***Stegosaurus***



This fossil of a *Stegosaurus* dinosaur is kept at the Natural History Museum in London, UK.

It has been given the nickname Sophie.

Dr Charlotte Brassey is a scientist.

She has studied the fossil of Sophie the *Stegosaurus*.



The *Stegosaurus* is a very

well-known type of dinosaur.

But we have only found fossils from fewer than ten individual *Stegosaurus*.

Sophie is the most complete

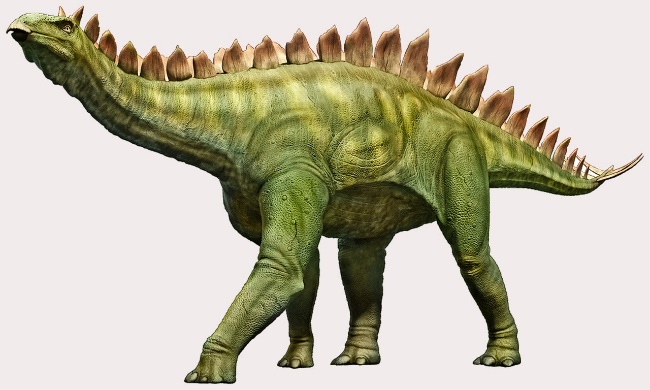
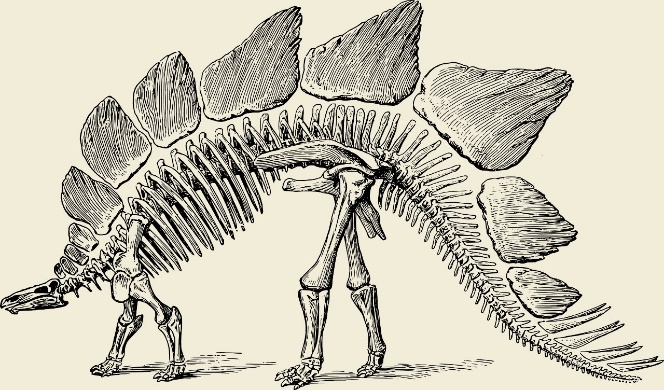
*Stegosaurus* fossil ever discovered.

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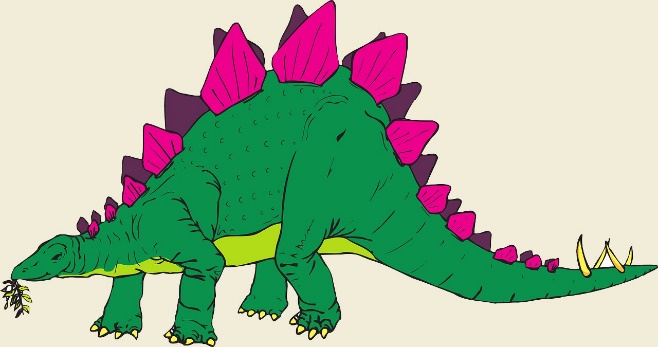
The fossilized skull of Sophie the *Stegosaurus* was found in many small pieces.

Scientists had to work out how to put the skull back together.

**To talk about in your group**







Many different pictures of *Stegosaurus* have been made.

1. How were these pictures of *Stegosaurus* made?
2. Could you decide which picture looks the most like a real *Stegosaurus*?
3. Why might none of the pictures look exactly like a real *Stegosaurus*?

*Biology> Big idea BVE: Variation, adaptation and evolution > Topic BVE1: Variation > Key concept BVE1.2: Changes in species over time – fossil evidence*

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| **Response activity** |
| ***Stegosaurus*** |

**Overview**

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| Learning focus: | The fossil record provides evidence that species change over time, but it is incomplete and there are limitations to the conclusions that can be drawn from it. |
| Observable learning outcome: | Explain why there are limitations to the conclusions and explanations that can be made from fossil evidence. |
| Activity type: | Discussion |
| Key words: | fossils, evolution |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic question:

* Diagnostic question: *Archaeopteryx*

**What does the research say?**

Numerous authors have recognised that young children find fossils interesting and thus that fossils can be used to increase student engagement in learning about evolution (e.g. Earland, 2004; Borgerding and Raven, 2018; Hunter et al., 2018).

Some authors have also noted that fossils provide a useful context for leaning about the nature of science, e.g. collecting evidence, making observations, and making inferences from evidence (e.g. Gift and Krasny, 2003; Balmer, 2015). Hence, fossils could be used as a context in which to explore ideas about the limitations of the conclusions and explanations that can be made from evidence.

**Ways to use this activity**

Students should complete this activity in pairs or small groups. The focus of the activity should be on group discussion. It is through the discussions that students can check their understanding and develop their explanations. Listening in to the conversations of each group will often give you insights into how your students are thinking.

After their discussions, each group should be prepared to report the key points of their discussion to another group, or to the class.

*Differentiation*

The quality of the group discussions can be improved with a careful selection of groups; or by allocating specific roles to students in each group. For example, you may choose to select a student with strong prior knowledge as a scribe, and forbid them from contributing any of their own answers. They may question the others and only write down what they have been told. This strategy encourages contributions from more members of each group.

**Expected answers**

Students are likely to come up with many ideas in their discussions. Some useful ideas include:

*How were these pictures of* Stegosaurus *made?*

Most dinosaurs are extinct, so there are no living *Stegosaurus* left upon which to base drawings. Humans were not alive at the same time as *Stegosaurus*, so there are no records of observations made at the time.

They were drawn using imagination and creativity, and there was some guesswork involved. They may or may not have been drawn by scientists.

They may or may not have been based on fossil evidence – e.g. shapes and sizes of ‘body fossils’ including fossilised bones and other parts body parts, or information from ‘trace fossils’ such as fossilised faeces, footprints and feeding marks, or fossil evidence that suggests colours – students familiar with *Archaeopteryx* may know that scientists studying those fossils have found preserved microscopic structures that make the pigments found in feathers.

*Could you decide which picture looks the most like a real* Stegosaurus*?*

It would be very difficult, if not impossible, to decide which picture looks the most like a real *Stegosaurus*. Most dinosaurs are extinct, so there are no living *Stegosaurus* left to compare with the drawings.

*Why might none of the pictures look exactly like a real* Stegosaurus*?*

Fewer than ten *Stegosaurus* fossils have been found, so all of our knowledge of what *Stegosaurus* looked like comes from these few individuals. These individuals may or may not have been typical representatives of their species. Scientists and artists make assumptions that the rest of the species looked like the few fossilised individuals we have found.

There would be variation between individual *Stegosaurus* (and differences between species of *Stegosaurus*, as *Stegosaurus* is a genus), caused by differences in their genomes and environmental factors (e.g. diet, disease, injury). The fossilised individuals that have been found may have been different age, sex or species.

*Stegosaurus* remains may have been damaged or changed during the fossilisation process, or in the very long period before the fossil was found. Sophie is the most complete *Stegosaurus* fossil ever discovered, so the others are all less complete. This means whole animals have been drawn from incomplete fossil evidence. Fossils may be damaged or broken (as was the case with the fossilised skull of Sophie the *Stegosaurus*). Scientists have to use imagination and guesswork when piecing individuals back together from fossilised parts and fragments.

**Note**

A limited selection of *Stegosaurus* drawings could be included in this resource due to licensing issues, but they could be replaced by or supplemented with others from books or the internet when this activity is used with students – or students could be challenged to find their own examples.

Carefully selected images could be used to show how our understanding changes over time as new evidence is discovered and new technology allows evidence to be analysed in different ways. For example: depictions of *Stegosaurus* from the 1800s show the back plates lying flat across the back of the animal, more like a pangolin. In another example of changing depictions, scientists have recently switched from portraying the tail dragging along the ground to it being held aloft.

**Acknowledgments**

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Images: fossil skeleton of Sophie the Stegosaurus – WikimediaCommons/Paul Hudson; photograph of Dr Brassey – Charlotte Brassey; skull fragments – Alistair Moore; drawing of *Stegosaurus* (top left) – pixabay.com/Parker\_West (3129447); drawing of *Stegosaurus* (top right) – pixabay.com/OpenClipart-Vectors (148318); other drawings of *Stegosaurus* – pixabay.com/Clker-Free-Vector-Images (44843; 48217; 312691)

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