Waterwatch Estuary Guide

Student resources: fact sheets and work sheets

Waterwatch New South Wales
Communities Caring for Catchments

NSW Government
Environment, Climate Change & Water

Australian Government

Acknowledgements

This *Waterwatch Estuary Guide* and the accompanying *Waterwatch Estuary Field Manual*, have been developed by Waterwatch coordinators for Waterwatch groups in coastal areas of New South Wales. The methods and procedures have been adapted and enhanced to ensure the success of monitoring within estuaries.

Many thanks to the following people for contributing their resources and expertise:

- Ingrid Berthold, Hunter Central Rivers CMA Waterwatch Coordinator
- Luke Brown, Bournda Environmental Education Centre.
- Amanda Gregory, Department of Education and Training and Hunter–Central Rivers CMA Waterwatch Education Officer
- Colin Mondy for sharing his extensive expertise as Waterwatch Coordinator (retired)
- Beryl Newman, Department of Environment, Climate Change and Water, Waterwatch Coordinator
- Carla Sbrocchi, Waterwatch Catchment Officer, Northern Rivers CMA
- Jane Smith, Community Environment Network, Ourimbah
- Debbie Venter, Community Environment Network, Community Seagrass Monitoring Coordinator
- Samantha Willis, Community Environment Network, Ourimbah.

NSW Waterwatch gratefully acknowledges the permission granted to use materials from a variety of sources including:

- Waterwatch Australia Steering Committee for material from the *Waterwatch Australia national technical manual* modules
- Department of Land and Water Conservation, draft *NSW Estuary Monitoring Manual*
- Department of Natural Resources (WA), *Ribbons of Blue: in and out of the classroom*
- OzCoasts at www.ozcoasts.org.au for permission to use online resources
- NSW Department of Industry and Investment Fisheries for permission to use photographic material on mangroves, saltmarsh, seagrass and caulerpa
- Waterwatch South Australia, for use of some text and illustrations from estuary resources
- Mark Hacking, Edith Cowan University, investigation procedures and worksheets
- Hawkesbury–Nepean CMA for permission to use saltmarsh illustrations
- Lake Macquarie City Council, for assistance with seagrass wrack methodology
- The Office of the Lake Macquarie and Catchment Coordinator for graphics from the publication *Living on the Edge*

NSW Waterwatch acknowledges the support provided in the development of this valuable resource by the Waterwatch network across New South Wales and Australia, and the community involved in Waterwatch.

The *Waterwatch Estuary Guide* and *Waterwatch Estuary Field Manual* are published by:
Department of Environment, Climate Change and Water NSW
59–61 Goulburn Street, PO Box A290, Sydney South 1232
Ph: (02) 9995 5000 (switchboard)
Ph: 131 555 (environment information and publications requests)
Ph: 1300 361 967 (national parks, climate change and energy efficiency information and publications requests)
Fax: (02) 9995 5999 TTY: (02) 9211 4723
Email: info@environment.nsw.gov.au Website: www.environment.nsw.gov.au
ISBN 978 1 74232 887 4, DECCW 2010/686

How to use these student resources

These student resources are designed to enhance student understanding of estuaries and complement the *Waterwatch Estuary Guide* and *Waterwatch Estuary Field Manual*.

The estuary student resources contain fact sheets and work sheets for students of different ages and abilities, to introduce them to estuarine processes and the ecosystems they support. This will provide classroom experiences that will complement field investigations within estuaries.

Understanding and monitoring estuaries is of great importance as they are amongst the most productive ecosystems and yet are highly vulnerable to human induced change.

These student resources will put Waterwatch monitoring within the context of the curriculum and will build skills in monitoring, analysis and recording, so that students can actively participate in the care and management of local estuarine environments.

The student resources include:

Student fact sheets

Student work sheets

Waterwatch offers a way for students to learn about and get involved in monitoring the health of estuaries and to actively take part in the protection and management of these fragile ecosystems.

Disclaimer

The Department of Environment, Climate Change and Water advises that those who participate in Waterwatch do so at their own risk. No responsibility or liability is accepted for any injury, loss or damage, however caused, arising from any participant's involvement in the organisation, conduct or participation in Waterwatch.

Table of contents

Student fact sheets

A series of fact sheets are provided in larger type that can be copied and given to students as background material for the work sheets in this section. They can also be used in conjunction with the relevant field activities in the Waterwatch Estuary Field Manual.

Fact sheets provided: *Page*

Fact sheet

Types of estuaries

Estuaries come in all shapes and sizes and have many different names, such as bays, lakes, lagoons, (shallow) harbours, rivers or inlets. Deep harbours, (for example, Sydney Harbour and Broken Bay) are drowned river valleys.

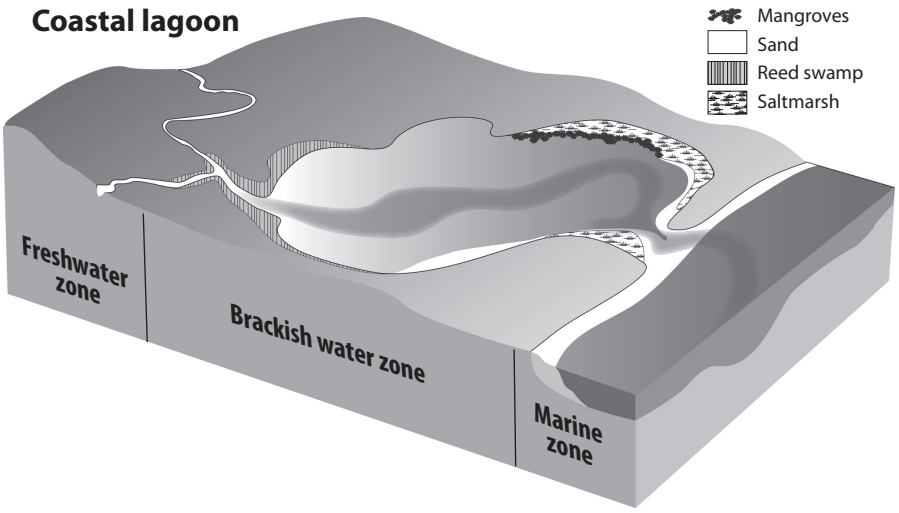
Estuaries vary in their level of salinity depending on how they were formed. Where there is a strong tidal influence, the salinity will go up and down with the tide.

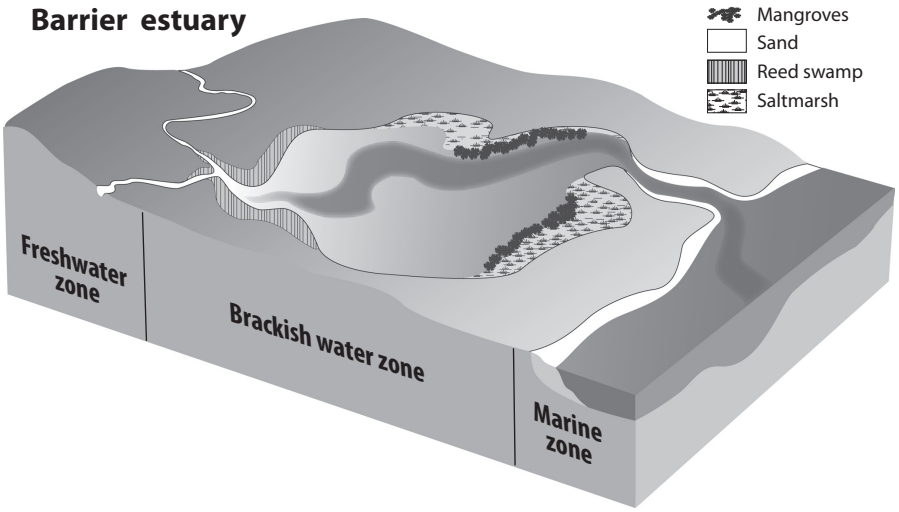
Lagoons and lakes are estuaries formed where waves depositing sand have created a barrier between the ocean and the lake. These may have a narrow opening to the sea and the tidal influence will not be strong.

Sometimes these lakes will open and close to the sea. These are called ICOLLS (intermittently closed and open lakes and lagoons).

Some coastal lakes are permanently opened by artificial channels. They lack tidal influence and depend on wind currents to mix the fresh and saltwater.

Examples of saline coastal lakes include small systems such as Dee Why and Manly lagoons, but also include larger systems such as Wollumboola Lake and Wallaga Lake.





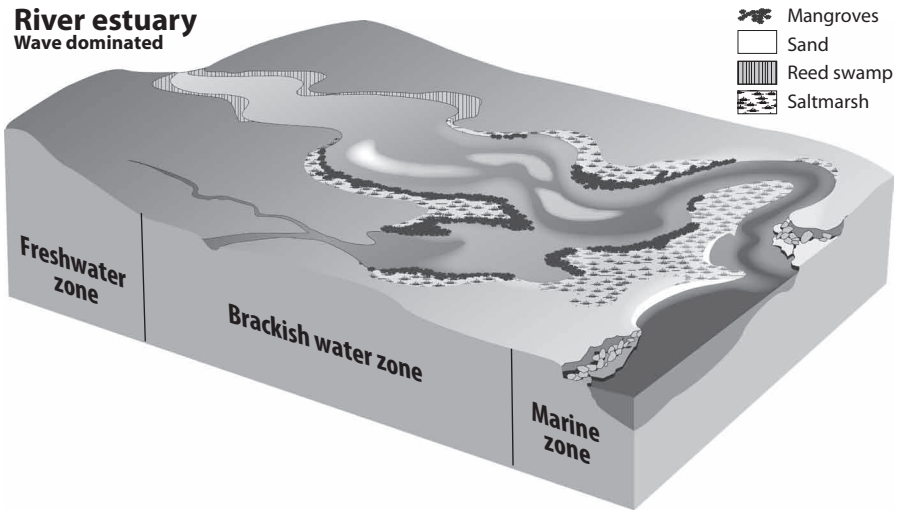
Estuaries formed by rivers

Some estuaries are formed by rivers. A strong flowing river will keep a wide entrance open. A weaker flowing river will allow waves to deposit sand in the entrance forming a barrier.

Wave dominated

When waves deposit sand they may form features such as sand bars that block the opening to the sea. This will limit the mixing of fresh and saltwater by tides. These estuaries will depend on wind to mix fresh and saltwater.

Many estuaries in south-east Australia are wave dominated, for example, Wagonga Inlet, Narooma.

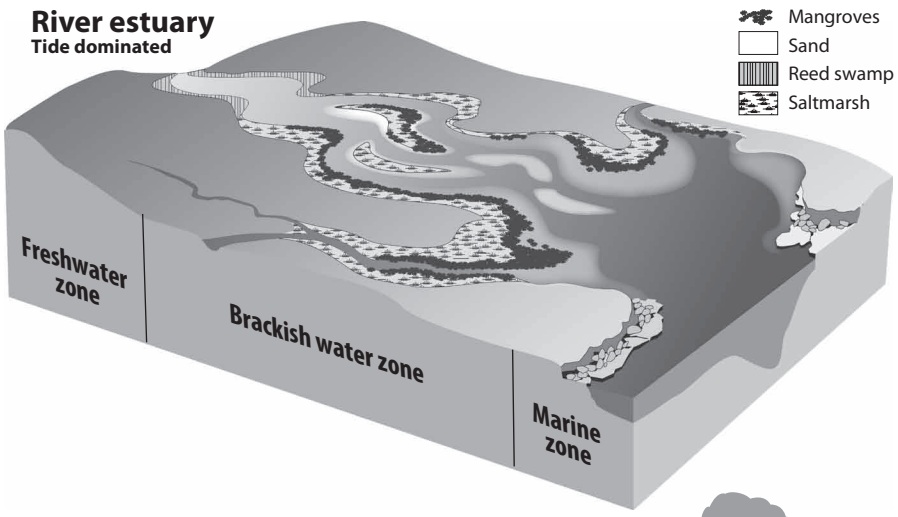


Tide dominated

When rivers create a wide opening to the ocean, tides will mix fresh and saltwater. In these estuaries, salinity will increase with closeness to the sea.

This type of estuary has a variety of habitats due to the influence of tides, including mangroves, saltmarsh, intertidal flats, rocky reefs and rocky shores.

Examples of tide dominated estuaries are the Tomaga and Deua rivers.

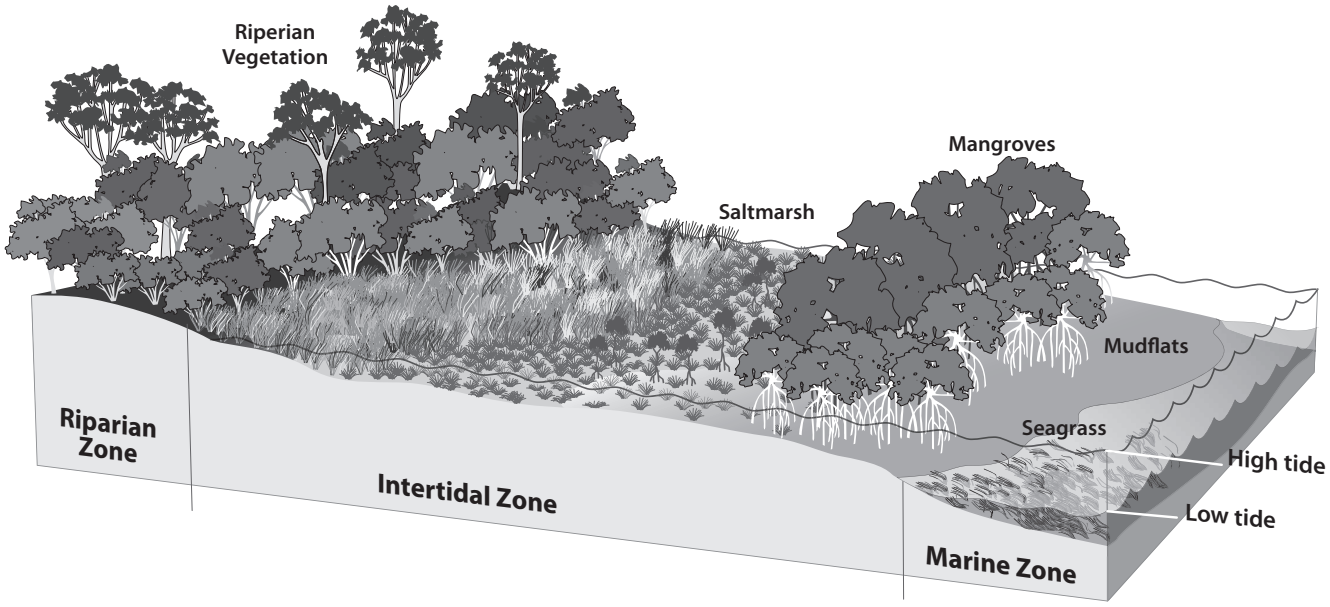


Fact sheet

Estuarine habitats

An estuarine habitat is a place within the estuary that provides food and shelter for living things. In an estuary, habitat changes occur due to the influence of fresh and saltwater.

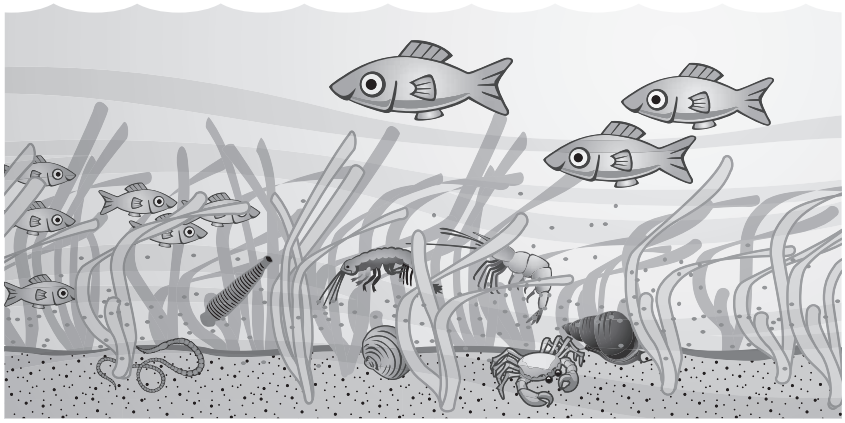
Estuarine habitats



Life in estuarine habitats

Seagrass: salty and wet

Estuary species: nudibranchs, sea slugs, squid, octopus, cuttlefish, prawns, pipe fish, seahorses, weedy sea dragons, many species of crab and fish.



Sand and mudflats: salty and usually wet

Estuary species: snails, whelks, cockles, pipis, isopods, amphipods, flatworms, ragworms, many species of crabs, small sand-dwelling macroinvertebrates.

Mangroves: salty and wet and occasionally dry

Estuary species: mangrove air breather, snails, whelks, many species of crabs, oysters, isopods and fish.

Saltmarsh: salty and fresh water, wet during high tide

Estuary species: snails, crabs, birds including migratory birds, fish.

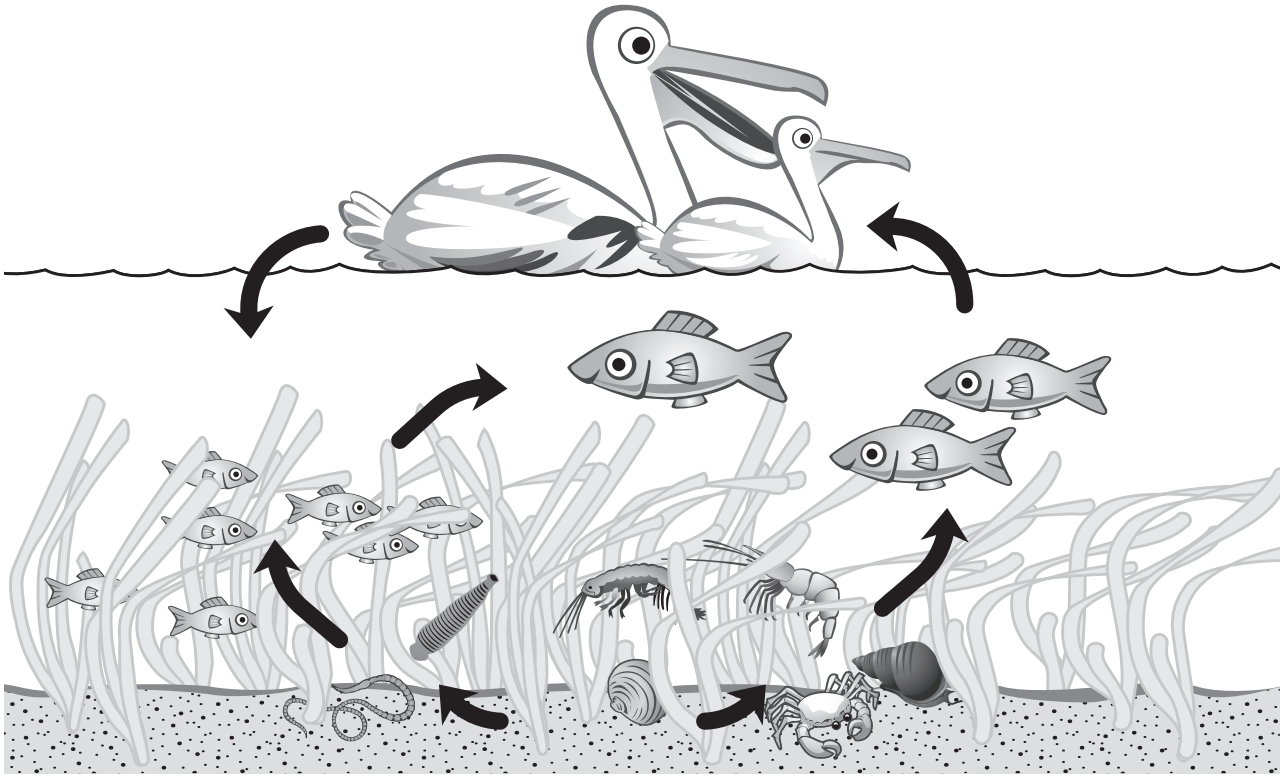
Fact sheet

What does an estuary mean to its wildlife?

An estuary can represent many things to different wildlife:

- **A nursery:** Many species such as fish, crustaceans and invertebrates spawn here because it is protected from oceanic waves and there is a plentiful supply of food and nutrients.
- **A restaurant:** Many small animals live in estuaries. Snails, isopods, insects, fiddler crabs are just a few. Many birds feed on the high protein species found in mangroves, mudflats, and saltmarsh and seagrass beds.
- **A food chain:** Plants and animals in an estuary depend on each other to meet their food requirements. For example, invertebrates may feed on algae and may then be eaten by crustaceans, small fish or birds. This is called a food chain.
- **A link:** Saltmarsh and mangrovs are an important link between the ocean and the land; they are the transition zones between freshwater from the catchment and saltwater from the ocean.

Relationships within an estuary food chain



Fact sheet

Estuary food chains

Estuaries provide habitat and a supply of food for a variety of small animals.

Estuary food chains show the feeding relationships between the different organisms that live in an estuary. They show the flow of matter and energy through the ecosystem. A food chain usually begins with producers which are eaten by herbivores which in turn are eaten by carnivores.

Producers

Producers, or plants, produce their own food, usually through the process of photosynthesis. In an estuary, these plants include phytoplankton, seagrasses, saltmarsh plants and mangroves.

Plankton are microscopic organisms that drift freely in the water and can have both animal and single-celled plant components.

Consumers

Plants are eaten by other organisms called consumers, which are classified by the food they eat. They include:

- **herbivores** – eat plants
- **carnivores** – eat other animals
- **omnivores** – eat both plants and animals.

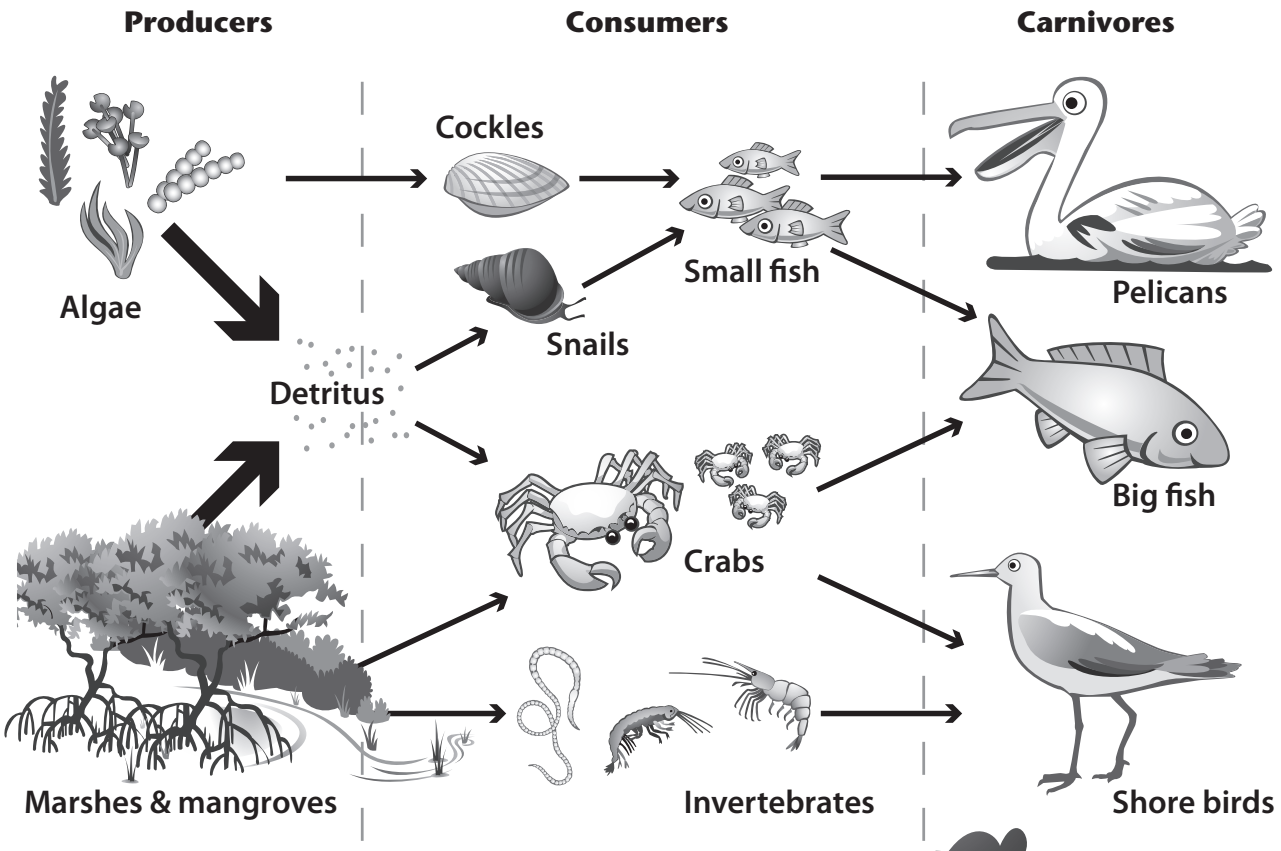
Decomposers

When an organism dies, it is broken down by decomposers such as fungi and bacteria. This process releases nutrients back into the environment to be used again by primary producers.

Detritivores

Decaying plant and animal matter is called detritus. Many animals are adapted to feeding on detritus, such as shore crabs and many worms.

Food chains within an estuary

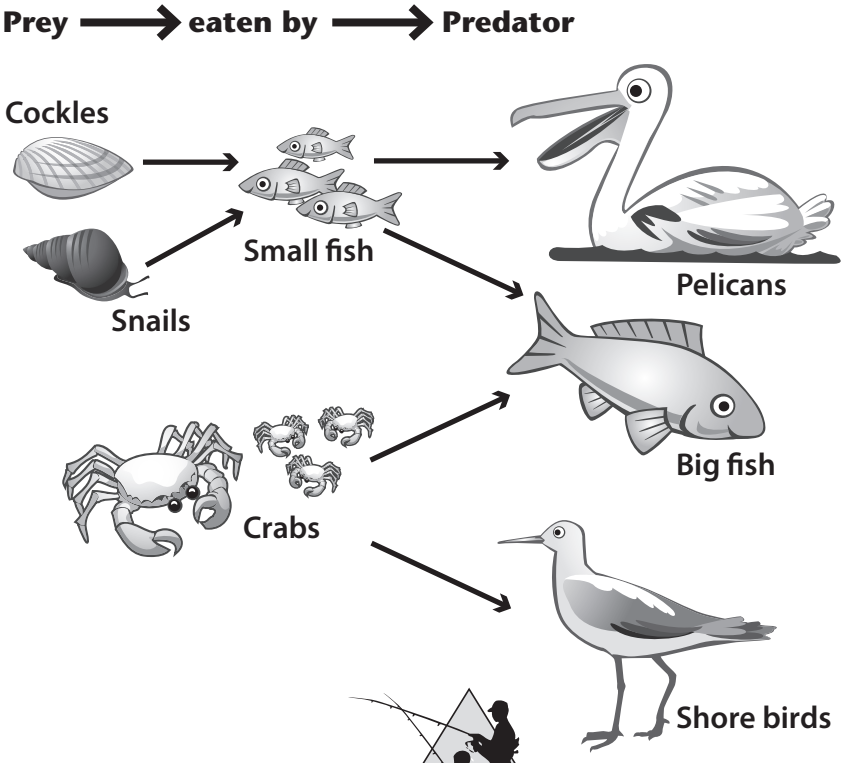


Fact sheet

Trophic interactions

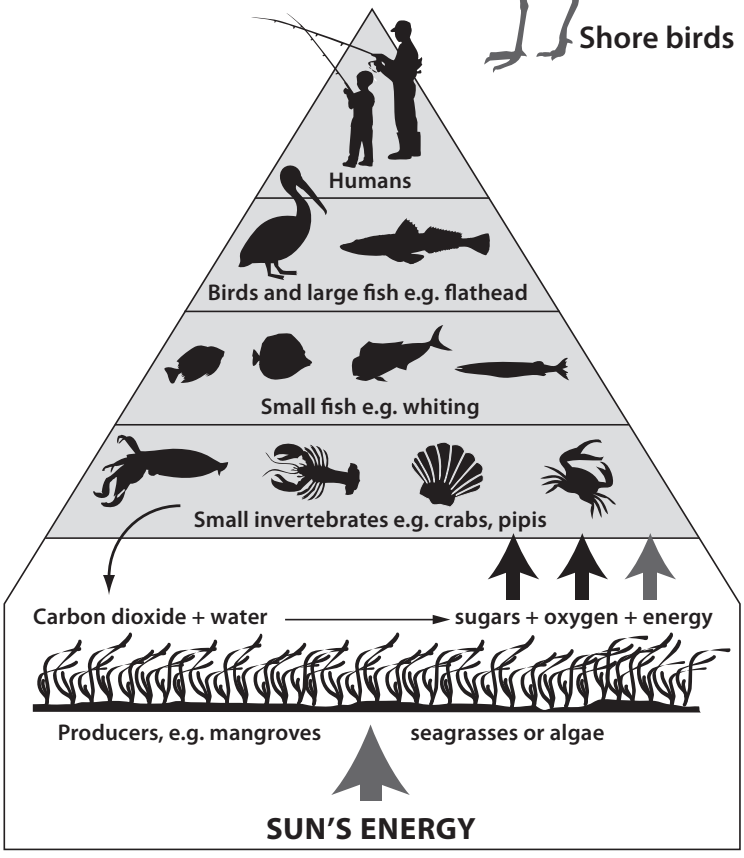
Predator/prey relationships

Trophic interactions are feeding relationships between organisms. There is a one-way flow of energy between predator and prey as shown in the diagram.



Biomass pyramids

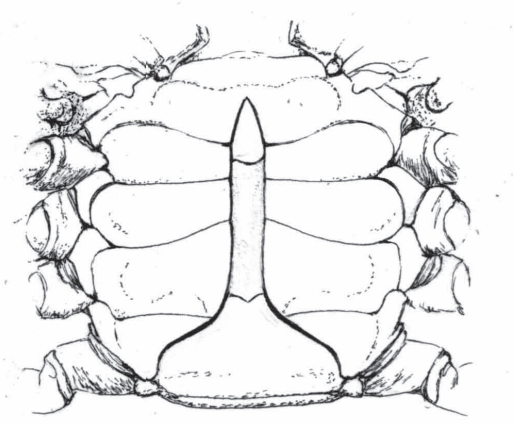
Energy from the sun is trapped by plants and transferred to other organisms. At each trophic level, some energy is lost through respiration. As a result, there is a reduction in biomass (living matter) at each trophic level. This reduction in biomass can be represented by a biomass pyramid.



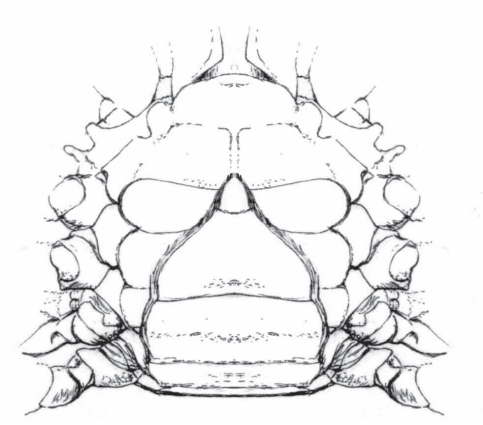
Fact sheet

Life cycle of a mud crab

- The mud crab uses the estuary as a nursery.
- Crabs have a hard outer skeleton (exoskeleton). When the female has just shed her shell and her new shell is still soft, the male produces a sperm packet which he deposits under one of her legs connecting to her egg pouch.
- The female crab carries her eggs in a wide oval flap under her body. The male crab has a V shaped flap.



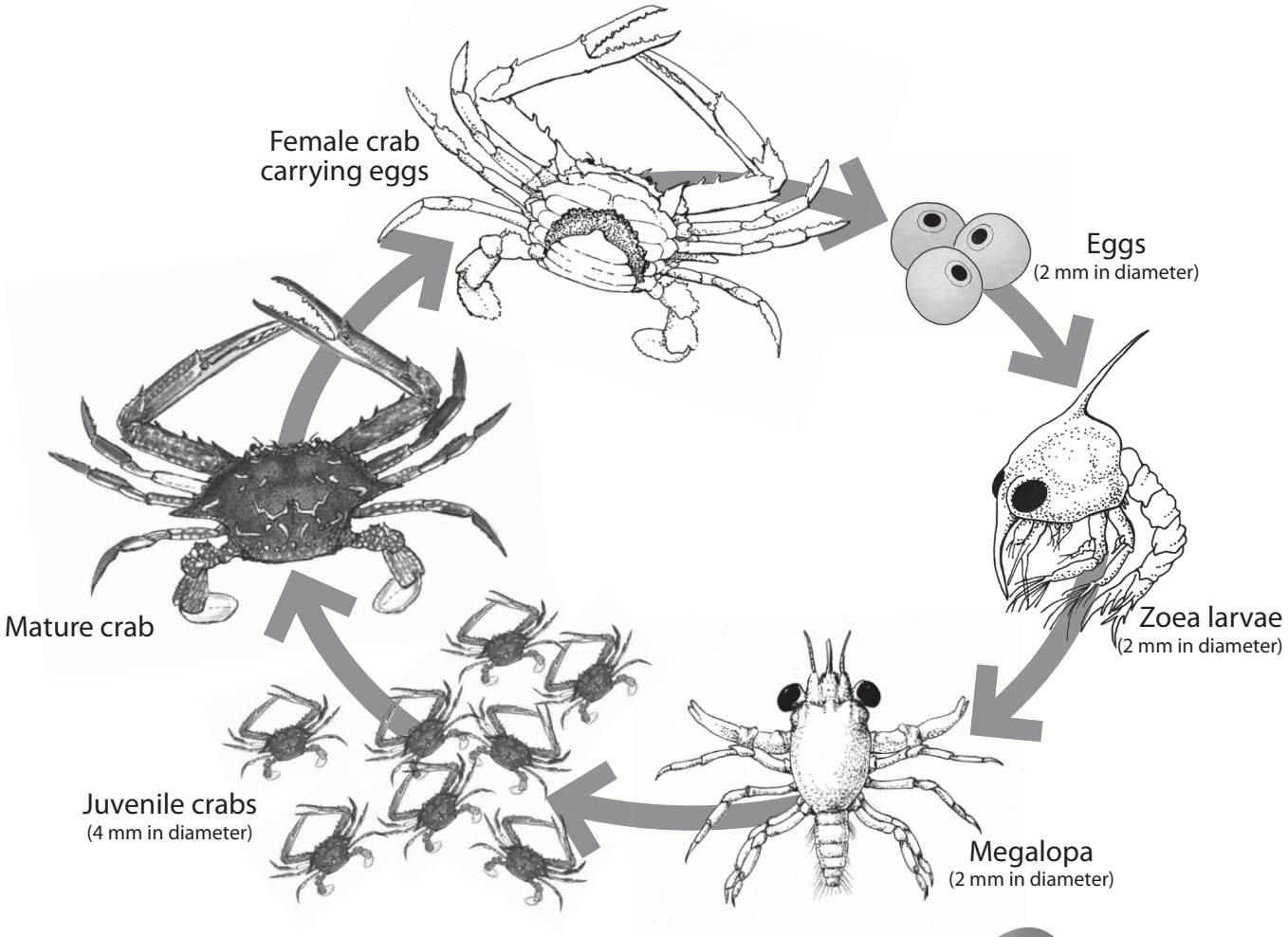
Male crab abdomen



Female crab abdomen

- The female crab swims out to sea and releases her eggs with her partner's sperm into the plankton.
- The eggs are fertilised and quickly grow into a larval stage. These are called zoea.
- Crab larvae undergo several changes and when they grow large claws they are called megalopa.
- The larvae are carried back towards the mangroves or saltmarshes where they settle out of the plankton and take on the form of tiny crabs.
- Tiny crabs grow quickly because there is plenty of food and lots of protection provided by the estuary habitat.
- As crabs grow into adults they shed their shell a number of times. This is called moulting.
- When grown, crabs make burrows in the nursery areas to find a mate and start the cycle again.

Life cycle of a mud crab



The crabs grow into mature adults over a period of two years and make burrows in the nursery areas to find a mate and start the cycle again.

Fact sheet

Salinity in estuaries

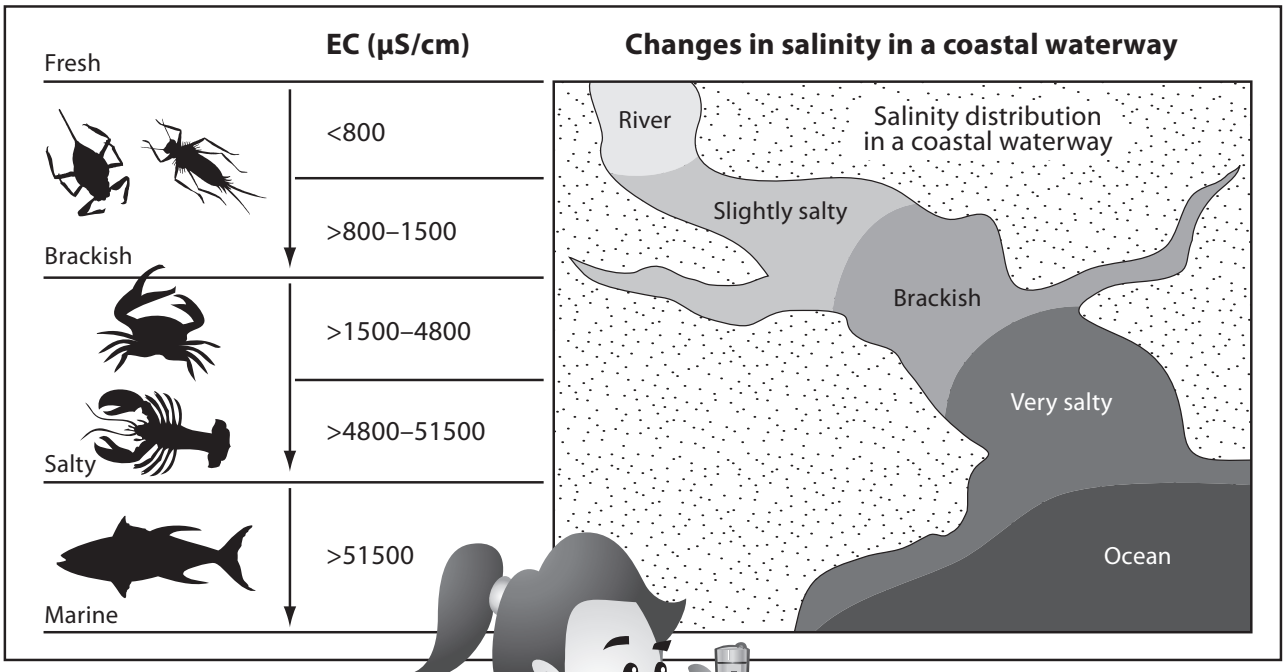
Salinity is a measure of the salt content of water. Salinity levels vary along an estuary depending on the mixing of freshwater and saltwater. Generally, salinity increases along a coastal stream as it gets closer to the river mouth, where tidal influences are strongest.

Saltwater is heavier than freshwater and can sink to the bottom of the estuary, making it more saline than the surface water. This can impact on life at the bottom of the estuary.

Many aquatic species can survive only within certain salinity ranges, so changes in salinity levels may result in changes to the variety and types of species present.

In coastal areas, salinity is the major factor limiting where plant and animal species can live within an estuary.

Changes in salinity within an estuary



Source: Adapted from Oz Estuaries

Fact sheet

Human impacts in estuaries

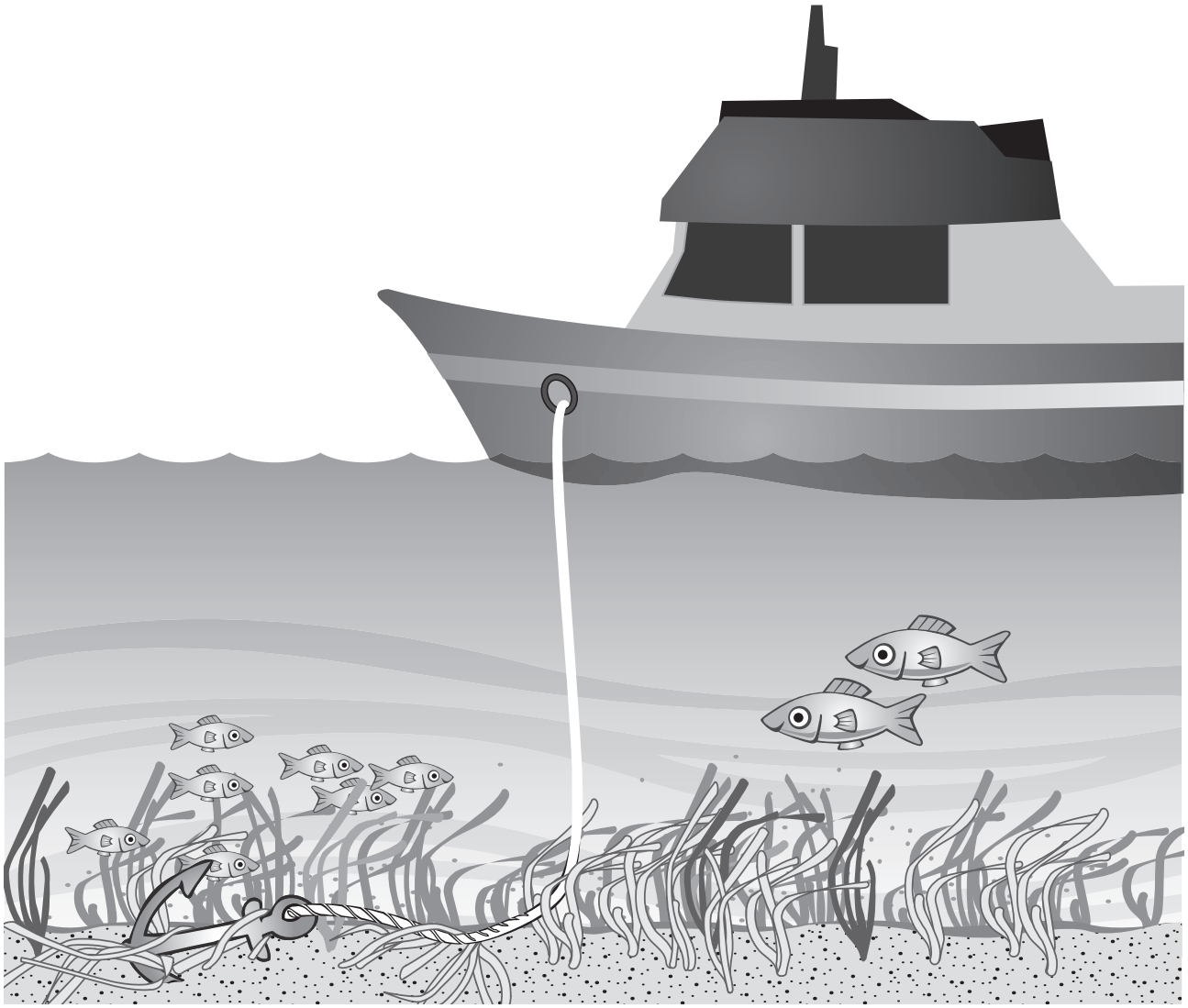
- **Urban development** – housing development, recreation and fishing will change the environment and impact on estuarine habitats.
- **Agricultural activities** – runoff from agricultural land can affect the health of estuaries. For example, the use of superphosphate on farms can increase nutrient levels and stimulate algal growth in estuaries.
- **Industries** such as fishing and oyster farming can impact on water quality and the movement of water in estuaries. Over-fishing and habitat loss reduces fish stocks and disrupts the food chain.
- **Boating** can damage seagrass, reducing or degrading habitat and disrupting the food chain. This can occur due to boat wakes, boat propellers and anchoring in seagrass beds.
- **Structures** such as sea walls, bridges, drains, jetties, marinas, levy banks, rock walls and breakwaters all affect the passage of water and can alter the conditions within an estuary.
- **Erosion** and the build-up of sediment in estuaries can smother seagrass and other aquatic vegetation and this reduces habitats and food sources.
- **Dams** and **power stations** can change water temperatures and affect aquatic ecosystems. Cold water from dams and warm water from power stations are forms of thermal pollution that affect waterways.
- **Litter** on our beaches and floating in Australian marine and estuarine waters is a problem, particularly non-biodegradable litter. It tangles in the appendages of our marine life and is harmful to divers and beach users.

Fact sheet

Keeping seagrass safe: Seagrass friendly moorings

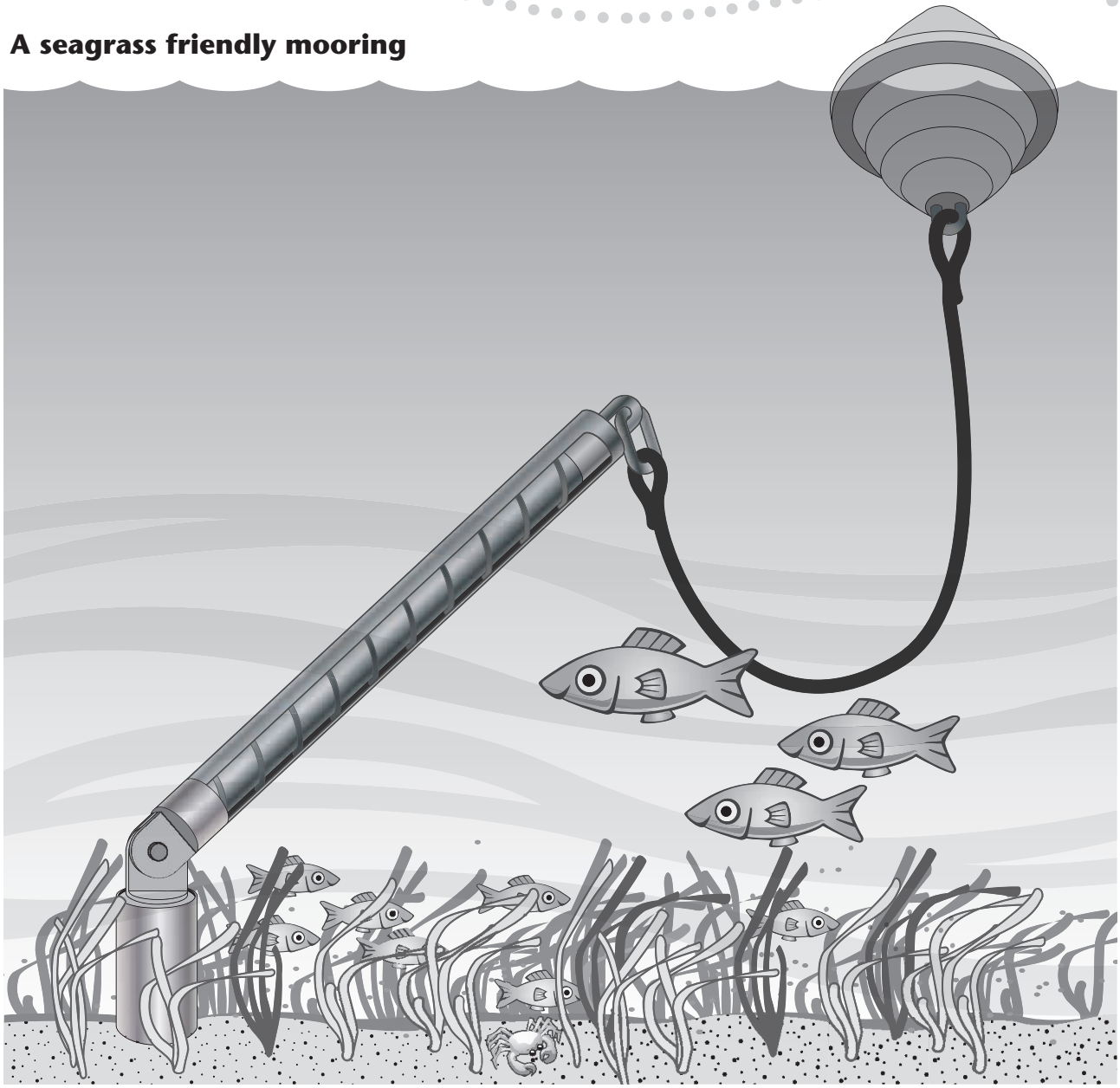
When boats drop their anchor, the anchor and chain may damage the seabed and seagrass. This will impact on sensitive ecosystems.

Some types of seagrass (e.g. *Posidonia*–strapweed) take up to 100 years to recover from damage due to anchors and their chains. Reef corals also take a long time to recover.



For boats to visit beautiful locations, we need to find a way to keep the seabed safe whilst allowing boats to stop and anchor.

A seagrass friendly mooring



Des Maslen, an Australian boat owner and inventor, developed a seagrass friendly mooring.

Made of galvanised steel it has an anchor pole that can screw into the seabed.

There is a swivel head attached to the top of the screw anchor. A length of marine-grade rope is attached to a loop on the swivel and then to a surface buoy. As this rope is buoyant, it keeps chain off the seabed even under extreme low tide conditions. This prevents damage to the seabed and seagrass.

The seagrass friendly mooring is installed and maintained from a boat that screws the anchor to the seabed.

Such moorings are being tested in several locations on the NSW coast.

Source: http://www.abc.net.au; search New Inventors and Des Maslen.

Fact sheet

Be a foreshore friend!

- When fishing, take bait bags and tackle home. Fishing tackle can entangle wildlife and plastic bait bags can end up in the estuary, causing the death of aquatic species.
- Make sure you have a fishing licence and that you observe the bag limits for particular species.
- Plant local native species in your waterfront buffer and garden and avoid plants that can 'escape' into bushland.
- Restore a natural slope to your water frontage and ensure access around the foreshore.
- Help protect and rehabilitate foreshore bushland by getting involved in Landcare.
- Leave dead and fallen trees to provide wildlife habitat.
- Compost your grass clippings and garden waste and keep them away from foreshore reserves.
- Launch boats only from properly constructed and authorised boat ramps and store boats within your property.
- Leave dead seagrass along the foreshore beach to reduce erosion and provide habitat.
- Keep vehicles off foreshore reserves to avoid environmental damage.
- Remove unauthorised structures, and ensure authorised structures are designed and maintained to reduce environmental impacts.

Source: *Living on the Edge*, Lake Macquarie City Council, 2005.

Fact sheet

The six steps of investigation

First

Write a short statement that makes clear what the problem is that you have to solve. Also write a research question or hypothesis, and then a prediction. Give a reason for your prediction.

Second

Write a plan which says what you intend doing. Say what you will do to make any tests fair. Explain what measurements are to be made and how they will be made. Draw a diagram to show how the equipment will be used to conduct your tests.

Third

Carry out your investigation and record all your observations and measurements. If you found that you needed to change your plan write down what changes were made and why they were necessary. Present your data in a way that helps show the patterns or trends in your results.

Fourth

Write a couple of paragraphs in response to these questions: What patterns or trends were present in the results? How do you explain the patterns? What did your results show you about the question or hypothesis that you were investigating?

Fifth

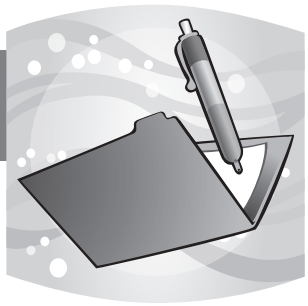
Write a paragraph that evaluates your investigation. Were your findings what you expected? To what extent did you reduce the errors associated with measurements, controlling variables and sampling?

Sixth

How will you communicate your findings? Who is the 'audience' for your report? What will be the most appropriate means of communicating your findings – a formal written report, a poster, an oral report, a PowerPoint presentation?

Source: Mark Hackling, Edith Cowan University, used with permission.

Work sheets



These work sheets are designed to introduce students to some key concepts. Some are best used in the classroom prior to going on a field trip, while others can be used before, during or following a site visit.

Work sheets included: *Page*

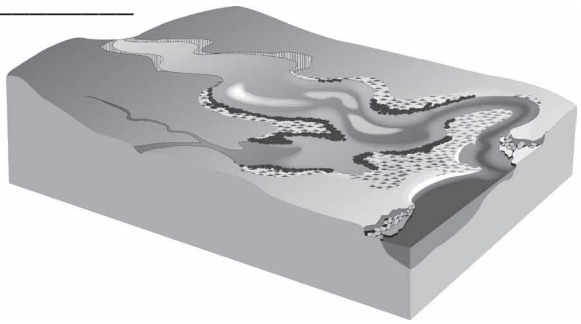
Work sheet

My estuary

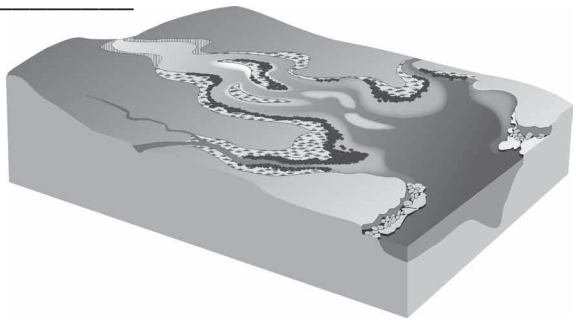
A. Types of estuaries

- From the list provided, name the estuary type represented by each block diagram: *Barrier estuary, Coastal lagoon, River estuary (tide dominated), River estuary (wave dominated).*
- Draw arrows and label the block diagrams to show the main features of each estuary type.

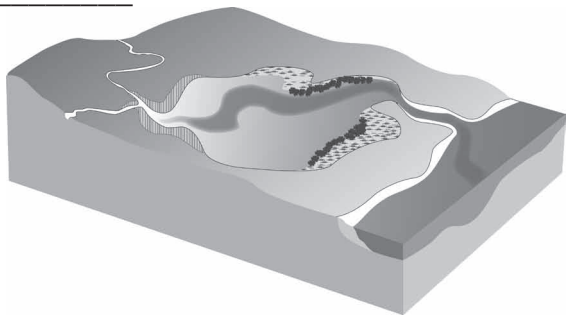
Estuary type: _____



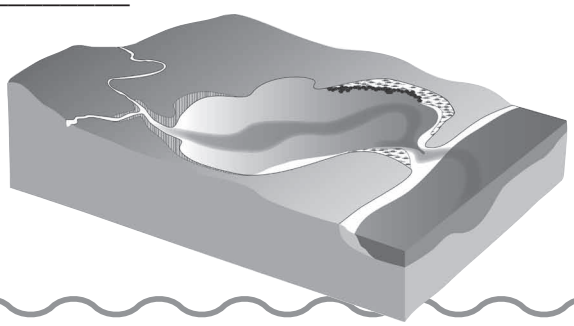
Estuary type: _____



Estuary type: _____



Estuary type: _____



B. Find your estuary by using the internet and identifying its type.

Estuary type: _____

C. Describe your estuary: Use the internet or other resources to find the following information. Your local council's website is a good place to start.

Location and area of catchment:.....

.....

Main rivers/creeks:.....

.....

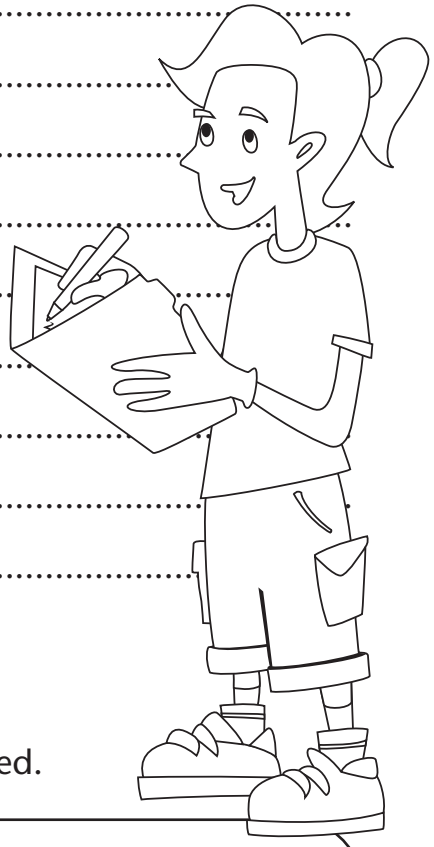
Main activities in the area: .....

.....

.....

Main towns: .....

.....



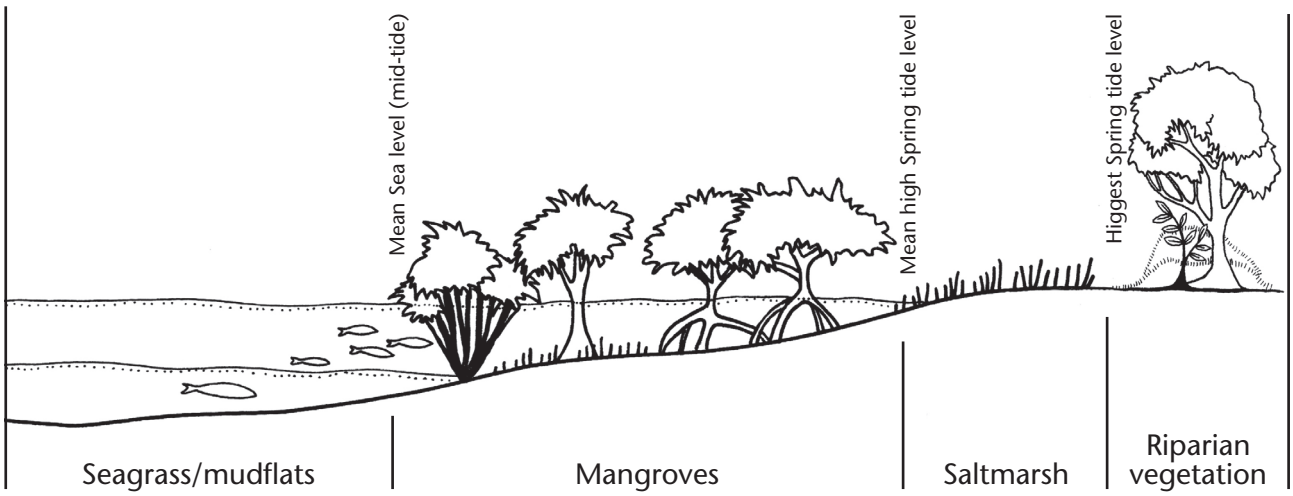
D. How my estuary was formed

Use words and pictures to show how your estuary was formed.

Work sheet

Cross-section of estuarine habitats

Name of site:_____



Tick the features present in each estuarine habitat at your site.

Mudflats and seagrass	**Mangroves**	**Saltmarsh**	**Riparian vegetation**
Plant types present: ☐ aquatic plants ☐ salt tolerant grasses ☐ trees/shrubs	Plant types present: ☐ aquatic plants ☐ salt tolerant grasses ☐ trees/shrubs	Plant types present: ☐ aquatic plants ☐ salt tolerant grasses ☐ trees/shrubs	Plant types present: ☐ aquatic plants ☐ salt tolerant grasses ☐ trees/shrubs
This area is: ☐ usually wet ☐ wet and dry ☐ wet during high tides ☐ usually dry	This area is: ☐ usually wet ☐ wet and dry ☐ wet during high tides ☐ usually dry	This area is: ☐ usually wet ☐ wet and dry ☐ wet during high tides ☐ usually dry	This area is: ☐ usually wet ☐ wet and dry ☐ wet during high tides ☐ usually dry
The soil comes mostly from: ☐ ocean – sand ☐ rivers – silt, mud ☐ both ocean and rivers	The soil comes mostly from: ☐ ocean – sand ☐ rivers – silt, mud ☐ both ocean and rivers	The soil comes mostly from: ☐ ocean – sand ☐ rivers – silt, mud ☐ both ocean and rivers	The soil comes mostly from: ☐ ocean - sand ☐ rivers – silt, mud ☐ both ocean and rivers

Work sheet

Who eats who in estuaries?

Use the saltwater detective guide in the *Waterwatch Estuary Field Manual* and information about invertebrates in estuaries to complete the table below. Tick or colour in the boxes to show who eats who and what in estuaries. An example is completed for you – barnacles feed on plankton, so the plankton box next to barnacles is coloured in.

	Seagrass	Detritus	Mangrove leaves	Plankton	Bivalves	Marine worms	Prawns	Fish	Crabs	Snails
Snails										
Whelks										
Cockles										
Mussels										
Oysters										
Razor shells										
Pipis										
Sea slugs										
Cuttle fish										
Squid										
Octopus										
Shrimp										
Prawns										
Barnacles				■						
Marine slater										
Pill bug										
Sand hopper										
Skeleton shrimp										
Crabs										
Rag worms										
Flat worms										
Tube worms										
Ribbon worms										
Pipe fish										
Sea dragons										
Other fish										
Green turtles										
Shore birds										
Pelicans										
Cormorants										
Spoonbills										
Black swans										
*										

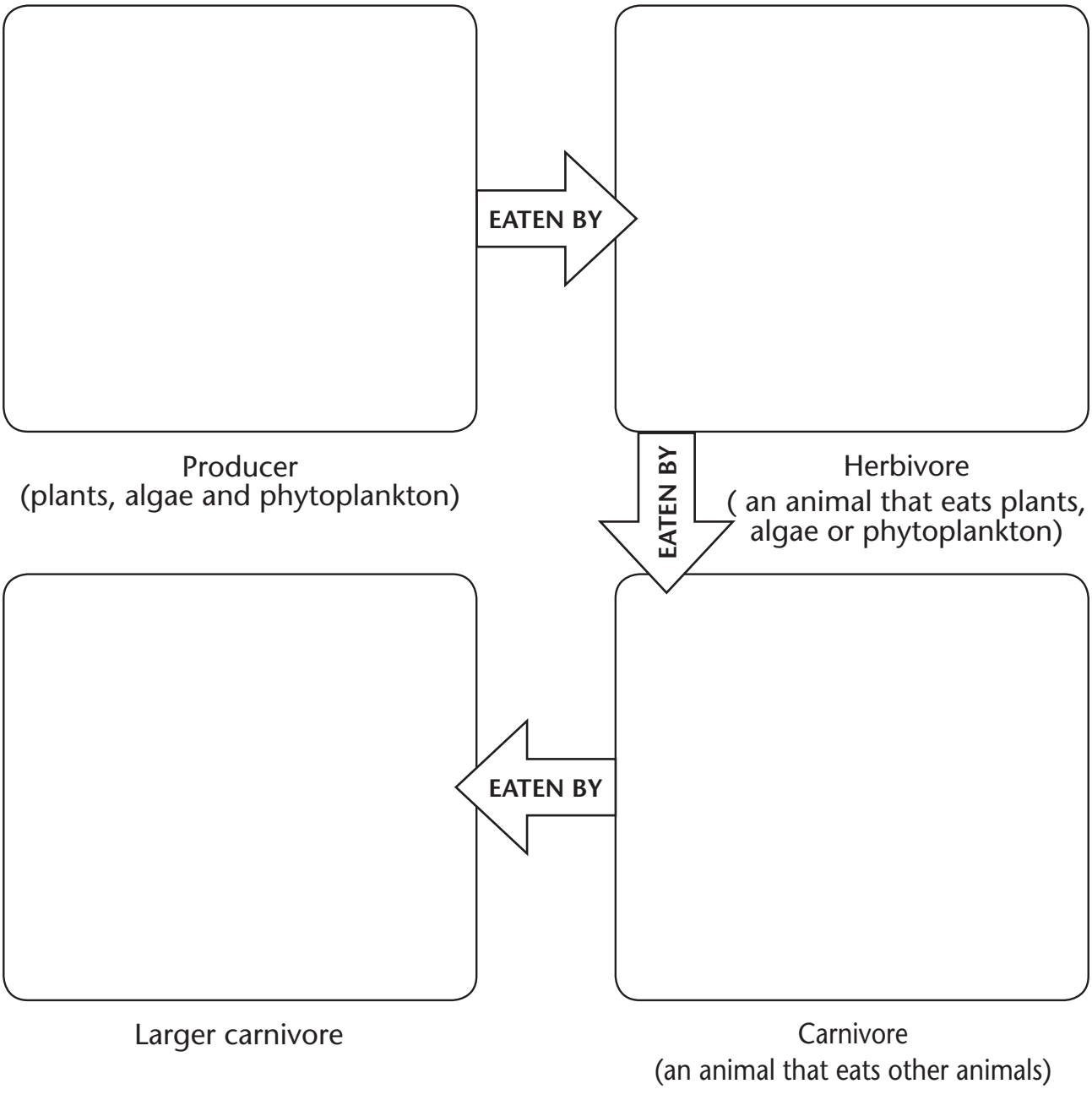
*Add additional species found in your estuary.

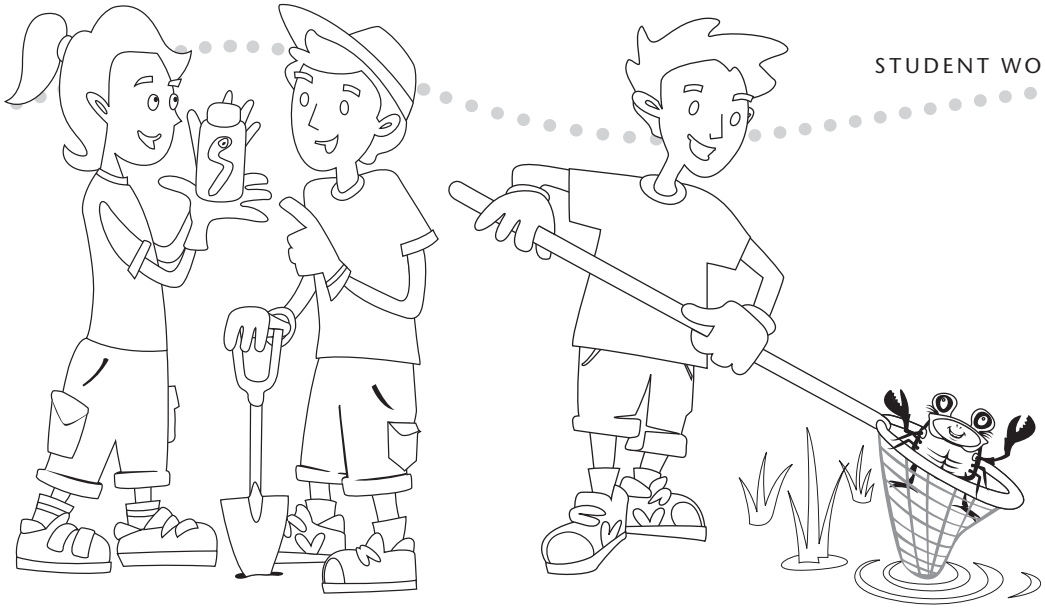
Work sheet

Estuary food chains (junior)

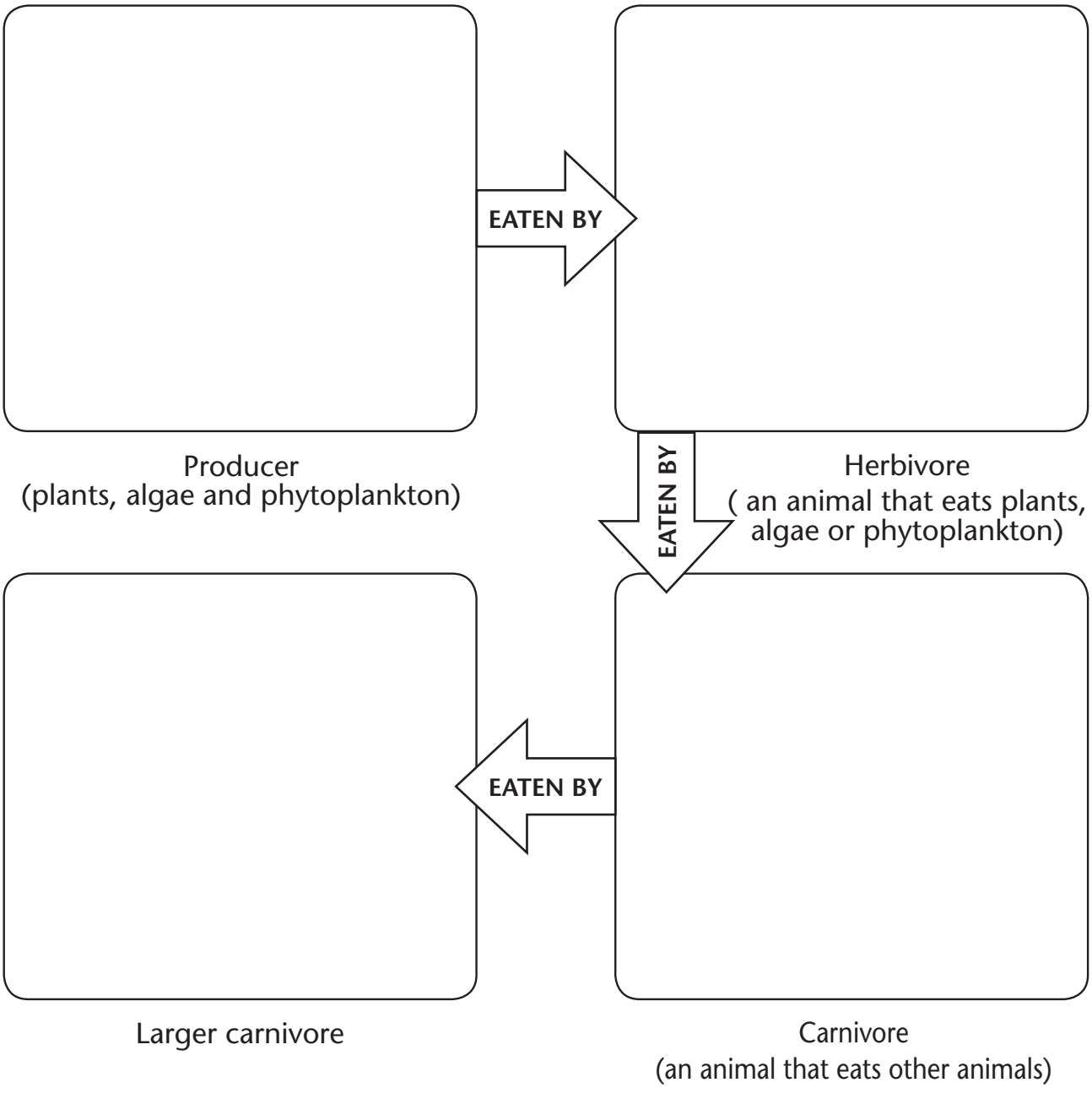
Choose two habitat types in your estuary. Select a small animal that lives in each. Complete the exercise below to show where each animal lives and how it fits into the food chain.

1. Habitat type: _____





2. Habitat type: _____

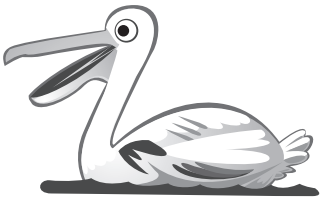


Work sheet

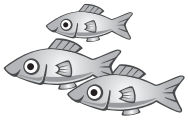
Mangrove food chains (senior)

Below is an example of organisms that live within a mangrove ecosystem. Draw arrows to show the feeding relationships.

Mangroves



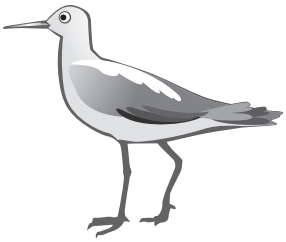
Pelican



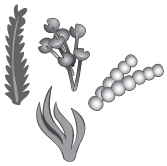
Small fish

Molluscs

Leaf litter

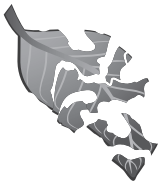


Shore birds

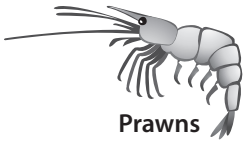


Algae
bacteria
fungi

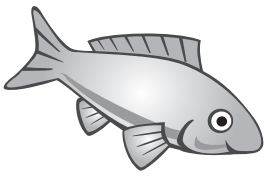
Crabs



Decomposition

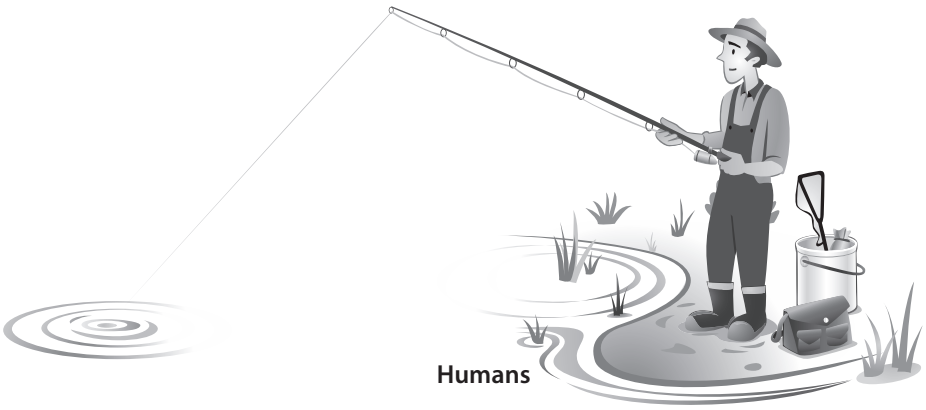


Prawns



Big fish

Detritus



Humans

Food Chains (senior)

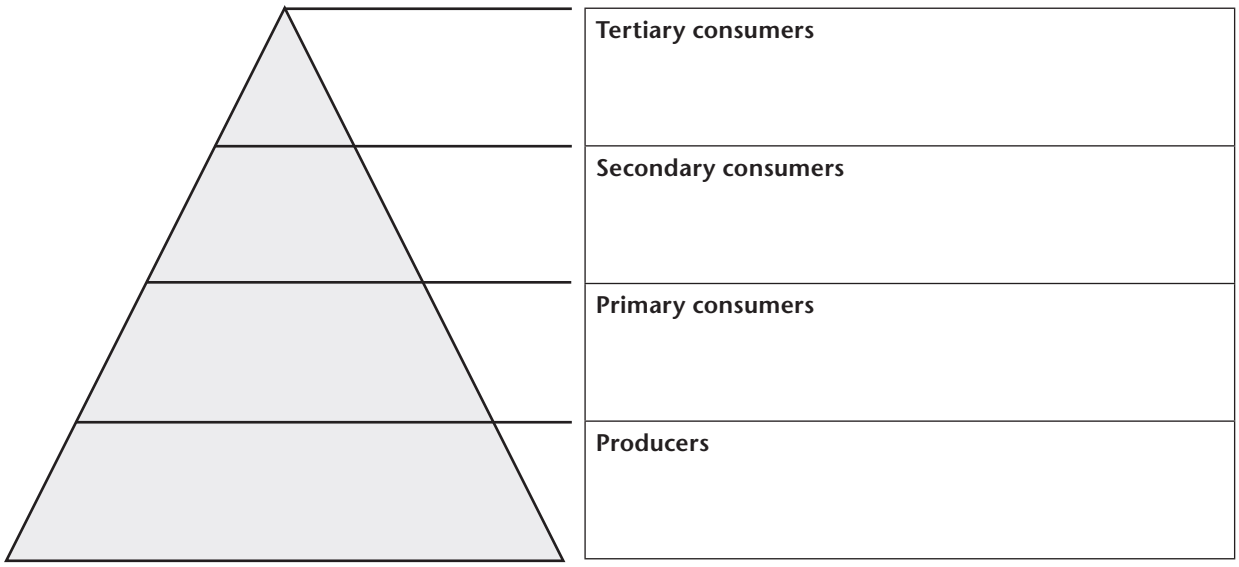
Predator/prey relationships

Refer to the fact sheet entitled "Trophic interactions". In the table below show the predator/prey relationships within an estuary by adding examples from an estuary food chain.

Predator	Prey (eaten by predator)
Shore birds	cockles

Biomass Pyramids

Write the names of organisms at each level of the biomass pyramid.



Work sheet

Animal life in the estuary

Select an animal that lives in one habitat in the estuary and fill in the boxes below:

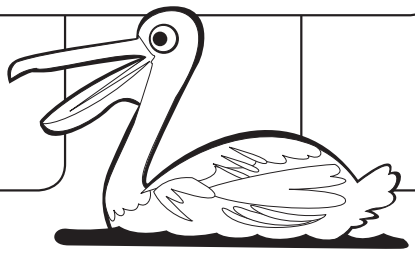
Lives in:

Eats:

The animal is:

Eaten by:

Adapted to life by:



Lives in:

Eats:

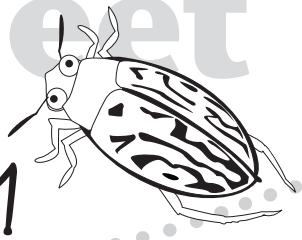
The animal is:

Eaten by:

Adapted to life by:

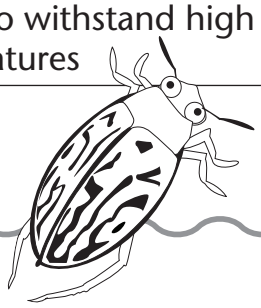
Work sheet

A bugs life in the estuary



How are animals adapted to life in the estuary? Name an animal with each adaptation described.

Adaptation	Animal	Why is this adaptation useful?
Attaches to objects by suction cups		
Breathes through a siphon		
Conical or rounded shell		
Filter feeding device		
File-like tooth (radula)		
Has eyes on its back		
Flat jointed exoskeleton		
Poisonous hooks		
Tentacles		
Rows of tube feet		
Larvae that spend part of their life in plankton		
Jointed legs adapted for swimming		
Eyes on stalks		
Can change body colour		
Moves by jet propulsion		
Soft, coiled abdomen usually hidden inside a discarded shell		
Squirts blue ink		
Ability to withstand high temperatures		



Work sheet

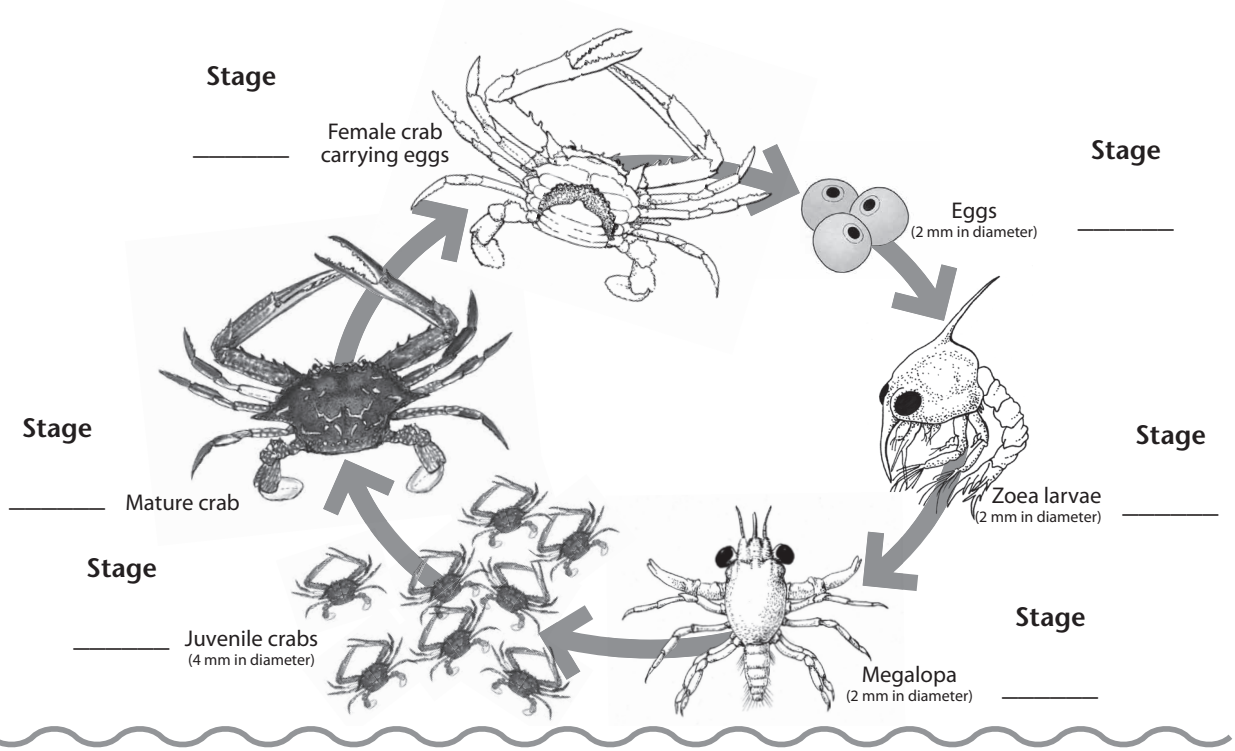
Life cycle of a mud crab

Name: _____Date:_____

Number the stages below in order according to the life cycle and match the information about each stage of the life cycle to these pictures.

Life cycle stages

Stage	Stage	Stage	Stage	Stage	Stage
_____	_____	_____	_____	_____	_____
The male crab mates with the female crab at the time of moulting. The sperm is stored by the crab until the eggs are ready to be fertilised.	After the 5th moult the larval crab changes into a megalopa with large claws. The larvae move inshore and they moult into tiny crabs about 4 mm wide.	About 12 days after spawning the eggs hatch, releasing the crab larvae called zoea. The crabs moult 4 times over the next 12–15 days.	Female crabs consume little food when carrying eggs. It is believed that hatching takes place offshore where salinity is stable and food is abundant.	The crabs mature in 2 years and make burrows in the nursery areas to find a mate and start the cycle again. The lifespan of a mud crab is about 3–4 years.	The crabs grow quickly and moult each time their shells are replaced. The crabs can reach a width of 100 mm within a year.



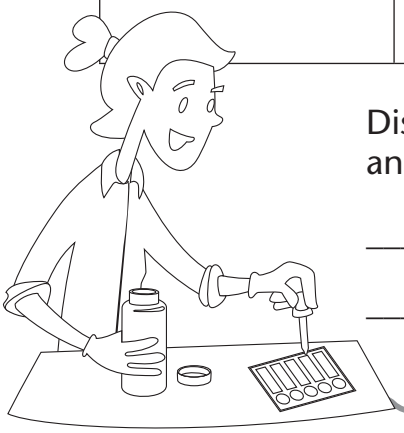
Work sheet

Water quality and habitats

1. Name a site/location/habitat type in an estuary _____

2. Complete the table below to predict the impact of water quality changes on plants and animals. (an example has been provided in the table).

Water quality test	Level goes up (What happens to animals and plants?)	Level goes down (What happens to animals and plants?)
pH		
Turbidity		
Temperature		
Salinity (EC)	Estuarine species may be reduced in number and diversity as salt levels rise. Marine species may increase due to their greater tolerance of higher salinity levels.	



Discuss the possible impacts of climate change on water levels and plants and animals at your site.

_____

_____

Work sheet

Conduct an experiment

Estuary investigations

Where freshwater and saltwater meet

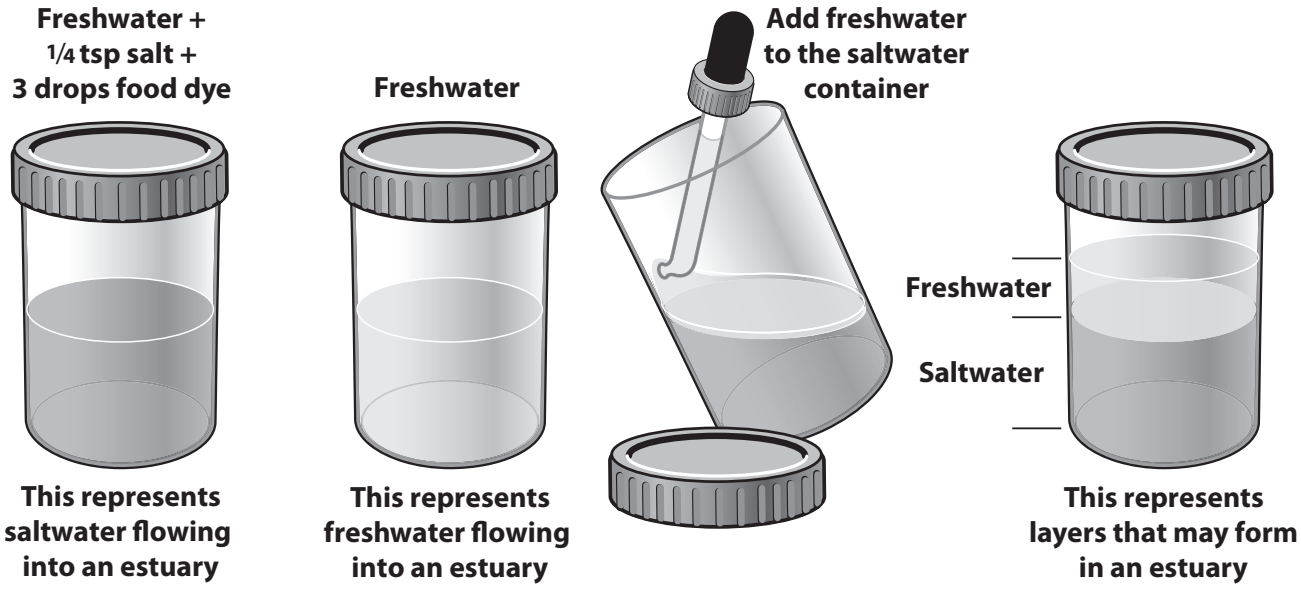
Aim: To determine how freshwater and saltwater meet and mix in an estuary

Materials required

Two small clear screw top containers, food colouring, salt, ¼ teaspoon measuring spoon, dropper or pipette.

Method

1. Half fill a small clear screw top container with freshwater.
2. Add ¼ teaspoon of salt and three drops of food colouring to the container. Put the top on the container and shake to mix well. (This represents saltwater flowing into an estuary).
3. Fill another small clear screw top container with freshwater. (This represents freshwater flowing into an estuary).
4. Fill a dropper with freshwater from the container.
5. Unscrew the cap from the container of saltwater and tilt the container at an angle.
6. Hold the dropper so the open end touches the inside of the container and squeeze the dropper very slowly and carefully. Let the freshwater trickle down the inside of the container into the saltwater. Do not shake or move the container when you are adding freshwater.
7. Continue adding freshwater until you have about a 2 cm layer on top of the saltwater. Allow the water in the container to sit for a few minutes.
8. Put the top on the container and shake. Observe what happens.



Observations and Discussion

1. What happened when freshwater was added to saltwater in the experiment? Explain why. Hint: mention layers and water density

_____

_____

2. What happened when the container was shaken? Explain why. Hint: mention salinity (shown by colour) and layers

_____

_____

3. Compare this experiment to what happens in an estuary:

(a) Source of freshwater in an estuary _____

(b) Source of saltwater in an estuary _____

(c) How does the mixing of freshwater and saltwater occur in an estuary?

_____

_____

(d) What factors would contribute to changes in salinity with changes in water depth?

_____

_____

(e) What impact would salinity levels have on plants and animals within an estuary?

_____

_____

Work sheet

Human impact in estuaries discussion

Would it make a difference?

Human activity can impact on plant and animal life in estuaries. Do changes in estuaries make a difference? Read each of the following questions and comment on the changes.

1. What would happen if part of a food chain disappeared? (Hint: What species would increase and what would decrease?)
2. What would happen if the water in estuaries became polluted and the seagrass died?
3. What would happen if mangroves were cut down to provide a better view for waterfront houses?
4. What would happen if saltwater marshes were filled with soil to make new land for houses and industry?
5. What would happen if boats could anchor and go at top speeds over seagrass beds?
6. What would happen if there were no bag limits for estuary species?

Pick one of these questions and draw and label a **before** and **after** picture to show what would happen. What could be done to solve the problem?

Work sheet

Seagrass friendly moorings

Keeping seagrass safe: seagrass friendly moorings

Research task

1. Cut out pictures from boating magazines or catalogues, or find pictures on the internet of current methods of anchoring boats.

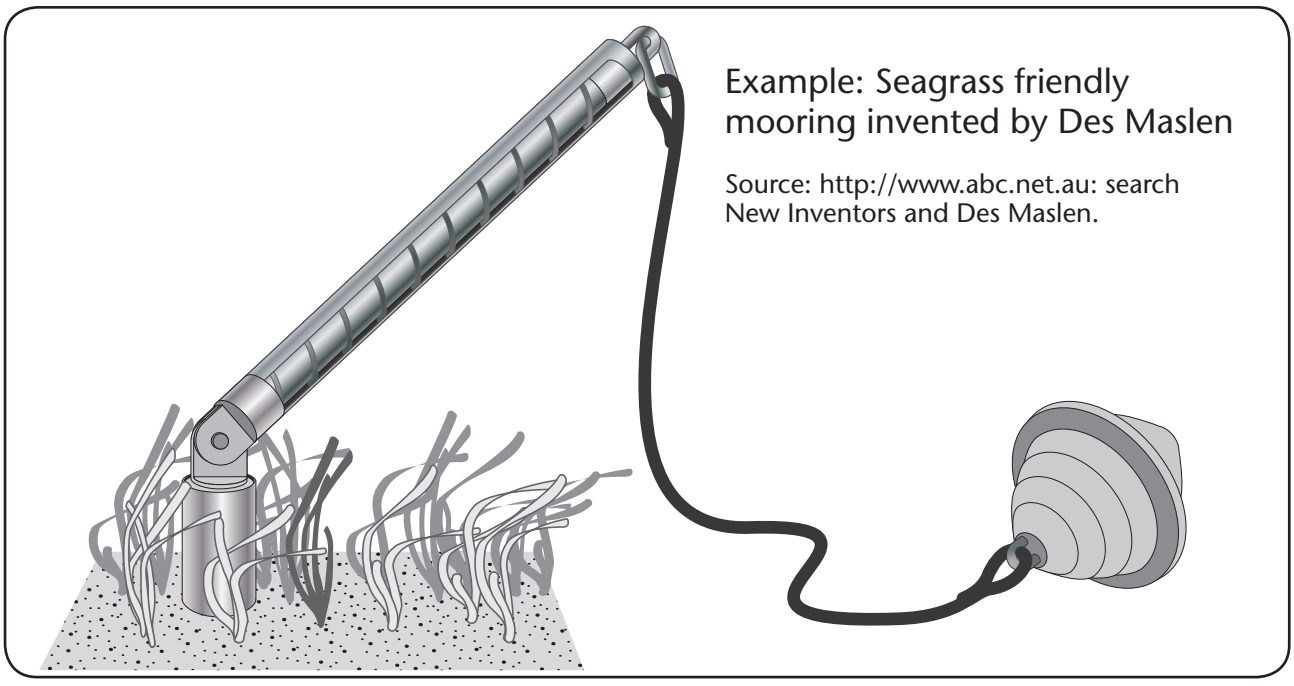
2. Assess the suitability of different anchoring designs for sensitive habitats like seagrass beds or reefs.

3. Review a new invention designed to reduce the impact of anchors on seagrass beds. Visit the ABC website http://www.abc.net.au and search New Inventors and Des Maslen to review one seagrass friendly mooring.

Design your own invention

1. Use everyday objects from your home, garden or classroom to design and make a model of a seagrass friendly anchoring.

2. Present your model to the class and explain how it will reduce the impact of boat anchoring on sensitive coastal habitats.



Example: Seagrass friendly mooring invented by Des Maslen

Source: http://www.abc.net.au: search New Inventors and Des Maslen.

Work sheet

Human use of estuaries

Human activity can impact on the health of an estuary. Tick the boxes below to identify the human activities at your estuary.

Towns, new housing developments	☐	Forestry	☐
Fishing	☐	Rock walls	☐
Agriculture	☐	Flood control structures	☐
Forestry	☐	Power stations	☐
Shipping	☐	Oyster farms	☐
Boating	☐	Prawn farms	☐
Mining	☐	Tourist developments	☐
Dredging	☐	Pest control	☐
Reclamation	☐	Dams	☐

Discussion

In what ways can human activity affect your estuary? (Include helpful and harmful.)

How can you protect the estuary from human use?

_____

_____

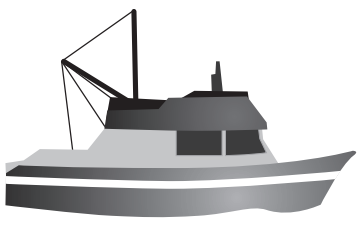
_____

Work sheet

Human impacts at your estuary

Helpful or harmful

People make changes to estuaries and streams. Write or draw pictures of the helpful and harmful things you can see at your site.

Helpful things		Harmful things
		
		
		
		

Work sheet

Investigations at your site

Planning and reporting work sheet for investigations at your site

Student name _____ Year/grade _____

Other members of your group _____

_____ , _____

_____ , _____

Planning

What are you going to investigate ? _____

_____

_____

_____

What do you think will happen? _____

_____

_____

_____

Why do you think this will happen? _____

_____

_____

_____

Experimenting

What are you going to do? _____

_____

_____

_____

What equipment will you need? _____

_____

_____

_____

How can you make this a fair test? _____

_____

_____

_____

Recording and analysing your results

What happened? Describe your observations and record your results. _____

_____

_____

_____

Can your results be presented as a graph?

What do your results tell you? Are there any relationships, patterns or trends in your results?

_____

_____

_____

Can you explain the relationships, patterns or trends in your results?

_____

_____

_____

What did you find out about the problem you investigated? Was the outcome different from your prediction? Explain.

_____

_____

_____

Evaluation

What difficulties did you experience in doing this investigation?

_____

_____

_____

How could you improve this investigation e.g. fairness, accuracy?

_____

_____

_____

Adapted from worksheets developed by Mark W Hackling, Edith Cowan University, used with permission.

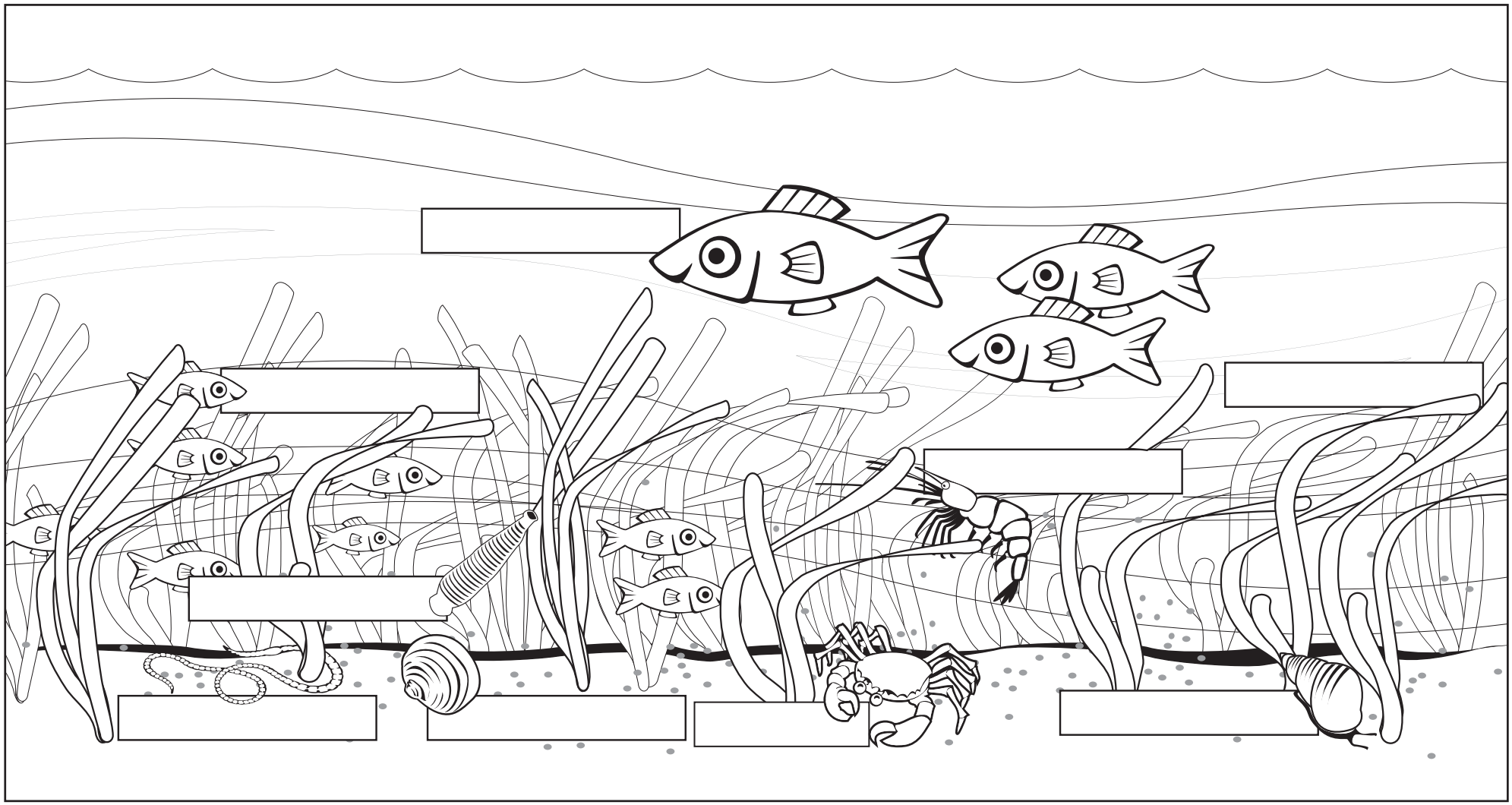
Work Sheet

Estuarine habitat

Read the fact sheet entitled estuarine habitats.

In the space provided name the estuarine habitat and colour in the drawing. Write the name of one species found in this habitat in each box provided.

Habitat:_____



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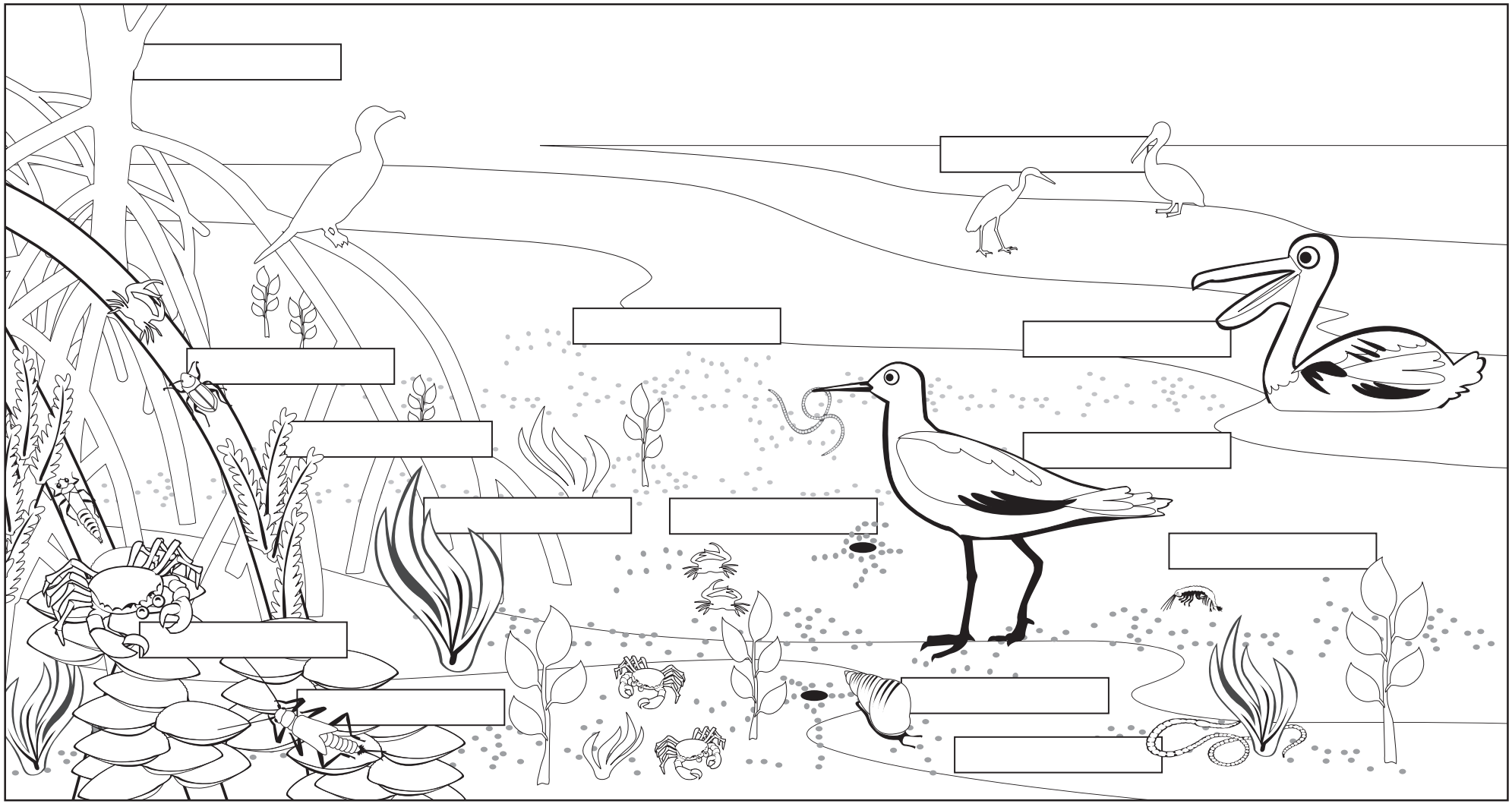

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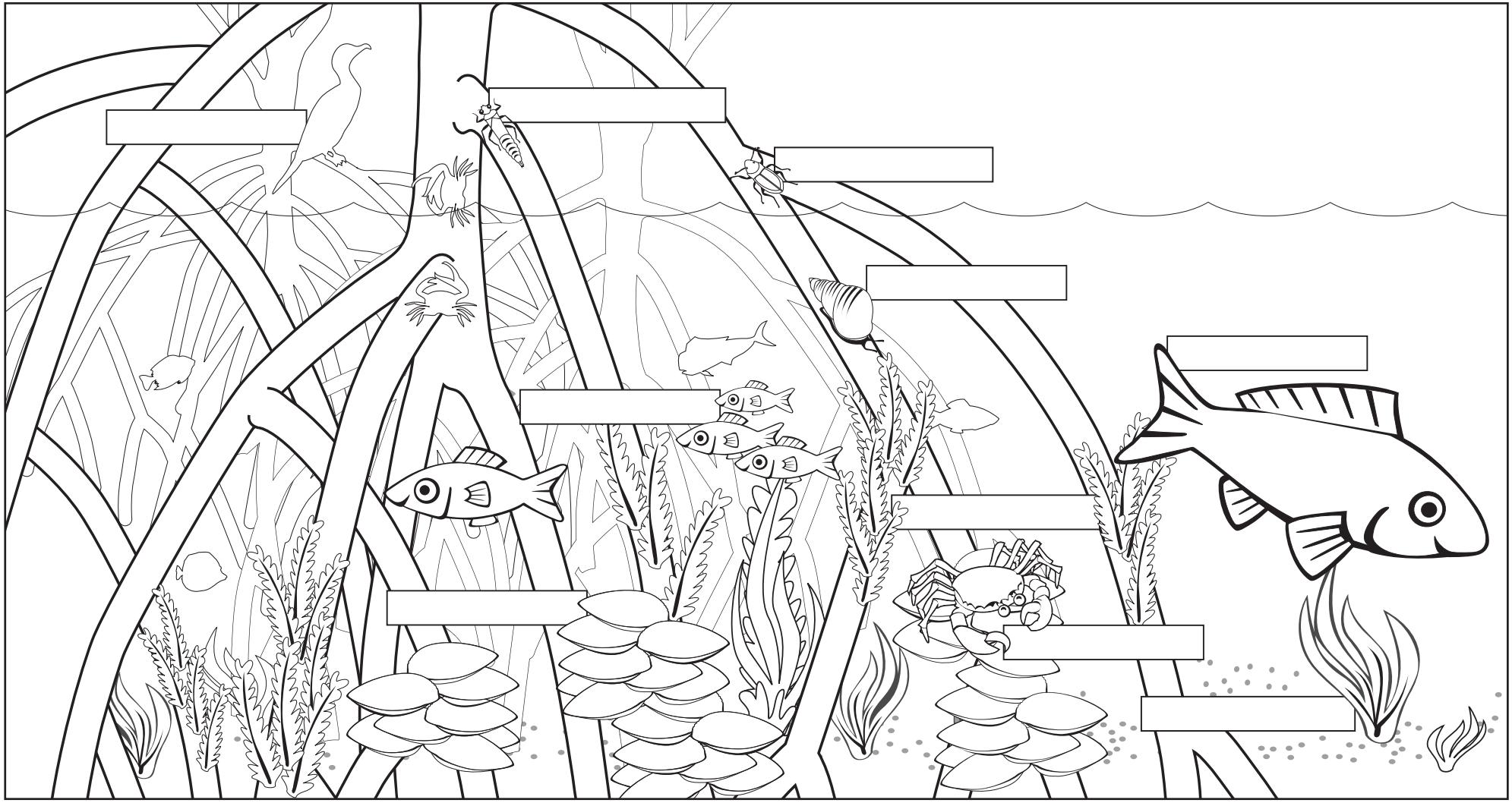

Work Sheet

Estuarine habitats

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Habitat: _____