Year 9

Conceptual narrative Science: The Earth's surface

In the Earth and space sciences sub-strand, there are two main conceptual threads being developed from Foundation through to Year 10, Earth in space and the Earth's surface.

Big ideas

The theory of plate tectonics can explain global geological activity.

What concepts do I want my students to understand?

We want students to understand that the theory of plate tectonics has several ideas:

- The Earth's crust is made of separate plates. These plates move slowly and in different directions.
- Currents in the hot molten rock of the mantle drive this and these ideas can be used to explain and predict geological activity, such as earthquakes and volcanoes at the plate boundaries.

Appendix 1 shows how the three interwoven strands, Science Understanding, Science as a Human Endeavour and Science Inquiry Skills, work together to build the sophistication and complexity of the science concepts from Foundation to Year 10.

This conceptual narrative illustrates one of the nine science concepts from the Australian Curriculum: Science Content structure. It tells the story of the concept in isolation of the eight others. However, there are situations when it is advisable to teach both concepts (Earth in space and the Earth's surface) together, because they complement each other.

Note: Not all concepts are specifically addressed in each year level.

Introduction

What might my students already know about this concept?

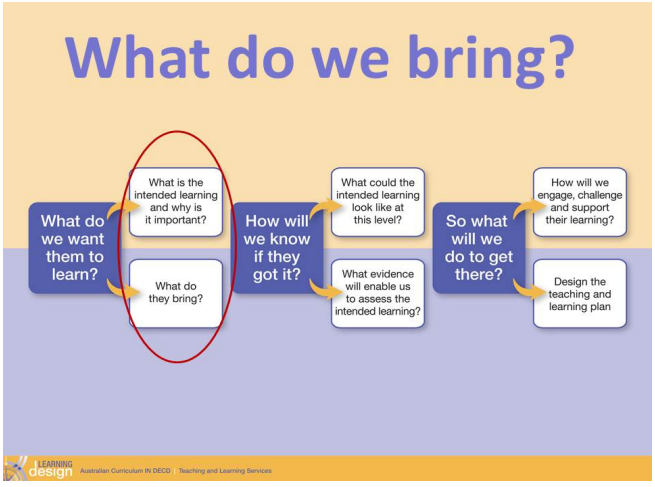
Students may understand that:

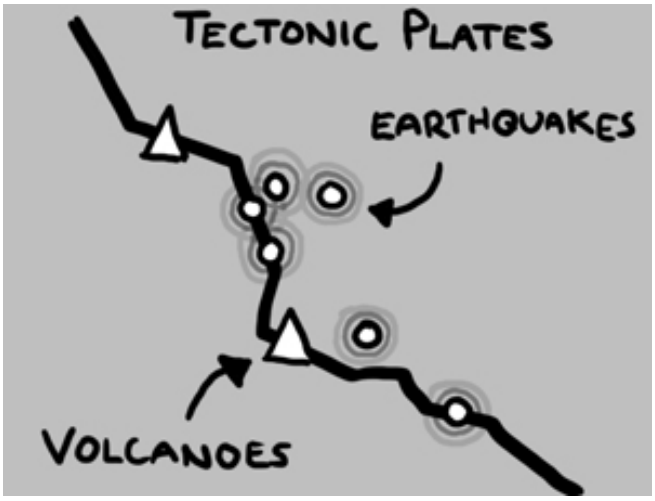
- There are both gradual and sudden changes in the surface of the Earth.
- Sudden changes occur in patterns over the surface of the Earth.
- Molten rock from the interior of the Earth is involved in the formation of new rocks.

What content could I use to explore this concept?

We could investigate this concept through explaining and predicting recent disasters, investigating the evidence for continental drift or a historical study of the contributions of the scientists that led to the current theory.

Now to bring the essence of scientific understanding to life, let's think about this concept through the six questions from the Bringing it to Life tool (BitL).





In Year 9, we want our students to understand that geological activity can be explained on a global and local scale by the theory of plate tectonics.

Year 9 example

In this example I want my students to investigate the evidence for continental drift.

What do you observe?

How can I help my students make observations?

Using the BitL questions, I could ask:

- *What do you observe?*

In Year 9, I want my students to make observations that change over time and geographically. In this case they will need to use secondary data sources such as geological maps of the world, fossil distributions and records of palaeomagnetism. Questions I could ask include:

- *What do you notice about the coastlines of Africa and South America?*
- *What is the same and different about the mountains of North America, Greenland and Scotland? The fossil distribution of Glossopteris?*
- *What other patterns do you notice?*

What patterns and relationships can you see?

How can I help students to see patterns and relationships? What questions might my students ask?

Student's curiosity leads them to ask questions. These questions help students to order their findings into a pattern to be able to make comparisons or find relationships. These questions support students to be more precise and foster analysis and classification of the observations.

Using the BitL questions, I could ask:

- *What patterns and relationships can you see?*

At Year 9, I want my students to start using models to reveal patterns from their observations. I could ask them to cut out the continents of the world from a map and move them around. Students could also do this digitally. Questions I might ask are:

- *What happens if you put the continents' similar edges together?*
- *In how many different ways can you get them to fit? Which is the simplest?*
- *What would have happened for the world to go from this to what it looks like now?*
- *What might make the continents move?*

What do you predict will happen?

How can I help students to identify and formulate investigable questions?

Students ask testable questions that help them to narrow the focus of the inquiry. These questions provide opportunities for students to make predictions.

Using the BitL questions, I could ask:

- *What do you predict will happen?*

In Year 9, I want my students to predict what they think might happen by formulating a scientifically testable hypothesis. Using their cut out map, I could ask:

- *What might the world look like in the future?*
- *What if we thought of the mantle as a boiling liquid?*
- *How might this explain what makes the continents move?*

What investigations could you design?

These questions support students to develop science inquiry skills and problem solve.

Using the BitL questions, I could ask:

- *What investigations could you design?*

At Year 9, I want my students to know how to use an inquiry approach to answer scientific questions in situations where they are unable to collect first hand data. I would ask the students:

- *What evidence could support your prediction?*
- *Where could you find it?*
- *What was it originally collected for?*
- *Why can't you collect first hand data about this?*
- *How will you consider fairness?*

How can you review and communicate?

How can I help students share their observations and questions?

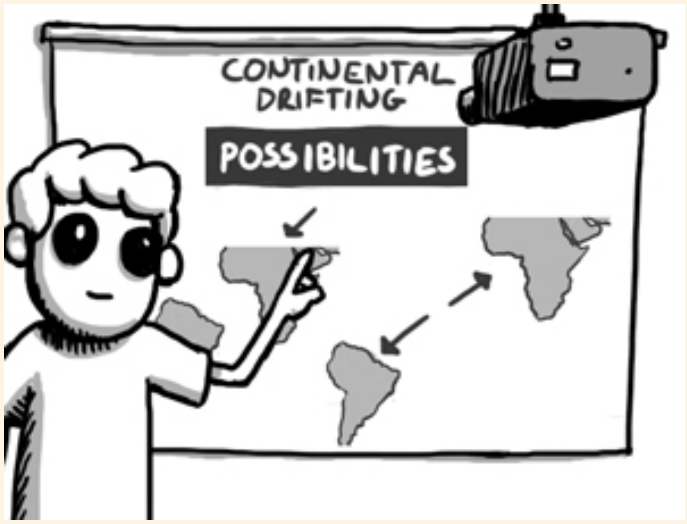
These questions stimulate student's reasoning and help them analyse, draw conclusions and make generalisations about the concepts.

Using the BitL questions, I could ask:

- *How can you review and communicate?*

At Year 9, I want my students to analyse and communicate any patterns they discover, and evaluate their results. I also want them to consider the source of uncertainty in their results and ways to improve the quality of the data. I would ask my students:

- *How could you effectively communicate this?*
- *How could you model the process to help people understand it?*
- *What other interpretations of this evidence might people have? Why might they think this?*
- *What arguments are there against your interpretation? How would you respond?*



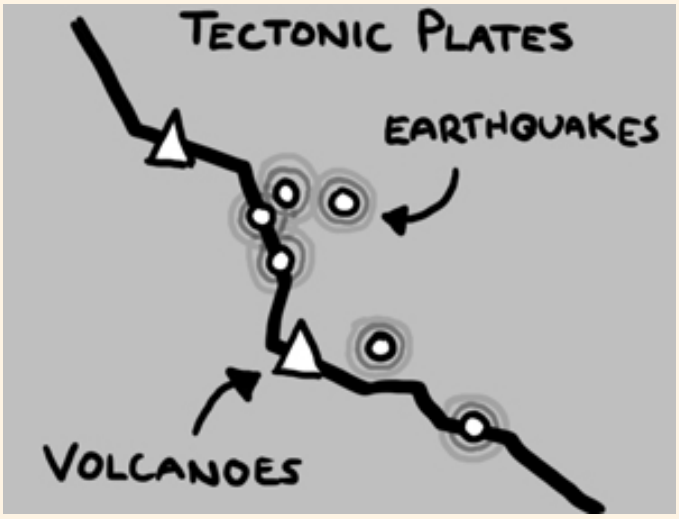
So what? What next?

How can I help students apply the concepts in a range of authentic contexts?

These questions support student's reasoning, to expand or change their ideas from their experience and evidence and generalise to new contexts.

Using the BitL questions, I could ask:

- *So what? What next?*
- *Who might be interested in this? Why?*
- *What implications does it have for the Earth today?*
- *How might this change the way people think about sudden geologic events like earthquakes and volcanic eruptions?*



Concluding comments

What concepts might students develop through working with the BitL questions in this way?

By exploring this science understanding through these questions, we can help our students to be able to think, work and process scientifically. Students can connect science to their world and consider why it is important for us to understand how the Earth has changed over very long time frames.

Appendix 1

Appendix 1 shows how the three interwoven strands, Science Understanding, Science as a Human Endeavour and Science Inquiry Skills, work together to build the sophistication and complexity of the science concepts from Foundation to Year 10.

This conceptual narrative illustrates one of the nine science concepts from the Australian Curriculum: Science Content structure. These concepts develop in depth and breadth of understanding from Foundation to Year 10. This conceptual narrative tells the story of the concept in isolation of the eight others. However, there are situations when it is advisable to teach both concepts (Earth in space and the Earth's surface) together, because they complement each other.

Note: Not all concepts are specifically addressed in each year level.

Earth and space sciences

In the Earth and space sciences sub-strand, there are two main conceptual threads being developed from Foundation through to Year 10. They are the concepts Earth in space and the Earth's surface. Let's look at the concept the Earth's surface.

Foundation

This begins in the Foundation year with students linking the weather to the effects it has on their daily life, for example how the weather can determine what clothing they wear.

Year 1

In Year 1, students observe changes in the landscape, such as water evaporating from a puddle or a sand castle washing away after the tide comes in.

Year 2

In Year 2, students focus on how we use resources from the Earth, including water. We want students to understand how they use water so they can identify ways to conserve water.

Year 4

At Year 4, students look at a range of changes to the surface of the Earth over time. Students group these changes as those caused by natural agents such as erosion or by human activity such as deforestation.

Year 6

In Year 6, students learn that sudden geological changes like earthquakes and volcanoes, and extreme weather conditions like hurricanes can affect the Earth's surface.

Year 7

In Year 7, students group the Earth's resources as renewable or non-renewable. For example, students can compare fossil fuels which take millions of years to form with wood that grows in decades and biofuel that grows in months. They also learn about the water cycle and that water is as an important resource.

Year 8

In Year 8, students develop an understanding of the rock cycle. They consider the timescale of the processes and formation of igneous, sedimentary and metamorphic rocks. Students also learn that rocks are made up of minerals.

Year 9

When students are in Year 9, they use the theory of plate tectonics to explain how major continental plate movement predicts areas prone to earthquakes and volcanic activity. Students identify global patterns of geological activity, such as considering the role of heat energy and convection currents in the movement of tectonic plates, and relating the extreme age and stability of a large part of the Australian continent to its plate tectonic history.

Year 10

In Year 10, students understand the connections between the different systems that make up the surface of the Earth. They appreciate how cycles of carbon and other materials involve interactions in the hydrosphere, lithosphere, atmosphere and biosphere. Students learn the role of carbon in the greenhouse effect and its effects on biodiversity.

So from Foundation to Year 10, students broaden and deepen their understanding by building on from their thinking about changes in their immediate surroundings, to consider those in the wider world, and then use models and theories to describe, explain, predict and generalise.