HUMAN IMPACTS ON MANGROVES
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HUMAN IMPACTS ON MANGROVES

Although mangroves contribute to the economy in many ways, these benefits are not obvious like the benefits from the same area of a commercial crop such as sugar cane or bananas. Mangroves are essential to maintain coastal fisheries, protect property and coastlines from the effects of cyclones and storms and protect coral reefs from sediments and pollutants. However mangroves are frequently seen as expendable and little care is taken of them. Often mangroves areas are just seen as an area for mosquito breeding and a place to unlawfully dump rubbish. Thankfully, this view is started to change as education improves about the benefits of these wetland areas.

Throughout the World, mangroves are being destroyed or degraded. Everywhere— including Australia—the pressures are the same. Most of the population and economic activity takes place on the coast, and there is an ever-increasing demand for coastal land. Over 80% of Australia's population lives within 50Km of the coast. Most of the more accessible land is already taken up, so pressures on mangroves are increasing.

Mangroves Destruction

Wetlands are being destroyed in many ways. Some examples of this are:

- Filling for ports, tourist resorts, housing, airports, and industrial sites
- Drainage for agriculture and aquaculture
- Excavation for fish and prawn farms
- Dumping of garbage
- Dredging of channels for navigation and drainage
- Drowning as a result of cyclones and rising sea levels

Mangroves Degradation

The quality and productivity of mangroves are being reduced by human activities. They include:

- Changes in water levels as a result of blocking of channels to sea, reduction of inflows from land, sink holes (the centre sinking theory), changes to water channels
- Reduction of natural regeneration as a result of fires, and grazing animals
- Pollution from sewage, garbage dumps, fogging for mosquitoes
- Construction of groins, docks, piers, causeways, runways, and roads
- 4WD access
- Increased boat access and potential damage from increased boat wash

Long-term Effects of Mangrove Destruction

When mangroves are lost or degraded, their economic and ecological functions are disrupted or destroyed. Some of the most obvious results are loss of fisheries, increased flooding, increased coastal damage from cyclones, and increased salinity of coastal soils and water supplies. The people who feel the costs of wetland destruction are the fishermen and other people who make their living on the coast. The people who reap the benefits from the developments usually live far away, in cities and towns.

Human Activities That Affect Wetlands

Approximately 17% of Australia's mangroves have been destroyed since European settlement, with mangroves near developing centres being removed and destroyed for land reclamation. For example in Moreton Bay, close to Brisbane, an estimated 20% of pre-European mangrove area has been reclaimed for landfill. As the population increases along the coastline, this has a corresponding increase in the usage and development of the wetland areas. This degradation of the mangrove habitat has a direct effect on the capacity for the area to function effectively as a viable ecosystem.

The chief threats to the mangrove areas are the conversion and land use change and the indirect effects of sediments and chemical runoff from catchments degraded by clearing of upland vegetation and associated agriculture.

Perhaps because people see mangroves as wastelands, they rarely hesitate before adding their own rubbish to them. Throughout the region, people who want to dispose of unwanted household or building wastes just dump them in wetlands. The effects on wildlife are severe. The rubbish prevents natural regeneration of wetland vegetation, pollutes water, and is dangerous to health.

Mangroves can also be destroyed by seemingly unconnected activities in the water cycle. Water extraction from rivers can reduce the amount of water getting to a wetland. Silt washed down from deforested hills can fill wetlands. These activities can cause the wetlands to dry out. As they dry out, they can become more vulnerable to fires. Occasional fires are a natural part of the cycle of wetland ecosystems, but when they happen too frequently, they prevent the natural regeneration of swamp forests and mangroves. Not all damage to wetlands is deliberate. Accidents, such as oil spills at sea, can cause serious damage to wetlands. Oil smothers mangrove roots and the trees die. The mangrove can take more than 20 years to recover.

Natural Processes That Affect Wetlands

Mangroves can also be destroyed by natural processes, including cyclones and storms, diseases, and pests. Cyclones are the most serious of these. Cyclones can uproot trees and remove branches and leaves. Most mangroves can recover from moderate cyclone damage—but global climate change means that the number and severity of cyclones will probably increase. More and more severe, cyclones could make it harder for mangroves to survive the other stresses they face.

Global warming will also cause a rise in sea levels. If they are healthy, recent studies show mangroves may be able to grow fast enough to keep up with the rise, and go on protecting our shorelines. Cyclones such as Yasi and Larry caused over 5 billion dollars' worth of damage to buildings, farms and the fishing industries in the Northern Queensland areas. In areas (Trinity Bay Inlet) where good mangrove protection existed, the damage to boats and associated marinas was limited through the presence of mangroves. In areas such as Cardwell, where mangroves had been removed for large marina developments, the damage bill was excessive.

In Australia, mangroves and wetlands are also affected by extreme weather events including floods and long periods of drought. During the Brisbane floods of 1974, the existing mangroves suffered very little damage due to the mangroves only being located at the mouth of the River. However the floods of January 2011 have had a much more damaging effect to the local mangrove populations. As a result of the 1974 floods, Wivenhoe Dam was erected allowing for an increase in the quantity of salt water within the Brisbane river system and in turn increase the amount of mangroves growing on the river banks. Surveys completed by the Queensland Department of Environment and Heritage Protection has documented an increase in siltation and resulting in the death of the majority of Grey Mangroves. However the Milky mangroves have already shown signs of regrowth and re-establishment. It is estimated that it will take 10 years for the mangrove ecosystem to recover.

Impact of Wetlands Loss

When wetlands are lost or damaged, the wildlife they support is lost or damaged too. The impacts spread far beyond the wetlands. For example, the endangered Illidge's Blue Ant Butterfly lays its eggs only on the stubs of the Grey Mangrove in the presence of specific ant colonies, the *Crematogaster*. The larvae are then "adopted" by the ant and thought of as their own and taken back to the colony where they are cared for. The larvae can mask it's presence through the use of pheromones and mimics the smell of the ant larvae within the nest. However as soon as it becomes a butterfly it loses this masking behaviour and must exit the nest quickly before the ants realise their mistake. The survival of the Illidge's Blue Ant Butterfly is dependent wholly on the Grey Mangrove population. If the increase of chemical run off is not stemmed the Grey mangroves with continue to recede causing the loss of habitat for this butterfly.

Unfortunately, human beings often do not realize the consequences of wetland loss until it is too late. Once they are gone, we begin to notice increased lowland flooding, the dying out of species, and pollution of streams. The groundwater will also begin to disappear.

While it is true that the Earth is an interconnected and dynamic whole, this "big picture" point of view is difficult to convey on local and individual levels. Unfortunately, changes in one corner of an environment can begin a chain of events with the power to affect everything from microscopic organisms to the earth's atmosphere. Wetlands are an interconnected system that contribute to flood control, pollution control, and habitat for many plants and animals, including humans.

Management of Mangroves in Australia

All three levels of government in Australia (local, state and federal) have a role in the protection of mangroves. They are managed through general legislation relating to the environment, fisheries, coasts and wetlands. Currently no mangrove species is considered threatened in Australia and it appears that the total mangrove area may in fact be increasing. In total approximately 8% of Australia's mangrove communities occur in protected areas and the clearing of mangroves is currently prohibited in Queensland and New South Wales. All mangroves are protected plants and require a permit or notification before they can be damaged or removed. Since 1993 there has been an increase in the National awareness of the importance of mangrove systems and the need to maintain the unique biodiversity of this valuable habitat.

Factsheet #1: Surface Water and Groundwater

Surface water is easy to see: it's the water that flows in rivers and streams, that fills lakes, bays, oceans, and wetlands everywhere.

Groundwater, on the other hand, is hidden from view. It fills the spaces between soil particles and rocks underground—a bit like the way water fills a sponge. Most groundwater is precipitation that has soaked into the ground, and sometimes it feeds lakes, springs, wetlands, and other surface water. Groundwater is what prevents the salinity of the water around the roots of mangroves from reaching lethal levels. Tidal groundwater can move through mangroves in two ways. It can flow into the mud due to tidal differences of the water table and it can be flushed from animal burrows through tide change. Unfortunately, groundwater is an easy way for mangroves to be polluted by heavy metals and pesticides as they travel from affected areas upstream.

Factsheet #2: Classifying Water Pollutants

Chemical Pollutants

Chemical water pollutants are water-soluble substances. Chemical substances can enter water sources through natural processes such as the leaching of minerals from soil, rocks, and mineral deposits. Chemical substances can also enter water sources as a by-product of manufacturing processes and power generation, through excess use or run-off in agriculture, or home use of chemicals and household products.

Organic: oil and dyes, synthetic detergents, chlorinated hydrocarbons (DDT, PCBs), refined hydrocarbons, phenols and carboxylic acids, carbohydrates, sugars

Inorganic: acids, bicarbonates (acid salts), alkalis, chlorine, metallic salts, nitrates, phosphates, sulphates, hydrogen sulphide, radioactive isotopes

Biological Pollutants

It is not easy to classify biological pollutants as either natural or manufactured. For example, algae may be present naturally, but nutrients added by people can cause abundant algae growth, with serious results for the quality of the water. Excessive algae growth greatly increases the water's biological oxygen demand.

Pathogenic forms: bacteria, viruses, protozoans, fungi, algae, disease-producing parasitic worms

Algae: excess growth caused by an excess of nutrients (decay uses up oxygen)

Aquatic weeds: use oxygen as they grow; can choke waterways

Physical Pollution

Physical water pollution refers to material that is either suspended or floating in the water. Physical pollutants may be added naturally to the waterway or placed there as the result of human activities, often in larger quantities than nature can easily handle and purify.

Floating matter: foam and scum, wood and leaves

Suspended matter: silt, sand, gravel, metal pieces, cinders, rubber, plastic, wood chips, paper, pulp, solid sewage material, animal carcasses

Thermal Effects

Heated water may be discharged into streams, lagoons, reservoirs, or the ocean by electric power plants or desalination plants. Heat reduces the ability of water to dissolve oxygen, and the loss of oxygen in the water harms fish and other aquatic life.

Factsheet #3: Effects of Pollutants on Water

Sediments

Particles of soil, sand, silt, clay, and minerals wash from land and paved areas into streams, wetlands, and oceans. In large, unnatural quantities these natural materials can be considered a pollutant. Construction projects often contribute large amounts of sediment. Sediments may fill stream channels and harbours that later require dredging—and the dredging itself will stir up or re-suspend the same sediments. These sediments suffocate fish and shellfish populations by covering fish spawning areas and clogging the gills of bottom fish and shellfish. They also cloud the water and prevent sunlight from reaching seagrass and corals, causing their death.

Hydrocarbons and Petroleum Products

Oil and other petroleum products like gasoline, kerosene and methane, can find their way into water from mining activities, oil refineries, power plants, gas stations, streets and ships. Oil spills kill aquatic life (fish, birds, shellfish and vegetation). Weathered oil becomes tarry and may make sand so hard that worms, molluscs, and the like can no longer live there. Birds are unable to fly when oil loads their feathers. Shellfish, crabs, and small fish are poisoned. Fuel oil, gasoline, and kerosene may leak into groundwater through damaged underground storage tanks, while methane can leak into groundwater through the process of natural gas fracking.

Human and Animal Wastes

Human wastes that are not properly treated at a waste treatment plant or in domestic septic systems, and are then released into water, may contain harmful bacteria and viruses. Diarrhoea, hepatitis, flu, and the common cold are examples of diseases that can be caused by bacteria and viruses in contaminated water. The main source of the problem is sewage getting into the water—which sometimes happens as a result of breakdown of waste treatment systems caused by cyclones and floods. People can come into contact with these microorganisms by drinking the polluted water. Unexpected flooding of barnyards or stock pens can increase the toxic effects of animal waste in water. Animal waste can also act as a fertilizer and create damage by increasing nutrients (see “Fertilizers” below).

Organic Wastes

Domestic sewage-treatment plants, food-processing plants, paper mills, and leather-tanning factories release organic wastes that bacteria consume. If too much waste is released, the bacterial populations increase and use up the oxygen in the water. Aquatic creatures, especially fish, die if too much oxygen is consumed by decomposing organic matter.

Inorganic Chemicals

Detergents, pesticides, and many synthetic industrial chemicals are released to waterways. Many of these substances are toxic to fish and harmful to humans. They cause taste and smell problems and are difficult to treat effectively. Some are very poisonous at low concentrations. Inorganic chemicals and mineral substances, solid matter, and metal salts commonly dissolve in water. They often come from mining and manufacturing industries, oilfield operations, agriculture, and natural sources.

These chemicals interfere with natural stream and wetland purification; they may also corrode expensive water-treatment equipment.

Fertilizers

The major source of agricultural and aquaculture pollution is surplus fertilizers in the run-off. Fertilizers contain nitrogen and phosphorus that can cause large amounts of algae to grow. The large algal blooms cover the water's surface and the algae die after they have used up all the nutrients. Once dead, they sink to the bottom, where bacteria feed on them. The bacterial populations increase and use up most of the oxygen in the water, and once the free oxygen is gone, many aquatic animals die. This process is called **eutrophication**.

Heated Water

Heat reduces the ability of water to dissolve oxygen. Electric power plants use up large quantities of water in their steam turbines. The heated water is often returned to streams, lagoons, reservoirs, or the ocean. The loss of oxygen in the water harms fish and other aquatic life. The same impact occurs with desalination plants, which heat up the water during the reverse-osmosis process and then discharge it into the ocean. Desalination plants also produce large quantities of very saline water, or salt which can damage the areas where it is discharged.

Acid Precipitation

The pH is the measure of acidity in a solution. Aquatic animals and plants are adjusted to a rather narrow range of pH levels in water. When water becomes too acid because of the presence of inorganic chemical pollution, exposed acid sulphate soils or acid rain, fish and other organisms die.

Pesticides (Insecticides, Herbicides, Fungicides)

Agricultural chemicals designed to kill or limit the growth of certain life forms are a common source of pollution. Farmers use them to limit the negative effects of "undesirable" species on crop production and golf courses. Irrigation, groundwater flow, and natural run-off bring these toxic substances to mangroves, and oceans.

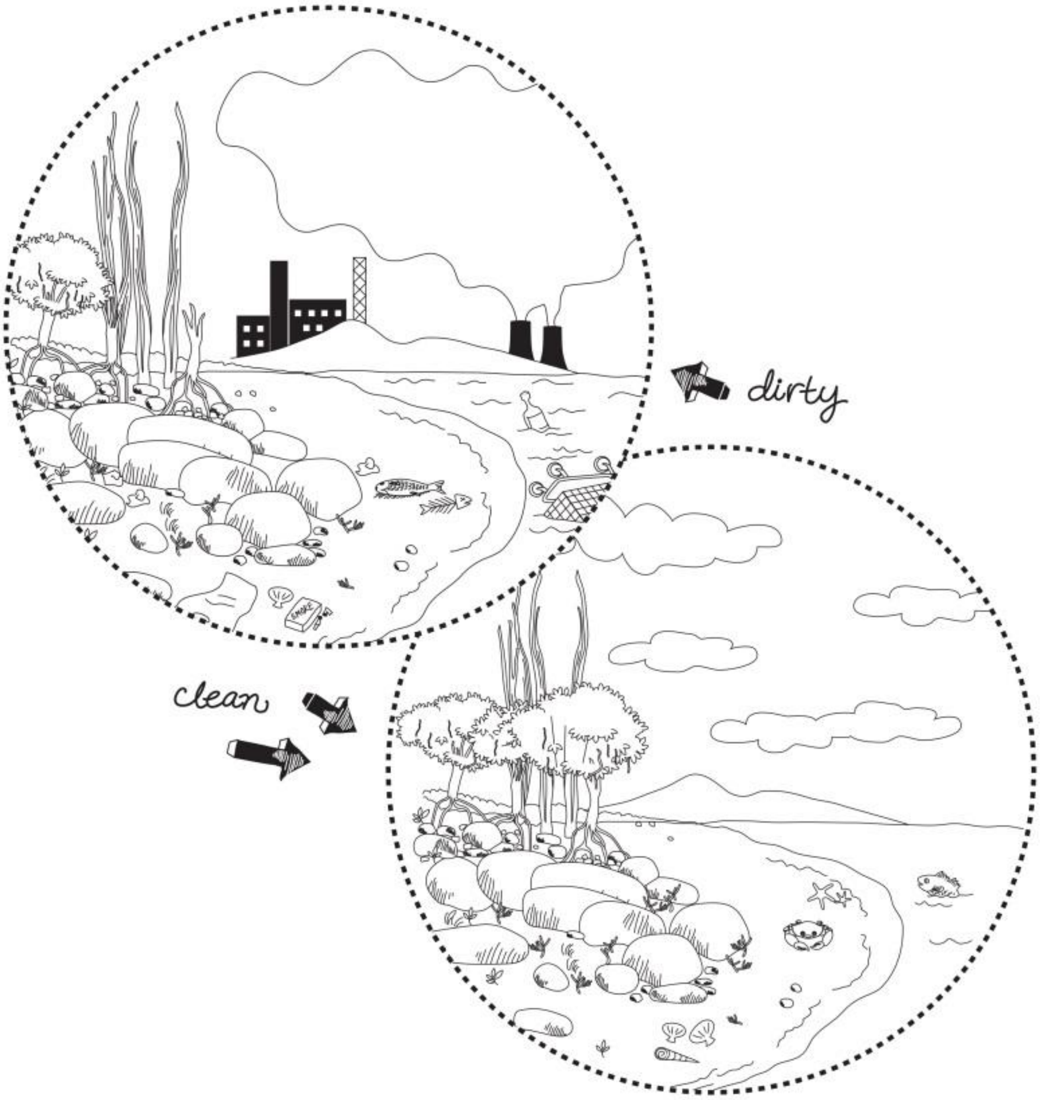


Figure 30: What impacts does pollution have on your waterway?

Factsheet #4: Pollution Sources

Down the Drain

When most people rinse something down their drain, flush their toilet, or do a load of wash, the wastewater either goes to a sewage treatment plant to be purified or runs through a septic system, which operates like a tiny sewage-treatment plant. The big plants remove dirt, biodegradable materials such as food waste, and many other pollutants from the water before the water is dumped into the waterways—usually the ocean. They also treat the water to kill harmful bacteria and viruses. Your septic tank does much the same. But neither the plants nor your own septic system can remove all the chemical pollutants. For example, chemicals that are used in paint thinners and phosphates that are used in many detergents pass right through some sewage treatment plants.

Off the Streets

Oil, litter, dirt, and anything else that's on the streets washes into stormwater drains. In some areas the stormwater is diverted to sewerage treatment plants where it is used to dilute the sewerage and becomes secondary or tertiary treated in the process. This is quite an expensive process and is not used widely in Australia. Otherwise stormwater drains drain directly into rivers and coastal areas. There are some mitigation techniques being currently used and these include Gross Pollutant Traps which work using a centrifugal design to remove litter and oil. Some places use coastal nets to prevent the larger litter from entering the rivers and wetlands however these fail to address the problem of oil and heavy metal pollutants. With stormwater consisting of freshwater, the direct impact of dumping this straight into a coastal area is an increase of siltation due to the mixing effect of salt and freshwater.

Industrial Waste

Factories that make chemicals, paper, medicines, steel, and many other products create a lot of waste. There are a lot of laws in place governing the disposal of this commercial waste with many companies able to treat these chemicals safely. However on some sites this waste may enter the stormwater system inadvertently, and as storm water is not treated. There are ways that responsible companies can reduce their impact. They can control the work site and ensure that it is tidy. They can contain the waste and isolate it from drainage areas. They can clean it up once they are done by sweeping or vacuuming and disposing of chemicals in line with manufacturers specifications.

Trashing the Water

When trash gets thrown overboard, it can create an ugly mess—both in the water and on the shore where it washes up. Trash can also harm or even kill wildlife. For example, thousands of seabirds and marine mammals die each year after eating or becoming entangled in plastic debris and ghost nets floating in the ocean or in mangroves.

Factsheet #5: Auto Awareness

The automobile is one of the biggest contributors to pollution problems throughout the world. The car seems to have an impact on every aspect of our lives (mostly because we all seem to want one, or two, or more!). Here are some of the ways the car and its operation cause pollution—and some solutions that we can each incorporate into our lives.

Direct impacts to Mangroves

Increasingly mangrove and wetland areas are becoming more available through the increased use of 4WD vehicles and other recreational vehicles. Driving through sensitive mangrove areas creates:

- Visible depressions changing the way water moves in the mangrove
- Breaks in the continuity of species such as salt marshes and mangrove communities
- Increases the surface compaction
- Causes physical damage to invertebrate species and mangroves
- Distresses migrating species such as shorebirds

Car Manufacturing

- Mining for raw materials such as bauxite (to make aluminium) or iron ore (to make steel) creates waste that can pollute land and water. It also creates dust that pollutes the air, and causes soil erosion that pollutes water when the soil washes into surface water.
- Processing raw materials into car parts causes pollution. Steel factories and other manufacturing plants, for example, create waste products that pollute air, land, and water.
- Many car parts are made of plastic—a product made from petroleum that takes hundreds of years to biodegrade.
- Auto assembly plants create waste such as toxic paints and lubricants, which pollute air, land, and water.

Junked Cars and Tyres

- Each year, millions of cars end up in junkyards. Car junkyards are ugly and take up much land.
- When reusable materials aren't recovered after cars are junked, resources are wasted, and new materials must be made from scratch.
- Batteries, air conditioners, and other parts of junked cars can leak. The toxic materials they release can pollute water supplies or air.
- Tire dumps can sometimes catch on fire, releasing toxic fumes that pollute the air and toxic residues that leach into water supplies. Tyres dumped in landfills take up a lot of space.

Fossil Fuels

- Most cars run on petrol, a product made from oil. Drilling, processing, and transporting oil creates air, water, and land pollution.
- When engines burn petrol they release toxic gases and other waste products into the air. These substances can cause respiratory diseases, cancer, and other health problems. They also contribute to acid rain and global climate change.
- Car engines require motor oil. Just one litre of oil can contaminate thousands of litres of water, polluting drinking water supplies and poisoning wildlife.

• Driving at excessive speeds cuts down fuel efficiency.

Roads

• Building roads creates dust and waste and causes soil erosion and habitat destruction.
• Asphalt, a main ingredient in road surfaces, is made from oil.
• Increased traffic on roads creates noise pollution and increases air pollution from exhaust fumes.
• Fluids that drip from cars into roads will wash off those roads, damaging roadside vegetation and polluting water supplies.

Auto Air Conditioners

• Using car air conditioners can cause a car to burn more fuel.
• When junked or improperly maintained, car air conditioners can leak damaging hydrocarbons into the atmosphere. Following information on the impacts chlorofluorocarbons (CFCs) had on the ozone layer, R134a refrigerant was moved in as a replacement. We now know that R134a is a 'super greenhouse gas' having over 1500 times more greenhouse potential (GHP) than CO_2 (carbon dioxide).

Car Care

• Washing cars can pollute waterways, when detergent and road grime run into storm drains and then into surface water.
• Improperly inflated tyres reduce fuel efficiency.
• Motor oil, brake and transmission fluids, window-washer fluid, coolant, and lubricants that leak or are disposed of improperly can pollute land and water.
• An improperly maintained engine doesn't burn fuel efficiently and increases air pollution.

Some Solutions

• Alternative power sources such as sunlight, electricity, ethanol (fuel from grains or the sugar industry), and methane can eliminate many of the pollution problems associated with burning fossil fuels.
• Recycling car parts can cut down on pollution caused by mining and processing of new materials.
• Recycling car air-conditioning refrigerants and oil can prevent air and water pollution.
• Developing safe refrigerants can reduce the greenhouse effect.
• Engine and exhaust systems can be redesigned to burn fuel more efficiently and to reduce the emissions of air pollutants.
• Individuals can reduce auto-caused pollution by walking, biking, sharing cars, or using buses or taxis; by driving at reasonable speeds on highways; by keeping cars well maintained; by patronizing service stations that support recycling and reuse of materials; by supporting laws that require tighter pollution-control measures; and by buying fuel-efficient cars.
• Limiting 4WD access to sensitive mangrove and wetland areas.

Activity 3-A: Deadly Links

Summary Students play a game that illustrates how pollutants that enter the food chain at the bottom work their way up until they finally affect predators at the top of the chain.

Learning Objective
Students will be able to give examples of ways in which pollutants—such as pesticides used in gardening, aquaculture, and agricultural practices as well as mosquito control—enter the food chain.
Age Levels
9 and up
Subject Area
Science
Time
30–60 minutes
Materials
A package of multi-coloured drinking straws, green, yellow, red, and blue, cut in lengths of approximately 6 cm so you have a total of about 100, roughly 25 of each colour (or in a ratio of 30 per student).
Eighteen stationery envelopes (or one-third the number of students in the class)
Copy of page 3-14 showing bioaccumulation
Eight coloured bibs or hats (optional)

Background During the past century, people have developed pesticides (including herbicides, fungicides, insecticides, and rodenticides) to control unwanted organisms such as weeds, insects, fungus, and rats. These pesticides contain poisons, toxic chemicals that settle into the soil or stay on crops until they are washed off by rain or irrigation. Through run-off or groundwater, they eventually reach a wetland or the ocean. Testing the ocean water after this has occurred typically does not show a particularly high concentration of these chemicals—but testing the fish does!
The natural recycling processes of mangroves do not work very well with toxic chemicals. Rather than being decomposed and broken into harmless products that can be used by plants and animals, toxins enter the estuaries. They are taken up and concentrated in aquatic plants and animals in a process known as **bioaccumulation**. Bottom-dwelling organisms such as amphipods siphon the detritus (dead or decaying plant or animal material) from the water and can easily take up pollutants that have settled. These toxins, when ingested, remain inside the bodies of the amphipods and are passed along at each step of the food chain.
This is how bioaccumulation works: If an amphipod ingests one piece of detritus containing 10 units of toxin, then it will retain 10 units of toxin: 1 x 10 = 10). If a Mangrove Jack eats 10 amphipods, each containing 10 units of toxin, then the Mangrove Jack will retain 100 units of toxin (10 x 10 = 100). If an Osprey eats 10 Mangrove Jack, each containing 100 units of toxin, and then the Osprey will retain 1000 units of toxin (10 x 100 = 1000), and so on.

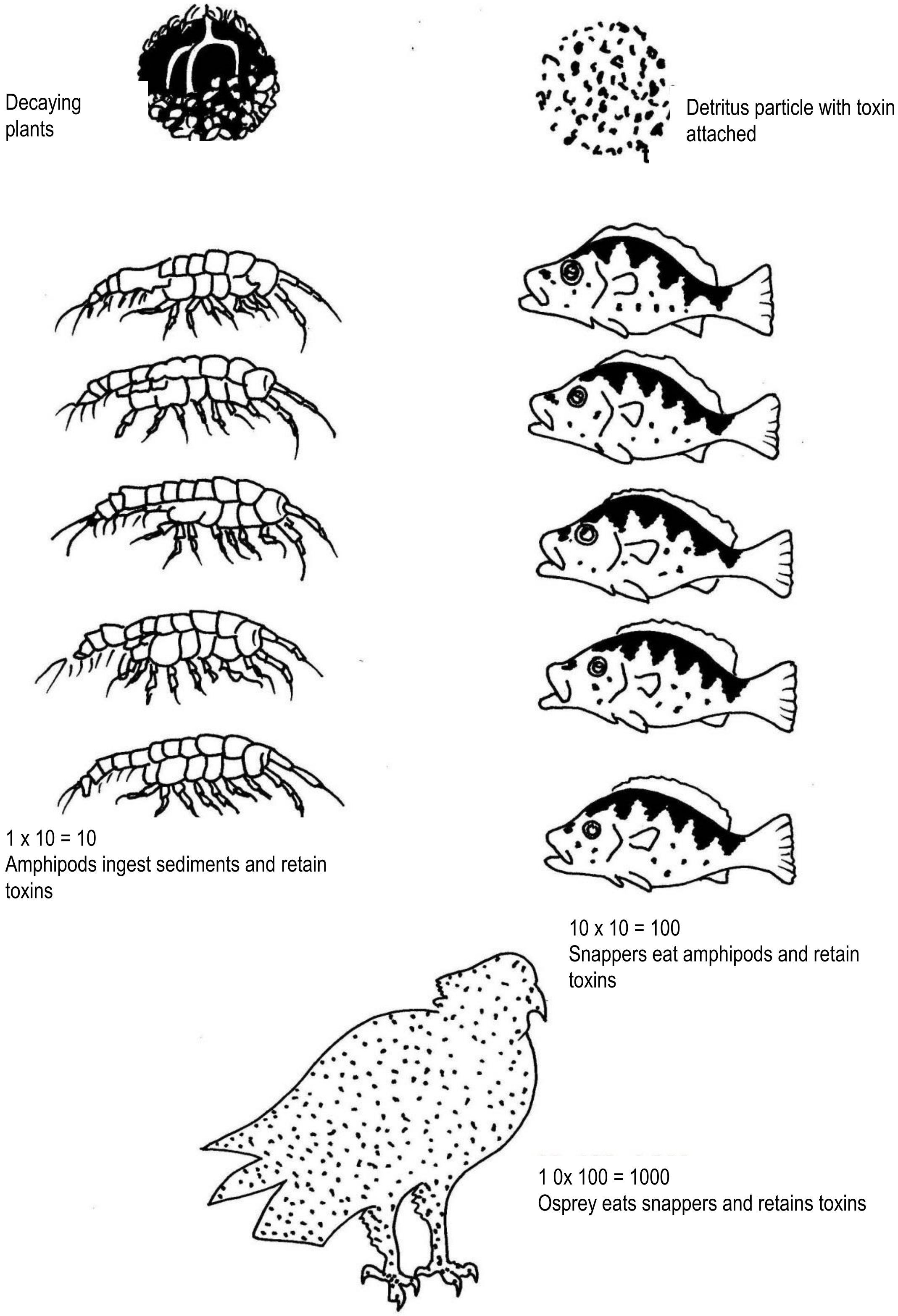


Figure 31: Bioaccumulation in the food chain

Procedure

Students become “Detritus”, primary and secondary consumers like “Amphipods” and “Mangrove Jacks”, and predators like “Ospreys” in a highly involving physical activity of a predator-prey relationship illustrating the food chain.

1. Tell the students this activity is about food chains: for example, Amphipods eat by filtering detritus, Mangrove Jacks eat Amphipods, and Ospreys eat Mangrove Jacks.

2. Divide the students as follows: three times as many Mangrove Jacks as Ospreys, and three times as many Amphipods as Ospreys. (In a class of 26, this would give two Ospreys, six Mangrove Jacks, and 18 Amphipods).

3. Each Amphipod is given an envelope, to represent the Amphipod’s “stomach” in which to collect its food (detritus/straws). The Mangrove Jacks and the Ospreys are given different-coloured bibs or hats so they can be easily identified.

4. Have the students close their eyes while you spread the food (detritus, represented by the straws) around a playing field, an open area, or a large floor area in the classroom.

5. Give instructions (times indicated are for classroom space; make it a little longer if played outside):

a. The amphipods will go out looking for food, which they each place in their stomach (envelope). The Osprey and Mangrove Jacks remain quietly on the sidelines, acting as predators do when watching their prey. After 20 seconds, signal (or whistle) for the Amphipods to stop feeding.

b. The Mangrove Jacks are now allowed to hunt the Amphipods. Ospreys still remain on the sidelines. When a Mangrove Jack catches an Amphipod by tagging, the Amphipod must give up its food envelope to the Mangrove Jack and move to “Amphipod heaven” at the side. Allow 15 to 20 seconds, enough time for each Mangrove Jack to catch one or more Amphipods. Give another signal (two whistles).

c. The Osprey are now introduced and given 15 to 20 seconds to hunt the Mangrove Jacks. When the Osprey tag the Mangrove Jack and retrieve the food envelopes, the Mangrove Jacks go to “Mangrove Jack heaven” at the side.

Note: Any Mangrove Jacks still alive may continue to hunt Amphipods, and Amphipods still alive may continue to eat detritus.

6. Give a signal (three whistles) to end all the action. Have the remaining “live” Ospreys, Mangrove Jacks, and Amphipods stand in view, with the “consumed” wildlife sitting on the floor a few feet away. Ask the “consumed” students who they were and who consumed them. Have the “live” Osprey, Mangrove Jacks, and Amphipods count the number of food pieces (straws) in their envelopes, putting them on the floor as they do (don’t let the students mix their straws with those of other students).

7. Inform the students that the following contaminants have been introduced into the food chain by farmers and gardeners to improve their crop, or by government agencies to destroy pests like mosquitoes.

- Insecticides—red straws
- Herbicides—yellow straws

All of the Amphipods who were not eaten by the Mangrove Jacks may now be considered dead if they have any yellow or red straws in their food supply. Any Mangrove Jacks that have more than half their food supply contaminated—yellow or red straws—are now dead. The Osprey with the highest quantity of yellow and red straws will not die at this time; however, it has accumulated so many pesticides in its body that the eggs produced by it and its mate during the next season will not hatch successfully. The other Osprey is not visibly affected at this time.

8. Try the activity again, choosing other colours of straws and different toxins—e.g., blue straws for fungicides and green straws for rodenticides.

Discussion/Reflection
What are the advantages and disadvantages to the farmer, and gardener of using pesticides?
What are some real or imaginative alternatives to the use of toxins? (For example, some farmers successfully use organic or non-toxic substances along with crop rotation, companion planting, biological controls, and genetic approaches in efforts to minimize damage to their crops).
What other species that you know of were or are affected by the use of pesticides?
What are other possible sources of toxic chemicals that could enter the food chain?

Extensions Below are two case studies, one documented, one anecdotal, of declines in bird populations due to the ingestion of toxins that have gotten into the food chain. Interview family members, particularly grandparents, and document similar declines. Ask them, for example, if they remember more of a particular species when they were children than they see now.

Case Study #1
The Osprey is a predatory bird which primarily feeds on fish. When the fish it feeds on lives in waters polluted with pesticides, the pesticides accumulate within the body of the bird. DDT was introduced in Australia in the 1950's to help control insects that damaged crops. The pesticide residue makes the bird's egg shell extremely fragile and subsequently reduced the birth rate. This unfortunately reduced the population of birds like the Osprey. The use of DDT in Australia has been fully banned since 1987.

Case Study #2
Bioaccumulation of pesticides in various fish species has led to decreased viability of sperm, eggs and larvae. There can also be an increase in growth abnormalities and reduced life expectancy of the affected fish. Certain levels of pesticide exposure to fish eggs can also cause skeletal defects and growth reduction of the developing fish. As the smaller fish in the food web are affected they become easily targeted prey for larger predatory fish, subsequently affecting more and more fish species within the mangrove habitat.

Activity 3-B: Pollution Soup

Summary This activity illustrates how many of the items we use every day in the home and yard can create hazardous waste when mixed with water and disposed of carelessly.

Learning Objectives
Students will be able to:
(a) Identify household items that are harmful to the environment and those that are benign; and
(b) Learn how long-term disposal of household products can end up polluting our water supplies, and how to avoid such pollution.

Age Levels
7 and up

Subject Area
Science

Time
30–60 minutes

Materials
A large container—goldfish bowl, glass jar, aquarium or clear plastic container
An improvised filter system to represent what primary sewage treatment does, made of a plastic bottle (cut off the top section of the bottle to make a funnel, turn it upside down and set it in the bottom section of the bottle) and a plastic vegetable strainer
Cardboard cups labelled with felt pen and containing small amounts of the items listed under "Procedure"
Factsheets #2, #3, and #4 on pages 3-5 through 3-10

Background As outlined in the factsheets on pages 3-5 through 3-10, every day we use chemicals in and around our homes that will have a long-term, serious impact on the environment. If we are going to cut down on the pollution of our water supplies and the destruction of waterways and wetlands habitats, we need to change our household habits. For example, many people like to use bleach in large amounts as a general-purpose cleaner, because it kills bacteria. However, bleach contains chemicals, like dioxins, that are a known cause of cancer if absorbed over an extended period of time. Baking soda works just as well as a scouring agent and is a harmless alternative.

Procedure
1. Have a student fill the container half-full with cold tap water. Ask students if we can assume this water is safe to drink. "Who would drink this water?"
2. Pass out the prepared film canisters to students.
3. Have the students add the contents of the cardboard cups to the large container of water (approximately in order of listing); one at a time or in groups as follows:

- Natural items
- Manmade items used in the home
- Manmade items used in the home that are quite toxic—these go down the drain, for the most part, and then to a treatment plant (in urban areas) or a septic system (in rural areas)

• items used in the yard or community that often get washed down storm drains or go untreated into ditches and streams and end up in the ocean

4. Discuss what effects they have on humans and on the animal and plant life in places where the water will end up.

Natural items

- **Milk** left over after a meal.
  Would you drink this water?
- **Vegetable water**, from the draining of hot cooked vegetables.
  Is the water still okay to drink? Does the temperature of the water make a difference to you? Does it make a difference to fish?
- **Salad oil** from leftovers remaining in the salad bowl.
  Would you feed this water to your pets (dog/cat/bird)?
- **Food scraps**—potato or banana peels
  Would you drink this water or let your pets drink it?
- **Potting soil, mud or sand, leaves** from rinsed-off muddy shoes or hands after planting in the home or yard.

What does sediment do to aquatic life? What if this water accidentally ended up in your bath or shower? How would you feel? Would you be mad? Would you want to know who put it in your water?

5. Continue the discussion by pointing out that excessive nutrients increase the level of nitrates and decrease the level of dissolved oxygen in water. Explain that the items so far have been natural things and, while they have not contaminated the water, it becomes unpleasant to us. Adding a lot of foodstuffs will cause algae to grow. When these producers of oxygen die and decompose, they use up much of the dissolved oxygen in the water, so there will not be enough for the fish and other animals. Discuss the difference between natural and manmade items.

Manmade items #1

- **Shampoo**, after washing hair.
- **Laundry detergent**, after washing clothes.
  What would happen to you if you unknowingly drank some of this water? Would you be fine? Would you be ill? Do you think you might have to see a doctor?
- **Bleach mixed with water**, after washing and cleaning.

What kind of effect do you think this will have on the plant life in the area? In turn, how will this affect fish and wildlife that use the plant life for food and protection?

Manmade Items #2

Note: Items in (parentheses) indicate a harmless substance to use in the demonstration rather than a toxic one.

- **Household cleaner (baking soda),** used for scrubbing sinks and tubs.
- **Drano (rock salt),** used for clearing drains.
- **Motor oil (molasses)—**washes down storm drains and into ditches from driveways and roads

- **Coolant/antifreeze** (**milk with a drop of green or blue food colouring**)—washes down storm drains and into ditches from driveways.

If this water accidentally ended up in your shower, what might it do to your body? So imagine what these things must do to fish and wildlife, which have no choice about whether they consume these toxic substances. What would you want to say to someone responsible for putting these things in your water supply that would make them realize they could harm you and the plants and animals?

- **Styrofoam litter**—is washed down storm drains and ditches, left on beaches, or thrown from boats.
- **Plastic bags**—are washed down storm drains and ditches, left on beaches, or thrown from boats.
- **Aluminium cans**—are washed down storm drains and ditches, left on beaches, or thrown from boats.

Litter is quite obvious, and we can easily recognize it as pollution. Many of our fast food and take-out items are packaged in Styrofoam containers, plastic bags, and cans or bottles that get tossed away. What effect does garbage have on plants and animals? Murkiness of the water will prevent sunlight from getting through to the plants—so what happens then? Also, creatures often mistake garbage for food or become entangled in it. As the litter breaks down with the elements, tide, wind and waves, the particles become smaller and more included in the natural surroundings increasing the chance of mistaken ingestion by species such as marine turtles and fish.

Discussion/Reflection

Some of the discussions are included in the procedure (such as items 4 and 5). As the teacher goes through the activity, it is best to discuss the items at that time. The discussions can also be geared to different age levels, depending on how much information you wish to use.

When all the items have been added, discuss what primary treatment does (mostly in a sewage plant or in a septic tank). We often think that treatment plants are going to fix up this mess. Demonstrate by using the improvised filter. With primary filtration, solids are removed from the water, but not much of anything else. All of the pollutants dissolved in the water will, unfortunately, remain in the water afterwards. The same is true of septic tanks and grease, or grey-water, pits. We must be conscious not only of the big stuff going down the drains, but everything else as well. What goes in will inevitably end up poisoning the water and the creatures dependent on it for life. We, too, are among those creatures.

Also discuss the water cycle. Whatever goes into the water will somehow find its way back to us—in the food we eat, the water we drink, the clothes we wash.

Ask where the water that we use goes—“down the drain” in our homes and “down the storm drains or into the ditch” from our yards and streets. Because wetlands and estuaries are where many pollutants end up, we have to be concerned about what we do with our water. Floating bits attached to pollutants end up settling on the bottom. Saltmarshes and mangroves help to keep the ocean’s water clean and healthy by filtering and removing harmful pollutants before they reach the sea.

Therefore, the water flowing out of the marsh is cleaner and purer. Some of these pollutants can actually be turned into harmless products through processes that take place inside the plants or below the soil in the plant roots.

There is, of course, a limit! Plants can store and get rid of only so much before these toxins are released back into the aquatic environment. As the plants die and decompose, these toxins will be harmful—in some cases, deadly—to the estuary and ocean. The effect of bioaccumulation on the food chain is an example of this (see page 3-14). The best solution is to reduce pollution or, better yet, eliminate it.

ALTERNATIVES TO HOUSEHOLD HAZARDOUS CHEMICALS

Cleaning Agents

Before the "chemical revolution," householders used creative non-toxic remedies for everyday cleaning problems. These alternatives are also usually much cheaper than the products you will purchase in a store! Can you find a non-toxic alternative in your home?

- Baking soda is a non-abrasive scouring powder.
- Use vinegar for windows and smooth surfaces.
- For gleaming wood furniture, use one tablespoon melted carnauba wax mixed with two cups mineral oil, or dissolve one teaspoon lemon oil in two cups mineral oil, or use pure beeswax.
- Rub toothpaste on wood to remove water stains.
- Avoid aerosol products; mist particles can enter the bloodstream. Use pump or spray bottles.
- Boil cinnamon and cloves in water on the stove for air freshener.
- Clean upholstery or carpet stains immediately with cold water or club soda.
- Open drain with metal snake or plunger, or pour baking soda followed by white vinegar down the drain (it will bubble—stand back!). Keep drains clear with rinses of boiling water and baking soda twice a week.
- Paint and Solvents
- Use latex- or water-based paints wherever possible; latex- and water-based paints don't require thinners or solvents.
- Before disposing of oil-based or enamel paint cans, take them outdoors, remove the lid, and allow the contents to air-dry and harden.
- Re-use cleaning solvent as much as possible.

Yard and Garden

Chemical fertilizers are fast-acting, short-term boosters that may deplete the growth capacity of the soil with extended use. Try these simple alternatives:

- Use peat moss, manure, or fish meal for fertilizer.
- Start a compost pile and use the compost to enrich the soil.
- When cutting the grass, try mulching it instead of using a collection bag.

Herbicides are toxic remedies for weed control. Try these solutions:

- Use organic gardening techniques
- Pull weeds instead of using chemical control.
- Cover weeds with a tarp or black plastic sheet.

Pest Control

Caterpillars

- Use a mixture of one cup linseed oil and two tablespoons melted paraffin. Paint around tree trunks.
- Keep your garden clean. Plant debris attracts pests, and infected plants will breed them.

Snails

- Fill a shallow pan with stale beer and place in the garden. Collect and destroy!

Aphids

- Spray plants with a “bubble bath” of dish suds or soapy water. Rinse off when insects are dead.

Ants

- Mix equal parts of powdered sugar and powdered borax; sprinkle on the opening to the anthill or burrow. Or pour a line of cream of tartar, paprika, red chili powder, or dried peppermint leaves at the point of entry. Boiling water is also effective when poured on the nest.

Activity 3-C: Dumpity Dump

Summary Many pollutants enter wetlands and the ocean through careless daily actions.

Learning Objectives
Students will be able to understand the impact of pollutants on water and wetlands, and to recognize how they get there through our everyday actions.
Age levels
8 and up
Subject Areas
Science, Civics and Citizenship
Time
1 or 2 lessons
Materials
Empty or half-empty paint cans
Two wrenches and/or a hammer
Plastic bottle of transmission fluid or oil (can be empty or full)
Pitchfork or garden fork
Can of weed killer
Bottle of paint stripper
Old chemistry set
Old photography chemicals
Factsheet #4 on page 3-10

Background Many people have developed the habit of getting rid of things by just throwing them away, or pouring them onto the ground. All of these actions have serious environmental impacts, with the liquids often ending up in the mangroves or the ocean. See Factsheet #4 on page 3-11 for more details.

Procedure
This song can be used as a radio or TV commercial. One member of the class speaks the monologue and the others sing out the verse. Different kinds of props such as paint cans, pitchforks, and a wrench can be used for the monologues—it makes the song more visually interesting. Each time one of the items is referred to, the speaker can wave it about.

Discussion/Reflection
Have students talk about their observations of themselves and their friends and relatives, and how certain actions might cause serious water pollution.

Extension Students could research ways to recycle oil waste and hazardous products, or find alternative means of disposal, and prepare community posters to point out these concerns to family and friends.

Monologue:
I learned how to change the oil in my car several years ago. I change it every 10,000 kilometres without fail. The used oil is a nuisance, but I figured out that if I sprinkled it on the road I could keep the dust down.

Chorus:
Dumpity dumpity dumpity dump
They dump it on the ground—
Dumpity dumpity dumpity dump
Now that's not very sound.
Dumpity dumpity dumpity dump
Where do they think it goes?
Dumpity dumpity dumpity dump
Nobody seems to know.
Dumpity dumpity dumpity dump
It cycles right around.
Dumpity dumpity dumpity dump
They dump it on the ground.

Monologue: I had to rebuild my transmission and now I have all this transmission fluid to get rid of. Oh, it won't hurt anything if I dump it down the storm drain. First good rain will wash it into the ocean.

Chorus:
Dumpity dumpity dumpity dump
They dump it down the drain—
Dumpity dumpity dumpity dump
I think it's quite insane!
Dumpity dumpity dumpity dump
Where do they think it goes?
Dumpity dumpity dumpity dump
Nobody seems to know.
Dumpity dumpity dumpity dump
It makes it 'round again
Dumpity dumpity dumpity dump
They dump it down the drain.

Monologue: I've been helping my Dad with the cattle since I was four years old. My least favourite job is cleaning up the manure after them. Mum doesn't want it near the house, so I just dump it into the stream and the water takes it away.

Chorus:
Dumpity dumpity dumpity dump
They dump it in the stream—

Dumpity dumpity dumpity dump
It makes me want to scream!
Dumpity dumpity dumpity dump
Where do they think it goes?
Dumpity dumpity dumpity dump
Nobody seems to know.
Dumpity dumpity dumpity dump
The damage can be seen
Dumpity dumpity dumpity dump
Further down the stream.

Monologue: I've been meaning to clean out the storage shed for weeks. Today's the day. I'm going to get rid of everything I haven't used in a year. Gosh, there must be at least 25 different paint cans here—most of them from years ago. This is the blue enamel we used on the outside of the house 10 years ago. I had almost forgotten it. I'll just bag them up and dump them in the trash.

Chorus:
Dumpity dumpity dumpity dump
They put it in the trash—
Dumpity dumpity dumpity dump
I think that's rather rash.
Dumpity dumpity dumpity dump
Where do they think it goes?
Dumpity dumpity dumpity dump
Nobody wants to know.
Dumpity dumpity dumpity dump
The leachate cycles back.
Dumpity dumpity dumpity dump
They dump it in the trash.

Monologue: This paint stripper is from that dresser I fixed up three years ago. Here's some weed killer—I heard the other day that this one was banned because it caused cancer. Here are all those old photographic chemicals from when Christopher took the photography class. And here's some chemicals left from Chris's old chemistry set. Well, this is a good boxful—I think I'll just pour these down the sink before I get too many.

Chorus:
Dumpity dumpity dumpity dump
They dump it down the sink—
Dumpity dumpity dumpity dump
That's crazy, don't you think?
Dumpity dumpity dumpity dump
Where do they think it goes?
Dumpity dumpity dumpity dump

Nobody wants to know.
Dumpity dumpity dumpity dump
I hope they stop to think
Dumpity dumpity dumpity dump
Next time they take a drink.

Monologue: All this hard work really makes me thirsty. I'll just go have a nice cool glass of water.

Activity 3-D: Away with Waste

Summary Students will learn that the waste we "wash away" can have harmful effects later.

Learning Objectives

Students will:

(a) Discover how pollution can affect waterways, including wetlands; and

(b) Discover that the waste we "wash away" can have harmful effects later.

Age

7 and up

Subject Area

Science, English, The Arts

Time

30–60 minutes

Materials

Story-poem beginning on page 3-29, "Away on the Bay"

Drawing paper

Crayons or markers

Construction paper (optional)

Stapler (optional)

Glue (optional)

Copies of Factsheet #3 on page 3-7

Background In our everyday lives, we have developed various ways of getting rid of household items ranging from shampoo to laundry detergent, from car oil to drain cleaners. Very few people actually think about what ultimately happens to these domestically used pollutants that we dump down the sink or into the road. Factsheet #3 on page 3-7 and the poem "Away on the Bay" beginning on page 3-29 clearly shows what happens to this waste, and what we can do to help prevent it.

Procedure

1. Before reading the story, ask the students to name some of the ways they use water (for drinking, bathing, brushing teeth, cleaning clothes and dishes, and so on). Then ask them what happens to the water that drains out of their washing machines or washes down the sinks. (Don't worry about whether the students know the answer at this point. You'll be discussing what happens to household waste with them after the story). Explain that many people never think about what happens to the water they use in their households each day. They also don't think about what happens to the water that runs off their streets and yards.

2. Now tell the students that you are going to read them a story about a town called "Away", where people polluted the water in the nearby bay without realizing what was happening. Ask the students to listen carefully to the story to find out just how the water in the bay became polluted. Also tell them to listen for the word "away". Each time they hear it they should gesture with their thumb over their shoulder to represent something going away.

3. After you've read the story, discuss it with the students. Ask them if the waste from Away simply disappeared.*[No.]* What happened to the waste? *[It ended up in the bay.]* Then go over the verses in the first half of the story to be sure the students understood what was happening in each one. Use the information in Factsheet #5, Pollution Sources, on page 3-11 to 3-12 to help with the discussion.

4. Pass out crayons or markers and have the students draw pictures of the story. They might draw the people in the town, the bay when it was polluted, or the bay when it was cleaned up again.

5. If you are working with older students, you might want them to create their own picture book or reference file of the story. Pass out copies of pages 3-29 through 3-30 and have the students draw a picture to go along with each verse of the story. Then have them glue their pictures on sheets of construction paper, copy the words of each verse onto the pages, and staple the pages together.

Extension Have the students do their own "Home Enquiry" research project. Students take home the questionnaire on page 5-20 and ask their parents to help them fill in the blanks. At the next class, use the answers to generate a discussion on where the water goes in their houses.

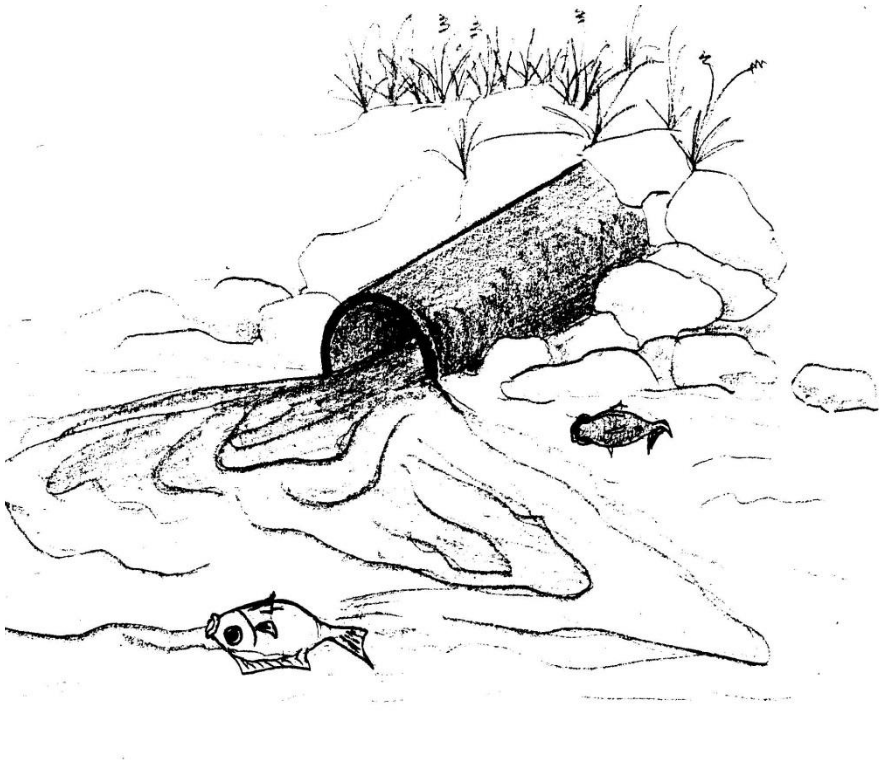


Figure 32: Where does your water go when it goes down a drain?

AWAY ON THE BAY

This is the tale of a town called **Away**
A town that was built on the shore of a bay.
A town where the folks didn't think much about
What they dumped in their water, day in and day out.

For one thing, a sink was an excellent place
To get rid of messes and leave not a trace.
Cleansers and cleaners and yesterday's lunch
Went **away** down the drain with a gurgly crunch.

At everyone's house there was laundry to do.
Day after day, how those laundry piles grew!
Load after load was washed, rinsed, and spun
And **away** went the water when each load was done.

On the High Street each day there were sidewalks to sweep.
The litter and dirt were swept into the street.
And then when it rained, everything washed **away**
Into drains in the road that dumped into the bay.

A mill there made "stuff" for the townfolk to use,
But a pipe from the mill churned out oodles of ooze.
And the ooze, well, it goozed from a pipe to the bay
Where it bubbled and glubbed as it drifted **away**.

Because the weather was warm, it was always a treat
To sail on the bay and bring picnics to eat.
But when folks were finished, they'd toss all their trash
Overboard and **away** with a plop and a splash.

Then folks started seeing that things weren't quite right;
The bay had become an unbearable sight.
Beaches and mangroves covered with garbage and glop
That rolled in with the waves—and the waves didn't stop.

The fish in the bay seemed all sluggish and sick,
The algae were everywhere—slimy and thick.
The birds near **Away** were all suffering too,
'Cause the fish they were eating were covered with goo.

The reefs where the coral was once pretty and bright
Began to turn white—a horrible sight.

And the tourists and divers who came all the time,
Went **away** somewhere else, where things were just fine.

So a meeting was called to discuss the sick bay,
And townspeople came from all parts of **Away**.
And during the meeting one person proclaimed,
“I know who’s at fault: We all should be blamed.

“For years we’ve washed chemicals, dirt, and debris
Down our sinks, off our streets, and out pipes—so you see,
Although we all thought that our waste went **away**,
It all ended up going down into the bay.

“Now the bay is a mess—full of trash, soap, and goop,
The water’s turned green, like a bowl of pea soup.
And our wildlife is sick from the garbage and grime;
The bay needs our help, right now while there’s time.”

The folks were all silent—they knew it was true.
And they realized now what they all had to do.
It was time to get busy, the bay couldn’t wait.
If they didn’t act now, it might soon be too late.

So they signed an agreement that very same minute
To care for the bay and to stop putting in it
The stuff that had made the bay icky and ill,
Like soaps that pollute and the ooze from the mill.

They also agreed to stop dumping their trash
Overboard and **away** with a plop and a splash.
And all of the efforts have been a success;
Today the bay’s clean and no longer a mess.

And that is the tale of the town called **Away**
A town where the people, to this very day,
Remember a saying that’s simple and plain:
Nothing just goes **away** ….when it’s washed down the drain.

Activity 3-E: Garbage Shuffle

Summary By performing a trash rap, students learn about the history of how people have dealt with trash.

Learning Objective
Students will be able to describe how people have disposed of solid waste throughout history.
Age Levels
8 and up
Subject Areas:
Language arts, music
Time
60–90 minutes
Materials
Copies of pages 3-33 through 3-34, "A History of Rubbish"
Copies of pages 3-35 and 3-36, "The Rubbish Shuffle Rap"
Materials to make costumes and props (optional)

Background If you were an archaeologist, you could sift through the dusty remains of every human population since prehistoric times and discover something common to all of them: trash…rubbish… litter. See "A History of Trash" on pages 3-33 through 3-34.

Procedure
1. Begin by asking the class how people get rid of their rubbish (by dumping it, burying it, or burning it). Explain that the task of getting rid of rubbish has been around as long as people have existed.
2. Pass out copies of pages 3-35 and 3-36, "Rubbish Shuffle Rap", and have the students read through the rap.
3. Then use the information under "A History of Rubbish" (pages 3-33 through 3-34) to discuss the disposal method common to the time period depicted in each of the verses.

Discussion/Reflection
While discussing waste disposal through the ages, ask the students the following questions:
What kinds of trash have people thrown out during different periods?
How did they dispose of it?
Why could prehistoric hunters throw trash on the ground without any problems? How did trash cause problems in ancient Rome, medieval London, and 19th-century cities?
What kinds of pollution can trash create?
What are some of the problems with dumping trash at sea that aren't mentioned in the rap?
Some people think we should launch trash into outer space. What do you think?

Do the Rubbish Shuffle Rap
1. Now tell the students that they can perform the rap. Have a volunteer who can demonstrate the rap rhythm read the first verse out loud so the group can get an idea of how the rap will sound.

2. Assign each of the verses to a different child or small group of students. Everyone can join in the chorus. Be sure to give the students plenty of time to practise their verses, and have them coordinate some moves to accompany the chorus, such as shuffling from side to side and clapping. Encourage them to make up appropriate actions for the verses too, such as pointing their fingers or shaking their heads.

3. You could also have the group make costumes and props to fit the different rap roles. The students may want to perform the rap for other groups to teach them about how people have disposed of trash through time.

4. When the students are ready to perform, have them stand in a semicircle. Start out with everyone doing the chorus, while the first “soloist” or small group moves out to do the first verse. At the end of the first verse, repeat the chorus while the first performer(s) returns to the semicircle and the second performer steps up front.

Continue alternating the verses with the chorus until the end of the rap.

Extension Have the students create a trash timeline, using drawings and short summaries to describe the various periods depicted in the rap. You could also have the group make up a new rap verse to describe the kinds of trash people might generate in the future and the ways they might dispose of it.

A History of Rubbish

1. Australia, 60,000 years ago
Many Aboriginal hunter-gatherers simply threw their rubbish on the ground around their camps. Others had special places to dump their refuse – for example shell middens where the debris from eating shellfish and other food have accumulated over time. They can contain:
shellfish remains, bones of fish, birds, and land and sea mammals used for food, charcoal from campfires and tools made from stone, shell, and bone. Made mostly of biodegradable items, the rubbish generally decomposed. Even non-biodegradable objects, such as old stone tools, never accumulated to any significant amount because people lived in small groups and moved from place to place.

2. Ancient Greece, 500 BC
For a time, city residents in ancient Greece and Rome threw their rubbish out into the streets. Human scavengers regularly picked through the waste for reusable items, a practice that continues even today in many parts of the world. Road levels grew higher and higher from the onslaught of trash. Old, torn-down homes were used as foundations on which to build new homes level with the roads.
People in Greece finally organized a system of municipal rubbish collection, carrying waste to dumps at least a mile outside town.

3. Medieval London, AD 1350
People in the Middle Ages threw trash, food, and human waste out into the streets, where it caused a problem in densely populated cities such as London. The mess contributed to the spread of various diseases. (The bubonic plague was one disease that became epidemic. It was spread by fleas from infected rats, which swarmed through the crowded, dirty cities).

4. Atlantic Ocean, 1500
People throughout most of history have considered the ocean limitless and have dumped rubbish into it without hesitation. The rubbish and food waste dumped during the age of ocean exploration usually disintegrated in the salt water. But today, the plastic, sewage, hazardous waste, and other materials we dump are harming marine life and washing up onto beaches, where they are dangerous to people and coastal wildlife. The Caribbean is particularly plagued with such marine debris because it is so close to the main shipping lanes, but there no beaches in Australia (not even ones that are uninhabited) where marine debris and plastics cannot be found . It's estimated that people around the world dump some 6.5 billion (6,500,000,000) Kg of waste into the oceans every year.

5. New York City, 1860
During the Industrial Revolution, large industrial cities in the U.S. became filthier than other cities in previous periods. Dead horses, coal and wood ash from furnaces, and kitchen and animal waste filled the streets and alleys. Pigs roamed the streets, eating much of the food waste. Rats and roaches also invaded the rotting mess, and there were epidemics of disease. Eventually, concerns

about public health led to city street clearing and better-regulated municipal garbage collection and disposal.

6. Melbourne, 1880

Many of Melbourne's parks were originally garbage dumping sites until the mid-1880's when large incinerators were used for garbage disposal. Melbourne City Council employed street cleaners and rubbish collectors in 1901 to dispose of the rubbish.

7. Melbourne, 1950's

Council rubbish collections were subsidized by other recycling facilities. People could return their glass bottles to be washed and refilled. Organisations such as the Salvation Army and Boy Scouts would recycle and reuse newspapers, and fish and chip shops and greengrocers would buy old newspapers to use for wrapping produce. Council were still allowing the use of backyard incinerators for the disposal of leaves and other combustible materials.

8. Australia, 1970's

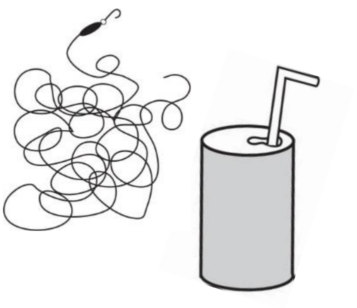
Waste generation was not a major problem for the 1970's Australia. Food scraps were often fed to the backyard chooks or composted on the garden, and most glass bottles were recycled and reused. There was very little unnecessary packaging and what little waste there was burnt in backyard incinerators. Clothes were handed down to younger children or shared within the community and broken toys etc. were fixed.

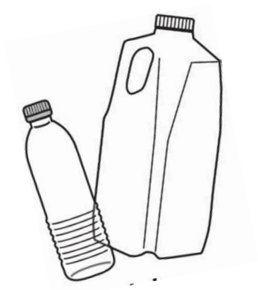
9. Australia, 1997

As the population has increased and the average household wage increased so too did the amount of rubbish. The majority of Australia's rubbish is processed using large landfill sites which are getting harder to find as our waste generation increases. In 1996-97 approximately 22.7 million tonnes of waste was generated, that's the equivalent to 1,200Kg per person! Increased packaging from the fast food and the convenience food industry and a decrease in the recycling techniques of many households led to this increase.

10. Australia, 2006-07

As the population has increased to over 22 million people in Australia so too has the amount of rubbish generated. In 2006/07 approximately 43.8 million tonnes was generated in Australia, that's approximately 2,100kg of waste per person per year! Recycling initiatives, such as Clean-up Australia Day has created more of an awareness of our waste and is hopefully instigating a decrease of household waste in the future.





The Rubbish Shuffle Rap

Chorus
Do the rubbish shuffle; it's an age-old thrill—
'Cause we all make rubbish, and we always will!

Now I bet you're askin', bet you're dyin' to see
What an Aboriginal hunter from history
Does with his rubbish! (clap) . . . like old tools of stone—
All that rubbish! (clap) . . . like those shells and animal bones.
Well, I throw 'em, I drop 'em I toss 'em in the midden.
Then I move my camp and we go fishin'.

I'm a wise orator, I'm an ancient Greek.
I was born to talk, and I love to speak.
About rubbish! (clap) . . . it used to fill our roads—
All that garbage! (clap) . . . now we take it in loads
'Bout a mile beyond our city's limit.
Now our homes and streets aren't buried in it.

Now you might be askin' why a British maid
From the Middle Ages would be afraid
Of rubbish! (clap) . . . out the window we throw
All our rubbish! (clap) . . . to the street below.
Well, our city's so crowded that all of that rubbish is
Making us sick and givin' us rashes.

I'm a Spanish explorer and here's what I love:
It's a sailing ship that isn't full of
rubbish! (clap) . . . who wants a messy boat?
All that garbage! (clap) . . . it's tough to stay afloat.
So I toss my trash out into the sea,
Where it disappears and never bothers me.

It's the 1860s. I'm a germ detector.
I'm a New York City health inspector.
I hate rubbish! (clap) . . . the alleys flow with trash—
All that rubbish! (clap) . . . the water's full of ash.
Now those rubbish fumes—they can make you ill,
So it's time we cleaned up what we spill.

In the 1880’s you would be a grump
If you lived, like me, near an open dump.
It’s all rubbish! (clap) . . . full of bugs and flies—
In the rubbish! (clap) . . . the rats are monster-size.
The trash is so high that people say
We’ll have rubbish mountains ’round here someday.

But there’s a quick solution, as some folks feel
That incinerators are the way to deal
With rubbish! (clap) . . . it all goes up in smoke—
All that rubbish! (clap) . . . but I cough and choke
On the cloudy fumes that fill the air.
I just wish that I could move away somewhere.

It’s the age of plastics; it’s the age of ease.
I’m a ’60s chemist, and I’m very pleased
With rubbish! (clap) . . . plastic cups, paper plates
In the rubbish! (clap) . . . disposables are great.
We’ve got landfills now to store this waste,
What we throw away can just be replaced.

There’s an oil crisis, and I have to brag,
’Cause I think I’ve fixed the biggest snag
With rubbish! (clap) . . . ’cause the rubbish can burn—
All that rubbish! (clap) . . . can make a turbine turn.
We’ll make energy from our piles of trash.
The only problem will be the toxic ash.

Now that’s all very well in the Europe and the USA
But I’m on an island continent, and I live by the bay
With rubbish! (clap) . . . on my foreshore
That rubbish! (clap) . . . .washes up more an’ more.
And people say the recyclin’ cost too vast
But we gotta find a way that block to pass.

I’m your average kid, and I have to say
That I’ve found an awesome, cleaner way
With rubbish! (clap) . . . I try to make much less—
All that rubbish! (clap) . . . I’m tired of all this mess.
Now I reuse, recycle, make a compost pile—
It’s the rubbish shuffle, 2014-style!

Activity 3-F: Oil Spill Clean-up

Summary Students will learn about the impact that oil spills, large or small, have on our waterways and wetlands.

Learning Objectives
Students will be able to:
(a) Understand the interaction of oil, water, and floating objects;
(b) Test the different methods of oil-spill clean-up on land and water; and
(c) Observe the effects of oil on bird feathers.

Age Levels
7 and up

Subject Area
Science

Time
60–90 minutes

Materials
Glass bottle or jar with cap
Water tinted blue with food colouring
Cooking oil coloured with black tempera paint
Cork or toy boat that fits inside the bottle
Large pan
Sand
Clean-up materials: cotton balls or swabs, cut-up pantyhose or stockings, paper towels, popcorn, sponges, sawdust, gauze pads, rope or string, turkey baster or eye dropper, popsicle sticks
Bird feathers
Clean water in small pan
Liquid detergent
Toothbrush
Factsheets #2, #3, and #5 on pages 3-6, 3-7, and 3-11

Background On the 11th March 2009, the 185m vessel the Pacific Adventurer lost 31 containers from its deck in rough seas. Some of these containers pierced the ship's hull resulting in the loss of 270 tonnes of heavy fuel oil. Due to weather and tidal conditions this oil was deposited on large sections of Moreton Island and in smaller quantities on the beaches of the Sunshine Coast and Bribie Island to the north of Brisbane. Approximately 2500 people were involved in the clean-up of the oil from state, local and federal government agencies and local community groups. Thankfully due to the time of year and the effects of Cyclone Hamish the wildlife damage was minimised and only 36 animals were affected. These included pelicans, petrels, turtles and sea snakes. Overall the cost of the clean-up operation was well over $100 million dollars!
To understand the impacts of oil spills on wildlife, three activities have been devised that will also help students understand what to do during an oil spill.

Part A: What Happens in an Oil Spill?

Procedure

1. Have the students fill a glass bottle or jar two-thirds full of water and add food colouring.

2. Put 1cm or more of black-tinted cooking oil into the bottle to represent the oil spill. Where does the oil congregate? *[On the surface.]*

3. Drop the cork or toy boat into the bottle. What happens to it? *[It becomes coated with oil.]*

4. Put on the cap and have the students shake the bottle vigorously to simulate a storm or wave action. What happens to the oil? *[Some mixes with the water.]*

Figure 33: What does happen in an oil spill?

Discussion What would happen to organisms that float on the surface, such as seabirds, ducks, seaweed, or plankton, or those that need to come to the surface to breathe, such as sea turtles, whales, or seals? *[They'd be coated with oil.]* Explain that over time, water and oil mix somewhat, and that some of the oil will sink to the bottom of the ocean. (Crude oil is heavier than cooking oil.) What would happen to the lobsters, crabs, sea urchins, and bottom-dwelling fish?

Part B: Cleaning up an Oil Spill

Procedure

1. In one end of the large pan, add a mound of sand to represent a sandy shoreline. Pour blue-tinted water into the rest of the pan.

2. Add black cooking oil to the water to simulate a spill.

3. Divide the class into teams of three or four students, and let each team choose two or three different clean-up materials to test.

4. Have the students make a plan for how they will use each material and then test them.

Discussion Talk about why the efforts worked or didn't work. Was all the oil removed? How well might their efforts work on an actual oil spill? What conditions might be different? Discuss what kinds of equipment actual oil-spill clean-up personnel use, such as containment booms, skimmers, and absorbent materials, and how similar they are to items the students used.

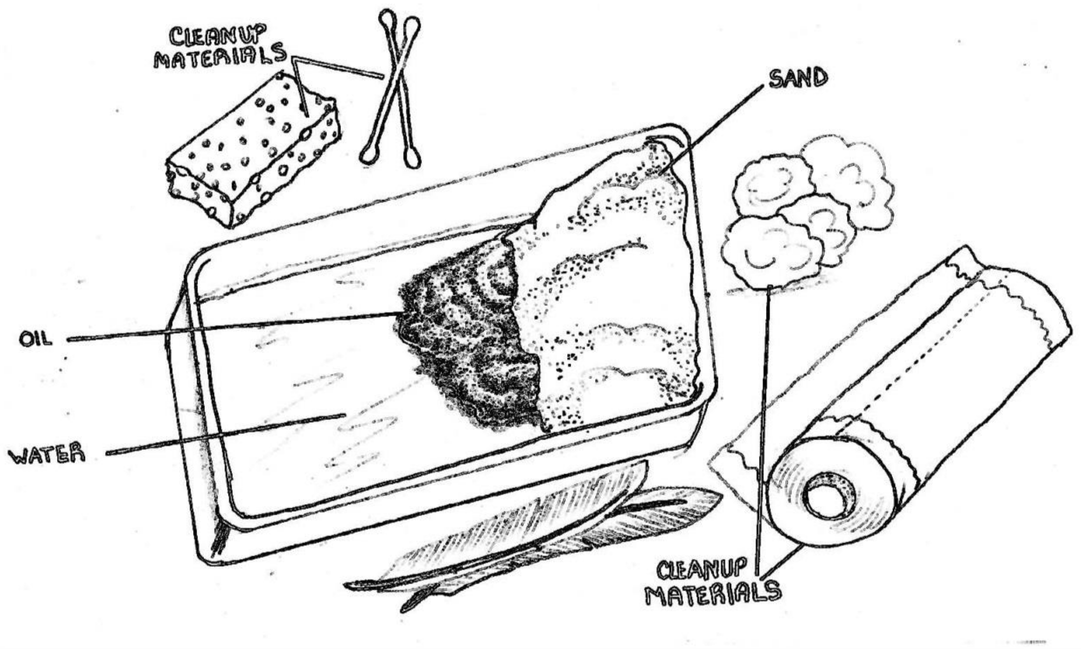


Figure 34: Clean up that oil spill

Extension: For homework, have the students research the concept of **bio-remediation** and how it works. What happens to the oil that is recovered after an oil spill? *[It is usually burned.]* Is bio-remediation a better alternative? Have the students make a diagram or list of the life in a marine environment (including mangroves and other shorelines) near them. How would each organism be affected by an oil spill? What animals are most vulnerable to an oil spill? *[Those that can't move; filter feeders like oysters, barnacles, and clams; those that surface often; those that depend exclusively on marine life for their food supply.]*

Part C: Oil and Feathers Don't Mix
Procedure
1. Examine a feather (see page 2-59, What Lives in Mangroves?). Natural oiliness on the feather keeps it from becoming waterlogged. Notice how it can fluff up after it's been handled.
2. Drop the feather into a pan of clean water. Does it float? Shake it off and dry it completely on a paper towel in the sun. Does it still fluff up after being wet?
3. Drop the feather into a pan of blue water and black oil. What happens to it?
4. Use more than one feather, and have the student groups try to clean them up. Some students may use liquid detergent; others may just scrub with a toothbrush. Dry the feathers on a paper towel in the sun. Do they fluff up?
5. Now drop them into a pan of clean water. Do they still float as before? These tests will indicate that the feathers have lost their ability to insulate and to resist waterlogging.

Activity 3-G: Wheel of Trouble

Summary Students will make a wheel that shows the reasons why the Beach Stone Curlew is becoming endangered.

Learning Objective
Students will understand why the Beach Stone Curlew is listed as vulnerable on the IUCN red list.
Age Levels
8–14
Subject Areas
Science, social studies
Time
40–60 minutes
Materials
Pictures of Beach Stone Curlew
Copies of page 3-42 showing “Wheel of Trouble”
Lightweight paper plates at least 23 cm in diameter
Crayons or markers
Scissors
Glue
Tape
Paper fasteners
Construction paper (optional)

Background The Beach Stone Curlew is endangered for the same reason that many other species are in trouble, including habitat loss, habitat degradation and pollution. Using the Curlew as an example, students can learn about the variety of problems that affect many endangered species.

Pre-procedure
Before you begin, make eight triangular patterns, following the directions under “Getting Ready” below. Then start the activity by showing the class pictures of Beach Stone Curlew and talking about their natural history. (For general information about Curlews, see *Shorebirds of Australia by Geering et.al.)*

Getting Ready
1. Cut out the circle on page 3-42 and tape it to the back of a paper plate. (Don’t use too much tape because you will eventually be removing the circle.)
2. Cut out each segment, making sure you don’t cut through the centre circle or along the outer edge of the circle (see diagram on page 3-42). After cutting out each segment, remove the paper pieces. (You will end up with four separate segments.)
Repeat until you have enough segments so each student can have one.

Procedure

1. Now tell the students that the Beach Stone Curlews are endangered. Explain to the class that they will be learning why these birds are in trouble by making a "Wheel of Trouble".

2. Give each child a copy of page 3-42, two paper plates, scissors, glue, a paper fastener, and crayons or markers. Also hand out the triangular segments you made earlier, one to each student.

3. Have students colour the pictures on page 3-42, then cut out the circle along the solid outer line.

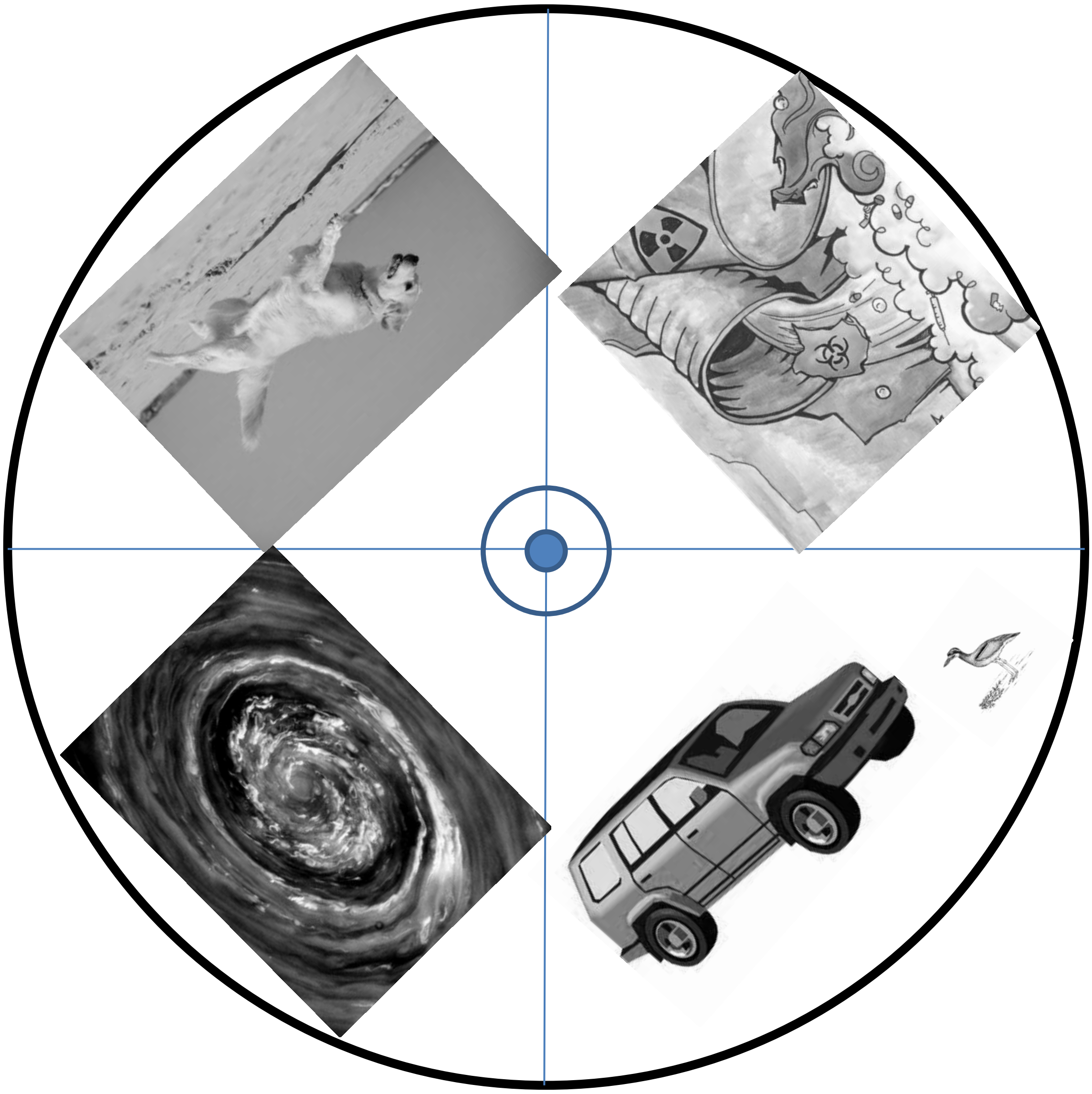
4. Glue the circle onto the back of a paper plate. (Tell the students to use a thin layer of glue). Set this plate aside.

5. Lay the triangular pattern on the back of the other paper plate so that the edge of the pattern meets the edge of the plate. Trace it and cut out the shape.

6. Place the cut-out plate on top of the plate with the pictures and push a paper fastener through the centre of both plates. (If you are using thick paper plates, you may have to first poke a hole through the plates with scissors or a pen.)

Discussion/Reflection

As the students turn the top or bottom plate, each of the four pictures will appear in the cut-out space. Explain that these pictures illustrate the four major problems the Beach Stone Curlew face. Have the students turn their wheels to picture A, then B, and so on, and use the information under "Trouble for Beach Stone Curlews" on page 3-43 to talk about each of the problems.
After your discussion, have the students draw a picture of a Beach Stone Curlew on their top plate and write the title "Why Beach Stone Curlews are in Trouble."



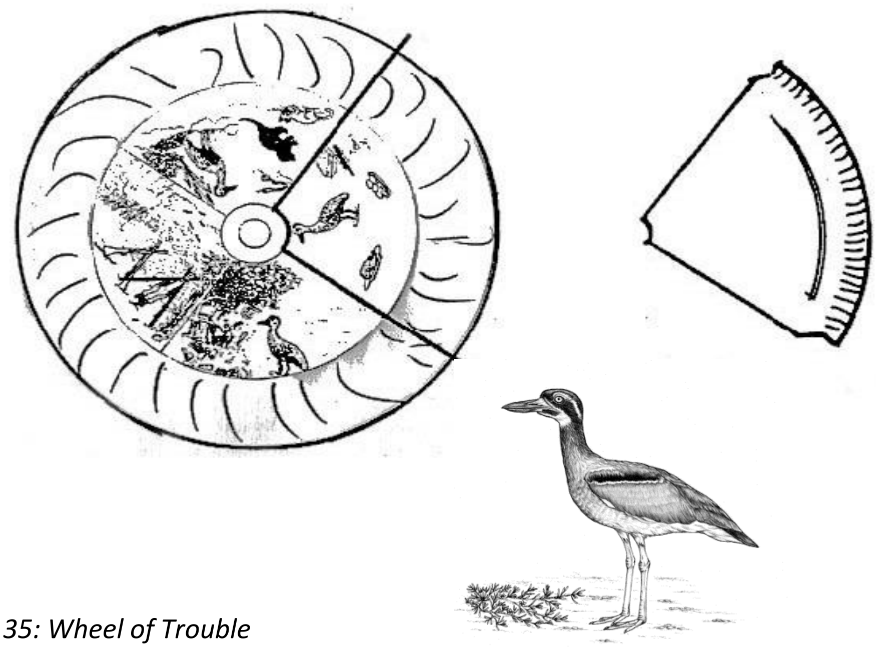


Figure 35: Wheel of Trouble

Trouble for Beach Stone Curlews

A. Recreational pressures.

Beach Stone Curlews are large birds that feed when the tide is low on exposed mudflats chasing small crustaceans and other invertebrates. They do not have a traditional "nest", however they generally lay one egg on the ground generally below a tree. This ground dwelling life can lead to lots of problems for this bird from humans. We like to fish from the beach at low tide often disturbing the birds from their nests. A lot of beaches are also easily accessed by 4WD vehicles and other recreational vehicles such as quad bikes and motorbikes. These are loud and noisy and often disturb the birds and compact their feeding grounds.

B. Habitat destruction and degradation.

Natural processes such as storms, cyclones, droughts and floods can cause a loss of habitat for the Beach Stone Curlew. With the loss of the protective mangroves the shore is opened to more predators and their eggs are exposed. Changes in the transport of sand through ocean currents by the construction of groynes and marinas have also led to the destruction of some historical mangrove sites which the birds have been migrating to for generations.

C. Water Quality and Pollution.

Poor water quality in coastal areas leads to a reduction in available food for the Curlews to eat. Curlews primarily feed on crabs and other invertebrates, poor water quality and excess siltation from upstream developments could lead to reduction of these food sources being available. Excessive siltation can also cause the loss of essential mangrove habitat by not allowing the mangroves to "breathe" through their pneumatophores being covered with mud. This can lead to fragmentation of the wetland areas providing less shade for the Curlews to nest around.

D. Introduced species.

Feral pigs, cats, dogs and foxes all have an impact on every aspect of the Beach Stone Curlew's lifecycles. Adults are predated by cats and foxes and are often exhausted by unrestrained dogs on the beach and in their wetland homes. Pigs and foxes are responsible for the devouring of their eggs. Beach Stone Curlews generally only lay one egg per season directly on the ground with only grass to camouflage them. The chicks are dependent on mum and dad until they are between 7-12 months old; this also makes them easy prey for the likes of cats and foxes.

Activity 3-H: The Rare Scare—the Road to Extinction

Summary Compare several imaginary animals to determine which has the characteristics of a "typical" endangered species.

Learning Objectives
Students will be able to:
(a) Define vulnerable, endangered, and extinct; and
(b) Describe several characteristics that make an animal extremely susceptible to extinction.

Age Levels
7–12

Subject Area
Science

Time
30–60 minutes

Materials
Copies of pages 3-47 and 3-48, "Imaginary Animals"
Index cards
Markers
Easel paper or chalkboard

Background Beach stone curlews, rusty monitor, the water mouse, green turtles, loggerhead turtles, dugongs and many other endangered species have more in common than just their endangered status. Many share characteristics that make them extremely susceptible to becoming extinct. They are more prone to extinction if they:

- Interfere in some way with people's activities. Compete with people for food or area usage e.g. crocodiles and fruit bats.
- Migrate. Animals that have to travel long distances between their feeding grounds and breeding grounds tend to encounter more problems that those that are resident to the area. Migration involves travels across oceans and continents either in the air where they are susceptible to storms, planes and tall buildings; or in the ocean where there are nets, boats and rubbish to threaten they travels. Good examples of migrating animals are the Bar-tailed Godwit, Beach Stone Curlew, Loggerhead turtle and the green turtle.
- Have very specific food or nesting requirements. Some animals specialise in what they eat and where they live. These specializations allow the animal to become endangered if their food source of habitat is damaged. A global example of this is the Giant Panda in China and local examples include the Illidge's ant-blue butterfly which relies on a certain species of ant and mangrove for its development and the water mouse which feeds lives on a mound built in the mangroves.
- Are very sensitive to changes. Many animals have a difficult time adapting to changes in their environment. Some animals struggle to deal with the introduction of a competing species. For example in Far North Queensland and the Northern Territory the freshwater crocodile is under threat from the movement of Cane toads into their areas. The cane toads have overrun populations of the natural food source of the crocodile; frogs, lizards and snakes; and in turn

made themselves the only food source for the crocodile. Unfortunately the Freshwater crocs cannot handle the cane toad's poison and they are now dying in record numbers.

- Are naturally rare. Some animals are rare throughout their range, and others have a very limited range. In both cases, the animals are often vulnerable to habitat destruction and other people-caused problems. A good example of this is the Rusty Monitor lizard. It primarily lives in hollows in mangroves and feeds on crabs, lizards and fish. Clearing of coastal habitat and fragmentation of the mangrove forest due to pollution has limited the quantity of trees with hollows for this lizard. Threats from introduced predators such as pigs, cats, foxes and cane toads have also had a big impact.
- Have small broods and long gestation periods. Ask the students if they can think of some animals that give birth to only one or two young a year or every two or three years (bats, elephants, beach stone curlews, grey nurse sharks). Explain that when the populations of these animals drop, it takes much more time for them to recover and sometimes become extinct before they have a chance to make a comeback.
- Animals with a low birth rate have another problem, too. They don't reproduce fast enough to produce offspring that can adapt to changing conditions. Have the class compare the capabilities of an elephant with those of a cockroach. Explain that, on the average, an elephant has about three young every 10 years, and that a cockroach has 80 young every six months. Copy the following figures onto the board and explain that if all the individual animals lived and mated, this would be the number of young produced in each generation:

	Elephant	Cockroach
1st generation	3	80
2nd generation	6	3,362
3rd generation	13	137,842
4th generation	28	5,651,522
5th generation	61	231,712,403
6th generation	132	9,500,208,482

Have the students compare the number of years it takes for an elephant and a cockroach to produce a sixth generation. (Since an elephant has an average of three young every 10 years, and a cockroach has an average of 80 young every half year, it would take elephants 60 years to produce six generations, and only three years for cockroaches to do the same). Emphasize that, because of their high birth rate, cockroaches have more opportunity to adapt to changes in their environment.

Preparation Paste each of the different characteristics that make animals prone to extinction (as outlined in the Background) onto index cards.

Procedure

1. Pass out copies of pages 3-47and 3-48, "Imaginary Animals".

2. Explain that each animal on these pages is imaginary but has the same characteristics as real animals living today.

3. Pass out index cards explaining reasons that animals become extinct.

4. Have students read the information on page 3-47 and on the index cards, and then decide what animals would be the first to become extinct as more and more people move into their area.
5. Tally on the blackboard how many students voted for each animal. Ask students why they picked each animal. Then explain that many animals that are threatened or endangered share one or more characteristics that make them more prone to extinction. Discuss some of these characteristics using information provided in the Background.
6. After the discussion, have the students look at pages 3-47 and 3-48 again to see if they agree with their original choices. Then take another tally and compare the results to those of the first one.
7. Explain that the Crested Crabbit is the animal that will probably become extinct first, because it has so many of the characteristics that make an animal susceptible to extinction. For example, it has a limited range, has a low birth rate, has a specialized diet, migrates, and nests only in one type of tree. Explain that the animals that have one or more of these characteristics usually survive well until people-related problems, such as habitat loss and pollution, start to affect them.

Extension Older students could research some of the costs of coastal developments that have been built on former mangroves. They could talk with people at both banks and insurance companies about such things as risk analysis and insurance premium costs. How much does cyclone insurance go up after claims caused by cyclone damage? The students could write a report on their findings. Students could research a "before and after" cyclone-damage scenario to determine what a storm actually costs a local community, and then write a report on their findings.

Scaly Mangrove Muncher

- Lives in mangrove forests.
- Feeds on insects, small mammals, and Grey Mangrove seeds, very fond of mangrove roots.
- Has one brood per year (average three young per brood).
- Lives in social groups called grandals.
- Some groups migrate, others stay year round.

Crested Crabber

- Is noted for its shiny mauve feathers.
- Lays three eggs every two years.
- Feeds on purple-shelled mud crabs.
- Nests on mud banks near gum trees.
- Migrates each year to Queensland.

Zobrun

- Lives in burrows.
- Often found in sandy dunes near the Equator.
- Feeds on rare shiny black cactus.
- Mates for life.
- Can have two broods a year, but usually has one; often gives birth to triplets, but two usually die.
- Is noted for its beautiful red fur.

Purple Ploon

- Lives in seagrass beds and Red Mangrove roots.
- Feeds on small fish and aquatic insects, very fond of mosquito larvae.
- Sleeps in mud 18 hours per day.
- Lays an average of four eggs per year; eggs very sensitive to pesticide poisoning.
- Has been introduced into other areas to control mosquitoes.

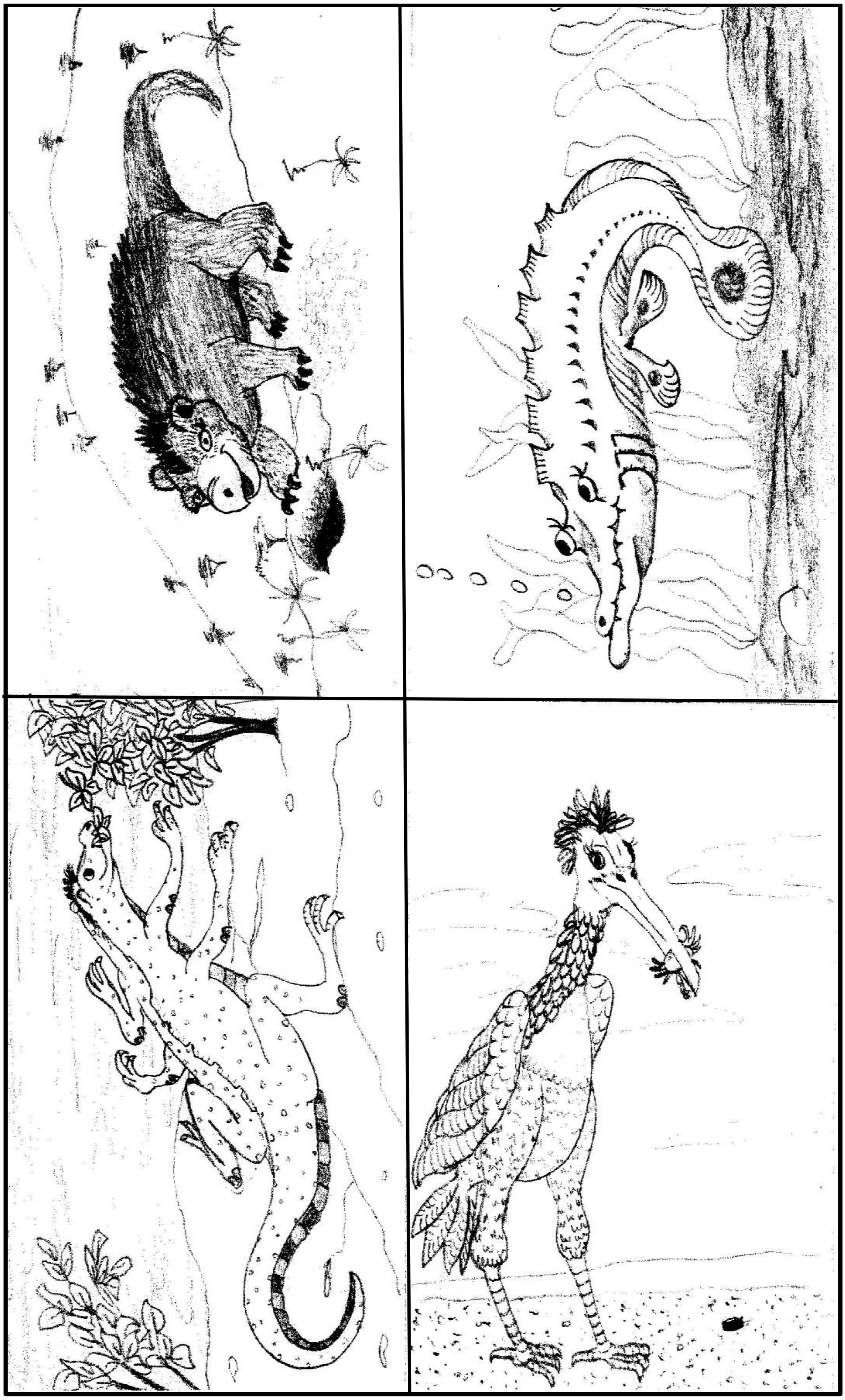


Figure 36: Imaginary Animals

Activity 3-I: Queensland Endangered Species Poster

Summary Many species of animals throughout Australia are either threatened or endangered. This activity will make students aware of what factors cause animals to become threatened and endangered.

Learning Objectives
Students will be able to:
(a) Understand which species are threatened or endangered regionally and locally; and
(b) Design a poster drawing attention to one particular endangered animal that contains information about why the animal became endangered, its habitat, and what can be done to protect both animal and habitat.

Age Levels
8–14

Subject Areas
Science, arts

Materials
Copy of Species at Risk list on page 3-51
Copy of example of endangered species poster on page 3-52
Drawing or art paper
Crayons or paints
Camera (optional)
List of suitable websites
Postcards and/or photographs

Background Endangered animals are specific animals whose populations are steadily becoming smaller or decreasing. These animals are in danger of dying out, or becoming extinct.
Animals become endangered for many reasons. Some are collected for the pet trade (eg. Rusty Monitor). Hunting is another threat, as is taking animals because they or their parts can be sold for profit. For instance, Hawksbill Turtles are killed for their shells. Some endangered species eat agricultural crops or prey on livestock, and farmers resort to shooting or poisoning animals that threaten their livelihood. As humans have needed more and more land for homes, recreational facilities, shopping centres, and agriculture, much habitat has been lost. In fact, habitat loss through alteration or destruction is the leading cause of species decline throughout the world.
Some species live in very specialized areas, thus limiting their ability to survive if their habitat is lost. Introduced predators—such as pigs, rats, cats, dogs, foxes, cane toads—create problems for endangered species, especially birds that are killed or lose their eggs through predation, and egg laying reptiles.

Procedure
1. Have each student select an endangered animal from the list provided on page 3- 51.
2. Have the students carry out research in the school or public library or on the Internet or through a local conservation organization to learn more about the way in which the existence of this animal is threatened.

3. Then have the students design a poster, featuring the animal they have chosen. See example on page 52.
4. Using what the students have learned about "their" creature, they can draw, use photographs, or write an answer to each question below to create an informative poster on their endangered species.

Discussion/Reflection
Have students share their knowledge by giving a presentation to the class on their chosen endangered species, using their poster as a visual aid.

Extension
Make a display of the posters in a central area of the school to create awareness in the school of endangered species in their region. Make a display of the posters in a local community area such as a library or sports complex to draw the community's attention to the problems of endangered species in their region.
Ask the students to generate their own endangered species list for their local area using the above-mentioned websites.

All about My Endangered Species
1. What does my endangered species look like?
2. What is its primary habitat?
3. Where does it have its young?
4. What does it eat?
5. What are the major threats to its survival?
6. How can we help to protect it?

Table 3: Examples of Threatened Fauna Species of Queensland

Regent Honeyeater (*Anthochaera phrygia*)	Eastern Curlew (*Numenius madagascariensis*)*
Blue Whale (*Balaenoptera musculus*)	Little Tern (*Sternula albifrons*)*
Grey Nurse Shark (*Carcharias taurus)*	Rusty Monitor Lizard (*Varanus semiremex*)*
Great White Shark (*Carcharodon carcharias*)	False Water Rat (*Xeromys myoides*)*
Loggerhead Turtle (*Caretta caretta*)	Illidge's Ant Blue Butterfly (*Acrodipsas illidgei*)*
Southern Cassowary (*Casuarius casuarius johnsonii*)	Koala (*Phascolarctos cinereus*)
Green Turtle (*Chelonia mydas*)*	Freshwater Sawfish (*Pristis microdon*)
Coxen's Fig Parrot (*Cyclopsitta diophthalma coxeni*)	Saltwater Crocodile (*Crocodylus porosus*)*
Leatherback Turtle (*Dermochelys coriacea*)	Spectacled Flying Fox (*Pteropus conspicillatus*)*
Mary River Turtle (*Elusor macrurus*)	Grey-Headed Flying Fox (*Pteropus poliocephalus*)*
Black Rock Cod (*Epinephelus daemelii*)	Fitzroy River Turtle (*Rheodytes leukops*)
Hawksbill turtle (*Eretmochelys imbricata*)	Whale Shark (*Rhincodon typus*)
Speartooth Shark (*Glyphis glyphis*)	Bridled Nail-Tail Wallaby (*Onychogalea fraenata*)
Swift Parrot (*Lathamus discolor*)	Greater Bilby (*Macrotis lagotis*)
Olive Ridley Turtle (*Lepidochelys olivacea*)	Giant Barred Frog (*Mixophyes iteratus*)
Wallum Sedge Frog (*Litoria olongburensis*)	Southern Marsupial Mole (*Notoryctes typhlops*)
Mary River Cod (*Maccullochella mariensis*)	Mahogany Glider (*Petaurus gracilis*)
Southern Giant Petrel (*Macronectes giganteus*)	Opal Cling Goby (*Stiphodon semoni*)
Humpback Whale (*Megaptera novaeangliae*)	Tinkling Frog (*Taudactylus rheophilus*)
Flatback Turtle (*Natator depressus*)	Campbell Albatross (*Thalassarche melanophris impavida*)
Australian Lungfish (*Neoceratodus forsteri*)	Grassland Earless Dragon (*Tympanocryptis pinguicolla*)
Beach Stone-Curlew (*Esacus magnirostris*)*	Northern Hairy Nosed Wombat (*Lasiorhinus krefftii*)
Australian Painted Snipe (*Rostratula australis*)	Ornamental Snake (*Denisonia maculata*)

And many, many more…… refer to http://www.environment.gov.au/cgi-bin/sprat/public/publicreports.pl?proc=species and generate your own list!

*Animals found in or adjacent to mangroves

Example: My Endangered Species Poster

Illidge's Ant Blue Butterfly
Acrodipsas illidgei

What does my endangered species look like?

The Illidge's Ant Blue butterfly has small white eggs with a diameter of ~0.7 mm. In its caterpillar stage it is white. The pupa of the butterfly is approximately 1 cm lengthwise and is brown.

Adults are brown and females have blue coloured regions on the upper surface of their wings that change colour depending on the angle from which the surface is being viewed. The underside of the wing of both male and females are fawn and contain small dark spots. The butterfly's wingspan is ~2 cm.

What is its primary habitat?

Illidge's Ant Blue lives in mangrove forests in SE Queensland. The species can be found at six confirmed sites: Mary River Heads, Beaver Rock and Maaroom in the Mary River Region; Redland Bay and Point Halloran in the Moreton Bay region; Brunswick Heads in New South Wales.

Where does it have its young?

The eggs are laid by the females in stumps on Grey Mangrove trees where there is a presence of Crematogaster ant colonies.

What does it eat?

The larvae are transported to the ants' nests by the ants where they feed on excretions from the butterfly larvae, while a larva on the other hand feeds on developing ants.

What are the major threats to its survival?

1. Destruction of mangrove habitats – particularly old mangrove trees which house the ant colonies in hollow stems and branches that are essential to their survival.
2. Spraying mangroves to control mosquitoes (fogging) using toxic substances such as malathion.

How can we help to protect it?

1. By protecting mangrove habitat.
2. By educating other people about the importance of the mangroves for the species.
3. Prevent the use of insecticides in mangroves that are known habitat for the butterfly.

Letter Soup

Find among the letters in the box the words that are part of mangroves as an important ecosystem:

Mangroves	Coastal	Importance	Seed
Propagule	Marine	Mud	Sustainable
Exchange	Economic	Resources	Management
Gases	Recover	Land	

A	T	K	H	I	L	C	R	Q	A	F	X	U	R	J	E	X	G	C	M	Y	E
O	C	C	T	S	M	Y	G	W	Y	K	R	H	B	K	N	I	P	D	Z	K	G
P	Y	O	M	G	B	P	K	O	C	N	P	Z	L	G	T	V	L	T	N	X	Q
E	U	T	A	Q	L	R	E	T	P	E	G	N	A	H	C	X	E	C	W	A	B
X	I	R	Z	S	G	O	V	P	T	Y	C	S	A	B	L	R	C	Q	I	S	L
I	Z	E	Z	B	T	P	T	F	B	K	E	Y	M	L	X	G	O	K	P	O	U
N	B	C	J	W	X	A	Z	C	I	S	H	G	Q	C	L	A	N	G	J	E	I
B	K	O	S	Q	C	G	L	E	M	Z	I	N	O	S	F	V	O	N	F	X	M
J	Y	V	C	Y	K	U	I	X	G	F	P	G	E	E	T	G	M	C	W	A	V
V	R	E	N	I	O	L	V	I	C	G	B	V	K	E	Y	T	I	U	K	S	C
L	G	R	P	G	Y	E	S	A	Z	C	O	G	W	D	M	L	C	E	Y	O	T
X	S	H	Y	B	T	C	K	U	L	R	T	A	J	S	G	H	S	N	R	L	N
C	W	D	U	M	F	P	Z	I	G	R	X	I	V	A	E	B	P	I	Z	B	E
I	M	T	Z	B	L	C	V	N	Q	B	E	M	I	P	X	I	J	R	N	H	M
O	F	Q	X	A	I	R	A	Z	T	Y	O	Z	B	U	J	C	T	A	L	W	E
K	V	E	L	F	H	M	G	J	G	E	C	N	A	T	R	O	P	M	I	Q	G
G	B	W	Z	C	N	O	Z	W	H	X	R	F	Y	W	Y	U	B	X	R	C	A
N	S	U	S	T	A	I	N	A	B	L	E	R	T	A	Q	G	V	H	F	T	N
P	U	H	O	P	U	S	X	B	P	U	M	P	L	S	K	N	I	E	L	G	A
A	J	Q	M	E	K	L	F	J	R	E	S	O	U	R	C	E	S	M	A	P	M