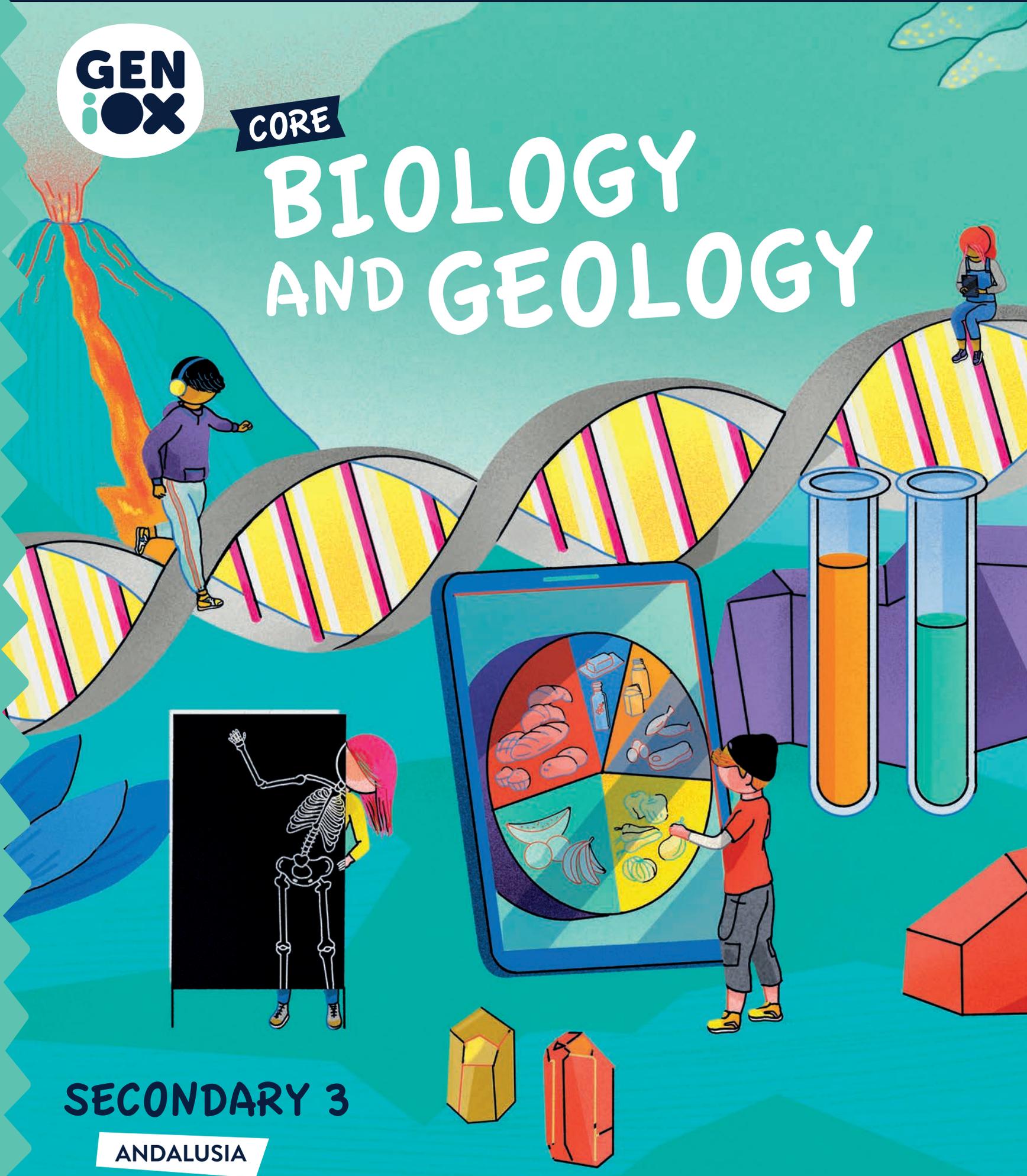




CORE

BIOLOGY AND GEOLOGY



SECONDARY 3

ANDALUSIA

1 The Earth's surface

¹**sculpt**: give form to something.

²**temperate**: mild.

³**ridge**: high pointed area along the top of a mountain.

Relief is the shape of landforms on the Earth's surface. Over millions of years, internal and external forces have worked to form and change the mountains, valleys, plains and plateaus.

New landforms are created by activity within the Earth's interior. Then, these landforms are slowly changed by external processes in the Earth's atmosphere and the hydrosphere. The **landscape** of an area is characterised by the relief, vegetation and the effects of human activity there.

Differences in relief

Climate, in particular temperature and precipitation, is a key factor in **sculpting**¹ the Earth's diverse landforms.

Climate influences...

- the conditions that produce ice in glacial areas and rivers in **temperate**² areas.
- the presence of vegetation and humans.

However, there can be a great variety of landforms in the same climate zone. One factor is the **type of rocks** in the zone and its **structure** and **geological history**.

Hard and resistant rocks, such as granite and quartzite, form sharp **ridges**³. Soft rocks, such as clay or chalk, erode more easily forming smooth shapes. This makes it easier for vegetation to grow. This variation is called **differential erosion**.



Las Cárcavas de Patones and La Pedriza are approximately 40 km apart.

CLIL activities

1 In your notebook, make a chart to show if these natural forces are internal or external: *volcanic activity, floods, avalanches, earthquakes*. With a classmate, add more.

2  Listen and correct the false sentences. Compare your sentences with a classmate.

3  Look at the photos above. With a classmate, describe the differences between the landscapes. Use these words:

Round, sharp, deep, high, soft clay, hard rocks, vegetation

4 With a classmate, discuss three natural forces that make this ocean cliff erode.



2 External geological agents and processes

External geological agents cause changes in the Earth's relief. This occurs through the force of **water**, **ice** and **wind**. Vegetation and human activity can also play an important role.



Water is the most common and powerful external geological agent of erosion because it's constantly moving through the Earth's water cycle. On the cold mountain tops and in dry deserts, there is very little liquid water. In these areas, ice and wind are the primary agents of erosion.

When the Sun's energy reaches the Earth, it warms the atmosphere. This heat generates wind. **Gravity** causes the water in rivers, glaciers and underground to move to the sea. Gravity is also responsible for the **tides**¹.

External geological processes are actions **exerted**² on the relief by external geological agents. The processes, in order, are **weathering**, **erosion**, **transportation** and **sedimentation**.

Weathering

When rocks deep within the Earth come to the surface, they are **exposed** to environmental conditions that cause them to **disintegrate**. Weathering is caused by wind, water, ice, oxidation, changes in temperature and living things.

There are different types of weathering:

Physical weathering occurs when rocks break. It can happen when water enters cracks in the rock. As water turns to ice, it expands and breaks the rock.

Chemical weathering occurs when minerals **dissolve**³ or chemically change into other minerals. This process is responsible for the formation of caves.

Biological weathering occurs when plants and animals **alter**⁴ rocks physically and chemically.

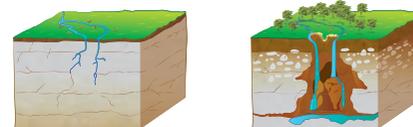


¹**tide:** regular rise and fall in sea levels.

²**exert:** apply.

³**dissolve:** when a solid mixes with a liquid.

⁴**alter:** modify.



Caves are formed by the dissolution of limestone.



Plants can cause physical and chemical weathering.

CLIL activities



5  Answer the questions in your notebook. Then compare your answers with a classmate.

- What natural agents change the Earth's relief?
- Explain the Sun's role in weathering.

6  Look at the picture of a tree breaking a rock. With a classmate, describe how this can happen. Is this process fast or slow?

7  Listen and identify the four agents that shape the relief.

Erosion, transportation and sedimentation

¹**tear:** damage by pulling apart.

²**collide:** crash against.

³**modify:** change.

Erosion is the gradual destruction of the Earth's surface. Weathering **tears**¹ away fragments of rock and soil, transporting them from one place to another.

Transportation is the journey eroded materials make. As the materials travel, they **collide**² and rub against solid objects. In the process, the rocks become polished. This process is known as **abrasion**.



Sedimentation occurs when eroded materials stop moving and are deposited and cemented. This process takes place in low areas in the Earth's surface known as **sedimentary basins**. Over time, the eroded material is compressed and transforms into sedimentary rocks.

Each external geological agent transports and **modifies**³ materials in a different way. By analysing sedimentary rocks, we can identify the agent that transformed and deposited it.

For example, as sediments travel through water, they become smooth and round through the process of traction. Wind and ice give sediments a different shape. In addition, wind and water group sediments by grain size.

CLIL activities

8 Listen to the four statements. In your notebook, write *erosion*, *transportation* or *sedimentation*.

9 Draw a flow chart to summarise the processes you can see in the diagram. Share it with a classmate.

10 Research and compare two different landscapes in your local area. Find out which external geological agents change the relief. Write a report and present it to the class.

3 Surface water

Rivers are the biggest sculpting force that shape the Earth's relief. River channels are **concave**¹ with different parts:

In the **upper course** of a river, the land is mountainous and **steep**². Erosion and transportation happen here. The river erodes the land into a V-shaped valley.

In the **middle** and **lower course**, the river travels slower because the land is flatter. The river loses its energy and deposits the materials it carries.

Rivers give a round shape to the sediments they carry. Rivers also classify sediments according to their grain size. Larger sediments are deposited first. Silt and clay-sized sediments are deposited last.

River relief

Waterfalls and **rapids** are formed in the **upper course** of the river. They are common when the riverbed changes suddenly from hard rock to soft rock. In the **lower** and **middle course**, we can find **meanders**, which are curves and turns in the river's channel. The **mouth** is where the river enters a lake, larger river or ocean. The sediments carried by the river are deposited in the mouth, forming deltas and estuaries.

Deltas	Estuaries
A delta is a landform created by the sediment deposited by the river as it enters the ocean. They can be found on sea and ocean shores where the tides are low.	An estuary is a partially enclosed body of water at a river mouth. They form when sea water rises and mixes with river water. As the river deposits its sediments into the estuary, the land changes. They're normally found where tides are high.

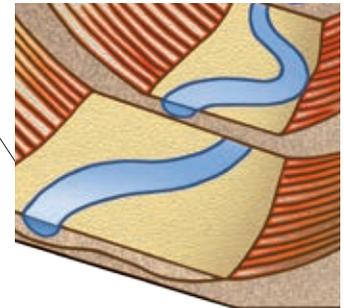
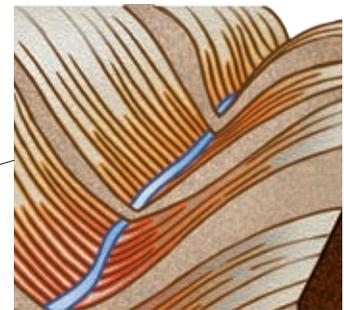
Torrents and deserts

In desert landscapes, we can find reliefs that have been sculpted by the fast moving water of **torrential**³ rains. Erosion happens quickly because of several factors.

- There's an absence of plants. This is normal in desert areas because water is **scarce**⁴. Plants help to protect land from floods and erosion.
- Steep slopes prevent water infiltrating the rock. The water moves quickly towards stream channels.
- Desert soil is made up of sand and clay, which erode easily.

CLIL activities

- 11  Listen and answer the questions in your notebook.
 - a. What's the longest river in the world? How long is it?
 - b. What's the widest river in the world? How wide is it?
 - c. What's the deepest river in the world? How deep is it?
- 12  With a classmate, compare the upper course of a river to its middle and lower course. Where are floods most likely to occur?
- 13 Draw a Venn diagram to compare an estuary and a delta.
- 14 Write a paragraph about how water shapes desert relief. Use these words: **torrential rain**, **flash floods**, **overflowing water**, **stream channels**



Parts of a river

¹**concave**: curving inwards.

²**steep**: rising or falling sharply.

³**torrential**: falling fast in abundant quantities.

⁴**scarce**: insufficient.



The Tabernas Desert in Almería receives very little rainfall, approximately 200 L/m² per year.

4 Underground water

¹**permeable:** allows liquids to move through it.

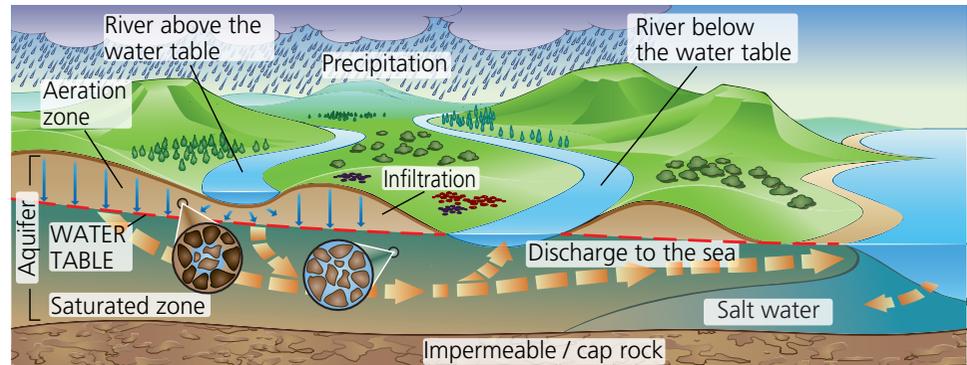
²**saturate:** completely wet.

³**pore:** small hole on a surface.

⁴**saline:** containing salt.

Aquifers are underground containers of water made of rock or sand. Water is stored inside the holes and cracks of the rock.

- Aquifers are **porous**, which means they have pores that can fill up with water, just like a sponge.
- They are also **permeable¹**, which allows for the water inside to circulate.



Rainwater or melted snow travels down into the ground until it reaches a **permeable layer**. The **saturated²** area of the aquifer is where the pores are filled with water. Above this there's another layer in which the **pores³** are filled with air. It's known as the **unsaturated area**.

Many people **rely** on the fresh water found in aquifers. They build **wells** to **extract** the water from the ground.

When people take out too much water before precipitation can refill it, the aquifer suffers from **overexploitation**.

refilling – discharging = variation in amount of water stored in aquifer

Overexploitation can cause wells to dry up, which can allow an **intrusion of sea water**. This makes the water stored in the aquifer more **saline⁴** and unusable for drinking and irrigation.

CLIL activities

15 🗣️ With a classmate, prepare a short presentation about how aquifers work. Organise your ideas in your notebook.

16 🎧 Listen and answer the questions about fossil water.

- What is fossil water?
- Is fossil water a renewable resource?
- What will happen to fossil water aquifers when we take out all the water inside?

17 📄 **STEAM TASK** Make an information poster about water consumption in Spain. Research these questions: Where does Spain and your region get its water supply? How many dams and reservoirs are there? How much water does one person use every day?

5 Karsts

Karst is a **distinctive**¹ type of landform formed by underground water that dissolves soluble rocks. Carbonate rocks such as limestone **undergo**² a special type of chemical weathering known as **carbonatisation**.

On the surface and the interior of karst landscapes, we can find a range of shapes such as caves, springs and sinkholes.



Torcal de Antequera, Málaga.



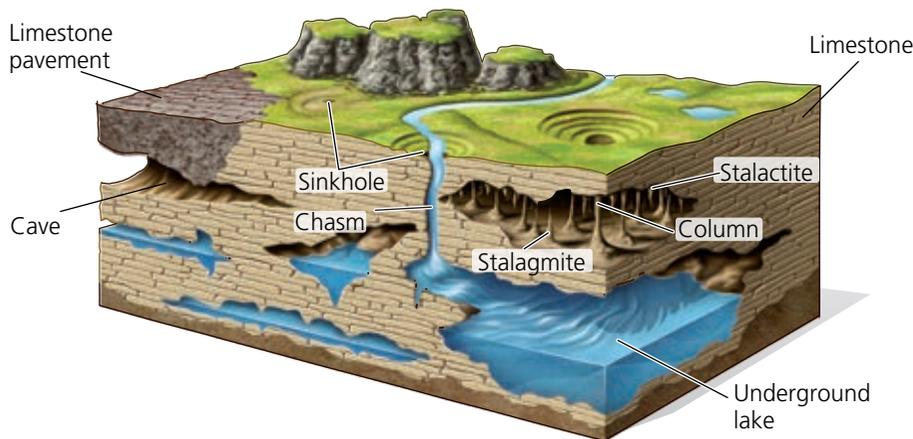
The Caves of Nerja, Málaga.



Torca de Lobo, Cuenca.

The dissolved carbonate can **precipitate**³ underground in caves as the water loses some of the CO_2 . This process leads to the formation of **stalactites** and **stalagmites**.

Formations of karst modelling



- ¹distinctive:** different and easily noticed.
- ²undergo:** experience.
- ³precipitate:** create a solid from a solution.

CLIL activities

18 Listen and answer the questions in your notebook.

- What kind of rock is limestone? What's it made of?
- What happens to limestone in water?
- Why does limestone weather quickly?

19 Find out more about how stalactites and stalagmites are formed. Share your research with a classmate.

20 **STEAM TASK** Make your own karstic model using plasticine. Include the formations shown in the diagram.

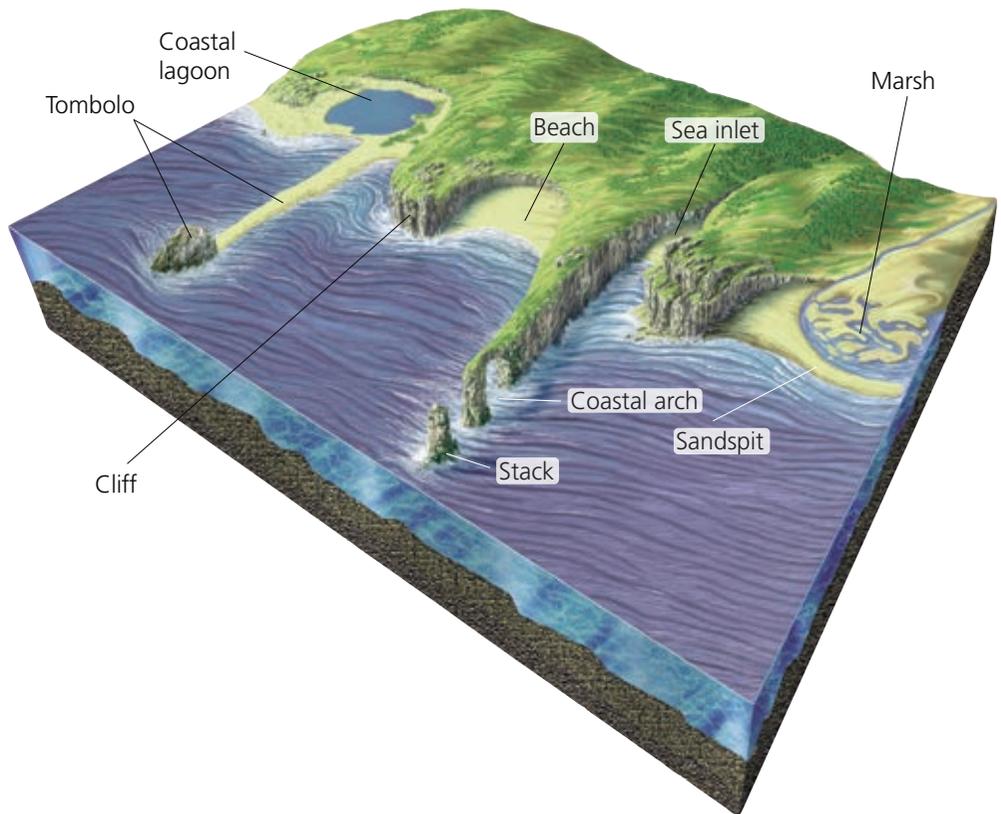
6 Coastal reliefs

¹dynamic: characterised by constant change.

²crash: hit hard.

³isolate: separate.

Coastal landscapes are highly **dynamic**¹. Powerful ocean waves **crash**² against the land. Rivers deposit sediments as they join the sea, forming deltas and estuaries. Even human activity changes the landscape. We can observe all of these factors at play on **beaches**.



Landforms created by erosion

Cliffs and **abrasion platforms** are the main shapes created by erosion. We can also find **arches** and **stacks**.

Landforms created by deposition

Beaches, sand dunes and **tombolos** are formed by the deposition of sediments. Tombolos are narrow stretches of land that connect islands to the coast. When a tombolo **isolates**³ a bay from the open sea, they form a lagoon.

Waves are commonly caused by wind and are particularly powerful during storms. **Tides** constantly pull and push the sea away and towards the coast. **Drift currents** travel parallel to the coast. When drift currents meet an obstacle, they stop and deposit materials they're carrying.

Types of coastal reliefs

The coast of Spain is 6 000 km long and displays contrasting characteristics. The **Atlantic** coastal regions show the erosive effects of strong waves and currents produced by the Atlantic Ocean. In these regions, we can find high cliffs and rivers ending in estuaries. The **Mediterranean** coast and **the Gulf of Cádiz** have fewer waves and currents, resulting in long sandy beaches. Here, the rivers form deltas where they meet the sea.

CLIL activities

- 21** Look at the diagram and identify coastal landforms formed by erosion and by deposition. Choose an example of each to explain how it forms to a classmate.

- 22** Listen and answer the questions in your notebook.

- What is a tsunami?
- What causes most tsunamis?
- How tall can they be?
- How fast can they travel?

- 23** With a classmate, research and make a fact sheet of the advantages and disadvantages of building a sea wall.

8 The power of ice



Erosive activity of ice



'slope': inclined surface.



Glaciers are thick bodies of ice that cover a large area of land. They're found in the North Pole and South Pole as well as in high mountain ranges. Glaciers form as snow accumulates on one place over hundreds of years. This snow becomes compacted by its own weight, turning it into ice. Glaciers store about 70% of the Earth's freshwater supply.

Gravity and the glacier's own weight keep them constantly moving down the mountain **slopes**¹, just like a flowing river. However, most glaciers only move about 25 centimetres per day because they are so large and heavy.

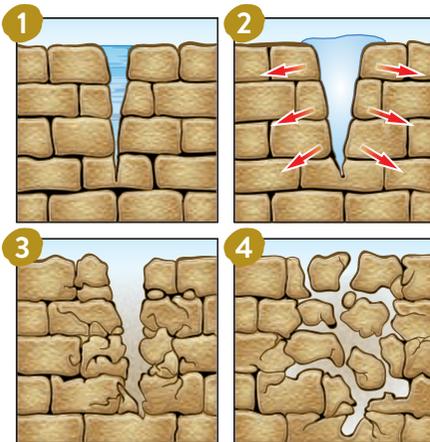
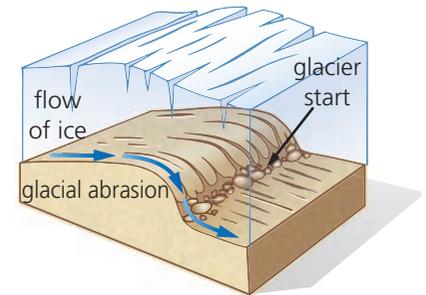
There are two major categories of glaciers.

- **Continental glaciers** form on continental surfaces, cover large areas and are several kilometres thick. They are also called ice sheets or ice caps.
- **Alpine glaciers** are found in high mountain valleys.

Ice: erosion, transportation, sedimentation and modelling

As glaciers move, they transport rocks and sediment. This scratches and erodes the surface of the land underneath it. This is called **glacial abrasion**.

Rock glaciers are landforms that occur when glaciers move down the mountain and mix with large masses of rock and debris. This creates a thick layer of rocky material which covers the ice.



Cryoclasty process

Types of glacier modelling

Cirques are bowl-shaped valleys that are formed by glaciers as they erode the mountain landscape. The **ablation zone** is the lower part of the glacier that melts or breaks off as it moves into warmer areas. A **moraine** is the accumulation of rocks and soil left behind by the glacier.

Periglacial modelling

Rocks can fracture when water enters the cracks and then repeatedly freezes and thaws. This is known as gelifraction or cryoclasty.

CLIL activities

27 In your notebook, make a flow chart to show how glaciers are formed and can shape the relief.

28 Listen to the students talking about glaciers. What mistakes do they make?

29 With a classmate, use the diagram to describe the process of cryoclasty. Use these words.

First over many years this causes

30 Research fjords and their relationship to glaciers. Write a short report.

9 Living things and relief

The biosphere is the layers of the Earth where organisms exist. It's made up of the lithosphere (the solid surface), the hydrosphere (the water) and the atmosphere (the air). These three parts interact so that the planet is able to support life.

Living things and the atmosphere

The Earth's original atmosphere was very different from the one we have today. It contained more CO₂ and less O₂. Many factors helped it evolve.

- **Cyanobacteria**¹, algae and plants carried out **photosynthesis**, which reduced the levels of CO₂ and increased the O₂ in the atmosphere. Oxygen contributes to the chemical weathering experienced by many rocks rich in iron.
- Plants and microorganisms **stored CO₂** in the geosphere as coal and oil.
- **Limestone rock** formed with the help of organisms with skeletons and carbonate shells, such as corals, red algae, molluscs and calcareous plankton.

Living things and the ground

Our planet changed dramatically when it started to be **colonised**² by lichens and plants. These organisms helped form the soil we know today. Animals living in soil help air enter into it. This air, with the help of water filtering into the ground, increases the weathering of rock.

Humans and their geological impact

Humans have become the main agent modelling the Earth's relief. The construction of **cities, roads, reservoirs, mines and quarries** has a great transforming impact. Humanised landscapes are now all over the planet while natural landscapes are mainly found in **uninhabitable**³ areas.

Human activity affects the dynamics of external agents. **Water reservoirs** accumulate sediments that are unable to continue their eroding activity downstream. **Deforestation** exposes the ground, which increases erosion and desertification. **Global warming** alters glacier and coastal dynamics. It also increases extreme phenomena, such as hurricanes and floods.

CLIL activities

- 31  With a classmate, look at the photos and discuss how human activity has changed the landscape.
- 32  Listen to the report and answer the questions in your notebook.
- 33 Research carbon footprint. Discuss what you find with a classmate.
- 34 In pairs, make a poster showing how we can reduce our carbon footprint at home.
- a. What three human activities are mentioned.
 - b. What does *Anthropocene* mean?
 - c. How long will human impact on the landscape last?

¹**cyanobacteria:** division of prokaryotic microorganisms related to the bacteria but capable of photosynthesis.

²**colonise:** live or grow in large numbers in a particular area.

³**uninhabitable:** a place where life cannot occur.

