

Overview

The Great Barrier Reef is very beautiful – and threatened. This report describes the Great Barrier Reef and explains what coral is. It also outlines the threats to the reef from climate change and its “evil twin”, ocean acidification.

The article contains subject-specific terms and explanations that will integrate well with other studies of how living things are threatened by change. It is well supported with photos, detailed diagrams, and a map. In an open ending, readers are challenged to think about how reefs may change and how we can all help to reduce our greenhouse gas emissions.

Texts related by theme

“The Emperor of Peka Peka Beach” SJ L4 Oct 2012 | “Plight of the Sea Turtle” SJ 3.2.08

Text characteristics from the year 8 reading standard

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

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

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

Warming Sea Water

The zooxanthellae that live inside polyps are important suppliers of food for coral – and they also provide a coral’s colour – but under stress, a polyp expels these zooxanthellae, turning the coral white. This process is known as coral bleaching. Although corals can survive bleaching, they’re more likely to die in this state. This is because without zooxanthellae corals risk starving to death.

Coral bleaching occurs when sea water becomes 2–3 degrees warmer than its normal temperature. When the water eventually cools, surviving corals take back the zooxanthellae and live on – although it can take up to thirty years for a reef to fully recover from a bleaching event.

Mass bleaching events affect hundreds of square kilometres and are highly destructive to coral reef ecosystems. The Great Barrier Reef has had six mass bleaching events since they were first reported in 1980. Around half of the reef bleached in 1998, when sea temperatures in the area were the highest on record. Further ocean warming is expected to cause more frequent mass bleachings, giving corals less time to recover between events.



A sorry sight: bleached staghorn coral in the Keppel Islands, Great Barrier Reef

Ocean Acidification

And let’s not forget about ocean acidification that evil twin of climate change. Around a third of all the carbon dioxide added to Earth’s atmosphere since 1900 (mostly from people burning oil, coal, and gas) has dissolved in the ocean. This has been good news for us on land because it’s reduced the amount of climate change we’ve experienced. But over the last few decades, the ocean’s delicate balance has come under threat. Before industrial times, sea water had a pH* of 8.2; now it’s 8.1. This may not sound like a big difference, but it has huge consequences for the ocean.

Some scientists predict that, at a worst-case scenario sea water will have a pH of 7.8 by the end of the century. This estimate is based on carbon dioxide emissions continuing at the current rate. How a significant change like this will affect marine life is a big question. Scientists agree that more acidic sea water will make it harder for corals to build their calcium carbonate exoskeletons – and they will be weaker and more likely to break off during storms. An ocean pH below 7.95 will cause coral exoskeletons to begin dissolving in the ocean. Corals will also grow more slowly and be more vulnerable to stress and disease.

Other marine creatures with calcium carbonate shells or exoskeletons will be affected in similar ways. These creatures include plankton, mussels, sea urchins, crabs, and some kinds of algae. Research is showing that some species are better at coping with variations in the pH level than others. Some marine plants and animals will survive; others will probably become extinct.

* A pH level measures (on a scale of 0–14) the level of acidity or alkalinity of a substance. Anything that measures below 7 is acidic; anything above 7 is alkaline. Water has a pH level of 7 and is considered neutral.

academic and content-specific vocabulary

complex layers of meaning, ... requiring students to infer meanings or make judgments

Possible curriculum contexts

SCIENCE (Living World)

Level 4 – Ecology: Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced.

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 learn about the corals that make up the Great Barrier Reef and why they are in danger
- To learn about the combination of factors that create good or bad environments for corals
- To identify another reason for concern about global warming.

See [Instructional focus – Reading](#) for illustrations of some of these reading purposes.

Possible writing purposes

- To write a persuasive text, supporting changes that will save the corals
- To research and write about another effect of global warming
- To research and write about the way another living thing is suited to its habitat and how it responds to environmental changes.

See [Instructional focus – Writing](#) for illustrations of some of these writing purposes.

 The New Zealand Curriculum

Text and language challenges

VOCABULARY:

- Possibly unfamiliar words and terms, including “snorkelling”, “mesmerised”, “vibrantly”, “ecosystems”, “teem”, “greenhouse gases”, “acidification”, “polyps”, “exoskeleton”, “carbonate”, “calcification”, “plankton”, “Conveniently”, “zooxanthellae”, “stress”, “expels”, “bleaching”, “mass bleaching events”, “industrial times”, “consequences”, “emissions”, “significant”, “vulnerable”, “variations”, “alkalinity”, “alkaline”, “neutral”, “devastating”, “colonies”, “high-resolution”, “artificially acidified”, “widespread”, “fishers”, “submersibles”
- The technical term, pH, which is explained in a footnote
- The acronym “NIWA” and its full name.

Possible supporting strategies

Preview the text to identify words (in particular, subject-specific terms) you may need to pre-teach. Select a small number of words, such as “ecosystems”, “greenhouse gases”, “stress”, “emissions”, “vulnerable”, and “colonies” to focus on. Provide a definition for each word before reading (ensuring that your definitions apply in the context of the article), asking students to record the words and definitions in a notebook. Reinforce the meanings during reading, then explore further nuances and their application in a range of contexts after reading.

Students could chart the names of the different fish and corals, making a visual glossary for use by the class.

The English Language Learning Progressions: Introduction, pages 39–46, has useful information about learning vocabulary.

SPECIFIC KNOWLEDGE REQUIRED:

- Knowledge of where the Great Barrier Reef is and what it is
- Knowledge of the ways living things are suited to their habitats and how they may respond to environmental changes
- Knowledge of climate change and some of the ways it is manifested
- Knowledge of the effects of climate change on environments.

Possible supporting strategies

Use a map of the Pacific to help students place the Great Barrier Reef, as well as other Pacific islands that have coral reefs.

Review students’ knowledge of the key concepts, reminding them to make connections with their prior knowledge as they read. Depending on their broader understanding of science concepts, students may need support to understand concepts such as pH, acidification, calcification, and global warming.

As well as the density and complexity of the text, the concepts are also complex. It may be helpful for English language learners to explore some of the concepts in their first language before reading. As you explore vocabulary, structures, and concepts before reading: find out what students know, make links to their prior knowledge, and build a shared knowledge of the topic and language that will support them.

TEXT FEATURES AND STRUCTURE:

- The detailed explanation of coral, which includes a map and a cut-away diagram with pull-outs and labels
- A footnote that explains pH
- Very broad range of long and complex sentence types
- Very broad range of verb forms, mostly present forms but some past and some future
- Wide range of language signalling relationships between ideas, for example, “Although corals can survive bleaching, they’re” (contrast), “since they were first reported in 1980” (time and sequence), “because it’s reduced the amount of climate change” (reason), “will make it harder for corals to”, “will cause coral exoskeletons to” (cause and effect).

Possible supporting strategies

Preview the text by looking at the headings, pictures, and diagrams so students can gain an overview of the topic and how it is covered. Talk about words that signal relationships and connect ideas. Select one or two types of relationship and go through a few examples, explaining the meanings and the structures. Ask students to look for more examples in a selected section of text. Start keeping charts of connecting words, organising them according to the types of relationships they can signal. (Note that connectives may be able to signal different meanings in different contexts. Also that meanings can be signalled in many different ways. It’s important to approach it in this way and not just create tidy de-contextualised lists.) Support students to start using the language in their writing.

For students who find this text challenging, break the text up, working on it in sections over two or more sessions. After reading the introduction on page 41, prompt students to identify that the first paragraph introduces the topic and the last paragraph defines the main points. After reading the information about coral on pages 42–43, you could use jigsaw reading for pages 44–45: assign some groups to find information about the threat to coral from warming sea water and others information about the threat of ocean acidification, then share their information. (See <http://esolonline.tki.org.nz/ESOL-Online/Teacher-needs/Pedagogy/ESOL-teaching-strategies/Reading/Jigsaw-reading>)

 Sounds and Words

Instructional focus – Reading

Science (Living World, level 4 – Ecology: Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced.)

English (Level 4 – Structure: Show an increasing understanding of text structures.)

Text excerpts from “The Great Barrier Reef”

Imagine snorkelling in the warm, clear water of the Great Barrier Reef, mesmerised by the huge variety of tropical sea life below.

Warmer sea water and ocean acidification both pose a serious threat to the world’s coral reefs. Some scientists warn that if the carbon dioxide level continues to rise at the current rate, coral reefs may disappear within fifty years.

The Great Barrier Reef is the largest coral reef system in the world – and widely considered one of the seven wonders of the natural world.

One piece of coral can be home ... protected by an exoskeleton.

In fact, corals have a clever system for ... on trapping plankton. Conveniently, this food-production system is inside a polyp’s body: plant-like ... the sun and turn it into nutrients that feed the polyp.

An Unknown Future

Both ocean warming and ocean acidification are under the scientific spotlight all around the world. The combination of these two threats may see some coral reefs disappear completely.

Students (what they might do)

The students pronounce the word “mesmerised”. They infer that it means you feel a particular way. They then use the context to work out the meaning. They infer that “mesmerised” could mean your attention is completely focused on the sea life. They check a dictionary to confirm it means transfixed.

The students integrate information, and what they already know about climate change, to infer that the reaction between warm water and carbon dioxide forms acid. They infer that when sea water is too acidic, corals die. The students synthesise information, including the photo and caption, to understand the enormity of the threat to the reef. The students identify emotive language and decide whether it supports facts or opinions.

The students check words in the body text with the diagram, integrating information to understand the magnified sections, the cut-away diagram, and the zooxanthellae in the polyps. They infer that the zooxanthellae are similar to plants and confirm this by checking the text (“plant-like organisms”).

The students use what they have learnt from the text, along with word-recognition strategies, to understand what “devastating consequences” means. They synthesise what they have learnt and evaluate the article in relation to their purpose for reading.

Teacher (possible deliberate acts of teaching)

PROMPT the students to use word-recognition strategies.

- As you come to an unfamiliar word, remember the strategies you can use:
 - > Is the word explained elsewhere in the paragraph?
 - > Can you infer the meaning from the context?
 - > Break the word into chunks or syllables. Is there a root word you know? Is there a prefix or suffix you already know?

Students who don’t know a lot of the vocabulary will benefit from being led through this process and having all of the elements explained. You may need to break the sentence into phrases or clauses and work through the meaning of each one and then explain how it relates to the meaning of the word.

ASK questions to remind students of possible information sources.

- What knowledge or experiences do you bring to this text?
- What new information have you found?
- What does the photo and its caption add to your understanding?

DIRECT the students to start a chart to support them as they synthesise information. Model this, using the extract as the first source of text information.

| What I know | What the text says | What I think | My questions |
|-------------|--------------------|--------------|--------------|
| | | | |

EXPLAIN that they can enter pieces of information (known and from the text) before synthesising. This is written in the third column. They can add any questions.

EXPLAIN that authors give variety of information (both facts and opinions) to support the main ideas they want their audience to understand.

- What language in this section is emotive? Why do you think the author used it?
- Think, pair, and share about how you can identify facts and opinions.

MODEL interpreting the diagram. Point to the main photo, then the yellow arrows, explaining that each one shows a higher magnification of the edge of a coral.

Ask questions to check the students’ understanding.

- The text says corals are animals. What do they eat?
- Are the zooxanthellae their only source of food? How do you know this?
- What questions do you have about how corals live?

PROMPT the students to add to the chart.

- What further thoughts have you had about the information in this text?
- What further questions do you have?
- How could you find answers?
- How would you evaluate the text in relation to your purpose for reading?
- Who should read the article? Why?

GIVE FEEDBACK

- You’ve combined your own experiences of coral reefs to understand how tragic it would be to lose them.

METACOGNITION

- What helped you understand climate change’s “evil twin”? Was the writer correct to use this metaphor?
- How did charting information and your thoughts help you gain a deeper understanding of the article?
- How do you make inferences from a range of information? What thinking processes do you use? What makes it easy or hard?
- What do you do to synthesise information across the text?

Reading standard: by the end of year 8

The Literacy Learning Progressions

Assessment Resource Banks

Instructional focus – Writing

Science (Living World, level 4 – Ecology: Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced.)

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

Text excerpts from “The Great Barrier Reef”

Coral Reefs under Threat

Coral reefs are unique ecosystems that teem with life – but this situation is changing. An increasing ... to warm up, little by little. People have known about this problem But one of these gases, carbon dioxide, is causing a second, lesser known problem. Carbon dioxide is ... of the sea water. Scientists call this process ocean acidification. Some consider it to be the “evil twin” of climate change.

And let’s not forget about ocean acidification, that evil twin of climate change. Around a third of all ... (mostly from burning oil, coal, and gas) has dissolved in the ocean.

Before industrial times, sea water had a pH of 8.2; now it’s 8.1. This may not sound like a big difference, but it has huge consequences for the ocean.*

* A pH level measures (on a scale of 0–14) the level of acidity or alkalinity of a substance. Anything that ... is acidic; anything above 7 is alkaline. Water has a pH level of 7 ... ”.



staghorn coral

A sorry sight: bleached staghorn coral in the Keppel islands, Great Barrier Reef

Examples of text characteristics

CLARIFYING THE TOPIC

The title usually gives an indication of what an article is about, but it needs to be stated clearly, often in an introductory paragraph. In many informational articles, this paragraph makes the topic clear and refers to the sub-topics.

INFORMATION

Writers give a variety of information (both facts and opinions) throughout an article to support the main ideas. This allows readers to make connections, integrate the information, and synthesise as they form their own understanding.

SUBJECT-SPECIFIC VOCABULARY

Writers use subject-specific vocabulary to add precision and authority to their writing. They provide more or less support for the vocabulary they use, depending on the audience they are writing for.

FOOTNOTE

One way of helping readers to understand subject-specific words is to use a footnote.

CAPTIONS

A caption gives information about the image it is linked to. The information can repeat words from the body text, add details, or make a comment. Captions are short and succinct.

Teacher (possible deliberate acts of teaching)

PROMPT the students to consider structure as they form their writing intentions.

- What overall text structure will convey your purpose to your audience?
- How will you organise the information?
- Will you use graphic features as well as words? Will you present your work online or in print – or in some other format?
- What difference will the format make to how you plan and structure your work? For example, if you’re making a short video, will you use storyboards to plan it? Will you use voiceover, “talking heads”, or captions in the video?
- Check that the structures you choose will help you meet your writing purpose.

Students who find this challenging may benefit from analysing the structure of a simplified model and co-constructing a writing frame to use for their writing. (For more information about writing frames, see ESOL Online <http://esolonline.tki.org.nz/ESOL-Online/Teacher-needs/Pedagogy/ESOL-teaching-strategies/Writing/Writing-frames-or-text-frames>)

EXPLAIN that in order to convey new understanding, writers need to provide information that the reader can integrate and synthesise. This means, as writers, they will need to include information from a variety of sources.

ASK QUESTIONS to support students as they select and organise information.

- Are you using information from a range of sources so your readers can synthesise ideas, for example, by comparing and contrasting?
- Will the information help readers to make connections with things they already know?
- Are you allowing readers to ask further questions about the topic?

DIRECT the students to work with a partner to identify subject-specific or challenging words in their writing. Have them discuss each example together.

- As you find each word, think about your audience. Consider:
 - > Will your readers know this term?
 - > Would a simpler term be better?
 - > Can you include an explanation in the text?
 - > Should you put the word in a glossary?
 - > Can you add a footnote to explain the term?

EXPLAIN that images (photos, maps, graphs, diagrams, and so on) are very useful ways of providing information.


- Do the images “speak for themselves” or do you need to write a caption?
- Will your readers need a caption to understand why the image is in the text?

GIVE FEEDBACK

- The template you used for your planning shows what sub-topics you will write about and what information sources you will use. This helps you decide what to include and what you can leave out.
- I’m glad you added a footnote – I didn’t know that term before.
- You’ve expressed the key ideas about ... in different ways. This gave me plenty to think about and allowed me to synthesise the information to develop my own response to the topic.

METACOGNITION

- Why did you organise your text like this? What other structures did you consider?
- How did you decide what to focus on to meet your purpose?
- How hard was it to find information? What sources did you use?
- Did working with a partner make a difference to your decisions? How?

 Writing standard: by the end of year 8

 The Literacy Learning Progressions