GEOGRAPHY

KEY STAGE 3

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Sample booklet
Contains material from:
- Student Book (pages 5–27)
- Planning and Assessment Pack (pages 28–29)
- Worksheet Pack (page 30)
- Workbook 3 (page 31)
This new KS3 Geography course puts progression and assessment at the heart of the curriculum, laying firm foundations for the reformed GCSEs.

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**Progress in Geography will give you the opportunity to:**

- Engage with and enjoy your studies, developing a passion for learning about our rich and diverse planet
- Be curious about people and places
- Expand your world knowledge of places and their location
- Investigate places at all scales, from personal to global
- Consider what places are like and how the past helps to explain the present and predict the future
- Appreciate the world and understand how physical and human landscapes are interdependent and interconnected
- Investigate issues affecting a diverse range of places and people, now and in the future
- Develop your understanding of the big ideas of geography and how they interconnect
- Investigate the world through increasingly complex geographical enquiry
- Make sense of people and places using a wide range of geographical data
- Use different maps routinely to develop your spatial awareness of a variety of places at different scales
- Investigate and ask your own geographical questions
6 Why are rivers important?
6.1 Why are rivers important?
6.2 How does water get into rivers?
6.3 What work do rivers do?
6.4 How do rivers change from source to mouth?
6.5 How do rivers shape the land?
6.6 How do I conduct a river fieldwork enquiry?
6.7 How are rivers important to people?
6.8 How do river floods create problems?
6.9 How can flooding be managed?
6.10 Why are rivers important? Review

7 What is development?
7.1 What is development?
7.2 How is money spread around the world?
7.3 What other ways can be used to measure development?
7.4 How can development change over time?
7.5 What is the global development map missing?
7.6 Why do people live in poverty?
7.7 How can gender equality increase development?
7.8 How do countries and organisations support development?
7.9 What are Sustainable Development Goals?
7.10 What is development? Review

8 One planet, many people: How are populations changing?
8.1 One planet, many people: how are populations changing?
8.2 Where does everyone live, and why here?
8.3 How can we describe the structure of a population?
8.4 Can we control population size?
8.5 Why do people move, and where do they go?
8.6 Who lives in the UK, and where do they come from?
8.7 How do urban areas change?
8.8 How do two different cities compare?
8.9 How can urban problems be improved?
8.10 One planet, many people: how are populations changing? Review

9 What happens where the land meets the sea?
9.1 What happens where the land meets the sea?
9.2 What shapes our coastal landscape?
9.3 What forms of erosion take place on the coast?
9.4 What landforms are created by forces of erosion?
9.5 How does transportation change the coastline?
9.6 How does deposition change the coastline?
9.7 How has life on the Holderness coast changed?
9.8 What defences can be used to protect the coast?
9.9 Weighing it up: are the benefits worth the cost?
9.10 What happens where the land meets the sea? Review

10 Diverse and dynamic: how is Asia being transformed?
10.1 Diverse and dynamic: how is Asia being transformed?
10.2 How does India rely on the monsoon climate?
10.3 How do floods threaten lives in Asia?
10.4 How does life adapt to the mountain biome?
10.5 Why is the population of Asia diverse and dynamic?
10.6 How is urbanisation changing lives in Karnataka, India? Part 1
10.7 How is urbanisation changing lives in Karnataka, India? Part 2
10.8 Is China helping to create an independent world?
10.9 How is Asia developing into the most important global economic region?
10.10 Diverse and dynamic: how is Asia being transformed? Review

11 Will we ever know enough about earthquakes and volcanoes to live safely?
11.1 Will we ever know enough about earthquakes and volcanoes to live safely?
11.2 Do continents fit together like jigsaw pieces?
11.3 Where are the world’s earthquakes, volcanoes and mountain belts?
11.4 What is happening beneath our feet?
11.5 What happens at plate boundaries?
11.6 What do we know about earthquakes?
11.7 Can people manage risk living in earthquake zones?
11.8 What do we know about volcanoes?
11.9 Can people manage risk living near volcanoes?
11.10 Will we ever know enough about earthquakes and volcanoes to live safely? Review

12 What are the challenges and opportunities facing Africa?
12.1 What are the challenges and opportunities facing Africa?
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12.5 What is the pattern of climate and biomes in Africa?
12.6 Is there a future for the Sahel?
12.7 What are the challenges and opportunities of population change in Africa?
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12.9 Does China want to help develop Africa?
12.10 What are the challenges and opportunities facing Africa? Review

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13.3 How do glaciers change landscapes?
13.4 How are landforms shaped by glacial erosion? Part 1
13.5 How are landforms shaped by glacial erosion? Part 2
13.6 How do we know the Lake District was glaciated?
13.7 How are landforms shaped by glacial deposition?
13.8 How do people use glacial landforms?
13.9 How do we investigate how glaciers are changing?
13.10 How does ice change the world? Review

14 Why is the Middle East an important world region?
14.1 Why is the Middle East an important world region?
14.2 How does physical geography influence the region?
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14.7 Why is Yemen the poorest country in the Middle East?
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14.10 Why is the Middle East an important world region? Part 2

15 What is the future for our planet? A geographer’s view
15.1 What is the future for the planet? A geographer’s view
15.2 What is the evidence for climate change?
15.3 What are the causes of climate change?
15.4 What are the consequences of climate change on our planet? Part 1
15.5 What are the consequences of climate change on our planet? Part 2
15.6 What are the consequences of climate change for the UK? Part 1
15.7 Antarctica – the frozen continent? A geographical enquiry
15.8 What can we do about climate change?
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15.10 What is a geographer? Review

Glossary
Index
In this unit, you will learn about:
- being a geographer
- asking geographical questions
- conducting geographical enquiries
- key aspects of studying people and places
- how to use geographical data including maps.

Welcome to Progress in Geography: Key Stage 3

This book has been designed to help you make progress across Key Stage 3. It will help you to think like a geographer!

It is full of different types of geographical data, such as Photo B. There are also lots of maps in the book, including four big Ordnance Survey maps that open out from the cover as flaps, to use across different lessons. The Activities box on each lesson spread provides questions and activities to help you make sense of the geographical data and the new ideas and knowledge presented in each lesson. The back cover of the book explains the book layout – have a look.

Activities

1. Look at page 3, the vision statement for Progress in Geography: Key Stage 3.
   a) What is a geographer?
   b) Create your own poster to show what a geographer knows, understands, values and can do.
2. What three aspects of the world does a geographer study?
3. Look at the front cover of this textbook.
   a) How does it show the world?
   b) What do you feel about this image?
   c) Which aspects of the world does the image show?
4. Geographers use questions to investigate places. Use the enquiry questions in Image C to describe what you can see in Photo B.
5. Look at the satellite image of the world in Photo A. Name the continents and oceans of the world, 1–11.

Stretch and challenge activities extend learning beyond the content in the book, with frequent online research tasks.

Geography helps you make sense of:
- the physical world – what our planet is like, the work of rivers, the sea and ice
- the human world – how and where people live, develop and earn a living
- the environmental world – habitats, such as mountains, forests, oceans, and how they develop and change.

A good geographer:
- investigates and understands all these aspects of the world in which we live
- develops a locational knowledge of where places are in the world
- asks questions, and uses a wide range of geographical data to investigate places.

Progress in Geography: Key Stage 3 has been designed to help you become a good geographer and we have provided a vision of what this looks like on page 3. Take a look.

Stretch and challenge
Geography is happening every minute of the day. Before next lesson, find a news report in a newspaper or on a website. Describe what the story is about and why you think it is geographical. What type of geography is it about? Share your discovery next lesson with the class.
Mapmaking
Cartography, or mapmaking, has been an important aspect of human history for over 8000 years. Geographers define a map as a graphic representation, presenting a spatial understanding of places, ideas, or events in the human and physical worlds. An accurate map of the world could not be constructed before the fourteenth century, because half of the planet had yet to be explored, or discovered. Maps A–C show examples of maps which demonstrate how our knowledge and understanding of the world has evolved through time.

1.2 How has our knowledge of the world progressed over time?

Map of the world according to Eratosthenes

Eratosthenes, a Greek scholar, was the first person to use the term ‘geography’. He was also the first person to calculate the circumference of the Earth, with amazing accuracy. His original map was drawn about 194 BC. It was lost long ago. Map A is a reconstruction. It shows the known world 2300 years ago.

Map B was published in 1658 by the Dutch cartographer, Nicolaes Visscher. This map shows more of the world than Map A because by the seventeenth century new areas of the world had been discovered and explored. Sailing ships had allowed explorers from Europe to travel across the oceans and discover new lands in North and South America, and parts of Australia. But look closely at Map B. You will notice that the coastlines of these continents suddenly stop, as though the map is unfinished.

A new age of exploration began in the 1960s leading to the NASA Apollo 11 space mission landing a man on the moon for the first time, in 1969. The images they sent back of Earth from space changed human perspectives about our planet. Space travel has become more commonplace today. Many satellites now circle the Earth sending back real-time images, like C, that are used to accurately map the planet. They are also used to monitor the changing environment and weather systems. GoogleEarth uses massive amounts of data to allow us to view the planet in great detail, as you will discover in this book.

145 1658

145 How does ice change the world?
1.3 What locational knowledge do you have of the world?

Learning objectives
- To compare the size of the world’s continents and oceans
- To understand the geography of North and South America, and Europe.

In Lesson 1.1 you labelled all of the continents of the Earth. Chart A and Tables B and C give you details of the size of each continent and the number of people living there. In this lesson you will remind yourself of what you know about North and South America and Europe – the continents that you investigated in your primary school. As you work your way through this book you will complete your world regional studies by investigating Africa, Asia, the area known as the Middle East, and the largest country in the world, Russia.

- The Americas cover 8 per cent of the Earth’s total surface and 28.4 per cent of its land area.
- A long mountain chain runs down the western sides of North and South America.
- The lower eastern sides are dominated by huge river basins such as the Amazon, Mississippi and La Plata.
- The voyages of Christopher Columbus from 1492 to 1502 opened up what became known as the ‘New World’ and people moved in great numbers to live here from Europe (the ‘Old World’).
- Today the population of North and South America is over 1 billion, with over 65 per cent living in the three largest countries by population USA, Mexico and Brazil.

Activities
1. Look carefully at Chart A.
   a) What percentage of the world is covered by oceans and continents?
   b) Which is the largest feature of the world?
2. Look carefully at Tables B and C.
   a) Draw a bar chart to show the area of each continent.
   b) Draw a bar chart to show the population of each continent.
   c) Write a paragraph to describe what you have learnt about the world’s continents from your charts.
3. Look carefully at Map D of the Americas.
   a) Name the countries labelled 1 to 6.
   b) Name the mountain ranges that run down the western side of North and South America.
   c) Which are the largest five countries by area in the two continents?
   d) Which five countries border Bolivia?
4. Write a paragraph about what you know and have learnt about North and South America in your primary school.
5. Look carefully at Map E.
   a) Name the countries labelled 1 to 5 and the seas, 6 and 7.
   b) Name the four countries of the United Kingdom.
   c) Which six countries border France?
6. Write a paragraph about what you know and have learnt about the continent of Europe at your primary school.
In this unit, you will learn:

- to define development
- to compare development around the world
- to understand where and why inequality occurs
- to understand the actions taken by individuals, governments and communities to aid development.

Development is a complex term. Most simply, development means people reaching an acceptable standard of living or quality of life. Other definitions are provided in C. Quality of life means the general well-being of people, which includes income, health, education, employment, and the environment. The photos in A, for example, show how access to toilets varies in quality across the world. The access people have to quality sanitation will impact their health and therefore will affect their quality of life.

Every country in the world is at a different stage of development. If a country is developing it is changing for the better. This is a complex process to achieve and maintain, often with many barriers and setbacks to overcome. In this unit you will investigate development around the world.

Anna Rosling Rönnlund has created Dollar Street

The World Bank uses a wealth indicator to define poverty. It has set a poverty line of US$1.90 or £1.40 per person a day – those receiving less than that are said to be living in poverty. The World Bank believes that in 2013 an estimated 767 million people lived below this poverty line figure. That’s almost 11 people in every 100 in the world or 10.7% of the world’s population.

Mahbub ul Haq – International development theorist

People are the real wealth of nations.

Mahbub ul Haq

Amartya Sen

Joseph Stiglitz – 2001 Nobel Memorial Prize in Economics

The welfare of a nation can scarcely be inferred from a measure of national income.

The Nobel Prize-winning economist

The Development Compass Rose

Understanding and questioning the idea of development involves thinking about a variety of factors. The Development Compass Rose (DCR) is a tool to support this thinking. The DCR encourages you to ask a range of questions and explore links between four areas – Natural, Social/cultural, Economic and Political (Who decides?). You will use this tool to investigate places and issues around the world, as part of an investigation or geographical enquiry, in this unit of work and beyond.

Activities

1. a) What is a simple definition of development?
   b) What is meant by the term ‘quality of life’?
2. Read the different expert views about development, given in C.
   a) For each, identify what they think of development.
   b) Write a sentence stating your own thoughts on each view.
   c) Write your own definition of development.
   d) Compare this with your answer to Question 1a. Identify how it is different.
3. a) How does the World Bank define world poverty?
    b) What do you think you could buy for £1.40? Make a list.
    c) Do you think many people in the UK are living on less than £1.40 per day?
    d) How is this statistical measure of poverty different to the views of the development experts?
4. The images shown in A are taken from the Dollar Street website.
   a) Read B and explain what the website is trying to achieve.
   b) How do the photos of toilets shown in A, help you better understand development?
5. a) Draw a Development Compass Rose.
    b) Write two questions for each part of your rose about what you can see in A.
    c) Go to the Dollar Street website www.gapminder.org/dollarstreet. Select a different category of photographs for homes on this street, by selecting from the dropdown menu.
    d) Repeat the activities above for this different category.
6. Reread your definition of development from 2c. Are you happy with this definition or having investigated real families on Dollar Street do you now want to change it? Write your new definition.
7. Explain why development is a complex idea to understand.
Learning objectives

- To understand how to measure development using one economic indicator
- To interpret different ways of presenting development data
- To investigate the patterns of wealth across the world.

The World Bank is an international organisation which provides loans, advice and research to countries to support economic development. The World Bank uses one main indicator to measure development, Gross National Income (GNI) per capita. This is the dollar value of a country’s final income in a year, divided by its population. Tables A and B show the top and bottom ten countries in the world using this indicator to measure development. Map C shows a choropleth map of the world of GNI per capita. It can be used to compare development at a global scale.

### Top ten countries ranked in terms of GNI per capita, 2016

<table>
<thead>
<tr>
<th>Country</th>
<th>GNI per capita</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Norway</td>
<td>82,330</td>
<td>5,232,930</td>
</tr>
<tr>
<td>Switzerland</td>
<td>81,240</td>
<td>8,272,100</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>76,660</td>
<td>582,970</td>
</tr>
<tr>
<td>Iceland</td>
<td>56,990</td>
<td>334,250</td>
</tr>
<tr>
<td>Denmark</td>
<td>56,730</td>
<td>5,721,120</td>
</tr>
<tr>
<td>USA</td>
<td>56,380</td>
<td>323,127,510</td>
</tr>
<tr>
<td>Sweden</td>
<td>54,420</td>
<td>9,903,120</td>
</tr>
<tr>
<td>Australia</td>
<td>52,560</td>
<td>24,127,160</td>
</tr>
<tr>
<td>Ireland</td>
<td>51,880</td>
<td>6,007,280</td>
</tr>
</tbody>
</table>

### Bottom ten countries ranked in terms of GNI per capita, 2016

<table>
<thead>
<tr>
<th>Country</th>
<th>GNI per capita</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burundi</td>
<td>280</td>
<td>10,524,120</td>
</tr>
<tr>
<td>Malawi</td>
<td>320</td>
<td>18,091,580</td>
</tr>
<tr>
<td>Central African Republic</td>
<td>370</td>
<td>4,594,620</td>
</tr>
<tr>
<td>Niger</td>
<td>370</td>
<td>20,672,980</td>
</tr>
<tr>
<td>Liberia</td>
<td>370</td>
<td>4,613,820</td>
</tr>
<tr>
<td>Madagascar</td>
<td>400</td>
<td>24,894,550</td>
</tr>
<tr>
<td>Congo, Dem, Rep.</td>
<td>420</td>
<td>76,738,150</td>
</tr>
<tr>
<td>Gambia, The</td>
<td>440</td>
<td>2,038,500</td>
</tr>
<tr>
<td>Mozambique</td>
<td>480</td>
<td>28,829,480</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>490</td>
<td>7,396,190</td>
</tr>
</tbody>
</table>

Key

- **High income (US$12 476 or more)**
- Upper middle income (US$4 036–$12 475)
- Lower middle income (US$1 026–$4 035)
- Low income (US$1,025 or less)
- No data

### Activities

1. **What is GNI per capita?**
   - Which organisation uses GNI to measure development?
   - Look at Tables A and B.
     a) Locate the countries on an outline political world map.
     b) Using two colours, one for the top ten countries and one for the bottom ten countries, shade and label these countries.
     c) Describe the distribution of the top ten and lowest ten countries in the world for GNI.
     d) Do any of the top ten countries in Table A surprise you?

3. Map C shows the GNI distribution for all countries.
   a) Use an atlas to help you name the countries labelled 1–10 on Map C.
   b) Create a table listing these ten countries in terms of wealth using the key on the map, with the highest one first.
   c) Why is the GNI per capita measured in US$ even though countries have different currencies?
   d) Why do you think GNI per capita is a useful figure to compare the level of development for countries?

4. **Look carefully again at Tables A and B comparing the GNI per capita and population of the USA and Iceland. The GNI per capita data suggests that Iceland is richer or more developed than the USA. The population data for these two countries provides a clue as to one of the problems with using GNI per capita as a measure of how developed a country is. Explain what this problem is.**

5. **Look at D.**
   a) Which organisation has published the poster, what is their message, and the name of the campaign?
   b) Discuss with a partner what you think about this poster.
   c) Write a paragraph outlining your view of it.
   d) Look again at Map C. In which countries do you think most of the 3.5 billion poorest people the poster refers to, are located?

6. **Write a paragraph to identify what you have discovered about the global distribution of development, using GNI per capita as the indicator.**
7.3 What other ways can be used to measure development?

**Learning objectives**
- To identify different measures of development
- To understand the benefits of using different measures of development

**The Human Development Index**
In Lesson 7.1, the expert views and the Development Compass Rose remind us that there are things to consider, other than just GNI per capita, when measuring development. In 1990, the Human Development Index (HDI) was created to better measure development. HDI combines three elements:
- **living standards**: the GNI per capita
- **health**: the life expectancy or average age which people live to
- **education**: the average number of years of schooling children receive.

The HDI has a value between 0 and 1. The higher the number the greater the level of development. Map B shows the global pattern of HDI.

<table>
<thead>
<tr>
<th>Country</th>
<th>GNI per capita</th>
<th>Life expectancy</th>
<th>Education</th>
<th>HDI</th>
</tr>
</thead>
<tbody>
<tr>
<td>China</td>
<td>8260</td>
<td>76.0</td>
<td>7.6</td>
<td>0.74</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>10,840</td>
<td>79.6</td>
<td>8.7</td>
<td>0.78</td>
</tr>
<tr>
<td>Japan</td>
<td>38,000</td>
<td>83.7</td>
<td>12.5</td>
<td>0.90</td>
</tr>
<tr>
<td>Malawi</td>
<td>320</td>
<td>63.9</td>
<td>4.4</td>
<td>0.48</td>
</tr>
<tr>
<td>Mexico</td>
<td>9040</td>
<td>77.0</td>
<td>8.6</td>
<td>0.76</td>
</tr>
<tr>
<td>Nepal</td>
<td>730</td>
<td>70.0</td>
<td>5.3</td>
<td>0.56</td>
</tr>
<tr>
<td>Norway</td>
<td>82,330</td>
<td>81.1</td>
<td>12.7</td>
<td>0.95</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>490</td>
<td>51.3</td>
<td>3.3</td>
<td>0.42</td>
</tr>
<tr>
<td>UK</td>
<td>42,390</td>
<td>80.8</td>
<td>13.3</td>
<td>0.91</td>
</tr>
<tr>
<td>USA</td>
<td>56,180</td>
<td>79.2</td>
<td>13.2</td>
<td>0.92</td>
</tr>
</tbody>
</table>

**Environmental impact**
In Unit 2 you were introduced to the term sustainability. Some development experts believe that development should consider the impact of human activities on nature, or its ecological footprint, shown in Map C. This is a measurement of how many natural resources a country consumes and how many planets would be required to support the world if every country consumed that amount.

**Activities**
1. **What is HDI?**
   a) What differences can you identify? (Hint: look at Argentina and South Africa.)
   b) Which aspects of the Development Compass Rose are ignored by HDI?
2. **Look at Table A**
   a) Sort the countries in Table A into a rank order for each indicator: GNI, life expectancy, education and HDI.
   b) What differences do you identify in the rank order for each indicator? Explain the differences.
   c) What conclusions can you make about using just one indicator of development?
3. **Study Map B carefully**
   a) Describe the distribution of countries with very high HDI.
   b) Describe the distribution of countries with very low HDI.
   c) Which countries have no data?
   d) Why might there be problems collecting data in these countries?
   e) Identify problems in collecting reliable data for measuring development.
4. **Compare Map B with Map C on pages 16-17.**
   a) What is the ecological footprint?
   b) Which aspects of the Development Compass Rose are ignored by HDI?
5. **Look at Map C**
   a) What is the ecological footprint?
   b) Look again at the countries in Table A and identify their ecological footprint.
   c) What extra information about development does this provide for each country?
6. **Go back to your Development Compass Rose from Lesson 7.1.** Add new questions to your rose about the development indicators you have studied today.
7. **Reread the expert view from Kuznets from Lesson 7.1 page 14.** Write a paragraph to compare this with the findings you have made about the different indicators in this lesson.
7.10 What is development – what have you learnt?

In this unit, you have learnt:
- to define development
- to compare development around the world
- to understand where and why inequality occurs
- to understand the actions taken by individuals, governments and communities to aid development.

Let’s see what you have remembered and understood!

- The total population is 10,561,887
- 7 per cent of the population live below the World Bank’s poverty line of $1.9 US.

You are to apply what you have learnt in this unit to make decisions and write a report on behalf of the Bolivian government about future development strategies. Bolivia is located in South America (Map A). It has many physical and human challenges to development, shown in the resources below.

7. What is development?

Future learning helps pupils make connections to later units and the topics they will study if they take GCSE Geography

Future learning at GCSE

An understanding of development is an important aspect of GCSE geography. You will be required to consider change in at least one lower income country or one that is within a newly emerging economy. You will investigate how it is changing, and the characteristics of international trade, aid and geo-political relationships with respect to that country.

Activities enable pupils to check and apply the skills, knowledge and understanding they have developed in that unit – an invaluable end-of-unit review for both pupil and teacher.

Activities

1. Look at resources A–C. Answer the '4 Vs' and 2 HS enquiry questions about Bolivia.
2. Use the maps from Lessons 7.2 and 7.3 to find out Bolivia’s level of development (HDI and GNI per capita, World Bank grouping).
3. Use A–D, and what you have learnt about the causes of inequality to explain the challenges to development that Bolivia needs to overcome.
4. Look at E, an example of how the sustainable development goals have been implemented in one area of Bolivia:
   a) Why were these SDGs a focus in this area?
   b) What SDGs priorities are identified for Bolivia?
   c) Do you agree with these priorities?
5. Write a report on behalf of the Bolivian government on the priorities for future development of the country. In your report, identify and explain the following:
   - the problems Bolivia needs to overcome
   - the type of aid that can be obtained from the UK government and ActionAid
   - which SDGs Bolivia should prioritise.
6. In Lesson 7.1 you produced a Development Compass Rose. You wrote what you thought were important questions on your rose. Now that you have made progress in your understanding of development, go back and re-read your questions. Do you still think these are the important questions in each category? Add new questions to your rose. Share your new questions with the class.
13

13.1 How does ice change the world?

In this unit you will learn:
- how ice changes the world
- how erosion and deposition create glacial landforms
- to identify glacial landforms on OS maps
- that the distribution of ice around the world changes through time.

What are glaciers?
Glaciers are made of snow that, over hundreds of years, has been pushed down or compressed into large, thickened ice masses. As well as snow, glaciers also contain rock and sediment. If a glacier is melting near the surface, it also contains running water. Glaciers are exciting and inspiring places to visit, see Photo A.

Glaciologists are Earth scientists who investigate glaciers all over the world. They measure glaciers to see how they change and how they alter landscapes through time. You will investigate their findings in this unit.

Where are glaciers found?
Glaciers form in locations where:
- average annual temperatures are near freezing point
- large amounts of snow fall during winter months
- temperatures throughout the year are not high enough to melt the previous winter’s build up of snow.

Glaciers form the largest reservoir of fresh water on the planet. They store 75 per cent of the world’s fresh water. They cover around 10 per cent of the Earth’s total land area and are found in 47 countries.

What are the different types of glacier?
Glaciers come in all shapes and sizes, from a small patch of ice a few 100 metres across to huge ice sheets. Glaciers are usually divided into two groups:
- Alpine glaciers, which form on mountainsides and move down slopes through valleys.
- Continental ice sheets, which spread out and cover larger areas, See Photo C.

Activities
1. What is a glacier?
2. Where do glaciers form?
3. Who are glaciologists and what have they discovered about glaciers?
4. What are the two main types of glacier?
5. Look carefully at Photo A:
   a) Use the enquiry questions to describe the glacier.
   b) Which type of glacier is shown in Photo A?
   c) Locate the glacier in Map B. Using an atlas, find the latitude and longitude for this glacier.
   d) What evidence can you find that the glacier is a popular place visited by tourists?
6. Look carefully at Photo C:
   a) Use the enquiry questions to describe the glacier.
   b) Which type of glacier is shown?
   c) What evidence can you find in the photo that this glacier is less popular with tourists?
7. Map B shows the world distribution of ice sheets and glaciers.
   a) Compare it with an atlas map of the world, and write a list naming the eleven main glaciated areas of the world.
   b) Mark and name these glaciated areas on an outline map of the world.
   c) Write a paragraph to describe the world’s distribution of glaciers.
   d) Compare Map B with a climate map of the world. Using your understanding of weather and climate, write a paragraph to explain the distribution of the world’s glaciers.
13.2 How and why do glaciers form and move?

Learning objectives
- To understand that the world’s distribution of glaciers varies through time
- To understand how glaciers form and move
- To understand what the differences are between advancing and retreating glaciers.

What is an Ice Age?
Glaciologists have discovered that global climate has changed in the past, as shown in Graph A. The climate of the British Isles, for example, has changed many times between very cold glacial, and warmer interglacial conditions. Ice Ages are when temperatures are low enough for ice to form glaciers and ice sheets. Polar ice moves into lower latitudes.

Scientists believe that there have been a number of Ice Age cycles. During the last Ice age, the world was, on average, around 5°C colder than today. Currently about 10 per cent of the Earth’s land surface is covered in glacial ice. During the last Ice Age, ice covered up to 30 per cent of land, shown in Map B.

How do glaciers form and move?
Glacial ice forms in upland or polar areas above the snowline. Here, snow and ice cover the ground throughout the whole year. It takes many years for snow to become glacial ice. As snow accumulates (gains ice), it is compressed by its own weight. Gradually, dense, hard ice forms and starts to flow down-slope under its own weight. Where more ice is gained than lost over a year, it is called the zone of accumulation. If temperatures remain low, with heavy snowfalls, glaciers advance down-slope.

If accumulation (the amount of ice gained) is greater than ablation (melting), then the amount of ice stored in a glacier increases and the glacier advances. If the ablation is greater than the accumulation then the glacier reduces in size and retreats. This occurs in the zone of ablation. The ice can move at different speeds. This creates wrinkles in the surface of the ice, forming great cracks called crevasses.

The end of the glacier is called the snout. This is where the main output from the glacier – water – is released. During the last century, most glaciers around the world have been shrinking and retreating. This is due to warmer, drier climate conditions.

Activities
1. What are ice ages and interglacials?
2. Look at Graph A.
   a) How many interglacials and ice ages have there been in the last 450,000 years?
   b) What are the lowest average temperatures during a glacial period?
   c) What are the highest temperatures during an interglacial period?
3. Look at Map B.
   a) Write a paragraph to describe the world’s distribution of ice and glaciers during the last ice age.
   b) Compare Map B with your map showing the distribution of glaciers today. Identify how it has changed.
   c) Add the distribution of ice during the last ice age to your map.
4. Write a list of the new terms introduced in this lesson. Write definitions for each of them.
5. Look carefully at Diagram D, which shows a glacier as a system.
   a) Make a copy of Diagram D.
6. a) Draw a sketch of the glacier shown in Photo C.
    b) On your sketch, label the names of zones 1 and 2, and glacial features 3 and 4.
7. Write a conclusion to your work for this lesson to explain how and why glaciers form and move.
How does ice change the world? What have you learnt?

In this unit, you have learnt:
- how ice changes the world.
- how erosion, and deposition create glacial landforms.
- to identify glacial landforms on OS maps.
- that the distribution of ice around the world changes through time.

Let’s see what you have remembered and understood.

This unit of work about glaciation has introduced you to new geographical terminology. It is important that you understand the meaning of new terms. You will be expected to use them in your future geographical studies. You should be familiar by now with all the glaciation words shown in the table below, now that you have almost completed this unit of work.

1. abrasion
2. corrie
3. outwash plain
4. glacial till
5. snout
6. striations
7. truncated spur
8. arete
9. glacial till
10. crevasse
11. plucking
12. erratic
13. snowline
14. hanging valley
15. Ice Age
16. drumlin
17. ice cores
18. ribbon lake
19. fjord
20. terminal moraine
21. interglacial
22. tarn
23. satellite images
24. repeat photography

Activities

1. Copy out Row A from the table below.
   a) Underline the word which is the odd one out.
   b) Explain why you think it is the odd one out, and what the other two words have in common.
   c) Repeat this activity for Rows B to H.

2. Make a list of all the locations studied in this unit. Make sure you have named and located each one on your world map of glaciers and ice sheets.

3. As you have discovered, glaciers change places through three processes: erosion, transportation and deposition. These three processes are occurring at the glacier shown in Photo A.
   a) Which process is likely to be occurring at positions 1, 2 and 3 on the glacier?
   b) Explain how each of these processes works.

4. Look carefully at Diagram B. Name the glacial landforms 1 to 10.

5. Look carefully at the Helvellyn map/plan and identify the glacial landforms at the following grid references:
   a) 348122
   b) 343156
   c) 332140
   d) 390185
   e) 375155

6. Melting glaciers make world news on a regular basis. C shows a political cartoon. What point is the cartoonist trying to make about how glaciers are changing?

7. Using what you have learnt in this unit, write 200 words explaining how glaciers are changing.

8. The information board in Photo D is there to help tourists to better understand the landscape, and get more out of their visit to the area. Choose a feature of glacial erosion in the Lake District and design an information board for visitors, to show how the feature was formed.

Future learning

In Unit 15 you will investigate why glaciers are melting and the consequences of this for the planet.
Lesson Plans

Unit 13 How does ice change the world?

13.1 How does ice change the world?

About the lesson
In this lesson, pupils will be introduced to glaciers including the different types of glacier and the global location of ice sheets and glaciers.

Prior learning
Pupils need to have an understanding of the varying climates around the world (Unit 4).

Learning objectives
- To understand what a glacier is
- To know where glaciers are distributed around the world
- To know the different types of glacier
- To understand what a glacier is

Key Vocabulary
Glacier – a mass of ice formed by the accumulation of snow over hundreds of years

Teaching and learning activities

Episode | Geography that you want pupils to know and understand at each episode of the lesson | Learning activities and resources to support pupil progress | Time
--- | --- | --- | ---
1 | Create a need to know
- Dramatic image or video clip of glaciers
- Introduce learning objectives | Play a dramatic video clip of glaciers to initially engage the class, for example the following drone movie of the Swiss Alps: https://vimeo.com/channels/geographyso/224112427 | 5 mins

2 | Learning objective: To understand what a glacier is
1. A glacier is a large ice mass made of snow which has been compressed over hundreds of years.
2. Glaciers form in locations where average annual temperatures are near freezing point, large amounts of snow fall during winter months, and temperatures throughout the year are not high enough to melt the previous winter’s build-up of snow.
3. Glaciologists are Earth scientists who investigate glaciers. They discover how glaciers change, and how they alter landscapes through time. | Geographical data: First two paragraphs on page 22. Activities from Student’s Book:
1. What is a glacier?
2. Where are glaciologists and what have they discovered about glaciers?
Suggested activity:
Work with pupils to analyse the dramatic photograph of the Perito Moreno Glacier. Show pupils the location and context of the glacier, following it from source to snout, using Google Earth. This includes some amazing 360° images of the glacier.
Both Google Earth and Image A in the Student’s Book demonstrate people’s fascination with glaciers. Pupils can use enquiry questions to describe the glacier.
Perito Moreno is a world heritage site: http://whc.unesco.org/en/list/145 | 10 mins

3 | Transition
Knowing about the different types of glacier can give a context to looking at how they are distributed around the world. | Review pupils’ answers to see if they understand what the different types of glacier are. | 5 mins

4 | Learning objective: To know where glaciers are distributed around the world
7. The eleven main glaciated areas of the world.
   a. Pupils should locate the distribution of ice around the world on a separate map outline.
   b. Ice sheets cover most of Greenland and Antarctica. Most glaciers are found in the Arctic Circle, although some are found in mountainous areas including the Andes and the Himalayas.
   c. Glaciers form in locations where average annual temperatures are near freezing point such as polar regions and land at high altitude. | Geographical data: Map B. Information on page 22. Activities from Student’s Book:
7. Map B shows the world distribution of ice sheets and glaciers.
   a. Compare it with an atlas map of the world and write a list naming the eleven main glaciated areas of the world.
   b. Mark and name these glaciated areas on an outline map of the world.
   c. Write a paragraph to describe the world’s distribution of glaciers.
   d. Compare Map B with a climate map of the world. Using your understanding of weather and climate, write a paragraph to explain the distribution of the world’s glaciers. | 10 mins

Plenary
Review the learning objectives and share with pupils their progress.

Review pupils’ knowledge and understanding of what they have covered in the lesson. | 5 mins
1. Compare the map of the world with an atlas.
   a) Mark and name the 11 glaciated areas on the map.
   b) In which two areas of the world are the largest areas of ice located?

   __________________________________________________________________________

   c) What type of glaciers form in these two areas?

   __________________________________________________________________________

   d) The other 9 glaciated regions are much smaller and seem to be distributed more randomly around the world. Compare their distribution with a world physical map. Now explain their distribution.

   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________

   e) What type of glaciers do you think form in these areas?

   __________________________________________________________________________

2. Think back to your work on weather and climate. Consider which factors affecting temperature might influence this distribution of glaciers around the world. Explain how these factors have led to this distribution.

   __________________________________________________________________________
   __________________________________________________________________________
   __________________________________________________________________________

Add a photograph of your glacier here

**Fact file: one of the world’s major glaciers**

Fill in the table below to create a fact file about one of the world’s major glaciers. You will need to carry out research on the internet to find a photograph and information about the glacier in order to fill out the table.

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<table>
<thead>
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<th>Longitude</th>
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</table>

<table>
<thead>
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<th>Type of glacier</th>
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</table>

<table>
<thead>
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<th>Size of glacier</th>
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</table>

<table>
<thead>
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<th>How the size of the glacier is changing</th>
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<table>
<thead>
<tr>
<th>Interesting facts</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

Here is a website to get you started:  
Glaciers online:  
http://www.swiseduc.ch/glaciers/  
An image search using Google gives you lots of choice.
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