Curriculum links

These notes accompanying the rock samples box can be linked to support several curriculum areas for secondary age groups.

The key curriculum areas in England & Wales

Geography
- enquiry skills and knowledge and understanding of places, patterns and process and environmental change and sustainable development
- breadth of study to geomorphological process and environmental and resource issues.

Science
- enquiry and investigative skills
- materials and their properties, classifying, changing materials - physical, geological and chemical changes and useful products
- physical processes, energy resources and energy transfer.

The key curriculum areas in Scotland

Environmental studies:

– Society
- enquiry skills, knowledge and understanding of people and physical environment and interaction.

– Science
- investigating skills, knowledge and understanding of earth and space, materials from the earth and changing materials
- energy and forces - properties and uses of energy and forces and effects.

BPES has a range of other resources - for your free catalogue please contact us at:

BP Educational Service
PO Box 105, Rochester, Kent ME2 4BE
Tel: +44(0)870 333 0428 Fax: +44(0)870 333 0449
Email: bpes@bp.com

Alternatively, visit our website at **www.bp.com/bpes**

Acknowledgments: Grateful thanks are extended to Peter Kennett and the Earth Science Teachers' Association (ESTA).
ESTA may be contacted at:
ESTA c/o The Geological Society, Burlington House, London W1V 0JU.
Website: www.esta-uk.org

BP is a member of the U.K. Offshore Operators' Association (UKOOA). UKOOA supports the Earth Science Education Unit which exists to provide Earth Science INSET in secondary schools and teacher education institutions throughout the country. The workshops all involve practical and investigative work. Such INSET is free apart from the travel costs of your local ESEU facilitator. For further information please contact Bernadette Callan: eseu@keele.ac.uk, tel: 01782 584 437 website: **www.earthscienceeducation.com**

The website **www.jesei.org** is compiled by teachers of physics, biology and chemistry, with ESTA advice, and contains many ideas for practical and investigative work in Earth Science.

rock samples

secondary teacher's notes

BP Educational Service

Rocks can be classified into three groups:

SEDIMENTARY, METAMORPHIC, IGNEOUS

Over millions of years they may change from one into another. This is called the Rock Cycle.

The Rock Cycle

Exposed surface rocks undergo '**weathering**' where they get broken down 'in situ'. The broken down pieces or particles are carried away **(erosion and transport)** and dropped **(deposition)**, later settling as loose material, often in layers **(sediments)**. Over millions of years these sediments get compressed and cemented, forming **sedimentary rocks**.

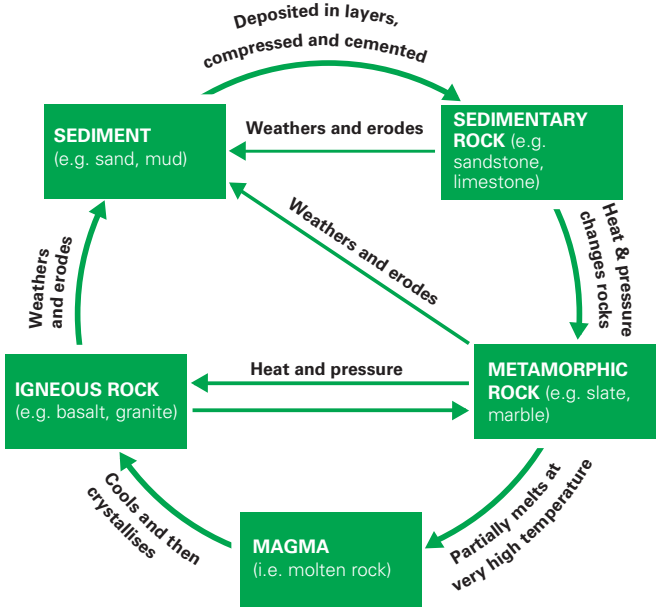
They may be brought to the surface by **uplift**.

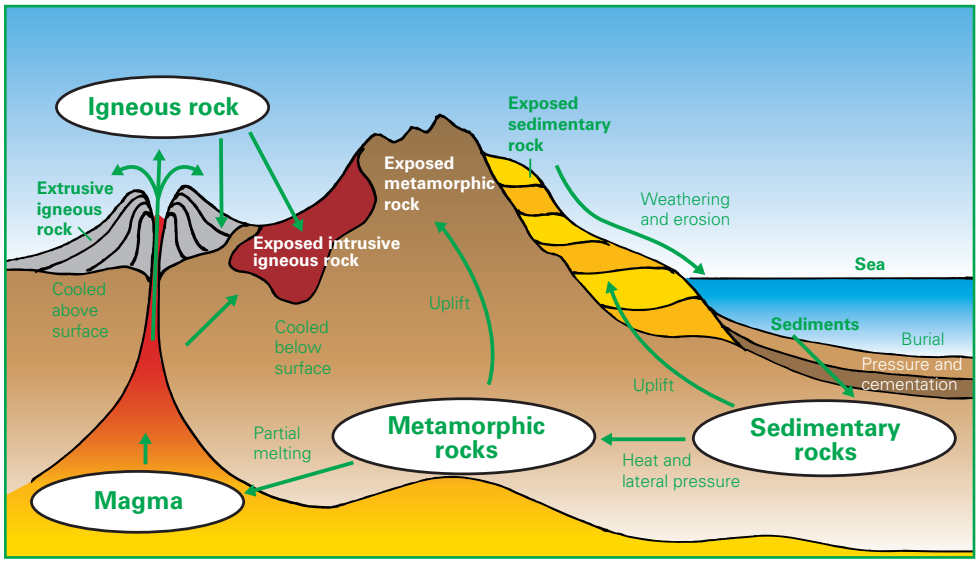
Pressure from the sides and increased temperatures may change the rocks into **metamorphic rocks**. These may again be uplifted to the surface.

Rocks may become hot enough to melt partly. Liquid rocks then rise and cool to form **igneous rocks**. The liquid rocks sometimes erupt as a volcano. They may also cool and set below ground.

When rocks return to the surface **(sedimentary, metamorphic or igneous)** the weathering process or cycle starts again.

The Rock Cycle





Sedimentary Rocks

The process of turning sediment into sedimentary rock is called **lithification**.

There are two stages to this:

1) as the layers of sediment build up, the pressure squeezes out air and water pockets, bringing the particles closer together

2) then underground water seeping through deposits minerals (calcite, silica or iron compounds). These build up on the sediment particles, cementing them into a solid mass.

It is always interesting to see what you can find in sedimentary rocks – they are often made up of lots of other rocks stuck together and may contain fossils of plants or animals.

There are three types of sedimentary rock:

- **Clastic sedimentary** – broken bits of pre-existing rocks (e.g. sandstone).
- **Chemical sedimentary** – when salt and other substances (dissolved in water) are separated by evaporation from the solution (e.g. rock salt).
- **Biogenic sedimentary** – built up from remains of living things (e.g. shelly limestone, coral reef).

Examples of sedimentary rock:

Pebbles become **conglomerate**
Sand becomes **sandstone**
Mud becomes **mudstone**
Shells become **limestone**.

The harder sedimentary rocks, such as well-cemented sandstones, are commonly used in building materials.

Examples	Characteristics	How formed
Sandstone Limestone	Particles cemented together and sometimes contain fossils.	Layers of sediment buried, squeezing water out and then particles cemented together. The rocks build up in layers.

Suggested questions/discussion

- Describe how sedimentary rocks are formed.
- Which processes affect exposed rock before its constituents can be deposited as sediment?
- Which of the above rocks is least likely to contain fossils?
- Give two examples of sedimentary rocks.
- Describe the characteristics of two of the sedimentary rock samples from the box.
- Give two possible uses for sedimentary rocks and explain why they are used for this purpose.

Metamorphic Rocks

The change from existing rock to metamorphic rock is a bit like dough changing into bread when it's baked in a hot oven; it doesn't melt - it changes. The word metamorphism means "change" of form.

There are two main types of metamorphic rock:

The more common – **regional metamorphic rock.**

This involves vast volumes and is found at the heart of mountain ranges and deep within the earth's crust.

- The deeper metamorphic rocks are usually high grade regional metamorphic rock such as schist and gneiss (pronounced 'nice').
- The low grade regional metamorphic rock, such as slate, has not been so compressed or heated.

The second type of metamorphic rock is **thermal (contact) rock**. This is produced when igneous rock heats surrounding rock it comes into contact with.

Examples of metamorphic rock:

Marble comes from limestone

Slate comes from mudstone

Quartzite comes from sandstone.

Marble is strictly a metamorphosed limestone, but the term is more loosely used in the stone industry for rocks that have a range of textures and colours, and are easily cut and polished for use in sculptures and buildings. Over the years, slate has been used in roofing - but this is now declining.

Examples	Characteristics	How formed
Slate Schist Gneiss	Crystals in 'layers', usually hard and smooth. The crystals in slate are too small to see. Schist is shiny. Gneiss is banded.	Rocks are put under great lateral pressure e.g. two plates collide. They are also heated. The original minerals are recrystallised.

Metamorphic Rock Samples

Suggested questions/discussion

- Describe how metamorphic rocks are formed.
- What two factors 'change' existing rock into metamorphic rock?
- Give two examples of metamorphic rock.
- Describe the characteristics of two of the metamorphic rock samples from the box.
- Give two possible uses for metamorphic rocks and explain why they are used for this purpose.
- Rocks produced by thermal metamorphism are not usually banded. Explain why.

Igneous Rocks

You can liken the formation of igneous rocks to the wax of a burning candle dribbling down and solidifying.

The term igneous means "to do with fire". It is true that they were once very hot, but burning was never involved.

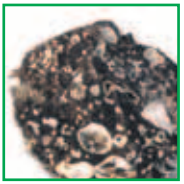
There are two main types of igneous rock:

Extrusive – forms when molten rock comes to the surface and cools very quickly as lava. This produces a fine grained rock such as basalt.

Intrusive – rocks that have cooled and solidified slowly underground such as granite with much larger crystals.

This rock is only seen when overlying rocks are worn away.

Igneous rocks are usually very hard and resistant to wear and tear. They make good road-surfacing materials, when coated with tar.



Examples	Characteristics	How formed
Basalt Granite	Very hard and usually have crystals. Extrusive igneous rocks (e.g. basalt) have small crystals due to fast cooling. Intrusive igneous (e.g. granite) have large crystals due to slow cooling.	The liquid rock or magma comes up towards the surface, cooling down and crystallising either above the surface (extrusive) or below the surface (intrusive).

Igneous Rock Samples

Suggested questions/discussion

- Describe how igneous rocks are formed.
- What are the differences between intrusive and extrusive igneous rocks?
- Give two examples of igneous rocks.
- Describe the characteristics of two of the igneous rock samples from the box.
- Give two possible uses for igneous rocks and explain why they are used for this purpose.

SEDIMENTARY SAMPLES

Chalk
Fine grained, white, soft, made of calcite.

Conglomerate
Composite rock made up of rounded pebbles of varying sizes in matrix.

Desert sandstone (Triassic)
Medium grains of sand easily seen, made of glassy mineral called quartz, poorly stuck together by iron oxide cement. Red in colour.

Limestone
Grey crystalline sedimentary rock consisting mainly of calcium carbonate that was deposited by the remains of marine animals.

Mudstone
Fine grained, dark sedimentary rock made up of silt and clay particles.

Oolitic limestone
Perfectly round grains stuck together (like fish eggs). Mostly made of calcite and creamy coloured.

Sandstone (Carboniferous age)
Medium grained light brown sandstone consisting of quartz grains with brown iron oxide cement.

METAMORPHIC SAMPLES

Gneiss
(pronounced 'nice')
Crystalline rock arranged in bands. Colour-banded pink to black with grey layers.

Mica schist
Crystalline rock with leaflike "wrinkled" layered structure. Bright, reflecting and silvery in colour.

Slate
Fine grained rock that can be split into thin layers. Grey to pale purple in colour.

White marble
Crystalline rock made of calcite, with a sugary texture. Pure white in colour unless impurities are present.

IGNEOUS SAMPLES

Granite
Large coarse grained crystals that can be easily seen. White, cream or pink in colour - feldspar. Glassy, colourless - quartz. Shiny black or silvery - mica.

Amygdaloidal basalt
Black or greyish black fine grained rock. The white 'blobs' are gas holes in the lava, later filled in with minerals.

Dolerite
Black coloured medium grained rock.

Gabbro
Greenish-black coarse grained igneous rock.

Basalt, dolerite and gabbro all have the same chemistry and mineral content, i.e. Fe/mg silicates, feldspars and iron ore minerals.

Samples of sedimentary, metamorphic and igneous rocks can be found in the rock samples box. Please be aware that whilst we try to ensure all the rocks in the box are safe for students to handle, extra care should be taken with the slate sample, as these edges can be sharp.

Glossary

Compression – pressing or squeezing together.

Deposition – the dropping of sediment load when moving water, air or ice slows down or stops.

Erosion – wearing away by water, wind, glacial ice or gravity.

Extrusive rock – forms when molten rock comes to the surface and cools rapidly.

Igneous rock – rock that has solidified from the molten state.

Intrusive rock – molten rock that has cooled and solidified slowly underground.

Lithification – the process of turning sediment into sedimentary rock: first air and water are squeezed out from between the particles, then water-borne minerals cement the particles together.

Metamorphic rock – changed rock - recrystallised, by heat and/or increased pressure.

Metamorphism – change of form, involving some recrystallisation of the original rock, but without melting.

Sedimentary rock – rock formed when sediments are compacted and cemented together.

Sediments – the matter that settles to the bottom of a fluid: material deposited by water, wind or glaciers.

Weathering – the action of atmospheric agencies, plants and animals in breaking down exposed rock, prior to its removal by erosion.