Using children's literature to teach marine science in schools: a teacher's guide

Over & Under the Waves of THE GREAT SOUTHERN REEF

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Using children's literature to teach marine science in schools: a teacher's guide

Over & Under the Waves of THE GREAT SOUTHERN REEF



Using children's literature to teach about the Great Southern Reef

A guide for primary school teachers.

This educational resource was produced by the Deakin SEA·Ed team.

Through stories we can bring marine science to life and make it more interesting and engaging for future generations. Thank you for helping us change the way young children see and care about the underwater world.



This booklet was developed in the scope of a PhD project entitled **Using children's literature to teach marine science concepts** conducted by Cátia Freitas, a Higher Degree by Research (HDR) student at Deakin University, Victoria, under the supervision of Dr Prue Francis, Dr Alecia Bellgrove and Dr Paul Venzo.

The promotion of ocean literacy in schools is the starting point to develop a more ocean literate society. This booklet offers educational activities and ideas on how to use children's literature, such as picture books, to promote critical and creative thinking, enhance students' knowledge and connection with the ocean, and inspire stewardship of their local marine environment. This guide is aligned with the recently announced UNESCO Decade of Ocean Science goal: "By 2030, 70% of formal educators worldwide receive continuous training in Ocean Literacy and pedagogical tools to incorporate Ocean Literacy in the classroom".

The activities proposed are linked to the following children's picture books about the biodiversity of the temperate marine environment of the southern coast of Australia:

- 1. The Great Southern Reef by Paul Venzo, Prue Francis and Cate James.
- 2. Rock Pool Secrets by Narelle Oliver
- 3. With a Little Kelp from Our Friends by Mathew Bate and Liz Rowland
- 4. The Way of the Weedy Seadragon by Anne Morgan and Lois Bury
- 5. The Underwater Forest by Rebecca Morris and Matt Howorth
- 6. The Hidden Forest by Jeannie Baker

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How to use this booklet

The activities proposed were designed with the purpose of developing students' knowledge about the Great Southern Reef (GSR). The sequence of activities begins with general topics, that are followed by more specific marine science concepts. The suggested activities are independent from each other. It is recommended that the activities are conducted in the order proposed on the contents table, however teachers may choose to do them in a different order, according to their students' level of knowledge about each topic(s).

All the activities can be conducted in the classroom, except for the field excursion. Different activities are aimed at different grades, from Foundation to Grade 6, but can be adapted to any level.

This guide offers activities that can be conducted before and after reading a story with students, as well as 21 core activities dedicated to a specific concept. Some are stand-alone activities, while others may be combined. Each of the core activities offers background information for teachers; the main objective(s); an explanation on how to conduct the activity; suggestions (for example, how to link one activity to others); the Ocean Literacy principle and the learning area(s) linked to it. Several activities include hyperlinks for online available educational resources. These are highlighted in blue and are clickable in the digital version of this guide.

A glossary is available on pages 53 and 54.

Key to symbols:



E

Represents the suggested reading(s) for each core activity.



Represents the suggested curriculum area(s) for each core activity.

This document was developed to be exclusively used in the professional development program created for primary school teachers.

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Ocean Literacy

Ocean literacy means "understanding the ocean's influence on you and your influence on the ocean". More specifically, an ocean literate person understands the essential concepts about the functioning of the marine systems, is capable of communicating about the ocean meaningfully and can make conscious choices regarding the marine environment and its resources.

Cava et al., 2005

Ocean Literacy Principles

Principle #1: The Earth has one big ocean with many features.
Principle #2: The ocean and life in the ocean shape the features of Earth.
Principle #3: The ocean is a major influence on weather and climate.
Principle #4: The ocean made the Earth habitable.
Principle #5: The ocean supports a great diversity of life and ecosystems.
Principle #6: The ocean and humans are inextricably interconnected.
Principle #7: The ocean is largely unexplored.

The Great Southern Reef

Australia is an island continent with the third largest marine territory of the world. Approximately 70% of the Australian population live within 50km of the southern coastline, and both benefit from and depend upon the ecological and economic benefits provided by the unique marine ecosystem of the Great Southern Reef. This interconnected shallow temperate rocky reef stretches across 8000km of the southern coastline of Australia, from New South Wales to Kalbarri, in Western Australia. The Great Southern Reef is a temperate marine habitat, which means that the water is a mixture of the cold water from the Southern Ocean basin and warm water from the tropics. It is home to marine species that are found nowhere else on Earth and it benefits people nutritionally, culturally, and ecologically.



Before reading the book

The following ideas can be conducted with your students before the storytelling/book reading begins. This is a way to introduce the topic and prepare for the activities proposed.

Activity: My local beach

Before the reading/storytelling activities start, you may choose to invite your students to share their adventures at their local beach. This is a great way to introduce the topic. Discuss what they may have found on the beach, what marine life they have observed, how they feel when they visit their local marine environment, what their favourite marine animal and/or plant is, which water-based sports they might know, etc. There are many exploratory auestions that can be asked to promote a connection with the ocean. This can be achieved through a group discussion, a written sentence/paragraph or even by writing a single word that would describe each category (e.g. on the board, allowing all the students to see each other's contributions).

Children's picture book covers make the first impression on the reader and may reveal a lot about the story inside.

Activity: Book cover jigsaw puzzle

Print the book cover, cut out puzzle pieces and ask the students to reassemble it. The level of difficulty of this activity will depend on the number of pieces you choose to divide the cover into. This activity might work better if students did not have any previous contact with the book – they will become curious about the story and feel challenged by the cover reconstruction activity.

Activity: The secret clues on the book cover

This activity can be conducted after the previous one, or just as a separate activity. Present the book cover to your students. Make sure all students can easily see it (this can be projected onto a wall). Challenge them to come up with ideas of what the book is about. For that, children will have to look for all the clues on the front and back cover of the book. You can suggest a few questions to start the discussion (see examples below) and your students can share their opinions with the class or write their answers on a piece of paper (unidentified) to be discussed later. Collect all student papers, mix them inside a bag, take out a few or all of them, read aloud and discuss.

Exploratory questions:

- Why do you think I chose this book today?
- Who is the book for? What makes you think that?
- [teacher to read the title or ask a student to read it] What do you see? What do you think the book is talking about?
- Let's have a look at the illustrations. What are the dominant colours? Why do you think the illustrator chose these colours? What might these colours mean and how do they make you feel?
- What are the dominant shapes in the cover? What are the effects of those shapes?
- Is there anything unfamiliar on this cover?

The illustrations

The traditional elements of a picture are colour, line, shape, and texture.

Colour: we tend to associate colours with feelings, sensations, moods. Blue is usually associated with serenity, while black is associated with grief and sadness. Colour has also cultural associations. For instance, in some Asian countries, grief might be represented with white, instead of black.

Line: Fragmented lines are normally associated with uncertainty or instability. On the other hand, solid closed lines appear to be more stable.

Shape: Horizontal shapes can be associated with stability while vertical ones might indicate energy. Pointed shapes can generate anxiety and rounded shapes are mostly linked with softness and safety.

Texture: While it is a challenge to represent texture on paper, it is possible to create an illusion of texture, by combining the elements describe above. The book "*The Hidden Forest*" provides a great example of how we perceive a three-dimensionality on a two-dimensional space.

Reading Aloud and Book Discussion

Activity: The Circle Strategy

Sit students in a circle before the reading aloud commences. The story can be read with a line, sentence, or page at a time, stopping to provide students the opportunity for discussion of the pictures and ideas/concepts that emerge. If this approach is selected, allow some time for students to speculate on what's going to happen next. Ask for volunteers to share their opinions. If no-one volunteers, the teacher can start. Using an object that indicates who's turn it is to talk next can help to conduct this activity to enable each student to take a turn. This is adapted from the technique called "passing the tip" by Donnelly (1994). The tip can be any object in the room and can be passed in any direction of the circle. Every child should be given a chance to speak, and therefore it is important to allow for plenty of time. If students do not wish to talk, then the object should be passed further. When the object comes back to the first person again, the teacher may ask the students that did not participate at first if they would like to do so.

The book(s) can be re-read multiple times. This will allow to build up the knowledge and understanding through discussion. Ask students to think about what they have noticed in each new reading session that they didn't realise before and what they would like to explore in more detail.



Fig. 1: Storytelling session in a classroom. © CDC, Unsplash

Note: Discussing incorrect predictions of the story offers a great opportunity for debate and critical thinking. Moreover, while in the circle, it is important to act as a facilitator and equal contributor. You may use the following examples to keep the discussion going: "Interesting. What do others think?" or "Thanks for your contribution – what else can you tell us about this idea?". If some children repeat what others said before, then this might be a good opportunity for teachers to explore language articulation. Children can be taught to give a reason why they agree/disagree with their peers.

Activity: Exploring the story

Explore the following questions with your class after reading the story.

- a) What is the book about?
- b) Who is telling the story?
- c) Who are the characters?
- d) When does it happen?
- e) Where does it happen (new environments/habitats)?
- f) Why does it happen?
- g) How is the story told?
- h) What's the significance of the story?

Note: Write children's contributions. You can choose to write it while they speak (quick notes) or at the end. Be careful not to make it look like you are evaluating everything they say – instead, this should be done to register ideas or topics to explore/discuss later.

Activity: Illustrating the story

Read the story to your students without showing them the illustrations. Page by page, allow them time to visualise the story settings and characters in their minds. Ask them to draw it. Let your students know that there are no right or wrong illustrations. Promote creativity and imagination by encouraging students to represent what they see, smell, hear and feel when listening to the story being told. When the story finishes, invite your students to put together all the illustrations in order and share with the class. Discuss drawings and finally project the book illustrations on a wall, allowing everyone to see it. Compare it with their own visual representations of the story.

Activity: Exploring illustrations

The illustrations are as important as the words in picture books. Allow children to look closely to the pictures in the book and ask them what they see, what is familiar to them and what's new. You may also choose to give students 5 seconds to look at the picture and ask what's the most important feature in the page they just looked at. Repeat this exercise as many times as you wish until enough detail has been collected. Share student's answers and discuss which aspects came up more often.

Then, encourage students to think about what the pictures are telling us that is not on the text, and vice versa.

Finally, one of the most exciting experiences about pictures books happens when turning the page. With your students, discuss what might have happened between pages/illustrations. For example, in the book "The Hidden Forest", Ben thinks of Sophie to help him to untangle the trap. Sophie is not represented on that double page spread, but when we turn the page, Sophie is already in the water, ready to help Ben. What happened between these two pages that are not represented in the pictures? One can speculate that Ben got out of the boat, went to find Sophie, then both headed to the beach, put their wet suits on and jumped in the water.

Activity: Matching pictures and words.

Show students the illustrations and the text separately and ask them to put both together as how they expect the story to be. This can be done by projecting it on the wall, allowing all the students to have the chance to participate and work together. This activity can be adjusted to different grade levels by only omitting a few words from the text and asking students to put them in the right place.

Another option is to present some of the pictures with "incorrect" text and ask students if the words and the images match and why, or why not. They can also be asked to think about what the "correct" text would be. This activity will promote a more insightful reading and story interpretation.

Activity: The "Wonder Notebooks" Strategy

The "Wonder Notebooks" strategy from Jones & Leahy (2006) encourage teachers and students to wonder about topics related to the book. You can start by giving your students examples of what you wonder (see exemplary practices next page). Then, students can share their wonders with the class, or write it down on paper. You may choose to group the questions into different topics that children can investigate later through a classroom or school project. This will engage students to practice critical thinking and engage with hands-on activities through planning and conducting experiments and analysing data.

I WONDER...

Book "The Great Southern Reef"

- 1. I wonder how big the Great Southern Reef is?
- 2. I wonder how this reef is connected along 8000km. Is it physically connected, through rocks from NSW to WA or by other ways?"
- 3. I wonder what the Great Southern Reef is made of and what sort of marine life can be found?

Book "Rock Pool Secrets"

- 4. I wonder where I can find rock pool secrets near me?
- 5. Shells protect animals from predators and rough environmental conditions, however the sea slug in the book looks like a snail without a shell. I wonder how these creatures protect themselves?
- 6. I wonder which are the most dangerous animals in the rockpools?

Book "The Way of the Weedy Seadragon"

- 7. I wonder if the Weedy Seadragon is the only fish where it is the male carrying the eggs?
- 8. The author says that 'Two seadragons are gliding out of the kelp, swaying slowly, leaning, twisting, performing a graceful courtship dance above the seagrass meadow.' I wonder what's the difference between seaweeds and seagrasses?

Book "The underwater forest"

- 9. I wonder how old I need to be to scuba dive?
- 10. I wonder if kelp forests are still in danger in Port Phillip Bay?
- 11.1 wonder what else sea urchins eat?
- 12. I wonder if Port Phillip Bay is the only area affected by sea urchins?

Book "With a Little Kelp From Our Friends"

- 13. I wonder where these seaweeds came from and how did they get here?
- 14. I wonder if people in my local area are using seaweed and how?

Book "The hidden forest"

- 15.1 wonder how kelp remains upright in the water column?
- **16.** I wonder if these underwater forests are just as important for life as the forests on land?

Activity

Where is the Great Southern Reef located?



The Great Southern Reef

Objective(s)

Students will investigate and understand the location and extent of the Great Southern Reef. It also provides a context for introducing students to Aboriginal language and geography.

Students will have the chance to think about and discuss the materials and resources they might need to create the map. In creating the map, children will develop their spatial thinking and understanding of measurements, distances, and directions.

This activity can also be conducted as a school project, where the school community can participate by, for example, painting a large map of the GSR on a school wall, or on the ground.



Method: Challenge your students to create a large map of Australia including a line outlining the Great Southern Reef, to exhibit on the classroom wall, like the one in The Great Southern Reef picture book. You may choose to start by presenting the world map showing the different ocean basins (using google maps or google Earth, for example). Find Australia and discuss which ocean basins Australia is surrounded by. Then, using only a map of Australia at a bigger scale, explore with your students, the limits of the Great Southern Reef. Students might need to conduct some research by consulting other books or the internet to find where the Reef starts and ends. Children will need some time to think how they want to do it, how big the map will be, which materials they plan to use and how they will distribute different tasks between them. You may want to allocate a few days (scattered over a couple of weeks) for this activity to be completed.

Suggestion(s): This activity is highly adaptable and there are many alternative ways to conduct it. Making a large-scale map may allow for other activities to be conducted, such as, practice place names, including names of Aboriginal Land/Sea Countries using stick pins with labels attached to show the distribution of the marine life that can be found along this temperate reef. Try to also include the organisms' scientific names and discuss the need for unambiguous attribution of names for species. Depending on the grade level, the map may include key map terminology and symbols allowing students to comprehend the importance of these items on the map.

Background

The ocean covers approximately 70% of the Earth' surface. There is only one ocean with several ocean basins: North Pacific, South Pacific, North Atlantic, South Atlantic, Indian, Southern, and Arctic."

The Great Southern Reef extends from the Indian Ocean basin in the west, across the Southern Ocean basin in the south and into the South Pacific Ocean basin in the east.

Quick Fact: The Southern Ocean basin was only named in 2002 – it was the last ocean basin to get an official name.

The Great Southern Reef is formed by interconnected shallow (<30m) temperate rocky patches that stretch across 8000 km and covers around 71,000 km2 of the southern coastline of Australia, from New South Wales to Kalbarri, in Western Australia

To become a storyteller

Upper grade students can organise and conduct a storytelling activity for lower grades students. This is also an opportunity to invite other classes to participate in the GSR map creation as a school project.

Ocean Literacy Principle(s)

OL1: The Earth has one big ocean with many features.

OL5: The ocean supports a great diversity of life and ecosystems.

Materials

A selection of different materials can be used for this activity, and these will depend on the students' grade level and the scale of the map being created. A few ideas of materials that can be used are:

- Digital technologies (for ideas and map visualisation)
- Paper
- Cardboard
- Colouring pencils/paints (e.g. acrylic)
- Brushes (different sizes)
- Tape measure/rulers
- Scissors
- Wool or string to connect places or add information
- Pins
- Glue



Foundation – Grade 6

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- Science
- Mathematics
- The Humanities
- The Arts

Activity

Of what is the Great Southern Reef made?



The Great Southern Reef

Objective(s)

Students will learn that kelp are the foundation species sustaining life in this biodiversity hotspot. Through the pictures and videos, they will get the opportunity to visualise what a seaweed forests looks like underwater.

The Great Southern Reef is defined by a hard bottom covered by kelp forests. Kelps are brown seaweeds found from the shallow coastal waters to depths up to 50m.

Golden kelp (<u>Ecklonia radiata</u>) is one of the dominant habitatforming seaweeds that creates forests along the Great Southern Reef.



Method: Ask students why they think the authors of the book chose to name Frankie and Sam's teacher "Professor Seaweed"? This exploratory question will help start the discussion. Open the book where seaweed is washed up on the beach.

Ask them what they imagine seaweed would look like underwater before the storm. Students can just describe it in words or draw it. Start a class brainstorm by questioning if these seaweeds would be floating or attached to something? If attached, what would it be attached to? Sand? Rocks?

Encourage students to share their ideas with the class, before viewing video 1 of shallow golden kelp, video 2 of bull kelp in waves and video 3 of crayweed and bull kelp in the Great Southern Reef. Explain that unlike plants, seaweeds are algae and do not have roots, but have a strong holdfast to attach onto rocks, and obtain their nutrients from the water, not the soil/sand.

Suggestion(s): You may harvest some seaweed washed up on the beach and use for this activity. Check with the relevant authority what is allowed before going foraging. Also, this is a good way to introduce the book "With a Little Kelp From Our Friends" (see book pages 14 and 15).

Ocean Literacy Principle(s)

OL5: The ocean supports a great diversity of life and ecosystems.



Grade 2 – Grade 6



- Science
- The Arts

Activity Foundation species: fantastic kelp



With a Little Kelp From Our Friends

Objective(s)

Students will gain an understanding of the importance of kelp forests for the local biodiversity.

Kelp grow in cold, nutrient-rich waters and create one of the most productive and dynamic ecosystems on Earth – kelp forests.

Kelp forests are as crucial to the ocean as trees are to the land. Many marine creatures rely on the kelp forests of the Great Southern Reef for habitat, food and shelter.

In addition to the Golden Kelp, other seaweed species also form vast underwater forests along the Great Southern Reef, such as the **Bull Kelp** (<u>Durvillaea</u> <u>potatorum</u> and <u>Durvillaea</u> <u>amatheiae</u>)and the **Giant Kelp** (<u>Macrocystis pyrifera</u>). The giant kelp is one of the fastest growing seaweed species on the planet (up to 50cm per day). Method: Read the first pages of the book (6-9). Students will learn that the ocean is responsible for roughly 50% of the oxygen produced on Earth. Marine algae (including phytoplankton and seaweed), produce the oxygen that is used by the microbes and animals living there. This is also a great opportunity to teach basic photosynthesis principles. In addition to oxygen, these underwater forests provide many benefits for the ecosystem and the marine life. Show your students the **underwater images** from the GSR official website and ask them to imagine how these animals would be impacted if the seaweeds were removed from the pictures. They may suggest that marine creatures would not have a place to live, food to eat or spots to hide from predators. Explain that these are some of the reasons why kelp is considered a foundation species. Show students the first minute of the following video published by The GSR official YouTube channel.

Suggestions: This activity links well with the picture book "Rock Pool Secrets" where students will get an understanding of how different animals benefit from these marine habitats formed by seaweeds.

Ocean Literacy Principle(s)

OL4: The ocean made the Earth habitable.

OL6: The ocean and humans are inextricably interconnected.



Grade 3 – Grade 6



Science

Activity

How is the Great Southern Reef connected?



The Great Southern Reef

Objective(s)

Students will get an understanding that these currents are crucial for the diversity and connectivity of this reef through the transport of water and organisms.

Two main ocean currents that transport water, nutrients, and organisms, dominate the Great Southern Reef:

<u>The Leeuwin current</u>: flows all the way down the west coast in Western Australia

<u>The East Australian Current</u>: flows from Queensland down to the east coast to Tasmania.



Method: Use the wonder strategy to initiate a class discussion (see wonder #2). Give students a few minutes to think about and share their thoughts on this. Depending on their level of knowledge about the topic, they might suggest that this happens because of the ocean currents, or you might need to drive the discussion by giving them some hints using, for example, the following exploratory questions:

- Do you think the water moves around the coast or stays always in the same area?
- 2. If the water moves around the coast, what else can be transported by this movement?
- 3. How do currents influence climate and weather patterns?

Document student answers and show them a map with the two main currents moving water around the GSR. Watch this **short video**, or the full 3 episodes of the ABC documentary Australia's Ocean Odyssey: A Journey Down The East Australian Current" **here**.

Suggestion(s): You may choose to conduct a class experiment to show how water currents move in the ocean (this video provides a great example on how to conduct it).

Ocean Literacy Principle(s) OL3: The ocean is a major influence on weather and climate. OL4: The ocean made the Earth habitable.



Grade 4 – Grade 6



Science

Activity A salty ocean



Any of the picture books provided.

Objective(s)

Students will get a deeper understanding of the differences between freshwater and saltwater and build their scientific and critical thinking skills through planning an experiment.

Seawater has unique properties. It is salty, denser than freshwater, and it freezes at approximately -2°C (at normal salinity). The average salinity of seawater is approximately 35 parts per thousand (ppt), meaning that in every litre of water there are 35 grams of salt.

Where the rivers meet the ocean, they form partially enclosed bodies of water – estuaries. Here, the salinity is higher than freshwater and lower than seawater. This water is called brackish water.

The ocean is salty due to salts and minerals washed from rocks and soils from the land, carried to the ocean by rivers. However, this is balanced by the input of fresh water, precipitation of rain and melting of ice. **Method:** Start by asking your students where they think it is easier to float, in the ocean or in a freshwater pool? Why is that? Ask them to predict which one is denser, freshwater or saltwater. Challenge them to think about an experiment that they could do to test it. Children may suggest different experiments and they should make predictions of what is going to happen. If safe, conduct the experiment(s) suggested even if you know that it won't work. This is part of the scientific process. If students struggle to come up with an idea on how to test this, you may propose the experiment on this video, published by "Sailor for the Sea", Oceana.

After the experiment, invite students to find why the ocean is salty. They may question people in their school and/or at home and note their answers. Back in classroom they should share their findings and investigate if people's answers are correct or not (for this they might need access to school resources).

Suggestion(s): For lower grades, simply use 2 cups, one with freshwater and one with saltwater. Have the students think about what might happen when dropping a few different objects into each cup (will these float or sink? why?).

Ocean Literacy Principle(s)

OL1: The Earth has one big ocean with many features.



Grade 5 – Grade 6



Science

Activity The Great Southern Reef residents



The Great Southern Reef; Rock Pool Secrets

Objective(s)

Students will become familiar with the marine life found in the GSR.

The Great Southern Reef is home to thousands of different species. Yet, scientists estimate that tens of thousands of species are still to be discovered and studied.

Some of the most charismatic species found in the GSR are:



Australian Sea Lion



Giant Cuttlefish



Moonlighter Fish



Method: Ask students to choose their favourite marine creature from the book(s). If they wish, they can select one that is not in the book(s), but make sure that it is found in the GSR. Challenge them to investigate about that specific animal/plant. Each student will be responsible to create an ID card of their marine creature. Show them some examples and let them be creative.

Ideas to include on the ID card:

| Photo: | Preferred food: |
|------------------|-----------------------------|
| Common name: | Feeding strategy: |
| Scientific name: | Predator(s): |
| Size: | Defences against predators: |
| Habitat: | Threats: |
| | |

We recommended creating an example ID card first. This will help students to get a better idea of what is requested from them. Check the "Marine Life" section on the GSR official website.

Suggestion(s): Free

images/vectors can also be found on IAN Symbols library, such as the Spotted Handfish below.



Fig.2: Spotted Handfish. © Dieter Tracey, IAN Symbols

Ocean Literacy Principle(s)

OL5: The ocean supports a great diversity of life and ecosystems.



Grade 4 – Grade 6

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Science

The Arts

Activity Sizing the Great Southern Reef residents



The Great Southern Reef/ Rock Pool Secrets

Objective(s)

Students will explore the relative size of marine organisms, make size comparisons between different species and use measurement tools.

The Great Southern Reef beams with life from all sizes and shapes. Even the tiniest living things can be found in these waters.

Some species of dinoflagellates, a type of marine plankton, are so small that they can only be seen with a microscope. However, some bioluminescent dinoflagellates, aggregated in high concentrations begin to glow when agitated - a spectacular phenomenon that can be seen with a naked eye (Fig. 3).



Fig. 3: Jervis Bay; NSW South Coast ©Trevor McKinnon, Unsplash

Method: This activity can be conducted with one or more picture books. Challenge your students to think about the size of the marine creatures in the book(s) and ask them to organise the different species from the smallest to the largest. Have students access other resources available (e.g. school library, internet) to investigate the size of marine creatures. Note that the illustrations in the book(s) are not at scale. This is also an opportunity to explore this concept with your class.

Later, encourage them to think about, compare and convert the marine creatures' measurements with daily objects that they often make use of (e.g. toothbrush, coin, car, school bus, etc). You may choose to create a poster with the marine creatures and the objects next to it. Display it on the classroom wall. Finish the activity by asking students if the organism's size matched their expectations.

Suggestion(s): Children can use a ruler and/or a measuring tape to determine the measurements of a few objects in the classroom.



Grade 2

Grade 6

Ocean Literacy Principle(s)

OL5: The ocean supports a great diversity of life and ecosystems.



- Mathematics
- The Arts
- Science

Activity

Endemic species of the Great Southern Reef



The Way of the Weedy Seadragon

Objective(s)

Students will learn the concept of endemic species and will become aware of some endemic species in their local marine environment as well as their extinction risk status.

The Great Southern Reef is incredibly biodiverse and a high number of the species residing here are found nowhere else on Earth.

Some species are endemic to the Great Southern Reef such as the:

- Weedy seadragon
- Leafy seadragon
- Spotted handfish
- Harlequin fish
- Southern dumpling squid
- Australian sea lion
- Golden decorator crab

• 613 species of seaweeds (and counting as new species are being discovered and described!)

Method: This activity can be conducted after reading the suggested book or following the activity "The GSR Residents". Start by explaining that species that live only in one geographical region are called **endemic species.** There is the chance that some of the species chosen by the students for the ID cards activity are endemic species of the GSR.

Challenge them to discuss some answers to the following exploratory questions:

- a) Is it important to protect endemic species? Can you think of 3 reasons why?
- **b)** Do you think that the Weedy seadragon is the only endemic species of the GSR?/ Which of the species in the ID cards/poster are endemic?

Introduce your students to the official website of the **IUCN Red List**, which provides global data on the extinction risk status of species. Let them explore the status of some of the GSR endemic species.

Suggestion(s): For lower grades levels, instead of using the term endemic, simply explain that these species are only found in the Great Southern Reef.

Ocean Literacy Principle(s)

OL5: The ocean supports a great diversity of life and ecosystems. OL6: The ocean and humans are inextricably interconnected. OL7: The ocean is largely unexplored.



Grade 5 – Grade 6



- Science
- The Humanities
- Technologies

Activity Creatures under cover



The Way of the Weedy Seadragon; The Hidden Forest; Rock Pool Secrets

Objective(s)

Students will identify a variety of marine creatures that use camouflage as a defence mechanism.

The great diversity of ecosystems found in the GSR allows many organisms to develop adaptations to survive in their habitat. One of these adaptations is the ability to blend in with their surroundings, allowing them to avoid predators and/or to sneak up on prey.

In the Great Southern Reef, some of the marine creatures with this remarkable adaptation are the:

- Weedy and Leafy seadragons
- Pot-bellied seahorse
- Giant Australian cuttlefish
- \cdot Southern dumpling squid
- \cdot Golden decorator crab
- \cdot Some species of seastars

Method: In the "The Way of the Weedy Seadragon" book, seadragons are described as the masters of camouflage. Start a discussion with your students about the importance of camouflage. How does this benefit seadragons?

The Weedy seadragon is not the only marine creature in the GSR with great camouflage skills. The books "The Hidden Forest" and "Rock Pool Secrets" offer some great examples too. Challenge your students to look carefully at the illustrations and try to find all the animals blended within their marine environment. Invite them to think about answers to the exploratory questions below for the marine creatures in the books.

- 1. Who might the marine creature(s) be hiding from?
- 2. Is the creature hiding so their prey gets closer and easier to capture?
- **3.** If it was a competition, which of these animals would win the first prize at disguising? Why?

Suggestion(s): For upper grades, you may also read the book "The squid, the vibrio and the moon" which provides a great example of a symbiotic relationship that allows the bobtail squid to go undetected and avoid predators.

Ocean Literacy Principle(s)

OL5: The ocean supports a great diversity of life and ecosystems.



Grade 2





Science

Activity Sneaky Little Thieves



Rock Pool Secrets

Objective(s):

Students will learn about the nudibranchs adaptations and practice and improve their listening skills through the podcast.

Nudibranchs are a type of sea slug and are considered the experts of adaptation. Without a shell to protect them against threats, these creatures have adopted other defence techniques.

Their bright colours are the most distinguishable characteristic of these molluscs. Nudibranchs get their colours through what they eat (algae, sponges, anemones, etc). Some use it to blend with their environment and others use it to warn predators to keep away. But that's not even the whole story. These bizarre creatures can steal poisons from their prey and use it to their own advantage.



Method: Start by asking students if they have ever seen a nudibranch before. Show them the video "Nudibranchs of the Great Southern Reef" and use the wonder strategy to initiate a class discussion (see wonder #5). Give students some time to think and write down their answers or share with the class. Play episode 11 from the podcast series "SeaCreatures" by Matt Testoni, where Jack Breedon shares some of the most interesting facts about nudibranchs. In teams of 4, provide students with the list of questions below and have them come up with answers while listening to the podcast.

Questions:

- · What does the word "nudibranch" mean?
- Where can nudibranchs be found?
- How big are they?
- What do they eat?
- Why are nudibranchs considered "thieves of the sea"?
- How does having bright colours protect nudibranchs from their predators?
- How do nudibranchs sense the world around them?
- Where can they be found?

Suggestion(s): Play only 10 minutes of the podcast a day, as there is a great amount of information provided. Review the knowledge acquired in the previous session before continuing the activity.

Ocean Literacy Principle(s)

OL5: The ocean supports a great diversity of life and ecosystems.



Grade 4 – Grade 6

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- Science
- English

Activity A Spiky Problem



The Underwater Forest

Objective(s)

Students will gain an understanding of how high densities of 2 different species of sea urchins can impact kelp forests of the GSR.

The purple sea urchin

Heliocidaris erythrogramma Purple sea urchins are native to the GSR, however a booming of the urchin populations have been clearing out kelp forests leaving reefs barren.

The long-spined sea urchin

Centrostephanus rodgersii Climate change is causing the East Australian Current to become stronger, which is sending the warmer water further south, to Tasmania, and the larvae of long spined sea urchins along with it. Combined with the overfishing of rock lobster populations (urchins' natural predators), we are seeing a dramatic decline of Giant Kelp forests (that prefer cold water and cannot reproduce fast enough to combat the urchin arazina), resulting in barren habitats.

Method: Show students the book illustrations below (hide the text as per example).



Fig. 4: Illustrations from the book "The Underwater Forest" © Matt Howorth

Give students time to think what's different and what could have happened from the first scenario to the third. Read the story and use "The Circle Strategy" for discussion. Ask them if they have heard about any other places along the GSR that have been affected by sea urchin outbreaks. Together watch this video. Stop the video strategically at 3.57 minutes. In groups of 5, ask students to imagine that they were hired by the government to find solutions for this problem and allow 15 minutes for group discussion. Have the groups share their ideas with the class and debate them. Watch the video until the end and discuss.

Suggestion(s): Invite the author of the book to visit your school in person (or virtually) and share with the students the progress of the project that aims to restoring the kelp forests in Port Phillip Bay.

Ocean Literacy Principle(s)

OL3: The ocean is a major influence on weather and climate.

OL5: The ocean supports a great diversity of life and ecosystems.



Grade 5 – Grade 6



Science

Activity Turning up the heat



The Underwater Forest

Objective(s)

Students will learn that species have specific environmental requirements and that changing crucial habitat factors such as temperature (due to climate change) will lead to a shift in species habitat ranges. This shift is having consequences on populations of kelp forests across the Great Southern Reef.

Some organisms are already being negatively impacted by the changes in water temperatures resultant from human activities.

Currently, the most significant threat upon the Great Southern Reef is climate change. The rising of water temperatures will allow some herbivorous tropical species to migrate down south, quickly grazing on the kelp forests. It is known that 95% of the kelp forests around Tasmania have already completely disappeared. **Method:** Following the previous activity, use "The Wonder Strategy" to question what other species might be affected by the increase of the water temperature in the East Australian Current and what might be the consequences of this happening.

Watch the **documentary** (episode 2; 09.43 to 16.04 min) where Dr. Adriana Verges explains their research work and talks about the effects of the increasing water temperature of the East Australian Current. Dr. Verges gives some examples of marine life that are being affected by this increase in water temperature. Watch the **documentary** (episode 3; 10.20 to 16.57 min).

Challenge your students to write about the similarities and differences between the "The Underwater Forest" book (in Port Phillip Bay, Victoria) and the video (in Shelly Beach, NSW) with respect to reasons leading to the decline of seaweed forests and the restoration strategies being implemented.

Suggestion(s): Read pages 44 to 47 from "With a Little Kelp From Our Friends" picture book before conducting this activity. This will allow students to better understand the rise in ocean water temperature.

Ocean Literacy Principle(s)

OL3: The ocean is a major influence on weather and climate. OL5: The ocean supports a great diversity of life and ecosystems.



Grade 5 – Grade 6

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Science

Activity

How connected are you with the Great Southern Reef?



The Great Southern Reef

Objective(s)

Students will learn how connected they are with the ocean and how their local marine environment benefits them, their families, their community, and their nation. Through the freezing game, student will develop physical, listening, and social-emotional skills.

Humans are connected with and dependent on the ocean. Marine systems provide countless benefits and resources such as oxygen, water, food, medicines, and energy; and play a cultural role supporting recreational activities that improve our wellbeing.

The GSR provides ecological, social, and economic benefits. It contributes \$10 billion a year to the Australian economy. Tens of thousands of people work in industries supported by the GSR such as fisheries, hospitality, and tourism. **Method**: Start by asking your students how Sam and Frankie might be connected with the GSR. If students struggle to start the discussion, help them by giving some suggestions (sports, food, wellbeing, family jobs). Then, ask your students if they benefit from the GSR the same way as Frankie and Sam.

Each student should write their thoughts on a piece of paper using dot points. When they finish, randomly group students in teams of 4. Students in the same group should select 4 different ways in which they are connected with the GSR and think how they will work to represent that benefit through the freezing game*.

Give a minute to all the other groups to try to come up with the answer. Repeat for each group. The winner is the team with most correct answers.

For older students, you may choose to provide them with pictures of different people where a clear benefit can be visualised and conduct the same game.

Suggestion(s): Free usable images can be found on Unsplash: Photos for everyone. (for example: wellbeing).

*Watch this video to get a better idea on how to play the freezing game.

Ocean Literacy Principle(s)

OL6: The ocean and humans are inextricably connected.



Grade 2 - Grade 6



- The Arts
- Science

Activity Understanding and exploring tides



Rock Pool Secrets

Objective(s)

Students will understand how tides work, why is it important to look at the tides before exploring the seashore and determine the time of low and high tides using a tide table.

Tides are a natural process where the water level rises and falls on daily cycles. Tides are caused by the gravitational pull of the sun and the moon. Understanding the tides is important for many reasons such as exploring coastal areas and making use of the resources present along the coast.

Along the GSR coast, there are usually 2 high tides and 2 low tides each day, which is known as semi-diurnal tidal cycle. Each day, it takes over 6 hours between each high and low tide, and approximately 50 minutes for tides to turn. **Method:** After reading the book, use the circle strategy to discuss tides with your students. You may start by mentioning that something seems to influence how these animals behave in the rock pools. Determine the level of prior knowledge through the following exploratory questions: (a) Do you think it's important to predict tides? Why? (b) Are tide times the same everywhere? (c) How do tide times differ from day to day?

Print a tide table for a given period of time (e.g. one month) but for different locations (use the tables provided by Bureau of Meteorology here). Group students in teams of 4 and give them a printed tide table for different locations. Ask them to find how many high and low tides occur in one day, what's the tidal range and period and predict when would be the best time to go exploring the rock pools in the place that was allocated to them. Compare responses allowing students to understand the difference in tide times for different coastal areas.

Suggestion(s): If you plan to conduct an excursion to your local beach, students can be challenged to choose the best day to visit the beach using the tide table.

Ocean Literacy Principle(s) OL 2: The ocean and life in the ocean shape the features of Earth.

OL6: The ocean and humans are inextricably interconnected.

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Grade 4 – Grade 6



- Mathematics
- Science

Activity Excursion to my local beach



The Great Southern Reef; Rock Pool Secrets

Invite your students to go on an adventure to your local beach and see what they can find, similarly to what Professor Seaweed did with the children in the book "The Great Southern Reef". Upper grade students can conduct an easy monitoring survey method used by marine scientists to investigate marine organism's abundance and distribution in the intertidal zone. The survey method is known as the (point-intercept) quadrat - transect method.

The **intertidal zone** is the coastal area exposed to air during low tide and is usually submerged at high tide.

The intertidal zone is one of the most extreme environments on earth, making it a tough place to live! Daily tidal changes mean species can experience long periods of exposure to air, which drives large changes in temperature and salinity, risk of drving out, limited food availability and a high probability of being eaten by predators such as marine birds. It takes longer for the tide to come back in the upper zone than the low zone, so these environmental stressors increase with height on the shore.



Fig. 5: Intertidal zone © Prue Francis

Objective(s)

Students will gain an understanding that organisms occupy different zones of the intertidal area according to distinct living conditions and will become familiar with organism's ability to adapt and survive in challenging and stressful environments such as rocky shores.

This activity promotes a connection between students and their local marine environment by observing and exploring the marine communities found on local shores.

Through the scientific approach proposed, students will learn sampling methods commonly used by scientists to explore community structure, including the distribution and abundance of organisms. Students will look for patterns in the data obtained to test novel predictions (hypotheses) and develop their observation and critical thinking skills.

Materials

🗵 Safe and suitable clothing and footwear

- Light, breathable clothing
- Long pants
- Old sneakers, gumboots or reef-walking shoes
- Sunscreen
- Hat

Identification keys

🗵 Quadrats

☑ Transects (30 m tape measure – 1 per group)

⊠ Notebook

Observations Worksheet (see pages 50, 51 and 52; print at least 5 copies of each page)

Pencils and clipboards

☑ Digital Camera



Fig. 13: Beachcombing © Nicole Wu

Additional resources

Use the identification guides from Parks Victoria provided to you. More copies can be downloaded from the Parks Victoria official website **here**.

Note: If you don't know the names of the organisms found, you and your students can elect to call it a name based on the features of the organism and then try to identify it (if you can) back at school using online resources. For this we recommend using the app **iNaturalist** or species identification guidebooks.

Like Sam and Frankie in the "Great Southern Reef" book, lower grade students can opt to explore what they can find washed up on the beach and play the beach bingo game (see the games section, page 48).



Grade 4 - Grade 6

Ocean Literacy Principle(s)

OL2: The ocean and life in the ocean shape the features of Earth.

OL4: The ocean made the Earth habitable.

OL5: The ocean supports a great diversity of life and ecosystems.

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- Science
- The Humanities
- The Arts
- Mathematics

Plants and animals have developed physical and behavioural adaptations allowing them to survive in these extreme environments. Some have hard shells which prevent them from drying out and work as a defence structure against predators (e.g. limpets), while others restrict their activity (reducing their metabolism and associated need for food) during low tides.

It can be difficult to quantify biodiversity of a seashore community by looking at the entire shore. To overcome this challenge, transect lines and quadrats are used to sample the population, and then estimate the biodiversity for the entire shore from this smaller sample.

Transect lines are placed along an abiotic gradient, such as the intertidal zone (Fig. 6). Quadrats are randomly placed along the transect line (Fig. 7) for an adequate number of times to give an accurate representation of the population. For example, if the distribution of organisms on the shore is very patchy, a larger number of quadrats may be required than if the distribution is very uniform. A quadrat is usually a square frame of a set size (e.g. 50 x 50 cm) and can be easily constructed from materials available at your local hardware store (Fig. 8). Each time the quadrat is placed down on the intertidal zone, observations of what is present can be made (e.g. counting how many marine snails are present).

See this video where a marine scientist explains how to conduct this method in the field.



Fig. 6: Transect line © Prue Francis



Fig. 7: Quadrats placed along the transect line. Researcher holding a marine species identification guide. © Prue Francis

Hands-on: Create your own quadrat

Teachers: to create your own quadrat you'll need 4 PVC pipes (15mm x 50cm), 4 PVC elbows, clothesline cord, a ruler or tape measure, a permanent marker or pencil, PVC glue, and a drill suitable for PVC.

Steps:

- 1. Drill 5 holes, equally spaced on each of the PVC pipes.
- 2. Bring together the 4 PVC pipes into a square. Assemble the four PVC pipes with their elbows.
- 3. Rotate the pipes so that the holes face the center of the quadrat.
- **4.** Cut 8 equal length segments of the clothesline to create the internal arid.
- 5. Tie 5 strings horizontally inside the square with the same distances apart.
- **6.** Tie 5 strings vertically inside the square with the same distances apart.
- 7. You now have a quadrat with 5 x 5 squares (Fig. 8).



Fig. 8: 50cmx50 cm quadrat ©Cátia Freitas

<u>Students</u>: they can also build their own smaller quadrats that can be used in the classroom to quantify biodiversity, using photos of a rocky shore. For this activity they will need icy pole sticks, PVA glue and wool or string to create the grid.

Steps:

- 1. Teachers help students to cut 5 small grooves of each stick, equally spaced within the center (allowing for the width of a stick on each end).
- 2. Then, the 4 sticks must be glued together, forming a square (let the glue fully dry this can take a day).
- **3.** Use a single length of wool/string and wound around the quadrat, horizontally and then vertically. Start and finish anchored at one corner, which usually results in better tension and greater strength.
- 4. You now have a quadrat with 5 x 5 squares (Fig. 9).



Fig. 9: 15cmx15cm quadrat ©Cátia Freitas

Before the field excursion

Teachers should visit the location chosen for the excursion prior to the field trip to ensure that it is a suitable seashore for students to explore safely. If in doubt, get in contact with the local authorities (e.g. Parks Victoria) and ask for advice.

Quadrat-related activities

Activity 1: As an extension maths and science task, students can use the data they collected from the photos to estimate how many quadrats they may need to use in the field to get an accurate representation of the biodiversity on the shore depicted in the photos. This can be achieved by (1) calculating the average number of species from different numbers of quadrats and (2) plotting the average number of species against the number of quadrats used (see example below). This will

determine how many quadrats are needed until the average number of species starts to plateau, indicating that adding more quadrats does not make much difference. Students could also discuss variability around the averages obtained if different groups of students plot data from different groups of quadrats.



Activity 2: Ask different students to make quadrats with different numbers of intersecting points (and/or different sized quadrats) and use these to estimate the diversity in the same set of photos. Comparing different sets of data will allow them to see how the sampling method can influence the estimate. A stopwatch can be used to measure how long it takes to record the data from a set of photos with the different quadrats.

Invite students to discuss about the costs and benefits of using different sized quadrats. They should try to figure out the best sampling plan considering both time (for construction of quadrats and sampling in the field with a limited window at low tide) and costs (e.g. cost of materials). For example, if it takes twice as long to sample from the big quadrats, but only half as many quadrats is needed for an accurate estimate, it may not matter which size is used. In this case, students might choose whichever size is cheapest to make, considering the costs of the materials and the time required to make them (encourage students to research different materials and costs at their local hardware store). On the other hand, if the accuracy is improved by using quadrats with more intersection points for a given size and number of quadrats, then this might be a better option.

Prepare: Discuss with the students the type of seashore that is going to be explored (is it a rocky shore or a sandy shore?) and divide it into zones (upper, middle, and lower intertidal). Explain the transect-quadrat method. Organise them in groups and have them thinking about what needs to be prepared before the fieldtrip. Students should consider the materials that they will need and guidelines to guarantee their safety while making sure that marine organisms are kept unharmed, and to minimise local disturbance. Ask them to include in their guidelines a list of do's and don'ts during the field excursion to the seashore. Compare their lists to the one provided in this booklet (page 36). See below some exploratory questions that will help students starting the discussion.

Exploratory questions:

• What should they consider and be aware of when at the seashore to keep them and others safe?

• Why is it important to respect and help protect the marine life while visiting the seashore?

• What sort of data will they be collecting and how will they record it? What do they need to be able to collect their data? (Note: clipboards with a large rubber band to secure the bottom of the paper are really useful to avoid pages flapping in the wind; pencils are best for recording data because pen will run if the pages get dropped in a rockpool or rained on; a large, clear plastic bag in which the clipboard can fit is useful for recording data if it's raining (or waterproof paper or a plastic dive slate, but these are more expensive than standard paper).

<u>Make predictions</u>: Encourage students to think about which organisms they may find, where they find them (e.g. on the sand, in the rockpools, etc.) and why. Think about 3 challenges that the marine creatures living in rock pools face during low tide. Carefully reading, discussing and analysing the suggested books will help students to come up with predictions. See additional exploratory questions below that might help them to brainstorm some ideas.

Exploratory questions:

• Which animals/plants do you expect to find (or have found before) at the seashore?

• Where did you find/expect to find these marine creatures? (e.g. on the beach, all in the same area, closest to the water, away from water, in rock pools).

• We need to plan this fieldtrip during low tide. Why is it important that we go to the seashore during low tide for this activity?

• We need to decide a day and check the time of the low tide. Where can we find this information? How much time will we have on either side of the peak low tide to sample?

• How might the time of the tide and the time that we arrive at the shore help us decide whether to start sampling in the low zone or high zone first?

In the field

Let students explore the environment before starting the survey. Form groups of 5 and each group should determine who is responsible for (1) making sure group members are following the safety guidelines, (2) taking pictures, (3) recording the physical features of the place being investigated, (4) using the identification guides, (5) recording data. These roles can change between different members of the group (for example, each time they place the quadrat).

Survey: Each group should randomly choose a location to lay the transect line and place it perpendicular to the water line along the intertidal zone (make sure children do not get too close to the water and always face the incoming waves). If the tide is still receding you can start in the high zone and extend the transect line lower on the shore as the tide recedes – think about how to anchor it at each end in case a wave comes in once laid. Once the transect line is placed, students randomly choose at least 4 different locations along the transect line to place the quadrats and record the number and the type of organisms they can see inside the quadrat at each intercept point (where the string crosses). If they are not able to identify some of the marine organisms, make sure they take a picture of it for later identification (without getting too close or disturbing the organism). Note: there may be more than one species under each point, especially if there is a canopy of algae with other organisms living underneath.

If there's still time, students may explore the seashore further by adapting the activity "Interview with the story characters" (see page 43) by interviewing a marine organism on the beach instead of a story character.



Fig. 10: Barwon Bluff Marine Sanctuary - Rockpool. © Prue Francis



Fig. 11: Barwon Bluff Marine Sanctuary - Intertidal zone with a few rockpools. © Prue Francis



Safety steps to consider before starting the activities:

Make sure that everyone is aware of the safety procedures and where to meet in case of an emergency.

© Make sure that everyone is wearing suitable clothing and enclosed, non-slip shoes for this activity. Note: shoes that can get wet are usually best, like old sneakers, gumboots or reef-walking shoes, because it means students can move safely over the reef without worrying about getting their shoes wet.

© Inspect the seashore at arrival and look for any hazardous areas. Make everyone aware of the area limits that they can explore and remind them to avoid cliff areas or any zones where the depth of the water is unknown. Students should be buddied up (groups of 2-4) to explore the reef and reminded to stay close and keep an eye on their buddies at all times.

© Remind everyone that running and jumping should be avoided, and to watch for waves and rocks. A safe distance should be maintained from the edge of the rocks and the water line. We recommend staff and students always face the incoming waves so that they can see if they need to move to higher ground if the tide is coming in.

Students may find hazardous litter (e.g., glass). Make sure they know that it should not be collected and that they should tell their supervisor/teacher.
 Always keep an eye on the water and timing of the low and high tides.



Fig. 12: Students sampling the biodiversity of the intertidal zone at Point Lonsdale, Victoria. © Prue Francis

Back in the classroom

Organise data: Discuss the best way for students to summarise the data they have collected to show the patterns and to be able to test the predictions they made previously. Starting by classifying the organisms found in different groups, might help with this task. Depending on the age level of your students, this classification can be done by looking at different sizes, shapes, colours (e.g. works very well with seaweed) and their feeding habits (for example, identify organisms based on primary producers, grazers, filter feeders, predators, and scavengers). Ask the students to think about whether the patterns in their data support their initial predictions/hypotheses.

Interpreting the data: ask students to look at all the information they have collected. Then start a class discussion about the reasons why some animals and/or plants were distributed in different zones of the seashore (e.g. closer to the water, exposed to the sunlight, in the rockpools). Students should be invited to brainstorm ideas to explain the results they obtained. Teachers might choose to focus only on a few different animals found or different seaweed/seagrasses. See additional exploratory questions below that might help the class discussions.

Exploratory questions:

- Are the organisms found during the fieldtrip the same ones represented in the "Rock Pool Secrets" and "The Great Southern Reef" books?
- What was the marine organism with the highest abundance found?
- Which organisms were only found underwater? Do you think there's a reason for that?
- Of the organisms that were found exposed to the air, what might change for them when they are submerged during high tide? How might they possibly adapt to these two different conditions?
- Why do organisms living in the intertidal area have to be better adapted to changes in temperatures compared to organisms living continuously submerged in the ocean?

Suggest explanations: have students explore the adaptations (might be structural, behavioural, or physiological) allowing these organisms to survive in the rocky shore. Some of these adaptations are described in the "Rock Pool Secrets" book. Students might need access to their school library and a computer to conduct research.

Communicate results to others: the last step for any scientist is to communicate your results. A class report or poster with the main findings can be created, printed, and displayed on a school wall where the school community can see it. Results must be presented clearly but not with too much information. Simple bar or pie charts can be used. Pictures/illustrations can also help to deliver the message.

Do's

Respect the natural environment.

Tread cautiously to avoid slipping.

 \clubsuit Keep an eye on the waves at all times to ensure your safety and that of your buddies.

& Avoid disturbing the marine life, always observe it with a safe distance.

 \clubsuit Listen carefully to any instructions about poisonous organisms in your region to avoid possible injury.

 $^{\&}$ Take pictures and make sure marine life is left where found.

If turning seaweeds and/or rocks, make sure to return them to their original position to protect them from environmental stressors.

& Avoid bird nesting areas (look for signs placed on the beach during nesting season and carefully read the guidelines).

& Let your teacher know about anything washed up on the beach that doesn't belong there.

If collecting seaweed samples, make sure your teachers hold the necessary permits from the local authorities.

Enjoy visiting your local marine environment! Take the time to observe the extraordinary organisms living there, appreciate it, care about it and advocate for it.

Don'ts

⑦ Don't explore the seashore on your own.

Don't disturb birds feeding.

I Don't leave any litter behind – always bag it and take it back with you.

I Don't get close to the water line and never turn your back to the ocean.

Avoid collecting shells from rocky shores as these can be home for some marine animals (but it's usually ok to collect a few shells from sandy beaches as long as you're not in a protected area).

The rockpools are home for some venomous animals such as the blue ringed octopus or other marine life that may harm you. Never place your hands where you can't see them (e.g., hidden holes, under ledges).

Activity Food chains



With a Little Kelp From Our friends

Objective(s)

Students will understand how energy flows through a food web and how organisms are classified in different trophic levels:

<u>Producers</u>: the first trophic level. These organisms make their own food.

<u>Consumers</u>: can be herbivores, carnivorous or omnivorous. <u>Decomposers</u>: the final trophic level. These organisms convert organic waste into inorganic materials that will be used by the producers, completing the cycle.

A food chain describes who eats whom in an ecosystem. A food web shows how energy is passed through organisms in a habitat. Disruptions to food webs may cause the decrease of some populations and increase of others, resulting in endangered or even extinct species.

On the GSR, the invasive Northern Pacific Sea star leads to imbalances in the ecosystem's food web, as it is a voracious feeder, that will eat almost anything it can find. **Method**: Conduct this activity after the fieldtrip, when students already have a more solid knowledge about the marine life found in the rock pools.

As a class, (re)read pages 8-9 & 18-19 of the suggested book.

Use a ball of string and the ID cards (or the **Totem cards** available on the GSR official website) plus one card representing the sun. Assign one card to each student and stick it to each child's shirt. Randomly arrange students in a circle. The first student represents the sun and should pass the string to the student with an organism that uses the energy from the sun. That student then passes the string to someone holding an organism that consumes it. Continue passing the string until everyone is included in the food web (note that most organisms will have more than one prey option). In the end, the class should have a big web of string connecting all the parts of the food web.

Suggestion(s): Impose a scenario where there's an outbreak of sea urchins. All students holding kelp species start to gently shake the string. Any other student who feels the shake must also shake the string. This will show how the impact of the urchin's outbreak has on the whole food web.

Ocean Literacy Principle(s)

OL5: The ocean supports a great diversity of life and ecosystems.



Grade 3 – Grade 6



Science

Activity

Seagrass habitats of the Great Southern Reef



The Way of the Weedy Seadragon

Objective(s)

Students will learn about the differences between seaweeds and seagrasses as well as the benefits that seagrass meadows provide to the ecosystem.

A large number of species found in the GSR make use of the rocky reef habitats, but the nearby sandy-bottomed areas covered with seagrass meadows are also popular. Apart from all the benefits provided by these highly productive marine ecosystems, seagrass habitats also establish connectivity between reefs.

Seagrass meadows provide important and productive nursery areas for commercial and recreationally important species present in the GSR.



Method: After reading the book, use the wonder strategy to introduce a discussion about seagrasses (see wonder # 8). Prior to the activity, collect samples of seaweed and seaarass from your local beach (check with the relevant authority what is allowed before going foraging, and always try to minimise your impact). Display samples in large trays and encourage students to handle them and describe the differences between seagrasses and seaweeds. They might mention the presence of roots, leaves and rhizomes in the seagrass samples and the absence of the same structures on the seaweeds. They may also start noticing that seagrasses have similar structures to land plants. Try to lead them to understand that segarasses are flowering plants that have adapted to live in the ocean. Invite students to think about at least 3 reasons why seagrasses are an important habitat for the Weedy Seadragon (e.g. provision of food, protection, and oxygen). Share with the class the videos (V1, V2, V3) published by the official GSR Facebook account about the seaarass ecosystems on the GSR.

Suggestion: For upper grades, challenge students to draw a labelled representation of seaweeds and seagrasses as per the example on this page. More background information about seagrasses can be found here.

Ocean Literacy Principle(s)

OL5: The ocean supports a great diversity of life and ecosystems.



Grade 4 – Grade 6



Science

Activity The Great Southern Reef as inspiration



Any picture book provided.

Objective(s)

Students will be introduced to a few artists that use the marine life and habitats of the GSR as an inspiration for their artwork.

Art and Science go hand in hand in understanding the natural world around us.

The unique marine habitats along the GSR inspire people to create remarkable artwork all over the world. These artists share their passion with others through paintings, photography, videos, stories, etc. Art can drive people's attention to this visually stunning natural reef and help them to connect and expand their understanding and appreciation of it.

"A good scientist can be a great artist just in the way that they do their work, and a great artist can be scientific in his exploration of his subject." Roger Swainston **Method:** Starting with all the authors and illustrators from the picture books to other artists who are inspired by the unique marine life found in the Great Southern Reef (see list below), there are many people working to raise awareness of the GSR through their artwork.

Explore the artwork with your students and ask them which questions they would like to ask to the different artists. Write them down and then organise the class in groups. Each group should draft an email to the artist that they would like to invite to visit (in person or virtually). Alternatively, the class can write an email together. Once the final version of the email is finalised, the teacher can send it to the artist(s). Schedule a day and time for the visit and make sure to have all the questions ready.

Students can be encouraged to create their own artwork based on their favourite artist(s). This can be linked to the activity in the next page.

Artists

- Stefan Andrews
- · Casa Adams Fine Wares
- · Angela Rossen
- Narelle Craven
- Matt Testoni

Ocean Literacy Principle(s)

OL6: The ocean and humans are inextricably interconnected.



Grade 2 – Grade 6

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- The Arts
- Science

Activity Raising awareness of my local beach



Any picture book provided.

Objective(s)

Teachers and students will help to raise awareness about the GSR through a school art exhibition/fair.

It is estimated that 16 million Australians live within 50km of the Great Southern Reef.

Some say that the GSR is Australia's best-kept secret. People depend upon the ecological and economic benefits provided by this temperate marine ecosystem. However, it is still relatively unknown within the community.

"With knowing comes caring, and with caring, there is real hope that the Great Southern Reef will be respected and protected."

Sylvia Earle

Method: Creating a local marine environment art exhibition can be a very engaging activity for your students and also gives other students, teachers and the staff members from your school an opportunity to engage with your local marine environment. There is a great deal of material that can be used to create an art exhibition of your local marine environment/beach. You may like to organise a beach clean-up, where rubbish found can be used to create representations of the local marine environment. This activity can be completed over a few months or a school year project.

Alternatively, if an excursion to the local beach is not possible, students can collect old/recycled materials in boxes placed at the school for everyone that wishes to contribute. This way the whole school community can be involved. Parents might help children with resource collection for the art exhibition. Get some inspiration here.

Suggestion(s): Additionally, you can create a class newsletter and students can be invited to write an article per month. Topics could include marine species they learned about, interviews to experts in the field, etc.

Ocean Literacy Principle(s)

OL6: The ocean and humans are inextricably interconnected.



Foundation

Grade 6



- The Arts
- Science
- English

Activity Ask an expert



Any of the books provided.

Objective(s)

Students will be able to clarify their questions and curiosities about the GSR by inviting experts in the field to their classrooms.

The natural system of the GSR was first named in 2016. Later, in 2019, it was nominated a Mission Blue's Hope Spot in recognition of its pristine temperate reefs, biodiversity, Indigenous values and importance.

The GSR remains largely unexplored. The next generation of scientists will have the opportunity to make great discoveries, as it is estimated that tens of thousands of species are yet to be discovered.



Method: After reading and discussing a book, ask your students if there are questions that they would like to get answers for. It might be related with the story, the characters, the habitat, or simply to discuss ideas of experiments/projects.

Depending on the book and the marine science field, invite a relevant speaker to your school. Students can investigate who they would like to invite. These speakers can be fishermen, marine scientists and educators, citizen scientists or anyone that has some level of knowledge about the GSR and would be able and available to share their knowledge with students, answer their questions about a specific topic and support the projects happening at a school level (by giving ideas, for example).

If the speaker that was selected cannot attend the school in person, with your support, ask students to organise a virtual meeting.

Suggestion(s): Whenever possible, conduct an excursion to formal or informal marine science education providers (e.g. Discovery Centres, Universities, etc).

Ocean Literacy Principle(s)

OL6: The ocean and humans are inextricably interconnected.

OL7: The ocean is largely unexplored.



Foundation

Grade 6

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- Science
- English

Activity Temperate vs Tropical marine ecosystems

Temperate and tropical marine ecosystems share a few similarities and several key differences.

Objective(s)

Students will learn about the main differences between tropical and temperate marine habitats.

Different locations



Fig.14: Globe © Dieter Tracey, IAN Symbols

Different habitat-forming species

Tropical: coral reefs formed in shallow, warm, nutrient-poor waters such as the Great Barrier Reef.

Temperate: kelp forests formed in shallow, cold, nutrient-rich waters such as the Great Southern Reef.

We recommend you conduct this activity after your students have an adequate level of knowledge about the marine life and habitats of the Great Southern Reef. Watch the episode "**Pacific Ocean**" from the "Magical Land of Oz" documentary. Ask them to think about the main differences between the Great Southern Reef and the Great Barrier Reef in terms of location, temperature, marine life, and threats. This activity can be conducted in teams of 2 or 4 students with each team completing a Venn diagram (example included below). Compare and discuss student's contributions.



Suggestion(s): Read the book "The Great Barrier Thief" by Sue Pillans before conducting the activity. This will help students to visualise and understand the differences in marine life inhabiting these two reefs.

Ocean Literacy Principle(s) OL2: The ocean and life in the ocean shape the features of Earth.

OL3: The ocean is a major influence on weather and climate.

OL5: The ocean supports a great diversity of life and ecosystems.

Grade 5 – Grade 6

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Science

Activity: Reflection of the book

Invite students to reflect about the following questions:

- 1. What did you like the most about this book? Why?
- 2. What did you not like so much/at all? Why?
- 3. Was there something that intrigued you?

4. Would you recommend this book to someone? If yes, describe who that person would be and why.

Activity: "Dear author"

This activity involves writing a letter to the book's author(s) and/or illustrator(s). This can be completed in groups or individually. After reading the book, students write to the author via the publisher (who forwards the messages). The letters can include questions to the author about the writing process, the book, the story, the illustrations, and what would have happened if something in the story was different, for example. Students should also be encouraged to give the author/illustrator positive feedback on what they liked about the book and why. Encourage discussion about the best way to structure the letter, e.g. should they start with positive feedback or questions etc., or perhaps an introduction to themselves and their passions relevant to the book? It might take some time until your students get an answer from the author/illustrator(s), but this should not discourage you from conducting the activity. Receiving a reply letter from the author will help your students to get even more engaged with the book and the topics being discussed.

Activity: "Interview with the story characters"

Ask your students to choose a marine organism from the book(s) they think has an interesting story to "tell". They should ask some questions and think about what it would answer if it could talk. Tell them to write down their interview. Some examples of questions include:

- How old are you?
- Have you always lived here?
- Do you live alone?
- Do you like to live here? Why?
- · Are you afraid of anything?
- Who helps you and who do you help?
- \cdot Where do you find food?
- \cdot Have you always been this big/small?
- · Would you like to share something else about yourself that not many people know?

Activity: New Words

Create your own class glossary about

the books' topics: If the book(s) includes words that will possibly be new for your students, ask them to let you know every time they do not understand the meaning of a specific word. Students should try to work out the meaning of the words with the other words next to it and the pictures on that page. Then, ask students to use a dictionary, and search for the meaning of the "new words". Some books also have a glossary at the beginning or at the end.

My favourite words: Invite your students to write down 1-3 (or more) favourite words while they listen to the story. Make sure they understand that their words don't necessarily need be words they already know. They can be new words they do not know the meaning of but liked how each sounded.

Activity: Finding connections and differences between books.

If your school or local library has access to more ocean-related picture books, then you can encourage students to explore other books and find similarities and differences between them.

Similarities: providing books about the local temperate marine environment and look for similar animals, similar habitats, similar features.

Differences: once students are familiar with their local marine environment; they can go one step further and explore marine science books about another environments (tropical environment such as the Great Barrier Reef).

Activity: Create your own themed t-shirt

Ask students to bring a white t-shirt that they can paint on. Using resources for marking fabric (e.g. fabric markers, paint), challenge students to draw and paint anything they would like to wear related with the topic of the book. Another option is to paint a t-shirt for another student or swap t-shirts at the end of the activity.

Activity: Song writing and music creation

Invite your students to write the lyrics for a music about the story. Songwriting can be a challenging and rewarding activity for children. You can start by asking them to contribute with everything they know so far about the story in the book. Questions may arise during this process and you, and your students may need to conduct some research to fact-check. Put together a first draft of the song and test a few different rhythms and song patterns.

A few questions that Mary Amato (website here) suggest teachers to ask students during the songwriting process include:

- Is there rhyme?
- What's the pattern of the song?
- What's the rhythm of the song?
- What's the emotion of the song?
- Does the rhythm and melody fit the emotion/meaning?
- What's the main idea of the song?
- Is there a chorus (a part that repeats)?
- Is there repetition?
- Is there a surprise?

Exemplary practice:

Watch the **music video** [starting at min 4] from Operation Crayweed Marine Education Project led by Dr. Adriana Verges.

Barry Peters (Canya Dantz) is an Australian children's music singer songwriter that writes songs with environmental themes. Watch the **song and film clip** called Weedy Seadragon for some inspiration.

Note: This is an excellent opportunity to collaborate with the music specialist teacher from your school.

Activity: Small World Play

This activity is ideal to foster children's creativity and enhance the learning process. A range of different materials can be used to create scenarios from stories or real life.

An underwater small world

Challenge your students to create an underwater small world below their desk/under their table. They can choose to work individually or in groups. To give them some inspiration, show them a few videos of the local marine life and/or use the books. Ask them to think about what they can use to create their underwater world and bring together the materials so the class can have access to them. In the end, children can invite their classmates to come around and have a look at their underwater world.



Fig. 15: Underwater small world © Prue Francis

Challenges may arise when creating

small worlds, such as conflict resolution among younger children when working in a team. Students will be encouraged to find solutions by listening and respecting others, sharing tasks, and taking turns. This activity can also help to develop numeracy skills through categorizing, grouping, and counting items.

Note: this activity might seem more appropriate for younger children, but this is something that older children can create in their class and invite the younger grades to come around and have a look at. Also, this activity does not need to be conducted and finished in one day, this might be something that you agree to do with your students on a specific day(s) of the week for a certain period of time. This will also allow them to come up with more ideas and ask for help from their friends and family.

Games that foster creativity

Who am I?

This game follows a similar format to the game charades where players ask questions to guess the unknown organism. Divide the class into 4 or 6 groups. Two groups will play together: for example, students from group 1 will select a flashcard and place it facing down. Students in group 2 ask "**Yes**" or "**No**" questions with the aim to find out which organism was selected by group 1. You can choose the number of rounds, but each round should not go for more than 2 minutes. The winner is the group that correctly guesses the highest number of organisms within the timeframe.

There are a few different options for resourcing this activity. Students can simply choose one creature from the book(s). Alternatively, you may download, print and use the GSR Totem Cards or the ID cards created before. If you wish to deepen your student's knowledge about seaweed exclusively, you may ask them to create their own flashcards for some of the many different species of seaweeds found in the GSR (see the book "With a Little Kelp From Our Friends" or the Taxonomic Toolkit for Marine Life of Port Phillip Bay for some ideas.

Example of questions:

- · Does it have a shell?
- · Does it eat seaweed?
- · Is it venomous?
- · Does it get exposed to the air during low tide?
- · Is it a primary producer/Does it photosynthesise?
- · Does it change colours to blend with its surroundings and hide from predators?
- · Is it an endemic species of the Great Southern Reef?
- Does it have 5 arms?

Suggestion(s): Conduct this activity after your students already have some level of knowledge of the common marine life that can be found on the GSR. This game will allow children to strengthen and consolidate previous knowledge acquired.

Mimic game

Teachers will have to create cards/papers with a specific word or sentence about any topic in the book being explored. Students should form groups of 2 or more. Each round, members of the same team will have to work together with the goal of describing the secret word provided by the teacher. The teacher can determine at the beginning how many rounds will be conducted and time each team.

Card game

The Great Southern Reef official website offers great educational resources for teachers, including the **GSR totem cards**. Teachers can print two sets of these cards, explore them with students in class and play the Memory game where students compete to try and find the matching cards as fast as possible.

Alternatively, the class can be challenged to create their own card deck with the local marine life. With teacher's help, students can laminate the cards for other educational activities.

Pictionary

For this game, students must be in teams of at least 2. Only one member of the team will draw a picture of what is described in the card and everyone else must try to guess what it is. We recommend allowing 60 seconds to draw. The team that guesses first wins that round. The teacher can determine at the beginning how many rounds will be conducted. The drawers and guessers should swap between rounds. For younger grades the card deck may focus on the marine species/characters from the books, but for older students, this game could be made more challenging by also including a category that has words to describe some of the marine science concepts

that have been explored in previous activities (e.g. photosynthesis, tides, salinity, foundation species, plastic pollution, climate change, predation, camouflage etc.)

Beach Bingo game

In class, discuss with your students what they would expect to find at their local beach. Write down their answers. Prepare a bingo grid with as many columns and rows as you would like. In each square, write the name and/or the illustration of an animal, plant, seaweed and/or other items that can be found on the beach. Organise students in small aroups, each with a bingo board. Students should look for those items when you visit the beach and the first team completing five items in a row or in a diagonal is the winner. If vou cannot take your students to the beach, adapt this game by hiding items in your classroom or school and play the same game.

Note: Try to create different bingo boards and add items that are easy to find and others a little more challenging (e.g. the seaweed, Neptune's necklace would be an easy seaweed to find on most rocky reefs on the GSR, however, the hermit crab might be more challenging. If you wish to discuss marine pollution, add a few items that don't belong to the beach but are often found there (e.g. a fishing line, plastics, etc).

"If they're laughing, they're listening."

Ken Robinson

Selecting children's picture books

Selecting picture books to teach about marine science is not an easy task and should be well considered. Often, we tend to read books that exclusively focus on the challenges that our ocean is facing, and we do it believing that this will help children to develop positive attitude and behavioural change. However, occasionally these books may not have the desired effects on children, and they can instead trigger eco-anxiety associated with feeling of powerlessness to prevent environmental change.

When selecting a children's book, it is also important to briefly check the background of the author(s)/illustrator(s) and their previous work. It is less likely to find misconceptions when books are written and illustrated in collaboration with someone that has a science background or if a science consultant was used.

Below is a list of questions that can help teachers when in the process of selecting picture books (these questions have been adapted from Mahzoon-Haghegui et al (2018)).

- Is the fact(s) discernible from fiction?
- Does the book contain misconceptions/misrepresentations?
- Are the illustrations accurate? If not, do my students have enough knowledge about the topic that will allow them to understand misrepresentations in the illustrations?
- Are characters depicted with gender equity?
- Are animals represented realistically?
- Does the story promote a positive attitude towards marine science?

What to do when finding misconceptions and/or misrepresentation of science concepts in picture books (for example: suggesting that parental care is provided by seahorses after birth)?

Scientifically inaccurate children's books can be helpful when students analyse them after they have gained a complete understanding of a scientific concept. Opportunities to correct the misconceptions transport students to a higher level of thinking (Ansberry & Morgan, 2010).

Observations Worksheet

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Glossary

Abiotic gradient: is related with the characteristics of a place (e.g. variation in elevation).

Adaptations: It happens when organisms become better suited to survive and reproduce in their environment.

Atmosphere: The layers of gases that surrounds the planet. Earth's atmosphere is composed of approximately 78% nitrogen, 21% oxygen, and one percent other gases.

Biodiversity: describes the variety of life (all living things) found in one area.

Bioluminescence: emission of light generated by a chemical reaction within a living organism.

Carbon dioxide: a colourless and odorless gas in Earth's atmosphere, usually resulting from the respiration of organisms and the combustion of organic matter.

Climate change: the long-term shifts in the weather patterns.

Climate: long-term pattern of weather prevailing in a particular area.

Density: a measure of mass per unit of volume.

Eco-anxiety: the distress triggered by changes in climate where people experience anxiety regarding their future.

Ecosystem: includes all the living organisms and their interaction between them and the physical environment, in a given area.

Extinct/Extinction: when a species is believed to have died out.

Filter feeders: organisms that obtain their food by filtering suspended particles/other organisms from the water column.

Foundation Species: species that have a strong role in determining the local biodiversity and regulating the ecosystem dynamics.

Grazers: organisms that rely on herbivory, feeding on vegetable substances, such as plants and seaweeds.

Habitat: the area or natural environment where an organism lives, including all living and non-living environmental factors.

IUCN: International Union for Conservation of Nature

Larvae: the immature stages of an organism that develops into different forms as it becomes an adult.

Marine algae: large group of organisms living in the ocean that have the ability to conduct photosynthesis.

Marine: Existing in or produced by the sea.

Microbes: all forms of microscopic organisms such as bacteria, viruses and protozoa.

Minerals: a solid, inorganic element or compound that occur naturally, with a welldefined chemical structure.

Nursery areas: in marine environments, it corresponds to an area that contributes to a recruitment greater than average number of individuals of a species, compared to other juvenile habitats.

Nutrient: a substance that an organism must obtain from its surroundings for life and growth.

Ocean current: the horizontal and vertical movement of water from one location to another powered by wind, differences in water density and tides.

Oxygen: a colourless, odorless gas essential to life on Earth. It makes up for approximately 21% of the earth's atmosphere.

Photosynthesis: process in which plants, algae and some types of bacteria use sunlight to produce oxygen and chemical energy from carbon dioxide and water.

Phytoplankton: microscopic photosynthetic marine algae that drift with the currents.

Plankton: usually microscopic plants and animals that drift with water currents.

Productivity: in ecology, it refers to the rate of formation of biomass in the ecosystem.

Scavengers: organisms that consume decaying biomass such as dead animals.

Seashore: land adjacent to the ocean.

Small World Play: an activity that allows children to create real world/ imaginative scenarios in a miniature play scene.

Species: a group of organisms that share common characteristics and are able to breed with each other.

Weather: short-term changes in atmospheric conditions such as temperature, humidity and precipitation.

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- 66. [Fig. 6] Image "Transect line" with permission to be used by the author (Prue Francis).
- **67.** [Fig. 7] Image "Quadrats placed along the transect line. Researcher holding a marine species identification guide." with permission to be used by the author (Prue Francis).
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- [Fig. 9] Image "15cm x 15 cm quadrat" with permission to be used by the author (Catia Freitas).

- 70. [Fig. 10] Image "Rockpool" with permission to be used by the author (Prue Francis).
- **71.** [Fig. 11] Image "Intertidal zone with a few rockpools" with permission to be used by the author (Prue Francis).
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