

Darwin's 'big soil idea'

Can you work out how Charles Darwin 'discovered' how soil formed?

Charles Darwin was puzzled. He was interested in how soil formed and his cousin Elizabeth had written to him in 1837,

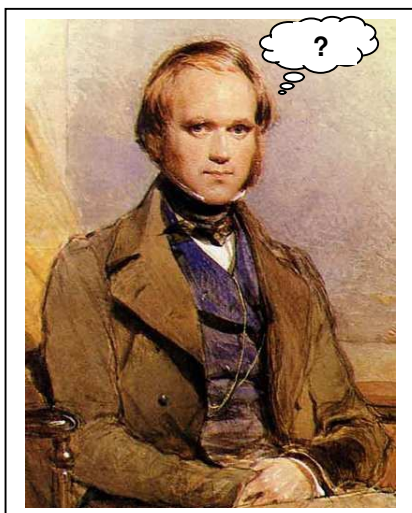
"William Dabb's bog meadow ... was sanded on the grass surface so as to be completely covered ... in the spring of 1835. ... An irregular stratum [layer] of sand is now found about ¾ inch [2 cm] below the surface ..."

He wondered – how could a layer of sand put on the surface of a field be 2 cm below the surface just 2 ½ years later?

Elizabeth's letter went on,

"William Dabb's old croft [field] ... was marled [covered by a thin layer of marl to make the soil more fertile] when his mother was a girl [about 80 years ago] ... [The marl] is found at 12 inches [30 cm deep][now] ..."

Darwin thought – how could a layer put on the top of a field 80 years ago be 30–35 cm deep now?



Charles Darwin at age 33; painted by George Richmond in 1840.

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So, Darwin's problem was to explain how material spread on top of soil could be under the surface just a few years later. This was a real problem because, at that time, nearly everyone thought that soil had been on Earth for ever and had been formed when the Earth formed.

- What could the answer be?
- How could you explain how layers could sink through soil?
- What could you do to test your idea?



A close up image of an earthworm.

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Darwin thought the answer must be 'worms' and built his own wormery to study them. He published his ideas in a book about worms and said.

"I was thus led to conclude, that all the vegetable mould [soil] over the whole country has passed many times through, and will again pass many times through, the intestinal canal of worms."

He ended,

"The plough is one of the most ancient and valuable of man's inventions; but long before he existed the land was in fact regularly ploughed, and still continues to be thus ploughed by earthworms. It may be doubted whether there are many other animals which have played so important a part in the history of the world, as have these lowly organized creatures."

Darwin had shown that soil is formed by worms that eat through the mixture of dead plant material and broken down rock and then eject the mixture as soil – he was the first person to 'discover' and describe how soil forms. He was also the first person to 'discover' just how important worms are to soil, to life on Earth, and to you and me!

Try building your own wormery like this one:



A 'Do-it-Yourself' wormery.

This and the following wormery photos – Peter Kennett.

- Cut the top and bottom off a plastic bottle.
- Put some damp soil into a pot and add about ten earthworms.
- Put the plastic bottle on top of the soil and add different layers; we used layers of red sand, white sand and soil.
- Put some grass and dead leaves on top.
- Cover the bottle with black plastic or paper so the worms think they're underground.
- Make sure it is all kept damp (but not too wet) and leave it for a few days.
- Then take off the covering to find out what has happened. Will you find out what Darwin discovered?

The back up

Title: Darwin's 'big soil idea'

Subtitle: Can you work out how Charles Darwin 'discovered' how soil formed?

Topic: Finding out how Charles Darwin 'discovered' soil by using the evidence he used and trying to think as he thought, including building a wormery like he did.

Age range of pupils: 10 – 19 years

Time needed to complete activity: To think through the evidence as Darwin did – 15 mins; to build a wormery – 1 hour; to see how the wormery progresses – several days.

Pupil learning outcomes: Pupils can:

- describe how observations can be used to develop a scientific idea or hypothesis;
- describe how such a hypothesis could be tested;
- describe how Darwin's thinking developed and how he tested his ideas and came to his conclusions;
- make observations of changes in a wormery over several days;
- build a wormery.

Context: Pupils are asked to think through how soil forms, as Darwin did in the 1830s, then to suggest how he could have tested his ideas. They then are invited to either build their own wormery or observe one that a teacher has built. Our wormery developed as follows over several days.



The 'Do-it-Yourself' wormery after 6 days.



The 'Do-it-Yourself' wormery after 15 days.

wormeries with different layers of sand, soil, chalk, organic material (grass, leaves, vegetable peelings, etc.) to see how the action of the worms affects the layers.

Underlying principles:

- Soil is formed of two main 'ingredients' weathered rock debris from below and organic material (humus) from above.
- However, the effects of life on the soil are paramount; worms play a critical role in reworking the soil through their intestines, but the many other animals that live in soil have critical roles as well, as does the rotting vegetation.
- Soil is formed by biological weathering; biological and biochemical activity on the physical debris of rocks.
- Soil formation is one example of the complex relationships between the lithosphere, hydrosphere, atmosphere and biosphere necessary for maintaining life on our planet.

Thinking skill development:

Considering Darwin's evidence and asking the questions he did involves construction, cognitive conflict and metacognition. Taking the practical steps to test the ideas, including building a wormery and evaluating the results, involves bridging.

Resource list:

- The 'thinking like Darwin' needs no apparatus or materials
- To build a 'Do-it-Yourself' wormery, you will need:
 - a plastic bottle (eg. 2 litres)
 - scissors to cut off the top and bottom
 - a pot to stand the bottle in (eg. a plant pot)
 - a trowel or spade to dig up soil and earthworms
 - earthworms (about ten) collected from the soil
 - sand of one or more colours – enough to make the layers shown
 - leaves, grass cuttings, etc.
 - a black sheet (plastic or paper) to cover the bottle

Useful links:

See how soil and worms can be introduced to children at: www.newlife.ecsd.net/Let%20it%20Grow%20AA.htm

Another wormery 'recipe' can be found at: http://www.wakeuptowaste.org/index/education/teachers/curriculum-assistance/green_waste/build_a_wormery.htm

Source: Written by Chris King of the Earthlearningidea Team.

Following up the activity: Try investigating the conditions that worms like best by making several

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