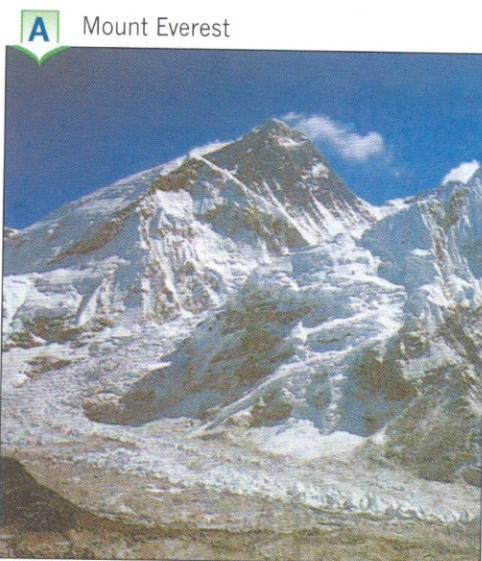


What is weathering?

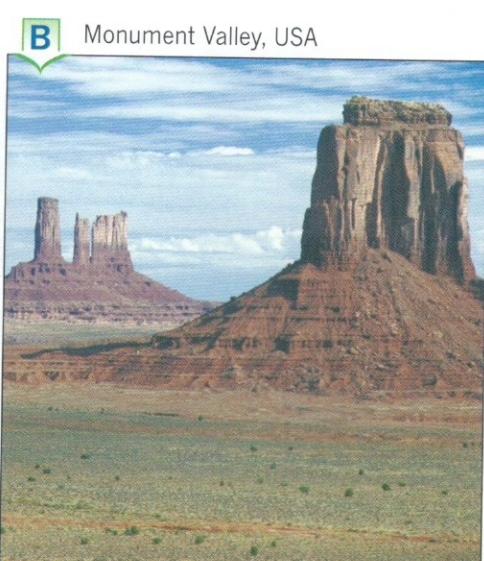
There is a great variety of different scenery in the world. Some places are mountainous, some are flat, some can be described as spectacular and others simply as interesting. Geographers call the scenery of a place the **landscape**. Some examples of the world's landscapes are shown in photos A, B and C.

The surface of the earth and the landscapes we see around us not only differ from place to place, but they are changing all the time.

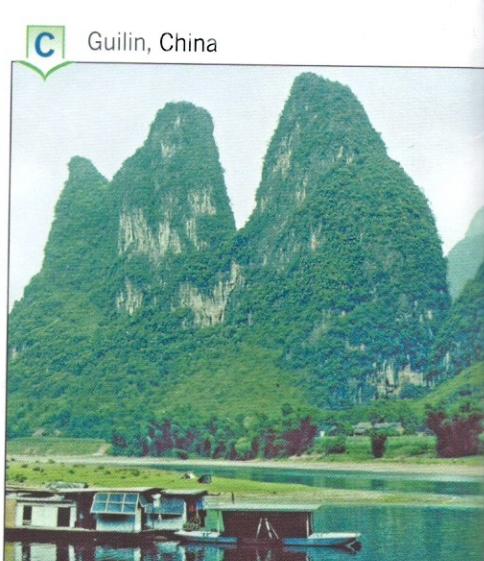
Rain, sun, wind and frost constantly break down the rocks. Great mountain ranges get worn down, valleys are made wider and deeper, and coastlines are changed. The breaking up of the earth's surface in this way is due to **weathering** and **erosion**. Weathering takes place when the rocks are attacked by the weather. Erosion is the wearing away of the land. These two pages show some examples of weathering. Erosion is explained more fully on pages 8 and 9.



A Mount Everest



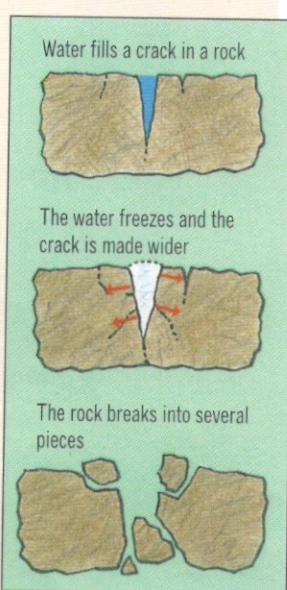
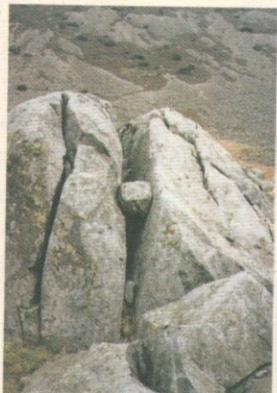
B Monument Valley, USA



C Guilin, China

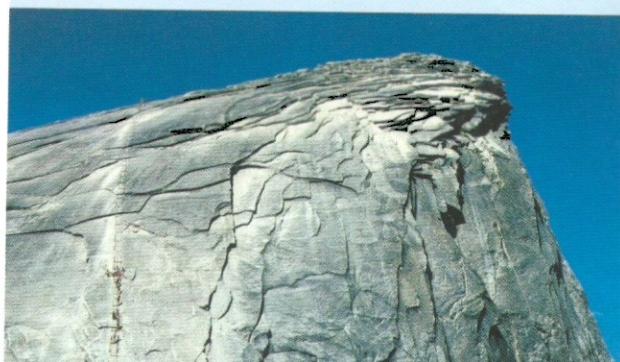
Freeze-thaw weathering

This can also be called frost shattering. Water may get into a crack in a rock and freeze. As the water turns to ice it expands and causes the crack to open a little. When it thaws the ice melts and changes back to water. Repeated freezing and thawing weakens the rock and splits it into jagged pieces. This type of weathering is common in mountainous areas where temperatures are often around freezing point.



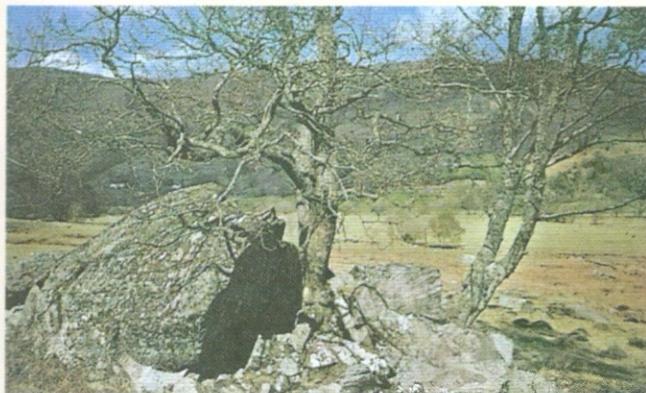
Onion-skin weathering

This happens when a rock is repeatedly heated and cooled. As it is heated, the outer layer of the rock expands slightly and as it cools the rock contracts. Continual expansion and contraction causes small pieces of the rock surface to peel off like the skin of an onion. This type of weathering is common in desert areas where it is very hot during the day but cool at night.



Biological weathering

This is due to the action of plants and animals. Seeds may fall into cracks in the rocks where shelter and moisture help them grow into small plants or trees. As the roots develop they gradually force the cracks to widen and the rock to fall apart. Eventually whole rocks can be broken into small pieces. Burrowing animals such as rabbits, moles and even earthworms can also help break down rock.



Chemical weathering

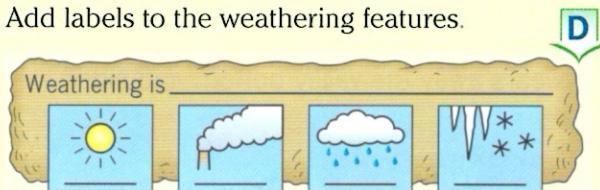
This is caused by the action of water. Ordinary rainwater contains small amounts of acid. When it comes into contact with rock the acid attacks it and causes the rock to rot and crumble away. The results of this can be seen on buildings and in churchyards where the stone has been worn away or pitted. Water and heat make chemical weathering happen faster, so it is greatest in places that are warm and wet.



Activities

- 1 Make a larger copy of diagram D.

- a Write in the meaning of weathering.
- b Add labels to the weathering features.



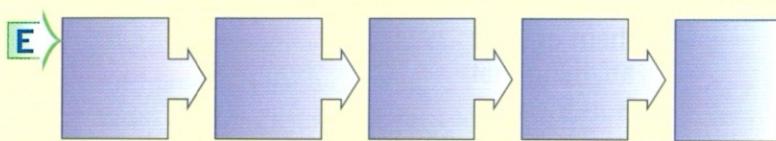
- 2 Copy and complete these sentences.

- a Freeze-thaw weathering is ...
- b Onion-skin weathering is ...
- c Chemical weathering is ...

- 3 With the help of a labelled diagram, show how freeze-thaw weathering can break up rocks.

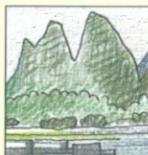
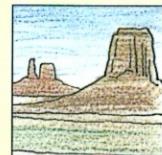
- 4 a Make a larger copy of diagram E.

- b Show how root action can break up rocks, by adding the labels in F to the correct boxes.
- Give your diagram a title.



- 5 a Draw these simple sketches of photos A, B and C.

- b Give each sketch a title and underneath say what type of weathering is likely to be most important there. Give reasons for your answer.



Summary

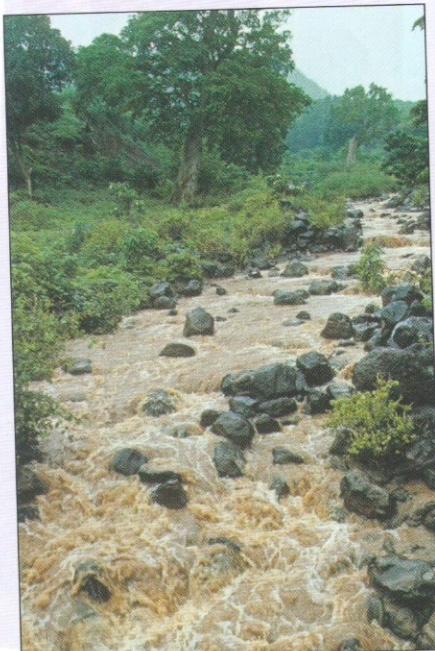
Weathering is the breakdown of rocks by water, frost and temperature change. Rocks can also be broken down by the effects of plants and animals.

1 Rivers, coasts and glaciation

What is erosion ...

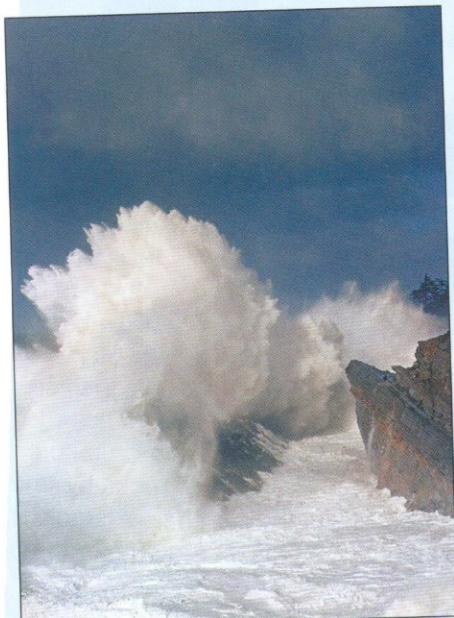
Weathering and erosion work together. Weathering breaks up and weakens the surface of rocks while erosion wears away and removes the loosened material. The action of rivers, the sea, ice and wind are the chief types of erosion. Human erosion is also important. Bulldozers and lorries can dig out and move large amounts of soil and loose rock, so

Rivers



Every day rivers wear away tiny bits of rock from their bed, and eat into the banks on either side of the channel. This material is carried downstream and deposited when the water slows down. In times of flood, large boulders may be loosened and rolled down the river bed.

Sea



Coastlines are under constant attack by **waves**. During storms each wave hits the rock with a weight of several tonnes. When this is repeated many times, the rock is weakened and pieces break off. **Currents** carry loose material away and deposit it elsewhere.

changing the landscape. People also remove trees and vegetation which can allow water, wind and ice to erode land more easily.

The work of rivers, the sea, ice and wind are explained in **A** below.

A

Ice

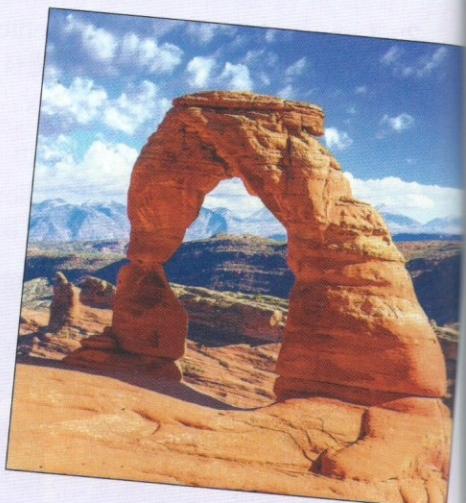
A **glacier** is a tongue of ice moving down a valley. Stones and boulders that fall onto it freeze into the ice and act like sandpaper on the rocks beneath. As the glacier moves, it carries the material downwards and at the same time wears away the valley bottom and sides.



Wind

Explorers who cross deserts in cars often find their paintwork worn away and their windscreens scratched. This is because the wind picks up tiny particles of sand and blasts them against anything that is in the way.

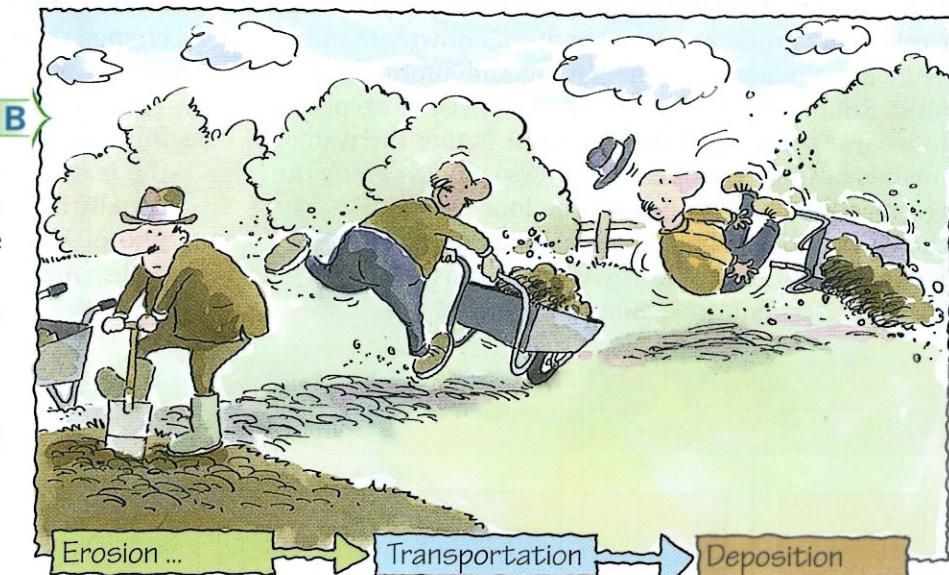
Rocks in desert areas are often eroded into strange shapes by this sandblasting effect.



... and how can it help shape the land?

Look at cartoon B on the right. It shows some gardeners who are trying to alter a garden by digging out soil (erosion), moving it in a wheelbarrow (transportation), and dumping it somewhere else (deposition). The more energy they have, the more soil they can dig or transport. When they are tired the digging slows down and they lack the strength to push the barrow, resulting in it toppling over and dumping its load.

On a larger scale, mountains, valleys, plains and coasts are shaped and changed by water, ice and wind. **Erosion** wears away the land, **transportation** moves the material from one place to another, and **deposition** builds up new landforms.



Activities

- 1 a List the following in order of how hard they are. Give the hardest first and the softest last.

steel chalk soap wood
rubber diamond plastic

- b Put a line under the two you think would be the most difficult to wear down.
c Choose any three from your list and say how they might be worn down.
- 2 Of the five statements below, three are correct. Write out the correct ones.
- Weathering is the breakdown of rock by nature.
 - Erosion is the wearing away of rock.
 - Weathering and erosion are the same.
 - Weathering moves material from one place to another.
 - Erosion includes the removal of loose material.
- 3 a Make a large copy of table C.
b Add labels to each drawing.
c Write a short description for each type of erosion.

Type	Description

C Types of erosion

- 4 Cartoon B shows erosion, transportation and deposition in a garden. How else could this be shown? What about a bulldozer, washing dishes or sandpapering wood? For one of these ideas, or for one of your own, draw a simple labelled cartoon to show how it works.

Summary

Erosion is the wearing away of rock and its removal by streams, ice, waves and wind. Erosion, transportation and deposition help shape the land.

1 Rivers, coasts and glaciation

How do rivers shape the land?

Rivers work hard. They hardly stop and they continually erode and move material downstream. They are a major force in shaping and altering the land. Running water by itself actually has little power to wear away rocks. What happens is that the water pushes boulders, stones and rock particles along the river's course. As it does so, the loose material scrapes the river bed and banks and loosens other material. Much of what is worn away is then transported by the river and put down somewhere else. In this way

rivers can wear out and deepen valleys. They can also change their shape by depositing material.

The landforms to be seen along a river change as it flows from source to mouth. These two pages explain the features of a river in its upper course which is usually in the hills or mountains. Diagram A and photo B show how a river cuts out a steep-sided valley that is V-shaped.

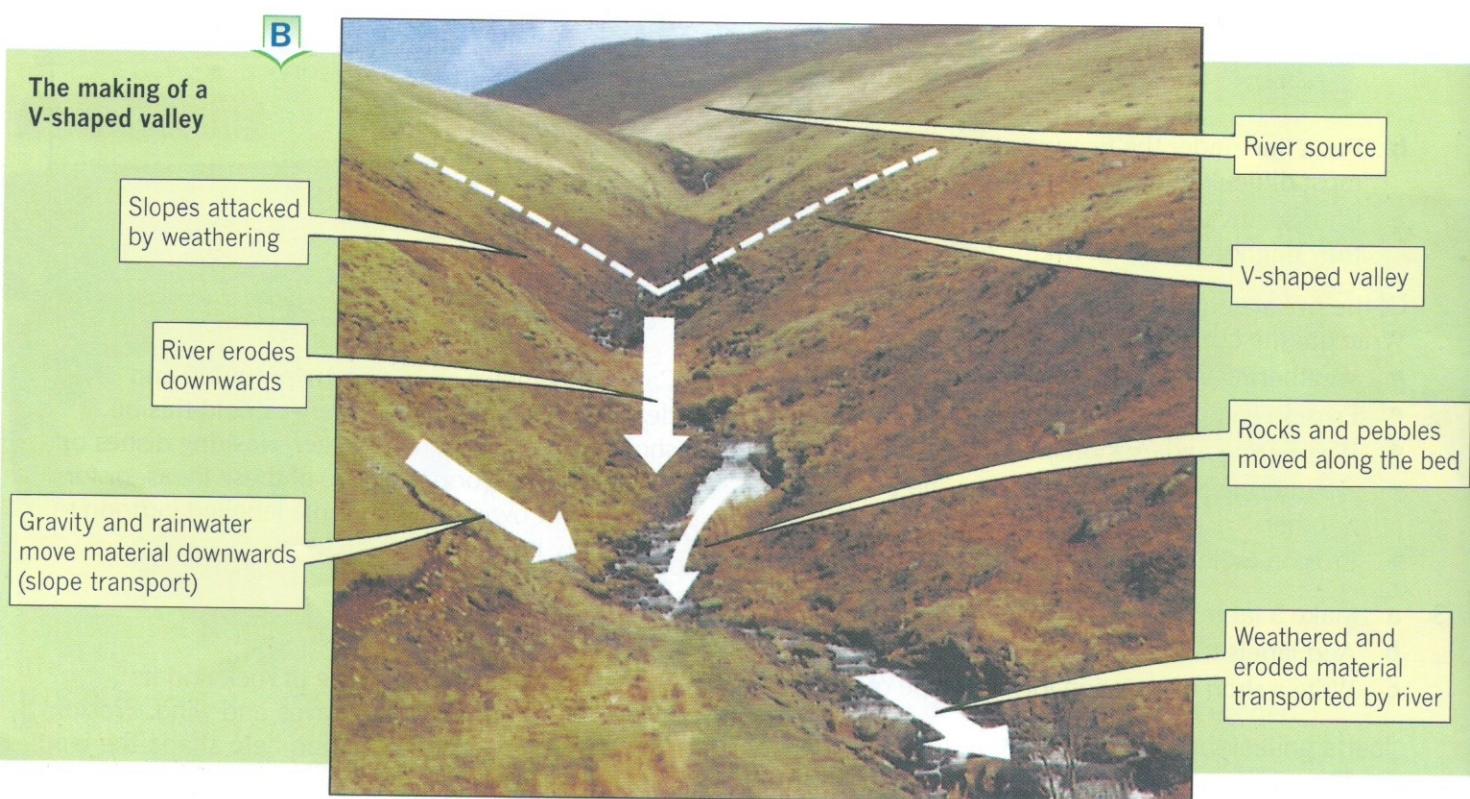
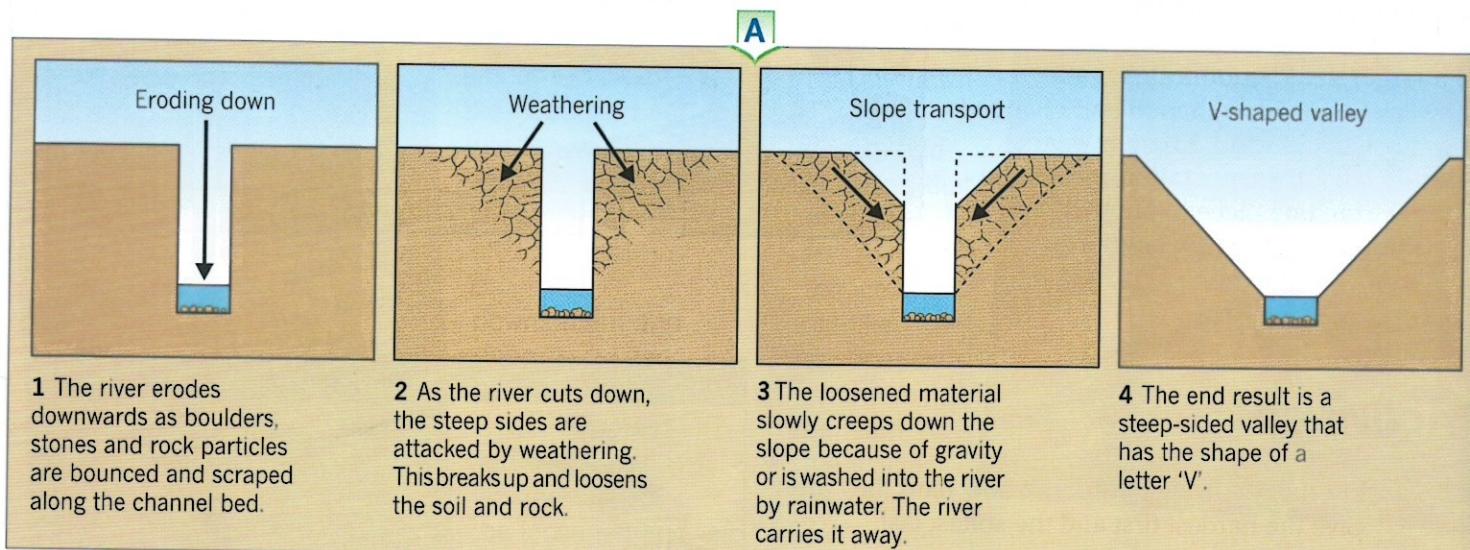
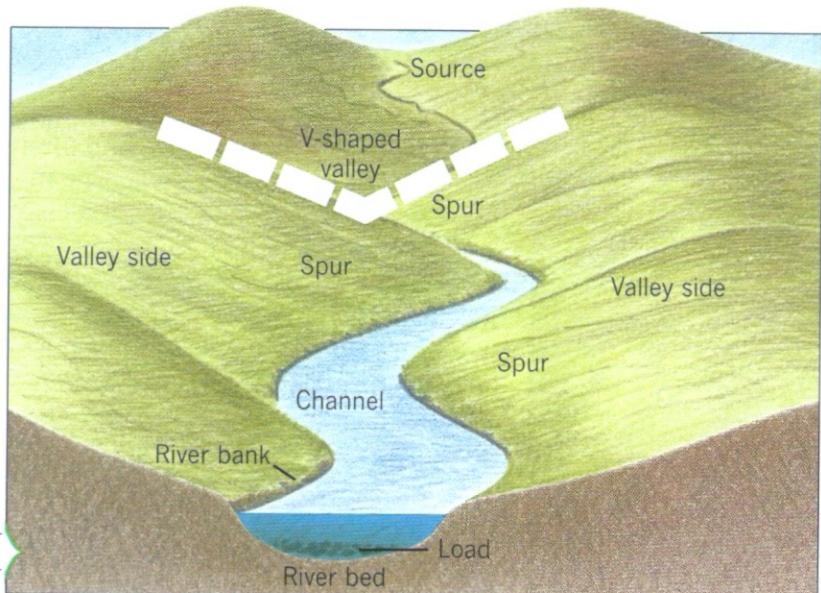


Table C below and sketch D give some features of a river and its valley.

	C
Source	Where a river starts
Spurs	Ridges of land around which a river winds
Valley sides	The slopes on either side of a river
V-shaped valley	The shape of a valley in its upper course
Channel	The course of a river
River banks	The sides of a river channel
River bed	The bottom of a river channel
Load	Material that is carried or moved by the river

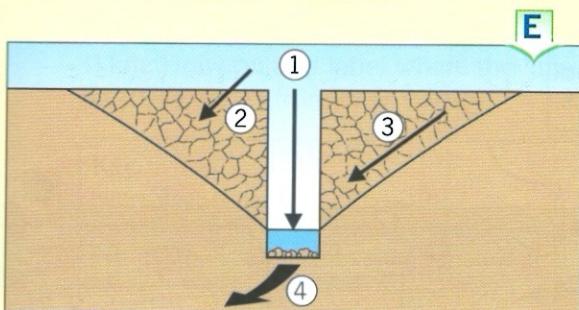


Activities

- 1 Describe how rivers erode their channels. Include these words in your description:

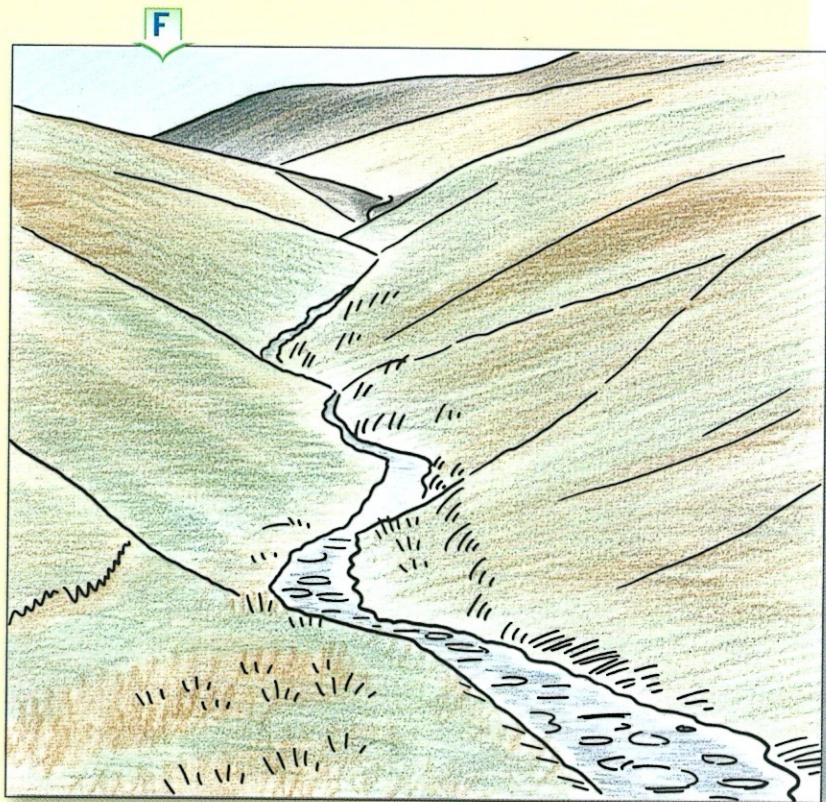
pushes scrapes loosens
moves drops

- 2 a Make a large copy of diagram E.
b Show how a valley gets to be V-shaped by describing what happens at ①, ②, ③ and ④.
c Give your diagram a suitable title.



- 3 a Sketch F is a simplified drawing of the river valley shown in photo B. Make a copy of the sketch.
b Add the terms below to your sketch in the correct places. The information at the top of this page will help you.

river channel river bank load
valley side spur V-shaped valley



Summary

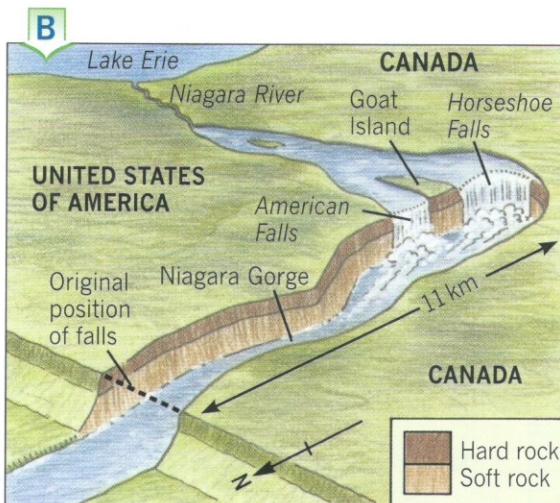
Rivers erode, transport and deposit material. This helps shape the land. V-shaped valleys are a common feature of a river in its upper course.

What causes waterfalls?



Waterfalls are an attractive and often spectacular feature of a river. The highest waterfall in the world is the Angel Falls in South America. Its total height is 979 metres. That is about four times the height of One Canada Square at Canary Wharf in London's Docklands. Waterfalls in Britain are much smaller than this (diagram A). One of the finest is High Force in the north of England. It has a height of just 20 metres. It is most impressive in times of flood.

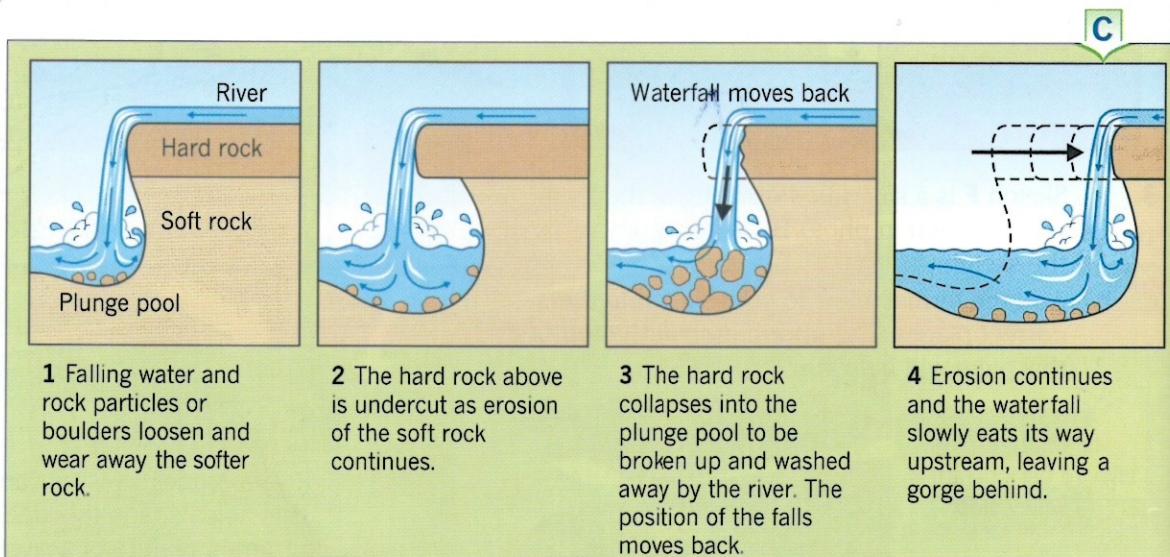
Probably the best-known waterfall in the world is Niagara Falls. It lies on the Niagara River which forms part of the border between Canada and the United States.

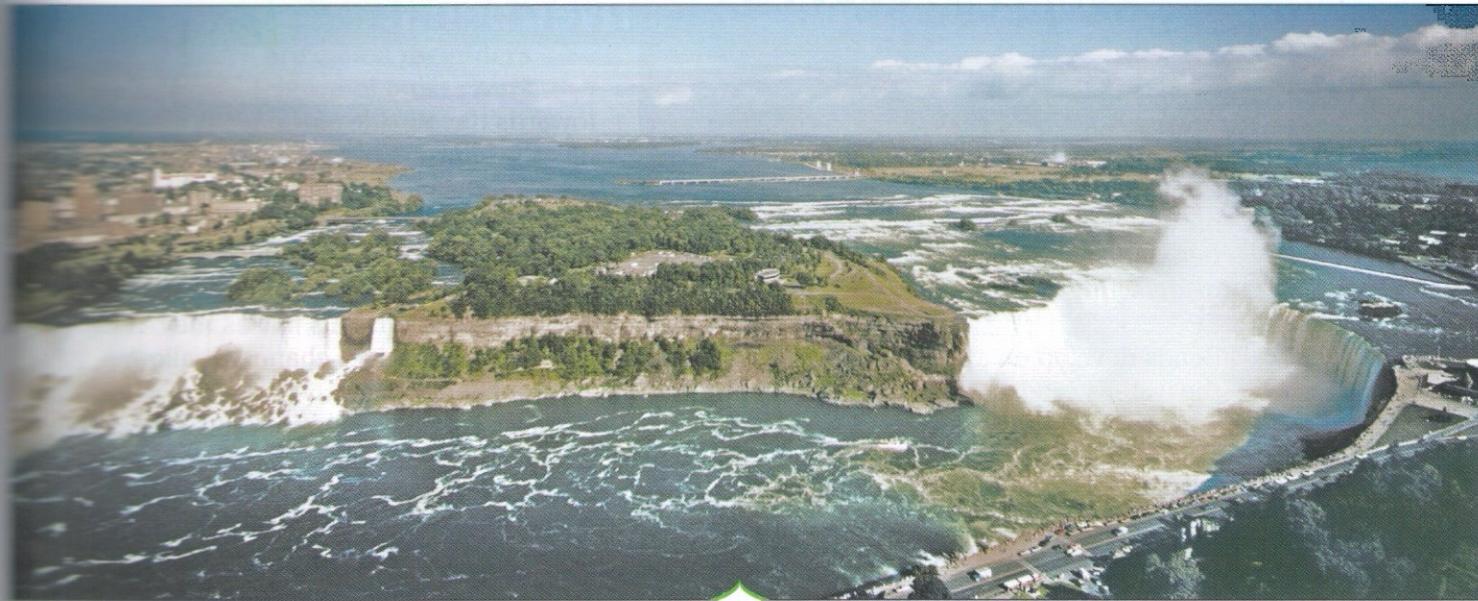


In this area, a band of hard limestone rock lies on top of softer shales and sandstone. The river flows over the top of the hard rock then plunges down a 50 metre cliff. At the bottom of the cliff the water has worn away the softer rocks to form a pool over 50 metres deep. This is called a **plunge pool**. Down from the falls is the Niagara Gorge. A **gorge** is a valley with almost vertical sides that has been carved out by the river and the waterfall. Photo D shows the gorge and waterfall at Niagara.

Sketch B shows the Niagara Falls area. The falls here are eating into the cliffs behind the waterfall at nearly one metre a year. The gorge that has been left behind is now 11 kilometres long.

Many waterfalls are formed in the same way as Niagara. They occur when rivers flow over different types of rock. The soft rock wears away faster than the hard rock. In time a step develops over which the river plunges as a waterfall. Water also cuts away rock behind the waterfall. This causes the falls to move back and leave a gorge as it goes. Diagram C shows how a waterfall may be worn away by a river.





D

Niagara Falls, USA

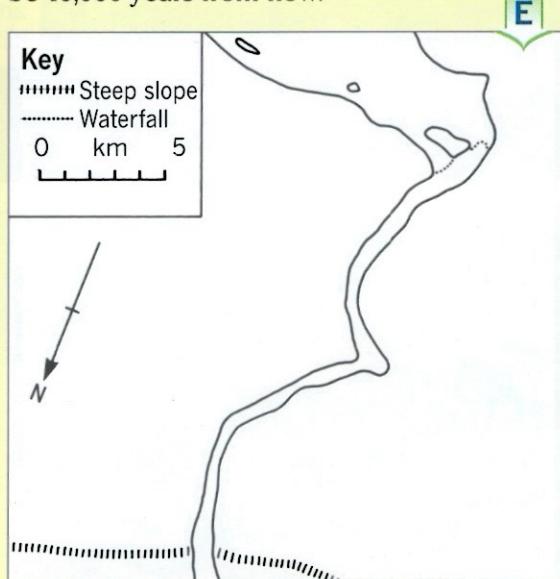
Activities

1 Map E shows the Niagara Falls area.

- a Make an accurate copy of the map.
- b Colour the water blue and the land area green.
- c Label the following:

USA	Canada	American Falls	Niagara River
Horseshoe Falls	Niagara Gorge	Goat Island	

- d Draw on and label the original position of the falls.
- e The falls have taken 30,000 years to wear back 11 km. Draw on and label where the falls might be 10,000 years from now.



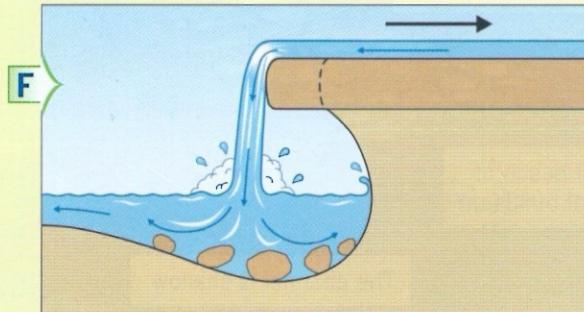
2 a Make a larger copy of diagram F.

- b Put these labels in the correct places.

Hard rock	Soft rock	Plunge pool
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Hard rock breaks off	Eroded material
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Undercutting	Waterfall moves back
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3 Sort the phrases in G into the correct order and link them with arrows to show how a waterfall may be worn away by a river.

Hard rock collapses	Plunge pool deepened
Soft rock worn away	Waterfall moves back
Waterfall moves back	Hard rock undercut

G

Summary

Many waterfalls are a result of water wearing away soft rock more quickly than the hard rock. As a waterfall erodes back, a gorge may be produced.