

Astrobiology: Finding Extraterrestrial Life

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Overview

This TSM contains a wide range of information and suggestions for teachers to pick and choose from, depending on the needs of their students and their purpose for using the text. The materials provide multiple opportunities for revisiting the text several times.

This article explains the work of astrobiologists and invites students to consider the possibilities of life beyond Earth. It asks what extra-terrestrial life might be like if it does exist. Could we be invaded by a dangerous species, or would the aliens be friendly? It also points out that for centuries, humans have wondered about whether life exists on other planets (as ancient philosophers have recorded). Many students may be surprised to find out that present-day scientists researching the possibilities of life elsewhere conduct much of their research on Earth. There are comparisons made between Antarctica and Mars and speculation that Mars could provide a breakthrough in this fascinating research. The photographs and diagrams will support students' understanding of key ideas.

This article:

- provides facts and speculation about the possibility of extraterrestrial life
- has photographs and labelled diagrams to support the text
- has non-continuous text with subheadings
- has links to related websites.

A PDF of the text is available at www.schooljournal.tki.org.nz

Texts related by theme

“Haritina Mogosanu: Starryteller” SJ L3 May 2017 | “The Trial” SJ L4 May 2017 | “Becoming a Martian” SJ L3 May 2017 | “Who Froze Farrell Flint?” SJ L3 May 2017

Text characteristics from the year 8 reading standard

A main idea of astrobiology borrows its name from the story of Goldilocks. You'll remember how it goes: Goldilocks rejects the bowls of porridge that are too hot or too cold, finally eating the one that's "just right".

Astrobiologists believe that for a planet to support life, it needs to be in a "Goldilocks zone". This means orbiting a star at the perfect distance: not so hot that all water boils away as vapour, not so cold that all water is frozen as ice. A planet must have water to be habitable. This is why scientists also use the term "habitable zone".

Mass is another essential factor if a planet is to have life. The greater the mass of a planet, the more gravity it will have, and gravity allows a planet to hold on to its atmosphere. Having an atmosphere is important because it contains life-giving gases, such as oxygen. A planet with low mass will have low gravity. This means essential gases will escape into space, leaving the planet with little or no breathable atmosphere. Although not a planet, our moon is a good example of this. Because it has low mass, our moon has much less gravity than Earth and virtually no atmosphere.

elements that require interpretation, such as complex plots, sophisticated themes, and abstract ideas

ALONE OR NOT?

Not everyone believes that the universe contains life, especially intelligent life. The famous Italian physicist Enrico Fermi rationalised that intelligent aliens couldn't exist because they'd have made contact by now. His reasoning has become known as Fermi's Paradox. Fermi believed that any intelligent life forms would have been able to colonise space and eventually entire galaxies. So where are they? Fermi's argument is strengthened by the fact that stars and planets are different ages, and any life in these places would have evolved on a different time frame. Think about it: if you were an alien from a

much older planet and had visited Earth four billion years ago, you'd have found nothing. Fermi asserted that the universe has had plenty of time to develop advanced civilisations, and yet we still haven't met anyone. So the obvious conclusion is that we're alone.

Whether you buy into Fermi's thinking or not, the next century will be a fascinating time. Some astrobiologists are predicting "unparalleled" discoveries – and maybe these discoveries will come in your lifetime. Perhaps your generation will be the first to learn the answer to one of the biggest questions of all time.

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

rest of Antarctica, there is no snow or ice.)

Scanning the valley landscape for the first time, you'd be forgiven for thinking it's completely lifeless. There are no trees, no birds, no sign of any animals except for a few mummified seals that have accidentally wandered inland and met a grisly end. Look beneath the surface, however, and the Dry Valleys come alive. Here, you'll find **microbes**. You might even find a few hardy invertebrates that feed on them. Like a green blanket of life, this layer of microbes extends across the region – but it's hidden for a good reason. Rock and soil provide protection from the sun's UV radiation, scouring winds, and extremes of temperature.

The McMurdo Dry Valley region in Antarctica

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

LIFE SUPPORT

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academic and content-specific vocabulary



Reading standard: by the end of year 8

VOCABULARY

Possible supporting strategies

- Possibly unfamiliar words and phrases, including “intrigued”, “domination”, “speculation”, “heresy”, “baptise”, “habitable”, “abundant”, “primitive”, “mummified”, “grisly”, “hardy”, “scouring”, “civilisation”
 - Scientific and subject-specific terms, including “extraterrestrial”, “astrobiologists”, “astronomers”, “orbiting”, “vapour”, “habitable”, “mass”, “gravity”, “atmosphere”, “oxygen”, “solar system”, “planetary neighbour”, “satellite imagery”, “Martian”, “microbes”, “invertebrates”, “UV radiation”, “life-sustaining”, “volcanic activity”, “robotic”, “galaxy”, “evolved”
 - Idiom and simile: “hell-bent”, “slap bang”, “like a green blanket of life”, “buy into”
- It may be helpful to develop a chart of subject-specific vocabulary, along with definitions.
 - Prompt the students to recall strategies they can use to work out the meaning of words.
 - English language learners could create vocabulary cards, or a chart, with a first-language translation and definition of the scientific terms.
 -  Students could use a digital tool such as [Quizlet](#) to make interactive flash cards with terms and images to support understanding.
 - Some of the terms, such as “heresy” and “baptise”, may need cultural sensitivity.
 - Build knowledge of the topic-specific words. For example, ask students to identify the root word where appropriate (planetary – planet, robotic – robot) and explore prefixes (such as astro-) and ask them for other prefixes they know.
 - Have the students focus on the compound words and discuss the meaning of each separate word.
 - Some words may need pre-teaching. Knowledge of your students will determine whether or not this is necessary.
 - *The English Language Learning Progressions: Introduction*, pages 39–46, has useful information about learning vocabulary.
 - See also ESOL Online, Vocabulary, for examples of other strategies to support students with vocabulary.

SPECIFIC KNOWLEDGE REQUIRED

Possible supporting strategies

- Knowledge of the world, including Antarctica
 - Some familiarity with the solar system
 - Understanding of gravity and atmosphere
 - Understanding of the technical information, some of which is abstract, for example, the Goldilocks zone
 - Understanding that scientists work on theories and speculation and try to find evidence to prove their theories
 - Some understanding that living things include life forms that are too small to see
 - Knowledge of acronyms: NASA and SETI
- Activate students' prior knowledge about the solar system and the universe.
 - Display and discuss an image of the solar system.
 -  Get students to explore our solar system using this interactive: [NASA Kids Solar System Exploration](#).
 - Use a globe or atlas to locate Antarctica. Prompt students to share what they know about Antarctica. Draw out ideas about the inhospitable environment (due to the temperature and the harsh weather) and its effect on plants and land-based animals. Elicit students' knowledge about other harsh environments on Earth, for example, deserts in Asia and Africa.
 -  You could use [Google Maps](#) (Earth view) to show the location of Antarctica and other harsh environments and explore images of them.
 - Have the students recall the Goldilocks story, in pairs, to support understanding of the Goldilocks zone. Check that English language learners are familiar with the story “Goldilocks and the Three Bears” – if not, they could access an online version.
 - Gather students' ideas about gravity and atmosphere, using questions to extend thinking.
 - Discuss the investigative process that scientists use, relating it to a classroom inquiry, for example, an evaporation experiment.

TEXT FEATURES AND STRUCTURE

Possible supporting strategies

- A non-fiction article with explanations, descriptions, and some speculation
 - Explanations in the timeless present tense using relating verbs (“is”, “has”), causal words (“because”, “so”), additive conjunctions (“and”, “as well as”), and temporal conjunctions (“when”, “after”)
 - Technical information, supported by diagrams and photographs with captions
 - Reported opinions of philosophers and physicists
 - A sidebar and links to websites
- Before reading, prompt the students to recall what they are likely to find in an article. Ask them to talk with a partner to remind each other of the features of information texts.
 - Skim and scan the text to support understanding of its purpose and the features.
 - Use the text features and the design to form ideas about what the text might reveal.
 - Verbs, conjunctions, and tense can be problematic for some English language learners. To scaffold them, model how to identify features of an explanation text. Have the students identify paragraphs that are mainly describing and paragraphs that are mainly explaining. Demonstrate how to identify and classify connectives. Then have the students work in pairs to read an explanation in the text and create verbal cause–effect chains. Afterwards, they could complete a cloze task (with words supplied) based on another section of the text and focusing on connectives and the passive voice. Then they can try writing their own explanations.
 - Direct students to the diagram on page 28 and, in pairs, have them discuss the key idea it conveys: that conditions on Earth are just right for human habitation.
 - Have the students preview the headings, photos, and captions. Ask them to discuss why some headings are in the form of questions.



Possible curriculum contexts

ENGLISH (Reading)

Level 4 – Ideas: Show an increasing understanding of ideas within, across, and beyond texts.

ENGLISH (Writing)

Level 4 – Ideas: Select, develop, and communicate ideas on a range of topics.

– Language features: Use a range of language features appropriately, showing an increasing understanding of their effects.

SCIENCE (Nature of Science)

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

Possible first reading purpose

- To learn about the work of astrobiologists

Possible subsequent reading purposes

- To explore the essential elements needed to support life
- To develop understanding about the similarities between Mars and Antarctica
- To weigh up the arguments and form an opinion on the possibility of life on other planets

Possible writing purposes

- To explain why the Goldilocks zone is also known as the habitable zone
- To write questions you would like to ask an astrobiologist
- To create a science-fiction story



Instructional focus – Reading

English Level 4 – Ideas: Show an increasing understanding of ideas within, across, and beyond texts.

First reading

- Set the purpose for reading.
- Spend time browsing through the article, encouraging students to chat with a partner.
- Focus on the title, “Astrobiology: Finding Extraterrestrial Life”, to clarify meaning.
- Guide students through sections of the text, allowing time for discussion in pairs and in a group.

If the students struggle with this text

- Direct students to the photographs and diagram.
- Use the strategy of “chunking” a word to make connections with known words, for example, “astro” – relating to outer space; “biology” – the study of living things.
- Invite students to discuss the range of jobs that scientists may be involved in.
- Read the introduction aloud with students following the text. *Who are the questions aimed at?*
- Clarify the meaning of “speculation” and make connections. *When we set up an experiment, we imagine what is going to happen based on what we already know. We form a theory or hypothesis.* The word speculation is sometimes linked to the idea of random guessing. Discuss the way people speculate about aliens, which cannot be based on what we know.
- Suggest students jot down any questions as they read.

Subsequent readings How you approach subsequent readings will depend on your reading purpose.

The teacher

Direct the students to the heading “Life Support” on page 28.

Explain that we are going to focus on what we *do* know about what living things need to survive.

Ask them to look at the diagram and explain it to a partner.

Encourage English language learners to find a partner who speaks their first language and have them discuss the diagram together.

Provide pictures of a range of living things, including things from the plant world and things from the animal world.

- *What is this? Plant or animal? Where would it be found?*

Have students identify the living things and draw conclusions about their needs for thriving and surviving.

- *If this is a plant, where would it thrive? What would it need?*

The teacher

Make connections for students with known settings. Take them outside, or lead them through a visualisation.

- *Bring to mind the main playground. Notice what the surface is made of. What else does it have? Would there be any living things there? Are there any that we can see?*
- *Bring to mind the netball court. Notice what this surface is like ... and so on.*

Direct students to the heading “Mars on Earth” and prompt them to respond to the photographs.

Have them create a comparison chart with headings of “Antarctica: Dry Valleys” and “Mars”.

The students:

- recall the traditional tale “Goldilocks and the Three Bears” identifying connections between the story and the Goldilocks zone described in the diagram and text
- reread the section “Life Support”
- analyse the diagram and explain it to a partner
- draw on their prior knowledge to identify a range of living things and decide what sort of environment the living things will thrive in
- synthesise their prior knowledge and the information in the text to form hypotheses for the possibility of there being living things on other planets.

The students:

- make links between the locations they know and the environments in the text
- form hypotheses and think critically about a location they have never visited to explain where they would get information from to visualise that location
- use the information and photographs in the article to draw conclusions and make comparisons between the two environments
- synthesise information to explain why life can exist in the harshest environments on Earth but not on Mars as far as we know.

GIVE FEEDBACK

- *I was listening to the conversation you were having with your partner when you were making the comparisons. You were both making connections to your prior knowledge and using this with the information in this article to make your comparisons. See if you can form a general statement about the probability of life on Mars based on your comparisons.*

METACOGNITION

- *Was this text as difficult as you first thought? How helpful are the headings? Would it be harder to read if there were no photographs or diagrams?*



Reading standard: by end of year 8



The Literacy Learning Progressions



Assessment Resource Banks

Instructional focus – Writing

English Level 4 – Ideas: Select, form, and express ideas on a range of topics; Language features: Use a range of language features appropriately, showing an increasing understanding of their effects.

Text excerpts from “Astrobiology”

Page 28

A main idea of astrobiology borrows its name from the story of Goldilocks. You’ll remember how it goes: Goldilocks rejects the bowls of porridge that are too hot or too cold, finally eating the one that’s “just right”. Astrobiologists believe that for a planet to support life, it needs to be in a “Goldilocks zone”. This means orbiting a star at the perfect distance: not so hot that all water boils away as vapour, not so cold that all water is frozen as ice. A planet must have water to be habitable, which is why scientists also use the term “habitable zone”.

Examples of text characteristics

EXPLANATION

The language of explanation needs to be clear and reasoned to be plausible. Writers will usually write in the timeless present tense and connect ideas logically. Accompanying diagrams often support the explanation.

Teacher (possible deliberate acts of teaching)

Have the students write an explanation of why the Goldilocks zone is also known as the habitable zone.

DIGITAL TOOLS  Students could write their explanation on a Google Doc so they can give and receive feedback from you and the other students. Students could create a diagram digitally using [Google Drawings](#), or they could do it by hand, then insert a photo of it into their Google Doc.

Encourage students to share ideas to clarify the information.

- *Work with your partner to make sure you both understand what you need to include.*

Revise the use of diagrams.

- *What will be useful for the reader?*
- *Which parts of the diagram will need labels?*
- *Will the position of the diagram be important?*
- *What medium will work best for the effect you want?*

You could turn the diagram into a split information barrier activity. Give each student only part of the information that they need to complete the diagram. Then have the students work in pairs and cooperate together to share their information (without showing their piece of information to each other). For examples, see the [ESOL Online strategies section](#).

Have the students work with a partner to review their explanation.

- *Has your partner given you all the information you need? Is everything labelled in their diagram?*

Page 32

... there’s a broader definition of intelligence we need to consider: the ability to reason, empathise, problem-solve, consider complex ideas, and interact socially. Is there a way we can search for these qualities? Are there tell-tale signs?

ASKING QUESTIONS

Writers include questions when they are wanting to challenge the reader to think more deeply or more critically about the information.

Writers also think about the sort of questions people might have about their topic, which helps them to predict the things their audience will want to know and to provide the information necessary to fully understand the text.

Have students identify areas in their own writing where they would like readers to consider something more deeply and then add one or two questions that will prompt this. Ask them to share their questions with a partner.

- *Are the questions clear? Do they make the reader stop and think about the topic?*

Have students choose a topic and then make a list of questions that they think readers might want to find out about. After they have finished their writing, have them go back and check that they have included enough information to answer all the questions.

Text excerpts from “Astrobiology”

Examples of text characteristics

Teacher (possible deliberate acts of teaching)

Page 32

So what about those aliens of our dreams – or nightmares? Scientists at the SETI (Search for Extraterrestrial Intelligence) Institute have spent many years scanning the galaxy for radio waves in the hope of finding an alien broadcast. They have yet to make contact, but this doesn't mean intelligent life isn't out there. SETI has scanned only a tiny part of the Milky Way, and we know that our galaxy is just one in a vast universe.

USING FACTS IN FICTION

Fiction works because the writer includes plausible ideas that readers can relate to, even when the setting may be beyond their experience. In historical fiction and science fiction, writers sometimes draw on what is known to create a story that readers will be better able to relate to.

METACOGNITION

- Tell me what helps you get started with a piece of writing. When you know what you want to say, how do you decide which words or language features to use?

Invite students to discuss the genre of science fiction. Ask them to share their prior experience of film, television, video games, and written stories.

Lead discussion about possibilities.

- People have been wondering about the possibility of intelligent life on other planets for centuries. How likely do we think it is?
- What is meant by “intelligent life”? Are robots intelligent?
- Are all life forms on Earth intelligent? Or just humans?
- Would there be different types of aliens?

Invite students to use their imaginations to consider an alien life form. Reference the many alien forms in fiction. Have them write a science-fiction story that includes their alien life form.

Prompt prior knowledge of the structure of a successful narrative. Co-create a list of the elements that will move a story along.

Remind students of how scientific knowledge can support a story, for example, by using planet names and the description of a planetary landscape.

Provide choices for students.

- You may want to storyboard your plot – use no more than six frames.
- You can write in prose, with illustrations.
- You can write in a graphic novel style, with speech bubbles.

DIGITAL TOOLS

As above, students could write their story on a Google Doc and use Google Drawings to add illustrations. They could use an online comic or graphic novel application, such as [Pixton](#), [Toondoo](#), or [Storyboard](#), to create and share their stories.

GIVE FEEDBACK

- You have made good use of a diagram to clarify your explanation. Most of your explanation is referenced in the diagram, labels, and captions.



Writing standard: by the end of year 8

The Literacy Learning Progressions