

Secondary School Discovery Pack



TEACHER'S GUIDE

Welcome to Dynamic Earth!

This guide has been designed to complement the **Secondary School Discovery Pack** to help you get the most out of your experience with us.

Each gallery within the Dynamic Earth exhibition has been given a dedicated section in the Discovery Pack to give your pupils the opportunity to:

- Explore gallery content in greater depth through descriptions and short exercises
- Work individually and in teams on exercises
- Have fun through exploratory learning

This Discovery Pack has been designed to help your pupils engage with gallery content and think critically about the material presented. It is curriculum-linked to meet the needs of several *Curriculum for Excellence Experiences and Outcomes* and *Learning for Sustainability* themes.

The following sections provide you with an overview to each gallery and the activities designed for your pupils within their discovery pack.



For curriculum links, see the last section of this pack.

We hope you find these resources useful in enhancing your experience and we would welcome your feedback to make them even better. Please email enquiries@dynamicearth.co.uk if you would like to share your thoughts with us.

For more ideas and resources please visit our website www.dynamicearth.co.uk/learning

Timings indicative of how long to spend in each gallery for a 90 minute experience. *denotes fixed time show.

YOUR JOURNEY THROUGH DYNAMIC EARTH STARTS HERE



Scotland's Time Lords

The purpose of this gallery is to:

- Tell the story of the heritage of our planet in exciting and innovative ways.
- Bring to life the characters who forged modern earth science thinking.
- Put these ideas into the context of the modern world.

Specifically, gallery content aims to highlight to your pupils the ideas of:

- James Hutton, Charles Lyell, Ben Peach, John Horne, Arthur Holmes and Alfred Wegener – Geologists who revolutionised our understanding of some of the fundamental principles of earth and environmental science.
- The emergence of Plate Tectonics as a fundamental paradigm of earth and environmental science.

Within their Discovery Packs, pupils are asked to listen to the talking portraits around the gallery.

- Can you identify the key Time Lords in the gallery and give a description of what they contributed to our geological heritage?

Answers:

Charles Lyell -> *I am the great communicator.(I share ideas with others)*

James Hutton -> *I discovered 'Deep Time'. The idea the Earth is really old!*

Ben Peach and John Horne -> *We worked out how mountains are formed.*

Arthur Holmes -> *I found out a way to uncover the age of rocks.*

Marie Tharp -> *I mapped the sea floor, discovering deep ocean mountains and trenches.*

- Name the 'Super Continent' pictured.

Answer: *Pangea*

- Draw what scientists will predict the continents will look like in 250 million years time using the 'Puffersphere'.

Answer: *The continents are predicted to drift back together again to form another 'super continent'.*

YOUR VISITOR SERVICES ASSISTANT WILL LET YOU KNOW WHEN
YOU CAN BOARD THE TIME MACHINE TO EXIT THIS GALLERY.

The Time Machine

The Time Machine will take you back 13.7 billion years into the past using audio visual special effects. The time machine highlights the importance of 'Deep Time' – the concept Hutton explored in 'Scotland's Time Lords' – and its contribution to our understanding of earth and environmental science.

YOU WILL BE IN THE TIME MACHINE FOR 90 SECONDS. PLEASE INFORM YOUR VISITOR SERVICES ASSISTANT IF THERE IS ANY PUPIL/ACCOMPANYING ADULT WHO DOES NOT WANT TO USE THE TIME MACHINE: THEY WILL BE ESCORTED SAFELY BY A MEMBER OF OUR TEAM 13.7 BILLION YEARS BACK IN TIME VIA A STAIRWELL.

How It All Started

As the Time Machine doors open, you will be met by a Visitor Services Assistant to take you on board the observation deck of a spaceship. An AV will begin shortly providing an overview to the formation of our universe and the structure of our planet.

Restless Earth

Your Visitor Services Assistant will take you into the next gallery: a volcanic eruption and earthquake simulator with supporting AV footage. The gallery highlights the role of continental processes explored initially in 'Scotland's Time Lords' in greater depth: the birth and death of oceans, the creation of mountains, volcanic eruptions and earthquakes.

PLEASE BE ADVISED THAT A MOVING FLOOR AND STROBE LIGHTING ARE USED IN THIS GALLERY. PLEASE SEEK ASSISTANCE FROM YOUR VISITOR SERVICES ASSISTANT SHOULD SOME PUPILS/ADULTS NEED TO BYPASS THIS GALLERY.

Shaping the Surface

Your Visitor Services Assistant will lead you on into your helicopter flight across glaciated landscapes of Scotland and Norway. This gallery uses AV footage to convey the power of ice and running water to shape the landscapes of Scotland. Processes of erosion, transportation and deposition are considered. At the end of this AV, your Visitor Services Assistant will introduce the next gallery to you which explores the processes of evolution and extinction.

PLEASE BE AWARE THAT THE NEXT FOUR GALLERIES IN THE EXHIBITION ARE SELF-GUIDED. SHOULD YOU REQUIRE ANY ASSISTANCE FROM THIS POINT YOU CAN FIND A VISITOR SERVICES ASSISTANT THROUGH THE DOORS IN FRONT OF YOU AS YOU ENTER THE CASUALTIES AND SURVIVORS GALLERY, OR ALTERNATIVELY IN THE 4D GALLERY LATER ON IN THE EXHIBITION.

Casualties and Survivors

The next four galleries in the exhibition focus heavily on interactive learning experiences. Pupils will be encouraged to learn through exploration of the galleries interactive features, exhibits and AV footage through both independent and collaborative learning.

Within this gallery specifically, pupils are encouraged to learn about:

- Early life on our planet: where it began, when it began and what it looked like.
- The process of evolution and how organisms have changed, adapted and become more complex across time.
- How animals that cannot adapt quickly to changes in their environments may become extinct.
- The influence of natural selection in earth and environmental science.
- The multiple causes of extinction on our planet.

Within their Discovery Packs, pupils are asked to:

- Complete the evolution timeline.

Answers: See next page

- Complete the ingredients for life equation.

Answers: Carbon + Water + Nitrogen + Sulphur + Phosphorus = Life

- Write down the causes and impacts of the three major extinctions listed.

Answers:

440 Million Years Ago – Extreme Ice Age, about 50% of animal species died out completely.

245 Million Years Ago – Reduction in living space, over 3million years 96% of animals died out in the biggest extinction the world has ever known.

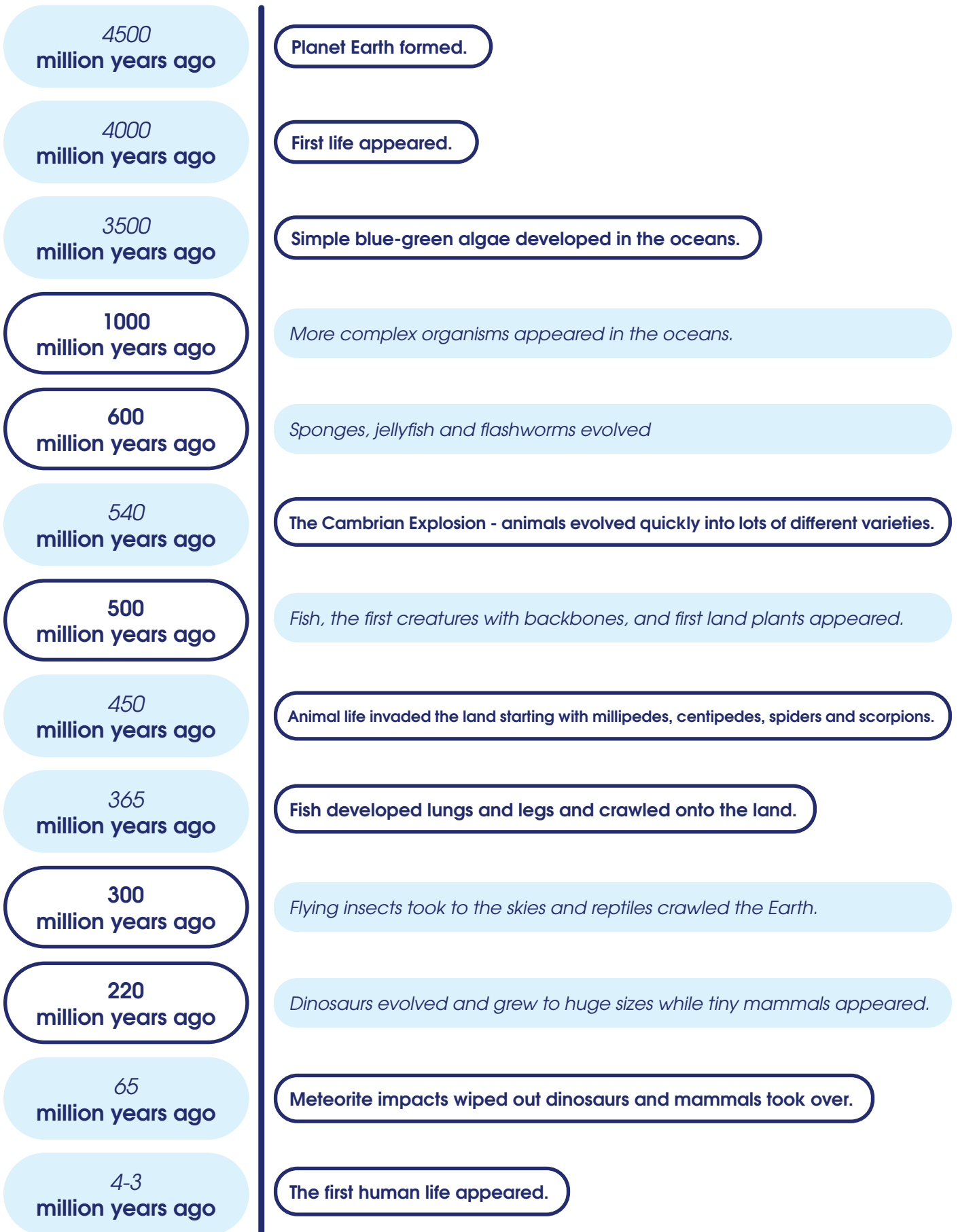
65 Million Years Ago – Chain reaction of extinction brought on by a meteorite strike, this was the extinction which eliminated the dinosaurs.

- Think about how some scientists argue that we are currently in the middle of another extinction – making a 6th great extinction on our planet. Pupils are asked whether they agree with this statement or not and why.

Key points to mention: *Climate change, unsustainable use of land, water and energy, creating conditions that make habitats inhospitable etc.*

Evolution Timeline

Answers:



Discover the Deep

The purpose of this gallery is to provide an overview of Scotland's marine heritage and habitats, and how the deep ocean is a vast and vital system supporting life on Earth.

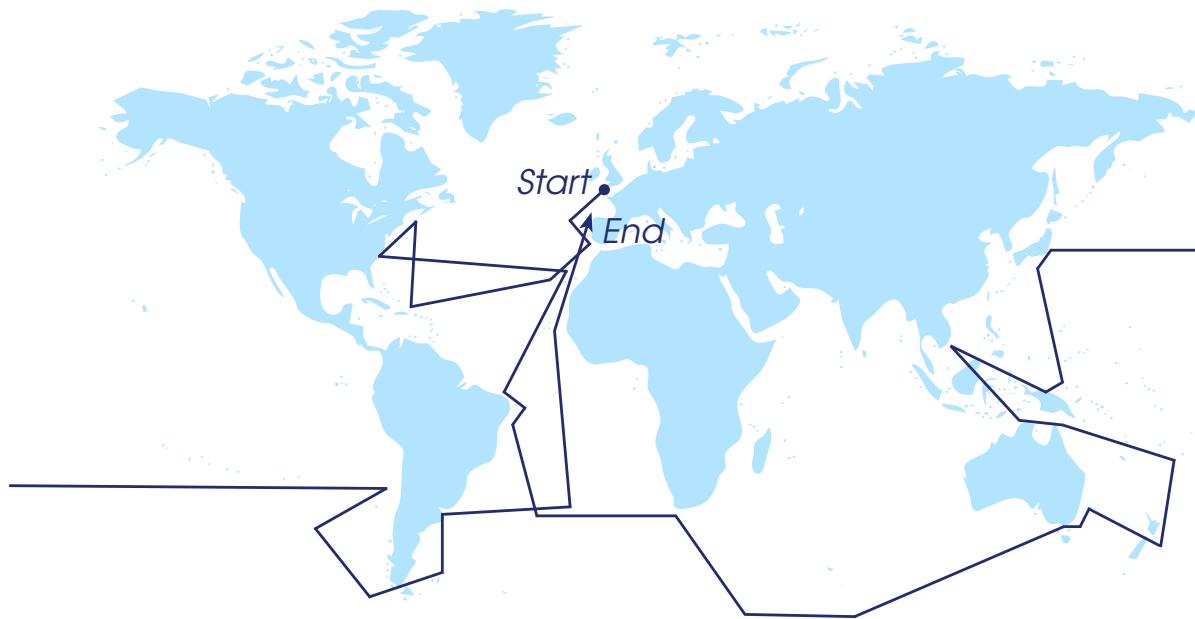
Explore our ocean resources from Dynamic Earth Online.



Within their Discovery Packs, pupils are asked to:

- Draw the route of HMS *Challenger* on the map.

Answer:



- Can you label each of the depth zones on this diagram?

Answer: (Top to bottom) Sunlight, Twilight, Midnight, Abyssal, Hadal Deep.

- Complete the creature profiles in the specimen cabinet.

Answers:

Name: Shum's Crab, Depth: 500 fathoms, Year: 1875

Name: Telescope Octopus, Depth: 320 fathoms, Year: 1872

Name: Faceless Cusk Eel, Depth: 2440 fathoms, Year: 1874

- Describe the main threats to our ocean.

Answers:

Bottom Trawling -> Dragging heavy nets across the floor to catch fish can be damaging to everything in the trawler's path, especially cold-water coral reefs which can take decades to recover.

Deep-Sea Mining -> There are lots of metals (such as copper and gold) in the ocean floor, but plans to mine it could cause irreversible damage to the deep-sea ecosystem.

Ocean Acidification -> Because the ocean is absorbing lots of carbon dioxide, this means it is getting more acidic. This means that creatures with hard shells are finding it difficult to survive, putting entire habitats at risk.

Drilling for Oil -> Extracting oil from beneath the seabed provides us with fuel, but comes with the risk of oil spills, which can have a big impact on the ocean ecosystem.

Polar Extremes

The purpose of this gallery is to provide a broad overview of the similarities and differences between the Arctic and Antarctic regions of planet Earth. More specifically, the gallery highlights the importance of the North and South Pole as natural laboratories of climate change.

Through exploring the gallery, pupils should have a greater awareness of:

- The diversity and way of life of various organisms in the polar regions.
- The impacts of climate change on melting polar ice.
- The impact of climate change on polar wildlife.
- By examining cores for bubbles of air, scientists can find out what greenhouse gas quantities have been in our atmosphere in the past. Ice core evidence supports that human beings are changing Earth's atmosphere; which we know is the driver for a warming world and climate change.
- The importance of paleoenvironmental proxies (polar ice cores) in understanding past environmental conditions.

Within their Discovery Packs, pupils are asked to:

- Find out the 4 main reasons why the polar regions are cold.

Answer:

Reason 1 – The 'tilt' of the Earth's axis means that during the winter months both the Arctic and Antarctic receive very little solar energy.

Reason 2 – The Sun's solar rays have a greater distance to travel before reaching the polar regions in comparison with locations closer to the equator. The longer journey means more energy is absorbed by the atmosphere.

Reason 3 – The angle at which the sun's energy hits the poles means that the energy is spread over a larger area than areas closer to the equator.

Reason 4 – The Albedo (the reflectivity of a surface) is much greater at the poles than at the equator. Hence, more energy is bounced back into the atmosphere than absorbed.

4D Adventure

This gallery is a 4D Cinema. You will meet a Visitor Services Assistant in this gallery who will explain to you what happens next and when the next 'flight' is due to depart. The area in which you wait for the flight is called the 'Arctic Base'. This is the boarding gate for your flight to the 'Tropical Rainforest'. The pupil Discovery Pack activity this gallery relates to the climate maps and film you can see on the screens around you in this area. In the Discovery Packs, pupils are encouraged to think about what they think the climate will be like in two contrasting biomes: the Tundra and the Sahara.

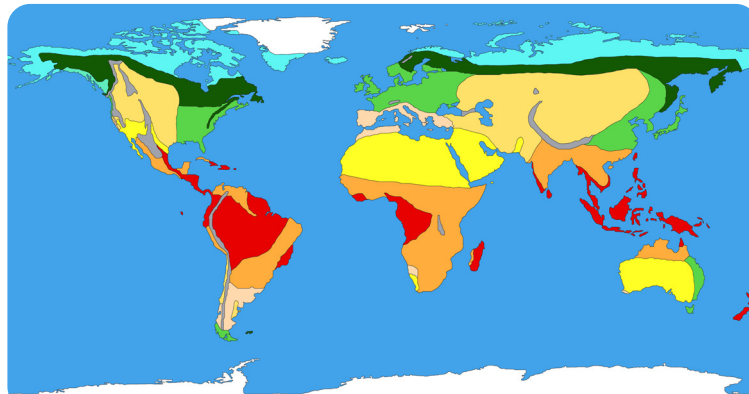
Within this gallery and the 4D film, your pupils will:

- Explore the rich diversity of living things found throughout the world's different biomes.
- Develop and broaden their understanding of how organisms are interrelated and how species depend on one another and on the environment for survival.
- Discover where these amazing biomes are found and why they vary across the globe.
- Quiz themselves on big questions such as "why is there life on Earth and not on Mars?" and discover what makes our world so special .

Within their Discovery Packs, pupils are asked to:

- *Look at the map on the wall and use it to help them label the different biomes of Earth.*

Answer:



- | | |
|---|---|
|  Savanna Grassland |  Desert |
|  Tropical Rainforest |  Mediterranean |
|  Temperate |  Alpine |
|  Boreal Forest |  Tundra |
|  Temperate Grassland/Desert |  Polar |

Tropical Rainforest

When you leave the 4D flight, you will be met by a Visitor Services Assistant who will be your Rainforest guide. They will engage your class in the wonders of the tropical rainforest biome, exploring the rich diversity of life in these unique environments, the threats facing them and the action we can all take in our everyday lives to protect them.

Within their Discovery Packs, pupils are asked to:

- Complete the spider diagram to show as many different reasons as to why rainforests are deforested.

Answer: *Could include but are not limited to: logging for furniture, logging for paper, medical/medicine research, hydro-electric power, cattle ranching, urban developments, shifting cultivation.*

- *How can deforestation contribute to global climate change?*

Key points to mention: *Stored carbon released into atmosphere as CO₂, removes the ability to absorb CO₂.*

Continue your learning through Dynamic Earth Online where we have a range of experiments and crafts, climate change science and stories, short videos, thought-provoking reading and more!



Curriculum Links

Science

I can sample and identify living things from different habitats to compare their biodiversity and can suggest reasons for their distribution. **SCN 3-01a**

I understand how animal and plant species depend on each other and how living things are adapted for survival. I can predict the impact of population growth and natural hazards on biodiversity. **SCN 4-01a**

I can use my knowledge of the different ways in which heat is transferred between hot and cold objects and the thermal conductivity of materials to improve energy efficiency in buildings or other systems. **SCN 3-04a**

By investigating renewable energy sources and taking part in practical activities to harness them, I can discuss their benefits and potential problems. **SCN 3-04b**

I can explain some of the processes which contribute to climate change and discuss the possible impact of atmospheric change on the survival of living things. **SCN 3-05b**

By using my knowledge of our solar system and the basic needs of living things, I can produce a reasoned argument on the likelihood of life existing elsewhere in the universe. **SCN 3-06a**

By researching developments used to observe or explore space, I can illustrate how our knowledge of the universe has evolved over time. **SCN 4-06a**

I have collaborated with others to find and present information on how scientists from Scotland and beyond have contributed to innovative research and development. **SCN 3-20a**

I have researched new developments in science and can explain how their current or future applications might impact on modern life. **SCN 4-20a**

Having selected scientific themes of topical interest, I can critically analyse the issues, and use relevant information to develop an informed argument. **SCN 4-20b**

Social Studies

I can make links between my current and previous studies, and show my understanding of how people and events have contributed to the development of the Scottish nation. **SOC 3-02a**

I have developed a sense of my heritage and identity as a British, European or global citizen and can present arguments about the importance of respecting the heritage and identity of others. **SOC 4-02a**

Having investigated processes which form and shape landscapes, I can explain their impact on selected landscapes in Scotland, Europe and beyond. **SOC 3-07a**

I can explain how the interaction of physical systems shaped and continue to shape the Earth's surface by assessing their impact on contrasting landscape types. **SOC 4-07a**

I can identify the possible consequences of an environmental issue and make informed suggestions about ways to manage the impact. **SOC 3-08a**

I can discuss the sustainability of key natural resources and analyse the possible implications for human activity. **SOC 4-08a**

I can investigate the climate, physical features and living things of a natural environment different from my own and explain their interrelationship. **SOC 3-10a**

I can develop my understanding of the interaction between humans and the environment by describing and assessing the impact of human activity on an area. **SOC 4-10a**

I can identify threats facing the main climate zones, including climate change, and analyse how these threats impact on the way of life. **SOC 4-12a**

I can use specialised maps and geographical information systems to identify patterns of human activity and physical processes. **SOC 4-14a**