MANGROVES AS HABITAT

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WHAT LIVES IN MANGROVES?

From a distance, mangroves don’t look very interesting, and they often have a strong and unpleasant smell. Large areas seem to be covered by uniform vegetation, composed of just a few tree species and a few larger plants. What a contrast to tropical forests where a small patch of woodland contains hundreds of species of trees! Take a closer look and you will see that the wetlands are teeming with life—full of living things that are different in unexpected ways. In the mangrove world, trees have roots that breathe and look like legs, jellyfish swim upside down, barnacles feed with their feet, and crabs live in trees.

How Are Mangroves and Other Plants Adapted to Live in Wetland Conditions?

Growing in waterlogged soil poses special problems for plants.

- **Standing up:** The roots of wetland plants do not have much to hold onto because wetland soils are sloppy, so staying upright can be a problem. Mangroves have developed prop roots to help spread the load of the trunk over a broader area. Other trees, like the Yellow Mangrove, have buttresses. Some places are too wet to support trees and only grasses and herbs grow there.

- **Breathing:** Wetland soils are often black and smelly. This is because they are low in oxygen (or anoxic). Waterlogged soils are often anoxic because oxygen spreads more slowly through water than through air. This slows the decomposition of plant materials. The bacteria that live in anoxic conditions produce sulphur-rich compounds—and bad smells. To compensate for the lack of oxygen, wetland plants often have roots that grow above the sediment out into the air—called *aerial roots or breathing roots*, also called *pneumatophores*.

- **Getting rid of salt:** Some wetlands, like saltwater ponds, are even saltier than the sea. This occurs when water evaporates from the surface, leaving salt behind. Water or soil that is saltier than the sea is hyper-saline. Plant cells cannot function properly if they contain too much salt. Some plants, like Red Mangroves, try to prevent salt getting into their tissues. Others, like Grey Mangroves, can tolerate more salt than usual in their sap, and control the salt in their tissues by excreting it through specialized salt glands in their leaves.

- **Getting enough water:** It seems odd that plants growing in the sea should be short of water; but where the water is salty, fresh water can be hard to get. Plants that grow in salty water often have thick, waxy leaves (like Red Mangrove) that help to reduce water loss, or fleshy leaves (like Grey Mangroves) that can store water. These adaptations are also found in plants that live in dry places.
MANGROVES AS HABITAT

How Are Animals Adapted to Live in Mangroves?

Mangrove animals have to live, feed, and reproduce in a world dominated by mud and water, where the amount of water and mud is constantly changing. When the tide is high, tidal wetlands are flooded. When it goes out, water levels fall. Pools may be cool at night and close to boiling in the heat of the day. Pools that are governed primarily by rainfall may get very salty in times of drought, and then are suddenly flushed by fresh water after rain. Food is abundant, but it may be salty, indigestible, or in the form of small particles.

Animals need special adaptations to live and feed in this changeable world. For example, Fiddler Crabs have lots of legs to spread their weight over a larger surface area and keep them from sinking in, so they can move over the surface of the mud, gobbling up tasty morsels like Red Mangrove leaves that have washed up. When animals are not feeding, they need a safe place to hide—or they may become prey themselves. Fiddler Crabs, for instance, burrow into the mud.

Using birds as an example, here are some mangrove wetland plant habitats and what they provide for various species.

- **Red Mangrove** roots provide perches for small herons to stand on and hunt from.
- **Salt marsh** provides cover for birds to hide in, and soft ground on which to nest.
- **Grey Mangrove** canopy provides roosting habitat for Terek Sandpipers and nesting habitat for Little Egrets and Lesser Noddys.
- **Samphire plants such as the succulent shrubs** provide low cover offering nesting habitats for terns and sandpipers.
- **Holes in trunks** of Grey Mangrove trees provide nesting habitat for Collared Kingfishers

Birds are adapted by their shapes to the areas in which they feed and nest. Long-legged herons, with their long, heavy bills, wade in deep water and hunt larger fish and occasionally crabs. Small herons like the Striated Heron have short legs but move very fast. These herons stand in the mangrove roots above the surface of the water and lean down to stab fish. The Little Egret, an intermediate-sized heron, wades in mid-level water. With its fine, sharp beak, it spears fish that are not hunted by the larger and smaller herons.

The Black-necked Stilt is adapted to wade in water and has a long, stiletto-like stabbing bill that can take insects like water boatmen off the surface of the water, or probe the soft mud. Different waders or shorebirds have different lengths of bill and leg, ensuring that they use different areas of the pond or foreshore, from the edge to mid-level, and different depths of mud. In this way, they do not compete with each other for the same food. The Ruddy Turnstone takes prey from under small stones and off the surface. Diving birds like the Collared Kingfisher and Whiskered Tern take their prey from the deeper parts of the water.

Adaptation allows many species to share the same wetland.
Roots and Root Dwellers

Roots are very useful to Red Mangrove trees, but they are equally useful to the hundreds of species of other plants and animals that make their homes on or near them. Once the Red Mangroves have started to grow in the mud, plants and animals settle on them. Red Mangrove roots host a fairyland of fantastic creatures and plants. Multi-coloured sponges (bright red, orange, yellow, or sky-blue), algae, corals of many shapes and colours, sea squirts (tunicates), fan worms, oysters, and sea anemones are just a few of the living things that crowd onto the roots. These creatures take advantage of the mangrove root surfaces to settle in places where there is nothing else to hold onto. Once there, they can feast on the detritus carried in by the tides, the decomposing leaves of the mangrove trees, and the other animals that seek shelter among the roots.

A mangrove root looks simple—but it is not. It is made up of several zones, the highest of which is almost always dry. The animals that live there (like monitors, crabs, and snails) do not like to be wet too often. The next zone is wet during high tides. Animals in this zone—barnacles and oysters, for example—have to feed when the tide is high and shut down tight when the tide is out. Below them, animals and plants are usually wet, but have plenty of light. Look for sea squirts in this zone. At the bottom, conditions are more stable. There is less light, but more food falling from the surface. Animals that feed by filtering food from the water, such as fan worms and sponges, are common in this zone. Some animals, like upside-down jellyfish (*Cassiopea andromeda*), just lie on the bottom of a pool with their feet up, waiting for food to fall on them.

The dense growth of roots protects animals and plants from waves and currents, and stops large predators from getting in. The currents carry the fry of many fish, prawns and crabs into the mangrove root ecosystem. There they hide, feed, and grow among the roots. These include the young of many favourite commercial species—Sea Mullet, Barramundi, Mud Crabs and many others.
Some creatures spend their whole lives in the water, while others move freely between the air and the water. Crabs and snails often live on the edge.

![Mangroves as habitat](image)

Figure 13: The mangroves are habitat for many different species

<table>
<thead>
<tr>
<th>Need</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>To prevent themselves from drying out</td>
<td>Ability to hide under rocks or mud (crab)</td>
</tr>
<tr>
<td></td>
<td>Ability to burrow in mud (crabs and prawns)</td>
</tr>
<tr>
<td></td>
<td>Ability to hide in plant cover (amphipods)</td>
</tr>
<tr>
<td></td>
<td>Ability to find tidal pools to stay in (small fish)</td>
</tr>
<tr>
<td>To prevent themselves getting washed away</td>
<td>Foot that acts like a suction cup to hold the animal in place (gastropod snail)</td>
</tr>
<tr>
<td></td>
<td>Strong byssal threads to attach themselves to surfaces (oyster)</td>
</tr>
<tr>
<td></td>
<td>Tube feet with suction cup that hold the surface (sea stars)</td>
</tr>
<tr>
<td></td>
<td>Cement that attaches them permanently to a surface (barnacles)</td>
</tr>
<tr>
<td>To protect themselves from severe</td>
<td>Hard outer shell to retreat into (crab, hermit crab, oyster)</td>
</tr>
<tr>
<td>temperature changes</td>
<td>Ability to find tidal pools to stay in, shaded areas in the roots of the mangroves (small fish)</td>
</tr>
<tr>
<td></td>
<td>Ability to hide beneath rocks, roots and leaf litter (crabs)</td>
</tr>
<tr>
<td></td>
<td>Ability to stay buried in the sand or mud (prawns)</td>
</tr>
<tr>
<td>To protect themselves from predators</td>
<td>Ability to change colour to blend into its surroundings (mangrove snapper)</td>
</tr>
<tr>
<td></td>
<td>Ability to retreat under rocks, branches or roots or into burrows (fiddler crab and mud crabs)</td>
</tr>
<tr>
<td></td>
<td>Strong hard shell (oyster)</td>
</tr>
<tr>
<td>To obtain food</td>
<td>Ability to scrape or graze algae and detritus from mud and rocks (snail)</td>
</tr>
<tr>
<td></td>
<td>Claws to rip flesh, leaves and detritus (crabs)</td>
</tr>
<tr>
<td></td>
<td>Ability to sweep through water with their legs and filter plankton and other food materials from water (barnacles)</td>
</tr>
<tr>
<td></td>
<td>Tongue (radula) that acts like a file to drill a hole through the shell of an oyster so the oyster can be digested (carnivorous snails like whelks).</td>
</tr>
</tbody>
</table>
What Eats What?

All the energy in the world comes from the sun. Mangrove leaves and the algae that grow on mangrove roots capture this energy by **photosynthesis**, converting it into leaves, trunks, and branches. This is called **primary production**. With plenty of sunshine, water and mineral resources, the mangroves can produce very efficiently; in fact, they are among the most productive ecosystems in the world. A healthy mangrove system produces one kilogram of litter per square meter per year. This litter consists of leaves, bark, twigs, flowers and seeds. What happens to this litter?

![Figure 14: Nutrient cycling of mangrove leaf litter](image)

Mangrove leaves are tough and few things eat them, but some crabs have developed a taste for them. Examine the leaves on a mangrove tree closely and you will probably see where they have been nibbled. The crabs are called **primary consumers**. Unlucky crabs are eaten by herons. The herons are **secondary consumers**, which eat primary consumers.

Take a look at a shallow pool in the Red Mangroves. It is likely to be lined with yellowing leaves—those that are not eaten on the tree fall into the water. They may look as if they are being wasted, but appearances are deceptive. As soon as a leaf enters the water, it is attacked by micro-organisms: bacteria and fungi. These are called **decomposers**. Look closer. Some leaves may have patches of bright pink. This is a fungus, busily breaking down the leaves. Take a leaf out of the water. It will probably feel slimy. This is due to the bacteria and fungi on its surface. Decomposers convert the cellulose of the leaves into proteins and simple sugars. When a leaf hits the water, it is about 3% protein. Microbial action converts a further 19% into protein—excellent food for the young fish, lobsters, and prawn that are growing up in the area.

As the fish and prawn feed and grow, they get too large for the narrow spaces between the roots. Soon they must venture out. There they may be eaten by bigger fish, such as Barramundi, that feed...
in the channels and lagoons. These bigger fish, along with other animals and birds that eat primary and secondary consumers, are predators. Predators lurk in the canopy of the Red Mangrove trees or out in open water, ready to swoop down and feed on the unwary. Herons often skulk on roots near the water, ready to spear a fishy victim. Spiders, lizards and Mangrove Kingfisher’s feast on the mosquitoes that breed in the water. Other birds like Pelicans roost and nest in the canopy, close to their open-water feeding grounds.

Much of the food produced in mangroves is washed away (or exported) by tides and currents, and provides food and nutrients for animals and plants along the coast.

**Food Chains and Food Webs**

Plants and animals in any given ecosystem or habitat are linked by their feeding relationships. Just like the mangrove swamp, every habitat creates decomposers: bacteria, fungi, and some insects that break down dead plant and animal matter (called *detritus*) into minerals and humus. The fertile soil that results enables producers—green plants—to grow, providing a food source for primary consumers—animals that eat plants and grasses, which are also called *herbivores*. (*Carnivores* eat other animals, and *omnivores*, like humans, eat both plants and animals.) These animals in turn provide a food source for predators—animals that eat consumers. *Predators* can be either secondary consumers, which eat only primary consumers, or tertiary consumers, which eat secondary consumers, or both. For example, the Heron eats crabs (primary consumers) as well as fish (secondary consumers), so the Heron is both a secondary and a tertiary consumer. This is called a food chain.

A food chain is one feeding cycle within a larger or more complex food chain called a food web. A food web begins with the process by which the sun’s energy is captured and shared among living organisms. A simple mangrove food chain is shown in Figure 15 and a food pyramid in Figure 16.
Figure 16: Mangrove Food Pyramid

Producers e.g. mangroves, seagrasses or algae

Carbon dioxide + water → sugar + oxygen + energy

Fishers

Large fish e.g. sharks

Small fish e.g. sardines, whiting

Small invertebrates e.g. crabs, pippies
Mangrove Habitat Study

• Name the plant and animal species.
• Create a food chain (simple) or food web (more complex)
• Is there a niche? Explain it.
• Does this habitat contain the four basic elements – food, water, shelter and space? (Explain and give examples.)
• What could harm this habitat?

Figure 17: The mangroves as habitat for other species
Activity 2-A: Spot the Difference - Mangroves

**Summary** Students will learn that the three species of mangroves (grey, red and yellow) have very different seeds, roots, and leaves. These adaptations to their particular environment help to identify the different species.

**Learning Objectives**
Students will be able to:
(a) Identify three species of mangroves;
(b) List adaptations of each species; and
(c) Explain the reproduction of the Red Mangrove.

**Age Levels**
10 and up

**Subject Area**
Science

**Time**
1 hour

**Materials**
Red Mangrove seed (propagule) with top attached, and leaf *
Grey Mangrove leaves and seed*
Picture of Grey Mangrove root (pneumatophore)
Yellow Mangrove leaf and seed*
Sketch pad or drawing paper
Mangrove plant illustrations from page 2-21 to 2-39

*Note due to the Fisheries Act 1994 (Qld) it is not possible to remove marine plant material (plants or seeds) without a permit.


Under the code, you are limited to collecting no more than two buckets each having a capacity of 10 litres of marine plants in one day. Once completed you fax or email the form to the District Officer of the nearest Queensland and Boating Fisheries Patrol and the Manager (Planning and Assessment) of the relevant regional Fisheries Facility at least 5 business days but not more than 20 business days before you need to collect your samples.

Otherwise, it is suggested that examine the plants in situ or use resource materials for this activity.
MANGROVES AS HABITAT

Background Mangroves are virtually the only trees that have learned to adapt to growing in salt water or conditions heavily influenced by salt. To do this, they have developed special features that enable them to process the salt. These are described in greater detail on page 2-2.

Preparation Examine the seeds and leaves from each of the three different species of mangroves

Procedure
1. Examine the Red Mangrove seed (propagule).
   a. Drop the seed into water. Which end falls first?
   b. Separate the top (attachment) from the seed. How are they attached?
2. Examine the Red Mangrove leaf.
   a. Is there a difference between the top and bottom sides?
   b. What is the shape of the leaf?
   c. With a fingernail, scrape the top and what do you see?
3. Examine the Red Mangrove root illustration.
   a. Is there a main trunk?
   b. How do you think the roots function?
4. Examine the Grey Mangrove leaf.
   a. What is the difference between the top and bottom of the leaf? [The bottom has salt pores.]
5. Examine the illustration of the Grey Mangrove root system.
   a. Estimate the extent of the root system and the tree cover (canopy). Is it larger, smaller, or the same? (Check this during field investigation or homework.)
   b. Predict the function of the roots. (With older students, try to design an experiment to test your predictions. For example, try breathing through a snorkel while under water. Explain that this is how Grey Mangroves get their carbon dioxide.)
6. Examine the Yellow Mangrove leaf and stem.
   a. How does the leaf function? What do you think the little bumps are on the stem just below the leaf?
7. Examine the illustration of the Yellow Mangrove root system.
   a. How are the roots similar to those of the Grey Mangrove?
   b. Predict the function of the roots. (With older students, try to design an experiment to test your predictions.)
8. Have students draw pictures of each set of leaves, roots, and stems.

Discussion/Reflection
Which of these three species would grow closest to water? What are your reasons for this answer? How do these three differ in the way they get rid of the salt in their systems?
Summary Mangrove ecosystems have a complex food web.

Learning Objectives
Students will be able to:
(a) Describe the elements of the food chain: producers; primary, secondary, and tertiary consumers; and decomposers;
(b) Understand the distinction between herbivores, carnivores, and omnivores;
(c) Gain a basic understanding of how pollutants work in the food chain; and
(d) Build a mangrove food web.

Age Levels
8 and up

Subject Area
Science

Time
1 hour

Materials
Reading background (page 2-6 to 2-8 and below)
Mangrove Food Web Clues (page 2-14)
One worksheet (page 2-15) per student

Background Plants and animals in any ecosystem or habitat are linked by their feeding relationships. Every habitat creates decomposers: bacteria, fungi, and some insects that break down dead plant and animal matter (called detritus) into minerals and humus. The fertile soil that results enables producers—green plants—to grow, providing a food source for primary consumers—animals that eat plants and grasses, which are also called herbivores. (Carnivores eat other animals, and omnivores, like humans, eat both plants and animals.) These animals in turn provide a food source for predators—animals that eat consumers. Predators can be either secondary consumers, which eat only primary consumers, or tertiary consumers, which eat secondary consumers, or both. For example, the Heron eats crabs (primary consumers) as well as fish (secondary consumers). So the Heron is both a secondary and a tertiary consumer. This is called a food chain. A food chain is one feeding cycle within a larger or more complex food chain called a food web. A food web begins with the process by which the sun’s energy is captured and shared among living organisms.

When certain chemicals enter water, they can affect the entire food chain. Chemicals, such as the herbicide diuron and heavy metals, get into the water through run-off from the land. They are ingested over time by microscopic organisms called plankton. Tiny invertebrates eat the plankton and store the chemicals in their own bodies, where they are more concentrated than in the plankton. Fish eat the invertebrates and also store the chemicals in their bodies, becoming more polluted than the invertebrates. Birds, mammals, and humans then eat the fish containing high levels of pollutants, and the chemicals get into our bodies. This is called bioaccumulation. (See the “Deadly Links” activity on page 3-13).
Procedure

2. Use the clues (page 2-14) to fill in the worksheet.
3. Check answers (see handout on page 2-16).

Discussion/Reflection
What other plants and animals that you know about could fit into the charts?
Mangrove Food Web: Clues

Complete the simplified food web for a mangrove habitat, using the following words to fill in the correct numbered circles: oyster, heron, amphipod, white-bellied sea eagle, human, plants, snake, green turtle, mangrove jack, detritus and fiddler crab.

Clues for Numbered Circles

- These organisms use energy from the sun to make food (1).
- This is dead plant material enriched with bacteria and fungi. It returns plant nutrients to the mangrove (2).
- This tiny invertebrate feeds on organic matter (3).
- These shelled animals live beneath Red Mangroves and filter-feed, concentrating on small particles of organic matter (4).
- This reptile feeds on algae, seagrass, mangrove fruit and jellyfish (5).
- This crustacean is the ultimate recycler; it will eat algae, microbes, fungus, or other decaying detritus (6).
- This vertebrate with fins lives underwater and feeds on prawns and small fish, their young will also eat amphipods (7).
- This bird of prey mainly eats reptiles and fish (8).
- This long-legged animal can be seen patiently standing in shallow water looking for small aquatic creatures including fish, frogs, and crabs (9).
- If it wants to, this creature can find and eat almost anything in the mangroves. Nothing in the mangroves can kill and eat this animal (10).
- This animal slithers around to hunt for frogs, birds and small mammals (11).
Mangrove Food Web Worksheet

Diagram of food web:

1. Producer
2. Primary consumer
3. Secondary consumer
4. Tertiary consumer
5. Decomposer
6. Secondary producer
7. Primary producer
8. Tertiary producer
9. Secondary consumer
10. Primary consumer
11. Tertiary consumer

Use the drawing tools to change the flow of energy through the food web.
Mangrove Food Web: Answers

1. Detritus
2. Small fish
3. Crab
4. Detritus
5. Sea turtle
6. Small fish
7. Mantis shrimp
8. Eagle
9. Heron
10. Human
11. Detritus

Detritus flows from the sediment at the bottom of an ecosystem.
Activity 2-C: Mangrove Story Board

**Summary** This activity focuses on the mangrove’s importance to juvenile fish and other animals by having students participate in creating a felt story board while listening to a story about Mr Lates Calcarifer, the Great Barramundi.

**Learning Objectives**
Students will be able to:
(a) Describe the different relationships that occur in a mangrove ecosystem—water cycle, food chains;
(b) Define the words habitat, mangroves, salinity, detritus; and
(c) List the basic requirements all living things need to survive.

**Age Levels**
4–11

**Subject Areas**
Science, language arts, art

**Time**
30–60 minutes

**Materials**
A felt board divided as follows, from the top down:
blue sky in the upper section
an area of high land (ridge), coloured grey or black
an area of grasslands, coloured green
soil, coloured brown
shallow water, coloured light tan
shallower ocean, coloured blue-green
deeper ocean, coloured darker blue
Cut-outs in felt, or drawings (use enlarged copies of illustrations in unit handouts or field guide) that have been laminated, with Velcro attached to the back, or cut-outs of coloured construction paper with tape attached to the back. Have students prepare these as they would for a class mural. Cut-outs should include:
- a sun (to represent energy source)
- a cloud or two (for discussing the water cycle)
- mangroves—red, grey, yellow
- samphire plants and sea grass
- animals that fly and live in the trees—lorikeets, Little Red Flying Fox, herons, pelicans, Ospreys
- reptiles that live in the trees—such as lizards
- amphibians that live in the trees like frogs
- spiders and insects—such as mosquitoes, dragonflies, butterflies, ants and bees—that live in the trees and fly in the air
- animals that live in the mud and dead mangrove leaves, such as clams, oysters, sponges, sea squirts, snails, crabs (fiddler and mangrove), worms and amphipods and copepods
• animals that live in the water (young, getting older towards the deeper water) such as
turtles, barramundi, mangrove jack, mullet, prawn, upside-down jellyfish; birds such as
herons, stilts, snipes, and other shorebirds

Note: If felt is unavailable for cut-outs, use coloured construction paper or colour part of each
section to indicate its composition. A poster depicting a typical mangrove ecosystem is just as
effective if a felt board cannot be obtained.

**Background** The mangrove wetland is a unique setting that provides habitat, or home, for a variety
of animals that are all completely dependent on the mangroves for the food, water, and shelter that
they provide. You can also include the following concepts during your presentation, leading into
further discussions on life cycles, food chains, and predator/prey relationships.

- **productivity**—The flow of energy that starts with the sun and is captured by photosynthesis, which
  enables plants to grow and thus the rest of the ecosystem to develop. With plenty of sunshine,
  water, and mineral resources, the mangroves are among the most productive ecosystems in the
  world.
- **abiotic**—Non-living elements that are present in the mangroves—water, clouds, mud, sun, and
  climate—that determine what will live here.
- **producers**—Plants that harvest energy from the sun in the process known as photosynthesis.
- **primary consumers**—Organisms that eat plants, such as grazing animals, birds, and insects.
- **secondary and tertiary consumers**—Predators that eat animals.
- **decomposers**—Micro-organisms responsible for decay.
- **detritus**—The term used to describe dead and decaying plants and animals.

**Procedure** When all the materials have been assembled, have students place appropriate items on
the board as you lead a discussion on what can be found in the mangroves. They may come up and
select items from an assortment at the front of the class, or provide ones they have made. You might
want to cover what lives where in the mangroves so students will focus on what to look for and
where. On visits to mangroves, students and teachers are often amazed at what they find in the
mud, so this is a good part to emphasize in your discussion.

**Discussion/Reflection**
Tell the following story, using the felt board and cut-outs to illustrate what you are saying. Involve
the students by encouraging them to answer your questions. (Correct answers, along with
suggestions to the teacher, are in italic type, in square brackets—see following page.)
Mr Lates Calcarifer – the Great Barramundi

DOES ANYONE KNOW what saltmarshes and mangroves are? Mangroves are amazing plants—they’re trees, really—that grow in salt water on the edge of the ocean. In a few moments we will see how important the mangroves are as habitat. Mr Lates Calcarifer, the Great Barramundi, was born from an egg tucked away safely in the saltmarsh behind the mangroves.

Soon after hatching, as the tide rises, little Lates moved into the mangrove behind a cluster of mangrove roots. For the first few days of his life he feeds on small plankton, like amphipods and copepods. As he grows, before he migrates upstream to freshwater where he will establish his territory and spend the rest of his life, he lives among those same mangrove roots. What a strange world to grow up in, but what an exciting place to explore!

And there’s so much to eat—hundreds of juvenile fish and prawns in silvery schools. Still and silent, Lates waits in more open water for a small fish to stray from the school; then, suddenly, he snaps it up for a tasty meal.

But Lates the Barrumundi is only a few centimetres long, and there are others who would like to make a meal of him. From the surface of the water, he catches a glimpse of a slow-moving shadow.

What do you think it is? [A white-faced heron.]
Where would be a good place to hide? [Among the roots of the mangroves.]
Briefly describe life in the mangrove roots and why it is so productive. What other animals might we see here that would use the shelter of the Red Mangrove roots? [Prawn, mud crabs, fiddler crabs, other young fish like mullet and crustaceans like amphipods and copepods.]

“Hmmm . . . looks like there are some interesting things to eat here,” says Lates, as he spies a tasty prawn. The amphipod and the prawn use the mangrove roots for shelter, but they also find lots of food to eat in the muddy layer of ooze underneath the dead mangrove leaves, called detritus.

Where did this rich stuff come from? [It is made up of dead and decaying plants and animal material that have fallen from the mangrove trees and flowed down from the land when it rained.] There is a good supply of invertebrates here in this rich habitat, and the barramundi’s survival depends on this healthy aquatic habitat.
Let’s review what the young barramundi needs in order to survive.

- **Food**—the barramundi eats tiny fish, fry, and some plankton like copepods and amphipods.

- **Shelter**—the mangrove roots give the barramundi a place to hide and find food, and also shelter the food the barramundi needs.

- **Water**—all animals need a good supply of water. In the years when there is drought, barramundi sometimes find it hard to make it back into the saltmarsh to lay their eggs. Also, the water flow into the mangroves carries much of the rich sediment we call detritus, which is necessary for a healthy ecosystem.

- **Space**—the barramundi needs adequate space. If a species is overcrowded, there is too much competition for food, and the animals become stressed. All these factors make up habitat.

Later, when we explore the mangroves, you’ll meet some of these animals and look at some of their adaptations—like how they move, breathe, and feed in this ever-changing environment called the mangrove swamp.
Figures to use in story board

Algae

Detritus
MANGROVES AS HABITAT

Dragonfly

Mosquito
MANGROVES AS HABITAT

Illidge’s Ant Blue Butterfly

Phytoplankton
Seed Shrimp

Ghost Shrimp
MANGROVES AS HABITAT

Oyster

Lizard
Frog

Fiddler Crab
MANGROVES AS HABITAT

Mud Crab

Barramundi
MANGROVES AS HABITAT

Duck

Black-winged Stilt
Terek Sandpiper

Heron
MANGROVES AS HABITAT

Whimbrel

White-bellied Sea Eagle
MANGROVES AS HABITAT

Flying Fox

Water Mouse
MANGROVES AS HABITAT

Dugong

Water
Grey Mangrove

Red Mangrove
Sun
Activity 2-D: Touchy-Feely Bag

**Summary** Mangrove ecosystems have a complex food web. Students will select an object and say whether it is found in the mangrove ecosystem.

**Learning Objective**
Students will be able to understand the basic functions of mangroves from the plants and animals that live there.

**Age Levels**
4–11

**Subject Area**
Science

**Time**
30–60 minutes

**Materials**
- Large black bag that looks mysterious, although a cloth shopping bag will also work well.
- Mature Red Mangrove seed (the entire seed)*
- Feather
- Shell (mangrove clam or any shell from a mangrove swamp)
- Crab claw (preferably fiddler crab) or shell
- Mangrove swamp mud (in a small plastic bag; smells like rotten eggs)
- Leaves (Grey Mangrove if possible) *
- Toy frog, fish, insect, duck, etc.
- Bird’s nest (only one that has fallen out of a tree)
- Water in a small, squeezable container
- Fish bones (remnants of a bird’s lunch)
- Grey Mangrove root
- Samphire and saltmarsh plants*

*Note due to the Fisheries Act 1994 (Qld) it is not possible to remove marine plant material (plants or seeds) without a permit.

To obtain a research permit, you will need to complete the **Code for self-assessable development - Works for educational, research or monitoring purposes in a declared fish habitat area or involving removal, destruction or damage of marine plants** – Code MP05 ([http://www.daff.qld.gov.au/__data/assets/pdf_file/0007/59632/MP05-Research-2011.pdf](http://www.daff.qld.gov.au/__data/assets/pdf_file/0007/59632/MP05-Research-2011.pdf)).

Under the code, you are limited to collecting no more than two buckets each having a capacity of 10 litres of marine plants in one day. Once completed you fax or email the form to the District Officer of the nearest Queensland and Boating Fisheries Patrol and the Manager (Planning and Assessment) of the relevant regional Fisheries Facility at least 5 business days but not more than 20 business days before you need to collect your samples. Otherwise, please substitute resource materials such as photos for this activity.
MANGROVES AS HABITAT

Background
Copy of mangrove ecosystem description from page 2-2 to 2-5, or illustrations in this section.

Procedure

1. The materials list offers a sample of mangrove wetland artefacts that you could put into the bag. Add other items or substitute when necessary. Keep these items in a safe place for future use, to lessen the impact on our environment of collecting natural items.

2. Introduce mangroves to your class if you haven’t already done so. Call upon a volunteer to come to the front of the room.

3. Blindfold the student and have him or her reach into the bag and pull out one item. Or you may prefer to put an item in the student’s hands. (This causes less disturbance to your collected items.) Have the volunteer hold the item up for the class to see. Remind the other students not to call out the name of the item.

4. While feeling the item and smelling it (if appropriate), the student describes how it feels and smells, then tries to guess what it is. If necessary, the class may help with clues.

5. Remove the blindfold so the student can see the object.

6. Repeat for several items and volunteers.

Discussion/Reflection
How are the different items in the mangrove ecosystem related to each other? Can you think of other items you might find that would be related to each other.
Activity 2-E: Living Web

**Summary** Students will learn that mangrove ecosystems have a complex food web with many different kinds of wildlife and plants dependent on each other for food and shelter.

**Learning Objectives**

Students will be able to:
(a) describe a mangrove system food web; and
(b) predict changes in a mangrove system that will occur if one or more parts is removed.

**Age Levels**

6 and up

**Subject Area**

Science

**Time**

30 minutes

**Materials**

A ball of string or thick wool at least 20–30 m long

Picture cards from pages 2-21 to 2-42 (see following list) sun, water, phytoplankton, algae, mangrove trees (red and grey), detritus, dragonfly, Illidge’s ant-blue butterfly, mosquito, copepod, amphipod, seed shrimp, ghost shrimp, crayfish, oyster, snail, fiddler crab, mud crab, lizard, frog, barramundi, permit, mangrove jack, sting ray, green turtle, crocodile, snake, duck, black-winged stilt, terek sandpiper, heron, whimbrel, white-bellied sea eagle, flying fox, water mouse and dugong.

Pictures of items can be photocopied from the drawings on pages 2-21 through 2-42.

If necessary, punch a hole in each and attach string or flagging tape long enough to hang the cards around the students’ necks.

Master list for teacher.

**Background**

Everything in a mangrove ecosystem is dependent on everything else—the baby fish that need the invertebrates as food and the mangrove tree roots as shelter; the fiddler crab that needs the mud as shelter and the leaves as food; the Heron that eats fish and invertebrates in the mud and water. And, of course, almost everything needs the sun and water for its survival. The removal or damage of any part of this ecosystem by pollution or any other form of destruction will have a profound effect on the rest of the creatures that live within it. The mangrove ecology description from page 2-2 to 2-5 shows these links in more detail.

**Procedure**

1. Attach a card representing a member of the mangrove ecosystem (including sun, water, sediment, phytoplankton, algae, detritus etc.) to each student.

2. Have the students stand in a small circle; the teacher stays outside the circle.

3. As the teacher calls out an item, the student holding the ball passes it to the student wearing the appropriate card. The teacher first call out “Sun” and passes the ball of string to the student wearing
the sun card. From then on, depending on age level and the particular class, either the teacher or
the students can call out the names of the items in turn.

4. Someone who needs sun (all qualify) calls: “I’m Red Mangrove, and I need Sun.” Sun passes the
ball of string to Red Mangrove, but still holds onto the end of it. Fiddler Crab might say “I need Red
Mangrove leaves for food” and is passed the string while Red Mangrove and Sun still hold onto it . . .
and so on. The reverse relationship might also be used; for example, Water might say, “I’m Water
and Fiddler Crab needs me.”

5. Continue game, connecting all the correct items. (Try not to cross the centre of the circle too
often, as it uses a lot of string.) The string should join all the students in a web.

6. Remove an item (a student drops the string and backs out of the circle) because of pollution or
other harmful impact on the ecosystem. Remove other items that might be affected by the
particular impact. Ask students to explain what is happening to a healthy food web. What is the
result if an item within this web is removed—say Red Mangrove dies (Red Mangrove lets go the
string)? How does it affect the species connected to it?

Discussion/Reflection
Ask students which items are producers (plants) and which are consumers.
Ask students to describe one food chain in the student-made web.
There are simple (a few items) and complex webs. Which webs are more able to handle losses of
individual species?
Discuss why some items might be removed (for example, pollution, and development).
Activity 2-F: Mr. Frog’s Dream

**Summary** Traditional story of a frog wanting to fly like a duck

**Learning Objective**
Students will learn about the role of animals in wetlands.

**Age Levels**
7–11

**Subject Areas**
English and Science

**Time**
30–60 minutes

**Materials**
Story

**Background** Not needed

**Procedure**
1. Read the story to the class. You can tell them the tale or have them participate by role-playing the different creatures in the tale.
2. List key science words (what students remember).

**MR. FROG’S DREAM**
*(This story has been adapted from a Central American tale told by the Nicarao people of Nicaragua, and depicts what happens one spring time to the talkative, self-centred Mr. Frog. You can set it in any mangrove or other wetland near your own school. If you give Mr. Frog a strong local or regional accent, the story works even better!)*

JUST DOWN THE ROAD, in a pond at the edge of Baldwin Swamp, lived a handsome young frog that had many talents. His name was Mr. Frog. Now, Mr. Frog wasn’t just any old frog; he could jump further [have the students practise jumping], swim faster [have the students practise swimming], and sing louder [have the students practise “ribbetting”] than any other frog in the whole wetland. He was so highly admired that all the other frogs and the creatures that inhabited the pond called him MISTER Frog.

Now, Mr. Frog could also talk. Well, all frogs can talk a little, of course, but Mr. Frog talked all the time, loudly and unceasingly. And do you know what he talked about? Himself, and, of course, his own accomplishments, which he considered most spectacular. “I am such an incredible creature,” he boasted. “I can jump higher, swim faster, and sing louder than any other frog in the whole world.” Pretty soon all the rest of the creatures in the pond got pretty bored with Mr. Frog’s constant boasting, and whenever they saw him coming, they would pretend they had something very important to do. They would dive to the bottom of the pond to look for something to eat, or hide behind a mangrove tree. They would do everything they could to avoid him. But Mr. Frog didn’t care, because he had the birds to talk to. Every spring and fall, when the migrating shorebirds stopped off at the mangrove pond for refreshments, they would be entertained with Mr. Frog’s
stories of his marvellous prowess and general brilliance. In fact, they encouraged his noisy boastings. Of course, they didn’t have to listen for very long—just for a few days, while they ate lots of food to get them ready for the next portion of their flight. They thought Mr. Frog was a very amusing fellow.

Summer ended, and the coolness of winter began. The birds had all made it to their warm wintering grounds—some even stayed in Baldwin Swamp for the season. Mr. Frog, however, had slowed down, and was spending a lot of time dozing in the shade of the mangroves. He’d wake now and then for an occasional nibble when it rained, but most of the time he just snoozed. And as he snoozed, he had a wonderful dream: he dreamed that he could fly!

One morning in early springtime, Mr. Frog finally emerged from his winter lassitude and swam over to his favourite lily pad. There, he basked in the sunshine and thought about his dream. Normally, he would have been very chatty, and would have leaped around enthusiastically. But this morning he just sat quietly contemplating. And every so often he would examine himself in a very peculiar manner. He twisted and turned and tried to look at his feet, his legs, his back . . . but he just couldn’t figure out how he was going to fly. He knew he wanted to go with the birds, flying to faraway lands and seeing strange and wonderful things, but how was he going to do it? However, he wasn’t so deep in thought that he forgot to eat, and every so often his long, sticky tongue would dart out and zap a nice juicy insect.

Mr. Frog was so quiet that all the other creatures in the mangrove pond thought there was something wrong with him. So they gathered around and said, “Mr. Frog, Mr. Frog, what is the matter with you? You haven’t said a word since you woke up. Are you sick or what?”

Well, now Mr. Frog had an audience, and he never could resist an audience. He drew himself up regally and said, “Well, you creatures of the pond, I have to tell you that I had the most amazing dream.” “A dream, Mr. Frog?” said the creatures. “What kind of dream?”

“I dreamed,” he said, “I dreamed . . . that I could FLY. Like a bird.”
“Yeah, right,” said the creatures in the pond, “How?”

Mr. Frog hadn’t quite figured that out. So, he thought long and very, very hard, and then suddenly he knew. “Ah yes, of course, what a genius I am! Sometimes I astound myself with my own intelligence. Such a brilliant idea, so simple, yet absolutely brilliant. Ah, I have the brainpower of a million, zillion other creatures to have come up with such an incredible scheme!”

“Tell us how, Mr. Frog! How?” all the creatures chorused.

“No, no, no,” said Mr. Frog, “That’s for me to know, and you to find out.”

And with that he hopped over to the edge of the pond where Mrs. Swallow was resting in the mangrove trees. “Hey, Mrs. Swallow, good morning. Have you seen the ducks?”

“Sorry, Mr. Frog, I haven’t seen the ducks on this trip. Why don’t you try the sandpipers over on the edge of the pond? They just flew all the way down from Northern Siberia. Maybe they saw the ducks on their way here.”

“Okay,” said Mr. Frog, and swam over to where the sandpipers were busy pecking in the mud, looking for yummy bugs to eat. “Hey, Sandpipers, have you seen the ducks?” he asked. “Nope—sorry, Mr. Frog,” replied all the sandpipers in unison. “Haven’t seen the ducks. And we can’t talk to you right now—too hungry. Gotta eat, eat, eat before we head north. Try some of the other pond creatures; maybe they saw the ducks.”

So Mr. Frog tried some of the creatures he hadn’t asked before. But nobody had seen the ducks. And so, very disappointed, he made his way sadly back to his favourite lily pad and sat staring miserably into the water—when, all of a sudden: “Quack, quack, quack.” Down came two wild ducks and landed on the pond.

“Oh boy, oh boy,” exclaimed Mr. Frog, as he swam hurriedly over to where the ducks were quenching their thirst. “Ducks, am I ever glad to see you!”

“Mr. Frog,” said the ducks, “how nice to see you again. Did you have a good winter?”

“It was a wonderful winter,” burbled Mr. Frog. “I had the most incredible dream.” And he was so rude that he forgot to ask the ducks how their winter had been. But they didn’t mind, because they were used to Mr. Frog’s ways.

“A dream, Mr. Frog?” they asked. “What kind of dream?”

“I dreamed . . .,” said Mr. Frog, “I dreamed that, with your help . . . I could fly.”

“Oh, I don’t think so, Mr. Frog,” said the ducks. “No, no, no. This sounds like another crazy Mr. Frog scheme to us. But, even if we could help you fly, where would you want us to fly you to?”

“I would love to fly with you to your summer home, where you make your nests.”

“Oh, I don’t think so, Mr. Frog,” said the ducks. “No, no, no. That would be much too far to fly—even if you do have some crazy scheme that works. The best we could do is fly you around the pond. Okay?”
Well, Mr. Frog was really disappointed, as he’d wanted to fly to faraway lands. But he didn’t dare say anything, just in case the ducks changed their minds. “Oh, no, that would be wonderful,” he chattered excitedly. “That would be absolutely marvellous. I would love to fly round the pond.”

“Oh, I don’t think so, Mr. Frog,” said the ducks. “No, no. no. Really, where do you get these crazy ideas? A reed in our beaks? Whatever next? But, you know, we don’t have anything else to do right now, so, what the heck, why don’t we give it a try? Off you go and get your reed.”

So Mr. Frog swam happily to the edge of the pond, found the perfect reed, and swam back with it in his mouth. He gave one end to each of the ducks to carry in their beaks, and was about to grab the middle in his mouth when the oldest and wisest duck said, “Now, Mr. Frog, a word of warning, and a word of advice. And we know this next bit will be very hard for you. Even supposing this crazy scheme of yours works—and we’re not convinced it will—under no circumstances must you open…your…mouth.”

“Moi? Open my mouth? Oh, you make a silly joke, yes? I would never do anything so stupid,” protested Mr. Frog.

“Okay, Mr. Frog,” said the ducks, “Don’t say we didn’t warn you.”

With that, the ducks grabbed the two ends of the reed in their beaks, and Mr. Frog took the middle in his mouth. Together they splashed across the pond, and pretty soon they were airborne. This was incredible. Mr. Frog had never been so happy. His dream had come true—he was actually flying. He looked down at the pond, and all the creatures there were looking up at him with admiration. Even the butterflies flitting by said, “Mr. Frog, Mr. Frog! You’re flying, just like us. Oooh!” And Mr. Frog began to think that maybe the ducks would change their minds, and fly him north. But then he looked at the ducks—and, being Mr. Frog, he got a wee bit jealous because they were so pleased with their performance. But he didn’t dare do anything about it.
The ducks started to really get into the whole project. They flew around the pond faster and faster. They boldly swooped lower, then higher, and then down they went. Round and round. Up and down. Faster and faster, until they were going so fast that Mr. Frog began to get dizzy—so dizzy that he couldn’t think.

“Stop!” he yelled. “Stop!”

And with that, he let go the reed and fell from the sky.

A gasp of horror came from the crowd below him, and they scattered in every direction to take cover.

With a mighty splash, Mr. Frog hit the water, and sank, stunned, to the bottom.

After a little while, he made his way woozily to the surface. His ego was totally deflated. So he found his favourite lily pad and sat there, staring miserably into the water. When the pond grew calm again, all the creatures gathered round him. His youngest cousin, who was the bravest frog of all (after Mr. Frog) timidly asked, “Mr. Frog, Mr. Frog, what happened? Tell us what happened.”

“I do not wish to speak of it,” said Mr. Frog. “Never again shall words of my dream or this event pass my lips. And I don’t want any of you,” he yelled angrily at the pond creatures, “to ever, ever, ever, speak of this again. Okay?”

“Okay,” they said.

And from that day ’til this, nobody ever spoke of Mr. Frog’s dream again.
Activity 2-G: The Story of the Rainbow Serpent

**Summary** Indigenous perspectives

**Learning Objectives**
Students will be able to:
(a) Identify some of the mangrove animals they have been learning about;  
(b) Identify at least one of the Indigenous methods of capturing fish;  
(c) The importance of sharing a resource in Aboriginal societies; and  
(c) Enjoy the story.

**Age Levels**
4–11

**Subject Areas**
English, Sustainability and Aboriginal and Torres Strait Islander histories and cultures

**Time**
30–60 minutes

**Materials**
Story

**Background** Find out some more about the Rainbow Serpent and its significance in Aboriginal society.

Aboriginal people believe that the Rainbow Serpent created the Earth during the Dreamtime. It is named for the connection between the shape of a rainbow and the shape of a snake. When the rainbow is seen in the sky, it is said to be the Rainbow Serpent moving from one waterhole to another, and this concept was used to explain why some waterholes never dried up when drought struck. There are many names and stories associated with the serpent, all of which communicate the significance and power of this being within Aboriginal societies. It is viewed as a giver of life, through its association with water, but can be a destructive force if angry. The Rainbow Serpent is one of the oldest continuing beliefs in the world and continues to be a cultural influence today.

**Procedure**
1. Read the story.
2. Have students illustrate the story.
3. Discuss in the class some of the lessons contained in the story and why they might have been important in Aboriginal society, why those lessons are still important today and introduce the concept of sustainability.

**The Story of the Rainbow Serpent**

There were once two young fellas who were heading down to their local waterhole with a big bundle of bark under their arm. As they headed down to the waterhole, they passed an old man sitting under a tree.

“Where are you going?” asked the man.
“We’re going to poison the river and get some fish,” replied the two young men. The old man asked the two younger men if they could bring just enough back for him and his family.

When the young men got to the river, they prepared the bark to make the sap run. They jumped in the water, making sure there were no crocodiles around and began to distribute the sap around the river.

A couple of hours later the men began to notice the first ripples in the river and saw the fish floating to the top of the water. They slipped into the water and took enough fish for themselves and the old man, however instead of stopping there and leaving the rest of the fish for others, they continued to take the fish and throw them on the bank to rot.

The Rainbow Serpent, Yamini, was watching the men from the far side of the waterhole and became very angry about their actions, as they killed and discarded of the fish for no reason. Yamini decided to set a big barramundi in the middle of the river and when the men went to get the barramundi Yamini grabbed them, swallowed them, and disappeared back into the waterhole.
It was getting late and the old man sitting under the tree had still not heard from the two young men. When he got down to the river, he saw all of the dead fish on the banks and the water was boiling over. The old man began to dance around the water and as he danced, he noticed a tunnel where the Rainbow Serpent had left the waterhole.

The old man followed the tunnel until he came to a large area of anthill plains where he caught up with the Rainbow Serpent. Using his spear, he jabbed Yamini who reared up out of the ground and spat the two men’s bodies out, covered in slime. The old man covered the two young men in sand and propped them up against an anthill. As the ants crawled up the men’s bodies and started to bite them, they began to move and the breath of life was put back into them.

By this time, the rest of the tribe had seen what happened at the riverbank and they too followed the Rainbow Serpent’s trail. They arrived just in time to hear the old man telling the two younger men about how wrong it was to be so greedy and throw all of the fish on the bank to rot. “Your greediness is what upset the Rainbow Serpent,” the old man said.

From that day on, and still today, when an Indigenous Australian who is familiar with the story of Yamini goes near a waterhole, they make sure they only take enough fish to feed themselves and their family, as they know the Rainbow Serpent is watching.

The lessons learnt by the two young men in the Rainbow Serpent story have helped today’s Indigenous Australians to understand the values of wetlands and they respect the waterhole for the precious food, resources and cultural significance that it offers.

Discussion / reflection:

1. Why do you think the old man asked the young men to bring back some fish for him and his family? [Respect for elders is very important in Aboriginal society].
2. How did the young men kill the fish in the river? [They used a plant sap that stunned the fish. The Australian Indigo bush (Indigofera australis) is one of several bushes or trees used by Aboriginals to stun fish. The poison, obtained by crushing the roots of the plant affects the fish but not the people eating the fish.]
3. Why do you think it would be important not to kill all the fish in the river? [If all the fish were killed there would be no food for next time. The Aboriginal people collected all their food from the environment around them, if there was no more food, they would have to move to a new area. They carefully managed their food supplies and even burned the grasslands to encourage the growth of grass and young plants to bring in food like kangaroos and wallabies. The Aboriginal people knew it was important to live within the food that they had available...They couldn’t just nip down to the local supermarket because they’d run out of cereal in the morning.]
4. What lessons did Yamini teach the young men? [Sharing, take only what you need and respect for their natural environment and the food that it provides].
Activity 2-H: Crusty the Fiddler Crab

**Summary** Story of a fictional Fiddler Crab’s adventure.

**Learning Objectives**
Students will be able to:
(a) Identify some mangrove animals and learn about moulting;
(b) Build a food web; and
(c) Enjoy the story.

**Age Levels**
4–11

**Subject Areas**
Science, English and The Arts

**Time**
30–60 minutes

**Materials**
Story
Handout: illustration of Fiddler Crab on page 2-55

**Background**
Fiddler crab data from the introduction to this section.

**Procedure**
1. Preparation: Ask students to sketch a Fiddler Crab (or show them an illustration of a fiddler crab from page 2-55).
2. Read the story.
3. Have students illustrate the story.

**Discussion/Reflection**
Create a food web for the story.

What sort of animals moult? *[Those with external skeletons.]*

What is the difference between the way crabs grow bigger and the way you grow bigger?

Extension: After the story, have students label on the drawing the various parts of a fiddler crab.

Ask students what other adventures Crusty might have.

**THE ADVENTURES OF CRUSTY**

(Begin by explaining that the students will be involved in an adventure. Introduce the main character of this adventure by displaying a picture of a fiddler crab, and tell the students that the main character of the story is a fiddler crab called Crusty. Ask the students, “Can you guess where this story will take place?” *[Answer: The mangroves and seashore.]*

Students could also role-play how crabs move, simulating how and what parts are used to feed and protect themselves. They could also “become” moulting crabs, escaping their too-small outer covering.)
MANGROVES AS HABITAT

Have students assume various roles: Crusty, the gull, the waves, etc. When you reach the sounds, have the students give the sound effects and also role-play where called for—pinching, scrambling sideways, tumbling, shedding shell of crab; screeching and flapping of gull; whoosh and thundering of ocean waves.

CRUSTY IS A FIDDLER CRAB who lives in a burrow in the mangroves on the edge of the ocean. Can you guess why his name is Crusty? [He has a hard, crusty outer covering.] Crusty also has a pair of large pincers, one much bigger than the other. How do the pincers of a crab work? [The powerful pincers open and close like a pair of pliers, and are often used for gripping and crunching.]

Crusty awoke one morning to the cries of a gull overhead: “SCREEETCH, SCREEETCH.” He stuck his eyes out from underneath his favourite mangrove root. Crusty’s eyes, like those of all fiddler crabs, are on stalks and move like a computer-game joystick so he can see all around. Crusty waved his big claw around, but the gull was too busy to notice him. Crusty watched the gull drop a clam from the sky onto the rocky beach nearby. The gull cried out louder “SCREEETCH, SCREEETCH!” The clam was now out of the seagull’s reach.

Moving sideways, Crusty scrambled out of the shelter of the mangroves and along the sandy beach towards the clam. He was curious to see what had happened to it. Crusty seldom went far from his mangrove home, where all his crab cousins lived. Before he reached the clam, he found himself travelling over a pile of dead seaweed. Feeling hungry, he cut up the tasty seaweed with his pincers and moved it to the six pairs of movable mouth parts on the underside of his shell. Crusty sat enjoying a most delicious breakfast. As Crusty munched, he noticed a rumble and began to feel vibrations on the sand. The waves came closer and closer. He had not paid much attention to how far down the beach he had travelled, and now, as the tide came in . . . WHOOSH!

A large wave rolled in and picked up Crusty. It tumbled him over and over in the foamy water and then dropped him far down the shore, past the sand and in the rocks where the clam had fallen.

As Crusty picked himself up to begin his walk back up the beach, he discovered that one of his walking legs was missing. Do you know how many walking legs a crab has? [Eight.] Crusty was not worried because he could still walk, and he knew he would eventually grow another leg. When a crab’s tough outer covering becomes too small, the back splits open. The back end of the crab’s body pops out first. Then the crab pulls and tugs each of its walking legs and pincers out of the old covering like a person taking off a coat and gloves. The crab still has a covering on its body, but its new covering is soft. The crab pumps it full of water to enlarge it so the crab can continue to grow. The soft carapace absorbs chemicals from the sea and gets hard in a couple of days. The shedding of the covering is called moulting. Can you name other animals that moult their outer covering? [Grasshoppers, cockroaches, some other insects, and snakes.] Crusty knew that with each moult to follow, he would grow some more of the new leg to replace the one he lost when the big wave hit. Eventually, he would have a complete new walking leg.

Crusty wondered where the big wave had dumped him. Looking up, he realized he was at the bottom of a deep pool. He saw the steep sides lined with shiny green and brown seaweed—alive,
Crusty had never ventured this far from home. When he saw two large eyes staring at him, he knew why! The eyes belonged to a creature with a big head and bigger mouth, and it was swimming up fast and very fiercely. Can you guess what creature was eyeing Crusty? [A large eel.]

Crusty crawled up and out of the tide pool and scurried sideways up the beach as fast as his little legs could carry him. Finally he was greeted by his crab cousins, waving their pincers from their burrows under the mangrove trees. He was home at last.
CRUSTY THE FIDDLER CRAB
MANGROVES AS HABITAT

WHY BIRD-WATCHING?

Bird-watching, or birding, is an ideal way for young people to gain an understanding about wildlife and the world of nature. Many activities can begin in the classroom, and field trips using natural mangroves (because there are so many different species to be found in wetlands) are excellent places for students to learn about birds, habitats, ecosystems, and how to care for the environment.

In the following activities, students will sharpen their observation skills as they learn the basics of bird identification. They learn to use size, shape, sound, behaviour, and field marks to tell the difference between ducks, herons, shorebirds, songbirds, and others.

We have included activities on bird identification that need to be supplemented with information about the birds found in your area. PowerPoint presentations (such as those available through the Queensland Wader Study Group Shorebird Identification Kit for Children), the Shorebirds 2020 Oz Shorebirds app (for iPhone, iPod and Android) and colour photographs are effective tools to help students learn about the birds they might see on the field trip. Local Coastcare group, Natural Resource management groups and local birding clubs in your area will almost certainly be willing to give a presentation on local species of birds. Ask your students if they can identify any birds, and if so, what the local names for them are.

Taking students birding may also help to build a new generation of stewards for our environment. If you instil in children a basic understanding of nature, they will grow up to be more environmentally sensitive and responsible adults.
Activity 2-I: Feather Features

Summary Students will learn how birds’ feathers enable them to fly and keep warm.

Learning Objectives
Students will be able to:
(a) Describe two types of feathers
(b) Describe parts of feathers and how birds keep them clean

Age Levels
6 and up

Subject Area
Science

Time
60 minutes

Materials
Collection of contour and down feathers
Paper and pencils
Small amount of salad oil
An overhead projector (if available)
Magnifying lenses (if available)
Handout: copy of page 2-59 illustrating feathers

Background What makes birds different from all other animals is that they have feathers. Other animals—bats /flying foxes, and many kinds of insects—can fly; reptiles, fish, insects, and some mammals (platypus) lay eggs; but only birds have feathers.

Feathers have many functions: they enable a bird to fly, keep warm and dry, hide from predators, and communicate with other birds.

There are two main types of feathers: contour feathers and down feathers. Contour feathers are the most common feathers. They cover the body, wings, and tail. They are smooth and firm, give a bird its smooth, sleek shape, and protect the bird from heat and cold. They are waterproof, serving as a bird’s raincoat. Flight feathers are special contour feathers on the wings that are shaped to help in flight. Down feathers are fluffy and soft. They lie under the contour feathers, close to the bird’s skin, and help to keep the bird warm by trapping a layer of air next to its body. They act like a bird’s down jacket. The softest, fluffiest feathers, the ones used by humans to stuff warm jackets and quilts, grow most thickly on birds that live in cold climates, especially waterbirds such as ducks, geese, and penguins.

Birds spend a lot of time every day preening—cleaning, arranging, and oiling their feathers with their bill. Preening is essential for birds. If feathers are not kept in shape, they lose their ability to keep the bird warm and dry. Most birds have a “preen gland” on the rump at the base of the upper tail feathers. Using its bill, the bird squeezes oil from this gland and then works it into the feathers,
drawing one feather after another through the clamped bill. The oil cleans and conditions the feathers and makes them waterproof. It is also thought to inhibit the growth of fungi and bacteria.

**Procedure**

1. Several days before the class, have students collect and bring in feathers. It doesn’t matter if these come from wild birds or from chickens—feathers are feathers!

2. Let students explore how they can “ziplock” the feathers together by running their fingers along them. Compare flight/contour feathers with down feathers.

3. Sketch the features of the feathers and label the shaft (the hard centre tube that is hollow at the base) and the vane. (If the feather has one vane wider than the other, it is a flight feather from the bird’s wing or tail. The vanes of regular contour feathers, which cover the body, are the same width on each side of the shaft).

4. Observe a feather projected to illustrate the fine structuring and barbs. Have the students draw a picture of each projected feather.

5. Flap the down and contour feathers up and down. Describe how each feels.

6. Dip the contour feathers into the salad oil. Run water over them.

**Discussion/Reflection**

- How do barbs help a messed-up feather?
- What is the difference between the flight/contour and down feathers?
- Which feather holds up better in the wind?
- Which feather makes a better pillow?
- How do the feathers protect against water (rain, snow, etc.)?
MANGROVES AS HABITAT

Figure 2.1: Down Feather

Figure 2.2: Feather features

- Vane
- Shaft
- Barbs
- Barbules
Activity 2-J: Birds in Flight

Summary Students will learn how birds’ unique bone structure enables them to fly.

Learning Objectives
Students will be able to:
(a) Describe the differences and similarities between the human arm and the bird wing; and
(b) Simulate bird flight patterns.

Age Levels
6 and up (terminology is for older students)

Subject Areas
Science, art

Time
60 minutes

Materials
Handouts: copies of page 2-61 illustrating wing and arm structure
Copies of “Flappers” from page 2-62
Eight index cards (5x10cm) per person
Scissors
Glue
Staplers
One large sheet of paper for each student

Background A bird’s wing is similar to our arm. Both birds and humans have an upper arm connected to the shoulder, an elbow that connects the upper arm to the forearm, and a wrist that connects the forearm to the hand. The upper arm and forearm make up the bird’s inner wing, and the rest of the wing is the hand section. Gliding birds such as gulls, frigatebirds and raptors like eagles have long inner wings compared to their small hand sections. The large inner wing provides the lift they need to soar. But flapping birds, such as finches, have smaller inner wings and long hand sections.

In flying, the wings perform two different functions. The arching inner wing stays steady, like the wing of a plane, while the “hand” feathers rotate, pushing ahead with every down-and-back stroke, much like swimmer’s hands stroking through water. This pulls the bird forward and draws air over the “arm” section of the wing. The feathers of the arm section form a curved arch. As the air moves over the arch, it creates lift over the upper section of the wing, and the bird rises. Sustained flight is the result of rowing forward to achieve lift on the arched feathers.

Procedure
1. Working in teams, students will extend their arms and locate the following bones and structures shown on the handout: humerous, radius, ulna, wrist, and fingers.
2. Study the handout and have students orally identify the comparable parts on a bird wing and their own arms.
3. Give each student a copy of the “Flappers” page and a set of index cards.
4. Have the students cut each index card exactly in half so each has 16 smaller cards. (All cards should be exactly the same size.)

5. Have the students cut out the pictures from “Flappers” and glue one on the bottom right-hand corner of each card. Be sure to keep the pictures in the same order in which they appear on the sheet.

6. Arrange the cards one on top of the other, starting with picture #16 on the bottom and ending with picture #1 on top.

7. Staple them across the side, as shown.

8. Flip through the cards and make the bird fly.

Discussion/Reflection
Ask each student to move his or her arms like a bird. Discuss how a real flight pattern is different from “Flappers”.

Figure 23: Bones and feathers - Human arm and bird wing
Figure 24: Flappers
Activity 2-K: Fill the Bill

Summary Each type of bird has a special beak and tongue adapted to eating a certain kind of food. In this demonstration, students can find out which beaks are best for tearing, scooping, stabbing, sucking, cracking, and picking up by going to different food stations that you have set up and deciding which tools go with which type of food.

Learning Objectives
Students will be able to:
(a) Describe eight different kinds of beak and how each is adapted to feed on different kinds of food; and
(b) Relate this adaptation to the birds’ survival in wetlands.

Age Levels
7 and up

Subject Area
Science (Adaptations)

Time
2 hours

Materials
Copies of “Fill the Bill Matching Game” from page 2-67
Two aquariums or other large clear containers
Large saucepan
Tall, narrow vase, bottle, or glass jar
Small log or large tree branch
Bowl
Long piece of string

Foods
• Raw rice
• Rice cereal (like Rice Bubbles)
• Plastic fishing worms or 7cm pieces of string
• Popcorn or tiny marshmallows
• Styrofoam chunks or pieces
• Oatmeal (oats/porridge)
• Walnuts (whole) or other nuts
• Grapes or stemmed cherries hanging from a string

Beaks (tools)
• Chopsticks, toothpicks, or small twigs (in pairs)
• Pliers or nutcrackers
• Tweezers
• Strainers
• Small fishnets or envelopes
• Bamboo skewers
• Eyedroppers or straws
Background Different kinds of birds have specially adapted beaks and tongues designed for eating certain types of food. This adaptation enables each species of bird to survive in its habitat, eating the food provided there. The following birds are found in Queensland and live in a variety of habitats.

Ibis, oystercatchers, sandpipers, godwits, Eastern Curlews and stilts have long beaks that they use to probe for worms, crustaceans, and other small creatures in mud and water.

Pelecans and spoonbills have long flattened and pouch-like beaks that they use to scoop up fish and other aquatic creatures.

Cormorants have a long bone coloured hooked bill for diving down and feeding on fish and crustaceans.

Egrets and herons have long, thin beaks for spearing frogs or fish in the water.

Beach-stone Curlews have thick bills for foraging on the exposed intertidal mudflats.

Ducks have bills that act like strainers, which they use to filter tiny plants and animals.

Raptors like Ospreys, sea eagles and kites use their talons to capture fish from the surface of the water and have a raptorial beak.

Terns and gulls have sharp heavy bills that are useful for diving into shallow water and feeding on small fish.

Cockatoos have short, powerful conical beaks that are very strong, with which they can break open tough seeds and get the fruit from around a seed.

Kingfishers have large strong beaks which is uses to eat insects and lizards. In wetland areas it also uses its bill to take fish and crustaceans.

Finches and mistletoebirds have short, conical beaks that are very strong and can break open seeds.

Plovers and stints have small, sharp, pointed beaks for crustaceans, worms and molluscs.

Honeyeaters and sunbirds have long, needle like beaks that they use to probe deep into flowers to feed on nectar.

Bee-eaters, swallows, flycatchers and fantails have large, gaping mouths that act like nets to trap insects. These birds catch insects on the wing.

Procedure

1. Set up eight different stations, each with a special type of food. At each station you will need three different tools, one that represents the beak that best fits the food (in one case, two) and two that don’t fit so well. Have a sign at each station that tells what type of food is represented (for example, a sign that says Nectar at station 1, a sign that says Worms at station 2 and so on).

The following is a list of food and tools for each station. The correct tool is indicated by an asterisk (*). In one case (station 4), there are two correct tools, for two different types of fish-eating birds; the second correct choice of bird and tool is indicated by a double asterisk (**).
**MANGROVES AS HABITAT**

**Station 1:** Large saucepan filled with dry oatmeal, with pieces of string or plastic fishing worms on the bottom to represent worms buried in the mud (Ibis, oystercatchers, sandpipers, godwits, Eastern Curlews and stilts)

**Tools:**
- chopsticks, toothpicks, or twigs*
- pliers or nutcrackers
- strainer

**Station 2:** Whole walnuts or other nuts to represent seeds with hard coverings, such as sunflower seeds and pine seeds (finches, and parrots)

**Tools:**
- pliers or nutcrackers*
- tweezers
- chopsticks, toothpicks, or small twigs

**Station 3:** Styrofoam chunks floating in an aquarium or other large container filled with water, to represent fish and other aquatic animals. (Spoonbills, pelicans,* herons, and egrets**)

**Tools:**
- large scoop or slotted spoon*
- bamboo skewer**
- eyedropper or straw
- chopsticks, toothpicks, or twigs

**Station 4:** Puffed rice in an aquarium or other large container filled with water, to represent tiny aquatic plants and animals. (Ducks)

**Tools:**
- strainer*
- tweezers
- pliers or nutcrackers

**Station 5:** Popcorn or tiny marshmallows, which must be tossed in the air and caught in the air, to represent flying insects. (Bee-eaters, swallows, flycatchers, fantails and kingfishers)

**Tools:**
- envelope or small fishnet*
- tweezers
- chopsticks, toothpicks, or twigs

**Station 6:** Rice spread on a log, surrounded by leaves (put rice under leaves as well), to represent caterpillars and other insects. (Bee-eaters)

**Tools:**
- tweezers*
- chopsticks
- strainer
Station 7: Bowl with water or juice representing nectar. (Honeyeater or sunbird)
Tools:
Straw

Station 8: Cherries or grapes hanging from a string to represent fruit hanging from a branch (Parrot)
Tools:
eye dropper or straw
strainer
nutcracker or pliers*

2. Pass out the copycat page on page 2-67.
3. Divide your group into eight teams. (i.e., if you have 40 students, each team will be made up of five students). Each team will start at a different station. Explain that there are three different tools at each station, each of which represents the beak of a different type of bird. Each group must decide which tool would most efficiently get the food at each station. (To decide, they must try each tool.) Also explain that one station will have two tools that work for the food provided.
4. Once they pick the best tool, they should match it with the appropriate food, using the “Fill the Bill Matching Game”. (You may want to set a time limit at each station to keep things moving).
5. Below the matching game on page 2-67 are pictures of different birds and their beaks. On the line underneath each picture, students should write the number of the tool that represents the correct beak. For example, they should write 1 on the line under the parrot.
6. Using the illustrations on page 2-68, students should describe how each bird uses its feet and bill to catch and eat food.

Discussion/Reflection
Discuss beak adaptations in general; explaining how, after millions of years, many birds have evolved very specialized beaks.
FILL THE BILL MATCHING GAME

Match the food in column 1 with the best tool for the job in column 2. Write the number of the correct tool on the blank next to the name of the food.

________Worms 1. Pliers or nutcrackers
________Seeds 2. Slotted spoon or scoop
________Fish and frogs 3. Strainer
________Tiny water plants and animals 4. Bamboo skewer
________Flying insects 5. Tweezers
________Caterpillars and crawling insects 6. Fishnet or envelope
________Fruit 7. Chopsticks, toothpicks, or twigs

Figure 25: Match that bill!
Figure 26: Birds’ Bills, Food and Feet
Activity 2-L: Bird Silhouettes

Summary Birds are found in many shapes and sizes.

Learning Objectives
Students will be able to:
(a) Use shape to identify familiar birds by matching silhouettes to the names of common birds; and
(b) Learn to distinguish between different shapes of beaks, feet, legs, etc.

Age levels
7 and up

Subject Areas
Science

Time
1 or 2 lessons or homework

Materials
Copies of Bird Silhouettes on page 2-70
Pencils

Background Over 230 species of birds have been documented in Australian mangroves. Some of these birds can be seen every day, and some are quite rare. The silhouettes are of commonly seen birds that are easily identifiable. Each has distinguishing features that are easy to spot if you look closely at the birds themselves. For more details about birds, their habitats and lifestyles please see bird identification books such as *Birds of Australia* by Jim Flegg and/or *What Bird is That?* By Neville Cayley.

Procedure
This is another activity to introduce the idea of identifying birds. In this activity, shape is used to identify some common birds.

1. The Bird Silhouettes on page 2-70 to 2-71 show the shape of some birds commonly found in the mangroves and wetland areas. Give each student a copy and see how many bird shapes they can identify. General names like “duck” are as specific as you need to get here, although with older grades, you can be more specific. You can also compare local names with “official” names.

2. Identify which birds are residents and which migrate to the mangroves. If the group is having trouble, you can write on the board the list of names they have to choose from. This can also be made a homework assignment together with the bird identification charts. The names are:


Discussion Discuss with the students what characteristics they used to identify the birds. Ask if they see these birds all year round or only in the winter. This is a good way to lead into the topic of migration. If a student has an “almost correct” answer (e.g., #3 Plover instead of Sandpiper), discuss the similarities of the species and how easy it is to mistake one for the other, but also point out that there are subtle differences and draw these to the students’ attention.)
Bird Silhouettes

1. Duck
2. Penguin
3. Night Heron
4. crane
5. Frigate Bird
6. Sooty Tern
7. Palm Tern
8. Kookaburra
9. Ibis
10. Cormorant
11. Stork
12. Penguin
Bird Silhouettes (Answers)

(1) Duck
(2) Osprey
(3) Sandpiper
(4) Heron
(5) Frigatebird
(6) Welcome Swallow
(7) Lorikeet
(8) Crested Tern
(9) Australian White Ibis
(10) White-bellied Sea Eagle
(11) Beach Stone Curlew
(12) Pelican
Activity 2-M: Spot the Difference: Birds

Summary Students will look for subtle differences among birds by listing the differences between drawings of two almost identical birds.

Learning Objective
By comparing two illustrations, students will learn:
(a) That birds have different plumage at different times of year; and
(b) How to spot characteristics of different birds in the field.

Age Levels
8 and up

Subject Area
Science

Time
10–20 minutes

Materials
Copies of “Spot the Difference” from page 2-73
Pencils

Background Review this section of this book, “Mangroves as Habitat”, concentrating on the parts about birds. Access additional resources (see resources section at the end of this guide) or field guides to your local bird species. At different times of year, birds change their plumage. They do this for many different reasons, including mating and breeding, as well as for migration.

Procedure Have the students list as many differences as they can find between the two bird drawings.

Discussion/Reflection
Discuss what differences were found.
What features do you think bird watchers use to identify birds [Shape, size, beak shape, wing shape, tail shape, colour and call]?
Figure 27: Shorebirds - spot the difference
Migration is the seasonal movement of birds or any other animal. Many birds have a summer home and a winter home, and each year they make the same round trip from one home to another. Some birds migrate only a short distance, but the majority fly thousands of kilometres every year.

More than one-third of the world’s bird species migrate with the seasons. Where do birds go? How do they know where to go and how to get there? Migration is complex, and science is still searching for many of the answers.

Why do birds migrate?
In order to survive, every animal needs a place to feed, rest, and reproduce in safety. Often these activities require different habitats, so the animal must move from one to another.

Many birds cannot live all year round in the place in which they were born and in which they breed. They are forced to leave when conditions become inhospitable, and return later when they improve.

Several species of migratory shorebirds breed within Russia, North Eastern China, Siberia and Alaska. These birds then migrate large distances to the Australian coast and associated mangrove areas to “winter” here (in our summer) and avoid the extremely cold climates of their nesting areas. The birds migrate south to find more abundant food sources to prepare for their next breeding seasons and what better place to do it, than in the well-stocked areas of coastal mangroves and tidal wetlands of Australia?

The incredible journey

Night or day: Some species migrate at night, others during the day. Ducks and wading birds are more likely to migrate during the night. Many small birds also fly under protection of darkness.

Speed: Migrating birds fly at a more or less constant rate. Ducks can do up to 80 km/h (and sandpipers fly up to 90 km/h. How long it takes a bird to migrate depends on how favourable the weather is, and how abundant the food along the way. A regular migratory visitor, the Bar-tailed Godwit is documented to complete the longest non-stop migration ever recorded completing a journey of just over 11 000km in approximately 9 days!

Rest stops: During migration, most birds don’t usually fly non-stop. They make a few stopovers for one or two days or even longer. These rest stops are usually after long stretches of sustained flight, and they are made in large wetland or estuarine areas—like mangroves—places particularly rich in food. These sites are called staging areas and include places like the Yellow Sea in China. The staging areas make up a chain of wetlands between Australia and Siberia called the East Asian Australasian Flyway.

Weather: Sometimes bad weather forces birds to stop and wait for several days. Heavy rain can delay migration, and a rainy front may cause migrating birds to turn back. Wind can slow migration
and even blow birds completely off course, especially if they are migrating over the ocean. Thick fog often confuses the birds’ sense of direction.

**Dangers:** Half of migrating birds never reach their destination. Birds face hazards such as storms with rain, ice, snow, and lightning; predators, predators like hawks and human hunters; tall buildings with glass windows; towers and power lines; airplanes and jets; and pollution, such as oil spills. Birds must pass through areas where their particular kind of food is scarce, through unfamiliar landscapes with unknown predators. Many must fly long distances over the open ocean with no place to land. Sometimes, after flying thousands of kilometres, birds arrive to find that their marsh, mudflat, or mangrove home has been filled in, paved over, or dredged while they were gone.

**How do birds find their way?**
How birds find their way from one home to another is a mystery. Scientists are still studying how birds navigate. They are thought to use several different methods, and different species seem to use different combinations of these methods.

Birds that migrate by day are thought to use their eyes, looking for landmarks such as rivers, mountain ranges, and coastlines. Some birds may also use the position of the sun in addition to landmarks.

Birds that migrate at night seem to orient themselves to the position of the stars. Small land birds migrating at night fly with the airflow. In spring, they fly northward on warm air masses coming from the south, and in the fall, they fly on cool winds flowing down from the north.

Birds are thought to use bands of polarized light, and the Earth’s magnetic directions. Some birds find their way by recognizing odours, by long-distance hearing, or by following other migrating birds. Other birds also learn the migratory route from their parents and once learned younger birds can travel these routes by themselves.
Activity 2-N: Migration Homework

Summary Mangroves are home to many species of migrating birds.

Learning Objective
Students will be able to write a story or poem about bird migration.

Age Levels
6 and up

Subject Areas
English, Science and social studies

Time
30 to 60 minutes

Materials
pencil
paper
copies of pages 2-74 to 2-76 on migration
copy of local Field guide to Bird Identification

Background There are two types of birds found in Queensland: residents, which live here year-round, and visitors, which are migrants that usually spend the summer here. Many of these birds are found in people’s gardens, and, of course, are seen frequently in the wild. Birds found in mangroves range from Beach Stone Curlew (residents) to Bar-tailed Godwit (migrants). Determining whether they are residents or migrants is a simple task: consult your local Field Guide to Bird Identification, and it will describe all of the commonly seen birds of your local area. For more information about migration, see pages 2-74 to 2-76, and the background to the Migration Headache activity on page 2-80.

Procedure
1. Write a story or poem like October Birds on Page 2-78 about a bird that migrates to your local beach or wetland for the summer. Describe the problems it faces when it flies here. Describe where it lives and what it does when it gets here, and what it does when it leaves in the autumn and arrives at its winter home (which will be summer in the northern hemisphere).
2. Students can draw pictures if they wish to illustrate their stories.
3. Read the stories or poems aloud in class.

Discussion/Reflection
Have students compare notes in class about the birds they saw as well as where and when they saw them.

Extension Have students discuss with their parents and grandparents any differences they have noticed in the number and type of birds that they have seen. Brainstorm about why there is a difference (if any) between the numbers of birds seen now compared with earlier times.
Example:

The October Birds (Swallows)*

By Crystal Scott
Year 7, Cayman Brac High School

The leaves are beginning to turn red, yellow, orange and brown. Winter, you always bring me down, making me frown, all over town.

Before I go I must eat three times my weight. Will I ever get off my feet?

I will fly two days straight, looking for a handsome mate.

I can’t wait to fill my mouth when I reach far down south.

On Cayman Brac I’ll make my home for several months, I’ll not roam.

When flowers bud way up north, that is when I’ll venture forth.

*On bird migration
Activity 2-O: Migration Stories

Summary Students will be asked to write about a bird that migrates to their area.

Learning Objectives
Students will be able to:
(a) Describe a local migratory bird;
(b) Describe its winter habitat; and
(c) Describe any migratory problems it may face.

Age Levels
6 and up

Subject Areas
Science, language arts

Time
1–3 hours

Materials
Local Field Guide to the Identification of Birds
Or web-based resources such as the Shorebird 2020 website
Paper and pencil
Local people

Background (See “Migration Headache” activity on page 2-80)

Procedure
1. Find out what migratory birds come to your area.
2. Write a real or fictional story about the migratory route, populations, and habitat problems of one of these species.
3. Describe where you might find this bird in your country—what area and what kind of habitat it needs.

Discussion/Reflection
Have you seen this bird?
Where would you go, and in what seasons, if you were this bird?
MANGROVES AS HABITAT

Activity 2-P: Migration Headache

**Summary** Migrating birds face many hazards in their travels between wintering and breeding grounds.

**Learning Objectives**
Students will be able to:
(a) Describe the role of Queensland mangroves and tidal wetlands for migrating birds;
(b) List three factors that favour their migration success;
(c) List three factors that reduce migratory success; and
(d) Describe one action that will improve migration success.

**Age Levels**
7 and up

**Subject Areas**
Science, social studies

**Time**
1 or 2 lessons

**Materials**
One paper plate for every student or every two students, depending on class size (Clearly mark the plates to differentiate bottom from top.)

In this activity, each student represents thousands if not tens of thousands of migratory birds. The game takes up to 45 minutes (maybe more), and requires a large outdoor area such as a playing field, gymnasium, or basketball court.

Copy of Migration Maze on Page 2-83.

**Background** Explain to the students that many factors limit the survival of populations of migrating birds. Some involve changes in wintering and nesting habitats. Sometimes there will be abundant food, water, shelter, and space suitably arranged to meet the habitat requirements of the birds. At other times, when the habitat is stressed, many factors limit the potential for survival (see chart on page 2-83). Sometimes the area of available habitat is reduced.

Some limiting factors are a natural and dynamic part of any environment. This is also true of factors favouring survival. However, the significant difference to the survival of populations of migrating shorebirds and aquatic birds seems to be the loss or degradation of huge areas of suitable habitat, much of it as a result of human intervention—such as draining of wetlands, destruction of nesting cover, and pollution of water supplies. And not only does this occur in wintering and nesting areas, it also takes place on the flyways, where the birds are dependent on wetlands for “refuelling” and resting stops.

Be sure to create one or more “disaster” years to illustrate catastrophic loss of large areas of available habitat. Remember that, overall, the availability of suitable habitats for migrating birds is diminishing; the activity should end with fewer areas of available habitat than can accommodate the birds. There is general agreement that the greatest long-term threats to the survival of populations of migratory shorebirds and waterfowl are the loss and degradation of habitat.
Rules of the Game
1. Students move only on command.
2. Referees judge which students arrive first to the plate. (Remember how many students are assigned to each plate: no more are allowed).
3. Referees remove and replace the plates as told by the teacher.

Game Players
1. Move (migrate) from one end of the field to a plate.
2. Any student not reaching a plate is removed from the game.
3. The winners are those students left when the game ends.

Representation
1. Students are playing birds going to summer in wetlands in Australia or to summer wetlands in Siberia for breeding.
2. Removing plates represents wetland losses.

Procedure
1. Select a large playing area about 20m long. Place the paper plates in two patches, one at each end of the playing field.
2. There should be one plate for each student or every two students at each end of the field. Designate one of these areas “nesting habitat” (Siberia, Russia, China and Alaska) and the other “over-wintering habitat” (Australia). Choose one or two students to remain at each end (over-wintering and nesting habitat). Explain that they are the referees and in charge of the paper plates. When you ask, they must remove or replace the paper plates. In the event of a fight between migrating birds as to who got to the plate first, these students are the judge.
3. Explain to the students that they are birds that are commonly found in Australia in spring, summer, and autumn, and they will migrate between the two areas at your signal. Tell them that the plates represent wetlands. These wetlands provide suitable habitat for migrating birds (shorebirds, etc.) At the end of each journey, the students will have to have one foot on a paper plate in order to continue. If they cannot get their foot on a plate, that means they have not found any suitable habitat. They “die” and have to move, at least temporarily, to the sidelines and watch. During migration, the birds may want to “flap their wings”, moving their arms like birds in flight.
4. Round One Begin the activity with all the students at the over-wintering habitat in Australia. Announce the start of the first migration. Have the students migrate in slow motion until they become familiar with the process; then they can speed up. On the first try, all the birds will successfully migrate to the nesting habitat in Siberia. Explain that there has been no loss of available habitat. Thus, a successful nesting season is at hand.
5. Round Two Before the students migrate toward the wintering habitat, have the student referees remove or turn over one plate from the over-wintering region. Explain that a large wetland has been drained and used for condominiums and a golf course. Repeat the instruction to migrate, and send the birds to the wintering habitat. Have the one or two students that didn’t make it stand on the sideline. Tell the students that these birds have died as a result of loss of habitat. Remind any “dead
birds” that they will have a chance to get back into the activity. They can come back as new, young birds born in their Siberian and Arctic tundra breeding grounds.

*Note: The next round will result in a large number of students waiting on the sidelines to re-enter the nesting habitat. Allow two to four young birds to join in Round Three.*

6. **Round Three** Before the next migration to the nesting region, turn over or remove four plates in the nesting habitat. This represents a catastrophic loss. Tell the students that this is the result of an oil spill in the local river that severely damaged the wetland habitat. Instruct the students to migrate.

7. **Round Four (optional)** Repeat the process for eight or 10 migration cycles to illustrate the changes in habitat conditions with resulting effects on the birds. Give examples of the factors that might influence the birds’ survival.

**Discussion/Reflection**

- What factors encourage migration success?
- What factors reduce migration success?
- What happens to migrating bird populations when there are wetland losses?
- What can you do to improve migratory success?

**Extension:** When back in the classroom, ask students to do Migration Maze (page 2-80) to reinforce problems encountered by migrating birds.
Migration Maze

Both the Sharp-tailed sandpiper and the Red-necked Stint migrate from the Arctic to Australia for the summer. Both face deadly hazards on the way here.

Figure 29: Migration Maze
## Migration Headache Plates Chart

<table>
<thead>
<tr>
<th>Factors REDUCING survival</th>
<th>No. of plates lost*</th>
<th>Factors FAVOURING survival</th>
<th>No. of plates gained*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban development and land reclamation</td>
<td>5</td>
<td>Preservation of wetlands</td>
<td>4</td>
</tr>
<tr>
<td>Wetland drainage</td>
<td>5</td>
<td>Dynamic balance with predators</td>
<td>4</td>
</tr>
<tr>
<td>Conversion of wetlands to farmland</td>
<td>3</td>
<td>Restoration of habitat</td>
<td>3</td>
</tr>
<tr>
<td>Pollution and contamination of groundwater e.g. oil spill</td>
<td>3</td>
<td>Education about wetlands and the importance of wetland habitat</td>
<td>3</td>
</tr>
<tr>
<td>Drought</td>
<td>3</td>
<td>Normal rainfall (neither drought nor flood)</td>
<td>2</td>
</tr>
<tr>
<td>Conversion of natural waterways to canals and stormwater systems</td>
<td>2</td>
<td>Installation of Water Sensitive Urban Design in new housing developments introducing wetlands</td>
<td>2</td>
</tr>
<tr>
<td>Lead shot in food supply</td>
<td>2</td>
<td>Education about hunting</td>
<td>1</td>
</tr>
<tr>
<td>Illegal hunting (poaching)</td>
<td>1</td>
<td>Arrest of poachers</td>
<td>1</td>
</tr>
<tr>
<td>Domestic dogs allowed to run free in wetland areas</td>
<td>1</td>
<td>Responsible pet owners keep their dogs on a lead near shorebird habitat</td>
<td>1</td>
</tr>
</tbody>
</table>

*Number of plates lost and gained: These numbers are only suggestions, and are not necessarily in accurate or direct proportion to the size of the threat, percentage change in survival rates, etc., which will vary between particular places and incidents. You may choose to alter the numbers, particularly in relation to class size.