

## Overview

This report describes how sedimentologist Dr Greg Browne found mysterious marks in rocks near the top of the South Island. The marks set him wondering how they were formed, eventually leading him to the theory that they were dinosaur footprints. The headings indicate the progress of his investigations, clearly illustrating the way scientists gather and

share evidence to support their ideas. The text includes diagrams and maps to help readers locate the time and place in which dinosaurs may have roamed New Zealand.

Texts related by theme

“When Life Nearly Ended” SJ 4.1.10 | “The Mystery of Tunguska” SJ 4.2.08

## Text characteristics from the year 8 reading standard

metaphor, analogy, and connotative language that is open to interpretation

sentences that vary in length, including long, complex sentences that contain a lot of information

complex layers of meaning, and/or information that is irrelevant to the identified purpose for reading (that is, competing information), requiring students to infer meanings or make judgments

academic and content-specific vocabulary

**On the Dinosaur Trail**  
by Sue Gibbison

Millions of years ago, New Zealand was part of a supercontinent that we call Gondwanaland. But the great chunk of land scientists now call Zealandia was slowly breaking away from Gondwanaland, carrying with it a cargo of plants and animals that may have been the ancestors of New Zealand's own unique species. Included in that cargo were dinosaurs. Until now, dinosaur remains had been discovered in only three parts of New Zealand: Hawke's Bay, Port Waikato, and Rēkohu (the Chatham Islands). No trace of the creatures had ever been found in the South Island.

**The Mesozoic Era**

PANGAEA

Triassic Period (251–200 million years ago)

LAURASIA

GONDWANALAND

Jurassic Period (200–145 million years ago)

ZEALANDIA

Cretaceous Period (145–65 million years ago)

**Old rocks, strange shapes**

What the South Island has always had, though, are some of New Zealand's oldest rocks. The most ancient were formed 510 million years ago – long before the first dinosaurs. At Whanganui Inlet (near the very top of the South Island), geologists have also found layers of sandstone that are 70 million years old. These date to the Mesozoic era,<sup>1</sup> a time when dinosaurs did roam Zealandia, although the sandstone was then tidal mudflats. Since then, the mudflats have been buried, uplifted, and eroded – a process that has eventually returned the ancient dinosaurs' stomping ground to the surface.

Scientists have been studying these rocks around Whanganui Inlet for decades, although they haven't been looking for dinosaurs. Most have been more interested in finding fossil fuels, such as oil, gas, and coal. So after a scientist named Dr Greg Browne noticed some strange, saucer-shaped marks in the rocks, he kept them at the back of his mind.

Dr Browne works in a special branch of geology, studying sediments like sand, mud, and clay. Sedimentologists spend years learning about the environments in which sediments are deposited. Even so, the round shapes Dr Browne saw in the rocks at Whanganui Inlet seemed peculiar. They didn't match anything he'd seen before. "When you see something that you can't make sense of, you start to wonder," he says.

**Mesozoic Rock in New Zealand**

Northland  
Auckland  
Hauraki  
East Cape  
Waikato  
Taupo  
Taranaki  
Hawke's Bay  
Whanganui Inlet  
Nelson  
Westland  
Marlborough  
Canterbury  
Stewart Island  
Fiordland  
Otago  
Southland  
Rēkohu

**KEY**

Rock formed during the age of the dinosaurs (the Mesozoic era)

<sup>1</sup>Between 251 and 65 million years ago

words and phrases with multiple meanings that require students to know and use effective word-solving strategies to retain their focus on meaning

illustrations, photographs, text boxes, diagrams, maps, charts, and graphs, containing main ideas that relate to the text's content

adverbial clauses or connectives that require students to make links across the whole text

## Possible curriculum contexts

### SCIENCE (Nature of Science)

LEVEL 4 – Understanding about science: Identify ways in which scientists work together and provide evidence to support their ideas.

### ENGLISH (Reading)

LEVEL 4 – Structure: Show an increasing understanding of text structures.

### ENGLISH (Writing)

LEVEL 4 – Structure: Organise texts, using a range of appropriate structures.

### Possible reading purposes

- To find out about a dinosaur discovery in New Zealand
- To learn how one scientist gathered evidence to support his theory
- To understand more about the geological history of New Zealand.

See Instructional focus – Reading for illustrations of some of these reading purposes.

### Possible writing purposes

- To explain the process used in an investigation
- To explain the split of Gondwanaland and how New Zealand came to be
- To report on sauropod findings from other countries
- To research and report on other dinosaur finds in New Zealand.

See Instructional focus – Writing for illustrations of some of these writing purposes.

## Text and language challenges

### VOCABULARY:

- Possible unfamiliar and/or specialist words and phrases, including “supercontinent”, “Gondwanaland”, “Triassic”, “Jurassic”, “Cretaceous”, “Mesozoic”, “fossil fuels”, “sedimentologists”, “defined edges”, “physical processes”, “sauropods”, “amphibians”, “time frame”, “herbivores”, “peer review”, “palaeontologists”, “published”, “claimed”, “evolution”, “titanosaurs”, “debated”
- Colloquial or idiomatic language: “stomping ground”, “that’s the way it goes”
- Metaphors: “a cargo of plants and animals”, “kept them at the back of his mind”
- The use of the word “fossil” as an adjective and a noun.

### Possible supporting strategies

- Identify the vocabulary your students will need support with. Preview the vocabulary before reading by brainstorming the topic (dinosaur fossils) or by creating a word map of the terminology associated with fossil finds. Refer to ESOL Online at <http://esolonline.tki.org.nz/ESOL-Online/Teacher-needs/Pedagogy/Vocabulary>
- Also see notes under specific knowledge below.
- Preview the three maps on page 8 with the students, checking they understand how to pronounce the names of the land masses and time periods.
- Identify the topic-specific vocabulary that students need support with to understand this text and the language they are likely to encounter in other contexts. Focus vocabulary learning on the latter. Offer students guidance on which words are most important for them to learn (and which are very low frequency and not such a priority).
- *The English Language Learning Progressions: Introduction*, pages 39–46, has some useful information about learning vocabulary.

### SPECIFIC KNOWLEDGE REQUIRED:

- Knowledge of Earth’s geological time periods
- Knowledge of what fossils are, and how they are formed
- Knowledge of the process of scientific investigation.

### Possible supporting strategies

- Combine support for specific knowledge of time periods and fossils with support for vocabulary. Ideally, create opportunities for students to encounter this background knowledge in practical and concrete ways, for example, by looking at fossils. As the students are doing this, introduce and record key vocabulary as well as key concepts. Make links to these before, during, and after reading. The text is complex, and students should have a lot of lead-in before they start reading.
- Support students to make connections with what they know of scientific investigations and the stages involved.

### TEXT FEATURES AND STRUCTURE:

- A report that contains a recount of a scientific discovery
- The introduction, which establishes the context
- The use of maps to show three different time periods and a map of New Zealand with a key
- The need to interpret complex information about geological and biological changes over time
- Headings that signal three stages in the scientific discovery
- Footnotes and a glossary
- A range of long, complex sentences.

### Possible supporting strategies

- Remind the students to use what they know of reports and recounts to identify key features as they read. If necessary, support students to use the footnotes and the map key.
- Students may require support to negotiate the complex and dense information on pages 8 and 9. Work through the text together, prompting students to make connections within the text and between the text and the maps. Provide other resources that students can use to help clarify the information.
- The text includes a lot of low-frequency vocabulary, highly complex and varied sentence structures, and possibly new concepts within this text. (Ideally the concepts shouldn’t all be new when students start reading.) For students who need more support, try guided or shared reading in groups of three, offering appropriate support for the group, then having them share with the others. You could work on one or two sections per session, then create questions for the next sessions/sections and come back to them.

# Instructional focus – Reading

**Science** (Nature of Science, level 4 – Understanding about science: Identify the ways in which scientists work together and provide evidence to support their ideas.)

## Text excerpts from “On the Dinosaur Trail”

At Whanganui Inlet (near the very top of the South Island), geologists have also found layers of sandstone that are 70 million years old. These date to the Mesozoic era, a time when dinosaurs did roam Zealandia, although the sandstone was then tidal mudflats. Since then, the mudflats have been buried, uplifted, and eroded – a process that has eventually returned the ancient dinosaurs’ stomping ground to the surface.

### Considering the possibilities

Dr Browne considered all the possibilities. He thought about mammals, amphibians, and birds – but none of them seemed likely to have made the marks he had seen.

The age of the rock prints was in the right time frame for dinosaurs, and he knew from his studies that the area had once been a coastal mudflat, a place where dinosaurs might have lived. From plant fossils, he also knew there had been forests where giant herbivores could browse. Dr Browne tracked down studies of dinosaur footprints from overseas. He could see that the marks he’d found matched photographs of sauropod footprints from France and the United States. Everything fitted.

## Students (what they might do)

*Students integrate related pieces of information within the text and make connections with their prior knowledge of land movement and fossils to understand the geological history of sandstone and infer that dinosaurs could have lived in the South Island.*

*Students use the heading to predict that this section will give information to support Browne’s theory. They ask and answer questions about the meaning of the marks. The students use their knowledge of sentence structure to understand that “none of them” refers to the animals listed in the previous clause.*

*Students synthesise information within the text to confirm the facts and the process Dr Browne undertook. They relate their understanding to the statement “Everything fitted”. They make connections with what they know about scientific processes to conclude that Dr Browne will now want to share his findings with other scientists.*

## Teacher (possible deliberate acts of teaching)

**ASK QUESTIONS** to support students to locate information.

- What information does the diagram on page 8 give you?
- Use the information on pages 8 and 9 to work out when the sandstone was formed. Which period was this?
- Which pieces of information might support the theory that dinosaurs could have lived in New Zealand?

If necessary, discuss or share read the text to the help students to identify and list the evidence from pages 8 and 9 that shows that dinosaurs could have lived in the South Island.

**EXPLAIN** that a useful reading strategy is to ask questions in your head as you read. The questions help you to find information.

**MODEL** some possible questions:

- I wonder what it means by “Dr Browne considered all the possibilities”? How did he do this in a scientific way?
- What are the possibilities? Note the forward reference – we know it’s going to tell us the possibilities – as well as the backward reference with “none of them”.
- Were there any possibilities he did not think of? – so it’s actually not literally “all” of the possibilities?

If students need more support with creating questions, ask pairs to create two questions and then share them with other pairs.

**ASK QUESTIONS** to help students clarify their understanding.

- What is Dr Browne’s theory?
- How has he gathered information to support his theory?
- What information supports it?
- What do you think he will do now? Why do scientists need so much evidence before they share their ideas with others?

Some students might benefit from explicit instruction/clarification about the use of the past perfect verb form (“had been”, “he’d found”). It’s meaningful in terms of identifying what he did and what he found out (in the first two sentences). Ask students to identify the main verbs in the first sentence (was, knew, had been, might have lived). Prompt the students to identify that the first two verb forms are past simple and convey the time frame of the recount (in the past in relation to now). Ask them when the area was a mudflat. Draw a timeline going backwards from “now” to “Dr Browne’s research” to the time of the dinosaurs. Explain, or let the students explain, that “had been” expresses a relationship between two pasts – that this was before the research. Tell the students “might have been” expresses a past possibility.

**GIVE FEEDBACK**

- By sharing your knowledge of geological periods. You’ve helped us to understand the vast time periods involved. Connecting to information you’ve read, or seen on TV or the Internet, is important for helping you to understand complex ideas and information.
- The comparison you made to detective work is a useful way of understanding the work of a scientist.

### METACOGNITION

**ASK QUESTIONS** to make the students’ strategies explicit for them.

- Tell me about a place where you had to pause and use strategies to follow the ideas in the text. Which strategies did you use?
- What did you do to work out the author’s purpose?
- How much did you already know about this topic? How did your prior knowledge help you to understand the article?
- What did you think of this article? Would you recommend it to someone else? Why or why not?

Reading standard: by the end of year 8

The Literacy Learning Progressions

Assessment Resource Banks

# Instructional focus – Writing

English (Level 4 – Structure: Organise texts, using a range of appropriate structures.)

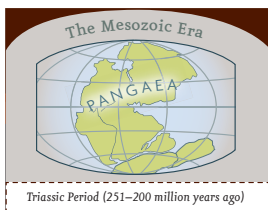
## Text excerpts from “On the Dinosaur Trail”

Dr Browne works in a special branch of geology, studying sediments like sand, mud, and clay. Sedimentologists like him can spend years learning about the environments in which sediments are deposited.

Some of them were in plan view as if they had been stamped on the surface of the rock.

### Starting to wonder

Dr Browne didn't forget about the strange shapes in the rocks. Each time he returned to Whanganui Inlet, he had another look. He thought about how they might have formed, took photos, and made notes. Then he wondered some more.



Next, Dr Browne published a report in the *New Zealand Journal of Geology and Geophysics*. It was called “First New Zealand record of probable dinosaur footprints from the Late Cretaceous North Cape Formation, northwest Nelson.”<sup>2</sup>

<sup>2</sup> Volume 52, issue 4 (December 2009), pages 367–377.

## Examples of text characteristics

### SPECIALIST VOCABULARY

*Technical topics require technical language. Writers consider their audience and give support for working out unfamiliar words, such as incorporating an explanation into the text or adding a glossary or footnote to explain them.*

### HEADINGS AND FIRST SENTENCES

*Headings cue the reader in to what is to come in the following paragraph or section. They are usually brief and capture the main idea of what is to follow.*

*The first sentence in a paragraph or section often contains the key idea, and the following sentences elaborate on that idea.*

### LABELLED DIAGRAMS

*Diagrams visually represent information in the text to help the reader to understand it. The labels need to be clear and succinct and to use terms that are found in the running text.*

### REFERENCES

*Giving the sources of information (citing) gives a text credibility. There are conventions for citing the published work of other authors, and students should seek guidance on these.*

## METACOGNITION

**ASK QUESTIONS** to encourage the students to think more deeply about their writing.

- What were the main messages or ideas you wanted your readers to understand? Do you think you've achieved your purpose? How?
- Why did you use this structure? How does it help you to achieve your purpose?

## Teacher (possible deliberate acts of teaching)

**PROMPT** students to consider their writing intentions.

- How are you making your decisions about topic, purpose, and audience?
- Where will you find the information you need for your writing?
- What structure will best suit your topic and purpose? How will you organise the information you want to convey?

**EXPLAIN** the way specialist vocabulary can be supported.

- You can explain a new word within the text: in this example, the first sentence lets the reader know what Dr Browne does. The next sentence uses the specialist word for his occupation. In this instance, the author assumes readers already know what “sediment” is.
- You can also use a glossary or a footnote.
- Think about the terms you need to use in your writing. What do your readers already know? What (if any) support do you need to give?

**ASK QUESTIONS** to support the students as they draft and edit their writing.

- How have you structured your writing? How do you help your readers to navigate the text?
- If you use headings, does each heading indicate a new topic or subtopic?
- How well does the heading capture the idea of what follows?
- Do the ideas within a section follow logically from each other?
- Will your readers be able to work out how each part of the text fits with the whole?

**ASK QUESTIONS** to support the students to use labelled diagrams.

- Are there some parts of your writing that could use a diagram to help the reader? Ask a partner to read your work and help you find any parts that are confusing.
- If you need a diagram, how will you draw it? What are the most important things to show?
- Will you need arrows or labels? If so, what will they show?
- Ask your partner to check the diagram against the text and give you feedback.

**TELL** students that if they have used another author's work as a source of information (including off the Internet), there are conventions they need to use. This is a very complex area, so step students through the process. Students might be best to just use direct quotes at first rather than attempting to paraphrase.

*You need to be aware that different cultures have different attitudes and conventions around using authorities and “owning” words and knowledge. Students need to have western academic attitudes and conventions clearly explained.*

### GIVE FEEDBACK

- I've learned several new words. The explanations you put in the glossary are really clear and helpful.
- I saw that you'd re-ordered your report to flow better. That's great, it helps me to keep track of the ideas you've covered.
- Your headings are great. They're amusing, but each one does its job of letting the reader know what's coming.