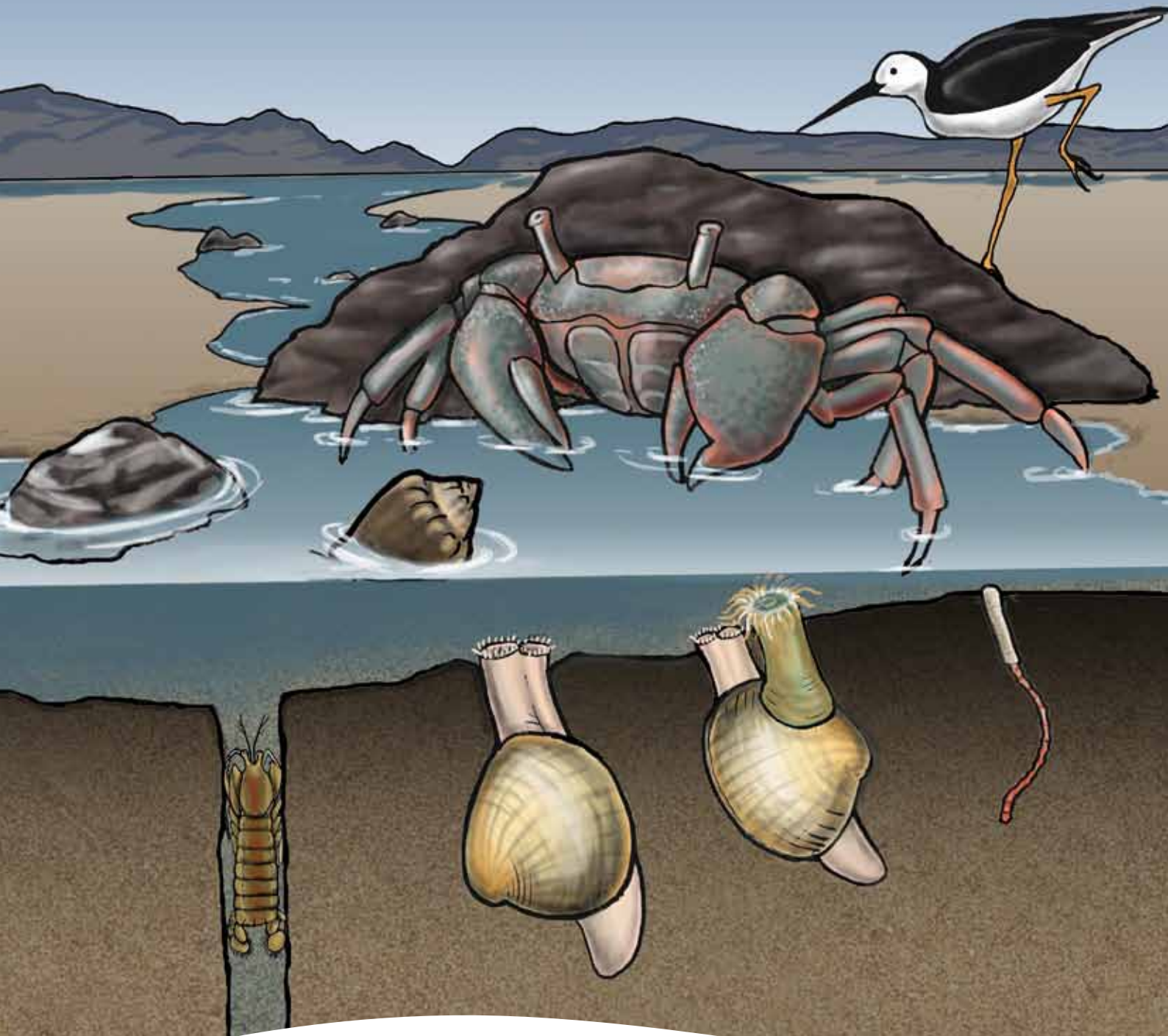


MUDFLAT MYSTERIES

AN EDUCATIONAL ACTIVITY BOOK



MUDFLAT MYSTERIES

This educational activity book was designed by staff at the New Zealand Marine Studies Centre and illustrated by Melissa Snider and Tessa Mills.

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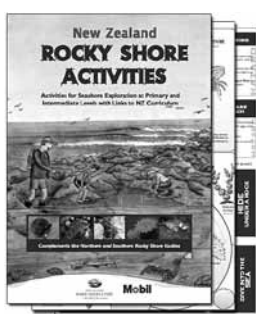
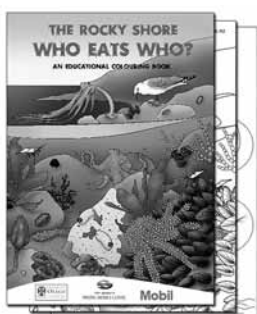
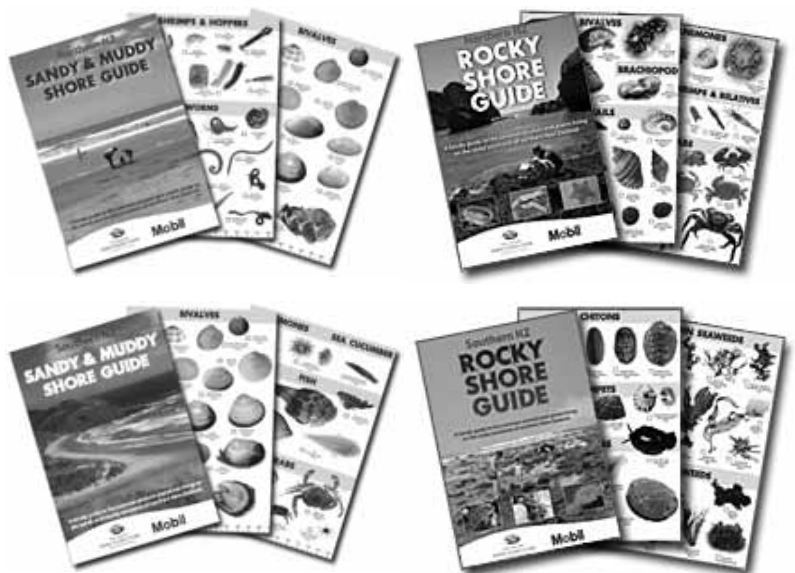
Information for Teachers and Parents. This educational activity book features the animals and plants found between the tides on New Zealand's muddy shores. The illustrations show where the creatures live and what signs can be seen on the shore to indicate what lives below the surface. They give indications of the diet, feeding strategies and adaptations to find and capture food and avoid predators. Children should be encouraged to interpret what is shown in the scenes and to answer the questions posed on each page. Further information about a selection of the creatures can be found at the back of this book. Carrying out your own shore survey will show what creatures are living on your own local shore (see www.mm2.net.nz for instructions). Further discussion topics include factors that could alter the environment these creatures live in, and affect their ability to find or catch food. Children could then make a poster to illustrate their ideas of what they could do to look after our unique environment.

The illustrations in this book may be copied for educational purposes.

Mobil Oil New Zealand Limited provides funds for community projects in areas where it operates and has been supporting the New Zealand Marine Studies Centre to develop and promote marine education resources since 2008. Mobil has supported a range of seashore publications, including Northern and Southern New Zealand Sandy and Muddy Shore Guides, Rocky Shore Guides, The Rocky Shore Activities Book, The Rocky Shore Who Eats Who Educational Colouring Book, and now the Mudflat Mysteries Educational Activity Book. These are also available in Māori.

These publications can be downloaded, free of charge, from www.marine.ac.nz

Further information about Mobil's operations and community programmes is available at www.mobil.co.nz



The New Zealand Marine Studies Centre, part of the University of Otago's Department of Marine Science, showcases marine life from southern NZ waters and provides expert knowledge and education about New Zealand's marine environment. The educational programmes involve students in the excitement of scientific discovery, help them develop knowledge and skills, and encourage individuals to take responsibility and action for the future of our ocean resource. Contact the NZ Marine Studies Centre for further information about the range of educational programmes and resources available for schools and interest groups.

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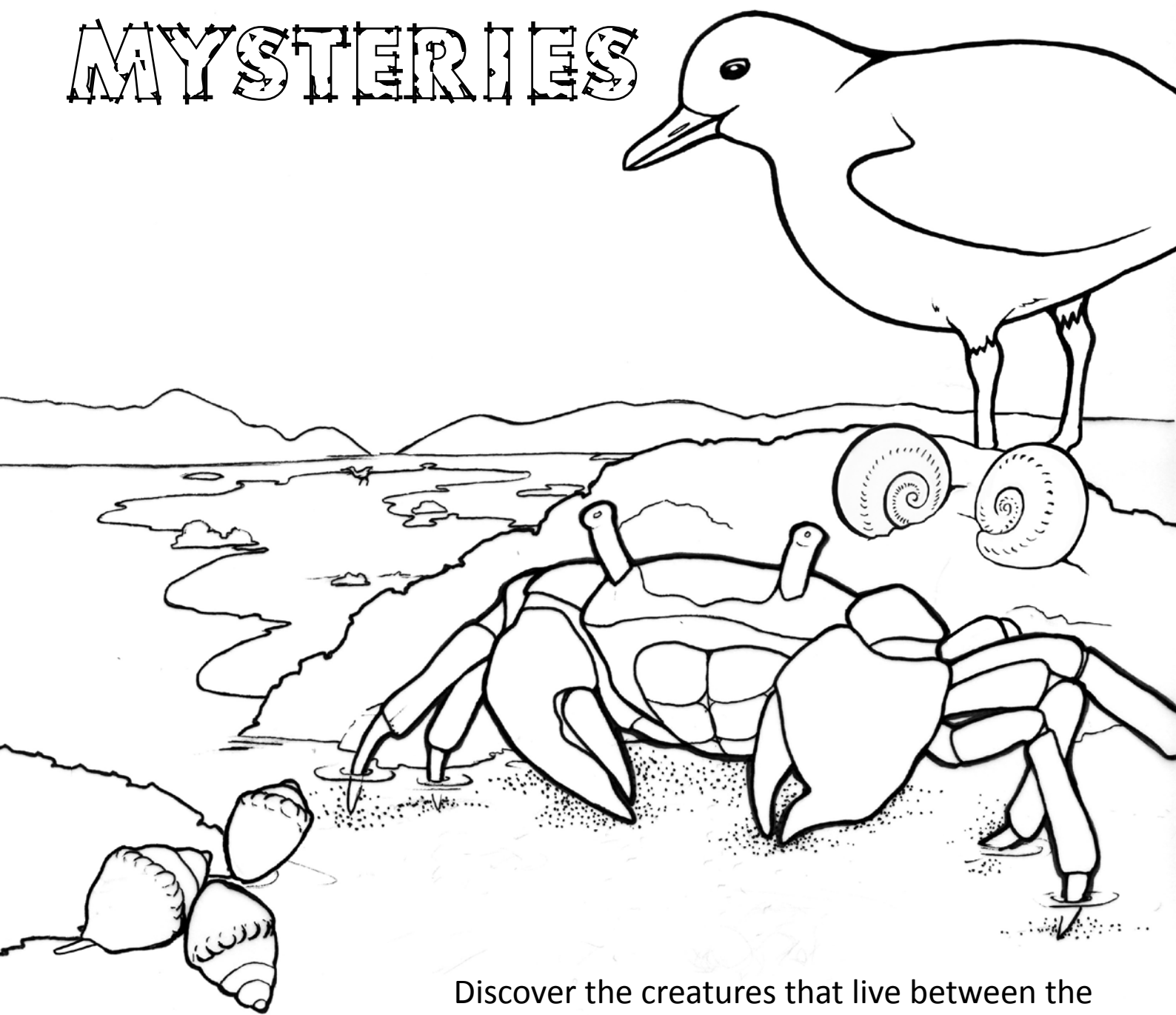
New Zealand Marine Studies Centre

Call (03) 479 5826

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Visit www.marine.ac.nz

MUDFLAT MYSTERIES



Discover the creatures that live between the tides on the muddy shores of New Zealand.

Gather clues about what lives on and beneath the surface. Find out what these creatures eat, how they catch their food and avoid predators.

To learn more, try the activities and colour in the pictures.

www.marine.ac.nz

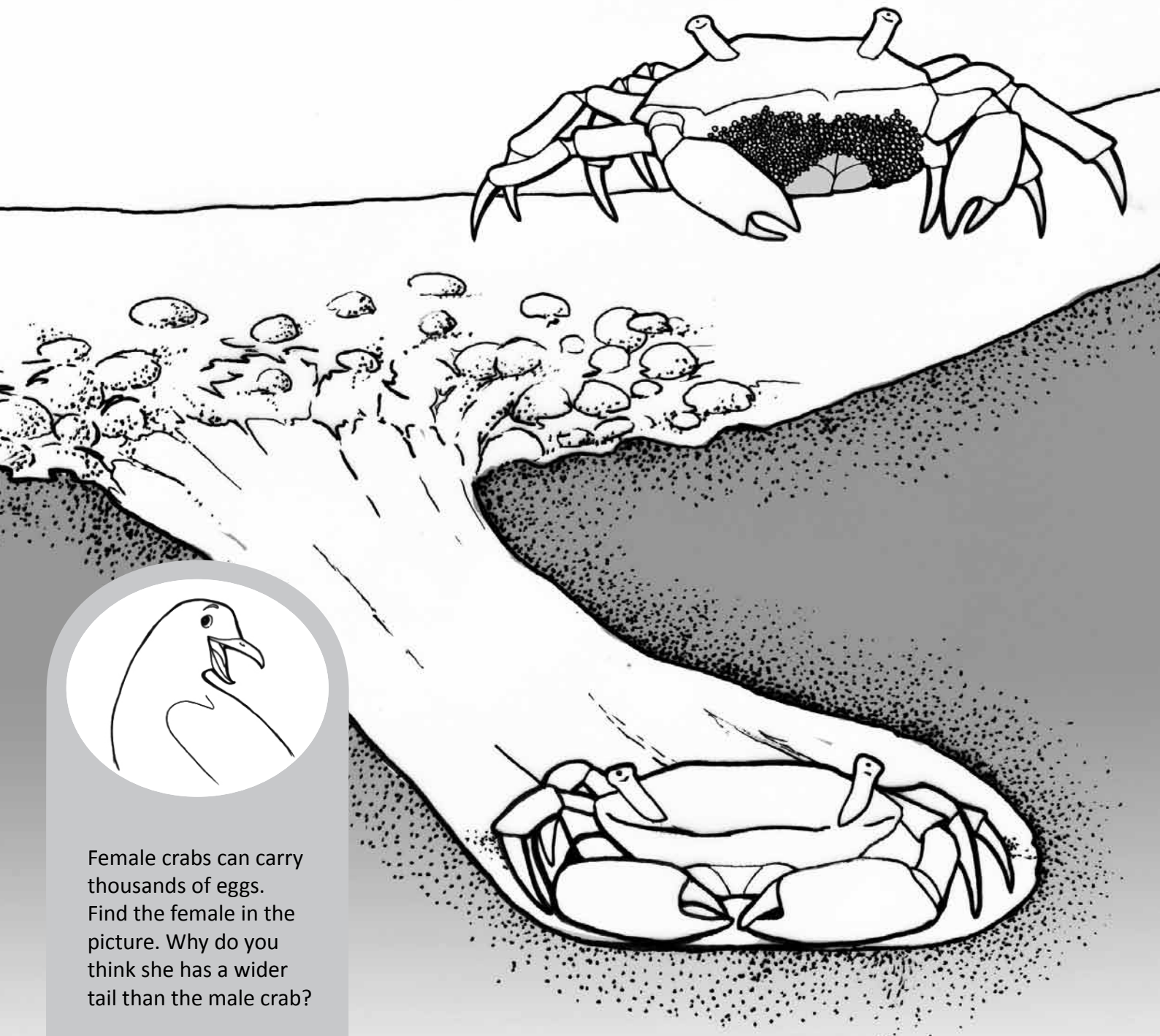
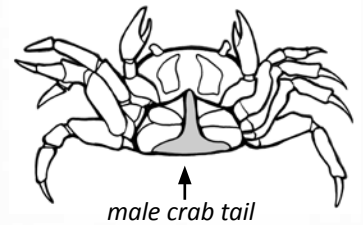
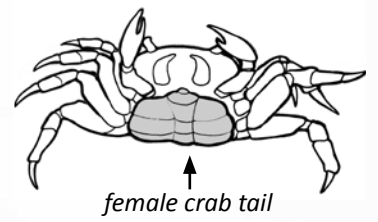


Hi! I'm Ruby, the Red-Billed Gull. Help me solve the mysteries of the mudflat.

CRABBY BEHAVIOUR

Look for crab burrows on the mudflat. The entrances are surrounded by pellets of sand and mud that the crabs have dug out to make their homes.

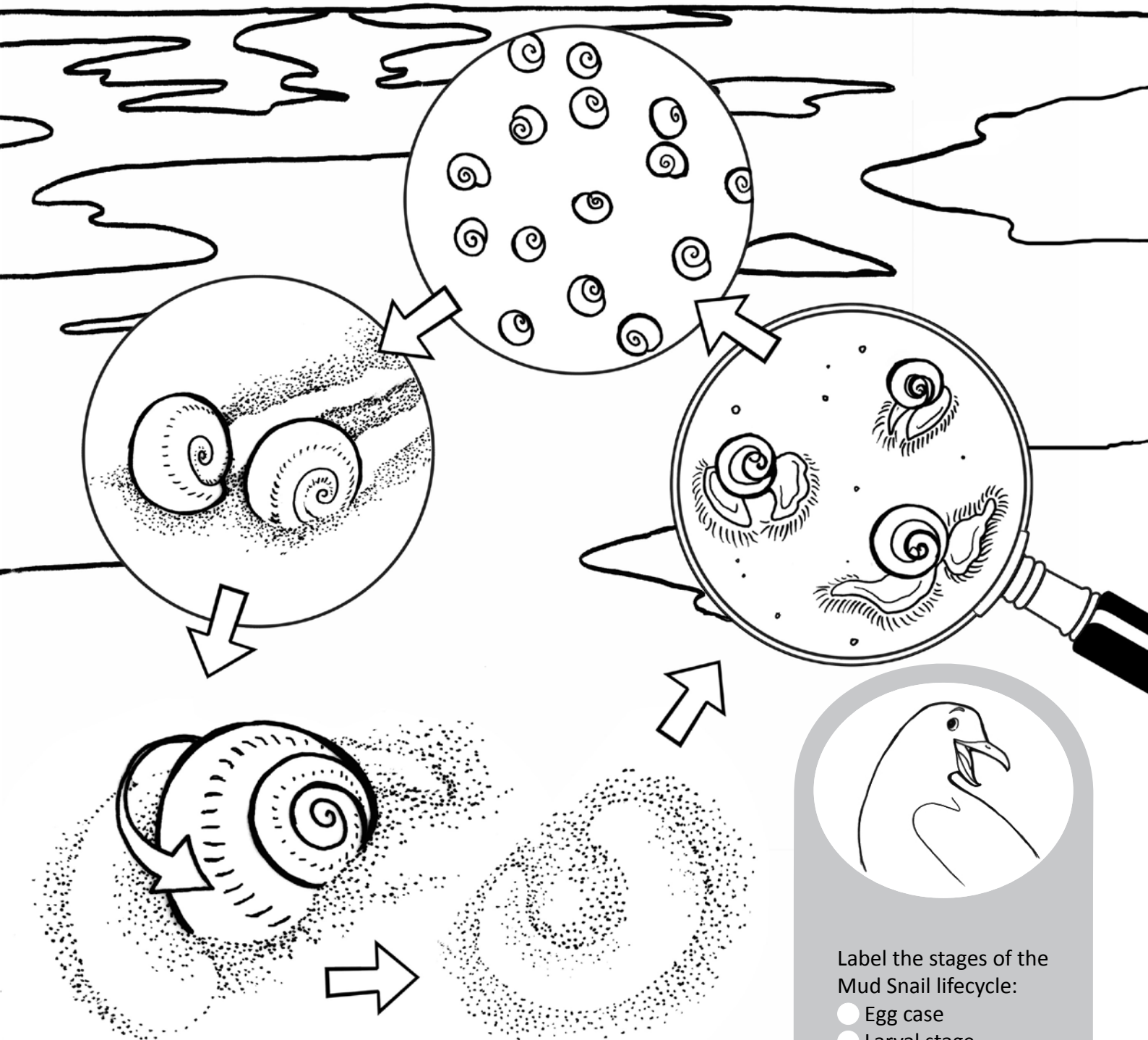
Crabs use these burrows to hide from predators and to stay damp and cool when the tide goes out.



Female crabs can carry thousands of eggs. Find the female in the picture. Why do you think she has a wider tail than the male crab?

SUMMER SAND COLLARS

Look for the egg case of the Mud Snail. The snail turns as she releases thousands of eggs, creating a collar-shaped case in the sand. These hatch into free-swimming larvae before growing into juvenile snails that live in the mud.

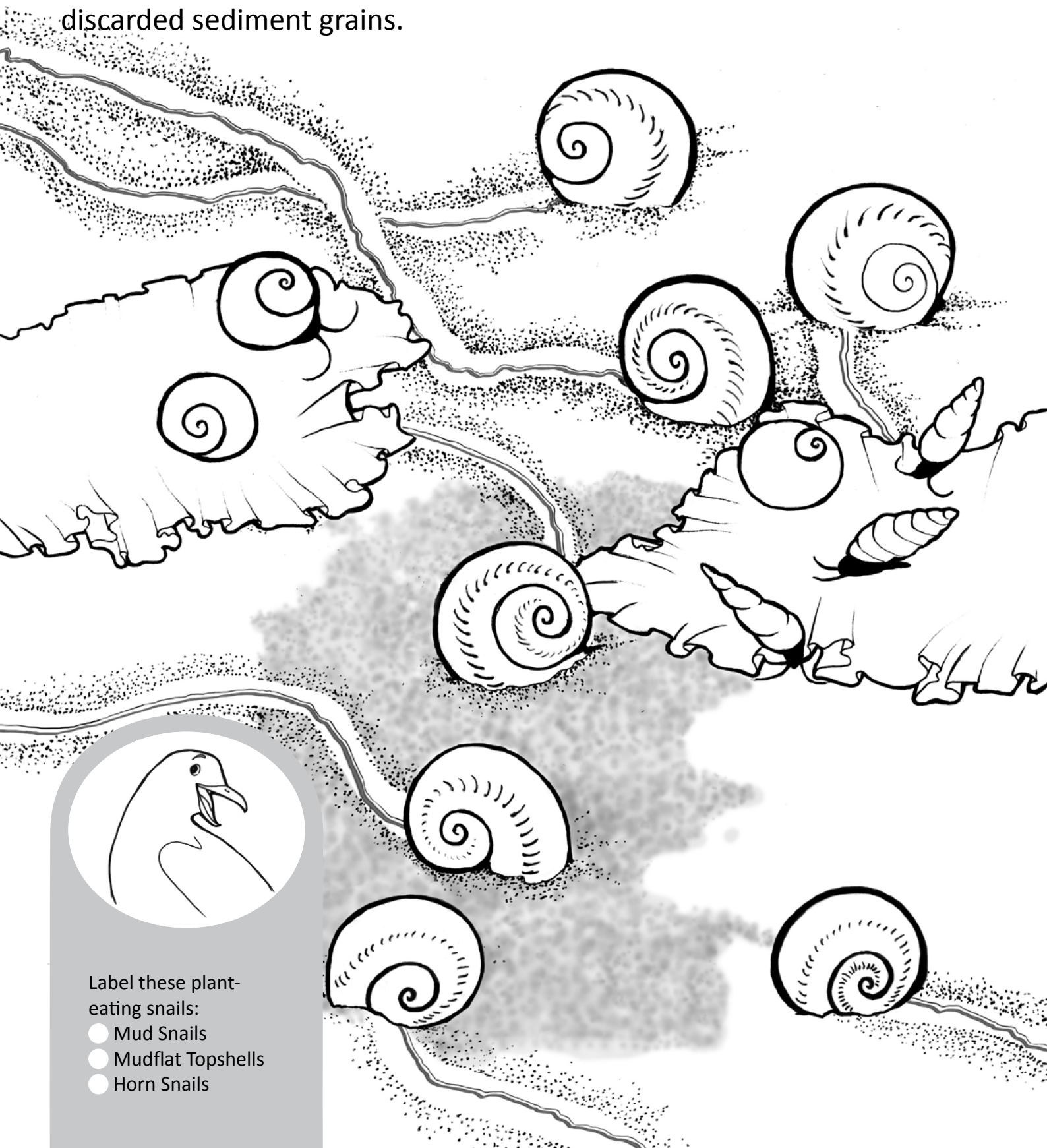


Label the stages of the Mud Snail lifecycle:

- Egg case
- Larval stage
- Juvenile snails
- Adult snails
- Adult laying eggs

TRAILS OF POO

Look for evidence of where Mud Snails have been feeding. They eat diatoms (microscopic plants) found in the surface mud and leave a poo trail of discarded sediment grains.

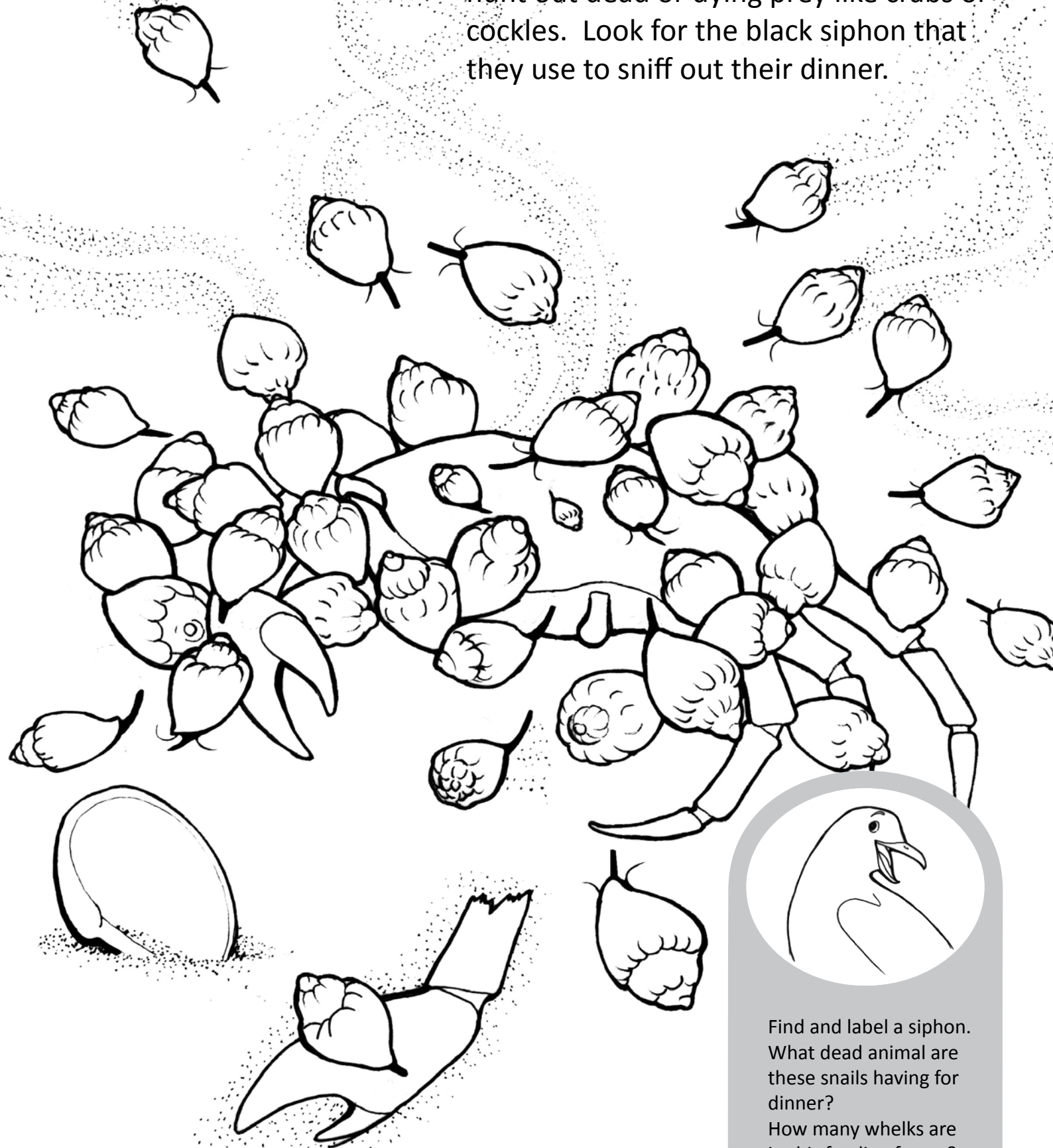


Label these plant-eating snails:

- Mud Snails
- Mudflat Topshells
- Horn Snails

FEEDING FRENZY

Mudflat Whelks are scavengers and will hunt out dead or dying prey like crabs or cockles. Look for the black siphon that they use to sniff out their dinner.

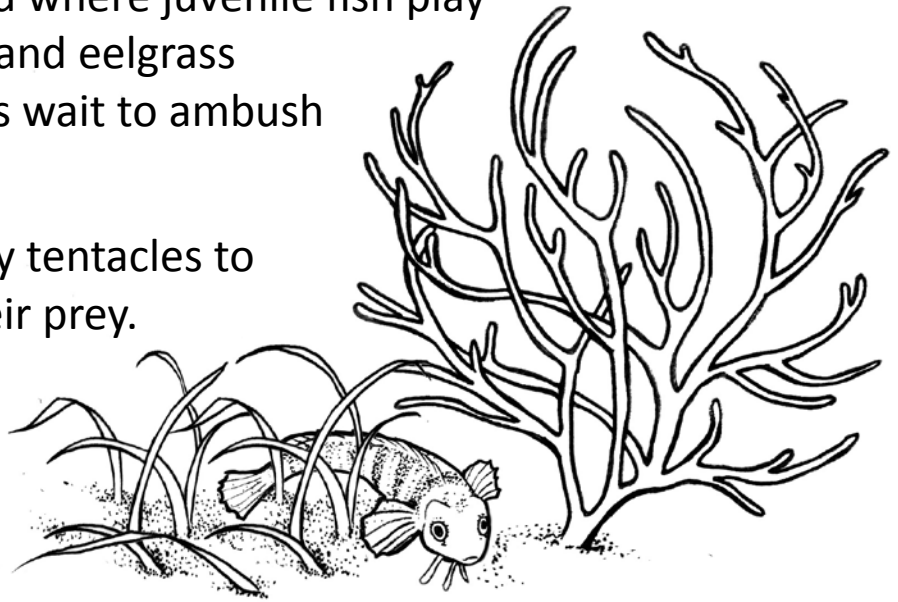


Find and label a siphon.
What dead animal are these snails having for dinner?
How many whelks are in this feeding frenzy?

AMBUSH PREDATORS

Mudflats are a playground where juvenile fish play hide and seek. Seaweed and eelgrass provide cover as Triplefins wait to ambush their food.

Anemones use their sticky tentacles to harpoon and paralyse their prey.

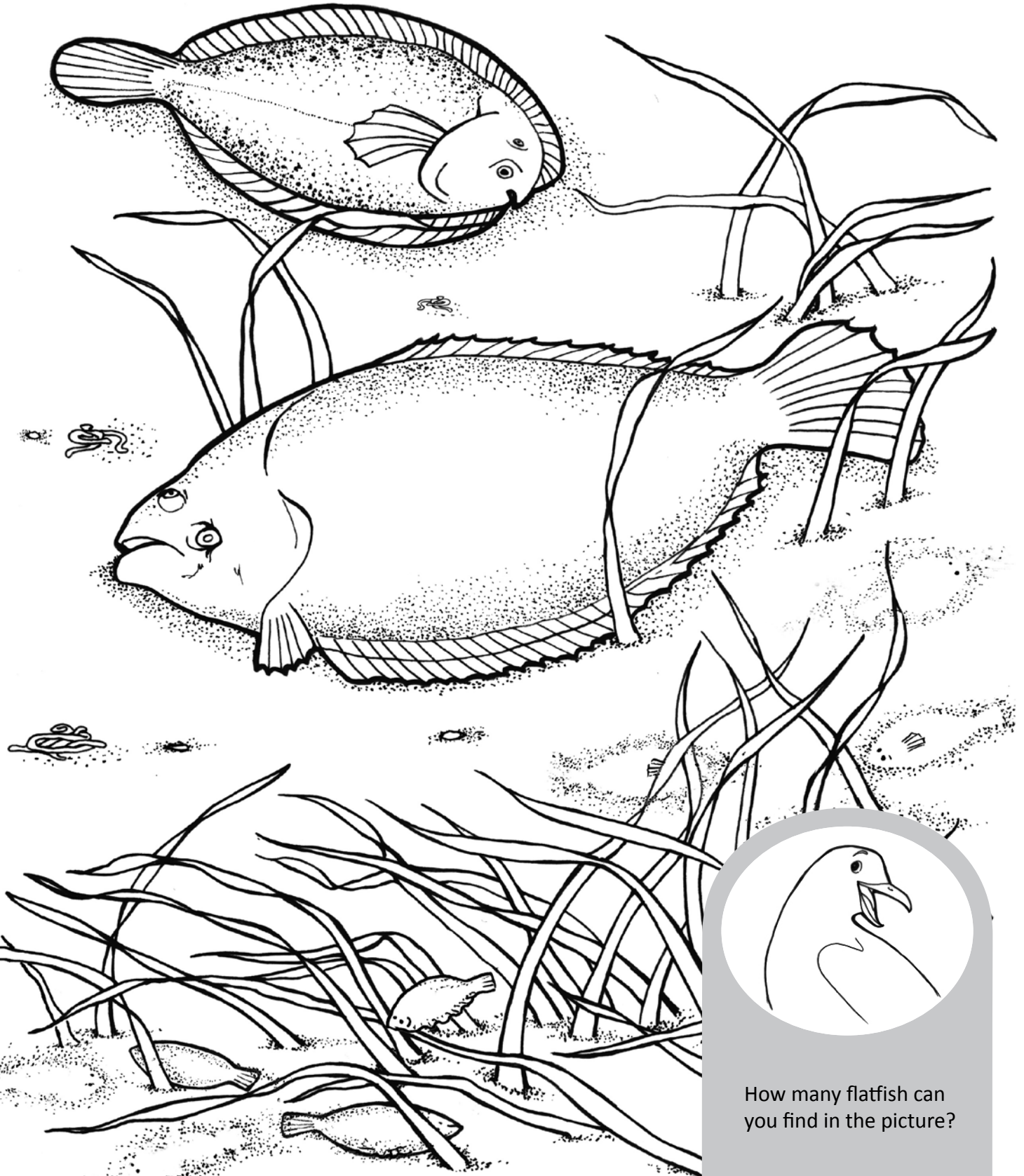


Label the animals and plants in the picture. How did the Stargazer get its name?

Stargazers bury themselves in the mud to hide. Only their eyes and mouth are visible as they lie in wait to pounce on unsuspecting worms and small crustaceans.

HIDDEN GEMS

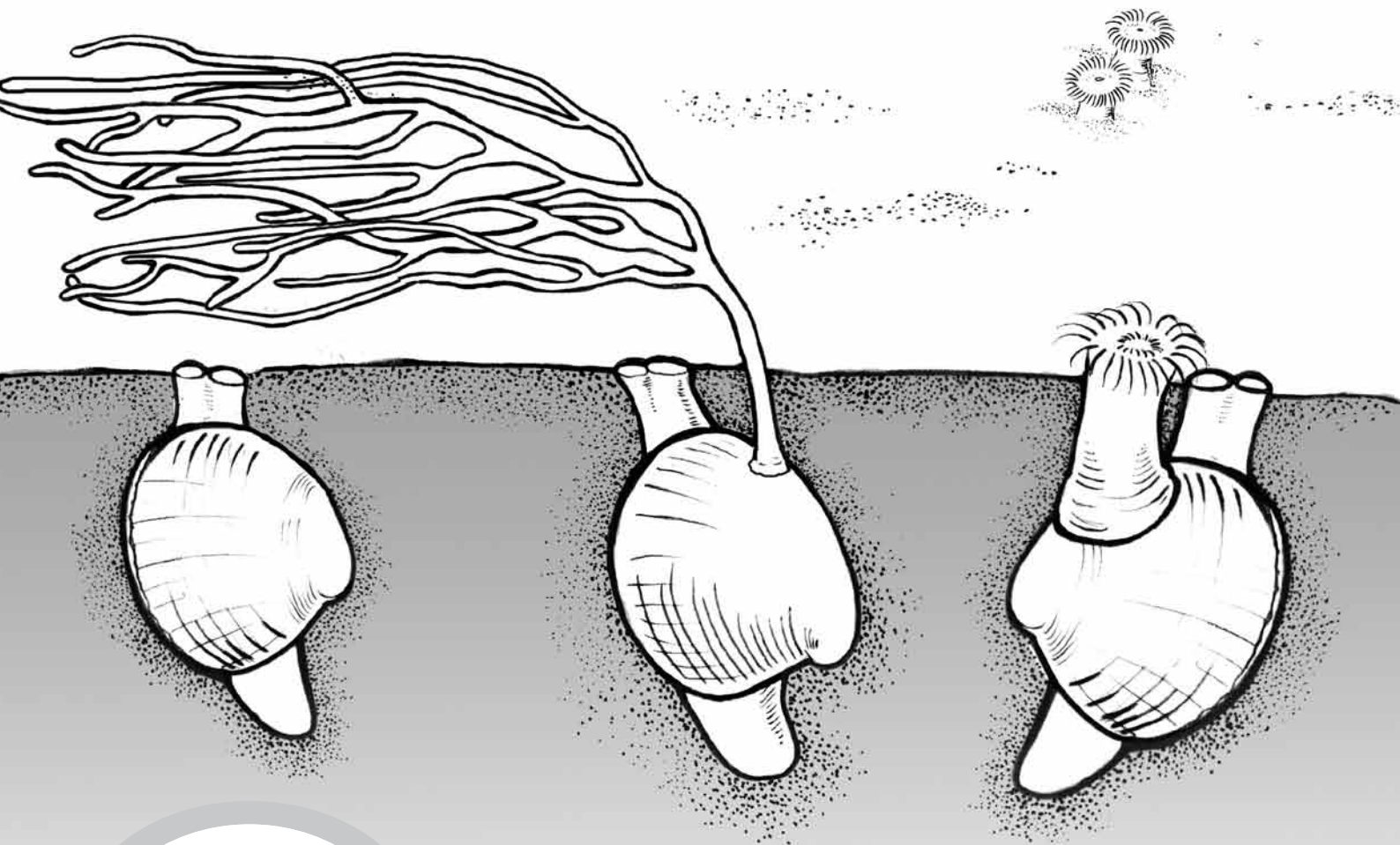
Finding flatfish on the mudflat is a real skill. They change their colour to match their environment and disturb the sand to disguise their body.



How many flatfish can you find in the picture?

ABOVE AND BELOW

Life on the surface provides exciting clues as to what is lurking below. A Mudflat Anemone poking through the mud or a mound of seaweed often leads to a Cockle below.

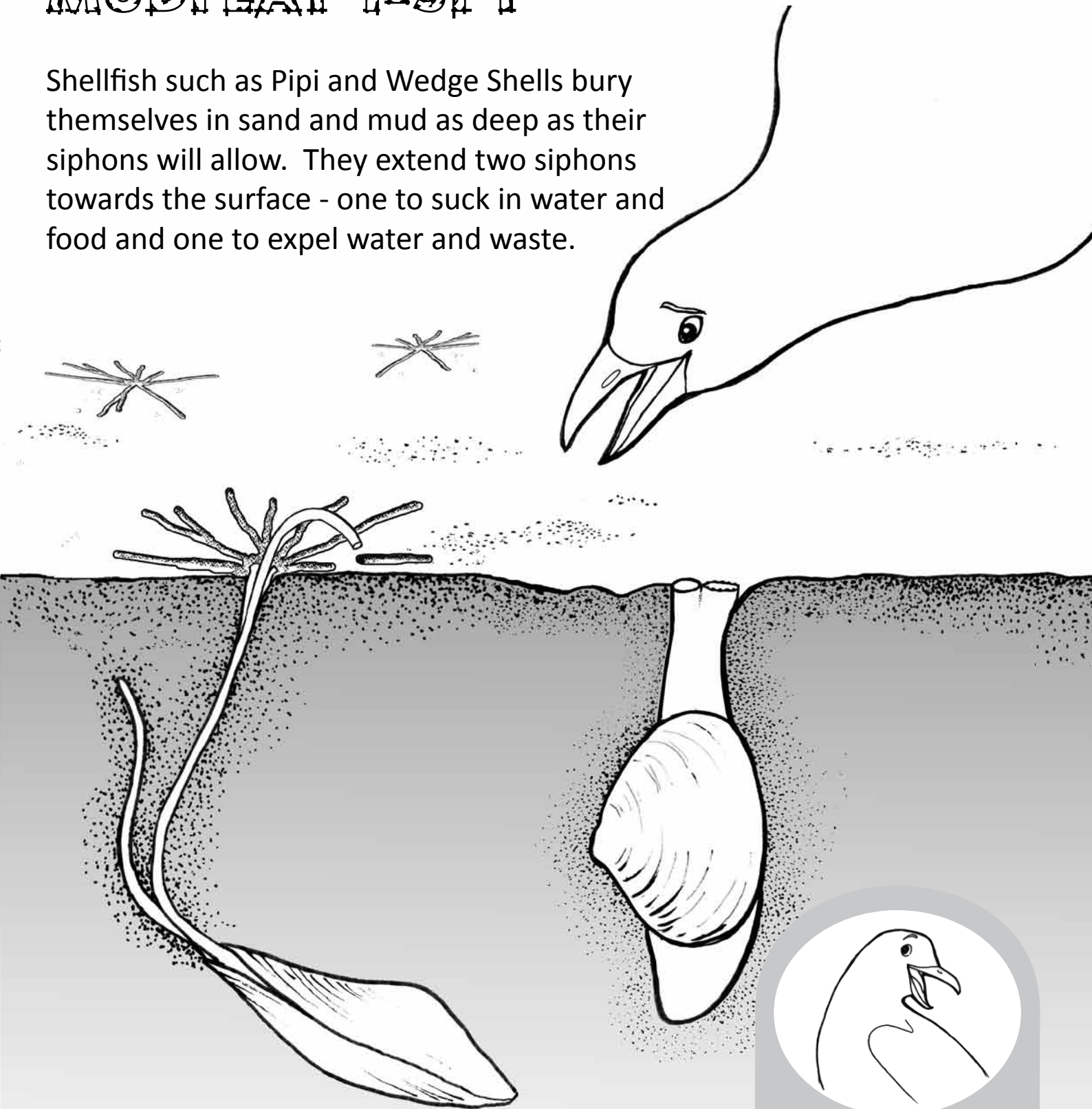


Draw a Cockle and label the parts:

- Shell
- Foot
- Siphons
- Hinge

MUDFLAT I-SPY

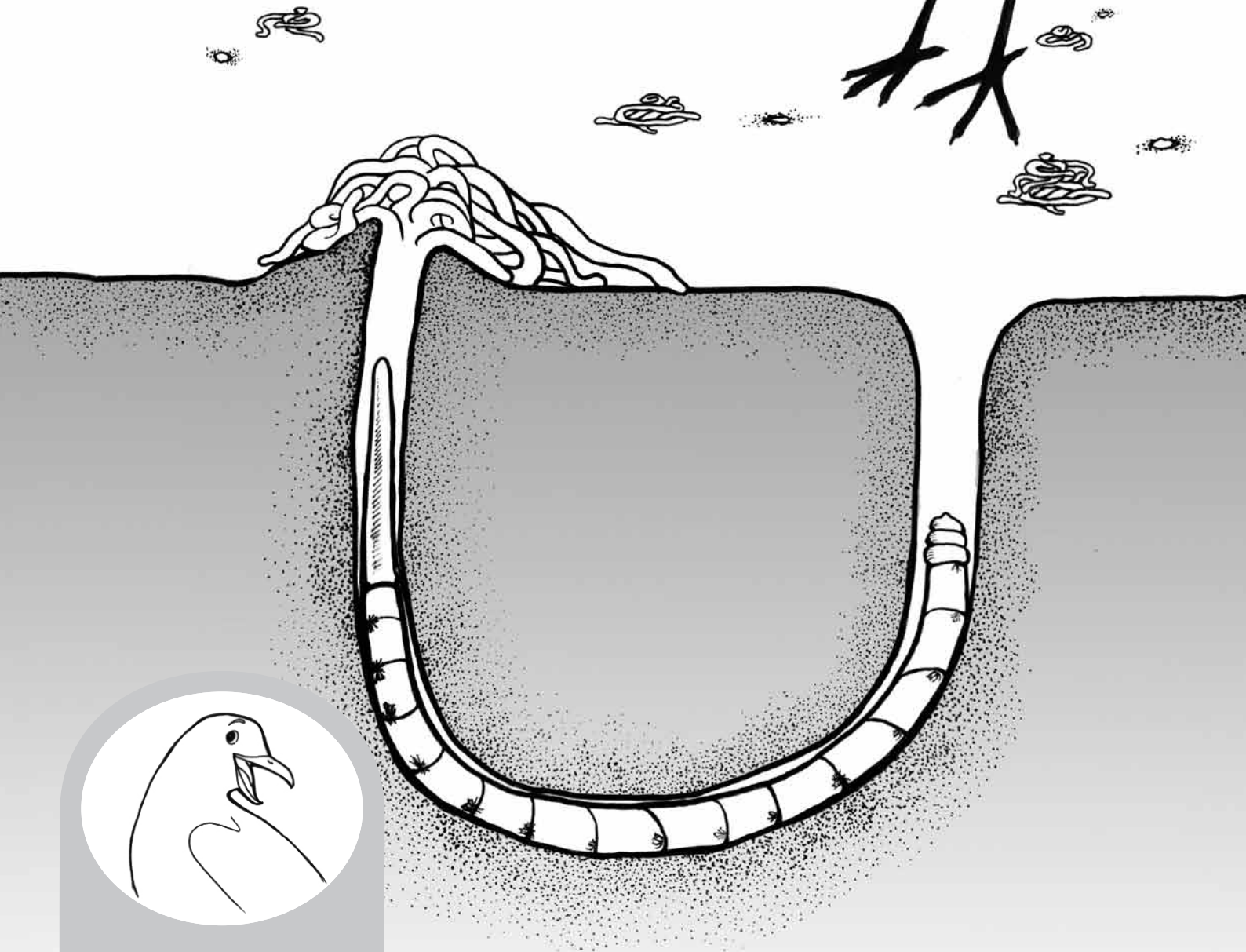
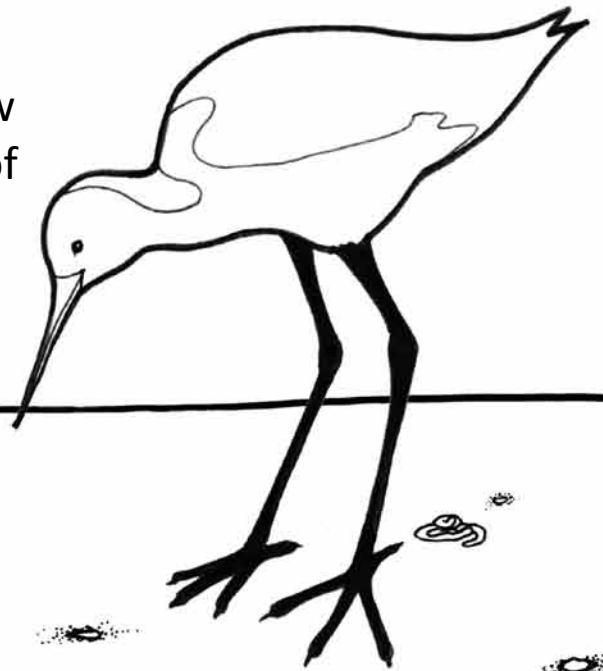
Shellfish such as Pipi and Wedge Shells bury themselves in sand and mud as deep as their siphons will allow. They extend two siphons towards the surface - one to suck in water and food and one to expel water and waste.



When a Wedge Shell is feeding it leaves a mark like a bird's footprint at the surface. Circle the clues that show you where Wedge Shells are. Label the different shells.

WIGGLY WORMS

You don't often see worms on the shore, yet there could be hundreds of them below the surface - just look for the clues. Coils of discarded sediment mark the U-shaped burrow of the Lugworm.

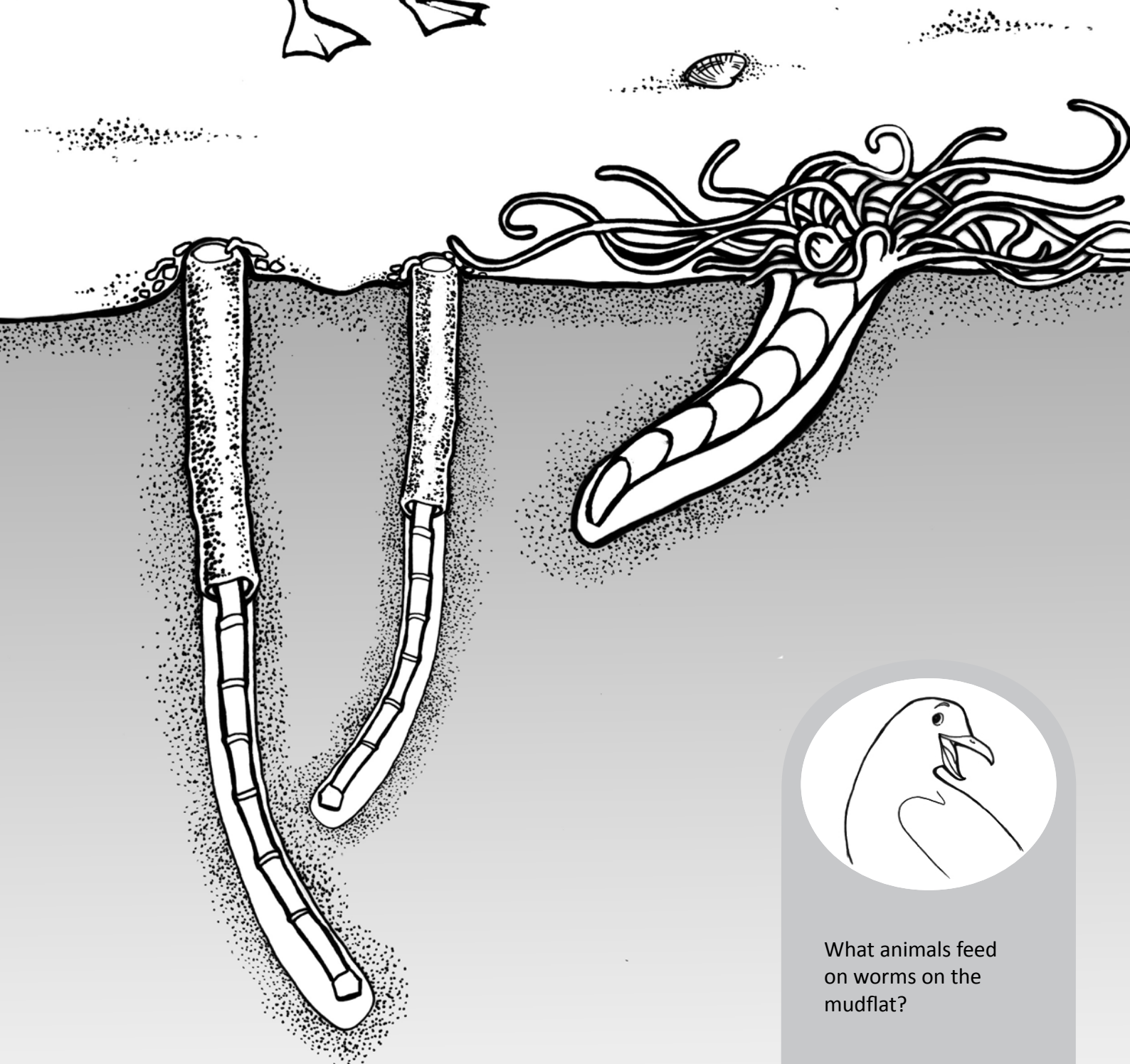
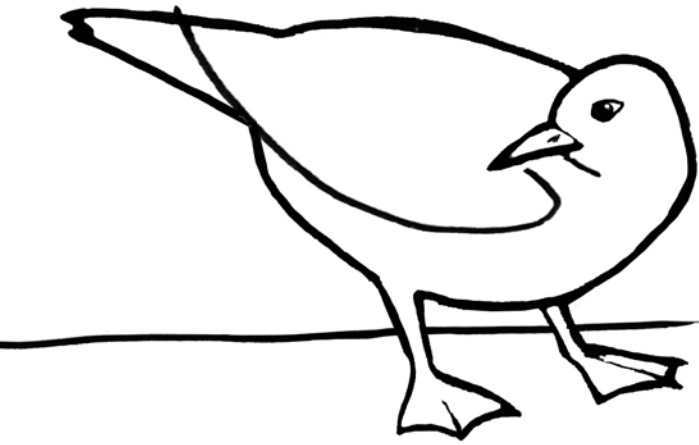


Which end do you think is the head. Why?
Label the head and the tail of the Lugworm.

MUD MOVERS

Bamboo Worms eat at depth and poo at the surface which helps recycle the nutrients trapped in the lower layers.

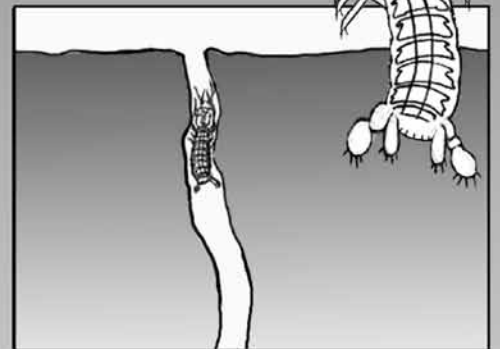
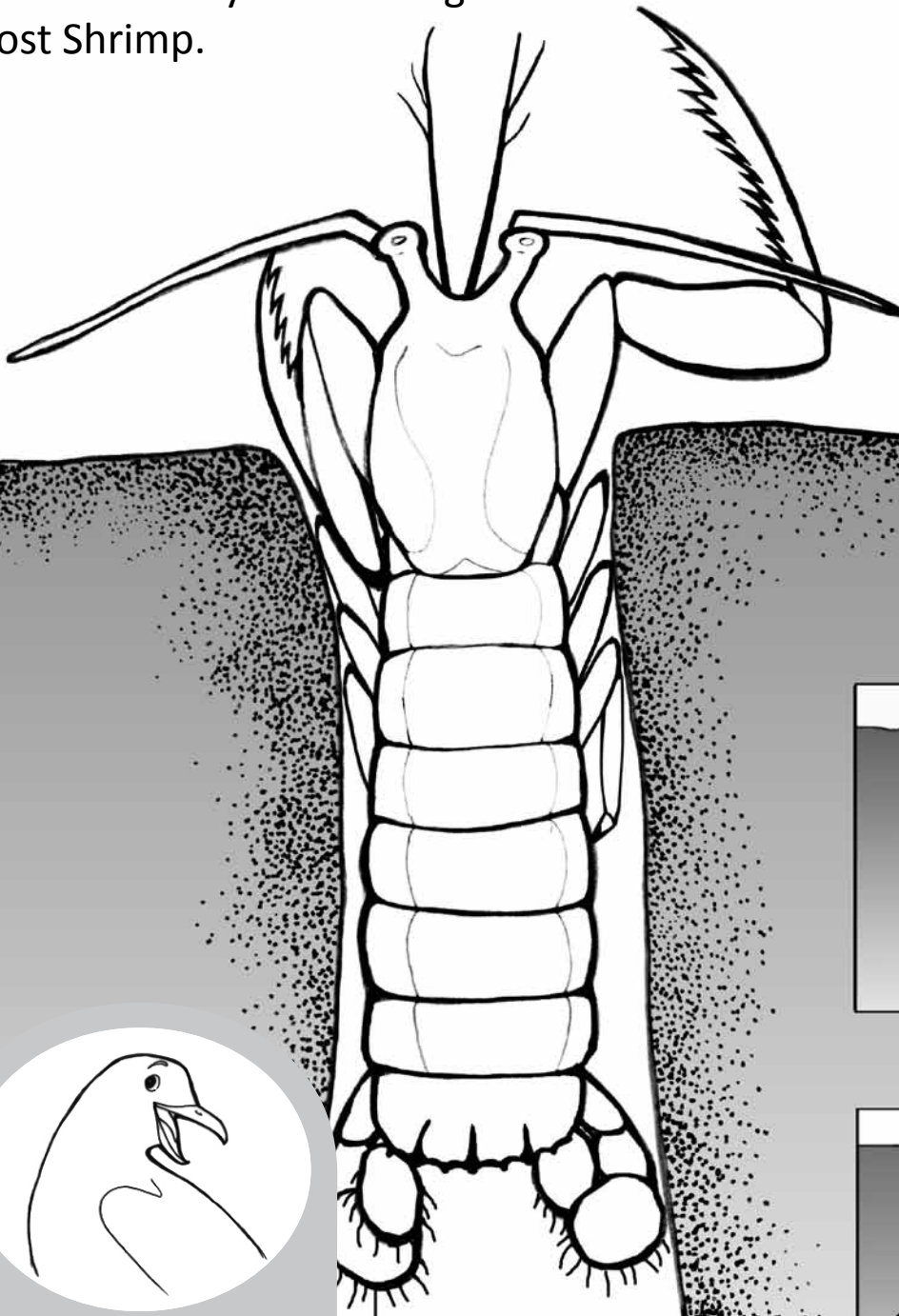
Spaghetti Worms use their many tentacles to pick up food particles from the surface.



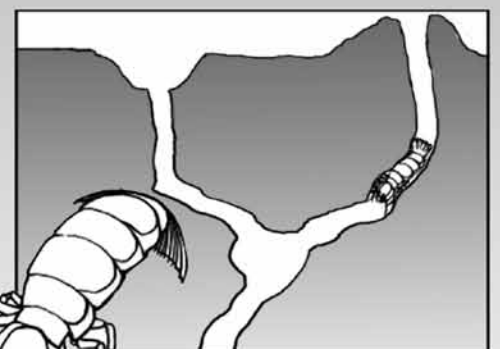
What animals feed on worms on the mudflat?

MUD VOLCANOES

Shrimps hide in the mud at low tide, but their burrows are easy to spot. A Mantis Shrimp burrow is marked by a clean hole. A volcano-shaped mound of mud and a crater close by is a sure sign of a Ghost Shrimp.



Mantis Shrimp burrow



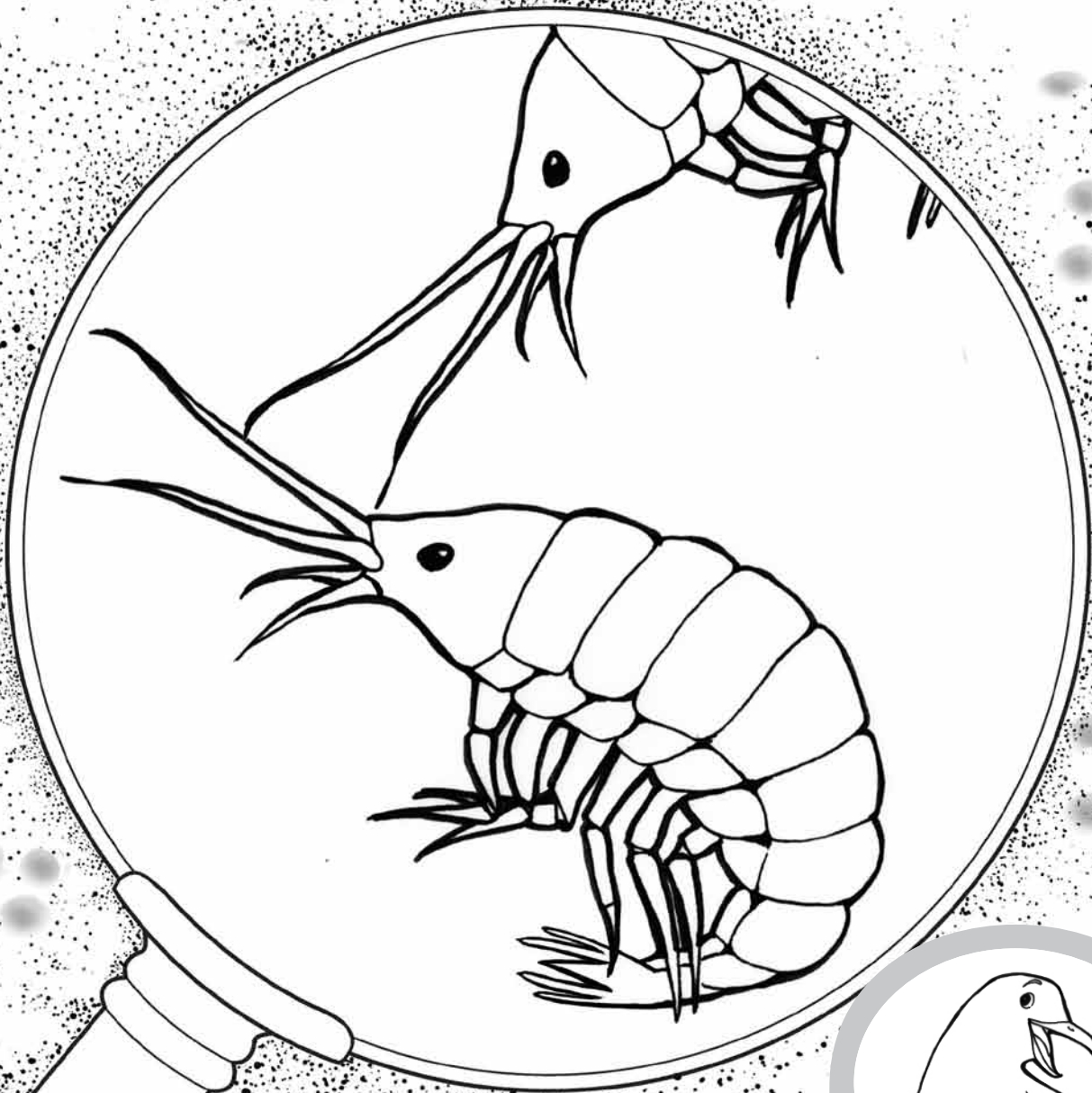
Ghost Shrimp burrow



Mantis Shrimps only come out of their burrows at high tide. Colour the limbs that the Mantis Shrimp uses to stab its prey.

BURROWING BUGS

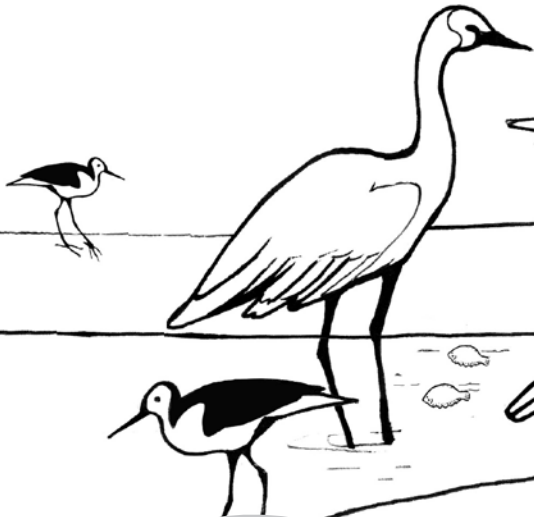
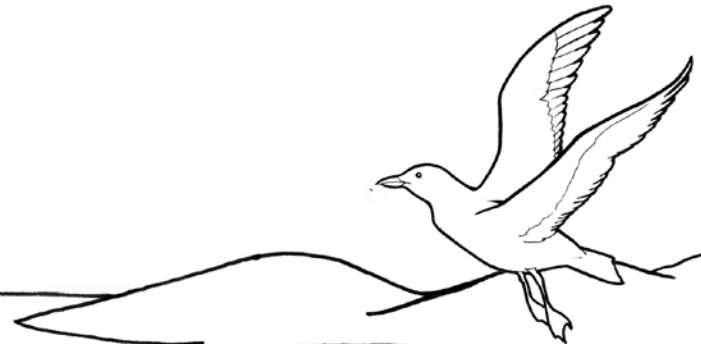
Each little bump in the mud could be the temporary burrow of an amphipod. Closely related to the Sand Hoppers of the sandy shore, they are the same colour as the mud they live in.



How could you catch an amphipod? Remember they are only a few millimetres in size.

SHORE VISITORS

Birds use the sandy and muddy shore as a feeding ground. Look at the size and shape of their bill to gather clues about what they feed on.



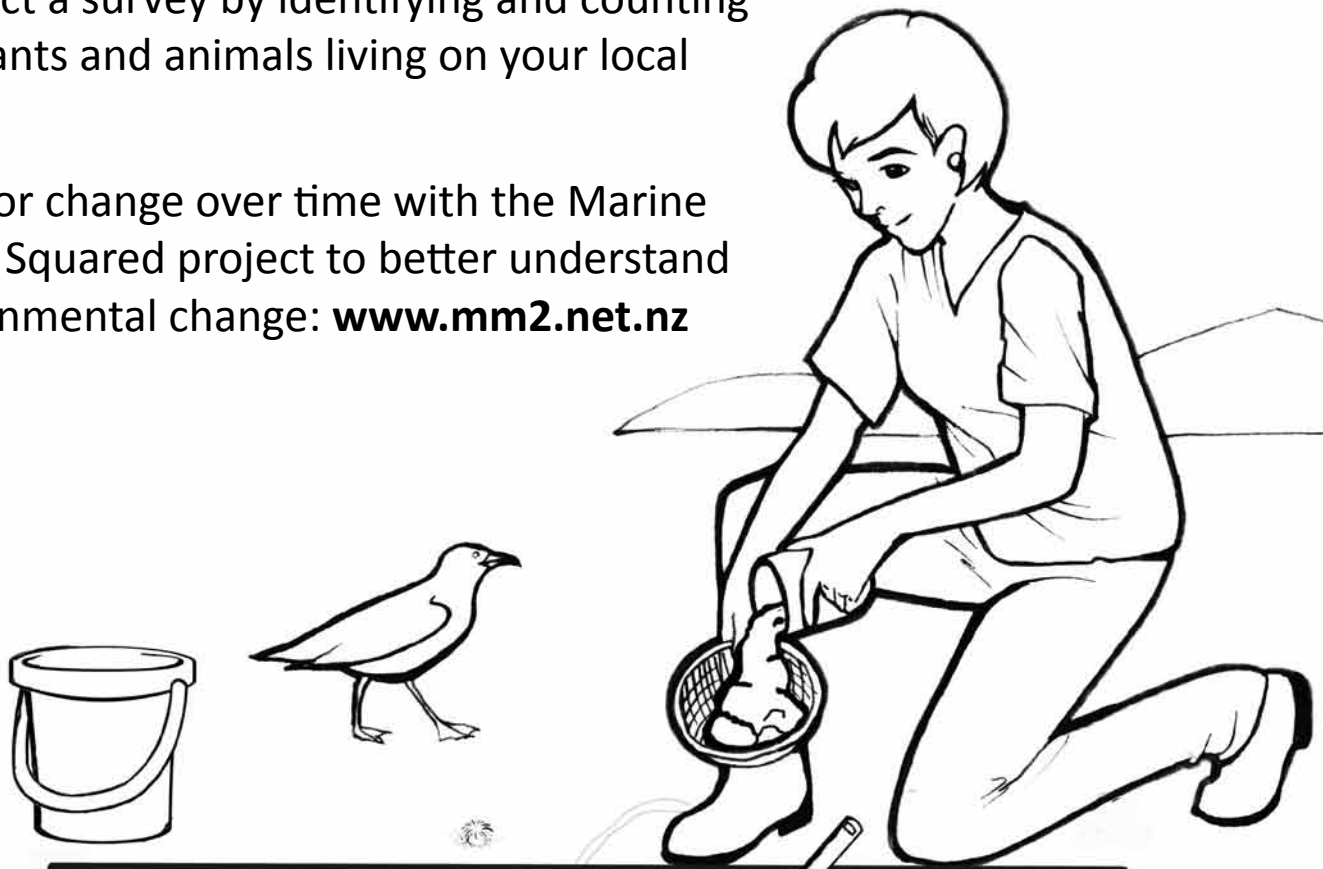
Label and colour the birds in the picture:

- Black Swan
- Heron
- Kingfisher
- Oyster Catcher
- Red-Billed Gull
- Pied Stilt

SEASHORE SURVEY

Conduct a survey by identifying and counting the plants and animals living on your local shore.

Monitor change over time with the Marine Metre Squared project to better understand environmental change: www.mm2.net.nz



Count the creatures in the square. (HINT: there could be more than one of each!)

- Tunnelling Mud Crabs
- Mud Crab Burrows
- Lugworm Burrows
- Mud Snails
- Mudflat Anemones
- Mudflat Whelks
- Cockles

CREATURE KEY



Tunnelling Mud Crab - It has eyes on stalks so it can peek out of its burrow. Its muddy colour provides camouflage to avoid predators.



Stargazer - This fish is much larger than it seems as it buries most of its body in the mud, with only its head, large mouth and upward-facing eyes exposed. It grows up to 45 cm in size.



Horn Snail - Small, narrow, and dark in colour, this snail is found on mudflats and between rocks. It eats algae and sediment to extract the nutrients.



Triplefin - Found in shallow pools on the mudflat, this small fish changes colour to blend in with its surroundings. It gets its name from the three fins on its back.



Mud Snail - This snail feeds when the tide goes out, and then buries itself in mud when the tide comes in. It feeds on microscopic plants in the surface layer of the sediment.



Amphipod - Found on most shores, the amphipod lives just under the surface, eating and recycling nutrients from dead material, especially seaweeds. The species on sandy beaches jump when disturbed, hence the common name "Sand Hopper".



Mudflat Whelk - This intertidal mudflat and shallow water snail is a scavenger. It burrows beneath the mud and comes out to feed when it smells dead and dying animals.



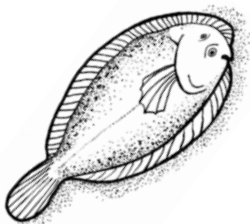
Ghost Shrimp - It constructs a burrow down to a depth of about 60cm. The entrance resembles a crater and the exit looks like a volcano-shaped mound. The Ghost Shrimp seldom leaves its burrow.



Mudflat Topshell - This vegetarian snail is usually found near seaweed and seagrass beds. At low tide, the snail pulls a door (called an operculum) across the shell opening, which prevents it from drying out.



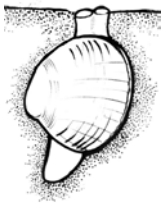
Mantis Shrimp - It excavates a vertical burrow, which it leaves at high tide for short periods, especially at night. The female has an irregular red band along the back flanked with dark green. The male has a sparse pepper-coloured body pattern.



Flatfish - Juvenile flatfish are present in shallow water off many of our beaches but are hard to find until they move. Flounders and Sole change their colouration pattern to match their surroundings. They wiggle their fins and throw sand over their fin edges obscuring their outline.



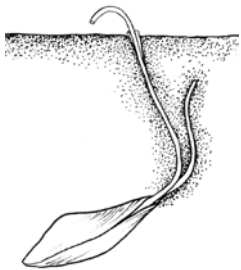
Mudflat Anemone - Small and brown in colour. It attaches to hard surfaces, often a Cockle. This prevents it from being washed away, but also camouflages the Cockle.



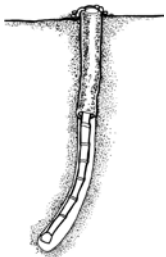
Cockle - This bivalve is common throughout New Zealand and prized as food. It is found just beneath the surface of sand and mud banks exposed at low tide. It has a ridged shell.



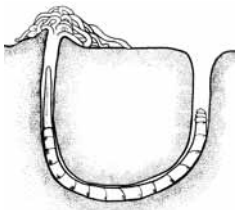
Pipi - A bivalve found on sandy beaches and in the silt and mud of estuaries. Its shell is smoother than that of the Cockle.



Wedge Shell - It has a large triangular foot and slender shell shape making deep burrowing easier. When buried it turns its shell to lie on its side, the bent shell edge allows its siphons to curve upward smoothly. When feeding, one siphon curls over to suck up food particles from the surface like a vacuum cleaner, leaving behind markings similar to a bird's footprint.



Bamboo Worm - A small worm that lives beneath the surface protected by a thin tube casing made of mucus and sand grains. Burrow openings are marked by small piles of mud.



Lugworm - A thick-bodied darkish brown worm with tufts of gills on the middle third of the body. It lies in a U-shaped mucus-lined burrow so the head and the tail almost reach the surface. Its presence is indicated by coils of mud.



Spaghetti Worm - This lives in burrows or crevices. Long spaghetti-like tentacles are often the only part of the worm that is visible. The tentacles are used to find food particles on the sediment surface and carry them to the worm's mouth.



Black Swan - Introduced from Australia, this large bird has black feathers and a red bill. It eats marsh and water plants such as sea grass. Its nest is a ground level mound of sticks, reeds and grasses.



Gulls - On the NZ seashore we see three species of gull. The Black-Backed Gull is the largest. It has a yellow bill and legs, white body and black wings. The Red-Billed Gull has a red bill, red legs and grey wings with black and white spotted tips. The Black-Billed Gull is similar in appearance, but has a finer black bill and reddish-black legs.



Heron - This bird is found by fresh water and on sea shores where it hunts for fish, standing in the shallows on its long legs. It builds its nest in a tree.



Kingfisher - Usually spotted perching on a pole or branch where it looks out for prey. It dives from a height when it spots a small fish. The Kingfisher nests in a burrow in a bank or a hole in a tree.



Oyster Catcher - The Pied Oyster Catcher is black and white; the Variable Oyster Catcher can be pure black. Both have long red bills which are good for probing for amphipods and for opening bivalves. The Oyster Catcher nests on the high shore.



Pied Stilt - Found in marshy areas and estuaries, it nests close to water. It eats worms, larvae and bivalves like clams and oysters which it often finds by wading in the water.

