Estuary Education Kit

Living on the Edge

Friends of The Bluff

Caring for the unique Barwon Bluff since 1994.

Estuary Education Kit

Estuary Education Toolkit

Produced by the Friends of the Bluff, 2022.

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Introduction
The Barwon River Estuary is an extensive wetland ecosystem. This estuary is amongst the most intact, diverse saltmarsh and estuary vegetation in south-eastern Australia. The estuary is part of an internationally recognised **Ramsar** site, and the lower reaches provide important habitat for migratory water birds escaping the harsh Siberian winter.
The Friends of the Bluff have created this **'Estuary 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 **'Estuary Education Kit'** can be classified into the following parts:

Virtual Habitats: Explore The Barwon Estuary from your own classroom by clicking the images below. Use these 'Virtual Habitats' as a pre and or post visit to the estuary, or the stimulus and information source for an Estuary 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).

Mangrove Virtual Habitat

Featured Estuary 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 as they are either the most common, rare or are the most indicative of the environment. This is just a small collection of the creatures found in the habitats along and around the Barwon Estuary.

Plants

Moonah
White Mangroves
Coast Wattle
Beaded Glasswort
Coast Twin-leaf
Small-leaved Clematis

Molluscs & Arthropods

Moon Snail
Sea Hare
Soldier Crab
Decorator Crab
Bass Yabby

Fish

Mulloway
Short-fin Eel
Sand Mullet
Estuary Perch
Black Bream
Australian Grayling
Flounder

Insects

Caper White Butterfly
Fiddler Beetle
Aurora Bluetail Damselfly
Golden Orb Weaver Spider
Leaf Curling Spider
Wingless Flower Wasp

Birds

Sharp-tailed Sandpiper
White-faced Heron
Royal Spoonbill
Little Pied Cormorant
Common Greenshank
Black Swan
Australian Pelican
Superb Fairy-wren

Reptiles

Blue-Tongued Lizard
Jacky Lizard
Long-necked Turtle
Copperhead Snake
Marbled Gecko

Frogs

Brown Tree Frog
Pobblebonk
Spotted Marsh Frog

Mammals

Common Ring-tailed Possum
Short-beaked Echidna
Rakali
Brush-tailed Possum
Black Wallaby
Bottlenose Dolphin

Teacher Notes

Activity Types

- Classroom activities are designed to deepen students understanding, highlight issues, and investigate scientific concepts as they relate to the Barwon Estuary. Each puzzle has one or two 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.

- The **'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, apps, picture story books, images of the Barwon Estuary and a YouTube video library

Living on the Edge - Online Activities

- Our **'Online Activities'** are 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. Students 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: Sand and Mudflats, Seagrass, Mangroves and Riparian

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 along the Barwon Estuary be?
- What animals might live in each of these habitats?
- What is your reason for your choices?

Activity 2: I Spy

Foundation-2 (whole class).

Play the **'Estuary Jigsaw'** puzzles or look at the completed puzzles in **'Appendix 1: Jigsaw Puzzles'**.

- Play the game 'I Spy' to bring attention to details in the puzzles.
- Discuss the featured plants and animals, their characteristics and where they live. Do they live in wet, dry or an environment with both?
- You can use **'Appendix 2: Wet, Dry or Both - Cut and Paste'** to sort animals into whether they live in a wet or dry area.

Activity 3: Estuary

Levels 3-4 (whole class)

Whole class investigation of the Barwon Estuary habitats using the **'Living on the Edge'** online puzzles.

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

Section 1: Jigsaw Puzzles - Habitats

Topic: Habitats: Sand and Mudflats, Seagrass, Mangroves and Riparian

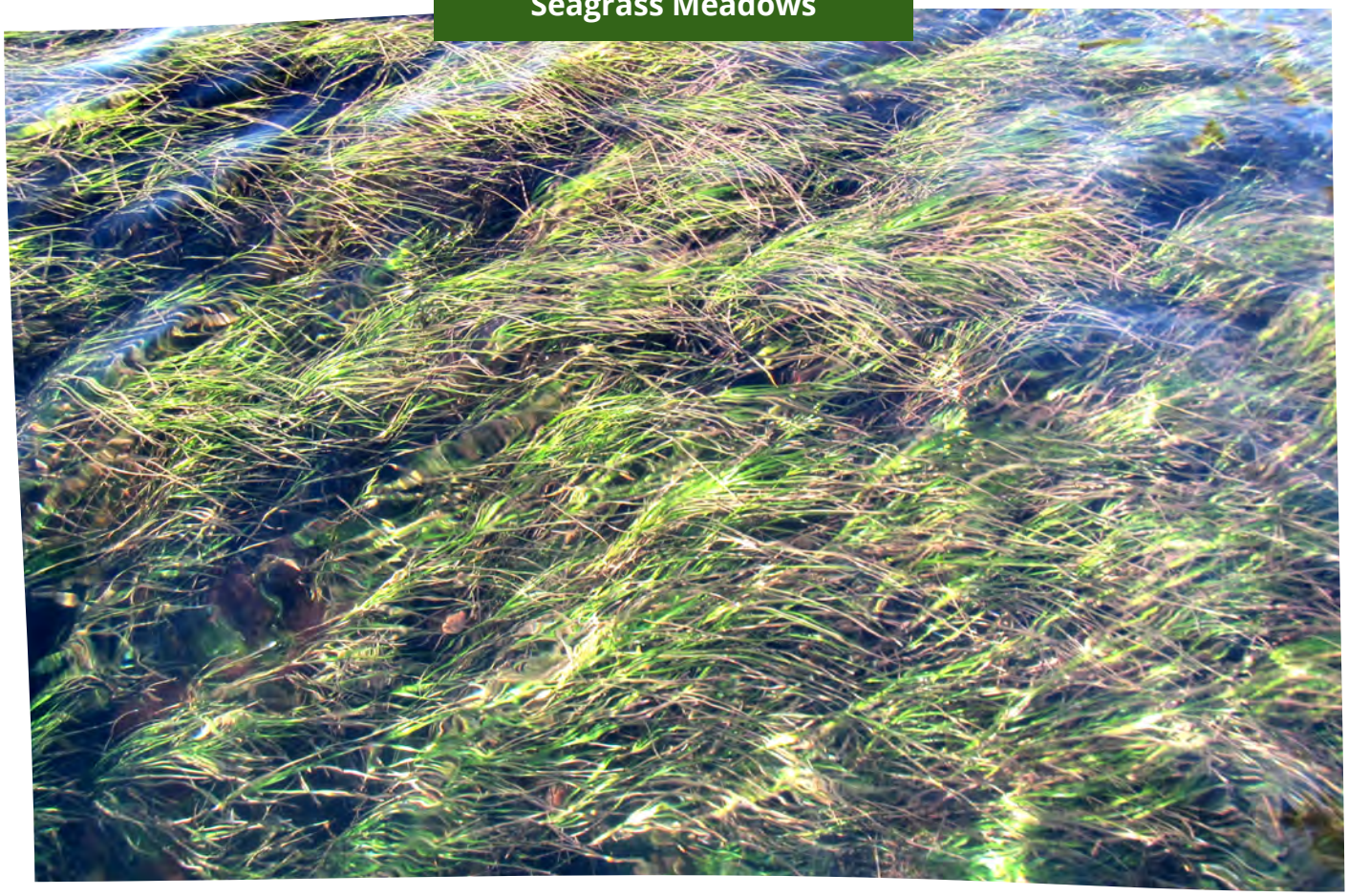
Activity 4: Estuary Habitats

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: Estuary 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.

Seagrass Meadows



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

- Using the puzzle, have the students decide whether each object is living or non-living. Discuss and have students explain their choices.
- On completion of the game 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-FaXNiIfU.

Note: this video only uses three criteria to question whether an object is living or non-living. It is especially useful though, as it provides a structured way, 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: Habitats

Activity 1: Celebrity Head

Foundation-2 (whole class)

As a class, play **'Estuary Memory: Images'**, a simple image to image match memory game. While playing, take note of:

- The various aspects of each creature as you play. For example, have they got legs? Do they live under water? Are they even alive? Where are their mouths?
- 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: Habitats

Level 3-4 (whole class)

As a class, play **'Estuary Memory: Habitats'**, an image to text memory game highlighting local creatures and the habitats they live in.

- Discuss by asking questions, such as; 'why do butterfly not live in water?' and 'why is that where a spider might choose to live?'.
- Using **'Appendix 6: Venn Diagram Worksheet'**, list the creatures used in the memory games in the correct section depending on whether they live in an area that is wet, dry or both.

Activity 3: Explore Habitats

Level 3-4 (whole class)

As a class, play **'Estuary Memory: Images'** and **'Estuary Memory: Habitats'**.

- Discuss and asking questions about what is specific to that habitat, which relates to the creature. For example, the Orb-weaver Spider needs branches of a suitable size and position (regarding catching prey) to anchor its web.

Section 3: Memory Puzzles and Virtual Habitats

Topic: Habitats

Activity 4: Creatures of the Estuary

Foundation-2 (whole class)

Using the **'Virtual Estuary Habitats', (Mangroves, Saltmarsh, Seagrass Meadow)**, have students explore all the different creatures and images available.

- Each student must choose one creature, draw it in detail, label its features, and name it. Ask students to capture this information on a piece of paper or a card.
- Ask students to hold up their drawing of their creature to see if they can match with anybody else and make pairs and/or groups.
- Discuss the process and any learnings. **Note:** not all may pair up. Use this to discuss how else we could group.
- Ask students to make their own groups according to the creature's characteristics. Each group must give the reason or rule for their grouping. Discuss and write a list so all students can see.
- Discuss with students what other rules, classifications they might try. For example; by zone, movement type, etc. Agree to the rules and ask students to sort themselves into the correct groups.
- **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: Habitats

Activity 5: Classification

Level 5-8 (whole class)

To make the most out of this resource, we suggest that you read and employ the **'See Think Wonder'** education strategy.

Ask a class, read the following statement:
Scientists use classification to help them decide how to group living things together. Classification is a way to organise living things. They are placed into groups with similar features. By grouping organisms and species together, huge masses of information can be stored and retrieved easily. Knowledge about a species can be saved and easily recovered.

- As a class, discuss and produce a simple definition of classification.
- Ask the class what characteristics do some groups of creatures have in common?
- Use a Moon Snail (a mollusc) and a Soldier Crab (an arthropod) as an example.
- What do these animals have in common? What do they need to survive? **Note:** Use the estuary 'Virtual Habitats' on our **'Online Activities'** page for more information.

Answer: Moon Snails and Soldier Crabs both have hard outer shells to protect them, from hungry predators. The shells of both creatures are largely made of calcium carbonate. Calcium carbonate is one of the most abundant minerals on Earth and accounts for about 4% of the Earth's crust. It occurs naturally in three principal rock types including chalk, limestone, and marble.

- Write or draw a diagram of what the below pairs of creatures have in common and list any features that they use to survive? Use the images and information from the 'Virtual Habitats' or **'Appendix 7: Memory Puzzle Answers'** to help you.

Classification	Pairs
Plants	**Mangroves** and **Beaded Glasswort**
Birds	**Black Swan** and **White-faced Heron**
Invertebrates	**Soldier Crab** and **Moon Snail**

Section 3: Memory Puzzles and Virtual Habitats

Topic: Habitats

Activity 6: Adaptations

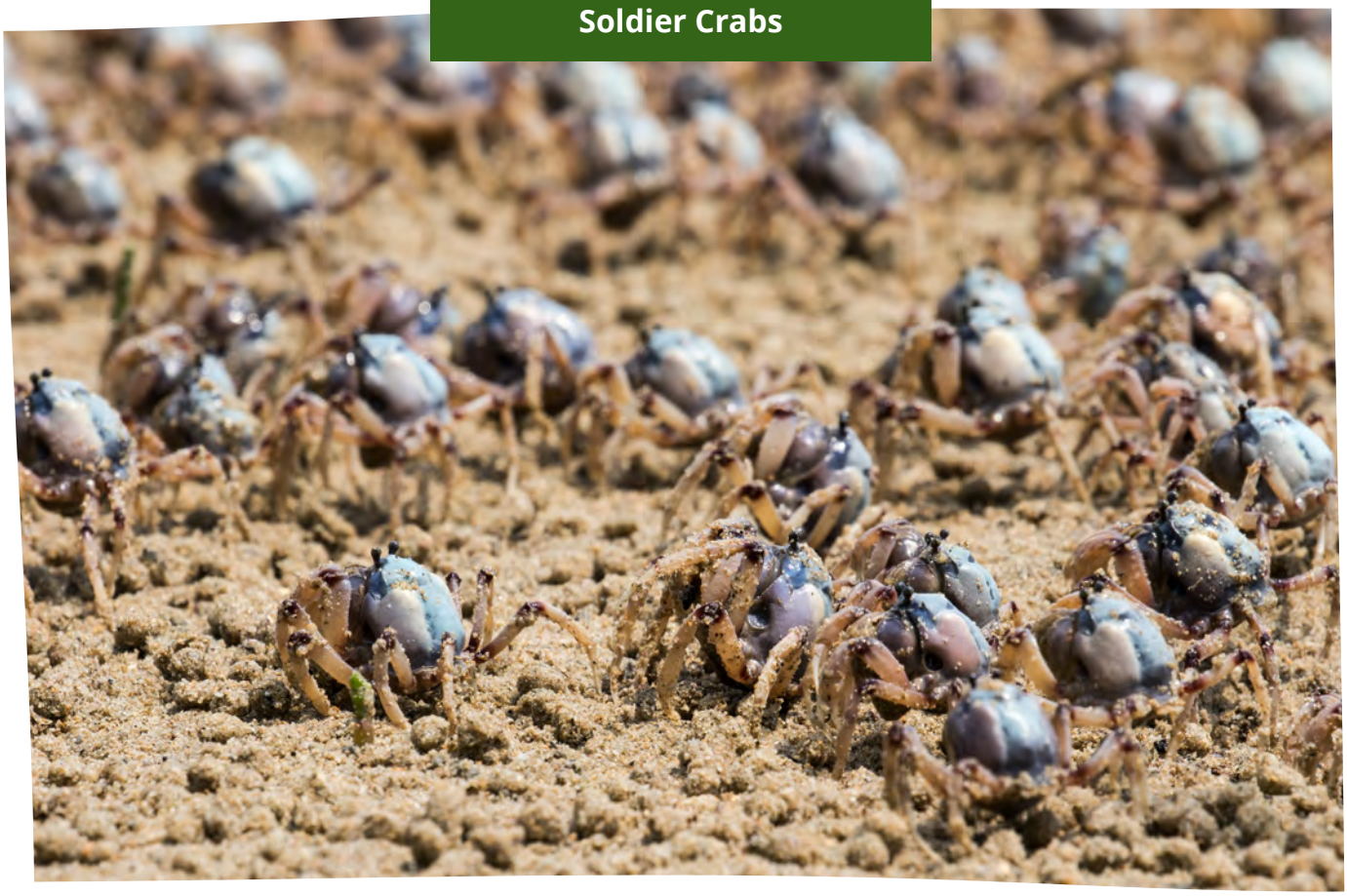
Level 5-8 (whole class)

Play the **'Estuary Memory: Facts'** and leave the completed puzzle open as a reference or look at **'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 and then explain how it gives the creature a greater chance of survival:

- Use of camouflage
- Have an exoskeleton (outer skeleton)
- Have specialised structures to collect sunlight
- Find safety in numbers
- Build traps to catch prey

Soldier Crabs



Section 4: Food Chains and Life Cycles

Topic: Food Chains, Food Webs and Life Cycles

Activity 1: Food Chains

Level 3-4 (whole class)

Play the **'Estuary Food Chains'** puzzles. As you complete each food chain sequence, 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 a predator to prey. Put an arrowhead on the line pointing at the prey showing the direction of predation.
- Repeat the process until you can see no more connections.

Activity 2: Food Webs

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 at the beginning of every food chain.

Watch this video from New Zealand about marine food webs (2 mins):
https://www.sciencelearn.org.nz/videos/37-understanding-food-webs

- Have the students chosen creature from previous activities.
- Choose one student to be the sun. Arrange students in a circle with the sun in the centre.
- 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.

Activity 3: Frog and Butterfly Life Cycle

Level 1-2 (whole class)

- Watch the **'Life Cycle of a Frog'** video or **'Life Cycle of a Butterfly'** from our YouTube video library and discuss.
- Introduce the words 'life cycle' to the class. You could talk about human life cycles as an example. Do frogs/butterflies behave the same? Discuss.
- Complete the **'Appendix 8: Frog Life Cycle Worksheet'** or **'Appendix 9: Butterfly Life Cycle Worksheet'**.

Spotted Marsh Frog

Section 5: Crossword Puzzles

Topic: Threats, Survival and Adaptations

Activity 1: Estuary Crosswords

Level 3-10 (whole class)

Play **'Estuary Crossword: Creatures'** as a class or as individuals. Discuss using the completed crossword puzzle and or the 'Virtual Habitats' puzzle.

- Ask students to choose one animal and complete **'Appendix 10: Animals and Their Habitats Worksheet'**. Only fill out the name of the animal and what it eats.
- Play **'Estuary Crossword: Ecosystems'** as a class or as individuals.
- Discuss this crosswords and then revisit the **'Appendix 10: Animals and Their Habitats Worksheet'** and get students to complete the rest of the worksheet using information from puzzles 1 + 2 and the 'Virtual Habitats' featured on our **'Online Activities'** page.
- Play **'Estuary Crossword: Ecosystems'** as individuals or as the whole class.
- Play the puzzle once, repeat the puzzle and then discuss the threats, recording as you go.
- Putting the words 'Barwon Estuary' at the center, make a mind map of threats to the Barwon Estuary. Use **'Appendix 11: Example of Mind Map'** for a reference.

Activity 2: Make Your Own Estuary Creature

Level 3-10 (whole class)

Look at the answers from the **'Estuary Crossword: Creatures'**.

- 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 estuary 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. Use **'Appendix 12: Make Your Own Creature Worksheet'** or **'Appendix 13: Example of Imaginary Estuary Creature'** to help the class. You can also play the online game **Switch Zoo** for fun: https://switchzoo.com/newzoo/zoo.htm
- Ask students to share their work with the class and explain their creatures adaptations.

Section 5: 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, and 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 **'Estuary 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.

Shrubby Glasswort

Section 6: Multiple Choice

Topic: Estuary Facts

Activity 1: DIY Estuary Quiz

Level 3-10 (whole class)

Play the **'Estuary 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 is drawn from the other puzzles such as memory and crosswords.

Section 7: Other Activities

Topic: Mangroves and Migration

Activity 1: Make Your Own Mangrove Habitat

Level 3-8 (whole class)

Using the skills you have learnt throughout this kit, make your own mangrove habitat. You can illustrate your mangrove habitat, create a diorama or create something online. Play the interactive games below for inspiration:

1: 'Make a Mangrove Ecosystem' - PBS Kids:
https://pbskids.org/plumlanding/games/ecosystem/make_a_mangrove.html
2: 'Mangroovin' - PBS Kids:
https://pbskids.org/plumlanding/games/mangroovin/index.html

Activity 2: Migration as an Adaptation

Level 3-8 (whole class)

Introduce the topic of bird migration by reading **'Circle' by Jeannie Baker**.

- Discuss the book and ask students whether or not Australia has migratory birds, and, if we do, who, what and where are they?
- Using our **'Bar-tailed Godwit Journey'** Google Earth activity, follow the Bar-tailed Godwit on its journey from the Barwon Estuary to Siberia or Alaska.
- Prompt students to ask questions such as; 'How does the Bar-tailed Godwit fly so far without stopping?', 'How does the Bar-tailed Godwit navigate during its journey?' and 'Does migrating increase the survival of a the species, and if so, how?'.
- Record these questions so that the entire class can see. Revisit the **'Bar-tailed Godwit Journey'** and see if you can find the answers to the questions above.
- Have the students brainstorm what threats there might be for migratory birds like the Bar-tailed Godwit on its long journey.

Use **'Appendix 14: Migratory Bird Threats Mind Map'** to help record these threats. Have students make their own migratory bird threats mind map.

Teacher notes: Australia's threatened birds declined by nearly 60% on average over 30 years, according to new research. This research reveals the true impact on native wildlife as a result of habitat loss, introduced pests and other human-caused pressures (*The Conversation*).

Appendix 1

Jigsaw Puzzles - *Mangroves and Saltmarsh*

Appendix 1

Jigsaw Puzzles - *Seagrass and Mudflats*

Appendix 1

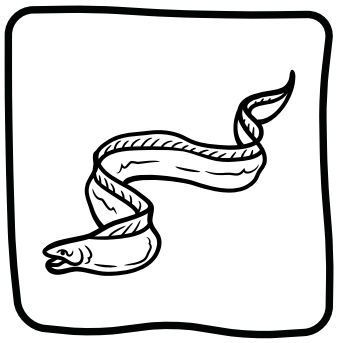
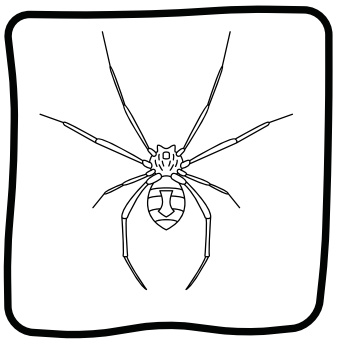
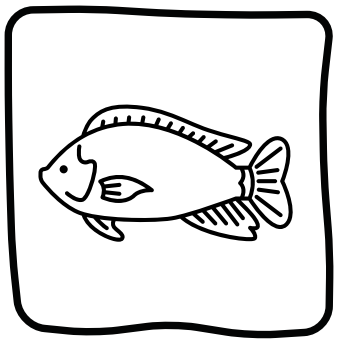
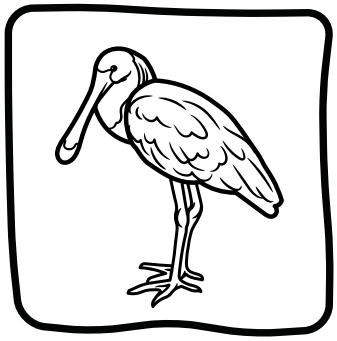
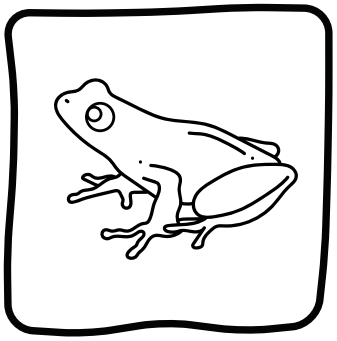
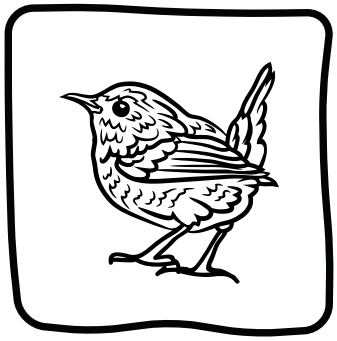
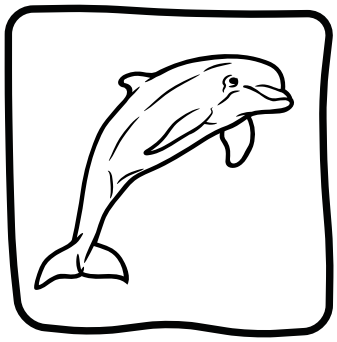
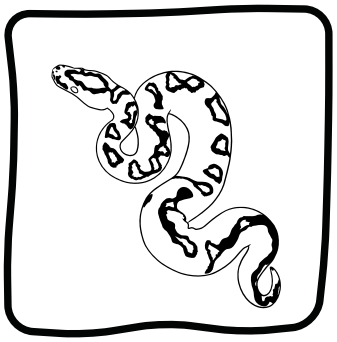
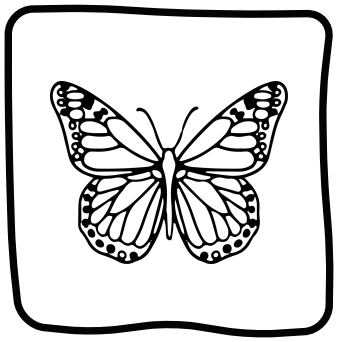
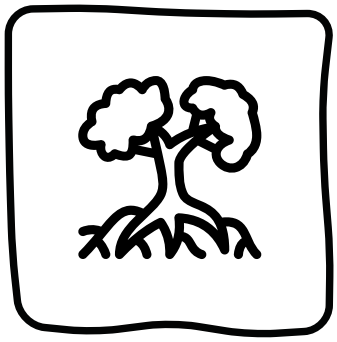
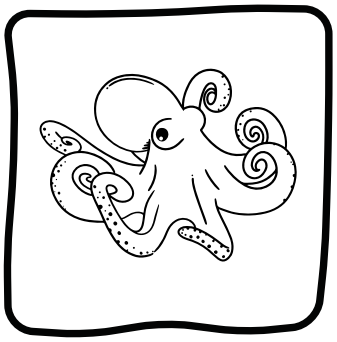
Jigsaw Puzzles - *Bays and Estuaries*

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 1: 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'. You may want to use **'Appendix 1: Jigsaw Puzzles'** to help you.

Wet

Dry

Both

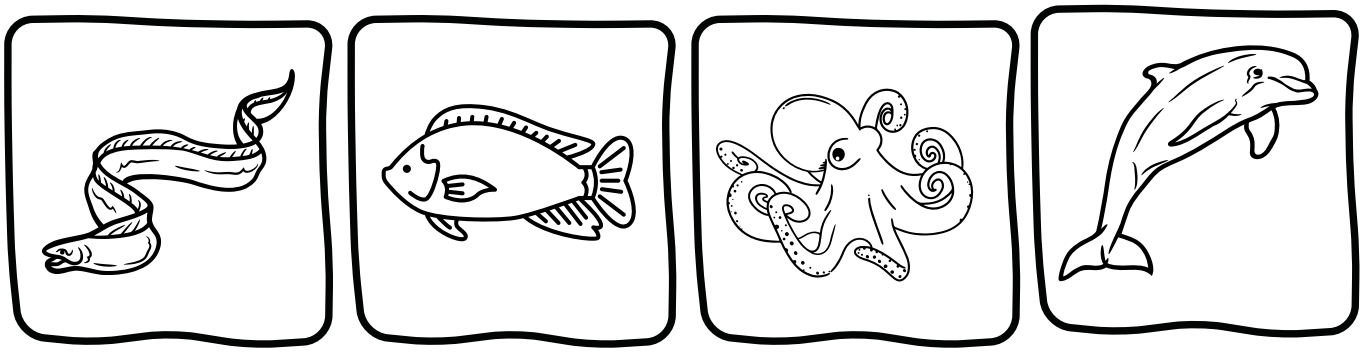
Appendix 2

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

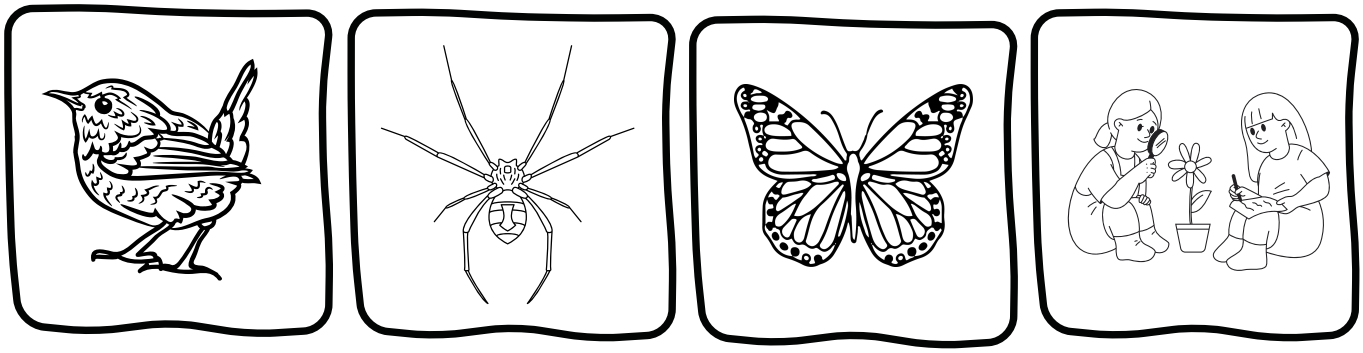
Outline

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'. You may want to use **'Appendix 1: Jigsaw Puzzles'** to help you.

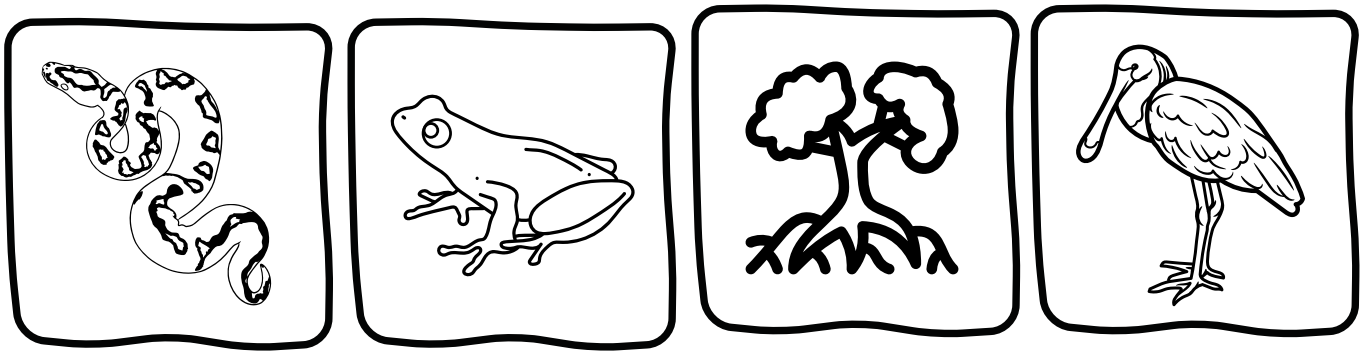
Wet



Dry



Both



Appendix 3

Estuary Zones Jigsaw Strategy Information Sheets - *Mangroves*

Outline

The jigsaw strategy is one which can be 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) Mangroves, b) Seagrass, c) Riparian, d) Sand and Mudflats, and e) Saltmarsh

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.

Mangroves

Mangroves are trees that grow between the high and low tide zones. In the Barwon estuary you can find *Avicenna marina,* commonly known as the Grey or White Mangrove. This unique species grows along the shores of the estuary and in some places have formed dense forests. Mangrove forests stabilize the coastline by reducing erosion caused by storm surges, currents, waves, and tides. Mangroves protect water quality by removing nutrients and pollutants from storm water runoff before they reach seagrass habitats and intertidal reefs.

Mangroves shed large amounts of plant material into ecosystems which breaks down and is known as Mangrove peat. Mangrove peat filters and absorbs water during heavy rains and storm surges, reducing the chances of coastal flooding.

Appendix 3

Estuary Zones Jigsaw Strategy Information Sheets - *Mangroves*

Mangroves provide essential habitat for thousands of species. They provide habitat for fish, crustaceans, molluscs, insects and birds. Over 70% of coastal fish species in south-eastern Australia need to move through estuaries to complete their life cycle.

Many birds depend on mangroves for part of their seasonal migrations. The critically endangered Orange-bellied Parrot breeds in south-west Tasmania during spring and summer, then migrates to the southeast coast of mainland Australia where they spend the autumn and winter in Victoria and South Australia. The estuary is visited by thirty seven species of international migratory birds. Each year, birds like the Bar-tailed Godwit and the Common Greenshank journey many thousands of kilometers along the East Asian-Australasian Flyway between Australia and breeding grounds in the northern hemisphere.

Appendix 3

Estuary Zones Jigsaw Strategy Information Sheets - *Seagrass*

Seagrass

In nearly all the seas around the world, in the shallow waters next to the land, are secret underwater gardens. These gardens are home to a special marine plant called seagrass. Seagrasses are flowering plants (also known as angiosperms) that have adapted, over millions of years, to life underwater in the sea. Seagrasses only flower for a short time each year and, like many terrestrial plants, flowering is linked to the seasons. Unlike land plants that have oxygen available from the soil around their roots, in the waterlogged sediments (the underwater sand or mud that seagrass grows in) on the seafloor there is very little oxygen available, so instead seagrass exchanges oxygen for carbon dioxide. This means they also absorb large amounts of carbon dioxide from the surrounding seawater and so help to reduce the speed of climate change. Seagrasses are one of the most productive plant communities on Earth.

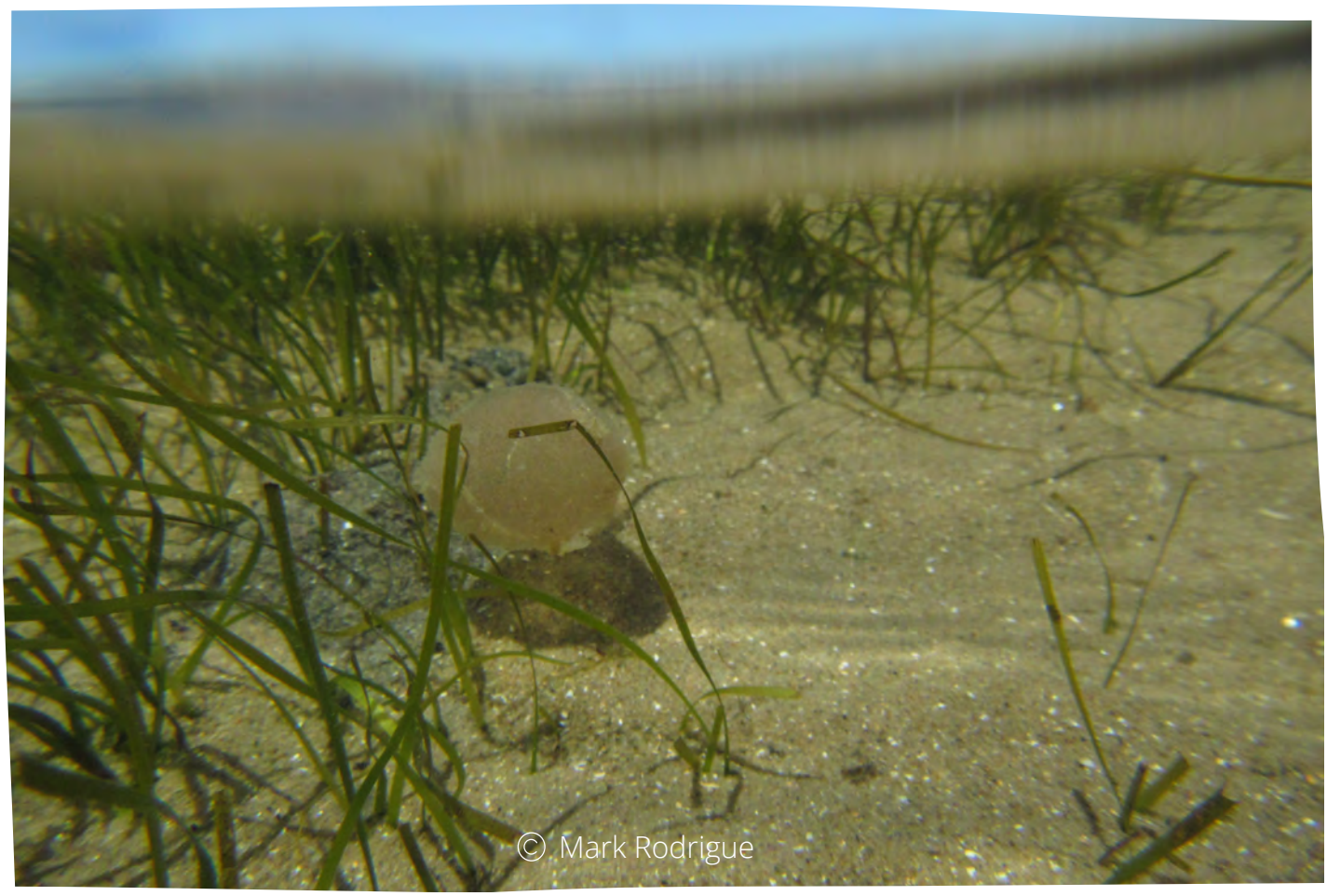
When seagrass grows in large areas, the habitat it creates is called a seagrass meadow. Seagrass meadows play an important role in keeping our oceans healthy and providing a home for all kinds of marine life. This marine life includes fish that people eat, such as flathead, bream and flounder.

Seagrasses are a very important food source and habitat for wildlife, supporting a diverse community of organisms including fish, octopuses, shrimp, crabs, oysters, sponges, sea urchins, anemones and squid.

Seagrasses have been used by humans for over 10,000 years - to fertilize fields, insulate houses, weave furniture, thatch roofs, make bandages and fill mattresses and even car seats.

Appendix 3

Estuary Zones Jigsaw Strategy Information Sheets - *Seagrass*



Many animals find refuge in seagrass meadows, from crabs, fish and sea slugs.

Seagrasses help protect our coastlines from storms and rising tides because their leaves take energy out of the waves hitting the coast, and their roots act as an anchor in the underwater sand. Seagrasses also soak up nutrients and bacteria, helping to keep our seawater clean.

Unfortunately, seagrass does not get the attention it deserves because most people are unaware of its existence. We need to increase awareness of the importance of this beautiful and valuable habitat.

Appendix 3

Estuary Zones Jigsaw Strategy Information Sheets - *Riparian*

Riparian

A riparian zone is land alongside creeks, streams, gullies, rivers and wetlands. These areas are unique and diverse, and are often the most fertile parts of the landscape. In a natural or well managed state, riparian areas are important for many reasons. They can support diverse vegetation, help maintain bank stability, and increase ecological and economic productivity. They support clean water, reduce diseases and pests, and retain important nutrients and soil. Healthy land supports healthy waterways.

Riparian areas are vulnerable and easily degraded. Damage can be caused by uncontrolled stock access, clearing for agriculture or urban development, invasion by pests and feral animals such as rabbits, weeds such as Spiny Rush (*Juncus acutus)* or from overuse from recreational activities. High foot traffic can destroy vegetation, soil structure and result in loss of valuable soil and land.

Vegetation in the riparian zone, such as grasses, can provide spawning habitat for fish when inundated. The velocity of flood water can be slowed by large woody debris and trees forming eddies and backwaters, which may also provide favourable spawning sites for fish that are cued to spawn during high flows.

Vegetation ranges from sedges, heaths, wattles and trees, including the iconic Moonah (*Melaleuca lanceolata*). Moonahs grow in coastal dunes and nearby grasslands extending approximately 5 kilometres inland. Some of the Moonahs around the Geelong and Surf Coast have been aged at over 300 years.

Appendix 3

Estuary Zones Jigsaw Strategy Information Sheets - *Sand and Mudflats*

Sand and Mudflats

Mudflats are mineral-rich coastal soils within and above high tide level, which are low in oxygen, often saline, and have a high organic content. In some areas, the organic content is lower, and the soils grain size is high, and such areas could be defined as sandflats.

These “bare” mudflat and sandflat. areas provide important habitat for mud and sand-dwelling invertebrates such as crabs, shells, and worms; sheltered habitat for larval and juvenile fishes; and are an important feeding area for various bird species, including migratory shore birds. Mudflats are feeding grounds for birds like Bar-tailed Godwits, Curlew Sandpipers, Sharp-tailed Sandpipers, Red-kneed Dotterels, Red-necked Stints and Grey Plovers.

Mudflats are an important buffer zone between the land and sea, particularly in areas with mangroves. Such areas help to reduce erosion and flooding by reducing water flow. They filter pollution and reduce the load of suspended sediment entering estuarine environments and thus help to purify the coastal the mudflats. Often they have little or no visible vegetation and at low tide, soft, muddy sediments are exposed to the air. Mudflats are made up of very fine particles that restrict water movement into the soil and have little oxygen below the surface. This environment supports bacteria which thrive in thick airless mud and contributes to the black colour and the sulfurous odour produced in these habitats.

Mudflats play a role in soluble nutrient recycling in estuarine system, including storing and releasing nutrients such as phosphorus, nitrogen, and carbon, as well as trace elements.

Bar-tailed Godwits

Appendix 3

Estuary Zones Jigsaw Strategy Information Sheets - *Saltmarsh*

Saltmarsh

Saltmarshes are coastal wetlands that are flooded and drained by salt water brought in by the tides. They are marshy because the soil may be composed of deep mud and peat. Peat is made of decomposing plant matter that is often several feet thick. Peat is waterlogged, root-filled, and very spongy. The water makes grassy and sinuous channels which fill and drain with saltwater as the tides ebb and flows. Saltmarsh provides food, shelter and acts as nursery grounds for birds, fish, and amphibians.

Saltmarshes are characterised by plant species that can tolerate high levels of salt such as glassworts, rushes and coastal grasses. Microscopic organisms like bacteria, small algae and fungi help decompose the detritus resulting from the decomposition of saltmarsh plants. These microorganisms and the remaining decomposing plant material become an ideal source of food for bottom-dwellers in saltmarshes like worms, fishes, crabs and shrimps. The cycle continues when the faeces of the bottom-dwellers is cleaned up by microorganisms.

Healthy saltmarshes cleanse the water by filtering run-off and helping other ecosystems, including oyster reefs and seagrass beds, thrive. Conserving saltmarsh helps people, too. Saltmarshes absorb flood waters and wave energy, decreasing property damage in adjacent communities. Saltmarsh can reduce erosion, stabilise shorelines, protect against storm surge and support species that are crucial to recreational and commercial fishing, bird watching and other activities. One acre of saltmarsh can absorb up to 50 million litres of floodwater, which is equivalent to more than 2.25 Olympic-size swimming pools.

Appendix 3

Estuary Zones Jigsaw Strategy Information Sheets - *Saltmarsh*

Saltmarshes are one part of a complex coastal ecosystem with interdependent habitats. For example, by filtering pollutants, marshes help oyster reefs and seagrass beds, which need clean water to survive. But as salt marshes degrade, the health of adjacent coastal habitats and marine life suffers.

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Appendix 4

Living and Non-Living Chart - *Living Things*

Living Things

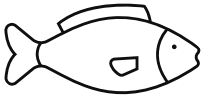
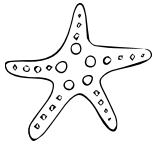
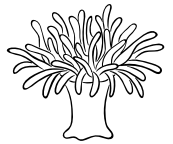
	**GROW**
	**NEED WATER**
	**NEED FOOD**
	**CHANGE**
	**REPRODUCE**

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**

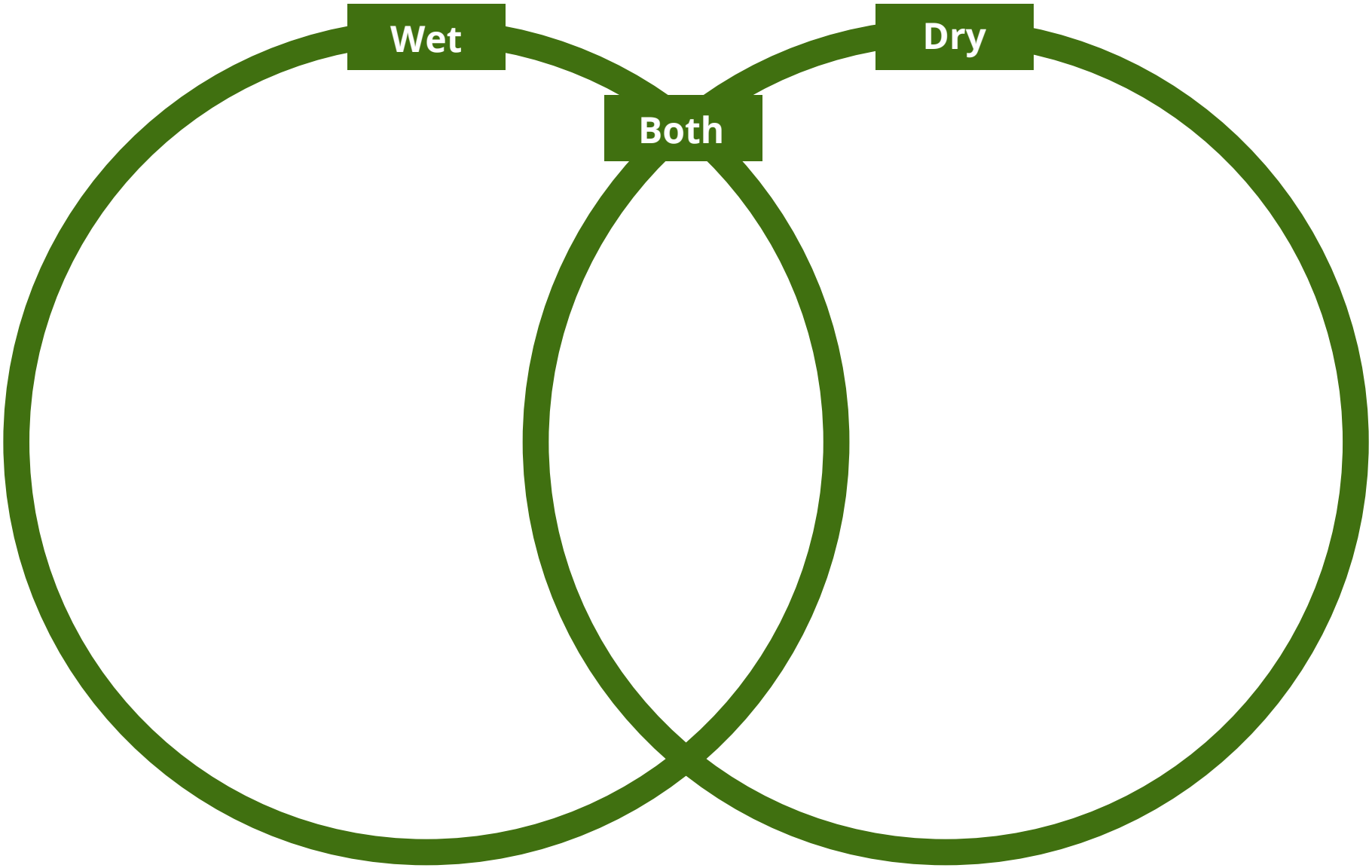
Appendix 5

Is it Living or Non-Living

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

Appendix 6

Venn Diagram Worksheet

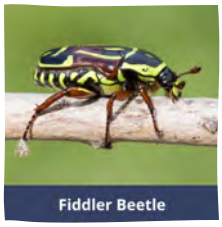


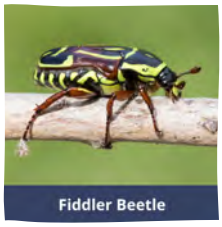
Appendix 7

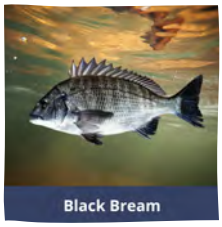
Memory Puzzle Answers - *Images*

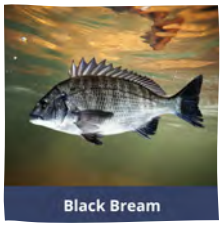
Outline

The below show the answers to our estuary 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 - *Facts*

Outline

The below show the answers to our estuary 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.

Purple Mottled Shore Crab

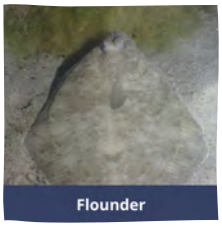
I can walk in all directions, but mostly walk and run sideways.

Caper White

I am mostly white with black edges to my upper wings and yellow-orange, black and white underwings.

Short-beaked Echidna

I am an egg-laying mammal. My young are kept safe and warm in my pouch.



Flounder

I bury myself in the sand and swim away quickly if disturbed. I am shaped like a plate.

Soldier Crab

I can be found in swarms of thousands.

Long-necked Turtle

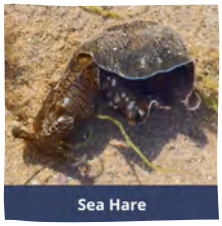
I can live up to 50 years and discourage predators by spraying a foul smell.

Common Greenshank

My bill is long and slightly upturned, my legs are long and a yellowish-green colour.

White-faced Heron

I have a white face and feed on fish, insects and amphibians.

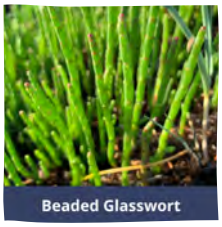


Sea Hare

I am sometimes called a sea slug. I am both male and female and can lay up to 500 million eggs in a season.

Golden Wattle

I have a bright yellow flower and I am Australia's National Flower.



Beaded Glasswort

I am a species of succulent and salt tolerant.

Brown Tree Frog

I take between 12 and 26 weeks to turn from a tadpole into a frog. My back is brown.

Bottlebrush Sawfly

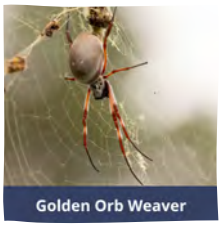
Despite my name, I am a wasp.

Rakali

I am the largest native rodent found in Australia.

Pobblebonk

I am a burrowing frog. I have powerful hind legs that can dig backwards into the ground, remaining there until it rains.



Golden Orb Weaver

I build a large, semi-permanent orb shaped web.

Appendix 7

Memory Puzzle Answers - *Habitats*

Outline

The below show the answers to our estuary 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.

Moonah

Riparian Habitat

Superb Fairy Wren

Riparian & small bush

Spotted Marsh Frog

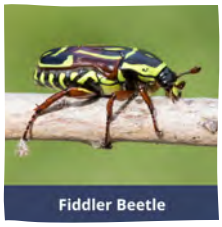
Saltmarsh

White Mangrove

Mangroves

Blue-tongue Lizard

Riparian



Fiddler Beetle

Riparian & Leaflitter

Beaded Glasswort

Saltmarsh

Black Wallaby

Riparian

Moon Snail

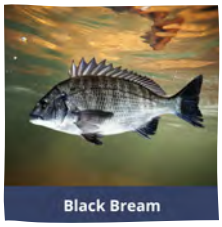
Sand & Mudflats

Leaf-curling Spider

Riparian & Bush

Short-beaked Echidna

Riparian



Black Bream

River & Seagrass

Royal Spoonbill

Sand & Waters edge

Brown Tree Frog

Saltmarsh

Soldier Crab

Sand

Little Pied Cormorant

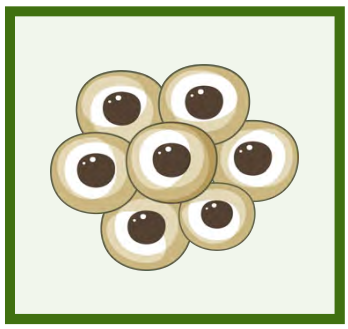
Sand & stump on water edge

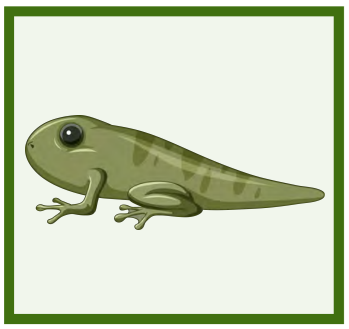
Appendix 8

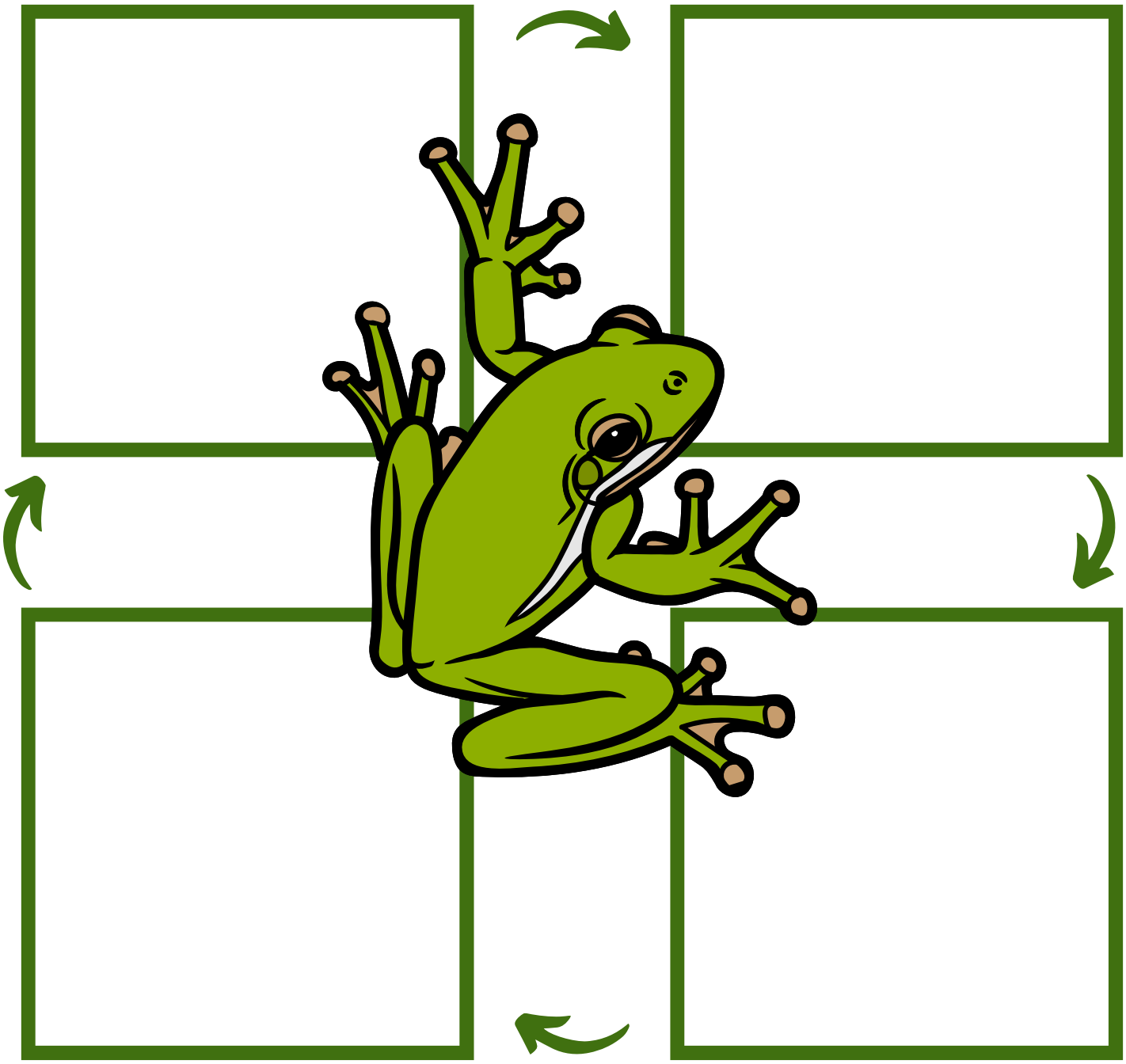
Frog Life Cycle Worksheet

Outline

Cut out the 4 images below and paste into the correct spots within the frog's lifecycle. Name each stage if you can!





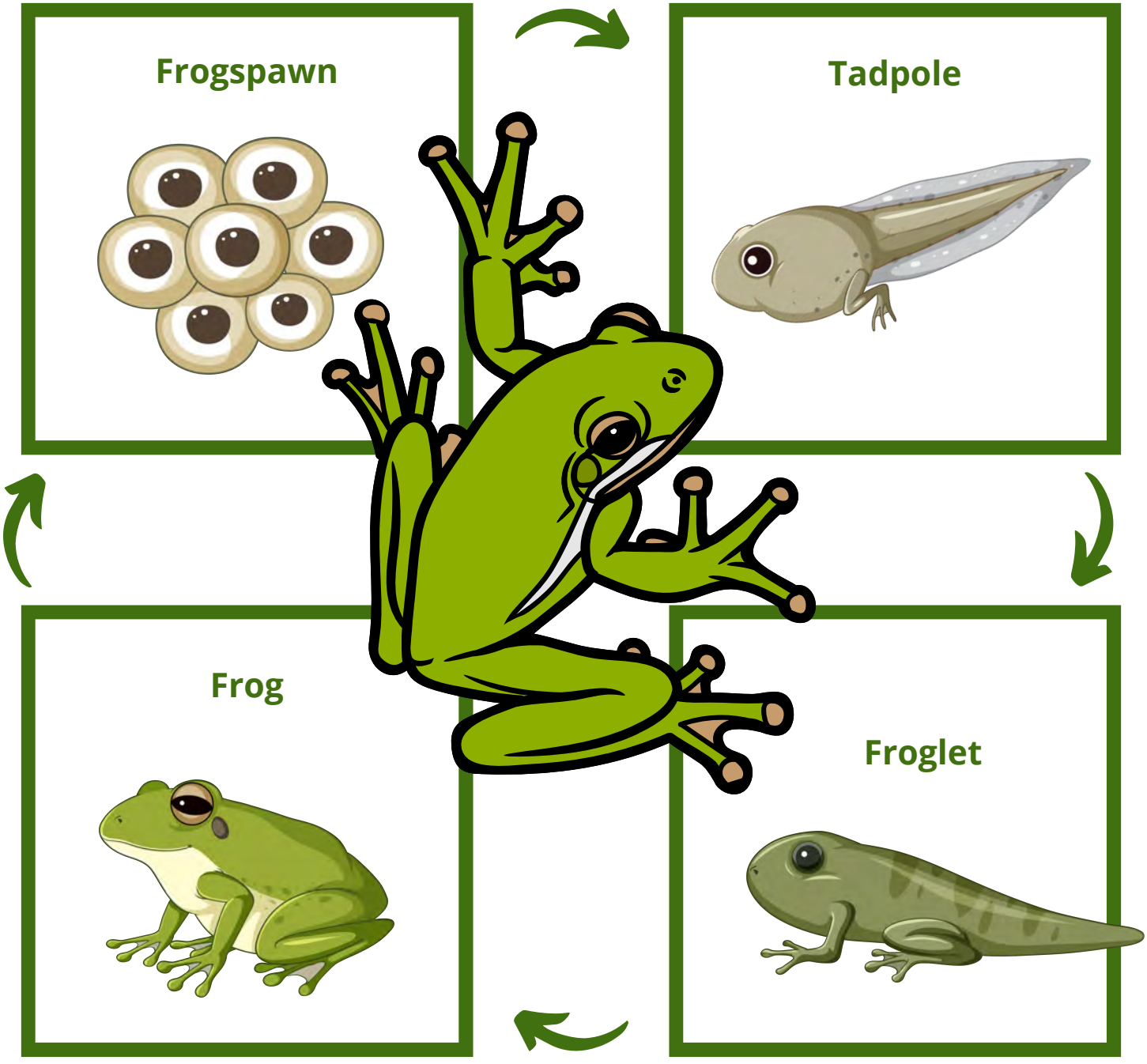


Appendix 8

Frog Life Cycle Worksheet - *Answers*

Outline

Cut out the 4 images below and paste into the correct spots within the frog's lifecycle. Name each stage if you can!

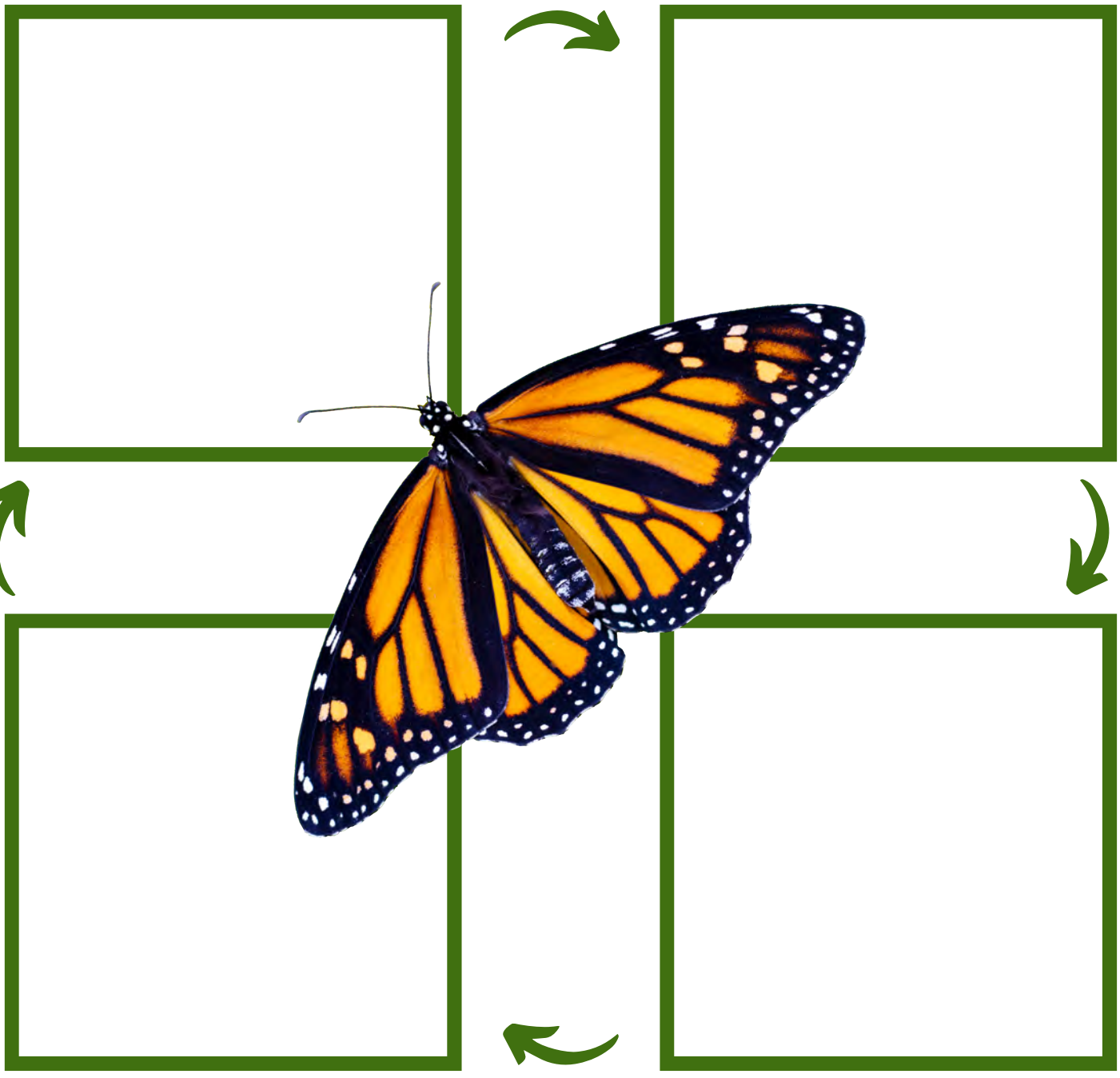


Appendix 9

Butterfly Life Cycle Worksheet

Outline

Cut out the 4 images below and paste into the correct spots within the butterfly's lifecycle. Name each stage if you can!



Appendix 9

Butterfly Life Cycle Worksheet - *Answers*

Outline

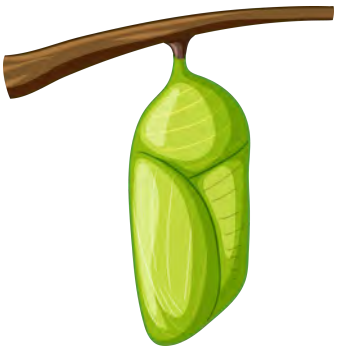
Cut out the 4 images below and paste into the correct spots within the butterfly's lifecycle. Name each stage if you can!

Egg

Larva or caterpillar

Adult Butterfly

Pupa

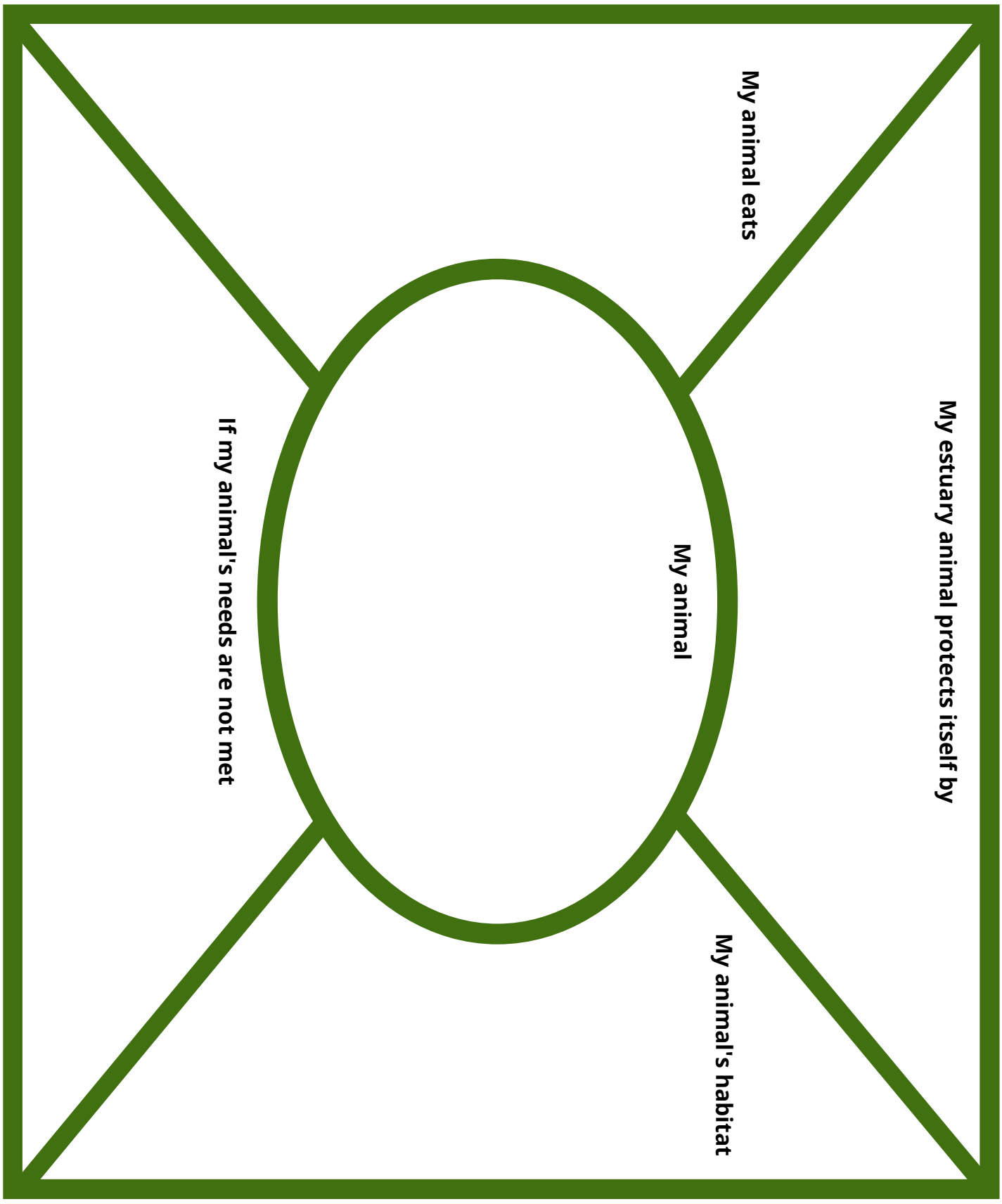


Appendix 10

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 11

Example of Mind Map

Appendix 12

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?

Appendix 13

Example of an Imaginary Estuary Creature

My creature is a zedgaroo.

It eats the very tops of the trees which is why it has a long neck.

It has strong hind legs to help it jump up to the tops of the trees to get the best leaves.

It has the unusual pattern so it can hide in long grass and make the predators sick from watching the wavy lines.

When I am scared a roll myself into a ball. You can only see my legs and tail and that blends with the ground.

Not many creatures eat me because I taste terrible and give you diarrhea. But other bigger animals hate me and attack me because I continually make high pitched squealing noises that keep them all awake.

I live on fairly flat land, with grass, creeks and lots of tall trees. Being able to jump helps me avoid the big patches of stinging weed.

Appendix 14

Migratory Bird Threats Mind Map

Learn about the migratory birds by thinking about what might threaten them, and what we can do to help protect them.

Threats to Migratory Birds	What can we do help Migratory Birds?