

Explore 2

Teacher's Guide

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Introduction to the series

Explore is a new, up-to-date geography series for secondary classes 6–8. The series covers all the geographical topics and learning competencies from the National Curriculum for Pakistan. Guided by the structure of the Curriculum for Geography, from Book 1 to Book 3 the focus gradually switches from local (including the geography of Pakistan) to global (world issues such as forest clearances, population and big city growth, and globalization). However, this is done not by following the exact layout and order of the written curriculum, but by identifying and developing particular topics and themes, in order to make the learning process more student-friendly and relevant.

Explore consists of three components: the Students' Books, Workbooks, and the Teachers' Guides. Together, the three books and their components provide a comprehensive introduction to geography for secondary classes. They meet all the main **Aims** outlined in the Introduction to the National Curriculum for Geography.

AIMS

- * To create an understanding of the Earth as a planet within the Solar System—Book 1
- * To familiarize students with the environment in which people are living, by studying major land features of the Earth—Books 1 and 2
- * To provide an insight into the natural and human geography of Pakistan, and the changes taking place in its administration, population, their activities and resources—Books 1, 2, and 3
- * To provide more knowledge to students about the environment in which they are living—Books 1, 2, and 3
- * To create awareness among students about the neighbouring countries—Books 1 and 3 in particular

Likewise, the full course will enable students to satisfy all the general subject **Objectives** in the National Curriculum (numbered 1–10). Although many are met throughout all three books, for some it is possible to identify chapters where an objective is addressed more particularly.

OBJECTIVES

1. *To impart an understanding of the Earth as the home of man with emphasis on the topics of water, land, and the atmosphere.*
Earth (Book1, Chapter 3); Atmosphere (Book1, Chapter 4); Land and sea (Book1, Chapter 5); Water (Book 2, Chapter 4); Landforms (Book 3, Chapter 2)
2. *To become acquainted with the concept of location and its importance with regard to what, where, and how.*
Throughout all three books
3. *To understand varying environments depending on climate, fauna and flora, natural resources and related human responses.*
Climate and human responses (Book 2, Chapter 3); Natural resources and economic activities (Book 2, Chapters 5 and 6); Fauna and flora and human responses (Book 3, Chapters 1 and 3)
4. *To develop consciousness about human-environment relationship and environmental hazards*
From first mention of environmental geography in Book 1, Chapter 1 and throughout all three books; Environmental hazards and people: Tectonic (Book 2, Chapters 1 and 2); Climatic (Book 2, Chapter 3); Environmental problems (Book 2, Chapters 7 and 8); Natural regions (Book 3, Chapters 1 and 3)
5. *To know main population characteristics and patterns of population distribution*
Asia (Book1, Chapter 6); Pakistan (Book 1, Chapter 7); The world (Book 3, Chapters 4 and 5)
6. *To understand the nature of human dwellings, rural and urban and knowledge of selected cities and their functions*
Pakistan (Book1, Chapter 7); Pakistan and the rest of the world (Book 3, Chapters 6 and 7)
7. *To get acquainted with the administrative divisions/units of Pakistan*
(Book 1, Chapter 7)
8. *To enhance understanding of the physical and human aspects of the geography of Pakistan*
In particular Book 1, Chapters 7 and 8; also throughout the rest of Book 1, and Books 2 and 3, including settlement (urban and rural) Book 3, Chapter 6.
9. *To acquire knowledge about the major natural regions of the world*
In particular Book 3 Chapters 1, 2, and 3
10. *To get acquainted with map symbols and elementary map reading*
Specifically Book 1, Chapter 2 and then throughout the three books

Introduction to *Explore 2*

STUDENT'S BOOK

Explore Book 2 consists of eight chapters. A photograph is used on the first page of each chapter to illustrate the topic under study. Questions arranged below it are intended to encourage pupils to observe and to think about what they are going to learn under this geographical heading. Each chapter is further broken down into sections, typically between two and four in number, for ease of study.

Activities are included both within and at the end of the sections. The majority can be answered from the book's content, using both text and figures, either directly or with some interpretation and thinking. A few activities require pupils to search for answers elsewhere—from an atlas, from another written source such as newspapers, from TV or the Internet, or from knowledge and investigation of the home area. In those activities where pupils are required to discover for themselves, some guidance about what to look for and what to do is usually included in the question.

From time to time, opportunities are provided for pupils to work in pairs or in small groups. Often it would be possible for the pupil to complete the same activity working alone, should that be considered more desirable. However, working with others can result in a greater number of suggestions and a wider range of points being made. Likewise, pupils exchanging work and marking another pupil's work according to a marking guide, can be valuable in highlighting to them where they have done well and what is less good about their own work compared with that of others. If successful, the technique may be used for other activities in the textbook, according to the teacher's discretion.

WORKBOOK

The Workbook contains twenty-nine pupil activities across the eight chapters. The layout of these is of particular help to lower-ability pupils compared with activities in the book, since spaces are left for completing the answers. Tables, charts, and map outlines are provided for answers. Compared with *Explore 1*, there is less emphasis on practical skills in favour of more written answers, but some questions also provide an opportunity for discussion. This is because of the different nature of the geographical work between Books 1 and 2, and it also takes into account

the maturity level of the pupils. However, the important geographical skills learned in *Explore 1* continue to be used. As in the workbook for *Explore 1*, some workbook activities are merely extensions of activities in the book, giving pupils extra opportunities to use practical geographical skills in drawing maps, graphs and diagrams.

TEACHER'S GUIDE

The main purpose of the Teacher's Guide is to provide a commentary to make the textbook easier to use. The main focus of the work is indicated; themes, topics, and key terms worthy of highlight are identified. Ideas which may be useful in planning and delivering lessons are included. From time to time some ways to extend the study are suggested. These can involve individual pupil investigation from other sources such as the media or the Internet, while others rely upon pupil investigation of geographical characteristics in the local surroundings.

Some indication is given for what is expected from the activities in the textbook and workbook. As appropriate, the best or expected answers to the questions are included. References to the workbook activities are inserted in the commentary after the work to which they are related has been covered in the textbook. Occasionally it would be possible, and/or desirable, for pupils to work ahead of coverage in the text.

At the beginning of each chapter is a table which summarizes the

- teaching objectives and learning outcomes in relation to the National Curriculum,
- geographical skills included in the chapter,
- new geographical terms used, and
- workbook activities which support and extend book content and activities.

At the end of each chapter is a summary of how the teaching objectives have been met, and how teachers might check the extent of pupils' knowledge and understanding.

LESSON PLANS

The inclusion of teaching objectives and learning outcomes, identifying the main topics of each chapter, and the guidance and explanation preceding each section's content in the Teachers' Guides will facilitate lesson planning. A sample lesson plan outline is given below to further facilitate lesson planning.

The sections in each chapter have concluding questions in the textbook and follow-up activities in the workbooks, which give a framework for planning lessons, class work and homework, and assessments.

Finally, it goes without saying that a good, updated, and comprehensive atlas and a globe are indispensable components of teaching and learning geography. *The Oxford School Atlas for Pakistan* (OUP, 2008) is recommended for use along with the *Explore* series.

SAMPLE LESSON PLAN

Class: 7

Subject: Geography

Topic: The effects of volcanoes on people Pages 27–29, Chapter 2

Additional resources: Photographs or news reports of erupting volcanoes; news report of a recent eruption from news websites, such as www.dawn.com or <http://news.bbc.co.uk>; update on volcanic eruptions such as for the volcano in Montserrat at www.mvo.ms or Vesuvius in Italy

Teaching time: 1 period (generally 40 minutes)

Objective: To acquaint students with the effects (both positive and negative) of volcanoes on people

Outcome: Knowledge of how people can be affected by volcanoes and understanding of the difference between positive and negative effects; pupil awareness that volcanoes can have benefits as well as disadvantages

Introduction: Begin by showing students a photograph of an erupting volcano and information about a major eruption such as Pinatubo, 1991 (Information Box page 29), or Krakatoa, 1883 (in the text page 28) emphasizing power, size, and scale.

Lesson outline: Examine in turn the positive and negative effects of volcanoes. Compare these effects with those of previously studied earthquakes. Discuss why volcanoes kill fewer people. Why can volcanoes, unlike earthquakes, bring benefits?

Activities: (Class work) Activities 1 and 2, page 29
(Workbook) Chapter 2 Activity 2, pages 7–8

Reinforcement: (Homework) Activities 3 and 4, page 29

Recap/conclusion: Check students' understanding of the key geographical terms relating to volcanoes (page 7) and the world distribution of active volcanoes on page 8 in Chapter 1.

Chapter 1 **Earthquakes, volcanoes and fold mountains**

National Curriculum

Target study area in NC

Volcanism and Earthquakes, Mountains

Teaching Objectives

An introduction to tectonic activity including earthquakes and major relief features formed by movement at plate boundaries, such as volcanoes and fold mountains

Learning Outcomes

Understanding of what causes earthquakes, volcanoes, and the creation of fold mountains; identification and understanding of the locations of the major earthquake and volcanic belts around the Earth

Geographical Skills

Practical skills used include comparison of distributions from world maps, division of a country into physical regions, and drawing labelled diagrams

Key geographical terms

- | | |
|-------------------------------|-------------------|
| * constructive plate boundary | * epicentre |
| * destructive plate boundary | * Richter scale |
| * conservative plate boundary | * crater |
| * magma | * vent |
| * lava | * dormant volcano |
| * faults | * extinct volcano |
| * earthquake focus | * fold mountains |

SECTION 1: TECTONIC PLATES AND PLATE BOUNDARIES (PAGES 1–11)

Introduce pupils to the idea that the Earth's crust is not just one unbroken rock layer; instead, show from Figure 1.2 that there exist eight very large, separate rock plates and many smaller ones. As background, briefly refer to the theory of continental drift; ask pupils to look for the good fit

between the shapes of the South American and African continents, which suggests that they were once joined together as part of a larger continent. (Even the continents we have today are not 'set in stone' in relation to geological time scale.)

Next, examine the three different types of plate boundaries and explain what happens at each one. Stress that these boundaries are the areas of great tectonic activity, action zones. This leads naturally into a study of earthquakes, volcanoes, and young fold mountains. The focus in this chapter is on their causes, formation, and characteristics, not on their effects on people; this follows in the next chapter. Figures 1.2, 1.6, 1.11, and 1.15 have been made the same size, deliberately. It could be a good idea for pupils to trace the main plate boundaries from Figure 1.2, and use the tracing as an overlay on the other three Figures. By doing this, pupils will be better able to appreciate the near-perfect relationship between plate boundaries and the distribution of earthquakes, active volcanoes, and young fold mountains.

Because this is a long section, the activities are broken up into four sets, one each for the main study themes of plate boundaries, earthquakes, volcanoes, and young fold mountains. Since plate boundaries pass through Pakistan, the common element in Activities 1–3 on page 3 is the situation in Pakistan in relation to aspects of the broader world picture. The second set on page 6 refers back to earthquakes. The focus of Activities 1–3 is on earthquake measurement and what happens during an earthquake. The next set of activities about volcanoes is on pages 8 and 9. Activities 1 and 2 test pupils' knowledge and understanding of volcanic activity, while in Activity 3 the field of study is narrowed down to Asia. Activities relating to young fold mountains are at the top of page 11 and cover both Asia in particular and fold mountains in general.

SECTION 2: MAJOR RELIEF FEATURES OF PAKISTAN (PAGES 11–14)

The objective here is to use wider world knowledge gained by pupils to increase their understanding of the physical geography of Pakistan. A long-established concept in physical geography, used to facilitate pupil study, is the division of areas or countries into regions. Pakistan is a good country to study because of the scale of the differences in relief between northern mountains and the Indus plains. It is relatively easy for pupils to distinguish three physical regions from Figure 1.16. The work relates back to showing relief on maps and the geography of Pakistan, covered

in *Explore* Book 1. Activities 1 and 2 on page 13 test pupils' understanding and skill in this regard. Activity 3 gives pupils a chance to write about the physical geography of their home area. The chapter is rounded off by references to the 'Pacific Ring of Fire', where the frequency and strength of current volcanic activity are greater than anywhere else in the world. Activities 1 and 2 on page 14 provide opportunities for case study and research.

WORKBOOK

Activity 1	Earthquakes
Activity 2	Measuring the strength of an earthquake
Activity 3	What happens in earthquakes?
Activity 4	Volcanoes

Workbook Activity 1: Question 1 isolates (from the world map showing the distribution of earthquakes) the two major, active earthquake zones in Asia—one from west to east which includes Pakistan, and the other from south to north running through the island chains of East Asia / western Pacific Ocean. The further north one goes in Asia, the lower the earthquake risk. Question 2 focuses on the destructive plate margin where the Indo-Australian and Pacific plates are actively moving against, and sinking under, the giant Eurasian plate, and on what is happening there to create these zones of high earthquake activity in Asia.

Workbook Activity 2: After every earthquake, the most significant piece of information is its strength. The value reported to the media is measured on the Richter scale. Pupils are shown a seismograph and a sample recording sheet of an earthquake. When the ground moves during an earthquake, the spring in the seismograph is agitated and ink marks from the pen attached to it are left on the recording sheet wrapped around the slowly revolving drum. The marks increase in size and are greatest during the main earthquake shock. The answer expected in Question 1(c) is to show shock waves of gradually decreasing size, but with occasional larger aftershocks, almost invariably smaller than the main shock wave (identified by X on the recording sheet in B). The best order of earthquake effects in Question 2 is shown below.

- 3: often felt, but rarely causes damage
- 4: noticeable shaking of indoor items; significant damage unlikely

- 5: can cause major damage to poorly constructed buildings over small regions; at most slight damage to well-designed buildings
- 6: can cause serious damage over larger areas
- 7: can be destructive in areas up to about 160km across
- 8: can cause serious damage in areas several hundred kilometres across
- 9: devastating in areas several thousand kilometres across.

Workbook Activity 3: This first makes use of Figure 1.7. Earthquake terminology is needed in Question 1, with ‘focus’ and ‘epicentre’ as the first two answers; this is followed by a description of decreasing damage from less strong shock waves away from the centre. The three parts of Question 2 require explanation, for people’s responses in (a) and (b) and for a later secondary effect in (c).

Workbook Activity 4: The focus changes from earthquakes to volcanoes. Asia is again highlighted within the world distribution; active volcanoes are much more noticeably concentrated along the destructive plate margin which runs through the island arcs of East Asia. Question 2 checks pupils’ understanding of the differences between volcanoes, according to the type of plate boundary, between constructive (volcano A) and destructive (volcano B). The table has been partly completed as a guide.

SUMMARY CHECK

Teaching objective: An introduction to tectonic activity

How it has been met:

- World maps of plate boundaries, earthquakes, active volcanoes, and fold mountains
- Separate studies of causes of earthquakes, and formation of volcanoes and fold mountains
- Study of the major relief features of Pakistan showing the effects of tectonic activity
- Mention of active tectonic zones such as the Pacific Ring of Fire

Learning outcome: Knowledge and understanding of plate boundaries, earthquakes, volcanoes, and fold mountains

Check that the objective has been met:

- Pupils study a physical map of the world; ask them to identify and explain major relief features of the continents such as high mountain

ranges; then to do the same for location and distribution of islands in the oceans due to tectonic activity such as the island arcs of East Asia.

- Refer to a recent tectonic event; ask pupils to investigate its characteristics and then explain its occurrence in relation to the map of plate boundaries.

Chapter 2 **Tectonic activity and the effects on people**

National Curriculum

Target study areas in NC

Volcanism and Earthquakes, Mountains

Teaching Objectives

Knowledge and understanding of the effects (both negative and positive) of earthquakes, volcanoes, and fold mountains on people

Learning Outcomes

Students will learn about the problems and opportunities which result from earthquakes, volcanoes, and fold mountains, including taking measures to prepare for future tectonic hazards like earthquakes and volcanoes

Geographical skills

Practical skills used include drawing sketches from photographs, organizing data, drawing graphs and tables in order to summarize information

Key geographical terms

- * primary effect
- * secondary effect
- * aftershock
- * glacier
- * growing season

SECTION 1: EARTHQUAKE DAMAGE (PAGES 16–23)

It is important to distinguish between the first (primary) effects caused directly by the main earthquake shock and the later (secondary) effects

that happen in the minutes, hours, and days after the main shock. Secondary effects add to the damage and loss of life. Far and away the largest secondary event in recent times was the great Asian tsunami of December 2004, the results of which are summarized in the Information Box. Figure 2.3 is an example to illustrate what Figure 1.7 showed about decreasing damage away from the earthquake centre. Another important area of study is why the effects of earthquakes vary so much; some of the factors referred to here are developed further later in the chapter.

Activity 1 on page 18 uses the practical skill of a sketch based on observation; in the best responses labels will be used to highlight the question theme of earthquake damage. Question 2 homes in on factors affecting the scale of damage and loss of life with high magnitude, self-built housing, epicentre in a housing area, earthquake focus near surface, and high density of population—the five factors most likely to lead to much destruction and many deaths and injuries. Question 3 takes the use of Figure 1.7 a stage further before requiring pupils to write longer answers to show their understanding.

Destructive plate margins in Asia having been explained in Chapter 1, the figures on pages 19 and 20 give further information. Figure 2.5 illustrates the high frequency of powerful earthquakes along the southern border of the Eurasian plate, some of which caused many deaths. Figure 2.6 shows just some of the many major faults in Pakistan associated with the India-Asia collision zone, while Figure 2.7 records the major earthquakes within recent history in this zone.

In the Activities, a study of Figure 2.5 gives strong support for a close relationship between high earthquake strength and large numbers killed for Question 1(b). The evidence for this includes;

- * the strongest earthquake (8.9) led to the largest number of deaths (250,000)
- * the least strong earthquake (6.0) caused the lowest number of deaths (just 70)

However, there are examples where support for the statement is weak;

- * the second strongest earthquake (8.7) was the fourth lowest for deaths (1300)
- * the fourth weakest earthquake (6.5) was the third highest for deaths (30,000)

This means that different pupils can justify different answers because strength is just one factor for numbers killed, albeit an important one.

The natural follow-up is what people can do to prevent or reduce earthquake losses. It is made clear from the start that the occurrence of individual earthquakes cannot be predicted, unlike volcanoes which often give preliminary warning signs (page 28). But places with a high earthquake risk are known (for example, northern and western Pakistan) so adequate measures can be taken. Methods to make even high-rise buildings earthquake proof are described. Figure 2.9 shows the critical importance of the type of building material for determining how well buildings can withstand earthquake shocks of different strengths. This can lead to a class discussion about why loss of life is still expected in future earthquakes.

In the Activities on page 23, pupils are most likely to use bar graphs (as in Figure 2.9) when answering Question 1(a). Part (c) tests their understanding of why the authorities and people in rich countries are better placed to prepare for earthquakes. Question 2 is a different way of asking what people trapped inside buildings in an earthquake can do to increase their chances of survival. This topic gives plenty of opportunities for small group and class discussions, particularly because of its relevance in Pakistan. Question 3 suggests ways in which small group discussions might be channelled for productive outcomes.

SECTION 2: CASE STUDY: PAKISTAN EARTHQUAKE, OCTOBER 2005 (PAGES 24–27)

Figures 2.11–2.13 contain information and comment about this devastating earthquake. The map in Figure 2.11 is similar to those carried by newspapers and on the Internet news sites after all major earthquakes; pupils should now be in a stronger position to interpret what it shows and its significance. Figure 2.12 shows the data of the earthquake and Figure 2.13 summarizes the different phases of rehabilitation during the first year; these are typical for the effects of a major natural event, namely immediate effects from the event itself, relief aid in the form of emergency help, relief work for redevelopment and recovery, and an assessment of what has been achieved one year later. It is worth stressing to pupils that media interest wanes considerably after one year and that the chances of further outside help fuelled by publicity are greatly reduced. Comments about what has or has not happened in Balakot (the worst hit town closest to the epicentre in 2005) follow.

Question 1 in the Activities on page 27 refers to the immediate effects of the earthquake. The pattern of estimates for the number of deaths should become clearer once pupils have drawn the bar graph. Estimates tend to go down with time because some people who are reported missing by relatives (often living outside the affected area) in the early days eventually turn up elsewhere or return at a later date; others, who were assumed to have been in the building when it collapsed, were either not there as was thought, or managed to escape. Factors covered earlier on pages 17-18 are relevant for answering Question 3.

SECTION 3: VOLCANOES AND THEIR EFFECTS ON PEOPLE (PAGES 27-29)

Volcanoes form distinctive landforms in the way that earthquakes do not. Also certain benefits of volcanoes can be identified. Volcanic soils, rich in minerals once the erupted materials have had time to be broken down by weathering, are in the top two of the world's most fertile soils along with silt soils in big river valleys and deltas. Nevertheless, volcanoes are destructive and disruptive, and can cause loss of life, albeit in smaller numbers than in many earthquakes. Massive eruptions, such as those of Krakatoa and Pinatubo, can cause secondary effects that are felt well outside the local area.

The purpose of Question 1 in the Activities on page 29 is to check pupils' understanding of the differences between primary and secondary effects. The four that are most obviously primary effects are 'people killed', 'farmland and buildings destroyed', 'roads blocked by lava flows' and 'public services disrupted'; this is because these are direct results of the eruption and happen during the eruption. In Question 2 the skill is to highlight with labels the features which show that the area in and around the crater is a wasteland. The best answer to Question 3 is 'fertile soils'. This one is most easy to support, using content from the paragraph beginning with a reference to the 500 million people living in the vicinity of active volcanoes. Question 4 gives pupils the chance to write about what has been one of the main themes running through this chapter, and to demonstrate their comprehension.

SECTION 4: FOLD MOUNTAINS: PROBLEMS AND OPPORTUNITIES FOR PEOPLE (PAGES 30–34)

The map in Figure 2.20 shows population density across Pakistan. As an introduction to this section, look back to Figure 1.12 and ask pupils to identify factors to explain why no one can live here; similarly, Figure 1.18 can help explain why population density is low on the Balochistan plateau, among the lowest in Pakistan. Also, ask pupils to look at Figure 1.17 on the opposite page to explain why opportunities for human activity are better here. Their responses should highlight the importance of physical geography for determining opportunities for people and settlement, before they are illustrated in Figure 2.21. In high mountain areas, changes in land uses and human activities are vertical (i.e. height-related). Figures 2.23 and 2.24 provide a good contrast between the great opportunities on the valley floor in the lower Chitral Valley compared with the virtually nil opportunity in the mountains higher up the Chitral Valley. The text expands upon the physical factors behind the changes in land use with height.

In Question 1 in the activities on page 33, pupils can enhance the visual effect of part-valley cross-section in Figure 2.22 by drawing sketches to bring out the major differences in landscape appearance between valley floors (Figure 2.23), upper slopes (Figure 2.24), and mountain peaks (Figure 1.12). In Question 2, the use of spider diagrams is a good way to summarize advantages and disadvantages and check the extent of pupils' comprehension. Question 3 supports written explanation of the concepts covered in this section.

WORKBOOK

- | | |
|------------|---|
| Activity 1 | Earthquake in India |
| Activity 2 | People vs. volcanoes |
| Activity 3 | Loss of life in earthquakes—must it happen? |

Workbook Activity 1 makes use of the information about the Gujarat earthquake in Figure 2.3 in preparation for the later, more detailed study of the Pakistan earthquake of 2005. Question 2 is the same as a later question in the textbook (Question 1, page 23), and as an advantage for lower-ability pupils, provides a graph paper base for graph construction. It introduces pupils to the issue of building materials, which is continued into Question 3, and can be used in advance of more detailed coverage in the textbook.

Workbook Activity 2 is an adapted newspaper report about the eruption of Mount Etna. The volcano is passing through one of its more active periods, having erupted regularly since 2000, although more recent lava flows have not been as extensive. This lava flow was no threat to life, but a serious threat to property; it shows the measures that people in a developed country tried to take in order to defeat nature. It gives pupils an opportunity to assess the relative value of the people's actions.

Workbook Activity 3 begins with comments from earthquake survivors in Turkey, following an earthquake with heavy loss of life. These comments echoed those from other earthquakes, such as at Balakot. Question 2 allows pupils to show what can be done to prepare for an earthquake, provided that there is the money, will, and organization to allow it.

SUMMARY CHECK

Teaching objectives: Knowledge of the effects of earthquakes, volcanoes, and fold mountains on people

How these have been met:

- Examples of the types of damage caused by earthquakes and volcanoes
- How and why the effects of earthquakes differ
- Ways to reduce the likely effects of future earthquakes
- Negative and positive effects of volcanic eruptions
- Problems and opportunities of fold mountain ranges for people

Learning outcomes: Knowledge of problems and opportunities resulting from earthquakes, volcanoes, and fold mountains

Check that the objectives have been met:

- Pupils study the effects of a recent earthquake; they are asked to explain the relative scale of loss of life and damage in relation to strength, location, and other factors.
- Show pupils new photographs of high mountain areas; ask them to describe and explain human land uses and activities.
- Check pupils' answers to summary activities such as Activity 3 on page 27 for earthquake effects and Activities 1, 3, and 4 on page 29 for the effects of volcanoes.

Chapter 3 **Climate and human activities**

National Curriculum

Target study area in NC	Climate
Teaching Objectives	Introduction to the Earth's major climates, including factors influencing them; understanding of the relationship between climate and human activities
Learning Outcomes	Knowledge of the elements and factors of climate; knowledge and understanding through examples of how climates affect human activities

Geographical skills

Practical skills used include drawing and interpreting climate graphs, drawing labelled diagrams for explanation, calculations using climate data, and labelled sketches from photographs

Key geographical terms

- | | |
|---------------------|---------------------|
| * relief rainfall | * onshore wind |
| * urban heat island | * global warming |
| * smog | * greenhouse effect |
| * haze | * heatwave |
| * fog | * cyclone |
| * offshore wind | * natural hazard |

SECTION 1: HOW CLIMATES CHANGE BETWEEN THE EQUATOR AND THE POLES (PAGES 36–44)

As an introduction, you may begin with basic features of the climate(s) of Pakistan, covered in *Explore* Book 1, with particular reference to the climate of your local region. Pakistan's climate(s) can be fitted into the world climate summary in Figure 3.2. Questions A–G listed at the bottom of page 36 are a guide to identifying key characteristics of, and differences between, the world's major climatic types. Essentially, tropical climates are always hot; therefore, rainfall (amount and seasons) is the main distinguishing factor. In temperate latitudes, differences in temperature increase in significance with latitude, until they dominate in polar climates.

In Figure 3.4, the global dimension is narrowed down to changes from south to north in Asia. The climate graphs are arranged so that pupils can work from south to north or vice versa and confirm the changes shown in Figure 3.2. The five climatic elements identified in the table at the bottom of Figure 3.4 show the key items that pupils should look for when studying climate graphs. Emphasize the need to pick out highest and lowest monthly temperatures, used for working out annual range of temperature. The overall shape of the temperature line is a visual illustration of the temperature range between summer and winter. Monthly rainfall amounts are clearly displayed in the graphs; total amount and seasonal distribution are the key elements needed.

Question 1 in the activities on page 38 enables pupils to understand what is to be checked in Figure 3.2. Question 2 brings pupils back to the climate of Pakistan. Lahore was chosen because it displays many of the characteristics of the monsoon climate, without the scale of summer wetness in coastal Mumbai. It would make sense to use climate data for the home region if it varies significantly from that of Lahore, such as for those living in the deserts in the south and west of Pakistan.

How latitude and altitude affect climate is the theme of the next subsection. Latitude has the greatest affect on temperature; Figure 3.5 illustrates higher rates of insolation around the Equator than in temperate and polar latitudes, due to more direct rays of light from the Sun and smaller area of the Earth's surface to heat up. Altitude has direct effects on both temperature and precipitation; these are illustrated in Figures 3.6 and 3.7. Emphasize how high mountain ranges like the Himalayas cause major variations from the climate experienced in surrounding lowland areas. Stress the wide climatic variations and the existence of 'local climates' within high mountain ranges. Figure 3.8 attempts to give one example of this.

Questions in the activities on page 40 continue these themes. In Question 1, labelled diagrams are used for this. Question 2 gives some climate data for places in the Gilgit Valley. The answers in (a) are 700 metres, 3.8°C, and 2.1°C and in (b) 0.5, and 0.3 per 100 metres. For the answer to (c), winter temperature change is seen to be closer to the average expected. Perhaps the strength of the tropical sun may be the offsetting factor in summer.

Distance from the sea and the wind direction are the next two factors examined for their effects on climate. The most obvious effect of both of

these in South Asia is on total precipitation. The caption on Figure 3.9 guides pupils to work from South-east to North-west Asia so that they follow the progressive decline in annual precipitation, until they reach the dry interior (Gobi Desert). Questions A–C in the text are an additional guide for what to look for in Figure 3.9. Differences in temperature between land and sea are of little significance to people living in a tropical country such as Pakistan, but for those living in Siberia they are of major importance. The examples of Irkutsk and Beijing in Figure 3.10 highlight the significance of inland locations in temperate latitudes. Questions D–J in the text help pupils to identify what is most significant.

There is no better example than the South Asian monsoon for showing the dominant, but different, effects of onshore and offshore winds on rainfall. The text explains why coastal Pakistan is not as favourably located as other South Asian countries for receiving the full benefit from the summer monsoon rains. This should help pupils to understand the distribution of annual precipitation in Pakistan shown in Figure 3.12.

Questions 1 and 2 in the activities on page 44 check pupils' understanding of what is shown in Figures 3.9 and 3.10. Question 3 checks the understanding of the differences between onshore and offshore winds, and their effects on rainfall in Pakistan. Question 4 relates this to the distribution of annual precipitation in Pakistan as shown in Figure 3.12. This question could be tied more closely to the local region, if desired.

SECTION 2: DO PEOPLE AFFECT CLIMATE? (PAGES 44–47)

This section begins with urban areas, where the question can be answered with a definite 'yes'. Some of the content here must be within the experience of pupils; this can be tapped into and used in the lessons. One important general theme is that favourable natural conditions for fog formation are made worse by humans: it then develops into haze and smog in cities. Many (but not all) people would now answer 'yes' to human contributions to the greenhouse effect and global warming. How the greenhouse effect works is illustrated in Figure 3.18. Part C puts forward some of the arguments used by the doubters, the 'No' lobby, which can be used to initiate class, group, or individual discussion.

In the activities on page 47, Question 1 requires pupils to use Figure 3.13 to explain why city centres (particularly in big cities in temperate latitudes) are measurably warmer than the surrounding countryside on most days. Question 2 brings the focus back to Pakistan. To help answer

part (a) pupils can look ahead to page 103; part (b) tests pupils' ability to apply general climatic factors for haze and smog to the specific example (Karachi). Question 3 requires pupils to identify evidence for climate change and global warming, and then demonstrate how humans might be contributing to global warming. Finally they must decide in a reasoned way their view about the possible human contribution.

SECTION 3: HOW CLIMATE AFFECTS PEOPLE IN PAKISTAN (PAGES 48–52)

In every country, some types of work are more directly affected by weather and climate than others. Worldwide, farmers are more dependent on climate than people in most other occupations. At first the focus of the text is on Pakistan. Figure 3.20 shows that where physical conditions are most favourable (relief and soils as well as climate), percentages of land under cultivation are highest. High agricultural productivity in the Punjab can be contrasted with very limited opportunities in the dry uplands of Balochistan. Climatic variations from the average (or expected) conditions bring problems. The main climatic hazards which affect Pakistan are described on page 50.

In the activities on page 50, Question 1 requires pupils to observe photographs and identify what is good and bad about farming in the two areas of Pakistan shown. The same theme is continued into Question 2, but this time for Pakistan as a whole. The purpose of Question 3 is to help pupils realize that not all climatic hazards affect people to the same degree.

The next short section broadens the coverage of the effects of natural hazards (including many that are climatic) for the whole world. Figure 3.24 shows how much more serious are losses of life from climatic hazards, notably drought and flood, than from those tectonic hazards referred to in Chapters 1 and 2. Questions A–C, which are included as part of Figure 3.24, help pupils reach this conclusion. The number of people affected by natural hazards is increasing, and two reasons are put forward for this in the text. The questions in the activities on page 52 include a mixture of graphical and written responses, plus individual and class assessment of their importance.

WORKBOOK

Activity 1	How do climates change from north to south in Asia?
Activity 2	Tropical cyclones
Activity 3	Flooding in Bangladesh

Workbook Activity 1 states the climate data which was used to draw up the climate graphs in Figure 3.4. Pupils are required to identify key elements and complete the table before completing the sentences to describe how climates change from south to north in Asia. **Workbook Activity 2** is focused more narrowly on tropical cyclones as one of the major natural hazards affecting people. Question 1 is a skills exercise to complete a block graph, as an alternative to the more frequently used pie graphs (variety of presentation is to be encouraged). Question 2 is about how and why cyclones can be so destructive, while Question 3 concentrates on location in Asia, and why, in terms of cyclones, Pakistan gets off more lightly than some other Asian countries. The focus of **Workbook Activity 3** is even narrower; however, Bangladesh has perhaps the highest flood risk of anywhere in the world. In some years, like 2004, floods were particularly bad; many of the advantages that the floods bring in normal years are destroyed in years of bad floods.

SUMMARY CHECK

Teaching objectives: Knowledge of major climates and related human activities

How these have been met:

- General survey of how climates change between the Equator and the Poles
- Factors responsible for these changes including latitude, altitude, distance from the sea, and wind direction
- How climate affects people and human activities in Pakistan
- Worldwide, how bad are the effects of climatic hazards for people compared with tectonic hazards

Learning outcomes: Knowledge and understanding of factors affecting climate and how climate affects human activities

Check that the objectives have been met:

- Look at accuracy and quality of pupils' answers to questions A–J posed in the text and used in Activities 1 and 2 on page 44.

- Give pupils a list of different occupations affected by the climate in Pakistan; ask them to describe how climate affects the work and to give an assessment of the strength of these effects.
- To check understanding of factors, ask pupils to explain why summer is the wet season and winter is the dry season in Pakistan and much of the rest of South Asia.

Chapter 4 **Water—the most vital natural resource**

National Curriculum

Target study area in NC	Freshwater Resources, Uses of Freshwater Resources
Teaching Objectives	Knowledge of fresh water as a resource and of the major sources of fresh water on Earth (both surface and underground), their availability, and various uses
Learning Outcomes	Understanding of water as a resource and its different sources; understanding of the different uses of fresh water and associated problems with particular reference to water supply and uses in Pakistan and the need for conservation

Geographical skills

Practical skills used include interpreting and drawing a variety of graphs, and drawing labelled diagrams. The new technique is interpretation and construction of dispersion diagrams.

Key geographical terms

* renewable natural resource	* perennial irrigation
* evaporation	* tributary river
* condensation	* managed river
* run-off	* barrage
* impermeable rock	* dam
* permeable rock	* aquifer
* infiltration	* water wealth
* inundation irrigation	* desalination

SECTION 1: SOURCES OF FRESH WATER (PAGES 54–57)

Expand on the first statement about water being vital for life on Earth. Stress the scarcity of fresh water as a natural resource, since only 3 per cent of the water on the Earth's surface is fresh water, and most of this is inaccessible for human use because it is locked up as ice and snow. However, the good news for people is that the available supplies of fresh water are constantly being renewed by precipitation. This leads into the study of the water cycle, which requires pupils' understanding of the six key geographical terms highlighted in bold in the text. Pupils must also know the difference between permeable and impermeable rocks, because they affect the ratio between run-off and infiltration after rain. Stress their human significance for water supplies, whether obtained on the surface or from underground.

Question 1 in the activities on page 56 focuses on water-cycle terms with a Mix and Match exercise to match term to definition. Pupils can make use of Figure 4.4 to answer Question 2; a simple flow diagram will be enough to show renewable nature, although for some pupils it may be helpful to suggest it, starting with 'precipitation' at the top. The answer to Question 3 explains why fresh water is a scarce natural resource (a theme which will be further developed later in the chapter).

The purpose of the sub-section about uses of freshwater is to emphasize the value of water as a natural resource, particularly in countries with dry climates, like Pakistan. Figure 4.6 highlights the dominant use of water as a source of irrigation for food production in Pakistan. Question 1 in the activities on page 57 requires pupils to interpret the graph in Figure 4.6 and explain the high agricultural use of water in Pakistan. A skills exercise in Question 2 (a) is followed by study of how and why the use of water in a developed country (the UK) with a cooler and wetter climate, is different from that in Pakistan. Question 3 offers an opportunity for individual investigation (which might usefully be undertaken along with Activity 2 on page 16 in the Workbook).

SECTION 2: WATER SUPPLY IN PAKISTAN (PAGES 58–66)

Figure 4.7 introduces pupils to the three main natural stores of fresh water on land. They are then placed in a Pakistan context, one of the world's countries with examples of all three. Figure 4.8 shows that rivers and surface supplies provide about 80 per cent; however, the contribution from wells and local groundwater supplies is very important. The purpose

of Figure 4.10 is to show that rivers have many more uses than only for water supply.

Question 1 of the activities on page 59 requires pupils to draw their own version of Figure 4.7, but then link it to Pakistan by adding names of rivers such as the Indus, and of sources such as the Himalayas. Question 2 requires pupils to organize the randomly arranged uses in Figure 4.10, before recognizing potential conflicts between certain river uses. Question 3 checks pupils' understanding of underground stores. D or E would be the best choice of place for digging a tube well because of nearness of the aquifer to the surface. In question 4, pupils need to explain how underground water supplies are obtained. Question 5 encourages evaluation after pupils have listed the advantages and disadvantages of the two major sources of water supply in Pakistan. There is no final answer to part (c); it is the justification that matters.

Different methods of surface irrigation are illustrated on page 61. All rely upon water management of the River Indus and its tributaries, wherever possible, to allow perennial irrigation and year-round cultivation. The related activities are on page 62. Answering Questions 1 and 2 should help pupils to understand why the Tarbela Dam was needed for perennial irrigation. Much of the information needed for the case study answer in Question 3 can be obtained from pages 61–2, but use of a good atlas map will help as well.

Next, pupils are introduced to the concept of 'water wealth', which relates a country's freshwater resources to its total population. There are enormous variations between world regions and countries, as well as within countries. Asia is the continent with highest water scarcity (Figure 4.15). Pakistan (like many of its neighbours) has high water scarcity nationally, now (Figure 4.16) and expected in the future (Figure 4.17). Within Pakistan much less rain falls in the southern half of the country (Figure 3.12) as compared to the north. Water scarcity naturally leads to 'water stress', made worse in Pakistan by the ever-increasing demands for more water (Figure 4.18). In relation to geographical techniques, pay particular attention to Figure 4.15. This might be the first time that most pupils have met a dispersion diagram, which is a useful technique for showing the spread and range of a set of values. Refer to the geographical skills box on page 64.

The related activities are on page 64. In Question 1, pupils are given the chance to draw a dispersion diagram for themselves and to comment on

what it shows. Question 2 requires use of the dispersion diagram in Figure 4.15. If desired, it would be easy to formulate other questions about water scarcity at continental and national scales using Figure 4.17; alternatively, use Workbook Activity 3 on page 17.

The theme of the next short sub-section is how freshwater supplies can be supplemented. The technology exists to extract fresh water from sea water using desalination. Unfortunately, for energy-poor countries like Pakistan, this is not an option. This is why most of the world's desalination plants are in oil-rich Gulf States and Saudi Arabia (Figure 4.19). The advantages and disadvantages of the options for increasing freshwater availability in a country are given in Figure 4.20. Questions in the activities on page 65 try to establish how many of these are viable options for Pakistan. Question 1 confirms the need for more water. Question 2 weighs up the options and leads to a decision. Although there are many advantages of pupils working in pairs or small groups to discuss the options, the task can also be undertaken as an individual exercise.

As a conclusion to this section, the costs and benefits of large dams (one of the most widely used of the options in Figure 4.20) are examined on page 66. The benefits are labelled in Figure 4.21; these essentially reiterate what was covered in the section on irrigation works in Pakistan on pages 60 and 61. The newspaper report in Figure 4.22 concentrates on the costs (social, economic, and environmental), which are described by it as 'unacceptable'. In the activities, Question 1 focuses on advantages, Question 2 on disadvantages, and Question 3 requires an assessment of likely public opinion about large dams in Pakistan.

WORKBOOK

- | | |
|------------|--|
| Activity 1 | The water cycle |
| Activity 2 | Water use in the home—Pakistan and the UK compared |
| Activity 3 | Differences in water wealth between continents—now and in the future |
| Activity 4 | Effects of forest clearance on the water cycle |

Workbook Activity 1 checks on understanding of key watercycle terms (Question 1) and conditions which favour high rates or large amounts for three of them (Question 2). **Workbook Activity 2** illustrates differences in the amount and types of water use between people in the developing and developed worlds. Water use is shown to be four times

greater in the UK than in Pakistan. Some of the reasons for explaining the size of this difference are in the uses; these indicate activities associated with greater wealth; household appliances undertake work done by hand in developing countries. What is not directly shown, but only implied, is that virtually every UK home, even in rural areas, has a piped water supply inside the house, permanently available at the turn of a tap.

Workbook Activity 3 makes use of Figures 4.15 and 4.17 on pages 62 and 63. The table entry for Europe has been done as a guide to the pupils for what they are expected to do. The theme of **Workbook Activity 4** is changes to the water cycle as a result of forest clearances. It is shown to cause increases in surface run-off at the expense of water infiltrating into the ground and evaporating back into the atmosphere. The already significant changes resulting from partial forest clearance will be further increased once forest clearance is complete. The reason why this activity was placed fourth instead of second was that it can be used as a link into the next chapter about Forest Resources.

SUMMARY CHECK

Teaching objectives: Knowledge of freshwater sources and their uses

How these have been met:

- Reference to the distribution and availability of freshwater sources on the Earth's surface and general uses of fresh water
- Water supply and water use in Pakistan (as an example)
- Fresh water as resource for human use worldwide—how scarce is it?
- How can available fresh water supplies be increased to satisfy all the demands?

Learning outcomes: Understanding of water as a resource and how it is used, including the need for conservation

Check that the objectives have been met:

- Use the diagrams showing natural freshwater stores, such as Figures 4.7 and 4.11, to check pupils' understanding of water sources and how they can be used by people.
- Show pupils photographs or diagrams of different water uses and ask for comments about possible sources and size of use.

- Ask pupils to identify major zones with and without water scarcity from Figure 4.17 and relate these to the distribution of major climates in Chapter 3.
- Look at the worth of pupils' answers to activity questions which act as section summaries such as Activity 3 on page 56, Activity 5 page 59 and Activities 1 and 2 on page 65.

Chapter 5 **Forest resources**

National Curriculum

Target study areas in the NC	Forest Resources
Teaching Objectives	Appreciation of the importance of forests to the Earth's environment, including a study of major types of forests
Learning Outcomes	Knowledge of forest resources and their importance in economic development in general, and to Pakistan in particular

Geographical skills

Practical skills used include observation and interpretation from photographs and sketches, organizing information into a table, and drawing sketches to show changes in vegetation cover and soils

Key geographical terms

- * natural resource
- * ecosystem
- * soil erosion
- * desertification
- * nutrient cycle

SECTION 1: WHY PLANTS AND FORESTS ARE IMPORTANT (PAGES 68–74)

Forests are a major part of the Earth's natural resource base upon which humans depend. Stress the importance of green plants for the survival of all life on Earth, not just human. If not already studied as part of their science course, acquaint pupils with the process of photosynthesis and the concept of food chains. Introduce pupils to the concept of ecosystems.

Ask pupils to identify the ‘living’ parts of the forest ecosystem from Figure 5.4 (trees and animals) and the ‘non-living’ elements (sun, rain, and soils). Explain how they are linked together by natural cycles, water (refer back to the water cycle), energy, and nutrients. Ask pupils to identify stages in the nutrient cycle from Figure 5.4 beginning with ‘dead leaves fall’. Why do forests provide more than just food for people?

In the activities on page 70, Question 1 is about the Earth’s natural resources in general. Question 2 is about plants as the producers of food on Earth for consumers such as humans and other animals. Question 3 requires pupils to describe the different ways in which forests are a valuable natural resource for people.

As an introduction to the next sub-section about the main types of forests and their global locations, it could be useful to look back to page 36 and refresh pupils’ memories about the main types of climate and their distribution according to latitude, perhaps one zone at a time (tropical, temperate, and polar). Climate is the main control for the world distribution of natural vegetation and forest types. From Figure 5.5 it is possible for pupils to identify the main natural vegetation zones that were dominated by forests—tropical rainforest and savanna in the tropics, Mediterranean, deciduous, and coniferous in temperate latitudes. Two types of forest extend over much larger areas than the others, mainly because of limited clearances; their contrasting distributions are shown in Figure 5.6. These two forest types are the focus of study, with brief mentions of monsoon and savanna.

What makes the forests unique is the theme under-pinning the study of tropical rainforests. The ideal climate for vegetation growth (all year heat and rainfall) explains forest size and diversity. The activities on page 73 relate to work covered so far. Question 1 is to identify salient points about the world distribution of natural vegetation. Question 2 focuses on tropical rainforest characteristics.

The brief references to monsoon forest and savanna are made in the context of how they are different from the rainforests because of changes in climate away from the Equator. How the vegetation adapts to the longer and more pronounced dry season forms the focus of the coverage. The next sub-section is devoted to coniferous forests. Many of the distinctive characteristics of the trees and forests are shown in Figure 5.11. Pupils can be asked to identify differences with tropical rainforests. The text explains how coniferous trees are adapted to withstand

challenging climatic conditions. The activities on page 74 focus on the characteristics of the monsoon forests of Asia.

SECTION 2: ECONOMIC USES OF FORESTS AND TREES (PAGES 75–77)

The major difference in timber use between developed and developing countries is highlighted first, essentially between commercial and subsistence uses, and the reasons for it. Figure 5.14 gives summary percentages for the continents which show this, as well as a comparative value for Pakistan. Of course, commercial forestry does exist in tropical and monsoon forests, but exploitation is less easy here than among the stands of coniferous trees in temperate forests. The text explains why.

Question 1 in the activities on page 77 is skills-based, to show in a more visual way the major differences in use of wood between developed and developing countries. Question 2 requires pupils to assemble different uses of wood from trees before answering Question 3, which is an explanation for the section's major theme. Question 4 is about sustainable forest use. One of the arguments put forward against further use of hardwoods from tropical rainforests is non-sustainability, since it takes a long time for hardwood trees to grow to full maturity; also, the most commercially valuable trees are dotted around the forests. They cannot be replanted after felling in the same way that fast growing coniferous trees can. Man-made coniferous forests, such as the one shown on the Alpine slopes in Figure 5.16, are almost indistinguishable from natural forests.

SECTION 3: FOREST RESOURCES OF PAKISTAN (PAGES 77–82)

Figure 5.17 is a 'historical' record of what the natural vegetation cover of Pakistan was thought to have been like before human interference. The climate is too dry in most of the country for thick forests; instead it is likely that thorn forest was the dominant cover in most of the country. This has now been reduced to thorn scrub at best (Figure 5.18). The exception is the coniferous forest on the slopes of the northern mountains. Figure 5.19 is a section from north to south showing the same information as on Figure 5.17, but in a different way. The pie charts and map in Figures 5.20 and 5.21 show just how badly off Pakistan is for forests and forest resources. This theme is continued into Question 1 of the activities on page 79. Question 2 gives pupils the opportunity to refer to vegetation cover (or the lack of it) in their home area.

The text becomes more general again relating to the effects of forest clearance on the water and nutrient cycles. Figures 5.22 and 5.23 illustrate the workings of the water cycle before and after forest clearance. This reinforces the content of Workbook Activity 4 on pages 18 and 19 for Chapter 4. Figures 5.24 and 5.25 do the same for the nutrient cycle. The negative results of forest clearances include soil erosion and desertification. The related activities are on page 81; the questions cover usefulness of forests, changes in the nutrient cycle and soil erosion. The final part of Question 3 provides pupils with another chance to think and then make a judgement.

The chapter summary is a random arrangement of students' views about the advantages of forests in Figure 5.26, which pupils are required to organize under four headings in Question 1 of the activities on page 82. In Question 2, pupils are asked to select the three which, in their opinion, are the most important and give reasons for their choice. The reasons given are more important than the choices. Drawing a poster in Question 3, of the type that might be designed by a conservation/environmental group, is an alternative way to communicate a message.

WORKBOOK

Activity 1	Tropical rainforests
Activity 2	Coniferous forests
Activity 3	Forest and tree cover in Pakistan

Workbook Activity 1 reinforces pupils' knowledge of flora and fauna within tropical rainforests. **Workbook Activity 2** does the same for the flora of coniferous forests, but by using a different approach to answering. **Workbook Activity 3** narrows the area of study down to Pakistan and is mainly a skills-based exercise to show the distribution of forest and tree cover in Pakistan, before written description and explanation are required.

SUMMARY CHECK

Teaching objectives: Appreciation of the importance of forests and knowledge of the major types of forests

How these have been met:

- Study of why forests are important for life on Earth, in general, and for people, in particular

- General study of the main types of forests and their locations, supported by special studies of tropical rainforests and coniferous forests
- Economic uses of forests and trees and an example of forest resources in Pakistan
- Study of the disturbing effects caused by forest clearance on the water and nutrient cycles

Learning outcomes: Knowledge of forest resources and understanding of their importance

Check that the objectives have been met:

- For knowledge of world forest resources, look at the worth of pupils' answers to Activities 1 and 2 on page 73.
- For understanding of the importance of forests for the environment, look at the worth of pupils' answers to Activities 1–3 on page 81.
- For understanding of the poverty of forest resources in Pakistan, look at the worth of pupils' answers to Activity 1 on page 79.

Chapter 6 **Minerals and fossil fuels**

National Curriculum

Target study area in the NC

Minerals and Fossil Fuels

Teaching Objectives

Study of the importance of minerals and fossil fuels as resources for economic development, including an appreciation of mining as an important human activity

Learning Outcomes

Understanding the importance of minerals and fossil fuels; appreciating differences in economic opportunity between Pakistan and other Asian countries, especially oil-rich Gulf States

Geographical skills

Practical skills used in activities include horizontal and vertical bar graphs; study of physical and political maps from atlases; drawing a sketch from a photograph with labels to match the stated purpose

Key geographical terms

- * mineral
- * reserves
- * fossil fuel
- * opencast mining
- * Industrial Revolution

SECTION 1: THE WORLD'S MAJOR MINERALS (PAGES 84–88)

This section begins with a simple classification of minerals between metallic and non-metallic, using examples of minerals most likely to be familiar to pupils. Minerals are very widely distributed within the rocks of the Earth. However, the point to emphasize about the exploitation of minerals is that they must be concentrated in large quantities at or near the surface in order to be commercially viable. One of the few exceptions to this is gold mining by individuals ‘panning’ in streams because of the high value of gold. Figure 6.3 identifies certain areas of the world which can be described as mineral-rich—places where in earlier geological periods conditions were favourable for large-scale mineral formation. The map shows that western Asia is rich in oil and gas, but in nothing else. Pakistan is definitely in the category of a mineral-poor country. Minerals that are in plentiful supply, such as rock salt and limestone, are of low value.

Within the activities on page 86, Question 1 asks for examples of useful minerals. The percentages in the Information Box can be used to explain in Question 2 why the Middle East is a major oil exporter; the difference between world percentages for production and consumption is 23 per cent. Over three quarters of the oil produced is available for export. Since the region has more than half the world’s reserves of oil, it is going to export oil for many more years, even if home consumption increases. Question 3 brings the focus back to Pakistan with a skills exercise and written explanation.

As an introduction to the next part on fossil fuels, pupils can be asked for examples of fossil fuel use by them and their families. How dependent are they upon fossil fuels? Emphasize the dominant role of fossil fuels in allowing improvements in technology and economic development. This section on fossil fuels is laid out in the form of a question and answer guide, supported by illustrations of the ‘fossil’ element. Figure 6.9 on page 88 exemplifies the earlier general point that minerals need to be formed

and found in sufficient quantities to be commercially viable. Oil companies spend much time and money ascertaining first where the geological structure is favourable for the formation of an oil trap and next on trial drilling to discover whether the oil actually exists and whether it is in commercial quantities. Pupils' knowledge of the difference between permeable and impermeable rocks (covered in Chapter 4) is essential to the understanding of this topic.

The answers to Questions 1 and 2 within the activities on page 88 can be obtained from the question and answer guide. Question 3 also uses Figure 6.9, while Question 4 is a follow-up task, exploring pupils' comprehension more fully.

SECTION 2: METHODS OF MINING AND DAMAGE TO THE ENVIRONMENT (PAGES 89–91)

The focus is on how mining damages the environment. Pupils are introduced to the two methods of mining, using coal as the example, but many other minerals could have been used instead. When studying Figures 6.10 and 6.11, pupils are recommended to read the labels in number order. Of the two methods, opencast mining is much easier and cheaper than deep mining. Explain to the pupils that opencast mining uses the same methods as quarrying to obtain rocks. The problems of deep mining are highlighted in the text, supported by the Information Box naming major mining disasters in the three years 2005–07. Pupils could be asked why anyone ever wants to be a miner. The main answer is that it is better paid than other jobs in the same area; in some places it is the only type of male work available. Mining and environmental damage are inseparable for the reasons explained in the text and summarized in the spider diagram in Figure 6.12.

The answers needed for Question 1 in the activities on page 91 are all in the text and Figures, and likewise with the answer to Question 2; however, requiring pupils to draw a spider diagram means that they need to isolate disadvantages more effectively. Question 3 requires higher levels of understanding and more judgement. The cheapest choice would certainly be C (oil trap on land) and the most expensive B (deep underground mine). The positions of the other two on the line are less clear cut; the opencast mine, despite needing more workers throughout its period of operation, might just be cheaper than the gas rig in deep water because it is on land. Although more automated, setting up and servicing a gas

rig are always more expensive at sea than on land. Explanation in part (b) is made easier by asking only for the two extremes. The others are better left for class discussion.

SECTION 3: USES AND ECONOMIC IMPORTANCE OF MINERALS (PAGES 91–93)

The focus switches from mining to use. Stress to pupils, with examples, how most minerals have a multitude of different uses, many of which only the companies processing them are aware of. Figure 6.13 on page 92 helps to explain this. By way of introduction to the sub-section about minerals and economic growth and development, provide pupils with a historical perspective of mineral use by humans—from the earliest times (e.g. Iron Age, Bronze Age). The text in this book picks up the story from the time of the ‘Industrial Revolution’ and the major changes wrought by using coal, steam power, and metals such as iron ore. Emphasize why this was such a revolution; Figure 6.14 tries to help with simple sketches of before and after for making things and for transport. Bring it up to date. How great are the changes now being wrought by the ‘Hi-tech Revolution’? Why are none of them possible without the Earth’s mineral supplies?

The activities relating to this part of the work are on page 93. Question 1 requires pupils to extend Figure 6.13 to include precious and ferrous metals. Question 2 focuses on the two periods of great change for economic development. Question 3 gives pupils the opportunity to bring Figure 6.14 up to date using their own hi-tech experiences.

SECTION 4: MINERAL RESOURCES IN PAKISTAN AND THEIR USES (PAGES 93–100)

Once again the study area is narrowed down to Pakistan. Continuing one of the earlier themes, some of the many uses of limestone are shown in Figure 6.15, followed by the uses of other commonly found minerals in Pakistan in Figure 6.16. Fossil fuel and energy supplies are singled out for a short special study and their distribution is summarized in Figure 6.17. The greatest disappointment for Pakistan has been the failure to discover large deposits of oil. Of all the minerals, oil has the greatest number of and most varied uses, as Figure 6.19 shows. For many of these uses, there are no direct substitutes and certainly none that are as cheap.

Question 1, in the activities on page 96, concentrates on the Salt Range, the area with the greatest variety of minerals in Pakistan. Pupils may go back to Figure 6.4 to answer part (a) more quickly. Part (b) maintains the theme of varied uses. Question 2 requires more careful study of the oil refinery in Figure 6.18. Question 3 is intended to increase pupils' awareness of the dominance of products made from oil, above that of all other minerals. Figure 6.19 provides the clues for this task.

Pakistan's disadvantage in terms of minerals has hindered economic development. Oil is an expensive import. High oil consumption and development go together. This is what Figure 6.20 shows—that the average person in the USA consumes 25 times more energy per year than the average person in Pakistan, a truly massive difference. Unfortunately for the economy of Pakistan, oil consumption has been rising (shown in Figure 6.21). The proportion that needs to be imported is greater for oil than for any of the other energy sources (Figure 6.22). Shortage of oil is an important contributory factor to why Pakistan remains primarily an agricultural country, with up to half its working population still employed in farming (Figure 6.23).

To vary the geographical skills practised, Question 1 in the activities on page 98 requires the drawing of a line graph which should provide a clear visual impression of the persistent increase in energy consumption in Pakistan. This is despite the low energy consumption per head as compared to developed countries, as shown in Figure 6.20 (Question 2). When the totals of all the energy sources shown in Figure 6.22 are added together, it is the equivalent of 47.3m tonnes of oil (Question 3). The energy gap in (a) is 16.1m tonnes; the percentage produced in Pakistan is 66 per cent (b). The difference between production and consumption of oil in Pakistan is represented by a pie chart (c). It is a drain on the economy and limits industrial as well as economic development (d). A study of Figure 6.23 (for answering Question 4) shows that Pakistan is still far from having the employment structure associated with an economically developed country, even if its industrial development is greater than that of many developing countries in Africa. Farming continues to dominate, and industry is the smallest sector of employment, despite a high dependence on labour rather than machines in the many small workshops.

The summary page aims to promote discussion and debate about what might be holding back industrial progress in Pakistan. Figure 6.24 shows

general factors which favour industrial growth in a country. In a way, the fact file comparing Japan and Pakistan is a little unfair, because Japan is such an industrial powerhouse, and something of a unique case. The disparity between the two countries in wealth and industrial output for export is enormous. But it does reveal one interesting statistic—the percentages employed in manufacturing are similar in the two countries, albeit for entirely different reasons. This shows the levels of mechanization in Japanese factories and industrial efficiency which reduces the number of employees. Figure 6.24 is the starting point for answering the questions in the activities on page 100. One factor, capital, has been filled in to provide a guide for how to answer for the other factors. This is the ideal type of activity for a group brainstorming session as there is plenty to discuss; the end product needs to be tangible, which is why drawing a spider diagram has been suggested.

WORKBOOK

- Activity 1 Chuquicamata copper mine, Chile
- Activity 2 All about fuels
- Activity 3 Rising world oil prices
- Activity 4 Oil refining

Workbook Activity 1 requires use of Figure 6.1, a valuable resource about opencast mining on an enormous scale, in a desert where there are few permanent inhabitants and where there is little destruction of vegetation and habitats. Massive trucks and cranes are dwarfed and almost invisible in comparison with the scale and size of the open pit. Question 2 and the information about the mine are attempts to reinforce pupils' understanding of this.

Workbook Activity 2, as it says, is all about fuels. Looking for differences between six pairs will increase pupils' understanding of the topic. The non-renewable fossil fuels are isolated in Question 2. Question 3 tests pupils' understanding of the use of fossil fuels in comparison with other fuels that are widely used in rural areas of developing countries (wood and animal dung). This is due to the availability and cheapness of the latter (mostly free).

Workbook Activity 3 includes the record of world oil prices from 1900. A major change that occurred during the 1970s forms the basis of Questions 1 and 2. Before this time, prices were consistently low; after

this they began to take off, although with significant fluctuations. The phenomenal rise from 2004/5 is the basis of Questions 3 and 4. You may wish to update pupils on the (approximate) current oil price because during early 2009 the price fell well back from its peak of US\$149 per barrel in mid-2008, making the range of fluctuations greater than anything previously known. (It is important to explain briefly the reasons behind these price changes. After 1973, oil prices rose when OPEC—the Organization of Petroleum Exporting Countries—put an embargo (control) on the export and raised prices. Later, in the 21st century, oil prices rose again as a result of the Iraq War.) In Question 5, pupils are required to think about likely winners and losers from high oil prices. The winners include oil-producing countries (especially those with high exports), the big oil companies, companies and people engaged in searching for and developing new oil fields, and foreign workers in the Gulf States with plenty of employment opportunities. The losers include countries without oil that rely on imports, industries and transport companies which use large amounts of oil (metal smelting and chemical industries, owners of aircraft, ships, trucks, and buses), and consumers (ordinary people) with cost increases in fuels for cooking, for electricity, and for manufactured goods. The poorer the country, the more chance of their economy being badly hit by oil price rises.

Workbook Activity 4, part 1 begins with a plan of an oil refinery (supporting what is shown on page 95 in the textbook). The crude oil comes in by tanker and pipeline (A); petrol and refined products go out by rail and road (B). The differences in bulk, and input of one product compared with the output of many different products, explain why different means of transport are normally used (C). What happens at A is described in the label on Figure 6.18 in the textbook (D). A variety of storage tanks, smaller compared with those for the crude oil, are shown (E). The second part is a decision-making exercise. Four possible locations for siting an oil refinery are indicated by letters A–D on the map. The choice which is easiest to justify is C—on flat land, but near to deep water for large oil tankers carrying crude oil, away from the sand and mud deposits, built-up area, and sensitive wildlife in the nature reserve. Of the others, A is next to shallower water and further up the estuary, and perhaps too close to the settlement, with the danger of an explosion and air pollution. B is shallow water and environmentally sensitive. D is near the deep water and well out of the way, but is on high and sloping land, where it will not be as easy to build the refinery.

Question 3 is an opportunity for more able pupils to write and explain the usefulness of oil (the modern equivalent of coal during the early Industrial Revolution).

SUMMARY CHECK

Teaching objectives: Importance of minerals and fossil fuels for economic development. Appreciation of mining as an important human activity

How these have been met:

- Classification of minerals and identification of major mining areas of the world
- Methods of mining (opencast and deep mining)
- Uses and importance of minerals for wealth and economic development
- Economic effects of mineral poverty with particular reference to Pakistan

Learning outcomes: Understanding of the importance of minerals and fossil fuels for economic development; appreciation of differences in economic opportunities that follows from the presence or otherwise of minerals.

Check that the objectives have been met:

- Look at the worth of pupil answers to Activities 1 and 2 on page 91.
- Look at the quality of pupils' work in Activities 1–2 on page 100 for limited industrial development in mineral-poor Pakistan.
- Provide comparable industrial and wealth data for countries of contrasting mineral wealth such as Middle East and South Asian countries with and without oil, or South Africa and its mineral-rich neighbours and other sub-Saharan countries, for pupil study and explanation.

Chapter 7 **Pollution—types, causes, and effects**

National Curriculum

Target study area in the NC	Environmental Problems
Teaching Objectives	Study of pollution as a hazard; knowledge and understanding of major environmental problems associated with air and water pollution, and land degradation
Learning Outcomes	Recognition of different types of pollution and understanding of pollution as a hazard to human life and activities

Geographical skills

Practical skills used include interpreting and drawing graphs, making observations of pollution from photographs and as part of an investigation in the local area near home or school, and making summary sheets for pollution information and observations

Key geographical terms

- | | |
|-------------------|------------------|
| * pollution | * acid rain |
| * air pollution | * salinization |
| * land pollution | * eutrophication |
| * water pollution | * toxic waste |

SECTION 1: TYPES OF POLLUTION (PAGES 102–111)

As an introduction to this topic you might ask pupils to investigate types of pollution in the local area and their effects. Then use the evidence in Figure 7.2 as a warning that, while most pollution is from people, some is natural, particularly in areas of volcanic activity. Emissions of sulphur have given this stream in Costa Rica (below the volcanic crater shown in Figure 2.17) its yellow-brown colour. Begin with as precise a definition of the term ‘pollution’ as possible and refer to Figure 7.3 to examine different ways in which people pollute the environment. For ease of study, pollution is normally classified according to the natural environment being polluted. Air, land, and water pollution are studied in that order.

The underlying point about air pollution is that it is both global and local in its effects. The most obvious example of global pollution, the greenhouse effect and global warming, was covered in Chapter 3. Chapter 7 focuses on local pollution, both types and effects. Air pollution is always going to be greatest and easiest to observe where large numbers of people are concentrated—in big urban areas. All big cities experience the type of traffic congestion shown in Figure 7.4 on work days. Labels on Figure 7.4 identify the cocktail of gases released from exhausts; those on the right label the effects on people and the environment. Certain cities, including some in the developed world, are noted for their high levels of air pollution; refer pupils back to pages 44–45 in the chapter on climate. Wet, windy climates, such as that of the UK, aid dispersal of pollutants, whereas climates with sinking air and light winds, such as in Pakistan, favour accumulation.

In the activities on page 104, Question 1 requires pupils to identify the types of air, land, and water pollution shown in Figure 7.3. Explain that what this Figure shows is far from complete; as an extension activity pupils could be asked to add to what the sketch shows. Question 2 brings pupils back closer to their likely personal experiences, while Question 3 makes fuller use of Figure 7.4 and supports earlier work in Question 2 in the activities on page 47.

The next section is about land pollution. The focus is upon the two types most associated with hot, dry climates, namely salinization and desertification. Words ending in ‘-ization’ like salinization, urbanization, etc. indicate increasing amounts or increasing numbers. Salinization is not simply salt in the soil (some salt is present in all soils in dry climates), but increasing amounts to the point where plant growth is badly affected, as shown in Figure 7.5. The cropland shown in the photograph has passed through all the stages shown in the flow diagram in Figure 7.6. The use of large amounts of water for irrigation is the primary cause—but how much cropland would there be in Pakistan without the use of irrigation water? The Information Box shows that this problem is not unique to Pakistan.

Refer back to page 81 for desertification: it is soil erosion in dry climates, which leads to the spread of deserts. Natural vegetation rarely forms a complete cover in desert and semi-desert areas due to lack of rainfall (to be explained under natural regions in Explore Book 3). Any human activity which overuses the limited vegetation resources runs the risk of

triggering off the sequence of events illustrated in the flow diagram in Figure 7.8. Activities related to land pollution are on page 106. Questions 1 and 2 are about salinization and desertification, with particular reference to Pakistan. Question 3 is a comparative exercise between them, based on what can be seen in the two photographs in Figures 7.5 and 7.9.

Water pollution is the most widespread of all, simply because most people in the world live close to a water course. The red lines showing water use on the sketch in Figure 7.10 indicate why the risk of water pollution from humans and their activities is so high. Emphasize to pupils how the water flowing down large rivers, such as the Indus or the Ganges (perhaps an even better example to use), will have been used many times, in several different ways, before it reaches the sea. Figure 7.10 shows just some of the ways. The other point to emphasize is that the risks of pollution are not equal from all the uses. For example, water in electricity power stations is simply used for cooling and passes back into the river warmer than it was, but without any contamination, whereas, if water from factories and homes is returned untreated, it is more likely to be toxic and a risk to plant and animal life downstream. Figure 7.11 is a summary table giving causes, effects, and an assessment of how serious the pollution is for each of the three main users of river water.

The answers to Question 1(a) in the activities on page 108 are choice of snow/ice in the mountains or lake for natural water store, and dam or reservoir for man-made store. For (b) the least pollution is where there is no sign of settlement upstream from the dam; in general, the nearer the source, the more guaranteed the purity of the water, with mountain springs being one of the most used sources for bottled water. The nearer the mouth of the river, the greater is the chance of polluted water. After studying the three types of pollution, pupils are in an even better position to extend or initiate an investigation into pollution in the local area. Question 2 suggests an order for doing this and provides a framework for making an overall assessment.

A broader, more worldwide view of water pollution follows. First, pupils are encouraged to think about the benefits of clean water—social, environmental, and economic. There are many causes of poverty in rural areas of developing countries, but unsafe and inadequate domestic water supply is definitely an important contributor. The flow diagram in Figure 7.12 shows this. Again there are many reasons why there is not the same

size of gap between urban and rural wealth for people living in rural areas in developed countries. One of them is equal access to clean water (refer back to Workbook Activity 2, Chapter 4 for the major contrasts in water use between rural Pakistan and rural UK). The two sets of bar graphs on page 110 show the inadequacy of sanitation provision in developing countries and in rural areas in particular. Reasons are easy to find and these have been assembled in the spider diagram in Figure 7.15.

The activities on page 111 focus on clean water and sanitation in Pakistan. Equivalent values to those in Figure 7.14 for sanitation are stated in Question 1 to enable pupils to draw them up into a pie chart in part (a). In their comments in part (b), pupils need to bear in mind that the values in Figure 7.14 are for all countries, both rich and poor, so that Pakistan cannot be expected to match them, but do its percentages have to be so low? Question 2 is for pupils to place reasons in order of importance and to justify the top two. Question 3 can be answered in writing or with the help of an amended version of the poverty cycle flow diagram.

SECTION 2: HOW BAD IS POLLUTION IN PAKISTAN? (PAGES 111–114)

For the rest of the chapter, the focus remains upon pollution in Pakistan. Some examples of air, water, and land pollution are shown in Figure 7.16. Ask the pupils how many of these have been experienced or seen by them. Special mention is made of Karachi and its pollution problems, because it is far and away the largest city, as well as being the major port and industrial centre. Also, it is close to coastal mangrove forests and, as previously mentioned, has a dry climate favouring high levels of air pollution. In other words, human and physical factors combine to increase the amount of pollution.

The information in Figure 7.17 gives an example of the problems for clean water supply facing most rural dwellers in Pakistan. Later, in Chapter 8 on page 123, the situation described here can be compared with that in villages where improvements in water supply have been made. Question 1 in the activities on page 113 asks pupils to describe and explain the problems in the rural areas (to link in later with Question 1 in the activities on page 124). Question 2 focuses on pollution in Karachi and why it is so bad. Question 3 gives pupils the chance to compare what they can observe for Karachi as a whole with their own local experiences.

The map in Figure 7.18 only indicates in general terms where pollution

and environmental damage are most noticeable. However, it guides pupils towards the main issue in different parts of the country—deforestation in the mountains and uplands of the north and west, waterlogging of soils and high salinity in the irrigated croplands of the Indus Valley, unsafe drinking water in dry rural areas of the south and west, and marine pollution close to the port of Karachi. These can be identified and elaborated upon by pupils on the summary sheet requested in Question 1 in the activities on page 114. Question 2 provides a framework for a summary of earlier investigations of pollution in pupils' home areas.

WORKBOOK

Activity 1	Traffic pollution in big cities
Activity 2	Desertification
Activity 3	How human activities cause river pollution
Activity 4	Pollution in Karachi

In **Workbook Activity 1** pupils are required to put together in Question 1, using a different style of diagram, the pollution risks to human health and the environment from heavy traffic in cities. Questions 2 and 3 are to be answered from pupils' own experiences of traffic pollution. The two diagrams in **Workbook Activity 2** illustrate the southern spread of the Sahara Desert in Africa (sometimes referred to as the 'advancing Sahara'). Pupils are expected to describe and explain the changes and then to suggest what is likely to happen in future if the process of desertification continues.

Workbook Activity 3 is based around a diagram, which is a variation on Figure 7.10 on page 107. Pupils are required to fill the boxes to describe how three different human activities cause river pollution. The best position for P on the diagram is downstream from the oil refinery and tanker terminal where the effects of all upstream water users and pollution will be felt. As an extension activity, go back to the uses of rivers on page 59 and discuss concerns of river use. Some reactions of residents living with Karachi's pollution, taken from a newspaper article, are quoted in speech bubbles in **Workbook Activity 4**. Pupils are asked to summarize the causes and effects of the pollution and comment upon how much ordinary people can do about it.

SUMMARY CHECK

Teaching objectives: Knowledge and understanding of pollution as a hazard, and the major environmental problems associated with air, water, and land pollution

How have these been met:

- Classification of types of pollution for what is included
- Separate studies of air, land, and water pollution dealing with characteristics, causes, and effects
- Coverage of these includes references to where and why pollution is greatest
- Assessment of the nature and distribution of different types of pollution in Pakistan

Learning outcomes: Recognition of different types of pollution and appreciation of the effects of pollution, which makes it a hazard to human life and activities

Check that the objectives have been met:

- Look at the accuracy of pupils' answers to Activity 1 on page 104 and Activities 1–3 on page 113.
- Show pupils different examples of pollution and ask them to identify types and effects, and then to suggest explanation for causes.
- Assess the worth of pupils' own investigations into pollution in their home areas for Activity 2 on page 109 and Activity 2 on page 114.

Chapter 8 **Pollution—can it be controlled?**

National Curriculum

Target area of study in the NC Environmental Problems

Teaching Objectives

Introduction to ways of controlling pollution, including seeking alternatives to fossil fuels, and ways to improve water quality and supply

Learning Outcomes

Appreciation and evaluation of people's roles and responsibility to improve the natural environment and maintain a healthy environment for life and work

Geographical skills

Practical skills used include labelled sketches and drawing graphs (including a pictograph)

Key geographical terms

- * recycle
- * alternative energy source
- * sustainable energy
- * acid rain

SECTION 1: WAYS TO CONTROL POLLUTION (PAGES 116–121)

Discuss general issues—why pollution is cheap but cleaning it up is expensive, why governments and authorities are reluctant to tackle the obvious pollution from transport (Figure 8.2 and earlier). The text is arranged according to the ‘stick and carrot’ approaches to controlling pollution. The stick approach involves taking direct action and punishing companies, organizations, and individuals who fail to comply with laws, rules, and regulations. One change that makes a big difference is compulsory installation of catalytic converters on car exhausts; it takes nine modern cars to give out the same emissions as one old car (Figure 8.4), but fitting the converter costs money. Some pressure from the authorities is needed. In developing countries, more progress is being made with urban public transport, such as increasing numbers of CNG-powered vehicles (Figure 8.1), than with trucks and private cars. The carrot approach is gentler and relies upon better education to make people think in terms of the three Rs—reduce, recycle and reuse. Figure 8.5 on page 118 illustrates recycling and reuse. Developed countries and rich people in developing countries are the main culprits for creating waste. Some cities in developing countries have very efficient waste collection and recycling systems, even if they often form part of the informal sector.

Question 1 in the activities on page 118 is about catalytic converters. Question 2 is about Los Angeles and what the authorities have done there to try to reduce the city’s notoriously high smog levels. Drawing the graph should give clear visual evidence for the downward trend in smoggy days, with immediate reductions recorded after the regulatory changes in 1975 and 1996. Individual pupil views are encouraged by the question wording in (d), hence there is no ‘right’ answer. But the natural conditions for fog

formation remain and there is still a base level of pollution from transport and other human activities in one of the world's big cities, Los Angeles.

Another approach to controlling pollution is to seek alternatives to fossil fuels, which are non-polluting or considerably less polluting. Best of all are energy sources which rely on natural resources which will never run out (water flow after rain, wind, sun, heat from volcanoes, and waves of the sea). These are truly renewable and sustainable. Slightly different is nuclear power (shown in Figure 8.6 C). The most detail is given about hydroelectric (hydel) power because it is the alternative of greatest importance in Pakistan. Mention of Tarbela Dam on page 120 supports earlier references to it in the context of irrigation stores (pages 60–61).

Advantages of alternative energy sources are summarized in the spider diagram in Figure 8.9. The obvious question which needs answering is: if alternative sources are renewable, sustainable, and non-polluting, why are they not used more? Figure 8.10 gives the principal reason—cost. Also, many alternatives require new technological breakthroughs to make them as cost-effective as fossil fuels. Fossil fuels have been so cheap and so easy to use for so long that the impetus to undertake research and development for alternatives has never been strong enough.

In the activities on page 121, Question 1 requires pupils to use varied figures and text in order to give information about two alternative energy sources as examples. Question 2 requires pupils to think about which of the newer alternatives might be useful in Pakistan in future years. Of the choices given, solar energy would appear to offer the best prospects in terms of the country's natural resources, but look at its relative cost in Figure 8.10.

SECTION 2: WAYS OF IMPROVING WATER QUALITY AND SUPPLY (PAGES 122–125)

An improved, clean, and safe water supply will improve the quality of life and standard of living of people in developing countries more than any other change. Fortunately, international awareness of the issue is increasing, even if implementation can be slow to follow. New statistics quoted on page 122 and earlier data (page 110) make grim reading. The example in Figure 8.12 on page 123 shows what can be done, and describes the benefits which follow from the provision of a clean and adequate water supply. What a contrast to the picture painted in Figure 7.17 on page 112! The supporting activities are on page 124. Question 1

is arranged as a case study with headings suggested to lead pupils through it. In a sense, it is a 'before and after' exercise comparing Figures 7.17 and 8.12. Question 2 has the same theme in relation to polluted rivers which are cleaned up.

The final section is on acid rain, traditionally a problem of the developed world, but increasing in Asia as countries industrialize. China and India are making increasing use of their large coal deposits. Acid rain in Figure 8.14 would be from the chimney to the right from which the oxides of sulphur and nitrogen are being released. Water vapour from the cooling towers, while it might look bad, is non-polluting. The study of acid rain in Western Europe is useful for showing how international the problem of air pollution can be. Sweden itself burns little coal, but its coniferous trees are dying because the main winds travel from south-west to north-east carrying pollutants from the UK and adjacent areas of continental Europe with them. Coniferous trees in Scotland are little affected. The final set of activities on page 125 covers the definition of acid rain, its causes, and effects, why it is an international problem, and why pollution problems (once they become international) become harder to control and stop.

WORKBOOK

- | | |
|------------|---|
| Activity 1 | Recycling |
| Activity 2 | Disadvantages of alternative energy sources |
| Activity 3 | Improvements in an Indian village |
| Activity 4 | Acid rain pollution |

Workbook Activity 1 focuses on recycling. **Workbook Activity 2** is about the disadvantages of alternative energy sources. Question 1 asks for the opposite picture to that of Figure 8.9 in the textbook. Question 2(a) requires pupils to think about specific disadvantages of individual alternative sources. Part (b) is an overall assessment of alternative sources.

Workbook Activity 3 itemizes changes in an Indian village, which mirror the improvements in villages in the Punjab in Figure 8.12 in the textbook. The differences that are needed to complete the table in Question 1 are 23, 1, 8, 45, 2, 3000, and 25,800. Increased agricultural output and higher income per household are the best two pieces of evidence for answering question 2(a). Water supply is the key to the explanation in part (b).

Question 3 relates back to the big dam issue on page 66 in the textbook. **Workbook Activity 4** begins with a sketch which conveys a similar message to that on the map in Figure 8.15; the diagram and activity reinforce pupils' understanding of this concept.

SUMMARY CHECK

Teaching objectives: Knowledge of ways to control pollution, including alternatives to fossil fuels and improved water quality and supply

How these have been met:

- Examples of both 'stick' and 'carrot' approaches to pollution control
- Study of alternative energy sources, including advantages and disadvantages
- Example of improved water quality and supply in the Punjab
- Short case study of acid rain as an example of pollution across frontiers

Learning outcomes: Ability to appreciate and evaluate ways people can improve the natural environment to make it healthier for life and work

Check that the objectives have been met:

- To elicit appreciation of ways to reduce pollution, ask pupils about what Figures 8.4 and 8.10 show.
- For pupil evaluation, look at the quality of answers given to Activity 2(d) page 118, Activity 2 on page 121 and Activity 4 on page 125.
- Suggest guidelines for pupil investigations in their home areas to discover and/or suggest ways to reduce the effects of pollution there.