LAVA OR VINEGAR?

How science models can create misconceptions

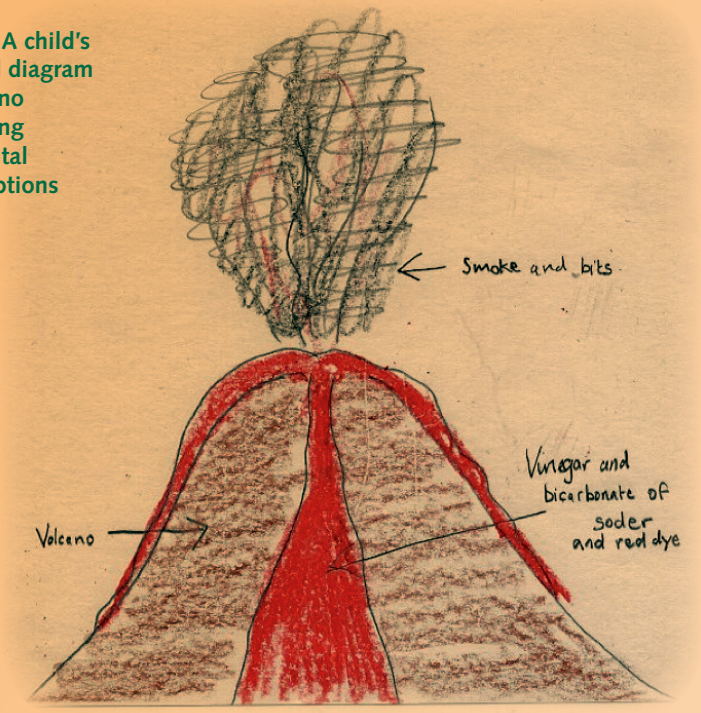

Figure 1 A child's annotated diagram of a volcano highlighting fundamental misconceptions

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consider the misconceptions that can result from common practical work demonstrations and how to avoid them

How would you respond to a child who had drawn a diagram to explain an erupting volcano with labels indicating misconceptions (Figure 1)? What would you do for a child who thought vinegar was the liquid at the centre of Mount Etna?

The picture above was handed to a student teacher on her placement in a class of 9- to 10-year-old children. The student had wanted to find out what her class knew about volcanoes and earthquakes, before embarking on a cross-curricular project focusing on 'natural disasters'. She was delighted when she observed 'Eddie' drawing a volcano, which, from a distance, seemed to show knowledge of the constituent parts. Imagine the student's consternation when she looked more closely and saw words such as '*bicarbonate of soder*' and '*vingar*' on the drawing. Seemingly, Eddie had remembered a science practical involving a 'volcano' being 'made' by mixing sodium bicarbonate with red dye and vinegar. He had a clear memory of the highly visual 'wow' moment but sadly had failed to realise that the materials used to create the 'volcano' in science were not the same as those in real life.

Through discussion, the student learnt that Eddie had seen photographs of real volcanoes on the internet and, from television news, knew that when one erupted it could cause immense damage and was '*burny hot*'. It came as a surprise then to the student to learn that, despite knowing that the vinegar was cold and that heat and fire were not features of the science demonstration, Eddie had still thought that volcanoes were the result of mixing common, kitchen ingredients. Gently, the student helped Eddie to appreciate the geographical components of the volcano, with the result that future diagrams included labels such as '*lava*', '*magma*', '*vent*' and '*crater*'. For the student's tutor who was observing the lesson, however, there were many more questions to answer, when she later returned to the university, on the use of science demonstrations to illustrate geographical phenomena.

Demonstrations used in science

Discussion with teachers and a search of the internet revealed a number of demonstrations often used in primary school science to illustrate geographical phenomena. These are listed in Box 1.

All these demonstrations create a lasting sense of wonder: later in

Key words: Misconceptions ■ Geography ■ Models

Box 1 Some common models used in primary schools to illustrate geographical phenomena

Modelling geysers using Mentos and Diet Coke

- **Geysers**. Dropping Mentos into a bottle of Diet Coke.
- **Rock formation**. Chocolate is first scraped and compressed (sedimentary rock). Then it is floated in foil or a cake case on hot water to melt and then cool (metamorphic rock). The 'sedimentary and metamorphic rocks' are then placed with some of the original chocolate in foil over very hot water and cooled (igneous rock).
- **Lava lamp**. A jar is a quarter filled with water and almost to the top with vegetable oil. Once separate layers have formed, food dye is added to colour the water. Finally, an effervescent vitamin tablet is dropped in.

Modelling a lava lamp using household products

- **Fossil formation**. A model is pressed into plasticine to make a mould, which is then filled with Plaster of Paris to make a 'fossil'.
- **Rain cycle**. Water is boiled in a kettle to produce steam. A teacher, wearing protective gloves, holds a pie dish containing ice cubes and water above the steam causing water vapour to condense and form droplets.
- **Tornado.** A large plastic bottle is almost filled with water and a few drops of washing-up liquid are added. The lid is screwed on tightly and the bottle is inverted and swirled vigorously.
- **Icebergs.** Water coloured with a drop of food dye is frozen in a large plastic tub and then floated in a water tray.
- **Volcano.** Bicarbonate of soda, red food dye and vinegar are mixed and added to a plastic bottle in a volcano model.

Making a model volcano

life children remember a highly visual experience and, probably, a pleasing degree of mess. Yet, given Eddie's volcano diagram, we have to ask whether the impact of the demonstrations on children's geographical knowledge is meaningful or just confusing. Should the geographical terms be used within the science demonstrations? Dropping Mentos into Diet Coke does not create a hot geyser. Fossils are not formed by filling a mould with Plaster of Paris. Alternatively, should we just query the way the demonstrations are used and ensure that the teaching of both the geography and science concepts go hand in hand?

Moving forward

A strand of 'Understanding the World' within the Early Years Foundation Stage curriculum for England asks children to '*know about similarities and differences*'. Perhaps this aspect should be a focus throughout the primary years as we encourage children to understand the differences between the science demonstration or model and the geographical process. When Eddie had a thorough understanding of the geography behind the volcano, he was then very eager to repeat the scientific 'volcano' and could clearly explain what the vinegar and dye represented. He used technical language correctly and had a thorough understanding of both the chemistry of mixing materials and '*how real volcanoes happen*'.

Further reading

Holbrey, C. (2018) Explosive storytelling. *Primary Geography*, **97**.

Linfield, R. S. (2000) *How things happen in the natural world*. Harlow: Pearson Education.

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