

James Hutton – or ‘Mr. Rock Cycle’? Thinking towards the rock cycle, the Hutton way

James Hutton - Try thinking like James Hutton in the 1700s by asking these questions. Remember that, at that time, most people thought that the oldest rock on Earth was granite, which had crystallised from an early ocean, and all other rocks lay on top; the Earth had formed like this, just 6000 years ago.



James Hutton – the ‘Founder of Modern Geology’.

Painting of James Hutton by Abner Lowe. This image is in the public domain because its copyright has expired.

Soil - Hutton was a farmer. He observed that soil was being eroded all the time but that a thick blanket of soil always remained. He asked himself ‘Where does the new soil come from?’ So - where does new soil come from?

A. *New soil is formed as decaying plants mix with weathered rock, helped by animals like worms in the soil – so it is a result of rock weathering.*

Sedimentary rocks - Hutton saw that beds of sedimentary rocks looked like the layers in modern sediments. He asked, ‘Why do sedimentary rocks look like modern sediments?’ So - why are sedimentary rocks similar to modern sediments?

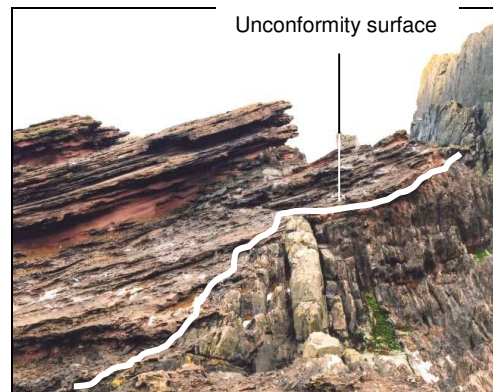
A. *Sedimentary rocks were modern sediments once, deposited long ago, before becoming hardened into rocks. This idea that ancient rocks were originally formed by processes active on Earth today, was later called, ‘the principle of Uniformitarianism’ – simply stated, ‘the present is the key to the past’.*

Uplift - Hutton observed that while the land was being eroded all the time, it never went below sea level. He asked himself, ‘Why is the Earth’s surface never eroded below sea level?’ So - why is this so?

A. *There must be some process that lifts bedrock up from time to time – that we now call uplift.*

At Hutton’s time steam engines were being developed and showed that things expanded when they became hot. Hutton saw that some layers of rocks had been tilted upwards. He asked himself, ‘Could the heating of deep layers of rocks cause rocks to be bent upwards and uplifted?’ So - could this be so?

A. *It is possible that heating deep rocks could cause some uplift, but we now know that the main mechanism causing uplift is Plate Tectonics, which wasn’t understood until the 1960s.*



‘Hutton’s Unconformity’ at Siccar Point in Scotland.

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Cycles - Hutton’s fieldwork showed that where rocks were tilted upwards, they could be eroded and new sedimentary layers could be laid down on the top. He thought, ‘Could there be more than one cycle of sediment being deposited, hardened into rock and then uplifted? So - can there be more than one cycle like this? If so, what is the cycle called?’

A. *We now know that there can be many cycles of deposition, rock-formation and uplift – this is the sedimentary part of the ‘the rock cycle’. The place where new sedimentary layers were deposited on top of older uplifted and eroded layers we now call an ‘unconformity’.*

Granite - Although most people at the time thought granite had crystallised from an ancient sea, Hutton’s fieldwork showed that it had once been molten. What clues might Hutton have found to show that granite was once molten magma?

A. *He found places where the granite had flowed into the surrounding rock, as dykes and veins.*

Time - Hutton asked himself, ‘How long would it take for rocks to be cycled?’ So - how long do you think it would take for old uplifted rocks to be eroded, new layers to be deposited, made into rocks and uplifted again?

A. *Hutton had no idea of the amount of time this must have taken, but when one of his friends realised what Hutton was saying, he wrote, ‘The mind seemed to grow giddy by looking so far into the abyss of time’ and Hutton himself wrote that the cycles had, ‘no vestige of a beginning - no prospect of an end’. Now we know that a complete ‘turn’ of the rock cycle takes millions of years.*

Rock cycle - Which parts of the rock cycle had Hutton ‘discovered’ in his work?

A. *Hutton understood weathering and erosion, sediment deposition, how sedimentary and igneous (granite) rocks were formed, that rocks were uplifted, and that all this would take a lot of time – time that we now call ‘geological time’.*

Hutton ‘discovered’ most of the rock cycle – maybe we should now call him, ‘Mr. Rock Cycle’!

The back up

Title: James Hutton – or ‘Mr. Rock Cycle’?

Subtitle: Thinking towards the rock cycle, the Hutton way.

Topic: A series of questions and answers that attempt to outline the possible thoughts of James Hutton as he developed his ideas in the context of what we now call the rock cycle.

Age range of pupils: 14 – 18 years

Time needed to complete activity: 15 mins

Pupil learning outcomes: Pupils can:

- describe and explain how Hutton’s thinking may have developed towards the ‘rock cycle’ idea;
- show understanding of many of the processes and products of the rock cycle.

Context: Study of James Hutton’s book ‘*Theory of the Earth*’, published in 1788 shows that he had developed many of the ideas that we have now come to associate with the rock cycle. Hutton’s work didn’t become widely known until it was publicised by John Playfair in his book, ‘*Illustrations of the Huttonian Theory of the Earth*’ published in 1802. After that, Hutton’s ideas were widely used and developed, particularly by Charles Lyell in his three volume book, ‘*The Principles of Geology*’ published between 1830 and 1833. Lyell’s work, in turn, strongly influenced Charles Darwin as he developed his theory of evolution. For these reasons, Hutton is now widely regarded as ‘the Founder of Modern Geology’. Hutton was a Scottish farmer and naturalist, who travelled widely and played a vital role in the development of scientific and other ideas in Scotland in the late 1700s (the time called ‘the Scottish enlightenment’)

Following up the activity:

Follow up the development of Hutton’s thinking by following Darwin’s thinking in the ‘Darwin’s ‘big soil idea’ and ‘Darwin’s ‘big coral atoll idea’ Earthlearningideas.

Try to make your own unconformity using the ‘The Himalayas in 30 seconds!’ activity, by removing the top of the folds and replacing them with horizontal layers of sand and flour.

Underlying principles:

- Rocks at the Earth’s surface are weathered and then eroded to form sediment.
- Sediment is deposited in layers to form sedimentary sequences.
- Sedimentary sequences become sedimentary rocks.
- Granite is formed by slow crystallisation from magma.
- Rocks are uplifted by natural Earth processes; this allows the rock cycle to continue cycling.
- A full ‘turn’ of the rock cycle takes millions of years.

Thinking skill development:

‘Thinking like Hutton’ involves bridging between the current ideas of the pupils and the ways in which geologists may have thought in the past. By its nature, such a process also involves construction, cognitive conflict and metacognition.

Resource list:

- imaginative minds.

Useful links:

You can find more about James Hutton, how his thinking developed, and how important this was in the development of geology, by typing “James Hutton” into an internet search engine, like *Google*.

Source: Developed by Chris King of the Earthlearningidea Team.

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