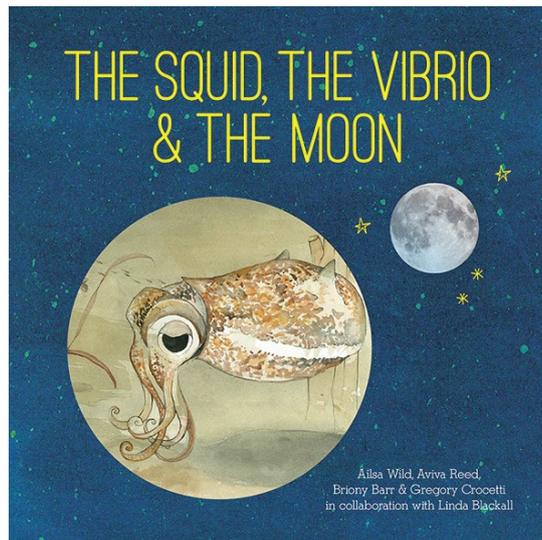


TEACHER NOTES



THE SQUID, THE VIBRIO & THE MOON

Ailsa Wild, Aviva Reed, Briony Barr,
Gregory Crocetti and Linda Blackall

About the book

When he hatches from his egg, Sepio, a baby bobtail squid, is not able to glow. His dark shape is too obvious in the moonlit water and all kinds of predators lurk nearby. Ali, an intrepid *Vibrio fischeri* bacterium, is determined to reach safety too. Can Ali and Sepio help each other?

The Squid, the Vibrio and the Moon is a beautifully illustrated storybook about the symbiotic relationship between the Hawaiian bobtail squid and the bioluminescent bacteria that help it glow in the moonlight.

Originally published in 2014, this book has been extensively re-written to delight and captivate primary-school aged readers.



CSIRO Publishing
Locked Bag 10, Clayton South, VIC 3169, Australia
Tel: 1300 788 000 (local call in Australia)
Fax: +61 (0)3 9545 8550
Email: publishing.sales@csiro.au

TABLE OF CONTENTS



• The Quiz: Questions	1
Exploring Symbiosis	1
Scientific Words	1
• The Quiz: Answers	2
• Drawing Activity	3
• Questions to Discuss	4
• More Questions and Some Jokes	5
Which Scientist is Which?	5
Squid and Bacteria Jokes	5
• Additional Activities	6
Writing Activities	6
Food Web Research Project	6
Food Web Role-Playing Card Game	6
Art Projects	7
• Imagining Activity	8
• Australian Curriculum Links (Year 1—6)	9

KEY LEARNING OUTCOMES



- Learn about scales of distance.
- Understand the concept of symbiosis (living together).
- Reflect on what types of symbiotic relationships affect humans.
- Recognise how some life forms compete, while some cooperate.
- Compare the behaviours of different creatures.
- Collaborate to make a food web and collect data.
- Analyse data to better explain how top predators affect a food web.

THE QUIZ: QUESTIONS

1. Here are the six main characters in the story.

Can you number them from smallest to biggest in size? (1 = smallest, 6 = biggest)



Lizardfish



The Moon



Guardian Haemocyte



Bobtail Squid



Vibrio Bacteria



Monk Seal

EXPLORING SYMBIOSIS

2. In the story, how did Ali, Mai and the other *Vibrio* bacteria help Sepio the squid?

3. In the story, how did Sepio the squid help Ali, Mai and the other *Vibrio* bacteria?

4. The relationship between Sepio the squid and the *Vibrio* bacteria (such as Ali and Mai) is called 'symbiosis'. What do you think the word symbiosis means?

5. Can you think of any other symbiotic relationships in nature – that is, where two different life forms work together to help each other?

6. Are there any relationships in your life which you could describe as symbiotic?

SCIENTIFIC WORDS

7. The *Vibrio* bacteria glowing inside the squid is described at the end of the story as an 'invisibility cloak'. What is the scientific word used to describe when something can blend into its surrounding environment?

8. The bobtail squid sleeps by day and hunts by night. What is the scientific word used to describe this behaviour?

9. Can you think of any other animals that hunt at night?

THE QUIZ: ANSWERS

1. The six main characters – from smallest to biggest are (see pages 2/3):

1. *Vibrio Bacteria*
2. *Guardian Haemocyte*
3. *Bobtail Squid*
4. *Lizardfish*
5. *Monk Seal*
6. *The Moon*

2. In the story, how did Ali, Mai and the other *Vibrio* bacteria help Sepio the squid?

*By glowing inside the light organ (chamber) in the belly of the squid, the *Vibrio* bacteria help the squid camouflage into the moonlit seawater around it while it hunts for shrimp.*

3. In the story, how did Sepio the squid help Ali, Mai and the other *Vibrio* bacteria?

*The bobtail squid pumps food into the light organ (chamber) for the *Vibrio* bacteria.*

4. The relationship between Sepio the squid and the *Vibrio* bacteria (such as Ali and Mai) is called 'symbiosis'. What do you think the word symbiosis means?

Sym = together and Biosis = living (living together). The word 'symbiosis' is used to describe two or more different life forms living closely together (usually helping each other, but not always).

5. Can you think of any other symbiotic relationships in nature – that is, where two different life forms work together to help each other?

- *Clown fish and anemone (clown fish cleans anemone and gets protection in return).*
- *Coral and zooxanthellae (coral provides safe home for zoox, while the zoox create sugar through photosynthesis, and share this with the coral)*
- *Flowering plants (e.g. orchids) and bees (flowers provide nectar for bees, who in return spread their pollen to help them reproduce)*
- *Cleaner shrimp and large fish (cleaner shrimp eats parasites it cleans off fish)*

6. Are there any relationships in your life, which you could maybe describe as symbiotic?

- *Humans and dogs (human provides food, dog provides safety)*
- *Humans and cats (humans provides food, cat catches mice)*
- *Does anyone have grandparents living at their home? How do you help each other?*

7. The *Vibrio* bacteria glowing inside the squid is described at the end of the story as an 'invisibility cloak'. What is the scientific word used to describe when something can blend into its surrounding environment?

Camouflage

8. The bobtail squid sleeps by day and hunts by night. What is the scientific word used to describe this behaviour?

Nocturnal

9. Can you think of any other animals that hunt at night?

Possums, rodents (such as mice and rats), owls, cockroaches, foxes, bats, bandicoots, and more...



DRAWING ACTIVITY

In the space below, or on a separate page, draw your favourite moment from the story...

QUESTIONS TO DISCUSS

Q: The word 'symbiosis' is often used to describe two or more different life forms, which live closely together. However, not all symbioses are to the benefit of everyone. Do you know the name of a symbiotic partner that takes advantage of the other partner, but causes harm? (In other words – something living inside or on the skin of another thing, often causing sickness.)

A: *A parasite*

Q: Can you think of any examples of parasites?

A: *Viruses, nits, lice, ticks, leeches, hookworms. (Be warned – new scientific research is showing hidden benefits from many 'parasites'.)*

Q: Trillions of bacteria live inside the guts of humans (that is, our intestines). Is this a symbiosis?

A: *Yes, bacteria help humans break down (decompose) many parts of our food, creating new vitamins, hormones, antibiotics and more. They also help control our immune system. (Sure, a rogue bacteria occasionally makes us ill, but that's a small price to pay.)*

Q: Can you figure out where the names of the main characters 'Ali' and 'Sepio' came from? HINT: you need to look closely at the science section of the book.

A: *Aliivibrio and Sepioidae*

Q: In the book, the bacterium Mai talks to Ali. Do you think they can actually talk to one another?

A: *No, not with words. However, bacteria can communicate with each other using molecules. In this story, we refer to 'greeting molecules' as an example of one of the ways of communicating. (This is discussed more in 'How do bacteria talk to each other' in the science section of the book.)*

Q: Other than talking, what other ways can humans communicate with each other?

A: *Using other senses:*

- *seeing (sign language/body language)*
- *feeling (braille)*
- *smelling (pheromones, odours)*

Q: If there is a cloudy night, do you think the squid would still want to glow? Why/why not?

A: *No, if there is no moonlight, the squid would not want to glow! Instead, the squid uses its ink sac to cover up the glow of the light organ, so it stays dark.*

Q: Can you think of any other animals that can glow?

A: *Glow worms, fireflies, deep sea fish, phosphorescent algae. (Note – deep sea fish also use *Vibrio fischeri* in their light organs!)*

Q: What would you do if you could glow like Sepio the squid?

A: *Imagine...*

Q: In the story, the monk seal eats some of the bobtail squid – some of Sepio's family. Do you like the character of the monk seal? Why/why not?

A: *The monk seal needs to eat small creatures like squid, octopus, eels, crustaceans and fish to survive, just like Sepio needs to eat smaller creatures than him, like shrimp, to survive. Sadly, monk seals are critically endangered... and need our help.*

Q: In the story, how does Mai know what to do (to safely get inside Sepio)?

A: *On page 2, Mai says, "Follow me...I've done this before!" This means Mai has been inside another squid light organ before! How? (In 'Sleeping by day, hunting by night' in the science section, the book explains 'Each morning, as the squid goes to sleep, it ejects about 95% of the *Vibrio fischeri* bacteria into the seawater. Many of the ejected *Vibrio* will survive long enough to find a new baby squid to live inside'.)*

MORE QUESTIONS & SOME JOKES

WHICH SCIENTIST IS WHICH?

Q: What type of scientist studies bobtail squid or monk seals?

A: Zoologist or marine biologist

Q: What type of scientist studies bacteria like *Vibrio fischeri*?

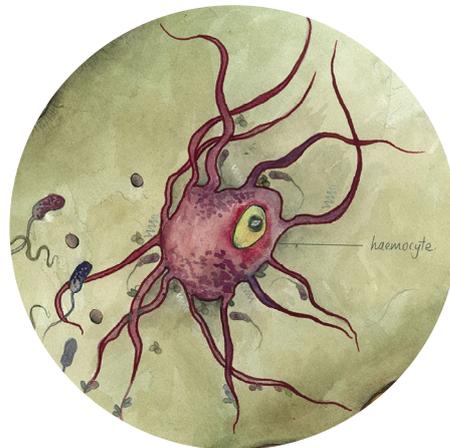
A: Microbiologist

Q: What type of scientist studies Guardian Haemocytes?

A: Immunologist

Q: What else might these kinds of scientists (above) study?

Q: Can you think of names of other kinds of scientists and what they study?



SQUID AND BACTERIA JOKES

Q: Who held the baby squid to ransom?

A: Squidnappers.

Q: How does a squid go to war?

A: Well-armed.

Q: How many tickles does it take to make a squid laugh?

A: Ten-tickles.

Q: Who has eight guns and squirts ink?

A: Billy the Squid.

Q: What did the boy squid say to the girl squid?

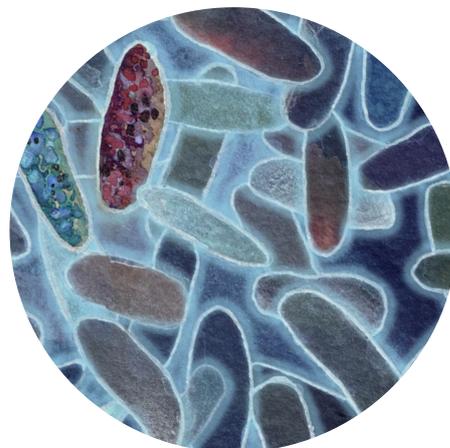
A: I wanna hold your hand, hand, hand, hand, hand, hand, hand, hand.

Q: What did one bacterium say to the other bacterium?

A: Let's make like an amoeba and split.

Q: Why did the bacterium fail the maths test?

A: He thought multiplication was the same as division.



ADDITIONAL ACTIVITIES



WRITING ACTIVITIES

- Tell a story about trying to catch bobtail squid from the viewpoint of the lizardfish.
- Part Two of the story is called 'Sepio's First Day'. Write a short story describing what might happen to Sepio on his second day and night.

FOOD WEB RESEARCH PROJECT

Research and make a drawing of a food web in the ocean, based on the characters in the story.* Students should also include sharks and whales near the top and plant plankton (algae) at the bottom of the food web, alongside bacteria.

- Use red arrows to point from each predator to all of its possible prey, e.g. lizardfish → squid.
- Use green lines to connect cooperation (symbiosis between the bobtail squid and *Vibrio fischeri*)

* The cards from the Food Web role-playing game (Partner-Predator-Prey) can be used to help visualise a food web for the above activity. Students can colour them in and draw extra creatures to complete the food web.

Examples of Food Webs:

- National Geographic:
<https://www.nationalgeographic.org/activity/marine-food-webs/>
- Scholastic Food Web game:
http://teacher.scholastic.com/activities/explorer/ecosystems/be_an_explorer/map/foodweb_play.htm

Online Food Web Activities:

- CoolClassroom Food Web Sorting Game:
http://coolclassroom.org/cool_windows/home.html
- EcoKids Foodweb Chain Reaction activity:
<https://ecokids.ca/play-a-game-and-learn>

FOOD WEB ROLE-PLAYING CARD GAME

The Partner-Predator-Prey food web game explores the roles that different life forms play in the shallow waters of Hawai'i.

It can be played by individuals or pairs on a table-top or by groups of 30 or more players in a classroom. It is perfect for representing and learning about population dynamics within an ecosystem and collecting data to analyse, compare and discuss.

Visit: <http://scalefreenetwork.com.au/teaching-resources/> to download instructions and a set of printable cards (also available for purchase).

ART PROJECTS

- Create shadow puppets of characters from a story in *The Squid, the Vibrio and the Moon* using paper, cardboard and bamboo sticks or dowel. Plan, rehearse and perform a shadow puppet show. Think of an effective way to show the bioluminescence at the end of the story in the performance.
- Create a series of clay sculptures of creatures from the story. Present them in a way that communicates the food web in this story.
- Create two drawings, one that represents the concept of Cooperation (beneficial symbiosis), the other Competition. Can you think of a situation or environment to demonstrate how these relationships operate?
- Make a bobtail squid lamp using LEDs and sculpture materials.
- Create an underwater painting of a moment from the book *The Squid, the Vibrio and the Moon*. You could try using fluorescent paint and a (ultraviolet) black light for the effect of night.



Related Links:

- Story about Squid-*Vibrio* research in Nature News (2015): <http://www.nature.com/news/microbiology-here-s-looking-at-you-squid-1.16698>
- Interview with the book authors on ABC Radio National: <http://www.abc.net.au/radionational/programs/scienceshow/microbes-the-good-guys-in-childrene28099s-storybook/5490576>



IMAGINING ACTIVITY



Make sure you're sitting comfortably. Then close your eyes and relax.

'Imagine you're sitting on a beautiful white sandy beach in Hawai'i, with waves gently lapping at your feet. Down the beach, you see some monk seals basking in the afternoon sun, but know it's not a good idea to approach them.'

As it gets dark, you paddle out into the warm seawater, holding a torch and breathing through your snorkel. You spot a beautiful patterned fish, who doesn't mind your torch glow, and lets you swim slowly beside it. You're swimming around the edge of a large coral mound, with lots of stunning red soft corals, sea anemones and blue sea stars. You sense the water getting very deep not too far away in the distance, and decide to stay in the shallower water, near the coral.'

With a full moon glowing brightly above you and your feet planted firmly in the sand, you decide to turn your torch off...and let your eyes adjust to the dimly lit water.'

Slowly, you start to see new features, like the way the moonlight shimmers across the sandy bottom. And the coral tentacles wafting in unison to the ocean currents, all trying to catch some dinner. You're being very still, as you notice a small school of shrimp swim into view, from out of the deeper water. Their big beady black eyes and tiny little legs fanning through the water are mesmerising. And then suddenly, you notice a tiny glowing shape hovering up through the water towards the shrimp.'

Open your eyes, and write about or draw a picture of what happens next...



AUSTRALIAN CURRICULUM LINKS

YEAR LEVEL	LEARNING AREA: SCIENCE	OTHER LEARNING AREAS
<p>Year 1/2</p>	<p>Science Understanding: Biological Sciences</p> <ul style="list-style-type: none"> • Living things have a variety of external features. ACSSU017 • Living things live in different places where their needs are met. ACSSU211 <p>Science as a Human Endeavour</p> <ul style="list-style-type: none"> • People use science in their daily lives, including when caring for their environment and living things. ACSHE022 <p>Science Inquiry Skills</p> <ul style="list-style-type: none"> • Use a range of methods to sort information, including drawings and provided tables and through discussion, compare observations with predictions. AC SIS027 • Compare observations with those of others. AC SIS213 • Represent and communicate observations and ideas in a variety of ways. AC SIS029 	<p>English</p> <ul style="list-style-type: none"> • Create short imaginative and informative texts that show emerging use of appropriate text structure, sentence-level grammar, word choice, spelling, punctuation and appropriate multimodal elements, for example illustrations and diagrams. ACELY1661 • Create short imaginative, informative and persuasive texts using growing knowledge of text structures and language features for familiar and some less familiar audiences, selecting print and multimodal elements appropriate to the audience and purpose. ACELY1671 <p>The Arts: Visual Arts</p> <ul style="list-style-type: none"> • Use and experiment with different materials, techniques, technologies and processes to make artworks. ACAVAM107 • Create and display artworks to communicate ideas to an audience. ACAVAM108
<p>Year 3/4</p>	<p>Science Understanding: Biological Sciences</p> <ul style="list-style-type: none"> • Living things can be grouped on the basis of observable features and can be distinguished from non-living things. ACSSU044 • Living things depend on each other and the environment to survive. ACSSU073 <p>Science as a Human Endeavour</p> <ul style="list-style-type: none"> • Science involves making predictions and describing patterns and relationships. ACSHE050 • Science knowledge helps people to understand the effect of their actions. ACSHE051 <p>Science Inquiry Skills</p> <ul style="list-style-type: none"> • With guidance, plan and conduct scientific investigations to find answers to questions, considering the safe use of appropriate materials and equipment. AC SIS065 • Represent and communicate observations, ideas and findings using formal and informal representations. AC SIS060 	<p>English</p> <ul style="list-style-type: none"> • Draw connections between personal experiences and the worlds of texts, and share responses with others. ACELT1596 • Learn extended and technical vocabulary and ways of expressing opinion including modal verbs and adverbs. ACELA1484 • Discuss literary experiences with others, sharing responses and expressing a point of view. ACELT1603 • Incorporate new vocabulary from a range of sources into students' own texts including vocabulary encountered in research. ACELA1498 <p>The Arts: Visual Arts</p> <ul style="list-style-type: none"> • Use materials, techniques and processes to explore visual conventions when making artworks. ACAVAM111 • Present artworks and describe how they have used visual conventions to represent their ideas. ACAVAM112
<p>Year 5/6</p>	<p>Science Understanding: Biological Sciences</p> <ul style="list-style-type: none"> • The growth and survival of living things are affected by physical conditions of their environment. ACSSU094 <p>Science as a Human Endeavour</p> <ul style="list-style-type: none"> • Scientific knowledge is used to solve problems and inform personal and community decisions. ACSHE083 <p>Science Inquiry Skills</p> <ul style="list-style-type: none"> • Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate. AC SIS090 	<p>English</p> <ul style="list-style-type: none"> • Use comprehension strategies to analyse information, integrating and linking ideas from a variety of print and digital sources. ACELY1703 • Create literary texts that adapt or combine aspects of texts students have experienced in innovative ways. ACELT1618 <p>The Arts: Visual Arts</p> <ul style="list-style-type: none"> • Develop and apply techniques and processes when making their artworks. ACAVAM115