

# Scotland's rocks and fossils handling collection



National  
Museum of  
Scotland



# Scotland's rocks and fossils handling collection

## Teachers notes

Welcome to the National Museum of Scotland.

Our Scotland's Rocks and Fossils handling collection contains 21 real specimens from our collections and we encourage everyone to enjoy looking at and handling them to find out more.

This resource is linked to the Early People gallery and can be used as part of your visit to that gallery.

### These notes include:

- Background information about metamorphic, igneous and sedimentary rocks.
- Background information about fossils.
- Tips on how to recognise different types of rocks and fossils.
- Details about each object.
- Ideas for questions, things to think about and to discuss with your group.

### NMS Good handling guide

The collection is used by lots of different groups so we'd like your help to keep the collection in good condition. Please follow these guidelines for working with the artefacts and talk them through with your group.

- 1 Always wear gloves when handling the specimens (provided)
- 2 Always hold specimens over a table and hold them in two hands
- 3 Don't touch or point at specimens with pencils, pens or other sharp objects
- 4 Check the specimens at the start and the end of your session
- 5 Please report any missing or broken items using the enclosed form

# Scotland's rocks and fossils handling collection

## Geology and Palaeontology

Geology is the study of our planet, Earth. It tells us:

- How the Earth was made
- What it is made of
- How it has changed over time

Paleontology is the study of fossils. It tells us:

- About ancient life on Earth
- The conditions on Earth in the past

## Scotland's landscape in the past

- The landscape of Scotland began to form billions of years before the arrival of humans and has changed dramatically over time to become the landscape we know today. The rocks and fossils that we will look at in this resource are the result of these processes of change.
- Around 500 million years ago, parts of Scotland formed part of a continent called Laurentia which existed in the southern hemisphere. This continent moved north over millions of years.
- Scotland and England joined together around 410 million years ago when the ocean that separated them gradually closed up.
- During its journey across the face of the Earth, the land we now know as Scotland has experienced extreme cold, desert heat and major volcanic activity.
- During the time period when dinosaurs roamed the earth, Scotland was either hilly ground or submerged beneath shallow tropical seas.
- For the last 60 million years Scotland, and indeed Europe as a whole, has been very slowly drifting away from North America.
- Over a period of 2.5 million years, Scotland has been covered in ice at least five times. The last Ice Age in Scotland ended 10,000 years ago.

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## Scotland's landscape today

Scotland can be separated into five main geological parts:

- 1 The North West
  - 2 The Central and Northern Highlands west of the Great Glen Fault
  - 3 The Central and Grampian Highlands
  - 4 The Midland Valley
  - 5 The Southern Uplands
- These areas are separated by big faults or breaks in the Earth's crust. Most of these faults can still be identified in landscape.
  - Each part of Scotland has its own distinctive rock types, some of which you will look at in this resource.
  - Although Scotland's natural landscape is now stable and has been for many millennia, changes are still slowly taking place. Who knows what types of rocks and fossils will form in millions of years to come?

# Scotland's rocks and fossils handling collection

## Contents

### Metamorphic rocks

1. Lewisian Gneiss
2. Schist
3. Garnet Mica Schist
4. Iona marble
5. Coal

### Igneous rocks

6. Granite
7. Basalt
8. Obsidian
9. Jasper

### Sedimentary rocks

10. Sandstone
11. Limestone

### Coral fossils

12. Chain coral
13. Solitary horn coral
14. Colonial coral

### Animal fossils

15. Fish scale
16. Gigantoproductus giganteus
17. Mammoth tooth
18. Plesiosaur bone
19. Ammonite

### Plant fossils

20. Leaf
21. Scale tree bark

## Fab fact!

When metamorphic rocks are heated they become bendy and the pressure underground can cause them to fold. Folds in the rock can be a few millimetres or a few kilometres thick!

## Metamorphic rocks

- Metamorphic rocks are rocks which have been changed by heat and pressure deep underground in the Earth's crust.
- The minerals in the rock are changed to new minerals
- Imagine baking a cake - the original ingredients look very different once they are baked. The same thing happens with metamorphic rocks.
- We can sometimes tell what the original rock was - for example, limestone becomes marble - but if the rock has been highly metamorphosed, this is more difficult.
- How to recognise metamorphic rocks
  1. They make a high pitched 'clink' sound instead of a low pitched 'clunk' sound when tapped.
  2. They have layers in the rock. This is called 'foliation'.
  3. They often have bands of light and dark colours.
  4. They have large grains that interlock with each other.

# Scotland's rocks and fossils handling collection

## See



The black and pink stripes in the rock.

## Touch



Feel how smooth the rock is. This smoothness is caused by weathering.

## Think



The Earth itself is 4.5 billion years old so this rock was created when the Earth was still young.



### 1. Lewisian Gneiss (pronounced 'nice')

- This is one of the oldest types of rock in the world. It is approximately 3 billion (3000 million) years old.
- It is found in North West Scotland and is named after the Isle of Lewis in the Outer Hebrides.
- Gneiss has been changed so much that it is difficult to tell what the original rock was like.
- Gneiss is usually black and white or pink and is often stripy. The stripes indicate different conditions in growth.

# Scotland's rocks and fossils handling collection

## See



The layers of crystal that follow the line of the folds.

## Touch



The smooth texture of the rock.

## Think



Why do you think this specimen is so shiny?

It is shiny because it contains lots of a mineral called 'mica'.



## 2. Schist

- This piece of schist is about 1 billion years old.
- It comes from Scourie in North West Scotland.
- Schist is mudstone (a sedimentary rock) that has been heated and compressed.
- The word schist comes from an ancient Greek word and means 'to split'.
- This piece of schist has been folded like paper by the immense heat and pressure deep in the Earth's crust.
- Schist has thin layers called 'foliation'.

# Scotland's rocks and fossils handling collection

## See



The three different components.

## Touch



You can feel the thin layers of schist round the edges.

## Think



Why do you think Garnets were considered precious?



### 3. Garnet mica schist

- This rock is about 1 billion years old.
- This rock is made up of garnets, mica and schist.
- Garnets are dark red stones. These are semi-precious stones that are often used in jewellery.
- Mica is a shiny silver mineral.
- Schist is the grey rock.

# Scotland's rocks and fossils handling collection

## See



The beautiful white and pale green colour.



## Touch



The smooth texture of the marble. Even the unpolished sides are very smooth.

### 4. Iona marble

- This piece of marble is about 450 million years old.
- It comes from Iona in the Inner Hebrides.
- Marble is limestone that has been heated and compressed.
- Marble is a very hard rock that polishes well and is often used for ornaments and statues.

## Think



The City Chambers in Glasgow has the largest marble staircase in the world.

# Scotland's rocks and fossils handling collection

See



The layers in the coal.

Touch



Why isn't this specimen making your hands dirty like most pieces of coal?

It has been painted with a special product which locks in the coal dust

Think



If coal is often found in Scotland, what does this tell us about our climate millions of years ago?

Scotland once had a warm, tropical climate.



## 5. Coal

- Coal began to form between 100 and 400 million years ago when large tropical forests covered most of Earth. When the forest trees and plants died, they fell into swamps and were covered by more plants.
- Over time, the plant material did not rot - it turned into peat before heat and pressure finally turned it to coal.
- Coal burns easily and is one of our main 'fossil fuels'.
- There are often well preserved plant fossils in coal.

## Fab fact!

Igneous rocks are the oldest of all the rock types and can be up to 4 billion years old!

## Igneous rocks

- Igneous rocks are formed when molten (melted) rock cools and hardens.
- The word 'igneous' comes from the Latin word for fire.
- Molten rock which erupts from a volcano is called lava. Molten rock beneath the Earth's crust is called magma.
- When molten rock cools above ground, it cools quickly and small crystals form inside it. This is called 'extrusive' rock.
- When molten rock cools below ground, it cools more slowly, allowing larger crystals to grow. This is called 'intrusive' rock.
- How to recognise igneous rocks:
  1. They are often dark coloured and heavy.
  2. They often have two different sizes of interlocking grains, one much larger than the other.
  3. Some extrusive igneous rocks have 'vesicles' (holes) in them.

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See



The pink colour of the rock with grey crystals.

Touch



Can you feel the difference in texture between the pink stone and grey crystals?

Think about



What qualities do you think granite has that makes it popular for buildings and interior fittings like floors and kitchen counters?



## 6. Granite

- Granite is an igneous rock which formed below ground.
- Granite can take millions of years to grow so the crystals in it can grow very large.
- Granite is a good material for building because it is very strong. Many houses in Aberdeen are built from granite which gives the city its' nickname - 'The Granite City'.
- Granite colours can vary from pink to gray.

# Scotland's rocks and fossils handling collection

## See



Look at how the black rock appears to sparkle. This is because of the crystals in it.

## Touch



Compare it to the metamorphic marble specimen. The two pieces are the same size. Which is heavier?

## Think



Most of the basalt in the world forms under the ocean. This means it is less commonly used than other rocks because it is harder to get.



## 7. Basalt

- Basalt is an igneous rock that erupted as lava.
- The tiny crystals in this specimen show that it cooled down very quickly.
- Arthur's Seat and Castle Rock in Edinburgh, North Berwick Law in East Lothian and Tinto Hill in South Lanarkshire were all volcanoes from which lava would have erupted.

# Scotland's rocks and fossils handling collection

## See



The shiny, glass-like appearance of the rock.



## Touch



It feels smooth like glass but if you move your finger slowly over it, you can feel the ridges in the rock.

## 8. Obsidian

- Obsidian rock forms when lava cools very, very quickly, usually in water.
- When lava cools very quickly, there is no time for crystals to grow and it forms this glass-like rock.
- Obsidian is often called 'volcanic glass.'
- It was very precious to ancient civilisations and is still used today to make jewellery and ornaments.

## Think



Why do you think it looks like glass?

Because it forms quickly without any crystals.

# Scotland's rocks and fossils handling collection

## See



The beautiful red and yellow stripes.

## Touch



Feel the weight of the stone.  
Do you think it is heavy or light?

## Think



Because of its beautiful colour, Jasper is often polished and used in jewellery.



## 9. Jasper

- This piece of jasper is from the Campsie hills in central Scotland.
- Jasper comes in a variety of colours including red (like this specimen), green and yellow. Red jasper contains high quantities of iron.
- Jasper often contains minerals which give it interesting patterns and stripes.

# Scotland's rocks and fossils handling collection

## Fab fact!

By looking at sedimentary rocks of different ages, scientists can figure out how Earth's climate has changed throughout history.

## Sedimentary rocks

- Seventy percent of all the rocks on earth are sedimentary rocks.
- Sedimentary rocks are formed on the Earth's surface, below seas, rivers, lakes and deserts.
- Tiny fragments of rock, sand, mud, minerals and the remains of plants and animals are washed away or blown to a new place. Over time, these fragments eventually form layers of sediment.
- The sedimentary layers can harden into rock in two ways: they can be compacted by pressure from above or 'glued' together by minerals dissolved in water.
- Sedimentary rocks often contain fossils.
- How to recognise sedimentary rocks:
  1. They have grains that are cemented together.
  2. They are lightweight and usually light-coloured.
  3. They might contain fossils.

# Scotland's rocks and fossils handling collection

## See



The red colour of this piece.  
Where do you think it came from?



## Touch



You can feel the grains of sand in the stone.

## Think



When you visit the National Museum of Scotland look at the outside of the building. It is covered in gold Moray sandstone.

### 10. Sandstone

- Sandstone is formed when layers and layers of sand are compressed and bound together by natural cement.
- Sandstones vary in colour depending on the properties or colours of the original sand. Gray sandstone is made in water and red sandstone forms in deserts.
- Red sandstone contains iron.

# Scotland's rocks and fossils handling collection

## See



The fossils in this piece of limestone - there are two kinds of coral fossils - spaghetti coral and horn coral - and some tiny ammonites. Can you identify each kind of fossil?



## Touch



Feel the difference in texture between the stone and fossils.

## 11. Limestone

- Limestone is made from the remains of shells and sea creatures such as coral.
- This means limestone is full of the mineral calcite. This is a form of calcium.
- This rock formed around 300 million years ago at a time when Scotland was a tropical reef.

## Think



Because limestone has lots of cracks and joints, water can seep down through them and form 'limestone pavements', 'limestone scars' and 'limestone sinkholes' in the ground.

# Scotland's rocks and fossils handling collection

## Fab fact!

Fossils that are millions of years old are clues to how life has evolved and adapted to changing environments over very long periods time.

## Fossils

- Fossils are the preserved remains of ancient corals, animals and plants.
- Fossils are usually found in sedimentary rocks as they are destroyed by the heat that creates igneous and metamorphic rocks.
- Animal and plant remains turn into fossils because:
  - The remains are usually quickly buried by mud or sand. This protects them from the weather.
  - They are deprived of oxygen which limits their decay.
  - Sediment builds up on top of the remains and ensures that they will stay buried for a long time.
  - They are protected from too much heat or pressure which would destroy them.
- Most fossils form under water as more than 70% of Earth's surface is covered in water.
- Fossils on land usually form in dry deserts and caves.
- Here is one example of how a fossil can be formed:
  - A dead animal falls to the bottom of a sea, river or lake.
  - The soft parts of the animal - the skin and muscles - rot away leaving the harder bones and teeth which are buried as sand and mud is washed over them.
  - Over time, the hard parts are buried deeper by the sediment. The weight of the layers of sediment causes it to compact and turn to hard rock.
  - Millions of years later, the rock is brought to the surface by natural rock moving processes. It is then weathered by wind and rain and the fossil is exposed.

# Scotland's rocks and fossils handling collection

**See**



The chain pattern formed by the living coral.

**Touch**



Use your finger to trace the pattern from the top down the edges of the fossil.

**Think**



Can you think of a place where coral grows today?

The best known is the Great Barrier Reef in Australia.



## Coral fossils

- Corals are marine animals with a sac-like body (polyp), mouth, tentacles and skeleton.
- Only the skeleton survives as a fossil.
- The corals may be solitary (living by themselves) or colonial (many joined together).
- Before they are fossilised, these corals would have lived in warm, shallow, tropical seas and fed on plankton, like the corals we can see today

### 11. Chain coral

- This piece of coral is about 450 million years old.
- It is known as a chain coral because it looks like the links of a chain.
- Each 'link' in the chain was where an individual coral animal lived.
- As this coral fossil was made up of many individual coral animals, it is a colonial coral.
- This coral fossil belongs to an extinct type of corals, called the 'Tabulate corals'.

# Scotland's rocks and fossils handling collection

## See



Two of the horn coral specimens have been cut and polished. You can see the growth lines that form a circular pattern and also run lengthways down the coral.



## Touch



Touch the uncut specimen- can you feel the 'wrinkles' in it?



## Think



Can you think of anything that looks like this today?

A sea anemone

## 12. Solitary horn corals

- These corals are between 320 and 340 million years old.
- They are called horn corals because the shape of the skeleton is like a horn.
- They are called solitary corals as each contained only one coral animal.
- They could vary in size from a few millimetres wide to 14 centimetres wide and grow up to 1 metre long
- They belong to an extinct type of coral called the 'Rugose corals'. The word rugose means wrinkled or corrugated.

# Scotland's rocks and fossils handling collection

## See



The honeycomb pattern and the growth lines in each individual coral.

## Touch



The bumps on the outside that follow the form of the pattern on the inside.

## Think



If this coral was found in Bathgate, what does this tell us about that area of Scotland 320 million years ago?



### 13. Colonial coral

- This piece of coral is about 320 million years old and comes from Bathgate in Scotland.
- This coral was made up of many individual coral animals forming a honeycomb pattern
- Like the other coral fossils it is believed to have lived in warm, clear, shallow seas.

# Scotland's rocks and fossils handling collection

## See



The shape and size of the scale. What size do you think the fish was?

## Touch



The texture- do you think it is like a modern fish scale?

## Think



Different species of fish have been living on Earth for about 400 million years. Why do you think they have lasted so long?



## Animal fossils

### 14. Fish scale

- This fossil is about 360 million years old and comes from Nairn in the Highlands.
- It is the scale from a primitive fish which is called *Asterolepis maxima*.
- These fish fossils are now only found preserved in Upper Old Red Sandstone, a British sedimentary rock formation.
- From their remains we can tell that these fish often grew to 6 or 7 metres.

# Scotland's rocks and fossils handling collection

See



Look at the shape- what does it remind you of?

Sea shell

Touch



Feel the ribs in the shell that helped anchor the creature in the sand.

Think



What did the shell do? Think of animals today that have shells and why they have one.



## 15. *Gigantoproductus giganteus*

- This is the fossil of an ancient type of shellfish, a brachiopod
- It was the largest of the brachiopods and grew to over 30 centimetres wide.
- Brachiopods lived in shallow waters close to the shore or near reefs. Its size, weight and ribbed shell would have prevented it from being washed too far away.
- Brachiopods were nearly wiped out 250 million years ago and are now only found in cold, deep parts of the ocean.

# Scotland's rocks and fossils handling collection

## See



The size of this one part of the tooth. Mammoths had four grinding teeth.

## Touch



The massive grooves in the tooth to help the mammoth chew and break up their food.

## Think



Mammoths had molar teeth as they were herbivores – they ate only plants. Animals such as lions have 'canine' teeth as they are carnivores and eat meat. We are omnivores and have both molars and canines to chew plants and also tear meat.



## 16. Mammoth tooth

- The shape of this tooth tells us that mammoths were plant eaters. Meat eaters have sharp teeth for tearing flesh – mammoths had ridged teeth to grind up the coarse plants they ate.
- This piece is only a fragment of the actual tooth. A whole tooth would have been about five times bigger!
- Mammoths lived during the ice Age when temperatures were much lower than they are today. They were protected from the cold by a thick covering of hair.
- During the last Ice Age the sea level was lower as the water was locked up in ice. As the ice melted, the bones of any mammoths that died on the it sank to the bottom of the ocean.

# Scotland's rocks and fossils handling collection

## See



Look at the shape of the flipper. It is similar in shape to the paddles used for rowing boats.

## Touch



This is a small bone that would have come from a small plesiosaur. Can you imagine the size of the flipper of a plesiosaur that was 20 metres long?

## Think



Perhaps fictional creatures like the Loch Ness Monster are based on plesiosaurs. What do you think?



### 17. Plesiosaur bone

- This is a bone from the flipper (paddle) of a reptile called a Plesiosaur which lived on Earth during the time of the dinosaurs.
- Plesiosaurs had a long neck, large body, four flippers to help them swim and a short tail.
- Remains of plesiosaurs are mostly found in shallow waters or estuaries. This is probably where smaller plesiosaurs fed and where they were hunted by the larger plesiosaur. Plesiosaurs could grow up to 20 metres long and are the biggest known predator ever.

# Scotland's rocks and fossils handling collection

## See



The four segments of the shell.

## Touch



The fossil is very heavy.  
Do you think it would have been this heavy when the creature was alive?

## Think



What was the shell for?  
It protected the soft body of the ammonite from predators.



### 18. Ammonite

- Ammonites were ancient relatives of the squid and octopus. They lived in the sea between 240 and 65 million years ago. They became extinct around the same time as dinosaurs.
- Ammonites belong to a group of predators known as cephalopods.
- They can be recognised by their coiled shells which contained a series of chambers.
- Ammonites moved by jet propulsion, expelling water through a funnel-like opening to propel themselves in the opposite direction.

# Scotland's rocks and fossils handling collection

## See



You can still see the veins in the leaf.

## Touch



The sandstone is very light so wouldn't have put too much pressure on the leaf and squashed it.

## Think



Do you think this leaf looks the same as or different to the leaves on trees today?



## Plant fossils

### 19. Leaf in sandstone

- This is part of a leaf preserved in sandstone. It is about 50 million years old and was found on the Isle of Mull.
- Leaf fossils are very rare because leaves often rot away.
- Sandstone is very good at preserving fossils.

# Scotland's rocks and fossils handling collection

**See**



The shape of the pattern on the bark.

**Touch**



It is still very rough, just like normal tree bark.

**Think**



The next time you see some trees perhaps you can take a rubbing of any unusual patterns in the bark.



## 20. Scale tree bark

- This fossil is about 350 million years old. It comes from a time when Scotland was covered in tropical forests and swamps.
- The fossil is from a tree called a scale tree because the diamond shaped pattern on its bark looked like fish scales.
- Scale trees could be enormous, growing to heights of more than 35 meters with their trunks measuring over 1.7 meters in diameter.
- Scale tree fossils are often found in coal seams where plant material turned into peat before heat and pressure finally turned it to coal.