Teacher's Notes

Stardiving

By Andrew Plant

Published in 2022 by Ford Street Publishing
www.fordstreetpublishing.com/

Synopsis

Fluke is a young sperm whale, living in the heart of a vast ocean with his mother's pod and best friend Amber. Some dolphins gently tease him about how they love seeing the sky and stars, something that is very difficult for a sperm whale. Amber dismisses the dolphins carelessly, but Fluke is intrigued with the idea of the stars. Unable to see them that cloudy night, old bull Cachalot advises him to stop trying to be a dolphin, and be himself, and *dive* for the stars. Fluke heads to the depths and finds a glittering world of bioluminescent animals. He returns to the surface, and tells Amber of what he has found, and together they head back down to the deeps.

Core Issues

- Self-esteem. Fluke feels some jealousy of the dolphins and their agility, and wants to see what they can so easily. He learns that his particular abilities are beyond anything the dolphins can do.
- Acceptance of difference. The dolphins are agile and live between the sea and the sky, but Fluke's deep diving ability allows him to see worlds few other creatures can. Both the dolphins and sperm whales can see stars – just not the same ones. Fluke is delighted and entranced by the huge variety of unusual and very different creatures he meets. He doesn't judge any of them as ugly or weird, but thinks they are all beautiful in their own ways.
- Determination and resilience. Fluke shows courage in heading down to the deeps by himself, aided by Cachalot's implicit belief in him.

Background to Stardiving

I'm not sure exactly when the idea for *Stardiving* came to me. Most stories I've written had their genesis in a very particular episode that I can pinpoint, but this one just seemed to grow out of my fascination for deep sea creatures. Created during the COVID-19 lockdown of 2021 in Melbourne, it went very smoothly; from acceptance by Ford Street Publishing, through editing, planning roughs, and creating all the final art, it was finished in four months. Easily a record for me – The Poppy took over a year and a half!

Story Structure and Related Activities

Books created by an author/illustrator (what I like to call *authorstrators*!) are often fundamentally different to those with a separate author and illustrator. Authors naturally write with words. But when I write, I also write visually. That is, I see the text of a page as pictures as well as words. Then I decide if the words are actually necessary. Often, they're not. The opening spread of *Stardiving* is a perfect example. There is nothing that words could add to the series of images. If anything, words would detract from the sense of silence and space that I wanted to create.

Stardiving's silent images and pages with few words give students the opportunity to extend and extrapolate the story. They can write their own text, describe the action with an emphasis on descriptive adjectives, or describe how they feel, or how the character feels. For upper primary students, they can rewrite the story as a chapter book without any pictures. Encourage students to talk about how they interpret the pictures, and compare and contrast their different responses. Remember, there are no wrong answers.

Language and Literacy

Discussion

- The opening words 'In the heart of a rolling ocean . . .' set the scene without any reference to land, such as 'Far away in a distant ocean . . .' Why do you think the author did this?
- What is the 'silver plume' that Amber makes. Why did the author describe her breath this way, rather than just use 'mist', for example?
- How is the dolphin's personality established when it speaks? What does 'chittering' make you think of? Is it calm and quiet, quick and flighty, or perhaps something else?
- Why does Fluke whisper the name 'Cachalot' rather than just say it? What does this indicate about how Fluke feels about the enormous old whale?
- Cachalot 'rumbled' and 'boomed' and his voice vibrated 'like soft thunder' when he spoke. What does this suggest about his size? He speaks in a very calm and deliberate manner. What does this suggest about his personality and age?
- When Fluke returns to the surface, he lets out his breath in a great 'plume'. Amber lies 'silver' in the moonlight. Where are these words used earlier in the story? What is the effect of using the same uncommon words near the start and end of the story?
- There is no such word as 'stardiving'. What combinations of words does it remind you of? What ideas or pictures does it create? Is it a good description of what Fluke does? Are there other words that could have been used to give the same idea?

Activities

- Find synonyms and antonyms for the following words: lazed, nestled, exhaled, streaked, chittering, snorted, boomed, gleaming, glimmering, shimmering. If you are unfamiliar with any of the words, can you deduce their meaning from their context?
- Alliteration is used when Fluke encounters the deep-sea creatures. Identify the phrases with alliteration.
- (For older students.) Rewrite *Stardiving* as a chapter book with no illustrations. You will need to describe everything; the look of the creatures, the feel of the ocean, and how the characters feel about each other and themselves.

- Pick one of the deep-sea creatures and write about it meeting Fluke from its point of view. Remember how enormous Fluke is compared to all the other creatures, and how he comes from a very alien place – the surface.
- Pick one of the species, and imagine a day in its life. Some move up towards the surface each night, then back down again during the day. Others remain in the deep all their lives. One stays on the sea floor. (*See the species description list below for details on each animal.*) Really think about which senses are important to the animals – how do they see/feel the world? If writing in the first person, try to remove all references to and experiences of being human (not easy!) What do they hunt? What are they afraid of? How would they react if a sperm whale swam past, looking for squid? Remember, it is not cold, nor is there crushing pressure, to the animals that live there – it's just normal life. How can you describe the conditions without referring to how we like things to be? (You could describe the 'awful heat' of water near the surface, the 'blinding light' and 'swarming predators all rushing about'. Perhaps they get a horrible, bloated feeling as all the wonderful pressure disappears if they rise too far. Think of our surface world as a terrifying, alien place no one would want to go to.)
- Fluke, Amber, and Cachalot are all words that relate to sperm whales. Write down their definitions.

Visual Literacy

Discussion

- Before reading the story, look at the front and back cover. What clues can you get from the illustrations that suggest what the story might be about?
- Every illustration is from sea level or below. There are no bird's-eye views from higher above the water. There are no *human* viewpoints, from a boat. Everything is from a whale point of view. Why? What effect does this have on how you see the story?
- In the two large views of Cachalot, he is very slow, almost still. He is not active like Fluke or the dolphins. What does this tell you about his personality?
- What is the effect of showing Cachalot's eye in close-up when he tells Fluke what he needs to do? Contrast it to the image on the facing page, where Fluke is tiny in the ocean. Why did the author put the words 'So Fluke did' right at the bottom of the picture?
- On the page with the four 'diving' panels, there is a final flurry of bubbles rising in the last panel. How does this image make you feel?
- On the following page, three almost identical panels show Fluke descending deeper and deeper into darkness. Is this effective? How could it have been done differently?
- Why has the author repeated the image of moonlight in the water above and behind Fluke, once when descending, the other time when returning to the surface?
- The final picture could have shown Fluke's and Amber's faces as they dive. Instead, the author chose to show just their tails against the cloudy moon. Why do you think he did this? Does it work for you? Would you do a different image for the ending?

The creatures of the deep

All the deep-sea creatures that Fluke meets are real. They have been photographed and filmed in their environment, and specimens have been collected. They are all bioluminescent, which means that they can glow in the dark. Most of these animals glow due to bioluminescent bacteria living in particular parts of their bodies. The animals provide the bacteria with a home and energy, and the

bacteria provide light. The light-emitting cells where the bacteria live are called photophores. A few however, like some jellyfish, produce the glow themselves.

The photophores range from simple clusters of cells to complex organs surrounded by reflectors, lenses, colour filters and muscles. The most common coloured light produced by marine creatures is blue. This is also the colour that penetrates furthest through water. Some creatures can produce yellow or red light, though.

Bioluminescence is different to fluorescence. Bioluminescence is a chemical reaction and can happen in complete darkness. Fluorescence only happens when some forms of light – especially ultra-violet (UV) light – strike an organism, and it is re-emitted at a different wavelength, making it glow. It is extremely common, occurring in fungi, corals, spiders and scorpions, insects, sharks and bony fish, frogs, turtles, chameleons (remarkably, it is their bones glowing through their skin!), birds (especially parrots and finches), and even mammals like the platypus, bilby, and wombat. Most of the animals can also *see* UV light (even though we can't) so they can spot each other in the dark. Interestingly, predatory marsupials don't glow in the dark, which makes sense – they prey could see them. Fluorescence can only happen if some light is present, though, and stops as soon as there is no UV light. Like visible light, there is no UV light in the deep oceans, and so no fluorescent deep-sea fish – they are bioluminescent.

There are four reasons why animals have bioluminescence – counter-illumination, attracting prey, hunting prey, and defence. Counter-illumination is a form of camouflage. If a fish is seen from below, it has a dark silhouette against the sunlit surface water. This even happens on moonlit nights. This makes the fish vulnerable to attack from below. So many bioluminescent fish have photophores on their lower, or ventral, surface. They are able to match the glow from their undersides to the glow of light from above, so that they almost disappear against the background compared to other fish, which stand out as dark shapes.

Some fish, such as the famous angler fish, use bioluminescent lures to attract prey to them. The glowing lures are usually quite small and possibly appear to be a tasty morsel for another fish. When it investigates, the anglerfish can snap it up.

A few fish hunt their prey with their bioluminescence, because they can generate red light, which is a colour most fish can't see. This is because, in deep water, red light is completely filtered out (which is why everything looks blueish underwater.) Many deep-sea crustaceans in particular are red, because it appears black in deep water, which is good camouflage. But a few fish like the Stoplight loosejaw have a red spotlight just under their eye, and they can see red light. So in the deep seas they can easily find their prey, using a light that no one else can see.

Bioluminescence can be used as a defence mechanism through startling a predator with sudden flashes of light. Some animals, particularly shrimp and squid, squirt out bioluminescent fluid that distracts the predator while the dark prey escapes. Some species of squid and marine worms can detach or 'sacrifice' a glowing part of their bodies that a predator attacks while the animal escapes. And scientists believe that some deep-sea animals glow when attacked to attract even bigger predators, which may want to snack on the first predator! Glowing food also presents a problem for a predator since many deep-sea creatures are partly transparent, and their stomachs might glow after a meal. To counter this problem, most angler fish, dragon fish and other hunters have black-lined stomachs to hide their last meal.

The midwater region of the ocean is the largest habitat by volume in the world, making up 99 percent of Earth's liveable space. So although there are literally trillions of animals there, in the

deeper parts particularly there is a very low *density* of animals. So it is very unlikely that you would see even two of the species in the book near each other, let alone all of them. Also, some are found at opposite ends of the earth, some only in the Atlantic, some only in the Pacific; one is found only in the Caribbean. So in that respect, this story is completely wrong – you would never see them all together. However, each of the four pages with deep-sea creatures on them do represent a depth range. The first page is from about 200 to 1,000 m, the next from about 1,000 to 2,000 m, and the third from below 2,000 m. Of course, animals don't care about our numbers and many of them move considerable distances up and down, sometimes on a daily basis, but the pages very roughly represent the *average* depth that those species have been recorded. The deepest record for that species is often much greater. The fourth page, with the two sharks, is shallower as Fluke returns to the surface.

Another aspect of the illustrations that isn't quite right are the fish's expressions. They shouldn't have any! Lacking eyelids, fish eyes appear blank and staring. The anatomy of most fish jaws produces downturned corners, which look at best angry, or nasty, or bewildered. I have tweaked the eyes – making most of them a little larger than they really are, and removing any 'scowling' ridges around them. I have also played with the corners of the mouth – hence the rather happy looks. Otherwise, all the animals are anatomically correct. Given the young readership, I didn't want to give some kids nightmares, or have them worried about whether Fluke was safe. Also, it's not a bad thing having children grow up thinking deep-sea creatures are nice and friendly. They are, after all, just fish, with as much personality – good or bad – as a goldfish. They've just got bigger teeth, and are a lot more interesting!

Finally, the bioluminescence of all these creatures is nowhere near as bright as I have shown – they would never light up a passing whale! But almost nothing would be visible except a few pinpricks of light if I was being completely scientifically accurate. There wouldn't be much of a story if all the characters were essentially invisible in the darkness, so I hope the more scientifically minded amongst you forgive me for some artistic licence!

Meet the creatures …

(The sizes are the maximum found so far. On average they are even smaller.)

Firefly squid *Watasenia scintillans*

Size: 8cm

Depth: 200 – 400 m

Firefly squid live for about one year. Near the end of their lives, females come up to the shores of Japan in their millions to lay their eggs before dying. Whole bays glow blue from the squid, attracting both tourists and fishermen.

Shao's double anglerfish *Bufoceratias shaoi*

Size: 10 cm

Depth: 200 – 1,200 m

So far, all the typical, ball-like anglerfish with a lure that have been found are females. Anglerfish are famous for having males that are tiny parasites that, after swimming around like a tadpole, attach themselves permanently to a female, and feed off her. Their only purpose is to fertilise her eggs. However, it is not certain if *Bufoceratias* anglerfish do this.

Wedl's double anglerfish *Bufoceratias wedli*

Size: 25 cm

Depth: 300 – 1750 m

Like Shao's double anglerfish, until male specimens are found, it remains unknown exactly how these fish breed. Like almost all anglerfish, Shao's is slow moving, with very underdeveloped muscles. She lures her prey in with her glowing esca – the bioluminous tip of her 'fishing rod'. When they are close enough, she snaps her enormous jaws shut. She can swallow fish larger than herself because her jaw bones are very flexible, and her stomach is extremely expandable. This is an adaptation to the scarcity of prey in the depths – one meal may have to last many months.

Stoplight loosejaw *Malacosteus niger*

Size: 25 cm

Depth: 500 – 3886 m

The stoplight loosejaw is so named because the red photophore just below its eye , and the green one behind its eye, remind people of traffic lights. The 'loosejaw' comes from the fact that there is no floor to its mouth, just the lower jaw and a tongue bone. So when it catches prey in its mouth, the prey could swim out of its 'slit throat'. However, the loosejaw snaps its jaws back onto its throat instantly, and swallows its prey. The strange open design of its jaws means that it can thrust its jaws out incredibly quickly as there is almost no water resistance. To make the loosejaw even odder, it is one of only three genera of fish that can generate and see red light. The red photophore under its eye acts as a searchlight that illuminates prey in a light beam that the loosejaw can see, but the prey can't.

Spookfish *Opisthoproctus soleatus*

Size: 10 cm

Depth: 300 – 800 m

The bioluminescent bacteria of the Spookfish live in a special pocket of its intestines. A mirror-like reflector organ directs this light down to the transparent, flat 'sole' underside of the fish, so its under surface glows in counter-illumination. The reflector organ can be contracted or expanded to change the amount of light, to match the intensity of light coming down from above. The spookfish has strange tubular eyes that look straight up through the transparent top of its head.

Crystal jellyfish *Aequorea victoria*

Size: 25 cm in diameter

Depth: 100 – 1,000 m

This jellyfish is almost completely transparent, and most photographs of it do not actually show it glowing. The whole animal doesn't glow – the photographs are showing light reflecting of the jellyfish's surface. The bioluminescence – which it produces without bacteria – is concentrated like a string of pearls around the outer rim of the bell, and glows green. In *Stardiving*, the jellyfish can be clearly seen because it is reflecting the glow of the Spookfish behind it. Only the bright green spots actually glow.

Fanfin seadevil *Caulophryne jordani*

Size: 20 cm (female), 1.6 cm (male)

Depth: 100 – 1510 m

Fanfins have enormously elongated fin rays that presumably allow the fish to sense any prey within eating distance through touch. The tiny males are parasitic on the females, biting onto the female, usually on the belly, and then slowly fusing with her so that he is kept alive by becoming part of her circulatory system. His only purpose is to fertilise the female's eggs. This method of reproduction results from the extreme difficulty for fanfins of finding each other in the vast darkness of their habitat – once they meet, it's best to hang on for life.

Gigantic whipnose *Gigantactis gargantua*

Size: 41 cm (female), 2 cm (male)

Depth: 500 – 2,500 m

Whipnoses have been filmed drifting slowly upside down deep in the ocean, sometimes just above the bottom, with their lure held out in front of them to attract prey. Despite the enormous size difference between females and males, no females have ever been found with an attached male, so it assumed that males are free-living.

Illuminated netdevil *Linophryne arborifera*

Size: 7 cm (female), 1.5 cm (male)

Depth: 200 – 1,000 m

Although one of the strangest looking of the anglerfish, this is also one of the smallest – about the size of a tennis ball. The males are parasites on the female. 'Linon' means anything made of flax, such as rope or net, and 'phryne' means 'toad' in Greek. So its name means 'the toad that hunts with a rope/net'. 'Arborifera' refers to the tree-like bioluminescent barbels under her chin.

Lovely Hatchetfish *Argyropelecus aculeatus*

Size: 7 cm

Depth: 80 – 1000 m

This little Hatchetfish spends the day in the depths, and vertically migrates each night towards the surface to feed on crustaceans and small fish. The very narrow body, and the photophores lining the belly, help to disguise it from predators looking for its silhouette from below.

Black dragonfish *Idiacanthus atlanticus*

Size: 50 cm (female), 5 cm (male)

Depth: 500 – 3,500 m

The female Black dragonfish has small eyes, huge teeth, a long chin barbel with a luminous tip, and is black. The little male has large eyes, no canine teeth, no barbel, and is brown. The larvae are even more dissimilar, being transparent with eyes on the end of long stalks sticking out sideways on either side of their heads! As they grow up, the stalks shrink and eventually the eyes assume their adult positions. The females make a daily vertical migration to the surface waters each night, whereas the males stay below 1,000 m at all times.

Whipchin barbeled dragonfish *Grammatostomias flagellibarba*

Size: 20 cm

Depth: 500 – 1,500 m

The chin barbel on this dragonfish can be over 1 m long – about six times longer than its body. It doesn't have a glowing tip, but there are many photophores along the fish's sides, and a large photophore just behind each eye. It also has a peculiar, roughly triangular 'squiggle' on each side of its body, behind the head, which glows a pale violet.

Pelican eel *Eurypharynx pelecanoides*

Size: 75 cm

Depth: 500 – 3,000 m

Also called the gulper eel (although this name is also used for a related group of huge-mouther eels), this is one of the largest deep-sea creatures. However, most of its length is a very thin, ribbon-like body, which can expand enormously when the Pelican eel swallows a large prey item. But, having tiny teeth, it is probably more common for the eel to swim through schools of small prey with its mouth open, scooping them up like a net.

Axel's wolftrap anglerfish So to get the ball rolling on the *The Secret History of the Rainbow Trout Hotel*, I've attached an agreement. It's the same as *Augustin*'s. My initial thoughts are that I like it — more specifically, I like your writing. But one thing stood out. It doesn't seem to be set in Australia. I know Australian place names are mentioned, but I kept thinking it was set in the deep South of America. Some dialogue especially; and this is especially true of Kenny's. He should be a Mr In-Between Man type or Les Norton from Barrett's books —likeable but a knockabout, but instead his dialogue belongs to neither. The setting for *Tiff and the Trout* seemed more local, somehow. Hopefully you can take a look at this aspect.

Thaumatichthys axeli

Size: 50 cm (female), 3.5 cm (male)

Depth: 2,000 – 3,700 m

Its name, in Greek, means 'Axel's wonder fish', and it certainly is amazing. It is one of the very few deep-sea predators to have its bioluminescent lure actually inside its mouth. It is also unusual among anglerfish in that it is benthic, which means it lives near or on the sea floor, not higher up in the water. It is not known if the males are parasites on the females, as no attached males have ever been found.

Atolla jellyfish *Atolla wyvillei*

Size: 17 cm in diameter

Depth: 1,000 – 4,000 m

Also called the Coronate medusa, the Atolla has earned the nickname of 'alarm jellyfish'. When attacked, it produces circular waves of bright blue flashes, which are believed to be in order to attract even larger predators which may be more interested in eating the first attacker than a

jellyfish. One marine biologist has made a device that mimics the flashing of an Atolla jellyfish to draw in deep-sea predators for filming – it even attracted a giant squid!

Glowing sucker octopus *Stauroteuthis syrtensis*

Size: 45 cm

Depth: 500 – 4,000 m

Unlike squid, in which many species are bioluminescent, *Stauroteuthis* is one of only two genera of bioluminescent octopus. It emits a blue/green light from modified suckers in a single row along the underside of each arm. Some of the photophores emit a continuous faint light, others are much brighter and turn on and off, producing a twinkling effect.

Dana viperfish *Chauliodus danae*

Size: 15 cm

Depth: 500 – 2,000 m

Viperfish move up towards the surface each night to hunt and so have counter-illumination photophores along their bellies. They also have a larger single photophore on the end of a long dorsal spine that can be moved around to attract prey.

Smalltooth dragonfish *Pachystomias microdon*

Size: 22 cm

Depth: 660 – 4,000 m

Like the Stoplight loosejaw, this dragonfish can emit and see red light from a photophore under its eye. Neither of them has a lure either. Since they can see their prey with light that is invisible to other fish, they don't need a lure to attract prey, which may also attract unwanted predators.

American pocket shark *Mollisquama mississippiensis*

Size: 14 cm

Depth: 1,000 m

This tiny shark not only glows from photophores on its belly, but it also squirts out a luminous fluid from two pockets located just behind its pectoral fins, hence its name. It is thought that the glowing fluid attracts small prey, or distracts predators to allow the shark to escape. This is the third species of shark discovered that produces glowing fluid – there is also a Pacific pocket shark, and the Taillight shark.

Velvet belly lanternshark *Etmopterus spinax*

Size: 45 cm

Depth: 20 – 2,500 m

This shark glows all over its belly, from its nose to tail. It is believed to be for counter-illumination. There are also photophores that extend up the flanks, making patterns that are different in each of the 45 species of lantern sharks. Since each pattern is species-specific, they may be used for recognition of mates.

Activities

- Most of the deep-sea creatures in *Stardiving* are quite small, so life size models can be easily made. Polystyrene balls of various sizes, toothpicks, thin cardboard and craft sheets, wire, and craft pipe cleaners, amongst other materials, can be used. Most of them are black or brown, so they are easy to paint. Glow-in-the-dark paints can be used for the photophores.
- Create a vertical 'mural' on a long roll of paper, or several sheets stuck together. Perhaps make it the height of the classroom ceiling, and mark off the depth down to 4,000 m. Draw life-size pictures of the animals found at various depths (perhaps including other species not in the story) and then hang it from the ceiling.
- On a large roll of paper, draw the outline of Fluke. He's about 4 m long and 0.5 m high. Cut out the outline so you have a whale-shaped sheet. Draw all the animals he meets in the story to scale on the sheet. In this activity and the previous one, the deep-sea creatures' pictures can be drawn on separate sheets of paper, cut out, and pasted on.
- On black craft paper, draw the deep-sea creatures in metallic pens so that they shimmer in the light. You could even use glow-in-the-dark paint.