Marine Education Kit

Living on the Edge

Friends of The Bluff

Caring for the unique Barwon Bluff since 1994.

Marine Education Kit

Marine Education Toolkit

Produced by the Friends of the Bluff, 2022.

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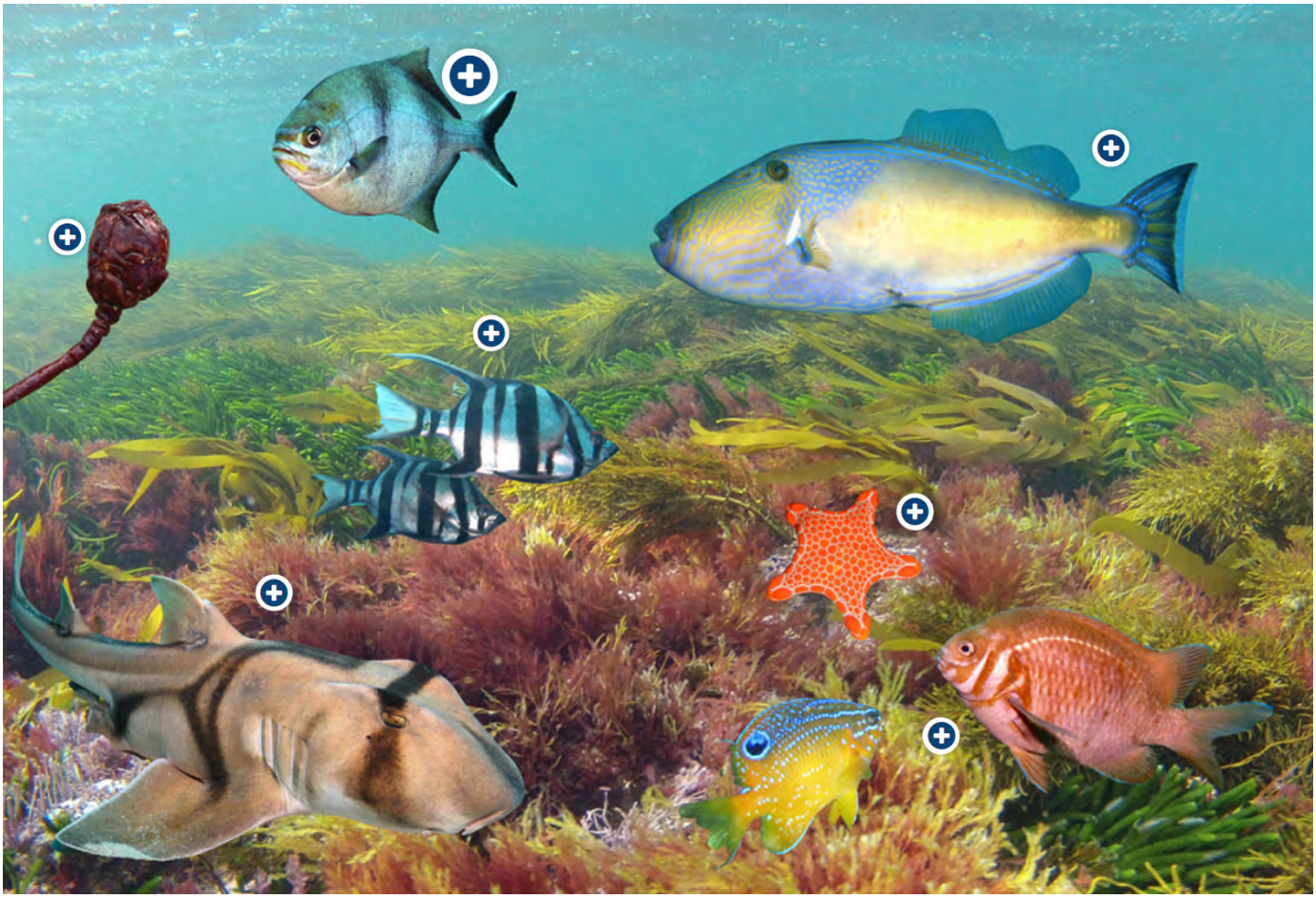
Introduction
The Barwon Bluff Marine Sanctuary protects 17ha of marine habitat at Barwon Heads. It is predominantly composed of rocky-reef and is famous for the diversity of its sea life, particularly in the intertidal areas. The Barwon Bluff Marine Sanctuary was listed as a Marine National Park by the Victorian Government to preserve this wonderful environment for future generations. The Friends of the Bluff have created this **'Marine Education Kit'** featuring virtual habitats, fun online puzzles and classroom activities based on a virtual world, the object of which is to deepen learning, all of which are enriched by the activities and resources on our website at **www.barwon.bluff.com.au**.

The **'Marine Education Kit'** can be classified into the following parts:

Virtual Habitats: Explore the Barwon Bluff from your own classroom by clicking the image below. Use these 'Virtual Habitats' as a pre and or post visit to the Barwon Bluff Marine Sanctuary, or as the stimulus and information source for a marine related Inquiry Unit.

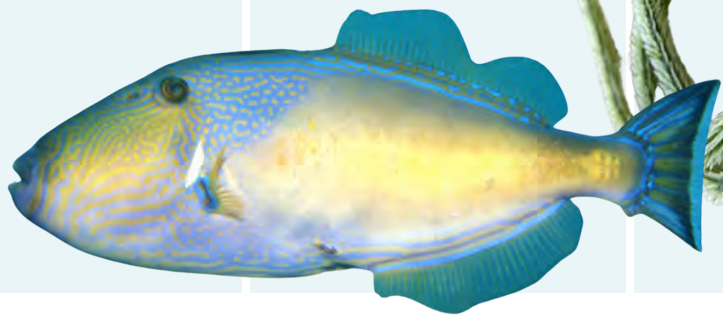
Click on the fauna and flora. Each creature has an image with information, their common name, scientific name and Wadawurrung name (if known).



Featured Marine Species

To assist teachers with planning and implementation, the table below lists the fauna and flora that have been used in the 'Virtual Habitats' and is content for the puzzles. These were chosen either as they are among the most common and/or most indicative of the environment. This is just a small collection of the creatures found in the Barwon Bluff Marine Sanctuary.

Molluscs	Crustaceans, Ascidians & Echinoderms	Seaweed	Fish	Mammals	Birds
Black Nerite Blue Periwinkle Cart-rut Shell Checkerboard Snail Striped Conniwink Tube Worm Beaked Mussel Keyhole Limpet Hairy Chiton Warrener Snail Elephant Snail Sea Hare	Cunjevoi Eleven-armed Seastar Waratah Anemone Honeycomb Barnacle Purple Mottled Shore Crab European Shore Crab (pest)	Neptune's Necklace Flat-lobed Cystophora Bull Kelp Sea Lettuce Coralline Algae	Dusky Morwong Six-spine Leatherjacket Western Blue Groper Blue-throated Wrasse Old Wife Magpie Perch Zebra Fish Port Jackson Shark Smooth Stingray	Australian Fur Seal Burrunan Dolphin	Australasian Gannet Pied Oystercatcher Hooded Plover Pacific Gull Silver Gull Crested Tern



Teacher Notes

Activity Types

- Classroom activities are designed to deepen students understanding, highlight issues, and investigate scientific concepts as they relate to the Barwon Bluff Marine Sanctuary. Each puzzle has activities designed to encourage students to think scientifically, to investigate biological concepts in the real world and apply this knowledge to help protect and maintain this special environment. All activities are in line with the Victorian School Science Curriculum.

- Our **'Living on the Edge'** resource library provides access to more classroom activities sourced from the original website and CD. There are links to other great marine resources, including online puzzles, storybooks, images of the Barwon Bluff Marine Sanctuary and a YouTube video library.

Living on the Edge - Online Puzzles

- Our **'Online Activities'** page features new versions of the old favourites including jigsaw puzzles, memory matching, crosswords, image sequencing and multiple choice questions. The puzzles themselves provide exposure to facts and images, which is the simplest form of learning. As educators, we are aiming for more meaningful learning and for our students to understand how all the pieces of an entire concept fit together. To achieve this, students need retention and the transfer of knowledge. We hope the puzzles format provides a fun way to feed and foster knowledge retention, while the class activities transfer knowledge to real life situations, encouraging life-long learning.

Difficulty

- The puzzles come with a rating; from easy, medium and hard. Although classified this way, this does not preclude them from being used by a variety of age groups. Younger children may benefit by the whole class playing as a group, older primary school children may attempt some of the harder puzzles as a small group and work cooperatively. Children can also work individually and the puzzles can be used as a timed pre and post-test. You are free to use our resources to suit your students and learning environment.

Content

- Science Inquiry Skills: Questioning and predicting scientific thinking, communication recording and evaluation.
- Science Understanding Concepts: Habitats, Classification, Adaptations, Food Chains and Food Webs, Threats.

Section 1: Jigsaw Puzzles - Habitats

Topic: Habitats: Sandy Shores, Intertidal Reefs, Sub-tidal Reef and Soft Sediments

Activity 1: Think See Wonder

To make the most out of this resource, we suggest that you read and employ the **'See think wonder'** education strategy. Some questions to ask your students to prompt wonderings may include:

- What might some common habitats on the Barwon Bluff be?
- What animals might live in each of these habitats?
- What are your reason for your choices?

Activity 2: Marine Habitats 1

Foundation-2 (whole class)

Play our **'Marine Jigsaws'** or use **'Appendix 1: Jigsaw Puzzles'** as a reference.

- Play 'I Spy' with the class to bring attention to specific details
- Discuss the plants/algae and animals, their characteristics and where they live. Is it wet or dry? You can use **'Appendix 2: Wet, Dry or Both - Cut and Paste'** to sort animals based on whether they live in a wet or dry area.

Activity 3: Marine Habitats 2

Levels 3-4 (whole class)

Investigate marine habitats using the **jigsaw strategy of teaching**. Then as a class:

- Divide the class into four groups. Give each group an online jigsaw to complete.
- Students may work as a group or individually to complete the jigsaw.
- Once completed, ask the students to discuss and record what is special about the habitat featured in the online jigsaw and the creatures featured.
- Share the group's findings with the whole class. Encourage the whole class to write and record definitions and share with whole class.

Section 1: Jigsaw Puzzles - Habitats

Topic: Habitats: Sandy Shores, Intertidal Reefs, Sub-tidal Reef and Soft Sediments

Activity 4: Marine Habitats 3

Levels 5-10 (whole class)

Investigate the estuary habitats using the **jigsaw strategy of teaching.** Then:

- Divide the class into four groups and assign each group a habitat from **'Appendix 3: Marine Jigsaw Strategy Information Sheets'**. Provide each group with a copy of this appendix for background information.
- Students read the text themselves, or read a paragraph each, then report back to their group, one student may read aloud. However, regardless of how the students choose to read the text, they must discuss the reading as a group. For example, what is special about the environment, habitat, creatures, and any threats perceived.
- The activity can be structured by having specific points to guide students reporting. You can use butchers paper to take notes and record information.
- All groups report back to the whole class to pool their knowledge. Students can write and record their own definitions of the four habitats.

Section 2: Drag and Drop

Topic: Living, Non-Living and Once Living

Activity 1: Living and Non-Living

Foundation-2 (whole class)

As a class, play our **'Living and Non-Living'**, a simple 'drag and drop' sorting activity.

- Using the puzzle, have the students decide whether the object is living or non-living. Discuss and have students explain their choices.
- On completion of the puzzle, pose the following question; 'How do we know if something is living or not living?' Make a list of possible reasons or rules.
- Watch this video: **'Living and Non-Living'** - https://youtu.be/NG-FaXNilfU.

Note: this video only uses three criteria to question whether an object is living or non-living. It is useful as it provides a structured, scientific way of thinking to evaluate an objects status.
The following questions can be used to assess if something is living or non-living:

- Will it grow?
- Does it need water?
- Does it need food?
- Does it change?
- Does it have offspring similar to themselves?

- Look at **'Appendix 4: Living and Non-Living Chart'** and **'Appendix 5: Is it Living or Not'** and ask students to apply scientific thinking to determine an objects status.
- Have students draw a line or fold a piece of paper in half. Label one column living and the other column non-living.
- Ask students to then go outside into the school grounds and find objects that are living or non-living. **Please note:** Please be safe when doing this.
- Students can draw and label objects or creatures under the correct column on the sheets in the appendices above.
- On return to the classroom, ask student to share their findings. Make sure that before going outside, students know that they will be expected to give reasons for their classification.

Section 2: Drag and Drop

Topic: Living, Non-Living and Once Living

Activity 2: Living, Non-Living and Once Living

Foundation-2 (whole class)

Play the **'Living, Non-Living and Once-Living'**, a simple 'drag and drop' sorting activity.

- On a whiteboard or large piece of paper, draw 3 columns. Label 2 of these columns with 'Living' and 'Non-Living', leaving the third unlabelled.
- Put the objects that don't fit the living and non living rules in the third column. On completion of the puzzle, direct their attention to the third unlabelled column. Discuss what this could be labelled.
- Refer to **'Appendix 4: Living and Non-living Chart'** and **'Appendix 5: Is it Living or Not'**. Discuss how these charts could be used to decide whether an object is non-living or once living. You can also use the below prompts:

    - Did it once grow?
    - Did it once need water?
    - Did it once need food?
    - Did it once breathe?
    - Was it once able to reproduce, have young or breed in some way?
    - Can it do those things now?

- Then complete the 'Once Living' column on the online puzzle.
- Ask students to use old magazines to find and cut and paste objects into the correct classification. Alternatively use very large paper and set up three sheets labelled 'Living', 'Non-Living' and 'Once Living'. Students use the same method but glue them on the large sheet and create class posters.

Section 3: Memory Puzzles and Virtual Habitats

Topic: Classification

Activity 1: Celebrity Head

Foundation-2 (whole class)

As a class, play **'Marine Memory: Images'**, a simple image to image memory match. While playing, note:

- The various aspects of each creature as you play. For example, has it got legs? Does it live in the sea? Is it alive? Where is its mouth?
- Use this memory game to play 'Celebrity Head'. Write the name of a creature in the memory puzzle behind the child's head on the whiteboard or chalkboard. Each student can ask a yes or no question to try and identify their chosen 'celebrity' creature.

Activity 2: Creatures of the Bluff

Level 3-4 (whole class)

As a class, play **'Memory Memory: Adaptation'**, an image to text memory game highlighting the unique features of various marine creatures. Using our **'Virtual Habitats' (Intertidal Reef, Subtidal Reef and Open Water),** ask students to explore all the different creatures by clicking the 'plus' icons. Each student must choose one creature and draw it in detail, label, and name it.

- Ask students to hold up their drawing and see if they can match with anybody else to make pairs and/or groups.
- Discuss with students what other rules or classifications they might use to classify creatures. For example, classify by zone or movement. As a group, agree on the rules and students sort themselves.
- Ask students to make their own groups according to the creature's features. Each group must give the reason or rule for their grouping.
- Discuss as a group and write a list so all can see.
- **Read the following statement to the whole class:** *Scientists use classification to help to organise living things. Living things can sometimes be placed into groups with similar features. By grouping organisms and species together, huge masses of information can be stored and retrieved easily. In this way knowledge about creatures can be saved and easily shared.*

- What has this got to do with what we have just done? Discuss how students have been classifying just like scientists.

Section 3: Memory Puzzles and Virtual Habitats

Topic: Classification

Activity 3: Classification

Level 5-8 (whole class)

As a class, discuss and produce a simple definition of classification.

- What characteristics do some individuals in a species have in common? For example, Chitons and Elephant Snails belong to the Phyla (group) 'Mollusca' which includes snails, slugs, squid, octopus, and others.
- What do Chitons and Elephant Snails have in common? Do they have common features that they need to survive? **Note:** you can use the 'Virtual Habitats' on our **'Online Activities'** page to help you.

Answer: Chitons and Elephant Snails both have a strong muscular foot that attaches them to rocks. They have this so they can withstand the pounding waves without being smashed and injured on the rocks.

Using **'Appendix 6: Elephant Snail and Green Chiton'** complete the following:

- Ask the class or students to choose a pair of creatures from the list below.
- Ask the class to write or draw a 'Venn Diagram' listing the features that their chosen pair has in common with each other, and ask students to list why these creatures need this feature to survive. Use **'Appendix 7: Memory Puzzle Answers'** for help.

Classification	Pairs
Algae	**Golden Kelp** (brown algae) and **Sea Lettuce** (green algae)
Crustacea	**Honeycomb Barnacle** and a **Shore Crab**
Bony Fish	**Blue-throated Wrasse** and a **Horseshoe Leatherjacket**

Section 4: Marine Virtual World - Adaptations

Topic: Ecosystems and Adaptations

Activity 1: Camouflage

Foundation-2 (whole class)

Download and open the **'Camouflage PowerPoint'** from our website.

- Read the directions and questions are located in the speaker notes of this PowerPoint.
- Discuss what camouflage is and what it does for animals and people.
- Ask students to choose an animal that uses camouflage and to pick a colour scheme to create a similar camouflage effect in their artwork. The students can choose their own creature or use one of the black and white outlines in **'Appendix 8: Camouflage Art Outlines'.**
- For inspiration, you can look at this Pinterest blog: https://www.pinterest.com.au/pin/424464333641350466/

Activity 2: Adaptations

Level 3-6 (whole class)

As a class, play **'Marine Memory: Adaptation'**, an image to text memory game highlighting the unique features of various marine creatures.

- Ask the class 'What do creatures need to survive?'
- Create 4 columns but do not initially label the columns. Using these unnamed columns, separate and sort the items featured in the memory games into living things, things that need food, things that need shelter from weather and predators, water, and a place to raise young. You may need a column labelled 'other' where at a later stage you can discuss whether the suggestions are real necessities or wants and likes.
- As students to give their answers and write down their answers in the columns grouping answers. Ask the class if and how a creature might increase its chances of survival?
- At the end of the session, ask students to help you title the columns. You can the **'Camouflage PowerPoint'** as background information.
- Use **'Appendix 9: Animals and Their Habitats Worksheet'**. Have students apply their knowledge to the creature of their choice and use the marine 'Virtual Habitats' on our **'Online Activities'** page as a source of information.

Section 4: Marine Virtual World - Adaptations

Topic: Ecosystems and Adaptations

Activity 3: Adaptations 2

Lesson 3-6 (whole class)

Use the marine 'Virtual Habitats' on our **'Online Activities'** page and your completed memory puzzles from section 2 as a reference. You can also refer to **'Appendix 7: Memory Puzzle Answers'**.

All fauna and flora have either behavioural or physical adaptations which help them to survive in a specific environment. Find an example of fauna or flora that illustrates each of the following adaptations and then explain how it gives the creature a greater chance of survival:

- Use of camouflage
- Has an exoskeleton (outer skeleton)
- Has specialised structures to collect sunlight
- Finds safety in numbers
- Builds traps to catch prey
- Hides in rock crevices

Activity 4: Marine Venn Diagram

Level 3-6 (whole class)

Explore the **'Virtual Habitat - Intertidal Reef'** activity.

- Sort the creatures featured into those who can survive at a) high tide, b) low tide and c) both high and low tide.
- Students must find examples in each category and draw their own **'Appendix 10: Venn Diagram Worksheet'** to record information.

Section 5: Food Chains and Life Cycles

Topic: Food Chains, Food Webs and Life Cycles

Activity 1: What is a Food Chain?

Level 3-6 (whole class)

Use the **'Think, Pair, Share'** education strategy, ask the class the following questions and instruct students to draw their answers:

- What might a food chain be?
- What might a food web be?

Note: Use the following videos to help you explain food chains and food webs

- **Fabulous Food Chains (3.25 mins)** - www.youtu.be/MuKs9o1s8h8
- **Food Webs (6 mins)** - www.youtu.be/aesKZR7J2nI

Activity 2: Food Chains

Level 3-6 (whole class)

Play our **'Marine Food Chains'** puzzles. Complete each food chain sequence and then copy it, or take a screenshot.

- Put all the correct food chains on one piece of paper or document. Look carefully at your food chains.
- Choose one creature and see if there are any other things it might eat in the other food chains.
- Where relevant, draw a line from predator to prey. Put an arrowhead on the line pointing at the prey showing the direction of predation
- Repeat until there are no more connections.

Activity 3: String Food Web

Level 3-8 (whole class)

All living things get their energy from food. Plants use energy from the sun to make their food and animals get their energy by eating plants or other animals. For almost all creatures, the sun is the beginning of every food chain.

- Have the students use their chosen creature from **Section 4: Marine Virtual World - Adaptations.**
- Choose one student to be the sun. Arrange students in a circle with the sun in the centre.

Section 5: Food Chains and Life Cycles

Topic: Food Chains, Food Webs and Life Cycles

- Explain that the ball of yarn represents energy from the sun. Ask the 'sun' to hold onto the loose end of yarn and toss (or walk) the ball of yarn to someone who can use that energy (a plant/algae).
- When the student representing a plant or algae has the ball of yarn, they toss the yarn to someone next in the food chain.
- Keep going until the yarn reaches the animal at the top of that food chain (e.g., a carnivore which is an animal that eats other animals). You have completed one food chain!

Ask the students:

- To whom in the circle would I give my energy? (who might eat me?)
- Who in the circle could give me energy? (whom could I eat?)

Return the yarn to the 'sun' and start a new chain. Continue making food chains until every student is holding at least one piece of yarn.

Ask the students:

- Have we made food chains? (yes, lots!)
- What do all our food chains together look like? (a food web)
- Who is holding the most pieces of yarn and why? The answer will be the sun because every food chain starts with the sun.

Australian Fur Seal

Section 5: Food Chains and Life Cycles

Topic: Food Chains, Food Webs and Life Cycles

Activity 4: Port Jackson Shark and Hooded Plover Life Cycle

Level 3-6 (whole class)

Before beginning the lesson, familiarise yourself with the life cycles of the Hooded Plover and the Port Jackson Shark. You can use **'Appendix 11: Teacher notes on Hooded Plovers and Port Jackson Shark'** to help you and provided YouTube videos.

Port Jackson Shark

With the whole class, ask the question; 'What is a life cycle?' and discuss using examples from humans, frogs or birds.

- What might the Port Jackson Shark's lifecycle look like? Discuss and students quickly draw their guess.
- Watch the following videos on the Port Jackson Shark:
  - **Port Jackson Shark (2.30 mins)** - www.youtu.be/FkT4E2nT9KY
  - **Shark hatching out of a shark egg (0.25 sec)** - www.youtu.be/fBX7R9lu7n4

- Discuss their guesses and compare to the real life cycle. Play **'Marine Food Chain 3 - Port Jackson Shark'**, a puzzle found on the **'Marine Food Chains'** page.
- Ask students to draw and label their own Port Jackson Shark life cycle diagram.

Hooded Plovers

- Either individually or as a whole class, watch the video about Hooded Plovers - www.youtu.be/Nc7UCzkz7hk
- Complete '**Appendix 12: Hooded Plovers - Threats and Responses'**

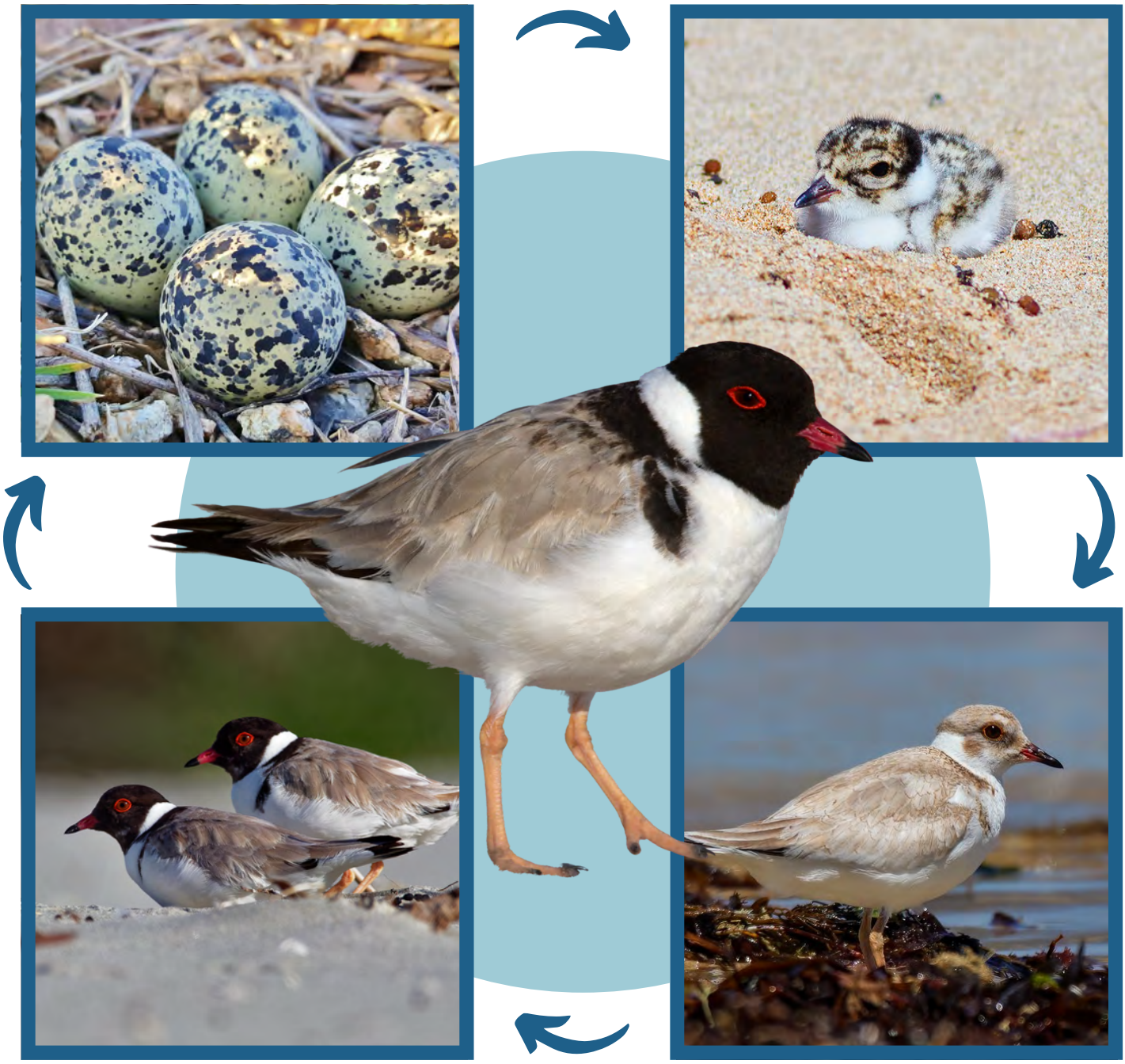
Section 5: Food Chains and Life Cycles

Topic: Food Chains, Food Webs and Life Cycles

Comparing the Life Cycle of a Hooded Plover and the Port Jackson Shark

Compare the diagrams of the Hooded Plover and the Port Jackson Shark.

- Create a Venn diagram to illustrate what is different and what is the same about the creature's life cycles.
- Expand on the following concept with the class: 'Are threats the same or different for both species? Create a Venn Diagram to illustrate.



Section 6: Crossword Puzzles

Topic: Threats, Survival and Adaptations

Activity 1: Marine Puzzles

Level 3-10 (whole class)

Play **'Marine Crossword: Adaptations'** as a class or as individuals.

- Discuss using the completed crossword puzzle or the 'Virtual Habitats' on our **'Online Activities'** page.
- Ask students to choose one animal and complete **'Appendix 9: Animals and Their Habitats Worksheet'**. Fill in the name of the animal and what it eats.

Play **'Marine Crossword: Threats'** as a class or as individuals.

- Discuss the crossword and revisit **'Appendix 9: Animals and their Habitats Worksheet'**.
- Discuss and ask students to complete using information from puzzles 1 + 2 and the marine 'Virtual Habitats ' on our **'Online Activities'** page.

Play the above 2 crosswords as individuals or as the whole class.

- Discuss and record threats as you go.
- Putting 'Marine' at the center, make a mind map of threats to the marine environment and use **'Appendix 13: Example of a Mind Map'** to help you.

Activity 2: Make Your Own Sea Creature

Level 3-10 (whole class)

Look at your answers from the **'Marine Crossword: Adaptations'** and **'Marine Crossword: Threats'** puzzles.

- As a class, list as many adaptations that the class can think of. Write these down into a list.
- Using this list, discuss and record how each adaptation helps creatures survive. List examples of creatures that may use or have these adaptations.
- Ask each student to draw their own sea creature and decide where it lives, labelling its body parts and how they help their creature survive.
- Ask students to imagine a unique habit and describe how their creature interacts with this environment using **'Appendix 14: Make Your Own Creature Worksheet'.**
- Ask students to share their work with the class and explain their creatures adaptations.

Section 6: Crossword Puzzles

Topic: Threats, Survival and Adaptations

Activity 3: Scientific Words

Level 7-10 (whole class)

Why do we use terms such as 'biodiversity', 'environment' and 'predator'? Do the terms mean the same in the USA, Europe, Japan or China? Science has a uniform language that is used all around the world. Scientists got together and talked and talked and talked about what each scientific word means. Finally, they agreed on what each term means.

Often scientists change these terms if they uncover new information. The worldwide discussion starts again, and changes might be to a creature's classification. This happened to poor little Planet Pluto. It was a planet then it was reclassified as a dwarf planet! To learn more about this:

- Play our **'Marine Crossword: Scientific Words'**.
- Instruct each student to choose a word from this crossword.
- Each student will then make a poster with their chosen word and its definition. Students can illustrate their word to show a visual example.
- Display these posters around the room.

Note: Check definitions via Google.

White-striped Anemone

Section 7: Multiple Choice

Topic: Marine Facts

Activity 1: DIY Marine Quiz

Level 3-10 (whole class)

Visit and play our **'Marine Multiple Choice'** activity and answer the questions. This puzzle can be played individually or in teams. Record your answers and see if you are right. If playing in teams, discuss your answer before making your selection.

- Discuss the structure and content of the multiple-choice questions, emphasising how some questions are simply recalling facts and others draw on deeper understanding.
- Ask students to then write their own multiple-choice question or questions. As a teacher you may like to check the questions accuracy or wait and make it a discussion point during the puzzles.
- Each student reads out their question to the class and the students select their answer. The answer is then given. The class may decide to keep track of their scores.

Note: The content in the multiple choice puzzles are drawn from the other puzzles such as memory and crosswords.

Appendix 1

Jigsaw Puzzles - *Beaches & Dunes*

Appendix 1

Jigsaw Puzzles - *Kelp Forest*

Appendix 1

Jigsaw Puzzles - *Open Water*

Appendix 1

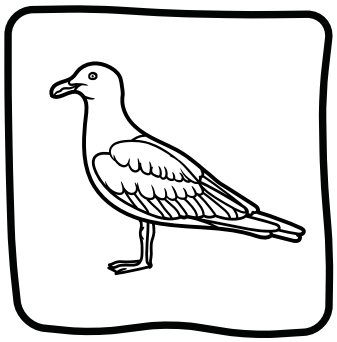
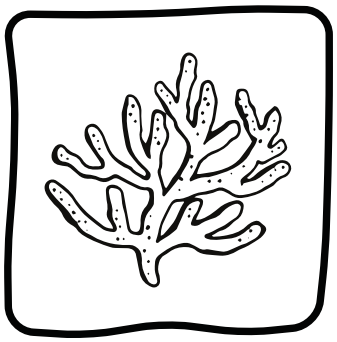
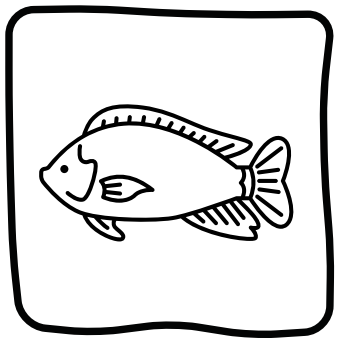
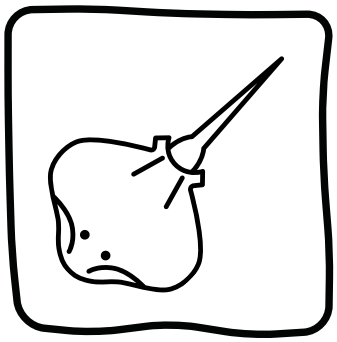
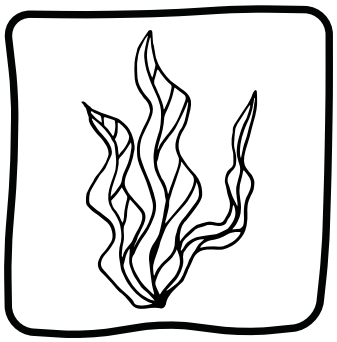
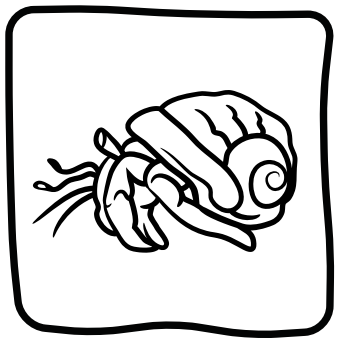
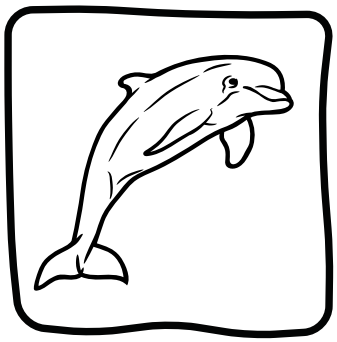
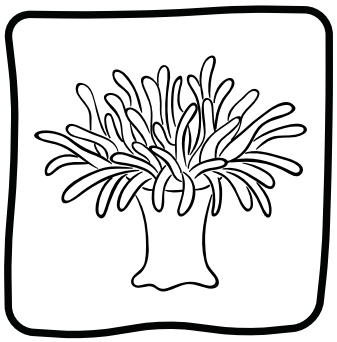
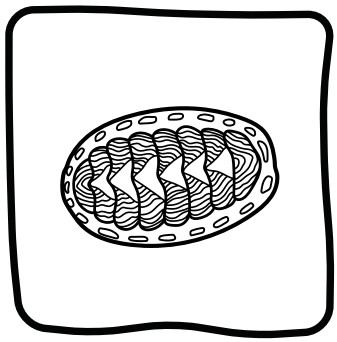
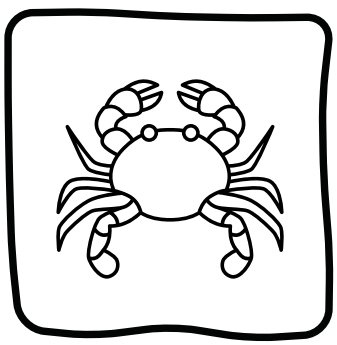
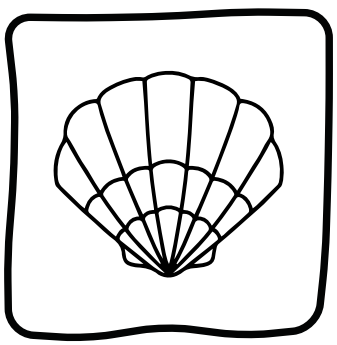
Jigsaw Puzzles - *Rocky Reefs*

Appendix 2

Wet, Dry or Both - Cut and Paste

Outline

Cut out each creature below and paste them into the correct section on the following page sorting them into whether the creature lives in 'wet', 'dry', or 'both'. You may want to use **'Appendix 2: Jigsaw Puzzles'** to help you.


Appendix 2

Wet, Dry or Both - Cut and Paste

Outline

Cut out each creature below and paste them into the correct section on the following page sorting them into whether the creature lives in 'wet', 'dry', or 'both'.

Wet

Dry

Both

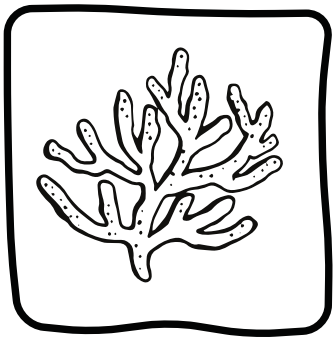
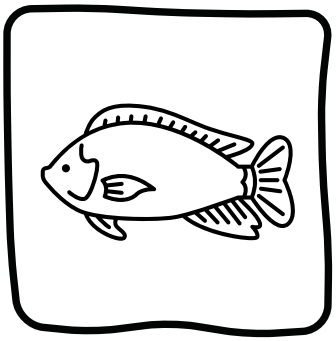
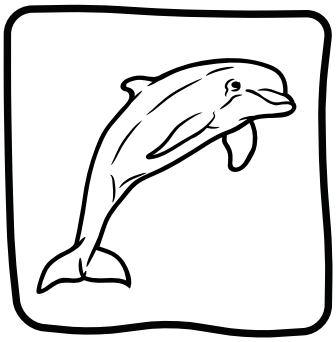
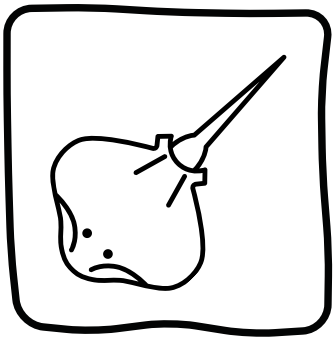
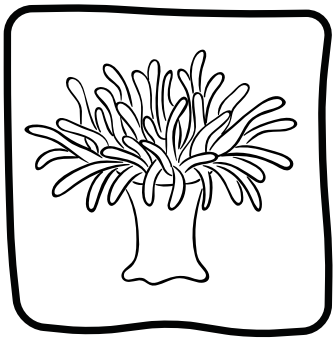
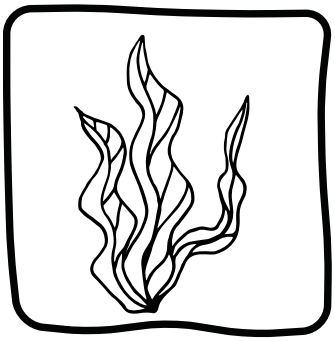
Appendix 2

Wet, Dry or Both - Cut and Paste - *Answers*

Outline

Cut out each creature below and paste them into the correct section on the following page sorting them into whether the creature lives in 'wet', 'dry', or 'both'.

Wet

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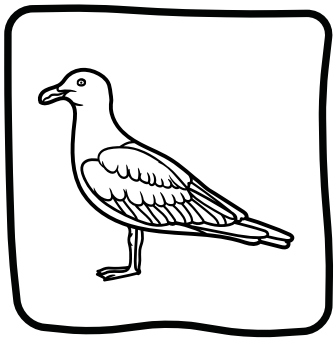
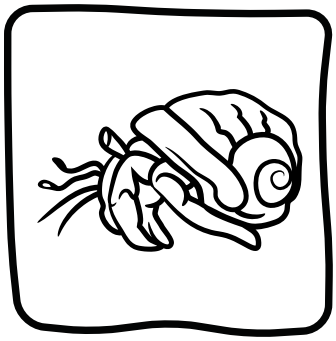
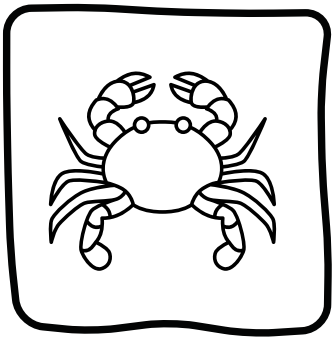
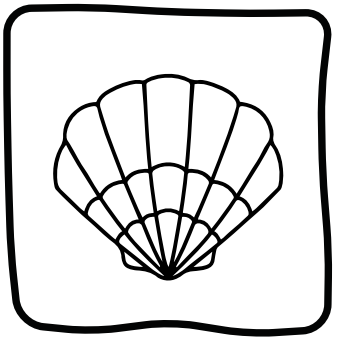
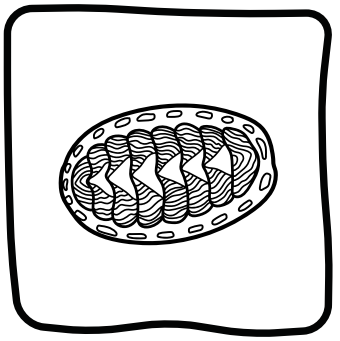



Both

Appendix 3

Marine Zones Jigsaw Strategy Information Sheets - *Intertidal Reefs*

Outline

The jigsaw strategy is one which can used when students need to explore a range of materials or texts. When participating in this strategy, a topic is divided into subtopics.

In this case they have been divided into:
a) Intertidal Reef, b) Sandy Shores, c) Subtidal Reef d) Open Water

Each student from the group separates and moves to a different area of the room to form an 'expert' group. Each 'expert' group researches, takes notes and discusses content on one of their topics and becomes an 'expert' on that topic. Group members then share their knowledge with the whole class.

Intertidal Reefs

Rocky shores are found where the sea meets the land. They are home to some of the most biologically diverse and productive communities throughout the world. Supporting lots of unusual plants and animals, rocky shores are important fish nurseries, roosting and feeding grounds for birds. Along with their commonly associated algal beds, they also help stabilise inshore sediments.

Life can be challenging for the creatures that live on the rocky shore, as organisms must cope with pounding waves, the harsh sun, fluctuating tides, wind, salt, and rapid temperature changes. Rocky shore plants and animals have developed many adaptations to cope with the rise and fall of the tides.

Appendix 3

Marine Zones Jigsaw Strategy Information Sheets - *Intertidal Reefs*

Habitat: another factor that has led to a range of animal adaptations is structure of the rocky shore itself. It includes many different habitat types such as steep rocky cliffs, platforms, rock pools and boulder fields.
Cobbled areas often retain moisture when the tide is out and provide habitat for smaller animals. Boulder fields provide shelter from pounding waves and shelter from the sun and wind.
Crevices provide many sheltering and hiding places for a variety of animals. This is where you may find the Blue ringed octopus.
Coastal rockpools, these shoreline sanctuaries are like an oasis in the punishing intertidal zone. They provide water for plants and animals and are a vital shelter from predators and the sun. Waratah Anemones and sea tulips can be found in these.
Platforms are often the most exposed habitats. Animals and plants that live here need to be able to cope with pounding waves. Limpets and chitons are well adapted to strong waves as they have a very strong muscular foot that helps them to firmly clamp onto the rocks. They also must cope with the occasional drying out and have shells or hard external surfaces to do this.

Rockpools are habitat for organisms that live nowhere else and they are also important in the growth, development and reproduction of many marine species that live away from the rocky shore. There are many advantages for some marine life to choose to live in a rockpool: algae and other intertidal plants grow in the abundant sunlight. Constant wave action supplies the tide pools with nutrients and oxygen. There is loads of food. There tends to be a lot of rocks, sand and plants which provides hiding places and surfaces to cling to or hide from predators.

Threats
Trampling: people visit the rock shore often step on rocky shore organisms. Some are protected by shells, but many organisms cannot withstand the full weight of a person standing on them. This can be a significant issue in areas with a lot of foot-traffic / visitors in summer
Pollution: waste materials and chemicals can enter water ways and get washed out to shore. Pollutants can poison rocky shore organisms or interfere with their life processes. For instance, small particles can clog gills and make it difficult for some organisms to breath under water.
Habitat destruction: In some instances rocky shore habitats are destroyed by the construction wharfs, boat ramps, marinas etc.
Farming and developments: trees are often cleared from land in order provide pasture for livestock or space for housing and other developments. Wastes from farm animals can leach through the soil and into waterways that \end up on our rocky shores. When trees are cleared there are often less root systems to hold the soil together. As a result, the land can erode and particles from the soil get washed out to the shoreline. This can make the water cloudy and as the particles settle a layer of mud forms that can smother some rocky shore organisms.
Climate change: there is evidence that the use of fossil fuels has resulted in an increase in atmospheric carbon dioxide levels. These can have a "greenhouse" effect and may be responsible for slight increases in average global temperatures. Small increases in temperature can have a significant effect on the levels of dissolved oxygen in water. This is need by organisms such as fish to breath.

Appendix 3

Marine Zones Jigsaw Strategy Information Sheets - *Sandy Shores*

Sandy Shores

Dynamic, harsh and changeable.

Sandy shores are dynamic harsh environments, the action of waves and tides largely determining species diversity and numbers. There is an interchange of sand, biological matter (matter that has come from a living organism) and other materials between dunes, intertidal beaches, and surf zones. Dunes usually sit beside or near the sandy shores. They are dynamic and constantly changing ecosystems that form a natural buffer between sea and land. Depending on conditions, they can either accumulate sand from the beach, growing the dunes and storing sand, or they can form a source of sand to the beach as the dunes erode.

Importance

While the economic and social values of beaches are generally regarded as very important, sandy shores also have unique ecological features and contain a special biodiversity that is often overlooked. Because of the shifting sands, organisms living on a beach have had to adapt to these changing conditions. Without the cover of water, many animals simply shut down during low tide or some spend most of their life buried under the sand. Beach organisms are often small and buried (e.g. Land animals that visit the shore include rodents, feeding and of course birds like gulls, cormorants, waders, and gannets, some of which are dependent on the shore.
Sand Dunes usually sit beside or near the sandy shores. They are dynamic and constantly changing ecosystems that form a natural buffer between sea and land. Dunes serve an important purpose by protecting inland areas from coastal flooding and erosion.. They can absorb the impact and protect inland areas from high energy storms and act as a barrier to the destructive forces of wind and waves. Depending on conditions, dunes can either accumulate sand from the beach, growing the dunes and storing sand, or they can form a source of sand to the beach as the dunes erode.

Appendix 3

Marine Zones Jigsaw Strategy Information Sheets - *Sandy Shores*

Karkalla (*Carpobrotus rossi*) and Hairy Spinifex (*Spinifex sericeus*)

Living Things

Plants play a major role in helping stabilize the dunes. Hairy Spinifex (*Spinifex sericeus*) and Karkalla (*Carpobrotus rossii*) are excellent at binding soil and sand. As well as being a home for threatened species such as Coat Twin-leaf (*Roepera billardierei*) and Coast Fescue (*Poa billardierei*), dunes are home to unique orchid species, snakes and lizards. Some reptiles burrow rapidly through the sand, an action known as sand swimming. Hundreds or even thousands of types of insects also make their habitats in sand dunes. There are also many beetles, moths, wasps, flies, crickets, and spiders that live in and around the sand.

Threats

Sand dunes are threatened by both naturally occurring and human-caused erosion. Sand is vulnerable to wind and water erosion because it is easily displaced. Newly formed dunes are most vulnerable to erosion since vegetation has not had time to form deep root systems. Once vegetation mats can form, dunes are more protected. The biggest and most common threats to sand dunes have a human origin - the construction of houses and infrastructure like car parks, roads, piers, groynes, as well as sand mining and farming. Climate change driven sea-level rise is also destroying these extraordinary natural fences.

Appendix 3

Marine Zones Jigsaw Strategy Information Sheets - *Kelp Forests*

Kelp Forests

Australia is blessed with some of the most iconic kelp forests that are an important part of the Great Southern Reef. Kelp Forests are underwater ecosystems formed in shallow water by the dense growth of several different species known as kelps. Though they look very much like plants, but kelps are actually extremely large brown algae. Growing up from the ocean floor about 2–30 meters, and as much as 20–30cm above the ocean's surface. Kelp does not have roots. Instead, it is secured by holdfasts that lock onto substrates made of rock, or cobble. Although it functions in a way like a root, holdfasts do not absorb nutrients.

Kelp Biology

Kelp is like a plant – it is photosynthetic and has structures that look like roots (the kelp holdfast) stems (the stipe) and leaves (blades) – but kelp and other algae belong to a separate kingdom of life from plants called protists. Like land plants, kelp uses energy from sunlight to make its own food. This process is called photosynthesis. Sunlight is captured by the plant and the energy particles in sunlight (photons) are used to drive a chemical reaction that produces sugar. This sugar is the food for the plant. Kelps may resemble land plants, but they are uniquely adapted to life in cool, clear, moving water. They depend on moving water to provide a steady supply of nutrients for photosynthesis. As water flows by the blades, their serrated edges help to increase water mixing.

Appendix 3

Marine Zones Jigsaw Strategy Information Sheets - *Kelp Forests*

Importance

Kelp forests are an important part of the marine food web. They provide several important ecosystem benefits. These include regulating (e.g., carbon storage and cleaning of the water), primary production, creating habitats including those for commercial species, providing raw material for commercial harvest, farming, and industry, and cultural (ecotourism and recreational activities). Kelp forests provide food, nursery areas, and shelter—including protection from predators and storms—for hundreds of commercially and recreationally important fish species as well as marine wildlife. Kelp absorbs nutrients such as nitrogen from the water and making them available to a variety of species that feed on their leaves (blades). Many organisms use the thick blades as a safe shelter for their young. To keep them safe from predators or even rough storms. These underwater towers of kelp provide food, shelter, and protection for all kinds of marine life, including seals, sea lions, invertebrates, fish, whales, birds, and more.

Appendix 3

Marine Zones Jigsaw Strategy Information Sheets - *Great Southern Reef*

Great Southern Reef

The Great Southern Reef (GSR) is an interconnected underwater system fringing more than 8000 km of Australia's southern coast: from Kalbarri, Western Australia to the NSW/Queensland border.

Vast, wild, and remote

Despite 70% of Australians living within 50km of the Great Southern Reef, public knowledge of the Reef is limited. The Rocky reef off the Barwon Bluff Marine Sanctuary is a small part of this vast underwater system and is easily accessible, by snorkeling or scuba diving. The south coast of Australia is remote and exposed to the wild weather of the Southern Ocean. This has allowed the Reef to flourish with minimal human interference. However, this lack of human input is a double-edged sword: consequently, rates of research investment and protection are extremely low. In Victoria thirty sections of the reef have been declared Marine Sanctuaries or Marine Protected Areas.

Living Things

The Great Southern Reef abounds with wildlife thanks to the iconic Kelp Forests. Diving on this reef at Barwon Heads will show you a small snapshot of its residents. You may see abalone, sponges, Blue Gropers, Dusky Morwongs, Leatherjackets, Wrasse, Old Wifes, Magpie Perch, Zebra Fish and Stingrays and Sharks. Barwon Heads is occasionally visited by sharks, Sea Lions and Blue Whales. In other parts of the Great Southern Reef you can find Giant Australian Cuttlefish, Giant Kelp, Golden Decorator Crabs, Golden Kelp, Golden Weedfish, Harlequin Fish, Box Fish, Southern Blue-fin Tuna, Southern Rock Lobsters, Leafy Seadragons and Hand Fish and hundreds more.

Appendix 3

Marine Zones Jigsaw Strategy Information Sheets - *Great Southern Reef*

Importance

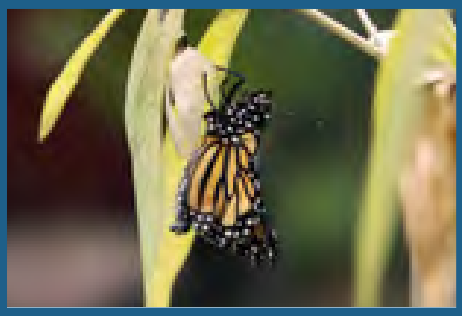
It's estimated that the Great Southern Reef contributes more than $10 billion a year to the Australian economy. The major fisheries in the reef are the rock lobster (worth around $375 million/year) and abalone (worth around $134 million/year)

Threats

The GSR covers two global warming hotspots - that is two areas where the rate of ocean warming has been in the top 10% globally over the last 5 years. This warming has already seen dramatic and devastating changes across all life on the GSR and is projected to keep increasing. The long-term health and functioning of the Reef is unknown, and scientists warn that without action, dieback of kelp forests will have irreversible consequences for biodiversity, fisheries, and our coastal economies.

The Great Southern Reef also faces threats coming from oil and gas giants targeting fossil fuel deposits in the pristine waters of the Great Australian Bight. The consequences of promoting non-renewable industries combined with the potential for direct effects of accidents/oil spills is unimaginable.

Living Things

	**GROW**
	**NEED WATER**
	**NEED FOOD**
	**CHANGE**
	**REPRODUCE**

Appendix 4

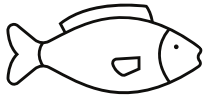
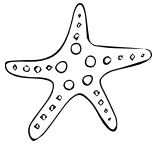
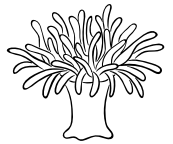
Living and Non-Living Chart

Non-Living Things

	**Did it once grow?**	**YES**
	**Did it once need water?**	**YES**
	**Did it once need food?**	**YES**
	**Did it once breathe or change?**	**YES**
	**Was it able to reproduce in some way?**	**YES**
	**Can it do those things now?**	**NO**

Appendix 5

Is it Living or Non-Living

						
						
						
						
						
						
✓ **Tick if living** ✗ **Cross if non-living**						

Appendix 6

Elephant Snail and Green Chiton

Outline

Look carefully and you will see that the Elephant Snail (top) and Green Chiton (bottom) both have a muscular foot. A molluscs muscular foot is used for locomotion and anchorage, it varies in shape and function and can both extend and retract.

Elephant Snail (*Scutus antipodes*)

© Naomi Wells

© Possum Pete

Green Chiton (*Ischnochiton australis*)

© Chris Porter

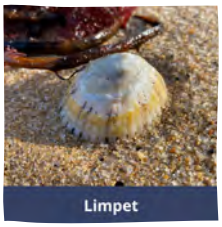
© Naomi Wells

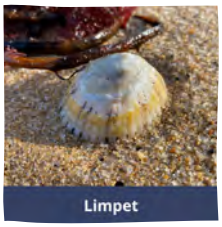
Appendix 7

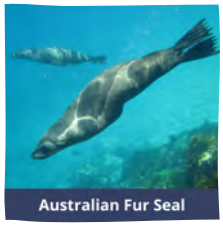
Memory Puzzle Answers - *Images*

Outline

The below show the answers to our marine memory puzzles. **Please note:** the order of the images in the puzzle will change each time you play it online. This appendix only shows you which images match with which.







Appendix 7

Memory Puzzle Answers - *Adaptations*

Outline

The below show the answers to our marine memory puzzles. **Please note:** the order of the images in the puzzle will change each time you play it online. This appendix only shows you which images match with which.

Black Nerite Shell

I have a trapdoor called an Operculum. It is used to seal my shell, trapping water inside and keeping predators out.

Kelp

My name comes from my thick, tough, leathery skin.

Sand Crab

I have a hard exoskeleton shell that protects me from the pounding waves.

Neptune's Necklace

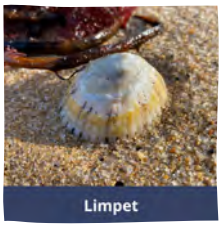
My fronds are shaped like bubbles, which are pockets of air. These help me to float on water and capture the sun to photosynthesize.

Wrasse

I was born a female and later in life transformed into a male. I am a protogynous hermaphrodite.

Sea Lettuce

I have a disc shaped holdfast, which resembles the roots of land plants. I grow quickly in nutrient rich water.



Limpet

I have a muscular foot to hold on to the rocks and a hard outer shell to protect me from predators and from drying out.

Australian Fur Seal

I have thick fur and a layer of blubber to keep me dry and warm.

Stingray

I have a grayish-brown color that helps me camouflage on the ocean floor. I use electrical pulses to find prey.

Leatherjacket

My name comes from my thick, tough, leathery skin.

Sea Anemone

I have many stinging tentacles. I use these to capture food and protect myself.

Dog Whelk Shell

I can bore holes in the shells of my prey and secrete a shell-softening chemical.

Dusky Morwong

I have a green, brown colour that blends into my surroundings as camouflage.

Dolphin

I have a blowhole on the top of my head. This allows me to come up to the surface, easily taking in air, and continue swimming.

Chiton

I have muscular foot, and when disturbed, I can clamp down so that I cannot be moved by crashing waves.

Cystophora

My fronds are very tough, they do not tear easily and keep water inside, so I don't dry out.

Appendix 7

Memory Puzzles Answers - *Facts*

Outline

The below show the answers to our marine memory puzzles. **Please note:** the order of the images in the puzzle will change each time you play it online. This appendix only shows you which images match with which.

Mottled Shore Crab

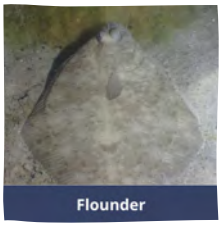
I can walk in all directions, but prefer to walk and run sideways.

Dolphin

I eat fish, squid, and crustaceans.

Sea Lettuce

I am safe for humans to eat; I am high in vitamins and minerals.



Flounder

I bury myself in sand and swim away quickly if disturbed.

Blue Periwinkle

I break down dead plant material.

Old Wife

I got my name because I make a grinding or grating noise when captured.

Elephant Snail

I emerge at night to graze on seaweeds.

Common Warrener Snail

I have a trapdoor called an operculum that I close if threatened.

Blue-throated Wrasse

I was born a female and later in life transformed into a male. I am a hermaphrodite.

Chiton

I graze on encrusting Bryozoa, that looks like moss on the rocks.

Kelp

I grow like a forest on land, but quicker! I provide food and shelter for thousands of marine creatures.

Neptune's Necklace

I have tough, modified fronds with small bladders (pockets) that store water to prevent me dehydrating.

Australian Fur Seal

I am the largest fur seal in the world.

Dusky Morwong

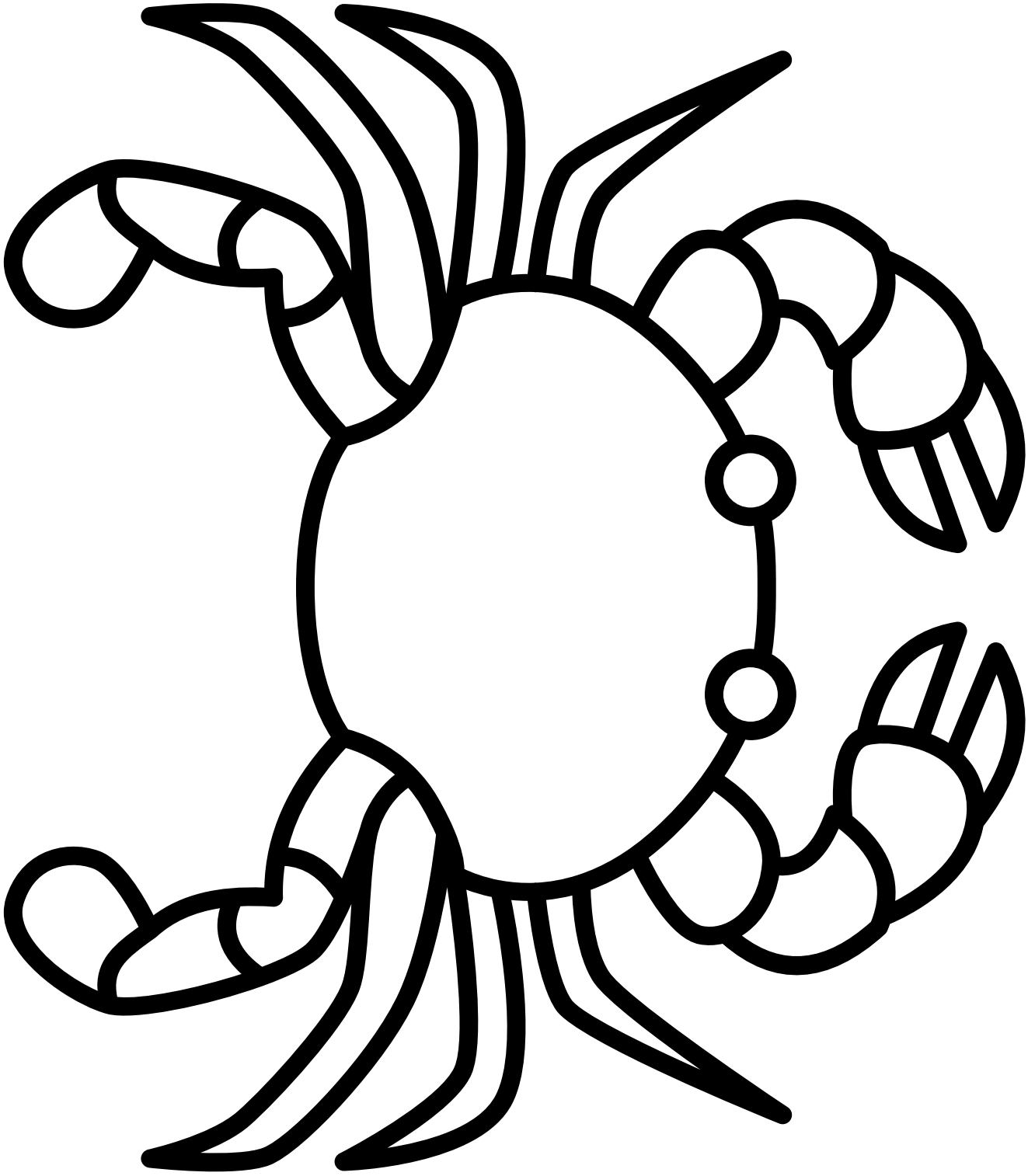
I am found in the cool waters of southern Australia. I eat algae.

Appendix 8

Camouflage Art Outlines

Outline

Ask students to choose an animal outline in this appendix and to pick a colour. Use the same colour scheme to create a similar camouflage effect in the artwork.



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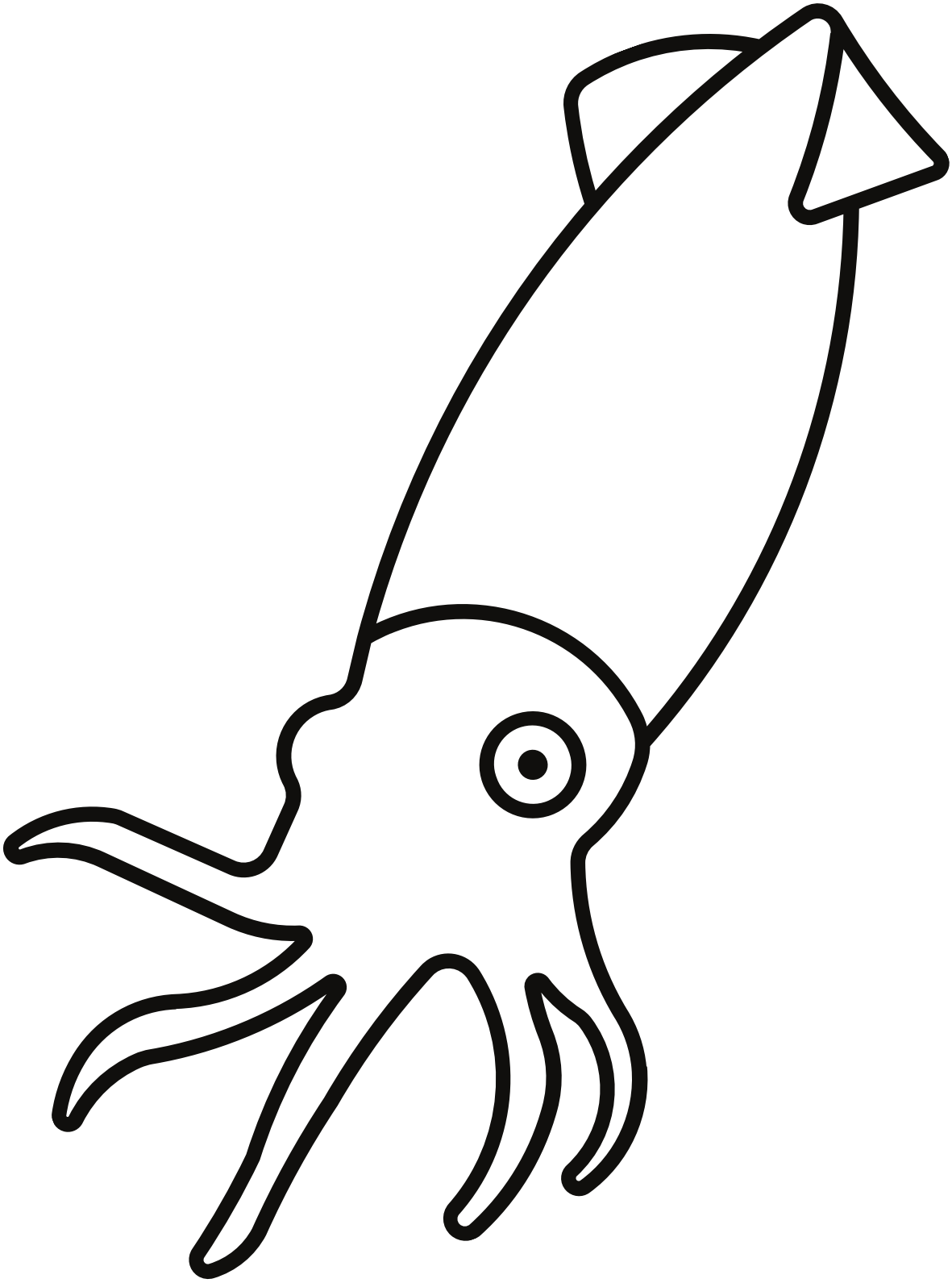

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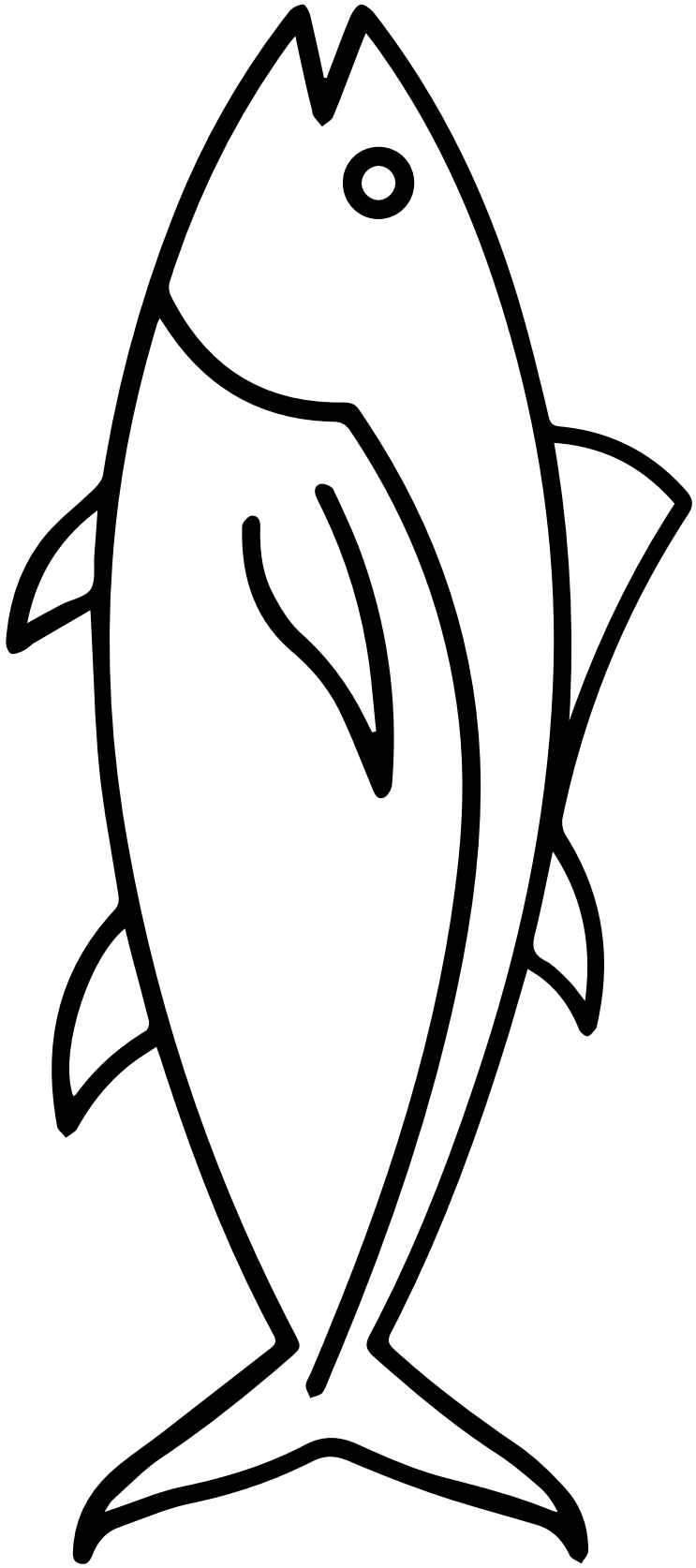
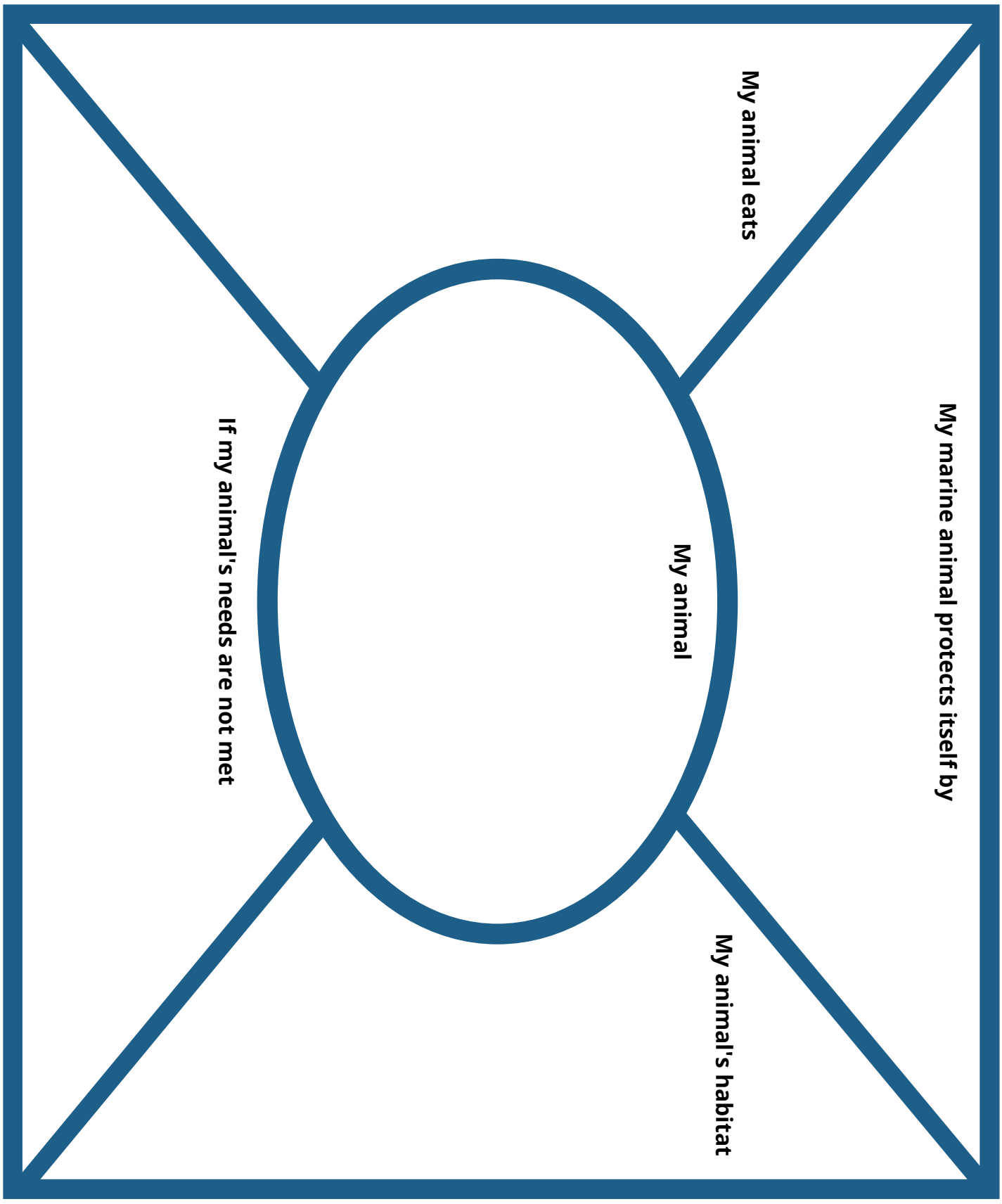


Appendix 9

Animals and their Habitats Worksheet

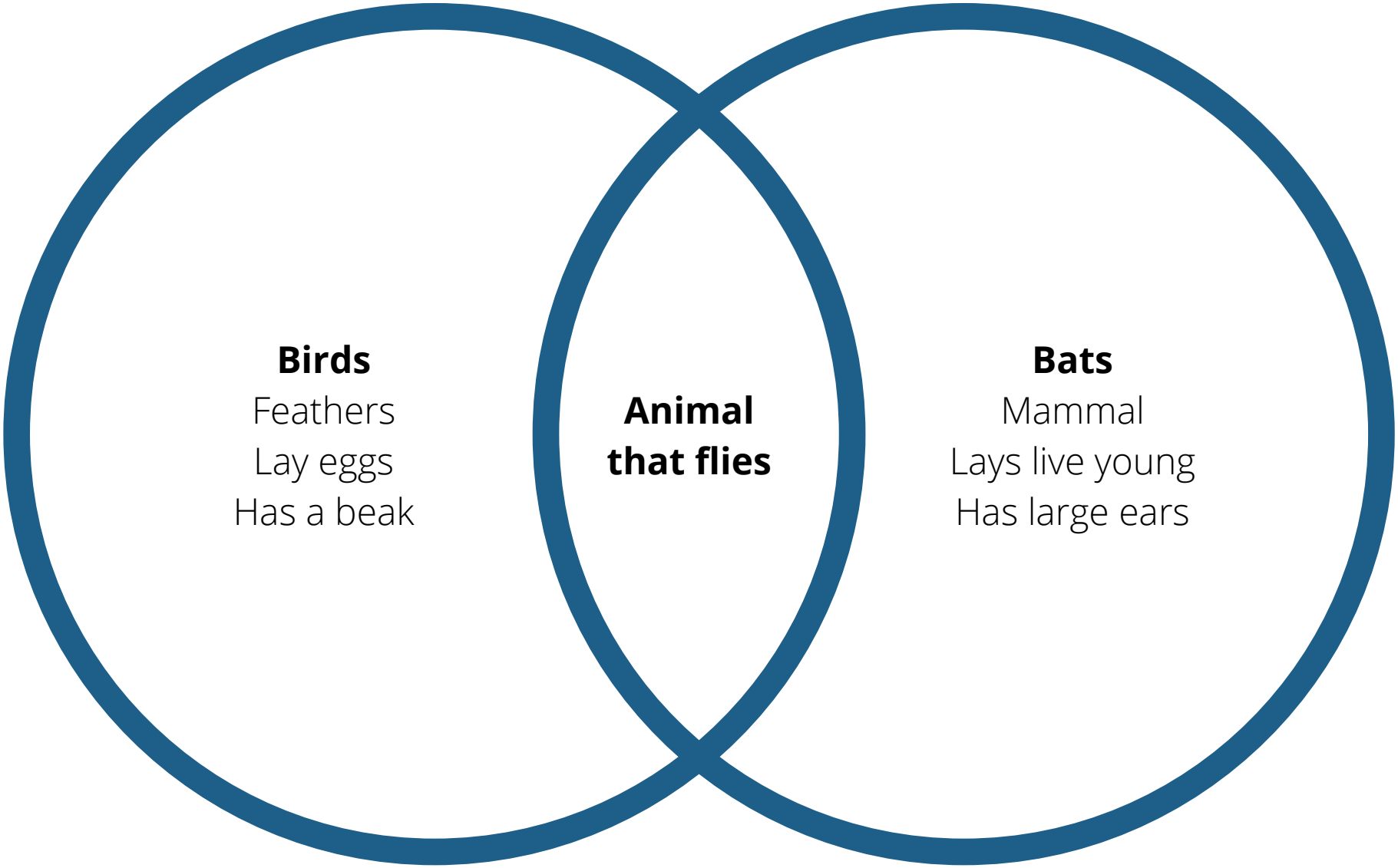
Outline

Choose a creature and fill in the answers to the questions to look at your creatures habitat and some special features.



Appendix 10

Venn Diagram Example



Appendix 11

Teacher notes on Hooded Plovers and Port Jackson Shark

Hooded Plovers

Hooded plovers have the same life cycle as most birds. That is egg chick and juvenile or fledgling, adult. But because of where and how they breed only 2.5% ever make it to the fledgling stage.

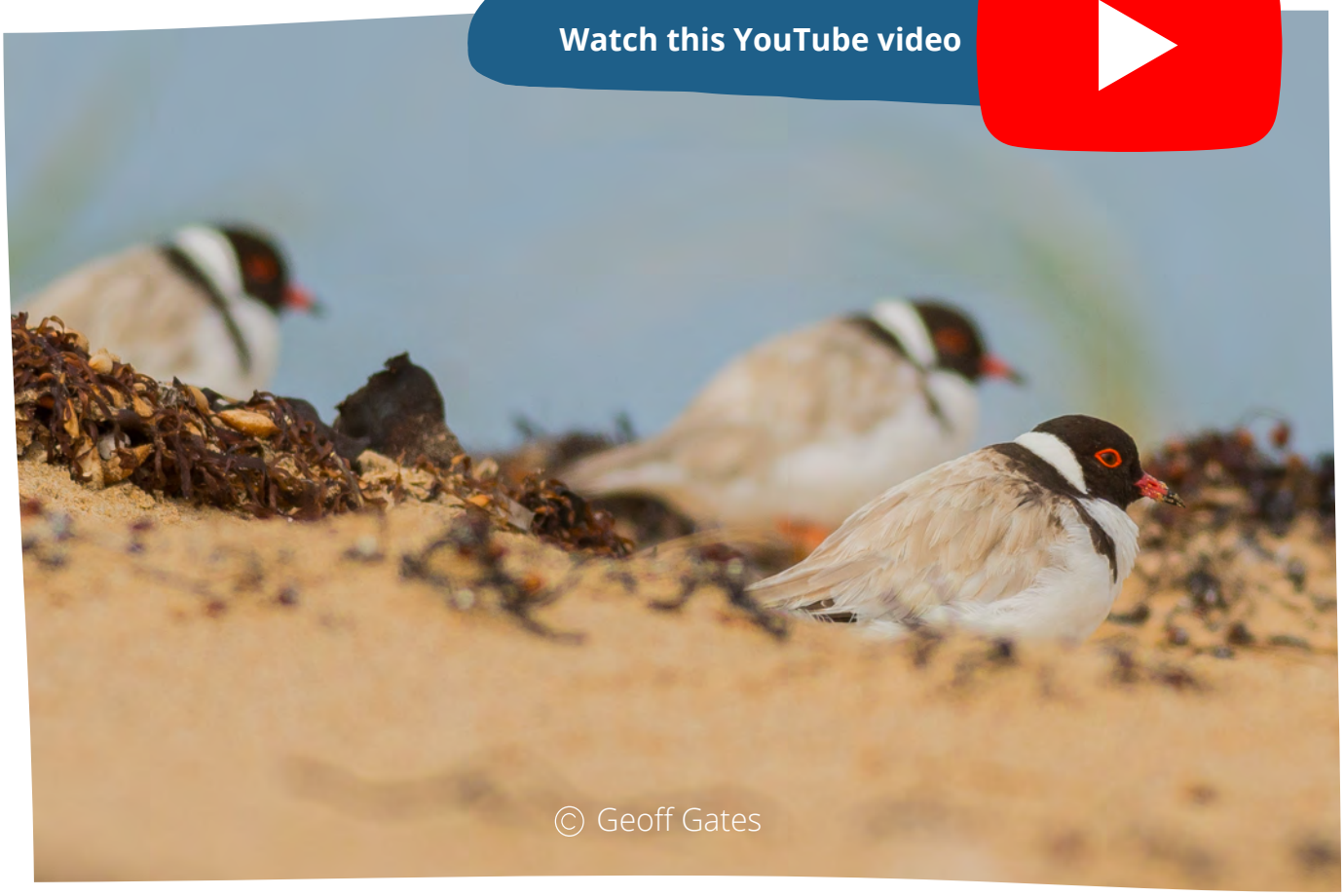
Nesting

This stage is where both eggs and parents are the most vulnerable to threats. Hoodies breed as a pair, with both male and female taking turns to incubate the eggs. Eggs are laid in a small scratch (depression) in the sand usually near vegetation or seaweed and above the high tide zone of beaches. They lay 1 one egg every 48 hours and typically have 3 eggs in a clutch. Eggs are incubated for around 28 days. Nests often fail as the parents will leave the nest to draw away the threat, which in turn can cause eggs to overheat or freeze.

Chicks

Chicks are still incredibly vulnerable to threats until they can fly. Chicks can leave the nest and feed themselves within hours of hatching. Parents continue to monitor and look after their chicks until they fledge (reach flying age) at 35 days old. Chicks still require brooding for two weeks after hatching as they unable to regulate their own body temperature. The chicks cannot fly to escape, and parents will try to hide the chicks and draw the threat away from them. Once chicks fledge, they may be evicted from their territory by their parents, especially if there is still time in the breeding season for more nest attempts. These two stages are the most vulnerable stages – with around a 20% survival rate for eggs and chicks.

Watch this YouTube video



Appendix 11

Teacher notes on Hooded Plovers and Port Jackson Shark

Threats

Over the course of their life, the Hooded Plovers face an array of threats to their survival. These threats include dogs, foxes, and even natural disturbances such as tides and storms which can damage fragile nesting sites. Hoodies create nests on the beach during the busiest season on the coast, forcing them to share their breeding sites with thousands of beachgoers (and their dogs). At all stages of the hoodie life cycle, you and your dog can be a threat. When you get too close: Nests, eggs and/or chicks can be trampled, nests, eggs and/or chicks can be eaten. Hoodies can be disturbed meaning they can't care for eggs/chicks. Hoodie parents and chicks can be too frightened to feed. Other threats include foxes, cats and natural disturbances including high tides and storms, all contributing to the Hooded Plovers low breeding success.

How can I help?

To help give our hoodies the best chance of survival this breeding season, make sure you:

- Stay close to the water's edge
- Observe signs and keep clear of fenced areas
- Keep dogs on leash or out of breeding zones
- Let others know about these special birds!

Appendix 11

Teacher notes on Hooded Plovers and Port Jackson Shark

Port Jackson Sharks

Port Jackson and some other sharks lay their already fertilized eggs in the water. The eggs contain the developing embryo, and each egg is encased in a tough, leathery case that looks very much like a purse. As a result, these eggs are commonly called “mermaid’s purse.” The eggs vary in appearance depending on the species of shark. Some have a corkscrew shape, some look like flat purses, others are like horns, but they all have sticky mucus tendrils that the mother uses to “anchor” the egg case to objects on the seabed such as reefs, seaweed, plants, in-between rocks, and so on. Just like chicken eggs, shark eggs have a yolk that feeds the embryo, in fact, everything the pup needs to develop is contained right inside the case. This is important because these eggs can sometimes take up to 9 months before they hatch.

Watch this YouTube video

Appendix 12

Hooded Plovers: Threats and Responses

Learn about the threatened Hooded Plover by thinking about what might threaten and also help this species of bird.

Threats to the Hooded Plover	What can we do help the Hooded Plover?

Appendix 13

Example of Mind Map

Appendix 14

Make Your Own Creature Worksheet

Make Your Own creature by using your imagination to answer the questions below!

Where does your creature live? Which zone is it in?

Draw your creature here

What does it eat?

Does it have skin, feathers or scales? Why?

Is it a predator or prey? Does it have clever ways of hunting or keeping safe?

How does your creature move? Wings? Legs?