be able to critically analyse websites such as Climate Skeptic (www.cambridge.org/links/gatd4035) and Skeptical Science (www.cambridge.org/links/gatd4036).

Worksheets

Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

Worksheet 4.1: Climate change timeline, requires students to annotate a timeline of the evidence from 10,000 years ago to the present day. It is unlikely, given such a wide spread of time, that timelines will be absolutely accurate but a generally correct chronology will be good evidence students have acquired knowledge.

Worksheet 4.2: Annotating global temperature change graph, requires students to annotate – with specific instances of climate change causes – a graph showing global temperature change and levels of CO2 from 1880 to 2010.

Worksheet 4.3: Annotating a blank world map, requires students to label countries and areas most likely to be at risk from sea level rise brought by climate change.

Videos

Chapter 4 in the Cambridge Elevate enhanced edition includes the video clip: How has the UK’s climate changed? The clip examines evidence for climate change in the UK. The clip comes from the Climate Change (DVD by Pumpkin Interactive Ltd).

Lesson ideas

4.1 What is the evidence for climate change?

This topic illustrates the evidence that the Earth’s climate has changed over the past two million years. It outlines the long-term evidence and concentrates, from a scientific basis, on the recent research on global warming using data from the past 200 years.

Starter activity

- Initial discussion should centre on students’ knowledge of climate change. This could include the greenhouse effect, man-made and natural processes and effects. It could be run as a carousel session using large sheets of flipchart paper that could be revisited at the end of the series of lessons.

Plenary activity

- Check whether students understand the evidence by asking them to set three questions and then find a partner to answer them.
- Teachers could illustrate examples of evidence using props – such as tree ring cores, if available – or pictures from the internet.

Homework

- Students could search for their own examples of evidence for climate change based on the examples in the Student Book. They could, for instance, ask their parents for anecdotal evidence of warmer winters or earlier springs.
Check students’ understanding

- Students should be encouraged to engage with the evidence of climate change from a scientific basis, rather than by hearsay or from information on the internet.
- Any evidence of global warming has to be secure over a long time-frame. The fact that this year’s summer is warmer than last year’s is irrelevant from a scientific point of view.

4.2 What are the causes of climate change?

In this topic, students look at the greenhouse effect and the different sources of greenhouse gases in the atmosphere. They will examine the long-term, mainly physical causes, and the short-term influences, which are mainly a result of human activities.

Starter activity

- Students could be shown a long-term global temperature graph (www.cambridge.org/links/gatd4037). Ask them for any ideas they may have of what could have caused the long-term fluctuations and draw attention to the increases in carbon dioxide concentration and temperature on the far right of the graph.

Plenary activity

- The Discussion Point from the Student Book, relating to evidence that supports change, could be a useful wrap-up exercise, asking if the evidence available is enough to be sure that climate change is taking place because of human activity or whether it is just due to natural variations.

Homework

- Students could write up their own version of the arguments for or against man-made climate change as a piece of persuasive or discursive writing.

Check students’ understanding

- Students should understand that burning of fossil fuels is often cited as the most important cause of man-made climate change but the evidence is that other causes, including changes in agricultural practice, may be even more damaging.

4.3 What are the effects of climate change and how do we manage them?

This topic looks at some of the potential consequences of climate change – both in the UK and around the world. It also considers how the impacts can be managed through both mitigation and adaption.

Starter activity

- Students can brainstorm, in groups, all the potential impacts of climate change they can think of. They can then separate them into global impacts, those that may affect the UK and, importantly, any that may directly affect the area in which they live.

Plenary activity

Opportunities for discussion at the end of this topic include:

- seeing if students have changed their minds on the causes of climate change
- analysis of which areas of the globe will be most adversely affected
- how students could change their own lifestyles to help mitigate the impacts.

Homework

- Students can take the opportunity to add more detail to the list of impacts of climate change shown in the Student Book under the topic ‘What are the effects of climate change and how do we manage them?’. Alternatively, as a piece of imaginative writing, students could imagine it is 2050 and they are a victim of some aspect of climate change, writing about how it has affected their life.
Check students’ understanding

• It is important for students to point out that, at least in the UK, not all of the impacts of climate change may be negative and that the way we adapt is key.

• Students should also be aware that, no matter what the effects on HICs, they will be far worse in LICs, which often do not have the resources to cope.

Model answers to ‘Assess to Progress’ questions

1 ‘The world’s climate is changing.’ Use evidence to support this statement. 6 MARKS

Evidence from ice cores found in the Antarctic and in high mountainous regions provides information about past climates. The rings in the cores are laid down on an annual basis and analysis of the amount of oxygen they contain provides an idea about relative temperatures. Similar measurements of tree rings (the study known as dendrochronology) provides evidence of warm and wet and cold and dry summers over the past few hundred years.

Since the mid 1800s, photographic evidence of glaciers in the Alps and other mountainous areas popular with walkers has shown us how glaciers have retreated as the climate has warmed. More recently still, satellite pictures have indicated that the sea-ice cover in the Arctic has become thinner and less extensive. Finally, non-scientific anecdotal evidence such as people talking about how winters now feel much warmer than they used to, give us ideas of where to direct our future research.

Mark scheme

The answer should contain examples including: photographic evidence from glacial retreat; direct measurements of global temperature using thermometers over the past 150 years or so; dendrochronology and the use of tree rings to show warmer and wetter years; people talking about snowier winters in the past; the early spring arrival of certain species of birds and plants; ice-core evidence dating back thousands of years in very cold and high mountainous regions; the decreasing sea-ice cover in the Arctic.

One mark should be given for identifying the evidence with a further mark for a more developed reason behind why it is used.

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Linked statements with reference to specific examples of evidence and the reasons why they are used.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• There should be descriptions of the evidence and the time-scales over which they operate.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Provides a reasonable description demonstrating clear knowledge and understanding.</td>
</tr>
</tbody>
</table>

1 (basic) 1–3

• Simple generic information with limited displayed knowledge of the evidence or the reasons why it is used.

• Answers not developed.

• There may be random statements about some aspects of climate change but little link to specific evidence of how the science is becoming more widely understood.

• Demonstrates some knowledge and understanding but description is limited and lacks specific information.
Suggested content

There should be some specific evidence to access Level 2. Examples of evidence could include:
photographic evidence from glacial retreat; direct measurements of global temperature using thermometers over the past 150 years or so; dendrochronology and the use of tree rings; people talking about snowier winters in the past; the early spring arrival of certain species of birds and plants; ice-core evidence dating back thousands of years in very cold and high mountainous regions; the decreasing sea-ice cover in the Arctic.

Reference should be made to what the evidence actually tells us so it should be explained that the photographic evidence dates from when explorers started walking in the Alps and brought back pictures that show a much greater extent of glaciers than is found today. Tree-ring evidence shows successions of wet, warm, cold or dry summers that have influenced the width of the rings while ice-core evidence shows differing concentrations of oxygen in the atmosphere which relate to air temperature. There should be some recognition that anecdotal evidence such as people remembering colder, snowier winters is unscientific but can provide a basis for further research.

2 Outline one reason why the concentration of methane in the atmosphere has increased over the past 100 years. 2 MARKS

Any one from:

- the global increase in the number of cattle
- the increase in decomposing vegetation in paddy fields
- the worldwide increase in fertiliser use.

Comment: Any identification of the above reasons with increased population will help gain full marks.

3 Complete the paragraph below. 3 MARKS

International ideas to help combat climate change include more renewable energy, changes in agriculture and carbon capture. Agreements such as the Kyoto protocol are needed to make sure these ideas work.

4 Give two natural causes of climate change. 2 MARKS

Any two from:

- volcanic eruptions emitting huge amounts of dust
- changes to the way the Earth moves around the Sun
- increases in sunspot activity and solar radiation
- changes in global ocean currents.
LEARNING OUTCOMES

By the end of this section introduction, students should be able to:

• describe an example of a small-scale UK ecosystem in terms of its interrelationships
• understand the balance between components of an ecosystem and how altering one component alters the ecosystem
• describe the distribution and characteristics of large-scale natural global ecosystems.

General notes

The section introduction provides an overview of ecosystems. Different types of ecosystems are then examined in detail in the subsequent chapters.

Suggested learning activities

• Introduce the major components of an ecosystem (flora/fauna/climate/rock/soil). Form discussion groups and discuss:
  ◦ the interrelationships within the natural system
  ◦ the impact of changing components.
• Relate these ideas to a small-scale ecosystem in the UK.
• Use an atlas to identify the major biomes.
• Use photos to identify specific characteristics of different biomes.
• The caption to Figure S2.1 in the student book contains the discussion question ‘Mangrove forests protect inland areas from erosion and flooding. In the Irawaddy River Delta, areas of mangrove forest have been cleared to provide space for rice cultivation. What effect could this have on the area?’ This could form the basis of a class discussion. Answers might include increased erosion and flooding, and loss of available land.
Introduction

Prior knowledge
Students should have a basic knowledge gained through Key Stage 3 study of ecosystems and tropical rainforests, including:

- a basic understanding of global biomes
- knowledge of the global location of tropical rainforests
- a basic knowledge of the climatic conditions experienced in rainforest ecosystems.

Geographical skills

Graphical and numerical skills can be developed using Activity 5.2. Students are asked to use a data table to draw a bar graph and interpret annual deforestation data.

Literacy skills are specifically assessed through Activity 5.3 where students are asked to read and analyse a travel review.

High-level thinking is developed in the Discussion Point boxes in the topics 'What are the impacts of deforestation?', ‘Why is sustainable rainforest management important?’ and ‘The Chocó rainforest’. The Discussion Points: ‘Do we have the right to tell other countries what to do with their own resources?’, ‘Why does deforestation need to be managed?’, ‘Can rainforests be exploited and protected at the same time?’ and ‘Why is roadbuilding an important part of any major development project in areas of tropical rainforest?’ encourage students to use the knowledge gained to think about how and why rainforest destruction can be managed. This requires a degree of high-level thinking as well as the ability to consider other people’s viewpoints.

General notes
It is important to be led by the GCSE specification when setting up teaching of this topic area. In addition to rainforest processes, students will need to know the causes of deforestation and some strategies that can be put in place to protect rainforests. The link to an interactive map of deforestation in the topic ‘Why does deforestation take place in areas of tropical rainforests?’ allows students to look at rates of deforestation. Detailed study of a named example, the Chocó Rainforest, is covered in the final topic of this chapter. There are many key terms to learn for this chapter and students should be made aware of the main stakeholders in the rainforest debate; some of these stakeholders are outlined in the topic ‘Why is sustainable rainforest management important?’.

Additional support
The application of theory to a case study can be difficult for some students. When studying the Chocó Rainforest it may be useful to show the location of the Chocó Rainforest and to introduce the reasons for the unique environment found there (www.cambridge.org/links/gatd4038). Knowledge of the layers of the rainforest and the species found within each may have been developed in Key Stage 3 Geography. It may be useful to revisit this previous study to reinforce the basic key terms that are required for this topic.
Extension

The questions in this chapter are scaffolded to encourage higher order thinking from students. Activity 5.1 question 3 offers scenarios for changes in the rainforest. Students might be able to give their own scenarios. Activity 5.2 question 3 asks students to synthesise information by categorising the impacts of deforestation. Activity 5.3 question 1c and 2c both require higher-order thinking: 1c asks for some evaluation and justification of various strategies to conserve the rainforests; 2c encourages lateral thinking as students must consider the true sustainability of ecotourism.

Worksheets

Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

- Worksheet 5.1: Forest loss graph, relates to the topic ‘Why does deforestation take place in areas of tropical rainforest?’.
- Worksheet 5.2: Rainforest management strategies, requires students to complete a table identifying the advantages and disadvantages of the five main strategies.

Lesson ideas

5.1 What are the distinctive characteristics of tropical rainforests?

This looks at the location of tropical rainforests and the characteristics of the tropical rainforest biome.

Starter activity

- Use a globe to lead a discussion about global air circulation. Ask students to identify the warmest, coldest, rainiest and driest parts of the globe. This introduces the idea that the hottest part of the globe (the equator) is also the rainiest. Students can then be told about the movement of warm air from the equator to the poles.

Plenary activity

- Give students a blank map of the world and ask them to locate the tropical rainforests as accurately as they can remember. Project the world map onto the whiteboard and allow students to come up and add their suggestions.

Homework

- Students must create a diagram to show global air circulation. They should label this diagram to illustrate why rainforest biomes are so hot and wet. As an extension, students could be asked to provide greater detail; for example, give three reasons why the equator is the hottest part of the Earth – rather than just saying the equator is closer to the Sun, they will have to consider other ideas, such as the fact that the Sun’s rays are more concentrated or that the angle of the Sun reduces the amount of atmosphere that the rays travel through.

Check students’ understanding

- Students need to remember that rainforests are found between the tropics of Cancer and Capricorn.
- They should also know that tropical rainforests have distinctive characteristics that set them apart from other global biomes.

5.2 What are the rainforest layers?

This looks at the layering of vegetation and the nature of the soil found in a tropical rainforest.

Starter activity

- Show students some images of different types of plants, e.g., tomatoes, oranges, potatoes and wheat. Ascertain the differences between the plants, e.g., conditions required for growing, preferred location, height above/below soil. This should introduce the idea of rainforest layering, using concepts that students are familiar with.
Plenary activity

- There are many key terms here. At the end of the lesson, carry out a vocabulary test to check that students have listened to the key terms and that they're able to use them appropriately.
- An alternative activity could involve a spelling test of the key terms: for example, saprophyte, emergent, leaching.

Homework

- Students must research two contrasting examples of rainforest plants; one that grows close to the ground and one that grows in the canopy. They should outline the characteristics of each plant that makes it suitable for its location within the rainforest layers.

Check students’ understanding

- Students need to remember that rainforest plants are arranged in layers.
- The layering of rainforest plants exists, but in reality it may be difficult to ascertain which layer a specific tree relates to. The rainforest layers are therefore just a model to represent reality.

5.3 Why does deforestation take place in areas of tropical rainforest?

This looks at the causes of deforestation in tropical rainforests.

Starter activity

- Students list objects within the classroom that are derived from rainforest materials. They should consider wood products, paper, rubber and medicines that they may be carrying. The teacher then initiates a discussion around the impact of our consumerism upon natural environments like rainforests.

Plenary activity

- Ask students to list the causes of rainforest destruction. They must then sort them into order, depending on which they think is the most and least destructive cause.

Homework

- Students should carry out research into a rainforest product of their choice. They could choose products such as wood, paper, coffee, fruit, nuts or medicines. They should find out what the Rainforest Alliance is and what its ‘seal’ means.

Check students’ understanding

- Students need to explain the ten causes of rainforest deforestation.

5.4 What are the impacts of deforestation?

This looks at the impacts of the removal of trees in tropical rainforests.

Starter activity

- In the last lesson, students learned about ten causes of deforestation. Challenge the class to recall all ten causes from memory.

Plenary activity

- This topic has outlined the negative impacts of deforestation. Students need to consider why something so destructive still takes place, i.e., what are the perceived ‘positives’ of deforestation?

Homework

- Students should watch the Cambridge Elevate clip on soil erosion in the tropical rainforests. They must then create a diagram to illustrate what they have learned.
Check students’ understanding

- Students need to list several implications of rainforest deforestation and categorise them into social, environmental and economic impacts.

5.5 Why is sustainable rainforest management important?
This looks at why rainforests are so important and how sustainable management strategies can be put in place.

Starter activity

- Students must take it in turns to give one reason why protecting biomes is important. The challenge is for every student to give a response, but in reality answers may run out after half the class have spoken.

Plenary activity

Students play the 'just a minute' game, where they talk continuously for one minute about one of the following:
- selective logging and replanting
- conservation and education
- ecotourism
- international agreements.

They are not allowed to stutter, pause or say anything inaccurate or silly.

Homework

- Students use the Discussion Point: 'Can rainforests be exploited and protected at the same time?'
  Using no more than 100 words, they have to attempt their own answer to the question.

Check students’ understanding

- Students should understand that management of the rainforests is a global concern, because they regulate the climate, produce oxygen and store water.
- They should also know that there are many different strategies in place that attempt to conserve rainforest areas.

Case study: the Chocó Rainforest
This applies the knowledge from the rest of the chapter to a case study.

Starter activity

- The teacher plays a short video clip showing the Chocó Rainforest in South America (e.g., www.cambridge.org/links/gatd4039). Students should write ten words to describe what they see on the clip. The teacher then explains that the rainforests are in South America and asks what they are called. Students are likely to suggest the Amazon.

Plenary activity

- The clip used in the starter activity should be shown again, but with no sound. Students create a voiceover for the clip to summarise what they’ve learned in the lesson. The clip is replayed once or twice with students reading out their voiceover scripts.

Homework

- Create a detailed mind map to summarise the Chocó Rainforest case study.

Check students’ understanding

- Students should understand that the Chocó Rainforests are coastal forests with unique environments. They stretch through Panama, Colombia and Ecuador.
- They should also know that the Chocó Rainforests face many local, national and global threats.
Model answers to ‘Assess to Progress’ questions

1  **Figure 5.16** shows rainforest that has been cleared for oil palm plantations. Describe how the plantation reduces biodiversity. 3 MARKS

Plantations are monocultures. This means that they consist of just one species, which reduces plant biodiversity. Plantations may also be exposed to agricultural chemicals, such as pesticides. This can reduce animal biodiversity.

Any three from:

- Single trees, monoculture or one species are grown. This means there is less variety of species.
- Trees are equally spaced, allowing space between for harvesting. This reduces the likelihood of other species growing in between.
- Vegetation is low density as unwanted plant species are removed to allow the main crop species to flourish.
- Some plantations grow grass between the trees, suppressing the growth of other vegetation.

**Comment:** Give a maximum of three marks; one mark for each point and a second mark for further explanation or clarification.

2  Explain the reasons for deforestation in areas of tropical rainforest. 6 MARKS

There are many causes of deforestation in rainforests such as palm oil plantations, oil extraction, road building, urban sprawl, cattle ranches, mines and shifting cultivation. Plantations, cattle ranches and shifting cultivation all require forest to be cleared to make space for agriculture. Road building and urban sprawl remove forest cover to accommodate buildings and transport. Oil extraction and mining cause deforestation as trees are removed to make space for equipment, buildings and infrastructure.

**Comment:** There are many causes of deforestation in rainforests. Students are more likely to mention those discussed in this chapter, such as palm oil plantations, oil extraction, road building, urban sprawl, cattle ranches, mines and shifting cultivation. Students must show how the cause leads to the loss of forests. Expect the use of connectives to explain in detail. Award marks for the identification of causes and also for explanations.

3  Use **Figures 5.17** and 5.18 and your own knowledge to explain how international organisations can protect tropical rainforest environments. 9 MARKS

International organisations such as Rainforest Concern, WWF, Rainforest Rescue and the Woodland Trust all work to protect rainforest environments. These organisations operate globally and so they can generate money in many countries and use expertise developed in other parts of the world. Using charitable donations, they carry out conservation work, such as setting up protected reserves and wildlife corridors. These strategies have been used in the Chocó Rainforests, where they have allowed animals such as the golden-mantled howler monkey (**Figure 5.17**) and the golden poison arrow frog (**Figure 5.18**) to move between fragmented areas of forest. Organisations and charities also support local communities to help them to understand how they can use their surroundings in a more sustainable way.
## Mark scheme

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<th>Level</th>
<th>Marks</th>
<th>Description</th>
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<tbody>
<tr>
<td>3 (detailed)</td>
<td>7–9</td>
<td>• Demonstrates detailed knowledge of the role of specific international organisations in protecting tropical rainforest environments.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shows thorough geographical understanding of the inter-relationships between places, environments and processes in the context of a tropical rainforest.</td>
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<tr>
<td></td>
<td></td>
<td>• Demonstrates application of knowledge and understanding in a coherent and reasoned way in analysing and evaluating the role of international organisations in the protection of tropical rainforest environments.</td>
</tr>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Demonstrates clear knowledge of the role of specific international organisations in protecting tropical rainforest environments.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shows some geographical understanding of the inter-relationships between places, environments and processes in the context of a tropical rainforest.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Demonstrates reasonable application of knowledge and understanding in interpreting, analysing and evaluating the role of international organisations in the protection of tropical rainforest environments.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Demonstrates limited knowledge of the role of specific international organisations in protecting tropical rainforest environments.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shows slight geographical understanding of the inter-relationships between places, environments and processes in the context of a tropical rainforest.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Application is limited with some use of the photographs to support response. Little or no recognition of the role of international organisations in the protection of tropical rainforest environments.</td>
</tr>
</tbody>
</table>

### Suggested content

There should be some specific evidence to access Level 2. Allow reference to a wide range of organisations, including Rainforest Concern, WWF, Rainforest Rescue and the Woodland Trust. Answers should suggest ways that these organisations have protected areas of rainforest; for example, wildlife corridors, protected reserves and supporting local communities to live sustainably.
There should be an awareness of the international nature of such organisations, in that money may be donated by people in other countries and expertise may come from projects in other parts of the world. Students must refer to Figures 5.17 and 5.18.
Learning outcomes

By the end of this chapter, students should:

- be able to explain how plants and animals have adapted to the harsh conditions found in hot deserts
- understand the economic opportunities that the hot desert environment provides
- be able to explain why the exploitation of the hot deserts is so challenging
- be able to discuss the causes and impacts of desertification
- know the strategies used to reduce the risk of desertification.

Introduction

Prior knowledge

The hot desert biome may have been one of the ecosystems students looked at in their Key Stage 3 geography. If so, they should have a basic knowledge of:

- what deserts are
- where they are found
- how they are formed
- some of the ways in which plants and animals have adapted to the harsh conditions.

They may also have studied desertification. If not, they will have some basic understanding of the concept of ecosystems that can be applied in the hot desert context.

Geographical skills

Graphical skills – accurate interpretation of climate graphs is a key skill for geographers. This skill is practised using Figure 6.1 and Worksheet 6.1: Interpreting climate graph of Doha. It is important students know how the graphs are constructed and can tell the difference in the ways temperature and precipitation are plotted.

Graph construction skills are developed using Table 6.1 and Worksheet 6.3: Creating a bar graph of hot desert countries with the largest oil reserves.

Cartographic skills are practised in Activity 6.1 using Worksheet 6.2: Map the world’s hot deserts.

General notes

The analysis of ecosystems is a very important part of geographical study, bringing together the human and physical aspects of the discipline and showing students its holistic nature. It is also one of the most enjoyable and interesting parts of the course to teach, bringing as it does exotic locations, landscapes, people, animals and plants to the classroom.

The use of visual media can be a very powerful teaching tool, especially for those needing additional support (as outlined below) and there are many resources available to help.

Preparation for exam questions should focus on the acquisition of knowledge about many different aspects including the distribution and physical characteristics of hot deserts. However, common questions also involve the synthesis of both human and physical geography when looking at, for instance, the causes and impacts of desertification or the opportunities for development of the desert.

Additional support

Visual clues are very important for engaging students with additional support needs, especially in bringing to life a subject far beyond most young people’s frame of reference. Large, glossy, coffee-table books including James Parry’s The Desert and George Steinmetz’s Desert Air have many pictures of the exotic animals, plants

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and landscapes that will be studied in this topic. Feature films from *Star Wars* to *Raiders of the Lost Ark* and *Sahara* also include scenes shot in the world’s desert areas.

Websites including *National Geographic* ([www.cambridge.org/links/gatd4040](http://www.cambridge.org/links/gatd4040)) have a wealth of information. *Easy Science for Kids* ([www.cambridge.org/links/gatd4041](http://www.cambridge.org/links/gatd4041)) has a ‘fun facts’ section and also a link to a YouTube video with basic explanations of what deserts are all about. The *NeoK12 website* ([www.cambridge.org/links/gatd4042](http://www.cambridge.org/links/gatd4042)) also has a wide variety of games and short video clips that can help students with their understanding.

**Extension**

Further research for this topic can take students in a number of different directions. First they can look to add depth to their case study of Qatar by further investigation into the country’s plans for expanding its agriculture, starting, perhaps, with a *news article on vertical farming* ([www.cambridge.org/links/gatd4043](http://www.cambridge.org/links/gatd4043)). There is a good video overview of how the country is *greening the desert* available on YouTube ([www.cambridge.org/links/gatd4044](http://www.cambridge.org/links/gatd4044)).

Students could also look in more detail at the problems of desertification across the world through the website of the *United Nations Convention to Combat Desertification* ([www.cambridge.org/links/gatd4045](http://www.cambridge.org/links/gatd4045)). They can also get up-to-date information on projects such as the Great Green Wall of the Sahel from the *Global Environment Facility* ([www.cambridge.org/links/gatd4046](http://www.cambridge.org/links/gatd4046)). Either of these will provide the extra detail useful in answering exam questions.

**Worksheets**

Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

There are three worksheets associated with this chapter. *Worksheet 6.1: Interpreting climate graph of Doha*, *Worksheet 6.2: Map the world’s hot deserts* and *Worksheet 6.3: Creating bar graph of hot desert countries with the largest oil reserves*, are associated with the skills identified in the Student Book – analysis of climate graphs, drawing of bar graphs and the annotation of maps.

**Lesson ideas**

### 6.1 What are the distinctive characteristics of hot desert ecosystems?

This topic shows the distribution of hot deserts, their weather and climate and the factors that lead to their formation.

**Starter activity**

- Students can find areas of hot desert using an atlas and try to work out some of their common characteristics, or be given some of the common characteristics and then use these to determine where in the world hot deserts may be found.

**Plenary activity**

Teacher-led questioning, using show-me boards, pairs or small discussion groups can focus on:

- the weather and climate
- how this leads to the distinctive characteristics of the landscape.

**Homework**

- Students should try to find a piece of descriptive writing about the desert from world literature to share with the whole class or in small groups. This can be researched online or, preferably, by a visit to the school or local library.

**Check students’ understanding**

- Students may think that deserts are always hot, or that they receive no rain at all. It is worth devoting some time to the characteristics of weather and climate to ensure they gain a fuller knowledge.
6.2 What is the hot desert ecosystem like?
This topic moves on from the formation of hot deserts to look at the characteristics of the ecosystems and how life has adapted to the harsh conditions.

**Starter activity**
- The lesson could begin with some dramatic visual stimulus of desert plants and animals. These can be found in some of the books listed in the introduction or through a simple search of images using the key words ‘desert plants and animals’ on Google.

**Plenary activity**
- Using their knowledge of the hot desert ecosystem pupils could discuss how they could survive and adapt if they lived in one of the world’s hot deserts.

**Homework**
- Students can carry out a creative task using the knowledge they have gained to design their very own perfectly evolved hot desert animal. Each animal created should be perfectly adapted to survive and be well-annotated to show how it is able to live in the harsh conditions.

**Check students’ understanding**
- Far from being a place devoid of life, this topic gives students the opportunity to see the wide variety of plants and animals that have adapted to live in areas where they may have thought this would be impossible.

6.3 What development opportunities are found in hot deserts?
In this topic, students will take an in-depth look at the ways in which people who live in hot deserts can make a living and how countries can exploit the natural resources available. The economic activities studied include agriculture, energy, mineral exploitation and tourism.

**Starter activity**
- Use a dramatic large-scale visual stimulus of a desert landscape, either on a whiteboard projector or print-outs for students to discuss in small groups – the question is: what would you do to make a living if you lived here? Decent images include the Kalahari ([www.cambridge.org/links/gatd4047](http://www.cambridge.org/links/gatd4047)) or the Sahara ([www.cambridge.org/links/gatd4048](http://www.cambridge.org/links/gatd4048)).

**Plenary activity**
- Revisit the image displayed at the start of the lesson and ask students, with the knowledge they have gained, to identify the possible economic activities such as agriculture, energy generation, mineral exploitation and tourism.
- For more variety, small groups could be given different desert images and could bullet-point economic activities to discuss with the rest of the class.

**Homework**
- Students could draw a mind map to summarise the information in the Student Book with the extra detail they have learnt in class. They should include details of all the development opportunities available and examples of countries where they are found.

**Check students’ understanding**
- Students may believe it is not possible for anybody to live and work in the desert. This topic will show them it is possible not only to survive but to thrive economically.

6.4 What are the challenges of developing hot desert environments?
This topic shows that, although economic opportunities are available, exploiting them can be fraught with difficulties. Challenges include the management of water resources, the extreme temperatures and the inaccessibility of many areas of hot desert.
Starter activity

• Carry out a think-pair-share exercise with students considering the top three challenges to development in a hot desert environment. They can keep these secret (writing them down and keeping them in a sealed envelope for later) or discuss them as a class.

Plenary activity

• Students need to take the challenges they have learned about in the lesson and make an attempt to apply them in context. They should use an atlas to pick a hot desert country and prepare a brief factfile with details such as population, natural resources and selected development indicators. This will form the basis of the homework exercise that follows.

Homework

• Using the country they chose in the plenary activity, students should engage in a research activity, taking the challenges listed in the Student Book and finding out which ones apply to their chosen country. Some students may need help with this and could perhaps be directed to looking at either one or two of the challenges listed, i.e., managing water resources, extreme temperatures, inaccessibility and development.

Check students’ understanding

• Extreme temperatures, while perhaps the most obvious feature of a hot desert environment, may not be the most challenging for development.

• Students may not have given much thought to issues of accessibility and may be surprised to find there are some hot desert countries with surprisingly well-advanced infrastructure (Australia, for instance).

6.5 What are the causes and impacts of desertification?

This topic looks at how, in many areas, desert fringes are under threat from land degradation. The causes of this – both physical processes and human activity – and the effects of climate change are outlined. The impacts of desertification on physical and human environments are also discussed.

Starter activity

• Start by showing the global desertification vulnerability map (www.cambridge.org/links/gatd4049). It should provoke some discussion on the countries affected and, in particular, it should be noted that desertification is not a problem limited to LICs.

Plenary activity

• One cause of desertification needing further discussion is worldwide climate change. In order to reinforce the messages from the earlier chapter in the Student Book, a video clip on the impact of climate change on desertification in Burkina Faso is useful (www.cambridge.org/links/gatd4050). Students should make notes on the causes and effects of desertification featured as they watch the clip for a class discussion session at the end.

Homework

• Students can classify the various impacts of desertification by constructing a table separating all the ideas from the Student Book into social, economic or environmental impacts (remembering that some of the impacts may lie in more than one category).

Check students’ understanding

• Students need to be aware that the problem is not merely one experienced by LICs and the global desertification vulnerability map is a good introduction to the topic.

6.6 What strategies can be used to reduce the risk of desertification?

This topic looks at how to protect marginal areas from desertification. It examines ways to protect the soil from erosion, often used by peasant farmers in affected countries, and also at multidimensional approaches used by governments and international organisations.
Starter activity

- Conduct a brainstorming session on what measures students think could be taken to stop desertification. This could be done as a teacher-led activity writing on the whiteboard or, perhaps, as a ‘one idea on a sticky note’ collated and discussed by the whole class.

Plenary activity

- Separate students into groups and give one of the methods to protect the soil from erosion to each group. They need to both promote and defend it as the ultimate solution in a whole-class debate. Students could vote on which method is the best for LICs based on cost, effectiveness and sustainability.

Homework

- To develop their skills, students could pick one of the methods of protecting the soil from erosion (such as gabions) and produce an annotated diagram showing the details of their selected method and what makes it effective.

Check students’ understanding

- Students should understand that Western technology is often viewed as the way forward for LICs but, as is obvious from the methods of protection outlined in this topic, listening to local people and acting on the knowledge they have can often be more effective.

Case study: the hot desert environment of Qatar

This topic presents Qatar as a case study of a country with a hot desert environment showing the development opportunities, the challenges and the solutions devised by one of the world’s richest economies.

Starter activity

- What do students know about Qatar (if anything)? Against a pictorial backdrop (such as www.cambridge.org/links/gatd4051) students could come forward with their own ideas of what the country is like.

Plenary activity

- A carousel session using the titles from the six topics featured in this chapter would be a useful way to check understanding of the hot desert ecosystem and to correct any misunderstandings students may have. Large flipchart sheets could be used by groups and students could take photographs on their phones to use as revision aids.

Homework

- Students could produce a piece of writing answering the question: How can Qatar possibly survive and expand when the country has no surface water? They could discuss the problems the population may face in the future and what people can do to combat them.

Check students’ understanding

- Students may have no idea where Qatar is or the history of the Gulf States – use the lesson as an opportunity to provide some background information.

Model answers to ‘Assess to Progress’ questions

1. Describe the distribution of the world’s hot deserts. 3 MARKS

The world’s hot deserts are mostly located within the tropics with many under either the tropic of Cancer or the tropic of Capricorn. They are often in the centre of a continent or, such as the Great Sandy Desert of Australia, located on the western side. Finally, some of the hot deserts are found in the rainshadow of major mountain ranges. One example is the Atacama in South America, which sits in the rainshadow of the Andes mountain range.

The answer should include all three of the following:
• mostly located within the tropics
• often in the centre or to the western side of the continents
• some are found in the rainshadow of major mountain ranges.

Comment: Names and locations of specific deserts should be given to gain the third mark.

2 Which one of the following statements describes the climate of a hot desert? 1 MARK
A high diurnal temperature range with annual rainfall less than 250 mm.

3 Describe one method used to protect the soil from erosion in desert areas. 2 MARKS
Any one of:
• cutting terraces into steep mountain sides to stop water washing topsoil down the slope
• earth bunds or small walls to let water build up behind them and infiltrate the soil
• building gabions in gullies to allow moisture to percolate through the soil
• afforestation programmes to stop wind blowing away the dry topsoil.

Comment: A fully developed answer to one of the methods above is needed to gain full marks.

4 Give one possible physical and one possible human impact of desertification. 4 MARKS
One physical and one human impact from:
Physical impacts:
• increasing areas of land on the desert margins turning into desert
• increased soil erosion and dust storms
• the failure of harvests and loss of crops from farmland.

Human impacts:
• with the loss of crops there can be widespread starvation, malnutrition and famine
• less money for farmers and other businesses and a decrease in living standards
• less education for children as people cannot afford to send them to school
• people moving away from their homes and their traditions being lost
• more women in rural areas as the young men are the ones who move to find jobs
• LEDCs relying more on foreign aid to help them survive.

Comment: A fully developed answer is needed to gain full marks.

5 Using a case study, explain how the environment in a hot desert provides both opportunities and challenges for development. 9 MARKS
Located on the Arabian peninsula, Qatar lies to the south of Saudi Arabia in a very arid climate. Rainfall is minimal, never reaching more than 20 mm in a single month and with several completely dry months. While the opportunities for developing the arid landscape are limited, the discovery and exploitation of oil in the 1940s has brought a huge amount of wealth to the country. The money has been invested wisely in port facilities and the development of an industrial base using the oil as a raw material in, for instance, the production of petrochemicals and fertilisers. It has also allowed some diversification into other industries including ship repair.

Taking advantage of the hot, dry climate, Qatar has also invested in its tourism industry and has sold the capital Doha as a centre for luxury accommodation. The surrounding desert provides opportunities for adventure tourism with activities including quad-biking over the dunes and camel treks. The government has also invested heavily in facilities aimed at attracting greater numbers of tourists to sporting events including a possible Formula One race and the 2022 FIFA World Cup.

One of the main challenges to development has been in keeping the growing population both fed and watered in a country with no surface water supplies and with only 5.6 per cent of the land suitable for agriculture. Money from oil has again provided the answer with desalination plants.
being built to convert sea water to a potable supply and with innovative agricultural solutions such as huge irrigation systems, soilless agriculture and vertical farming with ‘fields’ on different floors in huge skyscrapers.

Mark scheme

A full answer will include a detailed awareness of the challenges and opportunities available in hot desert environments and the relationships between them.

There will be a good understanding of the causes and effects and the named case study will be well used to make points about different activities, possibly concentrating on the development and use of water resources.

There will be a description and explanation of more than one type of economic activity in a number of different, correctly identified locations. Processes being carried out in desert environments will also be well explained.

Finally, there will be good application of knowledge and understanding used to interpret and analyse geographical information and issues.

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<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
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| 2 (clear) | 6–9   | • Linked statements with description and explanation of specific economic activities in a named case study country.  
  • There should be description of both the challenges and opportunities offered by a range of economic activities.  
  • Provides reasonable description and explanation demonstrating clear knowledge and understanding. |
| 1 (basic) | 1–5   | • Simple generic information with limited or no specific information related to a case study country.  
  • Answer not developed.  
  • There may be random statements about the challenges and opportunities available but limited link to the evidence for how these work in hot desert environments.  
  • Demonstrates some knowledge and understanding but description is limited and lacks specific information. |

Suggested content

There should be some specific evidence to access Level 2. A full answer will include a detailed awareness of the challenges and opportunities available in hot desert environments and the relationships between them. There will be a good understanding of the causes and effects and the named case study will be well used to make points about different activities, possibly concentrating on the development and use of water resources.

There will be a description and explanation of more than one type of economic activity in a number of different, correctly identified locations related to a single case study country. In the case of Qatar, such activities could include: the exploitation of oil and the use of the money raised to develop self-sufficiency in energy and a wide range of industries including fertiliser production and petro-chemicals; desert tourism with adventurous activities and luxury hotel services; the challenges and opportunities involved in developing desert agriculture; major sporting events including the 2022 World Cup.
**Introduction**

**Prior knowledge**

Students should have a basic knowledge gained through Key Stage 3 study of climate change from the Ice Age to the present, including:

- a basic understanding of global climate distributions and particularly the distribution of cold environments.

**Geographical skills**

**Cartographic skills** can be developed using Activity 7.1. Students are asked to use their knowledge to locate cold environments on a world map and to annotate their map with detailed information to show the characteristics of cold environments.

**High-level thinking** can be developed by using Activity 7.2 question 3. Students are asked to predict the knock on effects if one component of an ecosystem changes.

**Numerical skills** can be developed using Activity 7.3 question 2. Students are asked to describe the pattern shown in the graph and use their knowledge to explain the pattern.

**General notes**

It is important to be led by the GCSE specification when setting up teaching of this topic area. Remember, students will need to be able to describe the distribution of cold environments and their distinctive characteristics, the opportunities and challenges and strategies for managing cold environments. Detailed study of a specific case study, such as the North Slope region of Alaska, are needed to bring out the detail outlined above.

Several of the activities require high-level thinking skills and the ability to research effectively. Students should be encouraged to think creatively about ways of presenting information, particularly in response to Activity 7.4.

Many of the other activities in the chapter lend themselves to focused internet research. Appropriate weblinks have been suggested as a starting point and students should develop effective ways of managing the information that they find. If computers are unavailable during the lesson, students can be encouraged to carry out research for homework and bring their notes to the following lesson for further examination and discussion.

Preparation for exam questions should ensure adequate knowledge of the distribution and key characteristics of cold environments. A focus on the opportunities and challenges of cold environments and the relevant management strategies that have been put in place are important, particularly in reference to a detailed case study.
Additional support

Students need to understand how nutrients are cycled within an environment before applying this to cold environment ecosystems. Going over the basics by using websites such as the Sustainable Sanitation and water management website (www.cambridge.org/links/gatd4052) would be useful.

A basic knowledge of climate will have been developed in Key Stage 3 Geography. It may be useful to revisit this previous study before moving on to the more detailed understanding needed at this level.

Extension

While an understanding of climate change is not required for this topic, it may be useful for students to research how the distribution of cold environments has changed over time, both in the past and predictions for the future.

Students could also ensure they have a good understanding of the reasons why areas need to be exploited for their resources. This could link effectively to the chapters in Section 6 on the challenges of resource management, which require students to have an understanding of food, water and energy resources.

Finally, detailed case study knowledge of the development and challenges of cold environments is important and further information can be found at the weblinks suggested in this topic. Students can increase their chances of exam success by researching case studies in more detail or by extending their understanding and considering additional case studies such as the oil industry in Canada.

Worksheets

Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

Worksheet 7.1: Locating and annotating cold environment areas, supports Activity 7.1 question 1 and involves students annotating a blank world map with the distribution and characteristics of the three types of cold environment. Students could be encouraged to carry out further research to add detail to their annotations.

Videos

Chapter 7 in the Cambridge Elevate enhanced edition includes the video clip: Tourism in the French Alps. The clip looks at tourism in this cold environment. The clip comes from The Alps: Opportunities and Challenges (DVD by Pumpkin Interactive Ltd).

Lesson ideas

7.1 What are the distinctive characteristics of cold environments?

This topic introduces students to the location and distinctive characteristics of cold environments. It describes how animals and plants have adapted to the climate and the cycling of nutrients within the environment.

Starter activity

- Students could suggest where they would expect cold environments to occur, i.e., high latitudes and altitudes, and explain why they would occur there. This could provide a basis to Activity 7.1 question 2: ‘Carry out some research to explain why areas of higher latitude and altitude have lower temperatures.’

Plenary activity

- Students could play some games to help them to interpret and describe the climate graphs. For example, the teacher could set up a quiz using kahoot or socrative with questions asking about the temperature range, rainfall totals and maximum and minimum temperatures and rainfall amounts.

Homework

- Students could create a virtual tour of a cold environment using Google Earth. They could imagine that they are a tour guide and find suitable locations to point out important information about their selected cold environment.
Check students’ understanding

- Students need to understand that the three cold environment climates that have been identified do have variation within them. The Did You Know? feature in topic 7.1 What are the distinctive characteristics of cold environments? will help to explain this.

7.2 How are plants and animals adapted to cold environments?
This topic describes and explains a number of ways in which plants and animals have adapted to living in cold environments. It also introduces the Gersmehl diagram (www.cambridge.org/links/gatd4053) which illustrates nutrient cycling in the tundra environment.

Starter activity

- Students could be shown some photographs of plants and animals, some of which are found in cold environments and others which are not. They could sort them into these two categories and explain how they have sorted the images and whether any of them were difficult to sort.

Plenary activity

- Students could sketch a Gersmehl nutrient cycling diagram for the tundra. Students could annotate the diagram to explain the size of the stores and flows in the diagram.

Homework

- Students could select a plant or animal that lives in a cold environment and annotate a picture of it to explain how it has adapted to the climate. Alternatively, provide students with a list of adaptations and ask them to design their own plant or animal that would be able to survive in a cold environment.

Check students’ understanding

- Students need to understand some of the adaptations of plants and animals in the cold environment ecosystem. They also need to remember that components of cold environment ecosystems are interdependent and so a small change to one part of the ecosystem can have dramatic knock on impacts.

7.3 What are the challenges of developing cold environments?
This topic highlights a number of challenges related to the development of cold environments including the disruption of indigenous people, the challenge of permafrost, the effects of tourism and the impacts on food chains and webs.

Starter activity

- Students could imagine that they lived in a cold environment. They could discuss what the challenges would be and whether there was anything in their everyday lives that they currently do but that would be difficult to do in a cold environment.

Plenary activity

- There should be a check to see that students know and understand the range of challenges that cold environments face. Name the challenge and then invite students to provide a fact or explanation related to that challenge.

Homework

- Students could write a paragraph explaining whether they think the physical or the human challenges of cold environments are greater and why they think this.

Check students’ understanding

- Students can have quite stereotypical views of indigenous people in cold environments. It is worth challenging these stereotypes. An article such as the one at The Globe and Mail (www.cambridge.org/links/gatd4054) could be used to do this.
Case study: Alaska

This topic focuses generally on development opportunities and challenges in Alaska and then specifically the North Slope region of Alaska. It also highlights the future of the oil pipeline and the potential designation of an increased area as ‘wilderness’.

Starter activity

- Ask students to come up with some adjectives which describe what they think Alaska is like. Then show them some images of Alaska. They could then come up with some further adjectives using the photographic stimulus.

Plenary activity

- Students could discuss whether they think that the oil pipeline should be developed or whether the area should be further conserved as a wilderness area. This will check their understanding of the case study.

Homework

- Students could create a case study quiz to test a partner on the case study detail. They could swap quizzes in the following lesson and then mark each other’s answers.

Check students’ understanding

- Students need to be aware that detail is important when learning their case studies. They could discuss techniques for revision such as using scrabble letters to create key terms or creating mind maps to ensure that they can learn the detail.

7.4 How can cold environments be protected?

This topic highlights the fragility of cold environments and the subsequent need for management. It focuses on the management of Antarctica and the creation of the Antarctic Treaty as a management agreement.

Starter activity

- Discussion could focus around what is meant by a ‘fragile environment’ and whether cold environments could be considered ‘fragile’.

Plenary activity

- Discussion could focus on whether the management of Antarctica could be seen as sustainable. Students will require a clear understanding of the term ‘sustainable management’ in order to do this (see Key Terms for this topic).

Homework

- Students could carry out some research into the management of the Arctic and create a one-page fact-file about this. They could highlight the similarities and differences between the management of Antarctica and the management of the Arctic. A website such as the WWF project in the Arctic (www.cambridge.org/links/gatd4055) is a good starting point.

Check students’ understanding

- Students should understand that management requires organisation and funding that, given the lack of governance, is why it is so challenging in the case of Antarctica.

Model answers to ‘Assess to Progress’ questions

1 Using a case study, explain how cold environments can provide both opportunities and development challenges. 9 MARKS

Cold environments are those that include the Arctic. There are many opportunities to be found in the Arctic. For example, the Arctic has resources, such as oil, which can be exploited. In Alaska there has been drilling for oil at Prudhoe Bay, which provides millions of pounds for the economy. However, it isn’t just oil that can be exploited from the Arctic. The conditions there mean that there is hydroelectric power and opportunities for wind energy too. Other opportunities in Alaska include...
fishing. There are fisheries in the Bering Sea. Tourists also come to visit cold environments such as the Arctic too.

However, despite the opportunities, cold environments such as Alaska also bring challenges because the temperatures are so low and the area is so remote. There is also permafrost, which is permanently frozen ground. However, this has an active layer that melts and this can cause subsidence on the unstable ground that can damage pipelines and houses. Also, the extreme cold can kill people and because the areas are so remote, healthcare may not be near. There also may not be much opportunity to get a job because there aren’t many people there in the first place so not many jobs are needed. As climate change occurs, cold environments are likely to change dramatically, which might increase the opportunities or it might increase the challenges.

**Mark scheme**

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<thead>
<tr>
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<th>Description</th>
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| 3 (detailed) | 7–9   | • Focuses on the specific challenges and opportunities in cold environments and the relationships between them.  
• Cause and effect is well understood and there is effective use of detailed exemplification with clear sense of place. The named case study is used to make points regarding different activities, including scale of development and control over the inhospitable conditions.  
• More than one economic activity and challenge should be described.  
• Demonstrates comprehensive and accurate knowledge of locations, places and processes in relation to cold environments.  
• Shows thorough geographical understanding of the interrelationships between places, cold environments and processes.  
• Includes good application of knowledge and understanding to interpret and analyse geographical information and issues. |
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<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
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<tbody>
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<td>2 (clear)</td>
<td>4–6</td>
<td>• Some awareness of challenges and opportunities in cold environments and the relationships between them.</td>
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<td></td>
<td>• Cause and effect is understood and there is some limited use of exemplification.</td>
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<tr>
<td></td>
<td></td>
<td>• Demonstrates some knowledge of locations, places and processes in relation to cold environments.</td>
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<tr>
<td></td>
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<td>• Shows some geographical understanding of the interrelationships between places, cold environments and processes.</td>
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<td></td>
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<td>• Includes reasonable application of knowledge and understanding to interpret and analyse geographical information and issues.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Limited awareness of challenges and opportunities in cold environments and the relationships between them.</td>
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<tr>
<td></td>
<td></td>
<td>• Cause and effect is not well understood and there is very limited or no exemplification.</td>
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<td></td>
<td>• Demonstrates very limited knowledge of locations, places and processes in relation to cold environments.</td>
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<tr>
<td></td>
<td></td>
<td>• Shows slight geographical understanding of the interrelationships between places, cold environments and processes.</td>
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<tr>
<td></td>
<td></td>
<td>• Includes little or no application of knowledge and understanding to interpret and analyse geographical information and issues.</td>
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**Suggested content**

For cold environments, credit answers that focus on Arctic or Antarctic regions. Allow reference to tundra as well as polar areas. Answers should relate to economic opportunities and the associated challenges. Opportunities include resource exploitation, including agriculture, recreation and tourism. Economic benefits include employment, spending in the local economy, multiplier effect and improved infrastructure. Many cold environments are increasingly important economically. Case studies are likely to focus on Northern Canada and/or Alaska. Drilling and mining activities occur in the Canadian Arctic and Alaska. In Alaska there has been extensive drilling for oil at Prudhoe Bay. Oil and gas exploration and production taxes account for 88 per cent of the State of Alaska’s revenue, providing more than $10 billion per year. Alaska also offers some of the highest hydroelectric power potential in the country from its numerous rivers. Large parts of the Alaskan coastline offer wind and geothermal energy potential as well. The state has a large seafood fishing industry, with the primary fisheries in the Bering Sea and the North Pacific.

Challenges include environmental constraints, costs/remoteness, conflicts with indigenous populations, extreme low temperatures, low precipitation, variable daylight hours, permafrost/active layer, fragile ecosystems and relief barriers. Construction disrupts and melts the permafrost, creating unstable ground. Exposure to extreme cold can injure and kill, and healthcare may be many miles away. Restricted employment opportunities are a real problem for people living in remote areas, and there is a lack of
services due to low population density. Climate change may lead to widespread and rapid changes which are difficult to adapt.

Candidates may make the link between the nature of the challenges and the desire/ability to overcome them in order for development to take place. This might reflect, for example, the value of resources and the technological advances that enable their development.

No credit should be given for discussion of the management of cold environments.
Learning Outcomes

By the end of this section introduction, students should be able to:

- describe the location of major upland and lowland areas and river systems.

General notes

The section introduction provides an overview of the UK landscape including upland and lowland areas and rivers. Coastal, river and glacial landscapes in the UK are then examined in detail in the subsequent chapters.

Suggested learning activities

- Practise using an atlas.
- Ask students to mark the locations of major upland and lowland areas and rivers onto an outline map of the UK.
- The caption to Figure S3.1 in the student book contains the discussion question ‘The Old Harry Rocks in Studland, Dorset, are a great example of landforms created by coastal erosion. Why do you think these landforms are not seen on every part of the UK coastline?’ This could form the basis of a class discussion. Answers might include different types of rock in different areas, hard and soft rocks, and wave direction.
Teaching notes: Section 3 Chapter 8 Coastal landscapes in the UK

LEARNING OUTCOMES
By the end of this chapter, students should:

- understand what happens when waves reach the coastline
- describe and explain the physical processes that shape the coastline
- be able to describe and explain the formation of coastal features resulting from erosion
- be able to describe and explain the formation of coastal features resulting from deposition
- understand how coastlines are protected from the effects of physical processes.

Introduction

Prior knowledge
Students should have a basic knowledge of the characteristics of coastal areas and the general features associated with coastal processes.

Geographical skills
Cartographic skills can be developed using Activity 8.4, which asks students to give grid references for locations on a 1 : 25 000 OS map. Base maps can also be used throughout the topic as a learning tool by incorporating annotations and photographs.

Graphical skills can be developed using Activity 8.1 question 3, which asks students to draw annotated diagrams to describe constructive and destructive waves.

Research skills can be developed by investigating coastal management schemes as suggested in the Further Research boxes in topics 8.5 and 8.6 and the Named Example: Ventnor to Bonchurch, Isle of Wight.

General notes
It is important to be guided by the GCSE Specification when teaching this topic. Essentially, the topic is a combination of physical and human geography, but it is important that students have an understanding of the human-environmental links expressed throughout. Understanding the dynamic nature of coastal systems is a fundamental part of the topic and an appreciation of processes and features forms the background to the whole topic. This understanding is then used to illustrate the inter-relationship between natural and human systems by using examples of coastal management systems.

Additional support
As a largely physical geography topic, visual resources are potentially very important. A web search will provide a range of visual resources (the Coastal Observatory website is very useful: www.cambridge.org/links/gatd4056). Animations can be used to illustrate processes. Also, the development of annotated diagrams, to describe features and explain processes, is a useful teaching and revision tool. Every local authority that has a coastal environment will have a shoreline management plan, which can provide useful information and resources. News reports concerning the impacts of storms, mass movement events and coastal management strategies are particularly useful.

Extension
Extension activities are highlighted throughout the chapter in terms of research opportunities. Use these opportunities to develop the depth of understanding required for Level 3 examination answers rather than simply extending knowledge. Extension activities can be based around further exploration of any of the key words or ideas expressed in the GCSE specification. The use of newspaper reports/articles is particularly helpful for this topic, especially in relation to coastal storm or mass movement events and coastal
management strategies. Also, specific environment related research can be a good way of considering the physical-human interface. For example, Blakeney Point Nature Reserve can provide an excellent vehicle for an applied understanding of spit formation and characteristics, as well as an appreciation of the use and pressures on the coastal environment. Consequently, the use of local authority or environmental protection group websites provide an excellent avenue for extension work. Also, for schools that have access to a coastal area there is the possibility of the use of fieldwork, either as part of the teaching programme or as an extension activity.

**Worksheets**

Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book. **Worksheet 8.1** helps to identify the processes of weathering and erosion and offer a definition of each which includes a basic explanation of each of the processes. This is a useful learning exercise and the worksheet can then be used as a revision sheet nearer the examination. There are often short answer questions which simply ask students to name and describe these processes or longer questions about the formation of landforms where an understanding of process is a fundamental part of the answer.

**Videos**

Chapter 8 in the Cambridge Elevate enhanced edition includes the video clip: Studland’s changing coastline. The clip looks at the erosion taking place at Studland Bay in Dorset. The clip comes from the Managing the Dorset Coast: Conflicts, Challenges and Opportunities (DVD by Pumpkin Interactive Ltd).

**Lesson ideas**

### 8.1 What happens when waves reach the coastline?

This topic considers the relationship between wind and waves and how the motion of waves changes as they move towards the coast. This understanding will then be developed to show how waves break and introduce the ideas of swash, backwash and drift and constructive/destructive waves and how they create particular types of beach.

**Starter activity**

- Use an animation to show the motion of waves or a video of waves/swell in mid ocean (trawling/crab fishing programmes are useful here) to set the scene.

**Plenary activity**

- **Activity 8.1 questions 1 and 2** will confirm that students understand the key ideas expressed in the GCSE specification.

**Homework**

- Find a suitable photograph to show a beach created by constructive waves and a beach being removed by destructive waves. Download the photographs and annotate them to explain what is happening.

**Check students’ understanding**

- Students should understand the relationship between winds and waves and how the motion of waves changes as they reach shallower coastal waters.

### 8.2 How do physical processes affect the coast?

This topic considers the coastal conveyor (weathering/erosion, transportation and deposition) and the different types of weathering and erosion, and shows how these processes help to shape the coastal landscape. It will show how rock type and structure affects the rates of weathering and erosion and how this is reflected in the types of landforms found in coastal areas. The topic will also consider the forces of transportation and deposition and how these forces affect the coastal landscape and create distinctive landforms.
**Starter activity**
- Show a photograph/video of a coastal storm and ask students to describe what is happening. Or use audio and ask students to listen to the sound of storm waves breaking on a beach and ask them to identify the processes that are making the sounds.

**Plenary activity**
- Mix and match exercise with a list of named types of weathering and erosion and definitions (card sort type of exercise).

**Homework**
- A suggestion for a piece of homework: ‘A student decided to carry out an investigation about coastal erosion. Suggest three pieces of evidence that the student might use to show different types of erosion.’

**Check students’ understanding**
- Students should be able to define and describe the different types of weathering and erosion.

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**8.3 What landforms are associated with coastal erosion?**

This topic considers how the power of waves creates different types of beach and how weathering and erosion, in combination with other physical factors, creates the landforms associated with hard and soft coastlines.

**Starter activity**
- Use photographs to illustrate a range of different coastal landforms, especially headlands (and bays) and coastal areas affected by mass movement.

**Plenary activity**
- The two key assessment tasks generally associated with this area are naming the landforms associated with headland erosion and explaining their formation, and explaining the processes involved with landslides (especially rotational slumping). A useful plenary exercise would be to use a partially completed diagram and ask students to complete it or to ask a number of short questions (name features, types of weathering/erosion, describe what is happening).

**Homework**
- Use an example of a past examination question which asks students to describe and explain the landforms associated with headland erosion or a more challenging question about how rock type and structure affect physical processes and resulting landforms. Or, set an exercise which involves research and introduces students to a particular website that might be a useful revision resource at a later date.

**Check students’ understanding**
- Students should build on their understanding of physical processes and appreciate how these processes are affected by factors such as rock and structure, wave energy and the orientation of the coastline.
- This understanding should be further developed by investigating how all of these factors combine to create particular landforms associated with hard and soft coastlines.
- A series of short answer questions and the use of annotated diagrams or photographs can be used to check this understanding.

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**8.4 What landforms are created by coastal deposition?**

This topic considers how waves and wind move sediment to create distinctive coastal landforms, with particular reference to beaches, sand dunes, spits and bars.
Starter activity

• Remind students of the idea of constructive and destructive waves and how constructive waves create beaches. You could use photographs to contrast the difference between a constructive and a destructive beach.

Plenary activity

• Use an animation to summarise how longshore drift creates spits and bars.

Homework

• Investigate a particular feature of coastal deposition and how it creates a unique environment. Blakeney Point/Hurst Castle Spit/Spurn Head are all excellent examples and include areas which are designated nature reserves. If the physical geography has been completed in class, the idea could be developed in relation to the environmental opportunities created by the landform. There is also an opportunity for the possibility of fieldwork.

Check students’ understanding

• Student should be able to label a diagram showing longshore drift and/or a spit.
• Some students might include some element of explanation.

Named example: the Holderness coast, Yorkshire
This topic looks at the erosional and depositional landforms along the Holderness coast in Yorkshire. It reinforces the link between rock type and landforms and includes an opportunity for students to practise their map-reading skills.

Starter activity

• Ask students to locate the Holderness coast on a map of the UK.
• Show a video of a farm along the Holderness coast collapsing into the sea (www.cambridge.org/links/gatd4057).

Plenary activity

• Get students to close their books. List the different places along the Holderness coast and their rock types (e.g. ‘Flamborough Head – chalk’) and get the students to identify which coastal processes have taken place and what the resulting landforms are (e.g. ‘erosion – forming a headland’).

Homework

• Activity 8.4 allows students to practise reading OS maps.

Check students’ understanding

• Students need to be able to identify landforms created by erosion and those by deposition.

8.5 Protecting coastlines from the effects of physical processes
This topic will introduce students to the concept of coastal management and the reasons why some coastal areas need to be protected from physical processes. It will then consider the different options available (hard engineering, soft engineering and managed realignment) and how these work to protect areas from physical risks (erosion, mass movement, flooding). In each case a specific example will be used and the advantages and disadvantages of each method will be considered.

Starter activity

• Use a newspaper report or photograph of a flooding/mass movement event to show how physical processes can affect a coastal area. The destruction of the railway line in Dawlish might be a useful example.
Plenary activity

- There are a number of key ideas which students need to have some understanding about. These include: an appreciation of why some areas need to be protected against natural processes while other areas do not; the different methods of coastal management (and the techniques involved) and how they reduce risk; an understanding that each method has advantages and disadvantages. A plenary activity needs to reflect on these key factors or elements of them.

Homework

- Set a past examination question with specific reference to the topic. Make sure that the question requests the use of an example as this is a key GCSE specification requirement.

Check students’ understanding

- Students should be able to define soft engineering, hard engineering and managed realignment.
- Some students could discuss how each method reduces the risk from physical processes.

8.6 Protecting coastlines from the effects of physical processes – soft engineering

This topic goes into more detail about soft engineering strategies, including beach nourishment, dune regeneration and managed retreat.

Starter activity

- To recap, ask students to define hard engineering, soft engineering and managed retreat.

Plenary activity

- Show students photographs of different soft engineering strategies and ask students to identify them.

Homework

- Set the Assess to progress questions as a homework task.

Check students’ understanding

- Students need to understand both the advantages and disadvantages of soft engineering.
- They should be able to look up different areas of coasts which use soft engineering strategies and discuss the costs and benefits to each area.

Named example: Coastal Management Scheme: Ventnor to Bonchurch, Isle of Wight

This topic describes the coastal management techniques in place on the south coast of the Isle of Wight. It looks at why the scheme was needed, what the scheme is and how successful it has been.

Starter activity

Ask students to search on the BBC news website (www.cambridge.org/links/gatd4058) for articles about Undercliff in the Isle of Wight. They should find articles about the 2014 landslip and the resulting damage. Ask the students to suggest reasons why the area is so unstable.

Plenary activity

- Ask students to explain how each hard engineering strategy at Undercliff works (the strategies are shown in Figure 8.30 and 8.31).

Homework

- Activity 8.7 on coastal management is a useful homework activity.

Check students’ understanding

- Students need to understand the effects and conflicts around coastal management schemes.

Model answers to ‘Assess to Progress’ questions

1. Name and describe two types of coastal erosion. 4 MARKS
• Abrasion is where waves throw sediment at a cliff face, wearing it away.
• Attrition is where sand grains and pebbles are constantly moved as waves break on a beach. The constant movement wears away the beach material.

Comment: Allow 1 mark for the identification of a type (abrasion, attrition, hydraulic power) and 1 mark for an understanding of the method. A maximum of 1 mark should be given for the name of the method OR description given but they do not match.

2 Suggest how geology influences coastal landforms. 4 MARKS

Where there are hard rocks and soft rocks on the coasts the soft rocks will erode more quickly forming bays while the hard rocks stick out as headlands.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>3–4</td>
<td>• Clear understanding of the link between geology and specific landforms. May reference different types of rocks or offer generic links.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–2</td>
<td>• Basic understanding that softer/harder rocks will give rise to different types of coastal scenery with limited reference to landforms beyond basic description. ('If rocks are softer they will erode easier and there are often slumps').</td>
</tr>
</tbody>
</table>

3 Explain the formation of a coastal spit. You may use a diagram. 6 MARKS

When the waves come in at an angle they move the sediment up the beach at the same angle, as swash. This means that sediment is gradually moved along the coast in a zig-zag motion. Where the coast changes direction the sediment continues to move in the original direction, being deposited in the sea until it sticks above the sea and forms a spit.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>Offers some explanation of how sediment is moved along the beach and deposited to form a spit.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>Some basic, largely descriptive appreciation of movement and deposition OR clearer understanding of movement OR deposition. ('The beach material is moved along the beach and then dumped, forming a spit which sticks out into the sea' OR 'When the waves come in at an angle they move the sediment along the coast in a zig-zag motion so the beach material gradually moves along the beach'.)</td>
</tr>
</tbody>
</table>

4 Describe the features of erosion and deposition in a section of UK coastline you have studied. 6 MARKS

• Erosion: headland erosion features, soft coastline features (slumping)
• Deposition: sand dunes, spits, bars

On the Holderness coast at Flamborough Head there is a chalk headland which has wave cut notches, caves and stacks. Further south the erosion on the softer cliffs results in slumping. The
eroded material is moved south by longshore drift, eventually being deposited and creating a spit at Spurn Head.

**Comment:** The expectation is that students will have studied a coastline where the identified features in the GCSE specification are present.

**Mark scheme**

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Names a coastal area and identifies a range of landforms of erosion and deposition and gives some context of the landforms in relation to the coastline.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Names a coastal area and identifies some landforms of erosion OR deposition OR identifies two/three landforms which include features of erosion and deposition. Limited context of the landforms in relation to the coastline. ('On the Holderness coast there is a headland with caves and a stack and there is also a spit.')</td>
</tr>
</tbody>
</table>

5 Using an example you have studied, describe the features of a coastal management scheme and explain why management was required. **9 MARKS**

In Ventnor, storm waves reach the base of the cliffs which makes it vulnerable to erosion. In addition, the soft coastline has been affected by landslides. Millions of pounds worth of property is built near the sea so there is a high risk of damage. Because of this a number of management techniques are used to reduce the risks. Sea walls have been built in front of the cliffs to make sure the waves do not reach the cliff. Offshore bars have been built to reduce the wave energy and rock armour used to protect the beach. Areas of former landslides have had drainage systems put in the ground to reduce the amount of water in the land and have been regraded to make the land less steep, reducing the risk of landslides.

**Mark scheme**

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (detailed)</td>
<td>7–9</td>
<td>• Detailed description of a scheme which includes a number of techniques. Reference to why the scheme was required and how the techniques will reduce the risk.</td>
</tr>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Clear reference to elements of a scheme with some observations about why it was required beyond simple reference to erosion or flooding. ('In Ventnor there are large storm waves which break against the cliff, causing it to erode, threatening the houses on the top of the cliff. In order to reduce the risk of erosion sea walls were built in front of the cliffs and rock armour used so that the waves cannot reach the cliff.')</td>
</tr>
<tr>
<td>Level</td>
<td>Marks</td>
<td>Description</td>
</tr>
<tr>
<td>----------</td>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Basic description of an element of a scheme with only limited appreciation of why the scheme was required. (‘A coastal management scheme was used in Ventnor because the area is affected by storm waves and erosion. They built sea walls in front of the cliffs.’)</td>
</tr>
</tbody>
</table>
Teaching notes: Section 3 Chapter 9 River landscapes in the UK

LEARNING OBJECTIVES

By the end of this chapter, students should:

- understand how river valleys change from source to mouth
- describe and explain the physical processes that affect river valleys
- describe and explain the formation of river features resulting from erosion
- describe and explain the formation of river features resulting from deposition
- understand how flood risk can be assessed and reduced.

Introduction

Prior knowledge

Students should have a basic knowledge of the characteristics of rivers and the general features associated with fluvial processes.

Geographical skills

Cartographic skills can be developed using Activity 9.2 question 2, which asks students to draw and annotate a sketch from a photograph.

Graphical skills can be developed using Activity 9.5 question 1, which asks students to interpret a storm hydrograph.

Research skills can be developed by investigating topics suggested in the Further Research boxes in 9.3(1) on High Force waterfall; 9.4 on flood management and the Boscastle flood.

General notes

It is important to be guided by the GCSE Specification when teaching this topic. Essentially, the topic is a combination of physical and human geography, but it is important that students have an understanding of the human-environmental links expressed through the topic. Understanding the dynamic nature of fluvial systems is fundamental and an appreciation of processes and features forms the background to the whole topic. This understanding is then used to illustrate the inter-relationship between natural and human systems by using an example of a flood event and flood management systems.

Additional support

As a largely physical geography unit, visual resources are potentially very useful. A web search will provide a range of visual resources. Particularly useful are the Met Office website (www.cambridge.org/links/gatd4059) for links between rainfall and flood events, The Environment Agency (www.cambridge.org/links/gatd4060) and River Restoration Centre (www.cambridge.org/links/gatd4061). Animations can be used to illustrate processes and the development of annotated diagrams to describe features and explain processes is a useful teaching and revision tool. Investigating individual rivers can provide an opportunity to look at flood events and consider individual flood management strategies as well as drainage basin management. News reports concerning individual flood events and responses are particularly useful.

Extension

Extension activities are highlighted throughout the chapter in terms of research possibilities. Use these opportunities to develop the depth of understanding required for Level 3 examination answers rather than simply extending knowledge. Extension activities can be based around further exploration of any of the key words or ideas expressed in the GCSE specification. The use of news reports/newspaper articles is particularly helpful for this topic, especially in relation to flood events and post flood event management. An
example would be the reporting of the Boscastle flood and the subsequent management strategy used to reduce future risks.

Worksheets
Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

Worksheet 9.1: use the textbook to identify the processes of weathering and erosion and offer a definition of each, which includes a basic explanation of each of the processes. This is a useful learning exercise and the worksheet can then be used as a revision sheet nearer the examination. There are often short answer questions which simply ask students to name and describe these processes or longer questions about the formation of landforms where an understanding of process is a fundamental part of the answer.

Videos
Chapter 9 in the Cambridge Elevate enhanced edition includes the video clip: River erosion. The clip looks at the different types of erosion that take place along rivers. The clip comes from the River processes and landforms (DVD by Pumpkin Interactive Ltd).

Lesson ideas

9.1 How do river valleys change as rivers flow downstream?
This topic introduces students to the idea of the long profiles of a river and how factors such as volume and velocity change downstream. These ideas can be developed to explain how processes change downstream (vertical/lateral erosion; transportation and deposition) and how this is reflected in the shape of the river valley (cross profile) and the landforms found in different parts of the river’s course.

Starter activity
• Use a diagram of the course of a river – from highlands to the sea, and show a number of photographs to illustrate different features. Ask students to place each photograph in relation to the course (long profile) of the river.

Plenary activity
• Use a card sort type of exercise which identifies the key words expressed in the GCSE Specification and ask students to define each of the key words.

Homework
• Give students volume and velocity data for part of a river, see the The Environment Agency website (www.cambridge.org/links/gatd4062). Students can plot the data using a line graph (they could do it on one graph with different axis on each side and distance along the bottom). Describe and suggest reasons for the pattern shown.

Check students’ understanding
• Students should be able to define ‘long and cross profile’ and show an understanding of how these change downstream.
• They should also be able to show an understanding of how the significance of different processes (erosion/deposition) changes downstream.
• The idea used in the Starter activity above can be repeated to check this understanding, using a broader range of photographs.

9.2 What are the processes that affect river valleys?
This topic investigates erosion, transportation and deposition associated with rivers. It considers the different types of weathering and erosion and shows how these processes help to shape a river valley. It also considers the forces of transportation and deposition and how these forces affect the river landscape and create distinctive landforms at different points along the long profile of the river.
Starter activity

• Look at two photographs, one showing a river in flood (flash flood) and one showing an estuary where there is clear evidence of deposition. Divide the class and ask half of the class to consider what is happening in one photograph and the other half to consider what is happening in the other photograph.

Plenary activity

• Use a quiz type of exercise where students have to name and define processes, or a diagram showing processes (for example, transportation) where students have to name the processes.

Homework

• Give students photographs of different parts of river valleys (upland rapids, lowland flood plain etc.) and ask them to suggest, with reasons, the main processes that are taking place.

Check students’ understanding

• Students need to have an understanding of the different types of weathering, erosion and transportation linked to rivers and their valleys. Check with a card sort exercise or a definition box exercise.
• Building up definition boxes to be able to name and describe processes is a useful revision tool since this is frequently used in examinations.

9.3 Distinctive landforms resulting from different physical processes (1)

This topic considers the landforms resulting from erosion, generally found nearer the source of the river in upland areas. In this part of the river vertical erosion is a strong force and interlocking spurs, rapids, waterfalls and gorges are commonly associated features. Students are expected to be able to describe these features and explain the processes and conditions that enabled them to develop.

Starter activity

• Start with a photograph that clearly shows a river with high energy levels where there is strong evidence of vertical erosion. From that students get a strong initial impression of the erosive force of a river and the ability that it has to transport material.

Plenary activity

• Ask students to consider the evidence they might look for to show that erosion and transportation were taking place if they were carrying out a fieldwork investigation near the source of a river.

Homework

• Activity 9.3 questions 2 and 3 would be a useful homework exercise to consolidate the learning from the lesson.

Check students’ understanding

• Students need to have an awareness of the formation of the landforms highlighted in the GCSE specification. Use diagrams showing outlines of features and ask students to annotate the diagrams to describe the features and briefly explain how they were formed.

9.3 Distinctive landforms resulting from different physical processes (2)

This topic considers the landforms resulting from erosion and deposition in the lower course of a river where the river valley is flatter and wider and lateral erosion is a more significant process. In this part of the river both erosion and deposition create distinctive features such as meanders and ox-bow lakes. The topic will then consider features associated with deposition as the river reaches its lowest course. These features include levees, flood plains and estuaries. Students are expected to be able to describe all of these features and explain the processes and conditions that enabled them to develop.
Starter activity

- Start with a photograph which clearly shows a river in its lower course where there is strong evidence of lateral erosion and deposition (a meander might be useful here). From that students get a strong initial impression of the processes taking place and are visually introduced to some of the key landforms.

Plenary activity

- Ask students to consider the evidence they might look for to show that erosion and deposition were taking place if they were carrying out a fieldwork investigation in part of the lower course of a river.

Homework

- Activity 9.4 question 1 would be a useful homework exercise to consolidate the learning from the lesson.

Check students’ understanding

- Students need to have an awareness of the formation of the landforms highlighted in the GCSE specification. Use diagrams showing outlines of features and ask students to annotate the diagrams to describe the features and briefly explain how they were formed.

9.4 Assessing and managing flood risk

This topic considers the relationship between precipitation and discharge by using hydrographs and shows the importance of understanding these factors in assessing flood risk. It considers the physical and human factors that might influence the flood risk and then investigates the hard and soft engineering methods that can be used to reduce the risk of flooding, with some understanding of the advantages and disadvantages of each. The topic then uses an example of a river in the UK where flooding has been a major issue and assesses the impacts of a previous flood and evaluates the subsequent flood management strategy that has been put in place.

Starter activity

- Use a short video sequence to illustrate the different types of flood (slow build up flood/flash flood) and the impacts of these events.

Plenary activity

- Use summary questions which ask for single word/statement responses. These need to pick up the key points about hydrographs, the physical and human factors that influence flood risks and the techniques used in both soft and hard flood management schemes.

Homework

- A hydrograph exercise where students plot data for both precipitation and discharge and are then asked to explain how this information might be useful in relation to flood management, or use a research exercise which introduces students to the Met Office website [www.cambridge.org/links/gatd4063](http://www.cambridge.org/links/gatd4063) by asking them to focus on the weather conditions leading up to a specific river flood in the UK. This will alert students to the use and value of the Met Office website in relation to future learning and revision.

Check students’ understanding

- Students need to be able to draw and understand a hydrograph and explain how it might be useful in predicting flood risks.
- They then need to be able to describe both hard and soft flood management and show some awareness of the advantages and disadvantages of each.
- The use of the Met Office and The Environment Agency websites may be helpful since they give an applied understanding of this topic: [www.cambridge.org/links/gatd4064](http://www.cambridge.org/links/gatd4064) [www.cambridge.org/links/gatd4065](http://www.cambridge.org/links/gatd4065)
Named example: responding to a flood event – the Boscastle flood 2004

This topic looks at the 2004 Boscastle flood, including the factors which led to the flood, the effects of the flood and the responses to it. Students are encouraged to evaluate the effectiveness of the resulting flood management strategies.

Starter activity

• Ask students to locate Boscastle on a map and identify the rivers in the area.
• Students could do some internet research into the effects of the flooding in Boscastle.

Plenary activity

• Divide students into two teams, one to argue for the Boscastle flood management scheme and one to argue against it. Have the two teams debate whether the Boscastle flood management scheme was a worthwhile investment.

Homework

Ask students to research a local flood management scheme and write a report describing:

• why the scheme was required
• what the scheme is
• any social, economic and environmental issues associated with it.

Check students’ understanding

• Students need to have an understanding of the social, economic and environmental issues that can occur with flood management scheme. Ask the class for at least two examples of each type of issue.

Model answers to ‘Assess to Progress’ questions

1 Name and describe two ways that sediment is transported by a river. 4 MARKS

• Traction is where the force of water rolls stones along the river bed.
• Saltation is where small pebbles and stones are bounced along the river bed by the moving water.

Comment: One mark can be given for the identification of a method (traction, saltation, suspension, solution) and one mark for an understanding of the method. A maximum of one mark should be given for the name of method OR description given but they do not match.

2 How do hydrographs explain the relationship between rainfall and the discharge of a river? 4 MARKS

A hydrograph plots rainfall and the flow of water in a river so that you can see how rainfall affects the discharge in a river.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>3–4</td>
<td>• Shows a clear understanding between the two factors identified in a hydrograph. Does not have to be a complex understanding and may use terminology that implies an understanding ('lag time').</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–2</td>
<td>• Shows a descriptive awareness of what a hydrograph is but does not appreciate the relationship between the two factors. (‘A hydrograph shows the rainfall in an area and how much water is in the river.’)</td>
</tr>
</tbody>
</table>

3 Explain the formation of ox-bow lakes. You may use a diagram. 6 MARKS
On a meander, erosion will take place on the longer bends and they will gradually erode back until they meet and the river breaks through. It will then take the shortest route and the rest of the meander will be cut off and become silted up, forming an ox-bow lake.

**Comment:** Students do not have to use a diagram. An annotated diagram can show an implied understanding without requiring a lot of explanation.

**Mark scheme**

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Clear explanation of how erosion and deposition on a meander creates an ox-bow lake. Does not require a detailed explanation of the processes. (Not a three level question.)</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Offers a description which indicates an awareness of what an ox-bow lake is and suggests that it is related to meanders and results from physical processes (erosion/deposition). The different factors are not linked together effectively to explain the formation of an ox-bow lake. ('An ox-bow lake is part of a meander which has been cut off. There is usually a lot of erosion and deposition doing this.')</td>
</tr>
</tbody>
</table>

4 Describe the major landforms of erosion and deposition in a UK river valley that you have studied.

**6 MARKS**

- Erosion: interlocking spurs, waterfalls, gorges.
- Deposition: levees, flood plains, estuaries.

Near the source of the River Tees there are interlocking spurs and a waterfall created by erosion. Where the river reaches lower land it begins to meander, and material is deposited where it is flowing more slowly. Near the sea, at the estuary a lot of fine sediment is deposited.

**Comment:** The expectation is that students will have studied a river where the identified features in the GCSE specification are present.

**Mark scheme**

<table>
<thead>
<tr>
<th>Level</th>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Names a river and identifies a range of landforms of erosion and deposition and gives some context of the landforms in relation to the long profile of the river.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Names a river and identifies some landforms of erosion OR deposition OR identifies two/three landforms, which include features of erosion and deposition. Limited context of the landforms in relation to their position on the long profile of the river. ('On the River Tees there is a waterfall and also some meanders and an estuary where it meets the sea.')</td>
</tr>
</tbody>
</table>
Using an example you have studied, describe the features of a flood management scheme and explain why the scheme was required. **9 MARKS**

In Boscastle the steep slopes and narrow river channel make the area vulnerable to flash flooding after heavy rainfall. Many buildings had been built close to the river so after a period of heavy rainfall a flood caused a lot of damage. Afterwards a flood management scheme was put in place. The river was widened in order to take more floodwater and low bridges removed so the flow was not interrupted by trees trapped behind the bridges. Buildings were removed from alongside the river in order for the river to expand into a space without causing damage.

**Mark scheme**

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>3 (detailed)</td>
<td>7–9</td>
<td>• Detailed description of a scheme which includes a number of techniques. Reference to why the scheme was required and how the techniques will reduce the flood risk.</td>
</tr>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Clear reference to elements of a scheme with some observations about why it was required beyond simple reference to rainfall. (In Boscastle the river was widened in order to take more water and the low bridges were replaced so that trees would not get trapped if they were flowing down the river. It was needed because there was a major flood and the steep slopes and narrow river made flash floods a major risk.)</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Basic description of an element of a scheme with only limited appreciation of why the scheme was required. (A flood management scheme was used in York where the sides of the river were built up with concrete banks to stop it flooding. It was needed because when it rains the river cannot cope with it so it floods.)</td>
</tr>
</tbody>
</table>
LEARNING OUTCOMES
By the end of this chapter, students should:
• know the glacial processes of weathering and erosion, movement and transportation and deposition
• describe the characteristics and explain the formation of landforms of upland and lowland erosion
• describe the characteristics and explain the formation of landforms of deposition
• describe some of the economic activities which occur in glaciated areas
• explain the conflicts that exist between different land uses and people
• describe and explain how the Lake District National Park manages the pressures of tourism.

Introduction

Prior knowledge
Students should have a basic knowledge gained through Key Stage 3 study of climate change from the Ice Age to the present and glaciation, including:
• a basic understanding of global climate distributions and particularly the distribution of ice.
• a basic understanding of the processes and landforms found in glaciated regions.

Geographical skills
Graphical skills can be developed using Activity 10.1 question 1. Students are asked to use their skills to describe the pattern on a graph.

Cartographic skills can be developed using Activity 10.3 question 2. Students are asked to work out the direction that the corrie is facing and explain how they know this.

Numerical skills can be developed using Activity 10.3 question 3. Students are asked to calculate the length of Cwm Idwal given the ratio of length to height.

General notes
It is important to be led by the GCSE specification when setting up teaching of this topic area. Remember, students will need to be able to describe and explain the formation of a range of glacial landforms and describe some of the economic activities which take place. They will also need to be able to explain why conflicts exist in glaciated areas. Detailed knowledge of a specific named example, such as the Lake District National Park, is needed to bring out the detail outlined above.

Many of the other activities in the chapter lend themselves to focused internet research. Appropriate weblinks have been suggested as a starting point and students should develop effective ways of managing the information that they find. If computers are unavailable during the lesson, students can be encouraged to carry out research for homework and bring their notes to the following lesson for further examination and discussion.

Additional support
Students need to understand the mass balance of a glacier and this may prove difficult for some students. Spending time on the explanation of this and providing information in a number of forms, e.g. graphs, animations, diagrams etc. should help the understanding of this concept.

A basic knowledge of glaciation will have been developed in Key Stage 3 geography. It may be useful to revisit this previous study before moving on to the more detailed understanding needed at this level.
Extension
While an understanding of climate change is not required for this topic it may be useful for students to research the natural cycles which result in increased glaciation and whether this scenario is likely to re-occur in the future.

Also, detailed, named example, knowledge of how the pressures of tourism are managed in a glaciated area such as the Lake District National Park, is important and further information can be found at the weblinks suggested in this topic. Students can increase their chances of exam success by researching named examples in more detail.

Worksheets
Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

Worksheet 10.1 supports Activity 10.5 question 1 and involves students locating photographs of glacial features on a map of the Lake District. Students could be encouraged to add detail to their maps by annotating the photographs.

Worksheet 10.2 supports Activity 10.6 question 2 and involves students considering whether the costs of tourism in the Lake District outweigh the benefits.

Videos
Chapter 10 in the Cambridge Elevate enhanced edition includes the video clip: How has the UK’s climate changed? The clip looks at evidence for how the UK’s climate has changed over time. The clip comes from the Glaciation in the UK (DVD by Pumpkin Interactive Ltd).

Lesson ideas

10.1 Why do glacial landforms exist in the UK?
This topic describes the current distribution of ice and also the different forms that this can take. Interglacials and glacial are then introduced before a discussion of the distribution of ice in the last Ice Age. This highlights the fact that, during the last Ice Age, much of the UK was covered in ice which shaped the landscape.

Starter activity
• Show students a photograph of the landscape in the Lake District or Snowdonia. Students could discuss what they think shaped the landscape. They should explain why they think this. They could also consider what processes are currently working to shape the landscape.

Plenary activity
• Check knowledge and understanding of key terms such as glacials and interglacials. Read out a list of major towns and cities and the students could say whether they were under the ice sheet or not during the last Ice Age in order to check knowledge regarding the distribution of the ice sheet. This would also get students thinking about the location of places as well as the extent of the ice.

Homework
• Students could write a paragraph describing what the place where they live would have been like during the last Ice Age. They will need to locate their home town on a map of the UK and relate this to Figure 10.3.

Check students’ understanding
• Students need to understand that the environment of the UK was very different during the last Ice Age.
• They often want to know about what happened to the people and a website such as the British Geological Survey (www.cambridge.org/links/gatd4066) might be useful to explain this.

10.2 What are glaciers?
This topic explains how glacier ice forms before explaining the concept of the glacier budget.
Starter activity

- Discussion could focus on how glacial ice forms and the fact that it can take several hundreds of years for glaciers to form. The teacher could prepare a see-through container with different coloured layers of ice to demonstrate this. Each layer of water, coloured with food colouring or stained with different strengths of tea, will need to be frozen in turn.

Plenary activity

- There should be a check on knowledge gained about the glacial budget, particularly regarding the fact that it varies seasonally. Students should think about what is happening over the course of a year in order to describe whether the glacier is advancing or retreating.

Homework

- Students should carry out some research about the mass balance of a particular glacier. The South Cascade glacier in Washington State, USA is a good one to research. Some useful websites are the USGS (www.cambridge.org/links/gatd4067) and the Guardian article ‘Climate change melting US glaciers at faster rate, study finds’ (www.cambridge.org/links/gatd4068).

Check students’ understanding

- The concept of the glacier budget, combined with glacier movement is something that students find very difficult to grasp.
- Students should understand the fact that the glacier appears to be retreating even though it continues to move forward is something that needs to be reiterated. Using a physical model or an animation to illustrate this would be useful to ensure this is fully understood. The animations at University of Kentucky Earth and Environmental Sciences website (www.cambridge.org/links/gatd4069) or on the Norton website (www.cambridge.org/links/gatd4070) are quite useful to show this.

10.3 How do glacial processes shape the landscape? (1)

This topic describes and explains the processes of weathering and erosion which shape the glacial landscape. The process of freeze-thaw weathering is discussed before the processes of erosion – plucking and abrasion – are covered.

Starter activity

- Students need to understand the difference between weathering, which is due to freeze-thaw activity and erosion, which is due to glacial movement. There are many suitable videos available to show this or alternatively, students could be asked to discuss what they know already about the differences between weathering and erosion. One particular example is on YouTube (www.cambridge.org/links/gatd4071).

Plenary activity

- There should be a check on knowledge gained about the different processes of weathering and erosion that have been covered. Students could revisit the photographs of landscapes in the Lake District and Snowdonia and use their knowledge to explain how these processes created the distinct landscapes.

Homework

- Students could carry out the experiment in Activity 10.2 question 1. They could write up their findings and share these as a class in the following lesson.

Check students’ understanding

- It is important that students know and understand the differences between weathering and erosion.

10.3 How do glacial processes shape the landscape? (2)

This topic covers glacial movement and includes basal slippage, rotational slip and internal deformation. It then discusses how glaciers transport and deposit their loads.
Starter activity

- Students should discuss what the load of the glacier is like given the processes of weathering and erosion covered earlier. They should particularly focus on the fact that it is angular and of varying sizes.

Plenary activity

- Check students’ knowledge of glacial movement, transportation and deposition. This could be done by the teacher describing a key idea and the students having to identify what it is they are describing. For example, the teacher could pick the idea of bulldozing and describe it without using the term.

Homework

- Students could carry out some research to investigate the speed of glacier movement. In particular, they could explain why different glaciers have different rates of movement.

Check students’ understanding

- Students need to understand that because the glacial load is frozen and embedded within the ice it has restricted movement. This means that, unlike rivers, attrition does not occur. This means that the load remains angular.

10.4 What landforms result from glacial erosion in upland areas?
This topic describes and explains the formation of a range of upland landforms of glacial erosion.

Starter activity

- Show students a photograph of a corrie such as Figure 10.12. Students could come up with as many adjectives as possible to describe the corrie and tarn. This will help them to write their annotations in Activity 10.3 question 1.

Plenary activity

- Students could play a game of ‘Taboo’. A key term is written on a card along with three or four other associated words. Students have to try to make the rest of the class guess the key term without using any of the other associated words.

Homework

- Students could make a model of one of the landforms discussed in this topic. They could make it out of modelling clay, papier mache or in Minecraft. They should use their knowledge to annotate their model. They can do this by creating written flags which they can locate around the model or by screen capturing their computer models and annotating a print-out.

Check students’ understanding

- Students need to be able to recognise the features of erosion in upland areas both in photographs and on an OS map.

10.5 What landforms result from glacial erosion in lowland areas?
This topic describes and explains the formation of a range of lowland landforms of glacial erosion.

Starter activity

- The students could be provided with photographs of the lowland landforms, cards with the landform names and cards with a paragraph of information about the landforms. They should match the cards with the correct landform.

Plenary activity

- Students could create a crossword or wordsearch which tests their understanding of the different landforms of lowland erosion. They could then swap their puzzles with a friend and have a go at completing theirs to test their own knowledge.
Homework

- Students could create a ‘spotters guide’ to landforms of glacial erosion in lowland areas. They should find photographs and diagrams of the different landforms, provide useful information including its formation and suggest where these landforms might be found.

Check students’ understanding

- Students need to be able to recognise the features of erosion in lowland areas both in photographs and on an OS map.

10.6 What landforms result from glacial deposition? (1 and 2)
This topic describes and explains the formation of landforms of glacial deposition including moraine, drumlins and erratics.

Start activity

- Students should discuss where landforms of deposition are likely to be found. They should understand that deposition occurs in lowland areas as temperatures increase and so the ice melts. However, they should also appreciate that deposition can also occur in upland areas where there is friction between the rock and the moving ice.

Plenary activity

- Carry out a knowledge check to ensure that students can recognise the main landforms of deposition and can explain their formation. One way to do this would be to show students a photograph of a landform which they have to identify and explain the formation.

Homework

- Students could select one of the landforms of deposition and create a revision video for the particular landform. These could then be watched in class and students could vote for their favourite.

Check students’ understanding

- Students need to understand that landforms of deposition occur in areas where the ice melts either due to an increase in temperature or friction between the rock and the ice.
- Students also need to understand that some landforms of deposition, particularly moraines and drumlins, are likely to be vegetated in the UK given that deposition occurred at the end of the last Ice Age, 10,000 years ago.

10.7 What economic opportunities do glacial landscapes provide?
This topic discusses the various economic opportunities which are provided by glacial landscapes. The main focus is on tourism but other activities such as agriculture are also considered.

Start activity

- Students could write a list of opportunities that glacial landscapes provide. They should try to explain why these are opportunities specific to glacial landscapes.

Plenary activity

- Students could find a photograph which illustrates the opportunities that glacial landscapes provide. They should annotate the photograph to show their learning from the lesson.

Homework

- Students could carry out some further research about economic opportunities found in glaciated areas such as the Lake District. For example, they could carry out some research about Hill Sheep farming in the Lake District (www.cambridge.org/links/gatd4072).

Check students’ understanding

- Students need to understand that tourism is not the only economic opportunity of glaciated areas. They should be able to talk about other opportunities in detail.
10.8 Why do we need strategies for managing glacial landscapes?

This topic highlights why it is important to manage glacial environments.

**Starter activity**

- Students could come up with a list of people who may have conflicting viewpoints about how glacial landscapes may be managed.

**Plenary activity**

- Students could create a conflict matrix to show which people are likely to be in conflict with each other. Students should be able to explain some of the decisions that they have made.

**Homework**

- Students could consider one of the conflicts that they have identified in their matrix. They should come up with some strategies for reducing the conflict and solving the issues which might arise.

**Check students’ understanding**

- Students need to understand that different people will have different perspectives on how glacial landscapes should be used.

**Named example: the Lake District**

This topic introduces the Lake District as a named example of a glaciated area. It highlights the different economic opportunities the landscape provides before moving on to a discussion of the various management strategies which are required.

**Starter activity**

- Students should locate the Lake District on a map of the UK. They should be able to describe the location at a range of scales.

**Plenary activity**

- Check students’ understanding of glacial features in the Lake District by writing an example on the board. Students then have to determine the landform. This activity could include suggesting an example.

**Homework**

- Students could carry out some research to create their own factfile of a specific landform found in the Lake District. For example, they could create a factfile about Red Tarn or one of the glacial ribbon lakes such as Windermere.

**Check students’ understanding**

- Students need to understand the Lake District as a place rather than just as a location. The more information and knowledge they can build up about the named example the more understanding they will have.

**Named example: the Lake District National Park**

This topic introduces the Lake District National Park and, in particular, the physical and human characteristics which make this area unique. It also introduces the pressures and conflicts which exist within the area.

**Starter activity**

- Students need to be able to distinguish between the Lake District as a glaciated area and the Lake District National Park which was created in 1951 and aims to conserve and enhance the natural landscape.
Plenary activity

• Students could use Activity 10.6 question 3 to consider which places in the Lake District could be honeypot sites and why this might be.

Homework

• Students could create a mind map of the different pressures on the Lake District National Park. For each of the pressures they could explain what it is, give an example and suggest how each pressure can be managed. There are some examples in the text but students may want to carry out further research to ensure their mind maps are detailed.

Check students’ understanding

• Students need to understand that not everywhere in the Lake District National Park will have the same pressures. In order to access the highest grades they need to distinguish the specific pressures and management initiatives which occur in specific locations rather than being generic.

Model answers to ‘Assess to Progress’ questions

1 Using a diagram, explain the formation of a corrie. 6 MARKS

A corrie is a bowl-shaped hollow found in upland areas that have been glaciated. The corrie starts as a small indentation where snow gradually builds up. Over a period of many years these layers of snow become compressed to form firn and then glacial ice. As the glacial ice begins to flow downhill in the hollow it becomes wider and deeper. Plucking on the backwall of the hollow makes it steeper and abrasion in the bottom of the hollow makes it deeper. Eventually, the corrie glacier flows out of the hollow and down the mountain. The front of the hollow is marked with a rock lip where there has been less erosion. As the ice pulls away from the backwall (onto which it is frozen) deep crevasses can appear which are called Bergschrund. When the glacier melts the corrie is left. Sometimes corries can fill with water and small, round corrie lakes or tarns are formed. An example of a corrie is Red Tarn in the Lake District.

Comment: Students should draw a diagram that looks similar to Figure 10.13. They should then explain the formation of a corrie.

Mark scheme

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>3 (detailed)</td>
<td>5–6</td>
<td>• Includes thorough application of knowledge giving detailed explanation of formation of the features. Demonstrates specific and accurate knowledge of processes taking place and the resultant landforms in glacial environments.</td>
</tr>
<tr>
<td>2 (clear)</td>
<td>3–4</td>
<td>• Demonstrates specific and accurate knowledge of processes taking place and the resultant landforms in glacial environments. Shows sound geographical understanding of the interrelationships between environments and processes.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–2</td>
<td>• Demonstrates some knowledge of processes operating and the resultant landforms in glacial environments. Shows limited geographical understanding of the interrelationships between environments and processes.</td>
</tr>
</tbody>
</table>
Suggested content

The question asks for a diagram and therefore credit should be given for these within the answer. The diagram should be clear and well annotated to show the different parts of the corrie as well as the processes at work to create the landform. Poorly completed diagrams are likely to move the answer to Level 2. Credit should be given to students who draw more than one diagram to show process and change over time, i.e. before, during and after glaciation.

‘Corries start to form in upland, mountainous areas where snow is present all year round which collects in small hollows. Over many hundreds of years, successive layers of snow fall and become compacted to create firn and then glacial ice, so that a small, circular glacier occupies the hollow. Rotational slip causes the corrie glacier to move within its hollow and the processes of plucking and abrasion deepen and steepen the hollow over time. Abrasion takes places mainly at the base of the corrie glacier resulting in it becoming deeper whilst plucking tends to occur on the backwall of the corrie and this makes it steeper.’

Reference may be made to features which make up the corrie such as Bergschrund and the rock lip and students may highlight the presence of a corrie lake or tarn in the period after glaciation. Expect references to examples such as Red Tarn in the Lake District and the fact that corries tend to form on north-facing slopes in the UK as these are slightly cooler than south-facing slopes.

2 With the help of Figure 10.19 describe and explain the location and formation of one type of moraine. 6 MARKS

Boulder clay or glacial till is the material that is deposited by the glacier. Till is typically made up of a variety of different sizes of angular rock which are held together with smaller particles, e.g. clay. Medial moraine is a landform of deposition which means that it is composed of boulder clay. It is a long thin band of unsorted, angular material which is found in the middle of a U-shaped valley. The glacier has eroded bits of rock by the processes of plucking and abrasion and these are incorporated into the ice. As the glacier moves down the valley there is friction between the glacier and the valley sides and consequently there is melting where the glacier touches the valley. As two tributary glaciers (both with lateral moraines) flow down the valley, they merge halfway down the valley, which causes two lateral moraines to become one, which is located down the middle of the U-shaped valley.

Comment: The answer will depend upon the type of moraine selected. However, in describing the location students should firstly describe what moraine is, i.e. that it is made of unsorted glacial deposits and then describe where it is found. In explaining the formation students should explain why the glacier deposits its load in the position that they have chosen and also why these deposits are unsorted.

Mark scheme

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</thead>
<tbody>
<tr>
<td>3 (Detailed)</td>
<td>5–6</td>
<td>• Includes thorough application of knowledge and understanding to interpret geographical information, giving detailed explanation of formation of the features shown. Makes full use of source to provide valid interpretation and support response.</td>
</tr>
<tr>
<td>2 (Clear)</td>
<td>3–4</td>
<td>• Demonstrates specific and accurate knowledge of processes taking place and the resultant landforms in glacial environments. Shows sound geographical understanding of the interrelationships between environments and processes.</td>
</tr>
</tbody>
</table>
Suggested content

The location of the type of moraine should be described in detail, i.e. that it is made of unsorted glacial deposits and then describe its position in the valley. In terms of explanation, processes should be outlined as well as the sequence of formation in relation to the chosen landforms. Processes include freeze-thaw on mountain slopes, various forms of mass movement, and erosional processes of plucking and abrasion, all of which contribute to the creation of morainic debris. Transport processes are relevant as are processes of deposition under the ice (subglacial), on top of the ice (supraglacial), alongside the glacier and ahead of the glacier snout (proglacial).

‘Lateral moraine forms along the edges of the glacier. Material from the valley walls is broken up by frost shattering and falls onto the ice surface. It is then carried along the sides of the glacier. When the ice melts it forms a ridge of material along the valley side. Medial moraine is formed from two lateral moraines. When two glaciers merge, the two edges that meet form the centre line of the new glacier. As a result, two lateral moraines join in the middle of the glacier forming a line of material on the glacier surface. The existence of a medial moraine is evidence that the glacier has more than one source. When the ice melts it forms a ridge of material along the valley centre. Terminal moraine forms at the snout of the glacier. It marks the furthest extent of the ice, and forms across the valley floor. The ice scratches and scrapes the bed by a process of abrasion, generating large amounts of fine material added to by larger blocks plucked from the bed. This material is transported to the glacier snout where it is dumped in huge mounds across the valley. It is usually the feature that marks the end of unsorted deposits and the start of water sorted material.’

No credit for describing the features, location or position of other landforms of deposition.

3  Explain how tourism might put pressure on the physical environment of a glacial environment such as the Lake District National Park. 6 MARKS

Glaciated environments are often honeypot sites which means that they are attractive for tourists. However, the Lake District has over 15 million visitors per year, many of whom come for day trips, and this volume of tourists puts pressure on the physical environment. For example, if large numbers of tourists go walking to take in the picturesque views then there is likely to be footpath erosion. Also, if the erosion is so extensive that it is unclear where the pathway is, then tourists could stray and damage plants which may be rare, such as the blanket mire. Tourists can also drop litter which is unsightly and can damage wildlife. Some tourists take part in water sports on the Lake District’s famous lakes and this can disturb wildlife if not managed effectively.

Mark scheme

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</tr>
</thead>
<tbody>
<tr>
<td>3 (detailed)</td>
<td>5–6</td>
<td>• Includes thorough application of knowledge giving detailed explanation of how tourism might put pressure on the physical environment. Demonstrates specific and accurate knowledge of a glacial environment such as the Lake District.</td>
</tr>
<tr>
<td>Level</td>
<td>Marks</td>
<td>Description</td>
</tr>
<tr>
<td>-----------</td>
<td>-------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2 (clear)</td>
<td>3–4</td>
<td>• Demonstrates specific and accurate knowledge of processes of a glacial environment such as the Lake District. Shows sound geographical understanding of how tourism might put pressure on the physical environment.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–2</td>
<td>• Demonstrates some knowledge of a glacial environment such as the Lake District. Shows limited geographical understanding of how tourism might put pressure on the physical environment.</td>
</tr>
</tbody>
</table>

**Suggested content**

The question mentions the Lake District as an example and so credit should be given for the use of a case study example. The question also asks for candidates to link the activities of tourists to pressure on the physical environment and credit should be given for the identification of tourist activities such as walking and water sports and the identification of specific pressures on the physical environment.

‘Pressures are likely to focus on walkers eroding footpaths and the disturbance of wildlife and rare plants, the dropping of litter which is aesthetically unappealing and water sports which can lead to noise pollution and the disturbance of wildlife.’
LEARNING OUTCOMES
By the end of this section introduction, students should:

• know that a growing percentage of the world’s population live in urban areas
• know that urbanisation is associated with both opportunities and challenges.

General notes
The section introduction provides an overview of the global trend in urbanisation, which is explored in greater detail in Chapter 11.

Suggested learning activities

• Introduce key definitions (urban/urbanisation).
• The caption to Figure S4.1 in the student book contains the discussion question 'Urban areas create a wide range of social and economic opportunities but also a number of management challenges. What opportunities and challenges are suggested by this photograph?' This could form the basis of a class discussion. Answers might include overcrowding, the growth of slum areas, difficulty in supplying services such as water and sewerage to a growing population, a lack of green space, and environmental problems such as pollution.
Introduction

Prior knowledge
Students should have a basic knowledge of the characteristics of urban areas in different parts of the world.

Geographical skills
Cartographic skills can be developed through use of Ordnance Survey maps to identify land uses in Birmingham and locate identified regeneration projects. In Activity 11.11 question 1a, students are asked to construct a proportional bar graph on a blank world map.

Graphical skills can be developed through Worksheet 11.1, which asks students to plot a graph to show urban population numbers between 1950 and 2050 (projected).

Photographic interpretation skills can be developed using photographs: in Activity 11.3 question 7, students are asked to show how conditions depicted in a photograph are a risk to health.

Research skills can be developed by looking at websites associated with news events and examples appropriate to the specified areas of study. These could include recycling in Dharavi (Case study: Opportunities and challenges of urban growth in Mumbai), Dharavi redevelopment plan (Example: Urban planning in Mumbai), history of migration to Birmingham (Case study: Birmingham – national and international links), Longbridge regeneration plan (Example: Urban regeneration in Birmingham) and reducing traffic congestion (11.6 Managing traffic congestion in cities).

General notes
It is important to be guided by the GCSE specification when teaching this topic. To start, it is important that students have an appreciation of the nature of urban growth and how it is linked to economic development and the growth of urban/industrial core areas. In that context there is a clear link to both economic development models and the demographic transition model. Having established this link, it is worth observing the example of China or India, as countries with rapid economic development, high rates of urbanisation and a rapidly growing urban population. From this, the link to migration should be a logical step, with the additional development of identifying that younger people tend to migrate, which means that urban areas often have high proportions of their population in the fertile age range.

The case studies of one LIC/NEE and a UK city are used to identify changes and consider the opportunities and challenges that change creates. It is important to set the chosen cities in their broader context since these factors often influence change. Having considered the issues created by change there is then an opportunity to consider the management challenges that they pose.

In the early part of the 21st century the world’s urban population became greater than the world’s rural population for the first time and it is estimated that the world will become increasingly urban over the next
50 years. Consequently, there will be a need for urban areas to become increasingly sustainable if they are going to operate effectively.

**Additional support**

The use of the UN Habitat website ([www.cambridge.org/links/gatd4073](www.cambridge.org/links/gatd4073)) will give a good understanding of global urban change and provide useful statistical and cartographic information about urbanisation and the growth of megacities. It will also provide a useful insight into the opportunities and challenges presented by urban growth. Local authority websites will provide good information on both Mumbai and Birmingham and simply using a websearch in relation to key ideas expressed in the GCSE Specification will be helpful. In relation to Mumbai, visual images will provide a good stimulus for an appreciation of the city and video will give a useful perspective of the challenges facing the city. Useful internet resources include: Kevin McCloud – Slumming it (1) and (2) ([www.cambridge.org/links/gatd4074](www.cambridge.org/links/gatd4074)) and ([www.cambridge.org/links/gatd4075](www.cambridge.org/links/gatd4075)).

**Extension**

Extension activities are highlighted throughout the chapter in terms of research opportunities. Use these opportunities to develop the depth of understanding required for Level 3 examination answers rather than simply extending knowledge. Extension activities can be based around further exploration of any of the key words or ideas expressed in the GCSE specification. The use of news reports/newspaper articles is particularly useful for this topic: Search for the BBC report on urbanisation and the growth of megacities; articles in many newspapers about urban growth and the challenges it creates/sustainable urban growth).

Giving students a copy of a single article and asking them to identify a small number of key points is a useful exercise and will help to develop independent learning skills.

**Worksheets**

Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

**Worksheet 11.1** makes use of graphical skills in completing a line graph. Students are enabled to identify 2007 as the year that both urban and rural population accounted for 50 per cent of the world population. Helps students understand that some factors encourage people to move away from an area while others may encourage people to move towards an area.

**Worksheet 11.2** Students should show an understanding of the different aspects of sustainable urban planning (resources management, public transport etc.) and offer some suggestions about how these factors make an urban area more sustainable. They should be able to suggest how the development will help to regenerate the area, both in relation to the opportunities created by the development and how it might encourage business and people into the area.

**Worksheet 11.3** makes use of cartographical and graphical skills including constructing a proportional bar graph. Possibility of using spider diagram to suggest how traffic congestion can cause economic and environmental problems.

**Lesson ideas**

**11.1 Living in an increasingly urban world**

This topic looks at the relative growth of global and urban world population and considers the early 21st century as the time when we became an ‘urban world’ and how urban growth in LICs and NEEs will move the global urban population to 70 per cent by 2050.

**Starter activity**

- Use of UN Habitat data (graph) to open up a descriptive understanding of urban/rural population change. Draw a line graph to show urban and rural population. Discuss the changes shown by the graph. Encourage students to use specific data.

**Plenary activity**

- Identify those continents/countries that are going to add significantly to the world’s urban population in the next 30 to 40 years.
Homework

- Research the change (and predicted change) from 1980 to 2040 to the urban population in either China, India or Nigeria. Draw a line graph to show the change and write a description of the change, using the data to support the description.

Check students’ understanding

- It is important for students to appreciate the link between economic development and urbanisation and how rapid economic development in parts of Asia and Africa is generating high rates of urbanisation.

11.2 What are the causes of urbanisation in LICs and NEEs?

This topic looks at how migration and natural increase are key factors in urban population change. It then considers how migration and fertility rates might be related.

Starter activity

- Use visual images from an LIC/NEE city (or a rural and urban area) and get students to identify five possible advantages of living in an urban area.

Plenary activity

- Identify five reasons why people migrate to urban areas. Check the definition of ‘natural Increase’ and how birth rate/death rate are measured.

Homework

- A question which asks students to suggest how migration and natural increase might be linked (idea of age profile of migrants/youthful populations/fertility rates).

Check students’ understanding

- It is important for students to understand that migration is a major driving force for urbanisation in LICs and NEEs and also that natural increase plays a part in urban population growth.
- Students should also realise the relationship between these two factors.

11.3 The growth of megacities

This topic looks at the growth of megacities and how this growth is likely to continue and be focused in particular parts of the world, especially Asia. It also brings in the idea of spatial growth and begins to consider the pressures and challenges of growth and how cities of this scale are difficult to manage.

Starter activity

- Ask students to suggest how a megacity might be defined. You could use a world map showing megacities in 1980 (around that date) and ask students to name the cities and then show another world map with predicted megacities in 2030/2040.

Plenary activity

- Check the definition of ‘megacity’. Use visual/written sources such as BBC – megacities (www.cambridge.org/links/gatd4076) or the Guardian – Pearl River (www.cambridge.org/links/gatd4077).
- Suggest three challenges facing megacities.

Homework

- Research different sources which estimate the number of megacities in the future. Identify the sources and the data and suggest why the estimates vary.

Check students’ understanding

- Students should be able to define the term megacity and have an understanding of the current and future locational growth of megacities.
Case study: Mumbai – a city of national and international importance

This topic considers the importance of Mumbai within the State of Maharashtra and as the major industrial and commercial city in India. It also looks at wider links with other parts of the world.

Starter activity

- Use images or a short film clip of the commercial heart of the city and ask students to identify as many international names (companies/advertising hoardings) as possible. Introduce the concept of sphere of influence in relation to cities.

Plenary activity

- Use a simple concentric circle diagram to illustrate regional, national and international influences and suggest evidence for each scale.

Homework

- Use a business directory or business websites (Morgan Chase/international banks) to identify a range of international companies that operate in Mumbai.

Check students’ understanding

- Students should appreciate that cities are an important driving force in relation to economic development (idea of ‘core’ areas).
- As such they have a significant sphere of influence, which can be expressed in local, regional, national and international terms.

Named example: Urban planning in Mumbai

This topic looks at urban planning in Mumbai and how it is improving life for the urban poor. The topic looks at several schemes aimed at improving the quality of life in the Mumbai slums, including a resettlement scheme, sanitation project, incremental housing strategies and electrification project.

Starter activity

- Ask students to suggest how life in a Mumbai slum differs to life in a wealthy Mumbai suburb or their own lives. What would be the biggest challenges? Write these on the board or on a piece of paper.

Plenary activity

- Revisit the list created in the Starter activity and get students to identify how each scheme helps to address these challenges. Have any of the challenges not been addressed?

Homework

- Ask students to investigate the Dharavi redevelopment plan, describe the main changes and their advantages and disadvantages (this is the task in the Further Research box).

Check students’ understanding

- Students should understand the urban planning can improve living conditions.
- Students should be able to identify how urban planning has affected their own lives, e.g. access to schools, medical centres and so on.

11.4 The UK’s urban landscape

The topic introduces students to the UK urban landscape by identifying the major cities and urban conurbations. It considers how the term ‘urban’ is defined and the characteristics of urban areas.

Starter activity

- Ask students to name ten cities in the UK and locate them on a blank map. Put a map on the board naming and locating the UK’s major cities.
Plenary activity

- Put on the board the names of the five largest UK cities and five populations. Ask students to rank the five largest UK cities and their population in order of population size.

Homework

- Ask students to answer the question: ‘Why are cities important areas of economic development?’

Check students’ understanding

- Students should have an awareness of the urban background of the UK
- They should also have an understanding of the major urban areas in the UK and the infrastructural links that connect them.
- An atlas will be a useful resource to enable students to have an appropriate level of background knowledge.

Case study: Birmingham – national and international links

The topic looks at Birmingham city, its location and importance, how migration has affected the character of the city, and how urban change has created both opportunities and challenges.

Starter activity

- Ask the class if they’ve ever visited Birmingham and get them to share their thoughts and impressions of the city.

Plenary activity

- Ask students for five social and economic opportunities in Birmingham and five social and economic challenges.

Homework

- Ask students to create a poster trying to attract new businesses to Birmingham. The poster should explain the different attractions and opportunities in Birmingham.

Check students’ understanding

- Students should understand the effects of urban change in cities in the UK. Ask students to suggest how these apply to a local city.

Named example: Urban regeneration in Birmingham

The topic looks at regeneration schemes in Birmingham including the Big City Plan and Longbridge regeneration plan. It looks at the reasons behind the regeneration schemes and the main features of the schemes.

Starter activity

- Ask the class for reasons why areas might become derelict. This might broaden into a discussion about changes in economic activity in the UK, such as the loss of manufacturing industries.

Plenary activity

- Ask students to evaluate the regeneration schemes – do they think they will be successful?

Homework

- Activity 11.9 is a useful homework activity to consolidate student learning.

Check students’ understanding

- Students should understand why regeneration schemes are needed and how they create opportunities for local people.
- It could be useful to look at a local regeneration scheme and evaluate how successful it has been.
11.5 Sustainable urban living

This topic will consider the resource demands and pressures caused by urban growth and what factors need to be considered if an urban area is going to be increasingly sustainable. It will then look at strategies being used to make cities more sustainable and large scale sustainable urban planning projects.

Starter activity

- Use visual images to illustrate what ‘cities of the future’ might look like, for example ‘Urban Greening’ or ‘Megacity solutions’ (www.cambridge.org/links/gatd4078). This will get students thinking about the factors that need to be considered and encourage them to use their imagination.

Plenary activity

- Students should suggest the three most important factors that need to be considered if a city is going to be increasingly sustainable. Give reasons for their choice.

Homework

- Suggest that students EITHER research a proposed/planned eco-city and identify its major characteristics, OR (possibility of fieldwork) consider the management strategies that might be used in the local urban area in order to make it more sustainable (or, at least, improve the environmental quality), OR consider how a particular strategy (urban greening) might be implemented into a local urban area.

Check students’ understanding

- Students should understand the range of factors that need to be considered if an urban area is going to be increasingly sustainable.
- They should also have an awareness of how some of these factors are being managed in urban areas.
- Students should also have an understanding of how a range of sustainable management strategies are being incorporated into the development of newly planned urban areas.

11.6 Managing traffic congestion in cities

This topic considers how urban growth and economic development create increasing traffic congestion problems in urban areas and the impact that this can have on socio-economic and environmental conditions. It then goes on to look at different strategies that are being used to manage traffic congestion in cities (management can be seen in relation to individual strategies; ‘Park and ride’, or as a policy which will include a number of strategies).

Starter activity

- Short video clip of traffic congestion in an LIC/NEE (e.g. Bangkok). Identify three problems caused by traffic congestion and create a spider diagram suggesting ways that traffic congestion might be reduced.

Plenary activity

- Identify traffic management strategies in the local area or in an area that students have personally experienced.

Homework

- Investigate the different strategies used in one urban area (select an area where there are a range of strategies and give some reference points). List the different strategies and suggest how they might reduce traffic congestion.

Check students’ understanding

- Students should have an understanding that urban and industrial growth creates increasing traffic pressures.
- They should also know that for an urban area to be efficient it is important that traffic congestion is not a major issue.
• In this context the efficient movement of people and goods in urban areas is a fundamental part of any sustainable management strategy.
• Students should have an awareness of the different types of management used to reduce the risk of traffic congestion.

Model answers to ‘Assess to Progress’ questions

1. Describe the ‘push-pull’ theory of migration. **4 MARKS**

People move to places to find work or because life in the countryside is hard and they cannot get any healthcare. A push factor is something that pushes people away from a place, for example drought. A pull factor is something that attracts people to an area, for example the chance of a job.

Comment: Students may answer from the perspective of the theory, ‘The push-pull theory of migration tries to explain why people move to urban areas …’ [then developing the ideas].

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>3–4</td>
<td>• Clear reference to the idea of ‘push’ and ‘pull’ factors which offers a definition/implied definition with some development. Max 2 marks if only ‘push’ OR ‘pull’ factors considered.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–2</td>
<td>• Basic description of reasons for migration with limited reference/definition of the idea of ‘push’ or ‘pull’ factors. MAX 1 mark if only references ‘push’ OR ‘pull’ factors.</td>
</tr>
</tbody>
</table>

2. Suggest why the growth of megacities is largely in LIC/NEE countries. **4 MARKS**

A megacity is a city of ten million people and these are growing rapidly in LIC/NEE countries because these cities are going through a period of industrialisation and millions of people are attracted to them in order to find work. Cities in more developed countries have already gone through this period so their cities are not expanding very much. The growth is largely in LICs/NEEs because in these countries people are moving to the cities in order to get work and improve their living conditions and this means that the cities are growing rapidly and becoming very large.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (Clear)</td>
<td>3–4</td>
<td>• Clear reference to the idea of ‘megacity’ and offers some appreciation of relative growth and the reasons for growth in LIC/NEE countries.</td>
</tr>
<tr>
<td>1 (Basic)</td>
<td>1–2</td>
<td>• Basic answer which tends to focus on the general reasons for growth with no real discussion about relative factors such as levels of development and the process of economic development. No real reference to the idea of ‘megacity’.</td>
</tr>
</tbody>
</table>

3. Explain how urban transport strategies are being used to reduce traffic congestion. **6 MARKS**

There are many different types of urban transport strategies, including park and ride and integrated bus systems. They have an integrated bus system in Curitiba, Brazil. This picks up people from local areas and drops them off at particular stops where they catch an express bus into the city. It is fast and cheap and encourages people to use it rather than driving so it removes thousands of cars from...
the roads every day, reducing traffic congestion. In Manchester there is a tram system which brings people into the city centre from all over the city. It operates every day and connects up most places visited by people such as Old Trafford.

Mark scheme

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<th>Level</th>
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<th>Description</th>
</tr>
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<tbody>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Shows an awareness of different strategies and explains how they are being used to reduce traffic congestion.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Basic description of an urban transport strategy/strategies, for example ‘park and ride’, public transport. Limited explanation of how it works and the extent to which it reduces traffic congestion.</td>
</tr>
</tbody>
</table>

4 Using an example of an LIC/NEE city you have studied, describe the challenges of urban growth. 6 MARKS
In Mumbai, thousands of people migrate to the city each year and most end up in illegal squatter settlements, which are overcrowded and very polluted. Because it is so overcrowded it is difficult to put in water supply and electricity and improving the housing would be very expensive. Managing traffic congestion is a real challenge because the number of cars is increasing so quickly.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (Clear)</td>
<td>4–6</td>
<td>• Identifies a city and offers some appreciation of how growth creates challenges.</td>
</tr>
<tr>
<td>1 (Basic)</td>
<td>1–3</td>
<td>• Identifies a city and describes some of the problems that the city faces. Largely generic points with limited reference to the idea of growth. ‘In Mumbai there are lots of problems. There is a lot of pollution because of the growing number of cars and lots of people live in slums where the houses are poor and they use the street for a toilet.’</td>
</tr>
</tbody>
</table>

5 Using an example you have studied, explain how urban planning is improving the quality of life for the urban poor in an LIC or NEE. 9 MARKS
In the slum area of Dharavi, in the Indian city of Mumbai, there is a slum clearance scheme where new flats are being built and given to the slum dwellers at reasonably priced rents. The flats are larger and have up-to-date facilities such as water supply, sanitation and electricity. This means that the people will not have to live in overcrowded conditions with poor facilities which are polluted by sewage, reducing the risk of disease and increasing security.

Mark scheme

<table>
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<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (detailed)</td>
<td>7–9</td>
<td>• Detailed locational reference and a clearly identified link to a planning initiative with an awareness of how it will improve the quality of life.</td>
</tr>
<tr>
<td>Level</td>
<td>Marks</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
<td>-------------</td>
</tr>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>- Clearly identified example which offers an appreciation of how improvement schemes are improving the quality of life, with some evidence of specific quality of life factors. 'In Mumbai there are a number of slum improvement schemes including housing developments and service improvements where houses are being connected up to water and electricity supply. This means that people have access to clean water and sanitation systems so there will be less disease and illness.'</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>- Basic understanding which makes general points about improving the quality of life with no real locational context. Links to planning limited; 'In some places they are putting in water supply systems and making houses more permanent with better materials.'</td>
</tr>
</tbody>
</table>
Introduction to Section 5: The changing economic world

LEARNING OUTCOMES

By the end of this section introduction, students should be able to:

- understand how economic development relates to quality of life
- understand that the level of economic development varies across the world.

General notes

The section introduction provides an overview of the changing economies across the world, which is explored in greater detail in subsequent chapters.

Suggested learning activities

- Use images to identify socio-economic variations in development and how this affects ‘quality of life’.
- Use an atlas or Gapminder in order to show some global awareness of differences.
- Discuss what information might be useful in order to compare the level of development between different nations.
- The caption to Figure 55.1 in the student book contains the discussion question ‘Technology has a massive impact on economic development. Automation increases productivity but can also lead to a loss of jobs. Advances in communication have allowed companies to reach more consumers and also access employees around the world. What other examples can you think of?’ This could form the basis of a class discussion. Answers might include breakthroughs in fossil fuel extraction technologies allowing extraction to occur in previously inaccessible areas – leading to new jobs and investment.
Introduction

Prior knowledge
Students should have a basic knowledge gained through Key Stage 3 globalisation and development topics, including:

- contrasts in development
- factors influencing development.

Geographical skills

Cartographic skills can be developed by studying the maps in this chapter, including:

- Figure 12.5 A map of the global North/South divide, to show a simple global division
- Figures 12.9 and 12.10, concerning landlocked South Sudan, show the concept of being landlocked clearly and the difficult situation for South Sudan regarding its oil industry
- Figure 12.17 is a location map of Nampula eye clinic to help students with case study knowledge.

Graphical skills – scattergraphs and correlations can be worked on using Table 12.1 and Figure 12.6. Students need to be able to recognise positive/negative, strong/weak correlations. Best fit lines are an important skill for highlighting the degree of correlation.

The data table, Table 12.1, can also be used as a basis for further exercises of your own devising.

Photographical interpretation skills – this chapter contains several photographs for illustration and interpretation. Development characteristics can be discussed when comparing Figures 12.1 and 12.2. Figures 12.12, 12.13 and 12.14 can be used to highlight clean water issues. Figure 12.18, the Nampula eye clinic, shows a very modern building which could be in Europe or North America. This illustrates what charity money can achieve. Many students will not have seen a solar cooker before, as in Figure 12.19. Figures 12.19 and 12.20 are photographs of real people in improving development situations. This personalises the case studies and should make them more memorable. Rapid development in Malaysia is represented in Figures 12.26 and 12.27, begging the question “What difference is there between these images and any wealthy Western city?”

High-level thinking – Figure 12.11 is a fairly complex flow diagram. This example will help students create their own in other situations.

General notes
Students may feel they already know a good deal about development from Key Stage 3, but the concept of the development ‘gap’ and the factors leading to it are complex and can be challenged at GCSE level. It is important, therefore, to take a stepped and logical approach to this material, referring to the AQA GCSE specification. Some students will find the finer detail of this topic quite difficult, but detailed case studies provide a way around many of these issues. Moreover, this relatively long chapter presents the material in clear stages, so that it can be digested one piece at a time.
The class may include international students or children of migrants. They may be an asset to help their peers understand development situations in greater depth – there is nothing like first-hand knowledge and experience, and it is very memorable for students.

Another way to use personal experience is through film clips. Here are some suggestions:

- ‘Factors affecting the development gap’ gives an excellent summary of topic areas (www.cambridge.org/links/gatd4079). See particularly, 3 minutes 38 seconds.
- ‘GCSE Development 1 – How do we measure development?’ shows the classification of countries, key terms, measures of development (www.cambridge.org/links/gatd4080). See particularly, 34 minutes 34 seconds.

There can be a lot of misconceptions and prejudices around this topic. Be prepared for some difficult questions on development, for instance:

- ‘Why don’t people just work harder?’
- ‘Developed countries have made massive progress economically, why can’t poorer countries do the same?’
- ‘Why does the funding always have to come from us?’

Additional support
The film clips above help to divide necessary knowledge into neat, discrete categories. Students can watch them on their own for clarification, plus they can explore further on the film clip websites.

Extension
The film clip sites include KS5 level clips – you could direct students to these to stretch them and make them think outside the box.

Links between factors affecting levels of development can be complex, but it is an opportunity to encourage students to work things out for themselves.

Organise a debate to test whether economic or social factors are more important in development issues.

Empathy – students putting themselves in the positions of others – can help understanding and can stretch students at any level.

Worksheets
Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

Worksheet 12.1 involves interpretation of photographs. Students can use their own classroom and general school environment as a comparison for those in the images. Some poorer countries do have inputs of hi-tech equipment, which is excellent as long as the support networks are in place. If students voice simple judgements, these may need some picking apart.

Social indicators are included here too. Infant mortality indicators provide an opportunity to link to population topics.

Worksheet 12.2 enables students to create a list of definitions and examples for their files on ways to reduce the development gap. You could expand question 2 with more details of each example found. The ActionAid website (www.cambridge.org/links/gatd4081) is well worth a visit for examples and case studies. This link could lead to discussion of different types of aid, including sponsoring.

Worksheet 12.3 links stages of the Demographic Transition Model to levels of economic development. Students are encouraged to research example countries and use materials like the CIA World Factbook.

Videos
Chapter 12 in the Cambridge Elevate enhanced edition includes the video clip: Self-help housing in Bangalore. The clip looks at the Sunnadagudu housing project in Bangalore. The clip comes from the Challenges of Urbanisation: Inequalities in Bangalore (DVD by Pumpkin Interactive Ltd).
Lesson ideas

12.1 How do we measure levels of development?
and 12.2 Classifying countries according to their level of development

These topics aim to identify and explain what we mean by the development gap, the factors affecting it and exactly what it means to individuals.

There have been many attempts to classify countries according to their level of development in an economic sense. In some cases this has been ameliorated by adding in a cultural angle, with varying degrees of success. The North/South divide is introduced in the Did You Know? box in topic 12.1 and in text in topic 12.2. Students could research this idea further and comment on it.

Starter activity

- Students should define the term ‘development’ in a ‘think, pair, share’ exercise. This allows all students’ ideas to come together and create a top-notch definition. Some students may not have covered Key Stage 3 and therefore may have less of an idea of the concept. This exercise will allow all students to have an input and will aid memory.
- Figure 12.1 is a photograph of a school playground in Kibera, Nairobi. Students can research images and film clips of Kibera – this will most certainly give you material for discussion in class. Figure 12.2 is of another school, in a more economically developed situation, providing contrasting material. Figures 12.3 and 12.4 provide a similar contrast in a health context.

Plenary activity

- Ask students which is the most effective classification of countries, and why? In small groups in a limited time, say five minutes, students could discuss and vote – one vote per group, which will create debate in order to reach the group’s agreed vote.
- Find out what students think of the Human Development Index? How valuable is it? Is it more or less valuable than economic statistics? Why?
- Relate the concept of the North/South divide to the classroom and health photographs (Figures 12.1, 12.2, 12.3 and 12.4).

Homework

- Ask students to create a flow diagram for any indicator of development (e.g. unclean water supply) and include all the consequences (e.g. illness, missing school, inability to work, lack of opportunity, etc).
- Table 12.1 contains data on mean number of years in school. Students can consider how these differences affect people’s lives and, in the next lesson, report back and compare.

Check students’ understanding

- The links between factors affecting development can be complex. Check that students understand these links, for instance, why health affects educational attainment and job opportunities.

12.3 What are development indicators?

This topic aims to dispel the assumption that ‘development’ means ‘economic development’. Most development indicators are, in fact, social measures.

Starter activity

- Ask students to list as many development indicators as they can. Have as many pairs or small groups as there are indicators in the list (apart from the Human Development Index because that includes multiple indicators). Encourage students to discuss the meaning and value of their indicator. Reporting back to the class may be useful before moving on to use the data in Table 12.1 and doing the activities.

Plenary activity

- Return to the starter discussion. Can students put the indicators in the list in order of usefulness and, importantly, justify their decision? Clearly, not all will agree!
Homework

- Use the Further Research box to give students an opportunity to investigate the Millennium Development Goals and the Sustainable Development Goals.

Check students’ understanding

- Check that the students grasp the importance of the social indicators and the link to quality of life. This might be done through an exploration of HDI, the Human Development Index.

12.4 What are the limitations of development indicators?

This topic builds on, and consolidates, topic 12.3.

Starter activity

- Ask students to define the term ‘quality of life’ and the difference between that and ‘economic status’. What does Figure 12.7 indicate about family size?

Plenary activity

- Summarise the usefulness of death rate and birth rate as indicators of development.

Homework

- Find examples of countries to illustrate how birth and death rates are/are not useful in assessing the level of development of a country.
- Research the Chinese one-child policy. This will give you potential for a future debate on:
  - the positive and negative aspects of this policy
  - its level of success/failure.

Check students’ understanding

- Students should know which indicators of development are the most useful and why.

12.5 What is the Demographic Transition Model?

In this topic the Demographic Transition Model (DTM) is covered in the context of the Malaysia case study, so fulfilling two purposes:

- Introducing key population change concepts as background to explaining economic change across the world.
- Adding to the background knowledge students have of Malaysia.

Starter activity

- Students can research key words, such as:
  - demography/demographic
  - transition (change)
  - model.
- In the class define the concept of a geographical model and discuss its uses.
- Ask the question: Why might these statistics change over time in a country?
  - BR – birth rate
  - DR – death rate
  - NC – natural change (NI (natural increase) + ND (natural decrease)).

What might be the consequences of these statistical changes and why?

Plenary activity

- Practise calculating statistics for different countries to ensure students understand how things work.
- Ask students to identify countries that are at each stage of development and to explain why.
• Write a summary of the factors affecting BR levels, DR levels and NC levels.
• Ask students to consider their own possible future family size choices, with reasons. Be prepared for answers of ‘no children’.
• Ask students to draw the DTM model without any resource to help them. How much do they understand?

Homework

• Figure 12.8 gives an annotated diagram of the DTM – after completing Worksheet 12.3, students could add extra annotations of facts, figures and explanation. Consider adding examples of countries at different stages of development at different times.

Check students’ understanding

• Students should review and compare the Homework activity ensure they have understood the concepts.

12.6 Why is development uneven?
This topic considers both physical and human causes (economic and historical) of differential development, with reference to examples which could then be worked up into case studies with some research.

Starter activity

• Ask students to differentiate between physical and human factors affecting level of development.
• Introduce the concept of a country being landlocked – students could undertake a brief atlas exercise to list landlocked countries.

Plenary activity

• Give students a key terms test based on this topic and, perhaps, the previous one as well.
• In small groups or pairs, students should choose any of the subjects in Activity 12.5. Create a spider diagram or other visual feature to illustrate the consequences of the chosen subjects, whether positive, negative, or both.

Homework

• Students can look up WaterAid films on YouTube (www.cambridge.org/links/gatd4082), choose film clips and make notes. These could be presented in the class and compared to make clear the most basic of all development issues – clean water resources.

Check students’ understanding

• It is easier to believe that physical factors, rather than human ones, are clear causes of uneven development. Ensure that students understand a realistic balance here.

12.7 What are the economic causes of uneven development?
This topic not only identifies economic causes of uneven development but also illustrates the links between them.

Starter activity

• What is a flow diagram and what is its purpose? Use Figure 12.11 to help you.
• Discuss the idea of a ‘cycle of poverty’ in the context of this flow diagram.

Plenary activity

• Students could quickly list the causes of uneven development and try to place them in order of importance. This could lead to all sorts of debate!

Homework

• Research Oxfam, WaterAid and other similar charities. Link their activities to reducing the development gap.
Check students’ understanding

Ask students the following questions:

• Why is reliance on primary goods as exports unlikely to support development?
• What does corruption do to development and explain how/why this is the case.
• Why might Chinese investment in Africa become a development problem?

12.8 What are the consequences of uneven development?

This topic follows on from the previous one by taking some of the physical and human factors affecting uneven development and placing them in a real-world context.

Starter activity

• Define the following terms:
  ◦ natural hazard
  ◦ disaster hotspot
  ◦ infrastructure
  ◦ overpopulation.
• Students can do this from existing knowledge, by using the Student Book or by researching on the internet.
• Read through the first part of the text in the Student Book. Ask students to relate it to disparities in development.

Plenary activity

• What part does migration (of all categories identified in the text) play in development? You could develop these ideas later into a much bigger project.

Homework

• Invite students, by using the school library, internet or other resource, to find disaster hotspots around the world using the following side headings:
  ◦ global location – names, location by latitude/longitude, country/region, classification of country
  ◦ nature of hazards/disaster risks
  ◦ possible causes
  ◦ likely outcomes
  ◦ possible solutions, if any.

Check students’ understanding

• Ensure that students can use case studies to show that they understand causes of and possible solutions for limited development progression.

12.9 What strategies exist to reduce the global development gap? (1)

This is the first of two topics which provide a fuller covering of the material required: large-scale infrastructure projects, finance (loans) and aid, debt relief, Fairtrade, small-scale aid projects (mainly charity-based), intermediate technology, small-scale investment, micro-finance, tourism.

Starter activity

• Ask the class to define ‘infrastructure’.
• Instruct students to use the information on ‘top-down’ and ‘bottom-up’ approaches to compare and contrast as a starter to the different approaches to reducing the development gap.
• Research new terms, such as ‘fair trade’ and ‘intermediate technology’.
Plenary activity

- Discuss the ‘top-down’ and ‘bottom-up’ approaches to improving development in LICs. What are their advantages and disadvantages?

Homework

- Research fair trade products in the supermarket. Report back to the class.
- Check students’ understanding
- Invite students to consider which approaches are most suitable in which situations. Thinking about this should reap dividends in the long term.

12.9 What strategies exist to reduce the global development gap? (2)

This topic summarises the main small-scale approaches to improving development, reducing the development gap on a local scale.

Starter activity

- Ask students to imagine being blind. How would they cope with:
  - simple day-to-day activities?
  - earning a living?
- Discuss Mozambique and its likely level of development.
- Use Figure 12.17 to locate Mozambique and the Nampula eye clinic.

Plenary activity

- Which small-scale projects are most useful in promoting development and why? Discuss and then draw a joint class conclusion from your discussion.

Homework

- Research more about the British charity Sightsavers (www.cambridge.org/links/gatd4083). There are interesting video clips and information on their sight clinics based in planes, which fly from place to place to carry out operations, saving poor people’s sight, thereby enabling them to become economically secure once again. There is a case study film clip of a six-year-old Ugandan boy seeing for the first time, as well as the experiences of adults.

Checking students’ understanding

- After the homework exercise, ask students to explain how eye operations can contribute to increasing development and on what scales in countries such as Uganda.

Named example: how tourism in Tanzania is reducing its development gap

This topic focuses on one economic activity (tourism) frequently adopted with a view to enhancing economic growth in LICs and NEEs.

Starter activity

- ‘11 per cent of Tanzanians worked in tourism in 2013. This sector is growing rapidly.’ Use this quotation from the Student Book to consider the likely benefits of tourism for Tanzania’s economy. What jobs might be created through tourism? Use ‘think-pair-share’ to create a detailed list.
- ‘Think-pair-share’ is a way of making students think for themselves and then discuss with others to reach a set of ideas/conclusions. Students think alone for a short time, then go into pairs and discuss. Pairs then go together to share ideas and take them further. In this way, ideas are pooled so each student is exposed to as many points/thoughts/ideas as possible. It is a good start to decision-making.

Plenary activity

- Summarise how trips such as climbing Kilimanjaro may lead to economic growth. Figure 12.22 will help you.
• What does Figure 12.21, the graph showing impacts of tourism on Tanzania’s economy, indicate about current future development? How might development move forward in the future?

Homework
• Direct students to the term ‘multiplier effect’ in the Key term box and ask them to:
  ◦ define this term
  ◦ apply it to the Kilimanjaro climbing trip, and...
  ◦ to the Northern Safari Circuit holidays.
• Describe the patterns shown in the pie charts in Figures 12.22 and 12.24. This could lead on to pie chart skills work in another lesson.

Check students’ understanding
• Ensure students can use data from the pie charts in Figures 12.22 and/or 12.24 to explain how tourism can help reduce the development gap. Reference to data is essential and should be credited.

Case study: rapid economic development in Malaysia
This topic takes all the ideas explored to date and uses them within a case study. This gives students material for examination purposes as well as helping them understand the concepts previously explored.

Starter activity
• Ask students to locate Malaysia on a map and quickly research some key facts and figures on the country regarding economic and social characteristics. (Note that Malaysia is becoming an economic hub within the rapidly-growing global region of South East Asia.)
• Consider the dominance of capital cities in terms of a country’s economic growth and improving level of development.

Plenary activity
• Ask students to tackle some high-level questions:
  ◦ Consider the argument for and against aid and debt in Malaysia, or any other country you have studied.
  ◦ How might we assess the future development of Malaysia and its place in the global market?
  ◦ How has working on this chapter altered your knowledge and/or understanding?

Homework
• Ask students: What is the most important thing you learned in today’s lesson (or from this chapter of the Student Book) and why? How does it contribute to your understanding of the development gap?

Check students’ understanding
• Ask students to write comments on Figure 12.26.
• In what ways has global aid (large and small scale) helped Malaysia to develop?
• How would you describe Malaysia’s position in the world today?

Model answers to ‘Assess to Progress’ questions
1. Describe how loans are different from charity aid. 3 MARKS

Loans come from several sources. Those from global institutions like the IMF, or from other countries or big banks, are for capital intensive projects and represent ‘top-down’ finance. Charity aid is smaller-scale and usually goes to individuals or groups of people for small projects. This is ‘bottom-up’ aid. Small-scale loans like microfinance are also ‘bottom-up’ and are directed at individuals and small businesses.

Large-scale loans can impact on many people, for example the Itaipu Dam on the Brazil/Paraguay border. This is the second largest hydro-power dam in the world and, together with other dams, provides 90 per cent of Brazil’s electricity.
The UK charity Sightsavers built Nampula eye clinic in Mozambique in 2014: 40,000 people benefited in the first year. Charities like ActionAid co-ordinate support for individual children’s education as well as wider support for their villages.

Care International’s cash grants to individuals to set up or grow small businesses help them to be economically independent and support their families. Farmers in Gaza can produce better crops after funding for irrigation. Families in regions affected by natural disasters like Typhoon Haiyan (Philippines, 2013) have been able to re-stock their farms.

Loans have to be repaid with interest; charity funding does not. Loans can put countries into debt and threaten their economic future. Charity projects are usually aimed at people helping themselves.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
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| 2 (clear)   | 2–3   | • A top level answer includes awareness of the complexity of the different sources of finance and for whom and for what the funds are intended.  
          |       | • A good range of case studies are used to illustrate the answer, either from the Student Book or class notes.  
          |       | • There is a clear conclusion referring back to the wording of the question. |
| 1 (basic)   | 1     | • There should be a simple contrast between one or more of the following:  
          |       |   – Large/small-scale investment  
          |       |   – Source of funds – governments and global institutions/charities/individuals  
          |       |   – ‘Top-down’ versus ‘bottom-up’.  
          |       | • Some simple examples of loans and charity projects are given, but may not be elaborated.  
          |       | • There may not be a conclusion to the answer which refers back to the question. |

2 What are the problems for recipient countries of becoming dependent on aid? **4 MARKS**

In the past some charity aid gave food and other resources to particular villages, regions and countries. People were fed, but were not producing for themselves – they were not independent. This often happened in situations of war and natural disaster. An example is Haiti in the Caribbean after the 2010 earthquakes (January) followed by Hurricane Tomas (November). The devastation was so great that production was barely possible. In 2016 Haiti still remains dependent on aid.

The idea behind large-scale loans is that the infrastructure built will generate enough income to repay the debt and its interest. Brazil had a problem in the 1970s when exports intended to repay debts were limited by global economic recession. Interest on a debt adds up and a country can find itself in even more debt.

3 Define these terms:

- economic development
- social change. **4 MARKS**
Economic development is the improvement of economic well-being (people’s wealth) and quality of life by expanding a national economy, creating more jobs and raising incomes.

Social change is a combination of changes in the way in which society works, in people’s attitudes and in what is acceptable. An example would be the greater equality between girls and boys in China as a result of the one-child policy.

4 How might TNCs help a poorer country become more involved in world trade? 6 MARKS

TNCs contribute significantly to the economy of Malaysia, an NEE which has developed rapidly over recent decades. Global banks located in Malaysia such as Citibank and HSBC bring finance and investment opportunities to Malaysia, as well as skilled foreign workers who can train local people and so help them to progress. They earn more money and pay more taxes, all contributing to the national economy. TNCs are attracted to Malaysia because of the increasingly well-educated workforce demanding relatively low salaries.

Nike, the sportswear company, employs 700,000 in 70 countries globally. Some 75 per cent of the workforce is in NEEs in Asia and around 120 million pairs of shoes are made each year and the majority are exported. Workers are low paid and working conditions may be poor.

Thirty per cent of China’s GDP in 1978 was from agriculture; in 2015 this was reduced to 15 per cent. China’s economy has grown dramatically through manufacturing electrical products, made by TNCs and mostly exported. Millions of jobs have been created and China has become the third largest global economy.

Mark scheme

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<tr>
<th>Level</th>
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<tbody>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• It is a useful approach to answer questions like this by using case studies, including names and details. The Student Book case study was included here, as well as two other separate examples. Each was developed and linked to the idea of global trade. • There is some reference to negatives as well as positives in a top answer.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Simple facts about TNCs are given, but may not be directly linked to world trade. A lack of understanding of the link between TNCs and economic growth may be evident. • Detailed references to case studies/examples is lacking.</td>
</tr>
</tbody>
</table>
Teaching notes: Section 5 Chapter 13 Economic futures in the UK

LEARNING OUTCOMES
By the end of this chapter, students will have learned about:

• the factors leading to economic changes in the UK
• how the UK's economy has changed
• how the UK's infrastructure has changed
• how we can reduce the impact of industry on the physical environment
• strategies that have been used to resolve regional differences in the UK
• the UK's place in the wider world.

Introduction

Prior knowledge
This is a topic which students are likely to know relatively little about from Key Stage 3 or from their general experience. To address this, some prior research and discussion could be undertaken to give context. Areas where students are likely to have more background knowledge are:

• transport developments
• North/South divide – a basic concept of richer South/poorer North (see Chapter 12 in the Student Book)
• industrial decline, if they live in areas that have experienced this – improve knowledge for those students who live in more prosperous areas and are likely to know less about the consequences of de-industrialisation.

Geographical skills

Cartographic skills – a variety of maps are included in this chapter. Figures 13.7 (M6 Toll map), 13.11 (sea ports of the UK), 13.16 (the UK North/South divide) and 13.17 (deaths from coronary heart disease in England) are all straightforward.

Graphical skills are developed in Worksheet 13.1, which involves choosing suitable graph types, plus interpretation. Pie charts can be practised in Worksheet 13.3 and in the text on industrial change in topic 13.3.

Changes in employment in a range of countries, including the UK, is shown in Figure 13.5. Sets of pie charts can be using for showing change over time.

Figure 13.19 and 13.22 are simple bar charts and provide useful description and interpretation exercises.

Photographical interpretation – many of the photographs provide opportunities to interpret information on the UK economy and change over time. Students will benefit from such interpretation and ensuing discussion using Figures 13.2, 13.6, 13.8, 13.9, 13.10, 13.12, 13.13, 13.14, 13.15, 13.18 and 13.20.

Other images: Figure 13.1 is a simple spider diagram showing factors linked with globalisation, perhaps useful for revision. The postage stamp in Figure 13.3 from 1978 is an image used to represent the importance of, and attitudes to, coal-mining during the 20th century.

High-level thinking – all students are familiar with Marks & Spencer. They may be surprised at the article from the Independent.

Figure 13.9 contains a photograph of the HS2 train as well as a great deal of information – an exercise in unpicking the detail from a very busy image.

Worksheet 13.2 question 4 demands brainstorming and wider interpretations.
General notes
As a new area of study for the majority of students it is important to keep giving background information as the students work through the specification topics. Depending on your location, there will be different local examples with which to work, and there may be out of the classroom opportunities as industries and planners are often open to student visits. These could provide distinctive case studies and help students understand the economic functioning of their home area more fully.

The North/South divide is a difficult topic to teach without value judgements! Student thinking may be influenced by parental attitudes and experiences. Preparation for examinations needs to emphasise location and case study knowledge over opinion.

News clips and reading of newspapers will be useful in generating depth of understanding of not just local but, more importantly, national and global economic change. Discussion and group work to generate empathy for different regions and countries can lead to better balanced examination answers.

Additional support
Economics is a subject rarely studied until A level, and then by a minority of students. Moreover, concepts are often high-level and more challenging.

Here are two YouTube clips to help background understanding:

- **De-industrialisation of the North** – Burnley (30 Oct 2013) ([www.cambridge.org/links/gatd4084](www.cambridge.org/links/gatd4084))
  – includes opinions from local young people. See particularly, 2 minutes 59 secs.
- **A brief history of the EU** ([www.cambridge.org/links/gatd4085](www.cambridge.org/links/gatd4085)). See particularly, 4 minutes 17 seconds.

Extension
When studying particular projects, for example new infrastructure and re-industrialisation (new retail, business and science parks), look for BBC News updates as well as relevant clips on YouTube. Most students are more than able to pursue these things themselves and bring them back to the class. While stretching students, simplified versions can be created to support members of the class.

All students should be encouraged to read and research in the national newspapers for up-to-date material to enhance their understanding and the quality of their final examination answers.

Worksheets
Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

- **Worksheet 13.1** deals with traffic volumes (vehicle and passenger) through the Channel Tunnel. Students utilise the data to answer the questions, which involve interpretation and extended thinking. They can therefore be used as a differentiation activity. Graphical skills come into question 5 and photographic interpretation into question 6.
- **Worksheet 13.2** is generally a high-level exercise, but the question 1 graph exercise should be accessible to all.
- **Worksheet 13.3** is a graded exercise and therefore useful for a mixed ability group.

See Geographical Skills, above, for some more specific points on Worksheet usage.

Lesson ideas

### 13.1 What are the causes of economic change in the UK?
This topic explores the key factors affecting economic change in the UK in recent decades. The approach taken is determined by the experience of the region in which the school is situated. Globalisation and de-industrialisation are the two key strands. Case studies are crucial.

**Starter activity**

- Ask students for a definition of ‘globalisation’. In the ensuing discussion bring in the idea of the increasing interconnection between countries. Ask students to bring in products they own which were
made outside the UK, or make a list of such products. What brands or ‘labels’ do they like and where are these products made? Categorise the countries by classification.

- Use ‘Globalisation easily explained’ (www.cambridge.org/links/gatd4086). See particularly 4 minutes 18 seconds to support understanding for students at all levels.

**Plenary activity**

- Students need to look up the sites given in the Weblinks boxes in this chapter. In groups, they can then consider the approaches of companies like Marks & Spencer and Dyson and decide whether their decision to source/manufacture their products abroad is the correct route for UK economic progress. What might the alternatives be?

**Homework**

- Using Marks & Spencer, Dyson or other UK companies, ask students to write an assessment of their policies and any alternatives. Aim for at least two good paragraphs for all students and a longer reasoned discussion to stretch students as required.

**Check students’ understanding**

- Students need to understand that the UK’s economy is reliant on being part of a system with other countries through trade.
- Every student should have some knowledge of at least one case study.

13.2 How has industry in the UK changed?

In this topic industrial classification underlies the move towards service industry domination. The importance of finance as an export industry is introduced and may well need some exploration. Various photographs provided in the chapter will assist here. Cambridge Science Park is mentioned as an example of research and development expansion.

**Starter activity**

- A list of industry examples could be provided to students who then try to classify them appropriately. This may have been covered in Key Stage 3, in which case referring back to that would be valuable. The class can devise a classification before moving on to the rest of the chapter.

**Plenary activity**

- **Activity 13.3** could act as a summary of industrial classification. Ask students, in groups, to create a list of companies operating in each sector today.

**Homework**

- Students could research one company as a short case study.

**Check students’ understanding**

- Ensure students have definitions of sectors with which they were previously unfamiliar, e.g. finance; research and development; quaternary; and quinary (as an extension).

13.3 How has UK infrastructure changed? (1 and 2)

This topic considers road, rail, seaport and airport networks – their current situations and possible futures. Case studies are an important part of this and are covered in considerable detail. We suggest an overall approach with the lesson ideas below, and then one or more lessons in addition to explore aspects of infrastructure in the UK in more detail.

**Starter activity**

- Ask students to define ‘infrastructure’ and give examples. They should use local developments to illustrate different types of, and recent expansion in, infrastructure. Students can then discuss why road, rail, sea and air transport all have essential parts to play in a successful and growing economy.
Plenary activity

• Divide the class into groups, each to take one type of transport infrastructure: roads, rail, seaports and air traffic. Each group lists advantages and disadvantages of today’s current networks and possible improvements. Involve students in a short debate on which is the most useful in expanding the UK economy, and why.

Homework

• Ensure each student has a clear case study of each of the four types of transport network covered in this topic.

Check students’ understanding

• Students should realise that the UK’s transport networks are part of wider, sophisticated European and global networks. They are essential to the functioning of the UK economy.

Example: Teeside: impacts of industry on the physical environment

This topic explores some of the impacts heavy industry can have on the environment, followed by an explanation of carbon capture, a system designed to make heavy industry more environmentally sustainable.

Starter activity

• Students may not be familiar with the term ‘heavy industry’, so this needs to be clarified from the start. Use Figure 13.13, the photograph of Teesside heavy industry, and the first paragraph of text to guide them.

Plenary activity

Invite students to hold a discussion based on these questions:

• What arguments might you make in favour of CCS (carbon capture and storage)? This is straightforward.
• What arguments might you make against it? This question has more depth – the answers are less obvious.
• How might you support your assertions on CCS? This is a high-level question.

Homework

Students could undertake background research into any or all of the following:

• The consequences of high carbon dioxide outputs both locally and globally.
• Carbon capture and storage technology (a helpful website is: www.cambridge.org/links/gatd4088).
• The permit system for pollution emissions.

This activity will support students with a little extra depth and cross-curricular links, and at the same time also provides opportunities to stretch students.

Check students’ understanding

• Ensure that students have grasped the importance of heavy industry to the UK economy whilst understanding the global context of pollution control.
• Use Activity 13.5 question 1 to help summarise and check student empathy for others.

13.4 Social and economic changes in rural areas

Students may assume that change tends to occur in urban areas more than in rural ones, but clearly this is not always the case. This topic focuses on the amount and type of economic and landscape change in rural areas.
Starter activity

- Locate the towns and villages mentioned: Oxford, Kidlington (just North of Oxford), Wrotham (West Kent) and Corfe Castle in the Isle of Purbeck (Dorset).
- Ask students what characteristics they would expect to find in rural areas in general and in village settlements in particular. Depending on where you live, you will elicit different responses here.

Plenary activity

- Use Activity 13.5 questions 2 and 3.

Homework

- Students could prepare arguments for a debate using the Discussion Point.

Check students’ understanding

- Students could hold a debate based on the Discussion Point – you will be able to judge understanding in this way.

13.5 What strategies have been used to resolve regional differences in the UK?

This topic of resolving regional economic differences will have a different angle depending on where in the UK your school is situated. Students are likely to have preconceptions gathered from their parents and television. It is all too easy to judge one region positively and the other negatively – beware! Dealing with strategies for change should allow a more balanced angle.

Starter activity

- Find out what students already know about the concept of the North/South divide. In the previous chapter this has been discussed in terms of global wealth and poverty, so beware of confusion between global and UK contexts.

Plenary activity

- Ask students to write definitions of the terms ‘core’ and ‘periphery’ (see Key Terms box), then compare and improve. Ask them, in pairs, to list UK regions which belong in each and to give a reason for their decisions.

Homework

As a continuation of the plenary activity, ask students to explain why:

- cities and large towns are classed as part of the core
- rural areas and locations physically more distant from the capital or core regions are classed as peripheral.

Ask students this question: ‘Many people have a negative perception of peripheral areas. Do you agree? Use evidence to support your argument.’

Ask students which regional development strategy is likely to be the most effective and why?

Check students’ understanding

- Students should not let preconceptions get in the way of judgements on regional differences. They should be able to justify the positives and negatives of different strategies.
- Test students with some quick quizzing.

13.6 The place of the UK in the wider world

This topic is likely to be new for a majority of students because their knowledge of the EU and Commonwealth may be limited. EU knowledge may come from holidays taken in France, Spain, etc., but this could be limited and one-sided. Note that since the 2016 EU referendum, students are likely to have greater awareness about the EU, although they might not necessarily have more factual knowledge.
Starter activity

- Show students the Youtube clip ‘Brief history of the EU’ (www.cambridge.org/links/gatd4089).
- Create a list of Commonwealth countries from student knowledge and internet research.

Plenary activity

- Ask students to argue the advantages and disadvantages to the UK of belonging to global groups such as the EU and the Commonwealth.

Homework

- Invite students to think about what we mean by ‘British culture’. This is discussed in the news a good deal. The way this is introduced may vary according to the class profile. What are our images? Where do they come from?
- This could lead to interesting discussion/debate in a future lesson and the results will depend very much on your school’s location. Aim for a balanced conclusion.

Check students’ understanding

- The 2016 EU referendum was a widely publicised event in the UK and students may have strong opinions on it. Encourage students to identify and check factual information from statements that they might have heard.
- The Commonwealth involves a large part of the world’s people and links with the UK are valuable economically and politically.
- A significant amount of UK trade involves goods transported by air.
- Associated with Chapter 13 is an issue evaluation exercise on the expansion of an industrial estate in Bournemouth.

Model answers to ‘Assess to Progress’ questions

1. What are the benefits and challenges of globalisation for the UK? 5 MARKS

Globalisation is a process whereby countries develop many kinds of links. These may be economic or cultural.

Benefits include increased opportunities for businesses to trade and invest overseas. At the same time, there is a larger range of goods available as raw materials for UK manufacturing, cutting costs and therefore also prices for the eventual purchaser of the finished product. Export markets increase. There are more places where UK goods can be sold, and, as other parts of the world become wealthier through globalisation, there is more money to buy UK products. One of the fastest growing exports from the UK to India is Scotch whisky. India’s growing middle class has money to spend on such luxury items.

Globalisation also creates challenges for the UK economy. Labour costs are cheaper in developing countries, which gives UK workers huge competition; jobs may well be lost in the UK. One example is Dyson production moving from Wiltshire to Malaysia. Globalisation leads to more goods being carried around the world, leading to increased pollution by carbon dioxide and use of non-renewable resources like oil.

The UK economy is strongly influenced by events in other countries, for example in September 2015 and January 2016 problems in China reduced the value of the pound (£).

2. What is meant by the term ‘post-industrial economy’? 2 MARKS

A shift in the economy of a developed country in which traditional heavy industries decline and are replaced by a reliance on service industries creates a post-industrial economy. The UK is a good example. De-industrialisation took place in the later 20th century. Today, over 70 per cent of UK workers are involved in services.

3. In what ways does the UK’s infrastructure support and encourage its economy? 6 MARKS

Many raw materials come from elsewhere in the UK or the rest of the world, so an efficient transport network is needed to bring these to the place of use. Good transport networks allow goods to be carried further and cheaper and therefore open up markets over a wider area. The internet has led
to more businesses being opened up globally than any other event. UK companies have more possible customers than ever before.

Many people commute to work which requires good train services and an efficient road network. There have been clear improvements in rail services, such as the increase in services on the Tunbridge Wells (Kent) line out of Charing Cross Station (London). There remain many road traffic bottlenecks causing queues at peak times, such as the A27 around Brighton. The increase in low-cost airlines allows people more choice in holiday destinations. This includes UK people going abroad and non-UK residents coming to the UK. Tourists spend money and boost the economy.

**Mark scheme**

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
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</table>
| 2 (clear)| 4–6   | • Statements logically follow one another.  
• Several types of infrastructure are mentioned.  
• Examples of particular infrastructure networks are named.  
• There should be a clear understanding of the links between quality and scale of infrastructure and the economy’s performance. |
| 1 (basic)| 1–3   | • Information is not always specific to the UK.  
• Few, if any, examples are mentioned.  
• There is a lack of understanding about how good infrastructure helps the economy function. |
Introduction to Section 6: The challenge of resource management

**LEARNING OUTCOMES**

By the end of this section introduction, students should be able to:

- describe the significance of food, water and energy to economic and social well-being
- understand that there are global inequalities in the supply and consumption of these resources.

**General notes**

The section introduction provides an overview of resource management, which is explored in greater detail in subsequent chapters.

**Suggested learning activities**

- As a class, draw a diagram on the board showing how the three resources are linked, e.g.:
  - water is required to grow food
  - energy is required for farming machinery.

- Look at the idea of global inequalities, identify areas of low consumption/resource security and suggest reasons for this.

- The caption to **Figure S6.1** in the student book contains the discussion question ‘Nuclear power is one of the most controversial power sources. The production process emits much less carbon dioxide than coal and gas, but it does produce radioactive waste. Do you think we should build more nuclear power stations in the UK?’ This could form the basis of a class discussion. Encourage students to provide evidence and factual data for their arguments. You may want to extend this into a research activity.
Teaching notes: Section 6 Chapter 14 Demand on resources in the UK

**LEARNING OUTCOMES**

By the end of this chapter, students should have gained an understanding of:

- the changing demand for and provision of food resources in the UK
- the changing demand for and supply of water in the UK
- how to safeguard water resources and supply in the UK
- how the UK’s energy demands and supplies are changing
- the problems caused by the exploitation of energy resources.

**Introduction**

**Prior knowledge**

Students should have some knowledge of renewable and non-renewable energy resources from Key Stage 3. They may also have made some simple value judgements based on perceived levels of pollution.

There is a possibility that they may have touched on water resources in the physical hydrology section of Key Stage 3.

**Geographical skills**

**Cartographic skills** can be developed by working with and interpreting Figures 14.1 (climate) and 14.5 (a choropleth (shaded map where value is shown by depth of colour)).

Figure 14.7, showing the major water transfer schemes in England and Wales, might seem hard to read at first glance, but let students approach it in pairs and work it out for themselves.

Figure 14.13, showing coal resource areas in Northumberland, looks more difficult than it is. Perhaps this is an opportunity for showing students not to be put off by more complex maps or diagrams.

Figure 14.15 is much simpler, but is still an exercise for description and comment.

**Graphical skills** – there are two pie charts in this chapter (Figures 14.2 and 14.9). Figure 14.2 is complex in the sense that it contains so many small categories and so will stretch all students to some extent.

The line graph in Figure 14.8 is interesting in that it uses a mid base line to highlight how future energy use is likely to be lower than today’s.

Figure 14.10 provides a basis for description and analysis of compound bar graphs.

**Photographical interpretation** – Figure 14.6, a photograph of a drying reservoir in Kent, can be used to prompt discussion about UK water supply and demand. The farming pictures (Figures 14.3 and 14.4), whilst straightforward, are a basis for discussion of the links between physical characteristics of landscape and climate and the farming system pursued.

Figure 14.11, showing an anti-fracking demonstration, could act as a basis for discussing the depth of people’s feelings and actions in regard to controversial resource exploitation.

The photograph of the impacts of opencast coal-mining (Figure 14.16) is another opportunity for debate. This shows quite a scar on the landscape whilst providing an essential resource plus local jobs.

**Other diagrams** – Figure 14.12 in the Issues Evaluation exercise is a 3D block diagram incorporating considerable detail of opencast coal mining. It could be used as a basis for interpreting and drawing similar diagrams.

**High-level thinking** – food, water and energy supplies are all complex and controversial. Strategies to manage these need to be laid out clearly and justified, for example:
• the value of fracking after evaluating its pros and cons
• the visual costs of solar and wind energy sites
• problems of dealing with nuclear waste against the reliability of this form of power generation.

These all require higher-level thinking skills.

General notes
This chapter precedes Chapters 15, 16 and 17, which deal with food, water and energy in more detail. The aims of Chapter 14 therefore are:

• to act as an overview of resources in relationship to the UK
• to introduce students to food, water and energy as the three key resources in the UK.

and to look at:

• the resources we already have available or can import
• how these resources match demand now and in the future
• how we can adjust our strategies to become resource-secure in the future.

Students will, through this chapter, gain an overall understanding of the importance of resources and of being secure in our supplies. Much of the text and the activities encourage students to look at resources from their own point of view – what they and their families use, and how efficiently; how dependent they are on global producers; how they can adjust their personal behaviour to improve the resource demand/supply balance.

Additional support
This material should be relatively accessible to all students because of the personal approach discussed above. Any point not readily understood can be turned around to the angle of the student’s own experience. In addition, mixed ability groups for discussion will help bolster the understanding of students who are finding the concepts difficult to understand. Practical things like checking the provenance of supermarket products can be done by all students and will make things more memorable.

Extension
Encourage students to find out more about their local area in terms of the following:

• What foods are produced in the immediate area or in the surrounding region (depending on where you live)? What do the nearest farms produce? Is there demand for local produce, for example, meat? Are students aware of issues around food miles? Students can challenge each other to calculate food miles of various products.
• Where does the local water supply come from? Exactly how ‘local’ is it?
• What evidence of energy generation is found locally, if any?

These extensions give students examples and small case studies to enhance examination answers.

Worksheets
Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

Worksheet 14.1 brings North Sea oil news up to date. Emphasis recently has been on decline in resources and production, but the report here gives a more positive slant.

Worksheet 14.2 can be used either as a check-up test for students, an end of topic class test, or later on for examination revision.

Videos
Chapter 14 in the Cambridge Elevate enhanced edition includes the video clip: Europe’s gas crisis. The clip looks at Europe’s dependency on energy imports and its vulnerability to supply problems. The clip comes from the Global Energy Security (DVD by Pumpkin Interactive Ltd).
Lesson ideas

14.1 How is the demand and provision of food resources in the UK changing?

This topic gives an overview of the types of foodstuffs the UK can produce and where these activities take place. Links are made between increased disposable income and the demand for higher value food; a greater range of food and seasonal food being available all year. Globalisation of the food market helps enable these demands to be fulfilled.

Starter activity

- Begin with a review of the climate of the UK (Key Stage 3 and Chapter 3 of the Student Book). The old adage ‘wetter west, drier east’ works well here, plus mention that average temperatures generally decrease as latitude increases. Utilise Figure 14.1 to discuss precipitation norms, and Figures 14.3 and 14.4 for typical agricultural landscapes in the UK. There are clear links here which students should be able to work out for themselves.

Plenary activity

- Ask students to define the term ‘globalisation of food’. This would work well as a spider diagram with ‘legs’ labelled ‘food imports into the UK’ (with examples of products and source countries) and ‘UK food exports’ (with examples of products and destination countries). The next set of legs showing actual products and countries open out from there. This could be extended into a ‘web’ with cross-linkages. Let students play with ideas here and compare each other’s results.

Homework

Ask students these questions:

- How might you justify high levels of food imports and exports resulting in high numbers of food miles?
- Who might seek to justify high levels of food imports and exports, and why?

Some students might need the wording simplified here to allow access to the concept.

Check students’ understanding

- All students need to know some foods the UK produces, where and why.
- Globalisation means choice, but high food miles. Students should understand some of the consequences of food miles, economically and environmentally.

14.2 How has the demand for water changed?

This topic shows just how little fresh water really is available for human use on the planet, and these statistics should shock students at the beginning of this topic and make them aware of how precious water supplies are.

Top quality water for human use is essential, and we are fortunate enough to have this in the developed world. This in itself makes a point about countries which are not as fortunate. Nevertheless, there are water quality and pollution issues in the UK and a number of these are explored.

Emphasise the contrast between water supply and demand locations, including your own region as an example. Water transfer schemes are limited to date, but large-scale thinking is essential for the future and this topic allows students to make their own solution suggestions.

Starter activity

- Work with students to find out where your local water supply comes from and some facts and figures about it. Ask students to revise the hydrological (water) cycle, and fit it to the local water supply.

Plenary activity

- Ask students why a balance between supply and demand is so essential. Groups can develop a plan for future water supply either in your area, another one, or a theoretical one. Ask students what proposals they would make to guarantee water supply for the future in the chosen area? They should
aim to justify their proposals. This leads onto the next topic: **14.3 Matching supply and demand – areas of deficit and surplus**.

**Homework**
- Students should explore issues of water quality and pollution management, including photographs. These can then be brought back to the class.

**Check students’ understanding**
- Students should understand the place of our water supply within the hydrological cycle, the changing/increasing demand for water and the difficulties of balancing current and future supply and demand.

**14.3 Matching supply and demand – areas of deficit and surplus**

If we are honest, we all take our water supply as secure, unlike millions of other people in the World. We tend not to think of any supply issues. This topic may disabuse students of such an attitude, through making them consider their own home situation in this respect.

**Starter activity**
- Begin with the Did You Know? box. Then ask students to think about other domestic equipment at home which uses water. Ask the questions, ‘How much?’ and ‘Could this be reduced?’
- Why might we want to reduce water usage? Review the ‘wetter West, drier East’ concept alongside a UK population distribution/density map. This will lead to a supply and demand discussion.

**Plenary activity**
- Ask the question: ‘Why do cities like Manchester need water resources like Thirlmere?’
- Use Figure 14.7 to help students comment on current and possible solutions to UK water supply and demand.

**Homework**
- Describe the water insecurity map in Figure 14.5. Explain its implications for YOUR future. Answers will depend on where you live. You could extend this exercise by asking students to imagine living in a contrasting area of the UK.
- Students need to be aware of existing water transfer systems and what else might be possible in the future. They should research these as shown on Figure 14.7 and bring them back for class discussion.

**Check students’ understanding**
- Consider the photograph in Figure 14.6. Locate Bewl Water reservoir (Kent, SE England), an area of considerable water stress. Students should be able to explain the problems at Bewl Water and for the surrounding areas of Kent and East Sussex which it serves with water supply.

**14.4 The changing energy mix**

This topic considers the changing energy mix of the UK both in terms of what we produce and what we import.

**Starter activity**
- Ask students to read the first paragraph and define the concept of ‘energy mix’. Comparisons could be made with the energy mixes of a variety of other countries in order to put the UK situation in context.

**Plenary activity**
- Use Figure 14.12 and newspaper reports of the Sussex shale gas demonstrations to encourage students to evaluate:
  ◦ shale gas use
  ◦ how strongly people feel about the environmental impacts of energy exploitation.
- You can test student on Key Terms in this topic.
Why might UK energy use in 2030 be similar to that in 1970, despite our greater use of heating and electronic equipment plus a higher population?

Homework

Ask students to make a list of the UK's fossil fuel reserves, existing renewable energy projects and future possibilities. Even if students find only one or two each, the class together should have a thorough list.

Check students’ understanding

Students must know the various sources of UK energy supplies, their strengths and risks. Coal, nuclear power and shale gas are examples of energy sources with exploitation issues. Renewable forms of energy may seem to be the obvious solution, but students should be aware that things here are not so simple or straightforward. Examples can be discussed.

Students should know that the UK still has many fossil fuel resources which need to be exploited as efficiently and cleanly as possible. Refer back to carbon capture and the YouTube clips covered in Chapter 13 of the Student Book.

Shell’s carbon capture and storage [www.cambridge.org/links/gatd4090]. See particularly, 4.00 minutes.

British Geological Survey – What is carbon capture and storage (CCS)? [www.cambridge.org/links/gatd4091].

14.5 What is the future of energy in the UK?

This topic provides an exercise in viewing a current situation and taking its likely progress forward into the future. Students will remember this better if these ideas are presented within their own context.

Starter activity

Using a link to Chapter 12 and students' likely life expectancy, ask them to discuss in pairs the likely energy situation for them throughout their lives.

Then ask, ‘How might the UK move forward in terms of energy provision?’

Plenary activity

Having described and analysed the compound bar graph, Figure 14.10, during the lesson, students should write down three findings based on their work during the lesson. Links to other topics in this chapter might well be valuable. Compare ideas between students if you have time, or use these as a starter activity for a future lesson.

Homework

Students can use the photograph in Figure 14.11 as a basis to write their thoughts and reactions regarding public demonstrations against new methods of energy exploitation with potential environmental issues; then perhaps compare these next lesson.

Check students’ understanding

Students could use the Fieldwork box:

- to identify three of the most important questions that could be asked in an energy opinion survey
- to pick out three of the most useful diagrams which show data. This checks up on understanding of both content and skills work. You could use diagrams from anywhere in Chapter 14, and on other occasions do the same thing using figures from other chapters too.

Model answers to ‘Assess to Progress’ questions

1 Describe the UK’s energy mix, commenting on the country’s dependence on fossil fuels. 4 MARKS

The UK is heavily dependent on petroleum and natural gas, in other words, fossil fuels; these each provide around a third of the UK’s energy. Coal, which used to be so important, provides around 20 per cent of our energy needs, having fallen dramatically over the 20th century. Reliance on fossil
fuels is therefore very high. This keeps the UK’s carbon footprint and pollution levels high, although recent cleaning methods like sulphur scrubbers help to reduce these.

Nuclear power is important, providing around 10 per cent of the UK’s energy, although at present some power stations are being de-commissioned before new ones come on-line to replace them. By 2030 nuclear energy will have taken over from some imported oil and gas supplies.

It is not good to be too dependent on imported fossil fuels because energy security is reduced and prices are controlled by those from whom we buy, like Russia. This is a strain on the UK economy in terms of cost as well as reducing our energy security.

Renewable energy is gradually becoming more important. Together, wind and hydroelectric power provide only around 1 per cent of our needs, but this is set to grow. Bio-energy, including incinerating waste (5 per cent), is more important than people realise, and has great potential.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>3–4</td>
<td>• Detailed description of the UK’s energy mix.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• An underlying understanding of what we mean by the term ‘energy mix’ is apparent in the answer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Clear reference to the idea of energy security.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• This answer refers to change in the energy mix over time and looks to the future.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Generally good quality English.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–2</td>
<td>• Some description of the energy mix in the UK is included and there may be some data quoted.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• A lack of interpretation of the data.</td>
</tr>
</tbody>
</table>

2 Suggest how the UK could reduce its food miles and carbon footprint. **4 MARKS**

The UK, as one of the wealthiest countries in the world, can demand a large variety of food, including items which cannot be produced in our own climate zone. Bananas are a good example. As a tropical crop, we import them from South America and the Caribbean rather than grow them. They are transported by container ship, one of the most polluting forms of transport in terms of carbon dioxide.

We are used to having a huge choice of foods all year round. Strawberries are a case in point. Their natural harvest season in the UK is June and July, yet they are found in the supermarkets in winter. We can extend our season a little by growing in poly-tunnels, but we also import large quantities from Spain. South-west Spain produces 313 500 tonnes for the out of season markets in the rest of Europe.

Importing means food miles and environmental pollution. The journey adds to the cost of the strawberries. They are packaged in plastic containers which may increase carbon emissions during manufacture. Most strawberries are flown to their destination because they are perishable (go off quickly). Planes burn fossil fuel so emit high levels of carbon dioxide.

People could get used to seasonal food once again. Strawberries would be special if we only had them in June and July. If we buy locally-grown crops as much as possible, then food miles and carbon dioxide emissions are both cut. In contrast to the UK France concentrates more on locally produced food, so reducing food miles. Most meat is from the immediate area – in Aquitaine in the south-west the lamb comes from the adjacent Pyrenees mountain foothills. A favourite vegetable, green beans, is grown locally for many months and out of season is imported from nearby Morocco. Winter fruits come across the border from Spain. Food miles are minimised.
The UK has made a commitment to the EU to reduce its carbon footprint significantly by 2020. Limiting food miles is an important factor in achieving this.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2 (clear) | 3–4   | • Facts and figures are quoted.  
• The quality of English language is good with longer sentences and clear paragraphing.  
• There is a clear conclusion relating back to the question. |
| 1 (basic) | 1–2   | • A simpler answer with a number of ideas but in this case they are not explained in any detail.  
• English language will be less well structured.  
• There may not be a conclusion. |

3  Explain how the UK could increase its water security. 4 MARKS

In terms of water security, the UK’s problem is that locations of many population centres and of water supply do not often coincide. There is a simple North West/South East divide. The densely populated South East is amongst the drier regions (London 594 mm/annum). The highest rainfall regions in the North and West (Keswick, Lake District 1353 mm/annum) tend to be less densely populated. London and the South East will therefore not be water-secure for much longer.

Solutions can be divided into using the water we have more efficiently and creating new resources. Metering households makes people aware of how much water they are using and what it costs. Dual-flush toilets and water-saving washing machines decrease household usage.

Water has been moved from Thirlmere in the Lake District to help supply Manchester since 1925. North Wales serves Birmingham. One proposed future scheme intends to take water from Kielder reservoir in Northumberland, near the Scottish border, to boost reserves in London’s reservoirs. This would be expensive but would improve water security substantially.
LEARNING OUTCOMES
By the end of this chapter, students should be able to:
• outline the global patterns of food supply
• describe the global patterns of calorie intake and identify which countries consume the most calories
• identify how and why food consumption is increasing over time
• explain why food supply and consumption are not spread out evenly
• discuss the problems caused by food insecurity
• list the ways that food supply can be increased
• explain how Kilombero Plantations Limited (KPL) benefits Tanzania
• state what is meant by sustainable food supplies
• outline how the Democratic Republic of the Congo (DRC) is attempting to tackle food insecurity.

Introduction

Prior knowledge
Food resources are not always covered as a separate subject in Key Stage 3. However, students should have a basic knowledge of the global trade in commodities. They should already know that:

• food can be categorised into animal products or crops
• some food is grown in the UK, but some is imported from other countries.

Geographical skills
Numerical skills and the use of quantitative data are practised throughout this chapter. The topics from 15.1 Where does our food supply come from?, right through to 15.6 What are the impacts of food insecurity? all contain tables of data that students must analyse.

Statistical skills are required in Activity 15.5 question 3, which involves calculating percentage increases.

Graphical skills are developed in Activities 15.1 and 15.2.

Literacy skills are developed in Activity 15.4 question 3, where students write a newspaper article, and Activity 15.6 question 3, which involves the interpretation of text.

High-level thinking is developed in many of the activities, such as in Activity 15.2 question 4, where students consider the potential for a double burden of both obesity and malnutrition. High-level thinking is also addressed through the Discussion Points, such as under the heading ‘Where is the most food consumed?’, where students evaluate the use of average calorie intake when looking at global food consumption and are challenged to suggest a better measure. Also, in the discussion point in 15.7 What strategies can be used to increase food supply?, students are asked to consider which genes could be useful for crop production.

General notes
It is important to be led by the GCSE specification when setting up the teaching of this topic area. The food chapter is contemporary and some parts of the topic are constantly evolving. It is therefore important that the teacher maintains some up-to-date knowledge. There are many parts of the food topic that will be new to students and so it is essential not to assume prior knowledge.

Additional support
Students may find the data manipulation and analysis difficult for this topic. This will require some modelling from the teacher. They may also require support with the volume of new key terms that are required, some of which have complex spellings. Vocabulary and spellings tests would be beneficial to those with lower
reading ages. Some students may find it difficult to appreciate the global context of this chapter and so world maps should be actively used throughout.

Extension
The activities within this chapter have been carefully scaffolded to allow students to access higher-order thinking tasks. There are also opportunities for further extension tasks throughout. An example of this would be Activity 15.7 question 5. Students are asked to look at things that affect rice prices. Students might be able to suggest more factors than are present in this activity.

Worksheets
Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book. Worksheets are provided for use in class and some provide templates for specific activities. Worksheet 15.1 provides a blank World map, where students can plot countries with the highest and lowest calorie intakes; and Worksheet 15.2 asks students to look ahead to 2030 and beyond and explain why governments may need to manage overconsumption of food.

Videos
Chapter 15 in the Cambridge Elevate enhanced edition includes the video clip: Farming in India: the struggle for survival. The clip looks at the economic challenges of living in rural India. The clip comes from the Rural Challenges: Inequalities and Development (DVD by Pumpkin Interactive Ltd).

Lesson ideas

15.1 Where does our food supply come from?
This topic looks at where food is grown and produced and also patterns of food trade.

Starter activity

- Different examples of foodstuffs should be shown to the class, such as tins, vegetables and meat products. Students are challenged to categorise the products. They may come up with suggestions such as crops, animal products, dairy products, etc. The teacher then asks where each product comes from.

Plenary activity

- Create a summary table to show which foods are mostly grown in HICs and which are mostly grown in LICs. Suggest reasons why wheat is the only food that is grown in HICs.

Homework

- Collect ten food labels from home. On a world map, plot where each item was grown or produced. As an extension, students could calculate the actual food miles.

Check students’ understanding
Students should understand that:

- Most food is produced in developing nations.
- Different countries specialise in producing different types of foods.

15.2 Food security
This topic looks at parts of the world that have food security and also considers future challenges regarding the production of food.

Starter activity

- Ask students to remember the last time that they felt hunger. Refer to the definition of hunger in the Key Terms box and see how many students change their minds regarding their original answer.
Plenary activity

Using a world map at the front of the class, students point to countries that:

- have food security
- have food insecurity
- grow a lot of cereals
- grow oil crops
- rear a lot of meat
- produce dairy foods
- supply fish produce.

Homework

The World Health Organisation state that food security is built on three pillars:

- food availability: sufficient quantities of food available on a consistent basis
- food access: having sufficient resources to obtain appropriate foods for a nutritious diet.
- Food use: appropriate use based on knowledge of basic nutrition and care, as well as adequate water and sanitation.

Ask students to research ways that each of these three pillars can be tackled to improve food security.

Check students’ understanding

Students should know that:

- Food security occurs where people have access to an affordable and nutritious food supply.
- Global food issues are an important issue now and into the future.

15.3 Where are the world’s food resources consumed?

This topic looks at where the most calories are consumed and how global food consumption is changing.

Starter activity

- Students are shown images of different foods and asked to guess the calorific value. This ties in with Figures 15.3 and 15.4. The NHS provide calorific values of foods (www.cambridge.org/links/gatd4092); for example, bananas – 95 kcal, ready salted crisps – 97 kcal.

Plenary activity

- Students write a tweet (no more than 140 characters) to explain global inequalities in food consumption.

Homework

- Students research illnesses caused by undernutrition, malnutrition and overnutrition.

Check students’ understanding

- The amount of calories consumed throughout the world is not even.
- Developed countries are consuming the most calories but they are seeing the smallest growth in calorie intake (a 1.7 per cent increase).
- Developing countries are consuming the fewest calories, but they are seeing the biggest growth in calorie intake (a 4.6 per cent increase).

15.4 Is there enough food?

This topic explains how the world produces enough to feed everyone, but some areas have food surpluses and others have food deficits.
Starter activity

- Ask students what they think kills most people globally each year. Their choice of answers is hunger, AIDS, malaria and TB. For the response, direct them to the Did You Know? box in this topic, where it states that hunger kills more people every year than AIDS, malaria and TB combined. Gather responses to this fact.

Plenary activity

- What is a cash crop? How does the cultivation of cash crops benefit MICs and LICs? Does anyone lose out or suffer through the cultivation of cash crops?

Homework

- Following on from the plenary discussion, students should research an example of a cash crop. The children’s website Mocomi (www.cambridge.org/links/gatd4093) has some videos as a starting point. Students should find out where that crop is grown and where it is exported to. They should also identify whether the country of origin has food insecurity.

Check students’ understanding

Students should understand that:

- The world produces enough to feed everyone, but 1 billion people are still hungry.
- The most rapid population growth is taking place in MICs and LICs. Expanding populations lead to a greater demand for food.
- Food surpluses are common in developed nations and emerging economies.

15.5 What factors affect food supply?

This topic investigates six factors that affect global food supplies.

Starter activity

- Discussion activity: What will you have for tea tonight? What factors affect what you eat and indeed whether or not you eat this evening?
- In December 2014, the Archbishop of Canterbury (Justin Welby) said that he was ‘more shocked by the plight of Britain’s hunger-stricken poor than suffering in African refugee camps’. What do you think he meant?

Plenary activity

- There are six factors that determine the availability of food supplies (climate, technology, pests and diseases, water stress, conflict and poverty). Do any of these six issues also face people in urban areas of developed countries?

Homework

- Following on from the plenary activity, students should produce a report on food banks in the UK. The Trussell Trust (www.cambridge.org/links/gatd4094) is a good source of information.

Check students’ understanding

Students should know that:

- About 98 per cent of the world’s hungry live in rural parts of developing countries.
- The availability of food supplies is dependent on climate, technology, pests and diseases, water stress, conflict and poverty.

15.6 What are the impacts of food insecurity?

This topic looks at some of the main impacts of food insecurity, including hunger, soil erosion, rising prices and social unrest.
Starter activity

- In 2014, the BBC reported a ‘19 per cent increase in the number of people admitted to hospital with malnutrition over the past year’. The article could be displayed through a projector for students to read (www.cambridge.org/links/gatd4095). What types of illnesses could this have included? The article stated:

  *The main symptom of malnutrition is rapid weight loss – usually 5–10 per cent within a few months. Other signs include:*
  - weak muscles
  - constantly feeling tired
  - an increase in illnesses or infections
  - children will not grow as quickly
  - and will show changes in behaviour becoming irritable, sluggish and anxious.

Students are then challenged to think about impacts of food insecurity other than hunger.

Plenary activity

- Use Activity 15.5 question 2 to consider potential solutions to the impacts of food insecurity. The activity will identify specific problems, such as over-cultivation, so it may be possible to suggest strategies to tackle these problems.

Homework

- Choose one of the impacts of food insecurity. Write a short news article explaining the nature of this impact. The article must contain details of a named example and specific facts.

Check students’ understanding

Students should understand that:

- Food insecurity is a concern for lots of countries, particularly those in sub-Saharan Africa and parts of Asia.
- There are several impacts of food insecurity, but the main four are hunger, soil erosion, rising prices and social unrest.

15.7 What strategies can be used to increase food supply?

This topic examines how irrigation, aeroponics, hydroponics, the New Green Revolution, biotechnology and appropriate technology can all help to increase food supplies.

Starter activity

- Go to the Full Belly Project website and show a picture of an appropriate technology strategy, such as the rocker pump (www.cambridge.org/links/gatd4096). Ask students to write down what they think the picture shows and how it could be used. If time, print out several examples and give different images to different students. This will introduce the idea that food supply can be increased using simple but appropriate solutions.

Plenary activity

- Student could discuss the question: Which strategy do you think has the potential to increase food supplies by the largest amount? Have a class vote or pollster activity to gauge opinion? There is no right or wrong answer, but this activity encourages students to revisit the ideas from the Student Book.

Homework

- Return to the starter activity. Students need to find an example of appropriate technology. There are many websites that contain useful information and the Full Belly Project is one of them (www.cambridge.org/links/gatd4097). Students then need to create a ‘Dragon’s Den’ style sales pitch to deliver to the class next lesson.
Check students’ understanding

Student should know that:

- As the global population increases, we will need to find ways to grow more food or make better use of the food that we have.
- Irrigation, aeroponics, hydroponics, the New Green Revolution, biotechnology and appropriate technology can all help.

Named example: large-scale agricultural development in Kilombero Valley, Tanzania

This topic looks at Kilombero Plantations Limited (KPL), as an example of large-scale agriculture in Tanzania.

Starter activity

- Project an image of a paddy field onto the board. Ask students to list the products that can be made using this crop; for example, boiled rice, popped rice cereal, rice cakes and rice pudding. Students must then place a pin on a map of the world to show where they think the photograph may have been taken, i.e., where rice is grown.

Plenary activity

- Compare the KPL plantation to large-scale farming in the UK. Are the advantages and disadvantages the same? Why/why not?

Homework

Write a diary entry for a Tanzanian living in the Kilombero valley. The diary should either be from either:

- a new worker on the farm or
- a displaced local resident.

In each case, the diary should explain how KPL has changed that person’s life and how they feel about those changes.

Check students’ understanding

Students should know that:

- Kilombero Plantations Limited (KPL) grows rice crops in Tanzania and is the largest rice producer in East Africa.
- KPL brings many advantages to the region, such as increased food security, employment and housing.
- KPL also brings disadvantages, including debt, pollution and displacement.

15.8 How can food supply be increased sustainably?

This topic looks at ways to produce sustainable food supplies, including permaculture, organic farming, urban farming, sustainable fish and meat production, seasonal food consumption and the reduction of food waste.

Starter activity

- Show two examples of the same vegetables to the class. One is an ordinary supermarket version and the other is stamped with an organic label. The class can discuss the differences between the two. They may suggest the use of agro-chemicals, taste, nutritional value and price. Some of these suggestions may not be based on scientific evidence (e.g., taste) and so care must be taken to avoid bias. You could then introduce the idea of sustainable food production and how using natural methods of crop production may support this idea.

Plenary activity

- Visit Pizza Express’s Twitter site ‘Meat-Free Mondays’ (www.cambridge.org/links/gatd4098). This Twitter site is regularly updated with articles about sustainable food production. Read some of the recent tweets with the group. Ask the group to vote as to whether they think Pizza Express is leading the way with ‘Flexitarianism’. Students may wish to consider whether they think that Pizza Express
Homework

Students are to research vertical farming. The University of Nottingham (www.cambridge.org/links/gatd4099) and The University of Warwick (www.cambridge.org/links/gatd4100) both specialise in this field and have good websites as a starting point. Students should write a short report explaining:

- what vertical farming entails
- what the advantages and disadvantages of vertical farming could be
- an evaluation of the suitability of the UK for vertical farming systems.

Check students’ understanding

Students should understand that:

- Food supplies are increasing and we must look for ways to produce sustainable food supplies.
- Permaculture, organic farming, urban farming and sustainable fish and meat production can all help us to achieve sustainable food supplies.

Named example: sustainable food production in Kinshasa

This topic explains how Kinshasa in the DRC is coping with feeding an ever-increasing population.

Starter activity

- Project a blank outline map of the world onto the whiteboard. Students must take it in turns to guess where the DRC is. If they are struggling, give them the full name of the country: the Democratic Republic of the Congo.

Plenary activity

- Create a flow diagram to show how the benefits of urban or peri-urban horticulture (UPH) in Kinshasa have knock-on effects. Model the activity on the board by producing a flow diagram to show how healthier children leads to improved school attendance, which leads to better levels of education, which leads to better job prospects.

Homework

- Sketch a map of your house and surrounding area. Mark on that map any areas where you or your community could practise UPH. What would you grow and how would you decide what to grow? What would be the benefits and challenges? How would these benefits and challenges differ from those experienced in Kinshasa? Some students may have similar schemes in place already in their neighbourhoods.

Check students’ understanding

Students should know that:

- Kinshasa, the capital city of the DRC, has a rapidly growing population. People arrive looking for work or fleeing areas affected by conflict.
- Urban and peri-urban horticulture (UPH) is practised in Kinshasa. It has many advantages and disadvantages.

Model answers to ‘Assess to Progress’ questions

1 Suggest why Belgium has given money to the DRC’s urban farming schemes. 2 MARKS

Belgium gives money to the DRC as it has historical connections with the country. The DRC was a former colony of Belgium.

Comment: Allow one mark for a suggested answer and another for further explanation.

2 Explain the impact of rural to urban migration on food supplies in the DRC. 4 MARKS
City-dwellers in the DRC live below the poverty line and only eat one meal a day. As more people move into cities, the problem of poverty and food insecurity increases.

People came to Kinshasa from the countryside looking for work or fleeing conflict in the east of the country. Many of the migrants are skilled farmers, but have no land or money to buy seeds.

New housing is being built in and around Kinshasa to accommodate the new migrants. Urban farming is threatened and farmland around the edge of the city is used for housing.

Rural to urban migration impacts are likely to be about the growth of the city. This will lead to unplanned development, unemployment, congestion, crime, overcrowding and other issues.

A second impact of rural to urban migration could be the effect on rural communities. Workers will be lost and so productivity will decline.

**Comment:** Students should give two different impacts and explain each to get the top marks.

3 **Using Figures 15.30 and 15.31 and your knowledge, explain how urban and peri-urban agriculture in the Democratic Republic of Congo is a sustainable way to produce food. 9 marks + 3 SPaG MARKS**

Urban and peri-urban agriculture in low income countries is a sustainable way to produce food for many reasons:

- Plots can be very productive and grow more food than equivalent farmland.
- The government helps out with irrigation, which means that crops will always get enough water to grow (**Figure 15.30**).
- Surplus crops can be grown, which gives the farmer an income (**Figure 15.31**).
- Food miles will be lower than transporting food from the surrounding countryside.
- Nearby schools and training facilities can help farmers to learn new skills.
- Micro-loans are an affordable way to start up a small farm.

**Comment:** Students must refer to the figures in their answer. To get the SPaG marks, their spelling must be good and they must have used paragraphs to structure their answer.

**Mark scheme**

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
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| 3 (detailed)| 7–9   | • Demonstrates detailed knowledge of the role of urban and peri-urban agriculture in the Democratic Republic of Congo as a sustainable way to produce food.  
• Shows thorough geographical understanding of the inter-relationships between places, environments and processes in the context of a sustainable food production.  
• Demonstrates application of knowledge and understanding in a coherent and reasoned way in analysing and evaluating the role of urban and peri-urban agriculture in the Democratic Republic of Congo as a sustainable way to produce food. |
<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
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| 2 (clear)  | 4–6   | • Demonstrates clear knowledge of the role of urban and peri-urban agriculture in the Democratic Republic of Congo as a sustainable way to produce food.  
• Shows some geographical understanding of the inter-relationships between places, environments and processes in the context of a sustainable food production.  
• Demonstrates reasonable application of knowledge and understanding in interpreting, analysing and evaluating the role of urban and peri-urban agriculture in the Democratic Republic of Congo as a sustainable way to produce food. |
| 1 (basic)  | 1–3   | • Demonstrates limited knowledge of the role of urban and peri-urban agriculture in the Democratic Republic of Congo as a sustainable way to produce food.  
• Shows slight geographical understanding of the inter-relationships between places, environments and processes in the context of a sustainable food production.  
• Application is limited with some use of the photographs to support response. Little or no recognition of the role of urban and peri-urban agriculture in the Democratic Republic of Congo as a sustainable way to produce food. |
Teaching notes: Section 6 Chapter 16 Water resources

LEARNING OUTCOMES

By the end of this chapter, students should:

- know where our water resources come from
- know where the world’s water resources are consumed
- understand the human and physical impacts on water availability
- recognise the factors that affect water consumption
- understand the different impacts of water insecurity
- recognise the advantages and disadvantages of a water transfer project
- understand how we can move towards a sustainable water resource future
- know the social and economic advantages of a local water conservation scheme.

Introduction

This topic looks at the supply and demand for water resources. Students need to appreciate that the global distribution of water resources is uneven and water supply is not always secure. As a result of the rising demand, conflict over remaining water resources is increasing. Managing water resources is therefore essential to increase water supply and reduce the likelihood of conflict.

Prior knowledge

Students should have a basic knowledge gained through Key Stage 3 study of hydrology, including:

- a basic understanding of human and physical processes that interact to influence and change river landscapes
- a basic understanding of how human activity relies on effective functioning of natural river systems
- a basic understanding of the flows and stores in the water (hydrological) cycle.

Geographical skills

Cartographic and numerical skills can be developed using Activity 16.2. Students are asked to plot proportional circles on a World map and describe the resulting global pattern of water consumption.

Statistical skills can be developed using Activity 16.5 question 3. Students can draw a scattergraph showing life expectancy against access to safe drinking water, draw estimated lines of best-fit and interpret the results.

Graphical skills can be developed using Activity 16.1 question 3. Students can interpret and extract information from a climate graph for Hanoi. Graphical skills can also be developed using Activity 16.6 question 3. Students are asked to draw a labelled sketch of Lake Mead to show the characteristics of the dam and reservoir.

General notes

Students will need to know the reasons for global variations in water resources and understand how supply can be variable both between and within countries. Students may be unfamiliar with studying water resources as a geographical theme. It is important to introduce students to a number of water supply and demand datasets and maps at a range of scales to allow them to develop graphical and numerical skills. Many of the activities in this topic have been created to support this.

There are a variety of strategies such as aquifer recharging, water transfers and desalination that can be used to increase water supply. Associated with each of the strategies used to increase water supply are a number of social, economic and environmental problems that should be understood. Preparation for exam questions should ensure detailed knowledge of the advantages and disadvantages of the South-to-North Water Transfer Project in China and the Kyeni Kya Thwake local water conservation scheme in Kenya.
Additional support

Students may need support with recognising global patterns of water surplus and deficit; they may need simplified maps and a global climate map to aid their understanding.

The range of skills associated with water supply and demand can be challenging for some students. They may find it useful to explore interactive maps, such as those available on the NASA website ([www.cambridge.org/links/gatd4101](http://www.cambridge.org/links/gatd4101)) to support their understanding from the Student Book. Watch the video on Cambridge Elevate about urban communities gaining access to clean water and sanitation in Bangalore, India to understand how community projects can improve quality of life.

Spending time on some of the interactive maps, such as the World Resources Institute GIS Aqueduct Project ([www.cambridge.org/links/gatd4102](http://www.cambridge.org/links/gatd4102)) would be of great benefit. It would help students to understand the geographical distribution of water risk now and in the future.

As demand for water resources is rising globally but supply is increasingly insecure, future trends could include a reduction in water supplies and more conflict in particularly water stressed regions. Students may struggle to comprehend these future scenarios, so it is worth providing them with alternative scenarios, such as those provided by Growing Blue online ([www.cambridge.org/links/gatd4103](http://www.cambridge.org/links/gatd4103)).

Extension

There are a number of websites mentioned throughout the topic to guide students to further information about particular issues. It is well worth investigating why the Aral Sea has disappeared, the advantages and disadvantages of the South-to-North Water Transfer Project in China and the benefits of sand dams in Kenya in more detail than can be provided in the Student Book.

Conflict over water is increasing in areas of water scarcity. Students may like to investigate this further by investigating conflict on some of the rivers in the Middle East such as dam construction on the River Euphrates and River Jordan. Students should be encouraged to investigate these topics in more depth.

Finally, detailed case study knowledge of the social, economic and environmental impacts of dams and water transfer schemes is always available on news websites including Al Jazeera ([www.cambridge.org/links/gatd4104](http://www.cambridge.org/links/gatd4104)). Students can increase their chances of exam success by researching named examples in more detail.

Worksheets

Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

**Worksheet 16.1** is focused on understanding and interpreting a climate graph for Hanoi in Vietnam. When answering the questions, students need to appreciate the annual variability in climate common in different areas and how this variability in rainfall can impact on the population.

**Worksheet 16.2** focuses on where the world’s water resources are consumed. Students are asked to plot water consumption data and describe the resulting distribution patterns.

**Worksheet 16.3** explores the impacts of water insecurity. Students are asked to draw a scatter graph and line of best-fit showing life expectancy against access to safe drinking water in order to explain the correlation.

All of the worksheets will develop the students’ graphical and numeracy skills and their ability to interpret geospatial and numerical data.

Videos

Chapter 16 in the Cambridge Elevate enhanced edition includes the video clip: Challenges of urbanisation: water and sanitation. The clip looks at access to clean water and sanitation facilities in India. The clip comes from the Challenges of Urbanisation: Inequalities in Bangalore (DVD by Pumpkin Interactive Ltd).

Lesson ideas

**16.1 Where do our water resources come from?**

This topic starts with a recap of the hydrological cycle. Students should be familiar with this from their studies at Key Stage 3. It then moves on to look at the main sources of water used by humans. Later in the
topic, students will develop an understanding of what water supplies are used for, and how the quality and quantity of our water supplies are declining.

**Starter activity**

- Ask students to draw the water cycle from memory, including water stores and transfers. Ask students to guess which are the ten countries in the world with most of the Earth's freshwater supplies. Show a map with the top ten countries located. Further explore this by asking why these particular countries have large freshwater supplies.

**Plenary activity**

Use the following activities:

- Ask students to match key words such as ‘aquifer’, ‘groundwater’, ‘hydrological cycle’, ‘rivers’, ‘river basins’ with their correct definitions.
- Provide photographs and climate graphs for a range of places and ask students to pair them up and justify their choices.
- Play ‘Odd One Out’ with key terms. On a whiteboard, students can write their answers and justify their choice. For example ‘aquifer’, ‘lake’, ‘river’ and ‘reservoir’ – ‘aquifer’ is the odd one out as it is located underground, or ‘reservoir’ could be the odd one out as it is a man-made structure.

**Homework**

- Create an annotated diagram to present all the water stores and transfers mentioned during the lesson.
- There are many key terms introduced during this topic. Provide a glossary with the key terms presented in a word box for students to add to themselves.

**Check students’ understanding**

- Students need to understand why the flows of the hydrological cycle vary over time. Flows vary due to seasonal rainfall, natural climate cycles and climate change.
- Students should be able to recall the hydrological cycle, to include the key flows and water stores.

### 16.2 Global patterns of water surplus and deficit

This topic starts by exploring the different sources of freshwater, including rivers, lakes, reservoirs and aquifers. It then outlines the pattern of water surplus and deficits worldwide.

**Starter activity**

- Ask students if they can provide examples of freshwater sources. Where does the water come from? Is it a water store or a flow? Is the water easy to access? Does the water source vary seasonally?
- Show students the global map of water surplus and deficits in the Student Book. Ask students to suggest reasons for the pattern and discuss the problems of living in water-deficit areas.

**Plenary activity**

- Write a list of 15–20 global cities. Ask students to find out whether these are located in areas of water surplus or water deficit. Then explain how this will impact the city and the people who live there.
- Ask students to summarise the lesson in three sentences and then three key words.

**Homework**

- Find two contrasting climate graphs, then describe how the temperature and rainfall varies during the year. You might choose to compare a temperate area such as the UK with a polar or tropical area. Present your findings to your class.

**Check students’ understanding**

- Students should have a secure understanding of the concepts of water deficit and water surplus and the reason for the global variation in water surplus and deficits.
• Students should also be able to describe the distribution of water surplus and deficits.

16.3 What is water used for?
This topic starts by investigating the different uses for water, including agricultural, industrial and domestic use.

Starter activity
• Show a video clip of water use – such as ‘The Global Water Crisis: How much water do we really use every day?’ on YouTube (www.cambridge.org/links/gatd4105). After watching it, ask students to recall as many facts as they can in a minute. Ask students to estimate how much water they have already used today. Work out what activities are the most wasteful of water.

Plenary activity
Use the following activities:
• Pictionary – working in pairs and using whiteboards, ask students to draw different uses of water for their partner to guess.
• Play ‘Just a Minute’. Students have to talk about different uses of water for a minute without repetition or hesitation. As soon as a student repeats a key word or hesitates, the next student takes over the challenge until the minute is up.
• What if? Ask students how life would be different in the UK if we did not have piped water.

Homework
• Ask students to complete the Further Research suggested in this topic by carrying out a water survey at home. They could work out what they use water for and what activities are the most and least wasteful of water.

Check students’ understanding
• Students do not always comprehend how much water is used for domestic, industrial and agricultural use. It is worth constructing pie charts of water consumption by economic sector to help with this.
• Make it clear to students that water resources are not infinite. Increasing freshwater consumption cannot continue without having serious impacts on the environment.

16.4 What are the reasons for increasing water consumption?
This topic looks at the factors that have dramatically increased our demand for water, including global population growth, economic development and rising standards of living. It also gets students to consider future trends and strategies to use water use more efficiently in the home.

Starter activity
• Create a ‘layers of inference’ framework with two central images – water fountains in a park and standpipes in the street. Ask students what the source images tell them, what they do not tell them and what they can guess about water consumption in the two places.
• Present three graphs to show population growth, economic development and rising standards of living. Ask students to think about what might happen to water consumption in the future.

Plenary activity
Use the following activities:
• Ask students to write a summary of the lesson as a tweet. Limit the number of characters used to 140.
• Give out exit passes with two questions about water consumption written on them. Students have to correctly answer them in order to leave the classroom.
• Ask the class to create a question about demand for water and water consumption. Choose a student to be in the hot seat to answer correctly as many questions as they can in 60 seconds.
Homework

- Ask students to investigate the impact of the flower-growing industry on Lake Naivasha and the people of Kenya, beginning with a search of the BBC website (www.cambridge.org/links/gatd4106).

Check students’ understanding

- Students need to know that population growth and economic development can only drive up water demand as industrialisation and energy production require increasing quantities of water. Industrialisation can often be the cause of decreasing water quality as newly emerging economies (NEEs) rarely have strict environmental laws in place.
- Students should understand that trade in virtual water embedded in agricultural and manufactured goods can have a significant impact on water-insecure nations, such as Kenya.
- Students need to remember the difference between water stress and water scarcity and that there are two types of water scarcity – economic and physical.

16.5 Water stress and deficit

This topic outlines the ideas of water stress and water scarcity. Students should be aware of the two types of water scarcity – economic and physical.

Starter activity

- Write the words ‘stress’, ‘insecurity’ and ‘scarcity’ on the board and ask students what these terms mean.
- Draw a table on the board with the column titles – economic and physical. Ask students to list reasons why access to water supplies could be limited due to these two factors.

Plenary activity

Use the following activities:

- Ask students to talk on the topic of water stress for a minute, without hesitation or repetition.
- What are the likely impacts of population growth and climate change on water stress in Africa? Would all countries in Africa face the same problems? Justify your point of view.

Homework

- Ask students to add key terms to their topic glossary.

Check students’ understanding

- Students need to remember the difference between water stress and water scarcity and that there are two types of water scarcity – economic and physical.

16.6 Is there enough water for everyone?

This topic develops a student’s understanding of global water scarcity. It explores how human actions such as waste disposal and over-abstraction for industry and farming are having an impact on water quantity and water quality and how people in wealthy countries have better water infrastructure than those in poorer countries and therefore a more reliable water supply.

Starter activity

Use the following activities:

- Quick quiz – create true or false questions to test students’ knowledge of places in the world that are water scarce. Show a map of global water scarcity (Figure 16.9) as you go through the answers.
- Show students an image of a water vendor and ask for speculation as to where it is, why they are selling water, how much it costs and who the sellers are.

Plenary activity

Use the following activities:
• Working in pairs, ask students to discuss why it is not possible to supply everyone in the world with clean, safe water.
• Stickability – ask students to write down three things that will stick with them from today’s lesson.
• Using a whiteboard, ask students to draw a labelled sketch to show the process of eutrophication.

Homework

• Ask students to explore the World Resources Institute GIS Aqueduct Project (www.cambridge.org/links/gatd4107) to understand the geographical distribution of water risk now and in the future.

Check students’ understanding

• Students should realise that over-abstraction of groundwater can have some terrible consequences, such as ground subsidence, the formation of sinkholes and saltwater intrusion. These can all cause damage to property and the pollution of groundwater supplies.

16.7 What are the impacts of water insecurity?

• This topic addresses the impacts of water insecurity on the 785 million people without access to enough safe water. Students should be aware how problems such as waterborne diseases and water pollution significantly impact on the well-being of people, the environment and the economy.

Starter activity

Use the following activities:

• Use a question grid such as the one on John Sayers Geography Blog (www.cambridge.org/links/gatd4108) with an image of people living in squatter settlements. Encourage students to be curious and ask questions about the people and physical environment.
• Show students a photograph of the Aral Sea in 1960 and today. Ask students for suggestions as to why the world’s fourth largest inland sea has changed so dramatically in 20 years.

Plenary activity

Use the following activities:

• Ask students to create a mind map to show information about water insecurity. A mind map should be colourful and include illustrations.
• Write the words ‘mosquito’, ‘cholera’ and ‘mercury’ on the board. Tell students that these are three answers, but what were the questions?
• Ask students to summarise the lesson in three sentences, and then in three words.

Homework

• Students can research the causes and effects of the shrinking Aral Sea. Start with a search of the Earth Observatory website (www.cambridge.org/links/gatd4109).

Check students’ understanding

• Students need to link the ideas that water sources located in areas without sanitation will have waterborne diseases such as cholera and dysentery.
• Students do not always recognise that farming and industry both cause water pollution that can be dangerous to people and the environment. Discuss the process of eutrophication and how it can affect the marine environment.

16.8 What strategies can be used to increase water supply?

This topic outlines how a range of strategies including aquifer recharging, dams and reservoirs, water transfers and desalination are used to increase global water supplies, although each one comes with economic and environmental costs.

Starter activity

Use the following activities:
• Ask students to match pictures of strategies to increase global water supplies with the correct written description.
• Play ‘Spot the Difference’ with satellite images or photographs of the Colorado River valley before and after the Hoover Dam was constructed. Ask students to describe how the physical environment has changed.
• Show an image of Lake Mead on the board with the claim ‘This reservoir is sustainable’. Ask students whether they agree or disagree, they must justify their opinion.

Plenary activity

Use the following activities:

• In pairs, ask students to test each other about the advantages and disadvantages of different strategies used to increase water supply.
• Use an online name generator to pick students to answer quick-fire questions about different strategies used to increase water supply.
• Prepare a crossword for students including clues about the different strategies used to increase water supply.

Homework

• Ask students to find out more about the process of desalination, how it works and the impacts on the environment. Start by using the US Geological Society website [www.cambridge.org/links/gatd4110].

Check students’ understanding

• Many students are unaware of how little rain falls in some areas of the world. It is worth spending time comparing what life is like in semi-arid places with life in the UK.
• Water may be stored for several years in the soil and may remain stored in the ground, glaciers and ocean basins for decades. Students need to be aware of how slowly aquifers recharge and of water transfers through the hydrological cycle.

Named example: the South-to-North Water Transfer Project, China

This topic explains why such a mega-project is needed in China and the social, economic and environmental advantages and disadvantages of water transfer schemes.

Starter activity

• Show an image of the construction of the South-to-North Water Transfer Project and ask students to speculate what it is, the purpose, location, cost, benefits and so on.

Plenary activity

Use the following activities:

• Ask students to draw a storyboard to show the timeline of events for the construction of the South-to-North Water Transfer Project.
• Ask students to draft an email to send to the Chinese government. Tell them why the South-to-North Water Transfer Project is not the magic solution to water problems in the country.
• Ask students to create an acrostic. Students write WATER TRANSFER down the side of a page and make each letter the first letter of a word or phrase about the South-to-North Water Transfer Project.

Homework

• Direct students to the International Rivers website to find out more information about the South-to-North Water Transfer Scheme [www.cambridge.org/links/gatd4111].

Check students’ understanding

• Students should realise that mega-projects such as the South-to-North Water Transfer Scheme are controversial. They have huge financial costs and impact on both people and the environment. It is
currently not known whether the unintended impacts (negative externalities) of the scheme will cause more problems than they will solve.

16.9 How can we move towards a sustainable water resource future?
This topic outlines how water can be more efficiently used in agriculture, industry and the home. It uses the example of the Coca-Cola Company and the city of Las Vegas to show how water consumption can be reduced. It introduces the idea of appropriate technology as a way to improve water resources in lower-income countries.

Starter activity
Use the following activities:
- Use photographs of Las Vegas Strip and ask students what we can do to reduce water use in semi-arid areas such as Nevada.
- Show photographs of different water-saving strategies and ask students to order them according to which ones will save most water.

Plenary activity
Use the following activities:
- Write five true-or-false questions on appropriate technology for students to answer.
- Play ‘Just a Minute’. Students have to talk about sustainable water resources for a minute without repetition or hesitation. As soon as a student repeats a key word or hesitates, the next student takes over the challenge until the minute is up.
- Ask students to sum up what they have learnt today in 50 words.

Homework
- Design a water efficient house; begin by researching water efficiency at Waterwise website [www.cambridge.org/links/gatd4112](http://www.cambridge.org/links/gatd4112).

Check students’ understanding
- Students should be aware that in higher-income countries, most people have access to piped water. Water conservation, recycling and ‘grey’ water are strategies used to reduce water consumption. In lower-income countries, fewer people have access to clean safe water and water consumption is lower.

Named example: the Kyeni Kya Thwake water conservation scheme in Kenya
This topic outlines how a local water conservation scheme can improve the lives of people living in a small community such as the Kyeni Kya Thwake in Kenya. It describes the use of sand dams and sustainable farming methods.

Starter activity
Use the following activities:
- Students could be read a short article about sand dams and then answer five questions based on the content of the article to encourage them to recall factual information.
- Show students ten items related to appropriate farming; for example, corn, garden fork, watering can, etc. Cover them up after a minute and ask students to list the items. At the end of the lesson discuss what each item represents and how it links to the lesson.

Plenary activity
Use the following activities:
- Ask students to write a diary entry describing how life has improved for the Kyeni Kya Thwake community.
- Show a video clip of a sand dam without sound. Ask a student to provide a running commentary, using information learnt in the lesson.
Provide a photograph of a sand dam for students to label with at least five different features of the sand dam.

Homework

Ask students to write ‘water resources’ in the centre of a page, then create a detailed mind map about the topic. Remember to make the map colourful and include images where suitable.

Check students’ understanding

Many students believe that mega-projects such as the South-to-North Water Transfer Scheme in China will solve water supply problems, when in actual fact sand dams and other smaller more sustainable projects are more likely to be successful as they provide water and empower the local community.

Model answers to ‘Assess to Progress’ questions

1. Outline why water is essential for life. 4 MARKS

Water is essential for several reasons. Humans use water to grow crops, and water livestock. Worldwide, agriculture accounts for 70 per cent of all water consumption. In the home we use water for cooking, cleaning and drinking. Water is also used in industry to process goods, clean equipment and for the personal use of workers. In developed nations, industries consume more than half of the water available for human use.

Comment: Any two from these or other suitable developed points:

- Humans use water to grow crops, and water livestock; worldwide, agriculture accounts for 70 per cent of all water consumption.
- In the home we use water for cooking, cleaning and drinking. HICs use more water in the home due to a greater use of domestic appliances such as washing machines, dishwashers and power showers.
- Water is also used in industry to process goods, clean equipment and for the personal use of workers. In HICs, industries consume more than half of the water available for human use.

Expect students to provide a wide range of responses; some of their ideas may be developed (2 marks for each developed point).

2. Describe the global pattern of water surplus and deficit. 4 MARKS

Areas of water scarcity are located at low latitudes including South America, North Africa, Southern Asia and Australia. Countries such as Algeria, Chad and Mali in Africa receive very little rainfall each year and suffer from a water deficit. Areas of plentiful water tend to be located in temperate climate zones at higher latitudes including North America, Northern and Central Europe and Russia. Countries such as England, Canada, Brazil and the United States receive a surplus of water.

Comment: Students must include specific places to exemplify their answer and to gain the full 4 marks.

3. Explain the impacts of water insecurity for people and the environment. 9 MARKS

Water insecurity can impact on the health, well-being and safety of people. For example, 2.6 billion people lack access to improved sanitation such as a toilet; a majority of these people live in Asia. If not carefully managed, water sources located in areas without sanitation can become contaminated with infectious diseases and parasites including malaria and cholera. Malaria is found in 100 countries and affected more than 200 million people last year and can result in death if not diagnosed and treated promptly. Where water supply does not meet demand, competition among water users intensifies and there is a greater likelihood of conflict unless managed effectively. Water conflict could occur along the Mekong, Nile and Euphrates, three transboundary rivers that flow through fairly arid regions. This risk is greatest in arid areas and in the 276 river basins that cross national boundaries. Global food prices have been rising since 2012 and since one-third of food production occurs where water is becoming scarce, it is likely that food price rises will continue and the global poor will struggle to buy enough food. With limited availability and access to water the global poor are trapped in a cycle of extreme poverty.
### Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (detailed)</td>
<td>7–9</td>
<td>• Demonstrates detailed knowledge of the impacts of water insecurity. Expect linked statements with reference to a range of named examples.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shows good geographical understanding of the interrelationships between places, environments and processes in the context of water insecurity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Balance of different impacts discussed. Answer developed in detail.</td>
</tr>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Demonstrates clear knowledge of the impacts of water insecurity. Expect at least one linked statement and reference to at least one named example.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shows some geographical understanding of the interrelationships between places, environments and processes in the context of water insecurity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Some balance of different impacts discussed. Answer clearly developed.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Demonstrates limited knowledge of the impacts of water insecurity. Simple generic information with limited or no specific case study information.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Shows basic geographical understanding of the interrelationships between places, environments and processes in the context of water insecurity.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Little or no balance between the impacts discussed. Answer not developed.</td>
</tr>
</tbody>
</table>

### Suggested content

Credit only impacts (not causes or responses). Expect a wide range of responses. For example:

- Water insecurity can impact on the health, well-being and safety of people; 2.6 billion people lack access to improved sanitation such as a toilet, a majority of these people live in Asia.
- If not carefully managed, water sources located in areas without sanitation can become contaminated with infectious diseases and parasites including malaria and cholera. Malaria is found in 100 countries and affected over 200 million people last year and can result in death if not diagnosed and treated promptly.
- Where water supply does not meet demand, competition among water users intensifies and there is a greater likelihood of conflict, unless managed effectively. Water conflict is greatest in both arid areas and in the 276 river basins that cross national boundaries such as the Mekong, Nile and Euphrates.
• Global food prices have been rising since 2012 and since one-third of food production occurs where water is becoming scarce, it is likely that food price rises will continue and the global poor will struggle to buy enough food and become trapped in a cycle of extreme poverty.

4 Explain the social and economic benefits of a local water conservation scheme. 6 MARKS

There are many social and economic benefits of the sand dam built for the Kyeni Kya Thwake community in Kenya. With the dam in place, up to 20 million litres of water can be stored, supporting 1000 local people. The sand filters the water clean and having a secure water supply has increased food security for the village. The community have now been able to grow additional food and some of the highly profitable onions are sold at market. This income helps to pay for healthcare and primary education of the children. Women are spared the chore of walking for hours to collect water. Instead they can tend crops on the farm while their children are at school. As the water is stored underground, there is no surface water to act as a breeding ground for mosquitoes. This has reduced the risk of malaria.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2 (clear) | 4–6   | • Demonstrates clear knowledge of the social and economic benefits of a local water conservation scheme. Expect linked statements with reference to a named example.  
• Shows some geographical understanding of the interrelationships between places, environments and processes in the context of a local water conservation scheme. Distinction made between social and economic benefits.  
• Answer clearly developed. |
| 1 (basic) | 1–3   | • Demonstrates limited knowledge of the social and economic benefits of a local water conservation scheme. Simple generic information with limited or no specific case study information.  
• Shows limited geographical understanding of the interrelationships between places, environments and processes in the context of a local water conservation scheme. Little or no distinction made between social and economic benefits.  
• Answer not developed. |

Suggested content

Credit only social and economic benefits (not costs or environmental benefits). Answer should refer to a named example. There should be a balance of social and economic benefits to reach level 2 marks.

Social benefits of the Kyeni Kya Thwake community sand dam in Kenya:
• Up to 20 million litres of water can be stored, supporting 1000 local people.
• The sand filters the water clean and provides a secure water supply and food supply.
• As the water is stored underground, there is no surface water to act as a breeding ground for mosquitoes. This has reduced the risk of malaria.

Economic benefits:
• Low cost fresh water.
• Additional food can be grown and sold at market.
• Additional income can pay for healthcare and primary education.

5 What are the problems associated with over-abstraction of water from an aquifer? **4 MARKS**

When too much water is abstracted from an aquifer it can cause several problems. First, it can limit future water supplies. Second, ground subsidence can break water pipes, this can cause fresh water to escape and impact on the local water supplies. It can also cause pollution of the water supplies as dirty water travels into the water pipes. Over-extraction of aquifers can cause seawater to seep inland, this is known as saltwater intrusion. This is a concern in Los Angeles, where most of the water used by the ten million residents comes from groundwater stores and could be polluted by seawater seeping inland.

**Comment:** Any two from these or other suitable developed points:

• Over-abstraction can limit future water supplies.
• Ground subsidence can break water pipes, this can cause fresh water to escape and impact on the local water supplies.
• It can cause pollution of the water supplies as dirty water travels into the water pipes.
• Saltwater intrusion is the process of seawater seeping inland to replace lost groundwater as has happened in Los Angeles.

Expect a wide range of student responses (2 marks for each developed point).

6 Explain why water transfer schemes and large dams are often described as unsustainable. **6 MARKS**

Water transfer schemes are often described as unsustainable as there can be a decrease in river flow and native species of fish in rivers of the donor basin. As a result of the Snowy Mountain Scheme in Australia, which supplies 570 gigalitres of water annually to Sydney, there is a tenfold fall in flow rates in the Snowy River and as a result 12 out of the 17 migratory fish species previously found in the river, including trout, have disappeared. Water diverted from the lower basin of the Yangtze River is of a low quality and contains heavy metals, agricultural chemicals and human waste. Large dams are often described as unsustainable, as flooding the valley behind the dam can result in deforestation, the loss of fertile farmland and a fall in the number of mammals – these threaten the food security of the local people. Dams such as the Aswan High Dam in Egypt hold back water and sediment; this results in clear water erosion below the dam and a reduction in the supply of fertile sediments for farmers in the Nile Delta. Reservoirs fill with sediment and the capacity for water reduces over time.

**Mark scheme**

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
</table>
| 2 (clear) | 4–6   | • Demonstrates clear knowledge of the unsustainable nature of water transfer schemes and large dams. Expect reference to and balance between named water transfer schemes and large dams.  
• Shows some geographical understanding of the interrelationships between places, environments and processes in the context of water transfers and storage.  
• Answer clearly developed. |
Level | Marks | Description
--- | --- | ---
1 (basic) | 1-3 | • Demonstrates limited knowledge of the unsustainable nature of water transfer schemes and/or large dams. Expect reference to named water transfer schemes and large dams. Answer may be unbalanced focusing only on water transfer schemes or large dams.

• Shows limited geographical understanding of the interrelationships between places, environments and processes in the context of water transfers and storage. The description is limited and lacks supporting information.

• Answer not developed.

### Suggested content

Allow a wide range of responses. Expect balance between water transfer schemes and large dams; for example: Unsustainable nature of water transfer schemes:

- Decrease in river flow and native species of fish in rivers of the donor basin.
- The Snowy Mountain Scheme in Australia supplies 570 gigalitres of water annually to Sydney and has resulted in a ten-fold fall in flow rates in the Snowy River and the disappearance of 12 out of the 17 migratory fish species previously found in the river, including trout.
- Water diverted from the lower basin of the Yangtze River is of a low water quality and contains heavy metals, agricultural chemicals and human waste.

### Unsustainable nature of large dams:

- Flooding the valley behind the dam results in deforestation, the loss of fertile farmland and a fall in the number of mammals – these threaten the food security of the local people.
- Dams such as the Aswan High Dam in Egypt hold back water and sediment, resulting in clear water erosion below the dam and a reduction in the supply of fertile sediments for farmers in the Nile Delta.
- Reservoirs fill with sediment and the capacity for water reduces over time.

### 7 Explain the advantages and disadvantages of a named water transfer scheme. 6 MARKS

**Named water transfer scheme – the South-to-North Water Transfer Project, China.**

The advantages of this project are that more than 45 billion cubic metres of water will be diverted from the Yangtze River Basin to supply the people and industry in the north. When completed, the Chinese government claim the project will benefit up to 500 million people. The project is seen as a key to unlocking the development potential in the north of China.

Many of the unintended disadvantages of the project will impact on the environment and the people of China. In Hubei and Henan provinces, around 350,000 people were resettled to allow the Hanjiang valley to flood for the Danjiangkou Reservoir. Water diverted from the lower basin of the Yangtze River is of a low water quality and contains heavy metals, agricultural chemicals and human waste. More than £2 billion has been spent on pollution prevention projects and much more will be required in the future. There will be uncertain water futures due to external shocks to the system such as climate change. In recent years, rainfall has been higher in the north than the south. In times of drought, such as in 2011, there was not enough usable water to satisfy the demand in the south, let alone transfer water from the Yangtze to the north, making people question the decision to go ahead with the project.
### Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
</table>
| 3 (detailed)   | 4–6   | • Demonstrates detailed knowledge of the advantages and disadvantages of a water transfer scheme. Expect linked statements with reference to a named example.  
• Shows good geographical understanding of the interrelationships between places, environments and processes in the context of a named water transfer scheme.  
• Balance between advantages and disadvantages. Answer developed in detail. |
| 2 (clear)      | 3–4   | • Demonstrates clear knowledge of the advantages and disadvantages of a water transfer scheme. Expect at least one linked statement and reference to a named example.  
• Shows some geographical understanding of the interrelationships between places, environments and processes in the context of a named water transfer scheme.  
• Some balance between advantages and disadvantages.  
• Answer clearly developed. |
| 1 (basic)      | 1–2   | • Demonstrates limited knowledge of the advantages and disadvantages of a water transfer scheme. Simple generic information with limited or no specific case study information.  
• Shows basic geographical understanding of the interrelationships between places, environments and processes in the context of a named water transfer scheme.  
• Little or no balance between the advantages and disadvantages. Simple statements.  
• Answer not developed. |

### Suggested content

Credit only advantages and disadvantages of a water transfer scheme. Expect a balance between advantages and disadvantages. Answer should refer to a named example. There should be a balance of advantages and disadvantages to reach Level 2 marks.

Advantages, e.g., the South-to-North Water Transfer Project, China:

- More than 45 billion cubic metres of water will be diverted from the Yangtze River Basin to supply the people and industry in the north.
- The project may benefit up to 500 million people by unlocking the development potential in the north of China.
Disadvantages:

- Water diverted from the lower basin of the Yangtze River is of a low water quality and contains heavy metals, agricultural chemicals and human waste, requiring £2 billion to be spent on pollution prevention.
- In Hubei and Henan provinces, around 350,000 people were resettled to allow the Hanjiang valley to flood for the Danjiangkou Reservoir.
- There will be uncertain water futures due to external shocks to the system such as climate change.
- In times of drought, such as in 2011, there was not enough usable water to satisfy the demand in the south, let alone transfer water from the Yangtze to the north.
LEARNING OUTCOMES

By the end of this chapter, students should know:

• where global energy supplies come from
• how global energy consumption is changing over time
• how a country’s location affects its energy supplies
• why energy supplies change over time
• how energy insecurity affects different countries
• what the UK could do to improve its energy supply
• the advantages and disadvantages of oil exploitation in the North Sea
• measures that can be taken to reduce energy use
• how a Solar Mini Grid has improved life for people in rural Tanzania.

Introduction

Prior knowledge

Energy resources are not always covered as a separate subject in Key Stage 3. However, students should have a basic knowledge of renewable and non-renewable energy sources. They should already know that:

• energy resources are used to generate the electricity that we use
• renewable energy resources are naturally replenished on a human timescale
• non-renewable energy is finite and so cannot be replaced when used up
• fossil fuels are natural forms of energy such as coal or gas. They were formed from the remains of living organisms.

Geographical skills

Cartographic skills in the form of atlas maps are developed using Activity 17.2 question 1a where students annotate world maps to show energy data. Students are asked to use their knowledge to recognise and describe distributions and patterns on maps. They also analyse map information in 17.3 Why are there areas of energy surplus and deficit?

Graphical skills are developed through the analysis of choropleth maps (specifically proportional symbol maps) in 17.1 Where does our energy come from? and also through the construction of a graph in Activity 17.8 question 1b.

Literacy skills in the form of reading and written communication are covered in Activities 17.2 and 17.3. Activity 17.7 asks students to create a newspaper article about the impacts of the oil industry in Aberdeen.

High-level thinking is developed in the Discussion Point boxes throughout the chapter. These encourage students to apply the theory that they have learned to real life situations; for example, the advantages and disadvantages of the oil industry to Aberdeen.

General notes

It is important to be led by the GCSE specification when setting up teaching of this topic area. Students will need to know the difference between renewable and non-renewable energy and be able to give examples of each type. Detailed study of a named example, such as the oil industry in Aberdeen, is needed to show the impacts of extracting non-renewable energy sources. Students should also be able to talk about a named example of renewable energy; for example, solar mini-grids in Tanzania. Students should also be able to speak confidently about energy efficiency and ways to conserve energy supplies.
Additional support

The formation of fossil fuels can be a difficult concept for some students due to the geological timescales involved. Start with a basic explanation of how fossil fuels are formed using a video clip, such as ‘Fossil fuel formation’ on Vimeo (www.cambridge.org/links/gatd4113).

Students may need support with the numerical and graphical aspects of this chapter, such as the data shown in 17.1 Where does our energy come from? and also with the construction of a graph in Activity 17.8 question 1b.

The geopolitics surrounding global energy supplies is also a complex issue. Maps of Russian gas pipelines to Europe and reports surrounding the security of these pipelines could be used to illustrate delicate international relationships. The impact of the Russia–Ukraine conflict could be studied through the use of news articles, such on BBC News (www.cambridge.org/links/gatd4114).

Extension

Activities are scaffolded throughout this chapter to ensure that students of all abilities can access the resource. Students can be challenged to extend the more difficult questions; for example, in Activity 17.7 question 2, students could divide their advantages and disadvantages into social, economic and environmental.

Worksheets

Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

Worksheet 17.1 accompanies Activity 17.2 question 1a. The worksheet provides a World map where students identify top three countries for oil, coal, gas and uranium reserves. Students are then asked to suggest how these countries may benefit from having these levels of production.

Worksheet 17.2 accompanies Activity 17.6 question 3. Students are given a diagram of a house, which they must annotate to show how energy consumption can be reduced.

Videos

Chapter 17 in the Cambridge Elevate enhanced edition includes the video clip: Biogas production in India. The clip looks at a scheme to generate biogas as a cheap alternative cooking fuel. The clip comes from the Energy Security: India’s Sustainable Solutions (DVD by Pumpkin Interactive Ltd).

Lesson ideas

17.1 Where does our energy come from? (1)

This topic looks at where our energy comes from. It covers the non-renewable supplies of oil and coal.

Starter activity

• Ask students to identify uses of oil and coal. Establish that both can be used as a fuel to generate energy in the form of electricity.

Plenary activity

Project a World map onto a whiteboard and ask students to come to the front of the room and identify:

• countries with oil supplies.
• countries with coal supplies.

Homework

• Students should ask parents who their energy supplier is. They must then go onto their supplier’s website to ascertain the energy mix of that particular company. For example, EDF’s energy mix has over 50 per cent nuclear and less than 17 per cent renewable (www.cambridge.org/links/gatd4115).

Check students’ understanding

Student should understand that:
Fossil fuels are the most important energy resource, making up a large part of the world’s energy mix.
Non-renewable energy resources are found in specific locations globally.

17.1 Where does our energy come from? (2)
This topic looks at where our energy comes from. It covers gas and renewable supplies.

Starter activity
- Provide a list of energy sources and ask students to categorise them into renewable and non-renewable. The lists could include:

<table>
<thead>
<tr>
<th>Renewable</th>
<th>Non-renewable</th>
</tr>
</thead>
<tbody>
<tr>
<td>solar</td>
<td>coal</td>
</tr>
<tr>
<td>wind</td>
<td>oil</td>
</tr>
<tr>
<td>hydro-electric</td>
<td>gas</td>
</tr>
<tr>
<td>biogas</td>
<td>uranium*</td>
</tr>
</tbody>
</table>

*In the past uranium has been classified as renewable as supplies are unlikely to ever run out. However, it is non-renewable in that supplies will not be replenished within human timescales.

Plenary activity
Project a world map onto a whiteboard and ask students to come to the front of the room and identify:
- countries with gas supplies
- countries with uranium supplies
- countries that are suitable for different types of renewable energy; for example, solar, wind and tidal power.

Homework
- Using the government’s energy simulator [www.cambridge.org/links/gatd4116](http://www.cambridge.org/links/gatd4116), ask students to plan an energy strategy for the future. They should print-screen their final decision and write a paragraph to justify it.

Check students’ understanding
Students should know that:
- Fossil fuels are the most important energy resource, making up a large part of the world’s energy mix.
- Non-renewable energy resources are found in specific locations globally.
- Renewable energy resources can be generated in every country, but places differ in terms of their suitability; for example, sunny countries are more able to generate solar power.

17.2 How are energy consumption and economic development linked?
This topic looks at projected demands in energy consumption and identifies the largest consumers of renewable and non-renewable energy.

Starter activity
- Use this link to view real-time information on the UK’s national grid [www.cambridge.org/links/gatd4117](http://www.cambridge.org/links/gatd4117). Students should be encouraged to look at the dials at the top of the webpage to see the percentage breakdown on different types of energy being generated at that particular time.
- The webpage has a link in the top-left corner to the equivalent French site [www.cambridge.org/links/gatd4118](http://www.cambridge.org/links/gatd4118). Students can identify changes in national demand and the type of energy that each country is producing.
Plenary activity

- Look at the Guardian newspaper’s ‘Quiet at the back: classrooms around the world – in pictures’ feature (www.cambridge.org/links/gatd4119). For each image, students should identify potential uses of electricity and think about how this usage may change over time. They should use the discussion to help with their homework task, which is an adaptation of this plenary.

Homework

- Students choose and print two contrasting images from the James Mollison’s ‘Where children sleep’ webpage (www.cambridge.org/links/gatd4120). The teacher may choose to print the images, which could differentiate the task. The site shows images of where different children from around the world sleep. For each image, students should give an overview of the child’s energy usage and estimate the extent to which this usage may change over time.

Check students’ understanding

Students should understand that:

- Global energy consumption is expected to grow by 2040 and much of this growth will come from developing countries.
- Economic development and energy consumption are linked.
- The USA, China and Russia are big consumers of non-renewable fuels.
- Norway, Brazil, New Zealand, Colombia and Venezuela are all big consumers of renewable fuels.

17.3 Why are there areas of energy surplus and deficit?

This topic identifies countries with renewable and non-renewable energy surplus and deficits.

Starter activity

- Go to the Gapminder website (www.cambridge.org/links/gatd4121). Click ‘Gapminder World’ to bring up a World map. Plot oil production per person on the x axis and oil consumption per person on the y axis. In each case, choose logarithmic graph. Press the play button on the bottom left of the graph to see how the relationship between production and consumption has changed since 1965. Select specific countries using the tick boxes to the right of the graph, e.g. the BRIC economies, and play the animation through. This should display trails on the screen. Ask students to interpret the various graphs shown.

Plenary activity

Pose scenarios to the group and ask for suggestions about how this might change patterns of energy surplus and deficit. Some scenarios could be:

- Coal prices plummet as more coal is discovered.
- The Earth heats up through global warming, but this leads to increased levels of cloud over African nations.
- Oil supplies run out.
- Changes in the Earth’s atmospheric circulation leads to greater levels of rainfall in the Sahel region of Africa.

Homework

- Students must research current estimates for coal, oil and gas reserves. How many years’ worth of each type of fuel is left? Why do these estimates vary so widely?

Check students’ understanding

Students should understand that:

- Some parts of the world have a surplus of energy. People in other parts of the world do not have access to electricity.
- Fossil fuels are found in specific parts of the world.
• Some countries are able to generate lots of renewable energy.
• Many African countries have supplies of fossil fuels and suitable conditions for renewable energy, such as sunlight to generate solar power.

17.4 What factors affect energy supply?
This topic identifies factors that affect energy supplies and how these factors change over time.

Starter activity
• Show footage of the burning oil wells in Kuwait in 1991. There are many clips available, such as ‘Gulf War 1991 montage’ on Vimeo [www.cambridge.org/links/gatd4122] which shows footage set to music. Ask students to work out what’s going on in the clip. Explain that the fires were started as a result of conflict. Ask students to suggest what the same scenes would look like today and what the implication of the fires may have been.

Plenary activity
• Students are given a sticky note. They must write down one factor that affects energy supplies. They should then come to the board and place their sticky note into one of four categories: physical factors, cost, technology, and war and corruption.

Homework
• Research both sides of the fracking debate. Suggested websites could be Frack Off [www.cambridge.org/links/gatd4123] in opposition and Energy from Shale [www.cambridge.org/links/gatd4124] in favour. Students must choose one side of the argument and write a persuasive speech to read to the class.

Check students’ understanding
Students should understand that:
• Many factors affect global energy supplies. Over time, changes in these factors result in surpluses and deficits.
• Energy supplies are affected by:
  ◦ physical factors, such as the availability of rocks bearing fossil fuels and climate
  ◦ the cost of exploitation and production
  ◦ changes in technology, such as fracking and new drilling and mapping techniques
  ◦ political factors, such as war and corruption.

17.5 What are the impacts of energy insecurity?
This topic identifies five different impacts of energy insecurity, or energy supply problems.

Starter activity
• Ask the students to close their eyes and use their imagination. Talk them through a scenario where they wake up one morning to find that energy supplies have run out. They have no lighting (especially if the lesson is during the winter), no heating, no kettle and no TV. They may be able to get to school this morning as there is still petrol left in the car, but what about tomorrow? They may be able to use their mobile phone today as it still has charge, but what about tomorrow? How would we cope in a world with energy insecurity? Do places cope under these circumstances? Will we ever have to face this scenario? What would happen after one week, one month or even a year? Students should then discuss how they would feel in this situation and what may happen. Very quickly, the issues that are identified in the Student Book are likely to be suggested; for example, lack of food and the potential for conflict.

Plenary activity
• The Confederation of British Industry has around 190 000 members. These members employ nearly seven million people, about one-third of the private sector workforce, so they represent British businesses and industry. Visit the CBI website to look at the relationship between infrastructure and
economic growth in the UK (www.cambridge.org/links/gatd4125). How important is energy in terms of economic growth of a country?

Homework

- This topic explains how Thailand has an Alternative Energy Development Plan (AEDP). Students should provide an update on progress. The government’s Ministry of Energy website has lots of information (www.cambridge.org/links/gatd4126). To what extent do students think that the 2022 targets are achievable?

Check students’ understanding

Students should understand that energy insecurity, or energy supply problems, can have a number of impacts:

- the exploration of difficult and environmentally sensitive areas
- economic and environmental costs
- food production
- industrial output
- potential for conflict where demand exceeds supply.

17.6 What strategies can be used to increase energy supply?

This topic explains how energy supplies can be increased or used more efficiently.

Starter activity

- Ask students why the demand for energy is increasing over time. In topic 17.2 How are energy consumption and economic development linked? students learnt that global energy consumption is expected to grow by 2040 and much of this growth will come from developing countries. They also learned that economic development and energy consumption are linked.

Plenary activity

- Revisit Activity 17.6 question 1: Should we focus on developing renewable energy or increasing the efficiency of our non-renewable energy generation?

Homework

- Students should create a table showing all the potential renewable energy sources that could be used in the UK. The table should list the advantages and disadvantages of each for the UK. They should consider things such as cost and practicality. Finally, they should write a paragraph recommending which type of renewable energy they think would be best for the UK.

Check students’ understanding

Students should know that:

- Energy demand is increasing over time so we must find ways to increase supplies or use existing supplies more efficiently.
- Renewable solutions include biomass, solar, geothermal, HEP, wind power and waves and tides.
- Non-renewable solutions include combined-cycle systems, co-firing, constructing energy efficient buildings and nuclear fuel reprocessing.

Named example: the Gannet oilfield in the North Sea

This topic looks at the advantages and disadvantages of extracting oil from the North Sea.

Starter activity

- Show students a map of the UK and surrounding areas of sea. Ask them to identify where they think North Sea oil is located. Figure 17.27 can be used to reveal the extent of the North Sea oil fields.
Plenary activity

- Read an account of life aboard a UK oil rig [www.cambridge.org/links/gatd4127] which includes a good interview. Ask students what the advantages and disadvantages of life on the oil rigs would be for workers.

Homework

- Students should write a short news report, giving an update on the 2010 explosion on BP’s Deepwater Horizon rig in the Gulf of Mexico. They should look at the economic and environmental costs, both in the short and long term.

Check students’ understanding

Students should know that:

- The Gannet oil field is a manned platform that lies 180 km (112 miles) to the east of Aberdeen in Scotland. Shell have been extracting oil and gas from the Gannet A Platform since November 1993.
- The Gannet increases energy security for the UK and provides jobs.
- Supplies of oil in the North Sea will eventually run out and extracting oil from this area increases the potential for environmental accidents.

17.7 How can we use energy more sustainably?

This topic looks at how energy can be used in a sustainable way, through developing better buildings, transport systems and electrical appliances.

Starter activity

- Ask students how efficient our school buildings are. Are there any areas that lose heat? Do we leave lights or projectors on? Do we have solar panels or small wind turbines? Has anyone seen the Display Energy Certificate (DEC)? The school must have one, where is it? What could we do as a school to improve our energy efficiency?

Plenary activity

- Go to the WWF Footprint calculator [www.cambridge.org/links/gatd4128] to calculate some individual carbon footprints for the class. Calculate your own score in advance of the lesson to use as a comparison. Create a ‘league table’ to show the most environmentally friendly members of the class.

Homework

- Leading on from the starter activity, students should draw a picture of their home. They must label on any features that are currently energy efficient, such as energy-saving lightbulbs, loft insulation. They should then suggest ways to improve the energy efficiency of their home, such as triple-glazing, ground source heat. The Energy Savings Trust website contains useful information on ‘Energy saving quick wins’: [www.cambridge.org/links/gatd4129] and Energy saving tips [www.cambridge.org/links/gatd4130]. Finally, they should evaluate the suggested improvements, i.e. are the improvements cost-effective? Are they difficult to implement?

Check students’ understanding

Students will have learnt that:

- Carbon footprints are used to calculate our energy consumption and its impact on the planet.
- Energy Performance Certificates (EPCs) and Display Energy Certificates (DECs) monitor energy use in homes and public buildings.
- The government tries to encourage sustainable use of transport.
- The European Union (EU) has put a system in a place where all major household appliances, such as washing machines, dishwashers and fridge-freezers, have energy ratings.

Named example: the Solar Mini Grid Scheme in Melela, Tanzania

This topic looks at the advantages and disadvantages of the Melela solar mini-grid.
Starter activity

- Show students the Devergy video (www.cambridge.org/links/gatd4131). Ask students to identify and discuss the impact of Devergy’s work for local communities.

Plenary activity

- Students to write a blog or diary entry of a local resident in Melela. They should explain ways that their life is different as a result of the mini-grid and how they feel about the new development.

Homework

- Visit the Akon Lighting Africa project’s website (www.cambridge.org/links/gatd4132). Students should choose a country where Akon has provided help. They should then visit the gallery section of the site (www.cambridge.org/links/gatd4133) and choose three photographs to annotate to show how the project has benefited local people.

Check students’ understanding

Students should understand that:

- Melela is a village in Tanzania. In 2013, a solar mini grid was installed to provide a renewable and sustainable source of fuel.
- The mini-grid benefits local businesses and residents through cheaper energy bills and fewer environmental toxins (the alternative fuel source is Kerosene).
- However, the mini-grid is not affordable for some residents, and energy generation can be limited during the rainy season.

Model answers to ‘Assess to Progress’ questions

1 Why is it more difficult to access electricity in rural parts of Tanzania? 2 MARKS

Any from:

- It is difficult to obtain electricity in rural Tanzania because villages are not connected to the national grid. This means that they cannot access any electricity produced nationally.
- A lack of infrastructure means that energy supplies cannot reach rural dwellers.
- A lack of money in rural areas means that some rural dwellers cannot afford to buy energy.

Comment: Students should either make one point and explain it, or make two points.

2 Use Figures 17.34 and 17.36. Explain the suitability of small-scale solutions to the energy problems faced in Tanzania. 3 MARKS

Figure 17.34 shows a small solar panel and Figure 17.36 shows that the technology is easy to fit and maintain. This is suitable for rural Tanzania because it is quite basic and would require very little training to use. It is also relatively cheap and so villagers can afford it.

Comment: Students should refer to Figures 17.34 and 17.36 in their answers. They need to give three separate points, or two points with one explained.

3 The following are benefits linked to improved access to electricity in rural Tanzania:

- energy costs are lower
- fewer people are using kerosene.

For each of the benefits, explain how the lives of the people living in rural Tanzania will be improved. 4 MARKS

If energy costs are lower, more people will be able to afford to use it. This means that they will have access to mobile phones and televisions, which will improve their quality of life. People may also have more money to spend on other things.

If fewer people are using kerosene they will be healthier and therefore more able to work. The quality of the local environment will also be better, further improving their health.
If businesses can stay open longer, there will be more employment and therefore more wealth generated. It will also mean that people have greater access to goods and services, which will improve their quality of life.

Comment: One mark for a basic answer, two marks for an explanation.
Introduction to Section 7: Fieldwork, skills and assessment preparation

General notes
Section 7 contains general guidance on planning and carrying out fieldwork, developing geographical skills and preparing for assessments. It is not expected that students will work through these chapters but instead dip in and out as required. There are no suggested learning activities for the section introduction.
LEARNING OUTCOMES
By the end of this chapter, students should be able to:
• appreciate the factors that need to be considered when selecting a topic for enquiry
• understand how to plan a geographical enquiry
• describe and explain methods used to collect, process and present data
• understand the different techniques that can be used to analyse data
• understand the importance of using evidence to reach effective conclusions
• appreciate the importance of evaluation to the whole enquiry process.

Introduction

Prior knowledge
Students should have a basic appreciation of research skills, including:
• finding information
• presenting information
• describing and explaining what they have found out
• reaching conclusions based on evidence.

Geographical skills
This topic gives the opportunity to use a range of skills, including the following specific investigation skills:
• research skills; looking at websites associated with news events, evidence of flood events linked with extreme weather, different types of river management
• data collection and presentation skills
• visual skills using photographs (annotations)
• analytical skills
• evaluative skills.

General notes
Fieldwork should be seen as a teaching technique used to deliver a part of the course rather than a ‘bolt on’ addition. There are a number of opportunities to use fieldwork to teach particular parts of the course. Many of these are highlighted in the scheme of work. The following points may be worth considering when planning the two fieldwork enquiries which are required in order to fulfil the requirements of the specification:
• The fieldwork topics should be built into the scheme of work so that it has a logical place and students can understand the context of the fieldwork enquiries.
• The timing of the fieldwork enquiries needs to be carefully considered when developing a scheme of work.
• The fieldwork enquiries are not seen as very long pieces of work. The assessment value is considerably less than existing controlled assessment. Consequently, planning and organisation should reflect this.
• Any of the UK based parts of the specification provide an opportunity for the use of fieldwork.
• There is an expectation that fieldwork will cover both physical and human geography. There are a number of opportunities where fieldwork can consider the physical/human interface: an example would be the coastal and rivers topics.
• The choice of fieldwork topics may be partly dictated by location. This, in turn may need to be considered when selecting which of the option topics are chosen.
• It would be helpful to use an enquiry topic which also has the potential to be used as an example in relation to Paper 1 and Paper 2 examination questions.
• Follow a simple structure when carrying out fieldwork enquiries. Use the Student Textbook to make sure students understand the ‘enquiry journal’.

• Many of the techniques required for fieldwork enquiry can also be used when teaching other elements of the course. Many parts of the course lend themselves to enquiry based learning where students can use secondary evidence to investigate a particular geographical topic. This data can then be presented, analysed and used to reach a conclusion and finally the whole process can be evaluated, reflecting many of the requirements for the fieldwork enquiries.

• Using the enquiry process to teach some elements of the course will also provide a useful tool for preparing for the Issue Evaluation element of Paper 3 of the examination.

Model answers to ‘Assess to Progress’ questions

1 a Identify two potential risks when carrying out a geographical enquiry about coastal processes.

2 MARKS

Any reasonable points: ideas might include points about physical risks (the sea, beach (falls), cliffs, weather related risks and human related risks (human interaction questionnaires). For example:

• Slipping and falling on the wet beach surface.

• Being hit by falling material from cliffs.

b Suggest how one of the risks in (a) might be reduced. 4 MARKS

Make sure the beach area being investigated in not too uneven so that the slipping/falling risk is reduced. Wear sensible clothes, especially shoes that have good grip and do not come off easily. Make sure you have a first aid kit, in case there is an accident.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>3–4</td>
<td>• Identifies points which would reduce the identified risk with some clear development.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–2</td>
<td>• Basic points about being careful with some simple development which will reduce risk; ‘If the beach is uneven you need to be careful and make sure you wear sensible shoes so you don’t fall over’.</td>
</tr>
</tbody>
</table>

2 Describe and justify one data collection method that might be used in a physical geography enquiry. 6 MARKS

A number of sticks were placed in the river and the time it took for them to travel 50 m was measured. This was done a number of times to make sure that the data was accurate and the average velocity of the river calculated. This was important because the faster the speed the greater the opportunity for the river to erode and transport sediment.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Clear description of one data collection method appropriate to a physical geography enquiry with justification in relation to the aim of the enquiry.</td>
</tr>
</tbody>
</table>
3 Assess the usefulness of cartographic and visual presentation methods to geographical enquiries.  

6 MARKS

Using maps is a good way to show exactly where the enquiry is taking place and giving the background to the specific area, especially if labels are written on the map. Using diagrams and photographs can give a clear visual impression of the area and can be useful in identifying important features of the landscape.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Clearly understands ‘cartographic and visual’ and offers some sound evaluative reasoning for the use of these presentation techniques.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Shows limited understanding of ‘cartographic and visual’ and offers a largely descriptive account with tentative evaluative reasoning; ‘Diagrams and photographs are a good way to show information because you get a good impression of what a place is like without having to read a lot of information’.</td>
</tr>
</tbody>
</table>

4 For either a physical or a human geographical enquiry that you have carried out:

a State the title of the enquiry.

b Consider how effectively the enquiry satisfied its original aims. 9 MARKS

The aim of the investigation was to investigate traffic problems and all of the data collected was useful because it gave a good understanding of the traffic flows and pressures and also people’s views about congestion. Although there was sufficient accurate data to reach a conclusion a wider range of traffic flow data, including weekends and during the holiday season may have given a different picture. Also, the questionnaire was limited to people shopping so there was little information from people who drive to work and this may have affected the results.

Mark scheme

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 (detailed)</td>
<td>7–9</td>
<td>• Detailed reference to the original aim of the enquiry and makes evaluative points which reference the relative effectiveness.</td>
</tr>
<tr>
<td>Level</td>
<td>Marks</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
<td>-------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>2 (clear)</td>
<td>4–6</td>
<td>• Clear reference to the original aim of the enquiry and makes evaluative points which relate to it. Relative effectiveness only tentatively considered: ‘The aim of the investigation was to investigate traffic problems and all of the data collected was useful because it gave a good understanding of the traffic flows and people’s views about congestion. There was enough data to reach a conclusion and the data was accurate. A larger number of questionnaires may have given a wider range of views, but it seemed to work well’.</td>
</tr>
<tr>
<td>1 (basic)</td>
<td>1–3</td>
<td>• Basic evaluative observations which describe how the enquiry went without any real reference to the original aim: ‘The enquiry worked well and all of the data was useful. There were no particular problems with the data collection methods and there was enough information to answer the original question’.</td>
</tr>
</tbody>
</table>
LEARNING OUTCOMES

By the end of this chapter, students should be able to:

• recognise different types of graphs and charts that can show data
• interpret population pyramids and choropleth maps
• manipulate different types of numbers
• use ratios, proportions and sampling techniques
• compare different sets of data
• use lines of best fit to interpret scatter graphs
• use contour lines to see gradient
• draw cross-sections and transects
• use and interpret four and six-figure grid references.

Geographical skills

Geographical skills are practised throughout this book. The skills chapter focuses on these in greater detail.

Students will learn how to read data from a range of graphs, charts and maps, including population pyramids and choropleth maps. The use of numbers is covered through types of data, area, scale, ratios and proportions. Students will also learn how to apply different sampling techniques. In terms of data comparison this chapter covers the use of statistical techniques, such as central tendency, cumulative frequency, quartiles and percentage increase and decrease, and the use of lines of best fit to identify positive and negative correlations.

Students will use contour lines to interpret gradient on a map and then use this information to draw cross-sections and transects. The identification and interpretation of both four and six figure grid references are also developed. Finally, the use of Geographical Information Systems (GIS) is covered at the end of the chapter.

General notes

Many schools cover map skills in the early stages of Key Stage 3, which can mean that students at GCSE level need additional support. Mastering map and numerical skills results in additional marks that can allow students to access higher grades.

Students who use maps infrequently are likely to have forgotten how to use scale and grid references. Six figure grid references should be taught as an extension of four figure grid references. Once students have mastered four figure grid references they are able to progress to six. In terms of numerical and graph skills, students who struggle with maths will need more support with these skills in geography. The worksheets in this chapter provide graph templates, which mean that students are more likely to be able to complete graphs accurately, and also reminders about key mathematical concepts, such as averages and data types.

The Ordnance Survey offer free online support for students learning map skills via their Mapzone website. Geographical Information Systems (GIS) can be accessed via free or paid resources. Resources, such as the Ordnance Survey GIS Zone, QGIS, Google Earth and GE Graph can be accessed online for free. Google Earth and GE Graph work together to allow users to specify data collection points and attribute data to these points and overlay graphs. Paid resources, like the Advisory Unit’s AEGIS 3 and ESRI’s ArcGIS are loaded onto a school’s internal servers and teachers can create unique GIS activities that can be stored for use in later years.

A good way for students to practise map skills and GIS is through fieldwork and case studies. GIS maps of fieldwork areas can be used to overlay data that has been collected. Students can then use these to analyse their results. It is good practice to give students maps to use and interpret when they are learning case studies. Setting tasks, such as finding grid references and measuring distances, can integrate these core skills into everyday tasks.
Worksheets

Worksheets can be downloaded from the Cambridge Elevate enhanced edition of the Student Book.

**Worksheet 19.1** is for use with Activity 19.1 question 2 in the student book. The worksheet provides a table, where students identify appropriate forms of presentation for selected data types. Students are then given a graph template to draw a divided bar graph of questionnaire data for Oxford.

**Worksheet 19.2** is for use with Activity 19.2 in the student book. The worksheet provides a template, which enables students create a population pyramid for Bangladesh. Students are then asked to interpret a choropleth map, which shows rates of bicycle use in London.

**Worksheet 19.3** is for use with Activity 19.10 in the student book. The worksheet provides tables that will help students to calculate measures of central tendency.

**Worksheet 19.4** is for use with Activity 19.11 in the student book. The worksheet provides a table to calculate the percentage increase in the use of offshore wind farms between 2009 and 2014.

**Worksheet 19.5** is for use with Activity 19.12 in the student book. The worksheet provides a graph template, where students can plot data to show the change in sediment size and velocity along a river.
Chapter 20 offers general guidance on approaching assessments. It covers:

- the structure of the GCSE exams
- the general question types that students might encounter
- general techniques on answering questions.

It is envisaged that students will use this chapter for reference rather than working through it as they might the other subject content chapters. You might want to refer students to this chapter before they start answering the Assess to Progress questions, which are exam-style questions dispersed throughout the book. Alternatively, topic 20.3 Answering questions could be used to support peer-assessment activities.

The Assess to Progress questions will help students to practise answering exam-style questions, but it is also useful to provide students with past exam paper questions. Practising exam questions can help students to feel more confident in assessment situations and better able to display their learning.
Pumpkin Interactive videos

Pumpkin Interactive video clips appear throughout the GCSE Geography for AQA Elevate enhanced edition. These engaging video clips help to bring learning to life.

The video clips available in each chapter are identified in the teaching notes.

A message from Pumpkin Interactive

With over 20 years’ experience, UK-based Pumpkin Interactive are experts in producing high-quality specification matched video content for Key Stages 3–5.

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