Stories in stone

UNIT A5

Using the analogy of pages from a book, this unit looks at how scientists interpret evidence.

Using this unit

This unit involves interpreting information, group discussion and presenting findings to the class.

Pupils will find it helpful to be able to look at, and examine, describe and discuss some specimens of sedimentary, metamorphic and igneous rocks.

An old paperback novel that could be cut up will be required.

The ideas for this unit are based on the following articles:
'Color Me Metamorphic' by Donald L. Birdd in *The Science Teacher* (April 1990) Vol 57 (4) pp. 21-25;
'Book bits' by Joe Riederer *The Science Teacher* (October, 1991) Vol 58 (7) pp. 50 - 54.

Links with KS3 programme of study

- The interplay between empirical questions, evidence and scientific explanations (Sc1 ideas and evidence).
- The role of creative thought in the development of scientific ideas (Sc1 ideas and evidence).
- How igneous, sedimentary and metamorphic rocks are formed (Sc3 materials and their properties).

Moral and spiritual aims

- To communicate a view of science as a human communal activity which seeks to build up a fallible picture of the history of the universe from partial evidence.

TEACHER'S NOTES

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Notes on the activities

The wax crayon cycle - page 32

The idea here is to simulate the rock cycle using wax crayons. It is best done as a teacher demonstration.

Stage 1. Start to sharpen the wax crayons with a pencil sharpener (this represents the erosion of rock). Save all the shavings (these represent the sediment). Compress the sediment between two pieces of wood. (If different coloured crayons are used, this can represent different layers of sediment.) Put some of the 'sedimentary rock' aside.

Stage 2. Using a G-clamp tightly compress the sedimentary rock (to represent the metamorphic stage). Put some of the 'metamorphic rock' aside.

Stage 3. Using a hot-plate, very gently heat the compressed wax until it becomes molten (to represent the igneous phase). Some of the liquid wax can then be dropped into cold water to cool rapidly and the remainder left to cool slowly at room temperature. (This represents the different cooling rates of intrusive and extrusive igneous rock.)

Stage 4. Students can then compare the different types of 'rock'.

Reading the rocks: preparation - page 33

Choose a paperback novel (the Penguin 60s provide a good cheap source). Cut off the spine and top margin if it contains the title and/or author's name. Cut the remainder into different sized pieces. Each pupil is given a 'rock fragment' from the book. After the class presentations in Activity 2, encourage the pupils to ask questions of fellow 'researchers'.

Answers to questions in 'The wax crayon cycle'

1. Sedimentary; mud and sand.
2. Igneous; cools/condenses; solid.
3. Metamorphic/molten; heat; pressure.
4. They can complete this from the rock cycle diagram.

Selected answers to Activity 3

6. You may get closer and closer to it but finding the whole and complete story will be impossible.
7. Healthy scepticism on the part of scientists is useful. Many theories have had to change (see Charis Science Units 1-11, unit 8, 'Continental Drift').
8. Some different, unusual or conflicting evidence might cause ideas to be modified. Conflicting evidences are called 'anomalies'; they are either pushed to one side and forgotten about or, if enough anomalies accumulate, they may threaten the validity of a theory. It is very difficult for widely held ideas to change (see again Charis Science Units 1-11, unit 8).
9. This is analogous to a rock deformity; huge sections may be missing.

Questions 8-11 are extension questions which could be used for homework or for a bigger group discussion.

Stories in stone

UNIT A5

How can you read the story hidden in rocks? Is it the same as reading a story from a book?

This unit aims to help you to understand how scientists work together to build up a picture of the history of rock formation.

The rock cycle

You may already have studied the water cycle, and you will also study the carbon and nitrogen cycles. But here is another cycle: the rock cycle.

Cycles are very useful: very little material ever gets lost. We encourage each other to try to be environmentally friendly by 'recycling' materials such as paper, cans, glass, etc.

The Earth is made up of a limited amount of rock, the particles of which go round in a cycle. First of all, rock is not wasted and secondly, different sorts of rock are produced. These rocks will have different characteristics and therefore different uses. For example, slate from Cumbria and Wales is used for roofing material because it is waterproof and can be split into thin layers.

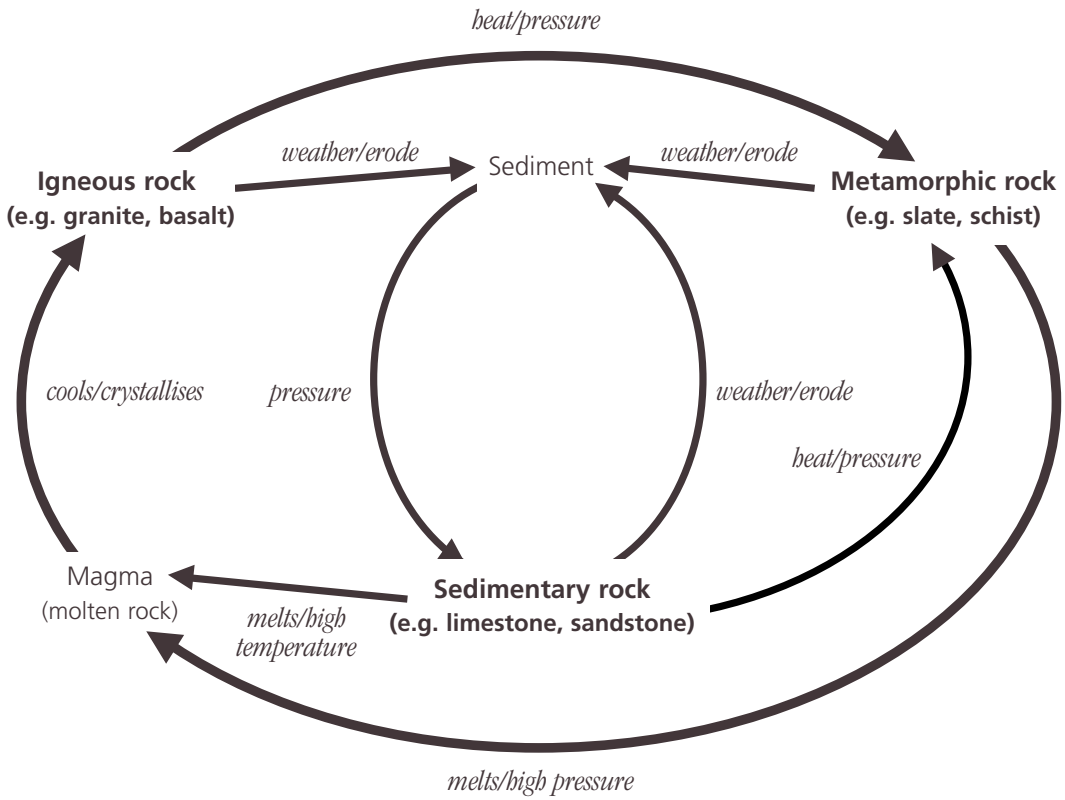
Three types of rock

Scientists have identified three main types of rock. These are **sedimentary**, **igneous** and **metamorphic** rocks.

Looking at the names of the different types of rock, can you join up the rock's name with how it was formed?

Sedimentary rocks	rocks that have been changed (morphed) by heat and pressure
Metamorphic rocks	made from rock that has been heated, melted and crystallised
Igneous rocks	made from tiny pieces of rock settling in layers

The rock cycle

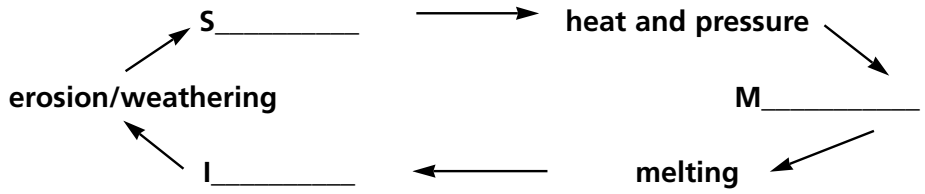


Wax crayon cycle

This is not another cycle found in science or the physical world but a model to show how the rock cycle might work. Your teacher will show this as a demonstration to the whole class.

Copy and complete these sentences

1. S_____ rocks are formed from layers of _____ deposited by seas, rivers and wind.
2. I_____ rocks such as granite and basalt, are formed when molten magma c_____ and turns to a s_____.
3. M_____ rocks are formed deep underground. The original rock is changed by h_____ and p_____.
4. Copy and complete these boxes to show a simplified rock cycle.



Reading the rocks

Rock fragments and fossils have been likened to pieces of a jigsaw that tell us something of the history of the Earth. You are going to examine pieces of a story book to see what it tells us about the whole book from which it comes. This is rather like Earth scientists trying to read the Earth's story from the rocks.

Look carefully at the piece of a book (rock fragment) that has been given to you.

1

(On your own)

Using the information you have on your paper fragment, list all the information that you can from the pretend 'rock fragment'. Can you suggest ideas that fit the story in the 'rocks' to explain:

- What characters are to be found in the book?
- What is the time period of the story?
- When was the book written?
- Who was the author?

2

(In threes or fours)

Scientists seldom work alone. They form research teams. Join up with three or four others and share your results. Can you develop a bigger picture that takes into account all the information obtained?

Can you predict what else other researchers may find? What guesses would you make about your book and do you think that another researcher would be able to confirm what you have guessed?

Scientists form part of a community. An important part of a scientific community is sharing ideas, evidence and experimental results. Scientists often publish their results in research journals or present them at conferences. Scientists also make guesses about what information could fill the gaps in their evidence or in their theory.

Appoint a group spokesperson to present your findings to the rest of the class (the scientific community).

3

1. Who are the main characters of the story?
2. What was the time period of the story?
3. Where was the story set?
4. When was the book written?
5. What does the story tell you about the author?
6. Will you ever be able to know, for sure, the full story contained in the book?
7. How confident are you, as researchers, that the scientific community (the whole class) is interpreting the story correctly?
8. What might be found in a single rock fragment that would force the scientific community to modify their ideas?
9. How would your understanding of the story be affected if fifty pages from the middle were removed? How would this affect your rock record?
10. How important is it that scientists share their findings with other scientists?
11. Can you be totally confident that the story you read from the rocks is accurate?

Changing theories

Scientific ideas are changing all the time. We cannot always be sure that we have all the information. Scientists once thought that the Sun moves around the Earth; we now think that the Earth moves around the Sun. Scientists once thought that light was a wave, and then became convinced that it was a particle; they now think it shows both wave and particle behaviour at the same time, depending upon the experiment being conducted! Our ideas have to change all the time.

As you worked out the story, it was vital to read the words. How did the words in the book get written down? Were they the result of an intelligence or merely a coincidence?

What about the rock cycle? Is there an intelligence behind it or is it merely the result of an accident?

Can scientists tell us whether the universe exists by chance or by design?